THE

NEW VOLUMES

OF THE

ENCYCLOPÆDIA BRITANNICA

CONSTITUTING, IN COMBINATION WITH THE EXISTING VOLUMES OF THE NINTH EDITION,

THE TENTH EDITION

OF THAT WORK, AND ALSO SUPPLYING

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DEALING WITH RECENT EVENTS AND DEVELOPMENTS

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PREFACE.

rriHE first edition of the Encyclopoedia Britannica was prepared by “A Society of -^ Gentlemen in Scotland,” as the authors are described on the title-page, and the first weekly section was sold in December 1768 by ” Colin Macfarquhar, at his printing office in Nicolson Street,” Edinburgh. In 1771 the publication was completed in three volumes quarto, containing 2670 pages and 160 copper plates. From this small beginning the Uncyclopcedia Britannica has increased, in size as well as in importance, until the present edition, when completed by the. new volumes, to the first of which these words of introduction are prefixed, will include more than 28,000 pages and more than 12,000 plates, maps, and other illustrations. The evolution, during the one hundred and thirty-four intervening years, was gradual. The second edition; containing 8595 pages, was completed iu 1784; the third, 14,579 pages, in 1797; the fourth, 16,033 pages, in 1810 ; the fifth, 16,017 pages, in 1817 ; the supplement to the fifth edition, 4933 pages, in 1820; the sixth edition, 16,017 pages, in 1823; the seventh, 17,011 pages, in 1842 ; the eighth, 17,957 pages, in 1861. The first volume of the Ninth Edition was published in 1875, and the last, making a total of 21,572 pages, in 1889 ; and the continued public recognition of the utility of the Encyclopoedia Britannica is strikingly shown by the fact that of this Ninth Edition more than 40,000 copies have been purchased in the United Kingdom alone during the past four years. The vitality and authority which the Encyclopaedia Britannica has maintained through a period of alinost a centm-y and a half may be attributed to two conspicuous and distinctive characteristics, inherent in the purpose, and apparent in the execution, of its successive editions. In the first place, the publishers and the successive editors, from the beginning, brought to the undertaking an elevated view of their task. The Scottish origin of the work imparted to* its inception a certain sternness of purpose, and the perfecting of the successive editions has been almost a cult, as well as a business. The second characteristic, the collaboration of distinguished contributors, was at once a corollary of the policy of the editors and a result of the reputation which the Encyclopoedia Britannica so promptly acquired and so firmly retained. The fact has often been cited that in 1812 Dugald Stewart received for one “Philosophical Dissertation,” in the supplement to the fifth edition, a sum of £1700, which was then an unprecedented remuneration for such a task, and from that time the cost of obtaining the best work seems never to have given pause to an editor. But no scale of payment, however liberal, could have enlisted the services of all the distinguished men who contributed to these nine

editions, if they had not held in high esteem the national library of reference — no longer merely a Scottish enterprise — for which they were invited to write. Sir Walter Scott, Macaulay, Arago, Hazlitt, De Quincey, Professor Playfair, Jeffrey, Charles Kingsley, Ricardo, Dr Hooker, Layard, Baron Bimson, Sir David Brewster, and Professor Owen were among the contributors to the first eight editions. The contributors to the Nihth Edition numbered more than a thousand, among them so liiany men of the highest distinction that their quality can only be indicated by the citation of a few such names as those of Professor Huxley, Lord “Kelvin, Lord Rayleigh, Sir Archibald Geikie, Professor Max-Miiller, Professor Eay Lankester, Sir William Crookes, Sir Robert- Ball, Mr Alfred Russel Wallace, Mr Swinburne, and Robert Louis Stevenson. The statement that the last of the new volumes of the EncyclopcBdia Britannica will be published within a year, and that the contributors are a body no less distinguished and proportionately even more numerous^ completes this brief

summary of the history of the work. It has been the aim of the editors to make the new volumes so complete that no further edition will be required by the present generation, for the new portion of the work, in combination with the existing volumes of the Ninth Edition, forms, for all intents and purposes, a tenth edition.

These new volumes constitute a new, distinctive, and independent library of reference, dealing with modern developments of science, art, literature, history, biography, sociology, industry, commerce, invention, medicine and surgery, although their primary purpose is to supplement, complete, and bring up to date the Ninth Edition. The urgency of complementing that edition was even greater than the date of its publication would indicate. The first four volumes were published in 1875, the remainder appearing at varying intervals until the work was completed in 1889. Roughly speaking, the year 1880 may be regarded as a median date fairly representing the time of production of the average article. As a matter of fact, however, the Ninth Edition gave to the events of the Victorian Era a consideration less minute than that which it accorded to earlier periods of history and earlier developments of the arts and sciences. The intellectual point of view, in 1875, was influenced by scholastic traditions of which the rigour has since undergone considerable modification. It was then the practice to await patiently a future time at which what was called the historical perspective might be attained. It was thought imprudent for the writer to venture upon ice as yet but newly formed. The article upon the History of England, for example, appeared in the eighth volume, published in 1878, and of its 104 pages, 102 are concerned with events prior to ‘ the death of George IV., and only two with English history subsequent to 1830. In adopting this policy, the editors of the Ninth Edition acted in accordance with the best opinion of their generation. Since their day opinion has altered; it now seems proper that a work of reference should, as closely as is consistent with the avoidance of hasty judgment, present a full account of the most recent events and the latest phases of ^progress. The new volumes thus cover a period of time and a field of subject-matter proportionately c larger, than the period and field which the Ninth Edition added to the scope of the eighth. In selectino- the point of departure for each article, as well as in deciding upon the moment at which its subject should be relinquished, the editors have been impelled by the changed conditions of our time to give more space than would have been required if they had been content to regard their task as limited by a period of twenty years, and by the degree of reticence with regard to recent events which was formerly thought to be advisable. Of the sixteen thousand articles in the Ninth

Edition, a great number needed no revision, but many others — even among the articles dealing with completed achievements, such as the lives of men long since deceased, and the histories of extinct nations — called for modificatio’n as a result of recent research. Yet, if the last twenty years alone were to be displayed to the reader, they would be recognized as marked by a progress absolutely unmatched in any equal period of the world’s history.

Sir Archibald Geikie, on the occasion of the banquet; held at Christ’s College, Cambridge, in 1888, to celebrate the issue of the twenty-fourth volume of the Ninth Edition, expressed a wish rtihat it were possible explicitly to contrast the conditions and prospects of the world at that time with what they had been when the eighth edition was completed in 1861, ” to sketch the vast realms of knowledge and of thought that had been cqnquered, and to enumerate even a few of the great -treasures, undreamt of in variety and value, which have been added t© the sum of human knowledge.” Such an apposition, displaying side by side the state of human knowledge in 1880 and its present state, would yield an even more striking lesson. Within these twenty years — and as we have seen, the period covered by the new volumes is in fact much longer — there have been astounding changes in all departments : political, social, economic, religious, scientific, literary, and artistic. Political frontiers have been altered by wars and conventions ; the British Empire has vastly increased in vitality as

well as in extent ; America, recovered from the shock of her Civil War, has become a world-power as well as an industrial factor of the first importance ; Germany, since the Franco-Prussian War, has become another industrial competitor ; France has made ex- traordinary efforts to regain lost ground ; and in the Far East, Japan has attained an unforeseen importance. The chief postulates of all branches of inquiry have been revolutionized by the wide- spread application of the theory of evolution and of new methods of research, while the application of science to the arts has enlarged our vision and led to new inventions in every sphere of life. Preventive medicine and aseptic surgery have come into existence and been matured ; literary and artistic production has increased with almost unexampled rapidity, and much of this increase has been wholesome and deserves attention ; great men and women have passed away, leaving their lives to the enlightenment of posterity, and new personalities of commanding importance have come to the front. •

Containing, as they do, not only an account of this fertile period, but dealing also with many events and developments earlier in the Victorian Era, the new volumes cannot but be of use as a distinct encyclopaedia of modern progress, adapted to the wants of readers who desire to confine their reading to modem topics. In order, on the other hand, to estimate the practical utility of the new volumes, if they be regarded as a supplement to the Encyclopcedia Brita?inica, attention must be given not only to the inevitable gaps with which the lapse of time has pitted the Ninth Edition, but also to the position which that edition occupies in public esteem. In the United King- dom alone more than fifty thousand persons possess the Ninth Edition and regard it as the most authoritative work of reference., In the United States more than four hundred -thousand copies have been purchased. There are, therefore, in all parts of the English-speaking world, a vast body of men who habitually use the work and who await the appearance of a complement to its contents. They form the half million readers whose requirements the editors have had primarily to consider. The endeavour to meet these requirements has been made at a particularly happy moment, for, in nearly all civilized countries, a census was completed just in time to enable the

editors and contributors to avail themselves of the latest official statistics. It is not simply in re- spect of its statistical information that a census yields important material. It affords a large body of fresh facts with regard to public health, commerce, agriculture, and manufacture, the spread of education, and the comparative vitality of various nations, so that articles of many different sorts are far richer and fuller than they could otherwise have been. There is, indeed, no publication other than these new volumes in which the results of this world-wide census are similarly comprised.

To the twenty-four volumes of text in the Ninth Edition of the Encyclopoedia Britannica there v\rill now be added eleven further volumes containing 10,000 articles by 1000 contributors, 2500 new maps, plates, portraits, and other illustrations ; in all about 7000 new pages, the volumes being ■of the same size as those of the Ninth Edition. The preparation of the new volumes was begun ■early in 1899, but the first year’s work was largely devoted to fixing the scope and plan ‘of the work, determining the subjects to be treated, selecting the departmental editors, to the selection by them of the contributors (a choice which could judiciously be made only by men of special technical knowledge), and to the discussions which necessarily preceded the actual’ task of writing. In order that the various contributions, especially those in which statistics play an important part, or in w^hich new inventions or discoveries are described, should be checked and corrected in the light of the most recent research, all the articles have been carried |in type, subject to revision by editors and contributors, and will thus be found to contain information available only a few weeks before they issue from the press. So great is the number of subjects treated in the new volumes, and so thorough their treatment, that only the most zealous goodwill on the part of the contributors has made it possible to keep the new matter within eleven volumes. This limitation was the more •difficult, or

from another point of view the size of the supplement was the more inevitable, for another reason. In the earlier history of the EncyclopcBciia Britannica, we find that biographies of a'ny sort were-barely tolerated. In 1776 the third Duke of Buccleuch, who was greatly interested in the project of the second edition, had much difficulty in persuading the editors to include bio- graphical articles, which they deemed " inconsistent with the purpose of a dictionary of arts and sciences." In the case of the new volumes it has been thought necessary, in order to bring the biographical section up to date and to make it as comprehensive as other sections, to include lives of certain living men and women. The policy of the editors in this particixlar was to select for the most part the lives of those ■ whose positions had become so fixed that, whatever promise of -future achievement their continued vigour might give, there was no reason to believe that the general •character and purpose of their work would materially change. Among the younger generation, biographies are included of reigning sovereigns or heads of states, and of some few others whose names are already of commanding interest.

A noteworthy feature of the new volumes will be the new and comprehensive index to the completed work, covering under one alphabetization the Ninth Edition and the new volumes. It Tvill contain more than 600,000 entries, and will not only be exceedingly minute in its analysis, dis- playing the latest development of the time-saving art of precise indexing, but will also be by far the most complete index to the general sura of human knowledge which has ever been compiled. An index thus constructed on modern lines will greatly facilitate the use of such a work as this, for its possessor will enjoy the advantages, without suffering the disadvantages, which mark a

work of reference consisting of general treatises rather than of brief and fragmentary articles treating, after the manner of a dictionary, each subdivision of a subject under a separate heading. This dictionary system of treatment gives a far less readable result, and its practical convenience is no greater than that which the new volumes will offer with the aid of their elaborate index.

Other considerations which affected the size of the supplement were the need for new maps, called for by recent political changes and geographical discoveries, and also the necessity for copious illustration. The Ninth Edition was more amply illustrated than any former work of reference had been, and since its time the utility of informative illustration, as distinguished from mere pictures, has become more and more generally recognized. A picture of a machine, occupying a few square inches of space, conveys a clearer impression than a whole page of description. The new volumes are therefore even more copiously illustrated than were those of the Ninth Edition, and the 2500 separate drawings which were made will, it is believed, fully justify the great care which has been expended upon them. The portraits and reproductions of pictures which accom- pany the biographies of living celebrities, have in important instances been chosen for this purpose by the persons themselves, and the engravings have all been executed specially for the work. Every effort has been made to conserve in the new matter the high standq,rd of the Ninth Edition, although the articles are conceived in a spirit more modern than that which obtained a generation ago. The present demand for practical details, for the industrial as well as the theoretical point of view in treating scientific developments — a natural result of the fact that new classes of readers have been stimulated to. practical research by the spread of education — is another factor which contributed to the number and variety of the articles. Men who are engaged, if not literally in the manual processes of manufacture, at any rate in the immediate supervision of these processes, form a section of the reading public peculiarly exacting in their requirements. The great keenness of competition between English and foreign manufacturers furtheripore makes it essential that financial, commercial, industrial, and scientific topics should not be approached from an insular and restricted point of view.

With this and many other considerations in mind, the selection of the contributors to the new volumes was a task of great delicacy. The first step was to choose the departmental editors by whom the individual contributors should in turn be nominated, and in both respects the editors believe the selections have been remarkably successful. A list of departmental editor^ and of contributors will be found in another part of the work, and it will be perceived that German, French, Dutch, Italian, Spanish, Russian, and Scandinavian writers have done much to round off the comprehensiveness of these new volumes, and to bring to a wider field of examination the same spirit of accurate scrutiny which characterized the Ninth Edition. It may be doubted whether in any previous work of reference the advantages to be gained from the cosmopolitan character of the staff of contributors have been so fully attained. Absolutely no discrimination was made between British and foreign writers, contributions having been invited from the men believed to be best qualified to write upon each of the subjects to be treated, and in respect especially of American writers the result has greatly added to the comprehensiveness of the work. Certain fields of applied science and industrial development have of late years owed so much to American initiative, and the subjects in regard to which it was desirable to enlist the co-operation of American writers consequently proved to be so numerous, that an editorial branch office was opened in New

York. The names of the American departmental editors and contributors speak for themselves, and for the purpose of this preface it is sufficient to say that, while Le Figaro described the Ninth Edition as ” Tin monument litteraire auquel V Europe savante tout entiere a collaborS,” these supplementary volumes are the product of the New World as well as of the Old.

It has already been observed that readers in the United States form a considerable proportion of the public to which these volumes may be expected to appeal, but it should be noted that the care with which American and Colonial subjects are treated would have been as sedulous if the supplement had been intended for readers in the United Kingdom only. The world beyond our own islands, and especially the English-speaking part of it,, has become more intimately associated with ,onr life and thought than it was twenty years ago. Qargoes of wool from Australia, and of cotton from America, are no longer the only enrichment we receive from the descendants of the British who betook themselves to fresh fields of enterprise. They send us new ideas and new inventions, and the fruit of their activities becomes indistinguishable from other portions of the common heritage of the race.

In allotting subjects to the various British and foreign writers whose co-operation was invited, the editors were guided solely by the desire to procure the best possible treatises, without regard merely to the measure of reputation enjoyed by individuals, and yet by this process they have associated with the work a body of men whose names will readily be recognized by the general reader. If the collaboration of eminent men can ensure success, an examination of the List of Contributors to these volumes will show that the editors have been greatly favoured. The natural impulse, when contributors are to be chosen, is to enlist the assistance of ready writers and trust to their versatility. But an authoritative work of reference cannot be created by so hazardous a method. Not only men accustomed to literary activity, but those to whom verbal expression is a mere incident of other activities — sailors and soldiers, men busied in commerce and finance, leaders in all the diflEerent divisiSns of life — must bring each his special knowledge to his special subject. That was the policy adopted by the editors of the Ninth Edition, and .their example has been followed in the present undertaking.

The editors desire in this connexion to express their great obligation to the departmental editors, whose expert knowledge has been of incalculable service in suggesting the names of the writers Ijest qualified to treat special subjects, and in advising the editors with respect to technical articles. A list

of these departmental editors will be found at the beginning of this volume. The editors are also indebted to other eminent authorities for advice with regard to larger aspects of the task. They have not hesitated, in the course of an undertaking so important from every point of view, to ask personal counsel from those whose rank or official position precluded a direct asso- ciation with the work, and in every instance their requests have met with the fullest acquiescence. More detailed acknowledgments of the editors' many obligations will be found in a note forming part of a later volume.

The practice of identifying the more important articles with their authors by means of initials has been followed in these new volumes to an even greater extent than in the Ninth Edition, although it has not seemed desirable for living writers to sign the biographies of liviug persons. In a few cases important articles are deliberately left unsigned, for anonymity was necessitated by the fact that only on that condition could the editors induce certain highly-placed writers to

undertake subjects which, they had made pecuharly theh: own and yet could not treat with the detachment which is essential to objective discussion if their personalities were formally associated with what they said. In enlisting the writers of both the signed and the unsigned articles, the editors had to overcome many reluctances, due often to the diflBculty ia which a new writer is placed when invited to complete another man's work. The editors fully recognize that in this respect, as "in others, their labours in the matter of securing the best writers have been lightened by the honour in which the Eneyclopcedia Britannica is held. Unchallenged throughout the changes of more than a century, that work stands as the classical embodiment of the highest scholarship and research. Contributors, as well as editors, are proud to associate their efforts with the traditions of an enterprise which confers some ray of its lustre upon the least among its servants.

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London, May 1902. _ The EDITORS.

EFCYCLOP^DIA BEITANNICA.

VOLUME XXV. (AACHEN— AUSTRALIA).

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ARABIA. Sir T. H. Holdich, K.C.I.E. ARACHNIDA. E. Ray Lankester, LL.D., F.R.S.,

Director of the Natural History Museum, South

Kensington. ARBITRATION. A. Wood Renton, Puisne Judge

of Mauritius ; International, M, Cbackanthorpb, .

K C ARCHEOLOGY, CLASSICAL. Percy Gardner,

Litt.D., Lincoln and Merton Professor of Classical

Archaeology, Oxford*

ARCHITECTURE. Modem, H. H. Statham, Edi- tor of ” The Builder ” ; Archceological, R. Phenb. Spiers, Master of the Architectural School, Royal Academy, London.

ARGON. Lord Rayleigh, D.C.L., F.R.S.

ARGOS. Charles Waldstein, Litt.D., Fellow of King’s College, Cambridge.

ARISTIDES, APOLOGY OF. The Rev. J. Armi- TAGE Robinson, D.D., Canon of Westminster.

ARIZONA. Professor Wm. P. Blake, A.M., Direc- tor of School of Mines, University of Arizona.

ARKANSAS. Hon. Edgar E. Bryant, LL.D., for- merly Justice of the Circuit Court of Arkansas.

ARMENIA. Sir C. W. Wilson, R.E., K.C.B.

ARMIES. British, Major-General Sir J. F. Maurice, K.C.B. ; British Colonial, Major Mathew Nathan ; Indian, Sir J. J. H. Gordon, K.C.B. ; United States, Lieut.-Col. W. A. Simpson, Asst. Adj. Gen., U.S.A. ; Italian Swiss, Ettssian, and TurMsh, Sir George S. Clarke; German, Lieut.-Col. J. M. Grierson ; French and Austrian, Lieut.-Col. E. M.. Lloyd.

ARMOUR. The late Capt. C. Orde-Bbowne.

ARNOLD, MATTHEW. Theodore Watts-Dunton..

ART GALLERIES. Lord Balcarres, M.P.

ARTHROPODA. E. Ray Lankester, LL.D, F.R.S.

ART SALES. W. Roberts.

ART SOCIETIES. A. R. C. Carter.

ART TEACHING and ARTS AND CRAFTS. Walter Crane, formerly Principal of the Royal College of Art, South Kensington.

ASBJORNSEN and MOE. Edmund Gosse, LL.D.

ASIA. Sir T. H. Holdich, K.C.I.E.

ASIA MINOR. Sir C. W. Wilson, R.E., K.C.B.

ASSAYING. Andrew A. Blair, author of “The- Chemical Analysis of Iron,” &c.

ASTRONOMY. Professor Simon Newcomb, Ph.D.,. LL.D.,. D.Sc, formerly director U.S. “Nautical Almanac ” ; Professor of Mathematics and As- tronomy, Johns Hopkins University.

ATHENS. J. D. BouRCHiER.

ATHLETIC SPORTS. BrUish, Montague Shear- ~ man ; United States, Walter Camp, author of ” Book of College Sports.” ,

ATLANTIC OCEAN. H. N. Dickson.

ATMOSPHERIC ELECTRICITY. Charles Chree,. D.Sc, F.R.S., National Physical Laboratory.

AUSTRALIA. Rev. J. Milne Curran, and T. A.. CoGHLAN, Government Statistician, N.S. Wales.

ENCYCLOPEDIA BRITANNICA.

(SUPPLEMENT.)

AACHEN-AARHUS

Aachen, tlie German name for Aix-larChapeUe (q.v.).

Aalborg, capital of county Aalborg, Denmark, on tlie S. side of Liimf jord, 87 miles by rail N. from Aarhus, a growing industrial and commercial centre. In 1899, 1632 vessels of 250,745 tons entered the port, and 1599 of 245,681 tons cleared. The iron bridge connecting Aalborg with Norre Sundby (pop. 3000) on the N. side of the fjord, 1250 ft. long, is one of the finest pieces of engineering in the kingdom. Population, 14,152 (1880) ; 19,503 (1890) ;

31,462 (1901).

Aalesund, a seaport town of Norway, situated on a ring of islands surrounding the harbour, co. Eomsdal, on the W. coast, 145 miles N. by E. from Bergen. Founded in 1824, it is the principal shipping-place of Sondmore, and one of the chief stations of the herring fishery. A little to the south of the town are the ruins of the reputed castle of Gangu Hrolf, the founder, in the 9th century, of the dynasty of the dukes of Normandy. Population, 5603

(1875) ; 8406 (1891) ; 11,672 (1901).

Aarau, the capital of the canton of Aargau in Switzerland, on the Aar, about 60 miles by rail from Berne, and 31 miles from Zurich. In the parliament house there is some good painted glass of the 16th cen- tury from the neighbouring Benedictine abbey of Muri, suppressed in 1841. Aarau was the residence of Heinrich Zschokke (born 1771, died 1848), the well-known Swiss novelist and historian, to whose memory a bronze statue has been recently erected in the town. Population, 6809

(1888) ; 7824 (1900).

Aargau, a Swiss^ canton, bounded on the N. by the Rhine, on the E. by Ziirich and Zug, on the S, by Lucerne^ and on the W. by Basel, Solothurn, and Berne. Its total area is 642 square miles. Of this 517-9 square miles are classed as ” productive,” forests covering 169 square miles, and vineyards 8-2 square miles. The population was 198,718 in 1870; 198,357 in 1880 ; 193,580 in 1888; and

206,460 in 1900, being 381 to each square mile. The popu- lation is almost exclusively German-speaking ; for in 1900 there were but 826 French-speaking, and 2468 Italian- speaking inhabitants. In 1888 there were 86,835 Eoman- ists, 106,351 Protestants, 1051 Jews; in 19Q0, 91,047 Romanists, 114,218 Protestants, 1010 Jews. The capital is Aarau, the only other towns in the canton which in 1888 had over 3000 inhabitants being Baden, Zofingen (4460), and Reinach (3130). The cantonal constitution dates from 1885. The legislature consists of members elected in the proportion of one to every 1100 (or fraction over 560) inhabitants. The ” obligatory referendum ” exists in the case of all laws, while 5000 citizens have the right ‘ of “initiative” in proposing bills or alterations in the cantonal constitution. The canton sends ten members to the Federal National Assembly, being one for every 20,000, or fraction over 10,000 inhabitants. In 1897 the state revenue was 3,260,156 francs, and the state expenditure 3,064,181 francs, but both in 1898 and in 1899 there was a deficit, while

another of 98,600 francs was in the budget of 1900. In 1897 the public debt was 2,430,000 francs, while the productive state property amounted to 19,317,644 francs. There are many old historical castles in Aai'gau, such as Habsburg, Lenzburg, Wildegg, &c. In 1841 Aargau, imder the influence of Augustine Keller, suppressed the eight monasteries (of which the most important were Muri and Wettingen) within its territory, this violent act ultimately leading up to the " Sonderbund " war in Switzerland in 1847.

See Argovia (published by the Cantonal Historical Society), Aarau, from 1860. — ^Bbonner. Der Kanton Aargau. 2 vols. St Gall and Bern, 1844.— Mbrz. Die Beehtsquellen d. Kant. Aargau, 2 vols, as yet. Aarau, 1898 and 1900.— MiJLLEK. Der Aargau. 2 vols. Zarioh, 1870.

Aarhus, a seaport and bishop's see of Denmark, CO. Aarhus, on the E. coast of Jutland, 68 miles by rail N. by E. from Fredericia ; the second largest town of the kingdom and the principal port of Jutland. There are two new churches — St Paul's (1885-86) and a Roman

Catholic chureh (1878-81)— a library (1899), and a theatre (1899). A new harbour basin was made in 1883-90. In 1899 the port was entered by 2711 vessels of 476,439 tons, and cleared by 2710 of 476,380 tons ; exports, chiefly agri- cultural produce (bacon, butter, eggs), coal (162,350 tons), iron, and manure. Pop. 24,831 (1880) ; 33,306 (1890) ; 43,000 (oflcial estimate, 1898).

Aasen, Ivar (1813-1896), N"orwegian philologist and lexicographer, was born at Aasen i Orsten, in Sondmore, Norway, on the 5th of August 1813. His father, a small peasant-farmer named Ivar Jonsson, died in 1826. He was brought up to farmwork, but he assiduously culti- vated all his leisure in reading, and when he was eighteen he opened an elementary school in his native parish. In 1833 he entered the household of H. C. Thoresen, the husband of the eminent writer Magdalene Thoresen, in Hero, and here he picked up the elements of Latin. Gradually, and by dint of infinite patience and concentra- tion, the young peasant became master of many languages, and began the scientific study of their structure. About 1841 he had freed himself from all the burden of manual labour, and could occupy his thoughts-with the dialect of his native district, the Sondmore ; his first publication was a small collection of folk-songs in the Sondmore language, 1843. His remarkable abilities now attracted general attention, and he was helped to continue his stud- ies undisturbed. His Qrammar of the Norwegian Dialects, 1848, was the result of much labour, and of journeys taken to every part of the country. Aasen's famous Dictionary of the Norwegiqn Dialects appeared in its original form in 1850, and from this publication dates all the wide cultivar tion of the popular language in Norwegian, since Aasen really did no less than construct, out of the different materials at his disposal, a popular language or definite folke-maal for Norway. With certain modifications, the most- important of which were introduced later by Aasen himself, this artificial language is that which has been adopted ever since by those who write in dialect, and which fanatics to-day (1901) are once more endeavouring to foist upon Norway as her olficial language in the place of Dano-Norwegian. Aasen composed poems and plays in the composite dialect to show how it should be used ; one of these dramas. The Heir (1855), was frequently acted, and may be considered as the pioneer of all the abundant dialect-literature of the last half -century, from Vinje down to Garborg. Aasen continued to enlarge and improve his grammars and his dictionary. He lived very quietly in lodgings in Christiania, surrounded by his books and shrinking from publicity, but his name grew into wide political favour as his ideas about the language "of the peasants became more and more the watchword of the popular party. Quite early in his career, 1842, he had begun to receive a stipend to enable him to give his entire attention to his philological investigations ; and the Storthing —

conscious of the national importance of his work — ^treated him in this respect with more and more generosity as he advanced in years. He continued his investigations to the last, but it may be said that, after the 1873 edition of his Dictionary, he added but little to his stores. Ivar Aasen holds perhaps an isolated place in literary history as the one man who has invented, or at least selected and constructed, a language which has pleased so many thousands of his countrymen that they have accepted it for their schools, their sermons, and their songs. He died in Christiania on the 23rd of September 1896, and was buried with public honours.

(B. G.)

A bad eh, a small walled town in the province of Fars in Persia, situated at an elevation of 6200 feet in a fertile plain on the high road between Isfahan and Shiraz,

140 miles from the former and 170 miles from the latter place. It has a population of about 4000, is the chief place of a district with the same name, has a telegraph and post office, and is famed for its beautifully-carved sherbet spoons and boxes, which are made from the wood of pear and box-trees.

Abai, lake. See Abyssinia.

Abai, river. See Abyssinia.

Abakan, Abakansk. See Minusinsk.

Abanah, or Amanah (E.V. Ahdna, classical Chry- sorrhoas, modern Baradd), one of the ” rivers of Damas- cus,” which rises in the heart of Anti-Lebanon. As the river escapes from the mountains, through a narrow gorge, its waters spread out fan-like, in canals or “rivers,” to irrigate the plain and supply Damascus. The name of one ” river,” Nahr ‘ Bani^s, retains a trace of Abanah ; and, in the Arabic translation of O.T., that of another, Nahr Taura, takes the place of Pharpar, which is identi- fied by some authorities with the Nahr el-‘Awaj.

Abattoir. See Slaughtek-houses.

Abbadie, Antoine Tliomson d’ (1810- 1897), and Arnaud Michel d’ (1815-1893), two brothers notabJe for their travels in Abyssinia during the first half of the 19th century. They were both born in Dublin, of a French father and an Irish mother, the former in 1810 and the latter in 1815. The parents removed to Prance in 1818, and there the brothers received a careful scientific education. – In 1835 tl^e French Academy sent Antoine on a scientific mission to Brazil, the results of which were published at a later date (1873) under the title of Observations relatives d, la physique du globe faites au Brisil et en Ethiopie. The younger spent some time in Algeria before, in 1837, the two brothers started for Abyssinia, landing at Massawa in February 1838. They visited various parts of Abyssinia, sometimes together, and sometimes separately ; not only the fairly well-known northern and central districts, but also the then little- known districts of Ennarea and Kaffa. They met with many difficulties and many adventures, and became in- volved in political intrigues, Antoine especially exercis- ing such influence as he possessed in favour of France and the Eoman Catholic missionaries. After collecting much valuable information concerning the geography, geology, archaeology, and natural history of Abyssinia, the brothers returned to France in 1848 and began to prepare tlieir materials for publication. The younger brother, Arnaud, paid another visit to Abyssinia in 1853. The more distinguished brother, Antoine, became involved in various controversies relating both to his geographical results and his political intrigues. He was especially attacked by Dr Beke, who impugned his veracity, especially with reference to the journey to Kaffa. But time and the investigations of subsequent explorers have shown that Abbadie was quite trustworthy. The topo-

graphical’ results of his explorations were published in Paris in 1860-73 in Giod&sie d’Ethiopie, full of the most valuable information and illustrated by ten maps. Of the Qiographie de I’Ethiopie (Paris, 1890) only one volume has been published. In Un catalogue raisonni de manuscrits Ethiopiens (Paris, 1859) is a description of 234 Ethiopian manuscripts collected by Antoine. He also compiled various vocabularies, including a Diction- naire de la langue amarinna (Paris, 1881), and prepared an edition of the Pastor of Hermes, with the Latin ver- sion, in 1860. He published numerous papers dealing with the geography of Abyssinia, Ethiopian coins, and ancient inscriptions. Under the title of Reconnaissances MagnA-

tiques, he published in 1890 an account of the magnetic observations made by him in the course of several journeys to the Red Sea and the Levant. The general account of the travels of the two brothers -was published by Arnaud in 1868 under the title of Douze ans dans la Haute-Ethio- pie. Both brothers received the grand medal of the Paris Geographical Society in 1850. Antoine was a Knight of the Legion of Honour and a member of the Academy of Sciences. He died in 1897, and, subject to the life- interest of his wife, bequeathed an estate in the Pyrenees, yielding 40,000 francs a year, to the Academy of Sciences, on condition of its producing within fifty years a cata- logue of half-armillion stars. His brother Arnaud died in 1893. ^ (j. s. k.)

Abbas II., Khedive of Egypt. — Abbas Helmi Pasha, bom in 1874, succeeded his father, Tewfik Pasha, as Khedive of Egypt in 1892. He was barely of age according to the Turkish law, which fixes majority at eighteen in cases of succession to the throne. He came straight from his college at Vienna to Cairo, where his accession was celebrated with great pomp, and the fir- man from the Sultan confirming him in all the powers and privileges and territorial rights which his father enjoyed was read from the steps of the Palace in Abdin Square. He is the great-great-grandson of Mehemet Ali, the founder of the present Egyptian dynasty. When quite a boy he visited England, and did not see it again until he paid a viceregal visit in 1899. He had an English tutor for some time in Cairo, and then went to school in Lausanne, and, from there he passed on to the Theresianum in Vienna, whence he was called to the throne by the premature and suddeu death of his father. Turkish is his mother tongue, but he talks Arabic with great fluency and speaks English, French, and German very well. For some time he did not co-operate very cordially with Great Britain. He was young and eager to exercise his new power. His throne and life had not been saved for him by the British, as was the case with his father. He was surrounded by intriguers who were playing a game of their own, and for some time’he ap- peared almost disposed to be as reactionary as his great- uncle. Abbas I. But in process of time he learnt to understand the importance of British counsels. During his visit to England in 1899 he frankly acknowledged the great good the British had done in Egypt, and declared himself ready to follow their advice and to co-operate with the British officials administering Egyp- tian affairs. The establishment of a sound system of native justice, the great remission of taxation, the reconquest of the Soudan, the inauguration of the stu- pendous irrigation works at Assouan, the increase of cheap, sound education, have each received his approval and all the assistance he could give. The waters of oblivion cover the quarrel, based on unfounded accusar tions, which he chose to have with Sir H. (afterwards Lord) Kitchener when that general was Commander-in- Chief of the Egyptian army ; and no one more than the Khedive rejoiced over the battle of Omdurman. Agri- culture and all the interests of farming are dearer to the heart of the Khedive than statecraft. At Koubah, near Cairo, he has a farm of cattle and horses that would do credit to any agricultural show in England, and at Montaza, near Alexandria, he has a similar Estab- lishment. He rides well, drives well, rises early, neither smokes nor drinks. The Vice-Eeine or Khediviah, his wife, has given him first a daughter and then a son, and the latter is the heir to the throne.

Abbas-Tuman, a spa situated in Caucasia, govern- ment of Tiflis, on a mountain road of Akhaltsykh, 60 miles from the Borzhom railway station, very pictu-

resquely situated at an altitude of 4413 feet. It has a high-level astronomical observatory.

Abbazia, a popular summer and winter resort on the the Gulf of Fiume, in the Austrian province of Istria, in a sheltered situation at the foot of the Monte Maggiore. The average temperature is 77° in summer and 60° in winter. The old abbey, from which the place derives its name, has been converted into a villa. Local population

(1890), 1192; (1900), 2343.

Abbeville, chief town of arrondissement, in the de- partment of Somme, France, 28 miles N.W. of Amiens, on railway from Paris to Boulogne and Calais. It is a very important industrial centre ; and, in addition to its old-established textile productions, hemp-spinning, siigar- manufacture, and ship-building are among the industries, and there is active commerce in grain and textile fab- rics. Population (1881), 18,065; (1891), 18,022 ; (1896),

19,669.

AbbiategrasSO, a town of Lombardy, prov. Milan, Italy, 17 miles S.W. from Milan on the Bereguardo Canal. It is the seat of one of the new commercial courts of arbitration of the prov. of Milan. Population,

7025 (1881) ; 12,184 (1901).

Abbot, Ezra (1S19-1884), American biblical scholar, was born in Jackson, Maine, 28th April 1819. He graduated at Bowdoin College in 1840; was appointed assistant librarian of Harvard University in 1856 ; and in 1872 became professor of New Testament criticism and interpretation in the divinity school of the same in- stitution. For some time previously his studies had been chiefly in Oriental languages and the textual criticism of the New Testament, though his work as a bibliographer had shown such results as the exhaustive list of writings (5800 in all) on the doctrine of the Future Life, appended to W. E. Alger's work on that subject. His publications, though always of the most thorough and most scholarly character, were to a large extent dispersed in the pages of reviews, dictionaries, concordances, texts edited by others, Unitarian controversial treatises, . &c. ; but he took a more conspicuous and more personal part in the preparation (with the Baptist scholar Horatio B. Hackett) of the enlarged American edition of Dr (afterward Sir) William Smith's Dictionary of the Bible (1867-70), and was an efficient member of the American revision com- mittee employed in connexion with the Eevised Version (1881-1885) of the King James Bible. His principal single production, representing his scholarly method and conservative conclusions, was The Authorship of the Fourth Gospel; External Evidences (1880; second edition, with other essays, 1888), deemed by Dr Philip Schaff and other scholars the ablest defence, based on external evidence, of the Johannean authorship. Abbot, though a layman, re- ceived the degree of D.D. from Harvard in 1872. He died in Cambridge, Massachusetts, 21st ikarch 1884.

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Abbott, Edwin Abbott, D.D. (1838- lish theological writer, educationalist, and scholar, for- merly headmaster of the City of London school, son of the late Edwin Abbott, headmaster of the . philological school, Marylebone, was born 20th December 1838. He was educated at the City of London school and at Cam- bridge, where he took the highest honours in the classi- cal, mathematical, and theological triposes (senior classic. Chancellor's medallist, and senior optime,

1861 ; 1st cl. Theology, 1862), and became fellow of his College (St John's). In 1862 he was ordained, taking priest's orders in 1863. After holding masterships at King Edward's School, Birmingham, and at Clifton College, he succeeded

Dr Mortimer as headmaster of the City of London school in 1865 at the unusually early age of twenty-six, and more than maintained the high character which the school had obtained under his predecessor. He retired in 1889, and has since devoted himself to literary and theological pur- suits. Dr Abbott's liberal inclinations in theology have been prominent both in his educational views and in his books. He has written several works on grammar, both English and Latin, and is the author of a life of Bacon (1885) and of an investigation of his relations with Essex (1877). Of his theological writings (which include some that have been published anonymously) the best known are his religious romances — Philochristus (1878) and Qnesimus (1882), The Kernel and the Husk (1886), Phih- _ mythus (1891), his criticism on Cardinal Newman as an ' Anglican (1892), and his article on " The Gospels ",in the ninth edition of the Encyclopcedia Britannica.

Abbott, Jacob (1803-1879), a popular American writer of books for the young, was born in Hallowell, Maine, on the 14th of November 1803. He graduated at Bowdoin College at the age of seventeen ; studied at An- dover Theological Seminary ; became a congregational minister ; was for a brief period professor of mathematics and physics in Amherst College ; and afterwards taught in schools at New York and Parmington; Maine, though devoting himself chiefly to the writing of juvenile stories, brief histories and biographies, or religious books for the general reader, together with a few works in popular sci- ence. His " Eollo Books " — Rollo at Work, Rollo at Play, Hollo in Europe, &c. — are the best known of his writings, having as their chief characters a representative boy and his associates. In them Abbott did for one or two gen- erations of young American readers a service not unlike that performed earlier, in England and America, by the authors of Evenings at Home, Sandford and Merton, and the Parent's Assistant. Of his other writings — he pro- duced more than two hundred volumes in all — the best are the Franconia Stories, a Icftig series of biographical histories (with his brother John S. C. Abbott)^ and The Young Christian. Their merits are interestingness and clearness of statement ; their faults a prevalent didac- ticism, and, in the histories, a superficial treatment of authorities, perhaps necessitated by the great range of ground covered by the author. He died at Farmington on the 31st of October 1879.

Abbott, John Stevens Cabot (1805-1877), American writer, was born in Brunswick, Maine, 18th September 1805. He was a brother of Jacob Abbott, and was associated with him in the preparation of his series of brief historical biographies, but is best known as the author of a partisan and unscholarly, but widely popular and very readable, History of Napoleon Bona- parte (1855), in which the various elements and episodes in Napoleon's career are treated with some skill in ar- rangement, but with unfailing adulation. Like his brother, Dr Abbott was a graduate of Bowdoin College, a congre- gational minister, a teacher, and a voluminous writer of books on Christian ethics, &c., though he never attempted the fictitious story for children. He died at Fair Haven, Conn., on the 17th of June 1877.

AbbOttabad, a town of British India, 4166 feet above sea-level, 63 miles from Rawal Pindi, the head- quarters of the Hazara district in the Punjab, called after its founder, Sir James Abbott, who settled this Tvild district after the annexation of the Punjab. It is an important military cantonment, with two native infantry regiments and a mountain battery; and the headquarters of the Punjab frontier force. Nearest

railway station, Hasan Abdul (44 miles). Popular tion, about 10,000. Municipal income (1896-97), Es.13,588.

Abd-el-Kader (1807-1883), Emie of Mascaka, the most prominent representative of Mussulman resist- ance to French conquest in Algeria, was born at Mascara, an Arab town between 40 and 60 miles south-east of Oran, in 1807. His family was of princely rank, and he re- ceived the best education attain,able, especially in Mahom- medan divinity and philosophy. Two incidents of his youth had great influence upon his career, — his pilgrim- age to Mecca, which stimulated his natural tendency to religious enthusiasm, and a visit to Egypt, where the re- forms of Mehemet Ali opened his eyes to the importance of European culture. /He was thus doubly prepared for the part he was called upon to perform on the French ‘ conquest of Algiers in 1830. Becoming emir of Mascara by the renunciation of his father, he carried on war with the French until 1834, when peace was concluded ; but Abd-el-Kader’s endeavours to reorganize his principality on a European model excited the jealousy of the French, and war again broke out in the following year. Mascara was taken in October 1835, but the contest on the whole was unfavourableto the French, and peace was eventually made in 1837, on terms highly honourable to Abd-el- Kader. He nevertheless imprudently recommenced the struggle in 1839, and although his capital was again taken in 1841, protracted it until 1844, when he was com- pelled to seek refuge in Morocco. The French under Mar- shal Bugeaud crossed the frontier, and in June entirely defeated the Moorish army at Isly, thus virtually ending the Arab revolt. The sultan, though compelled to make peace, continued to give Abd-el-Kader an asylum as long as possible ; but early in 1847 the latter re-entered Al- geria, and was made prisoner. In violation, as alleged, of the terms of surrender, he was detained a captive in France until 1852, when he was released by Louis Napoleon. He resided successively at Broussa and at Damascus, where in 1860 he rendered such service in repressing an out- break against the Christians that he received the insignia of the Legipn of Honour. In his latter years he devoted himself anew to theology and philosophy, and composed a philosophical treatise which has been translated into French. He died at Damascus 26th May 1883. Abd-el- Kader was an example of all the , bright, and few or none of _the less prepossessing, traits of the Arab national character. (r. q\

Abdul-Aziz, Sultan of Turkey (1830-1876), the second son of the great Turkish reformer Sultan Mah- moud, was born 9th February 1830. During the reign – of his brother Abdul-Medjid he lived in complete retire- ment, but upon his accession to the throne (25th June 1861) he manifested a reforming spirit and a disposition to economize in personal expenses, and to bring the ad- ministration into harmony with the ideas of European culture. Unfortunately, his extravagant outlay on the army greatly overbalanced the economies effected else- where, and years of ruinous loan- raising culminated in national bankruptcy in 1875. Before this event, the sultan’s mind had been almost entirely given to a project for securing the succession to his son Izeddin, to the prejudice of his nephew Murad, and in pursuit of this object he had thrown himself into the arms of Russia. Financial disaster combined with Russian preponderance rendered his government intolerable; a movement insti- gated by the principal pashas compelled his abdication on 30th May 1876, and on 4th June he was stated to have committed suicide. Abdul-Aziz was a violent and obstinate man, of great and not always ill-directed energy,

but of narrow intellect, and was probably not entirely sane during the last years of his life.

Abdul Aziz, Sultan of Moboggo, is the son of Sultan Mulai-Hassan. He was born about 1881, and suc- ceeded to the throne on the death of his father, 7th June 1894, being proclaimed sultan in the Sherifian camp on the 11th of the same month. In the following October he received the British mission, under Sir Ernest Satow,wil;h the utmost cordiality at Fez, and a convention was signed in

April 1895. The sultan has proved constant in his friendship to Great Britain, and welcomed Sir Arthur Nicholson, the British minister, in 1896. In the follow- ing year he made a vigorous campaign against the Eiffians and others of his disaffected subjects, and overthrew them completely at Tadla, in October 1897.

Abdul – Hamid II., Sultan of Tubkey, is the second son of Sultan Abdul-Medjid, who reigned from 1839 to 1861. He was born 22nd September 1842, and succeeded on 31st August 1876, on the deposition of his brother Murad on the ground of insanity. His position at the time was very difficult, and he feigned sympathy at first with the policy of reform advocated by progres- sive officials such as Midhat Pasha. The revolt of the Christian subjects of the Porte in European Turkey, and the barbarous methods adopted to quench Bulgarian disaf- fection, equally played into the hands of Russia; and though, during the Russo-Turkish war (1877-78), the mili- tary-virtues of the Turkish soldier and the gallant defence of Plevna restored a large measure of sympathy to Turkey, the treaties of San Stef ano and of Berlin marked a further stage in the dismemberment of the Ottoman empire. As soon as the war was over, Abdul Hamid began to apply himself, with equal dexterity and persistency, to two great objects, viz., the substitution of his own personal authority for that of the great bureaucracy which had ruled Turkey under his immediate predecessors from the Sublime Porte, and the extension of his influence as spiritual sovereign or Kalif in compensation for the loss of temporal power inflicted upon the sultanate. To es- tablish his autocracy he did not shrink from sacrificing all the ablest men in his empire. His external policy was scarcely less successful and less unscrupulous. His dexterous diplomacy played off one great Power against another, and enabled him even to escape the storm which threatened at one moment to overwhelm him, when public opinion in Europe, and especially in England, realized the horror of the Armenian massacres in 1896. Russia secretly, and Germany openly, discountenanced Lord Salisbury's efforts to secure the united action of Europe, and the Cretan insurrection soon diverted the attention of diplomacy to another quarter. The success- ful war with Greece in 1897 did much to revive Turkish military prestige; and the practical loss of Crete, al- though evincing the decay into which the Turkish navy had been allowed to fall, rather increased than dimin- ished the strength of the empire. Perhaps the most im- portant feature in Abdul-Iiamid's later policy has been the disposition shown to rely upon Germany, and to grant that Power special privileges in Asia Minor.

For a fuller account of his reign, see Turkey, Armenia, Cbbte, Bulgaria, &c.

Abdullah Khalifa (Saved Abdullah Ibu-Sated Mohammed), (1846-1899), successor of the Mahdi Mo- hammed Ahmed, was born in 1846 in the south-western portion of Darfur, and belonged to the Taaisha section of the Baggaras or cattle-owning Arabs. His father, Mohammed et Tabis, had determined to emigrate to Mecca with his family ; but the unsettled state of the country long prevented him, and he died in Africa after

advising his eldest son, Abdullah, to take refuge with some religious sheikh on the Nile, and to proceed to Mecca on a favourable opportunity. Abdullah, who had already had much connexion with slave-hunters, and had fought against the Egyptian conquest of Darfur, departed for the Nile valley with this purpose; but, hearing on the way of the disputes of Mohammed Ahmed, who had not yet claimed a sacred character, with the Egyptian of&cials, he went to him in spite of great dif- ficulties, and, according to his own statement, at once recognized in him the Mahdi (" Director ") divinely ap- pointed to regenerate Islam in the latter days. His advice to Mohammed to stir up revolt in Darfur and JCordofan being justified by the result, he became his most trusted qounsellor, and was soon declared khalifa or vicegerent of the Mahdi, all of whose acts were to be regarded as the Mahdi's own. The Mahdi on his death- bed (1885) solemnly named him his successor; and for many years Abdullah, though to European ideas a monster of cruelty, injustice, and hypocrisy, ruled suc- cessfully over the Sudan, with little opposition from within, and extending his sway over neighbouring dis- tricts.

Khartum was deserted by his orders, and Omdur- man, at first intended as a temporary camp, was made his capital. At length the progi-ess of Sir H. (after- wards Lord) Kitchener's expedition compelled him to give battle to the Anglo-Egyptian forces near Omdur- ■ man, where on 2nd September 1898 his army, fighting with desperate courage, was almost annihilated. He fled to the north, but want of provisions in the following year compelled him to venture too near the army of Sir Erancis Wingate, by whom, at the end, of November 1899, he was overtaken and slain at the battle of Om Debrihat. He met death wilih great fortitude, refusing to fly, and his principal emirs voluntarily perished with him. (e. g.)

Abdurrahman Khan, Amib of Kabul (Afghan- istan), (circa 1844-1901), was the son of Afzul Khan, who was the eldest son of Dost Mahommed Khan, the famous Amir, by whose success in war the Barakzaie family established their dynasty in the rulership of Afghan- istan. Before his death at Herat, 9th June 1863, Dost Mahommed had nominated as his successor Sher Ali, his third son, passing over the two elder brothers, Afzul Khan and Azim Khan ; and at first the new Amir was quietly recognized. But after a few months Afzul Khan raised an insurrection in the northern province, between the Hindu Kush mountains and the Oxus, where he had been governing when his father died ; and then began a fierce contest for power among the sons of Dost Mahommed, which lasted for nearly five years. In this war, which resembles in character, and in its striking vicissitudes, tl^e English War of the Roses at the end of the 15th century, Abdurrahman soon became distin- guished for ability and daring energy. Although his father, Afzul Khan, who had none of these qualities, came to terms with the Amir Sher Ali, the son's behav- iour in the northern province soon excited the Ami;r's suspicion, and Abdurrahman, when he was summoned to Kabul, fled across. the Oxus into Bokhara. Sher Ali threw Afzul Khan into prison, and a serious revolt fol- lowed in South Afghanistan ; but the Amir had scarcely suppressed it^ by winning a desperate battle, when Ab- durrahman's reappearance in the north was a signal for a mutiny of the troops stationed in those parts, and a gatheriug of armed bands to his standard. After some delay and desultory fighting, he and his uncle, Azim Khan, occupied Kabul (March 1866). The Amir Sher Ali marched up against them from Kandahar ; but in the battle that ensued at Shekhabad on 10th May he was

deserted by a large body of his troops, and after his signal defeat Abdurrahman released his father, Afzul Khan, from prison in Ghazni, and installed him upon the throne as Amir of Afghanistan. Notwithstanding the new Amir's incapacity, and some jealousy between the real leaders, Abdurrahman and his uncle, they again routed Sher All's forces, and occupied Kandahar in 1867 ; and when at the end of that year Afzul Khan died, Azim Khan succeeded to the rulership, with Abdurrahman as his governor in the northern province. But towards the end of 1868 Sher All's return, and a general rising in his favour, resulting in their defeat at Tinah Khan on January 3, 1869, forced them both to seek refuge in Per- sia, whence Abdurrahman proceeded afterwards to place himself under £ussian protection at Samarkhand. Azim died in Persia in October 1869.

This brief account of the conspicuous part taken by Abdurrahman in an eventful war, at the beginning of which he was not more than twenty years old, has been given to show the sough school that brought out his quali- ties of resource and fortitude, and the political capacity needed for rulership in Afghanistan. He lived in exile for eleven years, until on the death, in 1879, of Sher Ali, who had retired from Kabul when the British armies entered Afghanistan, the Eussian Governor-General at Tashkend sent for Abdurrahman, and pressed him to try his fortunes once more across the Oxus. In March 1880 a report reached India that he was in northern Afghan- istan; and the Governor-General, Lord Lytton, opened communications with him to the effect that the British Government were

prepared to withdraw their troops, and to recognize Abdurrahman as Amir of Afghanistan, with the exception of Kandahar and some districts adjacent. After some negotiations, an interview took place between him and Mr (afterwards Sir) Lepel Griffin, the di^plomatic representative at Kabul of the Indian Government, who described Abdurrahman as a man of middle height, with an exceedingly intelligent face, and frank and courteous manners, shrewd and able in conversation on the business in hand. At the durbar on 22nd July 1880, Abdurrahman was officially recognized as Amir, granted assistance in arms and money, and promised, in case of unprovoked foreign aggression, such further aid as might be necessary to repel it, provided that he followed British advice in regard to his external relations. The evacuation of Afghanistan was settled on the terms proposed, and in 1881 the British troops also made over Kandahar to the new Amir; but Ayub Khan, one of Sher All's sons, marched upon that city from Herat, defeated Abdurrah- man's troops, and occupied the place in July. This serious reverse roused the Amir, who had not at first displayed much activity. He led a force from Kabul, met Ayub's army close to Kandahar, and the complete victory which he there won forced Ayub Khan to fly into Persia. From that time Abdurrahman was fairly seated on the throne at Kabul, and in the course of the next few years he consolidated his dominion over all Afghanistan, suppressing insurrections by a sharp and relentless use of his despotic authority. Against the severity of his measures the powerful Ghilzaie tribe re- volted, and were crushed by the end of 1887. In that year Ayub Khan made a fruitless inroad from Persia; and in 1888 the Amir's cousin, Ishak Khan, rebelled against him in the north; but these two enterprises came to nothing.

In 1885, at the moment when (see Afghanistan) the Amir was in conference with the British Viceroy, Lord Dufferin, in India, the news came of a collision between Russian and Afghan troops at Panjdeh, over a disputed point in the demarcation of the north-western frontier of Af^anistan. Abdurrahman's attitude at this critical

juncture is a good example of his political sagacity. To one who had been a man of war from his youth up, who had won and lost many fights, the rout of a detachment and the forcible seizure of some debateable frontier lands was an untoward incident; but it was no sufficient reason for calling upon the British, although they had guaran- teed his territory's integrity, to vindicate his rights by hostilities which would certainly bring upon him a Russian invasion from the north, and would compel his British allies to throw an army into Afghanistan from the south-east. His interest lay in keeping powerful neighbours, whether friends or foes, outside his kingdom. He knew this to be the only policy that would be sup- ported by the Afghan nation; and although for some time a rupture with Russia seemed imminent, while the Indian Government made ready for that contingency, the Amir's reserved and circumspect tone in the consultations jvith him helped to turn the balance between peace and war, and substantially conduced towards a pacific solu- tion. Abdurrahman left on those who met him in India the impression of a clear-headed man: of action, with great self-reliance and hardihood, not without indications of the implacable severity that has too often marked his administration. His investment with the insignia of the highest grade of the Order of the Star of India appeared to give him much pleasure.

From the end of 1888 the Amir passed eighteen months in his northern provinces bordering upon the Oxus, where he was engaged in pacifying the country that had been disturbed by revolts, and in punishing with a heavy hand all who were known or suspected to have taken any part in rebellion. Shortly afterwards (1892) he succeeded in finally beating down the resistance of the Haz^ra tribe, who vainly attempted to defend their immemorial inde- pendence, within their highlands, of the central author- ity at Kabul.

In 1893 Sir Henry Durand was deputed to Kabul by the Government of India for the purpose of settling an exchange of territory required by the demarcation of the boundary between north-eastern Afghanistan and the Russian possessions, and in order to discuss with the Amir other pending

questions. The Amir showed his usual ability in diplomatic argument, his tenacity where his own views or claims were in debate, with a sure underlying insight into the real situation. The territorial exchanges were amicably agreed upon; the relations between the Indian and Afghan Governments, as previ- ously arranged, were confirmed; and an understanding was reached upon the important and difficult subject of the border line of Afghanistan on the east, towards India. In 1895 the Amir found himself unable, by reason of ill- health, to accept an invitation from Queen Victoria to visit England, but his second son Nasrvdla Khan went in his stead.

Abdurrahman died on the 1st October 1901, being suc- ceeded by his son HabibuUa. He had defeated all enter- prises by rivals against his throne ; he had broken down the power of local chiefs, and tamed the refractory tribes ; so that his orders were irresistible throughout the whole dominion. His government was a military despotism resting upon a well-appointed army; it was administered through officials absolutely subservient to an inflexible will, and controlled by a widespread system of espionage ; while the exercise of his personal authority was too often stained by acts of unnecessary cruelty. He held open courts for the receipt of petitioners and the dispensar tion of justice ; and in the disposal of business he was indefatigable. He succeeded in imposing an organized government upon the fiercest and most unruly popula- tion in Asia ; he availed himself of European inventions for strengthening his armament, while he sternly set

his face against all innovations wHch, like railways and telegraphs, might give Europeans a foothold within his country. His adventurous life, his forcible character, the position of his State as a barrier between the Indian and the Russian empires, and the skill with which he held the balance in dealing with them, combined to make him a prominent figure in contemporary Asiatic politics, and will mark his reign as an epoch in the history of Afghanistan.

The Amir received an annual subsidy from the British Government of 18^ lakhs of rupees. He was allowed to import munitions of war. In 1896 he adopted the title of Ziarul-Millat-ud-Din (Light of the nation and religion) ; and his zeal for the cause of Islam induced him to publish treatises on Jehad. His eldest son HabibuUa Khan, with his brother NasruUa Khan, was born at Samarkhand. His youngest son, Mahommed Umar Jan, Vas born in 1889 of an Afghan mother, connected by descent with the Barakzaie family.

See also S. Wheeler, P.E.G.S. The Amir Abdur JBahman. London, 1895. — The Life of Abdur Bahman, Amir of Afghanistan, G. C.B.,Gr. C.S.I., edited by MirMunshi, Sultan Mahommed Khan. 2 vols., Loudon, 1900. Also the article Afghanistan, (a. o. l.)

Abel, Sir Frederick Augustus, Babt.

(1827 -), English chemist, was born in London,

17th July 1827. Determining to adopt chemistry as his profession, he was one of the first students to enter the Eoyal College of Chemistry, which was established in 1845 under the direction of the distinguished German chemist, von Hofmann. After remaining there for six years, during five of which he acted as one of Hof ruann’s assistants, he became Professor of Chemistry at the Eoyal Military Academy in 1861, and three years later was appointed Chemist to the War Department and Chemical Referee to the Government. During his tenure of this office, which lasted until 1888, he carried out a large amount of work in connexion with the chemistry of explosives, one of the most important of his investigations having to do with the manufacture of gun-cotton. Con- tinuing and supplementing the work of Lenk in Austria, he devised a process which enabled it to be prepared

with practically no danger, and which at the same time yielded the product in a form that increased its usefulness. This consisted essentially in reducing the cotton, after nitration, to fine pulp. A double advantage was thereby gained ; the material could be more certainly washed free from every trace of the acid which, if not removed, renders it liable to spontaneous combustion, while control over the rate of explosion, which is largely a question of mechanical condition, could be gained by hydraulic compression of the pulp into masses of whatever size and shape might be found desirable. – These improvements in the manuf A,cture of gun-cotton contributed in an important degree to the preparation of the smokeless powders, which in the latter part of the 19th century came into general use for mili- tary purposes all over the world. Cordite, the particular form adopted by the British Government, was the joint invention of Abel and Professor Dewar, who, with Dr Dupre, constituted the special Committee on Explosives which sat from 1888 to 1891 to select a smokeless powder for the British army and navy. For his services as chairman of this committee Abel was made a K.C.B. 0\ir knowledge of the explosion of ordinary black powder was also greatly added to by him, and in conjunction with Sir A. Noble he carried out one of the most complete inquiries on record into its behaviour when fired. The invention of the apparatus, legalized in 1879, for the determination of the flash-point of petroleum, was another piece of work which fell to him by virtue of his official position. His first instrument, the open-test apparatus, was prescribed by the Act of 1868, but, being found to

possess certain defects, it was superseded in 1879 by the Abel close-test instrument. The earlier Act imposed restrictions on the storage of petroleum having a flash- point below 100° P., as ascertained by the open-test instrument, and by the second one it was intended to maintain the same standai-d. It therefore became neces- sary to ascertain the relation between the two tests, and for this purpose Abel superintended a long series of experiments, which showed that, on the average, oil which flashed at 100° open-test flashed at only 73° close-test. The latter figure was therefore legalized as the equivalent of the former under the new conditions. Abel's researches were not confined to chemistry. In electricity he studied the construction of electrical fuzes and other applications of that form of energy to warlike purposes, and in 1877 he served as president of the Institution of Electrical Engineers (theji the Society of Telegraph Engineers). Problems of steel manufacture also engaged his attention, and in 1891-93 he was president of the Iron and Steel Institute, whose Bessemer medal he was awarded in 1897. Of the Eoyal Society he became a member in 1860, receiving a Eoyal medal in 1887. He took an important part in the work of the Inventions Exhibition in 1885, and in 1887 became organizing secretary and first director of the Imperial Institute. Among the books he has published are Handbook of Chemistry (with BloxamV Modem History of Gunpowder (1866), Oun-cotton (1866), On Explosive Agents (1872), Researches in Explosives (1875), and Electricity applied to Explosive Purposes (1884). He also wrote several important articles in the ninth edition of the Encyclopmdia Britannica.

Abeolcuta. See Lagos.

Aberavon, a municipal and contributory parliamen- tary borough and railway station of Glamorganshire, Wales, near the mouth of the Avon, 11 miles E.S.E. of Swansea. It belongs to the Swansea parliamentary dis- trict of boroughs. The port of Aberavon is Port Talbot, where there is a dock over a mile long, and from 240 to 900 feet wide. Area of municipal borough, 2060 acres. Population in 1881, 4859; in 1891, 6300; in 1901,

7553.

Abercarn, a large village in the southern parlia- mentary 'division of Monmouthshire, England, 10 miles N.W. from Newport by rail. There are collieries and ironworks in the district. The urban district

includes part of the civil parish of Mynyddyslwyr ; area, 9504 acres; population in 1881, 5964; in 1891, 10,464; in

1900, 12,607.

Aberconway. See Conway.

A be rd a re, a market-town and railway station of Glamorganshire, Wales, 4 miles S.W. of Merthyr Tydfil, of which parliamentary borough it forms part. The town has continued to advance rapidly both in numbers and in general prosperity. The new erections include Established and Presbyterian churches, an infectious diseases hospital, a cottage hospital, a theatre, a memorial hall, a theological college, and a technical and interme- diate school ; there is also a commodious industrial train- ing school, and the town now possesses two extensive public parks. Besides the prosperous mineral industries, there are brick and pottery works, and several breweries. Population of township in 1881, 35,533 ; in 1891, 40,917 ; ‘ of urban district in 1891, 38,431 ; in 1901, 43,357.

Aberdeen, a royal burgh, city, and county of a city (1899), and the county town of Aberdeenshire, Scoir land, situated on a bay between the mouths of the rivers Dee and Don, 111 miles N. of Edinburgh by road and 130^ by rail (Forth Bridge route). The city

has grown and prospered in an exceptional degree during the past half-century, owing to the development of the trawling industry, its educational facilities, and the attractions it offers to residents. In 1883, 900 acres were added to the municipal area, which was further extended in 1891 from 2681 to 6602 acres, incorporating in the city the burghs of Old Aberdeen and Woodside, and the district of Torry on the other side of the Dee. A large number of handsome streets have been laid out, and 200, to 400 buildings have been erected annually at a total estimated cost of £150,000 to £350,000. An esplanade is being laid out along the searbeaeh, and a boulevard constructed round the city. Union Terrace Gardens are now public, and Duthie Park (44 acres), lying on the north bank of the Dee, has been opened; it is adorned with a granite statue of Hygeia in honour of the donor. The latest addition to the parks is Stewart Park (13^ acres). By the introduction of a freer treatment of gran- ite the architecture of the city generally has been much improved in recent years. Marischal College has been rendered a still more striking feature of Aberdeen. “Under an extension scheme to which the Treasury con- tributed £40,000, the Town Council £23,350, and one donor between £20,000 and £30,000, a splendid gradua- tion hall has been built, considerable additions have been made to the class-room accommodation, and the edifice has been crowned by a lofty and imposing tower, while the front, long concealed by mean houses, has been largely opened up. King’s College also has been extended, and the chapel reconstructed internally and decorated. A botanic , garden was presented to the university in 1899, and the opening of the Mitchell Hall coincided with the celebration of the quatercentenary of ,the university in 1895. Two viaducts carrying streets have been con- structed, and Victoria Bridge over the Dee opened. The East church, burned down in 1874, has been rebuilt, and a massive granite tower erected over the aisle connecting it with the West church. This tower has been furnished with a Jubilee peal of 36 bells. The Kew Market, de- stroyed by fire in 1882, was rebuilt in 1883. Perhaps the most important of the new public buildings is the Museum and Art Gallery and School of Art (Italian Renaissance in red and brown granites) opened in 1883 and 1884. Other recently erected public buildings are new harbour offices, new fish market, new School Board offices, free library, theatre. Union Club, bathing station, Salvation Army Citadel (on a prominent site), and new Parish Council Chambers. The Eoyal Infirmary has been largely rebuilt

since 1887 as a memorial of Queen Victoria's Jubilee, and Trinity Hall has been extended. St Mary's Chapel has been restored, and a dozen or more new churches have been built within the last few years. A large extension of the railway station was authorized in 1899. New statues are Queen Victoria in bronze (1893), General Gordon (1888), Sir William Wal- lace (colossal bronze) (1888), and Burns in bronze (1892). Aberdeen has been represented in Parliament since 1885 by two members, who sit for the north and south divisions. The Town Council has now 34 members, inoluding-six magistrates. The two parishes of St Nicholas and old Machar were amalgamated by the Local Government Act of 1894, and the poor law is administered by a parish council of 31 members. The Town Council began in 1899 to work the tramways ; one of the routes has been equipped for overhead electric traction. Electric light has been introduced by the Corporation. Extensive improvements of the harbour accommodation have been made, including the construction of a graving dock, which has proved a failure, and is being rebuilt ; a bridge across the docks is being constructed. The harbour revenue rose from £.32,229 in 1871 to £68,849 in 1899. At the end of 1898, 201 vessels of 96,682 tons were registered at the port, and the movements of shipping were — 1888, entered 2706 vessels of 726,886 tons, cleared 2649 vessels of 70.3,162 tons; 1898, entered 3417 vessels of 936,409 tons, cleared 3349 vessels of 9.34,175 tons. Imports were valued at £662,102 in 1888 and £927,624 in 1898;

exports £135,382 in 1888 and £145,118 in 1898. The customs revenue at the port averaged £82,384 a-year in 1894-98. The granite industry continues to progress, but the most striking devel- opment has been in the fishing industry. Beam-trawling was introduced in 1882, and steam line fishing in 1889. Now there are 83 trawlers 'registered at the port, and 52 more make Aberdeen their headquarters. These are manned by 1140 men, and the capital invested in boats and gear is estimated at over £700,000. During 1899 there were in all 7700 arrivals. Fifty foreign smacks and luggers made landings during the year. In 1899, 886,037 tons of fish were landed which were valued at £537,422, and of that quantity 687,814 tons of i434,885 were trawl fish. A fresh impetus has been given recently to linen manufacture. Ship- building, which at one time threatened to decay, has been revived by the trawling industry ; 11 vessels of 9380 tons were launched in 1889 and 28 vessels of 11,973 in 1899. The university has now 24 professors and 12 lecturers, mostly of recent institution, and' its scholarships and bursaries are of £7603 annual value, a bequest of £20,000 for this purpose having been maeie in 1897. Matriculated students numbered 753 in session 1898-9. Gordon's Hospital was transformed in 1881 into Gordon's College, a day and night secondary school, in which special attention is paid to scientific and secondary education. The grammar school for boys and a high-school for girls are under the School Board, and there are several private higher-class schools. An Educational Trust con- stituted under the Endowments Act of 1882 possesses a capital of £155,000. Valuation in 1889-90, £550,802 ; 1899-1900, £753,802. Population in 1881, 105,003 ; 1891, 121,623 ; 1901, 153,108.

Adthorities. — J. Gordon. Description of Both Towns of Aberdeen. Spalding Club, 1842. — W. Kennedy. Annals of Aberdeen. London, 1818. — Jos. Eobbktson. The Book of Bon- Accord. Aberdeen, 1839. — W. Bobbie. Aberdeen : Its Traditions and History. Aberdeen, 1893. — C. G. Bure and A. M. Monro. Old Landmarks of Aberdeen. Aberdeen, 1886. — A. M. Munro. Memorials of the Aldermen, Provosts, and Lord Provosts of Aber- deen. Aberdeen, 1897.— P. J. Anderson. Charters, &c., illus-^ trating the History of the Boyal Burgh of Aberdeen. Aberdeen, 1890.— idem. Selections from tAe Becords of Marischal College. New Spalding Club, 1889, 1898-9.— J. Cooper. Chartulary of the Church of St Nicholas. New Spalding Club, 1888, 1892.— G. Cadenhead. Sketch of the Territorial History of the Burgh of Aberdeen. Aberdeen, 1876. — W. Cadenhead. Guide to the City of Aberdeen. Aberdeen, 1897. — ^A. Smith. History and Antiq- uities of New and Old Aberdeen. Aberdeen, 1882. (w.Wa.)

Aberdeenshire, a maritime county of N.E. Scotland, bounded N. tind E. by the German Ocean, S. by the counties of Kincardine and Perth, and W. by Banff and Inverness shires..

Area and Population. — In 1891 the Banflshire portions of the parishes of Gartly, Glass, New Machar, Old Deer, and St Fergus were transferred to Aberdeenshire, and the Aberdeenshire portion of the parish of Cabrach to Banffshire. Of parishes partly in Aberdeen and partly in Kincardine, Drumoak was placed wholly in the former and Banchory-Ternan in the latter county. Accord- ing to the latest official estimate the a^ea of the county (foreshore excluded), is 1,268,705 acres, or about 1982 square miles. The populktion was in 1881, 267,990 ; in 1891, 281,332 ; in 1891 on the extended area, 284,036, of whom 135,185 were males, and 148,851 females. On the old area, taking land only (1,251,451 acres, or 1955 -4 square miles), the number of persons to the square mile in 1891 was 144, and the number of acres to the person 4-4. In the registration county the population increased between 1881 and 1891 by 4-83 per cent. In 1901 the population was 304,420, an increase of 20,384. The following table gives particulars of the births, deaths, and marriages in 1880, 1890, and 1899 : —

Tear.

Marriages,

Births.

Deaths.

Percentage of Illegitimate.

1880 1890 1899

1700 1743 2283

‘ 9099 8436 9135

4172 5205 4884

14-4

12-98

11-2

The birth-rate, death-rate, and marriage-rate were all below the rates for Scotland. The following table gives the birth-rate, death-rate, and marriage-rate per thousand of the population for a series of years : —

1880.

1881-90.

1890.

1891-98,

1899.

Birth-rate . Death-rate . Marriage-rate

34-05

16-73

6-36

32-15

16-77

6-23

30-02

18-52

6-20

31-08

16-72

7-25

31-04

16-59

7-75

A B E E G A VENN Y — A B I N G D 0 N

9

According to the census of 1891 there were in the county 1538 Gaelic-speaking persons, of whom 8 spoke Gaelic only, and there were 204 foreigners. Valuation in 1889-90, £856,173 : 1899-1900, £920,246.

Administration. — ^The county returns two members to Parlia- ment— for the East and West divisions respectively. Besides the county town, Aberdeen (121,623), which returns two members, there are in the county two royal and parliamentary burghs, Inverurie (3106) and Kintore (686), and one parliamentary burgh, Peterhead (12,195), all of which belong to the Elgin group of burghs for parliamentary representation. Important police burghs are Huntly (3760), Fraserburgh (7466), andXurrifE (2341). There are 82 civil parishes, 24 of which belong to the Buohan Combination, with a poorhouse at Maud, while the city parish has poorhouses in Aberdeen. The number of paupers and dependants in September 1899 was 6698. The county forms a sheriffdom with BanfE and Kincardine, and there are two resident sheriffs-substi- tute in Aberdeen, who sit also at Peterhead, Fraserburgh, Huntly, and Turifl.

Education. — Ninety-two school boards manage 258 schools, which had an average attendance of 43,388 in 1898-99, while 38 voluntary schools, of which 14 are Episcopal and 6 Koman Catholic,

had 6507. There are 3 higher-class schools in Aberdeen, and secondary schools at Huntly, Peterhead, and Fraserburgh, and 69 other schools in the county earned grants in 1898 for giving secondary education. The County Secondary Education Com- mittee dispensed £4268 in. 1899, of which £2247 came from the Education Department and £2006 was contributed by local authorities from the "residue" grant, and supported, besides the schools mentioned, local classes and itinerant lectures in agriculture, fishery, and other technical subjects, besides subsidizing the agricultural department of the university, of Aberdeen.

Agriculture. — In no county in Scotland has a more productive soil been made out of unpromising material during the 19th cen- tury. Oats are the predominant crop, but the barley acreage has been nearly doubled since 1872, while wheat has practically gone out of cultivation. The most distinctive industry is cattle- feeding. A large number of the home-bred crosses are fattened for the London and local markets, and Irish animals are imported on a large scale for the same purpose. An exceedingly large busi- ness in the sale of live stock and dead meat is done all over the county, and the average weekly export of dead meat from Aber- deen for the London and southern markets has been estimated at 150 to 200 tons, while the shipment of cattle for the same destina- tions averages 50 to 70 head weekly. The following table gives the piincipsd acreages at intervals of five years from 1880 : —

Tear.

Area nnder Crops.

Corn Crops.

Green Crops.

Clover.

Perma- nent Pasture.

FaUow.

1880 1885 1890 1895 1899

603,226 611,424 614,365 630,070 630,121

212,767 215,950 213,887 215,730 214,920

104,203 102,469 101,243 101,709 100,109

259,645 263,004 268,058 276,389, 283,968

25,861 29,372 30,290 35,711 30,563

748 626 543 196

184

The following table gives particulars of the live stock during the same years : —

Tear.

Total Horses.

Total Cattle.

Cows or

Heifers In

Milk or Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1899

26,851 25,963 26,637 31,114 30,330

152,106 166,003 163,240 173,961 175,407

41,318 45,235 43,261 43,49-7 45,540

137,693 158,687 195,689 183,951 232,863

7,240 10,761 12,061 10,379 12,346

Aberdeenshire has by farthe largest cultivated area of any county in Scotland', and the largest number of holdings, but the percentage of cultivation is only 49-6. Of the 11,567 holdings in 1895, the average size was 54 acres. The percentage under 5 acres was 14-37 ; between 5 and 50 acres 49-23, and over 50 acres 36-40. Farms between 50 and. 100 acres numbered 2164, between 100 and 300, 1912 ; between 300 and 500, 124, and between 500 and 1000, 10 ; there were none above 1000 acres. According to the census of 1891 there were 26,386 men and 1213 women engaged in agri- culture. The acreage under wood in 1895 was 108,976, of which 7986 had been planted since 1881.

Industries and Trade. — ^There are now a number of paper- making establishments in the shire, most of them on the Don in the vicinity of Aberdeen. Aberdeen is the premier granite county in the kingdom. There are quarries at Aberdeen, Kemnay, Peterhead, and elsewhere, and the output was. 242,168 tons valued

at £132,373 in 1895, and 385,075 tons valued at £176,461 in 1899. Quarrying and dressing the stone gave employment in 1891 to 6294 persons. Fishing, however, is the next most important industry to agriculture. The nineteen ports and creeks of the county are divided into the three fishery districts of Peterhead, Fraserburgh, and Aberdeen, the last of which includes also three Kincardine- shire ports. The following table gives statistics of the three dis- tricts jointly in 1890, 1898, and 1899 :—

Tear.

Boats.

Value of – Gear.

Resident Fishermen ‘ and Boys.

Total Value of all Pish.

No.

Tons.

Value.

1890 1898 1899

1503 1630 1436

18,994 22,306 22,969

£193,817 £497,669 £731,534

£153,695 £167,668 £164,243

” 4822 3929 5417

£556,657 £883,129 £968,805

The number of persons in the three districts employed in the various branches of the sea fisheries was 21,232 in 1899. Between a haU and a third of the catch consists of herrings. The Iverring season for Aberdeen, Peterhead, and Fraserburgh is from June to September, at which time the ports are crowded with boats from other Scottish districts. The development of the fisheries of late years has been due to the trawlers almost exclusively. (See ‘Aberdeen.) There are valuable salmon fishings — ^rod, net, and stake-net — on the Dfee, Don, Ythan, and Ugie. The average annual despatch of salmon from Aberdeenshire during the years 1894 to 1898 was about 400 tons. A branch (16Jm.) of the Great ‘North of Scotland Railway was opened in 1897, and a light railway (18 m.) has been sanctioned.

Authorities. — A. Smith. New History of Aberdeenshire. Aberdeen, 1875. — W. Watt. History of Aberdeen and Banff. ‘Edinburgh, •1900.-7-S:r A. Leith-Hay. Castles of Aberdeenshire. Aberdeen, 1887.—J. Davidson. Inverurie and the Earldom of the Garioch. Edinburgh, 1878. — W. Temple. The Thanage of Formdrtyn. Aberdeen, 1894. — Pratt. Buihan (rev. by R. Anderson). Aberdeen, IQOO.^A. I. M’Connochie. Deeside. Aberdeen, 1895. The Moyal Dee. Aberdeen, 1898. Queen Victorians Highland Home. Aberdeen, 1897. — W. Ferguson. The Gfreat North of Scotland Railway. Edinburgh, 1881. — A. Jervise. Epitaphs and Inscriptions. Edinburgh, 1875, 1879. — Transactions of Buchan Field Club. Peterhead, 1887. — A Guide to Donside. Aberdeen, 1866. (-w. VVA.)

Abergavenny, a municipal borough (1899), market- town, and railway station, in the northern parliamentary- division of Monmouthshire, England, at the confluence of the Gavenny and the Usk, 16 miles W. of Monmouth. The lunatic asylum has been enlarged and a cottage hospital built. Population of urban district (borough) in 1891, 7743, on an area of 825 acres ; in 1901, 7795 ; of parish in 1881, 7886 ; in 1891, 9036.

Aberystwith, a municipal borough, market town, and seaport of Cardiganshire, Wales, at the confluence of the Ystwith and Eheidol, 244 miles from London by rail. It ceased to be a parliamentary borough in 1885. Modern erections are two Established churches, Wesleyan and Welsh Calvinist chapels, a pier pavilion, a ladies’ hostel in connexion with the University College of Wales, baths, and a new infirmary. The University- College of Wales was opened in 1872, and in 1900 had

31 professors and 474 students. In the town and neighbourhood are engineering works, foundries, and slate-quarries. The corporation is lord of the manor, and owns nearly four- fifths of the town. Population in 1881, 7088 ; in 1891, 6725 ; in 1901, 8013. Area, 845 acres.

Abeshr. See Wadai.

Abila, (1) the capital of the tetrarchy of Abilene, was an important town on the imperial highway from Damas- cus to Heliopolis (Bcudbek), and is now represented by Siik ~WMi Baradii, a village called by early Arab geographers Abil es-Suk. The tetrarchy was granted by Caligula, 37 a.d., to Agrip'pa I., and by Claudius, 62 a.d., to Agrippa II. (2) A city in Perea, now Abil ez-Zeit.

Abingdon, a municipal borough and market-town in the Abingdon parliamentary division (since 1885) of Berkshire, England, 61 miles W.N.W. of London by rail. The old churches of St Helen and of St Nicholas have been restored, a corn exchange, a cottage hospital, and a

free public library erected, and municipal drainage works and water works executed. The town has important corn markets and horse fairs. Area of borough, 730 acres. Population in 1881, 6755; in 1891, 6557; in

1901, 6480.

Abo, city and seaport of Finland, Kussia, capital of the Abo-Bjorneborg province ; 381 miles by rail from St Petersburg, vid Tavastehus ; in regular steamer communi- cation with St Petersburg, Wasa, and Stockholm. Ship- building has considerably developed lately, warships being built for the Russian navy. This city is only second in Finland to Helsingfors for its trade. Its harbour (Bornholm, on Hyrvinsala Island) is entered yearly by from 700 to 800 ships, of about 200,000 tons. Population, 18,109 in 1867; 34,339 in 1897.

Abo-Bjbrneborg, a province occupying the S.W. corner of Finland, and including the Aland islands. Its population reached 413,351 in 1897, of whom 12 per cent, lived in towns. It occupies the first rank in Finland for its manufactures of cottons, sugar refinery, wooden goods, metals, machinery, paper, &c. Its chief towns are — ^Abo, Marienhaven (759), Nodendal (654), Nystad (4023), and Eaumo (4111).

Abomey. See Dahombt.

About, Edmond FrariQOis Valentin

(1828-1885), French novelist, publicist, and journalist, was the son of a grocer, and was born on the 14th of February 1828, at Dieuze, in Lorraine. The boy's school career was brilliant. In 1848 he entered the j^cole Nor- male, taking the second place in the annual competition for admission, Taine being the first. Among his college contemporaries were Taine, Paul Albert, Weiss, Assolant, Sarcey, Challemel-Lacour, the ill-starred Prevost-Paradol. Of them all About was, according to Sarcey (Souvenirs de Jeunesse), the most highly vitalized, exuberant, brilliant, and " undisciplined." At the end of his college career he joined the French school in Athens, but if we may believe his own account, it had never been his intention to follow the professorial career, for which the ificole

ISTormale was a preparation, and in 1863 he returned to France and frankly gave himself to literature and journalism. A book on Greece, La Orice contemporaine (1855), which did not spare Greek susceptibilities, had an immediate suc- cess. Tolla, which remains one of his best novels, ap- peared shortly after, and during the next few years, with indefatigable energy, and generally with full public recognition, he wrote novels, stories, a play — which failed — a book-pamphlet on the Roman question, many pam- phlets on other subjects of the day, newspaper articles in- numerable, some art criticisms, rejoinders to the attacks of his enemies, and popular manuals of political economy, Jj'A B G du Travailleur, Le Progr&s. About's attitude towards the empire was that of a candid friend. He be- lieved in its improvability, greeted the Liberal ministry of iSmile Olivier at the beginning of 1870 with delight, and welcomed the Franco-German war. That day of enthusiasm had a terrible morrow. For his own personal part he lost the loved home near Saverne in Alsatia, which he had purchased in 1858, out of the fruits of his earlier literary successes. With the fall of the empire he became a Republican, and, always an inveterate anti-cleri- cal, he threw himself with ardour into the battle against the conservative reaction which made head during the first years of the. Republic. From 1872 onwards for some five or six years his paper, the XIX° SiMe, of which he was the heart and soul, became a power in the land. But the Republicans never quite forgave the tardiness of his conversion, and no place rewarded his later zeal. On the 23rd January 1884 he was elected a member of the French Academy, but died on the 26th January 18,85, be-

fore taking his seat. Dust has accumulated on the mass of About's work. His journalism— of which specimens in his earlier and later manners will be found in the two series of Lettres d'un bon jeune homme d sa Cousine Made- leine (1861 and 1863) and Le Dix-neuvi&me SiMe (1892) — was of its nature ephemeral. So were the pamphlets, great and small. His political 'economy was that of an orthodox popularizer, and in no sense epoch-making. His dramas are negligible. His more.serious novels, Madelon, Vlnf&me, the three that form the series of the VieHle Bocke, and Le Roman d'un brave homme — a kind of counterblast to the view of the French workman presented in M. Zola's Assommoir — contain striking and amusing scenes no doubt, but scenes which are often suggestive of the stage, while description, dissertation, explanation too frequently take the place of life. His best work after all is to be found in the books that are almost wholly farcical, Le nez d'un notaire, Le Roi des Montagnes, L' Homme d, I'oreiUe cassie, Trente et quarante, Le Gas de M. Guirin. Here his most genuine wit, his sprightliness, his vivacity, the fancy that was in him, have free play. " You will never be jnore than a little Voltaire," said one of his masters wh*n he was a lad at school. It was a true prophecy. (f. t. m.)

Abrudbanya, a corporate town of S.E. Hungary, situated on the slope of the ^firczhegyseg (Ore Mountains), 45 miles S.W. by S. of Klausenburg {Hung. Kolozsvar). In Roman times it was the site of a town where resided the procurator aurarium of Daeia, and gold ore is still mined in the villages on the neighbouring mountains. The annual produce of these mines is about 34,400 oz. troy of fine gold. Considerable secondary products are silver, iron, copper, lead, and lignite. The ore raised from the mines belonging to the mine-captaincy of Falatna (to which Abrudbanya belongs) in 1899 represented a total value of £972,292. Population (1891), 2992; (1901) 3370; of recent years it has become joined to the village of Abrudfalva with (1901) 4978 inhabitants. It contains good state schools and many handsome buildings.

Abruzzi e Molise, a territorial division of Italy, a mountainous region embracing the middle Apennines and reaching down to the Adriatic on the E. It com- prises the provinces of Aquila, Chieti, Teramo, and Cam- pobasso, with an area of 6567 sq. miles, and includes a population of (1881) 1,317,215, (1901) 1,442,365. The first three provinces correspond to the former Neapolitan districts of Abruzzo, and Campobasso to the former Neapolitan province of Molise. The mountains are in great part covered with forests, and the wealth of the people consists principally in cattle, sheep, and pigs. Some wheat, wine, olives, and figs are grown in the val- leys. Beyond the rearing of silkworms

and silk-spinning, the industries are unimportant. The towns are mostly of small size, the chief of them being Chieti, Teramo, Aquila, Campobasso, and Solmona.

Abt, Franz (1819-1885), German composer, was born 22nd December 1819 at Eilenburg, Saxony, and died at Wiesbaden, 31st March 1885. The best of his popular songs have become part of the recognized folk-music of Germany ; his vocal works, solos, part-songs, &c., enjoyed an extraordinary vogue all over Europe in the middle of the 19th century, but in spite of their facile tunefulness have few qualities of lasting beauty. He was Kapell- meister at Bernburg, 1841, at Zurich in the same year, and at Brunswick, 1852-82, when he retired to Wiesbaden.

Abu, a mountain of India, in the Sirohi state of Rajputana, being an isolated spur of the Aravalli range. It is situated in 24° 35′ N. lat., and 72° 45′ E. long., 16 mileis from the Abu road station of the Raj-

putana railway. The height above the sea of the various peaks ranges from about 4000 to 5635 feet. It is the suminer residence of the governor-general’s agent for Eajputana, and a place of resort for Europeans in the hot weather. The annual mean temperature is about 70°, rising to 90° in April; but the heat is never op- pressive. The annual rainfall is about 68 inches. The

hills are laid out with driving-roads and bridle-paths, and there is a beautiful little lake. The chief buildings are a church, club, hospital, and a Lawrence asylum school for the children of British soldiers.

Abu Ahmed. See Sudan, Anglo-Egyptian.

Abushehr. See Bushibe.

ABYSSIlSriA.

1. Geogeaph-^ and Statistics.

DURING the last thirty years of the 19th century our knowledge of the physical features, climate, natural history, resources, and social condition of Abyssinia has been greatly advanced by scientific exploration, by hunting and military expeditions, and by the reports of numerous

embassies to the courts of its successive rulers. As fully explained in the historical section (see below), a main result of the political relations, some friendly, some hostile, with Egypt, Italy, and Great Britain, has been the con- solidation of the Abyssinian empire under one potentate, Menelek, king of Shoa, by the complete reduction of the ancient kingdoms of Tigre, Lasta, Amhara, and Gojam,

Scale of Miles so 100 aoo

Slun/hvSt Sto^raph* Bstai\ Loajw. >

Sketch Map oy Abyssinia.

followed by the absorption of all the surrounding Ethiopian lands. The area of the unified political system has thus been enlarged, especially in the direction of the south and south-east, while its absolute autonomy has been recognized by various international treaties with Great Britain and Italy. Menelek's dominions now comprise the whole of the Galla and Kaffa highlands, extending from Abyssinia proper southwards nearly to the Samburu (Lake Eudolf) depression, together with Harrar and Central Somaliland co- terminous with the French, British, and Italian possessions

along the seaboard. In the empire are thus now included, besides the above-mentioned vassal kingdoms, the territo- ries of Ennarea, Guragheh, Walamo, Jimma, Ghera, Guma, Leka, Walega, Kaffa, and all the other petty states which are exclusively occupied by the Hamitic Galla people, and constitute what is commonly called Gallalaud or South Ethiopia. The frontiers, mostly conventional lines regard- less of mountain ranges, river basins, or other natural features, have not yet been determined towards the N.W., W., and S. ; but they roughly coincide on the west towards

the Anglo-Egyptian Sudan, with the meridian of 35° E. be- tween the river Rahad, and 4° N. lat., and on the south with this parallel eastwards to 40° E. Here the line is deflected irregularly south-eastwards to Logh, on the river Juba, and then runs north by east at about 180 miles from the coast along the Italian frontier as far as British Somali- land. Beyond this district the boundary is coterminous eastwards with French Somaliland as defined in 1897, and the Italian colony of Eritrea as far north as 15° N. lat., and westwards to the Atbara, whence the line runs south and west to the poiit where the river Rahad is intersected by the meridian of 35° E. Within these limits the reconstituted Abyssinian empire has a total area of about 320,000 square miles, with a population approxi- mately estimated at 9,000,000 distributed as under: —

Hamran, Beni-Amer, Bilin, Marea, Mensa, Bas6 (Kunama), and Barea districts between the Plateau and Upper Nubia Abyssinia proper (North Ethiopia) : the old kingdoms of Tigr4, Lasta, Amhara and Gojam Shoa (Menelek's patrimony) Harrar and neighbouring districts Ogaden and other parts of Somali- land South Ethiopia (Gallaland)

'■)

Total (1901)

Area in 8q. MUes.

Population.

30,000

150,000

80,000

2,600,000

20,000 10,000

1,000,000 250,000

100,000

1,000,000

80,000

4,000,000

320,000

9,000,000

Despite its enlarged domain, Abyssinia still remains an inland state, nowhere reaching the coast, where all its natural outlets — Massawa and Assab on the Red Sea, Jibuti, Zeila, Bulbar, and Berbera on the Gulf of Aden — are held by foreign Powers. Even on the west side it is cut off from direct access to the White Nile, where both banks of the river are included in the Anglo-Egyptian Sudan. No doubt the upper courses of the eastern affluents of the main stream, Sobat, Abai (Blue Nile), Takazze (Atbara, or Black Nile), flow through Abyssinian territory. But here they have the character of intermittent wadies, nearly dry for a great part of the year, and during the rains raging torrents rushing wildly through deep rocky gorges down to the lowlands, hence at no time navigable, and of little use even for irrigation purposes. Hence their ex- clusion from marine and fluvial navigable waters has been all the more acutely felt by the native rulers, whose foreign policy continues to be largely directed towards acquiring territory both on the seaboard and along the right bank of the White Nile.

The Ethiopian higjilands, of which Abyssinia proper forms the northern, and Gallaland the southern section, occupy most of the „ . J space between the lowlands of the White Nile basin ^^tans ”” those of the Eritrean rift valley, separating them from the Bed Sea and the Indian Ocean. Their long axis is disposed in the direction of the meridian, and the whole region broadens out from near the Red Sea at Massawa southwards to the Lake Rudolf depression. The northern section, lying mainly between 10°-15° N. lat., may be described as a huge mass of Archsean gneiss and schists, forming a rugged plateau at a mean height of from 7000 to 7500 feet above the sea, profoundly weathered by sub-aBrial agencies, and- flooded in a deep central depression by the waters of Lake Tsana. Above the plateau, which presents its steepest escarpments towards the rift valley, and falls in terraces northwards and westwards down to the plains of Upper Nubia and Sennar, rise several irregular and generally ill-defined mountain ranges, consisting partly of Jurassic lime- stones and partly of old igneous rocks, great sheets of lava and vast piles of volcanic detritus, which in the western provinces of Gojam and Simen attain altitudes of from 12,000 to 15,000 or even 16,000 feet. But there appear to be nowhere any active cones, and the very craters have for the most part been obliterated. The plateau formation itself is broken and largely obscured by vast yawning chasms and fissures, through which the surface waters escape to the surrounding lowlands. Amid the chaos of Alpine heights and rugged plains which, seen from the higher summits, present the aspect of a storm-tossed sea suddenly

solidified, the best-defined mountain system is the coast range, which is formed by the precipitous eastern escarpments of the plateau, and maintains for a distance of about 600 miles a mean elevation of from 7000 to 8000 feet. It thus rises little above the inland plateau, and travellers penetrating from the coast to the interior find that on surmountiilg this rocky barrier they ha,ve already reached the normal level of the whole region. But the irregular Simen and Gojam groups, the true highlands of North Ethiopia, still rise 6000 or 7000 feet higher, several of their peaks penetrating to the snow-line.

Mount Dajan in the Simen range is certainly over 15,000 feet, and was long supposed to be the loftiest summit in Africa north of Kenia. But it now appears to be overtopped by others, such as Abbaryared (15,600 feet), and Buahit (16,000 feet) in the same group. At Ankober (9° N.) the coast range begins to trend round to the south-west, thus assuming the aspect of an inland chain, and gradually increasing in height until it culminates in Mount Metatiteh (11,000 feet), and the Entoto range crossed by the Hular Koh Pass (over 12,000 feet) in the kingdom of Shoa. Here the Abyssinian system merges in the South Ethiopian highlands, which are continued at considerable altitudes southwards to the Kaffa territory, and then fall rapidly down to the Lake Rudolf depression. Like the northern section, these less-known Galla uplands appear to form a much broken hilly plateau, presenting its steepest escarpments on the east side towards Somaliland, and falling more gently in a series of broad terraces down to the lowlands of the Nile basin. Although, the routes of the explorers in the Galla and Samburu lands have now been connected by the itineraries of Bottego, Donaldson Smith, Wellby, and a few other travellers, no accurate surveys have yet been made, and the heights assigned to the loftier peaks in South Ethiopia (Hamdo, 11,500 feet; Wartro, 13,000 feet ; Wosho, 16,000 feet) are little more than conjectural. This region, however, is known to be of a far less rugged character than the Abyssinian tableland, and there are few or no traces of the so-called ” ambas,” that is, isolated blocks or sections caused by erosion and underground agencies, which are such a characteristic feature of the Shoa and Gojam uplands. Some of the intervening rifts and fissures, which somevphat resemble the Mexican barrancas, are of vast extent and depth, but often very narrow. The most remarkable occur along the edge of the central plateau, “where the total fissure exceeds 6500 feet, measured from the summit of the degas (uplands) down to sea-level. Nowhere else can a more convincing proof be observed of the erosive action of running waters. The two walls of certain gorges, rising nearly vertically within a few feet of each other to a height of some hundreds of feet, represent an erosion of hard rock amounting to at least 10,500 million cubic feet” (^Beclus, X. p. 129).

Most of the Abyssinian uplands have a decided north-westerly tilt, so that nearly all the large rivers find their way in this direc- tion inland to the Nile Valley. Such are the Takazz6 in the north, the Abai in the centre, and the Sobat f’^”” “”’ in the south, and through these three arteries is “***• discharged about four-fifths of the entire drainage. The rest is carried oft by the Khor Baraka, which occasionally reaches the Red Sea below Suaklm-; the Hawash, which runs out in the saline lacustrine district near the head of Tajura Bay ; the Webi- Shebeyli and Juba, which flow through Somaliland to the Indian Ocean ; and the Omo, now known to be the main feeder of the closed basin of Lake Rudolf. The Takazzg, which is the true upper course of the Atbara (the Astaboras of the ancients, and the Bahr-el-Aswad or “Black Nile” of the Arabs), has its source in the Simen uplands, and falls from about 7000 to 2500 feet above sea-level in the tremendous crevasse through which it sweeps round east, north, and west down to the western terraces, where it passes from Abyssinian to Nubian territory. During the rains the Takazzfi, i.e., the “Terrible,” rises some 18 feet above its normal level, and at this time forms an impassable barrier between the northern and central provinces. In the Hamran district, where it becomes the Bahr-Setit, the Takazzg is joined on its left bank by the Upper Atbara, which is formed by the junction of the Angreb, Salaam, Aradeb, Koang, and several other head-streams descending from the Amhara uplands. Below the confluence the united stream retains the name of Atbara, and farther down receives on its right bank the intermittent waters of the Mareb or Gash, which rises near Adua in Tigrg and is dry for a great part of the year, but, like the Takazz6, is subject to sudden freshets during the rains. From its source to the Nile confluence at Ed-Damer, where it is now crossed by a railway bridge, the main stream has a total length of about 800 miles, and the drainage area exceeds 20,000 square miles within Abyssinian territory. But the discharge is slight except in the wet season, when it nearly equals that of the Blue Nile. In its lower reaches it rises at times to a height of 30 or 40 feet, with a breadth of over 600 yards. The Abai— that is, the upper

course of the Blue Nile— has its farthest source near Mount Denguiza, in the Gojam highlands, about 11° N. and 55° E. , and first

geography]

flows for 70 miles nearly due north to the south side of Lake Tsana (Dembea). This great island-studded basin, which stands some 3000 feet below the normal level of the plateau, has somewhat the aspect of a flooded crater, being of nearly circular form, with a diameter of about 40 miles, an area of over 1200 square miles, and a depth in some parts of 250 feet. Tsana has been identified with the Coloe Palus of the ancients, which, ailthough placed some 12° too far south by Ptolemy, was descriljed as a chief reservoir of the Egyptian Nile and the source of the Astopus, which was certainly the Blue Nile. At the south-east corner the rim of the crater is, as it were, breached by a deep crevasse through which the Abai escapes, and here develops a great semicircular bend like that of the Takazzfe, but in the reverse direction — east, south, and north-west — down to the plains of Sennar. In this section of its course its swirling waters rush over a long series of cataracts and rapids, descending from a height of 60U0 feet at the outlet to about 1400 feet at Fazokl, where it crosses the Abyssinian fron- tier, and flows with a sluggish current through the plains of Sennar to its confluence with the White Nile at Khartum, 1300 feet above sea-level. At Fazokl, where it becomes the Bahr-el-Azreq (Blue Nile), it is joined on its left bank by the auriferous Tumat, and higher up by the Yabus, both intermittent affluents from the South Ethiopian uplands. In Sennar it receives on its right bank two important tributaries from the Abyssinian heights, the Dinder, a very long and apparently perennial stream, and the Rahad, waterless in the dry season, copious and richly charged with sedi- ment during the rains from June to September. At this period the discharge of the Blue Nile rises from 6000 to 220,000 cubic feet per second, thus greatly exceeding that of the White Nile itself, which is only about 175,000 cubic feet during the floods above the con- fluence. The economic importance of the Kue Nile as the great fertiliser of Egypt is elsewhere discussed. (Nile; Egypt.) On the east side of the Abyssinian plateau the chief fluvial basin is that of the Hawash (Awash, Awasi), which rises on the landward side of the coast range, and, like the other large Ethiopian rivers, describes a great semicircular bend on its seaward coast between the Shoa uplands and Gallaland. After emerging on the Afar (Danakil) lowlands through a broad breach in the eastern escarp- ments of the plateau, it is joined on its left bank by its chief affluent, the Germama (Kasam)r..and then trends round to the north-east in the direction of Tajura !6ay. Here the Hawash is a copious stream nearly 200 feet wide and 4 feet deep, even in the dry season, and during the floods rising 50 or 60 feet above low-water mark, t^hus inundating the plains for many miles along both its banks. Yet it fails at any time to reach the coast, and after a winding course of about 500 miles runs out in the Lake Ausa basin, some 60 or 70 miles from the head of Tajura Bay. This remarkable phenomenon is explained by the position of Ausa in the centre of a saline lacustrine depression, which stands at present several hundred feet below sea-level. Recent surveys give 174 metres for the Assal lakelet near the bay, and several of the other surrounding hadds (basins) may even be lower, although the Hawash itself still flows at an elevation of 620 metres below its junction with the river Addifuha, where it begins to descend through a chain of badds down to Ausa. While most of the other lagoons are highly saline, with thick incrustations of salt round

their margins, Ausa remains fresh throughout the year, owing to the great body of water discharged by the Hawash into this closed basin. Formerly the whole of the Afar and neighbouring Adal (Somali) and Dawari (Galla) territories formed part, of the Red Sea, which flooded the now dry rift-valley right up to the foot of the coast range. Another lacustrine region, not however of marine, but

perhaps of igneous origin, extends from the Shoa heights southwards to the Samburu depression. In this chain of lovely upland lakes, some fresh, some brackish, some completely closed, others connected by short channels, the chief links in their order from north to south are Zwai, communicating southwards with Hara and Lamina, all in the Arusi Galla territory; then Abai with an outlet to a smaller tarn in the romaaitic Baroda and Gamo districts, skirted on the west side by grassy slopes and wooded ranges from 6000 to nearly 9000 feet high; lastly, in the Asilli country Count Teleki's Lake Stefanie, the Chuwaha of the natives, completely closed and falling to a level of 3700 feet above the sea. To the same system obviously belongs the neighbouring Lake ■Rudolf (Gallopa or Buzz), which is larger than all the rest put together, and terminates southwards with an active volcano, thus betraying the igneous origin of these basins and bringing them into line with Gregory's " Great Rift Valley." With the determination of the lower course of the Omo, one of the few remaining problems in African geography has been solved. Its upper course had long been identified with the Fintirfi, which rises on the northern slope of the Bor6 heights about 150 miles south-west of Addis-Abbaba, and, after flowing 38 miles north, bends round east and south to the Zighero district, where it takes the name of Omo. It was then supposed either to trend east to the Juba or west to the Sobat until Bottego, on his last disastrous expedition (1896), found that it discharged into the closed basin of Lake Rudolf. Its lower reaches have since been visited by Cavendish, Donaldson Spith, Austin, WeUby, Leontieff, Bulatovich, and others ; and the Nia- miam, as it is here called, is now known to be a noble perennial waterway, which is joined along its middle couiseby the Gojeb, Jibi^, Gumi, Kabish, and many other affluents onlioth its banks, and for some miles above its mouth at the north end of the lake flows in a deep channel varying with the seasons from 50 to 500 feet in width. Throughout its entire length of over 370 miles it has a total fall of about 60p0-feet (from 7600 at its source to 1600 at lake-level), and is consequently a very rapid stream, being broken by the Eokoby and other falls, and, navigable only for a short distance above its mouth. The Baraka, Shebeyli, Juba, and Sobat, belonging only fgr short stretches of their upper courses to the Ethiopian region, will be more conveniently described in their principal drainage areas. (Nile; Somalilans.)

The vertical disposition of the climatic zones, which is more or less common to all highland regions, and of which Mexico offers a typical example, is somewhat modifled on the Ethiopian uplands by the irregular distribution of the rainfall, the Climate! varying aspect of the land, and other local conditions. flora ; Nevertheless, striking analogies have been observed be- fauna. tween the superimposed Mexican and Abyssinian zones, so that it is possible to construct a comparative table of the more salient features, and even of the respective terminologies of each, as under : —

Climatic Zones.

Mean Bange of Altitudes.

Mean Kange of Temperatures.

Charjtcterlstic Flora.

1. /Mex. Tierra Caliente . (Hot) \Abys. Kwalla

2. /Mex. Tierra Templada (Temp.) \ Abys. Voina^dega

3. f Mex. Tierra Fria (Cold) \ Abys. Dega .

Oto 4,000ft.

Oto 5,000ft. 4000 to 6,000 ft. 5000 to 8,000 ft. 6000 to 9,000 ft. 9000 to 14,000 ft.

77°- 82° F. 70°-100° F. 62°- 70° F. 60°- 80° F. 58°- 64° F. 45°- 60° F.

Banana, sugar, cocoa-nut, coffee.

Banana, cotton, date, coffee.

Maize, wheat, tobacco, beans.

Wheat, bamboo, terebinth, pulse, citron.

Jucca, pine, cedar.

Pine, barley, oats, scrub.

The correspondence is even closer than appears from this table, because the Mexican scheme excludes Alpine heights, which are included in the Abyssinian dega. Allowance has also to be made for the much lower latitude of the Ethiopian region (4°-16° N.) compared with that of Mexico (16°-32° N.), while the mean alti- tude of the two plateaux is about the same (7000 feet). Besides the above-mentioned plants, many other tropical forms — indigo, tamarinds, ebony, gummiferous acacias, baobabs — ^flourish in the Kwalla bottom-lands. Nearly all the European cereals, grasses, and shell fruits are indigenous in the Voina-dega, where are also met the orange, peach, apricot, and other fruit trees, besides the vine, Zegba (Podocarpus), dhurra, tief, kolkwal {Euphorbia ahissinica), juniper, and several species of scyamores, some of which grow to a gigantic size in the sheltered gorges of the inter- mittent mountain torrents. But in the dega, which includes all the more elevated plains, ambas, and upland valleys, little thrives except the hardier cereals, scrubby plants, and rich grasses afford- ing excellent fodder for cattle, goats, and the long-haired native sheep. The South Ethiopian region between the Hawash and White Nile basins has also its three zones, which, as determined

by M. Michel of the Bonchamps Mission {La Geographie, July 1900), are : — 1. The wide treeless tableland between 6500 and 8500 feet high, covered in places with limestone strata, deeply scored here and there by the running waters. 2. The uplands between the sources of the Hawash and Omo rivers, stretching” west to the valley of the Didessa, affluent of the Sobat. Here the ranges, which fall little below 10,000 feet, and are separated by deep val- leys, are clothed with low forest, and lower down with scrub which has been partly cleared for cultivation. 3. A low, hilly region from 5000 to ~~5500 feet high, with scarcely any intervening level ground, but superabundantly watered by streams, flowing to the Sobat, and yielding large quantities of coffee and honey. The hitherto almost unknown region stretching still farther south tow~~ ards Lakes Rudolf and Stefanie proves to be much more elevated, and also more productive, than had been supposed. Alpine heights — one (Guge) nearly 14,000 feet — are spoken of by Bottego, Donaldson Smith, and other explorers near the lakes, and the waterparting between the Omo and Sobat basins, to which Bulatovich has given the name of the Tsar Nicholas Bange, is surmounted in its northern section by several peaks over 10,000

feet high. This range is lofty enough to intercept the moisture- charged clouds brought by the trade winds from the Indian Ocean, and thus raise the mean rainfall from 30 inches in Abyssinia proper to 40 or 50 inches on the eastern slopes of the Galla uplands. Here have been discovered clear

indications of iron and copper, while gold is known to occur in large quantities in the Tumat valley, where it was for some time profitably mined by Mehemet All. Gold, iron, and other metals are also mentioned in the Ham- mer Koki hills north of Lake Stefanie, and recent exploration fully confirms the reports of the early Italian explorers— Massaja, Antinori, Chiarini, Ceochi, and others — regarding the vast supe- riority of the Galla lands over the Abyssinian plateau in natural resources of all kinds. Wellby, who traversed the lacustrine region between Shoa and Lake Rudolf in 1898-99, describes the "demon- haunted" Walamo district and the Baroda and Gamo uplands about Lake Abai as " fairy lands," with fertile black and red soils abundantly watered by limpid streams, in parts well timbered or under rich pasturage, and, where cultivated, growing bananas, palms, tobacco, limes, cotton, ginger, raspberries, and godaris — " a remarkably good vegetable." Along the banks of the streams "grow big shady trees and a multitude of flowers and under- growth, alive with birds of bright plumage" {Geograph. Jour. September 1900). Whilst extensive woodlands are rarely met with in Abyssinia, except in the Kwalla districts, travellers in the southern uplands speak of the immense forests of conifers, wild olives, and other trees, under the matted moss-grown branches of which they have journeyed for hours together. This home of the coffee-shrub could still supply the world with many other valuable species, such as the aggieh, or korarima, a fruit much esteemed for its flavour and aroma, and the kosso, a beauti- ful plant with large pendent red flowers, highly prized for its medidnal properties. Besides the elephant, hartebeest, and other large African game, the wild fauna includes the gira&, rhinoceros, lion, black panther, leopard, hyena, buffalo, gazelles, wild donkeys (striped like a zebra), eagles, vultures, kites, guinea-fowl, par- tridges, and sand-grouse. Of great economic importance is the civet-oat (Viverra civetta), which is domesticated, and yields most of the musk that finds its way to the eastern markets. A zuore valuable product is coffee, which is indigenous in the KaSa country, whence it takes its name, and is extensively cultivated throughout the wooded districts of Gallaland. It thrives best on the clearings under the shade of large trees, and is of prime qaality ; much of the so-called Arabian " mocha " really comes from Ethiopia, and the two sorts are often' mixed together for the European markets.

Besides gold, ivory, musk, salt, and coffee, the staples of the export trade, many other commodities, such as com, flour, beer, , korarima, honey, wax, cotton, and indigo, are for-

aad^^ns ^^I'ed to the lo«il markets. Of these the Ijusiest are Basso in the north, Bonga in the extreme south, and Liekd, in the centre. Liek, the largest maj'ket in Gallaland, stands on the Bill6 plain near Sops6, and enjoys direct communication with Gojam, Shoa, and other parts of the empire. Bonga, the commercial centre of Kafia, is much frequented by traders from all the surrounding provinces, .and even by foreign merchants following the routes from Zeila and Berbera on the coast through Harrar and the Arusi Galla territory to South Ethiopia. Apart from these market-places there are few permanent centres of popu- lation in Abyssinia. Even these are not towns in the strict sense, but military stations, called kcUama, "camps," by the natives, who have no word for town. Since the fall of the great city of Axum, the so-cailed "capitals" and royal residences — Adua, Gondar, Magdala, and others — have been little more than overgrown vil- lages, flourishing for a time, and then perhaps suddenly abandoned at the whim of the reigning potentate. Menelek himself has suc- cessively shifted his headquarters from Ankober, LitchS, Debra- Berham, and Entoto, to Addis Abbaba (Addi- Abbas), the present seat of government both for his kingdom of Shoa and for the em- pire. This place, which dates only from 1892j stands on the south- ern slopes of the Entoto range (on which the next preceding capital was situated) on bare, grassy undulations, wsttered by small streams flowing S.S.E. to the Hawash. The centre of the camp, on which the principal tracks from all directions converge, is the " Gebi," or enclosure of King Menelek, around which straw- thatched native huts, with wattle and mud walls, are scattered in groups over a wide area. The Gebi — ^which includes the "Elfin- age" (Elfig) or two-storeyed dwelling-house, the "aderash" or hall of reception, the " saganet " or clock- bower (used as a hall of justice), and the "guoda" or storehouse — completely covers a small hill

overlooking the whole neighbourhood. While around it are the inclosures of the principal nobles. About a mile to the north-east of the palace is the military camp of the king. About thirty miles south of Addis Abbaba can be seen the sacred Mount Zakwalrf, while to the south-east lie the fine masses of Mount Yarhu, and to the north-west Mount Managasha. On the hills some five miles to the north, 1500 feet above the camp, are the ruins of an old fortress, and the churches of St Raguel and St

Mariam. The frequent change of capital is due in some measure to the destruction of the forest in the neighbourhood, which' in time exhausts the supply of fuel and building materials. These are now obtained from the vicinity of Mount Managasha. The palace of Menelek was placed by Captain Germain and Lieutenant Dyfe, of the Marchand Mission, by astronomical observations, in 9° 1′ 4″ N. lat., 38° 42′ 50″ E. long. ; but Mr Weld Blundell (Geogr. Journal, vol. xv. p. 308, map) places it in 38° 56′ E., which agrees with that assigned in the Italian map by Captain Chaurand (see Gleichen, With the Mission to Menelik, London, 1898).

In the following list will be found alphabetically arranged all the other important Abyssinian towns regarding which there need be given any information complementary or supplementary to that contained in the 9th edition : —

Addigrat, properly Add' Igrat, one of the chief markets in Tigrfi, east by north of Adua, on a fertile plain about 8000 feet above sea- level, with a permanent population of 1500 ; to the west is the monastery of Debra-domo, one of the most celebrated sanctuaries in Abyssinia. Adua (or Adowa), capital of Tigrfi, and one of the largest markets in Ethiopia, with a population of about 3000. It has played a large part in recent political events, and 13 miles S.E. of here was fought the decisive battle of 1st March 1896, in which the Italians were utterly defeated, and had consequently to re- nounce their claim to a protectorate over Abyssinia. Aliu-Amba, a large market in Shoa, the first station beyond Ankober, on the trade route between that place and the Gulf of Aden ; has a permanent population of 4000, chiefly Moslem. Amba-Mariam, a fortified station in the province of Beghemeder, midway between Gondar and Debra-Tabor near the nprth-east side of Lake Tsana, with a population of 3000. Here is the famous shrine and church dedi- cated to St Mary, whence the name of the place, " Fort St Mary " Debra-BerJiam, " Mountain of Light," a former capital of Shoa, a few miles south of LitchS, on the banks of the Beresa, an aurifer- ous head-stream of the Jemma, a tributary of the Blue Nile, with a population of 2500. Debra-Tabor, "Mount Tabor," the chief royal residence during the reign of King Johannes, occupies a strong strategic position overlooking the fertile plains east of Lake Tsana, at a height of about 8620 feet above the sea. It has a population of 3000, including the neighbouring station of Samara, headquarters of the Protestant missionai'ies in the time of King Theodore. Harrar, after the withdrawal of the Egyptian garrison, was occupied in 1887 by the Abyssinians with the view of establish- ing an advanced military and trading station towards the Gulf of Aden. Their claim to the city and surrounding territory has been recognised by international treaties, and here have recently been erected large government buildings in the European style. It is by far the largest town in Abyssinia, with a settled population esti- mated in 1900 at over 20,000, mostly Mohammedans. Harrar is now a great depot for the distribution of European wares (cottons, silks, cutlery, crockery, beads, &c.) amongst the surrounding Galla and 'Somali tribes, and throughout the southern provinces of the empire. Litche {Licheh), till recently the capital of Shoa, and largest market in South Abyssinia, on a terrace watered by a head- stream of the Jemma, a few miles north of Debra-Berham, has a population of 3000. East of this place are the ruins of Tegulet, which, after the fall of Axum, was for a time the imperial capital, and gave its name to the present kingdom of Shoa. MaMeror- Mariam, " Mary's Rest," for some time a royal residence, and still an important market and great place of pilgrimage in the kingdom of Amhara, a few miles south-west of Debra-Tabor on a head-stream of the Gumera, which flows east to Lake Tsana ; its two churches of the "Mother" and the "Son" are amongst the most venerated sanctuaries in the whole of Ethiopia. It has a con- siderable permanent population estimated at over 4000, Gallas and Amharas,

the former mostly Mohammedans. Sokota, one of the great central markets, and capital of the province of Wag in Am- hara, at the converging point of several main trade routes on the banks of the Bilbis, which flows through the Tsellari to the Takazz£, near the Lasta frontier. The market, which is held three times a week, is numerously attended, especially by dealers in the salt blocks which come from Lake Alalbed, and which are the currency throughout a large part of Ethiopia. In recent years Sokota has suffered much from epidemics, the population falling from about 5000 in 1868 to less than 2000 in 1900.

A railway has been projected to run from the Erench port of Jibuti, Tajura Bay, through Elba in the Harrar district to Addis Abbaba. The coast section was in progress in 1901, and should it ever be completed the whole way, which seems doubtful, Jibuti must become the chief outlet for the rich and varied produce of Gallaland, much of which at present finds its way by the old caravan route through the Arussi territory to the British ports of Zeila, Bulbar, and Berbera, on the Gulf of Aden. This route, followed from time immemorial by the Arussi and Ittu Gallas, is scarcely known to the outer world, and has not yet been followed by any European traveller. It was known, however, to Cecchi, who was informed by the native traders that beyond Harrar it turns ‘*<«"'»• sharply round to the west as far as the neighbourhood of Ankober,

history]

where it bifurcates, one branch penetrating into Shoa over the Ittu chain, the other turning south-west and reaching South Ethiopia over a pass in the Arussi range. By this trade route Harrar is reached in a month from the remotest confines of Kaffa, and in two or three weeks from the heart of Gallaland, whereas the northern routes through Abyssinia proper to Massawa and Assab are both much longer and far more difficult. The chief distances are : — Massawa by Saati and Asmara to Adua, capital of Tigr6, 104 miles ; Adua to Sokota, converging point of several trade routes from the coast and the interior, 110 ; Sokota to the Italian port of Assab, 240 ; Sokota to Basso, the great market of Gojam, near the Shoa frontier, 180 ; Basso to Liek^, the great market of Gallaland, 120 ; LiekSi to Bonga, the great market of Kaffa, 115 ; Bonga to Harrar over the Arussi Range, 270; Harrar to the coast at Zeila and Jibuti, 192andl30.

The Ethiopian uplands appear to have been originally peopled by the eastern branch of the Hamitio family, which has occupied Pooulatlon ‘‘® region from the remotest times, and still oonsti-

•^ ‘ tutes the great bulk of its inhabitants. But their

domain was encroached upon probably in the Stone Age, but certainly before the historic period, both by the uncultured negroes of the White Nile and by the cultured Himyaritic Semites from South Arabia. The presence of these elements is still conspicuous, especially in North Ethiopia, where the blends between blacks, Hamites, and Semites are so numerous and widespread that the natives, who call themselves lUopiavian (“Ethiopians”), are known to the Arabs as Sabashi (” mixed “),i whence our terms ” Abyssinia ” and ” Abyssinians.” Throughout historic times the politically dominant people have been the Semitic Himyarites, who, however, have failed to preserve their racial purity, and have gradually been merged in varying proportions with their Hamitic subjects in the present Abyssinian nationality, whose very dark skin, crisp or curly black hair, and some other physical traits, also betray a distinct strain of black blood. The prevailing colour in the central provinces (Amhara, Gojam) Is a deep brown, which sliades northwards (Tigr€, Lasta) to a light olive, and even fair

complexion, and southwards (Shoa, Kobbo, Amuru) to a decided chocolate and almost sooty black. Many are distinctly negroid, with tumid lips, small nose, broad at base, and frizzly or ringlety black hair. But the majority may be described as a mixed Hamito-Semitic people, who belong unquestionably to the Caucasic division of mankind. Several of the indigenous groups, such as the Khamtas of Lasta,, the Agaos of Agaomider (" Agaoland"), the Judaizing Ealaehas, the Khamantsof Dembea, still speak rude dialects of the old Hamitic tongue, whose affinities with the Galla, Somal, Afar, Beja, Egyptian, and Berber have now been established. But the official language and that of all the upper classes is Semitic, derived from the ancient Himyaritic, which is the most archaic member of the Semitic linguistic family. It was introduced with the first immigrants from Yemen ; and although no longer spoken, the Geez, as it is called, is still studied as the liturgical language of the Abyssinian Christians. Its litera- ture consists of numerous translations of Jewish, Greek, and Arabic works, besides a valuable version of the Bible dating apparently from the 4th century, when Christianity was introduced Yjj Frumentius of Alexandria. Its best modern representative is the Tigrina of Tigrfi and Lasta, which is much purer but less cultivated than the Amharic dialect, which is current in the cen- tral and southern provinces, and much affected by Hamitic ele- ments. All are written in a peculiar syllabic script which, unlike all other Semitic forms, runs from left to right, and is derived from that of the Sabseans and Minseans, still extant in the very M. rock inscriptions of South Arabia. The identity has been fully established by the palseographic studies of Bent, Mordtmann, D. H. Miiller, and other archaeologists. The heterogeneous elements entering into the constitution of the Abyssinians are reflected in their political and social Institutions, and especially in their reli- gious beliefs and practices. On a seething mass of African heathendom, already in early times affected by primitive Semitic ideas, was suddenly Imposed an undeveloped form of Ghristiariity in the 4th century. While the various ethnical elements have been merged in the composite Abyssinian nation, the primitive and more advanced religious ideas have nowbere been fused in a uniform Christian system. Even the social system is marked by crude notions of justice and absurd " Shamanistic " practices, tem- pered by a few elevated moral precepts. Foreigners are often surprised at the strange mixture of savagery and lofty notions in a Christian community which, for instance, accounts accidental manslaughter as wilful murder. Dreams, also, are still resorted to for detecting crime. A priest is sent for, and, if his prayers arid curses fail, a small boy is drugged, and " whatever person he dreams of is fixed on as the criminal. ... If he does not dream of the person whom the priest has determined on as the criminal, he is kept under drugs until he does what is required of him"

1 From Arabic root, habasha, to collect, gather, mingle, derivation has been questioned, but on insufficient%groQnds.

The

(Count Gleichen, With the Mission to Menelik, 1898). Before Menelek's predecessor, Johannes, the Monophysite Abyssinian Church had only one abuna (patriarch), always a Copt, and always consecrated by the patriarch of Alexandria. But Johannes raised the number to three, one each for the then vassal states of Gojam and Shoa, and one for his own kingdom of Tigr^, with the title of metropolitan. After his death the bishop of Shoa claimed supreme jurisdiction, and to settle the question of supremacy Menelek created two ahunas, set that the Abyssinian Church boasts of two primates. (See also Abys-sinian Chdrch.)

The Negfls Nagasti is an absolute monarch scarcely controlled in the exercise of unlimited authority even by the adat (custom, oral code) respected by most eastern despots. Menelek, whose treatment of his Galla and Somali subjects is Oovero- well spoken of by Wellby and other travellers, governs ™«"'- his own kingdom of Shoa directly, and the other vassal Abyssinian kingdoms indirectly through their several ras ("heads," "chiefs"), all supreme within their respective jurisdictions. The

outlying southern provinces are administered by ^governors v^ho are appointed by the Negfls, and who generally seek the aid of the hereditary local chiefs in maintaining order, levying the irregular forces, and collecting tribute. Under the governors are the dfjas- mach and kanyazmach (leaders of right and left wings in the £g:my), and under these the ^f-t«orari (literally “rhinoceros-born,” or leaders of the advanced guard), who, like the Boer fleld-cornets, are expected to lead the tribesmen when summoned to fight. Abys- sinia can put 30Q,000 men into the field, 240,000 of them armed with rifles. The emperor keeps court with a certain barbaric pomp, assisted by the azaj (master of ceremonies), alaka (lord of the treasury), mtislinie (receivers of tribute), and other dignitaries.

The Abyssinian Calendar is as follows : — The Abyssinian year of 365 days (366 in leap year) begins on the 1st of Mdskarram, which corresponds to about our 10th of September. Their months have thirty days each, and are thus named : M&skarram, Tekemt, Hadir, TahsSs, Tarr, Yekd,tit, Magawit, Mi^ziah, Genbot, 8anni, Hamle, Nas’hi. The remaining five days in the year, termed Pagmen or Quaggimi (six in leap year — leap day being named Kadis Yohannis), are put^ at the end and treated as holidays. The week-days correspond to ours, but are a week behind: e.g., their Easter Sunday is seven days behind ours. Tfheir reckoning is about seven years eight months behind ours : e.g., our New Year’s Day 1901 would be about the 21st TahsSls of their 1893, and their New Year’s Day 1894 would be about our 10th September 1901.

(a. h. k.)

II. HiSTOET.

Since tlie publication in 1875 of the article on Abyssinia, in the 9th edition of the Encyclopcedia Britannica, the centre of interest in this country has shifted from the northern to the southern provinces ; and several sources of information, not then available, have been opened to us. We make therefore no apology for glancing at the : earlier history of Shoa, and bringing up to the date of the British Expedition (1867) a sketch of the internal ; history both of Northern and Southern- Abyssinia before j proceeding with the more recent history.

For the last 200 years and more’ Abyssinia has been a conglomeration of provinces and districts, ill defined, loosely connected, and generally at war with each other. Of these the three chief provinces have been Tigre (north- ern), Amhara including Gondar (central), and Shoa (south- ern). The seatof governmentjOrratherof over]ordship,has usually been Amhara; the ruler of which, calling himself Negizs Nagasti (king of kings, or emperor), has exacted tribute, when he could, from the other provinces. The question of succession as Negils Nagasti has been largely dependent on the blood in the veins of the claimant. All the Emperors have based their claims on their direct descent from Solomon and the queen of Sheba ; but it is needless to say that in many, if not most, cases their suc- cess has been due more to the force of their arms than to the purity of their lineage. Some of the rulers of the larger provinces have at times been given, or given themselves, the title of Neglis or king, so that on occasions as many as three, or even more, Neguses have been reigning at the same tiftie ; and this must be borne in mind by the student of Abyssinian history in order to avoid confusion of rulers. ; The whole history of the country is one gloomy)record of internecine wars, barbaric deeds and unstable

govermnents of adventurers usurping thrones, only to be themselves unseated, and of raids, rapine, and pillage. Into this chaos enter from time to time broad rays of sunshine, the efforts of a few enlightened monarehs to evolve order from disorder, and to supply to their people the blessings of peace and civilization. Bearing these matters in mind, we find that during the 18th century the most prominent and beneficent rulers were the Emperor Yesu of Gondar, who died about 1720, Sebastie, Negus of Shoa (1703-18), Amada Yesus of Shoa, who extended his kingdom and founded Ankdber (1743-74), Tekla Giorgis of Amhara (1770-98 ?) and Asfa Nassen of Shoa (1774-1807), the latter being especially renowned as a wise and benevolent monarch. The first years of the 19th century were disturbed by fierce campaigns between Guxa, Ras of Gondar, and Wolda Selassie, Ras of Tigrd, who were both striving for the crown of Guxa's master, the Emperor Eguala Izeion. Wolda Selassie was eventu- ally the victor, and practically ruled the whole country till his death in 1816 at the age of eighty. Mention must here be made of the first British mission, under Lord Valentia and Mr Henry Salt, which was sent in 1805 to conclude an alliance with Abyssinia, and obtain a port on the Red Sea in case France secured Egypt by dividing up the Turkish empire with Russia. This mission was succeeded by many travellers, missionaries, and merchants of all countries, and the stream of Europeans continued until well into Theodore's reign. To Wolda Selassie succeeded . Sabagadis of Agame, by force of arms, and as Ras of Tigre he introduced various Englishmen, whom he much admired, into the country. He improved the prosperity of his land considerably, but by so doing roused the jealousy of Ras Marie of Amhara — to whom he had refused tribute — and Ubie, son of Hailo Mariam, a gov- ernor of Simen. In an ensuing battle (in January 1831), both Sabagadis and Marie were killed, and Ubi retired to watch events from his own province. Marie was shortly succeeded in the Ras-ship of Amhara by Ali, a nephew of Guxa and a Mohammedan. But Ubi^, who was' aiming at the, crown, soon- attacked Ras Ali, and after several indecisive campaigns proclaimed himself Negus of Tigre. To him came many French travellers, chief of whom were Lieut. Lefebvre, charged with political and geographical missions, and Captains Gali- mier and Ferret, who completed for him a use- ful triangulation and survey of Tigr^ and Simen (18i40-4S).

Northern Abyssinia was now divided into two camps, the one, Amhara and ~~Ras Ali, under Protestant British, and the other, Tigr^ and Ubie, under Roman Catholic French, influence.' The latent hostilitjs~~ between the two factions threatened at one time to develop into a religious war, but no serious campaigns took place until Kassa (later Theodore) appeared on the scene. Kassa (6. 1818), son of the chief of Kwara, a western' district of Amhara, by his talent and energy rapidly came to the front. In consequence of the arrest of his brother Bilawa by Ras Ali, he raised the standard of revolt against the latter, and, collecting a large force, repeatedly beat the troops that were sent against him by the Ras (1841-47). As his power was increasing, to the detriment of both Ras Ali and Ubi^, these two princes combined against him, but were heavily defeated by him at Gorgora (on the southern shore of Lake Tsana) in 1853. Ubie retreated to Tigre, and Ras Ali fled to Begemeder, where he eventually died. Kassa now ruled in Amhara, but his ambition was to attain to supreme power, and he turned his attention to conquering the remaining chief divisions of the country, Gojam,^ Tigre, and Shoa, which still

iFor names of Europeans, v. article in Ency. Brit., 9tli edition. 2 South of Amhara.

remained unsubdued. Berro, Ras of Gojam, in order to save himself, attempted to combine with Tigr^, but his army was intercepted by Kassa and totally destroyed, himself being taken prisoner and executed (May 1854). Shortly afterwards Kassa moved against Tigrd, defeated Ubie's forces at Deragie, in Simen (February 1855), took their chief prisoner and proclaimed himself Negus Nagasti of Ethiopia under the name of Theodore. He now tucned his attention to Shoa.

Retracing our steps for a moment in that direction, we find that in 1813 Sahela (or Sella) Selassie, younger son of the preceding Ras Wassan Seghed, had pro- claimed himself Negus or king. His reign^was long and beneficent. He restored the towns of Debra Brehan and Angolola, and founded Entoto, the strong stone-built town whose ruins now overlook the modern hut-capital of Addis Abbaba. In the terrible “famine of St Luke” in 1835, Selassie still further won the hearts of his subjects by his wise measures and personal gen- erosity ; and by extending his hospitality to Europeans, he brought his country \yithin the closer ken of civil- ized European Powers. During his reign he received the missions of Major Harris (1841) and M. Rochet d’H^ricourt (1843), with both of whom he conclyided friendly treaties on behalf of their respective govern- ments. He also wrote to Pope Pius IX., asking that a Roman Catholic bishop should be sent to him. This request was acceded to, and the Pope despatched Monsignor Massaja to Shoa. But before the prelate could reach the* country, Selassie was dead (1847), leaving his eldest son, Hailu Melekot, to succeed him. Melekot at once proclaimed himself Negus, and by sending for Massaja, who had arrived at Gondar, gave rise to the suspicion that he wished to have himself crowned as emperor. By increasing his dominions at the expens^ of the Gallas, he still further roused the jealousy of the Northerners, and a treaty which he concluded with Eas Ali against Kassa in 1850, determined the latter to crush him at the earliest op- portunity.

Thus it was that in :855 Kassa, under the name of the Emperor Theodore, advanced against Shoa with a large army. Dissensions broke out among the Shoans, and after a desperate and futile attack on Theodore at Debra Brehan, Hailu Melekot died of exhaustion and fever, nominating with his last breath his eleven-year-old son Menelek as successor (November 1855). Dargh, Hailu’s brother, took chargfe of the young prince, but after a hard fight with Angeda, one of Theodore’s Rases, was obliged to capitulate. Menelek was handed over to the Negus, taken to Gondar and there trained in Theodore’s service.

T|he following shows Menelek’s descent since the begin- ning of the 19th century : —

Asfa Nassen d. 1807

Wassan Seghed = Woizero Zenebe Work a. 1811 I

Becurraye Sella Selassifi = Woizero Betsabesh (1795-1847) I

Hailu Melekot = Ejigayu

(1825-1855)

Siefn

(1826-1860)

Mashasha

Darghg

6. 1827

Menelek h. 1844 = Taitu

1 son Zauditu Tanlna Work

(dead) (Judith) (daughter)

On the retirement of the Northerners, Siefu, another brother of Hailu, proclaimed himself Negus of Shoa at Arikdber, and beat the local representatives of Theodore's Government. The emperor returned, however, in 1858,. and after several repulses, succeeded in entering Ank6- ber, where he behaved with great cruelty, murdering or mutilating' all the inhabitants. Siefu kept up a gallant defence for two more years, but was then killed by Kebret, one of his own chiefs. Thus chaos again reigned supreme in Shoa. In'[1]SBS, Menelek, now a Dejazmach of Tigr, took advantage of Theodore's difficulties with the British Government, and escaped to Workitu, queen of the Wollo Galla country. The emperor, who held as hostage a son of Workitu, threatened to kill the boy imless Menelek were given up; but the gallant queen refused, and lost both her son and her throne. The fugi- tive meanwhile arrived safely in Shoa, and was there acclaimed as Negus.]For the next three years Menelek devoted himself to strengthening and disciplining his army, to legislation, to building towns, such as Litch^ (near Debra Brehan), Worra Hailu (Wollo Galla country), &c., and to repelling the incursions of the Gallas. On the death of Theodore ^ (13th April 1868), many Shoans, in- cluding Ras Dargh^, were released, and Menelek began to feel himself strong enough, after a few preliminary minor campaigns, to undertake offensive operations against the northern princes. But these projects were of little avail, for another Kassa, an adventurer of Tigre, had by this time (1872) risen to supreme power in the north. With the help of many rifles and guns, presented to him by the British in return for his help in the campaign, he had beaten Eas Bareya of Tigre, Wagshum Gobassi^ of Amhara, and Tekla Giorgis of Gondar, and after pro- claiming himself Negus Nagasti under the name of Yohannes or John, was now preparing to march on Shoa. Here, however, Menelek was saved from probable destruction through the action of Egypt. This Power had, by the advice of Munzinger, their Swiss governor of Massawa, seized and occupied in 1872 the northern province of Bogos ; and, later on, insisted on occupying Hamasen also, for fear 13ogos should be attacked. John, after futile protests, collected an army, and with the assistance of Ras Walad Mikael, hereditary , chief of Bogos, advanced against the Egyptian forces, who were under the command of one Arendrup, a Dane. Meeting near the Mareb, the Egyptians were beaten in detail, and almost annihilated at Gundet (13th November 1875). An avenging expedition was prepared in the spring of the following year, and, numbering 14,000 men under Eatib Pasha, Loring (American), and Prince Hassan, advanced to Gura and fortified a position in the neigh- bourhood. Although reinforced by Walad Mikael, who had now quarrelled with John, the Egyptians were a second time (25th March 1876) heavily beaten by the A- byssinians, and retired, losing an enormous quantity of both men and rifles. Colonel Gordon, governor-general of the Sudan, was now ordered to go and make peace with John, but the king had moved south with his army, intending to punish Menelek for having raided Gondar whilst he, John, was engaged with the Egyp- tians.

Menelek's kingdom was meanwhile torn in twain by serious dissensions which had been instigated by his concubine Bafana. This lady, to whoin he was much attached, had been endeavouring to secure the succession of one of her own sons to the throne of Shoa, and had almost succeeded in getting rid of Mashasha, son of. Siefu and cousin of Menelek, who was the apparent heir. On the approach of John, the Shoans united for a time

1 For details of Theodore's life and the British expedition, v. Eney. Brit., 9th edition.

against their common enemy. But after a few skirmishes they melted away, and Menelek was obliged to submit and do obeisance to John. The latter behaved with much generosity, but at the same time

imposed terms which .effectually deprived Shoa of her independence (March 1878). In 1879 Gordon was sent on a fresh mission to John on behalf of Egypt ; but he was treated with scant courtesy, and was obliged to leave the country without achieving anything permanent.

The Italians now come on the scene. Assab, a port near the southern entrance of the Red Sea, had been bought from the local Sultan in 1869 by an Italian com- pany, which, after acquiring more land in 1879 and 1880, was bought out by the Italian Government in 1882. In this year Count Antonelli was despatched to Shoa in order to improve the prospects of the colony by treaties with Menelek and the Sultan of Aussa. Several missions fol- lowed upon this one, with more or less successful results ; but both John and Menelek became uneasy when Beilul was occupied by the Italians in January 1885, and Massawa taken over by them from Egypt in the following month. This- latter act was greatly resented by the Abyssinians, for by a treaty concluded with a British and Egyptian mission under Admiral Hewett and Mason Pasha" in the previous year, free transit of goods was to be allowed through this port. Matters came to a head in January 1887, when the Abyssinians, in consequence of a refusal from General Gene to withdraw his troops from Waa and Tula, surrounded and massacred 400 Italian troops at Dogali. Eeinf or cements were sent from' Italy, whilst in the autumn the British Government stepped in and tried to mediate by means of a mission under Mr (afterwards Sir Gerald) Portal. His mission, however, proved abortive, and after many difficulties and dangers he returned to Egypt at the end of the year. In April 1888, the Italian forces, numbering over 20,000 men, came into touch with the Abyssinian army ; but negotia- tions took the place of fighting, with the result that both forces retired, the Italians only leaving some 5000 troops in Eritrea, as their colony was now called. Meanwhile John had notybeen idle with regard to the Dervishes. Although he had set his troops in motion too late to relieve Kassala, Eas Alula, his chief general, had suc- ceeded in inflicting a handsome defeat on Osman Digna at Amideb in July 1887. A large force of Dervishes had, however, entered and sacked Gondar in April 1887, and to avenge this John took the field in force against the enemy, who were still harassing the north-west of his territory. A great battle ensued at Gallabat, in which the Dervishes, under Zeki Tumal, were at first beaten. But a stray bullet pierced John's heart, and his men fled, leaving camp and stores, besides the body of their emperor, in the hands of the enemy (9th March 1889).

Immediately the news reached Menelek he proclaimed himself emperor^ and received the submission of Gondar, Gojam, and several other provinces. In common with other northern princes, Mangasha, reputed son and heir of King John, and Eas Alula, refused to acknowledge the sovereignty of Menelek, but on the latter marching against them in the following January with a large army, they submitted. As it happened. Count Antonelli was with Menelek when he claimed the throne, and promptly con- cluded with him on behalf of Italy a friendly treaty, to be known hereafter as the famous Uccialli treaty. In consequence of this the Italians occupied Asmara, made friends with Mangasha, and received Eas Makunnen,*

2 The main object of this mission was to seek John's assistance in evacuating the Egyptian garrisons in the Sudan, which were threat- ened by the Dervishes.

- Bas of Harrar, which province had been conquered and occupied by Menelek in January 1887.

Menelek's nephew, as his plenipotentiary in Italy. Thus it seemed as though hostilities between the two countries had come to a definite end, and that peace was assured in the land. For the next three years the land was fairly quiet, the chief political events being the conven- tion (6th February 1891) between Italy and Abyssinia, protocols between Italy and Great Britain (24th March and 15th April 1891), and a proclamation by Menelek (10th April 1891), all on the subject of boundaries. As, however, the Italians became more and more friendly with Mangasha and Tigre the apprehensions of Menelek increased, till at last, in February 1893, he wrote de- nouncing the Uccialli treaty, which differed in the Italian aiid Amharic versions. According to the former, the Negus was bound to make use of Italy as a channel for communicating with other Powers, whereas the Amharic version left it optional. Meanwhile the Dervishes were threatening Eritrea. A fine action by Colonel Arimondi gained Agordat for Italy (21st December 1893), and a brilliant march by Colonel Baratieri resulted in the acquisition of Kassala (17th July 1894). But on his return Baratieri found that Mangasha was intriguing with, the Dervishes, and had actually crossed the frontier with a large army. At Koatit and Senafe (13th to 15th January 1895) Mangasha was met and heavily defeated by Baratieri, TSfho occupied Adigrat in March. But as the year wore on the Italian commander pushed his forces unsupported too far to the south. Menelek was advancing with a large army in national support of Man- gasha, and the subsequent reverses at Amba Alagi (7th December 1895) and Makalle (23rd January 1896) forced the Italians to fall back.

Reinforcements of many thousands were meanwhile arriving at Massawa, and in February Baratieri took the field at the head of over 13,000 men. Menelek's army, amounting to about 90,000, had during this time ad- vanced, and was occupying a strong position at Abba Garima, near Adua. Here Baratieri attacked him on the 1st March, but the difiS.culties of the country were great, and one of the four Italian brigades had pushed too far forward. This brigade was attacked by overwhelming numbers, and on the remaining brigades advancing in support, they were successively cut to pieces by the encircling masses of the enemy. The Italians lost nearly 4000 killed and wounded and 2000 prisoners, wiiilst the Abyssinians owned to a loss of over 3000. General Baldissera advanced with a large body of rein- forcements to avenge this defeat, but the Abyssinians, desperately short of supplies, had already retired, and beyond the peaceful relief of Adigrat no further opera- tions took place. It may here be remarked that the white prisoners taken by Menelek were exceedingly well treated by him, and that he behaved throughout, as he has ever since, with the greatest humanity and dignity. A peace was signed at Addis Abbaba in the following October, and negotiations on the question of frontiers were commenced, which were only brought to a con- clusion in the autumn of 1900.

This war, so disastrous to Italy, attracted the attention of all Europe to Abyssinia and its monarch, and numer-

ous missions, two Russian, three French, and one British, were despatched to the country and hospitably received by Menelek. The British one, under Mr (now Sir) Rennell Rodd, concluded a friendly treaty with Abys- sinia (15th May 1897), but did not, except in the direc- tion of Somaliland, touch on frontier questions, which still form a subject of discussion. During the same year a small French expedition under Messrs Clochette and De Bonchamps endeavoured to reach the Nile, but, after surmounting many difficulties, stuck in the marshes of the Upper Sobat and was obliged to return. Another expedition of Abyssinians, under Dejaj Tasamma, and accompanied by three Europeans — a Frenchman, a Swiss, and a Russian — started early in 1898, and reached the Nile at the Sobat mouth in June, a few days only before Major Marchand and his gallant companions arrived on the *scene. But no contact was made, and the expedition returned to Abyssinia. In the same year (1898) Menelek proceeded northwards with a large army, for the purpose of chastising Mangasha, who was again rebelling against his authority. After some trifling fighting Mangasha submitted, and Ras Makunnen de- spatched a force to subdue Beni Shangul, the chief of which gold country. Wad

Tur el Guri, was showing signs of disaffection. This effected, the Abyssinians almost came into contact with the Egyptian troops sent up the Blue Nile (after the occupation of Khartum) ta Famaka and towards Gallabat. But as both sides were anxious to avoid a collision, no hostile results ensued,' and matters remain on a friendly footing between the nations. Negotiations and surveys on the subject of frontiers were in progress, and were likely to be brought to a successful conclusion in 1901,

Since 1897 British influence in Abyssinia, owing largely, no doubt, to the conquest of the Sudan, the destruction of the Dervish power, and the result of the Fashoda incident, has been sensibly on the increase. But it remains to be seen whether any European influence will be of much avail after the demise of the present enlightened emperor, or whether Abyssinia will relapse into the state of anarchy and desolation which has char- acterized so much of her history.

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Abyssinian Church. — As the chronicle of Axum relates, Christianity was adopted in Abyssinia in the 4th century. AJaout 330 a. d. Frumentius was made first Bishop of Ethiopia by Athanasius, patriarch of Alexandria. Cedrenus and Nicephorus err in dating Abyssinian Christianity from Justinian c. 642. From Frumentius to the present day, with one break, the Metro- politan has always been appointed from Egypt, and, oddly enough, he is always a foreigner. Little is known of

church history down to the period of Jesuit rule, which broke the connexion with Egypt from about 1500 to 1633. But the Abyssinians rejected the Council of Chalcedon, and still remain monophysites. Union with the Coptic Church (q.v.) continued after the Arab conquest in Egypt. Alii Saiih records (12th century) that the patriarch used always to send letters twice a^year to the kings of Abyssinia and Nubia, till Al Hakim stopped the prac- tice. Cyril, 67th patriarch, sent Severus as bishop, with

orders to put down polygamy, and to enforce observance of canonical consecration for all clmrclies. These exam- ples show the close gelations of the two churches in the Middle Ages. But late in the 16th century, the church was taken captive by a Portuguese mission. In 1439 an Abyssinian embassy to Eome had resulted in the despatch of a mission under Alvarez. Later, Ignatius Loyola wished to essay the task of conversion, but was forbid- den. Instead, the Pope sent out Barret as patriarch of the East Indies, with Oviedo as bishop; and from Goa envoys went to Abyssinia, followed by Oviedo himself, to secure the king’s adherence to Eome. After repeated failures some measure of success was achieved, but not till 1604 did the king make formal submis- sion to the Pope. Then the people rebelled and the king was slain. Fresh Jesuit victories wete followed sooner or later by fresh revolt, and Roman rule hardly triumphed, when once for all it was overthrown. In 1633 the Jesuits were expelled and allegiance to Alex- andria resumed.

There are many early rock-cut churches in Abyssinia, closely resembling the Coptic. After these, two main types of architecture are found — one basilican, the other native. The cathedral at Axum is basilican, though the early basilicas are nearly all in ruins — e.g., that at Adulis and that of Martula Mariam in Gojam, rebuilt in the 16th century, on the ancient foundations. These ex- amples show the influence of those architects who, in the 6th century, built the splendid basilicas at SanS, and elsewhere in Arabia. Of native churches there are two forms — one square or oblong, found in Tigre ; the other circular, found in Amhara and Shoa. In both, the sanc- tuary is square and stands clear in the centre. An outer court, circular or rectangular, surrounds the body of the church. The square type may be due to basilican in- fluence, the circular is a mere adaptation of the native hut : in both, the arrangements are obviously based on Jewish tradition. Church and outer court are usually thatched, with wattled or mud-built walls adorned with rude frescoes. The altar is a board on four wooden pil- lars having upon it a small slab (tabut) of alabaster, marble, or ahittim wood, which forms its essential part. At Martula Mariam, ths wooden altar overlaid with gold had two slabs of solid gold, one 500, the other 800 ounces in weight. The ark kept at Axum is described as 2 feet high, covered with gold and gems. The liturgy was celebrated on it in the king’s palace at Christmas, Epiph- any, Easter, and Feast of the Cross.

Gtenerally the Abyssinians agree with the Copts in ritual and practice. The LXX. version was translated into Geez, the literary language, which is used for all services, though hardly understood. Saints and angels are highly revered, if not adored, but graven imagfes are forbidden. Fasts are long and rigid. Confession and absolution, strictly enforced, give great power to the priesthood. The clergy

must marry, but once only. Pilgrimage to Jerusalem is a religious duty and covers many sins. (See also under AsTSSiiiriA.)

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(a. j. b.)

Academy, French. — The history of the French Academy has continued its tranquil course since 1875, marked perhaps in later years by a greater desire to re-

spond to the purely literary dictates of its composite conscience. Its elections, under the Eepublic, have been social functions of a highly fashionable character. One alteration in its methods has to be chronicled : in 1869 it became the custom to discuss the claims of the candidates at a preliminary meeting of the members. In 1880, on the instance of the philosopher Caro, supported by A. Dumas fils, and by the aged D^sir^ Nisard, it was decided to abandon this method, which led to great inconvenience in practice. A point upon which much stress is often laid, and regarding which the most in- accurate statements are put forth, is the degree in which, since its foundation, the French Academy has or has not represented the best literary life of France. On this subject it may be well to supply some supplementary information. It appears from an examination of the lists of members that a surprising number of authors of the highest excellence have, from one cause or another, escaped the honour of academic ” immortality.” When the Academy was founded in 1634, the moment was not a very, brilliant one in French letters. Among the forty original members we find only ten who are remembered in literary history; of these there are four who may reasonably be considered famous still — Balzac, Chape- lain, Eacan, and Voiture. In that generation Scarron was never one of the forty, nor do the names of Des- cartes, Malebranche, or Pascal occur ; it must not be supposed that any lack of honour was intended to these philosophers, but the French Academy had not come to consider its doors open to this class of writers. The duke of Eoehefoueauld declined the honour from a proud modesty, and Eotrou died too soon to be elected. The one astounding omission of the 17th century, however, is the name of Molifere, who was excluded by his profes- sion as an actor. On the other hand, the French Acad- emy was never more thoroughly representative of letters than when Boileau, Corneille, La Fontaine, Eacine, and Quinault were all members of its body. Of the great theologians of that and the subsequent age, the Academy contained Bossufet, Fl&hier, F^nelon, and Massillon, but not Bourdaloue. La Bruyfere and Fontenelle were among the forty, but not Saint-Simon, whose claims as a man of letters were unknown to his contemporaries. Early in the 18th century almost every literary personage of eminence found his place naturally in the Academy. The only exceptions of importance were Vauvenargues, who died too early for the honour, and two men of genius of dubious social position, Lesage and the Abbe Prevost d’JExiles. As the Eevolution approached, the personnel of the Academy became greatly disturbed. Montesquieu and Voltaire belonged to it, but not Eousseau or Beau- marchais. Of the Encyclopaedist, the French Academy opened its doors tcT D’Alembert, Condorcet, Volney, Marmontel, and La Harpe, but not to Diderot, Eollin, Condillac, Helvetius, or the Baron d’Holbach. It is to be supposed that the claims of Turgot and of Quesnay did not appear to the Academy sufiiciently literary, since neither was elected. In the transitional period, when the social life of Paris was distracted and the French Academy provisionally closed, neither Andr4 Chenier nor Benjamin Constant, nor Joseph de Maistre became enrolled among its members. In the early years of the 19th century considerations of various kinds excluded from the ranks of the forty the dissimilar names of Lamennais, Prudhon, Comte, and Bdranger. Critics of the

French Academy are fond of pointing out that neither Stendhal, nor Balzac, nor Th^ophile Gautier, nor Flau- bert, penetrated into the Mazarine Palace. It is not so often remembered that writers so academic as Thierry, and Michelet, and Quinet, suffered the same exclusion. In later times neither Alphonse Daudet nor Edmond de

Goncourt, Guy de Maupassant nor Ferdinand Fabre, has been among the forty immortals. The non-election, after a long life of distinction, of the scholar Fustel de Cou- langes, is less easy to account for. Verlaine, although a man of great genius, was an example of the kind of per- son no academy can ever be expected to recognize. Of the degree in which the French Academy represented the highest literary ability during the last quarter of the 19th century, an examination of the following facts will offer evidence. Of the forty members who composed its body at the close of 1875 only three were still alive in the summer of 1901. These were M. Ernest Legouv^, who was elected so long ago as 1856 ; M. Emile OUivier, elected on the 7th of April 1870, but, in consequence of the intractability of his political opinions, never formally received; and M. Mezieres, elected, in 1874. The first death to occur in the Academy was that of Patin ; he was. succeeded in June 1876 by the distinguished Latinist, M. Gaston Boissier. To succeed the poet Autran, M. Victorien Sardou was elected on the 7th of June 1877 ; his success was hotly contested by the duke of AudifEret- Pasquier, and one vote transferred would have annulled the election. In 1878, at the death of Thiers, his seat was taken by Henri Martin, that of Bernard by Ernest Eenan, and that of Lomenie by Taine. In December of that year, at the death of Dupanloup, no opposition was offered to the duke of Audiffret-Pasquier, although he was in the unique position of having never published anything of a literary character. For ,two years there was no change in the composition of the French Academy, but in 1880 several new names were added ; Maxime du Camp succeeded to Saint-Eene Taillandier, Labiche to Sacy, and M. Eousse to Jules Favre. In 1881 the absence of the younger poets from the Academy, which had been much commented on, was reformed by the election of M. SuUy-Prudhomme in the place of Duvergiei: de Hauranne. In the same year Pastfeur followed Littr^, and Cherbuliez Dufaure. At the death of the poet Barbier, Perraud, bishop of Autun, was unanimously elected in 1882 ; later on in the same year Pailleron replaced Charles Blanc and Mazade Champagny. At the death of Sandeau,' the popular writer, Edmond About, was elected to take his place, but died (January 1885) too soon to be received. The elections in the latter part of 1884 were more numerous than they had been, in a similar period, within the memory of man. M. Gopp^e had been admitted in February to take the place of the poet Laprade. The winter elections of 1884 included Lesseps in the room of Martin, Duri^ in that of Mignet, Bertrand in that of J. B. Dumas, and M. Halevy in that of the count of Haussonville. After this extraordinary influx the Academy was for some time at rest, but in 1886 four faiUeuUs had to be filled ; that of About was taken by Leon Say ; that of Victor Hugo (at his expressed wish) by Leconte de Lisle ; that of the duke of Noailles by Edouard Herv^ ; and tha,t ot, the count of Falloux by M. Greard. The philosopher Caro having^died (July 1887), he was re- placed by the historian, Count Othenin of Haussonville in 1888. The most aged member of the Academy, Viel- Castel, who had been born in 1800, died 4th Oct. 1887, and was succeeded by Admiral Jurien de la Gravi^re ; Labiche (d. Jan. 1888) was succeeded by Meilhac ; and Desir^ Nisard (d. 25th March 1888) by the Viscount Melchior de VogUe, all these in 1888. Augier, the play- wright, dying on 25th October 1889, his fauteuil was filled by M. de Freycinet, after a prolonged struggle (11th December 1890). Octave Feuillet dying (28th December 1890), three novelists contended for his seat — Emile Zola, Ferdinand Fabre, and Pierre Loti. At the first voting M. Zoia stood at the top of the poll, at the sixth scrutiny

Pierre Loti was declared elected. M; Ernest Lavisse, the historian, succeeded Admiral de la Gravi^re in 1892. In 1893, after the death of Xavier Marmier, Viscount Henri de Bornier, the poet, who had been a constant applicant for several years, was at length elected by a large majority. M. Thureau-Dangin on the same day succeeded Eousset ; in March Challemel-Lacour followed Eenan (died October 1892) ; and in June M. Brunetifere the critic, the journalist John Lemoinne. It proved impossible for the Academy to come to any understanding about the fauteuil of Taine (who died March 1893), and the election was therefore postponed. In the meantime Mazade died, and was replaced by the poet Heredia, in February 1894. Finally, after what seemed an end- less struggle, the historian, M. Albert Sorel, secured in May 1894 the vacant fauteuil of Taine ; and M. Paul Bourget was elected on the same day to succeed Du Gamp. Later elections to the French Academy have been as follows : in 1894, M. Henry Houssaye ; in 1895, M. Jules Lemaitre; in 1896, MM. Anatole France, the Marquis Costa de Beauregard, Gaston Paris, Andre Theuriet, and Albert Vandal; in 1897, the count de Mun and M. Gabriel Hanotaux; in 1898, the sculptor M. Eugene Guillaume, and the farce-writer M. Henri Lavendan; in 1899, the politician M. Paul Deschanel; in 1900, the novelist M. Paul Hervieu and the critic M. Emile Faguet, both elected on the 15th of February, and on the 28th of June, M. Berthelot; in 1901, the Marquis de Vogiie, the archaeologist, and M. Edmond Eostand, the poet and dramatist, both on 30th May.

(E. G.)

Academy, Royal. — The Eoyal Academy of Arts in London, to give it the original title in full, was founded in 1768, ” for the purpose of cultivating and im- proving the arts of painting, sculpture, and architecture.” Many attempts had previously been made in England to form a society which should have for its object the advancement of the fine arts. Sir James Thornhill, his son-in-law Hogarth, the Dilettanti Society, made efforts in this direction, but their schemes were wrecked by want of means. Accident solved the problem. The crowds that attended an exhibition of pictures held in 1758 at the Foundling Hospital for the benefit of that charity, suggested a way of making money hitherto un- suspected. Two societies were quickly formed, one calling itself the ” Society of Artists,” and the other the ’” Free Society of Artists.” The latter ceased to exist in 1774. The former flourished, and in 1765 was granted a royal charter under the title of the “Incorporated Society of Artists of Great Britain.” But though prosperous it was not united. A number of the members, including the most eminent artists of the day, resigned in 1768, and headed by William Chambers, the architect, and Benjamin West, presented on 28th November in that year to George III., who had already shown his interest in the fine arts, a memorial soliciting his ” gracious assistance, patronage and protection,” in ” establishing a society for promoting the arts of design.” The memorialists stated that the two principal objects they had in view were the estalDlish- ing of ” a well-regulated school or academy of design for the use of students in the arts, and an annual exhibition open to all artists of distinguished merit; the profit arising from the last of these institutions ” would, they thought, ” fully answer all the expenses of the first,” and, indeed, leave something over to be distributed ” in useful charities.” The king expressed his agreement with the proposal, but asked for further particulars. These were furnished to him on 7th December and approved, and on 10th December they were submitted in form, and the document embodying them received his signature, with

the words “I approve of this plan; let it be put into execution.” This document, known as the ” Instrument,” defined under twenty-seven heads the constitution and government of the Royal Academy, and contained the names of the thirty-six original member^ nominated by the king. Changes and modifications in the laws and regulations laid down in it have of course been made, but

none of them without the sanction of the sovereign, and the “Instrument” remains to this day in all essential particulars the Magna Charta of the society. Eour days after the signing’ of this document — on 14th December — twenty-eight of the first nominated members met and drew up the Form of Obligation which is still signed by every academician on receiving his diploma, and also elected a president, keeper, secretary, council, and visitors in the schools ; the professors being chosen at a further meeting held on the 17th. No time was lost in establish- ing the schools, and on 2nd January 1769 they were opened at some rooms in Pall Mall, a little eastward of the site now occupied by the Junior United Service Club, the president, Sir Joshua Reynolds, delivering on that occasion the first of his famous ” discourses.” The open- ing of the first exhibition at the same place followed on 26th April.

The king when founding the Academy undertook to supply out of his own privy purse any deficiencies between the receipts derived from the exhibitions and the expen- diture incurred on the schools, charitable donations for artists, &c. For twelve years he was called upon to do so, and contributed in all something over £5000, but in 1781 there was a surplus, and no further call has ever been made on the royal purse. George III. also gave the Academy rooms in what was then his own palace of Somerset House, and the schools and of&ces were removed there in 1771, but the exhibition continued to be held in Pall Mall, till the completion in 1780 of the new Somerset House, when the Academy took possession of the apart- ments in it which the king, on giving up the palace for Government offices, had expressly stipulated should be provided. Here it remained till 1837, when the Govern- ment, requiring the use of these rooms, offered in exchange a portion of the National Gallery, then just erected in Trafalgar Square. The offer, which contained no con- ditions, was accepted. But it was not long before the necessity for a further removal became imminent. Al- ready in 1850 notice was given by the Government that the rooras occupied by the Academy would be required for the purposes of the , National Gallery, and that they proposed to give the Academy £40,000 to provide them- selves with a building elsewhere. The matter slumbered, however, till 1858, when the question was raised in the House of Commons as to whether it would not be justifi- able to turn the Academy out of the National Gallery without making any provision for it elsewhere. Much discussion followed, and a royal commission was ap- pointed in 1863 ” to inquire into the present position of the Royal Academy in relation to the fine arts, and into the circumstances and conditions under- which it occupies a portion of the National Gallery, &c.” In their report, which contained a large number of proposals and sugges- tions, some of them since carried out, the commissioners stated that they had ” come to the clear conclusion that the Royal Academy have no legal, but that they have a moral claim to apartments at the public expense.” Negotiations had been already going on between the Government and the Academy for the appropriation to the latter of a portion of the site occupied by the recently purchased Burlington House, on which the Academy offered to erect suitable buildings at its own expense. The negotiations were renewed in 1866, and in March in

the following year a lease of old Burlington House, and of a portion of the garden behind it, was granted to the Academy for 999 years at a peppercorn rent, subject to the condition that ” the premises shall be at all times exclu- sively devoted to the purpose of the cultivation of the fine arts.” The Academy immediately proceeded to erect, on the garden portion of the site thus acquired, exhibition galleries and schools, which were opened in 1869, further additions being made in 1884. An upper storey was also added to old Burlington House, in which to place the diploma works, the Gibson statuary, and other works of art. Altogether the Academy, out of its accumulated savings, has spent on these buildings more than £160,000. They are its own property, and are maintained entirely at its expense.

The government of the Academy was by the ” Instru- ment” vested in “a president and eight other persons, who shall form a council.” Four of these were to retire every year, and the seats were to go by rotation to every academician. The number was increased in 1870 to twelve, and reduced to ten in

1875. The rules as to retirement and rotation are still in force. Newly-elected academicians begin their two years' service as soon as they have received their diploma. The council has, to quote the " Instrument," " the entire direction and man- agement of the business" of the Academy in all its branches ; and also the framing of new laws and regula- tions, but the latter, before coming into force, must be sanctioned by the general assembly and approved by the Sovereign. The general assembly consists of the whole body of academicians, and meets on certain fixed dates and at such other times as the business may require ; also at the request to the president of any five members. The principal executive officers of the Academy are the president, the keeper, the treasurer, the librarian, and the secretary, all now elected by the general assembly, subject to the approval of the Sovereign. The president is elected annually on the foundation day, 10th December, but the appointment is virtually for life. No change has ever been made in the conditions attached to this office, with the exception of its being now a salaried instead of an unsalaried post. The treasurership and librarianship, both offices originally held not by election but by direct appointment from the Sovereign, are now elective, the holders being subject to re-election every five years, and the keepership is also held upon the same terms ; while the secretaryship, which up to 1873 had always been filled like the other offices by an academician, has since then been held by a layman. Other officers elected by the general assembly are the auditors (three academicians, one of whom retires every year), the visitors in the schools (academicians and associates) ; and the professors pf painting, sculpture, and architecture — who must be members — and of anatomy and chemistry. There are also a registrar, and curators and teachers in the schools, who are appointed by the council.

The thirty-six original academicians were named by George III. Their successors have been elected, up to 1867, by academicians only — since that date by acade- micians and associates together. The original number was fixed in the "Instrument" at forty, and has so remained. Each academician on his election has to present an approved specimen of his work — called his diploma work — before his diploma is submitted to the Sovereign for signature. On receiving his diploma he signs the Roll of Institution as an academician, and takes his seat in the general assembly. The class of associates, out of whom alone the academicians can be elected, was founded in 17697— they were "to be elected from amongst the exhibitors, and be entitled to every advantage enjoyed by

the royal academicians, excepting that of having a voice in the deliberations or any share in the government of the Academy." Those exhibitors who wished to become candidates had to give in their names at the close of the exhibition. This condition no longer exists, candidates having since 1867 merely to be proposed and seconded by members of the Academy. On election, they attend at a council meeting to sign the Roll of Institution as an associate, and receive a diploma signed by the president and secretary. In 1867 also associates were admitted to vote at all. elections of members ; in 1868 they were made eligible to serve as visitors in the schools ; and in 1886 to become candidates for the professorships of painting, sculpture, and architecture. At first the number of asso- ciates was limited to twenty; in 1866 the number was made indefinite with a minimum of twenty, and in 1876 the minimum was raised to thirty. Vacancies in the lists of academicians and associates caused by death or resig- nation can be filled up at any time within five weeks of the event, except in the months of August, September, and October, but a vacancy in the associate list caused by election only dates from the day on which the new academician receives his diploma. The mode of election is the same in both eases, first by marked lists and after- wards by ballot. All who at the first marking have four or more votes are marked for again, and the two highest then go to the ballot. Engravers have always constituted a separate class, and up to 1856 they were admitted to the associateship only, the number, six, being in addition to the other associates ; now the maximum is four, of whom not

more than two may be academicians. A class of honorary retired academicians was established in 1862, and of honorary retired associates in 1884. The first ‘honorary foreign academicians were elected in 1869. The honorary members consist of a chaplain, an anti- quary, a secretary for foreign correspondence, and pro- fessors of ancient history and ancient literature. These posts, which date from the foundation of the Academy, have always been held by distinguished men.

Schools. — One of the most important functions of the Royal Academy, and one which for nearly a century it discharged alone, was the instruction of students in art. The first act, as has been shown, of the newly-founded Academy was to establish schools — “an Antique Academy” and a “School for the Living Model ” for painters, sculptors, and architects. In the first year, 1769, no fewer than seventy-seven students entered. A school of painting was added in 1815, and special schools of sculpture and architecture in 1871. It would occupy too much space to follow the various changes that have been made in the schools since their establishment. In one important respect, however, they remain the same, viz., in the instruction being gratuitous — no fees have ever been charged. Up to the removal of the Academy to its pre- sent quarters the schools could not be kept permanently open, as the rooms occupied by them were wanted for the exhibition. They are now open all the year round with the exception of a fortnight at Christmas, and the months of August and September. They consist of an antique school, upper and lower schools of painting, a school of drawing from the life, a school of modelling from the life, and an architectural school. Admission is gained by sub- mitting certain specimens of drawing or modelling, and the suc- cessful candidates, called probationers, have then to undergo a further test in the schools, on passing which they are admitted as students for three years. At the end of that time they are again examined, and if qualified admitted for a further term of two years. These examinations are held twice a year, in January and July. Female students were first admitted in 1860. There are many scholarships, money prizes, and medals to be gained by the various classes of students during the time of student- ship, including travelling studentships of the value of £200 for one year, gold and silver medals, and prizes varying from £50 to £10. There are permanent curators and teachers in all the schools, but the principal teaching is done by the visitors, academicians, and associates, elected to serve in each school. The average cost of maintaining these schools, including sala- ries, fees, cost of models, prizes, books, maintenance of building, &c., has been for the last thirty years from £5000 to £6000 a year. This sum does not include the cost of certain scholar-

ships and prizes derived from moneys given or bequeathed for this purpose, such as the Landseer scholarships, the Creswick prize, the Armitage prizes, and the Turner scholarship and gold medal.

Charities.— Another of the principal objects to which the profits of the Royal Academy have been devoted has been the relief of distressed artists and their families. From the com- mencement of the institution a fund was set apart for this pur- pose, and subsequently a further sum was allotted to provide pensions for necessitous members of the Academy and their widows. Both these funds were afterwards merged in the gen- eral fund, and various changes have from time to time been made in the conditions under which pensions and donations have been granted and in their ampunt. At the present time pensions not exceeding a certain fixed amount may be given to acade- micians and associates, sixty years of age, who have retired and whose circumstances show them to be in need, provided the sum given does not make their total annual income exceed a certain limit, and the same amounts can be given to their widows subject to the same conditions. No pensions are granted without very strict inquiry into the circumstances of the applicant, who is obliged to make a yearly declaration as to his or her income. The average annual amount of these pensions has been latterly about £2000. Pensions are also given according to the civil service scale to certain officers on retirement. It may be stated here that with the exception of these pensions and of salaries and fees for official services, no member of the Academy derives any pecuniary benefit from the funds of the institution. Dona- tions to distressed artists who are or have been exhibitors at the Royal Academy,

their widows and children under twenty-one years of age, are made twice a year in February and August. The maximum amount that can be granted to any one applicant in one donation is £100, and no one can receive a grant more than once a year. The average yearly amount thus expended is from £1200 to £1500. In addition to these charities from its general funds, the Academy administers for the benefit of artists, not members of the Academy, certain other funds which have been bequeathed to it for charitable purposes, viz., the Turner fund, the Cousins fund the Cooke fund, the Newton bequest, and the Edwards fund (see below).

Exhibitions. — The source from which have been derived the funds for carrying on the varied work of the Eoyal Academy, its schools, its charities, and general cost of administration, and which has enabled it to spend large sums on building, and provided' it with the means of maintaining the buildings, has been the annual exhibitions. With the exception of the money left by John Gibson, R>A., some of which was spent in building the gallery containing the statues and bas-reliefs bequeathed by him, these exhibitions have provided the sole source of revenue, all other moneys that have come to the Academy having been either left in trust, or been constituted trusts, for certain specific purposes. The first exhibition in 1769 contained 136 works, of which more than one half were contributed by members, and brought in £699 : 17 : 6. In 1780, the first year in which the receipts exceeded the expenditure, the number of works was 489, of which nearly one-third were by members, and the sum received was £3069 : Is. This increase continued gradually with fluctuations, and in 1836, the last year at Somerset House, the number of works was 1154, and the receipts were £5179 : 19s. No gr«at addition to the number of works exhibited took place at Trafalgar Square, but the receipts steadily grew, and their careful management enabled the Academy, when the time came for moving, to erect its own buildings and become no longer dependent on the Government for a home. The greater space afforded by the galleries at Burlington House rendered it possible to increase the number of works exhibited, which of late years has reached a total of over 2000, while the receipts have also been such as to provide the means for further building, and for a largely increased expenditure of all kinds. It may be noted that the number of works sent for exhibition soon began to exceed the space available. In 1868, the last year at Trafalgar Square, the number sent was 3011. This has gone on increasing, with occasional fluctuations, at Burlington House, and the year 1900 saw the maximum, so far, of 13,462. The annual winter exhibition of works by old masters and deceased British artists was begun in 1870. It was never intended to be a source of revenue, but appreciation by the public has so far prevented it from being a cause of loss. The summer exhibition of /works by living artists opens on the first Monday in May, and closes on the first Monday in August. The winter exhibition of works by deceased artists opens on the first Monday in January, and closes on the second Saturday in March. The galleries containing the diploma works, the Gibson statuary, and other works of art are open daily, free.

Presidents of the Royal Academy. — Sir Joshua Reynolds, 1768-92; Benjamin West (resigned), 1792-1805; James Wyatt (president-elect), 1805; Benjamin West (re-elected), 1806-20;

Sir Thomas Lawrence, 1820-30; Sir Martin Archer Shee, 1830- 60 ; Sir Charles Lock Eastlake, 1850-65 ; Sir Francis Grant, 1866-78; Frederick, Lord Leighton of Stretton, 1878-96; Sir John Everett Millais, Bart., 1896; Sir Edward John Poynter,

1896.

The total number of academicians elected since the foundation, •exclusive of the 36 original members, is 192, of whom 114 received their art education in the Academy schools. The total number of associates elected since the foundation, who have not reached the higher grade, inclusive of the 30 now living, is 103, of whom 46 received their art education in the Academy schools.

The total number of students admitted since 1769 is 4697, mak- ing a yearly average of about 36. The number at present on the books is 172.

The library contains about 7000 volumes, dealing with the history, the theory, and the practice of the various branches of the fine arts, some of them of great rarity and value. It is open daily to the students and members, and to other persons on a proper introduction.

The trust funds administered by the Royal Academy are : —

The Turner fund (J. M. W. Turner, R.A.), Vhich provides sixteen annuities of £50 each, for artists of repute not members of the Academy, also a biennial scholarship of £50 and a gold medal for a landscape painting.

The Ckantrey fund (Sir Francis Chantrey, R.A.), the income of which, paid over by the Chantrey trustees, is spent on pictures and sculpture.

The Creswiek fund (Thomas Creswlck, R.A.), which provides an annual prize of £30 for a landscape painting in oil.

The Cooke fund (E. W. Cooke, R.A.), which provides two an- nuities of £35 each, for painters not members of the Academy, over sixty years of age and in need.

The Landseer fund (Charles Landseer, R.A.), which provides , four scholarships of £40 each, two in painting and two in sculp- ture, tenable for two years, open to students at the end of the •first two years of studentship, and given for the best work done during the second year.

The Armitage fund (E. Armitage, R.A.), which provides two annual prizes Of £30 and £10, for a design in monochrome for a figure picture.

The Cousins fund (S. Cousins, R.A.), which provides seven annuities of £80 each for deserving artists, not members of the Academy, in need of assistance.

The Newton bequest (H. C. Newton), which provides an annual sum of £60 for the indigent widow of a painter.

The Bizofund (John Bizo), to-be used in the scientific investiga- tion into the nature of pigments and varnishes, &c.

The Edwards fund (W. J. Edwards), producing £40 a year for the benefit of poor artists or artistic engravers.

The Leighton bequest (Lord Leighton, P.R.A.), received from Mrs Orr and Mrs Matthews in memory of their brother, the in- come from which, about £-300, is to be expended on the decoration of public places and buildings.

The literature cdncerning the Royal Academy consists chiefly of pamphlets and articles of more or less ephemeral value. More serious works are : William Sandbt. The History of the Boyal Academy

of Arts. London, 1862 (withdrawn from circula- tion on a question of copyright). — Report from the Select Com- mittee on Arts and their Connexion with Manufactures, with the Minutes of Evidence and Appendix. London, 1836. — BepoH of the Boyal Commission on the Boyal Academy, with Minutes of Evidence and Appendix. London, 1863. — Maktin Akchbr Shee. The Life of Sir M. A. Shee, P.B.A. London, i860.— C. K. Leslie, R.A. and Tom Tatlob. Life and T^mes of Sir Joshua Beynolds, P.B.A. London, 1865. — J. E. Hodgson, R.A. (the late), and Fbed. a. Eaton, Sec. R.A. " The Royal Academy in the Last Century," Art Journal, 1889-91. But the chief sources of infor- mation on the subject are the minute-books of the council, and of the general assembly, and the annual reports, which, however, only date from 1859. (p. a. e.)

Accident. See Insukance.

Account, a term used chiefly on the Stock Exchange to designate either the periodical settlement itself or the interval between one periodical settlement and the next. In most securities the transactions which have been effected are settled twice a month. For transactions in consols and a few kindred securities, such as India stocks, the regular settlement occurs only once a month, but a considerable part of the business in them is done " for cash," i.e., for settlement immediately. For most securities except mining shares the settlement extends over three

days, the account or settlement in mining shares occupying four days. The first of these days is called the " carry ing- over " or " making-up " day, and is employed in adjusting the accounts open between the class of speculators known as " bulls," who buy securities for which they do not wish to pay in the hope of selling them before the settlement at higher prices, and that known as " bears," who sell securities which they do not possess in the hope of buying them before the settlement at lower prices. The second day, where there are three, and the second and third days, where there are four, are the " ticket days " or " name days," when purchasers of registered securities pass ~~to the sellers tickets setting forth the names into which the same are to be transferred. The last is the " pay day," "settling day," or "account day," when money balances, or " differences," have to be met, and brokers who have purchased securities must be prepared to pay for them on delivery. Much of the work of the Stock Exchange account is carried out by a department of that institution corresponding to the bankers' clearing house. Its function is to bring into direct communication the ultimate buyer and the ultimate seller as represented by their respective brokers, thus eliminating, for the purposes of the settle~~ ment, the middleman known as the " dealer " or " jobber." The further returns of the bankers' clearing house, con- cerning which, in illustration of the financial importance of the account, figures were given in the ninth edition of the Encyclopaedia Britannica (i. 91) down to 1873, are as follows : —

On Fourths of

On Stock Exchange

On Consols

the Month.

Account Days.

Settling Days.

1873

£272,156,000

£1,038,257,000

£249,755,000

1874

265,427,000

1,010,456,000

260,244,000

1875

245,810,000

1,043,464,000

251,572,000

1876

225,936,000

761,091,000

225,948,000

•1877

232,630,000

744,085,000

228,254,000

1878

217,753,000

795,443,000

227,241,000

1879

213,348,000

842,937,000

225,381,000

1880

2.36,809,000

1,151,867,000

255,224,000

1881 ‘

253,133,000

1,383,430,000

278,864,000

1882

238,150,000

1,228,916,000

278,3(^7,000

1883

239,080,000

1,058,703,000

254,620,000

1884

242,659,000

960,623,000

268,352,000

1885

221,873,000

935,084,000

249,-327,000

1886

215,519,000

1,198,557,000

263,497,000

1887

256,469,000

1,145,842,000

297,199,000

1888

272,091,000

1,252,466,000

332,470,000

1889

290,117,000

1,338,842,000

351,690,000

1890

289,107,000

1,416,543,000

358,598,000

1891

264,501,000

1,067,403,000

314,807,000

1892

260,422,000

■1,022,764,000

299,405,000

1893

268,084,000

1,002,664,000

300,478,000

1894

261,547,000

964,455,000

301,448,000

1895

283,610,000

1,304,679,000

345,446,000

1896

290,681,000

1,162,866,000

380,354,000

1897

302,123,000

1,113,682,000

362,610,000

1898

331,267,000

1,231,847,000

402,861,000

1899

359,088,000

1,544,295,000

403,042,000

1900

372,463,000

1,339,571,000

438,125,000

(S, D. H.)

Accountants. — The term “accountant” is one to which, of late yearsy its original meaning has been more generally attributed — ^that of an expert -in the science of book-keeping. It is sometimes adopted by book-keepers, but this is an erroneous application of the term ; it properly describes those competent to design and control the sys- tems of accounts required for the record of the multifarious and rapid transactions of trade and finance. It assumes the possession of a wide knowledge of the principles upon which accountancy is based, which may be shortly described as constituting a science by means of which all mercantile and financial transactions, whether in money or in money’s worth, including operations completed and

engagements undertaken to be fulfilled at once or in a future, however remote, may be recorded ; and this sci- ence comprises a knowledge of the methods of preparing statistics, whether relating to finance or to any transac- tions or circumstances which can be stated by numeration, and of ascertaining or estimating on correct bases the cost of any operation whether in money, in commodities, in time, in life, or in any wasting property. Generally, accountancy may be described as being the science by means of which all operations, as far as they are capable of being shown in figures, are accurately recorded and their results ascertained and stated.

The origin of the profession of accountancy in Great Britain is difftcult to trace; auditors of accounts were History. naturally of very earljy existence, being men- tioned as officers of importance in the statutes of Westminster in the reign of Edward I. The art of accountancy on a scientific principle must certainly have been understood in Italy before 1495, when Friar Lucas de Borga published at Venice his treatise on book-keeping ; but the iirst known English book on the science was pub- lished in London by John Gouge or Gough in 1543. It is described as A Profitable Treaty ce called the Instrument or Bake to learn to knowe the good order of the kepyng of the famouse reconyruge, called in Latin, Dare and Habere, and, in Englyshe, Debitor and Creditor. A short book of instruction was also published in 1588 by John Mellis of Soiithwark, in which he says, ” I am but the renuer and reviver of an auncient old copie printed here in London the 14 of August 1543 : collected, published, made, and set forth by one Hugh Oldcastle, Scholemagter, who, as appeareth by his treatise, then taught Arithmetike, and this booke in Saint OUaves parish in Marke Lane.” John Mellis refers to the fact that the principle of accounts he explains (which iS a simple system of double entry) is ” after the forme of Venice.” The very interesting and able book described as Tlie Merchants Mirrour, or directions for the perfect ordering and keeping of his accounts ; framed by way of Debitor and Creditor, after the (so tearmed) Ital- ian manner, by Richard Dafforne, accountant, published in 1635, contains many references to early books oh the science of accountancy. ■ In a chapter in this book, headed ” Opinion of Book-keeping’s Antiquity,” the author states, on the authority of another writer, that the form of book- keeping referred to had then been in use in Italy about two hundred years, ” but that the same, or one in many parts very like this, was used in the time of Julius Csesar, and in Rome long before.” He gives quotations of Latin book-keeping terms in use in ancient times, and refers to ” ex Oratione Cieeronis pro Roscio Comsedo ” ; and he adds : ” That the one side of their booke was used for Debitor, the other for Creditor, is manifest in a certaine place, Naturalis Historise Plinii, lib. 2, cap. 7, where hee, speaking of Fortune, saith thus :

Huic Omnia Expensa,

Huic Omnia Feruntur acoepta et in tota Ratione mortalium sola TJtramque Paginam facit.”

An early Dutch writer appears to have suggested that double entry book-keeping was even in existence among the Greeks, pointing to scientific accountancy having been invented in remote times.

There were several editions of Richard Dafforne’s book printed — ~~.the second edition having been published in 1636, the third in 1656, and another was issued in 1684. The book is a very complete treatise on scientific account~~ ancy, it was beautifully prepared and contains elaborate explanations ; the numerous editions tend to prove that the science was highly appreciated in the 17th century. From this time there has been a continuous supply of literature on the subject, many of the authors styling

themselves accountants and teachers of the art, and thus proving that the professional accountant was then known and employed. Very early in the 18th century the services of an accountant practising in the City of London were made use of in the course of an investiga^ tion. into the transactions of a director of the South Seaf Company, who had been dealing in the Company’s stock. During this investigation the accountant appears to have examined the ‘books of at least two firms of merchants. His report is described Observations made upon exam- ining the books of Sawbridge and Company, by Charles Snell, Writing Master and Accountant in Foster Lane, London. ,

In 1799, when Holden’s Triennial Directory of London, Westminster, and Southwark was first published, 11 indi- viduals and firms were therein described as accountants ; in the same Directory, for the period 1809-11, the number had risen to 24 ; and in that for 1822-24, there were 73 firms of practising accountants recorded.

It will be noticed that the English books dealing with scientific book-keeping, to which reference has been made, were written at a time when the English and Dutch were very actively engaged in foreign trade, in succession to the Italian merchants of the 14th, 15th and 16th centuries ; but it was not until the begin- Modern ning of the 19th century that, in consequence ^^ment of the’ adoption of improved methods of manu- facture and transit, restilting from the application of water and steam power to manufactures and methods of bonvey- ance which largely increased the trade of Great Britain, the profession of an accountant became one which men of scientific knowledge and capacity adopted for their business career. Corporations and companies were formed to carry out large operations previously either left to the State or not undertaken, and for the development of trades and manufactures which were becoming less prof- itable when carried on by hand labour and with limited capital ; and, for these, the services of public accountants were necessarily required to devise systems of accounts and methods of control, and to enable the results of the various transactions carried on to be ascertained with the least waste of power or chance of loss by negligence or fraud. The large number of companies formed in 1843 and 1844, when a great amount of capital was invested in railways and extensive speculation resulted, also added to the demand for the services of professional accountants. The Companies’ Clauses Consolidation Act made provision for the audit of the accounts ‘of com- panies regulated by Act of Parliament and gave some extensive powers to the auditors, who are now, to a very large extent, selected from among professional account- ants. The Companies Act of 1862 led to a large exten- sion of the business of accountants, both as auditors and liquidators of companies ; and the Acts relating to bank- ruptcy passed between the years 1831 and 1883 added to the work devolving on professional accountants. The Companies Act 1879, which affected banking companies, made provision for the audit of their accounts, and it has been found desirable, in most cases, to appoint profes- sional accountants to this duty. The experience and professional knowledge of trained accountants have, in fact, been utilized by their appointment as auditors in the majority of

joint-stock companies, whether manufactur- ing, banking, trading, or created for any other purpose. Until the Companies Act 1900 was passed there was no general obligation upon limited companies to have audi- tors; this Act not only requires that auditors shall be appointed in all cases, but provides for their remuneration, and to a limited extent defines their rights and duties. This modification of the law relating -to companies will doubtless have a beneficial effect upon their management,

as it provides a very necessary control upon the opersr tions of directors, and enables the shareholders to obtain an independent opinion on the transactions and position of the companies in which they are interested. The Legislature evidently did not find it easy to formulate at all clearly the duties of auditors, and it seems reasonable to suppose that any general definition will prove an im- possibility, as the work which auditors undertake must vary very widely, and depends largely upon the scope of the operations the accounts of which are to be examined ; at the same time, the provisions made mark a distinct advance in company law, and will probably create a considerable increase in the demand for the services of accountants.

The duties of practising accountants cover a very wide area: they act as trustees, liquidators, receivers, and

managers of businesses, the owners of which are ” **■ in default or their affairs in liquidation, both under the direction of the courts and by appointment of creditors and others ; they are largely engaged as arbi- trators, umpires, and referees in differences relating to matters of account or finance ; they prepare the accounts of executors and trustees, and the necessary statements of affairs in cases of bankruptcy, both of firms and compa- nies ; they prepare accounts for prosecutions in cases of fraud and misconduct ; and they are constantly called upon to unravel and properly state the accounts of complicated transactions. Their services are commonly required to certify the profits of businesses intended to be sold, either privately or to companies by means of a published prospectus ; and, in cases of compulsory purchases of busi- nesses by railway companies and public bodies, the state- ments of the profits of the businesses to be acquired are generally made by them. In a very large number of financial operations they are called upon to give advice and prepare- accounts, and in few business matters requir- ing arithmetical calculations or involving the investigation of figures, and particularly where a considerable acquaint- anceship with the principles of law is needed, are their services not utilized. One of the most important duties undertaken by accountants is the audit of accounts, and this >duty has, of late years, been widely extended. Originally, auditors were appointed to examine and vouch statements of receipts and payments ; but the provisions made in Acts of Parliament in relation to audit, and the requirements of most articles of association of limited

companies put much graver responsibilities on – ” ■ auditors, who are now generally required to certify to the accuracy of balance sheets and of revenue and other accounts, the performance of which duties in- volves far more knowledge of accounts that was once re- quired. The efficiency, in most cases, of audits conducted by skilled accountants has led the public to attach excep- tional value to their audit certificates, and to demand extensive knowledge and ability in the conduct of the audit of the accounts of public companies. One other requirement which is generally regarded as indispensable, is that the work of audit should be very expeditiously performed; for it is easy to xmder- stand that, were the presentation of the accounts of a company and the distribution of dividends materially delayed in consequence of the audit, much inconvenience would result, while the value of the criticism of the accounts of business operations would be much deterio- rated if it could not be made very shortly after the accounts were closed. In these circumstances, in the cases of

large concerns with wide ramifications and numerous transactions, it is necessary that auditors should have the help of trained assistants, and thus the personal examinar tion of details by the auditor himself is, to a large extent, rendered unnecessary and the cost of audit materially re-

duced. This delegation of duty by auditors is generally well understood, and is in accordance with the require- ments of those concerned ; but there has been a tendency of late years to enlarge the responsibilities of auditors to an extent which, if persisted in, might render it danger- ous for men of reputation and means to accept the duties. It is to be hoped that future legislation may, on the one hand, secure the faithful performance of difficult work by competent men ; and, on the other, not leave an audi- tor responsible to the extent of his means either for some carelessness on the part of a clerk, or for an inaccurate decision at a time of pressure on a matter j-espeeting which he is probably unable to obtain competent advice without disclosing that which it is his duty to' keep secret.

While the number of practising accountants has of late years been steadily increasing and their services are correspondingly appreciated,' the necessity for controlling those exercising the profession and ^Mr?"""' for improving its status has naturally become apparent. The first important steps in this direction were taken by the accountants in Scotland — ^the Society of Accountants in Edinburgh being incorporated by royal charter in 1854; similar societies in Glasgow and Aberdeen being also incorporated by charter in 1855 and 1867. The Institute of Accountants was formed in London in 1870, bht did not receive a royal charter until the 11th May 1880, when all the then existing accountants' societies and institutes in England were incorporated as the Institute of Chartered Accountants in England and Wales, and means were provided by which all the then practising accountants in these coun- tries could claim membership thereof. In the year 1885 the Society of Accountants and Auditors was incorporated, but has obtained no charter; this body, while numbering among its members a considerable number of practising accountants in the United King- dom, also includes treasurers and accountants to cities and boroughs in Engl^ind, as well as clerks to chartered and other accountants. A large proportion of its mem- bers also consists of accountants practising abroad. In 1888 an Institute of Chartered Accountants was formed in Ireland, and a great many institutes" and societies have been formed in the British colonies and in the United States, some of which have local charters. It is curious to note, however, that, outside the Upited Kingdom, it was only in the British colonies, and lately in America, that associations of practising accountants existed, until, in 1895, an Institute of Accountants was founded in Utrecht for Dutch accountants; when, al- though the principles of accountancy have been well understood and practised in Holland since the 16th cen- tury, and probably earlier, it was found necessary to borrow the words " accountant " and " accountancy " from the English language to convey to the Dutch an idea of the meaning of the terms.

The Institute of Chartered Accountants in England and Wales, on the 1st June 1900, numbered 3195 members, of whom 2469 were practising in England and Wales, and 119 were practising abroad ; the majority of the other members (607) having passed the qualifying examinations of the Institute. In the three chartered bodies in Scotland there were, at the end of 1899, 698 members, of whom about four-fifths were in practice ; and the Irish Institute numbered 50 members, of whom 42 were in practice. The list of 1344 members of the Society of Accountants and Auditors in the United Kingdom, dated June 1900, does not enable a classification to be made between those practising as accountants and those otherwise engaged; but it may fairly be assumed that about five-eighths of this number were practising. Making

an allowance for public accountants who are not members of any of the institutes and societies mentioned above, it would appear that about 4000 persons were, at the begin- ning of the year 1900, practising as public accountants in the pnited Kingdom. (j. g. gb.)

Accra. See Gold Coast.

Accrington, a municipal borough (1878), in the

Accrington parliamentary division of Lancashire, Eng- land, 19 miles N. of Manchester by rail. Modern erec- tions are Established, Free, Congregational, Baptist, and Methodist churches, and a municipal technical school. Dye-works, chemical manufactures, and manufactures of machinery for the cotton-mills have been established. Area, 3425 acres. Population in 1881, 31,436 ; in 1891, 38,603; in 1901, 43,076.

ACCUMULATORS.

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THE early study of electrolysis made scientific men acquainted pith what were called secondary currents and polarization. The former were first used by Grove, whose gas battery may be called the first accumulator; but systematic search for the best effects was not under- taken till 1869, when Plante began a masterly and fruit- ful investigation. He soon produced his well-known battery, a cell with higher electromotive force and greater current-yielding power than any other practical combina^ tion. He obtained these results by putting lead plates into dilute sulphuric acid and sending a current through ; after a few reversals he found one plate to be covered by peroxide of lead, the other with a porous mass of lead. He set himself to accumulate energy in the cell, by which he meant the formation of a quantity of the active ma- terials. The names given to Plante's first cell have been frequently misunderstood. The terms secondary battery, storage battery, and accumulator have been taken to in- dicate that there was an accumulation or storage of elec- tricity or of electric current; but the error is not Plante's, as is clear from his declaration that his couple is able to give discharges of long duration, or to retain its charge for a long time, " et d'elnmagasiner ainsi le travail chimique de la pile voltaique." The value of the cell arises from a happy combination of properties. The three active mar terials are peroxide of lead, spongy metallic lead, and dilute sulphuric acid. Of these, the peroxide is an excel- lent depolarizer; the lead is a sufficiently good electro- positive metal ; and the dilute sulphuric acid has a very high conductivity for an electrolyte. Moreover, the two solid substances are not only themselves insoluble in the dilute acid, but the sulphate of lead formed from them iu the course of discharge is also insoluble. Consequently, it remains fixed in the place where it is formed ; and on the passage of the charging current, the original PbOj and Pb are reproduced in the places they originally occu- pied. Thus there is no material change in the distribu- tion of masses of active material. Lastly, the active materials are in a porous, spongy condition, so that the acid is within reach of all parts of them. The resistance of the cell is low, while the energy of the chemical action to which it gives rise imparts a high electromotive force.

Plants carefully studied the changes which occur in the f orma- p, ,, tion, charge, and discharge of the cell. In forming, ™ * he placed two sheets of lead in sulphuric acid, separat- ing them by narrow strips of caoutchouc (Fig, 1). When a charging current is sent through the cell, the hydrogen

liberated at plate A escapes, a small quantity possibly being spent in reducing the surface film of oxide gener- ally found on lead. Some of the oxygen is always fixed on the positive plate B, forming

a surface film of peroxide. After a few min- utes the current is reversed, plate A is peroxidized, while the peroxide previously formed on B is reduced to metallic lead in a spongy state. By repeated reversals, the surface of each plate is alternately peroxi- dized

Fig.r.

action penetrates farther into the plate, furnishing each time a larger quantity of spongy PbOa on one plate and of spongy lead on the other. It follows that the duration of the successive charaing currents also increases. At the beginning, a few minutes suffice ; at the end, many hours are required. After the first six or eight cycles, Plantfe allowed a period of repose before reversing. He claimed that the PbOa formed by reversal after repose was more strongly adherent, and also more crystalline, than if no repose were allowed. The following figures show the relative amounts of oxygen absorbed by a given plate in successive charges (between one charge and the next the plate stood in repose for the time stated, then was reduced, and again charged as anode) : —

Separate Periods of Kepose.

Charge.

Relative Amount of Peroxide formed.

18 hours 2 days 4 „ 2 „

First

Second

Third

Fourth

Fifth

1-0

1-57

1-71

2.14

2-43

and so on for many days. — (Gladstone and Tribe, Chemistry of Secondary Batteries). Seeing that each plate is in turn oxidized and then reduced, it is evident that the spongy lead will increase at the same rate on the other plate of the cell. The process of “forming” thus briefly described was not continued indefinitely, but only till a fair proportion of the thickness of the plates was converted into the spongy material, Pb02 and Pb respectively. After this, reversal was not permitted, the cell being put into use and always charged in a given direction. If the process of forming by reversal be continued, the positive plate is ultimately all con- verted into PbOa and falls to pieces.

Plants made excellent cells by this method, yet three objections were urged against them. They required too much time to “form”; the spongy masses (PbOa more especially) fell ofE for want of mechanical support, and the separating strips of caout- chouc were not likely to have a long life. The first advance was madebyFaure (1881), who greatly shortened the time required for “forming” by giVing the plates a preliminary coating of red lead, whereby the slow process of biting into the metal was avoided. At the first charging, the red lead on the + electrode is changed to PbOa, while that on the – electrode is reduced to spongy lead. Thus one continuous operation, lasting perhaps sixty hours, takes the place of many reversals, which, with periods of repose, last as much as three months. Faure used felt as a separating membrane, but its use was soon abolished by methods of construction due to Volckmar, Sellon, Swan, and others. These inventors put the paste not on to plates of lead, but into the holes of a grid, which, when carefully designed, affords good mechanical support to the spongy masses and does away with the necessity for felt, &o. They are more satisfactory, however, as supporters of spongy lead than of the peroxide, since at the point of contact in the latter case the acid gives /ise to a local action, which slowly destroys the grid. Disintegration follows sooner or liter, though the best makers are able to defer the failure for a fairly long time. Efforts have been made by Tribe, Fitzgerald, and others to dispense with a supporting grid for the positive plate, but these attempts have not yet been suc- cessful enough to enable them to compete with the other forms.

The following description of well-known forms of cells will illustrate the methods adopted at the present time.

Plante Tj/pe.—” Chloride Accumulator” cells derive their name from the fact that chloride of lead is used in making the negative plates. There is no chiorUe chlorine or chloride in the cell when ready accumu- for use._ Eor the negatire plates, the chloride ^’”””• of lead is melted in large iron pans at a temperature of about 600° C, and then carried by plumbago crucibles to a

mould, where it is cast into short hexagonal prisms or pastilles. These are arranged in the bottom half of a plate mould, the top half of which is permanently fixed

to a hydraulic press; the press is closed and molten lead is injected under a pressure of 150 lb per square inch, to fill in the spaces between them. They are thus embedded in a lead plate whose thickness is equal to. their own length, their ends being flush with the face of the plate. The chlorine has now to be extracted, which is done by putting the plate between sheets of zinc in chloride of

which form the positive plate becomes covered with peroxide.

In the ” Monobloc ” cell, the general appearance and arrangement of which are shown in Fig. 4, the positive block is built up of corrugated sheets of lead, perforated by rectangular holes. When these j|^”?°^y, perforated sheets have been laid on each other to a height of about 9 inches, and the four corners burned to stout lead fillets, a very com- pact block is ob- tained, to all parts of which acid is able easily to penetrate. The negative plate consists of a series of rods, each having a lead core on which lies spongy lead. These are burned to i

a lug at the top, and each rod being enclosed in a per-

^/>.3.

zinc solution, when the zinc takes chlorine froin the lead chloride, and leaves the metallic lead in a finely-divid'ed, porous con- dition in the space previously occupied by the chloride. After several washings, the plate is made a negative pole in sulphuric acid for a little while, to ensure absolute freedom from chlorine, and is then ready for use. Fig. 2 shows the negative plate in position in a cell. The 'holes in the hex- agonal plugs are to facilitate diffusion of acid. For the positive plates, lead grids are first cast under pressure, the mould being arranged to give a plate of lead 0-4 inch thick, pierced by a number of circular holes about half an inch in diameter with slight coun- ter-sinks on the faces. Into each of these holes is thrust a roll or rosette of lead ribbon, which has first been cut to the right breadth (equal to the thickness of plate), then ribbed or gimped, and finally coiled into a rosette. The rosettes have sufficient spring to fix themselves in the circular holes of the lead plate, but are keyed into position by putting the plate through a hydraulic press. The plates are then put into tanks with temporary negatives, and a current is passed for a long time, whereby the rosettes become coated with a fine adherent hard crystalline peroxide. The cell can be discharged at very high rates; one square foot of plate will, give a current of 40 amperes when necessary.

A second cell of the Plants type is that known as the " D.p." Its construction is very simple (Fig. 3). A num- ber of corrugated lead strips, about one quarter of an inch wide, are piled to a height of 7 or 8 inches, and their ends are burned together. Thus a plate is formed through which the acid can easily pass. A nmnber of such plates are joined together to form the positives, the negatives being formed by pasting a somewhat similar framework with litharge. Having put the two sets of plates into the cells, a prolonged charging current is sent through ; the litharge is reduced to spongy lead, and the surface of the corrugated strips

"D.P. aeU.

forated ebonite sheath the whole is put into the perfora<- tions of the positive blocks. These cells have been used on the tramway cars at Ghent and other places on the Continent.

Pasted Types. — ^The best-known cell of this type is the E.p.s. cell, made by the Electric Power Storage Company. The paste for the positive plates is a mixture of red lead with sulphuric acid, and for the negative ' plates litharge is used instead of red lead. Different forms of grids are adopted, according to the special pur-

pose for which the cells are intended. For ordinary iso- lated installations, the grid wall has a section shown ia Fig. 5, the holes h, as seen from the direction of the arrow, being sq,uare and slightly larger on the negative than on the positive grid. For rapid discharges (up to two hours) the negative grid is much the same, except that the holes

are rectangular and the plate is thicker. The positive grid has quite a different shape (Fig. 6). For the quickest discharges (up to one hour or less) the grid, has the form of thin vertical ribs ~~^^ inch apart, strengthened at inter~~ vals by horizontal ribs. Between the vertical ribs are deep narrow grooves, which hold the active material. The nega- tive grid is like Fig. 5, the holes being rectangular in shape.

Hart cell.

Irfd

^ig. 7.

Fig. 7 shows the general appearance of the two-hour discharge cell, illustrating the method of connecting, and the greater thickness of the positive over the negative plate ; also, the clearance between .the plates and the bottom of the cell. There are other types of grids besides those mentioned, to suit the varying conditions of electrical work, for high discharge, traction, &c.

Another cell of pasted type is that known as the ” Hart ” accumulator. The positive and negative plates, which are similar in size and shape, are pasted with red lead and litharge respectively. The grid is in the form of lattice-work, arranged alternately on either side, with strong leaden ribs running diagonally across the plate. The active material in each plate is split up into a number of small pellets, each of which is gripped

hard on its surface /& _j^ ^y means of a leaden

rJCflffr^^’i*. “^ ^ ‘lip attached to the

grid and turned over by a special process. In joining up, a spe- cial terminal is used. The lugs are first faced up against each other and tightened by a temporary mas- ter connector. This then gives way to a non-corrosive bolt, which is conically tapered and gives a large connecting surface. Fig. 8 gives a view of the cells and also of the connector.

Mixed Type. — In this type, of which the “Tudor” cell is a well-known example, the positives are prepared by a pure Plante formation from a carefully-made lead casting, and the negatives by pasting. Fig. 9 shows ‘the unformed positive plate. A mould is made by supporting narrow guii-metal racks on each side of a cast-iron frame. The teeth of the racks form vertical grooves in the faces of the casting; and as narrpw spaces are left between one rack and the next

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•• Tador cell.

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Fig. 9.

lower or higher one, horizontal ribs are seen. To give greater strength, thicker vertical ribs are obtained by cut- ting out one tooth of each rack at intervals. The grooves are about ^ inch apart and \ inch deep. The positive plates are about | inch thick, and are formed (that is, covered with perox- ide) by charging them, /°°*\ and leaving them on«=*, ^ open circuit (repose) alternately. Later, charging and d charging are substi- tuted. Here, as in Plant^‘s .work, charg- ing and discharging become more pro- longed as the for- mation proceeds. As much as five or six weeks is required. The negative plate is a pasted plate. Litharge mixed with sulphuric acid is placed in the holes of a lead grid, to which, before pasting, is given a superficial coating of peroxide by making it a ter- minal in an acid bath and charging it as a positive for a short time. This gives a greater attachment between the grid Etnd the spongy lead when subsequently reduced. The negative plate is about y% inch thick.

There are many other types of cells. An interesting one is that known as the Lithanode. Originally, this was an attempt to prevent local action by making the positive of peroxide alone, and to form it so slowly that its mechanical arrangement and strength would facilitate diffusion and prevent disintegration. It has not yet been largely used. ^

Whatever the type of cell may be, it is important to attend to the following working requirements: — (1) The cells must be fully equal to the maximum demand, both in discharge _ . rate and capacity. (2) All the cells in one series ^fls ought to be equal in discharge rate and ca,pacity. This involves similarity of treatment. (3) The cells are erected on strong wooden stands. Where floor space is too expensive, they can be erected in tiers ; but if possible this should be avoided. They ought to lie in rows, so arranged that it is easy to get to one side (at least) of every cell, for examination and testing, and if need be to detach and remove it or its plates. Where a second tier is placed over the first, sufficient clearance space must be allowed for the plates to be lifted out of the lower boxes. The cells are insulated by supporting them on glass or mushroom-shaped oil insulators. If the containing vessels are made of glass, it is desirable to put them in wooden trays which distribute the weight between the vessel and insulators. To prevent acid spray from filling the air of the room, a glass plate is arranged over each cell. The positive and negative sections are fixed in position with insulating forks or tubes, and the positive terminal of one cell is joined to the negative of the next by burning or bolting. If the latter method is adopted, the surfaces ought to be very clean and well pressed home. The joint ought to be covered by vaseline or varnish. When this has been done, examination ought to be made of each cell to see that the plates are evenly spaced, that the separators (glass tubes or ebonite forks between the plates) are in position and vertical, and that there are no scales or other adventitious matter connecting the plates. The floor of the cell ought to be quite clear ; if Anything lies there it must be removed. (4) To mix the solution a gentle stream of sulphuric acid must be poured into the water (not the other way, lest too great heating cause an accident). It is necessary to stir the whole as thfe mixing proceeds and to arrange that the density is

about 1190, or according to the recommendation of ttie maker. About five volumes of water ought to be taken to one volume of acid. After mixing, allow to cool for two or three hours. The strong acid ought to be free from arsenic, copper, and other similar impurities. The water ought to be as pure as can be obtained, dis- tilled water being best ; rain water is also good. If potable water be employed, it will generally be improved by boiling, which re- moves some of the lime held in solution. The impurity in ordinary drinking water is very slight ; but as all cells lose by evaporation and require additions of water from time to time, there is a ten- dency for it to increase. The acid must not be put

into the cells till everything is ready for charging. (6) A shunt-wound ‘or separately-excited dynamo being ready and running so as to give at will 2 ‘6 or 2 ~~7 volts per cell, the acid is run into the cells. As soon as this is done, the dynamo must~~ be switched on and charging commenced. The .positive terminal ojf the dynamo must be joined to the positive terminal of the battery. If necessary, the + end of the machine must be found by a trial cell made of two plain lead sheets in dilute acid. It is important also to maintain this first charging operation for a long time without a break. Twelve hours is a minimum time, twenty-four not too much. The charging is not even then complete, though a short interval ‘is not so injurious as in the earlier stage. The full charge required varies with the cells, but in all types a full and practically continuous first charge is imperatively necessary. During the early part of this charge the density of the acid may fall ; but after a time ought to increase, and finally reach the value desired for permanent working. Towards the end of the ” formation ” vigilant observation must be. exercised. It is important to notice whether any cells are appre- ciably behind the others in voltage, density, or gassing. Such cells may be faulty, and in any case they must be charged and tended till their condition is like that of the others. They ought not to go on the discharge circuit till this is assured. The examination ■ of the cells before passing them as ready for discharge includes : — (a) Density of acid as shown by the hydrometer. (6) Voltage. This may be taken when charging or when idle. In the first case it ought to be from 2-4 to 2-6 volts, according to conditions. In the second case it ought to be just over 2 volts, provided that the observation is not taken too soon after switching off the charging current. For about half an hour after that is done, the E.M.F. has a transient high value, so that, if it be desired to get the proper e.m.f. of the cell, the observation must be taken thirty minutes after the charging ceases, (c) Eye observations of the plates and the acid between them. The positive plates ought to show a rich dark brown colour, the negatives a dull slate blue, and the space between ought to be quite clear and free from anything like solid matter. All the positives ought to be alike, and simi- larly all the negatives. If the cells show similarity in these re- spects, they will probably be in good working order. ‘

As to management, it is important to keep to certain simple rules, of which these are the chief : — (1) Never discharge below a potential difference of 1‘85 (or in rapid discharge, 1-8) volt. (2) Never leave the cells discharged, if it be avoidable. (3) Give the cells a special full charging once a montii. (4) Make a periodic examination of each cell, determining its e.m.f., density of acid, the condition of its plates, and freedom from growth. Any incipi- ent growth, however small, must be carefully watched. (5) If any cell shows signs of weakness, keep it off discharge till it has been brought back to full condition. See that it is free from any connexion between the plates which would cause shortcirouiting ; the frame or support which carries the plates sometimes gets cov- ered by a conducting layer. To restore the cell, two methods can be adopted. In private installations it may be disconnected and charged by one or two cells reserved for the purpose ; or, as is preferable, it may be left in circuit, and a cell in good order put in parallel with it. This acts as a ” milking ” cell, not only prevent- ing the faulty one from discharging, but keeping it supplied with a cliarging current till its p.d. is normal. Every battery attend- ant should be provided with a hygrometer and a voltmeter. The former enables him to determine from time to time the density of the acid in the cells; instruments specially constructed for the purpo.se are now easily procurable, and it is desirable that one be provided for every 20 or 25 cells. The voltmeter should read up to about 3 volts and be fitted with a suitable connector to enable contacts to be made quickly with any desired cell. A portable glow lamp should also be available, so that a full light can be thrown into any cell ; a frosted bulb is rather better than a clear one for this purpose. He must also have some form of wooden scraper to remove any growth from the plates. The scraping must be done gently, with as little other disturbance as possible. By the ordinary operations which go on in the cell, small portions of the plates become detached. It is important that these should fall below the plates, lest they shortcircuit the cell, and therefore sufii- cient space ought to be left between the bottom of the plates and the floor of the cell for these •’ scalings ” to accumulate without touching the plates. It is desirable that they be disturbed as little

as possible till their increase seriously encroaches on the free space. It sometimes happens that brass nuts or bolts, &c., are dropped into a cell ; these should be removed at once, as their partial solution would greatly endanger the negative plates. The level of the liquid must be kept above the top of the plates. It may sometimes be necessary to replenish the solution with some dilute acid, but strong acid must never be added.

The chief faults are buckling, growth, sulphating, and disinte- gration. Buckling of the plates generally follows excessive dis- charge, caused by abnormal load or by accidental shortcircuiting. At such times asymmetry in the cell is apt to make some part of the plate take much more than its share of the current. That part then expands unduly, as explained later, and curvature is pro- duced. The only remedy is to remove the plate, and press it back into shape as gently as possible. Growth arises generally from scales from one part falling on some other ; say, on the negative. In the next charging the scale is reduced to a projecting bit of lead, which grows still further because other particles rest on it. The remedy is, gently to scrape off any incipient growth. Sulphating, the formation of a white bard surface on the active material, is due to neglect or excessive ‘ discharge. It often .yields, if a small quantity of sulphate of soda be added to the liquid in the cell. Dis- integration is due to local action, and there is no ultimate remedy. The end can be deferred by care in working, and by avoiding strains and excessive discharge as mudh as possible.

Accumulators contain only three active substances — spongy lead on the negative plate, spongy peroxide of lead on the positive plate, and dilute sulphuric acid between them. It will be shown later that Accamu- a fourth substance, sulphate of lead, is formed ‘r^sJ” on both plates during discharge, and also, though to a small extent, during repose. Spongy lead looks much like ordinary lead. Its colour is a blue gray, density probably similar to that of lead, 11-3, and its electric resistance -0000195 ohm between opposite faces of a cubic centimetre. Spongy peroxide of lead is a dark brown crystalline powder, with a density of 9-28. Its electric conductivity has been determined by J. Shields (Chemical News, 65, 87). The hydrated peroxide prepared by purely chemical methods had a specific resistance of 5‘59xl0′ c.g.s. units (=5-59 ohms) ; but a similar hydrate, prepared electrolytically, gave slightly higher figures, 6-78×10′ c.g.s., or 6-78 ohms. Both forms of this substance con- duct metallically, and neither of them electrolytically. Sulphate of lead is a white powder, with a density of 6-3. Its electric conductivity is so low that it may be classed as a non-conductor. The densities of these three solids being known, it is easy to follow the changes in volume which accompany the formation of sulphate of lead on either plate. One hundred volumes of lead (on the nega^ tive plate) form 290 volumes of sulphate, and will there- fore require three times as much space as before the action, while 100 volumes of peroxide (on the positive plate) form 186 volumes of sulphate, and will therefore

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fill nearly twice as much space as before. These expansion figures are not only important in themselyes, but also

Locai action.

throw light on the -well-known tendency of the negative plate to run down before the positive. In a given dis- charge the quantities of sulphate of lead formed on the two lead plates are the same, but the expansion in the lead plugs (and consequent reduction of porosity) is 60 per cent, greater than in the positive plugs. Sulphuric acid is used in the dilute state. The usual density em- ployed is 1-210, which has an electric conductivity of 0-73 cg.s. units, or a specific resistance of 1-37 ohm for a centi- metre cube. The relative conductivity (the reciprocal of resistance) is shown in Fig. 10. Prom this and the datum just given, the specific resistance of any strength of acid can be found approximately.

There are three kinds of local action: — (1) In all the practical forms of accumulator the positive plate contains two conductors in contact — ^the lead grid or plate and the peroxide it is intended to sup- port. There exists between them a difference of potential (=2 volts), and, as the acid touches both, local currents must flow. The course of these will be from a point in the positive grid to the acid, thence to the adjacent peroxide, and back through it to the grid beneath. Such currents involve the formation of sulphate from both the grid and the peroxide, with two definite results : (a) a diminution of the available energy existing as peroxide, and (6) an attack on the lead-supporting surface below. In an early form of accumulator, Glad- stone and Tribe found 7 per cent, of sulphate was formed in two hours. Fortunately the sulphate of lead thus formed is insoluble, and covers the free lead surface. Consequently the action becomes very slow after the first hour or so, and would in fact stop ^altogether if the film of sulphate remained intact, and so prevented access of acid to the lead surface. But in the daily changes of temperature, &c., the strains are great enough to cause some conducting communica,tion, and the local action goes on. This progressive action explains the

advantage Plante derived from periods of repose in forming, since it brings a greater quantity of the lead within the reach of the next operation. It also explains the danger which waits on the positive grid or plate, and ultimately leads to its destruction. (2) Local action will arise on the negative plate if a more electro-negative conductor settle on the lead. This sometimes happens because of impurities in the materials used for the paste or existing in the acid. In either case thdy will find their. way to the negative grid or support, and lead to loss of energy and the evolution of hydrogen gas. (Swinburne, Journ. Inst. Elec. Eng. 1886.) Even where impurities do not exist in the materials, they are often introduced by small bits of metal being carelessly dropped into the cell. A not unusual habit of engineers is to scrape copper connecting-wires in close proximity to the cells, thus endangering their capacity and life very considerably. Besides this chance of local action on the negative plate, acid of density 1-210 acts directly on the finely-divided lead. S”winburne also drew attention to this in 1886, and indicated its effect on the capacity of the pells, which may be seriously reduced. (3) There is a local action on each of the plates, whenever the acid in one part -of the cell differs in density from that in another. This often happens. There is a constant tendency for the acid to get stronger at the bottom of the cell, because during charge the stronger acid brought to the positive plate tends to fall, andin discharge the weaker acid diffusing from the porous plugs of both plates tends to rise. Further still, during chai’ge the acid is strongest in the inner parts of the spongy material, and differences of 25 to 30 per cent, may exist between the inner and outer parts of a plug. A similar difference may exist during discharge, but in this case the acid is strongest on the outside and weakest in the interior. The following table gives the e.m.f.

between a plate of peroxide in weak and another in strong acid ; corresponding values are also given for lead plates in acid of different strength (Gladstone and Hibbert, Journ. Inst. Elec. Eng. 1892) :—

E.M.F. arising from Differences in Strength of Acid.

Two lead plates.

TiFo peroxide plates. 1

Acid round

Acid round

E.M.F.

Acid round

Acid round

E.M.F.

+ lead plate.

- lead plate.

in volts.

-PbO, plate.

+ PbOj plate.

in volts.

Per cent.

Per cent.

Per cent.

Per cent.

0-2

1-35

0-047

0-2

1-35

0-072

2-85

0-060

2-85

0-095

5-5

0-066

6-5

0-107

10-5

0-082

10-5

0-134

14-5

0-094

14-5

0-150

22-5

0-109

22-5

0-168

36-5

0-150

36-5

0-215

57-5

0-204

57-5

0-359

85-5

0-247

85-5

0-637

98-0

0-266

99-0

0-643

The lead in the weaker acid is ¦ to the other; with the peroxide plates the case is reversed. With these figures it is easy to picture the local currents flowing between an inner and an outer part of a single plug during the discharge, owing to the different strength of acid then existing.

The importance of these three kinds of local action arises not so much from the magnitude of the actions they set up as from the special parts of the plates affected by them. Sulphate of lead is formed in each case, but not in the course or path of the regular current. On the positive plate the local action forms sulphate along the interface between the plugs and the grid, and may effec- tively isolate a large proportion of the peroxide. On the negative plate, when due to deposited copper, &c., it cannot be so definitely followed, but may even give an outside surface coating of sulphate. That arising on both plates by reason of variable acid strength in the

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plugs cannot be localized, but must necessarily be out of the regular lines of flow of the working currents. It is partly by virtue of these special localizations of the chemical changes that an accumulator seems to be seriously damaged by a rest, whether charged or discharged, and it is a further consequence that subsequent charges only slowly get at this deep-seated sulphate, so that many cycles of work are required to bring back the cell to its earlier value as a working machine.

The electromotive force of a cell varies ~~with the strength of the acid, as may be seen from Fig. 11, taken Electro~~ from Gladstone and Hibbert's paper. The motive observations with very strong acid were very "^' difficult to obtain ; but one good experiment made with

98 per cent, acid is marked by x. Streintz {Ann. Phys. Chem. 46, p. 449) gives for the e.m.f. the expression

E=l-850+0-917 (s-So) between the density limits 1-055 and 1-279; (s— So) is the excess of the specific gravity of the acid over that of water. It must be understood that the acid referred to in the foregoing curve is that existing in the pores of the spongy masses of the plates. If there be any inequality

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Time in minutes , Fie. 12.

between that and the acid outside a process of diffusion sets in between them, aqd the e.m.f. varies so rapidly that no exact measurement can be made. The impor- tance of this diffusion was first pointed out by Duncan and Wiegand {Electrical World, N.Y". 1889), who took plates before and after discharge, soaked them in sul- phuric acid of 1-175 density, and then transferred them to vessels of distilled water. The acid which diffused out in a given time was estimated, with the residt shown in Fig. 12.

The plates contained about 5 grams of acid altogether, so that about one-half diffused out in thirty minutes, a good illustration of the slowness of diffusion. It is noteworthy that the rate of diffusion is much the same for both positive and negative plates, but that the rate for a discharged is considerably less than that for a charged plate. This last difference is undoubtedly due to the formation of sulphate in the porous plugs, with the expansions indicated in the paragraph on the properties and volumes of materials. Discharge affects the rate of

diffusion on the lead plate more than on the peroxide. This is in accordance with the higher rate of expansion and clog- ging when lead is changed to' sulphate over the change from peroxide to

sulphate. From what has al- ready been said about the dependence of E.M.F. on acid strength, it is obvious that while diffusion is proceeding there will be a corresponding change in b.m.f. Curve I., in Fig. 13, shows the rise when a positive plate, hitherto standing in 20 per cent, acid, is suddenly placed in 34 per cent. ;’ curve II., the rise when a similar plate is taken from 20 to 58 per cent, acid (GlMstpne and Hibbert, Pha. Mag. 1890).

In applying these diffusion and electromotive force curves to working conditions, it may be noticed that a given quantity of HjSO^ diffusing into very weak acid produces a much greater change in the electromotive force than if it pass into stronger acid. Thus if the acid be very weak, say, 2 per cent., a diffusion of 1 per cent. H2SO4 raises the E.M.r. by 0-036 volt, whereas if the acid

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be 10 per cent, a diffusion of 1 per cent, raises the e.m.f. by 0-006 volt only (see Fig. 11).

The important practical questions concerning an ac- cumulator are — its maximum rate of working, its capacity at various discharge rates, its efficiency, and its charge length of life. Apart froin mechanical injury, ana ais- all these depend on the way the cell is charged “barge. and discharged. For each type and size of cell there is a normal maximum current. Up to this limit any current may be taken, beyond it the cell may suffer. Again, it is desirable that the charge and discharge be confined between certain limits of potential differ- ence at the terminals. Injuriously excessive currents or a discharge below a potential difference of 1-8 volt

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are often accompanied by more or less disintegration. To illustrate and explain these points a connected series of observations on a given set of cells is here used, the data having been given by Ayrton, Lamb, Smith, and Woods {Joum. Inst. Elec. Eng. 1890). The cells employed contained three negative plates, weigh- ing 17 lb 2 oz., two positive plates, weighing 11 Bb 8 oz., and acid of 1-206 density. The plates measured 9 by 9 inches, and were intended for maximum currents of 9 amperes in charging and 10 amperes in discharg- ing. For reasons given in the paper, it was decided to make the

potential difference at terminals the gov- .►erning condition of working, the limits to be 2-4 and 1-6 volt.

Fig. 14 shows a typical discharge curve ; noteworthy points are : — (1) At the beginning and at the end there is a rapid fall in P.D., with an intermediate period of fairly uniform value. (2) When the p.D. reaches 1-6 volt the faU is so rapid that there is no advan- tage in continuing the action. When the p.d. had fallen to 1-6 volt the cell was automatically switched into a charging circuit, and with a current of 9 amperes yielded the curve in Kg. 15. Here

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again there is a rapid variation in p.d. (in these cases a rise) at the beginning and end of the operation. The cells were now carried through the same cycle several times, giving almost identical values for each cycle. After some days, however, they became more and more difficult to charge, and the return on discharge was proportionately less. It became impossible to charge up to a p.d. of 2-4 volts, and finally the capacity fell away to half its first value. Examination showed that the plates were badly scaled and that some of the scales had partially connected the plates. These scales were cleared away and the experiments resumed, limiting the fall of P.D. to 1-8 volt. The difficulties then disappeared,

showing that discharge to 1-6 volt caused injury that did not ari^e at a limit of 1-8. Before describing the new results it will be useful to examine these two cases in the light of the theory of B.M.F. already given.

(a) Fall in E.At.lj, at beginning of discharge. — At the moment when previous charging ceases the poreS of the positive plate contain strong acid, brought there by the charging current. There is consequently a high e.m.p. But the strong acid begins to diffuse away at once and the e.m.v. falls rapidly. Even if the cell were not discharged this fall would occur, and if it were allowed to rest for thirty minutes or bo the discharge would have begun with the dotted line (Fig. 14). (6) Final rapid fall. The pores being clogged by sulphate the plugs cannot get acid by difiusion, and when. 5 per cent, is reached the fall in e.m.f. is disproportion- ately large (see Fig. 11). If discharge be stopped, there is an almost instantaneous diffusion inwards and a rapid rise in b.m.f. (c) The rise in b.m.f. at beginning and end of the charging is due to acid in the pores being strengthened, partly by diffusion, partly by formation of sulphuric acid from sulphate, and partly by electro- lytic carrying of strong acid to the positive plate. The injurious results at 1-6 volt arise because then the pores contain water. The

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Fig. /6 -27.

chemistry is altered, oxide or hydrate is formed, which will partially dissolve, to be changed to sulphate when the sulphuric acid subsequently diffuses in. But formed in this way it will not appear mixed with the active masses in the electrolytic paths, but more or less alone in the pores. In this position it will more or less block the passage and isolate some of the peroxide. Further, when forming in the narrow passage its disruptive action will tend to force off the outer layers. It is evident that limitation of p.d. to 1-8 volt ought to prevent these injuries, because it prevents exhaustion of acid in the plugs. The other curves will now be easy to follow. Figs. 16 and 17 show a normal charge and dis- charge between the limits of 2-4 and 1-8 volt.

After the next charging the cells were allowed to rest for ten days. On discharge they showed a smaller capacity, and this was the case for several subsequent charges and discharges, though repeated chargiiigs at last brought them back to something like the previous values. Compare Figs. 18 and 19. Two other similar series were tried; that is, rest followed by repeated and continuous work to bring the cell back to its first state (see Figs. 20, 21, 22, 23). Then another charge was followed by a rest of sixteen days. The discharge which immediately followed the rest is shown in Fig. 24, while Fig. 25 shows the next charge — a great falling-off. The cells were now taken through eight cycles of

charge and discharge, and were then so far restored as to give Figs. 26 and 27. Integrating the curves, the following numbers were obtained :-^

CaDacltv and Efficiency under Tarious Conditions of Working.

Experiment.

Discharge.

Charge.

Efficiency.

Ampere Hours.

Watt ‘ Hours.

Ampere Hours.

Watt Hours.

Quantity.

Energy,

Normal cycle . Restoration

after 1st rest . Ditto, after 2nd

rest Ditto, after 3rd

rest . , . Discharge im- 1

mediately [■

after rest J Restoration

after 8 cycles .

102

100

91

82-6

56-5 56-5 .

80

201-7

190

176-7

161-3

110-5 110-5

156-9

104-5

103-8

96-8

86-2

86-2 71-1

83-8

230-7 228-2 213-2

190-5

190-5 158-3

184-6

97-2 96-8 94-1

95-8

65-6 79-6

95-5

87.4 85-8

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84-7

581 696

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The table shows that the efficiency in a normal cycle may be as high as 87-4 per oeht.; that during a rest of sixteen days the charged accumulator is so affected that about 30 per cent, of its charge is not available, and in subsequent cycles it shows a diminished capacity and eflficiency ; and that by repeated charges and discharges the capacity may be partially restored and the efficiency more

completely so. These changes might be due to — (a) leakage or shortcircuit, (6) some of the active material having fallen to the bottom of the cell, or (c) some ol^ange in the active materials.

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fig. 23.

(a) is excluded by the fact that the subsequent charge is smaller, and (6) by the continued increase of capacity during the cycles that follow the rest. Hence the third hypothesis is the one which must be relied upon. The change in the active materials has already been given. The formation of lead sulphate (on both plates) explains the loss of energy shown in I’ig. 24, while the fact that it is probably formed, not in the path of the regular currents, but on the wall of the grid (remote from the ordinary action), gives a probable explanation of the subsequent slow recov- ery. The action of the acid on the lead during rest must not be overlooked.

We have seen that capacity diminishes as the discharge rate increases ; that is, the available output increases as the current diminishes. Crompton’s diagram illustrating this fact is given in Fig. 28. At the higher rates the consumption of acid is too rapid, diffusion cannot maintain its strength in the pores, and the f all ‘ comes so much earlier. The resistance varies with the condition of the cell, as

shown by the curves in Fig. 29. It may be unduly increased by long or narrow lugs, and especially by dirty joints between the lugs.

It is interesting to note that it increases at the end of both charge and discharge, and much more for the first than the second. Now the composition of the active materials near the end of charge is almost exactly the same as at the beginning of discharge, and at first sight there seems nothing to account for the great fall in resistance from 0-0115 to 0-004 ohm ; that is, to about one-third the value. There is, however, one diffei-ence between charging and discharging — namely, that due to the strong acid near the positive, with a corresponding weaker acid near the negative electrode. The curve of conductivity for sulphuric acid shows

1 This discharge is here compared with the charge that preceded the rest ; in the next line the same discharge is compared with the charge following the rest.

that both strong and weak acid have much higher resistances than the liquid usually employed in accumulators, and it is therefore reasonable to suppose that local variations in strength of acid cause the changes in resistance. That these are not due to the

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Fig. 29.

constitution of the plugs is shown by the fact that, while the plugs

are almost identical at end of discharge and beginning of charge,

the resistance falls from 0-0055 to 0-0033 ohm. While a current flows through a cell, heat is produced at the rate of C^R X -24 calories (water-gram-degree) per second.

tUn’ofoell ^^ ^ consequence the temperature tends to rise. But ■ the change of temperature actually observed is n^uch

greater during charge, and much less during discharge, than the fore- going expression would suggest ; and it is evident that, besides the heat pro- duced according to Joule’s law, there are other ac- tions which warm the cell during charge and cool it during discharge. Messrs. Duncan and Wiegand (loc. cit.), who first observed the thermal changes, ascribe the chief influence to the electro- chemical addition of H2SO4 to the liquid during charge and its removal during discharge. Fig. 30 gives some results ob- tained by Ayrton, Lamb, &o. This elevation of temperature (due to elec- trolytic strengthening of acid and local action) is a measure of the energy lost in a cycle, and ought to be minimized as much as possible.

The chemical theory which has been adopted in the foregoing pages is very simple. It declares that sulphate of lead is formed on both plates in discharge, ‘ the chemical action being reversed in charge. Most of the other actions — associated with variations in the E.M.JF. of the cell — arise from local variations in strength of acid brought about by chemical action and the electrolysis of the acid. It will contribute to a clear i/nderstanding if the chemical actions be considered under various heads: — (1) Those occurring during ordi- nary charge and discharge ; (2) the cause of high b.m.*. at end of charge ; (3) the rapid fall of e.m.p. and p.d. at end of discharge; (4) the rapid recuperation of a dis- charged cell when allowed tq repose; (5) the effect of repose on a charged cell ; and (6) the agreement of the experimental e.m.p. and that calculated by the Kelvin- Helmholtz thermodynamic equation.

(1) Plants thought that the chemical action during charge and

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discharge was due to electrolytic hydrogen and oxygen simply. He ignored the chemical action of the acid. In 1882 Gladstone and Tribe published a series of papers, showing, by analyses, that sulphate of lead was formed on both plates, the action being, before discharge,

+ plate. Liquid.

X. PbOa +

fy. H2SO4-I l+n. H2OJ

— plate.

+ z. Pb

and after discharge

+ plate. Liquid. — plate.

r(x-p)FhOi-\ r(y~2p-)U2SOn r(8-jp)Pb “i

l+p. PbSOj + L (ra-|-2p)H20 J + l+p. PbSOj

These results are in harmony with Gladstone and Tribe’s analyses, which showed that in every case some of the active material remained unchanged. During charge, the substances are restored to their original condition, and the equation must be reversed. The theory received abundant confirmation — from Prankland in 1883, Eeynier (1884), Crova and Garbe (1885), Tchelltzow (1886), Heim and Kohlrausch (1889), Ayrton, &c., with Robertson (1890), Dolezalek (1897), and Mugdan (1899). Notwithstanding this body of evidence it has been objected to, chiefly on the ground that sulphate of lead is a white substance and is difficult to reduce to lead, whereas the substance formed in a cell is not white and is easy to reduce. But Gladstone and Tribe (and afterwards Swin- burne) showed in 1883 that sulphate was easy enough to reduce when mixed with other substances like peroxide, or lead itself, which is just the condition in which it occurs in all normal woi’king of the cells. Darrious suggests that sulphate is formed only on the negative plate, oxide of lead on the positive, and that the spongy lead is in an allotropic condition, which helps to give a higher e.m.p. This theory is contrary to the results obtained by the numerous experimenters already mentioned. Mugdan has es- pecially shown that oxide cannot be detected on the positive plate.

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It is doubtful if the experiment in favour of an allotropic condition of th^ lead can be confirmed. The body of evidence in favour of the formation of sulphate on both plates is exceedingly strong — in fact, decisive. Figs. ~~31 and 32 embody a complete series of chemi~~ cal and physical observations ; many of the preceding statements are illustrated by these curves and can be tested by their relation- ships. The current was stopped at the points marked A, B, C, D, to

take active material for analysis ; and the rise of b.m.f. in dis- charge, and fall in charge, during this short interval is noteworthy.

(2) Plants attributed the high charging e.m.f. to hydrogen dioxide, and similar oxygenized bodies. Gladstone and Tribe thought that occluded hydrogen and oxygen gases, though ver small in quantity, might account for it. Robertson thought that the oxygenized bodies arising from persulphuric acid might raise

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or lower the e.m.f. according to their exact position in a cell. If, however, these substances are added to a cell (without changing the acid strength) they do not produce a change at all comparable

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34

ACCUMULATOES

with that here dealt with, and there is no positive evidence that they will do what is required by the theory. The only known change which has been shown to be competent to aSeot the e.m.f. to this degree is the change which may locally and temporarily occur in the strength of the acid.i

(3) There are two explanations of the rapid fall at the end of discharge. The one already given ascribes the fall to a weakening of the acid in the spongy masses. This has already been considered and need not be further elaborated. The other explanation was first given by Plantfe, and adopted by Gladstone and Tribe, and afterwards by Robertson. All these workers observed that, at the end of a discharge, patches or small films of peroxide of lead were formed on the surface of tha lead plate. Such films speedily tend to annul the e.m.f. and bring the current to zero. Which of these two hypotheses (both representing actual facts and both competent to produce the change under consideration) contributes most to the result is a difficult question. But if a careful com- parison be made of the time at which peroxide appears on the negative, with the fall of e.m.f., it will be seen that the fall begins before the films can be detected with certainty. Thus (in Fig. 32) Robertson could not be sure of peroxide on the negative at the point C, although the fall had fairly begun at that time.

(4) The explanation of the rapid recuperation after discharge is that the cause of the rapid fall has ceased and that the conditions existing before it are now re-established. If the discharge fall be ascribed to peroxide films on the negative, then on stopping the discharge the films are destroyed by local action, and the e.m.f. is restored. If the fall be due to exhaustion of acid, then stopping the current allows acid to diffuse into the pores almost instantly, and so restores the e.m.f. If the discharge has not been carried too far, this is most probably the true cause. If the potential difierence is below 1-8 volt, both actions take place.

(5) As to the effect of repose on a charged cell, Gladstone and Tribe’s experiments showed that peroxide of lead lying on its lead support suffered from a local action, which reduced one molecule of Pb02 to sulphate at the same time that an atom of the grid ■below it was also changed to sulphate. There is thus not only a loss of the available peroxide, but a corrosion of the grid or plate. It is through this action that the supports gradualb’ give way. On the negative plate an action arises between the finely- divided lead and the sulphuric acid, with the result that hydrogen is set free.

Pb -F H2SO4 = PbSOi ₣ Hz.

This involves a diminution of available spongy lead, or loss of capacity, occasionally with serious consequences. The capacity of the lead plate is reduced absolutely, of course, but its relative value is more seriously affected. In the discharge it gets sulphated too much, because the better positive keeps up the e.m.f. too long. In the succeeding charge, the positive is fully charged before the liegative, and the differences between them tend to increase in each cycle.

(6) Kelvin and Helmholtz have shown that the e.m.f. of a voltaic cell can be calculated from the energy developed by the chemical action. Por a dyad gram equivalent (=2 grams of hydrogen, 207 grams of lead, &c.), the equation connecting them is

46000 c?T where E is the e.m.f. in volts, H is the heat developed by a dyad equivalent of the reacting substances, T is the absolute tempera- ture, and — is the temperature coefficient of the e.m.f. If the

‘ dT ,

E.M.F. does not change with temperature, the second term is zersT The thermal values for the various substances formed and de- composed are :— For PbOa, 62400 ; for PbSOi, 216210 ; for H2SO4, 192920; and for H2O, 68400 calores. Writing the equation in its simplest form for strong acid, and ignoring the temperature coefficient term,

PbOa +2H2S04-FPb=2PbS04 + 2H2O

-62440-385840 -1-432420-1-136720

leaving a balance of 120860 calories. Dividing by 46000 gives 2-627 volts. The experimental value in strong acid, according to Gladstone and Hibbert, is 2-607 volts, a very close approximation. For other strengths of acid, the energy will be less by the quantity evolved when the acid is diluted. The dotted curve in Fig. 11 indicates the calculated e.m.f. at various points when this is taken Into account. The difference between it and the continuous curve must, if the chemical theory be correct, depend on the second term in the equation. The figure shows that the observed e.m.f. is above the theoretical for all strengths from 100 down to 5 per cent. Below 5 the position is reversed. The question remains, Can the temperature coefficient be obtained ? This is difficult, because the

value is so small and it is not easy to secure a good cycle of obser- vations. Streintz has given the following values :—

E dE,

dT

1-9223 10′ 140

1-9828 228

2-0031 335

2-0084 285

2-0105 255

2-078 130

2-2070 73

1 Gladstone and Hibbert, PAii. Mag. 1890; Jour. Inst. Elec. Eng. 1892. Dolezalek, Ann. Phya- Ghem. 1898. Mugdan, EleJct. ZeiUehrift,

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These figures illustrate the difficulty of getting good determma- tions • it is quite improbable that cells so nearly alike as those giving 2-003 and 2-008 volts should have temperature coefficients diffenng by 16 per cent. Unpublished experiments by the writer

give ^-106=350 for acid of density'l-156. With stronger acid, a

dT true cycle could not be obtained. Taking Streintz's value, 335 for

25 per cent, acid, the second term of the equation is T— =290x

-000335=0-0971 volt. The first term gives 88800 oalories= 1-9304 volt. Adding the second term, 1-9304-1-0-0971=2-0275 volts. The observed value is 2-030 volts (see Fig. 11 and table 2), a remark- ably good agreement. This calculation and the general relation shown in Fig. 11 render it highly probaWe that, if the temperature coefficient were known for all strengths of acid, the result would be equally good. It is worth observing that the reversal of relation- ship between the observed and calculated curves, which takes place at 5 or 6 per cent., suggests that the chemistry must be on the point of altering as the acid gets weak, a conclusion which has been already arrived at on purely chemical grounds. The thermo- dynamical relations are thus seen to confirm very strongly the chemical and physical analyses. ^

As the efficiency of accumulators is not generally- higher .than 75 per cent., and machines must be used to charge them, it is not directly economical to use ^„„„„„. cells alone for public supply. Yet they play an lators in important and an increasing part in public work, central because they help to maintain a constant voltage stations. on the mains, and can be used to distribute the load on the running machinery, over a much greater fraction of the day. Used in parallel with the dynamo, they quickly yield current when the load increases, and immediately begin to charge when the load diminishes, thus largely reducing the fluctuating stress on dynamo and engine for sudden variations in load. Their use is advantageous if they can be charged and discharged at a time when the steam plant would otherwise be working at an uneconomi- cal load.

Regulation of the potential difference is managed in various ways. More cells may be thrown in as the dis- charge proceeds, and taken out during charge ; but this method often leads to trouble, as some cells get unduly discharged, and the unity of the* battery is disturbed. Sometimes the number of cells is kept fixed for supply, but the p.D. they put on the mains is reduced during charge by employing regulating cells in opposition. The working cells are then all kept in similar condition. But these methods are now being dir-carded. The number of cells is now fixed and the battery joined to the mains. The heaviest part of the load is shared by battery and dynamo, and after the evening's discharge the dynamo may charge the cells. But they must be charged to a higher potential difference than that kept on the mains, otherwise they cannot be said to be brought back to good condition. This may be done by disconnecting the battery and charging from a dynamo which gives the requisite higher e.m.f. ; or it may be done (and this is usual) by taking the current from the mains to the battery through a " booster," that is, a dynamo arranged so that its e.m.f. is added to that of the mains. The

power requisite for driving its armature may be obtained from any convenient source, but it is most usual to couple the armature to the shaft of a motor driven from the mains.

There are certain disadvantages in carrying accumulators

2 For the discussion of later electrolytic theories as applied to accumulators, see Electro-chemistry by Le Blanc ; also an article by Hoppe, Elektroteeh. Bunds. 1898.

on tramcgis. The cells add largely to tlie weight of the _^ car ; there is much expense in handling, owing

“^*’ to the substitution of charged for discharged cells every few hours; and there is a very rapid deterio- ration of the plates, consequent upon shaking and the heavy starting currents. For these reasons the use of – cells on the cars has not generally been a commercial success, though at the present time a few lines are being run. The following table gives some particulars of two systems worked by ” chloride ” cells : —

Items.

Birminghun.

Paris.

Weight of battery in pounds Average discharge in amperes during run Maximum discharge during run . Length of run with one charge in miles

Speed in miles

No. of passengers carried .

6048

50 120-180

45

8 to 15

50

6615

35 100-120

37

8 to 15

60

At Birmingham some cells have completed 20,000 car miles before renewal was necessary. Cost of renewal per

car mile is approxi- mately If penny. But if the accumulators be used in the central or a sub-station, there are many advantages. In

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during the hollow. For work like this, the cells ought to have a low resistance, and it is desirable that the shunt-wound dynamo shall have a falling characteristic. Compound ~~wound boosters are sometimes xised to help the accumulators to share the load. Fig. 34 Is a diagram of the arrangement. The following data illustrate the way in which accumulators are employed in the station belong~~ ing to the Plymouth Corporation. Alternate current is used for lighting and continuous current for the tramway line. There are two combined sets; that is, engine, alternator, and tramway generator coupled on the same shaft. Other and larger alternators are in use during the ” peak ” of the load. In the combined sets the alternator and generator are each 100 kilowatt machines ; the Belliss engine is 150 b.h.p. The engine is therefore only large enough to drive either of the machines at full load, but can run both at any combination of load not greater than 100 k.w. total. The generator gives 535 volts, and is in parallel with 260 cells of the Tudor type. The cars begin to run at 7.30 a.m. The cells and one generator are in parallel, sharing the tramway load through the day, with results very similar to those shown in Fig. 33. The alternator on the same shaft supplies the small day lighting load. When the evening lighting load comes on, the direct current generators are uncoupled, the accumulators take the tramway work, and the total engine power is available for running the fully-loaded alternators. This continues till the cars stop at 11 o’clock, by which time the lighting load has gone down again. , The pressure of the cells has diminished from 520 to 475 volts. A generator is now coupled up and charges the accumulators from 11 p.m. to 2.30 or thereabouts ; a booster adding from 70 to 130 volts, as may be required. The booster motor takes from 15 to 20 amperes at 530 volts, depending on the output from its dynamo. These arrange- ments give a well-distributed load and economical conditions of working for such machinery as is at any time runiBng, while the cells are a stand-by for exciting plant, &c.

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Fi6. 33.

a traction station, the load varies so rapidly that the plant is generally working at a low average load factor ; and the machinery must be capable of meeting the maximum demand, while the average load does not exceed one-half of the maximum. Now accumulators will take the peaks of the load, relieving the machinery from sudden jerks, and further allowing the running plant to be reduced to that which suffices for the average load. Some idea of the significance of this may be gained from Fig. 33.

The cells are in parallel with the generator. Eight cars were running. The thick line A shows the dynamo current, varying from 115 to 150 amperes. The line current varies from 0 to 375 amperes. It is evident that engine and generator are kept fiiliy loaded, the cells supplying the peaks and taking a charge

Fie. 34.

, The following books and papers may be consulted in addition to those already cited : —

Plants. BecherchessurV^lectriciti. Paris, 1879. — Gladstone and Tribe. Chemistry of Secondary Batteries. London, 1884. — Retnier. VAccumulateur Voltaique. Paris, 1888. — Heim. Die AkJcumulatoren. Berlin, 1889. — ^Hoppe. Die Akkumulatoren fur Elehtricitdt. Berlin, 1892. — Schoop. Handbuchfur Akkumulato- ren. Stuttgart, 1898. — ^Feankland. ” Chemistry of Storage Bat- teries,” JVoc. jSoj/. iSoc. 1883.— Retniee. ” Essai sur la Th^orie Chimique des Accumulateurs,” Jour. Sac. Fran!}, d. Phys. 1884. — Heim. ” TJ. d. Einfluss der Sauredichte auf die Kapazitat der

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Acetylene, klumene or ethine, is one of the gaseous compounds of hydrogen and carbon, and on analysis is found to contain —

Carbon Hydrogen

92-3

7-7

100-0

The molecule is represented by the formula CzHj. It is a clear, colourless’ gas, having a density of 0-92. When prepared by the action of water upon calcium carbide, it has a very strong and penetrating ‘^^^es. odour, but when it is thoroughly purified from sulphuretted and phosphuretted hydrogen, which are in- variably present with it in minute traces, this extremely

pungent odour disappears, and the pure gas has a not unpleasant etherial smell. It can be condensed into the

liquid state by cold or by pressure, and experi- tion.”’”’’ inents by Ansell show that if the gas be

subjected to a pressure of 21-63 atmospheres at a temperature of 0° C, it is converted into the liquid state, the pressure needed increasing with the rise of temperature, and decreasing with the lowering of the temperature, until at — 82° C. it becomes liquid under ordinary atmospheric pressure. The critical point of the gas is 37° C, at which temperature a pressure of 68 atmospheres is required for liquefaction. A great future was expected from its use in the liquid state, since a cylinder fitted with the necessary reducing valves would supply the gas to light a house for a considerable period, the liquid occupying about ^^ the volume of the gas, but in the United States and on the Continent of Europe, where liquefied acetylene was made on the large scale, several fatal accidents occurred owing to its explosion under not easily explained conditions. As a result of

these accidents Berthelot and VioUe made a Bxpiosi- series of valuable researches upon the explosion uqu^d”’ °^ acetylene under various conditions. They acetylene, found that if liquid acetylene in a steel bottle

be heated at one point by a platinum wire raised to a ,red heat, the whole mass decomposes and gives rise to such tremendous pressures that no cylinder would be able to withstand them. These pressures varied from 71,000 to 100,000 lb per square inch. . They, more- over, tried the effect of shock upon the liquid, and found that the repeated dropping of the cylinder from a height of nearly 20 feet upon a large steel anvil gave no explo- sion, but that when the cylinder was crushed under a heavy blow the impact was followed, after a short inter- val of time, by an explosion which was manifestly due to the fracture of the cylinder and the ignition of the escaping gas, mixed with air, from sparks caused by the breaking of the metal. A similar explosion will frequently follow the breaking in the same way of

a cylinder charged with hydrogen at a high pressure. Con- tinuing these experiments, they found that iii acetylene gas under ordinary pressures the decomposition brought about in one portion of the gas, either by heat or the firing in it of a small detonator, did not spread far beyond the point at which the decomposition started, while if the acetylene was compressed to a pressure of more than 30 lb on the square inch, the decomposition travelled throughout the mass and became in reality detonation. These results showed clearly that liquefied acetylene was far too dangerous for general introduction for domestic purposes, since, although the occasions would be rare in which the requisite temperature to bring about detonation would be reached, still, if this point were attained, the results would be of a most disastrous characjser. The fact that several accidents had already happened accentuated the risk, and in Great Britain the storage and use of liquefied acetylene are prohibited.

When liquefied acetylene is allowed to escape from

the cylinder in which it was contained into ^“ivi ordinary atmospheric pressure, some of the

liquid assximes the gaseous condition with such rapidity as to cool the remainder below the temperar ture of — 90° C, and convert it into a solid snow-like mass.

Acetylene is readily soluble in water, which at normal

temperature and pressure takes up a little more Solubility than its own volume of the gas, and yields a “acefylene. Solution giving a purple-red precipitate with

ammoniaeal cuproiis chloride and a white pre- cipitate with silver nitrate, these precipitates consisting

of acetylides of the metals. The solubility of the gas in various liquids, as given by different observers, is—

100 Volumes of

Vo

lumos of Acetylene

Brine

absorb .

5

Wate’r

110

Alcohol

600

ParafBn

150

Carbon disulphlde

100

Fusel oil

100

Benzene

400

Chloroiorm

400

Acetic acid

600

Acetone

3100

It wUl be seen from this table that where it is desired to collect and keep acetjrlene over a liquid, brine, i.e., water saturated with salt, is the best for this purpose, but in practice it is found that, unless water is agitated with acetylene, or the gas bubbled through, the top layer soon gets saturated and the gas then dissolves but slowly. The great solubility of acetylene in acetone was pointed out by MM. Claude and Hess, who suggested charging acetone with the gas under pressure, ^^^„g^ a litre of acetone dissolving 360 times its own, volume of the gas under a pressure of 12 atmospheres. When the pressure is relieved the gas again escapes, and it was thought that in this way a better method of stor- ing the gas would be provided by liquefaction. Experi- ment, however, has shown that acetone thus saturated under pressure shares many of the disadvantages of liquid acetylene itself.

When acetylene was first introduced on a commercial scale grave fears were entertained as to its safety, it being represented that it had the power of com-‘ bining with certain metals, more especially Explosive copper and silver, to form acetylides of a highly ^^°””* explosive character, and that even with coal gas, metals. which contains less than 1 per cent., such copper compounds had been knovm to be formed in cases where the gas distributing mains were composed of copper, and that accidents had happened from this cause. It was therefore predicted that the introduction of acetylene on a large scale would be followed by numerous accidents unless copper and its alloys were rigidly excluded from contact with the gas. These fears have, however, fortu- nately proved to be unfounded, and ordinary gas fittings can be used with perfect safety with this gas.

Acetylene was at one time supposed to be a highly

poisonous gas, the researches of Bistrow and

Liebreich having apparently shown that it acts f”’“^?”? ii. T.1 – J • J.-U ^ properties,

upon the blood m the same way as carbon

monoxide to form a stable compound. Very extensive experiments, however, made by Drs Grehant, Brociner, Malooz, Crismer, and others, all conclusively show that acetylene is much less toxic than carbon monoxide and indeed than coal gas.

Acetylene has the property of inflaming spontaneously when brought in contact with chlorine. If a few pieces of carbide be dropped into saturated a^/^^' chlorine water the bubbles of gas take fire as they reach the surface, and if a jet of acetylene be passed up into a bottle of chlorine it takes fire and burns with a heavy red fiame, depositing its carbon in the form of soot. If chlorine be bubbled up into a jar of acetylene standing over water, a violent explosion, attended with a flash of intense light and the deposition of carbon, at once takes place. When the gas is kept in a small glass holder exposed to direct sunlight, the surface of the glass soon becomes dimmed, and Bone has shown that when exposed" for some time to the sun's rays it undergoes certain polymerization changes which lead to the deposition of a film of heavy hydrocarbons on the surface of the tube.

Detona- tion.

It has also been observed by Cailletet and later by Villard that when allowed to stand in the presence of water at a low temperature a solid hydrate is formed. Acetylene is readily decomposed by heat, polymerizing under Acetylene its influence to form an enormous number of ling-point' In ^^^^^^^ compouflds; indeed the gas, which can synthesis, itself be directly prepared from its constituents, carbon and hydrogen, under the influence of the electric arc, can be made the starting-point for the

con- struction of an enormous number of different organic compounds of a complex character. In contact with nas- cent hydrogen it builds up ethylene ; ethylene acted upon by sulphuric acid yields sulphovinic acid ; this can again be decomposed in the presence of water to yield alcohol, and it has also been proposed to manufacture sugar from this remarkable body. Picric acid can also be ob- tained from it by first treating acetylene with sulphuric acid, converting the product into phenol by solution in potash, and then treating the phenol with fuming nitric acid. Acetylene is one of those bodies the formation of which is attended with the disappearance of heat, and it is for this reason termed an ” endothermie ” compound, in contra-distinction to those bodies which evolve heat in their formation, and which are called ” exothermic.” Such endothermie bodies are nearly al- ways found to show considerable violence in their decom- position as the heat of formation stored up within them is then liberated as sensible heat, and it is undoubtedly this property of acetylene gas which leads to its easy detonation by either heat or a shock from an explosion of fulminating mercury when in contact with it under press- ure. The observation that afeetylene can be resolved into its constituents by detonation is due to Berthelot, who started an explosive wave in it by firing a charge of 0-1 gram of mercury fulminate. It has since been shown, however, that unless the gas is at a pressure of more than two atmospheres this wave soon dies out, and the decom- position is only propagated a few inches from the detona- tor. Heated in contact with air to a temperature of 480° C. acetylene ignites and burns with a flame, ‘mint” *^® appearance of which varies with the way in which it is brought in contact with the air. With the gas in excess a heavy lurid flame emitting dense volumes of smoke results, whilst if it be driven out in a sufficiently thin sheet, it burns with a flame of intense brilliancy and almost perfect whiteness, by the light of which colours can be judged as well as they can by day- light. Having its ignition point below that of ordinary gas, it can be ignited by any red-hot carbonaceous matter, such as the brightly glowing end of a cigar. For its complete combustion a volume of acetylene needs approximately twelve volumes of air, forming as products of combustion carbon di- oxide and water vapour. When, however, the air is pre- sent in much smaller ratio the combustion is incomplete, and carbon, carbon monoxide, carbon dioxide, hydrogen, and water vapour are produced. This is well shown by taking a cylinder one-half full of acetylene and one-half of air ; on applying a, light to the mixture a lurid flame runs down the cylinder and a cloud of soot is thrown up, the cylinder also being thickly coated with it, and often containing a ball of carbon. If now, after a few mo- ments’ interval to allow some air to diffuse into the cylin- der, a taper again be applied, an explosion takes place, due to a mixture of carbon monoxide and air. It is probable that when a flame is smoking badly, distinct traces of carbon monoxide are being produced, but when an acetylene flame bums properly the products are as harmless as those of coal gas, and, light for light, less in amount. Mixed with air, like every other combustible

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gas, acetylene forms an explosive mixture. Clowes has shown that it has a wider range of explosive proportions when mixed with air than any of fi*P’o«’»‘e the other combustible gases, the limiting per- *” * ””*” centages being as follows : —

Acetylene Hydrogen Carbon monoxide Ethylene Methane

3 to 82 5 to 72

13 to 75

4 to 22

5 to 13

The methods which can be and have been employed from time to time for the formation of acetylene in small quantities are exceedingly numerous. Methods ot Before the commercial production of calcium ti^a”” carbide made it one of the most easily obtain- able gases, the processes which were most largely adopted for its preparation in laboratories were : — first, the decom- position of ethylene bromide by dropping it slowly into a boiling solution of alcoholic potash, and purifying the evolved gas from the volatile bromethylene by washing it through a second flask containing a boiling solution of alcoholic potash, or by passing it over moderately heated soda lime; and, second, the more ordinarily adopted process of passing the products of incomplete combustion from a Bunsen burner, the flame of which had struck back, through an ammoniacal solution of cuprous chloride, when the red acetylide of copper was produced. This on being washed and decomposed with hydrochloric acid yielded a stream of acetylene gas. This second method of production has the great drawback that, unless proper precautions are taken to purify the gas obtained from the copper acetylide, it is always contaminated with certain chlorine derivatives of acetylene. Edmund Davy first made acetylene in 1836 from a compound produced during the manufacture of potassium from potassium tartrate and charcoal, which under certain conditions yielded a black compound decomposed by water with considerable violence and the evolution of acetylene. This compound was afterwards fully investigated by Berzelius, who showed it to be carbide of potassium. He also made the corre- sponding sodium compound and showed that it evolved the same gas, whilst in 1862 Wohler first made carbide of Calcium, and found that water decomposed it into lime and acetylene. It was not, however, until 1892 that the almost simultaneous discovery was made by Willson in America and Moissan in France that if lime and carbon be fused together at the temperature of the electric fur- nace, the lime is reduced to calcium, which unites with the excess of carbon present to form calcium carbide. The cheap production of this material and the easy lib- eration by its aid of acetylene at once gave the gas a position of commercial importance. In the manufacture of calcium carbide in the electric furnace, lime and hard metallurgical coke of the highest pos- Manufac- sible degree of purity are employed. A good ^”,^4 working mixture of these materials may be carbide. taken as being 100 parts by weight of lime with 68 parts by weight of carbonaceous material. About 1-8 lb of this is used up for each pound of carbide pro- duced. The two principal processes utilized in making calcium carbide by electrical power are the ingot process and the tapping process. In the former, the coke and lime are finely ground and carefully mixed in the right proportions to suit the chemical actions involved. The arc is struck in a crucible into which the powdered mix- ture is allowed to flow, partially filling it. An ingot gradu- ally builds up from the bottom of the crucible, the car- bon electrode being raised from time to time automati- cally or by hand to suit the diminution of resistance due to the shortening 1 of the ard by the rising ingot; The”*-

crucible is of metal and considerably larger than the ingot, the latter being surrounded by a mass of unreduced material which protects the crucible from the intense heat. When the ingot has been made and the crucible is full, the latter is withdrawn and another substituted. The process is not continuous, but a change of crucibles only takes two or three minutes under the best condi- tions, “and only occurs every ten or fifteen hours. The essence of this process is that the coke and lime are only heated to the point of combination, and are not ” boiled ” after being formed. It is found that the ingot

of calcium carbide formed in the furnace, al- “““bu” t^oug^ itself consisting of pure crystalline

calcium carbide, is nearly always surrounded by a crust which contains a certain proportion of imper- fectly converted constituents, and therefore gives a lower yield of acetylene than the carbide itself. In breaking up and sending out the carbide for commercial work, packed in air-tight drums, the worst of

the crust is as far as possible picked out and rejected. A statement of the amount made per kilowatt hour may be misleading, since a certain amount of loss is of necessity entailed during this process. For instance, in practical working it has been found that a furnace return of 0-504 lb per kilowatt hour is brought down to 0-406 ft per kilowatt hour when the material has been broken up, sorted, and packed in air-tight drums. In the tapping process a fixed crucible

is used, lined with carbon, the electrode is l^f^g nearly as big as the crucible, and a much higher

current density is used. Tine grinding is un- necessary, as combination probably only takes place after fusion of the raw materials which mix more or less as liquids. The carbide is heated to complete liquefac- tion and tapped at short intervals. There is no unreduced material, and the process is considerably simplified, while less expensive plant is required. The run carbide, however, is never so rich as the ingot carbide, since an excess of lime is nearly always used in the mixture to act as a flux, and this remaining in the carbide lowers its gas-yielding power. Many attempts have been made to produce the substance without electricity, but have met with no commercial success.

Carbide of calcium, as formed in the electric furnace, is

a beautiful crystalline semi-metallic solid, hav- Properties jjjg ^ density of 2-22, and showing a fracture carWde.”’” “which is often shot with iridescent colours. It

can be kept unaltered in dry air, but the small- est trace of moisture in the atmosphere leads to the evolution of minute quantities of acetylene and gives it a distinctive odour. It is infusible at temperatures up to 2000° C, but can be fused in the electric arc. When heated to a temperature of 245° C. in a stream of chlorine gas it becomes incandescent, forming calcium chloride and liberating carbon, and it can also be made to burn in oxygen at a dull red heat, leaving behind a residue of calcium carbonate. Under the same conditions it becomes incandescent in the vapour of sulphur, yielding calcium sulphide and carbon disulphide; the vapour of phos- phorus will also unite with it at a red heat. It is a compound of

Calcium Carbon .

62-5 per cent,

37-5

100-0

Acted upon by water it is at once decomposed, yielding . acetylene and calcium hydrate. Pure crystal- b-om” liiie calcium carbide yields 6-8 cubic feet of calcium acetylene per pound at ordinary temperatures, carbUe. |j^^ ^j^g carbide as sold commercially, being a mixture of the pure crystalline material with the crust

which in the electric furnace surrounds the ingot, yields an average of 6 cubic feet of gas per pound imder proper conditions of generation. The volume of gas obtained, however, depends very la.rgely upon the form of apparatus used, and while some will give the full 6 cubic feet, other apparatus wiUonly yield, with the same carbide, 3f feet. The purity’ of the carbide entirely depends on the purity of the material used in its manu- facture, and before this fact had been fully grasped by manufacturers, and. only the purest material obtainable employed, it contained notable quantities of compounds which during its decomposition by water yielded a some- what high proportion of impurities in the acety- lene generated from it. . Although at the pre- *”’”’■«’««• sent time a marvellous improvement has taJien place all round in the quality of the carbide produced, the acety-

lene nearly always contains minute traces of hydrogen, ammonia, sulphuretted hydrogen, phosphuretted hydro- gen, sUiciuretted hydrogen, nitrogen, and oxygen, and sometimes minute traces of carbon monoxide and dioxide. The formation of hydrogen is caused by small traces of metallic calcium occasionally found free in the carbide, and cases have been known where this was present in such quantities that the evolved gas contained nearly 20 per cent, of hydrogen. This takes place when in the manufacture of the carbide the material is kept too long in contact with the arc, since this overheating causes the dissociation of some of the calcium carbide and the solu- tion of metallic calcium in the remainder. The presence of free hydrogen is nearly always accompanied by silici- uretted hydrogen formed by the combination of the nascent hydrogen with the silicon in the carbide. The ammonia found in the acetylene is due to the presence of magnesium nitride in the carbide. This is formed by the metallic magnesium in the molten condition taking up nitrogen from the air. On decomposition by water ammonia is produced by the action of steam or of nascent hydrogen on the nitride, the quantity formed depending very largely upon the temperature at which the carbide is decomposed. The formation of nitrides by actions of this kind and their easy conversion into ammonia, will probably at some no very distant date prove a useful method for fixing the nitrogen of the atmosphere and rendering it available for manurial purposes, although it could never compete in price with the ammonia formed in the destructive distillation of coal for coal gas. Sul- phuretted hydrogen, which is invariably present in com- mercial acetylene, is formed by the decomposition of aluminium sulphide. Murlot has shown that aluminium sulphide, zinc sulphide, and cadmium sulphide are the only sulphur compounds which can resist the heat of the electric furnace without decomposition or volatilization, and of these aluminium sulphide is the only one which is decomposed by water with the evolution of sulphuretted hydrogen. In the early samples of carbide this compound used to be present in considerable quantity, but now rarely more than J^ per cent, is to be found. Phosphuretted hydrogen, one of the most important impurities, which has been blamed for the haze formed by the combustion of acetylene under certain conditions, is produced by the action of water upon traces of calcium phosphide found in carbide. Although at first it was no uncommon thing to find a half per cent, of phosphuretted hydrogen present in the acetylene, this has now been so reduced by the use of pure materials that the average quantity is rarely above 0-15 per cent., and it is often not one-fifth of that amount.

In the generation of acetylene from calcium carbide and water, all that has to be done is to ofV^Ze bring these two compounds into contact,, when from car- they mutually react upon each other with the *’*■

formation of lime and acetylene, wMle, if there be suffi- cient water present, the lime combines with it to form calcium hydrate.

2.

Galclam carbide. Water. Acetylene. Lime. CaCa + H2O = C2H2 + CaO.

Ltoe. Water. Oalcium hydrate.

CaO + HaO = Ca(H0)2.

Geaera’ tors.

Every operation, no matter how simple it appears at first sight, is capable of being performed in several ways, and decomposition of the carbide by water may be brought about either by bringing the water slowly into contact with an excess of carbide, or by dropping the carbide into an excess of water, and these two main operations again may be varied by innumerable ingenious devices by which the rapidity of the contact may be modified or even eventually stopped. The result is that although the forms of apparatus utilized for this purpose are all based on the one fundamental principle of bringing about the contact of the carbide with the water which is to enter into double decomposition with it, they have been multi- plied in number to a very large extent by the methods employed in order to ensure control in working, and to get away from the dangers and inconveniences which are inseparable from a too rapid generation.

In attempting to classify acetylene generators some authorities have divided them into as many as six different classes, but this is hardly neces- sary, as they may be divided into two main classes : — first, those in which water is brought in contact with the carbide, the carbide being in excess during the first portion of the operation ; and, second, those in which the carbide is thrown into water, the amount of water present being always in excess. The first class may again be subdivided into generators in which the water rises in contact with the carbide, in which it drips upon the carbide, and in which a vessel full of carbide is lowered into water, and again withdrawn as generation becomes excessive. Some of these generators are constructed to make the gas only as fast as it is consumed at the burner, with the object of saving the expense and room which would be involved by a storage-holder. Generators with devices for regulating and stopping at will the action going on are generally termed ” automatic.” Another set merely aims at developing the gas from the carbide and putting it into a storage-holder with as little loss as pos- sible, and these are termed “non-automatic.” The points to be attained in a good generator are : —

1. Low temperature of generation.

2. Complete decomposition of the carbide.

3. Maximum evolution of the gas.

4. Low pressure in every part of the apparatus.

5. Base in charging and removal of residues.

6. Removal of all air from the apparatus before generation of the gas.

When carbide is acted upon by water considerable heat is evolved; indeed, the action develops about one- twentieth of the heat evolved by the combustion of car- bon. As, however, the temperature developed is a func- tion of the time needed to complete the action, the degree of heat attained varies with every form of generator, and while the water in one form may never reach the boiling-point, the carbide in another may become red-hot and give a temperature of over 800° C. Heating in a generator is not only a source of danger, but also lessens the yield of gas and deteriorates its quality. The best forms of generator are either those in which water rises slowly in contact with the carbide, or the second main division in which the carbide falls into excess of water.

It is clear that acetylene, if it is to be used on a large scale as a domestic illuminant, must undergo such pro-

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cesses of purification as will render it harmless and in- nocuous to health and property, and the sooner it is recognized as absolutely essential to purify acetylene before consuming it the sooner will the gas acquire the popularity it deserves. The only one of the impurities which offers any difficulty in removal is the' phosphuretted hydrogen. There are three substances which can be relied on more or less to remove this com- pound, and the gas to be purified may be passed either through acid copper salts, through bleaching powder, or through chromic acid. In experiments with these various bodies it is found that they are all of them effective in also ridding the acetylene of the ammonia and sulphu- retted hydrogen, provided only that the surface area pre- sented to the gas is sufficiently large. The method of washing the gas with acid solutions of copper has been patented by Herr A. Frank of Charlottenburg, who finds that a concentrated solution of cuprous chloride in an acid, the liquid being made into a paste with kieselgilhr, is the most effective. Where the production of acety- lene is .going on on a small scale this method of purifica- tion is undoubtedly the most convenient one, as the acid present absorbs the ammonia, and the copper salt con- verts the phosphuretted and sulphuretted hydrogen into phosphates and sulphides. The vessel, however, which contains this mixture has to be of earthenware, porce- lain, or enamelled iron on account of the free acid present; the gas must be washed after purification to remove traces of hydrochloric acid, and care must be taken to prevent the complete neutralization of the acid by the ammonia present in the gas. The second process is one patented by Dr Ullmann of Geneva, who utilizes chromic acid to oxidize the phosphuretted and sulphu- retted hydrogen and absorb the ammonia. The third process owes its inception to Lunge, who recommends the use of bleaching powder. Dr Wolff has found that when this is used on the large scale there is a risk of the ammonia present in the acetylene forming traces of chloride of nitrogen in the purifying boxes, and as this is a compound which detonates with considerable local force, it occasionally gives rise to explosions in the puri- fying apparatus. If, however, the gas be first passed through a scrubber so as to wash out the ammonia this danger is avoided. Dr Wolff employs purifiers in which the gas is washed with water containing calcium chloride, and then passed through bleaching powder solution or other oxidizing material.

When acetylene is burnt from a 000 union jet burner, at all ordinary pressures a smoky fiame is obtained, but on the pressure being increased to 4 inches a magnificent flame results, free from smoke, and developing an illumi- nating value of 240 candles per 5 cubic feet of gas con- sumed. Slightly higher values have been obtained, but 240 may be taken as the average value under these conditions. When acetylene was first introduced as a commercial illuminant in England, very small union jet nipples were utilized for its consumption, but after burning for a short time these nipples began to carbonize, iag%uver. the flame became distorted, and then smoking occurred with the formation of a heavy deposit of soot. While these troubles wpre being experienced in England, attempts had been made in America to use acetylene diluted with a certain proportion of air which permitted it to be burnt in ordinary flat flame nipples ; but the danger of such admixture being recognized, u™*”- nipples of the. same class as those used in England were employed, and the same troubles ensued. In France, single jets made of glass were first employed, and then Risener, Luchaire, Ragot, and others, made burners in which two jets of acetylene, coming from two tubes placed some little distance apart, impinged and splayed each other

out into a butterfly flame. Soon afterwards, Billwiller in- troduced the idea of sucking air into the flame at or just below the burner tip, and at this juncture the Naphey or Dolan burner was introduced in America, the principle employed being to use two small and widely separated jets instead of the two openings of the union jet burner, and to make each a minute Bunsen, the acetylene dragging in from the base of the nipple enough air to surround and protect it while burning from contact with the

stea- tite. This class of burner has been very successful, and its introduction, together with the realization of the im- portance of purifying the gas before combustion, has removed perhaps the most important obstacle to the use of this beautiful illuminant.

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(v. B. L.)

Achill Island, off the west coast of Ireland, part of the county of Mayo. Now under the control of the Congested Districts Board, who have made efforts to im- prove the condition of the people. There is now a station at Achill Sound, which is crossed by a swivel bridge opened in 1888. Populati'on, 4677.

Achin (Dutch Atjeh) and its dependencies form a gov- ernment of Northern Sumatra, extending from 2° 63′ N. on the W. coast to 4°32'l>r. on the E. coast. The area of Achin is estimated at 20,620 square miles. Since 1874 the valley of the Achin river has been subjugated by the Dutch. The restriction of export and import to Achin (1888) and further regulation of the ports (1892), the death of the traitor Tuku Umar, and the successful ex- peditions of General van Heutsz (1898-99) on both coasts and in the valley, have broken resistance and firmly estab- lished Dutch government. A scheme to' unite the coasts by a railway is under consideration. The administrative divisions are as follows — 1. Great Achin (the nine dis- tricts within and beyond the military posts) with Poeloe "Wai (isle) ; 2. dependencies (west coast, with the island of Simalu [Babi or Hog], north coast, east coast, and the southern settlements of Great Achin). Under the military and civil chief is a resident (for the regulation of shipping and Achin affairs), and under him again assistant-residents for the dependencies. Geographical knowledge of th« Achin valley, river, and coast has been considerably ad- vanced since 1874. In its upper part, near Selimun, the valley is 3 miles broad, the river having a breadth of 99 feet and a depth of 1^ feet ; but in its lower course, north of its junction with the Krung Daru, the valley broadens to 12^ miles. The marshy soil is covered by rice-fields, and on higher ground by Tcampongs full of trees. The river at its mouth is 327 feet broad and 20-33 feet deep, but before it lies a sandbank covered at low water by a depth of only 4 feet. The coasts are low and the rivers in- significant, rising in the coast ranges and flowing through the coast States (the chief of which are Pedir, Gighen, and Samalanga on the N., Edi, Perlak, and Langsar on the E., Kluwah, Eigas, and Melabuh on the W.). The chief ports are Olehleh, the port of Kotaraja or Achin (formerly Kraton, now the seat of the Dutch Government), Segli on the N., Edi on the E., and Analabu or Melabuh on the W., all visited by steamers of the Royal Packet Company.

The relief of the soil of Achin is imperfectly under- stood. With regard to the west coast, Resident van Lan- gen has spoken of the Barisan and other parallel ranges ■v^ich are characteristic of the island of Sumatra, and a

geological description of a small portion of the same coast has been given by the mining engineer Renaud, but the interior, possibly a continuation of the Batta plateau, is unexplored. The population of Achin in 1898 was es- timated at 636,432, of whom 328 were Europeans, 3933 Chinese, 30 Arabs, and 372 other foreign Asiatics. The natives of this commercial state are of very mixed origin (Hindu, Klings, Malay, Arab). They live in Tcampongs, collections of houses and gardens, which combine to form mukims or districts, which again combine to form sagis, of which there are three. The chief of a mukim is called an imeurri, of a sagi a panglima sagi. The people of the highlands {orang tunong)

differ in many respects from those of the lowlands {orang baroh). The means of subsist- ence are furnished by the culture of rice, betel (penang), tobacco, and pepper, but agriculture and stock-raising both declined during the war. The following industries are of some importance — gold-working, weapon-making, silk-weaving, the making of pottery, fishing and coasting trade. The value of the exports (chiefly pepper) has of late years been about £58,000, of the imports from £165,000 to £260,000.

Kruijt. Atjeh en de Atjehers. Leiden, 1877. — Van Langen. Atjeh's Wesskust, Tijdschrift Aardrijko. Genotktsch. Amsterdam, 1888, p. 226. — Renaud. Jaarboek van het Mynwezen. 1882. — Jacobs. Het famille-en Kampongleven op Qroot AtjeH. Leiden, 1894.— Snobck Hurgronje. De Atjehers. Batavia, 1894.

(c. M. K.)

Achinsk, a district town of Russia, East Siberia, government of Yeniseisk, 110 miles by rail W. of Kras- noyarsk, and on the Chulym river. It was founded in 1642, and remained quite insignificant till lately, when steamers began to ply on the Chulym to the gold mines. There are ~~tanneries and soap and candle works. Popu~~ lation (1860), 2601 ; (1897), 6714.

Achromatic Objectives. — The general equation for two lenses in contact and of negligible thicknesses is,

P == A(n – 1) + B(n' – 1),

where P is the power of the combined system, or the reciprocal of its focal length, A and B are the sums of the reciprocals of the radii of curvatures of the first and second lenses respectively, and n and n' are the indices of refraction of the materials of which these two lenses are made. It is obvious that in general the value of P varies with the refrangibility of light, i.e., with its wave-length. The mathematical condition which must obtain in order that the power shall be invariable is that the derivative of this equation shall vanish, or

^ = 0 = A-HB*L'. dn dn

Lenses, whether binary or multiple, subject to this con- dition and employed for the formation of real images are called achromatic objectives. These two equations would serve to determine the values of A and B, when P is assumed, and thus completely solve the problem in its elementary form, were it not unfortunately true that the

value of the coefficient -^ (called the dispersive ratio),

for all practicable materials is far from constant throughout the range of wave-lengths which are involved in optical images. Eor example, for the kinds of glass most generally employed for large telescopes, this quantity varies from 1-80 in the extreme red "to 2-20 in the extreme violet. The method of fixing upon the most advantageous value to substitute in the second equation was not obvious to the earlier opticians, even to those who produced some of the finest telescopes now in use ; but it is easily demonstrated that the value should be that which obtains for light of

maximum efficiency for the purpose to which it is to be applied. Thus, for visual use the value of y correspond- ing to a wave-length 1 of about 5600 is best, while for' photography with ordinary sensitive plates that for a wave-length of about 4300, a materially larger value, should be substituted.

The variability in the dispersive ratio for different regions of the spectrum gives rise to an imperfection in achromatic combinations, which, immaterial in small lenses, becomes of serious consequence in large tele- scopes and in spectroscopes. In astronomical telescopes the defect appears as a fringe of colour, properly violet, about bright objects; it also renders such instruments quite unavailable for photography. In spectroscopes it necessitates a continuous change in adjustment from one end of the spectrum to the other. As it constitutes the gravest error in the modern telescope, many efforts have been made during more than a century for its elimina- tion. A review of the success attained necessitates a consideration of other defects to which objectives are subject. These may be tabulated as follows : —

1. Chromatic differences of focal length, or secondary

colour.

2. Chromatic differences of spherical aberration.

3. Chromatic differences of magnification.

4. Zonal differences of magnification.

5. Images by reflections which illuminate the field. All of these are inherent in refracting objectives, and no maker, however skilful, is able wholly to eliminate them. The highest success in designing an objective is 'only attainable by a due regard to the relative importance of these errors, and an adjustment of them to the purpose to which the instrument is to be applied.

In the table of errors the first is that already con- sidered and shown to be dependent on the optical prop- erties of the materials employed ; 3 is not distinguishable from this except in cases where the members of the opti- cal system are separated, as in microscopes and camera objectives, and in some forms of telescope; 5, known as "ghosts" to opticians, is fixed as to number, but the positions of the images can be advantageously restricted. To explain the errors 2 and 4, especially important for our present purpose, another term must be first defined.

When a single lens is used for forming an image of a remote object, it is found that the power of the lens always increases continuously with the distance of the portion used from the axis; in other words, the foeal lengths of the concentric zones, into which the lens may be regarded as divided, continuously decrease with their diameters. This phenomenon, whose magnitude d.epends upon the shape as well as upon the power of the lens, is called spherical aberration. It is easy to see that it would be possible to combine a positive lens of such a shape as to yield a small degree of spherical aberration with a properly formed negative lens, even numerically less in power, so as to give a combination free froni aberration for light of a chosen refrangibility. An achromatic com- bination which meets this condition for remote sources of light is a telescope objective. If free from spherical aberration for yellow light it will still possess aberration for light of less refrangibility, while for shorter wave- lengths it will be over-corrected, or have negative aberra- tion. This property, given as 2 in the table, is quite negligible in telescope objectives constructed of ordinary materials, but in microscopic objectives of high ef&ciency it becomes by far the most serious error.

The error 4 is illustrated in the preceding paragraph as accompanying spherical aberration. In a combined system it may exi^t independently of such aberration,

and it is especially to be avoided in all instruments in which precision of images at even moderate distances from the axis is desired, such as meridian instruments, heliometers, and in all photographic objectives. The analytical condition for this end is that the sine of the angle of deviation of the light of each zone, in the pro- duction of an axial image, shall bear a constant ratio to the diameter of the zone.

The extent of secondary colour error (1 of the table) is pretty nearly independent of the kinds of glass em- ployed, provided that only silicic acid, soda, potash, lime, or oxide of lead enter into the composition of the materials. Fraunhofer seems to have experimented with boracic acid ‘ as a partial substitute for silica, but without satisfactory results. The experiments of, the eminent Jena glass-makers with phosphate crowns and borate flints are opti- cally highly successful, but unfortunately none of these materials is permanent. Recent experiments by the same makers with a very light flint and a dense crown are more promising, but the chromatic differences of spherical aber- ration are so great, even when the ratio of focal length to aperture is unduly increased over the customary value, that the gain for astronomical use is problematical. / Doubtless the Jena potash crown and a boro-silicate flint make the best binary combination for visual telescopes, although the crown has the great disadvantage of being strongly hygroscopic. A triple combination of ordinary crown and flint with a boro-silicate flint has been used with success, but the necessary increase of focal length, together with the fact that the number of harmful reflec- tions is increased from six, the number of the binary lens, to fifteen, renders the advantage in telescopes of large size questionable. A quadruple cemented combination of ordinary crown and flint with potash crown and boro- silicate flint, is practically perfect for small telescopes, and can be unhesitatingly recommended for spectrosco- pic use.

In microscope objectives the unrecognized error of chromatic differences of spherical aberration rendered all advance in the improvement of that important aid to scientific research nearly stationary for a third of a cen- tury, until Abbe made the brilliant discovery that it is pos- sible to eliminate it by a proper separation of the parts of the optical system. Very summarily stated, his method is this— a front, often quite complex in construction, strongly under-corrected for both colour and sphericity, is increased in power by ji back system over-corrected in both particulars to the requisite degree. The character of the image produced is found to vary greatly with the separation of the two systems, so that with successive trials a solution may ultimately be discovered in which the defect in question disappears. It is true that this process necessarily introduces the error 3 in a very marked degree, but this may be practically compensated, by employing an ocular with equivalent errors of an opposite sign.

The proper method of designing an objective, after find- ing the optical constants of the materials which are to be employed, is to deduce the values of A and B from the equations above, and then, assuming a ratio for the two radii of the first lens which experience has shown to ap- proximate to the form desired, find by successive trigo- nometrical computations (not neglecting thicknesses and separations) the remaining constants of construction which adjust the various errors to the best values for the purposes to which the objective .is to be applied. (c. s. h.)

Acid and Alkali Manufacture.— We com- prise under this heading the manufacture of the three great mineral acids (sulphuric, hydrochloric, and nitric), and that of the carbonate and hydrate of sodium, from which, however, the manufacture of chlorine and its com-

pounds cannot be entirely separated. The manufacture of acids and alkali, understood as above, is by far the most important of inorganic chemical industries, and occu- pies the great bulk of the capital and labour employed in that direction. It is, at the same time, the indispensable groundwork of all organic chemical industries, as well as of glass-making, paper-making, and many other branches of human activity. We can here give merely an outline of the progress made in these manufactures during the last twenty-five years, and of their actual state and their pros- pects for the immediate future.

Sulphuric Acid (comp. Ency. Brit. vol. xxii. p. 636).— Nearly all sulphuric acid, in its various states of dilution with water, is still made by the old ” lead-chamber pro- cess,” while all sulphuric^ anhydride, SO3, together with its solutions in sulphuric acid, known as fuming or Nord- hausen oil of vitriol, is now made by the ” contact process.” The last-named process is probably destined to supersede the lead-chamber process in the near future for the manu- facture of concentrated sulphuric acid, i.e., acid containing 92 per cent. H2SO4 and upwards. Acid, however, of less concentration (80 per cent, and below) has so far been made more advantageously by the old process, and this state of affairs will probably continue, at least until the respective patents have run out, especially since the large capital sunk in lead chambers is necessarily looking for some return, and is not likely to be abandoned without a determined struggle.

The first step is common to both processes, viz., the manufacture of more or less dilute sulphur dioxide from elementary sulphur, or from such sulphur compounds as readily act upon atmospheric oxygen with formation of sulphur dioxide (sulphurous anhydride, SO2). The ele- mentary sulphur is generally native brimstone, though in exceptional cases use is made of the sulphur recovered as a by-product in the manufacture of coal-gas, or from alkali waste, &c. The great bulk of the brimstone of commercp still comes from Sicily (comp. Eru:y. Brit. vol. xxii. p. 634) ; in comparison with this source of supply, the brimstone obtained in Japan and a few other localities plays but a very secondary part, and the great deposits of sulphur stated to exist in other localities, such as the southern states of North America, Mexico, Daghestan, &c., have not as yet been made available to any considerable extent. The production of sulphur dioxide from element- ary sulphur seems a very simple operation ; yet room has been left for many improvements made during the last decades by the introduction of continuously working burners, and by the utilization of the heat generated dur- ing the process. In most localities brimstone is too ex- pensive an agent for the manufacture of sulphuric acid ; in England it is used to a very limited extent for the manufacture of acid free from arsenic, and to a much larger extent in North America and Japan, but hardly at all in other countries. The great bulk of sulphuric acid is made by ” roasting ” metallic sulphides, principally pyrites and blende. Pyrites in the pure state, FeSj, occurs in many countries in large quantities ; most of that burned in the United Kingdom comes from Spain, and contains a small quantity of copper which is extracted from the residues (“cinders”). Spanish pyrites is also used in Germany, France, and America, together with the pyrites mined in those countries. Good pyrites contains from 48 to 50 per cent., and exceptionally good, 62 per cent, of sulphur, of which from 1 to 4 per cent, or upwards is left in the cinders. Blende, the most important of zinc ores, contains only about half as much sulphur, which is, more- over, burned off with much more difiiculty ; but as this has to be done in any case, in order to prepare the ore for the extraction of the metal, and as suitable apparatus

has been constructed for the purpose, very large quantities of sulphuric acid are now made from blende, especially in Germany and Belgium, and to some extent also in England and America.

The roasting of pyrites always takes place without using any extraneous fuel, the heat given off by the oxi- dation of the sulphur and the iron being quite sufficient to carry on the process. If the ore is in pieces of the size of a walnut or upwards, it is roasted in plain ” kilns ” or ” burners,” provided with a grating of suitable construc- tion for the removal of the cinders, with a side door in the upper

part for charging in the fresh ore on the top of the partially burned ore, and with an arch-shaped roof, from which the burner-gas is carried away in a flue common to a whole set of kilns. The latter are always set in a row of twelve or more, and are one after another charged once or twice a day at appropriate intervals, so that a regu- lar evolution of gas takes place all the day round. By employing suitable precautions, a gas of approximately uniform composition is obtained, containing from 6 to 8 per cent. SO2, with a little SOj, and about 12 per cent, of oxygen, which is more than sufficient for converting later all the SO2 into SO3 or H2SO4. The burning of ” smalls ” or ” dust ” was formerly considered much more difficult and incomplete than that of pieces, but this diffi- culty has been entirely overcome in various ways, prin- cipally by the ” shelf-burner,” originally constructed by Maletra, and by mechanical burners, which were formerly almost entirely confined to America, where the saving of labour is a primary consideration. Quite recently the Herreshoff mechanical burner (developed from a burner constructed many years ago by M’Dougal Bros., of Liver- pool) is making its way also in Europe. The roasting of blende is nothing like so easy as that of pyrites, since the heat developed by the oxidation of the zinc sulphide itself is not sufficient for carrying on the process, and ex- ternal heat must be applied. It is now usually performed by a series of muffles, superposed one over another, so that the whole forms a kind of shelf-burner, with internally heated shelves (the ” Ehemania ” furnace). This operation is both more costly and more delicate than the roasting of pyrites, but it is now perfectly well understood, and gas is obtained from blende furnaces hardly inferior in quality to that yielded by pyrites kilns. In America, and quite exceptionally also in Europe, mechanical furnaces are used for the roasting of blende.

Both kinds of gas, when issuing from the burner, hold in mechanical suspension a considerable quantity of ” flue- dust,” which must be removed as far as is practicable before the gas is subjected to further treatment. Flue- dust contains principally ferric oxide, zinc oxide, arsenious and sulphuric acids, and small quantities of the various metals occurring in the raw ore. All the thallium and selenium on the market is obtained from this source. Sometimes the burner-gas is employed directly for the sake of the SO2 which it contains, principally in the manufacture of ” sulphite cellulose ” from wood. If it is to be utilized for the manufacture of sulphuric acid, the practice up to the present has been, with few exceptions, to carry it into ” lead chambers ” (vitriol chambers), which are immense receptacles constructed of sheet-lead burned together without any solder and suitably supported out- side by wooden or iron framework. In these the sulphur dioxide acts upon the oxygen contained in the same gas, and upon water introduced as a spray or in the shape of steam, and the reaction S02-|-0+H20=H2S04 is brought about. As, however, this reaction of its own- accord takes place only to a vei-y small extent, an ” oxygen carrier ” is always introduced in the shape of the vapours of nitric acid or the lower oxides of nitrogen. By the play of

reactions induced in this way, practically the whole of the SO2 is ultimately converted into sulphuric acid, and at the same time the nitrogen oxides are always recov- ered with comparatively very slight losses and made to serve over again.

The reactions taking place in the vitriol chambers are very complicated, and have been explained in many dif- ferent ways. The view nc^ accepted by most chemists is that developed by Lunge, according to which there are two principal reactions succeeding each other, it may be in quite contiguous places, but under different con- ditions. Where the nitrous fumes prevail and there is less water present, sulphur dioxide combines with nitrous acid and oxygen to form nitroso-sulphuric acid, a crystalline substance of the formula S02(0N0). The reaction is therefore:— S024-0-|-NQ2H=S05NH. The solid substance is, however, only exceptionally met with, as it at once dissolves

in the mist of sul- phuric acid floating in the chamber, and forms ” nitrous vitriol.” Wherever this nitrous vitriol comes into contact with liquid water (not steam), which is also present in the chamber in the shape of mist, and prac- tically as dilute sulphuric acid, it is decomposed intoi sulphuric ahd nitrous acid, thus: — S02(0N0) + .H20=H2S04-FN02H. The re-formed nitrous acid, al- though not stable, any more than is its anhydride, K2O3, is nevertheless the “oxygen carrier” in question, as the products of its spontaneous decomposition, when meeting with other compounds, always react like nitrous acid itself and thus may transfer an indefinite quantity of oxygen to the corresponding quantities of SO2 and H2O, with the corresponding formation of H2SO4. . This theory at once explains, among other things, why the acid formed in the vitriol chambers always contains an excess of water (the second of the above-quoted reactions requiring the “mass action” of this excess), and why the external cooling produced by the contact of the chamber sides with the air is of great importance (liquid water in the shape of a mist of dilute sulphuric acid being necessary for the process).

The commercial production of sulphuric acid impera^ tively requires that the nitrogen oxides (which originally were always introduced in the shape of nitric acid) should be available as long as possible, before being lost mechan- ically or by reduction to the inactive forms of nitrous oxide or elementary nitrogen. The first step towards securing this requirement was taken as early as 1827 by Gay-Lussac’, who discovered that the nitrous fumes, other- wise carried away from the lead chambers by the waste atmospheric nitrogen and oxygen, could be retained by bringing the gases into contact with moderately strong sulphuric acid, the result being the formation of nitroso- sulphuric acid: 2H2S04+N203=2S02(OH)(ONO)-|-H20, and the latter remaining dissolved in sulphuric acid as ” nitrous vitriol.” But this important invention was of little use until John Glover, about 1866, found that the nitrous vitriol could be most easily reintroduced into the process by subjecting it to the action of burner-gas, before this enters into the lead chambers, preferably after diluting it with chamber acid, that is, acid of from 65 to 70 per cent., H2SO4, as formed in the lead chambers. The reaction is then: 2S02(OHX01

again for absorbing nitrous vapours or any other purpose desired. Since that time, in every properly appointed sulphuric acid manufactory, the following cycle of opera- tions is carried out. To begin with, in the burners pyrites (or, .as the case may be, brimstone or blende) is made to yield hot burner-gas, containing about 7 per cent, (in the case of brimstone 10 or 11 per cent.) of SO2. This, after having been deprived of most of the flue-dust, is passed through the “Glover tower,” i.e., an upright cylindrical or square tower, consisting of a leaden shell lined with heat- and acid-proof stone or brick, and loosely filled or ” packed ” with the same material, over which a mixture of acid from the Gay-Lussac tower and from the chambers trickles down in such proportions that it arrives at the bottom as denitrated acid of from 78 to 80 per cent. The gases then pass on to the ” chambers,” struc- tures of lead, generally about 20 feet wide, 18 feet high, and 100 or 160 feet long. Several such chambers are usually combined to a ” set,” with a cubic capacity of as much as 150,000 cubic feet or even more. Here the gases meet with more nitrous vapours, and with steam, or with water, converted into a fine dust or spray. Here the reactions sketched above take place, so that ” chamber- acid ” as already described is formed, while a mixture of gases escapes containing all the atmospheric nitrogen, some oxygen in excess, about 0-5 per cent, of the total SO2, and some oxides of nitrogen. This gas is now passed through the Gay-Lussac tower, which somewhat resembles the Glover tower, but is usually filled with coke, over which sulphuric acid of about 80 per cent., H2SO4, trickles down in sufficient quantity to retain the nitrous vapours. Ultimately the waste gas is drawn off by a chimney, or sometimes by mechanical means.

Of course a great many special improvements have been made in the plant and the working of chamber systems; of these we mention only some of the most important. By judiciously watching all stages of the process, by observing the draught, the strength of the acid produced, the temperature, and especially by fre- quent analyses of the gases, the yield of acid has been brought up to 98 per cent, of the theoretical maximum, with a loss of nitre sometimes as low as two parts to 100 of sulphur burned. The supply of the nitric acid required to make up this loss is obtained in England by “potting,” that is, by decomposing solid nitrate of soda by sulphuric acid in a flue between the pyrites burners and the chambers. On the Continent makers generally prefer to employ liquid nitric acid, which is run through the Glover tower together with the nitrous vitriol. Although this method appears more troublesome, it allows the amount of nitre to be more easily and more accurately regulated. The size of the Glover towers, and more especially that of the Gay- Lussac towers, has been progressively increased, a,nd thereby the cube of the lead chambers themselves has been diminished to a much greater extent. By improved ” packing,” the towers have been rendered more durable, and in the case of the Gay-Lussac tower, the loss of nitre has been diminished by avoiding the use of a coke pack-ing, which acts upon that substance as a reducing agent. Many atteliipts have been made to reduce the chamber space by apparatus intended to bring about a .better mixture of the gases, and to facilitate the interaction of the misty particles of nitrous vitriol and dilute acid float- ing in the chamber with each other, and with the chamber atmosphere. The earliest really successful, and still the most generally applied apparatus of this kind, is the Lunge^Eohrmann ” plate columns ” or ” reaction towers ” placed between the chambers, but though this and similar apparatus has proved to be very useful in the later stages of the process, it has not been found practicable to do

away witli the lead chambers entirely. The pumping of the acids up to the top of the towers is now always per- formed by means of compressed air, either in the old ” acid eggs,” or more economically in ” pulsometers.”

Most of the sulphuric acid manufactured is not required to be of higher strength than is furnished by the vitriol chambers, either directly (65 to 70 per cent.), or after a passage through the Glover tower (78 to 80 per cent.). This, for instance, holds good of the acid employed in the manufacture of sulphate of soda and hydrochloric acid from common salt, and in the manufacture of superphosphates. But for many purposes more highly concentrated acid is required. Until quite recently all such acid was made by boiling down the dilute acid, for which purpose a great variety of apparatus has been invented. The first question is always that of material. Lead can be used for the purpose only when the boiling-point of the acid is reduced by means of a vacuum — a plan which has not met with much success. Formerly glass vessels were generally employed and they still survive in England, but elsewhere they are not much used. Porcelain, enamelled iron, for high concentrations even cast-iron without any protection, are also in use. On the Continent platinum vessels have been for a long time almost universal, and they have been recently greatly improved by an internal lining of gold. The second consideration is the form of the vessels ; these may be open pans or dishes, or closed retorts, or combinar tions of both. We also note the Faure and Kessler apparatus, which consists of a platinum pan, surmounted by a double-walled leaden hood, in such a manner that, while the hood is constantly cooled from the outside by water, the thin acid condensing on its inside is carried away without being allowed to flow back into the pan. The majority of acid makers, however, prefer retorts made entirely of platinum, preferably provided by the Heraeus process with a dense, closely adherent coating of gold, including the top or ” dome.” The new Kessler furnace is a very ingenious apparatus, in which the fire from a gas-producer travels over the sulphuric acid contained in a trough made of Vol vie lava, and surmounted by a number of perforated plates, over which fresh acid is constantly running down; the temperature is kept down by the pro- duction of a partial vacuum, which greatly promotes the volatilization of the water, whilst retarding that of the acid. This furnace is also very well adapted for impure acids, unsuitable for platinum or platinum-gold stills on account of the crusts forming at the bottom of the retorts ; and it is more and more coming into use both in Great Britain and on the Continent. A third consideration is the condensation of the vapours formed in the concentrating process; the further the concentration proceeds the more sulphuric acid they contain. Condensation is a comparatively easy task in the case of platinum appa- ratus, but with glass or porcelain beakers or retorts it presents great difficulties. In this respect the Kessler furnace has also proved to be very efficacious. The highest strength practically attainable by boiling down is 98 per cent. H_2SO_4, and this is only exceptibnally reached, since it involves much expenditure of fuel, loss of acid, and wear and tear of apparatus. The usual strength of the O.V. of commerce, mostly designated by its specific gravity as 168° Twaddell, is from 93 to 95, or at most 96 per cent. H_2SO_4. When attempts are made to push the process beyond 98 per cent., it is found that the acid which distils over is as strong as that which remains behind. Eeal ” monohydrate ” or acid approaching 100 per cent, can be made by Lunge’s process of cooling strong O.V. down to —16° C. when H_2SO_4 crystallizes out, or by the ‘addition of anhydrous SO_3 in the shape of fuming acid.

Fuming or Nordhausen oil of vitriol, a mixture or

chemical compound of H_2SO_4 with more or less SO_3, has been made for centuries by exposing pyritic schist to the influence of atmospheric agents, collecting the solution of ferrous and ferric sulpha,te thus formed, boiling it down into a hard mass (” vitriolstein “) and heating this to a low red heat in small earthenware retorts. Since about 1800 this industry has been confined to the north- west of Bohemia, and it survived just till 1900, when it was entirely abandoned — not because its product had become any less necessary, but, quite on the contrary, because the enormously increasing demand for fuming sulphuric acid, arising through the discovery of artificial alizarine and other coal-tar colours, could not possibly be supplied by the clumsy Bohemian process. Other sources of supply had accordingly to be sought, and they were found by going back to a reaction known since the first quarter of the 19th century, when Doebereiner dis- covered the combination of SO_2 and 0 into SO_3 by means of spongy platinum. This reaction, now known by the name of the catalytic or contact

process, was made the subject of a patent by Philips, in 1831, and was tried later in many ways, but had been always considered as useless for practical purposes until 1875, when it was simultaneously and independently taken up by Clemens Winkler in Freiberg, and by Squire and Messel in Lon- don. Both ~~these inventors began in the same way, viz., by decomposing ordinary'sulphuric acid by a high tem~~ perature into SO2, 0, and H2O (the last of course being in the shape of steam), absorbing the water by sulphuric acid, and causing, the SO2 and 0 to combine to SO3 by means of moderately heated platinum in a fine state of division. Winkler showed that this division was best obtained by soaking asbestos with a solution of platinum chloride and reducing the platinum to the metallic state, and he described later a specially active /kind of "contact substance," prepared from platinum chloride at a low temperature. This revival of the synthetical production of SO3, at a period when this article had suddenly become of great importance, caused the greatest excitement among chemists and led to numerous attempts in the same direction, some of which were at once sufficiently successful to compete with the Bohemian process. It was soon found that the produc- tion of a mixture of SO2 and 0 from sulphuric acid, as above described, was both too troublesome and costly, and after a number of experiments in other directions inventors went back to the use of ordinary burner-gas from pyrites and sulphur burners. For a good many years the further development of this industry was sur- rounded by great mystery, but it is now known that a satisfactory solution of the difficulties existing in the above respect was attained in several places, for instance, at Freiberg and in London, by the labours of the original inventors. Professor Winkler and Dr Messel. These difficulties were mostly caused by the solid impurities contained in the burner-gases in the shape of fiue-dust, especially the arsenic, which after a short time rendered the contact substance inactive, in a manner not as yet entirely understood. Another difficulty arose from the fact that the reaction SOj-f 0 = 863 is reversible, the opposite reaction, S03=S02-|-0 setting in but little above the temperature required for the synthesis of SOs- As far as is known (so much secrecy having been observed) the best results obtained in various places, save one, did not exceed 67 per cent, of the theoretical quantity, the remaining 33 per cent, of SO2 having to be converted into sulphuric acid in the ordinary lead chambers. As is now known, the exception (undoubtedly the only one until 1899) was the process discovered as early as 1889 by Dr Knietsch, of the Badische Anilin-und-Soda-Fabrik, at Ludwigshafen, but kept strictly secret until 1899, when

the ijatents were published. The principal features of this invention are, first, a much more thorough purificar tion of the burner-gas than had been practised up to that time, both in a chemical and a mechanical sense, and second, the prevention of superheating of the contact substance, which formerly always occurred by the heat generated in the process itself. As the Badische process effects this prevention by cooling the contact apparatus by means of the gaseous mixture to be later submitted to the catalytic action, the mixture is at the time heated up to the requisite temperature, and a considerable saving of fuel is, the consequence. Altogether' this process has been brought to such a pitch of simplicity and perfection, that it is cheap enough, not merely for the manufacture of fuming oil of vitriol of all strengths, but even for that of ordinary sulphuric acid of chamber-acid strength, while it is decidedly cheaper than the old process in the case of stronger acids, otherwise obtained by concentra- tion by fire. It should be noted that these are not the results of a few years' working with an experimental plant, but of many years' work with large plant, now equal to a capacity of 120,000 tons of pyrites per annum. It is therefore not too much to say that, in all probabil- ity, the contact process will ultimately be employed generally for concentrated acids. Still, for the reasons given in the beginning of this article, the revolution thus impending will require a certaia time for its accom- plishment. Since the Badische process has become known, several other new contact processes have

come into the field, in some of which ferric oxide is employed as contact substance, but we must refrain from describ- ing these in detail.

Hydrochloric Acid aaid Sulphate of Soda. — As long as the Leblanc process was paramount in alkali manufacture, the decomposition of sodium chloride (common salt) by sulphuric acid was in the first instance carried on for the purpose of obtaining sulphate of soda, commercially known as ” salt-cake.” Hydrochloric acid (muriatic acid) was a necessary by-product of the reaction : 2NaCl ¦ H2SO4 = ^“3^804 ¦ 2HC1, but in some cases it was altogether treated as a waste-product, which at the same time constituted a great nuisance. Generally it was more or less perfectly recovered, but only exceptionally was it utilized to the fullest possible extent. The technical progress of the manufacture of hydrochloric acid (comp. Ency. Brit. vol. V. p. 678, and vol. xxii. p. 243) Was promoted, to an ex- tent perhaps unique in the history of legislative efforts, by the passing of the Alkali Acts, in 1863, 1874, 1881, and 1892, owing to the exemplary way in which the duties as inspector under these Acts were carried out by the late Dr R. Angus Smith and his successors, who directed their efforts not merely to their primary duty of preventing nuisance, but quite as much to showing manufacturers how to make the most of the acid formerly wasted in one shape or another. Not merely Great Brit- ain but all mankind has been immensely benefited by the labours of the British alkali inspectors, which were of course supplemented by the work of technical men in all the countries concerned. The scientific and technical principles of the condensation of hydrochloric acid are now thoroughly well understood, and it is possible to recover nearly the whole of it in the state of strong commercial acid, containing from 32 to 36 per cent, of HCl, although probably the majority of the manufacturers are stiU content to obtain part of the acid in a much weaker state, merely to satisfy the requirements of the law prescribing the prevention of nuisance. The principles of the condensation, that is of converting the gaseous HCl given off during the decomposition of common salt into a strong solution of hydrogen chloride in water, can be sum- marized in a few words. The vapours of HCl, which are

always diluted with air, sometimes to a very great extent, must be brought into the most intimate contact possible with water, which greedily absorbs the gas, forming ordinary hydrochloric acid, and this process must be carried so far that scarcely any HCl remai^is in the escaping gases. The maximum escape allowed by the Alkali Acts, viz., 6 per cent, of the total HCl, is far above that which is now practically attained. For a proper utilization of this condensed acid it is nearly always im- perative that it should be as strong as possible, and this forms a second important consideration in the construction of the condensing apparatus. Since the. solubility of HCl in water decreases with the increase of the temperature, it is necessary to keep the latter down — a task which is rendered somewhat dif&cult both by the original heat retained by the gases on their escape from the decom- posing apparatus and by the heat given off through the reaction of HCl upon water.

Very different methods have been employed to effect all the above purposes. In Great Britain Gay-Lussac’s coke towers, adapted by Gossage to the condensation of hydrochloric acid, are still nearly everywhere in use, frequently combined with a number of stone tanks through which the gas from the furnaces travels before entering the towers, meeting on its way the acid con- densed in the tower. This process is excellent for effect- ing a complete condensation of the HCl as prescribed by the Alkali Acts, and for recovering the bulk of the acid in a tolerably strong state, but less so for recovering nearly the whole of it in the most concentrated state, although even this is occasionally attained. On the Continent, where the last-named requirement has been for a long time more urgent than in Great Britain, another system has been generally preferred, namely, passing the gas through a long series of stoneware receivers, and ulti- mately through a small tower packed with stoneware or coke, making the acid flow in the opposite direction to the gas. Great success has also been obtained by specially-constructed ” plate towers ” (already raentioned in connexion with their application to the manufacture of sulphuric acid), which allow both the coke towers and most of the stoneware receivers to be dispensed with.

Improvements in the construction of the condensing apparatus had to go hand in hand with those in the con- struction of the ” salt-cake furnaces ” for treating the common salt with sulphuric acid. The ordinary way of effecting this treatment is to carry out the first reaction in cast-iron pans or ” pots,” fired from below, and to com- plete it by applying a higher temperature in a ” roasting- furnaoe.” If the latter is constructed as a reverberatory furnace, where the HCl given off is mixed with the pro- ducts of the combustion of the fuel, the acid obtained during this part of the operation is necessarily weak. It is therefore altogether preferable to construct the roasting- furnace as a ” mufle,” heated only on the outside, although the expenditure of more fuel is thus involved. The drawback formerly caused by leakages of acid gases into the fire-flues through cracks in the muffte has been re- moved by the construction of ” plus-pressure furnaces.” Many and often very costly attempts have been made to construct mechanical salt-cake furnaces.. Of these Mactear’s furnaces have met with the greatest success, though this is limited by the fact that, apart from their great cost, they yield the hydrochloric acid in a weaker state than hand-wrought furnaces. For this reason they have been abandoned in some places, and are not likely to be generally introduced. The same holds good of the ” direct salt-cake process ” of Hargreaves and Robinson, in which salt is subjected to the action of burner-gases and steam at a low red heat, thus effecting the reaction :

2NaCl + SO2 + 0 + H2O = NaaS04 + 2HClj without the intervention of lead chambers. This process, which re- quires complicated and costly plant, has been most ingeniously elaborated by the inventors, and has been made a perfect success for the manufacture of very pure sulphate of soda, also for the complete condensation of the HCl, but the latter is less easily obtained in the strong state possible with muffle furnaces, owing to the dilution of the gas with nitrogen, &c. (comp. Ency. Brit. vol. xxii. p. 242).

The manufacture of sodium sulphate and hydrochloric acid has been put on an entirely different economical basis through several great changes in the alkali industry, which have checked the further expansion of the Leblanc process. This process, which formerly absorbed most of the salt-cake produced, is giving place more and more to the ammoniarsoda process, which starts directly from sodium chloride. Outside Great Britain the Leblanc process now plays a very subordinate part, and in Great Britain itself it wiU certainly not spread any farther and will probably ultimately succumb, although this may be in a somewhat remote future. The only other consider- able outlet for salt-cake is the manufacture of glass, which naturally cannot be indefinitely extended. These circumstances, by restricting both the quantity and stUl more the valu^ of the sodium sulphate, necessarily con- ferred a greater value upon the hydrochloric acid manu- iactured along with it ; and as this acid was until recently indispensable for the production of chlorine, the enhanced price of Meaching-powder and chlorate of potash for a time compensated the manufacturer for his loss on the salt-cake, and thus again reacted favourably on the eco- nomical aspect of the Leblanc process. Much more atten- tion is now devoted than formerly to the preparation of the hydrochloric acid in a strong state, and to processes intended to make it yield a greater amount of chlorine. The recent development of the electrolysis of the alkaline chlorides necessarily again decreases the value of the hydrochloric acid obtained in the manufacture of salt- cake, and must in the end lead to a further restriction in the production of the latter.

The Manufacture of ALkali. — The term “alkali” is usually applied to several sodium compounds, viz., the hydrate (caustic soda), the carbonate (sodarash), and the bicarbonate. The corresponding potassium compounds are almost exclusively made in Germany, from Stassfurt salts, and in France, from the “vinasse” of beet-root manufactures. The alkali manufacture in this sense is intimately

connected with the chlorine industry, and both have for a long time formed the most important of British chemical industries. In vol. xxii. p. 242 a description has been given of the two principal forms of the soda manufacture, viz., the Leblanc process and the ammonia- soda process. The Leblanc process was for a long time that by which nearly all alkali was made. During the last decade many improvements have been effected in all its stages, principally by the development of mechanical furnaces and by attention to details ; in this connexion Dr Hurter's name should be especially mentioned. Its greatest drawback, viz., the loss of the sulphur originally introduced into the process, and formerly only imperfectly .and at not sufficiently small cost recovered from the "tank-waste" by the processes of Mond and Schaffner, has been overcome by the Claus-Chance sulphur recovery process. This consists in decomposing the calcium sul- phide of the tank-waste, which had been previously re- duced to a thin watery paste, by means of impure carbonic acid in the shape of lime-kiln gas, and converting the resulting HjS either into sulphuric acid, or, preferably, into a very pure form of free sulphur. Thus 86 per cent.

of the sulphur is recovered in a much more valuable form than it originally possessed in the shape of pyrites, and the remaining 15 per cent, as well as the solid residue of the operation are at least rendered innocuous.

In spite of these great improvements the Leblanc pro- cess cannot economically compete with the ammonia-soda process, principally for two reasons. The sodium in the latter costs next to nothing, being obtained from natural or artificial brine in which the NaCl possesses an ex- tremely slight value. The fuel required is less than half the amount used in the Leblanc process. .Moreover, the process has been gradually elaborated into a very com- plicated and costly, but perfectly regularly working scheme, in which the cost of labour and the loss of ammonia are reduced to a minimum. The only way in which the Leblanc process could still hold its own was by being turned in the direction of making caustic soda, to which it lends itself more easily than the ammonia-soda process; but the latter has recently invaded even this field. One advantage, however, still remained to the Leblanc process. All endeavours to obtain either hydro- chloric acid or free chlorine in the ammoniarsoda process turned out economical failures, all the chlorine of the sodium chloride being ultimately lost in the shape of worthless calcium chloride. The Leblanc process thus remained the sole purveyor of chlorine in its active • shapes, and in this way the fact is accounted for that, at least in Great Britain, the Leblanc process still furnishes nearly half of all the alkali made, while in other countries its proportional share is very much less. The profit made upon the chlorine produced has to make up for the loss on the alkali.

But the position still held by the Leblanc process is seriously threatened by the development of the electrolytic decomposition of the alkaline chlorides, which has taken place principally since 1890. These processes possess some of the advantages of both the old processes. They start with the cheapest form of NaCl, viz., brine ; and they at once furnish the most valuable form of alkali, viz., caustic soda, and at the same time either free chlorine, or, directly, bleaching-liquor of 'chlorates. Up to a certain stage they require no fuel, except for the production of energy, which may be furnished by the cheapest kind of motors, — best of .^ all, by water-power. Only for the conversion of the strong solution of alkali obtained in the electrolytic cell into a solid form is some fuel indispensable. The great dif&- culties at first experienced with electrodes and diaphragms do not seem to exist any more ; and so far as the produc- tion of chlorine compounds is concerned, there seems to be nothing to stop the triumph of electrolysis over the old processes, which were described in vol. v. p. 678. We must not omit to notice that the electrolysis of sodium chloride and the manufacture of alkali in a commercial shape are decidedly more difficult than the corresponding operations in the case of potassium chloride. But to the inroads of electrolysis into the domain of alkali manu^ factnre, there is one natural limitation brought about by the fact that this process produces for each 40 parts of NaOH, equivalent to 63 parts of NajCOa, 36-6 parts of chlorine, which yield about 100 paits of bleaching-

powder, whereas the present consumption- of chlorine products is in the proportion of about one part of bleaching-powder (or its equivalent of chlorates) to five parts of alkali. Manifestly only that quantity of alkali can be made which corresponds to the sale of the chlorine products necessarily made at the same time, and this means that about nine- tenths of the alkali consumed must be made in other ways. As far as we can see, the ammoniarsoda process will supply the principal portion of the great remainder, but for some time the Leblanc process will still contribute

a share, and “natural soda” from California, from Egypt, &c. (comp. vol. xxii. p. 240) will come in to a certain extent.

Nitric acid (comp. vol. xvii. p. 518). — Tlie manufacture of this acid has been very largely extended, on account both of the enormously increased production of explosives for engineering and mining purposes and of the substitu- tion of smokeless powders for the old gunpowder made from saltpetre. But it is still effected by the wasteful process of decomposing sodium nitrate by sulphuric acid, producing as residue ” nitre-cake,” a product of very little value. Several attempts have been made to decompose the nitrate in a more profitable way, e.g., by means of ferric oxide, in which case the soda is converted into the valuable shape of NaOH, and the ferric oxide is recovered as such ; but none of these processes have emerged beyond the experimental stage. The old process has been im- proved on various sides, chiefly by the elaboration of more rational systems of condensation, and by conducting the operation in such a manner that it furnishes at once a maximum of strong and su£B.ciently pure acid, which does not need to be freed from the lower oxides of nitrogen by the process of “bleaching” ; also by separating the decom- position of sodium nitrate into two stages and conducting it as a continuous process, with the employment of com- paratively weak sulphuric acid even for the production of strong nitric acid (the Ehenania-Uebel process).

References. — The principal work on acids and alkali is Lunge’s Sulphuric Acid and Alkali, 2pd ed. 3 vols. 1891-96. The same work has also appeared in French (by Lurige and Naville), 3 vols. 1879-81, and in German, 2nd ed. 3 vols. 1893-96. The same author has given a synopsis of the manufacture of sulphuric acid up to 1899 in his article “Sohwefel” in Muspratt’s Chemie, 4th ed. vii. 1114-1368. Other works are : — Jurisch, Sandbuch der SchwefelsSurefabrikation, 1893. — Sorel, Fabrication de Vacide sulfurique, 1887. — Annual Beports on Alkali, &c.. Works, from 1864 upwards. — Journal of the Society of Chemical Industry, from 1882. — Fischer’s Jahresberichte der chemischen Technologie. Chemische Industrie. Zeitschrift fur angewandte Chemie.

(G. L.)

Acireale, a town and episcopal see of the province of Catania, Sicily, Italy, 9 miles N. by E. from Catania by rail. It has a school of the industrial arts and sciences. Population, 25,900 (1881); 35,459 (1901).

Acland, Sir Henry Wentworth Dyke,

Bart. (1815-1900), British medical professor and man of learning, was bom 23rd August 1815, and was fhe fourth son of Sir Thomas Dyke Acland. He was educated at Harrow and Christ Church, was elected Fellow of All Souls’ in 1841, and, following the medical profession, took his Oxford degree of M.D. in 1848, having in 1845 been ap- pointed Lee’s Eeader in Anatomy. The revival of medical study and the introduction of the study of natural science into Oxford were in great measure due to

Sir Henry Acland. He promoted ia every way the foundation of laboratories and of the Oxford Museum, formed an extensive series of physiological preparations on the plan of John Hunter, and did far more to overcome the indifference and re- move the suspicion generally prevalent when he com- menced his labours than could have been achieved by one less generally acceptable from his birth, his amenity, and the elevation of his character. ” To Henry Acland,” says Ruskin, “physiology was an intrusted gospel of which he was the solitary preacher to the heathen.” On the other hand, as has been well observed, his thorough classical training preserved science at Oxford from too abrupt a severance from the humanities. In conjunction with his intimate friend, Dean Liddell, he revolutionized the study of art and archaeology, so that the cultivation of these subjects, for which, as Euskin declared, no one at Oxford cared before their time, began to flourish in the University. He published a memoir on the visitation of

cholera in 1854, and another on the topography of the Troad ; but his claims to remembrance rest chiefly on his systematic, sedulous, and successful promotion of his favourite objects. He was Eadcliffe librarian (1851), Eegius Professor of Medicine (1858), and president of the General Medical Council from 1874 to 1887; he was also a curator of the University Galleries and of the Bod- leian library. He was created a baronet in 1890. He resigned the Eegius Professorship in 1894, and died in October 1900.

Acoustics. —The original article in the ninth edition of this Encyclopaedia (hereafter referred to as 0. A.) contains an account of many of the leading phenomena of acoustics and their elementary theory, so that it is only necessary here to supplement that account by discuss- ing certain theoretical points, and by describing certain phenomena and methods of investigation which have been brought into more prominent notice, or have been discovered, in recent years.

The following elementary method of obtaining the velocity of plane waves of longitudinal disturbance in air brings into promiaence the fact that the velocity depends on and varies slightly with the excess]^^°^ °’ and defect of pressure from the normal or undis- turbed value. The method with appropriate modification will give the velocity of transverse disturbance in strings and longitudinal disturbance in rods. We suppose that a disturbance, the same at every point in a plane perpendicu- lar to the direction of propagation, is in some way made and started in the air, and that external forces are applied to every particle in such a manner that the disturbance is con- strained to move on with uniform velocity unchanged in form. The force per unit mass can be expressed in terms of the pressures due to the state of strain together with the applied force, and it can also be expressed in terms of the acceleration which is obtained from the condition that the disturbance moves on unchanged in form with constant velocity U. For this implies that the change in velocity of a particle at a given point during a small time dt is equal to the difference in the velocities at a given instant at that point, and at a point a distance \Jdt back along the line of propagation.

In Fig. 1 let QP represent the displacement curve of the disturbance (0. A. § 12). Let NM repre- sent two points distant \Jdt apart along the line of propagation. Let MP, NQ, represent at a given instant the displace- ments of the particles which were origin- ally at rest at M, N, but which are now displaced in the direction of propagation by amounts proportional to MP and NQ. Let Mm, t«N represent the velocities of the particles. Then the velocity of the M particle will change from mm to kn in time dt, so that the acceleration a is given

by

Us-Uu

dt

=U

NM

(1)

since NM=U(Z*.

But, drawing the tangent PT at P, the velocity at P is the rate at which the displacement is growing at P as the displace- ment curve travels along, and this is evidently at the rate TS per time taken by the disturbance to travel over NM.

Then

M„=TS=xj.TS. dt NM

(2)

This may be written as ~~U~~^r. But we may express the

pressure excess at M in terms of the displacement. For if the layer of air originally between M and N were all compressed as it is at P, the surface through N would be displaced forward NT, while that through M would only be displaced forward MP, or there would be a compression TS in length MN. Since the disturbance is purely longitudinal, this implies that there is a diminution of

volume proportional to TS in volume proportional to MN, or if v is the decrease of volume per original volume V,

V _TS.

V~MN' But if E is the elasticity of the air, and if ^m is the excess of pressure producing the decrease of volume, by definition we have

from (2)

Pm=E^=E.-

E

''Mn

= U-«M

(3)

This relation shows that wherever the particle velocity is forward Pjh is in excess, and that wherever it is backward pm is in defect of the undisturbed or normal pressure.

We may evidently putpM= — E.

Forming a similar expression for ps and subtracting

dx

and substituting in (1)

J— i’M=Vj(MN— Mm),

_U^Pn-£m ” E ISIM ■

(4)

Turning now to the forces acting on the layer originally between M and N and 1 sq. cm. in cross section, we have P+pu at N and P+Pm at M, where P is the normal pressure. There is also the applied force. If this is X per mass 1, and it the normal density is p, then the total force on mass pMN is

PN-PM+XpMN, and the acceleration is

—P^-P’^.+ X ... (5)

pNM Equating (4) an^ (5) we obtain

E,

P\ Pn

p.NM.X

fMC.XN -Pm)

(6)

If the disturbance is so small that the change in volume may be taken as exactly proportional to the change in pressure, then E is constant. If then X=0, or there is no external applied force,’

U2=E/p

(the value found in O. A. § 15). But if the disturbance is great we can no longer assume that E is the same for all changes of volume. We may, however, suppose that the change of pressure consists of two terms : (1) a term exactly proportional to the change in volume ; (2) a term, in general very small, expressing the divergence from proportionality. If we like, we may regard the second term as an applied force superposed on the force ex- pressed in the first term, and then trace the effect in equation (6). The relation between pressure and volume in air for sound dis- turbance is the adiabatic relation

PV^= constant, where 7= ratio of specific heats. If P change to F--p and V to

V-«,

(iF+p)(V-vy=FY\

Expanding the right hand and neglecting powers above the second,

p— ‘v^ ‘ 2 V2 If the second term on the right did not exist, we should iiave

i’ = 7Py’

and the elasticity would have the constant value E=7P.

We assume now that the elasticity does have this value, and that the second term is an applied force superposed on the pressures deduced from a constant elasticity which were used in obtaining equation (6). In that equation we must take the applied force on element cross section 1^, length NM, as

NM.X= excess of pressure denoted by second term at N,

atM.

linator of the fraction in (6), ^ . from a constant elasticity, so

Now in the denominator of the fraction in (6), pt^—pyi represents pressures deduced from a constant elasticity, so that,

Substituting these values in (6),

(since B =7? and (:^ J is in the limit equal to { y))

~~K’~~^l)

4

p 2

from (3)

(7)

This result’implies that the different parts of a ~~wave move on at different rates, so that its form must change. As we obtained the result on the supposition of un~~ changed form, we can of course only apply it for such short lengths and such short times that the part dealt with does not appre- ciably alter. We see at once that, where u=0, the ve- locity has its “nor- mal ” value, while where u is positive the velocity is in excess, and where u is negative the velocity is in defect -pi^ 2.

of the normal value.

If, then, a (Fig. 2) represent the displacement curve of a train of waves, b will represent the pressure excess and particle velocity, and from (7) we see that while the nodal conditions of b, with p=0 and u=0, travel with

velocity ~~y~~, the crests exceed that velocity by ^^i— m,

and the ioUows fall short of it by ^^^i-w, with the

result that the fronts of the pressure waves become steeper and steeper, and the train 6 changes into some- thing like c. If the steepness get very great our inves- tigation ceases to apply, and neither experiment nor theory has yet shown what happens. Probably there is a breakdown of the wave

somewhat like the breaking of a ‘ water-wave when the crest gains on the next trough. In ordinary sound-waves the effect of the particle velocity in affecting the velocity of transmission must be very small.

Experiments, referred to later, have been made to find”* the amplitude of swing of the air particles in organ pipes. Thus Mach found an amplitude 0-2 cm. when the issuing waves were 250 cm. long. The amplitude in the pipe was probably much greater than in the issuing waves. Let us take it as 0-1 mm. in the waves — a very extreme value. The maximum particle velocity is lirna (where n is the frequency and a the amplitude), or 2TaV/. This gives maximum M=about 80 ””/sec, which would not seriously. change the form of the wave in a few wave lengths. Meanwhile the waves are spreading out and the value of M is falling in inverse proportion to the distance from the source, so that very soon its effect must become negligible.

But in loud sudden sounds, such as a peal of thunder or the report of a gun, the effect may be more considerable, and there is no doubt that with such sounds the normal velocity is quite considerably exceeded. Thus there is the old observation of Parry (§ 23, 0. A.) that from a distance

the report of a gun was heard before the word ” Fire.” More recently Jaques {Phil. Mag. 1879, vii. p. 219) has investigated the transmission of the report from a cannon in different directions, finding that it rose to a maximum of 1267 «•/,,„. at 70 to 90 feet in the rear, and then fell off. If, too, the sound be confined in pipes so that the intensity cannot diminish rapidly the normal velocity is exceeded. Thus Regnault in his classical experiments {Phil. Mag. 1868, xxxv, p. 161) found that the velocity of the report of a pistol carried through a pipe diminished with the intensity, and his results have been confirmed by VioUe and Vautier (PhU. Mag. 1888, xxvi. p. 77). Possibly the prolonged boom into which the report of a gun changes at a distance is due to some kind of break-down and lengthening out of the original disturbance when the front of the pressure wave becomes impossibly steep.

Some light has been thrown on the curious ” whispering

gallery “. case of reflection of sound by observations made

by Lord Rayleigh in the circular gallery at the

Kefiection. ^^^^ ^j ^^^ ^^^^ ^^ g^ p^^,^ Cathedral. An

old explanation of the effect consisted in ascribing it to the concentration of the sound rays after single reflection from the surface to a focus conjugate to the source, or to the crowding in a caustic (0. A. § 38). But Lord Rayleigh finds that ” the abnormal loudness with which a whisper is heard is not confined to the positiondiametrically opposite to that occupied by the whisperer, ^nd therefore, it would appear, does not depend materially upon the symmetry of the dome. The whisper seems to creep round the gallery horizontally, not necessarily along the shorter arc, but rather along that arc towards which the whisperer faces. This is a conse- quence of the very unequal audibility of a whisper in front and behind the speaker, a phenomenon which may easily be observed in the open air ” (Sound, ii. § 287).

Let Kg. 3 represent a horizontal section of the dome through the source t. Let OPA be the radius through P. Let PQ represent a ray of sound maiing e with the tangent at A. Let ON=OP cos 0 be the perpendicular on PQ. Then the re- flected ray QR and the ray reflected at R, and so on, will all touch

the circle drawn with ON as radius. A ray making less than 6 with the tangent will with its reflections touch a larger circle. Hence all rays between ±6 will be confined in the space between the outer dome and a circle of radius OP cos $, and the weakening of intensity will be chiefly due to vertical spreading.

Rayleigh points out that this clinging of the sound to the surface of a concave wall does not depend on the exactness of the spherical form. He suggests that the propagation of earthquake disturbances is probably affected by the curvature of the surface of the globe, which may act like a whispering gallery.

In some cases of echo, when the original sound is a compound musical note, the octave of the fundamental tone is reflected much more strongly than that tone itself. This is explained by Rayleigh (Sound, ii, § 296) as a consequence of the irregularities of the reflecting surface. The irregularities send back a scattered reflection of the different incident trains, and this scattered reflection becomes more copious the shorter the wave length. Hence the octave, though comparatively feeble in the incident train, may predominate in the scattered reflection constituting the echo.

Osborne Reynolds (Proc. B. S. xxii. 1874, p. 531) first pointed out that refraction would result from a varia- Tewpera- ^^°^ ™ *^^ temperature of the air at different tate heights. The velocity of sound in air is inde-

retraction. pendent of the pressure, but varies with the temperature, its value at f C. being (0. A. § 18) —

U=U„(l-^f),

where Uq is the velocity at 0° C, and a is the coefficient of expansion •00365. Now if the temperature is higher overhead than at the surface; the velocity overhead is greater. If a wave front is in a given position, as a 1 (Fig. 4), at a given instant, the upper part moving faster

12 8

ILL im

Pig. 4.

gains on the lower, and the front tends to swing round as shown by the successive positions in a 2, 3, and 4 ; that is, the sound tends to come down to the surface. This is well illustrated by the remarkable horizontal carriage of sound on a still clear frosty morning, when the surface layers of air are decidedly colder than those above. At sunset, too, after a warm day, if the air is still, the cooling of the earth by radiation cools the lower layers, and sound carries excellently over a level surface. But usually the lower layers are warmer than the upper layers, and the velocity below is greater than the velocity above. Consequently a wave front such as 6 1 tends to turn upwards, as shown in the successive positions 6 2, 3, and 4. Sound is then not so jrell heard along the level, but may still reach an elevated observer. On a hot summer's day the tempef a^ ture of the surface layers may be much higher than that of the higher layers, and the effect on the horizontal carriage of sound may be very marked.

It is well known that sound travels far better with the wind than against it. Stokes showed that this effect is one of refraction, due to variation of velocity of the air from the surface upwards (B. A. Bep. y^^" 1857, p. 22). It is, of course, a matter of common observation that the wind increases in velocity

from the surface upwards. An excellent illustration of this increase was pointed out by Osier in the shape of old clouds ; their upper portions always appear dragged for- ward, and they lean over, as it were, in the direction in which the wind is going. The same kind of thing happens with sound-wave fronts when travelling with the wind.

The velocity of any part of a wave front relative to the ground will be the normal velocity of sound ¦ the velocity o^ the wind at that point. Since the velocity increases as we go upwards, the front tends to swing round and travel downwards, as shown in the successive positions a 1, 2, 3, and 4, in Fig. 4, when we must suppose the wind to be blowing from left to right. But if the wind is against the sound the velocity of a point of the wave front is the normal velocity — the wind velocity at the point, and so decreases as we rise. Then the front tends to swing round and travel upwards as shown in the successive positions 6 1, 2, 3, and 4, in Fig. 4, where the wind is travellinig from right to left. In the first case the waves are more likely to reach and be perceived by an observer level with the source, while in the second case they may go over his head and not be heard at all.

Many of the well-known phenomena of optical diffrac- tion may be imitated with sound-waves, especially if the waves be short. Lord Rayleigh has given various ex- amples, and accounts of experiments and theory will be found in, his Sound, vol. ii.

A simple mode of forming Lissajous figures, to find the ratio of the frequencies of two forks, consists, in attaching two small plane mirrors, one on the prong of one fork, the other on a prong of another ^^pl^^ fork. The two forks are arranged so that one vibrates in a ^^ertical, the other in a horizontal plane, and they are so placed that a converging beam of light, received in one mirror, is refiected to the

other and then brought to a point on a screen. If the first fork alone vibrates, the point on the screen appears lengthened out into a vertical line through the changes in inclination of the first mirror, while if the second fork alone vibrates, the poirtt appears lengthened out into a horizontal line. Jf both vibrate, the point describes a curve which appears continuous through the persistence of ”” the retinal impression. The curve is named a Lissajous figure after the deviser of this method of investigation. Lissajous also obtained the figures by aid of the vibration microscope, an instrument which he invented. Instead of a mirror, the objective of a microscope is attached to one prong of the first fork and the eye-piece of the microscope is fixed behind the fork. Instead of a mirror the second fork carries a bright point on one prong, and the micro- scope is f ocussed on this. If both forks vibrate, an observer looking through the microscope sees the bright point describing Lissajous figures. If the two forks have the same frequency, it is easily seen that the figure will be an ellipse (including as limiting cases, depending on relar tive amplitude and phase, a circle and a straight line). If the forks are not of exactly the same frequency the ellipse will slowly revolve, and from its rate of revolution the ratio of the frequencies may be determined (Eayleigh, Sound, i. § 33). If one is the octave of the other a figure of 8 may be described, and so on.

JLoenig has devised a clock in which a fork of frequency 64 takes the place of the pendulum (Wied. Ann. ix. p.

394, 1880). The motion of the fork is main- Kaenig's tained by the clock acting through an escape- c/TCi^'"" ™6nt, and the dial registers both the number

of vibrations of the fork and the seconds, minutes, and hours. By comparison with a clock of known rate the total number of vibrations of the fork in any time ma;y be accurately determined. One prong of the fork carries a microscope objective, part of a vibration microscope, of which the eye-piece is fixed at the back of the clock, and the Lissajous figure made by the clock fork and any other fork may be observed. With this apparatus Koenig studied the effect of temperature on a standard fork of 256 frequency, and found that the frequency decreased by -0286 of a vibration for a rise of 1°, the frequency being exactly 256 at 26.2° C. Hence the frequency may be put as 256 {1—000113 (f-26-2)|. Koenig also used the apparatus to investigate the effect on the frequency of a fork of a resonating cavity placed near it. He found that when the pitch of the cavity was below that of the fork the pitch of the fork was raised, and vice versd. But when the pitch of the cavity was exactly that of the fork when vibrating alone, though it resounded most strongly, it d>id not affect the frequency of the fork. These effects have been explained by Lord Rayleigh (Sound, i. § 117).

In the stroboscopic method of M'Leod and Clarke, the full details of which will be found in the original memoir

(Phil. Trans. 1880, part i. p. 1), a cylinder ^^^°^ is ruled with equidistant white lines parallel to Clarke's the axis on a black ground. It is set so that strobo- it can be turned at any desired and determined Im^od. speed about a horizontal axis, and when going

fast enough it appears grey. Imagine now that a fork with black prongs is held near the cylinder with its prongs vertical and the plane of vibration parallel to the axis, and suppose that we watch the outer outline of the right-hand prong. Let the cylinder be rotated so that each white line moves exactly iato the place of the next while the prong moves once in and out. Hence when a white line is in a particular position on the cylinder, the prong will always be the same distance along it and cut off the same length from view. The

most will be cut off in the position of the lines corre- sponding to the furthest swing out, then less and less till the furthest swing in, then more and more till the furthest swing out, when the appearance will be exactly as at first. The boundary between the grey cylinder and the black fork will therefore appear wavy with fixed un- dulations, the distance from crest to crest being the distance between the lines on the cylinder. If ,the fork has slightly greater frequency, then a white line will not quite reach the next place while the fork is making its swing in and out, and the waves will travel against the motion of the cylinder. If the fork has slightly less frequency the waves will travel in the opposite direction, and it is easily seen that the frequency of the fork is the number of white lines passing a point in a second ± the number of waves passing the point per second. This apparatus was used to find the temperature coefficient of the frequency of forks, the value obtained — -00011 being the same as that found by Koenig. Another important result of the investigation was that the phase of vibration of the fork was not altered by bowing it, the amplitude alone changing. The method is easily adapted for the converse determination of speed of revolution when the frequency of a fork is known.

The phonic wheel, invented independently by La Cour and Lord Kayleigh (see Sound, i. § 68 c), consists of a wheel carrying several soft iron armatures fixed at equal distances round its circumference, p^'/,''' The wheel rotates between the poles of an wheel. electro-magnet, which is fed by an intermittent current such as that which is working an electrically maintained tuning-fork (see infra). If the wheel be driven at such rate that the armatures move one place on in about the period of the current, then on putting on the current the electro-magnet controls the rate

of the wheel so that the agreement of period is exact, and the wheel settles down to move so that the electric driving forces just supply the work taken out of the wheel. If the wheel has very little work to do it may not be neces- sary to apply driving power, and uniform rotation may be maintained by the electro-magnet. In an experiment described by Kayleigh such a wheel provided with four armatures was used to determine the exact frequency of a driving fork known to have a frequency near 32. Thus the wheel made about 8 revolutions per second. There was one opening in its disc, and through this was viewed the pendulum of a clock beating seconds. On the pendulum was fixed an illuminated silver bead which appeared as a bright point of light when seen for an instant. Suppose now an observer to be looking from a fixed point at the bead through the hole in the phonic wheel, he will seethe bead as 8 bright points flashing out in each beat, and in succession at intervals of \ second. Let us suppose that he notes the positions of two of these next to each other in the beat of the pendulum one way. If the fork makes exactly 32 vibrations and the wheel 8 revolutions in one pendulum beat, then the positions will be fixed, and every two seconds, the time of a complete pendulum vibration, he will see the two positions looked at flash out in succes- sion at an interval of \ second. But if the fork has, say, rather greater frequency, the hole in the wheel comes round at the end of the two seconds before the bead has quite come into position, and the two flashes appear gradually to move back in the opposite way to the pen- dulum. Suppose that in N beats of the clock the flashes have moved exactly one place back. Then the flrst flash in the new position is viewed by the 8Nth passage of the opening, and the second flash in the original position of the first is viewed when the pendulum has made exactly]Sr beats and by the (8-1- l)th passage of the hole. Then

the wheel makes 8N+1 revolutions in N clock beats, and the fork makes 32 K +4 vibrations in the same time. If the clock is going exactly right, this gives a frequency for

the fork of 32+—. If the fork has rather less frequency

than 32 then the flashes appear to move forward and the

frequency will be 32——. In Rayleigh's experiment the

32 fork was made to drive electrically one of frequency about 128, and somewhat as with the phonic wheel, the frequency was controlled so as to be exactly 4 times that of the 32 fork. A standard 128 fork could then be com- pared either optically or by beats with the electrically driven 128, and the frequency of the standard determined. A very noticeable illustration of the alteration of pitch by motion occurs when a whistling locomotive moves rap- idly past an observer. As it passes, the pitch of laiiifie. *^ whistle falls quite appreciably. The explar nation is simple. The engine follows up any wave that it has sent forward, and so crowds up the suc- ceeding waves into a less distance than if it remained at rest. It draws off from any wave it has sent backward and so spreads the succeeding waves over a longer distance than if it had remained at rest. Hence the forward waves are shorter and the backward waves are loiter. Since U— mA. where U is the velocity of sound, \ the wave length, and n the frequency, it follows that the forward frequency is greater than the backward frequency.

The more general case of motion of source, medium, and re- ceiver, may be treated very easily if the motions are all in the line joining source and receiver. Let S (Fig. 5) be the source at a given instant, and let its frequency of vibration, or the nnmber of waves it sends out per second, be n. Let S' be its position, one second later, its velocity being u. Let R be the receiver at a given instant, R' its position a second later, its velocity being t>. Let the velocity of the air from S to R be w, and let U be the

velocity 6f sound in still air. If all were still, the n waves emitted by S in one second would spread over a length U. But through the wind velocity the first wave is carried to a distance

Kg. 5.

U-fto from S, while through the motion of the source the last wave is a distance u from S. Then the n waves occupy a space U-l-w— M. Now turning to the receiver, let us consider what length is occupied by the waves whit^ pass him in one second. If he were at rest, it would be the waves in length U+io, for the wave passing him at the beginning of a second would be so far distant at the end of the second. But through his motion v in the second, he receives only the waves in distance V+w~v. Since there are n waves in distance \J+w—u the number he actually receives is

H the velocities of source and receiver are equal then the fre- quency is not affected by their motion or by the wind. But if their velocities are difierent, the frequency of the waves received is affected both by these velocities and by that of the wind.

The change in pitch through motion of the source may be illustrated by putting a pitch-pipe in one end of a few feet of rubber tubing and blowing through the other end, while the tubing is whirled round the head. An observer in the plane of the motion can easily hear a change in the pitch as the pitch-pipe moves to and from him.

A musical note has a definite pitch or frequency, that is, it is a disturbance of definite periodicity. Yet notes of the same pitch, emitted by different instru- Quaiity. jugntg^ iiave quite different timbre or quality. The three characteristics of a longitudinal periodic dis- turbance are its amplitude, the length after which it repeats itself, and its form which may be represented by the shape of the displacement curve. Now the amplitude

evidently corresponds to the loudness, and the length of period corresponds to the pitch or frequency. Hence we must put down the quality or timbre as depending on the form.

The simplest form of wave, so far as our sensation goes, that is, the one giving rise to a pure tone, is, we have every reason to suppose, one in which the displacement is represented by a har- monic curve or a curve of sines,

y=asaim{x—e). If we put this in the form

y=asi.rx — (k— e), X

\ 2\ SX s

we see that y=0, for x=e, e+-, e+— , «-!-—, and so on, that y

2 2 2

X X 2X

is + from a;=e to x=e-\ — , — from e+~ to e+-—, and so on, and

that it alternates between the values +a and —a.

The form of the curve is evidently as represented in Mg. 6, and it may easily be drawn to exact scale from a table of sines.

Fig. 6.

In this curve ABCD are nodes. OA=e is termed the epoch,

being the distance from O df the first ascending node. AC is the

shortest distance after which the curve begins to repeat itself ; this

length X is termed the wave length. The maximum height of the

curve HM=a is the amplitude. If we transfer O to A, e=0, and

the curve may be represented by

. 2ir 3/= asm — X.

X

If now the curve moves along imchanged in form in the direction ABC with uniform velocity U, the epoch e=OA at any time t will be U«, so that the value of y may be represented as

j/=asin— (a;-UO

A

(1)

The velocity perpendicular to the axis of any point on the curve at a fixed distance x from O is

at

X X ^ ^

(2)

The acceleration perpendicular to the £|,xis is

4-^U^«sin2z^(x-U0

X2 47r2U2,

which is an equation characteristic of simple harmonic motion.

The chief experimental basis for supposing that a train of longitudiaal waves with displacement curve of this kind arouses the sensation of a pure tone, is that the more nearly a source is made to vibrate with a single simple harmonic motion, and therefore, presumably, the more nearly it sends out such a harmonic train, the more nearly does the note heard approximate to a single pure tone.

The average energy per cc. of a harmonic train of waves may easily be calculated. If /> is the density, the kinetic energy in a length X parallel to ABC, of cross- section 1 sq. cm., is

€’{%)

dtx

ef’*^^?I^cos=?(x-uod»; 2J0 xa x ^

from (2)

_p7r3UV X The potential energy in volume cross section 1 length dx, mauifested by the strain, may be calculated since it is equal to average pressure x strain produced.

{v + ^^vdx,

where p is the pressure excess and » the volume change per unit volume.

Now from equation (3) in the investigation of tlie velocity of sound (^supra), we see that

while putting V=:l

dy ax

-cos^(a;— U<),

Inserting these values and integrating the potential energy te- tween x=0 and x=\, we have

£(-11)1- ‘—K’i-^mi)’”-

But diflerentiatlng (1) above

dy_2Tra

dx~ \ X

and as this has equal + and — values over a length a;=X, the first integral = 0. The second gives on integration

X

Then, since E=pTJ2, the potential energy in one wave length, cross section 1,

_p7r2IW

~ X The total energy-, kinetic + potential, in a length X of cross section 1 is equally divided between the two kinds, and is

X If we regard this energy as travelling on with velocity U, the quantity passing across one sq. cm. in one second is U/X times as great, or

2pir^Wa^ X2 ■ This gives the measure of the intensity of the sound on the supposition that loudness or intensity is to be measured by energy received per sq. cm. per second. From the values of the

particle velocity and the pressure excess, it is easy to express the intensity in terms of these quantities.

Any periodic curve may be resolved into sine or har- monic curves by Fourier's theorem.

aeorem. Suppose that any periodic sound disturbance, consisting of plane waves, is being propagated

in the direction ABCD, Fig. 7. Let it be represented by

Kg. 7.

a displacement curve AHBKC. Its periodicity implies that after a certain distance the displacement curve exactly repeats itself. Let AC be the shortest distance after which the repetition occurs, so that CLDME is merely AHBKC moved on a distance AC. Then AC = A is the vyave length or period of the curve. Let ABCD be drawn at such level that the areas above andJbelow it are equal ; then ABCD is the axis of the curve. Since the curve represents a longitudinal disturbance in air it is always continuous, at a finite distance from "the axis, and with only one ordinate for each abscissa.

Fourier's theorem asserts that such a curve may be built up by the superposition, or addition of ordinates, of a series of sine curves

of wave lengths X, H' q' Z •

if the aniplitudes a, &, c . . . and the

epochs e, f, g . . . are suitably adjusted, and the proof of the theorem gives rules for finding these quantities when the original curve is known. We may therefore put

2ff,

47r,

6t,

y=a sin r- (a— e) +6 sin -r-Cs— /)+c svn.-(x—g)+eic.

\ X X

(1)

where the terms may be infinite in number, but always have wave lengths submultiples of the original or fundamental wave length X. Only one such resolution of a given periodic curve is possible, and eac^ of the constituents repeats itself not only in its own wave

length X/re, but also evidently in the fundamental wave length X. The successive terms of (1) are called the harmonics of the first term.

It follows from this that any periodic disturbance in air can be resolved into a definite series of simple har- monic disturbances of wave lengths equal to the original wave length and its successive submultiples, and each of these would separately give the sensation of a ptire tone. If the series were complete, we should have terms which separately would correspond to ' the fundamental, its octave, its twelfth, its double octave, and so on. Now we can see that two notes of the same pitch, but of

different quality, or different form of displacement curve, will, when thus analysed, break up into series having the same har- monic wave lengths ; but they may differ as regards the members of the series present and their amplitudes and epochs. We may regard quality, then, as determined by the members of the harmonic series present and their amplitudes and epochs. It may, however, be stated here that certain experiments of Helmholtz appear to show that the epoch of the harmonics has not much effect on the quality.

Fourier's theorem can also be usefully applied to the disturbance of a source of sound under certain conditions. The nature of these conditions will be best realized by considering the case of a stretched string. It is shown, in O. A. § 55, how the vibrations of a string may be deduced from stationary waves. Let us here suppose that the string AB is displaced into the form AHB (Fig. 8). Then let us imagine it to form half a. wave length of the extended train ZGAHBKC, on an indefinitely extended stretched string, the values of y at equal distances from A (or from B) being equal and opposite. Then we may suppose the vibrations of the string to be represented by the travelling of two trains in opposite directions each with velocity

Kg. 8.

V tension -^ mass per unit length

each half the height of the train represented in Fig. 8., For the superposition of these trains will give a stationary wave between A and B. Now we may resolve these trains by Fourier's theorem

into harmonics of wave lengths X, -, -, etc., where X=2AB and the

condition as to the values of y can be shown to require that the harmonics shall all

have nodes, coincid- h

ing with the nodes of the fundamental curve. Since the ve- locity is the same for all disturbances they all travel at the same speed, and the two trains will always remain of the same form. If then we resolve AHBKC into harmonics by Fourier's theorem, we may follow the motion of the separate harmonics, and their superpo- sition will give the form of the string at any instant. Further, the same harmonics with the same amplitude will always be present.

We see, then, that the conditions for the application of Fourier's theorem are equivalent to saying that all disturbances will travel along the system with the same velocity. In many vibrating systems this does not hold, and then Fourier's theoirem is no longer an appropriate resolution. But where it is appropriate, the disturbance sent out into the air contains the same harmonic series as the source.

The question now arises whether the sensation produced by a periodic disturbance can be analysed in correspond- ence with this geometrical analysis. Using the term note for the sound produced by a periodic disturbance, there is no doubt that a well-trained ear can resolve a note into pure tones of frequencies equal to those of the fundamental and its harmonics. If, for instance, a note is struck and held down on a piano, a little practice enables us to hear both the octave and the twelfth with the fundamental, especially if we have previously directed our attention to these tones by sounding them. But the

harmonics are most readily heard if we fortify the ear by an air cavity with a natural period equal to that of the harmonic to be sought. The form used by esona rs. jiq\jj{j^qH^^ {^ a, globe of thin brass with a large hole at one end of a diameter, at the other end of which the brass is drawn out into a short, narrow tube that can be put close to the ear. But a. card-board tube closed at one end, with the open end near the ear, will often suffice, and it may be tuned by more or less covering up the open end. If the harmonic corresponding to the resonator is present its tone swells out loudly. , This resonance is a particular .example of the general principle that a vibrating system will be set in vibration by any periodic force applied to it, and ultimately in the period of the force, its own natural vibrations gradually dying down. Vibrations thus excited are termed Forced Vibrations, and their amplitude is greater the more nearly the period of the applied force approaches that of the system when vibrating freely. Themathematical investi- gation of forced vibrations (Rayleigh, Sound, i. § 46) shows that, if there were no dissipation of energy, the vibration would increase indefinitely when the periods coincided. But there is always leakage of energy either through friction or through wave-emission, so that the vibration only increases iip to the point at which the leakage of energy balances the energy put in by the applied force. Further, the greater the dissipation of energy the less is the prominence of the amplitude of vibration for exact coincidence over the amplitude when the periods are not quite the same, though it is still the greatest for coincidence.

According to Helmholtz, the ear probably contains within it a series of resonators, with small intervals be- tween the periods of the successive members. The ear as ~~w^liile the series extends over the whole range amlysin °^ audible pitch. We need not here enter into the question of the structure constituting these resonators. Each of them is supposed to have its own natural frequency, and to be set into vibration when the ear receives a train of waves of that frequency. The vibration ia some way arouses the sensation of the corre~~ sponding tone. But the same resonator will be appreci- ably though less afEected by waves of frequency differing slightly from its own. Thus Helmholtz from certain observations (Rayleigh, Sound, ii. § 388) thought that if the intensity of response by a given resonator in the ear to its own tone is taken as 1, then its response to an equally loud, tone a semitone different may be taken as about ^. According to this theory, then, when a pure tone is received the auditory apparatus corresponding to that tone is most excited, but the apparatus on each side- of it is also excited, though by a rapidly diminish- ing amount, as the interval increases. If the sensations corresponding to these neighbouring elements are thus aroused, we have no such perception as a pure tone, and what we regard as a pure tone is the mean of a group of sensations. The sensitiveness of the ear in judging of a given tone must then correspond to the accuracy with which it can judge of the mean.

Determinations of the pressure changes, or extent of excursion of the air, iu sounding organ pipes have been made by Kundt (Pogg. Ann. cxxxiv. 1868, p. Amplitude 163), Topler and Boltzmann {Pogg. Ann. cxli., or aol. Eayleigh, Sound, § 422a), and Mach (Optisch-

Akustischen Versuche). Mach's method is per- haps the most direct. The pipe was fixed in a horizontal position, and along the' top wall ran a platinum wire wetted with sulphuric acid. When the wire was heated by an electric current a fine line of vapour descended from each drop. The pipe was closed at the centre by a membrane which jirevented a through draught, yet per-

mitted the vibrations, as it was at a node. The vapour line, therefore, merely vibrated to and fro when the pipe was sounded. The extent of vibration at different parts of the pipe was studied through a glass side wpU, a stroboscopic method being used to get the position of the vapour line at- a definite part of the vibration. Mach found an excursion of 0-4 cm.- at the end of an open pipe 125 cm. long. The amplitude found by the other observers was of the same order.

Lord Rayleigh has made experiments by two different methods to determine the amplitude of vibration in waves only just audible {Sound, ii. § 384). It will be sufficient to indicate the second method. A fork amplitude of frequency 256 was used as the source. The ot audible energy of this fork with a given amplitude of «<«'''*• vibration could be calculated from its dimensions and elasticity, and the amplitude was observed by measuring with a microscope the line into which the image of a starch grain on the prong was drawn by the vibration. The rate of loss of energy was calculated from the rate of dying down of the vibration. This rate of loss for each amplitude was determined (1), when the fork was vibrating alone, and (2) when a resonator was placed with its mouth under the free ends of the fork. The difference in loss in the two cases measured the energy given up to and sent out by the resonator as sound. The amplitude of the fork was observed when the sound just ceased to be audible at 27-4 metres away, and the rate of energy emission from the resonator was calculated to be 42-1 "Ky^^^^^^ Assuming this energy to be propagated in hemispherical waves, it is easy to find the quantity per second going through 1 sq. cm. at the distance of the listener, and thence from the energy in a wave, found above, to determine the amplitude. The result was an amplitude of 1-27 x 10''' cm. Other forks gave results not very different. M.- Wien (Wied. Ann. xxxvi. 1889, p. 834) by another method has obtained a smaller value still, though one of the same order. He used a globular resonator in which the pressure variations could be determined by a contrivance something like a delicate aneroid barometer. Erom the pressure changes the am- plitude was known, and from Helmholtz's theory of the resonator the amplitude In the external exciting waves was calculated. All the results show that "the streams of energy required to influence the eye and ear are of the same order of magnitude."

The simple theory of the vibration of air in pipes, due to Bernouilli, practically assumes that a stationary wave is formed with a node at a closed end and a loop at an open end. But (as pointed out in 0. A. o/*™^””* § 85) the condition for a loop at an open end, pipes. that of no pressure variation, cannot be exactly fulfilled. This would require that the air outside should have no mass in order that it should at once move out and relieve the air at the end of the pipe from any excess of pressure, or at once move in and fill up any defect. There are variations, therefore, at the open end, and these are such that the loop may be regarded as situated a short distance outside the end of the pipe. It may be noted that in practice there is another reason for pressure variation at the end of the pipe. The stationary wave method regards the vibration in the pipe as due to a series of waves travelling to the end and being there re- flected back do-wn the pipe. But the reflection is not complete, for some of the energy comes out as waves ; hencte the direct and reflected trains are no^ quite equal, and cannot neutralize each other at the loop.

The position of the loop has not yet been calculated for an ordinary open pipe, but Lord Rayleigh has shown {Sound, ii. § 307), that for a cylindrical tube of radius E, provided with a flat extended flange, the loop may be re-

garded as about 0-82 E, in advance of the end. That is, the length of the pipe must be increased by 0-^2 R before applying Bernouilli’s theory. This is termed the end cor- rection. Using this result Eayleigh found the correction * for an unflanged open end by sounding two pipes nearfy in unison, each provided with a flange, and counting the beats. Then the flange was removed from one and the beats were again counted. The change in virtual length by removal of the flange was thus found, and the open end correction for the unflanged pipe was 0-6 E. This correction has also been found by Blaikley by direct experiment (Phil. Mag. vii. 1879, p. 339). He used a tube of variable length and

determined the length resounding to a given fork, (1) when the closed end was the first node, (2) when it was the second node. If these lengths are l^ and l^, then

^2—^5=- and ’”~ ‘— ?! is the correction for the open end. Z 2

The mean value found was 0-576 E.

Helmholtz investigated the velocity of propagation of

sound in pipes, taking into account the viscosity of the air

Propaga- (E.ayleigh, Sound, ii. § 347), and Kirchhoff in-

tiottof vestigated it, taking into account both the

waves la viscosity and the heat communication between

‘*’”■ the air and the walls of the pipe (Sound, ii.

§ 350). Both obtained the value for the velocity

y(i-

c

where U is the velocity in free air, E is the radius of the pipe, N the frequency, and p the air density. C is a con- stant, equal to the coef&cient of viscosity in Helmholtz’s theory, but less simple in Kirchhoff’s theory. Experi- ments on the velocity in pipes were carried out by Schneebeli (Pogg. Ann. cxxxvi. 1869, p. 296), and by Seebeck (Pogg. Ann. cxxxix. 1870, p. 104) which accorded with this result as far as E is concerned, but the diminu- tion of velocity was found to be more nearly proportional to N”! Kuudt also obtained results in general agreement with the formula (Eayleigh, Sound, ii. § 260). He used his dust-tube method (0. A. § 93).

KuBdt’s dust-tube may also be employed for the determination of the ratio of the specific heats of a gas or vapour. Specific j£ ~~g jg ijjg yeiooity of sound in a gas at pressure P with density p, and if waves of length X and fre~~ quency N are propagated through it, then the distance between the dust-heaps is

1

beats’ ratio.

2 2N 2N

P ‘

where y is the ratio of the two speciflc heats. If d is measured for two gases in succession for the same frequency N, we have

71 PiPa di^’

where the suffixes denote the gases to which the quantities relate. If 71 is known this gives 72. Kundt and Warburg applied the method* to find 7 for mercury vapour (Pogg. Ann. clvii. 1876, p. 356),

using a double form of the apparatus in which there are two dust-tubes worked by the same sounding rod. This rod is sup- ported at I and J of its length where it enters the two dust-tubes,

^

n c

B=

u C

Kg. 9.

as represented diagrammatically in Fig. 9. It is stroked in the middle so as to excite its second mode of vibration. The method ensures that the two frequencies shall be exactly the same. In the mercury experiment the sounding rod was sealed into the dust-tube, which was exhausted of air, and contained only some mercury and some quartz dust to give the heaps. It was placed in a high temperature oven, where the mercury was evaporated. The second tube containing air was outside. When a known temperature was attained the sounder was excited, and da and di could be measured. Prom the temperature, Pa/pa was known, and

72/71 could then be found. Taking 7i=l-41, 72 was determined to be 1-66. Eayleigh and Ramsay (Phil. Trans. A. 1895, parti, p. 187) also used a single dust-tube with a sounder to find – *™ argon, and again the value was 1‘66.

, When a system is set vibrating and left to itself, vibration gradually dies away as the energy leaks ^ither in the waves formed or through friction. In order that the vibration may be maintained, ^’’’’ a periodic force must be applied either to aid the vibm internal restoring force on the return journey, or weaken it on the outgoing journey, or both. Thus if a dulum always receives a slight impulse in the directic motion just about the lowest point, this is equivalent t increase of the restoring force if received before pas through the lowest point, and to a decrease if received s that passage, and in either case it tends to maintain swing. If the bob of the pendulum is iron, and if a cc placed just below the centre of swing, then, if a cm- passes through the coil, while and only while the bo moving towards it, the vibration is maintained. If the rent is on while the bob is receding, the vibratio checked. If it is always on it only acts as if the vain gravity were increased, and does not help to maintai check the vibration, but merely to shorten the period. In a common form of electrically main- ^^“f^ tained fork, the fork is set horizontal with its ™^ prongs in a vertical plane, and a small electro- magnet is fixed between them. The circuit of the ele(maguet is made and broken by the vibration of the : in different ways — say, by a “wire bridge attached to lower prong which dips into and lifts out of two mer(cups. The mercury level is so adjusted that the cii is just not made when the fork is at rest. When set vibrating contact lasts during some part of the ward and some part of the inward swing. But pa owing to the delay in making contact through the carr down of air on the contact piece, and partly owing to delay in establishing full current through self-induci the attracting force does not rise at once to its full v in the outgoing journey, whereas in the return joui the mercury tends to follow up the contact piece, and full current continues up to the instant of break. H(the attracting force does more work in the return joui than is done against it in the outgoing, and the balant available to iacrease the vibration.

In the organ pipe — as iu the common whistle — a ■ sheet of air is forced through a narrow slit at the bot of the embouchure and impinges against the top _ edge, which is made very sharp. The disturbance ‘”’’’”• made at the commencement of the blowing will no doubt set the air in the pipe vibrating in its own natural

period, just as any irregular air disturbance will set a suspended body swinging in its natural period, but we are to consider how the vibration is maintained when once set going. When the motion due to the vibration is up along the pipe from the embouchure, the air moves into the pipe from the outside, and carries the sheet-like stream in with it to the inside of the sharp edge. This stream does work on the air, aiding the motion. ” When the motion is reversed and the air moves out of the pipe at the embouchure, the sheet is deflected on to the outer side of the sharp edge, and no \9ork is done against it by the air in the pipe. Hence the stream of air does work during half the vibration which is not abstracted during the other half, and so goes on increasing the motion until the supply of energy in blowing is equal to the loss by friction and sound.

The maintenance of the vibl-ation of the air in the singing tube (described 0. A. § 89) has been explained by Eayleigh (Sound, ii. § 322 h) J’f” as due to the way in which the heat is com- municated to the vibrating air. When the air in a

pipe open at both ends is yibrating in its simplest mode, the air is alternately closing into and out from the ‘Centre. During the quarter swing ending with greatest nodal pressure, the kinetic energy is changed to potential energy manifested in the increase of pressure. This becomes again kinetic in the second quarter swing, then in the third quarter it is changed to potential energy again, but now manifested in the decrease of pressure. In the last quarter it is again turned to the kinetic form. Now suppose that at the end of the first quarter swing, at the instant of greatest pressure, heat is suddenly given to the air. The pressure is further increased and the potential energy is also increased. There will be more kinetic energy formed in the return journey and the vibration tends to gi^ow. But if the heat is given at the iastant of greatest rarefaction, the increase of pressure lessens the difference from the undisturbed pressure, and lessens the potential energy, so that during the return less kinetic energy is formed and the vibration tends to die away. And what is true for the extreme points is true for the half periods of which they are the middle points; that is, heat given during the compression half aids the vibration, and during the extension half damps it. Now let us apply this to the singing tube. Let the gas jet tube be of somewhat less than half the length of the singing tube, and let the lower end of the jet tube be in a wider tube or cavity so that it may be regarded as an ” open end.” When the air in the singing tube is singing, it forces the gas in the jet tube to vibrate in the same period and in such phase that at the nozzle the pressure in both tubes shall be the same. The lower end of the jet tube, being open, is a loop, and the node may be regarded as in an imaginary prolongation of the jet tube above the nozzle. It is evident that the pressure condition will be fulfilled only if the motions in the two tubes are in the same direction at the same time, closing into and opening out from the nodes together. When the motion is up- wards gas is emitted ; when the motion is downwards it is checked. The gas enters in the half period from least to greatest pressure. But there is a slight delay in ignition, partly due to expulsion of incombustible gas drawn into the jet tube in the previous half period, so that the most copious supply of gas and heat is thrown into the quarter period just preceding greatest pressure, and the vibration is maintained. If the jet tube is somewhat longer than half the sounding tube there will be a node in it, and now the condition of equality of pressure requires opposite motions in the two at the nozzle, for their nodes are situated on opposite sides of that point. The heat communication is then chiefly in the quarter vibration just preceding greatest rarefaction, and the vibration is not maintained.

When a flame is just not flaring, any one of~ a certain range of notes sounded near it may make it flare while

the note is sounding. This was first noticed by Sensitive Leconte (J%»7. Mag. xv. 1858, p. 235), and mmes and jg^^gj. ^^ Barrett (Phil. Mag. xxxiii. 1867, p.

216). Barrett found that the best form of burner for ordinary gas pressure might be made of glass tubing about f inch in diameter contracted to an orifice ■j^ inch in diameter, the orifice being nicked by a pair of scissors into a V-shape. The flame rises up from the burner in a long thin column, but when an appropriate note is sounded it suddenly drops down and thickens. Barrett further showed by using smoke jets that the flame is not essential. Tyndall (Sound, Lecture VI. %7 et seq.) describes a number of beautiful experiments with jets at higher pressure than ordinary, say 10 inches of water, issuing from a pinhole steatite burner. The flame may be 16 inches high, and on receiving a suitably high sound it

suddenly drops down and roars. The sensitive point is at the orifice. Lord Rayleigh (Sound, ii. § 370), using as a source a ” bird-call,” a whistle of high frequency formed a series of stationary waves by reflection at a flat surface. Placing the sensitive frame at different parts of this train, he found that it was excited, not at the nodes where the pressure varied, but at the loops where the motion was the greatest and where there was little pressure change. In his Sound (ii. chapter xxi.) he has given a theory of the sensitiveness. When the velocity of the jet is gradually increased there is a certain range of velocity for which the jet is unstable, so that any deviation frqm the straight rush-out tends to increase as the jet moves up. If then the jet is just on the point of instability, and is subjected at its base to alternations of motion, the sinuosities impressed on the jet become larger and larger as it flows out, and the flame is as it were folded on itself. / Another form of sensitive jet is very easily made by putting a piece of fine wire gauze 2 or 3 inches above a pinhole burner and igniting the gas above the gauze. On adjusting the gas so that it bums in a thin column, just not roaring, it is extraordinarily sensitive to some particular range of notes, going down and roaring when a note is souuded. If a tube be placed over such a flame it makes an excellent singing tube.

If a jet of water issues at an angle to the horizontal from a round pinhole orifice under a few inches pressure, it travels out as an apparently smooth cylinder for a short distance and then breaks up into ^^la’tts drops which travel at different rates, collide, and scatter. But if a tuning-fork of appropriate fre- quency be set vibrating with its stalk in contact with the holder of the pipe from which the jet issues, the jet appears to go over in one continuous thread. Inter- mittent illumination, however, with frequency equal to that of the fork shows at once that the jet is really broken up into drops, one for each vibration, and that these move over in a steady procession. The cylindrical form of jet is unstable if its length is more than v times its diameter, and usually the irregular distxirbances it receives at the orifice go on growing, and ultimately break it up irregularly into drops which go out at different rates. But, if quite regular disturbances are impressed on the jet at intervals of time whi^ depend on the diameter and speed of out-flow (they must be somewhat more than IT times its diameter apart), these disturbances go on growing and break the stream up into-equal drops, which all move with the same velocity one after the other. An excellent account of these and other jets is given in Boys’_ Soap Bubbles, Lecture III.

The formation of beats (as described in 0. A. § 102) may be illustrated by considering the disturbance at any point due to two trains of waves of equal am- plitude a and of nearly equal frequencies rij n^. ^ea’»- If we measure the time from an instant at which the two are in the same phase the resultant disturbance

IS

y = a sin 2irnit + a sin 2irn^ = 2a cos 7r(mi – ni)t sin 2^”^ “+ ‘^H,

which may be regarded as a harmonic disturbance of fre- quency («! +n2)/2 but with amplitude 2a cos ■ir(n-^ —n^t slowly varying with the time. Taking the square of the amplitude to represent the intensity or loudness of the sound which would be heard by an ear at the poiut, this is 4a'' cos^ Tr(ni — n^jt = 2a^[l + cos 27r(7ii — n^i\,

a value which ranges between 0 and 4a2 with frequency jij— n^. The sound swells out and dies down n-^—n^ times per second, or there are Uy—n^ beats per second.

If, instead of considering one point in a sucaession of in- stants, we consider a succession of points along the line of propagation at the same instant, we evidently have waves of amplitude varying from 2a down to 0, and then up to 2a again in distance U/(Mi-nj). If the difference of frequency of the two tones is so great that the beats are not heard separately, and if the two sounds are of sufficient loudness, then a tone is heard of the same frequency, ni—n2, as the beats. This tone was first discovered by Sorge in 1740, and independently a few years later by Tartini, after whom it is named. It may easily be heard when a double whistle with notes of different pitch is blown strongly, or when two gongs are loudly sounded close to the hearer. It is heard, too, when two notes on the harmonium are loudly sounded. Formerly, it was generally supposed that the Tartini tone was due to the beats themselves, that the mere variation in the amplitude was equivalent, as far as the ear is concerned, to a super- position on the two original tones of a smooth sine dis- placement of the same periodicity as that variation. This ^ view has still some supporters, and among its recent advocates are Koenig and Hermann. But it is very diffi- cult to suppose that the same sensation would be aroused by a truly periodic displacement represented by a smooth curve, and a displacement in which the period is only in the amplitude of the to-and-fro motion, and which is represented by a jagged curve. No explanation is given by the supposition ; it is merely a statement which can hardly be accepted unless all other explanations fail.

Helmholtz has given a theory which certainly accounts for the production of a tone of the frequency of the beats,

and for other tones all grouped under the name tkmUuKs. °^ combination tones. The only question is

whether the intensity of the tones heard is accounted for by the theory. Combination tones may be produced in three ways : — (1) In the neighbourhood of the source ; (2) in the receiving mechanism of the ear ; (3) in the medium conveying the waves.

(1) We may illustrate the first method by taking a case dis- cussed by Helmholtz (Sensations of Tone, App. xvi.) where the two sources are reeds or pipes blown from the same wind-chest. Let us suppose that with constant excess of pressure, p, in the wind-chest, the amplitude produced is proportional to the pressure, so that the two tones issuing may be represented by pa sin 27rni* and pb sin 2irnit. Now as each source lets out the wind periodi- cally it affects the pressure in the chest so that we cannot re- gard this as constant, but may take it as better represented by p+\asin(27rMi«-|-e)^^&sin(27r«2{-|-/). Then the issuing dis- turbance will be

{p+\a sin (27rrei«+e) +^J> sin (2irn2t+f)}{a sin 27rmi{-|-6 sin 2ir?i2*} =pa sin 2irn\t+pb sin iirn^t

+— cos e-— cos (imt+e)

2 2

^ cos/-^cos(45rn2«/)

2 ‘2 ,

+«*^cos{27r(ni-n2)«-t-«}- — cos{27r’(mi-|-»2)«+e}

2 2

+ «|if cos{27r(«i-n2)*-/}-^ cos {2^ini+n2)t+f} (1) 2 • ^

Thus, accompanying the two original pure tones there are (1) the octave of each; (2) a tone of frequency (ni— tiz); (3) a tone of frequency (rai-|-Ji2). The second is termed by Helmholtz the difference tone, and the third the summation tone. The amplitudes of these tones are proportional to the products of a and 6 multiplied by \ or /i. These combination tones will in turn react on the pressure and produce new combination tones with the original tones, or with each other, and such tones may be termed of the second, third, etc. order. It is evident that we may have tones of frequency

hm kn2 hni—kui htii+kni, where h and k are any integers. But inasmuch as the successive orders are proportional to X X^ X’, or /j, ^fl. fi?, and X and ii are small, they are of rapidly decreasing importance, and it is not cer- tain that any beyond those in equation (1) correspond to our

actual sensations. The combination tones tbus produced in the source should have a physical existence in the air, and the ampli- tudes of those represented in (1) should be of the same order. The conditions assumed in this investigation are probably nearly realized in a harmonium and in a double siren of the form used by Helm- holtz (0. A. § 51), and in these cases there can be no doubt that actual objective tones are produced, for they may be detected by the aid of resonators of the frequency of the tone sought for. If ■ the tones had no existence outside the ear then resonators would not increase their loudness. There is not much difficulty in detect- ing the diSerence tone by a resonator if it is held, say, close to the reeds of a harmonium, and Helmholtz succeeded in detecting the summation tone by the aid of a resonator. Further, Rtioker and Edser, using a siren as source, have succeeded in making a fork of the appropriate pitch respond to both difference and sum- mation tones (Phil. Mag. xxxix. 1895, p. 341). But there is no doubt that it is very difficult to detect the summation tone by the ear, and many workers have doubted the possibility, notwithstand- ing the evidence of such an observer as Helmholtz. Probably the fact noted by Mayer (Phil. Mag. ii. 1878, p. 500, or Eayleigh, Sound, § 386) that sounds of considerable intensity when heard by themselves are liable to be completely obliterated by graver sounds of sufficient force goes far to explain this, for the sum- mation tones are of course always accompanied by such graver sounds.

(2) The second mode of production of combination tones by the mechanism of the receiver is discussed by Helmholtz (Sensa- tions of Tone, App. XII.) and Eayleigh (Sound, § 68). It depends on the restoring force due to the displacement of the receiver not being accurately proportional to the displacement. This want of proportionality will have a periodicity, that of the impinging waves, and so will produce vibrations just as does the variation of pressure in the case last investigated. We may see how this occurs by supposing that the restoring force of the receiv- ing mechanism is represented by

where x is the displacement and fix^ is very small. Let an external force F act on the system, and for simplicity suppose its period is so great compared with that of the mechanism that we may take it as practically in equilibrium with the restoring force. Then

Now /isc^ is very small compared with Xk, so that x is nearly equal to F/X, and as an approximation,

F=X»;+i^

X2

F F2

or x= fi——

X X3

Suppose now that F=a sin 2ir»iii-l-6 sin irn^t, the second term will evidently produce a series of combination tones of periodicities 2»i, 2m2, ni—n2, and ni+ni, as In the first method. There can be no doubt that the ear is an unsymmetrical vibrator, and that it makes combination tones, in some such way as is here indicated, out of two pure tones. Probably in most cases the combination tones which we hear are thus made, and possibly, too, the tones detected by Koenig, and by him named “beat-tones.” He found that if two tones of frequencies p and q are sounded, . and if q lies between Np and (N-f l)p, then a tone of frequency either (TS+l)p—q, or of frequency g— Np, is heard. The difficulty in Helmholtz’s theory Is to account for the audibility of such beat tones when they are of a higher order than the first. Rucker and Edser quite failed to detect their external existence, so that apparently they are not produced in the source. If we are to assume that the tones received by the ear are pure and free from partials, the loudness of the beat-tones would appear to show that Helmholtz’s theory is not a complete account.

(8) The third mode of production of combination tones, the production in the medium itself, follows from the varying velocity of different parts of the wave, as investigated at the beginning of this article. It is easily shown that after a time we shall have to superpose on the original displacement a displacement propor- tional to the square of the particle velocity, and this will intro- duce just the same set of combination tones. But probably in practice there is not a sufficient interval between source and hearer for these tones to grow into any importance, and. they can at most be only a small addition to those formed in the source or the ear.

AnxHOKiTiBS. — LoHD Eatleigh, Sound, 2nd ed. London, 1894, is the standard treatise on the’ phenomena of Acoustics ; the last chapter, on “Facts and Theories of Audition,” is a most valu- able summary of the present state of knowledge of audition and the different theories held. — Helmholtz, Sensations of Tone, 2nd Eng. ed. London, 1885, deals more with the physiological aspect. — Sedley Taylor, Sound and Music, London, 1873, is a general

account of Helmholtz’s Theory of Consonance and Dissonance (briefly stated in 0. A. § 106, but not discussed in tliis supple- ment).— PoYNTiNG and Thomson, Sound, London, 1899, is an elementary mathematical account of the phenomena of Acoustics.

(j. H. P.*)

Acqui, a town and episcopal see of the province of Alessandria, Piedmont, Italy, 21 miles S.S.W. from Ales- sandria by rail. The castle of the Palseologi is now con- Ycrted into a prison. Here is a technical school. Its sulphur baths attract annually about 4000 visitors. Popu- lation (1901), 13,786.

Acre (Arab. AMa), a survival of the Biblical Acco, and ancient Ake, the chief town of a Palestine sanjak which includes Haifa, Nazareth, and Tiberias. From its com- manding position on the sea-shore of a broad fertile plain over which the coast road from Syria to Egypt has always passed, and whence there is easy access to the rich lands of Galilee and the Trans- Jordanic countries, it has been called ” the Key of Palestine,” and its history is principally that of its many sieges. It was occupied in turn by Assyrians, Babylonians, Persitos, and Greeks, but never by the Hebrews, and was assigned on the division of Alexander’s kingdom to Ptolemy Soter, after whom it was ,called Ptolemais. One of its mediseval names, Aeon, has been preserved in that of the church of St Nicholas Aeons, in Lombard Street, London. It exports wheat, maize, olive oil, cotton, &c., but the trade is gradually passing to Haifa, where there is a safer roadstead. The town will be con- nected by a branch line with the Haifa-Damascus railway now being constructed. Population, 11,000 (Moslems, 8000 ; Christians, Jews, and others, 3000).

Actinozoa. SeeANTHOzoA.

• Acton, a parish and urban district (coextensive) in the suburbs of London, in the Ealing parliamentary division of Middlesex, about 7 miles W. of St Paul’s, with three railway stations. Many distinguished persons have lived there, among them Eichard Baxter, Sir Matthew Hale, Henry Fielding, and Lindley the botanist. A recreation ground of 21 acres was opened in 1887, and there are a cottage hospital, a free library (1900), and a Thomas Aske girls’ school (1901). Area, 2305 acres. Population (1881),

17,110; (1891), 24,206; (1901), 37,744.

Acton, John Emerich Edward Dalberg

Acton, 1st Baeon (1834), son of Sir Ferdinand

Acton, Bart., was born at Naples, 10th January 1834. His mother, who after her husband’s death in 1837 mar- ried Earl Granville, was the daughter of the duke of Dal- berg, which caused Lord Acton, after studying linder Cardinal Wiseman at the Roman Catholic college at Oscott, to receive the most valuable part of his education in Bavaria. Under the inspiration of Dollinger, in whose house he lived for a considerable time, he imbibed- not only that love of history, but that disposition to treat his- tory as a science in a thoroughly impartial spirit, and to render a profound investigation of canon and of inteit- national law auxiliary to historical research, which have ever since distinguished him. Such a spirit must be one of especial hostility to ultramontane pretensions ; and Lord Acton, although a sincere Catholic, made it for a time his especial mission to combat these in the Home and Foreign Beview, which he conducted from 1862 to 1864 with a vigour insuring its condemnation and virtual suppression by the Roman Catholic hierarchy. Nothing daunted, Lord Acton and his friends acquired the North British Beview, hitherto an organ of the Free Church of Scotland, and carried it on actively for several years in the interest of a high-class Liberalism both in temporal and in ecclesi- astical matters. Lord Acton contributed several valuable

articles, and in 1870 proceeded to Rome to take such part as was possible to a layman in opposing the promul- ga^tion of the dogma of papal infallibility. He was active as a writer under his own name and as an inspirer of the writings of others, but the calamity so much dreaded by Liberal Catholics was not to be averted. The Old Catholic separation followed, but Lord Acton held aloof. He had been raised to the peerage in 1869, but his great know- ledge and breadth of view have been too little enlisted in the service of the House of Lords. In 1874, however, he came forward conspicuously as a supporter of Mr Glad- stone in the controversy on ” Vaticanism,” pointing out in a series of letters to the Times various actions and char- acteristics of individual popes by no means easy to recon- cile

with the doctrine of papal infallibility. For many years little came from his pen except an article on the divorce of llenry VIII. in the Quarterly Beview for 1877, and an essay on modern German historians, contributed to the first number of the English Historical Beview in 1886. In 1895, however, his acceptance of the Regius Professor- ship of Modern History at Cambridge, vacant by the death of Sir John Seeley, drew from him an inaugural lecture on ” The Study of History,” with notes displaying a vast erudition, by no means merely historical. Lord Acton has since continued to lecture regularly, and, at the instance of the ‘university, undertook the editorship of a great modern history by various writers from the middle of the 15th century to the present day. Lord Acton is an Honorary Fellow of All Souls’ college, Oxford, and was a lord-in-waiting from 1892 to 1895.

Acts of the Apostles. — In this article we shall deal with such additions to our knowledge as have been made since 1875, when the article in the ninth edition of this work was published.

Text. — The apparatus criticus of Acts has grown con- siderably of recent years; yet mainly in one direction, that of the so-called ” Western ” text. This term, which our growing knowledge, especially of the Syriac and other Eastern versions, is rendering more and more unsatis- factory, stands for a text which used to be connected almost exclusively with the “eccentric ” Codex Bezoe. But it is now recognized to have been very widespread, both in east and’ west, for some 200 years or more from about the middle of the 2nd century. The process, however, of sifting put the readings of all our present witnesses — MSS., versions, fathers — has not yet gone far enough to yield any sure or final result as to the history of this text, so as to show what in its extant forms is primary, secondary^ and so on. Beginnings have been made towards grouping our authorities ; but the work must go on much further before a solid basis for the reconstruction of its primitive form can be said to exist. The attempts so far made at such a reconstruction, as by Blass (1896, 1897) and Hilgenfeld (1899), are quite arbitrary. And the like must be said of the most recent contribution to the problem, that of August Pott,’ though he has helped to define one condition of success — the classification of the strata in ” Western ” texts — and has taken some steps in the right direction, in connexion with the complex pheno- mena of one witness, the Harklean Syriac.

Assuming, however, that the original form of the ” Western ” text had been reached, the question of its his- torical value, i.e., its relation to the original text of Acts, yet remains. On this point the highest claims have recently been made by Blass. Ever since 1894 he has held that both the “Western “text of Acts (which he styles the /8 text) av-d. its rival, the text of the great uncials

1 Der abencUandische Text der Apostelgeschichte u. die Wir-quelle. Leipzig, 1900. S I — 8

(which he styles the a text), are due to the author’s own hand. Further, that the former is the more original of the two, being related to the latter as fuller first draft to severely pruned copy. But even in its latest form, that ” ^ stands nearer the Grwndschrift than a, but yet is, like a, a copy from it,” the theory is really untenable. In sober contrast to Blass’ sweeping theory sfand the views of Prof. W. M. fiamsay. Already in The Church in the Roman Empire (1893) he held that the Codex Bezce rested on a recension made m Asia Minor (somewhere between Ephesus and S. Galatia), not later than about the middle of the 2nd century. Though’” some at least of the altera- tions in Codex Bezce arose through a gradual process, and not through the action of an individual reviser,” the revision in question was the work of a single reviser, who in his changes and additions expressed the local interpre- tation put upon Acts in his own time. His aim, in suiting the text to the views of his day, was partly to make it more intelligible to the public, and partly to make it more complete. To this end he ”

added some touches where surviving tradition seemed to contain trustworthy addi- tional particulars," such as the statement that Paul taught in the lecture-room of Tyrannus "from the fifth to the tenth hour." In his later work, on ■St Paul the Traveller and the Boman Citizen (1895), Ramsay's views gain both , in precision and in breadth. The gain lies chiefly in seeing beyond the Bezan text to the " Western " text as a whole. But when he writes that, " wherever the Bezan text is confirmed by old versions and by certain Greek MSS., it seems to me to deserve very earnest considerar tion, as at least pointing in the direction of an original reading subjected to widespread corruption," he goes beyond the mark. Such agreement need not mean more than that the reading ia a gloss belonging to the " West- ern" text, as it arose under conditions which Ramsay himself excellently describes.

On the whole, then, the text of Acts as printed by Westcott and Hort, on the basis of the earliest MSS. (SB), seems as near the autograph as that in any other part of the New Testament ; whereas the " Western " text, even in its earliest traceable forms, is secondary. This does not mean that it has no historical value of its own. It may well contain some true supplements to the original text, derived from local tradition or happy inference ; certain of these may even date from the end of the 1st century, and the larger part of them are probably not later than the middle of the 2nd. But its value lies mainly in the light cast on the ecclesiastical tradition in certain quarters during the epoch in question. The nature of the readings themselves, and the distribution of the witness for them, alike point to a process involving several stages and several originating centres of diffusion. The classification of groups of " Western" witnesses has already begun. When completed, it will cast light, not only on the origin and growth of this type of text, but also on the exact value of the remaining witnesses to the original text of Acts.

Picm and Object of Acts. — Here the Tubingen school did its chief work in putting the needful question, not in returning the correct answer. Their answer could not be correct, because, as Ritschl shows, their premises were wrong. Still the attitude created by the Tubingen theory largely persists as a biassing element in much that is written about Acts. On the whol*, however, there is a disposition to look at the book more objectively, and to follow up the hints as to its aim given by the author in his opening verses. Thus (1) his second narrative is the natural sequel to his first. As the earlier one set forth in orderly sequence (xafle^s) the providential stages, by which Jesus was led, " in the power of the Spirit," to begin the establishment of the consummated Kingdom of

God ; so the later work aims at setting forth on similar principles its extension by means of His chosen repre- sentatives or apostles. This involves emphasis on the identity of the power, i.e., divine and not merely human power, expressed in the great series of facts from first to last, and so upon (2) the Holy Spirit, as directing and energizing throughout the whole struggle with the powers of evil to be overcome in either ministry, of Master or disciples. But (3) the continuity is more than similarity of activity, resting on the same divine energy. The work- ing of the energy in the disciples is conditioned by the continued life and volition of their Master at His Father's right hand in heaven. The living link between Master and disciples is the Holy Spirit, " the Spirit of Jesus." Hence the pains taken to exhibit afresh (i. 2, 4 f. 8, ii. 1 ff., c/. Luke xxiv. 49) the fact of such spiritual solidarity, whereby their activity means His continued action in the world. And (4) the scope of this action is nothing less than humanity as gathered within the Roman empire. It was foreordained that Messiah's witnesses should be borne by divine power through all obstacles and to ever-widening circles, until they reached and occupied Rome itself for the God of Israel — now manifest (as foretold by Israel's own prophets) as the one God of the one race of mankind. (5) Further, as we gather from the parallel account in Luke xxiv. 46-48, the divinely appointed method of victory is through suffering (Acts xiv. 22). This thought explains the large space devoted to the tribulations of the witnesses, and their constancy amid them, after the type and sample of their victorious Lord. It forms one side of the virtual apologia for the absence of that outward prosperity in which the pagan mind was apt to see the token of divine approval. Another side is the recurring exhibition of the fact that these witnesses were

perse- cuted only by those whose action should create no bias , against the persecuted. Their foes were chiefly Jews, whose opposition was due partly to a stiff-necked dis- inclination to bow to the wider reading of their own religion — ^to which the Holy Spirit had from of old been pointing — and partly to jealousy of those who, by preaching the wider Messianic Evangel, were win- ning over the Gentiles, and particularly proselytes, in such great numbers.

Such, then, seem to be our author's main motifs. They make up an account fairly adequate to the mani- f oldness of the book ; and yet they all run up into one central idea, viz., the divine character of the Christian religion, as evinced by the manner of its extension in the empire. This view has the merit of giving the book a practical religious aim — a sine qud non to any theory of an early Christian writing. Though addressed to men of pagan birth in the first instance, it is to them as inquirers or even recent converts, such as " Theophilus," that the appeal is made. In spite of all difficulties, this religion is worthy of personal belief and acceptance. Such is the moral of our author's work. Yet among the conditioning features of the occasion, which impressed him with the need of such an appeal, was doubtless the existence of persecution now actually carried out by the Roman authorities, sometimes perhaps of their own motion. To meet this special pferplexity our author holds up the picture of early days, when the great protagonists of the Gospel constantly enjoyed protection at the hands of Roman justice. It is implied that the present distress was but a passing phase, resting on some misunderstand- ing; meantime, the spectacle of apostolic constancy should yield strong consolation to the tried.

From this standpoint Acts no longer seems to end abruptly. Whether as exhibiting marvellous divine lead- ing and aid, or as recording the impartial and even kindly attitude of the Roman state towards the Christians, the

writer has reached a climax. ” He wished,” as Harnack well remarks, ” to point out the might of the Holy Spirit in the apostles, Christ’s witnesses ; and to show how this might carried the Gospel from Jerusalem to Eome and gained for it entrance into the pagan world, whilst the Jews in growing degree incurred rejection. In keeping with this, verses 26-28 of chapter xxviii. are the solemn closing verses of the work. But verses 30, 31 are an appended observation.” So far, so good ; but objection may be taken when Harnack goes on to say that this observation does not admit of explanation from the plan of the work, ” but rather from the almost independent interest which, not so much the life of Paul, as the mar- vellous manner of the realization of Paul’s journey to Eome, had incidentally acquired for the author.” To many it will seem that the writer is ending up most fitly on one of his keynotes, in that he leaves Paul preaching in Eome itself, ” unmolested.” The full force of this is missed by those who, while rejecting the idea that the author had in reserve enough Pauline history to furnish another work, yet hold that Paul was freed from the imprisonment amid which Acts leaves him.* But for those, on the other hand, who see in the writer’s own words in xx. 38, uncontradicted by anything in the sequel, a broad hint that Paul never saw his Ephesian friends again, the natural view is open that the sequel to the two years’ preaching was too notorious to call for explicit record. Nor would such silence touching Paul’s speedy martyrdom be disingenuous, any more than on the theory that martyrdom overtook him several years later. Our author would view Paul’s death as a mere exception to the rule of Eoman policy heretofore illustrated, due to the influence of a sort of niadman, such as Nero was naturally held to be in the latter part of his reign. Not even by the Eoman authorities were some of his acts regarded as precedents ; and so our author could honestly refrain from recording what he viewed as a mere freak of Neronian caprice, especially as it would be already known to his contemporaries. Such silence would be the more natural if he were writing ip. Eome, a conclusion to which certain things are often thought to point.

Date. — ^External evidence now points to the existence of Acts at least as early as the opening years of the 2nd century. As evidence for the Third Gospel holds almost equally for Acts, its existence in Marcion’s day (120-140) is now assured. Further, the traces of it in Polycarp ^ and Ignatius,’ when taken together, are highly probable. Aiid what is still more important, it is probable that Acts was already known in Eome by c. a.d. 96. For it is widely admitted that the resemblance of Acts xiii. 22, and 1 Clem, xviii. 1, in features not found in the Psalm (Ixxxix. 20) quoted by each, cannot be accidental.

Acts xiii. 22. 1 Clem, xviil. 1.

ijyeipev rbv Aaveld . , . iS Kal 11 Si etircainev iirl T

rbv Tov ‘leriral, ivSpa Kara t^v & Se6s, EBpoi’ AvSpa (tori r^v

KapStav iMv [ivSpa k.t.X. from 1 KapSlav /Mv, AavelS rbv toB

Sam. xiii. 14, dytf/Mtfiroc K.T.X.]. ‘Ie

airrkv.

Here the Greek Bible has simply ‘Evpav AovetS tov SoiiXdv lixm. Nor should the reference in either case to David as a man witnessed to by God, be overlooked, tending as it does to exclude the idea that the likeness

1 Unless we arbitrarily separate (in the face of the ancient Latin Teision) iirl rb rip/jui rijs Si

2 Polyc. ad Philipp. i. 2, Acts ii. 24; ii. 1, Acts x. 42; ii. 3, Acts XX. 35; vi. 3, Acts vii. 62.

« Ign. ad Magn. v. 1, Acts i. 25; ad Smyrn. iii. 3, Acts x. 41.

between the passages is due to some third source. The dependence seems clearly to be on the side of 1 Clement, especially in view of possible echoes of Acts xx. 35, which it contains in three distinct places (ii. 1, xiii.» 1, xlvi. 7, c/. Polyc. ii. 3). There is, then, high probability that Acts was current in Antioch and Smyrna not later than c. A.D. 115, and in Eome as early as c. a.d. 96.

With this view internal evidence agrees. In spite of Blass' advocacy of a date prior to a.d. 70, the bulk of critical opinion puts this theory firmly aside. Thus the prologue to the Gospel of which Acts is the sequel, already implies the dying out of the generation of eye- witnesses as a body. Of recent years, too, the relations of Church and Empire have been brought to bear, especially by Eamsay. And his dating, a.d. 81 or soon after, fits in with a strong consensus of critical opinion both in England and abroad — Harnack, for instance, placing Acts between 80 and 93, while Zahn prefers 75 to 80. So that A.D. 80 may be taken as a fair average date, while any year between it and 71 is open. Of the reasons for a date in one of the earlier decades of the second century, as argued by the Tubingen school and its heirs, several are now really untenable. Among these are the supposed traces of 2nd-century gnosticism and " hierarchical " ideas of organization ; but especially the argument from the relation of the Eoman state to the Christians, which Eamsay has completely reversed and turned into proof of an origin prior to Pliny's corre- spondence with Trajan on the subject. Another fact, now generally admitted, renders a 2nd-century date yet more incredible ; and .that is, the failure of a writer devoted to Paul's memory to make palpable use of his Epistles. Instead of this he wiites in a fashion that seems to traverse certain facts recorded in them. If, indeed, it were proved that Acts uses the later works of Josephus, we should have to place the book about a.d. 100. But this is far from being the case, .a critic like Harnack decisively rejecting the alleged dependence.

Sources. — So far from the recognition of a plan in Acts being in itself inimical to a serious quest after the materials used in its composition, one may say that it points the way thereto, while it keeps the literary analysis within scientific limits. Thus the more one realizes the theological standpoint of the mind pervading the book as a whole, the more one feels that the speeches in the' first part of Acts — and indeed elsewhere, too — are not " free compositions " of our author, the outcome of dramatic idealization such as ancient historians like Thucydides or Polybius allowed themselves. The Christology, for instance, of the early Petrine speeches is such as a Gentile Christian writing c. 80 a.d. simply could not have imagined, even had the idea of adopting Judseo-Christian categories been present to his mind. Thus we are forced to assume the use of a certain amount of early Judseo-Christian material, analogous to that implied also in the special parts of the Third Gospel. One critic, at least, Paul Peine (Eine vorkanonische Ueberlieferung des Lukas, 1891), suggests that a single document explains this material in both works, as far as Acts xii. ; while others maintain that more than one such source underlies Acts i.-xii., or even i.~~xv. (e.g., a source embodying the traditions of the largely Gentile Church of Antioch). Yet if~~ our author was an Antiochene and a careful inquirer (Luke i. 3), this may explain ^all. It cannot, indeed, be said that definite results have here been attained as yet. But the study is a new one, and the resources of analysis, the linguistic in particular, are by no means exhausted. One important analogy for the way in which one author may be supposed to have handled his sources exists ; and that is the maimer in which he uses Mark's narrative in compiling his own Gospel.

Guided by such an objective criterion, and safeguarded by growing insight into the author's plastic aim, we need not despair of reaching large agreement as to the main scope of the sources lying behind the first half of Acts.

In the second or strictly Pauline half we are con- fronted by the so-called " we " passages. Of these two main theories are possible; that which sees in them traces of an earlier document — whether entries in a travel-diary, or a more or less consecutive narrative written later ; and that which would regard the " we " as due to the author's breaking instinctively into the first person plural at those points in the history at which he t himself had been present. On the former hypothesis, it is still ia debate whether the "we" document does or does not lie behind more of the narrative than is defi- nitely indicated by the formula in question {e.g., cc. xiii.- XV., xxi. 19-xxvi.).

Authorship. — ^Was the author of the " we " passages, in any form, also the author of Acts as it now stands ? And if so, was that author's name Luke, as ecclesiastical tradition has steadily afi&rmed from the time when its voice fitrst reaches us ? Few deny that Luke, i.e., Paul's companion of that name, was the author of the " we " passages. The tradition connecting him with Acts is too early and unanimous to be mistaken, especially seeing that his name was not prominent enough to account for such an ascription by " spontaneous generation." Hence those who would see in the " we " passages traces of an earlier travel-document written by Timothy or Silas, seem bound in a special degree to make Luke the author of Acts as a whole. In this case, however, they have yet to explain how so skilled a writer, one elsewhere master of his sources as to literary form, could leave these sections couched in the first person of the eye-witness. And it may fairly be said that, if the weight of expert opinion is against ~~the theory of literary negligence, it inclines also against the theory of pious fraud — ^the re~~ tention of the first person with intent to deceive. The net result is, that unity of authorship between the " we " passages and the rest of Acts seems the one tenable view ; and this involves the Lucan authorship of both? As to such historical difficulties in Acts as at present perplex the student of the Apostolic age, one must re- member in most cases the possibilities of mistake in- tervening between the facts and the accounts reaching its author at second or even third hand. Yet it must be strongly emphasized that recent historical research at the hands of experts in classical antiquity has tended steadily to verify such parts of the narrative as it can test. That is no new result ; but it has come to light in greater degree of recent years, and notably during the last decade. The proofs of our author's trustworthiness extend also to the theological sphere. What was said above of the Christology of the Petrine speeches, applies also to the whole conception of Messianic salvation, the eschatology, the idea of Jesus as equipped by the Holy Spirit for His Messianic work, found in these speeches, as also to titles like "Jesus the Nazarene" and "the Righteous One" both in and beyond the Petrine speeches. These and other cases in which we are led to discern Ju- dsean witness behind Acts, do not indeed give to such witness the value of shorthand notes or even of abstracts based thereon. But they do support-the theory that our author meant to give an unvarnished account of such •words and deeds as had come to his knowledge. The perspective of the whole is no doubt his own ; and as his witnesses probably furnished but few hints for a con-

1 This accords excellently with the reference in Col. iv. 14 to Luke as a physician. For a good account of the argument from the medical language of Aots, see Knowling, Expositor's Greek Testament, vol. ii.

tinuous historical narrative, this perspective, especially in things chronological, may sometimes be faulty. Yet when one remembers that by 80 a.d. it must have been a matter of small interest by what tentative stages the Messianic salvation first extended to the Gentiles, it is surely surprising that Acts enters into such detail on the subject, and is not content with a summary account of the matter such as

the mere ” logic ” of the subject would naturally suggest. In any case the very difference of the perspective of Acts and of Galatians, in recording the same epochs in Paul’s history, argues such an indepen- dence in the former as is compatible, in the case of an admirer of the apostle, only with an early date, when as yet Galatians might easily be unknown beyond the dis- trict to which it was addressed.^

Quellenkritik, then, a distinctive feature of recent re- search upon Acts, is a solvent of many difficulties in the way of treating Acts as an honest narrative by a com- panion of Paul. It will account, for instance, for such discrepancies as lie on the surface of the three accounts of Saul’s conversion ; while the fidelity with which our author uses his materials is shown by his not assimilat- ing the accounts in Paul’s speeches to the earlier narrar tive in chapter ix. In addition to QueUenkritih, we may also count among recent gains a juster method of judg- ing such a book. For araong the results of the Tubingen criticism was what Dr Sanday calls ” an unreal and arti- ficial standard, the standard of the 19th century rather than the 1st, of Germany rather than Palestine [may we not add Antioch or Rome ?], of the lamp and the study rather than of active life.” In the recovery of a more real standard, we owe much to men like Mommsen, Earn- say, and Blass, trained amid other methods and traditions than those which had brought the constructive study of Acts almost to a deadlock.

LiTERATUEE. — It would take too much space to give an account of the extensive and varied literature that gathered round Acts during the last quarter of the 19th century. It may be found in two recent and representative commentaries, viz.’, Wendt’s last edition of Meyer (1899), and that by R. J. Knowling in The Ex- positor’s Greek Testament, vol. ii. 1900. (j. v. B.)

Adabazar, an important commercial town in Asia Minor, situated on the old military road from Constanti- nople to the east, and 5|- miles distant from a station of the same name on the Anatolian railway. It was founded in 1540 and enlarged in 1608 by the settlement in it of an Armenian colony. There are silk and linen indus- tries, and an export of tobacco, walnut-wood, cocoons, and vegetables for the Constantinople market. Imports are valued at £80,000, and exports at £480,000. Popu- lation, 18,000 (Moslems, 10,Q00 ; Christians, 8000).

Adalia, or Antalia, classical Attaleia, mediaeval Satalia, the chief town and seaport of a sanjak of the Konia viMyet in Asia Minor. It is situated at a re-enter- ing angle, in a flat limestone terrace which terminates seaward in a cliff about 120 feet high, and had an inner and outer harbour. The town lies partly within and ‘ partly without the old walls, in which may still be seen the Perga gate, built by Hadrian, a tower erected by the Empress Julia, and many Greek and Latin inscriptions. There are several mosques and medresses (or schools) built by the Seljuk sultans of Eum, and a few remains of Roman and Byzantine buildings.

Attaleia was founded, 159-138 b.c, to facilitate trade between the Pergamene kingdom and Syria and Egypt. Under the Romans it was an important town, coiinected by highways with Laodioea

2 Nor should one forget the numerous but subtle agreements between Acts and Galatians which Ramsay has shown to be involved in the now victorious ” South Galatian ” theory, that sees in St Paul’s ” Galatians ” the members of the churches whose foundation is described in Acts xiii. xiv.

and Fisidian Antioch, and the centre of a large sea-borne trade. It became the metropolis of Pamphylla, and in 1148 it gave timely shelter to the harassed troops that Louis VII. of France was lead- ing to Palestine. Afterwards it passed to the Seljiik Turks, 1206 ; to the Venetians, 1307 ; to the Mongols, the Genoese, and finally to the Osmanli Sultan Murad II. (1421-61). Adalia has lost much of its trade since the opening of railways from Smyrna to the interior, but it still exports cereals, timber, valonea, liquorice root, and cotton ; the exports in 1899 were valued at £152,156, the imports at £120,073. It is the seat of a British vice-consulate. Population, 30,000 (Moslems, 24,000 ; Christians, many apparently of Jewish origin, 6000).

Adamawa, a country of West Africa, now divided between the British, colony of Nigeria (which includes the chief town, Yola) and the German colony of Cameroon. Recent estimates place the height of the granite range of Alantika, the loftiest point in the country, at only 6000 feet. The pagan negro tribes have been dominated by the Mahommedan FuUas, so widely spread over West and Central Africa, for about four centuries. There are also in th« country to-day large numbers of Haussas, who con- tinue to push southwards as traders, as well as Arabs and Kanuri. The Emir of the state of Yola formerly claimed rights of suzerainty over the whole of Adamawa, but the country now consists of a number of separate sultanates which are gradually being brought under the influence of the British and Germans. The town of Garua on the Upper Benue is one of the principal trade centres in the north, and that of Yoko one of the principal in the south. After Barth, the first traveller to penetrate Adamawa was the German, E. E. Elegel (1882), but the country has since been traversed by many expeditions, especially that of Uechtritz and Passarge (1893-94). (See especially Passakge. Adamaua. Berlin, 1895.)

Adams, a town in Berkshire county, in the north- western part of Massachusetts, U.S.A., having an area of 23 square mUes. It includes a portion of the valley of Hoosac river, extending to the Hoosac range on the east, and on the west to Greylock mountain, the highest point in the state, having an altitude of 3505 feet. The valley portion is level and contains several villages, the largest of which bears the same name as the town. Adams village is on a branch of the Boston and Albany railroad, is irregularly laid out, and has an altitude above sea of 798 feet. The town was incorporated in 1778. The population in 1880 was 6591 ; in 1890 it was 9213, and in 1900 it was 11,134.

Adams, Charles Francis (1807-1886), American diplomatist, son of John Quihcy Adams, and grandson of John Adams, was born in Boston on the 18th of August 1807. His father, having been appointed minister to Eussia, took him to St Petersburg, where he acquired a perfect familiarity with French, learning it as his native tongue. After eight years spent in Eussia and England, he attended Harvard College, and graduated there at eighteen. Then he lived two years in the White House, Washington, during the presidency of his father, study- ing law and moving in society, where he met Webster, Clay, Jackson, and Eandolph. Eeturning to Boston he devoted ten years to business and study, and wrote for the North American Review. He also undertook the management of his father's pecuniary affairs, and actively supported him in his contest in the House of Eepre- sentatives for the right of petition and the anti-slavery cause. In 1848 he w4s prominent in politics as a " Con- science Whig," presiding over the Buffalo Convention which formed the Free Soil party and nominated Van Buren for president and himself for vice-president. As a member of the House of Eepresentatives in that Con- gress which sat from 3rd December 1860 to 4th March 1861, he represented Massachusetts in the committee of

thirty-three at the time of the secession of seven of the Southern States. His selection by the chairman of this committee to present to the full committee certain propositions agreed upon by two-thirds of the republican members, and his calm and able speech of 31st January 1861 in the House, served to make him conspicuous before Congress and the country. Together with Seward, he stood for the republican policy of concession; and, while he was criticized severely, and charged with incon-

sistency in view of his record as a Conscience Whig, he was of the same mind as Lincoln, willing to concede non- essentials, but holding rigidly to the principle, properly understood, that there must be no extension of slavery. He believed that as the republicans were the victors they ought to show a spirit of conciliation, and that the policy of righteousness was likewise one of expediency, since it would have for its result the holding of, the border slave States with the North until 4th March,, when the re- publicans could take possession of the Government' of Washington. With the incoming of the new administra^ tion Secretary Seward secured for Adafes the appoint- ment of minister to Great Britain. So much sympathy was shown in England for the southern cause that his path was beset with difficulties ; but his mission was to prevent the interference of Great Britain in the struggle ; and while the work of Lincoln, Seward, and Sumner, and the cause of emancipation, tended to this end, the American minister was insistent' and unyielding, and knew how to present his case forcibly and with dignity. He laboured with energy and discretion to prevent the escape of the Alabama; and, when unsuccessful in this, he persistently urged upon the British Government its responsibility for the destruction of American merchant vessels by that cruiser. His reaerve and frigidity, enforced by his diplomatic ability and high character, procured him the respect of the English, and were of marked assistance to him in his ministerial and social duties. In many emergencies he displayed coolness and courage of a high order. In his own diary he shows that underneath the calm exterior were serious trouble and keen anxiety ; and, in fact, the strain which he underwent during the Civil war made itself felt in later years. Adams was instrumental in getting Earl Eussell to stop the Aleaxi,ndra,&ndi it was his industry and pertinacity in argument and remonstrance that induced Eussell to order the detention in September 1863 of the two iron- clad rams intended for the Southern Confederacy. Adams remained in England until May 1868. His last im- portant work was as a member of the Tribunal of Arbitral tion at Geneva, which disposed of the "Alabama claims." His knowledge of the subject, and his fairness of mind, enabled him to render his dountry and the cause of inter- national arbitration valuable service. He died at Boston* on the 21st of November 1886.

An excellent biography of him has been written by his son, Charles F. Adams, in the American Statesmen series (1900). For his labours in editing works and memoirs, his private speeches and honorary degrees, see Memoir in Massachusetts Historical Society Proceedings, October 1899. (j. f. k.)

Adams, John Couch (1819-1892), British astronomer, was born at Lidcot farmhouse, Laneast, Cornwall, on 5th June 1819. His father, Thomas Adams, was a tenant farmer; iis mother, Tabitha Knill Grylls, inherited a small estate at Badharlick. From the village school at Laneast he went, at the age of twelve, to Devon- port, where his mother's cousin, the Rev. John Couch Grylls, kept a private school. His promise as a mathe- matician induced his parents to send him to the University of Cambridge, and in October 1839 he entered as a sizar at St John's College. He graduated B.A. in 1843 as the

senior wrangler and first Smith's prizeman of his -year. While still an undergraduate he happened to read of certain unexplained irregularities in the motion of the planet Uranus, and determined to investigate them as soon as possible, with a view to ascertaining whether they might not be due to the action of an undiscovered planet beyond it. Elected fellow of his college in 1843, he at once proceeded to attack the novel problem. It was this: from the observed perturbations of a known planet to deduce by calculation, assuming only Newton's law of gravitation, the mass and orbit of an unknown disturbing body. By September 1845 he obtained his first solution, and handed to Professor Challis, the director of the Cambridge Observatory, a paper giving the elements of what he described

as ” the new planet.” On 21st October 1845 he left at Greenwich Observatory, for the information of Airy, the astronomer royal, a similar document, still preserved among the archives. A fortnight afterwards Airy wrote asking a question about a point in the solution. Adams, who thought the point trivial, did not reply, and Airy for some months took no steps to verify by telescopic search the results of the young mathematician’s investiga^ tion. Meanwhile, Le Verrier, on 10th November 1845, presented to the French Academy a memoir on Uranus, showing that the existing theory failed to account for its motion. Unaware of Adams’s work, he attempted a like inquiry, and on 1st June 1846, in a second memoir, gave the position, but not the mass or orbit, of the disturbing body whose existence was presumed. The longitude he assigned differed by only 1° from that predicted by Adams in the document which Airy possessed. The latter was struck by the coiiuiidence, and mentioned it to the Board of Visitors of the Observatory, Challis and Hersehel being present. Hersehel, at the ensuing meeting of the British Association early in September, accordingly ventured to predict that a new planet would shortly be discovered. Meanwhile Airy had in July suggested to Challis that the planet should be sought for with the Cambridge equatorial. The search was begun by a laborious method at the end of the month. On 4th and 12th August, as afterwards appeared, the planet was actually observed ; but owing to the want of a proper star-map it was not then recognized as planetary. Le Verrier, still ignorant of these occurrences, presented on 31st August 1846 a third memoir, giving for the first time the mass and orbit of the new body. He communicated his results by letter to Dr Galle, of the_ Berlin Observatory, who at once examined the suggested region of the heavens. On 23rd September he detected near the predicted place a small star unrecorded in the map, and next evening found that it had a proper motion. No doubt remained that ” Le Verrier’s planet ” had been discovered. On the announcement of the fact Hersehel *and Challis made known that Adams had already calculated the planet’s elements and position. Airy at length pub- lished an account of the circumstances, and Adams’s memoir was printed as an appendix to the Nautical Almanac. A keen controversy arose in France and England as to the merits of the two astronomers. In the latter country much surprise was expressed at the apathy of Airy ; in France the claims made for an unknown Englishman were resented as detracting from the credit due to Le Verrier’s achievement. As the indisput- able facts became known, the world recognized that the two astronomers had independently solved the problem of Uranus, and to each ascribed an equal glory. The new planet, at first called Le Verrier by Arago, received by general consent the neutral name of Neptune. Its mathematical prediction was not only an unsurpassed intellectual feat; it showed also that Newton’s law of gravitation, which Airy had almost called in

question, prevailed even to the utmost bounds of the solar system.

The honour of knighthood was offered to Adams when Queen Victoria visited Cambridge next year ; but then, as on a subsequent occasion, his modesty led him to decline it. The Royal Society awarded him its Copley medal in 1848. In the same year the members of St John’s College com- memorated his success by founding in the University an Adams prize, to be given biennially for the best treatise on a mathematical subject. In 1851 he became president of the Eoyal Astronomical Society. His lay fellowship at St John’s College came to an end in 1852, and the exist- ing statutes did not permit of his re-election. Pembroke College, which possessed greater freedom, elected him in the following year to a lay fellowship, and this he held for the rest of his life. In 1858 he became professor of mathematics at St Andrews, but lectured only for a session, when he vacated the chair for the Lowndean professorship of astronomy and geometry at Cambridge. Two years later he succeeded Challis as director of the Observatory, where he resided until his death. In 1863 he married Miss Eliza Bruce, of Dublin, who survived him.

Although Adams’s researches on Neptune were those which attracted widest notice, the work he subsequently performed in relation to gravitational astronomy and terrestrial magnetism was not less remarkable. Several of his most striking contributions to knowledge originated in the discovery of

errors or fallacies in the work of his great predecessors in astronomy. Thus in 1862 he pub- lished new and accurate tables of the moon's parallax, which superseded Burckhardt's, and supplied corrections to the theories of Damoiseau, Plana, and Pontecoulant. In the following year his memoir on the secular accelera- tion of the moon's mean motion disproved the validity of Laplace's famous explanation, which had held its place unchallenged for sixty years. At first, Le Verrier, Plana, and others abroad disputed the soundness of Adams's startling result ; but further inquiry established beyond question that he was right, and his' memoir produced nothing less than a revolution in this branch of theoretical astronomy. The Boyal Astronomical Society in 1866 awarded him its gold medal for these researches. The great meteor shower of 1866 turned his attention to the Leonids, whose probable path and period had already been discussed by Professor H. A. Newton. Using a powerful and elaborate analysis, Adams ascertained that this cluster of meteors, which belongs to the solar system, traverses a nearly circular orbit in 334- years, and is subject to definite perturbations from the larger planets, Jupiter, Saturn, and Uranus. These results were published in 1867. Ten years later, when Mr G. W. Hill of Washington brpught out a new and beautiful method for dealing with the problem of the lunar motions, Adams announced in a brief notice his own work in the same field, which had followed a parallel course. His results confirmed and supplemented Hill's. In 1874-76 he was president of the Eoyal Astronomical Society for the second time, when it fell to him to present the gold medal of the year to Le Verrier. The determination of the constants in Gauss's theory of terrestrial magnetism occupied him at intervals for over forty years. The calculations involved great labour, and were not published during his lifetime. They were edited by his brother, Professor W. GryUs A,dams, and appear in the second volume of the collected ^Scienti/ic Papers. Numerical computation of this kind might almost be described as his pastime. The value of the constant known as Euler's, and the Bernoullian numbers up to the 62nd, he worked out to an unimagined degree of accuracy. For Newton and his writings he had a boundless admirar

tion ; many of his papers, indeed, bear the cast of New- ton's thought. He laboured for many years at the task of arranging and cataloguing the great collection of Newton's unpublished mathematical writings, presented in 1872 to the University by Lord Portsmouth. The account of these, issued in a volume by the University Press in 1888, is by his hand. The post of Astronomer Royal was offered him in 1881, but he preferred to pursue his peaceful course of teaching and research in Cambridge. He was British delegate to the International Prime Meridian Conference at Washington in 1884, when he also attended the meetings of the British Association at Montreal and of the American Association at Philadelphia, rive years later his health gave way, and after a long illness he died at the Cambridge Observatory on 21st January 1892, and was buried in St Giles' cemetery, near his home. An international committee was formed for the purpose of erecting a monument to his memory in West- minster Abbey ; and there, in May 1895, a portrait medal- lion, by Albert Bruce Joy, was placed near the grave of Newton, and adjoining the memorials of Darwin and of Joule. His bust, by the same sculptor, stands opposite that of Herschel in the hall of St John's College, Cam- bridge, of which both were fellows. Herkomer's portrait is in Pembroke College ; and Mogf ord's, painted in 1851, is in the combination room of St John's. Another bust, taken in his youth, belongs to the Eoyal Astronomical Society. A memorial tablet, with an inscription by Archbishop Benson, is placed in the cathedral at Truro ; and Mr Passmore Edwards erected a public institute in his honour at Launceston, near his birthplace.

The Sctetaific Papers of John Oouch Adams, 4to, vol. i. (1896), and vol. ii. (1900), edited by William Grylls Adams and Ralph Allen Sampson, with a memoir by Dr J. W. L. Glaisher, and his Lectures on

the Lunar Theory, edited by Professor Sampson, have been published by the Cambridge University Press. (p. m.*)

Adana, (1) ‘ a Turkish vilayet in the S.E. of Asia Miaor, which includes the ancient Cilicia. The mountain districts are rich in mineral wealth, and the fertile coast- plain is well watered by the rivers that descend from the Taurus range. Imports and exports pass through Mersina. Pop. 405,000 (Moslems, 158,000 ; Ansarieh, &c., 73,000 ; Christians, 174,000). (2) The chief town of the vilayet, situated in the’ alluvial plain on the right bank of the Sihun, Sarus, which is navigable for small craft to its mouth. It is connected with Tarsus and Mersina by a railway built in 1887, and has good buildings, river-side quays, cotton-miUs, and an American mission with church and schools. Adana, which retains its ancient name, rose to importance as a station on the Eoman military road to the east, and was at one time a rival of Tarsus. During the Middle Ages it often changed hands and suffered many vicissitudes. It is the seat of a British vice- consul. Population, 31,000 (Moslems, 14,000 ; Christians and Ansarieh, 17,000).

Addigrat. See Abyssinia.

Addis-abbaba. See Abyssinia.

Adelaide, the capital of South Australia, 7 miles from the mouth of the Torrens river, in 34° 67′ S. lat. and 138° 38′ E. long. Built on a broad plain running between a range of mountains and the gulf of St Vincent, it is con- nected by rail with the sea at several points besides Port Adelaide — 7^ miles away, including Largs Bay, where the great ocean liners anchor. It is also the terminus of an extensive railway system, of which the main line runs through Melbourne, Sydney, and Brisbane to Rock-hampton. Of late years the population, and more espe- cially that of the outlying suburbs, has rapidly increased. The city generally contained in 1901 38,981 inhabitants ; the city and suburbs within a 10-mile radius, 162,094i

The principal suburbs are Burnside, 7763 ; Glenelg (like Semaphore, a resort on the coast of the gulf), 3946; Hindmarsh, 9984; Kensington and Norwood, 12,562; Port Adelaide, 20,062; St Peter’s, 7605; Thebarton, 6297 ; and Unley, 18,119. The streets are generally broad, well kept, and well drained ; horse tramcars run through the principal thoroughfares ; and arrangements have been made with a private company to light certain parts of the city with electricity. A university was established in 1874, and receives a Government grant of £3200 per annum. It has also been magnificently endowed by Sir Thomas Elder, a former citizen, who presented £30,000 for a medical school, £20,000 for arts and science faculties^ £20,000 for a chair of music, and £25,000 for the general funds of the university. Other educational institutions include a technical college with over 300 scholars, and a school of mines and industries with over 800. There are extensive Government buildings and law courts, a fine museum and free library, an institute con- taining a library, an art gallery containing several splendid specimens of modern art, a town hall, a stock exchange, two handsome markets — one the property of the corpora^ tion, a hospital, two theatres, an academy of music, city baths, two lunatic asylums, and several charitable insti- tutions. The general post oflce also deserves special mention, being one of the finest in Australasia. The large hall of the exhibition building is largely used for the pur- pose of entertainments. Among the monuments are one to Colonel Light, the founder of the colony, statues of Queen Victoria and Robert Burns, and copies of the Farnese Hercules and Canova’s Venus. The city is stir- rounded by park lands, and also contains botanic gardens and a fine collection of zoological specimens. Near Glenelg stands MorpethvUle racecourse. The thermome- ter in summer frequently stands as high as 110° E. in the shade, hot winds blowing the while from the interior, but during the rest of the year the climate is mild and pleasant. During a period of about thirty years the mean annual rainfall has been 20-4 inches.

The Adelaide city government is regarded as more progressive than that of any other Australian capital. The municipal council consists of a mayor and six aldermen, elected by the whole body of ratepayers, and twelve councillors elected by six wards. In no other Australian city is the mayor elected by the ratepayers generally. The drainage is managed on a carefully-planned system. For the water-supply there are three storage reservoirs, with a capacity of about 3,550,000,000 gallons of water, and several service reservoirs. The telephone system is owned by the state. South Adelaide is tbp principal business part of the city, which is the central-share-market in Australia for the West Australian gold^ fields, and also for the silver-mines of Broken Hill, and the copper- mines of Wallaroo, Burra Burra, and Moonta in South Australia. Viewed from the standpoint of trade Port Adelaide is the third port of Australia. In 1900 the imports were valued at £4,739,483, and the exports at £4,363,971. This suburb is also an important manufacturing centre. Altogether four daily newspapers are issued in Adelaide. (j. d. F.)

Adelsberg (Slovene, Postojna), a market town in the Austrian duchy of Carniola, chief town of the district of the same name. Population of commune (1890), 3597, of whom 140 were German and the remainder Slovenes; (1900), 3636. The total length of the passages in the cele- brated stalactite cavern, about a mile from the town, is now over 5^ miles. The connexion with the Ottokar Grotto was established in 1890. The Magdalene Grotto, about an hour's walk to the north, is celebrated for the extraordinary subterranean amphibian, the proteus anguinus, first dis- covered there. It is about a foot in length, lives on snaUs and worms, and is provided with both lungs and gills.

Aden, a seaport and territory in Arabia, politically part of British India, under the governor of Bombay. The seaport is situated in 12° 45′ N. lat. and 45° 4′ E. long.,

on a peninsula near the entrance to the Eed Sea. It was first occupied by the British in January 1839. From time to tiihe additional land on the mainland has been acquired by cession or purchase, and the adjoining island of Perim, lying in the actual mouth of the strait, was permanently occupied in 1857. Further inland, and along the coast, most of the Arab chiefs are under the political control of the British Government, which pays them regular allow- ances. The area of the peninsula is only 15 square miles, but the total area of British territory is returned at 80 square miles, including Perim (5 square mUes). In 1891 the population was 44,079, of whom no less than 30,914 were males. In 1901 the population was 41,222, showing a decrease of 6 per cent. The average density is 615 persons per square mile. The gross revenue in 1897-98 was B,s.38,07,539, and the municipal income Rs.1,93,922. There are 42 schools, with 1949 pupils, being 5-6 per cent, of the population. There a^ e three printing presses, of which one is in the jail, and the other two belong to a European and a Parsi firm of merchants. In 1900 Aden suffered from an epidemic outbreak of plague.

Aden is strongly fortified, witli a permanent garrison of one British and one native regiment, two batteries of artillery, and one company of engineers. The administration is conducted by a political resident, who is also the military commandant. All food requires to be imported, and the water-supply is largely derived from condensation. A little water is obtained from wells, and some from an aqueduct 7 miles long, constructed in 1867 at a cost of £30,000, besides an irregular supply from the old reservoirs. The importance of Aden as a port of call for steamers and a coaling station has grown immensely since the opening of the Suez Canal. It also conducts a considerable trade with the interior of Arabia, and with the Somali coast of Africa on the opposite side of the Eed Sea. The submarine cables of the Eastern Telegraph Company here diverge — on the one hand to India, the Far East, and Australia, and on the other hand to Zanzibar and the Cape. The number of steamers visiting the port

rose from 535 in 1871-72 to 1214 in 1881-82. In 1897-98 the total number of merchant vessels that entered and cleared was 2496, of which 1080 with a tonnage of 2,124,043 were steamers. The “number that called to discharge or take cargo was 816. In addition, 129 British ‘and foreign men-of-war and troopships called at the port. In 1897-98, the total volume of trade amounted, in tens of rupees, to 8,188,893, which is classified into foreign, India, and inland. Of the foreign, the imports amounted to Ex. 2,851,193, and the exiports to Ex. 3,345,028. Of the Indian, the imports were Ex. 1,250,054, and the exports Ex. 258,800. Of the inland, the imports were Ex. 337,640 and the exports Ex. 145,678. The principal articles of import are coSee, cotton-piece goods, &e., grain, hides, coal, opium, cotton-twist and yarn. The exports are, in the main, a repetition of the imports. Of the total imports, nearly one-third come from the east coast of Africa, and anothe^ third from Arabia.

Of the total exports, nearly one-third again go to the east coast of Africa. In 1897-98 the share of the United Kingdom was only 18 per cent, of the total imports, and 6 per cent, of the total exports. In that year the receipts of the port trust amounted to Es.2,48,975, and the expenditure to Es.2,70,511. The number of vessels that called at Perim was 556, of which 396 were British.

(j. s. CO.)

Aderno, a town of Italy, Sicily, prov. Catania, situated at the S.W. foot of Mount Etna, 22 miles N.W. from Catania by the circum-Etna railway. It has a square Norman tower (now converted into a prison) and a monas- tery (1167), both built by the Norman count Roger of Sicily; some slight remains survive of the ancient Sikelian city of Hadranum, and of its famous temple to Hadranus. Aderno is famous for its oranges, and has flour-mills. Population (1871), 14,613 ; (1881), 19,180; (1901), 25,873.

Adiquala. See Ebitbea.

Adirondacks, a group of mountains in north- eastern New York, U.S.A., a portion of the Appalachian system of eastern North America, occupying the eastern part of the region between Lake Champlain and Lake Ontario, north of the Mohawk Valley. They do not form a connected range, but consist of many summits, isolated or in groups, arranged with little appearance of system. The highest peak, Mount Marcy, altitude 6344 feet, is near the eastern part of the group, and about it are many summits exceeding 4000 in height. These. moun- tains, consisting mainly of somewhat homogeneous granite rocks, are the result of long-continued erosion, carried on in a grea:tly elevated region, by which the softer areas have suffered the most and the harder the least. In recent geologic times this area, with the exception of the higher summits, was covered by the Laurentian glacier, whose erosion, while perhaps having little effect on the larger features of the country, has greatly modified it in details, producing many lakes and ponds, together with rapids and falls in the streams. The region is heavily forested with spruce, pine, and broad-leaved trees, forming the only continuous forest area remaining in the state. In order to preserve these f orestfff rom destruction the state withholds its lands from sale, and as opportunity offers, increases its holdings by ■purchase. In 1900 the area of state lands comprised 1,250,000 acres. The Adirondack region, with its mountains, lakes, and forests, presents much beautiful, and even grand, scenery, and is greatly frequented in summer as a resort and sanatorium.

Adi-Ugri. SeeEEiTKEA.

ADMIRALTY ADMINISTRATION.

Bbitish Empiee.

I. rr^HE Administrative System. — That the navy is the 1 only real defence of the British islands has been recognized by English people ever since the days of King Offa, who died in 796, leaving to his successors the admir- able lesson that ” he who would be secure on land must be supreme at sea.” The truth of the lesson thus learnt is sanctioned by all the experience of English history, and Parliament has repeatedly enforced the fact. The navy is the only force that can safeguard the British islands from hostile descents ; it is the only force that can protect their vast sea-borne commerce and food supplies; by giving safety to the home country it sets British troops free for operations abroad, and makes their passage secure ; and thus, as also by giving command of the sea, the fleet is the means by which the empire is guarded and has become a true imperial bond. British naval* administration is conducted by the Board

of Admiralty, and the function of that board is the main- tenance and expansion of the fleet in accordance with the policy of the Government, and the ™« supplying of it with trained officers and men ; Admiralty. its distribution throughout the world ; and its preservation in readiness and efficiency in all material and personal respects. The character of the Admiralty Board is peculiar to the British constitution, and it possesses certain features which distinguish it from other depart- ments of the State. The business it conducts is very great and complex, and the machinery by which- its work is done has grown with the expansion of that business. The whole system of naval administration has been developed historically, and ,is not the product of the organizing skill of one or a few individuals, but an organic growth possessing marked and special characteristics. The Admiralty Board derives its character from the fact that it represents the Lord High Admiral, and that its powers and operation depend much more upon usage than upon

those instruments whicli actually give it authority, and which, it may be remarked, are not in harmony among themselves. The executive operations are Conducted by a series of civil departments which have undergone many changes before reaching their present constitution and relation to the Board. The salient characteristic of the Admiralty is a certain flexibility and elasticity with which it works. Its members are not, in a rigid sense, heads of departments. Subject to the necessary and constitutional supremacy of the Cabinet Minister at their head, they are jointly and co-equally « commissioners for executing the office of High Admiral of the United Kingdom, and of the territories thereunto belonging, and of High Admiral of the colonies and other dominions.” The members of the Board are in direct and constant communication with the First Lord and with one another, as also with the civil departments which work under their control. It was enjoiaed by James I. that the principal officers and com- missioners of the navy should be in constant communica- tion among themselves, consulting and advising ” by common council and argument of most voices,” and should live as near together as could conveniently be, and should meet at the navy office at least twice a week. This system of intercommunication still exists in a manner which no system of minutes could give ; and it may be remarked, as illustrative of the flexibility of the system, that a Board may be formed on any emergency by two Lords and a secretary, and a decision arrived at then and there. Such an emergency Board was actually constituted some years ago on board the Admiralty yacht in order to deal on the iastant with an event which had just occurred ia the fleet. At the same time it must be remarked that, in practice, the First Lord being personally responsible under the Orders in Council, the operations of the Board are dependent upon his direction.

The present system of administering the navy dates from the time of Henry VIII. The naval business of the country, had so greatly expanded in his reign History. ^j^g^j. ᵍ ᵍ^ ^j^g Admiralty and Navy Board re- organized or established ; and it is worthy of remark that there existed at the time an

Ordnance branch, the navy not yet being dependent in that matter upon the War De- partment.* The Kavy Board administered the civil depart- ments under the Admiralty, the directive and executive duties of the Lord High Admiral remainiug with the Admiralty office. A little later the civil administration was vested in a Board of principal officers subordinate to the Lord High Admiral, and we can henceforth trace the work of civil administration being conducted under the navy and victualltag boards apart from, but yet subject to, the Admiralty itself. This was a system which con- tinued during the time of all the great wars, and was not abolished until 1832, when Sir James Graham, by his reforms, put an end to what appeared a divided control. Whatever may have been the demerits of that system, it sufficed to maintain the navy in the time of its greatest achievements, and through all the wars which were waged with the Spaniards, the Dutch, and the French. The original authority for the present constitution of the Admiralty Board is found in a declaratory Act of the 2 William and Mary, c. 2, in which it is enacted that ” all and singular authorities, jurisdictions, and powers which, by Act of Parliament or otherwise, had been lawfully vested” in the Lord High Admiral of England had always

1 The Board of Ordnance was originally instituted for the navy, but eventually fell into military hands, to the detriment of the navy— the only navy of any nation that has not fuU’authority over its own ordnance. In 1633, according to ,Oppenheim, it was, owing to its inefficiency, placed under the Admiralty. In 1632 it appears to have been independent but ” still retained that evil pre-eminence m sloth and incapacity it had already earned and has never smce lost.”

appertained, and did and should appertain to the com- missioners for executing the office for the time being ” to all intents and purposes as if the said commissioners were Lord High Admiral of England.” The Admiralty commis- sion was dissolved in 1701, and reconstituted on the death of Prince George of Denmark, Lord High Admiral in 1709. From that time forward, save for a short period in 1827-28, when the Duke of Clarence was Lord High Admiral, the office has remained in commission.

It is unnecessary to describe ia detail the many changes which have passed over the system of naval administration up to the present time. When Lord St Vincent accepted office under the Addington ministry in 1801, it fell to him to deal with a vast system of waste, extravagance, and malversation of public funds. The work of reform was too vast even for this strong administrator to accom- plish, and the great seaman became the object of a torrent of virulent abuse embodied in an extraordinary pamphlet literature. When the Addington ministry fell he left office, but the work he had done bore good fruit later. The investigations which were conducted at that time were essentially the basis of the reorganization effected by Sir James Graham under the administration of Earl Grey. That reorganization involved the abolition of the Board of principal officers and commissioners of the navy, and the commissioners for victualling, the whole business of naval administration being concentrated under the immediate direction of the Board of Admiralty. The ” Act to amend the laws relating to the business of the civil departments of the navy, and to make other regulations for more effectually carrying on the duties of the said departments ” (2 William IV. c. 40), vested in the Admiralty Board all the powers of the commissioners of the civil departments, and provided for the creation of five separate and in- dependent responsible superintendents of departments under the Admiralty collectively, and the several Lords individually. These new officers were the surveyor of the navy, the accountant-general, the storekeeper-general, the controller of victualling and transports, and the physician of the navy, whose title in 1843 became director-general of the medical department of the navy. A number of changes have since been made, but the general principle remains the same, and the constitution of the Admiralty Board and civil departments is described below. The Board consisted of the First Lord and four Naval Lords with a Civil Lord, who were accustomed to meet sometimes daily, but at all tim es frequently ; and the system developed provided for the sub-division of labour, and yet for the co-ordinated exertion of effort.

A fresh system, at variance with Admiralty tradition and practice, was introduced by Mr Childers in 1869. But those changes have now aim ost entirely been reversed. The system, of intercommunication in the Board was paralysed by an attempt to lay down definite rules of practice and to define what was essentially indefinable. When Mr Goschen succeeded Mr Childers he found it necessary to modify the system ; and since that time it may be said that the Admiralty Board has resumed, broadly, the character which it had after the reorganization of Sir James Graham. The merits of that system, as conducing to elasticity and flexibility of. working, have been pointed out ; and, what- ever its disadvantages, it is not to be denied that the system has worked well in practice, and has certainly won the approval and the admiration of many statesmen.^ Lord George Hamilton said, before the Royal Commission on civil establishments, 1887, that ” It has this advantage.

2 The Duke of Somerset, Lord Halifax, Sir J. Graham, SirF. Baring, and others stated that ” the administrative system contrasted most favourably with any department they had been connected with,” as did the more recent commission under Lord Hartihgton’s presidency.

that you have all departments represented round a table, and that if it is necessary to take quick action, you can do in a few minutes that which it would take hours imder another system to do ” ; and the report of the Eoyal Com- mission of 1889 remarked that ” The constitution of the Board of Admiralty appears to us well designed, and to be placed under present regulations on a satisfactory footiag.”

The special characteristics of the Admiralty Board which have been described are accompanied by a very peculiar and noteworthy feature, which is not without relation to the untrammelled and un- defined operations of the Admiralty. This feature arises from the discrepancy between the Admiralty patent and the Orders in Council, for the Admiralty is not adminis- tered according to the terms of the patent which invests it with authority, and its operations raise a singular point in constitutional law.

The legal origin of the powers exercised by the First Lord and the Board itself is indeed curiously obscure. Under the patent the full power and authority are con- ferred upon ” any two or more ” of the commissioners, though, in the patent of Queen Anne, the grant was to ” any three or more of you.” It was under the Act 2 Will. IV. c. 40 that two Lords received the necessary authority to legalize any action of the Board ; but already, under an Act of 3 George IV., two Lords had been empowered to sign so long as the Board consisted of six members. We therefore find that the legal authority of the Board under the patent is vested in the Board ; but in the Order in Council of 14th January 1869 the sole responsibility of the First Lord was ofB.cially laid down, and in the Order in Council of 19th March 1872 the First Lord was made ” responsible to your Majesty and to Parliament for all the business of the Admiralty.” As a matter of fact, the authority of the First Lord, independent ‘of his colleagues, had existed in an undefined manner from ancient times. Before a select committee of the House of Commons in 1861 the Duke of Somerset stated that he considered the First Lord responsible, that he had always ” acted under that impression,” and that he believed ‘•’ all former First Lords were of this opinion ” ; while Sir James Graham said that “the Board of Admiralty could never work, whatever the patent might be, unless the First Lord were supreme, and did exercise constantly supreme and controlling authority.” It is not, therefore, surprising to find that there has been undoubt- edly direct government without a Board. Thus, in the operations conducted against the French iphannel ports in 1803-4, Lord Melville, then First Lord, took steps of great

importance without the knowledge of his colleagues, though he afterwards bowed to their views, which did not coincide with his own. Again, when Lord Gambler was sent to Copenhagen in 1807, he was instructed to obey all orders from the King, through the principal Secretary of State for war, and in this way received orders to attack Copenhagen, which were unknown to all but the First Lord. In a similar way the secretary of the Admiralty was despatched to Paris in 1815 with instructic)ns to issue orders as if from the Board of Admiralty when directed to do so by the foreign secretary who accompanied him, and these orders resulted in Napoleon's capture. These instances were cited, except the first of them, by Sir James Graham before the select committee of the House of Commons in 1861, in order to illustrate the elastic powers under the patent which enabled the First Lord to take immediate action in matters that concerned the public safety. It is not surprising that this peculiar feature of Admiralty administration should have attracted adverse criticism, and have led some minds to regard the Board as "a fiction'not worth keeping up" — a view expressed

by Mr Ba^er, parliamentary secretary in 1871. There have been instances of the power of the First Lord being misused, and in relation to the loss of the CajJtain in 1870, it seemed a legitimate conclusion to draw from the evidence before the House of Lords committee that Mr Childers, being himself nominally responsible for sending this vessel to sea, constituted himself a judge of the case, and, exempting himself from blame, distributed censure among a number of persons, while he placed the chief weight on the Controller, who had been by a former board specially released from this responsibility.^ The truth is that there existed antecedently to the Admiralty patents, and now concurreiitly exists with them, an un- defined power based upon usage enabling the First Lord to act independently of his colleagues. This is a feature of administration that evidently springs from necessity and political expediency.

The case of the Captain had a beneficial effect upon Admiralty administration. It caused the Board to be reinstated in its former position, and gave once more to the system those advantages of intercommunication and consultation which have been alluded to. It cannot be said, however, that the question of ultimate responsibility is well defined. The Duke of Somerset, Sir James Graham, and Sir Charles Wood, afterwards Lord Halifax, held the view that the First Lord was singly and person- ally responsible for the suf&ciency of the fleet. Sir Arthur Hood expressed before the House of Commons committee in 1888 the view that the Board collectively were responsible ; whilst Sir Anthony Hoskins assigned the responsibility to the First Lord alone with certain qualifications, which is a just and reasonable view.

II. Admiralty Organization. — Under the organization which now exists, the Board of Admiralty consists of the First Lord, the first and secondNaval Lords, the Additional Naval Lord and Controller, the junior Naval Lord, and the CivU Lord, who are commissioners for executing the office of Lord High Admiral, and with them are the parliamentary and financial secretary and the permanent secretary. As has been explained, the First Lord is responsible imder the Orders in Council to the Crown and to Parliament for all Admiralty business. In the hands of the other Lords and secretaries rest duties very carefully defined, and they direct the civil departments which are the machinery of naval administration. The first Naval Lord, the second Naval Lord, and the j unior Naval Lord are responsible to the First Lord in relation to so much of the business concerning the personnel of the navy and the movements and condition of the fleet as is confided to them, and the Additional Naval Lord or Controller is responsible in the same way for the material of the navy ; while the parliamentary secretary has charge of finance and some other business, and the Civil Lord of all shore works — i.e., docks, buildings, &c. — and the permanent secretary of special duties. The First Lord of the Admiralty is the cabinet minister through whom the navy receives its political direction in accordance with imperial policy. He is the representative of the navy in Parliament, which looks to him for everything concerned with naval affairs. The members of the Board are his advisers ; but if their advice is not accepted, they have no remedy except protestor resignation. It cannot be denied

that the responsibility of the members of the Board, if their advice should be disregarded, must cease, and it is sufficiently obvious that the remedy of resignation will not always commend itself to those whose position and advancement depend upon the favour of the Government.

1 The late Admiral Sir Cooper Key, when director of naval ord- nance during Mr Chllders's administration, observed to the writer that no First Lord of the Admiralty knew so little of the working of the Admiralty as Mr Childers, because, owing to the discontinuance of Board meetings, be lost the great advantage Qf hearing the discussion, (b. v.h.)

empire]

Sometliing will be said a little later concerning the work- ing of the system and the relation of the First Lord to the Board in regard to the navy estimates. In addition to gen- eral direction and supervision, the First Lord has special charge of promotions and removals from the service, and of matters relating to honours and rewards, as well as the appointments of flag officers, captains, and other officers of the higher ranks. With him rests also the nomination to naval cadetships for the maj or part and assistant clerkships.

Apart from the First Lord, the first Naval Lord is the most important officer of the Board of Admiralty. It seems to be unquestionable that Sir James Graham was right in describing the senior Naval Lord as his " first naval ad- viser." Theoretically, the first Naval Lord is responsible for the personnel of the fleet ; but in practice he is neces- sarily concerned with the material also as soon as it is put into commission, and with the actual commissioning of it. It is correct to say that he is chiefly concerned with the emplojonent of the fleet, though his advice has weight in regard to its character and sufficiency, and is always sought in relation to the shipbuilding programme. Broadly speaking, the first Naval Lord's duties and au- thority cover the fighting efficiency anql employment of the fleet, and upon him and upon the Controller the naval business of the country largely falls. He directs the bpera^ tions of the admiral superintendent of naval reserves in regard to ships, the hydrographer, the director of naval ordnance, so far as the gunnery and torpedo training establishments are concerned, and the naval intelligence department, and he has charge of all matters relating to discipline. The mobilization of the fleet, both in regard to personnel and material, also falls to him, and among a mass of other business in his department are necessary preparations for the protection of trade and the fisheries. It will thus be seen that the first Naval Lord is the chief officer of the Board of Admiralty, and that the operations of the other members of the Board all have relation to his work, which is no other than preparation for war. It may here be remarked that it appears most necessary to change the Naval Lords frequently, so that there may always be in the Board some one who possesses recent touch with the service afloat.

The second Naval Lord may be regarded as the coadjutor of the first Naval Lord, with whose operations his duties are very closely related, though, like every other member of the Board, he is subordinate only to the First Lord. The duties of the second Naval Lord are wholly concerned with the personnel of the fleet, the manning of the navy, and mobilization. In his hands rests the direction of naval education, training, and the affairs of the royal marine forces. The training establishments and colleges are in his hands. He appoints navigating officers and lieutenants to ships (imless they be to command), sub-lieutenants, midshipmen, and cadets, engineer officers, gunners, and boatswains, and supervises the management of the reserve. In his province is the mobilization of the personnel, including the coastguard and the royal naval reserve. Necessarily, the first and second Naval Lords

work to- “gether, and upon occasion can replace each other. It was explained to the House of Lords committee in 1871 — and the condition still prevails — ^that the two senior Naval Lords — at that time Admiral Sir Frederick Grey and Vice- Admiral Eden — were in constant communication in rela- tion, to the complements of ships and the manning of the fleet, and that each knew intimately the other’s work, and when necessary could take charge of it with perfect confidence.!

Most important are the duties that fall to the Additional Naval Lord and Controller. He has charge of everything

1 The drawback is, that a Naval Lord can only go on leave by- throwing all his work on a colleague already 9verweiglltl4.wita work.

that concerns the material of the fleet, and his operations are the complement of the work of the first Naval Lord. A great number of civil departments are directed by the Controller, and his survey and supervision extend to the dockyards and building establishments of the fleet. He submits plans to the board for new ships, and is respons- ible for carrying into effect its decisions in regard to all matters of construction and equipment. The building operations both in the dockyards and in private yards are therefore under his supervision. In regard to all these matters, the director of naval construction and the engineer-in-chief are the heads of the civil departments that carry on the work. Again, the Controller is respons- ible in regard to armament — both gunnery and torpedo — and it is the work of his department to see to all gunnery and torpedo fittings, and to magazines, shell-rooms, and electric apparatus. The officer in immediate charge of this branch of the Controller’s work, under his direction, is the director of naval ordnance. In regard to work at the dockyards (q.v.) the Controller is aided by the director of dockyards. He supervises this officer in preparing the programme of work done in the dockyards, the pro- vision of the material required, and its appropriation to particular work in accordance with the programme. Other officers who conduct great operations under the authority and responsibility of the Controller, are the director of stores, who maintains all necessary supplies of coal and stores at home and abroad, and examines the store accounts of ships, and the inspector of dockyard expense accounts, who has charge of the accounts of dockyard ex- penditure and seeing that outlay is charged as directed. In regard to the navy estimates, the Controller, through his subordinates, is responsible for the preparation and administration of votes 8 and 9 (those for shipbuilding and naval armaments), except in regard to some sub- headings of the former, and thus in the year 1900-1 for the expenditure of something like £15,000,000.

The junior Naval Lord has in his hands the very impor- tant duties that are concerned with the transport, medical, and victualling services, as well as the regulation of hos- pitals, the charge of coaling arrangements for the fleet, and other duties that conduce to the practical efficiency of the navy. He also appoints chaplains, naval instructors, med- ical officers (except in special cases), and officers of the accountant branch. A vast biisiness in regard to the in- ternal economy of ships greatly occupies the junior Lord. He has charge, for example, of uniforms, prize-money, bounties, naval savings banks, and pensions to seamen and marines, and the widows of naval and marine officers. The work of the junior Naval Lord places under his direc- tion the director of transports, the director-general of the Medical Department, the director of victualling, and, in regard to particular matters, the director of stores, the accountant-general, the chaplain of the fleet, and the In- telligence Department, so far as the junior Lord’s depart- ment is concerned.

The Civil Lord supervises, through the director of works, the Works Department, dealing with Admiralty buildings and works, construction and labour, contracts, and pur- chases of building stores and land. He is also respons- ible for the civil staff of the naval establishments, except in regard to certain officials, and for duties connected with Greenwich Hospital, compassionate allowances, char-

itable funds, and .business of like character. The ac- countant-general, in regard to these matters, is directed by him, and the director of Greenwich Hospital is under his authority.

The parliamentary and financial secretary is responsible for the finance of the department, the navy estimates, and matters of expenditure generally, aild is qonsulted in re- gard to all matters involving reference to the Treasury.

His position in regard to estimates and expenditure is very important, and the accountant-general is his officer, while he has financial control over the director of contracts. The financial secretary also examines proposals for new expenditure.

A most important official of the Board is the permanent secretary, whose ofi&ce has been described as the ” nerve- centre ” of the Admiralty, since it is the channel through which papers for the Lords of the Admiralty pass for the inter-communication of departmfents and for the corre- spondence of the Board. The tradition of. Admiralty procedure largely rests with the permanent secretary, and it is most important that he should be chosen from one of the branches, and should have served in as many of them as possible, in order that he may possess a thorough knowledge of the theory and practice of the Admiralty system. In addition to the secretarial duties of the permanent secretary’s department, the permanent secre- tary has charge of the military, naval, and legal branches, each under a principal clerk, the civil branch, and the record office. The various branches deal with matters concerning the commissioning of ships and the distribu- tion of the fleet, and the manning and discipline of the navy, with other associated matters, being the channels for the operations of the Naval Lords. It is a highly important function of the department of the permanent secretary to preserve the inter-related working of the various departments, and to keep unbroken the thread of administration when a new Board is constituted.

The following is a list of the First Lords and first Kaval Lords since 1832 :—

First Lords. Sir James B. G. Graham, Bart.,

November 1830. Lord Auckland, June 1834.

Earl de Grey, December 1834.

Lord Auckland, April 1835.

The Earl of Minto, G.C.B., September 1835.

The Earl of Haddington, Sep- tember 1841.

The Earl of Ellenborough, Janu- ary 1846.

The Earl of Auckland, July

1846.

Sir Francis Thornhill Baring, Bart., January 1849.

The Duke of Northumberland,

K.G., February 1852. Sir James R. G. Graham, Bart.,

January 1863.

Sir Charles Wood, March 1865.

Sir John Pakington, Bart.,

March 1868. The Duke of Somerset, June

1869.

Sir John S. Pakmgton, Bart,

G.C.B., July 1866. Et. Hon. Henry Thomas Lowry

Corry, March 1867. Rt. Hon. Hugh Culli^ig Eardley

Childers, December 1868.

Senior Naval Lords. Bear-Adm. Sir Thomas M. Hardy.

(1) Rear-Adm. Sir Thomas M. Hardy.

(2) Rear-Adm. the Hon. George H. L. Dundas.

(3) Rear-Adm. Sir Charles Adam.

Vice-Adm. Sir John P. Beres-

ford, K.C.B. Rear-Adm. Sir Charles Adam. Rear-Adm. Sir Charles Adam.

George Cockburn, George Cockburn, Sir Charles ames W. D. James W. D. the Hon. M.

Adm. Sir

G.C.B. Adm. Sir

G.C.B.

(1) Vice-Adm. Adam, K.C.B.

(2) Rear-Adm. James W. D Dundas, C.B.

(1) Rear-Adm. Dundas, C.B,

(2) Rear-Adm. Fitzhardinge Berkeley, C.B.

Rear-Adm. Hyde Parker, C.B.

(1) Vice-Adm. Hyde Parker, C.B.

(2) Rear-Adm. the Hon. M. Fitzhardinge Berkeley, C.B.

(1) Rear-Adm. the Hon. M. Fitzhardinge Berkeley, C.B.

(2) Rear-Adm. the Hon. Sir Richard S. Dundas, K.C.B.

Vice-Adm. William Fanshawe Martin.

(1) Vice-Adm. the Hon. Sir Richard S. Dundas, K.C.B.

(2) Rear-Adm. the Hon. Sir Frederick W. Grey, K.C.B.

Vice-Adm. Sir Alexander Milne,

K.C.B. Vice-Adm. Sir Alexander BJilne,

K.C.B. Vice-Adm. Sir Sydney C. Dacres,

K.C.B.

First Lords. Et. Hon. George J. Goschen, March 1871.

Rt. Hon. George Ward Hunt, March 1874.

Et. Hon. William Henry Smith, August 1877.

The Earl of Northbrook, May

1880.

Lord George Hamilton, July

1886,

The Marquis of Ripon, K.G.,

February 1886. Lord George Hamilton, August

1886.

Earl Spencer, K.G., August

1892.

Rt. Hon. George J. Goschen, July 1895.

The Earl of Selbome, November

1900.

Senior Naval Lords.

(1) Vice-Adm. Sir Sydney C. Dacres, K.C.B.

(2) Adm. Sir Alexander Milne, G.C.B.

(1) Adm. Sir Alexander Milne, G.C.B.

(2) Adm. Sir Hastings R. Yel- verton, G.C.B.

(1) Adm. George G. Wellesley, C.B.

(2) Adm. Sir Astley Cooper Key, K.C.B.

Adm. Sir Astley Cooper Key,

K.C.B. Vice-Adm. Arthur W. Acland

Hood, C.B. Adm. Lord John Hay, K.C.B.

(1) Adm. Sir Arthur W. Acland Hood, K.C.B.

(2) Adm. Sir R. Vesey Hamil- ton, K.C.B.

(3) Adm. Sir Anthony H. Hos- kins, K.C.B.

Adm. Sir Anthony H. Hos- kins, K.C.B. (2) Adm. Sir Frederick W, Richards, K.C.B.

(1) Adm. Sir Frederick W. Richards, K.C.B.

(2) Vice-Adm. Lord Walter Kerr, K.C.B.

Adm. Lord Walter Kerr, K.C.B,

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III. Business and Responsibility. — The manner in which the Admiralty Board conducts the great operations under its charge has been indicated. It would be impos- sible here to describe it in detail, though something con- cerning the civil departments, which are the machinery of naval administration, will be found below. It will, however, indicate the, character of Admiralty administra- tion if we explain to some extent the conditions which surround the preparation of the estimates and the shipbuilding programme, the more so because this matter has been the battle ground of critics and supporters of the Admiralty. It has already been pointed out that the Naval Lords, if they dissent from the estimates that are presented, have no remedy but that of protest or resigna- tion. Into the controversies that have arisen as to the responsibility of the several Lords it is unnecessary to enter here. The Admiralty Board possesses, in fact, the character of a council, and its members can only be held responsible for their advice. It has even been contended that, in the circumstances, it should not be incumbent upon them to sign the navy estimates, and there have been instances in which the estimates have been pre- sented to Parliament without the signature of certain Naval Lords. It is in any case obvious, as has been ex- plained above, that the ultimate responsibility must always rest with the First Lord and the Cabinet, by whom the policy of the country is shaped and directed. In the report of the Hartington Commission to inquire into the civil and professional administration of the Naval and Mil- itary Departments, and the relation of these departments to each other and to the Treasury, the following recom- mendation occurs: “On the First Lord alone should rest the responsibility of deciding on the provision to be made for the naval requirements of the empire, and the existence of a council should be held in no degree to diminish that responsibility.”

Two conditions primarily rule the determination as to the strength of the navy. They are, the foreign policy of the Cabinet, and on the ground of practical expediency, the amount of money available. “The estimates and strength of the navy,” said Kear-Admiral Hotham before

the select committee on the navy estimates, 1888, ” are matters for the Cabinet to determine.” ” Expense,” said Sir Anthony Hoskins, ” governs everything.” The needs of the empire and financial considerations, as it is scarcely necessary to remark, may prove to be antithetical condi- tions governing the same problem, and in practice it follows that the Admiralty Board directs its operations in accordance with the views of the Government, but limited by the public funds which are known to be available. Such considerations suggest a practical limitation of re- sponsibility, so far as the several Lords of the Admiralty are concerned, but it may be presumed to be their duty individually or collectively to place their views before the First Lord; and Lord George Hamilton told the select committee of 1888 that, if his colleagues should represent to him that a certain expenditure was indispensable for the efficiency of the service, he would recognize that all financial considerations should be put on one side. The commissioners reported that this was the only common- sense view of the matter, and that it was difficult to see on what other footing the control of navy expenditure, con- sistently with responsibility to Parliament, could be placed.

Two practical considerations are bound up with the shipbuilding programme — ^the carrying forward of the work in hand and the new construction to be begun, siace it is absolutely necessary that proper provision should be made for the employment and distribution of labour in the dockyards, and for the purpose of necessary materials. Through the director of naval construction and the director of dockyards, the Controller is kept informed as to the progress of work and the amount of labour re- quired, as also in regard to the building facilities of the yards. These matters, in a general way, must form a sub- ject of discussion between the first Naval Lord and the Controller, who will report on the ‘subject to the First Lord. The accountant-general, as the financial officer of the Board, will be called upon to place the proposed estimates upon a financial basis, and when the views of the Cabi- net are known as to the amount of money available, the several departments charged with the duty of preparing the various votes will proceed with that work. The financial basis alluded to is, of course, found in the estimates of the previous year, modified by the new conditions that arise. ‘ There has been in past times a haphazard character in our shipbuilding programmes, but with the introduction of the Naval Defence Act of 1889, which looked ahead and was not content with hand- to- mouth provision, a better state of things has grown up, and, with a larger sense of responsibility, a policy char- acterized by something of continuity has been developed. Certainly the largest factor in the better state of things has been the growth of a strong body of public opinion as to the supreme value of the navy for national and imperial welfare. No Government could have carried forward the great work which has been accomplished for the British navy within the last ten years without the impulsion and the support of public opinion.

Another important and related matter that comes be- fore the Board of Admiralty is the character and design of ships. The naval members of the Board indicate the classes and qualities desired, and it is the practice that the sketch-design, presented in accordance with the instruc- tions, is fully discussed by the first Naval Lord and the Controller and afterwards by the Board. The design then takes further shape, and when it has received the final sanction of the Board it cannot be altered without the sanction of the same authority. A similar procedure is found in the other business of the Admiralty ‘Board, such as shore-works, docks, and the preparation of offensive and defensive plans of warfare — ^the last being

a very important matter that falls into the operations of the Naval Intelligence Department, which has been described, though not with perfect accuracy, and cer- tainly in no large sense, as “the brain of the navy.” That department is . under the direction of the first Naval Lord.

The shipbuilding programme may be described as the corner-stone of the executive business of the Admiralty, because upon’ it depends very largely the preparation of all the other votes relating to numbers, stores, victualling, clothing, &c. But if the Admiralty Board is responsible through the First Lord for the preparation of the estimates, it is also charged with the business of supervising ex- penditure. In this matter the financial secretary plays a large part, and is directed to assist the spending depart- ment of the Admiralty in their duty of watching the pro- gress of their liabilities and disbursements. Some notes on Admiralty finance will be found below (parts iv., vii.). The shipbuilding votes set the larger machinery of the Admiralty in motion. The executive departments, except in regard to the hulls and machinery of ships and the special requirements of the director of works, do not make purchases of stores, that work resting with the director of navy contracts. Most of the important executive and spending branches are in the department of the Controller, and it will be well, while we are dealing with the material side of the navy, to describe briefly their character and duties. The civil branches of the navy tributary to the Controller are those of the director of naval construc- tion, the engineer-in-chief, the directors of naval ordnance, of dockyards, and of stores, and the inspector of dockyard expense accounts. The first duty of the Controller is, as has been explained, in relation to the design and con- struction of ships and their machinery, and the executive officials who have charge of that work are the director of naval construction and the engineer-in-chief, whose opera- tions are closely inter-related. A vast administrative stride has been made in this particular branch of the Admiralty. The work of design and construction now go forward together, and the Admiralty designers are in close touch with the work in hand at the dockyards — a condi- tion which did not exist twenty-five years ago. This has been largely brought about by the institution, in 1883, of the royal corps of naval constructors, whose members interchange their duties between the designing of ships at the Admiralty and practical work at the dockyards. It is through the director of naval construction that many of the spending departments are set in motion, since he is responsible both for the design of ships and for their con- struction. It deserves to be noticed, however, that a certain obscurity exists in regard to the relative duties of the director of naval construction and the director of dockyards touching constructive works in the yards. The former officer has also charge of all the work given out to contract, though it is the business of the dock- yard officials to certify that the conditions of the con- tract have been fulfilled. In all this work the director of naval construction collaborates with the engineer-in- ohief, who is an independent officer and not a subordi- nate, and whose procedure in regard to machinery closely resembles that adopted in the matter of contract-built ships.

The director of naval ordnance is another officer of the Controller’s Department whose operations are very closely related to the duties of the director of naval construction, and the relation is both intimate and sustained, for in the Ordnance Department everything that relates to guns, gun- mountings, magazines, torpedo apparatus, electrical fit- tings for guns, and other electrical fittings is centred. A singular feature of this branch of administration is that the navy long since lost direct control of ordnance matters,

through the duties connected with naval gunnery, formerly in the hands “of the master-general of the ordnance, and those of the Board of Ordnance — a department common to the sea and land services — being vested in 1856 in the Secretary of State for war. A more satisfactory state of things has

grown up through the appointment of the director of naval ordnance; taking the place of the naval officer who formerly advised the director of artillery at the War Office. Expenditure on ordnance has also been transferred from the army to the navy estimates, and a Naval Ordnance Store Department has been created. ‘It cannot be said that the condition is yet satisfactory, nor can it be until the navy has control of and responsibility for its own ordnance. The assistant-director of torpedoes is an officer instituted at the Admiralty within recent years, and his duty is to assist the director of naval ord- nance in all torpedo matters.

As to the operations of the director of dockyards little need be said here. (See Dockyards.) This officer re- placed the surveyor of dockyards in 1885, at about which time the inspector of dockyard expense-accounts was in- stituted. It is upon the director of dockyards that the responsibility of the Controller devolves in regard to the management of dockyards and naval establishments at home and abroad, and to the performance of work in these establishments, ship and boat building, maintenance, repairs, and refits. In this department the programme for work in the dockyards is prepared, as well as certain sections of the navy estimates.

We now come to the Stores Department, with the di- rector of stores as its chief. This officer, about the year 1869, took over the storekeeping duties previously vested in the storekeeper-general. The Naval Store Department is charged with the custody and issue of naval, as distin- guished from victualling and ordnance stores, to be used in naval dockyards and establishments for the building, fitting, and repairing of warships. It has, however, no concern with stores that belong to the Department of Works. The business of the director of stores is also to receive and issue the stores for ships of all classes in commission and reserve, and he deals with a vast array of objects and materials necessary for the fleet, and with coals and coaling. He frames the estimates for his department, but his purchases are made through the director of navy contracts. In practice the main business of the Stores Department is to see to the provision of stores for the navy, and to the proper supply of these at all the estab- lishments, and for this purpose its officials direct the movements of storeships, and arrange for the despatch of colliers, the director being charged to be ” careful to pro- vide for His Majesty’s sMps on foreign stations, and for the necessary supplies to foreign yards.” Another im- portant business of the director of stores is the examinar tion of the store accounts of ships as well as some other accounts. Although the director of stores is really in the department of the Controller, he is supervised in regard to the coaling of the fleet by the junior Naval Lord. The inspector of dockyard expetise-accounts has been alluded to. He is the officer charged with keeping a record of expenditure at the dockyards and of supervising expense accounts.

IV. The Materiel of the Navy — Recent Administration. — Having now described the administrative system of the navy, taking the preparation of the shipbuilding pro- gramme as an illustration, it will be well here to recall the recent history of naval administration in that regard. The shipbuilding programme is the beginning of the practical work of administration, because the Government having shaped its policy and indicated its requirements and the possibilities that present themselves, the material elements of naval power are created, and the personal ele-

ments, with all that concerns the training of officers and men, follow according to the necessities implied by the existence of that materiel. This is not to say that the ship is more important than the company who are in her, but only that the materiel of the navy constitutes the con- ditions for which the personnel are embpdied, organized, and trained. It will be obvious from what follows, in regard to the shipbuilding programmes of recent years, that the development of the fleet, conducted by the Ad- miralty under the authority of the First Lord and the Cabinet, has been largely influenced by the voice of public opinion. A Government in power has strong inducement to keep down expenditure and taxation, and the stimulus of a strong body of public opinion appears to be necessary in order to insure that the navy shall be maintained in adequate strength. This is a matter which cannot be

overlooked in any account of naval administration. In the spring of 1870 Mr Childers assured Parliament that the navy was sufficient for any duty it was likely to be called on to perform — as did Lord Cardwell for the army. In June, when the Franco-German war broke out, £2,000,000 was voted to put the armed forces in a state of efficiency, although the war did not directly affect Great Britain.

At the time of the Eusso-Turkish war great uneasi- ness was manifested in the United Kingdom as to the sufficiency of the navy, and on 25th January 1878 a vote of credit of £6,000,000 was passed by the House of Coinmons to enable the Admiralty to make good the deficiency.

The existing programme was pushed forward, and a number of ships were bought, but consistent policy was still absent from the proceedings. Again, when the esti- mates of 1884-85 were presented uneasiness still existed, and Lord Northbrook said in the House of Lords that it would be an extravagance to spend £2,000,000 in the con- struction of large ironclads, and that the great difficulty the Admiralty would have to contend with if they were granted £3,000,000 or £4,000,000 for the purpose referred to, would be to decide how they should spend the money. It is true that at the time the minds of naval constructors were not settled as to the type of vessel desirable, and that there were many fluctuations of opinion in regard to naval policy. But at about the sarfie time alarm was spread by the action of Russia upon the Afghan frontier, in relation to what was known as the ” Panjdeh incident,” and Lord Northbrook introduced a special shipbuilding programme. He explained, in March 1885, that in the navy estimates for the year there would be an increase of £800,000 for building ships by contract and carrying out the programme announced in the previous December. In addition the navy estimates of the year showed the fur- ther increase of £700,000, making a total augmentation, exclusive of supplementary estimates, of about £1,600,000. The country had been profoundly moved by the political situation abroad, and from that time may be said to date the great expansion of the fleet which has taken j.^^ ACava/ place since the introduction of the Naval De- Deteace fence Act of 1889. A powerful agitation was ‘’‘ ‘***•• conducted by the press, and at length the necessity of a great expenditure was recognized by the Government. In the previous year Lord Charles Beresford, being dis- satisfied with the provision made for the navy, had resigned his seat at the Admiralty Board, proposing a programme of additional ships which he considered to be necessary. Many articles were contributed to the press, and a meeting was convened in the City of London by the Lord Mayor, so that pressure was put upon the Government and the Admiralty, and a five years’ programme was introduced by Lord George Hamilton, then First Lord. As a ground of decision in regard to the naval strength required, the

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Admiralty, after the naval manoeuvres of 1888, had di- rected three admirals— Sir William Dowell, Sir R. Vesey Hamilton, and Sir F. Richards — to furnish a report. They arrived at the following conchision: “It will not be found practicable to maintain an effective blockade of an enemy’s squadrons in strongly fortified ports by keep- ing the main body of the fleet off the port to be block- aded, without the blockading battleships being in the proporticm of at least five to three to allow a sufft- cient margin for casualties, to which the enemy’s ves- sels in a secure harbour would not be exposed, and the necessary periodical absence of a portion of the blockading squadron for the purpose of replenishing fuel, making good defects, &c. A still larger propor- tion might be necessary if the area to be covered by the blockaders was extensive.” It may be said that this report was at the base of the Naval Defence Act pro- gramme and of those which have followed it, and it has constantly been appealed to by writers and speakers, though it is a question whether recent

developments of foreign navies do not indicate the necessity of a larger pro- portion of British ships. The Naval Defence Act, 1889, 52 Vict. cap. 8, being ” an Act to make further provision for naval defence and defray the expenses thereof,” marked the beginning of a larger conception on the part of the Government and the Admiralty of the needs of the British empire, and it may be said to have formed the practical beginning of the existing efiB.cient navy. Ships were in , existence — the Admiral class, for example — of an earlier date, but it is nevertheless true that the vessels put in hand under the Naval Defence Act marked a real beginning. The preamble of the Act was as follows: “It is expedient that a sum not exceeding £21,000,000 be granted for the purpose of building, arming, equipping, and completing for sea vessels of Her Majesty’s navy ; and that it is expedient that a sum not exceeding £10,000,000 be issued out of the consolidated fund in seven years, ending the 31st of March 1896; and that a sum not exceeding £11,000,000 be issued out of the moneys to be provided by Parliament for the naval service during the financial years ending the 31st of March 1894.” A subse- quent measure supplemented the Act of 1889, and was described as the Naval Defence Act 1893, 56 & 57 Vict, cap. 45: “An Act to make further provision for the com- pletion and equipment of ships under the Naval Defence Act 1889, and to amend that Act,” and the new provision made was for a grant of moneys not exceeding £1,350,000. The programme of the Naval Defence Act was for the building of ten battleships, of which eight were of the first class, and displaced 14,150 tons, while two, which were then described as of the second class, but are now ranked of the first, were of 10,500 tons. The eight larger battleships built under the Act were the Royal Sovereign, Empress of India, Hood, Bamillies, Repulse, Resolution, Revenge, and Royal Oak, and the two smaller ships the Centurion and Barfleur. These are all ships of high freeboard, the larger ones with four 13‘5’inch and the smaller with as many 10-inch guns in their barbettes, and in the matter of protection they marked a great advance upon their predecessors. The Naval Defence Act also provided for the building of nine first-class cruisers — ^the Royal Arthur and the Crescent (7700 tons), and the Edgar, Endymion, Gibraltar, Qrafton, Hawke, St. George, and Theseus, as well as thirty-three second-class cruisers. The second-class cruisers were to be of 3400 tons, but before the programmes could be carried out the dimensions of several of them were increased to 4360 tons. The end of the financial year 1894-95 saw the completion of five second-class cruisers and four torpedo gunboats, which brought to an end the work provided for under the Naval Defence Act. The vessels were soon completed for sea,

and most of them were commissioned for the manoeuvres of 1895. The limit of five years, which had originally been fixed for the completion of these vessels, had been somewhat exceeded.

Meanwhile provision had been made in the programme of 1892-93 for the laying down of the battleship Renown, displacing 12,350 tons and lying midway Naval pro- between the Royal Sovereign and Centurion grammes, classes, as well as for certain destroyers and 1^02-1902, other torpedo craft. It was on 23rd June 1893, off the coast of Tripoli, Syria, that the lamentable cata- strophe occurred in which the Victoria, flagship of Sir George Tryon, commander-in-chief in the Mediterranean, was lost through collision with the Camperdoion. This, incident, combined with a strong feeling that after the close of the principal work of the Naval Defence Act no adequate provision had been made, caused Earl Spencer, then First Lord of the Admiralty, to in- troduce a new programme. In December 1893 Sir William Harcourt had told the House of Commons that the professional advisers of the Admiralty — mean- ing the NavAl Lords — were of opinion that the navy was in a satisfactory state, and that its supremacy was for the moment absolute, and added that he would undertake to say that the “Superiority of the British navy was never so great as it is now.” It was com- monly believed that the Naval Lords thereupon resolved to resign, but two days later Sir William Harcourt made a statement which modified the impression he had given. The agitation of that^ime materially strengthened the hands of Lord Spencer, and the programme of 1893-94 provided for the laying down of two new battleships — the Majestic and Magnificent — of 14,900 tons, afterwards first and second flagships of the Channel squadron, as well as three second-class cruisers — the Talbot, Eclipse, and Minerva — and two sloops. Two first-class cruisers — the Powerful and

Terrible — belong to the same year, and after being deferred were given out to contract in December 1893. They were the first large vessels of the British fleet to be provided with water-tube boilers, these being of the Belleville type. The shipbuilding pro- gramme of 1894-95 included seven battleships, six cruisers of the second class, and two sloops. The battleships were of the Majestic class, and received the names of Prince George, Victorious, Coesar, Hannibal, Illustrious, Jupiter, and Mars (14,900 tons). The second-class cruisers were the Venus, Diana, Dido, Isis, Juno, and Dwis, displacing 6600 tons. All these were built by contract, as was the case with two of the battleships of that year. The shipbuilding work put in hand under this programme gave full occupation to the building yards, and the con- structive scheme embodied in the estimates of 1895-96 did not include any battleships. There were four flrst- class protected cruisers of 11,000 tons, resembling in various ways the Powerful and Royal Arthur classes — the Diadem, Andromeda, Europa, and Niobe — all provided with Belleville boilers, and calculated for a speed of 20-5 knots; four second-class cruisers of 5760 tons — the Arrogant, Furious, Gladiator, and Vindictive; two third-class cruisers of 2136 tons — the Pelorus and Pro- serpine; and twenty torpedo-boat destroyers. The work conducted under the programme so far described was carried out with great rapidity. The Majestic and Magni- ficent, built respectively at Portsmouth and Chatham, were commissioned within twenty-two and twenty-four months from the laying of the keel, thus surpassing all previous records, and the Prince George at Portsmouth and the Victorious at Chatham maintained this rapidity of con- struction. Moreover the progress made with these vessels did not interfere with the maintenance of the progress intended either on new shipbuilding or in keeping up the

sea-going and fighting efficiency of ships in reserve or commission. Good progress was also attained with the remaining five ships of the Majestic class, though in subsequent years, owing to strikes in the engineering trade and some other circumstances, the work was much impeded. The programme of 1896-97 included five battleships, of which three — the Goliath, Canopus, and Ocean — were built in the dockyards, and two — the Albion and Oltyry — by contract on the Thames and the Clyde. They are of a new class, displac- ing 12,950 tons, standing midway between the Renown and the Majestic. The programme also included four first-class protected cruisers of the Diadem class (11,000 tons) — the Spartiate, Argonaut, Amphitrite, and Ari- adne; three second-class cruisers of 6600 tons — ^the Hermes, Highflyer, and Hyacinth; six third-class cruisers of 2135 tons — the Pomone, Prometheus, Pegasus, Pyra- mus, Pactolus, and Perseus; and twenty-eight torpedo- boat destroyers. Of the first-class cruisers, the Spartiate was laid down at Pembroke, and the others in private yards. The vessels under construction during this year comprised thirteen battleships, ten first-class cruisers, sixteen second-class cruisers, seven third-class cruisers, and a number of destroyers ; and the expenditure involved considerably exceeded that incurred in any pre- vious financial year, and the numbers and type of the new ships laid down were ^exceptional. The progress made was in many ways good, the Mars and Jupiter, for example, being delivered by the contractors five months within the contract date. Some of the ships were, how- ever, greatly retarded by the dispute in the engineering trade. The Caesar, Illustrious, and Hannibal were de- layed, and some of the ships of the Canopus class, though rapidly pushed forward until the engineering dispute began,, were, owing to the non-delivery of structural portions, much retarded. Progress with certain of the cruisers was also impeded. In the shipbuilding pro- gramme of 1897-98 four battleships were included — the Vengeance, of the Canopus class, built at Barrow, and the Formidable, Implacable, and Irresistible {Majesties with some improvements), constructed in the dockyards. The programme also included three third-class cruisers, two sloops, four gunboats, two torpedo-boat destroyers, and a new royal

yacht, which was built at Pembroke. In addition, Mr Goschen, then First Lord, announced in July 1897 that in consequence of the proposed additions to the navies of foreign Powers, he< had received an additional sum of £500,000 from the chancellor of the exchequer, wherewith it was proposed to begin the con- struction of four armoured cruisers of an entirely new design, which, it was said, would be capable both of commerce protection and of taking their place in the line of battle. These were the Cressy and Aboukir, built at Glasgow, the Hogue at Barrow, and the Sutlej at Clyde- bank— all displacing 12,000 tons. This extensive pro- gramme was very seriously affected by the prolonged labour disputes, which lasted from July 1897 until Teb- ruary 1898, and Mr Goschen confessed that the Board was unable to foresee the exact amount by which the anticipated expenditure on new constructions would fall short. The difficulties arising from the labour dispute affected the p:^oduction of machinery, gun-mountings, armour, and almost every important class of material, and in the dockyards the work was delayed by the inability of the contractors to deliver the material they had under- taken to supply. The commencement of the armoured cruisers was also delayed by the introduction and trial of new types of 12-inch and 6-inch guns. Nevertheless the estimates of 1898-99 proposed to build three battleships of 15,000 tons and of the Formidable class — the London, Venerable, and Bulwark; and to put in hand also two

armoured cruisers of the Cressy class — ^the Euryalus and Bacchante ; and two others — the Drake and King Alfred — of a still larger type, displacing 14,100 tons, as well as four sloops. The year 1898-99 was also marked by the introduction of a supplementary shipbuilding pro- gramme. It was explained by the First Lord, in July 1898, that the programme at first presented was considered adequate at the time, and was based on the principle that the British navy must be equal in number, but superior in power, to the fleets of any two countries. Mr Goschen stated that it was im- possible to conceal the fact that the action of Eussia, and the programme on which she had entered, was the cause of this further strengthening the fleet. Mr Goschen's explanation was enforced in these words : " What, then, is our position ? We know of six Eussian battleships to be laid down this year, including one al- ready begun. We have now verified where those six ships are to be built. Of those I took two into account in my original estimate, so that the balance against us was four. Accordingly, I must ask the House to sanction four bat- tleships beyond my original estimate. The new Eussian programme also provides for four cruisers from the com- mencement of this year, and we propose to commence an equal number — ^that is to say, four cruisers in addition to those provided for already." The supplementary pro- gramme, therefore, provided for the laying down of four battleships and four armoured cruisers, as well as twelve destroyers, and the total liability involved was about £8,000,000, to be spread over about three and a half years. The four new battleships Vere the Duncan, Corn- wallis, Exmouih, and Russell, all built by contract, dis- placing 14,000 tons, and intermediate in size between the Formidable and Canopus classes with superior speed and thinner armour, the latter being due to improved pro- cesses of steel-production. The armoured cruisers were the Leviathan and Good Hope, both of the Drake class (14,100 tons), and the Bedford and Monmouth of a smaller type (9800 tons). Shipbuilding progress was still impeded, work being much disarranged owing to the unprece- dented activity in mercantile shipbuilding which fol- lowed the labour dispute, and serious delay resulted from the inability of the shipbuilding contractors to pro- cure the necessary materials. The ships could not thus be laid down nor carried forward so advantageously as had been hoped, and further delay occurred owing to the introduction of the Krupp process of armour, which made necessary the reconstruction of steel-producing plant. The programme of 1899-1900 included two other battleships — the Monta.gue and Albeifiarle (14,000 tons) — of the Dun- can class, and two armoured cruisers — the Kent and Essex (9800 tons) — of the Bedford class, all to be built in the dockyards, as well as three smaller cruisers, two sloops, and two first-class torpedo boats. Once more it proved that abnormal activity in shipbuilding and engi- ogigyg i„ neering seriously affected building progress, and construe- checked expenditure on ships, machinery, and "«"'• armour. Delay in the delivery of material, difficulties in securing adequate numbers of workmen, and other cir-

cumstances caused the aggregate earnings on contract work to fall short of the ‘estimated amount by about £1,400,000, although the estimate had been calculated on the basis of actual earnings in past years of ships of similar character, and on close investigation of the possible output of armour. Progress in the dockyards was also impeded, and was further affected by the fact that a large number of the ships were designed for excep- tionally high speed, and were therefore to be provided with propelling machinery of great power. The ship- building programme of 1900-1 included two battleships — the Queen and Prince of Wales; six first-class armoured

empire]

Bxpeadl- tare.

cruisers — the Cornwall, Suffolk, Cumberland, Lancaster, Donegal, and Berwick; one second-class cruiser (an im- proved Hermes), two sloops, two light-draught gunboats, and two torpedo boats. The programme of 1901-2 in- cluded three battleships, six armoured cruisers, two third- class cruisers, ten destroyers, five torpedo boats,two sloops, and five submarine boats. Shortly after the estimates were presented the Admiralty Boiler Committee made an interim report, in which the Belleville boiler was con- demned, and a trial of other water-tube types recom- mended.

It may be useful to add a note concerning the spending of the money. Within the Controller’s Department, as has been explained, are centred the more importajit spending branches of the Admiralty. While tlie work of designing ships and preparing plans is in progress, the director of stores, the director of dock- yards, and other of&cials of that department concerned are making preparation for the work. The necessary stores, comprising almost every imaginable class of materials, are brought together, and the director of stores is specially charged to obtain accurate information in regard to require- ments. He is not, however, a purchasing officer, that work being undertaken by the director of navy contracts, who is concerned with the whole business of supply, except in regard to hulls and machinery of ships built by contract, and the special requirements of the director of works. At the same time, the civil departments of the Admiralty being held responsible for the administration of the votes they compile, it is their duty to watch the outlay of money, and to see that it is well expended, the accountant- general being directed to assist them in this work. The system is closely jointed and well administered, but it possesses a very centralized character, which interferes to some extent with flexible working, and with the progress of necessary repairs, especially in foreign yards. In so far as ships given out to contract are concerned (and the same is the case in regard to propelling machinery built by contract), the director of navy contracts plays no pail;, the professional business being conducted through the Controller of the navy, who is advised thereon by the director of naval construction ^nd the engineer-in-chief. The work conducted in private establishments is closely watched by the Admiralty officials, and is thoroughly tested, but, mutatis mutandis, the system in regard to contract-built ships is practically the same as that which prevails in the dockyards.

V. Personnel. — ^No work of the Admiralty is more important than the supply of trained officers and men to the fleet. ^ The provision of these in adequate number, the organization of the training service, the constitution of the reserve, and many other questions connected with the pay, promotion, and retirement of officers and men impose a great duty upon the Admiralty Board. The work mainly lies in the province of the second Naval Lord, who has charge of the work of manning the fleet, and educating and training the personnel, together with the affairs of the royal marine Ught infantry and

the royal marine artillery. Within his purview are all training establishments, including those for engineer students, the naval colleges, and the royal marine schools. The First Lord of the Admiralty has special charge of promotions and removals of naval and marine officers to or from the service, and of the appointments of flag officers, captains, all officers to command ships, commanders to the coast- guard, superior officers to the medical service, staff appointments to the royal marines, and civil appoint- ments and promotions, except where these fall under the Controller and the Civil Lord. The first Naval Lord appoints commanders (second in command), and the second Naval Lord navigating officers and lieutenants.

sub-lieutenants, midshipmen, cadets, engineer officers, and others, while the appointment of chaplains, naval in- structors, junior medical officers^ paymasters, and other officers of the accountant branch falls to the junior Naval Lord. The increase of the materiel of the fleet has led to large additions being made to the numbers of officers and men, and the conditions of service have been in some ways modified. The general regulations are published in the Quarterly Navy List, so that it is unnecessary to refer to them here. The great scarcity of lieutenants caused the Admiralty, in the year 1896, to institute a supple- mentary list of naval lieutenants and sub-lieutenants, who were appointed under special conditions from the mercan- tile marine, and are not promoted beyond the rank of lieutenant unless for distinguished service, but are retired at forty-five years of age. Changes have also been intro- duced in the conditions and service of the royal naval re- serve, and it may be said that the system of training is still under trial and that it is not yet definitely established. The number of officers, seamen, boys, coastguard, and royal marines borne on the books of His Majesty's ships and at the royal marine divisions are fixed yearly by vote A of the navy estimates. The following table shows the annual increase in the number in these ranks and ratings during the ten years 1890-1900 : —

Te»r.

1890-91 1891-92 1892-93 1893-94 1894-95 1895-96 1896-97 1897-98 1898-99 1899-1900

The total force voted for the year 1900-1 was 114,880, being an addition of 220 officers, 3050 petty officers and seamen, 150 engine-room staff, 200 miscellaneous ratings, 300 marines, and 320 apprentices (artisan ratings), mak- ing in all an addition of 4240. A further increase of 3745 was ,authorized in the next year. The number of officers is being increased under a scheme extended gradually over a certain number of years, and it was announced in 1899 that the flag officers would be in- creased from 68 to 80, the captains from 208 to 245, the ~~commanders from 304 to 360, and the lieutenants from 1150 to 1550. Increases were also instructed to be made in the othfer branches of the service. The additions made to the materiel of the navy had outrun the provision made for the supply of officers, and the list of supple~~ mentary lieutenants was increased to tide over the in- terval which would elapse before a sufficient supply of executive officers trained up in the service could be pro- duced in the ordinary cpurse, it being easier to build ships than to train those required to man them.

Except for the list of supplementary lieutenants and sub-lieutenants which has been referred to, all executive officers of the navy enter as cadets upon the nomination of the First Lord of the Admiralty (who also nominates assistant clerks for the accountant branch) and are trained in tJie naval establishment now located in the Britannia at Dartmouth, which is about to be transferred to a build- ing ashore. A few nominations are given to the sons of colonial gentlemen and of naval and military officers for special reasons of service, and in particular cases a few youths are entered from the Worcester and Conway training-ships of the mercantile marine. Latterly, a new arrangement as regards the entry and training of cadets

Total Number

Increase

borne at end

during

of Tear.

Tear.

67,748

1764

71,423

3675

74,420

2997

77,976

3556

83,117

5141

88,674

5557

94,376

5702

100,052

5676

106,002

5950

111,019

5017

74

has been instituted, and came into force in the year 1897-98. The result is gradually to raise the age for entering by one year, and to shorten the course of in- struction in the Britannia to about sixteen months, and cadets are now entered]bhree times a year instead of twice. The effect of this change is that about 190 cadets pass through the Britannia yearly instead of 125, as was the case formerly, and that 170 sub-lieutenants will be ulti- mately produced annually instead of 116. The question of a limited competition as compared with an open one has been much discussed. It has been argued that it is anomalous to have open competition for some branches and limited competition for others, and that the exercise of the right of nomination by the First Lord is liable to be influenced by political considerations.^ After passing a certain time afloat, or in the case of the most successful boys at the date of their leaving the Britannia, the cadets are appointed midshipmen, and upon gaining the age of nineteen and completing three and a half years' service afloat as midshipmen, they may pass for sub-lieutenants, the examination being in seamanship, navigation, torpedo, gunnery, and pilotage. As an acting sub-lieutenant the young officer proceeds to the Eoyal Naval College, Green- wich, where his navigation and pilotage examination takes place, and he then passes to the gunnery and torpedo estab- lishments at Portsmouth, where upon passing the exam- ination he is confirmed in the rank of sub-lieutenant.

Promotion to lieutenant depends upon the class ofoPffce^. °^ certificates obtained at these examinations.

Thus, five first-class certificates and promotion- marks secure the promotion of the sub-lieutenant after six months from the date of seniority in that grade, five ordinary first-class certificates after twelve months, and so on down to twenty-seven months as sub-lieutenant, after which promotion is only by seniority. The duties of a lieutenant afioat are many and various, and include the charge of watches and of a division of men, with drill at the guns. A certain number of lieutenants spe- cially qualify in gunnery, torpedo, and navigation, and are appointed to ships to act in the capacity of specialists in these matters. Above the rank of lieutenant promo- tion is by selection, twice a year, according to the needs of the service, a certain number of lieutenants being pro- moted to the rank of commander. Lieutenants are also promoted to commander from the royal yacht and for distinguished service. Before this time, however, a sep- aration of duties may have occurred, for it is open to a certain number of lieutenants, under pa.rticular condi- tions^ to be transferred to the coastguard, and to forego further chances of promotion. Captains are promoted by selection from the commanders' list, and captains, like officers of every other branch, are retired under the limit of age applicable to their rank. Their promotion to flag rank is by seniority, and depends upon the va- cancies arising in the rear-admiral's list. In the same way rear-admirals rise to vice-admirals and admirals by seniority, but are promoted " admirals of the fleet " by selection.

The position and pay of officers of the engineer branch has steadily improved during recent years. They enter between the ages of fourteen and seventeen, mostly by competitive examination, though a few nominations remain with the Admiralty. The course at the Eoyal Naval Engineers' College at Keyham is of four or five years. The most successful students at the final exami- nations go to the Eoyal Naval College, Greenwich, for a further course, and the most successful of these may be appointed to the royal corps of naval constructors.

1 See appendix to the Life of Admiral Lord C. Paget, who was for six year^parliamentary secretary of the Admiralty.

The less successful students are appointed probationary assistant engineers, and are confirmed in the rank after a period of service. Assistant engineers may pass for engineers after three years' service, and are eligible for promotion after five years' service. Promotion to chief engineer is by seniority as vacancies occur, and further promotion to inspector of machinery is by selection, and to chief inspector of machinery by seniority, these last two ranks being for officers appointed to various establish- ments at home and abroad.

The entry of accountant officers is like that of cadets, by nomination and limited competition, and under recent regulations the entry is made between the ages of seven- teen and eighteen. The successful candidates are assist- ant clerks, passing after twelve months as clerks, and at the age of twenty-one, upon examination, become assistant paymasters. Promotion to paymaster is by seniority, and by qualifying time afloat there is promotion to staff- paymaster, and fleet-paymaster. Admirals' secretaries are selected from the ranks of assistant paymasters and paymasters.

Officers of the medical branch must be qualified under the Medical Act, and upon examination the candidates are appointed surgeons in the royal navy, and are specially trained at Haslar Hospital. After twelve years' full-pay service surgeons are advanced to the rank of staff-sur- geons, and after a further period the rank of fleet-surgeon is gained. The deputy inspector-general is selected from the fleet-surgeons' list, and the inspector-general of hos- pitals and fleets from among the deputy-inspectors.

Chapl.ains are appointed to the fleet by the Admiralty after examination. They must have been ordained dea- cons or priests in the Church of England, or be of the same orders "by the lawful authority of one of the churches within the realm of Great Britain and Ireland which are in coinmunion with the Church of England." In addition to his clerical duties the chaplain may act as naval instructor, but there is a special branch of naval instructors who are found qualified after attaining at least a " senior optime " at Cambridge, a second class in the final mathematical schools at Oxford, or junior mod- erator in pure or mixed mathematics at Dublin. These officers are further trained at Greenwich, and it is only after passing a qualifying examination that chaplains can also undertake the duties of naval instructors.

The royal naval reserve is an extremely popular force composed of officers (and others) of the mercantile marine — lieutenants, sub-lieutenants, senior engineers, and en- gineers, assistant engineers, and midshipmen. These officers are entered by the Admiralty upon certification by the Board of Trade, under regulations which are found in the Quarterly Navy List. Many of them nndergo twelve months' training in ships of the fieet, and all those on the active list are relquired to drill on board one of the royal naval reserve drill-ships for ascertain number of days yearly. The number of those on the list who had served or were serving was 267 in April 1900. Vacancies for executive officers of the reserve are filled as soon as they occur, and many qualified candidates present them- selves for every vacancy. In 1898-99 provision was made for increasing the executive officers' list by 100, and the establishment of engineer officers of the Toyal naval reserve has been fixed at 400. The fleet reserve is a new organization devised to secure the retention of time-expired men on a system analogous to that of the army reserve.

The royal marines {q.v.), including the royal marine artillery and the royal marine light infantry, the former with their headquarters at Eastney, and the latter with their divisions at Chatham, Portsmouth, and Plymouth, are an extremely fine body of men, who serve alternately

afloat and ashore. Candidates for commissions enter through the Civil Service Commissioners' examination at the Koyal Military Academy at Woolwich, and upon passing out as second lieutenants the officers proceed to the Eoyal Navstl College, Green-wich, after which there is training at the gunnery "establishment at Portsmouth. In the case of tlie light infantry the training is similar, though there are some differences in procedure. A marine officer on board ship is in command of all marines in their distinct duty as such, but he cannot assume any naval command -whatever, unless ordered to do so by the senior naval officer.

Details in regard to qualifications, pay, emoluments, and duties, may be found in the Admiralty Instructions and the Quarterly Navy List.

We may now turn from the officers to the men. Boys are entered in the training-ships between 14^ and 16f years Men. °^ ^S6> sJtid they undergo a course of instruction

to qualify them for seamen, having on entry signed an agreement to serve for twelve years from the age of 18, after which they can claim their discharge. When the course of training in the training-ships and brigs is sufficiently advanced the boys proceed on active service. Many boys are periodically drafted to the ships of the channel squadron, and there become ordinary seamen. The next rating to which men rise by service and good conduct is that of able seamen, and the various ratings of petty officers to that of chief petty officer follow. A certain proportion of men may become warrant officers (gunners, boatswains, &c.), a most valuable class of men, and these may rise to commissioned rank in the case of special gallantry against the enemy. Pensions are granted at the age 6f forty to seamen who have served for twenty-two years from the age of eighteen, according to conduct, ability, and advantage. Stokers are entered direct from the shore, serve some time in the steam reserve to be taught their drill and learn the discipline of the service, and go out on steam trials before being sent to a sea-going ship. Like the seamen they can rise from petty officer to warrant officer, a rank which gives a pension to the widow. The artificer class, which comprises blacksmiths, armourers, plumbers, carpenters, &c., have to pass an examination in their trade before being sent to sea-going ships. As is the case with officers, there may come a time when the petty officer may think it desirable to join the coastguard, which gives him duties on shore, but places him only in the rank of able seaman, while his gunnery and torpedo pay are stopped.

Allusion has been made to the officers of the royal marine forces. The men are enlisted for twelve years, and the service may be extended to twenty-one years. ' The recruit receives his first training at the dep6t at Walmer and may volimteer for the artillery branch in which the pay is better, and be transferred to it upon fulfilling the conditions. His duties ashore are those of a soldier, but when the time comes he is drafted for service afloat, and his duties then are in many respects analogous to those of the seamen. The royal marines, both of the artillery and light infantry branches, are an extremely fine body of men who have never failed to do good service when called upon, and the force has been largely increased within recent years. The average height of the men on entry has lately ranged from 5 feet 7^ inches to

5 feet 8 inches for the royal marine artillery, and from

6 feet 6^ inches to 6 feet 6 inches for the royal marine light infantry. The numbers of the corps are being steadily increased, . and. in the year 1901-2 there was a further addition to the force of 1000 men. The marines — ^their barracks, driU, and books — are in- spected by the deputy adjutant-general of royal marines.

and their discipline is entirely under him, nor can they be sent away from their headquarters except by orders from the Admiralty. For garrison and field duties they are, when their naval duties so permit, under the general commanding the forces at their head- quarters.

In the year 1899, at the commencement of the South African war, the masted training squadron which had been employed for the training of the boys of the sear men class, as well as of young officers, was re- ‘”,,’”“s- placed by a squadron composed of modern cruisers. This circumstance led to a discussion concerning the right system of training boys for service afloat. The question had been debated before, but in Jime 1900 Mr J. R. Thursfield read a paper upon the subject before the Eoyal United Service Institution, which was followed by an important discussion. The argument of the lecturer was that, though masted ships are no longer used in the navy, the training or discipline of masts and sails was well adapted to educe those qualities of alert- ness, readiness, quickness of eye, and rapidity of decision which are universally thought essential in seamen. On the other hand, a large number of naval’ officers were of opinion that the system implied by the existence of the small training squadron of masted vessels had given anything but satisfactory results. One after another various admirals who had lately commanded fleets, or who were then in command, testified to the need of some system of training which would restore the type of officer and seaman which they affirmed to be disap- , pearing. The majority of these were of the opinion that no mere resuscitation of a training ship squadron of four-masted vessels would remedy the evil, while some ridiculed the idea of attempting to revive what they looked upon as dead and buried. It was very note- worthy, on the other hand, that some young officers appeared as stout advocates of the old system of training. In short, the discussion revealed the existence of two schools of thought on this important matter, and on either side were ranged officers of equal rank and experi- ence. There was a consensus of opinion that something was needed for the training of the fleet, but a wide divergence of view was revealed as to what that some- thing should be. It may be worth while to remark that the men of the naval brigade on the Benin expedition ■under Sir Harry Eawson, and those lately employed in South Africa and China, showed no deterioration in the characteristic handiness of the seaman.

VI. Mobilization of tfie Fleet. — By the mobilization of • the fleet is meant the placing of naval resources upon a war footing, in readiness in all material and personal respects for hostile operations. It is obvious that this is the real crown and completion of the work of the Admiralty Board, and that there can be no department or branch which is not in some way concerned in it. The work of mobilization falls chiefly within the province of the first Navgl Lord, and the mobilization branch of the Naval Intelligence Department is his agency. The essence of the work of that branch is described as ” preparation for war,” and it is concerned with the preparation of plans for organization, basing much of its work upon the in- formation gained by the Foreign Intelligence Branch. The Naval Intelligence Department is a consultative office in the department of the first Naval Lord. But of course the second Naval Lord, who is chiefly concerned with the manning of the fleet, including the coastguard and the royal naval reserve, has a very large share in the duties of mobilization. The same may be said of the Additional Naval Lord and Controller, who is charged with all that concerns the materiel of the fleet, and again of the junior Naval Lord, whose duties are largely in the matters of

transport and auxiliary services. A large amount of in- formation concerning mobilization — as indeed concern- ing all other naval subjects— “will be found in The British Fleet, by Commander Charles N. Eobinson, E.N., from which some of the following notes are taken. He re- marks that mobilization is the point to which everything naval tends. It is the duty of the Admiralty to pro- vide ships in efficient condition, with ammunition, coal, stores, and supplies, complete in every material respect — ^this implying of course adequate naval bases and coaling stations — and the mobilization

of the personnel is the bringing of every man in due time to the ship and the duties for which he is appointed. The mobili- zation for the naval manoeuvres is only a partial operar tion, for a complete mobilization would dislocate our searfaring life in a manner that would be justifiable only by actual war. Thus, the auxiliary cruisers of the mercantile marine are not mobilized, nor the pen- sioners, nor the men of the royal naval reserve, though large numbers of the latter are, of course, afloat during the manoeuvres.

The Admiralty is the central authority which sets the operation of mobilization in motion, but the duties in- volved fall to the naval commanders-in-chief at the ports and to the admiral superintendent of naval reserves. ” These high and important functionaries are collectively as the brain of the maritime body in direct communication, ‘ through various active sub-centres, with its outermost limits. From them emanate the instructions which give effect to the order to mobilize.” The first step is to complete in any details the complements of the ships actually in commission, and in practice young officers from Greenwich and other training establishments are attached to them. By a recent arrangement, however, the reserve squadron, consisting of the coastguard and the portguard ships at the various ports, is maintained with complete complements, and assembles periodically for training. The order to mobilize sets in motion many officers and men of the coastguard, and opens the gang- ways and doors of the training establishments, depSts, barrack, and harbour ships. From these come the seamen, gunners, torpedo men, signalmen, and stokers, who have been undergoing special courses, as well as the boys from the training-ships, the men who have had charge of machinery of ships in reserve, and, indeed, all classes of men required for ships commissioned, who are effective at the various quarters.

The arrangements made are admirably complete, and every man as he leaves his ship or depSt is provided with, a card indicating his ship, station, and duties, so that he knows exactly where he is to go and what to do, and he falls into the plan precisely in the place which the careful paper scheme has provided for him. In this way the ships in the first division of the fleet reserve are provided with complements. These are the ships lying at the dockyards in every respect complete except for their crews, officers, stores, and ammunition. Meanwhile, the various victualling and store departments have been actively .engaged in supplying every detail necessary for the ships, whose complements are completed by the embarkation of non-continuous service men, such as stewards and cooks. This is the point at which the annual mobilization generally stops short. But in case of hostilities it would, of course, go much further. Then the superintendent of naval reserves would be charged with the duty of supply- ing successive contingents of men to the naval ports to take the place of those sent afloat, these contingents to embark in their turn in the ships brought forward for commission, and to be succeeded again by others, according as the need arose. This work would begin from the head- quarters of the coastguard divisions at Harwich, Hull,

Queensferry, Greenock, Kingstown, Limerick, Holyhead, Portland, and Southampton. The officers and men of the coastguard would go afloat comparatively early in the operations, and, in fact, a number of them go to sea annually during the manoeuvres. Meanwhile, the officers and men of the royal naval reserve and the pensioners would have been set in motion to their respective drill- ships and barracks, and having been embodied would be converged upon the special naval ports where their services were required. In this way the ships in other classes of the reserve would receive their complements, as well as the auxiliary cruisers taken up from the merchant marine. As Commander Eobinson remarks : “It is impossible to say where, in a great national crisis, the mobilization of men would end; for all the sea-faring manhood of our islands, all our artisan popu- lation— boilermakers, engine-fitters, electricians, engi- neers, carpenters, and a host of others, would render their best in the empire’s need.” The work would not end with the provision of complements for the ships, and a hundred other considerations would occupy the mobilizing authorities. They would be engaged in passing men through the special training ships to form the eventual complements of ships, or to re-

place those killed in action, and they would also have to supply efficient men for the signalling Stations and for other duties.

A word has been said about the material requirements of the fleet upon mobilization. These are largely centred in the branches of the director of stores and the director of victualling. The former is concerned with the supply of a vast array of objects and necessaries, including coal, boats, oil, rope, candles, paint, varnish, and a host of other things. Adequate supplies are kept at the depSts, and the work of replenishment in case of mobilization would go forward steadily. The director of victualling being responsible under the junior Naval Lord for regulating the proper supply, care, and preservation of all victualling and clothing stores for the fleet, including mess-traps and seamen's utensils, and having charge of the victiialling yards and dep5ts, maintains constantly adequate quantities at the various stations ; and it may be useful to say that the chief victualling yard at home is that at Deptford, the others being at Portsmouth and Devonport, with a smaller establishment at Haulbowline (Queenstown), while there are dep6ts abroad at Gibraltar, Malta, Halifax, Bermuda, Jamaica, the Cape of Good Hope, Trincomalee, Hong-Kong, Esquimalt, Bombay, Ascen- sion, Coquimbo, and Sydney; All these, of course, are supplied with a great quantity of stores that would play a most important part during a complete mobilization of the fleet.

VII. Naval Finance : The Accountant-General's Depart- ment.— The subject of naval finance is one of great com- plexity and of vast importance. The large sums of money with which the Admiralty deals both in the way of estimates and expenditure, amounting recently to about £30,000,000 annually, implies the existence of the great organization which is found in the department of the accountant-general of the navy. Under the authority of the First Lord, the parliamentary and financial sec- retary is responsible for the finance of the Admiralty in general, and for the estimates Ind the expenditure, the accounts and the purchases, and for all matters which concern the relations of the Admiralty to the Treasury and to other departments of the Government ; and in all the practical and advisory work the accountant-general is his officer, acting as his assistant, with the director of^ naval contracts who, under the several Lords, is concerne'd with the business of purchase.

The organization of the accountant-general's department

has undergone many changes, and the resulting condition is the outcome of various modifications which have had for their purpose to give to this officer a measure of financial control. There have been various views as to what the duties of the accountant-general should be. After the reorganization of the Admiralty by Sir James Graham in 1832, the accountant-general was regarded as a recording and accounting officer, wholly concerned with receipt apd expenditure. His duties were limited to the auditing of accounts, payments, and expenditure generally. Owing to changes effected in 1869, which made the parliamentary secretary, assisted by the Civil Lord, responsible for finance at the Admiralty, bringing the naval and victualling store departments into his charge, the accountant-general was invested with the power of criticizing these accounts financially, though he did not as yet possess any financial control, and the position was little changed by fresh pules made in 1876. It was not until 1880 that the powers of the accountant-general were enlarged in this direction. It was then ordered that he should be consulted before any expenditure. which the estimates had not provided for was incurred, and before any money voted was applied to other purposes than those for which it was provided. The effect of this order was not happy, for the accountant-general could not undertake these duties without setting up friction with the departments whose accounts he criticized. It was contemplated by the Admiralty in 1885 to make the accountant-general the assistant of the financial

secretary, and to raise him to the position of a permanent officer of finance instead of being an officer of account invested with imperfect authority in the direction of control. A select committee of the House of Commons reported that the accountant-general possessed no financial control over the departments, and that there was an urgent need for establishing such a control. At the time the position of that officer did not enable him to exercise any sufficient general supervision over expenditure, and there was no permanent high official expressly charged with finance. Accordingly, after being submitted to a departmental committee, a fresh arrangement was made in November 1885, whereby the accountant-general, under the authority of the financial secretary, was given a direct share in the preparation of the estimates. His written concurrence was required before the final approval of the votes, and each vote was referred to him for his approval or observations, and he was to exercise a financial review of expenditure and to see that it was properly accounted for. He became, in fact, ” the officer to be consulted on all matters involving an expenditure of naval funds.” It was believed that economical administration would result; but much opposition was raised to the principle that was involved of submitting the proposals of responsible departments to the inexpert criticism of a financial authority. Mr Main, assistant accountant-general, stated before the Eoyal Commission on Civil Establish- ments, 1887, that the effect had been to develop a tendency to withhold information or to afford only par- tial information, as well as to cause friction when ques- tions were raised affecting expenditure, accompanied by protests, even in those cases in which these questions were manifestly of a legitimate character. The result was discouraging, and in the opinion of Mr Main had done much to weaken financial control and to defeat the purpose of the order. It is unnecessary to detail the various changes that have been made by the institution of dockyard expense accounts in the department of the Controller, and by various other alterations introduced. The Treasury instituted an independent audit of store accounts which greatly affected the position of the accountant-general, and the Eoyal Commission on Civil

Establishments reported that the Board of Admiralty were of opinion that they could dispense with the accountant-general’s review altogether. The commission was, however, of opinion that the accountant-general should be the permanent assistant and adviser, on all matters involving’ the outlay of public money, of the financial secretary.

The operations of the accountant-general are now conducted in accordance with the Order-in-Council of 18th November 1885, and of an office memorandum issued shortly afterwards. He thus acts as deputy and assistant of the parliamentary and financial secretary, and works with a finance committee Within the Admiralty, of which the financial secretary is president and the accountant-general himself vice-president. The duties of the department are precisely defined as consisting in the criticism of the annual estimates as to their sufficiency before they are passed, and in advising the financial and parliamentary secretary as to their satisfying the ordi- nary conditions of economy. The accountant-general also reviews the progress of liabilities and expenditure, and in relation to dockyard expenditure he considers the proposed programme of construction as it affects labour, material, and machinery. He further reviews current expenditure, or the employment of labour and material, as distinguished from cash payments of the yard, as well as proposals for the spending of money on new work or repairs of any kind for which estimates are currently proposed. The accountant-general’s department has three principal divisions: the estimates division, the. navy pay division, and the invoices and claims division. In the first of these is the ledger branch, occupied with the work of accounts under the several votes and sub- heads of votes, and with preparing the navy appropria^ tion account, as well as the estimates and liabilities branch, in which the navy estimates are largely prepared after having been proposed and worked out in the execu- tive departments of the Admiralty. There are also ships’ establishments and salaries branches. The navy pay division includes the full and half-pay branch and a registry section. There is also the seamen’s pay branch, which audits ships’ ledgers and wages, and has charge of all matters concerning the wages of seamen. The victual- ling audit is also in this branch, and is concerned with payments for savings in lieu of victualling and

some other matters. Further, the navy pay division examines ships' ledgers, and is concerned with the service, char- acters, ages, &c., of men as well as with allotments and pensions. The third division of the accountant-general's department, known as that of invoices and claims, con- ducts a vast amount of clerical work through many branches, and is concerned with the management of Naval Savings Banks and matters touching prize-money and bounties.

The importance of this great department of the Ad- miralty cannot be overrated. It is; in the first place, of supreme importance that the navy estimates should be placed upon a sound financial basis ; and in practice the board requires the concurrence of the accountant-general to the votes before they are approved, and thus in greater or less degree this officer is concerned in the preparation of every one of the votes. He does not concern himself with matters of larger policy outside the domain of finance, and it must be confessed that there appears to be something anomalous in his " review " of naval expendi- ture. It is, however, a mark of the flexibility or elas- ticity of the Admiralty system that in practice the opera- tions of the accoimtant-general's department work easily, and that Admiralty finance is recognized as having been placed upon a sound and efficient basis. There are important financial officers outside the accountant-gen-

eral's department concerned with assisting tlie Controller. The inspector of' dockyard expense Eiccounts, -who is entirely in the Controller's department, enables him to exercise careful supervision over expenditure and the distribution of funds to special purposes. This work, however, though highly important, is merely one part of the system of financial control. Within recent years the bonds have been considerably tightened, and the work is untainted by corruption. It is true that in exercising rigid supervision over expenditure the work has become more centralized than is desirable, and it is a mark of change within recent years that local oflcers have been in larger measure deprived of independent powers. This, indeed, is a necessary condition of financial control, or at least a condition which it is not easy to change where rigid control is necessary. (e. v. h. ; j. ld.)

United States.

The President of the United States is commander-in- chief of the navy — a constitutional prerogative which he seldom asserts.,. The Navy Department is administered by a civilian Secretary of the Navy — a cabinet officer ap- pointed by the President — who exercises general super- vision. Next in authority is the Assistant-Secretary, also a civilian nominee, who acts as an assistant, and has, besides, certain specific duties, including general super- vision of the marine ,corps, naval militia, and m^neai ^^■'^^.l stations beyond the continental limits of the United States. The details of administra- tion are supervised by the chiefs of bureaus, of which there are eight. They are appointed by the President from the navy list for a period of four years, and have the rank of rear-admiral while serving in this capacity. They have direct control of the business and correspond- ence pertaining to their respective, bureaus ; and orders emanating from them have the same force as though issued by the Secretary.

The bureau of Navigation is the executive, or military, bureau, and as such promulgates and enforces the orders and regulations prescribed by the Secretary ; it has gen- eral direction of the procurement, education, assignment, and discipline of the personnel. It also controls the movements of ships, including the authorization of manoeuvres and drills, such as target practice. The bureau of

Equipment has charge of all electrical appliances, com- passes, charts, and fuel, and generally all that relates to the equipment of vessels, exclusive of those articles that come naturally under the cognizance of other bureaus. It has charge of the naval observatory, where the ephem- eris is prepared annually, and of the hydrographic office, where charts, sailing directions, notices to mariners, &c., are issued. The bureau of Ordnance has charge of the gun factory, proving ground, and torpedo station, and all naval iha^azines ; all the details that pertain to the manufacture, tests, installation, or storage pi all ofEensive and defensive apparatus, including armour, ammunition hoists, ammunition rooms, &c., though much of the actual installation is performed by the bureau of construotion after consultation with the bureau of ordnance. The bureau of Construction and repair has charge of the de- signing, building, and repairing of hulls of ships, fticluding turrets, spars, and many other accessories. It builds all boats, has charge of the docking of vessels and the care of ships in reserve. The chief of this bureau is usually a naval constructor. The bureau of Steam engineering has charge of all that relates to the designing, building, and repairing of steam machinery, and with all the steam connexions on board ship. The bureau of Supplies aiid accounts procures and distributes provisions, clothing, and

supplies of the pay department afloat, and acts as the purchasing agent for all materials used at naval stations, except for the medical department and marine corps. It also has charge of the disbursement of money and keeping of accounts. The chief of this bureau is a pay officer. The bureau of Medicine and surgery has charge of all naval hospitals, dispensaries, and laboratories, and of all that pertains to the care of sick afloat and ashore. The chief of this bureau is a medical officer. The bureau of Yards and docks has charge of construction and maintenance of wet and dry docks, buildings, railways, cranes, and generally all permanent constructions at naval stations. The chief of this bureau is often a civil engineer.

Under the cognizance of the Secretary's office is the office of the judge-advocate-genera^, an officer selected by the President from the navy list for a term of four years, with the rank of captain while so serving. He is legal adviser to the Department, and reviews the records of all courts and statutory boards. Under the cognizance of the Assistant-Secretary's office is the office of naval intelligence, which collates information on naval matters obtainable at home and abroad. The staff is composed of naval officers on shore duty, the senior in charge being usually a captain, and known as chief intelligence officer. Several boards are employed under the various bureaus, or directly as advisers to the Secretary. Some are per- manent in character, while others are composed of officers employed on other duty, and are convoked periodically or when required. The naval policy board is composed of officers of high rank, and meets once a month ; its duties conform to those of the general staff in armies. The board on construction consists of the chiefs of bureaus of Ordnance, Equipment, Construction and repair. Steam engineering, and the chief intelligence officer. Its duty is to advise the Secretary in all matters relating to the construction policy in detail. The general construction policy is suggested by the naval policy board. The board of inspection and survey is composed of representatives of all bureaus, who inspect vessels soon after commission and on return from a cruise, and report on the condition of the ship and efficiency of its personnel; it also con- ducts the official trials of new vessels. The boards for the examination of officers for promotion are composed of officers of the corps to which the candidate belongs and of medical officers. Every t)fficer is examined profession- ally, morally, and physically at each promotion. The Navy Department is located at Washington, D.C., and occupies a building together with the State and War Departments (the latter being charged solely with army affairs).

The personnel is limited in number by law. The allowance of commissioned officers in July 1900 was 1449, distributed as shown in the table. AH others than line officers are termed, in contrar “” • distinction from them, staff officers. The relative navy or army rank of any staff grade may be ascertained from the table on p. 79.

The engineer corps was abolished in 1899, the then engineer-officers becoming line officers in their respective relative grades. Line officers are the military and execu- tive branch, and are required besides to perform engineer duties. They are graduates of the Naval Academy. Vacancies occurring in the construction corps are filled from the graduates of the Naval Academy having the highest standing in scholarship, who are given a two years' graduate course, generally abroad, on being graduated from the Academy, ' and are then appointed assistant naval constructors. All other staff officers are appointed directly from civil life by the President, from candidates passing prescribed examinations. Each repre-

states]

sentative and delegate in Congress has .authority to nominate a candidate for naval cadet whenever his con- gressional district has no representative in the Naval Academy. The candidate must be a resident of the

district which the Congressman represents, between fif- teen and twenty years old, and must pass prescribed mental and physical examinations. The President is allowed ten representatives at the Academy at all times, appointed

Link Officers

(Executive

Branch).

Medical Corps.

Pay Corps.

Naval Coiistructors.

Civil Engineers.

Chaplains.

Professors of Mathematics.

Belative Army Bank.

1 admiral

9 rear admirals

9 ■. » 70 captains 112 commanders no lieut.-coms.

SOO lieutenants

J

lieutenants S50-< (junior grade) ensigns

15 medical directors 15 medical inspectors 55 surgeons ^

110 passed assistant- surgeons and as- sist.-Burgeons.’

18 pay directors 13 pay inspectors 40 paymasters ‘■

SO passed assist.- paymasters^

40 assistant pay- masters 3

5 naval constructors

6 „

80 naval constructors and assist, naval constructors «

2 civil engineers

i ;; :;

- –

11 „ ” „

4 chaplains 18 I!’

8 prof, of math.

5 ;; ;’,>

General

Major-gen.

Brlg.-gen.

Colonel

Lieut. -col.

Major

Captain

1st lleut. 2nd lieut.

1021 total

195 total

186 total

40 total

21 total

24 total

12 total

1 With rank of lieut.-commander or lieutenant. » With rank of lieutenant, or lieutenant (junior grade). » With rank of lieutenant (junior grade) or ensign. * Naval constructors vrith rank pf lieut. -commander or lieutenant. Assistant naval constructors have rank of lieutenant, or lieutenant (junior grade) .

“at large,” and one appointed from the District of Columbia.

The course of instruction at the Academy is four years, each comprising eight months’ study, three months’ practice cruise, and one month’s furlough. At the expira- tion of four years, cadets are sent to cruising ships for two years’ further instruction, and are then commissioned ensigns. After three years’ further sea service, ensigns are promoted to lieutenants (junior grade). After this, promotion is dependent upon seniority alone, the senior officer in any grade being promoted to the lowest number in the next higher grade when a vacancy occurs in the higher grade, and not before. All officers are retired on three-fourths sea pay at the age of sixty-two, or whenever a board of medical officers certifies that an officer is not physically qualified to perform aU duties of his grade. A few officers are allowed to retire voluoitarily in certain circumstances, to stimulate promotion. Any officer on the retired list may be ordered by the Secretary to such duty as he may be able to perform : this is a legal provision to provide for emergencies. Promotion in the staff corps is dependent upon seniority, though relative rank in the lower grades in some corps somewhat depends upon pro- motion of line officers of the same length of service, and accounts for the existence of staff officers in the same grade having different ranks. All seargoing officers, after commission, are required to spend three years at sea, and are then usually employed on shore-duty for a time, according to the needs of the service — short terms of shore-duty thereafter alternating with three-year cruises. This rule is adhered to as strictly as circumstances will permit. Shore-duty includes executive or distinctly pro- fessional duties in the Navy Department, under its bureaus, and at navy yards and stations ; inspection of ordnance, machinery, dynamos, &c., under construction by private firms ; duty on numerous temporary or permar nent boards ; instructors at the Naval Academy ; recruit- ing duty; charge of branch hydrographic offices; inspection duty in the lighthouse establishment ; at state nautical schools ; as attaches with United States legations ; and many others. Naval constructors (usually), civil engi- neers, and professors of mathematics are continuously employed on shore-duty connected with their professions, the Naval Observatory, Nautical Almanac, and the Naval Academy employing most of the last.

Warrant officers include boatswains, gunners, carpen- ters, sailmakers, warrant machinists, and pharmacists. The last are limited in number to twenty-five, and are

stationed at hospitals, &c., ashore. Warrant machinists are at present limited by law to 160. The number of the others is at the discretion pf the Secretary. The number in January 1901 was as follows : boatswains, 91 ; gunners, 95; carpenters, 62; sailmakers 10. They are appointed by the Secretary, preference being given to enlisted men in the navy who have shown marked ability for the positions. They must be between twenty-one and thirty-five years of age, and pass an examination. After serving satisfactorily for one year under an acting appoint- ment, they receive warrants that secure the permanency of their office. Ten years after appointment, boatswains, gunners, carpenters, and sailmakers are eligible for examination for a commission as chief-boatswain, &c., and as such they rank with, but next after,, ensigns. Mates are rated by the Secretary from seamen or ordinary, seamen. They have no relative rank, but take precedence of all petty officers. Their duties approximate to those of boatswains, though they seldom serve on large cruising vessels. There were but eight on the active list in Janu- ary 1901. Clerks to pay officers are appointed by the Secretary on the nominations of the pay officers. They have no rank and are not promoted or retired. Their appointments are revoked when their services are no longer needed.

The enlisted force numbers 20,000, including 2500 apprentices. Boys between fifteen and seventeen years old of good character, who can read and write and pass the physical examination, may enlist for the term of their minority. They enlist as third class apprentice?, and are given six months' instruction at a training station, and thence go to sea in apprentice training vessels. When proficient they are transferred to regular cruising vessels as second class, and when further qualified are rated first class. All other enlistments are for four years. First enlistments are made only in the following ratings and between the ages specified : —

Rating.

Seamen . . Ordinary seamen . Landsmen Shipwrights Blacksmiths . Plumbers and fitters Sailmakers' mates . Machinists, first class Machinists, second class Electricians, third class Boilermakers .

Tears of Age.

21 to 35

18 „ 30

18 „ 25

21 ,, 35

21 „ 35

21 „ 35

21 „ 35

21 „ 36

21 „ 35

21 „ 36

21 „ 35

[united

Eatdng. ‘5^«’“‘s of

Age.

Coppersmiths 21 to 35

Firemen, first class 21 ,, 35

Firemen, second class . . . . 21 „ .35

Coal-passers 21 ,, 35

Hospital stewards 21 ,, 30

Hospital apprentices, first class . . 21 „ 28

„ apprentices . . . . 18 „ 25

OfBcers’ stewards 21 ,, 35

OfBcers’ cooks 21 ,, 35

Mess attendants 18 ,, 30

Ship’s cooks, fourth class . . . 18 , , 30

Musicians, first class . . . . 21 ,, 35

Musicians, second class . . . . 21 ,, 35

Buglers 21 „ 35

Painters 21 ,, 35

Recruits must speak English. Landsmen are usually sent to sea on special training-ships untU. proficient, and are then sent into general service. Eaw recruits may enlist as landsmen, or coal-passers, or mess attendants. Ordinary seamen must have served two years, and seamen four years before the mast, prior to first enlistment as such ; and before enlistment in any other rating allowed on first enlistment, applicants must prove their ability to hold such rating. Landsmen, coal-passers, &c., as soon as they become proficient, are advanced to higher grades and, if American citizens, may eventually become petty of&cers (ranking with army non-commissioned officers), with acting appointments. In twelve months, or as soon there- after as proficiency is established, the acting appointment is made permanent, and an acting appointment for the next higher grade is issued, &c. Permanent appoint- ments are not revokable except by sentence of court- martial, and a man re-enlists in that rating for which he held a permanent appointment in his previous enlistment. All persons re-enlisting within four months after expira^- tion of previous enlistment are entitled to a bounty equal to four months’ pay, and in addition receive a ” continu- ous service certificate,” which

entitles them to higher pay and to other special considerations. The same is true for each re-enlistment. When an enlisted man completes thirty years' service and is over fifty years of agie he may retire on three-fourths pay.

The marine corps constitutes a wholly separate military body, though under the control of the Navy Department. It is organized, equipped, uniformed, instructed. Marine ^nd drilled similarly to the army, both as inf an- '"""""* trymen and artillerymen, and hence may be

employed as soldiers either afloat or ashore. The corps is commanded by a brigadier-general, with headquarters in Washington, who bears to the Secretary a relation similar to that of a chief of bureau. The general has a general staff of ten members, and the remaining officers allowed by law are as follows : 5 colonels, 5 lieutenant- colonels, 10 majors, 60 captains, 60 first lieutenants, and 60 second lieutenants. Although the organization closely follows the army system, regimental or even permanent battalion organizations are impracticable, owiug to their numerous and widely-separated stations. Practically all shore stations have barracks where marines are enlisted and drilled. At these places they also do sentry, police, and orderly duties. From such stations they are sent to ships for sea duty. Nearly all ships carry a body of marines known as the guard, varying in size from a few men commanded by a sergeant, on small ships, to eighty or more, with one or more commissioned officers, on large vessels. It is customary to cause all marines to serve at sea three of the four years of each enlistment. On board ship they perform sentry and orderly duty, and assist in police duties. They are also instructed in many exer- cises pertaining to the navy, as rowing, naval signalliag, gun drill, &c. In action they act as riflemen, and on

many ships serve a portion of the guns. When circum- stances require a force to be landed from ships present to guard American interests in foreign countries, legations, &c., the marine guard is usually sent, though, if numeric- ally insufficient, sailors are landed also. Large bodies of marines are sometimes sent in transports for this purpose _ from other stations. Mariaes also garrison places beyond the territorial limits of the United States which are under navy control. The enlisted force numbers 6000. Candidates for first enlistment must be between the ages of 21 and 35 and unmarried, must be citizens of the United States, be able to read, write, and speak Eng- lish, and pass a physical examination. Second lieu- tenants are appointed from civil life after examination or from the graduates of the Naval Academy. Promo- tion is by seniority as in the navy. Occasional oppor- tunities are also given meritorious enlisted men to secure

commissions.

Navy and Maeine Coeps Pat Tables.

Table I. — Active List : Officers of the Line, Medical and Pay Corps of the Navy, and Officers of the Marine Corps.

Bank.

Admiral

Rear-admirals —

First nine

Second nine

Chiefs of bureaus and hrigadier-general commandant of marine corps

Captains,, navy

Judge-advocate-general and colonels, ma- rine corps, line and staff

Commanders, navy

Lieutenant-colonels, marine corps, line and staff

Lieutenant-commanders, navy .

Majors, marine corps, line and stafi .

Lieutenants, navy

Captains, marine corps — ^

Line

Staff

Lieutenants (junior grade), navy

First lieutenants and leader of band, marine corps

Ensigns, navy

Second lieutenants, marine corps, chief boatswains, chief gunners, chief car- penters, and chief sailmakers

On Sea

Duty or

Shore Duty

beyond

Sea.

i

13,500

7,500 5,500

3,500

3,500 3,000

3,000 2,500 2,500 1,800

1,800 2,000 1,500

1,500 1,400

1,400

On Shore.

9 13,500

6,375 4,675

5,500 2,975

3,500 2,550

3,000 2,125 2,500 1,530

1,800 2,000 1,275

1,500 1,190

1,400

Bemarks.

All ofBcers paid under this table below the rank of rear-admiral or brigadier-general are entitled by law. to 10 per cent, upon the full yearly pay of their grades for each and every period of five years' service, as increase for length of service, or " longevity pay," computed upon their total actual service in army, navy, and marine corps ; provided that the total amount of such increase shall not exceed 40 per cent, upon the full yearly pay of the grade ; and pro- vided further that the pay of a captain in the navy or colonel of marines shall not exceed $4500 per annum, and that of a com- mander in the navy or lieutenant-colonel of marines $4000 per annum.

Allowances. — ^The monthly commutation for quarters of the admiral is $125. All other commissioned of&cers of the line and of the medical and pay corps of the navy, and all ofBcers of the marine corps, are entitled to public quarters while on shore-duty or commutation therefor, the amount varying be- tween $24 per month for an ensign and $72 for a rear-admiral. Oflcers serving ashore in Cuba, Porto Rico, the Philippine Islands, Hawaii, or Alaska are allowed 10 per cent, increase of the pay proper.

states]

ADMIRALTY ADMINISTRATION

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Table II. — Active List : Other Officers of the Navy and others who are paid as Officers.

Bank.

First 5 Years after Date of Commission.

Second B Years after Date of Commission.

Third 6 Years after Date of Commission.

Fourth 5 Years after Date of Commission.

After 20 Years ii’om Dale of Commission.

At Sea.

On Shore

or other Duty.

On Leave

or •wait- ing Oixlers.

At Sea.

On Shore

or other Duty.

On Leave

or wait- ing Orders.

At Sea.

On Shore

or other Dn,ty.

On Leave

or wait- ing Orders.

At Sea.

On Shore

or other Duty.

On Leave

or wait- ing Orders.

At Sea.

On Shore

or other Duty.

On Leave

or wait- ing Orders.

Naval cadets — In other than prac- tice ships . At Naval Academy and elsewhere .

Chaplains .

Professors of mathe- matics and civil engineers .

Naval constructors

Assistant naval con- structors

Warrant ofBcers — Boatswa,ins, gun- ners, carpenters, sailmakers, phar- macists, and war- rant machinists ,

Matea— Those in service 1st

August 1894 Those appointed since .

9

950

500 2500

2400 3200

1

500 2000

2400 3200

9

, 500 1600

1500 2200

9

2800

2700 3400

1

2300

2700 3400

9

1900

1800 2400

9

3000 3700

9

3000 3700

9

2100 2700

9

3500 4000

1

3500 4000

9 ,

2600 3000

1 4200

9 4200

1 3200

First 4 Tears after Date of Appointment,

Second 4 Years after Date of Appointment.

After 8 Years from Date of Appointment.

J

$ 2000

9 2000

9 1500

9 2200

2200

$ 1700

9 2600

$ 2600

$ 1900

First 8 Years after Date of Appointment.

Second 8 Years after Date of Appointment.

Thuxl S Years after Date of Appointment.

Fourth 8 Years after Date of Appointment.

After 12 Years from Date of Appointment.

1200

$ 900

9 700

9 1300

9 1000

9 800

9 1400

$ 1300

9 900

9 1600

9 1300

9 1000

9 1800

9 1600

9 1200

At Sea.

Shore Duty.

On Leave

or wait- ing Orders.

”

1200 900

9

900 700

9

700

500

All officers paid under this table are allowed 30 cents per day when attached to a sea-going vessel as a commutation for rations. Naval cadets are allowed this amount at all times.

Table III. — Petty Officers, Enlisted Men, &c.- Classification and Pay. Chief Petty Officers.

-Navy.

Seaman Branch.

Artificer Branch.

%

Special Branch.

as; 1^

Chief masters-at-arma .

$ 65

Chief machinists . . . .

$ 70

Chief yeomen ....

9 60

Chief boatswains’ mates

50

Chief carpenters’ mates

50

Hospital stewards ....

60

Chief gunners’ mates .

50

Chief electricians ....

60

Bandmasters ....

52

Chief gun captains

60

Chief quartermasters .

50

Petty Officers— First Glass.

Masters-at-arms, first class .

40

Machinists, first class .

56

First musicians ....

36

Boatswains’ mates, first class

40

Boilermakers ....

60

Yeomen, first class

40

Gunners’ mates, first class .

40

Coppersmiths ....

50

Gun captains, first class

40

Blacksmiths

50

Quartermasters, first class .

40

Plumbers and fitters

46

Schoolmasters ....

40

Sailmakers’ mates …. Carpenters’ mates,- first class . Water tenders .... Electricians, first class .

Petty Officers— Second Class.

40 40 40 60

,/

Masters-at-arms, second class

35

Machinists, second class

40

Yeomen, second class .

36

Boatswains’ mates, second class .

35

Oilers

37

Gunners’ mates, second class

35

Carpenters’ mates, second class .

35

Gun captains, second class .

36

Printers

35

Quartermasters, second class

38

Electricians, second class

40

Petty Officers— Third Class.

Masters-at-arms, third class .

30

Carpenters’ mates, third class

30

Yeomen, third class

30

Coxswains (1) . . . •

30

Painters

30

Hospital apprentices, first class .

30

Gunners’ mates, third class .

30

Electricians, third class

30

Quartermaster, third class .

30

S.I.—

II

82

ADMIEALTY ADMINISTRATION

1 Table III. — Petty Oncers, Enlisted Men, &c. — continued.

[u.s.A.

Seaman Branch.

a’”

Artificer Branch.

a

Special Branch.

S

”

Seamen — First Class.

Seamen gunners ....

Seamen

Apprentices, first class .

26 24 21

Firemen, first class

Seamen — Second Class.

85

Musicians, first class .

32

Ordinary seamen . . ... Apprentices, second class

19 15

Firemen, second class . Shipwrights . . . ‘ . SaUmakers

Seamen — Third Class.

30 25 25

Musicians, second class

Buglers

Hospital apprentices

30 30 20.

Landsmen .....

Apprentices, third class

16 9

Coal passers

Messmen Branch.

22

Stewards to commandera-in-chief . Cooks to oommanders-in-chief

Cooks to commandants

Cabin stewards ....

Cabin cooks

45 40 45 40 37 32

Wardroom stewards Wardroom codks .... Steerage stewards …. Steerage cooks .... Warrant officers’ stewards . Warrant officers’ cooks .

37 32 26 22 24 20

Ship’s cooks, first class . Ship’s cooks, second class Ship’s cooks, third class Ship’s cooks, fourth class Mess attendants ....

35 30 25 20 16

Any man who has received an honourable discharge from his last term of enlistment, who re-enlists for a term of four years within four months from the date of his discharge, receives an increase of f 1.36 per month to the pay prescribed for the rating in which he serves for each consecutive re-enlistment.

Table IV. — Non-commissioned Officers, Musicians, and Privates. — Marine Corps.

First Enlistment, or

Brst 5 Tears.

First

Second

Third

Fourth

Grade.

First

Third

Fourth

Fifth

or second 5

or third 5

or fourth 5

or fifth 5

Tear.

Year.

Tear.

Tear.

Year.

Tears.

Tears.

Tears.

Tears.

1

■$

1

$

•1

•

$

«

$

Sergea,nt-maior

34

34

35

36

37

39.00

40

41.00

42

Quartermaster-sergeant .

34

34

35

36

37

39.00

40

41.00

42

Drum major .

25

25

26

27

28

30.00

31

32.00

33

Gunnery sergeant .

35

35

36

37

38

40.00

41

42.00

43

First sergeant

25

25

26

27

28

30.00

31

32.00

33

Sergeant

18

18

19

20

21

23.00

24

25.00

26

Corporal

15 ■

15

16

17

18

20.00

21

22.00

23

Drummer and trumpeter

13

13

14

15

16

18.00

19

20.00′

21

Private ....

13

13

14

15

16

18.00

19

20.00

21

Leader of the band

125

125

125

125

125

137.50

150

162.50

175

Second leader of band .

75

76

76

, 77

78

80.00

81

82.00

83

Musician, first class

60

60.

60

60

60

60.00

60

60.00

60

Musician, second class .

50

50

50 .

-50

50

50.00

50

50.00

The incessant changes in materiel and its distribution

render a comprehensive description of this subject of little

more than ephemeral value. On 1st January

Materiel, j^qq-^ ^^^^^^ ^^^^ 239 vessels of all classes on

the navy list, and 67 more under construction.

Table A. Completed Vessels-

7 1st class battleships 1 2nd ,, battleship

2 armoured cruisers

5 protected „

3 unprotected ,,

19 gunboats .

6 monitors . 1 harbour-defence ram 1 dynamite cruiser

20 torpedo boats . 1 ,, boat (submarine)

76

1 — Modern Construction.

10,288 to 11,565 tons.

6,315

8,200 to 9,215 3,000 to 7,375

2,089

839 to 1,710 3,990 to 6,060

2,155 929

46 to 273

73

All of the above are of modern steel construction (except the monitors, which are of iron), the first com- mission of the oldest dating December 1885, and the great majority were first commissioned since 1890, and most built prior to 1890 have since been rebuilt. Next in order of practical efficiency are the converted vessels purchased prior to or during the Spanish war. Many

are now in commission and may be retained in service indefinitely.

Table B. Auxiliary Fighting Ships. 5 converted cruisers .... 4260 to 6888 tons.

4 11

8 26

54

yachts

tugs

806 to 2690

302 to 786

82 to 192

150 to 840

There are also 26 gunboats captured or purchased from Spain, varying in size from 42 to 1159 tons, and in characteristics from single-screw iron boats to twin-screw steel craft of late design and high efficiency.

, Table C. 16 colliers .

2 distilling ships

1 tank „ .

1 hospital ,, .

5 supply „ .

1 marine transport 16 unarmed tugs

41

Auxiliaries.

3085 to 7600 tons. 6100 to 6206

6200 4700

2600 to 7000

1400

192 to 460

The following vessels of old construction are still seaworthy and efficient for their type, and many are in commission —

ADMIRALTY

83

Table D. Old Construction.

8 single-turret iron monitors.

2 iron steam cruisers.

2 „ paddle gunboats.

7 ■wooden steam cruisers.

1 ,, torpedo boat of 17 knots speed.

20

Table B.

22 wooden sailing vessels, mostly unserviceable, except as re- ceiving shQ)s, &c.

Table F.

10 1st class battleships 6 armoured cruisers

3 protected „ 6 „ „

4 monitors . 1 gunboat

6 submarine boats 1 torpedo craft .

67

Under Construction.

11,525 to 16,000 tons.

13,600 to 14,000 „ 9,600 „

8,100 „

3,214

120

165 to

420

TJnited States naval vessels are, as a rule, built at private yards under contracts awarded after competition. The Government is not committed to any fixed policy or building programme. Each, year the Secretary recom-

mends certain new construction. The final action rests with Congress, which must appropriate money for the new ships before the construction can be commenced. Repair- ing and reconstruction are usually done at Government navy yards.

Ships in commission are distributed among five stations: (l)the North Atlantic, which includes the ‘Atlantic coast of the United States, Central America, and South America as far as the Amazon, also the West yo®”*”’ Indies; (2) the South Atlantic, which includes the remainder of the Atlantic coast of South America and both coasts of South Africa; (3) the European, which com- prises the coast of Europe, including th5 inland seas, and the North Atlantic coast of Africa; (4)the Asiatic station, comprising the coast of Asia, including the islands north of the equator, also the east coast of North Africa ; (5) the Pacific station, comprising the Pacific coast of North and South America, and Australia and the adjacent islands lying south of the equator. Each station is commanded by a flag officer, and the number of ships under the command varies according to circumstances. Ships ia commission on special service, such as training, gunnery, surveying ships, &c., are not attached to stations. The shore stations of the navy are enumerated in the article on Dockyards. (w. t. s.)

Admiralty, Cinque Ports Court of.— The Court of Admiralty for the Cinque Ports exercises a co-ordinate but not exclusive Admiralty jurisdiction over persjons and things found within the territory of the Cinque Ports. The limits of its j urisdiction were declared at an inquisition taken at the Court of Admiralty, held by the seaside at Dover in 1682, to extend from Shore Beacon in Essex to Eedcliff, near Seaford, in Sussex; and with regard to salvage, they comprise all the sea between Seaford in Sussex to a point five miles off Cape Grisnez on the coast of France, and the coast of Essex. An older inquisition of 1526 is given by Mr Marsden in his Select Pleas of the Court of Admiralty, II. xxx. The court is an ancient one. The judge sits as the official and commissary of the Lord Warden, just as the judge of the High Court of Admiralty sat as the official and commissary of the Lord High Admiral. And, as the office of Lord Warden is more ancient than the office of Lord High Admiral (The Lord Warden v. King in his office of Admiralty, 1831, 2 Hagg. Admy. Rep. 438), it is probable that the Cinque Ports Court is the more ancient of the two.

The jurisdiction of the court has been, except in one matter of mere antiquarian curiosity, unaffected by statute. It exercises only, therefore, such jurisdiction as the High Court of Admiralty exercised, apart from the restraining statutes, 13 Ric. II. c. 5, 15 Ric. IIi c. 3, and the enabling statutes, 3 and 4 Vict. c. 65, and 24 Vict. c. 10. Cases of collision have been tried in it (the ” Vivid,” 1 A^. Maritime Law C&ses, 601). But salvage cases (the “Clarisse,” Swabey, 129; the ” Marie,” Law. Bep. 7 P.D. 203) are the principal cases now tried. It has no ptize jurisdiction. The one case in which jurisdiction has been given to it by statute is to enforce forfeitures under 6 Eliz. c. 6.

Mr Arthur Cohen, Z.C, is the present judge. His predecessor was Dr (afterwards the Right Hon. Sir Robert Joseph) Phillimore, who succeeded hi? father in the same office, and was judge from 1856 to 1875. As Sir Robert Phillimore was also the last judge of the High Court of Admiralty, from 1867 (the date of his appoint- ment to the High Court) to 1875, the two offices were probably for the first time in history held by the same

person. The appointment is by the Lord Warden. Dr Phillimore’s patent had a grant of the ” place or office of judge official and commissary of the Court of Admiralty of the Cinque Ports, and their members and appurtenances, and to be assistant to my lieutenant of Dover castle in all such affairs and business concerning the said Court of Admiralty wherein yourself and assistance shall be re-

quisite and necessary.” Of old the court sat sometimes at Sandwich, sometimes at other ports. But the regular place for the sitting of the court has for a long time been, and still is, the aisle of St James’s Church, Dover. Eor convenience the judge often sits at the Royal Courts of Justice. The office of marshal in the High Court is represented in this court by a serjeant, who also bears a silver oar. There is a registrar, as in the High Court. The appeal is to the queen in councJU, and is heard by the judicial committee. The court can hear appeals from the Cinque Ports salvage commissioners, such appeals being final (1 and 2 Geo. IV. c. 76, § 4^. Actions may be transferred to it, and appeals made to it, from the county courts in all cases arising within the jurisdiction of the Cinque Ports as defined by that Act. At the solemn installation of the Lord Warden the judge as the next principal officer installs him.

The Cinque Ports from the earliest times claimed to be exempt from the jurisdiction of the admiral of England. Their early charters do not, like those of Bristol and other seaports, express this exemption in terms. It seems to have been derived from the general words of the charters which preserve their liberties and privileges.

The Lord Warden’s claim to prize was raised in, but not finally decided by, the High Court of Admiralty in the “Ooster Ems,” 1 G. Bob. 284, 1783.

See BoTs. Sandwich and Cinque Ports. — EiirocKER. Grand Court of Shepway, 1862. (w. G. v. P.)

Admiralty, High Court of.— The High Court of Admiralty was the court of the deputy or lieutenant of the admiral. It is supposed in the Black Book of the Admiralty to have been founded in the reign of Edward I. ; but it would appear, from the learned dis- cussion of Mr Marsden, that it was established as a civU

court by Edward III. in tlie year 1360 ; the power of the admiral to determine matters of discipline in the fleet, and possibly questions of piracy and prize, being somewhat earlier. Even then the court as such took no formal shape ; but the various admirals began to receive in their patents express grants of jurisdiction with powers to appoint lieutenants or deputies. At first there were separate admirals or rear-admirals of the north, south, and west, each with deputies and courts. A list of them was collected by Sir H. Spelman. These were merged in or. absorbed by one high court early in the IStl;. century. Sir Thomas Beaufort, afterwards earl of Dorset and duke dIE Exeter (appointed admiral of the fleet, 9 Henry IV., and admiral of England, Ireland, and Aquitaine 1412, which latter office he held till his death in 1417), certainly had a court, with a marshal and other officers, and forms of legal process — mandates, warrants, citations, compulsories, proxies, &c. For the subject matters of the ancient Admiralty jurisdiction it is usual to refer to the inquisition of Queenborough , in 1375. Complaints of encroachment of jurisdiction by the Admiralty courts led to the restraining Acts, 13 Eic. II. c. 5, 15 Eic. II. c. 3, and 2 Hen. IV. c. 11.

The original object of the institution of the courts or court seems to have been to prevent or punish piracy and other crimes upon the narrow seas and to deal with questions of prize ; but civil jurisdiction soon followed. The jurisdiction in criminal matters was trans- ferred by 28 Hen. VIII. c. 15 to the admiral or his deputy and three or four other substantial persons appointed by the Lord Chancellor, who were to proceed accordiQg to the course of the common law. By 4 and 5 WUl. IV. c.

36, cognizance of crimes committed within the jurisdiction of the Admiralty was given to the central criminal court. By 7 and 8 Vict. c. 2, it has been also given to the justices of assize ; and crimes done within the jurisdiction of the Admiralty are now tried as crimes com- mitted within the body of a county. See also the Criminal Law Consolidation Acts of 24 and 26 Victoria.

Erom the time of Henry IV. the only legislation affect- ing the civil jurisdiction of the High Court of Admiralty till the time of Queen Victoria is to be found in § 10 of 32 Hen. VIII. c. 14, enabling the admiral or his lieutenant to decide on certain complaints of freighters against ship- masters for delay in sailing, and § 34 of 5 Eliz. c. 6, giving the Lord High Admiral of England, the Lord Warden of the Cinque Ports, their lieutenants and judges, co-ordinate power with other judges to enforce forfeitures under that Act — a very curious and miscellaneous statute called ” An Act for the Maintenance of the N^avy.”

In the Act 25 Hen. VIII. c. 19, with regard to ecclesi- astical appeals from the courts of the archbishops to the Crown, it is provided that the appeal shall be to the king in Chancery, ” and that upon every such appeal a com- mission shall be directed under the great seal to such persons as shall be nam’cd by the king’s highness, his heirs or successors, like as in cases of appeal from the Admiralty Court.” The appeal to these ” persons,” called delegates, continued until it was transferred first to the Privy CouncU, and then to the judicial committee of the Privy Council by the statutes 2 and 3 WUl. IV. c. 92, and 3 and 4 WHl. IV. c. 41.

The early jurisdiction of the court appears to have been exercised very much under the same procedure as that used by the Courts of Common Law. Juries are mentioned, sometimes of the county and sometimes of the county and merchants. But the connexion with foreign parts led to the gradual introduction of a procedure resembling that com- ing into use on the Continent and based on the Eoman civil law. The statute 28 Hen. VIII. c. 15, states the

objection to this application of the civU law to the trial of criminal cases with much force: “After the course of the civil laws, the nature whereof is that before any judgment of death can be given against the offenders, either they must plainly confess their offences (which they will never do without torture or pain), or else their offences be so plainly and directly proved by witness indifferent such as saw their offences committed, which cannot be gotten but by chance at few times.”

The material enactments of the restraining statutes were as follows: — 13 Eic. II. c. 5 provided that “the admirals and their deputies shall not meddle from henceforth of anything done within the ^^^^.’ realm, but only of a thing done upon the sea, as it hath been used in the time of the noble prince king Edward, grandfather of our lord the king that now is.” 15 Eic. II. c. 3 provided, that ” of all manner of contracts, pleas, and quarrels, and other things rising within the bodies of the counties as well by land as by water, and also of wreck of the sea, the admiral’s court shall have no manner of cognizance, power, nor jurisdiction; but all such manner of contracts, pleas, and quarrels, and all other things rising within the bodies of counties, as well by land as by water, as afore, and also wreck of the sea, shall be tried, determined, discussed, and remedied by the laws of the land, and not before nor by the admiral, nor his lieutena,nt in any wise. Nevertheless, of the death of a man, and of a maihem done in great ships, being and hovering in the main stream of great rivers, only beneath the [bridges] of the same rivers [nigh] to the sea, and in none other places of the same rivers, the admiral shall have cognizance, and also to arrest ships in the great flotes for the great voyages of the king and of the realm ; saving always to the king all manner of forfeitures and profits thereof coming; and he shall have also jurisdiction upon the said flotes, during the said voyages only ; saving always to the lords, cities, and boroughs, their liberties and franchises.” 2 Hen. IV. c. 11 adds nothing by way of definition or restriction, but merely gives additional remedies against encroachments, providing heavy fines for those who improperly sue in the court, and those officials of the court who

improperly assert jurisdiction. It was repealed by 24 Vict. c. 10. The statutes of Eichard, except the enabling part of the second, were repealed by 42 and 43 Viet. c. 59. The formation of a High Court of Justice rendered them obsolete.

In the reign of James I. the chronic controversies between the Courts of Common Law and the Admiralty Court as to the limits of their respective jurisdictions reached an acute stage. We find the records of it in the second volume of Mr Marsden's Select Pleas in the Court of Admiralty, and in Lord Coke's writings: Reports, part xiii. 51; Institutes, part iv. chap. 22. In this latter passage Lord Coke records how, notwithstanding an agreement asserted to have been made in 1575 between the justices of the King's Bench and the judge of the Admiralty, the judges of the Common Law Courts suc- cessfully maintained their right to prohibit suits in Ad- miralty upon contracts made on shore, or within havens, or creeks, or tidal rivers, if the waters were within the body of any county, wheresoever such contracts were broken, for torts committed within the body of a county, whether on land or water, and for contracts made in parts beyond the seas. It is due to the memory of the judges of Lord Coke's time to say that, at any rate as regards contracts made in partibus transmarinis, the same rule appears to have been applied at least as early as 36 Hen. VIIL, the judges then holding that " for actions transitory abroad action may lie at common law."

All the while, however, the patents of the Admirally

Judge's patent

judge purported to confer on him a far ampler jurisdic- tion than the jealousy of the other courts would concede to him. The patent of the last judge of the court, Sir Eobert Joseph PhiUimore, dated 23rd August 1867, styles him " Lieut. OfP. Princ'. and Commissary Gen', and Special in our High Court of Admiralty of Eng. and President and Judge of the same," and gives him power to take cognizance of " all causes, civil and maritime, also all contracts, complaints, offences or suspected offences, crimes, pleas, debts, exchanges, accounts, policies of assurance, loading of ships, and all other matters and contracts-which rek,te to freight due for the use of ships, transportation, money, or bottomry ; also all suits civil and maritime between merchants or between proprietors of ships and other vessels for matters in, upon, or by the , sea, or public streams, of fresh-water ports, rivers, nooks, and places overflown whatsoever within the ebbing and flowing of the sea and Mgh-water mark, or upon any of the shores or banks adjacent from any of the first bridges towards the sea through England and Ireland and the dominions thereof, or elsewhere beyond the seas." Power is also given to hear appeals from vice-admirals ; also " to arrest . . . £iccording to the civil laws and ancient customs of our high court ... all ships, persons, things, goods, wares, and merchandise " ; also " to enquire by the oaths of honest and lawful men . . . of all . . . things which . . . ought to be enquired after, and to mulct, arrest, punish, chastise, and reform " ; also " to preserve the public streams of our Admiralty as well for the preservation of our royal navy, and of the fleets and vessels of our kingdom ... as of whatsoever fishes increasing in the rivers " ; also "to reform nets too straight and other unlawful engines and instru- ments whatsoever for the catching of fishes " ; also to take cognizance " of the wreck of the sea . . . and of the death, drowning, and view of dead bodies," and the con- servation of the statutes concerning wreck of the sea and the office of coroner [3 and 4 Edw. I.], and concerning pillages [27 Edw. III.], and " the cognizance of mayhem" withm the ebb and now of the tide ; all in as ample manner and form as they were enjoyed by Dr David Lewis [judge from 1558-84], Sir Julius Csesar, and the other judges in order (22 in aU) before Sir Eobert Phillimore. This

form of patent differs in but few respects from the earlier Latin patents — tempore Henry VIIL — except that they have a clause non obstantibus statvtis.

As has been said, however, the contention of the Common Law judges prevailed, and the Admiralty Court (except during a temporary revival under Crom- well) sank into comparative insignificance during the 17th century. The great maritime wars of the 18th century gave scope to the exercise of its prize jurisdiction ; and its international importance as a prize court in the latter half of the 18th and the first part of the 19th centuries is a matter of common historical know- ledge.

There were other great judges ; but Sir William Scott, afterwards Lord Stowell, is the most famous. Before his time there were no reports of admiralty cases, except Hay and Marriott's prize decisions. But from his time on- wards there has been a continuous stream of Admiralty Reports, and we begin to find important cases decided on the instance as well as on the prize side.

In the reign of Queen Victoria, two enabling statutes, 3 and 4 Vict. c. 65 and 24 Vict. c. 10, were passed and greatly enlarged the jurisdiction of the court. The manner in which these statutes were administered by Dr Lushing- ton and Sir E. Phillimore, whose tenure of office covered the whole period of the Queen's reign till the creation of the High Court of Justice, the valuable assistance

Modem progress.

rendered bj the nautical assessors from the Trinity House, the great increase of shipping, especially of steam ship- ping, and the number and gravity of cases of collision, salvage, and damage to cargo, restored the activity of the court and made it one of the most important tribunals of the country. In 1875, by the operation of the Judicature Acts of 1873 and 1875, the High Court of Admiralty was with the other great courts of England formed into the High Court of Justice. The principal officers of the court in subordination to the judge were the registrar (an office which always points to a connexion with canon or civil law), and the marshal, who acted as the maritime sheriff, having for his baton of office a silver oar. The assist- ance of the Trinity Masters, which' has been already mentioned, was provided for in the charter of incorpora- tion of the Trinity House. These officers and their assist- ance have been preserved in the High Court of Justice.

See Sir Tkaveks Twibs. Black Book of the Admiralty. Rolls series. — Marsdejj. Select Pleas in the Court of Admiralty, published by the Selden Society. — Godolphin. View of the Ad- miral Jurisdiction. (w. a. f. p.)

Admiralty Jurisdiction. — The courts by which, as far as we kiow. Admiralty jurisdiction in civil matters was first exercised were the following. In and throughout England the courts of the several admirals soon combined into one High Court of Admiralty. Within the territories of the Cinque Ports the Court of Admiralty of the Cinque Ports exercised a co-ordinate jurisdiction. In certain towns and places there were local courts of Vice-^ Admiralty. In Scotland there existed the Scottish High* Court of Admiralty, in Ireland the Irish High Court of Admiralty. Of these courts that of the Cinque Ports alone remains untouched. The Scottish court was ab- sorbed, and its jurisdiction given to the Court of Session by 11 Geo. IV. and 1 Will. IV. c. 69— not, however, till a decision given by it and the appeal therefrom to the House of Lords had established a remarkable rule of Admiralty law in cases of collision (Hay v. Le Neve, 1824, 2 Shaw, Sc. App. Cos. 396). The local Vice-Admiralty Courts in England had ceased to do much work when they were abolished by the Municipal Corporations Act, 1835 ; the High Court became, with the other superior courts, a component part of the High Court of Justice by virtue of the Judicature Acts, 1873 and 1875. And the Irish court has in like manner become a part of the High Court of Justice in Ireland by the Judicature Act for that country.

As England first, and Great Britain afterwards, acquired colonies and possessions beyond seas,- Vice-Admiralty Courts were established. The earliest knovm ^/ce- was that in Jamaica, established in the year Admiralty 1662. Some Vice-Admiralty Courts which ^”’’*- were created for prize purposes in the last century were suffered to expire after 1815. In the year 1863, when the act regulating the Vice-Admiralty Courts was passed, there were Vice-Admiralty Courts at Antigua, Bahamas, Barbadoes, Bermuda, British Columbia, British Guiana, British Honduras, Cape of Good Hope, Ceylon, Dominica, Falkland Islands, Gambia Eiver, Gibraltar, Gold Coast, Grenada, Hong Kong, Jamaica, Labuan, Lagos, Lower Canada (otherwise ‘Quebec), Malta, Mauritius, Montserrat, Natal, Nevis, New Brunswick, Newfoundland, New South Wales, New Zealand, Nova Scotia (otherwise Halifax), Prince Edward Island, Queensland, Saint Christopher, Saint Helena, Saint Lucia, Saint Vincent, Sierra Leone, South Australia, Tasmania, Tobago, Trinidad, Vancouver’s Island, Victoria, Virgin Islands (otherwise Tortola), Western Australia. By the Act of 1867 one for the Straits Settlements was added. These courts have been regulated from time to time by the following statutes :

2 Will. IV. c. 51, 26 Vict. c. 24 already cited, and 30 and 31 Vict. c. 45. In 1890 the Colonial Courts of Admiralty Act provided that, except in the colonies of New South Wales, Victoria, Saint Helena, and British Honduras, Vice-Admiralty Courts should be abolished, and a substitution made of Colonial Courts of Admiralty. There is power, however, reserved to the Crown to erect through the Admiralty in any British possession any Vice- Admiralty Court, except in India or any British possession having a representative legislature. No Vice-Admiralty Court so established can exercise any jurisdiction except for some purpose relating to prize, the royal navy, the slave trade, foreign enlistment. Pacific Islanders’ protec- tion, and questions relating to treaties or conventions on international law. Vice-Admiralty Courts exercised all usual Admiralty Jurisdiction, and in addition a certain revenue jurisdiction, and jurisdiction over matters of slave trade arid prize (royal navy) and under the Pacific Islanders’ Protection Act. The appeal from Vice-Admi- ralty Coiirts used to lie to the High Court of Admiralty of England, but has been transferred to the King in Council.

Modern statutes have given Admiralty jurisdiction to the county courts in the following matters: — Salvage, where the value of the salved property does not SuS exceed £1000, or the claim for reward £300; towage, necessaries, and wages, where the claim does not exceed £150 ; claims for damage to cargo, or by collision, up to £300 (and for sums above these prescribed limits by agreement between the parties) ; and claims arising out of breaches of charter parties and other contracts for carriages of goods in foreign ships, or torts in respect thereof up to £300. This jurisdiction is restricted to subjects over which jurisdiction was pos- sessed by the High Court of Admiralty at thfe time when the first of these Acts was passed, except as regards the last branch of it (The “Aline,” 1880, 5 Ex. Div. 227 ; Beg. V. Judge of City of London Court, 1892, 1 Q.B. 272). In analogy with the county court ASmiralty jurisdiction created in England, a limited Admiralty jurisdiction has been given in Ireland to the recorders of certain boroughs and the chairmen of certain Quarter Sessions ; and in sal- vage cases, where a county court in England would have ju- risdiction, magistrates, recorders, and chairmen of Quarter Sessions may have jurisdiction as of&cial arbitrators (57 and 58 Vict. c. 60, § 547). In Scotland, Admiralty suits in cases not exceeding the value of £26 are exclusively tried in the Sheriff’s Court ; while over that limit the Sher- iff’s Court and the Court of Session have concurrent jurisdiction.

By the Act 1 and 2 Geo. IV. c. 76, an arbitral juris- diction in cases of salvage was given to certain commis- sioners of the Cinque Ports.

The appeal from county courts, and commissioners is to the High Court of Justice, and is exercised by a di- visional court of the Probate, Divorce, and ppeas. Admiralty Division. In cases arising within the Cinque Ports there is an optional appeal to the Ad- miralty Court of the Cinque Ports. The appeal from the High Court of Justice is in ordinary Admiralty matters, as in others, to the Court of Appeal, and from thence to the House of Lords. But it is specially provided by the Judicature Act 1891, as it was by the Prize Act 1864, that the appeal in prize cases shall be to the Sovereign in Council.

The unfortunate provisions of the Legislature, giving to the jurisdiction of coulity courts different money lim- its in Admiralty, Equity, and Common Law cases, make the distinction between cases coming under the Admi- ralty jurisdiction and other civil cases of practical moment in those courts. Arguments full of learning and research have been addressed to the courts, and weighty decisions

have been given, upon questions which would never have arisen if the county courts had not a larger money area of jurisdiction in Admiralty cases than they have in other matters {Beg. v. Judge of City of j^J”^^’ London. Court, 1892, 1Q.B. 273; The “Zeta,” 1893, App. Cos. 468). But as regards the high courts, whether in England, Scotland, or Ireland, it is not now necessary to distinguish their civil Admiralty jurisdiction from their ordinary civil jurisdiction, except for the pur- pose of seeing whether there can or cannot be process in rem. Not that every Admiralty action can of right be brought in rem, but that no process in rem lies at the suit of a subject unless it be for a matter of Admiralty jurisdiction — one, for instance, that could in England have been tried in the High Court of Admiralty. Now these matters of Admiralty jurisdiction with process in rem range themselves ui^der four primary aiid four sup- plementary heads. The four primary are damage, salvage, bottomry, wages ; and the four supplementary are exten- sions due to one or other of the statutes 3 and 4 Vict. c. 65, and 24 Vict. c. 10. They are damage to cargo carried in a ship, necessaries supplied to a ship, mortgage of ship, and master’s claim for wages and disbursements on account of a ship. In all these cases, primary and second- ary, the process of which a plaintiff can avail himself for redress, may be either in personam as in other civil suits, or by arrest of the ship, and, in cases of salvage and bot- tomry, the cargo. Whenever, also, the ship can be ar- rested, any freight due can also be attached, by arrest of the cargo to the extent only of the freight which it has to pay. Eor the purpose of ascertaining whether or not process in rem would lie, there have been distinctions as nice, and the line of Admiralty jurisdiction has been drawn as carefully, as in the cases of the Admiralty ju- risdiction of the county courts (The “Theta,” 1894, Prob. 280 ; The ” Gas Float Whitton,” 1897, App. Cas. 337). There have been similar questions raised in the United States, from De Lovio v. Boit . (1815, 2 Galli- son, 398), and Bamsay x. Allegre (1827, 12 Wheaton, 611), down to the quite modern cases which ■ will be found quoted in the arguments and judgments in the “Eloat Whitton.”

The disciplinary jurisdiction at one time exercised by the Admiralty Court, over both the royal navy and mer- chant vessels, may be said to be obsolete in time of peace, the last remnant of it being suits ^^j”’”’’ against merchantmen for flying flugs appropri- ate to men-of-war (The ” Minerva,” 1800, 3 C. Eob. 34), a matter now more effectively provided against by the Merchant Shipping Act, 1894. In time of war, however, it was exercised in some instances as long as the Admi- ralty Court lasted, and is now in consequence exercisable by the High Court of Justice (see Prize below). It was, perhaps, in consequence of its ancient disciplinary juris- diction that the Admiralty Court was made, ajid the High Court of Justice now is, the court to enforce cer- tain portions of the Foreign Enlistment Act, 1870.

Finally, appeals from decisions of courts of enquiry, under the Merchant Shipping Act, cancelling or suspend- ing the certificates of officers in the merchant service, may be made, to the Probate, Divorce, and Admiralty Division of the High Court of Justice.

The Admiralty jurisdiction in criminal matters extends over all crimes committed on board British ships on sea or tidal waters, even though such tidal waters be well within foreign territory (Beg. v. Anderson, 1868, L.E. 1 C.C.E. 161)^ but not over crimes committed on board foreign vessels upon the high seas {Beg. V. 8erva, 1845, 1 Denison C.C, 104). Whether it extended over crimes committed on foreign ships within territorial waters of the United Kingdom, and whether a

Criminal cases.

zone of three miles round the shores of the United King- dom was for such purpose territorial water, were the great questions raised in Beg. v. Eeyn (The “Franoonia,” L.E. 2 Ex. Div. 126), and decided in the negative by the majority of the judges, rightly, as the writer of this article respectfully thinks. Since then, however, the Legislature has brought these waters within the jurisdic- tion of the Admiralty by 41 and 42 Vict. c. 73. Section 2 runs as follows : ” An offence, committed by a person, whether he is or is not a British subject, on the open sea within the territorial waters of British dominions, is an offence within the jurisdiction of the admiral, although it may have been committed on board or by means of a foreign ship, and the person who committed such offence may be arrested, tried, and punished accordingly.” By § 7 the ” jurisdiction of the admiral ” is defined as “including the jurisdiction of the Admiralty of England or Ireland, or either of such jurisdictions as used in any Act of Parliament ; and for the purpose of arresting any person charged with an offence declared by this Act to be within the jurisdiction of the admiral, the territorial waters adjacent to the United Kingdom, or any other part of Her Majesty’s dominions, shall be deemed to be within the jurisdiction of any judge, magistrate, or ofi&cer.” And ” territorial waters of Her Majesty’s dominions” are defined as “in reference to the sea, meaning such part of the sea adjacent to the coast of the United Kingdom, or the coast of some other part of Her Majesty’s dominions, as is deemed by international law to be within the territorial sovereignty of Her Majesty; and for the purpose of any offence declared by this Act to be within the jurisdiction of the admiral, any part of the open sea within one marine league of the coast, measured from low-water mark, shall be deemed to be open sea within the territorial waters of Her Majesty’s dominions.” As to those portions of the sea and tidal waters which, by reason of their partially land-locked positions, are deemed to be in the body of a county, there is not Admiralty jurisdiction, but crimes are tried as if they were committed on land within the same county.

Pirates, whatever flag they pretended to fly, were, from 1360 onwards, wherever their crimes were committed, subject to the Admiralty jurisdiction. The criminal jurisdiction of the Admiralty was first exercised by the High Court of Admiralty; and then, by virtue of 28 Hen. VIII. c. 15, transferred to commissioners appointed under the great seal, among whom were to be the admiral or admirals, his or their deputies. Admiralty sessions were held for this purpose till 1834. Admiralty crimi- nal jurisdiction is now, by virtue of the series of statutes 39 Geo. III. c. 37, 4 and 5 Will. IV. c. 36, 7 and 8 Vict. c. 2, and the criminal law consolidation Acts passed in 24 and 25 Vict. c. 1, exercised by the Central Criminal Court and by the ordinary courts of assize. Special pro- vision for trial in the colonies of offences committed at sea has been made by 11 and 12 Will. III. c. 7, 46 Geo. III. c. 54, and -12 and 13 Vict. c. 96.

The Admiralty Court had jurisdiction in matters of prize from very early times; and although since the middle of the 17th century the instance, or ordinary civil jurisdiction of the court, has been kept distinct Prize. from the prize jurisdiction, thej were originally

both administered and regarded as being within the ordinary jurisdiction of the Lord High Admiral. The early records of the Admiralty show that the origin of the prize jurisdiction is to be traced to the power given to the court of the admiral to try cases of piracy and ” spoil,” i.e., captures of foreign ships by English ships. The earliest recorded case of spoil tried before the admiral is in 1357, when the goods of a Portuguese subject, taken at sea by Englishmen from a French ship which had

previously spoiled a Portuguese, were awarded by the admiral as good prize to the English captors ; and Edward III. in a letter to the king of Portugal answer- ing a complaint on the subject gives the admiral’s decision as a reason for refusing their restoration. During the 16th century a very large part of the business of the Admiralty Court related to spoil and piracy, and the Privy Council often directed the judge of the court how to deal with the spoil cases, with regard to which foreigners who had suffered from attacks by English ships made petition for redress to the admiral or the council. The spoil suit at this time {causa spolii) was a civil proceeding resulting in a decree dbsolutoria, dismiss- ing the defendant, or condemnatoria, ordering restoration to be made by him. In 1585 the patent of Howard, the Lord High Admiral, authorized him to issue letters of reprisal against Spain; and an Order in Council regulating the conduct of those to whom such letters were issued, provided by an additional article (1589) that all prizes ‘ were to be brought in without breaking of bulk for adjudication by the Admiralty Court. The court was also resorted to at this time by captors, sailing under commissions granted by the allies of England, such as the king of France and the Dutch. About the middle of the 17th century sepaiate sittings of the Court for In- stance and Prize business began, perhaps because of the conflicting claims to droits of Charles II. and the duke of York as Lord High Admiral; and privateering under royal commission took the place of the former irregular ” spoiling.” The account which Lord Mansfield gave of the records of the Admiralty Court, that there were no prize act books earlier than 1641, or prize sentences earlier than 1648, and that before 1690 the records were in confusion, must be qualified by the fact that there are in existence prize sentences (on paper, not parchment) as early as 1589.

Although the courts of Common Law hardly ever seem to have interfered with or disputed the Admiralty prize jurisdiction, its exclusive nature was not finally admitted till 1782; but long previously royal ordinances (1512, 1602) and statutes (13 Car. II. c. 9, giving an alternative of commissioners, 22 and 23 Car. II. c. 11, 6 Anne, c. 13) had given the Admiralty Court the only express jurisdic- tion over prize. The same statute of Anne, and 13 Geo. II. c. 4, and 17 Geo. IT. c. 24, give prize jurisdiction to any Court of Admiralty, and the Courts of Admiralty for the colonies and plantations in Korth America.

It has been a disputed question whether the prize jurisdiction of the court was inherent, i.e., coming within the powers given by the general patent of the judge, in which no express mention of it is made, or whether it required a special commission. Upon this subject the judgment of Lord Mansfield in Lindo v. Rodney (1782, Dougl. 612), the judgment of M* Justice Story in De Lovio V. Boit (1815, 2 Gallison, 398), and Mr Marsden’s Select Pleas of the Court of Admiralty (^introduction), may be consulted. But the settled practice now and for a long time past has been for a special commission and warrant to be issued for this purpose. In connexion with this it is observable that in 1793 the Admiralty Court of Ireland claimed to exel-cise prize jurisdiotion under its general patent ; and it is said to have been the opinion of Sir W. Wynne that the Admiralty of Scotland had a similar right (Brown, Givil Law of Admiralty, voL ii. 211, 212). Any jurisdiction of the Scottish Admiralty Court over prize of war was transferred to the English court by 6 Geo. IV. c. 120, § 57. As to the Irish court, by the Act of Union it was provided that there should remain in Ireland an Instance Court of Admiralty for the determination of causes civil and maritime only.

In 1864 the constitution and procedure of prize courts,

which had until then been prescribed by occasional Acts passed for each war as it arose, were for the first time made permanent by the Naval Prize Act, by which the High Court of Admiralty and ev^ry Admiralty or Vice- Admiralty Court, or any other court exercising admiralty jurisdiction in British dominions, if for the time being authorized to exercise prize jurisdiction, were made prize courts. The High Court of Admiralty was given juris- diction throughout British dominions as a prize court, and, as such, power to enforce any order of a Vice- Admiralty prize court and the judicial committee of the Privy Council in prize appeals — this Trover mutatis mvian- dis being also given to Vice-Admiralty prize courts. An appeal was given from any prize court to the Sovereign ia Council. Pjize courts were given jvirisdiction in cases of captures made in a land expedition or an expedition made conjointly with allied forces, and power to give prize salvage on recaptured ships and prize bounty ; and a form of procedure was prescribed. The High Court was also given exclusive jurisdiction as a prize court over questions of ransom and petitions of right in prize cases, and power to punish masters of ships under convoy dis- obeying orders or deserting convoy. By the Naval Dis- cipline Act, 1866, power to award damages to convoyed ships exposed to danger by the fault of the of&cer in charge of the convoy was also given to the High Court. Under other statutes it had power to try- questions of booty of war when referred to it by the Crown, in the same way as prize causes, and claims of King's ships for salvage on recaptures from pirates, which could be con- demned as droits of Admiralty, subject to the owner's right to receive them on paying one-eighth of the value, and also power to seize and restore prizes captured by belligerents in violation of British neutrality, or by a ship equipped in British ports contrary to British obligar tions of neutrality.

All jurisdiction of the High Court of Admiralty has since passed to the High Court of Justice, which is made a prize court under the Naval Prize Act, with all the powers of the Admiralty Court in that respect ; and all prize causes and matters within the jurisdiction of that court as a prize court are assigned to the Probate, Divorce, and Admiralty Division; and an appeal from it as a prize court lies only to the King in Council (Judicature Acts, 1873 and 1891).

By an Act of 1894 further provision is made for the constitution of prize courts in British possessions. A commission, warrant, or instruction from the Crown or the Admiralty maybe issued at any time, even in peace ; and upon such issue, subject to instructions from the Crown, the vice-admiral of the possessions on beiag satisfied by information from a Secretary of State that war has broken out between Great Britain and a foreign State, may make proclamation to that effect, and the commission or warrant comes into effect. The commission or warrant may authorize a Vice-Admiralty Court or Colonial Court of Admiralty to act as a prize court, or establish a Vice- Admiralty Court for that purpose, and may be revoked or altered at any time. The court is authorized to act as a prize court during the war, and shall after its conclusion continue to act as such, and finally dispose of all matters and things arising during the war, including all penalties and forfeitures incurred therein. Rules of court may also be made by Order in Council for regulating, subject to the Naval Prize Act, the procedure and practice of prize courts under that Act, the duties and conduct of their oflScers and practitioners, and the fees and costs therein (57 and 68 Vict. c. 39, § § 2, 3). This latter power has been exercised ; and prize rules for the High Court of Justice and the Vice-Admiralty prize courts were framed in 1898 (Statutory Rules and Orders, 1898).

United States. — Jurisdiction in admiralty proceedings is exclusively vested in the federal courts of the United States. The remedy in admiralty is much more exten- sive than in England (Insurance Company v. Dunham, 11 Wallace's Beports, 1). Where the common law affords another mode of action, either can be pursued. The term " admiralty " covers both civil and criminal causes, and is not

limited to strictly maritime affairs. The great lakes and rivers are subject to it equally with the sea (United States Revised Statutes, title LXX. chap. iii. ; 26 Statutes at Large, 424). The test is not whether the waters are tidal, but whether they are navigable. A jury may be de- manded in certain civil causes (see Revised Statutes, 566). The States cannot create maritime liens, nor can State courts enforce them. States can create liens of a non-maritime character on vessels, and the United States Courts of Admiralty may enforce them by in rem pro- ceedings (The “Glide,” 167 Uiited States Reports, 606). A merchantman at sea occupies the position, as to prop- erty rights, of a floating portion of the territory of the State to which he belongs (Crapo v. Kelly, 16 Wallace’s Reports, 610). The English International Rules of 1880 were adopted by the United States in 1885. In the United States, waters are held to be within the body of a county though not so land-locked that objects can be dis- tinctly seen by one looking from one shore to the other with the naked eye (Manchester v. Massachusetts, 139 United States Reports, 240, 263). The District Court of the United States is its court of admiralty of original jurisdiction.

Authorities. — Marsden’s Select Pleas of the Court of Admir- alty, Selden Society, London, 1892 and 1897. — Zodch, Jurisdiction of the Admiralty of England asserted. — Eobinson, Collectanea Maritima. — Brown, Admiralty. — Edwasdes, Admiralty. — ^Phil- LiMOKE, International Law, vol. iii.

(W. G. F. P. ; S. E. B.)

Admiralty Islands. See New Guinea.

AdonI, a town of British India, in the Bella,ry dis- trict of Madras, 307 mUes from Madras by rail, has manufactures of carpets, silk, and cotton goods, and three factories for ginning and pressing cotton. The hill-fort above, now in ruins, was an important seat of govern- ment in Mahommedan times, and is frequently mentioned in the wars of the 18th century. Population, about

26,000.

Adowa, or Adua. See Abtssih-ia.

Adrar. See Sahaba.

Adrian, a city of Michigan, U.S.A., the capital of Lenawee county, situated on the south branch of Raisin river, in the southern part of the state, 30 miles north- west of Toledo, at an altitude of 810 feet. Its plan is somewhat irregular ; it is divided into five wards ; and it is entered by three railways. Adrian college is a well- known Methodist institution. The population in 1880 was 7849 ; in 1890 it was 8756, and in 1900 it was 9654.

Adrianople, a city of European Turkey, 141 miles W.N.W. of Constantinople. It suffered heavily by the Russian occupation in 1878, not only through the dis- location of its commerce, but also through the extensive emigration to Asia Minor of the Mahommedan lower classes — a movement which so diminished the labour power of the province that agriculture, its staple industry, was paralysed, and a large area of land fell out of culti- vation. This mischief was partially remedied after the annexation (1886) of Eastern Rumelia to Bulgaria, when a large proportion of the Mahommedan inhabitants of the detached province came to settle in and around Adriano- ple; but this advantage was more than counterbalanced by

other consequences of tlie territorial change. In 1892, when the last census was taken, the population numbered 85,780. Little reliance, howcTer, can be placed on a Turkish census, the figures of which are always exagger- ated. The most competent residents estimate the present (1901) population at between 66,000 and 70,000. In point of structure Adrianople is thoroughly oriental — a mass of mean, irregular wooden buildings, threaded by narrow tortuous streets, with a sprinkling* of edifices of superior class. Of these the most important are the Idadieh school, the school of arts and crafts, the Jewish communal school ; the Greek college, Zappeion ; the Imperial Ottoman Bank and Tobacco Kegie, a fire-tower, a theatre, palaces for the prefect of the city, the administrative staff of the 2nd Army Corps, and the defence works commission, a hand- some row of barracks, a military hospital, and a French hospital. All these are sightly structiires; but they make little show amid their squalid surroundings.

Adrianople has five faubourgs, of wliicli Kjretchhan^ and Tilderim are on tlie left bank of the Maritza, and Kirdjilt stands on a hill overlooking the city. The two last-named are exclusively-Greek, but a large proportion of the inhabitants of Kiretchhan6 is Bulgarian. These three suburbs — as well as the little hamlet of Demirtash, containing about 300 houses all occupied by Bulgars — are all built in the native fashion ; but the fifth suburb, Karagatch, which is on the right bank of the Maritza, and occupies the region between the railway station and the city, is western in its design, consisting of detached residences in: gardens, many of them hand- some villas and all of them comely structures of modern European type. In all the communities schools have multiplied, but the new seminaries are of the old non-progressive type. The only exception is the Hamidieh school for boys — a government insti- tution which takes both boarders and day-scholars, Like the liycenm of Galata Serai in Constantinople, it has two sets of professors, Turkish and French, and a full course of education in each language, the pupils following both courses. The several communities have each their own charitable institutions, the Jews being specially well endowed in this respect. The Greeks have a literary syllogos, and there is a well-organized club to which members of all the native communities, as well as many foreigners belong. The economic condition of Adrianople — city and province — WBa much impaired by the war of 1877-78, and was just showing signs of recovery when the severance from it of Eastern Bumelia by a Customs cordon rendered the situation worse than ever. Theretofore Adrianople had been the commercial entrepdt for the whole of Thrace, as it had been also, prior to the war, for a large proportion of the region between the Balkans and the Danube, now Bulgaria. But the separation of Eastern Rumelia isolated Adrianople, and transferred to Philippopolis at least two-thirds of its foreign trade which, as regards sear-bome merchandise, is carried on through the port of Burghas. Sericulture, which prior to the war contributed largely to the prosperity of the town, suffered severely for a time, but about 1890 it began to show signs of revival which gradually developed. In 1897 and 1898 the output of silk increased in a remarkable degree, and in 1899 the crop equalled those of the most prosperous period which the silk industry has ever known in Adrianople. Unfortunately, the failure of the grain crops of the province in 1900 and in the four previous yeaiB almost neutralized the effect of these good silk harvests on the general prosperity of the population. The production of cheese continues steadily to increase. During the last few years great pains have been bestowed upon the improvement and extension of the fortifications, with the object of rendering them impregnable. In the opinion of military experts this object has been attained.

(e. w.*)

Adriatic. See MEDiTSEEAiirBAN.

Adullam, a’city in the “lowland” of Judah, now Aid el-Ma, 7 miles north-east of Beit-Jibrui. The cave was near the city, and not near the Dead Sea. As a political expression the ” cave of Adullam ” first occurs in a Eeform speeflh by Mr Bright in 1866.

Adulteration. — So many difficulties had been met with in the operation of the Adulteration of Food Act 1872, referred to in the ninth edition of this work, to- gether with the Act of 1860, that ia 1874 a Select Parliar mentary Committee was appointed, which, after hearing much evidence, reported that, while the Act had done much good, it had at the same time inflicted considerable

injury and enforced heavy and undeserved penalties upon some" respectable tradesmen. " This appears to have been mainly due to the want of a clear understand- ing as to what does and what does not constitute adul- teration, and in some cases to the conflicting decisions and inexperience of the analysts. Your committee are of opinion that the Act itself is defective and needs amendment." The Act had been but very partially applied ; in most districts it had not been put into opera- tion at all, ia many no analysts had been appointed, in others no inspectors whose duty it would have been to purchase samples and submit them to the analysts for analysis. At that time but very few chemists had a competent knowledge of the composition of articles of food and of drink. The work in previous years had been carried on by amateurs, microscopists, and sensa^ tion-mongers, and no systematic steps had been taken to collect trustworthy analyses and to work out efficient and practicable methods of analysis. Upon the report of the Select Committee of 1874 the Sale of Food and Drugs Act 1875 was based, all pre- fszs' vious Acts being repealed. This Act avoided the term "adulteration" altogether, and endeavoured to give a general definition of "food," of "drug," and of offences which would bring dealers in food and drugs into collision with the Act. The appointment of analysts was made incumbent upon the City of London, the vestries, all county quarter-sessions, and town councils of boroughs having a separate police establishment, and inspectors were empowered to collect samples for analysis. For the protection of the vendor such samples as were purchased for analysis were to be offered to be divided into three parts, one to be submitted to the analyst, the second to be given to the vendor to be dealt with by him as he inight deem fit, whilst the third was to be retained by the purchasing inspector, and, at the discretion of the magistrates hearing any summons, to be submitted, in case of dispute, to the Commissioners of Inland Eevenue for analysis by the chemical laboratory at Somerset House. The public analyst had to give a certificate to the person submitting any sample for analysis, which certificate was to be takeii as evidence of the facts therein stated, in order to render the proceedings as inexpensive as possible. If the defendant in any prosecution proved to the satisfac- tion of the court that he had purchased the article under a warranty of genuineness, and that he sold it in the same state as when he purchased it, he was to be dis- charged from the prosecution, but no provision was made that in that event the giver of the warranty should be proceeded against. For admixing injurious substances with food or drug a fine not exceeding £50 could be imposed, or, after a conviction for a first offence, imprison- ment for a period not exceeding six months with hard labour. For any ordinary practice of sophistication the maximum fine was fixed at £20.

The general definition above referred to, contained in clause 6 of the Act, was couched in the following words : — "No person shall sell to the prejudice of the purchaser any article of food or any drug which ^/f/ef,' is not of the nature, substance, and quality of the article demanded by such 'purchaser; provided' that an offence shall not be deemed to be committed in the following cases: — (1) Where any matter or ingredient not injurious to health has been added to the food or drug because the same is required for the production or prepa- ration thereof as an article of commerce, in a state fit for carriage or consumption, and not fraudulently to increase the bulk, weight, or measure of the food or drug, or conceal the inferior quality thereof ; (2) where the food or drug is a proprietary medicine or is the subject of a

patent in force ; (3) where it is compounded in accordance with the demand of the purchaser ; and (4) where the food or drug is unavoidably mixed with sopie extraneous matter in the process of collection or preparation." This clause soon gave rise to an immense'amount of litigation, and already in 1879 it was found necessary to pass a short Amendment Act, making it clear that if a purchase was effected by an inspector with the intent to get the purchased sample analysed he was as much "prejudiced" if obtaining a sophisticated article as a private purchaser who purchased an article for his own use and consump- tion. In the practical parrying out of the Act the chief difficulty was soon found to consist in ascertaining whether any article was "of the nature, substance, and quality demanded by the purchaser." This, on superficial con- sideration, seems to be a very simple matter. ' Thus, if a vendor supplies a customer who demands " milk " with milk and water, or with milk from which a part of the cream has been removed by skimming, it may appear to be a very easy task to ascertain whether the purchaser's demand has been complied with or not. But the com- position of milk as yielded by the cow varies widely under different conditions, with the race and breed of the animal, its food, state of health, the period of lactation, the time of year, climate, &c. Thus, while a good Jersey cow might yield milk with 8 per cent, of fat, a Dutch cow might have but 2f or 3 per cent, of fat in its milk, and a great portion of the fat from the former might be removed before it fell to the level of the latter. Were the analyst to insist upon a standard of fat equal to that present in the best milk, many, even the majority of, genuine samples would have to be condemned, while, if he adopted the lowest recorded limit found in genuine milk, cream might be removed from almost all milk of normal nature, to the great damage of farmers and of the public. Similarly, but not quite to the same degree, there is a variation in the amount of the other food-constituents of milk, the so-called "solids-not-fat" or non- fatty solids, from the quantity of which the analyst concludes whether water has been added to the milk. It is obviously im- possible to differentiate between the water which is natu- ral to pure mUk, and which constitutes the greater part of it, and between water that may have been fraudulently added to the article ; but by the addition of water the constituents upon which the food-value of milk is de- pendent become depressed, and the depression is naturally in proportion to the quantity of added water. It required the united efforts of public analysts, who in 1875 founded the Society of Public Analysts, to ascertain by many tens of thousands of analyses of samples of milk the natural variation of the composition of milk, and to fix reasonable and fair limits applicable to pure milk. The milk yielded by single cows varies widely, and it is almost impossible to state the extremes, but the milk supplied to the public by vendors is almost invariably the mixed product of a herd, and extremes are equalized by such mixing. A monumental record of the composition of mixed milk was made by Dr Paul Vieth, who in 1892 published results of no less than 120,540 analyses of genuine milk, showing that the average composition varied in such manner that the percentage of fat was highest in September, October, and November, and lowest in June and July, while the proportion of "solids-not-fat" was subject to compara- tively little variation, and that the numbers adopted by public analysts previously, namely, 3 per cent, for fat and 8.5 per cent, for solids-not-fat, were fair and equitable. Further reference will be found on this subject under the sub-heading " Milk " below. Similar difficulties are met with in all other articles of food, and, in fact, with annu- ally extending experience, wider and wider variations in

composition have been found, continually adding to the difficulty of arriving at a fair conclusion upon the basis of analysis. It may be said that a purchaser who obtains milk of extreme poverty, however untampered with, is prejudiced, because he expects to obtain milk of at least average quality, but the Food Acts are intended to repress and punish fraud only. While, however, milk vendors at first strongly opposed the use of more or less arbitrary limits of composition insisted upon by the executive officers, they slowly recognized that both the interest of the public and their own required them, and of late the raising of the limits has been favourably looked upon by some of the largest milk-vendors. By law no limit or standard is recognized at the present time, but a com- mittee

appointed by the Board of Agriculture have care- fully inquired into the matter, and have recently reported officially recommending limits for the composition of milk, setting at rest a question which, since 1876, has given rise to a vast amount of labour and to numberless disputes.

A curious condition of things arose out of the definition of « food ” as given in the Sale of Food Act 1875. ” The term ‘ food ‘ shall include every article used for food or drink by man, other than drugs or water.” It had been the practice of bakers to add alum to the flour from which bread was manufactured, in order to whiten the bread and to permit the use of damaged and discoloured flour. This practice had been strongly condemned as early as the middle of the century by Liebig, as rendering the bread indigestible and injurious to health. Very shortly after the passing of the Food Act this objectionable practice disappeared, and alumed bread now no longer occurs. A large trade, however, continued to be carried on in baking powders consisting of alum and sodium bicarbonate, mainly used in private households. It was naturally thought that, as baking powder is sold with the obvious intention that it may enter into food, the vendors could also be proceeded against and the noxious trade stamped out. A strongly contested case having come before the High Court {James v. Jones) from the Swansea County Bench, it was held that baking powder was not an article of food, and that it was not an offence within the Food Acts to sell alumed baking powder. Following this decision it was obvious that spices, like pepper, cayenne, &c., were also not articles of food, and a further amend- ment of the law became inevitable. Before referring to the passing of the amended Act, which came into force in 1899, consideration must, however, be given to another fragment of piecemeal legislation, the Margarine Act of 1887. As early as the sixth decade of the 19th century substitutes for butter had been tried and had found a small market, mainly on the Continent. During the siege of Paris their manufacture received a powerful impulse, and soon after 1870 imitation-butter began to be sold in increasing quantities under the name of “‘S’”””** ” butterine.” This consisted of the softer portion of beef and other fats, coloured in imitation of butter, and churned with milk, often also flavoured with butter. The chief seat of manufacture of the article was, as it still is, in Holland, the raw material coming mostly from the United States. Although imported as an article essentially different from butter, its appearance, consistency, and name invited its substitution for real butter at the hand of unscrupulous traders; and there is no doubt that immense quantities of “butterine” were sold to the public as butter, to the great damage of farming and legitimate trade interests. Again a parlia- mentary committee sat and took evidence, and it was re- solved to give a new name to the article, that of “mar- garine ” (first given by Chevreul to a substance isolated by him from fats in beautiful pearly crystals), and to compel

the labelling and branding of all boxes and vessels in ■which the article was conveyed aad stored, as well as the marking of the papers in which the retail dealer sold it, with the word “margarine,” even mixtures of the substi- tute with real butter coming under that obligation. It was probably hoped that by these means the trade in butter-substitutes might be checked or destroyed, but the contrary happened, the new name soon taking root, and the sale of the article increasing by leaps and bounds, in spite of the great rate of increase in the import of genuine butter. Thus the Margarine Act ran conjointly with the original Food Act of 1875 ‘and the Amendment Act of 1879. The result was a further increase in modifying decisions of High Courts and increasing difficulty in inter- preting the meaning of the Acts. Growing dissatisfaction was expressed by the vendors, wholesale and retail, and by the authorities who had to see the Acts enforced, and the outcome of much agitation was once more a parliamentary committee, appointed in 1894, and reappointed in 1896 and 1897, voluminous evidence lieing taken and considered, resulting finally in a fourth Act, the Sale of Food and Drugs Act 1899, again superimposed over the three prior pieces of legislation.

Tear.

Number of Samples.

Percentage

of

Adulteration.

Average percent- age in Quin- quennial Periods.

Examined.

Adulterated.

1877 1878 1879 1880 1881 1882 1883 1884 1885 1886 1887 1888 1889 1890 1891 1892 1893 1894 1895 1896 1897 1898 1899

14,706 16,191 17,049 17,673 17,823 19,439 19,648 22,951 23,230 23,596 24,440 26,344 26,956 27,465 29,028 32,447 37,233 39,516 43,962 45,555 46,856 49,556 53,056

2,826

2,782

2,535

2,772

2,613 ‘

2,931

2,956

3,311

3,076

2,813

3,134

2,836

3,096

3,069

3,540

4,009

4,793 •

4,060

4,093

4,202

4,383

4,319

4,970

19-2

17-2

14-8

15-7

14-7

15-1

15-0

14-4

. 13-2

11-9

12-8

10-8

11-5

11-2

12-2

12-4

12-9

10-3

9-3

9-2

9-4

8-7

9-4

1 1877-1^81

16-2

1882-1886 13-9

1887-1891 11-7

1892-1896 10-6

Samples Analysed under Food Acts in 1899.

Knmber of Samples.

Percentage Adul-

Description.

Examined.

Adulterated.

1899.

1898.

Milk .

21,964

2,314

10-5

9-9

Bread .

597

3

0-5

0-8

Flour .

720

9

1-3

2 0

Butter .

10,478

1,018

9-7

10-6

Coffee .

1,929

145

7-5

10-6

Sugar .

575

34

5-9

2-9

Mustard

693

22

3-2

3-9

Confectionery and

Jam . . ” .

511

14

2-7

2-9

Pepper

1,638

21

1-3

0-8

.Tea .

565

2

0-4 .

3-1

Lard .

1,462

6

0-3

0-1

Wine .

87

1

1-1

2-4

Beer .

239

2

0-8

0-4

Spirits .

4,724

ail

12-9 –

12-4

Drugs .

2,475

440

17-8

11-9

Other articles

4,399

329

7-5

5-0

Total

63,056

4,970

9-4

8-7

As to the working of the highly complicated machinery thus created since 1st January 1900 it is yet too early to speak, but of the beneficial results of the Sale of Food

of the

Acts.

and Drugs Act 1875, broadly speaking, there cannot be any doubt. The preceding table, taken from the Eeport of the Local Government Boar4 for 1900, shows clearly that the percentage of adulterated articles has steadily declined since 1877 from 19 per cent, of all samples analysed to 9 per cent.

The effect, gratifying as it is, would have been still greater if many towns and districts had not neglected, in spite of pressure brought to bear upon them by Government and others, to put the Acts into Working operation. The Acts compel the authorities to appoint analysts, but until the Act of 1899 no means existed to force unwilling councils to collect sam- ples for analysis, or in many cases only so small and insignificant a number that food control was virtually non-existent. As far, however, as statistics are available, figures prove that in districts where the Acts are more or less feebly administered the proportion of adulteration is greater than in others that vigorously apply the legal means for repressing fraud. Thus in 1890, Somersetshire, working the Acts efficiently, took one sample for analysis per annum for every 379 inhabitants, and the percentage of adulterated articles found was only 3-6, or only about one-third of the amount representing the average for the whole

country. Gloucestershire, with one sample for 770 inhabitants, had 6-2 per cent, of adulteration; Hampshire, with one sample for 1224 inhabitants, 12-2 per cent. ; Derbyshire, with one sample for 3164 inhabitants, 17-1 per cent. ; Oxfordshire, with only one sample for 14,963, no less than 41-7 per cent, of adulterated articles. Eveij in 1899 no samples whatever were officially analysed in seven English boroughs, while within the jurisdiction of six counties and seven boroughs, with a total population of 600,000, only 139 samples were analysed during the year, and in 65 other districts the proportion examined was less than was deemed sufficient by the Local Government Board. The public authorities, at the same time, recognize in most cases the material public benefit conferred by the various enactments. In 1899, 63,056 samples were examined by public analysts : 4970 were reported against, and proceedings were instituted against 3110 vendors — fines amounting to £6258 being imposed.

The increased vigilance on the part of the public officers is met by an increased application of science to adultera- tion. Thus, for some years the substitution of margarine for butter, an unabashed fraud, was ^^“f^”” common. The substitution, owing to advance %„„_ ”” in methods of chemical ansilysis, being readily discoverable since 1874 and punished, mixtures of butter with gradually decreasing percentages of margarine were made and sold ; and at the present time large quantities of mixtures, containing not more than 8 to 10 per cent, of margarine, are freely imported from abroad and sold as “warranted pure” butter, the mixing being done with the assistance of skilled ch’emists, who, knowing the com- position of the pure article, carefully let it down by the addition of margarine to such a point that the mixture still possesses the characters of pute, though slightly abnormal butter, against which proceedings could not be undertaken with probability of conviction of the vendor. Margarine, specially adapted for this fraud, is made by Dutch manufacturers. In milk, similarly, the skilful vendor, knowing the natural variations of milk, dilutes or skims it to the exact point which experience has shown to render him reasonably safe from detection. The whole of the information contained in analytical literature, primarily for the benefit of the analyst, is available to the fraudulent manufacturer, and no new process of analysis appears without immediate effort on the part of the mixer to circumvent and defeat it. Two practices which

are closely akin to adulteration, if not actually such, have much engaged the attention of analysts during the last fe-w years— naijiely, the addition of chemical preservatives and of -colouring matters to articles of food. Chemical preservatives are contained in many perishable articles — ^namely, sulphite of lime in beer, syrups, meat, lime-juice, &c. ; salicylic acid sometimes in wines and often in jams ; formaldehyde (formaline) in milk. But by far the most frequently used materials are borax and boracic acid, almost universally present in imported butter (with the exception of Danish butter), and in much that is made in Great Britain, in cured ham, in fish, cream, and milk. A preservative acts as a bactericide and in no case is physiologically inert, although the dose taken at a meal may not be sufficient to produce obvious effects. Medical opinion is, however, at present almost unanimous that the continual use of preservatives cannot fail to be injurious to the human system, and the increasing infant mortality in some towns is attributed to the fact that the milk used by the infants is now so frequently borated. A Committee appointed by the Board of Agriculture has been engaged on this subject, but at the time of writing no report has yet been made public. The employment of preservatives is justified by dealers in perishable articles by pointing to the difflculty which would otherwise be experienced in collecting in distant countries food-mate- rials like butter, shipping them to England, and distrib- uting them to the public without loss of quality; on .the other hand, modern means of preserving food, in cold- store, &c., are being pointed to as fully sufficient to meet all wants without the introduction of foreign matters.

Colouring matters, quite harmless in themselves, are largely used at the present time in many articles of food and drink. Originally the use of a yellow dye in milk was due to a fraudulent motive, namely, to hide the blueness produced by watering. Gradually the public, especially in London, became accustomed to see their milk of a distinct yeUow tint, and all milk, even genuine milk free from added water, sold in London, is now coloured, generally with anatto, often with aniline dye ; and it would be almost impossible for a vendor to sell milk of its natural colour. Again, all butter sold in London and the South of England is coloured yellow. Natural butter has often a very faint fawn tint, and the public, educated to see butter yellow, would not purchase such butter ; hence the now universal colouring adopted. The Food Act cannot cope with this practice, as long as the object of colouring is not a fraudulent one and the colour itself is harmless. The colouring of pre- served peas by the use of a little copper sulphate is on a different basis, as the copper is considered liable to pro- duce injury to health, and many vendors of coppered peas have been fined during recent years f .yet the public object to purchase preserved peas of the natural brown colour. Jam's are very frequently dyed, and the brill- iantly coloured jams now sold owe most of their colour to coal-tar dyes, which are often employed to hide the fact that unripe or inferior fruit has been used by the manufacturer.

We will now consider recent forms of adulteration in specific articles, and the means adopted for their detection. ■ J/t7fc.—- Although the general qualitative composition of milk has been known for very many years, all quanti- tative statements concerning the proportion of the several constituents published before 1884 are affected with con- siderable errors. About 1872 Wanklyn showed that, although, as was well known, the percentage of the fat of milk was siibject to very considerable fluctuation, when the percentage of milk-sugar, caseine, and other albuminoids and mineral water was added together, the "solids-not-fat"

varied but little, and he proposed to utilize that fact ta determine whether milk was genuine or had been impover- ished by the addition of water, — it being evident that water would diminish the percentage of solids-not-fat, the percentage of addition being readily calculated from the amount of the latter. Although the method of ascer- taining the proportion of "solids-not-fat" adopted by Wanklyn has been shown to be somewhat erroneous, the principle of analysis established by him has remained the basis upon which milk-analysis rests, and public analysts virtually adopted the limits proposed by him — viz., 2-5 per cent, of fat and 9 per cent, of solids-not-fat. In 1884 M. A. Adams showed, however, that the then usual method of analysis did not allow of the complete removal of the fat from the other mUk-constituents, that therefore the proportion of fat had been underestimated, the amount of the solids-not-fat being correspondingly too high. By the simple and ingenious expedient of spreading a known volume of the milk to be analysed upon a long strip of blotting-paper and extracting the paper together with the dried milk by a solvent, such as ether or benzene, the fat could be completely removed from all other constituents. After full investigation the , Society of Public Analysts altered the limits, iu accordance with the new discovery, to 3 per cent, as a minimum for the fat and 8-5 per cent, for the solids-not-fat. As the average composition of genuine milk, according to Vieth, is 4-1 per cent, of fat, 8-8 of solids-not-fat, and 12-9 per cent, of total matter other than water, it is obvious that the limits allow for a reasonable departure from the average. The Board of Agriculture's Departmental Committee has quite recently issued a report, in which the following recommendations are made as to proportions of food constituents which should be present in milk. The percentage of total solids must not be less than 12, the proportion of solids-not-fat not less than 8-5 per cent:, and that of fat at least 3-26. If the amounts are smaller, a presumption is raised, un- less the contrary is proved, that the milk is adulterated by skimming or watering. The recommendations of the Committee are most valuable, as tending to the improve- ment in the breed of dairy cattle, and cows yielding milk poorer than the above will probably be weeded out and replaced by superior breeds. A number of means are now known allowing of the complete analytical separar tion of the fat other than the " Adams " method. The "galactometer" and "lactometer" instruments, referred to in the article in the ninth edition of this work, have long been abandoned. Other far more exact and

more rapid means have been found to determine the composition of milk with a degree of accuracy sufficient for practical, especially dairying, purposes. As the fat of milk is its most valuable and most important constituent, it is of high importance to the butter^producer in particular to know the exact proportion of the fat, partly in order to know that he obtains value for his money, and also to check the efficiency of the working of his appliances for sepa- rating the cream — centrifugals being now universally em- ployed for that purpose. By centrifugal force alone the fat globules of milk do not coalesce into a layer of pure fat ; if, however, an acid, like hydrochloric or sulphuric acid, be added to the milk iu sufficient quantity prior to subjecting it to centrifugal force a clear layer of pure butter-fat separates, and if a measured quantity of milk be taken and the volume of the separated fat be deter- mined, generally in a graduated glass-tube, the amount of fat in any sample of milk can be arrived at in a few minutes. Upon this principle a number of instruments have been designed and render excellent service in the creamery and laboratory. As, moreover, a definite rela- tion exists between the specific gravity of a milk and its contents in fat and solids-not-fat, it follows that the

specific gravity of a milk beiag kno-vm and its contents in fat, the proportion of solids-not-fat can be calculated. Formulae for that end have been worked out by a number of chemists. An analysis of milk, showing the specific gravity, the percentage of fat and that of solids-not-fat can therefore now be made in as many minutes as the hours formerly required, and in scientifically conducted dairies the price paid for the milk is regulated by the analytical data obtained.

No forms of adulteration occur except the addition of water, the removal of cream (or its equivalent, the addi- tion of skim-milk), and, if adulteration it be, the addition of preservatives. All statements as to the occurrence of chalk and of sheep’s brains are fables. Although the addition of water is still a common form of adulteration, the percentage of added water is mostly not greater than from 8 to 15, and the grosser and more impudent frauds commonly met with twenty years ago have practically been stamped out. A number of the large dairies supply- ing London and other large towns have fully equipped laboratories, with a staff of highly trained chemists, analysing almost each churn of milk delivered by the farmers, adulteration being thus as completely prevented as possible. Against the skimming of milk the means available are not so effective as those against watering, as the natural variation of the amount of fat is so con- siderable, partially skimmed Jersey milk still containing as much fat as unaltered milk from lowland cattle.

Butter. — Since the introduction of margarine, frauds in the butter trade are exclusively confined to two kinds — namely, the substitution of margarine for and the addi- tion of margarine to butter, and the incorporation or undue retention of water. Referring firstly to the latter form of adulteration, it must be borne in mind that all butter contains water. Properly-made butter contains, as a rule, 11 to 15 per cent. ; it is not practicable to remove a larger proportion by rolling or squeezing, as the consist- ency of the butter suffers ; 16 or at most 17 per cent, of water may legitimately be present in good butter. If, how- ever, the churning of the cream is carried out at too high a temperature, an emulsion of water and butter is formed, containing as much as 30 or even 40 per cent, of water, causing the article to assume an ointinent-like appearance. In properly-equipped dairies, refrigeration gf the cream, if needful, is adopted to reduce the temperature of the cream in summer ; but in small and old-fashioned dairies, as in many of those in the West of Ireland, these means are not available, and Irish butter, therefore, often con- tains an excess of water, 25 per cent, and over. As in most cases magistrates have declined to consider this as an adulteration, and often enough the petty farmers are not to be blamed, the wilful introduction of water into butter has at times been carried out on an industrial scale, and even at the present time much butter is sold which has been loaded with water up

to 28 and more per cent., with of course good profit to the ” manufacturer.” Chemical differentiation between butter and butter- substitutes, now called margarine, was imknown prior to 1873, when the writer, with A. Angell, published a method which readily allowed of such differentiation, and of the estimation of the proportions of butter-fat and other fat contained in a mixture, based upon the fact that while fats other than butter-fat (and cocoa-nut oil) contain about 95-5 per cent, of fatty acids insoluble in water, butter- fat contains a smaller quantity — namely, about 86 to 88 per cent. — the difference being due to the presence of a corresponding amount of water-soluble fatty acids. Various modifications and simplifications of this principle ‘ have since been worked out, and the detection of marga- rine in butter, if present in substantial amount, has been

rendered easy and certain. In the case of butter, as in that of milk, the analyst has, however, to reckon with natural variations in the composition of the butter-fat itself, and no means have yet been discovered whereby percentages smaller than 10 per cent, can be discovered with suf&cient certainty to lead to the conviction of the vendors. It is a singular fact that while, as a rule, the composition of the butter-fat is almost independent of the food of the animal, under some conditions depending mainly upon the period of lactation, the composition of the fat undergoes material changes, so that a cow in the last stages of lactation may yield milk, small in quantity, from which butter can be churned which analyses as if it were a mixture of butter and margarine. Luckily it happens but rarely in prac- tice that all the cows of a whole herd become ” dry ” at the same time ; hence the natural variation in composition equalizes itself as a rule. There are, however, a few cases on record, notably one carefully worked otit by A. H, Allen, in which butter was made under strict supervision in Denmark from absolutely pure materials, yet analysed like a mixture. It is doubtful therefore whether adultera- tion of butter with small amounts of margarine can ever be quite prevented by certain discovery, especially if the admixture is made, as in some parts of Holland, with the active aid of skilled chemists. When it is considered that England imports about ten million pounds sterling worth of butter per annum, the immense importance of preventing substitution of margarine, of approximately half the price of butter, will be apparent.

Some most ingenious instruments have been con- structed, notably Abbe’s refractometer, with a view to obtain by physical means data for discrimination between butter and mixtures. Melted butter-fat refracts light to a less degree than do butter-substitutes ; the instrument in question allows of the determination of the ” index of refraction ” by the use of a mere droplet of the butter-fat, and is a most valuable tool in the hands of the chemist.

Clieese. — From America cheese has come into the Eng- lish market, made from skim-mUk which has again been provided with fatty matter, generally emulsified margar rine — Whence the term “margarine cheese,” or “filled cheese ” — a legitimate article if sold with full disclosure of its nature, but one which readily lends itself to fraud. Cases of cheese-poisoning have been recorded, and a highly poisonous substance, termed tyrotoxicon, has been extracted from cheese by Vaughan. Compounds of zinc and of lead have also been met with.

Lard. — Between the years 1880 and 1890 a gigantic, fraudulent trade in adulterated lard was carried on from America. A great proportion of the American lard im- ported into England was found to consist of a mixture of more or less real lard, with cotton-seed oil and beef- stearine. Cotton-seed oil is one of the cheapest vegetable oils fit for human consumption ; beef-stearine, the hard residue obtained in the manufacture of oleomargarine after the more fluid fat has been pressed out from the beef-fat. So skilfully were the mixtures made that for some years their very existence escaped notice, until in 1888 a bill introduced in the American Senate to stop the imposture directed general attention to the matter, and energetic measures by the food-officers quickly put a stop to’ it as affecting the United Kingdom. From the memorial pre- sented to the U.S. Senate in support of the bill, it ap- peared that in about 1887 the annual production of lard in the States was estimated at 600 million

pounds, of which more than 35 per cent, were adulterated. During the last seven or eight years compounds have been made containing no lard or only a faint trace of lard. These compounds were sold as “refined lard,” “pure refined lard,” “choice refined lard,” “choice refined family lard,”

and other similar names. Professor Wiley, in his evi- dence on the subject, said that ” Messrs Armour and Co. state that they use from 69 to 75 per cent, of lard in their mixtures, Fairbank from 50 to 75 per cent. The former firm use 75,000 barrels of cotton-seed oil, and make 60 million pounds refined lard. 75,000 barrels ■weigh 28 million pounds : hence the average proportion would be 46 per cent, of cotton-seed oil in the mixture j but as from 10 to 15 per cent, of beef-stearine are neces- sary to stiffen the mixture, the proportion of lard would be only about 42 per cent.”

Oils. — Since the article in the ninth edition of this work appeared, enormous progress has been made in the chemical knowledge of fats and oils, and complicated mixtures of various oils can now be satisfactorily an- alysed. Perhaps the most important step was taken by Allen and von Huebl, who showed that different fats and oils were ca;pable of combining with different percentages of bromine or iodine, the “iodine-absorption” number being characteristic for each class of oils — the ‘olive-oil group showing about 80-90 per cent. ; the cotton-oil group about 105-110; linseed-oil, 160-170. This number, to- gether with a determination of the saponifieation-value (the amount of caustic alkali needed for complete saponi- fication), the thermal rise with strong sulphuric acid (Maumene), or bromine (Hehner and Mitchell), the re- fraction of light and the specific gravity, enafile the analyst to form in most cases a close idea as to the nature of any sample under examination. The adulteration of oils has in consequence become far less. Cotton-seed oil and, latterly, the oil expressed from the maize-germ (maize oil), are the most common fatty adulterants, but much use is also made in this direction of paraffin oils and resin oil. So-called olive oil frequently consists of a mixture of olive oil, cotton-seed oil, earthnut (arachis) oil, and sesame-^eed oil, one or the other of these being some- times altogether substituted for genuine olive oil. Odour- less paraffin hydrocarbons also enter into these adulterated articles.

Pepper. — Some years ago ground olive-kernels were largely sold for admixture with pepper, under the name of ” poivrette.” They were easily recognizable on micro- scopic examination and the fraud did not live long. The older forms’ of adulteration (rice and other farinaceous meals) also still occur.

Ginger. — The more or less exhausted ginger result- ing in the manufacture of ginger beer used until lately to be re-dried, ground, and mixed with fresh ginger — a gre.at proportion of commercial ground ginger con- sisting of so-called “spent,” ginger. If exhausted by water the proportion of the water-soluble constituents of ginger — if by alcohol, those of the alcohol-soluble ones — were reduced by the treatment, thus affording to the analyst guidance in coming to a judgment. Similar fraud exists in the case of aromatic substances from which valuable oils can be extracted, the ex- hausted ground stuff being sold in admixture with the genuine.

Beer. — In 1899 an obscure illness broke out in Dublin resembling the tropical disease “beri-beri.” Early in August 1900 a rapid increase in the number of ” peripheral neuritis” cases, closely resembling the Dublin beri-beri cases, was observed in Lancashire. It soon became clear that there was some connexion between the drinking of beer and the obscure disease f and Dr Eeynolds, Physi- cian to the Eoyal Manchester Infirmary, on investigation found arsenic in the suspected beer. This discovery caused an immense amount of attention to be given to beer. Traces of arsenic were found

in samples from many parts of the country ; but the greatest amounts of arsenic (up to 1 grain per gallon, calculated as arsenious

acid, has been met with) were traced to the employment in a number of breweries of some starch-glucose that had been manufactured by the aid of very impure, arsenical, sulphuric acid by a Lancashire firm. Numerous deaths were due to the drinking of such arsenicated beer. It was also soon discovered that much of the malt used by brewers contained appreciable traces of arsenic, and in hops small traces were found. • Malt and hops probably derive their arsenic from the fact that both are prepared by an antiquated process, the drying of both being effected by the ‘gases and fumes which are given off by coke or anthracite fires, these fumes passing through the malt and hop, which absorb therefrom any arsenic that may be associated with the pyrites occurring in all coal. Sulphur, often arsenical, is also sprinkled upon the fires to lighten the colour of malt or hop. All the worst cases, however, of arsenic in beer were due to arsenical glucose, prepared by one firm. The use of glucose is perfectly legal, the brewer having the statutory right to brew from whatever material he may deem proper, as long as he pays due revenue to the State — the revenue being levied upon the basis of the specific gravity of the wort, every liquor under the Customs and Inland Rev- enue Act, 1885, being defined as beer, ” which is made or sold as a description of beer, or as a substitute for beer, which on analysis of a sample thereof shall be found to contain more than 2 per cent, of proof spirit.” The fact that arsenic was liable to occur in glucose and in beer was known as long ago as 1878, but no quantities in any way resembling those met with in the recent cases had previously been observed. Since the use of glucose has become general in brewing, other industrial users of sugar, principally the manufacturers of sweetmeats, jams, and syrups, have also largely employed glucose, mainly for the cheapening of their products. No doubt the strict supervision which will henceforth be exercised over 4he purity of glucose will render an occurrence such as that of beer-poisoning by arsenic unlikely in the future ; but a strong desire has been aroused to draw a distinction by Act of Parliament between beer made from malt and hops and such as may be prepared from substitutes.

(o. H *)

Advertisement, or advertising, as the process of purchasing publicity is now more commonly called, is of very recent origin if it be regarded as a serious adjunct to other phases of commercial activity. In some rudi- mentary form the seller’s appeal to the buyer must, how- ever, have accompanied the earliest development of trade. Under conditions of primitive barter, communities were so small that every producer was in immediate personal con- tact with every consumer. As the primeval man’s wolfish antipathy to the stranger of another pack gradually diminished, and as intercourse spread the infection of larger desires, the trapper could no longer satisfy his more complicated wants- by the mere exchange of his pelts for his lowland neighbour’s corn and oil. A began to accept from B the commodity which he could in turn deliver to C, while C in exchange for B’s product gave to A what D had produced and bartered to C. The mere statement of such a transaction sufficiently presents its clumsiness, and the use of primitive forms of coin soon simplified the original process of bare barter. It is reasonable to suppose that as soon as the introduction of currency marked the abandonment of direct relations between purchaser and consumer an informal system of advertisement in turn rose to meet the need of publicity. At first the offer of the producer must have been brought to the trader’s attention, and the trader’s offer to the notice of the consumer, by casual personal contact, supple-

mented by local rumour. The gradual growth of markets and their development into periodical fairs, to which merchants from distant places resorted, afforded, until printing was invented, the only

means of extended advertisement. In England, during the 3rd century, Stourbridge Fair attracted traders from abroad as well as from all parts of England, audit may be conjectured that the crying of wares before the booths on the banks of the Stour was the first form of advertisement which had any marked effect upon English commerce. As the fairs of the Middle Ages, with the tedious and hazardous journeys they involved, gradually gave place to a more convenient system of trade, the 15th century brought the inven- tion of printing, and led the way to the modern develop- ment of advertising. The Americans, to whom the elaboration of newspaper advertising is primarily due, had but just founded the first English-speaking community in the Western hemisphere when the first newspaper was published in England. But although the first periodical publication containing news appeared in the month of May 1622, the first newspaper advertisement does not seem to have been published until April 1647. It formed a part of No. 13 of Perfect Occurrences of Every Daie joumcdl in Parliament, and other Moderate Intelligence, and it read as follows : —

A Book applauded by the Clergy of England, called 7%e Divine Bight of Church Government, Collected by sundry eminent Minis- ters in the Citie of London; Corrected and augmented in many places, with a briefs Reply to certain Queries against the Ministery of England; Is printed and published for Joseph Sunscot and George Calvert, and are to be sold at the ■Stationers' Hall, and at the Golden Fleece in the Old Change.

Among the Mercuries, as the weekly newspapers of the day were called, was the Mercurius Elencticus, and in its 45th number, published on 4th October 1648 there appeared the following advertisement : —

The Reader is desired to peruse a Sermon,

Entituled A Looking-Glasse for Levellers,

Preached at St; Peters, Paules Wharf, on Sunday, Sept. 24th 1648,

by Paul Knell, Mr. of Arts. Another Tract called A Reflex

upon our Reformers, with a prayer for the Parliament.

In an issue of the Mercurius Politicus, published by Marchmont Kedham, who is described in the ninth edition of the Encydopcedia Britannica (see Newspapers, vol. xvii. p.. 414) as " perhaps both the ablest and the readiest man that had yet tried his hand at a newspaper," there appeared in January 1652 an advertisement, which has often been erroneously cited as the first among news- paper advertisements. It read as follows : —

Irenodia Gratulatoria, a heroic poem, being a congratulatory panegyriok for my Lord General's return, summing up his suc- cesses in an exquisite manner. To be sold by John Holden, in the New Exchange, London, Printed by Thomas Newcourt, 1652.

The article " On the Advertising System," published in the Edinburgh Review for February 1843, contains the fullest account of early English advertising that has ever been given, and it has been very freely drawn upon by all writers who have since discussed the subject. But it describes this advertisement in the Mercurius Politicus as " the very first," and the discovery of the two earlier instances above quoted was due to the researches of a contributor to Notes and Queries.

In The Crosby Becords, the commonplace-books of William Blundell, there is an interesting comment, dated 1669, on the lack of advertising facilities at that period —

It would be very expedient if each parish or village might have some place, as the church or smithy, wherein to publish (by papers posted up) the wants either of the buyer or the seller, as such a . field to be let, such a servant, or such a service, to be had, &c. There was a book published in London weekly about the year 1657 which was called (as I remember) The Publich Advice. It gave information in vpjy many of these particulars.]

A year later the same diarist says —

There is an office near the Old Exchange in London called the office of Publick Advice. From thence both printed and private information of this useful nature are always to be had. But what they print is no more than a leaf or less in a diurnal. I was in this office. The diurnal consisted of sixteen pages quarto in 1689.

In No. 62 of the London Gazette, published in June 1666, the first advertisement supplement was announced —

An Advertisement — ^Being daily prest to the Publication of Books, Medicines, and other things not properly the business of a Paper of Intelligence, This is to notifle, once for all, that we will not charge the Gazette with Advertisements, unless they be matter of State : but that a Paper of Advertisements will be forthwith printed apart, & recommended to the Publick by another hand.

In No. 94 of the same journal, published in October 1666, there appeared a suggestion that sufferers from the Great Fire should avail themselves of this means of pub- licity—

Such as have settled in new habitations since the late Fire, and desire for the convenience of their correspondence to publish the place of their present abode, or to give notice of Goods lost or found, may repair to the corner House in Bloomsbury on the East Side of the Great Square, before the House of the Right Honour- able the Lord Treasurer, where there is care taken for the Receipt and Publication of such Advertisements.

The earlier advertisements, with the exception of formal notices, seem to have been concerned exclusively with either books or quack remedies. The first trade adver- tisement, which does not fall within either of these cate- gories, was curiously enough the first advertisement of a new commodity, tea. The ninth edition of the Encyclo-‘ poedia Britannica (see Tea, vol. xxiii. p. 101) quotes this advertisement from the Mercurius Politicus, No. 435, for September 1658 —

That excellent and by all Physitians approved China Drink, called by the Chineans Tcha, by other nations Tay, alias Tee, is sold at the Sultaness Head, a cophee-house in Sweetings Rents, by the Royal Exchange, London.

The history of slavery, of privateering, and of many other curious incidents and episodes of English history during the 17th and 18th centuries, might be traced by examination of the antiquated advertisements which writers upon such subjects have already collected. In order that space may be found for some consideration of the practical aspects of modern advertising, the dis- cussion of its gradual development must be curtailed. Nor is it necessary to preface this consideration by any laboured statement of the importance which advertising has assumed.

It is a matter of common knowledge that several business houses are to be found in Great Britain, and a larger number in the United States, who spend not less than £50,000 a year in advertising, while one patent medicine company, operating both in England and the United States, has probably spent, not less than £200,000 in Great Britain in one year, and an English cocoa manu- facturer is supposed to have spent £160,000 in Great Britain. Some of the best works of artists as distin- guished as Sir

John Millais, Professor Herkomer, and Mr Stacy Marks, have been scattered broadcast by advertisers. The purchase of Sir John Millais' picture " Bubbles " for £2200 by i;he proprietors of a well-known brand of soap, is probably the most remarkable instance of tl^e expenditure in this direction which an advertiser may fin^ profit- able. There are in London alone more than 350 advertis- ing agents, of whom upwards of a hundred are known as men in a considerable way of business. The statements which from time to time find currency in the newspapers with regard to the total amount of money anni*ally spent upon advertising in Great Britain and in the United States are necessarily no better than conjectures, but no

detailed statistics are required in order to demonstrate what every reader can plainljr see for himself, that adver- tising has definitely assumed its position as a serious field of commercial enterprise.

Advertising, as practised at the beginning of the 2Qth century, may be divided into three general classes : —

1. Advertising in periodical publications.

2. Advertising by posters, sign-boards (other than those placed upon premises where the advertised business is conducted), transparencies, and similar devices.

3. Circulars, sent in quantities to specific classes of persons to whom the advertiser specially desired to address himself.

It may be noted at the outset that advertising in periodical publications exercises a reflex influence upon these publications. The daily, weekly, and monthly publications of the day are accustomed to look to adver- tisements for so large a part of their revenue that the purchaser of a periodical publication receives much greater value for his money than he could reasonably expect from the publisher if the aggregate advertising receipts did not constitute a perpetual subsidy to the publisher. It is not to be supposed, however, that the receipts from the sale of a paper cover all its expenses and that the advertising revenue is all clear profit. The average newspaper reader would be amazed if he knew at how great a cost the day's news is laid before him. A dignified journal displays no inclination to cry from the housetops the vastness of its expenditure, but from time to time an accident enables the public to obtain information in this connexion. The evidence taken by a recent Copyright Commission dis- closed that the expenditure of the leading English journal upon foreign news alone amounted to more than £50,000 in the course of one year, and that a year not characterized by any great war to swell the ordinary volume of cable despatches.

In the case of daily papers sold at the minimum price, it is not less obvious that the costliness of news service renders advertising revenue indispensable, for although these less important journals spend less money, the price at which they are supplied to the newsagents is very small in proportion to the cost of their production. If, however, this thought be pursued to its logical con- clusion, the advertiser must admit that he in turn receives, from those among newspaper readers who purchase his wares, prices sufficiently high to cover the cost of his advertising. So that the reader is in the curious position of directly paying a certain price for his newspaper, receiving a newspaper fairly worth more than that price, while this price is supplemented by the indirect incidence of a sort of tax upon many of the commodities he consumes. On the other hand, a great part of the advertisements in a daily newspaper have themselves an interest and utility not less than that possessed by the news. The man

who desires to hire a house turns to the classified lists which the newspaper publishes day after day, and servants and employers find one another by the same means. The theatrical announcements are so much a part of the news that even if a journal were not paid for their insertion they could not be altogether omitted without inconvenience to the reader. In the main, how- ever, it is the advertiser who seeks the reader, not the reader who seeks the advertiser, and the care with which advertisements are prepared, and the certainty with W-hich the success or failure of a trader may be traced to his skill or want of skill as an advertiser show that the proper use of advertising is one of the most indispensable branches of commercial training.

Before discussing in detail the methods of advertising in periodical publications it may be well to complete, for the use of the general reader, a brief survey of the whole

subject by examining the two other classes of advertise- ment. The most enthusiastic partisan of advertising will admit that posters and similar devices are very generally regarded by the public as sources of ^^/^^. annoyance. A bold headline or a conspicuous tisements' illustration in a newspaper advertisement may for a moment force itself upon the reader's attention. In the French, and in some English newspapers, where an advertisement is often given the form of an item of news, the reader is distressed by the constant fear of being hoodwinked. He begins to read an account of a street accident, and finds at the end of the paragraph a puff of a panacea for bruises. The best English and American journals have refused to lend themselves to this sort of trickery, and in no one of the best journals printed in the English language will there be found an advertisement which is not so plainly differentiated from news matter tha't the reader may avoid it if he sees fit to do so. On the whole, then, newspaper advertisements ask, but do not compel attention. The whole theory of poster adver- tising is, on the other hand, one of tyranny. The adver- tiser who pays for space upon a hoarding or wall, although he may encourage a form of art, deliberately violates the wayfarer's mind. A trade- mark or a catch-word presents itself when eye and thought are pccupied with other subjects. Those who object to this class of advertisement assert, with some show of reason, that an advertisement has no more right to assault the eye in this fashion than to storm the ear by an inordinate din ; and a man who came up behind another man in the street, placed his mouth close to the other's ear, and bawled a recommendation of some brand of soap or tobacco, would be regarded as an intolerable disturber of public peace and comfort. Yet if the owner of a house sees fit to paint advertisements upon his walls, his exercise of the jealously guarded rights of private property may not lightly be disturbed. For the most part, both law and public opinion content them- selves with restraining the worst excesses of the advertiser, leaving many sensitive persons to suffer. The National Society for Checking the Abuses of Public Advertising, founded in 1893 in London, was organized for purposes which it describes as follows : —

The society aims at protecting the picturesque simplicity of rural and river scenery, and promoting a regard for dignity and propriety of aspect in towns — with especial reference to the abuses of spectacular advertising.

It seeks to procure legislation whereby local representative bodies would be enabled to exercise control, by means of bye-laws framed with a view to enabling them, at any rate, to grant relief in cases of flagrant and acknowledged abuse.

It is believed that, when regulation is applied in cases where local conditions are peculiarly favourable, the advantage will be so apparent that, by force of imitation and competition, the enforcement of a reasonable standard will gradually become common. The degree of restraint will, of course, depend upon the varying requirements of different places and positions. No hard and fast rule is suggested ; no particular class of advertise- ment is proscribed ; certainly Ho general prohibition of posters on temporary hoardings is contemplated. Within the metropolitan, area sky signs have already

been prohibited, and it is hoped that some corresponding check will be placed on the multiplication of the field boards which so materially diminish the pleasure or comfort of railway journeys.

The society regards with favour the imposition of a moderate tax or duty for imperial or local purposes on exposed advertise- ments not coming within certain categories of obviously necessary notices. The difficulty of inducing a Chancellor of the Exchequer to iliove in a matter where revenue is not the primary considera- tion is not overlooked. But it is thought that any impost would materially reduce the volume of exposed advertisements, and would at once extinguish the most offensive and the most annoying class, i.e., the quack advertisements by the road sideS and the bills stuck by unauthorized persons on trees, walls, and palings.

Members are recommended to make it knovni that there exists an active repugnance to the present practice of advertising

disflgirrement, by giving preference, in private transactions, to makers and dealers -who do not employ objectioiiable methods, and by avoiding, as far as possible, the purchase of wares which, in their individual opinion, are offensively puffed. Action on these lines is advised rather for its educational than for its immediately deterrent effect ; although, in the case of many of the more expensive commodities, makers would undoubtedly be much influenced by the knowledge that they would lose, rather than gain, custom.

The foregoing proposals are based on the following estimate of the conditions of the problem. It is believed that the present licence causes discomfort or loss of enjoyment to many, and that, in the absence of authoritative restriction, it must grow far beyond its present limits ; that beauty or propriety of aspect in town and country form as real a part of the national wealth as any material product, and that to save these from impairment is a national interest; that the recent developments of vexatiously obtrusive advertising have not grown out of any necessities of honourable business, but are partly the result of a mere instinct of imitation, and partly are a morbid phase of competition by which both the consumers and ‘the trade as a whole lose; that restriction as regards the size and positions of advertising notices would not be a hardship to those who want publicity — since all competitors would be treated alike, each would have the same relative promi- nence ; that, as large sums of public money are expended on institutions intended to develop the finer taste, and on edifices of elaborate design, it must be held inconsistent with established public policy to permit the sensibilities thus imparted to be wounded, and architectural effect to be destroyed at the discretion of a limited class.

The influence of this society is to be seen ia many of the restrictions which have been imposed upon advertisers since its work began. About a year after its foundation the London County Coiuicil abolished (under statutory powers obtained from Parliament) advertisements coming within the definition of sky-signs ia the London BuUd- ing Act of 1894. These specifications are as follows : —

“Sky sign” means any word, letter, model, sign, device, or representation in the nature of an advertisement, announce- ment, or direction supported on or attached to any post, pole, standard, frame*ork, or other support, wholly or in part upon, over, or above any building or structure, which, or any part of which, sky sign shall be visible against the sky from any point in any street or public way, and includes all and every part of any such post, pole, standard, framework, or other support. The expression “sky sign” shall also include any balloon, parachute, or similar device employed

wholly or in part for the purposes of any advertisements or announcement on, over, or above any building, structure, or erection of any kind, or on or over any street or public way.

The Act proceeds to exclude from its restrictions flag- staffs, weathercocks, and any solid signs not rising more than 3 feet above the roof.

Another bye-law of the London County CouncU, in great measure due to the observations made at cotoners' inquests, protects the public against the annoyances and the perils to traffic occasioned by flashlight and search- light advertisements. This bye-law reads as follows : —

No person shall exhibit any flashlight so as to be visible from any street and to cause danger to the traffic therein, nor shall any ovraer or occupier of premises permit or suffer any flash- light to be so exhibited on such premises.

The expression "flashlight" means and includes any light used for the purpose of illuminating, lighting, or exhibiting any word, letter, model, sign, device, or representation in tlje nature of an advertisement, announcement, or direction which alters suddenly either in intensity, colour, or direction.

No person shall exhibit any searchlight so as to be visible from any street and to cause danger to the traffic therein, nor shall any owner or occupier of premises permit or suffer any searchlight to be so exhibited on such premises.

The expression "searchlight" means and includes any light exceeding 500-candle power, whether in one lamp or lantern, or in a series of Uimps or lanterns used together and projected as one concentrated light, and which alters either in intensity, colour, or direction.

' Advertising vans were so troublesome in London as to be prohibited in 1853; the "sandwich-man" has in the City of London and many towns been ousted from the pave- ment to the gutter, from the more crowded to the

less crowded streets, and as the traffic problem in the great centres of population becomes more urgent, he will probably be altogether suppressed.

Hoardings are now so restricted by the London Build- ing Acts that new hoardings cannot, except under special conditions, be erected exceeding 12 feet in height, and no existing hoardings can be increased in height so as to expeed that limit.

The huge signs which some advertisers, both in England' and the United States, have placed in such po- sitions as to mar the landscape, have so far aroused pub- lic antagonism that there is reason to hope that this form of nuisance will not increase.

In 1899 Edinburgh obtained effective powers of control over all sorts of advertising ia public places, and this achievement has been follow,ed by no little agitation in favour of a Parliamentary enactment which should once for aU do away with the defacing of the landscape in any part of the United Kingdom. The society already mentioned has drafted a Eural Advertisements Bill in the following terms : —

(1) The power of a County Council to make bye-laws conferred by Section 16 of the Local Government Act 1888, shall, subject to the provisions of that section, extend to bye-laws : —

(a) For regulating or prohibiting the erection or placing of advertisements in or upon any arable or pasture/land, woodland, garden, public park, common, or waste land, foreshore, or any inland or tidal water.

(6) For enforcing the removal of advertisements erected or placed in contravention of the bye-laws.

(c) For enforcing the removal, within a prescribed time — not being less than one year after the bye-laws come into operation — of any advertisements erected or placed before the making of the bye-laws in such a manner as would be in contravention of the bye-laws, if the same had been previously made.

(2) Nothing in any bye-law to be made under this Act shall affect any advertisement erected or placed either before or after the passing of thi^ Act, upon any premises and relating solely to any trade, business, or business transaction carried on, or proposed to be carried on, or any entertainment or meeting held or to be held, upon or in relation to the said premises or to any property thereon.

(.3) This Act shall not apply to or have any effect in the administrative county of London or in any [mJunicipal] borough.

The English law with regard to posters has undergone very little change. The Metropolitan Police Act 1839 (2 & 3 Vict. cap. 47) first put a stop to unauthorized posting, and the Indecent Advertisements Act of 1889 (section 3) penalized the public exposure of any picture or printed or written matter of an indecent or obscene nature. But in general practice there is hardly any limitation to the size or character of poster advertisements, other than good taste and public opinion. On the other hand, public opinion is a somewhat vague entity, and there have been cases in which a conflict has arisen as to what public opinion reaUy was, when its legally authorized exponent was in a position to insist on its own arbitrary definition. Such an instance occurred some few years ago in the case of a large poster issued by a well-known London music- hall. The Progressive majority on the London County Council, led by Mr M'Dougall, a well-known " purity " advocate, took exception to this poster, which represented a female gymnast in " tights " posed in what was doubtless intended for an alluring and attractive attitude ; and, in spite of any argument, the fact remained that the decision as to renewing the license of this music-hall rested solely with the Council. In showing that it would have no hesitation in provoking even a charge of meddling prudery, the Council probably gave a salutary warning to people who were inclined to sail rather too near the wind. But in Great Britain and America, at all events (though a doubt may perhaps exist as to some Continental countries), the advertiser and the artist are restrained, not only by their

own sense of propriety, but by fear of offending the sense of propriety in their customers.

Posters and placards in railway stations and upon pub- lic vehicles still embarrass the traveller who desires to find the name of a station or the destination of a vehicle. In respect of all these abuses it is a regrettable fact that unpopularity cannot be expected to deter the advertiser. If a name has once been fixed in the memory, it remains there long after the method of its impression has been forgotten, and the purpose of advertisements of the class under discussion is really no more than the fixing of a trade name in the mind. The average man or woman who goes into a shop to buy soap is more or less affected by a vague sense of antagonism toward the seller. There is a rudimentary feeling that even

the most ordinary transaction of purchase brings into contact two minds actuated by diametrically opposed interests. The pur- chaser, who is not asking for a soap he has used before, has some hazy suspicion that the shopkeeper will try to sell, not the article best worth the price, but the article which leaves the largest margin of profit ; and the pur- chaser imagines that he in some measure secures himself against a bad bargain when he exercises his authority by asking for some specific brand or make of the commodity he seeks. If he has seen any one soap so persistently advertised that his memory retains its name, he will ask for it, not because he has any reason to believe it to be better or cheaper than others, but simply because he baffles the shopkeeper, and assumes an authoritative attitude by exerting his own freedom of choice. This curious and obscure principle of action probably lies at the root of all poster advertising, for the poster does not set forth an argument as^does the newspaper advertise- ment. It hardly attempts to reason with the reader, but merely impresses a name upon his memory. It is possi- ble, by lavish advertising, to go so far in this direction that the trade-mark of a certain manufacturer becomes synonymous with the name of a commodity, so that when the consumer thinks of soap or asks for soap, his concept inevitably couples the maker's name with the word. " soap " itself. In order that the poster may leave any impression upon his mind, it must of course first attract his atten- tion. The assistance which the advertiser receives from the artist in this connexion is discussed in the article Posters.

The fact that the verb " to circularize " was first used in 1848, sufficiently indicates the very recent origin of

the practice of plying possible purchasers with Advertise- printed letters and pamphlets. The penny cinuiar. postage was not established in England until

1840 ; the halfpenny post for circulars was not introduced until 1855. In the United States a uniform rate of postage at two cents was not established until 1883. In both countries cheap postage and cheap printing have so greatly encouraged the use of circulars that the sort of people whom the advertiser desires to reach — those who have the most money to spend, and whose addresses, published in directories, indicate their prosperous condi- tion— are overwhelmed by tradesmen's price-lists, appeals from charitable institutions, and other suggestions for the spending of money. The addressing of envelopes and enclosing of circulars is now a recognized industry in many large towns both in Great Britain and in the United States. . It seems, however, to be the opinion of expert advertisers that what is called " general circularizing " is unprofitable, and that circulars should only be sent to per- sons who have peculiar reason to be interested by their specific subject-matter. It may be noted, as an instance of tl^e assiduity with which specialized circularizing is pursued, that the announcement of a birth, marriage, or

death in the newspapers serves to call forth a grotesque variety of circulars supposed to be adapted to the mo- mentary needs of the recipient.

In concluding this review of methods of advertising, other than advertisements in periodical publications, we may add that the most extraordinary attempt at adver- tisement which is known to exist is to be found at the churchyard at Godalming, Surrey, where the following epitaph was placed upon a tombstone : —

Sacred

To the memory of

Nathaniel Godbold Esq.

Inventor & Proprietor

of that excellent medicine

The Vegetable Balsam

For the Cure of Consumptions & Asthmas.

He departed this Life

The 17th. day of Deer. 1799

Aged 69 years. Hio Cineres, ubique Fama.

The preparation of advertisements for the periodical press has within the last twenty years or so become so important a task that a great number of writers and artists — many of the latter possessing con- Jsingin siderable abilities — gain a livelihood from this periodical pursuit. The ingenuity displayed in modern p^biica- newspaper advertising is unquestionably due to American initiative. The English newspaper advertise- ment of twenty years ago consisted for the most part of the mere reiteration of a name. An advertiser who took a column's space, supplied enough matter to fill an- inch, and ingenuously repeated his statement throughout the column. Such departures from this childlike method as were made were for the most part eccentric to the point of incoherence. It may, however, be said in defence of English advertisers, that newspaper publishers for a long time sternly discountenanced any attempt to render advertisements attractive. So long as an advertiser was rigidly confined to the ordinary single-column measure, and so long as he was forbidden to use anything but the smallest sort of type, there was very little opportunity for him to attract the reader's attention. The newspaper publisher must always remember that the public buy a newspaper for the sake of the news, not for the sake of the advertisements, and that if the advertisements are relegated to a position and a scope, in respect of display, so inferior that they may be overlooked, the advertiser cannot afford to bear his share of the cost of publication. Of late The Times, followed by almost all newspapers in the United Kingdom, has given the advertiser as great a degree of liberty as he really needs, and many experienced advertisers in America incline to the belief that the larger license accorded to American advertisers defeats its own ends. The truth would seem to be that the advertiser will always demand, and may fairly expect, the right to make his space as fantastic in appearance as that allotted to the editor. When some American editors see fit to print a headline in letters as large as a man's hand, and to begin half-a-dozen different articles on the first page of a newspaper, continuing one on page 2, another on page 4, and another on page 6, to the bewilderment of the reader, it can hardly be expected that the American advertiser should submit to any very strict code of decorum. The subject of the relation between a newspaper proprietor and his advertisers cannot be dismissed without reference to the notable independence of advertisers' influence, which English and American newspaper proprietors au- thorize their editors to display. Whenever an insurance company or a bank goes wrong, the cry is raised that all the editors in Christendom had known for years that the directors were imbeciles and rogues, but had conspired to

keep mute for the sake of an occasional advertisement. Wlien the British public persisted, not long ago, in paying premium prices for the shares of over-capitalized com- panies, the crash had no sooner come than the newspapers were accused of having puffed promotions for the sake of the money received for publishing prospectuses. As a matter of fact, in the case of the best dailies in England

and America, the editor does not stand at all in awe of the advertiser, and time after time the Money Article has ruthlessly attacked a promotion of which the prospectus appeared in the very same issue. It is indeed to the interest of the advertiser, as well as to the interest of the reader, that this independence should be preserved, for the worth of any journal as an advertising medium depends upon its possessing a bond-Jide circulation among persons who believe it to be a serious and honestly- conducted newspaper. All advertisers know that the minor weeklies, which contain nothing but trade puffs, and are scattered broadcast among people who pay nothing for their copies, are absolutely worthless from the adver- tiser's point of view. The most striking difference between the periodical press of Great Britain and that of America is, that in the former country the magazines and reviews play but a secondary role, while in the United States the three or four monthlies possessing the largest circulation are of the very first importance as advertising mediums. One reason for this is that the advertisements in an American magazine are printed on as good paper, and printed with as great care, as any other part of the contents. There are probably very few &,mong American magazine readers who do not habitually look through the advertising pages, with the certainty that they wiU be entertained by the beauty of the advertiser's illustrations and the quaint curtness of his phrases. Another reason is that the American monthly magazine goes to all parts of the United States, while, owing to the time required for long journeys on even the swiftest trains, no American daily paper can have so general a circulation as The Times in the United Kingdom. In comparison with points on the Pacific coast, Chicago does not seem far from New York, yet, with the exception of one frenzied and altogether unsuccessful attempt, no New York daily has ever attemp- ted to force a circulation in Chicago. The American advertiser would, therefore, have to spend money on a great number of daily papers in order to reach as wide- spread a public as one successful magazine offers him.

There is reason to believe that the English magazine publishers have erred gravely in taking what are known in the trade as " insets," consisting of separate cards or sheets printed at the advertiser's cost, and accepted by the publisher at a specific charge for every thousand copies. This system of insetting has the grave inconven- ience that the advertiser finds himself compelled to print as many insets as the publisher asserts that he can use. The publisher, on the other hand, is somewhat at the mercy of too enthusiastic agents and employes, who estimate over-confidently the edition of the periodical which will probably be printed for a certain month, and advertisers have had reason to fear that many of their insets were wasted. The added weight and bulk of the insets cause inconvenience and expense to the newsdealer, as two or three insets printed upon cardboard are equivalent to at least sixteen additional pages. Some newsdealers have further complicated the inset question by threatening to remove insets unless special tribute be paid to them ; and with all these difficulties to be consid- ered, many magazine publishers have seriously considered the advisability of altogether discontinuing the practice of taking insets, and of confining their advertisements to the sheets they themselves print. In connexion with this subject, it may be added that many readers habit-

ually shake loose bills out of a magazine before they begin to turn the pages, and that railway stations, railway carriages, and even public streets, are thus littered with trampled and muddy advertisements. The old practice of distributing handbills in the streets is dying a natural death, more or less hastened by local bye-laws, and when the loose bills in magazines and cheap novels have ceased to exist no one will be the loser.

Advertisements in the weekly press are on the whole more successful in England than in America. A few American weeklies cope successfully with the increasing competition of the huge Sunday editions of American daily papers. But even the most successful among them — a paper for boys — ^has hardly attained the prosperity of some among its English contemporaries in the field of weekly journalism.

The merchant who turns to these pages for practical suggestions concerning the advertising of his own busi- ness, can be given no better advice than to betake himself to an established advertising agent of good repute, and be guided by his counsels. The chief part that he can himself play with advantage is to note from day to day whether the agent is obtaining advantageous positions for his announcements. Every advertiser will naturally prefer a right-hand page to a left-hand page, and the right side of the page to the left side of the page ; while the advertiser who most indefatigably urges his claims upon the agent will, in the long run, obtain the largest share of the favours to be distributed. To the merchant who inclines to consider advertising in connexion with the broader aspects of his calling, it may be suggested that a new channel of trade demands very serious attention. What is called in England ” postal trade,” and in America ” mail order business,” is growing very rapidly. Small dealers in both countries have complained very bitterly of the competition they suffer from the general dealers and from stores made up of departments which, under one roof, offer to the consumer every imaginable sort of merchandise. This general trading, which, on the one hand, seriously threatens the small trader, and on the other hand offers greater possibilities of profit to the proportionately small number of persons who can under- take business on so large a scale, becomes infinitely more formidable when the general dealer endeavours not only to attract the trade of a town, but to make his place of business a centre from which he distributes by post his goods to remote parts of the country. In America, where the weight of parcels carried by post is limited to four pounds, and where the private carrying companies are forced to charge a very much higher rate for carriage from New York to California than for shorter distances, the centralization of trade is necessarily limited; but it is no secret that, at the present moment, persons residing in those parts of the United Kingdom most remote from London habitually avail themselves of the English parcel post, which carries packages up to eleven pounds, in order to procure a great part of their household supplies direct from general dealers in London. A trading company, which conducts its operations upon such a scale as this, can afford to spend an almost unlimited sum in adver- tising throughout the United Kingdom, and even the trader who offers only one specific class of merchandise is beginning to recognize the possibility of appealing to the whole country.

With regard to the literature of advertising, it need only be added that, in addition to the historical article in the Edinburgh Review for February 1843, already men- tioned, and that in the Quarterly Review for June 1855, the advertisers’ handbooks, issued by the leading adver- tising agents, will be found to contain practical information of great use to the advertiser. (h. k. h.*)

Adye, Sir John Miller (1819-1900), British gen- eral and colonel commandant royal artillery, son of Major James P. Adye, royal artillery, was born at Sevenoaks, Kent, on the 1st of November 1819. He entered the royal artillery in 1836, was promoted captain in 1846, and served ‘ throughout the Crimean War of 1854-66, as brigade- major and assistant adjutant-general of artillery (medal with four clasps, Turkish medalj third class of the Legion of Honour, fourth class of the Medjidie, C.B., and brevets of major and lieut.~~colonel). In the Indian Mutiny he served on the staff in a Similar capacity (medal). Pro~~ moted brevet-colonel in 1860, he was specially employed in 1863 in the N.W. frontier of India campaign (medal with clasp), and was deputy adjutant-general, , Bengal, from 1863 to 1866, when he returned home. Prom 1870 to 1875 Adye was director of artillery and stores at the War Office, where his influence was used to prevent the introduction of breech-loading ordnance. He was made a K.C.B. in 1873, havipg taken an active part in Mr Card- well’s army reform. ‘ He was promoted to be major-gen- eral and appointed governor of the Eoyal – Military Academy at Woolwich in 1875, and surveyor-general of the ordnance in 1880. In 1882 he was chief of the staff and second in command of the expedition to Egypt, and served throughout the campaign (medal with

clasp, bronze star, second class of the Medjidie, G.C.B., and thanks of Parliament). He held the government of Gibraltar from 1883 to 1886. Promoted lieut.~~general in 1879, and gen~~ eral-and colonel commandant of royal artillery in 1884, he, retired in 1886. He unsuccessfully contested the Parliamentary representation of Bath in the Liberal in- terest in 1892. He died on 26th August 1900, when on a visit to Lord Armstrong in Northumberland. He was the author of A Review of- the Crimean War; Tlie Defence ofOawnpore; A Frontier Campaign in Afghanistan ; Recol- lections of a Military Life; and Indian Frontier Policy.

(e. h. v.)

/Egades, or Mgai^s, in Italian Egadi, a group of islands lying W. of Sicily and belonging to the prov. of Trapani, the largest being Marittimo, the ancient Hiera, rising to 2244 feet in Mount Falcone ; Levanzo, the ancient Phorhantia, rising to 951 feet; and Pavignana, the ancient ^gusa; altitude, 1070 feet ; area of all, 70 square miles. Total population (1901), 6419. They carry on tunny and sponge fishing. Marittimo has a state prison, and produces honey and capers. Chief town and port, Favignana ; cleared annually, by some 400 vessels of about 100,000 tons. Population (1901), 6001.

Aeltre, a town of Belgium, in the province of East Flanders, 12 miles W. by N. of Ghent by rail, near the Ghent and Bruges caaaJ. Its traide is mainly in linen and wood. Population (1900), 6261 ; communal (1880),

7020; (1897), 7174.

Aeronautics. — ^Notwithstanding the prejudice con- sequent on past failures and upon premature assertion of impending success, the advance in aeronautics since the publication of the ninth edition of this work has been greater and more rapid than at any time in history. This advance has consisted in : — (1) The evolution of light motors ; (2) the elucidation of natural laws ; (3) many partially successful experiments. Electric, steam, gas, or petroleum engines have been reduced to a fraction of their former weights, formerly-accepted data for compu- tations have been quite superseded, and numerous experi- ments have been made.

Few scientific men have imitated Mr Glaisher in mak-

ing high ascents for meteorological observations.

a oons. g^^gj^ Croc^-Spinelli, and Tissandier, who

reacted 27,960 feet on 16th April 1875, were asphyxiated.

and only Tissandier came down alive. This put a stop to such attempts for a time ; but Gross and Berson attained 25,840 feet on 11th May 1894, Berson reached 29,740 feet on 4th December 1894, recording a temperature of -54° F., and Berson and Spencer are stated by the latter to have attained 27,600 feet on 16th September 1898, the thermometer registering ~~29° F. The personal danger attending such ascents led Hermite and Besanqon to in~~ augurate in November 1892 the sending up of unmounted balloons (Ballons Sondes), equipped with automatic re- cording instruments (see Meteorology); On 11th July 1897, Andree, Strindberg, and Frankel ascended from Spitzbergen in a daring attempt to reach the North Pole by balloon. One carrier pigeon, apparently liberated forty- eight hours after the start, was shot, and two floating buoys with messages were found ; but nothing more has been heard of the explorers.

From the very first invention of balloons the problem has been how to navigate them by propulsion. General Meusnier proposed an elongated balloon in 1784. It was experimented on by Eobert

Brothers, who made two as- censions and claimed to have obtained a deviation of 22° from the direction of a light wind by means of aerial oars worked by hand. The relative speed was probably about 3 miles an hour, and it was so evident that a very much more energetic light motor than any then known was required to stem ordinary winds that nothing more was attempted till 1862, when Giffard ascended with a steam- engine of then unprecedented lightness. The subjoined table exhibits the subsequent progress which has been made : —

Experiments

with Dirigible Balloons.

Year.

Inventor.

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o .

H.-P.

Ft.

Ft.

Cub. ft.

lb.

lb.

Jb,

Miles,

1852

Giffard

144

89

88,800

8,978

2,794

462

8-0

6-71

1872

Be L6me .

118

49

120,088

8,858

4,728

2000

0-8

6-26

1884

Tissandier .

92

80

87,439

2,728

933

616

1-5

7-82

1885

ilenard and

Krebs Wolfert .

165

27

65,886

4,402

2,449

1174

9-0

14-00

1897

92

28

.,

8-0

1897

Schwarz

157

(46) 189

180,500

8,138

6,800

800?

16-0

17-00

1900

Zeppelin’’ .

420

89

400,000

25,000

19,000

1500

82-0

18-00

Giffard, the future inventor of the injector, devised a steam-engine weighing, -with fuel and water for one hour, 154 lb per horse-power, and was laold enough to employ it in proximity to a balloon inflated with coal gas. He was not able to stem a medium wind, but attained some deviation. He repeated the experiment in 1855 with a more elongated spindle, which proved unstable and dangerous. During the siege of Paris the Government decided to build a navigable balloon, and entrusted the work to the chief naval con- structor, Dupuy de L6me. He went into the subject very carefully, made estimates of all the strains, resistances, and speeds, and tested the balloon in 1872. Deviations of 12° were obtained from the course of a wind blowing 27 to 37 miles per hour. The screw propeller was driven by eight labourers, a steam-engine being deemed too dangerous ; but it was estimated that had one been used, weighing as much as the men, the speed would have been doubled. Tissandier and his brother applied an electric motor, lighter than any previously built, to a spindle-shaped bMloon, and went up twice in 1883 and 1884. On the latter occasion he stemmed a wind of 7 miles per hour. The brothers abandoned these experiments, which had been carried on at their own expense, when the Prench War Department took up the problem. Eenard and Krebs, the officers in charge of the War Aeronautical Department at Meudon, built and experimented with in 1884 and 1885 the fusiform balloon “La France,” in which the “master” or maximum section Was about one-quarter of the distance from the stem. The propelling screw was at the front of the car and driven by an electric motor of unprecedented lightness. Seven ascents were made on very calm days, a maximum speed of 14 miles an hour was obtained, and the balloon returned to its starting-point on five of the seven occasions. Since then another balloon has been constructed, said to be capable of a speed of 22 to 28 miles per hour, with a different motor ; but no tests are known to the public and the secrets of this war engine

MiLTiPLE-wixG Gliding Machine.

Chanute’s Gliding Machine.

Lanoley’s Aerodrome.

r*”’”’-”

Zeppelin’s Airship in Flight.

Zeppelin’s Airship in its Shed. {From Photographs by F. Schujarzenlmch, KreuzHngen^ Switzerland.)

are carefully guarded. After many years of experiment Dr “Wolf ert bmlt and experimented witli in Berlin, in 1897, a cigar-shaped balloon driven by a gasoline motor. An explosion took place in the air, the balloon fell, and Dr Wolfert and his assistant were killed. It ~~was also in 1897 that an aluminium balloon was built froni the designs of D. Schwarz (then deceased) and tested in Berlin. It was driven by a Daimler benzine motor, and attained a greater speed than ” La I’ranoe ” ; but a driving belt slipped ofi its pulley, and in coming down the balloon was injured beyond repair. From 1897 to 1900 Count Zeppelin, of the German army, was engaged in constructing an immense balloon, truly an air ship, of most careful and most intelligent design, to carry five men. It was first tested in June 1900, when it attained a speed of 18 miles an hour and travelled a distance of 3J miles before an accident to the Bteermg gear necessitated the discontinuance of the experiment. In 1901 M. Santos Dumont carried out some more or less success~~ ful experiments with a dirigible balloon in Paris.

Tlie principles wliich govern the design of the dirigible balloon may be said to have been evolved. As the lifting power grows as the cube of the dimensions, and the resistance approximately as the square, the advantage lies with the larger sizes of balloons, as of ocean steamers, up to the limits within which they may be found practicable. Count Zeppelin may have reached the limit as to practicable size. He has gained an advantage by attaching his pro- pellers to the balloon, instead of to the car as heretofore; but this requires a rigid framework and a great increase of weight. ‘ Le Compagnon endeavoured, in 1892, to substi- tute flapping wings for rotary propellers, as the former can be suspended nearer the centre of resistance. Danilewsky followed him in 1898 and 1899, but thus far without remarkable results. Dupuy de L5me was the first to estimate in detail the resistances to balloon propulsion, but experiment showed that in the aggregate they were greater than he calculated. Eenard and Krebs also found that their computed resistances were largely exceeded, and after revising the results they gave the formula R=0-01685 IFV^, E being the resistance in kilograms, D the diameter in metres, and V the velocity in metres per second. Reduced to British measures, in pounds, feet, and miles per hour, E= 0-0006876 D^% which is somewhat in excess of the formtda computed by Dr Pole from De Lome’s experiments. The above coefficient applies only to the shape. and riggiug of the balloon “La France,” and combines all resistances into one equivalent, which is equal to that of a flat plane 18 per cent, of the ” master section.” This coefficient may perhaps hereafter be rediiced by one- half through a better form of hull and car, more like a fish than a spindle, by dimLnished sections of suspension lines and net, and by placing the propeller at the centre of resistance. To compute the results to be expected from new projects, it will be preferable to estimate the resist- ances in detail. The following table shows how this was done by De L6me, and the probable corrections which should have been made by him : —

Resistances — De Ldm^s Balloon.

Oompated by De Ldme. V =

2-22 m. per sec.

More Probable Values. V = 2-82 m. per see.

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Hull, with-

172-96

1/30

0-665

3-830

1/15

0-875

10-091

out net.

Car .

3-25

1/5

1

0-432

1/5

0-569

Men’s bodies

3-00

1/5

•i

0-400

1/2

1-312

Gas tubes .

6-40

1/5

)

0-850

1/2

2-750

Small cords

10-00

1/2

J

3-325

1/2

4-375

Large cords

9-90

1/3

11

2-194

i/s

2-887

11.031

21-984

When the resistances have been reduced to the lowest possible minimum by careful design, the attainable speed wUl depend upon the efficiency of the propeller and the relative lightness of the motor. It seems not unlikely that 30 miles per hour can be attained in the near future, but the commercial uses will be small, as the balloons must remain housed when the wind aloft is brisk. The sizes wUl be great and costly, the loads small, and the craft frail and short-lived, yet dirigible balloons constitute the proper type for Governments to evolve, until they are superseded by efficient flying machines.

While the flying machine is still inferior to the balloon in performance and safety, it has made more progress since 1888 than during the preceding three centuries. Investigation has turned from flapping wings and ^^Atoes. from sustaining screws to the aeroplane type, and encouragiug results have been obtained not only with models but with full-sized machines. The flights have been very short and hazardous, but the speeds have been much greater than with balloons. The danger involved in the

proximity of fire to gas being absent, Maxim, Langley, Ader, and others have produced steam itnotors weighing 10 lb or less per horse-power. This, it is true, is exclusive of fuel and water, and the engines work nearly to the limits of endurance ; but the automobile industry is developing gasoline motors which are nearly as light, and these may prove better adapted to aerial propulsion. Knowledge has been greatly increased as to the laws of flight. Professor Marey has furnished new data concerning bird locomotion, and Professor Langley has elucidated the problem of air < reactions on oblique planes. Physicists still computed, down to 1891, the normal pressures upon oblique planes as varying in the ratio of the square of the sine of the angle of incidence or, at best, in the ratio of the sine of that angle. Langley showed, by extensive experiments, that this normal had nearly twice the assigned value, and that Duchemin's empirical formula

N = P

2sina H-sin^o

which was proposed about 1838 but not adopted, was approximately correct for oblique planes. More than this, Lilienthal showed, about the same time, that concave bird- like surfaces afforded from three to seven times as much support as planes at acute angles of incidence, and gave also a small propelling component, so that former views and modes of calculating the surfaces and power required for

Principal Experiments

with

Flying Machines.

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Inventor.

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Motor.

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Ft.

Sq.ft.

lb.

Mis

Ft.

1879

Tatin.

6-2

7-5

8-85

0-61

18

100?

Com- pressed air .

0-03

110?

1R8S

1 Harerave f (N0.I6) Phillips

B-.5

260

5-00

0-19

10

848

0-06

79

IRR9

189.S

22-0

1S6-0

402-00

8-00

28

500?

Steam

5-6

72?

1894

Maxim* .

.-iD-n

4000-0

8000-00

2-00

86

H(MI?

”

863-00

28

1896

Langley

12-0

70-0

30-00

0-48

24

4000

M

1-00

80

189T

Tatin and Eiohet

21-0

86-0

72-00

0-8S

40

460

”

1-88

55

1897

Ader*

49-0

270-0

1100-00

4-00

50?

100?

»

40-00

27

1895

Lilienthal*

2»-n

151-0

220-00

1-46

28

1200

Gravity

2-00

no

ISSfi

Pilcher* .

28-0

170-0

200-00 1-17

25

900

”

2-00

100

1896

Chanute * ‘

16-0

185-0

178-00 1-81

22

860

2-00

89

flight have been quite revolutionized. Experiments have therefore been more intelligent and more successful than

1 The pounds sustained per horse-power in the last three experiments will probably be reduced one-half when an artificial motor is substituted for gravity.

ever before. It can no longer be said that men have] but this was still very good. The equilibrium was defeo- never flown through the air. The preceding table (p. 101) tive and greatly shortened the possible flights. A score

of different models have been produced by Hargrave, of New South Wales, since 1885. His No. 16 has been selected for the table given. It consisted in a body plane of kite shape, propelled by a pair of flapping vanes at the front (Figs. 1, 2, 3). Hargrave built a number of steam-engines weighing about 10 ft per h.p., but found such difficulties that he turned his attention to oil motors. He ad- vocates large surfaces and low speeds, and hopes to maintain those proportions by suspending a motor and

propellers from a tandem team of the “Cellular Kites” which he has invented, “and with which he has been lifted from the ground. The apparatus of Phillips resembles a Venetian blind. The slats are of wood, convex on the upper sur-; face and concave beneath. The lift is apparently very good, but the stability is defective. After many pre- liminary experiments on air reactions, Maxim tested, in 1894, a very large flying machine, a marvel of ingenuity and mechanical skill, carrying three men. It consisted in a combination of superimposed aeroplanes, driven by two screw propellers, which were rotated by a compound steam- engine of 363 h.p., weighing with its adjuncts some 10 ft per h.p. The apparatus gathered speed on a railway track, and demonstrated that it could lift much more than its own weight ; but the pounds sustained per h.p. were less than was expected, probably by reason of head resist- ance caused by many guy wires, and the stability was inadequate. After publishing his Experiments in Aerody- namics in 1891, Langley produced in 1896 a steam-driven flying model, with which he obtained the longest flights

Fig. 1. — General appearance of Hargrare^s flying machine. (From EngiiMwring,’)

exhibits the more important performances, and attention is called to the columns of pounds imposed per square

Fis. 2,— Engine for Harg^rave’s Sying macUne. (From Stigine&rvri’g.)

foot, to the resulting speed required for support, and to the pounds sustained per horse-power (the apparatus marked thus * carried a man or men).

The first aeroplane of Tatin (1879) consisted of a pair of flat wings and a tail, trac- tion being obtained from two screw propellers at the front. The horse-power was arrived at by allowing 26 to 30 per cent, of that shown by the indicator for the compressed air. When Tatin and Richet ^ _

substituted steam in 1897 **^-;.’=#

they only sustained about half as many pounds per h.p. ;

Fig. 8. — Another type of engine for Hargrave’s flying machine. (lYom EiiginMring.)

ever known. The apparatus consisted of two pairs of wings and a tail, with two screw propellers, driven by a high pressure steam-engine of 1 h.p. weighing but 7 ft. The longest flight was over \ of a mile, and the apparatus alighted safely on each of the three flights, made. The lift per horse-power was low, for a variety of reasons, but the stability was good. After having tested, in 1872 and in 1891, two full-sized flying machines, producing indifferent results, Ader built, in 1897, a third apparatus with funds furnished by the French Government. This re;produced the structure of a bird with almost servile imitation, save that traction was obtained by two screw pro-

Santos-Dumont’s Balloon in Flight.

{From a Photograph by J. Giletta, Nice.)

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ii ‘- ‘4’’ ‘■ –

W- a ‘*•

M- klip’

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^Sk

■K^^ ^^^*y ^ ^H

^B|iPi

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bk^^

B^^B^BBBIj^^^A^‘Jr! ‘i ‘^ F^

fffrtilrf T’^MT- Mi B

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^^^Kii^S£s!^^i3^;L’ffi&^ .^HHJ

MHi;’ ::^lfeL-_.. 1

Santos-Dumont’s Balloon, Rear Yiew, showing Rudder and Propeller.

{From a Photograph by Otto Barea, Paris.)

AEEONAUTICS

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pellers (Figs. 4, 5). The steam-engines weighed about 7 ft per h.p., but the equilibrium of the apparatus was defec- tive. To Lilienthal belongs the double credit of demon- strating the superiority

of arched surfaces over planes, and_ of reducing gliding flight to regular practice. He made over 2000 glides safely, using gravity as a motive- power, with various forms of apparatus, consisting of concave bat-like wings, in some cases superimposed. It

Fio. 4.— Ader's " Avion " In position for flight. (From Tht SdenUJle American.)

was with a machine of the latter type that he was upset by a sudden gust of wind and killed in 1896. Pilcher improved somewhat upon Lilienthal's apparatus, but used the same general method of restoring the baJance, .when endangered, by shifting the weight of the operator's body. He made several hundred glides in safety, until he too was upset by a gust of wind and killed in 1899. Chanute confined his endeavours exclusively to the evolution of automatic stability, and made the surfaces mov- able instead of the man. He obtained over 1000 glides without accident with two different types of appa- ratus. The last three experimenters have claimed that it is not impossible for man to imitate the soaring flight of certain birds, wherein support and propulsion are obtained from the wind alone under certain favour- able conditions.

The very first essential for success is safety, which will probably only be attained with automatic stability, and the foregoing account indicates that it is for lack of this that all the experiments have shown such slight success. Safety and stability are therefore to be sought first. The underlying principle is that the centre of gravity shall at all times be on the same vertical line as the centre of pressure. The latter varies with the angle of inci- dence. For square planes it moves approximately, as expressed by Joessel's for- mula: C = (0-2 ₹ 0-3 sin a)L, in which C is the distance from the front edge, L the length fore and aft, and a the angle of incidence. The movement is different on concave surfaces, but has not been formulated. The term Aeroplane is under- stood to apply to flat sus- taining surfaces, but experi- ment indicates that arched surfaces are more efficient. Langley has proposed the word Aerodrome, which seems the preferable term for apparatus with wing-like surfaces.

their propellers, shafting, supplies, &c., weighing less than 20 ft per h.p. The problem, then, is how they should be designed. The knowledge evolved within the last few years has at last made it practicable to give some data for calculating the effects to be expected, with some confidence that they will not be far wrong. It is evident that an apparatus must be designed to be as light as possible, and also to reduce to a minimum all resistances to • propulsion. This being kept in view, the strength and consequent section required for each member may be calculated by the methods employed in proportioning bridges, with the difference that the support (from air pressure) will be considered as uniformly distributed, and the load as con- centrated at One or more poiats. Smaller factors of safety may also have to be used. Knowing the sections required and unit weights of the materials to be employed, the weight of each part can be computed. If a model has been made to absolutely exact scale, the weight of the full-sized apparatus may approximately be ascertained by fhe formula

W

-Afiir

in which W is the weight of the model, S its surface, and W and S' the weight and surface of the intended apparatus. Thus if the model has been made one-quarter size in its homologous dimensions, the supporting surfaces will be sixteen times, and the total weight sixty-four times, those of the model. The weight and the surface being determined, the three most important things to know are the angle of incidence, the "lift," apd the

Fio. 6. — Ader's " Avion " with the wings folded. (From The ScienUfle Ameriocm.)

This type is the one which results poiat to as the proper type for further experiments. With this it seems prob- abl« that, with well-designed apparatus, 40 to 60 ft can be sustained per indicated h.p., or about twice that quantity per resistance or “thrust” h.p., and that some 30 or 40 per cent, of the weight can be devoted to the machinery, thus requiring motors, with

required speed. The fundamental formula for rectangular air pressure is well known: P=KV^S, in which P is the rectangular normal pressure, in pounds or kilograms, K a coefficient, (0-0049 for British, and 0-11 for metric measures), V the velocity in miles per hour or in metres per second, and S the surface in square feet or in square metres. The normal on oblique surfaces, at various angles of incidence, is given by the formula ‘P=‘KY^Sri, which

latter factor is given both for planes and for arched surfaces in the subjoined table : —

Percentages of Air Pressure at Various Angles of Incidence.

Planes : Ditchemin Formula.

T.T T 1

Wings : Lilienthal.

N p 2sina

1

Concavity 1 in 12.

Angle.

Normal.

Lift.

Drift.

Normal.

Lift.

Drift.

Tan- gential

a

1

TjcOBa

i^Blna

1

IJCOSd

ijsina

force.

a.

-9°

0-0

0-0

0-0

+0-070

-8°

0-040

0-0396

-0-0055

+ 0-067

-7°

0-080

0-0741

-0-0097

+0-064

-6°

0-120

0-1193

-0-0125

+0-060

-5°

0-160

0-1594

-0-0139

+0-055

-4°

0-200

0-1995

-0-0139

+0-049

-3°

0-242

0-2416

-0-0126

+0-043

-2°

0-286

0-2858

-0-0100

+0-037

-1°

0-332

0-3318

-0-0058

+0-031

0°

0-0

0-0

0-0

0-381

0-3810

-0-0

+0-024

+ 1°

0-035

0-035

0-000611

0-434

0-434

+ 0-0075

+0-016 ,

+2°

0-070

0-070

0-00244

0-489

0-489

+0-0170

+0-008

+S°

0-104

0-104

0-00543

0-546

0-545

+0-0285

00

+4°

0-139

0-139

0-0097

0-600

0-597

+0-0418

-0-007

+ 5″

0-174

0-173

0-0152

0-650

0-647

+0-0566

-0-014

+6°

0-207

0-206

0-0217

0-696

0-692

+ 0-0727

-0-021

+ 7″

0-240

0-238

0-0293

0-737

0-731

+0-0898

-0-028

+8°

0-273

0-270

0-0381

0-771

0-763

+0-1072

-0-035

+ 9°

0-305

0-300

0-0477

0-800

0-790

+0-1251

-0042

10°

0’-337

0-332

0-0585

0-825

0-812

+0-1432

-0-050

11°

0-369

0-362

0-0702

0-846

0-830

+0-1614

-0-058

12°

0-398

0-390

0-0828

0-864

0-845

+0-1803

-0-064

‘ 13°

0-431

0-419

0-0971

0-879

0-856

+ 0-1976

-0-070

14°

0-457

0-443

0-1155

0-891

0-864

+0-2156

-0-074

15°

0-486

0-468

0-1240

0-901

0-870

+ 0-2332

-0-076

The sustaining power, or “lift,” which in horizontal flight must, be equal to the weight, can be calculated by the formula : L = KV^Sijcosa, or the factor may be taken direct from the table, in which the ” lift ” and the ” drift ” have been obtained by multiplying the normal rj by the cosine and sine of the angle. The last column shows the tangential pressure on concave surfaces which Lilienthal found to possess a propelling component be- tween 3° and 32°, and therefore to be negative to the relative wind. Former modes of computation indicated angles of 10° to 15° as necessary for support with planes. These were prohibitory in consequence of the great “drift”; but the present data indicate that, with concave surfaces, angles of 2° to 6° will produce adequate ” lift.” To compute the latter the angle at which the wings are to be set must first be assumed, and that of +- 3° will gen- erally be found preferable. Then the required velocity is next to be computed by the formula :

4

or for concave wings at + 3° ;

KSiJCOSa

\0^

w

I-545KS

Having thus determined the weight, the surface, the angle of incidence, and the required speed for horizontal support, the next step is to calculate the power required. This is best accomplished by first obtaining the total resistances, which consist of the ” drift ” and of the head resistances due to the hull and framing. The latter are arrived at preferably by making a tabular statement similar to that shown under the head of balloons, sh6wing all the spars and parts offering head resistance, and apply- ing to each the coefficient appropriate to its “master section,” as ascertained by experiment. Thus is obtained an ” equivalent area ” of resistance, which is to be multi- plied Ijy the wind pressure due to the speed. Care must

be taken to resolve all the resistances at their proper angle of application, and to subtract or add the tangential force, which consists in the surface S, multiplied by the wind pressure, and by the factor in the table, jvhich is, however, 0 for 3° and 32°, but positive or negative at other angles. When the aggregate resistances are known, the ” thrust h.p.” required is obtained by multiplying the resistance by the speed, and then allowing for mechanical losses in the motor and propeller, which losses will gener- ally be 50 per cent, of indicated h.p. Close approximations are obtained by the above method when applied to full- sized apparatus. The following example will make the pro- cess clearer. The weight to be carried by an apparatus was 189 ft) on concave wings of 143-5 sq. ft. area, set at a positive angle of 3°. There were in addition rear wings of 29-6 sq. ft., set at a negative angle of 3°, carrying no weight ; hence L = 189 = 0-005 x V^ X 143-5 x 0-645.

Whence V

= \o^

189

.,„r , .„ , ,^ ,,, = 22 miles per hour, at ■005 X 143-5 X 0-545 ‘^ ‘

which the air pressure would be 2-42 ft) per sq.

ft.

The area of spars and man was 17-86 sq. ft., reduced by various coefficients to an ” equivalent surface ” of 11-70 sq. ft., so that the resistances were: —

Drift front wings, 143-5 x 0-0285 x 2-42 . , , rear wings, 29 -5 x (0 -043 – 0 -242 x 0 -0523)

X2-42

Tangential force at 3°

Head resistance, 11-70 X 2-42 ....

Total resistance ,

Speed 22 miles per hour.

=9-90 lb.

=2-17 „

=0-00 „

=28-31 „

=40-38 R>.

Power =^°:^^= 2-36 h.p. for

375

the “thrust” or 4-72 h.p. for the motor, being 189 lb, and the resistance 40-38 lb.

The weight the gliding

angle of descent was

, 40-38 .

189

: tangent of 12°, which was

verified by many experiments.

The following expressions, some of which have been given in the text, will be found useful in computing such project’s, with. the aid of the table above given: —

Wind force, r=KV2 Pressure, P=KV2S.

3. Velocity, V

VW KStjcoi

KStjcoso

4. Surface S varies as ™-

5. Normal, N=KSV2i7.

6. Lift, L=KSV2,,cosa.

7. Weight, W=L=Neoso.

8. Drift, D=KSV2),sino.

9. Head area E, get an equiva- lent.

10. Head resistance, H=EF.

11. Tangential force, T=Po.

12. Resistance, R = D+H±T.

13. Ft. it), M=RV. TJV

14. Thrust, h.p.,=j^^.

(O. c.)

^Ether. — In the mechanical processes which we can experimentally modify at will, and which therefore we learn to apprehend with greatest fulness, whenever an effect on a body B is in causal connexion with a process instituted in another body A, it is usually possible to discover a mechanical connexion between the two bodies which allows the influence of A to be traced all the way, across the intervening region. The question thus arises whether, in electric attractions across apparently empty space and in gravitational attr.action across the celestial regions, we are invited or required to make search for some similar method of continuous transmission of the physical effect, or whether we should rest content with an exact knowledge of the laws according to which one body affects mechanically another body at a distance. The view that our knowledge in such cases may be com- pletely represented by means of laws of action at a dis- tance, expressible in terms of the positions (and possibly motions) of the interacting bodies without taking any heed of the intervening space, belongs to modern times. It could hardly have been thought of before Sir Isaac

Newton’s discovery of the actual facts regarding universal gravitation. Although, however, gravitation has formed the most perfect instance of an influence completely ex- pressible, up to the most extreme refinement of accuracy, in terms of laws of direct action across space, yet, as is well known, the author of this ideally simple and perfect theory held the view that it is not possible to conceive of direct mechanical action independent of means of trans- mission. In this belief he differed from his pupil Cotes, and from most of the great mathematical astronomers of the 18th century, who worked out in detail the task sketched by the genius of Newton. They were content with a knowledge of the truth of the principle of gravita- tion; instead of essaying to explain it further by the properties of a transmitting medium, they in fact modelled the whole of their natural philosophy

on that principle, and tried to express all kinds of material interaction in terms of laws of direct mechanical attraction across space. If material systems are constituted of discrete atoms, separated from each other by many times the diameter of any of them, this simple plan' of exhibiting their inter- actions in terms of direct forces between them would indeed be exact enough to apply to a wide range of questions, provided we could be certain that the laws of the forces depended only on the positions and not also on the motions of the atoms. The most important example of its successful application has been the theory of capillary action elaborated by Laplace ; though even here it appeared, in the hands of Young, and in complete fulness afterwards in those of Gauss, that the definite results attainable by the hypothesis of mutual atomic attractions really reposed on much wider and less special principles — those, namely, connected with the modern doctrine of energy.

Idea of an \^ther. — The wider view, according to which the hypothesis of direct transmission of physical influ- ences expresses only part of the facts, is that all space is filled with physical activity, and that while an influence is passing across from a body A to another body B, there is some dynamical process in action in the intervening region, though it appears to the senses to be mere empty space. The question is whether we can represent the facts more simply by supposing the intervening space to be occupied by a medium which transmits physical actions after the manner that a continuous material medium, solid or liquid, transmits mechanical disturbance. Various analogies of this sort are open to us : for example, the way in which a fluid ijaedium transmits pressure from one immersed solid to another — or from one vortex ring be- longing to the fluid to another, which is a much wider and more suggestive case ; or the way in which an elastic fluid like the atmosphere transmits sound ; or the way in which an elastic solid transmits waves of transverse as well as longitudinal displacement. It is on our famili- arity with modes of transmission such as these, and with the exact analyses of them ~~vrhich the science of mathematical physics has been able to make, that our pre~~ dilection for filling space with an sethereal transmitting medium, constituting a universal connexion between mate- rial bodies, largely depends ; perhaps ultimately it depends most of all, like all our physical conceptions, on the inti- mate knowledge that we can ourselves exert mechanical effect on outside bodies only through the agencies of our limbs and sinews. The problem thus arises. Can we form a consistent notion of such a connecting medium ? It must be a medium which can be effective for transmitting all the types of physical action known to us : it would be worse than no solution to have one medium to transmit gravitation, another to transmit electric effects, another to transmit light, and so on. Thus the attempt to find out a constitution for the aether will involve a synthesis

or intimate correlation of the various types of physical agencies, which appear so different to us mainly because we perceive them, through different senses. The evidence for this view, that all these agencies are at bottom con- nected together and parts of the same scheme, was enor- mously strengthened during the latter half of the 19th century by the development of a relation of simple quan- titative equivalence between them; it has been found that we can define qiiantities relating to them, under the names of mechanical energy, electric energy, thermal energy, and so on, so that when one of them disappears it is replaced by the others to exactly equal amount. This single principle of energy has transformed physical science by making possible the construction of a network of ramifying connexions between its various depart- ments: it thus stimulates the belief that these consti- tute a single whole, and encourages the search for the coihplete scheme of interconnexion of which the princi- ple of energy and the links which it suggests form only a single feature.

Atomic Structure of Matter. — The greatest obstacle to such a search is the illimitable complexity of matter, as contrasted with the theoretical simplicity and uniformity of the physical agencies which connect together its differ- ent parts. It has been maintained since the times of the early Greek philosophers, and possibly even more remote ages, that matter is constituted of independent indestruc- tibl'e units, which cannot ever become divided by means of any mutual actions they can

exert. Since the period, a century ago, when Dalton and his contemporaries* constructed from this idea a scientific basis for chem- istry, the progress of that subject has been wonderful beyond any conception that could previously have been entertained; and the atomic theory in some form ap- pears now to be an indispensable part of the framework of physical science. Now this doctrine of material atoms is an almost necessary corollary to the doctrine of a universal aether. For if we held that matter is continuous, one of two alternatives would be open. We might consider that matter and aether can co-exist in the same space ; this would involve the co-existence and interaction, of a double set of properties, introducing great complication which would place any coherent scheme of physical action probably beyond the powers of human analysis. Or we might consider that aether exists only where matter is not, thus making it a very rare and subtle and elastic kind of matter; then we should have to assign these very propei-ties to the matter itself where it replaces aether, in addition to its more familiar properties, and the complication would remain. The other course is to consider matter as formed of ulti- mate atoms, each the nucleus or core of an intrinsic modi- fication impressed on the surrounding region of the aether ; this might conceivably be of the nature of vortical motion of a liquid round a ring-core, thus giving a vortex atom, or of an intrinsic strain of some sort radiating from a core, which would give an electric atom. We recognize an atom only through its physical activities as inanifested in its interactions with other atoms at a distance from it ; this field of physical activity would be identical with the surrounding field of sethereal motion or strain that is associated with the atom, and is carried on along with it as it moves. Here then we have the basis of a view in which there are not two media to be considered, but one medium, homogeneous in essence and differentiated as regards its parts only by the presence of nuclei of intrinsic strain or motion — in which the physical activi- ties of matter are identified with those arising from the atmospheres of modified aether which thus belong to its atoms. As regards laws of general physical inter- actions, the atom is fully represented by the constitu-

tion of this atmosphere, and its nucleus may be left out of our discussions ; but in the problems of biology great tracts of invariable correlations have to be dealt with, which seem hopelessly more complex than any known or humanly possible physical scheme. To make room for these we have to remember that the atomic nucleus has remained entirely undefined and beyond our problem; so that what may occur, say when two mole- cules come into close relations, is outside physical science — not, however, altogether outside, for we know that when the vital nexiis in any portion of matter is dissolved, the atoms will remain, in their number, and their atmospheres, and all inorganic relations, as they were before vitality supervened.

Nature of Properties of Material Bodies. — It thus appears that the doctrine of atomic material constitution and the doctrine of a universal sether stand to each other in a relation of mutual support ; if the scheme of physical laws is to be as precise as observation and measurement appear to make it, both doctrines are required in our efforts towards synthesis. Oar direct knowledge of matter can, however, never be more than a rough knowledge of the general average behaviour of its molecules ; for the smallest material speck that is sensible to our coarse per- ceptions contains myriads of atoms. The properties of the most minute portion of matter which we can examine are thus of the nature of averages. We may gradually invent means of tracing more and more closely the average drifts of translation or orientation, or of changes of arrange- ment, of the atoms ; but there will always remain an unaveraged residue devoid of any recognized regularity, which we can only estimate by its total amount. Thus, if we are treating of energy, we can separate out mechanical and electric and other

constituents in it ; and there will be a residue of which we know nothing except its quantity, and which we may call thermal. This merely thermal energy — which is gradually but very slowly being re- stricted in amount as new subsidiary organized types become recognized in it — though transmutable in equiva- lent quantities with the other kinds, yet is so only to a limited extent ; the tracing out of the laws of this limita- tion belongs to the science of thermodynamics. It is the business of that science to find out what is the greatest amount of thermal ~~energy that can possibly be recoverable into organized kinds under given circumstances. The dis~~ covery of definite laws in this region might at first sight seem hopeless ; but the argument rests on an implied postulate of stability and continuity of constitution of material siibstances, so that after a cycle of transforma- tions we expect to recover them again as they were origi- nally— on the postulate, in fact, that we do not expect them to melt out of organized existence in our hands. The laws of thermodynamics, including the fundamental principle that a physical property, called temperature, caube defined, which tends towards uniformity, are thus relations between the properties of types of material bodies that can exist permanently in presence of each other ; why they so maintain themselves remains unknown, but the fact gives a point d'otjppui. Eeturning now to the sether, on our pres- ent point of view no such complications there arise ; it must be regarded as a continuous uniform medium free from any complexities of atomic aggregation, whose func- tion is confined to the transmission of the various types of physical effect between the portions of matter. The problem of its constitution is thus one which can be attacked and continually approximated to, and which may possibly be definitely resolved. It has to be com- petent to transmit the transverse waves of light and electricity, and the other known radiant and electric actions; the way in which this is done is now in the main, known, though there are still questions as to the

mode of expression and formulation of our knowledge, and also as regards points of detail. This great advance, which is the result of the gradual focussing of a century's work in the minute exploration of the exact laws of optical and electric phenomena, clearly carries with it deeper insight into the physical nature pf matter itself and its modes of inanimate interaction.

If we rest on the synthesis here described, the energy of the matter, even the thermal part, appears largely as "potential energy of strain in the sether, which interacts with the kinetic energy associated with disturbances in- volving finite velocity of matter. It may, however, be maintained that an ultimate analysis would go deeper, and resolve all phenomena of elastic resilience into conse- quences of the kinetic stability of steady motional states, so that only motions, but not strains, would remain. On such a view the sether might conceivably be a perfect fluid, its fundamental property of elastic reaction arising (as suggested by Kelvin and FitzGerald) from a structure of tangled or interlaced vortex filaments pervading its substance, which might conceivably arrange themselves into a stable configuration and so resist deformation. This raises the further question as to whether the transmission of gravitation can be definitely recognized among the properties of an ultimate medium ; if so, we know that it must be associated with some feature, perhaps very deep- seated, or on the other hand perhaps depending simply on incompressibility, which is not sensibly implicated in the electric and optical activities. With reference to all such further refinements of theory, it is to be borne in mind that the perfect fluid of hydrodynamic analysis is not a merely passive inert pfewwrn; it is also a continuum, with the property that no finite internal slip or discon- tinuity of motion can ever arise in it through any kind of disturbance; and this property must be postulated, as it cannot be explained.

Motion of Material Atoms through the ^ther. — ^An important question arises whether, when a material body is moved through the sether, the nucleus of each atom carries some of the surrounding sether along with it ; or whether it practically only carries on its strain-form or physical atmosphere, which is transferred from one por- tion of sether to another after the manner of a shadow, or rather like a loose knot which can slip along a rope without the rope being required to go with it. We can

obtain a pertinent illustration from the motion of a vortex ring in a fluid; if the circular core of the ring is thin compared with its diameter, and the vorticity is not very great, it is the vortical state of motion that travels across the fluid without transporting the latter bodily with it except to a slight extent very close to the core. We might thus imagine a structure formed of an aggregation of very thin vortex rings, which would move across the fluid without sensibly disturbing it; on the other hand, if formed of stronger vortices, it may transport the portion of the fluid that is within its own structure along with it as if it were a solid mass, and therefore also push aside the sur- rounding fluid as it passes. The motion of the well-known steady spherical vortex is an example of the latter case.

Convection of Optical Waves. — The nature of the motion, if any, that is produced in the surrounding regions of the sether by the translation of matter through it, can be investigated by optical experiment. The obvious body to take in the first instance is the Earth itself, which on account of its annual orbital motion is travelling throiigh space at the rate of about 18 miles per second. If the surrounding sether is thereby disturbed, the waves of light arriving from the stars will partake of its move- ment; the ascertained phenomena of the astronomical aberration of light show that the rays travel to the observer, across this disturbed sether near the Earth, in

straight lines. Again, we may split a narrow beam of light by partial reflection from a transparent plate, and re- combine the constituent beams after they have traversed different circuits of nearly equivalent lengths, so as to obtain interference fringes. The position of these fringes will depend on the total retardation of the one beam with respect to the other ; and thus it might be expected to vary with the direction of the Earth's motion relative to the apparatus. But it is found not to vary at all, even up to the second order of the ratio of the Earth's velocity to that of light. It has in fact been found, with the very great precision of which optical experiment is capable, that all terrestrial optical phenomena — ^reflection, refrac- tion, polarization linear and circular, diffraction — are en- tirely unaffected by the direction of the Earth's motion ; and this is our main experimental clue.

We pass on now to the theory. We shall make the natural supposition that motion of the sether, say with velocity (u,v,w) at the point {x,y,z), is simply superposed on the velocity V of the optical undulations through that medium, the latter not being intrinsically altered. Now the direction and phase of the light are those of the ray which reaches the eye ; and by Fermat's principle, estab- lished by Huygens for undulatory motion, the path of a ray is that track along which the disturbance travels in least time, in the restricted sense that any alteration of any shoii reach of the path will increase the time. Thus the path of the ray when the aether is at rest is the curve which makes fds/Y least ; but when it is in motion it is the curve which makes fds / (Y + lu + mv + nw) least, where (l,m,n) is the direction vector of Ss. The latter integral becomes, on expanding in a series,

fds/y-f($^{udx+vdy+wdz)/Y}$+f(uclx+vdy+wdzy/Vids+...,

since Ids — dx. If the path is to be unaltered by the motion of the sether, as the law of astronomical aberration suggests, this must differ from /c?s /V by terms not de- pending on the path — that is, by terms involving only the beginning and end of it. In the case of the free sether V is constant; thus, if we neglect squares like (u/Y)", the condition is that udx + vdy + wdz be the exact differential of some function <. If this relation is true along all paths, the velocity of the sether must be of irrotational type, like that of f rictionless fluid. Moreover, this is precisely the condition for the absence of interference between the component of a split beam; because, the time of passage being to the first order

fds/Y —f(vdx + vdy + wdz)fV^,

the second term will then be independent of the path (<^ being a single valued function) and therefore the same for the paths of both the interfering beams. If therefore the sether can be put into motion, we conclude that such motion, in free space, must be of strictly irrotational type. But our experimental data are not confined to free space. If c is the velocity of radiation in free space and /H, the refractive index of a transparent body, V = c//a; thus it is the expression $c^{f/i}$ (u'dx + v'dy + w'dz) that is to be integrable exactly, where now {u',v',w') is what is added to V owing to the velocity {u,v,w) of the medium. As however our terrestrial optical apparatus is now all in motion along with the matter, we must deal with the rays relative to the moving system, and to them also Fermat's principle clearly applies; thus Y + Qu' + mv' +nw') is here the velocity of radiation in the direction of the ray, but relative to the moving material system. Now the expression above given canno^ be integrable exactly, under all circumstances and whatever be the axes of co-ordinates, unless (ji.^u',ij? v',ii?w') is the gradient of a continuous function. In the simplest case, that of uni-

form translation, these components of the gradient will each be constant throughout the region ; at a distant place in free sether where there is no motion, they must thus be equal to — m, — ■«, — w, as they refer to axes moving with the matter. Hence the paths and times of passage of all rays relative to the material system will not be altered by a uniform motion of the system, provided the velocity of radiation relative to the system, in material of index it., is diminished by iiT^ times the velocity of the system in the direction of the radiation, that is, provided the absolute velocity of radiation is increased by 1 — /«,-^ times the said velocity ; this involves that the free aether for which /* is unity shall remain at rest. This statement constitutes the famous hypothesis of Fresnel, which thus ensures that all phenomena of ray-path and refraction, and all those depending on phase, shall be unaffected by uniform convection of the material medium, in accordance with the results of experiment.

7s the uSIther Stationary or Mobile ? — This theory se- cures that the times of passage of the rays shall be inde- pendent of the motion of the system, only up to the first order of the ratio of its velocity to that of radiation. But a classical experiment of Michelson, in which the ray-path was wholly in air, showed that the independence extends to higher orders. This result is inconsistent with the sether remaining at rest, unless we assume that the dimensions of the moving system depend, though to an extent' so small as to be not otherwise detectable, on its orientation with regard to the sether that is streaming through it. It is however in complete accordance with, a view that would make the sether near the Earth fully partake in its orbital motion — a view which the null effect of convection on all terrestrial optical and electrical phenomena also strongly suggests. But the sether at a great distance must in any case be at rest ; while the facts of astronomical aberration require that the motion of that medium must be irrotational. These conditions cannot be consistent with sensible convection of the sether near the Earth without involving discontinuity in its motion at some intermediate distance : so that we are thrown back on the previous theory.

Another powerful reason for taking the sether to be stationary is afforded by the character of the equations of electrodynamics; they are all of linear type, and superposition of effects is possible. Now the kinetics of a medium in which the parts can have finite relative motions will lead to equations which are not linear — as, for example, those of hydrodynamics — and the pheno- mena will be far more complexly involved. It is true that the theory of vortex rings in hydrodynamics is of a simpler type ; but electric currents cannot be likened to permanent vortex rings, because their circuits can be broken and the element of steadiness on which the sim- plicity depends thereby destroyed.

Dynamical Theories of the u^ther.' — The analytical equar tions which represent the propagation of light in free sether, and also in sether modified by the presence of matter, were originally developed

on the analogy of the equations of propagation of elastic effects in solid media (See Wave Thboht, Ency. Brit. vol. xxiv.). Various types of elastic solid medium have thus been invented to represent the sether, without complete success in any case. In MacCullagh's hands the correct equations were derived from a single energy formula by the principle of least action ; and while the validity of this dynamical method was maintained, it was frankly admitted that no mechanical analogy was forthcoming. When Clerk Maxwell pointed out the way to the common origin of optical and electrical phenomena, these equations naturally came to repose on an electric basis, the connexion having been first definitely exhibited by FitzGerald in 1878 ; and according as the

independent variable was one or other of the vectors which represent electric force, magnetic force, or electric polarity, they took the form appropriate to one or other of the elastic theories above mentioned.

In this place it must suffice to indicate the gist of the more recent developments of the electro-optical theory, which involve the dynamical verification of Fresnel's hypothesis regarding optical convection and the other relations above described. The sether is taken to be at rest ; and the strain-forms belonging to the atoms are the electric fields of the intrinsic charges, or electrons, in- volved in their constitution. When the atoms are in motion these strain-forms produce straining and unstrain- ing in the sether as they pass across it, which in its motional or kinetic aspect constitutes the resulting mag- netic field ; as the strains are slight the coefficient of inertia here involved must be great. True electric current arises solely from convection of the atomic charges or electrons; this current is therefore not restricted as to form in any way. But when the rate of change of sethereal strain — ^that is, of {f,g,li) specified as Maxwell's electric displacement in free sether — ^is added to it, an analytically convenient vector (u,v,w) is obtained which possesses the characteristic property of being circuital like the flow of an incompressible fluid, and has therefore been made fundamental in the theory by Maxwell under the name of the total electric current.

As already mentioned, all efforts to assimilate optical propagation to transmission of waves in an ordinary solid medium have failed ; and though the idea of regions of intrinsic strain, as for example in unannealed glass, is familiar in physics, yet on account of the absence of mobility of the strain no attempt had been made to employ them to illustrate the electric fields of atomic charges. The idea of MacCuUagh's sether, and its property of purely rotational elasticity which had been expounded objectively by Rankine, was therefore imuch vivified by Lord Kelvin's specification in 1889 of a material gyrostatically constituted medium which would possess this character. More recently a way has been pointed out in which a mobile permanent field of electric force could e^ist in such a medium so as to travel freely in company with its nucleus or intrinsic chajge — the nature of the mobility of the latter, as well as its inti- mate constitution, remaining unknown.

A dielectric substance is electrically polarized by a field of electric force, the atomic poles being made up of the displaced positive and negative intrinsic charges in the atom : the polarization per unit volume {f,g',h') may be defined on the analogy of magnetism, and d/dt(f,g',h') thus constitutes true electric current of polarization, i.e., of electric separation in the molecules, specified per unit volume. The convection of a medium thus polarized involves electric disturbance, and therefore must con- tribute to the true electric current ; the determination of this constituent of the current is the most delicate point in the investigation. The usual definition of the com- ponent current in any direction, as the net amount of electrons which crosses, towards the positive side, an element of surface j^iced in space at right angles to that direction, per unit area per unit time, here gives no definite result. The

establishment and convection of a single polar atom constitutes in fact a gwosi-magnetization, the negative poles completing the current circuits of the posi- tive ones. But in the transition from molecular theory to the electrodynamics of extcDded media, all magnetism has to be replaced by a distribution of current ; the latter being now specified by volume as well as by flow, (u,v,w)8t is the current in the element of volume St. In the ~~present case the total dielectric contribution to this cur~~ rent works out to be the change per unit time in the

electric separation in the molecules of the element of volume, as it moves uniformly with the matter, all other effects being compensated molecularly without affecting the propagation.^ On subtracting from this total the cur- rent of establishment of polarization d/dt(f’,g’,h’), already formulated above, there remains vd/dx(f’,g’,h’) as the cur- rent of convection of polarization when the convection is taken for simplicity to be in the direction of the axis of x with velocity jb. The polarization itself is determined from the electric force (P,Q,E) by the usual statical formula

r(P.Q’K).

4^0″

because any change of the dielectric constant K arising from the convection of the material through the sether must be independent of the sign of v and therefore be of the second order. Now the electric force (P,Q,R) is the force acting on the electrons of the medium moving with velocity v ; consequently by Faraday’s electrodynamic law

(P,Q,E) = (P’,Q’ – vc, E’ + vb)

where (P’,Q’,E’) is the force that would act on electrons at rest, and (a,b,c) is the magnetic induction. The latter force is, by Maxwell’s hypothesis or by the dynamical theory of an sether pervaded by electrons, the same as that which strains the sether, and may be called the oethereal force ; it thereby produces an sethereal electric displacement, say (f,g,h), according to the relation

(f,g,h) = (4^cO-XP’,Q’,E’),

in which c is a constant belonging to the sether, which turns out to be the velocity of light. The current of sethereal displacement d/dt{f,g,h) is what adds on to the true electric current to produce the total circuital current of Maxwell.

“We have now to substitute these data in the univer- sally valid circuital relations — namely, (i) line integral of magnetic forpe round a circuit is equal to 47r times the current through its aperture, which may be regarded as a definition of the constitution of the sether and its relation to the electrons involved in it ; and (ii) line integral of the electric force belonging to any material circuit (i.e., acting on the electrons situated on it which move with the velocity of the matter) is equal to minus the time-rate of change of the magnetic induction through that circuit as it moves with the matter, this being a dynamical con- sequence of the sethereal constitution assigned in (i) .

We may now, as is somewhat the more natural course in the terrestrial application, take axes (x,y,z) which move with the matter; but the current must be invariably defined by the flux across surfaces fixed in space, so that we may say that relation (i) refers to a circuit fixed in space, while (ii) refers to one moving with the matter. These circuital relations, when expressed analytically, are then for a dielectric medium of types

• dy ds

where (”’”’«’) = (J + ”)(/-9”’”’) + |(/.fl’.’^).

g^jj^ dR *dQ,* _da

dy ds dt’ ‘ ‘ where, when magnetic quality is inoperative, the mag- netic induction (a,b,c) is identical with the magnetic force (a,l3,y).

These equations determine all the phenomena. They take this simple form, however, only when the movement of the matter is one of translation. If v varies with respect to locality, or if there is a velocity of convection (p,q,r) variable with respect to direction and position, the

1 See Lorentz, loc. cit. infra ; Larmor, .iEther and Matter, p. 262 and passim.

analytical expression of the relation (ii) assumes a more complex form ; we thus derive the most general equations of electrodynamic propagation for matter treated as con- tinuous, anyhow distributed and moving in any manner. For the simplest case of polarized waves travelling par- allel to the axis of x, with the magnetic oscillation y along z and the electric oscillation Q along y, all the quantities are functions of x and t alone ; the total current is along y and given with respect to our moving axes by

”” U« “dxj 47rc2 +dt V 4tc2 r ‘ also the circuital relations here reduce to dy , dQ dy

dx

thus

dx

dX^ dt

dt’

..cPQ

giving, on substitution for v,

For a simple wave-train, Q varies as sin m(x—Yf), leading on substitution to the velocity of propagation Vrelative to the moving material, by means of the equation KV^-|-2uV= 0^— u^; this gives, to the first order of v/c, V= c/K*— v/K, which is in accordance with Fresnel’s law. Trains of waves nearly but not quite homogeneous as re- gards wave-length will as usual be propagated as wave- . groups travelling with the slightly different velocity d(VA,‘)/d!A.*, the value of K occurring in V being a function of A determined by the law of optical dispersion of the medium.

For purposes of theoretical discussions relating to mov- ing radiators and reflectors, it is important to remember that the dynamics of this theory of electrons involves the neglect of terms of the order (v/cy, not merely in the value of K but throughout.

The modification of the spectrum of a radiating gas by a magnetic field, such as would result from the hypothesis that the radiators are the system of revolving or oscillat- ing electrons in the molecule, was detected by Zeeman in 1896; more minute investigation has largely confirmed the predictions as to its character that were made by H. A. Lorentz and others on the basis of the theoretical ideas here sketched.

Reference may be made generally to — Maxwell. Collected Papers. — H. A. Lorentz. Archives Neerlandaises, xxi. 1887, and XXV. 1892 ; and a tract, Versuch einer Theorie der elec- trischen und optisehen Erscheinungen in bewegten K'orpern, Ley- den, 1895. — O. Lodge. "Aberration Problems," Phil. Trans. 1893 and 1897.— -J. Labmoh, Phil. Trans. 1894-5-7, and a trea- tise JEther and Matter, Cambridge Univ. Press, 1900, where full references are given. See also in Ency. Brit. (9tli ed.) articles Atom, Ether, Molecule, Eleotbicitt, Wave Theory.

(J. L.*)

Afforestation. See Fobests.

AfFreightment. — Contract of Affreightment is the expression usually employed to describe the contract between a shipowner and some other person called the freighter, by which the shipowner agrees to carry goods of the freighter in his ship, or to give to the freighter the use of the whole or part of the cargo-carrying space of the ship for the carriage of his goods on a specified voyage or voyages, or for a specified time ; the freighter on his part agreeing to pay a specified price, called " freight," for the carriage of the goods or the use of the ship. A ship may be let like a house to some person who takes possession and control of it for a specified term. The person who hires a ship in this way occupies during the currency of his term the position of shipowner. The contract by

which a ship is so let may be called a charter-party ; but it is not, properly speaking, a contract of affreightment, and is mentioned here only because it is necessary to remember the distinction between a charter-party of this kind, which is sometimes called a demise of the ship, and a charter-party which is a form of contract of affreightment, as will hereinafter appear.

The law with regard to the contract of affreightment is, of course, a branch of the general law of contract. The rights and obligations of the shipowner and the freighter depend, as in the case of all parties to contracts, upon the terms of the agreement entered into between them. The law, however, interferes to some extent in regulating the effect to be given to contracts. Certain contracts are forbidden by the law, and being illegal are, therefore, in- capable of enforcement. Tha most important example of illegality in the case of contracts of affreightment is when the contract involves trading with an enemy. The law interferes again with regard to the interpretation of the contract. The meaning to be given to the words of the contract, or, in other words, its construction, when a dispute arises about it, must be determined by the judge or court. The result is, that certain more or less common clauses in contracts of affreightment have come before the courts for construction, and the decisions in these cases are treated practically, though not perhaps quite logically, as rules of law determining the sense to be put upon certain forms of expression in common use in shipping contracts. A third way in which the law interferes is by laying down certain rules by which the, rights of the parties are to be regulated in the absence of any express stipulation with regard to the matter dealt with by such rules. This is done either by statu- tory enactment, as by that part (Part VIII.) of the Mer- chant Shipping Act, 1894, which deals with the liability of shipowners ; or by established rules of ^the unwritten law, the " common law " as it is called, as for instance, the rule that the common carrier is absolutely responsible for the safe delivery of the goods carried, unless it is prevented by the act of God or the King's enemies. These rules of law, whether common law or statute law, regulating the obligations of carriers of goods by sea, are of most importance in cases

which are uncommon though not unknown at the present day, in which there is an affreightment without any written agreement of any kind. It will, therefore, be convenient to consider first cases of this kind where there is no express agreement, oral or written, except as to the freight and destination of the goods, and where consequently the rights and obligations of the parties as to all other terms of carriage depend wholly upon the rules of law, remembering always that these same rules apply when there is a written contract, except in so far as they are qualified or negatived by the terms of such contract.

The rules of the common or ancient customary law of England with regard to the carriage of goods were no doubt first considered by the courts and established with regard to the carriage of goods by common carriers on land. These rules were applied to common carriers by water, and it may now be taken to be the general rule that shipowners who carry goods by sea are by the English law subject to the liabilities of common carriers. (See as to the grounds and precise extent of this doctrine the judgments in Liver Alkali Company v. Johnson, L.K, 7 Ex. 267, and Nugent v. Smith, 1 C.P.D. 423.) In practice goods are not often shipped without a written contract or acknowledgment of the terms upon which they are to be carried. For each separate consignment or parcel of goods shipped a bill of lading is almost invari- ably given, and when a whole cargo is agreed to be carried

Rules of law.

the terms are set out in a document called a charter-party, signed by or on behalf of the shipowner on the one part, and the shipper, who is called the charterer, on the other part. But at present we are considering the rela- tions of shipowner and shipper independently of any express contract, as in a case when godds are shipped and received to be carried to the place to which the ship is bound for a certain freight, but without any further agreement as to the terms of carriage. In such a case the rights of the parties depend on the rules of law, or. In detaatt “w^hich is much the same fhing, upon the of express warranties or promises which though not coatract expressed must, as the courts have held, be implied as arising from the .relation between the parties as shipper and carrier. The obligations on the one side and the other may be defined shortly to be as follows : — The shipper must not ship goods of a nature or in a condition which he knows, or ought, if he used reasonable care, to know to be dangerous to the ship, or to other goods, unless the shipowner has notice of or has sufficient opportunity to observe their dangerous character. The shipper must be prepared, without notice from the ship- owner, to take delivery of his goods with reasonable despatch on the arrival of the ship at the place of destina- tion, being jeady there to discharge in some usual dis- charging place. The shipper must pay the agreed freight, and wUl not be entitled to claim delivery until the freight has been paid. In other words, the shipowner has a lien on the goods carried for the freight payable in respect of the carriage. On the other hand the obligation upon the shipowner is first and foremost to deliver safely at their destination the goods shipped, and this obligation is, by the common law, subject to this exception only that the shipowner is not liable for loss or damage caused by the act of God or the King’s enemies ; but by statute (Merchant Shipping Act, 1894, Part VIII.) it is further qualified to this extent that the shipowner is not liable for loss, happening without his actual fault or privity, by fire on board the ship, or by the robbery, or embezzlement of, or making away with gold, or silver, or jewellery, the true nature and value of which have not been declared in writing at the time of shipment ; and, further, the ship- owner is not liable for damage to or loss of goods or merchandise beyond an aggregate amount, not exceeding eight pounds per ton for each ton of the

ship’s tonnage. The sMpowner is bound by an implied- undertaking, or, in other words, is made responsible by the law as if he had entered into an express undertaking : (1) that the ship is seaworthy ; (2) that she shall proceed upon the voyage with reasonable despatch, and shall not deviate without necessity from the usual course of the voyage.

It is not OUT purpose in this article to discuss minute or doubtful questions; but in their general outline the obligations of shipper and shipowner, where no terms of carriage have been agreed, except as to the freight and destination of the goods, are such as have been described above. The importance of appreciating clearly this view of the relations of shipper and shipowner arises from the fact that these fundamental rules apply to all contracts of affreightment, whether by bill of lading, charter-party, or otherwise, except in so far as they are modified or nega- tived by the express terms of the contract.

BiUs of Lading.

The document signed by the master or agent for the shipowner, by which are acknowledged the shipment of a parcel of goods and the terms upon which it is to be carried, is called a Bill of Lading. Very many different forms of bills of lading are used. For the purpose of illustration the following form (from Mr Scrutton’s book on Charter-

parties and Bills of Lading) has been selected as a sample : —

Shipped, in apparent good order and condition by in and

upon the good Vessel called the now lying in the port of and bound for , with liberty to call at any ports in any order,

to sail without Pilots, and to tow and assist Vessels in distress, and to deviate for the purpose of saving life or property ; and

to be delivered in the like good order and condition at the afore- said port of unto or to bis or their assigns, freight and all other conditions as per Chstrter Party. The act of God, perils of the sea, fire, barratry of the Master and Crew, enemies, pirates, and thieves, arrests, and restraints of princes, rulers, and people, collisions, stranding, and other accidents of navigation excepted, even when occasioned by negligence, default, or error in judgment of the Pilot, Master, Mariners, or other servants of the Ship- owners.

Ship not answerable for losses through explosion, bursting of boilers, breakage of shafts, or any latent defect in the machinery or hull, not resulting from want of due diligence by the Owners of the Ship, or any of them, or by the Ship’s Husband or Manager.

General Average payable according to York-Antwerp Rules.

In Witness whereof, the Master or Agent of the said Ship hath afBrmed to three Bills of Lading, all of this tenor and date, drawn as first, second and third, one of which Bills being accomplished, the others to stand void.

Dated in this day of 188 .

The Bill of Lading is an acknowledgment of the shipment of goods in a named vessel for carriage to a specified destination on terms set forth in the document. It is usually signed by the master of the vessel, but very commonly by the agents of the shipowner or sometimes of the charterers of the

vessel. A vessel may be employed by its owners to earn freight in various ways : (1) It may be placed, as it is said, on the berth as a general ship, to receive cargo from any shippers who may desire to send goods to the port, or one of the ports, to which the vessel is bound. The mate or chief officer usually superintends the loading, and, as goods are shipped, a mate's receipt is given as an acknowledgment of the shipment. The mattes receipt is afterwards exchanged for the hill of lading. In the case of a shipment by a general'ship the bUl of lading is the evidence and memorandum of the contract between the shipowner and the shipper ; (2) a shipper may, however, require the whole cargo space oi the vessel to carry, for ex- ample, a full cargo of grain. In such a case the vessel will be chartered by the shipowner to the shipper, and the con- tract will be the charter-party. Even in such a case a bill or bills of lading will usually be given to enable the shipper to deal more conveniently with the goods by way of sale or otherwise. By the ancient custom of merchants recog- nized and incorporated in the law, the bill of lading is a document of title, representing the goods themselves, by the transfer of which symbolical delivery of the goods may be made. But when a cargo is shipped under a charter-party, although bills of lading may be given to the charterer, it is the charter-party, and not the bills of lading, which constitutes the record of the contract between the parties — of charter-parties we shall treat below. (3) There is a third class of case which is a combination of the two with Which we have dealt above. A vessel is very commonly chartered by her owner to a charterer who has no intention to ship and does not ship any cargo on his own account, but places the vessel on the berth to receive cargo from shippers who ship under bills of lading. The charterer receives the bill of lading freight and pays the charter-party freight, his object being of course to obtain a total bill of lading freight in excess of the chartered freight, and so make a profit. The master, although he usually remains the servant of the shipowner during the term of the charter-party, acts nevertheless under the directions and on behalf of the charterer in signing bills of lading. The legal effect of this situation is that shippers who ship goods under bills of lading without knowledge of the

terms of the charter-paxty are entitled to look to the shipowner as the person responsible to them for the safe carriage of their goods. This right depends essentially on the fact that the master who signs the bills of lading, although in doing so he is acting for the charterer, remains nevertheless the servant of the shipowner, who is not allowed to deny as against third persons, who do not know the relations between the charterer and the shipowner, that his servant, the master of the ship, has the ordinary authority of a master to bind his owner by signing bills of lading.

The forms of bills of lading vary very much, and their clauses have been the subject of judicial consideration and decision in a vast number of reported cases. The essential particulars, or at all events those common to all bills of lading, may be stated as follows :

1. The name of the shipper.

2. The name of the ship.

3. The place of loading and destination of the ship.

4. A description of the goods shipped. 6. The place of delivery.

6. The persons to whom delivery is to be made.

7. The freight to be paid.

8. The excepted perils.

9. The shipowner’s lien.

The description of (1) the shipper, and (2) the ship, calls for no remark. The (3) description of the voyage is important, because there is, as we have already explained, an implied undertaking by the shipowner in every contract of carriage not unnecessarily to deviate from the ordinary route of the voyage upon which the goods are received to be carried. The consequences of a deviation are serious, inasmuch as the shipowner is liable, not only for any loss or damage which the shipper suffers in consequence of the deviation, but for any loss of goods which occurs after the deviation, even though such loss is caused by one of the excepted perils. The only exception to this rule is that a deviation may be made to save life, but not to save property. It is, however, very usual to qualify the strictness of this implied undertaking by introducing in the bill of lading certain ” liberties ” to deviate, as, for example, in the form given above, ” liberty to call at any ports in any order, to tow and assist vessels in distress, and to deviate for the purpose of saving life and pro- perty.” The nature and extent of the liberty will depend on the words of the contract. The inclination of English courts has been to construe clauses giving a liberty to deviate somewhat strictly against the shipowner.

The (4) importance of the description of the goods shipped and their condition is obvious, as the contract is to deliver them as described and in the like good condition, subject, of course, to the exceptions. It must, however, be noted, that, as against the master or person who has himself signed the biQ of lading, the description therein of the goods shipped is absolutely conclusive. But as against the shipowner, tmless he has himself signed the bill of lading, the description of the goods shipped is not conclusive. It is evidence as against him that the goods described were shipped, but he is allowed to rebut this evidence by proving, if he can, that the goods mentioned, or some of them, were not in fact shipped.

As to (5) the place of delivery, very serious questions frequently arise. Primarily, of course, the shipowner is bound to deliver at the place named. Should he be prevented by some obstacle or difficulty which is of a temporary nature, the vessel must wait, and delivery must be made as soon as possible. Where, however, the obstacle is permanent, or at all events such as must cause unreason- able delay, having regard to the nature of the adventure, the shipowner is excused from delivery at the place named

in the bill of lading, provided the difficulty arises from an excepted peril, or in consequence of delivery at the place named being forbidden by the law of England, as may happen, for example, in the case of a declaration of war between Great Britain and the state in which the port named in the bill of lading is situate. A party to a contract cannot be held liable for breaking his contract if its performance has become illegal. There may be other cases in which, from the circumstances of the voyage and adventure, it must be inferred that the parties intended the performance of the contract tp be conditional on the existence at the time of performance of a certain state of things, the non-existence of which would render perform- ance impossible. For instance, if the port named in the bill of lading became permanently closed and inaccessible to shipping in consequence of an earthquake, it would probably be held that the continued existence of the place named as a port was an implied condition of the contract, and that the shipowner was excused. Where, however, the performance of the contract remains lawful, and is not excused by the express terms of the contract, or by some implied condition, the shipowner is liable for any loss or damage suffered by the shipper by reason of his goods not being delivered at the named place, even though such delivery has become impossible. There is another reason why the precise description of the place of delivery often becomes important.

It is only on the arrival of the ship at the place described as the place of delivery that the obligation of the consignee of the goods to take delivery commences. Delay involves consider- able loss and expense to the shipowner. The shipper or consignee is not responsible for any delay which occurs before the ship has arrived at the “place of delivery de- scribed in the bill of lading.

(6) The goods may be deliverable by the terms of the bill of lading to a named consignee, and to him only, but more usually they are made deliverable to the ” order or assigns ” of the named consignee or of the shipper. If the goods are made deliverable to order or assigns the bill of lading is a negotiable instrument, or, in other words, the right to the goods, and the rights and liabilities under the contract contained in the bill of lading, may be trans- ferred by indorsement and delivery of the document. When an indorsement has once been made by the shipper or consignee writing his name and nothing more on the back of the bill of lading, the rights in and under it may be transferred from hand to hand by mere delivery. A bUl of lading so indorsed is said to be indorsed ” in blank.” But the shipper or consignee may restrict the negotiability of the bill of lading by indorsing it not ” in blank,” but with a direction requiring delivery to be made to a par- ticular person or indorsee, or to his order. This is called an indorsement “in full.” When an indorsement has been made “in full” to a named indorsee or order, such indorsee must again indorse “in blank” or “in full ” to effect a new transfer of the rights in the bill of lading.

(7) The amount or rate of freight payable is stated in the bill of lading, either expressly, or, not uncommonly when the freight under the bill of lading is the same as under the charter-party, by reference to the charter-party. A common form of such reference is ” freight and other conditions, as per charter-party. ' It may here be mentioned that this form of words does not incorporate in the con- tract under the bill of lading aU the terms and conditions of the charter-party, but only those which apply to the person who is to take delivery, and relate to matters ejusdem generis, or similar to the payment of freight, such as demurrage and the like. The conditions of the charter- party thus incorporated do not include, for instance, the exceptions in the charter-party so as to add them to the

exceptions in the bill of lading. Treiglit, unless it is other-wise provided by the contract, is payable only on delivery of the goods at their destination. If the voyage is interrupted and its completion becomes impossible, the shipowner cannot claim payment of freight even pro raid itineris. He loses his freight altogether. This is so even ■when the completion of the voyage is prevented by causes for which the shipowner is not responsible, such as the act of God or the King’s enemies, or perils which are within the express exceptions in the bill of lading. When the voyage is interrupted by accident, and indeed in any case, the goods may, by agreement between the shipowner and the consignee, be delivered at some place short of their destination upon payment of a freight pro raid; that is to say, proportional to the length of voyage accomplished, and such an agreement may be implied in certain circum- stances from the conduct of the consignee in taking de- livery before they arrive at their destination. In all such cases it will be a question of fact whether the goods were in fact delivered upon the terms, express or implied, that freight pro raid should be paid. As a rule such an agreement would not be implied where the shipowner is unable or unwilling to forward the goods to their desti- nation, and the owner of the goods, therefore, has no option but to take delivery of them there.

When the ship is disabled and cannot proceed, or she is prevented by some obstacle from proceeding to the place of delivery named in the bill of lading, and the shipowner is unwilling or unable to

forward the goods by another ship, even though he may be excused for his failure to carry the goods to their destination, he is not entitled to be paid any part of the freight ; and the con- signee is entitled to have the goods delivered to him either at the place where the vessel has taken refuge in her disabled condition, or, if the obstacle arises without disablement of the vessel, at the place which is nearest and most reasonably convenient at the time and in the circumstances when the further prosecution of the voyage has to be abandoned. On the other hand, after the goods have been shipped, so long as the shipowner is ready and willing to carry the goods to their destination, or, if the ship is disabled, to forward them to their desti- nation by some other ship without unreasonable delay, the owner of the goods cannot require the goods to be delivered to him at any place short of their destination without payment of the full freight. Sometimes the freight, either wholly or in part, is made payable in advance. If freight payable in advance has become due, even though the ship is lost before it is paid, it must, in the absence of some special provision to the contrary, still be paid, and freight already paid in advance does not become repayable because the goods do not reach their destina- tion. If, however, goods upon which freight has been paid in advance are lost, and the shipowner is liable for their loss, the amount of freight paid in advance must be taken into account in assessing the damage recoverable from the shipowner.

(8) There is no part of the bill of lading which is of greater practical importance or which demands more care- ful consideration by shipowner and shipper alike than that which sets forth the excepted perils ; those perils, in other words, or causes of loss for which the shipowner is to be exempt from liability. By the common law, as we have seen, the exemption of the carrier, apart from express contract, extended only to loss by the act of God or the King’s enemies. The expression ” act of God ” requires a word of explanation. It will be sufficient to say that it is not synonymous with force majeure; but it includes every loss by force majeure in which human agency, by act or negligence, has had no part. The list of excepted perils , varies mueh in different forms of bills of lading.

In the older forms it usually included perils of the seas, robbers and pirates, restraint of princes and rulers, fire and barratry (that is, wilful wrongdoing) of the master and crew. The list, however, has grown in modern times, and is still growing ; the tendency being to exempt the ship- owner from liability for all loss which does not arise from his own personal default, or from the negligence of his managers or agents in failing to provide a vessel seaworthy and fit for the voyage at its commencement. It is im- portant to point out in this connexion that there are two duties which the shipowner is always presumed to under- take, and which are assumed to be unaffected and un- qualified by the exceptions, unless a contrary intention is very clearly expressed by the terms of the contract.. In the first place, he undertakes absolutely that the ship in which the goods are shipped is^ fit at the commencement of the voyage for the service to be performed. If during the voyage loss arises even from dangers of the seas or other excepted peril which would not have occurred if the vessel had been seaworthy and fit for the voyage at its commencement, the shipowner is not protected by the exceptions, and is liable for the loss. In the second place, there is an implied undertaking by the shipowner that all reasonable care will be taken by himself, his servants, and agents, safely to carry and deliver at their destination the goods received by him for carriage. Should loss or damage occur during the voyage, though the direct cause of such loss or damage be perils of the seas or other excepted peril, still the shipowner cannot claim exemption under the exceptions, if the shipper can prove that the loss or damage would not have occurred but for the negligence of the master, or crew, or other servants of the shipowner. The shipowner, in other words, is bound by himself and his servants to use all reasonable care to prevent loss by excepted perils as well as by any other cause.

It must not be supposed that even these primary obligations, which are introduced into every contract of affreightment not by words but by implication, may not be excluded by the _ express terms of the contract. It has now become stjau^atlons common form to stipulate that the shipowner shall not be

liable for any loss arising from the negligence of his servants, or that he shall not be liable for loss by the excepted perils even when brought about by the negligence of his servants. And with regard to seaworthiness, it is not uncommon for the shipovraer to stipulate that he shall not be responsible for loss arising even from the un- seaworthiness of the ship on sailing, provided that due care has been taken by the owner, and his agents, and servants to make the ship seaworthy at the commencement of the voyage. There is indeed no rule of English law which prevents a shipowner from exempting himself by the terms of the bill of lading from liability for damage and loss of every kind, whether arising from unsea- worthiness or any other cause whatsoever. In such a case the goods are carried at the owner's risk, and if he desires protection he must obtain it by insurance. In this respect the law of England permits greater freedom of contract than is allowed by the law of some other states. The owners, agents, and masters of vessels loading in the United States of America are forbidden by an Act of Congress, commonly called the Harter Act, passed in the year 1893, to insert in their contracts of affreightment any clause ex- empting the shipowner from liability for the negligence of his ser- vants ; but it is at the same time enacted that, provided all reasonable skill and care has been exercised by the shipowner to make the vessel seaworthy and fit for the voyage at its commence- ment, the shipowner shall not be liable for any loss caused by the negligence of the master or crew in the navigation of the vessel, or by perils of the sea or certain other causes set forth in the Act. It is now very usual to insert in the bills of lading of British vessels loading in the United States a reference to the Harter Act, incor- porating its provisions so as to make them terms and conditions of the bill of lading.

The difficulty of construing the terms of bills of lading with regard to the excepted perils, often expressed in obscure and inex- act language, has given rise to much litigation, the results of which are recorded in the Law Reports. Where such difficulties arise the question must be, What is the true and natural meaning of the language used by the parties ? This question is not governed by the general rules which we have endeavoured to explain ; but the words of the contract must always be considered with reference

to these rules, which are founded upon the well-established cus- toms of merchants recognized and formulated by the courts of law. (9) The bill of lading sometimes contains a clause as to the shipowner's lien. Without any express provision for it the shipowner has by the common law a lien for freight. If it is desired to give the shipowner a lien for demurrage (see below), or other charges, it must be expressly pro- vided for. The lien is the right of the shipowner to retain the goods carried until payment has been made of the freight or the demurrage, or other charge for which a lien has been given. The lien may be waived, and is lost by delivery of the goods, or by any dealing with the consignee which is inconsistent with a right qf the shipowner to retain possession of the goods until payment has been made. The shipowner may preserve his lien by landing the goods and retaining them in his own warehouse, or by storing them in a public warehouse, subject to the conditions required by the Merchant Shipping Act, 1894.

Charter-parties. Charter-parties are, as we have already explained, either for a voyage or for a period of time. (1) A charter-party for a voyage is a formal agreement made between the owner of the vessel and the charterers by which it is agreed that the vessel "being tight, staunch, and strong, and every way fitted for the voyage," shall load at a certain named place a full cargo either of goods of a specified description or of general merchandise, and being so loaded shall pro- ceed with all possible

despatch either to a specified place or to a place to be named at a specified port of call, and there deliver the cargo to the charterers or their assigns. There are clauses which provide for the amount of freight to be paid and the manner and tinie of payment ; for the time, usually described as lay days, to be allowed for load- ing and discharging, and for the demurrage to be paid if the vessel is detained beyond the lay days; usually also a clause requiring “the cargo to be brought to and taken from alongside at merchant’s risk and expense ” ; a clause that the master shall sign bills of lading for the cargo shipped either at the same rate of freight as is payable under the charter-party or very commonly at any rate of freight (but in this case with a stipulation that, if the totad bill of lading freight is less than the total freight payable under the charter-party, the difference is to be paid by the charterers to the master before the sailing of the vessel) ; and there is usually what is called the cesser clause, by which the charterer’s liability under the charter-party is to cease on shipment of the cargo, the shipowner taking a lien on the cargo for freight, dead freight, and demurrage. The charter-party is made sub- ject to exceptions similar to those which are found in bills of lading. There are also usually clauses providing for the commissions to be paid to the brokers on signing the charter-party, the ” address ” commission to be paid to the agents for the vessel at the port of discharge, and other matters of detail. The clauses in charter-parties vary of course indefinitely, but the above is probably a sufficient outline of the ordinary form of a charter-party for a voyage.

What has been said with regard to bills of lading as to the voy- age, the place of delivery, the exceptions and excepted perils, and the liability of the shipowner and his lien applies equally to charter- parties. It may be desirable to add a few words on demurrage, dead freight, and on the cesser clause.

Demurrage is, properly speaking, a fixed sum per day or per hour agreed to be paid by the charterer for any time during which the vessel is detained in loading or discharging over and above the time allowed, which is, as we have said, usuaHy described as the lay days. Sometimes the number of days during which the vessel may be kept on demurrage at the agreed rate is fixed by the charter-party. If no demurrage is provided for by the charter- party, and the vessel is kept loading or discharging beyond the lay days, the shipowner is entitled to claim damages in respect of the loss which he has suffered by the detention of his ship ; or, if the vessel is detained beyond the fixed number of demurrage days.

damages for detention will be recoverable. Sometimes there is no time fixed by the charter-party for loading or discharging. The obligation in such cases is to load or discharge with all despatch that is possible and reasonable in the circumstances ; and if the loading or discharging is not done with subh reasonable despatch, the shipowner will be entitled to claim damages for the detention of his ship. The rate of demurrage (if any) will generally be accepted as the measure of ~~the damages for detention, but is not necessarily the true measure. When the claim is for detention and not demurrage the actual loss is recoverable, which may be more or may be less than the agreed rate of demurrage. The con~~ tract usually provides that Sundays and holidays shall be excepted in counting the lay days, but unless expressly stipulated this exception does not apply to the computation of the period of detention after the lay days have expired.

Dead freight is the name given ,to the amount of freight lost, and therefore recoverable by the shipowner from the charterer as damages if a full and complete cargo is not loaded in accordance with the terms of the charter-party.

The cesser clause has come into common use because very fre- quently the charterers are not personally interested in the cargo shipped. They may be agents merely, or they may have char- tered the vessel as a speculation to make a profit upon the bill of lading freight. The effect of the clause is that when the char- terers have shipped a full cargo they have fulfilled all their obli- gations, the

shipowner discharging them from all further liability and taking instead a lien on the cargo for payment of all freight, demurrage, or dead freight that may be payable to him. It has become an established rule for the construction of the cesser clause that, if the language used will permit it, the cesser of liability is assumed to be coextensive only with the lien given to the shipowner ; or, in other words, the charterers are released from those liabilities only for which a lien is given to the ship-owner. The shipowner is further secured by the stipulation already referred to, that if the total freight payable under the bills of lading is less than the full chartered freight the difference shall be paid to the shipowner before the vessel sails. A difB.culty which sometimes arises, notwithstanding these precautions, is that although an ample lien is given by the charter-party the terms of the bills of lading may be insufficient to preserve the same exten- sive lien as against the holder of the bills of lading. The shippers under the bills of lading, if they are not the charterers, are not liable for the chartered freight, but only for the bill of lading freight; and unless the bill of lading expressly reserves it, they are not subject to a lien for the chartered freight. The master may guard against this difBculty by refusing to sign bills of lading which do not preserve the shipowner's lien for his full chartered freight. But he is often put into a difficulty by a somewhat improvident clause in the charter-party requiring him to sign bills of lading as presented.

(2) A time charter-party is a contract between the shipowner and charterers, by which the shipowner agrees to let and the charterers to hire the vessel for a specified term for employment, either generally in any lawful trade or upon voyages within certain limits. A place is usually named at which the vessel is to be redelivered to the owners at the end of the term, and the freight is payable until such redelivery ; the t)wner almost always pays the wages of the master and crew, and the charterers provide .coals and pay port charges; the freight is usually fixed at a certain rate per gross reg-: ister ton per month, and made payable monthly in advance, and provision is made for suspension of hire in certain cases if the vessel is disabled; the master, though he usually is and remains the servant of the owner, is required to obey the orders of the charterers as regards the employment of the vessel, they agreeing to indemnify the owners from all liability to which they may be exposed by the master signing bills of lading or otherwise complying with the orders of the charterers ; and the contract is made subject to exceptions similar to those in bills of lading and voyage charter-parties. This is the general outline of the ordinary form of a time charter-party, but the forms and their clauses vaiy of course very much, according to the circum- stances of each case.

It is apparent that under a time charter-party the shipowner to a large extent parts with the control of his ship, which is employed within certain limits accord-

ing to the ~~wish and directions, and for the purposes and profit of, the Qharterers. But, as we have already ex~~ plained at the beginning of this article, the shipowner continues in possession of his vessel by his servant the master, who remains responsible to his owner for the safety and proper navigation of the ship. The result of this, as has been already pointed out, is that the holder of a bill of lading signed by the master, if he has taken the bill of lading without knowledge of the terms of the time charter-party, may hold the owner responsible for the due performance of the contract signed by the mas- ter in the ordinary course of his duties, and within his ostensible authority as servant of the shipowner, although in fact in signing the bill of lading the master was act- ing as agent for and at the direction of the time char- terer, and not the shipowner. In the language of the ordinary time charter-party the ship is let to the char- terers ; but there is no true demise, because, as we have pointed out,

the vessel remains in the possession of the shipowner, the charterer enjoying the advantages and control of its employment. Where the possession of a ship is given up to a hirer, who appoints his own master and crew, different considerations apply ; but though the instrument by which the ship is let may be called a charter-party, it is not truly a contract of affreightment. There are certain rights and obligations arising out of the relationship of shipowner and cargo-owner in cir- cumstances of extraordinary peril or urgency rhibts”"^ ^^ the course of a voyage, which, though not strictly contractual, are well established by the custom of merchants and recognized by the law. It is obvious that, when a ship carrying a cargo is in the course of a voyage, the master to some extent represents the owners of both ship and cargo. In cases of emer- gency it may be necessary that the master should, with- out waiting for authority or instructions, incur expense or make sacrifices as agent not only of his employer, the shipowner, but also of the cargo-owner. Ship and cargo may be in peril, and it may be necessary for the safety of both to put into a port of refuge. There it may be necessai-y to repair the ship, and to land and warehouse, and afterwards reship the cargo. For these purposes

the master will be obliged to incur expense, of which some part, such as the cost of repairing the ship, will be for the benefit of the shipowner ; part, such as the ware- housing expenses, will be for the benefit of the cargo- owner; and part, such as the port charges incurred in order to enter the port of refuge, are for the common benefit and safety of ship and cargo. Again, in a storm at sea, it may be necessary for the safety of ship and cargo to cut away a mast or to jettison, that is to say, throw overboard part of the cargo. In such a case the master, acting for the shipowner or cargo-owner, as the case may be, makes a sacrifice of part of the ship or part of the cargo, in either case for the purpose of saving ship and cargo from a danger common to both. Voluntary sacrifices so made and extraordinary expenses incurred for the common safety are called General Aveeagb (q.v.) sacrifices and expenses, and are made good to the person who has made the sacrifice or incurred the expense by a general average contribution, which is recoverable from the owners of the property saved in proportion to its value, or, in other words, each contrib- utes ratably according to the benefit received. The law regulating the rights of the parties with regard to such contribution is called the Law of General Average. It must, however, be remembered that the owner of the cargo is entitled under the contract of affreightment to the ordinary service of the ship and crew for the safe carriage of the cargo to its destination, and the ship- owner is bound to pay all ordinary expenses incurred for the purpose of the voyage. He must also bear all losses arising from damage to the ship by accidents. But when extraordinary expense has been incurred by the ship- owner for the safety of the cargo, he can recover such expense from the owner of the cargo as a fecial charge on cargo; or when an extraordinary expense has been incurred or a voluntary sacrifice made by the shipowner to save the ship and cargo from a peril common to both, he may require the owner of cargo to contribute in gen- eral average to make good the loss.

See Carter, Carriage by Sea. London, 1899. — SoHniTON, Charter-parties and Bills of Lading. London, 1900. (w.)

AFGHAl^ISTAK

Geography and Statistics.

YEEY much was contributed to our knowledge of Afghadistan during the last quarter of the 19th century. The Afghan war of 1878-8Q afforded an oppor- tunity for the extension of wide geographical surveys on a scientific basis; and this opportunity was afterwards repeated by the Russo-Afghan Boundary Commission of 1884-86. Since then much of the country on the imme- diate borders of India has been explored by the native employes of the Indian Survey during the progress of a series of minor expeditions ; and the boundary delimita- tions which resulted from the agreement of November 1893 at Kabul, together with the frontier campaign of 1897-98, have finally

reduced the geography of the whole borderland to practical shape. For the purposes of this article there will be included within the general term “Afghanistan ” not only those districts which fall within the new political boundaries of the Kabul Government, but those states on the border, lying between Afghan- istan and British India, whose status has- lately been defined as ” independent,” and which are peopled either by Pathans or Afghans, speaking the same language and belonging to the same religious community as the Afghans of the Kabul kingdom.

Biver Basins. — Whilst, broadly speaking, the chief features of Afghan topography and hydrography were well enough known previously to the Afghan war of 1878, certain modifications in detail are to be noted in modem maps, and much supplementary information can now be added. It will be convenient to deal with Afghanistan under the natural divisions of its river basins rather than of the separate provinces included within its polit- ical boundaries. The following are the chief hydro- graphic divisions of the country — (1) the Kabul river and its tributaries; (2) the Indus affluents, which for the most part drain the independent provinces of the frontier ; (3) the Oxus basin ; (4) the basin of the Hel- mand ; (5) the basin of the Hari Eud.

The Kabul river rises at the foot of the Unai pass, leading over the Sanglakh range, an offshoot of the Hindu Eush, towards Bainian and Afghan Turkestan. From its source to Kabul is only 45 miles as the crow flies, and the amount of water which the river carries is small and often insufficient for purposes of irriga/- tion. Neither in volume nor in length is it to be compared with the Logar river, which joins it at a point less than half a mile east of Kabul. The Logar rises beyond Ghazni, amongst the slopes of the Gul Koh (14,200 feet) which overlooks the Ghazni plain from the west, and with minor affluents drains the rich valleys of Logar and Wardak for more than 100 miles ere it emerges from the gorges of the Shakh-i-Barant to join the Kabul

in the plain that stretches to Butkak. The valleys of the Logar are amongst the richest and most picturesque of Afghanistan. The united streams pass from the Kahul plain (6900 feet) through a precipitous gorge into the lower level of the Doaba to the north of the Kabul-Lataband road, and do not touch the road again till they pass Jalalabad. Meanwhile the volume of the river has been swelled at Doaba by the Tagao, which carries the drainage of the eastern slopes of the Hindu Kush from the head of the Jeanjshir, at the Khawdk pass (11,640 feet) to the sources of the Ghorband, near the junction of the Hindu Kush with the Koh-i-Baba. Into the Tagao fall the rivers and streams of the Koh Daman north of Kabul as well as those of a considerable section of Kohistan, which forms Western Kaflristan ; so that the Tagao affluents com- bined present probably a greater volume than the Kabul, at Doaba. Before reaching Jalalabad the Kabul receives another great contribution from the north in the united waters of the Alingar and the Alishang, which, under the former name, join in the Laghman plain. These two rivers between them drain all Central Kaflristan south of the Hindu Kush, and unite with the main channel of the Kabul in a broad clear stream which gives

little indication of its mountain origin. Very little is known about the catchment areas of these two rivers. It is a vast wilderness of mountains, the gates of which are jealously guarded by the Afghan Government ; but the lower reaches of the Alingar pass through comparatively open plains, and are fringed with flourish- ing villages. The Laghman (or Lamghdn) plain is important as indicating the ancient route from Kabul to India, which, instead of passing through Nangrahar and Jalalabad, followed the course of the Kabul river through this plain into the Kunar valley, and thence passed

into Bajaor, and was carried by one of several frontier passes into the plains of Peshawur. The Khaibar is a modern route, regarded as a main line of communication. The southern affluents of the Kabul river are insignlflcant ; but two other great tributaries from the north — the Kunar, or river of Chitral, and the Swat (with its Panjkora affluent) — have been thoroughly examined. Only about one-third of the total length of the Kunar (270 miles from Lake Karambar on the Hiodu Kush to Jalalabad) is within the limits of Afghanistan. The new political boundary crosses the valley at Amawai, near the junction of the Bashgol river of Kaflristan with the Kunar. Above this point Chitral intervenes

English Miles o sp 190 130

SxBTOH Map of Afqhahistak.

‘ Walker & Cockerell sc.

between Afghanistan and the Gilgit province of Kashmir. Below it the eastern water-divide of the river shuts ofi Bajaor. The extreme narrowness of the river basin is remarkable, there being no considerable affluent from either side except the Bashgol, whilst the craggy ranges which intervene between the stream and the Panjkora on the east (or again between the Panjkora and Swat rivers), although of enormous altitude (from 12,000 to 15,000 feet), stand on a base which averages less than 25 miles. Nearly due east of Chitral the culminating peaks overlooking the sources of the, Panjkora to the south, and those of the Gilgit river to the east, rise to nearly 19,000 feet of altitude.

The Swat and Panjkora river basins belong to the Cis-Afghan independent territoi-y, which was largely exploited during the recent north-western expeditions. Their main characteristics are those of the Kunar ; but they rise far to the south of the sources of that river, the range which forms the southern water-divide of the Upper Gilgit basin enclosing those small tributaries amongst its southern spurs, which swell into big affluents ere they join these two historic streams. Much of the northern parts of their basins, including the districts of Darel and Tangir, immediately south of Gilgit, still remains to be explored. “Within historic times much of the Lower Swat, Panjkora, and Kunar valleys was occupied by Kafir tribes, the limits of their occupation being traceable by the

total absence of those Buddhist archseologlcal remains which abound on all sides of the sphere of paganism.

That part of the basin of the Indus beyond the Kabul and its tributaries which appertains to Afghanistan is incon- siderable. It includes hardly more than the upper tributaries of the Gomul river, which rise in the plains between Wazi- ristan and Ghazni, but the area of Cis-Afghan independent territory which is dramed by the Indus is both extensive and politically important. Kanjut, the glacial region which gives birth to the Hunza river; the valleys of Yassin and of ‘ the Upper Gilgit; a long strip of territory adjoining the Indus— the region to which the name Kohistan is frequently given — all this independent territory forms a northern section of the Indus basin apart from the Kabul tributaries. Farther south the rivers of the frontier — the Kuram, the Tochi, the Gomul, and others between these, too many to enumerate — all drain downwards from the Afghan frontier through the independent strip of mountain barrier to effect (where the intervening sands permit) a junction with the Indus.

As all this country has been geographically surveyed, the outline of the disjointed hydrographioal network which forms the western catchment of the Indus between Attok and the Gomul (where the political boundary of Baluchistan intervenes) may be best studied

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on the maps of the Indian Survey. The frontier valleys belong ■A A distinct geological types. They are either deep, steep- sided valleys, with rapid streams carrying quantities of debris, or, where the upheaval of the river bed has been too rapid for the cuttmg-down action of the river, and the grade has been lessened, an alluvial plain has been formed, which affords a broad, open, and gently-rising ramp leading up to the Afghan plateau. Such are the valleys of the Kuram and the Tochi. The general flow of all these frontier affluents of the Indus from the Afghan plateau to the plains of the Derajat is directly across the axis of the minor frontier ranges, which lie packed in parallel lines of ridge and furrow, forming a series of grades, or steps, from the lower to the higher level. The streams rise on the plateau west of, and beyond, the prominent line of highest elevation, breaking straight through the hard sandstone or limestone ranges, and forming deep gorges where they pass; whilst their tributaries, joining almost at right angles in long narrow lateral valleys, wash the softer clays and. shales from ofE the surface of the harder rocks, and carry, down the debris to assist in grinding through the limestone barriers. The frontier hills between the Gomul and the Kuram present many instances of such narrow gateways to the Afghan highlands; to the south of the Gomul they form the most prominent type of opening into the hills. Two important river basins of Afghanistan, belonging to that central system which has no connexion with the sea, have been examined, and many interesting facts connected with them remain to be recorded. The Hari Bud, or river of Herat, which loses itself in the Tejend oasis north of the Trans-Caspian Railway, and west of Merv, rises in the western slopes of the Koh-i-Baba, the mountain mass which abuts on, and closes, the Hindu Kush to the west of Kabul. It runs a remarkably straight course west- ward through a narrow trough from Daolatyar to Obeh. This trough lies between the southern ridge of the great Central Afghan watershed, which holds the head-waters and sources of the Murghab on the north, and the narrow water-parting formed by the Band-i-Bai4n and Koh-i-Sufed on the south. From this latter divide the tributaries of the Farah Rud and other rivers of the Sistan basin take their rise. The deeply-eroded valley of the Hari Rud, filled in with the detritus washed down by periodi- cal floods from the soft loess formations of sand and clay which enclose it, is of great fertility in its lower and wider reaches between Obeh and Kuhsin, 50 miles west of Herat ; but its upper course is barren and sand-spread, winding amidst the bleak wind-swept uplands of the highest central elevations in Afghanistan. The most notable features about the lower Hari Rud are the absolute exhaustion of its waters in the early summer seasons of irrigation, and the rapidity with which natural processes of denudation are lowering its bounding watersheds. Immediately north of Herat the central water-divide, which is locally known by the name of Siah Bubuk (but to which the general term Paropamisus has been given in order to preserve a historical designation which belongs more correctly to the Hindu Kush), is being reduced so rapidly to a flnal stage of rounded curves and gentle declivities that it is already possible to drive a wheeled carriage across it without any preliminary road-making. The sources of the Helmand, like those of the Hari Rud, lie in the recesses of the Koh-i-Baba to the west of Kabul, its infant stream parting the Unai pass from the Irak, the two chief passes on the well-known road from Kabul to Bamian. For fifty miles from its source its course is ascertained, but beyond that point for the next fifty no European has followed it. About the parallel of 33° N. lat. it enters the Zamindawar province, which lies to the north-west of Kandahar, and thence- forward it is a well-mapped river to its termination in the Lagoons, or Hamlin, of Sistan. This great central depression, which is about 1700 feet above sea-level, also receives the waters of several northern affluents, of which the Harut, the Farah, and the Khash are the principal. They drain the highlands occupied by the Taimani section of the Chahar Aim^ik. About the upper affluents of the Farah lie the fertile valleys which surrounded Taiwara, . the capital of the ancient kingdom of Ghor, and here the Taimani

highlands culminate in peaks rising to a height of over 12,000 feet above sea-level. For 200 miles due east of Taiwara there stretches a region of “barren highland desolation marked by peaks of 11,000 to 13,000 feet, the home of the Hazaras. Herein is enclosed a northern section of the valley of the Helmand, and in this portion of the valley is situated Ghizao, marking a great road from north to south. No other place of any significance is known in this region. All these northern affluents of the Sistan Hamiins partake more of the nature of highland rivers than the broad and comparatively placid Helmand. Throughout its great southern curve the Helmand shapes an even and solitary course, receiving no contributions from either side, through a valley which is exceedingly narrow, but fertile and green, and full of the last relics of departed townships belonging to that Kaiani kingdom which once centred on Kala Fath. From the Helmand, near its great bend northwards, a most extensive system of irrigation was

once devised, a system which watered hundreds of square miles of now barren plain to the west.

A noteworthy feature of the Sistan lagoon is that in times of excessive flood it overspreads a vast area of country, both to the north and south, shutting off the capital of Sistan (Nasirabad) from surrounding districts, and spreading through a channel southwards known as Shelag to another great depression called the Gaud-i-Zirreh. This great salt swamp is about 1000 feet lower in elevation and is situated so close to the Helmand as to leave but a few miles of broken ridge between. By that ridge all communication with Sistan must pass in time of flood. Sistan becomes a promontory connected with the desert south of the Helmand by that isthmus alone. Recent boundary proceedings have included it within the Amir’s territory. The Afghan basin of the Oxus includes a part of the Pamirs and all Badakshan and Afghan Turkestan. Badakshan is drained by two main rivers — the Kokcha (or river of Faizabad) and the Khanabad, which takes its name from a town on its banks. Above the Kokcha junction the Oxus is a mountain-bred river, receiving no contributions of any importance from the Afghan side. Below the Khanabad the Oxus is a river of the plains ; and as far as Khamiab, where it ceases to be the boundary of Afghanistan, no Afghan river of any im- portance reaches it. The Tashkurghan river, the Band-i-Amir or Balkh river, the Shiburghan, and the Andkhui, all start for it, bringing down snow-fed torrents from the Koh-i-Baba, and Band-i- Turkestan in Spring, and tailing off into the countless irrigation channels in the Balkh plain ; but neither in winter nor in summer do any of them cross the fringe of sand desert that lies south of the Oxus river in cultivation. This appears to be due to the alter- ation of the plain levels by a gradual process of uphejival quite as much las to the absorption of the water-supply in irrigation. Where these rivers run into irrigation thfe plain is highly culti- vated; but the Oxus itself is no longer utilized for agricultural purposes, except within a comparatively narrow fringe. This fringe is, however, of considerable local importance (see Oxiis). On the western borders of Afghan Turkestan the Murghab river and the Hari Rud lose themselves in the Merv and Tejend oases. The Murghab starts from the Firozkhoi highlands (the northern scarp of which is defined by the Band-i-Turkestan), and, after traversing that plateau from east to west, it turns north through deeply-cut defiles to Bala Murghab and effects a final junction with the Kushk near Panjdeh. At Bala Murghab the valley is open, with the loess formation of the Chul bounding it on either hand. Beyond Panjdeh it emerges into the Yulatan desert.

Mountain Systems. — ^The dominant mountain system of Afghanistan is the Hindu Kush, and that exten- sion westwards of its water-divide which is indicated by the Koh-i-Baba to the north-west of Kabul, and by the Firozkhoi plateau (Karjistan), which merges still farther to the west by gentle gradients into the Paropamisus, and which may be traced across the Hari Kud to Mashad.

The culminating peaks of the Koh-i-Baba overlooking the sources of the Hari Rud, the Helmand, the Kunduz, and the Kabul, very nearly reach 17,000 feet in height (Shah Fuladi, the highest, is 16,870), and from them to the south-west long spurs divide the upper tributaries of the Helmand, and separate its basin from that of the Farah Rud. These spurs retain a consider- abte altitude, for they are marked

by peaks exceeding 11,000 feet. They sweep in a broad band of roughly .parallel ranges to the south-west, preserving their general direction till they abut on the Great Registan desert to the west of Kandahar, where they terminate in a series of detached and broken anticlinals whose sides are swept by a sea of encroaching sand. The long, straight, level-backed ridges which divide the Argandab, the Tarnak, and Arghastan valleys, and flank the route from Kandahar to Ghazni, determining the direction of that route, are outliers of this system, which, geographically, includes the Khojak, or Khwaja. Amran, range in Baluchistan.

North of the main water-divide of Afghanistan the broad, synclinal plateau into which the Hindu Kush is merged is. traversed by the gorges of the Saighan, Bamian, and Kamard tributaries of the-Kunduz, and farther to the west by the Band-i- Amir or Balkh river. Between the debouchment of the Upper Murghab from the Firozkhoi uplands into the comparatively low level- of the valley above Bala Murghab, extending eastwards in a nearly straight line to the upper sources of the Shiburghan stream, the Band-i-Turkestan range forms the northern ridge between the plateau and the sand formations of the Chul. It is a level, straight-backed line of sombre mountain ridge, from the crest of which, as from a wall, the extraordinary configuration of that immense loess deposit called the Chul can be seen, stretching away northwards to the Oxus — ridge upon ridge, wave upon wave, like a vast yellow-gray sea of storm-twisted billows. The Band-i- Turkestan anticlinal may be traced eastwards of the Balkh-ab

(the Band-i-Amir) within the folds of Kara Koh to the Kunduz, and heyond ; but the Kara Koh does not mark the northern wall of the great plateau nor overlook the sands of the Oxus plain, as does the Band-i-Turkestan. Here there intervenes a second wide synclinal plateau, of which the northern edge is defined by the flat outlines of the Elburz to the south of Mazar-i-Sharif , and immediately at the foot of this range lie the alluvial flats of Maz&r and Tashkurghan. . Opposite Tashkurghan the Oxus plain nar- rows to a short 25 miles. On the south this great band of roughly undulating central plateau is bounded by the Koh-i-Baba, to the west of Kabul, and by the Hindu Kush to the north and north-east of that city. Thus the main routes from Kabul to Afghan Turkes- tan must cross either one or other of these ranges, and must trav- erse one or other of the terrific defiles which have been carved out of them by the upper tributaries of the rivers running north- wards towards the Oxus. Probably in no country in the world are there gathered together within comparatively narrow limits so many clean-cut waterways, measuring thousands of feet in depth, affording such a stupendous system of narrow roadways through the hills.

After the Hindu Kush and the Turkestan ranges, that of the Safed Koh, which divides Ningrahar (or the valley of Jalalabad) from Kuram and the Afridi Tirah, is the most important, as it is the most impressive, in Afghanistan. But the general features of the Safed Koh have been sufficiently described already, and it only remains to illustrate its configuration in relation to the moun- tain systems about Kabul, and south of Peshawur. The highest peak of the Safed Koh, Sikaram, is 15,600 feet above sea-level. !From this central dominating peak it falls gently towards the west, and gradually subsides in long spurs, reaching to within a few miles of Kabul and barring the road from Kabul to Ghazni. At a pofnt which is not far east of the Kabul meridian an offshoot is directed southwards, which becomes the water-parting between the Kuram and the Logar at Shutargardan, and can be traced to a con- nexion with the great watershed of the frontier dividing the Indus basin from that of Helmand. This main watershed retains its high altitude far to the south. There are peaks

measuring over 12,000 feet on the divide between the Tochi and the Ghazni plains. At the eastern extremity the Safed Koh splits and spreads into several branches. Between these branches are the Bazar valley ; the Bara, which receives the Maidin drainage ; the Khanke, and other lesser valleys. The Afridi Tirah is but an upland basin held within the arms of some of the minor Safed Koh spin's, which, from the pecul- iarity of its formation and its narrow drainage outlet, contains a vast depth of highly fertile alluvial soil.

Between the Safed Koh and the Gomul (where lies the official boundary of Baluchistan) the frontier mountain system is more irregular than it is south of that river, where an invariable system of close parallel flexures predominates. The first developments of this system are recognizable in the long straight ridges trending from north-east to south-west, which may be seen to the west of the peaks heading the Waziri group, forming the dividing line of the Indus basin. But this configuration is not so apparent in the Waziri hills or in those between the Kuram and the Kaitu, where the mountains are massed in more independent and isolated groups, facing steeply westwards and culminating on their western sum- mits in peaks 11,600 feet above sea-level. But the same conforma- tion of crumpled limestone ridges, overlaid with Tertiary deposits, which pervades all Afghanistan and Baluchistan, prevails also throughout Waziristan and determines its general outlines. The extension of a long ridge towards the Indus, which curves in a grand sweep northwards overlooking the river, introduces a wel- come break into the monotonous regularity of frontier scenery. On this ridge is the frontier hill station of Sheikh Budin.

Geology. — So far as we know at present the geological History of Afghanistan differs widely from that of India. When, somewhere at the commencement of the Cretaceous period, the peninsula of India was connected by land with Madagascar and Southern Africa, all Afghanistan, Balu- chistan, and Persia formed part of an area which was not perhaps continuously below sea-level, but which ex- hibited alternations of land and sea. The end of the Cretaceous period saw the commencement of a series of great earth movements ushered in by volcanic eruptions on a scale such as the earth has never since witnessed, which resulted in the upheaval of the Himalaya by a process of crushing and folding of the sedimentary rocks till marine fossils were forced to an altitude of 20,000 feet above the sea. It was not till the Tertiary age, and even late in that age, that much of the land area of Afghanistan was raised above the sea-level. Then the

ocean gradually retired into the great Central Asian depressions.

Everywhere there have been great and constant changes of level since that period, and the process of flexure and the formation of anticlinals traversing the northern districts of Afghanistan is a process which is still in action. So rapid has been the land eleva- tion of Central Afghanistan that the erosive action of rivers has not been able to keep pace with that of upheaval ; and the result all through Afghanistan (but specially marked in the great central highlands between Kabul and Herat) is the formation of those immensely deep gorges and defiles which are locally known as "daras." One of these, in the Astardb, to the south-east of Maimana, is but 30 yards wide, and is enclosed between per- pendicular limestone cliffs 1500 feet high. Throughout Afghan Turkestan and Afghanistan the lowest beds belong to a marine' Car- boniferous era. These are overlaid by a long succession of strata, partly marine and partly fluviatile, forming an unbroken series up to Jurassic times. On the upturned and denuded edges of these strata enormously thick beds of Cretaceous limestone rest unconf ormably ; above these, again, marine and freshwater deposits are spread. Griesbach considers that the general outline of the land configuration has remained much the same since Pliocene times, and that the force which brought about the wrinkling of the older deposits still continues to add fold on fold. The high- lands which shut off the Turkestan provinces from Southern Afghanistan have afforded the best opportunities for geological investigation, and, as might be expected from their geographical position, the general result of the examination of exposed sections leads to the

identification of geological a£Bnity with’ Himalayan, Indian, and Persian regions. The general configuration pf the Turkestan highlands has been already indicated. Against the last great fold which terminates this mountain area northwards are ranged the Tertiaries and recent deposits. North of Maimana they form low undulating loess hills, in which most of the Band-i- Turkestan drainage is lost. This wide-spreading loess area, formed partly of wind-blown sand and partly of detritus from the moun- tains, is known as Chul, and merges into the great plains south of the Oxus river, a great part of which is covered with modern aerial deposits. Beneath this Chul formation the older beds of the outer and Turkestan ranges dip and pass IjO an irregular outcrop near the banks of the Oxus. Between the Oxus and the hills there has already been formed a rise or flexure in the ground, which extends more or less parallel to the northern edge of the hills, and, shutting in the cultivated area of the plains, arrests all tribu- taries seeking to effect a junction with the Oxus from the south, and leads to the formation of marshes and swamps. This appears to be the commencement of a new anticlinal which has altered the levels of the Balkh plain, and is indicative of those elevating processes which may have been effective within historic times in changing the climate and the agricultural prospects of this part of Central Asia. The Oxus itself is steadily encroaching on its right banks and depositing detritus on the left.

No fresh discoveries of minerals likely to be of high economic value to Afghanistan have been made, of late years. Such as are known and worked at present have been worked from very ancient times, and their capacity is not likely to develop greatly under the Kabul Government. The most important feature in this con- nexion which was noted by the geologist of the Eusso-Afghan Commission is the existence of vast coal beds in Northern Afghanistan.

There are no glaciers now to be found in Afghan Turkestan ; but evidences of their recent existence are abundant. The great boulder bed terraces in some of the valleys of the northern slopes of the Ferozkhoi plateau are probably of glacial origin. In the mountains west of Kabul glaciers have retired, leaving the mo- raines perfectly undisturbed. They were probably cotemporary with the older alluvia.

Climate. — Over an area so large as Afghanistan, involv- ing such varied conditions of geographical conformation, we find, as we might expect, a varied climatic record. Taking the highlands of the country as a whole there is no great difference between the mean temperature of Afghan- istan and that of the lower Himalaya. Each may be placed at a point between 50° and 60° F. But the remark- able feature of Afghan climate (as also of the climate of Baluchistan) is its extreme range of temperature within limited periods. The least daily range in North- ern Afghanistan is in the cold weather, the greatest in the hot. For seven months of the year (from May to Novem- ber) this range exceeds 30° F. daily. The coldest month of the year is February, the mean minimum being 17° F.,

and the maximum 38°, in the northern Herat districts. Waves of intense cold occur, lasting for several days, and one may have to endure a cold of 12° below zero, rising to a maximum of 17° below freezing-point. The eastern reaches of the Hari Eud river are frozen hard in winter, rapids and all, and the people travel on it as on a road. On the other hand the summer temperature is exceed- ingly high, especially in the Oxus regions, where a shade maximum of 110° to 120° is not uncommon. Afghanistan lying outside monsoon influences, there are steadier weatiier indications than there are in India. The north- west blizzards which occur in winter and spring are the most notable feature, and

their influence is clearly felt on the Indian frontier. The cold is then intense and the force of the wind cyclonic. It was a blizzard of this na- ture which proved so disastrous to the Afghan Boundary Commission in April 1886.

Political Boundaries. — In the realm of political geo- graphy, whilst no great changes have' lately been effected in the political status of Afghanistan as an independent state subject to British suzerainty, more exact definition has been given to the extent of territory under Kabul rule ; and the geographical limits of the Amir's respon- sibility have been more distinctly laid down by the delim- itation of boundaries. These delimitations commenced with the Eusso-Afghan Commission of 1885, and they concluded with the Mohmand expedition of 1897, at the close of a long series of disjointed efforts arising out of the agreement signed at Kabul in November 1893.

Commencing with the Persian border at Zulflkar on the IJari Kud river, the boundary between Afghanistan and Russia follows a line roughly parallel to the coiu^e of the Paropamisus, and about 35 miles to the north of it, till it strikes the Kushk river in Jamshidi territory at a point which was once known as Chahil Duktejan, but is now the Russian station of Kushk, and the terminus of a branch railway from Merve. The Russian Kushk is about 20 miles below the old Jamshidi settlement of the same name, itself about 15 miles north of the crest of the Paropamisus. The height of the Russian station is about 2000 feet above sea, and there is a rise of 4000 feet to the crest of the Paropamisus. From here to Herat (roughly 25 miles) the fall is about 3800 feet. From Kushk the boundary runs north-east, crossing the Murghab near Maruchak (which is an Afghan fortress), and thence passes north-east through the loess hills of the Chul, and the undulating deserts of the Aleli Turkmans, to the Oxus, leaving the valleys of Charshamba and of the Andkhui (to which it runs approximately parallel) within Afghan limits. These valleys denote the limits of cultivation in this direction. Throughout all this region the boundary is generally of an artificial character, marked by piUars, but it is here and there indicated by natural features forming local lines of water-parting or water-course. The boundary meets the Oxus at Khamiab at the western extremity of the culti- vated district of Khwaja Salar, and from that point to the eastern end of Lake Victoria in the Pamirs the main channel of the Oxus river forms the northern limits of Afghanistan (see Oxus). Eastwards from Lake Victoria the frontier line was determined by the Pamir Boundary Commission in 1895, A part of the little Pamir is included in Afghan territory, but the boundary crosses this Pamir before the great bend northwards of the Aksu takes place, and, passing over a series of crags and un- traversable mountain ridges, is lost on the Chinese frontier in the "snowflelds of Sarikol. Bending back westwards upon, itself, the line of Afghan frontier now follows the water-parting of the Hindu Kush ; and as the Hindu Kush absolutely overhangs the Oxus nearly opposite Ishkamish, it follows that, at this point, Afghanistan is about 10 miles wide. Thus a small and highly elevated portion of the State extends eastwards from its extreme north-eastern corner, and is attached to the great Afghan quadri- lateral by the thin link of the Panja valley. These narrow limits (called Wakhan) include the lofty spurs of the northern flank of the Hindu Kush, an impassable barrier at this point, where the glacial passes reach 19,000 feet in altitude, and the enclosing peaks 24,000 feet. The backbone or main water-divide of the Hindu Kush continues to form the boundary between Afghanistan and those semi-independent native states which fringe Kashmir in this mountain region, until it reaches Kaflristan. From near the Dorah pass (14,800 feet), which connects Chitral with the Panja (or Oxus) river, a long, straight, snow-clad spur reaches southwards, which divides the Kaflristan valley of Bashgol

from that of Chitral, and this continues to denote the eastern limits of Afghanistan till it nearly touches the Chitral river op- posite the village of Amawai, 45 miles south of Chitral. Here the Bashgol and Chitral valleys unite and the boundary passes to the water-divide east of the Chitral river, after crossing it by a spur which leaves the insignificant Arnawai valley to the north ; along this water-divide it extends to a point nearly opposite the quaint old tovyn of Pashat in the Kunar valley

(the Chitral river has become the Kunar in its course southwards), and then stretches away in an uneven and undefined line, dividing certain sections of the Mohmands from each other by hypothetical land- marks, till it strikes the Kabul river near Palosi. Thence fol- lowing a course nearly due south, it reaches Lundi Kotal. From the abutment of the Hindu Kush on the Sarikol in the Pamir regions to Lundi Kotal, and indeed throughout its eastern and southern limits, the boundary of Afghanistan which we are desicribing does not part that country from British India, but from certain outlying independent frontier districts, all of which lie beyond the boundary which Britain inherited from the Sikhs, and which is still recognized as the limit of British India. Kanjut, Chitral, Bajaor, the Mohmand districts. Swat, and Buner are all included in this fringe of quasi-independent territory, which, although the degree of independence enjoyed by it is of a differ- ent character altogether from that enjoyed by Afghanistan (being more immediately under British political control), has never yet. been included within the red line. From the neighbourhood of Lundi Kotal the boundary is carried to "the Safed Koh overlooking the Afridi Tirah, and then, rounding oft the cultivated portions of the Kuram valley below the Peiwar, it crosses the Kaitu and passes to the upper reaches of the Tochi. Crossing these again, it is con- tinued on the west of Waziristan, finally striking the Gomul river at Domandi. So far it has divided Aighanistan from the inde- pendent province of the Punjab. South of the Gomul it separates the interests of Afghanistan from those of Baluchistan. The Punjab independent provincesi are traversed by certain routes (the Khaibar, the Kuram, the Tochi, and the Gomul) which are held by British arms, and guarded by regulars or militia in British pay. At the western extremities of these routes India touches Afghanistan, and nowhere else. From Domandi (the junction of the Kundar river and the Gomul) the Afghan boundary marches with that of Baluchistan (see BALfccniSTAN). It is car- ried to the south-west on a line which is largely defined by the channels of the Kundar and the Kadanai to a point beyond the Sind Peshin terminal station of New Chaman, west of the Khojak range, and then drops southwards to Shorawak and Nushki. ■ From Nushki it crosses the Helmand desert, touching the crest of a well-defined mountain watershed for a great part of the way, and, leaving Chagai to Baluchistan, it strikes nearly west to the Persian frontier, and joins it on the Koh-i-Malik Siah mountain, south of Sistan. Two points of this part of the Afghan boundary are notable. It leaves some of the most fanatical of the Durani Afghan people on the Baluch side of the frontier in the Toba district, north of the Quetta^Chaman line of railway ; and it passes 50 mUes south of the Helmand river, enclosing within Afghanistan the only approach to Sistan from India which is available during the seasons of Helmand overflow. Between Afghanistan and Persia the boundary was defined by Sir F. Gold- smid's Commission in 1872 from the Malik-Siah-Koh to the Helmand Hamrins ; beyond those lagoons to the northward it is still indefinite till it touches the district of Hashtadum in lat. S4° 15'. Here again a small section of about 40 miles has been delim- ited as far as the Hari Eud river at Toman Agha (some 12 miles below KuhsSln), and from this point to Zulfekar the Hari Rud is itself the boundary.

Afghan Provinces. — Within the limits of this boundary the chief provinces of Afghanistan are those of Kabul, Zabul (or Kandahar), Herat, and Afghan Turkestan. The Kabul province mainly (for it is not possible to enter into details as regards these indefinite internal provincial boundaries) includes the Kabul basin, and Eoh. Eoh originally signified all the country of the Suliman and Khaibar hills so far as they are occupied by Pathnas, i.e., from Bajaor on the north to Peshin and Sibi on the south, and from the Indus to Ghazni and the Khojak in the west. The word Eoh means the same as Koh (a mountain), and the Eoh mountaineers are the Eohilla of history. By the late boundary demarcation a part of Eoh" has become independent of Afghanistan, and the name might conveniently be applied to all that independent

1 These provinces have been included in a political agency distinct from the Punjab since the above was written.

geography]

strip of territory which now intervenes as a buffer between British India and Afghanistan. Zabul includes Sistan, and, although well enough kuown to Afghans, the name has been superseded in colloquial English by Kandahar. It may be said to include the Helmand basin. Herat is, broadly speaking, the basin of the Hari Rud ; and Afghan Turkestan includes the plains of Balkh and BadakshSin.

Chief Cities. — The political and commercial activity of Afghanistan centres about the three cities of Kabul, Kandahar, and Herat, notices of which occur elsewhere in the Ency. Brit. Of other well-known cities of Af- ghanistan, Balkh (the mother of cities) and Ghazni are cities of the past, Mazar-i-Sharif is a religious, and Tash- kurghan a commercial centre for the Oxus provinces of Afghan Turkestan. Maimana, Andkhui, Khanabad, and Faizabad are all places of note — ^walled towns, with local commandants, or governors, and busy, well-filled bazaars. There are, indeed, more widespread signs of general in- dustrial activity in Afghan Turkestan than there are in the Herat and Kandahar provinces of Southern Afghan- istan, where wide spaces exist which do not include a single town of importance. This is especially the case towards the western frontier, where, however, such local centres as Farah and Sabzawar,and such smaller industrial communities as Adraskand, Kin, and many other frontier villages, would undoubtedly develop into significance if encouraged by a railway.

Independent Tribes. — Collaterally with Afghanistan the political geography of that independent strip of territory which intervenes between the Afghan frontier and British India requires notice, for some of it foi’med part of the Afghan Durani empire, together with a large portion of the Punjab and Sind. It is only since 1896 that this independent ” buffer ” territory has become a political entity by the creation of the present Afghan boundary. Whether it long survives beyond the red line of the Punjab or not, assuredly it wUl never form part of Afghanistan again.

From the central water-divide of the Hindu Kush there reaches southwards a wide strip of mountainous country, formed by its elevated and intricate spurs, to the borders of the Peshawur plain. On the west this mountain district is bounded by Afghan- istan ; on the east it stretches beyond the Indus to the Khagan valley and Kashmir. This great wilderness of mountains includes the Chitral basin north of Arnawai ; the valleys of Yasin, Kar- ambar (or Ashkumd,n), and Hunza (the last known, as Kanjut), all forming part of the Gilgit basin ; a considerable section of the Indus valley, in which lie the forts of Chilas and Takot ; together with the peaks of Kohistan, Darel, and Tangir ; the valley of Buner ; the valleys of the Swat, Panjkora, Dir, Bajaor, and a part of the Mohmand country. Some of these valleys are con- nected by political ties with Kashmir ; others are quite inde- pendent (see Gilgit). It is nothing but a broad waste of mountains intersected by narrow rock-bound valleys, and traversed “by routes which here and there are hardly distinguishable from the crudest goat-tracks. The southern part of this region, so full of geo- graphical surprises and thorny political problems, is usually termed Yaghistan (the country of the independents) by the frontier people, and throughout these southern tracts the domi- nant race is that of the Afghan Yusufzai. Amongst this vast array Of minor ranges, all of them offshoots of the Hindu Kush, the dividing ridge between the Gilgit drainage and the upper Chitral and Panjkora basins, which is called Shandur, is per- haps the most prominent feature. It shuts off Chitral from its base at Gilgit by a barrier which is over 12,000 feet in alti- tude. The alternative approach to Chitral from the south by Dir leads to no altitude greater than 10,500 feet — ^the height of the Lowarai pass leading from Dir to Kala Drosh. Yaghistan and the Chitral and Kanjut mountains separate British India effectu- ally from the highlands of the Pamirs. Across that independent mountain waste no irruption into India has ever spread from the north. It forms a barrier

which is practically as effective as that of Kaflristan on its western flank, and will continue to form a barrier so long as the glacier-bound passes and byways of the Hindu Kush are not improved into high-roads.

Immediately south of the Khaibar route the band of independ- ent territory is continued by the Afridi uplands of the eastern

spurs of the Safed Koh. Then occurs the Kuram valley and the irregular mountain belt occupied by the Shiah Turis and Jajis. Here once more, as at Lun4i Khana, British India touches Afghan- istan on the Peshawur spurs, the valley of the Kuram being held by British levies. Next there intervenes a rough independent mountainous district drained by the Kaitu, between the Kuram and Tochi, where again the British line of occupation penetrates the frontier to the Afghan boundary. Beyond this, to the south, lies the Switzerland of the frontier, Wazirifetan forming a separate geographical and ethnographical division from the rest of the frontier. Prom the Khaibar to the Gomul the character- istics of the borderland are wide, flattish valleys, with compara- tively gentle gradients filling in the open spaces between hills which are gradually being lowered by processes of denudation. There is little of that marked regularity of parallel flexures which is the prevailing feature south of the Gomul.

Ethnography. — ~~The term Afghan really applies to one section only of the mixed conglomeration of nationalities which forms the people of Afghanistan, but this is the dominant section. The predominance of the Afghan in Af~~ ghanistan dates from the middle of the 18th century, when Ahmad Shah carved out Afghanistan from the previous conquests of Nadir Shah, and called it the Durani empire.

The Afghans claim to be Sen-i-Israel, and insist on their descent from the tribes who were carried away captive from Palestine to Media by Nebuchadnezzai'. Yet they claim to be Pukhtun (or Pathto) in common with all other Pushto-speaking tribes, whom they do not a'dmit to be Afghan. The bond of afBnity between the various peoples who compose the Pathan community is simply the bond of a common language. All of them recognize a common code or unvfritten law called Pukhtun- wali, which appears to be similar in general character to the old Hebraic law, Uiough modified by Mahoramedan ordinances, and strangely similar in certain particulars to Eajput custom.

Since their national independence the Afghans of AfghanistM have styled themselves Durani. They are settled principally in the Kandahar country, extending into Sistan and to the borders of the Herat valley. Eastward they spread across the Afghan border into the Toba highlands north of the Khojak, where they are represented by Achakzai and Sadozai clans. They exist in the Kabul districts as Barakzai (the Amir's clan), and as Mah- mundzai (Mohmands) and Yusufzai they occupy the hills north of the Kabul river, Bajsior, Swat, Buner, and part of the Peshawur plains. All of the newly-demarcated independent provinces north of the Peshawur, and south of the Chitral and the Gilgit basin, are peopled with Afghans who are thus outside the frontier of Afghanistan.

After the Afghan the dominant people are the Pukhtun, or Pcahans, who are represented by a variety of tribes, many of which are recognized as being of Indian origin. These non- Afghan Pathans occupy the hilly regions on the immediate British frontier. The Afridi, Jowaki, and Orakzai clans hold the highlands immediately south of the Khaibar and Peshawur. The Turis of the Kuram (of the Shiah persuasion), the Dawaris of Tochi, and the Waziris of Waziristan flU up the intervening Pathan hills north of the Gomul. In the Kohat district the Khat- tak and Bangash clans are Pathan, so that Pathans are found on both sides of the border. Pathans are probably the Pactyii or PaotysB of Herodotus, who also mentions the Aprytse or Afridi. In the utter absence of written history or of trustworthy genealogi- cal evidence, the origin of most of the Pathan clans is likely ever to remain a mystery. It is enough that we can trace their existence in the regions they now occupy, or in contiguous districts,

from the days of Herodotus. The immediate connexion of Britain with the Pathan of the Indian border makes him an important item in frontier ethnography ; but he is not (within the limits of Afghanistan) to be considered as a political factor of anything like equal importance with the Ghilzai.

The Ghilzai is reckoned a Pathan, and he is connected with the Afghan ; but he is of an entirely distinct origin, and he only claims ties of faith and affinity of language with other Afghan peoples — he does not admit kinship. The popular theory of the origin of the Ghjlzai traces him to the Turkish tribe of Kilji, once occupying districts bordering the upper course of the Jexartes, and affirms ,that he was brought into Af- ghanistan by the Turk Sabaktegin in the 10th century of our era. However that may be, the Ghilzai clans now rank collec- tively as second to none in strength of military and commercial enterprise. They are a fine, manly race of people, and it is from some of their most influential clans (Suliman Khel, Nasir Khel, Kharotis, &c.) that the main body of povindah merchants is derived. These frontier commercial travellers trade between Ghazni and the plains of India, bringing down their heavily-laden khafl as at the commencement of the cold weather, and retiring

to the hills again ere the summer heat sets in. Thousands of them may be found during the winter months circulating through the farthest districts of the peninsula, where it not infrequently happens that they prove to be troublesome, if not dangerous, visitors. The Pathan, however, who finds his way across the sea to Australia is not of the Ghilzai tribe. He usually belongs to the Kakur section of Pathans, who occupy a large district in Baluchistan. Ghilzai chiefs take a lead in the politics of the country and possess much influence at the court of Kabul.

Underlying the predominant Afghan and Ghilzai elements in Af- ghan ethnography is the Tajik, representing the original Persian pos- sessor of the soil, who still speaks his mother tongue. There are pure Persians in Afghanistan, such as the Kizzilbashes of Kabul, and the Naoshirwanis of Kharau ; but the name Tajik appears to be applied only to an admixture of original Arab and Persian stock (such as the Dehwars), who are the slaves of the community — hewers of wood and drawers of water. Everywhere the Tajiks are the cultivators in rural districts, and the shopkeepers and clerks in the towns. The Tajik is as much the slave of the Pathan in Afghanistan as is the Hindki (whose origin is similar) in the plains of the Indus. Yet the Tajik population of the richly-cultivated districts north of Kabul proved themselves to be of good fighting material in the Af- ghan war of 1879-80, and the few Kizzilbashes that are to be found in the ranks of the Indian army are good soldiers.

Next in importance to the Tajik is the Mongul Hasara, who also speaks a dialect of Persian, and belongs to the Shiah sect of Mahommedans. The Hazara are descendants of military colonists introduced by Chenghlz Khan ; they occupy all the highlands of the upper Helmand valley, spreading through the country between Kabul and Herat, as well As into a strip of territory on the frontier slopes of the Hindu Kush north of Kabul. In the western provinces they are known as the Chahar AimAk (Hazaras, Jamshides, Taimanis, and Ferozkhois), and iu other districts they are distinguished by the name of the territory they occupy. They are pure Monguls, intermixing with no other races (chiefly for the reason that no other races wUl intermix with them), preserving their language and their Mongul characteristics uninfluenced by their surroundings, having absolutely displaced the former occupants of the Hazarajat and Ghor. They make good soldiers and excellent pioneers. The

Amir's companies of engineers are recruited from the Hazaras, and they form perhaps the most effective corps in his heterogeneous army.

In Afghan Turkestan we find the Tajik mixed with Turkish races — ^the Usbak and Turkman. Much interesting literature exists about the Turkman, the original Turk of Asia. By some ethnographers he is associated with the red-skinned Rajput in those early days when he was known to ancient geographers as Skyth. Others see in him an offshoot from the same original sources which developed the Teuton. He is at any rate non- Mongolian, and the old race hatred between Turk and Mongul is hardly less bitter now than it was in the days of Zahir-u-din Mahommed, otherwise called Babar, the royal Turk adventurer who founded that dynasty of Turkish emperors on the throne of Delhi which has been known to posterity as "Moghul." The chief Turkman tribes left to Afghan rule are the Alieli of the Daolatabad-Andkhui districts and the Ersari of the Khwaja Salar section of the Oxus frontier. Originally robbers and raiders, they are- all of them now engaged in agricultural pursuits.

North of Kabul, in the Kohistan that borders Kaflristan, are certain races of mixed origin speaking Persian dialects, such as the Nimchas, Safis, &c., who fringe round the central mountain wilderness of Kaflristan, where are to be found secluded valleys and glens containing tribes and peoples (collectively called ^a^ra), who speak dialects innumerable, and who were till lately inde- pendent of Afghanistan. Remnants of the ancient Baktria, flotsam and jetsam from old Greek colonies, ihtermingled with people of Indian origin forced upwards from the plains, are all represented in the Kaflristan wilderness. The ethnography of Kaflristan still requires elucidation. The well-known claim of the Kaflr to be considered as of Greek extraction is partially supported by the late identification of a tribe of Kamdesh in lower Bashgol with the ancient Nicseans of Arrian's history ; and it seems probable that, with the progress of scientific investiga^ tion, recent theories of recognizable Greek elements in the popu- lation of certain districts south of Kabul will be fully sustained.

Roads and Passes. — Omitting the group of northern routes to India from Central Asia, which pass between Kashmir and Afghanistan through the defiles of Chitral and of the Indus (see Hindu Kush), the highways of Afghanistan may be classed under two heads : (1) Foreign traSe routes, and (2) Internal communications.

Of the many routes which cross the frontiers of Afghanistan the most important commercially are those which connect the Oxus regions and the Central Asian Khanates with Kabul, and

those which lead from Kabul, Ghazni, and Kandahar to the plains of India. Kabul is linked with Afghan Turkestan and Badak- shan by three main lines of communication across the Koh-i-Baba and the Hindu Kush. One of these routes follows the Balkh river to its head from Tashkurghan, and then preserving a high general level of 8000 to 9000 feet, it passes over the water-divides separating the upper tributaries of the Kunduz river, and drops into the valley formed by another tributary, at Bamian. Erom Bamian it passes over the central mountain chain to Kabul either by the well- known passes of Irak (marking the water-divide of the Koh-i-Baba) and of Unai (marking the summit of the Sanglakh, a branch of the Hindu Kush), or else, turning eastwards, it crosses into the Ghorband valley by the Shibar, a pass which is considerably lower than the Irak and is very seldom snowbound. From the foot of the Unai pass it follows the Kabul river, and from the foot of the Shibar it follows the circuitous route which is offered by the drainage of the Ghorband valley, to Charikar, and thence southwards to Kabul. The main points on this route are Haibak, Bajgah, and Bamian. It is full of awkward grades and minor passes, but it does not maintain a high level generally, no pass (if the Shibar route be adopted) much exceeding 10,000 feet. That this has for centuries been regarded as the main route northward from Kabul, the Buddhist relics of Bamian and Haibak bear silent witness ; but it may be doubted whether the Amir's talent for roadmaking has not opened out better alter- native lines. One of his roads connects Haibak with the Ghor- band valley by the Chahardar pass across the

Hindu Kush. The pass is high (nearly 14,000 feet), but the road is excellently well laid out, and the route, which, south of Haibak, traverses a corner of the Ghori and Baghlan districts of Badakshan, is more direct. A third route also passes through Badakshan, and con- nects Kunduz with Charikar by the Khawdk pass and Panjshir river. The latter joins the Ghorband close to Charikar. The Khawdk (11,600 feet) is not a high pass ; the grades are easy and the snowfall usually light. This iigh road is stated (on Afghan authority) to be kept open for khafila trafSc all the year round by the employment of forced labour for clearing snow. It is a recently-developed route and one of great importance to Kabul, both strategically and commercially. Routes passing westwards to the Afghan highlands through the mountain barriers of the frontier between Peshawur and the Gomul occur at intervals along the western border, and in this northern section of the north-west frontier they are all well marked. The Khaibar, Kuram, and Tochi are the best known, inasmuch as all these lines of advance into Afghanistan are held by British troops or Indian levies. But the lately-explored Bara valley route into the heart of the Afridi Tirah is not to be altogether overlooked, although it is not a trade route of any importance. The Khaibar route is described elsewhere. It should be noted that it was not in ancient times the main route of advance from Kabul to Peshawur. From Kabul the old route followed the Kabul river through the valley of Laghman (or Lamghan, as the Afghans call it) over a gentle water-parting into the Kunar valley, leaving Nangrahar and Jalalabad to the south. From the Kunar it crossed into Bajaor by one Of several open and comparatively easy passes, and from Bajaor descended into India either by the Malakand or some other contiguous frontier gateway to the plains of Peshawur. The Kuram route involves the Peiwar and the Shutargardan passes (8600 and 10,800 feet respectively) across the southern extensions of the Safed Koh range, and has never been a great trade route, however suitable as an alternative military line of advance. Although trade at present does not extend largely between Afghanistan and India by the Tochi route, being locally confined to the valley and the districts at its head, yet this is the shortest and most direct route between Ghazni and the frontier, and in the palmy days of Ghazni raiding was the road by which the great robber Mahmud occasionally descended on to the Indus plains. Traces of his raiding and roadmaking are still visible, but it is certain that he made use of the more direct route to Peshawur far more frequently than he did of the Tochi. The exact nature of thfe connexion between the head of the Tochi and the Ghazni plain is still unknown to us. The > Gomul is, and has ever been, the great central trade route between Afghanistan and India ; and the position, which has lately been occupied by a British post at Wana, will do much to ensure its continued popularity. The Gomul involves no passes of any great difficulty, although it is impossible to follow the actual course of the river on account of the narrow defiles which have been cut through the recent conglomerate beds whiph flank the plains of the Indus. It has been carefully surveyed for a possible railway alignment ; and an excellent road now connects Tank (at its foot) with the Zhob line of communications to Quetta, and with Wana on the southern flank of Waziristan. The Gomul route is of immense importance, both as a commercial and strategic line, and in both particulars is of far higher signifi- cance than either the Kuram or the Tochi.

statistics]

Of the interior lines of communication, those which connect the great cities of Afghanistan, Herat, Kabul, and Kandahar, are obviously the most important. Between Kabul and Herat there is no “royal” road, the existing route passing over the fre- quently snowbound wastes that lie below the southern flank of the great Koh-i-Baba into the upper valleys of the Hari End tributaries. It is a waste, elevated, desolate region that the route traverses, and the road itself is only open at certain seasons of the year. Between Kabul and Kandahar exists the well-known and oft-traversed route by Ghazni and

Kalat-i-Ghilzai. There is but one insignificant water-parting — or kotal — a little to the north of Ghazni ; and the road, although unmade, may be considered equal to any road of its length in Europe for military purposes. Between Kandahar and Herat ther? is the recognized trade route which crosses the Helmand at Girishk and passes through Farah and Sabzawar. It includes about 360 miles of easy road, with spaces where water is scarce. There is not a pass of any great importance, nor a river of any great difBoulty, to be encountered from end to end, but the route is flanked on the north between Kandahar and Girishk by the Zamindawar hills, containing the most truculent and fanatical clans of all the Southern Afghan tribes. Little need be said of the 65 miles of route between Kandahar and the Baluchistan frontier at New Chaman. It is on the whole a route across open plains and hard, stony "dasht" — a route which would offer no great difiBculties to that railway extension from Chaman which has so long been contemplated. A very considerable trade now passes along this route to India, in spite of the almost prohibitive imposts of the Amir ; but the trade does not follow the railway from New Chaman to the eastern foot of the Khojak. This part of the line is officially " boycotted " by the court at Kabul, and long strings of camels may still be seen from the train windows patiently treading their slow way over the Khojak pass to Kila Abdullah, whilst the train alongside them rapidly twists through the mountain tunnel into the Peshin valley.

Statistics. — ^No trustworthy statistics exist showing either present numbers or fluctuations in the population of Afghanistan. Within the Amir's dominions there are probably from four to five millions of people, and of these the vast majority are agriculturists.

The cultivators, including landowners, tenants, hired labourers, and slaves, represent the working population of the country, and as industrious and successful agriculturists they are unsurpassed in Asia. They have carried the art of irrigation to great per- fection, and they utilize every acre of profitable soil. Certain Ghilzai clans are specially famous for their skill in the construc- tion of the karez or underground water-channel. There are two harvests in most parts of Afghanistan ; the first (consisting of cereals and some peas and beans) is reaped in summer, and the second in autumn, when rice, millet, arzun (panicum halicum), and Indian com ripen. Vast quantities of fruit are grown and exported to India from both Kabul and Kandahar. Assafoetida is indigenous to the western districts and also forms a consider- able item of export.

The manufactures of the country have not developed much during recent years. Postins (sheepskin clothing) and the many varieties of camel and goat's hair-cloth which, under the name of "barak," "karak," &c., are manufactured in the northern districts, are still the chief local products of that part of Afghan- istan. Herat and Kandahar are famous for their silks, although a large proportion of the manufactured silk found on the Herat market, as well as many of the felts, carpets, and embroideries, are brought from the Central Asian khanates. The district of Herat produces many of the smaller sorts of carpets (" galichas" or prayer-carpets), of excellent design and colour, the little town of Adraskand being especially famous for this industry ; but they are not to be compared with the best produ'cts of Eastern Persia or of the Turkman districts about Panjdeh.

The nomadic Afghan tribes of the west are chiefly pastoral, and the wool of the southern Herat and Kandahar provinces is famous for its quality. In this direction , the late boundary settlements have undoubtedly led to a considerable development of local resources. A large quantity of wool, together with silk, dried fruit, madder, and assafoetida, finds its way to India by the Kandahar route.

It is impossible to give accurate trade statistics, there being no trustworthy system of registration. The value of the imports from Kabul to India in 1892-93 was estimated at 221,000 Ex (or tens of rupees). In 1899 it was little over 217,000 Ex, the period of lowest intermediate depression being in 1897. These imports include horses, cattle, fruits, grain, wool, silk, hides, tobacco, drugs, and provisions (ghi, &c.). All this trade emanates from Kabul, there being no transit trade with Bokhara owing to the

heavy dues levied by the Amir. The value of the exports from India to Kabul also- shows great fluctuation. In the year 1892-3 it was registered at nearly 611,000 Ex. In 1894-5 it had sunk

to 274,000 Ex, and in 1899 it figured at 294,600 Ex. The chief items are cotton goods, sugar, and tea. In 1898-99 the imports from Kandahar to India were valued at 330,000 Ex, and the exports from India to Kandahar at about 264,000 Ex. Three- fourths of the exports consist of cotton goods, and three-eighths of the imports were raw wool. The balance of the imports was chiefiy made up of dried fruits. Comparison with trade statistics of previous years on this side Afghanistan is difficult, owing to the inclusion of a large section of Baluchistan and Persia within the official ” Kandahar ” returns ; but it does not appear that the value of the Western Afghanistan trade is much on the increase. The opening up of the route between Quetta and Sistap has doubtless affected a trade which was already seriously hampered by the Amir’s short-sighted restrictions.

The Government of Afghanistan is monarchical, and succes- sion to the throne is hereditary. There are five chief political divisions in the country — namely, Kabul, Turkestan, Herat, Kandahar, and Badakshan, each of which is ruled by a ” naib ” or governor, who is d,irectly responsible to the Amir. Under the governors of provinces the nobles and kazis (or district judges) dispense justice much in the feudal fashion. Apart from the universal system of bribery and spoliation to which they give rise, feudal methods are more popular (and possibly more effective with a people like the Afghans) than high courts and the slow machinery of. civil law would be. Swift even-handed justice is by no means rare in Afghanistan.

The Afghan army probably numbers nearly 50,000, distributed between the military centres of Herat, Kandahar, Kabul, Mazar-i-Sharif, Jalalabad, and Asmar, with detachments at frontier outposts on the side of India. The Amir’s factories at Kabul for arms and ammunition are said to turn out about 20,000 cartridges and 15 rifies daily, with 2 guns per week ; but it is probable that means are available for the acquisition of other military equipment than that manufactured in the country.

Financially, Afghanistan has never, since it first became a kingdom, been able to pay for its own government, public works, and army. There appears to be no inherent reason why this’ should be so. Whilst it can never (in the absence of any great ■mineral wealth) develop into a wealthy country, it can at least support its own population ; and it would, but for the short- sighted trade policy of the Amir, certainly have risen, during the last twenty years of peace, to a position of respectable solvency. Its revenues (about which no trustworthy informar tion is available) are subject to great fluctuations, and probably never exceed the value of one million sterling per annum. They fell in Sher All’s time to £700,000. The original subsidy to the Amir from the Indian Government was fixed at 120,000 Ex per annum, but in 1893 in connexion with the boundary settlement it was increased to, 180,000 Ex.

The religion of the country throughout is Mahommedan. Next to Turkey, Afghanistan is the most powerful Mahommedan kingdom in existence. The vast majority of Afghans are of the Sunni sect ; but there are, in their midst, such powerful com- munities of Shlahs as the Hazaras of the central districts, the Kizzilbashes of Kabul, and the Toris, or Turis, of the Kuram border, nor is there between them that bitterness of sectarian animosity which is so marked a feature in India. The Kafirs of the mountainous region of Kafiristan alone are non-Mahommedan. They are sunk in a paganism which seems to embrace some faint reflexion of Greek mythology, Zoroastrian principles, and the tenets of Buddhism, originally gathered, no doubt, from the varied elements of their mixed extraction. Those contiguous Afghan tribes once included in Kafiristan, who have not so long ago been converted to the faith of Islam, are naturally the most fanatical and the most virulent upholders of the faith around them. In and about the centre of civilization at Kabul, instances of Ghazidom are comparatively rare. In the western provinces about Kandahar (amongst the Durani or true ‘ Afghans— ^the people who

specially claim to be Ben-i-Israel), and especially in Zamindawar, the spirit of fanaticism runs high, and every other Afghan is a possible Ghazi — a man who has devoted his life to the extinction of other creeds.

Education is confined to most elementary principles in Afghan- istan. Of schools or colleges for the purposes of a higher, education befitted to the sons of noblemen and the more wesdthy merchants, there is absolutely none ; but the village school is an ever-present and very open spectacle to the passer-by. Here the younger boys are collected and instructed in the rudiments of reading, writing, and religious creed by the village mulla, or priest, who thereby acquires an early influence over the Afghan mind. The method of teaching is confined to that wearisome system of loud-voiced repetition which is so annoying a feature in Indian schools ; and the Koran is, of course, the text-book in all forms of education. Every Afghan gentleman can read and speak Persian, which is the language of the court, and which is, indeed, more often heard in Kabul than Pushtu ; but beyond this

acquirement (to which must certainly be added the arts and graces of good manners) education seems to he limited to the physical development of the youth by instruction in horsemanship and feats of skill. Such advanced education as exists in Afghanistan is cen- tred in the priests and physicians ; but the ignorance of both is almost phenomenal.

Authorities. — Since Afghanistan has been mapped and sur- veyed no comprehensive account of the country has been published. Apart from the survey reports and gazetteers of the Indian Gov- ernment, the following are the chief recent sources of information : — Kaye. History of the War in Afghanistan, 1878.— Mallb- soN. History of Afghanistan. London, 1879.— W. P. Simpson. “Jalalabad Region,” B.G.S. Proc, vol. i. 1879.— Dr H. W. Bellew. Afghanistan and the Afghans. London, 1879; “The Ethnography of Afghanistan,” Asiatic . Quarterly Review, Oct. 1891. — Major Holdich. ” Geographical Results of the Afghan Campaign,” B.O.S. Proc, vol. i. 1879.— Hensman. The Afghan War. London, 1881. — Major W. Broadfoot. “Reports on Part of the Ghilzai Country,” supplementary paper, B.G.S., vol. i. Part III. 1885. — C. L. Gkiesbaoh. “Afghan and Persian rield Notes,” Geol. Survey of India, vol. xix. Part I. 1886; “Field Notes from Afghanistan,” Geol. Survey of India, vol. xix. Part IV. 1886. — Captain A. C. Yate. England and Sussia’ face to face in Asia. Edinburgh, 1887.— Major C. E. Yate. North- ern Afghanistan. Edinburgh, 1888. — Maitland and Talbot. “Journeys in Afghanistan,” B.G.S. Proc, vol. ix. 1887. — W. L. Dallas. “The Climatology of Afghanistan,” J.U.S. India, vol. XX. 1891. — Oldham. “Evolution of Ipdian Geography,” Geog. Journ., vol. ill. 1894. — Major H. Ravbrty. “The Independent Afghan and Pathan Tribes,” Asiatic Quarterly Meview, vol. vii. 1894. — Dr Gray. At the Court of the Amir. London, 1895. — Hon. G. N. Cdezon. “A Recent Journey in Afghanistan,” P.B.I. 14, 1896.— Sir G. Robertson. l%e Kafir of the Hindu Kush. London, 1896.— Sir T. Holdich. “The Origin of the Kafir of the Hindu Kush,” Geog. Journal, vol. vii. 1896.

(t. H. H.*) Eecent Histoet.

In following the history of the course of affairs in Afghanistan during the 19th century, it should be Saddozais remembered that the Saddozais and BSrakzais and Barak- are two branches of the Durani

tribe, ■which was zais. raised to dominant power by its chief, Ahmed

Khan, the founder of an Afghan kingdom under the Sad- dozai dynasty towards the end of the 18th century. His descendants had ruled, amid many vicissitudes, at Kabul, until in 1818 the assassination by the reigning Amir of his powerful minister, Patteh Khan B^rakzai, led to a revolt headed by the BSrakzai family, which ended in the sbab expulsion of the Saddozai Shah Shujah, and the

shujab and establishment at Kabul of Dost Mahommed, Dost Ma- Patteh Khan's son ; while Shah Shujah took homme . j-gfuge i^ ~~fche Punjab. By this time the political situation of Afghanistan had become materially affected by the consolidation of a formidable military dominion on its eastern frontier in the Punjab, under Eanjit Singh and his Sikh army. Eanjit Singh took advantage of the distracted condition of Afghanistan to seize Kash~~ mir, and in 1823 he defeated the Afghans in a battle which gave him the suzerainty of the Peshawar province on the right bank of the Indus, though an Afghan chief was left to administer it. Ten years later Shah Shujah, the exiled, Saddozai Amir, made a futile attempt to re- cover his kingdom. He was defeated by Dost Mahom- med, when Eanjit Singh turned the confusion to his own account by seizing Peshawar and driving the Afghans back into their mountains.

At this point begins the continual interference of Eng- land and Eussia in the affairs of Afghanistan, which has inierier- ®^®^ since exercised a dominant influence upon ence of all Subsequent events and transactions. It has European not only transformed the situation of the ruling Powers. j^mirs, but has also profoundly affected the Asiatic policy of the two European Governments. Shah Shujah's enterprise in 1833 had been supported by the co-operation of Eanjit Singh, and encouraged by the British^ Viceroy, Lord W. Bentinck. Although the ex-

pedition failed, the result was to excite jealousy of the British designs ; and the Eussian envoy at Tehran insti- gated the Shah of Persia to attack Herat, the important frontier fortress of north-western Afghanistan, which was then in the possession of an independent chief. In 1837, in spite of remonstrances from the British representative at Tehran, a Persian army besieged the city, but the ap- pearance of British troops on the southern coast of Persia compelled the Persians to withdraw from Herat in 1838. The rivalry between England and Eussia was now openly declared, so that each movement from one side was fol- lowed by a counter move on the Afghan chess-board from the other side. The British ministry had been seriously alarmed at the machinations of Eussia and the attitude of Dost Mahommed at Kabul; and it was determined that the most effective means of securing their own interests within the country would be by assisting Shah Shujah to recover his sovereignty. A tripartite treaty was made between Eanjit Singh, the British Governor- General of India, and Shah Shujah; and a British army marched up the Bolan Pass to Kandahar, occupied that city, pushed on northwards to Ghazni, which was taken by assault, and entered Kabul in 1839. As Dost Mahom- med had fled across the northern mountains, Shah Shujah was proclaimed king in his stead. '

But this ill-planned and hazardous enterprise was fraught with the elements of inevitable failure. A ruler imposed upon a free people by foreign arms is British always unpopular; he is unable to stand alone; policy in and his foreign auxiliaries soon find themselves ^?*"'" obliged to choose between remaining to uphold his power, or retiring with the probability that it will fall after their departure. The. leading chief s of Afghan- istan perceived that the maintenance of Shah Shujah's rule by British troops would soon be fatal to their own power and position in the country, and probably to their national independence. They were iasatiable in their demands for office and emolument, and when they discovered that the Shah, acting by the advice of the British envoy, was levying from among their tribesmen regiments to be directly under his control, they took care that the plan should fail. Without a regular revenue no effective administration could be organized; but the at- tempt to raise

taxes showed that it might raise the people ; so that for both men and money the Shah's government was still obliged to rely principally upon British aid. All these circumstances combined to render the new regime weak and unpopular ; since there was no force at the ruler' s command except foreign troops to put down disorder or to protect those who submitted ; while the discontented nobles fomented disaffection and the inbred hatred of strangers in race and religion, among the general Afghan population. The result was that after two years' occupar tion of the country, in the vain hope of establishing a national government under Shah Shujah, the British found their own situation untenable; for the fierce and warlike tribes broke out into incessant revolt, until a serious insurrection at Kabul in the winter of 1841-42 compelled the British army to make an ignominious and disastrous retreat. The vs4iole force was lost on the road between Kabul and Jalalabad; but Jalalabad was success- fully defended by its British garrison, and General Nott held out at Kandahar vintil General Pollock's temporary re-occupation of Kabul in 1842 restored in. some degree the military reputation of Great Britain. The British troops then completely evacuated the country. Dost Mahommed, who had been a state prisoner in India, was replaced on the Kabul throne ; and the policy of inter- vention in Afghan affairs was suspended for nearly forty years.

It has been said, that the declared object of this policy

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had been to maintain the independence aid integrity of A roacb A^^^ianistan, to secure the friendly alliance of tow^Ss * ruler, and thus to interpose a great barrier Afghan- of mountainous country between the expand- '^it'and ^°? yowev of Eussia in Central Asia and the England. British dominion in India. After 1849, when

the annexation of the Punjab had carried the Indian north-western frontier up to the skirts of the Afghan highlands, the corresponding advance of the Russians south-eastward alon^ the Oxus river became of closer interest to the British, particularly when, in 1856, the Persians again attempted to take possession of Herat. Dost Mahommed now became the British ally, but on his death in 1863 the kingdom fell back into civil war, until his son Sher Ali had won his way to undisputed rulership in 1868. In the same year Bokhara became a dependency of Eussia. To the British Govern- ment an attitude of non-intervention in Afghan affairs appeared in this situation to be no longer possible. A meeting between the Amir Sher Ali and the Viceroy of India (Lord Mayo) at Umballa in 1869 drew nearer the relations between the two governments; the Amir con- solidated and began to centralize his power; and the establishment of a strong, friendly, and united Afghan- istan became again the keynote of British policy beyond the north-western frontier of India.

When, therefore, the conquest of Khiva in 1873 by the Eussians, and their gradual approach towards the Amir's ^^ northern border, had seriously alarmed Sher Ali,

^^t'^' he applied for support to the British ; and his sber All disappointment at his failure to obtain distinct B°M *b" pledges of material assistance, and at Great

Britain's refusal to endorse all his claims in a dispute with Persia over Seistan, so far estranged him from the British connexion that he began to entertain ami- cable overtures from the Eussian authorities at Tashkend. In 1869 the Eussian Government had assured Lord Claren- don that they regarded Afghanistan as completely outside the sphere of their influence; and in 1872 thfe boundary

line of Afghanistan on the north-west had been settled between England and Eussia so far eastward as Lake Vic- toria. Nevertheless the correspondence between Kabul and Tashkend continued, and as the Eussians were now extending their dominion over all the region beyond Af- ghanistan on the north-west, the British Government determined, in 1876, once more to undertake active meas- ures for securing their political ascendancy in that coun- try. But the Amir, whose feelings of resentment had by no means abated, was now leaning toward Eussia, though he mainly desired to hold the balance between two equally formidable rivals. The result of overtures made to him from India was that in 1877, when Lord Lytton, acting under direct instructions from Her Majesty's ministry, proposed to Sher Ali a treaty of alliance, Sher Ali showed himself very little disposed to welcome the offer; and upon his refusal to admit a British agent into Afghan- istan the negotiations finally broke down.

In the course of the following year (1878) the Eussian Government, to counteract the interference of England British "'i* th-Qix advance upon Constantinople, sent an expedition, envoy to Kabul empowered to make a treaty 187S-79. with the Amir. It was immediately notified to him from India that a British mission would be deputed to his capital, but he demurred to receiving it ; and when the British envoy was turned back on the Afghan fron- tier hostilities were proclaimed by the Viceroy in No- vember 1878, and the second Afghan war began. Sir Donald Stewart's force, marching up through Baluchistan by the Bolan Pass, entered Kandahar with little or no resistance ; while another army passed through the Khy- ber Pass, and took up positions at Jalalabad and other

places on the direct road to Kabul. Another force under Sir Erederick Eoberts marched up to the high passes leading out of Kuram into the interior of Afghanistan, defeated the Amir's troops at the Paiwar Kotal, and seized the Shutargardan Pass which commands a direct route to Kabul through the Logar valley. The Amir Sher Ali fled from his capital into the northern pro- vince, where he died at MazSr-i-Sherif in February 1879. In the course of the next six months there was much desultory skirmishing between the tribes and the Brit- ish troops, who defeated various attempts to dislodge them from the positions that had been taken up; but the sphere of British military operations was not materi- ally extended. It was seen that the farther they ad- vanced the more difficult would become their eventual retirement ; and the problem was to find a successor to Sher Ali who could and would make terms with the British Government.

In the meantime Yakub Khan, one of Sher All's sons, had announced to Major Cavagnari, the political agent at the headquarters of the British army, that he had succeeded his father at Kabul. The nego- ^^|^^ tiations that followed ended in the conclusion of a treaty in May 1879, by which Yakub Khan was rec- ognized as Amir ; certain outlying tracts of Afghanistan were transferred to the British Government ; the Amir placed in their hands the entire control of his foreign relations, receiving in return a guarantee against foreign aggression ; and the establishment of a British envoy at Kabul was at last conceded. By this convention the com- plete success of the British political and military opera- tions seemed to have been attained ; for whereas Sher Ali had made a treaty of alliance with, and had received an embassy from Eussia, his son had now made an exclusive treaty with the British Government, and had agreed that a British envoy should reside permanently at „ .

his court. Yet it was just this final concession, murdered the chief and original object of British policy, and the war that proved speedily fatal to the whole settle- ™"«'"«'- ment. For ia September the envoy. Sir Louis Cavagnari, with his staff and escort, was massacred at Kabul, and the entire fabric of a friendly alliance went to pieces. A fresh expedition was instantly despatched across the Shutargardan Pass under Sir Frederick Eoberts, who de- feated the Afghans at Charasia near Kabul, and entered the city in October. Yakub Khan, who had surrendered, was sent to India ; and the British army remained in mili- tary occupation of the district round Kabul until in December (1879) its communications with India were in- terrupted, and its position at the capital placed in serious

jeopardy, by a general rising of the tribes. After they had been repulsed and put down, not without some hard fighting. Sir Donald Stewart, who had not quitted Kanda- har, brought a force up by Ghazni to Kabul, overcoming some resistance on his way, and assumed the supreme command. Nevertheless the political situation was still embarrassing, for as the whole country beyond the range of British effective military fcontrol was masterless, it was undesirable to withdraw the troops before a govern- ment could be reconstructed which could stand without foreign support, and^with which diplomatic relations of some kind might be arranged. The general position and prospect of political affairs in Afghanistan bore, indeed, an instructive resemblance to the situation just forty years earlier, in 1840, with the important differences that the Punjab and Sinde had since become British, and that communications between Kabul and India were this time secure.

Abdurrahman, the son of the late Amir Sher All's elder brother, had fought against Sher Ali in the war for suc- cession to Dost Mahommed, had been driven beyond the

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comes Amir,

OxTis, and had lived for ten years in exile with the Rus- sians. In March 1880 he came back across the river, Abdarrab- and began to establish himself in the northern man be- province of Afghanistan. The Viceroy of In- dia, Lord Lytton, on hearing of his reappear- ance, instructed the political authorities at Kabul to communicate with him. By skilful negotiar tions a meeting was arranged, and after pressing in vain for a treaty he was induced to assume charge of the country upon his recognition by the British as Amir, with the understanding that he should have no relations with other foreign powers, and with a formal assurance from the Viceroy of protection from foreign aggression, so long as he should unreservedly follow the advice of the British Government in regard to his external affairs. The province of Kandahar was severed from the Kabul dominion ; and the Sirdar Sher Ali Khan, a member of the BSrakzai family, was installed by the British repre- sentative as its independent ruler.

!For the second time in the course of this war a conclu- sive settlement of Afghan affairs seemed now to have been attained; and again, as in 1879, it was md^rf;^ immediately dissolved. In July ,1880," a few rabman. days after the proclamation of Abdurrahman as Amir at Kabul, came news that Ayub Khan, Sher All's younger son, who had been holding Herat since his father's death, had marched upon Kandahar, had utterly defeated at Maiwand a British force that went out from Kandahar to oppose him, and was besieg- ing that city. Sir Frederick Roberts at once 'set out from Kabul with 10,000 men to its relief, reached Kan- dahar after a rapid march of 313 miles, attacked and routed Ayub Khan's army on 1st September, and restored British authority in southern Afghanistan. As the Brit- ish ministry had resolved to evacuate Kandahar, Sher Ali Khan, who saw that he could not stand alone, resigned and withdrew to India, and the Amir Abdurrahman was invited to take possession of the province. But when Ayub Khan, who had meanwhile retreated to Herat, heard that the British forces had retired, early in 1881, to India, he mustered a fresh army and again approached Kandahar. In June the fort of Girisk, on the Helmund, was seized by his adherents ; the Amir's troops were de- feated some days later in an engagement, and Ayub Khan took possession of Kandahar at the end of July. The Amir Abdurrahman, whose movements had hitherto been slow and uncertain, now acted with vigour and decision. He marched rapidly from Kabul at the head of a force, with which he encountered Ayub Khan under the walls of Kandahar, and routed his army on 22nd Septem- ber,

taking all his guns a’nd equipage. Ayub Khan fled toward Herat, but as the place had meanwhile been occupied by one of the Amir’s generals he took refuge in Persia. By this victory Abdurrahman’s ruler- ship was established.

In 1884 it was determined to resume the demarcation, by a joint commission of British and Russian officers, of the northern boundary of Afghanistan. The work went on with much difficulty and contention, until in March 1885, when the Amir was at Rawalpindi for a conference with the Viceroy of India, Lord Dufferin, the news came that at Panjdeh, a disputed place on the boundary held by the Afghans, the Russians had attacked and driven out with some loss the Amir’s troops. For the moment the consequences seemed likely to be serious ; but the affair was arranged diplomatically, and the demarca- tion proceeded up to a point near the Oxus river, beyond which the Commission were unable to settle an agreement.

During the ten years following his accessioil in 1880 Abdurijahman employed himself in extending and con-

solidating his dominion over the whole country. Some local revolts among the tribes were rigorously suppressed ; and two attempts to upset his rulership — the first by Ayub Khan, who entered Afghanistan from ■ Persia, the second and more dangerous one by ^an” Ishak Khan, the Amir’s cousin, who rebelled system of against him in Afghan Turkestan — were de- ^swe™” feated. By 1891 the Amir had enforced his ”””’ supreme authority throughout Afghanistan more com- pletely than any of his predecessors. In 1895 the Amir’s troops entered Kafiristan, a wild mountainous tract on the north-east, inhabited by a peculiar race that had hitherto defied all efforts to subjugate them — and they have since been gradually reduced to submission. Mean- while the delimitation of his northern frontier, up to the point where it meets Chinese territory on the east, has ‘been completed and fixed by arrangements betw;een the Governments of Russia and Great Britain ; and the east- ern border of the Afghan territory, towards India, has also been mapped out and partially laid down, in accord- ance with a convention between the two Governments. The Amir not only received’ a large annual subsidy of money from the British Government, but he also obtained considerable supplies of war material ; and he moreover availed himself very freely of facilities that were given him for the importation at his own cost of arms through India. With these resources, a,nd with the advantage of an assurance from the British Government that he would be aided against foreign aggression, he was able to establish an absolute military despotism inside his kingdom, by breakiiig down the power of the warlike tribes which held in check, up to his time, the personal autocracy of the Kabul rulers, and by organizing a regu- lar army well furnished with European rifles and artil- lery. Taxation of all kinds was heavily increased, and systematically collected. The result was that whereas in former times the forces of an Afghan ruler consisted mainly of, a militia, furnished by the chiefs of tribes who held land on condition of military service, and who stoutly resisted any attempt to commute this service for money payment, the Amir had at his command a large standing army, and disposed of a substantial reve- nue paid direct to his treasury. Abdurrahman executed or exiled all those whose political influence he saw rea- son to fear, or of whose disaffection he had the slightest suspicion ; his administration was severe and his punish- ments were cruel.; but undoubtedly he put down dis- order, stopped the petty tyranny of local chiefs, and brought violent crime under some effective control in the districts. Travelling by the high roads is now compara- tively safe ; although it must be , added that the exces- sive exactions of dues and customs have very seriously dan^aged the external trade. In short, Abdurrahman’s reign produced an important political revolution, or reformation, in Afghanistan, which has risen from the condition of a country distracted by chronic civil wars, under rulers w];iose authority depended upon their power to hold down or conciliate fierce and semi-independent tribes in the outlying parts of the dominion, to the rank of a formidable military state governed autocratically. How long such a system will outlast the death of its founder in 1901, in the hands of his successor HabibuUa, has yet to be seen ; for in Asia a centralized administra- tion and a

standing army are institutions which depend for their maintenance entirely on the ruler's personal courage and capacity. Up to Abdurrahman's reign the strength of the Afghan nation lay in its warlike charac- ter, in the readiness of the tribes to combine for opposing and harassing an invader, and in the local independence of powerful clans or chiefs. Now that the power of the chiefs has been levelled down, and the fighting strength

of the tribal groups has been dislocated, the defeat or mutiny of the regular forces may lead to widespread con- fusion in Afghanistan.

The extent of the territories subject to the rulers of Afghanistan has varied from time to time with political Abbaa vicissitudes. Abdurrahman governed a king- tribes on dom strictly delimited between the possessions Indian or dependencies of Russia, Persia, and India. trontier. j^ should be mentioned, however, that the geo- graphical boundaries of Afghanistan would include on the eastward all the highlands down to the skirts of the mountains that slope towards the Indian plains; for up to this line, and indeed beyond, the language, habits, and general character of the people are identical. But the frontier laid down in 1894 to mark the eastern limit of the Amir's jurisdiction, cut off from it a zone of tribal territory that had previously been for the most part under the nominal suzerainty of Kabul ; though in reality it has always been a debateable land held by unruly and inde- pendent tribes. The zone thus interposed between British India and the Afghan rulership may be roughly described as stretching from the southern border of the Chitral state, along the whole north-western frontier of India southwards to the confines of Baluchistan. It is trav- ersed by all the passes that lead out of the Afghan moun- tains into India ; it is occupied at several points by British garrisons or levies in British pay ; and it is inhabited by fierce, free, and warlike tribes, whose annals, so far as they have any, belong to the general history of the Afghan people. From time immemorial they have held the val- leys and high ranges which overhang the main, routes towards the low country ;• they have taken part in the incessant border wars and the great invasions of India, admitting allegiance to be due from them, as from all Afghans, to the chief ruler of their race, but acknowledg- ing no master. Since 1849 the protection of the Indian borderland has necessitated sending into these hills fre- quent military expeditions, which have twice entangled the British in serious and prolonged fighting. In 1863 the

obstinate resistance made by the tribes to a large British force sent into their country was not overcome without great exertions; and in 1897-98 an insurrection of the tribes in the Swat valley was followed by a general rising of the Afridis, who destroyed a post of British levies in the Khyber Pass, and were only brought to terms after an arduous and harassing campaign. Since 1894, when the Amir of Kabul renounced all claim to jurisdiction over this region, the tribes of the outer hills and valleys on the Indian border have been gradually brought under the superintendence of the British Government by the loca- tion of posts inside their country, by enrolling tribal levies, and by other methods for strengthening control. Yet the management of these intractable and fanatic high- landers is still by far the most troublesome of the polit- ical and military dif&culties that confront the Government along the whole external frontier of the Indian Empire.

Eawlinson. England and Bussia in the East, 1875. — Sir H. M. DoRAND. The First Afghan War, 1879. — Wyllie's Essays on the External Policy of India, 1875. — Lady Betty Balpoce. Lord I/ytton's Indian Administration, 1899. — Elphinstone. Ac- count of the Kingdom of Kabul, 1809. — Parliamentary Papers, "Afghanistan." — Lord CcEzoif. Problems of the Far East, 1894.

Afiun Kara-Hissar, the popular name of Kara- hissar S^hib, an important trade centre in Asia Minor, in the Brusa vilayet. Called Nicopolis by Leo III. after his victory over the Arabs, in 740, its name was changed by the Seljtik Turks to Karorhissar, “black castle.” The town is in the centre of the opium, afiiin, district, and is connected by railway with Smyrna, Konia, Angora, and Constantinople. Population, 18,000 (Moslems 13,000; * Christians, 5000).

Afragola, a town in the province of Naples, Cam- pania, Italy, 5 miles from Naples. It is on the steam tramway from Naples to Caivano. The principal indus- tries are in straw hats, wine, and the manufacture of wooden v articles of all sorts. There is a great annual fair on the second Sunday in May. Population about

20,000.

AFRICA.

I. Physical Geogbapht.

AFRICA, the largest of the three great southward pro- jections from the main mass of the earth’s surface,

includes within its remarkably regular outline an Porm and ^^33,, according to the most recent computations,

of 11,280,000 square miles, excluding the islands. Its main structural lines show both the east-to-west direc- tion characteristic, at least in the eastern hemisphere, of the more northern parts of the world, and the north-to- south direction seen in the southern peninsulas. The continent is thus composed of two segments at right angles, the northern running from east to west, the southern from north to south, the subordinate lines cor- responding in the main to these two directions.

Except quite in the north, the most striking feature in African geology is the great age of the fundamental

structures and the absence of signs of recent V disturbance of the crast leading to the elevation

of folded mountain ranges. Both in the east and west of the meridional portion of the continent a broad zone parallel to the coast-line is composed mainly of ancient crystalline rocks (some of these showing signs of folding), on the flanks of which rocks of palaeozoic age still remain in the position in which they were first deposited. In the east a band of gneissose and schistose

rocks, supposed to represent the primitive axis of the continent, has been traced at intervals for over half its length. Parallel with this and farther inland run broader belts of ancient rocks, forming in places wide granitic domes. In the west an almost continuous band of crys- talline rocks — chiefly schists of varying character — ac- companies the whole coast-line of the southern segment, as well as a large part of the southern margin of the western limb. Finally in the centre of the continent, pear the meeting-line of the two segments, these ancient rocks seem to occur in lines intermediate between the two main directions. The wide basin between the eastern and western crystalline belts seems to be occupied largely by sedimentary strata, among which horizontally-bedded sandstones figure largely. Owing to the imperfection of the data, and in many cases to the absence of fossils, the age of the strata cannot yet be determined ; but apart from recent fiuviatile and subaerial deposits, they seem to belong chiefly to the palaeozoic or older mesozoic periods. Along the eastern main axis the

crystalline rocks are largely overlaid with sheets of volcanic rocks, while nu- merous volcanoes, some long since extinct, some partially active, have thrust up piles of matter above them.

In Northern Africa the whole geologic structure dates from much more recent times. The most important feature here is the existence of a folded mountain range

of comparatively recent date, which runs from east to west parallel to the northern coast. This range — the Atlas — North and belongs to the European sjrstem both in its South direction and in its- constituent formations. Africa. Archaean rocks play quite a subordinate part, while a regular series of stratified formations, from palaeo- zoic to tertiary, most of which have equally experienced the effects of folding, constitute the greater part of the range. Of these the mesozoic — particularly the cretaceous ^over the largest area, while tertiary strata occur chiefly in narrow bands near the coast. The eastern half of North Africa contains large expanses both of tertiary formations and of cretaceous. The extreme south of the continent is marked by the large extent of mesozoic formations (trias, &c.), in addition to older rocks.

The mean elevation of Africa has been variously esti- mated at from 1962 feet (Heiderich) to 2133 (Wagner), Relief. ‘^ ™^y *^^® ^^ considered to approximate closely to 2000 feet, which is roughly the eleva- tion of both’ North and South America, but is considerably less than that of Asia (3117 feet). In contrast with the other continents it is marked by tte comparatively small area both of very high and of very low ground, lowlands under 600 feet occupying an unusually small part of the surface ; while not only are the highest elevations inferior to those of Asia and South America, but the area of land, over 10,000 feet, is also quite insignificant, being repre- sented almost entirely by individual peaks and mountain ranges. Moderately elevated tablelands are thus the characteristic feature of the continent, though the surface of these is broken by higher peaks and ridges. As a general rule, the greater elevations lie to the east, and south, while a progressive diminution in altitude towards the west and north is observable. Apart from the low- lands and the Atlas range, the continent may be divided into two regions of higher and lower plateaux, the dividing line (somewhat concave to the north-west) running from the middle of the Red Sea to about 6° S. on the west coast. We thus obtain the following four main divisions of the continent : — (1) The coastal plains^often fringed seawards by mangrove swamps — ^never stretching far from the coast, except on the lower courses of streams. Recent alluvial flats are found chiefly in the delta of the more important rivers. Elsewhere the coast lowlands merely form the lowest steps of the system of terraces which constitutes the ascent to the inner plateaux. (2) The Atlas range, which, orographically as geologically, is distinct from the rest of the continent, being unconnected with any other area of high ground, but divided off on the south by a depressed area in places below sea-level. (3) The high southern and eastern plateaux, rarely falling below a height of 2000 feet, And having a mean elevation of about 3500. (4) The north and “w^est African plains, bordered and traversed by bands of higher ground, but generally below 2000 feet.

The two last divisions may be again subdivided. Thus the high plateaux include : — (a) the South African plateau as far as about 12° S., bounded on all sides by ”’•«*«’■ bands of high ground which fall steeply to the “ ”””’ coasts. On this account South Africa has a general resemblance to an inverted saucer. The bounding ridges belong, as a rule, to the crystalline axes bf the continent, but in the south-east, where they attain their maximum elevation in the Drakensberg range, the ancient

rocks are overlaid by extensive beds of permian and trias. Quite in the south the plateau rim is formed by three parallel steps with level ground between them. In the north the interior basin is demarcated merely by a strip of plateau somewhat more elevated than the rest of the surface. The South African plateau is connected towards

the north-east with (b) the East African plateau, with probably a slightly greater average elevation, and marked by some distinct features. It is formed by a widening out of the eastern axis of high ground, which becomes subdivided into a number of zones running north and south and consisting in turn of ranges, tablelands, and depressions. A wide area of granite and gneiss runs down the centre, forming in psirt a rolling plain, while the more elevated ridges are composed chiefly of schists, quartzites, and stratified rocks. The most striking feature is the existence of two great lines of depression, due largely to the subsidence of whole segments of the earth's crust, the lowest parts of which are occupied by vast lakes. Towards the south the two lines converge and we find only one great valley (occupied by Lake Nyasa), the southern part of which is less distinctly due to rifting and subsidence than the rest of the system. Farther north the western depression, sometimes known as the Central African trough, is occupied for more than half its length by water, forming the four lakes of Tanganyika, Kivu, Albert Edward, and Albert, the first-named over 400 miles long and the longest fresh-water lak^ in the world. Associated with these great valleys are a number of volcanic peaks, the greatest of which occur on a meridional line east of the eastern trough. The eastern depression,known as the East African trough or rift-valley, contains much smaller lakes, many of them brackish and without outlet, the only one comparable to those of the western trough being Lake Rudolf, or Basso Norok. Towards the northern end are Kilimanjaro — with its two peaks Kibo ^.nd Mawenzi, the former (according to Dx. Hans Meyer's latest measurement) 19,430 feet, and prob- ably the culminating point of the whole continent — and Kenya (17,180 feet). Hardly less important is the Ruwenzori range (probably over 18,000 feet), which lies east of the western trough. Other volcanic peaks rise from the floor of the valleys, Kirunga, north of Lake Kivu, being still partially active, (c) The third division of the higher region of Africa is formed by the Abyssinian highlands, a rugged mass of mountains forming the largest continuous area of its altitude in the whole continent, little of its surface falling below 5000 feet, while the summits reach heights of 15,000 to 16,000 feet. This block of country lies just off the line of the great East African trough, the northern continuation of which passes along its eastern escarpment as it runs up to join the Red Sea. There is, however, in the centre a circular basin occupied by Lake Tsana. The basis of the region is a mass of ancient crystalline rocks which have been fur- rowed by deep valleys under the influence of denudation. They are surmounted, especially towards the south, by a large area of newer volcanic rocks, which have once covered the surface in continuous sheets, while the north-western margin is overlaid by sedimentary strata of Jurassic age.

The lower north-western half of Africa, though the greater part of its area is below 2000 feet, is traversed by bands of higher ground which run off from the higher lands to the south. Both in the east ^o^e' and west the bordering highlands are continued '' ' ”“' as strips of plateau parallel to the coast, the Abyssinian mountains being continued northwards along the Red Sea coast by a series of ridges reaching in places a height of 7000 feet. In the west the zone of high land is broader but somewhat'lower. The most mountainous districts lie in- ^land from the head of the Gulf of Guinea (Adamawa, &c.), where heights of 6000 to 8000 feet are reached. Exactly at the head of the gulf the great peak of the Cameroon, on a line of volcanic action continued by the islands to the south-west, has a height, according to the measure- ments of Dr. Preuss, of 13,370 feet, while Clarence Peak,

geogbapht]

AFRICA

in the first of the line of islands, rises to over 9000. Towards the extreme west the Futa Jallon highlands form an important diverging point of rivers, but beyond this, as far as the Atlas chain, the elevated rim of the continent is almost wanting. The intervening space between the east and west coast highlands is divided into separate basins by other bands of high ground, one of which runs nearly centrally through North Africa in a line corresponding roughly with the curved axis of the continent as a whole. The best marked of the basins so formed occupies a circular area in West Africa bisected by the equator, once probably the site of an inland sea and now largely covered by recent alluvium.

The following table gives the approximate altitudes of the most important features of the continent : —

Table of Altitudes.

MoDNTAiNS — Feet. Aiashi (Atlas) . . 14,000i Simen Mountains, Abys- sinia …. 15,2001 Elgon .... 14,200 Settima .... 13,390 Kenya .... 17,180 Kilimanjaro . . . 19,430 Ruwenzori . . . 18,000i Rungwe (Nyasa) . . 10,400 Brakensbeig . . . 11,700 Markham, Mashonaland 10,000^ Cameroon . . . 13,370

Lakes —

Chad 780

Tsana 5750

Eudolf 1250

Victoria Nyanza . . 3800

]!^ivasha . . . 6300

Manyara . . . 3300

Albert Nyanza . . 2100

Albert Edward . . 3200

Lakes (^continued) — Kivu

Tanganyika Nyasa . Mweni . Bangwenlu Ngami . Leopold II.

Towns, &o. — Constantine (Algeria) Timbuktu Khartum Addis Abbaba JSldoma Ravine .Sta.^

Brit. E. Africa Tabora . Zomba . Bulawayo Pretoria Bihe

Leopoldville . Stanley Ealls Sta.

Feet.

4900 2670 1700 2953 3700 2950 1100

2165

800

1263

8000

7240 4130 2948 4469 4462 5500 1115 1470

From the outer margin of the African plateaux a large number Of streams run down to the sea with comparatively short courses, whUe the rivers of the first class sl^ms. ° ° ^°°S distances on the interior highlands before breaking through the outer ranges. The main drainage of the continent is to the north and west, or towards the basin of the Atlantic Ocean. The high Basin at ^^^^ plateau of East Africa contains the head- tbe Atlantic Waters of the Nile and Congo ; the former the andJHedi- longest, the latter the largest river of the con- terranean. ^.jj^g^^.^ The southern branch of the Nile receives its chief supplies from the mountainous region adjoining the Central African trough in the neighbourhood of the equator. Thence streams pour east to the Victoria Ny- anza, the largest African lake, and west and north to the Albert Edward and Albert Nyanzas, to the latter of which the effluents of the other two lakes add their waters. Issuing from it the Nile flows north, and between 7° and 10° N. traverses a vast maxshy level, during which its course is liable to blocking by floating vegetation. After receiving the Bahr-el-Ghazal from the west and the Sobat, Blue (more correctly, Black) Nile, and Atbara from the Abyssinian highlands, it crosses the great desert and en- ters the Mediterranean by a vast delta. The most remote head-stream of the Congo is the Chambezi, which flows south-west into the marshy Lake Baagweulu, afterwards turning north through Lake Mweru and descending to the forest-clad basin of west equatorial Africa. Traversing this in a majestic northward curve and receiving vast supplies of water from many great tributaries, it finally turns south-west and cuts a way to the Atlantic Ocean through the western highlands. North of the Congo basin and separated from it by a broad undulation of the

1 Estimated.

surface is the interior basin of Lake Chad — a flat-shored lake filled principally bjp' the Shari coming from the south-east. West of this is the basin of the Niger, the third river of Africa, which, though flowing to the Atlantic, has its principal source in the far west, and reverses the direction of flow exhibited by the Nile and Congo. An important branch, however — the Benue — comes from the south-east. These four river-basins occupy the greater part of the lower plateaux of North and West Africa, the remainder consisting of arid regions watered only by iatermittent streams which do not reach the sea. Of the remaining rivers of the Atlantic b£|^in the Orange, in the extreme south, brings the drainage from the Drakens- berg on the opposite side of the contiaent, whUe the Kunene, Kwanza, Ogowe, and Sanaga drain the west coast highlands of the southern limb; the Volta, Komoe, Bandama, Gambia, and Senegal those of the western limb.

Of the rivers flowing to the Indian Ocean the only one draining any large part of the iuterior plateaux is the Zambezi, the western branches of which come sasin ot from the neighbourhood of the west coast, the Indian Eecent explorations have shown that the most O"*"- remote head-stream is the Liba, which, rising midway across the continent, flows west and south before assuming the eastward direction of the lower river. ■ All the largest tributaries, including the Shire, the outflow of Lake Nyasa, flow down the southern slopes of the band of high ground which stretches across the continent in 10° to 12° S. In the south-west the Zambezi system interlaces with that of the Taukhe (or Tioghe), from which it at times receives surplus water. The rest of the water of the Taukhe is lost in a system of swamps and saltpans which formerly centred in Lake Ngami, now dried up. Farther south the Limpopo drains a portion of the interior plateau but breaks through the bounding highlands on the

side of the continent nearest its source. The Rovuma, Eufiji, Tana, Juba, and Webi Shebeli principally drain the outer slopes of the East African highlands, the last-named losing itself in the sands in close proximity to the sea. Lastly, between the basins of the Atlantic and Indian Oceans, there is an area of inland drainage along the centre of the East African plateau, directed chiefly into the lakes in the great rift-valley. The largest river is the Omo, which, fed by the rains of the Abyssinian highlands, carries down a large body of water into Lake Eudolf.

The latest calculations of the areas of African drain- A„-g „f

age systems, made by Dr A. Bludau (Fetermanns drainage ‘

Mitteilungen, 43, 1897, pp. 184-6) gives the following systems. general results: —

Basin of the Atlantic

Do. Mediterranean

Do. Indian Ocean Inland drainage area

The areas of individual river-basins are: —

Congo 1,425,000 sq,

4,070,000 sq. miles. .1,680,000 „

2,086,000

3,462,000 „

miles.

Nile’ 1,082,000

Niger ..’.... 808,0003 „

Zambezi 513,500 „

Lake Chad 394,000 „

Orange 370,500^ „

Do. (actual drainage area) . . 172,500 ,,

The area of the Congo basin is greater than that of any other river except the Amazon, while the African inland drainage area is greater than that of any continent but Asia, in which the same area is 4,900,000 sq. miles.

The principal African lakes have been alluded to in the description of the East African plateau, but some of the phenomena connected with them may be spoken of more particularly here. As a rule the lakes

Lakes.

2 Including waterless tracts naturally belonging to basin.

which occupy portions of the great rift-valleys have steep sides and are very deep. This is the case with the two largest of the type, Tanganyika and Nyasa, the latter of which was found in 1899 to have a depth of 430 fathoms. Others, however, are shallow, and hardly reach the steep sides of the valleys in the dry season. Such are lake Eukwa, in a subsidiary depression north of Lake ISTyasa, and Eiassi and Manyara, in the system of the eastern rift- valley. Lakes of the broad type, such as the Victoria Nyanza, are probably of intermediate depth. Apart from the seasonal variations of level, most of the lakes show periodic fluctuatiqns, while some have supposed that a progressive desiccation of the whole region is traceable, tending to the ultimate disappearance of the lakes. Such

a drying up has no doubt been in pro- gress during long geologic ages, but is probably of no prac- tical importance at the present time. The periodic fluctu- ations in the level of Lake Tanganyika are such that its out- flow appears to be intermittent. After rising steadily, for some years after 1871, a fall seems to have set in about 1879, which before the end of the cen- tury had carried the lake back within its natural bed. Within about the same time the neighbouring Lake Eukwa (the level of which seems to be almost iden- tical with that of Tanganyika) has in great part dried up. Others of the East African lakes have, on the contrary, risen in level, Nyasa havi,ng been unusually high in 1896 and Eudolf in 1896-98 ; so that, if the fluctuations are due to variations of rainf-all, these do not affect the whole lake region simultaneously in the same direction. In the case of the Victoria Nyanza a variation to the extent of 5 feet has been thought to recur in periods of eighteen to twenty-five years. Since 1896 records of the seasonal variations have been kept at stations north of the lake; the maximum in the year having been so far about. 15 inches. They may be accounted for in part by the action of winds. Besides the East African lakes the principal are ; — Lake Chad, in the northern area of inland drainage ; Bangweulu and Mweru, traversed by the head-stream of the Congo ; and Leopold II. and Mantumba, within the great bend of that river. All, except possibly Mweru, are more or less shallow. The altitudes of the African lakes have already been stated.

Divergent opinions have been held as to the mode of origin of the Central African lakes, especially Tanganyika, which some geologists have considered to repre- sent an old arm of the sea, dating from a time when the whole central Congo basin was under water ; others holding that the lake water has accumulated in a depression caused by subsidence. The former view

BRITISH TERRITORY LEASED TO CONGO STATE

Sketch Map of the Lake Region op Africa.

Origin of lakes.

Climate.

derives some support from the existence in the lake of organisms of a decidedly marine type, the investigation of which has been the work of Mr J. E. S. Moore. They include a jelly-fish, molluscs, prawns, crabs, &c., and form an isolated group f oimd in no other of the African lakes. M. J. Cornet, a Belgian geologist, has expressed a doubt whether these organisms furnish evidence of a former connexion of Tanganyika with the sea.

Lying almost entirely within the tropics, Africa does not show excessive variations of temperature. Great summer heat is experienced in the lower plains of North Africa, removed by the great width of the continent from the influence of the ocean, and here too the contrast between day and night, and between summer and winter, is greatest. Farther south, the heat is to some extent modified by the moisture brought from the ocean, and by the greater elevation of a large part of the surface, especially in East Africa, where the range of temperature is also wider than in the western basin. In the extreme north and • south the climate is a warm tem- perate one. The most important climatic differences are due to variations in the amount of precipitation. The wide heated plains of North Africa, and in a lesser degree a corresponding zone of latitude in the south, have an exceedingly scanty rainfall, the winds which blow over them from the ocean losing part of their moisture as they pass over the outer highlands, and becoming constantly drier owing to the heating effects of the burn- ing soil of the interior ; while the scarcity of mountain ranges in the more central parts likewise tends to prevent condensation. In the inter-tropical zone of summer precipitation, this is greatest when the sun is vertical or soon after. It is therefore greatest of all near the equator, where the sun is twice vertical, and less in the direction of both tropics. The rainfall zones are, however, somewhat deflected from a due west-to-east direction, the drier northern conditions extending south- wards along the east coast, and those of the south north- wards along the west. Within the equatorial zone certain areas, especially on the shores of the Gulf of Guinea and in the Upper Nile basin, have an intensified rainfall, but this rarely approaches that of the rainiest regions of the world. The rainiest district in all Africa, and (in the pres- ent state of knowledge) the second rainiest in the world, is a little west of Mt Cameroon, where at the Debunja station the following results have been recorded : —

1895 . , 353-04 inches

1896 . 384-96 „

1897 . 372-72 „

1898 . 379‘20 „

as compared with a mean of 475 inches at Cherrapunji, in Assam. The two distinct rainy seasons of the equatorial zone, where the sun is vertical at half-yearly intervals, become gradually merged into one in the direction of the tropics, where the sun is overhead but once. The question of a progressive desiccation of the continent has been touched upon in speaking of the lakes. While the climate of the north and south, especially the latter, is eminently healthy, and even the intensely heated Sahara is salubrious by reason of its dryness, the tropical zone as a whole is the most’^”™’*”” unhealthy portion of the world. This is especially the case in the lower and moister regions, such as the west coast, where malarial fever is very prevalent and deadly; the most unfavourable factors being humidity with absence of climatic variation (daily or seasonal). The higher plateaux, where not only is the average temperature lower, but such variations are more extensive, are more healthy; but even here, with the exception of a few specially favoured localities, Europeans find it difficult to maintain their health permanently. Opinions still differ

Mean

372-40 inches.

meteoeology]

A F E I C A

as to the possibility of the acclimatization of white men in Africa, some holding that acclimatization can only be the result of a gradual process extending through many generations, while others believe that with improved knowledge the diseases of Africa and other tropical countries can be successfully dealt with. (On this subject see article by Dr Sambon in Geographical Journal, vol. xii. p. 689.) It is believed by the latter school that the malarial germs are propagated by the agency of mosquitos, and during 1899 the discovery of the particular species to which infection is due in West Africa was claimed to be Meteom- ^^^^ ^J M^aj or E.OSS. Hopes are entertained that logical suitable measures may lead to its destruction.

tloas. . During the last decade of the 19th century a great

impetus was given to the record of meteorological data at stations in Central Africa, and our scanty knowledge with respect to that region has already received important additions. The following tables summarize some of the latest results : —

Government Station, Camekoon.i

Lat. 4° 2′ N. Long. 9° 42′ E. Alt. 40 feet.

(Average for years 1894-98.)

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Belative

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Humidity

1^’

1

7 a.m.

2 p.m.

January .

29-815

o

79^9

12-2

95

74

-69

4

February .

■812

79^9

12-4

95

72

2-95

7

March

•796

79^2

12-8

95

75

8-45

13

April .

•819

79^2

13-1

93

76

8-00

16

May .

•862

78^4

12-4

95

77

11-72

19

June .

•941

76-8

10-3

96

82

21-54

21

July .

•957

74-5

» 7-9

97

87

23-47

26

August

■941

74^5

8-6

96

85

38-38

28

September .

•914

75-6

9-9

96

84

19-79

23

October

■884

76-3

10-6-

96

83

14-45

23

November .

•819

78-3

11-2

95

80

6-58

n

December .

•846

79-0

11-3

95

79

2-44

7

Year

29-867

77-6

11-1

96

79

168-46

198

^H OTWTl AAA

Lat. 4° 4′ S. Long. 39° 42’’ E. Alt. 60 feet. (Average for years 1894-98.)

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January

29^862

80-1

7^7

87

-39

2

February

-847

80-9

7^5

81

•71

2

March .

-816

82-1

7-7

81

1-89

5

April .

-838

81-4

7-0

82

5-01

9

May .

-899

80-1

6-9

87

12-58

13

June

-925

78-5

7-1

84

2-60

5

July .

-981

77-5

7-6

83

2-73

6

August .

-980

77-8

7-1

83

1-76

6

September

•971

78-5

6-9

84

3-05.

8

October

•914

79-0

6-7

84

1-92

5

November

•885

79-5

6-7

82 .

8-19

9

December .

•842

80-1

7-6

. 83

2-29

3

Tear .

29 897

79-6

7-2

83

4^12

73

The first of these tables gives the olimatological phenomena at a station in the humid and equable region of the west coast. The dry season is reduced to a minimum, occurring at the time when the sun is at its greatest southward declination. The relative humidity is high and the temperature shows small seasonal varia/- tions. The second table, relating to a station on the east coast, likewise shows small variations of temperature, but a relatively small rainfall, divided chiefly between two dis- tinct rainy seasons. The thii-d, the much_ greater temperature variations at an inland station, at a considerable altitude, and

1 This table is based on observations recorded in the Mitteilungen aua den Deutsdien Schutzgebieten ; the two following on those published by the British Association Committee.

farther removed from the equator. The high rainfall is due to the influence of the mountains ; but though no month is really dry, the bulk of the rain falls between December and April. Observations for 1897 at Kibwezi, an inland station in the drier

Lauderdale, Mt. Mlanji, Nyasaland.

Lat. 16° 2′ S. Long. 35° 36′ E. Alt. 2850 feet.

(Average for years 1894-98.)

«;

Relative

^

if

go- S

Humidity %•

g

k

6 a.m.

2 p.m.

H

a 1

(1895-8).

|Zi

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o

ins.

January

72-6

13-8

90

81

21-04

26

February

72-5

13-9

89

82.

20-98

25

March .

71-9

13-9

63

83

12-60

24

April .

69-5

13-4

90

79

15-40

21

May

66-2

14-9

87

74

5-01

13

June

63-2

13-4

81

68

4-34

13

July .

62-8

15-5

86

69

3-25

10

August .

64-7

18-8

86

74

2-59

7

September .

71-1

21-5

74

- 55

2-98

6

October

74-5

24-9

74

54

3-05

6

November .

76-9

22-2

84

58

6-39

11

December

73-6

16-2

92

80

18-86

22

Year .

69-9

16-9

85

71

116-48

184

parts of British East Africa (2° 25′ S.), at an elevation of 2990 feet, show a still greater daily range of temperature, the mean for the year being 28-5°. The mean temperature for the year was 72-5°, and the rainfall (occurring chiefly in two rainy seasons, separated by a short relatively dry interval) 21-51 inches. At Machakos, a station on the higher plateau (5400 feet), the mean temperature for 1894 was 66-2 (highest month 70-2, lowest 61-4), while a four years' average of the rainfall gives 30-98 inches.

The vegetation of Africa follows very closely the distribution of heat and moisture. The northern and southern temperate zones ■have a flora distinct from that of the continent gener- ally, the north corresponding with south Europe in P'ora. this respect. The zones of minimum rainfall have a very scanty flora, consisting of plants specialized to resist the great dryness. The more humid regions have a richer vegetation — dense forest where the rainfall is greatest and variations of temperature least, conditions found chiefly on the tropical coasts and in the west African equatorial basin ; and savanna interspersed with trees on the greater part of the plateaux, passing as the desert regions are approached into a scrub vegetation consisting of thorny acacias, &c. Forests also occur on the humid slopes of mountain ranges up to a certain elevation. The dense forests of West Africa contain, in addition to a great variety of dicotyledonous trees, two palms, the Elaeis Guineensis and Baphia vinifera, not found, generally speaking, in the savanna regions. In the latter, the most charac- teristic trees are the baobab (^Adanaonia digitalxC), Hyphsene palm, and Euphorbias. The higher mountains have a special flora show- ing close agreement over wide intervals of space, as well as affinities- with the mountain flora of the Eastern Mediterranean, the Hima- layas, and Indo-China (c/. A. Engler, Ueber die Hochgebirgsflora des tropischen Afrika, 1892).

The fauna again shows the effect of the characteristics of the vegetation. The open savannas are the home of large ungulates, especially antelopes, the giraffe (peculiar to Africa), and four species of rhinoceros ; and of carnivores, such *”””• as the lion, leopard, hyaena, &c. The elephant (though its range has become restricted through the attacks of hunters) is found both in the savannas and forest regions, the latter being poor in large game, though the special habitat of the chimpanzee and gorilla. The camel — as a domestic animal — is especially characteristic of the northern deserts and steppes, while the ostrich thrives in most of the drier regions. The rivers in the tropical zone abound with hippopotami and crocodiles, the former entirely confined to Africa. The vast herds of game, formerly so characteristic of many parts of Africa, have much diminished with the increase of intercourse with the interior. Game reserves have, however, been established in South Africa, British Central Africa, British East Africa (2), Somaliland, &c., while measures for the protection of wild animals were laid down in an international convention signed in May 1900.

Of practical questions relating to the African fauna, one of the most important is that of the domestication of the African elephant. Although rarely used in modern times in any of the various ways in which the Indian species is made of service to man, it is known that the African species was tamed in ancient times. A successful experiment in this direction has lately been made in French Congo, where a young African elephant has been used at the Feman \s!i

mission for purposes of transport, while out of eight captured in Cameroon in 1900, three have been successfully tamed. The employment of Indian elephants in East Africa was tried without much success, both by the Belgian expedition of 1879 under Captain Carter and by Count von Gotzen in 1893. It is among the lowest subdivisions of the animal kingdom that the species that most injuriously affect the settlement of Africa occur. , The devastation caused by locusts need not be dwelt upon, while the question of the spread of malaria by means of mosquitos has already been referred to. Hardly less detrimental by reason of the fatal effects of its bite on most domestic animals is the tsetse fly, an insect fortunately confined to Africa. Researches are being made with a view to discovering the way in which the poison «,ots, but though it has been proved that the blood of infected animals con- tains a hsematozoon closely allied to the Trypanosoma present in the Surra disease of India, the endeavour to produce immunity by inoculation has so far failed, nor have any means of alleviating the disease been discovered (cf. Proc. Boy. Sea. voL^lxiv.).

Exploration. The last quarter of the 19th century saw the almost entire completion of the broad outlines of African geo- graphy. This period has been in the main one of filling in of detail, the wide blank space which previously occupied the centre of the continent on our maps having practically disappeared in 1877. A very brief recapitulation of the earlier st&.ges of African exploration may be given before speaking of this later period.

After the Portuguese voyages to the East had in the 15th cen- tury made known the whole coast-line of the continent, a certain

amount of progress towards a knowledge of the interior, ^ii d principally in Angola and the region of the Zambezi, ” *■ was made. But with the decline of Portuguese power at the end of the 16th century

a period of stagnation ensued, broken only by Jesuit and Capuchin missionary enterprise in Abyssinia and Angola, and by French and English trading ad- venture in Senegambia. The first great advance was due to the action of the African Association (founded 1788), whose agents (Mungo Park amongst them) made knovTn the geography of the Niger region and of various parts of Northern Africa. About 1850 began the great series of journeys, which in the south, east, and north first shed certain light on the geography of the inner regions of the continent — ^the discovery of the course of the Zambezi by Dr Livingstone ; of the great lakes of Eastern Africa and the source of the Nile, by Burton, Speke, Grant, and Baker ; and the researches of Dr Barth in the Central Sudan, being liie principal results. Dr Livingstone's last great journey, commenced in 1866, began to lift the veil from the western half of the equatorial regions, but, though leading to the discovery of an entirely new river system west of Lake Tanganyika, it was' brought to a close by the travel- ler's death (1873) before the uncertainties which attached 'to this new river system were cleared up. With Livingstone's death, and the universal interest aroused by the story of his labours, the latest period of African exploration may be said to have begun.

In immediate connexion with Livingstone's work was the ex- pedition of Lieutenant Cameron, who early in 1873 left Zanzibar

with the object of supporting the great explorer and Latest carrying on independent geographical work. After Period learning of the death of Dr Livingstone, which occurred 1873-1900. Qj^ jgj. jiayi of that year, Cameron continued his way and^"'' *° Lake Tanganyika by a new route, and afterwards Stanley. effected the circumnavigation of the greater part of the

lake, discovering its outlet towards thi Congo on the west. He then proceeded to Nyangwe, the Arab trading post on the Lualaba or Upper Congo, which had been Livingstone's farthest point on the great river ; but the difficulties in the way of a further exploration of its course proving insurmountable, Cameron turned south-west through an entirely unknown region, and made his way across the southern Congo basin to Benguela on the west coast. From his view of the Lualaba, which had been at first thought by Livingstone to belong to the Nile basin, Cameron concluded that it could be nothing else than the upper course of the Congo. Meanwhile Mr H. M. Staooley, who had become famous for his relief of Dr Livingstone in 1871, started again for East Africa as correspondent of the Daily Telegraph and New York Herald to attempt the solution of the chief remaining problems of Central African geography. His first task was the thorough examination of the Victoria Nyanza, which had been held by some to consist of several independent lakes, and which he reached by a new, almost direct, route from Bagamoyo to its southern point. After circum- liavigating the lake and thus proving the general accuracy of its delineation by its discoverer. Captain Speke, Stanley turned west to

^ 1 4th, according to the inscription cut by his followers.

survey the Albert Nyanza, reaching what he supposed to be a bky of that lake, situated under the equator, but which subsequently proved to belong to an independent piece of water. Compelled to desist from further attempts in this direction, Stanley tfumed south for Ujiji on Lake Tanganyika, which lake he circumnavigated, and then went west to attack the problem of the termination of the Lualaba. He, too, encountered immense difficulties in the attempt to penetrate the trackless forests of the equatorial basin, but, build- ing a fleet of canoes, succeeded in tracing the river round its great northern bend, until after a journey of 1600 miles he finally reached the known part of the Congo, near the west coast. In this great journey he had to contend not only with natural difficulties, such as the furious cataracts by which the Congo is broken, but with the opposition of warlike cannibal tribes, through whose territory he had constantly to fight his way. The result was to bring to light a river system of hitherto unsuspected magnitude, the Congo proving to be one of the principal rivers

of the globe not only in respect of volume and size of basin, but also of length of course, in which respect it is second only to the Nile among African rivers.

This great achievement helped still further to stimulate a general interest in Equatorial Africa, which had already had its outcome, since Livingstone's death, in movements destined to lead to important results. In! 1873 the ^*®' German African Society was founded, and this body Equatorial set itself the task of exploring the interior of Angola "'' and otHer districts of West Africa. The success attained hardly came up to expectations, but in 1876 Dr Paul Pogge succeeded in reaching the town of the negro potentate, the Muata Yanvo. In that year King Leopold of Belgium summoned to Brussels an international conference to take measures for the systematic opening up of the continent. The outcome was the inauguration of the International African Association with its headquarters in Brussels, while committees were formed in the various European countries, the German society being reconstituted, and continuing to do good work in the southern Congo basin. On the Congo itself Mr Stanley inaugurated a great undertaking on behalf of King Leopold, which ended in the establishment of the Free State of the Congo in the basin of that river, and the exploration of its various tributary streams. Meanwhile the French had already been exploring the interior of their colony of the Gabun, the Ogowe having been explored in 1875 and 1876 by Marche and De Compifegne, and from 1875 by Pierre S. de Brazza, who, reaching the upper basin of that river, made his way across ^le watershed to the Congo in 1880. The whole region between the Gabun and the Congo was in time explored by French officials, among whom J. de Brazza, brother of Pierre, was one of the first to penetrate to the far north (1885). South of the Congo the Portuguese were likewise active, a great expedition being sent out in 1877 under Pinto, Capello, and Ivens, for the exploration of the interior of Angola. The first-named made his way by the head-streams, of the Kubango to the Upper Zambezi, which he descended to the Victoria Falls, thence proceeding south-east to Pretoria and Durban. Capello' and Ivens, after crossing the Upper Kwanza, confined their attention to the south-west Congo basin, where they disproved the existence of Lake Aquilunda, which had figured on the maps of that region since the 16th century. Farther south, in the region of the Kunene and Ovampo, good work was done in 1879 and following years by a French missionary, P6re Duparquet. Following the example set by Dr Pogge, the Germans Schiitt and Buchner added to the knowledge of the Muata Yanvo's empire, while Von Mechow explored the Kwango to about 5° south. The most important results were, however, obtained by Pogge and Wissmann, who passed through previously unknown regions beyond Muata Yanvo's kingdom, and reached the Upper Congo at Nyangwe, whence Wissmann made his way to the east coast. In 1884 Mr Arnot, who had reached Benguela from Natal by a route roughly the reverse of Pinto's, started west and made his way along the Zambezi-Congo watershed to Garenganze or Katanga. In 1884-85 a German expedition under Wissmann solved the most important geographical problem relating to ~~the southern Congo basin by descending the Kasai, the largest southern tributary, which, con~~ trary to expectation, proved to unite with the Kwango and other streams before joining the main river. Further additions to the knowledge of the Congo tributaries were made at the same time by Mr Grenfell, a Baptist missionary, who (accompanied in 1885 by Von Francois) made several voyages in the steamer Peace, especially up the great Ubangi, ultimately proved to be the lower course of the Welle. Another German expedition under Kund and Tappenbeck also made discoveries north of the Lower i Kasai. In 1885-87 an Austrian expedition under Dr Lenz crossed Africa from west to east by the Congo , ? "fr / and Lakes Tanganyika and Nyasa. Farther south Africa Capello and Ivens in 1884-85 crossed the continent from Mossamedes to the mouth of the Zambezi, breaking new ground en route, especially in the borderlands between the Upper

EXPLOKATION']

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Zambezi and Upper Congo. In the southern Zambezi basin and neighbouring districts, the journeys of Holub, . Selous, Montagu Kerr, Erskine, and others resulted in more accurate knowledge, especially in Matabeleland and Mashonaland, while Portuguese expeditions under Paiva de Andrada explored the country south of the Lower Zambezi.

On Lake Nyasa, where a Scottish mission was established in 1875, Mr E. D. Young in 1876 for the first time reached the north Bast ®°*^ °^ *® \«^, proving that it extended farther than

B^atorlal ^^^ ®®' Supposed. Surveys were also carried out by Africa. ^^ James Stewart. In 1877 Messrs Elton and Cotterill opened a new route north of the lake to Ugogo. In East, as in West Africa, operations were started by agents of the Belgian Association, but with less success than on the Congo. The first new journey of importance on this side was made (1878-80) on behalf of the British African Exploration Committee by Mr Joseph Thomson, who after the death of his leader, Mr Keith Johnston, made his way from the coast to the north end of Nyasa, thence to Tanganyika, on both sides of which he broke new ground, sighting the north end of Lake Rukwa or Leopold on the east. In 1880i-84 a German expedition under Reichard, B6hm, and Kaiser crossed Tanganyika, and penetrated beyond the Upper Congo to Katanga, while in 1882-84 the French Lieutenant Giraud proceeded by the north of Nyasa to Lake Bangweulu, of which he made the first fairly correct map. Between Nyasa and the coast useful work was done about this time by Mr H. E. O'Neill, British Consul at Mozambique, as well as by members of the Universities mission, and a little later by Mr J. T. Last. North of the Zanzibar-Tan- ganyika route a large area of new ground was opened in 1883-84 by Mr Joseph Thomson, who traversed the whole length of the Masai country to Lake Baringo and the Victoria Nyanza, shedding the first clear light on the great East African rift-valley and neigh- bouring highlands, including Mounts Kenya and Elgon. On the first part of his route he had been preceded by the German Dr G. A. Fischer, who in a second journey broke some new ground to the south and west of the Masai country, traversing for the first time the coast districts east of the Victoria Nyanza (1885-86). A great advance towards the north was made in 1887-89 by the Austrians Teleki and Von Hohnel, who discovered the large Basso Norok, now known as Lake BudoU, till then only vaguely indicated on the maps as Samburu.

Still farther north various attempts were made between 1870 and 1886 to explore the interior of Somaliland, the principal being those of Haggenmacher (1874) and Rfivoil (1870-84), North- Yfjxt they met with only partial success. In 1885, how-

™f' ever, the brothers James succeeded in making their

way for the first time from Berbera to the Webi She- beli. In Abyssinia and the Galla countries to the south of it the principal work was done by a band of Italian explorers, among whom the names of Antinori, Antonelli, Bianchi, Cecchi, and Chi- arini most deserve mention. Many of the expeditions were unfor- tunate, but valuable results were obtained by Cecchi and Chiarini, who penetrated the Galla countries to Kaffa (1876-81). In 1881- 83 Dr Stecker, and in 1886-87 Dr Traversi, explored the Lake Zuai region ; while in 1882 a Dutch traveller, J. M. Schuver, pushed through unknown districts south-west of Abyssinia beyond the Blue Nile. French travellers, among them M. Aubry (1883- 85), also made their way to the Galla countries, where a few years later a considerable advance was made by J. Borelli, who reached a point on the Omo farther south than any of his predecessors. On the Upper Nile, where General Gordon and his lieutenants were now waging war against ofiBcial corruption, and the oppression of the slave traders, the chief geographical work was the survey of the course of the river by Gordon and members of his staff ; the examination of the Albert Nyanza by Romolo Gessi and by Colonel Mason ; and, somewhat later, various journeys of Emin Fasha to' the

west of the lake. To the south of Darfur the bounds of knowledge were somewhat extended by Colonel Purdy and by the Greek Dr Potagos, while on and beyond the water- shed to the south-west the work of Schweinfurth was continued by the Russian Dr Junker (1878-86), who pushed far down the Welle river, and by Frank Lupton, governor of the Bahr-el- Ghazal province.

In Northern Africa, embracing the Sahara and western Sudan, the period 1873-85 was not marked by many important expedi- tions, the attention of explorers being directed to the North and more central regions. That of Dr G. Nachtigal, which North- threw valuable light on the region around Lake Chad,

“**’ had been begun in 1869, though not completed till

Africa. 1874. Its later stages took the traveller through the

almost unknown country of Wadai to the Nile. In 1873-74 the German traveller, Dr G. Rohlfs, undertook his second expedition to the oasis north of the Libyan desert, and in 1878-79 penetrated the latter as far as Kufra. A little later (1880-81) a crossing of North Africa from east to west was eflected by the Italians Mat- teucci and Massari, who, starting from Suakin, passed through

Wadai, and finally reached the mouth of the Niger. In the Sahara unsuccessful attempts were made to penetrate from Algeria to Tim- buktu in 1873-74 by Paul Soleillet, who only reached Insalah, and in 1874-76 by Victor Largeau. In 1876-77 a German traveller, Erwin von Bary, made his way to Rhat and Air, but was assassinated. A French expedition under Colonel Flatters met with a like disastrous fate in 1881. Farther west success was attained in 1880 by a German traveller, Dr Lenz, who starting from Morocco made his way across the Western Sahara, in part by a new route, to Timbuktu. Morocco itself was, a year or two later (1883-84), the scene of important explorations by M. de Fouoauld, a French traveller, who, disguised as a Jew, crossed and re-crossed the Atlas, and supplied the first trustworthy in- formation as to the orography of many parts of the chain. In Senegambia, where the political expansion inaugurated by Gen- eral Faidherbe was continued under Desbordes and Gallieni, additions were gradually made to geographical knowledge. An unsuccessful attempt to reach Timbuktu and Algeria from this side was made in 1878-79 by Soleillet, and it was not till 1887 that the former was reached by Lieutenant Caron, who navigated the Upper Niger in a gunboat. The source of the river had been reached in 1879 by MM. Zweifel and Moustier, agents of a commercial house at Sierra Leone. Behind the Gold Coast, where Kumasi, the capital of Asbanti, had long been the limit of European knowledge, the first step forward was made by Bonnat, who ascending the Volta reached the important mart of Salaga (1875-76). In 1882 Captain Lonsdale went farther, visit- ing Yendi and Bontuku, while two years later Captain Kirby made his way to Kintampo. On the Middle and Lower Niger no great advance was made during this period ; but on its eastern branch, the Benue, good work was done by E. R. Flegel, who charted the river in 1879 during a voyage in the missionary steamer Henry Venn, and in 1882-83 penetrated almost to its source during an overland journey in Eastern Adamawa.

Apart from the French operations in the Sahara, Senegambia, and the Ogowe region, most of the journeys had hitherto been in-* dependent of political motives, few territorial claims having yet been made by European nations. From about 1886 onwards ex- ploration was largely connected with the extension of political influence, over African territory, inaugurated in 1884 by the an- nexations of Germany, and regulated by the enactments of the Berlin Conference of 1884-85, and by subsequent international agreements. The future course of exploration can best be fol- lowed by taking in turn the work done in the different spheres by European Powers. One great expedition, however, not exclusively connected with any one sphere, must be first spoken of, viz., the Emin Pasha relief expedition under H. M. Stanley, which set out in 1887 by way of the Congo to carry Emin supplies to the governor of the old Egyptian Equatorial ^??” province. The route lay up the Aruwimi, the

principal ecM tributary of the Congo from the north-east, by which oaa the expedition made its way, encountering immense difficulties, through the great Equatorial forest, the character and extent of which were thus for the first time brought to light. The return was made to the east coast, and resulted in the discovery of the great snowy range of Ruwenzori or Bunsoro, and the confir- mation of the existence of a third Nile lake discharging its waters into the Albert Nyanza by the Semliki river. A further discovery was that of a large bay, hitherto unsuspected, forming the south- west corner of the Victoria Nyanza.

In the partition of the continent among European nations, attention was first directed to West Africa, where the activity of the International Association and of France was ^ quickly followed (1884) by the appropriation by ””«««>’•• Germany of the chief of the previously unclaimed strips of coast. In one of these — Cameroon — the unknown interior had till then been contiguous with the coast-line, but German travellers soon began to throw back its limits. Through the labours of Zint- grafE (1887-89), Kund (1887-88), Morgen (1889-90), the river systems of the Sanaga and Nyong were brought to light, and a connexion effected with the Benue and Adamawa in the north. Other travellers — Von Stetten, Konrau, Ramsay, &c. — supple- mented their work, while Von Uechtritz and Passarge explored- scientifically the region of the Benue (1894). The eastern borders of the territory were first explored in 1897-98 by b i.

Von Carnap, and later (1898-99), from the side of codm

the Congo, by Pleyn. In the adjoining French terri- tory, the Sanga, one of the principsd northern tributaries of the Congo, was explored in 1890-92 by Cholet, Ponel, Fourneau, and others, and was reached from the north by Mizon, who drew the first line of communication betweeii the Benue and the Congo (1890-92). In 1890 Paul Crampel, who in ^the previous year had explored north of the Ogowe, undertook a great expedition from the Ubangi to the Shari, but was attacked and killed, with several of his companions, on the borders of Bagirmi. M. Dybowski, who commanded a supporting expedition, reached the

Gnbingi, a principal branch of the Shari. He was followed in 1892-93 by Maistre, who, reaching the Gribingi by a more westerly route, passed westward to the Benue. In 1894 Clozel reached the Worn, a south-western feeder of the Shari, which last was reached in 1896 by Gentil, who for the first time launched a steamer on its waters, and pushed on to Lake Chad, the ultimate objective of the French for many years. Further exploration in the Shari basin was effected in 1898-99 by B^hagle. Farther east, towards the Nile watershed explored first by Junker and others from the north, the pioneers from the sOuth were Belgian officers, who went north from the Congo before the French territorial claims were fully acknowledged. Thus Hanolet reached Dar Runga, south of Wadai, while Nilis and De la K6thulle made their way (1894) to the borders of Darfur. Subse- quently French agents also pushed towards the Nile basin. In 1896-97 liiotard and Cureau reached the western borders of the Bahr-el-Ghazal, while Marchand led a large military expedition through the heart of the province, reaching Fashoda on the Nile early in 1898, and completing the crossing of the continent through Abyssinia to the east coast. Finally, in the west of the French territory, a iourney from the Sanga to the coast was accomplished by Fourneau in 1898-99.

Recent exploration in the Congo State has been carried out almost entirely by Belgian officers. After the identity of the Welle with the Ubangi had been finally ascertained, and its course surveyed (1887-88) by Vangele, the upper basin of the river was traversed in all directions by Van Kerkhoven and his subordinates (1891-93), and later by Chaltin and others. Various southern tributaries of the Congo were navi- gated by Delcommune in 1888-89, particularly the Lukenye and the Boloko or Lomame. In 1890-92 important expeditions traversed the south-east Congo basin by overland routes to Garenganze, under Le Marinel, Delcommune, and Bia, the second of whom reached Tanganyika, and explored the course of the Lukuga. In 1896-97 the two main upper branches of the Congo and the country between them were surveyed by Lieutenants Brasseur and Cerckel, and in 1898 the southern borders of the great Equatorial forest on the eastern verge of the Congo basin were traversed by Lieutenant Glorie. ^

In German South-West Africa journeys were made, after the annexation of the territory, by Schenck, Schinz, Fleck, Pfeil, Frangois, Dove, and others, who added to the know- Soatb- ledge of the western Kalahari as well as of the districts ^^^^ and nearer the coast. In British South Africa Selous and (Antral Holub continued their explorations, while in 1895-96 Africa. ^^ whole country between the Upper Zambezi and the

Kafukwe was explored by Captain (now Major) Gib- bons, Mr Reid, and Captain Bertrand. More recently (1898- 1900), Major Gibbons, assisted by Captains Quicke, Hamilton, and others, explored the gorges of the Middle Zambezi, as well as the whole upper basin of the river. The region of Lake Ngami and the Okavango was explored and its geology elucidated in 1896-97 by Dr Passarge. On the east the boundary with Portuguese territory was surveyed in 1892 by a mixed commission, on which the British representative was Major Leverson. West of Lake Nyasa explora- tions were made in 1899 and 1890 by Alfred Sharpe, who in the latter year crossed the Loangwa and ascended the Mchinga escarp- ment; in 1890-91 by Joseph Thomson, who crossed the plateau beyond that escarpment to the neighbourhood of Lake Bangweulu, making a wide circuit to the west and south on the return journey; and more recently by Foa,Weise, Moloney, Codrington, and others. Lake Bukwa, in German territory, north of Nyasa, was visited from the south in 1889 by H. H. Johnston and Kerr Cross ; in 1894 by W. H. Nutt, who made his way from the west across the Fipa plateau ; and in 1897 by L. A. Wallace, who made the first com- plete circuit of the lake. The fact of a diminution of its area had already been ascertained by German travellers from the north. Farther west Lake Mweru, Garenganze, and the Luapula were ex- plored in 1890 and 1892 by Alfred Sharpe, while Lake Bangweulu and the Luapula were carefully surveyed in 1895-96 and 1898-99 by Poulett Weatherley. A journey made in 1898 by Mr Campbell, a missionary, from Garenganze to Blantyre by the south of Bang- weulu, also deserves mention.

In the southern districts of German East Africa, the upper basin of the Bufiji was explored in 1886 by Count Pfeil, and the country between that river and the Rovuma in 1893-94 by Von Oerman Scheie and Ramsay.’ The hilly districts north of Nyasa ^’ have been examined by various travellers, including W.

Africa. Bomhardt, who in 1896 discovered there considerable

deposits of coal. Farther north the parts between the coast and Tanganyika have been surveyed by Prince, Ramsay, and others. Towards the north of the German sphere three important journeys were made across the whole width of the territory within a few years of its final acquisition. In 1891 Emin Pasha, accompanied by Dr Stuhlmann, made his way south of the Victoria’Nyanza to the western Nile lakes, visiting for the first time the southern and western shores of Lake Albert Edward. In the same year Dr 0. Baumann, who had already done good work in Usambara, near the coast. Started on a more extended journey through the region of

steppes between Kilimanjaro and the Victoria lake, afterwards visiting the latter and exploring the head-streams of the Kagera, its chief feeder. In the steppe region above alluded to he discovered two new lakes, Manyara and Eiassi, occupying parts of the East African valley system. This region was again traversed in 1893-94 by Count von Gotzen, who passed to the south of Manyara, ascend- ing Mount Gurui in its neighbourhood, and thence continuing his route westwards to Lake Kivu, north of Tanganyika, which, though heard of by Speke over thirty years before, had never yet been visited. He alsb reached for the first time the line of vol- canic peaks north of Kivu, one of which he ascended, afterwards crossing the great Equatorial forest by a new route to the Congo and the west coast. The region of the upper Kagera and Lake Kivu has since been further explored; especially by the Germans Von Trotha, Ramsay, Bethe, Kandt, and Von Beringe, and the Englishmen Grogan and Moore, the first accurate survey of the lake being inade by Kandt (1898-99). East of the Victoria Nyanza good work has been done by the zoologist Neumann, and by Von Trotha, Werther, Kaiser, and others. The exploration of Mount Kilimanjaro has been the special work of Dr Hans Meyer. ‘

In British East Africa the Tana river districts, as far as the slopes of Mount Kenya, were explored in 1889-91 by Pigott, Dun- das, Hobley, &c., and the Juba in 1891 by Dundas. The railway survey in 1892 under Macdonald gave cT * an improved basis for the mapping of the country on Mrlca. the line of route, while Captain Liigard traversed the whole territory to Lakes Albert Edward and Albert in 1891-92. Valuable scientific work was done in 1893 by Dr Gregory, who ascended BJount Kenya to a height of 16,000 feet, while the coun- try east and north of the mountain was explored between 1892 and 1896 by Chanler and Von H8hnel, A. H. Neumann, and Kolb, the last-named reaching a point only a few hundred feet below the summit. In 1893-94 Mr Scott Elliot reached Buwenzori by’ way of Uganda, returning by Tanganyika and JTyasa, and in 1896 Mr Hobley made the circuit of the great mountain Elgon, north-east of the Victoria Nyanza. During the pacification of Uganda various surveys were executed by British officers. Lake Choga on the Nile between the Victoria and Albert lakes was explored in 1898 by Captain Kiffkpatrick, a member of Colonel Macdonald’s expedition, while the leader himself advanced north-west from Mount Elgon to the Latuka country, and Captain Austin went north to Lake Ru- dolf and the Omo. In 1899 Mount Kenya was ascended to its summit by a party including Mr H. J. Mackinder. Lastly, in the region of the Lower Juba, explorations were made in 1895-96 by Mr C. H. Craufurd, and in 1899 by Mr A. C. W.’ Jenner and Dr W. Radford.

In the Peninsula of Somaliland, &c., a period of rapid advance, due chiefly to Italian activity, began about 1890, when Brichetti- Robecchi made a journey along the eastern coast from Obbia beyond Cape Guardafui. In the following year ‘^Qt, he went from Mukdishu to Obbia, and thence crossed ^andi” through Ogaden to Berbera on the Gulf of Aden. In the same year Prince Ruspoli made his first journey-southwards from Berbera, while Baudi and pandep penetrated to Ime on the Upper Webi, which place was also reached in 1893 by Captain Swayne. In 1892 Bottego and Grixoni left Berbera and made their way past Ime to the Upper Juba, which Bottego explored to its source, both travellers finally making their way vit Logh to the east coast. Prince Ruspoli in 1893 reached Logh from the north, and, proceeding north-west in search of the Omo, discovered the Sagah and Lake Abbaya, but was afterwards killed by an ele- phant. The next expedition was that of Dr Donaldson Smith, who, starting from Berbera in 1894, explored the head-streams of the Webi, and taade his way to the region of Lakes Abbaya, Stefanie, and Rudolf, ascending the main feeder of the last- named among the mountains to the north. Heeventually reached the east coast at Lamu by the east of Lake Rudolf? In 1895 Bottego, accompanied by Sacchi, Vannutelli, and Citerni, left Brava with the purpose of finally solving the problem of the Omo, which some had considered unconnected with Lake Rudolf. Be- yond Lake Abbaya he came upon a larger lake to the north, (Pagade or Margherita) and pushed west through mountainous country to the Omo, which he succeeded in tracing to Lake Ru- dolf. After exploring the west shore of that lake the explorers went north-west and discovered the head-streams of the Sobat, afterwards ascending to the Abyssinian highlands, where the leader lost his life during an attack by the natives. An English expedition under H. S. Cavendish (1896-97)

followed somewhat in Bottego’s steps, but after reaching the south end of Lake Rudolf went south, discovering a new lake in a volcanic region between Rudolf and Baringo. In 1897 the French traveller, De Bon- champs, traversed the southern borderlands of Abyssinia and further explored the head-streams of thp Sobat, and about the same time his compatriot, M. Darragon, went south near the chain of lakes ending in Abbaya. Captain Wellby, previously known as a Tibetan explorer, took a somewhat similar route south in 1898-99,

exploration]

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but pushed on to Lake Rudolf, and crossed a previously unexplored tract between the lake and the Lower Sobat. In 1899 Blundell, Lovat, &c., traversed the districts south of the Blue Nile; while Donaldson Smith crossed from Berbera to the Nile by Lake Rudolf in 1899-1900. In North Africa the last decade of the 19th century was not marked by great activity. The Sahara was crossed in 1892 from North ^^^^ ^^^^ *° “^“Poli iaiing the latter part of Monteil’s

Africa journey (to be spoken of later) ; but in spite of the

persevering efforts of the rrench to open a route from Algeria to the Sudan success was not attained until 1899, when M. Foureau, who year after year had returned to the task, succeeded In reaching Zinder, afterwards joining Gentil south of Lake Chad and returning by the Congo. In the Algerian Sahara surveys have been executed, partly in connexion with political movements, by Flamand, Gemiain, Laperrine, &c. In Southern Morocco the Tafilet oasis was reached in 1893 by a new route across the Atlas by W. B. Harris. In the western Sahara, the attempts of the Spaniards and French to penetrate inland met with little success until Adrar was reached (1900) by Blanchet.

In the western Sudan the same period was one of great activity from the Senegal to the Lower Niger and Lake Chad. In 1887-89 Captain Binger made a great journey through the Mandingo countries to Kong, and thence, after a tour to the north-east as far as Wagadugu, to the coast, of Guinea. In 1890-92 Monteil made his way east across the bend of the Niger to Say, and thence to Lake Chad and Tripoli. After the Trench occupation of Timbuktu surveys in that region were executed by Lieutenants Hourst, Bluzet, &c., and a system of lakes communicating with the Niger was disclosed. After

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Sketch Map of West Afkioa.

the conquest of Dahomey, Say was reached from that side in 1895 by Decoeur and Tout^e, both of whom added to ouR^knowledge of the Middle Niger, but more important results were obtained by Hourst, who, leaving Timbuktu in January 1896, descended thp river to the sea in spite of the dangerous rapids. The southern part^ of the ^French Sudan have since been traversed by Baud, Alby, Bretonnet, and others, and the interior of the Ivory Coast and parts of Liberia by Marchand, Hostains, Blondiaux, &c. East of the Middle Niger the expeditions of Cazemajou, and of Voulet and Chanoine, have had disastrous results.

In the British colonies, in addition to the work of various bound- ary commissions, the Gold Coast Hinterland has been penetrated

as far as Gambaga and Mosi. The Germans have British and shown great activity in the adjoining Togoland territory, ^r/nan jjjg interior being explored (1887-93) by Wolf, Von Ij^y' Frangois, Kling, Biittner, and' others, while in 1894-95,

Drs Gruner and Doering pushed north (simultaneously with the French expedition of Decoeur) through Gurma to Say, returning through Borgu, visited shortly before by Captain Lugard on behalf of the British Niger Company. East of the Niger the Benue and districts on each side have been surveyed by Macdonald (1890), and more recently by Clive, Moseley, Hewby, &c.

Trans-continental journeys not yet spoken of include those of Versepuy and De Romans, 1895-96 (Uganda, Lake Albert Edward,

Equatorial forest, Congo) ; A. B. Lloyd, a missionary, Trans-con- jggg ^^,y ^ somewhat similar route) ; Foa, 1897 tloental (Nyasaland, Tanganyika, Congo) ; and Grogan, 1899- journeys. ^^^^ (Zambezi, central line of lakes, Nile). By the last-named the whole length of the continent from eid to end was for the first time traversed.

The area of land accurately mapped in Africa is probably less than in any other continent. Although few extensive districts remain

of which the general features are not now known, the Mapping cartography of by far the greater part of the continent of Africa. ^ based merely on route surveys, carried out during more or less rapid journeys, which leave out of consideration the intervening stretches of country. Such route surveys are to a

certain extent supplemented by astronomical observations, which may give fairly correct latitudes, but which are rarely to be trusted as determining longitudes with close accuracy.

The countries in which exact topographical work by means of triangulation has been executed are, very few, being limited to Algeria and Tunis ; parts of Egypt and the Italian sphere on the Red Sea ; the greater part of Cape Colony, J''>"'gi'l^' and some portions of Natal and British South Africa. Even the results of these surveys have not yet been published in full as maps. In Egypt a survey department has lately been formed, and triangulation is proceeding at a satisfactory rate. The geodetic survey of Cape Colony is now being extended over British South Africa, work having been begun in 1897. It is hoped to carry the triangulation northwards along the 30th meri- dian to Lake Tanganyika, and thence with German co-operation to the Nile, and eventually down that river to Egypt. In Equatorial Africa the most accurate and most valuable triangulation yet carried out is that of Captain G. E, Smith, R.E., who, while en- gaged In road-making in British East Africa, executed a survey between the coast and the Victoria Nyanza, extending from Mounts Kilimanjaro and Meru in the south to Kenya and Elgon in the north. In addition to these triangulated areas fairly accurate surveys

have been executed along certain lines, such as international boundaries and the tracks of railways. Among the former are the Anglo-German boundaries in East Africa from the coast to Kilimanjaro and on the Nyasa-Tanganyika plateau ; the region of the Anglo-Portuguese boundary in South-East Africa ; and the Anglo-French boundary behind Sierra Leone ; while the most extensive railway survey, apart from the older colonies, is that from the east coast to the Victoria Nyanza.

The mapping of other parts of the continent on the basis of route surveys and astronomical observations is of very varying quality. Of large-scale maps of separate European possessions the best have been supplied by the Germans, who have undertaken a complete map of German East Africa on the scale of TTjj'irjny^ The southern part of Togoland has been mapped by P. Sprigade on the scale of ^(ntWiri 3.°dthe northern, with adjoining areas, on that of ij^i^jn. Maps of all the German possessions on the scale of aooiaoo are given in Langhans' Colonial Atlas, and the whole area of th« Congo State has been shown on the same scale by M. Wauters in the Mouvement Geographigue. The best maps dealing with the whole continent are those of the French "Service gfiographique de I'arm^e," on the scale of jd^ju ; and of Habenicht, issued by the German firm of Perthes, on that of TSilitf -^ movement for the better mapping of Africa was set on foot in 1895 by General E. F. Chapman, who brought the subject "^ j before the International Geographical Congress, which "'^foas. met that year in London. It was suggested that good results would follow from the mapping by travellers of areas rather than routeis, and from the accurate determination of certain points in the unsurveyed portions to form a framework for the whole. For the latter object the numerous lines of telegraph now being laid down will afiord great facilities, and something has already been done towards obtaining accurate longitudes by such means. The following were determined in this way in 1898-99 : —

Maps based on route surveys.

Point Fixed.

Bulawayo

Umtali

Telegraph clearing 1′ 6″ west of Nkata B., Nyasa

Omdurman (Khalifa's ho.)

Goz -Abn Guma (White Nile)

Wad Medani (Blue Nile)

Eoselres

Observers.

Oapt. "Watherstone Anglo-German

Boundary Oom-

mission Col. Talbot, Major

Austin, Capt.

Lyons Col. Talbot, Major

Austin Lieuts Gwynn and

Jackson

Method.

Signals exchanged with Cape Town

Signals exchanged with Cairo

Signals exchanged with Omdurman

Longitude.

Not published 82 40 18 E. 31 16 51 E.

82 29 12-5 E.

82 41 87-B E.

83 81 86-5 34 24 51

Tbade and Communications. Apart from the north and south temperate regions the commercial intercourse of Africa with the rest of the ■world has, for the size of the continent, remained until the present day of quite insignificant pro- portions. In addition to slaves, which have been furnished by the continent from the earliest times, a certain amount of gold and ivory has long been exported from the tropical regions, but no other product has supplied the material for a flourishing trade with those

Past Isolation.

^ The first accurate large-scale map of East Africa as a whole was compiled by Mr Bavenstein for the R.G.S. (1882).

parts. This was due not so mucli to the poverty of the country in natural resources, as to special circumstances which likewise caused so large a part of the continent to remain a terra incognita down to the 19th cen- tury. The principal drawbacks may be summarized as : — (V) Absence of means of communication with the interior ; (2) the unhealthiness of the coast lands ; (3) the small productive activity of the natives ; (4) the effects of the slave trade in discouraging legitimate commerce. Of these the first and last are not necessarily permanent, while the third can be remedied by the introduction of Europeans as supervisors, and possibly of other races as labourers.

\

[PEODUCTS

The resources of Africa may be considered under the head of-^(l) jungle products; (2) cultivated products; (3) animal products; (4) minerals. Of the first-named the most important are indiarrubber

***”””*»• and palm-oil, which in tropical Africa supply by far the largest items in the export list. The rubber-producing plants are found throughout the whole tropical belt, and the most important are creepers of the order Apocyn,ace(s, especially various species of Landolphia (with which genus Valiea is now united). In East Africa Landolphia Tdrkii (Dyer) supplies by far the largest amount, though at least four other species are known. Eorms of apparently wider distribution are

Jangle products.

igri^nt StanFontsGBOg! £stab^.

Sketch Map op Africa.

L. heMdelotii, which is found in the Bahr-el-Ghazal, and extends right across the continent to Senegambia ; and L. (formerly Vahecb) comorensis, which, including its variety L. florida, has the widest distribution of all the species, occurring in Upper and Lower Guinea, the whole of Central Africa, the east coast, the Comoro Islands and Madagascar. In Lagos and Cameroon much rubber is produced by a large apoeynaceous tree, Kickxia africana, and in West Africa generally by various species of Ficus, some promising species of which are also found in East Africa. The rubber produced is somewhat inferior to that of South America, but this ‘is largely due to careless methods of preparation. The great destruction of vines brought about by native methods of collection has already much reduced the supply in some districts, and renders it

precarious everywhere, unless some means are taken to cultivate the rubber-yielding plants. This has already been attempted in Cameroon and elsewhere. Experi- ments have been made in the introduction of South American rubber plants, but opinions differ as to the prospects of success, as the plants in question seem to demand very definite conditions of soil and climate. For cultivation the Ficus indica is said to be a favourable tree, but possibly some endemic species of Ficus might prove equally valuable. The second product, palm-oil, is ,at present derived from a much more limited area, for although the oil palm is found throughout the greater part of West Africa, from 10° N. to 10° S., the great bulk of the export comes from the coast districts at the head of the Gulf of Guinea. A larger supply would certainly be

products]

A F E I C A

135

available, but with tlie risk of over-production and lower prices it is doubtful whether an increased export would be profitable. A third valuable product, but one which has not yet been made use of as it might be, is the timber supplied by the forest regions, principally in West Af ricEi. It includes African teat or oak {Oldfieldia africana), excellent for shipbuilding ; the durable odum of the Gold Coast (Ghlorophora excelsa) ; African mahogany (Khaya senegdknsis); ebony (Diospyros ebenum); camwood {Baphia nitida) ; and many other ornamental and dye woods. Some development of the timber industry has lately taken place on the Gold Coast, whence timber was exported in 1898 to the value of £110,000. Valuable timber grows too in South Africa, including the yellow wood (Podo- carpus), stinkwood (Ocotea), sneezewood or Cape ebony (Elided), and ironwood. Other vegetable products of im- portance are : — Gum arabic, obtained from various species of acacia (especially A. seweg’ai),the chief supplies of which are obtained from Senegambia and the steppe regions of North Africa ; gum copal, a valuable resin produced by trees of the leguminous order, the best, known as Zanzibar or Mozambique copal, coming from the East African Trachylobium homemannianum, and

also found in a f ossH state under the soil ; kola nuts, produced chiefly in the coast lands of Upper Guinea by a tree of the order Steraidiacece (Kola acuminata) ; archil or orchUla, a dye- yielding lichen (Boccella tinctoriaajid triciformis) growing on trees and rocks in East Africa, the Congo basin, &c.; cork, the bark of the cork oak, which flourishes in Algeria ; and alf a, a grass used in paper manufacture (MachrocMoa tenacissima), growing in great abundance on the dry steppes of Algeria, Tripoli, &c. A product to which attention has been paid *of late in Angola is the Al- meidina gum or resin, derived from the juice of Euphor- bia tirucalli.

The cultivated products include those of the tropical and warm temperate zones. Of the fornier, coffee is per- haps the most valuable indigenous plant. It prwiu^ grows wild in many parts, the home of one species being in the Galla countries south of Abyssinia, and of another in Liberia. Cultivation is, however, necessary to ensure the best results, and attention has of late years been given to this in various European colonies. From Angola the export in 1897 reached a value of £175,000, but of this a large proportion was the produce of wild trees. Still more isthis the case with the exports from Harrar and Abyssinia, the amount of which passing through the ports of British Somaliland reached a total o| £119,000 worth in 1898-99. Encouraging results have been obtained inNyasaland, which in 1898 exported coffee to the value of over £23,000, although the planta- tions are still in their infancy. Plantations have also been started in German East Africa, Cameroon, the Congo Free State, &c.

‘Copra, the produce of the cocoa-nut palm, is supplied chiefly by Zanzibar and neighbouring parts of the east coast. Ground-nuts, produced by the leguminous plant Arachis hypogcea, are grown chiefly in West Africa, and the largest export is from Senegal and the Gambia ; while Bambarra ground-nuts (Voandzeia subterranea) are very generally cultivated from Guinea to Natal. Cloves are extensively grown on Zanzibar and Pemba islands, of which they are the staple products. The chief drawbacks to the industry are the fluctuations of the yield of the trees, and the risk of over-production in good seasons. Cotton, which grows wild in many parts of tropical Africa, is exported in small quantities in the raw state from Angola and elsewhere ; but the main export is from Egypt, which comes third among the world’s sources of supply of the article. Sugar, which is the staple crop of Mauritius, and in a lesser degree of Eeunion, is also produced in

Natal, Egypt, and, to a certain extent, in Mozambique. Dates are grown in Tunis and the Saharan oases, especially Tafilet ; maize in Egypt, South Africa, and parts of the tropical zone ; wheat in Egypt, Algeria, and the higher, regions of Abyssinia; rice in Madagascar. Wine is largely exported from Algeria, and in a much smaller quantity from Cape Colony ; fruit and vegetables from Algeria. Tobacco is widely grown, on a small scale, but, except perhaps from Algeria, has not yet become an important article of export, though experimental plantar tions have been tried in various tropical colonies. Cacao and tea have also been tried in some of these, but their cultivation has hardly advanced beyond the experi- mental stage. The most promising cacao plantations are along the coast of Cameroon, whence the product was exported in 1898 to the value of £16,000. Indigo, though not originally an African product, has become naturalized and grows wild in many parts, while it is also cultivated on a small scale, but is not likely to become an important article of export. The main diffi- culty in the way of tropical cultivation is the labour question ; but some races, such as the Angoni of Nyasa^ land, have proyed good workers, while the introduction of Indian coolies is regarded in some quarters as the solution of the difficulty.

For the study of economic botany, and the develop- ment of tropical cultivation, botanical gardens have been established in many of the European possessions, including the Gold Coast, Lagos, Sierra Leone, Old Calabar, Cameroon, British Central Africa, Uganda, and German East Africa.

Of animal, products one of the most important at present is ivory, the largest export of which is from the Congo Free State. The diminution in the number of elephants with the opening up of the remoter

.^du™! districts must in time cause a falling-off in this export. Beeswax is obtained from various parts of the interior of West Africa, and from Madagascar. Eaw hides are exported in large quantities from South Africa, as are also the wool and hair of the merino sheep and Angora goat. Both hides and wool are also exported from Algeria and Morocco, and hides from Somaliland. Ostrich feathers are produced chiefly by the ostrich farms of Cape Colony, but some are also obtained from the steppes to the north of the Central Sudan. Live stock, principally sheep, is exported from Algeria and cattle from Morocco. ^

The hitherto exploited minerals of Africa are confined to a few districts only, the resources of the continent in this respect being largely undeveloped. Since the discovery of gold in the Transvaal, parti- cularly in the district known as the Rand (1886), the output has grown enormously, until in 1898 it reached a value of over 16 millions sterling. The gold-yield- ing formations extend northwards through Mashonaland, which may produce a large amount in the future, and deposits may possibly be discovered in various parts of tropical Africa where ancient schistose rocks occur. In the Galla countries gold has long been an article of native commerce, and on the Gold Coast of European also. Copper is found in the west of Cape Colony, in German South- West Africa, and in the Garenganze or Katanga country in the southern Congo basin, where it has long been exploited by the natives. It also occurs in Morocco, Algeria, Darfur, &c. Iron occurs in Morocco and Algeria (some being exported from the latter), and is widely diffused, and worked by the natives, in the tropical zone. But the deposits are generally not rich, and European iron already competes with the native supply. Coal is worked, principally for home consumption, in Cape Colony, Natal, and Orange Eiver Colony, and has lately been dis-

[tbade

Future

develop’

ment.

covered in workable deposits ^n the Germaai territory north of Lake Nyasa. Diamonds are found in large quantities in a series of beds known as the Kimberley shales, the prin- cipal mines being at Kimberley, in the north of Gape Colony. Phosphates are exported to some extent from Algeria. Of otljer minerals which occur, but are little worked, zinc, lead, and antimony are found in Algeria, lead and manganese in Cape Colony, plumbago in Sierra Leone.

Of the natural resources here enumerated those from which a future increase of trade may be expected are prob- ably the plantation products, the cultivation pf which is still in an experimental stage. For sucb a development, however, the solution of the labour problem and the provision of ade- quate means of transport (to be spoken of later) are indispensable conditions. The country which under a civilized Government would perhaps give the greatest scope for development is Morocco, both the soil and climate of which are exceptionally favourable, while the mineral -resources are also considerable. British South Africa, too, contains many valuable minerals besides gold, which will no doubt in time be exploited.

The imports from foreign countries into Africa consist eiiiefly of manufactured goods, varying in oliaracter according to the amount Imooris °^ settlement by Europeans. In Algeria and South Africa

they include most of the necessaries and luxuries of civilized life, manufactured cotton and v^ooUen goods, especially the former, taking the first place, but various food stuffs, metal goods, coal, and miscellaneous articles being also included. In tropical Africa, and generally where few Europeans have settled, the great bulk of the imports consists as a rule of cotton goods, the only articles for which there is much native demand. This absence of a large demand for European goods is in fact a great obstacle to trade with Central Africa, but with the gradual advance in civilization it may in time be removed. Perhaps the most pro- mising field in this respect is to be found in the populous and comparatively civilized countries of the Central Sudan, reached from the Lower Niger.

The following tables show, so far as statistics are available, the total imports and exports of the various countries for 1898, and also the chief sources of supply of the principal African commodities. Any estimate, based on these figures, either of the' total commerce of Africa, or even of the external trade, can only be very vague. No figures are given for inland countries, partly for want of statistics, and partly because the transit trade to and from these already appears under the countries through which it passes. In estimating the total external trade, the special trade only of Zanzibar must be included, as the remainder appears under the countries of the opposite mainland. But in the case of Portuguese East Africa the general trade may be taken, as no figures are given for the adjoining inland countries. A certain amount of local trade between contiguous countries, as, e.g., between Lagos and Dahomey, is of necessity included, but this is possibly not more than enough to balance the absence of figures for certain other countries. The totals thus obtained are: — Imports, £66,828,000 ; exports, £67,675,000 ; total, ^134,503,000. In 1896 an estimate, probably based on the statistics for 1894-95, gave the grand total as roughly £100,000,000. The increase in about four years would thus be 34 per cent.

No continent has in the past been so backward in respect of means of communication as Africa, and it was only in the last decade of the 19th century that decided steps were CommunI- t^ken to remedy these defects. The African rivers, cations. ^j^j^ ^jjg exception of the Middle Congo and its affluents, are generally unfavourable to navigation, and throughout the tropical region almost the sole routes have been native footpaths, admitting the passage of a single file of porters, on whose heads all goods have been carried from place to place. Certain of these native trade routes are, however, much frequented, and lead for hundreds of miles from the coast to the interior. In the desert regions of the north transport is by caravans of camels, and in the south ox- waggons have, until quite recently, supplied the general means of locomotion. On the east side the principal termini of the native trade routes are : Suakin, for the Egyptian Sudan ; Massawa, for Abyssinia ; Zeila and Berbera, for the Somali and Galla countries ; Mombasa and Pangani, for the Masai countries, &c. ; Bagamoyo, for the Victoria Nyanza (south), Tanganyika, and Nyasa (north), and for the countries west of Tanganyika ; Kilwa, Lindi, Mozam- bique, a^d Quilimane for Southern Nyasa and the countries beyond.

Native

trade

routes.

Afeican Tkade, 1898. (Values in thousands of pounds sterling.)

1

^|e

*■■« •

^ S^ fl

Country.

Imports.

fA

Exports.

m

Total Trade.

^5«

Britinh Colonies, &o. :—

Egypt ....

10,766-3

41-1

12,100-1

78-2

22,855-4

Somali Coast

880-2

404-7

784-9

Zanzibar, ‘speoial trade

200-0 »

225-01

.,

425-01

„ general „

1,555-1

7-8

1,497-9

7-6

3,058-0

British East Africa

296-9

..

72-4

869-8

British Central Africa .

108-4

38-0

,.

146-4

Mauritius

2,877-6

18-9

2,913-9

3-7

5,791-5

Natal .....

5,369-72

69-8

1,263-8 »

68-2

6,633-0

Cape Colony .

16,682-4 <

68-9

25,818-76

98-1

42,001-1

Niger Coast Protector-

ate ... .

639-7

79

750-2

66-3

1,389-9

Niger Territory (1898) .

160-0

. 406-9

666-9

Lagos .... Gold Coast . . 1 .

908-4

7‘9’-7

882-8

46’-8

1,790-7

960-3

75-6

993-0

71-9

l,953-8

Sierra Leone .

606-3

84-5

291-0

40-5

897-8

Gambia ....

246-1

37-1

247-8

21-9

493-9

French Colonies^ &o. :— French Somah Coast .

..

4«

Madagascar .

857-1

196-4

15-76

1,053-5

Reunion

790-6

“-8

761-1

-1

1,551-7

French Congo

190-0

173-8

863-8

Dahomey

898-8

13-1′

298-6

48-0′

694-4

iTory Coast .

185-9

67-4′

186-8

3t2-7

French Guinea

360-8

67-7 8

812-0

77-48

672-8

Senegal ….

1,813-1

22-3

1,154-3

2-3

2,467-4

Algeria (189T)

11,076-1 ,

2-6

11,829-1

5-6

22,906-2

Tunis ....

2,140-8

13-9

1,767-9

13-1

8,908-7

German Colonies, &c.: —

German East Aftica .

807-3

■89

295-1

2-2 »

1,102-4

German South – West

‘ Africa . ^ .

287-5

2-6 1«

44-9

79-6

832-4

Cameroon

521-3 1

148-5 f

16-8

2521

773-4

Togoland

98-8

247-3

Portuguese Colonies :—

Port. E. Africa, special

1

trade

1,905-2

179-7

2,084-9

Port. E. Africa, general

trade

3,861-9″

554-5 «

,.

4,406-4

Angola ....

860-0

24-6

1,135-5

1,995-5

. Portuguese Guinea

Italian Colonies :—

Eritrea ....

Italian Bomaliland

182-8

111-9

294-2

Congo Free State . Liberia . . Morocco IS

1,007-4

14-9

1,015-9

i-2

2,028-8

1,276-0″

61-51=

1,179-0″

26-8″

2,4550 ”

TripoU ....

886-4

84-0

401-5

39-1

786-9

Articles.

Rubber

Palm-oil and kernels

Gum arable Gum copal Kola nuts . Copra Timber Cork wood Bamboos and reeds Vegetable horsehair Alfa. . .

Articles of Export, 1898.

Sources of Supply, with Values In Thousands of Pounds Sterling.

., Angola (887-3) ; Congo Eree State (634-0) ; Gold Coast (o51-7); Lagos (285-4); French Guinea (237-6); Cameroon (94-5). Niger Coast (705-7); Lagos (459-9); Gold Coast (180-7); Cameroon (110-7).

Zanzibar (26-7); French Guinea (10-7).

Sierra Leone ; Gold Coast (35-7) .

Zanzibar (1051).

Gold Coast (110-3).

Algeria (239-3).

Algeria (246-7).

Algeria (155-5).i^

Tunis (72-7); Tripoli (72-0); Algeria (20-1). ”

1 Estimated.

2 Including goods in transit to interior, 938-6.

‘ Including gold from South African States, 40-6. * Including goods in transit, 4581-0.

5 Including gold from South African States, 15,394-4.

6 26-5 and 42-8 respectively in 1896. J Percentages in 1896.

8 Including imports from and exports to Sierra Leone.

‘ Percentages from and to Zanzibar=59-2 and 74-2.

1″ Percentage fromXiape Colony=13-8.

11 Including goods in transit to Transvaal, 1770-1; to Mashona- land, 176-6.

, 12 Including exports from Transvaal, 368-9; from Mashonaland,

5-9.

IS Ports of Tangier, Tetuan, Laraiche, Dar el Baida, Rabat, Mazagan, Saffi, and Mogador.

1* Including estimate of 250-0 imports and 250-0 exports at Mogador.

15 Excluding Mogador ; from and to Great Britain and Gibraltar.

18 In 1897.

Articles.

Coffee .

Cacao Sugar

Wines

Cloves .

Vanilla .

Dates

Oround-nuts

Oilseeds (sesamum)

Beans

Almonds

Table fruit

Olive oil .

Cotton .

Tobacco .

Cereals .

Aloe fibre

Ivory

Ostrich feathers Wool and hair .

Hides and skins

SoTiroes of Supply, with TalueB in Thousands of Founds Sterling.

Angola (176-1) ; Harrar, &c., via Somali Coast

(119-2) ; Brit. Cent. Africa (23-8). Cameroon (15-3). Mauritius (2472-8) ; Egypt (557-3) : Reunion

(354-1) ; Natal (18-2). Algeria (5455-4) ; i Cape Colony (15-1). Zanzibar (143-7).

Reunion (275-4); Mauritius (14-0). Tunis (48-9) ” :al (C;

Wax

Eggs

Gold

Diamonds

Copper ore

Iron ore, &c.

Phosphates

„_. Jir. 330-0) ; Gambia (200-3).

. Mozambique Coast.

. Egypt (347-5).

. Morocco (63-6).

. Algeria (156-8) .1

. Tunis (121-8) .•

. Egypt (8659-8).

. Algeria (manufactured, 466-1 ;i leaf, 215-7) .i

. Algeria (813-7) .1

. Mauritius (42-7).

. Congo Free State (240-5) ; Zanzibar (112-9) ;

Cameroon (29-3) ; Somali Coast (24-1) ; French

Congo. . Cape Colony (748-6) ; Tripoli (70-0). . Cape Colony (2444-3) ; Natal (602-0) ; Algeria

(404-3) ; 1 Morocco (188-1) .8 . Cape Colony (548-5) ; Morocco (281-8) ; i Natal

(184-9); Algeria (233-8) ; i Somali Coast

(1.57-3).

. TripoU(72-0).

. Angola (57-6) ; 1 Morocco (31-3).!” . Morocco (75-1) .2

. Transvaal (15,695-1) ; Gold Coast (63-8). . Cape Colony (4566-9). . Cape Colony (262-8). , Algeria (160-3). I , Algeria (389-1) .1

On the west side there are fewer Important native routes, the dense forests of Guinea proving a barrier to intercourse, while the Central Sudan states have in the past communicated rather with the north across the Sahara than with the shores of the Atlantic. In Sene- gambia the most frequented routes have long been those up the Senegal and Gambia rivers. In Upper Guinea the chief are those leading north from the Gold Coast, Togoland, and Dahomey ports to the interior markets of Yendi, Sansanne Mangu, and Sansan Hausa on the Niger,' and from Lagos to the Niger and Sokoto. South of the equator the principal long-established routes are those from St Paul de Loanda to the Luuda and Baluba countries ; from Benguela vid Bihe to Urua and the Upper Zambezi, and from Mossamedes across the Kunene to the Upper Zambezi. In South Africa the ox-waggon routes, now partially superseded, made for Lake Ngami, the Middle Zambezi, and Matabeleland from Walfisch Bay and the middle course of the Orange river, while others tra- versed the Orange River Colony and Transvaal to the Limpopo and beyond. In the north the principal caravan routes across the Sahara lead from different points in Morocco and Algeria to Timbuktu ; from Tripoli 'to Timbuktu, Kano, and other great marts of the Central Sudan ; from Bengazi to Wadai : that from Siut on the Nile through the great oasis and the Libyan, desert to Darfur, &o., has been disused of late. Important routes also traverse the Sudan states from west to east, and proceed south to Adamawa from the commercial centres of the Hausa countries.

Some of these native routes are now being superseded by the improved communications introduced by Europeans in the utiliza- tion of waterways and the construction of roads and Recent Im- railways. Steamers have been conveyed overland in provf" sections and launched on the interior waterways above

meats. j^ obstructions to navigation. On the Upper Nile

and Albert Nyanza their introduction was due to Sir S. Baker and General Gordon (1871-76) ; on the Middle Congo and. Steamers. ^^ affluents to Sir H. M. Stanley and the officials of the Congo Free State, as well as to the Baptist missionaries on the river ; and on Lake Nyasa to the supporters of the Scottish mission. The comparative freedom from obstruction between the sea and this lake has led to the introduction on it ^and on the rivers leading to it of a flotilla of steamers (including gunboats belonging to the British Navy) by which — apart from a short interval broken by rapids on the Shirfi — water comraimication is supplied from the sea to the north end of the lake, beyond which the Stevenson road affords easy communication with Tanganyika. Here a steamer is being built by a British company, while a small

1 In 1897.

- Exclusive of export from Mogador.

' The former trade centres, Kong, Salaga, and Say, have lately lost their importance.

vessel was launched on Lake Mweru in 1900. The Germans have also a steamer on Nyasa, and in 1900 another was launched on Tanganyika, where a British sailing vessel had already plied for some years. A river steamer has been placed by the Germans on the Rufiji. A small vessel was launched on the Victoria Nyanza in 1896 by a British mercantile firm, and a larger Govern- ment steamer made its first trip in November 1900. On the Niger and Benue, where navigation is open from the sea for a consider- able distance into the interior, steamers have plied for many years, while the French have placed steamers on the navigable portion of the upper river. The middle course of the river is only

just navigable for part of the year. A small steamer for the navigation of the Shari and Lake Chad was taken out by the Gentil expedi- tion, by way of the Congo, in 1896-97.

Roads suitable for wheeled traffic, even of the most primitive kind, are still few. The first attempt at road-making in Central Africa on a large scale was that of Sir F. Buxton and Mr (afterwards Sir W.) Mackinnon, who completed the Koads. first section of a track leading into the interior from Dar-es-Salaam (1879). A still more important undertaking was the road, begun in 1881, from the head of Lake Nyasa to the south end of Tangan- yika, constructed mainly at the expense of Mr James Stevenson, which forms a link in the ” Lakes route ” into the heart of the continent. In British East Africa a road was made from Mombasa to Kibwezi under the auspices of the British Bast Africa Company, and afterwards continued fol: the British Government by Captains Sclater and Smith to Port Victoria on the Victoria Nyanza. From Kikuyu it descends to the great rift-valley, on the farther side of which it ascends the Mau Escarpment near the Eldoma ravine. The continuation, 400 miles long, was begun in 1895 and completed in about two years at a cost of some £t7,000. In German East Africa the caravan track to Tanganyika has recently been much improved and other roads made, generally with a width of 5 to 6 metres, while transport by means of mule carts has been initiated. In Cameroon a road has been made from Victoria northwards to Buea, and others are contemplated. In Madagascar a road 5 metres broad, macadamized to a width of 3 metres, was under con- struction in 1900 between Antananarivo and the coast at Ande- vorante, between which place and Tamatave communication is maintained both by a shore road and by the line of lagoons. Farther north the construction of a road from the capital to Mevetanana, whence water transport is available to Majunga, was begun in 1897.

Although still occupying a low place among the continents in the matter of railway communication, Africa was during the last decade of the 19th century the scene of an im- portant development in that direction. In 1890 ‘^””^vs. African railways were almost entirely confined to the extreme north and south (Egypt, Algeria, Cape Colony, and Natal) ; while apart from short lines in Senegal, Angola, and at Lourengo Marques, the rest of the continent was wholly without a railway system. In Egypt the Alexandria and Cairo railway dates from 18.55, while in 1877 the lines open reached about 1100 miles, and in 1890, in addition to the lines traversing the delta, the Nile had been ascended to Assiut. In Algeria the construction of an inter-provincial railway was decreed in 1857, but was still incomplete twenty years later, when the total length of the lines open hardly exceeded 300 miles. Before 1890 an ex- tension to Tunis had been opened, while the Atlas had been reached by the lines to Ain Sefra in the west and Biskra in the east. In Senegal the railway from Dakar to St Louis had been commenced and completed during the ‘eighties, while the first section of the Senegal-Niger, railway, that from Kayes to Bafulabe, was also con- structed during the same decade. In Angola a line from Loanda towards the interior, bearing the ambitious title ” Royal Trans- African Railway, ” had been opened for a short distance before 1890. In Cape Colony, where in about 1880 the railways were limited to the neighbourhood of Cape Town, Port Elizabeth, and East London, the next decade saw the completion of the trunk-line from Cape Town to Kimberley, with a junction at De Aar with that from Port Elizabeth, as well as of the lines from Port Elizabeth to Graaf Reinet, and from East London to Burghersdorp. The northern frontier had, however, nowhere been crossed. In Natal, also, the main line had not advanced beyond Ladysmith. In the neighbouring Portuguese territory the line from Lourengo Marques towards the Transvaal, commenced in 1887, had not quite reached the frontier when seized by the Portuguese authorities in 1889. Within the Transvaal the railway to Pretoria was, however, under construction.

Recent railway development was inaugurated by the scheme for the Congo railway, connecting the navigable portions of the upper and lower river, operations on which had been begun before 1890, but which was not opened throughout until j*”? ‘ July 1898. A little later the Angola railway was

“e^‘oP” opened as far as Ambaca, while its extension to Malanje “*” *’ has been decided upon. In East Equatorial Africa a beginning

was made by the construction, within the German sphere, of a short line from Tanga towards Usambara ; but in spite of many schemes for a trunk line to the great lakes, no decided action had yet been taken in 1901, the necessary credits for the expenses of a line from Dar-es-Salaam to Tanganyika, with a branch to the Victoria Nyanza, having been refused. In British East Africa a survey for a railway to the Victoria Nyanza was carried out in 1892, and the first rail laid in 1896. The route adopted, after traversing KJkuyu, drops down to the rift-valley by a steep and difScult descent, afterwards climbing the Mau Escarpment to Port Florence on Kavirondo Bay. In April 1901, 488 miles had been completed out of a total of 582. In French Somaliland a railway is under construction from Jibuti to Harrar, with the object of tapping the trade of Abyssinia. In British Central Africa a scheme has been set on foot for a railway past the rapids of the Shird In South Africa the Cape trunk-line has been continued vid, Mafeking to Bulawayo, which was reached in 1897, while a line from Beirato Salisbury, commenced in 1891, was completed in 1899. The Natal and Cape railways have been continued north to the Transvaal (the latter traversing the whole length of Orange River Colony), meeting the completed Lourengo Marques railway at Pretoria. Other lines have also been constructed or commenced both in the Transvaal and Orange River Colony. In 1899 a northern extension of the Bulawayo railway, towards the Zambezi, was commenced as a section of a great scheme for a railway from end to end of the continent, passing through German East Africa and Uganda to Cairo ; while another step towards the realization of the project was taken in the same year by the completion of the Nile railway to Khartum. Pending a possible extension to the Upper Nile, steam communication by river in that direction was opened by the cutting of the sudd, or grass barrier, early in 1900 by Major Peake. Another Egyptian railway which is probably only a question of time is one from Suakin to Berber or Kassala. Farther south a short line has been open for some years at Massawa. In Algeria an extension of the western railway was opened to Jenien-bu-Resg at the beginning of 1900, while the much-discussed project of a line or lines across the Sahara to Timbuktu and Lake Chad has again come into prominence. In French West Africa the construction of a line from Konakri to the Upper Niger has been commenced, while work on the Senegal-Niger line has been continued. On the Ivory Coast the survey for a proposed railway towards the interior was com- pleted in 1899, and in Dahomey a line from Kotonu to the Niger, by a route passing through Camotville and Niltki, has been begun. In French Congo, although the need of a line to Brazzaville on Stanley Pool is acknowledged, little progress towards a realization of the project has been made. In the British West African colonies lines have since 1896 been under construction in Sierra liCone, the Gold Coast, and Lagos. In the Congo Free State a short railway to Mayumbe, north of the lower river, is being con- structed, and lines are proposed from Stanley Falls to Albert Nyanza and Tanganyika. Finally, in Madagascar, the credits for a line from Tamatave to the capital were voted early in 1900.

The telegraphic system of Africa is on the whole older than that of the railways, the newer European possessions having in most cases been provided with telegraph lines before railway ‘ projects had

been set on foot. In Algeria, Egypt, and

graphs. Cape Colony the systems date back to the middle of the 19th century, before the end of which the lines had in each country reached some thousands of miles. In tropical Africa the systems of French West Africa, where the line from Dakar to St Louis was begun in 1862, are the most fully developed, lines having been carried from four difierent points on the coast of Senegal and French Guinea towards the Niger, the main line being prolonged north-west to Timbuktu, and west and south to the coast of Dahomey ; while other lines are either open, being constructed, or projected, including one connecting the Ivory Coast with the general system. In French Congo, also, a line connects Brazzaville with the coast at Loango, whence it runs northwards to Libre- ville. Most of the European colonies and protectorates have lines of more or less length, but the most important is that initiated by Mr Cecil Rhodes, which, starting northwards from the Cape, is destined before long to connect the north and south extremities of the continent. It crosses the Zambezi' to Lake Nyasa, beyond which it has already passed the south end of Tanganyika, while from the north the Egyptian lines have been prolonged beyond Khartum to the Upper Nile. A line from the east coast, which will eventually connect with the Cape to Cairo line in Uganda, has been carried through British East Africa in advance of the railway, reaching the Nile at Ripon Falls in February 1900. Considerable progress has been made with a line which will cross the whole width of the Congo Free State to Lake Tanganyika, where it may eventually be con- nected with the German line from Dar-es-Salaam to the lake.

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II. Ethnology.

That Africa has beea continuously occupied by two distinct branches of mankind — the C’aucasic and the Ethiopic — ^from the remotest times, seems evident both from the remains of primitive man vsrhich have been found v^herever they have been sought, and from the ethnical re- lations that have prevailed throughout the historic period. The remains — ^that is, rude and polished flints and other implements dating from the Old and New Stone Ages — have in recent years been brought to light in great abund-

ance in the extreme north and south, and in several inter- mediate places, under conditions which leave no doubt that the whole area was peopled since the early Pleistocene, if not even the late Pliocene, epoch. Thus, in Egypt Professor Flinders Petrie has collected large quantities of Palseoliths on the limestone Abydos plateau, 1400 feet above the present Nile level, and others embedded in the ancient gravels of the former High Nile, when the main stream still rolled down fifty times its present volume. In the same region of Upper Egypt M. J. de Morgan has identified four stations where primitive man’ worked his rude weapons, and where Oppert finds indications of a thoroughly established social and political organization in the New Stone Age, some 12,000 years before the new era. In Tunisia M. A. Dumont found flints in abundance under limestone beds deposited by a river which has since disappeared, and declares that the origin of man in Mauri- tania must be set back to an age which deranges all chronology and confounds the very fables of the mytho- logies. The same inference is drawn by Sir John Evans from the results of Mr Seton Karr’s researches in Somali- land, while the wide range of early man is further attested by the objects recovered by Sir R. Burton in Upper Guinea, and by W. D. Cooch and J. Sanderson in Cape Colony and Natal.

AD the works of the Old Stone Age present, wherever found, a striking resemblance in their appearance, form, and method of pro- duction, implying that they date from an age when all the in- habitants of Africa were still of one type and stood at the same low stage of culture. They appear to have migrated westwards from Indo-Malaysia, probable cradle of mankind, in two streams, one by the not yet submerged or but partly submerged Indo- Af rican continent, now flooded, by the Indian Ocean ; the other, by the overland Asiatic route, which was also followed by the large partly extinct and partly surviving Pliocene and Pleistocene mam- malian fauna.

In their new homes these two groups, originally of the same generalized proto-human Pleistocene type, gradually became specialized under the influence of the different physical environ- ments— relatively hot and dry in the north, hot and moist in the south. Thus may well have arisen on African soil the two now highly specialized divisions of mankind which share the continent between them, although the process of specialization may have been, and probably was, already in progress before their arrival. It now becomes easy to understand how what are accepted as the highest and the lowest sections of the human family are found occupying conterminous domains since prehistoric times, the southern stream being still represented by the Negro or black populations of Sudan and thence southwards to the extremity of the continent, the northern by the Caucasic or white populations of the Sahara, and thence northwards and westwards into Europe and Asia. We also see how unnecessary it is with a former school of anthropologists to derive the whites from their black neighbours, or, a still more difBoult process, the blacks from the whites. Both have been involved independently in their present respective habitats, where they may therefore be regarded as aborigines in tlie strict sense of the term.

But the two ethnical zones are nowhere separated by any marked mountain barriers except in the eastern (Abyssinian) highlands, or even by great marine or desert spaces, such as would be impassable by primitive man, for we now know that at all events since the early Tertiary epoch the Sahara has been dry, and, till later times, even habitable land, and not, as formerly supposed, a marine basin. Hence there have been constant and continuous overlappings and interminglings all along the ethnical divide, and as the large fauna — elephant, hippopotamus, giraffe, lion, hyssna, ostrich — range over the whole continent, so the dark Sudanese peoples have encroached at various points— Tibesti Range, Nile Valley, &c.— on the Cau- casic domain, while the Caucasians have to a far larger extent penetrated into the Negro zone, reaching especially on the eastern seaboard to the southern limits of the mainland.

These diverse secular blends have resulted in a multitude of transitional forms between the two primeval stocks, presenting a kaleidoscopic picture which has been further complicated by the intrusion of numerous foreign elements — Semitic Himyarites, Phcenicians, and Arabs, Greeks, Romans, Vandals, Malays, Hindus, modem Europeans, and others— generally round the periphery, but in some cases penetrating far into the interior.

But amid all this ethnical confusion the two original groups have in many places preserved their racial purity almost intact,

so that a tolerably correct estimate may still be formed of their essential physical characters. The Samites, as the Caucasic abo- rigines are conventionally called, present striking analogies both with the Asiatic Semites and with the South Europeans, so that by many ethnologists all are regarded as belonging fundamentally to one stock, collectively classed as Afro-Europeans or Mediter- raneani. Thus many of the Mauritauian Hamites (Berbers of Morocco, Algeria, and Tunisia) are of even lighter colour than the Spaniards or Italians, with blue eyes, yellow or brown beard, oval head of the long “type, large straight or aquiline nose, per- fectly regular features, shapely build, medium height, and alto- gether exceedingly handsome men. Similar traits occur amongst their southern kinsmen, the

Tuaregs of the Western Sahara, and even amongst the Fellaliin, of Egypt, who, however, are generally of swarthier complexion and often startlingly like their Setu ancestors, as figured and carved on the old Egyptian monuments. Still darker are the Herratin, or “Black Berbers,” of the Southern Atlas, and all the eastern Hamites between Egypt and the equator, who betray a varying strain of negro blood in their tumid lips, and especially in their crisp or ringlety and always black hair.

The Hamitic language also, which is of the inflecting order, presents several features in common with the Semitic, on the one hand, and on the other with the old Iberian, still surviving in the Basque of the Western Pyrenees. This Hamitic form of speech, which, like the Semitic > and unlike the Aryan, is of an extremely tenacious character, pervades the whole of the African Caucasic domain, where it has been current for countless ages, and had already been reduced to written form by the Egyptians some 5000 or 6000 years before the new era. Letters were also known in remote times to some other members of the Hamitic family, as shown by the not yet deciphered rook inscriptions in the Nile valley above Egypt, and in the peculiar Taflnagh script still in restricted use amongst the Mauritanian and Saharan Berbers.

Except in Egypt, where all were merged many millenniums ago in a single despotic monarchy, the Hamitic peoples have always shown a marked tendency towards Democratic institutions. In the tribal system everything is regulated by the public assembly, in which all have a voice, so that the Berber is what he calls himself, Amzigh (plural Imazlghen, the national name), a ” free- man,” whereas the more theocratic and feudal Semitic community is ruled by a despotic hereditary sheikh. The Berber is also less fanatical, though all have long been Mohammedans, more generous to his womenfolk, and of rather sedentary habits, preferring fixed dwellings and agriculture wherever possible to the tent-life of the nomad Bedouin stock-breeder. Pastoral ways, howevef, prevail largely amongst the Eastern Hamites — ^Bejas, Somali, Gallas, Turkanas, Masai — ^who roam the steppe lands between the Nile ^and Red Sea and the Mau plateau, which are unfavourable ‘for tillage. Hence it is that the Wahumas, who are of Galla descent, retain their nomad pastoral habits amid the Bantu Negroid populations of East Central Africa.

The negroes themselves, whose physical and mental characters are elsewhere described (Art. Negro), form almost everywhere settled agricultural communities. But this is not due to any superiority over the nomad Hamites and Semites, to whom they are greatly inferior in most respects, but to the nature of their environment, which, lying mainly between the tropics, enjoys an abundant rainfall, and is consequently more favourable for agricul- ture than for pasturage. Hence it is that the inhabitants of the arid south-western steppes (Damara and Namaqua lands) form an exception to the general rule, and are excellent herdsmen, but cultivate very little land. Compared with the Hamites, the negroes are also extremely cruel and superstitious, and with the exception of the mixed negroid populations of Sudan — Songhay, Hausas, Baghirmi, Kanuri, Mabas, and others now mostly Mohammedans — are still mainly pagans, though Christianity has made some pro- gress amongst the Waganda of Lake Victoria, and the Zulus-Xosas, Basutos, and Bechuanas of the extreme south. Ancestor-worship prevails on the eastern, nature-worship on the western seaboard, with interminglings in the interior. This is clearly seen by the distribution of the two chief names of the Deity — Munkulunkulu, “Great-grand-Eather,” and Nzamhi — of uncertain meaning, but indicative of the forces of nature, variants of which terms occur, the former almost exclusively along the east, the latter along the west side of the continent, while both are intermingled in t£e central regions.

It is further to be noticed that the two primordial stocks — ^the white and the black — are found from remote times already divided into several secondary groups, whose obscure inter-relations still offer many difficult problems to the ethnologist. In general such secondary groups are far less aberrant from the normal type, and more easily accounted for, in the Caucasic than in the negro

domain. Amongst the Hamites the chief divergences are represented by the Nubians of the Nile valley above Egypt, who are usually regarded as Hamites with a black strain, but are on the contrary true negroes with a Hamitic strain (Art. Nubia); the Tibhus of the Eastern

Sahara, treated as negroes with a Hamitic strain, but undoubtedly true Hamites, merging gradually southwards in the black popula- tions of the Chad basin (Art. Tibbus); the Fnlahs of West and Central Sudan, often allied to the Nubas, with whom they have nothing in common, being originally Hamites, now fused in many places with the surrounding negro peoples ; lastly, the Fans of the Ogoway basin, the Masai east of Lake Victoria, the Turkanas, Bendilehs, and others of Lake Rudolf, and the Wahumas, widely diffused under many names throughqjit East Central Africa. These also are -undoubtedly Hamites, mixed in varying proportions with negro elements. \

But the secondary groups of the negroes themselves are not so easily explicable. Here the Sudakese Negkoes have In the first place to be distinguished from the multitudinous Bantu Negroid groups, who occupy most of the southern half of the continent, from about 4° or 5° N. lat. to Natal and Pondoland. Although not always easily justified on anatomical grounds, this distinction between the northern Sudanese and southern Bantu sections of the negro family has a practical value and a substantial foundation in the geographical distribution, the mental qualities, and the speech of the two groups. No full-blood Sudanese Negro community has ever developed a political or social system higher than that of the tribal organization, while extensive kingdoms and empires, such as those of the Monomotapa, of the Cazembo, of Lunda, Barotseland, Kongo, and Zululand, based on unwritten codes and military institutions, have flourished often for several generations amongst the Bantu peoples. Nor have any true Sudanese Negroes ever acquired prominence for great intellectual or moral qualities, such as those by which several of the Tushilonge, the Balolo, the Makololo, Bechuana, Basuto, and Zulu-Xosa rulers hav« been distinguished in former and recent times. In a word, the average Bantu Is altogether more intelligent and far more capable of upward develop- ment than the average Sudanese Negro.

Very marked from this prfint of view are the contrasts presented by both groups in the linguistic domain. While all speak languages of “the agglutinating order, linguistic chaos prevails in Sudan, lin- guistic uniformity to a remarkable degree in Bantuland. The numer- ous dialects current amongst the Bantu peoples and diffused over an area of some 6,000,000 square miles are all reducible to half-a- dozen groups, which are themselves closely related and obviously all sprang from a single stock language presenting some structural features of a high order. Kongoese, a typical member of the family, possesses the qualities of precision, flexibility, and subtlety of expression to such an extent that “its daily use is in itself an education” (Rev. W. H. Bentley). In Sudan, on the contrary, the countless local dialects defy classification. The Nuba of Kordofan and Nubia differs as profoundly from the Fulah of Senegambia, the Songhay of the Middle Niger from the Kanuri and Baghirmi of Lake Chad, as English does from Arabic, or French from Chinese. In a word these Sudanese tongues may be grouped in a large number of fami- lies which are radically distinct from each other, and, whatever their origin, can no longer be traced to a single stock.

From these remarks it follows that the term ” Sudanese ” has a distinctly racial, but no linguistic value, whereas the term ‘ ‘ Bantu ‘ ‘ is primarily linguistic. It conveys a very clear idea to the philo- logist, but not to the anthropologist, who finds in the mixed Bantu domain not only every shade of

transition between the true negro and the true Hamite, but also some divergent types differing greatly from both. In the tropical forest tracts are scattered numerous groups of Negritoes, or ” Little Negroes,” true dwarfs, differing not only in their diminutive stature (3 ft. 6 in. to 5 ft.) but also in some other important respects — yellow colour, hirsute bodies, culture (all hunters exclusively) — ^from the blacks of normal type. Lastly, in the extreme south-west, range the primitive Bush- men, still at the Palaeolithic stage, and the neighbouring Hotten- tots, both’ presenting some remarkable and highly specialized features, such as the tablier and steatopygia peculiar to the female sex, and a distinctly yellow complexion common to both. (Art. Bushmen; Hottentots.)

Thus is completed the variegated picture presented by the aboriginal inhabitants of the continent. Of the intruders im- measurably the most important from the ethnical, but no longer from the political, standpoint are the Semites, who arrived from Asia, some in prehistoric, some in historic times, mainly by the Mediterranean and by the two routes at the southern and northern extremities of the Red Sea. Amongst the earliest arrivals were the civilized peoples of Arabia Felix (Yemen), i.e., Minmans and Sab

Thus were formed the extremely mixed populations of Abyssinia, while the dominant Semitic immigrants continued and continue to

hold the political overlordship, founding the three kingdoms of Tigr6, Amhara, and Shoa, at present united in the empire of “Ethiopia,” as it is officially called. The old Hamitic speech is not extinct, although everywhere somewhat eclipsed by various more or less corrupt forms of Geez, i.e., the archaic Semitic tongue, which was introduced by the Himyarites, still survives in the Marah district of South Arabia, and is the liturgical language of the Abyssinian Christians.

The Himyarites, who took the southern route, were probably preceded by their Phoenician kinsmen, who had already at an early date converted the Mediterranean into a great highway of trade and colonial enterprise. From the great cities of Tyre and Sidon came the founders of the greater cities of Leptis Major, Utica, Carthage, and other Phoenician settlements on the coast lands be- tween the Syrtes and the Atlantic, later merged in the Carthaginian empire, which contended with Rome for the mastery of the ancient world. After the fall of Carthage the Phoenician settlements every- where became Romanized, and both the Romans and their Vandal conquerors were all in their turn absorbed by the surrounding Hamitic aborigines.

Then came the third great Semitic invasion, that of the fiery Arab fanatics, which has modified the ethnical relations of’ the conti- nent to a far greater extent than all the other intrusions together. Before the close of the 7th century the Moslem Arab hordes had already reached the shores of the Atlantic, and soon after spread over the western Sahara, founded Mohammedan states (Timbuktu, Bomu, Baghirmi, Wadai) on the banks of the Niger and in the Chad basin, penetrated up the Nile valley to and beyond Khartum to the Sobat junction, developing great pastoral communities and even states — Kabbabish, Jaalins, Baggdras, Flinj empire of Senaar — ^in the present Anglo-Egyptian Sudan ; lastly, established themselves on the eastern seaboard from Cape Guardafui to Sofala beyond the Zambezi, everywhere dominating, but also intermingling with the aboriginal Hamitic, Negro, and Negroid Bantu populations.

Still later the Arabs advanced from the coast lands and the White Nile far inland, ranging over vast spaces westwards to the Upper Congo and southwards to Lakes Tanganyika and Nyasa, in associa- tion with their Nubian, Swahili, Ajao, Manyuema, and other native allies. Here also were founded some permanent settlements — Mpwapwa, Tabora, Ujiji, Nyangwe, Kota-Kota, Riba^Riba, Meshra- er-Eek, Lado — which, however, were not so much Arab colonies as eeribas, or strongly-fenced stations, established at convenient strategical points for the purpose of raiding the surrounding lands in quest of ivory and the men required to convey it to the coast, where they were sold as slaves. Hence since the partition of Africa the’se Arabs, mostly half-breeds, have been cleared out, and the stations transformed to centres of European trade and cultural influences. Thus it happens that in the Congo and Zambezi regions there is but a slight strain of Arab blood, whereas through- out the northern half of the continent Semitic elements are in many places grafted on the original Hamitic and Negritic stocks.

The Moslem Semites were accompanied and even preceded by others, the Jews of Palestine, who, however, were nearer akin to their Phoenician forerunners than to the Arabs and Himyarites. They began to arrive probably soon after the Babylonian captivity, and considerable numbers were already settled in Lower Egypt under the Ptolemies. After the fall of Jerusalem and the suppres- sion of the subsequent revolts these were joined by others, many of whom passed westwards and settled in all the large towns ancj sur- rounding districts, from Tripoli to Morocco, where, despite ages of oppression, they still form numerous wealthy communities. But, living mostly apart, they have scarcely disturbed the ethnical re- lations in Africa to any appreciable extent.

The same is true also of the still later immigrants from Europe into the northern and southern extrjt-tropical zones — Greeks, Italians, French, Spaniards, in Egypt and Mauritania, Dutch and British, with some French and Germans, south of the Zambezi. These intruders have given rise to dislocations and displacements, but not to interminglings, with the notable exception of the early Dutch Boers, from whose alliance with the Hottentots have sprung the so-called “Bastaards,” i.e., Griquas, Gonaquas, and seversd other half-caste Hottentot groups in Cape Colony and Namaqua-land. Bdth in the Cape and in Natal are several communities of Mohammedan Malays from various parts of the Eastern Archi- pelago, while numerous Banians (Hindus of the trading caste) are settled in all the coast towns from Durban to Mombasa. Subjoined is a table of all the African populations, indigenous and intruders, from ancient to present times, as far as known : —

A. Caucasic Division. I. Eastern Hamites: —

Betu, ancient Egyptians ; later Copts and Fellahin (mixed),

Nile valley from 1st cataract to the Delta. Blemmyes ; Bugaitse, now Begas, Bejas ; Ababdeb ; Haden- dowa ; Bishari ; Beni-Amer, from Nile to Red Sea between Egypt and Abyssinia.

histoet]

A F K I C A

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Athagao, Agao, Agaomedir (” Agaoland “) and other parts of

Abyssinia. Afar (Danakil), between Abyssinia, Eed Sea, and Gulf of

Aden. Somali; Gallas; Somali and Galla lands. Turkana; Bendileh; Lake Rudolf district. Masai ; Wakwafi; Mau plateau between Great Rift-Valley and

Lake Victoria. Wahuma, intermingled with the Bantus m the equatorial lake

region. H. Western Hamites : —

Mahurlm (“Westerns “) , so called by the Carthaginians, whence

Mauri, “Moors,” call themselves /maaijfAen, “Freemen”;

Maziges, Kumidse, Gsetuli, Leucsethiopes, all now known as

“Berbers ” ; Shellalas (Shluhs) of the western Atlas; Kabyles

of North Morocco and Algeria; Shawiahs, Zenagas, Benl-

Mzabs of Algeria and Tunisia ; Haratin (” Black Berbers “)

of the southern Atlas ; Tuaregs of the western Sahara. Tamahu {Libyans), Nasomones ; Aujilas ; Hammonii ;’ Siwahs,

Cyrenaica and Siwah oasis. Garamantes, Tedamansi, Tedas and Dazas (northern and

southern IXbbus), Tibesti range and the oases of the eastern

Sahara.

III. Semites : —

Himyarites, Axumites ; Tigrifias ; Amhariflas ; Shoas ; north,

central, and south Abyssinia. Fhoenicians, Carthage and Mauritanian coast lands (extinct). Arabs (mostly Bedouins), Egypt, Anglo-Egyptian Sudan,

Tripolitana, Mauritania, western Sahara, central Sudan,

east coast southwards to Sofala. Jews, Egypt, Tripolitana, Mauritania.

IV. Europeans : —

Hellenes, Cyrenaica, Nile Delta (extinct).

Vcmdals I ■*^'^'°* Provincia, Mauritania (extinct).

Modern Greeks, Egypt, Anglo-Egyptian Sudan.

Maltese “j

Italians I Egypt, and thence to Morocco ; Canary Islands

French j (Spaniards).

Spaniards)

Dutch, Huguenots (extinct), Cape Colony, Natal, the late Boer

States. Britons, Cape, Natal, late Boer States, North and South

Rhodesia, Nyasaland, East and West Coast sporadically^ Germans, The Cape, Transvaal, elsewhere sporadically. Portuguese, East and West Coasts, Sao Thom£, Cape Verde

Islands, Madeira, Azores.

B. Negritic Division.

I. Sudanese Negeoes,”) II. Bantu Negkoids /

Full details in Art. Neobo.

m. Bushmen, formerly ranged from Tanganyika- to the Cape, now mainly confined to the Kalahari Desert (Art. Bush- men). rV. Hottentots (Khoi-Khoin) : —

Namaqua, Great and Little Namaqudland. Koraqua, Upper Orange and Vaal rivers. Griqua, Griqualand East. Gonaqua, Cape Colony, Eastern Provinces. All except the Namaqua are Dutch-Hottentot or Bantu- Hottentot half-breeds. V. Negritoes : —

Danga (Tank) in Egypt from Shade-land beyond Punt

(Somaliland) 3300 b.c. Akkas 1 Wochuas l-vveiie^ Arawuni and Semliki river valleys.

Wambutti)

Dumes ^ g ·j (jaUajanfl Lake Rudolf district, Masai-

Dokos \ jg^jj^ . ‘

Wandorobos)

Babinga, Middle Sangha, northern tributary, Congo.

Batwa, Sankuru river, southern tributary, Congo.

Abongo, Akoa (Okoa), Okande district, Ogoway basin.

Obongo, Ashiraland, Ogoway basin.

Vaalpens, Middle Limpopo river, North Transvaal.

(a, h. k.)

III. Eecent Political Histoet.

Africa is the last of the continents to be annexed by the nations of Europe, and the process of annexation presents many features which have no parallel in the previous history of the relations of the white with the coloured races. Until 1875 Europe had concerned herself

politically mainly with the northern and southern extrejjii- ties of the continent, and with a narrow strip along the eastern and western seaboards. There were vast areas in the interior which were still unexplored, but the explorer had penetrated far beyond the limits of European political influence, and in 1875 the explorer did not necessarily include a batch of ready-made treaties among his outfit. It would be interesting to discuss the causes which have, directly or indirectly, led to the extraordinary causes ot activity which the Grreat Powers of Western European Europe have displayed in annexing and marking ”’‘*y- out spheres of influence in the African continent. But such an inquiry would involve a review of the whole field of European politics, and it must be sufficient, before pro- ceeding to a recapitulation of the steps by which Europe has absorbed Africa, to indicate one or two of the main factors in the situation. The Franco-German war of 1870 must be regarded as the real starting-point in the move- ment. From that war Germany emerged strong and united, eager for new worlds to conquer. France, after the first shock of despair had passed away, began to de- velop fresh stores of reserve energy, and her statesmen and people, half unconsciously at first, but later of set design, sought to find outside Europe compensation for her lost provinces on the Khine. France and Germany were both,. therefore, ripe for a policy of colonial expan- sion, and a rapid survey of the land-masses of the globe made it clear that Africa, alone among the continents, offered adequate opportunities for satisfying this new-bom land hunger. France still possessed some remnants o{ her former colonial possessions, and in Northern Africa, and on the Atlantic seaboard, had a firm foothold on the continent. Germany was entirely without colonies, either in Africa or elsewhere. The more temperate regions of the earth had already been acquired by the colonizing Powers that were earlier in the field, and the more acces- sible parts of the tropics had also been earmarked as British, Dutch, Spanish, or Portuguese. Africa alone, therefore, offered any large field for the resuscitated ener- gies of France, or the virgin activities of Germany ; and the history of the modern partition of Africa is mainly a record of the struggles of these two Powers and of Great Britain to secure for

themselves as large a share as pos- sible of the continent. The part played by Leopold II., King of the Belgians, in the founding of the Congo Free State, and in the opening up of the continent to the political influence of Europe, furnishes a remarkable episode in that history ; but France, Germany, and Great Britain are the principal actors in the drama, and in fol- lowing the various stages in the work of partition it is necessary, for a proper understanding of t^e part which each of these three Powers played, to remember that France was the first consciously to recognize the magni- tude of the undertaking and the need for speed in its accom- plishment; that, in Germany^ Prince Bismarck, at the instigation of a small but influential body of ” Kolonial- Menschen,” took the first steps in the direction of colonial expansion, not only in advance of German public opinion, but before other countries, or at least Great Britain, had realized that Germany was seriously entering the lists as a colonial Power ; and finally that Great Britain, though more favourably placed than either of her rivals, was, from a variety of causes, the last to realize the need for action and the urgency of the situation.

The position of Great Britain requires a few words of explanation. She was already in possession of a vast colonial empire, widely distributed over the globe. It was a favourite conception of the public men of the middle half of the 19th century that colonies were quite as much a burden as a blessing, and that, at no very remote period, the young communities which had settled in distant lands

uader the British flag would shake themselves free from the control of the mother-country, and begin an independ- ent existence, as soon as they felt themselves able to ■walk alone. There was a strong disinclination to increase Great Britain’s commitments abroad, and in Africa the repeated solicitations of native kings and chiefs in the s neighbourhood of British settlements, to be taken under British protection, were rejected in pursuance of a de- liberately adopted policy. In 1865 a strong representa- tive committee of the House of Commons unanimously resolved “that all further extension of territory or as- sumption of government, or new treaty offering any pro- tection to native tribes, would be inexpedient.” But while the overtures of native kings were rejected, the fact that they were made, coupled with the further fact that the exploration of the continent had been mainly undertaken by British subjects, or under British auspices, gave rise to the feeling that, in some not very clearly defined way. Great Britain had a sort of vague claim over regions, which, if they were not British, were not claimed by any other European Power. It was not tintil France had fairly entered on her career of annexa- tion in West Africa, and Germany had entered the field, that the British Government and the British public awoke to the consciousness of the fact that there was no time to be lost if Great Britain was to take her part in the “scramble.”

A brief survey of the political situation, and of the position of the European Powers in Africa, at the begin- Tbeposi- ^“ig of t^6 ^^st quarter of the 19th century, tioa In will form a fitting prelude to the history of the 187S. modern partition of the continent. In 1876

Egypt was under the rule of Ishma’il Pasha, who had, two years before, been granted by the Sultan the right of con- cluding treaties with foreign Powers and of maintaining armies. The Khedive’s troops had by this time pushed their way southwards along the Nile valley, and had established Egyptian rule in Darfur and Kordofan, while Egyptian influence may be said to have extended right up to the Albert Nyanza. Tripoli was then, as now, a pro- vince of the Turkish empire. Morocco, then as now, was an independent state, while Algeria, which had been con- quered by France in the second

quarter of the century, had been for four years under civil administration so far as the coast regions were concerned, though military rule was still maintained in the interior, and the Saharan tribes did not recognize French authority in any form. On the west coast France had, since the 17th century, been settled at the mouth of the Senegal river, and had made successive advances into the interior towards the valley of the Upper Niger. On the coast her influence was recog- nized by treaty, from Cape Blanco to the British settle- ments on the Gambia, and a considerable region had been brought under some sort of administrative control. Below ~~the Gambia France touched the coast again at Casamance, ;and had extended her influence for some distance towards the interior. On the Ivory Coast France had acquired vague rights, which were turned to good account in the subsequent scramble at Grand Bassam and Assinie, but in 1875 she had taken no practical steps to occupy and administer even these isolated points. The same observa~~ tion applies to Porto Novo, where France had acquired some sort of footing which enabled her to lay the founda- tion of her present colony of Dahomey. Farther down the coast the French had establishments at the estuary of the Gabun and on the Ogow^ river, but M. Savorgnan de Brazza had not yet begun the work of founding the French ■Congo Colony. Save for the islands of Reunion, St Marie, Mayotte, and Nossi-B^, and for the port of Obok, near the southern entrance to the Red Sea — which had been acquired by purchase in 1862, though it was not

effectively occupied till 1883 — this exhausts the list of French possessions in Africa in 1875.

Spanish possessions in Africa at the same date con- sisted of the Canary Islands, an old fort on the Rio d'Oro, — on the ownership of which Spain subsequently based claims to the stretch of coast between the southern limits of Morocco and France's Senegambian possessions, ex- tending from Cape Bojador to Cape Blanco, a distance of some 500 miles, — the island of Fernando Po in the Gulf of Guinea, and a small strip of territory on the banks of the Muni river, which was also claimed by France.

The position of Portugal in Africa in 1876 is very diffi- cult to define. The glorious record of the Portuguese in the exploration of the continent cannot be recapitulated here. But on the strength of her achievements in the past Portugal put forward claims which were as vague as they were extensive, and which the other European Powers interested in Africa firmly refused to recognize. Com- pared with the claims which she subsequently made, the area of African territory which was actually administered by Portugal in 1875 was ludicrously small. Apart from hef island possessions Portugal had a small settlement on the Guinea Coast, south of the French settlement of Casa- mance, another small settlement at Kabinda, north of the estuary of the Congo, and more extensive possessions south of that river, constituting the provinces of Loanda, Benguela, and Mossamedes. On the east of the continent the Portuguese were settled at Sofala, Mozambique, and other parts of the coast, but their administration was sunk in lethargy, and it is impossible to say, with any approach to accuracy, what were the limits within which they exercised any effective supervision. It was, however, in 1876 that Marshal MacMahon, the then President of the French Republic, settled the long-standing dispute be- tween Great Britain and Portugal for the possession of Delagoa Bay in favour of the latter Power.

In 1875 Great Britain Was without question, both as regards the area and the importance of her possessions, the European Power most considerably interested in Africa. But her interests were not confined to territorial rights. British explorers, missionaries, and traders had established British " influence " in various regions of the continent, without obtaining, and in some cases without seeking, Government sanction. For this apparent slack- ness in regularizing British interests by formal engage- ments there were two' reasons. In the first place the home Government, acting in pursuance of the resolution of 1865, was unwilling to extend the area of its obligations ; and in the second place, except in West Africa, where' France had shown considerable activity, little" or no fear was entertained of the competition of other European Powers. Native chiefs, in many parts of the

continent which are now included in non-British spheres of influ- ence, petitioned for British protection ; but their requests were refused, partly because of an unwillingness to ex- tend responsibilities beyond the coast, and partly because it was assumed that Great Britain could at any moment take formal possession, should it suit her purpose to do so. In this way British influence “predominated” on the Niger and in the Sultanate of Zanzibar, but in neither case had that predominating influence found formal expression, and when the scramble suddenly began, intruding rivals forced Great Britain to defend her position, which she was only able to make good by considerable sacrifices. At the beginning of the last quarter of the 19th century Great Britain had in fact no recognized footing on the eastern mainland of the African continent north of Natal, the area of which colony was at that period ‘ estimated at less than 12,000 square miles. To the north of Natal, along the coast, Zululand was still independent. South

of Natal, Pondoland was also independent, and there were other isolated patches of territory which had not been brought under British rule ; but with . these compara- tively unimportant exceptions the whole of the south- ern end of the continent, up to the Orange river and the Orange Free State, was British. Basutoland had been annexed in 1868, and three years later had been added to Cape Colony. In 1875 the estimated area of Cape Colony, including British KafEraria and Basutoland, was 201,000 square miles. Between the Orange river and the Vaal was the Orange Free State, and farther to the north the Transvaal was still an independent republic. On the west coast of Africa Great Britain’s possessions were little more than coast settlements, with more or less ill defined relations with the tribes of the interior, established for purposes of trade rather than of administration. Pass- ing up the west coast from the Orange river, the first British territory reached was, in 1875, the Gold Coast Ccdony, which incliided the island of Lagos and a strip of the adjacent coast land, as well as the British settle- ments on the Gold Coast proper. Four years previously, in 1871, the possessions of Great Britain on the coast had been extended by the transfer, for a money consideration, of the Dutch settlements to Great Britain, but even so British authority did not extend any considerable dis- tance from the coast, and the whole area of the Gold Coast settlements proper was roughly estimated at some 6000 square miles. Still farther round the coast was the then still smaller colony of Sierra Leone, and still farther to the north was the last of the West African, settlements, on the Gambia river, at that time estimated to have an area of only 21 square miles.

Neither Germany nor Italy had at this time set foot on the continent, nor had the Congo Free State begun to take shape in the mind of its fouiMer. Besides the inde- pendent states already named, there were Abyssinia in the north-east; the Sultanate of Zanzibar on the east coast, including the islands of Zanzibar and Pemba, and a large tract of territory on the mainland with no very clearly defined boundaries; and on the west coast the negro republic of Liberia, which had been established in 1820 as an experiment by the Washington Colonization Society, and had been recognized as an independent, state by the European Powers in 1847.

Such, in brief outline, was the political condition of Africa in 1875. In the interior, much of which was either wholly unknown or but very imperfectly known to Europeans, there were considerable native kingdoms, but the materials for fixing their limits at any given moment are extremely scanty, and in dealing with the partition of Africa among the Powers of Europe it is unnecessary to attempt to describe the political condi- tion of the interior of the continent. It may, however, be useful before proceeding further to attempt to tabu- late the political position in continental Africa in 1875, for the

purpose of comparison with the subsequent table showing the partition of the continent in 1900. It must be borne- in mind that the figures given are in almost all cases approximate, and have little positive value in themselves : —

Position in 1875.

Area In sq. miles. Great Britain —

Cape Colony 201,000

Griqualand West 17,800

Natal 11,172

Lagos 5,000

GoldCoaet 6,000

Sierra Leone 468

Gambia 21

Total British Africa

241,461

Area In sq. miles. Fbance —

Algeria 150,500

Senegambia 10,000

Guinea Coast and Gabun 7,750

Total French Africa

168,260

Portcoal —

Senegambia and Guinea 1,687

Angola 14,700

Mozambique 18,000

Total Portuguese Africa

Spain — Ceuta, &c., Muni river settlements

Total Spanish Africa .

34,387

3

850

853

NON-EtTEOPBAN SxATBS —

Transvaal 110,000

Orange Free State 49,000

Liberia 14,300

Egypt and Sudan 1,406,250

Tunis 42,000

Morocco 219,000

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Many circumstances had combined to arouse the inter- est of Europe in the hitherto neglected continent of Africa. Narratives of travel by such men as Rebmann, Krapf, Burton, Speke and Grant, Schweinfurth, Nachti- gal, Livingstone, and Stanley, had stimulated interest outside geographical circles. Livingstone’s tragic death in the heart of the continent, and Stanley’s letters from Uganda, where he arrived in April 1875, had aroused the enthusiasm of the missionary societies, while the impor- tance of finding new markets was turning the thoughts of the manufacturing and trading classes to the possibil- ity of Africa as a centre of commercial enterprise. The psychological moment had arrived, and with it the man who was to shape these inchoate forces to a definite end. Leopold, King of the Belgians, the sovereign of one of the smallest states of Europe, found ^a”iand’ in the narrow limits of his kingdom an hxsTif- the Brussels ficient field for his restless energies and ambi- ‘j^fl”’’’’’’’ tions. He had travelled in the Far East, and had entertained thoughts of founding a colony in that part of the world. But Africa fascinated him as it did so many less distinguished personages. The vast area of the almost virgin continent offered an apparently illimit- able field, both for scientific exploration and for commer- cial development ; and in September 1876 King Leopold^ took what may be described as the first definite step in the modern partition of the continent. He summoned to a conference at Brussels representatives of Great Britain, Belgium, France, Germany, Austria-Hungary, Italy, and Russia, to deliberate on the best methods to be adopted for the exploration and civilization of Africa, and the opening up of the interior of the continent to commerce and industry. The conference was entirely unofficial. The delegates who attended neither represented nor pledged their respective Governments. Their delibera- tions lasted three days, and resulted in the foundation of “The International African Association,” with its headquarters at Brussels. It was further resolved to establish national committees in the various countries represented, which should collect funds and appoint dele- gates to the International Association. The central idea appears to have been to put the exploration and develop- ment of Africa upon an international footing. But it quickly became apparent that this was an unattainable ideal. The national committees were soon working inde- pendently of the International Association, and the Asso- ciation itself passed through a succession of stages until it became purely Belgian in character, and at last developed

into the Congo Free State, under the personal sovereignty of King Leopold. At first the Association devoted itself to sending expeditions to the great central lakes from the east coast ; but failure, more or less complete, attended its efforts in this direction, and it was not until the return of Stanley from his great journey down the Congo in January 1878, that its ruling spirit. King Leopold, definitely turned his thoughts towards the Congo. In June of that year, Mr Stanley visited the king at Brussels, and in the following November a pri- vate conference was held, and a committee was appointed for the investigation of the Upper Congo.

Mr Stanley's remarkable discovery ha^ stirred ambi- tion in other capitals than Brussels. France had always taken a keen interest in West Africa, and in sfaafey the years 1875 to 1878 M. Savorgnan de Brazza Otago^ had carried out a successful exploration of the Ogowe river to the south of the Gabun. M. de Brazza determined that the Ogow^ did not offer that great waterway into the interior of which he, was in search, and he returned to Europe without having heard of the discoveries of Mr StanTey farther south. Natu- rally, however, Mr Stanley's discoveries were keenly fol- lowed in France. In Portugal, too, the discovery of the Congo with its magnificent unbroken waterway of more than a thousand miles into the heart of the continent, served to revive the languid energies of the Portuguese, who promptly began to furbish up claims whose age was in inverse ratio to their validity. Claims, annexations, and occupations were in the air, and when in January 1879, Mr Stanley left Europe as the arccredited agent of King Leopold and the Congo committee, the strictest secrecy was observed as to his jeal aims and intentions. The expedition was, it was alleged, proceeding up the Congo to assist the Belgian expedition which had entered from the east coast, and Mr Stanley himself wept first to Zan- zibar. But in August 1879 Mr Stanley found himself again at Banana Point, at the mouth of the Congo, with, as he himself has written, " the novel mission of sowing along its banks civilized settlements to peacefully con- quer and subdue it, to remould it in harmony with, modern ideas into national states, within whose limits the European merchant shall go hand in hand with the dark African trader, and justice and law and order shall prevail, and murder and lawlessness and the cruel barter of slaves shall be overcome." The irony of human aspi- rations was never perhaps more plairdy demonstrated than in the contrast between the ideal thus set before themselves by those who employed Mr Stanley, and the actual results of their intervention in Africa. Mr Stan- ley founded his first station at Vivi, between the mouth of the Congo and the rapids that obstruct its course where it breaks over the western edge of the central continental plateau. Above the rapids he established a station on Stanley Pool and named it Leopoldville, found- ing other stations on the main stream in the direction of the falls that bear his name.

Meanwhile M. de Brazza was far from idle-. He had returned to Africa towards the end of the same year ' which saw Stanley back on the Congo, and while the agents of King Leopold were mak- ing treaties and founding stations along the southern bank of the river, M. de Brazza and other French agents were equally busy on the northern bank. M. de Brazza was sent out to Africa by the French com- mittee of the International African Association, which provided him with the funds for the expedition. His avowed object was to explore the region between the Gabun and Lake Chad. But there is not much doubt that his real object was to anticipate Mr Stanley on the Congo. The international character of the association

French rivalry.

f OTjnded by King Leopold was never more than a polite fiotion,'and the rivalry between the French and the Bel- gians on the Congo was soon open if not avowed. In October 1880 M. de Brazza made a

solpmn treaty with a chief on the north bank of the Congo, who claimed that his authority extended over a large area, including terri- tory on the southern bank of the river. As soon as this chief had accepted French protection, M. de Brazza crossed over to the south of the river, and founded a station close to the present site of Leopoldville. The discovery of the French station by Mr Stanley-naturally annoyed- King Leopold's agent, and he promptly chal- lenged the rights of the chief who purported to have placed the country under French protection, and himself founded a Belgian station close to the site selected by M. de Brazza. In the result, the French station was withdrawn to the northern side of Stanley Pool, where it is now known as Brazzaville.

The activity of French and Belgian agents in the Congo had not passed unnoticed in Lisbon, and the Portuguese Government saw that no time was to be lost if the claims it had never ceased to ^^f""* put forward on the west coast were not to go by default. At varying periods during the 19th century Portugal had put forward claims to the whole of the West African coast, between 5° 12′ and 8° south latitude. North of the Congo mouth, she claimed the territories of Kabinda and Molemba, alleging that they had been in her possession since 1484. Great Britain had never, however, admitted this claim, and south of the Congo had declined to recognize Portuguese possessions as extending north of Ambriz. In 1856 orders were given to British cruisers to prevent by force any attempt to extend Portuguese dominion north of that place. But the Portuguese had been persistent in urging their claims, and in 1882 negotiations were again opened with the British Government for recognition of Portuguese rights over both banks of the Congo on the coast, and for some distance inland. Into the details of the negotiations, which were conducted for Great Britain by Lord Gran- ville, who was then Secretary for Foreign Afi'airs, it is unnecessary to enter; they resulted in the signing on the 26th February 1884 of an agreement, by which Great Britain recognized the sovereignty of the king of Portu- gal " over that part of the west coast of Africa, situated between 8° and 5° 12′ south latitude," and inland as far as Nokki, on the south bank of the Congo, below Vivi. The navigation of the Congo was to be controlled by an Anglo-Portuguese comniission. The publication of this treaty evoked immediate protests, not only on the Con- tinent, but in Great Britain. In face of the universal disapproval aroused by the agreement, Lord Granville found himself unable to ratify it. The protests had not been confined to France and the King of the Belgians. Germany had not yet acquired formal footing in Africa, but she was crouching for the spring prior to taking her part in the scramble, and Prince Bismarck had expressed, in vigorous language, the objections entertained by Ger- many to the Anglo-Portuguese agreement.

For some time before 1884 there had been growing up a general conviction that it would be desirable, for the Powers who were interesting themselves in Africa, to come to some agreement as to " the rules of the game," and to define their respective interests so far as that was practicable. Lord Granville's ill-fared treaty brought this sentiment to a head, and it was agreed to hold an international conference on African affairs. But before discussing the Berlin Conference of 1884-85, it will be well to see what was the position, on the eve of the con- ference, in other parts of the African continent. In the southern section of Africa, south of the Zambezi, impor-

taut events had been happening. In 1876 Great Britain had concluded an agreement with the Orange Free State g^^^ for_ an adjustment of frontiers, the result of

Britain In which was to leave the Kimberley diamond South fields in British territory, in exchange for a ‘■”- payment of £90,000 to the Orange Free State. On the .12th April 1877, Sir Theophilus Shepstone had issued a proclamation declaring the Transvaal — the South African Eepublic, as it was formerly designated — to be British territory. (See Transvaal.) On the 29th September 1879, Sir Garnet Wolseley, the com- mander-in-chief in South Africa, issued another procla- mation, declaring the Transvaal to be for ever an integral portion of the British dominions in South Africa. In December 1880 war broke out, and lasted until March 1881, when a treaty of peace was signed. This treaty of peace was followed by a convention, signed in August of the same year, under which complete self-government was guaranteed to the inhabitants of the Transvaal, sub- ject to the suzerainty of Great Britain, upon certain terms and conditions and subject to certain reservar tions and limitations. No sooner was the convention signed than it became the object of the, Boers to obtain a modification of the conditions and limitations imposed, and in February 1884 a fresh convention was signed, amending the convention of 1881. Article IV. of the new convention provided that “The South African Ee- public wUl conclude no treaty or engagement with any state or nation other than the Orange Free State, nor with any native tribe to the eastward or westward of the Ee- public, until the same has been approved by Her Majesty the Queen.” The precise effect of the two conven- tions has been the occasion for interminable discussions, but as the subject is now one of merely academic inter- est, it is sufficient to say that when the Berlin Conference held its first meeting in 1884 the Transvaal was practi- cally independent, so far as its internal administration was concerned, while its foreign relations were subject to the control just quoted. As early as 1875, in a pro- tocol attached to a treaty of friendship, commerce, and boundaries, between the Transvaal and Portugal, ap agree- ment had been made for the construction of a line be- tween Delagoa Bay and Pretoria ; and in 1884 a further agreement was made between the same parties to the same effect, both agreements receiving the sanction of Queen Victoria as suzerain.

But although the Transvaal had thus, between the years 1875-84, become and ceased to be British terri- tory, British influence in other parts of Africa south of the Zambezi had been steadily extended. To the west of the Orange Free State, Griqualand West was annexed to the Cape in 1877, while to the east the territories be- yond the Kei river were included in Cape Colony be- tween 1877 and 1884, so that in the latter year, with the exception of Pondoland, the whole of South-East Africa up to Natal was in one form or another under British control. North of Natal, Zululand was not actually an- nexed until 1887, although since the 1879 war, and the restoration of Cetewayo in 1882, British influence had been admittedly supreme. In December 1884 St Lucia Bay had been proclaimed.a British possession, and three years later an agreement of non-cession to foreign powers made by Great Britain with the regent and paramount chief of Tongaland, completed the chain of British pos- sessions on the coast of South Africa, from the mouth of the Orange river on the west to Kosi Bay and the Portu- guese frontierj on the east. In the interior of South Africa, the year 1884 witnessed the beginning of that final stage of the British advance towards the north which was eventually to extend British influence from the Cape to the southern shores of Lake Tanganyika. The activ-

ity of the Germans on the west, and of the Boer republic on the east, had brought home to both the imperial and colonial authorities the impossibility of relying on vague traditional claims. In May 1884 treaties were made with native chiefs by which the whole of the country north of Cape Colony, west of the Transvaal, south of 22° S. lati- tude, and east of 20° E. longitude was placed under Brit- ish protection, though a protectorate was not formally declared until the following January. The southern por- tion of this newly-acquired territory up to the Molopo river was in September 1876, under the name of British Bechuanaland, placed under thc^ jurisdiction of the gov- ernor of Cape Colony, while the territory north of the Molopo river and south of 22° S. latitude, which included Khama’s country, Bathoen’s country, Scheie’s country, and the Kalahari desert, was at the ^same time declared a British protectorate, the local administration being left in the hands of the native chiefs.

Meanwhile some very interesting events had ,been taking place on the west coast, north of the Orange river, and south of the Portuguese province of Qg,^g,, Mossamedes. In Germany a variety of circum- /n™uSl stances had conspired to turn the thoughts of West both the rulers and the ruled towards the ac- *<^ quisition of territories overseas, where German colonists could settle under the German flag. It must be suffi- cient here to touch very briefly on the events that pre- ceded the foundation of what is now the colony of German South- West Africa. For many years prior to 1884, German missionaries had settled among the Dama- ras and Namaquas, often combining small grading oper- ations with their missionary work. From Itime to time trouble arose between the missionaries and the native chiefs, and appeals were made to the German Govern- ment for protection. The German Government in its turn begged the British Government to say whether it assumed responsibility for the protection of Europeans in Damai'aland and Namaqualand. The. position of the British Government was intelligible, if not very intelli- gent. It did not desire to see any other European Power in these countries, and it did not want to assume the responsibility and iacur the expense of protecting the few Europeans settled there. Sir Bartle Frere, when Governor of the Cape (1877-81), had foreseen that this attitude portended trouble, and had urged that the whole of the unoccupied coast-line, up to the Portuguese fron- tier, should be declared under British protection. But he preached to deaf ears, and it was as something of a concession to him that in March 1878 the British flag was hoisted at Walflsch Bay, an4 the country for a radius of 15 miles was declared to be British. The fact appears to be that British statesmen failed to understand the change that ha^ come over Germany. They believed that Prince Bismarck would never give his sanction to the creation of a colonial empire, and, to the German inquiries as to what rights Great Britain claimed in Damaraland and Namaqualand, procrastinating replies were sent. Meanw^le the various colonial societies es- tablished in Germany had effected a revolution in public opinion, and, more important still, they had convinced . the great Chancellor. Accordingly when, in Noveiteber 1882, Herr Lilderitz, a Bremen merchant, informed the German Government of his intention to establish a fac- tory on the coast between the Orange river and the Little Fish river, and asked if he might rely on the protection of his Government in case of need, he met yith no dis- couragement from Prince Bismarck. In February 1883 the German ambassador in London informed Lord Gran- ville of Herr Ltlderitz's design, and asked " whether Her Majesty's Government exercise any authority in that locality." It was intimated that if Her Majesty's Gov-

emment did not, the German Government would extend to Herr Llideritz’s factory “the same measure of protec- tion which they give to their subjects in remote parts of the world, but without having the least design to estab- lish any footing in South Africa.” An inconclusive reply was sent, and on the 9th April Herr Llideritz’s agent landed at Angra Pequena, and after a short delay concluded a treaty with the local chief, by which some 215 square miles around Angra Pequena Bay was ceded to Herr Liideritz. In England and at the Cape irritation at the news was mingled with incredulity, and it was fully anti- cipated that Herr Liideritz would be disavowed by his Government. But for this belief, it can scarcely be doubted that the rest of the unoccupied coast-line would have been promptly declared under British protection. In the month of August the German Government inti- mated to their consular representative at the Cape their preparedness to take Herr Llideritz’s concessions under the protection of the Imperial Government. In Novem- ber the German ambassador again inquired if Great Britain made any claim over this coast, and Lord Gran- ville

replied that Her Majesty exercised sovereignty only over certain parts of the co^st, as at Walfisch Bay, and suggested that arrangements might be made by which Germany might assist in the settlement of Angra Pe- quena. By this time Herr Liideritz had extended his acquisitions southwards to the Orange river, which had been declared by the British Government to be the northern frontier of Cape Colony. Both at the Cape and in England it was now realized that Germany had broken away from her former purely Continental policy, and, when too late, the Cape parliament showed great eager- ness to acquire the territory which had lain so long at its very doors, to be had for the taking. It is not neces- sary to follow the course of the subsequent negotiations. On the 15th August 1884 an official note was' addressed by the German consul at Capetown to the High Commis- sioner, intimating that the German Emperor had by proclamation taken "the territory belonging to Mr A. Luderitz on the west coast of Africa under the direct pro- tection of His Majesty." This proclamation covered the coast-line from the north bank of the Orange river to 26° S. latitude, and 20 geographical miles inland, including " the islands belonging thereto by the law of nations." On the 8th of the following month — September 1884 — the German Government intimated to Her Majesty's Government, " that the west coast of Africa from 26° S. latitude to Cape Erio, excepting Walfisch Bay, had been placed under the protection of the German Emperor." Thus, before the end pt the year 1884, the foundations of Germany's colonial empire had been laid in South-West Africa.

In April of that year Prince Bismarck intimated to the British Government, through the German charg^ d'affaires in London, that "the Imperial consul-general, amL. ^^ Nachtigal, has been commissioned by my Government to visit the west coast of Africa in the course of the next few months, in order to complete the information now in the possession of the Foreign OflB-ce at Berlin, on the state of German commerce on that coast. With this object Dr Nachtigal will shortly embark at Lisbon, on board the gunboat Mowe. He will put himself into communication with the authorities in the British possessions on the said coast, and is author- ized to conduct, on behalf of the Imperial Government, negotiations connected with certain questions. I ven- ture," the official communication proceeds, "in accordance with my instructions, to beg your excellency to be so good as to cause the authorities in the British possessions in West Africa to be furnished with suitable recommendar tions.'' Although at the date of this communication it

must have been apparent, from what was happening in South Africa, that Germany was prepared to enter on a policy of colonial expansion, and although the wording of the letter was studiously vague, it does not seem to have occurred to the British Government that the real object of Dr Nachtigal's journey was to make other an- nexations on the west coast. Yet such was indeed his mission. German traders and missionaries had been par- ticularly active of late years on the coast of the Gulf of Guinea. German factories were dotted all along the coast in districts under British protection, under French protection, and under the definite protection of no Euro- pean Power at all. It was to these latter places that Dr Nachtigal turned his attention. The net result of his operations was that on the 6th July 1884 a treaty was signed with the King of Togo, placing his country under German protection, and that just one week later a German protectorate was proclaimed over the whole of the Cameroon district. Before either of these events had occurred Great Britain had become alive to the fact that she could no longer dally with the subj^t, if she desired to consolidate her possessions in West Africa. The British Government had again and again refused to accord native chiefs the protection they demanded. The Cameroon chiefs had several times asked for British protection, and always in vain. But at last it became apparent, even to the official mind, that rapid changes were being effected in Africa, and on the 16th May Consul Hewett received instructions to return to the west coast and to make arrangements for extending British protec- tion over certain regions. He arrived too late to save either Togoland or Cameroon, in the latter case arriv- ing five days after King Bell and the other chiefs on the river had signed treaties with Dr Nachtigal. But the British consul was in time to secure the delta of the river Niger and the Oil Eivers District, extending from Rio del Eey to the Lagos frontier, where for a long period British traders had held almost a monopoly of the trade. Meanwhile

France, too, had been busy treaty- making. During the year 1884 no less than forty-two treaties were concluded with native chiefs, an even larger number having been concluded in the previous twelve months. While the British Government still remained under the spell of the fatal resolution of 1865, the French Government was strenuously endeavouring to extend France's infiuence in West Africa, in the coun- tries lying behind the coast-line. In the campaign of 1880-81 Captain Gallieni advanced as far as Bammako, on the Upper Niger, and other French officials were steadily pursuing the policy fwhich has resulted in surrounding all the old British possessions in West Africa with a continuous band of French territory. In 1881 a preliminary step was taken in a project which, still unrealized, has always exercised a strange fascination over that section of public opinion in France which mostly concerns itself with African affairs. To join France's possessions on the Mediterranean with her colonies in West Africa, by means of a railway is, with many Frenchmen, a haunting ambition. We need not consider the strategical, political, and commercial argu- ments which are advanced in favour of the proposed trans-Saharan railway, or discuss the difficulties which surround the accomplishment of this grandiose concep- tion. But, in 1881, an expedition was sent from Algeria to make a preliminary survey and report. It was under the command of Colonel Flatters, and had not advanced very far into the desert before it was attacked by the Tuaregs and massacred.

There was, however, one region on the west coast where, notwithstanding the lethargy of the British Government, British interests were being vigorously pushed, protected,

and consolidated. This was on the Lower Niger, and the leading spirit in the enterprise was Sir George Taubman The Niger °^^®- -A-fter the discovery of the course of

the Lower Niger in 1829 several expeditions had been undertaken, both by the British Government and by private persons, up the river, but owing to the opposition of the tribes who acted as middlemen between the European traders on the coast and the native traders in the interior, and to the unhealthy climatic conditions, very little progress was made in opening up communicar tion with the inland tribes. Factories were established on the Niger delta and oh the Oil Rivers creeks by several trading firms, mostly hailing from Liverpool and Glasgow, but up to the year 1879 nothing was done to secure joint action. In that year the various trading firms on the Lower Niger formed themselves into the "United African Company," and the foundations were laid of something like settled administration. An appli- cation was mad# to the British Government for a charter in 1881, and the capital of the company increased to a million sterling. Henceforth the company was known as the " National African Company," and it was acknow- ledged that its object was not only to develop the trade of the Lower Niger, but to extend its operations to the middle reaches of the river, and to open up direct relar tions with the great Fulah empire of Sokoto and the smaller states associated with Sokoto under a somewhat loosely-defined suzerainty. The great development of trade which followed the combination of British interests carried out under the skilful guidance of Mr Goldie- Taubman (now Sir George Goldie) did not pass unnoticed in France, and, encouraged by Gambetta, French traders made a bold bid for a position on the river. Two French companies, with ample capital, were formed, and various stations were established on the Lower Niger. Sir George Goldie realized at once the seriousness of the situation, and lost no time in declaring commercial war on the new comers. His bold tactics were entirely suc- cessful, and a few days before the meeting of the Berlin Conference he had the satisfaction of announcing that he had bought out the whole of the French interests on the river, and that Great Britain "alone possessed any inter- ests on the Lower Niger.

To complete the survey of the political situation in Africa, when the plenipotentiaries met at Berlin, it is

necessary to refer briefly to the course of Jmsitioain Stents in North and East Africa since 1875. North and In 1881 the French army entered Tunis, and ^^ compelled the Bey to sign a treaty placing

^**’”’’ that country under French protection. The Sultan of Turkey formally protested against this inva- sion of Ottoman rights, but the Great Powers took no action, and France was left in undisturbed possession of her newly-acquired territory. In Egypt the joint con- trol exercised by Great Britain and France under the Xhedival decree of 10th November 1879 had broken down, owing to the refusal of France to join in the suppression of the Arabi Pasha rebellion, and had been abolished by the decree of 18th January 1883; since which date Great Britain had assumed a predominant position in Egyptian affairs. (See Egypt.) In East Africa, north of the Portuguese possessions, where the Sultan of Zanzibar was the most considerable native potentate, Germany was secretly preparing the founda- tions of her present colony of German East Africa. But no overt act had warned Europe of what was impending. The story of the foundation of German East Africa is one of the romances of the continent. Early in 1884 the Society for German Colonization was founded, with the avowed object of furthering the newly-awakened colonial aspirations of the German people. It was a society in-

spired and controlled by young men, and on the 4th November 1884, eleven days before the conference assem- bled at Berlin, three young Germans arrived as deck passengers at Zanzibar. They were disguised as mechan- ics, but were in fact Dr Carl Peters the president of the Colonization Society, Joachim Count Pfeil, and Dr jiihlke, and their stock-in-trade consisted of a number of German flags and a supply of blank treaty forms. They proposed to land on the mainland opposite Zanzibar, and to conclude treaties in the back country with native chiefs placing their territories under German protection. The enterprise was frowned upon by the German Govern- ment ; but, encouraged by German residents at Zanzibar, the three young pioneers crossed to the mainland, and on the 19th November, while the diplomatists assembled at Berlin were solemnly discussing the rules which were to govern the game of partition, the first ” treaty ” was. signed at Mbuzini, and the German flag raised for the first time in East Africa.

In the period between 1875-84 Italy had also obtained her first footing on the African continent. By a treaty with the sultan of Assab, chief of the Danakils, signed on the 15th March 1883 and subsequently approved by the King of Shoa, Italy obtained the cession of part of Ablis (Aussa) on the Red Sea, Italy undertaking to protect with her fleet the Danakil littoral.

One other event of some importance must further be recorded as happening before the meeting of the Berlin Conference. The King of the Belgians had been driven to the conclusion that, if his African enterprise was to obtain any measure of permanent success, its international status must be recognized. To this end negotiations were opened with various Governments. The first Govern- ment to ” recognize the flag of the International African Association as the flag of a friendly Government ” was that of the United States, its declaration to that effect bearing date the 22nd April 1884. There were, however, difficulties in the way of obtaining the recognition of the European Powers, and in order to obtain that of France, and while labouring under the feelings of annoyance which had been aroused by the Anglo-Portuguese agree- ment concluded by Lord Granville in February, King Leo- pold, on the 23rd April 1884, authorized Colonel Strauch, president of the International Association, to engage to give France “the right of preference if, through unforeseen circumstances, the Association were compelled to sell its possessions.” France’s formal recognition of the Associa- tion as a Government was, however, delayed by the discus- sion of boundary questions until the following February, and in the meantime Germany, Great Britain, Italy, Aus- tria-Hungary, Holland, and Spain

had all recognized the Association; though Germany alone had done so — on 8th November — before the assembling of the conference.

The conference assembled at Berlin on 15th November

1884. Its last sitting was held on the 30th January

1885, and the “. General Act of the Berlin Con- ference” was signed by the representatives ^e Berlin of all the Powers attending the conference, un’nce. except the United States, on the 24th February.

The European Powers represented were Great Britain, Germany, Austria-Hungary, Belgium, Demnark, Spain, France, Italy, Holland, Portugal, Russia, Sweden and Norway, and Turkey, to name them in the order adopted in the preamble to the General Act. It is unnecessary to examine in detail the results of the labours of the con- ference. The General Act dealt with six specific sub- jects : (1) freedom of trade in the basin of the Congo, (2) the slave trade, (3) neutrality of territories in the basin of the Congo, (4) navigation of the Congo, (5) navi- gation of the Niger, (6) rules for future occupation on the coasts of the African continent. It will be seen that the

Act dealt with other matters than the political partition of Africa ; but, so far as they concern our present pur- pose, the results effected by the Berlin Act may be summed up as follows. The signatory Powers undertook that any fresh act of taking possession on any portion of the African coast must be notified by the Power taking possession, or assuming a protectorate, to the other signa- tory Powers. It was further provided that any such occupation to be valid must be effective. ‘ It is also note- worthy that the first reference in an international Act of the obligations attaching to ” spheres of influence ” is contained in the Berlin Act.

The basin of the Congo was defined as ” bounded by the watersheds (or mountain ridges) of the adjacent basins, namely, in particular those of the Niari, the Pnes^. Ogo’^^e, the Shari, and the Nile on the north ; by . theeasternwatershedlineof the afBluentsof Lake

Tanganyika on the east ; and by the watersheds of the bar sins of the Zambezi and the Loge on the south. It therefore comprises all the regions watered by the Congo and its aflu- ents, including Lake Tanganyika, with its eastern tributar lies.” In this conventional basin of the Congo the trade of all nations was to enjoy complete freedom. But the free-trade zone was extended considerably beyond the Congo basin. It comprised on the east coast the maritime zone, extended from 2° 30′ of S. lat. to the mouth of the Loge. The northern boundary of the free-trade zone fol- lowed the parallel of 2° 30′ to the geographical basin of the Congo, and thence to the east coast at 5° N. lat., the eastern boundary following the coast southwards to the mouth of the Zambezi ; from this latter point the soijthern bouildary followed the Zambezi to 5 miles above its conflu- ence with the Shir6, and thence along the NyasarZambezi watershed to the Congo-Zambezi watershed and the source of the Log^, which it followed to the coast. The approval of independent sovereign states in the eastern zone, which were not parties to the convention, was, however, to be ob- tained as a condition precedent to the extension of free trade to the eastern zone. The Act contained provisions limiting the dues to be levied within the prescribed area to such as ” may be levied as fair compensation for ex- penditure in the interests of trade,” prohibiting the imposition of preferential duties, and declaring the river free to the trading flags of all nations. The conventional basin of the Congo was to remain neutral in all circum- stances,

and an international navigation commission of the Congo was to be instituted to supervise the carrying out of the principles proclaimed in the General Act on that river and its af&uents. No such commission was, however, in fact appointed. The navigation of the Niger and all its af&uents was declared free to the merchant vessels of all nations, ‘and Great Britain and Trance severally undertook to extend protection to traders of other nationalities in those portions of the river which were under their sovereignty or protection.

It will be remembered that when the conference assembled the International Association of the Congo had only been recognized as a sovereign state by the United States and Germany. But King Leopold and his agents had taken full advantage of the opportunity which the conference afforded, and before the General Act was signed the Association had been recognized by all the signatory Powers, with the not very important exception of Turkey, and the fact communicated to the conference by Colonel Strauch. It was not, however, until two months later, in April 1885, that King Leopold, with the sanction of the Belgian legislature, formally assumed the headship of the new state; and on the 1st August in the same year His Majesty notified the Powers that from that date the ” Independent State of the Congo” declared that “it. shall be perpetually neutral ” in conformity with

Article X. of the Berlin Act. Thus was finally consti- tuted the Congo Free State, under the sovereignty of King Leopold, though the boundaries claimed; for it at that time were considerably modified by subsequent agreements.

Prom 1885 the scramble among the Powers went on with renewed vigour, and in the fifteen years that re- mained of the century the work of partition, so Develop- far as international agreements were concerned, ments was practically completed. To attempt to fol- **’”•** ‘^^^ low the process of acquisition year by year would involve a constant shifting of attention from one part of the continent to another, inasmuch as the scramble was pro- ceeding simultaneously all over Africa. It will therefore be the most convenient plan to deal with the continent in sections, roughly corresponding to the quarters of the compass, with the Congo Free State as a sort of central state, the ‘groivth of which may serve as the starting- point for the story of the partition after the Berlin Con- ference. In the notification to the Powers of 1st August 1885, the boundaries of the Free State were set out in considerable detail. The limits thus determined resulted partly from agreements made with France and Portugal, and partly from treaties with native chiefs, and left the northern bank of the Congo to a point a little above Manyanga to the Free State, and the southern bank as far as Nokki to Portugal. The southern frontier was continued along the parallel of Nokki till it intersected the river Kwango, which it followed in a southernly direction. The northern frontier from Manyanga fol- lowed the Congo as far as Stanley Pool, then the median line of that pool, leaving the Congo at a point above the LikonarNkunja river, following its watershed to the 17th degree of longitude east of Greenwich, which degree it followed until its intersection with the 4th parallel of N. latitude, following that latitude until it met the 30th degree of longitude east of Greenwich, which formed the eastern boundary of the Free State. The south-eastern, frontier claimed by King Leopold extended to Lakes. Tanganyika, Mweru, and Bangweulu, but it was not until some years later that it was recognized and defined by the agreement of May 1894 with Great Britain. The international character of King Leopold’s enterprise had not long been maintained, and his recognition as sovereign of the Free State confirmed the distinctively Belgian character which the Association had assumed, even before that event. The king was naturally anxious that the right of pre-emption which he had given to France should not operate against Belgium, and in April 1887 the French Government, in return for territorial concessions on the Mobangi, formally declared that France’s right of pre- emption could not be opposed to Belgium’s preferential rights; and by his will, dated 2nd August 1889, His Majesty made Belgium heir to the sovereign rights of the Congo Free State. In July 1890 the Free State con- cluded an agreement with Belgium, by which the Belgian Government agreed to make a loan to the Free State of twenty-five millions of francs, spread over ten years, Belgium acquiring the right within

six months after the expiry of that period to annex the Free State. To com- plete this section of the subject, it may be stated that an annexation Bill, introduced into the Belgian parliament in 1895, was withdrawn, and up to June 1901 Belgium had still taken no formal steps to assume direct responsi- bility for the Free State as a Belgian colony.

The area of the Free State, vast as it was, did not suf&ce to satisfy the ambition of its sovereign. King Leopold maintained that the Free State enjoyed, equally with any other state, the right to extend ^”°/,** its frontiers. As this ambition brought the Free State into sharp conflict with its various European neighbours, it may be well to consider, in the light of

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subsequent events, what were at this period the designs entertained by the different European Powers that parti- cipated in the struggle for Africa. Portugal was striving to retain as large a share as possible of her shadowy- empire, and particularly to establish her claims to the Zambezi region, so as to secure a belt of territory across Africa from Mozambique to Angola. Great Britain, once aroused to the imminence of the danger, put forth vigor- ous efforts in East Africa and on the Niger, but her most a,mbitious dream was the establishment of an unbroken line of British possessions and spheres of influence from south to north of the continent, from Cape Colony to Egypt. Germany’s ambition can be easily described. It was to secure as much as possible, so as to make up for lost opportunities. French ambitions, apart from Madar gascar, were confined to the northern and central portions of the continent. To extend her possessions on the Mediterranean littoral, and to connect them with her colonies in West Africa, the Western Sudan, and on the Congo, by establishing her influence over the vast inter- mediate regions, was France’s first ambition. But the defeat of the Italians in Abyssinia, and the impending downfall of the Khalifa’s power in the valley of the Upper Nile, suggested a still more daring project to the French Government — none other than the establish- ment of French influence over a broad belt of territory stretching across the continent from west to east, from Senegal on the Atlantic coast to Jibutil on the Gulf of Aden. These conflicting ambitions could not all be realized, and Germany succeeded in preventing Great Britain from realizing her ambition of a continuous band of British territory from south to north, while Great Britain, by exclu&ing France from the Upper Nile valley, dispelled the French dream of an empire from west to east.

It was in the struggle between France and Great Britain for the Upper Nile valley that the ambition of j^j King Leopold involved the Congo Free State.

Leopold The Egyptian Sudan, after the death of Gordon and the in January 1885, was abandoned to the Mahdi. Atf/e. rpjjg Egyptian frontier was withdrawn to Wady-

Halfa, and the vast provinces of Kordofan, Darfur, and the Bahr-el-Ghazal were given over to Dervish tyranny and misrule. But it was obvious that this was not a state of things which could contintie indefinitely. Under the wise guidance of Lord Cromer the finances of Egypt had been placed on a soimd basis, and under British officers the despised fellaheen had developed soldierly qualities of which they had before given no sign. That Egypt woidd seek to recover her position in the Sudan was a foregone conclusion, as the command of the Upper Nile was recog- nized as essential to her continued prosperity. But the international position of the abandoned provinces was by no means clear. The British Government, by the Anglo- German agreement of July 1890, had sfecured the assent of Germany to the proposition that the British sphere of influence in East Africa

was bounded on the west by the Congo Free State and by ” the western watershed of the basin of the Upper Nile ” ; but this claim was not recog- nized either by France or by the Congo Free State. From her base on the Congo, France was busily engaged pushing forward along the northern tributaries of the great river. On 27th April 1887 an agreement was signed with the Congo Free State by which the right bank of the Mobangi river was secured to French influence, and the left bank to the Congo Free State, with this proviso, that the northern boundary of the Free State was not to descend below the fourth parallel of north latitude. The desire of France to secure a footing in the Upper Nile valley was partly due, as we have seen, to her anxiety to extend a French zone across Africa, but it was also and to a large extent

attributable to the belief, widely entertained in France, that by establishing herself on the Upper Nile France could regain the position in Egyptian affairs which she had sacrificed in 1882. With these strong induce- ments France set steadily to work to consolidate her position on the tributary streams of the Upper Congo basin, preparatory to crossing into the valley of the Upper Nile. As a step in this direction the Mobangi region was. constituted a separate province, under M. Liotard as governor. Meanwhile a similar advance was being made from the Congo Free State north- wards and eastwards. King Leopold had two objects in view — to obtain control of the rich province of the Bahr-el-Ghazal and to secure an outlet on the Nile. Stations were established on the Welle river, and in February 1891, Captain van Kerckhoven left Leopold- ville for the Upper Welle with the most powerful expe- dition which had, Up to that time, been organized by the Free State. After some heavy fighting the expedition reached the Nile in September 1892, and opened up com- munications with the remains of the old Egyptian garri- son at Wadelai. Other expeditions under Belgian officers penetrated into the Bahr-el-Ghazal, and it was apparent that King Leopold proposed to rely on effective occupa- tion as an answer to any claims which might be advanced by either Great Britain or France. The news of what was happening in this remote region of Africa filtered through to Europe very slowly, but King Leopold was warned on several occasions that Great Britain would not recognize any claims by the Congo Free State on the Bahr-, el-Ghazal. The difficulty was, however, that neither from Egypt, whence the road was barred by the Khalifa, nor from Uganda, which was too far removed from the coast to serve as the base of a large expedition, could a British force be despatched to take effective occupation of the Upper Nile valley. There was, therefore, danger lest the French should succeed in establishing themselves on the Upper Nile before the preparations which were being made in Egypt for ” smashing ” the Khalifa were com- pleted.

In these circumstances Lord Eosebery, who was then foreign minister, began, and his successor. Lord Kimber- ley, completed, negotiations with King Leopold which resulted in the conclusion of the Anglo- coogoUse Congolese agreement of 12th May 1894. By agreement this agreement King Leopold recognized the ’’’^*’* British sphere of influence as laid down in the Anglo- German agreement of July 1890, and Great Britain granted a lease to King Leopold of certain territories in the western basia of the Upper Nile, extending on the Nile from a point on Lake Albert to Fashoda, and west- wards to the Congo-Nile watershed; The practical effect of this agreement was to give the Congo Free State a lease, during its sovereign’s lifetime, of the old Bahr-el- Ghazal province, and to secure after His Majesty’s death a portion of that territory, with access to a port on Lake Albert, to his successor. At the same time the Congo Free State leased to Great Britain a strip of territory, \5\ miles in breadth, between the north end of Lake Tanganyika and the south end of Lake Albert Edward. This agreement was hailed as a notable triumph for British diplomacy. But the triumph was short-lived. By the agreement of July 1890 with Germany, Great Britain had been reluctantly compelled to abandon her hopes of through communication between the British spheres in the northern and southern parts of the con- tinent, and to consent to the boundary of German East Africa marching with the eastern frontier of the Congo Free State. Germany frankly avowed that she did not wish to have a powerful neighbour interposed between herself and the Congo Free State, and later troubles as

to frontiers in the Lake Kivu region fully jiistified tlie attitude of the German Government. It was obvious that the new agreement would effect precisely what Germany had declined to agree to in 1890. Accordingly Germany protested ia such vigorous terms that, on the 22nd June 1894, the offending article was withdrawn by an exchange of notes between Great Britain and the Congo Free State. Opinion in France was equally excited by the new agree- ment. It was obvious that the lease to the Congo Free State was intended to exclude France from the Nile by placing the Congo Free State as a barrier across her path. Pressure was brought to bear on King Leopold, from Paris, to renounce the rights acquired under the agreement. It is not known what communications, if any, passed between the sovereign of the Free State and the British Govern- ment, whether King Leopold asked for, or was refused, support against French pressure ; but on the 14th August 1894 King Leopold signed an agreement with France by which, in exchange for France's acknowledgment of the Mbomu river as his northern frontier. His Majesty renounced all occupation and all exercise of political influence west of 30° E. longitude, and north of a line drawn from the intersection of that meridian with the parallel 5° 30′ of N. latitude, and along that parallel to the Nile.

This left the way still open for France to the Nile, and in June 1896 Captain Marchand left France with secret ^ instructions to lead an expedition into the Nile

oi^B^h"^ valley. On the 1st of March in the following ei-ahazai. J^^ ^^ 1^^* Brazzaville, and began a journey which all but plunged Great Britaia and France into war. The difficulties which Captain Marchand had to overcome were mainly those connected with transport. In October 1897 the expedition reached the banks of the Sueh, the waters of which eventually flow into the Nile. Here a post was established and the Faidherbe, a steamer which had been carried across the Congo-Nile watershed ia sections, was put together and launched. On the 1st May 1898 Marchand started on the final stage of his journey, and reached Fashoda on the 10th July, having established a chain of posts en route. At Fashoda the French flag was at once raised, and a "treaty" made with the local chief. Meanwhile other expeditions had been concentratiag on Fashoda — a mud-fiat situated iu a swamp, round which for many months raged the angry passions of two great peoples. French expeditions, with a certaiu amount of assistance from the Emperor Menelek of Abyssinia, had been striving to reach the Nile from the east, so as to joia hands with Marchand and complete the line of posts to the Abyssinian frontier. In this, how- ever, they were unsuccessful. No better success attended the expedition under Colonel Macdonald, E.E., sent by the British Government from Uganda to anticipate the French in the occupation of the Upper Nile. It was from the north that claimants arrived to dispute with the French their right to Fashoda, and all that the occupation of that dismal post implied. In 1897 an Anglo-Egyptian army, under the direction of Sir Her- bert (afterwards Lord) Kitchener, had begun to advance southwards for the reconquest of the Egyptian Sudan. On the 2nd September 1898 Khartum was captured, and the Khalifa's army dispersed. It was then that news reached the Anglo-Egyptian commander, from native sources, that there were white men flying a strange flag at Fashoda. The Sirdar at once proceeded in a steamer up the Nile, and courteously but firmly requested Captain Marchand to remove the French fiag. On his refusal the Anglo-Egyptian flag was raised close to the French flag, and the dispute was referred to Europe for adjust- ment. Diplomatic negotiations followed between the British, and 'French Governments. At length, on 21st

March 1899, a declaration was signed, by the terms of which France withdrew from the NUe valley and accepted a boundary line, between the British and French spheres of influence in Central Africa,

which satisfied her earlier ambition by uniting the whole of her territories in North, West and Central Africa into a homogeneous whole, while effectually preventing the realization of her dream of a transcontinental empire from west to east. By this declaration it was agreed that the dividing line between the British and French spheres, north of the Congo Free State, should follow the Congo-Nile water-parting up to its intersec- tion with the 11th parallel of north, latitude, from which point it was to be “drawn as far as the 16th parallel in such a manner as to separate in principle the kingdom of Wadai from what constituted in 1882 the province of Darfur,” but in no case was it to be drawn west of the 21st degree of east longitude, or east of the 23rd degree. From the 15th parallel the line took a north-westerly direction, until it intersected the Tropic of Cancer, on the southern frontier of the Turkish prov- ince of Fezzan to the south of Tripoli. French influence was to prevail west of this line, British -influence to the east. Wadai was thus definitely assigned to France. This partition was and still is (1901) merely a paper partition; and it should be added that while it, of course, only binds the parties to it, the Sultan of Turkey entered a protest against the agreement as infringing his prior acquired rights both iu the Sahara and in the Central Sudan.

Let us now return to the mouth of the Congo and see what was the course of events in the southern half of the continent. It will be remembered that by the agreement in which Portugal recognized the i„soath- sovereignty of the Congo Free State, Portugal’s west and claim to the southern bank of the river as far f J”,*’^®’ as Nokki had been admitted. Thus Portuguese ‘ ™’ possessions on the west coast extended from the Congo to the mouth of the Kunene river. In the interior the boundary with the Free State was settled as far as the Kwango river, but disputes arose as to the right to the country of Lunda, otherwise known as the territory of the Muato Yanvo. On the 25th May 1891 a treaty- was signed at Lisbon, by which this large, territory was divided between Portugal and the Free State, the bound- ary line leaving the Kwango .at the 8th degree of soiith latitude and reaching the Kasai, one of the main south- ern afluents of the Congo, at the 7th degree, then pass- ing along the thalweg of that river to its source in Lake Dilolo, and then along the watershed between the Zaire and the Zambezi to its intersection by the 24th meridian east of Greenwich. The interior limits of Portuguese possessions in Africa south of the equator gave rise, however, to much more serious discussions than were involved in the dispute as to the Muato Yanvo’s kingdom. Portugal, as we have seen, claimed all the territories between Angola and Mozambique, and she succeeded in inducing both France and Germany, in 1886, to recognize the King of Portugal’s ” right to exercise his sovereign and civilizing influence in the territories which separate the Portuguese possessions of Angola and Mozambique.” The publication of the treaties containing this declaration, together with a map showing Portuguese claims extending over the whole of the Zambezi valley, and over Matabele- land to the south and the greater part of Lake Nyasa to the north, immediately provoked a formal protest from the British Government. On the 13th August 1887, the British Charge d’ Affaires at Lisbon transmitted tp the Portuguese minister for foreign affairs a memorandum from Lord Salisbury, in which the latter formally protested ” against any claims not founded on occupa-

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tion” and contended that the doctrine of effective occu- pation had been admitted in principle by all the parties to the Act of Berlin. Lord Salisbury further stated that ” Her Majesty’s Government cannot recognize Por- tuguese sovereignty in territory not occupied by her in sufficient strength to enable her to maintain order, pro- tect foreigners, and control the natives.” To this Portu- gal replied that the doctrine of effective occupation was expressly confined by the Berlin Act to the African coast, but at the same time expeditions were hastily despatched up the Zambezi and some of its tributaries to

discover traces of former Portuguese occupation. Matabeleland and the districts of Lake Nyasa were ecially mentioned in the British protest as countries in which Her Majes- ty's Government took a special interest. As a matter of fact the extension of British influence northwards to the Zambezi had engaged the attention of the British authori- ties, ever since the appearance of Germany in South-West Africa and the declaration of a protectorate over Bechu- Matabei analand. There were rumours of German land and activity in Matabeleland, and of a Boer trek Masbona- north of the Limpopo. Hunters and explorers

'^ had reported in eulogistic terms on the rich

goldfields and healthy plateau lands of Matabeleland and Mashonaland, over both of which countries a powerful native chief, Lobengula, son of the great Moziligazi, claimed authority. The Matabele, or Amandebele, were a branch of the great Zulu family and a race of warriors. There were many suitors for' Lobengula's favours ; but on the 11th February 1888 he signed a treaty with Mr J. S. Moffat, the assistant commissioner in Bechuanaland, the effect of which was to place all his territory under British protection. Both the Portuguese and the Transvaal Boers were naturally chagrined at this extension of British influence. A number of Boers attempted unsuccessfully to trek into the country, and Portugal opposed her ancient claims to the new treaty. She contended that Lobengula's authority did not extend over Mashonaland, which she claimed as part of the Portuguese province of Sof ala, and suddenly developed spasmodic activity in the distribution of flags 'and the establishment of stations and forts, not only in Eastern Mashonaland, but in the countries north of the Zambezi. Meanwhile preparations were being actively made for the exploitation of the mineral and other resources of Lobengula's territories. Two rival syndicates obtained, or claimed to have obtained, concessions from Lobengula ; but in the summer of 1889 Mr Cecil Rhodes succeeded in amalgamating the conflict- ing interests, and on the 29th October of that year Her Majesty granted a charter to the British South Africa Company (see Chartered Companies), the grantees being the Duke of Aberqorn, the Duke of Pife, Lord Gifford, Mr Cecil J. Rhodes, Mr Albert Beit, Mr Albert Grey, and Mr George Ca^ston. The first article of the charter declared that "the principal field of the operations " of the company "shall be the region of South Africa lying immediately to the north of British Bechu- analand, and to the north and west of the South African Republic, and to the west of the Portuguese dominions." No time was lost in making preparations for effective occupation. On the advice of Mr F. C. Selous it was de- termined to despatch an expedition to Eastern Mashonar land by a new route, which would avoid the Matabele country. This plan was carried out in the summer of 1890, and, thanks to the rapidity with which the column moved and Mr Selous's intimate knowledge of the coun- try, the British flag was, on 11th September, hoisted at a spot on the Makubusi river, where the town of Salisbury now stands, and the country taken possession of in the name of Queen Victoria. Disputes with the Portuguese ensued, and there were several frontier incidents which

for a time embittered the relations between the two countries.

Meanwhile, north of Zambezi, the Portuguese were making desperate but futile attempts to repair the neglect of centuries by hastily-organized expeditions and the hoisting of flags. In 1888 an attempt f^^*"'" to close the Zambezi to British vessels was nirtagai frustrated by the firmness of Lord Salisbury, "ortb of In a despatch to the British minister at Lisbon, Zambezi. dated 26th June 1888, Lord Salisbury, after brushing aside the Portuguese claims founded on doubtful discoveries three centuries old, stated the British case in a few sentences. " It is," he wrote, " an undisputed point that the recent discoveries of the English traveller, Liv- ingstone, were followed by organized attempts on the part of English religious and commercial bodies to open up and civilize the districts surrounding and adjoining the lake. Many British settlements have been established, the access to which from the sea is by the rivers Zambezi and Shire. Her Majesty's Government and the British public are much interested in the welfare of these settlements. Portugal does not occupy, and has never occupied, any portion of the lake, nor of the Shire; she has neither authority nor influence beyond the confluence of the Shire and Zambezi, where her interior custom house, now withdrawn, was placed by the terms of

the Mozambique Tariff of 1877." As a matter of historical accuracy it may be well to add that the Nyasa region has, from the first, been peculiarly associated with Scottish enterprise. Apart from the fact that Livingstone was a Scotsman, the first missions were established by the Scottish churches,* the first planters were Scottish, and the " African Lakes Company," which was the pioneer in trading and trans- port operations, was a Scottish corporation. In 1889 it became known to the British Government that a consid- erable Portuguese expedition Vras being organized for operating in the Zambezi region. In answer to inquiries addressed to the Portuguese Government, the foreign minister stated that the object ef the Serpa Pinto expedi- tion was to visit the Portuguese settlements on the Upper Zambezi. The British Government was, even so'late as 1889, averse from declaring a formal protectorate over the Nyasa region; but early in that year Mr H. H. (afterward Sir Harry) Johnston was sent out to Mozam- bique as British consul, with instructions to travel in the interior and report on the troubles that had arisen with the Arabs on Lake Nyasa and with the Portuguese. The discovery of a navigable mouth of the Zambezi — '■ the Chinde — and the offer by Mr Rhodes' of a subsidy of £10,000 a year from the British South Africa Com- pany, removed some of the objections to a protectorate entertained by the British Government; but Mr John- ston's instructions were not to proclaim a protectorate unless circumstances compelled him to take that course. To his surprise, Mr Johnston learnt on his arrival at the Zambezi that Major Serpa Pinto's expedition had been suddenly deflected to the north. Hurrying for- ward, Mr Johnston overtook the Portuguese expedition and warned its leader that any attempt to establish politi- cal influence north of the Ruo river would compel him to take steps to protect British interests. On arrival at the Ruo, Major Serpa Pinto returned to Mozambique for instructions, and in his absence Lieutenant Coutinho crossed the river, attacked the Makalolo chiefs, and sought to obtain possession of the Shir^ highlands by a coup de main. Mr Buchanan, the British vice-consul, lost no time in declaring the country under British pro- tection, and his action was subsequently confirmed by Mr Johnston on his return from a treaty-making expe- dition on Lake Nyasa. On the news of these events reaching Europe the British Government addressed an

ultimatum to Portugal, as the result of ■which Lieutenant Coutinho's action, was disavowed, and he was ordered to withdraw the Portuguese forces south of the Kuo. But while Mr Johnston was busily engaged in concluding treaties with the native chiefs in the districts to which Portugal had no priof claim, the diplomatists in Europe were seeking for a solution of the troubles which had arisen both north and south of the Zambezi. As the result of ^prolonged negotiations, an agreement was signed between Great Britain and Portugal on the 20th August 1890, by which Great Britain obtained a broad belt of territory north of the Zambezi, stretching from Lake Nyasa on the east, the southern end of Tanganyika on

the north, and Lake Bangweulu on the west; while south of the Zambezi Portugal was allowed to retain the right bank of the river from a point ten miles above Zumbo, and the eastern boundary of her territory south of the river was made roughly to coincide with the 33rd degree of east longitude. The publication of the agree- ment aroused deep resentment in Portugal, and the Gov- ernment, unable to obtain its ratiiication by the Chamber of Deputies, resigned. In October the abandonment of the treaty was accepted by the new Portuguese ministry as a fait accompli; but on the 14th November the two Governments signed an agreement for a modus vivendi, by which they engaged to recognize the territorial limits

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indicated in the convention of 20th August ” in so far that from the date of the present agreement to the termi- nation thereof neither Power will make treaties, accept protectorates, nor exercise any act of sovereignty within the spheres of influence assigned to the other party by the said convention.” The breathing-space thus gained enabled feeling in Portugal to cool down, and on the 11th June 1891 another treaty was signed, the ratifications being exchanged on the 3rd July. This is the main

treaty, defining the British and Portuguese of 1891^ spheres both south and north of the Zambezi.

It contained many other provisions relating to trade and navigation, providing inter alia a maximum transit duty of 3 per cent, on imports and exports cross- ing Posituguese tertitories on the east coast to the British

sphere, freedom of navigation of the Zambezi and Shir^ for the ships of all nations, and stipulations as to the making of railways, roads, and telegraphs. The territorial readjustment effected left Portugal a triangular strip of territory north of the Zambezi, with its base on the Zambezi-Shire watershed and its apex on the angle formed by the Zambezi and the Loangwa, close to Zumbo. South of the Zambezi the Portuguese frontier, after run- ning for a short distance due south, takes an east-south-easterly direction to the Mazoe river, which it intersects at the 33rd degree of east longitude and follows that meridian to its intersection by the 18° 30′ parallel of south latitude, whence it follows the eastern slope of the Manica plateau southwards to the centre of the main channel of the Sabi, follows that channel to its confluence

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with, the Lunte, ~~whence it strikes directly to the north~~ eastern point of the frontier of the Transvaal, and fol- lows the eastern frontier of that territory and the frontier of Swaziland to the river Maputa. The delimitation of this frontier was not accomplished without considerable difficulty and a recourse to arbitration. Some parts of the boundary north of the Zambezi were not delimited until the closing months of the 19th century. The western boundary between the British and Portuguese spheres of influence was only vaguely indicated, and had not been settled in 1900 by the Anglo-Portuguese Com- mission ; but it was to be drawn in such a manner as to leave the Barotse country within the British sphere, Lewanika, the paramount chief of the Marotse, claiming that his territory extended much farther to the west than was admitted by the Portuguese.

Before the conclusion of the treaty of June 1891 with Portugal, the British Government had made certain ar- rangements for the administration of the large ?f’”^ area north of the Zambezi reserved to

British AMca. influence. On the 1st of February Mr H. H. Johnston was appointed Imperial Commissioner in Nyasaland, and a fortnight later the British South Africa Company intimated a desire to extend its opera- tions north of the Zambezi. Negotiations followed, and the field of operations of the Chartered Company was, on the 2nd of April 1891, extended so as to cover the whole of the British sphere of influence north of the Zambezi, with the exception of Nyasar land, the Company agreeing to appoint Mr Johnston political Administrator of its territories north of the Zambezi, now known as Northern Ehodesia, and to contribute £10,000 a year towards the cost of ad- ministration, to be applied by Mr. Johnston at his discretion either in Nyasaland or in the Company's sphere. On the 14th of May a formal protectorate was declared over Nyasaland, including the Shire highlands and a wide belt of territory from the Anglo-German frontier on the north end of Lake Nyasa along the west- ern shore of the lake. The name was subsequently changed to the British Central Africa Protectorate {q-v.). The arrangement as to the joint administration of the Protectorate and the Company's sphere lasted for some three years, and at the end of that time the Company ap- pointed a separate administration for Northern Rhodesia, and the subsidy was withdrawn.

At the date of the assembling of the Berlin Conference the German Government had notified that the coast-line on the south-west of the continent, from the Soutt" Orange river to Cape Prio, had been placed West under German protection. On the 13th April

AMca. JL885 the German South-West Africa Company was constituted under an order of the Imperial Cabi- net with the rights of state sovereignty, including mining royalties and rights, and a railway and tele- graph monopoly. In that and the following years the Germans vigorously pursued the business of treaty- making with the native chiefs in the interior; and when, in (July 1890, the British and German Govern- ments came to an agreement as to the limits of their respective spheres of influence in various parts of Africa, the boundaries of German South-West Africa were fixed in their present position. By Article III. of this important agreement the north bank of the Orange river up to the point of its intersection by the 20th degree of east longitude was made the southern boundary; of the German sphere of influence. The eastern boundary followed the 20th degree of east longi- tude to its intersection by the 22nd parallel of south latitude, then ran eastwards along that parallel to the point of its intersection by the 21st degree of east longi-

tude. Prom that point it ran northwards along the last- named meridian to the point of its intersection by the 18th parallel of south latitude, thence eastwards along that parallel to the river Chobe, and along the main channel of that river to its junction with the Zambezi, where it terminated. The northern frontier marched with the southern boundary of Portuguese West Africa. The object of deflecting the eastern boundary near its northern termination was to give Germany access by her own territory to the upper waters of the Zam- bezi, and it was declared that this strip of territory was at no part to be less than twenty English miles in width.

To complete the survey of the political partition of Africa south of the Zambezi, it is necessary briefly to refer to the events connected with the South African Eepublic and the Orange Free State. f ''^ In October 1886 the British Government made AMca. an agreement with the New Eepublic, a small community of Boer farmers who had set up a. Govern- ment of their own, defining the frontier between the New Eepublic and Zululand ; but less than a year later — in September 1887 — the New Eepublic was incorporated in the South African Eepublic. In a convention of July- August 1890 the British Government and the Govern- ment of the South African Eepublic confirmed the inde- pendence of Swaziland, and on the 8th November 1893 another convention was signed with the same object ; but on the 19th December 1894 the British Government agreed to the South African Eepublic exercising " all » rrights and powers of protection, legislation, jurisdiction, and administration over Swaziland and the inhabitants thereof," subject to certain conditions and provisions, and to the non- incorporation of Swaziland in the Eepublic. Subsequently, on the 23rd April 1895, Tongaland was

declared by proclamation to be added to the dominions of Queen Victoria, and in December 1897 Zululand and Tongaland, or Amatongaland, were incorporated with the colony of Natal. The history of the events that led up to the last Boer war cannot be recounted here (see Teajsts- VAAL Colony and Oeangb Eiver Colony), but in October 1899 the South African Eepublic and the Orange Free State addressed an ultimatum to Great Britain and invaded Natal and Cape Colony. As a result of the military operations that followed, the Orange Free State was, on 28th May 1900, proclaimed by Lord Eoberts a British colony under the name ” Orange Eiver Colony,” and the South African Eepublic was on the 25th October 1900 incorporated in the British Empire as the ” Trans- vaal Colony.”

On the east coast the two great rivals were Germany and Great Britain. Germany on the 30th December 1896, and Gi^eat Britain on the 11th June 1891, „ formally recognized the Eovuma river as the aaaar^t northern boundary of the Portuguese sphere of BrUaia in influence on that coast ; but it was to the north ^^^ of that river, over the vast area of East or East Central Africa in which the Sultan of Zanzibar claimed to exercise suzerainty, that the struggle between the two rival Powers was most acute. The independence of the Sultans of Zanzibar had been recognized by the Govern- ments of Great Britain and Prance in 1862, and the Sultan’s authority extended almost uninterruptedly along the coast of the mainland, from Cape Delgado in the south to Warshekh on the north — a stretch of coast more than a thousand miles long — ^though to the north the Sultan’s authority was confined to certain ports. In Zanzibar itself, where Sir John Kirk, Livingstone’s com{)anion, was British consul-general, British influence was, when the Berlin Conference met, practieally supreme, though German traders had established themselves on

the island and created considerable conunercial interests. Away from the coasts the limits and extent of the Sul- tan’s authority were far from being clearly defined. The Sultan himself claimed that it extended as far as Lake Tanganyika, but the claim did not rest on any very solid ground of effective occupation. The little-known region of the Great Lakes had for” some time attracted the atten- tion of the men who were directing the colonial movement in Germany ; and, as we have seen, a small band of pio- neers actually landed on the mainland opposite Zanzibar in November 1884, and made their first ” treaty ” with the chief of Mbuzini on the 19th of that month. Pushing up the Wami river the three adventurers reached the Usagara country, and concluded more ” treaties,” the net result being that when, in the middle of December, Dr Peters returned to the coast he brought back with him documents which were claimed to concede some 60,000 square miles of country to the German Colonization Society. Dr Peters hurried back to Berlin, and on the 17th of February 1885 the German Emperor issued a ” Charter of Protec- tion” by which His Majesty accepted the suzerainty of the newly-acquired territory, and ” placed under our Im- perial protection the territories in question.” The con- clusion of these treaties was, on the 6th March, notified to the British Government and to the Sultan of Zanzibar. Immediately on receipt of the notification the Sultan telegraphed an energetic protest to Berlin, alleging that the places placed under German protection had belonged to the Sultanate of Zanzibar from the time of his fathers. The German consul-general refused to admit the Sultan’s claims, and meanwhile agents of the German society were energetically pursuing the task of treaty-making. The Sultan despatched a small force to the disputed, territory, which was subsequently withdrawn, and in May sent a more imposing,expedition under the command of General Mathews, the commander-in-chief of the Zanzibar army, to the Kilimanjaro district, in order to anticipate the German agents who were reported to be hastening to conclude treaties with the chiefs of Chagga and Taveta. Meanwhile Lord Granville, who was then at the Foreign Office, had taken up an extremely

friendly attitude towards the German claims. Prior to these events the Sultan of Zanzibar had, on more than one occasion, practically invited Great Britain to assume a protectorate over his dominions. But the invitations had been declined. Egyptian affairs were, in the year 1885, causing consider- able anxiety to the British Government, and the fact may not have been without influence on the attitude of the British foreign secretary. On the 251^ May 1886, in a despatch to the British ambassador at Berlin, Lord Granville instructed Sir E. Malet to communicate the views of the British Cabinet to Prince Bismarck : —

I have to request your Excellency to state that the supposition that Her Majesty's Government have no intention of opposing the German scheme of colonization in the neighbourhood of Zanzibar is absolutely correct. Her Majesty's Government, on the contrary, view with favour these schemes, the realization of which will entail the civilization of large tracts over which hitherto no European influence has been exercised, the co-operation of Ger- many with Great Britain in the work of the suppression of the slave gangs, and the encouragement of the efforts of the Sultan both in the extinction of the slave trade and in the commercial development of his dominions.

In the same despatch Lord Granville instructed Sir E. Malet to intimate to the German Government that some prominent capitalists had originated a plan for a British ^ settlement in the country between the coast and the lakes, which are the sources of the White Nile, " and for its connexion with the coast by a railway." But Her Majesty's Government would not accord to these promi- nent oftpitalists the support they had called for " unless

they were fully satisfied that every precaution was taken to ensure that it should in no way conflict with the interests of the territory that has been taken under Ger- man protectorate," and Prince Bismarck was practically invited to say whether British capitalists were or were not to receive the protection of the British Government. The reference in Lord Granville's despatch was to a proposal made by a number of British merchants and others who had long been interested in Zanzibar, and who saw in the rapid advance of Germany a menace to the interests which had hitherto been regarded as paramount in the Sultanate. In 1884 Mr H. H. Johnston had concluded treaties with the chief of Taveta, and had transferred these treaties to Mr John Hutton of Manchester. Mr Hutton, with Mr (afterwards Sir William) Mackinnon was one of the founders of what subsequently became the Imperial British East Africa Company. But in the early stages the champions of British interests in East Africa received no support from their own Government, while Germany was pushing her advantage with the energy of a recent convert to colonial expansion, and had even, on the coast, opened negotiations with the Sultan of Witu, a small territory situated north of Tana river, whose ruler claimed to be independent of Zanzibar. On the 5th May 1885 the Sultan of Witu executed a deed of sale and cession to a German subject of certain tracts of land on the coast, and later in the same year other treaties or sales of territory were effected, by which German subjects acquired rights on the coast-line claimed by the Sultan. Inland, treaties had been concluded on behalf of Germany with the chiefs of the Kilimanjaro region, and an intimation to that effect made to the British Government. But before this occurred the German Government had succeeded in ex- tracting an acknowledgment of the validity of the earlier treaties from the Sultan of Zanzibar. Early in August a powerful German squadron appeared off Zanzibar, and on the 14th of that month the Sultan yielded to the inevitable, acknowledged the German protectorate over Usagara and Witu, and undertook to withdraw his soldiers.

Meanwhile negotiations had been opened for the ap- pointment of an International Commission, "for the purpose of inquiring into the claims of the j.jj,g Sultans of Zanzibar to sovereignty over certain saitaaate territories on the east coast of Africa, and of "' ascertaining their precise limits." The Govern- ''''>''- ments to be represented were Great Britain, France, and 'Germany, and towards the end of 1885 commissioners were appointed. The commissioners reported on the 9th of June 1886,

and assigned to the Sultan the islands of Zanzibar, Pemba, Lamu, Mafia, and a number of other small islands. On the mainland they recognized as be- longing to the Sultan a continuous strip of territory, 10 sea miles in depth, from the south bank of the Minengani river, a stream a short distance south of the Eovuma, to Kipini, at the mouth of the Tana river, some 600 miles in length. North of Kipini the commissioners recognized as belonging to the Sultan the stations of Kismayu, Brava, Meurka, and Magadisho, with radii landwards of 10 sea miles, and of Warshekh with a radius of 5 sea miles. By an exchange of notes in October-November 1886 the Gov- ernments of Gr^at Britain and Germany accepted the re- ports of the Delimitation Commissioners, to which the Sultan adhered on the 4th of the following December. But the British and German Governments did more than determine what territories were to vbe assigned to the Sultanate of Zanzibar. They agreed to a delimitation of their respective spheres of influence in East Africa. The territory to be affected by this arrangement was to be bounded on the south by the Eovuma river, ” and on the north by a line which, starting from the mouth of the

Tana river, follows the course of that river or its afflu- ents to the point of intersection of the equator and the 38th degree of east longitude, thence strikes direct to the point of intersection of the 1st degree of north latitude with the 37th degree of east longitude, where the line terminates.” The line of demarcation between the Brit- ish and the German spheres of influence was to start from the mouth of the river Wanga or Umba, to pass round the eastern and northern side of Lake Jipe, cross the Lumi river, pass between the territories of Taveta and Chagga, skirt the northern base of the Kilimanjaro range, and thence be drawn direct to the point on the eastern side of Victoria Nyanza which is intersected by the 1st degree of south latitude. South of this line German influence was to prevail; north of the line was the British sphere. The Sultan’s dominions having been thus truncated, Germany associated herself with the recognition of the ” independence ” of Zanzibar in which France and Great Britain had joined in 1862. The effect of this agreement was to define the spheres of influence of the two countries as far as Victoria Nyanza, but it provided no limit to the westwards, and left the country north of the Tana river, in which Germany had already acquired some interests near the coast, open for fresh annexations. The conclusion of the agreement immedi- ately stimulated the enterprise both of the German East Africa Association, to which Dr Peters’s earlier treaties had been transferred, and of the British- capitalists to whom reference had been made in Lord Granville’s de- spatch. The German Association was incorporated by Imperial charter in March 1887, and the British capital- ists formed themselves into the British East Africa Association, and on 24th May 1877 obtained, through the good offices of Sir William Mackinnon, a concession of the 10-miles strip of coast from the Umba river in the south to Kipini in the north. The Association was to have the entire admtinistration of the territory for fifty years, and was to govern in the Sultan’s name, on certain conditions as to the payment of the customs dues. The British Association further sought to extend its rights in the sphere reserved to British influence by making treaties with the native chiefs behind the coast strip, and for this purpose various expeditions were sent into the interior. When they had obtained concessions over the country for some 200 miles inland the associated capital- ists applied to the British Government for a charter, which was granted on ~~3rd September 1888, and the Association became the Imperial British East Africa Company (see Chakteeed Companies). The example set by the British company in obtaining a lease of the coast strip between the British sphere of influence and the sea was quickly followed by the German Association, which, on the 28th April 1888, concluded an agreement with the Sultan Khalifa, who had succeeded his brother Burghash, by which the Association leased the strip of Zanzibar territory between the German sphere and the sea. It was not, however, until August that the Geriii,an officials took over the administration, and their want of tact and ignoranee of native administration almost im~~ mediately provoked a rebellion, of so

serious a character that it was not suppressed until the Imperial authorities had taken ~~the matter in hand. Shortly after its suppres~~ sion the administration was entrusted to an Imperial offi- cer, and the Sultan's rights on the mainland strip were bought outright by Germany for four millions of marks.

Events of great importance had been happening, mean- while, in the country to the west and north of the British sphere of influence. The British company had Vgaada. ^^^^ caravans into the interior to sxirvey the country, to make treaties with the native chiefs, and to report on the commercial and agricultural possibilities.

One of these had gone up the Tana river. But another and a rival expedition was proceeding along the northern bank of this same river. Dr Carl Peters, whose energy cannot be denied, whatever may be thought of his meth- ods, set out with an armed caravan up the Tana on the pretext of leading an expedition to the relief of Emin Pasha, who was then reported to be hemmed in by the dervishes at Wadelai. His expedition was not sanctioned by the German Government, which was at that moment receiving material assistance from Great Britain in the suppression of the Bushiri rebellion, and the British naval commander had orders to prevent his landing. But Peters succeeded in evading the British vessels and proceeded up the river, planting German flags and fight- ing the natives who opposed his progress. Early in 1890 he reached Kavirondo, and there found letters from Mwanga, King of Uganda, addressed to Mr F. J. Jackson, the leader of an expedition sent out by the British East Africa Company, imploring the Company's representative to come to his assistance and offering 'to accept the British flag. To previous letters, less plainly couched, from the King, Mr Jackson had returned the answer that his instructions were not to enter Uganda, but that he would do so in case of need. The letters that fell into Peters's hands were in reply to those from Mr Jackson. Peters did not hesitate to open the letters, and on reading them he at once proceeded to Uganda, where, with the assistance of the French Eoman Catholic priests, he succeeded in inducing Mwanga to sign a loosely-worded treaty intended to place him under German protection. On hearing of this Mr Jackson at once set out for Uganda, but Peters did not wait for his arrival, leaving for the south of Victoria Nyanza some days before Jackson arrived at Mengo,' Mwanga's capital. For the complicated story of Euro- pean relations with Uganda, reference must be made to the article on the Uganda Protectorate. It must be sufficient to say here that, as Mwanga would not agree to Mr Jackson's proposals, Mr Jackson returned to, the coast, leaving Mr Gedge at Mengo to protect the Com- pany's interests. Captain Lugard, who had recently entered the Company's employment, was at once ordered to proceed to Uganda. But in the meantime an event of great importance had taken place, the conclusion of an agreement between Great Britain and Germany with reference to their different spheres of influence in vari- ous parts of Africa.

The Anglo-German agreement of 1st July 1890 has already been referred to in connexion with German South- West Africa. It was, however, of much greater importance in reference to East Africa. Aogio- In return for the cession of Heligoland, Lord a^™^^^^ Salisbury obtained from Germany the recogni- ©/ 1890. tion of a British protectorate over the domin- ions of the Sultan of Zanzibar, including the islands of Zanzibar and Pemba, but excluding the strip leased to Germany, which was subsequently ceded absolutely to Germany. Prince Bismarck further agreed to withdraw the protectorate declared over Witu and the adjoining coast up to Kismayu, in favour of Great Britain, and to recognize as within the British sphere of influence the vast area bounded, on "the south by the frontier line laid down in the agreement of 1886, which was to be extended along the first parallel of south latitude across Victoria Nyanza to the frontiers of the Congo Free State; on the west by the Congo Free State and the western watershed of the Nile, and on the north by a line commencing on the coast at the north bank of the mouth of the river Juba, then ascending that bank of the river until it reached the territory reserved to the influence of Italy in Gallaland and Abyssinia,

when it followed the frontier of the Italian sphere to the confines of Egypt. To the south-west of the Ger- man sphere in East Africa the boundary was formed by the eastern and northern shore of Lake Nyasa, and round the western shore to the mouth of the Songwe river, from which point it crossed the NyasarTanganyika plateau to the southern end of the last-named lake, leaving the Stevenson Road on the British side of the boundary. The effect of this treaty was to remove all serious causes of dispute about territory between Ger- majiy and Great Britain in East Africa. It rendered quite valueless Dr Peters's treaty with Mwanga and his promenade along the Tana ; it freed Great Britain from any fear of German competition to the northwards, and recognized that her influence extended to the western limits of the Nile valley. But, on the other hand, Great Britain had to relinquish the ambition of coimecting her sphere of influence in the Nile valley with her posses- sions in the NyasarTanganyika region. On this point Germany was quite obdurate ; and, as we have already seen, an attempt subsequently made (May 1894) to se- cure this object by the lease of a strip of territory from the Congo Free State, was frustrated by German opposition. Uganda having thus been assigned to the British sphere of influence by the only European Power in a position to contest its possession with her, the subse- quent history of that region, and/of the country between the Victoria Nyanza and the coast, must be traced in the articles on East Apeica, British, and Uganda, but it may be well briefly to record here the following facts : — The Imperial British East Africa Company, finding the burden of administration too heavy for its financial resources, and not receiving tim assistance it felt itself entitled to receive from the Imperial fiuthorities, in- timated that it would be compelled to withdraw at the end of the year 1892. Funds were raised to enable the Company to continue its administration until the end of March 1893, and a strong public protest against evacu- ation compelled the Government to determine in favour of the retention of the country. In January 1893 Sir Gerald Portal left the coast as a special commissioner to inquire into the "best means of dealing with the country, whether through Zanzibar or otherwise." On the 31st March the Union Jack was raised, and on the 29th May a fresh treaty was concluded with King Mwanga, placing his country under British protection. A formal protectorate was declared over Uganda proper on 19th June 1894, which was subsequently extended so as to include the countries westwards towards the Congo Free State and eastwards to the British East Africa Protectorate. This latter protectorate was constituted in June 1895, when the Imperial British East Africa Company relinquished all its rights in exchange for a money payment, and the administration was assumed by the Imperial authorities.

In 1883 Italy had obtained her first formal footing on the African coast at the Bay of Assab (Aussa) on the Eed Sea. In 1885 the troubles in which Egypt Italy In found herself involved Compelled the Khedive and his advisers to lOpsen their hold on the Eed Sea littoral, and, with the tacit approval of Great Britain, Italy took possession of Massawa and other ports on that coast. By 1888 Italian influence had been extended from Eas Kasar, on the north, to the northern frontier of the French colony of ■ Obok on the south, a distance of some 650 miles. The interior limits of Italian influence were but ill defined, and King John of Abyssinia viewed with anything but a favourable eye the approach of the Italians towards the Abyssinian highlands. In January 1887 an Italian force was almost annihilated at Dogali, but the check only served to spur

East Africa.

on the Italian Government to fresh efforts. The Italians occupied Keren and Asmara in the interior, and eventu- ally, in May 1889, concluded a treaty of peace and friendship with the Emperor Menelek, who had suc- ceeded King John on the death of the latter in battle with the dervishes. This agreement, known as the Treaty of Ucialli, settled the frontiers between Abyssinia and the Italian sphere, and contained the following article : —

XVII. His Majesty the King of Kings of Ethiopia consents to avail himself of the Italian Government for any negotiations which he may enter into with the other Powers or Governments.

In Italy, and by other European Governments, this article was generally regarded as establishing an Italian protectorate over Abyssinia, but this interpretation was never accepted by the Emperor Menelek, and at no time did Italy succeed in establishing any very effective control over Abyssinian affairs. North of the Italian coast sphere the Eed Sea littoral was still under Egyptian rule, while immediately to the south a small stretch of coast on the Bay of Tajura constituted the sole French possession on the East African piainland. France had, in 1862, ob- tained from the Danakil tribes a concession of "the harbour, roadstead, and anchorage of Obok, situated near Cape Eas Bir, with the plain extending from Eas Aly to the south, as far as Eas Dameirah to the north." It was not, however, until 1883 that the place was effec- tively occupied, and in the following year treaties were concluded with the Sultan and chiefs of Tajura extend- ing the French sphere to the southern side of the gulf of that name. The East India Company had, as far back as 1840, concluded a treaty of friendship with the ~~gov~~ ernor or chief of Zeila, not far from the Bay of Tajura ; and when Egyptian claims to the Somali coast were withdrawn Great Britain took the oppoi-tunity to es- tablish her influence on the northern Somali coast, op- posite Aden. Between 1st May 1884 and 15th March 1886 ten treaties were concluded, placing under British influence the northern Somali coast from Eas Jibuti on the west to Bunder Ziadeh on the ieafet. In the mean- time Italy, not content with her acquisitions on the Eed Sea, had been concluding treaties with the Somali chiefs on the east coast. The first treaty was made with the Sultan of Oppia on the 8th February 1889. Later in the same year the British East Africa Company transferred to Italy, the transference being subsequently approved by the Sultan of Zanzibar, the ports of Brava, Meurka, Magadisho, and Warshekh, leased from Zanzibar. On the 24th March 1891 an agreement between Italy and Great Britain fixed the northern bank of the Juba up to latitude 6° N. as the southern boundary of Italian in- fluence in Somaliland, the boundary being provisionally prolonged along lines of latitude and longitude to the intersection of the Blue Nile with 35° E. longitude. On the 15th April 1891 a further agreement fixed the north- ern limit of the Italian sphere from Eas Kasar on the Eed Sea to the point on the Blue Nile just mentioned. By this agreement Italy was to have the right of tempo- rarily occupying Kassala, which was left in the Anglo- Egyptian sphere — in trust for Egypt — a right of which she availed herself in 1895. To complete the work of delimitation the British and Italian Governments, on the 6th May 1894, fixed the boundary of the British sphere of influence in Somaliland from the Anglo-French bound- ary, which had been settled in February 1888. The interior limit of British Somaliland thus agreed upon was subsequently modified in 1897 by an agreement with the Emperor Menelek, made by Sir Eennell Eodd on behalf of Great Britain. The effect of this agreement was to reduce the area of British Somaliland from 75,000 to 68,000 square miles.

But while Great Britain was thus lending her sanction to Italy's ambitious schemes, the Abyssinian emperor was becoming more and more incensed at Italy's preten- sions to exercise a protectorate over Ethiopia. In 1883 Menelek denounced the treaty of Uciali, and eventually, in a great battle, fought at Adowa on 1st March 1896, the Italians were disastrously defeated. By the subsequent treaty of Addis Abbaba, concluded on 26th October 1896, the whole of the country to the south of the Mareb, the Belesa, and Muna rivers was restored to Abyssinia, and Italy acknowledged the absolute independence of Abys- sinia. The effect of this was practically to destroy the value of the Anglo-Italian agreement as to the boundaries to the south and west of Abyssinia; and negotiations were afterwards set on foot between the British, the Egyptian, and the Abyssinian Governments for determin- ing the Abyssinian frontiers.

The position of Egypt is theoretically unchanged since the abolition of the Dual Control, though in fact Brit- ish influence is now recognized as virtually paramount ia Egypt proper. In the reconquered Anglo-Egyptian Sudan, which consists of the territory south of the 22nd parallel of latitude, the administration is carried on in accordance with the terms of a convention between the British and Egyptian Governments, signed at Cairo, 19th January 1899, under which the British and Egyptian flags are used together. Tripoli still remains a Turkish province. In Tunis the French protectorate has prac- tically eliminated the Bey for all but ceremonial purposes. In Algeria France, in her progress south and south-west,

has come into conflict with Morocco. In the ^^Jj^ closing days of 1899 au attack by some of the

inhabitants of the Tidikelt oasis on a French “scientific” mission furnished the occasion for which France had long been seeking for the occupation of a nuinber of groups of oases in the western Sahara, known as the Tuat .Oases, and consisting of Tuat, Tidikelt, and Gurara. The last two groups were occupied by French troops after some fighting, and at the end of 1900 France was preparing to make good her hold on these two groups and to establish her infiuence in Tu9,t proper, the Sultan of Morpoco having protested to the European Powers against the action of France and asked for their intervention. The occupation of Igli, half-way between the frontier of Morocco proper and Tuat, by French troops further excited the Sultan’s subjects. The claim of Morocco was that the tribes of the oases owed allegiance to the Sultan, and that France acknowledged them to be within the Moorish sphere of influence by the treaty of 1845, which is the only document fixing the frontier ‘between Morocco and AlgeHa. At the opening of the Berlin Conference Spain had established no formal claim to any part of the coast to the south of Morocco ; but while the conference was sitting, on 9th January 1885, the Spanish Government intimated that in view of the importance of the Spanish settlements on the Rio Oro, at Angra de Cintra, and at Western Bay, and of the docu- ments signed with the independent tribes on that coast, the King of Spain had taken under his protection ” the territories of the western coast of Africa comprised between the fore-mentioned “Western Bay and Cape Bajador.” Numerous attempts were made with France to :settle the landward extension of Spain’s possessions in this part of Africa, both Governments claiming to include ~~the Adrar country within their sphere of influence; but in 1900 an agreement was come to by which Spain recog~~ nized the French claim to Adrar and agreed to the twelfth meridian west of Greenwich being the eastern boundary of the Spanish sphere, north of the Tropic of ■Cancer, the boundary line to the south being deflected -westwards so as to leave the Sebkha, or dry salt lake, of

Ijil to France. The same agreement settled’ a long- standing dispute between Spain and France as to the ownership of the district around the Muni river to the south of Cameroon, and Spain secured a block of territory, with a ctoast-line from the Campo river on the north to the Muni river on the south. The northern frontier is formed by the German Cameroon colony, the eastern by 11° 20′ E., and the southern by the 1st parallel of north latitude to its point of intersection with the Muni river.

Apart from this small block of Spanish territory south of Cameroon, the stretch of coast between Cape Blanco and the mouth of the Congo.is partitioned among four European Powers — Great Britain, France, Division Germany, and Portugal — and the negro republic ^^^f ‘ of Liberia. Following the coast southwards from Cape Blanco we come first to the French colony of Senegal, which is indented, along the Gambia river, by the small British colony of that name, and then to the com- paratively small territory of Portuguese Guinea, all that remains on this coast to represent Portugal’s share in the scramble in a region where she once played so conspicu- ous a part. To the south of Portuguese Guinea is the French Guinea colony, and still pursuing our way south and east we come to the British colony of Sierra Leone, the republic of Liberia, the French colony of the Ivory Coast, the British Gold Coast, German Togoland, French Dahomey, the British colony of Lagos, the British terri- tory of Southern Nigeria, the German colony of Cam- eroon, the Spanish settlements on

the Muni river, the French Gabun colony, and the small Portuguese enclave north of the Congo, of which the principal town is Kabinda, which is administratively part of the Angola colony. When the General Act of the Berlin Conference was signed the whole of this coast-line had not been formally claimed ; but no time was lost by the Powers interested in notifying claims to the unappropriated sec- tions, and the conflicting claims put forward necessitated frequent adjustments by international agreements. Be- fore describing the results of these agreements, both on the coast and in the interior, it may be interesting to glance briefly at one or two of the main features of the problem which so many rival Powers were approaching from their several standpoints. The dominant part in West Africa has been played by France. Her anxiety to connect her West African possessions with Southern Algeria, and her Congo colony with both, has already been allude^ to. Ancillary to this desire was the wish to establish a con- tinuous territorial conhexi.on between her scattered pos- sessions on the West African coast. When this design was consciously adopted *as the object of French states- manship, it is very difficult to say ; but for several years before the Berlin Conference military and exploring ex- peditions had been pushed forward into the great Niger bend from the upper waters of. the Senegal, and the pur- pose became clearer and more defined in the strenuous years of struggle that followed the Conference. The ex- haustion of Portugal, the apathy of the British Govern-‘ ment, and the late arrival of Germany in the field, are all elements that favoured the success of France’s West African policy. If, in her larger design of joining on her empire in the Western Sudan to her possessions on the Congo, she experienced a check by reason of the vigour with which British interests were pushed on the Middle Niger and eastwards to Lake Chad, the credit for this cannot be claimed by the British Governinent, but is due entirely to the Royal-Niger Company and its distin- guished governor. Sir George Taubman Goldie. France’s double object was to secure as large a share of the Niger basin as possible, and to make Lake Chad a French lake. In this latter object she was not wholly successful, and

for the much-desired comnnmication between the West- ern Sudan and the Congo -was reluctantly compelled to go round the northern and eastern shores of the lake, instead of through the richer and more populous regions to the west and south of the lake. The real struggle in West Africa was between France and Great Britain ; but before tracing the steps of that historic contest, it may be well to deal briefly with the part played by the other Powers in West Africa.

Portuguese Guinea, with a coast-line of some 200 miles, is entirely surrounded by French possessions. Its fron- ” tiers were fixed by an agreement signed at Paris

cuw “* oil tJie 12th May 18^6. The northern frontier extends almost due east from Cape Eoxo for about 200 miles, then the boundary turns due south for 80 or 90 miles, and then sweeps west and south in a curve to the mouth of the river Cajet. By another article in the same agreement the boundaries of the Portuguese Congo enclave with the French Congo colony are determined.

The negro republic of Liberia has a coast-line of about 350 miles in length, stretching from the river Mano and the frontier of Sierra Leone to the river Cavally and the French Ivory Coast. Its interior limits were fixed by agreements with Great Britain on the 11th November 1885, and with France on the 8th December 1892. Starting from the left bank of the Mano river, the frontier extends generally in a north- easterly and northern direction, the coast-line having been traced by an Anglo-Liberian Boundary Commis- sion, until it reaches a point about half-way between the 8th and 9th parallels of north latitude, when it strikes due east to beyond the 9th meridian of west longitude, then strikes south-east, and after a short run due east intersects the Cavally river, which it fol- lows to the coast.

It will be remembered that Dr Ifachtigal, while the proposals for the Berlin Conference were under discussion, had planted the German flag on the coast of Germany Togo and in Cameroon in the month of July 1884. In Cameroon Germany found herself with Great Britain for a neighbour to the north, and with France as her southern neighbour on the Gabun river. The utmost activity was displayed in making treaties with native chiefs, and in securing as wide a range of coast for German enterprise as was possi- ble. In May 1885 a provisional agreement was made be- tween Great Britain and Germany as to the northern limits of Germany's activity. This was subsequently modified in August 1886, and on the 28th March 1887 Great Britain renounced in f a-^ur of Germany her sov- ereignty over Ambas Bay. In the famous agreement of 1st July 1890 a "provisional line of demarcation" was adopted, starting from the head of the Rio del Bey creek and going to the point, about 9° 8′ E. longitude, marked " rapids " on the British Admiralty Chart. By a further agreement of 14th April 1893, the right bank of- the E.io del Rey was made the boundary between the Oil Rivers Protectorate (now Southern Nigeria) and Cameroon. In the following November (1893) the boimdary was con- tinued from the " rapids " before mentioned, on the Old Calabar or Cross river, in a straight line towards the centre of the town of Yola, on the Benu^ river. Yola itself, with a radius of some 3 miles, was left in the British sphere, and the German boundary followed the circle eastwards from the point of intersection as it neared Yola until it met the Benud river. From that point it crossed the river to the intersection of the 13th degree of longitude with the 10th degree of north latitude, and then made direct for a point on the southern shore of Lake Chad " situated 35 minutes east of the meridian of

and Cameroon,

Kuka, this being the distance between the meridian of Kuka and the 14th meridian east of Greenwich, measured on the map (by Kiepert) published in the German Kolonicd Atlas of 1892." Provision was made for settling a new terminal point of the German boun- dary on Lake Chad, should our present want of know- ledge of the geography of that region render such an alteration desirable. By this agreement the British Government withdrew from a considerable section of the upper waters of the Benue with which the Royal Niger Company had entered into relations. The object of making this sacrifice was, however, apparent. France was, as we have seen, eagerly desirous of securing the whole of Lake Chad for herself. By giving ~~Ger~~ many access to the lake Great Britain at the same time satisfied German ambition as to the hinterland of the Cameroon colony and interposed a barrier against the junction of the French Congo and the French Sudan to the south and west of the lake. The limit of Ger- many's possible extension eastwards was fixed at the basin of the river Shari, and Darfur, Kordofan, and the Bahr-el-Ghazal were to be excluded from her sphere of influence. Germany now found l^erself in a position to come to terms with France as to the southern and eastern limits of Cameroon. She had already, on the 24th December 1886, signed a protocol with France fixing her southern -frontier from the mouth of the river Campo to the intersection of that river with the 10th degree of east longitude, thence along the parallel of latitude to the point of its intersection with 15° E. longitude. But to the east German explorers were crossing the track of French explorers from the northern bank of the Mobangi, and the need for an agreement was obvious. Accordingly, on the 4th February 1894, a protocol — ^which, some weeks later, was confirmed by a convention — was signed at Berlin, by which France accepted the presence of Germany on Ljjke Chad as a. fait accompli and effected the best bargain she could by making the left bank of the Shari river, froni its outlet into Lake Chad to the 10th parallel of north latitude, the eastern limit of German extension. From this point the boundary line went due west some 230 miles, then turned south, and with various indentations joined the south-eastern frontier, which had been slightly extended so as to give Germany access to the Sangha river — a tributary of the Congo. Thus, early in 1894, the German Cameroon colony had reached its present definite limits.

The German Togoland Settlements occupy a narrow- strip of the Guinea Coast, some 35 miles only in. length, wedged in between the British Gold xa i d Coast and French Dahomey. At first France •«» ” • was inclined to dispute Germany’s claims to Little Popo and Porto Segiiro; but in December 1885 the French Government acknowledged the German protectorate over these places, and the boundary between French and German territory, which runs in an irregular line almost due north from the coast to the 11th degree of lati- tude, was laid down by the Franco-German Convention of 12th July 1897. It was not, however, until the end of 1899, after two years of arduous and constantly-inter- rupted labours, that the Joint Commission completed the work of delimitation. The fixing of the 11th parallel as- the northern boundary of German expansion towards the interior was not accomplished without some sacrifice of German ambitions. Having secured an opening on Lake Chad for her Cameroon colony, Germany was anxious to- obtain a footing on the Middle Niger for Togoland. German expeditions reached Gando, one of the tributary states of the Sokoto empire on the Middle Niger, and, notwithstanding the existence of prior treaties with Great Britain, sought to conclude agreements with the Sultan of

that country. But tMs German ambition conflicted both with the British and the French designs in West Africa, and eventually Germany had to be content with the 11th parallel as her northern frontier. On the west the Togoland frontier on the coast was fixed in July 1886 by British and German commissioners at 1° 10′ E. longi- tude, and its extension towards the interior laid down for a short distance. By a further agreement in 1888 the boundary was extended so as to leave the district of Towe, Kowe, and Agotime within the German sphere, and to include the countries of Aquamoo and Crepee within the British protectorate. A neutral zone farther north was also agreed upon at the same time. The agree- ment of 1st July 1890, already so frequently referred to, defined the limits up to this neutral zone ; but it was not until November 1899 that, as part of the Samoa Settle- ment, this neutral zone was partitioned between the two Powers in such a manner as to leave the important trad- ing centre of Salaga to Great Britain and that of Yendi to Germany. At the same time the territory to the north of the neutral zone up to the 11th parallel was divided between the Gold Coast and Togoland, and the present limits of both colonies were then definitely determined.

The story of the struggle between Trance and Great Britain in West Africa may roughly be divided into twO

sections, the first dealing with the Coast p^cb colonies, the second dealing with the struggle Compemion for the Middle Niger and Lake Chad. As ’”^^^ regards the coast colonies, Trance was wholly

successful in her design of isolating all Great Britain’s separate possessions in that region, and of securing for herself undisputed possession of the Upper Niger and of the countries lying within the great bend of that river. When too late, the British Government awoke to the consciousness of what was at stake; but France had obtained too great a start. French governors of the Senegal had succeeded, before the Berlin Con- ference, in establishing forts on the Upper Niger, and the advantage thus gained was steadily pursued. Every winter season French posts were pushed farther and farther along the river, or in the vpst regions watered by the southern tributaries of the Senegal and Niger rivers. The two most formidable chiefs encountered by France were Ahmadu, a son of the faijaous El-Haj-Omar, and Samory, a man of humble origin who had risen by force of character to be the ruler of an immense area of coimtry in the Upper Niger basin. Campaign after cam- paign was fought against this formidable chief by Gallieni, Desbordes, Frey, Archinard, and other French

officers; but it was not until September 1898 that Samory's power was finally broken, and he himself cap- tured. In 1887 the Almamy of Futa Jallon, who had formerly been anxious to obtain British protection, signed a treaty placing the whole of that moimtainous region under French protection. Simultaneously with her mili- tary operations France undertook a series of splendid exploring expeditions in the Niger countries. In 1888-90 Captain Binger traversed the regions between the Upper Niger and the Guinea Coast, making treaties all along his route. In the campaign of 1890-91 Sego, one of Ahmadu's principal towns, was captured by Colonel Archinard. In 1891-92 Captain Monteil traversed the Niger bend from west to east, and from Say made his way to Lake Chad, returning to Europe across the Sahara to the Mediterranean. In December 1893 Timbuktu was occupied by Colonel Bonnier, in defiance of the order of the civil authorities, and every year saw one or more fresh expeditions launched by France, regardless of cost, into the Niger basin. This ceaseless activity met with its reward. Great Britain found herself compelled to acknowledge accomplished facts and to conclude agree-

ments with France, which left her colonies mere coast patches, with a very limited extension towards the interior. On the 10th August 1889 an agreement was signed by which the Gambia colony and protectorate was confined to a narrow strip of territory on both banks of the river for about 200 miles from the sea. In June 1882 and in August 1889 provisional agreements were made with France fixing the western and northern limits of Sierra Leone, and commissioners were appointed to trace the line of demarcation agreed upon by the two Govern- ments. But the commissioners failed to agree, and on the 21st January 1895 a fresh agreement was made, the boundary being subsequently traced by a mixed commis- sion. Sierra Leone, as now definitely constituted, has a coast-line of about 180 miles and a maximum extension towards the interior of some 200 miles.

At the date of the Berlin Conference the present colo- nies of Lagos and the Gold Coast constituted a single colony under the title of the Gold Coast Colony, but on the 13th January 1886 the Gold Coast Settlements were erected into a separate colony. The coast limits of the new colony were declared to extend from 6° W. longitude to 2° E. longitude, but these limits were subsequently curtailed by agreements with France and Germany. We have already followed the course of the arrangements that fixed the eastern frontier of the Gold Coast Colony and its hinterland in connexion with German Togoland. On the western frontier it marches with the French colony 'of the Ivory Coast, and in August 1889 the two Governments agreed that the frontier should start from the neighbourhood of the Tanoe lagoon, and river of the same name, and should be prolonged to the 9th degree of north latitude in accordance with the treaties concluded by the two Governments with the natives, Great Britain being allowed full liberty of action as regards the Ashantis. Commissioners having failed to agree as to the delimitation of 'the frontier, plenipotentiaries were appointed in Europe by the two Governments, and on the 12th July 1893 an agreement was signed setting out in detail the course of the frontier up to the 9th degree of north latitude. In August 1896, following the destruc- tion of the Ashanti power and the deportation of King Prempeh, as a result of the second Ashanti campaign, a British protectorate was declared over the whole of the Ashanti territories and a Besident was installed at Kumassi. But no northern limit had been fixed by the 1893 agreement beyond the 9th parallel, and the countries to the north — Gurunsi (Grusi), Mossi, and Gurma — were entered from all sides by rival British, French, and German expeditions. The conflicting claims established by these rival expeditions may, however, best be consid- ered in connexion with the struggle for supremacy on the Middle Niger, and in the Chad region, to which we must now turn.

A few days before the meeting of the Berlin Conference Sir George Goldie had succeeded in buying up all the French interests on the Lower Niger. The British company's influence had at that date ™" mimib been extended by treaties with the native chiefs ij^g oad. up the main Niger stream to its junction with the Benu4 and some distance along this latter river. But the great Fulah States of the Central Sudan were still outside European influence, and this fact did not escape attention in

Germany. German merchants had been settled for some years on the coast, and one of them, Herr Flegel, had displayed great interest in, and activity on, the river. He recognized that in the densely-populated States of the Middle Niger, Sokoto and Gando, and in Bornu to the west of Lake Chad, there was a magnificent field for Germany's new-born colonizing zeal. The German African Society and the German Colonial Society listened

eagerly to Herr Flegel's proposals, and in April 1886 he left Berlin on a mission to the Fulah states of Sokoto and Gando. But it was impossible to keep his intentions entirely secret, and the British National African Asso- ciation had no desire to see the French rivals, whom they had with so much difficulty dislodged from the river, replaced by the even more troublesome German. Accordingly Mr Joseph Thomson, the young Scottish explorer, was sent out to the Niger, and had the satisfac- tion of concluding on the 1st June 1885 a treaty with "Umoru, King of the Mussulmans of the Sudan and Sultan of Sokoto," which practically secured the whole of the trading rights and the control of the Sultan's foreign relations to the British company. Mr Thomson concluded a similar treaty with the Sultan of Gando, so as to provide against the possibility of its being alleged that Gando was an independent state and not subject to the suzerainty of the Sultan of Sokoto. As Mr Thomson descended the river with his treaties, he met Herr Flegel going up the river, with bundles of German flags and presents for the chiefs. The German Government recog- nized that they had been forestalled, and, except for the despairing attempt many years later to establish relations with Gando from Togoland, Germany dropped out of the competition for the Western Sudan and left the field to France and Great Britain. After this first great success the National African Company renewed its efforts to obtain a charter from the British Government, and on the 10th July 1886 the charter was granted, and the company became " The Koyal Niger Company, chartered and limited." In. June of the previous year a British protectorate had been prdelaimed over the whole of the coast from the Eio del Bey to the Lagos frontier, and on the 13th January 1886 the Lagos Settlements had been separated from the Gold Coast and erected into a separate colony. It may be convenient to state here that the eastern boundary of Lagos with French territory was determined in the Anglo-French agreement of 10th August

1889, which provided that "the line of demarcation between the spheres of influence of the two powers shall be identical with the meridian which intersects the terri- tory of Porto Novo at the Ajarra creek, leaving Pokrah, or Pokea, to the English colony of Lagos. It shall follow the above-mentioned meridian as far as the 9th degree of north latitude, where it shall stop." Thus both in the Gold Coast hinterland and in the Lagos hinterland a door was left wide open to the north of the 9th parallel.

Notwithstanding her strenuous efforts, France, in her advance down the Niger from Senegal, did not succeed in reaching Sego until the winter of 1890-91, and the rapid advance of British influence up the river raised serious fears lest the Eoyal Niger Company should reach Tim- buktu before France could forestall her. It was, no doubt, this consideration that induced the French Government to consent to the insertion in the agreement of 5th August

1890, by which Great Britain recognized France's pro- tectorate over Madagascar, of the following article : —

The Government of Her Britannic Majesty recognizes the sphere of influence of France to the south of her Mediterranean possessions up to a line from Say on the Niger to Barruwa on Lake Chad,

drawn in such a manner as to comprise in the Sphere of action of the Niger Company all that fairly belongs to the kingdom of Sokoto ; the line to be determined by the commissioners' to be appointed.

The commissioners never were in fact appointed, and the proper meaning to be attached to this article 'subse- quently became a subject of bitter controversy between the two countries. An examination of the map of West Africa will show what possibilities of trouble were left open at the end of 1890 by the various agreements con- cluded up to that date. From Say on the Niger to the northtem limit of the Lagos frontier there was no bound-

ary line between tHe French and British spheres of influ- ence. To the north of the Gold Coast and of the French Ivory Coast Colony the way was equally open to Great Britain and to France, while the vagueness of the Say- Barruwa line left an opening of which France was quick to avail herself. Captain Monteil started on his journey in 1890, immediately after the conclusion of the August agreement ; but he did not hesitate to pass well to the south of the Say-Barruwa line, and to attempt to conclude treaties with chiefs who were, beyond all question, within the British sphere. Still farther south, on the Benu^ river, the two expeditions of Lieutenant Mizon — in 1890 and in 1892 — ^failed to do any real harm to British interests.

In 1892 an event happened which had an important bearing on the future course of the dispute. After a troublesome war with Behanzin, kiug of the important native state of Dahomey, France annexed some portion of Dahomeyan territory on the coast, and declared a pro- tectorate over the rest of the kingdom. In 1894 Dahomey was divided into two kingdoms, and the new sovereigns , were appointed by France and accepted the French pro- tectorate. Thus was removed the barrier which had up to that time prevented France from pushing her way Nigerwards from her possessions on the Slave Coast, as well as from the Upper Niger and the Ivory Coast. Meanwhile her progress from both these directions had been considerable, and in particular Timbuktu had been occupied in the last days of 1893.

In 1894 it appears to have been suddenly realized in France that, for the development of the vast regions which she was placing under her protection in West Africa, it was extremely desirable that she should obtain free access to the navigable portions of the Niger. In the neighbour- hood of Bussa there is a long stretch of the river so im- peded by rapids that navigation is practically impossible, except in small boats and at considerable risk. Below these rapids France had no foothold on the river, both banks from Bussa to the sea being within the British sphere. In 1890 the Eoyal Niger Company had concluded a treaty with the Emir and chiefs of Bussa (or Borgu) ; but the French declared that the real paramount chief of Borgu was not the king of Bussa, but the king of Nikki, and three expeditions were despatched in hot haste to Nikki to take the king under French protection. Sir George Goldie, however, was not to be baffled. While maiutaining the validity of the earlier treaty with Bussa, he despatched Captain (now General) Lugard to Nikki, and Captain Lugard was successful in distancing all his French competitors by several days, reaching Nikki on the 5th November 1894, and concluding a treaty with the king and chiefs. The French expeditions, which were in great strength, did not 'hesitate on their arrival to compel the king to execute fresh treaties with France,, and with these in their possession they returned to Dahomey. Shortly afterwards a fresh act of aggression was committed. On 13th February 1895 a French officer, Commandant Tout^e, arrived on the right bank of the Niger opposite Bajibo and built a fort. His presence there was notified to the Eoyal Niger Company, who pro- tested to the British Government against this invasion of their territory. Lord Eosebery, who was then foreign minister, at once made inquiries in Paris, and received the assurance that Commandant Tout^e was "a private traveller." Eventually Commandant Toutee was ordered to withdraw, and the fort was occupied by the Eoyal Niger Company's troops. Cdmmandant Toutee subse- quently published the official instructions from the French Government

under which he had acted. It was thought that the recognition of the British claims, in- volved in the withdrawal of Commandant Toutee, had marked the final abandonment by France of the attempt

to establish herself on the navigable portions of the Niger below Bussa, but in 1897 the attempt was renewed- in the most determined manner. In February of that year a French force suddenly occupied Bussa, and this act was quickly followed by the occupation of Gomba and Ilo higher up the river. In November 1897 Nikki was occupied. The situation on the Mger had so obviously been outgrowing the capacity of a chartered company that for some time before these occurrences the assumption of responsibility for the whole of the Niger region by the Imperial authorities had been practically decided, on ; and early in 1898 Colonel Lugard was sent out to the Niger with a number of Imperial officers to raise a local force in preparation for the contemplated change. The advance of the French forces from the south and west was the signal for an advance of British troops from the Niger, from Lago^, and from the Gold Coast protectorate. The situation thus created was extremely serious. The Brit- ish and French flags were flying in close proximity, in some cases in the same village. Meanwhile the diploma- tists were busy in London and in Paris, and in the latter capital a commission sat for many months to adjust the conflicting claims. Fortunately, by the tact and forbear- ance of the officers on both sides, no local incident oc- curred to precipitate a collision, and on the 14th June 1898 a convention was signed by Sir Edward Monson and M. Hanotaux, which finally removed all causes of dispute as to the spheres of influence of the two countries in West Africa ; and, subject to the division of the small area in the hinterland of the Gold Coast and Togoland between Great Britain and Germany, which was effected in November 1899, completed the partition of this part -of the continent.

The settlement effected was in the nature of a compro- mise. France withdrew from Bussa, Gomba, and Ilo, the frontier line west of the Niger being drawn from Pn^^ ”’ ® **9** parallel to a point 10 miles, as the crow agreement flies, above Giri, the port of Ilo. France was “isis”’ thus shut out from the navigable portion of the Middle and Lower Niger ; but for purely com- mercial purposes Great Britain agreed to lease to France two small plots of land on the river — the one on the right bank between Leaba and the mouth of the Moshi river, the other at one of the mouths of the Niger. By accept- ing this line Great Britain abandoned Nikki and a great part of Borgu, as well as some part of Gando to France. East of the Niger the Say-Barruwa line was modified in favour of France. From the point indicated 10 mUes above Giri the boundary follows the Niger as far as the mouth of a dry water-course called the Dallul Mauri, which it follows till it cuts the circumference of a circle drawn from the centre of the town of Sokoto with a radius . of a hundred miles. The line then follows the northern arc of this circle till its point of intersection with the 14th parallel of north latitude, which it follows eastwards for a distance of 70 miles, then dips due south until it reaches the parallel of 13° 20′ north latitude, then runs eastwards along this parallel for a distance of 250 miles, then turns due north iintU it regains the 14th parallel, then runs eastwards again along that parallel as far as its iutersection with the meridian, passing 35′ east of the centre of the town of Kuka, and thence follows this meri- dian southwards until its intersection with the southern shore of Lake Chad, at which point, it will be remembered, the Anglo-German frontier reaches its northern limit. This line assigns to France parts of both Sokoto and Bornu. In the Gold Coast hinterland the French with- drew from Wa, and Great Britain abandoned all claim to Mossi, though the capital of the latter country, together with a further extensive area in the territory assigned to both countries, is declared to be equally free, so far as

trade and navigation are concerned, to the subjects and protected persons of both nationalities. The western boundary of the Gold Coast was prolonged along the Black Volta as far as latitude 11° north, and this parallel was followed with slight deflections to the Togoland frontier. In consequence of the acute crisis which shortly afterwards occurred between France and Great Britain on the Upper Nile, the ratification of this agreement was delayed until after the conclusion of the Fashoda agree- ment of March 1899 already referred to. In 1900 the two patches on the Niger leased to France were selected by commissioners representing the two countries, and in the same year the Anglo-French frontier from Lagos to the west bank of the Niger was delimited. But east of the Niger to Lake Chad it had not been found possible even to make a survey of the country through which the boundary will run, before the close of the 19th century.

The settlement of the matters in dispute with France enabled the British Government to carry out several changes in the administration of British Nigeria, which had been in contemplation for some time. On the 1st January 1900 the Imperial authorities took over the whole of the territories of the Eoyal Niger Company, which, with reduced capital, became henceforth a purely com- mercial undertaking. The Lagos protectorate was ex- tended to the northwards, the Niger Coast Protectorate became Southern Nigeria with extended frontiers, and the greater part of the territories formerly administered by the company were constituted into Northern Nigeria — all three administrations being placed under the Colonial Office. In like manner France, having definitely fixed her international frontiers, turned her attention to a rearrangement of her possessions. The French Sudan was abolished as an administrative entity, large slices of territory were added on to Dahomey, the Ivory Coast Colony, French Guinea, and Senegal, the portions not assigned to these colonics, all of which were placed under civil administration, being created military districts. For the limits assigned to the various French colonies in West Africa, reference must be made to the articles deal- ing with ea«h.

There are, around the coast, numerous islands or groups of islands, which are regarded by geographers as outliers of the African mainland. The majority of these African islands were occupied by one or other of f^^^, the European Powers long before the period of continental partition. The Madeira Islands to the west of Morocco ; the Bissagos Islands, off the Guinea Coast ; and Prince’s Island and St Thomas’ Island, in the Gulf of Guinea, are Portuguese possessions of old standing ; while in the Canary Islands and Fernando Po Spain possesses remnants of her ancient colonial empire which are a more valuable asset than any she has acquired in recent times on the mainland. St Helena in the Atlantic, Mauritius, and some small groups north of Madagascar in the Indian Ocean, are British possessions acquired long prior to the opening of the last quarter of the 19th century. Zanzibar, Pemba, and some smaller islands which the Sultan was allowed to retain were, as has already been stated, placed under British protection in 1890, and the island of Soco- tra was placed under the ” gracious favour and protec- tion” of Great Britain on 23rd April 1886. France’s ownership of E^union dates back to the 17th century, but the Comoro Archipelago was not placed under French protection until April 1886. None of these islands, with the exception of the Zanzibar group, have, however, materially affected the partition of the continent, and they need not be enumerated in the table which follows. But the important island of Madagascar stands in a different category, both on account of its size and because it was

during the period under revie-w that it passed through the various stages which led up to its becoming a French colony. The first step was the placing of the foreign relations of the island under French control, -which was effected by the treaty of 17th December 1885, following the Franco-Malagasy war that had broken out in 1883. In 1890 Great Britain and Germany recognized a French protectorate over the island, but the Hova government declined to acquiesce in this view, and in May 1895 France sent an expedition to enforce her claims. The capital was occupied on 1st October in the same year, when Queen Kana valona signed a convention recognizing the French protec- torate. In January 1896 the island was declared a French possession, and on 6th August was declared to be a French colony. In February 1897 the last vestige of ancient rule was swept away by the deportation of the queen.

Although the ” Brussels Act ” of 1890 did not affect the actual territorial partition of Africa, it had a direct bear- jjg ing on the manner in which the Powers dis-

Brusseis charged the obligations which they assumed in f^’ acquiring African territory, and must therefore be briefly referred to here. The British Gov- ernment had for long borne the greater part of the burden of combating the slave trade on the east coast of Africa and in the Indian Ocean, but the changed conditions which resulted from the appearance of other European Powers in Africa induced Lord Salisbury, then foreign secretary, to address, in the autumn of 1888, an invitation to the King of the Belgians to take the initiative in invit- ing a conference of the Powers at Brussels to concert measures for ” the gradual suppression of the slave trade on the continent of Africa, and the immediate closing of all the external markets which it still supplies.” The conference assembled in November 1889, and on the 2nd July 1890 a ” General Act ” was signed subject to the ratification of the various Governments represented, rati- fication taking place subsequently at different dates, and in the case of France with certain reservations. The General Act began with a declaration of the means which the Powers were of opinion might be most effectually adopted for ” putting an end to the crimes and devasta- tions engendered by the traffic in African slaves, protect- ing effectively the aboriginal populations of Africa, and ensuring for that vast continent the benefits of peace and civilization.” It proceeded to lay down certain rules and regulations of a practical character on the lines sug- gested. The Act covers a wide field, and includes no less than a hundred separate articles. It established a zone “between the 20th parallel of north latitude and the 22nd parallel of south latitude, and extending westward to the Atlantic Ocean and eastward to. the Indian Ocean and its dependencies, comprising the islands adjacent to the coast as far as 100 nautical miles from the shore,” within which the importation of firearms and ammuni- tion was forbidden except in certain specified cases, and within which also the Powers undertook either to prohibit altogether the^mportation and manufacture of spirituous liquors, or to impose duties not below an agreed-on mini- mum. An elaborate series of rules were framed for the prevention of the transit of slaves by sea, the conditions on which European Powers were to grant to natives the right to fly the flag of the protecting power, and regulat- ing the procedure connected with the right of search on vessels flying a foreign flag. The Brussels Act was in effect a joint declaration by the signatory Powers of their joint and several responsibility towards the African native, and notwithstanding the fact that many of its articles have proved difficult, if not impossible, of enforcement, the solemn engagement taken by Europe in the face of the world has undoubtedly exercised a material influence on the action of several of the Powers.

Thus by the close of the 19th century the political partition of Africa had practically been completed. There remained still for settlement various questions j.^^ of f rontiSt, as between Great Britain, Egypt, and posi- Abyssinia in North-East Africa, and between tioma France and Morocco in the north-western corner ”’^’ of the continent. The limits of Barotseland to the west had to be determined by Great Britain and Portugal, and much delimitation work had still to be done. But in its broad outlines the partition of Africa was begun and ended iu the short space of a quarter of a century.

Much labour is necessary before the actual area of the continent and its subdivisions can be accurately deter- mined, but in the following table the figures are at least approximately correct, and may be taken to represent the political situation in Africa, from the European stand- point, at the opening of the 20th century. It is perhaps well to add that in fact large areas of the spheres as- signed to different European Powers are still under native rulers who have in no way admitted the title of their European overlords.

Position in 1900.

Square Miles. British —

Cape Colony 277,151

Natal and Zululand 29,434

Basutoland 10,293

Bechuanaland 386,200

Transvaal Colony 119,139

Orange River Colony 48,326

Ehodesia 600,000

British Central Africa Protectorate 42,217

British East Africa and Uganda 1 ˜ „„„

Protectorates (including Nile basin to 10° N.) / ” * o’”-”””

Somaliland 68,000

Northern Nigeria 310,000

Southern Nigeria . . . .^ . . . 21,500^

Lagos and Yoruha 20,500^

Gold Coast (and hinterland) 74,500

Sierra Leone 33,100

Gambia .3,550

Total British Africa . . . 2,713,910

Pkench —

Algeria Proper 184,474

Algerian Sahara 123,500

Tunis 51,000

Senegal 182,000

Guinea 92,000

Ivory Coast 119,500

Dahomey 59,000

Sudan Military Districts 183,000

Congo and Gabun 550,000

Bagirmi, Wadai, Kanem 126,000

Sahara, including Tibesti 1,892,000

Somaliland . . ‘ 14,000

Madagascar 228,500

Total French Africa . . . 3,804,974

German —

East Africa 385,000

South- West Africa 322,450

Cameroon 191,130

Togoland 34,800

Total German Africa . . 933,380

Italian —

Eritrea 88,500

Somaliland 100,000

Total Italian Africa . . . 188,500

POBTUGUBSB —

Guinea 4,394

Angola 484,730

East Africa . . – 301,000

Total Portuguese Africa . . 790,124

Spanish — Rio de Oro Muni River

Total Spanish Africa .

Turkish — QTripoli and Benghazi

Egyptian —

Egypt Proper . Anglo-Egyptian Sudan

Total Egyptian Africa

Sbpabate States — Congo Free State Liberia Morocco . Abyssinia .

Total Independent Africa .

167,400 1,750

169,150

398,900

400,000 610,000

1,010,000

900,000

52,000

219,000

320,000

1,491,000

Thus, collecting the totals, we see that at the present day (1901) Africa is portioned out among the Powers as follows : —

V Square Miles.

British Africa 2,713,910

French Africa (including Madagascar) . . . 3,804,974

German Africa 933,380

Italian Africa 188,500

Carried forward 7,640,764

Brought forward 7,640,764

Portuguese Africa 790,124

Spanish Africa 169,160

Turkish Africa 398,900

Egyptian Africa 1,010,000

Independent Africa 1,491,000

Total Africa (including Madagascar) . 11,499,938

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(j. S. K.)

Africa, South. See South Afbica.

Africa, Central. See Gentbal Afbica.

Africa, East. See East Afbica.

Aga Khan I., His Highness the (1800-1881), was the title accorded by general consent to Hasan Ali Shah (born in Persia, 1800), “wben, in early life, be first settled in Bombay under the protection of the British. Govern- ment. He was believed to have descended ia direct line from Ali by his wife Fatima, the daughter of the Prophet Mahommed. Ali’s son, Hooseia, having married a daugh- ter of one of the rulers of Persia before the time of Mahommed, the Aga Khan traced his descent from the royal house of Persia from the most remote, almost prehistoric, times. His ancestors had also ruled ia Egypt as Khalifs of the Beni-Fatamites for a number of years at a period coeval with the Crizsades. Before the Aga Khan emigrated from Persia he was appointed by the Emperor Fateh Ali Shah to be governor-general of the extensive and important province of Kerman. His rule was noted for firmness, moderation, and high political sagapity, and he succeeded for a long time in retainiag the friendship and confidence of his master the Shah, although his career was beset with political intrigues and jealousy on the part of rival and court favourites and with internal turbulence. At last, however, the fate usual to statesmen ia oriental countries overtook him, and he incurred the mortal displeasure of Fateh Ali Shah. He flew from Persia and sought protection ia British territory, preferring to settle down eventually in India, makiag Bombay his headquarters. At that period the first Afghan War was at its height, and in crossiag over from Persia through Afghanistan the Aga Khan found opportunities of rendering valuable services to the British army, and thus cast in his lot for ever with the British. A few years later harendered similar conspicuous services ia the course of the Scinde campaign, when his help was utilized by Napier ia the process of subduing the frontier tribes, a large number of whom acknowledged the Aga’s authority as their spiritual head. Napier held his Moslem ally in great esteem, and entertained a very

high opinion of his political acumen and chivalry as a. leader and soldier. The Aga Khan reciprocated the distiaguished British commander’s confidence and friend- ship by giving repeated proofs of his devotion and attach- ment to the British Goverament, and when he finally settled down in India, his position as the leader of the large Ismailiah section of Mahommedan British subjects was recognized by the Government, and the title of His Highness was conferred on him, with a large pension. From that time until his death in 1881, the Aga Khan, while leading the life of a peaceful and peacemaking citizen, under the protection of British rule, continued to discharge his sacerdotal functions, not only among his followers in India, but towards the more numerous com- munities which acknowledged his religious sway in distant countries such as Afghanistan, Khorassan, Persia, Arabia, Central Asia,

and even distant Syria and Morocco. He remained throughout unfiinchingly loyal to the British Maj, and by his vast and unquestioned influence among the frontier tribes on the northern borders of India he exercised a control over their unruly and wild passions in times of trouble, which proved of invaluable service in the several expeditions led by British arms on the north-west frontier of India. He was also the means of checking the fanaticism of the more turbulent Mahommedans in British India, which in times of internal troubles and misunderstandings finds vent in the shape of religious or political riots.

He was succeeded by his eldest son, Aga Khan II. This prince continued the traditions and work of his father in a manner that won the approbation of the local Government, and earned for him the distinction of a knighthood of the order of the Indian Empire, and a seat in the Legislative Council of Bombay.

Aga Khan III. (Sultan Mahommed Shah), only son of the foregoing, succeeded him on his death in 1885, and is the present head of the family and its devotees. He was bom in 1877, and, under the fostering care of his mother, a daughter of the ruling house of Persia, has been given not only that religious and oriental education which his position as the religious leader of the Ismailiahs made indispensable, but a sound European training, a boon denied to his father

and grandfather. This blending of the two systems of education has produced the happy result of fitting this Moslem chief in an eminent degree both for the sacerdotal functions which appertain to his spiritual position, and for those social duties of a great and enlightened leader which he is called upon to discharge by virtue of that position. He has travelled in distant parts of the world to receive the homage of his followers, and with the object either of settling differences or of advancing their welfare by pecuniary help and personal advice and guidance. The distinction of a Knight Commander of the Indian Empire was conferred upon him by Queen Victoria in 1897, a,nd he has received like recognition for his public services from the German Emperor, the Sultan of Turkey, the Shah of Persia, and other potentates.

(m. m. Bh.)

Agades. See Sahaba.

Agassiz, Alexander (Emanuel) (1835-

-),

Am.erican scientist, son of Louis Agassiz, was born in Neuchatel, Switzerland, 17th December 1835. He came to the United States with his father ‘in 1846; graduated at Harvard in 1855, subsequently studying engineering and chemistry, and taking the degree of bachelor of science at the Lawrence Scientific School of the same institution in 1857 ; taught for a time in his father’s school for girls in Cambridge; and in 1859 entered upon his scientific career by becoming an assistant in the United States Coast Survey. Thenceforward he became a specialist in marine ichthyology, but devoted much time to the investigation, superintendence, and exploitation of mines, being superintendent of the Calumet and Hecla copper mines. Lake Superior (the richest in the world) from 1866 to 1869, and afterwards, as a stockholder, acquiring a fortune, out of which he gave to Harvard, for the Museum of Comparative Zoology and other purposes, some $500,000. In 1875 he surveyed Lake Titicaca, Peru ; examined the copper mines of Peru and Chile; and made a collection of Peruvian antiqui- ties for the

museum, in which he had been an assistant, under his father, from time to time, and of which he was curator 1874-85, when he resigned. He assisted Sir Wy- ville Thomson in the examination and classification of the collections of the Chcdlenger exploring expedition,, and wrote the Review of the Echini (2 vols., 1872-T4) in the reports. Between 1877 and 1880 he took part^n the three dredging expeditions of the steamer Blake, of the United States Coast Survey, and presented a full account of them in two volumes (1888). Of his other writings on marine zoology most are contained in the bulletins and memoirs of the Museum of Comparative Zoology ; but he published in 1865 (with Elizabeth Cary Agassiz, his father's wife) Seaside Studies in Natural History, a work at once exact and stimulating, and in 1871 a volume on the Marine Animals of Massachusetts Bay.

Agen, chief town of department Lot-et-Garonne, Prance, 380 miles S.S.W. of Paris, on railway from Bor- deaux to Cette. The Garonne is here crossed by a sus- pension and two stone bridges ; one of the latter, a fine structure of twenty-three arches, carries the lateral canal. Amongst thepublie buildings are thecathedral of St Caprais (who introduced Christianity in the 3rd century), parts of which date from the 12th and 13th centuries, and the an- cient church of the Jacobins. The industries include the manufacture of drugs and pottery, and there are phosphate and dye works. Agen is noted for fine prunes, in which, as well also in other fruits, it carries on considerable trade. It was the bii-thplace of Joseph Scaliger the philologist, the naturalist Lacepfede, and the poet Jacques Bod, better

known as Jasmin. Population (1881), 17,098; (1C91),

18,463; (1896), 18,389.

Aggregation, States of. See Col^densatioit OP Gases.

Agira, formerly San Eilippo d'Abgie6, a town of the province of Catania, Sicily, Italy, 9 miles S.E. from Nicosia, standing 2133 ft. above sea-level, with sulphur mines and fiour-mills. It is the ancient Argyrium, one of the oldest of the Sikelian towns, and was colonized by Timoleon, the liberator of Syracuse, in 339 b.c. It was the birthplace of the historian Biodorus Siculus (1st cent. B.C.). Population

13,498 (1881) ; 17,749 (1901).

Agnew, David Hayes (1818-1892), American surgeon, was born in Lancaster county, Pennsylvania, on 24th November 1818. He graduated from the medical department of the University of Pennsylvania in 1838, and a few years later set up in practice at Philadelphia and be- came a lecturer at the Philadelphia School of Anatomy. He was appointed surgeon at the Philadelphia Hospital in 1854, and was the founder of its pathological museum. Por twenty-six years (1863-89) he was connected with the medi- cal faculty of the University of Pennsylvania, being elected professor of operative surgery in 1870 and professor of the principles q,nd practice of surgery in the following year. From 1865 to 1884 — except for a brief interval — he was a surgeon at the Pennsylvania Hospital. During the American Civil War he was consulting surgeon in the Mower Army Hospital, near Philadelphia, and acquired considerable reputation for his operations in cases of gun- shot wounds. He attended| as operating surgeon when President Garfield was fatally wounded by the bullet of an assassin in 1881. He was the author of several works, the most important one being a three-volume. The. Principles and Practice of Surgery. He died at Philadelphia on 22nd March 1892.

Agnosticism. — The term "agnostic" was in- vented by Huxley in 1869 to describe the philosophical and religious attitude of those who hold that we can have scientific or real knowledge of phenomena only, and that so far as what may lie behind phenomena is con- cerned— God, immortality, &c. — ^there is no evidence which entitles us either to deny or affirm anything. The attitude itself is as old

as Scepticism (g'.'w.) ; but the expressions " agnostic " and " agnosticism " were applied by Huxley to sum up his deductions from those contemporary develop- ments of metaphysics with which the names of Hamilton (" the Unconditioned ") and Herbert Spencer (" the Un- knowable ") were associated ; and it is important, there- fore, to fix precisely his own intellectual standpoint in the matter. Though Huxley only began to use the term " agnostic " in 1869, his opinions had taken shape some time before that date. In a letter to Charles Kingsley (23rd September 1860) he wrote very fully concerning his beliefs : —

I neither affirm nor deny the immortality of man. I see no reason lor believing it, but, on the other hand, I have no means of disproving it. I have no a priori objections to the doctrine. No man who has to deal daily and hourly with nature can trouble himself about a priori difficulties. Give me such evidence as would justify me in believing in anything else, and I will believe that. Why should I not? It is not half so wonderful as the conservation of force or the indestructibility of matter. . . .

It is no use to talk to me of analogies and probabilities. I know what I mean when I say I believe in the law of the inverse squares, and I will not rest my life and my hopes upon weaker convictions. ...

That my personality is the surest thing I know may be true. But the attempt to conceive what it is leads me into mere verbal subtleties. I have champed up all that chaff about the ego and the non-ego, noumena and phenmnena, and all the rest of it, too often not to know that in attempting even to think of these

questions, the human intellect flounders at once out of its depth.

And again, to tlie same correspondent, Sth May 1863:—

I have never had the least sympathy with the a priori reasons against orthodoxy, and I have by nature and disposition the greatest possible antipathy to all the atheistic and infidel school. Nevertheless I know that I am, in spite of myself, exactly what the Christian would call, and, so far as I can see, is justified in calling, atheist and infidel. I cannot see one shadow or tittle of evidence that the great unknown underlying the phenomenon of the universe stands to us in the relation of a" Father — loves us and cares for us as Christianity asserts. So with regard to the other great Christian dogmas, immortality of soul and future state of rewards and punishments, what possible objection can I — who am compelled perforce to believe in the immortality of what we call Matter and Force, and in a very unmistakable present state of reward^ and punishments for our deeds — ^have to these doctrines ? Give me a scintilla of evidence, and I am ready to jump at them.

Of the origin of the name " agnostic " to cover this atti- tude, Huxley gave (CoU. Ess. v. pp. 237-239) the follow- ing account : —

When I reached intellectual maturity, and began to ask myself whether I was an atheist, a theist, or a pantheist, a materialist or an idealist, a Christian or a freethinker, I found that the more I learned and reflected, the less ready was the answer. The one thing on which most of these good people were agreed was the one tUng in which I differed from them. They were quite sure they had attained a certain " gnosis" — had more or less successfully solved the problem of existence ; while I was quite sure that I had not, and had a pretty strong conviction that the problem was insoluble. This was my situation when I had the good fortune to find a place among the members of that remark- able confraternity of antagonists, the Metaphysical Society. Every variety of philosophical and theological

opinion was represented there ; most of my colleagues were -ists of one sort or another ; and I, the man without a rag of a belief to cover himself with, could not fail to have some of the uneasy feelings which must have beset the historical fox when, after leaving the trap in which his tail remained, he presented himself to his. normally elongated companions. So I took thought, and invented what I conceived to be the appropriate title of ” agnostic.” It came into my head as suggestively antithetic to the “gnostic” of Church history, who professed to know so much about the very things of which I was ignorant. To my great satisfaction the term took.

This account is confirmed by E. H. Hutton, who in 1881 wrote that the word ” was suggested by Huxley at a meeting held previous to the formation bf the now defunct Metaphysical Society at Mr Knowles’s house on Clapham Common in 1869, in my hearing. He took it from St Paul’s mention of the altar to the Unknown God.” Hutton here gives a variant etymology for the word, which may be therefore taken as partly derived from ayroMTTos (the “unknown” God), and partly from an antithesis to Gnostic ; but the meaning remains the same in either case. The name, as Huxley said, ” took ” ; it was constantly used by Hutton in the Spectator, and became a fashionable label for contemporary unbelief in Christian dogma, particxdarly during the ‘seventies and ‘eighties. Hutton himself frequently misrepresented the doctrine by describing it as ” belief in an unknown and unknowable God ” ; but agnosticism as defined by Huxley meant not belief, but absence of belief, as much distinct from belief on the one hand as from disbelief on the other; it was the half-way house between the two, where all questions were ” open.” All that Huxley asked for was evidence, either for or against ; but this he be- lieved it impossible to get. Occasionally he too mis-stated the meaning of the word he had invented, and described agnosticism as meaning “that a man shall not say he knows or believes what he has no scientific ground for pro- fessing to know^or believe.” But as the late Rev. A. W. Momerie remarked, this would merely be ” a definition of honesty; in that sense we ought all to be agnostics.” Agnosticism really stands or falls by the doctrine of the Unknowable,the assertion that concerning certain objects—

among them the Deity — we never can have any ” scientific ” ground for belief. In the ‘seventies and ‘eighties this way of solving, or rather passing over, the ultimate problems of thought had many followers in cultured circles imbued with the new science of the day, and with disgust for the dogmatic creeds of contemporary orthodoxy ; and its out- spoken and even aggressive vindication by physicists of the eminence of Huxley had a potent influence upon the attitude taken towards metaphysics, and upon the form which subsequent Christian apologetic adopted. As a nickname the term agnostic was soon misused to cover any and every variation of scepticism, and just as popular preachers confused it with atheism in their denunciations, so the callow, freethinker — following Tennyson’s path of “honest doubt” — classed himself with the agnostics, even while he combined an instinctively Christian theism with a facile rejection of the historical evidences for Christianity.

Huxley’s agnosticism was a natural consequence of the intellectual and philosophical conditions of the ‘sixties, when clerical intolerance was trying to excommunicate scientific discovery because it appeared to clash with the book of Genesis. But as the theory of evolution did its work, anew spirit was gradually introduced into Christian theology, which has turned the controversies between religion and science into other channels, and taken ipost of the wind out of the” sails of agnosticism. A-similar effect has been produced by the philosophical reaction against Herbert Spencer, and by the perception that the canons of evidence required in physical science must not be exalted ‘ into universal rules of thought. It does not follow that justification by faith must be eliminated in spiritual matters, where sight cannot follow, because the physi- cist’s duty and success lie in pinning belief solely on verification by physical phenomena, when they alone are in question ; and for mankind generally, though possibly not for an exceptional man like Huxley, an impotent suspension of judgment on such issues as a future life or the Being of God is both unsatisfying and demoralizing.

It is impossible here to do more than indicate the path out of the difi&culties raised by Huxley in the letter to Kingsley quoted above. They involve an elaborate discussion, not only of Christian evidences, but of the entire subject-matter alike of Ethics and Metaphysics, of Philosophy as a whole, and of the philosophies of in- dividual writers who have dealt in their different ways with the problems of existence and epistemology. It is, however, permissible to point out that, as has been ex- haustively argued by Professor J. Ward in his Gifford lectures for 1896-98 (Naturalism, and Agnosticism, pub- lished by A. & C. Black, 1899, London), Huxley's challenge (" I know what I mean when I say I believe in the law of the inverse squares, and I will not rest my life and my hopes upon weaker convictions ") is one which a spiritualistic philosophy need not shrink from accepting at the hands of naturalistic agnosticism. If, as Huxley admits, even putting it with unnecessary force against himself, " the immortality of man is not half so wonderful as the conservation of force or the indestructibility of matter," the question then is, how far a critical analysis of our belief in the last-named doctrines will leave us in a position to regard them as the last stage in systematic thinking. It is the pitfall of physical science, immersed as its students are apt to be in problems dealing with tangible facts in the world of experience, that there is a tendency among them to claim a superior status of objective reality and finality for the laws to which their data are found to conform. But these generalizations are not ultimate truths, when we haye to consider the nature of experience itself. "Because reference to the Deity will not serve for a physical explanation in physics, or a

chemical explanation in chemistry, it does not therefore follow," as Professor Ward says (op. cit. vol. i. p. 24), " that the sum total of scientific knowledge is equally in- telligible whether we accept the theistic hypothesis or not. It is true that every item of scientific knowledge is concerned with some definite relation of definite phe- nomena, and with nothing else; but, for all that, the systematic organization of such items may quite well yield further knowledge, which transcends the special relations of definite phenomena." At the opening of the era of modern scientific discovery, with aU its fruitful new generalizations, the still more highly generalized laws of epistemology and of the spiritual constitution of man might well baffle the physicist and lead his iutellect to "flounder"; but Logic too is capable of advancing, and with a superior Logic the new premisses supplied by the revelations of science are not inconclusive to those who patiently follow truth.

Agony. See Dahomey.

Agordat. See Ebi^bea.

Agosta. See Augusta.

Agra, a city of British India, in the North-west Provinces, which also gives its name to a district and a division. The city, on the right bank of the Jumna, 841 miles from Calcutta, is now an important railway centre, whence two main liues diverge southwards towards Bom- bay. In 1872 the population was 149,008; in 1881 it was 160,203 ; in 1891 it was 168,662 ; in 1901 it was 188,300, showing an increase of 12 per cent. The death- rate in 1897 was 62 per thousand. It has 2 cotton mills, with 24,460 spindles, employing 1200 hands ; 7 factories for ginning and pressing cotton ; a tannery and boot fac- tory; flour mUl; 48 printing presses. In 1896-97 the government college had 194 students. There are also two missionary colleges. The native town is well laid out and handsomely built. Only a small garrison is now kept in the cantonment. The municipality consists of 34 members, of whom 24 are elected, with the magistrate as ex officio chairman. The water-works provide a daily

consumption of 1,338,000 gallons, being 8 gallons per head in the town, and 11^ gallons in the cantonment. The municipal income in 1896-97 amounted to Es.

3,82,388.

The district of Agea is traversed by several lines of railway, and part of it is irrigated by the Agra Canal. Land revenue and rates (1896-97) amounted to Es.l9,- 74,298, the incidence of assessment being R.l : 12 per acre ; the cultivated area was 683,111 acres, of which 313,728 were irrigated from wells, &c. ; the number of police was 3763; of vernacular schools, 153, with 6265 pupils; the registered death-rate in 1897 was 56 per thousand. The principal crops are millets, pulses, bar- ley, wheat, ccftton, and a little indigo. Area, 1845 square miles; population (1891), 1,003,796, being 544 persons per square mile ; (1901), 1,060,646, showing an increase of 6 per cent.

The division of Agba has an area of 10,139 square miles. In 1891 the population was 4,767,759, being 470 persons per square mile. In 1901 the population was 6,248,121, showing an increase of 10 per cent., attributed to the extension of irrigation from canals. It comprises the six districts of Muttra, Agra, Farukhabad, Mainpuri, Etawah, and Etah.

Agram (Slavonic, Zagrab; Croatian, Zagreb), a mu- nicipal town of Hungary, the capital of the provinces of Croatia and Slavonia. Population (1890), 38,742 ; (1900), 57,930. It is the seat of an archbishop and a imiversity. The inhabitants carry on a brisk commerce and industry.

its more considerable establishments being a tobacco manufactory, the works of the Hungarian state railways, a leather manufactory, a manufactory of war articles and one of carpets, &c. The new streets, especially in the lower town, are very flne, with numerous large mansions and excellent statues. The scientific and financial insti- tutions are rapidly acquiring a recognized status.

Agricultural Machinery.— Since 1875 there has been a marked advance in agricultural machines — not so miich in the invention of machines wholly unknown prior to that time, but rather in the constant improve- ment of those which then existed. So gradual, however, has been the change that it is hardly possible, except in the case of the Self-binding Harvester, to point to any single invention as showing a great departure from the general lines of development, though the final results are very apparent when the simple, strong, and effective ma- chines of to-day are compared with those of a quarter of a century ago. Under these circumstances it seems un- desirable to treat the subject historically, and we shall therefore illustrate and describe one or more types of the latest machines in each important class, leaving the reader to judge for himself the extent of the advance since the article in the ninth edition of this work (vol. i. p. 311) was written.

American implement makers have gone far ahead of Europe or the United Kingdom, and the following article is accordingly written from an American standpoint, and does not repjesent the actual conditions in operation in more conservative countries (see, however, p. 208 below). The several classes of machines wiU be treated by de- scribing them in the order in which they are used in carrying on the operations performed : 1st, ploughing ; 2nd, the preparation of the seed-bed; 3rd, seeding or planting ; 4th, cultivating ; 6th, harvesting.

Ploughs.

Where the amount of work to be done is small, and the character of the farm does not permit the use of the rid- ing plough, the old, familiar walking plough is still in use; but it has several serious defects. Owing to the fact that the friction between the earth and the plough is entirely a sliding friction, the character of material employed in constructing the plough, and the finish im- parted to it,

and also the form given to the parts, have a very important effect in determining the force required to carry on the operation ; and it is in respect of these features that most of the improvements in this style of implement have been made. Instead of cast iron, left in the rough state as it comes from the mould, the mould- boaxd is now made of steel, well tempered and highly polished, the result of which is to improve its scouring qualities, and greatly reduce the draft necessary to oper- ate it. The use of this form of plough calls for consider- able skill and strength in holding it to its work, and the attention of the inventor has been naturally turned to the production of a machine in which these objections are obviated ; and on the larger farms, and where the char- acter of the surface permits it, the sulky or riding plough is now generally used ^ (see Pig. 1).

In this form of plough the frame is mounted on three wheels, one of which runs on the land, and the other two in the furrow. The furrow wheels are placed on inclined axles, the plough beam being carried on swinging links, operated by a hand lever when it is necessary to raise the plough out of the furrow. The land wheel and the f or-

1 Sulky machines for tilling the soil are not used in the United Kingdom. The driver is not seated, In the case of ploughs, harrows, cultivators, rollers, etc. ; but mowing machines, hay makers, har- vesters, &o., have a seat for the driver, as in the United States.

ward furrow wheel are adjustable vertically with reference to the frame, for the purpose of controlling the action of the plough. The team is hitched to a clevis at the end of the plough beam, and the machine is guided by a pole secured to an arm on the upper end of the spindle of the forward furrow wheel ; and, by means of a connexion between this arm and a controlling arm on the spindle of the rear wheel, the latter is controlled in turning by the former.

The sulky plough has important advantages over the walking plough from the fact that the weight and down- ward pull due to its action on the ground are taken by

Fia. 1. — Sulky plough.

the wheels, and the friction, being thus converted from sliding into rolling friction, is much less, and the draft is correspondingly diminished. It is also easily guided, and the depth of the furrow is readily controlled by the levers, which are assisted in their action by springs, thus greatly lightening the labour. The walking plough also possessed a serious defect on account of the downward pressure on the bottom of the furrow, which not only added to the friction, bpt had the effect of forming a hard and smooth bottom, which served to turn water, causing it to run along the bed thus formed and wash away the fertile soil. This was remedied to some extent by the sulky plough, as the bottom pressure was taken up by the wheels ; but a form of plough intended to overcome this defect is being introduced into extensive use.

This plough is built both as a riding and a walking plough, and is shown in Mg. 2. The essential feature is the substitution of a concavo-convex disk, pivoted on the plough beam, for the mould- board and share of the ordinary plough. This disk is carried on an axle inclined to the line of draft, and also to a vertical plane. As the machine is drawn forward the disk turns on its axis and cuts deeply into the ground, and, by reason of its inclination, crowds the earth outwards and thus turns a furrow. A scraper is provided to keep the disk clean and prevent sticking, and a small plough in the rear squares the comer of the furrow. The controlling levers and draft arrangements are similar to

those already described in connexion with the sulky plough. The advantage of this plough over the ordinary form is in the absence of sliding friction, and in the mellow and porous condition in which it leaves the bottom of the furrow.

Variations in soil and in the character of the surface of farming lands have led to various modifications of the pl6ugh to suit it to these different conditions. In cases where the soil is hard and clayey, it is desirable to plough

deeper than usual, and for this purpose a subsoiling plough is used, which does not turn a furrow, but digs deeply into the ground and thoroughly stirs it.

Fio. 2.— Disk plough.

Where a hillside is to be worked, a swivel plough (Fig. 3) is used. In this machine the mould-board is symmetrical about a line drawn from its point to the middle of its rear end, and is pivoted at its front and

Fio. 8.— Swivel plough.

i

rear to the landside, so that it can be swung underneath from one side to the other, and thus changed from right to left hand, in order that the furrow may be always turned down hill.

Preparation of the Seed-Bed.

The ground having been ploughed, it becomes necessary to pulverize it and break up the clods to furnish a good seed-bed, and for this purpose the harrow is used.

Harrows. — The oldest and simplest form of harrow consisted of a frame of wood, having on its under side a number of teeth, which, as the implement was drawn over the ploughed field, combed or raked the surface until it was substantially level. The first step iu improviug this harrow consisted in building the frame of steel bars and forming them in two or more sections secured to a common draft bar by flexible connexions, thus enabling the harrow to accommodate itself more exactly to the inequalities of the ground, and to secure a more perfect result. A harrow of this type is shown ta Fig. 4.

In this machine the teeth are secured to bars pivoted at their ends in the side bars of the frame, and provided with crank arms connected to a common link bar, which may be moved horizontally by means of a lever for the purpose of

adjusting the angle which the teeth make with the ground, smoothing harrow. The small figure illustrates a spring and thus convert the machine from a pulverizer to a connexion between the adjusting lever and its locking

Fio. 4.— Harrow.

barj which allows the teeth to yield upon striking an obstruction.

The course of improvement of the harrow has been much the same as in the plough, i.e., in so constructing it that the operator may ride and control its movements with ease from his seat on the machine.

Fig. 6. — Spring-tooth harrow.

rig. 5 illustrates a spring-tooth harrow arranged for riding. In this harrow the independent frames are carried upon wheels, and a^seat for the operator is mounted upon standards supported by the two frames. The teeth consist of flat steel springs of scroll form, which

Showing tooth mechanism of harrow.

before described. The levers enable the operator to raise the teeth more or less, and thus free them from trash, and also regulate the depth of action.

The next improvement of the harrow is illustrated in Fig. 6.

Fio. 6.— Disk harrow.

yield to rigid qbstructions, and are mounted on rock shafts in the same manner as in the walking harrow

Fie. 7. — Eoller pulverizer.

This machine consists of a main frame, having a pole and whifB.e-trees attached, and to this frame are pivoted, near their outer ends, two supplemental frames, each of which has mounted therein a shaft carrying a series of concavo-convex disks. The supplemental frames may be swung by the adjusting levers to any angle with relation to the line of draft, and the disks then act like that of the disk plough, throwing the soil outward with more or less force, ac- cording to the angle at which they are set, and thus thoroughly breaking up and pulverizing the clods. Above the disks is a bar to which are pivoted a series of scrapers, one for each disk, which are held to their work with a yielding action, being thrown out of operation when desired by the levers shown ia connexion with the operating bar. The pans on the main frame are used to carry weights to hold the disks down to their work.

For the purpose ■ of more thoroughly pulverizing the soil, a roller is frequently used, and an improved form of this im- plement is shown in Fig. 7.

It consists of a set of skeleton rollers car- ried on a shaft, and revolving freely in such a manner that the longitudinal bars break up all lumps as the roller passes over them.

One of the hardest and most disagreeable tasks of the farmer is the hauling and distribution of manure and fertilizers; and for the purpose of lightening his labours in this respect a machine has been produced (see Fig. 8).

It consists of a waggon, the bottom of which, is formed by a travelling bed or apron driven by suitable connexions

Fio. 8.— Fertilizer distributor.

with the wheels of the waggon. At the rear is moimted a revolvyig spiked drum or cylinder, which tears up and distributes the fertilizer as it is fed by the apron.

Seeders and Planters.

The soil having been prepared, the next step is to sow the seed, and this is done either by broadcasting, drilling, or planting in hills.

I’m. 9. — Broadcast seeder.

^he broadcast seeder (see Fig. 9) consists of a wheeled fraine carrying transversely thereto a seed-box having a number of seed-cups in its bottom into which the seed f aHs, and extending through these cups is a shaft carrying feed-wheels, one for each seed-cup. These feed-wheels are similar to a common spur gear, and serve to feed the seed regularly and deposit it in the downwardly extending tubes, where it falls upOn an iuclined plate and is scattered in all directions. The feed-shaft is made longitudinally

Fie. 10.— Broadcast seeder.

adjustable; and draws the feed-wheels in or out through a revolving washer in the side of the feed-cups, thus expos- ing more or less of the width of the teeth and regulating the quantity of seed carried thereby.

A very convenient and cheap form of broadcast seeder is shown in Fig. 10.

This machine consists of a seed-hopper, mounted on a special tail-board, which can be substituted for the one generally used by the farmer on his waggon ; a driving shaft, also mounted thereon and connected by a sprocket- chain with a sprocket-wheel on one of the rear wheels of the waggon ; a rotating seed-plate in the bottom of the hopper; and a distributing wheel, shaped much like a windmill, upon which the grain falls. The seed is very effectively scattered from the distributing wheel by cen- trifugal force.

Machines used for drilling the seed in rows are sub- stantially like the broadcast seeder, except that the seed falls from the tubes into a boot, as illustrated in Fig. 11.

Fig. U.— Grain drill.

Each of these boots is carried on an arm hinged at its forward end to the main frame, and provided at its lower end with a hoe, which makes a shallow furrow for the seed.

In some of the latest machines other forms of furrow- making devices are substituted doi the hoes, and two of these variations are illustrated in Figs. 12 and 13.

Fio. 12.— Shoe Itorower.

In Fig. 12 the furrow is formed by a shoe consisting of two plates converging at their forward ends, and spaced apart immediately beneath the boot, through which the seed falls into the furrow.

In Fig. 13 the furrowing tool is the concavo-convex disk, set at an angle to the line of draft as in the disk plough, and the seed is dropped into a space formed between the disk and a flat plate secured to the lower end of the boot and bearing against the concave face of the disk.

In the United States the maize or Indian-corn M^op ^ exceeds all others in value, and machines used in planting

and handling this crop are of great im- portance. Corn (maize) is sometimes listed or planted in a continuous row like wheat, and for this purpose a machine

FiQ. 18.— Disk fiirrower.

known as a lister is employed, which is shown in Fig. 14.

in both directions, so that a cultivator may be driven between them. This work is done by a machine called a check row corn planter, shown in Fig. 15.

In using the corn planter, a wire, having buttons attached thereto, at intervals corresponding to the distance between the hills, is first stretched across the field and anchored at its ends. This wire is then placed upon the guide rollers at the side of the machine and passes between the jaws of a forked lever, which is connected at its other end with a rock-shaft passing across the machine and

Fio. 14. — ^Maize lister. ‘

In its general construction this machine is a sulky plough, having a double mould-board, which turns the furrow in both directions. Immediately behind the plough is a sub-soiler for deepening the furrow and penetrating to !the moist soil below the surface. A seed-box is mounted on the plough beam, and is provided with a feed-plate operated by a shaft geared to one of the wheels. The seed is delivered to the furrow in rear of the sub-soiler and covered by two shovels which turn the soil back into thfe furrow.

Fid. 16. — Check row com planter.

It is, however,, more common to plant maize in hills, which are spaced equally from each other and form rows

1 In America the word ” com ” nsually signifies maize, not wheat— as in the United Kingdom— and so throughout this article. As a gram crop maize can only >e grown In Europe in the southern parts and in the Danube valley.

Fio. 16.— Check row corn planter.

serving to oscillate a feed-plate in the bottom of each seed-hopper. As the buttons on the check-wire strike the forked’lever, the latter is drawn to the rear and causes the feed-plate to drop the seed through the tubes into the open space between the plates of the furrowing shoe. The reel at the rear of the machine is used to take up the check—vyire as the planter progresses.

In one of the latest corn planters, shown in Tig. 16, the check-wire is dispensed with, and the machine is pro- vided with a shaft carrying two reels, the blades of which are at a distance apart equal to the distance between the hills of corn, and thus measure the intervals at which the corn is to be

dropped. A rod, extending from the side of the machine, and carrying a small wheel, marks the next row and serves as a guide to the driver.

Potatoes are also planted by a special machine, which may be seen in Fig. 17.

Fig. 17.— Potato planter.

The potato planter consists of a frame mounted on wheels, carrying a seed-box and usually a receptacle for fertilizers. The potatoes are fed by a suitable valve-plate into a chamber in which revolves a wheel having at the extremities of its spokes pins which impale the potatoes one by one, and carry them over to the seed tube, through which they fall into the furrow opened for them by a shoe, in the same manner as in the corn planter. An endless

apron feeds the fertilizer and drops it with the potatoes, the fxirrow being closed by a pair of disks which follow the seed tube.

Cultivators amd Weeders.

It is important, after the seed has been planted and sprouted, to keep the ground in a porous conditicm, in order that it may absorb and retain moisture, and be easy of penetration by the growing roots. This result is

Tio. 18.— CultiTator.

attained by the use of cultivators, and their construction will be easily understood from Fig. 18.

PiQ. 19, — nisk cultivator.

These machines are made as walking cultivators ; but, as in all the implements before described, the tendency is to provide a machine upon which the operator may ride. The drawing shows one adapted for either mode of opera-

Fio. 20.— Weeder.

tion. It comprises an arched axle, to extend over the row

of plants ; a draft frame, secured to the axle ; and a pair of cultivator frames, carrying small shovels for breaking up the soil. These cultivator frames are hinged at their forward ends to the main frame, and are supported by springs, so that they would be normally raised feom the ground ; but the necessary pressure is applied by the feet of the rider, or by the hands of the operator in case he is walking behind the machine.

The latest forms of the cultivator, as shown in Fig. 19, substitute for the shovels two sets of concavo-convex disks, operating precisely as in the disk plough and harrow be- fore mentioned.

Fig. 20 shows a new type of weeding machine now coming into use, and consisting of a wheeled frame, to which the team is attached, and from which depend a number of spring wires, whose action

is to rake and tear out the weeds. A lever permits the operator to adjust the angle of the teeth with the ground.

— Gombiaation implement.

In Fig. 21 is shown a very interesting implement, which is intended for gardeners, and is pushed by the operator. By changing one part for another, by simply detaching them and making the necessary substitution, the machine may be used as a hill or drill seeder and marker, a plough, a wheel hoe, a cultivator, and a harrow or rake.

Harvesters.

Mowing machines have long been in use, but have been constantly improved in construction, and the modem machine far exceeds in durability and convenience of

Fis. 22.- Mower.

operation that which was in use a few years ago. It is now made almost entirely of iron and steel, with very

little wood, and this construction enables all joints to be bars, “whicli extend rearwardly between the teeth, pre-

made much stronger and more permanent.

A recent form of mower is shown in Fig. 22. The cutter bar is of the. well- known type. The draft evener slides in guides upon th6 tongue, and is connected with the coupling bar in such a manner that the weight of the entire cutting appa- ratus is taken off the ground, thus produc- ing a very light running machine. Levers are provided for tilting the finger bar for cutting closer or higher, and a second lever raises the coupling frame and finger bar in passing obstructions. The latter opera- tion may also be performed by the foot of the operator pressing upon the curved lever at the rear of the axle.

vent the hay from clinging and ensure its discharge.

Fig. 28. — Lawn mower.

For mowing lawns, the machine shown in Fig. 23 is used.

Instead of a reciprocating knife, the lawn mower employs- a revolving reel, having spi- rally- arranged knives which impinge upon a stationary knife and cut the grass with a shear- ing action which is more effective in short and tender grass than a reciprocating knife. The gauge roller at the rear of the machine regu- lates the height of the cut.

Instead of raking hay by hand, the f a^er now employs a horse rake, which is illustrated in Fig. 24.

The hay is raked by the spring teeth, and when a sufficient quantity to form a wind-row has accumulated, the driver presses with his foot upon a lever operating a clutch and connecting the rake

head to the, driving wheels. The rake is thus raised and the

FiQ. 25, — Side deliveiy horse rake.

In Fig. 25 is shown what is known as a side-delivery horse rake, which takes up the hay by means of a re- volving toothed cylinder, from which it is taken by a toothed carrier and delivered upon a transversely moving apron. The hay is thus discharged from the machine in a continuous wind-row, extending in a direction parallel with the line of draft of the machine.

Another labour-saving machine is the tedder (Fig. 26) used for spreading and turning the hay while it is being cured.

Wio. 24. — Horee rake.

load flumped by the action of the team. The clearer

Fie. 26.— Hay tedder.

This machine is mounted on two wheels, and carries in bearings at the rear of the frame a multiple-cranked shaft, provided with a series of forks sleeved on the cranks and having their upper ends connected by links to the frame. As the crank-shaft is driven from the wheels by proper gearing the. forks move upward and forward, then down- ward and rearward, in an elliptical path, and kick the hay sharply to the rear, thus scattering and turning it. The tedder forks are hinged to the arms and are provided with cranks connected by rods to springs on the arms, being thus enabled to yield and avoid breakage by striking an obstacle.

For loading the hay on waggons a combined hay rake and loader, shown in Fig. 27, may be used.

This machine is coupled to the rear of the hay-rack and is drawn over the field, the revolving hay rake picking up the hay and feeding it to the elevator, which consists of

an endless belt driven from the wheels, and discharging the hay into the rack as it follows the machine.

to the power.

point where it is to be deposited by horse-

Fio. 2T. — Hay rake and loader.

In Storing hay in the barns the work may be done by a travelling carrier running on tracks above the hay mow,

If the hay is to be stacked, a drag-rake and stacker, as shown in Fig. 28, may be employed.

The drag-rake consists of a triangular frame, having a supporting wheel at each angle, and a rake head pivoted to the frame parallel with the base of the triangle. The rake head can be lowered so that the teeth sweep the ground and take up a large quantity of hay* The rake is then driven to the stacker

and the load is deposited on the elevating rake, which is hoisted by a system of pulleys and ropes, and discharges the hay on to the stack.

If hay is to be shipped it is advanta- geous to bale it, a press operated by horse- power (Fig. 29) being used for the purpose.

The hay-press is provided with a hopper into which the loose hay is fed in front of a plunger moved by means of a lever, to which the horses are attached. The action of the lever is then reversed, the plunger retreats, a new charge of hay is fed, and the movement is repeated. In this way the hay is pressed into a compact bale, wires are passed around it and secured, and the bale is then ejected. By treating the hay in this . manner much storage space is saved, and, in shipping, the freights are greatly reduced. In fact, it

FiQ. S8. — ^Drag-rake and stacker.

the hay being removed from the waggon by means of a harpoon fork or by slings upon which it is laid when put

Fie. 29.— Hay baling press.

in the waggon. The fork or slings are attached to the pulley of the carrier, and the load is elevated and carried

I.— Potato digger.

would be impossible to ship hay to any distance unless it were baled.

Potatoes are, perhaps, most often dug by hand, but there are also machines and implements provided for this purpose.

One of the simplest of potato diggers (Fig. 30) consists of a double plough, to each wing of -which are secured rearwardly extending fingers. As the plough is drawn through the field, the potatoes are thrown up, and as they slide over the fingers the loose earth is sifted through, while the potatoes fall ofE at the rear upon the surface of the ground, from which they are pitked up by hand.

Fis. 81.— Potato digger.

A slightly different form of digger is shown in Fig. 31. This plough throws up the potatoes like the former one, but turns them off on each side, where they fall upon a floating frame composed of steel rods, which are caused to vibrate by the inequalities of the ground, sifting out the earth and leaving the potatoes on the surface.

Fia. 33.— Potato digger.

A more complicated form of potato digger is shown in Fig. 32. This machine is designed to be drawn by a pair of horses, and carries at its forward end a power- ful scoop, which takes up the earth and potatoes, delivering them upon an endless carrier driven from the wheels of the machine. This carrier

is composed of rods, and is given a vibrating motion by which most of the earth is sifted out, and the potatoes are dis- charged upon a second carrier which completes the operation.

The scoop can be adjusted by a suitable lever to dig at any desired depth.

Ghrain Harvesters.

Twenty-five years ago grain was harvested by machines, but they were very different in character from those now in use, and in no class of agricultural machines has in-

vention made so great a change. Most of the grain was then harvested by machines cutting by a reciprocating knife and throwing the grain upon a travelling canvas apron, which delivered it to a second elevator apron carry- ing it over the driving wheel, where it was dropped upon a table and bound by an attendant. These machines were furnished with a divider at the end of the cutter bar for separating the grain to be cut from the standing grain, and also with a reel which pressed forward into the stand- ing grain and pushed it back to present it properly to the cutter bar. All these are essential features of the mod- ern harvester.

About 1873, what was probably the first commercially successful automatic self-binding harvester was brought out in the Locke wire binder. This was extensively used for several years, and wire binders were also built by other manufacturers, but there were serious objections to their use, principally on account of pieces of the wire be- ing carried into the threshing machines and even into the flour-mills, where, by contact with the rapidly moving machinery, they were likely to cause flres.

The attention of inventors was then turned to the twine binder, but although some of the earliest attempts at grain binding were made with twine, even antedating the wire binders, it was not until 1879 that the Appleby patent, under which most of the self-binding harvesters of to-day are built, was taken out; and it was not until several years later that they came into extensive use. Some of the most important parts of the binder had been invented before the Appleby patent, such as the automatic trip which regulates the action of the binder, invented by Gray in 1858, and the knotting bill and revolving cord-holder, patented by Behel in 1864. For various reasons, however, none of these inventions went into use until they were embodied in the Appleby machine. The self-binding harvester is probably the most ingenious and interesting of all agricultural machines, and will be briefly described.

Fig. ~~33 shows a rear view of the self~~ binding harvester. As already explained, the grain is bent over and presented to the reciprocating cutter bar by means of the revolving reel, and is then conveyed by the apron and elevator over the master wheel and discharged upon the downwardly in- clined binder table.

Fio. 88.— Self-binding liarvester.

As the grain flows from the elevator, the butts are at the front of the machine and are evened up by a device called a butt adjuster, shown in Fig. 34, which is con- nected to a crank at its upper end and guided on a rod at its lower end, being thus given an elliptical movement and patting the ends of the grain, thus squaring the butt of the sheaf.

The grain moving on down the binder deck is forwarded by the packers, as seen in Fig. 35. These consist of a

Fia. 84.— Bntt adjuster.

pair of arms sleeved upon cranks on a constantly driven shaft, and having their lower ends connected by links to

Fie. 3&. — ^Binding mechanlam.

the frame of the machine. By means of the packers, the grain is forced against the compressor or trip arm until a

■Knot-tying mechanism.

sufficient quantity has accumulated to form a bundle, the size of which is regulated by suitable adjusting devices. When the pressure on the trip arm becomes sufficient to

overcome the tension of the spring, shown at the right of the figure, the latter yields, and the trip latch, being connected to the compressor shaft, is raised and releases the end of a dog carried on a gear by which the knotter shaft is driven, and the dog is immediately thrown down by a spring engaging a lug on the packer shaft. This starts the knotter shaft, which carries the compressor cam, and, the cam wheel being connected by a pitman with the needle shaft, the needle moves upward, passing the cord round the bundle. ‘Simultaneously with the motion of the needle, the compressor is forced against the grain, and the bundle is tightly compressed between the compressor and the needle, thus taking most of the strain off the cord. Previously to the upward movement of the needle, the cord is held by one end in the cord holder, which lies outside the knotter bill, as seen in Figs. 36 and 37, and extends

Fie. ST.— Knot-tying mechanism.

over the knotter, underneath the bundle, through the eye of the needle, and thence to the twine box. As the needle carries the cord upward, the second strand is laid over the knotter and cord holder, and, at this moment, the seg- mental racks on the knotter wheel engage the pinions of the knotter and cord holder. As the knotter rotates, a loop of both strands of the cord is formed round both jaws, and when about three-quarters of the revolution is completed, the upper jaw is raised by a cam, the strands between the knotter and cord holder passing between the

Fie. 88.— Holmes binder.

jaws and being grasped thereby. The cord-holder disk carries a knife which now strikes the cord and severs it, the end running to the eye of the needle remaining in the grasp of the holder. The discharger arms, which are rigidly secured to the knotter wheel, then reach the bundle, forcing it out of the binder, drawing off the loop from the knotter over the bight held between its jaws, and the knot is complete. All this takes place during a single revolution of the knotter shaft, and as

the needle retreats, the trip latch is lowered into position to strike the trip dog, thus releasing it from the lug on the packer shaft and stopping the binder until the next bundle is formed, when the action is

repeated.

Fig. 89. — Holmes binder.

As the bundles are discharged from the binder, they are received by a bundle carrier and retained until it contains the number necessary to form a shock, when the carrier is tripped by the operator and the sheaves are deposited upon the ground. The bundle carrier is an impor- tant addition to the binder, and the cost of labour in setting the sheaves in shocks is lessened, as they are deposited in a single spot instead of being gathered from a considerable area.

The cord holder is of the sliding jaw type instead of the rotary form.

On small farms, the sweep-rake reaper shown in Fig. 40 is frequently used.

The cutting apparatus of this machine is similar to that in all harvesting machines, but is attached to the front of a quadrantal platform upon which the grain falls as it is cut. At the stubbleward end of the frame, just inside the master wheel, is a pedestal having upon its top a cam. A rotating shaft carrying a number of rake arms, hihged thereto, is mounted in the pedestal, and the rake arms are guided by>the cam in such a manner that they bring the grain to the cutter bar, sweep it back over the plat- form, depositing it in a gavel on the ground, and are then raised abruptly to clear the driver. These cams can gener- ally be set by a switch, so that every rake, or every second, third, or fourth rake, may deposit the gavel.

On the Pacific coast of America the wheat farms are of immense size, sometimes as large as 20,000 acres in a single field, and the climate is very dry, so that the grain is allowed to ripen in the field. These conditions have enabled American farmers to make use of headers and combined heading and threshing machines. ‘

The only binder built in the United States ^p

differing from the Appleby type is the Holmes ^^ “^ binder, illustrated by Figs. 38 and 39.

This binder differs in its general organiza- tion from the Appleby, the packers being of the toothed disk type and carried above the binder table, as is also the starting clutch. The discharger is similar in constructioii to the forks of a tedder. The knotter is composed of two parts carried by a rotary spindle, one of them being

Fig. 40. — Sweep-rake reaper.

sleeved in the other, and having an independent move- ment in opening and closing the jaws to receive the loop.

Fig. 41.— Header.

The header frame is mounted upon two wheels and has a pole extending to the rear, at the end of which is a swivelled steering wheel operated by a suit- able tiller (Fig. 41). An evener is pivoted forward of the steering wheel, and to this the horses are attached and push the ma- chine in advance. At the forward end of the frame a platform is hinged and can be adjusted vertically by means of a long lever extending back to the driver. This plat- form carries the cutting apparatus and the platform apron, which delivers at One side to an elevator. The cutting apparatus is adjusted to cut the heads from the grain, leaving the straw, and the heads are dis- charged into a waggon which moves along

with the header. The header cuts a much wider swathe than the self-binder, and therefore, under the conditions to which it is adapted, is capable of doing more work.

The next step in decreasing the cost of harvesting ~~v^as to combine with the header a threshing machine, the former being at~~ tached to the side of the latter, and de- livering the grain thereto. The grain is then threshed out and bagged at the rate of 25 to 45 acres per day, according to the stand of grain and other varying conditions, thus reducing the cost

from 6 to 9 cents per 100 pounds below that incurred when a header alone is used.

By applying a traction engine to a combined harvester, it is possible to increase the width of cut and thus add stUl further to its capacity. The machine shown in Fig. 42 is built with a cut as great as 42 feet, and will cut, thresh, reclean and sack 125 acres of wheat in one

day, requiring eight men to operate it. It is undoubt- edly the most economical machine in use for harvesting grain.

Fig. 43 illustrates a harvesting outfit consisting of engine, thresher, header, water-tank waggon, and cook- house, travelling from ranch to ranch, which gives a good idea of the scale on which this work is done.

Fie. 42.— Combined steam harrester.

Fio. 48.— Combined harvesting outfit.

Com Harvesters.

Until very recently, corn (maize) was harvested in America by hand, sometimes by breaking off the ears and leaving the stalks standing, and turning the cattle in to feed, and sometimes by cutting the stalks with a

Fig. 44. — Corn liarvester and binder.

com knife and securing them in shocks. Within the last few years machines have been built for performing this very laborious work. If the intention be to leave the stalks standing, a machine called a stripper and husker is used, which passes the stalks between two inclined rollers

as the machine advances, the ears being snapped from the stalks by the rollers and falling on to a travelling carrier by which they are fed into a husker, and from thence to a waggon travelling with the machine. If the com is to be shocked, a machine of the type shown in Fig. 44 is employed.

In this type of com harvester a pair of inclined gatherers passes, one on each side of the row, picking up all down stalks, and feeding them through the machine by means of the gathering chains which support them as they are cut off by the knife. The stalks are then pushed to the rear by the packers of a vertically placed automatic binder, operating in the same way as a grain binder, to bind the bundle securely and discharge it into the bundle carrier, which retains it until enough is accumulated to form a shock. The bundle carrier is then operated and deposits the bundles on the ground.

Another type of corn harvester cuts the stalks in a vertical position, as above de- scribed, but forces them over on to an inclined table, down which they slide into a horizontal binder, where they are bound in the same way as in a grain binder. The corn having been shocked, it is now customary to feed the stalks to a husking and shredding machine, in which the ears are snapped by rollers from the stalks, and then pass on to a cylinder having a series of knives, which split the stalk and tear it into small pieces. It is finally

discharged by an elevator and hauled away to be used in feeding stock. The ears of corn snapped off fall between a pair of husking rolls, which strip off the husks, the lat- ter being carried ofE with the shredded stalks.

The ears of corn are then fed to a corn sheller, which rolls and rubs them between toothed disks until the kernels are detached, and they are then passed through cleaning devices in order to separate them from the chaff.

In Pig. 45 is shown a threshing machine for separating wheat and other small grain from their straw. The grain is fed between a rotating toothed cylinder and a toothed concave, by which means the straw is thoroughly beaten and the grain shaken from its husk. The straw then passes over shaking screens which shake down the grain, the latter being thoroughly cleaned by, a blast of air passing upward through the screens. The straw is finally blown out through the stacking pipe on.to the stack.

In conclusion, it may be said that the improvements in

agricultural machinery in the last few years have made possible the opening up of vast tracts of the world’s farming lands which would otherwise have remained

Fig. 45. — ^Threshing machine.

unproductive for years to come, on account of the scarcity of labour, and have enabled agricultural operations to be carried out upon such a scale as greatly to reduce the cost of food to all the world. (f. o. s.)

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GENBEAt StTBVBY, 1875-1900.

THE time which has elapsed since the article Agei- cxTLTURE was published in the ninth edition of the Encyclopaedia Britannica has been a fateful period for the greatest British industry. The hopeful views that were expressed at the conclusion of that article have not been realized. The great future that seemed then to await the application of steam power to the tillage of the soil has proved illusory. The clay soils of England, the latent fer- tility of which was to be brought into play in a fashion that should mightily augment the home-grown supplies of food, remain almost as intractable as ever, and the extent of land devoted to the cultivation of corn crops, instead of expanding, has diminished in a degree to which there is no

1 These portraits are not intended to convey any idea of the relative sizes of the different animals. In plate 14, for example, the Hampshire Down Bam, though represented by a smaller picture, is a decidedly bigger animal than the Southdown Bam portrayed in the same plate.

recorded parallel. Farmers of long experience commonly look back to 1874 as the last of the really good years, and consider that the palmy days of British agriculture began to dwindle at about that time. The shadow of the approaching depression had already fallen upon the land before the year 1875 had run its course, and the outlook became ominous as the decade of the ‘seventies neared its close. One memorable feature was associated with 1877 in that this was the last year in which the dreaded cattle plague (rinderpest) made its appearance in England. There has been no record of it in the British isles since that year, and it is hoped that it has been banished for ever. The same year, 1877, was the last also in which the annual average price of English wheat exceeded 50s. per imperial quarter. The average was 56s. 9d. that year, but it has never since been within 10s. of this level. With declin- ing prices for farm produce came that year of unhappy memory, 1879, when persistent rains and an almost sun- less summer ruined the crops, and reduced many farmers to a state of destitution. Much of the grain was never

harvested, whilst owing mainly to the excessive floods there commenced .an outbreak of liver-rot in sheep, due to the ravages of the fluke parasite. This continued for several years, and the mortality was so great that its adverse effects upon the ovine population of the country were still perceptible ten years afterwards. A fall in rents was the necessary sequel of the agricultural dis- tress, to inquire into which a royal commission cot^is- ^^^ appointed in 1879, under the chairmanship s/on” «». °* *^® duke of Eichmond and Gordon. Its re- port, published in 1882, testified to ” the great extent and intensity of the distress which has fallen upon the agricultural community. Owners and occupiers have alike suffered from it. No description of estate or tenure has been exempted. The owner in fee and the life tenant, the occupier, whether of large or of small holding, whether under lease, or custom, or agreement, or the provisions of the Agricultural Holdings Act — all without distinction have been involved in a general calamity.” The two most prominent causes assigned for the depression were bad seasons and foreign compe- tition, aggravated by the increased cost of production and the heavy losses of live stock. Abundant evidence was forthcoming as to the extent to which agriculture had been injuriously affected ” by an unprecedented suc- cession of bad seasons.” As regards the pressure of for- eign competition, it was stated to be greatly in excess of the anticipations of the supporters, and of the apprehen- sions of the opponents, of the repeal of the Corn Laws. Whereas formerly the farmer was to some extent compen- sated by a higher price for a smaller yield, in recent years he had had to compete with an unusually large supply at greatly reduced prices. On the other hand, he had en- joyed the advantage of an extended supply of feeding- stuffs — such as maize, linseed cake, and cotton cake — and of artificial manures, imported from abroad. The low price of agricultural produce, beneficial though it might be to the general community, had lessened the ability of the land to bear the proportion of taxation which had hereto- fore been imposed upon it. The legislative outcome of the findings of this royal commission was the Agricultural Holdings Act 1883, a measure which continued in force in its entirety till 1901, when a new Act came into operation. The apparently hopeless outlook for corn-growing com- pelled farmers to cast about for some other means of subsistence, and to rely more than they had hitherto done upon the possibilities of stock-breeding. It was in par- ticular the misfortunes of the later ‘seventies that gave the needed fillip to that branch of stock-farming con- cerned with the production of milk, butter, and cheese, and from this period may be said to date the revival of the dairying industry, which received a powerful impetus through the introduction of the centrifugal cream separa- tor, and was fostered by the newly-established British Dairy Farmers’ Association. The generally wet character of the seasons In 1879

and the two or three years following was mainly responsible for the high prices of meat< so that the- supplies of fresh beef and mutton from Australia which now began to arrive found a ready market, and the trade in imported fresh meat which was thus commenced has practically continued to expand ever since. The great losses arising from spoilt hay crops served to stimulate experimental inquiry into the method of preserving green fodder known as ensilage, with the result that the system eventually became successfully incorporated in the ordi- nary routine of agricultural practice. A contemporaneous effort in the direction of drying hay by artificial means led to nothing of practical importance. By 1882 the cry as to land going out of cultivation became loud and gen- eral, and the migration of the rural population into the

towns in search of work continued unchecked. In 1883 foot-and-mouth disease was terribly rampant amongst the herds and flocks of Great Britain, and was far more preva- lent than it has ever been since. It was about this time that the first experiments were made (in Germany) with basic slag, a material which had hitherto been regarded as a worthless by-product of steel manufacture. A year or two later field trials were begun in England, with the final result that basic slag has become recognized as a valuable source of phosphorus for growing crops, and is now in constant demand for applipation to the soiHas a fertilizer. In 1883 the veterinary department of the Privy Council — which had been constituted in 1865 when the country was ravaged by cattle plague — was abolished by order in council, and the "Agricultural Depart- Board ot ment" was substituted, but no alteration was Agri- effected in the work of the department, so far culture, as it related to animals. In 1889 the Board of ^**'* Agriculture (for Great Britain) was formed under an Act of parliament of that year (52 & 53 Vict. c. 30), and the immediate control of the Agricultural Department was transferred from the clerk of the Privy Council to the secretary of the Board of Agriculture, where it remains. A Minister for Agriculture had for years been asked for in the interests of the agricultural community, and the functions of this of&ce are discharged by the president of the Board of Agriculture, whose appointment of course is, like that of the president of the Board of Trade, a politi- cal one, and may or may not carry with it a seat in the Cabinet. The Board of Agriculture, on its establishment, took over from the Privy Council the responsibilities of the Contagious Diseases (Animals) Acts, besides the com- prehensive duties of the Land Commission, and the au- thority and responsibilities of the Commissibners of Her Majesty's Works and Public Buildings under the Survey Act of 1870. The Board is entrusted with the collection and preparation of statistics relating to agriculture and forestry, the inspection of schools (not being public ele- mentary schools) in which technical instruction is given in agriculture or forestry, and the instituting of such experimental investigations as may be deemed conducive to the progress of agriculture and forestry. The election took place in the same year (1889) of the first county councils, and the allotment to them of various sums of money under the Local Taxation (Customs and Excise) Act 1890 enabled local provision to be made for the pro- motion of technical instruction in agriculture. It was at about this time that the value of a mixture of lime and sulphate of copper (bouillie bordelaise), sprayed in solu- tion upon the growing plants, came to be recognized as a check upon the ravages of potato disease.

The general experience of the decade of the 'eighties was that of disappointing summers, harsh winters, felling prices, declining rents, and the shrinkage of land values. It is true that one season of the series, that of 1887, was hot and droughty, but the following summer was exceed- ingly wet. Nevertheless the decade closed more hope- fully than it opened, and found farmers taking a keener in- terest in grass land, in live stock, and in dairying. Cattle- breeders did well in 1889, but sheep-breeders fared better; on the other hand, owing to receding prices, corn-growers were more disheartened than ever. With the incoming of the last decade of the century there seemed to be some justifiable hopes of the dawn of better times, but they were speedUy doomed to disappointment. In 1891 exces- sively heavy autumn rains washed the arable soils to such an extent that the next season's corn crops were below average. Wheat in particular was a poor crop in 1892, and the low yield was associated with falling prices, due to large imports. The hay crop was very inferior, and in/

some cases it -was practically ruined. This gave a stimiiius to the trade in imported hay, which rose from 61,237 tons in 1892 to 263,050 tons in 1893, and despite some large home-grown crops in certain subsequent years (1897 and 1898) this expansion Jias never since been wholly lost. The misfortunes of 1892 proved to be merely a prepa- ration for the disasters of 1893, in which year occurred the most destructive drought within living memory. Its worst effects were seen upon the light land farms of England, and so deplorable was the position that a Eoyal Commission on agricultural depression was ap- Cammis- poi^t^d in September of that year under the sioa, 1893. chairmanship of Mr Shaw Lef evre. Thus, with- in the last quarter of the 19th century — and, as a matter of fact, only fourteen years apart — two Eoyal Commissions on agriculture were appointed, the one in a year of memorable flood, 1879, and the other in a year of disastrous drought, 1893. The report of the Commission of 1893 was issued in March 1896. Amongst its chief rec- ommendations were those relating to amendments in the Agricultural Holdings Acts, and to tithe rent-charge, rail- way rates, damage by game, sale of adulterated products, and sale of imported goods (meat, for example) as home produce. Two legislative enactments arose out of the work of this Commission. In the majority report it was stated ” that, in 6rder to place agricultural lands in their right position as compared with other ratable properties, it is essential that they should be assessed to all local rates in a reduced proportion of their ratable value.” The Agricultural Rates Act, 1896, gave effect to this recom- mendation. Its objects were to relieve agricultural land from half the local rates, and to provide the means of making good out of Imperial funds the deficiency in local taxation thereby caused. It was provided that the Act should continue in force only till 31st March 1902, but a further Act in 1901 extended the period by four years. Meanwhile the Royal Commission on local taxation was inquiring into the general incidence of local taxation, both urban and rural, and its proper adjustment between real and personal property, and presented its report in the summer of 1901. The other measure arising out of the report of the Royal Commission of 1893 was the Agricultural Holdings Act, 1900. This is an amending Act and not a consolidating Act ; consequently it has to be read as if incorporated into the already existing Acts. As affecting agricultural practice there are three note- worthy improvements in respect of the making of which, without the consent of or notice to his landlord, a tenant’ may claim compensation — (1) the consumption on the holding ” by horses, other than those regularly employed on the holding,” of corn, cake,‘or other feeding-stuff not produced on the holding ; (2) the ” consumption on the holding by cattle, sheep, or pigs, or by horses other than those regularly employed on the holding, of corn proved by satisfactory evidence to have been produced and con- sumed on the holding”; (3) “laying down temporary pasture with clover, grass, lucerne, sainfoin, or other seeds sown more than two years prior to the determina- tion of the tenancy.”

After 1894, in which year the brilliant prospects of a bountiful harvest were ultimately extinguished by un- timely and heavy rains, all the remaining sea- d^d^bt ^^^^ °^ *^® closing decade of th^ 19th century were dominated by drought. A fact that was amply illustrated, moreover, is that the period of incidence of a drought is not less important than its duration, and the same is true of abnormal rainfall. A spring drought, a summer drought, an autumn drought, each has its distinc- tive characteristics in so far as the effect upon the crops is concerned. The hot drought of 1893 extended over the spring and summer months, but there was an abun-

dant rainfall in the autumn ; correspondingly there was an xmprecedentedly bad yield of corn ^nd hay crops, but a moderately fair yield of the main root crops (turnips and swedes). In 1899 the

drought became most intense in the autumn, after the corn crops had been harvested, but during the chief period of growth of the root crops ; correspondingly the corn crops of that year rank very well amongst the crops of the decade, but the yield of turnips and swedes was the worst on record. It is quite possible for a hot dry season to be associated with a large yield of corn, provided the drought is confined to a suit- able period, as was the case in 1896, and still more so in 1898 ; the English wheat crops in those years were prob- ably the biggest in yield per acre that had been harvested since 1868, which is always looked back upon as a re- markable year for wheat. The drought of 1898 was inter- rupted by copious rains in June, and these falling on a warm soil led to a rapid growth of grass and, as measured by yield per acre, an exceedingly heavy crop of hay.

With the exceptions of 1891 and 1894, every year in the period 1891-1900 was^stricken by drought. The two meteorological events of the decade which will prob- ably live longest in the recollection were, however, tl^e terrible drought of 1893, resulting in a fodder famine in the succeeding winter, and the severe frost of ten weeks' duration at the beginning of 1895. Between these two occurrences came the disastrous decline in the value of grain in the autumn of 1894, when the weekly average price of English wheat fell to the record minimum of 17s. 6d. per imperial quarter. As a consequence, the ex- tent of land devoted to wheat in the British isles receded in 1895 to less than 1^ million acres, which is the lowest area on record. Successful trials of sulphate of copper solution as a means of destroying charlock in corn crops took place in the years 1898-1900. Charlock is a most per- sistent Cruciferous weed, but if sprayed when young with the solution named it is killed, the corn plants being uninjured.

Amongst recent legislative measures of importance to agriculturists mention should be made, in addition to

those that have been referred to, of the Tithe

Legisla- tion.

Rent-charge Recovery Act, 1891, which transfers the liability for payment of tithe from the occu- pier to the owner. In the same year was passed the Markets and Fairs (Weighing of Cattle) Act. The object of the Small Holdings Act, 1892, was to facilitate the acquisition of small agricultural holdings. It provides that a county council may acquire any suitable land, with the object of allotting from one to fifty acres, or, if more than fifty acres, of an annual value not exceeding £50, to per- sons who desire to buy, and will themselves cultivate, the holdings. If, owing to proximity to a town or otherwise, the prospective value is too high, the council may hire such land for the purpose of letting it. The Fertilizers and Feeding Stuffs Act, 1893, compels sellers of fertilizers (i.e., manures), manufactured or imported, to state the percent- age of the nitrogen, of the soluble and insoluble phos- phates, and of the potash in each article sold, and this statement is to have the effect of a warranty. Similar ' stringent conditions apply as regards the sale of feeding stuffs for live stock. The Finance Act of 1894, with its great changes in the death duties, overshadowed all other Acts of that year both in its immediate effects and in its far-reaching consequences. The Copyhold Consoli- dation Act, 1894, supersedes six previous copyhold statutes, but does not effect any alteration in the law concerning enfranchisement. The Diseases of Animals Act, 1896, provided for the compulsory slaughter of im- ported live stock at the place of landing. The Light Rail- ways Act and the Locomotives on Highways Act were added to the Statute Book in 1896, and various clauses in

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the Finance Act effected reforms in respect of the death duties, the land-tax, farmers' income-tax, and the beer duty. The ChaflE-cutting Machines (Accidents) Act, 1897, is a measure very similar in its intention to the Thresh- ing Machines Act, 1878, and provides for the automatic prevention of accidents to persons in charge of chaff-cut- ting machines. The Sale of Food and Drugs Act, 1899, has special reference in its earlier sections to the trade in dairy produce and margarine. In 1899 was also passed the Act establishing a department of agriculture and tech- nical instruction in Ireland.

The Acreage of Crops. The most notable feature in connexion with the crop- ping of the land of the United Kingdom during the last quarter of the 19th century was the lessened cultivation of the cereal crops, associated with an expansion in the area of grass land. At the beginning of the period the aggregate area under wheat, barley, and oats was nearly 10|^ million acres ; at the close it did not much exceed 8 million acres. There was thus a withdrawal d^iring the period of considerably over 2 million acres from cereal cultivation. From Table I., showing the acreages at Table I. — Areas of Cereal Crops in the United Kingdom — Acres.

Tear.

Wheat.

Barley.

OatB.

Total.

1875

3,514,088

2,751,362

4,176,177

10,441,627

1880

3,065,895

2,§95,000

4,191,716

9,952,611

1885

2,553,092

2,447,169

4,282,594

9,282,855

1890

2,483,695

2,300,994

4,137,790

8,922,379

1895

1,456,042

2,346,367

4,527,899

8,330,308

1900

1,901,014

2,172,140

4,145,633

8,218,787

intervals of five years, it will be learnt that the loss fell chiefly upon the wheat crop, which at the close of the period occupied barely more than half the area assigned to it at the beginning. If the land taken from wheat had been cropped with one or both of the other cereals, the aggregate area would have remained about the same. This, however, has not been the case, for a fairly uniform decrease in the barley area has been accompanied by somewhat irregular fluctuations in the acreage of oats. To the decline in prices of home-grown cereals the de- crease in area is largely attributable. The extent of this decline is seen in Table II., wherein are given the annual average prices, calculated upon returns from the statutory markets of England and Wales (numbering 196 * since 1890, ujider the Corn Eetums Act, 1882). These prices are per imperial quarter, — that is, 480 lb of wheat, 400 ft of barley, and 312 lb of oats, representing 60 ft, 50 ft, and 39 ft per bushel respectively. Since 1883 the annual average price of English wheai has never again been so high as 40s. per quarter, and only twice since 1892 has it exceeded 30s. !&i one of these exceptional years, 1898, the average rose to 34s., but this was due entirely to a couple of months of inflated prices in the early half of the year, when the outbreak of war between Spain and the United States of America coincided with a huge speculative deal in the latter country. The weekly aver- age prices of English wheat in 1898 fluctuated between 48s. Id. and 25s. 5d. per quarter, the former being the highest weekly average since 1882. The minimum annual average was 22s. lOd. in 1894, in the autumn of which year the weekly average sank to 17s. 6d. per quarter, the lowest on record. Wheat was so great a glut in the

market that various methods were devised for feeding it to stock, a purpose for which it is not specially suited ; in thus utilizing the grain, however, a smaller loss was often incurred than in sending it to market. In 1894 the monthly average price for October, the chief month for wheat-sowing in England, was only 17s. 8d. per 1 Altered to 190 on 1st January 1901.

quarter, and farmers naturally shrank from seeding the land freely with a crop which could not be grown except

Table II. — Gazette Annual Average Prices per Imperial Quarter of British Cereals ‘in Englcmd and Wales, 1875 to 1900.

Tear.

Wheat.

Barley.

OatB.

8. d.

B. d.

s. d.

1875

45 2

38 5

28 8

1876

46 2

35 2

26 3

1877

56 9

39 8

25 11

1878

46 5

40 2

24 4

1879

43 10

, 34 0

21 9

1880

44 4

33 1

23 1

1881

46 4

31 11

21 9

1882

45 1

31 2

21 10

1883

41 7

31 10

21 5

1884

35 8

30 8

20 3

1885

32 10

30 1

20 7

1886

31 0

26 7

19 0

1887

32 6

25 4

16 3

1888

31 10

27 10

16 9

1889

29 9

25 10

17 9

1890

31 11

28 8

18 7

1891

37 0

28 2

20 0

1892

30 3

26 2

19 10

1893

26 4

26 7

18 9

1894

22 10

24 6

17 1

1895

23 1

21 11

14 6

1896

26 2

22 11

14 9

1897

30 2

23 6

16 11

1898

34 0

27. 2

18 6

1899

25 8

25 7

17 0

1900

26 11

24 11

17 7

at a heavy loss. The result was that in the following ‘ year the wheat crop of the United Kingdom was har- vested upon the smallest area on record, — less than 1^ million acres. In only one year of the last quarter- century, 1878, did the annual average price of English barley touch 40s. per quarter ; it has never again reached 30s. since 1885, whilst in 1895 it fell to so low a level as 21s. lid. The same story of declining prices applies to oats. An average of 20s. ppr quarter was touched in 1891, but with that exception this useful feeding grain has not reached that figure since 1885. In 1895 the average price of 480 ft of wheat, at 23s. Id., was identi- cal with that of 312 ft of oats in 1880, and it was less in the preceding year. The declining prices that have operated against the growers of wheat should be studied in conjunction with Table’ III., which shows, at intervals

Table III. — Imports into the United Kingdom of Wheat Grain, and of Wheat Meal and Flour — Cwt.

Tear.

Wheat Grain.

Meal and Flonr.

Total.

1876

51,876,617

6,136,083

58,012,600

1880

55,261,924

10,658,312

65,820,236

1885

61,498,864

15,832,843

77,331,707

1890

60,474,180

15,773,336

76,247,516

1895

81,749,955

18,368,410

100,118,365

1900

68,615,990

21,542,036

90,158,026

of five years, the imports of wheat grain and of wheat meal and flour into the United Kingdom. The import of the manufactured product is increasing at a much greater ratio than that of the raw grain, for whilst in 1875 the former represented less than one-ninth of the total, by 1900 the proportion had risen to nearly one- fourth. The offal, which is quite as valuable as the flour itself, is thus retained abroad instead of being utilized for stock-feeding purposes in the United King- dom. The highest and lowest areas of wheat, barley, and oats in the United Kingdom during the period 1875- 1900 were the following : —

Wheat . . 3,514,088 acres in 1875 Barley . . 2,931,809 acres in 1879 Oats . . 4,527,899 acres in 1896

1,456,042 acres in 1895 2,068,760 acres in 1898 3,998,200 acres in 1879-

These show differences amouuting to 2,058,046 acres for wheat, 863,049 acres for barley, and 529,699 acres for oats. The acreage of wheat, therefore, has fluctuated the most, and that of oats the least. Going back to 1869, it is found that the extent of wheat in that year was 3,981,989 acres, or very little short of four million acres.

The acreage of rye grown in the United Kingdom as a grain crop is small, the respective maximum and minimvm areas during the period 1875-1900 having been 102,676 acres in 1894 and 47,937 acres in 1880. Eye is perhaps more largely grown as a green crop to be fed off by sheep, or cut green for soiling, in the spring months.

Of corn crops other than cereals, beans and peas are both less cultivated than formerly. In the period 1876-1900 the area of beans in the United Kingdom fluctuated be- tween 574,414 acres in 1875 and 230,429 acres in 1897, and that of peas between 318,410 acres in 1875 and 163,- 325 acres in 1899. The area of peas has thus shrunk nearly one-half, and that of beans more than one-half. Tak- ing cereals and pulse corn together, the aggregate areas of wheat, barley, oats, rye, beans, and peas in the United Kingdom have varied as follows over the five quinquen- nial intervals embraced in the period 1875-1900 : —

Tear.

Acres.

Tear.

Acres.

1875 .

. 11,399,030

1890 .

. 9,574,249

1880 .

. 19,672,086

1895 .

. 8,865,338

1885 .

. 10,014,62S

1900 .

. 8,707,602

Disregarding minor fluctuations, there has thus been a loss of corn land over the quarter-century of 2,691,639 acres, or nearly 24 per cent.

The area that has been withdrawn from corn growing is not to be found under the head of what are termed ” green crops.” In 1900 the total area of these crops in the United Kingdom was 4,301,774 acres, made up thus : —

Crop. Acres.

Potatoes 1,227,569

Turnips and swedes 1,994,421

Mangel 484,050

Cabbage, kohl-rabi, and rape . . . 242,967

Vetches or tares 181,679

Other green crops 171,088

The extreme aggregate areas of these crops during the quarter-century were 5,057,029 acres in 1875 and 4,261,- 441 acres in 1898. At flve-year intervals the areas have been : —

Tear.

1876 1880 1886

Acres.

5,057,029 4,746,293 4,765,195

tear.

Acres.

1890 .

. 4,534,145

1895 .

. 4,399,949

1900 . <.

. 4,301,774

These crops, therefore, which, except potatoes, are used mainly for stock-feeding, have like the corn crops been grown on gradually diminishing areas.

The land that has been lost to the plough is found to be still further augmented when an inquiry is instituted into the area devoted to clover, sainfoin, and grasses under rotation. In the period 1875-1900 this area has fluctuated between 6,557,748 acres in 1878 and 5,862,754 acres in 1894, whilst the areas at five-year intervals are given in Table IV. Under the old Norfolk or four-course rotation (roots, barley, clover, wheat) land thus seeded with clover or grass seeds was intended to be ploughed

up at the end of a year. Labour diflBculties, low prices of produce, bad seasons, and similar causes provided inducements for leaving the land in grass for two years, or over three years or more, before breaking it up for wheat. In many cases it would be decided to let such land remain under grass indefinitely, and thus it would no longer be enumerated in the Agricultural Returns as temporary grass land, but would pass into the category of permanent grass land, or what is often spoken of as “permanent pasture.” Whilst much grass land has been laid down with the intention

from the outset that it should be permanent, at the same time some considerable areas have through stress of cir- cumstances been allowed to drift from the temporary or rotation grass area to the permanent list, and have thus still further diminished the area formerly under the dominion of the plough. The column relating to permanent grass in Table IV. shows clearly enough how the British Isles have

Table IY.^— Areas of Grass Land (excluding Heath and Mountain Land) in the United Kingdom — Acres.

Tear.

Temporary (i.e. under rotation).

Permanent {i.e.

not broken up

in rotation).

Total.

1875 1880 1885 1890 1895 1900

6,337,953 6,389,232 6,738,206 6,097,210 6,061,139 6,024,317

23,772,602 24,717,092 25,616,071 27,115,425 27,831,117 28,261,629

30,110,555 31,106,324 32,354,277 33,212,635 33,892,266 34,285,846

for the last quarter-century been becoming more pastoral, whilst figures previously quoted demonstrate the extent to which they have become less arable. In the period 1876- 1900 the extreme areas returned as “permanent pasture” — a term which, it should be clearly understood, does not include heath or mountain land, of which there are in Great Britain alone about thirteen million acres used for grazing— were 23,772,602 acres in 1875, and 28,261,529 acres in 1900, whilst the totals at five-year intervals are stated in Table IV. Comparing 1900 with 1875 the in- crease in permanent grass land is found to amount to close upon 4^ million acres, or about 19 per cent.

On account of the greater humidity and mildness of its climate Ireland is more essentially a pastoral country than Great Britain. The distribution between the two islands of such important crops of arable land as cereals and potatoes is indicated in Table V.^ The figures are those

Table V. — Areas of Cereal and Potato Crops in Great Britain and Ireland in 1900.

Great Britain . Ireland

Totai .

Wlieat.

Barlfey.

Acres.

1,846,042 53,797

Per Cent.

97-2

2-8

Acres.

1,990,265 174,006

Per Cent.

92

8

1,898,839

100-0

2,164,271

100

Great Britain . Ireland

Total .

Oats.

Potatoes.

3,026,088 1,104,848

73-3 26-7

561,361 664,413

46 64

4,130,936

100-0

1,216,774

100

for 1900, but, though the absolute acreages vary some- what from year to year, there is not much variation in the percentages. The comparative insignificance of Ireland in the case of the wheat and barley crops, represented by 2.8 and 8 per cent, respectively, receives some compensation when oats and potatoes are considered, fully one-fourth of the area of the former and more than half that of the latter being claimed by Ireland. It is noteworthy, how- ever, that Ireland is year by year placing less reliance upon the potato crop. In 1888 the area of potatoes in Ireland was 804,566 acres, but it continuously contracted each year, until in 1900 it did not exceeed 654,413 acres, or 150,163 acres less than twelve years previously.

A similar comparison for the several sections of Great Britain, as instituted in Table VI., shows that to England belongs about 96 per cent, of the wheat area, over 80 per cent, of the barley area, over 60 per cent, of the oats area, and 70 per cent, of the potato area, and these proportions do not vary much from year to year. The figures for

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cereals are important, as they indicate that it is the farmers of England who are the chief sufferers through the diminishing prices of com ; and particularly is this true of East Anglia, where corn-growing is more largely pursued than in any other part of the country. Scotland

Table VI. — Areas of Oereal and Potato Crops in Eng- land, Wales, and Scotland, and in Great Britain, in 1900.

England .

Wales

Scotland

Wheat.

Barley.

AoreB.

1,744,556 51,654 48,832

Per Cent.

94-6

2-8

2-6

Acres.

1,645,022 105,048 240,195

Per Cent.

82-7

5-3

12-0

Great Britain

1,845,042

100-0

1,990,265

100-0

England . Wales Scotland .

Oats.

Potatoes.

1,860,513 216,447 949,128

61-5

7-1

31-4

396,936

33,225

131,200

70-7

5-9

23-4

Great Britain

3,026,088

100-0

561,361

100-0

possesses nearly one-third of the area of oats and nearly one-fourth of that of potatoes. Beans are almost entirely confined to England, and this is even more the case with peas. The mangel crop also is mainly English, the summer in most parts of Scotland being neither long enough nor warm enough to bring it to maturity.

The PEODtrcE op Ceops.

Whilst the returns relating to the acreage of crops and the number of live stock in Great Britain have been ofB-cially collected in each year since 1866, the annual official estimates of the produce of the crops in the several sections of the kingdom do not extend back beyond 1885. The practice is for the Board of Agriculture to appoint local estimators, who report in the autumn as to the total production of the crops in the localities respectively assigned to them. By dividing the total production, say of wheat, in each county by the number of acres of wheat as returned by the occupiers at 4th June, the estimated average yield per acre is obtained. It is important to notice that the figures relating to total production and yield per acre are only estimates, and it is not claimed for them that they are anything more. The fact that much of the wheat to which the figures apply is still in the stack after the publication of the figures shows that the latter are essentially estimates. The total produce of any crop in a given year must depend mainly upon the acreage grown, whilst the average yield per acre will be determined chiefly by the character of the season. In Table VII. are

Table VII. — Estimated Annual Total Produce of Com Crops in the United Kingdom, 1890 to 1900 — Thousands of Bushels.

Year.

Wheat.

Barley.

OatB.

Beans.

Peas.

1890

75,994

80,794

171,295

11,860

6313

1891

74,743

79,555

166,472

10,694

5777

1892

60,775

76,939

168,181

. 7,054

5028

1893

50,913

651746

168,588

4,863

4756

1894

60,704

78,601

190,863

7,198

6229

1895

38,285

75,028

174,476

5,626

4732

1896

58,247

77,825

162,860

6,491

4979

1897

56,296

72,613

163,556

6,650

5250

1898

74,885

74,731

172,578

7,267

4858

1899

67,261

74,532

166,140

7,566

4431

1900

54,322

68,546

165,137

7,469 .

4072

shown, in thousands of bushels, the estimated produce of the corn crops of the United Kingdom in each of the years 1890 to 1900. The largest area of wheat in the period was that of 1890, and the smallest was that of 1895 ;

the same two years are seen to have been respectively those of highest and lowesttotal produce. It is noteworthy that in 1895 the country produced little more than half as much wheat as in any one of the years 1890, 1891, and 1898. The produce of barley, like that of oats, is less irregular than that of wheat, the extremes for barley being 80,794,000 bushels and 65,746,000 bushels, and those for oats, 190,863,000 bushels and 162,860,000 bushels. As to beans, the produce of 1890 was about equal to that of 1892 and 1893 together. Similar details for pota- toes, roots, and hay, brought together in Table VIII.,

Table VIII. — Estimated Annual Total Produce of Potatoes, Roots, and Hay in the United Kingdom, 1890 to 1900— Thousands of Tons.

Tear.

Potatoes.

Turnips.

Mangels.

Hay.

1890

4622

32,002

6709

14,466

1891

6090

29,742

7558

12,671

1892

5634

31,419

7428

11,567

1893

6541

31,110

5225

9,082

1894

4662

30,678

7310

15,699

1895

7065

29,221

6376

12,238

1896

6263

28,037

5875

11,416

1897

4107

29,785

7379

14,043

1898

6225

26,499

7228

15,916

1899

5837

20,370

7604

12,898

1900

4577

28,387

96^0

13,742

show that the production of potatoes varies much from year to year. The imports of potatoes into the United Kingdom vary, to some extent, inversely ; thus, the low production in 1897 was accompanied by an increase of imports from 3,921,205 cwt. in 1897 to 6,751,728 cwt. in 1898. No very great reliance can be placed upon the figures relating to turnips (which include swedes), as these are mostly fed to sheep on the ground, so that the estimates as to yield are necessarily vague. Mangels are probably more closely estimated, as these valuable roots are carted and stored for subsequent use for feeding stock. Under hay are included the produce of clover, sainfoin, and rotation grasses, and also that of permanent meadow. The extent to which the annual production of ^he leading fodder crop may vary is shown in the table by the two consecutive years 1893 and 1894 ; from only nine million tons in the former year the production rose to upwards of fifteen million tons in the latter, an increase of fully 70 per cent.

l\irning to the average yields per acre, as ascertained by dividing the number of acres into the total produce, the results of a decade are collected in Table IX. The effects of a prolonged spring and summer drought, like that of 1893, are exemplified in the circumstance that four corn crops and the

two hay crops all register their minimum average yields that year. On the other hand, the season of 1898 was exceptionally favourable to cereals and to hay. The effects of a prolonged autumn drought, as distin- guished from spring and summer drought, are shown in the very low yield of turnips in 1899. Mangels are sown earlier and have a longer period di growth than turnips ; if they become well established in the summer they are less susceptible to autumn drought. The hay made from clover, sainfoin, and grasses under rotation generally gives a bigger average yield than that from permanent grassland. The mean values at the foot of the table — ^they are not, strictly speaking, exact averages — indicate the average yields per acre in the United Kingdom to be about 30 bushels of wheat, 34 bushels of barley, 40 bushels of oats, 27 bushels of beans, 26 bushels of peas, 4|- tons of potatoes, 13 tons of turnips and swedes, 17 tons of mangels, 31 cwt. of hay from temporary grass, and 28 cwt. of hay from permanent grass. Although enormous

single crops of mangels are sometimes grown, amounting occasionally to 100 tons per acre, the general average yield of 17 tons is about 4 tons more than that of turnips and swedes. Again, although from the richest old permanent meadow lands very heavy crops of hay are taken season after season, the general average yield of permanent grass is about 3 cwt. of hay per acre less than that from clover, sainfoin, and grasses under rotation. The general average yields of the corn crops are not fairly comparable one with the other because they are given by

measure and not by weight, whereas the weight per bushel varies considerably. For purposes of comparison it would be much better if the yields of corn crops were esti- mated in cwt. per acre. This, indeed, is the practice in Ireland, and in order to incorporate the Irish figures with those for G-reat Britain so as to obtain average values for the United Kingdom, the Irish yields are calculated into bushels at the rate of 60 lb to the bushel of wheat, of beans, and of peas, 50 lb to the bushel of barley, and 39 ft to the bushel of oats.

Table IX. — Estimated Annual Average Yield per Acre of Crops in the United Kingdom, 1890-1900.

Tear.

Wheat.

Barley.

Oats.

Beans.

Peas.

Potatoes.

Turnips.

Mangels.

Hay.

. Botation.

Permanent.

.1890 1891 1892 1893 1894 1895 1896 1897 1898 1899

Mean, 1 10 yrs. /

Bnsh.

30-66 31-30 26-48 26-08 30-70 26-33 33-63 29-07 34-75 32-76

Bush.

35-23 34-72 34-78 29-30 34-77 32-09 34-16 32-91 36-24 34-64

Bush.

41-54 40-46 39-82 38-14 42-34 38-67 37-97 38:84 42-27 40-57

Bush.

32-77 29-82 22-38 19-61 29-17 22-98 25-69 28-91 31-13 30-19

Bush.

28-71 28-23 25-85 22-61 25-64 22-62 25-34 27-55 27-60 27-22

Tons.

3-53 4-74 4-45 5-23 3-82 5-64 4-93 3-47 5-23 4-82

Tone.

14-27 13-40 14-04

13-^6

13-53 13-11 12-79 13-90 12-74 9-97

Tons.

17-76 18-60 17-99 13-26 18-02 16-44 14-99 18-03 17-71 17-41

Cwt.

33-19 31-39 29-10 23-55 .35-77 , 29-08 27-95 32-53 36-49 31-04

Cwt.

30-81 28-13 23-30 20-41 33-65

V 25-21 \ 24-14

30-71 34-27 29-11

30-18

33-88

40-06

27-26

26-14

4-59

13-14

17-02

31-01

27-97

The figure denoting the general average yield per acre of any class of crop needs readjusting after every suc- cessive harvest. If a decennial period be taken, then — ^f or the purpose of the new calculation — the earliest year is omitted and the latest year added, the number of years contiuuing at ten. Adopting this course in the case of the cereal crops of Great Britain the decennial averages recorded ia Table X- are obtained, the period 1885-94

Table X. — Decennial Average Yields in Great Britain of Wheat, Barley, and Oats — Bushels per acre.

lO-Tear Periods.

Wheat.

Barley.

Oats.

1885-1894

29-32

33-02

38-21

1886-1895

28-81

32-68

38-23

1887-1896

29-49

32-82

38-13

1888-1897

29-19

32-97

38-51

1889-1898

29-86

33-26

38-86

1890-1899

30-15

33-50

38-81

being the earliest decade for which the official figures are available. It thus appears that the average yield of wheat in Great Britain, as calculated upon the crops harvested during the ten years of the ‘nineties (1890-99), exceeded 30 bushels to the acre, whereas shortly before, as for the ten years ended 1895, it fell below 29 bushels- A large expansion in the acreage of the wheat crop would probably be attended by a decline in the average yield per acre, for when a crop is shrinking in area the tendency is to with- draw from it first the land least suited to its growth. The general average for the United Kingdom might then recede to rather less than 28 bushels of 60 ft per bushel, which was for a long time the accepted average — ^unless, of course, improved methods of cultivating and manuring the soil were to increase its general wh’eat-yielding capacity.’

“> ■hiTE. Stock.

The numbers of live stock in the United Kingdom are shown at five-yearly intervals in Table XI. Under horses

1 The higher yield of wheat in recent years appears to be largely- attributable to better ^ain-growing seasons. The yields in the experi- mental wheat-field at Rothamsted — where there is no change

either of land or of treatment — indicate this. The following figures show the average yields per acre of the selected plots at Bothamsted over six

are embraced only unbroken horses a’tid horses used solely for agriculture (including mares kept for breeding). The

Table XI. — Numbers of Horses, Cattle, Sheep, and Pigs in the United Kingdom.

Tear.

Horses.

Cattle.

Sheep. >

Pigs.

1875

1,819,687

10,162,787

33,491,948

3,495,167

1880

1,929,680

9,871,153

30,239,620

2.863,488

1885

1,909,200

10,868,760

30,086,200

3,686,628

1890

1,964,911

10,789,858

31,667,195

4,362,040

1895

2,112,207

10,753,314

29,774,853

4,238,870

1900

2,000,402

11,454,902

31,054,547

3,663,669

highest and lowest annual totals for the United Kingdom in the period 1875-1900 were the following : —

Highest.

Lowest.

Difference.

Horses Cattle Sheep Pigs

2,112,207 in 1895 11,519,417 in 1892 33,642,808 in 1892

4,362,040 in 1890

1,819,687 in 1875

9,731,537 in 1877

27,448,220 in 1882

2,863,488 in 1880

292,520 1,787,880 6,194,588 1,498,552

The highest total in each case is in the ‘nineties. After the maximuip year of 1892 cattle and sheep declined continuously for three years to the totals of 1895, the diminution being mainly the result of the memorable drought of 1893. Sheep, which numbered 32,571,018 in 1878, declined continuously

to 27,448,220 in 1882— a loss of oyer five million head in five years. This was chiefly attributable to the ravages of the liver fluke which

8-yearly periods from 1852 to 1899, and afford evidence that the higher yield of the last sixteen years is due to the seasons : —

Average of- =”’t 1™” ””-

^^ per acre.

28i

284

27i

25)

29|

80

2TS

80

The average of the first thirty-two years is thus 271 bushels per acre, of the last sixteen years 30 bushels, and of the whole forty-eight years 284 bushels.

8^

1860-6T

8

1868-75

8

1876-88

8

1884-91

8

»

1892-99

82

1852-88 ....

16

..

1884-99

48

”

1852-99

PLATE 1.

Photo by C. Tadman, Stansted^ Essex.

Hackney Stallion, “Royal Danegelt. ”

1st Prize and Champion, Eoj’al Agricultural Society’s Shows, Leicester, 1896; Manchester, 1897. 1st Prize and Challenge Cup, Haclcney Horse Society’s London Show, 1898, and 1st Prize, 1S99 and 1900. The property of Sir Walter Gilbey, Bart., Elsenham Hall, Essex ; bred by Mr. H. Livesey, Eotherfield, Sussex. (Height, 15*2 hands.)

Photo by F. Babbage, 9 Robert Street, London, N. W.

Hackney Mare, “Eosadoea.”

Ist Prize, Eoyal Agricultural Society’s Show, Maidstone, 1899. Ist Prize and Champion, Hackney Horse Society’s London Shows, 1900 and 1901. The property of Mr. C. E. Galbraith, Terregles, Dumfries, N.B. ; bred by Mr. J. F. Kichardson, Norton Lodge, Malton, Yorkshire.

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AGEICULTUEE

185

began in the disastrously wet season of 1879. Pigs, being prolific breeders, fluctuate more widely in numbers tban cattle or sheep, for the difference of 1,498,552 in their case represents fully one-third of the highest total, whereas the difference is less than one-seventh for horses, less than one-sixth for cattle, and less than one-fifth for sheep. The relative proportions — as distinguished from the actual numbers — in which stock are distributed over the several sections of the United Kingdom do not vary greatly from year to year. Table XII., in which the totals for the United Kingdom include those for the Channel Islands and Isle of Man, illustrates the prepon- derance of the sheep-breeding industry in the drier climate of Great Britain and of the cattle-breeding industry in the more humid atmosphere of Ireland. In Great Britain, for every head of cattle there are about four head of sheep, whereas in Ireland the cattle slightly outnumber the sheep. Again, whilst Great Britain possesses only

Table XII. — Numbers of Horses, Cattle, Sheep, and Pigs in the United Kingdom in 1900.

1900.

Horses.

Cattle.

Sheep.

Pigs.

England . “Wales Scotland .

1,152,321 153,284 194,588

4,848,698

758,386

1,198,086

15,844,713 3,432,516 7,314,997

2,021,422 228,097 132,413

Great \ Britain /

1,500,143

6,805,170

26,592,226

2,381,932

Ireland

491,143

4,608,443

4,386,697

1,268,474

United I Kingdom i j

2,000,402

11,454,902

31,054,547

3,663,669

half as many cattle more than Ireland, she possesses six times as many sheep. The cattle population of England alone slightly exceeds that of Ireland, but cattle are more at home on the broad plains of England than amongst the hills and mountains of Wales and Scotland, which afford suitable habitat for sheep. Hence it happens that, whilst in England sheep are not four times as numerous as cattle, in Wales they are nearly five times as numerous, and in Scotland more than six times as many. Great Britain has twice as many pigs as Ireland, but the swine industry is mainly English and Irish, and England is seen to possess nearly six times as many pigs as Wales and Scotland together, the number in the last-named country being particularly small. Onfe English county alone, Suffolk, maintains more pigs than the whole of Scotland.

Imports of Live Animals and Meat.

The stock-breeders and graziers of the United Kingdom have, equally with the corn gi-owers, to face the brunt of foreign competition, the aggregate importation, free of

Table XIII. — Numbers of Cattle, Sheep, and Pigs im- ported into the United Kingdom, 1891-1900.

Year.

Cattle.

Sheep.

Pigs.

1891

507,407

344,504

542

1892

502,237

79,048

3826

1893

340,045

62,682

138

1894

475,440

484,597

8

1896

415,565

1,065,470

321

1896

562,553

769,592

4

1897

618,321

611,504

1898

569,066

663,747

450

1899

503,504

607,755

/

1900

495,645

382,833

duty, of meat in the carcase and on the hoof continuing steadily to increase. Up to 1896 store cattle were admitted

1 Including Channel Islands and Isle of Man.

into the United Kingdom for the purpose of being fattened, but under the Diseases of Animals Act of that year animals imported since then have to be slaughtered at the place of landing. The dimensions of this trade are shown in Table XIII.

The animals come mainly from the United States of America, Canada, and Argentina, and the traffic in cattle is more uniform than that, in sheep, whilst that in pigs seems to have reached extinction. The quantities of dead meat imported have increased with great rapidity, a circumstance largely due to the rise of the trade in chilled and frozen meat. Fresh beef in this form is im- ported chiefly from the United States and Australasia, fresh mutton from Australasia and Argentina.

Table XIV. shows how rapidly this trade expanded during the decade of the ‘nineties. The column headed bacon and hams indicates clearly enough that the im- ports of fresh meat did not displace those of preserved pig meat, for the latter expanded from 4,715,000 cwt. to 7,784,000 cwt. during the decade. The column for all dead meat includes not only the items tabulated, but also

Table XIV. — Quantities of Dead Meat imported into the United Kingdom, 1891-1900 — Tliousands of Cwt.

Tear.

Fresh

Fresh

Fresh

Bacon

All

Beef.

Mutton.

Pork.

and Hams.

Dead Meat.

1891

1921

1663

128

4715

9,790

1892

2080

1700

132

5135

10,500

1893

1808

1971

182

4187

9,305

1894

2104

2295

180

4819

10,610

1895

2191

2611

288

5353

11,977

1896

2660

2895

299

6009

13,347

1897

3010

3193

348

6731

14,729

1898

3101

3314

558

7684

16,445

1899

3803

3446

669

7784

17,658

1900

4128

3393

695

7444

17,912

the following, the quantities stated being those for 1900 : — Beef salted, 194,668 cwt. ; beef, otherwise pre- served, 516,529 cwt. ; preserved mutton, 64,452 cwt. ; salted pork, 248,710 cwt. ; dead rabbits, 473,167 cwt. ; meat, unenumerated, 754,114 cwt. The quantities of these are relatively small, and, excepting rabbits from Australia, they show no general tendency to increase. The extent to which these growing imports have been associated with a decline in value is shown in Table XV.

Table XV. — Average Values of Fresh Meat, Bacon, and Hams imported into the United Kingdom, 1891-1900 — Per Cwt.

Tear.

Fresh Beef. •

Fresh Mutton. •

Fresh Pork.

Bacon.

Hams.

s. d.

s. d.

8. d.

s. d.

«. d.

1891

42 r

39 6

47 6

87 11

46 4

1892

42 5

40 6

46 11

40 10

■47 4

1893

42 4

39 3

50 0

53 0

58 5

1894

40 0

37 10

48 5

48 10

49 1

1895

39 0

. 35 2

46 1

89 0

44 11

1896

37 10

32 7

45 11

34 6

43 0

1897

38 5

30 3

44 «

35 5

42 8

1898

38 2

29 7

41 10

86 2

39 6

1899

38 8

31 7

41 11

35 10

41- 5

1900

39 7

34 5

43 0

41- 9

46 10

The trend of the import trade in meat, live and dead, may be gathered from Table XVI., in which are given the annual average imports for the seven quinquennial periods embraced between 1866 and 1900. An increase in live cattle has accompanied a decrease in live sheep and pigs, but the imports of dead meat have expanded nearly f ourteen-f old over the period.

The rate at which the trade in- imported frozen mutton is increasing as compared with the industry in

home-grown mutton is illustrated in tte figures published annually by Messrs W. Weddel & Company, from which those for 1885 and for each year from 1890 to 1900 are

Table XVI. — Average Annual Imports of Cattle, Sheep, and Pigs, and of Dead Meat, into the United Kingdom over seven 5-yearly Periods.

Period.

‘ Cattle.

Sheep.

Pigs.

Dead Meat.

No.

No.

No.

Owt.

1866-70

194,947

610,300

64,827

1,155,867

1871-75

215,990

864,516

74,040

3,134,175

1876-80

272,745

938,704

44,613

5,841,913

1881-85

387,282-‘

974,316

24,355

6,012,495

1886-90

438,098

800,599

19,437

7,681,729

1891-95

448,139

407,260

967

10,436,549

1896-1900

549,818

607,086

91

15,785,854

giren in Table XVII. The home-grown is the estimated dead weight of sheep and lambs slaughtered, which is taken at 40. per cent, of the total number of sheep and lambs returned each year in the United Kingdom. In the imported column is given the weight of fresh (frozen) mutton and lamb imported, plus the estimated

Table XVII. — Home Product and Imports of Sheep and Mutton into the United Kiv/gdom — Thousands of Tons.

Tear.

Home- grown,

Imported.

Tear.

Home- grown.

Imported.

1885 1890 1891 1892 1893 1894

822 339 359 360 340 322

47 92 92 87 100 128

1895 1896 1897 1898 1899 1900

319 329 327 .333 339 332

157 164 175 182 187 179

dead weight of the sheep imported on the hoof for slaughter. The home production of mutton would appear to have reached its limit, for the quantity entered under this head for 1899 is seen to be no more than that for 1890. On the other hand, the quantity imported in 1899 is double that in 1890, and quadruple that in 1885. Moreover, in 1886 the imported product was only about one-seventh as much as the home-grown, whereas in 1890

Table XVIII. — Average Prices of Dead Meat per Stone of 8 lb at the London Central Market in 1898 and in 1899.

Description. 1898. 1899.

Beef.

s. a.

s. a.

s.

d. s. d.

Scotch, short sides

3 llto4 3

4

3to4 6

,, long sides

3 8,

, 3 10

3

11 „ 4 1

English

3 6,

,3 8

3

9„3 11

Cows and Bulls ....

2 0,

,2 8

2

0 „ 2 10

American, Birkenhead-killed

3 1,

, 3 5

3

5„ 3 8

„ Deptford-killed .

3 2,

,3 5

3

6„3 9

Argentine, Deptford-killed .

2 7,

,2 11

3

0,,3 4

American, refrigerd., hind-quarters

3 6,

,3 9

3

7 ,, 3 10

,, ,, fore-quarters

2 2,

,2 6

2

4,,2 6

Australian, frozen, hind-quarters

1 11,

,2 1

2

1,,2 4

,, ,, fore-quarters

1 6,

,1 8

1

8,,1 9

New Zealand, ,, hind-quarters

2 2,

,2 4

2

3„2 6

„ „ fore-quarters

1 8,

, 1 10

1

9 „ 1 11

MCTTON.

Scotch, prime ....

4 1,

,4 8

4

6 ;, 4 11

English, prime ....

3 10,

,4 5

4

2„4 8

Ewes

2 9,

,3 3

3

1„3 6

Continental ....

3 7,

,3 11

3

9„4 2

River Plate, town-killed .

3 0,

,3 3

3

3„3 6

New Zealand, frozen .

1 9,

,2 6

1

11 „ 2 8

Australian „ •

1 8,

, 1 10

1

10 „ 2 0

River Plate „ . . .

1 8,

,1 9

1

11„2 0

Lamb.

English

4 10,

,5 9

5

0„6 2

New Zealand, frozen .

3 1,

,3 6

2 11 „ 3 3

it was more than one-fourth, and in 1897 and each year since more than one-half. This large-import trade in fresh meat, which sprang up entirely within the last quarter of the 19th century, has placed an abundance of

cheap and wholesome food well within the reach of the great industrial populations of the United Kingdom. At the same time it cannot be gainsaid that it has opened the way to fraud, when butchers have palmed off upon their customers imported fresh meat as home-grown, and secured a dishonest profit by charging for it the prices of the latter, which are considerably in excess of those of the imported product. How wide is the margin for obtain- ing a fraudulent profit in this way is shown by the prices of home-grown and imported meat in Table XVIII. taken from the Agricultural Returns.

Many suggestions have been made to render it an offence at law for a seller to offer imported fresh meat as home-grown, but up to 1901 no legislative effect had been given to these proposals.

Sale OF Cattle by Live Weight.

In connexion with the internal live stock trade of Great Britain attention must be directed to the Markets and Fairs (Weighing of Cattle) Act, 1891. The object of this measure is to replace the old-fashioned system of guessing at the weight of an animal by the souiyier method of obtaining the exact weight by means of the weighbridge. The grazier buys and sells cattle much less frequently than the butcher buys them, so that the latter is naturally more skilled in estimating the weight of a beast through the use of the eye and the hand. The resort to the weighbridge should put both on an equality, but the method does not seem to have found much favour. Under the Act there are 15 scheduled places in England and 6 in Scotland, or 21 altogether (19 previous to 1898), from which returns are regularly obtained. The numbers of cattle weighed at these places in the seven years, 1893 to 1899, were respectively 92,492, 96,344, 100,033, 109,184, 111,767, 138,652, and 139,482, so that there was an increase of about 60 per cent, during the period. The numbers for Scotland are greater throughout than those for England. The scheduled places at which weighing appears to be most resorted to are Edinburgh, Aberdeen, and Glasgow in Scotland, and London, Shrewsbury, Carlisle, and Liverpool in England. But, as will be apparent from Table XIX., the

Table XIX. — Nos. of Cattle Weighed in Cheat Britain under the Markets and Fairs Weighing of Cattle Act,

1893-1900.

■ \

/“Tear.

Entering Markets.

Weighed.

Weighed.

No.

No.

Per Cent.

1893

1,219,208

92,492

7-59

1894

1,203,533

96,344

8-01

1895

1,186,149

100,033

8-43

1896

1,000,014

109,184

9-93

1897

1,115,183

111,767

10-02

1898

1,263,991

188,652

10-97

1899

1,236,091

139,482

11-28

1900

1,187,603

141,611

11-92

number of cattle weighed bears but an insignificant pro- portion to the total which pass through the scheduled markets. The figures given in Table XX. for the two years, 1898 and 1899, show how little use is made of the weighbridge in the sale of sheep and swine. Now that weighbridges are moderate in price and excellent in quality they are placed in most markets, so that there* is little excuse for retaining the old empirical method of sale. As the primary object of the Act is to obtain records of prices, it follows that only in so far as State- ments of the prices realized, together with the description of the animals involved, are obtained is the full advantage of the statute secured. In 1899 average prices for cattle of first or priine quality ranged from 32s. 2d. per cwt. in Leeds to 38s. per cwt. in London. Eor second quality beasts

PLATE 3.

Photo by T. Beeeley, Wantage.

Shire Stallion, “BnscOT Harold.”

1st Prize and Champion, London Shire Horse Shows, 1898, 1899, 1900. The property of, and bred by, Mr. Alexander Henderson, M.P.,

Euscot Park, Faringdon, Berks.

Photo by F. Babbage, 9 Robert Street, London, If. W.

Shire Mare, ” Stanney Commotion.”

1st Prize EoTal Aericultural Society’s Show, York, 1900. The property of Sir .1. Rlnndell Maple, Bart., M.P.. Childwiok, St. Albans ; bred by ‘ Mr. William Parker, Great Stanney Hall, Sutton, Chester.

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the range was from 28s. lOd. per cwt. in Leeds to 34s. 6d. in Edinburgh. In the case of third quality cattle the lowest average was 24s. 6d. per cwt. in Liverpool, and the highest was 31s. 8d. in Glasgow. These examples illus-

Table XX. — Nos. of Animals Weighed in 1898-99 under the Markets and Fairs (Weighing of Cattle) Act.

1898.

1899.

Cattle :—

Entering markets ....

“Weighed

Prices returned with quality distin- guished Sheep : —

Entering markets ....

Weighed

Prices returned with quality distin- guished Swine : —

Entering markets ....

Weighed

Prices returned with quality distin- guished

No.

1,263,991 138,652 102,299

4,691,619 49,953 40,460

363,370 1,614 1,437

No.

1,236,091 139,482 103,613

4,681,602 48,643 42,154

455,056 2,205 2,070

trate the kind of information which the Act is competent to elicit. The number of fat cattle which were reported as having been actually sold by live weight at an agreed-on price per cwt. or per stone — a most commendable innova- tion— ^was greater than ever before in 1899, and amounted to 16,844 head. The weighing of store cattle for sale is, like that of fat cattle, slowly extending.

Eaelt Maturity. In the fattening of animals for the butcher the princi- ple of early maturity has received full recognition. If the sole purpose for which an animal is reared is to pre- pare it for the block — and this is the case with steers amongst cattle and with wethers amongst sheep — ^the sooner it is ready for slaughter the less should be the outlay involved. During the whole time the animal is living the feeder has to pay what has been termed the ” life tax ” — ^that is, so much of the food has to go to the maintenance of the animal as a living organism, indepen- dently of that which may be undergoing conversion into what will subsequently be available in the form of beef or mutton. If a bullock can be rendered fit for the butcher at the age of two or three years, wiU. the animal repay another year’s feeding ? It has been proved at the Christmas fat stock shows that the older a bullock gets the less wOl he gain in weight per day as a result of the feeding. With regard to this point the work of the

Smithfield Club deserves recognition. This fbJ^s”””’ ^o*y ^^^ instituted in 1798 as the Smithfield

Cattle and Sheep Society, the title being changed to that of the Smithfield Club in 1802. The original object — the supply of the cattle markets of Smith- field and other places with the cheapest and best meat — is stiU kept strictly in view. The judges, in making their awards at the show held annually in December, at (since 1862) Islington, North London, are instructed to decide according to quality of flesh, lightness of offal, age, and early maturity, with no restrictions as to feed- ing, and thus to promote the primary aim of the club in encouraging the selection and breeding of the best and most useful animals for the production of meat and test- ing their capabilities in respect of early maturity. At the fijst show held (at Smithfield) in 1799, two classes were provided for cattle and two for sheep, the prizes offered amounting to £52 :10s. In 1839 the classes comprised seven for cattle, six for sheep, and one for pigs, with prizes to the amount of £300. By 1862 the classes had risen to 29 for cattle, 17 for sheep, and 4 for pigs, and the prize money to £2072. At the centenary show

in 1898 provision was made for 40 classes for cattle, 29 for sheep, 18 for pigs, and 7 for animals to be slaughtered, whUst to mark the importance of the occasion the prizes offered amounted to close upon £5000 in value. In 1900 there were 36 classes for cattle, 32 for sheep, 18 for pigs, and 7 for cattle and sheep to be slaughtered, and the value of the prizes was £3894. The sections provided for cattle are properly restricted to what may be termed the beef breeds ; in the catalogue order they are Devon, Hereford, Shorthorn, Sussex, Eed Polled, Aberdeen- Angus, Galloway, Welsh, Highland,

cross-bred, and a section for Kerry, . Dexter, and Shetland. It wUl be noticed that such characteristically milking breeds as the Ayrshire, Jersey, and Guernsey have no place here. Pro- vision is made, however, for all the well-known breeds of sheep and swine. In the cattle classes, aged beasts of huge size and of considerably over a ton in weight used to be common, but in recent years the tendency has been to reduce the upper limit of age, and thus to bring out animals ripe for the butcher in a shorter time than was formerly the case. The latest important step in this direction was taken in 1896, when the senior class for steers, viz., animals three to four years old, was abolished, the maximum age at which steers were allowed to compete for prizes being reduced to three years. The cow classes were abolished in 1897, and in the schedule of the 1900 exhibition the classes for each breed of cattle were (1) for steers not exceeding two years old, (2) for steers above – two years and not exceeding three years old, and (3) for heifers not exceeding three years old. The single excep- tion is provided by the slowly-maturing Highland breed of cattle, for which classes are allotted to (1) steers not exceeding three years old, (2) steers or oxen above three years old (with no maximum limit), and (3) heifers not exceeding four years old. As illustrating heavy weights, there were in the 1893 show, out of 310 entries of cattle, four beasts which weighed over a ton. They were all steers of three to four years old, one being a Hereford weighing 20 cwt. 2 qr. 4 lb, and the others Shorthorns weighing respectively, 20 cwt. 2 qr., 20 cwt. 3 qr. 21 lb, and 22 cwt. 2 qr. 18 lb. In the 1895 show, out of 356 entries of cattle, there were seven beasts of more than a ton in weight. They were all three to four years old, and comprised four Shorthorns (top weight 21 cwt. 1 qr.

18 lb), one Sussex (22 cwt. 3 qr. 71b), and two cross- breds (top weight 20 cwt. 3 qr. 24 lb). In the 1899 show, with 311 entries of cattle, and the age limited to three years, no beast reached the weight of a ton, the heaviest animal being a cross-bred (Aberdeen-Angus and Shorthorn) which, at three years old, turned the scale at

19 cwt. 1 qr. 5 lb. Out of 259 entries of cattle at tha show of 1900 the top weight was 19 cwt. 2 qr. 3 lb in the ease of a Eed Polled steer, aged two years and eleven months; the next being 18 cwt. 2 qr. 6 ft) for a Hereford steer two years eight and a half months old. Useful figures for purposes of comparison are obtained by divid- ing the weight of a fat beast by the number of days iu its age, the weight at birth being thrown in. The average daily gain in live weight is thus arrived at, and as the animal increases in age this average gradually diminishes, until the daily gain reaches a stage at which it does not afford any profitable return upon the food consumed. At the centenary show of the Smithfield Club in 1898 the highest average daily gains in weight amongst prize-win- ning cattle were provided by a Shorthorn-Aberdeen cross- bred steer (age, one year seven months ; daily gain, 2-47 lb) ; a Shorthorn steer (age, one year seven months ; daily gain, 2-44 lb); and an Aberdeen-Shorthorn cross-bred steer (age, one year ten months ; daily gain, 2-33 ib). These beasts, it will be observed, were all under two years old. Amongst prize steers of two and a half to three years old, on the

same occasion, the three highest daily average gains in live weight were 2-07 ft ‘for an i^berdeen-Angus, 1-99 lb for a Shorthorn-Aberdeen cross-bred, and 1 -97 for a Sussex. In the sheep section of the Smithfield show the classes for ewes were finally abolished in 1898, and the classes restricted to wethers and wether lambs, whose function is exclusively the production of meat. At the 1900 show sheep of each breed, and also cross-breds, competed as (1) wether lambs under twelve months • old, and (2) wether sheep kbove twelve and under 24 months old. The only exception was in the case of

the slowly-maturing Cheviot and mountain breeds, for which the second class was for wether sheep of any age above twelve months. Of prize sheep at the centenary show the largest average daily gain was 0-77 Bb per head given by Oxford- Hampshire cross-bred wether lambs, aged nine months two weeks. In the case of wether sheep, twelve to twenty-four months old, the highest daily increase was 0-56 per ft> per head as yielded by Lincolns, aged twenty- one months. Within the last quarter of the 19th century the stock-feeding practices of the country were much modified in accordance with these ideas of early maturity. The three-year old wethers and older oxen that used to be common in the fat stock markets are now rarely seen, excepting perhaps in the case of mountain breeds of sheep and Highland cattle. It was ia 1875 that the Smithfield Club first provided competitive classes for lambs, and in 1883 the champion plate offered for the best pen of sheep of any age in the show was for the first time won by lambs, a pen of Hampshire Downs. The young classes for bullocks were established in 1880. The time- honoured notion that an animal must have completed its growth before it could be profitably fattened is no longer held, and the improved breeds which now exist rival one another as regards the early period at which they may be made ready for the butcher, by appropriate feeding and management.

In 1895 the Smithfield Club instituted a carcase com- petition in association with its annilal show of fat stock, and it has been continued each year since. The cattle and sheep entered for this competition are shown alive on the first day, at the close of which they are slaughtered and the carcases hung up for exhibition, with details of live and dead weights. The competition thus constitutes what is termed a ” block test,” and it is instructive in affording the opportunity of seeing the quality of the carcases furnished by the several animals, and in particu- lar the relative proportion and distribution of fat and lean meat. The live animals are judged and subsequently the carcases, and, though the results sometimes agree, more often they do not. Tables are constructed showing the fasted live weight, the carcase weight, and the weight of the various parts that are separated from and not in- cluded with the carcase. An abundance of lean meat and. a moderate amount of fat well distributed constitutes a better carcase, and a more economical one for the con- sumer, than a carcase in which gross accumulations of fat are prominent. To add to the educational value of the display, information as to the methods of feeding would be desirable, as it would then be possible to correlate the quality of the meat with the mode of its manufacture. A point of high practical interest is the ratio of carcase weight to fasted live weight, and in the case of prize-winning carcases these ratios usually fluctuate within, very narrow limits. At the 1899 show, for example, the highest proportion of carcase weight to live weight was 68 per cent, in the case of an Aberdeen-Angus steer and of a Cheviot wether, whilst the lowest was 61 per cent., afforded alike by a Shorthorn-Sussex cross-bred heifer and a Mountain lamb. A familiar practical method of estimating carcase weight from live weight is to reckon one

Smitl^field stone (8 lib) of carcase for each imperial stone (14 ft) of live weight. This gives carcase weight as equal to 67 per cent, of live weight, a ratio much inferior to the best results obtained at the carcase competition promoted by the Smithfield Club. Table XXI., given as an example.

Table XXI.— Block Test, Smithfield Club Show, 1900.

Eatio of

Prize.

Description and Breed.

Fasted Live

Weight.

Carcase Weiglit.

Carcase to Live

Weight.

lb.

lb.

Per cent.

Cattle.

Steers, not over two years

old:—

1

Aberdeen-Hereford

1192

> 787

66

2

Shorthorn-Galloway

1297

843

65

3

Aberdeen-Shorthorn

Steers, two to three years old:—

1315

847

64

1

Aberdeen-Angus

1332

878

66

2

Aberdeen-Shorthorn

1381

927

67

3

Shorthorn-Galloway

Heifers, not over three years old:—

1418

897

63

1

Aberdeen-Angus

1304

817

63

3

Aberdeen-Sussex

Sheep. Longwool Lambs, not over 12 months old : —

1290

801

62

1

Devon cross

141

86

60

2

Suffolk cross

118

71

60

3

Cheviot

Longwool Wethers, 12 to 24 months old : —

123

77

63

1

Mountain

165

105

64

2

Suffolk-Cheviot

158

99

63

3

Cheviot

Shortwool Lambs, not over 12 months old : —

147

91

62

1

Southdown-Suffolk

120

81

67i

2

Hampshire Down

138

87

63^^

3

Hampshire Down

rShortwool Wethers, 12 to 24 months old : —

150

96

63

1

Norfolk-Homed

160

106

66

2

Hampshire Down

172

103

60

3

Southdown

109

68

62

relates to prize carcases in the competition at the 1900 show.

The Breeds op Live Stock.

In the last quarter of the 19th century the many native breeds of farm live stock became more clearly defined than ever, before, and various breeds which at the be- g:inning of that period had received no separate classifica- tion in showyard schedules were fully recognized before its close. As a matter of record, it is deemed desirable to notice the breeds as they stand at the beginning of the 20th century. For fuller details than it is here possible to give, the reader should consult the respective stud books, herd books, and flock books pertaining to the several breeds.

Horses.

The breeds of light horses include the Thoroughbred, the Yorkshire Coach-horse, the Cleveland Bay, the Hackney, and the pony ; of heavy horses, the Shire, the Clydesdale, and the Suffolk. The Thoroughbred is the oldest of the breeds, and it is known as the ” blood-horse ” on account of the length of time through which its purity of descent can be traced. It has sprung from the old native horses of England. In past times Arab and Turkish sires were imported for the improvement of the breed, though the use of Eastern blood has, with a few

PLATE 5.

Photo by F. Babbage, 9 Robert Street, London, ^’. W.

GcERNSET Cow, “Jessie 10th.”

1st Prize, Eoyal Agricultural Society’s Show, York, 1900. The property of, and bred by, the Hon. Mrs. A. Baillie-Hamilton,

Burley Lodge, Eingwood, Hants.

Photo by C. Reid, Wishaw, N.B.

Guernsey Bull, “Frolic 6th.”

1st Prize, Eoyal Agricultural Society’s Shows, Maidstone, 1899 ; York, 1900. The property of, and bred by, Mr. W. A. Glynn,

Seagrove, Seaview, Isle of Wight.

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exceptions, long since been, abandoned. The frame of the thoroughbred is light, slender, and graceful ; its limbs are clean cut and sinewy, its skin is fine, its hair is glossy, and its eyes are bright and intelligent. Being so highly bred it is apt to be nervous and excitable, and is sometimes unruly, but its speed, resolution, and endur- ance, as tested on the racecourse, are beyond praise. The demand for hunting horses has, during recent years, been productive of useful efforts to improve their quality by crossing thoroughbred stallions with half-bred mares, and work of this nature had been readily undertaken on many horse-breeding farms, stimulated by the premiums offered by the Eoyal Commission on Horse-breeding. A good type of hunter horse should be thick and strong on the back and loin, with long, powerful quarters and muscular thighs, and hocfes neatly shaped and clean. The head should be long, lean, and blood-like, and the eye full. A mahogany-brown colour is in high favour, then black, bay, or dark chestnut. Greys, roans, and light chestnuts ai-e less popular.

The Yorkshire Coach-horse is extensively bred in the North and East Ridings of York, and the thoroughbred has taken a share in its development. The colour is usually bay or brown, the legs being black. The mane and tail are abundant, but not curly. A fine head, sloping shoulders, strong loins, lengthy quarters, high-stepping action, flat legs, and sound feet are charadteristic. The height varies from 16 hands to 16 hands 2 inches. The Cleveland Bay is a near relation of the Yorkshire coach-horse, and is bred in various parts of Yorkshire, Durham, and Northumberland. He is adapted alike for the plough, for heavy draught, and for slow saddle work. Some specimens make imposing-looking carriage horses. The colour is light or dark bay, with clean black legs, and black mane and tail. Though rather coarse-headed, the Cleveland Bay has a well-set shoulder and neck, a deep chest, and round barrel. The height is from 16 to 17 hands.

The Hackney has come prominently to the front in recent years. The term Nag, applied to the active riding or trot- ting horse, is derived from the Anglo-Saxon knegan, to /ueigh. The Normans brought with them their own word haquen4e, or hacquenie, the French derivative from the Latin egwMs, a horse, whence the name hackney. Both nag and hackney continue to be used as synonymous terms. Frequent mention is made of hackneys and trotters in old farm accounts of the 14th century. The first note- worthy trotting hackney stallion, of the modern type, was a horse foaled about 1765, and variously known as the Schales horse, Shields, or Shales, and most of the recog- nized hackneys of to-day trace back to him. The breed- ing of hackneys is extensively pursued in the counties of Norfolk, Cambridge, Huntingdon, Lincoln, and York, and in the showyard competitions a keen but friendly rivalry is usually to be noticed between the hackney-breeding farmers of Norfolk and Yorkshire. Hackneys include both riding horses and driving horses. The aim of the breeder is to

produce an animal which is saleable at an early age, which can be bred and reared at moderate expense, and which c,an be broken in without much risk. Excellent results have followed the use of hackney sires upon half-bred mares, the latter being the offspring of thoroughbred stallions and trotting mares. As regards the movement, or, as it is termed, the ” action ” of the hackney, he should go light in hand, and the knee should be so elevated and advanced during the trot as to be seen by the rider projecting beyond the breast, whilst, before the foot is put down, the leg should be well extended. Above all, the hackney should possess good hock action, as distinguished from mere fetlock action, the propelling power depending upon the efficiency of the former. To

be classed as a hackney an animal must be over 14 hands high, that is, exceeding 56 inches.

The Pony differs essentially from the hackney in the matter of height, the former being required not to exceed 14 hands. There is, however, one exception, the nature of which is made clear in the following extract from Sir Walter Gilbey’s Ponies Past and Present, 1900 : —

Before the establishment of the Hackney Horse Society in 1883 the dividing line between the horse and the pony in England was vague and undefined. It was then found necessary to distinguish clearly between horses and ponies, and, accordingly, all animals measuring 14 hands or under were designated ” ponies,” and regis- tered in a separate part of the (Hackney) Stud Book. This record of height, with other particulars a^ to breeding, &c., serves to direct breeders in their choice of sires and dams. The standard of height established by the Hackney Horse Society was accepted and oflacially recognized by the Koyal Agricultural Society in 1889, when the prize-list for the Windsor show contained pony classes for animals not exceeding 14 hands. The altered polo-rule, which fixes the limit of height at 14 hands 2 inches, may be productive of some little confusion ; but for all other purposes 14 hands is the recognized maximum height of a pony. Prior to 1883 small horses were called indifferently Galloways, hobbies, cobs, or ponies, irrespective of their height.

Native ponies include those variously known as English, New Forest, Exmoor, Dartmoor, Cumberland and West- morland, Highland, Shetland, and Connemara, the last named comprising — according to Professor J. C. Ewart — five types, viz., Andalusian, Eastern, Cashel, Clydesdale, and Clif den. Ponies range in height from 14 hands down to 8^ or 9 hands, many Shetland ponies not exceeding the latter. As in the case of the hackney, so with the pony, thoroughbred blood has been used, and with good results. One object of the pony breeder is to control size, — to compress the most valuable qualities into the least com- pass. He endeavours to breed an animal possessing a small head, perfect shoulders, true action, and good manners. A combination of the best points of the hunter with the style and finish of the hackney produces a class of weight-carrying pony which is always saleable.

The Shire horse owes its happily-chosen name — of quite recent application, however, — to Arthur Young’s remarks, in the description of his agricultural tours during the closing years of the 18th century, concern- ing the large black old English horse, “the produce principally of the Shire counties in the heart of Eng- land.” Long previous to this, however, the word Shire, in connexion with horses, was used in the stat- utes of Henry VIII. By the various names of the War Horse, the Great Horse, the Old English Black Horse, and the Shire Horse, the breed has for centuries been cultivated in the rich fen-lands of Lincolnshire and Cambridgeshire, and in many counties to the west. The Shire is the largest of draught horses, the stallion com- monly attaining a height of 17 to 17.3 hands. Though the black colour is still frequently met with, bay and brown are more usually seen. The lighter icolours, such as chest- nut, roan, and grey, are not so much in favour. With their immense size and weight — 1800 lb to 2200 Ri^the Shires combine great strength, and they are withal docile and intelligent. They stand on short stout legs, with a plenti- ful covering — sometimes, perhaps, too abundant — of long hair extending down the back of the limbs from knees and hocks to pasterns. The head is of

medium size, and broad between the eyes. The neck is fairly long, and well arched on to the shoulders, which are deep and strong, and moderately oblique. The chest is wide and full, the back short and straight, the ribs are round and deep, the hind quarters long, level, and well let down into the mus- cular thighs. The cannon-bones should be flat, heavy, and clean, and the feet wide, tough, and prominent at the heels. A good type of Shire horse combines symmetrical

outlines and bold free action, with clean, heavy, fiat bone, and soft silky hair. Despite the introduction of the motor-car there is a good and remunerative demand for Shire geldii^gs for use as draught horses in towns.

The Clydesdale, the Scottish breed of ~~which the native home is in the valley of the Clyde, is not quite so large as the Shire, the average height of stallions being about 16 hands 2 inches. The shoulder is more oblique than in the Shire. The popular colour is bay, particularly if of a dark shade, or dappled. Black is also a common colour, but grey is not encouraged. White markings on one or more of the legs, with a white star or stripe on the face, are quite usual.' The " feathering," that is, the development of silky hair on the backs of the legs, as in the Shires, is a point to which Clydesdale breeders attach much im~~ portance, it being regarded as an indication of strong, healthy bone. The bones of the legs should be short, flat, clean, and hard. With symmetry, activity, strength, and endurance, the Clydesdale associates a good temper and willing disposition, is easily broken to harness, and makes an admirable draught horse.

The Suffolk is a horse quite distinct from the Shire and the Clydesdale, two breeds which possess many points in common. It stands altogethier lower, its body looking almost too heavy for its limbs ; it possesses a character- istic chestnut or light dun colour, and its legs are free from the " feather " which is so much admired in the two other heavy breeds. How long the Suffolks have been associated with the county after which they are named is unknown, but they are mentioned as long ago as 1586 in Camden's Britannia. With an averageTieight of about 16 hands, they often have a weight of as much as 2000 lb, and this may explain the appearance which has given rise to the name of the Suffolk Punch, by which the breed is known. If the Suffolk is not in all respects a handsome animal, he is none the less a resolute and unwearying worker, and is richly endowed with many of the best qualities of a horse.

Cattle.

The recognized breeds of cattle in the British Isles comprise the Shorthorn, Hereford, Devon, South Devon or South Hams, Sussex, Welsh, Longhorn, Red Polled, Aberdeen-Angus, Galloway, Highland, Ayrshire, Jersey, Guernsey, Kerry, and Dexter. These names — with the four exceptions of Shorthorn, Longhorn, Ked Polled, and Dexter — are geographical, and serve to indicate the " homes " of the several breeds or the places whence they originated. The Shorthorn, Hereford, Devon, South Devon, Sussex, Longhorn, and Eed Polled breeds are native to England; the Aberdeen- Angus, Galloway, High- land, and Ayrshire breeds to Scotland; and the Kerry and Dexter breeds to Ireland. The Jersey and Guernsey breeds — often spoken of as Channel Islands cattle — belong to the respective islands whose names they bear, and great care is taken to keep Jersey cattle out of Guernsey, and Guernsey cattle out of Jersey. The term Alderney is obsolete, and' no pure breed is designated by that name.

The Shorthorn is the most widely distributed of all the breeds of cattle, both at home and a;broad. No census of breeds ‘ has ever been taken in the United Kingdom, but such an enumeration would show the Shorthorn far to exceed in numbers any other breed, whilst the great majority of cross-bred cattle contain Shorthorn blood. During the last quarter of the 18th century the brothers Charles Colling (1751-1836) and Eobert Colling (1749- 1820) set to work, by careful selection and breeding, to

1 In 1900 the bulls of Ireland were for the first time enumerated. There were 8406 Shorthorns, 764 Aberdeen- Angus, 376 Kerries, 329 Herefords, 116 Red Polled, 103 Dexters, 66 Channel Islands, and 4126 others and cross-breds ; total, 14,286.

improve the cattle of the Teeswater district in the county of Durham. If the Shorthorn did not actually originate thus, it is indisputable that the efforts of the CoUings had a profound influence upon the fortunes of the breed. It is still termed the Durham breed in most parts of the world except the land of its birth, and the geographical name is far preferable, for the term ” shorthorn,” describes no characteristic which is not shared by a number of other breeds. Other skilled breeders turned their attention to the Shorthorns and established famous strains, the de- scendants of which can be traced down to the present day. By Thomas Booth, who dwelt at Killerby and Warlaby in Yorkshire, the “Booth” strains of Short- horns were originated. Similarly, by Thomas Bates, of Kirklevington in Yorkshire, the ” Bates ” families were established.^ When Shorthorn breeders of to-day talk of ” Booth blood,” or of ” Bates blood,” they refer to animals descended from the respective herds of Thomas Booth and Thomas Bates.

Shorthorns are sometimes spoken of as the ubiquitous breed, and also as the ” red, white, and roan ” breed. The roan colour is very popular, and the full red has its supporters, as in the case of the Lincolnshire Bed Short- horns ; unbroken white is not much in favour. The striking characteristic of the Shorthorn is the ease with which it adapts itself to varying conditions of soil, climate, and management. Add to this that the breed is equally noted both for its beef -making and its milk-yielding pro- perties, and — serving as it thus does the dual purpose- it is not difBeult to see why the Shorthorn is so extensively bred over such wide areas. Its importance exceeds that of any other breed, whether it be viewed as a grazier’s beast or a dairyman’s cow. Shorthorns may be seen at nearly all the fairs and cattle markets of Great Britain and Ireland, a statement’ that can be made of no other breed. For crossing purposes, for the production of beef- cattle, the Shorthorn is unrivalled.

The culmination of what may be termed the Booth and Bates period was in the year 1875, when the sales took place of Lord Dunmore’s and Mr. William Torr’s herds, which realized extraordinary prices. In that black year of farming, 1879, prices were declining, and continued to do so till within the last few years of the close of the 19th century, when there set in a gradual revival, stimulated largely by the commercial prosperity of the country. The result of extremely high prices when line-bred animals were in fashion was a tendency to breed from all kinds of animals that were of the same tribe, without selection. Consequently, a deterioration set in, which was aggravated by the overlooking of the milking properties. Shorthorn breeders thus came to see that a change of blood was necessary. Meanwhile, for many years breeders in Aber- deenshire had been holding annual sales of young bulls and heifers from their herds. The late Mr Amos Cruickshank began his annual sales in the ‘forties, and the late Mr W. T. Talbot-Crosbie had annual sales from his Shorthorn herd in the south-west of Ireland for a number of years. .Many Aberdeen farmers emigrated to Canada, and bought Shorthorn calves in their native county to take with them. The Cruickshanks held their bull sqles at that time, and numerous animals were bought by the small breeders in Canada. This continued until 1875, when the Cruick- shanks had so much private demand that they discon- tinued their public sales. Subsequently, when Messrs Cruickshank sold their herd privately to Messrs Nelson for exportation the animals could not all be shipped, and

^C. J. Bates, “The Brothers Colling,” Jour. Soy. Agric. Soc. 1899. s. » »

‘ C. J. Bates, Thomas Bates and the Kirklevington Shorthorns : a Contribution to the History of Pure Durham Cattle. Newcastle- upon-Tyne, 1897.

PLATE 7.

Shorthorn Cow, “Cicely.”

Eoyal Counties Agricultural Society’s Show, WindBor; lat Prize and Champion, Royal Agricultural Society’s Show, Maidstone; >n, Highland and Agricultural Society’s Show, Edinburgh. In 1900, Ist Prize and Champion, Eoyal Counties Agricultural Society’s

In 1899, 1st Prize,

Ist Prize and Champion, __-„ „ „ . „ ...

Show, Winchester ; 1st Prize and Champion, Birmingham Cattle Show ; 1st Prize and Shorthorn Champion, Smithfleld Club Show. The property of, and bred by. Her Majesty Queen Victoria, the Prince Consort’s Shaw Farm, Windsor.

Shorthorn Bull, “Royal Duke.” In 1899 lat Prize, Highland and Agricultural Society’s Show, Edinburgh. In 1900, 1st Prize and Chammon, Royal Dublin Society’s Show, Koyal Counties Agricultural Society’s Show at Winchester, Royal Agricultural Society’s Show at York, and Highland and Agricultural Society’s Show at Stirling. The property of, and bred by, Her Majesty Queen Victoria, the Prince Consort’s Shaw Farm, Windsor.

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Mr Duthie, of CoUyhie, Aberdeenshire, bought some of the older cows, whilst Mr Deane Willis, of Bapton Manor, Wilts, bought the yearling heifers. Mr Duthie thereupon resumed the sales that the Cruickshauks had relinquished, his averages being £30 in 1892, about £50 in 1893-94, and £80 in 1895. These prices advanced through English breeders requiring a little change of blood; and also through the increasing tendency to exhibit animals of great substance, or rather to feed animals for show. The success of this movement has strengthened the demand, whilst an inquiry for this line of blood has arisen in the United States and Canada. A faithful contemporary history of the Shorthorn breed is to be found in Thornton’’ s Circular, which is published quarterly and dates Isack to

1868.

The Hereford breed is maintained chiefly in Hereford- shire and the adjoining counties. Whilst a full red is the general colour of the body, the Herefords are distin- guished by their white faces, white chest and abdomen, and white mane. The legs up to the knee or hock are also often white. The horns are moderately long, springing straight from the head in the bull, and turning somewhat forward and upward in the cow. Herefords, though they rear their own calves, have acquired but little fame as dairy cattle. They are, however, very hardy, and produce beef of excellent quality. As, moreover, they are docile they fatten easily and readily, and as graziers’ beasts they are in high favour.

The Devon cattle — the ” Rubies of the West,” as they are termed, in allusion to their colour— are reared chiefly in Devon and Somerset. The colour is a whole red, its depth or richness varying with the individual, and in summer becoming mottled with darker spots. The De- vons stand somewhat low ; they are neat, compact, and plump, and possess admirable symmetry. Whilst they do not attain the size of the Shorthorn or the Hereford, yet, taking their height into consideration, they perhaps weigh better than either. In the male animal the thick- set horns project straight out at right angles to the rest of the body ; in the female they are more slender, and often curve neatly upwards. Being fine-limbed, active animals, they are well adapted for grazing the poor pas- tures of their native hills, and they turn their food to the best account, yielding excellent beef. They have not yet attained much celebrity as milch kine, for, though their milk is of first-class quality, its quantity is usually small. Latterly, -however, the milking qualities have received moi^ attention from breeders, whose object is to qualify the Devon as a dual-purpose breed.

The South D^von or South Hams cattle are almost re- stricted to that southern part of the county of Devon known as the Hams, whence they are also called- ” Ham- mers.” With a somewhat ungainly head, lemon-yellow hair, yellow skin, and large but hardly handsome udder, the South Devon breed bears far more resemblance to the Guernseys than to the trim-built cattle of the hills of North Devon. The cows are heavy milkers, and furnish excellent butter. They are rarely seen outside their locality, and seldom appear in the showyards.

The Sussex breed, named after its native county, re- sembles the Devon in many respects. The Sussex cattle, however, are bigger, less refined in appearance, less grace- ful in outline, and of a deeper brown-chestnut colour than the Devons, — the “dainty Devons,” as the latter may well be called in comparison with, the massive animals of the Sussex breed. As a hardy race, capable of thriving on poor rough pastures, the Sussex are highly valued in their native districts, where they have been rapidly im- proved in recent years. They are “essentially a’ beef- producing breed, the cows having little reputation as milkers. By stall-feeding they can be ripened off for the

butcher at an early age. The Sussex cattle are said to ” die well,” that is, to yield a large proportion of meat in the best parts of the carcase.

In the Welsh breed of cattle black is the prevailing colour, and the horns are long. They do not mature very rapidly, but some of them grow eventually into big ponderous beasts, and their beef is of prime quality. In Wales several varieties are recognized — the Anglesey, Pembroke, Glamorgan — and the cows often acquire con- siderable reputation as milkers. As graziers’ beasts Welsh cattle are well known in the midland counties of Eng- land, where, under the name of Welsh runts, large herds of bullocks are fattened upon the pastures, or ” topped up ” in the yards in winter.

In the Longhom breed of cattle the interest is largely historical. It was with the Longhorns that the famous Eobert Bakewell, of Dishley, Leicestershire (1726-95), gave evidence of his remarkable skill as an improver of cattle in the middle of the 18th century.’ At one period the Longhorns were widely spread in England and Ireland, but, as the Shorthorns extended their do- main, the longhorned cattle made way for them. Long- horns are to be seen in the midland counties of England, chiefly in Warwickshire. They are big, rather clumsy animals, with long drooping horns, which are very objectionable in these days of cattle transport by rail and sea, and which sometimes grow in such a fashion as to prevent the animals from grazing. The bullocks feed up to high weights, and the cows are fair milkers. No lover of cattle can view these quaint creatures with- out a feeling of satisfaction that efforts are being made to resuscitate a breed which has many useful qualities to commend it.

The Bed Polled is the only hornless breed of English cattle, and, though an old breed, it is within quite recent years that it has come into prominence. These cattle were formerly known as the East

Anglian Polls, and later as the Norfolk and Suffolk Polled cattle, being confined chiefly to the two counties named. They are symmetri- cally-built animals, of medium size, and 6f uniformly red colour. They have a tuft of hair on the poll, or upper part of the forehead. Of the native breeds of England, the Red Polled have acquired the highest distinction as dairy cattle, and are noted for the length of the period during which they continue in milk. Not less are they valued as beef-producers, amd, as they are hardy and docile, they fatten readily and mature fairly early. Hence, like the Shorthorn, they may claim to be a dual-purpose breed. As beef cattle they are always seen to advantage at the Norwich Christmas cattle show, held annually in November.

The Aberdeen-Angus breed belongs to Aberdeenshire and adjacent parts of Scotland, but many herds are main- tained in England and some in Ireland. They possess glossy black coats (occasionally red), have no horns, and are often termed ” Doddies.” They attain great size and weight, make first-class beasts for the butcher, and yield beef of excellent quality. The cross between the Short- horn and the Aberdeen-Angus, known as the “Blue Grey,” is a “favourite in the meat markets.

The Galloways are named from the district in the south- west of Scotland to which they are native. Like the Aberdeen-Angus cattle, the Galloways are hornless, and normally of a black colour. But the Galloway, with its thicker hide and shaggy hair, suited to a wet climate, has* a coarser appearance than the Aberdeen-Angus, the pro- duct of a less humid region, though it approaches the latter in size. The Galloways yield superior beef, but they mature less rapidly than the Aberdeen- Angus. The

1 Honsman, ” Eobert Bakewell,” Jour. Soy. Agric. Soc. 1894.

Galloways make admirable beasts for the grazier, and the Siross between the Galloway and the Shorthorn, also known as ” Blue Grey,” is much sought after by the butcher.

The Highland breed — termed also the West Highland and the Kyloe — is perhaps the most picturesque of the breeds of British cattle. Their home is amidst the wild romantic scenery of the Highland counties and Western Isles of Scotland, thougli herds of them may be seen in various English parks. There is no hardier breed. In their native haunts they live exposed to all weathers, and thrive upon scanty herbage which they gather with great effort. They have not made much progress towards early maturity, but their slowly ripened beef is of the choicest quality. Whilst they are not often remarkable for size, they look larger than they really are on account of the thick shaggy hair in which they are enveloped. The colour varies from light dun, or tawny yellow, to black. Their long, handsomely curved horns are set widely apart.

The Ayrshires are the dairy breed of Scotland, where they have considerably overstepped the limits of the humid western county whence they take their name. They are usually of a white and brown colour, the patches being well defined. Sometimes the brown is replaced by red, and any one of the colours may prevail to the exclu- sion of the others. The neat, shapely, upstanding horns, with a peculiar curve upwards at the tip, are character- istic. The Ayrshires are of medium size and are graceful movers, and the females have the wedge-shape possessed by typical dairy cows. They are a hardy breed, and give good yields of milk even from poor pastures. The milk of the Ayrshires is especially usefid for cheesemaking purposes.

The Jerseys are a breed of graceful, deer-like cattle whose home is in the island of Jersey, where, by means of stringent regulations against the importation of cattle, the breed has been kept pure for many generations. As its milk is especially rich in fat, the Jersey has attained a wide reputation as a butter- producing breed. It is a great favourite in England, where many pure-bred herds exist. The colours most preferred are the light silver- grey, the brown, and the fawn; brindled markings are very rarely seen. The white zone behind the black muzzle gives to these cattle the appearance in respect of which they are sometimes termed "^mealy-mouthed." The horns are short, and generally curve inwards ; the bones are fine. The best milch cows have a yellowish circle round the eye, and the skin at the extremity of the tail of a deep yellow, almost orange, colour. The Jersey cattle possess peculiarities of colour not seen in any other breed in the British Isles. The cows are gentle and docile, but the bulls, despite their small size, are often fierce.

The Guernsey cattle have their native homes in the islands of Guernsey, Alderney, Sark, and Herm, and they are kept pure there by the same kinds of restrictions as are adopted in Jersey for the protection of the native breed of that island. Herds of pure-bred Guernseys exist in the Isle of Wight and in various southern counties of England. They have not the refined and elegant appear- ance of the Jerseys,, which, however, they exceed in size. They are usually of a rich yellowish-brown colour, patched with white, whilst in some cases their colour almost merits the appellation of " orange and .lemon." The yellow colour inside the ears is a point always looked for •by judges. ■ The cows, large-bellied and narrow in front, are truly wedge-shaped, the greatly developed milk-bag adding to the expanse of the hinder part of the body. They yield an abundance of milk, rich in fat, so that, like the Jerseys, they are excellent butter-producers. The horns are yellow at the base, curved, and not coarse. The nose is free from black markings, whereas, in the Jerseys,

there is, as has just b'een stated, a dark muzzle, encircled by a light colour, thus giving a "mealy-mouthed" ap- pearance.

The Kerry is a breed of small black cattle belonging to the south-west of Ireland, whence they have spread into many parts, not only of their native land, but of England as well. Although they are able to subsist on the roughest and scantiest of fare, and are exceedingly hardy, the cows are, nevertheless, excellent milkers, and have acquired celebrity as. a dairy breed. The colour is black, but the cows sometimes have a little white on the udder. The horns are white, with black tip, and are turned upwards. The Kerry is active and graceful, long and lithe in body, and light-limbed.

The Dexter breed is an offshoot of the Kerry, its origin being attributed to Mr Dexter, who is credited with having established it, by selection and breeding from the best mountain types of the Kerry. Until recently it was called the Dexter Kerry. It is smaller, shorter in the leg, and more compact than the Kerry, and gains in plumpness what it loses in elegance. Whilst valuable as a beef-making animal, it is equally noted for its milk- producing capacity. Black is the usual colour, but red is also recognized, with, in either case, a little white. When of a red colour, its appearance has been aptly com- pared to that of a grand Shorthorn viewed through the wrong end of a telescope. The Kerry and the Dexter are readily distinguishable. The Kerry has a light, deer- like head and horn, light limbs, with ribs, hips, and shoulders well set, thin skin, straight back, light, well-set tail, with long brush. The Dexter has, as has just been intimated, yery much the character of a diminutive Short- horn, with short strong legs, square body, flat back, thick shoulder^ short neck, and well-set head and horn.

The breeds of cattle which are more especially note- worthy as beef-makers include the Shorthorn, Hereford, Devon, Sussex, Welsh, Aberdeen-Angus, Galloway, and Highland. As milk-producers, and therefore as dairy cattle, the Shorthorn, South Devon, Longhorn, Red Polled, Ayrshire, Jersey, Guernsey, Kerry, and Dexter breeds have acquired eminence. Such breeds as the Shorthorn, Devon, Welsh, B.ed Polled, and Dexter are claimed as useful both for beef -making 'and for milk-producing,

and are hence regarded as serving the dual purpose. As re- gards colour, red is characteristic of the Hereford, Devon, Sussex, and Eed Polled. Black is the dominating colour of the Welsh, Aberdeen-Angus, Galloway, Kerry, and Dexter. A yellowish colour is seen in the Guernsey and South Devon breeds. Various shades of fawn colour are usual in the Jersey cattle. The Herefords, though with red bodies, have white faces, manes, and dew-laps, whilst white prevails to a greater or less extent in the Shorthorn, Longhorn, and Ayrshire breeds. The Shorthorn breed is exceedingly variable in colour ; pure-bred specimens may be red, or white, or roan, or may be marked with two or more of these colours, the roan resulting from a blending of the white and red. Black is not seen in a pure-bred Shorthorn. With respect to size and weight, the biggest and heaviest cattle come from the beef -making breeds, and are often cross-bred. Very large beasts, if pure-bred,' usually belong to one or other of the Shorthorn, Here- ford, Sussex, Welsh, Aberdeen-Angus, and Galloway breeds. The Devon, Red Polled, and Guernsey are medium-sized cattle; the Ayrshires are smaller. The Jerseys are small, graceful cattle, but the Kerries and Dexters furnish the smallest cattle of the British Isles.

Sheep.

The sheep native to the British Isles may be classified as longwool, shortwool, and mountain breeds. The long- wool breeds are the Leicester, Border Leicester, Cotswold,

PLATE 9.

Photo by A. E. Coe^ Norwich.

Ked Polled Bull, '-Redmond'' The property of Mr. Garrett Taylor, Trowse House, Norwich ; bred by Mr. J. J. Colman, Carrow House, Norwich.

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Photo by F. Babbage, 9 Robert Street, London, N. W.

South Devon Bull, “County Councillok.”

1st Prize, Bath and West Society’s Show, Exeter, 1899. The property of Mr. T. B. Bolitho, M.P., Trewldden, Penzance ; bred by

Mr. J. P. Garland, Stockadon, Aveton Gifford.

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Lincoln, Kentishi, Devon Longwool, South Devon, Wens- leydale, and Eoscommon. The shortwool breeds are the Oxford Down, Southdown, Shropshire, Hampshire Down, Suffolk, Ryeland, Somerset and Dorset Horned, and Clun Forest. The mountain breeds include the Cheviot, Black- faced Mountain, Herdwick, Lonk, Dartmoor, Exmoor, Welsh Mountain, and Limestone. These breeds are all English, except the Border Leicester, Cheviot and Black- faced Mountain, which belong to Scotland; the Welsh Mountain, which belongs to Wales ; and the Roscommon, which is Irish. The true mountain breeds are homed sheep — usually the males only in the case of the Cheviot, the Herdwick, and the Welsh, though many Cheviot rams are hornless. In the only other horned breed, the Somerset and Dorset, both sexes are furnished with horns. The remaining breeds are hornless. The white-faced breeds include the Leicester, Border Leicester, Lincoln, Kentish, Cheviot, Ryeland, Devon Longwool, South De- von, Somerset and Dorset Horned, Dartmoor, Exmoor, and Roscommon. Black faces characterize the Hamp- shire Down and the Suffolk, whilst some amount of black is seen on the faces of the Black-faced Mountain and the Lonk.

The Leicester, though sparsely distributed now, is of high interest in that it was the breed which Robert Bake- well took in hand in the 18th century, and greatly improved by the exercise of his skill and jildgment. Bake well lived at Dishley Grange, Leicestershire, and in France th^ Leicester sheep are still called Dishleys. In past times Leicester blood was extensively employed in the improvement or establishment of other breeds of sheep. The Leicester, as seen now, has a long tapering head, projecting horizontally forwards ; rather long, thin ears pointing backwards ; a full broad breast ; fine clean legs standing well apart ; deep round barrel, with the sides diminishing in width towards the rump ; thin, soft skin, covered with fine white wool ; and the top of the head protected by close short wool. The breed is maintained pure upon the rich pastures of Leicestershire, Yorkshire, and adjacent counties, but its chief value is for crossing, when it is found to promote maturity and to improve the fattening propensity.

The Border Leicester originated after the death in 1795 of Bakewell, when the Leicester breed, as it then existed, diverged into two branches. The one is represented by the breed still known in England as the Leicester. The other, bred on the Scottish Borders, acquired the name of Border Leicester. The characteristics of the latter are a sharp profile, with dark, full nostrils, black muzzle, well- set ears, and hair on the face and poll pure white ; back broad and muscular, belly well covered with wool ; legs clean, and a fleece of fairly long white wool.

The Cotswold is an old-established breed of the Glouces- tershire hills, extending thence into Oxfordshire. They are big, handsome sheep, with finely-arched necks and graceful carriage. With their broad, straight backs, curved ribs, and capacious quarters, they carry a great weight of carcase

upon clean, wide-standing legs. The white silky fleece of long wavy wool gives the Cotswold an attractive appearance, which is enhanced by its stylish topknot or forelock. The mutton of the Cotswolds is not of high quality, but the sheep are useful for crossing purposes, as tiiey impart size.

The lAncoJ^n breed is descended from the old native breed of Lincolnshire, improved by the use of Leicester blood. The Lincolns are a hardy, prolific breed, but do not quite equal the Cotswolds in size. They have larger, bolder heads than the Leicesters. Breeders of Lincoln rams like a darkish face, with a few dark spots on the ears. The legs should be white. The wool has a broad staple, and is denser, longer, and the fleece heavier, than

in the Leicester. In 1898 Mr Henry Dudding, Riby Grove, Lincolnshire, obtained at auction the sum of 1000 guineas for a Lincoln ram bred by. him, this being the highest price ever paid for a sheep in the United King- dom. He secured the same price again for a ram in 1900.

The Kentish or Bomney Marsh is a somewhat local breed, native to the rich tract of grazing land on the south coast of Kent. They are hardy, white-faced sheep, with a close-coated longwool fleece.

The Oxford Down is a modern breed which owes its origin to the cross-breeding of longwool and shortwool sheep, the former being Cotswolds and the latter Hamp- shire Downs and Southdowns. Although it has inherited the forelock from its longwool ancestors, it approximates, more nearly to the shortwool type, and is accordingly classified as such. An Oxford Down ram has a bold masculine head; a poll well covered with wool, and adorned by a topknot ; ears self-coloured, upright, and of fair length; face of uniform dark brown colour; legs ‘ short, dark in colour, and free from spots ; back level and chest wide; and the fleece heavy and thick. The breed is popular in Oxford and other midland counties.

The Southdown was formerly known as the Sussex Down, as it was from the short, close pastures upon the chalky soils of the South Downs in Sussex that the breed sprang. In past times it did for the improvement of the shortwool breeds of sheep very much the same kind of work that the Leicester performed in the case of the long- wool breeds. A pure-bred Southdown sheep has a small head, with a light brown or brownish grey (often mouse- coloured) face, fiiie bone, and a symmetrical, well-fleshed body. The legs are short and neat, the animal being of small size compared with the other Down sheep. The fleece is of fine, close, short wool, and the mutton is excellent.

The Shropshire is descended from the old native sheep of the Salopian hills, improved by the use of Southdown blood. Though heavier in fleece and a bulkier animal, the Shropshire has resemblance to an enlarged Southdown. As distinguished from the latter, however, the Shropshire has a darker face, blackish brown as a rule, with very neat ears, whilst its head is more massive, and is better covered with wool on the top and at the sides. This breed has made rapid strides in recent. years, and it has acquired favour in Scotland and Ireland as well as abroad.

The Hampshire Down is another breed which owes much of its improved character to an infusion of South- down blood. Early in the 19th century the old Wiltshire horned sheep and the Berkshire Knot roamed over the Downs of their native counties. .Both these old-fashioned types have disappeared, but their descendants are seen in the modern Hampshire Down, which originated in a cross with the Southdown. Early, maturity , and great size have been the objects aimed at and attained, this breed, more perhaps than any other, being identified with early maturity. Whilst heavier than the Shropshire, the Hamp- shire Down sheep is less symmetrical. The Hampshire Downs have black faces and legs, big heads with Roman nose, darkish ears set well back, and a broad level back nicely filled in with lean meat. The mutton of the Down breeds is of superior quality.

The Suffolk is another modern breed, which probably took its origin in the crossing of improved Southdown rams with the old horned Norfolk ewes. The character- istics of the latter are still retained in the black face and legs of the Suffolk, but the horns have been improved away. The fleece is moderately short, the wool being of close, fine, lustrous fibre, without any tendency to mat together. The limbs, woolled to the knees and hocks, are clean below. In general appearance the Suffolk is like

tlie Hampshire Down, from which it differs in the rather darker face, head legs covered with wool, and the nose of a less pronounced Eoman type.

The Cheviot takes its name from the range of hills extending along the boundary between England and Scotland, on both sides of which the breed now extends, though its origin has to be sought in Northumberland. The Cheviot is a hardy sheep with straight wool, of moderate length and very close-set, whilst wiry white hair covers the face and legs.

The Black-faced Mountain breed is chiefly reared in Scotland^ but it is doubtful whether its origin is English or Scottish. Their greater hardiness, as compared with the Cheviots, has brought them into favour upon the higher grounds of the north of England and of Scotland, where they thrive upon coarse and exposed grazing lands. The colour of face and legs in this hancdy mountain breed is well-defined black and white, the black predoiuinating. The horns are low at the crown, with a dear space between the roots, and sweep away in a wide curve, sloping slightly’ backwards^ and quite clear of the cheek. Thef ashionable fl«ece is deep, hairy, and strong, and’ of uniform Equality throughout.

The LonTc has its home amongst the hills of Lancashire and Yorkshire, and it is the largest of the mountain breeds. It bears most resemblance to the Black-faced Mountain sheep, but carries a finer,: heavier fleece, and is larger in head and body. Its face and legs are mottled white and black, and its horns are handsome. The tail is long and rough.

The Herdwick is a hardy breed thriving upon the poor mountain land in Cumberland and Westmorland. The rams sometimes have curved horns. The colour of these sheep is white, with a few darkish spots here and there ; the faces and legs are often speckled. The wool, is strong, coarse, and open, and inclined to be hairy about the neck. The forehead has a topknot, and the tail is broad and bushy.

The Wensleyddle takes its name from the Yorkshire dale (Yoredale) of which Thirsk is the centre. The Wenslfeydales are longwool sheep, derived from the old Teeswater breed by crossing with Leicester rams. They are dark-faced, and the head is broad and flat, with a tuft of wool on the forehead. -The skin is blue, fine, and soft, whilst the wool has a bright lustre, is curled in .all parts of the body, and is of uniform staple. The fore-legs are set well apart; and the hind-legs have a little ‘fine wool below the hock.

The Limestone is a breed of which little is heard. It is almost restricted to the fells of Westmorland,’ and is probably nearly related to the Black-faced Mountain breed. The so-called ” Limestones ” of the Derbyshire hills are really Leicestersw

The Welsh Mountain is a small, active, soft-wooUed, white-faced breed of hardy character. The’ legs are often brownish, and this coloiir may extend to the’ face. Horns may or may not be present. The mutton is of excellent quality.

The Glun Forest is a loCal breed in Wefet Shropshire and the adjacent part of Wales. It is descended .from the old tan-fa,ced sheep that once occupied the district, and has been much crossed with the Shropshire ■ sheep, but its wool is rather coarser than that of the latter. ■ The first cross with the Shropshire is a favburite with butchers.

The Byeland breed is so named from the Eyelands, a poor upland district in Herefordshire. It is a very old breed, against which the Shropshires have made substan- tial headway. The Eyeland sheep are small, hornless, have white faces and legs, and remarkably fine short wool, with a topknot on the forehead.

The Somerset a.ndi Borset Home^ is a,n old west-country breed of sheep. The fleece is of close texture, and the wool is intermediate between long and short, whilst the head carries a forelock. Both sexes have horns, which are very much coiled in the ram. The muzzle, legs, and hoofs are white ; the nostrils are pink. This is a hardy breed, in size somewhat exceeding the Southdown. Two crops of lambs in a year are sometimes obtained from the ewes, the winter lambs being dropped from October onwards.

The Devon- Longwool is a breed locally developed in the valleys of West .Somerset, North and ‘East Devon, and parts of Cornwall. It originated in a strong infusion of Leicester blood amongst the old Bampton stock of Devon- shire. The Devon Longwool is not. unlike the Lincoln, but is coarser. It is white-faced, with a lock of wool on the forehead.

The South Devon or Sotith Hams are, like the cattle of that name, a strictly local breed, which likewise exem- plify’ the good results of crossing with the Leicesters. The South Devons have a fairly fine silky fleece of long staple. . , , :

The Dartmoor is a hornless, longwool, white-fleeced sheep, with a long whitish face like that of the Leicester. It is a hardy local- Devonshire breed, and is much larger than the Exmoor.

. The Eocmoor. is a horned breed of Devonshire moorland sheepi probably of direct descent from thfe old forest or mountain breeds of England. They ha.ve white legs and faces and black nostrils. The horns curl more closely against the head than in the Somerset and Dorset breed. The Exmoors are delicately formed about the head and neck, and they have a close, fine fleece of short wool. They are very hardy, and yield mutton of choice flavour.

The Roscommon — the one breed of modern sheep native to Ireland — is indebted for its good qualities largely to the use of Leicester blood. It is a big-bodied sheep, carry- ing a long, wavy, silky fleece. It ranges mainly from the middle of Ireland westwards.

Pigs.

The classification of the native breeds of pigs compares unfavourably with that of either cattle or sheep, and in .many parts, of England there are nondescript animals which it would be difficult to. assign to any; of the recog- nised breeds. The latter include the Large White, Middle White, arid Small White, which were all formerly em- braced under the general term of Yorkshires, and are still so called in^ other countries. The Berkshire and the so- called Black breeds ‘(Suffolk or Essex) are black, and the Tarn worths are red.

The Large. Whites often have a few blue spots in the skin. The head is of fair length, light in the jowls, and wide between the eyes, with somewhat drooping ears. The neck is long, but not coarse, the ribs are deep, the loin is wide and level, the tail is set high, and the legs are straight and set well outside the carcase. The whole body is covered with; straight silky hair, which denotes quality and lean meat. Pigs of this breed are very prolific, and they may be grown to enormous weights.

The MyMle Whites are built on a smaller scale than the Large Whites. They are shorter in the heads and legs, thicker and more compact in the body, and have a denser clothing of silky hair. The sows are quite as prolific as those of the Large White breed, and, as their produce matures earlier, they are much in demand for breeding porkers.

The Small White pigs are much smaller than the Middle Whites. The head and legs are very short, and the body, which is short, thick, and wide, is close to the ground. The jowls are heavy, the ears are pricked, and the thin skin

PLATE 11.

Photo by R. H. Lord^ Cambridge,

Dexteh Bull, “Little John” (at 9 months old) .

The property of, and bred by, His Majesty King; Edward VH., Sandringham, Norfolk.

Phcto by R. B. Lord, Cambridge.

Dexter Cow, “Baba.”

1st Prize and Champion, Eoyal Agricultural Society’s Shows, Cambridge, 1894 ; Maidstone, 1899. The property of His Majesty King Edward VII., Sandringham, Norfolk; breeder unknown.

kingdom]

is laden with long silky hair, wavy, but not curly, whilst the tail is very fine. A deficiency of lean meat is a common characteristic of the breed.

The STiiaU Black (Suffolk or Essex) breed resembles the Small White, except that the skin is coal-black in colour, and the coat of hair is not usually profuse. The Small Black, moreover, is rather longer, and stands some- what higher, whilst it yields more lean meat than the Small White. It matures early and is quick to fatten. A closely similax pig to this of the eastern counties of England thrives in Dorset, Devon, and Cornwall.

The Large Black breed has only recently received show- yard recognition, but it is claimed that there is ample evidence that, with its characteristic whole colour, length, fine hair, lop ear, and grefit grazing capacity, the Large Black existed in many parts of England long previously to the memory of any of the present generation of breeders. It has been continuously and carefully bred in Cornwall, Devon, Essex, Suffolk, and more recently in Yorkshire, Somerset, Norfolk, and Hampshire. Large Blacks are exceedingly docile, and the natural carriage of the ears, well forward over the eyes, is said to contribute materially to a quietness of habit which renders them peculiarly adapted to field

grazing. On account of their hardiness and disposition to early maturity they have proved valu- able for crossing purposes in Cumberland, Yorkshire, and other counties. The Large Black Pig Society was incor- porated so recently as 1899.

The Berkshire, though a black pig, usually has a white blaze or mark down the face, a white tip to the tail, and feet white up to the ankle joint. It has a moderately short head with heavy jowls, a deep carcase, wide, low, and well-developed hind-quarters, with he§,vy hams. The skin is free from rucks and lines, and carries an abundance of fine hair.

The Tamworth is one of the oldest breeds of pigs. The colour is red, with darkish spots on the skin. The head, body, and legs are long, and the ribs are deep and flat. Originally a local breed in the districts around the Staf- fordshire town from which it takes its name, it is now much more extensively bred, and is valued as a bacon

pig-

The enormous imports of bacon and hams into the United Kingdom — amounting in the year 1900 to 7,443,918 cwt., valued at £15,996,786— has led to the bestowal of greater attention upon the bacon-producing industry at home. In spite of all foreign competition, English bacon and hams command the highest prices, for there is something in the English method of feeding and curing which is equivalent to an addition of so many shillings per cwt. to the price. Much information on this subject is contained in the papers ^ by Mr L. M. Douglas, which may be consulted for fuller details.

Bkeed Societies.

A noteworthy feature of the closing decades of the 19th century was the formation of voluntary associations of stockbreeders, with the object of promoting the interests of the respective breeds of live stock. As a typical ex- ample of these organizations the Shire Horse Society may be mentioned. It was incorporated in 1878 to improve and promote the breeding of the Shire or old English race of cart horses, and to effect the distribution of sound and healthy sires throughout the country. Up to the year 1901 inclusive the society had held twenty-two annual shows in London, and had distributed prizes of an aggre- gate value of nearly £19,000, besides offering gold and

1 “Bacon Curing,” Jour. Soy. Agric. Sac, 1898 ; and “The Con- struction of a Modern Bacon Factory,” Ibid. 1900.

silver medals for competition amongst Shire horses at agri- cultural shows in different parts of the country. Twenty- two annual volumes of the Shire Horse Stud Book had been published, recording the pedigrees of 19,276 stallions and 34,578 mares, or a total of 63,853 animals. In 1901 the society possessed more than 3000 members, paying an annual subscription of one guinea, or a life composi- tion of ten guineas. It is out of the funds thus obtained that the society has carried on a work of high national im- portance, and has effected a marked improvement in the character and quality of the Shire horse. What has thus voluntarily been done in England would in most other countries be left to the state, or would not be attempted at all. It is hardly necessary to say that the Shire Horse Society has never received a penny of public money, nor has any other of the voluntary breeders’ societies. The Hackney Horse Society and the Hunters’ Improvement Society are conducted on much the same lines as the Shire Horse Society, and, like it, they each hold a show in Lon- don in the spring of the year and publish an annual vol- ume. Other horse-breeders’ associations, all doing useful work in the interests of their respective breeds, are the Suffolk Horse Society, the Clydesdale Horse Society, the Yorkshire Coach Horse Soqiety, the Cleveland Bay Horse Society, the Polo Pony Society, the Shetland Pony Stud Book Society, and the Association for the Improvement of New Forest Ponies.

Thoroughbred race-horses are regis- tered in the General Stud Book. The Royal Commission on Horse Breeding, which dates from 1887, is, as its name implies, not a voluntary organization. Through the commission the money previously spent upon Queen's Plates is offered in the form of " Queen's Premiums " (" King's Premiums " in 1901 and subsequent years) of £160 each for thoroughbred stallions, on condition that each stallion winning a premium shall serve not less than fifty half-bred mares, if required. The winning stallions are distributed in districts throughout Great Britain, and the use of these selected sires has resulted in a decided improvement in the quality of half-bred horses. The annual show of the Eoyal Commission on Horse Breeding is held in London jointly and concurrently with those of the Hunters' Improvement Society and the Polo Pony Society. At the 1901 show 29 premiums of £160 were offered for thoroughbred stallions over 4 years old and not exceeding 20 years.

Of organizations of cattle-breeders the English Jersey Cattle Society, established in 1878, may be taken as an illustrative type. It offers prizes in butter-test competi- tions and milking trials at various agricultural shows, and publishes the English Herd Book and Register of Pure-bred Jersey Cattle, of which the tenth volume was issued in 1899. This volume records the births in the herds of members of the society, and gives the pedigrees of 1178 cows and 337 bulls, besides furnishing lists of prize-winners at the principal shows and butter-test awards, and reports of sales by auction of Jersey cattle. Other cattle societies, all weU caring for the interests of their respective breeds, are the Sliorthorn Society of Great Britain and Ireland, the Lincolnshire Red Short- horn Association, the Hereford Herd Book Society, the Hereford Cattle Breeders' Association (the two last- named are now amalgamated), the Devon Cattle Breeders' Society, the South Devon Herd Book Society, the Sussex Herd Book Society, the Longhorned Cattle Society, the Red Polled Society, the English Guernsey Cattle Society, the English Kerry and Dexter Cattle Society, the North Wales Black Cattle Society, the Polled Cattle Society (for the Aberdeen-Angus breed), the English Aberdeen- Angus Cattle Association, the Galloway Cattle Socieiy, the Ayrshire Cattle Herd Book Society, and the Highland Cattle Society of Scotland.

In the case of sheep the National Sheep Breeders' Association looks after the interests of flockmasters in general, whilst most of the pure breeds are represented also by separate organizations. The Hampshire Down Sheep Breeders' Association may be taken as a type of the latter, its principal object being to encourage the breeding of Hampshire Down sheep at home and abroad, and to maintain the purity of the breed. It publishes an annual Flock Book, the first volume of which appeared in 1890. In this book are named the recognized and pure- bred sires which have been used, and ewes which have been bred from, whilst there are also registered the pedi- grees of such sheep as are proved to be eligible for entry. Prizes are offered by the society at various agricultural shows where Hampshire Down sheep are exhibitejd. Other sheep societies include the Leicester Sheep Breeders' Association, the Cotswold Sheep Society, the Lincoln Longwool Sheep Breeders' Association, the Oxford Down Sheep Breeders' Association, the Shropshire Sheep Breed- ers' Association and Flock Book Society, the Southdown Sheep Society, the Suffolk Sheep Society, the Border Leicester Sheep Breeders' Society, the Wensleydale Long- wool Sheep Breeders' Association and Flock Book Soci- ety, the Incorporated Wensleydale Blue-faced Sheep Breeders' Association and Flock Book Society, the Kent Sheep Breeders' Association, the Devon Longwool Sheep Breeders' Society, the Dorset Horn Sheep Breeders' Asso- ciation, the Cheviot Sheep Society, and the Eoscommon Sheep Breeders' Association.

The interests of pig breeders are the care of the National Pig Breeders' Association, in addition to which there exist the British Berkshire Society and the Large Black Pig Society.

The addresses of the secretaries of the various live- stock societies in the United Kingdom are published annually in the Live Stock Journal Almanac.

The Maintenance of the Health op Live Stock.

It was not tin the closing decade of the 19th century that the stock-breeders of the United Kingdom found themselves in a position to prosecute their industry free from the fear of the introduction of contagious disease through the medium of store animals imported from abroad for fattening on the native pastures. ' By the Dis- eases of Animals Act, 1896 (69 & 60 Vict. c. 15), it was provided that cattle, sheep, and pigs imported into the United Kingdom should be slaughtered at the place of landing. The effect was to reduce to a minimum the risk of the introduction of disease amongst the herds and flocks of the coimtry, and at the same time to confine the trade in store stock exclusively to the breeders of Great Britain and Ireland. This arrangement makes no differ- ence to the food-supply of the people, for dead meat con- tinues to arrive at British ports in ever-increasing quan- tity. Moreover, live animals are admitted freely from certain countries, provided such animals are slaughtered at the place of landing. At Deptf ord, for example, large numbers of cattle and sheep which thus arrive — ^mainly from Argentina, Canada, and the United States — are at once slaughtered, and so furnish a steady supply of fresh- killed beef and mutton. The animals -w^hich are shipped in this way are necessarily of the best quality, because the freight on a superior beast is no more costly than on an inferior one, and the proportion of freight to sale price is therefore less. With this superior description of butchers' stock all classes of home-grown stock — good, bad, and indifferent — have, of course, to compete. The Board of Agriculture has the power to close the ports of the United Kingdom against live animals from any country in which

contagious disease is known to exist. This accounts for the circumstance that so few countries — none of them in Europe — enjoy the privilege of sending live animals to British ports. So recently as 1900, the discovery early in that year of the existence of foot-and-mouth disease amongst cattle and sheep shipped from Argentina to the United Kingdom led to the issue of an order, by which all British ports were closed against live animals from the country named. This order came into force on 30th April, and was still in operation a year later, with the result that there was a marked decline in the shipments of live cattle and sheep from the feiver Plate, but a de- cided increase in the quantity of frozen meat sent thence to the United Kingdom.

The last quarter of the 19th century witnessed an im- portant change in the attitude of public opinion towards legislative control over the contagious diseases of animals. When, after the introduction of cattle plague or rinder- pest in 1865, the proposal was made to resort to the ex- treme remedy of slaughter in order to check the ravages of a disease which was pursuing its course with ruinous results, the idea was received with public indignation and denounced as barbarous. Views have undergone profound modification since then, and the most drastic remedy has come to be regarded as the most effective, and in the long run the least costly. The Cattle Diseases Prevention Act, 1866 (29 & 30 Vict. c. 2), made compulsory the slaughter of diseased cattle, and permitted the slaughter of cattle which had, been exposed to infection, compen- sation being provided out of the rates. The Act 30 & 31 Vict. c. 125, 1867, is of historical interest, in that it con- tains the first mention of pleuro-pneumonia, and the ex- posure in any market of cattle suffering from that disease was made an offence. The Contagious Diseases (Ani- mals) Act, 1869 (32 & 33 Vict. c. 70), revoked all former Acts, and defined disease to mean cattle plague, pleuro- pneumonia, foot-and-mouth disease, sheep-pox, sheep-scab, and glanders, together with any disease which the Privy Council might by order specify. The principle of this Act in regard to foreign animals was that of free importa^ tion, with

power for the Privy Council to prohibit or subject to quarantine and slaughter, as circumstances seemed to require. The Act of 1869 was at that time the most complete measure that had ever been passed for dealing with diseases of animals. The re-introduction of cattle plague into England in 1877 led to the passing of the Act 41 & 42 Vict. c. 74, 1878, which repealed the Act of 1869, and affirmed as a principle the landing of foreign animals for slaughter only, though free importa- tion or quarantine on the one hand and prohibition on the other were provid.ed for in exceptional circumstances. By an Order of Coimcil which came into operation in December 1878, swine fever was declared to be a disease for the purposes of the Act of that year. It was not, however, till October 1886 that anthrax and rabies were officially declared to be contagious diseases for the pur- poses of certain sections of the Act of 1878. In 1884 the Act 47 & 48 Vict. c. 13 empowered the Privy Council to prohibit the landing of animals from any country in respect of which the circumstances were not such as to afford reasonable security against the introduction of foot- and-mouth disease. After one or two other measures of minor importance came the Act 63 & 54 Vict. c. 14, known as the Pleuro-pneumonia Act of 1890, which transferred the powers of local authorities to slaughter and pay com- pensation in cases of pleuro-pneumonia to the Board of Agriculture, and provided further for the payment of such compensation out of money specifically voted by Parliament. This measure was regarded at the time as a marked step in advance, and was only carried after a vigorous campaign in its favour. In 1892, by the Act

Photo by C. Rod, Wishato, N.B.

CoTSwoLD Ram.

Ist Prize, Royal Agricultural Society's Sliow, Warwick, 1892. The property of, and bred by, Mr. Robert Game, Aldsworth, Northleach, Gloucestershire.

Photo 6y C. Seid, Wishaw, N.B.

Oxford Down Ram.

1st Prize, Eoyal Agricaltaral Society's Show, York, 1900. The property of, and bred by, Mr. James T. Hobbs, Maisey Hampton, Fairford, Gloucestershire.

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65 & 66 Vict. c. 47, power was giYen to the Board of Agriculture to use the sums voted on account of pleuro- pneumonia for paying the costs involved in dealing with foot-and-mouth disease ; under this Act the Board could order the slaughter of diseased animals and of animals in contact with these, and could pay compensation for animals so slaughtered. Under the provisions of the Contagious Diseases (Animals) Act, 1893 (56 & 57 Vict. c. 43) swine fever in Great Britain was, from 1st Novem- ber in that yeq,r, dealt with by the Board of Agriculture in the same way as pleuio-pneumonia, the slaughter of infected swine being carried out under directions from the central authority, and compensation allowed from the imperial exchequer. In 1894 was passed the Diseases of Animals Act (67 & 68 Vict. c. 67), the word " contagious " being omitted from the title. This was a measure to con- solidate the Contagious Diseases (Animals) Acts, 1878 to 1893. In it " the expression ' disease ' means cattle plague (that is to say, rinderpest, or the disease commonly called cattle plague), contagious pleuro-pneumonia of cattle (in this Act called pleuro-pneumonia), foot-and-mouth disease, sheep-pox, sheep-scab, or swine fever (that is to say, the disease known as

typhoid fever of swine, soldier purples, red disease, hog cholera or swinS plague).” The Diseases of Animals Act, 1896 (69 & 60 Vict. c. 16)— the last of the series of such Acts passed in the 19th century — ren- dered compulsory the slaughter of imported live stock at the place of landing, a boon for which British stock- breeders had striven for many years. The ports in Great Britain at which foreign animals may be landed are Bristol, Cardiff, Glasgow, Hull, Liverpool, London, Man- chester, and Newcastle-upon-Tyne. Animals from the Channel Islands may be landed at Southampton.

The Diseases of Animals.

Under the Diseases of Animals Acts, 1894 and 1896, weekly returns are issued by the Board of Agriculture of outbreaks of anthrax, foot-and-mouth disease, glanders (including farcy), pleuro-pneumonia, rabies, and swine fever in the counties of Great Britain ; also monthly returns of outbreaks of sheep-scab. There is a popular notion that tuberculosis is included amongst the diseases scheduled under the Diseases of Animals Act, but this is not (1901) the case.

Cattle plague, or rinderpest, has not been recorded in Great Britain since 1877. In that year there were 47 outbreaks distributed over five counties, and involviug 263 head of cattle.

The course of foot-andrmouth disease in Great Britain between 1877 and 1900 inclusive is told in Table XXII.,

Table XXII. — Ovibreaks of FooUand-Mouth Disease in Great Britain, 1877 to 1900.

Tear.

Counties.

Outbreaks.

Animals attacked.

Otlier

Cattle.

Sheep.

Swine.

Animals.

1877

55

858

5,640

7,405

2,099

1878

46

235

912

8,609

245

1879

29

137

261

15,681

5

1880

38

1,461

20,918

9,572

1,886

2

1881

49

4,833

59,484

117,152

6,330

80

1882

49

1,970

23,973

11,412

2,564

1

1883

75

18,732

219,289

217,492

24,332

32

1884

55

949

12,186

14,174

1,860

1

1885

10

30

354

34

30

1886

1

1

10

1892

16

95

1,248

3,412

107

1893

2

2′

30

1894

3

3

7

261

1900

9

21

214

50

2

both inclusive, are omitted, because there was no out- break during those periods. The disease is seen to have attained its maximum virulence in 1883.

Sheep-scab, a loathsome skin disease due to an acarian parasite, is in a most unsatisfactory position in Great Britain. Table XXIII. shows the number of outbreaks,

Table XXIII. — Outbreaks of Sheep-Scab in Great Britain, 1877 to 1900.

Tear.

Counties.

Outbreaks.

Tear.

GountieB.

Outbreaks.

1877

77

3214

1889

75

1207

1878

75

2385

1890

75

1506

1879

83

2229

1891

80

2250

1880

70

1556

1892

82

2821

1881

77

2055

1893

86

2603

1882

78

2234

1894

84

2811

1883

73

1898

1895

88

3092

1884

73

1509

1896

79

3536

1885

69

1512

1897

80

2191

1886

74

1602

1898

79

2514

1887

75

1596

1899

79

2056

1888

72

1260

1900

78

1939

and the number of counties over which they were distri- buted, in each year from 1877 to 1900. The outbreaks are seen to have been more numerous in the decade of the ‘nineties than in that of the ‘eighties, though possibly this may have been due to greater official activity in the later period. The

number of sheep attacked each year has ranged between 68,715 in 1877 and 18,762 in 1888. It is compulsory on owners to notify the authorities as to the existence of scab amongst their sheep, but there is no general or well-defined method of suppressing the dis- order, and the periodical dipping of sheep for the destruc- tion of the scab parasite is not obligatory. Each year the disorder runs a similar course, the outbreaks dwind- . ling to a minimum in the summer months, June to August, and attaining a maximum in the winter months, Decem- ber to February. It is chiefly in the ” flying ” flocks and not in the breeding flocks that the disease is rife, and it is so easily communicable that a drove of scab-infested sheep passing along a road may leave behind them traces sufficient to set up the disorder in a drove of healthy sheep that may follow. For its size and in relation to its sheep population, Wales harbours the disease to a far greater extent than the other divisions of Great Britain, as the following numbers of outbreaks in the three years 1898 to 1900 serve to show :—

Tear.-

England.

Wales.

Scotland.

Great Britain.

1898 1899 1900

Total, 3 years .

Per cent. .

1342

1123

932

1038 791 917

185

142

90

2515, 2056 1939

3397 52

2746

43

^

367

6510 100

from which the years 1887 to 1891 and 1895 to 1899,

The fatal disease known as anthrax did not form the subject of ofiicial returns previous to the passing of the Anthrax Order of 1886. Isolated outbreaks are of common occurrence, and from the totals for Great Britain given in Table XXIV. it would appear that there is little prospect of the eradication of this bacterial disorder.

Glanders (including farcy) has been the subject, during the twenty-four years 1877 to 1900, of outbreaks in Great Britain ranging between a minimum of 518 in 1877 and a maximum of 1657 in 1892; in the former year 768 horses were attacked, and in the latter 3001. A recru- descence of the disease marked the closing years of the 19th century, the outbreaks having been 748 in 1898, 863 in 1899, and 1119 in 1900. The counties of Great Britain over which the annual outbreaks have been

distributed have ranged between 24 in 1890 and 62 in 1879. As a matter of fact, bowever, tbe disease is

Table XXIV. — Outbreaks of Anthrax in Great Britain, 1887 to 1900.

Animals attacked.

Year

Counties.

Outbreaks.

Cattle.

Sheep.

Swine.

Horses.

1887

51

236

415

37

184

1888

49

180

280

45

76

18891

46

167

236

4

69

1890

48

152

■253

72

210

1891

60

226

300

15

156

1892

60

289

446

11

190

18932

68

663

833

108

313

46

1894

64

494

625

125

188

62

1896

66

434

604

158

140

32

1896

64

488

632

34

200

38

1897

67

433

521

89

284

38

1898

73

556

634

22

161

39

1899

67

534

634

69

253

30

1900

74

571

668

40

204

44

strongly centred upon the metropolitan area, more than half of the outbreaks being reported from the county of London alone.

The Rabies Order was passed in 1886, and the num- ber of counties in Great Britain in which cases of rabies in dogs have been reported in each subsequent year is shown in Table XXV. In addition there have been some cases of rabies in animals other than dogs. The disease was very rife in 1895, but the extensive applicar tion of the muzzling restrictions of the Board of Agri- culture was accompanied by so steady a diminution in the

Table XXV. — Cases of Rabies in Dogs in Great Britain,

1887*0 -1900.

Tear.

Counties.

Oases.

Year.

Counties.

Gases.

1887

28

217

1894

17

248

1888

19

160

1895

29

672

1889

20

312

1896

41

438

1890

20

129

1897

30

151

1891

17

79

1898

10

17

1892

12

38

1899

4

9

1893

18

93

1900

2

6

prevalence of the disease that it was thought the latter had been extirpated. The entire revocation of the muz- zling order which accordingly followed proved, however, to be premature, and it became necessary to reimpose it in the districts where it had last been operative, namely, certain parts of South Wales.

Pleuro-pneumonia in Great Britain was dealt with by the local authorities up to the year 1890. Between 1870 and 1889 the aimual outbreaks had ranged between a minimum of 312 in 1884 and a maximwm of 3262 in 1874, the largest number of cattle attacked in any one year being 7983 in 1872. The largest number of counties over which the outbreaks were distributed was 72 in 1873. On 1st September 1890, the Board of Agricul- ture assumed powers with respect to pleuro-pneumonia under the Diseases of Animals Act of that year. Their administration was attended by success, for from 192 out- breaks in Great Britain in 1891 the total fell to 35 in 1892, and to nine in 1893. In the four subsequent years, 1893 to 1897, the outbreaks numbered two, one, two, and seven respectively. In January 1898 an outbreak was discovered in a London cow-shed. This proved to be the last case in the 19th- century of what at one time had been a veritable scourge to cattle-owners, and a source of heavy financial loss.

1 In 1889 the animals attacked Included 461 deer.

2 Before 1893, horses, asses, and mules were not included in the ‘Word ” animals ” in the Orders relating to anthrax.

The record of m]ine fever va. Great Britain is discourag- ing. Between 1879 and 1892 inclusive, the administration was entrusted to local authorities. The largest number of outbreaks reported in any one of those years was 7926 in 1885, and the smallest 1717 in 1881. In 1893 the Board of Agriculture took over the management, and Table XXVI. shows the number of counties in which

Table XXVI. — Outbreaks of Svnne Fever in Great Britain, 1894 to 1900.

Tear.

CoUntieB.

Outbreaks Confirmed.

Swine Slaughtered as Diseased,

OT as haying been Exposed to

Infeotlon.

1894 1895 1896 1897 1898 1899 1900

73 73

77 74 72 71 62

5682 6305 5166 2155 2514 2322 1940

66,296 , 69,931 79,686

40,482 ■

43,756 30,797 17,938

swine fever existed, the number of outbreaks confirmed, and the number of swine slaughtered by order of the Board in each year since. The trouble with this disease is mainly in England, the outbreaks in Wales and Scot- land being comparatively few. What are termed ” Swine- fever infected areas ” are scheduled by the Board when and where circumstances seem to require, and the move- ment of swine within such areas is prohibited, much inconvenience to trade resulting from restrictions of this kind. Frequently, moreover, the exhibition of pigs at agricultural shows has to be abandoned in consequence of these swine-fever regulations.

The TrAde in Live Stock between Ireland and Great Britain. ,

The compulsory slaughter at the place of landing does not extend to animals shipped from Ireland into Great Britain, and this is a matter of the highest importance to Irish stockbreeders, who find their best market close at hand on the east of St George’s Channel. Table XXVII.

Table XXVII. — Imports of Live Stock from Ireland into Great Britain, 1891 to 1900.

Tear.

Cattle.

Sheep.

Pigs.

Horses.

1891

630,802

893,176

503,584

33,396

1892

624,457

1,080,202

500,961

82,481

1893

688,669

1,107,960

456,571

30,390

1894

826,954

957,101

584,967

83,689

1895

791,607

652,578

547,220

34,560

1896

681,560

737,306

610,589

39,856

1897

746,012

804,515

695,307

38,422

1898

803,862

833,458

588,786

38,804

1899

772,272

871,953

688,553

42,087

1900

745,519

862,263

715,202

85,606

shows the numbers of cattle, sheep, and pigs shipped from Ireland into Great Britain in each of the ten years 1891 to 1900, the numbers of horses similarly shipped being also indicated. On the average rather more than half the total of cattle is made up of store animals for fattening or breeding purposes, the fattening of Irish stores being a business of considerable magnitude in Norfolk and other counties. Calves constitute about one-twelfth of the total number of cattle. Most of the pigs sent from Ireland into Great Britain are fat,- the store pigs accounting for less thg,n one-tenth of the total number. The returns froin Ireland under the Diseases of Animals Acts, 1894 and 1896, are less significant than those of Great Britain. Thus, in 1900, they included 2 outbreaks of anthrax, 10 of glanders, 233 of swine fever, and 645 of sheep-scab, together with 16 cases of rabies. Compared with the export trade in live stock from Ireland

PLATE 15.

Photo by C. Reid, Wishaw, N.B.

Heedwick Ram. 1st Prize, Royal Agricultural Society’s Show, York, 1900. The property of, and bred by, Mr, John Kothery, Palace Howe, Cockermouth, Cumberland.

Pholo by C. Reid, Wishaw, X.B.

Kentish or Rohnet Marsh Rah.

l6t Prize, Eoyal Agricaltural Society’s Show, York, 1900. The property of, and bred by, Mr. Frederick Neame, Macknade, raverBham, Kent.

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to Great Britain the reciprocal trade from Great Britain to Ireland is small, and is largely restricted to animals for breeding purposes. Owing to the reappearance of foot- and-mouth disease in Great Britain early in 1900 the im- portation of cattle, sheep, goats, and swine therefrom into Ireland was temporarily suspended by the authorities in the latter country.

ExpoKTS OF Animals prom the United Kingdom.

The general export trade of the United Kingdom in living animals represents an aggregate average annual value, over the five years 1896 to 1900, of £1,017^000. To this sum of rather more than one million sterling the value of horses alone contributes three-fourths, Belgium taking more than half the number of exported horses. The export trade in cattle, sheep, and pigs is practically restricted to pedigree animals required for breeding pur- poses, and though its aggregate value is not large it is of considerable importance to stockbreeders, as it is a fre- quent occurrence for buyers for export — to Argentina, Australasia, Canada, the United States, and, elsewhere — to bid freely at the sale rings, and often to pay the highest prices, thus stimulating the sales and encouraging the breeding of the best types of native stock. Details for the five years 1896 to 1900 are summarised in Table XXVIII.

Table XXVIII. — Quantities and Vaivss of Some-bred Live Stock ea^orted from the United Kingdom, 1896 to 1900.

Tear.

Horses.

Cattle.

Sheep.

Pigs.

Other Animals.

No.

No.

No.

No.

No.

1896

29,414

4,369

9,512

359

31,151

1897

34,471

3,776

11,569

214

42,654

1898

36,412

2,861

10,224

434

■ 57,376

1899

33,701

2,979

7,586

938

56,381

1900

30,645

2,784

5,044

440

73,692

£

£

£

£

£

1896

671,332

122,004

107,507

2847

38,123

1897

825,246

119,548

141,714

1700

43,744

1898

842,106

94,414

120,310

3231

43,923

1899

757,079

118,294

78,103

5281

4.3,723

1900

680,943

120,042

54,799

3052

45,100

Cbops and Cbopping.

The greater freedom of cropping and the less close adherence to the formal system of rotation of crops, which characterized the later years of the 19th century, rest upon a scientific basis. Experimental inquiry has done much to enlighten the farmer as to the requirements of plant-life, and to enable hiTn to see how best to meet these require- ments in the case of field crops. He cannot afford to ignore the results that have been gradually accumulated — the truths that have been slowly established — at the agri- cultural experiment stations in various parts of the world. Of these stations the greatest, and the oldest now existing, is that at Eothamsted, Harpenden, Herts, England ; and it will be expedient before discussing the lessons which Eothamsted has taught, to refer briefly to the origin and scope of the work of a centre of investigation the name of which is known and honoured in all countries where progressive agriculture is practised. The agricultural experiment station at Eothamsted was founded in 1843 by the late Sir John Bennet Lawes, and maintained at his own expense ; whilst he made provision for its continuance by putting in trust during his life- time £100,000, the laboratories, and certain areas of land, which since 1889 have been administered by the Lawes Agricultural Trust Committee. Sir J. Henry Gilbert be- came associated with Sir John Lawes in 1843 as director of the chemical laboratory, and the collaboration thus com- menced was terminated only by the death of the founder

Rotbam-

on 31st August 1900. The results of more than half a century of sustained experimental inquiry have been com- municated to the world by Lawes and Gilbert in about 130 separate papers or reports, many of which were pub- lished, from 1847 onwards, in the Journal of the Boyal Agricultural Society of England.

Two main lines of inquiry have been followed, the one relating to plants, the other to animals. In the case of plants the method of procedure has been to grow some of the most important crops of rotation, each separately year after year, for many years in succession on the same land, (a) without manure, (6) with farmyard manure, and (c) with a great variety of chemical manures ; the same

description of manure being, as a rule, applied year after year on the same plot. Experiments on an actual course of rotation, without manure, and with different manures, have also been made. Wheat, barley, oats, beans, clover, and other leguminous plants, turnips, sugar beet, mangels, potatoes, and grass crops have thus been experimented upon. Incidentally there have been extensive sampling and analysing of soils, investigations into rainfall and the composition of drainage waters, inquiries, into the amount of water transpired by plants, and experiments on the assimilation of free nitrogen.

Amongst the field experiments there is, perhaps, not one of more universal interest than that in which wheat has been grown for fifty-seven years in succession, (a) without manure, (6) with farmyard manure, and (c) with various artificial manures. The results show that, unlike legumin- ous crops such as beans or clover, wheat may be success- fully grown for many years in succession on ordinary arable land, provided suitable manures be applied, and the land be kept clean. Even without manure, the aver- age produce over forty-six years, 1852-97, was nearly thirteen bushels per acre, or more than the average yield of the whole of the United States of America, including their rich prairie lands — in fact, about the average yield per acre of the wheat lands of the whole world. Mineral manures alone give very little increase, nitrogenous ma^ nures alone considerably more than mineral manures alone, but the mixture of the two considerably more than either separately. In one case, indeed, the average produce by mixed mineral and nitrogenous manure was more than that by the annual application of farmyard manure ; and in seven out of the ten cases in which such mixtures were used thie average yield per acre was from over two to over eight bushels more than the average yield of th6 United Kingdom (assuming this to be about twenty-eight bushels of 60 lb per bushel) under ordinary rotation. It is estimated that the reduction in yield of the unmanured plot over the forty years, 1852-91, after the growth of the crops without manure during the eight preceding years, was, provided it had been uniform throughout, equivalent to a decline of one-sixth of a bushel from year to year due to exhaustion — that is, irrespectively of fluctuations due to season. It is related that a visitor from the United States, talking to Sir John Lawes, said, ” Americans have learnt more from this field than from any other agricul- tural experiment in the world.”

Another field experiment of singular interest is that relating to the mixed herbage of permanent meadow, for which seven acres of old grass land were set apart in Eothamsted Park in 1856. Of the twenty plots into which this land is divided, two have been left without manure from the commencement, two received ordinary farmyard manure for a series of years, whilst the remainder have each received a different description of artificial or chemical manure, the same being, except in special cases, applied year after year on the same plot. No one can inspect this field during the growing season without being impressed by the striking evidence it affords of the influ-

enee of different manurial dressings. So much, indeed, does the character of the herbage vary from plot to plot that the effect may fairly be described as kaleidoscopic. Repeated analyses have shown how greatly both the botanical constitution and the chemical composition of the mixed herbage vary according to the description of manure applied. They have further shown how domi- nant is the influence of season. Such, moreover, is the influence of different manures that the gross produce of the mixed herbage is totally different on the respective plots according to the manure employed, both as to the proportion of the various species composing it, and as to their condition of development and maturity.

The experiments with farm animals began in 1847, and amongst the points that “have been investigated are the following:; — (1) The amount of food, and of its several constituents, consumed (a) in relation to a given live weight of animal within a given time, (6) to produce a given amoimt of increase in live weight. (2) The propor- tion and relative development of the different organs, or parts, of different animals. (3) The proximate and ulti- mate composition of the animals in different conditions as to age and fatness, and the probable composition of their increase in live weight during the fattening pro- cess. (4) The composition of the solid and liquid excreta (the manure) in relation to that of the food consumed. ^) The loss or expenditure of constituents by respiration . and the cutaneous exhalations — ^that is, ^ in the mere . sustenance of the living meat-and-manure^ making machine. (6) The yield of milk in relation to the food consumed to produce it; and the influence of different descriptions of food on the quantity and on the composition of the milk.

Incidentally, the results obtained from these inquiries have furnished data essential to the consideration of such problems as (a) the sources in the food of the fat produced in the animal body ; (6) the characteristic demands of the animal body — for nitrogenous or non-nitrogenous constitu- ents of food — ^in the exercise of muscular power ; (c) the comparative characters of animal and vegetable food in human dietaries.

In proceeding to discuss the various classes of crops, it will be convenient to deal with them under the three separate heads of root-crops, cereal crops, and leguminous crops, and then to inquire into their inter-relations when grown in rotation.

Boot-Crops. — ^Experiments upon root-crops — chiefly white turnips, Swedish turnips (swedes), and mangels — ^have resulted in the establishment of the following conclusions. Both the quantity and the quality of the produce, and consequently its feeding value, must depend greatly upon the selection of the best description of roots to be grown, and on the character and the amount of the manures, and especially on the amount of nitro- genous manure employed. At the same time, no hard and fast rules can be laid down concerning these points. Independently of the necessary consideration of the gen- eral economy of the farm,- the choice must be influenced partly by the character of the soil, but very much more by that of the climate. Judgment founded on knowledge and aided by careful observation, both in the field and in the feeding-shed, must be relied upon as the guide of the practical farmer. Over and above the great advantage arising from the opportunity’ which the growth of root- crops affords for the cleaning of the land, the benefits of growing the root-crop in rotation are due (1) to the large amount of manure applied for its growth, (2) to the large ■ residue of the manure left in the soil for future crops, (3) to the large amount of matter at once returned as manure again in the leaves, (4) to the large amount of

food produced, and (5) to the small proportion of the most important manurial constituents of the roots which is retained by store or fattening animals consum- ing them, the rest returning as manure again ; though, when roots are consumed for the production of milk, a much larger proportion of the constituents is lost to the manure.

Cereal Crops — Barley and Wlieat. — Experiments upon the growth of barley for nearly fifty years in succession on rather heavy ordinary arable soil have resulted in show- ing that the produce by mineral manures alone is larger than that without manure; that nitrogenous manures alone give more produce than mineral manures alone ; and that mixtures of mineral and nitrogenous manure giye much more than either used alone — generally twice, or more than twice, as much as mineral manures alone. Of mineral constituents, whether used alone or in mixture with nitrogenous manures, phosphates are much more effective than mixtures of salts of potash, soda, and mag- nesia. The average results show that, under all conditions of manuring— excepting with farmyard manure — the pro- duce was less over the later than over the earlier periods of the experiments, an effect partly due to the seasons. But the

average produce over forty years of continuous growth of barley was, in all cases where nitrogenous and mineral manures (containing phosphates) were used together, much higher than the average produce bf the crop grown in ordinary rotation in the United Kingdom, and very much higher than the average in most other countries when so grown. The requirements of barley within the soil, and its susceptibility to the external influences of season, are verj' similar to those of its near ally, wheat. Nevertheless, there are distinctions of result dependent on differences in the habits of the two plants, and in the conditions of their cultivation accordingly. Wheat is, as a rule, in the British Isles sown in the autumn on a heavier soil, and has four or five months in which to distribute its roots, and so it gets possession of a wide range of soil and subsoil before barley is sown in the spring. Barley, on the other hand, is sown in a lighter surface soil, and, with its short period for root-develop- ment, relies in a much greater degree on the stores of plant-food within the surface soil. Accordingly, it is more susceptible to exhaustion of surface soil as to its nitrogen- ous, and especially as to its mineral supplies ; and in the common practice of agriculture it is fouiid to be more benefited by direct mineral manures, especially phosphatic manures, than is wheat when sown under equal soil con- ditions. The exhaustion of the soil induced by both barley and wheat is, however, characteristically that of available nitrogen ; and when, under the ordinary condi- tions of manuring and cropping, artificial manure is still required, nitrogenous manures are, as a rule, necessary for both crops, and, for the spring-sown barley,, superphos- phate also. Although barley is appropriately grown on lighter soils than wheat, good crops, of fair quality, may be grown on the heavier soils after another grain crop by the aid, of artificial manures, provided that the land is sufficiently clean.

Leguminous Crcfps and the Acquisition of Nitrogen. — The fact that the growth of a leguminous crop, such as red clover, leaves the soil in a higher condition for the subsequent growth of a grain crop — that, indeed, the growth of such a leguminous crop is to a great extent equivalent to the application of a nitrogenous manure for the cereal crop — was in effect known ages ago. The Romans recognized it two thousand years since, for Varro writes, ” Certain things are to be sown, not with the hope of any immediate profit being derived from them, but with a view to the following year, because being ploughed in and then left in the ground, they render the soil after-

PLATE 17.

Photo by C. Reid, Wisham, N.B.

“Welsh Mountain Bam, “Hero II.”

1st Prize, Eoyal Agricultural Society’s Shows, Maidstone, 1899 ; York, 1900. The property of, and bred by, Mr. J. Marshall Dugdale,

Llwyn, Llanfyllin, Montgomeryshire.

Photo by C. Seid, Wuhaa, N.B.

Welsh Mountain Ewes.

1st Prize, Eoyal Agricultural Society’s Show, Maidstone, 1899. The property of, and bred by, Mr. J. Marshall Dugdale,

Llwyn, Llanfyllin, Montgomeryshire.

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wards more fruitful ” ; and the plants used for this pur- pose were lupins, beans, vetches, and other leguminous species. Nevertheless, it was not till near the approach of the closing decade of the 19th century that the explana- tion of this long-established point of agricultural practice was forthcoming. It was in the year 1886 that Hellriegel and Wilfarth first published in Germany the results of investigations in which they demonstrated that through the agency of micro-organisms dwelling in nodular out- growths on the roots of ordinary leguminous plants the latter are enabled to assimilate the free nitrogen of the air. The existence of the root nodules had long been recognized, but hitherto no adequate explanation had been afforded as to their function.

Since Hellriegel’s striking discovery farm crops have been conveniently classified as nitrogen-accumulating and nitrogen-consuming. To the former belong the ordinary leguminius crops — the clovers, beans, peas, vetches or tares, sainfoin, lucerne, for example — which obtain their nitrogen from the air, and are independent of the applica- tion of nitrogenous manures, whilst in their roots they accumulate a,” store of nitrogen which will ultimately become available for future crops of other kinds. It is, in fact, fully established that these leguminous crops acquire a considerable amount of nitrogen by the fixation of the free nitrOgen of the atmosphere under the influence of the symbiotic growth of their root-nodule-microbes and the higher plant. The cereal crops (wheat, barley, oats, rye, maize) ; the crucifferous crops (turnips, cabbage, kale, rape, mustard) ; the solanaceous crops (potatoes) ; the chenopodiaceous crops (mangels, sugar beets), and other non-leguminous crops have, so far as is known, no such power, and are therefore more or less benefited by the direct application of nitrogenous manures. The field experiments on leguminous plants at Eothamsted have shown that land which is, so to speak, exhausted so far as the growth of one leguminous crop is concerned, may still grow very luxuriant crops of another plant of the same natural order, but of different habits of growth, and espe- cially of different character and range of roots. This result is doubtless largely dependent on the existence, the distribution, and the condition of the appropriate mi- crobes for the due infection of the different descrip- tions of plant, for the micro-organism that dwells symbiotically with one species is not identical with that which similarly dwells with another. It seems certain that success in any system involving a more extended growth of leguminous crops in rotations must be depend- ent on a considerable variation in the diescription grown. Other essential conditions of success will commonly include the liberal application, of potash and phosphatic manures, and sometimes chalking or liming for the leguminous crop. As to how long the leguminous crop should occupy the land, the extent to which it should be consumed on the land, or the manure from its consump- tion be returned, and under what conditions the whole or part of it should be ploughed in — these are points which must be decided as they arise in practice. It seems obvious that the lighter and poorer soils would benefit more than the heavier or richer soils by the extended growth of leguminous crops.

Remarkable as Hellriegel’s discovery was, it merely furnished the explanation of a fact which had been empirically established by the husbandman long before, and had received most intelligent application when the old f oui^-course (or Norfolk) rotation was devised. But it gave some impetus to the practice of green manuring with leguminous crops, which are equally capable with such a crop as mustard of enriching the soil in humus, whilst in addition they bring into the soil from the atmosphere a quantity of nitrogen available for the use of subsequent

crops of any kind. In Canada and the United States this rational employment of a leguminous crop for ploughing in green is being largely resorted to for the amelioration of worn-out wheat lands and other soils, the condition of which has been lowered to an unremunerative level by the repeated growth

year after year of a cereal crop. The well-known paper of Lawes, Gilbert, and Pugh (1861), ” On the Sources of the Nitrogen of Vegetation, with spe- cial Eeference to the Question whether Plants assimilate free or uncombined Nitrogen,” answered the question referred to in the negative. The attitude now taken up with regard to this problem is set forth in the following words, which are quoted from the Memoranda of the Eothamsted Experiments, 1900 (p. 7) : —

Experiments were commenced in 1857, and conducted for several years in succession, to determine whether plants assimilate free or uncombined nitrogen, and also various collateral points. Plants of the gramineous, the leguminous, and of other families, were operated upon. The late Dr Pugh took a prominent part in this inquiry. The conclusion arrived at was that our agricultural plants do not themselves directly assimilate the free nitrogen of the air by their leaves.

In recent years, hovpever, the question has assumed quite a new aspect. It nov7 is — whether the free nitrogen of the atmosphere is brought into combination under the influence of micro-organisms, or other low forms, either within the soil, or in symbiosis with a higher plant, thus serving indirectly as a source of nitrogen to plants of a higher order. Considering that the results of Hellriegel and Wilfarth on this point were, if confirmed, of great significance and importance, it was decided to make experiments at Eothamsted on somewhat similar lines. Accordingly, a preliminary series was undertaken in 1888 ; more extended series were conducted in 1889 and in 1890 ; and the investigation was continued up to the com- mencement of the year 1895. Further experiments relating to certain aspects of the subject were commenced in 1898, and are still in progress. The results have shown that, when a soil grow- ing leguminous plants is infected with appropriate organisms, there is a development of the so-called leguminous nodules on the roots of the plants, and coincidently, increased grovrth, and gain of nitrogen.

The Rotation of Crops. — Although many different rota- tions of crops are practised, they may for the most part be considered as little more than local adaptations of the system of alternating root-crops and leguminous crops with cereal crops, as exemplified in the old four-course rotation — roots, barley, clover, wheat. The rotations extending to five, six, seven, or more years are, in most cases, only adaptations of the principle to variations of soil, altitude, aspect, climate, markets, and other local conditions. They are effected chiefly by some alteration in the description of ‘ the’ root-crop, and perhaps by the introduction of the potato crop ; by growing a different cereal, or it may be more than one cereal consecutively ; by the growth of some other leguminous crop than clover, or the intermixture of grass seeds, with the clover, and perhaps by the extension of the period allotted to this .member of the rotation to two or more years. Whatever the specific rotation, there may in practice be deviations from the plan of retaining on the farm the whole of the root-crops, the straw of the grain crops, and the legumi- nous fodder crops (clover, vetches, sainfoin, &c.), for the production of meat or milk, and, coincidently, for that of manure to be returned to the land. It is equally true that, when under the influence of special local or other demand — proximity to towns, easy railway or other communication, for example — the products which would otherwise be retained on the farm are exported from it, the import of town or other manures is generally an essential condition of such practice. This system of free sale, indeed, frequently involves full compensation by purchased manures of some kind. Such deviations from the practice of merely spiling grain and meat off the farm have much extended in recent years, and will probably continue to do so under the altered conditions of British agriculture, determined

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by very large imports of grain, increasing imports of meat and of other products of stock-feeding, and very large imports of cattle-food and other agricultural pro- duce. More attention is thus being devoted to dairy produce, not only on grass farms, but on those that are mainly arable.

The benefits that accrue from the practice of rotation are -well illustrated in the results obtained from the investigations at Eothamsted into the simple four-course system, -which may fairly be regarded as a seK-sup- porting system. Reference may first be made to the important mineral constituents of different crops of the four-course rotation. Of phosphoric acid, the cereal crops take up as much as, or more than, any other crops of the rotation, excepting clover ; and the greater portion thus taken up is lost to the farm in the saleable product — the grain. The remainder, “that in the straw, as well as that in the roots and the leguminous crops, is sup- posed to be retained on the farm, excepting the small amount exported in meat and milk. Of potash, each of

the rotation crops takes up very much more than of phosphoric acid. But much less potash than phos- phoric acid is exported in the cereal grains, much more being retained in the straw, whilst the other products of the rotation — ^the root an,d leguminous crops — ^which are also supposed to be retained on the farm, contain very much more potash than the cereals, and comparar tively little of it is exported in meat and milk. Thus, the whole of the crops of rotation take up very much more of potash than of phosphoric acid, whilst probably even less of it is ultimately lost to the land’. Of lime, very little is taken up by the cereal crops, and by the root-crops much less than of potash; more by the leguminous than by the other crops, and, by the clover especially, sometimes much more than by all the other crops of the rotation put together. Very little of the lime of the crops, however, goes off in the saleable products of the farm in the case of the self-supporting rotation under consideration. Although, therefore, dif- ferent, and sometimes very large, amounts of these

Table XXIX. — Tlie Weight and Average Composition of Ordinary Crops, in Pounds per Acre.

Weight of Crop.

Total Pure

ABh.

Nitro- gen.

Sul- pliur.

Potash.

Soda.

Lime.

Mag- nesia.

Phos- phoric Acid.

Chlor- ine.

Silica.

Crop.

At Hai-yeat.

Dry.

Wheat, grain, 30 liusliels „ straw

Total crop .

1,800 3,158

1530

2653

30 142

34 16

2-7 5-1

9-3 19-5

0-6 2-0

1-0 8-2

3-6 3-5

14-2 6-9

0-1 2-4

0-6 96-3

4,958

4183

172

50

7-8

28-8

2-6

9-2

7-1

21-1

2-5

96-9

Barley, grain, 40 bushels ,, straw

Total crop .

2,080 2,447

1747 2080

46 111

35 14

2-9 3-2

9-8 25-9

1-1 3-9

1-2 8-0

4-0 2-9

16-0 4-7

0-5 3-6

11-8 56-8

4,527

3827

157

49

6-1

35-7

5-0

9-2

6-9

20-7

4-1

68-6

OElts, grain, 45 bushels ; „ straw

Total crop .

1,890 2,835

1625 2353

51 140

34

18

3-2

4-8

9-1 37-0

0-8 4-6

1.8 9.8

3-6 5-1

13-0 6-4

0-5 6-1

19-9 66-4

4,725

3978

191

52

8-0

46-1

5-4

11-6

8-7

19-4

6-6

85-3

Maize, grain, 30 bushels – ,, stalks, &c.,

Total crop . ‘ .

1,680 2,208

1500

1877

22 99

28 15

1-8

6-5 29-8

0-2

0-5

3-4

10-0 80

0-2

0-5

3,888

3377

121

43

...

36-3

...

...

18-0

Meadow hay, IJ ton .

3,860

2822

203

49

5-7

50-9

9-2

32-1

.14-4

12-3

14-6

56-9

Eed Clover hay, 2 tons

4,480

3763

258

98

9-4

83 ‘4

5-1

90-1

28-2

24-9

9-8

7-0

Beans, grain, 30 bushels „ straw

Total crop .

1,920 2,240

1613 1848

58 90

78 29

4-4 4-9

24-3 42-8

0-6 1-7

2-9 26-3

4-2 5-7

22-8 6-3

1-1 4-3

0-4 6-9

4,160

3461

157

107

9-3

67-1

2-3

29-2

9-9

29-1

5-4

7-3

Turnips, root, 17 tons „ leaf .

Total crop .

38,080 11,424

3126 1531.

218 146

61 49

15-2 5-7

108-6 40-2

17-0 7-5

25-5 48-5

5-7 3-8

22-4 10-7

10-9 11-2

2-6

5-1

49,504

4657

364

110

20-9

148-8

24-5

74-0

9-5

33-1

22-1

7-7

Swedes, root, 14 tons . leaf . .

Total crop .

31,360 4,704

3349 706

163 75

70 28

14-6 3-2

63-3 -16-4

22-8 9-2

19-7 22-7

6-8 2-4

16-9 4-8

6-8 8-3

3-1 3-6

36,064

4055

238

98

17-8*

79-7

32-0

42-4

9-2

21-7

15-1

6-7

Mangels, root, 22 tons leaf

Total crop .

49,280 18,233

5914 1654

426 254

98 51

4-9 9-1

222-8 77-9

69-4 49-3

15-9 27-0

18-3 24-2

36-4 16-5

42-5 40-6

8-7 9-2

67,513

7568

680

149

14-0

300-7

118-7

42-9

42-5

52-9

83-1

17-9

Potatoes, tubers, 6 tons

13,440

3360

127

46

■2-7

76-5

3-8

3-4

6-3

21-5

4-4

2-6

- Calculated from a single analysis only.

typical mineral constituents are taken up by the various crops of rotation, there is no material export of any in the saleable products, excepting of phosphoric acid and of potash; and, so far at least as phosphoric acid is con- cerned, experience has shown that it may be advanta- geously supplied in purchased manures.

Of nitrogen, the cereal crops take up and retain much less than any of the crops alternated with them, not- withstanding the circumstance that the cereals are very characteristically benefited by nitrogenous manures. The root-crops, indeed, may contain two, or more, times as much nitrogen as either of the cereals, and the leguminous

PLATE 19.

EoscoMMON Ewes. 1st Prize, Eoyal Dublin Society's Show, 1898. The property of, and bred by, Mr. Mathew Flanagan, Tomona, Tulsk, Co. Eoscommon, Ireland.

Flwto by Scott and Wilkinson, Cambridge.

Middle White Boar, "Holywell Rosador."

Ist Prize, Highland and Agricultural Society's Show, Stirling, 1900. The property of, and bred by, Mr. Sanders Spencer, Holywell Manor, St. Ives, Hunts.

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crops, especially the clover, mucli more than the root-crops. The greater part of the nitrogen of the cereals is, however, sold off the farm; but perhaps not more than 10 or 15 per cent, of that of either the root-crop or the clover (or other forage leguminous crop) is sold off in animal increase or in mUk. Most of the nitrogen in the straw of the cereals, and a very large proportion of that of the much more highly nitrogen-yielding crops, returns to the land as manure, for the benefit of future cereal and other crops. As to the source of the nitrogen of the root-crops — the so- called “restoiative crops ” — these are as dependent as any crop that is grown on available nitrogen within the soil, which is generally supplied by the direct application of nitrogenouis manures, natural or artificial. Under such conditions of supply, however, the root-crops, gross feeders as they are, and distributing a very large extent of fibrous feeding root within the soil, avail themselves of a much larger quantity of the nitrogen supplied than the cereal crops would do in similar circumstances. This result is partly due to their period of accumulation and growth extending even months after the period of collection by the ripening cereals has terminated, and at the season when nitrification within the soil is most active, and the accumulation of nitrates in it is the greatest. When a full supply of both mineral constituents and nitrogen is at command, these root-crops assimilate a very large amount of carbon from the atmosphere, and produce, besides nitrogenous food materials, a very large amount of the carbohydrate sugar, as respiratory and fat-forming food for the live stock of the farm. The still more highly nitro- genous leguminous crops, although not characteristically benefited by nitrogenous manures, nevertheless contribute much more nitrogen to the total produce of the rotation than any of the other crops comprised in it. It is the leguminous fodder crops — especially clover, which has a much more extended period of growth, and much wider range of collection within the soil and subsoil, than any of the other crops of the rotation — that yield iu their produce the largest amount of nitrogen per acre. Much of this is doubtless taken up as nitrate, yet the direct applicar tion of nitrate of soda has comparatively little beneficial influence on their growth. The nitric acid is most likely taken up chiefly as nitrate of lime, but probably as nitrate of potash also, and it is significant that the high nitrogen- yielding clover takes up, or at least retains, very little soda. Table XXIX. from Warington’s Chemistry^ of the Farm will serve to illustrate the subjects that have been discussed in this section.

It is not only the conditions of growth, but the uses to which the different crops are put, that have to be con- sidered in the case of rotation. Thus the cereal crops, when grown in rotation, yield more produce for sale in the season of growth than when grown continuously. More- over, the crops alternated with the cereals accumulate very much more o^ mineral constituents and of nitrogen in their produce than do . the cereals themselves. By far the greater proportion of those constituents remains in cir- culation in the manure of the farm, whilst the remainder yields highly valuable products for sale in the forms of meat and mUk. With a variety of crops, again, the mechanical operations of the farm, involving horse and hand labour, are better distributed over the year, and are therefore more economically perform ed. The opportunities which rotation cropping affords for the cleaning of the land from weeds is another distinct element of advantage.

The Feeding op Animals, and the Manitkiai, Value

OF DiFFEKENT FoODS.

In the feeding experiments at Rothamsted it has been shown that the amount of food consumed, both for a given

live weight of animal within a given time, and for the production of a given amount of iucrease, is, as current food-stuffs go, measurable more by the amounts they con- tain of digestible and available non-nitrogenous constitu- ents than by the amounts of the digestible and available nitrogenous constituents they supply. The non-nitroge- nous substance (the fat) in the increase in live weight of an

animal is, at any rate in great part, if not entirely, derived from the non-nitrogenous constituents of the food. Of the nitrogenous compounds in food, on the other hand, only a small proportion of the whole consumed is finally stored up in the increase of the animal — in other words, a very large amount of nitrogen passes through the body beyond that which is finally retained in the increase, and so remains for manure. Hence it is that the amount of food consumed to produce a given amount of increase in live weight, as well as that required for the sustentation of a given live weight for a given time, should — provided the food be not abnormally deficient in nitro- genous substance — be characteristically dependent on its supplies of digestible and available non-nitrogenous constituents. It has further been shown that, in the ex- ercise of force by animals, there is a greatly increased expenditure of the non-nitrogenous constituents of food, but littl'e, if any, of the nitrogenous. Thus, then, alike for maintenance, for iucrease, and for the exercise of force, the exigencies of the system are characterized more by the demand for the digestible non-nitrogenous or more specially respiratory and fat-forming constituents than by that for the nitrogenous or more specially fiesh-form- ing ones.' Hence, as current fattening food-stuffs go — assuming, of course, that they are not abnormally low in the nitrogenous constituents — they are, as foods, more valuable in proportion to their richness in digestible and available non-nitrogenous than to that of their nitroge- nous constituents. As, however, the manure of the ani- mals of the farm is valuable largely in proportion to the nitrogen it contains, there is, so far, an advantage in giv- ing a food somewhat rich in nitrogen, provided it is in other respects a good one, and, weight for weight, not much more costly.

In Table XXX., which underwent revision in 1885, and was adopted as trustworthy in 1897, is shown the average composition, both per cent, and per ton, of all the leading cattle-foods. It is obvious that, in the case of almost every one of the articles enumerated, individual samples may vary even considerably from the average. In foods which are manufactured or imported the percentage of dry matter is usually high. In those which may be either imported or home-grown, the variations in the percentage of dry matter in different samples may be comparatively wide, it being as a rule distinctly higher in the imported articles, which could not be shipped unless in a drier con- dition than is usual with the home-grown product. In such cases the imported food will probably contain a higher, or the home-grown one a lower, percentage of dry matter than the average given in the table. Hence the figures as tabulated need to be adopted or modified with judgment, having regard to the influence of the conditions of growth, maturity, preparation, or preservation to which the foods have been subject. Unless, however, the varia- tion from the standard composition adopted in the table be more than usual, the effect on the estimates of the manure value — for which the table is primarily intended — will not be material, though it will obviously be much greater in the case of the nitrogen than in that of either the phosphoric acid or the potash. The table is useful for purposes of comparison — for example, one ton of decor- ticated cotton cake contains about four times as much nitrogen as a ton of maize, wheat, or barley, and thirty times as much as a ton of mangel wurzels.

Table XXX. — Average Composition, Per Cent, and Per Ton

of Cattle Foods.

FoodB.

Per Cent.

Per Ton.

Mineral

Phos-

Phos-

Dry Matter.

Nitro- gen.

Matter (Ash).

phoric Acid.

Potash.

Nitrogen.

phoric Acid.

Potash.

^

Per cent.

Per cent.

f er cent.

Per cent.

Per cent.

ft

ft

ft

1. Linseed

90-00

3-60

4-00

1-54

1-37

80-64

34-50

30-69

2. Linseed cake

88-50

4-75

6-50

2 00

1-40

106-40

44-80

31-36

3. Decorticated cotton’ cake

90-00

6-60

7-00

3-10

2-00

147-84

69-44

44-80

4. Palm-nut cake .

91-00

2-50

3-60

1-20

0-50

56-00

26-88

11-20,

5. Undecortioated cot-”

ton cake .

6. Cocoa-nut cake .

87-00

3-75

6-00

2-00

2 00

84-00

44-80

44-80

90-00

3-40

6-00

1-40

2-00

76-16

31-36

44-80

7. Rape cake .

8. Peas ....

89-00

4-90

7-50

2-50

1-50

109-76

56-00

33-60

85-00

3-60

2-50

0-85

0-96

80-64

19-04

21-50

9. Beans

85-00

4-00

3-00

1-10

1-30

89-60

24-64

29-12

10. Lentils

88-00

4-20

4-00

0-75

0-70 .

94-08

16-80

15-68

11. Tares (seed)

12. Maize

84”=00

4-20

2-50

0-80

0-80

‘94-08

17-92

17-92

88-00

1-70

1-40

0-60

0-37

38-08

13-44

8-29 ‘

13. Wheat

85-00

1-80

1-70

0-85

0-53

40-32

19-04

11-87

14. Malt ....

94-00

1-70

2-50

0-80

0-50

38-08

17-92

11-20

15. Barley

84-00

1-65

2-20

0-75

0-55

36-96

16-80

12-32

16. Oats ....

86-00

2-00

2-80

0-60

0-50

44-80

13-44

11-20

17. Rice meal 1

90-00

1-90

7-50

(0-60)

(0-37)

42-56

(13-44)

(8-29)

18. Locust beans ^ .

19. Malt coombs

85-00

1-20

2-50

26-88

90 00

3-90

8-00

2-00

2-00

87-36

44-80

44-80

20. Fine pollard

86-00

2-45

6-50

2-90

1-46

54-88

64-96

32-70

21. Coarse pollard .

86-00

2-50

6-40

3-50

1-50

56-00

78-40

33-60

22. Bran ....

23. Clover hay

86-00

2-50

6-50

3-60

1-45

56 00

80-64

32-48

83-00

2-40 •

7-00

0-57

1-50

53-76

12-77

3^-60

24. Meadow hay

25. Pea straw .

84-00

1-50

6-50

0-40

1-60

33-60

8-96

35-84

82-50

1-00

5-50

0-35

1-00

22-40

7-84

22-40

26. Oat straw .

83-00

0-50

5-50

0-24

1-00

11-20

5-38

22-40

27. “Wheat straw

84-00

0-45

5-00

0-24

0-80

10-08

5-38

17-92

28. Barley straw

85-00

0-40

4-50

0-18

1-00

8-96

4-03

22-40

29. Bean straw 80. Potatoes .

82-50

0-90

5-00

0-30

1-00

20-16

6-72

22-40

25-00

0-25

100

0-15

0-55

5-60

3-36

12-32

31. Carrots

14-00

0-20

0-90

0-09

0-28

4-48

2-02

6-27

32. Parsnips .

16-00

0-22

1-00

019

0-36

4-93

4-26

8-06

33. Mangel wurzels .

12-50

0-22

1-00

0-07

0-40

4-93

1-57

8-96

34. Swedish turnips

11-00

0-26

0-60

0 06

0-22

5-60

1-34

4-93

35. Yellow turnips 1

9-00

0-20

0-65

(0-06)

(0-22)

4-48

(1-34)

(4-93)

36. “White turnips .

8-00

0-18

0-68

0-05

0-30

4-03

1-12

6-72

I In the case of neither rice meal, locust beans, nor yellow turnips, have records of ash analyses been found. For rice meal the same percentages of phosphoric acid and potash as in maize, and for yellow turnips the same as in swedes, are proyision- aUy adopted ; but where the results are assumed they are given in parentheses. For locust beans no figure has been assumed and the columns are left blank.

Table XXXI., revised by La”9sres and Gilbert in 1897, ^ shows the method and the results of the calculation of the totai or original manure value of the different foods, adopt- ing as a basis their composition as given in Table XXX. “WTien the table “was constructed in 1875 the values per lb of the important manurial ingredients were taken as am- monia, 8d. ; phosphoric acid, 2id. ; potash, 2d. At the revision of the table in 1886 these were altered to 6d., 3d., and 2-^d. respectively. At the subsequent re-vision in 1897 the fluctuations in prices which had then taken place rendered necessary a further modification to 4d. per lb for ammonia, 2d. per lb for phosphoric acid, and l-|-d. per ft) for potash, these being the lowest of all. They determine the figures given in the last column of the table, representing the total manure value per ton of food consumed. The sum of £2, lis. lid., for example, de- noting the manure value of one ton of linseed cake con- sumed, is the aggregate of £2, Is. 2d. for nitrogen ; 6s. lid. for phosphoric acid, and 3s. lOd. for potash.

This table is of interest alike to the stockfeeder and to the valuer, and it “will repay closer study. The first column shows the estimated amounts of each food re- quired to give one part of fattening increase in live

weight of oxen or sheep ; and the second column shows the amounts of such increase that would, accordingly, be acquired by the consumption of one ton of each food. Some such estimate must necessarily be made before it is possible to calculate how much of the manure constitu- ents of the food are carried off by the animal increase, and consequently how much remain for manure. It must not, however, be concluded that, by the consumption by oxen or sheep of one ton of any one of the different foods used alone, the amount of fattening increase given in the second column of the table would be produced,^~~that, for example, a ton of linseed cake, if so given, would yield 373 ft, a ton of oat straw 124 ft, or a ton of mangels. 23 ft of increase. What is meajit is that, when any one of the foods is given in the judicious amount and in ad~~ mixture with other foods which experience shows to be beneficial, it may be estimated that one ton of the food so consumed will, approximately, contribute the amount of increase in live weight stated.

TaMng into consideration the difficulties attending the experimental determinati’bn of these values, it is claimed that they are the best that existing knowledge renders it possible to arrive at. Nevertheless, it is pretty certain

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Total or original Manure Value per Ton of Food

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rH v.^

Per Cent, of total con- sumed.

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Total remain- ing for Manure.

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Per

Cent, of total con- sumed.

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per ft.

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Total remain’ Ing for Manure.

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Per

Cent, of total con- sumed.

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Fattening In- crease in live

■weight (Oxen or Sheep).

In- crease per Ton of Food.

ft.

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IN^-^

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Linseed . Linseed cake . f Decorticated “1 1 cotton cake 1

Palm-nut cake f Undecorticat-1 \ed cotton cake/ Coooa-nutcake Rape cake

... 10

Peas Beans Lentils . Tares (seed)

Maize Wheat . Malt

Barley . Oats

Rice meal Locust beans

Malt coombs Fine pollard Coarse pollard Bran

1!

II

Pea straw Oat straw Wheat straw Barley straw Bean straw

Potatoes . Carrots . Parsnips . Mangel wurzela Swedish turnip Yellow turnips White turnips

1

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that the amounts of increase assumed to be produced are higher than those usually obtained. The amount estimated to be yielded by linseed cake, for example, is certainly higher than would be obtained when, as is some- times the case, it is given in such excessive amount that much is voided fey the animals undigested. On the other hand, the amounts of the different foods estimated to be required to give one part of increase are doubtless higher than would be so required, if as large a proportion of the constituents were digested and utilized as has been shown to be digestible in the German experiments on that subject. In those experiments the animals were for the most part kept on mere sustenance food, so that they would digest the maximum proportion of the constituents they received. In the case of fattening, however, especially with early maturity, the conditions are very different. The animal receives a greater or less excess of food, and not only voids proportionally more undigested, but may transform more than is fully utilized. It is, nevertheless, economy to give an excess within certain limits. The apparent waste is, in fact, more than counterbalanced. Thus, in the first place, the manure value of the not-utilized food still remains intact; but the real source of the economy is in the shortening of the time of feeding, and so, at the cost of some excess of food, saving the amount that would be expended in the mere sustenance of the animal in feeding for a longer period.

The next section of the table, headed “Nitrogen,” and comprising seven columns, relates to the amount and to the distribution of the foods. There are given the amounts of nitrogen per cent, and per ton as in Table XXX. ; the actual amount estimated to be contained in the increase in live weight of the animal consuming one toil of the food, and the percentage of the total nitrogen con- sumed which is so retained in the increase ; the amount of the nitrogen of the food* remaining for manure, the amount of ammonia to which it corresponds, and its money value, reckoned at 4d. per lb. Throughout the calculations it is assumed that only fattening increase is produced, and that this will contain 8 per cent, of nitrogenous substance, corresponding to 1-27 per cent, of nitrogen in the increase. It will be seen that, according to the figures, the only food in the list of which a ton is estimated to contribute more than 5 lb of nitrogen to the fgitening increase is linseed, and that in the case of none ot the cakes, or of the leguminous seeds, will 1 ton contribute 5 ft of nitrogen to the increase, whilst the amount is in several cases under 4 ft. A ton of the cereal grains, or of their products (and locust beans), generally contributes under 4 ft ; a ton of hay or straw less than half as much ; and a ton of roots very much less still. To put it in another way: of the total nitrogen consumjCd in the foods rich in that substance, such as the cakes and the leguminous seeds, there is generally less than 5 per cent, retained in the fattening increase in live weight. The cereal grains, on the other hand, which are much less rich in nitrogen, contribute a much larger proportion of their total amount to the increase ; indeed, generally about 10 per cent, of it. The gramineous straws contribute a higher proportion still, whilst roots (mangels and turnips) lose by feeding on an average only about 6 or 6 per cent, of their nitrogen. Hence, when fattening increase only is produced, the proportion of the nitrogen of the food

which is retained by the animal, and so lost to the manure, is very small in the case of the richer foods, but more in that of the poorer ones; but even with them it seldom exceeds 10 per cent., excepting Tvith the straws. It may be assumed, however, that when the foods are consumed by store animals, about twice as much of thOi nitrogen of the food is retained by the animal, and

so lost to the manure. And when, as is more and more the case with early maturity, the increase comprises a larger proportion of growth than in mere fattening, the amount of the nitrogen of the food which will be lost to the manure will be between that given in the table and twice as much.

The third section of the table relates to the phosphoric acid, and there are given for each food, as in the case of the nitrogen, the amounts of it per cent, and per ton of the foods; the amount estimated to be retained in the increase; the amount remaining for manure, and the money value of this at 2d. per ft. It will be seen that there is only about two-thirds as much phosphoric acid as of nitrogen retained in a given weight of fattening increase ; but, owing to the very generally less, and some- times much less, amount of it in the foods, a greater proportion of that consumed is retained in the animal, and a less proportion remains for manure. It should be added that, in the case of store animals and of animals still growing, the amount of phosphoric acid retained in -a given weight of increase will be very much greater than in mere fattening ; indeed, in mere store increase it may, as in the case of the nitrogen, be nearly twice as great.

Of potash, the table shows that a given weight of fattening increase retains only about one-eighth as much as it does of phosphoric acid; and the percentage of the whole in the food which is lost to the manure is generally very small. In its case, as in that of the nitrogen and phosphoric acid, the amount retained in mere store increase will be nearly twice as much as in mere fattening increase, but the total quantity retained is still very small. The potash remaining for manure is valued at 1^. per ft.

The last column of the table shows the total manure value of a ton of each of the foods after consumption, reckoning the nitrogen, the phosphoric acid, and the potash at the prices above named, which are those at which they could, at the time (1897-98), be purchased in artificial manures. The reductions in the prices of am- monia, phosphoric acid, and potash, now adopted, bring all the estimates of total or original manure value almost exactly one-third lower than those given in 1885. Thus the total value of a ton of linseed cake consumed, which in 1885 was reckoned at £3, 18s. 6d., was taken in 1897-98 at £2, lis. lid. ; that of a ton of oats was reduced from £1, 9s. lOd. to 19s. 9d. ; and that of other foods in the same proportion.

Unexhausted Manure Value of Cattle Foods. — A much more complicated problem than the estimation of the total or original manure value of cattle foods is that of estimat- ing the unexhausted manure value of the different foods, or what may be called their compensation value, after they have been used for a series of years by the outgoing tenant, and he has realized a certain portion of the manure value in his increased crops. In the light of experimental and other evidence, Lawes and Gilbert fixed upon a scale of reduction, starting from the total or original manure value, as estimated in Table XXXI. The method so arrived at is to deduct one-half of the original manure value of the food used the last year, and one-third of the remainder each year to the eighth, in the case of all the more con- centrated foods, and of the roots ; whilst, for the hays and straws, which contain larger amounts of indigestible matter, and the constituents of which will be more slowly available for crops, two-thirds of the original manure value is deducted for the last year, and only one-fifth from year to year to the eighth year. The results of the estimates of compensation value so made are given in Table XXXII. The first column shows the total or original manure value of each food. The second column shows the allowance

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Table XXXII. — Plan and Results of Estimations of the Compensation Value of Unexhausted Manure, starting from the Original Manure Value, that is, the Value deducting the constituents of increase in (Fattening) Live Weight only.

Original Manure Value,

Compensation Value of Unexhausted Manure.

Foods.

deducting

Increase in

Live Weight

only.

Last Tear.

Second Tear.

Third Tear.

Fourth Tear.

Fifth Tear.

Sixth Tear.

Seventh Tear.

Eighth Tear.

Total.

Deduct One-half of Original Manure Value the Last Tear, and One-third from Year to Year.

One Ton.

£ «. d.

£ «. a.

£ a. d.

«. d.

a. d.

8. d.

». d.

«. d.

». d.

£ «. d.

1. Linseed ....

1 19 2

0 19 7

0 13 1

8 9

5 10

3 11

2 7

1 9

1 2

2 16 8

2. Linseed cake .

2 11 11

16 0

0 17 4

11 7

7 9

5 2

3 5

2 3

1 6

3 15 0

3. Decorticated cotton cake

3 14 9

1 17 4

1 4 11

16 7

11 1

7 5

4 11

3 3

2 2

5 7 8

4. Palm-nut cake

16 4

0 13 2

0 8 9

5 10

3 11

2 7

1 9

1 2

0 9

1 17 11

6. UndecoTticated cotton cake

2 5 3

12 7

0 15 1

10 1

6 9

4 6

3 0

2 0

1 4

3 5 4

6. Cocoa-nut cake

1 19 10

0 19 11

0 13 3

8 10

1^

3 11

2 7

1 9

1 2

2 17 4

7. Bape cake

8. Peas ....

2 16 5

18 3

0 18 10

12 7

5 7

3 9

2 6

1 8

4 17

1 16 5

0 18 3

0 12 2

8 1

5 5

3 7

2 5

1 7

1 1

2 12 7

9. Beans ....

2 1 11

1 0 11

0 13 11

9 3

6 2

4 1

2 9

1 10

1 3

3 0 2

10. Lentils ....

2 0 8

1 0 4

0 13 7

9 1

6 1

4 1

2 9

1 10

1 3

2 19 0

H. Tares (seed) .

“12. Maize ....

2 11

1 0 7

0 13 9

9 2

6 1

4 1

2 9

1 10

1 3

2 19 6

0 16 7

0 8 4

0 5 7

3 9

2 6

1 8

1 1

0 9

0 6

1 4 2

13. Wheat ....

0 18 11

0 9 6

0 6 4

4 3

2 10

1 11

1 3

0 10

0 7

17 6

14. Malt ....

0 17 7

0 8 10

0 5 11

3 11

2 7

1 9

1 2

0 9

0 6

15 5

15. Barley ....

0 17 2

0 8 7

0 5 9

3 10

2 7

1 9

1 2

0 9

0 6

1 4 11

16. Oats ....

0 19 9

0 9 11

0 6 7

4 5

2 11

1 11

1 3

0 10

0 7

18 5

17. Rice meal

(0 18 6)

(0 9 3)

(0 6 2)

(4 1)

(2 9)

(1 10)

(1 3)

(0 10)

(0 7)

(1 6 9)

18. Locust beans .

19. Malt coombs . ‘ .

...

...

2 6 7

13 3

0 15 6

10 4

6 11

4 7

3 1

2 1

1 5

3 7 2

20. Fine poUard .

1 15 2

0 17 7

0 11 9

7 10

5 3

3 6

2 4

1 7

1 1

2 10 11

21. Coarse pollard

1 18 1

0 19 1

0 12 9

8 6

5 8

3 9

2 6

1 8

1 1

2 15 0

22. Bran ....

1 18 6

0 19 3

0 12 10

8 7

5 9

3 10

2 7

1 9

1 2

2 15 9

One Ton. Deduct Two-thirds of Orig

inal Manur

3 Value the

Last Ye

%r, and

One-fifth

from Year to Year.

23. Clover hay . .. .

1 7 0

0 9 0

0 7 2

5 9

4 7

3 8

2 11

2 4

1 10

1 17 3

24. Meadow hay .

25. Pea straw

0 18 7

0 6 2

0 4 11

3 11

3 2

2 6

2 0

1 7

1 3

15 6

0 12 2

0 4 1

0 3 3

2 7

2 1

1 8

1 4

1 1

0 10

0 16 11

26. Oat straw

0 7 5

0 2 6

0 2 0

1 7

1 3

1 0

0 10

0 8

0 6

0 10 4

27. Wheat straw .

0 6 6

0 2 2

0 19

1 5

1 2

0 11

0 9

0 7

0 6

0 9 3,

28. Barley straw .

0 6 5

0 2 2

0 19

1 5

1 2

0 11

0 9

0 7

0 6

0 9 3

29. Bean straw .

0 11 5

0 3 10

0 3 1

2 6

2 0

1 7

1 3

1 0

0 10

0 16 1

Ten Tons. ~~D~~*’’’’’’*”

fof Originc

il Manure 1

Talue the L

1st Year

and Or

le-third)

from Year to Year.

30. Potatoes ….

2 0 10

10 5

0 13 7

9 1

6 1

4 1 ”

2 9

110

1 3

2 19 1

31. Carrots ....

17 6

0 13 9

0 9 2

6 1

4 1

2 9

1 10

1 3

0 10

1 19 9

32. Parsnips ....

1 15 0

0 17 6

0 11 8

7 9

5 2

3 5

2 3

1 6

1 0

2 10 3

33. Mangel wurzels ‘.

1 11 8

0 15 10

0 10 7

7 1

4 9

3 2

2 1

1 6

0 11

2 5 10

34. Swedish turnips

19 2

0 14 7

0 9 9

6 6

4 4

2 11

1 11

1 3

0 10

2 2 1

35. Tellow turnips

(1 5 0)

(0 12 6)

(0 8 4)

(5 7)

(3 9)

(2 6)

(1 8)

(1 1)

(0 9)

(1 16 2)

36. White turnips

1 5 10

0 12 11

0 8 7

5 9

3 10

2 7

1 9

1 2

0 9

1 7 4

for the last year, and the succeeding seven columns that for each succeeding year to the eighth. The last column gives the total compensation value for the eight years' con- sumption. It may seem at first sight that a deduction of 50 per cent, from the original manure value of the food used in the last year is large. Allowance has to be made, however, for all losses to which the manure may be sub- ject, which may be considerable, especially if much of the food is consumed in the yards ; and it has to be borne in mind that the money paid for compensation will not yield its full return for a long time. Only half the original manure value would, therefore, be allowed if the food were only used one year^ and all scales of allowance arranged by farmers' clubs assume the consumption for more than one year. Nevertheless, if the food is used for eight years, or more, it will be seen that the total allowance consider- ably exceeds the original manure value of one year's con- sumption— ^the allowance made for the accumulation bringing it up to from one and a third to one and a half as much as the original manure value.

In order to test the applicability-of the scale of compen- sation proposed, the case may be considered of a Norfolk

or Lincolnshire farm under the ordinary four-course rotar tion, with meat and grain only sold, and the roots fed partly on the land and partly in the yards. Let it be assumed, fur- ther, that the land is thoroughly clean, and that the farm is in every respect in good order when given up. The essen- tial basis of the system of estimate and valuation of the unexhausted residue adopted is the assumption of gradual accumulation within the soil, and of slow recovery from it. Suppose then that linseed cake had been used annually for eight years, at the average rate of one ton over eight acres each year, or of one ton per acre in eight years. Each acre would thus on the average receive, either in farmyard manure or directly by the feeding with roots or clover on the land, the manure from the consumption of one ton of linseed cake in eight years, or at the average rate of one- eighth of a ton, or 2\ cwt., per acre per annum.

The first column of Table XXXII. shows that the total or original manure value of one ton of linseed cake con- sumed— ^that is, the value deducting only the constituents stored up in the animal — is estimated to be £2, lis. lid. The subsequent columns of the same table show the estimated compensation value of the unexhausted residue

from one ton consumed (that is, after the tenant has J realized the benefit of the increase of his crops) to be, if used each year for eight years, as givep in the first col- umn of the following statement, the second column showing the amount per acre per annum : —

Compensation Allo-wanooB for One Ton of

Lineeed Oake consumed.

Per annum,

Per acre, in

Eight Tears.

Eight Tears. ,

£ «. a.

£ s. d.

Last year

16 0

0 3 3

2nd ..

0 17 4

0 2 2

3rd ..

0 11 7

0 15

4th »

0 7 9

0 10

5tll n

0 5 2

.0 0 8

6th ..

0 3 5

0 0 5

7th ..

0 2 3

0 0 3

8th ..

0 16

0 0 2

Total

3 15 0

0 9 4

Thus, according to the first column of figures, the value of the unexhausted manure residue from the consumption of one ton of linseed cake annually for eight years would be £3, 15s., .pr nearly 45 per cent, more than the original manure ralue of one year's consumption. Or, as the second column shows, the allowance would be at the rate of 9s. 4d. per acre over the whole farm. Whether such an allowance would be too much or too little under the conditions supposed is a question for consideration. These conditions are : a light-land farm, upon which the manure from purchased food is an essential element of profitable cultivation; that meat and grain alone are sold; and that the farm is given up in a satisfactory state in every respect. Also that, on the average, each acre received during the last eight years the manure derived from the consumption of one ton of , linseed cake. The question between the two parties concerned is, whether the outgoing tenant would receive sufficient remuneration for his unexhausted manure ; and, on the other hand, whether the landowner, or the incoming tenant, would pay more than will be recovered in increase of crops. An allowance of 9s. 4d. per acre on a farm of 400 acres would amount to £186, 13s. 4d., which is a large sum to pay ; and it is certain that the recovery of the amoimt would only be gradual. It is well known that both time and money are required to get land into condition, and here is land already in condition.

Although in the foregoing tables the estimates of the manure values of food-stuffs are made in accordance with the prices of ammonia, phosphoric acid, and potash at the time (1898), it is evident that the results may require further revision as the value of manure constituents in the market changes, and perhaps also in other ways, as knowledge advances and experience is gained.^

1 For a fuller discussion of the subject the reader should consult Lawes and Gilbert's paper in the Journal of the Royal Agriculltural Society, 1897. In the course of a letter written early in 1901, Sir J. Henry Gilbert referred to the question as to how the manure from store stock should be valued. The loss to the manure is more in the case of the feeding of lean or store stock than in that of fattening animals, but is much less than in the case of milk production. Assuming the increase from the consumption of a given food by store stock removed twice as much of the constituents valuable as manure as when used for fattening, the result would approximately be that, in the case of any of the high-nitrogen foods, Nos. 1 to 11 in Table XXXII., 5 per cent, would be sufficient to deduct from the original manure vahie before applying the scale according to the "class of farm" as defined below; and that in the case of the lower-nitrogen foods, Nos. 12 to 17, a deduction of 10 per cent, would be sufficient. With reference to the valuation of the manure constituents when the foods are consumed by fattening pi^s, the conclusion arrived at is that, although there are characteristic differences between the amount and proportion of the various foods consumed by oxen and sheep on the one hand, and by pigs on the other, yet there would not be such material

Implements and Maohineet.

Agricultural machinery is dealt with elsewhere. As, however, it is the custom of the Eoyal Agricultural Society of England to invite competitions at its annual shows in specified classes of

implements, an enumeration of these wiU indicate the character of the appliances which were thus brought into prominence during the closing quarter of the 19th century. These trials taking place, with few intermissions, year after year serve to direct the public mind to the development, which is continually in pro- gress, of the mechanical aids to agriculture. The awards here summarized are quite distinct from those of silver medals which are given by the Society in the case of articles possessing sufftcient merit, which are entered as ” ” new implements for agricultural or estate purposes.”

In 1875, at Taunton, special prizes were awarded for one-horse and two-horse mowing machines, hay-making machines, horse rakes (self-acting and not self-acting), guards to the drums of threshing-machines, and combined guards and feeders to ,the drums of threshing-machines. In 1876, at Birmingham, the competitions were of self-delivery reapers, one-horse reapers, and combined mowers and reapers without self-delivery. In 1878, at Bristol, the special awards were all for dairy appliances — milk-can for convey- ing milk long distances, chum for milk, churn for cream, butter-worker for large dairies, butter- worker for small dairies, cheese tub, curd knife, curd mill, cheese-turning apparatus, automatic means of preventing rising of cream, milk-cooler, and cooling vat. A gold medal was awarded for a harvester and self-binder (M ‘Cormick’s) . In 1879, at Kilburn, the competition was of railway waggons to convey perishable goods long distances at -low temperatures. In 1880, at Carlisle, and in 1881 , at Derby, the special awards were for broadside steam diggers and string sheaf-binders respectively. In 1882, at Reading, a gold medal was given for a cream separator for horse power, whilst a prize of 100 guineas offered for the most efiBcient and most economical method of drying hay or corn crops artiiicially , either before or after being stacked, was not awarded. In 1883, at York, a prize of £50 was given for a butter dairy suitable for not more than twenty cows. In 1884, at Shrewsbury, a prize of £100 was awarded for a sheaf-binding reaper, and one of £50 for a similar machine. In 1885, at Preston, the competitions were concerned with two- horse, three-horse, and four-horse whipple-trees, and packages for conveying fresh butter by rail. In 1886, at Norwich, a prize of £25 was awarded for a thatch-making machine. In 1887, at Newcastle-on-Tyne, a prize of £200 went to a compound portable agricultural engine, one of £100 to a simple portable agricultural engine, and lesser prizes to a weighing machine for horses and cattle, a weighing machine for sheep and pigs, potato-raisers, and one-man power cream separators. In 1888, at Nottingham, hay and straw presses for steam power, horse power, and hand power were the subjects of competition. In 1889, at Windsor, prizes were awarded for a fruit and vegetable evaporator, a paring and coring machine, a dairy thermometer, parcel post butter-boxes to carry different weights, and a vessel to contain preserved butter. In 1890, at Plymouth, competitions took place of light portable engines (o) using solid fuel (6) using liquid or gaseous fuel, grist mills for use on a farm, disintegrators, and cider-making plant for use on a farm. In 1891, at Doncaster, special prizes were given for combined portable threshing and finishipg machines, and cream separators (hand and power). In 1892, at Warwick, the competitions related to ploughs — single furrow (a) for light land, (6) for strong land, (c) for press drill and broadcast sowing ; two-furrow ; three-furrow ; digging (a) for light land (6) for heavy land ; and one-way ploughs. In 1893, at Chester, self- binding harvesters and sheep-shearing machines (power) were the appliances respectively in competition. In 1894, at Cambridge, the awards were for fixed and portable oil engines, potato-spraying and tree-spraying machines, sheep-dipping apparatus, and churns. In 1895, at Darlington, the competitions were confined to hay-making machines and clover-making machines. In 1896, at

difference in the case of the same description of food consumed respec- tively by oxen, sheep, and pigs, as to render it desirable to make any distinction in estimating the manure value of the same food thus consumed. ‘

In actual practice it has been found convenient, in applying the estimates of manure value, to modify the compensation according to the class of farm, thus : (1) where the consumption is on farms that

have been well managed, with the yard accommodation for the proper conservation of manure good, or where the feeding-stuffs have been fed on land left clean, and the management has been generally good and judicious ; (2) where such conditions are not so good and merito- rious ; (3) where such conditions are bad.

Leicester, prizes were awarded after trial to' potato-planting machines, potato-raising machines, and butter-drying machines. In 1897, at Manchester, special awards were made for fruit basliets and milk-testers. In 1898, at Birmingham, a prize of £100 was given for a self-moving vehicle for light loads, £100 and £50 for self-moving vehicles for heavy loads, and £1C) for safety feeder to chafl-cutter, in accordance with the Chaflrcutting Machines (Accidents) Act, 1897. In 1899, at Maidstone, special prizes were oflered for machines for washing hops with liquid insecticides, cream separators (power and hand), machines for fiie evaporation of fruit and vegetables, and packages for the carriage of (a) soft fruit, (6) hard fruit. In 1900, at York, the competitions were concei-ned with horse-power cultivators, self-moving steam diggers, milking machines, and sheex)-shearing machines (power and hand). In 1901, at Cardiff, competition was invited in portable oil engines, agricultural locomotive oil engines, and small ice-making plant suitable for a dairy.

The progress of steam cultivation has not justified the hopes that were once entertained concerning this method of •working implements in the field. It was about the year 1870 that its advantages fiLrst came into prominent notice. At that time owing to labour dispiites the supply of hands was short and horses were dear. The wet sea- sons that set iu at the end of the 'seventies led to so much hindrance in the work on the land that the aid of steam was further called for, and it seemed probable that there would be a lessened demand for horse power. It was found, however, that the steam work was done with less care than had been bestowed upon the horse tillage, and the result was that steam came to be regarded as an aux- iliary to horse labour rather than as a substitute for it. In this capacity it is capable of rendering most valuable assistance, for it can be utilized in moving extensive areas of land in a very short time. Accordingly, when a few days occur early in the season favourable to the working of the land, much of it can be got into a forward condition, whilst horses are set free for the lighter operations. The crops can then be sown in due time, which in wet years, and with the usual teams of horses kept on a farm, is not always practicable. Much advantage arises from the steam-working of bastard fallows in summer, and after harvest a considerable amount of autumn cultivation can be done by steam power, thus materially lightening the work in the succeeding spring. On farms of moderate size it is usual to hire steam tackle, as required, the out- lay iuTolved in the purchase of a set being justifiable only in the case of estates or of very big farms where, when not engaged in ploughing, or in cultivatiag, or in other work upon the land, the steam-engine may be employed in threshing, chaff-cutting, sawing, and many similar operations which require power. The labour question again became acute in 1900, when owing to \he scarcity of hands and the high rate of wages, self-binding har- vesters were resorted to in England for the ingathering of the corn crops to a greater extent than ever before. For the same reason potato-planting and potato-lifting machines were also ip greater requisition. (w. fb.)

II. The United States.

Covering as it does the breadth of the North American continent, with 3,000,000 square miles of land surface, not including Alaska and the islands, of 'which 700,000,000 acres are in farms and

400,000,000 in actual cultivation, representing every variety of soil and all the climatic life zones of the world, except the extreme boreal and the hottest tropical, the United States affords an impor- tant subject of study in respect of agriculture. Its cotton, wheat, and meat are large factors in all markets, and its many other agricultural products are distributed throughout the' civilized world. To the student the equipment and methods of agriculture in the United States form as interestiug a subject of examination as do its resources and production. In quantity, distribution,

and inter-relation of heat and moisture — ^the chief factors in agricultural production — ^the United States is greatly blessed. We find in this vast territory all the agricultural belts mapped by the biologist, producing all varieties of cereals, fruits, and breeds of live stock. All kinds of soils, adapted to different crops, are spread out at all altitudes from 8000 feet down to sea-level. The country is equally fortunate in the character of its farming class. There is no peasant class, but the agricultural population is made up of the same people who form the professional and mercantile classes. The negroes, who supply the farm labour in the Southern States, are by nature admirably suited to these pursuits. The inventive skill of the Ameri- can has had almost as full scope upon the farm as in the shop, with the result that the equipment and methods used are well adapted to the conditions.

The story of the vast and varied agriculture of the United States can be most briefly, and, perhaps, best told in the figures of the census and other Govern- ment reports. Unless some other source is ^^*'<- mentioned, the statistics in this article are taken from the eleventh (1890) census (crops of 1889), or the reports of the Department of Agriculture, whose annual esti- mates are based upon the latest figures.

As a result of the great supply of available land the number of farms in the United States increased between 1850 and 1890 216 per cent., or from 1,450,000 to 4,565,000 ; their total acreage increased 112 per cent., or from 294,000,000 to 623,000,000 acres; their improved acreage increased 216 per cent., or from 113,000,000 to 358,000,000 acres ; and their unimproved acreage 47 per cent., or from 181,000,000 to 266,000,000 acres. The following table (No. I.) exhibits the increases of number of farms, total and improved acreage, by decades : —

Table I. — Percentage of Increase of Number and Acreage of Farms by Census Decades.

Farms.

The United States.

Number of Farms.

Acreage.

Total.

Improved.

1850 to 1860 1860 to 1870 1870 to 1880 1880 to 1890

41-1 30-1 50-7 13-9

38-7

0-1

31-5

16-2

44-3 15-8 50-7 25-6

1850 to 1890

215-0

112-3

216-4

The largest percentage of increase of improved land was 5-07,irom 1870 to 1880 ; the lowest was in the decade 1860 to 1»70, the period of the Civil war, and was 15-8. There was a marked slackening in the increase both of the number of farms and pf improved land m the last decade, when public lands adapted to agriculture had approached more nearly the point of complete occupation. The chief cause of this wonderful development of agriculture is the large area of cheap public lands which has been available for immigrants and natives alike. Up to 1897, 529,000 homestead entries had been made and finally settled for 70,397,000 acres of (government land under the Home- stead Act of 20th May 1862, while the number of entries, both final and pending, covered 102,280,000 acres] Between 1875 and 1897 the public and Indian lands sold for cash and under homestead and timber culture laws, as well as those allotted by scrip, granted to the colleges of agri- culture and mechanic arts and other institutions, and by military bounty land warrants, and selected by States and railroad corporations, covered 300,000,000 acrps. In addi- tion to this, the States and railroad corporations sold a large amount of land to farmers of which we have no accurate record. This vast territory, greater in extent than

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Germany and France combined, was added to the farms of the country in twenty-two years. In many cases rail- road building has made the settlement of the public lands possible for the first time, and the building of branch lines, by providing means for transporting products to market, has greatly facilitated the acquisition of other lands. The mileage of railways increased 245 per cent, between 1870 and 1896. The interesting fact is that this increase corresponds geographically to the increase in farms.

The agricultural statistics do not include any farm of less than three acres unless it produced at least f 600 worth of products the preceding year. The census of 1890 showed that the average size of farms was 137 acres, or three acres more than in . 1880 and 66 acres less than in 1850. Within a certain limit the average area of farms is determined by the financial ability of the owners. In this day of farm machines, an owner must have a certain amount of land in order to afford the necessary equipment for cultivating it successfully. This fact appears to have stopped the further subdivision of farms and to have started a movement towards their consolida- tion. As will be seen from the following table (No. II.), the average farm, which steadily diminished in size from 1850 to 1880,

actually increased slightly between 1880 and 1890, owing chiefly to the enlargement of the wheat farms of the west.

Tabie II. — Average Acreage of Farms and Improved Land therein by Census Years.

The United States.

Average Number of Acres.

Improved.

Whole Farm.

1850

1860

1870

1880

1890

78 80 ‘71 70 78

203 198 155 133 137

The figures for the average farm areas of improved land represent more truly the actual economic condition. Thus it is instructive to notice that the number of acres under cultivation (improved land) on each farm was on the average the same — 78 acres — at the end of the forty-years period as at its beginning. The existence of available surplus land has its influence ; but the increasing use of improved machines and tools, and the construction of convenient railroads, appear to be the chief causes for the enlargement of farms. g

In farms cultivated by owners there was^n increase between 1880 and 1890 of 285,422, or 9-66 per cent. ; in farms rented for iponey, of 132,302, or 41 per cent. ; and in farms rented for a share of the products, of 138,010, or 19-65 per cent. In 1890, 71-6 of all the farms were cultivated by their owners, as against 74*4 per cent, in 1880. From 1880 to 1890 the farm tenancy grew from 25-6 to 28-4 per cent., an increase of 2-8 per cent. The steady drift towards farm tenaricy of late is believed to be injurious to production; but it is impossible to prove this, so great has been the aggregate increase in products.

The number of persons engaged in agriculture as a business in 1890 was 8,395,634, or 37 per cent, of all persons in gainful occupations. It is interest- Agricuh ing to note that 678,000 of these were women. aipat^ons. ^^’^ is an increase of nearly 1,000,000 persons over 1880, or 12-6 per cent. Thus, if the farm family is the same size as that of the Remainder of the population — it is probably slightly larger — ^the agricultural population would be 37 per cent, of the whole. Statis-

ticians usually put it at 40 per cent., and this is probably more nearly correct.

Table III. — Number of Persons of Ten Tears of Age and over in the Different Agricultural Pursuits in 1890.

Occupation.

Total Persons.

Dairymen and women .

Farmers and farm superintendents . . ,

Farm labourers

Gardeners, nurserymen, and vitioulturists Otlier pursuits

ToUl

17,895

5,281,567

3,004,061

72,601

19,520

8,395,634

The increase in farm tenancy, and especially the diminished demand for labour relative to products, due to the growing use of machinery, reduced the number of agricultural labourers who work for wages from 49 per cent, of all agricultural workers in 1870 to 43-6 in 1880 and 35-8 in 1890. The wages paid farm labourers, as ascertained by the Department of Agriculture, are rather low compared with the average wages of labiur, but not lower than the wages of other unskilled labour. The average monthly wage of the agricultural labourer, with- out board, was $19.50 in 1870, $16.42 in 1880, f 18.33 in 1890, and $17.70 in 1895. These wages are good as compared with those earned in Continental countries.

The figures for farm capital and the value of agricul- tural products are so vast that it is extremely difficult to put them in form to be grasped intelligently. The farm capital of the United States reported ’”’”^ ot by the census of 1890 reached $15,500,000,000, p^l^.” the main classes being, in round numbers: — Land, fences, and buildings, $13,000,000,000 ; machines and ifmplements, $500,000,000; live stock, $2,000,000,000. The products of the farms in the census year, 1889, were valued at $2,500,000,000. Between 1850 and 1890 the aggregate farm capital increased 303 per cent. ; the value of annual products increased between 1870 and 1890, 15.5 per cent. The greatest increase of farm capital was between 1850 and 1860, 101 per cent. ; the next was the decade 1880 to 1890, when the increase was 29 per cent. From 1870 to 1880 the value of farm products increased 4 per cent. ; from 1880 to 1890, 11 per cent. It is note- worthy that ” the value of capital increased in a much greater degree than the value of products.”

In order to put the facts about the crops grown in the United States in a form that may be readily understood, Mr Holmes of the Department of Agriculture has computed the num- ber of railroad freight cars of fifteen tons’ capacity required to haul the crops of 1897 and what their length in trains would be. He tells us that to haul the hay crop 4,017,933 cars would be needed, and the length of the train would Ije 25,112 miles, or more than long enough to encircle the earth at the equator ; for the

corn crop there must be 3,540,257 cars, making a train 22,127 miles long ; the wheat crop would take 1,060,000 cars, with a total length of 6625 miles, or farther than from New York to Cape Horn ; for the oat crop a ‘train of 772,098 cars, extending 4826 miles, or from New York to the Congo river ; the potato crop would take a train of 327,354 cars, and 2046 miles long, which would extend from New York to Utah ; the cotton crop would take a train as long as from New York to Chicago, and the barley crop one that would reach from “Washington, D.C., to Atlanta, Ga.

The growth of farm area and of capital invested in agriculture was followed by a proportionate increase in the principal crops. Between 1880 and 1890 the area devoted to each crop increased as follows : — Indian corn (maize), 15-6 per cent. ; rye, 17-9 per cent. ; oats, 75-4 per cent. ; barley, 61-2 per cent. ; cotton, 39-3 per cent. ; sugar-cane, 20-7 per cent.; hay, 72-9 per cent.; and tobacco, 8-8 per cent. ; while the area in wheat decreased 6-2 per cent. ; buckwheat, 1-3 per cent. ; and rice, 7-4 per cent. The

states]

following table (No. IV.), arranged by Holmes, gives the increase or decrease in five principal crops for eacb decade from 1840, wben the first census of agricultural products was taken, down to 1890 : —

Table IV. — Percentage of Increase (+) or Decrease (,—)of ProdMction of Farm, Crops, by Time Periods.

The United states.

Indian Corn.

Wheat.

Oats.

Cotton.

Tobacco.

1840 to 1850 1850 to 1860 1860 to 1870 1870 to 1880 1880 to 1890

+ 56-8 + 41-7 – 9-3 + 130-6 + 21-0

+ 18-5 + 72-3 +66-2 +59-7 + 1-9

+ 19-1 + 17-8 + 63-4 + 44-6 + 98-4

+ 56-2 +118-2 – 44-1 + 91-1 + 29-8

- 8-9 + 117-4

- 39-5 + 79-9 + 3-3

1840 to 1890

+462-2

+452-2

+567-6

+ 372-7

+ 122-8

The distinguishing feature of the period 1870 to 1880 is the rate of increase of corn, wheat, cotton, and tobacco. Since 1870 the production of nearly all of the farm crops increased more rapidly than the population, the most absolute proof of the Sdbstantial prosperity of the people. The increase in population for the fifty years from 1840 to 1890 was 267 per cent. ; from 1870 to 1880, 30 per

cent. ; from 1880 to 1890, 25 per cent. ; but the food and other supplies have far exceeded the demands of even this great population.

Untn the use of more and cheaper motors becomes possible, farm animals must increase with farming opera- tions. “At the census of 1890 there were 14,969,467 horses on farms, 2,295,532 mules and asses, 1,117,494 working oxen, 16,511,950 milch cows, 33,734,128 other cattle, 57,409,583 swine, and 35,935,364 sheep, not includ- ing spring lambs ; and in the census year the wool clip amounted to 165,449,239 pounds, not including pulled wool and wool clipped on ranges, which were sufficient, accord- ing to the estimates of the department, to make the entire wool clip for the census year 276,000,000 pounds. In forty years, from the census of 1850 to that of 1890, the number of horses on farms increased 245-2 per cent.; mules and asses, 310-4 per cent. ; milch cows, 158-6 per cent. ; other cattle, 248 per cent. ; swine, 89-1 per cent. ; sheep, not including spring lambs, 65-4 per cent., and the farm wool clip increased 215 per cent. ; but working oxen decreased 34-3 per cent.” (.HbZmes).

The following tables give the most important facts with regard to the cereal production of the United States between 1870 and 1899 (Tables V. and VI.) :—

Table V. — Average Yield and Value of Cereal Crops in the United States, by Periods of Years,

1870 to 1899.

The United States.

Corn.

Wheat.

Oats.

Average

Average

Average

Average

Average

Average

Average

Average

Average

Farm Price

Tield per

Value per

FarmPnce

Yield per

Value per

Farm Price

Tield per

Value per

per Bushel.

Acre.

Acre.

per Bushel.

Acre.

Acre.

per Bushel.

Acre.

Acre.

Dollars.

Bashels.

Dollars.

Dollars.

Bushels.

Dollars.

Dollars.

Bushels.

Dollars.

1870 to 1880 .

0-426

27-1

11-54

1-05

12-4

13-00

0-353

28-4

10-03

1880 to 1889 .

•393

24-1

9-48

•827

121

9-98

•309

26-6

8-22

1890 to 1896 .

-355

24-1

8-55

■658

130

8-54

•286

25-2

7^21

1897

,.,

23-8

6-27

...

13-4

10-86

27-2

fr75 <

1898 .

• *•

24-8

7-10

...

15-3

8-92

...

28-4

7-23

1899

...

25-3

...

12-3

30-2

Table VX — Average Yield and Value of Cereal Crops in the United States, by Periods of Years, 1870 to 1896.

‘The United states.

Barley.

Eye.

B_uckwheat.

Average Farm Price per Bushel.

Average

Tield per

Acre.

Average

Value per

Acre.

Average Farm Price per Bushel.

‘ Average

Tield per

Acre.

Average

Value per

Acre.

Average Farm Price per Bushel.

Average

Tield per

Acre.

Average

Value per

Acre.

1870 to 1880 . 1880 to 1889 . 1890 to 1896 .

Dollars.

0-738 . -589

•374

Bushels.

22-1 21-7 22-8

Dollars.

16-34

12-79

8-52

Dollars.

0^701

•622

•467

Bushels.

14-1

11^9

13-6

Dollars.

9-92 7-39 6-35

Dollars.

0-715 -642

•490

Bushels.

17-7 12-8 17-4

Dollars.

12-65

8-24

8-51

The average farm price of wheat declined, as is shown iu the above tables, from $1.05 per bushel for the decade 1870 to 1880 to 65-8 cents for the period 1890 to 1896. The farm prices of the other cereals declined less during the twenty-seven years. Corn declined from an average farm price of 42-6 cents per bushel for 1870-80 to 35-5 cents in 1890 to 1896. The farm value of wheat per acre ranged from $13 in 1870-80 to $8.54 in 1890-1896; it then advanced to f 10.86 in 1897, and fell to $8.92 in 1898. In farm value per acre corn averaged $11.54 in the decade 1870 to 1880, and $8.55 in 1890-96. The other cereals declined in the same manner in value per acre. The average production per acre shows nothing ■ conclusive with regard to the fertility of the soil of the country. The expansion of the crop area usually causes a lowering of the average yield per acre by distributing the culture, fertilizers, &c., over more surface. Likewise the contraction of crop area will usually increase the average yield per acre of the entire country. The average bushels of wheat per acre was 12-4 in the decade 1870 to

1880, and 13 in the period 1890 to 1896 ; of corn, 27-1 in 1870 to 1880, and 24-1 in 1880 to 1896 continuously. Oats fell off from 28-4 to 25-2 bushels per acre from the first to the last period.

The agricultural returns for 1890 to 1899 may be taken as an illustration of the cereal production of the United States. The figures for wheat, oats, and Indian corn are presented in Tables Nos. VII., VIII., and IX.

The acreage and production of wheat have steadily increased ; the total farm value of the crop has averaged $330,000,000 a year for the last ten years. The acreage in Indian corn, the great American crop, reached its highest in 1899, 82,000,000 acres, and its production its highest figure in 1896, 2,284,000,000 bushels.

Producing as the United States does so much more than its people can consume, its exports form a large per- centage of some of the crops, as Table X., from the Year Book of the Department of Agriculture for 1897, shows.

The average percentage of wheat crop exported annually

Table YIL— Acreage, Production, Value, Prices, and Exports of Wheat in the United States in 1890 to 1899.

Chicago Cash Price per Bushel, No «

Tmh-.

Acreage.

Average Yield per

Production.

Average Farm Price per Bushel,

Farm Value, 1st Dec.

Domestic Exports, IncludingFlour, Fiscal Years ,

December.

May. of following

Ist Deo.

Year.

beginning 1st July.

Low.

High.

‘Low.

High.

Acres.

Bushels.

Bushels.

Cents.

Dollars.

Cents.

Cents.

Cents.

Cents.

Bushels.

1890 .

36,087,154

11-1

399,262,000

83-8

334,773,678

87.

98|

108

, 106,181,316

1891 .

39,916,897

15-3

611,780,000

83-9

513,472,711

89f

93^

80

85

i

225,665,812

1892 .

38,554,430

13-4

515,949,000

62-4

322,111,881

69i

73

68i

W

191,912,635

1893 .

34,629,418

11-4

396,131,725

53-8

213,171,381

59

64

52

60i

164,283,129

1894 .

34,882,436

13-2

460,267,416

49-1

225,902,025

52f

634

60

76

144,812,718

1895 .

34,047,332

13-7

467,102,947

50-9

237,938,998

63|

64|

57.

67t

126,443,968

1896 .

34,618,646

12-4

427,684,346

72-6

310,602,539

in

93i

68

97:

145,124,972

1897 .

39,465,066

13-4

530,149,168

80-8

428,547,121

92

109

117

185

217,306,005

1898 .

44,055,278

15-3

675,148,705

58-2

392,770,320

62|

70

68|

79i

222,694,920

1899 .

44,592,516

1^-3

547,303,846

58>4

319,545,259

64

69i

...

...

T4.BLE VIII.

—^Acreage, Production,

Value, Prices, and Mayports of Oats in

the United States in 1890 to 1899.

Chicago Cash Price per Bushel,

-

Tear.

Acreage.

Average

Yield per

Acre.

Production.

Average Farm Price per Bushel,

Ist Dec.

Farm Value, 1st Dec.

Domestic Ex- ports, including Oatmeal, Fiscal Years beginning 1st July.

Imports during Fiscal Years begin- ning 1st July.i

December.

May of

following

Year.

Low,

High.

Low.

High.

Acres.

Bushels.

Bushels.

Gents.

Dollars.

Cents.

Cents.

Cents. –

Cents.

Bushels.

Bushels.

1890

26,431,369

19-8

523,621,000

42-4

222,048,486

39: t

43

45

54

1,382,836

41,848

1891

25,581,861

, 28-p

738,394,000

31-5

232,312,267

31

83|

28.

33

10,586,644

47,782

1892

27,063,835

24-4

661,035,000

31-7

209,253,611

26

31 –

28|

32

2,700,793

49,433

1893

27,273,033

23-4

638,854,850

29-4

187,576,092

27J

29

32i

36

6,290,229

31,759

1894

27,023,553

24-5

662,086,928

32-4

214,816,920

28j

29

.27.

30|

1,708,824

330,317

1895

27,878,406

29-6

824,443,637

19-9

163,656,068

16|.

17

18

194

15,156,618

66,602

1896

27,665,985

25-7

707,346,404

18-7

132,485,033

16;.

18|

1«?

18j

37,726,083

893,908

1897

25,730,375

27-2

698,767,809

21-2

147,974,719

21

23|

26

32

73,880,307

25,093

1898

25,777,110

28-4

720,906,643

25-5

186,405,364

26

27

24

27|

33,534,264

28,098

1899

26,341,380

30-2

796,177,713

24-9

198,167,975

221

23

...

...

I In years 1866 and 1884 to 1899, inclusive, oatmeal is included:

Table IX.-

-Acreage, Production, Value, Prices, and ExpoHs of Corn in the United States in 1890 to 1899.

Acreage.

Average

Yield per

Acre.

Production.

Average Farm Price per Bushel,

1st Dec.

Farm Value, 1st Dec.

Chicago Cash Price per Bushel, No. 2.

Domestic Exports,

including Corn Meal, Fiscal Years beginning 1st July.

Year.

December.

May of

following

Year.

Low.

High.

Low.

High.

1890 1891 1892 1893 1894 1895 1896 1897 1898 1899

Acres.

71,970,763 76,204,515 70,626,658 72,036,465 62,682,269 82,075,830 81,027,166 80,096,051 77,721,781 82,108,587

Bushels.

20-7 27-0 23-1 22-5 19-4 26-2 28-2 23-8 24-8 25-3

Bushels.

1,489,970,000 2,060,154,000 1,628,464,000 1,619,496,131 1,212,770,052 2,151,138,580 2,283,875,165 1,902,967,933 1,924,184,660 2,078,143,933

Cents.

50-6 40-6 39-4 36-5 45-7 25-3 21-5 26-3 28-7 30-3

Dollars.

764,433,451 836,439,228 642,146,630 691,625,627 564,719,162 544,985,534 491,006,967 501,072,952 . 652,023,428 629,210,110

Cents. 47J

394 40

34J 44|

25

22i

25

33i . 30^

Cents.

53

42|

36i

47i

26|

23f

27i

38

31i

Cents.

55

40J

39*

36|

47 1 27* 23 324

32|

Cents. 69i

100 44* 38* 551 29* 25* 37

34|

Bushels.

32,041,529

76,602,285

47,121,894

66,489,629

28,585,405

101,100,376

178,817,417

212,055,543

177,265,046

Table X. — Percentage of Crops Exported, for Period 1878 to 1896.

Annual Average.

Crop,

1878-82.

1888-92.

1894-96.

Wheat .

27-84

17-68

15-96

Corn

4-82

3-49

5-39

Eye ^

10-30

,,

12-21

Oats

■37

-80

2-22

Barley

1-66

...

12-96

Potatoes

•37

• ••

•30

Tobacco

56-84

67-42

Cotton

72-80

66-79

73-60

from 1894 to 1896 was 16; of com, 5^4; of rye, 12^2; of

barley, 13; of tobacco, 67^4; of cotton, 73^6. Large portions of some of these crops, like corn and oats, are exported in the form of animals and animal products (meats, lard, hides, &c.). The hay crop is almbst entirely used in this way, and the tendency is to convert more and more of these crops into these higher-priced products. StUl, the time is far distant when domestic consumption will come anywhere near overtaking domestic production, especially of wheat and the other cereals. The certain extension of acreage with the growth of demand and price, the increased use of agricultural implements, and the im- provement of methods will be sure to keep up a large surplus for export for long years to Come. The Depart- ment of Agriculture has found that for home use there is required per caput 5^5 bushels of wheat, 28-6 bushels of

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com, and lO-T bushels of oats, the computations being made from the figures for population, production, and exports for 1888 to 1892. The following number of acres in these crops are required, therefore, to supply the home demand: — 0-43 of 1 acre in wheat, 146 acre in corn, and 0-43 acre in oats per head of the population. If we take the year 1890 as an illustration, this gave a surplus area in wheat of 11,264,478 acres, of 2,648,404 acres in com, and of 238,162 acres in oats.

There were 4,008,907 farms in the United States in 1880, and in 1890 there were 4,564,641, an increase of 13-9 per cent. In 1880 the average number of horses to Number ^^^ ‘,’ “^^^ 2-8, and in 1890, 31. In 1880 and value there was an average of 0;4 mule per farm in of animals the United States, and in 1890 the number had per arm. increased to 0-5. There were on the average three milch cows on each farm in 1880, and in 1890 the number had increased to 3-5. The number of other cattle per farm was 5-3 in 1880, and in 1890 it was 8-1. The average number of sheep fell from 10-2 in 1880 to 9-7 in 1890. There was a corresponding decrease in value. The number of swine rose from 8-5 in 1880 to 11-3 in 1890. There were on the average farm in the United States in 1880, 30”2 animals, whose total value was $393, and in 1890 there were 36-2 animals valued at $529, an increase in numbers of 19-9 per cent., more than keeping pace with the increase in number of farms, which was 13*9 per cent. ; and in value the increase was $136, or 34-6 per cent.^

Table XI. shows the average number and value of animals on farms in the United States in 1880 and 1890, with the percentage of increase or decrease during the decade.

In 1880 there were 23 horses to each 100 of popular tion in the United States. The number increased to 25 in 1893, and declined to 21 in 1896. Tor the decade 1880-90 the average was 21|, and for the period 1890-98 the average was 23. The average value of horses per 100 of population for the ten-years period 1880-90 was $1462, and for the period 1890-98 $1300. In 1880 there were 3 mules for each 100 of population, and after increasing to 4 in 1894 it fell to 3 in 1899. The value

of mules per 100 of population increased from $214 in 1880 to $296 in 1889, and declined steadily to $150 in 1898. Since the war with Spain there has been a marked increase in value, which still continues. Between 1880 and 1890 there were about 25 milch cows for every 100 of population. After 1890 the number increased to 26, and in 1896 fell off to 23. . The average value of cows per 100 of population increased steadily from $565 in 1890 to $780 in 1884, but decreased to $520 in 1898. The latest reports indicate a marked increase again. The

Table XI. — Average Number and Value of Animals per Farm in the United States in 1880 and 1890, and Percentage of Increase or Decrease. /

Animals.

1S80.

1890.

Percentage of increase (+) or / decrease (—).

Number.

Value.

Number.

Value.

Number.

Value.

Horses . Mules . Milch cows . Other cattle . Sheep . Swine .

Total .

2-8 0-4 3 0 5-3 10-2 8-5

$153 26 70 85 23 36

3-1 0-5 3-5 81 9-7 11-3

$214 40 77 123 22 53

+ 10-7 + 25-0 -)-16-7

-f52-8

- 4-9 -1-32 -9

-t-39‘9

-1-53 -8

-t-10-0

-1-44-7 – 4-3 -(-47-2

30-2

393

36-2

529

-1-19 -9

-t-34-6

number of sheep in proportion to population increased from 82 per 100 in 1880 to 93 in 1884, from which there was a steady decrease to 53 in 1898. The values increased from $182 per 100 of population in 1880 to $234 in 1883, from which there was a downward movement, reaching the lowest point, $92, in 1896. The number of swine per 100 of population commenced with 69 in 1880 and reached their highest point, 85, in 1882, then decreased to 75 in 1888, and to 63 in 1898. The values started at $295 in 1880, went up to $550 per 100 in 1883, and then declined to $270 in 1898. The total value of all farm animals per 100 of popiilation increased from $3185 in 1880 to the highest point, $4454, in 1884, from which there was a steady decrease to $2300 in 1898. The following tables (XII. and XIII.) give the number, total value, and average price of farm animals in 1880, 1890, and 1900 : —

Table XII. — Number and Value of Farm Animals in the United States, 1880 to 1900.

January

Horses.

Mules.

Milch Cows.

Number.

Value.

Number.

Value.

Number.

Value.

1880 1890 1900

11,201,800 14,21.3,837 13,537,524

$613,296,611 978,516,562 603,969,442

1,729,500 2,331,027 2,086,027

$105,948,319 182,394,099 111,717,092

12,027,000 15,952,883 16,292,360

$279,899,420

352,15^,133

514,812,106

January

Other Cattle.

Sheep.

Swine.

Total Value of Farm Animals.

Number.

Value.

Number.

Value.

Number.

Value.

1880 1890 1900

21,231,000 36,849,024 27,610,054

$341,761,154 560,625,137 689,486,260

40,765,900 44,336,072 41,883,065

$90,230,537 100,659,761 122,665,913

34,034,100 51,602,780

$145,781,515 243,418,336

$1,576,917,556

2,418,766,028

02,042,650,813

a Exclusive of swine.

Table XIII. — Average Value of Farm Animals in the United States on 1st January, 1880 to 1900.

Tear.

Horses.

Mules.

MUch Cows.

Other CatUe.

Sheep.

Swine.

1880 1890 1900

$54.75 68.84 44.61

$61.26 78.25 53.56

$23.27 22.14 31.60

$16.10 15.21 24.97

$2.21 2.27 2.93

$4.28 4.72

Since the Civil War the number of horses has increased and prices have gradually declined. In 1893 the number

1 Condensed from Report of the Division of Statistics of the U.S. Dept. of Agriculture, 1899.

of horses reached the highest figure, 16,206,802, an increase of over 5,005,002, or 44-6 per cent, over the number in 1880. The average farm price of horses increased from $54.75 in 1880 to $74.64 in 1884, after which there was an uninterrupted decrease to $31.51 in 1896. The extension of street-car lines, and the substitu- tion of caljle and electric power for that of horses, and the use of bicycles have been factors in decreasing the demand for these animals. The record for mules has been parallel to that for horses.

The returns for milch cows show an increase throughout the period 1880-99 in every year, with the exception of

1895 to 1899. For the first ten years the numbers increased 32-6 per cent., and from 1890 to 1899, -2 per cent. The total value of milch cows increased each year until 1884, then decreased until 1891, “with a gradual increase until the end of the period. The farm price of milch cows rose from f 23.27 in 1880 to $31.37 in 1884, then fell to f 21.40 in 1892, after which there was a steady increase to $31.60 in 1899.

Ko marked changes in the numbers of sheep have taken place. During the period 1880-90 there was an increase in numbers amounting to about 8-8 per cent. Since 1893 there has been a rather steady decrease, with fluctuations amounting to a marked depression after 1894. This industry is very^susceptible to adverse influences, and felt keenly the depression in the price of wool. The increase commenced again in 1898, and numbers have gone up for two years.

The numbers and values of swine constantly fluctuate with the movement and value of the corn crops. The returns for 1890 showed a numerical increase of 51-6 per cent, over those of 1880 ; then followed a steady decrease in numbers down to 1897, since which time there has been a slight increase. The movement in values was similar to that in numbers. From $4.28 in 1880, the average farm price of hogs increased steadily to $6.75 in 1883. The lowest figure, $4.15, was reached in 1891, and after numerous fluctuations it became $4.40 in 1899.

The total value of farm animals had a steady increase from 1880 to 1890, with slight variations in 1885 and

1886. Following 1890 there has been a steady decrease down to the present time, with the exception of slight increases in 1892 and 1893. In 1880 the total value of farm animals in the United States was $1,576,917,556. In 1890 it had increased to $2,418,766,028, or’ 53-4 per cent. In 1896 the value had

decreased to $1,727,926,084, or 28-6 per cent., from the 1890 values, and an increase of 9-6 per cent, over those of 1880.

The exports of live stock and its products have increased enormously in recent years, both in quantity and value. This is especially true of the exportation of beef, cattle, and meat products. The exports of cattle increased from 182,750 in 1880 to 331,720 in 1896, or 81| per cent., and values from $13,340,000 in 1880 to $30,600,000 in 1895, an increase of 129 per cent. The average value of cattle exported has increased from $19 in 1870 to $73 in 1880 and $92 in 1895. It must be said, however, that only the best and heaviest cattle are exported, which command a much higher price than the average of the country.

The total value of farm animals exported from the United States has fluctuated greatly. On the whole, however, the value has increased from $16,000,000 in round numbers) in 1880, to nearly $36,000,000 in 1895, or 125 per cent. The following table (No. XIV.), compiled from statistics of the United States Treasury Department, shows, by years, the number and value of each kind of live animal exported between 1880 and 1895, inclusive.

The exports of meat products of all kinds, including

Table XTV. — Member and Valiie of Farm Animals exported from the United States, by years, 1880 to 1895.

Tear ending

Horses.

Mules.

Cattle.

Sheep.

Swine.

Total

Both Jane.

Number.

Value.

Number.

Value.

Number.

Value.

Number.

Value.

Number.

Value.

Value.

1880

3,060

$675,139

5,198

$532,362

182,756

$13,344,195

209,137

$892,647

83,434

1421,089

$15,865,432

1881

2,523

390,243

3,207

353,924

185,707

14,304,103

179,919

762,932

77,456

572,138

16,383,340

1882

2,248

470,183

2,632

320,130

108,110

7,800,227

139,676

603,778

36,368

509,651

9,703,969

1883

2,800

475,806

4,237

486,560

104,444

8,341,431

337,251

1,154,856

16,129

272,516

10,731,169

1884

2,721

424,317

3,742

490,809

190,518

17,855,495

273,874

850,146

46,382

627,480

20,248,247

1885

1,947

377,692

1,028

127,580

135,890

12,906,690

234,509

512,568

55,026

579,183

14,503,713

1886

1,616

348,323

1,191

148,711

119,065

10,958,954

177,694

329,844

74,187

674,297

12,460,129

1887

1,611

351,607

1,754

214,738

106,459

9,172,136

121,701

254,725

75,383

564,753

10,657,959

1888

2,263

412,774

2,971

378,765

140,208

11,577,578

143,817

280,490

23,755

193,017

12,842,624

1889

3,748

592,469

2,980

356,333

205,786

16,616,917

128,852

366,181

45,128

356,764

18,288,664

1890

3,501

680,410

3,544

447,108

394,836

31,261,131

67,521

243,077

91,148

909,042

33,540,768

1891

3,110

784,908

2,184

278,658

374,679

30,445,249

60,947

261,109

95,654

1,146,630

32,916,554

1892

3,226

611,188

1,965

•238,591

394,607

35,099,095

‘46,960

161,105

31,963

364,081

36,474,060

1893

2,967

718,607

1,634

210,278

287,094

26,032,428

37,260

126,394

27,375

397,1-62

27,484,869

1894

5,246

1,108,995

2,063

240,961

359,278

33,461,922

132,370

832,763

1,553

14,753

36,659,394

1895

19,984

2,209,298

2,515

186,452

331,722

30,603,796

405,748

2,630,686

7,130

72,424

35,702,656

canned meats and oleomargarine, are subject to consider- able fluctuation, both in quantity and value, rendering it impossible to describe them in a few words. The ex- ports of beef products, which amounted to 241,000,000 pounds, in round numb^ers, in 1880, increased, with fluctuations, to a maximum of 507,000,000 pounds in 1891, since which “time they have decreased to 345,000,000 pounds in 1895. The values of beef products exported from the country fell from $26,000,000 in 1880 to a minimum of $15,000,000 in 1887, and reached a maximum value of $35,000,000 in 1891. The value of beef products exported in 1895 was $27,000,000, in round numbers. The exports of hog products have varied in a similar manner from 1,230,000,000 pounds in 1880 down to a minimum of 715,000,000 pounds in 1884, reaching 1,160,000,000 pounds in 1890. The exports for 1895 were 1,090,000,000 pounds. Values have varied in a similar manner from a maximum of $105^000,000 in 1881 down to $57,000,000 in 1886, and back up to $93,000,000 in 1894. The exports of mutton show a marked, decrease, both in quantity and values. Starting

from a maximum of 3,380,000 pounds in 1881, they have decreased, with many fluctuations, to- 101,000 pounds in 1892, but increased suddenly to 2,200,000 pounds in 1894,. since which time they. have fallen off’ again. The values of these exports fell from $258,000 in 1881 to $9000 in 1892, and increased to $174,000 in 1894. The exports of oleomargarine were first regularly reported in 1884, and have increased, on the whole, from 40,000,000 pounds in 1884 to 127,000,000 pounds in 1894, and in values from $4,800,000 in 1884 to $12,400,000 in 1894. The total value of exported meat products, including canned goods and oleomargarine, has increased from $111,000,000 in 1880 to $134,000,000 in 18^4 and $125,400,000 in 1895. The increase for the entire period was about $14,480,000, or 13 per cent.

The facts with regard to the production, imports,, exports, and consumption of wool in the United States- are presented in Table XV., compiled from estimates from the Department of Agriculture and the reports of the bureau of statistics of the Treasury Department. The production of wool shows an increase, with fluctuations^

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from 232,600,000 pounds in 1880 to 309,748,000 pounds in 1895, an increase of 33 per cent. The imports show numerous fluctuations, both in quantities and values. The total value of the imports of wool in 1896 was $26,666,421. The exports of domestic wool show an enormous increase, with numerous violent fluctuations, especially in recent years. Starting with 191,661 pounds in 1880, valued at $71,987, these exports increased in

1896 to 4,279,109 pounds, valued at f 484,463, an in- crease of 2000 per cent, for quantity and 670 per cent, for value. The exports of foreign wool also show numer- ous fluctuations. Their lowest value was in 1884 — $343,466, and their highest in 1881— $991,407. The consumption of wool in the United States has increased from 356,791,676 pounds in 1880 to 509,159,716 pounds in 1895, an increase of nearly 43 per cent.

Table XV. — Production, Imports, Exports, and Consumption of Wool in the United States, by years, 1880 to 1896.

Tear ending 30th June.

Production.

Imports.

Exports of Domestic,

Exports of Foreign.

Total Exports.

Retained for Consumption.

Quantity.

Value.

Quantity.

Value.

Quantity.

Value.

Quantity.

Value.

Pounds.

Pounds.

Dollars.

Pounds.

Dollars.

Pounds.

Dollars.

Pounds.

Dollars.

Pounds.

1880

232,500,000

128,181,747

23,727,650

191,551

71,987

3,648,520

637,586

8,840,071

709,673

366,791,676

1881

240,000,000

56,964,236

9,703,968

71,455

19,217

5,507,534

991,407

5,578,989

1,010,624

290,386,247

1882

272,000,000

67,861,744

11,096,050

116,179

37,327

3,831,836

670,503

3,948,016

707,830

335,913,729

1883

290,000,000

70,575,478

10,949,331

64,474

22,114

4,010,043

664,160

4,074,517

686,274

356,600,961

1884

300,000,000

78,350,651

12,884,709

10,393

3,073

2,.304,701

343,456

2,316,094

346,529

376,035,557

1885

308,000,000

70,596,170

8,879,923

88,006

16,739

3,115,339

516,019

3,203,345

632,758

375,392,825

1886

302,000,000

129,084,958

16,746,081

146,423

19,625

6,534,426

759,442

6,680,849

779,067

424,404,109

1887

286,000,000

114,038,080

16,424,479

257,940

78,002

6,728,292

824,770

6,986,232

902,772

392,061,798

1888

269,000,000

113,558,753

15,887,217

22,164

5,272

4,359,731

626,868

4,381,895

632,140

378,176,858

1889

265,000,000

126,487,729

17,974,515

141,576

23,065

3,263,094

460,560

3,404,670

483,626

388,083,059

1890

276,000,000

105,431,285

16,264,083

231,042

33,543

3,288,467

556,473

3,519,509

690,016

377,911,776′

1891

285,000,000

129,308,648

18,231,372

291,922

39,423

2,638,123

361,260

2,930,045

400,683

411,373,603

1892

294,000,000

148,670,832

19,688,108

202,456

30,664

3,007,563

403,531

3,210,019

434,195

439,460,813

1893

303,153,000

172,433,838

21,064,180

91,858

14,808

4,218,637

515,470

4,310,495

630,278

471,276,343

1894

298,057,384

55,152,586

6,107,438

520,247

90,676

5,977,407

824,882

6,497,654

916,568

346,712,316

1895

309,748,000

206,033,906

26,556,421

4,279,109

484,463

2,348,081

294,100

6,622,190

778,663

509,169,716

American Wheat-Farming.

That wonderful agricultural region, extending from the international line on the north to the 37th parallel, and from the Atlantic Ocean to the 100th meridian, and com- prising 26 States, produces 76 per cent, of the American wheat crop. This region, which contains only 30 per cent, of the land surface of the country, but embraces 60 per cent, of its total farm area and 70 per cent, of its improved farm acreage, is the greatest cereal-producing region of the world. Besides wheat, it produces 82 per cent, of the total com crop, 91 per cent, of the total oat crop, and 83 per cent, of the total hay crop of the United States. The methods pursued in the eastern portion of this region are similar to those used in other parts of the world ; but in the north-western portion wheat-growing is carried on on a gigantic scale, ‘ and by methods almost unknown anywhere else. The best illustrations of the great or “bonanza” wheat farms, as they are called, are found along the Eed River of the North, where it flows between the States of North Dakota and Minnesota.

The wheat grown in the United States is of two distinct kinds. One is the large-kernel winter wheat of the eastern States ; the other is the hard spring wheat. The ” blue stem ” or the ” Scotch-Fife ” are native varieties of the latter kind grown in Minnesota and the two Dakotas. For flour-making this wheat is considered the best in the world. During the season of 1899 the product of hard spring wheat amounted to nearly 260,000,000 bushels, or two-fifths of the entire wheat product of the United

States. Of this, Minnesota and the two Dakotas alone produced 200,000,000 bushels. Minnesota is the greatest wheat- producing State in the Union. Her fields in 1899 cov- ered 5,000,000 acres, and she produced nearly 80,000,000 bushels, which is twice the entire production of all Aus- tralia, and more than that of Great Britain and Ireland put together. In Minnesota and the Dakotas the farms are devoted almost exclusively to wheat-growing. Many of them contain from 3000 to 10,000 acres. All operations on farms of this size must be carried on upon a gigantic scale. The country is a very level one, making it plossible to use all kinds of machinery with great success. As

Bonanza farms.

there are no mountains or swamps, there is here very little waste land, and every squai;e foot of the vast wheat fields can be made productive.

The first characteristic of a ” bonanza ” wheat farm is the machinery. The smallest agricultural implement used upon them is a plough, and the largest is the elevator. A hoe or a spade is almost unknown. Between these two there are machines of all sizes adapted to the ne;eds of the particular work. Let us assume the conditions prevailing upon a bonanza farm of 5000 acres, and briefly describe the process of wheat pro- duction from the ploughing of the land to the delivery of the grain in the final market. These great wheat farms were established upon new lands sold directly to capitalists by the railroads. The lands became the property of the railroads largely through Government grants, and they attracted capitalists, who bought them in large bodie^ and at low prices. The improvements made upon them consist of the cheap wooden dwellings for the managers, dormitories and dining-halls for the men, stables for the horses, and sheds and workshops for repairing machinery. Very little of the land is under fence. Since the desirable lands of the country have been occupied, the prices of these lands have advanced slowly, with the result that the big farms are being divided up into small holdings. After a generation or two, if land continues to rise in the market as it has recently, the bonanza farms will become a thing of the past. At present the best of these lands in the valley of the Eed River of the North a!i;e worth from $25 to $30 an acre. The improvements upon them add about $5 an acre more. A farm is not considered a big one unless it contains from 2000 to 10,000 acres at least. There are, of course, many small farmers, owning from two to five sections (640 acres in each section), but their methods are more like those of the small farmers in the eastern United States or on the continent of Europe. It is necessary to own a large body of land in order to be able to use the machinery and methods here described. It is hard to convey a just notion of the .size of these farms. They stretch away as far as the eye can reach in every direction, making it difficult even for the visitor to conceive their size. The distances across wheat fields are

so great that even horseback communication is too slow. The farms are separated into divisions, and lodging- houses and dining-halls and barns are scattered over them, so as to keep the workmen and teams near the scene of their labour. The men living at one end of the farm may not see those at the other for mon^ihs at a time. Even then it is necessary to take the meals to the men in the fields rather than allow them to walk or ride to the dining-halls. It is not an unusual thing for a working crew to find’ themselves at the dinner hour two miles from their hall.

First, after burning the old straw of the previous year — which is real labour in itself, so enormous is its bulk —

/ PI bi *’°™^^ *^® ploilghing. This begins in October.

(””* “^” The plough used has a 16-inch share, turns two furrows, and is drawn by five horses. Each plough covers about 250 acres in a season, travelling an average of 20 miles a day. The ploughing begins in October, and con- tinues a month or six weeks, according to the season. The ploughs are driven in ” gangs ” under the eye of a superintendent, who rides with them. From eight to ten of these ploughs follow each other around the vast section. If one stands a few rods ahead of them they seem to be following one another in a line ; but, if one stands to the right of the ” gang,” one sees that the line is broken, and that the second plough is a width farther in the field than the leader, and so on for the entire num- ber. Experience shows that it costs about 70 cents an acre to plough the land in this way. About forty men are employed upon a farm of 5000 acres during the ploughing season. The men are paid by the month, and receive about f 25, including their board. They break- fast at five o’clock, take an hour for their dinner at noon — ^usually in the field — and have their supper at seven. At the end of the ploughing season these particular men are usually discharged. Only eight or ten are kept on a farm of this size throughout the year. The other men go back to their homes or to the ^ factories in the cities, where they await the harvestjing and threshing season. The eight or ten who remain upon the farm are employed in doing odd jobs, such as overhauling machinery, or help- ing the carpenter and blacksmith, or looking after the horses. The wheat region is a country of heavy sno”ys, and of severe, dry cold ; but when March comes the snows begin to melt away, and by April the ploughed land is dry enough for the harrow. The harrowing is done with ^5-foot harrows, drawn by four horses, and operated by a single man. One man can harrow 60 to 75 acres a day.

The seeding follows immediately with four-horse press

drills that cover 12 feet. The harrows and drills are

worked in ” gangs ” as the ploughs were. Each

Seeding. ^^^-^ -j g^ ^^^^ 20 to 25 miles a day. When

the weather is good the seeding upon a 5000-acre farm will be done in twenty or twenty-five days. It is usual to seed a bushel and a peck of wheat to the acre. The wheat used for this purpose is carefully selected after the harvest of the previous year, and is thoroughly cleaned of foreign seeds. Through years of cultivation, varieties of wheat have been produced which are particularly well adapted to the soil and climate of this region. It has been found more profitable to use the native ” blue stem ” or ” Scotch- Fife ” wheat than the seed from any other country, or even from the neighbouring States. Counting the seed, wheat, and the labour, it costs about f 1 an acre to harrow the ground and plant the wheat.

■y^^en the planting is done the extra labourers are dis- charged again, and the regular ones are put to work on the corn, oats, and millet, which are grown’ to Labour. £gg^ ^j^g jjorses. The men who do the most im- portant work are all temporary labourers. They come

The harvest.

from the cities of the east or the farms of the south. They begin with the early harvest in Oklahoma, and work northwards up the Missouri and the Red Eiver until the season closes in Manitoba. They are not tramps, but steady, industrious men, with few bad habits and few ambitions. On well-

managed farms drinking and gambling are strictly forbidden. The work is hard, and, as there are few amusements of the farm, the men spend their resting periods in sleep. Their dormitories are usually comfortably furnished, their dining-halls clean. The bonanza farmers find it good policy to feed their men well. Many a strike has occurred in the midst of the harvest because the quality or quantity of the food served was not what it ought to have been. The largest part of this food is brought from the eastern States. Some po- tatoes, turnips, and beans are grown upon the farms; but the corned beef, bacon, and groceries come from the cities. It is estimated thai it costs 35 cents a day to feed each labourer. Farmers say that a good name in these respects enables them to get the choice of workmen, and that no m'oney brings such sure returns as that expended in the bedrooms and upon the food.

The harvest labourers begin to arrive from the south about the middle of July, and by the end of this month the harvest is at its height. A farm of 5000 acres will use 75 or 100 extra men. With the men comes the new machinery in train loads. It is estimated that at least $5,000,000 worth of agricul- tural machines is annually sold in this region. The wheat farmers say that it does not pay to take undue care of old machinery, that more money is lost in repairing and tinker- ing an old machine than would pay for a new one. The result is that new machinery is bought in very large quan- tities, used until it is worn out or cannot be repaired without considerable wor'^, and then left in the fields to rust. Heaps of cast-iron can be seen already upon many of the large farms. Of course a great many extra parts are boi^hlj to take the place of those which break most frequently, and some men are always kept at work repair- ing machines in the field. One of the big 10,000-acre farms will use up two car- loads of twine in a single harvest, enough to lay a line around the whole coast of England, Ireland, and Scotland. The harvesters vary in size accord- ing to the character of the land. Upon the rougher ground and small farms the ordinary binders are used; upon the great plains, like those of California, a great harvester is used, which has a cutting line 52 feet wide. These machines cut, thresh, and stack the grain at the rate of 1600 sacks a day, and cover an area in that time of 100 acres. These machines can only be used where the wheat ripens thoroughly standing in the field. The harvest labourer earns f 10 a week everywhere in America. The bonanza farmer expects one machine to cut at least 250 acres, and three men are required for each of them. The harvest lasts from ten days to three weeks, according to the weather. Including the labour and the wear and tear, it costs about 60 cents an acre to harvest wheat.

The wheat is not stacked as in the eastern States and in England, but stands upright in shocks Jn the field. The grain cures very rapidly in the dry climate, so that by the time the wheat is all cut and ™"«*''W. shocked on one end . of the division, it is ready for the thresher at the other. The shocks of wheat are hauled directly to the thresher and fed into the self-feeder. It usually takes a day and a quarter to thresh the wheat which it took a day to cut. The farmer estimates that a threshing-machine can thresh all the wheat ordinarily grown upon 2600 acres, so that a 5000-acre farmer would have at least two machines running at the same time. Time is a very important thing in threshing, since a rain- fall might spoil enough grain in one night to buy several

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The returns.

machines. The threshing season is thus a time of great pressure and of extensively active work. The wheat straw is worse than a waste product — ^it is a great nuisance upon the bonanza farm. A little of it is used for fuel for the engines and for bedding the stock ; but the bulk of it is dragged away

from the threshing machine by machinery, and left lying in great heaps until an opportunity is afforded for burning it up. This is usually done imme- diately before the ploughing in the autumn. The grain falls from the spout of the thresher into the box wagon, which carries it to the elevator. The elevator is placed at the railway station, and is usually owned by the bonanza farmer.

From the time the sheaves of wheat are tumbled into the wagon until the flour reaches the hands of the cook, no hand touches the wheat that passes through the great Minneapolis mills. When the box-wagons reach the elevator the loosing of a bolt dumps the grain into the bin, where it remains until the pulling of a lever lets it into the cars. Every pound of it is weighed and accounted for, and entered upon the books, so as to show the exact product of each division of the farm. After the rush of the threshing is over the farmer studies these books carefully to see what his land is doing, and makes his plans for the next year, so as to rest or strengthen those divisions which are failing. It costs about $1.50 an acre to thresh the grain and put it into the elevator. This sum, added to the estimated cost of the other processes mentioned above, makes the total cost of growing an acre of grain about $3.80. This in- cludes the cost of labour, seed, and wear and tear of machinery, but does not include the interest on land or plant. The taxes on land will average 25 cents an acre. The farmers estimate that the other improvements, the water- works, elevators, insurance, horse feed, &c., will make this up to $6 an acre. The best of these farms will yield 20 bushels to the acre. This makes the wheat cost 30 cents a bushel. During the last five years the average farm-selling price of wheat in the North- West has been 58 cents. An acre thus produces $11.60, making a gross profit of $5.60. Still to be provided for is the interest on the operating expenses for eighteen months, which will, at 8 per cent., be 48 cents per acre. Interest on the capital in land, improvements, and machinery, at $30 per acre, makes $1.80 more, or a total interest charge of $2.28. When this is deducted from the gross profits of $5.60 prices found above, we have a net profit of $3.32 an acre, not an exorbitant one by any means. This is about 8 per cent, on the capital invested in the land, plant, and operating expenses. But we have described the conditions on one of the best bonanza farms. The average yield per acre in this region is not over 18 bush- els, and the average expenses would be higher than those given.

Every bonanza farmer’s office is connected by wire with the markets at Minneapolis, Chicago, and Buffalo. Quo- tations arrive hourly in the selling season, and Marketing, j^ superintendent keeps in close touch with his agents in the wheat-pits of these and other cities. When the instrument tells him of a good price, his agent is in- structed to sell immediately. The farmer on the upper waters of the Red River of the North is kept fully informed as to the drought in India, the hot winds in the Argentine, and the floods of the Danube. Any occurrences in these distant parts of the world are known to la,im in a surpris- ingly short time. The world’s great wheat fields almost lie within his sight, so well does he know the conditions that prevail in them. Ten days are allowed for delivery, so that he can usually ship the wheat after it is sold. In the early days of wheat-farming the bonanza farmer often speculated, but experience has taught him that he had

better leave this to the men in the cities, and content himself with the profit from the business under his eye. The great elevator centres are in Duluth, and Minneapolis, Chicago, and Buffalo. T^ese elevators have a storage capacity of from 100,000 to 2,500,000 bushels. The new ones are built of steel, operated by steam or electricity, protected from fire by pneumatic water-pipes, and have complete machinery for drying and scouring the wheat whenever it is necessary. The elevators are provided with long spouts containing movable buckets, which can be lowered into the hold of a grain-laden vessel. The wheat is shovelled into the pathway of the huge steam shovels, which draw it up to the ends of these spouts, where the buckets seize it, and carry it upwards into the elevator, and distribute it among the various bins according to grade. A cargo of 200,000 bushels can thus be unloaded in two hours, while spouts on the other side of the elevator reload it into cars, five to ten at a time, filling a car in from five to ten minutes, or the largest canal boat in an hour. The entire work of unloadin g, storing, and reloading adds only one cent to the price of a bushel of wheat.

The great wheat-growing States like Minnesota have established systems of inspecting and grading wheat under State supervision. In Minnesota the system is carried out by the Railway and Warehouse Com- ti'pecUng mission, which fixes and defines the different graaiag. grades of wheat and directs the work. At pre- sent there are 18 grades recognized in this State. The first is described as " No. 1, hard spring wheat, sound, bright, and well cleaned, composed mainly of hard ' Scotch-Fife,' weighing not less than 58 lb to the meas- ured bushel." The second grade is known as "No. 1, northern spring wheat, sound, and weU cleaned, com- posed of the hard and soft varieties of spring wheat." So the varieties run — "No. 2, northern"; "No. 3, northern," &c. — down to the 18th, which is " no grade." The official inspectors examine, grade, and sample the wheat in the cars in which it is received at the great markets or elevators. The cars are sealed at the point of original shipment. The first thing, therefore, is to examine the seals to see that thiey are upbroken. The inspector then samples and examines the wheat, and enters the grade upon a blank opposite the number and letters of the car. His tag and sample go to the wheat exchange or chamber of commerce, where they are exposed in small tin pans, and form the basis of the trading. A few years ago the wheat received from the North- West was very clean indeed, but since the new land has all been cultivated the fields are growing more weedy, with the result that the wheat brought in is becoming mixed with oats and seeds of weeds, requiring more careful separating and inspection. After the inspector has finished his work the cars are resealed with the State seal, and await the orders of the purchaser. The delay will not ordinarily be more than one day. The Commis- sion keeps complete records and samples of each car until the wheat has passed entirely out of the market. When disputes occur as to the grade they can thus be instantly settled. If the grade is changed after a second examina- tion the State pays the expense of the inspection ; if not, it is paid by the agent who raises the objection. Only about 5 per cent, of the samples are ever reinspected, and in less than 2 per cent, of these is the grade changed. The Commission collects the small fee of 20 cents a car for its services as inspector, and later weighs all the wheat as it is distributed intQ the elevators. This small charge pays all the expenses.

The transportation of the wheat from the fields of the North- West to the seaport is a business of tremendous magnitude. Most of this wheat goes by way of the lakes through the Sault de Saiate Marie canal to Buffalo, where

it is shipped by rail or inland canal to New York, Phil- adelphia, or Baltimore. Duluth, on Lake Superior, is, sur-

prising to say, the second port in the United poX/on. States in point of tonnage. The Sault de Sainte

Marie canal passes two and a half times as much tonnage during the eight months it is open as the Suez canal passes in the entire year. The cheapest trans- portation in the world is found upon these lakes, the rate being only three-fourths of a mill per ton of wheat per mile. The greater lake vessels, called " Whalebaeks," carry cargoes up to 250,000 bushels, a bulk difficult to conceive. 700 bushels is a car-load. At that rate the cargo of 250,000 bushels will fill 360 American cars, or 9 trains of 40 cars each. At 20 bushels to the acre, this single cargo would represent the yield of two and a half farms of 5000 acres each, like that described above, with every acre in cultivation. The railways of the North- West tave a: monopoly of the business of hauling wheat, with the result that it costs 20

cents to ship a bushel of wheat from the Dakota fields to Duluth, which is as much as it costs to forward it from Duluth to Liverpool. The bushel of wheat, or an equivalent amount of flour, can be shipped from Minneapolis or Duluth to almost any point in western Europe for from 20 to 25 cents.

What are the prospects of wheat production ‘in the United States ? . In his presidential address before the Prospects British Association for the Advancement of of wheat Science (1900), Sir William Crookes painted a produc- rather dark picture of the future of the world’s ‘”’■ wheat production. Among other things he said;

“It is almost certain that within a generation the ever- increasing population of the United States will consume all the wheat grown within its borders, and will be driven to import like ourselves.” Americans think that this statement is altogether too pessimistic. Not sufficient account had been taken of the uncultivated land in farms, and of the possibilities of improving the yield, and still further cheapening the product. It is probable that the United States will by 1933 have a population of 133,000,- 000. This population would require a wheat crop of 700,000,000 bushels for its own use alone. Limiting attention to the great cereal-producing region described above, let us see what the prospects are for increasing the acreage and the yield. The fact that these States contain, according to the last census, over 100,000,000 acres of unimproved land, already enclosed in farms, suggests at once the great possibilities in wheat. But all this land is not immediately available for cultivation. The availableness of the unimproved land in these States is chiefly a question of population and physical features. In States like New York and Pennsylvania, which are much broken up by hills and mountains, and have already a large population, it is probable that the land available for wheat cultivation is now nearly all taken up, although they still have 30 per cent, of unim- proved land in farms. In the great States of Michigan, Missouri, Wisconsin, Minnesota, and the Dakotas there is still 40 to 50 per cent, of unimproved land in farms. There are few mountains and hills in these States, and there is still room in them for a large population. It is evident that in States like these wheat culture is destined to increase greatly. Twelve States in this vast cereal- growing region — Ohio, Indiana, Illinois, Missouri, Kansas, Nebraska, Michigan, Iowa, Wisconsin, Minnesota, North and South Dakota — still have from 20 to 40 per cent, of unimproved land in farms. The total area of these States is nearly four times that of France. Their soil is primar rUy as fertile as hers. If we put the population of France at 40,000,000, the States in question could, at the same ratio, support a population of 140,000,000. Prance pro- duced during the five years ending 1897 eight bushels of

wheat per caput. At eight bushels per caput, the people in these twelve States alone could produce 1,120,000,000 bushels, or 420,000,000 bushels more than will be required by the population of 133,000,000 expected by 1933. This is a great manufacturing as well as a great agricultural region, and it is here, therefore, that a large part of this increase in population will be found.

It is evident that there is great room for improvement also in the matter of yield per acre. The average yield of wheat per acre has increased slowly in recent years. So long as there was so much virgin land to be brought under cultivation, it is surprising that it has increased at all, since the tendency everywhere is to ” skin ” the rich, new lands first. Mr B. W. Snow, formerly one of the statis- ticians of the United States Department of Agriculture, has shown (The Forum, vol. xxviii. p. 94) that the pro- ducing capacity of the wheat lands, under favourable weather, increased steadily during the period 1880-1899. He distinguishes between the actual yield and the producing capacity, and bases his comparison upon the latter. He takes the average for each year of five years between 1880-1899, and shows that the producing capacity per acre increased 0-5 bushel between the first and the second period, 1-3 bushels between the second and the third, and 1-4 bushels between the third and the fourth. In the period 1880-84, inclusive, the maximum capacity was a little less than 14 bushels, while in the period 1895- 99 the maximum capacity exceeded slightly 17 bushels — an increase of 3-2 bushels per acre, or 23 per cent, in less than twenty years. He says, “To account for this in- crease

in the potential yield in our wheat-fields many factors must be taken into consideration Among these may be mentioned improved methods of ploughing, tile drainage, use of the press drill, which results in greater immunity against winter killing, crop rotation, and, to a very small extent, fertilization. An important factor to be mentioned in this connexion is the change in the dis- tribution of the acreage under wheat, consequent upon falling prices. A decline in the price of wheat rendered its production unprofitable where the rate of yield was small. Gradually these lands were passed over to crops better suited to them ; while at the same time the wheat acreage was increased in districts having a better rate of yield." He predicts that " the increase in the acre yields in this country has only begun. All that has been accom- plished during the period under review may be attributed to improvements in implements for preparing the soil and planting the seed. Wheat is grown year after year with- out rotation — except in a few cases — on a third or more of our wheat acreage ; not one acre in fifty is directly fertil- ized for the crop, and only a minimum amount of attention is given to the betterment of seed stock. If, in the face of what cannot be considered less than careless and ineffi- cient agricultural practice, we have increased the wheat capacity of our land by 3-2 bushels per acre in so short a time, what may we not expect in the way of large acre yields, before we experience the hardships of a true wheat famine ? "

Cotton.

Soil and climatic conditions restrict the cultivation of cotton to a groups of States in the southern portion of America constituting less than one-fourth of the total area of the United States, yet these States grow over 60 per cent, of all the cotton consumed in the world. The total value of the annual crop is exceeded among the cultivated crops of the United States only by Indian corn, which is grown in every State, and about one year in four by wheat, which is grown in almost -every State. Its production engages almost exclusively 7,000,000 of

states]

the people, and its handling for domestic and foreign markets employs the capital or labour of several millions more.

Cotton is limited by climatic conditions to the States south of latitude 37° N. The essential features of the climate in this section are the long warm season and the peculiar distribution of the rainfall. Cotton is a sun plant. Fluctuations in yield per acre in a given place are less in the case of cotton than in any other product of the soil ; in other words, a certain amount of sunlight produces a certain amount of cotton. This may be due to the greater uniformity of all the climatic conditions obtaining in the cotton belt ; but the determining con- dition as between different sections is the amount of light and heat distributed over the required number of months. This period is ordinarily measured by the date of the last killing frost in the spring and of the earliest frost in the fall. Cotton-picking may be ex- tended far into the winter, but the first killing frost stops the active growth of the plant, and by killing the blossoms and young bolls puts an end to the production of cotton for that season. Cotton requires for its devel- opment from six to seven months of favourable growing weather. It thrives in a warm atmosphere, even in a very hot one, provided it is moist and the transpiration does not overtax the leaves. The plant requires, how- ever, an abundant supply of moisture during the grow- ing stage. A rainfall increasing from the spring to the middle of summer and then decreasing to autumn is probably the most favourable condition for the produc- tion of this crop. These are exactly the conditions that prevail in the cotton States. Cotton grows more or less successfully on nearly all kinds

of soil within this cli- matic belt. Light sandy soils, loams, heavy clays, and sandy ” bottom lands ” will all grow it, though not with equal success. Sandy uplands produce a short stalk, which bears fairly well. Clay and bottom lands grow a plant of large size, yielding less lint in proportion. The best soils for cotton are the medium grades of loam. The cotton soil should be of a quality to maintain very uniform conditions of moisture. Sudden variations in the amount of water supplied injure the plant decidedly. A sandy soil does not retain water ; a clay soil maintains too much moisture and causes the plant to take on too rank a growth. The best soil for cotton, therefore, is a deep, well-drained loam. Cotton is successfully grown in the south on nearly all kinds of soils, from the piny ridge soils of North Carolina to the rich bottom soils on the Mississippi.

The cotton-growing States include those on the Atlan- tic slope from North Carolina to Florida and on the gulf from Florida to New Mexico ; also the south-western por- tion of Tennessee, the State of Arkansas, and a portion of Oklahoma. A little cotton has also been grown in Utah and California. The cotton-growing region meas- ures over 550,000 square miles, which is about one-fourth of the total, or one-third of the settled, area of the United States. In 1890 over 50 per cent, of this was in farms, and over 20 per cent, was improved, but only about 5 per cent, of the total area, or one-tenth of the area in farms, and one-fourth of the area of improved land, is annually cultivated in cotton. Since the present methods of culti- vation require about two and one-half acres to produce one 400-pound bale, the area now in farms in this section would, if all cultivated in cotton, produce over 80,000,000 bales. So far, therefore, as climatic conditions are con- cerned, the Southern States could produce eight times as much cotton as they have ever done without taking in any more land.

The question of labour required for the production of a cotton crop is a serious one. Expert estimates place the

amount of human labour at about 64 per cent, of the whole expense of growing the crop. This is a much higher ratio of the cost of labour than is found in most other industries. It exceeds the cost ^■«*o”’’- of labour in corn, and wheat-growing, and also in manu- facturing industries. In the cotton mills reporting to the Department of Labour the average cost of labour em- ployed is only about 28 per cent. In 1880 the people in the cotton belt produced an average of 231 pounds of cotton per caput; in 1890 this had been increased to 254; and in the State of Mississippi, where conditions are most favourable, the production per caput was 427 pounds in 1889. With their present population, and under present conditions, the Southern States yield 300 pounds per caput. The total population of the cotton States may be fairly placed at 16,000,000. This population could easily produce a far larger crop than it does now, for there is great room for improvement in methods of cultivation and fertilization. There are three classes of farmers engaged in cotton cultivation, namely, owners of the land, renters who pay money rental, and share croppers. In the ten principal cotton States, according to the cen- sus of 1890, there were 67 per cent, of the first class, 16 per cent, of the second, and 28 per cent, of the third.

The result of a careful inquiry as to the cost of pro- ducing cotton in the United States, made in 1897 by the Department of Agriculture, gives an average cost per acre on upland farms of $15.42, and the average total return of cotton fibre and seed $19.03, the average net profit being $3.61. The average yield is 265-6 pounds of lint and 16 pounds of seed per acre, and the average price of lint 6-7 cents per pound and of seed 11-9 cents per bushel. The average cost of picking one hundred pounds of cotton is 44 cents and the average cost of producing lint cotton in all the States and territories is 6-27 cents per pound. Eighty per cent, of the cotton plantations reporting in 1896 showed a profit and 20 per cent, a loss.

Figfure 1 shows in a graphic manner the record of cotton production in the United P^dacUon States every tenth year from 1790 to 1890, ^Exports. and also for the year 1896 ; the portion of each crop

consumed at home (divided between north and south), and the portion exported.

A cotton crop of 9,000,000 bales, such as that of 1899, represents at 7 cents a pound a money value of $300,000,000. Of this amount, 70 per cent, is exported, bringing into the country about $210,000,000. Basing the calculation on the average price of each year, the cotton crops in America for the last one hundred years have been worth $15,000,000,000. During the hundred years about 82,000,000,000 pounds have been exported, representing a value of $11,000,000,000. In 1790 Great Britain received from America something less than one six-hundredth part of her total cotton imports, but only fifty years later she received from the Southern States four-fifths of all the cotton she used; and the South has always maintained and still maintains its position in relation to the cotton consumption of the world. It has never supplied less than 80 per cent, of the cotton used by Great Britain and the United States together, and in 1892 the Southern cotton formed 82 per cent, of the total amount consumed in these two countries. ,

In the next chart (Fig. 2) an attempt is made to present in somewhat greater detail the chief facts with regard to area, production, exports, and values of the cotton crop during the ten years from 1886 to 1896. It shows that an average area of a little less than 20,000,000 acres, cultivated each year, has produced in these ten years a total of over 36,000,000,000 pounds, valued at more than $3,000,000,000. Of the total production of

these ten years we exported 24,600,000,000 pounds, worth $2,250,000,000. The amount exported was 68-3 per cent, of the entire production, leaving only 31-7 per cent, for home consumption. The average yield per acre during the last ten years was only 181 pounds and the average New York price was nearly 9 cents per pound, making the average value per acre nearly $16.

Fig. 1. Most interesting and instructive are the results of the investigations made by the Department of Agri- Pertuizers. ^^^^j.^ ^ jggj ^j^j^ regard to the use of ferti- lizers upon cotton. They show that no plant responds

more promptly or more generously to judicious fertilization than does the cotton plant. The results obtained upon about fifteen hundred representative cotton plantations in the five Atlantic coast States — ^North Carolina, South Carolina, Georgia, Alabama, and Florida, where fertilizers have been longest and most used — were tabulated accord- ing to the cost of fertilizer per acre. Six classes were formed, ranging from under one dollar's worth to six dollars' worth and over of fertilizer. The planters who spent an average of 74 cents for fertilizers per acre made an average profit of $4.62; those who spent from $1.00 to $2.00 for fertilizers made a profit of $5.09; from $2.00 to $3.00, a profit of $5.34; from $3.00 to $4.00, a profit of $5.91; from $4.00 to $5.00, a profit of $7.96; from $5.00 to $6.00, a profit of $8.76; and those whose fertilizers cost them $6.00 and more per acre made a profit of $12.51. The word profit was used in this investigation to mean "the excess of returns over expenses, in- cluding the theoretical one of rent." " Some small charges, such as insur- ance, repairs, renewals, and supervision, were omitted." "It is evident from the figures above that the point of diminishing returns was not reached, when the crop was profitable, at any degree of fertilization." The total num- ber of plantations reporting losses is only 15 per cent. " The returns from the planters who suffered a loss, while at first seeming to indicate a conclusion contrary to the aboye, in reality do not, be- cause their crops were subject to abnormal conditions

and were partial failures, the cause generally having been a drought." " In cases of the planters who lost on their crops the loss is greater as the cost of fertilizers is greater ; but had climatic conditions been favourable, the loss would have been a profit." Co-operative experiments by selected farmers, directed by the experiment stations, show that the application of 60 pounds of nitrogen, 20

pounds of potash, and 20 pounds of phosphoric acid in suitable form, made on fair average land, containing a reasonable amount of humus, such, for example, as would without fertilizer produce 250 pounds of lint per acre, would usually double this crop. Cotton-seed meal, the offal of fisheries, abattoirs, &c., are the commonly used sources of nitrogen ; the superphosphates are made from

Carolina, Tennessee, or Florida phosphates ; and the potash salts are imported from Germany. These are commonly mixed to produce a fertilizer containing about 2^ per cent, of nitrogen, 9 per cent, of soluble and reverted phosphoric acid, and 2 per cent, of potash. Such a fertilizer can usually be laid down upon the farms in the cotton country for about $5.00 per acre for the above amounts. Five dollars invested in this kind and amount of fertilizer "will, upon land of the character described, -with favourable weather, produce an increase in the crop amounting to $10.00 to $15.00. Fertilizers are gradually being introduced throughout the cotton country, with the exception of the rich bottoms of the Mississippi and the black prairies of Texas, where they have so far never been needed.

Great improvements have also been made in the im- plements and in the methods of cultivation. This crop, which imder the slave system was cultivated almost entirely with the hoe, is now cultiyated wholly with machines. On many plantations the hoe is used only once, to thin the cotton. The culture is carried out with horse cultivators and is prosecuted as long as the growth of the plant continues, or until the actual fruit- ing begins. According to the reports to the Depart- ment of Agriculture the percentage of each item in the total average cost of cultivating a crop of cotton is as follows : — ^Rent of land, 19 ; ploughing, 18 ; seed, 1 ; planting, 2 ; fertilizers and distributing, 9 ; thinning and hoeing, 8; picking, 22; ginning and pressing, bagging and ties, 11 ; wear and tear on implements, 3 ; marketing and other expenses, 7 per cent. It will be seen that picking is much the most expensive item in cotton cultivation. The great desideratum still is the cotton- picking machine.

The cotton-plant has undergone a remarkable develop- ment since its introduction in the southern States. The cultivated cottons of to-day differ much from the original form of Gossypium herbaceum, which produced seed cotton, whose lint was only 25 per cent. of its weight, and had a staple only 20 to 30 mm. long. Under the influence of the climate, soils, and cultivation of these States the proportion of lint has been greatly increased, reaching as high as 36 and even 40 per cent, in some varieties ; while the length of the staple has increased correspondingly, reaching in a few varieties a length of 50 or even 60 mm. In only a few varieties, however, have we obtained this great increase in both percentage of lint and length of staple. Usually, when the length and fine- ness of the staple are increased the weight is reduced, and vice versd. In cases where both length of fibre and weight have been increased the cotton runs down agaia very rapidly, first usually in the weight produced. Cotton is a plant which supports easily and responds quickly to differences in environment, soil, climate,

treatment, and manures, and can thus be greatly modified in form and habit in a few successive generations. The flowers are open ; the pollen is produced in great abundance, and is borne upon the slightest breeze. The stigmas are well above the anthers, so that cross-fertilization is easy and common. Seeds from the earlier maturing bolls produce plants yielding a longer lint than those from the later- ripened bolls on the same plant. Some varieties produce a long, silky fibre when grown in rich, moist soil, but soon lose these qualities when grown on the poorer hill lands. A variety which has been grown for years in the northern belt of the cotton region will mature its whole crop at the same time, while the same variety grown for a few years in the southern part of the belt will continue to ripen through several weeks, though the total yield will be no greater. With this natural tendency to vary, and with all these forces to impel the plant to change its form

Varieties.

or habit, varieties are multiplied indefinitely, even without the help of the cultivator. Of true botanical varieties, ■however, there are few, if any; while the agricultural varieties, so called, are almost innumerable. The result of this natural tendency of the plant is that the names of agricultural varieties are in great confusion, and there is a good deal of humbugging connected with the business of selling cotton-seed for planting. The natural tendency of this variation is always back towards its original form. Unusual fruitfulness always results in loss of vitality, and the original form, yielding a small crop, always has the greater vitality, and so a greater prepotency in cross- fertilization. As a result of this law, constant care in the selection of seed is essential in order even to keep an im- proved variety up to its present standard. Only the seed from the finest typical plants should be saved and used. The neglect of these principles leads surely to degenera- tion of the so-called unproved variety. In this way planters are often disappointed with the results secured from high-priced seed of new varieties, for which great claims are made by their originators, and large prices paid. The old method of saving seed for planting was to take a sufiBcient number of bushels just as they came from the gin. The new method of selecting the best plants only of the typical form is resulting in the steady improvement of the cotton-plant. If it is intelligently pursued by a large number of planters for another cen- tury, or even a score or two of years, it will certainly result in the still further improvement of this wonder- ful plant. The great desire, of course, is to secure a cotton-plant which will yield a maximum amount of. fibre of the longest and finest staple. It is believed by experts that cotton will be improved steadily until this end is reached.

The culture of cotton must be a clean one. It is not necessarily deep culture, and during the growing season the cultivation is preferably very shallow. The result of this is a great destruction of the humus ” “”’ of the soil, and great leaching and washing, especially in the light loams of the hUl country. The main object, therefore, of the cotton-planter is to prevent erosion. Wherever the planters have failed to guard their fields by hillside ploughing and terracing, these have been ex- tensively denuded of soil, rendering them barren, and devastating other fields lying at a lower level, whirai are covered. The hillsides have to be gradually terraced with the plough upon almost an exact level. On the better farms this is done with a spirit-level or compass from time to time, and hillside ditches put in at the proper places. In the moist bottom-lands along the rivers it is the custom to throw the soil up in high beds with the plough, and then to cultivate them deep. This is the more common method of drainage, but it is an expensive one, as it has to be renewed every few years. More intelligent planters drain their bottoms with underground or open drains. In the case of small plantations the diflSculties of adjusting a right-of-way for outlet ditches have interfered seriously with this plan. Many planters question the wisdom of deep-breaking and subsoiling. There is no question that a deep soil is better for the cotton-plant ; but the expense of obtaining it, the risk of injuring the soil through lea’ch- ing, and the danger of bringing poor soil to the surface, have led many planters to oppose this plan. Sandy soils are made thereby too dry and leachy, and it is a question- able proceeding to turn the heavy clays up upon the top. Planters are, as a result, divided in opinion as to the wisdom of subsoiling.

Nothing definite can be said with regard to a rotation of crops upon the cotton plantation. Planters appreciate generally the value of broad-leaved and narrow-leaved plants and root crops, but there is an absence of exact knowledge, with the result that their

practices are very varied. It is believed that the rotation must differ with every variety of soil, with the result that each planter has Ms own habit in this respect, and little can be said in general. A more careful study of the physical as weU as the chemical properties of a soil must precede intelligent experimentation in rotation. This knowledge is still lacking with regard to most of the cotton soils. The only uniform practice is to let the fields “rest ” when they have become exhausted. Nature then restores them very rapidly. The exhaustion of the soil imder cotton culture is chiefly due to the loss of humus, and nature soon puts this back in the excellent climate of the cotton-growing country. Fields considered utterly used up and allowed to ” rest ” for years, when cultivated again, have produced better than those which had been under a more or less thoughtful rotation. In spite of the clean culture, good crops of cotton have been grown on some soils in the south for more than forty successive years. The fibre takes almost nothing from the land, and where the seeds are restored to the soil in some form, even with- out other fertilizers, the exhaustion of the soil is very slow. If the burning-up of humus and the leaching of the soil could be prevented, there is no reason why a cotton soil should not produce good crops continuously for an in- definite time. Bedding up land previous to planting is almost universal. The bed forms a warm seed-bed in the cool weather of early spring and holds the manure, which is drilled in usually, to better advantage. The plants are generally left 2 or 3 inches above the middle of the row, which in 4-foot rows gives a slope of one inch to the foot, causing the plough to lean from the plants in cultivating, and thus to cut fewer roots. The plants are usually cut out with a hoe from 8 to 14 inches apart. It seems to make little difference exactly what distance they are, so they are not wider apart on average land than 1 foot. On rich bottom-land they should be thinner. The seed is dropped from a planter, five or six seeds in a single line, at

regular intervals 10 to 12 inches apart. A narrow, deep furrow is usually run immediately in advance of the planter, to break up the soil under the seed. The only time the hoe is used is to thin out the cotton in the row ; all the rest of the cultivation is by various forms of ploughs and so-called cultivators. The question of deep and shallow culture has been much discussed among planters without any conclusion applicable to all soOs being reached. All grass and weeds must be kept down, and the crust must be broken after every rain, but these seem to be the only principles upon which all agree. The most effective tool against the weeds is a broad, sharp ” sweep,” as it is called, which takes everything it meets, while going shallower than most ploughs. Harrows and cultivators are used where there are few weeds, and the mulching process is the one desired. The date of cotton-planting runs from 1st March to 1st June, according to situation. Planting commences early in March in Southern Texas, and the first blooms will appear there about 15th May. Planting may be done as late as 15th April in the Piedmont region of North Carolina, and continue as late as the end of May. The first blooms will appear in this region about 15th July. Picking may commence on 10th July in Southern Texas, and continue late into the winter or until the rare frost kills the plants. It may not begin until the 10th of SeptemberinPiedmontjNorth Carolina. Itis apeculiarity of the cotton-plant to lose a great many of its blooms ‘and bolls. When the weather is not favourable at the fruiting stage the otherwise hardy cotton-plant displays its great weakness in this way. It sheds its forms, as the buds are called, its blooms, and even its half-grown bolls in great numbers. It has frequently been noted that even well-fertilized plants upon good soil will mature only 15 or 20 per cent, of the bolls

put on. No means is known so far for preventing this great waste. Even experts are at an entire loss to form a correct idea of the cause or to apply any effective remedy.

Table XVI.^Acreage, Froduction, and Value

, Prices, and Exports of Cotton in the United States,

■■

1875-1898.1

New York Closing Prices per

Tear.

Acreage.

Average Tield Der

Production.

Average Farm Price

Value.

Pound on Middling Upland.

Bomestic

Exports,

Pificat Tears

T^pr>j>Tvi^m*

May of Follow-

Acre.

per

JL/UC6UiUOX .

ing- Tear.

beginning 1st July.

Low.

High.

Low.

High.

^

Bales of 500

Acres.

Bales.

Bales.

Cents.

Dollars.

Cents.

Cents.

CentB.

Cents.

pounds.

1875

10,803,030

■43

4,632,313

IM

233,109,945

13A

13A

iiH,

13t

2,982,810

1876

11,677,250

■38

4,474,069

9^9

211,655,041

12A

12i

lOH

11

2,890,738

1877

12,600,000

■88

4,773,865

10-5

235,721,194

lU

111 ‘

lOf

11

3,215,067

1878

12,266,800

■41

5,074,155

8^2

193,467,706

m

9|

11

13

3,256,745

1879

12,595,500

•46

5,761,252

10^2

242,140,987

12t

13f^

iiH

11

3,644,122

1880

15,475,300

■43

6,605,750

9^8

280,266,242

11*

12

lOft

io|

4,381,857

1881

16,710,730

■33

5,456,048

10-0

294,135,447

111

12*

12ft

12f

3,479,951

1882

16,791,557

■41

6,949,756

9-9

309,696,500

lOi

lOA

lOi

Hi

4,576,150

1883

16,777,993

•34

5,713,200

9-0

250,594,750

lOf

Hi

llf

3,725,145

1884

17,439,612

■33

5,706,163

9-2

253,993,385

lOA

lift

lOii

11

3,783,318

1885

18,300,865

•36

6,575,691

8^5

269,989,812

9^

9ft

9ft

9ft lift

4,116,074

1886

18,454,603

•35

6,505,087

8^1

309,381,938

9*

9ft

10|

4,338,914

1887

18,641,067

•38

7,046,833

8-5

337,973,453

lOJ

^gf

m

10ft

4,528,241

1888

19,058,591

•36

6,938,290

8^5

354,454,340

9|

11

lift

4,769,633

1889

20,171,896

•36

7,311,322

8^3

402,951,814

lOJ

lOi

iiH

12|

4,943,599

1890

20,809,053

■42

8,652,597

8-6

369,568,858

9A

9ft

8*

8if

5,814,717

1891

20,714,937

•44

9,035,.379

7^3

326,513,298

n

8ft

7i

7ft

5,870,439

1892

18,067,924

■37

6,700,365

8^4

262,252,286

9f

10

7t

7il

4,424,230

1893

19,625,000

•3?

7,549,817

7^0

274,479,637

7il

8ft

^i

7|

5,366,564

1894

23,687,950

•42

9,901,251

4^6

287,120,818

5fi

5M

6f

71

7,034,866

1895

20,184,808

■36

7,161,094

7^6

260,338,096

sf

8ft

8

8|

4,670,452

1896

23,273,209

■37

8,532,705

6^6

291,811,564

7A

7ft

7f

711

6,207,509

1897

24,319,584

■45

10,897,857

6^6

319,491,412

sH

i-

6ft

7,700,528

1898

24,967,295

■45

11,189,205

5^7

305,467,041

5f

6i

7,546,820

1 From the Year-Book, U.S. Department of Agriculture, for 1899.

Cotton-picking is at once this most difficult and most at the rate of from 45 to 50 cents per cwt. of seed cotton, expensive operation in cotton production. It is paid for This is light work, and is effectually performed by women

states]

and even children, as -well as by men ; but it is tedious, and requires care. The picking season will average 100 picki ds-ys- It is difRoult to get the hands to work ^' until the cotton is fully opened, and it is hard to induce them to pick over 100 flb a day, though some expert hands are found in every cotton plantation who can pick twice as much. The loss resulting from careless work is very serious. The cotton falls out easUy or is dropped. The careless gathering of dead leaves and twigs, and the soiling of the cotton by earth or by the natural colouring matter from the boUs, injure the quality. It has been commonly thought that the produc- tion of cotton in the south is limited by the amount that can be picked, but this limit is evidently still very remote.

The negro population of the towns and villages of the cotton country is usually available for a considerable share in cotton-picking. There is in the cotton States a rural population of over 7,000,000, more or less occupied in cotton-growing, and capable, at the low average of 100 lb a day, of picking daily nearly 500,000 bales. It is evident, therefore, that if this number could work through the whole season of 100 days, they could pick three or four times as much cotton as the largest crop ever made.

The comparative figures in Table XVII., compiled from the reports of the bureau of statistics of the Treasury Depart- ment, show the number of bales of cotton exported to each foreign country in 1889, as compared with the years 1898 and 1899. All bales are reduced to the uniform weight of 600 pounds each.

Table XVII.-

-Exports of Cotton from United States to Foreign Countries^ In Bales of 500 pounds.

Year ending 30th June

Tear ending 30tli June

Tear ending SOtli June

1889.

1898.

1899

Countries.

Bales.

Value.

Bales.

Value.

Bales.

Value.

Austria-Hungary .

5,610

$275,275

35,614

1987,724

57,127

$1,576,175

Belgium.

147,807

7,556,687

161,942

4,809,609

129,625

3,599,471

Denmark

...

24,741,

732,810

39,249

1,078,300

France ....

400,196

20,174,839

842,038

24,599,724

803,406

21,946,691

Germany

660,756

32,308,593

1,858,524

54,886,246

1,728,975

47,346,679

luly ....

131,068

6,460,413

387,581

11,468,026

417,353

11,662,768

Netherlands .

44,354

2,188,771

43,509

1,292,788

51,621

1,401,040

Portugal

...

18,835

588,928

21,627

612,132

Bussia ....

144,086

7,506,201

103,826

3,133,758

95,011

2,796,793

Spain ....

181,533

9,200,998

263,648

8,180,970

248,635

7,194,100

Sweden and Norway

8,717

420,412

26,613

744,287

23,624

703,503

United Kingdom .

2,940,800

146,605,505

3,532,101

105,853,614

3,609,444

99,709,352

Rest of Europe

9,547

475,182

...

...

...

Dominion of Canada .

61,143

2,980,556

122,495

8,961,586

98,280

2,994,674

Mexico ....

33,803

1,607,396

42,433

1,321,473

36,180

1,043,478

West Indies (French) .

*•.

...

17

653

6

187

China ....

>•>

11,302

370,670

4,060

131,734

Bast Indies (British) .

*••

297

9,130

9

308

Hong-Kong .

...

1,800

72,000

56

1,710

Japan ....

47

“2,341

224,214

7,428,226

182,734

5,774,784

All other countries Total

216

12,102

...

...

...

4,769,633

237,775,270

7,700,529

230,442,215

7,646,821

209,563,874

1 From the Year Book, U.S. Department of Agriculture, for 1899.

Except in the cases of Belgium and Bussia, the increase in exports has been very large, in some cases the amount being more than double what it was eight or ten years earlier. Notwithstand- ing a net decrease of 153,708 bales in 1899 as compared with 1898, these two years are conspicuous as having recorded the largest ex- ports of cotton in the history of the United States (see Table XVI.) . The extremely low prices in 1897-98 and 1898-99 reduced the ex- port values $7,338,065 in the former, and $28,?11,396 in the latter year, as compared with those of 1889, although the number of bales exported in 1898 was 2,930,896, and in 1899 was 2,777,188 greater than in 1889.

While there are no available statistics showing the annual crops of all the cotton-producing countries, the consumption of the mills in Great Britain, the Continent of Europe, the United States, India, Japan, Canada, Mexico, a^d other countries fairly approxi- mates the world's production. The following statistics (Table XVIII.) taken from Dr Thomas Neilson's Annual Seview of the Cotton Trade, issued in Iiiverpool, 1st November 1899, show the number of bales of cotton consumed by the mills of the world from 1890-91 to 1898-99, inclusive :—

Table XVIII. — TTie World's Consumption of Cotton, 1890-91 to 1898-99.

In bales of 500 pounds.

Tear ended Sept. 80.

Great Britain.

Continent of Europe.

United States.

India.

All other Countries.

Total.

1891 1892 1898 1894

189S

1896 1897 1898 1899

3,884,000 8,381,000 2,866,000 8,288,000 8,250,000 8,276,000 3,224,000 8,432,000 8,519,000

8,631,000 8,640,000 8,692,000 8,848,000 4,080,000 4,160,000 4,368,000 4,628,000 4,836,000

2,867,000 2,576,000 2,551,000 2,264,000 2,748,000 2,572,000 2,788,000 2,962,000 8,558,000

924,000

914,000

918,000

959,000

1,074,000

1,105,000

1,004,000

1,141,000

1,297,000

150,000 160,000 220,000 250,000 800,000 419,000 488,000 713,000 727,000 1

10,456,000 10,471,000 10,247,000 10,554,000 11,897,000 11,532,000 11,822,000 12,876,000 18,932,000

These figures certainly show a very large increase in the con- sumption of cotton, the increase in all countries in 1898-99 over the previous year amounting to 1,056,000 bales, of which more than one-half was in the IJnited States, while the increase in all countries since 1890-91 amounts to 3,476,000 bales. In 1898-99 this increase, as compared with the previous year, amounts to 591,000 bales, as against 208,000 in all continental European countries, 156,000 in India, and 87,000 in Great Britain. Since 1890-91 the United States shows an increase of 1,186,600 bales, as compared with 1,205,000 in all continental European countries, 373,000 in India, and 135,000 in Great Britain.

Prices of all products entering the world's markets tend to fluctuate less and less with the development of transportation, the telegraph, the crop reporting system, and the publication of market news. Present prices are raised or lowered in anticipation of higher or lower prices in the future. This is well illustrated by the prices of cotton shown in Table XIX.

The range of prices was higher and the fluctuations were more violent in the decades 1821-30 and 1881-40, than during any other decades except that of the Civil War (1861-70). There has been a gradual diminution in the range of prices, the fluctuations being less during the decade 1881-90 than at any other period. The greatly increased crops since 1890 have depressed the price very much, causing a slightly increased range. But the tendency is towards a permanently narrow range of fluctuations. ■ The use of improved implements, the introduction of better methods of cultivation, the establishment of a more economical system of labour, and especially the^use of fertilizers, have cheapened considerably the cost of cotton production — exactly how much, however, it is impossible to say. Until recent years no accurate records of the cost of cotton production were kept. So long as cotton brought a high price, the planters were extrava- gant in their methods of culture, and the factors and transporta- tion companies excessive in their charges. The low prices of cotton which have prevailed for a number of years have taught farmers how to make cotton more economically and how to get

the full value of it after it is made, with the result that they are in better condition now to produce cotton at a steady and trustworthy profit than they ever were before.

Table XIX.— i

Showing the Range of Prices of Middling Upland

Cotton, per Found, in

New York from 1821 to 1895, inclusive.

Tear.

Range of Prices.

Year.

Range of PrioeB.

Tear.

Range of Prices.

Tear.

Range of Prices.

CeiJts.

Cents.

Cents.

Cents.

1821

9-00

1841

4-50

1861

12-00

1881

2-50

1822

8-00

1842

5-50

1862

31-50

1882

1-50

1823

8-00

1843

2-37

1863

41-00

1883

2-87

1824

6-50

1844

3-75

1864

121-00

1884

100

1825

18-00

1845

1-75

1865

147-00

1885

1-00

1826

8-50

1846

2-50

1866

27-50

1886

•87

1827

2-75

1847

5-25

1867

15-50

1887

2-25

1828

4-75

1848

7-00

1868

17-50

1888

1-60

1829

3-50

1849

4-75

1869

10-75

1889

1-81

1830

Aver.

1831

4-50

1850

Aver.

1851

3-87

1870

Aver.

1871

15-75

1890

Aver.

1891

2-37

7-35

4-12

43-96

1-77

5-75

6-25

6-25

2-69

1832

5-00

1852

2-87

1872

8-37

1892

2-06

1833

7-50

1853

2-00

1873

3-12

1893

2-81

1834

8-50

1854

1-75

1874

7-37

1894

1-69

1835 1836

7-50 7-50

1855 1856

4-50 2-62

1875 1876

2-62 2-87

1895

i;8i

1837

12-50

1857

4-12

1877

2-37

Aver.

2-21

1838

6-75

1858

6-87

1878

1-50

1839

7-50

1859

2-37

1879

4-37

1840

Aver.

7-50

1860

Aver.

1-25

1880

Aver.

2-75

7-60

3-46

4-16

Cotton Seed.

The history of no agricultural product contains more of interest and instruction for the student of economics than does that of cotton seed. The revolution in its treatment is a real romance of industry. Up till 1870, or thereabouts, it was regarded as a positive nuisance upon the plantation. It was left to accumulate in vast heaps about ginhouses, to the annoyance of the farmer and the injury of his premises. For cotton seed in those days was the object of so much aversion that the planter burned it or threw it into running streams, as was most convenient. If the seed were allowed to lie about, it rotted, and hogs and other small animals, eating it, often became sick and died. It was very difficult to burn, and when dumped into rivers and creeks, was carried out by flood water to fill the edges of the flats with a decaying mass of vege- table matter which gave rise to offensive odoxirs and malaria. Although used in the early days to a limited extent as a food for milch cows and other stock, and to a larger extent as a manure, no systematic efforts were made anywhere in the South to manufacture the seed until the later ‘fifties, when the first cotton seed mills were established. It is said that there were only seven cotton oU mills in the South in 1860. The cotton-growing industry was interrupted by the Civil “War, and the seed- milling business did not begin again until 1868. Since that time the number of mills has been rapidly increas- ing. There were 25 in the South in 1870, 50 in 1880, 120 in 1890, and about 500 in 1901.

Long experience shows that 1000 pounds of seed are produced for every 500 pounds of cotton brought to market. On the basis, therefore, of a cotton crop of 10,000,000 bales of 500 pounds, there were produced in the South in 1900, 5,000,000 tons of cotton seed. About 3,000,000 tons only are pressed, producing products worth $65,000,000 at present prices. There remains, therefore, to be utilized on the farm 2,000,000 tons of cotton seed, which, if manufactured, would produce a total of $100,000,000 from cotton seed. In contrast with the farmers of the ‘sixties, the southern planter of to-day

appreciates the value of his cotton seed, and farmers, too remote from the mills to get it pressed, now feed to their stock all the cotton seed they conveniently can, and use the residue either in compost or directly as manure. Tlie average of a large number of analyses of whole cotton seed gives the following figures for its fertilizing con- stituents:— ^Nitrogen, 3”13 per cent.; phosphoric acid, 1-27 per cent. ; potash, 1-17 per cent. ; besides small amounts of lime, magnesia, and other valuable but less important ingredients. Using average prices paid for nitrogen, phosphoric acid, and potash, when bought in large quantities and in good forms, these ingredients, in a ton of cotton seed, amount to $9.00 worth of fertilizing material. Compared with the commercial fertilizer which the farmer has to buy, cotton seed possesses therefore a distinct value.

The products of cotton seed have become important elements in the national industry of the United States. The main product is the refined oil, which is used for a great number of purposes, such as salad oil, compound lard, ininers’ oil, and the like. The poorer grades are employed in soap-making. Cotton seed cake or meal is one of the most valuable of feeding stuffs, as the follow- ing simple comparison between it and oats and corn will show : —

Average Analyses.

Proteins or Flesh Formers.

Carbo-hydrates

or Fuel and Fat

Suppliers.

Fats.

Ash or Bone Makers.

Cotton seed meal . Corn . Oats .

43-26

10-5

17-0

22-31

70-0

65-0

13-46 6-6 8-0

7-02 1-02 1-2

Cotton seed meal, though poor in carbo-hydrates, the fat and energy-supplying ingredients, is exceedingly rich in protein, the nerve- and muscle-feeding ingredients. But it still contains a large amount of oil, which forms animal fat and heat, and thus makes up for part of its deficiency in carbo-hydrates. The meal, in fact, is so rich in pro- tein that it is best utilized as a food for animals when

mixed with some coarse fodder, thus furnishing a more evenly-balanced ration. In comparative valuations of feeding stuffs, it has been found that cotton seed meal exceeds corn meal by 62 per cent., wheat by 67 per cent., and raw cotton seed by 26 per cent. Cotton seed meal, in the absence of sufficient stock to consume it, is also used extensively as a fertilizer, and for this purpose it is worth, determining the price on the same basis as used above for the seed, from $19 to $20 per ton. But it has seldom reached this price, except in some of the Northern States, where it is used for feeding purposes. A more rational proceeding would be to feed the meal to animals and apply the resulting manure to the soU. When this is done, from 80 to 90 per cent, of the fertilizing material of the meal is recovered in the manure, only 10 to 20 per cent, being converted by the animal into meat and milk. The profit deri-ved from the 20 per cent, thus removed is a very large one. These facts indicate that we have here an agricultural product, the market price of which is still far below its value as compared, on the basis of its chemical composition, either with other feeding stuffs or with other fertilizers. Though it is probably destined to be used even more extensively as a fertilizer before the de- mand for it as a feeding stuff becomes equal to the sup- ply, practically all the cotton seed meal of the South will ultimately be used for feeding. One explanation of this condition of things is that there is still a large surplus of cotton seed which cannot be manufactured by the mills, at least under the existing arrangements for its trans- portation. Another reason is found in the absence of cattle in the South to eat it.

states]

With tlie consideration of cotton seed oil and meal we have not, however, exhausted its possibilities. Cotton seed hulls constitute about half the weight of the ginned seed. After the seed has been passed through a fine gin, which takes off the short lint left upon it by the farmer, it is passed through what is called a sheller, consisting of a revolving cylinder, armed with numerous knives, which cut the seed in two and force the kernels from the shells. The shells and kernels are then separated in a winnowing machine. This removal of the shell makes a great difference in the oilcake, as the decorticated cake is more nutritious than the undecorticated. For a long time these shells or hulls, as they are called, were burned at oil mills for fuel, two and a half tons being held equal to a cord of wood, and four and a third tons to a ton of coal. The hulls thus burned produced an ash containing an average of 9 per cent, of phosphoric acid and 24 per cent, of potash — a very valuable fertilizer in itself, and one eagerly sought by growers of tobacco and vegetables. It was not long, however, before the stock-feeder in the South found that cotton seed hulls were an excellent substitute for hay. They are now fed on a very large scale in the vicinity of oil mills in southern cities like Memphis, New Orleans, Houston, and Little Eock, from 500 to 5000 cattle being often collected in a single yard for this pur- pose. No other feed is required, the only provision neces- sary being an adequate supply of water and an occasional allowance of salt. Many thousands of cattle are fattened annually in this way at remarkably low cost. For this purpose hulls sell at from $2.50 to f 3 per ton.

The following diagram, modified from one by Grim- shaw, in accordance with the results obtained by the better class of modern mills, gives an interesting r^sumi of the products obtained from a ton of cotton seed : —

Pi’oducts from a Ton of Cotton Seed.

Cotton seed, 2000 pounds.

Meats, 1090 pounds.

LJDters, 23 pounds.

Cake, 800 pounds.

Meal.

(Feeding stuff. Fertilizer.)

Fibre.

Hulls. 888 pounds.

J_

Cmde ofl. 290 pounds. (High-grade paper.)

Summer Yellow.

(Winter yellow

Cotton seed stearin.)

Soap stock.

(Fuel.)

Bran.

(Cattle food.)

Ashes.

Salad oU.

Summer white.

Fertilizer.

Lard.

(Cattle food) with the meal.

These together,

a Tery valuable

manure.

Oottolene (with beef stearin, cooking oil).

Miners’ oil.

Soap

ElCE.

Eice production in the United States is limited to that portion of the South Atlantic States nearest the sea. For two decades prior to 1861 the annual production of rice in North Carolina, South Carolina, and Georgia averaged more than 1,000,000 pounds of the clean grain. South Carolina produced over three-fourths of this. This industry was wrecked by the CivU War and has never been fully restored. From 1866 to 1880, inclusive, the annual production of these three States averaged only about 40,000,000 pounds, of which South Carolina pro- duced one-half. Since 1880 their average annual produc- tion has been 46,000,000 pounds, of which South Carolina

produced 27,000,000. Since the Civil War the rice industry has been developing steadily in Louisiana; it averaged nearly 30,000,000 pounds for the decade 1870-80, 71,000,000 pounds in 1880-90, and obtained its greatest development in 1892, when it reached 182,000,000 pounds. The annual production is only about one-half as great as the annual consumption. The only statistics available are those made up by commercial companies, and repre- sent only the amounts placed upon the market. The quantities consumed at home and retained for seed are considerable, but cannot be ascertained. The following table is from statistics reported by Dan Talmage's Sons Co., and gives the annual average market production of rice for the periods 1881-90 and 1891-98 :—

Table XX. — Annual Average Market Production of Bice in the United States for the periods 1881-90 and 1891-98.

Periods.

North

South Carolina.

Georgia.

Louisiana.

t Total.

1881-90 1891-98

7,185,870 8,941,712

28,403,940 25,881,895

16,919,910 9,423,064

71,409,961 104,848,675

128,869,681 148,095,846

The annual imports of rice in the United States for 1894 to 1899 "averaged 121,000,000 pounds, and the Imports of broken rice, flour, and meal, 63,000,000 pounds— the whole having an average annual value of $3,200,000.

Flax and Hemp.

The total number of acres devoted to the cultivation of flax for geed and fibre, both in 1889, was only 1,318,698. The production of flax seed was 10,250,000 bushels and the production of fibre 242,000 pounds. Throughout the greater portion of the flax-producing region the straw is not utilized, even for tow or for paper-making. That por- tion of the flax straw having' a determinable value was only 207,757 tons. The total value of all flax products in 1889 was $10,436,000. The imports of flax fibre and manufactured goods amount to from $16,000,000 to $18,000,000 a year, and $2,000,000 to $3,000,000 of this represents raw flax fibre. In consideration of these facts, the United States Department of Agriculture is making spe- cial efforts to establish the flax fibre industry in the United States. Experiments have been carried on in Minnesota, Oregon, and Washington, which indicate that flax can be successfully grown for fibre in these States. In 1860 nearly 100,000 tons of hemp (Cannabis sativa) were pro- duced, while in 1895 hardly more than 6000 tons were reported for the whole" country. The introduction of Manila hemp, the large importation of jute, and the de- cline in American shipbuilding are the reputed causes for this falling-off. The census of 1890 showed 26,000 acres in hemp, yielding 11,600 long tons, worth $1,102,000. Nearly all of this was grown in the State of -Kentucky.

Tobacco.

The tobacco crop of 1889 amounted to 488,256,646 pounds, grown upon 695,301 acres; that of 1879 was 472,661,167 pounds, grown on 638,841 acres, which shows an increase of about 9 per cent, in acreage and 4 per cent, in products. The average yield per acre for 1879 was 738-28 pounds; for 1889, 702-22 pounds. Tobacco is grown to a greater or less extent in nearly every State and territory, the only exceptions being the northern Eocky Mountain States : but it is a commercial product in only fifteen States, which together raise 98 per cent, of the crop of the country. These fifteen States are, in the order of the weight of the crop, Kentucky, Virginia, Pennsylvania, Ohio, Tennessee, North Carolina, Maryland, Connecticut, Missouri, Wisconsin, Indiana, New York, Massachusetts, Illinois, West Virginia. Two other States, Florida and Texas, are known to have produced some cigar tobacco

since the last census was taken. In yield per acre Connecticut ranks first, with Massachusetts, Pennsylvania, New York, Wisconsin, Ohio, Missouri, and Kentucky following in the order named. In area cultivated Kentucky is first, Virginia second. North Carolina third, Tennessee fourth, Maryland fifth, Ohio sixth, Pennsylvania seventh, and Missouri eighth. There is a great difEerenee in the annual yield per acre by weight in the different States, due not alone to the difference in soil and care in culti- vation, but also to the varieties cultivated and to differences in the weather, to which the tobacco plant is extremely susceptible. Some of the lighter varieties are grown for beauty of colour and richness of flavour ; other varieties are grown for bulk and weight. In the States having the

highest yield per acre, the seed leaf varieties are princi- pally grown and high manuring practised. In Ohio e ud Kentucky the burly varieties are largely grown, which produce a large bulk. In North Carolina, on the other hand, the bright yellow variety is extensively raised, which gives a low yield per acre by weight. The following table (XXI.) contains statistics of tobacco production, exports, and

imports, based upon information collected by the com- missioner of internal revenue and the bureau of statistics of the Treasury Department. The tobacco manufactured is reported to the first-named oifice, and that imported and exported to the last. From these data it is pos- sible to ascertain approximately the total crop of the country : —

Table XXI. — Production of Tobacco in the United States, 1892 to 1898, as compiled from tJie Reports of the Bureau of Internal Revenue and of the Bureau of Statistics of the Treasury Department.

1892.

1893.

1894.

1895.

1896.

1897.

1898.

Tobacco manufactured : Chewing, smoking, and snuff i . Cigars and Cigarettes 1 Exports, domestic 1 . Exports, foreign 1

Less imports i . . . .

Pounds.

234,081,332

96,925,980

277,258,871

1,611,863

Pounds.

249,858,869

89,973,814

304,797,808

1,776,636

Pounds.

250,994,675

93,639,213

293,637,217

3,060,385

Pounds.

234,561,904

95,053,056

300,047,687

2,767,454

Pounds.

265,871,158

96,213,473

281,074,422

1,779,103

Pounds.

247,358,414 102,519,323 269,966,833

2,323,516

Pounds.

286,453,738 106,855,524 346,823,677

1,847,637

609,878,046 22,093,270

646,407,127 24,899,175

641,331,490 31,355,899

632,430,101 20,258,704

644,938,156 12,848,743

622,168,086 11,307,830

741,980,576 17,107,839

587,784,776

621,507,952

609,975,591

612,171,397

632,089,413

610,860,256

724,872,737

1 For calendar year following.

The average amount of unmanufactured tobacco exported each year during the five years 1894-98 was 293,033,628 pounds, valued at $24,267,718. The exports averaged 45 per cent, of the crop.

Sugar and Molasses.

The product of sugar cane, sorghum, and maple sap in 1880 and 1890 was as follows :—

Sugar

Produced on , Molasses .

Sugar Cane.

1880.

. 214,646,400

227,776

16,578,273

1890.

301,284,395 pounds. 274,975 acres. 25,409,228 gallons.

This is an increase of 20-72 per cent, in area under cultivation, of 40-36 per cent, in sugar, and 53-31 per cent, in merchantable molasses.

Sugar

Sugar

Molasses

Sorghum.

1880.

12,792 28,444,202

Maple Sap.

1880. 86,576,071 1,796,048

1890.

pounds. 24,235,219 gallons.

1890.

32,952,927 pounds. 2,258,376 gallons.

Cane sugar is confined almost entirely ‘to lower Louisi- ana. Some cane is grown in the adjacent portions of Texas, and a little in Georgia and Florida. The follow- ing table shows the sugar product of Louisiana for the years 1895 to 1900 inclusive : —

Tons of 2240 pounds.

1895-1896 287,720

1896-1897 282,009

1897-1898 310,447

1898-1899 245,511

1899-1900 132,000

The cane sugar of commerce has averaged 2,900,000 tons in round numbers during 1895-1900; of this all America and the West Indies produces 1,400,000 tons.

The production of sorghum molasses is about evenly distributed over the five States of Tennessee, Kentucky, Missouri, lUinais, and Iowa, with Nebraska and Kansas

as the next most important. The maple sugar product is confined to the north-western and central States. The States yielding 2,000,000 pounds, or more, each of maple sugar, are Vermont, New York, Michigan, Ohio, Pennsylvania, and New Hampshire. In 1895 only 30,000 tons of sugar were made in the United States from beets in the States of California, Nebraska, and Utah. The Department of Agriculture has recently devoted considerable attention to the culture of sugar beets, with the result that 73,000 tons of sugar were produced in 1899-1900 in tlfese and a few other States. The total cane and beet sugar production of the world, 1899-1900, as given by the year-book of the Department of Agriculture, was 8,500,000 tons in round numbers. The United States produced 132,000 tons; Porto Kico, 50,000 tons ; Cuba, 395,000 tons ; the Hawaiian Islands, 275,000 tons; and the Philippine Islands (exports only), 40,000 tons, making a total of 892,000 Hons for the United States and Siese islands.

Agricultural Education.

The agricultural schools of the United States owe their origin to the movement against the old classical school, and in favour of technical education which commenced in most civilized nations about the middle of the century. A rapidly growing country with great natural resources needed men educated in the sciences and arts of life, and this want was first manifested in the United States by a popular agitation on behalf of agricultural schools. A number of so-called agricultural schools were started between 1850 and 1860 in the eastern and middle States, where the movement made itself

most felt, but without trained teachers and suitable methods they accoinplished very little. They were only ordinary schools with farms attached. The first constitution of the State of Michigan, adopted in 1850, provided for an agricultural school, and this was the first one established in the United States. The General Assembly of the State of Pennsylvania incorporated the Farmers' High School, now the State College, in 1864. Maryland incorporated her agricultural

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college in 1856, and Massachusetts chartered a school of agriculture in the same year. The agitation, which finally reached Congress, led to the establishment of the so-called " land-grant," or agricultural colleges. The establishment of these colleges was due chiefly to the wisdom and foresight of Justin S. Morrill, for over forty years a Representative or Senator from the State of Vermont, who introduced the first Bill for their endowment in the House of Representatives on 14th December 1857, and saw the latest one approved by the President on 30th August 1890. Mr Morrill is justly known, therefore, as the father of the American agricultural colleges. The first Act for the benefit of these colleges was entitled " An Act donating public lands to the several states and territories which may provide colleges for the benefit of agriculture and the mechanic arts," and granted to each State an amount of land equal to 30,000 acres for each senator and representative in Congress to which the State was 'entitled at that time. The object of the grant was stated to be " the endowment, support, and maintenance of at least one college " (in each State), " where the leading object shall be, without excludiag other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, ... in order to promote the liberal and practical education of the industrial classes in the several piixsuits and professions in life." The total num- ber of acres of land granted to the States under this Act was 9,359,241, of which 985,833 are still unsold. This grant has produced an endowment fund amounting to $10,262,944. The lands still imsold are valued at $4,062,850. The invested land-grant funds yield these colleges a total annual income of $624,673. Including the United States appropriation under a Supplementary Act of 1890, commonly known as the second Morrill Act, which now gives each college $25,000 a year, the interest on the land-grant and all other invested funds, all State appropriations and other sources of revenue, these colleges had in 1899 a total income of $5,995,000. Sixty-four in- stitutions have been organized under this Act, of which sixty-one maintain courses in agriculture; nineteen are departments of agriculture and engineering in State universities ; twenty-seven are separate colleges of agri- culture and mechanic arts ; and the remainder are organs ized in various other ways. Separate schools for persons of African descent have been established under this Act in eight southern States. These colleges take students prepared in the common schools and give them a course of from two to four years in the sciences pertaining to agriculture. Many of them offer short courses, varying from four to twelve weeks in length, in agriculture, horticulture, forestry, and dairying, which are largely attended. Agricultural experiment stations are connected with all the colleges, and many of them conduct farm- ers' institutes, farmers' reading clubs, and correspondence classes.

The agricultural Experiment Stations of the United States grew up in connexion with the agricultural colleges. Several of the colleges early attempted to establish separate departments for research and practical experiments, on the plan of the German stations. The Act establishing the Agricultural College of Maryland required it to conduct " a series of experiments upon the cultivation of cereals and other plants adapted to the latitude and climate of the State of Maryland." This was the first suggestion of an experiment station in America, but resiSted in little. The first experiment station was established at Middletown, Connecticut, in 1875, in connexion with the agricultural branch of the

Sheffield Scientific School of Yale College. The State of Connecti- cut made in 1877 an appropriation of $5000 to promote

agriculture by scientific investigation and experiment — the first State appropriation for this purpose. The State of North Carolina established, on 12th March 1877, an agricultural experiment and fertilizer control station in connexion with its State university. The Cornell university experiment station was organized by that institution in 1879. The New Jersey station was organized in 1880, and the station of the University of Tennessee in 1882. From these beginnings the experi- ment stations multiplied until, when Congress passed the National Experiment Station Act in 1887, there were seventeen already in existence. The Hatch Experiment Station Act, so called from the fact that its leading advocate was Mr William H. Hatch of Missouri, appro- priated $15,000 a year to each agricultural college for the purpose of conducting an agricultural experiment station. The object of the stations was declared to be, “to conduct original researches or verify experiments on the physiol- ogy of plants and animals ; the diseases to which they are severally subject, with the remedies for the same ; the chemical composition of useful plants at their different stages of growth ; the comparative advantages of rotative cropping as pursued under a varying series of crops ; the capacity of new plants or trees for acclimation; the analysis of soils and water ; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds ; the adaptation and value of grasses and forage plants ; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs “of the respective States or territories.” The stations were authorized to publish annual reports and also bulletins of progress for free distribution to farmers. The franking privilege was given to these publications. The office of experiment stations, in the Department of Agriculture, was established in 1888 to be the head office and clearing- house of these stations. Agricultural experiment stations are now in operation in all the States and territories. Alabama, Connecticut, New Jersey, and New York each maintains a separate station, supported wholly or in part by State funds ; and Louisiana has a station for sugar experiments. Excluding all branch stations, the total number of experiment stations in the United States is fifty-six, and of these fifty-two receive the national appro- priation. The .total income of the stations during 1899 was $1,143,335, of which $720,000 was received from the National Government and the remainder was derived from societies, fees for analyses of fertilizers, sale of products, &c. The stations employ 678 persons in the work of administration and research; the chief classes being — directors, 71; chemists, 150; agriculturists, 70; horticulturists, 80 ; botanists, 52 ; entomologists, 47 ; physicists, 7 ; bacteriologists, 20 ; dairymen, 25 ; weather observers, 17; irrigation experts, 6. During 1899 the stations published 450 annual reports and bulletins, besides a large number of ” press ” bulletins, which are reproduced in the agricidtural and county papers. The stations are to a great extent bureaus of information ‘‘on all farm questions, and carry on an extensive correspond- ence covering all conceivable questions. Their mailing lists aggregate half a million names.

Agkicultueal Department.

The United States Department of Agriculture was established as a result of a recommendation of President

Washington, thougli not until many years after his death. An office for distributing seeds and collecting agricultural statistics grew up in the patent office which was originally the only scientific agency of the goveniment. This developed gradually into the present department, which became in 1889 an executive department of the govern- ment with a secretary. This secretary is now charged with the supervision of all business relating to the agri- cultural and productive industries. The fisheries have a separate bureau, and the public lands and mining interests are cared for in the interior department ; but with these exceptions, all the productive interests are looked after by the Department of Agriculture. There are various bureaus in this department. The weather bureau has charge of the forecasting of weather; the issue of storm warnings ; the display of weather and flood signals for the benefit of agriculture, commerce, and navigation; the gauging and reporting of rivers; the reporting of temperature and rainfall conditions for the cotton, rice, sugar, and other interests ; the display of frost and cold waves signals 5 and the distribution of meteorological information in the interest of agriculture and commerce. The bureau of animal industry makes investigations as to, the existence of contagious pleuro-pneumonia and other dangerous and communicable diseases of live stock, superintends the measures for their extirpation, makes original investigations as to the nature and prevention of such diseases, and reports on the conditions and means of improving the animal industries of the country. The division of statistics collects information as to the condition, prospects, and harvests of the principal crops, and of the number and status of farm animals. It re- cords, tabulates, and co-ordinates statistics of agricultural production, distribution, and consumption, and issues monthly and annual crop reports for the information of producers and consumers. The section of foreign mar- kets makes investigations and disseminates information ” concerning the feasibility of extending the demands of foreign markets for the agricultural products of the United States.” The office of experiment stations represents the department in its relations to the experi- ment stations which are now in operation in all the States and territories. The division of chemistry makes investi- gations of the methods proposed for the analyses of soils, fertilizers, and agricultural products, and such analyses as pertain in general to the interest of agriculture. The division of entomology obtains and disseminates information regarding insects injurious to vegetation. The biological survey studies the geographic distri- bution of animals and plants, and maps the natural life zones of the country ; it also investigates the economic relations of birds and mammals, and recommends measures for the preservation of beneficial, and the destruction of injurious species. The division of forestry is occupied with experiments, investigations, and reports dealing with the subject of forestry, and with the dissemination of information upon forestry matters. The

division of botany investigates botanical agricultural problems, including the purity and value of agricultural seeds, methods of controlling the spread of weeds or preventing their introduction into the country, &c. The division of vegetable physiology and pathologj has for its object the study of the normal and abnormal life processes of plants. It seeks by investigation in the field and experiments in the laboratory to determine the causes of diseases and the best means of preventing the same. The division of agrostology is charged with the investigation of the natural history, geographical distribution, and use of grasses and forage plants, their adaptation to special soils and climates, and tlie introduction of native and foreign kinds into cultivation. The division of pomology collects and distributes information in regard to the fruit interest of the United States. The division of soil has for its object the investigation of the physical properties of the soils and their relation to crop production. The office of public road inquiries collects information con- cerning systems of road management, conducts investi- gations regarding the best method of road-making, and prepares publications on this subject. The division of seeds is charged with the purchase and distribution of valuable seeds, a certain portion of which are collected from foreign countries for experiments with reference to their introduction into the United States. They are distributed in allotments to senators, representatives, delegates. in Congress, agricultural experiment stations, and by the Secretary of Agriculture, as

provided by law. The appropriations for the Department of Agriculture for the fiscal year ending 30th Jime 1899 aggregate f 2,829,702, distributed in part as follows :—

Salaries $319,300

Library 6,000

Museum 1,500

Animal quarantine stations 12,000

Collecting agricultural statistics 105,000

Botanical investigations and experiments . . . 20,000

Entomological investigations 20,000

Vegetable pathological investigations . . . 20,000

Biological investigations 17,500

Fomological investigations 9,500

Laboratory of chemistry 12,400

Forestry investigations 20,000

Experimental gardens and grounds 20,00Q

Soil investigations 10,000

Grass and forage plant investigations . . . 10,000 Office of agricultural experiment station in the

department 1 40,000

Nutrition Investigation 15,000

Public road inquiries 8,000

Publications 65,000

Sugar investigations 7,000

Purchase and distribution of valuable seeds . . 130,000

Salaries and expenses, bureau of animal industry . 900,000

Irrigation 10,000

Weather bureau 1,015,502

The balance is devoted to miscellaneous current ex- penses.

(c. w. D.)

AgU ad i 1 1 a , a town on the west coast of Porto Rico, the capital of a province of the same name. It is surrounded by a fertile country producing sugar-cane, oranges, and lemons, and possesses a copious natural fountain, said to have been discovered by Columbus on his second voyage. It was founded in 1775. Population (1899), 6426.

Aguascalientes, a state of Mexico, bounded on the N., W., and E. by the state of Zacatecas, and on the S. by the state of Jalisco. Its area covers 2950 square miles. The population in 1879 was 140,430,

and in 1895, 102,378. It is divided politically into four partidos, subdivided into eight municipalities. The fauna embraces twenty-seven species of mammals, fifty-eight of birds, nine of reptiles, five batrachians, four fishes, and seventy-four insects. The flora includes 137 species of wild trees, forty-eight of fruit, eleven tex- tile plants, and 103 medicinal plants, &c. The principal industries are agriculture and stock-raising. The total

1 In addition to this amount which went to the support of the central bureau of experiment stations, $720,000 was paid directly to agricul- tural experiment stations in the States by the United States Treasury.

value of the trade is estimated at about $7,600,000 (Mexi- can currency). The Mexican Central railway crosses the state in two directions. The capital, Aguascalientbs, with a population in 1895 of 30,872, is 364 miles from the city of Mexico by rail. It has two lines of tram- ways, telegraph and telephone lines, schools, hospitals, public libraries, &c. The other principal towns are Ein- cdn de Eomos (or Victoria de Calpulapam), Asientos de Ibarra, and Calvillo, all with populations of less than 5000.

Aguilas, a town of Spain, province of Murcia, on the Mediterranean, 37 miles W.S.W. of Cartagena. It has two ports, one safe, the other bad. Its trade has become important, owing to the greater facilities now afforded for transport of ores by several lines of railways. In 1898, 74 foreign steamers of 70,372 tons (60 English of 58,372 tons) cleared from the port, and 120 Spanish steamers of 65,368 tons. The chief exports were: iron ore, 59,630 tons, of which 47,180 were for Great Britain ; spart grass, 19,496 tons for Great Britain; and barley, soapstones, and dried figs. Population in 1897, 12,331.

Ahaggar. See Saeaba.

Ahmedabad, or Ahmadabad, a city and district of British India, in the Gujarat division of Bombay. The city is situated on the left bank of the river Sabarmati. It is still surrounded with walls, enclosing an area of about 2 square miles. Ahmedabad has a station on the Bombay and Baroda railway, 309 miles from Bombay, whence branch lines diverge into Kathiawar and Mahi Kantha, and is a great centre for both trade and manufacture. Its native bankers, shopkeepers, and workers are all strongly organized in guilds. In 1897 there were 16 cotton-mills, for spinning and weaving, besides many hand-looms, and 14 factories for ginning and pressing cotton. Other indus- tries include the manufacture of gold and silver thread, silk brocades, pottery, paper, and shoes. The principal educational institutions are the Gujarat College, managed by a board, with 199 students in 1896-97 ; a government training college for both male and female teachers, with 219 students altogether; and a high school, with 365 boys. There are 2 churches, 22 printing presses, issuing 7 news- papers and

periodicals, a hospital, a lunatic asylum, an asylum for lepers, and a panjra/pol or home of rest for animals, supported by the trading community. The mili- tary cantonment, 3 miles north of the native town, is the headquarters of the northern division of the Bombay command, with an arsenal. Population (1881), 127,621 ;

(1891), 148,412.

The district of AhmeiJabad lies at the head of the Gulf of Cambay, between Baroda and Kathiawar. Area, 3949 square miles; population (1881), 856,342; (1891), 921,712, showing an increase of 8 per cent, and an average density of 233 persons per square mile; in 1901 the population was 795,094, showing a decrease of 14 per cent., due to the results of famine. Land revenue and rates (1897-98) amounted to Es.23,63,780, the incidence of taxation being E.l : 1 : 0 per acre; the cultivated area was 1,151,117 acres, of which 69,149 acres were irrigated from wells, &c., including 6142 acres from government canals; the number of police was 1098 ; the number of children at school was 28,795, being 3-56 per cent, of the total popu- lation ; the registered death-rate in 1897 was 25-37 per thousand. The principal crops are millets, cotton, wheat, and pulse. The district is traversed by the Bombay and Baroda railway, and has two seaports, Dholera and Gogo, the former of which has given its name to a mark of raw cotton in the Liverpool market. It suffered severely in the famine of 1899-1900.

Ahmednagar, a city and district of British India, in the Deccan division of Bombay, on the left bank of the

river Sina. Several mosques and tombs have been con- verted to the use of British administration. The old industries of carpet-weaying and paper-making have died out ; but there is a large trade in cotton and silk goods, and in copper and brass pots, and there are 9 factories for ginning and pressing cotton. It is a station on the loop line of the Great Indian Peninsula railway, 218 miles from Bombay, and a military cantonment for a native infantry regiment. It has three high schools, with 435 pupils in 1896-97, and 7 printing presses, issuing 6 ver- nacular newspapers. Population (1881), 37,492; (1891),

41,689.

The district of Ahmednagae is a comparatively hilly and barren tract, with a small rainfall. Area, 6645 square miles; population (1881), 750,021 ; (1891), 888,755, show- ing an increase of 18 per cent, after the famine of 1876-77; average density, 134 persons per square mile; (1901), 837,774, showing a decrease of 6 per cent., due to the results of famine. In 1897-98 the land revenue and rates were Es.19,07,825, the incidence of assessment being Es. 2:1:2 per acre ; the cultivated area was 2,585,616 acres, of which 110,246 were irrigated from wells, &c.; the number of police was 807 ; the children at school numbered 15,569, being 1-8 per cent, of the total population ; the death-rate in 1897 was 43 per thousand. The principal crops are millets, pulse, oil-seeds, and wheat. The district suffered from drought in 1896-97, and again in 1899-1900. Down to July 1898 the deaths from plague numbered 852.

Ahmed Vefik, Pasha, (1819-1891), Turkish states- man and man of letters, was born in Stambul, 1819. He was the son of Eouheddin Effendi, at one time Charge d’affaires in Paris, an accomplished Erench scholar, who because of this accomplishment was attached in the capacity of secretary-interpreter to Eeshid Pasha’s diplo- matic mission to Paris in 1834. Eeshid took Ahmed with him, and placed him at school, where he remained about five years and completed his studies. He then returned to Constantinople, and was appointed to a post in the Bureau de traduction of the ministry for foreign affairs. While thus employed he devoted his leisure to the translar tion ofMoli^re’s plays

into Turkish, and to the compilation of educational books — dictionaries, historical and geographical manuals, &c. — for use in Turkish schools, with the object of promoting cultivation of the Erench language among the rising generation. In 1847 he brought out the first edition of the Sailnameh, the official annual of the Ottoman empire, of which the publication is continued tov this day. Two years later he was appointed imperial com- missioner in the Danubian principalities, and held that office till early in 1851 when he was sent to Persia as ambassador — a post which suited his temperament, and in which he rendered good service to his Government for more than four years. Eecalled in 1855, he was sent on a mission to inspeet'the eastern frontiers, and on his return was appointed member of the Grand Council of Justice', and was entrusted with the revision of the penal code and the code of procedure. This work occupied him until the beginning of 1860, when he was sent as ambassador to Paris, for the sjiecial purpose of averting the much-dreaded intervention of Erance in the affairs of Syria. But Ahmed Vefik's abrupt frankness, irascibility, and abhorrence of compromise unfitted him for European diplomacy. He offended the Erench Government; his mission failed; and he was recalled in January 1861. None the less his integrity of purpose was fully understood and appreciated in Paris. On his return he was appointed minister of the Evkaf, but he only retained his seat in the Cabinet for a few months. He was then for a brief period president of the Board of Audit, and subsequently inspector of the

Anatolian provinces where he was engaged for ~~more than three years. His next appointment was that of director~~ general of customs, whence he was removed to the office of musteshar of the grand vizierate, and in the following year entered the Cabinet of Midhat Pasha as minister of public instruction, but very soon retired to his seat in the Council of State, and remained out of office until 1875 when he represented Turkey at the International Tele- graphic Conference in St Petersburg. He was president of the short-lived Turkish parliament during its first session — 19th March to 28th June 1877 — and at its close was appointed vali of Adrianople, where he rendered invaluable aid to the Red Cross Society. On his recall at the beginning of 1878 he accepted the ministry of public instruction in the Cabinet of Ahmed Hamdi Pasha, and on the abolition of the grand vizierate (5th February 1878) he became prime minister, and held office till about the middle of April, when he resigned. Early in the following year he was appointed vali of Brusa, where he remained nearly four years, and rendered admirable ser- vices to the province. The drainage of the pestilent marshes, the water-supply from the mountains, the numer- ous roads, the suppression of brigandage, the multiplica- tion of schools, the vast development of the silk industry through the substitution of mulberry plantations for rice fields, the opening out of the mineral springs of Tchitli, the introduction of rose-trees, and the production of otto of roses — all these were Ahmed Vefik's work; and he became so popular that when in 1882 he was recalled, it was thought advisable that he should be taken away secretly by night from the konak in Brusa, and brought to his private residence on the Bosphorus. A few days after his return he was again appointed prime minister (1st December 1882), but Ahmed Vefik demanded, as the condition of his acceptance of office, that he should choose the other members of the Cabinet, and that a number of persons in the sultan's entourage should be dismissed. Upon this, the sultan, on 3rd December, revoked the irad^ of 1st December, and appointed Said Pasha prime minister. For the rest of his life Ahmed Vefik, by the sultan's orders, was practically a prisoner in his own house ; and eventually he died, 1st April 1891, of a renal complaint from which he had long been a sufferer. Ahmed Vefik was a great linguist. He spoke and wrote French perfectly, and thoroughly un- derstood English, German, Italian, Greek, Arabic, and Persian. From all these languages he translated many books into Turkish, but wrote no original work. His splendid library of 15,000 volumes contained priceless manuscripts in many languages. In his lifetime he appreciably aided the progress of education ; but, as he had no following, the effects of his labour and influence

in a great measure faded away after his death. In all his social and family relations Ahmed Vefik was most exemplary. His charity knew no bounds. He was devoted to his aged mother and to his one wife and children. To his friends and acquaintances he was hospitable, courte- ous, and obliging ; his conversation was intellectual and refined, and in every act of his private life he manifested the spirit of a true gentleman. At home his habits, attire, and mode of life were quite Turkish, but he was per- fectly at his ease in European society; he had strong English proclivities, and numbered many English men and women amongst his intimate friends. In public life his gifts were almost sterilized by peculiarities of tem- perament and incompatibility with official surroundings ; and his mission as ambassador to Persia and his adminis- tration of Brusa were his only thorough successes. But his intellectual powers, literary erudition, and noble char- acter made him for the last forty years of his life a conspic- uous figure in Eastern Europe. (e. w.*)

Ahvaz, a town in the province of Arabistan, Persia, situated on the left bank of the river Karun, has been identified with the Aginis of Nearch. It is now a wretched collection of mud hovels, with a small rect- angular fort in a state of ruin, and an Arab population of about 700. Since the opening of the Karun to foreign commerce in October 1888 another settlement called Ban- der i Ndssiri, in compliment to the shah (N^ssir ed din), hafe been established on a slight elevation overlooking the river at the point near the rapids, where steamers come to anchor, and about one mile below Ahvaz. It has post and telegraph offices, and a few mercantile firms have established agencies at Bander Ndssiri. Should the new caravan road to Isfahan prove a success, Ahvaz will no doubt soon acquire greater commercial importance.

Aidin, (1) a Turkish viMyet, in the S.W. part of Asia Minor, which includes the ancient Lydia, Caria, and Western Lycia. It derives its name from the Seljuk emir who took Tralles, and is the richest and most productive province of Asiatic Turkey. The seat of government is Smyrna. Population, 1,400,000 (Moslem, 1,090,000 ~~j Christians, 288,000; Jews, 22,000). (2) The principal town of the rich, productive valley of the Menderez, called also Gtizelhissar from the beauty of its situation at the foot and on the lower slopes of Mons Messogis. Aidin is on the SmyrnarDineir railway, has large tanneries, and sweet~~ meat manufactories, and exports figs, cotton, and raisins. It was almost destroyed by an earthquake in 1899. It is the seat of a British vice-consul. Population, 34,000 (Moslems, 23,000; Christians, 9000; Jews, 2000).

Aigun, or AiHUJsr (also Sakhalyan-ula-khoto), a town of China, province Hei-lun-tsian, in Northern Manchuria, situated on the right bank of the Amur, ‘in a fertile and populous region, 20 miles below Blagovyeshchensk, where it occupies nearly two miles on the bank of the river. There is a palisaded fort in the middle of the town, inside of which is the house of the fuAvrfun (governor). Its merchants carry on an active local trade in grain, mus- tard, oil, and tobacco, and some of its firms supply the Kussian administration with grain and flour. During the ” Boxer ” rising of 1900 it was, for a few weeks, the cen- tre of military action directed against the Russians. The population, of some 20,000, includes a few hundred Mus- sulmans. The town was founded first on the left bank of the Amur, below the mouth of the Zeya, but was abandoned, and the present town was founded in 1684. It was here that Count Muravieff concluded, in May 1857, the Aihun treaty, according to which the left bank of the Amur was conceded to Russia.

Ain, a department in the E. of France, bordering on Switzerland. Its eastern part is traversed by the southern end of the Jura. The Rh6ne enfold^ it on the E. and S., the Sa5ne forms its western border ; the Ain runs through its centre from N. to S. into the Rh6ne. Among the lacustrine formations is Lake Nantua. The chief towns are Bourg, Belley, Gex, Nantua, and Tr^voux.

Area, 2249 square miles. The department comprises 36 cantons and 463 communes. Population in 1896, 351,569, against 364,408 in 1886. Births in 1899, 7204, of which 362 were illegitimate ;

deaths, 7204 ; marriages, 2665. In 1896 there were 1063 primary schools, with 57,502 pupils. Less than 1 per cent, of the popu- lation was illiterate. The total surface under cultivation was 1,236,173 acres, of which 601,744 acres were plough-land ; 229,786 acres In grass, and 265,772 acres in forest. In 1899 the produce of wheat amounted to the value of £1,025,000 ; of wine, £405,000. There were (1899) 14,260 horses, 3080 asses and mules, 240,190 cattle, 60,720 sheep, 87,030 pigs, and 20,190 goats. The mineral production (lignite, peat, and other substances) is unimportant. There is no industiy in metals. With agriculture, the industries in weaving, wearing apparel, foods, and the manufacture of paper, are the sources of the prosperity of Ain.

Ainsworth, William Harrison (18051882), English novelist, son of Thomas Ainsworth, solicitor, was born at Manchester, 4th February 1805. He was educated at Manchester Grammar School, and articled to the firm of which his father was a member, proceeding to London in 1824 to complete his legal training at the Inner Temple. At the age of twenty-one he married a daughter of John Ebers, the publisher, and started in his father-in-law's line of business. This, however, soon proved unprofitable, and he decided to attempt literary work. A novel called Sir John Chiverton, in which he appears to have had a share, had attracted the praise of Sir Walter Scott, and this encouragement decided him to take up fiction as a career. In 1834 he published Rodkwood, which had an immediate success, and thenceforth he was always occupied with the compilation of " historical " novels. He published about forty such stories, of which the best known are Jack Shep- pard (1839),*27ie Tower of London (1840), Guy Fawkes (1841), Old St Paul's (1841), and Windsor Castle (1843). He edited Bentley's Miscellany, in which Jack Sh&ppard was published as a serial, and for twelve years from 1842 he was proprietor of Ainsworth's Magazine. He continued his literary activity until his death, but his later stories were less striking than the earlier, perhaps owing to his having exhausted the more fruitful fields of historical narrative in his first flights. He died at Reigate, 3rd January 1882, and was buried at Kensal Green. Ains- worth had a lively talent for plot, and his books have many attractive qualities. He was skilful in weaving historical facts into the fabric of fiction, and in giving just sufficient of the former to leaven the latter with an air of probability. His style was not without archaic affectation and awkwardness, but when his energies were aroused by a striking situation he could be brisk, vigorous, and impressive. He did a great deal to interest the less educated classes in the historical romances of their country, and his tales were invariably instructive, clean, and manly. • (a. wa.)

Aintab, mediaeval Hamtdb, a large garrison town in Syria, in the Aleppo vilayet, situated in the broad valley of the Sajiir. Its position is one of military and com- mercial importance, and its castle was noted in the Middle Ages for its great strength. In 1895 many Armenians were massacred and the bazars were pillaged. American missionary and educational enterprise has established Central Turkey College, with a medical school, a girls' school and arr hospital. Cereals and tobacco are exported, and cotton cloths are made. Population, 45,000 (Moslems, 26,000; Christians, 18,500; Jews, 600).

Ainu. — The Ainu — often erroneously called Aino — are usually spoken of as the autochthonous inhabitants of Japan, but the most accurate researches go to prove that they were immigrants, who reached Yezo from the Kuriles, and subsequently crossing Tsugaru strait, colon- ized a great part of the main island of Japan, exterminat- ing a race of pit-dwellers to whom they gave the name of koro-pok-guru (men with sunken places). These koro-pok- guru were of such small stature as to be considered dwarfs. They wore skins of animals for clothing, and that they understood the potter's art and used flint arrow-heads is clearly proved by excavations at the sites of their pits. The Ainu, on the contrary, never had any knowledge of pottery. Ultimately the Ainu, coming into contact with the

Japanese, who had immigrated from the south and west. Were driven northward into the island of Yezo, where, as well as in the Kuriles and in the southern part of Saghalien, they are still found in some numbers. When, at the close of the 18th and the beginning of the 19th century, Eussian enterprises drew the attention of

the Japanese Government to the northern districts of the empire, the Tokugawa Shogims adopted towards the Ainu a policy of liberality and leniency consistent with the best principles of modern colonization. But the doom of unfit- ness appears to have begun to overtake the race long ago. History indicates that in ancient times they were fierce fighters, able to offer a stout resistance to the incomparably better armed and more civilized Japanese. To-day, they are drunken, dirty, spiritless folk, whom it is difficult to suppose capable of the warlike rdle they once played. Their number is virtually stationary, as the census shows : —

Ainu Population of Yezo and the Kuriles.

1893 17,280

1894 15,308

1895 17,314

1896 . . . 17,400

1897 .... 16,972 1898 17,573

The Ainu are somewhat taller than the Japanese, stoutly built, well proportioned ; with dark-brown eyes, high cheek-bones, short broad noses and faces lacking length. Naturally very hairy and never shaving after a certain age, they have full beards and moustaches. Men and women alike aut their hair level with the shoulders at the sides of the head, but trim it semicircularly behind. The women tattoo their, mouths, arms, and sometimes their foreheads, using for colour the smut deposited on a pot hung over a fire of birch bark. Their original dress is a robe spun from the bark of the elm tree. .It has long sleeves, reaches nearly to the feet, is folded round the body and tied with a girdle of the same material. Females wear also an undergarment of Japanese cloth. In winter, the skins of animals are worn, with leggings of deer-skin and boots made from the skin of dogs or salmon. Both sexes are fond of ear-rings, which are said to have been made of grape-vine in former times, but are now purchased from the Japanese, as also are bead necklaces, which the women prize highly. Their food is meat, whenever they can procure it — the flesh of the bear, the fox, the wolf, the badger, the ox, or the horse — fish, fowl, millet, vegetables, herbs, and ropts. They never eat raw fish or flesh, but always either boil or roast it. Their habitations are reed- thatched huts, the largest 20 feet square, without parti- tions and having a fireplace in the centre. There is no chimney, but only a hole at the angle of the roof ; there is one window on the eastern side and there are two doors. Public buildings do not exist, whether in the shape of inn, meeting-place, or temple. The furniture of their dwellings is exceedingly scanty. They have no chairs, stools, or tables, but sit on the floor, which is covered with two layers of mats, one of rush, the other of flag ; and for beds they spread planks, hanging mats around them on poles, and employing skins for coverlets. The men use chop-sticks and moustache-lifters when eating ; the women have wooden spoons. Uncleanliness is char- acteristic of the Ainu, and all their intercourse with the Japanese has not improved them in that respect. The Rev. Mr Batchelor, in his Notes on the Ainu, says that he lived in one Ainu habitation for six weeks on one occasion, and for two months on another, and that he never once saw personal ablutions performed, or cooking or eating utensils washed. Not having been at any period acquainted with the art of writing, they have no literature and are profoundly ignorant. But at schools established for them by

the Japanese in recent times, they have shown that their intellectual capacity is not deficient. No distinct conception of a universe enters into their cosmology. They picture to themselves many floating worlds, yet they deduce the idea of rotimdity from the course of the sun, and they imagine that the ” Ainu world”

rests on the back of a fish whose movements cause earth- quakes. It is scarcely possible to doubt that this fancy is derived from the Japanese, ■who used to hold an iden- tical theory. They believe in a supreme Creator, but also in a sun god, a moon god, a bear god, a water god, and a mountain god ; deities whose river is the Milky Way, whose voices are heard in the thunder and whose glory is reflected in the lightning. They have no priests by profession. The village chief performs whatever religious ceremonies are necessary ; ceremonies confined to making libations of wine, uttering short prayers and offering willow sticks with wooden shavings attached to them, much as the Japanese set up the well-known gohei at sacred spots. The Ainu gives thanks to the gods be- fore eating, and prays to the deity of fire in time of sickness. He thinks that his spirit is immortal, and that it will be rewarded hereafter in heaven or punished in hell, both of which places are beneath the earth, hell being the land of volcanoes ; but he has no theory as to a resurrection of the body or metempsychosis. He pre- serves a tradition about a flood which seems to be the counterpart of the Biblical deluge, and about an earth- quake which lasted a hundred days, produced the three volcanoes of Bzo, and created the island by bridging the waters that had previously separated it into two parts. He is now governed by Japanese laws and judged by Japanese tribunals, but in former times his affairs were administered by hereditary chiefs, three in each village, and for administrative purposes the country was divided into three districts, Sara, Usu, and Ishikari, which were under the ultimate control of Sara, though the relations between their respective inhabitants were not close and intermarriages were avoided. The functions of judge were not entrusted to these chiefs ; an indefinite number of a community’s members sat in judgment upon its criminals. Capital punishment did not exist, nor was imprisonment resorted to, beating being considered a sufficient and final penalty, except in the case of murder, when the nose and ears of the assassin were cut off or the tendons of his feet severed. These peculiar methods of criminal procedure are alluded to by ancient Japanese historians, who appear to have regarded them as more barbarous than infliction of the death penalty. Little as the Japanese and the Ainu have in common, intermar- riages are not infrequent, and at Sambutsu especially, on the eastern coast, many chil- dren of such marriages may be seen. Doenitz, Hilgen- dorf, and Scheube, arguing from a minute investigation of the physical traits of the Ainu, have concluded that they are “Mongolians who differ less, perhaps, from the Japanese thaa the Germans do from the Eumanians,” but if their customs, traditions, and religious beliefs be con- sidered, the points of dissimi- larity are very striking. Ac- cording to Professor A. H. Keane, the Ainu ” are quite

distinct from the surrounding Mongolic peoples, and pre- sent several remarkable physical characters which seem to point to a remote connexion with the Caucasic races. Such are a very full beard, shaggy or wavy black or dark- brown hair, sometimes covering the back and chest ; a somewhat fair Or even white complexion, large nose, straight eyes, and regular features, often quite handsome.

and of European type. They seem to be a last remnant of the Neolithic peoples,^ who ranged in prehistoric times across the northern hemisphere from the British Isles to Manchuria and Japan. They are bear-worshippers, and have other customs in common with the Manchurian ab- origines, but the language is entirely different, and they have traditions of a time when they were the dominant people in the surrounding lands.” It should be noted finally that the Ainu are altogether free from ferocity or exclusiveness, and that they treat strangers with gentle kindness. (=•• b^.)

Airdrie, a parliamentary and municipal burgh (Fal- kirk group) in new Monkland parish, Lanarkshire, Scotland, 10 miles E. of Glasgow by rail. There are 35 coal mines in the parish, but the seams are now largely worked out. Brass-founding, steel-casting, tube-making, boiler-making, wagon-bnilding, the weaving of woollens, calico-printing, paper-making, and oil and m-e-clay manu- facture, are ‘now important, while several new branches of engiaeering have been started. There is a good free library. One of the board schools is an academy or sec- ondary school. Population in 1881, 13,363; 1891,19,135;

1901, 22,288.

Air Cun. — Airas a propellant has in recent years been applied to guns of large calibre, in which its com- paratively gentle action has proved advantageous when high explosives contained in their shells are employed as projectiles. In 1883 Mr Mefford of Ohio utilized an air pressure of 500 Hb per square inch in a 2-inch gun, and succeeded in propelling a projectile 2100 yards. The arrangement was of the simplest form — a hose with an ordinary cock by which the air was admitted into the gun behind thei projectile. The question was then taken up by Captain E. L. Zalinski of the United States Artil- lery, who in 1888 reduced the so-called ” dynamite gun ” to a practical shape and obtained excellent firing results.

The principal features of liis system are : — 1. An extremely in- genious balanced valve admitting the air pressure into the gun. This valve is opened and closed by a simple movement of the firing lever, and is capable of adjustment so that the propelling force, and consequently the range, can be regulated. 2. A light steel projectile carrying the bursting charge, and provided with a tail

Dynamitk Gun Mounted at Bandy Hook, New Tork Habbotjb.

to which vanes are attached in order to give rotation. 3. Electric fuses of entirely original design. Each shell carries a wet battery, the current from wfifch flres the charge on impact with any solid object, and a dry battery which becomes active after the shell has diyed below the surface of the water, and ignites the charge after delay capable of regulation. For safety all the electric circuits are made to pass through a disconnector, which prevents them from being completed until the shell has been fired. The gun is a built-up

smooth-bore tube, 15 inches or less in’ diameter. The full-calibre shell weighs 1000 lb, and carries a bursting charge of 600 lb of blasting gelatine, cut into the form of cheeses, fitting the steel envelope, and provided with a core of dry gun-cotton as a primer. Sub-calibre projectiles, 10 in. and 8 in., can also be use^. In their case, rotation is given by vanes or lins attached to the body of the shell. Air at 1000 K) pressure is stored in tubes close to the gun, and is supplied from primary reservoirs, to which it is directly pumped at a pressure of about 2000 R). There is always, therefore, a considerable reserve of power available without pump- ing. Pneumatic guns of this description (see figure) have been mounted for the protection of New York and San Francisco. With a full-calibre shell (1000 ib) these guns have a range of 2400 yards ; with a sub-calibre 8-in. shell (250 ft) the maximum range is 6000 yards. The ofSoial trials showed remarkable accuracy. At 5000 yards 75 per cent, of the projectiles fell in an area of 360 x 90 feet. When the gun was tried at Shoeburyness the accuracy was far greater than could be obtained with howitzer shells propelled by explosives. – On account of the power of exploding the shell under water, and thus securing a torpedo action, a direct hit upon a, ship is hot required, and the target offered is largely in excess of the deck plan. The gun is, in fact, capable

of replacing systems of submarine mines with economy, and without the great objection of interfering with a waterway.

The pnly employment of the dynamite gun afloat has been in the case of the U S.A. gunboat Vesuvius, which carries three in the bows. These guns are fixed at a constant angle of elevation, and the range is regulated by the air valve, training being given by the helm. Thus mounted on an unstable platform, the accuracy of fire obtainable must evidently be much less than on shore. The Vesuvius was employed during the Spanish- American war of 1898, when on several nights in succession she approached the defences of Santiago, under cover of dark- ness and discharged three projectiles. Tire delivered under such conditions could not be sufficiently accurate to injure coast defences ; but the shells burst well, and made large craters. (g. s. c.)

Airy; Sir George Biddeii (1801-1892), British Astronomer Royal, was born at Alnwick on 27th July 1801. He came of a long line of Airys who traced their descent back to a family of the same name residing at Kentmere, in Westmoreland, in the 14th century, but the branch to which he belonged, having suffered in the civil wars, removed to Lincolnshire, where for several genera- tions they lived as farmers. George Airy was educated first at elementary schools in Hereford, and afterwards at Colchester Grammar School. In 1819 he entered Trinity College, Cambridge, as a sizar. Here he had a most brilliant career, and seems to have been almost imme- diately recognized as the leading man of his year. In 1822 he was elected scholar of Trinity, and in the follow- ing year he graduated as senior wrangler and obtained first Smith's prize. On 1st October 1824 he was elected fellow of Trinity, and in December 1826 was appointed Lucasian Professor of Mathematics in succession to Tur- ton. This chair he held for little more than a year, being elected in February 1828 as Plumian Professor of Astron- omy and director of the new Cambridge observatory. Some idea of his activity as a writer on mathematical and physical subjects during these early years may be gath- ered from the fact that previous to this appointment he had contributed no less than three important memoirs to the Philosophical Transactions of the Royal Society, and eight to the Cambridge Philosophical Society. At the Cambridge observatory Airy soon gave evidence of his remarkable power of organization. At the time of his appointment the only telescope erected in the observatory was the transit instrument, and to this he devoted him- self with^vigour. By the introduction of a regular sys- tem of selection and arrangement of his observations, and a carefully worked out plan of reduction, he was able to keep his observations reduced practically up to date and published annually with a degree of punctuality which

astonished his contemporaries. Under his direction a mural circle was soon erected, and regular observations were instituted with it in 1833. In the same year the duke of Northumberland presented the Cambridge obser- vatory with a fine object glass of 12 inches' aperture, which was mounted according to Airy's designs and under his superintendence, although the erection was not com- pleted ,until after his removal to Greenwich in 1835. Airy's writings during this time are divided between mathematical physics and astronomy. The former are for the most part concerned with questions relating to the theory of light, arising out of his professorial lectures, among which may be specially mentioned his paper " On the Diffraction of an Object-Glass with Circular Aper- ture." In 1831 the Copley medal of the Eoyal Society was awarded to him for these researches in optics. Of his astronomical writings during this period the most im- portant are his investigation of the mass of Jupiter, his report to the British A,ssociation on the progress of astronomy during the 19th century, and his memoir On an Inequality of Long Period in the Motions of the Earth and Venus. His report is remarkable for the conciseness and accuracy with which the condition of the science at the time is exhibited. The last section but one of this report is devoted to " A Comparison of the Progress of Astronomy in England with that in other Countries," very much to the disadvantage of England. This re- proach was subsequently, to a great extent, removed by his own labours.

Airy’s discove:fy of a new inequality in the motions of Venus and the earth is in some respects his most re- markable achievement. In correcting the elements of Delambre’s solar tables he had been led to suspect an inequality not embraced by those tables. For the cause of this he did not long seek in vain. Eight timles the mean motion of Venus is so nearly equal to thirteen times that of the earth that the difference amounts to only the l/240th of the earth’s mean motion, and from the fact that the term depending on this difference, although very small in itself, receives in the integration of the differen- tial equations a multiplier of about 2,200,000, ‘Airy wa,s led to infer the existence of a sensible inequality extend- ing over 239 years. The investigation by which this result was established was probably the most laborious that had been made up to Airy’s time in the planetary theory, and was the first specific improvement in the solar tables made in England since the establishment of the theory of gravitation. In recognition of this work the medal of the Eoyal Astronomical Society was awarded to him in 1833.

In June 1835 Airy was appointed Astronomer Eoyal in succession to Pond, and thus commenced that long career of wisely directed and vigorously sustained industry at the National Observatory which, even more perhaps than his investigations in abstract science or theoretical astron- omy, constitutes his chief title to fame. The state of the observatory at the time of his appointment was such that Lord Auckland, the first lord of the Admiralty, considered that ” it ought to be cleared out,” while Airy admits that it “was in a queer state.” With his usual energy he set to work at once to reorganize the whole management. He remodelled the volumes of observations, the library was put on a proper footing, the new (Sheep- shanks) equatorial was erected, and a new magnetic obser- vatory was built. In 1847 the altazimuth, designed by Airy to enable observations of the moon to be made when- ever she might be visible (and not only on the meridian), was constructed. In 1848 Airy invented the reflex zenith tube to take the place of the zenith sector which had been employed up to that time. At the end of 1850 the great transit circle of 8 in. aperture and 11 ft. 6 in. focal length

was erected; this telescope is still the principal instru- ment of its class at the observatory. And finally, in 1859, a large equatorial of 13 in. aperture was erected. In his journal for that year he remarks, ” There is not now a single person employed or instrument used in the observatory which was there in Mr Pond’s time.”

The great work of reducing the accumulated planetary observations made at Greenwich from 1750 to 1830 had been already commenced and was in progress when Airy became Astronomer Royal. Shortly afterwards he under- took the further laborious task of reducing the enormous mass of observations of the moon made at Greenwich during the same period under the direction, successively, of Bradley, Bliss, Maskelyne, and Pond, to defray the expense of which a large sum of money was allotted by the Treasury. The immediate result of this work, which was not completed till 1846, was to rescue from oblivion no less than 8000 observations of the moon, and to place them, at the disposal of astronomers in such a form that they could be used directly for comparison with the theory and for the improvement of the tables of the moon’s motion. For this work Airy received a testimo- nial from the Eoyal Astronomical Society in 1848. The first-fruit of this work was soon seen in the discovery by Prof. Hansen, of Seeburg in Gotha, of two new inequali- ties in the moon’s motion. After completing this labour, and before engaging in any theoretical investigation in connexion with it. Airy made inquiries whether any other mathematician was pursuing the same subject, and learn- ing that Prof. Hansen, had undertaken this problem under the patronage of the

king of Denmark, but that, owing to the death of the king, it was in danger of falling through for lack of funds, he applied to the Admiralty for the sum required to enable Prof. Hansen to complete his work. This request was immediately granted, and thus it comes about that Hansen's famous Tables de la Lune are dedicated to La Haute Amirauti de sa Majest6 la Heine de la Grande Bretagne et d'Irlande.

One of the most remarkable of Airy's researches is his determination of the mean density of the earth. In 1826 the idea occurred to him of attacking this problem by means of pendulum experiments at the top and bottom of a deep mine. His first attempt, made in the same year, at the Dolcoath mine in Cornwall, failed in consequence of an accident to one of the pendulums ; a second attempt in 1828 was defeated by a flooding of the mine, and many years elapsed before another opportunity presented itself. The experiments eventually took place at the Harton pit near South Shields in 1854. The immediate result of the experiment was to show that gravity at the bottom of the mine exceeded that at the top by l/19286th of its amount, the depth being 1256 feet. From this he was led to the final value of 6-566 for the mean density of the earth as compared with that of water. This value is considerably in excess of that previously found by other methods, but from the care and completeness with which the observations were carried out and discussed, it is, as Airy himself says, " entitled to compete with the others on, at least, equal terms."

In 1872 Airy conceived the idea of treating the lunar theory in a new way, and at the age of seventy-one he. embarked on the prodigious labour which this scheme entailed. A general description of his method will be found in the Monthly Notices of the Boyal Astronomical Society, vol. xxxiv. No. 3. His method consisted essen- tially in the adoption of Delaunay's final numerical ex- pressions for longitude, latitude, and parallax, with a symbolic term attached to each number, the value of which was to be determined by substitution in the equar tions of motion. In this mode of treating the question the order of the terms is numerical, and though the

amount of labour is such as might well have deterred a younger man, yet the details were easy, and a great part of it might be entrusted to a mere computer. This work was published in 1886, when its author was eighty- five years of age. For some little time previously he had been harassed by a suspicion that certain errors had crept into the computations, and accordingly he addressed him- self to the task of revising his work. But his powers were no longer what they had been, and he was never able to examine sufficiently into the matter. In 1890 he tells us how a grievous error had been committed in one of the first steps, and pathetically adds, " My spirit in the work was broken, and I have never heartily pro- ceeded with it since." In 1881 Sir George Airy re- signed the office of Astronomer Hoyal and resided at the White House, Greenwich, not far from the Royal Observatory, until his death, which took place on 2nd January 1892.

A complete list of Airy's printed papers, numbering no less than 618, will be found in his Autobiography, edited by his son, Wilfrid Airy, B.A., M.Inst.C.B. Amongst the most important of his works not already mentioned may be named the following: — Mathematical Tracts (1826) on the Lunar Theory, Figure of the Earth, Precession and Nutation, and Calculus of Variations, to which, in the second edition of 1828, were added tracts on the Planetary Theory, and the Undulatory Theory of Light ; Experiments on Jron-built Ships, instituted for the purpose of discovering a correction for the deviation of the Compass produced by the Iron of the Ships (1839) ; On the TJieoretical Explanation of an apparent new Polarity in Light (1840) ; Tides and Waves (1842).

He was elected a fellow of the Royal Society in 1836 and president in 1871, and received both the Copley and Eoyal medals. He was five times president of the Royal Astronomical Society, was correspondent of the 'French Academy, and belonged to many other foreign and American societies. He was D.C.L. of Oxford, and LL.D. of Cambridge and Edinburgh. In 1872 he was made K.C.B. In

the same year he was nominated a Grand Cross in the Imperial Order of the Rose of Brazil ; he also held the Prussian Order ” Pour le M^rite,” and belonged to the Legion of Honour of France, and to the Order of the North Star of Sweden and Norway. (a. a. r.*)

Aisne, a department in the N.E. of France. The northern part is crossed by branches of the Ardennes. The country is watered by the Somme, the Escaut, the Sambre, the Oise, the Aisne, and the Marhe.

Area, 2868 square miles. The department comprises 87 cantons and 841 communes, and its population in 1901 numbered 535,583, against 555,925 in 1886. The chief towns are Laon, the capital of the department, Chateau- Thierry, St Quentin, with important industries and 48,868 inhabitants in 1896, Soissons, and Vervins. Births in 1899, 12,164, of which 1450 were illegitimate ; deaths, 12,077 ; marriages, 4251. In 1896 there were 1363 primary schools, with 76,645 pupils. Eight per cent, of the population was illiterate. Agriculture is highly developed, 1,717,107 acres being under cultivation in 1896, of which 1,197,950 acres were plough-land, 210,274 acres forest, and 197,688 acres in grass. In 1899 the produce of wheat was valued at £1,960,120 ; rye at £176,000 ; oats at £983,240. The production of mangold-wiirzel and of potatoes is also considerable. The production of beetroot (1899) exceeded 26,000,000 hundredweights, placing the department second in this respect. The live stock numbered (1899) 781,060, of which 77,870 were horses. The value of milk products in 1899 was £1,012,000. There are no metals in the department of Aisne, but there is abund- ance of building-stone and of brick-clay. The industries of Aisne are weaving, St Quentin being renowned for its cambrics ; plate- glass manufacture (St Gobain) ; glass-making (Folembray) ; but especially sugar-reflning. With a production in 1899 of 171,000 tons, involving the labour of 10,500 men and women, Aisne takes the lead of all the departments of Trance in the sugar industry.

Aitaluki. See Cook Islands.

Aivali, aprosperous town on the west coast of Asia Minor, opposite the island of Mitylene. It stands, near the site of the ^olian Heracleia, on rising ground at the end of a bay which is separated from the Gulf of Adramyt- tium, and protected from the prevailing winds by tiie Muskonesi Islands (Hecatonnesoi). In 1821 it was burned to the ground during a fight between the Turks and the Greeks, and a large number of its Greek population killed or enslaved. It is now one of the most thriving towns in the Levant, with a purely Greek population distinguished for its commercial, industrial, and maritime enterprise. The exports are olive oil, soap, and raki ; and a fleet of fishing-boats supplies Constantinople and Smyrna with fish ; the exports in 1899 were valued at £944,743, and the imports at £286,425. It is the seat of a British vice- consulate. Population, 36,000.

Aix-la-Ch£|pelle, German Aachen, a town and watering-place of Prussia, in the Rhine prov., between the Meuse and the Ehine, 44 miles W.S.W. from Cologne by the railway to Lifege. It possesses more than thirty churches, besides the cathedral. Ahandsome building was put up in 1886-89, behind the faqade (1267) of the old town hall, to accommodate the archives. The Suermondt museum contains collections of antiquities, pictures, arms, and industrial art objects. There are two or three tech- nical schools, a commercial college, a commercial high school (opened in 1898), a deaf and dumb asylum, lunatic asylums, a teachers’ sieminary, a polytechnic, a technical high school,, and a newspaper museum. In the vicinity are coal-mines employing about 9000 men. This city is the seat of a very active commerce in cereals, timber, leather, coal, metals, wool, wine, &c. In 1897 the town of BuBTscHEiD was incorporated with Aix-la^Chapelle. Burtscheid also has thermal baths (140° to

160° Pahr.), and carries on the same industries as Aix-la-Chapelle. Population (1885), 95,725; (1895), 110,551; (1901),

135,235.

Ajaccio, the chief town of the island of Corsica, a department of France, stands on the west side of the island. . It lies 676 miles S.E. of Paris, and is the ter- minal station of railways from Bastia and Calvi. The library (35,000 volumes), a fine collection of pictures, and a communal college, all now in the Palais Fesch, were founded by the cardinal of that name, half-brother of Napoleon's mother. The culture of the citron has greatly extended in recent years, and gallic acid is now an im- portant export. The Citadelle harbour affords good anchorage, but the port accommodation is indifferent. The total length of quays is 2000 feet, with a depth along- side of from 9 to 22 feet. In 1899, 640 vessels of 213,370 tons entered, and 650 of 214,107 tons cleared. Population (1881), 15,351; (1891), 17,248; (1896), 17,398, (comm.)

18,553 ; (1901), 21,779.

Ajaigai'h, a native state of India, in Bundelkhand, under the Central India agency ; lying between 24° 45′ and 24° 58′ IST. lat., and between 80° 4′ and 80° 22′ E. long. It has an area of 802 square miles ; and a population of 93,048, being 116 persons per square mile. The chief, who is a Bundela Eajput, bears the title of Sawai Maharaja. He has an estimated revenue of about Es.2,25,000, and pays a tribute of Es.7010. He resides at the town of Naushahr, at the foot of the hill-fortress of Ajaigarh, from which the state takes its name. The state suffered severely from famine in 1868-69, and again in 1896-97.

Ajmer, a city of British India, in RajputEina, which gives its name to a district and also to a petty province called Ajmer-Merwara; situated in 26° 27′ N. lat. and 74-44° E. long., on the lower slopes of TaragarhHill,in the Aravalli Mountains. It is an important station on the Eajputana

railway, 615 miles from Bombay and 275 miles from Delhi, with a branch running due south to the Great Indian Peninsula main line. The city is well laid out, with wide streets and handsome houses. It is still surrounded by a stone wall. The educational institutions include a college, with 212 students in 1897-98, and the Mayo Eajkumar College, opened in 1875, for training the sons of the nobles of Eajputana on the lines of an English public school, with 63 pupils in 1897-98, maintained at a total cost of Es.47,479. Population (1867), 34,763; (1881), 48,735; (1891), 68,843; (1901), 75,759, showing an increase of 10 per cent. The district of Ajmee, which forms the larger part of the province of Ajmer-Merwara, has an area of 2070 square miles. Population (1891), 422,359, being 204 persons per square mile ; (1901), 366,800, showing a decrease of 13 per cent. Besides the city of Ajmer, it contains the military station of Nasirabad ; population,

21,710.

Ajmer-Merwara, a division or petty province of British India, in Eajputana, consisting of the two districts of Ajmer and Merwara, separated from each other and isolated amid native states. The administration is in the hands of a commissioner, subordinate to the governor- general's agent for Eajputana. The capital is Ajmer city. The area is 2711 square miles. The population in 1891 was 542,358, being 200 persons per square mile, the classification according to religion being : Hindus, 437,988, or 81 per cent. ; Mahommedans, 74,265, or 13 per cent. ; Jains, 26,939, or 6 per cent. ; Christians, 2683 ; and "others," 483; in 1901 the f)opulation was 476,330, showing a decrease of 12 per cent., due to the results of famine. Among Hindus, the Eajputs are land- holders, and the Jats and Gujars are cultivators. The Jains are traders and money-lenders. The aboriginal tribe of Mers are

divided between Hindus and Mahom- medans. In 1897-98 the total cultivated area was re- turned at 404,413 acres, of which 62,305 acres were twice cropped. The chief crops are millet, wheat, cotton, and oil-seeds. The irrigated area was 142,287 acres, of which 107,677 were irrigated from wells, and 33,955 from tanks. The land revenue was Es.4,42,526, being at the rate of E.l : 3 : 11 per cultivated acre, and 14 annas per head of population. The total number of schools was 192, with 10,771 pupils ; and the total expenditure on education was Es.92,463. There are 12 factories for ginning and pressing cotton, the chief trading centres being Beawar and Kekri. Together with the surrounding country, Ajmer-Merwara suffered very severely from the famine of 1899-1900. In June 1900 the number of per- sons in receipt of relief was 143,000, being more than one-fourth of the total population.

‘Akabah, Culf of, the classical ^laniticus Sinus, from the town of Minna, at its head; a continuation southward of the Jordan-‘Araba depression. Eaised beaches on the coast show that there has been an elevation of the sea-bed of 200 feet. Near the head of the gulf is Jeziret Faraun, mediseval Oraye, a rocky islet with the ruins of a castle built by Baldwin I. (ciVc. 1115). The village of ‘Akabah was transferred from Egypt to Tur- key in 1892, and has a small import trade. Near it was Elath, the port from which Solomon’s fleet sailed to Ophir, which as u^lana was the station of the tenth Eoman legion, and a place of commercial importance. As Haila or Ailat, under the Arabs, it was in the 10th century the great port of Palestine and the emporium of the Hej^z.

Akalkot, a native state of India, in the Deccan division of Bombay, ranking as one of the Satara Jagirs, situated between the British district of Sholapur and the Nizam’s dominions. Area, 498 square miles ; population

(1891), 75,744; (1901), 82,062, showing an increase of 8 per cent. In 1897-98 the gross revenue was Es.3,52,867, of which Ks.39,102 was expended on public works ; the tribute is Es.14,592; the number of police was 59; there were 38 schools, with 1897 pupils. The chief, who is a Mahratta of the Bhonsle family, resides at Poona on a pension, while the state is under British management. The town of Akalkot is situated in 17° 31′ N. lat. and 76°_16′ E. long., near the Great Indian Peninsula railway, which traverses the state. Population, 6551.

Akanyam, R. See Nile.

Akassa. See Nigebia.

Akhal-teke. See Tbanscaspian Tereitoet.

Akhaltsykh (Geovgian Jhaltsikhe, « new fortress “), a fortified district town of Russia, Transcaucasia/govern- ment of Tiflis, 67 miles, east of Batum, situated on a tributary of the Kura, at an altitud.e of 3370 feet. It enjoys an excellent climate and its houses are scattered amidst gardens. The new town is on the right bank of the river, while the old town and the fortress are on the oppo- site bank. It has a considerable inland trade, and brown coal is found in the neighbourhood. In 1897 the population, of whom many were Armenians, was 15,387.

Ak-hissar, the classical Thyateira, the “town of Thya,” situated in a fertile plain, on the Greurduk Chai (Lycus), in the Smyrna viMyet. Thyateira was an impor- tant station ontheEomah road fromPergamos toLaodieea, and one of the “seven churches” of Asia (Eev. ii. 18). The town is connected with Smyrna by railway and exports cotton, wool, opium, cocoons, and cereals. Population, 13,000 (Moslems, 8200; Christians, 4800).

Akhtyrka, a district town of Eussia, government of Kharkoff, near to the Vorskla river, connected by a branch (11 m.) with the railway from Vilno to Nikolaevsk. It is surrounded by moving sands, and often inundated. It has a beautiful cathedral, bnilt upon a plan by Eastrelli in 1753, to which numerous pilgrims ■ come every year to venerate the ikon of the Virgin of Akhtyrsk. There is an active trade in corn, cattle, and the produce of domestic industries. Population (1897), 23,390.

Akim. See Gold Coast.

Akkerman (Tpkish Ak-herman, “white town”), a district town, formerly a fortress, of South-West Eussia, government of Bessarabia, situated on the right bank of the estuary of the Dnieper, 12 miles from the Black Sea. It was taken by the Eussians in 1770 and 1774 and returned to the Turks, but was definitely annexed to Eussia in 1881. Its proximity to Odessa gives it an advantageous position for trade, and it does a thriving business in wine, salt, fish, wool, tallow, &c. The town, with its three suburbs, contains beautiful gardens and vineyards. In 1897 the population was 28,303, or 40,000 including the suburbs.

Akmolinsk, in Asiatic Eussia, the north-eastern of ibhe three provinces belonging to the general governorship of the Steppes, formerly known as the Kirghiz Steppe; bounded by Turgai on the W., Tobolsk on the N., Tomsk on the B., and Eussian Turkestan on the S. Area, 211,566 square miles, of which 4535 are lakes. It is low and dotted with salt lakes in its northern portion, and sandy on the banks of thelrtysh.. An undulating plateau stretches in the middle, and is watered by the Ishim, the plains .gradually rising southwards, where a wide spur of the Tarbagatai Mountains runs north-westwards, containing gold, copper, and coal. Many lakes, of which the largest is Denghiz, are scattered along the northern slope of these hills. . To the south of these hills, towards Lake Balkhash,

situated on its south-eastern frontier, and to the north-west of this lake, spreads a wide waterless desert, Bek-pak-dala, or Pamine Steppe (Golodnaya). The province is watered by the Ishim, tributary of the Irtysh (which flows near to the eastern frontier) and the Nura. The climate is very continental and dry, the average temperatures atAkmoUy being: year 35°, January 1-5°, July 70°; yearly rainfall, only 9 inches. The population, which was 678,957 in 1897 (324,587 women) consists chiefly of Eussians in the northern and middle portions, and Kirghiz (about 350,000), who breed large quantities of cattle, horses, and sheep. The urban population was only 74,069. Agriculture is successfully carried on in the north, where the Siberian railway runs from Zlatoust to Omsk through a very fertile, well- populated region. Steamers ply on the Irtysh. The province is divided into five districts, the chief towns of which are: Omsk, formerly capital of West Siberia (37,470 inhabitants) ; Akmolinsk, or Akmolly, chief town of the province (9560), situated on the Ishim, 285 miles south-west of Omsk, and chief centre for the caravans coming from Tashkent and Bukhara ; Atbasar, 3030 ; Kokchetav, 5000 ; and Petropavlovsk, 20,014.

Akola, a town and district of India, in Berar or the Haidarabad Assigned Districts, under British administra^ tion. The town is on the Morna river, 930 feet above the sea ; railway station, 363 miles fromBombay. Population (1881), 16,608; (1891), 21,470; municipal income (1897-98), Es.45,057. It is a centre of trade in raw cotton. There are 13 factories for ginning and pressing cotton, with an out-turn of 80,000 bales. It has a high school, with 202 pupils in 1896-97 ; a training college, with 69 students ; an industrial school, supported by a Christian mission; an engineering class ; two printing presses, each issuing a vernacular newspaper.

The district of Akola has an area of 2660 square miles; population (1881), 592,792; (1891), 674,782, showing a decrease of 3 per cent ; average density, 216 persons per square mile; (1901) 582,763, showing an increase of 1 per cent. Land revenue and rates in 1897-98 amounted to Es.22,34,308, the incidence of assessment being E.l : 7 : 2 per acre ; the cultivated area was 1,303,757 acres, of which

9344 are” irrigated from wells ; number of police, 601 men ; the number of boys at school in 1896-97 was 12,412, being 27-8 per cent, of the male population of school-going age ; the registered death-rate in 1897 was 54-9 per thousand. The principal crops are millet and cotton.

Akron, a city of Ohio, U.S.A., the capital of Summit county, situated in 41° 05′ N. lat. and 81° 32′ W. long, in the north-eastern part of the state, at an altitude of 1000 feet, being on the divide between Lake Erie and Ohio river. The water supply is derived from wells. The plan of the streets is quite irregular ; there are six wards, and the city is entered by no fewer than six railways, giving it excellent connexions in all directions. Its industries are chiefly manufacturing, and its products consist largely of agricultural implements, cement, brick, and tiles. Biichtel College, one of the smaller institutions of learning, is situated here. The population in 1880 was 16,612, in 1890 it was 27,601, and in 1900 it was 42,728.

Ak-Shehr, the classical Philomelion, a town in Asia Minor, in theKonia viMyet, situated at the edge of a fertile plain, on the north side of the Sultan Dagh. Philomelion was on the great Greco-Eoman highway from Ephesus to the east, and to its townsmen the Smyrniotes wrote the letter thatdescribes the martyrdom of Polycarp. The town is connected by railway with Konia, Smyrna, and Constantinople. Population, 15,000 (Moslems).

Aksu (TTMe Water), a town of tl;e Chinese empire, Eastern Turkestan, in 41° 7′ N..and 79° 7′ E., 70 miles E. of Ucli-Turf an and 270 miles N.E. of Yarkand, near to the left bank of the Aksu river, which takes its origin in the Tian-shan Mountains and joins the Tarim. It belongs to the series of oases (Uch-Turfan, Bai, Koucha, &o.) situated at the southern foot of the eastern Tian-shan Moun- tains. The town, which is supposed to have about 6000 houses, is enclosed by a wall. It is an important centre for caravan routes, and has a considerable trade. Extensive cattle breeding is carried on by the inhabitants.

Aktyubinsk (Ak-tube), a district town and fort of Russian Central Asia, province Turgai, situated on the Ilek river, 135 miles S.E. of Orenburg. It is the centre for the administration of the Kirghiz, with whom a lively trade is carried on. In 1897 the population was 2840.

Akyab, a district and city in the Arakan division of Burma, lies along the north-eastern shores of the Bay of Bengal. The district area is 5136 square miles. Popu- lation (1891), 416,305; (1901), 482,374. There were 2040 villages paying a revenue of Es.16,91,191 in 1898-99. Buddhists and Jains numbered 258,259, Mahommedans 119,157, Hindus 9762, aborigines 28,234, and Christians (European and native) 893. Of the total are’a of 3,287,040 acres, the area under cultivation was 690,991, there were 64,950 acres lying fallow, the cultivable waste amounted to 1,669,478 acres, knd 961,621 acres were not capable of cultivation. The rainfall in 1898-99 was 193-49 inches. Aktab, the chief town, had in 1891 a population of 37,938; in 1871-72 the total was 15,281. It has a municipality with a committee of 16 members, 10 of whom are elected. There is a second-class district jail. The export of rice from Akyab has increased greatly of late years. There are two oil-wells in the district, both on Boronga island, worked under the Canadian oil-boring system. During the year 1898-99, 290 vessels with a tonnage of 167,158 entered the port, and 282 of a burden of 166,752 cleared.

Ala, a town in South Tyrol, Austria, in the govern- ment district of Rovereto, on the Adige river, at the entrance of the Bonchi valley. It is the last station on the Brenner railway, and has an Austrian

and an Italian custom-house. Silk and velvet manufactures. Population in 1890, 4646 ; in 1900, 4933, chiefly Italian.

Alabama, one of the Southern States of the American Union, situated between 35° and 30° 13′ N. lat., and 84° 53′ and 88° 35′ W. long., and bounded on the IST. by Tennessee, on the E. by Georgia, on the S. by Florida and the Gulf of Mexico, and on the W. by Mississippi. In the last quarter of the 19th century Alabama experienced a new era of prosperity. During the decade of the CivU war the cotton product had fallen off from 989,955 bales in 1860 to 429,482 bales in 1870^, and the corn product from 33,226,282 bushels to 16,977,948 bushels, these beiug the leading products of the State, which was almost entirely agricultural. Politi- cally and economically the result of the war was even more marked. The emancipation and enfranchisement of the negroes, who constituted almost half of the popula- tion (475,510 coloured in a total of 996,992), threw the Government into the hands of strangers, “carpet-baggers,” who were attracted mainly from the north by the prospect of political power. When these went into office under the constitution born of the bayonet, their auditor said in his first report : ” Alabama stands in a proud position in the

financial world. . . . Nothing but gross mismanagement of her finances will cause her credit to decline.”

The State’s bonded deht was . . . $5,270,000.00 Educational fund and miscellaneous . $3,085,683.51

Total . . . $8,355,683.51

Under the new regime the State’s endorsement was granted to railways to the extent of $16,000 a mile; and many roads were begun, partially completed, and then aban- doned. So gross was the mismanagement in general that, before the close of 1873, the governor was compelled to. report to the legislature his inability ” to sell for money any of the State bonds,” a condition of things which, according to an official report (30th September 1874), had resulted from the fact that the debt had grown to the sum of $25,603,693, including both direct and endorsed railway securities. At this crisis the white people, worn out by misgovernment at the hands of irresponsible rulers, resolved to re-establish the public affairs of the common- wealth upon a normal basis. Under the lead of George S. Houston, the bulk of the white voters united in the democratic and conservative party triumphed in the memorable contest of 1874, electing not only the governor, but large majorities in both branches of the legislature. The affairs of the State were again in the hands of the tax- payers. That event made possible the political, economic, and industrial reorganization which has since lifted the State to its present condition of prosperity, not only as an agricultural community, but as one of the^great coal and iron-producing States of the Union.

Under the constitution of 1875, which superseded that of 1868, and which is still in force, official salaries and the power of the legislature to indulge in financial extra- vagance were severely restricted. The debt, then beyond the ability of the State to bear, was readjusted, and was so reduced by amicable settlements that, on 30th September 1888, it had shrunk from $25,000,000 to $12,086,220. Owing to subsequent payments, the total bonded debt amounted on 1st March 1898 to only $9,357,600.

The total population, which had increased in 1890 to 1,513,017 (833,718 whites and 679,299 negroes), was 1,828,697 iu 1900, showing an increase for the decade of 20-8 per cent. The total land surface of Alabama is, approximately, 61,540 square miles, and the density of population was therefore 35-4 per square mile in 1900, as compared with 29-3 ten years earlier. There were, in 1900, 201 incorporated cities, towns, and villages, and of these 9 had a population in excess of 5000, and 3 in excess of 25,000. These three were Mobile, with 38,469 inhabitants, Birmingham, with 38,416,

and Montgomery, with 30,346. The proportion of rural to urban population is increasing. The total taxable values, which in 1876 were $135,535,790, were in 1898 $266,266,295, the total state tax being 5^ mills on the total values. The total cotton product, which in 1870 was 429,482 bales, was in 1899, 1,130,000 bales.

The main feature in the modern transformation is the vast development of the mineral region, which occupies the north-eastern two-fifths of the State. The south- eastern fourth of this area, the Gold Belt, produces gold, copper, pyrites, and mica. In the north-western three- fourths are the three coal-fields — Warrior, Cahaba, and Coosa — aggregating 8000 square miles (about 2000 pro- ductive), separated by narrow north-east and south-east valleys, in which are bauxite, barytes, iron ores, and lime- stones. Thus all the raw materials for the production of iron occur in close proximity, with no natural barriers between. The total annual coal production, which in 1870 amounted only to 13,200 tons, had risen in 1875 to 67,200; in 1880 to 380,000; in 1885 to 2,492,000; in

1890 to 4,090,409; in 1896 to 5,693,775; and in 1899 to 7,500,000 estimated. Prof. M'Calley has reached the con- clusion that the three coal-fields (Warrior, Cahaba, and Coosa), combined, probably contain an aggregate of at least 42,100,000,000 tons. Tests made by the United States navy have established the superior quality of cer- tain seams of this coal for steam purposes, while the coke tonnage of the Pratt and Blue Creek seams of the Warrior field (1,609,839 tons in 1898) is second only to the famous Connellsville district of Pennsylvania. The pig-iron production, which during the year 1870 amounted only to 7060 tons, had risen in 1875 to 22,418 ; in 1880 to 68,925; in 1885 to 203,069; in 1890 to 816,911; in 1895 to 854,667 ; and in 1899 to 1,083,905. The supply of iron ore (red and brown) is practically inexhaustible. That used in the Birmingham district is principally of the red fossiliferous kind derived from Eed Mountain, the vein running about 20 feet thick at the outcrop, and extend- ing under cover at an angle of from 15 to 20 degrees from the horizontal to an unknown depth. Birmingham, Ala., is now the third largest point of export of pig-iron in the world, — Middlesbrough in England being the first, and Glasgow in Scotland the second. Within the eighteen months ending 1st January 1898 there were exported from Birmingham 297,000 tons of pig-iron to all parts of the world. During the year 1899 the production of steel began, in the Birmingham district, one plant producing 9670, tons and another 2263.

To render the waterways available for commerce, the Federal Government has spent millions of dollars. The Mobile river, with its branches, resembles a gigantic tree rising from tidal limits in one of the best harbours on the Giilf of Mexico, and spreading northward, eastward, and westward into Tennessee, Mississippi, and Georgia. The total of mUeage of rivers in use to-day either for commercial purposes or in the process of improvement by the Federal Government, is 2214 miles. On either side the mineral region is pierced by the Warrior and- Coosa rivers, destined soon to be the great highways through which the coal and iron products are to be brought in barges to tidal limits for shipment through the port of Mobile. The deepening of Mobile harbour in the south, the construction of the Muscle Shoals Canal on the Tennessee river in the north, and the improvement of the interior rivers have involved an expenditure upon the part of the Federal Government of about twelve mHlions of dollars, nearly all of which has been appropriated since 1870. The most important part of the work now in progress is the improvement of the Warrior river, the early comple- tion of which has been assured by the action of Congress placiag it under the contract system directed by the sec- retary of war. In order, however, to give an outlet for coal and iron by water from the heart of the best mineral region, it is necessary to cut a canal about 64 miles long from Birmiagham to the Warrior, vid Bessemer. After a careful survey Major Eossell, the Government engineer- in-charge, declared that "the project is both feasible and advisable." A waterway will thus be opened through which coal and iron, mined within 300 miles of tidal limits, can be floated to the sea. Experts estimate that a ton of pig-iron can be loaded at Birmingham and landed at Mobile at 49 cents, a rate 55 cents lower than any yet iq existence. The cost of steam coal at Mobile is now about f 2.80 a long ton, the cost of railway transportation being about f 1.25. After the canal and Warrior route has been made available, a scrupulous estimate places the cost of such coal at Mobile at f 1.50. The railway system of the State has also been steadily developing. The 1602 miles of railway in operation in 1871 had increased to 3560 miles at the close of 1898.

Mobile is the only seaport of the State. The ba;y is about 32 miles long, with an average width of 16 mues. The United States Government has dredged a channel, now 23 feet deep, from the docks to deep water. At the mouth of the bay there is a deep water cup, with a depth of from 30 to 60 feet, and an area of 5 or 6 square miles. The bar separating this deep water from the water of the gulf has a depth of 23-1/2 feet, which has been increas- ing by natural processes since the earliest Government records. Estimates by Government engineers have settled the fact that a channel across this bar can be cut to a depth of 30 feet, with a width of 300 feet, by the excava^ tion of 220,000 cubic yards of material at a cost insignifi- cant when compared with the value of the improvement. If that work is completed, Mobile Bay may be entered at any time by vessels drawing 28 feet — something that can be said of few land-locked harbours.

During the year ending 30th June 1870, 105 vessels of 70,249 tons entered, and 129 vessels of 81,276 tons cleared, in the foreign trade. During the year ending 30th June 1900, 755 vessels of 549,198 tons entered, and 717 vessels of 505,273 tons ijleared. For the year ending 30th June 1901 the total imports were f 3,008,449, and the total exports, $11,837,105. The thirteen mills manufacturing cotton goods in 1870 have been increased to fifty-two, with 813,939 spindles and 18,590 looms, the total capital invested amounting to $16,278,780. The annual output of the cotton oil mills of the State is 139,500 tons, valued at $2,929,500. The lumber and shingle mills, numbering about 1000, repiresent an invested capij;al of $18,700,000, the average output per day for each mill being 15,000 feet. The annual product of rosin and naval stores is valued at $1,150,000.

The number of national banks in operation, 31st Octo- ber 1900, was 30, with paid-up capital of $3,565,000, and outstanding circulation of $1,968,666. The state banks numbered in the same year 62, with a capital and surplus of $3,292,874 ; the private banks 26, with a capital and surplus of $1,021,078 ; and the loan and trust companies 9, with capital and surplus of $869,723.

In 1890 Alabama had 6013 church edifices, and church property valued at $6,768,477. There were 559,171 communicants or members, of whom 258,405 were Bap- tists, 242,624 Methodists, 21,502 Presbyterian, and 13,230 Roman Catholics.

The law establishing a public school system- was en- acted in 1854, but it was twenty years after that date before the period of substantial, permanent growth began. The school term ranges from four to nine months, and tuition is free. Separate schools are provided for children of African descent. The funds for maintaining the public schools are derived from a direct appropriation from the state treasury, a special state school tax, a poll tax, inter- est on the sixteenth section fund, and municipal appro- priations. In 1855 they amounted to $237,516.39. In 1900 the appropriations for common school education amounted to $1,100,000.00. The school age is from seven to twenty-one years. In 1855 the enumeration showed a white school population of 145,588. In 1899 the number was 633,546— white, 350,667; coloured, 282,879. The State is thoroughly committed to the policy of universal education at governmental expense, and is making rapid progress in that direction. Besides the public schools, Alabama has a number of private and denominational in- stitutions of learning of high grade. All the leading denominations are well represented in this number. The amount expended on private and denominational educa- tion annually approximates $300,000.

The special question with which Alabama, in common with her

sister Southern States, is confronted, is the race problem. The constitution of 1875, under which the political supremacy of the white race was re-established, provides (Art. XIII. sec. 1) that a system of public schools shall be maintained throughout the State “for the equal benefit of the children thereof . . . but separate schools shall be provided for the children of citizens of African de- scent.” From that time negro children have been enjoying in their separate schools the equal benefits of an educational fund of approximately one million dollars a year, the bulk of which is pro- duced by taxes contributed by the whites. In spite of this, how- ever, the great mass of negroes, in whose hands rests so large a pro- portion of the political power, have little or no training in the duties of citizenship. In the hope of solving the race problem upon a broad and humane basis a South Conference was formed in Alabama, the first meeting of which was held under brilliant auspices. The chief difficulty is, of course, that of franchise. If it is to be Umited by educational or property qualifications, whatever disabilities may be imposed must rest upon both races alike. If the negro shall be dis- franchised by his illiteracy, he can remove the disability in the schools which the white people of the State maintain for his equal benefit. Such a plan, if adopted as in other Southern States, will result in a gradual and conservative political emancipation.

(h. t.*)

Alabama Arbitration. See Abbitbation, Iit-

TEKNATIONAl.

Alagoas, an Atlantic state of Brazil. Its area covers 22,580 square mUes. The population in 1872 was 348,009, and in 1890, 511,440. The capital is Alagdas Maqeid, and amongst other towns are Camaragibe, Pe- nedd^S. Miguel dos Campos, Pilar, and Porto Calvo. The state has railways from Ma^eid to Muricy and ViQosa, and from Piranhas to the Kio Moxotd. Alag6as Ma- ^i6, with a

population of 30,000, is an important ship- ping port, visited by Transatlaatic steamers, and the ter- minus of the Alagoas railway (55 miles).

Alais, chief town of arrondissement, department of Gard, France, 27 miles N.W. by N. of Nimes, on rail- way from Paris to Nimes, vid the Cevennes. Amongst the public institutions are the municipal chemical labora- tory and two hospitals. Sericulture is extensively en- gaged in, and silk, both raw and manufactured, furnishes a large part of the town's widespread trade. Pasteur here prosecuted his early investigations. A statue has been erected to his memory. The chemist Dumas was a native of Alais. Population (1881), 16,945; (1891),

18,333 ; (1896), 18,249. '

Alajueia, a province of Costa Eica, Central Amer- ica. Its area is 4260, square miles, and the population in 1897 numbered 60,000. The capital is Alajueia, and amongst other considerable towns are San Ramdn, Grecia, Atenas, and Naranjo. The province is divided into seven cantons.

Alajueia, capital of the above province, situated at th£ terminus of the railway line from Limon, 12 miles W. of San Josd, and 23 miles W.N.W. of Cartago. It has some trade with Punta Arenas, 23 miles distant by mule road, and on the formation of the new port on the Pacific at the head of the Gulf of Nicoya will increase in importance. Population, 7000.

Alameda, a residential city of Alameda county, California, U.S.A., is situated in 37° 46′ N. lat. and 122° 16′ W. long., on the east side of San Francisco Bay, di- rectly south of Oakland, and separated from it by San Antonio creek. Its site is low and level and its plan fairly regular. It is entered by the Southern Pacific railway. The population in 1880 was 5708, in 1890 it was 11,165, and in 1900 it was 16,464.

Alantika, Mount. See Cameboon.

Aiarcon, Pedro Antonio de (1833-1891), Span- ish writer, was born on 10th March 1833 at Guadix. He graduated at the university of Granada, studied law and theology privately, and made his first appearance as a dramatist before he was of age. Deciding to follow lit-

erature as a profession, he joined with Torcuato T^rrago y Mateos in editing a Cadiz newspaper entitled HI JEco de Occidente. In 1853 he travelled to Madrid in the hope of finding a publisher for his long continuation of Es- pronceda's celebrated poem, El Diablo Mundo. Disap- pointed in his object, and finding no opening at the capi- tal, he settled at Granada, became a Eadical journalist in that city, and showed so much ability that, in 1854, he was appointed editor of a very advanced journal, JEl Ldtigo, published at Madrid. The extreme violence of his polemic writings led to a duel between him and the Byronic poet, Josd Heriberto Garcia Quevedo. The earliest of his novels. El Final de Norma, was published in 1855, and though its construction is feeble, it brought the writer into notice as a master of elegant prose. A small anthology, called Mananas de Abril y Mayo (1856), proves that Alarcdn was recognized as a leader by young men of promise, for among the contributors were Caste- lar, Manuel del Palacio, and Ldpez de Ayala^ A dra- matic piece. El Hijo prddigo, was hissed off the stage in 1857, and the failure so stung Alarcdn that he enlisted under O'Donnell's command as a volunteer for the war in Morocco. His Diario de un testigo de la guerra de Africa (1859) is a brilliant account of the events of the expedition. The first edition, amounting to fifty thou- sand copies, was sold within a fortnight, and Alarcdn's name became famous throughout the Peninsula. The book is not in any sense a formal history ; it is precisely what its title implies, a series of picturesque impressions told with remarkable force. On his return from Africa Alarcdn did the Liberal party much good service as edi- tor of La Polltica, but his marriage to a devout lady, Paulina

Contrera y Eeyes, in 1866, led him to modify his political views considerably. On the overthrow of the monarchy in 1868, Alarcdn advocated the claims of the. Due de Montpensier, was extremely neutral during the period of the Eepublic, and declared himself a Conserva- tive upon the restoration of the dynasty in December 1874. These political variations alienated Alarcdn's old allies and failed to conciliate the royalists. But though his political infiuence was ruined, his success as a writer was greater than ever. The publication in the Bevista Europea (1874) of a short story, " El Sombrero de tres picos," a most ingenious resetting of an old popular tale, made him almost as well known out of Spain as in it. This remarkable triumph in the picaresque vein encour- aged him to produce other works of the same kind ; yet, though his Cuentos amatorios (1881), his Historietas nacionales (1881), and his Narradones inverodmiles (1882) are pleasing, they have not the delightful gaiety and charm of their predecessor. In a longer novel, El Ea- cdndalo (1875), Alarcdn had appeared as a partisan of the neo-Catholic reaction, and this change of opinion brought upon him many attacks, mostly unjust. His usual bad fortune followed him, for while the Eadicals denounced him as an apostate, the neo-Catholics professed that El Escdndalo was tainted with Jansenism. Of his later volumes, written in failing health and spirits, it is only necessary to mention the Capitdn Veneno and the Historia de mis libros, both issued in 1881. Alarcdn was elected a member of the Spanish Academy in 1875. He died at Madrid, after a long and painful illness, on the 20th of July 1891. The impression which he makes upon the reader is brilliant, but unenduring. His later novels and tales are disfigured by their didactic ten- dency, their feeble drawing of character, and _ even by certain Gallicisms of style. But, at his best, Alarcdn may be read with great pleasure. The Diario de un testigo is still unsurpassed as a picture of campaigning life, whUe " El Sombrero de tres picos " is a very perfect example of malicious wit and minute observation. (j. f. k.)

Alard, Jean Del phi n (1815-1888), a distinguished French violinist and teacher, was born at Bayonne, 8th May 1815, and died at Paris, 22nd February 1888. He was a pupil of the Paris Conservatoire, under Habeneck, from 1827; he succeeded Baillot as professor there in 1843, and retained the post till, 1875. His playing was full of fire and point, and his compositions, consisting mainly of fantasias and such things, had a great success in France, while his Violin School had a wider vogue and considerably greater value.

Ala-shehr, the classical Philadelphia, a town of Asia Minor, in the Smyrna vilayet, situated in the valley of the Kuzu Chai {Oogamus), at the foot of Boz Dagh (M. Tmolus). Philadelphia was a Pergamene foundation, was one of the "seven churches" of Asia, and was called "Little Athens " on account of its festivals and temples. It was an independent, neutral city when taken in 1390 by Sultan Bayazid I., and an auxiliary Christian force under the Emperor Manuel II. The town is connected by railway with Konia and Smyrna. There are small industries and a fair trade. From one of the mineral springs comes a water known in commerce as " Eau de Vals." Population, 22,000 (Moslems, 17,000 ; Christians, 5000).

Alaska. — Alaska, formerly Eussian America, is a territorial district of the United States, occupying the north-western extreme of North America and adjacent islands. The inhabitants of the Aleutian islands called the continental land eastward from tliem Alayeksha, which was corrupted by early Eussian explorers to Aliashka. The name was subseqiiently restricted to the peninsula, and, in the simplified form now adopted, was proposed as a name for the new territory by Charles Sumner in a speech before the U.S. Senate advocating its purchase. The territory of Alaska comprises, first, all that part of continental North America west of the 141st meridian from Greenwich; secondly, the eastern Diomede Island in Bering Strait and the islands of Bering Sea, and the Aleutian chain east of

a line drawn from the Diomedes in a south-westerly direction so as to pass midway between Attu Island of the Aleutian, and Copper Island of the Commander group; lastly, of a narrow strip of coast with its adjacent islands, north of lat. 54° 40′ N., west of Portland Channel, and thence, as designated in the treaty of cession, bounded to the east and north by a line, following ” the summit of the mountains situated parallel to the coast ” ” to the point of intersection with the 141st meridian:,” provided that when this line ” shall prove to be at a dis- tance of more than ten marine leagues from the ocean the limit ” ” shall be formed by a line parallel to the windings of the coast and which shall never exceed the distance of

B.V.Dir O.J.R.H.

Sketch Map of the Albtjtian Islands.

ten marine leagues therefrom.” The islands comprise several main groups : the Alexander Archipelago, extend- ing from the southern boundary north-westward to Cape Spencer ; the Kadiak group, south-east of the peninsula of Alaska ; the Catherina Archipelago, westward from the end of the peninsula to Attu, and is further subdivided into four minor groups — the Fox, Andreanoff, Eat, and Nearer Islands, often collectively designated the Aleutian Islands. Northward from the Aleutian group, in Bering Sea, are the PribilofE or Fur Seal Islands, St Matthew,

and St Lawrence, at subequal distances, and the large island of Nunivak eastward near the coast. The estimated area of the Alexander Archipelago is 31,206 square miles, and of the Aleutians 6391 square miles. The tot^l area of the territory is approximately 580,107 square miles. From north to south it extends about 1200 miles, and from east to west nearly 2400 miles.

The coast-line, omitting minor sinuosities but including the islands, exceeds 16,000 miles. Beginning at the south and proceeding northward and westward the most conspicuous capes are Muzon, Ommaney, Spencer, St Elias, Newenham, Vancouver, Eomanzoff, Prince of Wales (the westernmost point of the continent), Lisburne, Icy Cape, and Point Barrow, the last being the most northern point of the territory and situated in lat. 71° 21′ N. and long. 156’’ 15′ W. Three great peninsulas project from the shores : Kenai, to the east of Cook’s Inlet, the peninsula of Alaska, and the Kaviak peninsula between Kotzebue and Norton Sounds. The great embayment north of a line drawn from Queen Charlotte Islands to Kadiak has been named the Gulf of Alaska. Omitting the inter- stices of the archipelago, Yakutat Bay, Prince William Sound, Cook’s Inlet, are the principal arms of the gulf. The eastern shores of Bering Sea are indented by Bristol Bay, north of the Alaska peninsula, and Norton Sound, south of the Kaviak peninsula; north of the latter Kotzebue Sound is the only inlet of importance.

The entire north-west coast of America is folded by mountain-building forces in general harmony with the trend of the coast. The state of Washington, British Columbia, and south-eastern Alaska have had their s,trata violently and sharply crumpled, the lines of elevation and depression being roughly N.N.W. and S.S.E., with’ occasional transverse depressions. These have been the site of a vast system of glacial action which has deepened and modelled the valleys, though its processes were never carried far enough to cut down and remove the interven- ing ridges. TEe result is what has been aptly termed a ” sea of mountains,” in which the existing glaciers, stupendous as many of them are, are mere tatters of the ice that preceded them. Consequently this coast, unlike that of Norway, which in outline is not dissimilar, is bold, steep, and craggy, with few beaches and hardly level shote enough anywhere to build a cabin on or cultivate a garden patch. Nevertheless the mountain sides are densely wooded with evergreens, the snow-line being at an approximate elevation of 3000 to 5000 feet, according to location. The passages of the archipelago are merely submerged portions of this broken area, and would be reduplicated to the eastward were the level df the land to be still further

depressed. The summits are of unusually even elevation, and, near the sea, present no peaks of remarkable height. North- westward from Cape Spencer the mountain-building forces seem to have been more intense and the ranges of the Fairweather aud St Elias Alps rise to great heights at a short distance from the sea. Mt. Fairweather (15,300 feet), Lituya (12,000), Laperouse (10,750), Cook, Vancouver, St Elias (18,100), and, further inland, Logan (19,500), are the most noteworthy summits of this region. The Muir glacier, the Malaspina, and the Bering glacier flank portions of these mountains and rank next to those of Greenland. These mountains continue westward parallel with the coast and terminate as the backbone of the Kenai peninsula. Parallel uplifts further inland near the meridian of 145° W. rise to great heights. Mt. Tillman has been assigned a height of 16,600 and Mt. Wrangell of 17,500 ; the latter, on somewhat insufficient evidence, has been ranked as a volcano. Still further north and west a range which corresponds in general with the line of the range of the Alaska peninsula further

180* 175» 170′

south and west, and -whicli has been named the Alaskan mountains, culminates in lat. 64° E”. in the peak of Mt M’Kinley, rising over 20,000 feet. Beyond the Alaskan range and its foothills lie broad river valleys, north-westward from which are ranges of comparatively low hills, none of which have been recorded as exceed- ing 3500 feet, and beyond which again stretches the Arctic tundra.

Much of the rock of North-Western Alaska is vol- canic. Along the great line of orographic folding indi- cated by the Alaskan range and the Aleutian chain numerous remarkable volcanic peaks exist, varying in height up to 12,000 feet. Enumerating them from Cook’s Inlet westward, and omitting all cases of doubtful vul- canicity, the most notable are Redoubt Volcano, Iliamna, Augustin, Olai, Chiginagak, Pavloff, Isanotski (extinct), Shishaldin, Akutan, Makushin, Vsevidotf, Atka, Gareloi, and Semisopochnoi, all of which, with the exception noted, emit steam or smoke, or show other evidences of activity. North of the Alaskan range no active volcanoes are at present known.

The transverse depressions of the mountainous continental border are occupied by rivers and continued as straits. Thus the Naas river, just south of the boundary, corre- sponds to the trough of Dixon Entrance and Portland Channel, the Stikine to that of Sumner Strait, the Takii to that of Cross Sound. The summit of the moun- tains at the head of Lynn Canal, sitU|ated about 15 miles from the sea, has an elevation of 2800 feet (White Pass) to 3500 feet (Chil- koot Pass) ; and here only, on the whole extent of the South-Eastern Alaskan coast, is a clear-cut wajier- shed exhibited between the sea^ board and interior drainage. Be- tween the Alexander Archipelago and the peninsula of Alaska but few rivers make their way across the ranges to the sea, chiefly through difficult canyons. The Atna, or Copper river, is the most important of these and reaches the sea just east of Prince William Sound. At the head of Cook’s Inlet a considerable valley is drained by the Knik (Fire) and Sushitna rivers. The latter rises in the Alaskan range. North- westward from the main axis of this range, especially towards the coast of Bering Sea, a number of large lakes exist, giving rise to rivers of some magnitude. West of Cook’s Inlet, over the range, Lake Clark and Lake Iliamna feed the Kvichak river. Another assemblage of many smaller lakes is drained by the Nushagak river. Both empty into Bristol Bay. North of Cape Newenham Ber- ing Sea receives the Kuskokwim, as yet hardly explored, but believed to have a length of 450 miles, chiefly through a rather mountainous country. Next northward in lati- tude about 62° 30’, is the enormous delta of the Yukon, the chief river of Alaska and one of the great rivers of the world. It rises in British Columbia ; the head of the branch called the Lewes river rising within 30 miles of the coast of Lynn Canal. Flowing in a north-westerly direc-

tion it cuts the Alaskan range, forming a canyon called the Upper Ramparts ; a little later it receives the famous

Klondike river from the north-east, and enters Alaska in about lat. 66° N. Just above the Arctic circle, near the site of old Fort Yukon, it turns to the south-west, passes through the canyon of the Lower Ramparts, receives from the south-east a large tributary, the Tanan^ ; 175 miles farther down receives the Koyukuk river from the northward, bends more to the southward, and in about lat. 62° N. turns again to the north-west and debouches through a vast delta into Bering Sea, south of Norton Sound. The total length of the unsurveyed Yukon has been estimated at 2000 miles ; near the delta, in spring, one bank is not always visible from the other. It is navigable for steamers of light draft nearly to its headr waters, navigation opening early in June and closing in October. In the summer of 1899 thirty-five steamers were in active service on its waters. North of Bering Strait a number of rivers fall into the Arctic Sea : of these the most notable are the Selawik, Kowak, and Noatak of

160″ 1*6″ ionJW»»t W(r»f Greenwich 136′

landtnnStmnOnli O^ag/EwtatP

Sketch Map op Alaska.

Kotzebue Sound ; the Meade, Ikpikpung, and Colville of the Arctic coast.

The region now known as Alaska was first explored by the Russian officers Bering and Chirikoff in 1741. They visited parts of the coast between Dixon ^^^^ Entrance and Cape St Elias, and returned along * ”’’ the line of the Aleutians. Their expedition was followed by many private vessels manned by traders and trappers. Spanish expeditions in 1773 and 1775 visited the south- eastern coast and laid a foundation for subsequent terri- torial claims. Cook in 1778 made surveys from which the first approximately accurate chart of the coast was published ; but it was reserved for Vancouver, in 1793-94, to make the first charts, in the modern sense, of the intricate south-eastern coast, which only in recent years have been superseded by new surveys. Owing to excesses committed by private traders and companies, the trade and regulation of the Russian possessions was in 1799

confided to a semi-official corporation called the Russian- American Company for a term of twenty years, afterward twice renewed for a similar period. Alexander Bar^nofE, one of the early administrators, became famous through the successes he achieved as governor. He founded Sitka, the present ca]f)ital, in 1804, after the massacre by the natives of an earlier settlement at an adjacent point. In 1821 Russia attempted by ukase to exclude navigators from Bering Sea and the Pacific Coast of her possessions, which led to immediate protests from the United States and Great Britain. This led to a treaty with the United States in 1824 and one with Great Britain in 1825, by which the excessive demands of Russia were relinquished and the boundaries of the Russian possessions were fixed as at present. . The last charter of the Russian- American Company expired 31st December 1861, and Prince Maksiitoff, an imperial governor, was appointed to ad- minister the affairs of the territory. In 1864 authority was granted to an American company to make explorations for a proposed Russo-American telegraph line overland from the Amur river in Siberia to Bering Strait, and through Alaska to British Columbia. Work was begim on this scheme in 1865 and continued for nearly three years, when the success of the Atlantic cable rendered the building of the line unnecessary and it was

given -up, but not until important explorations, especially of the Yukon region, had been made by Kennicott, Ketchum, Kennan, and Dall.

In 1867 negotiations with the Russian Government resulted in the purchase of Russian America by the United – States for the sum of $7,200,000, and on 18th October 1867 the formal transfer of the territory was made in Sitka. In 1870 the fur seal industry of the Pribiloff Islands was leased for twenty years to the Alaska Commercial Company under certain restrictions, producing for that period an average revenue to the Government of f 317,000. After the expiration of the lease in 1890 a renewal of the monopoly was secured by the Iforth American Commercial Company at an increased rental. Pelagic sealing, which began to be of importance about 1882, made great inroa,ds on the herds during their migrations ; and it was contended that, owing to the killing of fejnale seals in the waters of Bering Sea during the breeding season, the total destruction of this commercially valuable industry was imminent. After protracted negotiations between the United States and Great Britain the subject was referred to arbitrators, who met at Paris in 1893 and deMded that the seals were feroi naturce, but, in view of the interests involved, formulated regulations in the belief that they would mitigate the evils complained of.

In' 1895 the discovery of rich deposits of gold on the Klondike tributary of the Yukon induced a vast immi- gration of prospectprs, not only into British territory but into every part of Alaska, with the usual concomitants of hardship to those involved. Over 50,000 people are believed to have been engaged in this search for the precious metal, and a vigorous exploration of the territory by the United States Government was one of the results. Numerous placers were discovered in the gold belt, which extends in a general line from old Fort Selkirk on the Yukon to Bering Strait, with an average width of about 100 miles. The gold-bearing gravels are chiefly on the smaller tributaries of the Yukon, where numerous mining camps have sprung up with a fluctuating population. In 1898 gold was discovered on the north shore of Norton Sound at Cape Nome, and a year later the settlement of Anvil City in this district was reported to contain a population of 5000, and to have produced during 1899 nearly two millions of dollars.

Alaska may be divided climatologically and topographi-

cally into several districts. The SitJca district takes its shore water mainly from the Japanese current or „. ·^ Kuro Siwo, which performs for the Pacific sudh a function as does the Gulf Stream for the Atlantic ; but owing to the much greater breadth of the Pacific, the heat and energy of the Kuro Siwo are greatly depleted before it reaches America. It crosses the ocean far south of the Aleutian Islands in about lat. 45° N. and impinges on the American coast near Queen Charlotte Islands. Thence one portion turns southward and the other north- ward and westward along the coast, becoming finally dissipated among the Fox Islands. To the warmth and moisture brought by this means the Sitkan district owes its fog and rain (80 to 103 inches per annum), its high mean temperature (43°-28), and its dense vegetation, chiefly of spruce^ hemlock, and cedar. The narrow, deep channels, precipitous wooded slopes, multitudinous islands, and mainland glaciers make this district remarkably picturesque and characteristic, attracting thousands of tourists. It is inhabited by Indians of the HaidaandTlinkit stocks, who live chiefly by fishing and hunting. The prin- cipal settlements are Sitka on Baranoff Island, the capital of Alaska, where the chief officials are stationed ; Douglas, on Douglas Island, a town grown up about the mines of the Treadwell lode, an enormous mass of low grade ore, reduced by mills of 800 stamps and producing nearly $1,000,000 per annum ; Juneau, on the mainland opposite, another mining town fed by the precious metals of the Silver Bow basin adjacent ; and Skagway, at the head of Lynn Canal, the port of entry for the Yukon, which is reached by the Yukon aiid White Pass Railway from Skagway to Lake Bennett, in, Canadian territory. A missionary colony on Annette Island, under the direction of the Rev: Mr Duncan, contains about 900 Indians of the Tsimpsyan stock from British Columbia, and is famous for its thrift and successful

influence iipon these people. Agriculture is difficult in this district, but potatoes and many garden vegetables are successfully grown. The Kadiak district includes Cook's Inlet, the peninsula of Alaska, and the Kadiak islands. It is less densely wooded, with more sunshine, less rain, and greater seasonal extremes of temperature. There is more arable land and the possibilities of agriculture are greater, but the mining resources apparently less. The district exists by its salmon fisheries, the waning fur trade, a few placer and quartz, mines, and a little agriculture. There are large deposits of tolerably good Eocene lignite. The principal settlements are Sunrise City, a placer mining camp at the head of Turnagain arm of Cook's Inlet; St Paul, on Kadiak Island ; and Unga, on the island of the same name, largely supported by the Apollo Mine, the second best quartz mine in Alaska, producing over $200,000 in gold annually. The Alevtian district derives its name from traditions of islands beyond the Oliutorsk Cape of Kamchatka, which related to the Diomedes. When the Russians explored Bering Sea and found the Catherina Archipelago they transferred to it and its people the name of the long-sought Oliutorski Islands. The islands are destitute of trees but covered by a luxuriant growth of herbage, and have a foggy, somewhat boisterous, but less rainy climate than that of Sitka, with about the same mean temperature, very free from extremes. They are inhabited by the Unttngun (long known as Aleuts), a rapidly-decreasing race, half civilized, with many virtues and the usual aboriginal weaknesses. Their chief resource, the sea otter, is nearly exterminated, the fur seal industry in a state of decline, and the people live chiefly by fishing. There are no native land animals larger than the blue fox ; but sea fowl are remarkably abundant, cod and other sea fish plentiful, and salmon obtainable in moderate quantity.

Agriculture is hardly practised, though a few vegetables are raised. The raising of sheep and reindeer is believed to be practicable on the less mountainous islands. The chief settlements are on Unalashka Island, where Dutch Harbour is the principal port for Bering Sea commerce ; Atka, on the island of the same name; and the small settlement of Attu, at the western extreme of the chain. The Yukon district, which may be taken as the vast region north-westward from the Alaskan mountains, has a colder and drier climate than those above mentioned, passing northward into Arctic conditions. The immediate shores are treeless, but the interior is fairly well wooded with spruce, poplar, and birch along the water-courses. The inhabitants of the coasts are Eskimo, of the interior Tinneh, or Athabaskan Indians. The search for gold has brought into the valley of the Yukon and its tributaries a large population of prospectors. The residents depend for substance chiefly upon salmon and white fish, with which the rivers swarm; wild fowl, which are very abundant ; and the continental mammals, chief of which is the wild caribou. Mining for placer gold is the only industry, the fur trade being now unimportant, and there are few salmon canneries. The chief port for the Yukon is St Michael, on Norton Sound, though a large mining camp, caUed Anvil City, has been established at Cape Nome, on the north shore of the sound.

Though forming what is called a judicial and customs district, Alaska is still an unorganized territory, with a governor and some other officials appointed by the president. Since 1884 the people have vigorously worked for the extension of law and the organization of some kind of official system throughout the territory. Until recently these efforts have been but partially successful, but in 1900 a code for the administration of the territory under improved conditions became law. The total population in 1890 was 32,052, of whom 23,631 were natives, 1823 of mixed blood, and 4298 white. Of the natives 6000 were of Haida, Tsimpsyan, and Tlinkit stock; 3400 of the Tinneh tribes, 1000 Aleuts, and 13,100 Eskimo. The annual diminution of the native population (1880-90) was about 2 per cent., and of late the rate is believed to be much more rapid. It is estimated that the white population was in 1900 about 32,000.

The products of the territory have fluctuated with the decline of certain industries and the rise of others. In 1890 they were as follows : —

Fur seal I yearly average f Other fur / for ten yeaxs \ Salmon (cases tinned, 642,175) „ (salted, 18,039 barrels) Cod (salted, 760 tons) Whale oil (12,503 barrels) Whalebone (231,981 tb) . Walrus ivory (5799 lb) . Gold ....

Silver ....

value

#1,744,200

628,400

2,568,700

162,351

38,000

116,250

463,962

3,000

4,604,500

27,340

The. value of gold produced by the territory in 1899 is calculated by the director of the United States Mint to be $4,610,000, and of silver $258,585. The fur seal skins taken in 1887 on the Pribiloff Islands numbered 106,000 ; those taken by the pelagic sealers, 20,628. In 1897 the PribUoffs could furnish only 19,200, while the pelagic catch was 24,321. The continental fur trade is waning, and, owing to competition, less profitable than formerly. The whale fishery, now carried on only for the baleen, as there is no profit on the oil, is reduced to eight vessels. The salmon and cod fisheries are reasonably prosperous. Mining has taken a great stride in advance, especially for the precious metals, and the prospect of valuable copper mines in the Prince William Sound region is believed to be good.

See Whtmpeb. Travels in Alaska and on the Yukon, 1868. — Dali,. Alaska and its Besources, 1870. — Banoropt. History of Alaska, 1886. — Shepard. Cruise of the “Bush,” 1889.— U.S. Senate ex. doc. 146. Beport on the Boundary line between Alaska and British Columbia, 1889. — Welcome. The Story of Met- lakahtla, 1887. — Scidmore. Alaska and the Sitkan Archipelago, 1885. — U.S. Coast Survey. Meteorology and Bibliography of Alaska, 1879 ; Coast Pilot of Alaska, 1883.— U.S. Geological Survey (Dall) — Coal and Lignite of Alaska, 1896 ; (Beokbr) — Ooldfields of Southern Alaska, 1898 ; Map of Alaska, with descrip- tive text, 1898. — Dall. Bemains of Prehistoric Man in Alaska, 1878 ; Tribes of the Extreme North-West, 1877 ; Alaska as it was and is, 1895. — U.S. State Department (D. S.Jordan) — Fur Seals and Fur Seal Islands of the North Pacific, 1898-99.

(w. H. D.)

Ala’tau {Variegated Mountains) is the name of three different inountain ranges in the Russian dominions in Asia: (1) the Kuznetsk Ala^-tau is on the frontiers of Tomsk and Yeniseisk (g.u) ; (2) the Dzungarian Ala-tau is in the province of Semiryechensk {q.v.); and (3) the Trans-Hi Ala-tau is in Turkestan {q.v.).

Alatyr, a district town of Eussia, in the government and 107 miles N.W. of Simbirsk, on the Sura, a tributary of the Volga, in steamer communication with Vasilsursk on the Volga, and by rail with Kazan (153 miles). It does considerable trade in com and has some historically important monasteries. Population (1897), 11,090. The important river port of Promzino Gorodische (4350) is in its district.

A lava, a province in the north of Spain — one of the Spanish Basque Peovinges, q.v. — with an area of 1200 square miles. The couutship of Trevino (190 square mUes)’, in the centre of the province, belongs to the province of Burgos. Population (1897), 94,642. There are two admin- istrative districts and eighty-five parishes. Few provinces in Spain are inhabited by so laboriotls, active, and well- to-do a population. The primary schools are numerously attended, and there are very good normal schools for teachers of both sexes, and a model agricultural farm. The public roads and other works of the province are excellent, and, like those of the rest of the Basque provinces, entirely kept up by local initiative and taxes. Railways from Madrid to the French frontier, and from Castej on to Bilbao, both cross this province. The climate is mild in summer, fitful in autumn and spring, and very cold in winter, as even the plains are a high plateau surrounded on three sides by mountains always snowclad during several months. Asphaltic stone is quarried, and there are mineral waters at many places. The local industries are of some impor- tance since 1880 — foundries, manufactures of beds, furni- ture, railway carriages, matches, paper, sweets, woollen and cotton goods. Breadstuffs, colonial products, machinery are largely imported. The live stock in the province includes 7552 horses, 2844 mules, 1447 donkeys, 22,716 cattle, 68,066 sheep, 14,614 goats, and 21,355 pigs. Wheat is grown on 49,955 acres ; oats, barley, rye, and maize on 28,075; vines on 36,000; and olives on 1795. Only four mines are actually worked ; lead, blende, and lignite are produced.

Albacete, a province in the S.E. of Spain, with an area of 5971 square miles. Population (1897), 233,005. It is divided into eight districts and eighty ~~three parishes. The state and provincial roads are not in very good con~~ dition, and the municipal ones are worse. The climate is temperate in the mountainous parts of the Jurre Alcaraz district and in lower regions, but it is cold for months in the ranges that have peaks several thousand feet high; the rich and fertile valleys and some plains are most thickly peopled. The live stock in the province includes 1987 horses, 16,461 mules, 15,252 donkeys, 2410 cattle, 187,853 sheep, 50,687 goats, 22,113 pigs. Wheat

is grown on 342,415 acres, other cereals on 249,500 acres, vines on 98,630, and olives on 26,738. Two salt-mines are worked, and there are important lagoons.

Albacete, the^capital of the above province, has a station on the Madrid-Alicante line. Modern erections

are, besides other buildings, the town hall, courts of jus- tice, barracks, and provincial council palace. There are an institute, schools for teachers of both sexes, seven municipal and fifteen private schools. Matches are in- cluded in the manufactures. The population was 18,589 in 1887, and 21,637 in 1897.

ALBAIS^IA.

ALBANIA, a portion of the Turkish Empire extend- ing along the western littoral of the Balkan penin- sula from the southern frontier of Montenegro to the northern confines of Greece, is perhaps the least known region in Europe; and though more than a hundred years have passed since Gibbon described it as ” a country within sight of Italy, which is less known than the in- terior of America,” but little progress has yet been made towards a scientific knowledge of this interesting land and its inhabitants. The wild and inaccessible character of the country, the fierce and lawless disposition of the people, the difficulties presented by their language and their complex social institutions, and the inability of the Turkish authorities to afford a safe conduct in the remoter districts, combine to render Albania almost a terra in- cognita to the foreign traveller, and many of its geo- graphical problems still remain unsolved. The region of the Mirdites, the Mat district, the ■ neighbourhood of Dibra, and other localities have never been thoroughly explored. The northern boundary of Albania has under- gone some alteration in consequence of the enlargement of Montenegro, sanctioned by the Berlin Treaty (13th July 1878) ; owing to subsequent arrangements providing for the cession of Dulcigno to Montenegro (25th Novem- ber 1880) in exchange for the districts of Plava and Gusinye, restored to Turkey, the frontier-line (finally settled December 1884) now ascends the JBoyana from its mouth to Lake Sass, thence passes northward, and cross- ing Lake Scutari separates the district of Kushka Kraina on the N. from the territories of the Hot and Klement tribes on the S. ; leaving Gusinye and Plava to the S.E., it turns to the N.W. on reaching the Mokra Planina, and then follows the course of the Tara river. On the S., Albanian territory has been curtailed owing to the acquisi- tion of the Arta district by Greece (May 1881), the river Arta now forming the frontier. On the E. the chains of Shar, Grammos, and Pindus constitute a kind of natural boundary which does not, however, coincide with ethnical limits, nor with the Turkish administrative divisions. Albania is inhabited by six different races : Albanians (who form the great majority), Serbs, Bulgars, Greeks, Vlachs, and Turks, togetifier with an inconsiderable num- ber of gypsies and Jews. The larger portion of the interior is occupied by a fairly compact Albanian popular tion. Since about the year 1870 there has been a remark- able advance of the Albanians in a north-easterly direc- tion towards Prishtina, Vrania, and Uskiib, the invaders inflicting much injury on the Serb and Bui gar inhabit- ants. Servian settlements exist in various parts of Northern Albania ; there is a strong Bulgarian colony in -the neighbourhood of Dibra and Ochrida; farther south. Mount Zygos and the Pindus range — the “Great Wallachia ” of the middle ages — are inhabited by Vlakhs or Tzintzars; several Turkish settlements are found in the south-eastern districts, while in Southern Epiros there is a large admixture of the Greek element. North-western Albania forms part of the Turkish vilar yet of Kossovo; the northern highlands are included in the vilayet of Shkodra (Scutari), the eastern por- tion of Central Albania belongs to the vilayet of Mon-

astir, and the southern districts are comprised in the vilayet of lannina. The boundaries of the three last- named vilayets meet near Elbassan. The name Albania (“in the Tosk dialect Arberia, in the Gheg Arhenla), like Albania in the Caucasus, Armenia, Albany in Britain, and Auvergne (Arvenia) in France, is probably connected with the root alb, alp, and signifies ” the white or snowy uplands.” ‘

The mountain system is extremely complex, especially that of the northern region. On the E. the great Shar range, extending ia a south-westerly direction from the neighbourhood of Prishtina to that of Z^’^J, Dibra, is continued towards the S. by the ranges of Grammos and Pindos : the entire chain, a pro- longation of the Alpine systems of Bosnia and Dalmatia, may be described as the backbone of the peninsula; it forms the watershed between the Aegean and the Adri- ‘ atic, and culminates in the lofty peak of Liubotrn, near Kalkandele, the highest summit in South-Eastern Europe (3050 metres). The country to the W. of this natural barrier may be divided geographically into three dis- tricts— ^Northern, Central, and Southern Albania. The river Shkumb separates the northern from the central district, the Viossa the central from the southern. The highland region of Northern Albania is divided

into two portions by the lower course of the Drin ; the mountains of the northern portion, the Bieska Malziis, extend in a confused and broken series of ridges from Scutari to the valleys of the Ibar and White Drin; they comprise the rocky group of the Prokletia, or Accursed Mountains, with their numerous ramifications, including Mount Velechik, inhabited by the Kastrat and Shkrel tribes, Bukovik by the Hot, Golesh by the Klement, Skulsen (2296 metres), Baba Vrkh (a,bout 2227 metres), Maranazh near Scutari, and the Bastrik range to the E. South of the Drin if another complex mountain system, including the highlands inhabited by the Mirdites and the Mat tribe; among the principal summits are Deia Mazzuklit, Mal-i Velesh, Kraba, and Toll. Central Albania differs from the northern and southern regions in the more undu- lating and less rugged character of its surface ; it contains considerable lowland tracts, such as the wide and fertile plain of Musseki, traversed by the river Simen. The principal summit is Tomor (2413 metres), overhanging the town of Berat. Southern Albania, again, is almost wholly mountainous, with the exception of the plains of lannina and Arta ; the most . noteworthy feature is the rugged range of the Tehika, or Khimara mountains, which skirt the sea-coast from S.W. to N.E., terminat- ing in the lofty promontory of Glossa (ancient AJcro-keraunia). Eurther inland the'Mishkeli range to the N.E. of Lake lannina and the Nemertzika mountains run in a parallel direction. In the extreme S., beyond the basin of the Kalamas, the mountains of Suli and Olyzika form a separate group. The rivers, as a ' rule, flow from E. to W. ; owing to the rapidity of their descent none are navigable except the Boyana and Arta in their lower courses. The principal rivers are the Boyana, issuing from Lake Scutari, and consequently regarded as a continuation of the Montenegrin Moratcha,

the Drin, formed by the confluence of the White arid Black Di'in, which flowing respectively to the S. and N. through a long valley at the foot of the Shar range, take a westerly direction after their junction, the Matia, the Arzen, the Shkumb (anc. Genusos), the Siinen {a,uo. Apsos), formed by the junction of the Devol and Ergene, the Viossa (anc. Adiis), which owing to the trend of the Chi- mara range takes a north-westerly direction, the Kalamas (anc. Thyamis), and the Arta (anc. Arachthos), flowing S. mto the Ambra- cian Gulf. A portion of the stream of the Drin has recently found its way into the Boyana channel ; the result has been a rise in the level of Lake Scutari and the inunda- tion of the adjacent lowlands. A proposal to confine the Drin to its former course by means of a dyke, and to ease the downflow of the Boyana by a canal opening navigation to Lake Scutari, has long been considered by the Turkish authorities. The great lakes of Scutari (350 sq. kil.) and Ochrida (270 sq. kil.) are among the most beautiful in Europe ; the waters of the latter, which find an outlet in the Black Drin, are of marvel- lous clearness. Lake Malik, to the S.W. of Ochi'ida, is drained by the Devol. The waters of the picturesque Lake lan- nina (61 sq. kil.) find an issue by leata- bothra, or underground channels, into the Ambracian G-ulf. The lake of Butrinto (anc. Buthrotum) is near the sea-coast op- posite Corfu!

The climate is healthy in the uplands, though subject to violent changes ; in the valleys fever is very prevalent, especially in the basins of the Boyana, the lower Drin, and the Simen. The winter is short, but exceedingly cold ; snow remains on the Pro- kletia and other mountains till August, and sometimes throughout the year. The sum- mer temperature in the plains is that of southern Italy ; in the mountain districts it is high during the day, but falls almost to freezing-point at night. The searcoast is exposed to the fierce bora, or north wind, during the spring.

The mountains of Albania are said to be rich in minerals, but this source of wealth remains practically unexplored. Iron and coal are probably abun- dant, and silver-lead, copper, and antimony are believed to exist. Gold mines were worked in antiquity in the Drin valley, and silver mines in the

Mirdite region- were known to the Venetians in the middle ages. At Selinitza, near Avlona, there is a remark- able deposit of mineral pitch which was ex- tensively worked in Roman times ; mining operations are still carried on here, but in a somewhat primitive fashion. The splendid forests, of which there are 70,000 square acres in the vilayet of Scutari alone, are undergoing a rapid process of destruction, as in other lands under Turkish rule. The principal trees are the oak, the valonia oak, the beech, ash, elm, plane, celtis, poplar, and walnut, which give way in the higher re- gions to the pine and fir. The oak forests near Dibra, where charcoal-making is a considerable industry, and the beech-woods of the Prishtina district, are especially re- markable. The sumach is largely grown in the Mirdite

district ; its leaves are exported to Trieste for use in tan- neries and dyeworks. In 1898 the export of valonia was estimated at 280,000 francs, of sumach at 60,000 francs. Of fruit-trees the white mulberry, cherry, and wild pear are plentiful ; the chestnut and walnut are sometimes met with, and the olive is grown in the lowland and mari- time districts. The exportation of olive oil in 1898 was

Natural products.

Sketch Map of Albania.

valued at 600,000 francs. The greater part of the country is admirably ‘suited to viticulture, and wine of tolerable quality is produced. Tobacco is grown exten- sively in Southern Albania, especially near Berat and in the upper valley of the Viossa; but the quantity ex- ported is small. The means of subsistence are mainly provided by the cultivation of grain and cattle-rearing. Notwithstanding the primitive condition of agriculture,

the deficiency of commiuiications, and the damage caused by frequent inundations, Albania furnishes almost the entire corn supply of the Dalmatian coast and islands. Maize is the favourite grain for home consumption, but considerable quantities of this cereal, as well as barley, rye, and oats, are exported. The total export of cereals m 1898 was valued at 1,770,000 francs. Sheep and goats form almost the only wealth of the mountaineers of Northern Albania; large cattle are found only on the plains. The slopes of Pindos afford excellent pasture for the flocks of the Vlakh shepherds. The export of raw hides and wool is considerable ; the former was estimated in 1898 at 2,260,000 francs, the latter at 600,000 francs. The lakes and rivers of Albania abound in fish. The scoranze, a kind of sardine, is taken in great quantities in Lake Scutari ; it is salted and smoked for home consump- tion and exportation. Sea fishing is almost wholly ■neglected. There are salines at Avlona and other places on the coast.

The exports in 1898 were estimated at 12,000,000 francs, the imports at 34,000,000 francs, the former <;omprising

agricultural produce, live stock, hides, wool, Commerce cheese, eggs, poultry, olive oil, valonia, sumach industries, leaves, timber, skins of wild animals, silk,

tobacco, and salted fish, the latter manufactured articles, cloth, hardware, furniture, firearms, gunpowder, sugar, coffee, etc. The monopoly of Albanian commerce formerly possessed by Venice has descended to Austria- Hungary ; the trade with other countries, except Italy, is inconsiderable. Owing to the poverty of the people, cheap Austrian goods find a readier sale than the more expen- sive and solid British manufactures. The maritime traf- fic is largely conducted by the steamers of the

subsidized Austrian-Lloyd company, Trieste being the principal commercial centre ; the coasting trade is carried on by small Greek and Turkish sailing vessels. The trade of the northern and western districts has to some extent been diverted to Salonika since the opening of the rail- ways from that town to Mitrovitza and Monastir. The development of commerce is retarded by lack of communi- cations ; the country possesses no railways and few roads. Several railway lines have been projected, but there is no great probability of their construction under existing political conditions. The Via Egnatia, the great Roman highway to the east, is still used ; it runs from Durazzo (Dyrrhachium) to Elbassan and Ochrida. lannina is con- nected by carriage-roads with Monastir, Agii Saranta, and Preveza. As a rule, however, bridle-paths supply the only means of communication. The native industries are inconsiderable, and many of them are in a languishing condition. The manufacture of highly ornate firearms, yataghans, and other weapons at Scutari, Gyakovo, and Prizren has declined, owing to the importation of modern rifles and revolvers. Gold and silk embroidery, filigree work, morocco, and richly-braided jackets are produced for home use and for sale in Bosnia, Macedonia, and Montenegro.

The population of Albania may be estimated at between 1,600,000 and 1,500,000, of whom 1,200,000 or 1,100,000

are Albanians. Of the other races the Slavs ttan”’” (Serbs and Bulgars) are the most numerous,.

possibly numbering 250,000. There is a con- siderable Greek-speaking population in Epiros (including many Mahommedan Albanians), which must, however, be distinguished from the genuine Greeks of lannina, Pre- veza, and the extreme south ; the latter may be estimated at 100,000. The Vlakhs, mainly in the Pindos district, possibly number 70,000. The population of the vilayet of Scutari is given as 322,000, or 28 per square kilometre ; that of the vilayet of lannina as 648,000, or 33 per square kilometre. The principal towns are Scutari (Albanian

Shkdder, with the definite article Shkdder-a), the capital of the vilayet of that name, pop. 37,000; Prizren, 30,000; lannina (often incorrectly written loannina), capital of the southern vUayet, 25,000; Gyakovo, 25,000; Dibra, 20,000 ; Ipek (Slav. Fetch), 15,000 ; Berat, 15,000 ; Ochrida, 15,000; Tirana, 12,000; Argyrokastro, 11,000; Kortcha (Slav. Goritza), 10,000; Elbassan (perhaps anc. Albano- polis), 8000 ; Metzovo, 7500 ; Preveza, 6500 ; and Kroia, the ancient fortress of Skanderbeg, 5000.

The Albanians are apparently the most ancient race In South- Eastem Europe. History and legend afford no record of their arrival in the Balkan peninsula. They are probably the descend- ants of the earliest Aryan immigrants, who were represented in historical times by the kindred lUyrians, Macedonians, and Epirots ; the Macedonians and Epirots are believed by Hahn to have formed the core of the pre-hellenic Tyrrheno-Pelasgian population which inhabited the southern portion of the peninsula and extended its limits to Thrace and Italy. The Illyrians were also ” Pelasgian,” but in a wider sense. Of these cognate races, which are described by the Greek writers as barbarous or non-hellenic, the Illyrians and Epirots, he thinks, were respectively the progenitors of the Qhegs, or northern, and the Toslcs, or southern, Albanians. The Tia Egnatia, which Strabo (vii. fragment 3) describes as forming the boundary between the Illyrians and Epirots, practically corresponds with the course of the Shkumb, which now separates the Ghegs and the’Tosks. The same geographer (v. 2, 221) states that the Epirots were also called Pelasgians ; the Pelasgian Zeus was worshipped at Dodona (Homer, 11. xvi. 234), and the neighbourhood of the sanctuary was called Pelasgia (Herodotus, ii. 66). The name Tosk is possibly identical with Tuscus, Etruscus, while the form Tyrrhenus perhaps survives in Tirana. The large number of Slavonic local names in Albania, even in districts where no trace of a Slavonic population exists, bears witness to an extensive Servian or Bulgarian immigration in the early middle ages, but the original inhabitants appear to have gradually

ousted the in- vaders. The determination with which titis remarkable race has maintained its mountain stronghold through a long series of ages has hitherto met with scant appreciation in ‘the outside world. While the heroism of the Montenegrins haSsbeen lauded by writers of all countries, the Albanians — it we except Byron’s eulogy of the Suliots — still carent vate sacro. Not less noticeable is the tenacity with which isolated fragments of the nation have preserved their peculiar characteristics, language, customs, and traditions. The Albanians in Greece and Italy, though separated for six centuries from the parent stock, have not yet been absorbed by the surround- ing populations.

The Albanians, both Ghegs and Tosks, call themselves Shkyipetar, and their land Shlcyipenia or Shkyiperia, the former being the Gheg, the latter the Tosk form of the word. Shkyipetar has been variously interpreted. According to Hahn it is a participial from shkyipoy ” I understand,” signifying ” he who knows ” the native language ; others interpret it as “the rock-dweller,” from shkep, shkip, “rock.” The designations Arber (Greek Ap^avtTtjs, Turkish Arnaout) denoting the people, and Arbenia or Arberia the land, are also, though less frequently, used by the Albanians. The Tosk form Arberia strictly applies only to the mountain district near Avlona. The region inhabited by a more or less homogeneous Albanian population may be roughly marked out by a line drawn from the Montenegrin frontier at Berane to Leskpyatz in Servia, thence to Vrania, Uskiib, Prilep, MonastirTPlorina, Kastoria, lannina, and Parga. These limits, however, are far from including all the members of a widely-scattered race. The Albanians in Greece, whose settlements extend over Attika, Bceotia, the district of Corinth, and the Argo- lid peninsula, as well as Southern Euboea and the islands of Hydra, Spetzse, Poros, and Salamis, descend from Tosk immigrants in the 14th century. They played a brilliant part in the war of independence, and to-day supply the Greek army with its best soldiers. They were estimated by Leake at 200,000. A large number still speak the Albanian language ; many of the older men, ajid a con- siderable proportion of the women, even in the neighbour- hood of Athens, are ignorant of Greek. The Albanian settlements in Southern Italy and Sicily were founded in

1444, 1464, and 1468; minor immigrations followed in the three succeeding centuries. In Southern Italy there are 72 Albanian communes, with 154,674 inhabitants ; in Sicily 7 communes, with 52,141 inhabitants. The Italian and Sicilian Albanians are of Tosk descent, and many of them still speak a variation of the Tosk dialect. There are also several Albanian settlements in European Turkey and Asia Minor, some founded by military colonists who received grants of land from successive sultans, others owing their origin to enforced migrations after insurrec- tions in Albania. The only genuine division of the Albanian race is that of Ghegs and Tosks ; the Liaps, who inhabit the district between the Viossa and the sea, and the Tshams or Chftms, who occupy the coast-land south of the Kalamas, are subdivisions of the Tosk family. The name Gheg {Qege-a) is not adopted by the Ghegs them- selves, being regard.ed as a nickname; the designation Tosk (TosM-d) is restricted by the Tosks to the inhabit- ants of a small region north of the lower Viossa (Toskeria). While the other primitive populations of the peninsula were either hellenized or latinized, or subsequently

absorbed by the Slavonic immigration, the National Albanians to a great extent remained unaffected taMcs’**’’ ^y foreign influences. Eetaining their original

language and preserving the customs and institutions of remote antiquity, they present a distinct type, and differ in many essential particulars from the other nations of the peninsula. The Ghegs, especially, notwithstanding their fierce and lawless character, their superstition, ignorance, and

predatory propensities possess some noteworthy qualities rarely found in Eastern Europe : simple, brave, faithful, and sometimes capable of devoted attachment, these wild mountaineers make excellent soldiers and trustworthy retainers ; they have long fur- nished a bodyguard to the sultan, and are much employed as kavasses and attendants at foreign embassies and consulates in the East. The native disposition of the Tosks has been modified by intercourse with the Greeks and Vlakhs ; while the Gheg devotes his attention ex- clusively to fighting, robbery, and pastoral pursuits, the Tosk occasionally occupies himself with commercial, industrial, or agricultural employments ; the Gheg is stem, morose, and haughty, the Tosk lively, talkative, and affable. The natural antipathy between the two sections of the race, though less evident than in former times, is far from extinct. In all parts of Albania the vendetta (gyah) or blood-feud, the primitive lex taJionis, is an established usage ; the duty of revenge is a sacred tradition handed down to successive generations in the family, the village, and the tribe. A single case of homicide often leads to a series of similar crimes or to protracted warfare between neighbouring families and communities ; the murderer, as a rule, takes refuge in the mountains from the avenger of blood, or remains for years shut up in his house. It is estimated that in con- sequence of these feuds scarcely 75 per cent, of the population die a natural death. A truce (bessa : literally “faith, pledge”), either temporary or permanent, is sometimes arranged by mediation or, among the Ghegs, by the intervention of the clergy; a general bessa has occasionally been proclaimed by special irad^ of the sultan, the restoration of peace being celebrated with elaborate ceremonies. So stringent are the obligations of hospitality that a household is bound to exact reparation for any injury done to a guest as though he were a member of the family. No traveller can venture into the mountain districts without the bessa of one of the inhabit- ants ; once this has been obtained he wiU be hospitably welcomed. In some districts there is a fixed price of blood; at Argyrokastro, for instance, the compensation

paid by the homicide to the relatives of his victim is 1200 piastres (about £10), at Khimara 2000 piastres ; once the debt has been acquitted amicable relations are restored. Notwithstanding their complete subjection, women are treated with a certain respect, and are often employed as intermediaries in the settlement of feuds ; a woman may traverse a hostile district without fear of injury, and her bessa will protect the traveller or the stranger. Women accompany their male relatives to the battlefield for the purpose of tending the wounded and carrying away the dead. The bride brings no dowry to her husband ; she is purchased at a stipulated price, and earnest-money is paid at the betrothal, which usually takes place while the contracting parties are still children. It is customary for young men who are attached to each other to swear eternal brotherhood (compare the Slavomc pobratimstvo) ; the contract is regarded as sacred, and no instance has been known of its violation. The costume of the Tosks differs from that of the Ghegs ; the distinctive feature of the former is the white plaited linen fustanella or petti- coat, which has also been adopted by the Greeks ; the Ghegs wear trews of white or crimson native cloth adorned with black braid, and a short, close-fitting jacket, , which in the case of wealthy persons is embellished with gold lace. The fez is worn by both races, and in the northern highlands yataghans and firearms are almost invariably carried. The costume of the Mirdite and Mat tribes is peculiar. It consists of a sheepskin cap, a long white tunic bound with a red girdle, white linen trousers, and opinki, or sandals.

The tribal organization in Northern Albania is an in- teresting survival of the earliest form of social combina- tion; it may be compared in many respects with that which existed in the Scottish highlands J’J^ in the time of the Stuart kings. The practical autonomy which the Gheg mountaineers enjoy has been won by a prolonged and successful resistance to Turkish domination ; as a rule they pay no taxes, they are exempt from the conscription, they know nothing of the Ottoman law, and the few Turkish oflB.cials established amongst them possess no real authority. Their only obligation to the Turkish government is to furnish a contingent in time of war; the only law they recognize is either traditional custom {adit) or the unwritten Kanun-i Leks Dukajinit, a civil and criminal code, so called

from its author, Leka Dukajini, who is supposed to have lived in the 13th or 14th century. The tribe or mal (” mountain “) / is often composed of several clans (phis-i phdred) or baryaks (literally ” standards “) each under a chief or baryahtar (standard-bearer), who is, strictly speaking, a military leader ; there are in each clan a certain number of elders- or voivodes (Albanian kru-ye, pi. krene-te) who form a council and, like the baryaktar, hold their of&ce by hereditary right ; they preside over the assemblies of the tribesmen, which exercise the supreme legislative power. The clan is generally subdivided into smaller communities (mahaU), each administered by a local notable or gyobar. The gyobars superintend the execution of this laws, collect fines, and administer capital punishment; they are in contact with the buluk-pashi, or resident representative of the tribe at Scutari, who forms the only link between the mountaineers and the Turkish government. lie com- municates to the tribesmen the orders of the Vali, which must be framed in accordance with their customs and institutions. The tribes of Northern Albania, or Ghegeria, may be classified in seven groups as follows : — (1) The Mirdites, who inhabit the alpine region around Orosh to the south-east of Scutari — the most important of all in respect of numbers (about 26,000) and political inde- pendence. A Catholic tribe, occupying an inaccessible

district, they have hitherto defeated every effort of the Turks to encroach on their autonomy. Their i hereditary chiefs or capidans, belong to the family known as Bera e Gyon Markut (the house of John Marco) which is said to be’ descended from Skanderbeg. In 1868 the reigning chief, Bib Doda, died, and his son and successor Prenk was detained as a hostage by the Turks. The Mirdites consequently refused to contribute their customary con- tingent to the Turkish army, and eventually Prenk was restored. His ambiguous conduct, however, led to the despatch of two expeditions against the Mirdites and the devastation of their territory. In 1880 Prenk was kid- napped by the Tiirkish authorities and exiled to Anatolia ; another member of the ruling family was appointed kaimakam, but the Mirdites refused to obey him, and their district has ever since been in a state of anarchy. No Moslem is allowed to remain in Mirdite territory, (2) The Mi-shkodrak (Upper Scutari) group or confedera- tion, also known as the MalsiarMadh^ (Great Highlands) is composed of the Klement, Grud-a Hot, Kastrat, and Shkrel tribes, which occupy the mountainous district north-east of Scutari. Owing to the proximity of the capital this group is comparatively subject to the Turkish power, and pays a small annual tribute ; the chiefs, who assess and collect the, tribute, form a kind of administra- tive council ; the confederation has also an official repre- sentative council at Scutari, called the Jibed, under the presidency of a Serkardi or Moslem oflcial. (3) The Du- kajin, whose territory lies between that of the last-named group and the Mirdite country, include the Pulati, Shalla, Shoshi, and other tribes; they are more independent and more savage than the Mi-shkodrak, and have never paid tribute from time immemorial. (4) The Puka group, known as ” the Seven Baryaks of Puka,” dwell farther to the east ; they are nominally administered by a Turkish kaimakam, who is a mere spectator of their proceedings. (5) The Malsia Gyakovs, a group of two Catholic and three Moslem tribes, extend in the direction of Gyakovo, where they maintain an official representative ; they are entirely exempt from taxation. (6, 7) The Malsia-Lezhs, who occupy the Alessio highlands, and the Malsia Krues, who inhabit the region north of Kroia, live in a state of extreme poverty and pay no tribute ; the latter are much addicted to brigandage. To these seven groups, which are included under the general appellation of Malissori, or ” highlanders,” may be added the Malsia of Dibra, who extend to the west and north of that town, and form a large separate group ; they are notorious for their fierce lawless character, and maintain themselves by plunder- ing the Bulgarian peasants in their neighbourhood, In general the attitude of the Albanians in the north-western districts towards the Slavonic peasantry may be compared with that of the Kurds towards the Armenians. In Central Albania the Mat tribe, which occupies the upper valley of the Matia, presents an entirely different

organi- zation ; their district is governed by four wealthy families possessing hereditary rank and influence. Towards the south the tribal organization becomes looser and is grad- ually supplanted by a kind of feudal system; among the powerful aristocratic houses may be mentioned the Vliores at Avlona, who are stated to own 400 square kilometres of land, and the Toptans at Tirana. The principal landowners, who reside in fortified houses, are all Moslems ; their estates are cultivated on the metayer system. Since the time of Ali Pasha, who broke the power of the local chieftains, Southern Albania has been subject to the central Turkish power; before that period the mountaineers of Suli and Khimara enjoyed an inde- pendence similar to that of the Gheg tribes.

The great majority of the Albanians, probably more

than three-fifths, are Moslems. The conversion of the Christian population to Islam appears to have taken place during the 16th and 17th centuries. «”«”””*■ Like the Cretan Moslems and the Bulgarian Pomaks, the Albtoian Mahommedans retain many Christian traditions and customs; it is- said that many thousands of them secretly adhere to their original faith. In the vilayet of Scutari they form more than 60 per cent, of the popula- tion ; Central Albania is almost entirely Moslem ; in South- ern Albania, however, there is a considerable Christian population, whose limits practically coincide with those of the Greek-speaking districts. Of the Christian Albanians (about 480,000) some 100,000 are Catholics, almost all belonging to the Gheg tribes of the north ; the remainder, including a small proportion of the Tosks, and nearly all the Greeks, Slavs, and Vlakhs, are of the Orthodox Church. The Catholic Ghegs appear to have abandoned the Eastern for the Western Church in the middle of the 13th century. Their bishops and priests, who wear the moustache in deference to popular prejudice, are typical specimens of the church militant. Some of the Gheg tribes, such as the Puka, Malsia, Gyakovs, and Malsia Krues, are partly Catholic, partly Moslem; among fellow-tribesmen the difference of religion counts for little. The Mirdites are exclusively Catholic, the Mat-i exclusively Moslem. At the head of the Catholic hierarchy are the archbishops of Scutari (with three suffragans), Prizren, and Durazzo; the mitred abbot of St Alexander is the spiritual chief of the Mirdites. The Orthodox Church has metropolitans at Prizren, Durazzo, Berat, lannina, and Kortcha; the Bulgarian exarchate maintains a bishop at Dibra. Of the Albanians in Sicily the great majority (44,791) re- main faithful to the Greek Church; in Italy 116,482 follow the Latin ritual, and 38,192 the Greek. All the Albanians in Greece belong to the Orthodox Church.

Education is almost non-existent, and the vast majority of the population, both Christian and Moslem, are totally illiterate. Instruction in the Albanian language gj„ga^/„„ is prohibited by the Turkish Government for political reasons ; a single exception has been made in the case of an American school for girls at Kortcha. There are Turkish primary and secondary schools in some of the towns ; in the village mosques instruction in the Koran is given by the imtms, but neither reading nor writing is taught. The aristocratic Moslem families send their sons to be educated in Constantinople or Vienna. At Scutari a college and a sfcminary are maintained by the Jesuits, with the aid of the Austrian Government ; the Franciscans have several primary schools, and three lay schools are supported by the Italian Government : in all these insti- tutions Italian is the language of instruction. There are two Servian seminaries at Prizren. In Southern Albania there are Greek schools iq the towns and a large Greek gymnasium at lannina. The priests of the Greek Church on whom the rural population depend for instruction, are often deplorably ignorant. The merchant families of lan- nina are well educated ; the dialect spoken in that town is the purest specimen of colloquial Greek.

Albania has never had a national history, owing to the want of unity and cohesion amongst its inhabitants; even the heroic resistance of Skanderbeg to the Turks (1443-67) can hardly be described as a great tistonr. national effort. The surrender of Scutari in 1478 marked the end of Venetian supremacy in Upper Albania; many of the native Christian defenders of the town eventually took refuge in the mountains, and became, it is said, the ancestors of the Catholic Ghegs.* Notwith-

standing the abandonment of Christianity by a large section of the population, the authority of the sultans was never effectively established, and succeeding centuries

present a record of interminable conflicts between the tribesmen and the Turks, between the Christians and the converts to Islam, or between all combined and the tra- ditional Montenegrin enemy. The decline of the Ottoman power, which began towards the end of the 17th century, was marked by increasing anarchy and lawlessness in the outlying portions of the empire. A Moslem chieftain, Mehemet of Bushat, after obtaining the pashalik of Scu- tari from the Porte, succeeded in establishing an almost independent sovereignty in Upper Albania, which re- mained hereditary in his family for some generations. In Southern Albania Ali Pasha of Tepelen (6. about 1750), an able, cruel, and unscrupulous man, subdued the neigh- bouring pashas and chiefs, crushed the Suliotes and Khimarrhotes, and exercised a practically independent sovereignty from the Adriatic to the ^gfian. He intro- duced comparative civilization at lannina, his capital, and maintained direct relations with foreign powers. Event- ually he renounced his allegiance to the Sultan, but was overthrown by a Turkish army in 1822. Shortly after- wards the dynasty of. Scutari came to an end with the defeat of Mustafa Pasha, the last of the house of Bushat. The opposition of the Albanians, Christian as well as Moslem, to the reforms introduced by the Sultan Mah- mud II. led to the devastation of the country and the expatriation of thousands of its inhabitants. During the next half-century several local revolts occurred, but no movement of a strictly political character took place till after the Berlin Treaty (13th July 1878), when some of the Moslems and Catholics combined to resist the stipu- lated transference of Albanian territory to AustriarHun- gary, Servia, and Montenegro, and the Albanian League was formed by an assemblage of chiefs at Prizren. The movement, which was instigated by the Porte with the object of evading the provisions of the treaty, was so far successful that the restoration of Plava and Gusinye to Albania was sanctioned by the Powers, Montenegro re- ceiving in exchange the town and district of Dulcigno. The Albanian leaders, however, soon displayed a spirit of independence, which proved embarrassing to Turkish diplomacy and caused alarm at Constantinople; their forces came into conflict with a Turkish army under Dervish Pasha near Dulcigno (November 1880), and eventually the league was suppressed. A similar agitar tion on a smaller scale was organized in Soutl^ern Albania to resist the territorial concessions awarded by the Powers to Greece. These movements, however, were far from displaying a genuinely national character. In recent years attempts have been made by Albanians resident abroad to’ propagate the national idea among their compatriots at home ; committees have been formed at Brussels, Bucha- rest, Athens, and elsewhere, and books, pamphlets, and newspapers are surreptitiously sent into the country. Unity of aim and efEort, however, seems foreign to the Albanians, except in defence of local or tribal privileges. The growth of a wider patriotic sentiment will depend on the spread of popular education: up to the present no appreciable progress has been made in this direction.

Albania abounds in ancient remains, which as yet have been little explored. Fragments of Cyclopean structures were discovered by Hahn at Kretzunista, Ari- nista, and other sites in the district of Argyro- kastro; the walls, partly Cyclopean, of an ancient city (perhaps Bullis) are visible at Gradista on the Viossa. The remains of the classical epoch attest the influence of Eoman rather than of Greek civilization. At Pollina, the ancient Apollonia, are the remnants of a Doric tem- ple, of which a single column is still standing. A little north of Preveza are the considerable ruins of Nikopolis, founded by Octavian to commemorate the victory of Actium. At Khimara (ancient Chimcera) the remains

Antiqui- ties.

of an old Greek city may still be seen; at Santa Qua- ranta (ancient Onchesmos) the walls and towers of a later town are in good preservation. Pew traces remain of the once celebrated Dyrrhachium. The ruins of Pandosia, Ephyra, Elatea, Phoenik^, Buthrotum, Akrolissos, and other towns may be identified. The most important and interesting remains, however, are those of Dodona, near lannina, the seat of the famous oracle of the Pelasgian Zeus. The ruins, which were excavated by Mr Constan- tine Carapanos of Athens in 1875, furnished a rich yield of inscriptions, statuettes, vases, and other objects. The temple of Zeus stood in the uppeir part of a temenos or sacred precinct, together with two other buildings, one of which was probably a sanctuary of Aphrodite; the inclosure was approached by propylsea. A remarkably large theatre is situated in a ~~neighbouring valley. Por details see Mr Carapanos's work, Dodone et ses Buines (Paris, 1878). Of the mediaeval ruins those of Kroia, the stronghold 6f Skanderbeg, are the most interesting. Albanian is peculiarly interesting as the only sur~~ viving representative of the so-called Thraco-IUyrian group of languages which formed the primitive speech of the peninsula. It has afforded an '"S!"' - attractive study to philologists, amongst whom may be mentioned Malte-Brun, Leake, Xylander, Hahn, Mik* lositch, and G. Meyer. The analysis of the language presents great difficulties, as, owing to the absence of literary monuments, no certainty can be arrived at with regard tO its earlier forms and later development. The groundwork, so far as it can be ascertained, and the gram- mar are Indo-European, but a large number of words have been borrowed from the Latin, or Italian, and Greek, and it is not always easy to decide whether the mutilated and curtailed forms now in use represent adopted words or belong to the original vocabulary. There is also a considerable admixture of Turkish and Slavonic words. Notwithstanding certain points of re- semblance in structure and phonetics, Albanian is en- tirely distinct from the neighbouring languages ; in its relation to early Latin and Greek it may be regarded as a co-ordinate member of the Aryan stock. It pos- sesses seven vowels; among the consonants are the aspirated d and t, as in Greek, and many other sounds, such as 6, d, sh, zh (French j), and hard g, which are wanting in Greek, but exist in the Slavonic languages. There are three declensions, each with a definite and indefinite form ; the genitive, dative, and ablative are usually represented by a single termination : the voca- tive is formed by a final o, as memmo from memme, "mother." The neuter gender is -absent. There are two conjugations ; the passive formation, now wanting in most Indo-European languages, has been retained, as in Greek : thus Tcerko-iy, "I seek," forms kerko-n- em, "I am sought." The infinitive is not found ; as in Greek, Eumanian, and Bulgarian it is replaced by the subjunctive with a particle. The two auxiliary verbs are Mm, " I have," and yam, " I am." An interesting and characteristic feature of the language is the definitive article, which is attached to the end of the word: e.g., mik ("friend," amicus), mik-u (" the friend ") ; Men (" dog "), keirtri ; Shkumb, Shkumb-i. The suffix-article likewise appears in Eumanian and Bulgarian, but in no other Latin or Slavonic language. Another remarkable analogy between the Albanian and the neighbouring languages is found in the formation of the future ; the Albanian do (3rd pers. sing, of dova, " I will,") like the Greek ^o, is prefixed without change to all persons of the verb: a similar usage in Servian and Bulgarian, as well as in Eumanian (especially the Mace- donian dialect), is peculiar to these languages in the Slavonic and Latin groups. These and other points of similarity have led to the conjecture that the primitive

Illyrian language may have exerted some kind of influence on the other idioms of the peninsula. In the absence of literary culture the Albanian dialects, as might be ex- pected, are widely divergent ; the limits of the two prin- cipal dialects correspond with the racial boundaries of the Ghegs and Tosks, who understand each other with difiiculty : the Albanians in Greece and Italy have also

separate dialects. In writing Albanian the Latin char- acter is employed by the Ghegs, the Greek by the Tosks ; neither alphabet sufBces to represent the manifold sounds of the language, and various supplementary letters or distinguishing signs are necessary. In the use of these no uniform system has yet been adopted. An alphabet of fifty-two letters, some presenting ancient Phoenician and Cretan forms, was found by Hahn in partial use at Elbassan and Tirana ; its antiquity, however, has not been established. The Tosks generally use the Greek lan- guage for written communications. The native folklore and poetry of the Albanians can hardly compare with that of the neighbouring nations in originality and beauty. The earliest printed works in Albanian are those of the Catholic missionaries ; the first book containing specimens of the language was the Dictionarium Latino-Epiroticum

of Bianchi, printed in 1635. The literature of the last two centuries consists mainly of translations and relig- ious works written by ecclesiastics, some of whom were natives of the Albanian colonies in Italy. The most note- worthy Albanian writer was Girolamo di Eada (&. 1815), a poet, philologist, and collector of national folklore. Among his successors may be mentioned Vincenzo Dorsa and Demetrio Camarda.

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(j. D. B.)

Albany, a river of Canada, forming part of the boundary between Ontario and Keewatin, rises in Lake St Joseph in (head of lake) long. 91° 25′ W. and lat. 50° 65′ N., and falls into James Bay, its total length being upwards of 500 miles. There are four Hudson’s Bay Company’s posts on its banks. The Ogoki and Kenogami rivers are the principal tributaries.

Albany, the capital of New York state, and of Albany county, U.S.A., situated in 42° 40′ N. lat. and 73° 45′ W. long., on Hudson river, just below the mouth of Mohawk river. The mean annual temperature is 49°, and the annual rainfall is 40 inches. The death;-rate, 20-90 per thousand in 1900, is more than that of the country at large and the average of large cities. The plan of the city presents considerable regularity, although its site, rising sharply from the river in bluffs, is by no means level. The city is divided into nineteen wards, and is supplied with water by pumping from Hudson river and smaller streams, the water-works being owned by the city. Th^ streets are broad, about half of them paved, mainly with granite blocks and cobble stones, and the drainage is fairly good. The fire and police equip- ment are good. The finest of the many public buildings is the magnificent new state Capitol, situated at the summit of State Street Hill. It is built of granite, en- closing a court, and is 300 by 400 feet on its ground plan. It is not yet entirely completed, but its estimated cost is $25,000,000. The city contains many educational and scientific institutions. It is entered by four railways — the Boston and Albany, the New York Central and Hud- son Eiver, the Delaware and Hudson, and the West Shore. It is also the terminus of the Erie and Cham- plain canals, and is near the head of navigation on the Hudson river. These various avenues of communication give it a large commerce by raU, canal, and river. Nu- merous steamboat lines connect it with New York and other river points. It is a manufacturing city of import- ance, having in 1890 $17,270,000 invested capital,

em- ploying 15,041 persons, and its products were valued at $25,531,000. The assessed valuation of property, real and personal, in 1898 was $66,685,000, and the debt of the municipality $3,294,000. The tax-rate, city, county, and state, was $20.60 per thousand dollars. The popula-

tion in 1880 was 90,758; in 1890 it was 94,923, and in 1900 it was 94,151.

Albany, a city of Georgia, U.S.A., the capital of Dougherty county, situated in the south-western part of the state, on Flint river, at an altitude of 232 feet. It is in the midst of an agricultural region producing cotton and corn, for which this city serves as a supply point. It is a railway centre of importance, being entered by the Plant System, the Georgia and Alabama, the Central of Georgia, and the Albany and Northern rail- ways. The population in 1880 was 3216, in 1890 it was 4008, and in 1900 it was 4606.

Albany, a municipality in West Australia, on King George Sound, 352 miles by rail, and 254 miles by road S.S.E. of ~~Perth, in the county of Plantagenet. It is a port of call for the Peninsular and Oriental Company's and the Orient Company's steamers carrying the Aus~~ tralian mails, and also for those of the Messageries Maritimes and N. G. Lloyd steamers. This town is the health resort of the state. Its harbour is one of the finest on the Australian coast, and is well protected from winds. Defence works have been carried out at King George Sound and Princess Eoyal Harbour. The climate is very fine, and a scheme for a pure water supply is being devised. The Marine Drive, 6^ miles in circuit, was completed in 1898. Mean temperature (six years) for the year 58-6° E. ; for February, 661° F. ; for July, 52-6° F. ; rainfall, 35-65 inches. The population in 1881 was 1024; in 1891, 2665; in 1900 about 3250.

Albany, Leopold George Duncan Albert,

Duke of, eighth child, and youngest son of Queen Victoria, was born 7th April 1853. The delicacy of his health seemed to mark him out for a life of retire- ment, and as he grew older he evinced much of the love of knowledge, the capacity for study, and the interest in philanthropic and ecclesiastical movements which had characterized his father, the Prince Consort. He matriculated at Christ Church, Oxford, in November 1872, living with his tutor at Wykeham House, St. Giles's, and diligently pursued his favourite studies of science, art, and the modern languages. In 1876, he left the University with the honorary degree of D.C.L., and resided at Boy ton

House, Wiltshire, and afterwards at Claremont. On coming of age in 1874, he had been made a Privy Coun- cillor, and granted an annuity of £16,000. He travelled on the Continent, and in 1880 visited the United States and Canada. He was a trustee of the British Museum, a bencher of Lincoln's Inn, and continued to take an active part in the promotion of education and knowledge generally. Like his father and other members of his family, he was an excellent public speaker. On 24th May 1881 he was created Duke pf Albany, Earl of Clarence, and Baron Arklow. On 27th April 1882, he married Hel^ne Frederica Augusta, princess of Waldeck- Pyrmont, and his income was raised by Parliament to £25,000. Having gone to the south of France for his healtTi in the spring of 1884, he was attacked by a fit, the cause or the consequence of a fall in a club-house at Cannes, on 27th March, and died very unexpectedly on the following morning. His death was universally re- gretted, from the gentleness and graciousness of his character, and the desire and ability he had shown to promote intellectual interests of every kind. He left a daughter, born in February 1883, and a posthumous son,

born 19th July 1884, who succeeded to the dukedom of Albany, and who on 30th July 1900 became duke of Saxe-Coburg on the death of his uncle. (b. g.)

A I bay, a town of 34,000 inhabitants, on the eastern coast of Luzon, Philippine Islands, and capital of the province of Albay. Well buUt, with good government and public buildings, it was badly injm- ed by fire in 1900. It is at the centre of one of the most important hemp-pro- ducing districts, and ships large quantities of this product to Manila. Other exports are rice, Indian corn, sugar, copra, and cloth made from hemp or from sinamay. It is near the foot of Mayon volcano, and in the year 1714 was completely destroyed during a violent eruption. The language is Bicol.

Albemarle, George Thomas Keppel, sixth Earl of (1799-1891), British general, second son of the fourth earl, was born on 13th June 1799. Educated at Westminster- school, he entered the army as ensign, 14th Foot, in 1815. He joined his regiment in Belgium, and took part in the Waterloo campaign and the march to Paris, joined the second battalion in Corfu and was trans- ferred to the 22nd Foot, with which he served in Mauri- tius and at the Cape, returning home in 1819, when he was appointed equerry to the duke of Sussex. Promoted to a lieutenancy in the 24th Foot, he was transferred to the 20th Foot, and went to India, where he was aide-de- camp to the marquis of Hastings until his resignation in 1823, when Keppel returned to England, travelling over- land through Persia, Moscow, and St Petersburg. He published in 1825 an account of his travels, entitled Jour- ney from India to England. He was aide-de-camp to the Marquess Wellesley, lord-lieutenant of Ireland, for two years, was promoted captain in the 62nd Foot, studied in the senior department of the Eoyal Military College at Sandhurst, and in 1827 obtained a half-pay unattaxjhed majority. He did not again serve on full pay, but rose to be a general. In 1829 he visited the seat of the Russo- Turkish war and was with the British fleet in Turkish waters. In 1832 he was returned in the Whig interest to the first reformed parliament as member for East Nor- folk, and sat until 1835. He was private secretary to the premier. Lord John Russell, in 1846, and M.P. for Lymington from 1847 to 1849. He succeeded to the title on the death of his brother in 1851. He died in 1891, and was buried at Quiddenham, Norfolk. He wrote an account of a Jourmy across the Balkans, Memoirs of the Marquis of BocTdngham, and an autobiography entitled Mfiy Years of My Life. («• h. v.)

Albert, formerly Axoee, a town of France, arron- dissement of Peronne, department of Somme, 16 miles N.E. by E. of Amiens, on railway from Paris to Amiens. The town stands on a branch of the Ancre, which here forms a pretty cascade. There are large and important engineering establishments of every kind. Population (1881), 5374; (1891), 5941; (1896), 6433, (comm.) 6651.

Albert, Frederick Augustus, King of

Saxony (1828-), was born 23rd April 1828, being the

eldest son of Prince Johann, who succeeded to the throne in 1854. His education was, as is usual with German princes, to a great extent military, but he attended lec- tures at the university of Bonn. His first experience of warfare was in 1849, when he served as a captain in the campaign of Schleswig-Holstein against the Danes. When the war of 1866 broke out. Saxony, which had for many years under the ministry of Beust adopted an anti- Prussian policy, was the most active ally of Austria. The crown prince was given the command over the army ; no attempt was made to defend Saxony, but the Saxons fell back intff Bohemia and effected a jimction with the 1st Austrian army corps under Clam-Gallas. They took a prominent part in the battles by which the Prussians forced the line of the Iser and in the disastrous battle of Gitschin. The crown prince, however, succeeded in effecting the retreat in good order, and in the decisive battle of Koniggratz he held the extreme left of the Aus- trian position. The Saxons maintained their post with great tenacity, but were driven back after many hours' fighting. During these operations the crown prince won the reputation of a thorough soldier;

aiter peace was made and Saxony had entered the North German Con- federation, he was placed in command of the Saxon army, which had now become the 12th army corps of tjie North German army, and in this position carried out the necessary reorganization. He was a firm adherent of the Prussian alliance. On the outbreak of war in 1870 he again commanded the Saxons, who were included in the 2nd army under Prince Frederick Charles, his old opponent. At the battle of Gravelotte they formed the extreme left of the German army, and with the Prussian guard carried out the attack on St Privat, the final and decisive action in the battle. In the reorganization of the army which accompanied the march towards Paris the crown prince was given a separate command over the 4th or army of the Meuse, consisting of the Saxons, the guards, and the 4th army corps ; he was succeeded in his former post by his brother Prince George, who had served under him in Bohemia. He took a leading part in the operations which preceded the battle of Sedan, the 4th army being the pivot on which the whole army wheeled round in pursuit of MacMahon ; and the actions of Busancy and Beaumont on 29th and 30th August were fought under his directions ; in the battle of Sedan itself, with the troops under his orders, he carried out the cir- cumvention of the French on the east and north. His conduct in these engagements won for him the complete confidence of the army, and during the siege of Paris his troops formed the north-east section of the investing force. After the conclusion of the armistice he was left in com- mand of the German army of occupation, a position which he held till the fall of the Commune. On the conclusion of peace he was inade an inspector-general of the army and field-marshal. On the death of his father on 29th October 1873 he succeeded to the throne. His reign has been un- eventful, and he has taken little public part in political affairs, but his advice and experience have been constantly used in military matters. In 1897 he was appointed arbi- trator between the claimants for the principality of Lippe. King Albert married in 1853 Carola, daughter of Prince

Gustaras of Vasa, and grand-daughter of the last king of Sweden of the house of Holstein. (j. w. he.)

Albert Nyanza and Albert Edward Nyanza,

the two western reservoirs of the White Nile, lying north and south in the great Central African rift-valley, near it? north end. When the northern lake, Albert Ny- anza, was first reached by Sir Samuel Baker, it was thought to extend southwards far beyond the equator — farther, in fact, than the southern end of- Albert Edward Lake, which does not reach to 1° S. In 1876 Stanley reached the arm of a lake, situated on the equator, which he thought to be Albert Nyanza, but which the voyages of Gessi and Mason on the latter lake in 1876 and 1877 proved to be distinct.

The true position and form of Albert Edward Nyanza were made known by Stanley’s journey of 1888-89, while its contours have since been determined with greater exactness by Stuhlmann (1891) and Grogan and Moore (1899). The lake, which lies at an altitude of about 3200 feet, is roughly elliptical, in outline, with a length of 50 miles and maximum breadth of about 30 miles, the area approximating to 1000 square miles. The arm above alluded to is practically an independent lake (Kuisamba) running to the north-east and Connected by a narrow channel with the main lake. A swampy plain, traversed by the Kuchuru and other streams, extends to the south of the lake, and must once have been covered by its waters. On the east a wide space intervenes between the eastern wall of the rift-valley and the present shore of the lake, two distinct terraces being clearly defined. The vegetar tion (Euphorbias, &o?) on the lower of these is of small size and seems to be of recent origin. Near the lake, pits of fire and huge jets of smoke still testify to the presence o4 volcanic activity. On the west the wall of the rift- valley runs close to the lake, but on the north a barren level plain comes

between the lake and the southern spurs of the Ruwenzori range. On this plain, separated by a narrow neck of land from Lake Albert Edward, is a crater- like depression occupied by a shallow salt lake. The salt, which has a reddish tint, is exported to great distances. The main feeder of Lake Albert Edward, the Euchuru, rises on the north side of the volcanoes north of Lake Kivu (q.v.). On reaching the level plain 15 miles from the lake its waters become brackish, and the vegetation on its banks is scanty. The reedy marshes near its mouth form a retreat for a primitive race of fishermen. Lake Kuisamba, the shores of which are generally high, is fed by streams from the east of Mount Ruwenzori. At the north-west corner of the larger lake issues the Isango or Semliki, at first a small stream, but gradually increased to a large river by streams from the Ruwenzori range on the eastern side of the rift-valley. Before entering Albert Nyanza, in 1° 5′ N., it traverses a plain once covered by the latter lake, forming marshes inhabited by another tribe of fishermen, the Wanyabuga. The shores of Lake Albert Edward are partitioned between British East Africa and the Congo Free State, the dividing line being here the 30th meridian of east longitude. Just east of that line the British post of Port George was established on the north shore by Lugard in 1891.

Lake Albert lies at an altitude of about 2100 feet. Its extreme length is about 100 miles, and its general breadth somewhat over 20, the area being approximately 2000 square miles. It is shut in both on the east and west by plateau escarpments, which for the most part approach the shores closely. Near the south end a plain, saline in places, with a width of some 7 miles, intervenes on the west between the plateau and the lake. At this part there are signs that the lake is shrinking, Nyamsasi, which was an island at the time of Stanley’s visit in 1889,

having since become a peninsula. Farther north, from Kahoma to Mahagi, the hills descend abruptly to the water, rocky headlands alternating with semicircular beaches. Near the coast the water is in places very shallow, owing to the sediment brought down by mountain torrents, and reeds have been seen growing 2 miles from the shore. The gorges cut in the plateau escarpment produce magnificent timber. This plateau — a sparsely- inhabited rolling upland 2000 to 3000 feet above the lake (the Blue Mountains of Baker) — falls again steeply on th6 west to the Congo Basin, its maximum width being about 20 miles. The greater part of the shores of Lake Albert fall to British East Africa (Uganda Protectorate), but the stations established at Kibero on the east and Mswa on the west have been abandoned, owing to their un- healthiness. The extreme north-west portion has been leased to the Congo Free State during King Leopold’s life- time, and of this a strip 15 miles wide, reaching the lake at Mahagi, will eventually revert to the state, (e. he.)

Alberta. See Noeth- West Teebitoeies.

Albertina. See Oeange Eivbe Colony.

AIbi, chief town of department Tarn, France, 423 miles S. of Paris, on railway from Carmaux to Castel- naudary. The Park of Rochegude, gift of the admiral of that name, contains a fountain adorned with 13th-century carvings. On the Vigan, a fine promenade, is a statue of the navigator La P^rouse, who was born here. Manufac- tures of umbrellas and hats, the latter forming a con- siderable branch of industry, have become important. Population (18^1), 14,729; (1891), 14,219; (1896), 14,983, (comm.) 18,760.

Albina, formerly a city of Multnomah county, Oregon, U.S.A., annexed to Portland in 1891. It is on the east bank of the Willamette river, not far from its mouth, in the north-western part of the state. The population in 1880 was 123; in 1890 it was 6129; in 1900 (see Poetland).

Albox, a town of Spain, in the province of Almeria, 42 miles N.N.E. of Almeria. It owes its prosperity to woollen, spart, and fiour industries, and to the wine, olive oil, and spart produced in the

surrounding fertile country, where also live stock is abundant, especially sheep, goats, and mules. Population (1897), 10,313. Albox was originally an Arab town. Box. An earthquake almost entirely destroyed it in 1663, and it had to be rebuilt in great part.

Albrecht, Frederick Rudolph, Aeohduke of AusTEiA (1817-1895), eldest son of the Archduke Charles who defeated Napoleon at Aspern, was born on 3rd August 1817 at Vienna. He began his military career at the age of twenty, and after holding several minor posts, was in 1844 appointed commander of the forces in Upper and Lower Austria. It was his duty therefore to maintain order during the disturbances of 1848, and at the out- break of revolution in Vienna during the month of March he was in command of the troops who came into collision with the rioters. Owing to the collapse of the Government it was impossible to repress the disturbances, and he was relieved from a post which brought much unpopularity and was not suitable to be held by a member of the imperial family. Like so many others of the Austrian military he spent the summer of 1848 in the army of Italy, under Radetzky, and though he was given no com- mand he fought with distinction as a volunteer in the battles of Santa Lucia and Pastrengo. In the campaign of 1849 he was placed in command of the second division, which was in the vanguard of the army, and he gained

great credit for the resolution with which, at the battle of Novara, he held his ground against the superior forces of the enemy. Erom 1851 to 1860 he commanded the forces in Hungary, a post of great political difficulty. In 1859 and 1864 he was sent on important military and diplomatic missions to Berlin. When war became imminent in 1866 the archduke, who had now been made field-marshal, was placed in command of the Austrian army in Italy. With an army of about 130,000 he had to keep in check the Italian forces of nearly double the number. In the short campaign which followed he dis- played the highest military qualities; leaving only a small force to watch the army which was advancing from the Po, with 75,000 men he attacked 130,000 Italians, who under the command of the king had crossed the Mincio, and at the battle of Custozza (23rd June) defeated them with the loss of 8000 men and fourteen cannon. The result of this battle was that both the Italian armies had to retreat, and the archduke was able to send 50,000 men to reinforce the northern army, when, after being defeated by the Prussians, it fell back on Vienna. The Italians, moreover, had to give up the hope of obtaining from Austria any territory except Venetia. On 10th July the archduke was summoned to Vienna to take command of the combined forces which were being collected to defend the capital, but peace was made before further hostilities took place. From this time he was chiefly occupied with the reform and reorganization of the Austrian army ; he was made inspector-general of the forces in 1868. In 1870 he conducted the military negotiations preparatory to an alliance with France, which, however, was not con- cluded. He married, in 1844, Hildegarde, daughter of Ludwig, first king of Bavaria, who died in 1864. He died himself 18th February 1896, leaving two daughters. His only son died in childhood, and his nephew. Archduke Frederick (born 1856), inherited his great possessions.

(j. W. He.)

Albuquerque, a city of New Mexico, U.S.A., the capital of Bernalillo county, situated in the central part of the territory, on the east bank of the Eio Grande, in 35° 05′ N. lat. and 106° 38′ W. long., at an altitude of 4950 feet. The streets extend in a regular plan over a’plain sloping gently to the river. It is the connecting point of two main lines of the Atchison, Topeka, and Santa Fe railway system. The old Mexican town of Albuquerque, which antedates American jurisdiction over the region, lies about two miles north-west of the modern town, with which it is connected by a street railway. The

population of the new town in 1890 was 3785, and in 1900 it was 6238 ; of the old Mexican town, 1733 in 1890, and 1191 in 1900.

Albury, a town in Australia, New South Wales, in the county of Goulburn; it stands on the border of Victoria and on the right bank of the Murray river, here spanned by two bridges, one carrying the roadway, the other the double railway ; 386 miles by rail from Sydney. The Murray is navigable for small steamers from this town to its mouth, a distance of 1800 miles. Altitude 572 feet. Mean rainfall (23 years) 26-39 inches. Popu- lation (1881), 5715 ; (1891), 5447 ; (1901), 5820.

Alcala de Henares, a city of Spain, 17 miles E.N.E. of Madrid. Population, 8745. After the transfer of the university to Madrid the Government turned most of the principal buildings erected by Cardinal Cisneros in the 16th century into a depSt for the archives of various state departments. Here, too, are kept very complete and curious documents of the Inquisition, showing aU its workings from the 15th to the 19th century.

Alcala de los Cazules, a town of Spain, province of Cadiz, 32 miles E. by S. of Cadiz. It has a splendid climate, and the soil in the surrounding dis- tricts is very fertile. There is a prosperous cork indus- try. It was originally a Moorish town, as its name indicates. Population (1897), 10,027.

A lea mo, a town of Sicily, Italy, in the province of Trapani, 24 miles S.W. from Palermo. It stands 837 feet above sea-level, and produces wine. It was originally a Saracenic town, and was made Christian by the Emperor Frederick II. in 1233. Population (1881), 37,697 ; (1901),

51,811.

Alcester, a market-town and railway station, under a rural district council, in the south-western parliamentary division of Warwickshire, England, on the Alne, 15 miles W.S.W. of Warwick. A Eoman Catholic school chapel, a hospital for iufectious diseases, and a reading room have been erected. The manufacture of needles has declined ; ia the town there are implement works, cycle works, and a brewery. Area, 1626 acres. Population of rural district (1901), 11,392.

Alcester, Frederick Beauchamp Paget Seymour, Baron (1821-1895), British admiral, son of Colonel Sir Horace Beauchamp Seymour, and cousin of Francis George Hugh Seymour, 5th Marquis of Hertford, was born on 12th April 1821. Entering the navy in 1834, he served in the Mediterranean and the Pacific, was for three years flag-lieutenant to his uncle Sir George Seymour, and was promoted to be commander in 1847. He served in ■ Burma as a volunteer in 1862 ; was made a captain in 1854 ; took the Meteor ironclad battery out to the Black Sea and home again in 1856 ; was captain of the Pelorus on the Australian station from 1857 to 1863, and commanded the naval brigade in New Zealand during lie Maori war, 1860-61, for which he was made a C.B. He became a rear-admiral in 1870 ; in 1871-72 he commanded theflying squadron; was alord of, the Admiralty in 1872-74, and commanded the Channel fleet,’ 1874-76. On 31st December 1876 he was made a vice-admiral ; a K.C.B. on 2nd June 1877. In 1880-83 he was commander- in-chief of the fleet in the Mediterranean, and in 1880 had also the chief command of the European squadron sent to the coast of Albania as a demonstration to compel the Porte to cede Dulcigno to Montenegro. On 24th May 1881 he was made a G.C.B., and on 6th May 1882 was promoted to the rank of admiral. In July 1882 he commanded at the bombardment of Alexandria and in the subsequent operations on the coast of Egypt, for which service he was raised to the peerage as Baron Alcester of Alcester in the county of Warwick, received a parliamentary grant of £25,000, the freedom of the city of London, and a sword of honour. On his return from the Mediterranean he was for a couple of years again at the Admiralty, and in 1886 he was placed on the retired list. For the next nine years he lived chiefly in London, but

latterly his health Vas much broken, and he died on 30th March 1895. He was unmarried, and the peerage became extinct. (j- k. l.)

Alcock, Sir Rutherford (1809-1897), British consul and diplomatist, was the son of Dr Thomas Alcock, who practised at Ealing, near London, and himself followed the medical profession. In 1836 he became a surgeon in the marine brigade which took part in the Car list war, and gaining distinction by his services was made deputy inspector-general of hospitals. He retired from this ser- vice in 1837, and seven years later was appointed consul at Foochow in China, where, after a short official stay at Amoy, he performed the functions, as he himself expressed

it, “of everything from a lord chancellor to a sheriff’s officer.” Foochow was one of the forts opened to trade by the treaty of 1842, and Mr Alcock, as he then was, had to maintain an entirely new position with the Chinese authorities. In so doing he was eminently suc- cessful, and earned for himself promotion’ to the consulate at Shanghai. Thither he went in 1846, and made it an especial part of his duties to superintend the establish- ment and laying out of the British settlement, which has developed into such an important feature of British com- mercial life in China. In 1858 he was appointed consul- general in the newly-opened empire of Japan, and in the following year was promoted to be minister plenipoten- tiary. In those days residence in Japan was surrounded with many dangers, and the people were intensely hostile to foreigners. In 1860 Mr Alcock’s native interpreter was murdered at the gate of the Legation, and in the follow- ing year the Legation was stormed by a body of Eonins, whose attack was repulsed by Mr Alcock and his staff. Shortly after this event he returned to England on leave. Already he had been made a C.B. (1860), and in 1862 he was made a knight commander of the order. Two years later he returned to Japan, and after a year’s further residence he was transferred to Peking, where he repre- sented the British Government until 1871, when he retired. But though no longer in official life his leisure was fully occupied. He was for some years president of the Eoyal Geographical Society, and he served on many commissions. He was twice married, first in May 1841 to Henrietta Mary, daughter of Charles Bacon, Esq., who died in 1853, and secondly (8th July 1862) to the widow of the Eev. John Lowder, who died on 13th March 1899. He was the author of several works, but the one by which he will be known is The Capital of the Tycoon, which appeared in 1863. He died in London on 2nd November 1897. (k. k. d.)

Alcott, Amos Bronson (1799-1888), American educationalist and writer, was born in Wolcott, Con- necticut, 29th November 1799. His father was a farmer and mechanic, Joseph Chatfield Alcox, whose ancestors, then bearing the name of Alcocke, had settled in eastern Massachusetts in early colonial days. The external events in Amos Bronson Alcott’s long life were for the most part, simple and unimportant. Self-educated in youth, and early thrown upon his own resources, he began to earn his living by peddling books and merchan- dise in Virginia, afterward teaching in that state and in other southern states. Determined to devote himself to educational work, in 1828 he opened, in Boston, a school which became locally famous because of his original methods; his plan being to develop self-instruction on the basis of self-analysis, with an ever-present desire on his own part to stimulate the child’s personality. The feature of his school which attracted most attention, perhaps, was his scheme for the teacher receiving punishment, in certain circumstances, at the hands of an offending pupil, whereby the sense of shame might be quickened in the mind of the errant child. The school was not pecuniarily successful, although Alcott had won the affection of some of his pupils, and his educational experiments had chal- lenged the attention of students of pedagogy. After a visit to England, in 1842, he founded, with two English associates, at ” Eruitlands,” in the town of Harvard, Massachusetts, a communistic experiment at farm-living and nature-meditation, as tending to develop the best powers of body and soul. This speedily came to naught, and Alcott subsequently

took up his home near Emerson, in Concord, Massachusetts, and spoke, as opportunity offered, before the “lyceums” then common in various

parts of the United States, or addressed groups of hearers as they invited him. These ” conversations “/as he called them, were more or less informal talks on a great range of topics, spiritual, aesthetic, and practical, in which he emphasized the ideas of the school of American Transcendentalists led by Emerson, who was always his supporter aijd discreet admirer. He dwelt- upon the illumination of the mind and soul by direct communion with the Creative Spirit; upon the spiritual and poetic monitions of external nature; and upon the benefit to man of a serene mood and a simple way of life. As regards the trend and results of Alcott’s philosophic teaching, it must be said that, like Emerson, he was some- times inconsistent, hazy, or abrupt. But though he formulated no system of philosophy, and seemed to show the influence now of Plato, now of Kant, or of German thought as filtered through the brain of Coleridge, he was, like his American master, associate, and friend, steadily optimistic, idealistic, individualistic. The teachings of William Ellery Channing, a little before, as to the sacred inviolability of the human conscience — anticipating the later conclusions of Martiueau — really lay at the basis of the work of most of the Concord Transcendentalists and contributors to The Dial, of whom Alcott was one. In his last years, living in a serene and beautifid old age in his Concord home, where every comfort was provided by his daughter Louisa (q.v.), Alcott was gratified at being able to become the nominal, and at times the actual, head of a Concord summer school of philosophy, in which — in a rudely-fashioned buUding next his house — thoughtful listeners were addressed, during a part of several succes- sive summer seasons, on many themes in philosophy, religion, and letters. Of Alcott’s published works the most important is Tablets (1868) ; next in order of merit is Concord Days (1872). His Sonnets and Canzonets, 1882, are chiefly interesting as an old man’s experiments in verse. He left a great and symmetrical collection of personal jottings and memorabilia, most of which remain unpublished. He died in Boston, 4th March 1888.

(c. F. E.)

Alcott, Louisa May (1832-1888), during the last quarter of the 19th century the favourite American author of juvenile stories (especially for girls), was the daughter of Amos Bronson Alcott, and thouglx of New England parentage and residence, was born in German- town, Pennsylvania, 29th November 1832. She began work at an early age as teacher and writer, and was an amateur nurse in army hospitals during the civil war of 1861-65. Her newspaper letters, collected as Ho^Ual Sketches (1863), displayed some power of observation and record; while Moods, a novel (1864), despite its uncer- tainty of method and of touch, indicated the possibility that Miss Alcott might develop into a strong novelist of character, with a sympathetic insight into the deeper springs of vital action. She soon turned, however, to the rapid production of stories for girls, and, with the exception of the cheery tale entitled Work (1873), and the anonjnnous novelette A Modem, Mephistopheles (1877), which attracted little notice, she did not return to the more ambitious fields of the novelist. Her success dated from the appearance of the first series of Little Women: or, Meg, Jo, Beth, and Amy (1868), in which, with unfailing humour, freshness, and lifelikeness, she put into story form many of the sayings and doings of herself and her sisters. Little Men (1871) similarly treated the character and ways of her nephews, in that house in Concord, Massachusetts, in which Miss Alcott’s industry had now established her parents and other mem- bers of the Alcott family ; but most of her later volumes,

An Old Fashioned Girl, Aunt Jo’s Scrap Bag (6 volumes), Base in Bloom, &c., followed in the line of Little Women, of which, the author’s large and loyal public never wearied. Her natural love of

labour, her wide- reaching generosity, her quick perception, and her fond- ness for sharing with her many readers that cheery humour which radiated from her personality and her books, led her to produce stories of a diminishing value, and at length she succumbed to overwork, dying in Boston 6th March 1888, two days after the death of her father in the same city. Miss Alcott's early education had partly been given by the naturalist Thoreau, but had chiefly been in the hands of her father ; and in her girlhood and early womanhood she had fully shared the trials and poverty incident to the life of a peripatetic idealist. In a news- paper sketch entitled " Transcendental Wild Oats," after- wards reprinted in the volume Silver Pitchers,she narrated, with a delicate humour, which shows what her literary powers might have been if freed from drudgery, the experiences of her family during an experiment towards communistic "plain living and higl\ thinking" in the town of Harvard, Massachusetts, in 1843. The story of her career has been fully and frankly told in Mrs Ednah D. Cheney's Louisa May Alcott: her Life, Letters, and Joumais (1889), one of the most noteworthy of American biographies, considered as an unconsciously pathetic record of a cheery woman's life-sacrifice for the support and comfort of her relatives. (c. f. e.)

Alcoy, a town of the province of Alicante, Spain. It has much grown iu importance owing to its manu- factures, in which that of linen must be included. New private and public schools, a chamber of commerce, town hall, barracks, hospital, institute, and casinos have been built and the churches repaired. It has been frequently the scene of strikes and popular disturbances. Popu- lation (1897), 30,118. _

Alcyonaria. See Anthozoa.

Aldan, a river of Asiatic Russia, East Siberia, a right bank tributary of the Lena, rises iu the southern parts of the high plateau of East Siberia, flows mostly over desert highlands for 1160 miles N.E., N., and N.W., and joius the Lena 120 miles below Yakutsk. There are a few settlements in its lower course. The Aldan Range is the name given to the part of the Stanovoi border range which faces the Sea of Okhotsk.

Aldeburgh, or Aidbokotigh, a municipal borough (1885), market-town, and railway station in the Wood- bridge parliamentary division of Suffolk, England, on the coast, 24 miles E.N.E. of Ipswich. A small 16th-century moot-hall, restored in 1855, is used for corporation meet- ings. The church of St Peter and St Paul was restored in 1882 and 1891. A jubilee hall has been erected. There is an excellent golf course. Area, 1972 acres. Popula- .tion (1881), 2106; (1891), 2159; (1901), 2405.

Aldershot, a town and parish of England, 35 miles S. W. of London by rail, in the Basingstoke parliamentary division of Hampshire, situated one inUe from the Basingstoke Canal. A mere village till 1855, when Aldershot Camp was established, the town was in 1857 erected into a local government district, and in 1894 was created an urban district. The ancient parish church was restored in 1891. There are a theatre and a cottage hospital (1897). Area of urban district, 4178 acres. Population (1881), 20,155; (1891), 25,595 ; (1901), 30,974.

Military Depot. — " Camp " is no longer a suitable name for the military buildiags at Aldershot. The wooden huts erected in 1855, which formed the North and South Camps, were not calculated to last many years, and it became necessary to replace them with permanent build- ings. A commencement was made ia 1881, and under

the Barracks Act, 1890, and the MUitary Works Acts of 1897 and 1899, large sums were provided for completing the work. Although a few wooden buildings remain for a time, the expenditure of nearly £1,800,000 thus provided has made Aldershot, at the commencement of the 20th century, by

far the largest assemblage of permanent bar- racks, as well as the greatest training station for troops, in the British Empire.

The Old North Camp is now named Marlborough Lines, with a three-battery field artillery barrack and five infantry battalion barracks called after Marlborough's victories — ^Blenheim, Mal- plaquet, Oudenarde, Eamillies, and Toumay. South Camp is now named Stanhope I^ines, after Mr Stanhope, secretary of state for war when the Barrac^ Act, 1890, was passed and the reconstruction commenced iu earnest. They contain barracks for the Royal Engineers and Army Service Corps north of the General Parade, which stretches east and west, and four infantry battalion barracks south of it, with a fifth at the east, called Albuera, Barossa, Corunna, Maida (Sicily), and Mandora (Egypt), after battles of the wars with France, 1793-1815, in which Wellington did not command. There are also barracks for the Royal Army Medical Corps. The old permanent barracks have been renamed Wellington Lines, with barracks for three cavalry regiments, west, east, and south ; for three batteries of horse and three batteries of field artillery ; and for three infantry battalions called Badajos, Salamanca, and Talavera, after Wellington's victories in the Peninsula. For the sick there are the Connaught Hospital iu Marlborough Lines, the Cambridge Hospital in Stanhope Lines, and the Union Hospital in Wellington Lines, besides the Louise Margaret Hospital for women and children alongside Cam- bridge Hospital, and the infection hospital on the isolated Thorn- hill, half for men and half for women and children. The build- ings in Wellington Lines, for the most part completed about 1857, are in some respects not up to the modem standard, but those in Stanhope and Marlborough Lines may be regarded as typical examples of modem barracks and hospitals.

The drainage of the station is all modem and of the best description, and the sewage is disposed of on a sewage farm worked by an expert, under the direction of the War Department, with the primary object of meeting all sanitary requirements, not of making a profit. The water-supply is partly from the Aldershot Water Company, and partly from springs and reservoirs collecting water from a reserved area of War Department property. The lighting of Wellington Lines is by gas, and Stanhope and Marl- borough Lines are lighted by electricity.

Most of the barracks are large enough to accommodate not only the units they are constructed for, but also detachments of soldiers from other stations who are going through courses of instruction. Including these detachments and the large number of soldiers' wives and children for whom quarters are provided, the population of the station may at times reach a total of 24,000, with 4000 or more horses.

Besides the regimental buildings there are a large number of buildings for garrison purposes, in addition to the hospitals already mentioned ; such as quarters and offices for general, staff, and departmental officers, with the warrant and non-commissioned officers employed under them ; the supply depot with abattoir and bakery, whence the garrison is supplied with rations both of food and forage ; the ordnance stores, where are kept all kinds of military stores and mobilization equipment, barrack stores for furniture and bedding, engineer shops and stores for services performed by the Royal Engineers, the balloon establishment for the manufacture of military balloons, the vaccine establish- ment for the production of caU-lymph for the army, the military prison, fire brigade stations, five churches, recreation grounds for officers and men, schools for the literary instruction of adults and children, and especially those military technical schools which form one of the chief features of Aldershot as a training station. These technical schools are as follows : army cookery school, for training cooks who shall not only cook for soldiers, but also teach them to cook for themselves ; army gymnastic school, for the gymnastic instruction of the troops at Aldershot, and especially for training instractors for other stations ; Army Service Corps school, for instruction of Army Service Corps officers in their duties; army signalling school, for training signallers; army veterinary school, for training of officers and men, the latter as farriers ; ballooning school, for

instruction and training of officers and men in the management of balloons; mounted infantry school, for instruction of officers and men in the duties of mounted infantry, the whole training of which force is carried out at Aldershot ; training school for Royal Army Medical Corps, for training officers and men for their duties in hospital and field.

The work of these schools is, however, only a small part of the

military training afforded at Aldershot: there still remain those very important branches for which Aldershot was originally started, and for the carrying out of which a considerable extent of land Is essential, viz., musketry, company training, recon- naissance, and field days. For these purposes a large tract of land was purchased between 1854 and 18i30, and since then additional property has been acquired from time to time, ^o that at present it extends, though with many interruptions, over an area about 9i miles in extreme length by 7} miles in extreme width. In addition to this there is the land at Sand- hurst and the Staff College, about 6i miles distant, and at Wolmer Forest, 12 miles distant. The musketry practice of the troops at Aldershot is carried out at the Ash ranges, 2 miles east of the barracks, while the Pirbright ranges, alongside those of the National Eifle Association at Bisley, are utilized by the house- hold cavalry and guards, who are encamped there in succession. Suitable land, within an easy march of the barracks, is utilized for company, battalion, and brigade training of infantry, while the mounted branches work over a wider area, and the engineers carry out their practices where most convenient. For field days of the three arms — cavalry, artillery, and infantry — the whole of the War Department property is available.

Besides the troops in barracks, during the drill season there is often a considerable force in camp, both regular troops from other stations, and militia and volunteers. Some sixty camping grounds have been specially prepared for them, so that, including the regular garrison, sometimes as many as 40,000 troops have been concentrated at the station for training and manoeuvres.

(h. 10.)

Aldrich, Thomas Bailey (1836), American

author, was born in Portsmouth, New Hampshire, on the 11th November 1836 ; his birthplace being the ” River- mouth ” of several of his longer and shorter stories, while the Piscataqua river, the Isles of Shoals, and other scenes familiar to his boyhood, are frequently commemorated in his prose and verse. His early life — ^partly described in his Story of a Bad Boy (1869), in which ” Tom Bailey” is the juvenile hero — was spent in business offices in New Orleans and New York, until his literary tastes led him to become a contributor to various news- papers in the latter city. Between 1856 and 1859 he was on the staff of the New York Home Journal, then edited by the once popular poet N. P. Willis; while during a part of the Civil war he was editor-in-chief of the New York Illustrated News, the most graphic of the pictorial recorders of that conflict. These journalistic experiences brought him into close relations with Stedman, Stoddard, Taylor, Whitman, the sculptor Launt Thompson, and many others of the younger writers and artists of the ” sixties,” some of whota essayed to set up a mild Bohe- mia in the American metropolis. In later years he edited the eclectic (and, for a time, illustrated) weekly Every Saturday, Boston, between 1870 and 1874, and The Atlan- tic Monthly for nine years, beginning with 1881. Aldrich’s successive books of verse, chiefly The Ballad of Bahie Bell (1856), Pampinea, and Other Poems (1861), Flower and Thorn (1876), Friar Jerome’s Beautiful Book (1881), Thirty- six Lyrics and Twelve Sonnets (1881), Mercies and Later Lyrics (1883),

Wynjdham Towers (1889), and the collected editions of 1865 and 1882, showed him to be a poet of lyrical skill, dainty touch, and felicitous conceit, the influence of Herrick being constantly apparent. He has repeatedly essayed the long narrative or dramatic poem, but seldom with success, save in such earlier work as Onmavt Hall in the 1865 collection. But no American poet has shown more skill in describing some single pic- ture, mood, conceit, or episode. The best things he has written are such lyrics as ” Hesperides,” “When the Sultan goes to Ispahan,” ” Before the Eain,” “Nameless Pain,” “The Tragedy,” “Seadrift,” “Tiger-Lilies,” “The One White Rose,” ” Palabras Carifiosas,” ” Destiny,” or the eight-line poem ” Identity,” which did more to spread Aldrich’s reputation than any of his writing after the ” Babie Bell ” of 1856. Beginning with the collection of stories entitled Marjorie Daw and OtJier People (1873),

Aldrich applied to his later prose work that minute care in composition which had previously characterized his verse — taking a neat, new, or salient situation, and setting it before the reader in a pretty combination of kindly realism and reticent humour. In the novels of Prudence Palfrey (1874), Tlie Queen of Sheba (1877), ahd The Still- water Tragedy (1880), there is more rapid action ; but the Portsmouth pictures in the first-named are elaborated with the affectionate touch shown in the shorter humor- ous tale, A Rivermouth Romance. In An Old Town by the Sea (1893) the authpr’s birthplace was once more commemorated in plainer colours, while travel and descrip- tion are the theme of the chapters entitled From Ponka- pog to Pesth (1883), though the portrayals are still those of a poet and humorist.

Aleardi, Aleardo, Count (1812-1878), Italian poet, was born at Verona, 4th November 1812, and thus soon after his birth became an Austrian subject. Inspired from his cradle with a hatred of the foreigner, he found himself disqualified f or £he position in the public service to which his rank would have entitled him, and imable to publish his patriotic verses. Amaldo da Rocca, a narra- tive poem, nevertheless appeared in 1842, and the revolu- tionary year 1848 made an opening for his Lettere a Maria. He took an active part in the popular uprising, and was for some time imprisoned. In 1856 he produced the finest of his pieces, an ode to the maritime cities of Italy, and in 1858 a poem on his own misfortunes. After the expulsion of the Austrians from Lombardy he returned to Verona, published his poems in a collected edition, became professor at the Academy of Pine Art, member of the Italian Parliament, and eventually senator. He died on 17th July 1878. Aleardi’s warmth of patriotic feeling hardly finds adequate expression in his poetry ; it is his merit to excel in description, but his fa^lt to substitute description for action.

Alefi. See New Caledonia.

Alemtejo, a’southem province of Portugal, measuring 155 miles long from N. to S.,-and 60 miles in mean breadth, with an area of 9425 square miles, and population 393,054 ; density, 41-7 inhabitants to the square mile. The horses in this province embrace the Alter breed, the finest in the kingdom. Marble is found, and there are copper and iron mines. Mineral waters exist at Aljustrel, Cabeqo de Vide, Mertola, Ouguella, Portalegre, Souzel, and Vimieiro. Cloth is manufactured at Portalegre and pottery at Estre- moz. The only port is Villa Nova de Milf ontes. There are meteorological stations at Evora, Beja, and Campo Maior.

Aleppo, (1) a vilayet of Asiatic Turkey, in Northern Syria. The mountain districts, which occupy nearly half the area, are rich in mineral wealth, and the large inland plains are fertile but uncultivated. Mineral springs are numerous. Nearly all the external trade passes through Alexandrstta; the average annual value of the exports for 1896-98 was £1,075,453, and of imports £2,014,012. Population, 995,800 (Moslems and Ansarieh, 792,400; Christians, 183,400 ; Jews, 20,000). (2) The chief town of the viMyet, situated near the edge of the Syrian desert, in a fertile valley, almost enclosed by limestone hills, through which runs the Koweik (GJialus). Its former importance and rapid recovery

from repeated disaster were due to its position on the caravan route to Baghdad, Persia, and India. Its large trade led to the establishment of a British consulate and factory in the reign of Elizabeth. The opening of the sea route to India affected its prosper- ity, but it is still the emporium of Northern Syria, and connected with its port Alexandretta by a carriage road (96

miles). Aleppo was a place of importance 2000 years b.c, and is mentioned in Egyptian and Assyrian inscriptions. It was enlarged and called JBercea by Seleucus Nicator, but the old name afterwards reasserted itself under the form Haleb. It was rebuilt after an earthquake in the 12th century by the famous Niir' ed-Din, and was closely con- nected with the history of Saladin and his successors. The town has always retained its Arab character, and the Christians and Jews have their own quarters. Population, 129,000 (Moslems, 98,000; Christians, 23,000; Jews, 8000). It is the seat of a British consulate.

Alessandria, chief town of the Italian province of the same name, situated almost entirely upon the right bank of the river Tanaro, slightly to the west of its confluence with the Bormida. It is distant 67 miles from Turin by rail. The population numbers 70,000, half living in the city proper and half in the suburbs. Ales- sandria is therefore divided into two municipal districts, the one within, the other outside the walls. It is the headquarters of the second army corps. From a military point of view its importance is great, its citadel being considered one of the principal bulwarks of Italy and the strategic key of Piedmont. The interior of the cathedral was recently restored in Bramantesque style, ac- cording to designs by Count Mella. Among public buildings are the provincial and municipal palaces, the civil hospital, lately remodelled in accordance with modern hygienic exigencies, the synagogue, the lunatic asylum, the episcopal seminary, the library, and the municipal theatre. The ' cattle market with its vast roofing and pens is the most important in Italy. Education is provided for by a royal lyceum-gymnasium, by a technical school and an institute, and by a normal female school. In regard to charitable institutions Alessandria is provided with a foundl|ing hospital, a refuge for mendicants, and several asylums and hospitals. More than 50 mutual benefit associations pro- vide for the insurance of the working classes, while an im- portant savings bank testifies to the thrift of the population. The principal monuments are statues to the liberal states- man Urbano Rattazzi, to Andrea Vochieri, and to the Alessandrians who fell during the Risorgimento. The chief manufactures are furniture-making, hat-making, and iron-smelting. Trade is favoured by the circumstance that the town stands at the converging point of several valleys, rich both in industrial and agricultural products, (a. fb.)

Aleutian Islands. See Alaska.

Alexander II. (1818-1881), emperor of Russia, eldest son of Nicholas I., was born on 29th April 1818. His early life gave little indication of his subsequent activity, and up to the moment of his accession in 1855 no one ever imagined that he would be known to posterity as a great reformer. In so far as he nad any decided political con- victions, he seemed to be animated with tha,t reactionary spirit which was predominant in Europe at the time of his birth, and continued in Russia to the end of his father's reign. In the period of thirty years during which he was heir-apparent, the moral atmosphere of St Petersburg was very unfavourable to the development of any originality of thought or character. It was a time of government on martinet principles, under which all freedom of thought and all private initiative were as far as possible suppressed vigorously by the administration. Political topics wire studiously avoided in general conversation, and books or newspapers in which the most keen-scented press-censor could detect the least odour of political or religious free- thinking were

strictly prohibited. Criticism of existing authorities was regarded as a serious offence. The common policeman, the insignificant scribe in a public of&ce, and even the actors in the “imperial ” theatres, were protected

against public censure as effectually as the Government itself ; for the whole administration was considered as one and indivisible, and an attack on the humblest representa- tive of the imperial authority was looked on as an indirect attack on the fountain from which that authority flowed. Such was the moral atmosphere in which young Alexander Nicolaevitch grew up to manhood. He received the educa^ tion commonly given to young Russians of good family at that time — a smattering of a great many subjects, and a good practical acquaintance with the chief modern European language^. Like so many of his countrymen he displayed great linguistic ability, and his quick ear caught up even peculiarities of dialect. His ordinary life was that of an ofiicer of the Guards, modified by the ceremonial duties incumbent on him as heir to the throne. Nominally he held the post of director of the military schools, but he took little personal interest in military affairs. To the disappointment of his father, in whom the military instinct was ever predominant, he showed no love of soldiering,

Alexander 11. (JYom a photograph T>y W. db D. Downey, London.’)

and gave evidence of a kindliness of disposition and a tender-heartedness which were considered out of place in one destined to become a military autocrat. These tendencies had been fostered by his tutor Zhukovski, the amiable, humanitarian poet, who had made the Russian public acquainted with the literature of the German romantic school, and they remained with him all through life, though they did not prevent him from being severe in his official position when he believed severity to be necessary. In 1841 he married the daughter of the Grand Duke Ludwig II. of Hesse, Maximilienne Wilhelmine Marie, thenceforward known as Maria Alexandrovna, who bore him six sons and two daughters. He did not travel much abroad, for his father, in his desire to exclude from Holy Russia the subversive ideas current in Western Europe, disapproved foreign tours, and could not con- sistently encourage in his own family what he tried to prevent among the rest of his subjects. In the years, however, immediately preceding his accession, he was entrusted with several missions to the courts of Berlin and Vienna. On 2nd March 1855, during the Crimean war, he succeeded to the throne on the death of his father.

The first year of the new reign was devoted to the prosecution of the war, and, after’ the fall of Sebastopol, to negotiations for peace. Then began a period of radical reforms, recommended by public opinion and carried out by the autocratic power. The rule of Nicholas, which had sacrificed all other interests to that of making Russia an irresistibly strong military power, had been tried by the Crimean war and found wanting. A new system must, therefore, be adopted. All who had any pretensions to enlightenment declared loudly that the country had been exhausted and humiliated by the war, and that the only way of restoring it to its proper position in Europe was to develop its natural resources and to reform thoroughly all branches of the administration. The Government found, therefore, in the educated classes a new-bom public spirit, anxious to assist it in any work of reform that it might think fit to undertake. Fortunately for Bussia the autocratic power was now in the hands of a man who was impressionable enough to be deeply influ- enced by the spirit of the time, and who had sufficient prudence and practical common-sense to prevent his being carried away by the prevailing excitement into the danger- ous region of Utopian dreaming.- Unlike some of his pred-

ecessors, he had no grand, original schemes of his own to impose by force on unwilling subjects, and no pet crotchets to lead his judgment astray ; and he instinctively looked with a suspicious, critical eye on the panaceas which more imaginative and less cautious people recommended. These traits of character, together with the peculiar circumstances in which he was placed, determined the part which he was to play. He moderated, guided, and in great measure realized the reform aspirations of the educated classes. Though he carefully guarded his autocratic rights and privileges, and obstinately resisted all efforts to push him farther than he felt inclined to go, he acted for several years somewhat like a constitutional sovereign of the Con- tinental type. At first he moved so slowly that many of the impatient, would-be reformers began to murmur at the unnecessary delay. In reality not much time was lost. Soon after the conclusion of peace important changes were made in the legislation concerning industry and commerce, and the new freedom thus accorded produced a large number of limited liability companies. At the same time plans were formed for constructing a great network of railways, partly for the purpose of developing the natural resources of the country, and partly for the purpose, of increasing its powers of defence and attack. Then it was found that further progress was blocked by a great obstacle, Bmancipa- ^^^ existence of serfage; and Alexander II. iioaofthe showed that, unlike his father, he meant to serfs. grapple boldly with the difficult and dangerous

problem. Taking advantage of a petition presented by the Polish landed proprietors of the Lithuanian provinces, praying that their relations with the serfs might be regulated in a more satisfactory way — meaning in a way more satisfactory for the proprietors — he authorized the formation of committees ” for ameliorating the condition of the peasants,” and laid down the principles on which the amelioration was to be effected. This was a decided step, and it was followed by one still more significant. “Without consulting his ordinary advisers, his Majesty ordered the minister of the interior to send a circular to the provincial governors of European Russia, containing a copy of the instructions forwarded to the governor-general of Lithuania, praising the supposed generous, patriotic in- tentions of the Lithuanian landed proprietors, and suggest- ing that perhaps the landed proprietors of other provinces might express a similar desire. The hint was taken, of course, and in all provinces where serfage existed emanci- pation committees were formed. The deliberations at once raised a host of important, thorny questions. The eman-

cipation was not merely a humanitarian question capable of being solved instantaneously by imperial ukaz. It contained very complicated problems affecting deeply the economic, social, and political future of the nation. Alexander II. had little of the special knowledge required for dealing successfully with such problems, and he had to restrict himself to choosing between the different measures recommended to him. The main point at issue was whether the serfs should become agricultural labourers dependent economically and administratively on the landlords, or should be transformed into a class of independent communal proprietors. The emperor gave his support to the latter project, and the Russian peasantry accordingly acquired rights and privileges such as are enjoyed by no other peasantry in Europe. Inthenumerous other questions submitted to him he began by consulting carefully the conflicting authorities, and while leaning as a rule rather to the side of those who were known as “Liberals,” he never went so far as they desired, and always sought some middle course by which conflicting interests might be reconciled. On the 3rd of March 1861, the sixth anniversary of his accession, the emancipation law was signed and published. Other reforms followed in quick succession during the next five or six years: army and navy organization, a new judicial administration on the Erehch model, a new penal code and a greatly simplified system of civil and criminal procedure, an elaborate scheme of local self-government for the rural districts and the large towns, with elective assemblies possessing a restricted right of taxation, and a new rural and municipal police under the direction of the minister of the interior. These new institutions were incomparably better than the old ones which they replaced, but they did not work such miracles as inexperienced enthusiasts expected. Comparisons were made, not with the past, but with an ideal

state of things which never existed in Russia or elsewhere. Hence arose a general feeling of disappointment, which acted on different natures in dif- ferent ways. Some of the enthusiasts sank into a scep- tical, reactionary frame of mind; while others, with deeper convictions or capable of more lasting excitement,, attributed the failure to the fact that only half-measures, and compromises had been adopted by the G-overnment. Thus appeared in the educated classes two extreme groups : on the one hand, the discontented Conservatives, who rec- ommended a return to a more severe disciplinarian rigime; and on the other, the discontented Radicals, who would have been satisfied with nothing less than the adoption of a thoroughgoing socialistic programme. Between the two extremes stood the discontented Moderates, whO' indulged freely in grumbling without knowing, how the unsatisfactory state of things was to be remedied. For some years the emperor, with his sound common- sense and dislike of exaggeration, held the balance fairly between the two extremes; but long years of uninterrupted labour, anxiety, and disappointment weak- ened his zeal for reform, and when radicalism assumed more and more the form of secret societies and revo- lutionary agitation, he felt constrained to adopt severe repressive measures.

The revolutionary agitation was of a very peculiar kind. It was confined to a section of the educated classes, and emanated from the universities and higher- technical schools. At the beginning of the reform period there had been much enthusiasm for scien- tific as opposed to classical education. Russia re- quired, it was said, not classical scholars, but practical, scientific men, capable of developing her natural re- sources. The Government, in accordance with this view, had encouraged scientific studies *"'

until it discovered to its astonishment that there was some

mysterious connexion between natural science and revolu- tionary tendencies. Many of the young men and ■women, wlio were supposed to be qualifying as specialists in the various spheres of industrial and commercial en- terprise, were in reality devoting their time to consider- ing how human society in general, and Eussian society in particular, could be reconstructed in accordance with the latest physiological, biological, and sociological prin- ciples. Some of these young people wished to put their crude notions immediately into practice, and as their desire to make gigantic socialist experiments naturally alarmed the Government, their activity was opposed by the police. Many of them were arrested and imprisoned or exiled to distant provinces, but the revolutionary work was continued with unabated zeal., Thfis arose a struggle between the youthful, hot-headed partisans of revolutionary physical science and the zealous of- ficial guardians of political order — a struggle which has made the strange term Nihilism a familiar word not only in Eussia but also in Western Europe. The move- ment gradually assumed the form of terrorism, and aimed at 'the assassination of prominent officials, and even of the emperor himself, and the natural result was that the reactionary tendencies of the Government were strengthened.

In foreign policy Alexander II. showed the same qualities of character as in internal affairs, ever trying prudently

to steer a middle course. When he came to the Doi^^" throne, a peace policy was imposed on him by

circumstances. The Crimean war was still going on, but as there was no doubt as to the final issue, and the country was showing symptoms of exhaustion, he con- cluded peace with the Allies as soon as he thought the national honour had been satisfied. Prince Gortchakoff could then declare to

Europe, “La Russie ne boude pas; elle se recueille” ; and for fifteen years he avoided foreign complications, so that the internal strength of the country might be developed, while the national pride and ambition received a certain satisfaction by the expansion of Eussian influence and domination in Asia. Twice, indeed, during that period the chancellor ran the risk of provoking war. The first occasion was in 1863, when the Western Powers seemed inclined to interfere in the Polish question, and the Eussian chancery declared categorically that no inter- ference would be tolerated. The second occasion was during the Franco-German war of 1870-71, when the Cabinet of St Petersburg boldly declared that it considered itself no longer bound by the Black Sea clause of the Treaty of Paris. On both these occasions hostilities were averted. Not so on the next occasion, when Eussia aban- doned her attitude of reaueiUement. Wlien the Eastern Question was raised in 1875 by the insurrection of Herze- govina, Alexander II. had no intention or wish to provoke a great European war. No doubt he was waiting for an opportunity of recovering the portion of Bessarabia which had been ceded by the Treaty of Paris, and he perceived in the disturbed state of Eastern Europe a possibility of obtaining the desired rectification of frontier, but he hoped to effect his purpose by diplomatic means in conjunction with Austria. At the same time he was anxious to obtain for the Christians of Turkey some amelioration of their condition, and to give thereby some satisfaction to his own subjects. As autocratic ruler of the nation which had long considered itself the defender of the Eastern Orthodox faith and the protector of the Slav nationalities, he could not remain inactive at such a crisis, and he gradually allowed himself to drift into a position from which he could not retreat without obtaining some tangible result. Supposing that the Porte would yield to diplomatic pressure and menace so far as to make some reasonable concessions, he delivered his famous Moscow speech, in

which he declared that if Europe would not secure a better position for the oppressed Slavs he would act alone. The diplomatic pressure failed, and war became inevitable. During the campaign he displayed the same perseverance and the same moderation that he Ijad shown in the emancipation of the serfs. To those who began to despair of success, and advised him to conclude peace on almost any terms so as to avoid greater dis- asters, he turned a deaf ear, and brought the campaign to a successful conclusion; but when his more head- strong advisers urged him to insist on terms which would probably have produced a conflict with Great Britain and Austria, he resolved, after some hesitation, to make the requisite concessions. In this resolution he was influenced by the discovery that he could not rely on the expected support of Germany, and the discovery made him waver in his devotion to the German alliance, which had been the main pivot of his foreign policy ; but his personal attachment to the Emperor William prevented him from adopting a hostile attitude towards the empire he had helped to create.

The patriotic excitement produced by the war did not weaken the revolutionary agitation. The struggle between the Terrorists and the police authorities became more and more intense, and attempts at assassination became more and more frequent. Alexander II. succumbed by degrees to the mental depression produced originally by the disappointments which he experienced in his home and foreign policy ; and in 1880, when he had reigned twenty- five years, he entrusted to Coimt Loris-Melikof a large share of the executive power. In that year the empress died, and a few weeks afterwards he married secretly a Princess Dolgoruki, with whom te had already entertained intimate relations for some years. Early in 1881, on the advice of Count Loris-Melikof, he determined to try the effect of some moderate liberal reforms on the revolutionary agitation, and for this purpose he caused an ukaz to be prepared creating special commissions, composed of high officials and private personages who should prepare reforms in various branches of the administration. On the very day on which this ukaz was signed — 13th March 1881 — he fell a victim to a Nihilist plot. When driving in one of the central streets of St Petersburg, near the Winter Palace, he was mortally wounded by the explosion of some small bombs, and died a few hours afterwards.

(d. m. w.)

Alexander III. (1845-1894), emperor of Eussia, second son of Alexander II., was born on 10th March 1846. In natural disposition he bore little resemblance to his soft- hearted, liberal-minded father, and still less to his refined, philosophic, sentimental, chivalrous, yet cunning grand- uncle Alexander I., who coveted the title of ” the first gentle- man of Europe.” With high culture, exquisite refinement, and studied elegance he had no sympathy, and never af- fected to have any. Indeed, he rather gloried in the idea of being of the same rough texture as the great majority of his subjects. His straightforward, abrupt manner sa- voured sometimes of gruffness, while his direct, unadorned method of expressing himself harmonized well with his rough-hewn, immobile featiires and somewhat sluggish movements. His education was not fitted to soften these peculiarities. During the first twenty years of his life he had no prospect, of succeeding to the throne, because he had an elder brother, Nicholas, who seemed of a fairly robust constitution. Even when this elder brother showed symptoms of delicate health it was believed that his life might be indefinitely prolonged by proper care and atten- tion, and precautions had been taken for the succession by his betrothal with the Princess Dagmar of Denmark. In these circumstances the greatest solicitude was devoted

to the education of Nicholas as cesarevitcli, whereas Alexander received only the perfunctory and inadequate training of an ordinary grand duke of that period, which did not go much beyond primary and secondary instruc- tion, practical acquaintance with French, Eiiglish, and German, and a certain amount of drill. When he became heir-apparent by the death of his elder brother in 1865, he began to study the principles of law and administration under Professor Podgdonostsef, who did not succeed in awakening in his pupil a love of abstract studies or pro- longed intellectual exertion, but who influenced the character of his reign by instilling into his mind the belief that zeal for Eastern Orthodoxy ought,, as an essential factor of Russian patriotism, to be specially cultivated by every right-minded Tsar. His elder brother when on his deathbed had expressed a wish that his affianced bride, Princess Dagmar of Denmark, should marry his successor, and this wish was realized on 9th November 1866. The union proved a most happy one and remained unclouded to the end. During those years when he was heir- apparent — 1865 to 1881 — he did not play a prominent

part in public affairs, but he allowed it to become known that he had certain ideas of his own which did not coincide with the principles of the existing Government. He deprecated what he considered undue foreign influence in general, and German influence in particular, and he longed to see the adoption of genuine national principles in all spheres of official activity, with a view to realizing his ideal of a homogeneous Eussia — ^homogeneous in language, administration, and religion. With such ideas and aspirations he could hardly remain permanently in cordial agreement with his father, who, though a good patriot according to his lights, had strong German sympathies, often used the German language in his private relations, occasionally ridiculed the exaggerations and eccentricities of the Slavophils, and based his foreign policy on the Prussian alliance. The antagonism first appeared publicly during the Franco-German war, when the Tsar supported the Cabinet of Berlin and the cesare- vitch did not conceal his sympathies with the French. It reappeared in an intermittent fashion during the years 1876-79, when the Eastern Question produced so much excitement in all ranks of Russian society. At first the cesarevitch was more Slavophil than the Government, but his phlegmatic nature preserved him from many of the

exaggerations indulged in by others, and any of the prevalent popular illusions he may have imbibed were soon dispelled by personal observation in Bulgaria, where he commanded the left wing of the invading army. The Bulgarians had been represented in St Petersburg and Moscow not only as martyrs but also as saints, and a very little personal experience sufficed to correct the error. Like most of his brother officers he could not feel any very great affection for the ” little brothers,” as the Bulgarians were then commonly called, and he was constrained to admit that the Turks were by no means so black as they had been painted. He did not, however, scandalize the believers by any public expression of his opinions, and did not indeed make himself conspicuous in any way during the campaign. Never consulted on political questions, he confined himself to his military duties, and fulfilled them in a conscientious and unobtrusive manner. After many mistakes and disappointments, the army reached Constan- tinople and the treaty of San Stefano was signed, but much that had been obtained by that important document had to be sacrificed at the Congress of Berlin. Prince Bismarck failed to do what was confidently expected of him. In return for the Russian support, which had enabled him to create the German empire, it was thought that he would help Russia to solve the Eastern Question in accordance with her own interests, but to the surprise and indignation of the Cabinet of St Petersburg he confined himself to acting the part of “honest broker” at the Congress, and shortly afterwards he ostentatiously con- tracted an alliance with Austria for the express purpose of counteracting Russian designs ia Eastern Europe. The cesarevitch could point to these results as confirming the views he had expressed during the Franco-German war, and he drew from them the practical conclusion that for Russia the best thing to do was to recover as quickly as possible from her temporary exhaustion and to prepare for future contingencies by a radical scheme of military and naval reorganization. In accordance with this conviction, he suggested that certain reforms should be introduced. During the campaign in Bulgaria he had found by painful experience that grave disorders and gross corruption existed in the military administration, and after his return to St Petersburg he had discovered that similar abuses existed in the naval department. For these abuses, several high-placed personages — among others two of the grand diikes — ^were believed to be responsible, and he called his father’s attention to the subject. His representations were not favourably received. Alexander II. had lost much of the reforming zeal which distinguished the first decade of his reign, and had no longer the energy required to under- take the task suggested to him. The consequence was that the relations between father and son became more strained. The latter must have felt that there would be no important reforms until he himself succeeded to the direction of affairs. That change was much nearer at hand than was commonly supposed. On 13th March 1881, Alexander II. was assassinated by a band of Nihil- ists, and the autocratic power passed to the hands of his son.

In the last years of his reign, Alexander 11. had been much exercised by the spread of Nihilist doctrines, and the increasing number of anarchist conspiracies, and for some time he had hesitated between strengthening the hands of the executive and making concessions to the widespread political aspirations of the educated classes. Finally he decided in favour of the latter course, and on the very day of his death he signed an ukaz, creating a number of consultative commissions which might have been easily transformed into an assembly of notables. Alexander III. determined to adopt the opposite policy. He at once cancelled the ukaz before it was published, and in the

manifesto aimouncing his accession to the throne he let it be very clearly understood that he had no intention of limiting ot weakening the autocratic power which he had inherited from his ancestors. Nor did he afterwards show any inclination to change his mind. All the internal reforms which he initiated were intended to correct what he considered as the too liberal tendencies of the previous reign, so that he left behind him the reputation of a sovereign of the retrograde type. In his opinion

Russia was to be saved from anarchical disorders and revolution- ary agitation, not by the parliamentary institutions and so-called liberalism of Western Europe, but by the three principles which the elder generation of the Slavophils systematically recommended — ^nationality. Eastern Ortho- doxy, and autocracy. His political ideal was a nation con- taining only one nationality, one language, one religion, and one form of administration ; and he did his utmost to prepare for the realization of this ideal by imposing the Russian language and Russian schools on his German, Polish, and Finnish subjects, by fostering Eastern Ortho- doxy at the expense of other confessions, by persecuting the Jews, and by destroying the remnants of German, Po- lish, and Swedish institutions in the outlying provinces. In the other provinces he sought to counteract what he con- sidered the excessive liberalism of his father's reign. For this purpose he clipped the feeble wings of the Zemstvo, an elective local administration resembling the county and parish councils in England, and placed the autonomous administration of the peasant communes under the super- vision of landed proprietors appointed by the Government. At the same time he sought to strengthen and centralize the imperial administration, and to bring it more. under his personal control. In foreign affairs he was emphatic- ally a man of peace, but not at all a partisan of the doctrine of peace at any price, and he followed the principle that the best means of averting war is to be well prepared for it. Though indignant at the conduct of Prince Bismarck towards Russia, he avoided an open rupture with Germany, and even revived for a time the Three Emperors' Alliance. It was only in the last years of his reign, when M. Katkoff had acquired a certain influence over him, that he adopted towards the Cabinet of Berlin a more hostile attitude, and even then he confined himself to keeping a large quantity of troops near the German frontier, and establishing cordial relations with France. With regard to Bulgaria he exercised similar self-control. The efforts of Prince Alexander and after- wards of M. Stamboloff to destroy Russian influence in the principality excited his indignation, but he persistently vetoed all proposals jbo intervene by force of arms. In Central Asian affairs he followed the traditional policy of gradually extending Russian domination without provok- ing a conflict with Great Britain, and he never allowed the bellicose partisans of a forward policy to get out of hand. As a whole his reign cannot be regarded as one of the event- ful periods of Russian history ; but it must be admitted that, under his hard, unsjrmpathetic rule, the country made considerable progress. He died at Livadia on 1st November 1894, and was succeeded by his eldest son, Nicholas II. (d. m. w.)

Alexander of Battenbeeg (1857-1893), first Prince of Bulgaria, was the second son of Prince Alexander of Hesse and the Rhine by his morganatic marriage with Julia, Countess von Hauke. The title of Battenberg, derived from an ancient residence of the grand-ducal family of Hesse, w^s conferred, with the prefix Durch- laucht or " Serene Highness," on the countess and her descendants in 1868. Prince Alexander, who was born 6th April 1857, was nephew of the Tsar Alexander II.,

who had married a sister of Prince Alexander of Hesse ; his mother, a daughter of Count Moritz von Hauke, had been lady-in-waiting to the Tsaritsa. In his boyhood and early youth he was frequently at St Petersburg, and he accompanied his uncle, who was much attached to him, during the Bulgarian campaign of 1877. When Bulgaria under the Berlin Treaty was constituted an autonomous principality under the suzerainty of Turkey, the Tsar recommended his nephew to the Bulgarians as a candidate for the newly-created throne, and Prince Alexander was elected prince of Bulgaria by unanimous Vote of the Grand Sobranye, 29th April 1879. He was at that time serving as a lieutenant in the Prussian life- guards at Potsdam. Before proceeding to Bulgaria, Prince Alexander paid visits to the Tsar at Livadia, to the courts of the Great Powers, and to the Sultan ; he was then con- veyed on a Russian warship to Varna, and after taking the oath to the new constitution at Tirnova (8th July 1879) he repaired to Sofia, being everywhere greeted with immense enthusiasm by the people. (For the political history of Prince Alexander's reign, see Bulgaria.) Without any previous training in the art of government, the young- prince from the outset found himself confronted with difficulties which would have tried the sagacity of an experienced ruler. On the one hand he 'was exposed to numberless humiliations on the part of the representatives of official Russia, who made it clear to

him that he was expected to play the part of a roifaindant; on the other he was compelled to make terms with the Bulgarian poli- ticians, who, intoxicated with newly-won liberty, prosecuted their quarrels with a crude violence which threatened to subvert his authority and to plunge the nation in anarchy. After attempting to govern under these conditions for nearly two years, the prince, with the consent of the Tsar Alexander III., assumed absolute power (9th May 1881), and a suspension of the ultra^democratic constitution for a period of seven years was voted by a specially convened assembly (13th July). The experiment, however, proved unsuccessful ; the Bulgarian Liberal and Radical politi- cians were infuriated, and the real power fell into the hands of two Russian generals, Soboleff and Kaulbars, who had been specially despatched from St Petersburg. The prince, after vainly endeavouring to obtain the recall of the generals, restored the constitution with the concur- rence of all the Bulgarian political parties (18th September 1883) . A serious breach with Russia followed, which was widened by the paxt which the prince subsequently played in encouraging the national aspirations of the Bulgarians. The revolution of Philippopolis (18th September 1885), which brought about the union of Eastern Rumelia with Bulgaria, was carried out with his consent, and he at once assiimed the government of the revolted province. In the anxious year which followed, the prince gave evidence of considerable military and diplomatic ability. He rallied the Bulgarian army, now deprived of its Russian officers, to resist the Servian invasion, and after a brilliant victory at Slivnitza (19th November) pursued King Milan into Servian territory as far as Pirot, which he captured (27th November). Although Servia was protected from the consequences of defeat by the intervention of Austria, Prince Alexander's success sealed the union with Eastern Rumelia, and after long negotiations he was nominated governor-general of that province for five years by the Sultan (6th April 1886). This arrangement, however, cost him much of his popularity in Bulgaria, while dis- content prevailed among a certain number of his officers, who considered themselves slighted in the distribution oi rewards at the close of the campaign. A military con- spiracy was formed, and on the night of the 20th August the prince was seized in the palace at Sofia, and com-

pelled to sign his abdication ; he was then hurried to the Danube at Eakhovo, transported on his yacht to Eeni, and handed over to the Russian authorities, by w^hom he was allowed to proceed to Lemberg. He soon, however, returned to Bulgaria, owing to the success of the counter- revolution led by Stamboloff, which overthrew the provi- sional government set up by the Russian party at Sophia. But his position had become untenable, partly owing to an ill-considered telegram which he addressed to the Tsar on his return; partly in consequence of the attitude of Prince Bismarck, who, in conjunction with the Russian and Austrian Governments, forbade him to punish the leaders of the military conspiracy. He therefore issued a manifesto resigning the throne, and left Bulgaria on the 8th September 1886. He now retired into private life. A few years later he married Fraulein Loisinger, an actress, and assumed the style of Count Hartenau (6th Tebruary 1889). The last years of his life were spent principally at G-ratz, where he held a local com- mand in the Austrian army. Here, after a short illness, he died on the 23rd October 1893. His remains were brought to Sofia, where they received a public funeral, and were eventually deposited in a mausoleum erected in his memory. Prince Alexander possessed much charm and amiability of manner; he was tall, dignified, and strikingly handsome. His capabilities as a soldier have been generally recognized by competent authorities. As a ruler he committed some errors, but his youth and in- experience and the extreme difficulty of his position must be taken into consideration. He was not without apti- tude for diplomacy, and his intuitive insight and percep- tion of character sometimes enabled him to outwit the crafty politicians by whom he was surrounded. His principal fault was a want of tenacity and resolution; his tendency to unguarded language undoubtedly in- creased the number of his enemies.

The literature relating to Prince Alexander's reign is still scanty. See Dbandae. Le Prince Alexandre de Battenberg en Bulgarie. Paris, 1884.— Koch. Fiirst Alexander von Bulgarien. Darm- stadt, 1887. — Matteybv. Bulgarien nach dem Berliner Congress. Petersburg, 1887. — Bourchibk. " Prince Alexander of Batten- berg," in Fortnightly Review, January 1894. /j jj_ g \

Alexander, king of Servia (1876), was born

14th August 1876. He succeeded to the crown on 6th March 1889, when his father. King Milan, abdicated and proclaimed him king of Servia under a regency until he should attain his majority at eighteen years of age. King Alexander on 13th April 1893, being then in his seven- teenth year, made his notable coup d'itat and took the royal authority into his own hands. After a banquet on that day he made a stirring appeal to the army, pro- claimed his majority, and dismissed the regents and their ministry. His action was popular, and was rendered still more so by his appointment of a Radical ministry. In May 1894 King Alexander, by another coup d'ital, abolished the constitution of 1889 and restored that of 1869, thus reinstating King Milan and Queen Natalie in their constitutional rights as members of the royal house of Obrenovitch. His attitude during the Turco-Greek war of 1897 was one of strict neutrality. In 1898 he appointed his father commander-in-chief of the Servian army, and from that time, or rather from his return to Servia in 1894 until 1900 ex-King Milan was regarded as the de facto ruler of the country. But on 21st July 1900 King Alexander publicly betrothed himself to ' Madame Draga Maschin, a vridow, formerly a lady-in- waiting to Queen Natalie. The projected union aroused great opposition at first, and ex-King Milan resigned his post, an example followed by all the government officials ; the marriage, however, was duly celebrated on 5th August,

and the king's firmness in the matter greatly strengthened his position, which was made even more secure by the death of his father shortly afterwards.

Alexander, William (1824- ^), Protestant Arch- bishop of Armagh and Primate of all Ireland, wasiorn at Londonderry 13th April 1824, and educ9,ted at Tonbridge Grammar School and at Exeter and Brasenose colleges, Ox- ford. After holding several livings in the north of Ireland he was made bishop of Derry and Raphoe in 1867, and was elevated to the primacy in 1896. An eloquent preacher and the author of numerous theological works, he is best known to literature as a master of dignified and animated verse. His poems were collected in 1887 under the title ■ of St Augustine's Holiday, and other Poems. His wife, who died in 1895, was also known as a writer of graceful poetry, and particularly for her hymn " There is a Green Hill far away."

Alexandra, Queen. See Edwabd YII.

Alexandretta, or Iskandebuit (Alexandria ad Is- sum), the principal port of the Aleppo viMyet, founded by Alexander in memory of the battle of Issus. The town was formerly unhealthy, but since the drainage of the marshes and the provision of a better water-supply, its sanitary condition has greatly improved and trade is increasing. Population, iSOOO (Moslems, 5500 ; Christians, 2500). ^ It is the seat of a British vice-consulate. See Aleppo.

Alexandria, the chief seaport and, next to Cairo, the largest city in Egypt. It suffered severely during the revolt of Arabi Pasha in June and July 1882, when, both before and after the bombardment of the forts by the British fleet, great disorders broke out in the town. On 11th June over 400 Europeans were massacred by the fanatical Mahommedans, and on the night following the bombardment (11th July) incendiary riots caused great loss of life and property, for which Egypt had eventually to raise £9,000,000 to meet the claims for compensation made chiefly by Europeans. Since then it has been visited by two epidemics of cholera (1883 and 1897). Nevertheless under the British occupation it has recovered its former commercial and industrial prosperity, as shown by the rapid increase of the

population, which rose from 213,000 in 1882 to 320,000 in 1897, including over 46,000 Europeans, chiefly Greeks and Italians, and about 100 English families. Most of the foreign trade of Egypt passes through this seaport, the imports and exports of which advanced from £5,000,000 and £13,000,000 respectively in 1881 to £9,945,000 and £15,068,000 in 1899. The vessels entered were 3*305 of 1,192,000 tons in 1881, and 2805 of 2,414,674 tons in 1899; the clear- ances for the corresponding years being 3250 of 1,304,000 tons and 2758 of 2,389,058 tons. In 1899 the British entries were 747 of 1,150,231 tons, and clearances 741 of 1,139,698 tons. Alexandria was the first Egyptian town provided with a municipal council, on which the govern- ment, the foreign merchants, and natives are represented. A great deal has been done to improve the town, which is provided with several new thoroughfares, electric light, and electric tramways, while the suburb of Ramleh has been greatly enlarged, and is now occupied chiefly by English residents. A new quay and promenade, extensive wharves and graving docks are also being constructed, while a projected channel 30 feet deep and 300 wide will enable large vessels to enter the port at all times. Amongst the scientific and literary establishments are the Egyptian institute, an athenaeum, with courses of lectures, a public library, and an archaeological museum. In the last-mentioned, founded in 1893, are now safely housed the antiquities, especially Greek and Roman, which are

from time to time brought to light in the district. During the excavations near Pompey’s column in 1900 some monumental ruins were exposed, which have by some archaeologists been identified with the foundations of the great temple of Serapis. Alexandria is held by a British garrison of about 1000 men, including a battalion of infantry and artillery, under a British major-general.

Alexandria, a town in Rumania, situated in a rich grain-producing country, near the Danube, between Roshi-de-Vede and Zimnitza. It was founded by Prince Alexander Couza. Population (1900), 13,676.

Alexandria, a district town of Russia, government of Kherson, 93 miles S.W. of Poltava, on the Ingulets, with tanneries, tallow-houses, and soap and candle works. Population (1897), 14,002.

Alexandria, a manufacturing town of Dumbarton- shire, Scotland, situated on the right bank of the river Leven, opposite Bonhill, by rail 19^ miles W.N.W. of Glasgow. It contains the largest of the five Turkey red dyeing establishments recently amalgamated under one company. The public buildings include a public hall, the mechanics’ institute library, an institute for men, with library and recreation rooms, and a similar institution for women. Population in 1881, 6173 ; 1891, 7796 ; 1901, 8392. Alexandria is in the parish of Bonhill, with the town of which name it is connected by a bridge which replaced in 1898 one bought three years earlier by the County Council from the Smollett family. Population of Bonhill town in 1901, 3922 ; of Bonhill parish, 14,581.

Alexandria, a city of Virginia, U.S.A., situated in 38° 48′ N. lat. and 77° 02′ W. long. Though within the limits of Alexandria county, it is independent of county government, is divided into four wards, and is entered by the Pennsylvania and the Southern railways, and by electric railway from Washington, with which it is also connected by ferry. The Civil War checked its growth, and the powerful rivalry of Washington, only seven miles distant, has held it almost at a standstill for a generation. The Chesapeake and Ohio Canal, which formerly extended to this place, now ends at Washington. The population in 1880 was 13,659, in 1890 it was 14,339, and in 1900 it was 14,528.

Alexandria, a city of Madison county, Indiana, U.S.A., a little north-east of the centre of the state, at the intersection of the Cleveland, Cincinnati,, Chicago, and St Louis and the Lake Erie and Western

railways. It has had a rapid growth, the population increasing from 715 in 1890 to 7221 in 1900.

Alexandria, a town of Louisiana, U.S.A., capital of Rapides Parish, on the south bank of the Red river, in the central part of the state, in a region devoted to the cultivation of sugar-cane and cotton. The population in 1890 was 2861 ; in 1900 it was 6648.

Alexandropol, or Alexandbapol (Turkish Ouleri), a iftussian town, fortress, and fortified camp in Trans- caiicasia, government of Erivan, near the junction of the Arpachai with the Aras, 30 miles by rail E.N.E. of Kars. It has an extensive fortified military camp, and six spacious caravanserais, besides considerable silk trade. Population (1885), 22,670; (1897), 32,020.

Afexandrovsk, the name of several towns in Russia: (1) New settlement of the government of Ar- changel, in the military harbour of Catherine (Ekaterin- insk), on the Norman coast, 6 miles from the mouth of Kola Bay and 26 miles from Kola. It is a naval station. (2) District and town south of Ekaterinoslav, near the

left bank of the Dnieper, below its rapids, and on the rail- way to Sebastopol. It has great store-houses. Population (1897), 16,393. Opposite it is the island of Khortitsa, upon which was the renowned Sich (or Syech) of the Zaporogue Cossacks. All its neighbourhood is strewn with kurgans (tvjxivli). (3) Russian village and fort, on the coast of the maritime province in Gulf De Castries, opposite Sakhalin island. It has a good harbour, hospital, and government store-houses, and trade with America.

Alexandrovsk-Crushevskaya, a Cossack vil- lage of Russia, province of the Don, 6 miles N.W. of Nqvocherkask, in the centre of the Grushevskiya anthra- cite mines. The stock of coal of the latter is estimated at 16,000,000 tons. About 646,000 tons are now ex- tracted every year by about 13,100 workmen. Popula- tion of the village, 16,250 in 1897.

Alfortville, a town, arrondissement of Sceaux, de- partment of Seine, 4 miles E.S.E. of Paris, at the conflu- ence of the Seine and the Marne. India-rubber goods are manufactured, boat-building is carried on, and there are forges and rolling-mills. Population (1891), 7735; (1896), 11,410, (comm.) 11,614.

Alfred Ernest Albert, Duke of Edinburgh, and Duke of Saxe-Cobueg and Gotha, (1844-1900), second son and fourth child of Queen Victoria, was born at Windsor Castle, 6th August 1844. In 1866 it was decided that the prince, in accordance with his own wishes, should enter the navy, and a separate establishment was accordingly assigned to him, with Lieutenant Sowell, R.E.j as governor. He passed a most creditable examination for midshipman in August 1858, and being appoihted to the Euryalus, at once began to work hard at the practical part of his profession. In July 1860, while on this ship, he paid an official visit to the Cape, and made a very favourable impression both on the colonials and on the native chiefs. On the abdication of Otho, king of Greece, in 1862, Prince Alfred was chosen by the whole people to succeed him, but political conventions of long standing rendered it impossible for the British Government to accede to their wishes. The prince therefore remained in the navy, and was promoted lieutenant 24th February 1863, and captain 23rd February 1866, being then appointed to the command of the Galatea. On attaining his majority in 1865, the prince was created duke of Edinburgh and earl of Ulster, with an annuity of £15,000 granted by Parliament. While still in command of the Galatea, the duke started from Plymouth, 24th January 1867, for his voyage round the world. On 11th June 1867, he left Gibraltar and reached the Cape on 24th July, and landed at Glenelg, South Australia, on 31st October. Being the first royal prince to visit Australia, the duke was received with the greatest enthusiasm. During his stay of nearly five months he visited Ade- laide, Melbourne, Sydney, Brisbane, and Tasmania ; and it was on his second visit to Sydney that, while at-

tending a public picnic at Clonfert in aid of the Sailors' Home, an Irishman named O'Farrell shot him in the back with a revolver. The wound was fortunately not dangerous, and within a month the duke was able to resume command of his ship and return home. He reached Spithead on 26th June 1868, after an absence of seventeen months. The duke's next voyage was to India, where he arrived in December 1869. Both there and at Hong Kong, which he visited on the way, he was the first British prince to set foot in the country. The native rulers of India vied with one another in the magnificence of their entertainments during the duke's stay of three months. On 23rd January 1874 the marriage of the duke to the Grand Duchess Marie Alexandrovna, only

daughter of Alexander II., emperor of Eussia, was cele- brated at St Petersburg, and the bride and bridegroom made their public entr;y- into London on 12th March. The duke still devoted himself to his profession, showing complete mastery of his duties and unusual skill in naval tactics. He was promoted rear-admiral, 30th December 1878; vice-admiral, 10th November 1882 ; admiral, 18th October 1887 ; and received his baton as admiral of the Fleet, 3rd June 1893. He commanded the Channel Fleet, 1883-84; the Mediterranean Fleet, 1886-89; and was commander-in-chief at Devonport, 1890-93. He always paid the greatest attention to his official duties, and was most efB.cient as an admiral.

On the death of his uncle, Ernest II., duke of Saxe- Coburg and Gotha, 22nd August 1893, the vacant duchy fell to the duke of Edinburgh, for the Prince of Wales had renounced his right to the succession. At first regarded with some coldness as a " foreigner," he gradually gained

popularity, and by the time of his death, 30th July 1900, he had completely won the good opinion of his subjects. The duke was exceedingly fond of music, and an excellent violiaist, and took a prominent part in establishing the Eoyal College of Music. He was also a keen collector of glass and ceramic ware, and his collection, valued at half a million of marks, was presented by his widow to the "Veste Coburg," near Coburg. When he became duke of Saxe,Coburg he surrendered his English allowance of £16,000 a year, but the £10,000 granted in addition by Parliament on his marriage he retained in order to keep up Clarence House. The duke had one son, who died un- married, 6th February 1899, and four daughters. The third daughter, Princess Alexandra Louisa Olga Victoria, mar-^ ried the hereditary Prince Ernest of Hohenlohe-Langen- burg, who became regent of the duchy of Coburg during the minority of the deceased duke's nephew, the young duke of Albany, to whom the succession fell. (g. f. b.)

ALa^.

THE Latin word Alga seems to have been the equivalent of the English word " seaweed," and probably stood for any or all of the species of plants which form the "wrack" of a seashore. When the word "Algse" came to be employed in classification as the name of a class, an arbitrary limitation had to be set to its signification, and this was not always in keeping w^ith its original meaning. The absence of differentiation into root, stem, and leaf, which prevails among seaweeds, seems, for example, to have led Linnaeus to employ the term in the Genera Plantarum for a sub-class of Oryptogamia, the members of which presented this character in a greater or less degree. Of the fifteen genera included by Linnaeus among Algse, not more than six, viz. i^^Ohara, Fucus, Viva, and Conferva, and in part Tremella and Byssus, would to-day, in any sense in which the term is employed, be regarded as Algse. The excluded genera

are distributed among the Liverworts, Lichens, clulonT ^^^ Fungi; but notwithstanding the great

advance in knowledge since the time of Lin- nseus, the difficulty of deciding what limits to assign to the group to be designated Algae still remains. It arises from the fact that Algse, as generally understood, do not constitute a homogeneous group, suggesting a descent from a common stock. Among them there exist, as vnll be seen hereafter, many well-marked but isolated natural groups, and their inclusion in the larger group is generally felt to be a matter of coifvenience rather than the expres- sion of a belief in their close inter-relationship. Efforts are therefore continually being made by successive writers to exclude certain outlying sub-groups, and to reserve the term Algoe for a central group reconstituted on a more natural basis within narrower limits.

It is perhaps desirable, in an article like this, to treat of Algse in the widest possible sense in which the term may be used, an indication being at the same time given of the narrower senses in which it has been proposed to employ it. Interpreted in this way, the place of Algae in the vegetable kingdom may be shown by means of a table: —

(Myxomycetes Thallophytal Fungi

[AlgcB Bryophyta Pteridophyta Gymnosperms Angiosperms

Algse in this wide sense may be briefly described as the aggregate of those simpler forms of plant life usually

The Vegetable Kingdom

Oryptogamia

Phanerogamia

devoid, like the rest of the ThaUophyta, of differentiation into root, stem, and leaf ; but, unlike other ThaUophyta, possessed of a colouring matter, by means of which they are enabled, in the presence of sunlight, to make use of the carbonic acid gas of the atmosphere as a source of carbon. It is true that certain Bryophyta (Marchantiaxece, Anthocerotece) possess a thalloid structure similar to that of ThaUophyta, and are at the same time possessed of the colouring matter of the Green Algse. Their life-cycle, however, the structure of the reproductive organs, and their whole organization proclaim them to be Bryophyta. (See MusciirE.ai, ninth ed., and Bktophyta.) On the other hand certain undoubted animals (Stentor, Hydra, BonelUa) are provided with a green colouring matter by means of which they make use of atmospheric carbonic acid. A more important consideration is the occasional absence of this colour in species, or groups of species, with, in other respects, Algal affinities. Such aberrant forms are to be regarded in the same light as Cuscuta and Oroban- chacece, for example, among Phanerogams. As these non-green plants do not cease to be classed with other Phanerogams, so must the forms in question be retained among Algse. In all cases the loss of the colouring matter is associated with an incapacity to take up carbon from so simple a coilipound as carbonic acid.

Further discussion of the general characters of Algse will be deferred in order to take a brief survey of the sub- divisions of the group. For this purpose, there will be adopted the classification of Algse into four sub-groups, founded on the nature of the colouring matters present in the plant : —

1. Cyanophtgejb, or Blue-green Algae.

2. Chlorophtcejb, or Green Algse.

3. Phjeophyce^, or Brown Algse.

4. RhodophtcbjE, or Eed Algae.

The merits and demerits of this system will appear during the description of the characters of the members of the several subdivisions.

1. Ctanophtob^.i — This group derives its name from the circumstance that the cells contain in addition to the green colouring matter, chlorophyll, a blue-green colouring matter to which the term phyoocyanin has been applied. To the eye, how- ever, members of this group present a greater variety of colour

1 Includes (exclusive of Bacteriacese) : —

1. CoccogoneiB—2 families, 29 genera, 2S3 species.

2. JSormogonetB—6 families, 59 genera, 701 species.

(Engler and Prantl's Pflanzen/amilienX

than those of any other— yellow, brown, olive, red, purple, violet, and variations of all these being known. They dlvl'sloas 'I'l'ioul'tedly represent the lowest grade of Algal life, and their distribution rivals that of the Green Algss. They occur in the sea, in fresh water, on moist earth, on damp rockis, and on the bark of trees. Certain species are regularly found in the intercellular spaces of higher plants ; such are species of Nostoc in the thallus of Anthoceros, the leaves of Azolla, and the roots of Cycads. Many of them enter into the structure of the lichen-thallus, as the so-called gonidia. It is remarkable that species belonging to the OscillatoriaceK are known to flourish in hot springs, the temperature of which rises as high as 85° C.

The thallus may be unicellular or multicellular. When uni- cellular, it may consist of isolated cells, but more commonly the cells are held together in a common jelly (^Chroococcaceas) derived from the outer layers of the cell-wall. The multicellular species consist of filaments, branched or unbrauched, which arise by the repeated division of the cells in parallel planes, no formation of mucilage occurring in the dividing walls. Such filaments may not give rise to mucilage on the lateral surface either, in which case they are said to be free ; when mucilage does occur on the lateral wall, it appears as the sheath surrounding either the single fila- ment, or a sheaf of filaments of common origin. The mucilage may also form an embedding substance similar to that of Chroo- coccacecB, in which the filaments lie parallel or radiate from a com- mon centre (^BivulariacecB). The cells of the filament may be all alike, and growth may occur equally in all parts (Oscillatoriaceoe) ; or certain cells (heterocysts) may become marked off by their larger siize and the transparency of their contents ; in which case growth may still be distributed equally throughout (iVostoc), or the filament may be attached where the heterocyst arises, and grow out at the opposite extremity into a fine hair (_I{ivulariace(B) . An African form {Gamptothrix) , devoid of heterocysts and hair-like at both extremi- ties, has recently been described. Branching has been described as "false " and " true." The former arises when a filament in a sheath, either in consequence of growth in length beyond the capacity of the sheath to accommodate it, or because of the decay of a cell, becomes interrupted by breaking, and the free ends slip past one another. "True" branching arises only by the longitu- dinal

division of a cell of a filament and the lateral outgrowth of one of the cells resulting from the division (^Sirosiphonacece).

The nature of the contents of the cells of Cyanophycex has given rise to considerable controversy. The cells are for the most part exceedingly minute, and are not easy to free from their colouring matters, so that investigation has been attended with great difficulty. Occupying as these Algse do perhaps the lowest grade of plant life, it is a matter of interest to ascertain whether a nucleus or chromatophore is differentiated in their cells, or whether the functions and properties of these bodies are diflused through the whole protoplast. It Is certain that the centre of the cell, which is usually non-vacuolated, is occupied by protoplasm of different properties from the peripheral region ; and Fischer has further established the fact that the peripheral mass, which is a hollow sphere in spherical cells, and either a hollow cylinder or barrel-shaped body in filamentous forms, must be regarded as the single chromatophore of the Cyanophyceous cell. But whether the central mass is anything more than protoplasm laden with the products of assimilation still remains uncertain. Among other contents of the cell, fatty substances and tannin are known. A curious adaptation seems to occur' in certain floating forms, in the presence of a gas-vacuole, which may be made to vary its volume with varying pressure. There is evidence that the dividing wall of filamentous forms is deeply pitted, as is found to be the case in Red Algse. Reproduction is chiefly effected by the vegetative method. Asexual reproductive cells are not infrequent, but sexual ueproduction even in its initial stages is unknown. Nor is motility by means of cilia known in the group. In the unicellular forms, cell-division involves multiplication of the plant. In all the multicellular plants of this group which have been adequately investigated, vegetative multiplication by means of what are known as hormogonia has been found to occur. These are short segments of filaments consisting of a few cells which disengage themselves from the ambient jelly, if it be present, in virtue of a peculiar creeping movement which they possess at this stage. After a time they come to rest and give rise to new colonies. True reproduction of the asexual kind occurs, however, in the formation of sporangia, particularly in the ChamoBsiphonacecB. Here the contents of certain cells break up endogenously into a great ~~number of spores, which are distributed as a fine dust. Resting spores are also kn(|wn. In these cases certain cells of a colony of unicellular plants or of the filaments of multicellular plants enlarge greatly and thicken their wall. When unfavour~~ able external conditions supervene and the ordinary cells become atrophied, these cells persist and reproduce the plant with the return of more favourable conditions. The Oscillatoriacece are capable of a peculiar oscillatory movement, which has earned for

them their name, and which enables them to move through con- siderable distances. It is not clear how the movement is effected, though it has frequently been the subject of careful investigation.

With the Oyanophycece must be included, as their nearest allies, the Bacteriacece: Notwithstanding the absence of chlorophyll, and the consequent parasitic or saprophytic habit, Bacteriacece agree in so many morphological features with Cyanophycece that the aflnity can hardly be doubted.

They are, however, not further considered here, since they are separately dealt with in this work. (See Bactekiologt.)

2. ChiiOeophyceje.' — This group includes those Algse in which the green colouring matter, chlorophyll, is not accompanied by a second colouring matter, as it is in other groups. It consists of three subdivisions : — Conjugatx, Muchlorophycem, and CharacecB. Of these the first and last are relatively small and sharply defined families, distinguished from the second family, which forms the bulk of the group, by characters so diverse that their inclusion with them in one larger group can only be justified on the ground of convenience. HuchlorophycecB are made up in their turn of three series of families: — Protococcales, Confervales, and Siphonales. ChlorophycecB include both marine and freshwater plants. Con- jugatce, Protococcales, and Characeoe are exclusively freshwater;

Confervales and Siphonales are both freshwater and marine, but the latter group attains its greatest development in the sea. Some ChlorophycecB are terrestrial in habit, usually growing on a damp substratum, however. Trentepohlia grows on rocks and can sur- vive considerable desiccation. Phycopeltis grows on the surface of leaves, Phyllobium and Phyllosiphon in their tissues. Gomontia is a shell-boring Alga, Dermatophyhn grows on the carapace of the tortoise, and Trichophilus in the hairs of the sloth. Certain Proto- coccales and Confervales exist as the gonidia, of the lichen-thallus.

The thallus is of more varied structure in this group than in any other. In the simplest case it may consist of a single cell, which may remain free during the whole or the greater part of its existence, or be loosely aggregated together within a common mucilage, or held together by the adhesion of the cell-walls at the surface of contact. These aggregations or colonies, as they are termed, may assume the form of a plate, a ring, a solid sphere, a hollow sphere, a perforate sphere, a closed net, or a simple or branched filament. It is not easy in all cases to draw a dis- tinction between a colony of plants and a multicellular indi- vidual. In a Volvox sphere, for example, there is a marked protoplasmic continuity between all the cells of the colony. The UlvacecB, the thallus of which consists of laminse one or more cells thick, or hollow tubes, probably represent a still more advanced stage in the passage of a colony into a multicellular plant. Here there is some amount of localization of growth and distinction of parts. It is only in such cases as Volvox and Ulvaceoe that there is any pretension to the formation of a true parenchyma within the limits of the ChlorophycecB. In the whole series of the Confervales, the thallus consists of filaments branched or un- branched, attached at one extremity, and growing almost wholly at the free end. The branches end in fine hairs in ChcetophoracecB. In Coleochcetacece the branches are often welded into a plate, simulating a parenchyma. In all Conjugates and most Proto- coccales, and in the bulk of the Confervales, the thallus consists of a cell or cells, the protoplast of which contains a single nucleus. In JSydrodictyacece, Cladophoracece, Sphceropleacew, and Q-omonti- acece this is no longer the case. Instead of a single relatively large nucleus, each cell is found to contain many small nuclei, and is spoken of as a ccenocyte. This character becomes still more pro- nounced in the large group of the Siphonales. Valoniacece and Dasycladacece are partially septate, but elsewhere no cellulose parti- tions occur, and the thallus is more or less the continuous tube from which the group is named. Yet the Siphonaceous Algse may assume great variety of form anS reach a high degree of differentia^ tion. Protosiphon and Botrydium, on the one hand, are minute vesicles attached to muddy surfaces by rhizoids ; Caulerpa, on the other, presents a remarkable instance of the way in which much the same external morphology as that of cormophytes has been reached by a totally different internal structure. Many Siphonales are encrusted with lime like Corallina among Red Algse. Penicillus is brush-like, Salimeda and Cymopolia are jointed, Acetabularia has much the same external form as an expanded Coprinus, Neomeris simulates the fertile shoot of Equisetum with its densely-packed whorled branches, and in Microdictyon, Anadyomene, Struvea, and Boodlea the branches, spreading in one plane, become bound together in a more or less close network.

1 Chlorophycese include : —

1. Confervoideae — 12 families, 77 genera, 1021 species.

2. Siphonese — 9 families, 26 genera, 271 species.

3. Protococcoidese— 2 families, 90 genera, 342 species.

4. ConjagatsB— 2 families, 33 genera, 1296 species.

(De Toni’s Sylloge Algarum.) 6. Gharacess— 2 families, 6 genera, 181 species.

(Engler and Frantl's PJlanzenfamilien.)

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A L G ^

Characex are separated from other Chlorophycece by a long inter- val, and present the highest degree of differentiation of parts known among Green Algae. Attached to the bottom of pools by means of rhizoids, the thallus of Gharacece grows upwards by means of an apical cell, giving off ~~whorled appendages at regular intervals. The appendages have a limited growth ; but in connexion with each whorl there arise, singly or in pairs, branches which have the same unlimited growth as the main axis. There is thus a close approach to the external morphology of the higher plants. The streaming of the protoplasm, known elsewhere among Chloro~~ phycew, is a conspicuous feature of the cells of Gharacece.

The ChlorophycecB excel all other groups of Algae in the magni- tude and variety of form of the chlorophyll-bodies. In Ulva and Mesocarpus the chromatophore is a single plate, which in the latter genus places its edge towards the incident ligtit ; in Spirogyra they are spiral bands embedded in the primordial utricle ; in Zygnema they are a pair of stellate masses, the rays of which branch periphe- rally ; in (Edogonium they are longitudinally-disposed anastomosing bands; in Desmids plates with irregular margins ; in Gladophora polyhedral plates ; in Vaucheria minute elliptical bodies occurring in immense numbers. Embedded in the chromatophore, much in the same way as the nucleus is embedded in the cytoplasm, are the pyrenoids. Unknown in Gyanophycece and PhoBophyceoB, known only in Bangiacem and Nemalion among ShodophycecB, they are of frequent occurrence among Ghlorophycece, excepting Gharacece. Sometimes several pyrenoids occur in each chloroplast, as in Meso- carpus and Spirogyra; sometimes only an occasional chloroplast contains pyrenoid at all, as in Gladophora. The pyrenoid seems to be of proteid nature and gelatinous consistency, and to arise as a new formation or by division of pre-existing pyrenoids. When carbon-assimilation is active, starch-granules crowd upon the sur- face of the pyrenoid and completely obscure it from view.

Special provision for vegetative multiplication is not common among Ghlorophycece. Valonia and Gaulerpa among Siphonales detach portions of their thallus, which are capable of independent growth. In Gaulerpa no other means of multiplication is as yet known. In Gharacece no fewer than four methods of vegetative reproduction have been described, and the facility with which buds and branches are in these cases detached has been adduced as an evidence of affinity with Bryophyta, which, as a class, are distinguished by their ready resort to vegetative reproduction.

With regard to true reproduction, which is characterized by the formation of special cells, the group Euchlorophycece is charac- terized by the production of zoospores ; that is to say, cells capa- ble of motility through the agency of cilia. Such ciliary motion is known in the adult condition of the cells of Volvocacem, but where this is not the case the reproductive cells are endowed with motility for a brief period. The zoospore is usually a pyriform mass of naked protoplasm, the beaked end of which where the cUia arise is devoid of colouring matter. ' A reddish-brown body, known as the eyespot, is usually situated near the limits of the hyaline portion, and in the protoplasm contractile vacuoles similar to those of lower animals have been occasionally detected. The movement of the zoospore is effected by the lashing of the cilia, and is in the direction of the beak, while the zoospore slowly rotates on its long axis at the same time. Usually two cilia are present ; in Botrydium and Hydrodictyon only one is pres- ent ; in certain species of Gladophora four ; in Dasycladus a chaplet, and in (Edogonium a ring of many cilia. The so-called zoospore of Vaucheria is a ccenocyte covered

over with paired cilia corresponding in position to nuclei lying below. In all other cases, zoospores are uninucleate bodies. Zoospores arise in cells of ordinary size and form termed zoosporangia. In unicellu- lar forms {Sphxrelld) the thallus becomes transformed into a zoosporangium at the reproductive stage. In the zoosporangia of Edogonium, Tetraspora, and Goleochmte, the contents become transformed into a single zoospore. In most cases repeated divi- sion seems to take place, and the final number is r^resented by some power of two. In cosnooytic forms the zoospores vrould seem to arise simultaneously, probably because many nuclei are already present. The escape of zoospores is effected by the de- generation of the sporangial wall (Ghastophora) , or by me^s of ~~a pore {Gladophora), or a slit (Pediastrum), or a circular fracture (Edogonium). Zoospores are of two kinds: — (1) Those which come to rest and germinate to form a new plant ; these are asexual and are zoospores proper. (2) Those which are incapable of germination of themselves, but fuse with another cell, the product giving rise to a new individual ; these are sexual and are zooga~~ metes. When two similar zoogametes fuse, the process is conju- gation, and the product a zygospore. Usually, however, only one of the fusing cells is a zoogamete, the other gamete being a much larger resting cell. In such a case the zoogamete is male, is called an antherozoid or spermatozoid, and arises in an anthe- ridium; the larger gamete is an oosphere and arises in an oogo- nium. The fusion is now known as fertilization, and the product is an oospore. Reproduction by conjugation is also known as

isogamy, by fertilization as oogamy. When zoospores come to rest, a new cell is formed and germination ensues at cnce. When zygospores and oospores are produced a new cell-wall is also formed, but a long period of rest ensues. All investigation goes to show that an essential part of sexual union is the fusion of the two nuclei concerned. It is interesting to know, on the authority of Oltmanns, that when the oosphere is forming in the oogonium of Vaucheria, there is a retrocession of all the included nuclei but one. That the antherozoid of Vaucheria contains a single nucleus had been inferred before.

From a comparison of those Euchlorophycece which have been most closely investigated, it appears probable that sexual repro- ductive cells have in the course of evolution arisen as the result of specialization among asexual reproductive cells, and that in turn oogamous reproduction has arisen as the result of differentiation of the two conjugating cells into the smaller male gamete and the larger female gamete. It would further appear that ooga^ mous reproduction has arisen independently in each of the three main groups of Euchlorophycece, viz., Protococoales, Siphonales, and Gonfervales. Thus among Volvocacece, a family of Protococ- cales, while in some of the genera (Ghloraster, Sphondylomoruvi), no sexual union has as yet been observed, in others {Pandorina, Chlorogonium, Stephanosphcerai Sphcerella) conjugation of similar gametes takes place, in others still (Phacotus, Eudorina, Volvox) the union is of the nature of fertilization. No other’ family of Protococcales has advanced beyond the stage of isogamous repro- duction. Again, among Siphonales only one family {Vaucheriacece) has reached the stage of oogamy, although an incipient heterogamy is said to occur in two other families (Codiacece, Bryopsidacece). Elsewhere among Siphonales, in those cases where reproductive cells are known, the reproduction is either Isogamous or asexual. Among Gonfervales there is no family in which sexual reproduc- tion— misogamy or oogamy — is not known to occur among some of the component species, and as many as four families {Cylindro- capsaceae, Sphceropleacece, CEdogoniacece, Goleochcetacece) axe ooga- mous. On these, as well as other grounds, Gonfervales are regarded as having attained to the highest rank among Euchlorophycece. Although the phenomena attending isogamous and oogamous reproduction respectively are essentially the same in all cases, slight variations in both instances appear in different families, attributable doubtless to the independent origin of the process in different groups. Thus, although isogamy consists in typical cases of a union of naked motile gametes by a fusion which begins at the beaked ends, and results in the formation of an immotile spherical zygote surrounded by a cell-wall, in Leptosira it is noticeable that the fusion begins at the blunt end ; in a species of Ghlamydo- monas the two gametes are each included in a cell-wall before fusion; and in many cases

the zygote retains for some time its motility with the double number of cilia. Again, in oogamous reproduction, while in general only one oosphere is differentiated in the oogonium, in Sphceroplea several oospheres arise in each oogonium; and while the oospheres usually contract away from the oogonial wall, acquiring for themselves a new cell-wall after fertilization, in Coleochcete the oosphere remains throughout in contact with the oogonial wall. The oosphere is in all cases fertilized while still within the oogonium, the antherozoids being admitted by means of a pore. There is usually distinguishable upon the surface of the oosphere an area free from chlorophyll, known as the receptive spot, at which the fusion with the antherozoid takes place ; and in many cases, before fertilization, a small mucilaginous mass has been observed to separate itself off from the oosphere at this point and to escape through the pore. In Goleochmte the oogonial wall is drawn out into a considerable tube, which is pro- vided with an apical pore, and this tube has a somewhat similar appearance to the imperforate trichogyne of Floridem to be here- after described. In certain species of (Edogonium minute male plantlets, known as dwarf males, become attached to the female plant in the neighbourhood of the oogonia, thus facilitating fertili- zation. Indeed the genus (Edogonium exhibits a high degree of specialization in its reproductive system, considering that its thallus has not advanced beyond the stage of au unbranched filament.

Many Euchlorophycece are endowed with both asexual and sexual reproduction. Such are GoleocJicete, (XJdogonium, Gylin- d«-ocapsa, Ulothrix, Vaucheria, Volvox, &c. In others only the asexual method is yet known. When a species resorts to both methods, it is generally found that the asexual method prevails in the early part of the vegetative period, and the sexual towards the close of that period. This is in consonance with the facts already mentioned that zoospores germinate forthwith, and that the sexually-procjuced cell or zygote enters upon a period of rest. It is known that zoogametes, which usually conjugate, may, when conjugation fails, germinate directly {Sphcerella). In rare cases the oosphere has been known to germinate without fertilization {(Edogonium, Gylirir drocapsa). The germination of a zygospore or oospore is ef- fected by the rupture of an outer cuticularized exosporium ; then

the cell may protrude an inner wall, the endosporium, and grow out Into the new plant (Vattcheria), or the contents may break up into a first brood of zoospores. It is held that in Coleochwte a parenchyma results from the division of the oospore, from each cell of which a zoospore arises.

Reproduction is also effected among EuchlorophycecB by means of apianospores and akinetes. Aplanospores would seem to repre- sent zoospores arrested in their development ; without reaching the stage of motility, they germinate within the sporangium. Akinetes are ordinary thallus cells, which on account of their acquisition of a thick Wall are capable of surviving unfavourable conditions. Both aplanospores and akinetes may germinate with or without the formation of zoospores at the initial stage.

Among Conjugatm reproduction is effected solely by means of conjugation of what are literally aplanospores. Among those Desmidiacem, which live a free life, two plants become surrounded by a common mucilage, in which they lie either parallel {Clos- terium) or crosswise (Cosmarium’). Gaps then appear in the apposed surfaces, usually at the isthmus ; the entire protoplasts either pass out to melt into one another clear of the old walls, or partly pass out and fuse without complete detachment from the old walls. Among colonial Desmidiacex, the break-up of the filament is a preliminary to this conjugation ; otherwise the process is the same. The zygospore becomes surrounded with its own wall, consisting finsjly of three layers, the outer of which is furnished with spicular prominences of

various forms. In Zygnemaceoe there is no dissolution of the filaments, but the whole' contents of one cell pass over by means of a conjugation-tube into the cavity of a cell of a neighbouring filament, where the zygospore is formed by the fusion of the two protoplasts. In these cases the activity of one of the gametes, and the passivity of the other, is regarded as evidence of incipient sex. In Sirogonium there is cell- division in the parent-cell prior to conjugation ; and as two segments are cut off in the case of the active gamete, and only one in the case of the passive ^mete, there is a corresponding difference of size, marking another step in the sexual differentia- tion. In Zygogonium, although no cell-division takes place, the gametes consist of a portion only of the contents of a cell, and this is regularly the case in Mesocarpacece, which occupy the highest grade among Oonjugatce. Some Zygnemacem and Mesocarpacece form either a short conjugating tube, or none at all, but the fila- ments approach each other by a knee-like bend, and the zygospore is formed at the point of contact, often being partially contained within the walls of the parent-cell. It would seem that in some cases the nuclei of the gametes remain distinct in the zygospore for a considerable time after conjugation. It is probable that in all cases nuclear fusion takes place sooner or later. In Zyg- nemacece and Mesocarpacece the zygospore, after a period of rest, germinates, to form a new filamentous colony ; in Desmidiacece its contents divide on germination, and thus give rise to two or more Desmids. Gametes which faU to conjugate sometimes assume the appearance of zygospores and germinate in due course. They are known as azygospores.

The reproduction of CharacecB is characterized by a pronounced oogamy, the reproductive organs being the most highly differ- entiated among Chlorophyceoe. The antheridia and oogonia are formed at the nodes of the appendages. The oogonium, seated on a stalk cell, is surrounded by an investment consisting of five spirally-wound cells, from the projecting ends of which segments are cut off, constituting the so-called stigma. The oosphere is not differentiated within the wall of the oogonium, but certain cells known as wendungszellen, the significance of which has given rise to much speculation, are cut off from the basal portion of the parent-cell during its development. The antheridia are spherical, orange-coloured bodies of very complex structure. The anthero- zoid is a spirally-coiled thread of protoplasm, furnished at one end with a pair of cilia. It much more resembles the antherozoids of Bryophyta and certain Pteridophyta than any known among other Algse. The fertilized egg charged with food reserves rests for a considerable period, surrounded by its cortex, the whole having assumed a reddish-brown colour. On germination it gives rise to a row of cells in which short (nodal) and long (intemodal) cells alternate. From the first node arise rhizoids ; from the secoiid a lateral bud, which becomes the new plant. This peculiar product of germination, which intervenes between the oospore and the adult form, is the proembryo. It wiU be remembered that in Musci the asexual spore somewhat similarly gives rise to a protonema, from which the adult plant is produced as a lateral bud. The proembryonic branches of Characece, one of the means of vegetative reproduction already referred to, are so called because they repeat the characters of the proembiyo.

Before leaving the Chlorophycece, it should be mentioned that the genus Volvox has been included by some zoologists (Biitschli, for example) among Flagellata ; on l5ie other hand, certain green Flagellata, such as Uuglena, are included by some botanists (for example, van Tieghem) among unicellular plants. A similar

uncertainty exists with reference to certain groups of Phceophycece, and the matter will thus arise again.-

3. PHiEOPHTCE^.i — ^The Phceophycece are distinguished by the possession of a brown colouring matter, phycophsein, in addition to chlorophyll. They consist of the following groups : — Pucaceas, PhceosporeoB, Dictyotaceoe, Oryptomonadacece, Peridinacece, and DiatomacecB. Of these the first three include multicellular plants, some of them of great size ; the last three are unicellular organ- isms, with little in common with the rest excepting the possession of a brown colouring matter.

Fucacece and Phxosporeoe are doubtless closely allied, and to these Dictyotaceoe may be joined, though the relationship is less close. They constitute the Euphce- ophycecB, and will be dealt with in the first place.

Euph

Growth in length is effected in a variety of ways. In Bictyota, Sphacelariacece, and Fucacece there is a definite apical cell. In the first it is a biconvex lens, from which segments are continu- ally cut off parallel to the posterior surface ; and in the second an elongated dome, from which segments are cut off by a transverse wall. While, however, in Dictyota the product of tiie subsequent division in the segment enlarges with each subdivision, the divi- sions in the cylindrical segment of Sphacelariacece are such that the whole product after subdivision, however many cells it may consist of, does not exceed in bulk the segment as cut off from the apical cell. In Dictyotaceoe the apical cell occasionally divides

1 Fhsophycese include : —

1. Cyelosporime {Fucacese) — 4 families, 32 genera, 347 species.

2. Tetrasporinx {Dictyotacese) — 1 family, 17 genera, 130 species.

3. PhseoMosporiTiess (Phssosporese) — ^24 families, 143 genera, 571 species.

(De Toni’s Sylloge Algarum.) i. Peridiniaks — 3 families, 32 genera, 167 species.

5. Cryptomonadaeese (including Ghrysomonadacea) — 2 families, 28 genera, SO-dO species.

6. Bacillariales {Diatomacese) — about 150 genera, and 5000 species, fossil and recent.

(Engler and Prantl’s Pflanzenfamilien.)

longitudinally, and thus the diohotomous branching is provided lor. In some Sphacelariacem branches may appear at their incep- tion as lateral protuberances of the apical cell itself. In Fucaceoi an^apical cell is situate at the surface of the thallus in a slit-like depression at the apex. From this cell segments are cut off in three or four lateral oblique planes.

A peculiar manner of growth in length is that to which the term trichothallio has been applied. It may readily be observed that in the hair-like branches of JSetocarpacece, the point at which most rapid division occurs is situate near the base of the hair. In Des- marestia and Arthrocladia, for example, it is found that the thallus ends in a tuft of such hairs, each of them growing by means of an intercalated growing point. In these cases, however, the portions of the hairs behind the growing region become agglutinated together into a solid cylindrical pseudp-parenchymatous axis. In Cutleria the laminated thallus is formed in the same way. The intercalated growing region of Laminaria aflords an example of another variety of growth in Phoeophyceoe. While the laminated portion of the thallus is being gradually worn oft in our latitudes during the autumnal storms, a vigorous new growth appears at the junction of the stipe and the blade, as the result of which a new piece is added to the stipe and the lamina entirely renovated.

Both asexual and sexual reproduction occur among Euphmo- phyceoe. Fucaceoe are marked by an entire absence of the asexual method. The sexual organs — oogonia and antheridia — are borne on special portions of the thallus in cavities known as conceptacles. Both organs may occur in one conoeptaole, as in Pelvetia, or each may be confined to one conceptacle or even one plant, as in Fucus vesiculosus. The oogonia arise on a stalk cell from the lining layer of the cavity, the contents dividing to form eight oospheres as in Fucus, four as in Ascophyllum, two as in Pel- vetia, or one only as in Halidrys. It would seem that eight nuclei primarily arise in all Fucaceoi, and that a number cor- responding to the number of oospheres subsequently formed is reserved, the rest being discharged to the periphery, where they may be detected at a late stage. On the maturation of the oospheres the outer layer of the oogonial wall ruptures, and the oospheres, still surrounded by a middle and inner layer, pass out through the mouth of the conceptacle. Then usually these layers successively give way, and the spherical naked oospheres float free in the water. The antheridia, which arise in the con- oeptacular cavity as special cells of branched filaments, are similarly discharged whole, the antherozoids only escaping when the antheridia are clear of the conceptacle. The antherozoids are attracted to the oospheres, round each of which they swarm in great numbers. Suddenly the attraction ceases, and the oosphere is fertilized, probafely at that moment, by the entry of a single antherozoid into the substance of the oosphere ; a cell-wall is formed •thereupon, in some cases in so short an interval as five minutes. Remarkable changes of size and outline of the oosphere have recently been described as accompanying fertilization in Hali- drys. Probably the act of fertilization in plants has nowhere been observed in such detail as in Fucacex. Dictyotacece resemble Fip- eaceoe in their pronounced oogamy. They difier, however, in being also asexually reproduced. The asexual cells are immotUe spores arising in fours in sporangia from superficial cells of the thallus. In Dictyota the oospheres arise singly in oogonia, crowded together in sori on the surface of the female plant. The antheridia have a similar origin and grouping on the male plant. Until the recent discovery by Williams of motility, by means of a single cilium, of the antherozoids of Dictyota and Taonia, they were believed to be immotile bodies, like the male cells of red seaweeds. In Dictyota the unfertilized oosphere is found to be capable of under- going a limited number of divisions, but the body thus formed appears to atrophy sooner or later.

Of the small family of the Tilopteridaceoe our knowledge is as yet inadequate, but they probably present the only case of pro- nounced oogamy among PhcBO^orece. They are filamentous forms, exhibiting, however, a tendency to division in more than one plane, even in the vegetative parts. The discovery by Brebner of the specific identity of Haplospora globosa and Scaphospora speciosa marks

an important step in the advance of our knowledge of the group. Three kinds of reproductive organs are known : first, sporangia, which each give rise to a single tetra-, or multi- nucleate non-motile, probably asexual spore ; second, plurilocular sporangia, which are probably antheridia, generating antherozoids ; and third, sporangia, which are probably oogonia, giving rise to single uninucleate non-motile oospheres. No process of fertiliza- tion has as yet been observed.

The CutleriacecB exhibit a heterogamy in which the female sexual cell is not highly specialized, as it is in the groups already described. From each locule of a plurilocular sporangivim there is set free an oosphere, which, being furnished with a pair of cilia, swarms for a time. In similar organs on separate plants the much smaller antherozoids arise. Fertilization has been observed at Naples; but it apparently depends on climatic con-

ditions, as at Plymouth the oospheres have been observed to ger- minate parthenogenetically. Tl^e asexual organs in the case of Cutleria multifida arise on a cmstaoeous form, Aglaosonia reptans, formerly considered to be a distinct species. They are unilocular, each producing a small number of zoospores.

The possession of two kinds of reproductive organs, uniloоular and plurilocular sporangia, is general among the rest of the Phcsosporex. Bomet, however, called attention in 1871 to the fact that two kinds of plurilocular sporangia occurred in certain species of the genus Ectocarpus — somewhat transparent organs of an orange tint pro- ducing small zoospores, and also more opaque organs of a darker colour producing relatively larger zoospores. On the discovery of another such species by Buffham, Batters in 1892 separated the three species, Ectocarpus secundus,, E. fenestratus, E. Lebelii, together with the new species, into a genus, Giffordia, characterized by the possession of two kinds of plurilocular sporangia. The suspicion that a distinction of sex accompanied this difEerence of structure has been justified by the discovery by Sauvageau of undoubted fertilization in Griffordia secunda and G. fenestrata. The conjugation of similar gametes, arising from distinct pluri- locular sporangia, was observed by Berthold in Ectocarpus silicu- losus and Scytosiphon lomentarius in 1880 ; and these observations have been recently confirmed in the case of the former species by Sauvageau, and in the case of the latter by Kuckuck. In these cases, however, the potential gametes may, failing conjugation, germinate directly, like the zoospores derived from unilocular sporangia. The .assertion of Areschoug that conjugation occurs among zoospores derived from unilocular sporangia, in the case of Dictyosiphon hippuroides, is no doubt to be ascribed to error of observation. It would thus seem that the explanation of the existence of two kinds of sporangia, unilocular and plurilocular, ■ among PJiwosporece, lies in the fact that unilocular sporangia are for asexual reproduction, and that plurilocular sporangia are gametangia — potential or real. It must, however, be remembered that so important a generalization is as yet supported upon a somewhat narrow base of observation. Moreover, for the im- portant family of the LaminariacecB only unilocvdar sporangia are known to occur ; and for many species of other families, only one or other kind, and in some cases neither kind, has hitherto been observed. The four species — Ectocarpus siliculosus, Giffordia secunda, Cutleria muUifidtit and Haplo^ora globosa — may be taken to represent, within the Phxosporece, successive steps in the advance from isogamy to oogamy.

The Peridiniacece have been included among Flagellata under the title of Dinoflagellata. The majority of the species belong to the sea, but many are found in fresh water. The thallus is some- what spherical and unicellular, exhibiting a distinction between anterior and posterior extremities, and dorsal and ventral surfaces. The wall cpnsists of a basis of cellulose, and in some oases readily breaks up into a definite number of plates, fitting into another like the plates of the carapace of a tortoise ; it is, moreover, often finely sculptured or coarsely ridged and fianged. Two grooves are a con- stant feature of the family, one running transversely and another longitudinally. In these grooves lie two cilia, attached at the point of meeting on the dorsal surface. The protoplast is uninucleate and

vacuolate, and contains chromatophores of a brownish colour. It is not clear that the brown colouring matter which is added to chlorophyll is identical with phycophsein ; two varieties of it have been termed phycopyrrin and peridinine. Certain species such as Oymnodinium spirale, are colourless and therefore saprophytic in their method of nutrition. Multiplication takes place in some cases by the endogenous formation of zoospores, the organism having come to rest ; in others by longitudinal division, when the organism is still motile. No method of sexual reproduction is known with certainty.

The OryptomonadacecB also are unicellular, and live free or in colonies. Each cell contains a flattened chromatophore of a brown or yellow colour. Hydrurus forms a branched gelatinous colony attached to stones in mountain streams. Chromophyton form an eight-celled colony. Both plants multiply solely by means of zoospores. The Cryptomonadem and ChromuUnem are motile through the greater part of their life. Cryptomonas, when dividing in a mucilage after encystment, recalls the condition in Gloeocystis, In Synura and Chromulina the cells form a spherical motor colony, recalling Volvocacem. Chromulina is unioiliate and is contained in the hyaline capsule. Like the PeridinioAieK, the Cryptomonadaceos have been included among Flagellata. They have no close affinity with Euphceophycex. Such colonial forms as Hydrurus and I^oeocystis are supposed, however, to indicate a stage in the passage to the multicellular condition.

DiatomaceoB have long been recognized as plants'. Together vrith PeridiniaceiB they constitute the bulk of marine plankton, and thus play an important part in the support of marine animal life. They exhibit striking adaptations in these cucumstances to the floating habit. (See DiA.TOHA0E.aE:, ninth ed.)

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4. — Rhodophtce^e, or Floride^.' — The members of this group are characterized by the possession of a red colouring-matter, phycoerythrin, in addition to chlorophyll. There is, however, a considerable amount of diSerence in the shades of red which mark different species. The brightest belongs to those species which grow near low-water mark, or under the shade of larger Algse at higher levels ; species which grow near high-water mark are usually of so dark a hue that they are easily mistaken for brown seaweeds. Bhodophyceoe are mostly marine, but not exclusively so. Thorea, Lemanea, Titomeya, Stenocladia, Batrachospermum, Balbiania, are genera belonging entirely to fresh water; and Bangia, Ghantransia, Caloglossa, Bostrychia, and Delesseria contain each one or more fresh-water species. Most of the larger species of marine Bhodophycece are attached by means of a disc to rocks, stones, or shells. Many are epiphytic on other Algse, more especially the larger Phasophycem and Bhodophycex. As in the case of epiphytic brown seaweeds, th& rhizoids of the epiphyte often penetrate the substance of the supporting Alga. Some Red Algse find a home in the gelatinous substance of Plustra, Alcyonidium, and other polyzoa, only emerging for the forma- tion of the reproductive organs. Some are perforating Algse and burrow into the substance of moUuscan shells, in company with certain Green and Blue-green Algse. Some species belonging to the families SquamariacecB and Corallinaceoe grow attached through their whole length and breadth, and are often encrusted with lime. The forms which grow away from the substratum vary greatly in external configuration. In point of size the largest cannot rival the larger Brown Algae, while the majority require the aid of the microscope for their investigation.

No unicellular BhodophycecB are known, although a flagellate oi^anism, Shodomonas, has recently been described as possessed of the same red colouring-matter. If the sub-group, Bangiacece, be excluded, they may be said to consist exclusively of branched filaments. Growth in these cases takes

place by means of an apical cell, from which successive segments are cut off by means of a transverse wall. The segment so cut off does not usually divide again by means of a transverse wall, nor indeed by a longitudinal wall which passes through the organic axis of the cell. New cells may be cut off laterally, which become the apical cells of branches. When the new cells grow no further, but constitute a palisading round the central cell covering its whole length, the condition is reached which characterizes the species of Polysiphonia, the “siphons” of which may be regarded as one-celled branches. To the law that no subsequent transverse division takes place in segments cut off from the apical cell, there seem to be two exceptions: first, the calcareous genus Corallina, in the pliable joints of which intercalated division occurs; and, second, the Nitophylleae, in which, moreover, median longitudinal division of axial cells is said to occur. Like the Fungi, therefore, the Red Algae consist for the most part of branched filaments, even where the thallus appears massive to the eye, and, as in the case of Fungi, this fact is not inconsistent with a great variety of external morphology. In the great majority the thallus is obviously filamentous, as in some species of GalUthamnion. In other species of that genus an apparent cortication arises by the downward growth of rhizoids, which are retained within the gelatinous wall of the axial cells. In Batrachospermum the whole system 6f branches are retained within a difHuent gelatinous substance derived from the outer layers of the cell-walls. In other cases the mucilage is denser and the branches more closely compacted {Selminthora). In such cases as Lemanea, the terminal cells of the lateral branches form a superficial layer which has all the appearance of a parenchyma when viewed from the surface. In Champia and allied genera, the cylindrical axis is due not to the deriva- tives of one axial filament, but of several, the growth of which is co-ordinated to form a septated tube. The branching of the thallus, which meets the eye in all these cases, is due to the unlimited growth of a few branches. When such a lateral branch over- tops the main axis whose growth has become limited, as in Ploca-mium and Dasya, a sympodium is formed. For the most part the branching is monopodia!. Besides the differentiation into holdfast and shoot, and into branches of limited and branches of unlimited growth, there appear superficial structures of the nature of hairs. These are for the most part long, thin-walled, unicellular, and colourless, and arise from the outer cells of the pseudo-cortex, or from the terminal cells of branches when the filaments are free. Among Bhodomilaceoe, hair-like structures of a higher order are known. These arise from the axial cell, and are multi- cellular and branched. They soon fall off, and it is from the

1 These include : —

1. Bangiacess—i families, 9 genera, 58 species. _

2. Nemalioninse—i families, 33 genera, 343 species.

3. Gigartininea—S families, 54 genera, 409 species.

4. RhodymeniniB—i familieSj 92 genera, 602 species.

(De Toni’s Sylloge Algarvm.)

persistent basal cell that the branches of unlimited growth arise. Upon them also the reproductive organs arise in this family. It is not surprising, therefore, that they have been regarded as the rudiments of leaves. In Iridxa the thallus is an entire lamina ; in Oallophyllis a lobed lamina ; in Delesseria it is provided with midrib and veins, simulating the appearance of a leaf of the higher plants ; in Oonstantinea the axis remains cylindrical, and the lateral branches assume the form of leaves. In the compact thalli a secondary development often takes place by the growth of rhizoid-like internal filaments. They present a hypha-like appearance, running longitudinally for considerable distances. It is not difficult in such compact species to distinguish between superficial cells, whose

chief function is assimilation, subjacent cells charged with reserve material, and a core of tissue engaged in the convection of elaborated material from part to part.

An interesting feature of the minute anatomy of Eufloridece, as the Red Algae, exclusive of the Bangiacex, have been termed, is the ex- istence of the so-called Ploridean pit. When a cell divides it is found that there remains in the middle of the new wall a single large circular pit, which persists throughout the life of the cells, becom- ing more and more conspicuous with' the progress of the thickening of the wall. These pits serve to indicate the genetic relationship of adjacent cells, when they form a compact pseudo-parenchyma, notwithstanding the fact that somewhat smaller secondary pits appear later between any contiguous cells. Protoplasmic continuity has been observed in the delicate membrane closing the pit.

Vegetative multiplication occurs only sparingly in Bhodophycece. Melobesia callithamnioides gives rise to multicellular propagnla ; Oriffithsia corallina is said to give rise to new individuals, by detaching portions of the thallus from the base of which new attachment organs have already arisen. The spores of Mono- spora are by some regarded as unicellular propagula. Repro- duction is both asexual and sexual. It is noteworthy that although all the members of the group are aquatic no zoospores are produced, a negative character common to them and the Blue- green Algse. As a rule the asexual cells and the male and female sexual cells arise upon different plants, so that the species may be said to be tricecious. Numerous exceptions, however, occur. Thus in Lemaneacex asexual spores are unknown; in Batracho- spermum, Bonnemaisonia, and Polysiphonia byssoides both kinds of sexual cells appear on the same plant; and in some cases the asexual cells may occur in conjunction with either the male or female sexual cells. The asexual cells are termed tetraspores on account of the usual occurrence of four in each sporangium. What may be termed monospores, bispores, and octospores, however, are not unknown. The sporangia may be terminal or intercalated. When they are confined to special branches, such branches are spoken of as stichidia. The tetraspores may arise by the simultaneous division of the contents of a sporangium, when they are arranged tetrahedrally, or they may arise by two successive divisions, in which case the arrangement may be zonate when the spores are in a row, or cruciate when the second divisions are at right angles to the first, or tetrahedral when the second divisions are at right angles to the first and also to one another. .Tetraspores are at first naked, but soon acquire a cell-wall and germinate without a period of rest. The male sexual cells are produced singly in the terminal cells of branches. They are spoken of as spermatia. Great numbers of antheridia are usually crowded together, when the part is distinguishable by the absence of the usual red colour. In Polysiphonia they cover the joints of the so-called leaves ; in Chondria they arise on flattened discs ; in the more massive forms they arise in patches on the ordinary surface ; in a few cases {Gracilaria, Corallina, Galaxaura). they line the walls of con- ceptacle-like depressions. The female sexual cell is represented by the contents^ of a cell which is terminal on ordinary or specialized branches. This is the carpogonium ; it consists of a ventral portion which contains a nucleus, but in which no oosphere is differentiated, and an elongated tubular portion known as the trichogyhe, into which the cytoplasm extends. Fertilization is effected by the passive convection of a spermatium from the an- theridium to the triohogyne, to which it adheres, and to which it passes over its nucleus through an open communication set up at the point of contact. The nucleus then passes down the tricho- gyne and fuses with that of the egg. This fusion has been observed by Wille in Nemalion multifidim, and by Schmidle in Batrachospermum. It is singular that in the last-named species two nuclei occur regularly in the spermatium. The ventral por- tion of the carpogonium may be imbedded deep in the thallus in the massive species ; the trichogy^e, however, always reaches the surface. The first effect of fertilization is the occlusion of the triohogyne from the fertilized carpogonium. The subsequent course of development is characteristic of the Florideai, The carpogonium germinates forthwith, drawing its nourishment almost wholly from the parent plant. The ultimate product in all cases is a number of carpospores, but before this stage

is reached the development is difCerent in different sub-groups. In Batrachospermum filaments strise from the carpogonium on all sides ; in Chantransia and Scinaia on one side only ; in Helminthora the filaments are enclosed in a dense mucilage ; in Nemalion, prior to the formation of the filaments, a sterile segment is cut off below. In all these cases, however, the end- cells of the filaments each give rise to a carpospore, and the aggregate of such sporiferous filaments is a cystocarp. Again, in the family of the Q-eliMaceas, the single filament arising from the carpogonium grows back into the tissue and preys upon the cells of the axis and larger branches, after which the end-cells give rise to carpospores and a diffused cystocarp is formed. In the whole group of the Cryptonemiales the parasitism becomes more marked still. The filaments arising from the carpogonia grow into long thin tubes, which fuse with special cells rich in protoplasm contents ; and from these points issue isolated tufts of sporogenous filaments, several of which may form the product of one fertilized female cell. In Naocaria, one of the QeliMacem, it is observable that the ooblastema filament, as the tube arising from the fertilized carpogonium has been called, fuses completely with a cell contiguous to the carpogonium before giving rise to the foraging filaments already referred to. This is also the case among Cryptonemiales. In a whole series of Red Algae, the existence of a highly-specialized auxiliary cell in the neighbour- hood of the carpogonium is a characteristic feature. In the Gigartinales it is already differentiated previous to fertilization ; in Bhodymeniales it arises subsequent to fertilization. In the Gigartinales, the filaments which arise from the auxiliary cell may spread and give rise to isolated tufts of sporogenous filaments, as in the Cryptonemiales. In the Bhodymeniales a single tvjt arises directly from the auxiliary cell. The carpo- spores are in all cases bright red naked masses of protoplasm when :^st discharged. They soon acquire a cell-wall, and germi- nate without a period of rest. When the cystocarps or segments of cystocarps are formed in the substance of a thallus, the site is marked merely by a swelling of the substance. When the cysto- carp is produced externally, it may form a berry-like mass without an envelope, in which case it is known as a favella. In Bhodo- melaeecB there is a special urn-shaped envelope surrounding the sporogenous filaments. This is a ceramidium.

The attachment of the cell of an ooblastema filament to a cell of the thallus may be effected by means of a minute pore, or the two cells may fuse their contents into one protoplasmic mass. In the latter case, and especially where the union is with a special auxiliary cell, it is of importance to know what happens to the nuclei of the fusing cells. Schmitz was of opinion that in the cases of open union there occurred a fusion of nuclei similar to that which occurs in the sexual union of two cells. He founded his generalization to a large extent upon the observation that in Cflceosiphonia capillaris two cells completely , fuse, and that only one nucleus can be detected in the fused mass. Oltmanns has recently reinvestigated the phenomena in this plant, among others, and has shown that the nucleus of the cell which is being preyed upon recedes to the wall and gradually atrophies. The nucleus of the ooblastema filament dominates the mass, and from it all the nuclei of the carpospores are thus derived. There thus seems to be no jus- tification for believing, as Schmitz taught, that a second sexual act occurs in the life-cycle of these Floridem.

The Bangiales are a relatively small group of Red Algse, to which much of the description now given does not apply. Structurally they are either a plate of cells, as in Porphyra, or filaments, as in Bangia. There is no exclusive apical growth, and the celfc divide in all directions. The characteristic pit is also absent. Sexual and asexual reproduction prevail. The male cell is a spermatium, but the female cell bears no such receptive trichogyne as occurs in other Bhodophycece. After fertilization the equivalent of the oospore divides directly to form a group of carpospores. There is thus a certain resemblance to JEuJlorideoe, but sufBcient difference to necessitate their being grouped apart.

Fertilization by means of non-motile spermatia and a trichogyne are known among the Fungi in the families Collemaeem and Laboulbeniaceoe.

Mter this surTey of the four groups comprised under Algae, it is easier to indicate the Tariations in the limits of the class as defined by different authorities. LimHsot rpQ consider the Cyanophyceoe first, either the tbeAgw. jjjgj.g contrast in the method of nutrition of the generally colourless Bacteriacece to that of the blue- green •C3/anqp%c'ece is regarded as sufficient ground for

excluding BacteriacecB from Algae altogether, notwith- standing their acknowledged morphological affinity with CyanophycecB, or, in recognition of the incongruity of effecting such a separation, the whole group of the ScMzophytOr— that is to say, the Cyanophyceoe. in the narrow sense, together with Bacteriacem, is included or excluded together. Again, while Conjugates may be shut out from ChlorophyceoB as an independent group co-ordinate with them in rank, the Characece constitute so aberrant a group that it has even been proposed to raise them as Charophyta to the dignity of a main division co-ordinate with Tkallophyta. Similarly, while DiatomacecB may be excluded from among PhmophycecB, though retained among Algse, the Cryptomonadaceoe and PeridiniaceoB, like Euglena and othej* CJdorophyceoe, may be excluded from Tkallqphyta and ranged among the Flagel- late Protozoa. (See Protozoa.) It is doubtful, however, whether the conventional distinction between plants and animals wUl continue to be urged ; and the suggestion of Haeckel that a class Protista should be established to receive the forms exhibiting both animal and plant affinities has much to recommend it on phylogenetic grounds. To adopt a figure, it is probable that the sources from which the two streams of life — animal and vegetable — spring may not be separable by a well-defined watershed at all, but consist of a great level upland, in which the water- ways anastomose. Finally, while Chlorophycece and PhcBo- phyceoB exhibit important affinities, the Mhodophyceoe are so distinct that the term Algae cannot be made to include them, except when used in its widest sense.

It has been well said that the attempt to classify plants according to their natural affinities is an attempt to con- struct for them the genealogical tree by which their relationships can be traced. Algae aie,"""'"^' however, so heterogeneous a class, of which the constituent groups are so inadequately known, that it is at present futile to endeavour thus to exhibit their pedigree. A synoptical representation of the present state of know- ledge would be expressed by a network rather than by a tree. The following table is an adaptation of a scheme devised by Klebs, and indicates the inter-rela- tionships of the various constituent groups. The area

Fkotozoa

protomastigina. .

Peridiniaceos iHatomacece

~ iruracece — EuPHaioPHTOEJE

.Bacteriacae

Chlororrumadi/nce Folvocaceoe

TetraaporaceoB'

CTANOPHTCaa.,

ThoreaceoB

1

, .Bwngiacece — Euflobidils

PlewrococcaceoBr^EndospluzraceiK. hlorospTuxracecB ““Conjtjoatjb

~~Ulvacae~~

i^IFEONALES ■CoNrE^VALEB .*’. . . . .ChAKAOEA

aliii

Fungi-

‘■Betophyta’

included in the thick boundary line represents Algae in the widest sense in which the term, is used, and the four included areas the four main subdivisions. A continuous line indicates a close affinity, and a dotted line a doubtful relationship.

In comparing Algae with the great Archegoniate series which has doubtless sprung from them, it is natural to inquire to what extent, if any, they present evi- dence of the existence of the marked alternation AHematioa of generations which dominates the life-history “j^”” of the higher plants. Turning first to the Bhodophycece, both on account of the high place which

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they occupy among Algae and also tlie remarkable uni- formity in their reproductive processes, it is clear that, as is the case among Archegoniatce, the product of the sexual act never germinates directly into a plant which gives rise to the sexual organs. Even among Barir giacem the carpospores arise from the fertilized cell by division, while in all other Bhodophycece the oospore, as it may be called, gives rise to a filamentous structure, varying greatly in its dimensions, epiphytic, and to a large extent parasitic upon the egg-bearing parent plant, and in the end giving rise to carpospores in the terminal cells of certain branches. There is here obviously a cer- tain parallelism with the case of Bryophyta, where the sporogonium arising from the oospore is epiphytic and partially parasitic upon the female plant, and always culminates in the production of spores. Not even Biccia, with its rudimentary sporogonium, has so simple a corre- sponding stage as Bangia, for, while there is some amount of sterile tissue in Biccia, in Bangia the oospore com- pletely divides to form carpospores. Excluding Bangi- aceae, however, from consideration, the Euflorideoe present in the product of the development of the oospore like Bryophyta a structure partly sterile and partly fertile. There is, nevertheless, this important difference between the two cases. WhUe the spore of Bryophyta on germi- nation gives rise to the sexuaJ plant, the carpospore of the Alga may give rise on germination to a plant bearing a second sort of asexual cells, viz., the tetraspores, and the” sexual plant may only be reached after a series of such plants have been successively generated. It is possible, however, that the tetraspore formation should be regarded as comparable with the prolific vegetative reproduction of Bryophyta, and in favour of this view there is the fact that the tetraspores originate on the thallus in a different way from carpospores with which the spores of Bryophyta are in the first place to be compared ; moreover, in certain Nemalionales the production of tetraspores does not occur, and the

difficulty referred to does not arise in such cases. Altogether, it is diflBLcult to resist the conclusion that Florideae present in a modified form the same fundamental phenomenon of alternation of generations as prevails in the higher plants. Among PhoBophyceoe it is well known that the oospore of Fuca-cece germinates directly into the" sexual plant, and there is thus only one generation. More-over, it is known that the reduction in the number of chromosomes which occurs at the initiation of the game- tophyte generation in Pteridophyta occurs in the culminat- ing stage of Fucus, where the oogonium is separated from the stalk-cell, so that, tmless it be contended that the Fucus is really a sporophyte which does not produce spores, and that the gametophyte is represented merely by the oogonium and antheridium, there is no semblance of alternation of generation in this case. The only case among Phceqphycece which has been considered to point to the existence of such a phenomenon is Cutleria. Here the asexual cells are borne upon the so-called Aglaozonia rep- tans and the sexual cells upon the plants known as Cut- leria. The spores of the Aglaozonia form are known to give rise to sexual plants, and the oospore of CvMeria has been observed to grow into rudimentary Aglaozonia. It is probable, however, that there is nothing more here than strongly-contrasted growth-forms. Among Chlorophycece, it is often the case that the oospore on germination divides up directly to form a brood of zoospores. In Ooleochoete, this seems to be preceded by the formation of a minute parenchymatous mass, in each cell of which a zoospore is produced. In SpJiceroplea, it is only at this stage that zoospores are formed at all ; but in most cases, such as (Edogoniura, Ulothrix, Coleochcete, similar zoospores are produced again and again upon the thallus, and the product of the oospore may be regarded as merely a first brood of

a series. It has been held by some, however, that the first brood corresponds to the sporophyte generation of the higher plants, and that the rest of the cycle is the gametophyte generation. Were the case of SpJiceroplea to stand alone, the phenomenon might perhaps be regarded as an alternation of generations, but still only comparable with the case of Bangia, and not the case of the Floridece. But it is difficult to apply such a term at all to those cases in which there intervene between the oospore and the next sexual stage a series of generations, the zoospores of which are all precisely similar.

The difficulty of tracing the relationships of Algae is largely due to the inadequacy of our knowledge of the conditions under which they pass through the critical stages of their life-cycle. Of the thou- ^^^/g^, sands of species which have been distinguished, relatively few have been traced from spore to spore, as the. flowering plants have been observed from seed to seed. The aquatic habit of most of the species and the minute size of many of them are difficulties which do not exist in the case of most seed-plants. From the analogy of the higher plants observers have justly argued that when they have seen and marked the characters of the reproductive organs they have found the plant at the stage when it exhibits its most noteworthy features, and they have named and classified the species in accordance with these observations. While even in such cases it is obvious that interesting stages in the life of the plant may escape notice altogether, in the cases of those plants the reproduction of which is unknown, and which have been named and placed on the analogy of the vegetative parts alone, there is considerable danger that a plant may be named as a distinct species which is only a stage in the life of another distinct and perhaps already known species. To take an example, Lemanea and Batracho- spermum are Floridece which bear densely-whorled branches, but which, on the germination of the carpospore, give rise to a laxly-filamentous, somewhat irregularly branched plant, from which the ordinary sexual plants arise at a later stage. This filamentous structure has been attributed to the genus Chantransia, which it greatly resembles, especially when, as is said to be the case in Batrachospermum, it bears similar monospores. The true Chantransia, however, bears its own sexual organs as well as monospores. To the specific identity of Hap- lospora globosa and Scaphospora speciosa, and of Cutleria multifida and Aglaozonia reptans, reference has already been made. Again, many Green Algae — some uni- cellular, like Sphoerella and Chlamydomonas ; some co- lonial forms, like Volvox and Hormotila; some even filamentous forms, like Ulothrix and

iStigeoclonium — are known to pass into a condition resembling that of a PalmeUa, and might escape identification on this accoimt.

It is, on the other hand, a danger in the opposite sense to conclude that all Chantransia species are stages in the life-cycle of other plants, and, similarly, that all irregular colonial forms, like PalmeUa, represent phases in the life of other Green Algae. Long ago, Kutzing went so far as to express the belief that the lower Algae were all capable of transformations into higher forms, even into moss-protonemata. Later writers have also thought that in all four groups of Algae transformations of a most far-reaching character occur. Thus Borzi finds that Protoderma viride passes through a series of changes so varied that at different times it presents the characters of twelve different genera. Chodat does not find so general a polymorphism, but nevertheless holds that Baphidium passes through stages represented by Protococcus, Char- adum, Dactylococcus, and Sciadium. Klebs has, however, recently canvassed the conclusions of both these investi-

gators ; and as the result of his o-vm observations declares that Algae, so far from being as polymorphic as they have been described, vary only within relatively narrow limits, and present on the whole as great fixity as the higher plants. It certainly supports his view to discover, on subjecting to a careful investigation Botrydium granvr latum, a Siphonaceous Alga whose varied forms had been described by Eostafinski and Woronin, that these authors iiad included in the life-cycle, stages of a second Alga described previously by Kutzing, and now de- scribed afresh by Klebs as Protosiphon botryoides. In Botrydium the chromatophores are small, without pyre- noids, and oil-drops are present; in Protosiphon the chromatophores form a network with pyrenoids, and the contents include starch. Klebs insists that the only solution of such problems is the subjection of the Algae in question to a rigorous method of pure culture. It is interesljing to learn that Senn, pursuing the methods described by Klebs, has confirmed Chodat's observation of the passage of Baphidium into a Dactylococcus-st&ge, although he was unable to observe further metamor- phosis. He has also seen Pleurococcus viridis dividing so as to form a filament, but has not succeeded in seeing the formation of zoospores as described by Chodat. While, therefore, there is much evidence of a negative character against the existence of an extensiv.e poly- morphism among Algae, some amount of metamorphosis is known to occur. But until the conditions under which a particular transformation takes place have been ascertained and described, so that the observation may be repeated by other investigators, scant credence is likely to be given to the more extreme polymorphistic views.

In comparison with the higher plants, Algse exhibit so much simplicity of structure, while the conditions under which they grow are so much more readily ^^y^'”’ controlled, that they have frequently been the ’’^’ subject of physiological investigation with a

view chiefly to the application of the results to the study of the higher plants. (See Physiology of Plants). In the literature of vegetable physiology there has thus accumulated a great body of facts relating not only to the phenomena of reproduction, but also to the nutrition of Algae. With reference to their chemical physiology, the gelatinization of the cell-wall, which is so marked a feature, is doubtless attributable to the occurrence along with cellulose of peotic compounds. There is, however, considerable variation in the nature of the membrane in different species ; thus the cell-wall of (Edogonium, treated with sulphuric acid and iodine, turns a bright blue, while the colour is very faint in the case of Spirogyra, the wall of which is said to consist for the most part of pectose. While starch occurs commonly as a cell-content in the majority of the Green Algae no trace of it occurs in Vaucheria and some of its allies, nor is it known in the whole of the PhceophycecB and

Bhodophycece. In certain UuphceophycecB bodies built up of concentric layers, and attached to the chromatophores, were described by Schmitz as phaeophycean-starch ; they do not, however, give the ordinary starch reaction. Other granules, easily mistaken for the ” starch” granules, are also found in the cells of PhcBophycece ; these possess a power of movement apart from the protoplasm, and are considered to be ves- icles and to contain phloro-glucin. The colourless gran- ules of FloridecB, which are supposed to constitute the carbohydrate reserve material, have been called floridean-starch. A white efflorescence which appears on certain Brown Algae (Saccorhiza hulhosa, Laminaria saccharina), when they are dried in the air, is found to consist of mannite. Mucin is known in the cell-sap of Acetabularia. Some Siphoncdes (Oodium) give rise to proteid crystalloids.

and they are of constant occurrence among Floridece. The presence of tannin has been established in the case of a great number of freshwater Algae.

By virtue of the possession of chlorophyll all Algae are capable of utilizing carbonic acid gas as a source of carbon in the presence of sunlight. The presence of phycocyanin, phycophaein, and phycoerythrin „°te”*’ considerably modifies the absorption spectra for the plants in which they occur. Thus in the case of phycoerythrin the maximum absorption, apart from the great absorption at the blue end of the spectrum, is not, as in the case where chlorophyll occurs alone, near the Fraunhofer line B, but farther to the right beyond the line D. By an ingenious method devised by Engelmann, it may be shown that the greatest liberation of oxygen, and consequently the greatest assimilation of carbon, occurs in that region of the spectrum represented by the absorption bands. In this connexion Pfeffer points out that the penetrating power of light into a clear sea varies for light of different colours. Thus red light is reduced to such an extent as to be insuflcfient for growth at a depth of 34 metres, yellow light at a depth of 177 metres, and green light at 322 metres. It is thus an obvious ad- vantage to Eed Algae, which flourish at considerable depths, to be able to utilize yellow light rather than the red, which is extinguished so much sooner. The experi- ment of Engelmann referred to deserves to be mentioned ‘here, if only in illustration of the use to which Algae have been put in the study of physiological problems. Engel- mann observed that certain Bacteria were motile only in the presence of oxygen, and that they retained their mo- tility in a microscopic preparation in the neighbourhood of an Algal filament when they had come to rest elsewhere on account of the exhaustion of oxygen. After the Bac- teria had all been brought to rest by being placed in the dark, he threw a spectrum upon the filament, and observed in what region the Bacteria first regained their motility, owing to the liberation of oxygen in the process of carbon- assimilation. He found that these places corresponded closely with the region of the absorption band for the Algae under experiment. ’’

Although Algae generally are able to use carbonic acid gas as a source of carbon, some Algae, like certain of the higher plants, are capable of utilizing organic compounds for this purpose. Thus Spirogyra filaments, which have been denuded of starch by being placed in the dark, form starch in one day if they are placed in a 10 to 20 per cent, solution of dextrose. According to Bokorny, moreover, it appears that such filaments will yield starch from formal- dehyde when they are supplied with sodium oxymethyl sulphonate, a salt which readily decomposes into formal- dehyde and hydrogen sodium sulphite, an observation which has been taken to mean that formaldehyde is always a stage in the synthesis of starch. With reference to the assimilation of nitrogen, it would seem that Algae, like other green plants, can best use it when it is presented to them in the form of a nitrate. Some Algae, however, seem to flourish better in the^ presence of organic com- pounds. In the case of Scenedesmus acutus, it is said that the Alga is unable to take up nitrogen in the form of a nitrate or ammoniacal salt, and requires some such sub- stance as an amide or a peptone. On the other hand it has been held by Frank and other observers that atmo- spheric nitrogen is fixed by the agency of Green Algae in the soil. (For the remarkable symbiotism between Algae and Fungi, see Fungi.)

Excepting where the thallus is impregnated with silica, as in Diatomacece, or carbonate of lime, as in Corallinacece, Characece, and some SiphorwUes, it is perhaps not surpris- ing that Algae should not have been extensively preserved I in the fossil form. Considering, however, that it is gener-

ally believed that Bryophyta and vascular plants are de- scended from an Algal ancestry, it is natural to suppose

that, prior to the luxuriant vegetable growths of rence'in *^^ Carboniferous period, there must have ex- tbe rocks. Jsted an age of Algae. It was doubtless this

expectation that has led to the description of a number of Silurian and Devonian remains as Algee upon what is now regarded as inadequate evidence. The geo- logic record is, as perhaps is to be expected, exceedingly poor, except as regards the Calcareous Siphonales, which are well represented at various horizons, from the Silu- rian to the Tertiary; even the Diatomacece, which are found in great quantities in the Tertiary deposits, do not occur at all earlier than the chalk. It is believed, how- ever, that the Devonian fossil, Nematophycus, is a Lami- narian Alga, but it is not until the late Secondary and the Tertiary formations that fossil remains of Algae become frequent. (See Pal^eo- botany.)

The subjoined list includes the larger standard works on Algae, together with a number of papers to which reference is made In this article. For a detailed catalogue of Algological literature, see the "Bibliotheca Phycologica " in De Toni's Sylloge Algarum, vol. i. (1889), with the addendum thereto in vol. iv. (1897) of the same work.

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Algarve, the southernmost province of Portugal, coinciding with the modern district of Faro, with an area of 1872 square miles and population 228,635 — a density of 122 inhabitants to the square mile. The coast is fringed for a distance of 30 miles, from Quarteira to Tavira, with long sandy islands, through which there are six passages, the most important being the New Bar, be- tween Faro and Olhao. In 1896 the fisheries yielded 61,132 tons of herring, valued at £79,100; in 1897, 76,845 tons,- valued at £68,200 ; and in 1898, 65,637 tons, valued at £66,900. The sardines caught in the same years averaged £73,250 in value. The capital is Faro.

Algebra, Universal.— 1. This term (employed by Sylvester in a rather more restricted sense) has come to be used to denote the comparative study of algebra in general, as distinguished from its applications, and from

the detailed exposition of any special variety of it. It is not easy to give a thoroughly satisfactory definition of algebra ; for the purpose of this article ” an algebra ” will be taken to mean a mathematical calculus in which sym- bolical expressions of certain conventional types are con- structed, and their relations investigated according to a fixed consistent system of formal rules of equivalence. This definition, imperfect as it is, will at least serve to indicate the essentially formal and abstract nature of algebraic reasoning. Whether a particular symbolism is to be regarded as an; algebra or not depends partly upon its formal development, partly upon the sense attributed to the term “mathematical.” Thus, for instance, the methods of symbolic logic have produced a calculus which is generally recognized to be an algebra, because it admits of a formal treatment which is independent of the par- ticular meaning originally given to its symbols ; while,

on the other hand, the ” equations ” of chemistry, although symbolical in form, are not deductions from a limited number of fundamental equivalences, and for this reason are not regarded as algebraical. It is conceivable that, in course of time, a neii? algebra may be invented, sug- gested by chemistry and admitting of a chemical inter- pretation, and in fact a certain analogy has been observed between the graphic symbols of organic chemistry and the umbral notation introduced by Aronhold into the theory of algebraic forms.

2. What will here be called “ordinary” algebra developed very gradually as a kind of shorthand, devised to abbreviate the discussion of arithmetical problems and the statement of arithmetical facts. Although the dis- tinction is one which cannot be ultimately maintained, it is convenient to classify the signs of algebra into symbols of quantity (usually figures or letters), symbols of opera- tion, such as ₹, ^, and symbols of distinction, such as brackets. Even when the formal evolution of the science was fairly complete, it was taken for granted that its symbols of quantity invariably stood for numbers, and that its symbols of operation were restricted to their ordinary arithmetical meanings. It could not escape notice that one and the same symbol, such as J{a — b), or even (a — b), sometimes did and sometimes did not admit of arithmetical interpretation, according to the values attri- buted to the letters involved. This led to a prolonged controversy on the nature of negative and imaginary quantities, which was ultimately settled in a very curious way. The progress of analytical geometry led to a geometrical interpretation both of negative and also of imaginary quantities; and when a “meaning,” or, more properly, an interpretation, had thus been found for the symbols in question, a reconsideration of the old algebraic problem became inevitable, and the true solution, now so obvious, was eventually obtained. It was at last realized that the laws of, algebra do not depend for their validity upon any particular interpretation, whether arithmetical, geometrical, or other; the ~~only question is whether these laws do or do not involve any logical contradiction. When this fundamental truth had been fully grasped, mathematicians began to inquire whether algebras might not be discovered which obeyed laws different from those obtained by the generalization of arithmetic. The answer to this question has been so manifold as to be almost embar~~ rassing. AU that can be done here is to give a sketch of the more important and independent “special algebras” at present known to exist.

3. Although the results of ordinary algebra will be taken for granted, it is convenient to give the principal rules upon which it is based. They are

(a + b) + c = a-i-{b + c) (a) (axb)xc = ax (bxc) (a’)

a + b = b + a (c) ay.b = by.a (g’) a{b + c) = ab + ae (d)

{a-b) + b = a (i) (a-i-b)xb = a (i’)

These formulae express the associative and commutative laws of the operations ɨ and x , the distributive law of x , and the definitions of the inverse symbols – and ꝛ , which are assumed to be unambiguous. The special symbols 0 and 1 are used to denote a- a and a-i-a. They behave exactly like the corresponding symbols in arithmetic ; and it follows from this that whatever ” meaning ” is attached to the symbols of quantity, ordinary algebra includes arith- metic, or at least an image of it. Every ordinary algebraic quantity may be regarded as of the form a + p J-l, where a, /8 are ” real ” ; that is to say, every algebraic equivalence remains valid when its symbols of quantity are interpreted as complex numbers of the type a + fi J -I (cf . Number). But the symbols of ordinary algebra do not necessarily

denote numbers; they may, for instance, be interpreted as coplanar points or vectors. Evolution and involution are usually regarded as operations of ordinary algebra; this leads to a notation for powers and roots, and a theory of irrational algebraic quantities analogous to that of irrational numbers.

4. The only known tyj)e of algebra which does not contain arithmetical elements is substantially due to Boole. Although originally suggested by formal logic,

it is most simjJly interpreted as an algebra of ^o”- regions in space. Let * denote a definite algebra. region of space ; and let a, b, etc., stand for definite parts of i. Let a + b denote the re^on made up of a and b together (the common part, if any, being reckoned only once), and let a x 6 or ab mean the region common to a and b. Then a + a = aa = a; hence numerical coeflScients and indices are not required. The .inverse symbols – , ɨ are ambiguous, and in fact are rarely used. Each symbol a is associated with its supplement a which satisfies the equivalences a + d = i, ad — 0, the latter of which means that a and a have no region in common. Finally, there is a law’ of absorption expressed hy a + ab = a. From every proposition in this algebra a reciprocal one may be deduced by interchanging ɨ and x , and also the symbols 0 and i. For instance, x + y = x + xy and xy = x{x + y) are reciprocal. The operations + and x obey all the ordinary laws a, c, d (§ 3).

5. A point A in space may be associated vrith a (real, positive, or negative) numerical quantity a, called its weight, and denoted by the symbol aA. The

sum of two weighted points aA, ^B is, by JUSbius’s definition, the point (a + ^)G, where G divides ^‘S!”” AB so that AG : GB = /3 : a. It can be proved by geometry that

(aA + PB) + yC = aA + (l3B + yC) = (a + /3 + y)F,

where P is in fact the centroid of masses a, yS, y placed at A, B, C respectively. So, in general, if we put

aA + ;8B + yC+ ... +XL^{a + l3 + y+ ... +X)X.

X is, in general, a determinate point, the barycentre of aA, /3B, etc. (or of A, B, etc. for the weights a, j8, etc.). If (a + j8 ɨ ... ɨ A) happens to be zero, X lies at infinity in a determinate direction ; unless —

aA is the barycentre of ,/8B, yC, ... A.L, in which case aA-H)8B-(- ... +AL vanishes identically, and X is indeterminate. If ABCD is a tetrahedron of reference, any point P in space is deter- mined by an equation of the form

(a + is Ł 7 Ł S)P = aA » ^B + 7C 4- SD :

o, ;8, y, S are, in fact, equivalent to a set of homogeneous co-ordinates of P. For constructions in a fixed plane three points of reference are sufficient. It is remarkable that Mobius employs the symbols AB, ABC, ABCD in their ordinary geometrical sense as lengths, areas, and volumes, except that he distinguishes their sign ; thus AB = -‘ BA, ABC = – ACB, and so on. If he had happened to think of them as ” products,” he might have anticipated Grassmann’s discovery of the extensive calculus. From a merely formal point of view, we have in the barycentric calculus a set of ” special symbols of quantity ” or ” extra- ordinaries ” A, B, C, etc., which combine with each other by means of operations ₣ and – which obey the ordinary rules, and with ordinary algebraic quantities by operar tions X and ■¥ , also according to the ordinary rules, except that division by an extraordinary is not used.

6. A quaternion is best defined as a symbol of the type

2 = 2a^« = Vo _+ <»1«1 + «2«2 + Vs. Hamilton's

where e^ ... eg are independent extraordinaries quater- and ttj . . . 03 ordinary algebraic quantities, which “*’”” • may be called the co-ordinates of q. The sum and pro-

«0

«i

«2

«3

«1

-«o

«3

-«2

e.

-«s

-«o

«1

«s

«2

-«1

-80

duct of two quaternions are defined by the formulae

Dorer X S^jfig = “Zar/Sgeres,

where the products «,€» are further reduced according to the following multiplication table, in which, for example.

the second line is to be read e^e^ = ej, e^^ = – e„, e-^e^ = %, 6163 = — 62- The effect of these definitions is that the sum and the product of two quaternions are also quaternions ; that addition is associative and commutative ; and that multiplication is associative and distributive, but not commutative. Thus e-^e^ = — e^e-^, and if q, q’ are any two quaternions, qq’ is generally different from q’q. The symbol e^ behaves exactly like 1 in ordinary algebra ; Hamilton writes 1, i,j, h instead of e^, e^, e^, e^, and in this notation all the special rules of operation may be summed up by the equalities

i^=j^ = k^ = ijk= -1.

Patting q=a + pi+-ff + Bk, Hamilton calls a the scalar part of q, and denotes it by Sg’; he also writes Yq for Pi + yj+Sk, which is called the vector part of q. Thus every quaternion may be written in the form g = Sg’ + Yq, where either Sg” or Yq may separately vanish ; so that ordinary algebraic quantities (or scalars, as we shall call them) and pure vectors may each be regarded as special cases of quaternions.

The equations q’ + x = q and y + q’ = q are satisfied by the same quaternion, which is denoted by q-q’. On the other hand, the equations q’lc = q and yq’ = g have, in general, different solutions. It is the value of y which is generally denoted by g-i-g’; a special symbol for x is desirable, but has not been established. If we put q’g = Sg’ — Yq’, then g^ is called the conjiigafe of q’, and the scalar q’ql, = qgq’ is called the norm of q’ and written Ng’. With this notation the values of x and y may be expressed in the forms —

x = q’aql’Nq’, ^ l/ = qq’JW,

which are free from ambiguity, since scalars are commuta- tive with quaternions. The values of x and y are different, unless Y(qq’f,) = 0.

In the applications of the calculus the co-ordinates of a quaternion are usually assumed to be numerical ; when they are complex, the quaternion is further distinguished by Hamilton as a hiquaternvm. Clifford’s biquatemions are quantities ^q + i/r, where g, r are quaternions, and ^, 1] are symbols (commutative with quaternions) obeying the laws

7. In the extensive calculus of the wth category, we have, first of all, n independent “units,” mann’s *ii *2′ • • • *«• From these are derived symbols extensive of the type

which we shall call extensive quantities of the first species (and, when necessary, of the wth category). The co- ordinates a^, . . . a^ are scalars, and in particular applica- tions may be restricted to

real or complex numerical values. If Bj = 2jS^ there is a law of addition expressed by Aj -h Bi = 2(af ₣ Pi)ei = Bi -f Ai ; this law of addition is associative as well as commutative.

The inverse operation is free from ambiguity, and, in fact, Ai-Bi = 2(ai-^i)ei.

To multiply Aj by a scalar, we apply the rule |Ai = Ai^ = 2(^ai)ei, and similarly for division by a scalar.

All this is analogous to the corresponding formula in the barycentric calculus and in quaternions; it remains to consider the multiplication of two or more extensive quantities. The binary products of the units e^ are taken to satisfy the equalities

e^^ = 0,

ViUj –

• ejei J

this reduces them to ^{n- 1) distinct values, exclusive of zero. These values are assumed to be independent, so we have ^n(n— 1) derived units of the second species or order. Associated with these new units there is a system of extensive quantities of the second species, represented by symbols of the type

A2 = 2aiE/2′ fi =l,2,...{n- 1)], where E,‘, Ej’‘, etc., are the derived units of the second species. If Aj = 2046^, B^ = SySjei, the distributive law of multiplication is preserved by assuming

A^B, = 2{

it follows that AiBi= – BjAj, and that A^^^q.

By assuming the truth of the associative law of multi- plication, and taking account of the reducing formulae for binary products, we may construct derived units of the third, fourth . . . «th species. Every unit of the rth species which does not vanish is the product of r different units of the first species ; two such units are independent unless they are permutations of the same set of primary units e,-, in which case they are equal or opposite according to the usual rule employed in determinants. Thus, for instance —

and, in general, the number of distinct units of the rth species in the wth category {r

Let A,.=2aE’”’ and Bs = 2;8E’»’ be two extensive quan- tities of species r and s ; then if r + s ‘Sn, they may be multiplied by the rule

A,.Bg=2(a;8)E’‘E’”

where the products E’^^‘E’‘ **may be expressed as derived units of species (r + s). The product B«Ar is equal or opposite to ArB„ according as rs is even or odd. This process may be extended to the product of three or more factors such as A,.B«Ct . . . provided that r + s + t+ ... does not exceed n. The law is associative; thus, for instance, (AB)C = A(BC). But the commutative law does not always hold; thus, indicating species, as before, by suffixes, ArBA = (l)”**”’’ QBA,** with analogous rules for other cases.

If r + g>n, a product such as IS^E,, worked out by the previous rules, comes out to be zero. A characteristic feature of the calculus is that a meaning can be attached to a symbol of this kind by adopting a new rule, called that of regressive multiplication, as distinguished from the foregoing, which is progressive. The new rule requires some preliminary explanation. If E is any extensive unit, there is one other unit E', and only one, such that the (progressive) product EE' = 1. This unit is caUed the supplement of E, and denoted by |E. For example, when » = 4,

l«i = '

■^v'v

CiCo — Cq€,

OjCg

■3C4,

1*2*8*4 *

and so on. Now when r-|-s>», the product ErE, is

defined to be that unit of which the supplement is the progressive product |Er|E,. For instance, if » = 4, E, = ei«3, Ej = CgggC^, we have

|Er|Es = (– e^e^{ – eJ = e■^e^e^ = \e^, consequently, by the rule of regressive multiplication,

Applying tl;e distributive law, we obtain, when r + s>m,

ArB, = 2aE,2^Eg = 2(aj8)E,E,, where the regressive products E^Ej are to be reduced to units of species (r + s – m) by the foregoing rule.

If A = 2aE, then, by definition, |A = 2a|E, and hence

A|(B + C)=A|B + A|C. ■ Now this is formally analogous to the distributive law of multiplication ; and in fact we may look upon A|B as a particular way of multiplying A and B (not A and |B). The symbol A|B, from this point of view, is called the iuTier product of A and B, as distinguished from the outer product AB. An inner product may be either progressive or regressive. In the course of reducing such expressions as (AB)C, (AB){C(DE)} and the like, where a chain of multiplications has to be performed in a certain order, the multiplications may be aU progressive, or all regres- sive, or partly one, partly the other. In the first two cases the product is said to be pure, in the third case mixed. A pure product is associative ; a mixed product, speaking generally, is not.

The outer and inner products of two extensive quanti- ties A, B, are in many ways analogous to the quaternion symbols Yah and Sa6 respectively. As in quaternions, so in the extensive calculus, there are numerous formulae of transformation which enable us to deal with extensive quantities without expressing them in terms of the primary units. Only a few illustrations can be given here. Let a, h, c, d, e, f be quantities of the first species in the fourth category ; A, B, C . . . quantities of the third species in the same category. Then

{de)(abe) = (abde)c + {cade)b + {bcde)a

= (abce)d — {abcd)e,

(a6)(AB) = (aA)(6B) – (aB)(6A)

ab\c = {a\c)b – {b\c)a, {ab\cd) = (a\c){b\d) – {a\d){b\e).

These may be compared and contrasted with such quater- nion formulae as

S(YabYcd) = SadSbc – SacSbd dSabc = aSbcd — bScda + cSadb

where a, b, c, d denote arbitrary vectors.

8. An «-tuple linear algebra (also called a complex number-system) deals with quantities of the type A = UoiSi derived from n special units gj, e^. . . e„. The sum and product of two quantities are defined

in the first instance by the formulae

.2ae + 2)8e = 2(a 4- ^)e, loiei x 2/i/j = l^ail3j)eiej,

so that the laws a, c, d of § 3 are satisfied. The binary products ei ej, however, are expressible as linear functions of the units ei by jneans of a ” multiplication table ” which defines the special characteristics of the algebra in question. Multiplication may or may not be commutative, and in the same way it may or may not be associative. The types of linear associative algebras, not assumed to be commutative, have been enumerated (with some omissions) up to sextuple algebras inclusive by B. Peirce. Quater- nions afi’ord an example of a quadruple algebra of this kind. If, in the extensive calculus of the reth category, all the units (including 1 and the derived units E) are taken to be homologous instead of being distributed into species, we may regard it as a (2”-l)-tuple linear algebra, which, however, is not wholly associative. It

Linear algebras.

should be observed that while the use of special units, or extraordinaries, in a linear algebra is convenient, especi- ally in applications, it is not indispensable. Any Unear quantity may be denoted by a symbol (aj, o^, . . . a„) in ■ which only its scalar coefficients occur ; in fact, the special units only serve, in the algebra proper, as umhrce or regulators of certain operations on scalars (see Numbbe, § 33). This idea finds fuUer expression in the algebra of matrices, as to which it must suffice to say that a matrix is a symbol consisting of a rectangular array of scalars, and that matrices may be combined by a rule of addition which obeys the usual laws, and a rule of multiplication which is distributive and associative, but not, in general, commutative. Various special algebras (for example, quaternions) may be expressed in the notation of the algebra of matrices.

9. The algebras discussed up to this point may be considered as independent m the sense that each of them deals with a class of symbols of quantity more

or less homogeneous, and a set of operations f^*!’!”” applying to them all. But when an algebra is used with a particular interpretation, or even in the course of its formal development, it frequently happens that new symbols of operation are, so to speak, superposed upon the algebra, and are found to obey certain formal laws of com- bination of their own. For instance, there are the symbols A, D, E used in the calculus of finite differences; Aronhold’s symbolical method in the calculus of

invariants ; and the like. In most cases these subsidiary algebras, as they may be called, are inseparable from the applications in which they are used ; but in any attempt at a natural classification of algebra (at present a hopeless task), they would have to be taken into account. Even in ordinary algebra the notation for powers and roots disturbs the symmetry of the rational theory ; and when a schoolboy illegitimately extends the distributive law by writing ^/{a + h)=]ja -f ,Jb, he is unconsciously emphasizing this want of complete harmony.

10. The reader cannot faU to observe that this article is far from being an outline of universal algebra, in the sense ascribed to that term at the beginning ; it is, rather, a brief presentation of some of the principal facts with which universal algebra has to deal. It may even be doubted whether any theory of universal algebra, except in a very restricted or provisional sense, is actually possible at present. It may, perhaps, be admitted that we have arrived at the conception that an ” algebraic quan- tity ” is a symbol defined merely by its formal relations ; and that the symbols -f and x are legitimately used when the first is commutative and associative, and the second distributive. But there is hardly any other general statement that may not be upset by future discoveries; and in fact even these are inconsistent with much current notation. The state of mathematical symbolism to-day may be fairly compared to that of botany, when the idea of a natural classification first began to suggest itself.

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ALGEBRAIC FORMS.

THE subject-matter of algebraic forms is to a large extent connected ■with the linear transformation of algebraical polynomials which involve two or more variables. The theories of determinants and of sym- metric functions and of the algebra of differential opera- tions have an important bearing upon this comparatively new branch of mathematics. They are the chief instru- ments of research, and have themselves much benefited by being so employed. When a homogeneous polynomial is tranSormed by general Hnear substitutions as hereafter explained, and is then expressed in the original form with new coefficients affecting the new variables, certain func- tions of the new coefficients and variables are numerical multiples of the same functions of the original coefficients and variables. The investigation of the properties of these functions, as well for a single form as for a simultaneous set of forms, and as well for one as for many series of variables, is included in the theory of invariante. As far back as 1773 Lagrange, and later Gauss, had met with simple cases of such functions ; Boole, in 1841 (Camb. Math. Joum. iii. pp. 1-20), made important steps, but it was not till 1845 that Cayley (Coll. Math. Papers, i. pp. 80-94, 95-112) showed by his calculus of hyper-deter- minants that an infinite series of such functions might be obtained systematically. The subject was carried on over a long series of years by himself, Sylvester, Salmon, Hesse, Aronhold, Hermite, Brioschi, Clebsch, Gordan, &c. The year 1868 saw a considerable enlargement of the field of operations. This arose from the study by Klein and Lie of a new theory of groups of substitutions ; it was shown that there exists an invariant theory connected with every group of linear substitutions. The invariant theory then existing was classified by them as appertaining to " finite continuous groups." Other " Galois " groups were defined whose substitution coefficients have fixed numerical values, and are particularly associated with the theory of equations. Arithmetical groups, connected with the theory of quad- ratic ^orms and' other branches of the theory of numbers, which are termed "discontinuous," and infinite groups connected with differential forms and equations, came into existence, and also particular linear and higher transforma- tions connected with analysis and geometry. The effect of this was to co-ordinate many branches of mathematics and greatly to increase the number of workers. The sub- ject of transformation in general has been treated by Sophus Lie in the classical work Theorie der TroMsfornwh Uonsgruppen. The present article is merely concerned with algebraical linear transformation. Two methods of treatment have been carried on in parallel lines, the un- symbolic and the symbolic ; both of these originated with Cayley, but he with Sylvester and the English school have in the main confined themselves to the former, whilst Aronhold, Clebsch, Gordan, and the Continental schools have principally restricted themselves to the latter. The two methods have been conducted so as to be in constant touch, though the nature of the results obtained by the

one differs much from those which flow naturally from the other. Each has been singularly successful in discovering new lines of advance and in encouraging the other to renewed efforts. Gordan first proved that for any system of forms there exists a finite number of covariants, in terms of which all others are expressible as rational and integral functions. This enabled HUbert to produce a very simple unsymbolic proof of the same theorem. So the theory of the forms appertaining to a binary form of unrestricted order was first worked out by Cayley and MacMahon by unsymbolic methods, and later Stroh, from a knowledge of the results, was able to verify and extend the results by the symbolic method. At the moment of writing no English work exists on the symbolic methods, so that it has been judged proper to present to English readers a short resumS of those processes, and to refer them for other information to the existing English treatises. The partition method of treating symmetrical algebra is one which has been singularly successful in in- dicating new paths of advance in the theory of invariants ; the important theorem of expressibUity is, directly we exclude unity from the partitions, a theorem concerning the expressibility of covariants, and involves the theory of the

reducible forms and of the syzygies. The theory brought forward has not yet found a place in any systematic treatise in any language, so that it has been judged proper to give a fairly complete account of it.

I. The Theory of Determinants. Let there be given n^ quantities

Oil “ts ‘hs •■• “‘in

t^2l ^^22 23 *•■ ‘ a^ 0^32 ®83 ••■ ‘^

ani a,a a,^ •■■ a,„„ and form from them a product of n quantities

aia «2/S “Sy ••■ “■nv Where the first suffixes are the natural numbers 1, 2, 3, ... n taken in order, and a, /S, 7, ... » is some permutation of these n numbers. This permutation by a transposition of two numbers, say o, /3, becomes p, a, 7, ... v, and by successively transposing pairs of letters the permutation can be reduced to the form 1, 2, 3, ... n. Let k such ^anspositions be necessary ; then the expression

2(-)*aio»2i3«3v-«lly.

the summation being for all permutations of the n numbers, is called the detenninant of the n^ quantities. The quantities aia, 02^... are called the elements of the determinant ; the term ~~()*aioa3poS8y…osnv is called » member of the determinant, and there are evidently n ! members corresponding to the n ! permuta~~ tions of the n numbers 1, 2, 3, ... n. The determinant is usually written ‘

%i ‘hi ‘ha ■■■ “In

0^21 “22 ‘^ • ■ ■ ”^Sn A= O31 033 O33 ... Osn

Onl <'n2 0'v3 ■■• OSnn

the square array being termed the matrix of the determinant. A matrix has in many parts of mathematics a signification apart from its evaluation as a determinant. A theory of matrices has been constructed by Cayley in connexion particularly with the

theory of linear transformation. The^matrix consists of n rows and n columns. Each row as well as each column supplies one and only one element to each member of the determinant. Con- sideration of the definition of the determinant shows that the value is unaltered when the suffixes in each element are transposed.

Theorem.— li the determinant is transformed so as to read by columns as it formerly did by rows its value is unchanged. The leading member of the determinant is Oua^ss ... Onm and corre- sponds to the principal diagonal of the matrix.

We write frequently

A = S + diiOigaass . . . OnM = ((hi«22a«>‘i viz., o and (3 are transposed, and it is clear that the number of trans positiops necessary to convert the permutation /307…;’ of the second suffixes to the natural order is changed by unity. Hence the transposition of columns merely changes the sign of the determinant. Similarly it is shown that the transposition of any two columns or of any two rows merely changes the sign of the determinant.

Theorem. — Interchange of any two rows or of any two columns merely changes the sign of the determinant.

Corollary. — If any two rows or any two columns of a deter- minant be identical the value of the determinant is zero.

Minors of a Determinant. — From the value of A we may separate those members which contain a particular element «(* as a factor, and write the portion aa Aj* ; Aa, the cofactor of ««, is called a minor of order m – 1 of the determinant.

Now aSuAii = S + ajia22a33… a™, wherein Oi, is not to be changed, but the second suffixes in the product a;^tgg…a„„ assume all permutations, the number of transpositions necessary determining the sign to be affixed to the member.

Hence aiiA.-y^=a^{S. + a^^...ann, where the cofactor of ajj is clearly the determinant obtained by erasing the first row and the first column.

^W ^33 ■ • . a’ I

“na fflnS ••■ a„„ \

Similarly A^, the cofactor of Oji, is shown to be the product of (–)’** and the determinant obtained by erasing from A the i”’ row and h”’ column. No member of a determinant can involve more than one element from the first row. Hence we have the development

proceeding according to the elements of the first row and the corresponding minors.

Similarly we have a development proceeding according to the elements contained in any row or in any column, viz.,

A=fl!uAn-l-a42Aj2-l-ai3Ai3 + ...-t-a*.Aj„ \ A = asiiAis + asasAa* ± asjAsi + ...+ a^-^J This theory enables the evaluation of a determinant by successive reduction of the orders of the determinants involved.

.Ex. gr.

1 0

3

2 1

6

0-5

3

=1

3

-1-3

= l|l =3-h 30-30-0=3, Since the determinant

Oai 0(22 ^^ ••• 2n fl21 * ^h& •■• a2n Osi asz ass ••■ <*3n

6 I -5 I -1-3.2 1 -5 I -3.1 |0|

having two identical rows,

vanishes identically ; we have by development according to the elements of the first row

<%Aii-l-a22Aij-l-a!23-^i3-l-...-)-O2»AiB=0 ; and, in general, since

«ilAfl Ł 0(2 Ai2 4- flliS A(3 Ł . . . Ł flSinAte = A,

if we suppose the #* and k”’ rows identical

Oil An + OjaAja Ł OisAffl ŧ . . . + a»nAin =0 (* 5 »’) 5

and proceeding by columns instead of rows,

On Aii + arnAnit aaiAu---+ OniAn* =0 (fc < »)

identical relations always satisfied by these minors.

If in the first relation of (A) we write ai, = bu + Cu+di,+ ... we find that Sai,Aj,=26i,Ai, + S(!i,A(,-H2£ii,Ai,ł... so that A breaks up into a sum of determinants, and we also obtain a theorem for the addition of determinants which have n-1 rows in common. If we multiply the elements of the second row by an arbitrary magnitude X, and add to the corresponding elements of the first row, A becomes 2ai,Ai,-l-XZa2.Ai,=Zai,Ai,=A, showing that the

value of the determinant is unchanged. In general we can prove in the same way the —

Theorem. — The value of a determinant is unchanged if we add to the elements of any row or column the corresponding elements of the other rows or other columns resjjeotively each multiplied by an arbitrary magnitude, such magnitude remain- ing constant in respect of the elements in a particular row or a particular column.

Observation. — Every factor common to all the elements of a row or of a column is obviously a factor of the determinant, and may be taken outside the determinant brackets.

JEx.

gr.

a^ ^2 7′ a. p y

1 1 1

=

a p-a y-a

10 0

yS-o 7-0

= (/3-oX7-a)

^ + »T + a =(^_^X7-«) ^-T”)’ + «

= {P

-a)(7-aX^-7).

The minor Au, is =— , and is itself a determinant of order n-1.

We may therefore differentiate again in regard to any element a„ where r^i, s^k ; we will thus obtain a minor of Ajj,, which is

a minor also of A of order n-2. It will be Ajj=-5=^=5 — = — •

r. oa„ eaiitOa„ and will be obtained by erasing from the determinant Am the row and column containing the element a„ ; this was originally the r’* row and s** column of A ; the r”’ row of A is the r** or (r-1)’* row of Aji according asrji and the s’* column of A is the s’* or s-1’* column of Afs according as sj*. Hence, if Tw denote the number of transpositions necessaiy to bring the succession ri into ascending order of magnitude, the sign to be attached to the determinant arrived at by erasing the i”” and r’* rows and the k”’ and s” columns from A in order produce An, will

be – 1 raised €0 the po*er of Trt + Tke + i + k+r+s. Similarly proceeding to the minors of order » – 3, we find that

■^«=sr- ■^i*=a„ a„ ■•^«=a„_a„ a„ ^ ^ obtained from A by

datu

dar^att

doudoridoftt

erasing the i’**, r’**, «’* rows, the k’\ s**, m’* columns, and multiplying the resulting determinant by -1 raised to the power T^ + T^* +i + k+r + s + t + u a,ni the general law is clear. Corresponding Minors. — In obtaining the minor Aa in the

rs

form of a determinant we erased certain rows and columns, and we would have erased in au exactly similar manner had we been forming the determinant associated with At,, since the deleting

lines intersect in two pairs of points. In the latter case the sign is determined by – 1 raised to the same power as before, with the exception that T„j, replaces T^* ; but if one of these numbers be even the other must be uneven ; hence

Aa= ■

Moreover

Aft.

rk

«<»«A«+attartAi,= ^* "** A,

Or* a„

where the determinant factor is given by the four points in which the deleting lines intersect. This determinant and that associated with Ajj; are termed corresponding determinants. Suhilarly p

rs

lines of deletion intersecting in p^ points yield corresponding determinants of orders p and n~p respectively. Eecalfing the formula

A = Oil Au + ai2Ai2 + OisAis + ... + (ii„Ai„,

it will be seen that Ou and Ai* involve corresponding determin- ants. -Since An is a determinant we similarly obtain

Ajs = OaiAu ⊥ ... ⊥ 02,**_iAi, J, + Oj^M-iAi,** + . . . Ł a2,BAi,ifc ,

!4*-l

2,*+!

and thence

and as before

2.n

A = ZouOsiAu where i%k;

an an

A=S

i,i

an important expansion of A. Similarly

flsu 02J as(A=S

OlJ; OjJ Ost

Olr Oar Os,

All i>k, at

An %>‘k>r, at

Sr

and the general theorem is manifest, and yields a development in a sum of products of corresponding determinants. If the j’*

column be identical with the i”* the determinant A vanishes identically ; hence if ^” be not equal to i, k, or r,

0 = S

O’y -‘‘y O’Sj <*1* «2* I3* axr Oar ^Sr

Similarly, by putting one or more of the deleted rows or columns equal to rows or columns which are not deleted, we obtain, with Laplace, a number of identities between products of determinants of complementary orders.

Multiplication. — From the theorem given above for the ex- pansion of a determinant as a sum of products of pairs of corre- sponding determinants it will be plain that the product of A=(ou, 022,... Omm) and D = (6ii, 6221 inn) may be written as a determinant of order 2n, viz. —

ou 021 “a — Oni -1 0 0 ... 0

Ctl2 ^22 ai3 O23

«33

.. flS„2 .. fl5„3

Oln O&l a-Sn ... Oni

0 0 0 ... 0

0 0 0 ... 0

0 0 0 ... 0

0 0

6

In in

-1 0 0 -1

0

J2S

0 0

-i

iln isn

_ I A B| – |C D| for brevity.

0 0 0 ... 0 6^ i„2 h^ ... 6,... Multiply the 1″ 2»<',...m'» rows by 6u, J12, ...6i„ respectively, and add to the ra-fl* row; by 621, 622, ■■•*2n, and add to the wH-2'* row ; by 631, 632, ...l^n and add to the »-f3'^ row, &c. C then becomes

‘‘ll Ju + «12 J12 ŧ . . . + fl!i„6i„, a2i5u Ł 022612 -f . . . + Ban Jin,

■ • • (lnl*ll + On26l2 + • ■ • + Onniln Oil J21 + 012*22 ŧ...+ Oi„62n, ffl2l621 + 022*22 + • • • + Osnisn,

■ • ■Onl621 + Onafe + . . . + OnnJ2n Ouisi + 012632 +••■ + Oljiftsn, 021631 + O22632 -H . . . ŧ a2ii6sn,

.. .0,^631 -HO,^682-t- ... -|-0„„J2n

Bii*ni + oi26„2 + . . . -f Oi„6„„, a2i5ni + a226„2 Ł . . . + 02„6„„,

• • -Onlftnl + O’v^ni ■■■ 0„„6„„

and all the elements of D become zero. Now by the expansion theorem the determinant becomes

(_)l-Ha+3+- ■ -H2»B . C = (– l)n{2»+l)-Hl C = C.

We thus obtain for the product a determinant of order n. “We may say that, in the resulting determinant, the element in the i* row and A’* column is obtained by multiplying the elements in the T(f^ row of the first determinant severally by the elements in the ‘^ TOW of the second, and has the expression Oijfta + 0*2**2 + oj3*i3. • . + oj,„5j„ , and we obtain other expressions by transforming either or both determinants so as to read by columns as they formerly did by rows.

Remark. — In particular the square of a determinant is a de- terminant of the same order (611^633… J„„) such that 6«=6m ; it is for this reason termed symmetrical.

The Adjoint or Reciprocal Determinant arises from A = (011022033 . . .o„„) by substituting for each element Og, the corresponding minor Att so as to form D = (AiiA22A33…A„„). If we form the product A.D by the theorem for the multiplica^tion of determinants we find that the element in the i”’ row and A** column of the product is

owAa Ł OjaAo -H . . . Ł OinAin ,

the value of which is zero when k is difl'erent from , whilst it has the value A when k=i. Hence the product determinant has the principal diagonal elements each equal to A and the remaining elements zero. Its value is therefore A" and we have the identity D.A = A"orD = A"-.

It can now be proved that the first minor of the adjoint deter- minant, say B„, is equal to A»—a„. From the equations

ffluaii -K ai29!2 ł Oi3a!3 -h . . . = fi ,

oaiaii ł 022^ + 023253 +...= fe >

OsiaSl ł a32a!2 + 033a!3).=&,

we derive

and thence

Aa!A?■fA2If+A3l&-^. Aa!2 = A12I1 ~~^ A22& 4~~ A32I3) . Aa!3 = Aisii + A23|2 -h A33I3 -h .

A"-'f 1 = Bu Aa^ + B12&X2 + Bi3 Axs + . A'*-i|a= BaAxi + 'B^iiXi + '&a^Xi + . A"-if 3 = BsiAiCi ł BsaAaja + BssAass + .

and comparison of the first and third systems yields

B„ = A"-2o„.

In general it can be proved that any minor of order p of the adjoint is equal to the complementary of the corresponding minor of the original multiplied by the p-V* power of the original determinant.

Theorem. — The adjoint determinant is the n-l'* power of the original determinant. The adjoint determinant will be seen sub- sequently to present itself in the theory of linear equations and in the theory of linear transformation.

Determinants of Special Forms. — It was observed above that the square of a determinant when expressed as a determinant of the same order is such that its elements have the property ex- pressed byo«=aM. Such determinants are called symmetrical. It is easy to see that the adjoint determinant is also symmetrical, viz., such that Aij = AM, for the determinant got by suppressing the i'* row and k"' column differs only by an interchange of rows and columns from that got by suppressing the k"' row and i"' column. If any symmetrical determinant vanish and be bordered as shown below

Oil Oij Oi3 Xi t^2 "22 * ^

023 033

it is a perfect square when considered as a function of Xi, X2, X3. For since AiiA22-Au=Aos3, with similar relations, we have a number of relations similar tf v/{A„A„) or – tJ(,ArrA„) for all different values of r and s. Now the determinant has the value

- {XJ All Ł X| A22 Ɉ X| A33 ł 2Xi,XsA25 + 2X3X1A31 + 2X1X2A12}

= -2X^A„-22XrX,A„ in general, and hence by substitution

± {Xi ^/All + Xj v'Ajj 4- . . . + X„ x/A„„}2.

A skew symmetric determinant has o,.,=0 and a„= ~~Om~~ for all values of r and s. Such a determinant when of uneven degree vanishes, for if we multiply each row by – 1 we multiply the determinant by ~~(1)"=~~!, and the effect of this is otherwise merely to transpose the determinant, so that it reads by rows as it formerly did by columns, an operation which we know leaves the determinant unaltered. Hence A=-A or A=0. When a skew symmetric determinant is of even degree it is a perfect square. This theorem is due to Cayley, and reference may be made to Salmon's higher Algebra, 4th ed. Art. 39. In the case of the determinant of order 4 the square root is

A skew determinant is one which is skew symmetric in all respects, except that the elements of the leading diagonal are not all zero. Such a determinant is of importance in the theory of orthogonal si'bstitution. In the theory of surfaces we trans- form from one set of three rectangular axes to another by the substitutions ,

X= ax+ by+ cz,

Y—a'x + Vy + c'e,

Z=a"x + b"y+d'z,

where X" •(- y -H Z^ = a? ł 3/" ŧ 2". This relation implies six equations between the coefficients, so that only three of them are independ- ent.

Further we find

a;=oX-)-o'Y+o"Z,

y=bX+VY+V'Z,

e=cX + <^Y + d'Z,

and the problem is to express the nine coefficients in terms of three independent quantities.

In general in space of n dimensions we have n substitutions similar to

Xl = Oiia!i-fOi2iB2-f ... -|-Oi„a!„,

and we have to express the rfl coefficients in terms of Jm(» — 1), independent quantities ; which must be possible, because XI+XI + ...+-S.l=xl+xl+xl + ...+xi,.

Let there be 2» equations

a!l=*llfl + *12f2 + *lS?3+ -. ai! = *inll + *22^2 + *23?S + • ■ • ,

Xi = 6iifi f 621? 2 + *sif 3 + • ■ • 1 Xjj = 6]^ Ji -f 622^2 + *32?S + • • • I

where Jrr=l and h„= -b„ for all values of r and s. There are then J^(n – 1) quantities b„. Let the determinant of the 6's be As and Bn, the minor corresponding to *„. We can eliininate the quantities fi, l2,...|n and obtain n relations

AjXi=(2Bu-As)Wi +2B2ia!j-(-2B3ia!s-l-...,

AsX2= 2Bija!i-K2BiB-A6)a!j-(-2B3ja!s-t-...,

and from these another equivalent set

Asa!i=(2Bu-A6)Xi + 28^X2 + 2Bi8Xs+...,

Aja!j= 2821X1 + (2Bia-Ai)X2 + 2823X3+...,

and now writing

2B«-Aj

-=ai,

28,;

‘ A»

=<»(*,

we have a transformation which is orthogonal, because X=‘Sx^ and the elements an, an, are functions of the i»i(m – 1) independent quantities b. We may therefore form an orthogonal transforma- tion in association with every skew determinant which has its leading diagonal elements unity, for the J7i(k – 1) quantities b sue clearly arbitrary.

For the second order we may take

**Aj= [_l’\ =l + **

and the acljoint determinant is the same ; hence

, (1 + \^)Xi = (1 – X=)Xi + 2XX2, (1 + \^}Xi = – 2\Xi + (1 – X2)X2.

Similarly, for the order 3, we take

Ai=

and the adjoint is

n + X^+ii’+ii^,

l + \^ v + Xm -/t+Xv

-K + X/l l+/l^ X + yBK

/i + Xk -X+fiv 1+v^ leading to the orthogonal substitution

Aja!i = (l+X”-/t=-»2)Xi +2(i’ + Xm)X2 +2(-/4+Xi’)Xj

AiX2= 2(X/i – i’)Xi + (1 + M^ – X2 – i/2)X2 + 2(iir + X)X3

A6a!s= 2(X^ + /t)Xi 2(fiy-\)X^{l + v^-\^-iJ?)X3.

Functional determinamts were first investigated by Jacobi in a wor^ Se Determinantibus Functionaliius. Suppose n dependent variables yi, 1/2, ■••ym e^eh of which is a function of n independent variables x^, a^,...x„, so that 2/<=/»(a^, X2,...Xa). From the differ- ential coefficients of the ^'s with regard to the x'a we form the functional determinant

R=

dxi dx^ dyn dyn

3^ 3a!„

dXn

for brevity.

If we have new variables z such that z,=4>,{yv y^...yni, we have also 2j=^,(a;i, X2,...Xn), and we may consider the three de- terminants

(yi,yi,-yn\ /%, Z2,...»„\ /’«i, as, ...^nY

\xi,x2,...x„J’ \yi,y3,-ynj \Xi, X^,...X„/ Forming the product of the first two by the product theorem, we obtain for the element in the if’ row and A* column

dyi dxt 87/2 Ba* ■■■ dyn 8jc*’ which is 1^, the partial differential coefficient of zi with regard

OK*

to xn. ■ Hence the product theorem

/zi, Zi,...Z„\(y^,V2,...yn-(lll, 2a,...2»'.

\yi,ya>—yn/\"2>—<^J \xi,x2,...x,ij

and as a particular case

(yi, yi,—y«\(<^> !>!2,..-a;n'\=i.

\Xi, x^...xnj\yi,ya…yn/

Theorem. — If the functions 3/1, 1/2,... yn be not independent of one another the functional determinant vanishes, and conversely if the determinant vanishes, y^, y2,...y„a,TB not independent func- tions of aii, a;2,...a!n. ...

Linear Equations. — It is of importance to study the application of the theory of determinants to the solution of a system of linear equations. Suppose given the n equations

/l = OlliBl + ai2a!2 + • • • + aiwiJn = Oj

/2 = aaiKi Ł 22^ Ł . . . Ł fl^niCn = 0, /n = a«liBl + ao2i»! + . • • + "nniBn = 0.

Denote by A the determinant (flJiiffl22"-<*nn).

Multiplying the equations by the minors A.^,k^ii.,...&nii, re- spectively, and adding, we obtain

%(oi»iAi(i Ł aajiAj,! Ł . . . -f oinji A^iji) = asji A = 0, since from results already given the remaining coefficients of a!„a!a, ...a!»-i,a;»«-(-i. -"Ki. vanish identically. . , , ,

Hence if A does iiot_ vanish Xi=X2=...=x„=0 is the only solu-

tion ; but if A vanishes the equations can be satisfied by a system of values other than zeros. For in this case the n equations are not

independent since identically

Ai,i/i + A2H/2 Ł . . . + A^/„ = 0, and assuming that the minors do not all vanish the satisfaction of » – 1 of the equatioijs implies the satisfaction of the n'K Consider then the system of Ji – 1 equations

a2ia:'l H- «22'"2 + • • • + "snaJn = 0 ttgiaa + «32^ + ■ ■ • + "SMi^n = 0

a„ia!i Ł a„^ ... »«„!!;„ = 0,

Xs

which becomes on writing ~ = yi,

***n a-nyi + "wy^ ■■■**

a^yi + avsy-i ■■■ an,n-l2/n-l + a«n = 0.

We can solve these, assuming them independent, for the » – 1

ratios 2/1, 2/2. •••yn-i- Now

O'al-^ll + <''22-A-l2 + • • • + a2nAln = 0 "'sJ^-il + «32-*-12 + • • ■ + «3nAi„ = 0

"biAii -H a,^ A12 H . . . H OnnAln = 0.

and therefore, by comparison with the given equations, a!j=pAii,' where p is an arbitrary factor which remains constant as * varies.

Hence 2/4 =t-^ where Ak and Ai„ are minors of the complete

Aln

determinant {aryM^...a„,^.

.-.ViH-y^-

«21 '*22 ■•■«2,i-l

a2,i-n

...am

osji a^ ...aa,i-i

03,i+l

...Oan

,aM.

flSnii+l

...a„„

a21 «22 •

■

flSgi 1*32 .

•a3,ti-l

Ctnl "'tH ■

■an,n-l

or, in words, j/j is the quotient of the determinant obtained by erasing the i"' column by that obtained by erasing the re'* column, multiplied by (– 1)*+". For further information concern- ing the compatibility and independence of a system of linear equations, see Gordan, Vorlesungen iiber Invariantentheorie, 8d. 1, § 8.

JtesuUanis. — When we are given A homogeneous equations in k variables or k non-homogeneous equations in A; – 1 variables, the equations being independent, it is always possible to derive from them a single equation B=0, where in R the variables do not appear. R is a function of the coefficients which is called the "resultant" or

“eliminant” of the k equations, and the process by which it is obtained is termed ” eUmination. ” We cannot combine the equations so as to eliminate the variables unless on the supposition that the equations are simultaneous, i.e., each of them satisfied by a common system of values ; hence the equation R=0 is derived on this supposition, and the vanishing of R ex- presses the condition that the equations can be satisfied by a common system of values assigned to the variables.

Consider two binary equations of orders m and n respectively expressed in non-homogeneous form, viz.

/ (a;) =/ = flija!™ – OiS ⟩ flSj^-* – . . . = 0, (p{x) =

If Oi,02,...a„ be the roots of /=0, /81, |32,.../3„ the roots of 0=0, the condition that some root of 0=0 may cause/ to vanish is clearly

Er,<^=/(/3iy(/32)...//(/S„) = 0;

so that R^,^ is the resultant of /and

f=^a^^-a^x + a2=0, =b^-biX + b^

We have to multiply a^l-a^^ + a^ by a^l-a^^+a^ and we obtain

»§^5^3 -aoai(/3|/3a+/Si/31) + ao»2(/3! -^/SD + afftft

where

and clearing of fractions

R^,^ = (oso*2 –

«i«a(ft+ft)+aj, 5?-2i„Ja

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We may equally express the result as

^(oa)...(o„)=0, or as . .

This expression of R shows that, as will afterwards appear, the resultant is a simultaneous invariant of the two forms.

The resultant being a product of mn root differences, is of degree rnn in the roots, and hence is of weight mn In the coefficients of the forms ; i.e., the sum of the suffixes in each term of the re- sultant is equal to mn.

_ HesuUant .Expressible as a Determinant. — From the theory of

linear equations it can be gathered that the c/)ndition that^ linear

equations in p variables (homogeneous and independent) may be

simultaneously satisfied is expressible as a determinant, viz., if

tiiia^ + Oija^ + . . . + Ou^ = 0,

I a^a^ + a;ifi^+...+a2ifiSp=0,

apiaii + ap^+ ... +Oppa^=0,

be the system the condition is, in determinant form,

(0Siiaaj…a^) = 0;

in fact the determinant is the resultant of the equations. Kow, suppose / and tp to have a common factor x-y,

/(a!)=/i(a!)(a!-7); i>{x)=^i{x){x-y),

/i and 01 being of degrees m – 1 and n-1 respectively ; we have the identity i>i{x)f(o!)=:fi{x)tp{x) of degree m+n-1.

Assuming then ^ to have the coefficients Bj, B^, ...B„ and /i the coefficients Aj, A2, . . . Am,

we may equate coefficients of like powers of x in the identity, and obtain tn + n homogeneous linear equations satisfied by the m + n quantities Bx,62,...B„,Ai,A2,...Am. Forming the resultant of these equations we evidently obtain the resultant of/ and .

Thus to obtain the resultant of

f^a^+OiH^+a^+a^, ip=hffe^+biX + b2

we assume the identity

(Bja; + Bi){a^ + OjO? + a^ + a^) = {A(fl? + AjO! + Aa)(JoSb” + b^x + b^),

and derive the linear equations

Bofflo -A|)5|) =0,

Boai + Bjao-Aofti-AiJo =0,

B„a2 + BiOii – A062 – AjJi – A^Q = 0, BoOj + BjOj – Ajftj – AjJi = 0,

B1O3 -A2i>a=0,

and by elimination we obtain the resultant

0 6„ 0 0

02 0

“0

h

0 0

****

a numerical factor being disregarded.

This is Euler's method. Sylvester's leads to the same ex- pression, but in a simpler manner.

He forms n equations from / by separate multiplication by a:"~~', a^', ... a, 1, in succession, and similarly treats 0 with m mtdtipliers af"~~, al"^, ...x, 1. From these m + n equations he eliminates the m+n powers 0!""~~', a!™~~"^, ...x, 1, treating them as independent unknowns. Taking the same example as before the process leads to the system of equations

a^ + a^af + a^^ + a^ =0,

afft^ + Oja^+a^+a^ =0,

, bfpi^+bja^ + bsX^ =0,

bgH^+biX'+iiX =0,

bax'+biX+b2=0,

whence by elimination the resultant

(t„

"2

%

0

0

a„

«1

"a

«s

***o**

h

h

0

0

0

h

h

h

0

0

0

io

h

****

which reads by columns as the former determinant reads by rows and is therefore identical with the former. Bezont's method gives the resultant in the form of a determinant of order m or n, according as m is %n. As modified by Cay ley it takes a very simple form. He forms the equation /(!B)0(ai')-/(a!')0(a!)=O,

which can be satisfied when /and possess a common factor. He first divides by the factor a- a/, reducing it to the degree TO- 1 in both X and

x’ where m>n; he then forms m equations by equating to zero the coefficients of the various powers of a/ ;

these equations involve the m powers as”, x, x^, ... a;”*-! of a;, and regarding these as the unknowns of a system of linear equations the resultant is reached in the form of a determinant of order m, Ex. gr. Put

{afpi? + Or^ + a^ + ag){b^’^ + b^x’ + b^) – {a^^ + a^x”’ + a^’ + a^)

(b^^+bjX+bf^ = 0;- after division by aj – aj* the three equations are formed

a^b^^ + aJ>TX + a„b2 =0,

af})-^x’ + (dofij ++{arj) -aj}^)x+aj>2-a^bi =0,

and thence the resultant

a„J„

(lA “■ah

ao6i

«o*2 + »A-

“0*2

« A – <»3° «2*a – "A

which is a symmetrical determinant. r

Case of Three Variables. — In the next place we consider the resultants of three homogeneous polynomials in three variables. We can prove that if the three equations be satisfied by a system of values of the variably, the same system will also satisfy the Jacobian or functional determinant. For if u, v, w be the poly- nomials of orders m, n, p

respectively, the Jacobian is (u-^ v^ w^, and by Euler's theorem of homogeneous functions

xnjr^ +yu^ +zu^ =mu xvj^ +yv2 +zvi=nu xwi + yw^ + zw^ =pw ;

denoting now the reciprocal determinant by (XJi Vj Wj) we obtain 3x=mu\]-y+nvWi+pwWi; Jy=..., Jz=..., and it appears that the vanishing of u, v, and w implies the vanishing of J. Further, il m=n=p, we obtain by differentiation

**„ 3j / au, aVi^ 9W, „^ „^ „. **

dx

= (m-l)J + »^(“-h»^ + «,-^'j.

3J

Hence the system of values also causes ^ to vanish in this case ;

3J j3J dz

The proof being of general application we may state that a. system of values which causes the vanishing of k polynomials in k variables causes also the vanishing of the Jacobian, and in particular, when the forms are of the same degree, the vanishing also of the differential coefficients of the Jacobian in regard to each of the variables.

There is no difficulty in expressing the resultant by the method of symmetric functions. Taking two of the equations

an^ +{by +cz)3f^-^ + ...=0, '*

a'3i" + lb'y + c'2)a!»-i +...=0,

we find that, eliminating x, the resultant is a homogeneous function of y and z of degree ?»» ; equating this to zero and solving for the ratio of 3; to z we obtain mn solutions ; if values of y and z, given by any solution,

be substituted in each of the two equations, they will possess a common factor which gives a value of X which, combined with the chosen values of y and z, yields a system of values which satisfies both equations. Hence in all there are mn such systems. If, therefore, we have a third equation, and we substitute each system of values in it succes- sively and form the product of the mn expressions thus formed, we obtain a function which vanishes if any one system of values, c6mmon to the first two equations, also satisfies the third. Hence this product is the required resultant of the three equations.

Now by the theory of symmetric functions, any symmetric functions of the mn values which satisfy the two equations, can be expressed in terms of the coefficient of those equations. Hence, finally, the resultant is expressed in terms of the coefficients of the three equations, and since it is at once seen to be of degree mn in the coefficient of the third equation, by symmetry it must be of degrees np and pm in the coefficients of the first and second equations respectively. Its weight will be mnp (see Salmon's Higher Algebra, 4th ed. § 77). The general theory of the resultant of k homogeneous equations in k variables presents no further difficulties when viewed in this manner.

The expression in form of a determinant presents in general considerable difficulties. If three equations, each of the second degree, in three variables be given, we have merely to eliininate the six products x^, y^, z', yz, zx, xy from the six equations

M=»=ji)=K-=^-=5-=0 ; if we apply the same process to these

equations, each of degree three, we obtain similarly a deter-

minant of order 21, but thereafter the process fails. Cayley, however, has shown that, whatever be the degrees of the three equations, it is

possible to represent the resultant as the quotient of two determinants (Salmon, I.e. p. 89).

Discriminants. — The discriminant of a. homogeneous poly- nomial in k variables is the resultant of the k polynomials formed by differentiations in regard to each of the variables.

It is the resultant of k polynomials each of degree m-1, and thus contains the coefficients of each form to the degree (m-1)*-‘; hence the total degrees in the coefficients of the k forms is, by addition, k{m – 1)*-‘ ; it may further be shown that the weight of each term of the resultant is constant and equal to m(m-l)*-‘ (Salmon, I.e. p. 100).

A binary form which has a square factor has its discriminant equal to zero. This can be seen at once because the factor in question, being once repeated in both differentials,, the resultant of the latter must vanish.

Similarly, if a form in A variables be expressible as a quadratic function of k-\, linear functions X^, X^, ...Xt_j, the coefficients being any polynomials, it is clear that the k differentials have, in common, the system of roots derived from X, = Xj = . . . = Xis_i = 0, and have in consequence a vanishing resultant. This implies the vanishing of the discriminant of the original form.

Exspressicm m Terms of Roots.

S/

Since x J-+y^=mf, if we take

any root ajj, j/j, of J-, ahd substitute in mf we must obtain

12^1

(dyX

hence the resultant of ^ and / is, disregarding

numerical factors, yi2/2…y„^i x discriminant of /=aoxdisct. of/. Now

f={xyi-!>!iy){xy2~x0)...{xym-3imy),

- rif

-‘Zyi{3cyi-x)...{xym-Xmy),

and substituting in the latter any root of/ and forming the pro- duct, we find the resultant of/ and d-, viz. : —

ViVi- ■ -Vmixiyi – xiyifixiys – a^yif. ..(icy, – a:,yrf. . .

and, dividing by yiy^-.~~ym, the discriminant of/ is seen to be equal to the product of the squares of all the differences of any two roots of the equation. The discriminant of the product of two forms is equal to the product of their discriminants multi~~ plied by the square of their resultant. This follows at once from the fact that the discriminant is

n(a,.-a.)2n(/3,~~ft)2{n(a,~~/3,)}».

Beferences for the Theory of Determinants. — T. Muik’s “List of Writings on Determinants,” Quarterly Jowrnal of Mathematics, V. 18, pp. 110-149, October 1881, is the most important biblio- graphical article on the subject in any language ; it contains 489 entries, arranged in chronological order, the first date being 1693 and the last 1880. — T. MuiR. History of the Theory of Deter- minants. ■ London, 1890. — School treatises are those of Thom- son, Mansion, Bartl, Mollame, in English, French, German, and Italian respectively. — Advanced treatises are those of Spottis- wooDB, 1851 ; Brioschi, 1854 ; Baltzer, 1857 ; Salmon, 1859 ; Trudi, 1862 ; Garbieri, 1874 ; GtJNTHBR, 1875 ; Dostor, 1877 ; Baraniecki (the most extensive of all), 1879 ; Scott, 1880 ; MuiR, 1881.

II. The Theory of Symmetric Functions.

Consider n quantities ai, oa, as, ...

Every rational integral function of these quantities, which does not alter its value however the n suffixes 1, 2, 3, ... m be permuted, is a

rational integral symmetric function of the quantities. If we write (l-Haia!)(l + aja!)...(l-l-o„a!) = H-aia!Ł asK^-t- ... +OnP5”,

fltl = ai Ł 02 Ł . . . Ł On = Stti

Og =ala2-^ala8-^-c^2tt3-^...=Sala2

cZn ^ Qiasas ...On.

The general monomial symmetric function is

12 8 “■ ‘

the summation being for all permutations of the indices which result in different terms. The function is written

(Pi’pm—Pn) for brevity, and repetitions of numbers in the bracket are in- dicated by exponents, so that (piPiPi) is written {p^Pij. The

weight of the function is the sum of the numbers in the bracket, and the degree the highest of those numbers. Ex. gr. The elementary functions are denoted by

(1). cn (1»), ... (1»),

are all of the first degree, and are of weights 1, 2, 3, ... to re- spectively.

Remark. — In this notation (0)=Sa!=(i); (0^) = SaiO2=(2) ;... (0») = (7), &c. The binomial coefScients appear, in fact, as sym- metric functions, and this is frequently of importance.

The order of the numbers in the bracket (piP’i…pn) is im- material; we may therefore always place them, as is most i con- venient, in descending order of magnitude ; the numbers then constitute an ordered partition of the weight w, and the leading number denotes the degree.

The sum of the monomial functions of a given weight is called the AomogrejieoMS-produrf-SMm or complete symmetric function of that

weight ; it is denoted by h„ ; it is connected with the elementary functions^ by the formula

■ =l + hjX+l

»+...,

1 – Oi* ŧ a^ – a^3? + ...

which remains true when the symbols a and h are interchanged, as is at once evident by writing -x for x. This proves, also, that in any formula connecting a^, a^, a^, ... with h^, h^, hg, ... the symbols a and h may be interchanged.

Sx. gr. from ^2=”! -«2 ^* derive 02=^1 -^

The function Sof’o?···!) being as above denoted by a parti- tion of the weight, viz. (jBii‘2- • •?»)> it ” necessary to bring under view other functions associated with the same series of numbers : such, for example, as

Safa|»Sof»a?«...aP”_f=(i,iy3)(iJ2p,...i,„_2).

The expression just written is in fact a partition of a partition, and to avoid confusion of language will be termed a separation of a partition. A partition is separated into separates so as to produce a separation of the partition by writing down a set of partitions, each separate partition in its own brackets, so that when all the parts of these partitions are reassembled in a single bracket the partition which is separated is reproduced. It is convenient to write the distinct partitions or separates in descending order as regards weight. If the successive weights of the separates iBi,W2, w^,... be enclosed in a bracket we obtain a partition of the weight w which appertains to the separated partition. This partition is termed the specification of the separation. The degree of the separation is the sum of the degrees of the component separates. A separation is the symbolic representation of a product of monomial symmetric functions. A partition; (i’iPijPiP2P2P3) =

(i'iPiP3)i can be separated in the manner (p^il{piPi){PiP3) = {PiP2)\PiPs), and we may take the

general form of a partition to be {pT^^V'...) and that of a separation (Ji)"i(J2)-'2(J3)-'3… when Jj, J2, J3… denote the distinct separates involved.

Theorem. — The function symbolized by (»), viz., the sum of the ?i«* powers of the quantities, is expressible in terms of func- tions which are symbolized by separations of amy partition

(wj^Wj'Wj'...) of the number n. The expression is —

I'll 1-2! 1-3!...

(Ji)A(J2)^2(J3)4… being a separation of {.n^^^n^ ...) and the summation being in regard to all such separations. For the particular case (n^n"ii"...) = {V')

To establish this vn-ite —

1 Ł yitXi ł M% + M*Xs }... =n(l + /*ai!l!i ł AMi"^ + MMiKs +•••)j a

the product on the right involving a factor for each of the quantities Oj, oj, 03…, and /* being arbitrary. Multiplying out the right-hand side and comparing coefficients

X, = (l)a!i, X2=(2)a!2 + (!>!,

'S.3 = {^)Xi + {2\)x^ + (V)x\,

4= (4)a!i Ł (Zl)x + {■^)xl + {7.V)x^l + (l*)a!},

X™^2!(m»J^...)a!52^!»;"'..., the summation being for all partitions of m.

Henoe the products s^, %«!, s|, s^sl will appear. From the formula

(21^) =S(ja2) – S(2i)S(i) – ^(2)S(i2) +^S(ii)s5j

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Auxiliary Theorem.— The coefficient of xi^x^^... in the product ^^g^- is -g(J^H.WWs…

(Ji)-‘i(Jj)^a(J3)j8… is a separation of (l^H^l^...) of specification (m^^m’m’...), and the sum is for all such separations. To establish this observe the result.

(3)»i(21)’^(l’)“s is a separation of (3’^2”»l’^2+3“8) of specification (3P). A similar remark may be made in respect of

/ij! %’ /Uj! ‘»a’ /Xj! Wa’””

and therefore of the product of these expressions. Hence the theorem. Now

log (l+MXi + /i3X2 + /l»X3+...)

=S log (l+f«»ia!i + /i=a2a!ij+At’o»a!3+...)

a

whence expanding by the exponential and multinomial theorems a comparison of the coefficients of /j.” gives

{n)^(-)’^+“a+“s+- – 1 (■‘i + »‘a+i-3+—l)!

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»‘i:>‘2

Vi’-y^’-v^i.

x^x^x^...

and, by the auxiliary theorem, any term

right-hand side is such that the coefficient of !&s^^... in , } , XiS'XS'X!^... is

2(Ji)^i(j2ya(j3y….

where since (mj^ mf* m^ . . .) is the specification of (Ji)^i(J2)"!(Ja)^'. . . , l^ + M^+f^+--- =A +^2 +^3 + ... Comparison of the coefficients of s&c^x!?... therefore yields the result

, _ vl+'~~a+'sH~~ ■ ■ ■(»'i + ya + y3+—l)!...x

for the expression of Sa" in terms of products of symmetric functions sjrmbolized by separations of (m'^re're'^'...).

Let {n)a, {n)„ {n)x denote the simis of the n"' powers of quantities whose elementary symmetric functions are dj, 012, 03,... ; Xi, x^, Xg, ... ; Xi, Xj, X3, . . . respectively : then the result arrived at above from the logarithmic expansion may be written

«xhibiting (to)x as an invariant of the transformation given by

the expressions of X^, Xj, X, ... in terms of Xx> ^> "h

The inverse question is the expression of any monomial sym- metric function by means of the power functions (r)=j,. We have just seen that «r is expressible in terms of symmetric function products symbolized by separations of any partition

Let this expression be denoted by sCrJ'rJVj*...). Theorem. — It can be shown that

=2()~^^

(ar„-l)!(Z7r2,-l)!... .MAiJ.

Ji'JaW •..Tu!Ti2.

..lir^lTTo,! ...

‘(‘a)”’

where

denotes a separation o{(p^p^^pl’...) and the summationisinregard to all such separations. If (Ji), (Ja), (J3) ... be of weights ij, i^, %,... it is clear that the product s^»^s|j— wiU appear on the right- hand side, and that (ijVj^j…) is a specification of a separation of

.Eb. gr. To express (21*) in terms of power functions. The separations of (212) are (i.) (21«), (ii.) (21) (1) ; (iii.) (2) (1»), (iv.) (2) (1)2 and the corresponding specifications (4), (31), (2^),

a result easy to verify.

Theorem of Reciprocity. — If

XS^X^XiJ^... = ... + e(,X»...)<'x^^»... + ...,

where 9 is a numerical coefficient, then also

X^‘X^=X^3… = ... + e^‘m^f ….)a,^‘a,a,,.. + ...

We have found above that the coefficient of xi^xf^xf’... in the product XS^XJ^^X!^... is

2(Jl)^l(J2}^3(J3)‘8…

the sum being for all separations of (l^H^^’...) which have the specification (m’^^m’m‘...). We can multiply out this expres- sion so as to obtain a series of monomials of the form 6{s^h^‘s^’...). It can be shown that the number 0 enumerates distributions of a certain nature defined by the partitions (mj’m”...), {s^h^’...),

(l^H^...) and it is seen intuitively that the numbej 8 remains unaltered when the first two of these partitions are interchanged (see CoMBlNATOMAL ANALYSIS). Hence the theorem is estab- lished.

Putting a^l=l and x2=io^=Xi= ...=0, we find a particular law of reciprocity given by Cayley and Betti,

(l“r(l’^ni’^r’... = ...-l-e(mf’m^mf. ..)-(-...;

and another by putting a!i=a!2=a!3=...=l, for then Xm becomes hm, and we have

“‘mfimj“mi

■+e’{sl%‘s:

‘iKK’- = «’(<'«)—

Theorem of ExpressiMUty. — “If a symmetric function be sym- bolized by (X/w…) and {\{K^...), f/ij/ijA^...), {y.y^...)... be any partitions of X, /i, v,... respectively, the function (X/tc…) is ex- pressible by means of functions symbolized by separations of

(^iNs^S- • /^l/Vs- • •<'l>‘2>‘3- • •)• ”

For, writing as before,

P is a linear function of separations of {I’^H^l’^’...) of specification

(m>fm«...), and if l^ixyx^»... = SP’a!‘a;^=..., P’ is a linear

function of separations of {i’^H’iI. . .) of specification (s^‘sj’s^”. . .).

Suppose the separations of {I’^l’l’...) to involve k different specifications and form the k identities

where {m’^m’m’...) is one of the k specifications. The law of reciprocity shows that

pWj

Sff«(<; e=i "

,”»™Mi!l™»‘3«

),

viz. : — a linear function of symmetric functions symbolized by the k specifications ; and that 9a=0u- A table may be formed expressing the’i expressions PW, PP’,...P”’ as linear functions of

the k expressions (mj’m

“...), s=l, 2, ...k, and the numbers

6^ occurring therein possess row and column symmetry. By solving k linear equations we similarly express the latter func- tions as linear functions of the former, and this table will also be symmetrical.

Theorem. — “The symmetric function (OT’^m’^m”*’ ...) whose

•* , ^ 1« 2» S» ‘

partition is a specification of a separation of the function symbolized by (Zj’^Zj’...) is expressible as a linear function of

symmetric functions symbolized by separations of {t^l’^^...) and a symmetrical table may be thus formed.” It is now to be re- marked that the. Dartition il^t^l ‘...) can be derived from

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(mj^“in^’“mj^^...) by substituting for the numbers mj,, m^, m^,... certain partitions of those numbers {vide the definition of the specification of a separation).

Heuoe the theorem of expressibility enunciated above. A . new statement of the law of reciprocity can be arrived at as follows : — Since

where {Jj)h{J^h{Jsya… is a separation of {l^H^l^...) of specifica- tion (m’“mj’^m”*’...), placing s under the summation sign to denote the specification involved ;

Ml i-i

”””” ‘ •■•2 ‘Swr’—2’¯r---). t 1=1

■where 0n=Su.

Theorem of Symmetry. — If we form the separation function i(J,)

each separation having a specification {‘”’■’^””■^m^...), multiply hy /111! ju2i! /usi! ... and take therein the coefficient of the function (mj‘“m^m’^...), we obtain the same result as if we formed the

separation function in regard to the specification (m„“OTj?‘m^”...), multiplied by /titlA’alMst! •■■ and took therein th^ coefficient of the function {m’^m’m’...).

.25«.9-r.,take(2^’«^...) = (21«); K“m;^...) = (321) ; (m^Tn^...) = (31»); we find

(21)(1^(1) + (1»)(2)(1) = . .. + 13(31») + . . .,

(21)(1)’=... + 13(321) + ...,

The Differential Operators. — Starting with the relation (l + Oia!)(l + 02a!)...(l + a„a!)=‘l + aia!a2!c’...+a,a!”

multiply each side by l + ux, thus introducing a new quantity /* ; we obtain ‘

(1 + aii)(l + 02a!)...(l + o^)(l +yua!) = l + (ai+/i)a! + (o2+/«ii)a!’+ ...

so that/(ai, Oj, a3,...a„)=f, a rational integral function of the elementary functions, is converted into

/(di + ft 02 + /i«ii,...a„+/«i„_i)=/+/«i]/+^|(«f/+|i4/+ ... where

‘■ 3a, ‘802 ^»3 oa„

and di denotes, not s successive operations of rfj, butthe operator of order s obtained by raising di to the «’* power symbolically as in Taylor’s theorem in the Diff. Cal.

l~s ‘ Write also -rd, =D, so that

5: 1 ^

J\ai +fi,a2+fMi, ...a„+ fM„-j) =/+ /tDi/+ ii!‘T)J’+ /t’D3/+ ....

The introduction of the quantity fi converts the symmetric function (\jW—) i”*”

Hence, if /(Oi, (tj, ...an) = [‘\iW…),

(^,^2V••)+/””’(^2^3-)+i^^(^l^a■••)+i^M^l^2••.)+■.. = (1 + /*Di + /i=Dj + m’Ds + ■ • •)(^l^2^s■ • ■)•

Comparing coefficients of like powers of /t we obtain DKiCKiW. ..) = (W- . ■), while D,(Xj\jX3…) = 0 unless the partition (XiXj^j…) contains a part s. Further, if DajDxj denote successive operations of Dx, and Da2,

and the operations are evidently commutative.

Also D^‘DjpjJ…(p[»^J^^^»...) = l, and the law of operation of the operators D upon a monomial symmetric function is clear.

We have obtained the equivalent operations

where exp denotes (by the rule over eaip) that the multiplication of operators is symbolic as in Taylor’s theorem. (^ denotes, in fact, an operator of order s, but we may transform the right-hand side

so that we are only concerned with the successive performance of linear operations. For this purpose write

d, = da, + OSlSu^n +

It has been shown {mde "Memoir on Symmetric Functions of the Roots of Systems of Equations," Phil. Trans. B. S., London, 1890, p. 490) that

e^{m^dx + in^i + m^^ +...)= ca!p(Mi(ij + Msjdj + W^^ + . .\ ),

where now the multiplications on the dexter denote successive operations, provided that

exp(ii + M^ + U^'+ ...) = l + myi + m^+7n^+ ... ,

J being an undetermined algebraic quantity. Hence we derive the particular cases

ea^di = ea^{di

-^2 + ^s-—)'>

e3^ljd,^ = exp(jjdj^—^d2+-liHi-...),

and we can express B, in terms of d,, d^, d^, ... , products denoting successive operations, by the same law which expresses the elementary function a, in terms of the sums of powers j,, s^, S3, ... Further, we can express d, in terms of D,, Dj, Dg, ... by the same law which expresses the power function s, in, terms of the ele- mentary functions a^, a^, ag, —

Operation of D, ripon a Product of Symmetric Functions. — Sup- pose /to be a product of symmetric functions fifi-.fm— If in the identity /=/i/2…/m we introduce a new root /* we change o, into a, + iM,-i, and we obtain

(l + /tDi+/t'=D3+ ... <u>M'D.</u> ...)/ = (l + AiDi + /t"Dj+ ... <u>/i'D.</u> ...)/i

X (1 +/ltDi+Al"D2+ ... <u>ill'I>.</u> .••)/2

X .

X (1 /iDi/i2Dj+ ... ^‘D, ...)/„,

and now expanding and equating coefficients of like powers of /i

Di/=S(D./i)A/3…/™, Dj/=S(D^,)A/3…/™+S(D,/,)(D,/,)/3…/„, _^^^^ ^

D3/= S(D3/i)A/3- . ■/» + 2(Ci!/l)(I>l/2)/3- • •/» + 2(D3/,)/j/3. . ./„,

the summation in a term covering every distribution of the operators of the type presenting itself in the term. Writing these results

I>i/=D(i)/.

D2/=D(2)/+D(1»)/.

D3/=D(8)/+Dta)/+D(i»)/. we may write in general

Ds/=SD(j)iJ)2Pj…)/,

the summation being for every partition (piPsft…) of s, and D(PiP2Pa. ..)/ being = 2(DpJj){DpM(Dp,fs)A. . .fm. JBx. gr. To operate with Dj upon (21”)(21*)(1.’), we have

Dfe)/=(1»)(21^)(1S) + (21»)(1«)(1”), D,ii!,/= (21”)(21S)(1=) + (21S)(21») (1*) + (21‘2)(21*)(1<),

and hence

T>J= (21<)(1=)(1?) + (21!')(1')(1<) + (21»)(21'')(1'>) + (21’)2(1<)

+ (21«)(21=(1*).

to SymmetriB Function Multiplication. — An ex- ample will explain this. Suppose we wish to find the coefiicient of (62*1’) in the product (21’)(21*)(1”). Write ,

(21’)(21«)(l’i) = . . . + A(52«)(l>) + . . . ; then

D5DSD?(21»)(21«)(1”) = A;,

every other term disappearing by the fundamental property of D,. Since

Db(21»)(21*)(1’) = (1’)(1*)(1«). we have : —

D|D»(1<)(1^)(1»)=A DgD? {(1')(1')(1») + 2(1<)(1')(1=)} = A DID? |5(l») (12)(li!) + 2(1*)(1=)(1) + 2(1»)(1»)(1)} = A DjD? {12(1!')(12)(1) Ł 7(1») (1)(1) + 2(1*)(1) + 6(l»)(l2)} = A D512‘=A,

where ultimately disappearing terms have been struck out. Filially A = 6. 12 =72.

The operator rfi=ao3ai + oi3aj2+(ij3ag+... which is satisfied by every symmetric fraction whose partition contains no unit (called by Cayley non-unitary symmetric fuTictiona), is of particular im- portance in algebraic theories. This arises from the circum- stance that the general operator

\afldai + \a1da2 + XjiOsSog + ... ,

is transformed into the operator di by the substitution

(oq, Oi, Oji ■••”«>) = (o’hi Nj^a • • • J ^o’^i • ■ • ^«-]”« ■ • •)>

so that the theory of the general operator is coincident with that of the particular operator d^. For example, the theory of in- variants may be regarded as depending upon the consideration of the symmetric functions of the differences of the roots of the equation

“o*” – (“i)ai’B”~’ + (”)ai!a!”-‘ – . . . = 0 ; and such functions satisfy the differential equation a^doi + 2aii3a2 + Sa^a^ + . . . + 7ia„_i3om= 0.

For such functions remain unaltered when each root receives the same infinitesimal increment h ; but writing x-h for x causes flSj, tti, Oj, aj, ... to become respectively a„, Of^ + hag, a^ + hoi, 0,3 + dha, ... and^ag, a^, a^i’^at-.) becomes

/+ h{a„dai + 2ai3aj + SojBm +■■■)/,

and hence the functions satisfy the differential equation. The important result is that the theory of invariants is from a certain point of view coincident with the theory of non-unitary symmetric functions. On the one hand we may state that non-unitary symmetric functions of the roots of aifl!” – ai3i^~^ + a^~^ – ...=0, are symmetric functions of differences of the roots of

aoa?” – 1 !(aia!”-i -H 2!(a2a!»-2 – . . . = 0 ;

and on the other hand that symmetric functions of the differ- ences of the roots of

ao*° – (“X” + (”)a^-‘ – . . . = 0,^

are non-unitary symmetric functions of the roots of

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Symbolic Representation of Symmetric Funetiims. — Denote the

a* o’ o’ elementary symmetric function a^ by — ,?,* , ... at pleasure ;

a^

1!

V-i-l-S?a!»-2-...=0.

2!

An important notion in the theory of linear operators in general is that of MaoMahon’s multilinear operator (“Theory of a Multilinear partial Differential Operator with Applications to the Theories of (nvariants and Reciprocants,” Proc. Land. Maih. Soc, t. xviii. (1886), pp. 61-88). It is defined as having four elements, and is written

(/I, v;m,n)

ir m^ . / , \ m\ m-1 3

= ^L^X + ^^ + ”m-l)ll!”” »l-.fi

+ (” + 2“H(;r^lTrr!”’> ”^ + {m-2)\2f0 “Pa,

■^^*^”\m-\)\’"”> “3 + (™_2)!i!i!«0 »1»2 ^ , rn\ m-8 s-

+ (m-3)!3!“0 “«/3an+3

1..

].

the coeflScient of a^a^a^... being ;·| i^^, _ ■ The operators

«o3ai + «l9a2+-. ao9oi + 2ai9a2+--- ^^^ ^een to be (1, 0 ; 1, 1) and (1, 1 ; 1, 1) respectively. Also the operator of the Theory of Pure Reciprocants (see Sylvester Lectv/res on the New Theory of Beeiproccmts, Oxford, 1888) is

(4, 1 ;2, l)=i{4a?9ai + 10ao»l3a2+6(2aoa2 + aD9a3+-}

It will be noticed that

(ft ;- ; m, n)=ii{\, 0 ; to, n) + v{0, 1 ; m, »). The importance of the operator consists in the fact that taking any two operators of the system

(/I, v;m,n); (m’, ”’ ; m^, n}), the operator equivalent to ,

(ft V ; rh, n){ii>, v^ ; m>, n^) – (mS “^ ; m\ ™’)(a». ” ; ™i n), known as the “alternant” of the two operators, is also an operator of the same system. We have the theorem (ft i’;m,n)(ji\ v^;m^, n^) – {/i\ “^ ; m^, n^){iJ,, v;m,n) = (mi, ^i! w^j »i) ; where ■

P^ = (m’+m-l){^,{^ + r<.h)-^i^' + nv^)}.

, , TO-1 1 ot’-1 1 „, = (»! -«)^V-h-^M’.’ — T* ‘

j»j=TO’-F7ra-l ,

and we conclude that qud “alternation” the operators of the system form a “group.” It is thus possible to study simultane- ously all the theories which depend npo» operations of the group.

si’ si’ s\ then, taking n equal to 00 , we may write

1 Ł ajK + oijiiK^ Ł . . . = (1 -f Pia!)(l (Pjjk) , . . = e”i* = 6021 = e”»*= . . . where

p^,...p.=J=^=-^=....

Further, let

l + iiX+b^+...+i„^={l + (riX){l + (r^)...{l+(r„pc) ; so that

, l-f-flSiiri-l-a2(r|-t-... = (l-|-ftffi)(l-l-/)2«i, 1 + osiffa Ł daffl + . . . = (1 Ł piI pao-j) . . . = e’a’ .

1 4-ai

and, by multiplication,

U{l + aiff + ay+ ...)=n{\ + bip + by+ ... + b,np’^) , a P

_ ^(Tiai+ 0-302+ .. -Htr„

Denote by brackets ( ) and [ ] symmetric functions of the quan- tities p and a respectively. Then

1 Ł OiCl] + aKl”] + a22 + a?[l’] + ai02[21] + a,[3]-f …

+ »pi»p2»i)a- • • »p,„[^iFijP8- • •i’m] + ■ • ■ = l-^5l(l) + 6!(l2) + 62(2) + 6^(l”) + il62(21) + 63(3y+...

_ jOioi+o-atta ■ ■ +o-„a„

Expanding the right-hand side by the exponeiitial theorem, and then expressing the symmetric functions of o-j, a^, ...am, which arise, in terms of ftj, ftj, ...6m, we obtain by comparison with the middle series the symbolical representation of all symmetric func- tions in brackets ( ) appertaining to the quantities pj, pj. Pa

To obtain particular theorems the quantities ctj, (Tj, ctj, ...«■„ are auxiliaries which are at our entire disposal. Thus to obtain Stroh's theory of seminvariants put

61 = 0-1-1- 0-2 ┤...+(7m=[l] = 0 ;

we then obtain the expression of non-unitary symmetric functions of the quantities p as functions of differences of the symbols

"■U "2, Oj,...

Ex. gr. bl{2^) with m=2 must be a term in

gcnai-|-0-2a2_gOi(oi-O2)_ .,.2.$^{4(}$„_a^)4 + , ,^

and since 4| =

= 2ai-2ar^a2 + al

as is well known.

Again, if ffj, o-j, o-g.-.o-m be the m, m"' roots of -1, 61 = 62= ••• = 6m_i = 0 and 6^=1, leading to

1 ł (to) Ł (to=) ŧ (toS) <u>....= e"iai</u>"l!«2+ . ■ H-"™-™

and

.-. {m') = ~~(^(r202-l-...-^»■mnm)'°',~~

msv

and we see further that ((TiO, -f 0-2*2 +—• + •^m”’’)* vanishes identically unless k=0 mod m. If m be infinite and

\ + biX + b^^+ ... = (\ +

gOioi-l-o-aaa-fffaos-t-. .. _jpift-l-p2fe-Hp3P8+-“,

and

(o-jOi -f o-jOj H- 0-303 •+-...)p = (ft/3i Ł pa/Sj -f pa^s ł ...)P .

Instead of the above symbols we may use equivalent differential operators. Thus let ,

5a=»i3o„ + 2a29ai + 3«80a2+ – and let a, 6, c, ... be equivalent quantities. Any function of differences of 5a, S„, S^, ... being formed fhe expansion being carried out, an operand a„ or 6„ or Cq… being taken and 6, c,... being subsequently put equal to a, a non-unitary symmetric function will be produced.

&. gr. (S„ – St)Va. – So) = («a – 2S«S6 + «?)(«« – SJ = 5^ – 2Sld, + dJl – Sis, + 2SJtSc – Sis, = 6oj – 40261 + 20162 – 202C1 + 2ai6i(!i – 262C1 = 2(0.1 – ‘“a + “^ = ⸨)- The whole theory of these forms is consequently contained im- plicitly in the operation S.

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Symmetric Functions of Several Systems of QwmiUies. — It will suffice to consider two systems of quantities as the corresponding theory for three or more systems is obtainable by an obvious enlargement of the nomenclature and notation.

Taking the systems of quantities to be

we start with the fundamental relation

(1 + Oja; + ft3/)(l + a^ + p^y){\ + a^+ jSjj/) . . . = \ + ai^ + a^^y + a^+ari^xy + a^y^+...ap^yi_...

As shown by Sohlafli* this equation may be directly formed and exhibited as the resultant of two given equations, and an arbitrary linear non-homogeneous equation in two variables. The right-hand side may be also written

1 + Sojij! Ł Sfti/ (SajOisa? + 2a^,py + S^A?/" +...

The most general symmetric function to be considered is

Safi|39i«|'2/3|i'a|^/39s…

conveniently written in the symbolic form

(i'l?li'2?2i'3?8—)-

Observe that the summation is in regard to the expressions obtained by permuting the n suffixes 1, 2, 3,...n. The weight of the function is bipartite and consists of the two numbers 2p and Sj ; the symbolic expression of the symmetric function is a partition into biparts (multiparts) of the bipartite (multi- partite) number 'Sp, Sj. Each part of the partition is a bi- partite number, and in representing the partition it is convenient to indicate repetitions of parts by power symbols. In this nota- tion the fundamental relation is written

{l + a^+Pi^l + a^+Mil+yc+Psy)^.. = l + (10)x+(01)y + (ia')3i? + (1001)xy + (0V)y^ + (lff')ai» + {W6i)x^ + (10 Oi^)xy^ + {W)y' +...

where in general apq=(lQP 01«).

All symmetric functions are expressible in terms of the quan- tities fflpj in a rational integral form ; from this property they are termed elementary functions ; further they are said to be single- unitary since each part of the partition denoting Op, involves

, but a single unit.

The number of partitions of a biweight pq into exactly m biparts is given (after Euler) by the coefficient of ancPyi in the expansion of the generating function

1

l-OiB.l-a^.l-aa^.l-oiBy.l-a^.l-OiES.i-aa^.l-aa:^. l-ayS…

The partitions with one bipart correspond to the sums of powers in the single system or unipartite theory ; they are readily expressed in terms of the elementary functions. For write (pg)=Spg and take logarithms of both sides of the funda- mental relation ; we obtain

SioK Ł %Sf = S(oia! H- ftj/) s^^+2SijiKy + So^y^=:S{ajX+Piy)\ &c., and

Sioa; + s^y – {s + 2saxy + s^y^) + ...

=log {l + aiaX+a„ji/+...aj„x“y^...) From this formula we obtain by elementary algebra

(-)■

p-H-l(p+g -1)1

2, .St-hZtt-II! m 1

‘VAi—

corresponding to “Waring’s formula for the single system. The analogous formula appertaining to n systems of quantities which expresses Sp„... in terms of elementary functions can be at once written down. Ex. gr. We can verify the relations

80 10 20 10 SO ‘

s =a”a„ -a.,a„ -a„ai„„+<»„ •

21 WOl aOflX 11 10 21

The formula actually gives the expression of (pq) by means of separations of

(lO^‘Ols) ,

which is one of the partitions of {pq). This is the true_ stand- point from which the theorem should be regarded. It is but a particular case of a general theory of expressibility. To invert the formula we may write

l+a^fiC+aa^y + ...ap,x’>y...

=exp {(sioa! + Soi2/) -2(»2oi>*° + 2»ii!B2/+»022/”) + •■•}.

- **Vienna Trcmsadwas, t. iv. 1852.**

and thence derive the formula —

(-)iH,-ia

-2(

<£i+?irlI!\'''/(P2+&il)!\"'...(:i]:

iS.r-1

ITilTTa!.

^I’g-i! / «. i)a which expresses the elementary functions in terms of the single bipart functions. The similar theorem for n systems of quantities can be at once written down.

It will be shown later that every rational integral symmetric function is similarly expressible.

The FvMd,ion hpq. — As the definition of ^p, we take

l+hi^+h^y+...hp^y...

1 ■

Further

{1- OjX- Piy){l age p^)... and now expanding the right-hand side

the summation being for all partitions of the biweight. writing

■i. + 7ir„fe+haiy+ — ‘^rT>’“y —

‹l-ai-aa^y+... + (-)^ap,xPy+...’

we find that the effect of changing the signs of both x and y is merely to interchange the symbols a and h ; hence in any re- lation connecting the quantities hp, with the quantities Up, we are at liberty to interchange the symbols a and A. By the ex- ponential and multinomial theorems we obtain the results —

(

r’^v=2(-

2»-l (2^)1 „, „,

and in this a and h are interchangeable.

p\q

‘pa— X|(‘

_^f(Pi + gi-l)a”/(j‘2+g2-l)!'’ ‘ ZiX p^\q^\ J \ Pi’.q,’.... J

.,“1 .“2

iTiiiTa!.

Differential Operations. — If, in the identity

{l + aiX+Piy)(,l + a2X+M—i^ + <^'

we multiply each side hy (l+fos+vy), the right-hand side be- comes

1 + (aio /*)» (<»oi + "te + ■•• + ("m +I^p-i,9 + va,p,q-i)x''y^ +...; hence any rational integral function of the coefficients aio, agi, •■■ Opj, ... say/(aio, aoi. ...)=/ is converted into

exp{iidi„ + vd^)f

where <«io=2»^-''»^ ■ ''^ = S"'"'''"'^ " The rule over exp will serve to denote that luiyf + vclfsy is to be raised to the various powers symbolically as in Taylor's theprem.

Writing n ^J^AV^i

p\q\ ^ ^

e^(/«ii„ t Krfoi) = (1 + i”Dio + “Doi + • – + /’”■“D^ + •■■)/; now, since the introduction of the new quantities ii, v results in the addition to the function (i’i2’ii‘2?2i‘3?s—) of the new terms

we find

Dmi(Pi9’ii’i!?2Ps^”)=(i‘2?2i’s?3-) ; and thence

Dl)iSiI>3)i,82l>j)jaj. . .(piJiiJjg’ayaJa. ..) = 1 ; while D„/=0 unless the part rs is involved in/. We may then state that Up, is an operation which obliterates one part pq when such part is present, but in the contrary case causes the function to vanish. From the above Dj«, is an operator of order ^gi, but it is convenient for some purposes to obtain its expression in the form of a number of terms, each of which denotes pq successive linear operations ; to accomplish this write

and note the general result.+

exp (my^^ + m^dfa^ + ...mp^j^...)

=exp (M,o(ii|,-HMoi<«oi+ ■•• Mp,rfp, ...) ;

where the multiplications on the left- and right-hand sides of the

+ Phil. Trcms.-H. S. London, 1890, p. 490.

equation aie symbolic and unsymbolic respectively, provided tnat TTipq , Mpg are quantities which satisfy the relation exp (Mio| + Moi7)+... + M„p'i)«+...)

where | , i; are undetermined algebraic quantities. In the pre- sent particular case putting ?%(,=/*, »noi=i' and mpg = 0 otherwise

Mio? + Mbtj + . . . + Mpj^-ijs + . . . = log (1 + /if + PT)) or

and the result is thus

= exp {fidin + vdfii – l^d^ + 2iivda + v^^) + ...}

= 1+mI>io + "Doi+"A^'"I>«- ; and thence

M<^io + >"*oi – 2(^%o + 2/«'

=log (1 +/iDio + .'Doi+ ... +/n"»9D,j-l'...). From these formulse we derive two important relations, viz. : —

(-)

i>+«-f

ly.Y^

Ti ^ f to + gi – l)!'^/(y2+g2- 1)!

(-)■

2ir-l

."mA^s"

the last written relation having, in regard to each term on the right-hand side, > to do with 2ir successive linear operations. Recalling the formulae above which connect Spj and a^, we see that dp, and Dp, are in corelation with thjese jjuantities re- spectivSy, and may be said to be operations which correspond to the partitions {pq) , {W 01») respectively. We might con- jecture from this observation that every partition is in corre- spondence with some operation ; this is found to be the case, and it has been shown {loc. cit. p. 493) that the operation

_1 L…” ^’^2

(multiplication symbolic)

corresponds to the partition (Piqi”^ p^^’^—)- The partitions being taken as denoting symmetric functions we have complete correspondence between the algebras of quantity and operation, and from any algebraic formula we can at once write down an operation formula. This fact is of extreme importance in the theory of algebraic forms, and is easily representable whatever be the number of the systems of quantities. We may remark the particular result

dp, causes every other single part function to vanish, and must cause any monomial function to vanish^ which does not comprise one of the partitions of the biweight jjy amongst its parts. Since

J -I .y+«-l(£H^J-l)! *rf*

the solutions of the partial differential equation dp,=0 are the single bipart forms, omitting Sp,, and we have seen that the solutions of ‘Dpq=0 are those monomial functions in which the

part pq is absent.

One more relation is easily obtained, viz. : —

-^ ‘^dfq – Alorfp-)-l,j – hlBdp,q+\ + ...{- Y‘hr^p^r,q+l+ ■■■ ■

dClpg

Theory of Three Identities. — Let

\+av!fe+apv^‘“y^ ■■■

= {l + aix + ^iy)0. + aiic + p&)...

= (1 + aO’a!ł/Sj’VXl +<'a' + i3"V)- \ + Ci^ + Csiy+...CpqXf’>fi...

wherein x and y are to be regarded as undeterminal quantities, and the identities as merely expressing relations between the coefficients on the left and the quantities o, /S on the right. Assume the coefficients and quantities in the identities I. and II. to be given, and the coefficients in III. to be then determined by

=n(H-oAof +/3Ai‘7 + ... of ft‘6«f”’?’ ••■)i a

I and ri being undetermined quantities.

(I.)

(11.)

(III.)

This assumes that the coefficients c^, of III. are certain functions of the quantities and coefficients ot I. and II. Denoting sym- metric mnctions of the quantities in I., II., and III. by partitions in brackets ( ), (}i, ( )j respectively, we find that the assumed relation gives—

<:io=(10)5io.

Ca,=(20)6a,-K102)6|„,

(!u=(U)6ii + (10 01)6i„6oi, _

Cia=(21)Jia + (20 01)Voi + (ll 10)6ii6jo + (10“01)5?o5oi.

&c. . . . .) .

and generally, in the expression of Cpj, every symmetric function of biweight pq of the quantities in I. occurs, each attached to the corresponding product of coefficients from the second identity. Now

n(l -H o,6iof Ł /SAii? + . ■ ■ + of /3?6j^f »>>!« + . . .)

is from II. equal to

^^{l+o.a™|-^/34^},

s t

as can be seen by putting x=a^, y=p,% Hence, from the assumed relation and III.,

Slog {l + of|-H;8i%}=SSlog {l-l-o,o™f-f-ft;8?',} ; and now, expanding and equating coefficients of ^tfl,

a simple and important consequence of the assumed relation. It shows that the relation in question is unaltered by interchange of the quantities in I. and II. in such wise that a, and a|" and also /S, and ^W are transposed.

Let the operations dp,, Dp, refer to I., and the corresponding operations of II. and III. be denoted by the same symbols with the addition of single and double dashes respectively. Write the assumed relation in the abbreviated form

V=i then

"ai/5i"ajft,«Ojft.-

and

<^'pq^ = i

+ ..

^Pi~db„

+K

- + i.

‘p.i+i

+ ..

hence

wdbp^i,, when performed upon m^b,. gives

and, replacing U by its expression,

dpjCj^={pq), and in general

<^pi<'rs=iP9)'T-p,s-a'> whence, regarding the coefficients bp, as functions of the co- efficients Cp, only,

««M=2(

1/

In a precisely similar manner dpq={pq)idj^, and making use or

the established relation (.pq)2= iPQ)iPQ)i>

(OT)i!PS= (‘)x<^i>g = (.Pl)dpq ■ As a consequence of this, if we regard the assumed relation as defining a transformation of the quantities in III. into either of the sets of quantities occurring in I. and II., the operation (pf)jdL. is an invariant. We can now derive relations between the operations Dj,g , D^^ , D^j . For

=?(io)<„+,(or)<, – l{^\ml+mii)d[^+v'm)d''J +...,

and this leads to

log a+i^[,v^[,-+fv%j+-)

= S log {l + ^a.sDl+vPPl + i“v’o”Pl“pi); and thus to

l-^^D;„+,D;+...fVD;...

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and this, when compared with the assumed relation, establishes that in any formula connecting the coefficients c„ and i™, we are

.pq and Dpj for 6j,j ,

we thus

at liberty to substitute Dj,^ for &

obtain a corresponding operator relation ; further, itls similarly proved that, in any relation connecting the quantities Cp, and a,„, we may substitute Dj,j for Cj„ and D’^ for a^,^.

First Law of Symmetry. — We are now in a position to establish certain laws of symmetry which appertain to the systems of algebraic forms under consideration. The relation {pq)i=(M)i ipq) shows that any symmetric function in brackets ( )j may be expressed as a linear function of products, each of which is a function ( )i multiplied by a function ( ), and that, moreover, such expression is symmetrical in regard to the brackets ( )j and ( ).

Hence we may write

= . . . + JCoA”! oA”. ■ • Umi’^mi”- ■■)

+ J(o,6i”i o,*2’^...)(;‘j?i’“M/i!)j+ ... (A)

Moreover, any product of the coefficients Cpq can be expressed as a linear function of terms, each of which contains a monomial function of

the Quantities a^, ft, a^, fti— ^^^ ^ product of co- efficients bpp so that we may assume

“mAL- = ■■■+U~^ ^-KlA- + – (B)

and it will appear that L = M ; for from (B) can be derived the operator relation

““l ““2 Pi P2

D’ D’ ... = ... +L(ai6i“ia262”2…)D” D” –

+ ...

and performing each side of this equation upon the opposite side of equation (A) we obtain, after cancelling (aifti”! aji^...’) ,

Pl P2 — ‘-^ ^ ^2 •

LD” D” ■•.(riSi’”’ r^s/a…)2=JD’ D’ ■■■{PiSi’^Pai”’-)! nh ‘■jsa Piii PiQi

or

L=J.

By a similar process, in which equation (C) replaces (B), we find M=J and hence L = M and the equations (B) and (C) indicate with L = M a law of symmetry. We may say that in (B) the interchange of the partitions {pyix’^p^i’^—), {a^i°-^aj)^...) leaves the number L unchanged. To explain the nature of the theorem that has been established, recourse must be had to the notion of a separation of a partition of given specification ; the definitions of these terms have been given above in respect of a single system of quantities and the analogous definitions, in respect of several systems, will be easily understood without further remarks. Writing the relation (B) in the form

■•• + I’»?JA-

+..

“Piii’PA”

where P denotes the complete cofactor of J^j^i^ ••• we may state that P is a linear function of symmetric function products each of which is a separation of

and has a specification

This appears at once by actually forming the product “^giCp^j—

from the separate expressions of ^gi> “j)jgj>”- Let $1,62, ...ffic be the different specifications which appertain to thet separations of r^l^riSJ^...) and let P^ denote the symmetric function pro- duct, of specification 6, above alluded to. It may be seen that when Fg , Fg f.-.I’g^ are multiplied out, so as to be exhibited as a linear function of monomial functions, the partitions of the latter are all drawn from the series $1, 6^,...8ic and we may write

Pg, = miiSi Ł mi292 + • • • + “ii A >

P«j = “121^1 + ‘“22*3+ •■• +™2l9i , Pflk = “iH^l + inKffi ... my^x ,

the quantities m being numbers.

The law of symmetry, that has been found, may now be stated in the form

viz., the determinant of the above relations is symmetrical. We may say, in regard to any monomial function (r^Sii^ r^J^...), that if *i, di,...S)c be the monomial functions, whose partitions are the specifications o£ the various separations, the coefficients of the

monomial 6, , in the development of the assemblage of separations Pfl,., is equal to the coefficients of the monomial 6r in the develop- ment of Pj,.

By solving k linear equations we obtain ‘

»i=^mP9i+WaPflj+ ••• /«uP«t> 92=/*iaPei/^Pej+ — +/^P9i. flj, = fiaPg^ + /aP«j + ■ • • + /t**Pto ,**

and the determinant of this system is also symmetrical since ii^,=fi,„ is a necessary consequence of m^=mr,. We can evidently form two symmetrical tables in connexion with every partition of a multipartite number.

The last system of equations involves an important theory of expressibility ; for any one of the monomial functions 0 is ex- pressed by a partition which is the specification of some separation

of ;

(.r.sJ^V/'-),

and this implies that the parts of the partition of 0 can be partitioned into parts the aggregate of which is identical with the parts of {risj'i r^j^...). Hence the theorem of expressibility. " If the parts of the partition of a monomial function 6 be parti- tioned in any man/ner into parts, which when all assembled in a single bracket are represented hy (riSi'^r^j'^...), the symmetric function 8 is expressible as a linear function of assemblages of separations of the function

We may write the relation {pc[)i={pq){pq\ in the form : —

1, ,ar-l(S7r-l)!., „j

."^mr^PsSz"

=(˜)2()~~"'"fer^*SA~~

If we express the quantities Cpq in terms of the quantities 6™ and tti , j3i , 02 , ft , &c., the symmetric function products which multiply bZ\ hZ\ ... on the left will be, all of them, necessarily separations

of (i'lJi^^PaSa""—)) aud the result of comparing the cofactors of jji j"2 ..., on the two sides, will be the expression of {pq) by

means of separations of (i’lJi^‘i^affa’^*.-.). Let

be any separation of a given partition of (pj) ; the comparison yields the result

,Sj-l(Si-l)!,TW.,

3'3i

W’W’-

the summation, on the right, having reference to every separation of the given partition of {pq). This result, when applied to one part symmetric functions of m systems of quantities, is the furthest generalization of Waring’s formula connected with sums of powers that has yet been made. The inverse formula, for the expression of any monomial function by means of one-part functions, may be written

,2j-l (25ri-_l)!(&r2-l)!-

Ji\Ji...ir^^\Tr^...Tr^

jJi Ja

= x-r

where

{hYKhV^- ■ ■ = (^^^‘“Mra””- • •)Hp^”<^p^''^:. a. ■

is any separation of P\q-il”‘P2q^^---), the summation is in respect of all such separations, and sj denotes the one part function of the same weight as the monomial (J).

1

Second Law of Symmetry. — The operation

jfi j”a 5r,!jra!...“ft9i”P29a”’

the multiplication of linear operations being symbolic, and (Pi2i^P^2^'---) being a partition of (pq), may be said to have the ypeight pq ; if the operand be of the same weight the operator is clearly equivalent to

1 / d NiTi/ d \t8 7ri!«-j!...Uap,g,/ \da^J "■' and thence

£ j^i fj^2 Ti ""a — 1

TTj ! TTa! . . .PiirPsSi ■ '"PiSi^Ma

Now, from the three identities I., 11., and III., we have (m;'M"»-)2=... + P6^5,^^... + ...,

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and the corresponding operator relation

1

^ H^

. = ... + PD>" D"' ... + ...;

where P consists entirely of symmetric functions of the quantities appertaining to the first identity. Assuming now a relation

(riSjl'ir^^...)^=.

• + Q%.*S.,-

. + ...,

and employing upon its left-hand side the right-hand side of the operator relation and vice versd, we obtain the result P=Q, show- ing that, in the relation '

(Mi’^Ma”=’)2=-+P6(:;,6f^- + -. we are at liberty to interchange the partitions

{m’l^M”^-) and (v^Pi^v/^-)- Third Law of Symmetry. — From the relation

= – + I‘6?jA- + –

rih ‘■a’a

to which corresponds

D^’ d’” ... = ...-HLr«’ T.S»

PlQi PiSl we obtain by the usual process

(n^‘ii^...) = ...+L(,“iy“2…) + ..-;

involving an interesting law of reciprocity which has been dis- cussed in the Memoirs referred to.

Linear Separation Operations. — A monomial function is ex- pressible as a linear function of separations of any one of the partitions obtained by partitionnjeut of its parts (see ante). In particular the partition (10” 01’) can be thus obtained, from any monomial of weight pq, and thence we find that the latter is expressible in terms of the elementary functions, since every pro- duct of these, of weight pq, is in fact a separation of (10“01”). The linear operations dpg, as above defined, are suited to operate upon such expressions, but are not at present adapted_tooperands associated with a separable partition other than (10^ 01’). Let the separable partition be

and of this let any separation be

(Jiyi(j,y»...,

(Ji), (Jj),... being the distinct factors that may occur. Then

d„=Sd„(J)-jTyr, the summation being for all the factors (J) that may present themselves.

Let the general expression of (J) be

Tf;Pio+<''ionT(>oi+“oi

then, since

(10′

‘01”’

Pr,s,+“i

‘i’....);

T+»-l(r+^-l)!

= >(-)■

Sp-l (Sp-D!

fto!/>oi

.10

we obtain

“ “TIT! — ”

=22-)”””-^

fto’Poi!---Pri!i

■* ■(10”»»01’

‘rf(J)’

the summation being in regard to every distinct factor (J) that may present itself in a separation of the given separable partition, and to every partition (10“i«01”«>...) of the weight rs of the given linear operator dn.

Regarding ft,„ poi,...as constant write

2(10”^ Oi’”- • ~~/del>‘r^s,.. .)^-(jj = rf (iOfto oiPoi . . .r7Ai»i. • •).~~

and the operator relation becomes

r+s-\{r + s-\)

(-) –

d„

=2-

‘ r\s\ S— 7 p! r-^cJ(lUft»01“M…riSiV,-),

the summation now being in regard to every partition (lOdo OlPoi. . i)’ of the weight rs. Observe that rf„ is a linear weight operator ; that d(Wf“‘W’i^...) is a linear partition operator; and that we have expressed the weight operator as a linear function of the partition operators of the same weight. Compare

(i.) the expression of d„ in terms of the operations Dp, ;

(ii.) the expression of (pj) by means of elementary functions. It will be seen th^ the same law obtains. Ex.gr. cJn=d(10 01)-

dm

= d{l(fo\)

~~d(20 01)~~(i(1110)H-d(21),

are examples of the expressions of weight linear operators in terms of partition linear operators. The latter have developed expressions such as

d(W) = -L^ + (X0)-L (i(10) d{\Q^)

d

d(20 01)= —^+(10)

}(Ol) -_. + (ll)

rf(lOOl)

d

T5T + -.

d(20 01)

‘ci!(20l601)

The alternant (“Combination,” ” Zusammensetzung “), of any two partition linear operators vanishes, and, as a consequence, if d(A), (i(B) be any two operators and ^ a solution of (i(A) = 0, d{B)(j> will also be a solution of the same equation. It has also been shown {loc. eit.) that if a function, expressed in terms of separations of a given monomial symmetric function, be caused to vanish by ‘any weight operator, every partition operator of the same weight will also cause it to vanish. This is a cardinal theorem appertaining to the expression of any function by means of separations of a given partition.

Ex. gr. Suppose it requisite to express the^ function (31 01) by means of separations of the function (21 10 01) ; the ^law of expressibility ” {ante) shows this to be possible, because (21 01) is a partition of (31). Assume

(31 01) = A(2r io)(oT) + B(2i ioT)(io) -h C(10 0T)(2T) + D(21 lO 01),

siucethetenns^l)(10)(01) clearly cannot present itself. dgi,d^i,d^ do not make_(31 01) vanish, because (31 01) involves partitions of 31, 01, and 32 ; but every other weight operator makes it vanish. Selecting d^^ and d^ we may make further selection of the parti- tion operators d(10) and d{2\). Operating then with d

d(10) (i(lOOl)

and with

+ (21) -f_ ŧ (21 01) — — – , ^

d

-l. + (io) ^-KoT) ---kTooT) ,

d(21)

we find A-hC = B + D = C + D = A-l-B = 0, and thence

(3l Ol) = A {(21 10)(01) – (21 0T)(10) – (10 01)(21) } (21 10 01)} . There are many ways of showing that A = – ^ ; perhaps the most instructive is to make use of the relation d,, = . . . – Do, + . . .

= ...-Ki(2110)-l-. sides,

. ; and, performing – Dgjand d(21 10) on opposite

■(01) = A{(01)-1-(01)} or A =

1 2′

It has been seen that a generalization has been made from a weight operator dpq to a partition operator. The same thing obtains with respect to the obliterating operator Dp,. In the case of a single system of quantities it was established that Dp is performed upon a product of monomial functions through its various partitions ; we have, in fact, to pick out all partitions of p in all possible ways from the given product,

taking one part only from each factor of the product ; the component operation

associated with the partition (pl^p”^^- ■■)o{p we may appropriately denote by

Dorvr-

..).

So similarly, in respect of several systems, we have the weight operator Dp, and the partition operator

and we have the equivalence

Dp,=2D(Mi’” »/=••■) the summation being for all partitions of the weight {loc. cit. § 10). Ex. gr. Dio=D(10)_ _

Du = D(10 01)-l-D(ll).

The connexion between the weight operators dpg, Dp, has been established ; the corresponding relations between the partition operators are important. The analogy between quantity and operation must be kept in view ; with this object denote by (Mi^Mi”’---) ^^^ expression of Sp, by means of separations of (PiPi’‘Ma”—)) and by Sp, the sum of all the monomial sym- metric functions of weight pq. Sp, differs from Ap, as will be seen

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by recalling the definition of Ap^ write

^ TTillTj!...

From a previous result we may

which must be compared with

y{ – f”-\2^ – 1) !.d(>-ii…)

■<^ I IT, TTn ...

Now, just as

so D7,=2D(M,’^iM2””...),

and substituting for S}>,3i, Spjjj, ... their partition ezpiessions we obtain, from the quantity relation, the important formula

(-f”~\ZT-l)! , ni—w, .

where (JiHiCJz)^^... is a separation of (p^q^ ^P^2 ‘•••)> so in the operator relation, by substituting for the weight operators their expre.ssions in terms of partition operators, we obtain the new formula,

TTilTTj!...

,(f>i-l)!DV,)DV,)....

j” D(Ji), D(J2),... being partition D operators. Reversing the two formulae we obtain

_^, ,Tj-i (Z7r,-l)l(S7r,-l)!...

5^l(Jl)sMJ2)-;

(-)^^-V,..l

(2;iri-l)!(S^B-l)l.

Ji!.;2!---Tii!Ti2!-“T2i

rf.‘i(Ji)

where (Ji) = (i>ii?ii““i’a2?i2”””~~), (J2) = (?‘2i?2i”’^22?22”’=~~), &c.

We have thus complete correspondence between the algebras of quantity and differential operation.

Observe the particular results

_i- dh{i^)dJ^{Z^).. . {Z{)h{Z^)h. . . = 1.

Iteferences for Symmetric Functions. — Girabd. Invention nouvelle en Valgihre. Amsterdam, 1629. — Waking. Medita- tiones AlgebraicoE. London, 1782. — Lagkange. M&m.de Vacad. de Berlin, 1768. — Mbtbr-Hirsch. Sammlimg von Aufgaben aus der Theorie der algebraischen Gfleieh/ungen. Berlin, 1809. — Sereet. Cours d’algibre supMeure, t. iii. Paris, 1885. — TJnfer- DINGEE. Sitzungsber. d. Acad. d. WissenscTi. i. Wien. Bd. Ix. Vienna, 1869. — L. Schlafli. “Ueber die Eesultante eines System’es mehrerer . algebraischen Gleichungen, ” Vienna Trans- actions, t. iv. 1852.— MacMahon. “Memoirs on a New Theory of Symmetric Functions,” American Journal of Mathematics. Baltimore, Md. 1888-90 ; “Memoir on Symmetric Functions of Boots of Systems of Equations,” Phil. Trams. H. S. London,

1890.

IIL The Theory op Binary Forms.

A binary form of order ?i is a homogeneous polynomial of the nth degree in two variables. It may be written in the form

ax’+bx-\ + cx’’ + -i or in the form’

which Cayley denotes by

(a, 6, c, ...){Xi, »j)”

.»-2 2 , »„ + ..

(j) ,(2). ..being a notation for the successive binomial coefficients n, -»i(ra – 1), ... Other forms are

oaij +nbx^

«-l

x^+n{n-l)ae^

-2 2 ,

»,+ ■

For present

the binomial coefScients (“)being replaced by s!(“), and « . 1 I n-1 , ^ m-2 2 ,

the special convenience of which will ^ppear later, purposes the form will be written

the notation adopted by German writers ; the literal coefficients have a rule placed over them to distinguish them from umbral coefficients which are introduced almost at once. The coefficients a^, a^, ’...a, n + l in number are arbitrary. If the form, some- times termed a quantio, be equated to zero the m Ł 1 coefficients are equivalent to but n, since one can be made unity by division and the equation is to be regarded as one for the determination of the ratio of the variables.

If the variables of the quantic / (Xy, x^ be subjected to the linear transformation

aa = «ufi + “i2f2i

a!2 = “2lfl + “22f2>

fi) fa being new Variables replacing Xi, ajj and the coefficients Oil, aij, O21, Oj2, termed the coefficients of substitution (or of trans-

formation), being constants, we. arrive at a, transformed quantic

/(fi, &) = »/i + Cl >ili f J + C2 PA I2 + • • • + “«fa in the new variables which is of the same order as the original

quantic ; the new coefficients a , a^, a^...a^ are linear functions of the original coefficients, and also linear functions of products, of the coefficients of substitution, of the nih degree. By solving the equations of transformation we obtain

rli= Ojja!! – ojjjajj ,

rii= -OziiJji + Oii’Kai

where »” = !^^ “^^ = 011O22 – <«i2<«2i ; I "ai "22 I

r is termed the determinant of substitution or modulus of transformation ; we assume x^, x^ to be independents, so that r must differ from zero.

In the theory of forms we seek functions of the coefficients and variables of the original quantic which, save as to » power of the modulus of transformation, are equal to the like functions of the coefficients and variables of the transformed quantic. We may have such a function which does not involve the variables, viz. : —

r(a^, flSj, Oj,...a„)=r F(ga, a^, a^...a„),

the function F(oo, Oy, a^, ...a„) is then said to be an invariant of the quantic qud linear transformation. If, however, F involve as well the variables, viz. : —

Ifi.fa)

=7- F(ao, <»i, flSa."

;aa. iKa).

the function F(ao, a^, a^,...= ; x^, aja) is said to be a covariant of the quantic. The expression ” invariantive forms ” includes both invariants and covariants, and frequently also other analogous forms which will be met with. Occasionally the word ” in- variants ” includes covariants ; when this is so it will be implied by the text. Invariantive forms will be found to be homogeneous functions alike of the coefficients and of the variables. Instead of a single quantic we may have several

/(«o. «i. “a— ; ai. i^)> {K K K— ; a^^, Ka), ••• which have different coefficients, the same variables, and are of the same or different degrees in the variables ; we may transform them all by the same substitution, so that they become

~~t __r — / _’ .^ _/

/(«o> “r «2’— ‘^1′ ^2). (. ' *2.— ; fi. fa).— If then we find

!■(»„, Kj, a^,..\, \,\,...,...; ?i, y,

=r F(a„, «!, a^,...b„, b^, Jj,.

1 ^1 ^) 7

the function F, on the right which multiplies r , is said to be a simultaneous invariant or covariant of the system of quantics. This notion is fundamental in the present theory because we will find that one of the most valuable artifices for finding invariants of a single quantic is first to find simultaneous invariants of several different quantics, and subsequently to make all the quantics identical. Moreover, instead of having one pair of variables Xi, x^ we may have several pairs 2/1, y^; z^, Zj;...va.

addition, and transform each pair to a new pair by substitutions, having the same coefficients Ojj, 0,2, a^, 022 and arrive at functions of

the original ooeffloients and variables (of one or more quantics) which possess the above-defined invariant property. A particular quantio of the system may be of the same or different degrees in the pairs of variables which it involves, and these degrees may vary from quantic to quantic of the system. Such quantics have been termed by Cayley multipartite.

Symbolic Form. — Restricting consideration, for the present, to binary forms in a single pair of variables, we must introduce the symbolic form of Aronhold, Clebsch, and Gordan ; they write the form

wherein Oj, o^ are umbrae, such that

n n-l n-1 n

“I’^l «2’-«A •%

are symbolical representations of the real coefficients 05, Oj,... “»-!> <*»> ”” “^ general Oj a^ is the symbol for aj^. If we restrict ourselves to this set of symbols we can uniquely pass from a product of real coefficients to the symbolic representations of such product, but we cannot, uniquely, from the symbols recover the real form. This is clear because we can write n-l n-2 2 2n-3 a

while the same product of umbree arises from » 71-3 s 271-S 3

Hence it becomes necessary to have more than one set of umbrae, so that we may have more than one symbolical representation of the same real coefficients. We consider the quantic to have any

number of equivalent representations aj.^6j.=Cj, = ... So that

a^~ aj=S”~ i—‘ “2””””*’ ”” if we wish to denote, by umbrse, a product of coefficients of degree s we employ s sets of nmbne.

Ex. gr. “We write a^a^=a,~ a. b^~“bl,

s n — 3 3 iW — 3i3 w-— 3_s

«3 = »1 »2-*i ^’-^l i’

and so on whenever we require to represent a product of real coefficients symbolically ; we then have a one-to-one correspond- ence between the products of real coefficients and their sym- bolic forms. If we have a function of degree s in the coefficients, we may select any s sets of umbrae for use, and having made a selection we may when only one quantic is under consideration at any time permute the sets of umbrse in any manner without alter- ing the real significance of the symbolism. Bx. gr. To express the function a^a^ – ah which is the discriminant of the binary quadratic a,fCl + 2aiXiX2+a^l=a%=bl, in a symbolic form we have

2(

dctx 96b ^^x dbx

dxi dx^ dx^ dxi ‘ is usually written (aft) for brevity ; in the same notation the determinant, whose rows are Oj, 02, a,^ ; ii, 621 *3 j •‘i. “2, C3 respec- tively, is written (abc) and so on. It should be noticed that the real function denoted by (a6)^ is not the square of a real function denoted by (ab). For a single quantic of the first order (ab) is the symbol of a function of the coefficients which vanishes iden- tically ; thus

(ab)=arfi^- a^bi = a^- a^a„=0

and, indeed, from a remark made above we see that {ab) remains unchanged by interchange of ffl and b ; but (ab)= – (6a), and these two facts necessitate (ab) = 0.

To find the effect of linear transformation on the symbolic form of quantio we will disuse the coefficients Ou, oij, a^, Ojj, and em- ploy \i, /*!, Xj, /Uij. For the substitution

of modulus

I \ ft i

(Xl/t3-X2/ti) = (X/t),

the quadratic form aifsl+2aiXiX^ + a^l =ax=f{x), becomes

Aoff ŧ 2AAI2 + AjJi = a|= 0(1), where _ _ _

Ao=a,^i+2aiW+a^l,

1^=0^1 + 2aifi2/i2+asnl.

We pass to the symbolic forms

by writing for

«,), ai, as2 the symbols aj, aia^, «§

Aj, Ai, Aj „ AJ, AjAj, Al

and then

A„ = flsJX? Ł iajUiW +al\l= (OiXi +Ojj\j)'=»J, I Aj = (os,Xi-hffi2X2)(

A2= (Oijtti-Kl2ft!)2 = oJ^ ;

so that

^=aUl+2a,a^i,i,+aX=(fl,S, + '^^i,y; whence Aj, Aj become a^, (i„ respectively and

The practical result of the transformation is to change the umbrse ai, itj into the umbrse

a;^^=aj\i + a^2>a^=aifii + a^fi2 respectively.

By similarly transforming the binary n" form a" we find

A(|=(ajXi -t-a2'^2)"=«"=-^r'

Ai=(ai\+a2\f'~ (ai/iti + asaftj)='»"" "n"-*"" ■'^2′

T / ■* . -v \n-k, , .k n-lc k .n-k.k

Ai= (01X1-1-02X2) (oi/ii-l-aaiUj) =a^ <^^ = \ \'

so that the umbrse Aj, A2 are a;’ a respectively. Theorem. — When the binary form

ax = (,^ih + <:hi^y'> is transformed to

A^=(Aifi-l-A2f2)*, by the substitutions

• !Bl = Xlfl+/hf2>ai! = Vl + /^2.

the umbrse Ai, A2 are expressed in terms of the umbrse Oi, Oj by the formulas

■^l = ^l

We gather that Ai, Aj are transformed to Oi, a^ in such wise that the determinant of transformation reads by rows as the original determinant reads by columns, and that the modulus of the transformation is, as before, (X/i). For this reason the umbrse Al, A2 are said to be eontragredient to x^, x^. If we solve the equations connecting the original and transformed umbrse we find

(M(– «2) = ‘^i(– -A-a) + MiAi , (X/i)ai = X2(– Aj) + /12A1 ,

and we find that, except for the factor (Xjit), -d.^ and -hosi are transformed to – A^ and + Aj by the same substitutions as Xi and ajj are transformed to li and Ij. For this reason the umbrse – Oj, Oi are said to be oogredient to x^ and atj. We frequently meet with cogredient and eontragredient quantities, and we have in general the following definitions : — (1) ” If two equally

numerous sets of quantities x, y, z, ... x’, y’, a’, are such that

whenever one set as, y, ii, ... is expressed in terms of new quantities X, Y, Z, ... the second set x’, y”, z’, ... is expressed in terms of other new

quantities X’, Y’, Z’, ..., by the same scheme of linear substituti’on the two sets are said to be co- gredient quantities.” (2) “Two sets of quantities x, y, a, ... ; i, 11, f, ... are said to be eontragredient when the linear substitu- tions for the first set are

a!=XiX-f-ytiiY-l-i’iZ-l-...,

2/=X2X-l-M2Y-t->‘2Z-l-...,

2;=X3X-fM3Y-H^3Z-l-...,

and these are associated with the following formulae appertaining to the second set,

S = XiH-X27)-hX3f-|-...,

H=/iiH-M2’) + /^f+-“.

Z = i’if + i‘2’;+>‘3f + ...

wherein it should be noticed that new quantities are expressed in terms of the old, as regards the latter set, and not vice versd.”

Ex. gr. The symbols ±, ^, ^, the variables x, y,z, ... for when

(x, y, z, ...)=(Xi, Ml, i-i, ...)(X, Y, Z, ...), \, /^. “2,

^3j M31 “Si

are eontragredient with

we find

\dX’ rfY’ dZ’ •■•) = (‘^i> ‘^i- ‘3> ■■■\d‘ d^’ dz’ •■■)

;»i. Ih> /*s. ■ “i. “s. “s.

Observe the notation, which is that introduced by Cayley into the theory of matrices which he himself created.

Just as cogrediency leads to a theory of covariants, so contra- grediency leads to a theory of contravariants. If u, a quantic in X, y, z, ..., be expressed in terms of new variables X, Y, Z ... ; and if f , i;, f, . . . be qU|antities contragredjent to k, y; z, ... ; there are found to exist functions of |, ri, I; ..., and of the coefficients in u, which need,- at most, be multiplied by powers of the modulus to be made equal to the same functions of S, H, Z, ... of the transformed coefficients of u ; such functions are called contravariants of u. There also exist functions, which involve both sets of variables as well as the coefficients of u, possessing a like property ; such have been termed mixed concomitamts, and they, fike contravariants, may appertain as well to a system of forms as to a single form.

As between the original and transformed quantic we have the umbral relations

Ai = XiflSi + XjOa , Aa = /tjOi + /V^a > and for a second form

Bi = Xi*, + Xji^ , Ba = /«i6i + /<2*a •

The original forms are a,., b^t and we may regard them either as different forms or as equivalent representations of the same form. In

other words, B, 6 may be regarded as different or alternative symbols to A, a. In either case

(AB)=AiB2- AA = (MW ;

and, from the definition, (ab) possesses the invariant property. We cannot, however, say that it is an invariant unless it is ex- pressible in terms of the real coefficients. Since (ab) =ctj>2- aj)^, that this may be the case each form must be linear ; and if the forms be different (ab) is an invariant^ (simultaneous) of the two forms, its real expression being a^i – Ojbg. This will be recognized as the resultant of the two linear Ibrms. If the two linear forms be identical, the umbral sets asi, Oj ; 61, 65 are alternative, are ultimately put equal to one another and (ab) vanishes. A single linear form has, in fact, no invariant. When either of the forms is of an order higher than the first (ab), as not being expressible in terms of the actual coefficients of the forms, is not an invariant and has no significance. Introducing now other sets of symbols C, D, ... ; iJ, rf, ... we may write

(AByCACWBC)*. . . = (\/t)W+*+-(a6)«(ac)^(Jc)*. . . ,

so that the symbolic product

(«)-. ‘

possesses the invariant property. If the forms be all linear and different the function is an invariant, viz., the i”’ power of that appertaining to i«x and b^ multiplied by the /* power of that appertaining to u^ and Cx multiplied by &o. If any two of the linear forms, say p„ qx, be supposed identical, any symbolic ex- pression involving the factor (p?) is zero. Notice, therefore, that the symbolic product (a6)’(ac)^(i(!)*. . . may be always viewed as a simultaneous invariant of a number of different linear forms “x, K Cx, ~~... In order that (a6)’(a«y(ic)*... may be a simul~~ taneous invariant of a number of different forms osj; , J^ , Cj, , ..., where »„ %, %, ... may be the same or different, it is necessary that every product of umbrae which arises in the expansion of the symbolic product be of degree TOi in ai, osa ; in the case of Jj, b^ of degree % ; in the case of Cj, c^ of degree % ; and so on. For these only will the

symbolic product be replaceable by a linear function of products of real coefficients. Hence the condition is

i+j+...=ni,

i + k+ ...=n^.

If the forms o”, C c”, . . . be identical the symbols are alternative, and provided that the form does not vanish it denotes an in- variant of the single form a^..

There may be a number of forms a”, 6™, c”, ...and we may suppose such identities between the symbols that on the whole only two, three, or more of the sets of umbrae are not equivalent ; we will then obtain invariants of two, three, or more sets of binary forms. The symbolic expression of a covariant is equally simple, because we see at once that since Af, Bf, Cf, ... are equal to ax, bx, Cx, ...

respectively, the linear forms ax,hx,Cx, ... possess the invariant property, and we may write

(AB)*(AC/(BC)”’...A|BJC|... y

and assert that the symbolic product

{ab)\ac)\bci’...aX<_ _="" p="" class="calibre13">

possesses the invariant property. It is always an invariant or co- variant appertaining to a number of different linear forms, and as before it may vanish if two such linear forms be identical. In general it will be simultaneous covariant of the different forms JH j”! A if

i+j+...+p=ni, i + k+...+

It will also be a covariant if the symbolic product be factoriz- able into portions each of which satisfies these conditions. If the forms be identical the sets of symbols are ultimately equated, and the form, provided it does not vanish, is a covariant of the

form a^.

The expression (ab)* properly appertains to a quartic ; for a quadratic it may also be written {ab)^{cd)”, and would denote the square of the discriminant to a factor ^r«s. For the quartic

(ab)*={aib2-a^j)*=atbt – iala^ibl+Salalblbl

- 4oia5if ia 1 o J6} =(1,(14 ~ *“i”s + 6a^ – lOiOj + a^^ = 2{a^i – 4fl!iOj +3al),

one of the well-known invariants of the quartic.

For the cubic (abYaJ)x is a covariant because each symbol a, b occurs three times ; we can first of all find its real expression as a simultaneous covariant of two cubics, and then, by supposing the two cubics to merge into identity, find the expression of the quadratic covariant, of the single cubic, commonly known as the Hessian.

By simple multiplication

{alb^l – 2a\aj>\b2+(Halbl)xl + (albl-ayalblbi-alaj>^bl+albiyis^Xi + \alaj)%-‘ia^alb^bl + alblb^xl ;

and transforming to the real form,

‘. (“o^a ~ Zajii + aa%o)^i + (“^o^s ~ “tPi ~ ‘h^i + “sWa’i’Ka + lajbg-2a^2+a^bj)xl,

the simultaneous covariant ; and now, putting b=a, we obtain twice the Hessian

(ajBa – af)a;5 + (ajOs – aiaa)a!ia!a + (01% – fls i)a!| .

It will be shown later that all invariants, single or simultaneous, are expressible in terms of symbolic products. The degree of the covariant in the coefficients is equal to the number of different symbols a, b, c, ... that occur in the symbolic expression; the degree in the variables {i.e.

the order of the covariant) is p-l-ir + T+... and the weight* of the coefficient of the leading term

ajj* ” ^ ■■•is equal to i+j + k+ It will be apparent that

there are four numbers associated with a covariant, viz., the orders of the qUantio and covariant, and the degree and weight of the leading coefficient ; calling these n, e, 9, w respectively we can see that they are not independent integers, but that they are invariably comnected by a certain relation n8-2w = e. For, if 0(a„, ...a!],a!a) be a covariant of order e appertaining to a quantic of order n,

^(Ao, ...?i,?2) = (XM)Xao. -\fi +ft?2.^2fi+Mafa) ;

we find that the left- and right-hand sides are of degrees n9 and 2m) Ł e respectively in \, n^, X^, fn^, and thence n6 = 2w+.2e.

Symbolic Identities. — For the purpose of manipulating symbolic expressions it is necessary to be in possession of certain .simple identities which connect certain symbolic products. From the three equations

ax=aiixi + a^, bx=biXi + b^, Cx=eiXi + c^,

we find by eliminating x^ and x^ the relation

ax{bc) + bx{ca) + Cx{ab) = 0 . . (I.)

Introduce now new umbrse ($^{fj,\ d}$ and recall that +(ia, -d^, are cogredient with Xi and x^. We may in any relation substitute for any pair of quantities any other cogredient pair so that

- **The weight of a term «„ Sj ... a^ is defined as being i^ + 2fc, + .. . + nk„.**

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writing +^2, ~di for x^ and x^ and noting that g^ then becomes {gd), the above- written identity becomes

{ad){bc) + (bd){ca) + {cd){ia) = 0 . . (II.)

Similarly in (I.), writing for ci, Cj, the cogredient pair -y^, +yi, we obtain

ajb„-a^^={ab)(xy). . . . (III.)

Again in (I.) transposing ax{bc) to the other side and squaring, we obtain

2(ac){bc)ajb^={bcf4 + (ac)-(abf4 . (IV.)

and herein writing d^ – d^ for Xi, x^

2{ac)(bc){ad){bd) = {bc)\(idf + {,ac)\Uf – {flb)\cdY. (V.)

As an illustration multiply (IV.) throughout by a”~ jj” “» ~ so that each term may denote a covariant of an »*’.

n/„ \/i. \ 71 — 1,71 — 1 71—1

. 2(ac){6c)a^ b^ c^

f-L \2 71,71-2 71-2 . , .2 71-2,71 71-2 , ,v2 71-2,71-2 n = {fic) ajfix Cj. + (ac) ttj, ij;Cj, -{ab)ax b^ Cj,.

Each terra on the right-hand side may be shown by permuta- tion of a, b, c to be the symbolical representation of the same covariant ; they are equivalent symbolic products, and we may accordingly write

o/ \/r \ 7t-l,7l-l U-2 / ,.2 71-2,71-2 n

2{ac)(fic)ax b^ c^ =(ab) a^ b^ c^,

a relation which shows that the form on the left is the product

of the two covariants

/ ,.2 71-2,71-2 J n (ab) a^ Oj ana c^.

The identities are, in particular, of service in reducing symbolic products to standard ‘ forms. A symbolical expression may be always so transformed that the power of any determinant factor {ab) is even. For we may in any product interchange a and b without altering its signification ; therefore

(oi)2»+Vi= – (aJ)’”**!^, where ^ becomes ^ by the interchange, and hence

(a6)=”»+>0,=l(ai)»™+i(^-0a);

and identity (I.) will always result in transforming 0j – 02 so ^^ to make it divisible by (ab). Ex. gr.

{ab){ac)bxCx= – (ab){bc)a,/:x

=l{ab)ex{{ac)bx – (bc)ax} =l{ab)\i ;

so that the covariant of the quadratic on the left is half the pro- duct of the quadratic itself and its only invariant. To obtain the corresponding theorem concerning the general form of even

order we multiply throughout by {ab) ~ Cj. ~ and obtain

, ,.2771-1, ., 27»-l 1/ ,\?7» 27B

{ab) {ac)b^x =2 ”” ‘

Paying attention merely to the determinant factors there is no form with one factor since {ab) vanishes identically. For two factors the standard form is {aii)” ; for three factors {dby{ac) ; for four factors {ab)* and {ab)\cd)’^ ; for five factors (a6)*((ic) and {a:b)%ac){def ; for six factors {db)\ {abf{be)\ca)\ and {abf{cd)\ef)K It will be a useful exercise for the reader to interpret the corre- sponding covariants of

the general quantic, to show that some of them are simple powers or products of other covariants of lower degrees and order.

The Polar Process. — We are now going to introduce other sets of cogredient variables into the symbolic products. The /ii'* polar of the binary form a^ =/ with regard to y is expressed by

i.e., n of the symbolic factors of the form arci replaced by /t others in which y^, y^, replace ajj, x^.

By giving /I the values 0, 1, 2, ...71 we obtain inallra + l y-polars in regard to x. They may be obtained by partial differential operations upon the form. Write in symbolic form

SO that

and let then

the first polar.

/»=/i2/i+/2y2;

Jy—ax ay,

Similarly

.2 n-2 2 , , 71-2 Ji 71-2 2

fi=ax a^,f^f^=ax a^a^,f^=ax a^.

Si. , – 2 7-2 2 the second polar ; and in general the /i'* polar is

In symbolic form we may write

AU the polars may be generated from a" by writing therein

iBj-l-XT/i, iRj-l-XT/a f°r 'ht "^ respectively, for aj becomes (oj.-fXoj,)" and

Kflx+i^y) =<^x + \i.)'^x <^y + \2)>^ax ay+...+\ay

Ex. gr. The first polar of a|=(tjjOy

={aiXi + a^){a^yi + a^2)='h'h&i) + <^l'^2 ^ynVi + «i(a!i3/z+ aWi) +_a^y2 = (ao»a + «ia!2)yi + (^

^A (a^l + ^a^XyX^ +0^1).

Similarly the second polar of the binary cubic is

(fl^ + a^x^yl+2(aiXi+'a^yiy^+{a^+a,yl which is a^ or

-K

1/ d

d N"

The operation of taking the polar results in a symbolic product and the repetition of the process, in regard to new cogredient sets of variables, must result in symbolic forms. It is therefore an invariant process, and all the forms obtained are invariants in regard to linear transformations, in accordanqe with the same scheme of substitutions, of the several sets of variables.

An important associated operation is

3″ 8′

dxfiy^ dx^dyi ' which performed upon any polar causes it to vanish ; for

and conversely it can be shown that every function which it causes to vanish is a polar. It is usual to write

and we have the theorem that S2, performed upon any invariant form, produces an invariant form. Ex. gr.

r. 7n,7l 1 / , , A 771-1,71-1

Stoj, Oj, = (otjiOiOj – mna^i)ax b^ ,

. ,^. 771-1,71-1

= {ab)ax by ;

-V) 77t,7l , „0 771-2,71-2

***^«ji*a; = («*)“i ‘>y > and in general**

ifa::b; = {ab)“ar%”’-

These are invariants of forms which are oinary in two sets of variables and, by putting y=x, we obtain simultaneous in- variants of two binary forms in a single set of variables. Observe the easy passage from a bipartite form to two unipartite

forms. The polar of a product a^ • b^ is obtained by, first of all, writing a^ .b^ in the symbolic form^Jx ; thus if

=ax.bx—Px > Tpk m+n-h k . •‘y=Px Py

now, in^™ =a^. j”, write x + \y for x, so that

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expanding and comparing coefficients of X^

fm+n\m+n-k Te ~^fm\f n •» m-s s,»-J:+s,l!-s . k fc)Px i’]/=^(.Ju-s>a! «»*« by 1

a

or writing a^=/, i”=^,

a general formula for the polar of a product of two forms. The expression /^^j,”’ is called a memier of the polar; writing it Gj we have altogether a series of A; + 1 members, viz.!

Cro,Gri,G2,...6j.;

and

Two memhers, Gj,Gj^i, are said to be adjacent, and we can prove that the difference between any two adjacent members contains the factor {ab){xy) ; for

whence also

=aa, a^x ^ by {ao)[sey) ;

wherein _/^0*”’”^ is a member of the k-l*” polar of ‘E=f.. Again, if s be less than t,

G,-Gj=G,-G,+i + G,+i-G,2...+G^«.l-Gj;

and since the successive differences <>

6s-G,+i, Gj+i-G,+2.“G«-l-<^«> involve, each of them, the feiotor (ab) {psy) ; , so also does Gj – Gj the difference between any two members of the polar. Also the cofactor of (flb){xy) in aAC^j- Gj) must be a sum of members of the A- 1’* polar of F. Moreover, since /

and

we may write

2CX’-«)=(™i)’

r»=<'o6.+<'iGi + ... + CfcGfc,

where Co+Ci+...+Ci=l, and

G,=(c„+Ci + ...+cj)G.; we obtain, by subtraction,

fJ-G,=

which proves that the difference between the complete polar and any one of its members contains the factor {aJ>){siiy), and that the cofactor of aJ)J^~G^ is a linear function of the members of the k – 1«* polar of F. Since

we find

~~.e8+es+l+~~ + <'k)fy^y ---"kfy 9y,

and we see that the cofactor of (xy) in Vy – G, is a sum of terms obtained by writing (ab) for ajb^t i° ^^^ cofactor of (ab)(xy), iu the expression of aJbj[jy-G,). Hence the cofactor of {xy) in r?- G. is a linear function of the members of the ft- 1«* polar of

y e

(ab)a^~h^ , which is a oovariant of 7=/., usuaUy written (/, ^)i and termed (see post) the first transvectant of /over ip. ■file k – V polar will be written

and

will denote one of its members. We thus have the relatioa

, G,=G,{c/.0){(/,)$^{2'}$=G{o.*y}‘;

or, in words, we express a member of the ft«* polar of /.^ as a sum of the polar itself, and the product of (asj/) into a linear function of the members of the ft-1’* polar of the first trans- vectant of/ over . We may similarly treat any member

G{(/,*yry*-‘

of the ft – 1' polar of the first transvectant, so as to exhibit it as a sum of the polar itself and a product of {xy) into a linear function of the members of the ft ~~2* polar of the second trans~~*

vectant,

(.abfarX-' =(/,<>?.

off over 0 ; we can continue the process so as finally to reach the development

Gs={(f.4')}U<-yX{i/'i'yVv~"

Hence the theorem which states that any member of the ft« polar of the product of two forms/, 0 may be expanded in ascending powers of the determinant (xy), the cofactor of {xy)' being a numerical multiple of the ft-s«* polar of the ««* transvectant of /over 0. All of these transvectants are, as we shall show pre- sently, covariants.*

&!. gr. Let F=/. 0=a|.6|; and let us exhibit the second member of the second polar in the desired form,

or

%=y,a's,j?y+za^^y,y+a^y>t); ,

the second member is a|(i^|ij, and

=\{xy)\abfa^^=\{xyf{f, .pf ; therefore

aia^y>y'='pi-l(=^nf,?,

the result. In this instance the term, involving the first power of {xy), happens to be absent. In regard to the polar of a pro- duct of n forms it is easy to establish that if

Fi=«r^,/,=c-A=»r.

=2c)(?)-(t')(/.);'U).^-(A)r.

where

Si=ft.

As regards polars, with more than two sets of cogredient variables, the generating function is

(ox+Xa,+/«ij-l-...)"; and we can establish the theorem that every symbolic product involving several sets of cogredient variables can be expanded into a number of terms, each of which is a complete polar, multiplied by a product of powers of the determinant factors {xy), {xz), {yz), ...

Trcmsvection. — Certain covariants, termed transvectants, have been met with above. We have seen that {ab) is a simultaneous invariant of the two different linear forms /=

dxi dx2 dx2 dxi' The process is generalized by forming the function

(m-ft)!

i

!(ro-ft)!/8/30 3/ 5»\ft 91 ! \dx1dx2 dx^dx^J '

*where /, 0 are any two binary forms ; it is called the ft** trans- vectant of/ over 0. It should be noted that the multiplication of operations is symbolic in the sense that the operation in the bracket is to be performed ft times successively. The transvectant is denoted by*

(/,

Thus if

1,»- h

from which it is evident that the ft"^ transvectant is a simul- taneous covariant of the two forms.

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li m^n there are » + l transvectants corresponding to the values 0, 1, 2, . . .re of Jc ; if A: = 0 we have the product of the two forms, and for all values of A;>ji the transvectants vanish. In general we may have any two forms

01. 05 ; "Ai. ^a being the umbrae, as usual, and for the ‘ trans- vectant we have

(0S, ^s'=(0wV-vr'.

*a simultaneous covariant of the two forms. We may suppose 0» ^% *" ^^ '"^y ^'^o oovariants appertaining to a system, and the process of transvection supplies a means of proceeding from them to other oovariants.*

*The two forms a^., h^, or ' \l/, may be identical; we then have the ft** transvectant of a form over itself which may, or may not, vanish identically ; and, in the latter case, is a covariant of the single form. It is obvious that, when k is uneven, the ft'* transvectant of a form over itself does vanish. We have seen that transvection is equivalent to the performance of partial differential operations upon the two forms, but, practically, we may regard the process as merely substituting (a6)*, (0^)* for as* 6^, <^ f^ respectively in the sjmbolic product subjected to transvection. It is essentially an operation performed upon the product of two forms. If, then, we require the transvectants of the two forms /+X/, tji+nip', we take their product '*

/0 + X/'^ + ft/0' + Xa/‘0',

and the ft' transvectant is simply obtained by operating apon each term separately, viz. : —*

(/, 0)+x(/', 0)*+M/, 0')*+M/', 0')* ;*

*and, moreover, if we require to find the ft** transvectant of one linear system of forms over another we have merely to multiply the two systems,*

and take the ft' transvectant of the separate products.*

The process of transvection is connected with the operations 0 ; for

" {axby)={ab) a^ by ;

or ii%7iy)y=x=^f"t>f:

SO also is the polar process, for since

Jc m-fc,fe Jc jn-kjlc

/» = «« By, y = t)x V

*if we take the ft** transvectant of /„ over y, regarding y^, y^ as the variables.*

S;\fc

ifl-Pl)

ab) a^ bx ={f,

*or the ft** transvectant of the ft** polaps, in regard to y, is equal to the ft'* transvectant of the forms. Moreover, the ft** trans- vectant {ab) a^~ bx~ is derivable from the ft** polar of o", viz., dj ~ ay by substituting for j/i, 2 tl^ cogredient quantities ij, – b^,*

and multiplying by J^. ~ .

Frequently the forms to which the process is applied are, each" of them, products of other forms. Thus suppose

/=«>:», 0=a?^?, we find

(Bii + m^){ni + n^)(a'b,a^p^y

where, on the dexter, there is a term for every pair of umbrae, one taken from/ and one ff&m (p. The sum of the_ numerical coefficients of the

members of the transvectant is unity. If we suppose the product al^l^a^^ virritten out as a product of »ii + «i2+% + ™2 factors ; the coefficient (TOi+m2)("i+™2) enumer- ates the number of ways of picking out one factor from aj^bx' and one factor from a^f^^ ; the coefficient mi% oh the dexter of the above results shows the number of ways of picking out one factor from a^ and one from ;8JJ' ; consequently the fraction "'i"' , which affects one term of the transvectant, de-

{ini + 'ni^{ni+n2 , . « ,. j

notes the probability of picking out the pair o^ when a random

selection is made of one factor from a^^ and one factor from a'P. Similarly if

J — H Ox '^x ■■■^x J

the first transvectant will consist of scr terms, and any term, involving say the determinant factor (nj|8), will have a numerical coefficient which denotes the probability of a random selection of two factors, one each from / and , being a^x- The sum of the coefficients is unity. Proceeding to the second transvectant each term is treated in a sin^ilar manner, with the result that a num- ber of terms are obtained ; one such term is, say

*yj{"'P){ay)a^^*

'6?—?/3?-

•1 ij-l

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m(m- l)ji(«

and the numerical coefficients denote the probability of two random' selections of pairs of symbols yielding {apj{ay), and so on. Hence, in general, the ft' transvectant involves terms, each of which has ft determinant factors, and a numerical coefficient which denotes the*

probability of such factors arising from a random selection. Hence the sum of the coefficients of the terms must be unity.

Ex. gr.

{aj)x, cJ,xY=-^{ae)

. + ^at

+ -(J(;)Oa^a

+ j(M)a!A;

(aA, c^xf=\{{ac){hd) + {a^{bc)).

Ex. gr. We will find the fourth transvectant, of a binary quartio upon itself, so as to obtain the invariant (flbY in terms of the roots of the quartic.

Let ax=K= (==1 – 'h'^^'i – "{"^ – "sP^^^i – <^*^i)>

(4 4\1 o-xi^x) is a sum of a number of terms, each of which involves a factor of the form Or- o„ and proceeding we find (ctj., 6j.) equal to

T-f ^(oj – i»i)(a; – Oa)(ai – 03)(a; – aj,

the summation being for every permutation ijkl of the numbers 1, 2, 3, 4. There are 4 ! terms, but certain of them vanish. Those which survive correspond to the permutations in which each num- ber is displaced. These are nine in number, and we can, finally, throw the result into the form

j^|(ai – 02)(03 – 04) + (oj – a3)(o2 – Oi) 1 (oi – 04)(aa – a3)| ;

a well-known expression of the simplest invariantof the binary quartic. It will be seen later that the coefficient a^ of every co- variant of a binary form is a symmetric function of the differences of the roots of the forms.

The various transvectants can be obtained by partial differential operations in which the independent variables are a^, bx, ■■■

can be obtained by operating upon the product with

‘^d^c.+^’^^^d^p’-

^”m+^^^mp’

and multiplying by (^ +)(+ „j- Disregarding the multi-

*plier we obtain the ft** transvectant by ft successive operations of this operator, the quantities operated upon being a=ax,b=bx, ... and not the determinant factors. In general the operator is*

the number of terms in the operator being s

Me. gr. To find in this manner the second transvectant of {abfal^-%”^ upon itself, we take the product (flb)\edfa’%«ifi‘ a?«* and perform the operation*

when we obtain the result in the form of a linear function of the

three forms : —

*{ab)\aef{edfa’~*l”h<'*d”- ,*

(abf((!df{ac){ad)a,«-^b<''>H”,

(ahf{cd)^{ae)(bd)a’%”-h”V”.

A very important particular case of transvection is that in which /=Ma^J^... , =ffx’> 0 i^ ^^^ original form, /a covariant of 0, and M is the product of determinant factors involved in/. Writing for convenience

/=Ma’^r…,0=/,

the operator, for the fe" transvectant, becomes effectively

or if we take the operand to be /and nbtf.f we may consider the operation

and disregard the factor gi".*

We can transform the operator by expressing, by means of one of the fundamental identities, {bg), (eg), ... in terms of (ag) and determinant factors which are free from g. Thus

Now

where m=7?ij + m2 + TO3+ ... ; therefore the first transvectant is

an important form, because it shows that the transvectant can be broken up into two portions, in only one of which does the symbol g occur in the determinant factors. Conversely, if we have a form involving wi + 1 symbols in the determinant factors, in one of which g occurs only once, we may exhibit it by means of the transvectant of a form not involving g upon the original form, and of a form whose determinant factors involve only m symbols and do not involve g. This theorem is of great significance in the proof of Gordan's theorem concerning the finite number of covariants of a given form, and we must further generalize it. The operator for the second transvectant is

which may be written either as or as

Taking the first form we find the second transvectant to be

m(m-l)^,(o3)V.S»-"

together with a number of terms in which (ag) occurs at most once. Hence a form, containing m + 1 symbols and the m + 1"' symbol g only in the form (,ag)^, can be exhibited by means of the second transvectant of a form in m symbols over the original form and of a form which involves

*(ag) at most once ; and now, combining the former result, we find that a form in m + 1 symbols which involves the m + 1** symbol g only in the form {ag)'^, can be expressed by means of forms involving m symbols, and by first and second transvectants of such a form upon the original form. The second form of operator above written leads to the same conclusion in regard to the factor {ag){bg). Similarly it is proved that a form in m + 1 symbols which involves the determinant factors {ag), (bg), ... to the order k is expressible by means of forms in m symbols and 1st, 2nd, ... ft** transvectants of such forms upon the original forms.,*

Every symbolic product is expressible as a sum of transvectants.

£x. gr. Gordan takes as an example

4)l={abf{,ac)\bcfajb^^; substituting for Cj, c^ the cogredient variables – y^, y^ we obtain (xt/){ab)"aj>jaylyy which is a memter of the fourth polar of

(aJ)2

«»»M|6|=(Fj)j+f(!B2/){(a5)a|6=}»;

. (o6)Va^?»S=(G|)^ 5(a!3/)(Hj)j,

where

H|=(aJ)'o|6|.

Now for yi , ya write Ca , – ci and multiply by c^. %=o,G'{Ge) + l4R,{ncf*

= (Gj,4>f(H,4)'. = {(abfalil, 4}'|{ Wa,p,l, 4.}' ; or if 4=61=4=/=/'=/", this is*

0l={a/')V"}Vi{C^./)V"}'-

In general it suffices to say that we transform one set of umbral symbols to a new set of variables, and make use as above of the properties of

polars. The theorem establishes that transvectants are as inclusive as symbolic products in general.

First and Second TrcmsvedaMs. — A few words must be said about the first two transvectants as they are of exceptional

interest. Since, if/=a„, (p=b^,

the first transvectant differs but by a numerical factor from the Jacobian or functional determinant, of the two forms. We can find an expression for the first transvectant of (/, Y over another

form (T . For

{m+n){f,)\=nf.i,\ + mf.^, and

/.J-/9-=(«A-V«)”™’*«~^=(‘^)(/’);*

Put m-1 for m, ra-1 for n, and multiply through by (oi) ; then

{(/,0)}J=(ai)<»™"V”’+;rMr^()(/’)‘*

, „ m-.l,«-2, TO-1 „„ ..2

= (aJ)a^ b^ j,-m+ir32(‘^)(/.) ■

Multiply by c^” and for y-^, y^ write Oj, ~~Cj ; then the right~~ hand side becomes

i„r,\iu \ m-l.1-2 p-1 , m — 1 p, . ..2 {ab){be)a^ b^ c^ +^^.„_ 2° »(/■») .

of which the first term, writing e%=

*m-2,»-2 p-2, ,.„, , % *» Ci {ab)lfie)a^x*

_ 1 m-2,»-2 »-2(/-, \2 2 , , ,.2 2 , ,2,21 = ~~x K B% \J>c)a+{flJ)) cx~~{ae)b^)

- _i/„“fMV~/.P~^ J.,.P^/y7,2 m-2,1-2 i”/„\2 m-2 »-2)*

= -^{(0.f)V+(/.i^)=-v^-(/,i^)'.«} ;

and,if(/,)=A™+"-^,

{(/.)'}j.cr'=*r"v^*

and this, on writing c^, – Cj for yi, y^, becomes

•••{(/»Sl^}'=i{^;^^^(/.0)V + (/.).0-{0.^)V};

and thence it appears that the first transvectant of (/,0)i over Ji is always! expressible by means of forms of lower degree in the coefficients wherever each of the forms/, 0, \p is of higher degree than the first in a!i, iKj. a e

The second transvectant of a form over itself is called the Hessian of the form. It is

a/)'=(«5)'ar-v-'=H^-=H;*

2?^??°^*^^^7 ^* ^^ * numerical multiple of the determinant ov of (9^ \^*

*Sf S| ~ ISajS^j ■ * ' °'^^° ^^ '■* transvectant of the dif- ferential coefficients of the form with regard to the variables, viz., V^' 3^) ■ ^°' *^® qnadratic it is the discriminant {aVf and for the cubic the quadratic oovariant [fiJ>?aJ>x.*

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In general for a form in n variables the Hessian is

ay ^ ^/_ jy_ ay 9y

*dx^dxndx^Xn" dx^*

and there is a remarkable theorem which states that if H = 0 and w=2, 3, or 4 the original form can be exhibited as a form in 1, 2, 3 variables respectively.

Ex. gr. If (a6)V-"C"0, for the binary form a, the theorem states that the form is a simple m« power [oiX^ + a^)'", and therefore, by linear transformation, depends only on a single variable.*

It may be verified that, if a™=/, '

and now assuming/ to have the form a^.x a form of order ff ; p +

■ + -'^x 'Py

m(m-l)/j,=p(f)-l)'»S "j^^J + Spo-aJ Oy^J" y

+ ,r[a-l)44,rVy, leading to

0=m^m-l){f./l-(/lf}

= {™p(p- 1) – {m-l)p^}al"~\l

+ 2p(Tal"~^ayl.l)^yi> {m-l)irXiy}al" ;

and, since each term on the right must vanish separately, m=p, a=0, which proves the theorem.

It has been established above that every symbolic product can be expressed by means of transvectants. We have now to show that every invariant can be expr-essed by means of symbolic pro- ducts. It suffices to prove tliis for invariants as will appear.

*When an invariant is expressed in terms of the umbrae Oj, a^ ; *n *2 ;*

symbols aj, b^, Cj, ... and also in the series Oj, h^c^ Let then

an invariant j of weight w be written symbolically

j = (siOi + Sjdi + S3C1 + . . .)"(

3={sja^ + s^^ + s^^+ ...)«’(

= {(»lO]+S26i + S3Ci+ ...)Xl + (8,(12+ 8262 + 8303+ ...)X2}”’

X {(

y} .11; V} W ‘

where

^ ^l = 8iaSi + S25i + «3Ci + ...,

*?i=^‘h + *2*i + *3<:i + -"> q2=tia2+tib^ + tsf^+ ... ,*

= »i«2(o6) + s^tg{ac) + ...+ S2«s(«e) + . . . ; now, since ^]J’j![‘=(X/)”!/, if we operate with*

*d\id/i2 3^3/*i*

=io(w+1)(Xai)

and

we obtain

*2, . w-1 i»-l w (P1)Pk ?^*

-1.

J,

again operating

W , . M)-l w-i_rt„'”i..

Ifi-l, ,2 w-2 w-2 « \«

j;

and continuing to operate we arrive at

=^^{8j<3(oi)+si«8(o«)+ ... +«j*3(Jc) + ...}«-;

establishing that the invariant j is expressible as a sum of sym- bolic products, each product involving w determinant factors. The F(yrmf+\. — An important method for the formation of

covariants is connected with the form/+X0, where /and 0 are of the same order in the variables and \ is an arbitrary constant. If the invariants and covariants of this composite quantic be formed we obtain functions of X such that the coefficients of the various powers of X are simultaneous invariants of / and . In particular, when ^ is a covariant of /, we obtain in this manner covariants of/. Consider, for example, the cubic

and take for ^ its cubic covariant

Q = (a5)V)cX- If J be any covariant of /, denote by J/+xQ ^^^ corresponding covariant of /+XQ. There are four fundamental covariants of /, viz. :—

A=(/,/')"=Wa«ix,

Q=(/,A)i = (a6)2(c6)cX.

E = (A, A')" = (a:bf{,cdf{,ac){l^ .

To find the fundamental system of /+ XQ we have

//+AQ=/+XQ,

=(f,f'?mfMf>-\Q.,<^?.

To reduce this expression take the first polar of A=A|,

2A«A,= {obYaJby + {abfa^b:,, or

AxAy={ab'faJ>p.

Herein, A^, A^ being symbols equivalent to Ai, Aj, substitute

A ,a’ for -a!2,!Bi and multiply by Aj,, so that

{AA)Ay\=iab)HaA)byAy.

Now

Q|=(/A/ = (»A)ojA^, Z(^Qy={aA){alAy+2a^yA^ ,

= {aA){ SalAy + iaJ^ayA^ – a,Ay) }

=3(aAKAj, + 2(a!2/)(fl!A)X;

and, since it is easy to see that (/,A)^=(aA)‘az vanishes identi- cally,

Q|Qj,=(aA)4\; and, herein writing Jj, – ft, for xi, x^,

(6Q)^Q»=(aA)(a6)2Aj,;

Again, since

(6Q)=ftxQ,=(aA)(a6)“6^A„

= (Aa’)aX=(A,A>; .-. (/,Qf=0.

qlqy={aA)alAy, substituting Q^j, – Q^ for x^, x^,

mmy%={aA)(aQfAy%.

(/,Q)”=(»Q)VQ«=0,

But

and

•. , by addition.

{aA){aqfAyQy^~{aQfAl=lR.A^,

2^^’ V 2 since it is quite easy to show that (aQ)’=(A, A’),*

and finally Similarly

.-. (Q,Q')»=^R.A;

%AQ = A + ‘2R-

Q/+AQ=(/+XQ,A + 2X»RA)i,

=(/, A)i+X{Q, A)i+|\»R(/, A)i + ixSR(Q, A) ,

wherein (/, A)^=Q, and we have to reduce (Q, A)^.

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From I

(QA)QjA^=(aA)(AA)4A;, or

(Q. A)'=:l(AA')a|{(aA)A;- (aA)Aj, = -1(AA>„|=-1k./;

= (i+1x^r)(q-1xb./).

So also it may be shown that

%+xQ = R + x'li^ + ^x^E'- In general, if/=aj. ,^=aj,, be any two forms, and any invariant of/ be /=fl(oJo> ‘hi •■•«in)> the corresponding invariant of /+X0,

where

if+\(^=(«o + Xao> “h + Xoi. ...a™ + Xom)*

_ 9 _ 9 9

Kow, if y be of degree i> in the coefScients a, it is a homogeneous function, and may be denoted symbolically by

involving m+1 umbrae. Thence ^

.?>+A^=/'y=0,„ + XpJ"=2()i'r i"?^ ; it and, comparison of the coefficients ofX, gives*

*)|7(S*i/= GK' *Pa= (ft)(i'a)a= (Dia'*

which is simply a numerical multiple of the is"' a- polar of j. It must be noticed that (S) denotes an operator of order k, and that it is only equivalent to k successive operations of S in the particular case when the coefficients Og, a^, . . .are independent of the coefficients a,,, Oj,.... The operation of 5 upon a symbolic product is very simple ; suppose A to be a symbol which occurs in the product ; it may present itself in a determinant factor say (A/)), or in a power form A^. If we find SA™=\f'™ we write \// for A wherever A occurs, and thus obtain one term in the result of the jperation ; the complete result is obtained by summation in re- gard to all the synibols dealt with in this manner. The opera- tion of 5 upon a transvectant, expressed as such, is precisely similar. JEb. gr. Let Fj = {ab)\ac)\bc)%*

where /=«» 'i> = <4:>

and SasJ = Sb = Sc% = o| ;*

then

SFi = {ab)\acf{bcf + (aaf{ac)\a.cf + (ab)\aaf(fiaf, = Z{ab)\aa)\bii.f.

Again let Fs= {(/,/) VV.

where Sf= Sf' = Sf'=;

then

«F,= {{, f'f,fV+ U t-)VV+ UfT, V, =s{if,f7,

So far we may always go whatever Jhe values of 0|„Oi… ; but when these are independent of »(,, Oj, ...we may introduce new symbols and obtain

*S^Fi = 3<^J)2(/3o)»(6a)2 + Z(apy{aa^(Pa)^*

*83Fi = 6(7/3)«(To)”(a/S)2; so that e F^*

= iabnac)^{bey+Siabf(aanba)

Also 8^F2=3{(0’,/’)^ ^} + S{lf, ‘?,*

S»F2=6{(0,T,“}; leading to*

When, on the other hand, Oo, Oj, ... are functions of ag, O],... the matter is not so simple, for now (8) an operator of order k is not equivalent to 8*, k successive operations of 8. Write S=Si ; then 8^=(8^)H-8itSi when 8i+Si is an operator formed by operating upon Si with 8; regarding the former merely as a function of ag, a^, . . . ; so that*

Si+3i=(8iO„);^-KS,a,)-i-l-...;

write Si+8i=Sj, and generally SitS,= S»f.i, then it is easy to show that

according to a well-known law established by the theorem of operator-transformation given in the section on symmetric functions.

The Partial DifferentiaZ Equations. — It will be shown later that covariants may be studied by restricting attention to the

leading coefficient, viz., that affecting ajj where e is the order of the oovariant. An important fact, discovered by Oayley, is that these coefficients, and also the complete covariants, satisfy certain partial differential equations which suffice to determine them, and to ascertain many of their properties. These equations can be arrived at in many ways ; the method here given is due to Gordan. \, Xj, ft, /tj being as usual the coefficients of sub- stitution, let

be linear operators. Then if j, J be the original and transformed forms of an invariant

w being the weight of the invariant. Operation upon J results as follows : —

The first and fourth of these indicate that (\/u)<' is a homogeneous function of X^, X^i ^ud of ft, /tj separately, and the second and third arise from the fact that {X/) is caused to -vanish by both*

7\ r

Da^ and D^-

TC-fc k

Since J=F(Ao, Ai,...Ai,...), where Ai=a;^ we find that the results are equivalent to

According to the well-known law for the changes of independent variables. Now

I^Wi--j;=(n.-*)Aj;;D;^^Afc=AAfc_i ; so we obtain*

k k

equations which are valid whenXj, \i ft> fh have arbitrary values, and therefore when the values are such that J =;', Ai= Oj. Hence

"3a„

+ {n-

1)'h5^ + (»- 2)asi5^ -h ... = «)/ ,

(Ml OOj Odj

oog 9ai ^ 3(ij

oOi Offa tWs

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the complete system of equations satisfied by an invariant. The fourth shows that every term of the invariant is of the same weight. Moreover, if we add the first to the fourth we obtain

k where 6 is the degree of the invariant ; this shows, as we have before observed, that for an invariant

The second and third are those upon the solution of which the

theory of the invariant may

hose up be said!^ i

to depend. An instantaneous

deduction from the relation w=-^6 is that forms of uneven orders

possess only invariants of even degree in the coefficients. The two operators

„ – 8 „- 3 – a

” = »or^ + 2oir= + . . . + na„-ir=- OOi OOji OOfn

~ 7\ — ?) — 3

0=noti5^+(«-l)ai2-:^+ ... +

have been much studied by Sylvester, Hammond, Hilbert, and Elliott (Elliott, I.e. ch. vi.) It has been established that, if F(ag, Oj, . . .On) be any rational, integral, homogeneous, and isobaric function of the coefficients,

FCAcAj,...!™)

= (V)V-’”«^{^0 + |^5fi}F(a„,-a„...a.

a resnlt &om which all the important facts concerning invariants may be deduced.

The analogous partial differential equations satisfied by any CO variant y may be established as follows. We have

where J=F{A|„ A],...(a!/i), (Xa;)}

y=F(o„, aj,...Xi, !&j)

the new variables being f j = (xjj.) = /i^ – ii^x^ l2=(Xa!)= – Vi+XiiR,. We then obtain

2(^vA;fc)£+(Dvfl)J = 0. Ic

or

^3J

k

2_ 3J 3J ,

h XT) – 3J 8J n

^(71 – Jc)H+ldAt. ~ ^l3|2 – ” ‘

k

*2_: 3J 3J , *A^3r/^^3l^=(”’+^^’^-*

Now, as before, we pass from J to y ; further, we make use of the formula

and we obtain

=0,

> Od]

the complete system

Adding the first and fourth equations we obtain n8-e=2w ,

the invariant relation connecting the four numbers n, 6, e, w. The satisfaction of the differential equations is not only necessary, but it is also sufficient. To establish this, in the case of in- variants let J be any solution of the differential equations, in which the quantities A^ are independent variables, and K any other solution. We obtain

or, if J=KL,

K<-g)^-4.(†‘S)^-«.

1 /^3J t9K\ _, 1Yt.3J M.\ n K%-r’3\h + pl%-“3X^h=°’

s?

s?

3L

3Xi’ 3L

3L,

“3x;’

3L,

OH

3L _ 3L JL –

As (\») does not vanish, these equations necessitate 3Ii_„ 3L_ 3L 3L^o

showing that L is independent of Xj, X^, jUi, ^ We may put K = (Xjii)" so that

J=(Xm)"L and now putting Xi=/i2=l, X2=/ti = 0, L becomes equal to j, and J=(Xjit)'^' ; hence this relation is satisfied by every solution j of the differential equations. If we have several binary quantics we have similarly the two operations

which cause the vanishing of a covariaut and the invariable relation

connecting the numbers %, B^, n^, 6^,...w, e.

The Evectant Process. — If we have a symbolic product, which contains the symbol a only in determinant factors such as (aft), we may write a^j, – Oq for a^, a^, and thus obtain a product in which {db) is replaced by h„ {ac) by c, and so on. In particular, when the product denotes an invariant we may transform each of the symbols a, J,. ..to x in succession, and take the sum of the resultant products ; we thus obtain a covariant which is called the first evectant of the original invariant. The second evectant is obtained by similarly operating upon all the symbols remain- ing which only occur in determinant factors, and so on for the higher evectants.

Ex. gr. Prom {a,cf{M)\ad){U) we obtain

{ldy{hc)4d^ + {acy{cid)e^^ – (bdylad)a% – (acy(be)aj>l = i(bdy(bc)c^x t^« fi'^^t evectant ; and thence ic^d^ the second evectant ; in fact the two evectants are to numerical factors pr^s, the cubic covariant Q, and the square of the original cubic.

If S be the degree of an invariant j

dctQ doi

=a, 5=-l-a. loo.

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—I-.

■0 • ‘^dai and, herein transforming from a to evectant

3a„ 2 3a„

X, we obtain the first

i’x = ^(‘

\k k n

3a»

Comhinants. — An important class of invariants, of several binary forms of the same order, was discovered by Sylvester. The invariants in question are invariants qud linear transforma- tion of the forms themselves as well as qvd linear transformation

of the variables. If the forms be aj, jj, c^,... the Aronhold pro- cess, given by the operation S as between any two of the forms,

causes such an invariant to vanish. Thus it has annihilators of the forms

- d , – d – d

“o^r + “i7r + ‘^”;r + —

dbn

dbi d

db^ d

*oaQ acti aa^*

and Gordan, in fact, takes the. satisfaction of these conditions as defining those invariants which Sylvester termed ” Combinants. ” The existence of such forms seems to have been brought to Sylvester’s notice by observation of the fact that the, resultant of

fls^ and 6^ must be a factor of the resultant of Xa^+;i2^ and

Xc^ + lib^ for a common factor of the first pair must be also a common factor of the second pair ; so that the condition for the existence of such common factor must be the same in the two

*cases. A leading proposition states that, if an invariant of Xa^*

and |ui^ he considered as a form in the variables X and /(, and an invariant of the latter be taken, the result will be a combinant of (% and i^. The idea can be generalized so as to have regard to ternary and higher forms each of the same order and of the same number of variables.

For further information see Gordan. VorUsungen iiber In- variantentheorie, B. ii, § 6, Leipzig, 1887 ; . E. B. Elliott. Algebra of Quantics, Art. 264, Oxford, 1895.

Associated Forms. — A systefn of forms, such that every form appertaining to the binary form is expressible as a rational and integral function of the members of the system, is difficult to obtain. If, however, we specify that all forms are to be rational, but not necessarily integral functions, a new system of forms arises which is easily obtainable. A binary form of order n con- tains n independent constants, three of which by linear trans- formation can be given determinate values ; the remaining n-S coefficients, together with the determinant of transformation, give us n-2 parameters, and in consequence one relation must exist between Any re – 1 invariants of the form, and fixing upon « – 2 invariants every other invariant is a rational function of its members. Similarly regarding a^, aj^ as additional parameters, we see that every covariant is expressible as a rational function of n fixed covariants. We can so determine these n covariants that every other covariant is expressed in terms of them by a fraction whose denominator is a power of the binary form.

First observe that with/j, =a^=b2= ... ,f^ = a^a^~ ,f^= a^ ” ,
A=/i«i+/iia!3, we find

yao]— -f ,

Jx

and that thence every symbolic product is equal to a rational function of covariants in the form of a fractioii whose denominator is a power oifx. Making the substitution in any symbolic pro- duct the only determinant factors that present themselves in.the numerator are of the form (af), (bf), (c/),...and every symbol a finally appears in the form

^s has/ as a factor, and may be written/, un ; for, observing that
*^^=f.=f.u„; v(‘i = 0=/.Mi; where Mo = l, 1*1 = 0,*

“We may write therefore

assume that

^j. = (a/) Oj; =

■■f-UTc=ax-u.,

Taking the first polar with regard to y (n-k){af)\T^’\+Kaf)^-‘^al

\ab){n

-l)6r

, , „. » kn-ik-

1 , Ti-1 k(n-

and, writing/j and -/i for y^ and (

k+l n-k-1

(»-)(<»/)"•■"%*

+ k{n-

= Jc(n

*-2)/.(«/)M^*

l)(oJ)(a/)”

2k-

Moreover the second term on the left contains

~~2.!;~~

br.

*4{(«/)^*

■2,k- bx

‘-(/f*

~~2 k~~ ar.

i.aff-hl-^ = \{{af)’

~~1 f~~t ar.

if k be uneven, and

in either case the factpr

*(«/;*x-(i/K=(a6)/; and therefore*

(» – i)^j+i + M ./=k{n – 2)/. (n/yaf-^^’ and fk+i is seen to be of the form/. Mjt+i.

if k be even ;

Uk=-

/„^\k TO — fc

W) ax f

These forms, n in number, are called |_' associated forms of/ (" Schwesterformen " " formes associ^es ").

Every covariant is rationally expressible by means of the forms /, ■Ms, Ms, ■■• Mn since, as we have seen, M(,= 1, Wi = 0. It is easy to find the relations

«2 = |(/,/')', % = ((/,/')^/")

u,=\{f,fY.f-l{{f,f)V,

and so on.

To exhibit any covariant as a function of Mq, Mi, %, ... take a" =:(ariy^ + a^^^ and transform it by the substitution

- *n-r\ ^ 71-1*

thence and

f.a,=a^ + {af}v,

=i(iiA/=-A»-2<»);

/" .ay=u^^ +C2X? " +C3>s ' +-+UnV ■ Now a covariant of a!^=/is obtained from the similar covariant*

ofttj by writing therein x^.x^, foT y^.y^ and, since yi,y ha.ve been linearly transformed to f and ij, it is merely necessary to form the covariants in respect of the form (iti+u^)", and then division, by the proper power of/, gives the covariant in question as a function of/, «o =1 , ^2 , «3 , • • • Mn ■ Hx. gr. , in the case of the binary quartic,

f.a=i'+SA^V^ + it^ri'+ g»/»-|A"),**

«0.£fl>5!

andj'=6 ai,a2,a3

which is exactly the relation connecting the 'five ground forms. The above system /, M2,«3, ■■• «» is not, however, for many purposes the most convenient system of associated forms. Writing (/,/)"* =62*, ((/,/)"*, /") = H2j+i, Hermiteand Clebsch have shown that u, is expressible in terms of the s forms/, Ga, H3, G4, ... G, or H, according as s is even or uneven. Hence, we _ may take this for an associated system appertaining to a form of" order s. We have G2j.=(ao) a^ bx ,*

Tx f j.\2fc/„,\ n,-ik-l,n-ik n-l.

hixtf.{ab) = {af)bx-(.bf)ax; (oc),!^ ^ = («/) i .: (i2k-/"=a:-'hr"'{{af)b,-m"xr.

Whence expression, by the binomial theorem, gives

Gikf =U2kf -(l)M2fc-l«l-/ ««2J;-2«2/ -■••"2fc/' . or,

G2fc-/'^ = 2{M2i;«O + (20'*2J;~~2M2~~(8)»2ft-3%*

and, similarly,

„ -211; -2 , 2ki2k-S) , ,ii;/2j;

*^2J;-|-1-/ ="2J;-(-l«0 + 2] «2J!-l«2~ -"V " ^ U/"*ft-l-l«fc>*

and, from these, we can express the members of the u system in terms of the G and H system.

As the symbolic expression oi forms with two series of cogredient variables, we take

«iS=K»'i + "2V C<»i2/i + V2-' '

2/m\/n\ m-k k %-\ \ m-k k n-k X (.fc;U>i "a"! OjaJi a!a2/i V^,

*the real expression being ^(kXK)Vt?‘T ~ ‘^vl’ ” V ‘ *lie form being of degree m in a^ , Xj and of degree n in y^, y^ and the coefficients a^.a;^ being arbitrary.*

It may happen that a™o^ is the product of the two forms a^, o?, and then ajflj^=ak . Oj^ ; this case is included in the general theory.

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A symbolic product contains factors of seven types, viz. : —

(i.)aj,=6x=..., (ii.)o=^i=-, (m.)fl!,=6,= ..., (iv.)o,=/3, = ..., (v.)(aJ), (vi.) (aj3), (vii){0/3),*

and, if it is to have a real expression, each letter a, b, c, ... must occur m times, and each letter a, |3, 7, ... n times. An im- portant proposition is the expression of a^ Oj. in a series of polars

of forms, of type (aa) a, ~ Oj,” , each polar being multiplied by a power of (xy). Gordan’s formula is

m « ‘1 KkAk) I /„\lc m-k n-lc\n-lc/^,\k.

and the right-hand side is a simultaneous covariant of the forms (ao) Oj. ~ Oj. ~ which involve but one series of variables. Other useful series are

I m 7i\n ‘^7/ JcKkAk/, Jc m-k n-k, ,S;

■’-‘ \ k)

As an application consider the second transvectaiit of the quartic aj with its Hessian, (a6)^a|6|=Aj; Expand a member of the third polar of (a6)aJ6|, viz. : —

+ ~iabf{aj,,}l{an,f+]{ab)\a^)’ ; the first and third terms vaniiih, and hence

{ab)<4Jbl=l{i^i}l(xy)+^ab)\ayr. By a previous theorem if we transform from ^ to c and multiply by y, {i^Yyi^y) becomes 4(A<:)»AS=(/^,4)^ Hence

- (o6)(ic)‘a|c^=|(A ,o*)»-f-i(„J)^cJ, and*

- {

=^bcf<>z{(.ac)b^-(<>)Cx]=loM=l(,ab)*4.*

Summary of Results. — We will now give a short account of the results to which the foregoing processes lead. Of any form Oj, there exists a finite number of invariants and covariants, in terms of which all other covariants are rational and integral functions (cf. Gordan, Band ii. § 21). This finite number of forms is said to constitute the complete system. Of two or more binary forms there are also complete systems containing a finite number of forms. There are also algebraic systems, as above mentioned, involving fewer covariants which are such that all other covariants are rationally expressible in terms of them ; but these smaller systems do not possess the same mathematical interest as those first mentioned.

The Binary Quadratic. — ^The complete system consists of the

form itself, a%, and the discriminant, which is the second trans- vectant of the form upon itself, viz.: {f,f’f={abf; or, in real coefBcients, 2(a^a^-a^’). The first transvectant, {f,f’f=<,ab)aj)^, vanishes identically. Calling the discriminant D, the solution of the quadratic a|=0 is given by the formula

<^x=gj^a^ + a^X2-Xi /y/ --^j\S,^ + d^x^+x^ ^ "'2 / If the form a% be written as the product of its linear factors ^j^j,, the discriminant takes the form - ^(jpq?. The vanishing of this invariant is the condition for equal roots. The simultaneous system of two quadratic forms o|, a%, say /and 0, consists of six forms, viz. ; the two quadratic forms/, 0 ; the two discriminants {f,fy,{,)\ and the first and second transveotants of / upon 0, (/, 0)1 and (/, 4>f, which may be written (aa)Oa,Oj, and [oaY, These fundamental or ground forms are connected by the relation

If the covariant {f,(t>Y vanishes/ and 0 are clearly proportional and if the second transvectant of (/, 0)' upon itself vanishes, / and 0 possess a common linear factor ; and the condition is both necessary and sufficient. In this case (/, 0)' is a perfect square since its discriminant vanishes. If (/, 0)' be not a perfect square, and rxySx be its linear factors, it is possible to express / and 0 in the canonical forms \{rxf + M{Sxf, li.i{rxf + ii^(SxY respectively. In fact, if / and 0 have these forms, it is easy to verify tliat (/> 0)^ = (V)("s)"»Sx. The fundamental system connected with n quadratic forms consists of (i.) the ?i forms themselves/i ,/2 , . . ./„, (ii.) the (2) functional determina-nts (/i./j;)^ (iii.) the (t)

invariants (/{,/) , (iv.) the (3) forms (ji,ifk,fm)) > each such form remaining unaltered for any permutations of i, k, m. Between these forms various relations exist (cf. Gordan, § 134). The Binary Cubic. — The complete system consists of*

/=4 , (/./'>=(»6>«A= A|, (/, A) = (a6K««)Jxc|=Q| ,

and

(A,A')"=(ab)^{cd)^{ad){bc) = Ii.

To prove that this system is complete we have to consider

(/,A)^ (A,A)S C/,Q)', (/,Q)», (/,Q)», (A,Q)i, (A,Q)2,

and each of these can be shown either to be zero or to be a rational integral function /, A ,Q and E. These forms are connected by the relation

2Q2 + A3 + R/'=0.

The discriminant of / is equal to the discriminant of A, and is therefore (A , A')"=R ; if it vanishes both /and A have two roots equal, A is a rational factor of/ and Q is a perfect cube ; the cube root being equal, to a numerical factor ^r^s, to the square root of

*A. The Hessian A = A|is such that (/, A)"=0, and if / is ex- pressible in the form MpxT + KQxYi t^*t is *s the sum of two perfect cubes, we find that*

A| must be equal to^ijar for then {Hp.r+IJ^iq.?,P:cqxV=0.

Hence, ifpx, ?i be the linear factors of the Hessian A|, the cubic can be put into the form MPxf + /'•{gif and immediately solved. This method of solution fails when the discriminant R vanishes, for then the Hessian has equal roots, as also the cubic f. The Hessian in that case is a factor of /, and Q is the third power of the linear factor which occurs to the second power in /. If, moreover, A vanishes identically / is a perfect cube.

The Binary Quartic. — The fundamental system consists of five

*forms 4=/; (/,/)''=(»6)M*l=AJ; (/./'>=(«0'=* ! (f.^)'*

= (aA)alAl=(aby(cb)ap>A=t ; (/. A)=(aA)*=(a6X6«K<=«)'' =j, viz., two invariants, two quartics, and a sextic. They are connected by the relation*

2t^=lif^A-A^-ljf.

The discriminant, whos'e vanishing is the condition that / may possess two equal roots, has the expression ./^ – «' ; it is nine*

times the discriminant of the cubic resolvent P – ^k – -j, and

has also the expression i{t, i)'. The quartic has four equal roots, that is to say, is a perfect fourth power, when the Hessian vanishes identically ; and conversely. This can be verified by equating*

to zero the five coefficients of the Hessian (aft)^a|6|. Gordan has also shown that the vanishing of the Hessian of the binary m^'is the necessary and sufficient condition to ensure the form being a perfect «.' power. The vanishing of the invariants i and/ is the necessary and sufficient condition to ensure the quartic having three equal roots. On the' one hand, assuming the quartic' to*

have the form ii&>:„, we find i=j = 0, and on the other hand, assuming i=j=0, we find that the quartic must have the form a^x + ia which proves the proposition. The quartic will have two pairs of equal roots, that is, will be a perfect square, if it and its Hessian merely differ by a numerical factor. For it is*

easy to establish the formula (2/a!)^A = 2/./|- 2(/^)" connecting the Hessian with the quartic and its first and second polars ; now a, a root of /, is also a root of Aj, and consequently the first*

polar fl=y^^ + y^ must also .vanish for the root a, and thence

5^ and J- must also vanish for the same root ; which proves that o is a double root of /, and / therefore a i)erfeot square. ■When/=6a!ja!^ it will be found that A= -/. The simplest form

to which, the quartic is in general reducible isf=x+6'm!i^+x*, involving one parameter m ; then A* = 2ot(xJ + a^) + 2(1 – 3TO^)a!^{a} J*

i=2(l + 3mO; i = 6TO(l-m>; i = {l-9m-X3?$^{-!i?}$(i>$^{+!i?}$^x^. The sextic covariant t is seen to be factorizable into three quadratic factors =x^^, $^{!i}$+a^, \j/=a^-x^, which are such that the three mutual second transveotants vanish identically; they are for this reason termed conjugate quadratic factors. It is on a consideration of these factors of i that Cayley bases his solution

~~*i./=A*~~

of the quartio equation. For, since -2i=A'*

he compares the right-hand side with the cubic resolvent

fifl-^fiPk—^j>?, of/=0, and notices that they become identical

*-/for X ; hence, if ij, R^i fe ^^ ^^^*

l,\,

2 ” 3-

on substituting A for k, and roots of the resolvent,

and now, if all the roots oij’ be different, so also are those of the resolvent, since the latter, and /, have practically the same dis- criminant ; consequently each of the three factors, of – 2t^, must he perfect squares and taking the square root

and it can be shown that , %, iji are the three conjugate quadratic factors of t above mentioned. We have A+Jcif=

, the remaining roots being obtained by vary- ing the signs which occur in the radicals

‘Py >X^j ^^’ The transformation to the normal

form reduces the quartic to a quadratic. The

„ —O new variables are the linear factors of 4>-

2^2=1 If0=rj;. Sjj, the normal form of as|, can be shown to be given by

tp is any one of the conjugate quadratic factors of t, so that, in determining r^.s^ from ^/A-^Al/=0, k^ is ;any root of the re- solvent. The transformation to the normal form, by the solution of a cubic and a quadratic, therefore, supplies a solution of the quartic. If (\/t) is the modulus of the transformation by which

aj. is reduced to the normal form, i becomes (X/x)^, andy, (X/)^’ ; hence*

l,fc„

tXy

l.^s'^y

-i^ is absolutely unaltered by transformation, and is termed

the absolute invariant.

Since therefore -==

I we have

a cubic equation for determining m' as a function of the absolute

invariant.

Remark. — Hermite has shown {finlU, Bd. Hi.) that the sub-

"■ A J x^Xt-x," -J, reduces — — -i-—

/ 'yff

1. / J dz

2i V

stitution, z=-.

" to the form

V 3"2^+i5'

*The Binary Qwintie. — The complete system consists of 23 forms, of which the simplest are/=4 ; the Hessian H=(/,/')^=(aS)"a|6«J the quadratic covariant *=(/>/')"=(«6)*»x*ir '> *°d the,nonic co- variant T= (/,(/',/"» = (/, B.y = (an)4Kl={,ib)Xca)ayA; the.remaining 19 are expressible as transveotants of compounds of these four.*

There are four invariants (i,i')^ {i',W; (A»T; (/H.')"*

four linear forms (/,»=)«; (/,i»)5; (i^T)'; (»»,!)»

three quadratic forms i ; (H,!^); (H.i')'*

three cubic forms (/, i)^ ; (/, 1=)^ ; (i», T)«

two quartic forms (H , i)^ ; (H , i^)'.

three quintic forms/; (/,i)i; (i",T)<

*two sextic forms H ; (H , i)^*

*one septic form (i , T)^*

one nonic form T. We will write the cubic covariant (/, i)'^=j, and then remark that the result, {f,jf = ^, can be readily established. The form j is completely defined by the relation (/,i)'=0 as no other covariant possesses this property.

Certain covariants of the quintic involve the same determinant factors as appeared in the system of the quartic ; these are /, H, i, T, and j, and are of special importance. Further, it is con- vftiient to have before us two other quadratic covariants, viz. ,

r={J,jfjxj^ ; B=(iT)i^Tj,; four other linear covariants, viz., o-=-{jifjsc; j3= (ia;4; y={Ta)T^; S=(t/S)tj,. Further, in the case of invariants, we write A = (i,i')' and take three new forms B = (i,T)^; C = (t,t')^; R=(;87). Hermite expresses the quintic in a forme-type in which the constants are invariants and the variables linear covariants. If o, /? be the linear forms, above defined, he raises the identity aj.ap) = a^(ap)-pj,aa) to the fifth power (and in general to the power n) obtaining*

(o^)=/=(a/S)»o| – 5(a^X«o)a^^-l- ... – (aa)»;S» ;

and then expresses the coefficients, on the right, in terms of the fundamental invariants. On this principle the covariant j is ex- pressible in the form

B.^j = S» + |b8% + IaCSo" Ł |C(3AB – 4C)o»

when S, o are the above defined linear forms. Hence, solving the cubic,

E'^' = (5 – 7»io)(5 – mja)(5 – Wgo)

wherein mi, m^, m, are invariants.

Sylvester showed that the quintic might, in general, be ex- pressed as the sum of three fifth powers, viz., in the canonical form f—ki(^pxf+k4.qxY' + k^r:cf. Now, evidently, the third transveotant of /, expressed in this form, with the cubic p^^x'Tx is zero, and hence from a property of the covariant } we must have j=p^x'rx ; showing that the linear forms involved are the linear factors of y. We may therefore write

f=ki(S – ntiof+k^S – in^f + k^{S – ntgo)^;

and we have merely to determine the constants k^, k^, k^. To determine them notice that R=(aS) and then

*(/,a*sy> =-5B?(m^k^-i-mJc^+m^k^), (f, a'S^y^ – lQB.%ml\+myc^+myc^.*

three equations for determining k^, k^, k^. This canonical form depends upon j having three unequal linear factors. When C

vanishes j has the form J=p^x> and if,/y=(apy(aq)ax=0.

Hence, from the identity ax{pq)=Px(ps)~9xi"lO> ^^ obtain

(;'?)y=(«?)'i'i-5(«p)(aS')V&'i-(a!p)VI. ^^^ required canonical form. Now, when 0=0, dearly (see ante) Ky=S'p where

p=S + -'Ba ; and Gordan then proves the relation

6RV= BS5 (5B8»/) – 4AV,

which is Bring's form of quintic at which we can always arrive, by linear transformation, whenever the invariant C vanishes.

JReTnark.—The invariant C is a numerical multiple of the resultant of the covariants i and/, and if C=0, /> is the common factor of i and J.

The discriminant is the resultant of -^ and ^ and of degree

8 in the coefiicients ; since it is a rational and integral function of the fundamental invariants it is expressible as a linear function of A" and B ; it is independent of C, and is therefore unaltered when C vanishes ; we may therefore take /in the canonical form

6Ry= B3= -H 5B«V – 4AV. The two equations

^=5(B5-)-4BS»p)=0,*

dp

=5(B5«-4A=/)=0,

yield by elimination of S and p the discriminant D = 64B-A2.

The general equation of degree 5 cannot be solved algebraically, but the roots can be expressed by means of elliptic modular functions. For an algebraic solution the invariants must fulfil certain conditions. When R=0, and neither of the eipressions AC – B^, 2AB – 3C vanishes, the covariant Oj, is a linear factor of /; but, when R=AC-B2 = 2AB-3C = 0, a« also vanishes, and then /is the product of the form j| and of the Hessian of /J. When ax and the invariants B and 0 all vanish, either A or j must vanish ; in the former case j is a perfect cube, its Hessian vanishing, and further/ contains j as a ~~factor; in the latter case, if px, cally, and so also does/. If, however, the condition be the vanish, ing of 1, /contains a linear factor to the fourth power.~~

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The Binary Sextic. — The complete system consists of 26 forms, of which the simplest are /=aj; the Hessian H=(a6)'a^iJ; the

quartici = (aJ)"aj6|; the co variants i=(oi)^o=; T=(ai)"(c6)o^|cJ; and the invariants A = ((t6)^ ; B = (w'). There are*

5 invariants : {a,bf,{i,i'), {l,l')\ (f, Pf, Uf,i), l^ i*

6 of order 2xl,{i,) (/, P), (.i,P)\ (/, P)\ ({/. i) , Pf ; 5 of order i-.i, (/, iy\ (i, I), (/, Pf, ((/, »),?)<' ;*

5 of order 6 :/,p = (o^)X4. (/. ^). ((/. »). ^)" P')" 3 of order 8 : H, (/, i), (H , i) ;

loforder 10:(H,i); 1 of order 12 : T.

For a further discussion of the binary sextic see Gordan he. cit., Clebsch loc. eit. The complete systems of the quintic and sextic were first obtained by Gordan in 1868 {Joum. f. Math. Ixijf. 323- 354). Von GaU in 1880 obtained the complete system of the binary ootavic {Math. Ann. xvii. 31-52, 139-152, 456) ; and, in 1888, that of the binary septimic, which proved to be much more complicated (Math. Ann. xxxi. 318-336). Single binary forms of higher and finite order have not been studied with complete suc- cess, but the system of the binary form of infinite order has been completely determined by Sylvester, Cayley, MacMahon, and Stroh, each of whom contributed to the theory.

As regards simultaneous binary forms, the system of two quad- ratics, and of any number of quadratics, is alluded to above, and has long been known. The system of the quadratic and cubic, consisting of 15 forms, and that of two cubics, consisting of 26 forms, were obtained by Salmon and Clebsch ; that of the cubic and quartic we owe to Gundelflnger {Programm Stuttgart, 1869, 1-43) ; that of the quadratic and quintic to Winter {Programm Darmstadt, 1880) ; that of the quadratic and sextic to von Gall {Programm Lemgo, 1873) ; that of two quartics to Gordan {Math. Ann. ii. 227-281, 1870) ; and to Bertini {Batt. Giorn. xiv. 1-14, 1876 ; also Math. Arm., xi. 30-41, 1877). The system of four forms, of which two are linear and two quadratic, has been in- vestigated by Perrin {S. M. F. Bull. xv. 45-61, 1887).

Ternary and Higher Forms. — The ternary form of order n is represented symbolically by

{0^x^^+0,$^{X2+0}$)^=0^ ; and, as usual, b,c,d,... are alternative symbols, so that

To form an invariant or covariant we have, merely to form a product of factors of two kinds, viz. determinant factors' (a6c),

(dbd), {bee), etc and other factors a„ b„ Cx,... in such manner,

that each of the symbols a,b,c,... occurs n times. Such a symbolic product, if it does not vanish identically, denotes an invariant or a covariant, according as factors Ox, ^x, ex,... do not or do appear. To obtain the real form we multiply out, and, in the result, sub- stitute for the products of symbols the real coefficients which they denote.

For example, take the ternary quadratic

{a^Xi + a^ + a^)^ = a| ,

or in real torm a3^ + ba^ + c!t^ + 2fx^x^ + 2g!i!^^+2ha!^{Xj}. We can see that (abc) ajbxfix is not a covariant, because it vanishes iden- tically, the interchange of a and b changing its sign instead of

leaving it unchanged; but (aJc) is an invariant. If oJ,6|,c|be different forms we obtain, after development of the squared deter- minant and conversion to the real form (employing single and double dashes to distinguish the real coefficients of bl and el),*

oiVi'+lY – 2/7") + l{e'a"+

*a simultaneous invariant of the three forms, a*nd now suppressing the dashes we obtain*

6(aJI 2fgh – op – Ig^ – eW),

the expression in brackets being the well-known invariant of a%, the vanishing of which expresses the condition that the form may break up into two linear factors, or, geometrically, that the conic may represent two

right lines. The complete system consists of the form itself and this invariant.

The ternary cubic has been investigated by Cayley, Aronhold, Hermite, Briosohi, and Gordan. The principal reference is to Gordan {Math. Ann. i. 90-128, 1869, and vi. 436-512, 1873). The complete covariant and contravariant system includes no fewer than 34 forms ; from its complexity it is desirable to consider the cnbic in a simple canonical form ; that chosen by Cayley was

aa? + by^ + c^+6dxyz {Arrier. J. Moth. iv. 1-16, 1881). Another form, associated with the theory of elliptic functions, has been considered by Dingeldey {Math. Ann. xxxi. 157-176, 1888), viz. xy^-i;^ + g^^ + g^, and also the special form axz'-iby^ of the cuspidal cubic. An investigation, by non-symbolic methods, is due to Mertens (Wien. Ber. xcv. 942-991, 1887). Hesse showed independently that the general ternary cubic can be reduced, by linear transformation, to the form

a?+y' + ii?+6mxyz,

a form which involves 9 independent constants, as should be the case ; it must, however, be remarked that the counting of con- stants is not a sure guide to the existence of a conjectured canonical form. Thus the ternary quartic is not, in general, expressible as a sum of five 4th powers as the counting of constants might have led one to expect, a theorem due to Sylvester. Hesse's canonical form shows at once that there cannot be more than two independ- ent invariants ; for if there were three we could, by elimination of the modulus of transformation, obtain two functions of the coefficients equal to functions of m, and thus, by elimination of m, obtain a relation between the coefficients, showing them not to be independent, which is contrary to the hypothesis.

The simplest invariant is S^{abe){abd){acd){bed) of degree 4, which for the canonical form of Hesse is m{l – m") ; its vanish- ing indicates that the form is expressible as a sum of three cubes.

The Hessian is symbolically (aJc)%ij.6^j.=H|, and for the canonical form {l + 2m')xyz-m'{3?/ins>!. By the process of Aronhold we can form the

invariant S for the cubic a|-HXHJ, and then the coefficient of \ is the second invariant T. Its symbolic expression, to a numerical factor pris, is ^

{Ilbe){md)(acd){bcd),

and it is clearly of degree 6.

One more covariant is requisite to make an algebraically com- plete set. This is of degree 8 in the coefficients, and degree 6 in the variables, and, for the canonical form, has the expression

- 9ot«(!b2 + y"+ir>)^ – {2m + 5m+ 20m^){ii^ + y' + !?)xyz*

- {\hvfi + 78«i= – 12OTe)!K2i/V + {\ + 8m'>)^{y^^ + ir>a? + a?y^).

Passing on to the ternary quartic we find that the number of ground forms is apparently very great. Gordan {Math. Ann. xvii. 217-233), limiting himself to a particular case of the form, has determined 54 ground forms, and Maisano {Batt. ^. xix. 198-237, 1881) has determined all up to and including the 5th degree in the coefficients.

The system of two ternary quadratics consists of 20 forms ; it has been investigated by Gordan {Clebseh-Lindemann's Vor- lesungen, i. 288, also Math. Ann. xix. 529-552) ; Perrin {S. M. F. Bull, xviii. 1-80, 1890) ; Rosanes {Math. Ann. vi. 264) ; and Ger- baldi {AnnoH (2), xvii. 161-196).

Ciamberlini has found a system of 127 forms appertaining to three ternary quadratics {Batt. G. xxiv. 141-157).

Forsyth has discussed the algebraieally complete sets of ground forms of ternary and quaternary forms (see Amer. J. xii. 1-60, 115-160, and Carrib. Phil. Trans, xiv. 409-466, 1889). He proves, by means of the six linear partial differential equations satisfied by the concomitants, that, if any concomitant be expanded in powers of a^, a^, tcs, the point variables — and of Mi, u^, %, the contra- gredient line variables — it is completely determinate if its leading coefficient be known. For the unipartite ternary quantic of order

n he finds that the fundamental system contains -(ra ŧ 4)(» – 1)

individuals. He successfully considers the systems of two and three simultaneous ternary quadratics. In Part III. of the Memcdr he discusses bi-ternary quantics, and in particular those which are lineo-linear, quadrato-linear, cubo-linear, quadrate-quadratic, oubo-cubic, and the system of two lineo-linear quantics. He shows that the system of the bi-ternary n'm^ comprises

-(m + l)(re Ł 2)(m } 1)(ot Ł 2) – 3 individuals.

Bibliographical references to ternary forms are given by Forsyth {Amer. J. xii. p. 16), and by Cayley {Amer. J. iv. 1881).

IV. Enttmekating Gbnbkatinq Functions.

Professor Michael Roberts {Quart. Math. J. iv.) was the first to remark that the study of covariants may be reduced to the study of their leading coefficients, and that from any relations connect- ing the latter are immediately derivable the relations connect- ing the former. It has been shown above that a covariant, in general, satisfies four partial differential equations. Two of these show that the leading coefficient of any covariant is an isobario and homogeneous function of the coefficients of the form ; the remaining two may be regarded as operators which cause th»

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vanishing of the covariant. binary 71",

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ka.

These may be written, for the d

'da.r'^^r^'

2(ra – A)at+i

d

a!i-r-=0 ;

or in the form

where

“=»«^ + 2»iA+.

■+””»-‘£’

Let a covariant of degree e in the variables, and of degree 6 in the coefficients (the weight of the leading coefficient being w and n8-ew=2), be

CoKi + ecjiBi” X2+.-..

Operating with fi Kj — we find QCo = 0 ; that is to say, Co satis- fies one of the two partial difierential equations satisfied by an invariant. It is for this reason called a seminvariant, and every seminvariant is the leading coefficient of a covariant. The whole theory of invariants of a binary form depends upon the solutions of the equation n= 0. Before discussing these it is best to trans- form the binary form by substituting \ai,2\a ,Z\a^,...n\a„, for fl!i , (tj , as . . . a„ respectively ; it then becomes

n , 71-1 , , ,\ 71-2 2 ,

.+n\aji,X2,

and a takes the simpler form d , d

doi da>2 do/^ ‘ ‘ dan ‘

One advantage we have obtained is that, if we now write 0^=0, and substitute 0,-1 for a, when s > 0, we obtain

d-

d

d

“»^+“i55" + “=’^+-

..-K»„

d ■“rfOi ‘ “da ‘ »’da “^da„-i

which is the form of il for a binary 71-1°.*

Hence, by merely diminishing each suffix in a seminvariant by unity, we obtain another seminvariant of the same degree, and of weight w-0, appertaining to the n – 1’°. Also, if we increase each suffix in a seminvariant, we obtain terms, free from Oo, of some seminvariant of degree 6 and weight w + B. Ex. gr. from the invariant a| – ia^a^ + 2affl^ of the quartic the diminishing pro- cess yields al – 2a^i, the leading coefficient of the Hessian of the cubic, and the increasing process leads to a§ – 2a^^ + ia^a^ which only requires the additional term – iaffi^ to become a seminvariant of the sextic. A more important advantage, springing from the new form of fi, arises from the fact that if

a;» – Oiii!”-^ Ł Oaa!”-^ ...()”«»= (a! – oi)(a! – Oj) ... (ar – a„) ,

the sums of powers So’ , 2o’ , 2a , ...2a” all satisfy the equation 0=0. Hence, excluding a,), we may, in partition notation, write down the fundamental solutions of the ec[uation, viz. — (2),(3),(4),...(7i),*

and say that, with a^, we have an algebraically complete system. Every symmetric function denoted by partitions, not involving the figure unity (say a non-unitary symmetric function), which remains unchanged by any increase of n, is also a seminvariant, and we may take if we please another fundamental system, viz. —

»o>(2),(3),(22), (32),...(2') or (32«"~~'>). Observe that, if we subject any symmetric function {jpip^Ps.~~) to the diminishing process, it becomes aJ^~^^(j'2Ps—)-*

Next consider the solutions of 0=0 which are of degree 6 and weight w. The general term in a solution involves the product a^'a^^a^^-.~~a^" wherein 27r = e,2sir,= w; the number of such pro~~ ducts that may appear depends upon the number of partitions of w into 6 or fewer parts limited not to exceed n in magnitude. Let this number be denoted by (vi ; 8, n). In order to obtain the seminvariants we would write down the (w ; 8, n) terms each asso- ciated with a literal coefficient ; if we now operate with O we obtain a linear function of (w-l;8,n) products, for the vanish- ing of which the literal coefficients must satisfy [w-\;8,n) linear equations ; hence (7« ; ff, 7i) – (io – 1 ; 9, n) of these coefficients may be assumed arbitrarily, and the number of linearly independent solutions of 0=0, of the given degree and weight, is precisely {w;e,n)-{w-\;e,n). This theory is due to Cayley ; its validity depends upon showing that the (w-\8,n) linear equations satisfied by the literal coefficients ^re independent ; this has only

recently been established by E. B. Elliott. These seminvariants are said to form an asyzygetic system. It is shown in the Article on Combinatorial Analysis that {w ; 8, n) is the coefficient of a z"' in the ascending expansion of the fraction*

1

1-os. l-az.l-az". ...1-02"' Hence [w; 8,n)-{w-\; 8, n) is given by the coefficient of

*0*2"" in the fraction*

l-£ .__

1 – a.l – az. 1 – os'^. ...1 – »«".' the enumerating generating function of asyzygetic seminvariants. We may, by a well-known theorem, write the result as a coeffi- cient of ^ in the expansion of

-z^.-s?....-z^ ‘

and since this expression is unaltered by e interchange of n and 8 we prove Hermite’s Law of Keoiprooity, which states that the asyzygetic forms of degree 8 for the 71° are equinumerous with those of degree n for the 6.*

The degree of the covariant in the variables is e=n8-‘i,w, consequently we are only concerned with positive terms in the developments and {w, 8,n)-{iu!-l ; 8, n) will be negative unless nB-2w^0. It is convenient to enumerate the seminvariants of degree 8 and order e=n8-2whj a, generating function ; so, in

the first written generating function for seminvariants, write -5

for z and az” for a ; we obtain

l-ar’ ^_

1 -az”.l ~~az”~~“.! ~~a«”~~. ...1 -asr”**.! -az-»+’.l -oa-»*

*in which we have to take the coefficient of a*z^~2«’, the expansion being in ascending powers of a. As we have to do only with that part of the expansion which involves positive powers of z, we must try to isolate that portion, say A„(z). For 7i = 2 we can prove that the complete function may be written*

A2(z)

where

P^VJ’

A,(z) =

*1-az^.l-a^*

and this is the reduced generati^ig function which tells us, by its denominator factors, that the complete system of the quadratic is composed of the form itself of degree order 1, 2 shown by az^, and of the Hessian of degree order 2, 0 shown by a\ Again, for the cubic, we can find

1 — a^ifi ■-‘^^^ “l-az3.l-aV.l-aV.l-a*’*

where the ground forms are indicated by the denominator factors, viz. : these are the cubic itself of degree’ order 1, 3 ; the Hessian of degree order 2, 2 ; the cubi-covariant G of degree order 3, 3, and the quartic invariant of degree order 4, 0. Further, the numerator factor establishes that these are not all algebraically independent, but are connected by a syzygy of degree order 6, 6. Similarly for the quartic

**,,‘ ~ l-azKl-a:’.l-a^.l-a\l-aV*

establishing the 5 ground forms and the syzygy which connects them.

The process is not applicable with complete success to quintio and higher ordered binary forms. This arises from the circum- stance that the simple syzygies between the ground forms are not all independent, but are connected by second syzygies, and these again bj third syzygies, and so on ; this introduces new difficulties which have not been completely overcome. As regards invariants a little further progress has been made by Cayley, who established the two generating functions for the quintic

l-a3«

and for the sextic

l-a.l-a».l-a^.l-a^’*

1 – aM – a.! – a«.l – a”.l – a^’*

Accounts of further attempts in this direction will be found in Cayley’s Memoirs on Quantics (Collected Papers), in the papers of Sylvester and Franklin {Amer. J. i.-iv.), and in Elliott’s Algebra of Quantics, chap. viii.

Perpetuants. — Many difficulties, connected with binary forms of finite order, disappear altogether when we come to consider the form of infinite order. In this case the ground forms, called also perpetuants, have been enumerated and actual representative

seminvariant forma established. Putting n equal to m, in a generating function obtained above, we find that the function, which enumerates the asyzygetic seminvariants of degree S, is

1-zM-

3.1-

....1-

that is to say, of the weight w, we have one form corresponding to each non-unitary partition of w into the parts 2,3,4, ...d. The extraordinary advantage of the transformation of 0 to associa- tion with non-unitary symmetric functions is now apparent ; for we may take, as representative forms, the symmetric functions which are symbolically denoted by the partitions referred to. Ex. gr., of degree 3 weight‘8, we have the two forms (3^2), a(2). If we wish merely to enumerate those whose partitions contain the figure 0, and do not therefore contain any power of a as a factor, we have the generator*

l-s2.l-sS.l-s-i,...l_se

If 6=2, every form is obviously a ground form or perpetuant, and the series of forms is denoted by (2), (2^), (2’), ...(2”l) ... . Similarly, if 6 = 3, every form (3”^{2}) is a perpetuant. For these two cases the perpetuants are enumerated by

-2 ^

and .

l-s”’ l-s2.1-s3

respectively.

When S=4 it is clear that no form, whose partition contains a part 3, can be reduced ; but every form, whose partition is com- posed of the parts 4 and 2, is by elementary algebra reducible by means of perpetuants of degree 2. These latter forms are enumer-

ated by ^ ^ — -^ ; hence the generator of quartic perpetuants

must be

l-s^.l-zM-z 1-*

2.1-z l-z’.l-i^.l-^’*

and the general form of perpetuant is (4”3^2”).

When 6^5, the reducible forms are connected by syzygies which there is some difficulty in emimerating. Sylvester, Cayley, and MacMahon succeeded, by a laborious process, in esteblishing the generators for $ = o, and 0=6, viz. ;

^15 ‘ z3l

l-sM-z^.l-

M-

l-z^.l-

3.1-s^.l-i!i».l-a«

but the true method of procedure is that of Stroh which we are about to explain.

Method of Stroh. — In the section on "Symmetric Functions," it was noted that Stroh considers

s s s

where 0-1 ~~I~~ (To ~~)~~... -Krg=0 and ^ = ?^ =... = _= a, symbolically, to*

s\ s\ s!

be the fundamental form of seminvariant of degree 0 and weight w ; he observes that every form of this degree and weight is a linear function of such symbolic expressions. We may write

(H- t o-jl). . . (1 ~~KTgl) = H~~ AjT" -f AjJ' -h .. . ~~1~~ Aef«. If we expand the symbolic expression by the multinomial theorem, and remember that any symbolic product a^a^^a^'... retains the same value, however the suffixes be permuted, we

Tj W2 Tg

shall obtain a sum of terms, such asMi! J- -^ _i^...2ff'V"'V"'...,

*which in real form is io ! <^„^(iv3''^,- ■ ■^o'i^<'i'''l' — 5 *"*

*1 o^*

*=a^{-2A2) + alA^^(,al-2a^)A2=(2)Ai=ali2)A^*

In general the coefficient, of any product A^^A^^A^^..., will have, as coefficient, a seminvariant which, when expressed by parti- tions, will have as leading partition (preceding in dictionary order all others) the partition (irjir^v^...). Now the symbolic eJcpression of the seminvariant can be expanded by the binomial theorem so as to be exhibited as a sum of products of seminvariants.

of lower degrees if o-jai H- o-joij ~~)~~... -H(rga# can be broken up into any two portions

((TiOi + ffjaj ⸸...((r,a,) + {(r^^.la^^.l + I ... ⸸ ir jOg), such that 0-1 + 0-2 + . ..+(r,=0, for then

“■j+i + ”•-H! + • • • +(^0=0 ; and each portion raised to any power denotes a seminvariant.

Stroh assumes that every reducible seminvariant can in this way be reduced. The existence of such a relation, 8,aa-i +

Me. gr. for 6 = 2, {tr-fi^ + a-^^)^ ; either ff-j or (r^ will vanish if 0-10-2= A2=0 ; but every term, in the development, is of the form

(222. ..)A2 and therefore vanishes ; so that none are left to undergo reduction. Therefore every form of diegree 2, except of course that one whose weight is zero, is a perpetuant. The

generating function is . _ 2-

*‘ For 0 = 3, ((riOi-Ho-gOj-l-o-sOs)’” ; the condition is clearly iTiirgffj =A3=0, and since every seminvariant, of proper degree 3, is associated, as coefficient, with a product containing A3, aU such are perpetuants. The general form is (3*2’^) and the generating*

function :; s-q 5.

For 9=4, (o-iOi + o-jOa-H 0-303 -H 0-404)”’; the condition is o-T

Hence every product of Aj, A2, A3, A4, which contains the pro- duct AjAg disappears before reduction ; this means that every seminvariant, whose partition contains the parts 4, 3, is a per- petuant. The general form of perpetuant is (4“3’^2”) and the generating function

l-isM-z.!-!!;*’ In general when 0 is even and =2, the condition is*

(Tiffa.. .

and we can determine the lowest weight of a perpetuant ; the degree in the quantities 0- is ,

Again, if 9 is uneven =2^-1-1, the condition is o-iffj. . .) 0-3 (ffj) . . .II(o-, +

and the degree, in the quantities a, is

= 22-l = 2*-l-l.*

Hence the lowest weight of a perpetuant is 2”^ – 1, when 0 is >2. The generating function is thus 5«-l 1*

(l-2”)(l-s’)(l-j;<)...(l-z)*

The actual form of a perpetuant of degree 6 has been shown by MacMahon to be

1-4

e» ,0-

9-1

+1

0-2 ‘

,+2

,0-3

■9-3

+ ,“3+2*

.2”^),

Kg, Kg_i, ...K2 being given any zero or positive integer values.

Simultaneous Seminvariants of two Bina/ry Forms. — Taking the two forms to be

a(fsi+paix\ X2+p[p-V)a^i X2+..- + apX2,

*Vl + ?Ml~^»‘2 ■<-?(? -1)*2='1~ »'2 + — + h^,*

every leading coefficient of a simultaneous covariant vanishes by the operation of

„„ d d , , d , , d , , d , , , d

Oa ŧ Os = aio:r- -f

doi da2

da~

■“dh

‘dh

“dh

Observe that we may employ the principle of suffix diminution to obtain from any seminvariant one appertaining to a ^ – 1” and a, q- 1”, and that suffix augmentation produces a portion of a higher seminvariant, the degree in each case remaining unaltered. Eemark, too, that we are in association with non-unitary sym- metric functions of two systems of quantities which will be*

denoted by partitions in brackets ( )a, ( )» respectively. Solving the equation

by the ordinary theory of linear partial differential equations, we obtain p + q + 1 independent solutions, of which p appertain to OaM=0, q to iiiU

— O ; the remaining one is Jab=i-aJio, the leading coefficient of ttie Jacobian of the two forms. This con- stitutes an algebraically complete system, and, in terms of its members, all seminvariants can be rationally expressed. A similar theorem holds in the case of any number of binary forms, the mixed seminvariauts being derived from the Jacobians of the several pairs of forms. If the seminvariani be of degrees 0 ,B' in the coefficients, the forms of orders p, q respectively, and the weight w, the degree of the covariant in the variables will be pd + qB' -iw = e, an easy generalization of the theorem connected with a single form.

The general term of a seminvariant of degrees 6, 0' and weight w will be

where

p g p q

2p,=9,Z(r,=e' and Ssp, + Ss(r,=«>.

11 11

Tlie number of such terms is the number of partitions of i« into 0 + 0' parts, the part magnitudes, in the two portions, being limited not to exceed p and q respectively. Denote this number by (w ; 0,p ; 0', q). The number of linearly independent seminvariants of the given type will then be denoted by

{w;0,p;e',q)-{'w-\;0,p;0',q); and will be given by the coefficient of a%Vz^ in

l-« __.

1 -a. 1-az.l -02=. ... l-a«*. 1-6.1-62. l-6i!?... 1-62* '*

that is, by the coefficient of a'" in

1 -2^^. 1 -2»+'. ... 1 -zJ^9. 1 -sfft-M -2«+2. ... 1 -2»^-«'

l-s.l-zM-a3….1-

.l-isM-

..1-

which preserves its expression when 0 and p and 0′ and q are separately or simultaneously interchanged.

Taking the first generating function, and writing a^ ,lz^ ,-^ for a, 6, and z respectively, we obtain the coefficient of ae6fl’«J’»+9»’-2«’, that is of a»i9’z», in

l-02P.l-oa’’-^....l-£K-+^l-as-^.l-6a«.l-6a»-^....l-6z-‘+’’.l-fe-9′*

the unreduced generating function which enumerates the co- variants of degrees 0, 8′ in the coefficients and order e in the variables. Thus, for two linear forms, p=q=\, we find

l-z-a

1 – az. 1 – oz-i. 1 – fe . 1 – 6z-i’ the positive part of which is

-az.-bz.-ab ‘

establishing the ground forms of degrees-order (1, 0 ; 1) , (0, 1 ; 1) , (1, 1 ; 0), viz. : — the linear forms themselves and their Jacobian Jab. Similarly, for a linear and a quadratic, p=l’,q=2, and the reduced form is found to be

1-

-az.l-bz^.-abz.l-b^.l-a%’

where the denominator factors indicate the forms themselves, their Jacobian, the invariant of the quadratic and their resultant ; connected, as shown^by the numerator, by a syzygy of degrees- order (2 , 2 ; 2).

The complete theory of the perpetuants appertaining to two or more forms of infinite order has not yet been established. For two forms the seminvariants of degrees 1,1 are enumerated by

——, and the only one which is reducible is ao^o of weight zero ;

1 — »

hence the perpetuants of degrees 1 , 1 are enumerated by

J— 1 = ⊼ 1-z 1-z'

and the series is evidently

"■oh – "tJ>o >

O562 –

*<^ah - «i*2 + "■ih ~ "^3*0 >*

one for each of the weights 1, 2, S, ...ad infin. For the degrees 1, 2, the asyzygetic forms are enumerated by

^ 5, and the actual forms for the first three weights are

1 – z . 1 – J?

*(«o*i-<'i*o)*o>*

o„(j;- 26062),

(ojjj – ai6a + O361 – ^360)60 >

flSo(6i62 – 36063) – ai(6S – 25o5a) ;

amongst these forms are included all the asyzygetic forms of degrees 1, 1, multiplied by 60, and also all the perpetuants of the second binary form multiplied by «„ 5 li™ce we have to subtract

from the generating function -r— and yZ^ ^^^ ^® obtain the

generating function of perpetuants of degrees 1, 2

1-z.l-z^ 1-s l-z" 1-z.l-z^ .

The first perpetuant is the last seminvariant written, viz. :—

a„(6o62- 36063) -ai(6|-26o5j),

or, in partition notation,

■oo(21)»-(l)<.(2)s;

and, in this form, it is at once seen to satisfy the partial differ- ential equation. It is important to notice that the expression

{0)a{e'vh – (ei)«(«'!')» + (ei')<.(e'i'")» – ■ • • + m'U»')o

denotes a seminvariant, if 0, 0', be neither of them unity, for, after operation, the terms destroy one another in pairs ; when 0 = O,i0)a must be taken to denote a, and so for 0'. In general it is a seminvariant of degrees 0, 6', and weight 0 + 0' + s; to this there is an exception, viz., when 0 = 0, or when 0'—O, the corre- sponding partial degrees are 1 and 1. When 6=0' =0, we have the general perpetuant of degrees 1, 1. There is a still more general form of seminvariant ; we may have instead of 0, ff any collections of non-unitary integers not exceeding 0, 8' in magni- tude respectively. Ex. gr.

(^..0^«X{l'2'S>...a'"^)i – (i^z. 0^»\(f-h'i>'K..0^X

+(ih"^..0^X('–"^^"'-^"^)b

(– y(l'2'3=...9"«)a(2'^3"»...fl"'')6, is a seminvariant ; and since these forms are clearly enumerated*

1-Z.l-Z=....l-29.1-Z2.1-Z».... l-Zfl

an expression which also enumerates the asyzygetic seminvariants, we may regard the form, written, as denoting the general form of asyzygetic seminvariant ; a very important conclusion. For the case in hand, from the simplest perpetuant of degrees 1, 2, we derive the perpetuants of weights,

ao(21"-%-Oi(21"-3)i Haj(21"')j – ...+a„-2(2)6, a„(22l"-*(j-Oi(2n"-')j-Ki2(2n»-«)j-...±a„_4(2=')s, ao(2'l"-«)j –*

a series of ^{w – 2) or of ^{w – 1) forms according as w is even or

uneven. Their number for any weight w is the number of ways of composing w-S with the parts 1, 2, and thus the generating function is

verified. We cannot, by this method, easily discuss the perpetuants of degrees 2, 2, because a syzygy presents itself as early as weight 2. It is better now to proceed by the method of Stroh. We have the symbolic expression of a seminvariant.

.TT^'i"! + "2a2 + • • ■ + "TflOfl + t^t,tA-+ rffPfff

where

and

w

…«„ ^,—... -6,,

a-^ + a^-V ...■-

Proceeding as we did in the case of the single binary form we find that for a given total degree B + ff, the condition which expresses reducibility is of total degree 2+*'~^-l in the co- efficients a and t ; combining this with the knowledge of the generating function of asyzygetic forms of degrees 0, 0', we find that the perpetuants of these degrees are enumerated by*

z°^+«'-^-l

l-z.l-zM-z». ...l-zS.l-zM-zS. ...l-zS-'

and this is true for 9 -^ 6' = 2 as well as for other values ai 0 + 9 (compare the case of the single binary farm).

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Observe that, if there be more than two binary forms, the weight of the simplest perpetnant of degrees B, 6', e",...is

'L, .'.'^^ ""'^ ^8 ^^^ ^y reasoning of a similar kind.

To obtain information concerning the actual forms of the per- petuants, write

(1 + o-iIbXI + o-aCB). . .(1 + o-gCB) = 1 + Aia + Aaar” + . . . + AgajS

*(l + ria!Xl+Tija!)...(l+Tg«) = l + Bia!B2ar’... + B9,a^*

where Ai + Bi=0.

For the case 6=1 ,«’=!, the condition is

J.

which, since Ai + Bj = 0, is really a condition of weight unity. For m; = 1 the form is Ajaj + Bj Jj, which we may write a^^ – Orfi^ =

*«o(l)6- (1)0*0; the remaining perpetuants, enumerated by^ ,*

have been set forth above.

For the case 9=1, #’=2, the condition is

*]^ _ 2 1 _ s2 ™*y ^^ represented by the form*

(l^i+l).(2’+l)j – {Xh)J2l+-^\)^+ ... + (^+-il^x+\ ;

\ and /«2 each assuming all integer (including zero) values. For the case 0=6' =2, the condition is

(ri

To represent the simplest perpetuant, of weight 7, we may take as base either A | BjBj or AjAjB | , and since Aj + Bj = 0 the former ^ is equivalent to AjAlBj and the latter to A^BjEl ; so that we have, apparently, a choice of four products. A|B,B, gives (22)«(21)j – (2^1),(2)j, and AjAiBj, (2n),(2)6 – (22)<.(21)j ; these two merely differ in sign; and similarly AjBiB| yields (2)^(231)»- (21)„(2)». and that due to AjAjBI merely differs from it iij sign. We will choose from the forms in such manner that the product of letters A is either a power of Aj, or does not*

contain Aj ; this rule leaves us with AlBiBjj au(l AaBjBi ; of these forms we will choose that one which in letters B is earliest in ascending dictionary order ; this is AfB^Bj, and our earliest perpetuant is

(22)„(21)j-(2=l).(2)j, and thence the general form enumerated by the generating

(2'^2+2),(2M2+ll»il+l)5_(2^1+2l),(2M+llMl)5+... + (2^>+2lW+l) „(2>^+l)j . For the case 8=1, $'=3 the condition is

By the rules adopted we take Af BjBg, which gives (12).(32)6 – (l)„(321)j + a„(3212)j ,

the simplest perpetuant of weight 7 ; and thence the general form enumerated by the generating function

,7

l-z.l-ss^.l-zS' viz. ..(l'+\{s'+h'+- ...±ao(3>+h'+h'+X For the case 6=2, 8'=3, the condition is

o-iffjTiTarsCffi + ff2)((rj + Tj)((Ti +T2)((ri + T,)(

The calculation results in

*- AJB3B2B; -l-iAiBsBiB? – AlBsBIBf + AfBSBi – 2A|BiB2Bi -A|B|BjB? + AiBiBiBi + A2B§BiB»+AiB?B»-2A2B»B2BJ ' + A2B*B,=0.*

By the rules we select the product AlBjB^B J , giving the simplest perpetuant of weight 15, viz. : —

(2).(321=)5 – (2n),(321)i + (2n"),(32)» ;*

and thence the general form

(2'»+%(3>+h'+h"+-...±(2'+h"+\(3'+^2l^+X

due to the generating function

(l-2Xl-2T(l-^»)' For the case 6=1, 6'=i, the condition is

(TlTiTaTsT^Co-i + TiXo-i + T^fffi + T^XfT^ + u)I!.(t, + T,) = 0 ,"

the calculation gives

A,B4(AJB2 + AiBs + B4)(-B|-AiB2B3-AfBJ = 0.

Selecting the product AJB4B3B5, we find the simplest per- petuant

(1<)„(4822)4 - (13W432n)j 1 (l«).(432n=)j – (l),(4322l')j

. +a,{i32?l),.*

and thence the general form

il^'%{i>'h'/ins>2! -... + ao(i"h>'2r^+h^'+% due to the generating function

I-Z.l-Z'. 1-^.1-2-*

The series may be continued, but the calculations soon become very laborious.

Three Binary Forms. — Taking the partial degrees of a sem- invariant of three binary forms to be 6, 6', 6", an easy generaliza- tion of the foregoing leads to the generating function

1

of the asyzygetio forms. If we place as numerator to this

fraction ^ – 1 we obtain the generator of the perpetu-

ants. To obtain representative forms of perpetuants we reqiiire a general solution of the partial differential equation

or say Oa-l-O6 + Qc=0-

The general form of solution of Oj + Oo=0 we have seen to be

the expression consisting of « Ł 1 terms and the coefficients being alternately + 1 and – 1. Denote this by

|(2V^../’”)6(l‘2’3’.../”)c|• Now construct the expression*

(l‘2^3’»...e’^”)i(l‘2’^3”».../”)<=*

~~Ct’)(l’+‘2V»...A)i(l’~~^2’^3’”.../Oo

+CVXi+h’^3..e’\ii’-^2>3>...ff”’“‘l*

continued to s + 1 terms and denote it by

*I (l*2^3*»...9’-’),(l^2’3’...e”””‘“X I ,*

and verify that, if it be operated upon by Oj+Oc, the effect is to change t into t-1. The consequence of this is that if we form the expression

(2”’^r..e’»X \ (l‘2’3’...fl”’’)j(l‘2’3’...6(“‘“0*

-d^^’^.-e’^X I (l-l2V’.../*’)i,(l‘2’3’.../*”)o I-*

+(i^‘3”...e’X \ {i’-h’..e^”\(f^3’...ff^’\ I

continued to t + 1 terms, we obtain a solution of

O„H-fi6H-fi„=0.

To find the enumerating generating function of these forms sup- pose 6, ff, and ff’ to be in ascending order of magnitude, and denote the form by

I {t^“K..er»)ll^H^3”..6^^\{V^‘t‘3’...&^’\ I .

In constructing this we have a choice of two places in which to place the part 1, three places in which to place the part 2, and so on ; hence the

generating function is

1

1-2.1-22.1-23. ..l-z«. 1-2. 1-22.1 -28… l-s'. I -22.1 -«S…l_se"'*

precisely that of the asyzygetic forms. Hence the constructed expression m^ be taken to be the general expression of an asyzy- getic form. This idea is easily generalizable to the case of any number of binary forms. Stroh's form of seminvariant being

— , (a-fix + "^a^a + • ■ • + "tf^s + 7" A + 7-2^2 + • • • + f«^« + "iTi

+ Us72+- + <'9"7r)'". the first case to consider is 6 = \, fl' = l, fl"=l, leading to the con-

dition (riTiUi=AiBiCi=0, where Ai + Bi + Ci=0. We have a choice of six products for our base, viz.,

BJC,, Bfil, AJC,, Afil, A^B,, A^BJ,

*and these yield respectively **

^ I a„(lVl)o|,I «o(l)im»l, I mA (l)o I , I (l)»6o (l')« I .

I maWi »o I . I (m^\o, I ,

Taking the product AJB and the corresponding form we find

I (1)1(1)6 ho- I (1)»(1)6 I 01+ I «o(l)6 I "2

*= («2*f – 3«A)<'o – (»i*i – ^<'^o)*

the generator

(1-2)-

, being

Similarly for 4 binary forms the simplest perpetuant, of degrees

1, 1, 1, 1, is (corresponding to product AjB^C)

I {l%m»Wdo I ; and has the expression

+ diibiCid^ + 2b^ffli – h^dg + Sbfydg)

+ a^hQ&id^ — b^CffiL^ + ^b-^c^^ — ib^f^^ + b^^^ ” S&gCo^^a)

+ ag{ — Zb^idg + Zb^Cffilg — 3biCjd2 + 6b^^2 ~ ^29i^x + 36gCo(2i)

+ a^(&bffi^2 ~ SftjCorfa + 46j(jj^i — 862^0^1 + &2“i”o ”” 36sCoSo)

+ a^{, – ihb^d^ + lOJiCorfi – 5b-fijd^ f lOijC^o) ‘

+Oj(+ IS&oCicio – ISJiCo^o)-

V. Eestkictbd Substitutions,

We may regard the factors of a binary n” equated to zero as denoting n straight lines through the origin, the co-ordinates being Cartesian and the axes inclined at any angle. Taking the variables to be x, y and affecting the linear transformation a!=XiX-l-(iiiY,*

so that

Y y

Xi+MiX

lh-lh.~

it is seen that the two lines, on which lie {x, y), (X, Y), have a definite projective correspondence. The linear transformation replaces points on

lines through the origin by corresponding points on projectively corresponding lines through the origin ; it therefore replaces a pencil of lines by another pencil, which corresponds projectively, and harmonic and other properties of pencils which are unaltered by linear transformation we may expect to find indicated in the invariant system. Or, instead of looking upon a linear substitution as replacing a pencil of lines by a projectively corresponding pencil retaining the same axes of co-ordinates, we may look upon the substitution as changing the axes of co-ordinates retaining the same pencil. Then a binary 7i°, equated to zero, represents n straight lines through the origin, and the x, y, of any line through the origin are given constant multiples of the sines of the angles which that line makes with two fixed lines, the axes of co-ordinates. As new axes of co- ordinates we may take any other pair of lines through the origin, and for the X, Y corresponding to x, y any new constant multiples of the sines of the angles which the line makes with the new axes. The substitution for x, y in terms of X, Y is the most general linear substitution in virtue of the four degrees of arbitrariness introduced, viz., two by the choice of axes, two by the choice of multiples. If now the n" denote a given pencil of lines, an invariant is the criterion of the pencil possessing some particular property which is independent alike of the axes and of the multiples, and a covariant expresses that the pencil of lines which it denotes is a fixed pencil whatei^er be the axes or the multiples.*

Besides the invariants and covariants, hitherto studied, there are others which appertain to particular oases of the general linear substitution. Thus, what have been called, seminvariants are not all of them invariants for the general substitution, but are invariants for the particular substitution

Again, in plane geometry, the most general equations of substitu- tion which change from old axes inclined at u to new axes in- clined at u'=/3-o, and inclined at angles o, ;8 to the old axis of X, without change of origin, are

sin (m – a)Y , sin(tj-ffl^,.

X= ; AH r-' X ,

sinu

sin (3.

sin u sino„ y=—. — A sin 0)

sinu

a transformation of modulus

sin(i> sinu' The theory of invariants originated in the discussion, by Boole, of this system so important in geometry. Of the quadratic

ax^ + 2bii!y + (yi/\ he discovered the two invariants '

ae – 6", a- 26 cos a + c, and it may be verified that, if the transformed of the quadratic be

*AX2-|-2BXY + CY^*

\ sm u /

A – 2B cos u' ^ C= I . " I (a 2b cos u+c). \sinuj

The fundamental fact that he discovered was the invariance of x^-^2cosaxy + y^, viz. —

x^ + 2coauxy + y^=X' + 2eosa'XY + Y'^, from which it appears that the Boolian invariants of aa? + 2bxy + y" are nothing more than the full invariants of the simultaneous quadratics

ax^+2bxy + y', x^,+ 2 cos 01 xy + y%

the word invariant including here covariant. In general the Boolian system, of the general »", is coincident with the sim- ultaneous system of the «*" and the quadratic iB^ I 2 cos uxy + y^. _*

Orthogonal System. — In particular, if we consider the trans- formation from one pair of rectangular axes to another pair of rectangular axes we

obtain an orthogonal system which we will now briefly inquire into. We have cos w'=cos (ii = 0 and the sub- stitution

aji = cos ffXi – sin OX^ ,

a!2 = sin ^Xj H- cos SXj ,

with modulus unity. This is called the direct orthogonal sub- stitution, because the sense of rotation from the axis of Xj to the axis of X2 is the same as that from that of Xi to that of x^. If the senses of rotation be opposite we have the skew orthogonal substitution

a!j = cos SXi + sin BX^ ,

x^ = sin flXi – cos 9X2 ,

of modulus – 1. In both oases -=— and -=— are oogredient with Xi and X2 ; for, in the case of direct substitution,

d . d . a d

3— =cos 0-p – sin e-j^p ,

€iXi uA^ UA2

d . „ d „ d

-J— = sin e^^ + cos e T^r ; ax^ uA^ aA2

and for skew substitution

d . d , . „ d

d^r'°'dx,-"^^dx,'

d . .d

dX2 uAi

cosff

a!X.,'

Hence, in both cases, contragrediency and cogrediency are identical, and contravariants are included in covariants.

Consider the binary m'", {aT,Xi + a^"=a^, and the direct sub- stitution

Xi = \Xi — /tX2 ,

Xi—nXi+XXz,

where >?+ii?=l ; X, /t replacing cos 9, sinfl respectively. In the notation

observe that

Suppose that

is transformed into

o»=aia!i-l-a2a'2)

aa.=al + a\, aft=ai6i-{-a2&2'

ai = Ja:=Ci=...

■A'X=Bx=Cx=---

then of course (AB) = (aJ) the fundamental fact which appertains to the theory of the general linear substitution ; now here we have additional and equally fundamental facts ; for since

Ai=Xai-t-/«i2, A2= -jM!i+\ni2, Aa=A; -l-Ai = (X^-l-^2)W +ai) = a„ ; Ab = AiBi Ɨ AgBa = (X^ + ij?){aibi + aM) = at ; (XA) = XiA2 – X2A1 = (Xa!i - F itXi){ -1M1 + Xa2)

-{-IKC1 + \X2){\ai + /KOa) = (X^ ɨ ju,^)(a!ia2 – x^fii) = (m) ;

showing that, in the present theory, «„, at,, and (ajo) possess the invariant property. Since x\+xl=Xx we have six types of symbolic factors which may be used to form invariants and co- variants, viz. — I

(06), flSa, aj, {xa), ax, Xx. The general form of covariant is therefore

(ab)\acfXbc)..a^b^c^...ai'<^^bt- xixa)%b)\xc)\..al}b^c^...x:

X (xa)\xb)\xc)\ . . a|b|c|. . .x™.

If this be of order e and appertain to an nf"

*Si+Si + 2m=6, ki+}i2+... + 2ii+ji+j-i+...+ki + li=n, hi + h3+... + 2ii+ji+js+... + k2+li=n, ^ + ^3+ ■•• +2i3+ia+J8+ ■•■ +*s + ^3=» ;*

viz. , the symbols a,b,c,... must each occur n times. It may denote asimultaneous orthogonal invariantofformsof orders »i, »2, »s,---> the symbols must then present themselves ni, n^, 713… times re- spectively. The number of different symbols a, b, c,... denotes the degree 8 of the covariant in the coefficients. The coefficients of the covariants are homogeneous, but not in general isobaric functions, of the coefficients of the original form or forms. Of the above general form of covariant there are important trans- formations due to the symbolic identities : —

(aby=aaib – o? ; {xay=a^x " "I '>

as a consequence any even power of a determinant factor may be expressed in terms of the other symbolic factors, and any uneven power, may be expressed as the product of its first power and a function of the other symbolic factors. Hence in the above general form of covariant we may suppose the exponents

hi, ?i2, hi,...ki, k2, ks,...

if the determinant factors to be, each of them, either zero or unity. Or, if we please, we may leave the determinant factors untouched and consider the exponents Ji, h, js,---h, h, h,--- to be, each of them, either zero or unity. Or, lastly, we may leave the exponents h, k, j, I untouched and consider the product

to be reduced either to the form g'g where g is a, symbol of the

series a, I, e,... or to a power of Kj.. To assist us in handling the symbolic products we have not only the identity

{ab)Cx + (ic)osi + {ca)bx=0 , but also

{db)Xx + {bx)ax+ {xa)bi — 0 , (oi)ac + (bc)aa + (,ca)ai = 0 ,

and many others which may be derived from these in the manner which will be familiar to students of the works of Aronhold, Clebsch, and Gordan. Previous to continuing the general dis- cussion it is useful to have before us the orthogonal invariants and covariants of the binary linear and quadratic forms.

For the linear forms a^ + aiX2=ax=bx there are four funda- mental forms, __

(i.) ax=a^ + OjX^ of degree-order (1,1), (ii.) Xx=xl + xl __„ (0,2),

(iii.) (xa) = aiXy-a^ „ (1,1),

(iv.) at=al + al „ (2,0),

(iii.) and (iv.) being the linear covariant and the quadrinvariant respectively. Every other concomitant is a rational integral function of these four forms. The linear covariant, obviously the Jacobian of ax and Xx, is the line perpendicular to ax, and the vanishing of the quadrinvariant osj is the condition that »« passes through one of the circular points at infinity. In general any pencil of lines, connected with the line »« by descriptive or metrical properties, has for its equation a rational integral function of the four forms equated to zero. __

For the quadratic a^l +20^X1X^+0^1, we have

(i.) al=a-^x[+2\x^x^+a^^,

(ii.) Xx=xl+xl , (iii.) {abf=i(fiifli-al), (iv.) a„=ao + «2,

(v.) {xa)ax=ariX\ + {a2-a^)XiX2-aryX. This is the fundamental system ; we may, if we choose, replace

{aJ>f by al=a^^ + 2a\ + a\ since the identity a^i-al={aVf shows the syzygetio relation

(oo + a^f – (fll + 2al+a,l) = 2(a^2 – af). There is no linear covariant, since it is impossible to form a symbolic product which will contain x once and at the same time appertain to a quadratic, (v.) is the Jacobian ; geometrically it

denotes the bisectors of the angles between the lines a|, or, as we

may say, the common harmonic conjugates of the lines a| and the lines Xx. The linear invariant a« is such that, when equated to zero, it determines the lines o| as harmonically conjugate to the

lines Xx ; or, in other words, it is the condition that o| may denote lines at right angles.

To resume the general discussion we recall the relations Ai=:\ai+ /M^ , A.2= – iMii + \a2,

and put \=\=ii^;=ii.=\2=-lh;

so that Aj = 01;^ = (ttju) ,

A2=a!|^=(Xa),

Ah=\ \ = “K %

= (a/i) <»^=a;i (Xa) =(aw (Xa)

*A^=^a^X^ + a^XX = {(a^)X^ + a^X^*

= {a^X^ + (\a}Xy= { {an)X^ + {\a)X^y ;

four forms |0f expression.

The polar process is available here to an enhanced degree. For put

we not only have

but also

Jy ttg; Uyf

*and j ust as the substitution of Xi + ty^, X2+ 1/2 fo' "Hi * converts ax into ax + tay, the same substitution converts (xa) into (xa) + t[ya), and the symbolic power*

{(xa) + t{ya)}"

Taa,y be regarded as the generator of polars of (aa)". Note also the results

where

1 / d\ m m-1, .

*d d f d\ f d *

y^d^-y^d^=\yTxr~\d^y)'

indicating processes analogous to the polar process by which o™ is converted into a™~ (yaf, {xaf" is converted into (ara)"'" ay

Combining the processes we fi'nd that we are in possession of a process, equivalent to a compound partial differential operation, by which o™ can be converted into a"^ Oy (i/a) , and one also by which (ara)" can be converted into (xa) ^ ^a-.

We already know that the polar Oj, Uy satisfies the partial differential equation of the second order

and the performance of the operation

*1/8" _ 9' *

(m-k)k\dx^2 3^82/1/ has been termed the 0 process. As regards the now forma Mi=aj (W ,U2=(xa) ay,

*Afc-1_*

dx^dy; dxidyi dxSV'.

= (m-k)kax~ ~ (ya) ~ (-a^a^),

I i-tl^ \U-fc-l fc-1

= (n-k)k(xa) Oy ajO^,

= (n-k)k(xa)

»-fc-l fc-l

a„ (– OiOj) ,

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we find that they hoth satisfy the partial differential equation of the second order

and the operation indicated occupies the same position in regard to the new forms that the fi process does in regard to polars. Gordan finds it convenient sometimes to denote the ii operation

by I J I ={!isy) symbolically. In the same symbolism the new

process 0 is denoted by Xiy-^ + Xfiy2=x,.

*Let 0(/) = (‘-i+J^^*

the operand being any form p^g^.

Then and thence also and thence

OarW=(a6)a™-\j,J)»-S .0“a:iyhf={abfa::%if”’,

0(M!)X = («5)”(™r”X”*’*

which should be compared with the result

Ok mill f ,Jc m-fc-ii-A:

Moreover, it is easy to see that (a!as)’”(^a)” satisfies the 0 equation, and that

O(a!as)’»(y5)”=(o6)*(a!o)’»-*(yft)»-*.*

We may catalogue results as follows : —

O Uxby

Oh Wi-t/ti axOy.

ax (fiy)

(aa;) by

“k •m.-k-ra.-‘k

= a^g. Oy ,

= (a5) Sj, {yV) , ‘ = (o5) \wx) by ,

a\xaf{:ybf={abf(xai

Ok/ \7tl/ i\7E JCr -.Wi — TC/ -.xtl — h

(ara) (3/6) =06 (am) (j/i)

The important point is that we always obtain symbolic products when we operate with i2 or 0 on symbolic products. It is clear that we may write

Ex, gr. To find all the polars and co-polars of fli|j|=F («„ + t^il/a) + tfyy = o| + 3a%(i)«j + 3»|a/j + Sa^yaftl + 6a^{yajayt^t^ + Sa^y^l + (yaftl + Z{,yafajjt\t^ + i{.ya,)a^^f^ + o|<». (j>x + UV)\ + 2M!/«2

Multiplying and applying the formulas

^y”=^Uybf+^V>J.ya){yi)+yMy’i)

112 1

*6**

-Eyo=laJ,ya)\ybf + li^{ya.)\yb),

3,

(^O^a^iybf

Je I m-k-l-.n-k-l

= {ab) ojoij = (-) OjtaWOj.

{yb1

n~k-l

‘.m-Tc-hn-h-l

0,1

*0*0 W)X =(-)‘4(aJA’»’) ..J,*

foreshadowing an extension of the process of transveotion which will be reached later.

*The co-polar processes, by which a^ is converted to a^ iya) , and (xaT to (xa)’~*ay, are rej(resentable by writing x -ty , as+ty^ioT x^,x^VD. al, &-ai.x^+ty^,x^-ty^ioix^,x^ia*

and (xa)” becomes

{(a!a) + te„}».

*The combined polar and co-polar process on. os” can be obtained by writing a^ ⸗ (yt) , Kj -H j/, for ajj , ajj, and expanding in powers of ti,h; for then asa; becomes Oj Ɨ «i(yos) Ɨ Ufly, the »** power of which generates the functions ; similarly if the function be (asa)” we can substitute x-i_ + ty,Xi + {ty) for Xi,Xi, converting {xa) into (xa) + h{ya) + t^y, and the »’* power generates the polar functions. To find the polar and co-polar functions of the product*

write F^’j>r+»-‘_‘S .

This, obviously,. arises from^™ when we write a!i ŧ (j/), x^ + y^ for a!j and x^ mp^^’^, and take the co-factor of (^Qt^t^- Since*

{Px+h{yp) + hPyf-^={a:^+h{ya)+t^y)’iJb+Uyb) + t^y)”,

(¦;)F^”^=ooefficient of t^t^ in the product (a/+ h{ya) + tiHyf^ifix + Uyh) + hiy)”-

+ j^^7fly^y«’)\yi), +-^b^y,ya)(,yb),

Q O Q 1

F J’ ‘ = Jo»a:fflj,6|(2/a) + j^^p,/yb) + j^b^p/ya) + ^b^y^yb) ,

^l”’={y’^nyif.

F5,”’=5a|6|(3/a)-H^|6j,(2,6),

Fj"=o|5^.

Of any order, fei+fcj=fc, there are i-l-l polars corresponding to the binary compositions of k. It will be remarked that the sum of the coefficients of the terms of the polar is always unity. A term, without its numerical coefficient, is termed a member of

the polar. If we take a member of the polar Fj,"^ and put in it 6= a, we obtain ay iya) , and this is exactly what we obtain

on putting 6= a in F^'; hence, making this substitution, we find that the sum of the coefficient of the members is unity. What we may call the-

*ieading membe of F^" *^, where F=b™J" involves Aj factors of the kind {ya) or (yb) ; say {ya)hi{yb)hi where k^i + ki,i=ki ; and also ti^ factors of the kind «„ or by say Oyby where ^31 + ^22=^3. So the member may be written*

a^^-HT^-^a^b^yaf^ybf^. We may arrange the members (i.) in descending order as regards the exponent of a^ ;

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f^-.) ";"> descending order as regards the exponents of bg and (ya) ; (m.) m ascending order in regard to the exponents of ay, (yb), and u if ^^® ^^^^ ^^^ notion of adjacent memhers, and we can show that the ditference between any two adjacent members is either divisible by {ab) {xy) , {ab)x, or {ab)y„ and the theory of the po^r members may be proceeded with in the nsual manner.

The process of transvection can be extended in the same way as the polar process. Of two forms

we define the transvectant of orders k, I to be

and similarly

"x>K^i') } =(-) as(a6)aa, (xb) ,

*(xa) ,6j,J- ={-)a (,ab){xa) b^*

\[aa) ,(xo) j- ={ab) ai{xa) (xb) ;

and if the forms be ‘p7,f’^,

K^x’Yx) ={H) ^x fi ;

and similarly

and the intermediate processes also in the same way. Taking as before /=au , = b^, we find that the process of transvection of order i + Z is equivalent to the performance of the differential operation

/ 3/ 3^^ 5^ 3^\ Y 9/; 3^^ 9^ 80 y.

X^x^dx^ dx^dx^J \3a!i9a!i BajjSajj/ ‘

omitting a mere numerical factor. The multiplication of opera- tions is, of course, symbolic, so that

We will now give some examples of transvectants. MB.gT.i{f=al,4,==bl (/,0)»’»=o|| (/,^ = (a,,*! – a^a)xl + (a^^ – a^o)XiX2__*

*+ (oifta – »2*i)^l >*

|(Qll6l + fl!A)a!|,

*(/■, 4,f”>=(abf=a„\ – 2^\+a^b„ , ifl’Pf’^— (0SJ)0S6 = (toftl – 01*0 + «1*2 – “a^i ,*

(f, 0)”’ ^=ai§=0(,J„ + 2aiFi + OaFj ,

five orthogonal concomitants of two simultaneous quadratics

obtained by simple transvection. If a, b be alternative symbols

(Jtf’f’” and iftf’f’^ vanish identically, and we are left with the

quadratic covariant

{/,/')" '^ = {al+a\)xl + 2(aoOi + a^^)xj3^ + («! + oj)a!2 ,

and the two invariants

We may proceed by transvection from the forms (ara)^, and {xa,)K Observe that

(xa)a,x=aixl – ((to – a^!'!'!'- CtxI ,

{xaY=a^l- 20^X1X2+ a^l ; thus

*{{xaf,blY"^=aii?m)bx = (a^a + a^i)xl – (ao*o – a.i^ii'ihP'i – ("0*1 + a^iP^l *

{ {xaf, bl] ' ' = – (ab){xa)bx = -\ (flSi&i – a^^)xl + (– a(|6i + Oiio + a^b^ – a^^)x^ +

{ (xaf, (xbf } ^ ' " = (ab)(xa)(xb)

*= (^ij – a^i)2!f – Ms – «s6o)a^i'K2 + («o*i – «^a>l ; where observe that this form is obtained from (ab)aj)x by writing -x^,Xi in place of aJijXg, a process which is always invariant. From one covariant we can in this way always derive another of*

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the same degree -order. To see how this is take the linear operator

3 3 / 3

and further the operator of order k

obtained by symbolic expansion. Then

so that

and

(

f„^\ -“_ “! , -Jc n-k

“dxj (‘»«) = (–) (ir^(^) »« ‘

(-

Hence the operation of writing -x^, x^va place of aj^, X2 in any form ax or (xa) is, disregarding a numerical factor, equal to the

performance of (x^ j , an operation of order ■». Hence, when this operation is performed upon any symbolic product

(xay(xby. . ~~a^x~~ • • of order n in x, it effectively produces

^A-MXxby…

The operations

(4),(“‘l)’-(=“l)”

when performed upon a^ or (aja)” produce the n + 1 covariants,

of order n,

n f \ 71-1 / •,2 71-2 / sv, Oj, , (wojaa, ,(xa) a^ ,...{xa) ;

which we may conceive to be generated by the expansion of {a^+^xa))” • that is to say, by giving, in a^,a-i,a2 the incre- ments + Xa2> -‘^<»i) respectively. We have a relation connecting any two quasi-adjacent covariants of the series, for since

{xaf

-2»-p-H2

+ {.xafa^ ”=aJ.xaT fli”~“a!j.;

which shows that the sum of every two quasi-adjacent covariants contains the factor UaXx- The identity obtains whether n be the order of the original form or no. From it may be derived others of the kind

2/ •,0-2 71-P-2 2

These relations indicate that these covariants do not constitute a fundamentally irreducible set of covariants ; for the covariant

ajjsaf oj ‘kj;, is the product of aJ,xaT~ a”””, Xj. each of which is a covariant; and similarly aaixaf’ a^”””” a;^ is the product ofaj.xa)”’ aj”””” and x^, each of which is a covariant. Between the n + 1 covariants we can establish n-1 independent relations giving 71 – 1 reductions ; the system is therefore reduced

to two forms which we may take to be a^ and (.xa)aj. ~ . So also, in regard to any covariant x> ^s need only consider the further form {x)x~ >

A process, somewhat similar to transvection, may like I at-) be performed upon a single form ; this is

3a!?”‘“3a!i~3a!».

dX

in analogy with the notation a;| +xl =Xx. We have

2!V3a!;^3a;i/”».-^2>o» > a covariant of degree-order 1 , ?i – 2.*

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While, in general,

\dxl ■ dxlJ ^^> -{n-2kyM’^’ To these results it is useful to add

Hx. gr. from the quadratic a% we derive

aa=al + al = a^ + a^,

from the cubic a| the linear covarlant

anil ={.%-¥a^x^ + {fl^ + a^x^,

and from the cubic covariant a%{xa) of the cubic

a„(m) = (oi + aj)!! – (a„ + a^x^,*

a linear covariant -otherwise obtainable by operating upon aijUx with

3 9

Similarly, from the quartic a%, we obtain the quadratic covariant

and the invariant

It has been shown, by Sylvester, that all orthogonal covariants satisfy the partial differential equation

f3,-9 31 3 3.

- r»‘3^+(”)«++»“Ss;;rj +’^^-‘g=°’

which, in the notation employed in a previous page, is

If then a covariant, of order e to an ra’, be*

the operation produces

Ic the vanishing of which necessitates the relations which, writing Oa-fio=V, take the form

Ci – VC„ =0, 2C2-VC1 – eC„ =0, , SCs-VCa -(e-l)Ci =0,

2C.

=0;

eC,VC,.i and thence

Ci=VC„, 2C!,= <(V»+l) + (e-l)}Co,

4!C4=|(V” + l)(V= + 9) + 6(e-3)(V2+l) + 3(e-l)(e-3)}Co, 5!Cb={V(V + 4) (V2+16) + 10(6-4)V(V” + 4)*

+ 15(e-2X£-4)}Co;

indicating the manner of obtaining the successive covariant co- efficients when once the leading coefficient Co is known.

Ex. gr. Taking as leading coefficient a%, the order of. the co- variant is 2n – i, and the three first terms

/■ 2 , „-2 , -2\ 2n-4

+ 2(n-2)(a,oai + 2aia2 + a,

+ (™ – 2) {‘(ra – 2)(af + 2a| H- 03) 4- (w – 3)(aoa2 + 2a “3 + <»2«4) }

2n-6 2

XXi X2

+ ....

It may be gathered, from the above relations, that, for covariants

of orders 0, 1, 2, 3, ,4,..., the leading coefficients Co satisfy the

equations

VC„=0,

(V»-l-l)C„=0,

V(V” + 4)C„=0,

(VHl)(V2-i-9)Co=0,

V(V2-l-4)(V»-H6)Co=0,

resp^tively. It is thus important to notice that for each order

of covariant we have a special differential equation. We can infer from the annihilating operator V(V2 + 4) for covariants of the second order that the function (V^ + 4)Cois an invariant of the same binaiy form.

ZSb. gr. For the binary quadratic (»|, a^ is the leading co- efficient of the form itself, a covariant of the second order, and as a consequence the operation

13^0 “”

.„A_2 -3. “301 Boj

+ i

when performed upon a„ must produce an invariant ; it, in fact, produces the invariant

K% + %)- The annihilator, in respect of a covariant of order 2s, is

V(V2+2»)(V2 + 4”)...(Vi^-H4s2); and if the order be 2j + 1

so that, in general, the operation V^ + e^ ifpon a leading co- efficient of a covariant of order e produces a leader of a covariant of order e – 2 appertaining to the same binary form, and this must necessarily be of the same degree in the coefficients.

Sx. gr. From the Hessian of the cubic a%, viz., (abyaj)^, we thus obtain the invariant

It will be noticed that a source of a linear covariant is annihilated by V” + l.

TheBooliam System. — The form is a”=(o K^-l-ajB^)”, associated

with the quadratic !i^+2coawx^ +x^. a^ is transformed to

Aj. = (AjSIj + A^x^^, by the substitutions

*aiu{u-a)^ sin(M-/S)^*

X2=

-Xi +

sinu sin;8

^21

of modulus-: : wherew’ = S-a.

sinu

The problem is to find functions of the original coefficients,

variables, and a, which by the transformation become the like

functions of the new coefficients and variables and u’, save as to

a power of the modulus, a^ and {ab) clearly possess the invariant

property.

Put osi — 02 cos ti) = ij – Jg cos (I) = . . . = Oj — jSj = . . . ,

*a2~’*iCos 07=62 — &i cos w=...= 02=^2=”’ a!iH-a:jC0S(i)=li,*

• !B2 + !BiC0Stt) = {j,

where oj, a^; ft, p^,... are new umbrse and li’, I3 are auxiliary variables.

Let the transformation convert Oj, 02 into Aj, Aa, where

Aj = Ai – A2 cos ci)', Aj = Aj – Ai cos «', and fi, Jj into Si, Sa, where

Observe that Now

Si = Xj + Xj COS u' = cos O a!j Ł cos (u – o)K2J

S2 = Xj + Xi cos w'. = cos /3 asi -f cos (« – jSJiRj.

i^^!hSi+x^i=xl + 2cos'UiXiX2+xl.

„ sinS sin(w-S)

smu ^ sinw ^" yr sino sin(w-o)

A2= r- — ;»!, H V – ,- a!o,

sinw ^ smu "

, sin(w-o) . sin a

Ai= — ^ 'a, + —. a„,

smw ' smw

A,=

sin (w – B) sin B sin bi sm u

-sinw', , , , .

whence it can be shown that

(XA) = X1A2 – XjAi = Xi(A2 – Aj COS a') – Xz{A, – Aj, cos w') sinw', , sm

from which we learn that {xa) possesses the invariant property. Further, it may be verified that

, /sinu'Y . /sinw'N"

so that a„, a^ possess, each of them, the invariant property. There are thus six invariant symbolic factors, viz., (ai), o„, a^, (aia), Ox, x^ ; and from these types we are able to form invariant symbolic products. We must note the results—

(?a) = {xa) ; oj = sin" ua^ ; (oj3) = sin^ w(aJ)

*(kI) = cos a{xl – xl) ; {aa):= cos w(aj – ap. Since sin^*

{ai)\ac)\bc)..a'^hj^c^..4^ay:;...

x(.xa)\xp)\ary).Jib^c^...xf,

which should be contrasted with the corresponding expression for orthogonal invariants.

If this be of order e and appertain to an 7i'°

Xk + Xl + 2m=e,

the pair of symbols a, a must together appear n times ; so also for J, ^; c, 7;...

We have the symbolic identities

a^Xf- {xa)^=a^f = sva?u a| ; {ab)c^ + {bc)a^ + (ca)i^= 0 ;

and many others, derivable from these, which are of assistance in the reduction of symbolic products. We may give here some simple examples of Boolian invariants.

JEb. gr. For the linear form ax=bx= ... , we have

(i.) ax=a^ + aiXi, (ii.) a!f=a!j+2cosciia!i!B2+a!2 , (iii.) sin^w,

(iv.) (ao) = (oj – a„ cos ajx^ – (a„ – a^ cos (D)a!j , (v.) ap=a^-2a^i00su + af. For two linear forms (v.) yields the simultaneous invariant

*ao*o + "1*1 – cos w(aj4j +'a^„) . For the quadratic form fli|= J|= ... , we have the system*

(i.) <4, (ii.) a;^, (iii.) sin^w,

(iv.) ^{ai)"=a^2-'^i,

(v.) {xa)ax=(cii – flSo cos"w)a!f + (02 – «o)"a'"'2+ (<% cos u – oja;! ,

which is the Jacobian of a| and xt ;

(vi.) flS„=aQ-2cos wdj + a.^;

and it may be shown that all other covariants are rational integral functions of these six forms.

Again, take the quadratic a%=h%=... and the linear form

aj=6j.= ...; besides the forms, appertaining to the linear form and quadratic separately, which have been already given, we have four additional forms involving the coefficients of both forms, viz. : —

2 „ __ 2

(aa')(flV)=a^^ – 2a^a^a^ + a^^,

-J -i-i ~ – _?

a'{aa') = (a – o„ cos u) a^ + (a^ – a^a^a^ + ifl^ao% a – a^t^,

(aa')ax = (a„aj – \a^-P + {a^a^ – «2«oK' \xa){aa') = { a^^ – a^„ – cos 0, {l^^ – a^^)x^ – {o„aj – ajO, – cos u (^^^ – a^^]x^.

(See Elliott, loc. ait. p. 366). , ^ ,

The polar processes must now be examined. We have, i/j , 7/2, being oogredient with f 1 , fj ,

(m-^/ 3

(m-i)!/ 8

*•x ‘*y>*

f(v.|H-.)’=(.a)»=(.a)™-V)

{m^ky.f 9 , ^ 8 \fc m m-J; fc ml '“8^ + “28TJ««=” «*.*

-i (‘“9|+”=84)‘W”=W™“V)”.

,\m / \m-/[/ \J;

(m-fc)!/ 8

(w-;i;)!f „ / 3,3 ^l’’ m m-k, .k jn \™ “V‘35 ” ^^Wi) i “« =”’ ^^””^ ‘*

*(ro-^)!/ 8 8 * m m-k, ,k*

(m-lcy.f_,_^ / 8 8 \k m m-S; k

from which it appears that, as regards a™, we need only consider the operations

*8,8,33 *

and, as regards (aai)”, only

3 ‘ 3 , 3 3

and we have the processes

(m-fci-^a)!/.. 8 8 \)fci/ 3 3 \«^ „

__ . — i‘^+3’j i”’-“^^; »”

(w-Ai-^a)!/ 8 ^ 8 \ii/ 8 8 \fc2, ,m

*= (aa!)’”,/del>*2(a2/)*ia.*

The two forms o™ ” a^, (ajo)” ” “^(i^o), satisfy the partial differential equation ♦

”’ i_ 8°%

dxfiy^ dxj^yi

-0;

and the two forms o™”’(2/o)’,(a!a)™”*a^, the partial differential equation*

dxfirii dx^2 ‘ to verify this statement recall that

*(yo) = (17a) , u,| = sin’ wftj, ■ Taking, as operand, any form a™~*6* we write*

*n- ^ /^ 8′ 8^*

*(to – A)A \ dx^^ dx^iii J ‘ O – ^ / 3° 1 8^ \ *•” (to – k)k\ dx^dvi dx^V2 J ‘*

and we can establish the relations

Q\0^am^”’

a^0^a^[y§r=[-)\ab)X}a’—‘-%pr-”^-

D%^(xarb;={-fyab)%f{xar-‘-S;’

*(fi cosec 2 u,)%^(.xar(ypr=(,ab)\f(xa.r ” ^^ ” %;8)» ” “^^ ” *2.*

From these relations, by putting y=x, we derive the processes of transvection, and we may write

(a':,b^y^"a -^S:/del>, [a^,(,xpf' -'=a' -"'=a}{ab)\x«.r- 'S2- -^, {(xaf',
(xpr" ={ab)\}{xa/- '-\xpf' ^.

Of order Ar=Ai + i2 there are k + 1 transvectants, and Jc may have any value not greater than the least of the numbers to, n.

The process is practically equivalent to the performance of the differential operation

\8a!i8a!jj ^dx^J V8a!i3fx die^'S^i) '

the multiplication of operators being symbolic. We have next to consider the operation

S. I. — 40

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*{'%) '^~'^' "^P**" '«r= (sin' m) ""al* ; we find*

(a!a)=-

.•. Calling the operation

*when performed upon a™, P, we have V^a^-imafa^"^*

P IS, in fact, 4^sm "(oa^-^yj .*

the operator being expanded symbolically. Similarly

-a. (ajo) ;

(-r

Hence

(3

^, ,7» , ,i»-I; ft*

(iBo) =(a»> (jj,.

has the effect, practically, of converting a™ into (aa)”’ ; this can (be otherwise accomplished by writing x^tX^va. place of x^ , x^, and changing a into a. (ajo)” is similarly converted into Oj, , only here a is changed into a. If the operand be o™” feo) it becomes converted by the operation into {mf” a^ The co variants of the series (xa) a^ ~ are all reducible except a^ and (a!o)oj, ~ , as may be seen from, the identities*

= (!i!a) Oj, -[sin woj + liBo) I

/■ \ft m—k-2 =a^{xa) a J. x^ ;

which exhibits the reduction of (jxa) o™~ ~ . Next consider the operation of

8"

upon (Jj. and (au) sin” w I*

“We find

*Vaa!iati”‘“3ar5,9fJ “^ -(OT-2ifc)l”»”»^*

fc m-2fc

/ cP ^ d^ \K .m [dx^d^^’^dx^ij^’ ~

(ni-2fc)!

ft/ \m-2ft ffl,(a!a; ,

*„-„2t / S” , 3" * m-1, > (m-1)! ft m-2&-l/„„’, V3a!i9li BiKjOls/ * (m-2k-iy. ” **

Before proceeding to give examples of these processes it must be observed that th? transveotant

is always reducible where k^ is even. This arises from the symbolic identity

sin ^ u {abf + a| = ajt^ ; for, thence,

/ 2 m-4N/,2,»-4

with similar identities which establish the theorem. Hx. gr. Consider transvectants of a% over 6j

(a|,J|>'»=(aJ)«|6|.

(ffl|, i^)''=apa*6| ; which, for the single cubic a| gives*

(a" -2abcoau+ h^);^ + i {db – {ac + IP) cos a + lc}s?y

+ 2{ac + 2J2 – ((K« + 56c) cos u + bd-^ 20^} a;y

+ i\be-{bd +

+ {(?-2edcasw + d!')y,*

which is unchanged when a, b, e, d, x, y are changed into d, e, b, a, y, X respectively.

(a;|,6j)^'i=(oJ)a^aa,5aa which vanishes for the single cubic,

(aj, Jj)'''a; which for a single cubic, is

2{{ac-V^) – {ad-be) cos u + {jbd-^,).

((4,6|y'°=(oft)a|; which vanishes for a single cubic, but, for two cubics, is

ab' – ba'+%bc' – cb') + (cd' – de')

- 2(ac' – ca' + bd' – db') cos u

+ (fld' – da' + be' – c6') cos ^ u.

(ffl|,i|)''''=oJ which, for a single cubic, is

' a»-(-3J= + 3c2+(^-6(aJ + 26c+cd)oosw

+ &{ac + b''+bd + e^)cos^w-2(ad+Sbe)ooa'a.

Again, the linear covariant e^flix is

(a, – 26 cos ii) + fi)!!! + (6 – 2e cos (1) + d)2/ ;

and the linear covariant aj.xa) is

*{6+(Z- (a + 3(!)cosai + 25cos^6)}i8 – {oH-c-(3J+ci)cosw+2ccos*w}5f.*

An invariant of the cubic which is of the fourth degree in the

coefficients is

which is derived from

{ab)\cdWaeyifid)

by an obvious method of universal application. Generally, from any covariant given by its symbolic product in the theory of the general' linear substitHtioB, we may derive a conjugate form by writing m» for (mrs) and (a/i) for m^, and we are permitted to do this whether or no the former ultimately vanishes ; the conjugate cannot vanish. In the general Boolian theory, in any symbolic product, we can pass to a conjugate form by writing

Mi„ for (mn), (mm) for m^, {x/i) for ntj., m^ for (aJ/t).

A form, containing only a^ or x^, will have no conjugate, and may be called a non-conjugate form. Other forms may have vanishing conjugates.

The differential equation, satisfied by Boolian covariants of

the binary form o^, has been shown, by Sylvester, to be cos

*nan^r^ + (« – 2)03-^*

_ 0 _ s /^ 1

+ {n-i)a3r^+ ... + (n-2)a„^x-= — + na„-^ \ ; ooj dttji-i can J

if then a covariant be

operation gives

Mso,Cix\~\ + Ck{l,e-k)x\~~\^^-kx\~^'^'x~'^}

•fKi a!2L.Cj;J = 0j leading to

- (fc (l)C+i Ł {L -H (e – 2A;) cos u} C* Ł (e – A Ł l)Ct_i= a, and thence to the series. of relations*

- Ci-I- (L + ecosoj) Co =0, -2Ca-f jL + {e-2).cosu}^Ci-)-e Co.=0, -3C3-l-|L-h(e-4)oo3(.i}C2-l-(e-l)Ci=0,

- 4C4 H- {L Ł (6 – 6) cos mJCs t (e – 2)C2= 0,

which may be written

Ci=CIi+ecos(i))Co, 2Cj=p-l-sin»a,t(e-l)(...)}C„, 6C,= {L(i;>-l-4 sin3w)-f-(e- 2)(...)}Co 2404= {(I/-1- sin» w)(L2 4- 9 sin»u) } (« – 3)(...)}Co.

Hence for leading coefficients of covariants of orders 2s and 2s -1-1

we have annihilators

LCLii + 2" sin" a>)(L" H 42 sin« oi) . . . (L»(- 4rf» sin" u) , (L"-H"siu"w)(L" + 3"sin"a)...{L=-l-(4s2-|-4s-H)sin'"u}

respectively. These conditions are necessary but plainly not suinoient ; for every leading coefficient of a covariant, of even order ^2s, satisfies the

first operator and, of uneven order ^2s-)-l, the second operator. We may say, however, that, if the order be 2s, either

(L=H^4s»sin'w)Co=0,

or else (L" + 4s"8in'(i))Cois the leading coefficient of a covariant of ev en order ^ 2s – 2 . Similarly, for uneven order 2s ~ 1 , either

{L"l(2s + l)"sin"«}C,=0,

or {L" h (2s 4 1)" sin ' u} Co , as the leading coefficient of a covariant of uneven order ^ 2s – 1 .

ALGERIA

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Ex. gr. For order 3 of the cubic a we find*

(L2+9sinau)ao=6(ao-2oicosa)+02), where oo— 2fflicos

It is to be remarked that the sources of linear covariants are annihilated by L^+sin u. It has been customary for writers to regard the orthogonal and Boolian theories as particular cases of that arising from the general linear substitution. The above sketch will convince the reader that the latter theory is more properly viewed as a particular case of the former theories. Investigations, connected with this section, are a desideratum. No references can be given Other than those alluded to, incident- ally, in the text.*

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Algeria, in North Africa, the most important of the colonies of France, lies between Tunis on the east and Morocco on the west, and extends from the Mediterranean to the Sahara. Its area is estimated at 98,500,000 acres, or 163,906 square miles. The principal indentations of

B. V.DarlnsAire S> O. J.R.HtmQtt!P Engl Miles ^

■0 100

Sekioh Map op Ai.gebia.

the coast are the Gulf of Oran, the Gulf of Arzeu, the Bay of Algiers, the Gulfs of Bougie, Stora, and B6ne. The ports are Nemours, Mers el Kebir, Oran, Arzeu, Mostaganem, Tenes, Cherchelle, Algiers, Dellys, Bougie, Jijelli, Collo, Philippeville, Bone, La Calle. Algeria is

ii.yjtirojjtjf French Territory ^^ French Protectonto I

Map SHOwnfo the Polttioal Position of AxaiBiA.

naturally divided into three parts — the Tell, or coast region, with a breadth varying from 76 to 160 miles; the high plateaus; and the Sahara region. The Tell is traversed by the first chain of the Atlas, consisting in

reality of seventeen distinct ranges, among which it is suflB.cient to mention the Tlemcen range (6500 feet), the Waransenis (6000 feet), the Tit^ri range (4900 feet), the Jerjera or Grand Kabyle range (7100 feet), with the peaJk of Lalla Kedija, and the Babor range (6000 feet). The streams of the Tell are the Tafna (106 miles), the Macta, formed by the Sig

and the Habra; the Cheliff (415 miles), the Isser (130 miles), the Sahel (125 miles), the Kebir (140 miles), the Seybouse (145 miles), and the, Mejerda, which flows through Tunis ,to the sea. None of these rivers is navigable. The temperature of the Tell is moderated by the sea-breeze, but the sirocco wind sometimes brings scorching heat. The climate is very healthy, except in the extreme coast region. The high plateaus form a plain of an average height of from 2500 to 3000 feet, dominated by the ridges of the second or Saharan chain of the Atlas, of which the chief points are the Ksour (6000 feet), the Amour and the Aurfes (7200 feet). At the foot and to the north of this chain, towards the middle of the plateaus, is a depression containing saline lakes or chotts,

of which the best known are the Chergui

Oxford igot a_^^ tj^g Hodna. The rivers are unim- portant; the temperature is variable, pass- ing from one extreme to the other, and rain seldom falls. The Saharan region consists of wide sandy or rocky plains without noteworthy features. The water in general remains under the siu- face; the temperature is very high by day ; rain falls scarcely in one year out of three. Life exists only round the oases or cultivated places. Geologically, the Atlas of the Tell consists of crystalline rocks, schists, and lias. The Tertiary formation hardly ever appears except in its eastern portion. On the other hand, the Little or Saharan Atlas is essen- tially of Cretaceous and Jurassic formation, like the rocks of the desert itself.

Population. — The population consists of E[abyles or Berbers, Arabs, Moors, Jews, Turks, Coulouglis, Negroes, Mozabides, and

1881.

1896.

Native

French and naturalized Other Europeans .

Total

2,850,886 269,502 190,014

3,847,448 334,713 211,535

3,310,402

4,393,696

Europeans of various nationality. The Berber population is estimated at 76 per cent, and the Arab at 15 per cent, of the

whole, but this estimate, due to General Faidherhe, is not easy to verify. The total population increased from 3,310,402 in 1881 to 4,393,696 in 189‘6. In those years the numbers of the native and of the European inhabitants are shown in the above table.

According to these figures, the native element increased by 28 per cent., the Prench by 25 per cent., and the non-French Euro- pean by 12 per cent.

Of the European (non-Erench) population in 1896, 63,205 lived in th^ department of Algiers, 113,279 in the department of Oran, 35,051 in the department of Constantine. About half the number virere Spanish ; after them came Italians, Maltese, Germans, &c.

In 1896 the area and population of the three departments and the population of the military territory in each department weve as follows: —

-

Departments.

Area, Square MUes.

Total Population.

Population of

Military

Territory.

Algiers Oran . Constantine .

Total

65,929 44,616 73,921

1,526,667 1,028,248 1,838,781

213,461 140,071 202,611

184,466

4,393,696

556,143

The area of the Algerian Sahara is about 123,500 square miles, and the population about 50,000.

Movement of population. — During three years the registered marriages, births, and deaths were as follows: —

Tears.

Marriages.

Births.

Deaths.

Surplus of Births.

1897 1898 1899

37,140 36,484 42,816

133,164 123,674 135,479

78,951 87,671 90,557

54,213

36,003 44,922

In 1897 the divorces numbered 12,267 ; in 1898, 11,876 ; in /1899, 12,364. In those years, respectively, the still-births numbered 2423, 2837, and 2803. Of the Uvlng births in 1899, 17,637 were European, 2464 Jewish, and 115,274 Mussulman. In 1899, 10J.7 persons were naturalized. From 1865 to 1899, 25,611 were naturalized, of whom 8001 were Italian, 4816 Spanish, 6633 German, and 1315 Anglo-Maltese.

Algeria, in its three departments, contains 17 subordinate prefectures and 348 communes. The important towns are Algiers (96,784 inhabitants), Blidah (27,772), M6d6a (16,235), Tizi-Ouzou (27,466), in the department of Algiers; Constantine (61,997), Bane (34,498), Bougie (14,299), Guelma (7288), Philippeville (20,450), S6tif (16,061), in the department of Constantine; Oran (85,081), Mascara (22,203), Mostaganem (17,353), Tlemcen (34,- 866), in the department of Oran.

Government. — Algeria is administered by a civil governor- general. By decree of 26th August 1881, the budget of the colony was divided among the budgets of the various ministries, and the various services were placed under the direct authority of the respective ministers of France (a system called the rattache- ment), but, after the parliamentary inquiry of 1891, the system was modified, and the decree of 1st January 1897, augmenting the powers of the governor-general,' suppressed the rattoxhenient, ex- cept as regards worship, non-Mussulman justice, public instruction, and the customs. The governor is assisted by a superior council of government, the number of members of which was increased by a decree of 23rd August 1898. Another decree of the same date created the Algerian financial delegations, an elective body repre- senting three categories of taxpayers : (1) the colonists, (2) tax- payers other than

colonists, and (3) the natives. The duty of the delegations is to investigate all questions of taxation. Since 1900 Algeria has had a special budget of its own.

Education. — Algiers is the capital of an academic circumscrip- tion comprising the whole colony, and is besides the seat of an establishment for superior instruction consisting of faculties of law and of sciences, and a superior school of letters. The total number of students is 786, of whom 300 are students of law. Algeria has three lycees (at Algiers, Constantine, and Oran) with 2000 pupils, and nine communal colleges with 3863 pupils, besides a college for girls at Oran with 194 pupils. Most primary schools are Arab-French ; the purely Arab are not numerous ; some purely French exist. In the year 1897-98 the total number of primary schools was 1168, of which 489 were in the department of Algiers, 347 in that of Constantine, and 332 in that of Oran. The total number of pupils in the schools was 108,000, of whom 65,000 were boys and 43,000 girls. In the year 1897-98 the number of children at infant schools was 29,000. There are three superior Mussulman schools at Algiers, Tlemcen, and Constantine, where pupils are prepared for native employments.

Justice. — Justice is administered in the last resort by a court of appeal sitting at Algiers. There are sixteen tribunals of arrondisse- ments or, tribunals of first instance, besides tribunals of commerce

and justices of the peace with extensive jurisdiction. Criminal justice is organized as in France. In 1897, 470 criminal charges were laid, resulting in 439 convictions ; 71,210 persons were ac- cused of minor offences and 21,228 of misdemeanours. In the penal establishments there were registered 60,223 entrances, of which 797 were for long terins of imprisonment and 49,426 (includ- ing 1416 women) were for shorter terms. Concurrently with the French there is a Mussulman system of justice for the decision of suits between natives. It is administered in the first instance by the cadis, whose sentences, on appeal, are within the jurisdiction of French courts.

Finance.— The increase of the expenditure is shown by the fol- lowing budget estimates for 18S0, 1890, and 1899 (25 francs =£1) :-

Tears. Expenditure.

1880 £4,040,000

1890 4,920,000

1899 5,100,000 I

In 1899 the civil expenditure amounted to £2,920,000, the military to £2,080,000, and the pensions to £100,000. The receipts for 1899 were put at £2,166,000, of which £1,584,000 was from taxation, £218,000 from monopolies, and £178,000 from customs. The expenditure thus exceeded the receipts by £2,934,000, the deficit being met by the French Treasury, which besides providing for the military outlay contributes £860,000 towards the civil expenditure. But for a proper estimate of the cost of Algeria to France, besides the sums paid to the state as contributions to the public service, those paid to the departments and to the communes, amounting to about £1,600,000 annually, must be taken into account. Altogether Algeria spends about £6,680,000, towards which it contributes only £3,760,000.

Army. — The army constitutes the nineteenth French army corps. Its three divisions are at Algiers, Oran, and Constantine respec- tively, and contain a total strength of 60,800 rank and file. The elements of the divisions are the Zouaves (13,670), Algerian Bifles (15,249), the foreign legion (10,769), the African light infantry (8253), the African chasseurs (5314), and theSpahis (3532).

Agriculture. — By far the most important of the resources of the colony is agriculture, on which on 1st January 1898, 3,644,614 persons were estimated to be dependent, 207,310 being Europeans. At the same date the area cultivated was estimated at 26,182,000 acres, of which 7,647,100 acres were under wheat and other cereals (1,188,100 acres belonging to Europeans, and 6,459,000 acres to natives). In 1880 the area under cereals did not exceed 7,768,000 acres. The crops of wheat, barley, and oats yielded respectively 12, 16, and 1-2 millions of cwt. in 1880, and 14-6, 18, and 1-6 in 1898.- In the latter year rye and maize yielded respectively 1,748,000 and 200,000 cwts. The cultivation of the vine, after

encountering serious difficulties, has greatly extended. The vine- yard area and produce in various years were : —

Tears.

Acres.

Gallons.

1872 1880 1888 1898

39,500

55,800

308,750

348,270

4,994,000

9,504,000

60,742,000

100,194,600

The value of the wine-yield in 1898 was not less than £6,600,000 sterling. Of the three departments Oran produced the largest quantity, 40,772,600 gallons; then Algiers, 37,037,000 gallons; and Constantine, 22,385,000 gallons. Tobacco covers 17,330 acres, yielding 106,480 cwt. Early fruits are cultivated with success in the Mitija. There are about 7,000,000 olive-trees, which promise to become a source of wealth. Alfa-grass, an important article of commerce with England, grows on the high plateaus, where about 410,000 tons are annually gathered on ah area of about 2,964,000 acres or 4630 square miles.

Forests. — The forests cover an area (chiefly on the mountain slopes) of about 7,410,000 acres, or 11,600 square miles. About 1,235,000 acres are

in private ovraership, 247,000 acres belong to communes, and the whole of the remainder is the property of the state. The cork-oak extends over an area of 684,000 acres, the zeen-oak and the aleppo pine belong to valuable species. The date-palm is cultivated in the oases ; at Biskra there are 150,000 palm-trees ; In the Ziban, 556,000 ; in the Wed Kir, 637,000 ; in the Souf, 180,000.

Live Stock. — ^The live stock in 1898 consisted of 202,343 horses, 142,796 mules, 255,870 asses, 205,827 dromedaries, 1,004,175 cattle, 7,026,290 sheep, 3,566,508 goats, and 90,765 pigs ; in all, 12,494,574 animals, of which 831,457 belonged to non-natives and 11,663,117 to natives. The value of the agricultural material was estimated at £1,160,000 sterling.

Mines and quarries. — In the department of Algiers are coal-mines yielding about 10,000 tons of coal annually; Iron is mined at Mokta el Hadid, at Ain Mokra, and at other places ; the yearly

output being about 470,000 tons, worth £200,000 sterling. In the extraction of the ore about 1600 workpeople are employed. The zinc and lead mines yield about 43,000 tons, worth £55,000 sterling. Antimony is found in the department of Constantine. The phosphate beds recently discovered provide material for a rapidly increasing industry. They yielded 240,000 tons of phosphate in 1899. There are more than 300 quarries of stone, marble, &c. Salt is collected on the margins of the chotts or lakes on the high plateaus.

Industry. — Industries are not very active. The more important are pottery, employing 1520 workmen ; shipbuilding, 256 ; tanning and leather-dressing, 2462 ; weaving and plaiting esparto goods, 9272 ; chemical works. In 1898 there were altogether 19,398 in- dustrial establishments, employing 59,077 persons.

Commerce. — The principal imports are living animals, cereals, cofEee, timber, coal, and tissues ; while the chief exports are wine, alfa, tobacco, iron-ore, hides, cork, phosphates. The general trade (imports and exports) in 1870 amounted to the value of 12 millions sterling ; in 1880 to 18-4 millions, in 1889 to 16-4 millions, in 1898 to 23-5 millions. The special trade in 1898 amounted to 11-6 millions sterling for imports and 10-6 millions for exports. The imports from France were of the value of 9 millions sterling, and the exports to France almost reached the same amount. France sends to Algeria tissues, ready-made clothing, furniture, metal goods, leather and leather goods ; and receives from Algeria wine, cereals, sheep, wool, and horses. The imports from Great Britain reached the value of £248,000, knd the exports to Great Britain £544,000. Other countries trading with Algeria were in 1898 (in order of importance) Morocco, Russia, Tunis, Spain, the United States, Italy, Brazil, and Belgium.

Shipping.— la 1898, 1834 vessels of 1,101,668 tons entered Algerian ports from abroad, and 1798 of 1,117,408 tons cleared for ports outside of Algeria. In the coasting trade, 8627 vessels, aggre- gating 1,621,623 tons, entered, and the same cleared. Direct shipping relations between Algeria and France are reserved exclu- sively for the national flag. The most frequented Algerian port is Algiers (1,700,000 tons), then Oran (1,000,000), Philippeville (500,000), and Bona (500,000). On 1st January 1899 the mercantile marine consisted of 657 sailing vessels of 7420 tons, and 64 steamers of 10,958 tons.

Bailways. — In 1888 Algeria had 1740 miles of railway ; in 1900, 2087 miles, of which 1357 were of normal gauge, besides 1134 miles under construction, of which 160 miles were of normal gauge. The principal lines are those from Algiers to Constantine, 290 miles ; from Algiers to Oran, 266 miles ; and the lines crossing or pene- trating the countrjr from Mostaganem to Am Sefra in the depart- ment of Oran, and from Philippeville to Biskra in the department of Constantine. The line from Algiers to Constantine is continued across the -Tunisian frontier as far as the city of Tunis. The railway receipts in various years and the receipts per mile were as follows : —

Years.

Total Keoelpts.

Receipts per Mile.

1870

£94,000

£431

1880

489,600

594

1890

965,840

554

1896

968,000

500

1898

1,040,000

498

The receipts per mile have fallen off since 1880 owing to the construction of new lines.

Boads. — ^The length of the national roads in 1884 was 1784 miles ; in 1888, 1794 ; in 1898, 1791.

Post-offices. — In 1897 there were 553 post-offices. The post and telegraph receipts in 1883 amounted to £150,600; in 1892 to £164,100; in 1897 to £183,000. The ■post-oflSce orders issued in 1888 numbered 618,861 and were of the value of £1,364,818 ; in 1897, 925,498, of the value of £1,602,770. The payments into the post- office savings bank in 1888 amounted to £154,750 ; in 1897 to £387,940.

Banks. — The movement of coin and notes at the Bank of Algeria, whose head office is at Algiers, amounted in 1897-98 to over 56 millions sterling ; that at the office of the Algerian Company to 52 millions ; and at the five branches of the Cridit Lyonnais to 2 millions. In 1897 the Credit Fonder et Agricole of Algeria made advances to the amount of over 4 millions sterling.

History. — Since the great insurrection of 1871 there have been two revolts in Algeria, that of El Amri in 1876, and that of Bou Amama in 1881, in southern Oran, which was repressed not without difficulty. Another important event was the annexation of Myab (1882), where the, inhabitants, tributary since 1853, had refused to fulfil their engagements. ■ Since 1896 Algeria has suffered from the anti- Jewish agitation, which on several occasions, especially at Algiers, Oran, and Constantine, has led to riot and bloodshed. In consequence of the difficulties raised by this propaganda, there has lately been a constant change in governors (see also Anti- semitism).

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Algiers, capital city and seaport of Algeria, the seat of the government-general, of a qourt of appeal, and of an archbishop, and station of thei 19th Corps d'Armfe. Taking into account only the ancient Algiers within the circuit of the city walls to the exclusion of the suburban faubourgs, the population, 48,908 in 1872, had increased to 82,585 in 1891, and reached 96,784 in 1900. The Trench population, 18,216 in 1872 and 38,041 in 1891, numbered 42,004 in 1900 ; but this increase was mainly due to the facilities offered for the acquisition of writs of naturalization. The Jews numbered 7857; the Arabs, 23,202; foreigners, 23,721. Including the suburban faubourgs from the Pointe Pescade to Maison Carrde, namely, St Eugene, Hussein Dey, Busarea, El-biar, El- Kouba, to mention only the most important groups of population, the inhabitants of Algiers in 1900 numbered 135,000 against about 66,000 within the same area in 1872. Such a marked growth of population is to be ascribed to the extension of commerce, of shipping, of the public services, and of agriculture. Eesting on high hills all covered with gardens, Algiers enjoys a delightful situation, and has become one of the most frequented winter resorts. The old Algiers of narrow and steep streets, crovraed by the Citadel, the Kasbah, is distin- guished from the new Algiers, on level ground, which has for its principal road the superb Boulevard de la E^publique. The chief public buildings are the Govern- ment House (Palais du Gouvernement), the cathedral, the Grand Mosque, the library, and museum. The old walls of Algiers will soon be completely demolished, and in their place will be planted a line of forts which will occupy the edge of Mount Busarea at an elevation of over 1300 feet above the sea. The port of Algiers is to be entirely trans- formed, the Chamber of Commerce and the Government having taken the necessary measures to push forward the works rapidly. The main object is to do away with the sorry port of Agha. At present, however, a public warehouse has been established in connexion with the loading and unloading of the goods. The jetty to the south of the port has been enlarged, pending the extension of the north jetty. Owing to the improvement already accomplished, Algiers has become one of the most con- siderable colonial maritime entrepdts. The tonnage, which in 1883 did not exceed 314,633, entered and cleared, amounted in 1894 to 924,616, and in 1898 to 1,702,310. In short, Algiers engrosses more than 40 per cent, of the total traffic of Algeria. The merchant ships at the port numbered, in 1898, 250 of 10,348

tons, or 72 per cent, of the total tonnage of the merchant marine of Algeria. The seat of a college, with schools of law, medicine, science, and letters, Algiers in 1898 counted 1069 students of higher instruction — 509 in letters, 64 in science, 230 in medicine, and 266 in law. Algiers maintains communica- tion with Marseilles by a quick service of steamers, which run the 497 miles across the Mediterranean in twenty-eight to thirty hours. The journey between Algiers and Paris, from which it is distant 1031 miles, is accomplished in about forty-five hours.

Authorities. — Tardieu. Alger tel quHl est. 1887. — Dhouet. Alger et le Sahel. 1887.— Wahl. VAlgerie. 1897.— Pensa. Algerie : Voyage de la delegation de la Commission d'' Etudes, &c. .1894. — PiESSE. Algirie (Guide Joanne). — Playpair. Handbook (Murray's) of Algeria and Tunis. 1895. (p. l.)

Alhama de Granada, a town in the province of Crranada, Spain. Population, 7382. In 1884 five churches, the hospital, the prison, the theatre, and more than a thousand houses were destroyed by an earthquake. Eight hundred persons were buried under the ruins. A new town was built near the old one, mostly by subscriptions raised in the rest of Spain. Strange to say, the baths, situate outside the town, were not much injured.

Aliaga, a town of 17,000 inhabitants in the west- central portion of the province of Nueva Ecija, Luzon, Philippine Islands. It is well situated in the midst of a rich Indian corn, rice, sugar, and tobacco-producing region, and has a comparatively cool and healthful climate. Tagalog is the most important language ; Ilocano, Pam- pango, and Pangasinan are also used.

Alicante, a maritime province in the S.E. of Spain, with an area of 2096 square miles. Population (1897), 451,174. The coast-line has an extent of 107 miles. The roads are not in very good condition. EaUway s run through the province from Alicante to Madrid, and to Murcia and tite

south of Spain, The province is divided into 14 districts and 138 parishes. There are, in working condition, 7 mines of iron ore, 2 of lignite, and 2 salt-mines. The salt-mines of Torrevieja employed 561 men, and produced in 1898 93,493 tons of the estimated value of £31,082. The live stock in the province includes 4031 horses, 14,960 mules, 8908 donkeys, 2160 oxen and cows, 52,790 sheep, 19,461 goats, and 6555 pigs. Wheat is grown on 9000 acres, rye, oats, barley, and maize on 59,000, vines on 259,000, olive on 41,250. The births in the province average five to every four deaths. The population does not increase, however, owing to the emigration, mainly to Oran in Algeria. Only the provinces of Almeria and Pontevedra show more emigrants annually than Alicante.

Alicante, a town of Spain, capital of the above pro- vince, and a resort in winter for invalids on account of its mild and steady climate. Population in 1897, 49,463. Ali- cante was more affected than the other Mediterranean ports in 1898 when Spain lost her colonies, after her struggle with the United States, as is shown by the figures of the shipping at the port in 1897 and 1898. In 1897 the return of all the shipping gives 1769 vessels, with 1,475,994 tons, and in 1898,, 1660 vessels, with 1,008,937 tons. The coast- ing trade has been on the increase for several years, and this partly explains how 1250 Spanish vessels, with 836,795 tons, rank in the returns for 1898. The principal exports were wines, valued at £700,000 in 1897, and £800,000 in 1898; lead, valued at £160,000 in 1897, and £150,000 in 1898 ; almonds, valued at £60,000 in 1897, and £65,000 in 1898; esparto, valued at £10,000 in 1897, and £20,000 in 1898; saffron, valued at £75,000 in 1897, and £40,000 in 1898.

Alice Maud Mary, Geand-Ditchess of Hessb- Darmstadt (1843-1878), second daughter and third child of Queen Victoria, was born at Buckingham Palace, 25th April 1843. A pretty, delicate-featured child — "cheer-^ ful, merry, full of fun and mischief," as her elder sister described her — ^fond of gymnastics, a good skater, and a devoted rider, she was a general favourite from her earliest days. Her first years were passed without particular incident in the home circle, where the training of their children was a matter of the greatest concern to the Queen and the Prince Consort. Among other things, the royal children were encouraged to visit the poor, and the effect of this training was very

noticeable in the later life of Princess Alice. After the marriage of the Princess Eoyal in 1858, the new responsibilities devolving upon Princess Alice, as the eldest daughter at home, called forth the

higher traits of her character, and brought her into still closer relationship with her parents, and especially with her father. In the summer of 1860, at Windsor Castle, Princess Alice first met her future husband. Prince Louis of Hesse. An attachment quickly sprang up, and on the prince's second visit in November they were formally engaged. In the following year, on the announcement of the contemplated marriage, the House of Commons unani- mously voted a dowry of £30,000 and an annuity of £6000 to the princess. In December 1861, while prepa- rations were being made for the marriage, the Prince Consort was struck down vntla. typhoid fever, and died on the 14th. Princess Alice nursed her father during his short illnSss with the utmost care, and after his death devoted herself to comforting her mother under this terrible blow. Her marriage took place at Osborne, on 1st July 1862. The princess unconsciously wrote her own biography from this period in her constant letters to Queen Victoria, a selection of which were allowed to be printed in 1883. They first appeared in Germany, under the editorship of Doctor Sell ; the English edition which followed being edited by Princess Helena (Princess Chris- tian). These letters give a complete picture of the daily life of the duke and duchess, and they also show the in- tense love of the latter for her husband, her mother, and her native land. She managed to visit England every year, and it was at her special request that when she died her husband laid an English flag upon her cofBn.

In the war between Austria and Prussia in 1866, Hesse-Darmstadt was upon the side of the Austrians ; Prince Louis accompanied his troops to the front, and was duly appointed by the grand-duke to the command of the Hessian division. This was a time of intense trial to the princess, whose husband and brother-in-law, the crown prince of Prussia, were necessarily fighting upon opposite sides. The duke of Hesse also took part in the principal battles of the Franco-Prussian war, while the duchess was actively engaged in organizing hospitals for the relief of the sick and wounded. The death of the duke's father. Prince Charles of Hesse, on 20th March 1877, was followed by that of the grand-duke on 13th June,

and Prince Louis succeeded to the throne as Grand Duke Louis IV. In the summer of 1878 the grand-duke and duchess, with their family, came again to England, and went to East- bourne, where the duchess remained for some time. She returned to Darmstadt in the autumn, and on 8th November 1878 her daughter. Princess Victoria, was attacked by diphtheria. Three more of her children, as well as her husband, quickly caught the disease, and the youngest, " May," succumbed on the 16th. On 7th December the princess was herself attacked, and, being weakened by nursing and anxiety, had not strength to resist the disease, which proved fatal on 14th December, the seventeenth anniversary of her father's death. In a sermon preached on the day after her death. Canon Duckworth admirably summed up the character of the princess: "Endowed with rich intellectual gifts, and with a force and charm of char- acter which would have made her a conspicuous power in any rank, the princess whom we mourn has passed her brief days in unwearied use of great opportunities." She left one son and four daughters. (g. p. b.)

Aligarh, a city and district of British India, in the Meerut division of the North-West Provinces. The city, also known as Koil, is a station on the East Indian railway, 876 miles from Calcutta. Sir Sayad Ahmad Khan, K.C.S.I., who died in 1898, founded in 1864 the Aligarh Institute and Scientific Society for the translation intothe vernacular of western literature ; and afterwards the Mahon;imedan Anglo-Oriental College, under English professors, with an English school attached. In 1896-97 the college had 114*

students, and meets with strong support from the enlight- ened portion of the Mussulman community, whose aim is to raise it to the status of a university, with the power of conferring degrees. Population (1881), 61,730; (1891), 61,485 J (1901), 70,127, showing an increase of 14 per cent; the municipal income in 1897-98 was Es.63,923; the death-rate in 1897 was 40 per thousand. There are three flour-mills, several cotton-presses, and a dairy farm. The district of Aligaeh is traversed by several rail- ways, and also by the Ganges Canal, which is navigable. The chief

trading centre is Hathras. Area, 1952 square miles; population (1891), 1,043,172, being 534 persons per square mile; (1901), 1,203,047, showing an increase of 15 per cent., due to the extension of irrigation. The land revenue and rates are Rs.25,97,223, the incidence of assessment being R.l : 11 : 4 per acre ;' the cultivated area in 1896-97 was 889,182 acres, of which 526,667 were irrigated from wells, &c. ; the number of police was 2954 ; there are 78 vernacular schools, with 6979 pupils; the registered death-rate in 1897 was 34 per thousand. There are 12 factories for ginning and pressing cotton, and 182 indigo factories, with an out-turn which is valued ait Rs.6,88,000.

, All pur. See Calcutta.

Alirajpur, a native state of India, under the. Bhopawar agency. It lies in Malwa, near the frontier of Bombay. It has an area of 837 square miles ; and a population (1891) of 70,091, being 84 persons per square mile. The country is hilly, and many of the inhabitants are aboriginal Bhils. It has from time to time been under British administration. The chief, whose title is Eana, is a Kahtor Rajput. He has an estimated reveAue of Rs.130,633 and pays a tribute of Ks.11,000. The town of Alirajpur is situated in 22° 11' N. lat. aad 74° 24' E. long. The Victoria bridge was built to commemorate the Diamond Jubilee of 1897.

Alison, Sir Archibald, Babt. (1826-),G.C.B.,

British general and colonel of the Seaforth Highlanders, eldest son of the first baronet, the well-known historian, was born at Edinburgh, on 21st January 1826. Educated at Glasgow and Edinburgh Universities, he entered the 72nd Highlanders as ensign in 1846. He was promoted captain in 1853, and served in the Crimean campaign at the siege of Sebastopol (medal with clasp, Turkish medal, brevet majority). During the Indian Mutiny he was military secretary to Sir Colin Campbell, commander- in-chief, and was severely wounded at the relief of Lucknow, losing an arm (medal with clasp, brevet lieut.- colonelcy, C.B.). From 1862 to 1873 he served on the staff as an assistant adjutant-general at headquarters, Portsmouth, and Aldershot. He commanded the Euro- pean brigade, and was second in command of the Ashanti Expedition 1873-74, distinguishing himself at the battle of Amoaful, capture of Bequah, action

of Ordahsu, and capture of Kumassi (medal with clasp, thanks of parliament, and K.C.B.). For three years Alison was deputy adjutant-general on the headquarters staff in Ireland and then, for a few months, commandant of the Staff College. He was promoted to be major-general in 1877, and from 1878 to 1882 was head of the intelligence branch of the War Ofi&ce. He commanded the troops at Alexandria in 1882 until the arrival of Sir Garnet Wolseley, commanded the Highland Brigade at the battle of Tel-el-Kebir in the Egjrptian campaign, and remained in command of the army of occupation of Egypt until 1883 (medal with clasp, bronze star, second class Osmanieh, thanks of parliament, and promoted lieut.- general for distinguished service). He commanded the Aldershot division from 1883 to 1888, was for some

months adjutant-general to the forces during Lord Wolseley's absence in Egypt, was made G.C.B. in 1887, and was promoted general and became a military member of the Council of India in 1889.

Aliu-amba. See Abyssinia.

Aiiwal, a village of British India, in the Ludhiana district of the Punjab, situated in 30° 57′ N. lat. and 75° 37′ E. long., on the left bank of the Sutlej. Here, on 28th June 1846, Sir Harry Smith, in command of a cavalry force, inflicted a severe defeat upon the Sikhs.

Aiiwal North, a town of Cape Colony, on the left bank of the Orange river, which is here spanned by a fine railway bridge, 860 feet long. It is the present terminus of the line running from East London tiirough Molteno and Burghersdorp northwards, and carries on a brisk trade with the Orange Biver Colony and surrounding districts. The population is about 3000. Aiiwal North is so named to distinguish it from Aliwal South, which is the seaport of the pastoral Grasveld district, and stands on the west side of Mossel Bay under the Cape St Blaize headland, by which it is sheltered from the fierce south- ern winds. It has a considerable import and export trade, ^'anking in this respect fourth amongst the sear ports of Cape Colony. The population is about 3000.

Alkmaar, a town of the Netherlands in the province of North Holland, about 20 miles N.N.W. of Amster- dam by rail. It is also connected by

steam tramway (1896) with Purmerend, Amsterdam, and Hoorn. There is a military school here. Population in 1870, 11,410; in 1900, 18,275..

Allada. See Dahomey.

Allahabad, a city of British India, the capital of the North-West Provinces, also a district and a division. The city is situated at the confluence of the Ganges and the Jumna, 564 miles from Calcutta by rail. Modern buildings include Government House, the High Court, the Mayo memorial and town hall, the Muir Central College, the Thornhill and Mayne memorial library and museum, the Naini central jail, Trinity church, and the Roman Catholic cathedral. The Jumna is crossed by a railway bridge, and there are two bridges of boats over the Ganges. The military cantonments contain accommodation for all three arms. Population (1881), 148,647 ; (1891), 175,246 ; (1901), 175,748. The municipal income in 1897-98 was Bs.3,93,283 ; the registered death-rate in 1897 was 36-5 per thousand. The municipality consists of 28 members, of whom 21 are elected, with the magistrate as ex officio chairman. The water-supply, which was extended in 1897, provides 1,425,000 gallons a day, or 8 gallons per head. In 1896-97 the Muir Central CoUege had 195 students ; the Kayasth Pathsala had 73 students. There are four high schools and an American mission. There are 33 printing presses, 4 English and 4 vernacular news- papers, a literary institute, the Kayasth association, a Mahommedan union, and debating society.

The district of Allahabad is traversed by the East Indian railway and the Great Trunk road. Apart from the city, it contains no town with a population exceeding 5000. Area, 2852 square miles; population (1891), 1,548,737, being 543 persons per square mile; (1901), 1,487,904, showing a decrease of 4 per cent. The land revenue and rates are Rs.19,12,757, the incidence of assessment being R.l: 5:3 per acre; the cultivated area in 1896-97 was 882,887 acres, of which 232,774 were irrigated from wells and tanks ; the number of police was 4745 ; there are 217 vernacular schools, with 5941 pupils ; the registered death- rate in 1897 was 45 per thousand. The principal crops are rice, millet, pulse, barley, cotton, opium, and indigo.

There are 23 indigo factories, with an out-turn valued at Es.1,09,000.

The division of Allahabad has an area of 17,265 square miles. Population (1891), 5,757,121, being 333 persons per square mile; (1901), 5,535,803, showing a decrease of 4 per cent., due to the famine of 1896-97, which was severely felt in this traot. It comprises the eight districts of Cawnpore, Fatehpur, Banda, Hamirpur, Allahabad, Jhansi, Jalaun, and Lalitpur.

Allegheny, a city of Pennsylvania, U.S.A., situ- ated in lat. 40° 27′ N. and long. 80° 00′ W. on the north bank of the Allegheny and Ohio rivers, opposite Pittsburg, with which it forms a single business and manufacturing community. The elevation above sea-level at the station of the Pennsylvania Eailroad, in the lower part of the city, is 736 feet, most of the city being much higher. The main position is on a plateau immediately above the rivers, with residence portions extending over the hills behind. The river part is occupied by manufacturers, while the principal mercantile quarter is , along Federal and Ohio streets, which intersect at a central square, containing the city hall, post ofifi.ce, Carnegie free library, and the market- place.' The parks consist of the east, north, and west parks, nearly surrounding the central business section, and Riverview Park on the Mils about two miles to the north. The population in 1890 was 105,287; in 1900, 129,896, with a death-rate of 16-23. The higher institutions of learning are the Western University of Pennsylvania and theological seminaries of the Presbyterian and United Presbyterian, churches. In the lower part of the city is the Riverside State Penitentiary. The government con- sists of a mayor, and departments of pubKc safety, public works, and public charity, with select and common councils. The annual expenditure is f 2,099,000, the debt is 14,810,588, and the valuatibn of property f 81,601,300. There are three hospitals, ten banking institutions, and four insurance companies. It has extensive manufactures, amounting in 1890 to f 20,500,000, mainly of iron, leather, and paint. Three railways, the Pennsylvania, the Pitts- burg and Western, and the Buffalo, Rochesterj and Pitts- burg, enter the city.

Allenstein, a town of Prussia, prdvince East Prussia, 100 miles by rail N.E. from 'Thorn. It has a mediaeval episcopal castle, a couple of

churches, a syna- gogue, a lunatic asylum, and various industries — iron- foundries, saw-mills, brick-works, and breweries ; also a trade in cereals and timber. Population (1885), 11,555 ;

(1895), 21,579.; (1901), 24,307.

Allentown, a city of Pennsylvania, U.S.A., the capital of Lehigh county, situated in 40° 37′ N. lat. and 75° 27′ W. long., in the eastern part of the state, in Lehigh Valley, at an altitude of 256 feet, sixty miles north by west from Philadelphia. Though its site is hilly, its plan is quite regular. The city is divided into eleven wards, and is entered by four railways, the Central of New Jersey, the Lehigh Valley, the Perkiomen, and the Philadelphia and Reading. It has ilnportant manu- factures of boots and shoes, iron and silk. It is the site of Muhlenburg College. The population in 1880 was 18,063, in 1890 it was 25,228, and in 1900 it was

35,416.

■ Alleppi, or AuLAPALAY, a seaport of Southern India, in the state of Travancore, 33 miles south of Cochin, situated on a strip of coast between the sea and one of those backwaters that here form the chief means of inland communication. There is a lighthouse, 85 feet high, with a revolving white light visible 18 miles out at sea. The exports consist, of coffee, pepper, cardamoms, and cocoar nutsr There are two factories for coir matting. The

Raja has a palace, and Protestant missionaries have a church. Population (1891), 22,768.

Aller, a town of Spain, in the province of Oviedo, 21 miles S.E. of Oviedo, on the coast si^e of the Picos de Europa that separate the basin of the rive:rs running towards the sea from the dry plateau of Old Castile. It stands in the midst of a wooded country, and in the neigh- bourhood are coal and iron-ore mines and an iron foundry. There are two churches and schools. Population (1897),

11,975.

Alliance, a city of Stark county, Ohio, U.S.A., situ- ated in the north-east part of the state, at an altitude of 1081 feet, on three lines of railway. It is the seat of Mount Union College. Its manufactures consist in great part of agricultural tools and machines. The population in 1880 was 4636, in 1890 it was 7607, and in 1900 it was 8974.

Alller, a department in the centre of France. It is traversed by the ramifications of the mountains of D6me and of the Forez, and watered by the AUier and the Cher. Its area occupies 2850 square miles. The department comprises 29 cantons, 321 communes, and had a popula- tion in 1901 of 422,083, against 424,582 in 1886. Births (1899), 7999, of which 463 were illegitimate; deaths, 7236 ; marriages, 3590. The towns are Moulins (22,416 inhabitants in 1896), Gannat, La Palisse, Commentry, MontluQon, and Vichy. In 1896 there were 872 primary schools, with 60,688 pupils, and 9 per cent, of the popu- lation was illiterate. The area, under cultivation measured 1,660,255 acres, of which 1,185,600 acres were in forest and 34,68Q acres in vineyards. In 1899 the wheat crop yielded a value of £1,804,210, and the vines £200,000. The live stock (1899) numbered 742,510 head, of which 275,900 were cattle. AUier counts among the depart- ments of France in which the mining industry is in a for- ward state. It produces a million tons of coal yearly in the basin of Commentry. The industry in metals has likewise assumed large proportions around Montluqon, turning out 69,000 tons of iron, cast-iron, and steel, of the value of £700,000, in 1898. The other industries are in glass, in paper, in chemical products (Commentry), and in cutlery (St Pourqain).

Allingham, William (1824.1889), Irish man of letters and poet, was bom at Ballyshannon, Donegal, 19th March 1824 (or 1828, according to some authorities), and was the son of the manager of a local bank. He obtained a post in the custom-house of his native townandfilled several similar situations in Ireland and England until 1864, when he became sub-editor of Fraser's Magazine, which he subse- quently edited until 1879. He had made himself .known by the publication of a volume of poems in 1850, followed by Tlie Music Master and Day and Night Songs, a volume con- taining many charming lyrics, in 1855, and by Lawrence Bloowfield, a narrative poem illustrative of Irish social questions, in 1864. He married

Helen Paterson, known under her wedded name as a distinguished water-colour painter, and died at Hampstead on the 18th of Novem- ber 1889. Though working on an unostentatious scale, Allingham produced much excellent lyrical and descriptive poetry, and the best of his pieces are thoroughly national in spirit and local colouring.

Allman, George James (1812-1898), British biologist, was born in Cork, Ireland, in 1812, and received his early education at the Academical Institution, Bel- fast. For some time he studied for the Irish bar, but ultimately gave up law in favour of natural science. In 1844 he graduated in medicine at Dublin, and was at once appointed Professor of Botany in that university. This position he held for about twelve years until he removed to Edinburgh as Regius Professor of Natural History,

There he remained till 1870, when considerations of health induced him to resign his professorship and retire to Dorsetshire, -where he devoted himself to his favodrite pastime of horticulture. The scientific papers which came from his pen are very numerous. His most important work was upon the gymnoblastic hydrozoa, on which he published in 1871-72, through the Eay Society, an ex- haustive monograph, based largely on his own researches and illustrated with drawings of remarkable excellence from his own hand. Biological science is also indebted to him for several convenient terras which have come into daily use, e.g., endoderm and ectoderm for the two cellular layers of the body-wall in Coelenterates. He became a Fellow of the Royal Society in 1854, and received a Eoyal medal in 1873. For several years he occupied the presidential chair of the Linnsean Society, and in 1879 he presided over the Sheffield meeting of the British Association. He died 24th November 1898.

Alloa, a ri'ver port and police burgh on the north side of the Forth in the county of Clackmannan, Scotland, 28 miles from Leith by water, and 6^ miles E. of Stirling by rail. The register of shipping included 7 vessels of 374 tons at the end of 1898 ; in 1898 entered 918 vessels of 177,004 tons, cleared 1056 of 201,576 tons. Coal is the chief article of export, 345,631

tons being shipped in 1898. There are in the town 8 breweries. Spinning mills (its yarn is famous), engineering works, and chemical works are among the industrial features. The parish church has been restored internally, and recent erections are a hall and m.useum, a. town hall and free public library (designed by Mr. 'Waterhouse, E.A., the gift of Mr. J. Thomson Paton), a county combination hospital, a secondary school, public baths and gymnasium, and an accident hospital-. A public park has been opened. One of the schools is an academy. Population of police burgh in 1881, 8812 ; 1891, 10,754; 1901, 11,417.

Allotments and Small Holdings.— As the

meaning of these terms varies in different localities, it may be as well to say at once that for the present pur- pose they are definable as pieces of land detached from cottages, and hired or owned by labouring men to supple- ment their main income. We do not include any farm, however small, from which the occupier derives his main support by dairying, market-gardening, or other form of la petite cvlture. So, also, no account is taken of the tiny garden plot, used for growing vegetables for the table and simple flowers, which is properly an appurtenance of the cottage. Clearing away what is extraneous, the essential point round which much con- troversy has raged is the labourer's share in the land. To some extent this .depends upon tradition. In agri- culture, the oldest of all industries, a cash payment is not even now regarded as discharging the obligations between master and servant. Mr. Wilson Fox, in report- ing to the Board of Trade on the earnings of agricultural labourers in Great Britain, gives, as a typical survival of an old custom, the case of a shepherd whose total income was calculated at £60 a year, but who got only £16 in money, the rest being made up by rights of graz^ ing live-stock and growing .crops on his master's land, and kindred privileges. That is exactly in the spirit that used to pervade agriculture, and doubtless had its origin in the manorial system. If we turn back to the 13th century, from Walter de Henley's Husbandry it will be seen that practically there were only two classes engaged in agriculture, and corresponding with them were two kinds of land. There were, on the one hand, the employer, the lord, and his demesne land ; on the other, the villans, and the land held in villenage.

Putting aside for the moment any discussion of the exact degree of servitude, it

will be seen that the essence of the bargain was that the villan should be permitted to cultivate a virgate of land for his own use in return for service rendered on the home farm. This is not altered by the fact that the con- ditions approached those of slavery, that the villans were adscripti glebce, that in some cases their wives and sons were bequeathed by deed to the service of religious houses, and that in many other respects their freedom was limited. Out of this, in the course of centuries, was developed the system prevailing to-day. Lammas lands are indeed a survival from it. There are in the valley of the Lea, and close to London, to take one example, lands allotted annually in little strips till the crops are carried, when, the day being fixed by a reeve, the land becomes a common pasture till the spring closing takes place once more. Perhaps the feature of this old system that bears most directly on the question of allotments was the treatment of the waste of the manor. The lord, like his tenants, was limited by custom as regards the number of beasts he could graze on it. After the havoc of the Black Death in 1349, many changes were necessi- tated by the scarcity and dearness of labour. It became less unusual for land to be let and for money payment to be accepted instead of services. There was a great demand for wool, and to conduct sheep-farming on a large scale necessitated a re-arrangement of the manor and the enclosure of many common fields under the statute of Merton and the statute of Westminster Second. Never- theless, up to the 18th century, a vast proportion of agri- cultural land was technically waste on which rights of common were exercised by yeomen, some of whom had acquired holdings by the ordinary methods of purchase or inheritance, whUe others had merely squatted and built a house on the waste. It is to this period that belongs a certain injustice to which the peasantry were subject. No reasonable doubt can be entertained of the necessity of enclosure. Husbandry, after long stagnation, was making great advance ; and among others, Arthur Young raised his voicd against the clumsy inconvenient common fields that were the first to be enclosed. Between 1709 and 1797 no fewer than 3110 Acts, affecting, as far as can be calculated, about 3,000,000 acres, were put into operation. They seem mostly to have been directed to th^ common fields. In the first half of the 19th century the movement went on

apace. In a single year, 1801, no fewer than 119 Acts were passed; and between 1801 and 1842 close on 2000 Acts were passed — many of them expressly directed to the enclosure of wastes and commons. The same thing continued till 1869. It touched the peasant directly and indirectly. The enclosure of the common fields proved most hurtful to the small farmer ; the enclosure of the waste injured the labourer by depriving him, without adequate compensation, of such useful privileges as the right to graze a cow, a pig, geese, or other small animals. It also discouraged him by tending to thej extinction of small tenancies and freeholds that were no longer work- able at a profit when common rights ceased to go with them. The industrious labourer could previously nourish a hope of bettering his condition by obtaining a small holding. Yet, though the labourer suffered, impartial study does not show any intentional injustice. He held a very weak position when those interested in a common affixed to the church door a notice that they intended to petition. As Mr Cowper said in the House of Commons on 13th March 1844, " the course adopted had been to compensate the owner of the cottage to whom the common right belonged, forgetting the claims of the occupier by whom they were enjoyed" ; and in the same debate Sir Eobert Peel pointed out that not only the rights of the ten- ant, but those of his successors ought to have been studied. The course adopted divorced the labourer from the soil.

Parliament, as a matter of fact, had from a very early- period recognized the wisdom, of contenting the peasant. In the 14th 'century England was aland oi small farms wherein the tenant lived in rude abundance. Next century a rural exodus began, owing to the practice of enclosing the holdings and turning them into sheep walks. In 1487 an Act was passed enjoining landlords to " keep up houses of husbandry," and attach convenient land to them. Within the next hundred years a number of similar attempts were made' to control what we may call the sheep fever of the time. Then we arrive at the reign of Elizabeth and the famous Small Holdings Act passed in 1597 — an anticipation of the three-acres-

and-a- cow policy advocated towards the end of the 19th cen- tury. It required that no person shall "build, convert, or ordain any cottage for habitation or dwelling for per- sons engaged in husbandry " unless the owner " do assign or lay to the same cottage or building four acres of ground at the least." It also provided against any " inmate or under-sitter " being admitted to what was sacred to one family. This measure was not conceived in the spirit of modern political economy, but it had the effect of staying the rural exodus. It was repealed in 1775 on the ground that it restricted the buildiag of cottages. By that time the modern feeling in favour of allotments had begun to ripen, and it was contended that some compensation should be made to the labourers for depriving them of the ad- vantages of the waste. Up to then the English labour- ing rustic had been very well off. Food was' abundant and cheap, so were clothes and boots ; he could graze his cow or pig on the common, and also obtain fuel from it. Now he fell on evil days. Prices rose, wages fell, privi- leges were lost, and in many cases he had to sell the patch of land the possession of which made all the differ- ence between hardship and comfort. All this was seen plainly enough both by statesmen and private philan- ' thropists. One of the first experiments was described by Sir John Sinclair in a note to the report of a select com- mittee of the House of Commons on waste lands in 1795. About 1772 the lord of the manor of some commonable lands near Tewkesbury had with great success set out 25 acres in allotments for the use of some of the poor. Sir John was very much struck with the result, and so heartily applauded the idea that the committee recommended that any general Enclosure Bill should have a clause in it providing for "the accommodation of land." Sir Thomas Bernard and Mr Wilberforce took an active part in ad- vocating the principle of allotments, on the ground, to summarize their argument in language employed later by a witness before the House of Commons, that " it keeps the cottagers buoyant and makes them industrious." In 1806, at the suggestion of the rector, a clause assigning an allotment of half an acre to every cottage was inserted in an Enclosure Bill then under consideration for the parish of Broad Somerford in Wiltshire. This was done, " and the example-was followed by nearly every adjoining parish in that part of Wiltshire." Passing over several praise- worthy establishments of allotments by private persons, we come to 1819, when Parliament passed an Act akin in spirit to several that came intp existence during the later portion of the

Victorian era. It empowered the church- wardens and overseers of any parish, with the consent of the vestry, to purchase or hire land not exceeding 25 acres, and to let it in portions to " any poor and industrious inhabitant of the parish." This was amended in 1831 by an Act extending the quantity of land to 50 acres, and also conveying an important new power to enable the same authorities to enclose from any waste or common land not exceeding 50 acres to be devoted to the same purpose. This was followed next year by an Act relating to fuel, and in 1834 the Poor Law Commissioners reported favour-

ably on the principle of granting allotments. In 1843 an important inquiry into the subject was made by a com- mittee of the House of Commons, which produced a number of valuable suggestions. One consequence was the Bill of 1846, brought into Parliament by Mr Cowper. It passed the House of Commons ; and there Mr Bright made a remark that probably summarized a general opin- ion, since it never came to a third reading in the House of Lords. He said that "the voluntary system of arrangement would do all the good that was expected to accrue from the allotment system."

At this point in the history of the movement it may be as well to pause and ask what was the net result of so much legislation and benevolent action. Messrs Tremen- heere and Tufnall, who prefixed an admirable epitome of what had been done'to the report of the Commission " appointed to inquire into the employment of women, young persons, and children in agriculture" (1867), ex-' pressed considerable disappointment. Between 1710 and 1867, 7,660,413 statute acres were added 1;o the cultivated area of England and Wales, or about one-third of the area in cultivation at the latter date ; and of this total, 484,893 acres were enclosed between 1846 and 1867. Of the latter, only 2119 acres were assigned as public allot- ments for gardens to the labouring poor. It was found to be the case, as it is now, that land was taken up more readily when offered privately and voluntarily than when it came through official sources. Meanwhile competent and thoughtful men saw well that the sullen discontent of the peasantry continued, in Lord Bacon's phrase, to threaten " the might and manhood of the kingdom." It had existed since the beginning of the Napoleonic wars, and had becofae more articulate with the spread of edu-

cation. We shall see a consciousness of its presence re- flected in the minds of statesmen and politicians as we briefly examine the later phase of the movement. This found expression in the clauses against enclosure intro- duced by Lord Beaconsfield in 1876, and gave force to the three-acres-and-arcow agitation, of which the more prominent leaders were Mr Joseph Arch and Mr Jesse CoUings. In 1882 the Allotments Extension Act was passed, the object of which was to let the parishioners have charity land in allotments, provided it or the reve- nue from it was not used for apprenticeship, ecclesiastical, or educational purposes. A committee of the House of Commons, appointed in 1885 to inquire into the housing of the working classes, reported strongly in favour of allot- ments, and this was followed in 1887 by the Allotments Act — the first measure in which the principle of com- pulsory acquisition was admitted in regard to other than charity lands. Its administration was first given to the SSjUitary Authority, but passed to the District Councils when these bodies were established in 1894. The local body is empowered to hire or purchase suitable land, and if they do not find any in the market they are to petition the County Council, which after due inquiry may issue a provisional order compelling owners to sell land, and the Local Government Board may introduce a Bill into Par- liament to confirm the order. It was found that the Sanitary Authority did not carry out the scheme, and in 1890 another Act was passed for the purpose of allow- ing applicants for allotments, when the Sanitary Au- thority failed to provide land, to appeal to the County Council. Judging from the evidence laid before the commission on agricultural depression (1894), the Act of 1887 has not been a conspicuous success. Most of the witnesses reported in such terms as these — " the Allot- ments Act has been quite inoperative in Cornwall " ; "the Act has been a dead letter in the district (Wigtown- shire) " ; " the Allotments Act has not been in operation in Elintshire" ; " nothing has been done in the district of

Pembrokeshire under the Act." No evidence whatever was adduced to show that in a single district a different state of things had to be recorded.

From a return pre- sented by the Local Government Board to Parliament in 1896 we learn that eighty-three rural sanitary authorities had acquired land for allotment prior to the 28th Decem- ber 1894, the date at which these authorities ceased to exist under the provisions of the Local Government Act

1894. Land was acquired by compulsory purchase in only one parish; by purchase or agreement in eighteen parishes; by hire by agreement in 132 parishes. The total acreage dealt with was 1836 acres 1 rood 34 poles, and the total number of tenants 4711. The number of County Councils that up to the same date had acquired land was twelve, and they had done so by compulsory purchase in one parish, by purchase or agreement in five parishes, by hire by agreement in twenty-four parishes. The total area dealt with was only 413 acres 1 rood 6 poles, and the total number of tenants 825. The com- plete totals affected at the date of the return, 21st August

1895, by the Acts, therefore, were 2249 acres 2 roods 39 poles, and 5536 tenants. A considerable extension has taken place since, but before dealing with that point a word should be said of a measure closely akin to the allotments legislation — ^viz., the Small Holdings Act in- troduced by Mr Henry Chaplin, and passed by Parliament in 1892. It was an attempt to appease the rural discontent that had been seething for some time past and was silently but most eloquently expressed in a steady migration from the villages.

The object of this measure was to help the deserving labouring man to acquire a small holding, that is to say, a portion of land not less than one acre or more than fifty acres in extent and of an annual value not exceeding £50. It is not necessary here to describe the legal steps by which this was to be accomplished. The essence of the bargain was that a fifth of the purchase money should be paid down, and the remainder in half-yearly instalments spread ^over a period not exceeding fifty years. But if the local authority thought fit a portion of the purchase money, not exceeding one-fourth, might remain unpaid, and be secured by a perpetual rent charge upon the hold- ing. It cannot be said that this Act has attained the object for which it was drawn up. From a return made to

the House of Commons in February 1898 we obtain a statement of the working of the Allotments and Small Holdings Acts between the 27th December 1894 and the 24th of June 1897. Of this document the following is a summary.

Land was acquired for allotments between the 27th December 1894 and 24th of June 1897 by—

3 county councils : (a) in two cases by purchase by agreement, the land handed to parish councils to manage ; (&) in one case hiring by agreement. Total acreage, 33 acres 38 poles — let to forty-five tenants.

3 councils of county boroughs : one case of purchase,

three of hiring by agreement. Total acreage, 42

acres 2 roods 23 poles — let to 171 tenants. 120 urban district councils : (a) in 17 cases purchase

by agreement ; (b) in 118 cases hiring by agreement.

Total acreage, 1591 acres 2 roods 4 poles — let to

6644 tenants. 9 rural district councils : four cases by purchase, seven

by hire. Total acreage, 160 acres 2 roods 18 pole's

— ^let to 288 tenants. 1009 parish councils : (a) in six cases by compulsory

hiring; (6) in 1022 cases by hiring by agreement.

Total acreage, 12,967 acres 2 roods 24 poles — let to

24,389 tenants.

4 parish meetings: by hiring by agreement. Total

acreage, 19 acres 17 poles — ^let to 47 tenants.

1 metropolitan vestry: by hiring by agreement. 4 acres 2 roods 12 poles — let to 79 tenants.

In this period, therefore, local authorities have acquired for allotment 14,818 acres — let to 31,663 tenants ; but 61 county councils, 61 councils of county boroughs, 963 urban district councils, 692 rural district councils, 6361 parish councils, and 5733 parish meetings had not acquired land for allotment.

These facts are not highly encouraging to those who would wish to see every workman in possession of an allotment ; but the results of the Small Holdings Act are trivial in comparison. Within the same period only three county councils had acquired land in six parishes for small holdings ; in one it was by purchase, in the other five by hire, and the total acreage amounted to only 120 acres 3 roods 5 poles — let to 46 tenants.

It is, however, an English characteristic to prefer private to public arrangements, and probably a very great majority of the allotments now being cultivated are due to individual initiative. There are no means of arriving at the actual facts, but data exist whereby it is at least possible to form some rough idea of them. It is not the custom to give in the annual agricultural returns any statement of the manner in which land is held, and the latest information is to be found in the returns presented to Parliament in 1895. From these we get the following table, which will enable the reader to compare the num- bers of large and small holdings, and understand how land is held: —

Prom 1 to 5 Acres.

Prom 5 to 50 Acres.

Above 50 Acres.

No.

Acreage.

No.

Acreage.

No.

.^creage.

Bug-land . . Wales . . . Scotland . .

Great Britain .

87,055 10,768 20,150

265,268 85,638 65,891

170,691 80,969 88,921

3,2S8,«69

685,024 608,980

122,538 18,656 25,568

21,290,751 2,167,702 4,219,645

117,968

366,792

235,481

4,582,623

166,657

27,678,098

It would appear from this that, whereas 27^ million acres are held in large holdings, scarcely five million acres are in small holdings. The proportion varies greatly according to the district. Some counties, such as

Cheshire and Worcester, are rich in small holdings ; while others — ^Westmoreland and Devonshire, for example — contain few. We may assume, however, that the allotments do not come into the table at all. They are separately tabulated as holdings of land not exceeding an acre in extent. They may be summarized as follows : —

Under 1 Acre.

Of 1 Acre.

Total of 1 Acre and over.

England . . Wales . . . Scotland

Great Britain

522,163

12,179

7,648

34,459 1,095 1,589

556,622

13,274

9,237

541,990

37,143

579,133

These figures are useful, but they should be taken as only approximate. It is in the nature of the case that there should be much fluctuation in the number of these tiny plots, movement of population and other causes

frequently leading to whole nests of them being deserted by the original occupiers and turned into ordinary fields again. A large proportion of them are held by persons not engaged in agriculture, but following other pursuits : witness the fact that they are most numerous in propor- tion to every 1000 acres cultivated in Nottingham, North- ampton, and Leicester. Very often an allotment is more acceptable to a village tradesman, a carpenter, bootriiaker, or miner, than to a farm-servant. Work on it to the

latter represents only a continuation of the day's drudg- ery, ~~while it is a pleasant change and relief to the former. Further, local conditions have much to do Vith their popularity. In pradtice, it is not found that a North~~ umbrian hind cares much for an allotment. He has a thousand or fifteen hundred yards of potatoes grown with his master's crop, and he gets meal and fuel as part of his wages. Better still, he has a twelve months' en- gagement for "rain or shine, sickness or health"; but where perquisites are not given on a scale so liberal, and wages are lower and engagements from week to week — even from day to day, as in some of the eastern counties of England, — then naturally the advantages of the allot- ment are much more highly prized.

Apart from those created by legislation, there are many groups of small agricultural holdings that have either come to exist naturally or have been made during the last few years. Cheshire is a county wherein the former prevail. A. typical estate in it is that of Lord Egerton of Tatton. This is divided into 189 holdings, of which 117 are of less than 60 acres and 72 are under 10 acres. Even in a •county so notable for its' excellent pasture a man could scarcely manage to live on one of these last- mentioned holdings ; and, as a matter of fact, those who have them are either agricultural labourers or possess some other means of earning a livelihood; but the land forms a valuable supplement to wages. One point of importance is that nowhere are large healthy families more prized than on these small holdings, where the girls at a very early age learn to look after the poultry and attend to the lighter duties, while boys are set to harder tasks. It has been observed that in portions of England where farm

labour is badly paid, and the men have no land, children a,re regarded as burdens and misfortunes. The Peckforton •estate of Lord Tollemache differs from that of Lord Egerton, inasmuch as pains have been taken to make small ^holdings on it. There are over 250 cottages, to which as juuch land is attached as enables the occupier to keep a cow, and the sale of milk and butter brings in enough to- pay the rent and vastly improve the food supply of the cottage. As there are over 120,000 holdings of less than 50 acres in Cheshire, it will be understood that the estates mentioned are typical of others. The Isle of Axholm, in Lincolnshire, has long been famous for its small hold- ings, and as they are to a great extent cultivated on the open-field system they are probably of great antiquity. In the parish of Epworth there are 421 agricultural hold- ings, of which 356 are under and 65 over 20 acres in extent ; in the parish of Haxey, 574 agricultural holdings, 475 under and 99 over 20 acres ; in West Butterwick, 132 agricultural holdings, 109 under 20 acres and 23 over. It would appear that the tendency is towards sub- division. Most of the land is held in strips, and at the owner's death these are often sold separately. During the worst of the depression a great amount of sufEering was felt, but recently accounts have been more cheerful. Lord Savile's estate in Yorkshire is an outstanding example of land in small holdings. It consists of 10,848 acres, held in 682 tenancies, averaging about 16 acres each. Experience there seems to show that a man requires about 30 acres of ordinary agricultural land in order to obtain a living from it.

To these examples of small holdings, it may be useful to add an account of the manner in which one set was formed ; and we select for the purpose that at Winterslow, in Wiltshire, chiefly for the reason that, save for a little guidance, the men worked out their own salvation. Maj or Poore, who originally conceived the idea, has not been a penny out of pocket on account of it. When land was cheap in 1892, owing to the depression in agriculture, he purchased an estate. The price came to an average of

£10 an acre, and he made the average for selling it out again £15 on a principle of instalments. But his object was not to make any profit from the transaction, and he formed what is termed a Landholders' Court, formed of the men themselves, every ten choosing one to represent them. This court was found to act well. It collected the instalments, which are i

paid in advance ; and of course the members of it, down to the minutest detail, knew not only the circumstances, but the character of every applicant for land. The result speaks for itself. Early in 1901 there were no arrears, and the expenses having proved only trivial there was a balance of £666 in favour of the court, and about £150 had been spent in sinking a well. This fund has the very great advan- tage of establishing a common interest in the holders and inducing them to stick together. Various sums have been lent out on mortgage, and,- were a neighbouring village to wish it, the Winterslow holders are prepared to listen to an application for a loan. It should be added that all the owners are, in the true sense of the word, peasants. They do not depend on the land for a living, but work in various callings — many being woodmen — for wages that average about 15s. a week. The holdings vary in size from less than an acre to ten acres, and are technically held on a lease of 1999 years, practically freehold, though by the adoption of a leasehold form a saving was effected in the cost of transfer. On the holdings most of the men have erected houses, using for the purpose chalk dug up from their gardens, it lying only a few inches below the surface. It is not rock, but soft chalk, so that they are practically mud walls ; but being as a rule at least 18 inches thick, the houses are very cool in summer and warm in winter. Major Poore calculSites that in seven years these poor people — there are not thirty of them altogether — have managed to produce for their houses and land a gross sum of not less than £5000. This he attributes to the loyal manner in which even distant members of the family have helped.

It remains to give a brief outline of what small hold- ings are like outside Great Britain. From the results of the Belgian Agricultural Inquiry of 1895 the following table has been compiled, assuming that one hectare = 2^ acres : —

Size of Holding.

Occupied by Owner.

Occupied by Tenant.

Total.

Whole.

More tlian , Iialf.

More than half.

Whole.

li acres and under .

1} „ „ 5 acres .

6 „ „ 10 „ . 10 „ „ 60 „ . 50 or 100 acres . Over 100 „

No.

109,169

27,395

12,089

16,690

2,021

908

No.

8,759 19,544 13,878 18,909

1,497 470

No.

84,779 58,829 30,340 33,448 8,315 1,417

No.

805,413 70,465 25,006 28,887 4,517 2,895

No.

458,120

176,233

81,308

97,429

11,850

5,185

Total

168,267

63,052

162,128

436,188

829,625

It will be seen from this table that Belgium is pre- eminently a country of small holdings, more than half of the total number being under 50 acres in extent. Of course it is largely a country of market gardens ; but as the holdings are most numerous in Brabant, East and West Flanders, and Hainault, the provinces showing the largest number of milch cows, it would seem that dairy- ing and la petite '•culture go together.

In Germany, the number of small holdings is propor- tionately much larger than in Great Britain. The returns collected in 1895 showed that there were 3,235,169, or 58-22 per cent, of the total number of holdings under 5 acres in area ; and of these no fewer than 11 per cent, are held by

servants as part of their wages. A table compiled for the Journal of the Board o/ Agriculture

ALL 0 Y S

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enables us to compare the other holdings with those of Great Britain : —

Size of HoldingB.

Germany.

Great Britain.

Number.

Per cent.

Number.

Per cent.

5 to 50 acres 50 to 500 „ Over 500 „

2,014,940

292,082

13,809

86-8

12-6

0-6

235,481

161,438

5,219

58-6

40-1

1-3

Total .

2,321,731

100

402,138

100

Great Britain, it will be seen, has over 40 per cent, of large farms of between 50 and 500 acres as compared with Germany's 12-6, while the latter has 86-8 of small hold- ings, compared with England's 58-6.

France also has a far larger proportion of small holdings than Great Britain; its cultivated area of 85,769,000 acres being divided into 6,618,000 separate holdings, of which the size averages a little over 15 acres as against 63 in Great Britain. Of the whole number, 4,190,795 are farmed by the owners, 934,338 are in metayage, and 1,078,184 by tenants. The leading feature is the peasant proprietary. Half of the arable, more than half of the pasture, six-sevenths of the vine- yards, and two-thirds of the garden lands are farmed by their owners. Comparison with Great Britain is difficult; but it would appear that, whereas only 11 per cent, of British 520,000 agricultural holdings are farmed by the owners, the proportion in France is 75 per cent. A fur- ther point to be noted is that the average agricultural tenancy in France is just one-fourth of what it is in Great Britain, and the average owner-farmed estate only one-sixth.

Those interested in the formation of small holdings in Great Britain wUl find much to interest them in the history of Danish legislation. British policy for many generations was to preserve demesne land, and there are

many devices for insuring that a spendthrift life-owner shall not be able to scatter the family inheritance ; but as long ago as 1769 the Danish legislators set an exactly opposite example. They enacted that peasant land should not be incorporated or worked with estate land ; it must always remai'n in the ownership and occupation of peasants. In this spirit all subsequent legislation was conceived, and the allotment law that came into force in October 1899 bears some resemblance to the English Small Holdings Act of 1892. It provides 'that labourers able to satisfy certain conditions as to character may obtain from the state a loan equal to nine-tenths of the purchase-money of the land they wish to acquire. This land should be from 5 to 7 acres in extent and of medium quality, but the limits are from 2f to 10| acres in the case of better or poorer land. The total value should not exceed 4000 kr. (£222). The interest payable on the loan received from the state is 3 per cent. The loan itself is repayable after the first five years by annual in- stalments of 4 per cent, until half is paid off ; the remain- der by instalments of 3^ per cent., including interest, i Provision is, however, made for cases where the borrower desired to pay off the loan in larger sums. Eegulations are laid down regarding the transfer of such properties and also their testamentary disposition. The Treasury was empowered to devote a sum of 2,000,000 kroners (£111,000) to this purpose for five years ; after that the land is subject to revision.'

Even before this law was passed Denmark was a country of small holdings, the peasant farms amounting to 66 per cent, of the whole, and the number is bound to increase,^since the incorporation of farms is illegal, while there is no obstacle to their division. Between 1836 and 1885, the number of small holdings of less than one ton- dekarthorn increased from 24,800 to 92,856. What gives

point to these remarks is, that Denmark seems in the way to arrest its rural exodus, and was one of the first coun- tries to escape from the agricultural depression due to the extraordinary fall in grain prices.

Authorities. — Walter of Henley's Husbandry. — T%e Eng- lish Village Community, by Frederic SeebOhm. — Annals of Agri- culture, by Arthur Young. — The Agricultural Labourer, by T. E. Kebbbl. — Beport on the Employment of Women and Children in Agriculture, 1867 (historical

sketch by Messrs Tremenhebre andTuENALL). — A Study of Small Holdings, by W. E. Bear. — The Law and the Labourer, by C. W. Stubbs. — " Agricultural Holdings in England and Abroad," by Major Cbaigie {Statistical Society^s Journal, vol. 1.). (p. a. g.)

Alloys. — The derivation of this word is very clear. The old French cdei, which was retained in the Norman as allai or alai, comes from alleium or alaium, the original being probably ad-ligo (alligo), to bind together. In the modern sense it would be dif&cult to find a better de- scription of the nature of an alloy than that given by the metallurgist Biringuccio in 1540, who says that an alloy only signifies an intimate association of one metal with another.

From a modern point of view the question immediately arises whether the associations of metallic elements give results which are in any way different from the juetais union of a metal with a non-metal. Though the and non- whole tendency of modern work has been to '"etais. break down the barrier between metals and non-metals, still in some ways alloys appear to present a special case of union. Metallic vapours are miscible with any other gas, but metals and non-metals do not seem to unite to form a liquid or solid solution. Nor, it should be re- membered, do all metals mix and form a solid mass which is uniform in composition. It has been held that there is no non-metallic solvent for a metal which acts without recognizable chemical action, or one from which the pure metal can be obtained by crystallization. Metallic com- pounds wiU, however, dissolve readily in metals ; thus, cuprous oxide dissolves in metallic copper. Metallic sulphides again will dissolve in metals, e.g., silver sul- phide in lead, and lead in sulphide of lead, and the sulphides will crystallize out from the metallic solvent. In this way bismuth sulphide crystallizes from bismuth. The solubility of carbon in iron, and its separation as graphite from the solvent, is a fact of great industrial importance. It is also considered that no isomorphous mixture of a metallic and a non-metallic substance is known. The molecular structure of a metal appears, therefore, to present some differences from that of a non- metal. Metals possess a characteristic property of con- ducting electricity without an attendant transfer of matter. This is known as metallic conduction. It has been shown that the diffusion of one metal

into anbther can take place in solid metals at compeiratively low tem- peratures, that is, at temperatures which are far below the melting-points, either of the metals undergoing diffusion, or of the alloys which result from their union. In comparatively recent years a large amount of attention has been devoted to the investigation of the properties and constitution of alloys.

In ordinary cases the constituent metals of alloys are united by melting them together and stirring the molten mass. The action is, however, far from being a simple one, as the union is not merely due to the mechanical stirring, but to the fact that the metals dissolved in each other become spread uniformly by true diffusion. In some cases, the constituent metals of an alloy which are miscible when fluid, separate if the fluid mass is allowed to rest, while in other cases partial sepa- ration occurs even after the bulk of the mass has become solid. It sometimes happens that metals will unite at temperatures which are far below those required to fuse

them ; to the union so effected the term cementation is applied. A very interesting observation was made in 1820 by Faraday and Stodart, who, in the course of an in- vestigation on the alloys of iron with other metals, note their failure to produce certain alloys by cementation, but consider it " remarkable " that platinum will unite with steel at a temperature at which the steel is still solid. This early recognition of the fact that alloys can be produced by cementation is very curious, and shows that Faraday and Stodart had observed a creeping mole- cular action to occur at a temperature below the f using- point of either platinum or carburized iron. So long ago as 1878 W. Spring showed that under a pressure varying from 13 to 47 tons per square inch, metallic filings will unite into solid masses which under pressure behave like fluids and truly flow through the apertures of the recep- tacle in which they are compressed. This fact lends support to the view that cohesion is a form of chemical affinity. By compressing, in a finely divided state, 15 parts of bismuth, 8

parts of lead, 4 parts of tin, and 3 parts of cadmium, an alloy is produced which fuses at 100° C. Hallock found that metals might be imited without pressure, if they were heated to the melting- point of the alloy to be formed, that is, to a point which as a rule is much below the melting-point of the least fusible constituent.

It has long been known that brass may be formed by electro- deposition from a solution containing copper and zinc. In this connexion J. B. Senderens has made a very interesting series of experiments on the precipitation of one metal from solution by another metal. He points out that Kichter in his researches, published between the years 1796-99, was led to the promulgation of the law which is now expressed as follows: "Metals are pre- cipitated from their saline solution atom for atom of the same valency." Senderens shows that this is not rigorously accurate, since the amo.unt of the precipitating metal is always in excess. Thus, in the well-known reaction employed in refineries for the precipitation by copper of silver from sulphate solutions, in accordance with the equation — ^AgS04-|-Cu=Ag+CuS04, if the solution of sulphate of silver contains 4-5 grammes of the salt in a litre of water, a plate of copper immersed in it for seven days will be found to have lost 0-012 gramme more than theory demands. Senderens shows that this fact is of singular interest in relation to the allotropy of iron, but his work is quoted here on account of its bearing on the formation of alloys in the "wet way." Several chemists, among whom Planch 6 and Brugnatelli may be specially mentioned, have thought that alloys might be so prepared, while Gay-Lussac at first favoured that opinion, but abandoned it later. So long ago as 1857, in a remarkable paper on "The Reciprocal Precipitation of Metals," Odling showed that a piece of copper coated with cadmium, and a coil of copper and cadmium foils rolled up together, behave very differently when treated with hydrochloric acid, the metallic deposit of cadmium partaking of the character of an alloy. Such precipitation of one metal on another he attributes to the affinity of one metal for the other. He in fact formed alloys in the " wet way." More recently Mylius and Fromm have shown that alloys may be precipitated from dilute solutions by zinc, cadmium, tin, lead, and copper. Thus a strip of zinc plunged in a solution of sulphate of silver containing not more than 0-03 gramme of silver in the litre, becomes covered with a flooculent precipitate which is a true alloy of

silver and zinc, and in the same way, when copper is precipitated from its sulphate by zinc, the alloy formed is brass. They have also formed certain alloys of definite composition such as AuCds, Cu2Cd, and, more interesting still, CusSn. If volatile metals in the form of vapour are brought in contact with non- volatile metals, union will in many cases ensue. It has been shown that alloys of platinum and palladium with cadmium, zinc, and magnesium may be so produced.

In the classical monograph on alloys published by Matthiessen in 1860 (Phil. Trans. B. S.), it was clearly Alloys as Stated that alloys must be considered to be solid- soiu ified solutions. Few generalizations have been

solutions. j^Qj-e fruitful in results, and much modern work has been devoted to the developmBnt of the view. The constitution of solutions has been very closely studied in recent years, and from the point of view of their freezing- poinfk F. Guthrie has shown that solutions of metals ia

each other behave like ordinary aqueous solutions of salts.

His actual results for solutions of common salt in water

are given in Fig. 1.

If, for instance, a g

thermometer be |

placed in a 10 per J

cent, solution of g

salt in water which |

is being slowly s

cooled by means

of an external

freezing mixture.

Fig. 1.

the mercury will halt in its fall at about 8° C, owing to the separation of pure salt-free ice. This gives the point d on the branch AB. The mercury then continues to fall until the temperature of 22° C. is reached, and the cryo-hydrate or eutectic of ice and salt solidifies. This eutectic, as has been abundantly shown, consists merely of a very intimate mixture of ice and salt in juxtaposition. As the degree of concentration of salt in the original solu- tion increases, the initial freezing-point on the branch AB will become lower and lower, while the second freezing- point always remains constant at — 22° C. ; and when the solution contains 23-5 per cent, of salt, both freezing-points coincide in the point B at — 22° C. The salt branch of the diagram is a very steep one, because the melting-point of pure salt is above 700° C Take on this branch a point e representing water containing more salt than 23‘5 per cent., say 25 per cent. In this case the first solid to sep- arate on cooling is pure salt, and it does so at — 12° C, which, for this degree of concentration is the first halting stage of the thermometer ; the second is, as before, the solidification of the

eutectic of salt and ice, which always has the same composition, and freezes at the same tem- perature, namely 22° C. The diagram therefore has two branches joining at B a horizontal line. This curve has been described at some length, because curves representing the freezing-points of any series of alloys may be derived in the same way. Guthrie considered that alloys in cool- ing behave like a cooling mass of clear molten granite. This would throw off in cooling "atomically definite" bodies, leaving behind a fluid mass not definite in compo- sition, since the quartz and felspar undergo solidification before the mica. In alloys much the same thing happens, for when a molten mass of lead and bismuth, or bismuth and tin, cools, a certain alloy of the metal falls out, just as the quartz and felspar did, and ultimately the most fusible alloy of the series is left. This is called by Guthrie the eutectic alloy, but the proportions between the con- stituent metals are not atomic, and Guthrie pointed out that " the preconceived notion that the alloy of minimum temperature of fusion must have its constituents in simple atomic proportions, and that it must be a chemical com- pound, seems to have misled previous investigators " ; but he adds " that certain metals may and do unite with one another in the small multiple of their combining weights, may be conceded; the constitution of eutectic alloys is not in the ratio of any simple multiple of their chemical equivalents, but their composition is not on that account less fixed, nor are their properties the less definite." The constitution of eutectic alloys as revealed by the microscope will be dealt with in the article on Metal- lography.

Mendel^eff regards solutions as strictly definite atomic chemical combinations at temperatures higher than their dissociation temperatures. Definite chemical substances may be either formed or decomposed at temperatures which are higher than those at which dissociation begins ; the same phenomenon occurs in solutions. In order to show how close the relation is between freezing solutions of salt in water and in an alloy, no simpler case could well be taken

than the lead-tin series given in Fig. 2. It represents, more- over, a series in which the freezing-points are well within

range of the ordinary mer- curial thermometer, and of which the complete freez- ing-point curve is exactly of the same order as that which represents the freez- ing of a solution of salt, as Eoberts-Austen has shown. For alloys of which the meltiug- points are beyond the range of the ordinary mercurial thermometer, some fornr of pyrometer must be employed. Heycock and Neville, in a very elaborate and prolonged series of investigations on the freezing-point curves of alloys, have used the platinum resistance pyrometer, and they determine the points at which alloys solidify or metallic constituents fall out of solution by noting the points at which the electrical resistance (as measured by a Wheatstone Bridge) remains constant. Roberts- Austen, on the other hand, has devised a recording pyrometer for use with a thermo-junction. This instrument traces auto- graphically on a sensitized plate the cooling curve of any definite alloy, the halting places corresponding to the arrests in the fall of the mercurial column in an ordinary thermometer being indicated by more or less horizontal portions. H. le Chatelier has thrown much light on the question of the fusibility of alloys. He points out that in considering them as solutions it is necessary to modify the view in which ordinary solutions are regarded. In ordinary chemical language, it is usual to distinguish the solvent from the body which is dissolved, but really the two bodies play the same part. Many aqueous solutions, as he shows, can exist below the freezing-point of water : that of chloride of calcium, for instance, which is liquid down to —55° C. He demonstrates that the typical curves which represent the fusibility of alloys have in each case corresponding curves in saline solutions, and in con- firmation quotes experiments by Loewel and Bakhuis- Eoozeboom, together with his own results, especially referring to the freezing-point curves of isomorphous mixtures of certain organic substances first recorded by Kuster. The result of Le Chatelier's very interesting work is the division of the freezing-point curves of alloys into the following classes : — In the first the metals dissolving each other give neither definite compounds nor isomorphous mixtures. The curves of this class consist of two branches as is shown by the lead-tin curve in Fig. 2, in which composition and temperature are co- ordinates, and it would appear that when a curve is

composed of two branches only it is safe to conclude that after solidification the two isolated metals are sim- ply in juxtaposition. In the second case, the two metals give rise to one or more definite compounds. Here, as in the case of a solution of sulphate of soda in water, one branch of the curve is

peculiar and characteristic.

If the compound which is Composition.

formed between the two met- ^^S- 3.

als fuses without dissociation, there will be a maximum point iu the curve which corresponds to the definite compound, and the curve will be of the form shown by Roberts-Austen's gold-aluminium curve in Fig. 3. H. le Chatelier has found similar curves for the copper-tin alloys. In the case of the aluminium-gold series the maximum point occurs, as Fig. 3 shows, at the alloy AuAlj, the freezing-point of which is higher than that

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of pure gold itself. If the compound formed in the alloy is dissociated, the portion of the curve which marks its presence will be rounded. With regard to the gold- aluminium series, Heycock and Neville have shown that it presents a very compli- cated case, as not merely one com.pound (AuAlj), but several compounds of gold

and aluminium are formed. Compooitiom.

In the third case, the two ^'£- ^•

metals which are dissolved in each other form isomor- phous mixtures. In this group the freezing-points of the alloys of the series lie on a straight line, Fig. 4, as do the silver-gold alloys examined by Schertel. This question is very important, and Gautier has given several instances of such isomorphous alloys, among which that of antimony and bismuth may be cited.

Metals do not appear to have been studied from the point of view of surfusion until 1880, when A. D. van Riemsdijk showed that gold and silver would both pass below their actual j freezing-points without becoming solid. Roberts-Austen pointed out that surfusion might be easily measured in metals and in alloys by the sensitive method of recording pyrometry to which reference has already been made. He also showed that the crossing of curves of solubility which had already been observed by H. le Chatelier and by Dahms in the case of salts could also be measured in the lead-tin alloys (Fig. 2\ The investigation of the mutual rela- tions of partially miscible liquids due to Alexejew, Konovalow, and to Duclaux was extended to alloys by Alder Wright. The addition of a third metal will sometimes render the mixture of two other metals homo- geneous. Heycock and Neville proved that when one metal is alloyed with a small quantity of some other metal the solidification obeys the law of Raoult. They also showed that the molecule of a metal when in dilute solution often consists of one atom. There are, however, numerous exceptions to this rule. In the case of alumin- ium dissolved in tin and mercury or

bismuth in lead, it is a?b least probable that the molecules in solution are Alj, Hg2, and Bi2 respectively, while tin in lead appears to form a molecule of the type Sn4.

Matthiessen in the paper already referred to showed that the electrical conductivity of all alloys maybe represented graphically by three types of curves. Gold and electrical silver alloyed afford an instance of the first of conduc- these types, there being a rapid decrease in the ”””<>‘■ conductivity (or increase in the resistance) when either silver is added to gold or gold to silver. The tin-copper alloys are, as regards electrical conductivity, types of the L-shaped curve. There is a rapid diminution of conductivity when tin is added to copper, and at a certain point there is an abrupt bend, and the curve proceeds more or less horizontally. More recent work has, how- ever, shown that there are certain breaks where the definite compounds SnCug and SnCui occur. The conductivities of tin and lead are both low, and the lead-tin series is represented by a straight line connecting the two metals. The conductivity curve of these alloyed metals represents the third type. For the details reference must be made to Matthiessen’s memoir. At low temperatures, Dewar and Fleming have shown that the conductivity of pure metals increases greatly as the temperature is diminished. Gold, in the purification of which elaborate precautions were taken, appears to present a very good instance. On the other hand, the conductivity of alloys does not increase with diminution of temperature in the same manner, and a marked contrast between the behaviour of metals and

alloys is thus presented. Eayleigh has pointed out that this difference may arise from the heterogeneity of alloys. When a current is passed through an alloy, a series of Peltier effects, proportional to the current, are set up between the particles of the different metals, and these create an opposing electromotive force which is indis- tinguishable experimentally from a resistance. If the alloy were a true chemical compound the counteracting electromotive force should not occur, and experiments in this direction are much needed. Roberts-Austen has shown that in the Case of molten

alloys the conduction of electricity is apparently metallic, no transfer of matter attending the passage of the current. A group of bodies may, however, be yet discovered between alloys and electrolytes in which evidence may be found of some gradual change from wholly metallic to electrolytic con- duction. Laurie has determined the electromotive force of a series of copper-zinc, copper-tin, and gold-tin alloys, and as the result of his experiments he points to the existence of definite compounds. Explosive alloys have been formed by Deville and Debray in the case of rhodium, iridium, and ruthenium, which evolve heat when they are dissolved in zinc. When the solution of the rhodium-zinc alloy is treated with hydrochloric acid, a residue is left which undergoes a change with explosive violence if it be heated in vacuo to 400°. The alloy is then insoluble in " aqua regia." The metals have therefore passed into an insoluble form by a comparatively slight elevation of temperature. The feature of the period from 1875 to 1901 has been the increased attention which has been devoted to the ap- industriai plications of the rarer metals. Thus nickel, appiica- which was formerly used in the manufacture tioas. qJ « German silver " as a substitute for silver, is

now widely employed in naval constructi'on, and in the manufacture of steel armour-plate, projectiles, and, when alloyed with copper, the envelopes of bullets. Manganese not only forms with iron several alloys of great interest, but alloyed with copper is used for electrical purposes. Chromium also, in comparatively small quantities, is tak- ing its place as a constituent of steel axles and tyres, and in the manufacture of tool-steel. Vanadium, molybdenum, and titanium may be expected soon to play an important part in the constitution of steel. Titanium is alloyed in small quantities with aluminium for use in naval archi- tecture. The importance is now widely recognized of considering the mechanical properties of alloys in con- nexion with the freezing-point curves to which reference has already been made, but the subject is a very com- plicated one, and all that need be said here is that when considered in relation to their melting-points the pure metals are consistently weaker than alloys. The presence in an alloy of a eutectic which solidifies at a much lower temperature than the main mass, implies a great reduction in tenacity, especially if it is to be used above the ordinary temperature as in the case of pipes conveying super-heated steam. It may also be stated that alloys of metals

with similar melting-points have higher tenacity when the atomic volumes of the constituent metals differ than when they are nearly the same.

For further information the reader may refer to: — Egberts- Austen. Reports i'. to vi. to the Alloys Besearch Committee of the Institution of Mechanical Engineers, London, 1891 to 1899 ; Intro- duction to Study of Metallurgy, London, 1898 (see section devoted to Alloys for references to foreign papers). — Cantor Lectures on Alloys delivered at the Society of Arts, 1884-1901. — Heycock and Neville. Various papers Transactions of the Royal Society and Journal of the Chemical Society, 1890 to the present time. — Osmond, Le Chatelier, Charpy, and Others. Bull. soe. de V encouragement pour Vindustrie nationaHe, Paris (various papers 1880 to present year, especially last ten years). — Eobbbts-Austen and Stansfield. "La constitution des alliages mfitalliques," Beport of the Physical Congress, Paris, 1900, vol. i. Gauthier Villaif-s, Paris. — W. Spring. Bull, de Vacad. ray. de Belgique,

1878 to recent years.— R. H. Thurston. Materials of Engineering. Wiley, New York. (w. C. B.-A.)

Allport, Sir James Joseph (1811-1892), English railway manager, born 27th February 1811, was a son of William Allport, of Birmingham, and was associated with railways from an early period of his life. In 1843 he became general manager of the Birmingham and Derby railway, and in the following year succeeded to the same position on the Newcastle and Darlington line. • Six years later he assumed the charge of the Manchester, Shefiield, and Lincolnshire (now the Great Central) railway, and finally, in 1863, was appointed to the general managership of the Midland railway — an office which he held con- tinuously, with the exception of a few years between 1867 and 1860, until his retirement in 1880, when he became a director. During these twenty-seven years the Midland grew to be one of the most important railway systems in England, partly by the absorption of smaller lines and partly by the construction of two niain extensions — on the south to London and on the north to Carlisle— ^whereby it obtained an independent through-route between the metropolis and the north. In the railway world Sir James Allport was known as a keen tactician and a vigor- ous fighter, and

he should be remembered as the pioneer of cheap and comfortable railway travelling. He was the first to appreciate the importance of the third-class passenger as a source of revenue, and accordingly, in 1872, he inaugurated the policy — subsequently adopted more or less completely by all the railways of Great Britain — of carrying third-class passengers in well-fitted carriages at the uniform rate of one penny a mile on all trains, even the fastest.. The diminution in the receipts from second-class passengers, which was one of the re- sults, was regarded by some authorities as a sign of the unwisdom of his action, but to him it appeared a sufficient reason for the abolition of second-class carriages, which therefore disappeared from the Midland system in 1876, the first-class fares being at the same time substantially reduced. This innovation too has been followed by other companies, though not with the same unanimity as at- tended his earlier reform. He was also the first to intro- duce the Pullman car on British railways. Allport received the honour of knighthood in 1884. He died in London on 26th April 1892. (h. m. r.)

Almada, a town of Portugal, district Lisbon, on the left bank of the Tagus, immediately opposite Lisbon, with manufactories of cork. It was founded by English crusaders in the reign of Affonso Henriques. Population about 7000.

Almaden, or Almaden del Azogue, a town of Spain, in the province of Ciudad Eeal, in the Sierra Moreno. In the latter part of the 19th century the Almaden quick-silver mines were leased by the state to the house of Rothschild, whose contract expired in 1900, but who still sell the quicksilver for the Spanish Government. The town has a good hospital, schools, and other build- ings. Care is taken to minimize the effects of the fumes on the operatives, whose health is very rapidly and seri- ously impaired. Hence the custom formerly was to use convicts for the labour in the quicksilver mines. Owing to the deleterious effects of the atmosphere, exemption from military service is granted to men who have been two years employed in the quick-silver mines. The average output of mercury is' 10 per cent, on the ore extracted, and, according to official returns, 75 per cent, of the value of the output is clear profit. In 1898 there were 1906 men and 417 lads employed in the mines. The amount of ore extracted

was 19,945 tons, from which 1595 tons- of quicksilver were drawn, being 46,211 flasks weigh-

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ing 55,000 lb . Intlie Arrayaues sulphurous and lead mines 930 men, 18 women and 35 lads were employed, and 18,962 tons of ore were extracted in 1898. The Almaden conces- sion covers over 490,872 acres ; the Arrayanes only 1397 acres. Population, 7388.

Alma-Tadema, Sir Laurence (or Laurens),

British artist, was born on the 8th of January 1836, at Dronryp, a Friesian village near Leeuwarden, the son of Pieter Tadema, a notary, who died when he was four years old. Alma was the name of his godfather. His mother (d. 1863) was his father's second wife, and was left with a large family. It was designed that he should follow his father's profession; but he had so great a leaning towards art that, after a long struggle between duty and inclination, during which his health broke down, he was sent to Antwerp, where in 1852 he entered the academy under Gustav Wappers, the leader of that romantic movement in Belgian art which was fast oblit- erating the old classical school of David. Thence he passed to the atelier of Henri (soon afterwards to become Baron) Leys. In 1859 he assisted Leys in his frescoes in the hall of the HStel de Ville at Antwerp. In the exhibition of his collected works at the Grosvenor Gal- lery in London in the winter of 1882-83 were two pictures which may be said to mark the beginning and end of his first period. These were a portrait of himself, dated 1852, and " A Bargain," painted in 1860. His

first great ‘ success was a picture of “The Education of the Children of Clovis ” (1861), which was exhibited at Ant- werp. In the following year he received his first’ gold ^ medal at Amsterdam. The ” Education of the Children of Clovis ” (three young children of Clovis and Clotilde prac- tising the art of hurling the axe in the presence of their widowed mother, who is training them to avenge the mur- der of their own parent) was one of a series of Merovingian pictures, of which the finest was the ” Fredegonda ” of 1878 (exhibited in 1880), where the dejected wife or mis- tress is watching from behind her curtain window the mar- riage of Chilperic I. with Galeswintha. It is perhaps in this series that we find the painter moved by the deepest feeling and the strongest spirit of romance. One of the most passionate of all is ” Fredegonda at the Deathbed of Prsetextatus,” in which the bishop, who has been stabbed by order of the queen, is cursing her from his dying bed. Another distinct series attempts to reproduce the life of ancient Egypt. One of the first of these was called “^Egyptians 3000 Years Ago,” and was painted in 1863. A profound depth of pathos is sounded in ” The Death of the First-born,” painted in 1873. Among his other notar ble Egyptian pictures are ” An Egyptian at his Doorway ” (1865), “The Mummy” (1867) (depicting the family of the defunct bringing offerings to a mummy which stands on end at the right of the spectator), ” The Chamberlain of Sesostris” (1869), “A Widow” (1873), and “Joseph, Overseer of Pharaoh’s Granaries ” (1874). On these scenes from Frankish and Egyptian life Alma-Tadema spent great energy and research; but his strongest art-impulse was towards the presentation of the life of ancient Greece and Eome, especially the latter. Amongst the best known of his earlier pictures of scenes from classical times are ” Tarquinius Superbus ” (1867), ” Phidias and the Elgin Marbles” (1868), and “The Pyrrhic Dance” and “The Wine Shop ” (1869). ” The Pyrrhic Dance,” though one of the simplest of his compositions, stands out distinctly from them all by reason of its striking movement. ” Phidias and the Elgin Marbles ” is the first of those glimpses of the art-life of classical times, of which « Hadrian in England,” ” The Sculpture Gallery,” and « The Picture Gallery ” are later examples. ” The Wine Shop ” is one of his many pictures of historical genre, but

marked with a more robust humour than usual. In 1863 Alma-Tadema married a French lady, with whom he lived at Brussels till 1869, when she

died, leaving him a widower with two daughters, both of whom have since made repu- tations— one in art, the other in literature. In 1869 he sent from Brussels to the Royal Academy two pictures, “Un amateur Eomain” and “Une danse Pyrrhique,” which were followed by three pictures, including “Un Jongleur,” in 1870, when he came to London. By this time, besides the distinctions he gained in Holland and Belgium, he had been awarded medals at the Paris Saloh of 1864 and the Exposition Universelle of 1867. In 1871 he married an English lady. Miss Laura Epps, who, under her married name, has also won a high reputation as an artist. After his arrival in England Alma-Tadema’s career was one of continued success. Amongst the most important of his pictures during this period are—” The Vintage Festival ” (1870), ” The Picture Gallery ” and « The Sculpture Gallery ” (1875), “An Audience at Agrippa’s” (1876), “The Seasons” (1877), “Sappho” (1881), “The Wlay to the Temple” (1883), his diploma work, “Hadrian in Britain” (1884), “The Apodyterium” (1886), “The Women of Am- phissa ” (1877), ” The Eoses of Heliogabalus ” (1888), ” An Earthly Paradise” (1891), and “Spring” (1895). Most of his other pictures have been small canvases of exqui- site finish, like the « Gold-fish ” of 1900. These, as well as all his works, are remarkable for the painting of flow- , ers, textures, and hard reflecting substances, like metals^ pottery,’ and especially marble. He paints with much of the fine execution and brilliant colour of the old Dutch masters. By the human interest with which he imbues all his scenes from ancient life he brings them within the scope of modern feeling, and charms us with gentle sentiment and playful humour. He has also painted some fine portraits, including those of Mr Arthur Bal- four, Mr Henschel, Herr Eichter the musician, and Dr Joachim. He was knighted on the occasion of Queen Victoria’s eighty-first birthday, 1899. He was made an associate of the Eoyal Academy in 1876, and a Eoyal Academician in 1879. He is a knight of the order Pour le Merite of Germany (Arts and Science Division) ; of Leo- pold, Belgium ; of the Dutch Lion ; of St Michael of Bava^ ria ; of the Golden Lion of Nassau ; and of the Crown of Prussia. He is an officer of the Legion of Honour, France. He is a member of the Eoyal Academies of Munich, Ber- lin, Madrid, and Vienna. He received a gold medal at Berlin in 1872, and a grand medal at Berlin in 1874 ; a first-class medal at the Paris International Exhibition of 1878, and medals of honour at the Paris Exhibitions of 1889 and 1900. He is a member of the Eoyal

Society of Water-colours. He received letters of denization from the Crown in 1873.

See also 'Geoeg Ebees. "Lorenz Alma-Tadema," Westermanri's Monatshefte, November and December 1885, since republished in volume form. — Helen Zimmern. "L. Alma-Tadema, his Life and Work," Art Annual, 1886. — C. Monkhouse. British Con- temporary Artists. London, 1899. (c. M.)

Almendralejo, a town of Spain, province of Badajoz, 27 miles E.S.E. of Badajoz. Population, 11,766. It has doubled in importance since 1880, owing to the fertility of its neighbourhood, the cereals, fruit, and wine produced in which are easily exported by the Merida-Sevilla railway. There are thirty-six factories for the production of brandy. The town is well built, with broad streets, a good theatre, a bull-ring, and many private mansions.

Almeria, a maritime province in the S. of Spain, with an area of 3300 square miles. The Linares- Almeria

railway was completed in 1898, also a line connecting the three provinces of Almeria, Granada, and Jaen, and the three with Madrid. Another line from Baeza to Linares is near completion. The local industries have developed with the growth of the means of communication in the last decade. Manufactures of textiles, chocolate, matches, bricks and chalk, oil and flour mills, foundries, have attained importance. Agricultural interests have received a great impulse in the valleys nearest the sea and on the banks of the Almanzora, Antas, and Aguas. Viticulture has been much developed, chiefly with a view to meet the increasing foreign demand for the fruit ; a great number of new plantations have been made to replace the indigenous vines. Esparto grass, oil, cereals, barley, have also been exported in greater proportion than a few years ago. Mining

interests have been given a considerable impulse by foreign and native capital. The province contained, in 1898, 210 working mines, covering 4710 acres. Of these 14 were zinc mines, 66 iron, 102 lead, and 21 argen- tiferous lead. The number of hands employed in 1898 was 6449 ; a few hundred were engaged in 3 lead and 6 argentiferous lead works. The Sierra Alhamilla railway brought down 50,086 tons of iron ore in 1898. A short rail- way is being constructed between Calahorsa and Alguip to work ten million tons of fine ore at Alguip. The live stock consisted, according to the latest official statistics, of 1163 horses, 11,983 mules, 16,221 donkeys, 3299 oxen and cows, 128,078 sheep, 30,513 goats, and 15,041 pigs. 60,350 acres were devoted to the culture of wheat, 105,000 acres to other cereals, 6500 acres to vineyards, 5000 acres to olive plantations, and 44,500 acres to pod fruit. The population in 1897 was 344,681, or only 78 to the square mile. Education is still ia a backward condition, though some improvement has taken place in the last twenty years. With a higher rate of births than deaths the population has yet not increased, because of the steady flow of emigration, which carries away to French Algeria annually from 2000 to 3000 Almerians. ^

Almeria, a port of Spain iu the above province. Population, 46,806. It has greatly grown in importance, and in 1898, 1130 vessels, with a total tonnage of 638,551, entered, exactly the same number of vessels and tonnage clearing. In 1897, 178 British vessels of 173,133 tons entered and Cleared ; in 1898, 191 British vessels (only 13 with British cargoes) of 183,125 tons. Imports m 1898 were chiefly coal, 14,430 tons ; patent fuel, 4331 tons ; timber, cod, steel, and railway bars. In the export trade 143 British vessels cleared for Great Britain and her colonies with 129,973 tons. Exports were 135,000 tons of iron ore, valued at £56,700 ; 658,530 barrels of grapes, £237,071; 17,300 tons of esparto, £69,200; and 24,000 cases of almonds, oranges, melons, pomegranates. The western pier, recently built, is 1 mile 77 yards in length, and has a depth of 8 fathoms at the end.

Almodovar del Campo, a town of Spain, in the province of Ciudad Real, 18^ miles S.S.W. of Ciudad Eeal. There are lace and linen factories. Population in 1897, 12,110. It was formerly an Arab fortress, hence its name, meaning a sphere. '

Almora, a town and district of British India, in the Kumaun division of the North-West Provinces, situated on a mountain-ridge 5494 feet above the sea. J'opulation (1881), 7390; (1891), 7826; municipal income (1897-98), Rs.10,135. It has a college, called after Sir Henry Eamsay ; a government high school, a Christian girls' school, and 4 printing presses.

The district of.ALMOEA was recently constituted, together with Naini Tal, by a redistribution of the two former districts of Kumaun and the Tarai. It lies among

the mountains of Kumaun, between the upper waters of the Ganges and the Gogra, here called the Kali. Area, 5416 square miles ; population (1891), 411,501, the aver- age density being 77 persons per square mile; (1901), 465,876, showing an increase of 13 per cent. The land revenue and rates are Es.2,65,946 ; the incidence of as- sessment being R.0 : 12 : 5 per acre ; the cultivated area in 1896-97 was 239,684 acres, of which 2602 were under tea ; the number of police was 68 ; there are 122 ver- nacular schools, with 4080 pupils ; the death-rate in 1897 was 24 per thousand. The district includes the military- sanatorium of Eanikhet. The nearest railway vid Naini Tal is the extension of the Oudh and Eohilkhand ^ine from near Bareilly to Kathgodam.

Alnwick, a market-town, under an urban district council, and the county town of Northumberland, England, in the Berwick-upon-Tweed parliamentary division of the county, on the Aln, 34 miles N. by W. of Newcastle by rail. By prescription, Alnwick is a borough, and its free-men form a body corporate. This body has no authority over the affairs of the town, but, by the Alnwick Corporor tion Act, 1882, it is required to expend, out oi. corporate property, not less than £500 a year in payment of teachers' salaries, &c. in connexion with the corporation schools. The peculiar ceremonies long observed in the initiation of freemen are now discontinued. Area 4777 acres; population (1881), 6693; (1891), 6746; (1901), 6716. Area of parish, 16,986 acres ; population (1881),

7440; (1891), 7428; (1901), 7386.

Alora, a town of Spain, in the province of Malaga, 17 miles W.N.W. of Malaga, on a spur of mountains commanding a fertile plain where maize,

sugar-cane, and palms are grown. There are distilleries, Arab ruins of some importance, and sulphurous springs, and the town is a favourite summer resort for wealthy families from Mal- aga. Population (1897), 10,308.

Alost (Flemish Aelst), a town of Belgium, on the eastern frontier of the province of East Flanders, on the river Dender, 17 miles S.E. of Ghent by rail. Jute yarns and tissues are manufactured. Population (communal)

(1880), 20,679 ; (1890), 26,544; (1897)28,771.

Alpena, a city of Michigan, U.S.A., the capital of AJpena county, situated on the eastern side of the lower peninsula, on Thunder Bay, an arm of Lake Huron, at an altitude of 607 feet. Its excellent harbour attracts much lake commerce. It is entered by the Detroit and Mack- inaw railway. Its industries consist mainly in the manufacture of lumber, shingles, and laths. The popu- lation in 1880 was 6153, in 1890 it was 11,283, and in 1900 it was 11,802.

Alpes, Basses, a department in the S.E. of Fi'ance, traversed by the Alps of Provence, and watered by the Var, the Durance, and its affluents, the Buech, the Ubaye, the Bl^onne, and the Verdon. Area, 2699 square miles, distributed among 30 cantons and 250 communes. The population fell from 129,494 in 1886 to 112,763 in 1901. The inhabitants readily emigrate to America, more particularly to Mexico. Births in 1899, 2441, of which 63 were illegitimate ; deaths, 2537 ; marriages, 797. The chief towns are Digne (7751 inhabitants in 1896), Bar- celonriette, Castellane, Forcalquier, Sisteron, and Man- osque. In 1896 there were 604 primary schools, with 18,757 pupils. Nine per cent, of the population was illiterate. The soil of the department is poor in the mountainous region, but more fertile in the valley of the Durance, especially in the neighbourhood of Manosque. The surface under cultivation comprised 841,380 acres in

1896, of whicli 346,800 acres were in cereals, 172,900 acres in forest, and the rest in grass. The value of the wheat crop in 1899 was £432,810. Rye, barley, oats, as also fodder, give inferior returns, but olive and mulberry are cultivated with success, and the rearing of the silk- worm yields good results — 2283 cwts. of cocoons in 1899. There ai-e few hbrses, but the Basses Alpes is among the departments most abounding in mules. In 1899 the live stock numbered 13,570 head of mules and asses, 6920 cattle, 318,350 sheep, 30,270 pigs, and 25,420 goats. The mining industry is not important, counting in 1899 about 3000 tons of coal ,and 5000 tons of lignite, and the indus- try in metals comprises only a few workshops. Altor gether the department ranks among the least rich in Trance.

Alpes, Hautes, a department in the S.E. of France, traversed by the Alps of the Dauphin^, attaining in the Oisans Mountains 12,000 to 13,000 ft. high, and watered by the Drac and the Durance. Area, 2178 square mUes, distributed among 24 cantons and 187 communes. The population declined from 122,924 in 1886 to 106,857 in 1901. Births (1899), 2519, of which 68 were illegiti- mate ; deaths, 2413 ; marriages, 703. The chief towns are Gap, Brianqon, and Embrun. In 1896 the primary schools numbered 600, with 24,708 pupils. Four per cent. of the population was illiterate. The soil is extremely poor. Out of 795,340 acres under cultivation in 1896, only 212,420 acres were utilized for cereals. In 1898 the wheat crop was of the value of £274,325, by the side of which may be ranked only that of the walnut, the plum, and the mulberry. The production in sUk husbandry in 1899 amounted to only 363 cwts. of cocoons. There is no mining or metallurgic industry of any importance.

Alpes Maritlmes, a department of the S.E. of France, bordering on Italy. It is traversed by the Alps and watered by the Roya and the Var. The climate is mild on the coast, but cold in the interior. Area, 1444 square miles, distributed among 26 cantons and 153 com- munes. Population, 238,057 in 1886,265,155 in 1896, and 320,822 in 1901. There is a strong current of Italian immigration. Births in 1899, 6438, of which 658 were illegitimate ; deaths, 6037 ; marriages, 1848. The chief towns are Nice (93,150 inhabitants in 1896), Grasse, Puget-Theniers, and Cannes. In 1896 there were 480 primary schools, with 24,000 pupils. Seven per cent, of the population was illiterate. The total surface under cultivation was

501,410 acres, of which 156,845 acres were in corn-lands, and 34,580 acres in vineyards. Cere- als and fodder yield small returns — wheat (1899) only £212,720 ; but the production of wine was of the value of £136,000, while the department takes the first rank for the culture of the olive, which amounted in 1899 to 893,000 cwts. Orange and citron, which are also grown, yielded 113,500 cwts. The live stock in 1899 counted altogether 146,050 head, a very low figure, and not com- pensated by the induslarial development. There are some important distilleries.

Alphabet. See Wkiting.

Alphonso XII. (1867-1885), king of Spain, the son of Isabella II. and Maria Fernando Francisco de Asis, eldest son of the duke of Cadiz, was born 28th November 1867. When Queen Isabella and her husband were forced to leave Spain by the revolution of 1868 he accompanied them to Paris, and from thence he was sent to the There- sianum at Vienna to continue his studies. On 25th June 1870 he was recalled to Paris, where his mother abdicated in his favour, in the presence of a number of Spanish nobles who had followed the fortunes of the exiled queen. Shortly afterwards he proceeded to Sandhurst to continue

his military studies, and while there he issued, on 1st December 1874, in reply to a birthday greeting from his followers, a manifesto proclaiming himself the sole repre- sentative of the Spanish monarchy. At the end of the year, when Marshal Serrano left Madrid to take command of the northern army. General Martinez Campos, who had long been working more or less openly for the king, car- ried off some battalions of the central army to Sagunto, rallied to his own flag the troops sent against him, and entered Valencia in the king's name. Thereupon the president of the Council resigned, and the power was transferred to the king's plenipotentiary and adviser, Canovas del CastUlo. In the course of a few days the king arrived at Madrid, passing through Barcelona and Valencia, and was received everywhere with acclamation. In the following year, 1876, a vigorous campaign against the Carlists, in which the young king took part, resulted in the defeat of Don Carlos and his abandonment of the struggle. Early in 1878 Alphonso married his cousin Princess Maria de las Mercedes, daughter of the duke de Montpensier, but she died

~~within six months of her marriage. Towards the end of the same year a young workman of Tarragona, Oliva Marcousi, fired at the king in Madrid. On 29th November 1879 he married a prin~~ cess of Austria, Maria Christina, daughter of the Arch- duke- Charles Ferdinand. During the honeymoon a pastrycook named Otero fired at the young sovereigns as they were driving in Madrid. In 1881 the king refused to sanction the law by which the ministers were to re- main in office for a fixed term of eighteen months, and upon the consequent resignation of Canovas del Castillo he summoned Sagasta, the Liberal leader, to form a Cabi- net. Alphonso died of phthisis, 24th November 1885. Coming to the throne at such an early age, he had served no apprenticeship in the art of ruling, but he possessed great natural tact and a sound judgment ripened by the trials of exile. Benevolent and sympathetic in disposi- tion, he won the affection of his people by fearlessly visiting the districts ravaged by cholera or devastated by earthquake in 1886. His capacity for dealing with men was considerable, and he never allowed himseK to be- come the instrument of any particular party. In his short reign peace was established both at home and abroad, the finances were well regulated, and the various administrative services were placed on a basis that after- wards enabled Spain to pass through the disastrous war with the United States without even the threat of a revolution. (o. B". b.)

Alps. — The writer of the article " Alps " in the ninth edition of this work possessed a more intimate knowledge of that chain than any of his contemporaries. Hence, so far as regards ordinary geography, nothing of importance in it calls for alteration. New surveys have occasion- ally somewhat altered the heights assigned to mountains, a few of which are noticed below, together with one or two minor corrections or additions ; but in one respect, the geology of the Alps and its relation to their structure, very great advances have been made during the last thirty years, and to a brief outline of these this supplementary article will be mainly devoted. Much, no doubt, has yet to be learnt; many questions are still far from being set- tled ; but the labours of numerous invtestigators, Ger- man, Austrian, and Swiss, with some Italian and English, aided especially by the application of the microscope to the examination of rocks, have cleared up not a few dif- ficulties, and laid a safe, foundation for future work.

Perhaps the most important advance has been the knowledge gained in regard to the metamorphic rocks, viz., those in which subsequent changes have' so affected the original structure that we infer rather than recognize

■*what it has been. Formerly most geologists supposed that all schists (using the ~~word in its strict sense of foliated crystalline rocks), together with saccha~~ mlrpbism. ^oidal marbles and gneisses, resulted from the alteration of sediments by the combined action of heat, pressure, and water ; some even going so far as to maintain that certain igneous rocks represented the extremest stage of this process. In their opinion a mud, if of the right chemical composition, might become in the first stage a schist, in the next a gneiss, in the last a granite. This kind of change, it was believed, had oc- curred during every geological period, so that, in the one or the other of these, schists and gneisses were identified without hesitation. Hence Mr Ball not infrequently mentions various Palaeozoic schists. But, whatever may be the case elsewhere, we may venture to af&rm that in the Alps aU. the rocks thus modified are much more ancient than any to which a date can be assigned. Though in most districts we can only prove them pre-Carbonif erous, in the north-eastern region they are pre-Silurian, and in all it is highly probable that they are older than the Paleeozoic era, as usually imderstood. Every effort to strengthen the old hypothesis, and not in the Alps only, has signally failed. For instance, in 1S88 two large stems of a fossil plant were asserted to have been found in a gneiss at Guttannen in Canton Berne, thus proving it to be Carboniferous in age; in 1900 this supposed organism was admitted to be a mere lusiis naturfs. In 1888, also, garnets and staurolites were said to occur in a rock in which belemnites and crinoids could still be recognized, thus establishing the Jurassic age of a great group of schists. . In 1890 it was demonstrated that this far-reaching hypothesis had no better foundation than an erroneous identification of the two minerals, those actually present having no real bearing on the question.*

Of the advances, mentioned above, none is more im- portant than the recognition of the effects due to severe pressure. That it had produced cleavage in Effects of ordinary sediments was long since generally on Alpine ^.dmitted ; that in some cases it had generated rocks. minute scales of mica in vast numbers and con- verted a slate into a " micro'scopic " schist was more than conjectured; but it is now ascertained that crushing due to the great earth movements which have formed mountain chains has produced cleavages even in crystalline igneous rocks, and led to the development of various minerals, especially in connexion with the new surfaces, so that many gneisses and some mica schists are only granite modified by subsequent pressure. Other gneisses, however, and certain cognate schists, especially those with a conspicuous mineral banding, are the result of fluxional movements in the magma at the time of consolidation ; while a third group of schists, and possi- bly some gneisses, may be explained by the old hypothe- sis. One difficulty doubtless still exists: in certain instances it is almost impossible to determine whether a very fine-grained schist represents a stage in the last- named process or results from the'pulverization of a crys- talline rock. This uncertainty, however, does liot vitiate the general statement that a group of true schists can be distinguished from one composed of sediments in which changes only of microscopic magnitude have occurred, neither does it prove that the two may be present in the same geological formation; it only shows that in certain cases nature has so damaged her own inscription that it is no longer legible. t

Thus, the following facts in regard to the nature and age of the Alpine rocks would now be generally admitted by those who have studied them in the field as well as Tinde^ the microscope. Those rocks (mainly sedimentary) which cp;n be assigned to a definite geological age rest

upon a fundamental crystalline mass of much greater antiquity. This appears to be separable into two groups, generally, though not always, rather sharply distinguished. The lower one consists mainly ^eoftbe of granitoid rocks and gneisses, the majority, if n,2ts. not the whole, being igneous rocks modified by subsequent pressure. Some are later in date than others; for instance, the protogine of the Mont Blanc range, long supposed to be the oldest rock, is clearly intrusive in the adjacent gneisses.*

The upper group is mainly composed of mica schists, commonly calcareous, passing on the one hand into marbles, on the other to quartz schists; being thus metamorphosed sediments. With these are associated, sometimes abundantly, horn- blendic and chloritic schists, in great part at least modi- fied igneous rocks. Rocks of similar character occur also, though less frequently, in the other group ; and normal granites, gabbros, and serpentines in both, the age of which has not yet been certainly determined.

These rocks, the foundation-stones of the Alps, are followed, but so far as is known only in the north-east- ern region, by sedimentary deposits of Silurian and Devonian age. Representatives of the Carboniferous system are more widely distributed, though generally in isolated strips, folded in among the crystalline masses. These are commonly dark in colour, and vary from good slates to coarse conglomerates or breccias, which often are full of pieces of the older schists and gneisses. They occasionally contain plant remains or a little anthracite, but marine fossils occur in the Gailthal and elsewhere in the Eastern Alps. The Permian system also is gener- ally represented sporadically, as a rule by grits and con- glomerates, indicating that high ground existed in the neighbourhood; but during this period the region of the South-eastern Alps was the scene of volcanic activ- ity, which produced the great masses of "porphyry" around Botzen and Predazzo, which can be traced west- wards beyond the lower end of Lago Maggiore. Out- breaks of this age can be detected in other localities, as on the Windgelle and to the east of Vernayaz, on the right bank of the Rhone. In South-eastern Tyrol the volcanic discharges continued into th^ Triassic period, and were renewed, in the opinion of some geologists, at a much later date. In this district the Trias is repre- sented by sedimentary strata, consisting largely of pure dolomitic limestones, some of which have been thought to be coral reefs. Be this as it may, the existing moun- tains can hardly represent ancient atolls, as some have supposed. At this period, also, the surface contours of the Alpine region must have been very irregular, for in other parts, notably in the Pennine, Central,, and Dau- phin^ Alps, the Trias is either absent or is represented by friable limestones and even gypsum, often not more than a few feet in thickness.

In regard to the rest of the Mesozoic and the Kaino- zoic systems, little need be added to the account given in the ninth edition of this work, except in regard to a perplex- ing deposit called the Flysch. It is a thick mass of mud- stones, more or less gritty and generally unfossiliferous, which, it is now ascertained, represents identity of physical conditions rather than exact contemporaneity of deposit. In the northern part of the Eastern Alps it begins before the close of the Cretaceous period ; in the southern its greatest extent is from the top of the Middle Eocene to that of the Middle Oligocene. In the Western Alps it ranges, in the Swiss portion, from the bottom of the Mid- dle Eocene to the top of the Lower Oligocene, while in the south it does not begin till the Upper Eocene. It contains locally beds of breccia and even large isolated boulders, the volume of^ which is sometimes, as in the Habkernthal, several cubic yards, representing granites

not known to occur elsewhere in the Alps ; in other places, for example near Sepey, the erratics may not have come from any great distance. But it is difficult to account for their presence. Ice is the most obvious means of trans- port ; but the temperature during Eocene and Oligocene ages appears to have been much higher than it now is, being at a maximum in the former, while no evidence can be found of the existence of mountains on or near the present site of the Alps. Some authorities place the requisite range immediately to the north, supposing its roots to be buried beneath the Miocene deposits of the Swiss lowlands, but it would be strange if such an important mass had so quickly vanished and left " not a radi behind."

A geological map of the whole Alps, on a scale large enough to indicate clearly the above-mentioned divisions,

shows them to be arranged in zones which are s^actJn! rudely symmetrical with the outline of the

chain, the crystalline rocks occupying its central portion. But on examination irregularities appear which are far from unimportant. The southern sedimentary zone, for instance, gradually becomes attenuated &s it is followed from its eastern end westwards, till it disappears rather beyond Lago Maggiore, after which crystalline rocks rise directly frbm the Piedmontese plain. The structure of the chain, also, is the most simple in its eastern .part, a central range of crystalline rock forming the watershed, with two masses of sedimentary rocks flanking it north and south, through which the rivers have cut their paths. But this structure, as we approach the headwaters of the Inn, becomes more complex, as we shall explain in speaking of the hydrography, the change being probably connected with a feature in the geology. The outcrops of the rocks, as we have said, conform to the general course of the chain at its eastern end, trending almost west, but then they gradually sweep round the north Italian plaia till at last they are almost parallel to their original direction. This structure, however, is modified by another of minor, but sometimes considerable importance, which is most conspicuously exhibited in the district about Lago di Garda. Here a broad belt of Mesozoic sedimentary rock, bounded on the south by a line extending approximately from Brescia to Verona, runs across the chain in a N.N.E. direction; flanked on the west by crystallines, and on the east, though less continuously, by the same and by great masses of Permian " porphyry." This belt may be traced by outlying patches across the central range until near Innsbruck it apparently dies out against the northern sedimentary range. It is in this neighbourhood, and the coincidence is significant, that the Alps attain their greatest width from north to south. Here, in fact^ the dominant wave-like folds, of which the Alpine chain is composed, are iiraversed obliquely by a syncline. To the west of this, passing approximately between Chur and Mais, we find traces of a second syncline with the same general trend, but possibly subdivided by a central rise, while the structure of the crystalline rocks between the two mam syncliues hints at the existence of a corre- sponding anticline. A similar structure is suggested in the Bernina group, and yet farther to the west (in maps on a larger scale) ; while from Mont Blanc for a con- siderable distance to the south the whole chain has a general trend, in the same direction, and that is repeated by the outlying crystalline masses, the outcrops of which, as far as Dauphin^, run conspicuously from N.N.E. to S.S.W. How this

structure is connected with the making of the Alps will be presently considered. But since ridge and furrow, swelling and dimple, are closely related on the earth's surface, any complete discussion of the physical history of the Alpine chain must regard it

as inseparable from the Apennines on the one side and the mountains of Istria and Dalmatia on the other, and as related in some way or other to the basin of the Adriatic and the plain of Northern Italy. But putting aside this more general question and restricting ourselves to the Alps proper, we must bear in mind two facts in any attempt to explain their complications : — (!)■ This chain was not the product of a single set of movements, but of two at least, which were separated by a consider- able interval: the one occurring when the Eocene was passing into the Oligocene, the other in like way between the Miocene and Pliocene. (2) That the sedimentary masses thus affected were deposited on an irregular floor of more ancient, chiefly crystalline, rocks ; parts at least of the present site of the Alps having been mountainous districts in Carboniferous and again in Permo-Triassie times. These irregularities in the thickness and strength of materials would cause corresponding inequalities in their resistance to pressure, and thus introduce numerous complications. Still, though allowance must be made for them, the general process in the rise of the Alps can be inferred from the experiments of A. Favre, H. M. Cadell, and Bayly Willis, and be described as follows : — Lateral pressures have formed a group of great folds in the earth's crust; these sometimes have been grad- ually bent over imtil their axial planes became inclined to the horizon. The strain occasionally has continued till the masses have been ruptured along these planes, and the upper portion of the fold has then slid on above the lower, thus producing an " overthrust fault." During these processes the less pliant crystalline masses are crushed and sheared, thus giving rise to structures analogous to cleavage, and often suggestive of bedding. The remarkable folding in the Alpine rocks has long been known, but the recognition of these other structures is comparatively recent, and its absence seriously detracts from the value of not a few geological maps and memoirs. One instance may suffice as an example: — The North Swiss Alps between the valleys of the Eeuss and the Rhine, especially near the Glamisch, exhibit a singularly complicated structure, the strata apparently being bent over to form a double fold, with complete

inversion on both sides. No doubt the arrangement of the strata suggests this structure ; but the mechanics of the process are so difficult to understand that Rothpletz with several other authorities explains it as a combination of overf old- ing followed by great overthrust faulting, and this seems to the present writer far more probable.

Another perplexing structure may be mentioned here which/is found in certain mountains on the northern face of the Alps, such as the Mythen and Stanzerhorn, and has of late attracted much attention. These, called Klippen, are abrupt pyramidal masses, the beds in the upper part being not only older than those in the lower, but also " contorted, fractured, crushed, and mixed up," while the newer are comparatively undisturbed. They are due to overfolding and overthrusting, being remnants of larger masses, the greater part of which has been removed by denudation; but that they have been forced into their present position from so great a distance as the Brian^on- nais, as some have suggested, is hardly possible.

It is now generally admitted that the valleys in moun- tain regions are mainly the results of denudation, though the movements and structures of the uprising land masses must have done much, especially at first, "rajihy. to determine the directions in which the water ran. Thus the Alpine valleys may be divided broadly into valleys of dip and valleys of strike — the former, as the name implies, following the dip of the ■ strata, and so being the narrower and steeper ; the latter running

along their outcrop, and thus the broader and more level. These are generally excavated in a mass softer than those adjacent on either side, whether it is intercalated or infolded. When this mass is prolonged for a great dis- tance the strike valleys are sometimes divided by low watersheds into different drainage systems. Of this, the Upper Ehone, the Eeuss at its outset, and the Vorder Rhein afford an exceUent example. They are

excavated in an infold, composed mainly of Jurassic rocks, which is divided by watersheds at the Furka and Oberalp passes. As valleys of strike are both supplied and drained by valleys of dip, the course of an Alpine river, unless affected by some of the irregularities mentioned above, has a rude resemblance to the outline of a flight of steps.

In the Eastern Alps, and in the isouthern more than in the northern region, the main lines of draiinage run towards the east. The precise cause is not easily determined, but probably it is connected with the rather abrupt cessation of the chain at this extremity. The watershed then follows the central or crystalline range until on approaching the upper part of the Inn valley it bends towards the south, returning from the Maloja Pass, in the neighbourhood of the Kheinwald- horn, nearly to its former position. Thus the upper waters of the Inn and the Hinter Rhein are supplied from a dis- trict distinctly south of the usual line of the watershed. The precise cause of this flexure is also dif&cult to deter- mine, but it is probably connected with the syncline, mentioned in a former paragraph. The watershed after- wards follows the crest of the Lepontine and Pennine Alps, having to the north a second range — ^largely con- sisting of crystalline rocks — the Bernese Oberland — higher than the former and not much inferior to the latter, through gashes in which the Reuss and the Rljone discharge their waters. From this we infer that the structure of this region, when the river system of the Alps was first deter- mined, was a simpler one, more like that of the Eastern Alps ; the Pennine Alps, forming a watershed, flanked on either side by sedimentary ranges, of which the southern has been removed by denudation, and the northern greatly exaggerated by a later series of movements, which, how- ever, must have been slow enough to allow the rivers to deepen their valleys pari passu with the rise. Though the range of Mont Blanc is connected with that of the Oberland, its crest forms the watershed, for this passes from the Great St Bernard over the low gap of the Col Ferret, and by the Little St Bernard returns to its former course at the Rutor; a diversion probably due to the excep- tional elevation of the

northern range in the vicinity of Mont Blanc, which has enabled it to discharge part of its water into the Val d'Aosta. Its original inferiority is, however, suggested by the fact that one tributary of the Durance actually drains the north-eastern flank of the now- dominant massif. South of the Little St Bernard Pass the watershed keeps in its old position along the crest of the crystalline mass which encloses the Italian plain, while the prolongation of the Mont Blanc massif may be traced ~~through the Tarentaise and Maurienne as far as the HIgh Alps of Dauphind The structure of these masses, how~~ ever, is anything but simple. The Romanche, rising on the Col de Lautaret, forces its way through two crystalline ranges, that of the G-randes Rousses and of the Belledonne, between which is an infold of Jurassic rocks. Do these two crystalline masses, together with the other and larger one, lepresent the double range system (Mont Blanc and the Brevait) farther north ; or should the chief Dauphin mass (that around the Pointe des i^crins) be connected, as some think, with the crystalline ridge, of which the Grande Casse and Mont Pourri form parts ; or is this latter ridge merely an outlier of the great central system, which farther

north is represented by the Pennines ? ^he fact that the zone of the Brianqonnais (an important trough of sedi- mentary rocks) in the main keeps to the west of the Grande Casse-Pourri massif seems to link the latter to the central system.

It is generally admitted that, whatever be the case in regard to Mont Blanc, the headwaters of streams flowing towards Italy have frequently trespassed on those running in the opposite direction. The ottbT^" most striking instance is afforded by the Maloja larger Pass. Here the head of the Inn valley is an ^^|^" almost level trough, about 9 miles long, be- tween lofty mountains, which is terminated at the actual pass by precipices descending to the Val Bregaglia. But it is inferred from studying the surrounding district that the watershed once lay some 6 miles farther south, the Val Forno and Val Albigna being then tributaries of the

Inn, but that it has been completely cut away by the greater erosive action of the Maira, which has annexed the drainage of these two glens. Those shorter trenches, which afford a passage to the great Alpine roads, may be similarly explained, and such apparent anomalies as the structure of the mountains near Zermatt. Here the truncation of the range between the two arms of the Visp at the Strahlhom, the wide gap between it and Monte Rosa, and the apparent disappearance of the Gornergrat- Stockhorn spur, may be due to the recession of the head of the Val Anzasca.

The Alpine chain, as it exists, is the result of two separate sets of movements during the Tertiary era in a region which, as stated above, had already been the scene of disturbances. But the history Relation ot of the former set is not yet certain. Some men^"' authorities think that the apparent change in general structure, near the headwaters of the Inn, indi- cates that the Alps to the east and the west were pro- duced by independent disturbances. But even if the other view be adopted, the movements may not have been uniform or quite simultaneous. The effects of the second set were, at any rate, more marked in the Central and Western Alps, as is shown by the facts already mentioned, and by the upheaval of the nagelflue (gravel from the rivers of the Oligocene Alps), to full 6000 feet above sea-level in the Rigi and the Speer. Some recent writers have maintained that parts of the Alps have been affected by torsional movements. It is, however, difficult to understand the mechanical conditions under which such movements, in the strict sense of the term, could be pro- duced in the earth's crust, though no doubt unequal resistances to pressure and the joint eifects of successive sets of thrusts, acting in different directions, would present a very similar aspect. Apart, however, from this it has been demonstrated, especially since 1870, that the struc- ture of the Alps is far more complicated than was formerly supposed. It was also believed that in the Alps igneous rocks of Tertiary age occurred only in the Vicentin and in one or two isolated spots ; recently, however, it has been maintained (though the question is still sub judice) that some of the intrusions in the Dolomite district belong to this era instead of to the Trias.*

Much attention has been given to the movements and physics of glaciers. In the Alps their average motion is not far from a foot a day ; while the

study of other regions has shown that, cmteris paribus, the larger the glacier the quicker its pace. Special attention “””””• ha^ been paid to the changes in volume exhibited by the Alpine glaciers. These are sometimes irregular, but as a rule they affect the majority of glaciers almost simultane- ously. A universal shrinkage set in soon after 1860, but nowthetide seems to have turned. The diminution in some cases has bden very great; for instance, the thickness of*

the Unter Grindelwald glacier has been reduced by 115 feet. Its periods of advance during the last two centuries were 1703-20, 1770-1779, 1814-1822, 1840-1855. It is now generally agreed that during the Glacial epoch the Alpine ice more than once advanced and retreated. For instance, the glacier of the Ehone not only welled up against the flank of the Jura, where it dropped the noted Pierre-drbot and other erratics, but also descended to within a few leagues of Lyons, thus attaining a total length of about 270 miles. As an example of fluctuation we may take the ancient Limmat glacier, which many authori- ties believe to have exhibited the following phases : — (1) First advance indicated by morainic deposit on the Uetliberg; (2) Retreat and formation of the Decken- schotter (coarse conglomerate) ; (3) Second advance (ex- tension to Jura) represented by moraines considerably above the level of the Lake of Zurich ; (4) Eetreat and deposit of the gravels forming the valley plain of the Limmat ; (6) Third advance, limited by the moraine near Killwangen. That most of the Swiss lowland was for a time covered by ice (forming a huge ” piedmont ” glacier) is now generally admitted. This would require the mean temperature to be much lower than at present, probably about 18° F. at the time of maximum extension, while the glaciers would practically disappear from the Alps with a rise of 9° F.

The hypothesis attributing the greater lake basins in the Alps to the erosive action of glaciers has been declining in favour during the last thirty years, as the subject has been more thoroughly and precisely studied. Many, per- haps the majority of geologists now admit that the action of glaciers is abrasive rather than erosive, and that they can

excavate only in special circumstances and to a limited extent. Some tarns or lakelets may have been thus formed ; in others the water is dammed back by old moraines or berg-falls; in others (though not Lago di Tremorgio) a hollow has been formed by the removal of soluble rock ; but the larger Alpine lakes are now more generally attributed (like those of the St Xawrence region) to differential movements in the beds of pre-existing valleys.

A few corrections and additions to the article in the ninth edition of this work may be noted here. In regard to the Alpine mammals it is now certain that the ibex or bouquetin is restricted to the Eastern Graians. The brown bear still occurs in one or two of the more remote- districts, with the lynx and wild cat. The stoat (P. erminea) ranges up to 10,000 feet. The golden eagle, though rare, and the raven may be added to the birds ; one or two of the small raptores are not uncommon ; the black redstart, the siskin, the crested titmouse, the crossbill, and the nutcracker are not rare ; the wall-creeper (Tichodroma muraria), the Alpine accentor, the Alpine pipit, and the snowfinch occur in the upper region. " Grouse " in the list of game birds presumably means the hazel grouse, for of course Tetrao scotiaus does not occur; the ptarmigan is rather common well above the tree-line, and ranges to a great height. The blackhead and common gull frequent the lakes, with the black and common terns. In the mountain lakes Salmo lacustris has been found at 8626 feet, and Triton alpestris slightly above that elevation. On page 621, col. 1- (Ency. Brit. ninth edition, vol. i.), the Piz Tremoggia (11,322 feet) and Piz Cam- brena (11,834 feet) hardly deserve to be called dominant peaks of the Bernina group. The height of the Gross Venediger is 12,008 feet. Even since 1875 the Alps have been made much more accessible. Railways have been carried over the Brenner, Arlberg, and Brunig passes, and through the Mont Cenis and the St Gothard by the aid of long tunnels. The piercing of the Simplon is now in progress. Several light railways on more than one plan have been con- structed, as that from Chur to Thusis, or from Visp to Zermatt, those up the Rigi, Pilatus, over the Wengern Alp, even up the Gomer- grat ; the latest attempt being to burrow up to the summit of the Jungfrau. Carriage roads have replaced mule paths, as at the Lukmanier, Flviela, Oberalp, and Col de Forolaz passes, also to Chamouni from Vemayaz by Salvan, and in several other places. Club-huts have been

erected in many convenient positions among the peaks and glaciers; hotels have multiplied, not only in the'^ villages but also on commanding situations. One has even been

Addenda

and

corrigenda.

built on the Gornergrat, thus ruining the grandest readily acces- sible point of view in the Alps. The result has been to flood many parts of the Alps with tourists, to whom their beauties make no real appeal, and thus to take away much of their charm.

In several instances new surveys have slightly altered the altitudes of peaks or passes given in Mr Ball's list; but it has been thought sufficient to substitute exact figures for those which he was obliged to leave as approximations, except in two or three cases where the writer has failed to obtain more precise information.

Feet.

8823 8714

Passes of the Maritime Alps

Peaks of the Cottian Alps .

Passes of the Cottian Alps Peaks of the Dauphini Alps

Peaks of the Graian Alps .

Passes of the Qraian Alps . Peaks of the Pennine Alps Passes of the Pennine Alps

\ Passes in the Bernese Alps

Passes in the North Swiss Alps .

Passes of the Bhcetian Alps

Peaks of the Lombard Alps

Passes of the Lombard Alps

Passes in the Vindelician Alps . Passes in the Central Tyrol Alps

Passes in the Styrian Alps

Peaks of the South Tyrol and Venetian Alps

Passes in the South Tyrol and Venetian Alps

Peaks of the South-eastern Alps Passes of the South-eastern Alps

f Col de Sautron . ■ \ Col de Lauzanier .

IPointe de St Anna ; the higher summit is called P. de la Fonte Sancta, and is . . . 11,057 Cold'Izouard . . 7835 Pic d'Ailefroide . . 12,878 f Grande Motte . . 12,018 1 Bee de I'Invergnan . 11,838 Col de Lauzon . . 10,831 Pointe de Salles . . 8183 Col de Vessona . , 9167

(Monch Joch . . 11,385

Triftlimmi . . .10,170 Geschenenlimmi(? Susten- limmi) . . .10,180 f Sardona Pass . . 9317 VKamorPass. . . ?5900 rPassodi Val Viola . 8070 i Gavia Pass . . . 8465 (Bieler Joch . . . 6630 f Pizzo dei Tre Signori . 11,020 \ Brenta Alta . . . 9735 r Gampen Pass . . 5060 -j Croce Domini Pass . 6215 (. Passo di S. Valentino . 9080 /Madeleioch . . . 6665 1. Kaiserjoch . . . 7560 Gebatsch Joch . . 10,640 ■ Rottenmanner Tauem . 4150 FladnitzPass . . ?5930 Gleinalp Pass . . 5210 Marmolata . . . 11,020 Drei Zinnen (highest) . 9850 Cimon della Pala . 10,450

Palle di S. Martino . 9830 (Perhaps Cima di Vezzana

10,465 intended) Marmarolo . . . 9620 Peuschelstein Pass . 6000

f Kellerwand . . . 9104

t Jof di Montasio . . 9030

f Piano di Sappada . . 4275

\ Skarbinja Joch . . 6240

For topographical information, see the publications of the English, French, Italian, Swiss, German, and Austrian Alpine clubs ; the well-known guide books of Murray, Baedeker, and Joanne, the Climbers' Guides, the Guide du Haut Dauphine; Ball's Alpine Guide (new edition, vol. i. " Western Alps," edited by W. A. B. Coolidge, 1898, alone published) ; and Notes for Travellers in the Alps (1899), by the same editor (being the "General Introduction" to Ball's Chiide, revised and rewritten). This last contains a list of all the more important books and maps on the Alps, with articles on their geology and physical geography, natural history, social life, &c. Among the more important books published of late years may be mentioned the following: — ^aillib-Geohman, W. A. Sport in the Alps, 1896.— Conwat, Sir Martin. The Alps from end to end, 1895. — Dent, Clinton T. Mountaineering (Badminton Library), 1892.— Forbes, J. D. Travels through the Alps (revised and annotated by W. A. B. Coolidge, 1900).— Freshfibld, D. W. The Italian Alps, 1875. — GussFBLD, Paul. In den Hochalpen, 1886. — Lendenfeld, R. von. Aus den Alpen, 2 vols., 1896. — Lubbock, Sir John. The Scenery of Switzerland, 1896.— Main (Burnabt), Mrs. The High Alps in Winter, 1883. — Mathews, C. E. The Annals of Mont Blanc, 1898. — Roman, J. Dictionnaire Topographique du Department des Sautes Alpes, 1888. — Sinioaglia, L. Climbing Reminiscences of the Dolomites (trans.), 1896. — Sowerbt, J. The Forest Cantons of Switzerland, 1892.— Umlaupt, F. Die Alpen, 1887 (Tlie Alps, 1889). — Whtmper, B. Chamonix and the Range of Mont Blanc, 1897 ; The Valley of Zerm,att and the Matterhorn, 1897.

The list of papers and books on Alpine geology and physical

geography is also very extensive. Of the former the more im- portant have appeared in some of the following publications : — Academie des Sciences de Vlnstitut de France (Comptes Rendus); Aceademia Beale dei Lincei (Atti) ; Annates des Mines, Deutsche geologische Qesellschaft (Zeitsohrift); Geological Society of London (Quarterly Journal) ; Kaiserliche Akademie der Wisse'nschaften (Vienna) (Sitzungsberichte) ; Konigliche Bayerische Ahademie.der Wissenschaften (Sitzungsberichte);' Societh Qeologica Italiana (Bollettinq) ; Societe Qiologique de France (Bulletin) ; Neue Benk- schriften der allgemeinen Schweizerischen Qesellschaft. The last- named contains (vol. sxxvii.) an important paper by Dr Zschokkb, on the "Pauna of the higher Mountain Lakes," and one by Dr Baltzbr (vol. xxxiii.) on the " History of the TJnter-Grindelwald Glacier." — The folio-wing more special books may be added: — Baretti, M. Oeologia della Provincia di Torino : Atlas, 1895. — DiENEK, C. Der Gebirgsbau der Westalpen, 1891. — Fkaas, E. Sce- nerie der Alpen, 1892. — Fkech, F. Die Karnischen Alpen, 1892.— Heim, a. Untersuchungen uber den Mechawlsmus der. Oebirgs- hildung (2 vols, and atlas), 1878 ; Handbuch der Gletscherkwide, 1885. — Mojsisovics, E. von. Die Dolomitriffe von Sudtirol und Venetiens, 1819. — Suess, E. Die Fntstehung der Alpen, 1816. See also Das Antlitz der Erde. Livret-Guide Qeologique dans le Jura et lesAlps de la Suisse, 1894. — ^Favrb and Schardt. Fclogae Geologicce SelveticcB now contains summaries of papers on Alpine geology.

The following works are ofBcial : — Austria : K. K. Geologische Beichsanstalt (Abhandlungen and Jahrbuch). France: Bulletin des Services de la Carte Geologique de la France:. Italy: Beale Comitato Geologico d' Italia (BoUetino). Switzerland: Beitrdge zur geologischen Karte der Schweiz.

The Alps, at lea&t up to the frontier, are included in the Govern- ment maps of the following countries : — Austria: " Special Karte des osterreichisch-ilngarisohenMonarchie," scale ys^ooi '63 sheets, 18J4-1888 ; a revised edition now appearing. — France : " Carte de I'lfetat Major" (type 1889), scale ,0;, 258 sheets, — Italy: "Carta Topographica del Regno d' Italia," scale joq.^o,,,), 277 sheets, 1884- 97. — Switzerland:

“Topographisoher Atlas der Schweiz” (Siegfried atlas), scale gooi^oop fo^ mountains, 589 sheets, 1870. — Others, with maps of special districts, are enumerated in Hints and Notes for Travellers in the Alps, cli., and a list of geological maps is given (p. xcviii.). The best and most recent geological map of the whole chain is F. Noe, Geologische JJebersichtskarte der Alpen, 1890. (t. G. b.)

1,000.0001

Alsace-Lorraine, in German Elsass-Lothringen, a German Imperial territory formed out of the former Prench provinces of Alsace and Lorraine, lying between the Rhine on the E., the Bavarian Palatinate, Prussian Rhine province, and grand-duchy of Luxemburg on the N., Prance on the W., and Switzerland on the S. Maxi- mum length, N. to S., 118 miles ; maximum breadth (iii the]Sr.), 106 miles ; maximum breadth (in the S.), 22 miles. The determining features of its physical conformation, are the Vosges Mountains and the Rhine. The foothills of the former and the valley of the latter account for almost the entire area of Alsace ; and the greater part of Lorraine belongs to the high-pla,in which stretches from the Moselle to the Saar, but seldom rises to 1300 feet above the sea-level. The drainage of the Vosges valleys and of the Rhine valley is collected and carried into the Rhine about 10 miles below Strasburg by the 111. The climate is on the whole temperate — warmest in the lowest districts (460 ft. above sea-level) of N. Alsace, and coldest on the summits of the Vosges, where snow lies six months in the year. The mean annual temperature at Strasburg is 49-8° Pahr., at. Metz 48-2° ; the rainfall at Strasburg 2&\ inches, and at Metz 27-|- inches. The Rhine valley is in great part fertile, yielding good crops of potatoes, cereals (including maize), sugar beet, hops, tobacco, flax, hemp, and products of oleaginous plants. But wine and fruit are amongst the most valuable of the crops. The cereals chiefly grovm are wheat, oats, barley, and rye. Great quantities of hay are harvested. In 1898 about 3000 acres were pla^ted with tobacco, and the yield, when dried, weighed about 3000 tons ; and 73,730 acres were planted with vines, the yield being 11,348,000 gallons of wine, valued at £950,000. These statistics embrace also the production of Lorraine, where agriculture is less strenuously carried on, and the fertility of the soil is less.

But Lorraine possesses, in compensation, greater riches in the earth, in her coal and iron and salt mines, the output of which in 1897 was 1,057,550 tons of coal, valued at £441,970 ; 5,360,840 tons of iron ore, valued at £615,880 ; and 70,578 tons -of salt, valued at £39,860. The total mineral output of Alsace-Lorraine in 1898 was valued at £1,276,340. In 1897 the live stock of the territory numbered 138,689 horses, 512,329 head of cattle, 375,635 pigs, and 93,204 sheep. Cows are grazed on the S. Vosges in sumnxer, and large quantities of cheese (Milnster cheese) are made and exported. Total population (1901), 1,717,451.

The farms in Alsace are mostly small, and are held partly as a private possession, partly on the communal system; in Lox'raine there are some larger occupations. The distribution and classifi- cation of the holdings was as follows in 1895 : —

Under 2J acres.

25 to 250 acres.

Above 260 acres.

Total farms.

98,666

119,955

12,919

407

231,947

The total area of these 232,000 farms was 2,230,368 acres, the rest of the territory being covered by forests, barren lands, lakes, roads, &c. Agriculture and wine-growing are general industries ; but coal and iron mining are special to Lorraine, as the manu- facture of cottons, and on a smaller scale of woollens, is special to Alsace, the chief centres of the industry being Miilhausen, Colmar, and the valleys of the Vosges. The

territory has always been the centre of an active commerce, owing to its situation on the confines of Germany, France, and Switzerland, and alongside the great highway of the Rhine. The communications embrace some 1090 miles of railway (1898 : of which about 1000 miles belonged to the state), a good system of roads, and several canals, in addition to the rivers. Administratively the territory is divided into the following three districts : —

) Districts.

Area in sq. miles.

PopulatiDn.

Density

per sq.

mile, 1895.

1875.

■ 1885.

1895.

Upper Alsace . . Lower Alsace] . . Lorraine J . . .

Total

1854 1845 2402

462,649 612,077 489,729

477,477 638,624 524,885

862.6

S46.1

218.6

5601

1,581,804

1,564,355

1,640,986

292.9

Oh the sex division, 833,173 were in 1895 males, and 807,813 females. The percentage of illegitimacy in the same year was 8 -3, also in 1898. The rural population embraced 54-8 per cent, of the whole, the urban population 45-2 per cent. The largest towns are Strasburg (the capital of the territory), Miilhausen, Metz, Colmar, Hagenau, Saargemtind, Gebweiler, and Markirch, all above 10,000 inhabit- ants each. Classified according to religion there were, in 1895, 3.56,458 Protestants, 1,246,791 Roman Catholics, and 32,859 Jews. Education is provided for (1898) at the university of Strasburg, in 28 classical and pro-classical schools, in 13 modeKn schools, and in nearly 3500 schools of a more elementary character. Over 80 per cent, of the people speak German as their mother-tongue, the rest French, or a patois of French. The supreme executive officer of the territory is a governor-general, who is appointed by the German emperor ; but he is assisted by a ministry bf four members, under the chairmanship of a secretary of state, and by a council of state numbering 58 members, jind consisting of the governor-general, secretary of state, chief provincial officials, and 8 to 12 nominees of the emperor. In 1900 the revenue was esti- mated at £3,020,242, and the expenditure at £3,002,733. There was also an extraordinary budget of £199,822 revenue and £217,362 expenditure. Customs and indirect taxes yield more than three-fifths of the total revenue, and direct taxes less than one-fourth. The state forests give about one-ninth of the whole. The public debt, capitalized, amounted in 1900 to £1,192,150, and the territory's contribution to the imperial exchequer to £830,425 in 1900.^ The higher administration of justice is devolved upon six provincial courts and a supreme court, sitting at Colmar. Moreover, there are purely industrial

tribunals at Miilhausen, Thann, Markirch, Strasburg, and Metz. The fish-breeding estab- lishment at Hiiningen in Upper Alsace should be mentioned.

(j. T. BE.) Alston, or Aldstonb, a maj:ket-town and rail- way station in the Penrith parliamentary division of Cumberland, England-, 29 miles byroad E.S.E. of Carlisle. The preparation of umber for colours and paint is carried on. There are limestone quarries, and argentiferous lead, copper, and blende are found in the neighbourhood. Coal

is -worked chiefly for lime-burning. Area of paxish (under a rural district council), 36,968 acres ; population (1881),

4621; (1891), 3384; (1901), 3133.

Altai, the name given to an extensive region of Southern West Siberia, composed of many mountain ranges and broad, fertile valleys, similar in character to, but covering an area nearly three times larger than, Switzerland (52,600 square miles). It is watered by the upper tributaries of the Ob— Biya, Katun, Oharysh, and partly Tom, as also the Upper Irtysh. It has a quad- rangular shape, and is bounded on the S.W. by the Black (Chornyi) Irtysh, on the S.E. by the high plateau of North-western Mongolia, on the N.E. by the government of Yeniseisk, parts of which belong to or merge into the Altai, and on the N.W. by the lowlands of Tomsk, strewn with many lakes and watered by the Ob. The name of Altai — Ektagh Altai, or Southern Altai, or Chinese Altai, and Altain-nauru — ^is also given to a mountain range which separates the drainage area of Lake Kobdo from that of the Black Irtysh and its former tributary, the Ulungur. This range borders on the N. — as the Eastern Tian-Shan borders on the S. — the great and broad Dzungarian trench, excavated in a north-west to south-east direction in the High Plateau of East Asia, and leads with a gentle gradient from the lowlands of Lake Balkhash to the high level of the plateau.

The highest parts of the Altai region are along the border of the Mongolian plateau, where in all probability we have a border-ridge similar to the Western Sayan, which might be named the Sailughem range. Its south- eastern slope is short and gentle for the most part, as it leads to the 4000-5000 feet high plateau, upon which rise the tributaries of the Kemchik (Yenisei) at a great altitude, and the lakes Ubsa-nor and Kobdo are situated. Several small plateaus, such as the Ukok (7800 feet), Chuya (6000 feet), Kendykty (8200 feet), and Juvlukul (7900 feet) pla- teaus, situated along a common axis running south-west to north-east, enter into the composition of that mountain range. There is no tree vegetation on these heights; only the dwarf birch (B. nana) stands the cold, and the Arctomys bobac makes his furrows in the frozen mud. Easy passages lead from these alpine lands to the high plateau of Mongolia, but the slopes directed towards the Altai rivers are extremely steep and very difficult of access. The snow-line lies here at an altitude of about 9000 feet, and many summits rise above that level, especially the Byelukha (the Mont Blanc of the Altai), whose two summits reach 14,800 and 14,500 feet respec- tively, and give origin to six large and several small glaciers (30 square miles aggregate area). The Kuitun, 12,000 feet, and several other high peaks belong to the same range. Several chains of mountains fill up the space between the Sailughem and the lowlands of Tomsk, but their mutual relations are yet far from being well known, and they are mostly described under local names. Such are the Chuya Alps (Chuiskiye Byelki), having an aver- age altitude of 9000 feet, with summits rising from 11,400 to 12,000 feet, and giving origin to at least ten glaciers on their northern slope ; the Katun Alps (Katunskiye Stolby); the Kholzun range; the range which is known locally under the names of Korgon (Korgonskiye Byelki, 6300 to 7600 feet), Talitsk, and Selitsk ranges ; the Tigeretsk Alps, and so on. Several secondary plateaus of lower altitude are also distin- guished by geographers.

The picturesque and fertile valleys of the Altai, sur- rounded as they are by majestic alps, are, of course, better known. The Katun valley begins as a wild gorge on the south-west slope of the Byelukha peak ; then the

river makes a great winding before it pierces through the Katun Alps, when it enters a wider valley, lying at an altitude of from 2000 to 350O

feet, which it follows until it emerges from the Altai highlands to join the Biya and to form the Ob by their confluence in a most picturesque region. The next valley is that of the Charysh, which has the Korgon and Tigeretsk Alps on one side and the Talitisk and Bashalatsk Alps on the other side. It is again very fertile, and is well peopled with Russian peas- ant immigrants in its lower parts. The Altai, seen from this valley, presents the most romantic scenes, including the small but deep Kolyvan lake (altitude, 1180 feet), described by so many geographers, surrounded by fan- tastically-shaped granitic domes and towers. Earther west the valleys of the Uba, the Ulba, and the Bukhtarma open south-westwards towards the Irtysh. The lower part of the first is thickly populated ; in the often- described valley of the Ulba is the Eiddersk mine, at the foot of the 6770 feet high Ivanovsk peak, covered with beautiful alpine meadows. As to the valley of the Bukhtarma, which has a length of 200 miles, it also has its origin at the foot of the Byelukha and the Kuitun peaks, and as it falls from the 6195 feet high level 'of an alpine plateau to the Bukhtarma fortress (1130 feet) it offers the most striking contrasts of landscapes and vege- tation. Its upper parts are rich in glaciers, the best known of which is the Berel, which flows from the double peak of the Byelukha. On the northern side of the mountain range which separates the upper Bukhtarma from the upper Katun one finds the Katun glacier, which, after two ice-falls, becomes from 700 to 900 yards wide, and is often described as the Altai Mer de Glace, while the Byelukha is described as the Altai Mont Blanc. From a grotto in this glacier wildly runs the Katun. The middle and lower parts of the Bukhtarma valley have been colonized since the 18th century by Russian peasant runaways — serfs and non-conformists— who had created there a free republic on Chinese territory ; and after 1869, when this part of the valley was annexed to Russia, it was rapidly colonized, on account of the fertility of the wide prairies in its lower portion.

North-East Altai. — The north-eastern Altai is much less known. High passes, of difficult access and over 10,000 feet of altitude, lead from it across the Sailugh'Bm to the IVtongolian plateau; but they are seldom visited unless by Kirghiz shepherds. The high valleys of this portion of the Altai — Bashkaus, Chulyshman, and Chulcha, all three leading to the beautiful alpine lake Teletskoye (length, 117 miles ; maximum width, 4

miles ; altitude, 1600 feet) are only inhabited by nomad Telen- guts. Even the shores of the lake — reminding one of the Lake of the Eour Cantons — are too wild to receive a numerous population. Erbm this lake issues the Biya, which becomes navigable only after it emerges from the mountains, i.e., at Biysk. Sixty miles below this town it joins the Katu^, and here begin the beautiful prairies in the north-west of the Altai.

Kuznetsk District. — Farther to the north-east the Altai highlands are continued in the Kuznetsk district, which has a slightly different geological aspect, but still belongs to the Altai system. At the south-east limits of this district the Sayan range (from 6000 to 8000 feet, or more) appears as a continuation of the Sailughem, and has the same border-ridge character. But the Abakan river, which rises on its north-western slope, belongs to the system of the Yenisei. The Kuznetsk Alatau range, on the left bank of the Abakan, runs north-east into the province of Yeniseisk, while a complexus of imperfectly mapped mountains (Chukchut, Salairsk, Abakan, &c.) fills up the western portions of this territory. The Tom and its

numerous tributaries rise on the northern slopes of the Alatau, and their fertile valleys are occupied by a thick Russian population, the centre of which is Kuznetsk, on the Tom.

Q-eology. — ^The geology of the Altai is yet imperfectly known. Granite, together with porj^hyry and porphyrite, intersected by veins of jade (veined porphyrite) and various breccias used for decorative purposes at the Kolyvafl stone-cutting works, as also diorites, diabases, augite porphyry, hyperstenite, &c., enter to a large extent into the composition of its mountains. The granites are very much decomposed, and take fantastic shapes round Lake Kolyvaft. Volcanic basalts and andesites are found in the Salair range. The great bulk of the mountains consists of various schists, limestones, sandstones, &c., belonging to the pre-Silurian period,

the Silurian, Devonian, and Carboniferous ages ; they are chiefly developed in the northern outer parts of the Altai. Since the Car-boniferous period the Altai has not been under the sea, and its coal-bearing Jurassic deposits are of fresh-water origin ; only in the Alatau are they of marine origin, and show that this part of the highland was partially invaded by the sea during the Secondary age.

Numerous traces of an extended glaciation (including striated rocks) have been discovered by Prof. Sapozhnikoff. As a rule, the mountains are covered with thick diluvial deposits, and the forms of their granitic domes also suggest a wide glaciation.

Flora. — The flora of the Altai, explored chiefly by Ledebour, is rich and very beautiful. Up to a level of 1000 feet on the northern, and 2000 feet on the southern slopes, the flora is the habitual European flora which spreads in Siberia as far as the Yenisei. The steppe flora also penetrates' from the south-west and drives the Altai flora to a stUl higher level. But above these levels up to 6000 feet, which is the average limit of tree vegetation, the mountains are covered with beautiful forests of birch, Pinus cembra, Abies sibirica, Larix sibirica, Picea obovata, and so on, while the meadows are clothed with a rich, brightly coloured, and typical covering of herbaceous plants. Even the alpine meadows, which have many species in common with the Alps, have a number of their own Altayan species.

Mineral wealth. — In respect of mineral wealth, the Altai proper , is rich in silver, copper, lead, and zinc ores, while in the Alatau, gold, iron, and coal are the chief resources. The Alatau mines are only now beginning to be explored, while the copper, and perhaps also the silver ores of the Altai proper were already worked by the prehistoric "Chud," at a time when the use of iron was not yet known. Russians began to mine in 1727 at Kolyvail, arid in 1739 at Barnaul. But the Altai mines were made the property of the imperial family (" The Cabinet of His Majesty "), and the miners were made serfs, which they remained until 1861; and this circum- stance hampered to a great extent both the development of mining and the colonization of the country. The ores of the Altaj proper appear nearly always in the shape of irregular veins containing silver,

lead, copper, and gold, — sometimes all together, — and they are worked chiefly at Zmeinogorsk (or Zmeiefl),' Zyryanovsk, Ust- Kamenogorsk, Riddersk (abandoned in 1861), and elsewhere. They offer, however, great difficulties, especially on account of their continually varying productivity and temperature of fusion. The beautiful varieties of porphyries— green, red, striped, &o. — which are obtained, often in big monoliths, near Kolyvafi, are cut at the imperial stone-cutting factory, whose produce is well known in the art galleries and palaces of Europe. Aquamarines of mediocre quality but enormous size (up to 3 inches in diameter) are found in the Korgon mine. The northern, or Salairsk, mining region also is rich in silver ores, and the mine of this name used formerly to yield up to 7776 lb of silver in one year. But the chief wealth of the north-east Altai is in the Kuznetsk coal-basin, also containing iron ores, which fills up a valley between the Alatau and the Salairsk range for a length of about 270 miles, with a width of about 65 miles, and is considered by Prof. Mushketoff as equal to the best coal basins of England and South Russia. Sohmahlhausen^s researches prove that these Coal Measures belong, like all those of East Siberia, Turkestan, &c., to the Jurassic forma- tion. The country is also covered with thick diluvial and alluvial deposits containing gold. Gold is extracted in many places in the Altai; to the extent of 2887 kilograms in 1897. However, all the mining is now on the decline. Instead of the 36,000 ft> of silver which used to be extracted, only 6060 lb were extracted in 1897. The yield of lead was 33,000 cwts. in 1868-71, and 20,000 cwts. in 1895; of copper, 4400 cwts. in 1897. Coal, however, is being extracted in small quantities.

Population. — The Russian agricultural population has rapidly increased since the fertile valleys belonging to the imperial family have been thrown open to immigration, and it is estimated that the present agricultural population of the region (Biysk, Barnaul, and Kuznetsk districts) already reaches about 800,000. The natives may represent a population of about 45,000. They are AltayanB in the west and Telenghites in the east, with a few

Kalmyks and Tatars. Although all called Kalmyks by the Russians, they speak a Turkish language. Both the Telenghites and the Altayans are Shamanists, but many of the former are already quite Russified. As to the

virgin forests of the Kuznetsk Alatau — the Cherii, or the Black Forest of the Russians, — they are peopled by Tatars (Chernevyie or Black Forest Tatars) , who live in very small settlements, sometimes of the Russian type, but mostly in wooden yurtas of the Mongolian fashion. They can hardly keep any cattle, and live the poor life of foresUdwellers, feeding upon various wild roots, when there is no grain in the spring to be crushed with a hand-mill. Honey and cedar-nuts (from Pinus cembra) collected in the forests are much relied upon for buying grain from the Russians. Hunting and fishing are also resorted to, and the skins and furs are tanned by the family.

Agriculture. — The chief occupation of the Russians is agriculture (about 3,500,000 acres under culture), cattle breeding, bee culture (over 400,000 hives),' mining, gathering of cedar-nuts (from 3000 to 10,000 cwts. yearly), and hunting. AH this produce is exported partly to Tomsk and partly to Kobdo in Mongolia.

Towns. — The real capital of the Altai is Barnaul, the centre of the mining administration and altogether an animated commercial town (29,408 inh.) ; Biysk, which is the commercial centre (17,206 inh.) ; Kuznetsk (3140 inh.), Ust-Kamenogorsk (8958), and the mining towns Kolyvafi (11,703), Zmeinogorsk (6083), Riddersk (4000), and Salairsk (2500). Many villages are very populous.

Administration. — Most of the Altai region, covering an area of nearly 170,000 square miles and including the Kuznetsk region, forms a domain of the imperial family under the name of Altai Mining District.

Authorities. — Rittbr's Asien, Ledebour's Reise, Tchik- hatchepf'i. Altai, and Cotta's Altai are still very well worth consulting. Of modern works, Zhivopisnaya Bossiya (" Pictur- esque Russia"), vol. xi., by Potanin, Mdshketoff, Ai^rianoff, and others ; Semenopf's Geographical Dictionary ; Adrianopf's " Journey to the Altai," in Zapiski Buss. Geogr. Soc. xi. ; Yadkintseff's "Journey in West Siberia " in Zapiski West Sib. Geogr. Soc. ii. ; Golubeff's Altai, 1890 (Russian) ; Schmurlo, " Passes in S. Altai " (Sailughem), Izvestia Buss. Geogr. Soc. 1898, xxxiv. 5 ; Prof. Sapozhnikoff, various articles on glaciers, &c., in same periodical, 1897, xxxiii. ; 1899, xxxv. (p. a. k.)

Altdorf, the capital of the Swiss canton of Uri, with a station on the St Gothard Eailway, 22 miles from Goschenen and 34 miles from Lucerne. In 1899 a fine new carriage road was opened from Altdorf through the Schachenthal and over the Klausen Pass (6404 feet) to Linththal (30 miles from Altdorf), and so to Glarus. In 1896 a fine bronze statue of Tell and his son, by Kissling, was set up in the market-place. In 1899 a theatre, close to the town, was opened for the sole purpose of represent- ing Schiller's William Tell. There is a stately parish church. Population in 1888, 2542 ; 1899, 2553 ; in 1900,

3134.

Altena, a town of Prussia, province Westphalia, 38 miles by rail S.S.E. from Dortmund. It has hardware (especially fine wire) industries, a castle, and a museum. Population (1886), 9387 ; (1896), 12,108 ; (1900), 12,769.

Altenburg, a town of Germany, capital of the duchy of Saxe-Altenburg, 23 miles S. from Leipgic by rail, with fine suburbs. A museum, with natural history, archaeo- logical, and art collections, has been erected, and there may be mentioned St Bartholomew's church (1089), the German Eenaissance town hall (1662-64), a lunatic asy- lum, teachers' seminary, and agricultural school. There are lignite mines in the vicinity. Population (1885),

29,110; (1895), 33,420; (1901), 37,110.

Altendorf, a commune of Prussia, in the Rhine province, 1 mile W. from Essen, with coal-mines and iron-works. It embraces the two colonies of Krupp's work-people — Kronenberg (population, 7764 in 1890) and Schederhof (4431). In 1901 it was incorporated with Essen. Population (1885), 25,693; (1895), 40,280;

(1900), 63,271.

Altenessen, a commune of Prussia, in the Rhine province, 3 miles IsT. from Essen, with coal-mines, machinery factories, and lime-kilns. Population (1885),

15,599; (1895), 20,976; (1901), 27,938.

Alton, a city of Madison county, Illinois, U.S.A., situated in the western part of the state, on the eastern bank of Mississippi river, just above the mouth of Missouri river, and twenty -one miles above St Louis, at an altitude of 436 feet. It is built on the river bluffg, and its plan is fairly regular. It is entered by four railways. The population in 1880 was 8975, in 1890 it was 10,294, and in 1900 it was 14,210.

Altona, a town of Prussia, province Schleswig-Hol- stein, immediately W. of Hamburg, with which it is com- mercially identified, though administratively it is a separate town. Municipal offices, a bronze equestrian statue of the Emperor William I., and a bronze statue of Bismarck have been erected ; there may also be noticed the public museum (containing ethnographical and natural history collections), and monuments of the wars of 1864 and 1870-71. Altona is the headquarters of the 9th German army corps, and possesses a school of navigation and famous fish-markets. Among its industries are the production of cottons, woollens, chemicals, chicory, hats, and varnish. Since 1888, when Altona joined the Im- perial Zollverein, approximately half a million sterling has been spent upon harbour improvement works. The im- ports and exports resemble those of Hamburg (q.v.). In the ten years 1871-80 the port was entered on an average by 737 vessels of 67,735 tons, in 1881-90 by 608 vessels of 154,713 tons, and in 1891-98 by 839 vessels of 253,384 tons. In 1889 Ottensen (to the W. of Altona), where the poet Klopstock lies buried, was incorporated with the town. In 1885 (including Ottensen, Oevelgonne, 0th- marschen, and Bahrenfeld) the population was 126,306 ; in 1895, 148,944 ; in 1900, 161,508 ; without the four suburbs, 113,526 (1895); 117,824 (1900).

Altoona, a city of Blair county, Pennsylvania, U.S.A., situated in 40° 32' N. lat. and 78° 24' W. long., at the foot of the «A.llegheny plateau, not far from the centre of the state, at an altitude of 1179 feet. It is on the main line of the Pennsylvania railway. The cj.ty is divided into nine wards, is

regularly laid out, and is well buUt, having been in great part constructed by the railway corporation as its chief manufacturing depot. Fostered by the railway, it has had a very rapid and solid growth. The population in 1880 was 19,710, in 1890 it was 30,337, and in 1900 it was 38,973.

Altrincham, or Altringham, a market town and railway station in the Altrincham parliamentary division of Cheshire, England, 8 miles S.W. by S. of Manchester. The more recent structures are a Baptist chapel, a Unitarian chapel, and a market hall. Area of township (an urban district), 662 acres. Population (1881), 11,260 ; (1891), 12,440; (1901), 16,831 ; of parliamentary division

(1901), 78,796.

Altwasser, an industrial village of Prussia, province Silesia, 43 miles by rail S.W. from Breslau, and 3 N. from Waldenburg. It has factories for glass, porcelain, machinery, cotton-spinning, iron-foundries, and coal-mines. Population (1885), 8672 ; (1895) 10,207.

Altyri'tagh, or Astyn-tagh, a lofty mountain range of Central Asia, running from the S.W. to the N.E., from 38° N.-87|° E. to 39° lsr.-91° E., forms a border range of Northern Tibet, having to the north-west the lower terrace of the East Turkestan plateau, about 2700 feet high on the banks of the Cherchen-daria, and to the south-east the north- western extremity of the Tsaidam plateau, nearly 10,000 feet of altitude. In 89° 30′ E. it is separated from the Tarim basin by a secondaiy chain, about 7200 feet high, but farther west it rises above the desert as a nearly vertical wall. The passes visited by Prjewalsky and Carey reach

10,140 and 13,000 feet respectively, the summit attaining from 12,000 to 14,000 feet. (See Kuen-lun.)

Alt-Zabrze, a village of Prussia, province of Silesia, 5 miles by rail E. from Gleiwitz. It is in repute for its iron-works, coal-mines, manufactory of wire ropes, &e. Population (1885), 9390 ; (1895), 14,012 ; (1900), 19,571.

Aluminiurin. — Although never met with in the elemental state, the metal aluminium is more widely dis- tributed throughout the world than any similar substance. The word is derived from the Latin ahimen, and is probably akin to the Greek aXs (the root of salt, halogen, etc.) ; but while Pliny the Elder and other Roman authors discuss its properties at some length, there is considerable doubt whether the alum they knew was not largely composed of sulphate of iron. In the 16th century a.d., Paracelsus drewthefirst real distinction between alum and the vitriols ; in 1722 Hoffmann announced the base of alum to be an individual substance ; in 1761 Morveau suggested that this base should be called alumine, after Sel alumineux, the French name for alum ; and finally about 1820 the word was changed into alumina. In 1760 the French chemist Baron unsuccessfully attempted " to reduce the base of alum " to a metal, and shortly afterwards various other investigators essayed the problem in vain. In 1808 Sir Humphry Davy, fresh from the electrolytic isolation of potassium and sodium, strove to break up the molecule of alumina by heating it with potash in a platinum crucible and submitting the mixture to a current of electricity ; in 1809, with a more powerfid battery, he raised iron wire to a red heat in contact with alumina, and obtained distinct evidence of the production of an iron-aluminium alloy. Naming the new metal in anticipation of its actual birth, he called it alumium; but for the sake of analogy he was soon persuaded to change the word to aluminum, in which form, alternately with aluminium, it occurs in chemical literature for some thirty years. The metal is occasionally called aluminum in America to this day ; but the European spelling is preferable, as the termination -ium harmonizes with the names of other metallic elements.

In the year 1824, endeavouring to prepare it by chemical means, Oersted heated its chloride with potassium amalgam, and failed in his object simply by reason of the mercury, so that when Wohler repeated the experiment at .Gottingen in 1827, employing potassium alone as the reducing agent, he obtained it in the metallic state for the first time in history. Contaminated as it was with potassium and with platinum from the orucible,.the metal formed a grey powder and was far from pure ; but in 1845 he improved the conditions of his process, and succeeded in producing metallic globules wherewith he examined its chief properties, and prepared several compounds hitherto unknown. Early in 1854, H. St Claire Deville, who was attempting to make some non-existent salts of aluminium, accidentally and in ignorance of Wohler's later results, imitated the 1845 experiment. At once observing the reduction of the chloride, he realized the importance of his discovery, and immediately began to study methods for winning the metal on a commercial scale. His attention was at first divided between two processes— the chemical method of re- ducing the chloride with potassium, and an electrolytic method of decomposing it with a carbon anode and a platinum cathode, which was simultaneously imagined by himself and Bmisen. Both schemes appeared well-nigh impossible: potassium cost about £17 per lb, gave a very small yield, and was dangerous to manipulate, while, on the other hand, the only source of electric current then available was the primary battery, and zinc as a store of industrial energy was utterly out of the question. Deville accordingly returned to pure chemistry and invented a practicable method of preparing sodium which, having a lower atomic weight than potassium, reduced a larger proportion. He next devised a plan for manufacturing pure alumina from the natural ores, and finally elaborated a process and plant which held the field for almost thirty years. So admirably and exhaustively were his researches conducted that it required a Castner to improve on his methods. Only the discovery of dynamo-electric machines and their applica- tion to metallurgical processes rendered it possible for the brothers Cowles to remove the industry from the hands of chemists, till the time when Messrs. Hgroult and Hall, by devising the electrolytic

Prepara- tion.

method now in use, placed the business finally under the control of electricians, and inaugurated the present era of industrial electrolysis.

The chief natural compounds of aluminium are four in number : oxide, hydroxide (hydrated oxide) , silicate, and fluoride. Corundum, the only important native oxide (AI2OS), occurs in large Ores. deposits in southern India and the United States.

Although it contains a higher percentage of metal (52-9 per cent.) than any other natural compound, it is not at present employed as an ore, not only because it is so hard as to be crushed with dilflculty, but also because its very hardness makes it valuable as an abrasive. CryoliU (AljFe . GNaF) is a double fluoride of aluminium and sodium, which is scarcely known except on the west coast of Greenland. Formerly it was used for the preparation of the metal, but the inaccessibility of its source, and the fact that it is not sufBciently pure to be employed without some preliminary treatment, caused it to be abandoned in favour of other salts. When required in the H6roult>Hall process as a solvent, it is sometimes made artificially. Aluminium silicate is the chemical body of which all clays are nominally composed. Kaolin or China clay is essentially a pure disilicate (AlaOs . 2Si02. 2HaO), occurring in large beds almost throughout the world, and containing in its anhydrous state 24-4 per cent, of the metal, which, however, in common clays is more or less replaced by calcium, magnesium, and the alkalis, the proportion of silica sometimes reaching 70 per cent. Kaolin thus seems to be the best ore, and it would undoubtedly be used were it not for the fatal objection that no satisfactory process has yet been discovered for preparing pure alumina from any mineral that is chemically a silicate. If, according to the present method of winning the metal, a bath containing silica as well as alumina is submitted to electrolysis, both oxides are dissociated, and as silicon is a very undesirable impurity, an alumina con- taminated with silica is not suited for reduction. Bauxite is a hydrated oxide of aluminium of the ideal composition, AI2O3 . 2H2O. It is a somewhat widely distributed mineral, being met with in Styria, Austria, Hesse, and French Guiana ;

but the most important beds are in the south of France, the north of Ireland, and in Alabama, Georgia, and Arkansas in North America. The chief Irish deposits are in the neighbourhood of Glenravel, Co. Antrim, and have the advantage of being near the coast, so that the alumina can be transported by water-carriage. After being dried at 100° C, Antrim bauxite contains fi-om 33 to 60 per cent, of alumina, from 2 to 30 per cent, of ferric oxide, and from 7 to 24 per cent, of silica, the balance being titanic acid and water of combination. The American bauxites contain from 88 to 67 per cent, of alumina, from 1 to 23 per cent, of ferric oxide, and from 1 to 32 per cent, of silica. The French bauxites are of fairly constant composition, containing usually from 58 to 70 per cent, of alumina, 3 to 16 per cent, of foreign matter, and 27 per cent, made up of silica, iron oxide, and water in proportions that vary with the colour and the situation of the beds.

Before the application of electricity, only two compounds were found suitable for reduction to the metallic state. Alumina itself is so refractory that it cannot be melted save by the oxy-hydrogen blovvpipe, or the electric arc, and except in the molten state it is not susceptible of decomposition by any chemical reagent. Deville " first selected the chloride as his raw material, but observing it to be volatile and extremely deliquescent, he soon substituted in its place a double chloride of aluminium and sodium. Early in 1855 Percy suggested that cryolite should be more convenient, as it was a natural mineral and might not require purification, and at the end of March in that year, Faraday exhibited before the Eoyal Institution samples' of the metal reduced from its fluoride by Dick and Smith. Rose also carried out experiments on the decomposi- tion of cryolite, and expressed an opinion that it was the best of all compounds for reduction ; but, finding the yield of metal to be low, receiving a report of the difficulties experienced in mining the ore, and fearing to cripple his new industry by basing it upon the employment of a mineral of such uncertain supply, Deville decided to keep, to his chlorides. "With the advent of the dynamo, the position of affairs was wholly changed. The first successful idea of using electricity depended on the enormous heating powers of the arc. The infusibjlity of alumina was no longer prohibitive, for the molten oxide is easily reduced by carbon. Nevertheless, it was found impracticable to smelt alumina electrically

except in presence of copper, so that the Cowles furnace yielded, not the pure metal, but an alloy. So, long as the metal was principally regarded as a necessary ingredient of aluininium-bronze, the Cowles process was popular, but when the advantages of aluminium itself became more apparent, there arose a fresh demand for some cheap method of obtaining it unalloyed. It was soon discovered that the faculty of inducing dissociation possessed by the current might now be utilized with some hope of pecuniary success, but as electrolytic currents are of lower voltage than those required in electric furnaces, molten alumina again became impossible. Many metals, of which copper, silver, and nickel are types, can be readily won or purified by the electrolysis of aqueous solutions, and theoretically it may be feasible to treat aluminium in an identical manner. In practice, however,

it cannot be thrown down electrolytically with a dissimilar anode so as to win the metal, and certain difficulties are still met with in the analogous operation of plating by means of a similar anode. Of the simple compounds, only the fluoride is amenable to electro- lysis in the fused state, since the chloride begins to volatilize below its melting-point, and the latter is only 5° below its boiling-point. Cryolite is not a safe body to electrolyse, because the minimum voltage needed to break up the aluminium fluoride is 4-0, whereas the sodium fluoride requires only 4-7 volts; if, therefore, the current rises in tension, the alkali is reduced, and the final product consists of an alloy with sodium. The corresponding double chloride is a far better material ; first, because it melts at about 180° C, and does not volatilize below a red heat, and second, because the voltage of aluminium chloride is 2-3 and that of sodium chloride 4-3, so that there is a much wider margin of safety to cover irregularities in the electric pressure. It has been found, how- ever, that molten cryolite and the analogous doublefluoride repre- sented by the formula AlgFe . 2NaF are very efficient solvents of alumina, and that these solutions can be easily electrolysed at about 800° C. by means of a current that completely decomposes the oxide but leaves the haloid salts unaffected. Molten cryolite dis- solves roughly 30 per cent, of its weight of pure alumina, so that when ready for treatment the solution c(^ntains about the same pro- portion of what may be termed ” available ” aluminium as does the fused double chloride of aluminium and sodium. The advantages lie with the

oxide because of its easier preparation. Alumina dis- solves readily enough in aqueous hydrochloric acid to yield a solu- tion of the chloride, but neither this solution, nor that containing sodium chloride, can be evaporated to dryness without decomposi- tion. To obtain the anhydrous single or double chloride, alumina must be ignited with carbon in a current of chlorine, and to exclude iron from the finished metal, either the alumina must be pure, or the chloride be submitted to purification. Thus preparation of a chlorine compound suited for electrolysis becomes more costly and more troublesome than that of the oxide, and in addition four times as much raw material must be handled.

At different times propositions have been made by Bucherer, Blackinore, and others, to win the metal from its sulphide. This compound possesses a heat of formation so much lower that elec- trically it needs but a voltage of 0-9 to decompose it, and it is easily soluble in the fused sulphides of the alkali metals. It can also be reduced metallurgically by the action of molten iron. Various considerations, however, tend to show that there cannot be so much advantage in employing it as would appear at first sight. As it is: easier to reduce than any other compound, so it is more difficult tO' produce. Therefore while less energy is absorbed in its final reduction, more is needed in its initial preparation, and it isi questionable whether the economy possible in the second stage' would not be neutralized by the greater cost of the first stage in the whole operation of winning the metal from bauxite with the sulphide! as the intermediary.

The Deville process as gradually elaborated between 1855 and 1859 exhibited three distinct phases : — Production of metallic sodium, formation of the pure double chloride of sodium cb I 1 and aluminium, and preparation of the metal by the redttcOoa interaction of the two former substances. To produce the alkali metal, a calcined mixture of sodium carbonate, coal, and chalk was strongly ignited in flat retorts made, of boiler-plate ; the sodium distilled over into condensers, and was preserved under heavy petroleum. In order to prepare pure alumina, bauxite and sodium carbonate were heated in a furnace until the reaction was complete ; the product was then extracted with water to dissolve the sodium aluminate, the solution treated with carbon dioxide, and the precipitate removed and dried. This purified oxide, mixed with sodium

chloride and coal tar, was carbonized at a red heat, and ignited in a current of dry chlorine as long as vapours of the double chloride were given off, these being condensed in suitable chambers. For the production of the final aluminium, 100 parts of the chloride and 45 parts of cryolite to serve as a flux were powdered together, and mixed with 35 parts of sodium cut into small pieces. The whole was thrown in several portions on to the hearth of a furnace previously heated to low redness, and was stirred at intervals for three hours. At length when the furnace was tapped a white slag was drawn off from the top, and the liquid metal beneath was received into a ladle and poured into cast-iron mouldy The process was worked out by Deville in his laboratory at the Ecole Normale in Paris. Early in 1855 he conducted la^ge- scale experiments at JjCvel in a factory lent him for the purpose, where he produced sufficient to show at the French Exhibition of 1855. In the spring of 1856 a complete plant was erected at La Glacifere, a suburb of Paris, but becoming a nuisance to the neighbours, it was removed to Nanterre in the following year. Later it was again transferred to Salindres, where the manufacture ‘ was continued by Messrs. Pechiney till, after Deville’s death iri 1881, the advent of the present electrolytic process rendered it no longer profitable. Deville received much encouragement and

pecuniary assistance from the French Academy, and also from the hands of Napoleon III., who, impressed with an aluminium medal struck in his honour, and with a baby-rattle presented to the infant Prince Imperial, conceived the idea of furnishing his Cuirassiers with aluminium armour and helmets. For over a year the Emperor defrayed Deville’s expenses, and although the latter did not find it possible to gratify his patron’s military aspirations, yet Napoleon III. ‘s generosity in assisting scientific research has borne much fruit both in the western and eastern hemispheres.

When Deville quitted the Javel works, two brothers named Tissier, formerly his assistants, who had devised an improved sodium furnace and had acquired a thorough knowledge of their leader’s experiments, also

left, and erected a factory at Amfreville, near Rouen, to work the cryolite process. This need not be described at length. It consisted simply in reducing cryolite with metallic sodium exactly as in Deville's chloride method, and it was claimed to possess various mythical advantages over its rival. Two grave disadvantages were soon obvious— the limited supply of ore, and, what was even more serious, the large proportion of silicon in the reduced metal. The Amfreville works existed some eight or ten years, but achieved no permanent prosperity. In 1858 or 1859 a small factory, the first in England, was built by F. W. Gerhard at Battersea, who also employed cryolite, made his own sodium, and was able to sell the product at 3s. 9d. per oz. This enterprise only lasted about four years. Between 1860 and 1874 Messrs Bell Brothers manufactured the metal at Washington, near New- castle, under Deville's supervision, producing nearly 2 cwt. per year. They took part in the International Exhibition of 1862, quoting a price of 40s. per R troy.

In 1881 Webster patented an improved' process for making alumina, and the following year he organized the Aluminium Crown Metal Co. of Hollywood to exploit it in conjunction with Deville's method of reduction. Potash-alum and pitch were calcined together, and the mass was treated with hydrochloric acid ; char- coal and water to form a paste were next added, and the whole was dried and ignited in a current of air and steam. The residue, con- sisting of alumina and potassium sulphate, was leached with water to separate the insoluble matter which was dried as usual. All the by-products, potassium sulphate, sulphur, and alumiuate of iron, were capable of recovery, and were claimed to reduce the cost of the oxide materially. From this alumina the double chloride was prepared in essentially the same manner as practised at Salindres, but sundry economies accrued in the process owing to the larger scale of working and to the adoption of Weldon's method of regenerating the spent chlorine liquors. In 1886 Castner's sodium patents appeared, and The Aluminium Co. of Oldbury was pro- moted to combine the advantages of Webster's alumina and Castner's sodium. Castner had long been interested in aluminium, and was desirous of lowering its price. Seeing that sodium was the only possible reducing agent, he set himself to cheapen its cost, and deliberately rejecting sodium carbonate for the more expensive sodium hydroxide (caustic soda) , and replacing carbon by a

mixture of iron and carbon — the so-called carbide of iron — ^he invented the highly scientific method of winning the alkali metal which has remained in existence almost to the present day. In 1872 sodium prepared by Deville's process cost about 4s. per lb, the greater part of the expense being due to the constant failure of the retorts ; in 1887 Castner's sodium cost less than Is. per lb, for his cast-iron pots survived 125 distillations.

In the same year Grabau patented a method of reducing the simple fluoride of aluminium with sodium, and his process was operated at Trotha in Germany. It was distinguished by the un- usual purity of the metal obtained, some of his samples containing 99-5 to 99-8 per cent. In 1888 the Alliance Aluminium Co. was organized to work certain patents taken out during the previous year by Dr Netto, Capt. Cunningham, and Mr Forster for winning the metal from cryolite by means of sodium, but these were only modifications in detail of the processes already described. This company erected plant in London, Hebbum, and Wallsend, and by 1889 were selling the metal at lis. to 15s. per lb. The Aluminium Company's price in 1888 was 20s. per ft and the output about 250 ft per day. In 1889 the price was 16s., but by 1891 the electricians commenced to offer metal at 4s. per ft and aluminium reduced with sodium became a thing of the past.

About 1879 dynamos began to be introduced into metallurgical

practice, and from that date onwards numerous schemes for utiliz-

ing this cheaper form of energy were brought before the

frlf„ public. The first electrical method worthy of notice is reaucaoa. ^^^^ patented by Messrs E. H. and A. H. Cowles in 1885, which was worked both at Lockport, New York State, and at Milton, Staffordshire. The furnace consisted of a fiat rectangular firebrick box, packed with a layer of finely powdered charcoal 2 inches thick. Through stuffing-boxes at the ends passed the two electrodes, made after the fashion of arc-light carbons, and capable of being approached together according to the requirements of the operation. The central space of the furnace was filled with a

mixture of corundum, coarsely powdered charcoal, and copper ; and an iron lid lined with firebrick was luted in its place to exclude air. The charge was reduced by means of a 50- volt current from a 300-kilowatt dynamo, which was passed through the furnace for IJ hours till decomposition was complete. About 100 ft of bronze, containing from 15 to 20 ft of alluminium, were obtained from each run, the yield of the alloy being reported at about 1 ft per 18 e.h.p.hours. The composition of the alloys thus produced could not be predetermined with exactitude ; each batch was therefore analysed, a number of them were bulked together, or mixed with copper in the necessary proportion, and melted in crucibles to give merchantable bronzes containing between IJ and 10 per cent, of aluminium. Although the copper took no part in the reaction, its employment was found indispensable, as otherwise the aluminium partly volatilized, and partly combined with the carbon to form a car bide. It was also necessary to give the fine charcoal a thin coating of calcium oxide by soaking it in lime-water, for the temperature was so high that unless it was thus protected it was gradually converted into graphite, losing its insulating power and diffusing the current through the lining and walls of the furnace. That this process did not depend upon electrolysis, but was simply an instance of electrical smelting, or the decomposition of an oxide by means of carbon at the temperature of the electric arc, is shown by the fact that the Cowles furnace would work with an alternating current.

In 1883 Gratzel patented a useless electrolytic process with fused cryolite or the double chloride as the raw material, and in 1886 Kleiner propounded a cryolite method which was worked for a time by the Aluminium Syndicate at Tyldesley near Man- chester, but was abandoned in 1890. In, 1887 Minet took out patents for electrolysing a mixture of sodium chloride with aluminium fluoride, or with natural or artificial cryolite. The operation was continuous, the metal being regularly run off from the bottom of the bath, while fresh alumina and fluoride were added as required. The process exhibited several disadvantages ; the electrolyte had to be kept constant in composition lest either fluorine vapours should be evolved or sodium thrown down, and the raw materials had accordingly to be prepared in a pure state. After prolonged experiments in a factory owned by Messrs Bernard Fr^res at St Michel in Savoy, Minet's process was given up, and at the close of the 19th century the H6roult-

Hall method was alone being employed in the manufacture of aluminium throughout the world.

The original Deville process for obtaining pure alumina from bauxite was greatly simplified in 1889 by Bayer, whose most recent patents are being exploited at Lame in Ireland. Crude bauxite is ground, lightly calcined to destroy organic matter, and agitated under a pressure of 70 or 80 ft per square inch with a solution of sodium hydroxide having the specific gravity 1-45. After two or three hours the liquid is diluted till its density falls to 1-23, when it is passed through filter-presses to remove the in-soluble ferric oxide and silica. The solution of sodium aluminate, containing aluminium oxide and sodium oxide in the molecular proportion of 6 to 1, is next agitated for thirty-six hours with a small quantity of hydrated alumina previously obtained, which causes the liquor to decompose, and some 70 per cent, of the aluminium hydroxide to be thrown down. The filtrate, now con- taining roughly two molecules of alumina to one of soda, is concen- trated to the original gravity of 1-45, and employed instead of fresh caustic for the attack of more bauxite; the precipitate is then collected, washed till free from soda, dried, and ignited at about 1000° C. to convert it into a crystalline oxide which is less hygroscopic than the former amorphous variety.

The process of manufacture which now remains to be described was patented during 1886 and 1887 in the name of C. M. Hall in America, in that of P. V. L. Hfiroult in England and France. It would be idle to discuss to whom the credit of first imagining the method rightfully belongs, for probably this is only one of the many occasions when new ideas have been born in several brains at the same time. Hall, however, at once realized that his aim should be to win aluminium itself in an electrically warmed bath ; for a while Hgroult seemed undecided between the pure metal and an alloy, between internal and external heating. By 1888 Hall was at work on a commercial scale at Pittsburg, reducing German alumina ; in 1891 the plant was removed to New Kensington for economy in fuel, and was gradually enlarged to 1500 h.p. ; in 1894 a factory of 5000 h.p. driven by water was erected at Niagara Falls. In 1890 also the Hall process operated by steam power was installed at Patricrof t, Lancashire, where the plant had a capacity of 300 ft per day, but by 1894

the turbines of the Swiss and French works ruined the enterprise. About 1897 the Bernard factory at St Michel passed into the hands of Messrs Pechiney, the machinery soon being increased to 8000 h.p., and there, under the control of a firm that has been concerned in the industry almost from its inception, aluminium is being manufactured by the Hall process. In July 1888 the Soci^tfe Mfitallurgique Suisse erected plant driven by a 500 h.p. turbine to carry out H6roult's alloy process, and at

the end of that year the AUgemeine Elektricitats Gesellsohaft united with the Swiss firm in organizing the Aluminium Industrie Aotien Gesellschaft of Neuhausen to manufacture the metal on a larger scale. Hfiroult and Kiliani then reverted to the plan of winning the metal alone, and gradually the alloy process was abandoned. At present (1900) about 4000 h.p. obtained from the Rhine are employed at Neahausen, and about 2000 h.p. at Eheinfelden, while some 3000 h.p. are similarly used by the Soci6t6 Electro-M^tallurgique Pran^aise of La Praz near Modane. In 1895 the British Aluminium Company was founded to mine bauxite and manufacture alumina in Ireland, to prepare the necessary electrodes at Greenock, to reduce the aluminium at Foyers, and to refine and work up the metal into marketable shapes at the old Milton factory of the Cowles Syndicate, remodelled to suit modem requirements.

The river Foyers in Inverness-shire, which empties itself int6 liOch Ness, makes a total descent of 400 feet during the last IJ- mile of its course, and forms two cascades 40 feet and 165 feet high respectively. From a point some distance above the upper fall an 8-feet tunnel has been drilled through the solid rock, bringing the water at a high level to the brow of the hill that slopes down to the loch, which it descends in steel tubes to drive the turbines at the bottom. Lest the natural river should fail in times of drought, water-rights over some 100 square miles of Inverness-shire have been acquired, and a masonry dam has been built across the southern end of the mountain valley (700 feet high) that con- tained Lochs Faraline and Garth, so as to raise the water level and form one vast reservoir 5 miles long by f mile wide holding 4000 million gallons —

sufficient without any rainfall to propel the machinery for 100 days. By the end of 1899 plant equal to 7000 h.p. had been installed, some of it, however, being employed in the manufacture of calcium carbide. Each dynamo ,is carried on the same vertical shaft with its turbine, and runs at a speed of 150 revolutions per minute, developing 700 e.h.p., and giving a current of some 8000 amperes at 60 volts.

The Hfiroult cell consists of a square iron or steel box lined with carbon rammed and baked into a solid mass ; at the bottom is a cast- iron plate connected with the negative pole of the dynamo, but the actual working cathode is undoubtedly the layer of already reduced and molten metal that lies in the bath. The anode is formed of a bundle of carbon rods suspended from overhead so as to be capable of vertical adjustment. The cell is filled up with cryolite, and the current is turned on till this is melted ; then the pure powdered alumina is fed in continuously as long as the operation proceeds. The current is supplied at a tension of 3 to 5 volts per cell, passing through 10 or 12 in series ; and it performs two distinct functions — (1) it overcomes the chemical affinity of the aluminium oxide ; (2) it overcomes the resistance of the electrolyte, heating the liquid at the same time. As a part of the voltage is consumed in the latter duty, only the residue can be converted into chemical work, and as the theoretical voltage of the aluminium fluoride in the cryolite is 4-0, provided the bath is kept properly supplied with alumina, the fluorides are not attacked. It follows, therefore, except for mechanical losses, that one charge of. cryolite lasts indefinitely, that the sodium and other impurities in it are not liable to contaminate the prodlict, and that only the alumina itself need be carefully purified. The operation is essentially a dissociation of alumina into aluminium, which collects at the cathode, and into oxygen, which combines with the anodes to form carbon monoxide, the latter escaping and ijieing burnt to carbon dioxide outside. Theoretically 36 parts by weight of carbon are oxidized in the production of 54 parts of aluminium ; practically the anodes waste at the same rate at which metal is deposited. The current density is about 700 amperes per square foot of cathode surface, and the number of rods in the anode is such that each delivers 6 or 7 amperes per square inch of cross- sectional area. The working temperature lies between 750° and 860° C, and the actual yield is 1 Bb of metal per 12 e.h.p. hours. The bath is heated internally with the

current rather than by means of external fuel, because this arrangement permits the vessel itself to be kept comparatively cool ; if it were fired from without, it would be hotter than the electrolyte, and no material suitable for the construction of the cell is competent to with- stand the attack of nascent aluminium at high temperatures. Aluminium is so light that it is a matter requiring some ingenuity to select a convenient solvent through which it shall sink quickly, for if it does not sink, it short-circuits the electrolyte. The molten metal has a specific gravity of 2-54, that of molten cryolite saturated with alumina is 2-35, and that of the fluoride AlzFe. 2NaF saturated with alumina 1-97. The latter therefore appears the better material, and was originally preferred by Hall ; cryolite, however, dissolves more alumina, and has been finally adopted by both inventors.

Aluminium is a wliite metal with a characteristic tint which most nearly resembles that of tin ; when impure, or

*after prolonged exposure to air, it has a slight violet shade. Its atomic weight is 27 (26*77, H = 1, according to J. Thomsen). It is trivalent. The specific gravity pj„ ^^^g of cast metal is 2‘583, and of rolled 2-688 at 4° C. It melts at 626° C. (freezing-point 654-5°, Heycoek and Neville). It is the third most malleable and sixth most ductile metal, yielding sheets 0-000025 inch in thick- ness, and wires 0-004 inch in diameter. When quite pure it is somewhat harder than tin, and its hardness is con- siderably increased by rolling. It is not magnetic. It stands near the positive end of the list of elements arranged in electromotive series, beiug exceeded only by the. alkalis and metals of the alkaline earths ; it therefore combines eagerly, under suitable conditions, with oxygen and chlorine. Its coefficient of linear expansion by heat is 0-0000222 (Eichards) or 0-0000231 (Eoberts-Austen) per 1° C. Its mean specific heat between 0° and 100° is 0-227, and its latent heat of fusion 100 calories (Richards). Only silver, copper, and gold surpass it as conductors of heat, its value being 31-33 (Ag = 100, Eoberts-Austen). Its electrical conductivity, determined on 99-6 per cent, metal, is 60-5 per cent, that of copper for equal volumes, or double that of copper for equal weights, and when chemically pure it exhibits a somewhat higher relative efficiency. The average strength of 98 per cent, metal is approximately shown by the following table : —*

Elastic Limit,

tons per square inch.

Ultimate

Strength, tons

per square

inch.

Redaction of

Area per

cent.

Cast .... Sheet .... Bars .... Wire ....

3 7-13

7

11

12

13-29

15 35 40 60

Weight for weight, therefore, aluminium is only ex- ceeded in tensile strength by the best cast steel, and its own alloy, aluminium bronze. An absolutely clean surface becomes tarnished in damp air, an almost invisible coating of oxide being produced, just as happens with zinc ; but this film is very permanent and prevents further attack. Exposure to air and rain also causes slight corrosion, but to nothing like the same extent as occurs with iron, copper, or brass. Commercial electrolytic aluminium-

of the best quality contains as the average of a large number of tests, 0-48 per cent, of silicon and 0-46 per cent, of iron, the residue being essentially aluminium itself. The metal in mass is not affected by hot or cold water, the foil is very slowly oxidized, while the amalgam decomposes rapidly. Sulphuretted hydrogen has no action upon it, therefore articles made of it are not blackened in foggy weather or in rooms where crude coal gas is burnt. To inorganic acids, except hydrochloric, it is highly resistant, ranking well with tin in this respect; but alkalis dissolve it quickly. Organic acids such as vinegar, common salt, the natural iugredients of food, and the various extraneous substances used as food preservatives, alone, or mixed together, dissolve traces of it if boiled for any length of time in a chemically clean vessel ; but when aluminium utensils are submitted to the ordinary routine of the kitchen, being used to heat or cook milk, coffee, vegetables, meat, and even fruit, and are also cleaned frequently in the usual fashion, no appreciable quantity of metal passes into the food. Moreover, did it do so, the action upon the human system would be infinitely less harmful than similar doses of copper or of lead.

The highly electro-positive character of aluminium is most important. At elevated temperatures the metal decomposes nearly all other metallic oxides, wherefore it is most serviceable as a metallurgical reagent. In the casting of iron, steel, and brass, the addition of a trifling

proportion (0-005 per cent.) removes oxide, and renders the molten metal more fluid, causing the finished products to be more homogeneous, free from blow-holes, and solid all through. On the other hand, its electro-positive nature necessitates some care in its utilization. If it be exposed to damp, to sea-water, or to corrosive influences of any kind in contact with another metal, or if it be mixed with another metal so as to form an alloy which is not a true chemical compound, the other metal being highly negative to it, powerful galvanic action will be set up, and the structure will quickly deteriorate. This explains the failure of boats built of commercially pure aluminium which have been put together with iron or copper rivets, and the decay of other boats built of a light alloy, in which

the alloying metal (copper) has been injudiciously chosen. It also explains why aluminium is so difficult to join with low-temperature solders, for these mostly contain a large proportion of lead. This disadvantage, however, is often overestimated, since in most cases other means of uniting two pieces are available.

The metal produces an enormous number of useful

alloys, some of which, containing only 1 or 2 per cent.

of other metals, combine the lightness of alu-

***^*' minium itself with far greater hardness and strength. Some with 90 to 99 per cent, of other metals exhibit the general properties of those metals conspicu- ously improved. Among the heavy alloys, the aluminium bronzes (Cu, 90-97-5 per cent.; Al, 2-5-10 per cent.) occupy the most important position, showing mean tensile strengths increasing from 20 to 41 tons per square inch as the percentage of aluminium rises, and all strongly re- sisting corrosion in air or sea-water. The light copper alloys, in which the proportions just given are practi- • cally reversed, are of considerably less utility, for al- though they are fairly strong, they lack power to resist galvanic action. This subject is far from being exhausted, and it is not improbable that the alloy-producing capacity of aluminium may eventually prove its most valuable characteristic. In the meantime, ternary light alloys appear the most satisfactory, and tungsten and copper, or tungsten and nickel, seem to be the best substances to add.*

The uses of aluminium are too numerous to mention.

Probably the widest fleld is still in the purification of iron

and steel. To the general public it appeals

**■ most strongly as a material for constructing*

cooking utensils. It is not brittle like porcelain and cast iron, not poisonous like IcE^d-glazed earthenware and un- tinned copper, has no enamel to chip ofE like steel, does not rust and wear out like cheap

tinplate, and weighs but a fraction of other substances. It is largely replacing brass and copper in all departments of industry — espe- cially where dead weight has to be moved about, and lightness is synonymous with economy — for instance, in bed-plates for torpedo-boat engines, internal fittings for ships instead of wood, complete boats for portage, motor- car parts, and boiling-pans for confectionery and in chem- ical works. The British Admiralty employ it to save weight in the Navy, and the Continental war-offices equip their soldiers with it wherever possible. As a substitute for Solfenhofen stone it is used in a modified form of lithography, which can be performed on rotary printing- machines at a high speed. With the increasing price of copper, it is coming into vogue as an electrical conductor for uncovered mains ; it is found that an aluminium wire 0-126 inch in diameter will carry as much current as a copper wire 0-100 inch in diameter, while the former weighs about 79 lb and the latter 162 fb per mile. Assum- ing the materials to be of equal tensile strength per unit of area — hard-drawn copper is stronger, but has a lower conductivity — ^the adoption of aluminium thus leads to a

reduction of 52 per cent, in the weight, a gain of 60 per cent, in the strength, and an increase of 26 per cent, in the diameter of the conductor ; a saving in cost of poles is also effected. At present prices (1900) it is already cheaper than copper per unit of electric current conveyed ; but when insulation is necessary, the smaller size of the copper wire renders it more economical. Aluminium con- ductors have been employed on heavy work in many places outside England, notably for a 30,000 volt current in Washington Territory, U.S.A., which is transmitted a distance of over 30 miles, and similar developments are proceeding in England, the earliest being at Northaller- ton. Eor telegraphy and telephony, aluminium conductors are in frequent demand, and givei perfect satisfaction. Difficulties were at first encountered in making the nec- essary joints, but they have been largely overcome by practice and experience.

Two points connected with this metal are of sufficient moment to demand a few words by way of conclusion. Its extraordinary lightness forms its chief claim to general adoption, yet is apt to cause mistakes when its price is mentioned. It is the weight of a mass of metal which governs its financial value ; its industrial value, in the vast majority of cases, depends

on the volume of that mass. Provided it be rigid, the bed-plate of an engine is no better for weighing 30 cwt. than for weighing 10 cwt. A saucepan is required to have a certain diameter and a certain depth in order that it shall hold a certain bulk of liquid : its weight is merely an encumbrance. Copper being 3^ times as heavy as aluminium, whenever the latter costs less than 3^ times as^much as copper it is actually cheaper. It must be remembered, too, that electrolytic aluminium has only been known during the last decade of the 19th century. Samples dating from the old sodium days are still in existence, and when they exhibit unpleasant properties the defect is often ascribed to the metal instead of to the process by which it was won. Much has yet to be learnt about the practical qualities of the electrolytic product, and although every day's experience serves to place the metal in a firmer industrial position, a final verdict can only be passed after the lapse of time. The individual and collective influence of the several impurities which occur in the product of the Hdroult cell is still to seek, and the importance of this inquiry will be seen when we consider that if cast iron, wrought iron, and steel, the three totally distinct metals included in the generic name of " iron " — which are only distinguished one from another chemically by minute differences in the proportion of certain non-metal- lic ingredients — ^had only been in use for some dozen years, attempts might occasionally be made to forge cast iron, or to employ wrought iron in the manufacture of edge-tools. (e. j. e.)

A I va , a police burgh and (woollen) manufacturing town of Clackmannanshire (transferred from Stirlingshire, 1891), Scotland, 7 miles E. of Stirling, the terminus of a branch of the North British Railway. Population (1881),

4961; (1891), 6225; (1901), 4624.

Alverstone, Richard Everard Webster, 1st

Baeon, Lord Chief Justice of England (1842), was

born 22nd December 1842, being the second son of Thomas Webster, Q.C. He was educated at King's College and Charterhouse schools, and Trinity College, Cambridge ; was called to the bar in 1868, and became Q.C. only

ten years afterwards. His practice was chiefly in commercial, railway, and patent cases until (June 1885) he was ap- / pointed attorney-general in the Conservative Government in the exceptional circumstances of never having been solicitor-general, and not at the time occupying a seat in parliament. He was elected for Launceston in the fol-

lowing month, and in November exchanged this seat for the Isle of Wight, which he continued to represent until his elevation to the House of Lords. Except under the brief Gladstone administration of 1886, and the G- ladstone- Eosebery Cabinet of 1892-95, Sir Richard Webster was attorney-general from 1885 to 1899. In 1890 he was leading counsel for the Times in the Parnell inquiry ; in 1893 he represented Great Britain in the Bering Sea arbitration ; and in 1898 he discharged the same function in the matter of the boundary between British Guiana and Venezuela. He was well known as an athlete in his earlier years, having represented his university as a run- ner, and his interest in cricket and foot-racing was kept up in later life. In the House of Commons, and outside it, he was throughout his political career prominently associated with Church work ; and though he had no claim to a reputation for eloquence, his speeches were distinguished for the more solid qualities of gravity and earnestness. In 1899 he succeeded Sir Nathaniel Lindley as Master of the Rolls, at the same time being raised to the peerage as Baron Alverstone, and in October of the same year he was elevated to the office of Lord Chief Jiistice upon the death of Lord Eussell of Killowen.

Alwar, or Ulwai;, a native state of India, in the Eajputana agency. Area, 3051 square miles ; population (1881), 682,926; (189.1), 767,786— average density, 252 persons per square mile ; (1901), 828,888, showing an increase of 8 per cent. When compared with a heavy decrease elsewhere throughout Eajputana, this increase may be attributed to the successful administration of famine relief, under British officials. The gross revenue in 1896-97 was Rs.27,88,410, of which Es.20,48,000 was derived from land, Es.1,25,000 from salt, and Es.1,85,000 from interest. The expenditure included Es.3,59,000 for public works, Es.5,10,706 for

imperial service troops, Es.3,87,602 for irregular forces, Es.1,53,000 for palace, and Rs.3,13,000 for stables, &c. There was a balance of Es.65,53,00Q, mostly invested in government securities. The present Maharaja, Jai Singh, who succeeded in 1892, was educated at the Mayo College, where he excelled both in sports and in knowledge of English. Alw^r was the first native state to accept a currency struck at the Cal- cutta mint, of the same weight and assay as the imperial rupee, with the head of" the British Sovereign on the obverse. Imperial service troops are maintained, con- sisting of both cavalry and infantry, with transport. The state is traversed by the Delhi branch of the Eajputana railway. A settlement of the land revenue is being car- ried out by an English civilian.

The city of Alwar is situated in 27° 34′ lat. N. and 76° 38′ E. long. ; railway station on the Eajputana line, 98 miles from Delhi. Population (1881), 49,876 ; (1891), 52,398 ; (1901), 56,740, showing a steady increase. It stands in a valley overhung by a fortress 1000 feet above. It is surrounded by a rampart and moat, with five gates, and contains fine palaces, temples, and tombs. The water-supply is brought from a lake 9 miles distant. It has a high school, affiliated to the Allahabad university ; and a school for the sons of nobles, founded to commem- orate the Diamond Jubilee of Queen Victoria. The Lady DufEerin hospital is under the charge of an English lady doctor, with two female assistants.

Amakusa, an island belonging to Japan, 36^ miles long and 13^ wide, situated in 32° 20′ N. lat. and 131° E. long., on the west of the province of Higo, from which it is separated by the Yatsushiro-kai. It has no high mountains, but its surface being very hilly — ^four of the peaks rise to a height of over 1600 feet — ^the natives resort to the terrace system of cultivation with remarkable success. A number of the heads of the Christians exe-

cuted in connection with the Shimabara rebellion in the 17th century. were buried in this island. Amakusa pro- duces fine kaolin, which was largely used in former times by the potters of Hirado and Satsuma.

Amaifi, a town and archiepiscopal see of Campania, province of Salerno, Italy, on the N. coast of the Gulf of Salerno, 13 miles W. by S. from

Salerno. This part of the coast produces first-class lemons. Macaroni is manu- factured. A serious landslip choked up the harbour in January 1900. Population, 4792 (1881) ; 7329 (1901).

Amara, a town of Asiatic Turkey, in the Basra vilayet, on the left bank of the Tigris, connected with the right bank by a bridge of boats. It is the chief town of a rich district and exports grain and dates. Popular tion, 9500.

Amarapura, formerly capital of Burma, now a sub- division of the Mandalay district, with an area of 304 square miles and a population of 62,310. The old city of Amarapura is in a state of utter ruin. The Burmans know it as Myohrung, " the old city." It is a station on the Eangoon-Mandalay railway, and is the junction for the line to Maymyo and the Kunlong ferry, and for the Sagaing-Myitkyina railway. The group of villages called Amarapura by Europeans is known to the Burmans as Taung-myo, " the southern city," as distinguished from Mandalay, the Myauk-myo, or " northern city," 3 miles distant. Amarapura, though little more than a century old and abandoned so recently as 1860, is stamped with the desolation of ages, so completely have the climate and vandalism changed its aspect. It contains many pagodas.

Amasia, the chief town of a district in the Sivas vildlyet in Asia Min,or, and an important trade centre on the Samsiin-Sivas road. It was one of the chief towns of the kingdom of Trebizond, and was much favoured by the early Osmanli sultans, one of whom, Selim I., was born there. Am^sia has extensive orchards and fruit gardens ; and there are steam flour-mills. Wheat, flour, and silk are exported. In 1895 there was a massacre of Arme- nians. Population, 30,000 (Moslems, 20,000, of whom one-third are Shias ; Christians, 10,000).

Amazon. — The river Amazon, the largest in the world, has a drainage area of 2,722,000 square miles, if the Tocantins be included in its basin. It drains four- tenths of South America, and it gathers its waters from 5° N. to 20° S. latitude. Its most remote sources are found on the inter-Andean plateau, but a short distance from the Pacific Ocean ; and, after a course of about 4000 miles through the interior of Peru and across Brazil, it enters the Atlantic Ocean on the equator. It is gener- ally accepted by

geographers that the Maranon, or Upper Amazon, rises in the little lake, Lauricocha, in 10° 30′ S. latitude and 100 miles N.N.E. of Lima. They appear to have followed the account given by Padre Eritz, which has since been found incorrect. According to Antonio Raimondi, it is the Eio de Nupe branch of the small stream which issues from the lake that has the longer course and the greater volume of water. The Nupe rises in the Cordillera de Huayhuath, and is the true source of the Maranon. 'There is a difference among geographers as to where the Maranon ends and the Amazon commences, or whether both names apply to the same river. The Pongo de Manseriche, at the base of the Andes, and the head of useful navigation, seems to be the natural terminus of the Maranon ; and an examination of the hydrographic conditions of the great valley makes the convenience and accuracy of this apparent. Eaimondi terminates the Maranon at the

moutli of the Ucayali, Eeclus the same, both following the missionary fathers of the colonial period. M. de la Condamine uses "Amazon" and "Maranon" indiscrimi- nately, and considers them one and the same. Smith and Lowe give the mouth of the Javary as the eastern limit, as does d'Orbigny. Wolf, apparently uncertain, carries the "Maranon or Amazon" to the Peruvian frontier of Brazil, at Tabatinga. Other travellers and explorers contribute to the confusion. This probably arises from the rivalry of the Spaniards and Portuguese. The former accepted the name Maranon, in Peru, and as the missionaries penetrated the valley they extended the name until they reached the Ucayali; while, as the Portu- guese ascended the Amazon, they carried its name to the extent of their explorations. Beginning with the lower

river we propose to notice, first, the great affluents which go to swell the Volume of the main stream. , ^

Tributaries. .

The TocANTiNS is not really a branch of the Amazon, although usually so considered. It is the great central fluvial artery of Brazil, running from south to north for a distance of about 1500 miles. It rises in the mountainous district known as the Pyrenees ; but its more ^ambitious , western affluent, the Araguay, has its extreme southern headwaters on the slopes of the Serra Cayapd, and flows a distance of 1080 miles before its junction with the parent stream, which it appears almost to equal in volume. Besides its main tributary, the Bio das Mortes, it has twenty smaller branches, offering many miles of canoe navigation.

B. V.Dar6ishire&OJ.R:Howarth

Oxford igoi

The Amazon and its Tributaries.

In finding its way to the lowlands, it breaks frequently into falls and rapids, or winds violently through rocky gorges, until, at a point about. 100 miles above its junction with the Tocantins, it saws its way across a rocky dyke, for 12 miles, in roaring cataracts. The tributaries of the Tocantins, called the Maranhao and Parana-tinga, collect an immense volume of water from the highlands which surround them, especially on the south and south- east. Between the latter and the confluence with the Araguay, the Tocantins is occasionally obstructed by rocky barriers which cross it almost at a right angle. Through these, the river carves its channel, broken into cataracts and rapids, or cachoeiras, as they are called throughout Brazil. Its lowest one, the Itaboea cataract, is about 130 miles above its estuarine port of Gamete, for which distance the river is navigable; but above that it is useless as a commercial avenue, except for laborious and very costly transportation. The flat, broad valleys, com-posed of sand and clay, of both the Tocantins and its Araguay branch, are overlooked by steep bluffs. They are the margins of the great sandstone plateaux, from 1000 to 2000 feet elevation above sea-level, through which the

rivers have eroded their deep beds. Around the estuary of the Tocantins the great plateau has disappeared, to give place to a part of the forest-covered, half-submerged alluvial plain which extends far to the north-east

and west. The Par^ river, generally called one of the mouths of the Amazon, is only the lower reach of the Tocantins. If any portion of the waters of the Amazon runs round the southern side of the large island of Marajo into the river Para, it is only through tortuous, natural canals, which are in no sense outflow channels of the Amazon.

The XiNGu, the next large river west of the Tocantins, is a true tributary of the Amazon. It was but little known until it was explored in 1884-87 by von den Steinen, from Cuyabii. Travelling east, 240 miles, he found the river Tamitatoaba, 180 feet wide, flowing from a lake 25 miles in diameter. He descended this torrential stream to the river Eomero, 1300 feet wide, entering from the west, which receives the river Colisii. These three streams form the Xingii, or Parana-xingii, which, from 73 miles lower down, bounds along a succession of rapids for 400 miles. A little above the head of naviga- tion, 106 miles from its mouth, the river makes a bend to

the east tp find its way across a rocky barrier. Here is the great cataract of Itamaracdl, -which rushes down an inclined plane for three miles and then gives a final leap, called the Fall of Itamarac^. Near its mouth, the Xingii expands into an immense lake, and its waters then mingle with those of the Amazon through a labyrinth of cafios (natural canals), winding in countless directions through a wooded archipelago.

The Tapajos, running through a humid, hot, and unhealthy valley, pours into the Amazon 600 miles above Para, and is about 1200 miles long. It rises on the lofty Brazilian plateau near Diamantino, in 14° 25' S. lat. Near thig place, a number of streams unite to form the river Arinos, which, at latitude 10° 25', joins the Juruena, to form the "Alto Tapajos," so called as low down as the Rio Manoel, entering from the east. Thence, to Santarem, the stream is known as the Tapajos. The lower Arinos, the Alto Tapajos, and the Tapajos to the last rapid, the Maranhao Grande, is a

continuous series of formidable cataracts and rapids ; but from the Maranhao Grande to its mouth, about 188 miles, the river can be navigated by large vessels. For its last 100 miles, it is from 4 to 9 miles wide, and much of it very deep. . The valley of the Tapajos is bordered on both sides by bluffs. They are from 300 to 400 feet high" along the lower river; but, a few miles above Santarem, they retire from the eastern side and only approach the Amazon flood-plain some miles below Santarem.

The Madeira has its junction with the Amazon 870 miles by river above Para, and almost rivals it in the volume of its waters. It rises over 60 feet during the rainy season, and the largest ocean steamers may ascend it to the Fall of San Antonio, 663 miles above its mouth ; but in the dry months, from June to November, it is only navigable, for the same distance, for craft drawing from 5 to 6 feet of water. According to the treaty of San Ildefonso, the Madeira commences at the confluence of the Guapor^ with the Mamore. Both of these streams have their headwaters almost in contact with those of the river Paraguay. The idea of a connecting canal is based on ignorance of local conditions. San Antonio is the first of a formidable series of cataracts and rapids, nineteen in number, which, for a river distance of 263 miles, obstruct the upper course of the Madeira until the last rapid, called Guajar£ Merim (or Small Pebble), is reached, a little below the union of the Guapore with the Mamore. The junction of the great river Beni with the Madeira is at the "Madeira" Fall, a vast and grand display of reefs, whirlpools, and boiling torrents. Between Guajara-Merim and this fall, inclusive, the Madeira receives the drainage of the north-eastern slopes of the Andes, from Santa Cruz de la Sierra'to Cuzco, the whole of the south-western sloped Brazilian Matto-grosso, and the northern one of the Chiquitos sierras, an area about equal to that of France and Spain. The waters find "their way to the falls of the Madeira by many great rivers, the principal of which, if we enumerate them from east to west, are the Guapor^ or Itenez, the Baures or Blanco, the Itonama or San Miguel, the Mamore, Beni and Mayu- tata, or Madre de Dios, all of which are reinforced by numerous secondary, but powerful afiluents. The Guapord presents many difficulties to continuous navigation ; the Baures and Itonama offer hundreds of miles of navigable waters through beautiful plaias; the Mamore has been sounded by the writer, in the driest month of the year, for a distance of

600 miles above Guajar^Merim, and found never less than from 10 to 30 feet of water, with a current of from 1 to 3 miles an hour. Its Eio Grande branch, explored under the writer's instructions, was found navig- able for (Craf t drawing 3 feet of water to within 30 miles

of Santa Cruz de la Sierra — a level sandy plain interven- ing. The Grande is a river of enormous length, rising in a great valley of the Andes between the important cities of Sucre and Cochabamba, and having its upper waters in close touch with those of the Pilcomayo branch of the great river Paraguay. It makes a long curve through the moun- tains, and, after a course of about 800 miles, joins the Mamor^ near 15° S. lat. The Chapare, Secure, and Chimor^, tributaries of the Mamore, are navigable for launches up to the base of the mountains, to within 130 miles of Cochabamba. The Beni has a fall, 18 miles above its mouth, called " La Esperanza " ; beyond this, it is navigable for 217 miles to the port of Eeyes for launches in the dry season, and larger craft in the wet one. The extreme source of the Beni is the little river La Paz, which rises in the inter-Andean region, a few miles south- east of Lake Titicaca, and flows as a rivulet througji the Bolivian city of La Paz. From this point to Eeyes, the river is a torrent. The principal afluent of the Beni, and one which exceeds it in volume, enters it 120 miles above its mouth, and is known to the Indians along its banks as the Mayu-tata. Its ramifications drain the slopes of the Andes between 12° and 16° of latitude. It was long thought to be a tributary of the Purus, until the ill-fated Maldonado demonstrated that it be- longed to the Madeira river system. It is navigable, in the wet season, to the base of the Andes, to within 180 miles of Cuzco. Its upper waters are separated by only a short transitable portage from those of the Ucayali. When, however, the river is low, it is obstructed by several shoals, and violent, but surmountable currents, and its middle course has two rapids, each with the usual " head, body, and taU." It has sixty -three islands, great and small, from its mouth to its principal affluent, the Inambari, which joins it from the south, flowing along the base of the Andes. Its bed is definitively formed, its banks are solid, and the country it traverses is picturesque and frequently of exceeding beauty. All of the upper branches of the river Madeira find their way to the falls across the open, almost level Mojos and Beni plains, 35,000 square miles of which are yearly flooded to an average depth of about 3 feet, for a period of from

three to four months. They rival if they do not exceed in fertility the valley of the Nile, and are the healthiest and most inviting agricultural and grazing region of the basin of the Amazon.

The PuKus, a very sluggish river, enters the Amazon west of the Madeira, which it parallels as far south as the falls of the latter stream. It runs through a continuous forest at the bottom of the great depression lying between the Madeira river, which skirts the edge of the Brazilian sandstone plateau, and the Ucayali, which hugs the base of the Andes. Chandless found its elevation above sea level to be only 107 feet 590 miles from its mouth. It is one of the most crooked streams in the world, and its length, in a straight line, is less than half that by its curves. It is practically only a drainage ditch for the half -submerged, lake-flooded district it traverses. Its width is very uniform for 1000 miles up, and, for 800 miles, its depth is never less than 45 feet. It is navigable by steamers for 1648 miles as far as the little stream, the CurumahSi, but only by light-draft craft. Chandless ascended it 1866 miles. At 1792 miles, it forks into two small streams. Occasionally a cliff touches the river, but in general the lands are sub- ject to yearly inundations throughout its course, the river rising at times above 50 feet, the numerous lakes to the right and left serving as reservoirs. Its main tributary, the Aquiry or Acre, enters from the right about 1104 miles from the Amazon. Its sources are near those of the Mayu-tata. It is navigable for a period of about five months of the year, when the Purus valley is inundated;

and, for the remaining seven months, only canoes can ascend it sufficiently high to communicate overland with the settlements in the great india-rubber districts of the Mayu-tata and lower Beni : thus these regions are forced to seek a canoe outlet for their rich products by the very dangerous, costly, and laborious route of the falls of the Madeira.

The JuEUA is the next great southern affluent of the Amazon west of the Purii's, sharing with this the bottom of the immense inland Amazon depression, and having all the characteristics of the Puriis as regards

curvature, sluggishness, and general features of the low, half-flooded forest country it traverses. It rises among the Ucayali highlands, and is navigable and unobstructed for a dis- tance of 1133 miles above its junction with the Amazon.

The Javakt, the boundary line between Brazil and Peru, is another Amazon tributary of importance. It is supposed to be navigable, by canoe, for 900 miles above its mouth to its sources among the Ucayali highlands, but only 260 have been found suitable for steam naviga- tion. The Brazilian Boundary Commission ascended it, in 1866, to the junction of the Shino with its Jaquirana branch. The country it traverses in its extremely sinuous course is very level, similar in character to that of the Jurua, and is a forested wilderness occupied by a few savage hordes.

The Ucayali, which rises only about 70 miles north of Lake Titicaca, is the most interesting branch of the Amazon next to the Madeira. Peru has fitted out many costly and ably-conducted expeditions to explore it. One of them (1867) claimed to have reached within 240 mUes of Lima, and the little steamer Napo forced its way up the Violent currents for 77 miles above the junction with the Pachitea river as far as the river Tambo, or Apurimac, 770 miles from the confluence of the Ucayali with the Amazon. The Napo then succeeded in ascending the Urubamba branch of the Ucayali 35 miles above its union with the Tambo, to a point 200 miles north of Cuzco. The remainder of the Urubamba, as shown by Bosquet in 1806, and Gastelnau in 1846, is interrupted by cas- cades, reefs, and numberless other obstacles to navigation. The Tambo, which rises in the Vilcanota knot of moun- tains south of Cuzco, is a torrential stream valueless for commercial purposes. The banks of the Ucayali for 500 miles up are low, and, in the raiuy season, extensively inundated.

The HuALLAGA, which joins the Amazon to the west of the Ucayali, rises high among the mountains^ in about 10° 30′ S. lat., on the slopes of the celebrated Cerro de Pasco. For nearly its entire length, it is an impetuous torrent running through a succession of gorges. It has forty -two rapids, its last obstruction being the Pongo de Aguirre, so called from the traitor Aguure, who passed there. To this point, 140 miles from the Amazon, the Huallaga can be q,scended by large river steamers. Between the Huallaga

and the Ucayali lies the famous "Pampa del Sacramento," a level region of stoneless alluvial lands covered with thick, dark forests, first entered by the missionaries in 1726. It is about 300 miles long, from north to south, and varies in width from 40 to 100 miles. Many streams, navigable for canoes, penetrate this region from the Ucayali and the Huallaga. It is still occupied by savage tribes.

The river Maranon rises about 100 miles to the north- east of Lima. It flows through a deeply-eroded Andean valley, in a north-west direction, along the eastern base of the Cordillera of the Andes, as far as 5° 36′ S. lat. ; then it makes a great bend to the north-east, and with irre- sistib|le power cuts through the inland Andes, until, at the Pongo de Manseriche, it victoriously breaks away from the

mountains to flow onwards through the plains under the name of the Amazon. Barred by reefs, and full of rapids and impetuous currents, it cannot become a commercial avenue. At the point where it makes its great bend, the river Chinchipe pours into it from southern Ecuador. Just below this, the mountains close in on either side of the Maranon, forming narrows or pongos, for a length of 35 miles, where, besides numerous whirlpools, there are no less than thirty-five formidable rapids, the series conclud- ing with three cataracts just before reaching the river Imasa, or Chunchunga, near the mouth of which La Con- damine embarked, in the 18th century, to descend the Amazon. Here, the general level of the country begins to decrease in elevation, with only a few mountain spurs, which, from time to time, push as far as the river and form pongos of minor importance, and less dangerous to descend. Finally, after passing the narrows of Guaracayo, the cerros gradually disappear, and,f or a distance of about 20 miles, the river is full of islands, and there is nothing visible from its low banks but an immense forest-covered plain. But the last barrier has yet to be passed, the Pongo de Manseriche, 3 miles long, just below the mouth of the Kio Santiago, and between it and the old abandoned missionary station of Borja, in 38° 30′ S. lat. and 77° 30′ 40″ W. long. Accordingto Captain Carbajal, who descended it in the little steamer Napo in 1868, it is a vast rent in the Andes about 2000 feet deep, narrowing in places to a width of only 100 feet, the precipices " seeming to close in at the top." Through this dark canon, the Maranon leaps

along, at times, at the rate of 12 miles an hour.* From the northern slope of its basin, the Amazon receives many tributaries, but their combined volume of water is not nearly so great as that contributed to the parent stream by its affluents from the south. That part of Brazil lying between the Amazon and French, Dutch, and British Guiana, and bounded on the west by the Rio Negro, is known as Brazilian Guiana. It is the southern watershed of a tortuous, low chain of mountains running, roughly, east and west. Their northern slope, which is occupied by the three Guianas first named, is saturated and river-torn ; but their southern one, Brazilian Guiana, is in general thirsty and semi-barren, and the driest region of the Amazon valley. It is an area which has been left almost in the undisturbed possession of nomadic Indian tribes, whose scanty numbers find it difficult to solve the food problem. From the divortium aquarum between French Guiana and Brazil, known as the Tumuc-humac range • of highlands, two minor streams, the Yary and the Paron, reach the Amazon across the intervening broken and bar- ren tableland. They are full of rapids and reefs.

The Teombetas is the first river of importance we meet on the northern side as we ascend the Amazon. Its con- fluence with this is just above the town of Obidos. It has its sources in the Guiana highlands, but its long course is frequently interrupted by violent currents, rocky barriers, and rapids. The inferior zone of the river, as far up as the first fall, the Porteira, has but little broken water and is low and swampy ; but above the long series of cataracts and rapids the character and aspect of the valley com- pletely change, and the climate is much better. The river is navigable for 135 miles above its mouth.

The Negko, the great northern tributary of the Amazon, has its sources along the watershed between the Orinoco and the Amazon basins, and also connects with the Orinoco at one point. Its main affiuent is the Uaupes, which disputes with the headwaters of the Guaviari

1 One of the most daring deeds of exploration ever known in South America was done by the engineer A. Werthgrnan. He fitted out three rafts, in August 1870, and descended this whole series of rapids and cascades from the Bio Chinchipe to Borja.

branch of tlie Orinoco the drainage of the eastern slope of the ” oriental ” Andes of Colombia. The Negro is navigable for 450 miles above its mouth for 4 feet of ■water in the dry season, but it has many sandbanks and minor difficulties. In the wet season, it overflows the country far and wide, sometimes to a breadth of 20 miles, for long distances, and for 400 miles up, as, far as Santa Isabella, is a succession of lagoons, full of long islands and intricate channels, and the slope of the country is so gentle that the river has almost no current. But just before reaching the Uaupes there is a long series of reefs, over which the river violently flowsin cataracts, rapids, and whirlpools. The Uaupes is full of similar obstacles, some fifty rapids barring its navigation, although a long stretch of its upper course is said to be free from them, and to flow gently through a forested country. Despite the im- pediments, canoes ascend this stream to the Andes.

The Branco is the principal afBuent of the Negro from the north ; it is enriched by many streams from the sierras which separate “Venezuela and British Guiana from Brazil. Its two upper main tributaries are the Uraricuera and the Taqutli. The latter almost links its sources with those of the Essequibo. The Branco flows nearly south, and finds its way into the Negro through several channels and a chain of lagoons similar to those of the latter river. It is 350 miles long, up to its Uraricuera confluence. It has numerous islands, and, 2.35 miles abdve its mouth, it is broken by a bad series of rapids.

The Yapuba. West of the Negro the Amazon re- ceives three more imposing streams from the north-west — the YapurSi, the Iqa or Putumayo, and the Napo. The first was formerly known as the Hyapora, but its Brazilian part is now called the Yapur and its Colombian portion the Caquet^. Barao de Marajo gives it 600 miles of navigable stretches ; but Crevaux, who descended it, describes it as a frightful river — forests, jungles, rapids, cataracts, torrential rains, cannibals, and fevers

*throughout its course. It rises in the Colombian Andes, nearly in touch with the sources of the Magdalena, and augments its volume from many branches as it courses through Colombia. It was long supposed to have eight mouths ; but Eibeiro de Sampaio, in his voyage of 1774, determined that there was but one real mojuth, and that the supposed others are all faros or canos. In 1864-68, the Brazilian Government made a somewhat careful examination of the Brazilian part of the river, as far up as the rapid of Cupaty. Several very easy and almost complete water- routes exist between the Yapur and Negro across the low, flat intervening country. Barao de Marajo says there are six of them, and one which connects the upper Yapura with the Uaupes branch of the Negro; thus the Indian tribes of the respective valleys have facile contact with each other. *

The IgA, or Putumato, west of and parallel to the Yapur^, was found more agreeable to navigate by Crevaux. He ascended it in a steamer drawing 6 feet of water, and running day and night. He reached Cuemby, 800 miles above its mouth, without flnding a single rapid. Cuemby is only 200 miles from the Pacific Ocean, in a straight line passing through the town of Pasto in southern Colombia. There was not a stone to be seen up to the base of the Andes ; the river banks were of argillaceous earth and the bottom of fine sand.

The Napo rises on the flanks of the volcanoes of Anti- sana, Sincholagua, and Cotopaxi. Before it reaches the plains, it receives a great number of small streams from impenetrable, saturated, and much broken mountainous districts, where the dense and varied vegetation seems to flght for every square foot of ground. From the north, it is joined by the river Coca, having its source^ in the gorges of Cayamb^ on the equator, and also a power- ful riv«r, the AgUaripo, having its headwaters between

Cayambd and the Colombian frontier. From the west, it receives a secondary tributary, the Curaray, from the Andean slopes, between Cotopaxi and the volcano of Tunguragua. From its Coca branch to the mouth of the Curaray, the Napo is full of snags and shelving sand- banks, and throws out numerous canos among jungle- tangled islands, which in

the wet season are flooded, giving the river an immense width. From the Coca to the Amazon, it runs through a forested plain where not a hill is visible from the river — its uniformly level banks being only interrupted by swamps and lagoons. From the Amazon, the Napo is navigable for river craft up to its Curaray branch, a distance of about 216 miles, and perhaps a few miles farther ; thence, by painful canoe navigation, its upper waters may be ascended as far as Santa Eosa, the usual point of embarkation for any venturesome traveller who descends from the Quito table- land. The Coca river may be penetrated as far up as its middle course, where it is jammed between two mountain walls, in a deep canon, along which it dashes over high falls and numerous reefs. This is the stream made famous by the expedition of Gonzalo Pizarro.

The Nanay is the next Amazon tributary of importance west of the Napo. It belongs entirely to the lowlands, and is very crooked, has a slow current, and divides much into canos and strings of lagoons which flood the flat, low areas of country on either side. It is simply the drainage ditch of districts which are extensively overflowed in the rainy season. Captain Butt ascended it 195 miles, to near its source.

The TiGRE is the next west of the Nanay,. and is navi- gable for 125 miles from its confluence with the Amazon. Like the Nanay, it belongs wholly to the plains. Its mouth is 42 miles west of the junction of the Ucayali with the Amazon. Continuing west from the Tigre we have the Parinari, Chambira, and Nucuray, all short lowland streams, resembling the Nanay in character.

The Pastaza is the next large river we meet. It rises on the Ecuadorian tableland, where a branch from the valley of Eiobamba unites with one from the Latacunga basin and breaks through the inland range of the Andes ; and joined, afterwards, by several important tributaries, finds its way south-east among the gorges ; thence it turns southward into the plains, and enters the Amazon at a point about 60 miles west of the mouth of the Huallaga. So far as known, it is a stream of no value except for canoe navigation. Its rise and fall are rapid and un- certainj and it is shallow and full of sandbanks and

The MoKONA flows parallel to the Pastaza and immedi- ately to the west of it, and is the last stream of any importance on the northern side of the Amazon before reaching the Pongo de Manseriche. It is formed from a multitude of water-courses which descend the slopes of the Ecuadorian Andes south of the gigantic volcano of Sangai ; but it soon reaches the plain, which commences where it receives its Cusulima branch. The Morona is navigable for small craft for about 300 miles above its mouth, but it is extremely tortuous. Canoes may ascend many of its branches, especially the Cusulima and the Miazal, the latter almost to the base of Sangai. The Morona has been the scene of many rude explorations, with the hope of finding it serviceable as a commercial route between the inter-Andean tableland of Ecuador and the Amazon river. A river called the Paute dashes through the eastern Andes from the valley of Cuenca ; and a second, the Zamora, has broken through the same range from the basin of Loja. Swollen by their many affluents, they reach the lowlands and unite their waters to form the Santiago, which flows into the Maranon at the head of the Pongo de Manseriche. There is but little known of a trustworthy character re-

garding this river, but Wolf says that it is pobably navig- able up to the junction of the Paute with the Zamora.

The Main River.

The Amazon- Main Eivee is navigable for ocean steamers as far as Iquitos, 2300 miles from the sea, and 486 miles higher up for vessels drawing 14 feet cb^r^r- ° "«^ater, as far as Achual Point. Beyond that, istics. according to Tucker, confirmed by Wertheman, it is unsafe; but small steamers frequently ascend to the Pongo de Manseriche, just above Achual Point. The average current of the Amazon is about 3 miles an hour ; but, especially in flood, it dashes through some of its contracted channels at the rate of 5 miles. The U.S. steamer Wilmington ascended it to Iquitos in 1899. Commander Todd reports that the average depth of the river in the height of the rainy season is 120 feet. It commences to rise in*

November, and increases in volume until June, and then falls until the end of October. The rise of the Negro branch is not syn- chronous ; for the steady rains do not commence in its valley until February or March. By June it is full, and then it begins to fall with the Amazon. According to Bates, the Madeira "rises and sinks " two months earlier than the Amazon. The Amazon at times broadens to 4 and 6 miles. Occasionally, for long distances, it divides into two main streams with inland, lateral channels, all connected by a complicated system of natural canals, cutting the low, flat igapo lands, which are never more than 15 feet above low river, into almost numberless islands. At the narrows of Obidos, 400 miles from the sea, it is compressed into a single bed a mile wide and over 200 feet deep, through which, the water rushes at the rate of 4 to 5 miles an hour. In the rainy season it inundates the country throughout its course to the extent of several hundred thousand square miles, covering the flood-plain, called vargem. The flood-levels are in places from 40 to 50 feet high above low riv^r. Taking four, roughly equidistant places, the rise at Iquitos is 20 feet, at TefEe 45, near Obidos 35, and at Para 12 feet.

The first high land met in ascending the river is on the north bank, opposite the mouth of the Xingu, and extends for about 150 miles up, as far as Monte Alegre. It is a series of steep, table-topped hills, cut down to a kind of terrace which lies between them and the river. Monte Alegre reaches an altitude of several hundred feet. On the south side, above the Xingii, a line of low bluffs ex- tends, in a series of gentle curves with hardly any breaks nearly to Santarem, but a considerable distance inland, bordering the flood plain, which is many mUes wide. Then they bend to the south-west, and, abutting upon the lower Tapajos, merge into the bluffs which form the terrace margin of that river valley. The next high land on the north side is Obidos, a bluff, 56 feet above the river, backed by low hills. From Serpa, nearly opposite the river Madeira, to near the mouth of the Rio Negro, the banks are low, until approaching Manaos, they are rolling hills ; but from the Negro, for 600 miles, as far up as the village of Canaria, at the great bend of the Amazon, only very low land is found, resembling that at the mouth of the river. Vast areas of it are submerged at high water, above which only the upper part of the trees of the sombre forests appear. At Canaria, the high land commences and continues as far as Tabatinga, and thence up stream.

On the south side, from the Tapajos to the river Madeira, the banks are usually low, although two or three hills break the general monotony. From the latter river, however, to the Ucayali, a distance of nearly 1500 miles, the forested banks are just out of water, and are inundated

long before the river attains its maximum flood-line. Thence to the Huallagathe elevation of the land is some- what greater ; but not until this river is passed, and the Pongo de Manseriche approached, does the swelling ground of the Andean foot-hiUs raise the country above flood-level.

The Amazon is not a continuous incline, -but probably consists of long, level stretches connected by short inclined planes of extremely little fall, sufiicient, however, owing to its great depth, to give the gigantic volume of water a continuous impulse towards the ocean. The lower Amazon presents every evidence of having once been an ocean bay, the upper waters of which washed the cliffs qear Obidos. Only about 10 per cent, of the water discharged by the mighty stream enters it below Obidos, very little of which is from the northern slope of the valley. The drainage area of the Amazon basin above Obidos is about 1,945,000 square miles, and, below, only about 423,000 square miles, or say 20 per cent., exclusive of the 354,000 square miles of the Tocantins basin.

The width of the mouth of the monarch river is usually measured from Cabo do Norte to Punto Patijoca, a distance of 207 statute miles ; but this includes the ocean outlet, 40 miles wide, of the Par^ river, which should be de- ducted, as this stream is only the lower reach of the Tocantins.

Following the coast, a little to the north of Cabo do Norte, and for 100 miles along its Guiana margin up the Amazon, is a belt of half-submerged islands and shallow sandbanks. Here the tidal phenomenon called the bore, or Pororoca, occurs, where the soundings are not over 4 fathoms. It commences with a roar, constantly increasing, and advances at the rate of from 10 to 16 miles an hour, with a breaking wall of water from 5 to 12 feet high. Under such conditions -of warfare between the ocean and the river, it is not surprising that the former is rapidly eating away the coast and that the vast volume of silt carried by the Amazon finds it impossible to build up a delta.

The Amazon is not so much a river as it is a gigantic reservoir, extending from the sea to the base of the Andes, and, in the wet season, varying in width from 5 to 400 miles. Special attention has already been called to the fourteen great streams which discharge into this reservoir, but it receives a multitude of secondary rivers, which in any other part of the world would also be termed great.

*For 350 years after the discovery of the Amazon, by Pinzon, in 1600, the Portuguese portion of its basin remained almost an undisturbed wilderness, p. , , occupied by Indian tribes whom the food quest tion, trade. had split into countless fragments. It is doubt- «*c- ful. if its indigenous inhabitants ever exceeded one to every 5 square miles of territory, this being the maxi- mum it could support under the existing conditions of the period in question, and taking into account Indian methods of life. A few settlements on the banks of the main river and some of its tributaries, either for trade with the Indians or for evangelizing purposes, had been founded by the Portuguese pioneers of European civili- zation. The total population of the Brazilian portion of the Amazon basin in 1850 was perhaps 300,000, of whom about two-thirds were white and slaves, the latter num- bering about 25,000. The principal commercial city. Para, had from 10,000 to 12,000 inhabitants, including slaves. The town of Manaos, at the mouth of the Eio Negro, had from 1000 to 1500 population; but all the remaining villages, as far up as Tabatinga, on the Brazilian frontier of Peru, were wretched little groups of houses which appeared to have timidly effected a lodgment on the river bank, as if they feared to challenge the mysteries of*

the sombre and gigantic forests behind them. The value of the export and import trade of the whole valley in 1850 was but £600,000.

On the 6th September 1850, the great emperor, Dom Pedro II., sanctioned a law authorizing steam navigation on the Amazon, and confided to an illustrious Brazilian, Baxao Maudi (Irineu Evaugilista de Sousa), the task of carrying it into effect. He organized the ” Compania de Navigaqao e

Commercio do Amazonas ” at Eio de Janeiro in 1852 ; and in the following year it commenced opera- tions with three small steamers, the Monarch, the Marajo, and Bio Negro. At first, the navigation was principally confined to the main river ; and even in 1857 a modifica- tion of the Government contract only obliged the company to a monthly service between Par^ and Manaos, with steamers of 200 tons cargo capacity, a second line to make six round voyages a year between Manaos and Tabatinga, and a third, two trips a month between Para and Gamete The Government paid the company a sub- vention of £3935 monthly. Thus the first impulse of modern progress was given to the dormant valley. The success of the venture called attention to the unoccupied field ; a second company soon opened commerce on the Madeira, Puriis, and Negro; a\third established a line between Par£ and Manaos ; and a fourth found it profit- able to navigate some of the smaller streams ; while, in the interval, the Amazonas Company had largely increased its fine fleet. Meanwhile private individuals were build- ing and running small steam craft of their own, not only upon the main river but upon many of its afluents. The Government of Brazil, constantly pressed by the maritime powers and by the countries encircling the upper Amazon basin, decreed, on the 31st July 1867, the opening of the Amazon to all flags ; but limited this to certain defined points — Tabatinga, on the Amazon ; CametSi, on the Tocantins; Santarem, on the Tapajos; Borba, on the Madeira ; Manaos, on the Hio Negro ; the decree to take effect on 7th SeptemJ)er of the same year. Pardl is now a city of over 100,000 inhabitants, Manaos has about 40,000, and the Peruvian town of Iquitos, 10,000. In

1898 there entered the port of Para 603 ocean steamers and 123 sailing ships — a total of 610,597 tons ; and in

1899 the entries of English ocean-going ships reached 814,646 tons register. The first direct foreign trade with Manaos was commenced about 1874. There is now a regular service of two English, one Italian, and one Portuguese line — a total of 35 steamships, representing 52,953 tons register. There is also a Brazilian line of seven ships, of 1999 tons each, running between Manaos and Kio de Janeiro.

The local trade of the river is carried on by the Eng- lish successors to the Amazonas Company — the Amazon Steam Navigation Company^-with 29 steamers, aggregat- ing 9184 registered tons. In addition to its excellent fleet, there are 150 small river steamers belonging to companies and firms in the rubber trade, and 12 of from 150 to 300 tons each, navigating the Negro, Madeira, and Purus rivers. The principal exports of the vaUey are india-rubber, cacao, Brazil nuts, and a few other products of very minor importance. The india-rubber yield is now from 25,000 to 26,000 tons yearly. The finest quality comes from the Acre and Beni districts of Bolivia, especially from the valley of the Acre (or Aquiry) branch of the river Puriis. The yield of these for 1898 was 3151 tons, of which 2000 tons was the official estimate of the product of the Acre district; for 1899, it was 1150 tons ; and for the first eleven months of 1900 it was only 791 tons, the decrease being due to the recent unsuccessful attempt of the rubber collectors to segregate the region of the Acre from Bolivia and form a separate republic. Of the rubbe^r production of the Amazon basin, the State of

Pard; gives about 40 per cent. The cocoa tree is not culti- vated, but grows wild in great abundance. The quantity exported for 1899 was 4064 tons. There is but one rail- way in the whole valley. It runs from Par^ towards the coast and is &5 miles long. The cities of Para and Manaos have excellent tramways, many fine public buildings and private residences, gardens and public squares, all of which give evidence of artistic taste and great prosperity. The import dues collected at the port of Pardi in 1899 by the national Government amounted to £844,000. The revenues of the State of Amazonas for the same year were nearly £750,000, of which £476,000 were derived from export duties.

The number of inhabitants in the Brazilian Amazon basin (the States of Amazonas and Par^) is purely a matter of rough estimate. There may be 500,000 or 600,000, or more ; for the immigration, during recent years, from the other parts of Brazil has been large, due to the rubber excitement. The influx from the State of Ceardi alone, from 1892 to 1899 inclusive, reached 98,348.

As Commander Todd, in his report to the United States Government, says: "The crying need of the Amazon valley is food for the people. ... At the small towns along the river it is nearly impossible to obtain beef, vegetables, or fruit of any sort, and the inhabitants depend largely upon river fish, mandioc, and canned goods for their subsistence. . '. . The ship's company lived, the greater part of the time, upon the regular sea ration, and any ship ascending the Amazon should be well supplied with its own provisions, as it is impossible to live upon the country." Although 400 years have passed since the discovery of the Amazon river, there are probably not 20 square miles of its basin under cultivation, excluding the limited and rudely cultivated areas among the moun- tains at its extreme headwaters, which are inaccessible to commerce. The extensive exports of the mighty valley are entirely derived from the products of the forest.

(g. b. c.)

Amazonas, the largest state of Brazil, in the ex- treme west of the Republic, has an area of 732,250 square miles. The population in 1872 was 56,610, and in 1890 147,915, of whom nearly two-thirds were Indians. The capital, Manaos, at the mouth of the Eio Negro, has a population of 30,000. The chief towns are Teffe, Itar coatiara (or Serpa), Parintins, Codajaz, and San Gabriel. (See also under Amazon.)

Amazonas, an interior department of northern Peru, with an area of 13,943 square miles and a popula- tion officially estimated at 70,676 in 1896. It is sub- divided into three provinces, Bongara, Luya, and Chacha- poyas ; the principal town, Chachapoyas, has a population of 6000.

Ambala. See Umballa.

Amba Mariam. See Abyssinia.

Am berg, a town of Bavaria, Germany, district Upper Palatinate, 42 miles E. from Nuremberg by rail. The manufacture of stoneware, zinc-goods, and colours is carried on. A former Jesuit monastery is now used for a grammar school and seminary. There are a pilgrim- age church, on a hill 1621 ft. high, a large convict prison for men, an industrial and commercial school, &c. Popu- lation, 15,812 (1885); 20,200 (1895).

Ambleside, a market-town in the Appleby parlia- mentary division of Westmorland, England, a mile from the north end of Windermere. Recent erections are a preparatory school for the novitiate of St Norbert's Home and assembly rooms. Bobbins are manufactured, and in the neighbourhood are slate quarries. Area of parish (an urban district), 4421 acres. Papulation in 1881, 1989 ; in 1891, 2360 ; in 1901, 2536.

Amboyna, a Dutch colony and residency in the east of the East Indian archipelago, which shares with the residency of Ternate the administration of the Moluc-' cas, the previous Government of which was abolished m 1867. The residency includes a mass of islands in the Banda Sea (2° 30'-8° 20' S. and 126° 45'~~135° E.) and is now divided for administrajtive purposes into nine dis~~ tricts (afdeelingen) : 1, Amboyna, the island of that name; 2, Saparua, with Oma and Nusa Laut; 3, Kajeli (Eastern Burn) ; 4, Masareti (Western Burn) ; 5, Kairatu (Western Ceram); 6, Wahai (the ' northern part of Mid- Ceram) ; 7, Amahai (the southern part of Mid-Ceram) ; 8, the Banda Isles, with East Ceram, Ceram Laut, and Goram; 9, The islands of Aru, Ke, Timor Laut or Tinimber, and the south-western islands. Since 1874 several residents (Riedel, van Hoevell, &c., see below) have contributed to the geography and ethnography of various groups. The population, of the residency (area, about 19,840 square miles) was estimated in 1898 at 296,768 (natives 291,763, Europeans 2346, Chinese 913, Arabs 722, other foreigners 24). The products and means of sul^sistence in the different groups of islands vary, the culture of cloves being mainly confined to Banda and Amboyna ; shipbuilding and the timber trade to the Ke islands ; the extraction of cajuput oil to Buru. The ship- ping, fisheries, and trade are unimportant and generally declining.

See van Hoevell, Ambon en deEliaser (Dordrecht, 1875). — Riedel, De sluik-en kroesharige rassen tusschen Selebes en Papua ' (den Haag, 1886). — Maktin, Beisen in den Molukken (Leiden,

1894).

Amboyna (Dutch Ambon), the chief island and town of the above residency. The former, lying between 3° 28 '-3° 48′ S. and 127° 58'-128° 26′ E., is the last of a series of volcanic isles which form an inner circle in the archipelago round the Banda Sea (Martin). The highest mountains, Wawani (3609 feet) and Salhutu (4020 feet), have hot springs and solfataras. They are considered to be volcanoes, and the mountains of the neighbouring Uliasser islands the remains of volcanoes. Granite and serpentine rocks predominate; but the shores of Amboyna bay are of chalk, and contain stalactite caves (t|ie chief, Batu Lobang). The surface is fertile, the rivers are small and not navigable, and the roads are mere footpaths. Cocoa is one of the products. The population (estimated at 30,000) is divided into two classes — orang borger or citizens, and orang negri or villagers, the former being a class of native origin enjoying certain privileges conferred on their ancestors by the old Dutch East India Company. The chief town and seat of the resident and military commander of the Moluccas is protected by Fort Victoria, a clean little town with wide streets and numerous schools and churches. Agriculture, fisheries, and trade furnish the chief means of subsistence. The combined value of the exports and imports of late years has been about £85,000 (£83,333 literal conversion). The population is about 8000 (788 Europeans, 696 Chinese, 351 Arabs, 6218 natives).

Ambriz. See Angola.

Ambrosiaster. — A commentary on St Paul's Epis- tles, " brief in words but weighty in matter," and valuable for the criticism of the Latin text of the New Testament was formerly but erroneously attributed to St Ambrose ; and its author is usually spoken of as Ambrosiaster or pseudo-Ambrose. In modern days it has been ascribed to almost every known Hilary (owing to the fact that St Augustine cites it as by " Sanctus Hilarius "), and to many other writers ; above all to Hilary the Roman deacon and (by Langen) to the presbyter Faustinus.

Dom Morin has lately argued, with very great plausibility, that the author was one Isaac the Jew, who became a Christian and joined the party of the anti-pope Ur sinus, and was instigated by them to make criminal charges against Pope Damasus. These were ultimately dismissed, and

Isaac was exiled to Spain 378-380. In 380 he relapsed to Judaism; and nothing appears to be known of his later life.

Dom Morin first shows that none of the earlier attempts to identify Ambrosiaster can be accepted as satisfactory ; that the Quaestiones Veteris et JVovi Testamenti formerly ascribed to Au- gustine are also his (the attempt of C. Marold to disprove this breaking down entirely) ; that he wrote between 374 and 384 a.d., and that he lived and wrote at Rome. Then he compares the Quaestiones and Oommentaria with the little tract of Isaac the Jew on the Trinity and Incarnation, and with an incomplete Mxpositio Fidei printed by Caspari {Kirchenhist. Anecdota, 304 f), which, if not part of the same work, is nearly allied to it ; and the com- parison shows how close their literary and theological affinities are. Next, Ambrosiaster's writings are shown to contain just such characteristics as might be expected from Isaac the Jew : a cap- tious spirit of reform, exact knowledge of Judaism, and a legalist temperament; whilst there is no insuperable objection to such authorship. And lastly, the later history of Isaac would account for the subsequent uncertainty as to the authorship of the writings.

See G. MoEiN. " L' Ambrosiaster et le juif convert! Isaac " in Bevue d'histoire et de Utterature religieuses, torn. iv. 97 f. Paris, 1899. — Arnold. Art. " Ambrosiaster " in Herzog-Hauck, Seal- JSnq/klopddie fur protestantische Theologie, i. 441. Leipzig, 1896. — J. Langen. Qesehichte der romischen Kirche, i. 600 f. Bonn, 1881. (w. B. Co.)

Ambulance. — Medical organization for military field service comprises all the arrangements for the care and treatment of the sick and wounded from the time they are injured or taken ill till they are able to return to duty or are invalided home. In the British service, not only land transport but hospital ships are required. The working of the system is as follows (the case of a soldier wounded in action in South Africa being taien as an example). When he falls he is attended by the regimental surgeon and stretcher-bearers, who apply some extempo- cized method of stopping bleeding and dress the wound with the dressing — a packet of antiseptic appliances — which every fighting man carries stitched in^^o the inside of his tunic, and which contains all things necessary for dressing and

bandaging an ordinary gunshot wound. From the field he is carried on a stretcher by the men of the bearer company of the Royal Army Medical Corps to the collecting station, where he is placed in an ambulance waggon of the first line of assistance and taken to the dressing station. Here his wound will be examined, any operation urgently required will be performed, and a specification tally stating the nature of the injury and any other important facts connected with the case will be attached to him (if this has not already been done by the regimental surgeon), in order to avoid the disturbance and pain of repeated examinations. After this, and per- haps the administration of nourishments, stimulants, or opiates, the patient is moved to the field hospital in an ambulance waggon of the second line of assistance. From the field hospital he is transferred as soon as possible by the ambulance train to a general hospital at the advanced base of operations, and from there in due time in another train to the base of operations at the coast, from which he is ultimately either returned to duty or sent home in a hospital ship.

The organization by which these requirements are ful- filled is the following : — Every regiment and fighting unit has posted to it, on proceeding on active service, a medical officer who looks after the health of the men and advises the commanding officer on sanitary matters. When the regiment goes into action he takes command of the regi-

mental stretcher-bearers to the number of two per com- panjr -who have previously been instructed in first aid and in the carrying of the wounded on stretchers. These men leave their arms behind and wear the Red Cross armlets so as to be under the protection of the Geneva Convention, but when a battle takes the form of magazine

Fig. 1. — Type of British Army Ambulance.

rifle fire, continued for many hours without either side advancing or retiring much, it may not be the fault of the\ enemy that the bearers and medical officers are some- times shot in attending to the wounded.

The bearer company, into whose charge the wounded man next passes, is composed of three officers, thirteen non-commissioned officers, and forty-eight privates of the Royal Army Medical Corps, with a detachment of the Army Service Corps for transport duties. There is one such bearer company to every brigade, and six to an army corps, and their duties are to collect and succour the wounded on the battlefield, handing them over to the field hospitals, with which the companies are closely associated, though separately organized. In the Indian

Fia. 2.— Plan of Improved United States Army Ambulance.

army the bearer company is provided pro tern, from the personnel of the field hospital when there is a battle, and then reverts to the hospital again after it is over. The teaching of the South African war rather points to the advantage of the Indian plan, for after action the bearer 'company personnel should be available to give the much- needed help in the work of the field hospital. The bearers afford the wounded any treatment necessary, supply water

and sedatives, and then carry them back on stretchers to the collecting station in the rear, whence they are con- veyed to the dressing station in waggons or other form of transport (mule cacolets or litters in mountainous districts where wheeled carriages cannot go, camel cacolets and litters in the Sudan, dhoolies or Lushai dandies in India, hammocks on the West- Coast of Africa, or sedan chairs in China). Cacolets are seats slung on icach side of a pack saddle. British ambulance waggons (Figs. 1, 3), which are built very strongly to stand rough roads, are of several patterns. They have been reported upon as heavy and uncomfortable in the South African war, and they can only carry two men so seriously wounded as to have to lie down, besides those seated; but a new vehicle has been tried which will convey four cases lying down as well as six seated, or fourteen all seated. All patterns of waggons weigh from VI\ to 18^ cwt. At the dressing station — which ought to be out of range of the firing, and near a good water supply — the patient is made as comfortable as possible; nourish- ment and stimulants are administered, and he is then taken to the field hospital. There is one field hospital to each brigade, but since in larger organizations extra accommodation is

required for the corps troops not included in brigades, such as the ammunition supply col- umns, balloon and bridging detachments, &c., the total number of field hospitals for an army corps (roughly speaking 40,000 men) is ten. In times of great stress when it is desirable to remove the wounded quickly from the field, and there are no roads, or wheeled transport is not obtainable, it is becoming the custom to employ bearers in large numbers, temporarily en- gaged, whom a little training will render fairly efficient for the purpose. This was done in ^Natal at the battle of Spion Kop, and also in the Egyptian campaigns, where the local troops not required for the fighting line were requisitioned, and the arrangement was in both instances considered successful.

In India the rank and file of the Royal Army Medical Corps are not employed, the bearer work being carried out by natives called kahars, specially en- listed. These men are bearers by caste, and are most expert in carrying the dhoolies and dandies which are used instead of stretchers — except those used by the regimental (Euro- pean) stretcher-bearers — and their courage on the battlefield is the admiration of all be- holders. The same remark applies to the bheesties or water-carriers, who also accom- pany the troops into action. The ambulance organization of the army in India thus dif- fers materially from that elsewhere. The main difference is that, as already stated, the rank and file of the Royal Army Medical Corps are not employed, although the commissioned officers are. The warrant and non-commis- sioned ranks are replaced by a most useful body of men of Anglo-Indian or Eurasian birth called |iie Subordinate Medical Department, the members of which, now called assistant sur- geons, formerly apothecaries, receive a three –"' years' training in medical work at the Indian organixa- universities, and are competent to' perform the """ »' <• compounding of medicines and to undertake the '," management of all but the most serious cases of illness and injury. The privates of the Royal Army Medical*

Corps are replaced by natives graded as ward servants, cooks, water-carriers, and sweepers. The caste system necessitates this division of labour, and the men are not so efficient or so trustworthy as the regular soldiers whose places they take. The bearers of the sick and wounded are a separate and distinct class, as above explained, and they are in part attached to regiments as a portion of the regimental transport, and in part to the field hospital bearer compar nies on mobilization. The dandies, a more portable form of the old-fashioned dhoolie, are very comfortable, and have a canvas roof and curtain to keep off sun and rain. They are borne slung on a long , bamboo upon the shoulders of four or more men, but being very heavy and clumsy are not well suited for mountain warfare; moreover, as they cannot, be folded up into a smaller

compass for transport like a stretcher,~~they take up a great deal of room in railway trucks, and cannot be carried on the backs of animals. Hence riding ponies and mules are much used in Indian warfare for transport~~ ing the less severely wounded men. The ambulance tongas of India are small, very strongly built two-wheeled bullock or mule carriages capable of carrying four men seated or two lying down ;■ but the most serious cases are carried in dandies all the way from the field to the hospital. In India it is necessary to provide separate hospitals for the white and black troops, and also to have accommodation in the latter case for the large numbers of non-combatant camp- followers who are employees of the commissariat depart- ment, servants, grooms, cooks, bullock- and mule-drivers, and the like. The frontier war of 1897-98 may be taken

Fis. 8.— Plan of British Army Ambolance.

to illustrate the medical organization of the Indian army. In that war 18,688 white troops, 41,677 native troops, and 32,696 followers were engaged, and for the accommo- dation of these there were fourteen field hospitals for white troops and twenty-two for native troops, each having 100 beds. Attached to the corps engaged were 160 dandies, 274 stretchers, and 900 bearers, while the field hospitals and bearer companies had a personnel of 9658, with 720 dandies and 720 tongas.

Field Jiospitals are each supposed to provide accommo- dation for 100 patients, who live upon their own field rations suitably cooked and

supplemented by medical Hospitals, comforts. The patients are not supplied with hospital clothing, nor do they have beds, but lie on straw spread on the ground and covered with waterproof sheets and blankets. Thus field hospitals can and must at times accommodate more than the proper number of patients, but in the South African war their resources were at times con-

siderably overtaxed, with consequent discomfort and hard- ship. These hospitals are supposed to move with the army, and therefore it is imperative to pass the wounded quickly back from them to the hospitals on the lines of communi- cation (which vary in number according to the length of that line), and thence to the general hospital at the base. The size of these hospitals on the lines of communication varies according to circumstances ; they are as a rule dieted — ^that is to say, proper hospital diets and not field rations are issued to the patients, who also have beds and proper hospital clothing. In these hospitals there may be nursing sisters, who are unsuited for the rough life and work nearer the front. Sisters may also be employed on the hospital trains, which were found very useful in the South African war, being fitted with beds, kitchens, dispensaries, &c., so that the patients were removed long distances in comfort. Having arrived at the base of operations the wounded are transferred to the; general hospitals. The numbers and*

situation of these vary with circumstances and require- ments, but according to regulations there is supposed to be one of 520 beds to each field force of 20,000 men. Each is fully equipped -with beds, clothing, diets, &c., and the staff consists of 21 officers, 9 nursing sisters, 3 warrant officers, 25 non-commissioned officers, and about 120 privates. There are separate officers' wards. In South Africa, owing to the impossibility of the Eoyal Army Medical Corps meeting all the requirements of the enormous force engaged, many of the officers attached were civil doctors, and the

rank and file were often civilians drawn from the St John's Ambulance Brigade and men

Fia. 4.— Type of English Civil Ambulance (side and rear view).

temporarily enlisted from the Volunteer Medical Staff Corps. Many of the nursing sisters belonged to the Army Nursing Reserve, who are ordinarily employed in the civil hospitals, but liable to be drafted to the seat of war.

In the South African war the patriotism and liberality of the British public furnished several general hospitals, perfectly equipped and officered by some of the most eminent members of the medical profession in the United Kingdom. Among others may be mentioned the Princess Christian, the Imperial Yeomanry (both field and general), the Langman, the Portland, the Irish, Scottish, and Welsh hospitals. In addition to the staff of these hospitals, several eminent surgeons, including Sir Wm MacCormac and Sir Frederick (then Mr) Treves, went out as consultants. These civil hospitals were staffed entirely by civilians, except that an officer of the E.A.M.C. was

attached to each as administrator and organizer; and their personnel ' was made up of physicians, surgeons, nurses, dressers (who were medical students, and in some cases qualified surgeons), and servants. The numbers of course varied according to the size of the hospitals ; in the case of the Portland hospital of 100 beds, for example, the staff comprised 41 individuals of the various grades. Lastly, our wounded man is transferred to a hospital ship. This is fitted up with comfortable swinging cots in airy wards, refrigerators, punkahs for hot weather, and every other luxury which modern science can supply. Each division of an army corps is supposed to have attached to it, when necessary, a hospital ship of 200 or 250 beds, which is provided with medical officers, nursing

Fig. 5.— Type of American Civil Ambulance (side and rear view).

sisters, and the same staff and equipment as hospitals ashore.

The medical staff of the regular army in the South African war in its later stage comprised the following officers : — 1 surgeon- general, 11

colonels, 41 lieut-colonels, 183 majors, 71 captains, and 115 lieutenants-^total 422 officers. The total strength of the Royal Army Medical Corps at that time was 905, and out of the balance there were 365 officers employed in other foreign stations, and only 118 at home. This shows how severely the war taxed the resources of the corps. Probably there were as many civil, colonial, and volunteer medical officers employed at the front as there were army medical officers. Of the rank and file of the Eoyal Army Medical Corps there were over 3000 men employed, and about the same number of St John's ambulance men, and other civilians and volunteers. To the army medical organization in war time is affiliated that of the Red Cross Society and other charitable associations, which during the South African war aided the medical services greatly by the provision of clothing, money, and numerous luxuries for the sick and wounded.

The material and equipment for the bearer companies, field hospitals, &c., are stored in times of peace at the various head- quarters stations in the United Kingdom, and on the orders for

methods.

mobilization being issued, the personnel told off for each unit repairs to the allotted station, draws the equipment and transport, and embarks with the brigade to which it is attached. The trans- port of the ambulance department has profited by the concentra- tion in strength of drugs, and the arrangements whereby space is economized. As the fighting man can carry in his wallet nourish- ment enough for thirty-six hours in the form of an emergency ration in a tin the size of a cigar-case, and enough sweetening material in the form of saccharine to last him a fortnight, in a bottle the size of a watch, so the medical department can take compressed tabloids of drugs, each tabloid being a dose, and each taking up about one-tenth of the space the drug would otherwise occupy ; while the med- ical officers can carry hypodermic cases, not so large as ordinary cigarette-cases, contaiiiing a syringe and hundreds of doses of highly con-

centrated remedies. The traction-engines with the army can supply steam-power for X-ray and electric-light work, ice-making, &c.

The American Civil War (1861-65) marked the commencement of the modem ambulance system. The main feature, how- ever, of the hospital organization throughout that campaign was the railway hospital service, which provided for the rapid conveyance of the sick an(^ wounded to the' rear of the contending armies. These hospital carriages (Pig. 2), equipped with med- ical stores and appliances for the transport of cases from the front to the base, were rapidly introduced into other armies, and played a great part in the ambulance service of the Franco-German war. On the continent of Europe, the two rival military Powers, Trance and Germany, who were not slow to follow the American lead, have since 1871 stiU further developed and im- proved their ambulance systems. The German hospital service for armies in the field was modified and extended by the " Kriegs Sanitats ordnung " of 1878 and the " Kriegs Etappen ordnung " of 1887, which completed the organization by the addition in time of war of numerous subordinate offices and departments. The peace organization does not materially differ from the English system. The main divisions of the ambulance organization of the German army in the field would now fall into (1) sanitary detachments ; (2) field hospitals ; (3) fiying hospitals ; hospital reserve dep5ts ; (5) commissions of transport ambulance ; and (6) railway hospital trains. The whole administration of the ambulance service of the grand army in the field is in the hands of the chief of the army sanitary staff, who is attached to headquarters. Next in command come surgeons-general of armies operating in the field, surgeons-general of army corps, and under them again surgeons- in-chief of divisions and regiments. Civil consulting-surgeons of eminence, notably professors from the universities, are also attached to the various armies and divisions to co-operate with and act as advisers to the surgeons of the standing military sur- gical staff. The hospital transport service on the lines of com- munication is highly organized, and the hospital railway carriages are equipped on an elaborate scale. The Erench ambulance system, finally settled by the rfeglement of 1884, is organized on almost identical lines with the German. But the chief point wherein the German and French ambulance systems differ from the British lies in the military organization of the volunteer assistance offered by the various Bed Cross

societies under the Geneva flag. Whereas in France and Germany such aid is officially recognized and placed under direct military control, the English Bed Cross societies act side by side with, but independently of, the military ambulance organization. In Germany the volunteer organiza- tion is presided over by an imperial commissioner or inspector- general, appointed in peace time, who in time of war is attached to the headquarters staff. His functions are to control the relations of the various Bed Cross societies, and to secure their harmonious inter- working. Delegates appointed by him are attached to the various corps and transport commissions. Ko volunteer assistance can be utilized which is not entirely subor- dinated to the military control, and which has not already in peace time received official recognition, and been organized on a skeleton footing. Moreover, only persons of German nationality can be employed under it with the armies in the field. In the case of base hospitals situate in Germany itself, the services of foreigners may be enlisted by special permission of the war office. In France, in the mam, the same rules obtain in the case of the volunteer hospital service.

*Civil ambulances. — In 1878 the British ambulance association of St John of Jerusalem was founded. Its object was to render first aid to persons injured in accidents on the road, railway, or in any of the occupations of civil life. As a result of the initia^*

tive taken by this society, ambulance corps havft been formed in most large towns of the United Kingdom ; and police, railway ser- vants, and workmen have been instructed how to render "first aid" pending the arrival of a doctor (Fig. 4). This Samaritan work has been further developed and extended to most parts of the British Empire, notably to Canada, Australia, and India. In the United States the civil ambulance is not general. Each city has its own system and organization. In some the ambulance service is

Fig. 6. — Type of Motor Ambulance.

worked by the police, as in Boston ; in others, notably New York, by the hospitals (Figs. 5, 6), whilst Chicago boasts an admirable ambulance service under municipal control. Apart from these " Samaritan " services, as they may be called, there is also in most of the larger cities of America

a specially organized police am- bulance for the rapid conveyance of arrested persons to the police stations. In most of the capitals of Europe there are likewise civil ambulance organizations dispensing "first aid "in urgent cases, but their modus operandi is in no special feature distinguishable from that of the ambulance association of St John.

(j. B. D.)

Amedeo Ferdinando Maria di Savoia,

Duke of Aosta (1845-1890), third son of Victor Emmanuel n., king of Italy, and of Adelaide, archduchess of Austria, was born at Turin on 30th May 1845. Entering the army as captain in 1869 he fought through the campaign of 1866 with the rank of major-general, leading his brigade into action at Custozza and being wounded at Monte Torre. In May 1867 he married the Princess Maria Carlotta Del Pozzo della Cisterna. In 1868 he was created vice-admiral of the Italian navy, but, two years later, left Italy to ascend the Spanish throne, his reluctance to accept the invitation of the Cortes having been overridden by the .Italian Cabinet. On 16th November 1870 he was proclaimed king of Spain by the Cortes ; but, before he could arrive at Madrid, Marshal Prim, chief promoter of his candidature, was assassinated. Undeterred by rumours of a plot against his own life, Amedeo entered Madrid alone, riding at some distance from his suite to the church where Marshal Prim's body lay in state. His efforts as constitutional king were paralysed by the rivalry between the various Spanish factions, but with the approval of his father he rejected all idea of a coup d'itat. Though warned of a plot against his life (18th August 1872) he refused to take precautions, and, while returning from Buen Eetiro to Madrid in company with the queen, was repeatedly shot at in Via Avenal. The royal carriage was struck by several revolver and rifle bullets, the horses wounded, but its occupants escaped unhurt. A period of calm followed the outrage. On 11th February 1873, however, Amedeo, abandoned by his partisans and attacked more fiercely than ever by his opponents, signed his abdication. Upon returning to Italy he was cordially welcomed and reinstated in his former position. His consort, whose health had been

undermined bj anxiety in Spain, died on 3rd November 1876. Not until 11th September 1888 did Amedeo con- tract bis second marriage with his niece, Princess Letitia Bonaparte. Less than two years later (18th January

1890) he died at Turin in the arms of his elder brother. Zing Humbert I., leaving four children — the duke of Aosta, the Count of Turin, the duke of the Abruzzi, and

the duke of Salemi.

(h. w. s.)

AMERICA.

THE historical accident that resulted in the use of a single name, America, for the pair of continents that has a greater extension from north to fbrmatioa. °–*^ ^^^”^ ^^7 Other continuous land area of the globe, has had some justification in recent years, since geologicg.1 opinion has begun to turn in favour of the theory of the tetrahedral deformation of the earth’s crust as affording explanation of the group- ing of continents and oceans. America, broadening in the north as if to span the oceans by reaching to its neighbours on the east and west, tapering between vast oceans far to the south where the nearest land is in the little-known Antarctic regions, roughly presents the tri- angular outline that is to be expected from tetrahedral warping; and although greatly broken in the middle, and standing with the northern and southern parts out of a meridian line, America is nevertheless the best witness among the continents of to-day to the tetrahedral theory. There seems to be, however, not a unity but a duality in its plan of construction, for the two parts, North and South America, resemble each other not only in outline but, roughly speaking, in geological evolution also ; and the resemblances thus discovered are the more remarkable when it is considered how extremely small is the probability that among all the possible combinations of ancient mountain systems, modern mountain systems, and plains, two continents out of five should present so many points of correspondence. Thus regarded, it be- comes reasonable to

suppose that North and South America have in a broad way been developed under a succession of somewhat similar strains in the earth's crust, and that they are, in so far, favourable witnesses to the theory that there is something individual in the plan of continental growth. The chief points of corre- spondence between these two great land masses, besides the southward tapering, are as follows : — (1) The areas of ancient fundamental rocks of the north-east (Lauren- tian highlands of North America, uplands of Guiana in South America), which have remained without signifi- cant deformation, although suffering various oscillations of level, since ancient geological times ; (2) the highlands of the south-east (Appalachians and Brazilian highlands) with a north-east south-west crystalline axis near the ocean, followed by a belt of deformed and metar morphosed early Palaeozoic strata, and adjoined farther inland by a dissected plateau of nearly horizontal later Palaeozoic formations — all greatly denuded since the ancient deformation of the mountain axis, and seeming to owe their present altitude to broad uplifts of compar- atively modern geological date; (3) the complex of younger mountains along the western side of the con- tinents (Western highlands, or Cordilleras, of North America; Andean Cordilleras of South America) of geologically modern deformation and upheaval, with en- closed basins and abundant volcanic action, but each a system in itself, disconnected and not standing in align- ment; (4) confluent lower lands between the highlands, giving river drainage to the north (Mackenzie, Orinoco), east (St Lawrence, Amazon), and south (Mississippi, La Plata). Differences of dimension and detail are nu- merous, but they do not suf&ce to mask what seems to be a resemblance in general plan. Indeed, some of the

chief contrasts of the two continents arise not so much from geological unlikeness as from their unsymmetrical situation with respect to the equator, whereby the north- ern one lies mostly in the temperate zone, while the south- ern one lies mostly in the torrid zone. North America is bathed in frigid waters around its broad northern shores ; its mountains bear huge glaciers in the north- west ; the outlying area of Greenland in the north-east is shrouded with ice ; and in geologically recent times a vast ice-sheet has spread over its north-eastern third ; whUe warm waters bring corals to its southern shores. South America has warm waters and coral's on the north-east, and cold waters and glaciers only on its

narrowing southern end. If the symmetry that is so noticeable in geological history had extended to climate as well, many geographical fea- tures might now present likenesses instead of contrasts.

When America is compared with the continents of the Old World, an important correspondence is found between its northern member and the greater part of Eurasia ; but here the corresponding parts are reversed, right and left, like the two hands. The Laurentian highlands agree with Scandinavia and Finland, both having escaped deformation since very ancient times. A series of water bodies (the Great lakes in North America, the southern Baltic, with Onega, Ladoga, &c., in Europe) occupy depressions that are associated with the boundary between the very ancient lands and their less ancient covering strata. The old worn-down and re-elevated Appalachian mountains of south-eastern North America agree well with the Her- cynian mountains of similar histoiy in Middle Europe (Ardennes, Slate mountains of the middle Rhine, &c.), each range entering the Atlantic at one end (in Nova Scotia and Newfoundland ; in Brittany, Wales, and Ire- land), and dipping under younger formations at the other. Certain younger ranges — seldom recognized as mountains because they are mostly submerged in the American mediterraneans (Gulf of Mexico and Caribbean Sea), but of great absolute relief and with crests rising in the larger West Indian islands — may be compared with the younger ranges of southern Europe (Pyrenees, Alps, Caucasus) bordering the classic Mediterranean and the seas farther east. The central plains of North America correspond well with the plains of Russia and western Siberia; both stretch from great enclosed water bodies on the south to the Arctic Ocean, and both are built of undisturbed Palaeozoic strata toward the axis of symmetry and of younger strata away from it. Finally, tJEie West- em highlands of North America may be compared with the great mountain complex of central and eastern Asia. In this remarkable succession of resemblances, we find one of the best proofs of the continental unity of Eurasia, however independently Europe and Asia should have been developed on a tetrahedral earth, and however fully the separation of these two grand divisions is demanded on historical and political grounds. Moreover, the resemblances thus described controvert the idea, prevalent when geology was less advanced than to-day, that the New World of civilised discovery is an "old world" geologically, and that

the Old World of history is geologically "new." Both worlds are so old, and both share so well the effects of succes- sive geological changes from the most ancient to

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the most modem periods, that neither can regard the other as older or younger than itself. No simple generalization is admissible concerning the age of any- thing whose history is so complicated as that of a continent.

The climatic contrasts between North and South America are replaced by several climatic Isimilarities between North America and Eurasia. The Appalachians and the Hercynian mountains of middle Europe both contain extensive coal deposits of similar geological age, thus indicating a climatic and geographic resemblance at a time of great antiquity. The Laurentian highlands and the Scandinavian highlands were both heavily and repeat- edly glaciated in recent geological times, and the ice sheets that crept out on all sides from those centres spread far over the lower lands to the south and away from the axis of symmetry towards the continental in- terior, scouring the central highlands and leaving them rocky and barren, strewing extensive drift deposits over the peripheral areas, and thus significantly modifying their form and drainage ; while the much loftier mountain ranges of western America and central Asia suffered, singularly enough, a far less extensive glaciation. At the present time, .the plentiful and well-distributed rainfall of the continental border on either side of the Atlantic is succeeded by an increasing aridity towards the continental interior, until the broad plains that rise towards the distant mountain complexes are comparatively barren or even desert. Within each greater mountain area exten- sive interior drainage basins are found holding salt lakes, and the suspected former extension of these lakes in central Asia agrees well with the proved extension of the lacustrine conditions in western North America. In matters of temperature, however, there are certain con- trasts, as will be more fully stated below when the ques- tion of climate is discussed.

North America.

The following sketch of the geological development of North America considers the larger physiographic divi- sions in the order already presented.

The extensive area of ancient crystalline rocks (Archaean), stretching from Labrador past Hudson Bay to the Arctic Ocean, is of greatly disordered hTbi'a^ structure, and hence must have once haA a g an s. JJ^Q^J^(;g^^J^Q^g form. Moreover, the crystalline texture and deformed foliation of the rocks prove that the surface now seen was once buried deep beneath the surface of an earlier time, for only at great depths can such texture and foliation be acquired. Both these lines of evidence lead to the conclusion that the moderate relief prevalent over the existing Laurentian region is the work of persevering erosion during a long con- tinuance of dry land conditions, and hence that the region must be regarded as one of those worn-down mountain systems which so eloquently testify to the vast duration of geological time. But the full value of this testimony is appreciated only when it is dis- covered that the worn-down old land is gently over- lapped, chiefly around the south and west, and south of Hudson Bay, by very early Palaeozoic strata which rest upon the eroded surface of the crystallines, thus proving that the destruction of the ancient mountains had already been accomplished before some of the oldest f ossiliferous formations of the world had been deposited. All the evidence goes to prove that from then to now the Lauren- tian region has been relatively quiescent, as if the forces of deformation had been exhausted by their efforts in the earlier ages of the earth's history. In all subsequent time there have been here no such great crushings and upheavals as have occurred elsewhere, but only moderate

oscillations of level, one of which allowed the transgression of the ancient sea in which the overlapping strata were deposited, while another of much more modern date gave the region its present highland altitude (1000 to 2000 feet; mountains near the Labrador coast, 8000 feet), again offering it to the forces of erosion.

It is this ancient Laurentian area that the earlier geologists named the " Continental Nucleus," as if it had been the first part of North America to

rise from the primeval waters of an assumed universal ocean. The " Archaean V," formed by the two arms of the Laurentian oldlaud stretching from Labrador to the Arctic, between which Hudson Bay is included, has been repeatedly de- scribed as the oldest area of the continent, the beginning around which many later additions have built the existing outlines ; and as such it has been adduced in favour of the theory of the permanence of continents. But when thus stated, the half of the story in favour of this theory is not told. Hudson Bay is not due to a primitive failure of elevation between the arms of the " Archaean V " ; it is not a deep basin whose floor has never emerged from the primeval ocean, but an ancient and comparatively shallow depression in a pre-existent land, over which the sea flowed as the surface sank below sea-level. South and west from the "Archaean Nucleus," the Cambrian strata of the medial plains of North America are found to lie, wherever their base is discovered, on a foundation that possesses all the essential features of the Laurentian oldland. This relation is found all around the Adiron- dack mountains in New York, along the Appalachians southward to Georgia, through the Mississippi basin in Wisconsin and Missouri, and beyond in Texas, and farther west in the Black Hills, as well as certain points in the Kocky Mountains region. Hence the pre-Cambrian land surface of the continent must have had not only a vastly greater area than was formerly attributed to it, but also an earlier origin; for at the time when it was thought by the older geologists to be first rising from the primeval ocean, it is now proved to have been slowly sinking after a prolonged land existence. The crystalline Archaean rocks in the Lau-rentian region and its scattered fellows cannot possibly be explained as a primitive sea bottom, rising above sea-level to make the beginning of a continent and receiving Cambrian strata upon its still submerged borders, but only as portions of an already old and deeply- denuded land area, which was in pre-Cambrian time much larger than the visible Laurentian area of to-day, and which was reduced to perhaps half its primeval dimen-sions by a gradual submergence beneath the transgressing sea in which the Cambrian sediments were laid down. We are thus led to believe that much of the continent of to-day was a continent in the earliest geological times, and that the seas which partly covered it in Palaeozoic and Mesozoic time were due to partial submergence, not to partial emergence. Furthermore, all the marine strata that now stretch over a large part of

what is believed to have been the ancient continental surface are of relatively shallow water origin ; none of them bear any close re- semblance to the deposits of the deep oceans that have been so well studied in the last thirty years. Hence the Palaeozoic and Mesozoic seas of North America were not deep oceans, and as far as this continent is concerned it is by no means admissible to assume, as some of the /earlier geologists did, that the position of continents and oceans have repeatedly changed places. The testimony of the rocks is decidedly in favour of Dana's view that con- tinental masses are relatively permanent, and hence also, as far as stability is concerned, in favour of the theory of a tetrahedral earth.

The early history of the Laurentian region has been

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dwelt upon because of its great importance in the history of the continent, and because its history has so generally been misunderstood. To these reasons may be added a third : through Palaeozoic and Mesozoic time the history of the Laurentian region is for the most part a blank. Eecords are wanting from the early Palaeozoic to the Pleis-

tocene, when the Laurentian uplands became the centres from which the ice sheets of the Glacial period spread out on all sides. As a result of this late chapter in the history of the region, the weathered soils of earlier periods were swept away along with an unknown amount of firm rock, leaving bare ledges, scattered boulders, and gravelly drift

Sketch Map of North America.

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to-day upon a rugged upland without mountains (except in north-east Labrador), but diversified by innumerable knobs and hollows. The

drainage of the region has thus been thrown into disorder; large and small lakes and marshy hollows abound ; the streams are repeatedly in- terrupted by rapids, and frequently split into two or more channels, enclosing islands many miles in length. They are the only highways of this thinly inhabited region.

The Appalachian province is a generally hiUy and moun- tainous belt, stretching from Newfoundland to Alabama. It seems for the most part to have belonged in the earliest times to the great pre-Cambrian *«»» land area, of which the Laurentian highland 'h^tiands. is the more manifest representative; for wher- ever the basal members of the Palaeozoic sedimentary series are found in the Appalachians, they rest upon a floor of

denuded Archaean rocks, and the lowest layers are largely- composed of Archaean detritus. This province must, how- ever, be set aside from the undisturbed Laurentian region because of the repeated movements of depression, defor- mation, and elevation that it has suffered, generally along a north-east south-west trend, causing the successive alter- nations of heavy deposition, and almost equally heavy denudation, that have prevailed with varying intensity during the whole stretch of geological time covered by the fossiliferous record. The earliest important mountain-making disturbances interrupted the conditions of deposi- tion in Cambrian time, and produced what has been called the Green Mountain system. A later, and probably greater, disturbance, with its climax at the close of Car- boniferous time, established the Appalachian Mountain system ; but, as understood to-day, the "Appalachian revo- lution" of the older geologists should be regarded as a long-lasting process, perhaps intermittently enduring as long as the whole of Carboniferous time. A subordi- nate period of deposition and deformation occurred early in Mesozoic time, marked by the accumulation and dis- turbance of several basins of the Newark formation, roughly corresponding to the Triassic of Europe.

The Appalachian mountains of to-day were formerly regarded as the unconsumed remnants of the chief Ap- palachian uplift; but it is now generally agreed that Mesozoic erosion reduced the greater part of the range to a lowland of moderate or small relief, leaving only isolated groups of subdued mountains in the areas of the most resistant rocks, and that the altitude and form of the mountains are chiefly the result of 'the Tertiary elevation and dissection of the previously worn-down mass, — ^the additional height thus ^iven in Tertiary time to the pre-existent subdued mountain groups making them now the loftiest areas of the range, as in the White Mountains of New Hampshire (Mount Washington, 6293 feet), and the Black Mountains of North Carolina

(Mount Mitchell, 6711 feet). It is interesting to note that the axis of Tertiary elevation is nearly parallel to and closely associated with the axes of the earlier dis- turbances, but it lies somewhat to the north-west of its predecessors, and therefore involves considerable areas of flat-lying Palaeozoic strata on the inner side of the previ- ously disturbed belt from New York to Alabama, thus pro- ducing what is known as the Allegheny plateau (altitudes, 2000 to 4000 feet). It should be added that the Osark pla- teau of Missouri and the Ouachita mountains on the south in Arkansas and farther west are related to one another in much the same way as the Allegheny plateau and the middle ranges of the Appalachians — the two pairs cor- responding to a remarkable degree in regard to conditions of ancient accumulation, mediaeval deformation and denu- dation, and more modern uplift and dissection; it is, there- fore, admissible to classify this western group of uplifts as an annex to the normal Appalachians. Numerous and extensive coal seams occur in the worn-down Appalachians of Nova Scotia, Pennsylvania, and Alabama, as well as in the Allegheny plateau from Pennsylvania to Alabama, and in the extension of the same strata through the Ohio and middle Mississippi basins.

The eastern coast of the continent has a ragged shore line from Maine to Greenland, with numerous sub- merged lowlands and valleys forming bays, and as many uplands and ridges outstretching in promontories and islands ; this being the result of the summation of many movements of the land, whose total gives an increasing measure of depression to the north where an archipelago at last replaces what was probably once a comer of the continent ; but the measure of the depression is uncer- tain, because of the doubt regarding the depth beneath sea-level to which the Pleistocene glaciers may have

worn the pre-Glacial valleys. South of New England, along the Atlantic coast, and ar^nd the border of the gulf into Mexico, the dominating movement of the land in late geological periods has been upward with respect to sea-level, whereby a former sea bottom, on which the land waste of Cretaceous and Tertiary times had been outspread, was revealed as a coastal plain, across which the rivers of the former land area now extend their courses, from the old shore line to the new. Part of the same

plain, still submerged, forms the "continental shelf" of the mid- Atlantic border. Florida seems to be a project- ing swell of this shelf, around whose extremity coral reefs have been added, but whose greater mass is still under a shallow sea cover. Along the ragged coast in the north a moderate and very modern movement of elevation has laid bare clay-floored lowlands that were lately beneath the sea, as in the plain of the lower St Lawrence valley, while along the coastal plain of the south a slight movement of depression has drowned a number of low valley floors, producing shallow arms of the sea, as Chesapeake Bay, Albemarle and Pamlico Sound, and Mobile Bay.

The great complex of mountains in the Western high- lands, sometimes styled the Cordilleras of North America (the Eocky Mountains being the eastern mem- bers of the system in the United States and The Cor-

Canada), differ from the Laurentian and Appa- g'** "' *lachian regions in having suffered numerous America. disorderly movements at dates so recent that the existing relief of the region bears a significant relation to its irregular uplifts ; a relation that doubtless once obtained in the older mountain areas of the east, where it has now been obliterated by erosion. It is not, however, only in modern geological periods that mountain-making disturb- ances have prevailed in the regions of the Western high-lands ; their geological history is one of repeated and long continued movement — ^the ruins of the more ancient up- heavals supplying materials for the strata of newer ranges. For example, in Canada an axial belt of ancient rocks is bordered on the east and west by stratified formations of enormous thickness (40,000 to 60,000 feet), those on the west including a large share of contemporaneous volcanic materials ; all three belts having been deformed and up- heaved, as well as deeply dissected in the later chapters of geological time. It is, however, important to note that the interval between Palaeozoic and Mesozoic time, in which mountain-making disturbances were so general in western Europe and eastern North America that the older geologists thought them to be of world-wide extent, was here generally passed over in relative quiet, so that con- tinuous sedimentation produced in certain districts a con- formable series of deposits from Silurian to Cretaceous time. Furthermore, the Carboniferous period, which gained -its name from the extensive coal deposits that were then formed in western Europe and eastern North*

America, was a marine limestone-making period in the Cordilleran region. If the science of geology had had its origin on the Pacific side of America, some of its early generalizations would have been very different from those which gained credence in the lands bordering the North Atlantic.

There is here exemplified, as might be expected in a region extending over 3000 miles from Alaska to south- ern Mexico, and measuring over 1000 miles in breadth at its middle, a great variety of plateau and mountain structures. The broad upheaval of adjacent blocks of earth-crust vnthout significant tilting or disturbance has produced the plateaus of Arizona and Utah. Some of the simplest and youngest mountain ridges in the world are to be found in the broken and tilted lava blocks of southern Oregon. Tilted blocks on a larger scale, much more affected by processes of sculpture, are found in the lofty St Elias Alps of Alaska, the site of some of the

greatest glaciers in the world. The wall of a huge fracture, now elaborately carved, constitutes the western slope of the Wahsatch range, facing the desert basin of Utah. Eanges of a relatively simple arch structure are seen in the Uinta mountains of Wyoming and Utah. Arched upheavals also characterize the front range of the Eocky Mountains proper in Colorado and Wyoming and in the Black Hills of South Dakota, bending up the strata of the adjacent plains in the simplest fashion, and producing dome-like mountains, now deeply dissected by outflowing consequent streams. A ~~remarkable change occurs in the structure of the Eocky Mountains north of the Missouri river in Montana and northward into Canada, where the front range is of synclinal or trough structure, with the youngest instead of the oldest rocks along the axis, while the strata of the plains are bent down and overridden in the most abnormal manner. Indeed, moun~~ tain structure occurs of so great diversity in various parts of the Cordilleran region as to elude general de- scription.

The disturbances extend directly to the western coast line, including not only the coast range of California, but the peninsular area of Lower California (belonging to Mexico) and the detached mountainous islands of British Columbia and Alaska.

Volcanoes of commanding form here and there domi- nate the plateaus and mountains. Orizaba, Popocatepetl and their neighbours, terminating the Cordilleran system in Mexico ; Mount San Francisco, bearing snow and Arctic plants above the nearly desert plateau of Arizona ; Mount Shasta, with small glaciers in northern California; Mount Eainier, with extensive glaciers surmounting tlie Cascade range of Washington ; Mount Wrangell in Alaska, and farther on the many cones in the curved chain of the Aleutian islands : all these have been heaped up around vents through which their lavas rose from some deep source. Vast lava floods have been poured out at differ- ent times. Extensive lava beds, barren and rugged, cover . large areas in north-eastern California. The basins of Snake and Columbia rivers in Idaho and Washington are flooded with older and more extensive lava sheets, whose borders are varied by promontories and islands of the " mainland." Still older lava flows in British Columbia are now deeply dissected by the branches of Frazer river, and remain only in disconnected upland areas. High plateaus in. Utah are protected by a heavy lava capping, the result of great eruptions before the plateaus were up- lifted. Here and there rise dome-like mountains, the result of the underground intrusion of lavas in cistern- like spaces, forming " laccoliths," and blistering up the overlying strata. Thus, by mountain upheaval or vol- canic eruption, great altitudes have been gained. Where the uplift has been strong, ranges of truly Alpine form with extensive snow-fields and glaciers occur, as in the Selkirk range of Canada (now traversed by the Canadian Pacific railway), and again in Alaska. Heights of 12,000 and 14,000 feet are exceeded by numerous summits in the central _part of the system; but the dominating peaks are found far in the north-west and in the south. Several mountains in Alaska exceed 18,000 feet (Mount McKinley, 20,464 feet; Mount Logan, 19,600 feet; Mount St Elias, 18,024 feet); and the great Mexican volcanoes rise nearly as high (Orizaba, 18,250 feet). Widespread plateaus maintain upland altitudes of more than a mile over vast areas.

As in all regions of great altitude, the erosion of valleys has progressed on a magnificent scale in the Cordilleran region, and the actual fo^m of many of its parts is more the result of sculpturing than of uplifting. The plateaus of Arizona are traversed by the deep cafions of the Colorado river and its branches, at places a , mile deep; and with elaborately carved walls, from which the

most impressiVe lessons have been learned regarding the origin of valleys by river action. Upon the plateaus themselves, long and ragged cliffs of recession attest au even greater work of erosion than the canons. In all the mountain ranges except those of youngest uplift, valleys have been actively eroded, sometimes producing steep peaks as in Mount Assiniboine (11,500 feet) in the Cana- dian Eockies, rivalling the Swiss Matterhorn in sharp- ness of form ; but the greater number of summits have been worn to roughly pyramidal form between wide- flaring valleys, and the mountain flanks have thus come to be extensively covered with rock waste lying on slopes of relatively uniform declivity. Some of the ranges are in a second cycle of dissection, having been once worn down to moderate relief and now being elevated for renewed erosion; the Sierra Nevada of California is believed to be, in part, of this history, having at least in its central and northern parts been well reduced and now again enjoying a mountainous character in virtue of a later slanting uplift en bloc, with rapid descent on its eastern fractured face. Other ranges, almost completely worn down, still remain low, as in south-eastern Califor- nia, where they are now represented by gently sloping rock floors veneered with gravel and retaining only small remnants of their original mass still unconsumed; thus the end, as well as the beginning, of the cycle of erosion, together with many complications of its progress, are illustrated in different parts of this great and varied mountain system. In the fiorded coast of Alaska, signs of intense glacial erosion are seen in the discordant junc- tion of the " hanging " lateral valleys and the deep trunk valleys — ^the floors of the former being cut off on the walls of the latter.

Fitting complements of the deeply-eroded mountains are found in the great accumulations of mountain waste now occupying basins of depression between the various ranges, as in Mexico, Utah, Nevada, Montana, and else- where. Erosion and transportation here combine to

build up the floors of the basins with the waste of the sur- rounding highlands ; a result that is peculiarly beneficial in Mexico, where the climate of the plateau basin is ren- dered relatively temperate by reason of its altitude, and where the surface is easily habitable by reason of its smoothness. In the larger depressions, as along the boundary of the United States and Mexico, isolated ranges frequently rise like islands over the plain of waste that has been built up on their flanks. Shallow saline lakes or playas (wet-weather lakes) without outlets lie on the lowest parts of the waste-filled basins ; their failure to overflow in rivers discharging to the sea being less the result of enclosure by barriers than of deficiency of rain- fall ; for it is chiefly in the arid region that the waste- floored basins are best developed. Indeed, the rainfall is often so scanty that the streams from the mountains — where most of the little precipitation occurs — often fail even to form lakes, withering away on the waste plains. In all these cases, the wash of rock waste from the mountains remains on the continent and builds up the basin plains, instead of being carried away from the land to form stratified sediments on the sea floor. The , habit of gathering mountain waste in interior basins that characterizes so much of the Cordilleran region to-day is only the continuation of an earlier practice, for extensive basin deposits of Tertiary date are found in many parts of the Cordilleran region ; some of them are famous for preserving vertebrate fossils, such as those of the many- toed ancestors of the horse.

Between the loftier Western highlands and the lower Eastern highlands (Laurentian and Appalachian) lies a great extension of Medial plains, stretching in moderate altitude from the Arctic Ocean to the Gulf of Mexico,

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and having in their middle a breadth of 1500 miles. They are composed throughout of nearly horizontal strata and mark a region long exempt from strong dis- turbance. Although for the most part floored by marine formations, their structure and com- position indicate, as has already been said, relatively shallow water. The ancient sea that once occupied the middle belt of, the continent therefore had little likeness to the abysmal oceans, but resembled rather the shallow ocean margins that to-day overlap various continental masses — the largest example of this kind now existiag being between Asia and Australia. The eastern part of the plains is underlaid by Palaeozoic strata, already mentioned as having been laid down upon the subsiding Archaean continent or folded in the making of the Appalachians ; coal beds are here included in the Ohio and middle Mississippi basins. The area of the western plains remained submerged to a later date, preserving a stretch of marine waters to the end of Mesozoic time, and thus resembling the lowland belt of western Asia, which was similarly covered by a broad and a shallow arm of the ocean extending from the Arctic to the European mediterraneans until a late geological date. The surface of the Medial plains is not ^ways so even as might be in- ferred from their name. Both the eastern and the western areas have been extensively denuded, even to the point of being reduced to lowlands of denudation. Their present altitude is not so much the result of their original uplift from the sea as of a later elevatory movement. The great river basins, for which North America is famous, have thus been formed between the Eastern and Western high- lands— the Mississippi receiving the drainage of a vast area (about 1,240,000 square miles) for discharge to the south, while the Saskatchewan and Mackenzie gather their waters from somewhat less extensive areas in the north. Pleistocene glaciation covered the plains of the Ohio, upper Mississippi and Winnipeg districts with extensive deposits of ice-laid or water-laid drift, furnishing a generally smooth surface and a fertile soil: here are the true prairies — ^treeless, biit richly grassed.

The traditional contiuuity of the Cordilleras of North and South America has been broken by investigations in the isthmian portion of the northern continent. 'America '^^^ Structural peculiarities of the Western high-

andtbe lands of Korth America may be traced only to Wes' the east and west belt of great volcanoes by

Indies. ^~~rhich the plateau of central Mexico is termi~~ nated on the south. The ranges of the Andes fail to reach Panama, from which the nearest one is separated by the valley of the Atrato. The two Cordilleras are out of line with each other, and their ends are some 1200 miles apart. Central America, the West Indies, and various submarine ridges by which they are connected with one another and with the mainland to the west, as well as certaiu ranges along the northern margin of South America, all belong together in what has been termed the Antillean mountain system, in which east and west trends of late geological date predominate, with abundant vol- canic additions on the Pacific border of Central America, and along the eastern end of the system in the Windward islands of the Lesser Antilles. The unity of this system has been until recently overlooked partly because the Antillean ranges are for the most part still under water, and yet further because the volcanoes which form the strongest reliefs of the isthmian region are so arranged along the Pacific coast as to suggest the continuity of the Cordilleran systems on the north and south ; but these volcanoes are really only superadded to a foundation of quite another kind. Geological studies on the mainland and on the islands have shown that both fundamental

structure and surface form are not Cordilleran; and numerous soundings in the adjacent mediterraneans sug- gest that the islands are best interpreted as the somewhat denuded crests of great crustal ridges. The warm waters that bathe the West Indies come with a high temperature from the equatorial Atlantic, and favour the growth of corals along the shores. Fringing and elevated reefs are known on many of the islands. The Bahamas are the slightly overtopping parts of a broad platform of coral and other calcareous marine deposits, of which the greater area constitutes extensive shallow banks, which descend by a steep slope on the north-east to great depths in the Atlantic. The lowlands of Yucatan resemble Florida in being the emerged part of a much larger mass, of which an equal portion is still under water in the shelf around the Gulf of Mexico. All this region is luxuriantly pro- ductive and is advantageously surrounded by waters which would be barren and desert if replaced by

lowlands. The active volcanoes on the Pacific slope have built many cones and uplands, some of their historic eruptions having been of terrible violence. Thus Lake Nicaragua, once a bay of the Pacific, has been cut off by volcanic deposits, leaving only the Gulf of Fonseca open to the western ocean, raising the level of the lake behind the barrier and turning its discharge eastward to the Carib- bean Sea across what was once the inter-oceanic water- shed.

*The successive crustal movements by which the land area of what we now know as North America has been increased and connected have determined the growth of several great river systems through *’”«’«• which the broader part of the continent is drained. The movements that resulted in the emergence of the Plains had the effect of engrafting many ancient rivers of moder- ate size upon trunks of unusual dimensions. The Mis- sissippi system, some of whose eastern branches probably date from early Mesozoic time, received great reinforce- ments by the addition of many long western branches in Tertiary time, roughly contemporaneous with the uplift of the Gulf coastal plain by which the lower trunk of the river was extended to the sea. The present headwaters of that stream to which the name of Mississippi is applied, and which for that reason have gained an undue subjective importance, are of relatively modern date, as they are controlled by the abundant glacial deposits of northern Minnesota. The evolution of the Mackenzie resembles that of the Mississippi in a very general way, although some of its eastern branches may be the descendants of ancestors more ancient than those flowing westward from the Appalachians ; but the rigime of the great northern river is strikingly unlike that of its still greater southern analogue on account of its course being from a warmer to a colder climate : hence ice-dams, obstructed discharge, and overflows. The Nelson and the St Lawrence systems, draining eastward to Hudson Bay and St Lawrence Gulf, receive drainage from areas that would belong to the Mackenzie and the Mississippi systems under a simpler plan of continental growth ; and there is much reason for thinking that this simpler plan obtained until the occur- rence of those changes, in association with the Glacial period, whereby sea waters gained access to the depressions that now hold the bays and sounds of the north-eastern coast. In exemplification of the rule that the larger ocean receives the drainage of the smaller continental*

area, the rivers that fiow into the Pacific rank below those belong- ing to the Atlantic. The greatest is the Yukon, of farther Canada and inner Alaska, one of the great rivers of the world, little known until the recent active exploration of its basin for gold fields. The Frazer drains much of the mountainous area of Southern British Columbia, as the Columbia drains that of the north-western United States ;

[north

the latter is peculiar in that one of its headwaters rises at the eastern base of the Rocky Mountains in northern Montana. The Colorado discharges a muddy current into the Gulf of California ; but for the aridity of its large drainage area its volume would be much larger. The same is true of the Eio Grande, whose name would be better justified if so much of its basin were not semi-arid.

The references already made to lakes may now be reviewed and summarized. Several lake districts may be ^^^^ mentioned. The most remarkable lacustrine region of the continent, rivalling that of central Africa, forms a belt around the border of the Laurentian highland ; here, in addition to ten large lakes, there are hundreds of medium size, and many thousand small lakes. They are peculiar in occupying a region of moderate relief, in which no strong dislocations have taken place in recent geological time (unless in the case of Lake Superior), and thus in contrasting with the great African lakes which occupy rift-valleys or graben of comparatively recent fracture. The Laurentian lakes are further characterized by an intimate association with the ice-sheets of the Glacial period; but while glacial erosion and drift obstruction suf&ce to account for the smaller lakes, it is very probable that broad crustal warping and drainage reversal have been potent aids to the other processes in producing" the great lakes. The northern Cordilleran region contains many beautiful lakes of moderate size in deep valleys among the crowded

ranges of the narrowed mountain belt. Their origin has not been closely studied. The basins among the spaced ranges of the middle and southern Cor- dilleras, in the United States and Mexico, contain many lakes that occupy shallow depressions in desert plains ; they are usually without outlet and saline ; many of the basins were formerly occupied by lakes of much greater size, some of which overflowed, implying aclimate moister than that of to-day, probably correlated with the glacial climate of the regions farther north. Lakes in volcanic craters or behind volcanic barriers occur in Central America, while Florida possesses many small lakes in limestone basins. The following table is taken from Russell's Lakes of North Americar —

Lake.

Altitude.

Area,

Depth.

Ontario ....

Erie

Huron .... Michigan .... Superior ....

Feet.

247 573 582 582 602

Square Miles.

7,200(?)

9,900 22,322 21,729

31,000(?)

Feet.

738 210 750 870 1008

The climatic features of North America are best ap- preciated when considered as exhibiting modifications of those general climatic conditions which pre- ciimate. ^^:^ ^ consequence of the globular form of the earth as a whole. In January, when the isotherms of 65° to 76° F. stretch almost directly across land and sea in the torrid zone, a mean temperature of zero or less in vades the region north-west of Hudson Bay, which thus resembles north-eastern Asia in departing greatly from the mean prevailing in similar latitudes on the northern oceans, and in bringing upon the northern lands an ex- tension of frigid conditions that have no analogue in the southern or oceanic hemisphere. In July, when the iso- therms of 40° and 50° have a tolerably direct course around the latitude circles that border the continent on the north, a great middle area of North America becomes warmer than the seas on the east and west, having a mean of over 80°, and in part over 90°. In January, the Hudson Bay region is 30° colder than the mean of its own latitude, about 60° colder than the mean of the corresponding southern

latitude ; while in July the Arizona-Mexican region is 20° above the mean of its own latitude, or about 40° above the mean of the corresponding southern latitude. In both winter and summer the isotherms are more closely crowded while crossing the continent than while crossing the adjacent oceans; or, in other words, the poleward temperature gradient is stronger on the land than on the oceans ; and all these features should be regarded as inherent characteristics of the climate of North America in virtue of its being a continent chiefly in temperate latitudes.

An associated feature of continental climate is found in the strong annual range of temperature of the central land area. The range between the means of January and July exceeds 40° for the largest part of the lands, and 70° for much of the northern lands ; the range of extreme temperatures is much gi^eater. On corresponding oceanic areas in the northern hemisphere the range is little more than 20°, and in the southern hemisphere it is probably less than 10°. It must appear from this that if the largest part of North America is said to be in the north temperate zone, "temperate " must be taken as having little of the

meaning originally given to it in southern Europe, for the winter cold is severe and the summer heat is excessive over much of the North American continent. In this respect two more unlike belts can hardly be found than the north and south temperate zones, in spite of the resemblance that is implied in their names.

The several members of the terrestrial wind system, including therein the trade winds of a broadened torrid zone, the stormy westerly winds of middle latitudes, and the irregular winds of the polar regions, are well exem- plified over North America ; but, as is usually the case on land, the systematic movement of the atmosphere is better seen in the drift of the clouds than in the movement of the surface winds, which are much modified by the changes from hill to valley, from mountain to plain. Neverthe- less the prevalence of the general atmosphere currents has much to do with the control of certain values of annual temperature range, as well as with the distribution of rain- fall. The former are small (about 20°) along a great stretch of the Pacific coast, even as far north as Alaska, where the moderating influences of the ocean are brought upon the land by the westerly winds ; ■ while a range ap- propriate to a continental interior (30° or 40°) is experi- enced over most of the eastern side of the continent in temperate latitudes, and even upon the North Atlantic ocean near the American coast, where strong seasonal changes of temperature are carried forward by the westerly winds. It is particularly inthis respect that the general climatic resemblances between North America and Eu- rasia, above referred to, are broken ; for eastern Canada and western Europe are strikingly unlike in seasonal variations ,of temperature. Labrador is about 10° cooler than northern Germany in July, but nearly 40° colder in January.

The distribution of rainfall is in general controlled by the prevailing course of the winds. The West Indies receive abundant rain from the passing trades. In Mexico and Central America the eastern slopes are for the most part better watered than the western, because the winds there come chiefly from the east (maximum over 100 in. in Guatemala and adjacent parts). Farther north the reverse holds true ; the Pacific slope north of 40° latitude has an abundant rainfall (maxinlum over 100 in.), and its mountains are clothed with dense forests. There are large areas of

deficient rainfall (less than 20 in.) in the interior of the continent, where the intermontane basins and the pied- montese plains that slope eastward from the Rocky Moun- tains in middle latitudes are treeless. The areas afiflicted with dryness are unsymmetrically distributed, being west

nobth]

of the Medial meridian (95°), because of the ranges near tiie Pacific by which rain is withheld from the basins and from the plains farther east. The dryness is induced not only by light precipitation, but also by active evaporation in the warm season — a rule that holds true until a high latitude is reached. East of the medial meridian great profit is received from the warm and moist winds that are drawn inland from the water surface of the mediterraneans which so advantageously occupy the latitudes that are given up to the Sahara in the Old "World. It is largely on this account that the central and eastern parts of the Mississippi basin enjoy a sufficient ' and well-distributed rainfall, producing forests or fertile prairies over great areas (rainfall over 40 in.). Eegions of prevailing snowfall are chiefly in the north-west and north-east; the former includes the higher ranges of the Western highlands in Canada and Alaska, where the snowfall from the Pacific winds is heavy, and exten- sive snowfields and glaciers are formed ; the former includes Greenland, where a heavy ice^sheet shrouds the land, the snowfall of moderate measure being probably supplied mostly from the relatively warm waters of the North Atlantic. In the northern continental interior snow covers the ground during the winter season, not that the snowfall is heavy but that the persistent cold weather preserves the moderate amount that falls.

The extension of the continent across the belts of the terrestrial wind system tends to turn branch winds from the westerlies toward the trades on the Pacific border, and from the trades toward the westerlies on the Atlantic border. This effect is strengthened in summer, when the higher temperature prevalent over the continent causes the air to fiow away from

above the lands, and to accumulate pver the neighbouring oceans, on each of which a vast anticyclone is thereby established, — the circulation of the atmosphere over the North Atlantic and North Pacific thus coming to simulate the circu- lation of the surface waters of the oceans themselves. It is partly on account of this deflection of the summer winds up the Mississippi valley that the eastern inte- rior of the continent receives a beneficent rainfall as already stated. In winter when the infiow from the south is replaced by an outflow, little rain or snow would fall but for the indraft winds of cyclonic storms by which the outflow appropriate to the cold season of the continent is temporarily reversed. The free play of the winds norths and south over the great Medial plains permits indrafts from torrid and frigid sources, which sometimes succeed each other rapidly, producing abrupt and frequent weather changes. Something of the same contrasts is produced by winds drawn in upon the eastern coast alternately from over the moist and warm waters of the Gulf Stream, and from over the moist and cold waters of the Labrador current.

The southerly flow of the branching winds along the Pacific coast gives them, a drying quality, and thus stiU further broadens the western arid region towards the ocean untU it reaches the coast in southern California and north-western Mexico (rainfall less than 10 in.), there joining the arid belt of western Mexico, and presenting a strong contrast to the rainy forested coast farther north ; but ^though unfavourably dry, the southern California coast is one of the most truly temperate regions of the world, in respect of mUdness and constancy of temperature. The drying winds cover all California in summer, but they migrate southward in the winter, giving place to the stormy westerlies. Thus California has a subtropical climate of wet winters and dry summers ; while north in British Columbia and Alaska there is plentiful rainfall all the year round, and farther south there is persistent aridity.

The fauna of North America (Nearctic) is more closely related to that of Europe- Asia (Palsearctic) than to that of any other zoogeographical province ; the two being united by many writers in one faunal ^““f” province (Holarctic). The reindeer (caribou), beaver, and polar bear are common to both provinces. The moose, wapiti, bison, and grizzly bear of North America are closely related to the elk, red deer or stag, aurochs,

and brown bear of Eurasia; and the following groups are well represented in both provinces: cats, lynxes, weasels, bears, wolves, foxes, seals, hares, squirrels, marmots, lemming, sheep, and deer. On the other hand, the follow- ing forms are characteristic of North America : (rodents) pouched rats or gophers, musk rat, prairie dog, Canadian porcupine ; (camivora) raccoon and skunk ; (ungulates) musk ox, bighorn, Eocky Mountains goat, pronghom ; (marsupial) opossum. Among birds there is a close resemblance to those of Eurasia, with some admixture of South American forms, as in the humming birds. The forms especially characteristic of the northern continent are the Baltimore oriole, bobolink, cowbird, flycatchers, wood-warblers, Calif ornian quail, tree grouse, sage grouse, wild turkey, and turkey buzzard. The house sparrow of Europe has been introduced, and has become very common, especially in the cities, where it is knowrras the English sparrow. Reptilian and amphibian groups are well represented ; turtles are especially numer- ous ; salamanders are varied and large ; rattlesnakes are among the more peculiar forms. Among fish, the charac- teristic forms are the cyprinoids (<^Jp), sturgeon, salmon/ pike, and especially the suckers, sunfish, mudfish (Amia), and gar pike (Lepidosteus). The most characteristic group of invertebrates is the Unionidse or river mussels.

The fioral areas of North America, limited by the geo- graphic divisions of the continent, may be divided into five belts : the eastern forested area, the western forested area, the interior unforested area, the ^'ora- northern barren lands, and the Gulf coast. The eastern forested area extends from the Laurentian highland in Canada to the Great lakes, and southward east of the Mississippi to the Gulf coast. In the north and along the mountains southward, the forests are largely conifer- ous, with a mixture of birches, poplars, and maples. Southward, especially in the interior and at low altitudes, the conifers largely disappear, and oaks, hickories, plane- trees, tulip-trees, walnuts, and other valuable deciduous species abound. Throughout this belt lumbering is an important industry. The western forested area begins in the eastern Rocky Mountains, and extends to the Pacific. Eastward in the mountains the forests are interspersed with arid districts which increase in area southward. Northward, in Canada, the mountains of the middle Cordilleras are densely wooded with continuous forest. Near the middle Pacific coast the

forests attain a luxuriant development, the redwood (Sequoia) of California and Oregon sometimes reaching a height of from 300 to 400 feet. In this western forested area lumbering is extensively carried on. The unforested area of the interior consists of two very dissimilar portions. The vast fertile prairies extend from the Great lakes westward to the Great plains, and southward west of the Missis- sippi, with occasional eastward lobes at low altitudes. On these plains grasses and other herbaceous vegetation abound, and throughout this fertile belt agriciflture is largely followed, the grain and hay crops being especially important. Northward in Canada the plains become wooded, the western mountains and the eastern highlands being thus connected by a narrow strip of forest. South- westward and westward the fertile prairie gives way to a vast arid region beginning on the Great plains and extend- ing as far as south-eastern California, and thence south-

ward into Mexico. On this broad desert few trees are found, although pinons grow on the cliffs and ledges, and cottonwoods occur along the watercourses. The vegetation as a whole consists of cacti, agaves, sage-brush (Artemisia), and other plants adapted to arid conditions. North of the eastern forested area and east of the northern Cordil- lera are the " barren lands," with frozen subsoil, extending thence to the Arctic coast. The growing season here is short and the climate forbidding, so that trees cannot develop, although birches, poplars, willows, and other genera, . which southward attain great size, are present as dwarf shrubs. The vegetation of this northern barren •district, like that of bleak mountain summits southward, is very similar in character to that of other extreme boreal regions. Blueberries, cro wherries, and some other small fruits are abundant, but the brief summer will not mature most crops of the temperate zone. The Gulf coast, on the other hand, supports a vegetation decidedly tropical in its nature. Somewhat developed in Florida and the

other southern states, this flora becomes the prevailing one on the coast of Mexico and Central America, especially from the region of Vera Cruz southward, where the forests are largely composed of palms and live oaks, and where giant bamboos often attain a- height of 40 feet. In these tropical forests many orchids and other showy plants of northern conservatories are native.

North America, with an area of about 8,000,000 square miles (16 per cent, of all the lands, or 442 per cent, of the „ whole earth's surface), and a mean altitude of

develop-" ^bout 2000 Jfeet, at present plays a part in ment of human history that is of greater importance than is warranted by its size alone, although it has not in this respect the extraordinary impoiv tance of Europe. The continent has the good fortune to lie chiefly in a temperate rather than a torrid zone, and in temperate latitudes to be much nearer to Europe than to Asia. Whatever may have been the first home of the aboriginal inhabitants, the dominating people of to-day are derived from the leading countries of the Old World. Jfot only so, temperate North America has become the most progressive part of the continent because of receiving its new population chiefly from the most advanced nations of middle western Europe — Great Britain, France and Ger- many ; while the torrid islands and the narrowing southern mainland of North America have been settled chiefly from the less energetic peoples of southern Europe ; and the inhospitable northern lands are hardly entered at all by newcomers, except in the recently -discovered gold fields of the far north-west. From the plantation of colonies on the eastern coast, the movement inland has been governed to a remarkable degree by physiographic factors, such as form, climate, and products. The cities of the Atlantic harbours and of the adjacent lowlands still take a leading part in industry and commerce, because of their longer establishment and of their relation to Europe. The up- lands, ridges, and mountains of the Appalachian system — the " Backwoods " of a century ago — still remain rather thinly occupied except at certain centres where coal or other earth-product attracts an industrial population. Beyond the AUeghenies, the middle interior contains a very large proportion of habitable land. It was long ago recognized as a land of great promise, and

it is to-day a land of great performance, covered with a wonderful network of single-line railways, yielding an enormous product of grain, and developing industries of all kinds towards a future of rapidly increasing power. Indeed, within and closely around an area marked by the St Lawrence system on the north, the Ohio on the south, and stretching from the Atlantic coast between the Gulf of St Lawrence and Chesapeake Bay inland to the middle prairies, there is a remarkable concentration of the population, industry.

progress, wealth, and power of North America — ^the focus of attention from all other parts of the continent. The regions of the far- north and north-east, including the greater part of the Laurentian highland and the extreme northern stretch of the Medial plains and the Western highlands, remain and wiU long remain thinly popu- lated. The furs of wild animals are their characteris- tic product. Timber is taken from their more accessible forests; but only in mining districts does the popula- tion notably increase, as in the iron region around Lake Superior and in the recently-discovered Klondyke gold region.

In the south-eastern United States lies a belt of coastal lowlands skirting the Appalachians, long blighted by negro slavery and still suffering under its consequences, not only because the institution of slavery demanded the impor- tation of African savages, but even more because its perpetuation held the slaves in ignorant poverty and made labour disgraceful, and still more because its abolition has not yet removed the race prejudice under which the progress of the negro, even only to political equality with the whites, is so long delayed. This is nowhere the case with European immigrants of whatever nationality or religion. The descendants of the early French settlers of Canada stand in political rights as well as in loyalty to the Government on an equal footing with' the British citizens of the Dominion. The Italians of the cities, the Hungarians of the mines, the Scandinavians of the northern prairies, the Irish and Germans everywhere are "Americanized" in the second or third generation, rapidly entering local and national politics, and hardly less rapidly attaining an honourable social standing as tested by intermarriage with English and other stocks. But the negro is set aside, even though he has adopted the language and the religion of his former masters : political and social

rights are denied him, and inter- marriage with whites is practically excluded, although mulattos are numerous. Thus has slavery left upon a people, amongst whom political rights and social opportu- nities should be equal for all, the heavy burden that has always retarded progress where strongly contrasted races are brought together. Farther south still are the tropical islands and the narrowing mainland, rich in possible pro- ductiveness, but slowly developed because of a prevailing diversity and instability of government and lack of pro- gressive spirit among the people. Here also there is a considerable proportion of negroes, but they live under less unhappy conditions than those now obtaining in the United States.

West of the Mississippi in middle latitudes the popula- tion rapidly decreases in density, and over a large extent of the "semi-arid plains it must long remain sparse. The settle- ments bordering the plains on the east longitude for a time marked the " Frontier " of civilisation, for the vast stretch of dry country was a serious barrier to farther advance. But the plains are now crossed by many railways leading to the Cordilleran region — the " Far West " — in large part too rugged or too arid for occupation, but rich in minerals from one end to the other, the seat of many mining camps of unstable population, and containing numerous regular settlements in the intermontane basins. On nearing the farther ocean the climatic conditions improve, and the population is rapidly increasing in number and wealth ; this district not being content to take its name with respect to the east, not considering itself as included in the " Far West," but choosing the distinctive designar tion of the " Pacific Slope," and, while maintaining an active intercourse all across the breadth of the continent, already opening relations with the distant Orient by a new approach. Among the earliest results of the latter movement was the arrival of Chinese labourers, a humble,

south]

industrious and orderly class of men, but one whicli stands apart in language, religion, and race from the dominant population, lives largely without domestic ties, and gains neither political nor social standing in the New World.

Two hundred years ago the aboriginal population of North America would have deserved description before the immigrant population. To-day the aborigines are displaced from all the most valuable parts of the continent. Never very numerous, they are now decreasing ; many tribes are already extinct, many more are almost so. Those which remain less diminished are in the Far North or North- West, where nature is rigorous; or in the tropical forests of Central America where nature is overbounteous ; or in the more desert parts of the Middle West where nature is arid. The replacement of the native races by the foreign has too often been harsh, cruel, and unjust; yet it has' resulted in an advance of civilization. Many savage tribes, speaking many different languages, holding little intercourse with each other, and frequently engaged in intertribal wars, have given place in little more than two centuries to a great .population of European origin, whose dominant parts speak one language, whose arts are highly advanced, whose home intercourse is most active, and whose foreign commerce has attained unexpected propor- tions at the opening of the 20th century.

(w. M. D.)

South Ambkioa.

Granites and gneisses, supposed to be of Archaean age, occur at many places along the east side of the Andes, in the highlands of Venezuela and near the coast ∘ ”‘ about Caracas. There is a more or less con- tinuous area of granites along the watershed between the Amazon and Venezuela and the Guianas extending from the fall line on the Cunani, and the Araguay on the east to the mouth of Rio Meta on the Orinoco, and the mouth of the Uauapes on Rio Negro. In this region the granites are overlapped in many places by more recent beds of unknown age. In the

highlands of Brazil south of the Amazon they are found at the falls of the Madeira river, on the Tapajos, at the falls of the Xingii on the south side of the Amazon valley, and along the eastern border of the continent, with certain short interruptions from Maranhao, Brazil, southward to Montevideo, at the mouth of the Rio de la Plata. The largest of these granite areas is the one along the east coast and in the highlands of Eastern Brazil, but even here it is more or less irregular in outline, and its exact limits are unknown except on the immediate coast. Associated with the granites and gneisses is a series of metamorphosed beds exposed over a still larger area. These include schists of various kinds, itacolumites, itabirites, slates, quartzites, and marbles. The series is more or less folded, faulted, veined, and cut by old eruptives. The age of these beds has never been definitely determined, for they have thus far yielded no fossils. In many places they bear a strong resemblance to the Algonkian series of North America, but their position would admit equally well of their reference to the Cambrian. In this series occur most of the mineral deposits of the eastern part of the continent — the gold veins of Venezuela, o the Guiana highlands, and of the gold regions of Brazil, and also the iron, manganese, diamonds, and topazes of Brazil.

Rocks of Silurian age have been found in the Amazon valley, on the north side of the river east of Manaos ; in Bolivia, along the eastern slope of the Andes and near Cuyab^, about the headwaters of the Rio Paraguay. It is quite possible, even probable, that many of the un- fossiliferous beds, now provisionally referred to the Cambrian, are of Silurian age. The Amazon river along

its lower course, that is, east of Manaos, flows through a Devonian basin filled with rocks of later age. Near longi- tude 55°-66° W., Devonian rocks outcrop on both sides of the stream a little more than a hundred miles away from it. It is improbable that this Devonian basin extends far up , the Amazon valley, for there are metamorphic rocks on the Rio Negro, a

short distance above Manaos. In the highlands of Matto Grosso, Brazil, just east of Cuyab^, Devonian rocks cap the hills. Devonian beds are known, in Bolivia along the eastern slope of the Andes, and it seems probable that they extend north and south along the range for a long distance. In the state of Parang, Brazil, a belt supposed to be of Devonian age crosses the state from north to south (Derby), dipping westward beneath a series of rocks referred to the Trias.

The known areas of Carboniferous rocks in South America are small — one basin underlying the Lower Amazon valley contains marine fossils, having a Permian facies. Carboniferous rocks of about the same geological horizon are known also from the vicinity of Lake Titicaca in Bolivia. In the state of Sao Paulo, and extending into the adjacent states of Minas Geraes and Parang, is another Carboniferous or possibly Permian basin, but the fossils are scarce and are not marine. The western and southern limits of this Sao Paulo basin are not known at present. In the southernmost states of Brazil, namely, in Santa Catharina and Rio Grande do Sul, there are at least six separate basins in which coal of Carboniferous age occurs. One of these basins is on Rio Tubarao, near Laguna, Santa Catharina ; another is on the Rio Verde, the line between Santa Catharina and Rio Grande do Sul. In Rio Grande do Sul there is one coal basin at Candiota on the railway leading from Pelotas to Bagd, another near the south end of Arroyo dos Ratos, one 100 miles in length lies along the south side of Rio Vacacahy, and another is just west of the city of Porto Alegre. Overlying the rocks of Car- boniferous or Permian age in Minas Sao Paulo and Parana, Brazil, is a series of sediments and eruptives that have been referred provisionally to the Triassic. Thus far no fossils have been found in them. Rocks believed to be of Triassic age occur in Paraguay, near Diamantino, in the states of Matto Grosso, Brazil, and in Chile and Bolivia. Jurassic rocks are found in Chile, Bolivia, Peru, and the Argentine Republic, and it is possible that some of the Brazilian rocks previously referred to the Triassic belong to the Jurassic.

Rocks of Cretaceous age cover a large area in the interior of the states of Cear^, Piauh;f, Parahyba, and Pernambuco in Brazil, while on the coast of the states of Sergipe and AlagSas there are Cretaceous beds containing

an abundance of marine fossils. Cretaceous rocks are found in Tierra del Fuego, in Southern Patagonia, in the province of Santa Cruz, Argentine Republic, and they extend northward along the eastern flank of the Andes, with interruptions through Ecuador, Colombia, and Vene- zuela. On the west side of the Andes a narrow belt of Cretaceous extends nearly or quite the whole length of the continent. The coal or lignite beds of Southern Chile are in the Laramie of the upper Cretaceous. Cre- taceous rocks cover a part of the island of Trinidad, off the north coast of Venezuela, and the same Cretaceous basin extends over a part of the Venezuela mainland. The rocks of this age on Trinidad are of organic origin, and it is from these that the remarkable pitch deposits of that island have been derived.

Eocene Tertiary beds occur on the island of Trinidad and on the Venezuela mainland, but it is not knoVn how far these beds extend to the south along the eastern border of the continent. Just south of the Rio Oyapok granites are exposed on the lower courses of the streams,

[south

but on tlie lower part of the Eio Araguay sedimentary beds form low hills, and extend along both the north and south sides of the Amazon valley for hundreds of miles. These beds have generally been regarded as Tertiary, but they have yielded no fossils, and their age is not known. There are f ossiliferous Tertiary beds of brackish water origin in the Upper Amazon valley covering a large area, extending westward from Tabatinga, on the Brazilian fron- tier. Tertiary beds form a narrow belt along the coast of Brazil, probably from the Amazon valley to near Victoria in the state of Espirito Santo. This belt is a hundred miles wide at some places, while at others it is only a fraction of a mile in

width, or is entirely

wanting. At and for

some miles north of

Pernambueo the fos-

siliferous portions of

these beds show them

to be of marine

origin ; south of Per- nambueo, on the

coast of Alag5as and

in the state of Bahia,

they are of fresh- water origin. The

sandstone reefs of

the Brazilian coast,

the elevated beaches

of 5ahia and Eio

de Janeiro, and the

older parts of the

coral reefs, may pos- sibly be of late Ter- tiary age. Beds

known to belong to

the Tertiary spread

over a wide area in

the valley of the Rio

de la Plata, and over

the lowlands of

Eastern Argentina and Patagonia. On

the west coast Ter- tiary rocks form much of the narrow plain between the Andes and the ocean, and there are besides isolated Tertiary basins in the high parts of the moun- tains.

Some of the erup- tive rocks of the

Andes are post-Tertiary, while others are pre-Tertiary. The eruptives of the Parang basin are newer than the Trias, but their age has not as yet been more precisely determined. All through the highlands of Venezuela, the Guianas, and Brazil, the older Palae- ozoic rocks are extensively cut by eruptives. Along the north-eastern and south-eastern sides of the con- tinent, most of these eruptives are pre-Tertiary. In only one place — on the Abrolhos Islands — ^is there a dyke known to be in rock of Tertiary age, while the island of Fernando de Noronha is the only place on the eastern side of the continent at which a volcano of late geologic age is known to have existed.

The earliest land areas of the South American continent are approximately represented by the areas of old granites

Sketch Map op Bohtb AMESicik.

and gneisses. The largest of these is along the eastern border of the continent, reaching, with few interruptions, from a short distance south of the mouth of the Amazon river to the mouth of the Eio de la Plata. To the west of this land area there were probably ^^”^ many islands over what is now the interior of contiBent the continent. North of the present Amazon valley there was another and smaller land area or islands, where are now the highlands of North-eastern Brazil, South-eastern Venezuela, and Guiana. Another land area, or perhaps more correctly a string of islands, extended from the Falkland Islands the entire length of the

west side of the conti- nent. Against these shores the Cambrian or oldest sediments of the continent were laid down.

At the close of Cambrian times elevations of the con- tinent added large tracts to the land, but the Silurian seas still covered what is now the Paraguayan basin, and extended from the Serra do Mar on the Brazilian coast to the axis of the Andes, on the Pacific side of the continent. During the Devonian period the land area of the continent was greatly increased in the Bra- zilian highlands, but the Devonian seas still covered the in- terior of the con- tinent, extending from the Serra do Mar on the east to the Andes of Bolivia and Peru on the west, and forming a medi- terranean sea over two hundred miles wide and several hun- dred miles long in the Lower Amazon valley region. In Carboni- ferous times the Amazonian inland sea was only slightly changed, but in the southern part of the continent the land areas increased enormously. In Southern Brazil there were peat bogs, while farther north and west were shallow brackish water bays or estuaries.

But little is known of the Triassic and Jurassic history of the continent.

The Cretaceous history of the east coast is preserved in only a few fragments of sedimentary areas. About the mouth of Eio Sao Francisco the land sank, carrying beneath the water large portions of the states of Sergipe and AlagSas. What are now the highlands of the interior of Piauh^, Cear4 Pernambueo, and Parahyba were then under water. The island of Trinidad was two-thirds under water at that time. On the west coast the land was lower than at present, and the ocean washed the base

40° Longitudfl ZO'W.Grecnwich

iontfon^ SCfioftin/k GoogfSatabt

south]

A M E K I C A

of the Andes at many places. Here and there, however, along that coast were great peat marshes extending from Peru as far south as the Strait of Magellan. The sea covered what are now the plains of Patagonia and Argen- tina, and there was a wide bay between the low Andes ridges on the west and the Uruguayan peninsula on the east.

In the early part of Tertiary times the land sank some- what, but the geography of much of the eastern coast was not greatly different from its present form. Prom Santa Catharina to Victoria on the coast of Brazil the shore was very nearly where it now is. From Victoria to Cape St Roque the shore line was from a few miles to a hundred miles farther inland than it is at present. Much of the coast belt, however, was covered by freshwater lakes, and in the Amazon valley region it is possible that these lakes, or some combination of lakes and estuaries, extended far up the valley.

In Tertiary times, probably at the end of the Eocene, great changes took place in the geography of South America. The entire continent rose to an elevation much greater than that at which it now stands. The coast lines were carried oceanward on all sides, so that the continent was enormously larger than it is at pre- sent. The coast line was 200 miles to the east of the Abrolhos Islands, which were then a parb of the mainland, and 300 miles east of Victoria, Brazil. The Falkland Islands were also a part of the continent, and it is even probable that South America joined New Zealand and Australia through the antarctic regions. Denudation was very active during this jperiod, and enormous quan- tities of the Eocene sediments were removed from the land. Towards the close of Tertiary times the continent sank again until the sea entered the Orinoco and Amazon valleys and made an island or group of islands of the highlands between Brazil, Venezuela, and the Guianas. During this period the valleys of Magdalena and Canca and of Lake Maracaibo were covered by great bays. Still later a slight elevation added to the continental land area the lower portions of the Orinoco, Amazon, and La Plata valleys. During the Tertiary period volcanic activity culminated on the continent. The Andes rose, partly by continental uplifting, partly by faulting and folding, and partly by an upbuilding by the volcanic ejectamenta, from a series of comparatively low ridges to be the great moun- tain chain of the world.

Volcanic activity, which had previously characterized the west coast region, increased enormously, lava sheets were poured out along the entire length of the continent, and enormous lava and cinder cones were built up about the craters. This volcanism was not confined to the Andes, but extended to the Patagonian plains, the highlands of the Parang basin, the Abrolhos Islands, and as far east as the island of Fernando de Noronha. In recent times volcanic activity has entirely ceased along the eastern and north-eastern parts of the continent, and it has also subsided greatly, though it has not ceased altogether, along the west coast. The earth- quakes that still disturb the west and north-west coast of the continent are more or less the result of this diminished volcanic action.

During Pleistocene times the southern end of the con- tinent as far north as latitude 27° on the west coast was covered with glaciers moving away from the mountain ranges. North of 27° the glaciers did not flow down as far as the present sea-level, but they moved farther down the slopes of the higher portions of the Andes than they do at present. During a portion of the Glacial epoch the southern end of the continent stood at a somewhat lower elevation than at present, and the sea covered the plains of Patagonia and La Plata. On the east coast

Eabtzbn Brazil.

evidences of glaciation do not extend as far north as they do on the west coast.

The South American continent rises abruptly from the ocean's floor along nearly all its coast line, but the abrupt- ness of the continental margin is more marked physical on the western than on the eastern side. Con- geo- tours of equal depth along the west coast show s"V'y- that from Valparaiso to the Isthmus of Panama, a distance of 3000 miles, the great Andes ranges are but the upper or subaerial portions of mountains rising from bases that lie 10,000 feet below the surface of the Pacific Ocean. South of Valparaiso the 10,000-feet contour moves far off the coast, but opposite the Strait of Magellan it approaches again within a distance of 150 miles. East of Patar gonia the 1000-feet contour is so far from the coast that it passes to the east of the Falkland Islands, show- ing that this group stands upon a submerged conti- nental shelf. From the mouth of

the Rio de la Plata northward the 1000-feet sub- marine contour keeps at a distance of from 50 to 160 miles off the shore, nearly to Bahia, Brazil ; from Bahia northward clear around Cape St Eoque this line is close to the shore, and the ocean's bottom is steep, dropping abruptly to a depth of 5000 feet. The land relief of the continent of South America is charac- terized by — (1) the great range of lofty mountains which, with its narrow coast plain, follows its west coast from its northern to its southern extremity ; (2) comparatively low and flat plains that slope eastward and southward from the base of these mountains down the drainage basins of the Orinoco, the Amazon, and the Paraguay; (3) the high table-lands of Eastern Brazil. The physical features of the west coast are bold. South of latitude 41°, the coast is characterized by a vast system of fjords and islands, probably produced by the recent submergence of a region of bold mountains and steep-sided valleys. The many islands, including Chiloe, Wellington, and Tierra del Fuego, are the higher portions that have remained above water ; while the Strait of Magellan (properly Magalhaes), Smyth Channel, and the other deep fjords that indent this coast line are the submerged valleys. The scenery in Smyth Channel is remarkably fine ; the snow-clad mountains are visible on the east, while here and there glaciers flow down nearly or quite to the sea. Some of the islands are steep-sided peaks, mostly barren and uninhabited, and, in some cases, reaching an eleva- tion of 4000 feet. The Strait of Magellan is 400 miles long, from 4 to 20 miles wide, and very deep. North of latitude 41° the coast is but little indented, and there are but few good ports. From Cape Horn, where the southern submerged end of the Andes forms the islands of Tierra del Fuego to the Isthmus of Panama^ the great Cordillera range follows the coast line closely, and at an even distance from it. The belt between the ocean and the mountains has an average width of about 40 miles, and on rare occasions, when the weather is favourable, the mountains are visible from the sea nearly all the way from Panama to the Strait of Magellan. Along the northern part of the continent, from Panama to Guayaquil,

[south

the coastal belt is covered with tropical vegetation ; but from Guayaquil southward to latitude 30° much of the coast IS a sandy, arid, and barren alkali desert. This arid belt is crossed here and there by streams flowing down from the high mountains, and along these streams are fertile valleys. Many of the streams, however, do not reach the sea, but dry up on their way across the coastal plain. The great mountain chain is neither a single continuous sharp range nor a pair of ranges, but a broad ridge upon j^^ which rise many great isolated peaks. Towards

Cordillera, i^s northern end, however, this great range divides — one branch, the Western Cordillera, con- tinuing northward along and near the coast ; another, the Merida, swinging away to the east, and, after certain

breaks, ending east of Carar cas in Venezuela, or, more properly, on the northern side of the island of Trini- dad; while a third branch, the Sierra de Perija, runs northward between the val- ley of the Magdalena and Lake Maracaibo. On its west side the main Cordil- leran ridge is scored by narrow steep-sided valleys, while on its eastern slope the average grade is more gentle and the valleys are less precipitous. Upon the Cordil- leran ridge rise many of the highest mountain peaks iu the world. The following are some of the highest and

Peaks of the Andes.

most noted of these peaks : —

Peak.

Aconcagua, Argentina

Mercedario, Argentina

Tupungato, Argentina

Dlampu (Sorata), Bolivia

niimani, Bolivia .

Sajama, Bolivia .

Chimborazo, Ecuador

Juncal, Chile

San Jose, Chile

Cotopaxi, Ecuador

Antisana, Ecuador

Cayamhfi, Ecuador

Tacora, Bolivia .

Tolima, Colombia

Misti, Peru

Altar, Ecuador .

Maipd, Argentina

Sangai, Ecuador

niiniza .

Torlola, Argentina

Carihuairazo

Tunguragua, Ecuador

Sierra de Santa Marta, Colombia

Sincholagua

Cotocaclu, Ecuador

Piohincha Ecuador

Sara-urea

Elevation.

23,080 22,315 21,550 21,500 21,030 21,028 20,545 20,180 20,020 19,613 19,335 19,186 19,000 18,300 17,934 17,730 17,670 17,464, 17,405 17,350 16,750 16,690 16,640 16,365 16,301 15,918 15,602

Snow-line

(approximate).

17,500

16,700

15,500 16,000 15,000

14,000

15,000

15,300 14,500

i4',boo

There are several other peaks whose elevations exceed some of those given, but they have never been measured. The elevation of the snow-line upon these mountains varies somewhat, but it is lower on the east than on the west side. Of these peaks Cotopaxi, Tunguragua, Maipd, and Sangai are the largest active volcanoes in the world..

There are glaciers in the Andes immediately beneath the equator. The largest of thege are upon Antisana, Cayambe, and Chimborazo, Altar, Carihuairazo, Cotocachi, Illiniza, Sara-urea, and Sincholagua

(Whymper). Farther south in ChUe and Argentina there are glaciers upon Aconcagua, Tupungato, &c., while in Patagonia along Smyth Channel and in the Strait of Magellan they are very large and flow down to the sea. The high iaides regions, even far below the lofty peaks, are cold, bare of vegetation, monotonous, and desolate. At a very few

places there are cities and towns in the high mountains ; Quito in, Ecuador has an elevation of 9343 feet, Bogota in Colombia of 8665 feet, while La Paz iu Bolivia is 12,000 feet above the sea. The highest habitable portion gener- ally has an elevation of about 8000 feet. But for the most part the lofty regions are unpeopled, so much so that this belt is known as the Despoplado or the un- peopled country. The high barren belt is comparatively narrow in Peru, but it widens southward through Bolivia, Chile, and Argentina. It has an average width of about 150 miles. (For further details see Andes.)

The mountainous character of the western side of the continent ends abruptly in the Strait of Magellan. Northward along the east side of the continent the coast is flat as far as the northern part of E.io Grande do Sul. From latitude 33° 30′ to latitude 29° 30′ the coast is bordered by large brackish lakes. At latitude 29° 30′ the coast mountains of Brazil (the Serra do Mar) are near the ocean and follow the shore northward as far as latitude 19° 30’. This piece from 29° 30′ to 19° 30′ is the most picturesque portion of the Brazilian coast. The moun- tains rise in many places directly from the seashore to an elevation of more than 2000 feet. Where their sides are not smooth bare granite, they are covered with luxuriant tropical vegetation from base to summit. The port of Eio de Janeiro, one of the most beautiful in the world, and the ports of Santos and Victoria as well, are formed by a late depression of the coast that admitted the sea to narrow submerged valleys that had been cut by denuda- tion on the margins of granite mountains. From lati- tude 20° northward the mountains swing inland, and the coast is low as far as Prado, latitude 17° 25’. North of Prado the coast is bordered by a wall of brightly coloured bluffs from 60 to 260 feet high, which continue with interruptions almost to the mouth of the Amazon. About Cape St Eoque the coast is covered with sand dunes. From the Abrolhos Islands (lat. 18°) northward to Cape St Eoque there are many coral reefs. In some places

these reefs are several miles off shore, as they are near the Abrolhos, and many miles in length and breadth ; in other places they follow the coast line for a hundred miles or more with few interruptions, now touching the shore and now standing out two or three miles from land. Occasionally there are small ports behind them. The most considerable break in their continuity is between the Bay of Bahia and the mouth of the Eio Sao Francisco. Along this same coast are reefs of hard sandstone that are often mistaken for coral reefs. These stone reefs stand like artificial walls or breakwaters across the mouths of the smaller rivers and the choked-up valleys, and thus form several of the ports on this part of the coast ; such are Pernambuco, Natal, Porto Seguro, and several others of minor importance.

The Serra do Mar, or Brazilian coast range, is the most prominent topographic feature of the eastern side of the continent. "This range, or group of ranges, backed by a high plateau, is within sight of the ocean from the north- eastern corner of Eio Grande do Sul in Brazil (lat. 29° 30') to the mouth of Eio Doce, in S. latitude 19° 30'. The following are the highest points that have been measured on the Brazilian highlands :
—

Peak.

Itatiaya, State of Eio de Janeiro Itajub^ or Temb6, State of Sao Paulo Organ Mountains, State of Rio de Janeiro Prade, State of Espirito Santo Caraga, State of Minas Geraes Itamb^, State of Minas Geraes Itaoolomi, State of Minas Geraes Morro do Lopo, State of Sao Paulo . Serra da Onga, State of Rio de Janeiro Pyrenees, State of Goyaz

Elevation.

9840 feet

7800± „

7323 6770

6234± „

5900 ± „

5748 „

5250 „

4592 „

4544

south]

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There is an elevated region near the eastern corner of the continent on the Watershed between Rio Sao Francisco, Eio Jaguaribe, and Rio Parahyba do Norte. This water- shed is not a mountain range, but a broad and broken plateau with an elevation of about 3000 feet, and with individual peaks reaching 4000 feet above tide level.

North of the mouth of the Amazon the coast is low, much of it is swampy, and all of it is forest-covered as seen from the ocean. This low coast extends across the Guianas and Venezuela as far as the headland north of the Gulf of Paria, where the Merida or Venezuelan branch of the Andes reaches the sea. Along this Guiana coast is a belt of low wooded land, beyond which the streams are not navigable save by canoes. The highlands south of Venezuela and the Guianas, and north of the Amazon valley, form a broad plateau, above which rise several high peaks. The known peaks are : —

Boraima .

. 8740 feet

Ouida

. 8500 „

Maraguaca

. 8230 „

Turagua .

. 6000 „

This highland is mostly forest-covered, but there are in the area also large campos or open grass-covered plains.

The Amazon, the Orinoco, and the Paraguay or La Plata river systems drain an area of 3,686,400 square miles. Less imposing, but yet large and im- R vers. portant streams are the Magdalena in Colombia, the Essequibo in British Guiana, and the Sao Francisco in Brazil. The Amazon (properly the Rio das Amazonas or river of the Amazons) and its tributaries is not only the largest river in South America, but by far the largest in the world (q-v.). The total navigable length of the main stream, from Pard^ to the head of the navigation on the Huallaga in Peru, is 3000 miles. This does not include the hundreds of equally navigable parallel side channels that accompany the main stream from its mouth almost to the mouth of the Javary. Above the falls, again, all these streams are navigable for long distances. The river is nowhere confined to a single channel, but its waters spread over an enormous flood-plain and flow with a sluggish current through thousands of side channels that anastomose with each other so that it is impossible for one not familiar with the stream to distinguish the main channel. In several places the river is so wide that one looking across it sees a water horizon as if he were looking out over the ocean. Indeed much of the region is more like a great freshwater sea filled with islands than it is like a valley with a stream running through it. For the most part the land along the river is low, flat, and marshy, and under water a part of the time ; but at a few places, notably at Erefe, Obidos,Velha Pobre,Paru Parau^qu^ra, and Almeirim table-topped hills are visible from the river. The banks of the stream and of its side channels are every- where lined with a dense forest. The valley, however, is not all forest-covered. Beginning near the Oyapok on the Guiana frontier, a series of dry sandy campos or open grassy plains, interrupted by wooded river banks, follow along the north side of

the river for about 700 miles. The Upper Amazon valley opens broadly towards the north-east and descends to the sea through the Orinoco, while towards the south the Madeira basin, through one of its upper branches — the Guapor^ — ^unites with the basin of the Paraguay.

The Orinoco proper (q.v.) rises in the highlands between Brazil and Venezuela, by a broad curve swings around the western end of 'these highlands, and then for 400 miles flows east into the Atlantic. Along its lower course the banks are covered with heavy forests. In its upper course the mountainous highlands are visible along its right bank, while on its left are enormous stretches of flat, tree-

less, grass-covered plains, extending to the foot-hills of the Cordillera de Merida. During high water, the low, flat country looks like a vast lake. The stream is navigable during a part of the year a distance of 1000 miles or more. Unlike the Amazon, the Orinoco has a great delta, and the stream enters the sea through many channels.

Under the name of the Rio de la Plata (q.v.) may be in- cluded the Uruguay, the Parana, and the Paraguay, with all their tributaries. The plains of Argentina begin on the Amazonian watershed in the highlands of 'Matto Grosso, Brazil, and in Eastern Bolivia, and following down the valley of the Paraguay pass out of the drainage area of the Parang properly speaking, and form the flat region lying between the foot-hills of the Andes and the Atlantic Ocean almost to the Strait of Magellan — a length for this plain of more than 2000 miles. The plains in the latitude of Buenos Ayres and from there southward are low, nearly "^flat on the east side, and rise almost imperceptibly to the lower slopes of the Andes. They are mostly treeless deserts covered with tufts of coarse grass, with here and there shallow pools of salt or brackish water. There are many small volcanic peaks and some short mountain ranges over this great plain.

The valley of the Paraguay is here and there heavily timbered, in other places it is a treeless or sparsely- covered grassy plain, and in still others it is a hilly, dry, and thinly-covered campo. The upper Paraguay river winds through grass-covered, meadow-like plains appar- ently as flat and boundless as the sea. Above this plain rise a few isolated peaks, like so many islands in a great lake. Only above the navigable portions of the

stream, 1700 miles from its mouth, does it flow through a hilly country. A noteworthy feature of the tributaries of the Paraguay is that many of those flowing down from the region of the Andes are more or less brackish, while the Uruguay and Parand and their tributaries entering from the rainy, forest-covered regions of Brazil, are all fresh- water streams.

The Sao Francisco is the largest river that lies wholly in Brazil. It rises in the highlands not far from the coast in latitude 21° and flows north-east parallel with the coast until it reaches latitude 9° 30', where it bends sharply to the right and enters the Atlantic 360 miles south of Cape St Roque. It is navigable in its lower course, but at a distance of 140 miles from its mouth the falls of Paulo Affonso, the " Niagara of Brazil," interrupt all navigation. The upper part of the river, however, is navigable for a long distance. Throughout its en- tire length it flows through a hilly or mountainous country.

The Rio Magdalena in Colombia is a crooked, muddy stream entering the sea thro'ugh two mouths ; it is navi- gable up to Honda (862 feet above tide-level) and has a length of 2000 miles. Above the mouth of Rio Cauca, the mountains are visible on both sidfes of the river.

There are remarkably few freshwater lakes in South America, and most of these are in the Andes mountains. Lake Titicaca, near La Paz in Bolivia, is, in respect of elevation and position, the most re- markable lake of its size in the world. Its surface has an elevation of 12,545 feet, it covers an area of between 4000 and 5000 square miles, has a maximum depth of 700 feet, and never freezes over. Titicaca discharges into another shallow lake or marsh which is supposed to have no outlet. Lake Junin or Chinchaicocha on the plateau east of Lima in Peru has an area of 200 square miles, and an altitude of 13,380 feet. Along the eastern base of the Andes, in Southern Argentina, is a series of lakes whose basins were probably formed by the glaciers that formerly flowed down to the plains from the mountain ranges. There are many lakes over the

[south

flood-plains of all the great rivers of South America, but these are phases of the rivers themselves rather than lakes in the ordinary sense. . Lagoa dos Patos and Lagoa Merim on the southern coast of Brazil are shallow brackish lakes shut in by sandbanks thrown up by the sea. There are small lagoons, formed in a similar manner, at many places along the coast in the states of Eio de Janeiro, Espirito Santo, and AlagSas. Lake Maracaibo on the Venezuela coast is a narrow-necked bay rather than a lake.

The eastern coast of the South American continent has remarkably few islands, and these are all small, except Islands. Trinidad, off the coast of Venezuela, and the islands in the mouth of the river Amazon. The island of Trinidad (area, 1755 square miles) is sepa- rated from the continent by the Gulf of Paria. Along the northern end of the island is a range of mountains about 3000 feet high, which are geologically the eastern end of the Cumana range of the Venezuela mainland, with which they were formerly united. On the south side of the island is the famous pitch lake — the most extensive de- posit of asphalt known. The island of Fernando de Noronha, 230 mUes ofE Cape St Eoque, is of volcanic origin, and h9,s an area of 12 square miles. Although this island is separated from the mainland by a channel 13,000 feet deep, it really stands on the deep continental shelf. The Kiocas, a small coral island, lies 80 miles west of Fer- nando de Noronha. The shores of the Falkland Islands (area, 6500 square mUes) are indented by long tortuous channels that have the appearance of having been formed by the depression of a hilly land surface. One of these channels quite separates the two main islands. One peak, Mount Adams, has an elevation of 2300 feet. The group is separated from the mainland by a shallow sea, while its flora and fauna show that it was formerly connected with the Patagonian mainland. The Tierra del Fuego group of islands and the other islands that border the south-west coast, from the Strait of Magellan to latitude 42°, by their flora, fauna, the land forms and the forms and depths of the channels about them, show that they were not long ago, geologically speaking, a part of the

*mainland, from which they have become separated by the depression of the southern portion of the continent. This depression has admitted the sea to the lower valleys, making fjords of them, while the highlands and mountain tops remain pro- jecting from the water as islands.**

The flora of South America embraces a large number of peculiar types originating either in the highlands of Brazil or in the Andes region. Several of our ""■ most useful plants are natives of the South American tropics. Among these are the rubber-producing plants, cotton, potatoes, maize, the cinchona, Paraguayan tea, ipecac, vegetable ivory, coca, and the chocolate plant. Other tropical and subtropical plants, such as coffee, sugar-cane, oranges, and bananas have been introduced, and are extensively cultivated. The flora of the Amazon valley may be taken as the type of that of the moist valleys. The forests are almost impenetrable; roads through them are soon closed by the rank growth, and vines, creepers, and climbing plants turn them into verit- able mats down to the water's edge. Bamboos reach an enormous size and form extensive thickets along certain streams. Palms are the most characteristic and beautiful trees, and reach their greatest development in the Amazon

1 The continent of South America has nearly all been explored after a fashion, but much of it has never been mapped. The statements frequently met with to the effect that there are large unexplored tracts should be taken with allowances. The various governments have concerned themselves but little with explorations and mapping, and whatever has been accomplished has been done incidentally rather than for the direct purpose of determining the geography and topography.

valley. They take on a great variety of forms : some have a height of 100 feet or more, others are no larger than a lead pencil and only a yard high; some are trunkless, while, others are slender and climb like vines. A note-worthy feature of these tropical plants is that they seldom form forests of a single or of a few species, as so often occurs in the temperate zones. The shaded woods of the forests in many places abound in beautiful ferns, some of them reaching the dimensions of trees. The plants of the campos and plains have a stunted appearance. The grasses are wiry and tough, in places spreading evenly over thousands, of square miles of nearly level

marshy lands, as in the Gran Chaco of the Paraguay valley, in others growing in tufts over the sandy plains. In the high table-lands of Southern Brazil, the araucarian pine grows in beautiful forests as far north as Barbacena, state of Minas. In the north-west, the western slopes of the mountains are covered with a dense tropical vegetation high up their sides, while on the east they are compara- tively bare. In tlxe high mountains, the flora, though scant, resembles that of temperate regions. Sixty per cent, of the genera are like those of the temperate zones, but the species are peculiar to the Andes. On the lofty peaks Whymper collected, of flowering plants, fifty-nine species above 14,000 feet; thirty-five species^ above 15,000 feet ; and twenty species above 16,000 feet.

The fauna of South America includes a large number of species, but relatively a small number of individuals. With local exceptions, this seems to be true of „ aU the forms of life. The land mammals are nearly all small. There are many species of monkeys, all of them arboreal. The only reptiles that are at all abundant are lizards, and, in some places, alligators. There are only two large snakes, the boa constrictor and the water boa, and they are not abundant. The other kinds of snakes are represented by a small number of individuals. Certain ruminants having long woolly hair, the llamas, alpacas, and vicunas, are found only in the high Andes. The llama has been domesticated, and is used for carrying small burdens. The condor, the largest living bird of flight, inhabits the lofty Andes. The insects of the highest peaks are related generically, but not specifically, to those of the temperate latitudes of North America, a fact interpreted by biologists to mean that, probably on account of some obstacles to free move- ment since the Glacial epoch, there has been no migration along the Andes during the existence of living species.

(j. 0. BE.)

South American Meteorology.

South America lies between the mean annual isotherms of 40° and 80° Fahr. The northern and north-eastern portions of the continent, down nearly to the tropic, are within the . district enclosed by the "" " mean annual isotherm of 80°. The cold Peruvian cur- rent deflects the isotherms strongly equatorwards along the Pacific coast, especially*

between latitudes 30° S. and the equator, while these same isotherms loop strongly polewards over the land. The equatorward deflexion on the west coast results in giving places on that coast much lower temperatures than those of stations in correspond- ing, or even considerably higher, latitudes on the east coast. Lima, in latitude 12° S., has a mean annual tem- perature of 66-2°; Eio de Janeiro, which is nearly on the tropic on the east coast, has a mean annual of 72-1°. The mean annual temperatures on the Atlantic coast between latitudes 30° and 40° S. are about 5° higher than those in corresponding latitudes on the Pacific coast. The average position of the heat equator (axis of the equatorial belt of high temperature) is on the immediate sea-coast in North-

south]

eastern Brazil, whence the line runs north-west parallel with, but somewhat inland from, the coast of Guiana and Venezuela. In January the heat equator moves to about 15° S. in Brazil, while in July it migrates northward be- yond the limits of the continent. In the former month the isotherm of 50° crosses the southernmost extremity of South America. In July the isotherm of 30° is found somewhat to the south of Cape Horn. Thus the southern summer is not marked by ex- cessively high mean tempera- tures, and the southern winter is moderate, even in the higher latitudes. The mean annual range of temperature is very small over all of South Amer- ica. Over the northern portion of the continent, including Peru, Northern Bolivia, and the greater part of Brazil, it is less than 10°. Over a consid- erable part of this same area the range is even less than 5°. South of the tropic and east of the Andes the ranges in- crease to between 30° and 40° in Northern Argentina. In Chile, on the other hand, they are less than 20°. The whole of the narrow western coastal strip thus has a very moderate climate. Even in the higher latitudes the winters are very mild; the summers distinctly cool. Over a portion of the coasts of Guiana and of Eastern Venezuela the mean minimum temperatures average over

68°. The lowest mean minima are found in the interior east of the Andes and south of latitude 20° S. Tempera- tures below 32° occur normally every winter over the highlands of the southern interior of BrazU, and thence southward over the interior of Argentina. The highest mean maxima. (104°) occur in the northern portion of Argentina. All of the west coast has decidedly lower maxima. Throughout the mountainous region of South America altitude controls temperature to a marked degree. Places situated far above searlevel (e.g., Quito) enjoy "perpetual spring" temperatures. On the high peaJcs, even on the equator, there is eternal snow.

Eor the mean of the year the barometric equator crosses South America closely along the line of the geographical equator, ruaning north of it on the western '^^lads. ^o^s- ^^^ middle portion of the continent is under the control of the tropical high pressure belt, while over the southern extremity the pressure decreases rapidly towards the south pole. The seasonal migration of sun and heat equator involve a sympathetic migration of barometric equator and tropical high pressure belt. In January the barometric equator moves south to about lat. 10° in Brazil, while the axis of the tropical high pressure belt lies about along 30° S. lat. in the Atlantic, and 35° S. lat. in the Pacific. In July the barometric equator lies along the northern coast, and the axis of the tropical high pressure belt is also farther north than in January. Seasonal changes and mean monthly ranges of pressure are slight. The broad northern portion of the continent east of the Andes, and north of the tropical high pressure belt, is in the trade-wind zone. Here the trades prevail as a rule, except when the sun is most nearly overhead. They are then replaced by the equa- torial belt of calms and rains, which migrates north and south over this portion of the continent, following the sun. The west coast within the trade-wind latitudes south of the equator has its own system of winds, which*

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are under control of the tropical high pressure area of the Pacific, and blow from a southerly direction. The winds of extra-tropical South America are also chiefly controlled by the tropical anti-cyclonic areas of

the South Atlantic and South Pacific oceans. The former of these areas gives easterly and south-easterly winds in the lower latitudes of the eastern portion of the continent, and pre- vailing north-westerly winds ia the higher latitudes. On

the west coast strong south-

erly winds blow with trade- like regularity north of the Pacific anti-cyclone, whUe north-westerly winds prevail to the south of it. The sesr sonal migration of these areas of high pressure involves a corresponding shift in the wind systems under their con- trol. In summer south and south-west winds prevail along the west coast between 30° and 40° S. lat. South of 40° S. lat. north and north-west winds predominate. In winter the winds between 30° and 40° S. lat. are variable, with some calms, while the west and north-west winds blow nearer the equator than in summer. In corresponding latitudes on the east coast there is also a northward exten- sion of the limits of the north-west winds in winter. In Argentina north-east, east, and south-east winds increase in summer, and north, north-west, and west winds in winter. In the mountains there are local winds, much influenced by topography.

Darwin first distinctly emphasized the essential charac- teristics of South American rainfall. In the latitudes of prevailing easterly winds (trades) the eastern side of the continent and the eastern slopes of the Andes are well watered, while the western slopes are comparatively dry. In the latitudes of prevailing westerly winds the western slopes of the mountains have the most precipitation, while the eastern side is dry. The rainfall

is considerable (60-80 inches and over) on the elevated windward coasts of the conti- nent (Guiana, South-east Bra- zil) within the trade ~~wind belts, as it is on the eastern slopes of the Andes, and over an extended area along the Amazon. Within the south~~ east trade belt there is not- ably less rainfall in the lee of the highlands of South-east Brazil, and the rainfall also decreases rapidly in the inte- rior over the more southern latitudes of this same belt. The migration of the belt of equatoriaj calms and rains over the northern portion of South America involves a seasonal rainfall over the greater part of the trade-wind latitudes. There is a dry season while the trade blows, and a rainy season while the equatorial

rainy belt is overhead. The coast of Guiana, and Pemambuco and Bahia have winter rains. The west coast within the trade-wind latitudes, from 4° S. lat. to about 30° S., is very dry. It is shut off from the trades, and has southerly, cool, non-rainy winds. Along

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this desert coastal strip it seldom rains, but rain and snow- fall on the mountains of Peru and Boliyia during the summer. North of lat. 4° S. there is abundant rainfall from the equatorial rainy belt, reaching 160 inches a year on the coast of Colombia north of the equator. Near the west coast the migration of the equatorial rain belt produces two rainy and two dry seasons at certain sta,tions nearly on the equator (Quito and Bogota). Within the latitudes of the prevailing westerly winds, the rainfaU reaches 80 inches annually along the south- ern coast of Chile. East of the Andes, over much of the pampas of Argentina and Patagonia, the average is under 10 inches. Towards the southern extremity of the cofitinent the rainfall east of the mountains increases again, reaching 40 inches a year in the extreme south- east. There is a seasonal distribution of rainfall in Chile which depends upon the migration of the tropical high pressure belt. Northern Chile, north of about 30° S. lat., is always dry. Southern Chile has rain throughout the year, because it is always under the regime of the prevailing westerly winds. In the central portion there are rains only in winter, when the wester- lies impinge on that coast. Cyclonic storms do not occur north of the latitudes occupied by the prevailing westerly winds, but are very common in the high southern latitudes. The winter rains of Central Chile come in con- nexion with the cyclonic storms of that season. Thunder- storms are most frequent over the north-west coast, as far south as 4° S. lat., and occur in considerable numbers over all of tropical South America, except the arid west coast.

The violent summer thunderstorms of Argentina and Uruguay (pamperos) often do serious damage to shipping in the Rio de la Plata estuary.

South America may be divided into six climatic pro- vinces (following Supan). The first ("Tropical Cor- dUleran") includes the extreme north-western pmvfa^s. section (coasts of Colombia and Ecuador), with "perpetual spring" climates at high altitudes, high temperatures near searlevel, and tropical rains. The second (" Tropical ") takes in the vast northern and north- eastern territory east of the Andes, and reaches somewhat

south of the tropics. This is under the control of trades and e4uatorial rains, and has mean annual temperatures over 80°. The third ("Pera-vian") extends along the Pacific coast to 30° S. lat., in- cluding Northern Chile. This province is abnormally cool, and rainless. The "North Chilian" province, adjoining it on the south, has a sub- tropical climate, with winter rains. Farther south the " South Chilian " province, which takes in also the ex- treme southern extremity of the continent, is very rainy and has equable tempera- tures throughout the year, with cool siunmers. The sixth ("Pampa") province, which includes the section east of the Andes and south of the tropical province, has a fairly large range of tempera- ture, especially in the north, while rain is not plentiful.

The following brief list includes some of the last not- able additions to our knowledge of the geography of South America : —

Henki a. Coudkeau. J^tudes sur les Guyanes et VAmasonie. Paris, 1886. — Hbnki A. ConDBEAtj. Voyages h trovers les Guyanes et VAm^onie. Parfe, 1887. — Kabl von den Stbinen. Beise-

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schilderung und Mrgebhisse der zweiter Sching4 Expedition, 1887- 1888. Berlin, 1894. — Edward Whymper. Travels amongst the Great Andes of the Equator. London, 1892.— Teodobo Woli'. Geografia y Geologia del Ecuador. Leipzig, 1892.— B. A. Fitz- gerald. The Highest Andes. London, 1899.—^ Topographic Survey of the State of SSo Paulo, Brazil, under the

direction of O. A. Debet, H. E. Williams, chief topographer. In course of publication at SSo Paulo, Brazil.— 4 Topographic Survey of the State of Minas Geraes, Brazil, under the direction of Alvaro da Silveira. In course of publication at Bello Horizonte, Minas Geraes, Brazil.

See also for Climate.^HANN. Handbuch der Klimatologie. 2nd edition, Stuttgart, 1897. (The most complete discussion of South American climates. Gives numerous references.) — Bartholomew's Physical Atlas, ^o. m. "Meteorology," London, 1899. (Charts of temperature, pressure, winds, rainfall, &c., with discussion.)

(r. dk c. w.)

American Ethnology and Archeology.

The opinion is now well-nigh universal among anthro- pologists that the American aborigines came from the Old World. Whether with Payne it is assumed that, in some remote time a speechless anthro- ™ poid passed over a land bridge, now the Bering aborigines. Sea, which then sank behind him; or with Dawkins and Brinton, that the French cave man came hither by way of Iceland ; or with Keane, that two sub- varieties, the long-headed Eskimo-Botocudo type and the Mexican round-headed type, prior to all cultural develop- ments, reached the New World, one by Iceland, the other by Bering Sea ; or that Malayoid wanderers were stranded on the coast of South America; or that no breach of continuity has occurred since first the march of tribes began this way — ethnologists agree that the aborigines of the western came from the eastern hemisphere, and there is lacking any biological evidence of Caucasoid or Negroid blood flowing in the veins of Americans before the invasions of historic times. The time question is one of geology.*

PoUowing Wotes and Queries on Anthropology, published by the British Association for the Advancement of Science, the study of the American aborigines divides itself into two parts : that relating to their biology, and that relating to their culture. In the four subdivisions of humanity based on the hair, the Americans are straight-haired or Mongoloid. But it will free this account of them from embarrassments if they be looked upon as a distinct subspecies of Homo sapiens. Occu- pying 135 degrees of

latitude, living on the shores of frozen or of tropical waters ; at altitudes varying from sea-level to several thousands of feet ; in forests, grassy prairies, or deserts; here starved, there in plenty; with a night here of six months' duration, there twelve hours long; here among health-giving winds, and there cursed with malaria ; this brown man became, in different culture provinces, brunette or black, tall or short, long-headed or short-headed, and developed on his own hemisphere variations from an average type.

Since the tribes practised far more in-breeding than out-breeding, the tendency was toward forming not only verbal linguistic groups, but biological varieties; the weaker the tribe, the fewer the captures, the greater the isolation, and harder the conditions — producing dolicho-cephaly, dwarfism, and other retrogressive characteristics. The student will find differences among anthropologists in the interpretation of these marks — some averring that coniparative anatomy is worthless as a means of sub- dividing the American subspecies, others that biological variations point to different Old World origins, a third class believing these structural variations to be of the soil. The high cheek-bone and the hawk's-bill nose are universally distributed in the two Americas ; so also are proportions between parts of the body, and the frequency

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of certain abnormalities of the skull, the hyoid hone, the humerus, and the tibia. Viability, by which are meant fecundity, longevity, and vigour, was low in average. The death-rate was high, through lack of proper weaning foods, and hard life. The readiness with which the American Indian succumbed to disease is well known. For these reasons there was not, outside of southern Mexico, northern Central America, and Peru, a dense population. In the whole hemisphere there were not over ten million souls.

The materials for studying the American man zoo- logically exist in the form of collections in Peabody Museum, Cambridge, Massachusetts, the Academy of Natural Sciences in Philadelphia, and the United States National Museum in Washington. Professor Putnam measured for the World's Columbian Exposition 17,000 living Indians, and the results have been summed up by Boas. The breadth of the Indian face is one centimetre more than that of the whites, and the half-breeds are nearer the Indian standard; this last is true also of colour in the skin, eyes, and hair. In stature, the tall tribes exceed 170 cm.; middle stature ranges between 166 and 170; and short tribes are under 166 cm. The Indians are on the whole a tall people. Tribes that have changed residence have changed stature. The tallest statures are on the plains. The mountains of the south-east and of the west reveal the shortest statures. The whole Mississippi Valley was occupied by tall peoples. The Athapascans of New Mexico are of middle stature, the Pueblo peoples axe short. The Shoshone, Shahaptin, and Salish tribes are of middle stature ; on the coast of British Columbia, Puget Sound, in Oregon, and Northern California, are the short- est of all the North Americans save the Eskimo, while among them, on the Columbia, are taller tribes. The comparison of cranial indexes is rendered diflBcult by intentional flattening of the forehead and undesigned flattening of the occiput by the hard cradle-board. The Mississippi Valley tribes are nearly brachycephalic ; the index increases around the Great Lakes, and lessens far- ther east. The eastern Eskimo are dolichocephalic, the western are less so, and the Aleuts brachycephalic. On the North Pacific coast, and in spots down to the Eio Grande, are short heads, but scattered among these are long heads, frequent in Southern California, but seen northward to Oregon, as well as in Sonora and some Kio Grande pueblos. In the regions of greatest linguistic mixture is the greatest heterogeneity of cephalic index.

The concepts on which the peoples of the Old World have been classified, such as stature, colour, skeletal measurements, nationality, and so on, cannot as ciassifica- yg^ ^,g gg ^ America with success. The only "" basis of division practicable is language, which:

must be kept separate in the mind from the others. How- ever, before the conquest, in no other part of the globe did language tally so nearly with

kinship. Marriage was exogamic among clans in a tribe, but practically, though not wholly, endogamic as between tribes, wife and slave capture being common in places. In his family tree of Homo Americanus Keane follows out such a plan, placing the chief linguistic family names on the niain limbs. North American on one side, and South American on the other. Deniker groups mankind into twenty-nine races and sub-races. Americans are numbered thus : — 21, South American sub-race ; Palaeo-Americans and South Ameri- cans. 22, North American sub-race ; tall, mesocephalic. 23, Central American race; short, brachycephalic. 24, Patagohian race; tall, brachycephalic. 26, Eskimo race; short, dolichocephalic.

Zoologists divide the earth into biological areas or regions, so both archaeologists and ethnologists may find

it convenient to have in mind some such scheme of pro- vinces as the following, named partly after the dominant ethnic groups: — Eskimo, on Arctic shores; Dene, in North-western Canada; Algonkin-Iroquois, p^y/'Xces. Canada and Eastern United States ; Sioux, plains of the west ; Muskhogee, Gulf States ; Tlinkit-Haida, North Pacific coast; Salish-Chinook, Eraser-Columbia coasts and basins ; Shoshone, interior basin ; California- Oregon, mixed tribes ; Pueblo province, South-western United States and Northern Mexico; Nahuatla-Maya, Southern Mexico and Central America ; Chibcha-Kechua, the Cordilleras 'of South America ; Carib-Arawak, about Caribbean Sea; Tupi-Guarani, Amazon drainage; Arau- canian. Pampas; Patagonian, peninsula; Euegian, Ma^ gellan Strait. It is necessary to use geographical terms in the case of California and the North Pacific, the Caucasus or cloaca gentium of the western hemisphere, where were pocketed forty out of one hundred or more families of native tribes. The same is true in a limited sense of Matto Grosso. That these areas had deep significance for the native races is shown by the results, both in biology and culture. The presence or absence of useful minerals, plants, and animals rendered some congenial, others unfriendly; some areas were the patrons of virile occupations, others of feminine pursuits.

Among the languages of America great differences exist in the sounds used. A collection of all the phonetic elements exhausts the standard alphabets and calls for new letters. A comparison of one family with another shows also that some are vocalic and soft, others wide in the range of sounds, while a third set are harsh and guttural, the speaking of them (according to Payne) resembling coughing, barking, and sneezing. Powell also thinks that man lived in America before he acquired articulate speech. The utterance of these speech elements in definite order constitutes the roots and sentences of the various tongues. From the-manner of assemblage, aU American languages are agglutinative, or holophrastic, but they should not be called polysynthetic or incorporative or inflexional. They were more or less on the way to such organized forms, in which the world's literatures are preserved. As in all other languages, so in those of aboriginal America, the sentence is the unit. Words and phrases are the organic parts of the sentence, on which, therefore, the languages are classified. It is on this basis of sentential elements that Powell has arranged the linguistic families of North America. He has brought together, in the Bureau of Ethnology in Washington, many hundreds of manuscripts, written by travellers, traders, missionaries, and scholars ; and, better still, in response to circulars, carefully-prepared vocabularies, texts, and long native stories have been written out by trained collectors. A corps of specialists — Boas, Dorsey, Gatschet, Hewitt, Mooney, Pilling — have studied many of these languages analytically and comparatively. Other institutional investigations have been prosecuted, the result of all which will be an intelligent comprehension of the philology of a primitive race.

Attention is frequently called to the large number of linguistic families in America, ne'^rly 200 having been named, embracing over 1000 languages and dia- lects. A few of them, however, occupied the ^^/^l" greater part of the lands both north and south of Panama ; the others were encysted in the territory of the prevailing families, or concealed in culs-desac of the mountains. They are, through poverty of material, un-classed languages, merely outstanding phenomena. Fac- tions separated from the parent body developed dialects or languages by contact, intermarriage, and incorporation with foreign tribes. To the old-time belief that languages

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multiplied by splitting and colonizing, must be added the theory that languages were formerly more numerous, and that those of the Americans were formed by combining.

The families of North America, Middle America, and South America are here given in alphabetical order, the prevailing ones in small capitals : —

Algonquian, E. Can., M. Atlantic States, middle States, middle Western States; Athapascan, N.W. Can., Alaska, Wash., Or., Cal., Ariz., Mez. ; Attacapan, La. ; Beothukan, Nova Scotia; Caddoan, Tex., Neb., Bak. ; Chimakuan, Wash. ; Chimarikan, N. Cal. ; Chimmesyan, Brit. Col. ; Chinookan, Or. ; Chitimachan, La. ; Chumashan, S. Cal. ; Coaiuiltecan, Tex. ; Copehan, N. Cal. ; Costanoan, Cal. ; Eskimahan, Arctic province ; Esselenian, Cal. ; Iroquoian, N.Y., N.C. ; Kalapooian, Or. ; Karankawan, Tex. ; Kekesan, N. Mex. ; Kiowan, Neb. ; Kitunahan, Brit. Col. ; Koluschan, S. Alaska ; Kula- NAPAN, Cal. ; Kusan, Cal. ; Lutuamian, Or. ; Mariposan, Cal. ; Moquelumnan, Cal. ; Mdskhogean, Gulf States ; Natchesan, Miss. ; Palaihnihan, Cal. ; Piman, Ariz. ; Pujunan, Cal. ; Quora- tean, Or. ; Salinan, Cal. ; Salishan, Brit. Col. ; Sastean, Or. ; Shahaptian, Or. ; Shoshonean, Interior Basin; Siodan, Mo. Valley ; Skittagetan, Brit. Col. ; Takilman, Or. ; Tantoan, Mex. ; Timuquanan, Ela. ; Tonikan, Miss. ; Tonkawan, Tex. ; Uohean, Ga. ; Waiilatpuan, Or. ; Wakashan, Vancouver I. ; Wa- shoan, Nev. ; Weitspekan, Or. ; Wishoskan, Cal. ; Yakonan, Or. ; Yanan, Or. ; Yukian, Cal. ; Yuman, L. Cal. ; Zcntan, N. Mex.

Chapanecan, Chi. ; Chinantecan, Oax. ; Chontalan, So. Mex. ; HautnsEai, Nic. ; Lencan, Hon. ; Mayan, Yuo. and Guat. ; Na-HUATLAN, Mex. ; Otomitlan, Cen. Mex. ; Raman, Hond. ; Subtiaban, Nic. ; Tarascan, Mich. ; Tehuante- pecan. Isthmus; Tequistlatecan, Oax. ; Totonacan, Mex. ; Triquian, So. Mex. ; Ulvan, Nic. ; Xicaquean, Hond. ; Zapot^oan, Oax.; Zoquean, Tehuant.

Alikulufan, T. del Fuego; Arauan, R. Purtis ; Arawakian, E. Andes ; Atacamenyan, S. Peru ; Araucanian, Pampas ; Aymaran, Peru ; Barbaooan, Colombia ; Betoyan, Bogota ; Cani- chanan, Bolivia ; Carahan, S. Brazil ; Caribian, around Caribbean Sea ; Catamarenyan, Chaoo ; Changuinan, Panama ; Charruan, Parand R. ; Chibchan, Colombia ; Churoyan, Orinoco R. ; Cooonucan, Colombia ; Cunan, Panama; Gdayouruan, Paraguay R. ; Jivaroan, Ecuador ; Kechuan, Peru ; Laman, N.E. Peru ; Lulean, Vermejo R. ; Mainan, S. Ecuador ; Matacoan, Vermejo R. ; Moooan, Colombia ; Mosetenan, E. Bolivia ; Onan, T. del Euego; Paniquitan, Colombia; Panoan, Ucayali R., Peru; Puquinan, Titicaca L. ; Samucan, Bolivia ; Tacanan, N. Bolivia ; Tapcyan, Brazil ; Timotean, Venezuela ; Tupian, Amazon R. ; TzoNBCAN, Patagonia ; Yahgan, T. del Fuego ; Ynncan, Truxillo, Peru ; Yuruc^rian, E. Bolivia ; Zaparoan, Ecuador.

Written language was largely hierographic and heroic. The drama, the cult image, the pictograph, the synechdo- chic picture, the ideaglyph, were steps in a progress with- out a break. The warrior painted the story of conflicts on his robe only in part, to help him recount the his- tory of his life ; the Eskimo etched the prompters of his legend on ivory ; the Tlinkit carved them on his totem post; the women fixed them in pottery, basketry, or blankets. At last, the central advanced tribes made the names of the abbreviated pictures useful in other con- nexions, and were far on the way to a syllabary. Inter- tribal communication was through gestures ; it may be, survivals of a primordial speech, antedating the differen- tiated spoken languages.

To supply their wants the Americans invented modificar tions in natural materials, the working of which was their industries. The vast collections

in richly-en- Tecbno- dowed European and American museums are the °^' witnesses and types of these. There is danger*

of confounding the products of native industries. The following classes must be carefully discriminated: — (a) pre-Columbian, (6) Columbian, (c) pre-contact, (d) first contact, (e) post-contact, (/) present, and (g) spurious. Pre-Columbian or pre-historic material is further classified into that which had been used by Indians before the dis- covery, and such as is claimed to be of a prior geological period. Columbian, or 16th-century material, still exists in museums of Europe and America, and good descriptions are to be found in the writings of contemporary historians.

Pre-contact material is such as continued to exist in any tribe down to the time when they were touched by the presence of the trade of the whites. In some tribes this would bring the student very near to the present time ; for example, before Steinen, the Indians in Matto Grosso were in the pre-contact period. Post-contact material is genuine Indian work more or less influenced by aecultura^ tion. It is interesting in this connexion to study also first contact in its lists of articles, and the effects produced upon aboriginal minds and methods. For example, a tribe that would jump at iron arrow-heads stoutly declined to modify the shafts. Present material is such as the Indian tribes of the two Americas are making to-day. Spurious material includes all that mass of objects made by whites and sold ^s of Indian manufacture ; some of it follows native models and methods; the rest is fraudulent and pernicious. The question whether similarities in tech- nology argue for contact of tribes, or whether they merely show corresponding stages of culture, with modi- fications produced by environment, divides ethnologists.

The study of mechanics involves materials, tools, pro- cesses, and products. No iron tools existed in America before the invasion of the whites. Mineral, vegetable, and animal substances, soft and hard, ^^^_ were wrought into the supply of wants by means of tools and apparatus of stone, wood, and bone; tools for cutting, or edged tools; tools for abrading and smoothing the surfaces of substances, like planes, rasps, and sandpaper; tools for striking, that is, pounding for the sake of pounding, or for crushing and fracturing violently; perforating tools; devices for

grasping and holding firmly. These varied in the different culture provinces according to the natural supply, and the presence or absence of good tool material counted for as much as the presence or absence of good substances on which to work. As a means of grading progress among the various tribes, the tool is valuable both in its working part and its hafting, or manual part. Eire driUs were universal.

Besides chipped stone knives, the teeth of rodents, sharks, and other animals served an excellent purpose. In North-west America and in the Caribbean area the adze was highly developed. In Mexico, Colombia, and Peru the cutting of friable stone with tough volcanic hammers and chisels, as well as rude metallurgy, obtained, but the evidences of smelting are not convincing. Engineering devices were almost wanting. The Eskimo lifted his weighted boat with sheer-legs made of two paddles ; he also had a tackle without sheaves, formed by reaving a greased thong through slits cut in the hide of a walrus. The North- West Coast Indians hoisted the logs that formed the plates of their house frames into position with skids and parbuckles of rope. The architectural Mexicans, Central Americans, and especially the Peruvians, had no derricks or other hoisting devices, but rolled great stones into place along prepared ways and up inclined planes of earth, which were afterwards removed. In building the fortress of Sacsahuaman, heights had to be scaled; in Tiahiianaco stones weighing 400 tons were carried seven- teen miles ; in the edifices of OUantaytambo not only were large stones hauled up an ascent, but were fitted perfectly. The moving of vast objects by their simple processes shows what great numbers of men could be enlisted in a single effort, and how high a grade of government it was which could hold them together and feed them. In Arizona, Mexico, and Peru reservoirs and aqueducts prove that hydrotechny was understood.

Time-keeping devices were not common. Sun dials ajid calendar monuments were known among the more advanced tribes. Eractional portions of time were gauged by shadows, and time of day indicated by the position of the sun with

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reference to natural features. No standards of weighing or measuring were known, but the parts of the body were the units, and money consisted in rare and durable vegetable and animal substances, which scarcely reached the dignity of a mechanism of exchange. If the inter- pretation of the Maya calculiform glyphs be trust- worthy, these people had carried their numeral system into the hundreds of thousands, and devised symbols for recording such high numbers.

The Americans were, in most places, flesh-eaters. The air, the waters, and the land were their base of supplies. Food. ^^^ cannibalism, it is admitted, was widespread.

With this animal diet everywhere, vegetable substances were mixed, even in the boreal regions. Where the temperature allowed vegetable diet increased, and fruits, seeds, and roots were laid under tribute. Storage was common, and also the drying of ripened fruits. The most favoured areas were those where corn and other plants could be artificially produced, and there barbaric cultures were elaborated. This farming was of, the rudest kind. Plots of ground were burned over, trees were girdled, and seeds were planted by means of sharpened sticks. The first year the crop would be free from weeds, .the second year only those grew whose seeds were wafted or carried by birds, the third year the crop required hoeing, which was done with sticks, and then the space was abandoned for new ground. Irrigation and terrace culture were practised at several points on the Pacific slope from Arizona to Peru. The steps along which plant and animal domestication passed upwards in artificiality are graphically illustrated in the aboriginal food quest.

Except in the boreal areas the breech-clout was nearly universal with men, and the cincture or short petticoat with women. Even in Mexican and Mayan cioibing sculptures the gods are arrayed in gorgeous breech-clouts. The foot-gear in the tropics was the sandal, and passing northward the moccasin, becoming the long boot in the Arctic. Trousers and the blouse were known only among the Eskimo, and it is difBcult to say how much these have been modified by contact. Leggings and skin robes took their place south- ward, giving way at last to the nude. Head coverings

also were gradually tabooed south of the 49th parallel. Tattooing and painting the body were well-nigh universal. Labrets were worn by Eskimo, Tlinkit, Nahuatlas, and tribes on the Brazilian coast. For ceremonial purposes all American tribes were expert in masquerade and dramatic apparel. A study of these in the historic tribes makes plain the motives in gorgeous Mexican sculptures. The tribal system of family organization, universal in America, dominated the dwelling. The Eskimo under- ground houses of sod and snow, the Dene and Habitatioa. g^^^^ bunch of bark or skin wigwams, the Pawnee earth lodge, the Iroquois long house, the Tlinkit great plank house, the Pueblo with its honeycomb of chambers, the small groups of thatched houses in tropical America, and the Patagonian toldos of skin are examples. The Indian habitation was made up of this composite abode, with whatever out-structures and garden plots were needed. A group of abodes, however joined together, constituted the village or home of the tribe, and there was added to these a town hall or large assembly structure where men gathered and gossiped, and where all dramatic and religious ceremonies were held. Powell contends that in a proper sense none of the Indian tribes were nomadic, but that governed by water-supply, bad seasons, and superstition (and discomfort from vermin must be added), even the Pueblo tribes often tore down and rebuilt their domiciles. The fur trade, the horse, the gun, dis- turbed the sedentary habit of American tribes. Little

and adorn meat

Stone- working.

attention was paid to furniture. In the smoke-infested wigwam and hut the ground was the best place for sitting or sleeping. The communal houses of the Pacific coast had bunks. The hammock was universal in the Tropics, and chairs of wood or stone. Eating was from the pot, with the hand or spoon. Tables, knives, forks, and other prandial apparatus were as lacking as they were in the palaces of kings a few centuries before.

Stone-working was universal in America. The tribes quarried by means of crowbars and picks of wood and bone. They split the silicious rocks with stone hammers, and then chipped them into shape with bone tools. Soap-stone for pottery was partly cut into the desired shape in the native ledge,

broken or prised loose, and afterwards scraped into form. Paint was excavated with the ubiquitous digging-stick, and rubbed fine on stones with water or grease. For polished stonework the material was pecked by blows, ground with other stones, and smoothed with fine material. Sawing was done by means of sand or with a thin piece of harder stuff. Boring was effected with the sand-drill ; the hardest rocks may have been pierced with specially hard sand. At any rate stones were sawed, shaped, polished, carved, and perforated, not only by the Mexicans, but among other tribes. For building pur- poses stones were got out, dressed, carved, and sculptured with stone hammers and chisels made of hard and tena- cious rock. Stonecutters' tools of metal are not known to have existed, and they were not needed. Their quarry- ing and stone-working was most wasteful. Those locali'. ties where chipping was done reveal hundreds of tons of splinters and failures, and these are often counted as ruder implements of an earlier time. The dressed stones for great buildings were pecked out of the ledges, and broken off with levers in pieces much too large for their needs. , Metals were treated as malleable stones by the American aborigines. No evidence of smelting ores with fluxes is offered, but casting from metal melted in open „ „ fij^es is assumed. Gold, silver, copper, pure or "'"■*

mixed with tin or silver, are to be found here and there in both continents, and nuggets were objects of worship. Tools and appliances for working metals were of the rudest kind, and if moulds for casting were employed these were broken up; at least no museum contains samples of them, and the processes are not described. In the Arctic and Pacific coast provinces, about Lake Superior, in Virginia and North Carolina, as well as in ruder parts of Mexico and South America, metals were cold-hammered into plates, weapons, rods, and wire, ground and polished, fashioned into carved blocks of hard, tenacious stone by pressure or blow, overlaid, cold-welded, and plated. Soldering, brazing, and the blowpipe in the Cordilleran provinces are suspected, but the evidence of their exist- ence must be further examined. A deal of study has been devoted to the cunning Tubal Cains, the surprising pro- ductions of whose handiwork have been recovered in the art provinces of Mexico and the Cordilleras, especially in Chiriqui, between Costa Rica and Colombia. It must be admitted, however, that both the tools and the processes have escaped the

archseologist, as they did " the ablest goldsmiths in Spain, for they never could conceive how they had been made, there being no sign of a hammer or an engraver or any other instrument used by them, the Indians having none such " (Herrera).

The potter's wheel did not exist in the Western world, but it was almost invented. Time and muscle, knack and touch, a trained eye and brain, and an unlimited array of patterns hanging on fancy's walls, aided p°^'7- by a box of dry sand, were competent to give the charming results. No more striking contrast can be found between

forlorn conditions and refined art products. Art in clay ■was far from universal in the two Americas. The Eskimo on Bering Sea had learned to model shallow bowls for lamps. No pottery existed in Athapascan boundaries. Algonkin-Iroquois tribes made creditable ware in South-eastern Canada and Eastern United States. Muskhogean tribes were potters, but Siouan tribes, as a rule, in all the Mississippi drainage were not. In their area, however, dwelt clay-working tribes, and the Mandans had the art. Moreover, the mound-builders in the eastern half of this vast plain, being sedentary, were excellent potters. In the Muskhogee province the tribes were more settled, making clay vessels possible. On the Pacific side of the continent not one of the forty linguistic families made pottery. The only workers in clay west of the Eockies and north of the Pueblo country belonged to the Sho- shonean family in the interior basin.

The study of Indian textiles includes an ^account of their fibres, tools, processes, products, ornaments, and

uses. Their fibres were either animal or vege- Jndustries. ^^-^le ; animal fibres were hair, fur on the skin,

feathers, hide, sinew, and intestines ; vegetable fibres were stalks of small trees, brush, straw, cotton, bast, bark, leaves, and seed vessels in great variety as one passes from the north southward through all the culture provinces. The products of the textile industry in America were bark cloth, wattling for walls, fences and weirs, paper, basketry, matting, loom products, needle or point work, net-work, lace-work, and embroidery. In the manufacture of these the substances were reduced to the form of slender filaments, shreds, rods, splints, yarn, twine, and sennit or braid. All textile work was done by hand ; the only devices known were the bark-peeler, the shredder, the flint-knife, the spindle, the rope-twister, the bodkin, the warp-beam, and the most primitive har- ness. The processes involved were gathering the raw material, shredding, splitting, gouging, wrapping, twin- ing, spinning, and braiding. Twining and spinning were done with the fingers of both hands, with the palm on the thigh, with the spindle, and with the twister. Orna- mentation was in form, colour, technical processes, and dyes. The uses to which the textiles were put were for clothing, furniture for the house, utensils for a thousand industries, fine arts, social functions, and worship.

In order to comprehend the more intricate processes of the higher peoples it is necessary to examine the textile industry in all of the culture areas. It is essentially woman's work. The Eskimo woman did not weave, but was expert in sewing and embroidering with sinew thread by means of a bodkin. The D^n^ peoples used strips of hide for snowshoes and game-bags, sewed their deerskin clothing with sinew thread, and embroidered in split quill. Their basketry, both in Canada and in Arizona, was coiled work. The northern Algonkin and Iroquoian tribes practised similar arts, and in the Atlantic States wove robes of animal and bird skins by cutting the latter into long strips, winding these strips on twine of hemp, and weaving theip by the same processes employed in their wicker basketry. Textile work in the Sioux province was chiefly the making of skin garments with sinew thread, but in the Gulf States the existence of excellent cane and grasses gave opportunity for several varieties of weaving. On the Pacific coast of America the efflorescence of basketry in every form of technic was known. This art reached down to the borders of Mexico. Loom-weaving in its simplest form began with the Chilkats of Alaska, who hung the warp over a long pole, and wrought mythological

figures into their gorgeous blankets by a process resem- bling tapestry work. The forming of bird skins, rabbit skins, and feathers into robes, and all basketry stitches, existed' from Vancouver Island to Central America. In

Northern Mexico net-work, rude lace-work in twine, are followed farther south, where finer material existed, by figured weaving of most intricate type and pattern ; warps were crossed and wrapped, wefts were omitted, and tex- ture changed, so as to produce marvellous effects upon the surface. This composite art reached its climax in Peru, the llama wool affording the finest staple on the whole hemisphere. Textile work in other parts ofSouth America did not differ from that of the Southern States of the Union. The addition of brilliant ornamentation in shell, teeth, feathers, wings of insects, and dyed fibres completed the round of the textile art. A peculiar type of coiled basketry is found at the Strait of Magellan, but the motives are not American.

Since most American tribes lived upon flesh, the activi- ties of life were associated with the animal world. These activities were not confined to the land, but had to do also with those littoral meadows where "" ^ "^' invertebrate and vertebrate marine animals fed in unlimited numbers. An account of savage life, therefore, includes the knowledge of the animal life of America and its distribution, regarding the continent, not only as a whole, but in those natural history provinces and migror tions which governed and characterized the activities of the peoples. This study would include industries connected with capture, those that worked up into products the results of capture, the social organizations and labours which were involved in pursuit of animals, the language, skill, inventions, and knowledge resulting therefrom, and, finally, the religious conception united with the animal world, which has been named zootheism. In the capture of animals would be involved the pedagogic influence of animal life ; the engineering embraced in taking them in large numbers; the cunning and strategy necessary to hunters so poorly armed giving rise to disguises and lures of many kind«. Capture begins among the lower tribes with the hand, without devices, developing knack and skill in seizing, pursuing, climbing, swimming, and maiming without weapons; and proceeds to gathering with devices that' take the place of the hand in

dipping, digging, hooking, and grasping; weapons for striking, whether clubs, missiles, or projectiles ; edged weapons of capture, which were rare in America; piercing devices for capture, in lances, barbed spears, harpoons, and arrows ; traps for enclosing, arresting, and killing, such as pens, cages, pits, pen-falls, nets, hooks, nooses, clutches, adhesives, deadfalls, impalers, knife traps, and poisons ; animals consciously and unconsciously aiding in capture ; flre in the form of torches, beacons, burning out and smoking out ; poisons and asphyxiators ; the accessories to hunting, including such changes in food, dress, shelter, travelling, packing, mechanical tools, and intellectual apparatus as demanded by these arts. Finally, in this connexion, the first steps in domestication, beginning with the improvement of natural corrals or spawning grounds, and hunting with trained dogs and animals. Zootechnic products include food, clothing, ornaments, habitations, weapons, industrial tools, textiles, money, &c.

In sociology the dependence of the American tribes upon the animal world becomes most apparent. A great majority of all the family names in America were from animal totems. The division of labour among the sexes was based on zootechny. Labour organizations for h\int- ing, communal hunt, and migrations had to do with the animal world.

In the duel between the hunter and the beast-mind the intellectual powers of perception, memory, reason, and will were developed ; experience and knowledge by experience were enlarged, language and the graphic arts were fostered, the inventive faculty was evoked and developed, and primitive science was fostered in the unfolding of numbers,

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metrics, clocks, astronomy, history, and the philosophy of causation. Beliefs and practices with reference to the heavenly world were inspired by zoic activities ; its locar tion, scenery, and environment were the homes of beast gods. It was largely a zoopantheon ; thus zootheism in- fluenced

the organization of tribes and societies in the tribes. The place, furniture, liturgies, and apparatus of worship were hereby suggested. Myths, folk-lore, hunt- ing charms, fetishes, superstitions, and customs were based on the same idea.

Excepting for extensive and rapid travel over the snow in the Arctic regions by means of dog sleds, the extremely j^^^j limited transportation by dog travail (or sledge) in the Sioux province, and the use of the llama as a beast of burden throughout the Peruvian highlands, land travel was on foot, and land transportation on the backs of men and women. One of the most interesting topics of study is the trails along which the seasonal and annual migrations of tribes occurred, becoming in Peru the paved road, with suspension bridges and wayside inns or tambos. In Mexico, and in Peru especially, the human back was utilized to its utmost extent, and in most parts of America harness adapted for carrying was made and frequently decorated with the best art. In the , Mexican codices pictures of men and women carrying are plentiful. Travel- ling on the water was an important activity in aboriginal times. Hundreds of thousands of miles of inland waters and archipelagoes were traversed. Commencing in the Arctic region, the Eskimo in his kayak, consisting of a framework of drift wood or bone covered with dressed sealskin, could paddle down East Greenland, up the west shore to Smith Sound, along Baffin Land and Labrador, and the shores of Hudson Bay throughout insular Canada and the Alaskan coast, around to Mount St Elias, and for many miles on the eastern shore of Asia. In addition to this most delicate and rapid craft, he had his umiak or freight boat, sometimes called woman's boat. The Athapascan covered all North-westerji Canada with his open birch-bark canoe, somewhat resembling the kayak in finish. The Algonkin-Iroquois took up the journey at Bear Lake and its tributaries, and by means of paddling and portages traversed the area of Middle and Eastern Canada, including the entire St Lawrence drainage. The absence of good bark, dugout timber, and chisels of stone, deprived the whole Mississippi Valley of creditable water- craft, and reduced the natives to the clumsy trough for a dugout and miserable bull-boat, made by stretching dressed buffalo hide over a crate. On the Atlantic coast of the United States the dugout was improved in form where the waters were more disturbed. John Smith's Indians had a fleet of dugouts. The same may be said of the Gulf

States tribes, although they added rafts made of reed. Along the archipelagoes of the North Pacific coast, from Mount St Elias to the Columbia river, the dugout attained its best. The Columbia river canoe resembled that of the Amur, the bow and stern being pointed at the water line. Poor dugouts and rafts, made by tying reeds together, constituted the water- craft of California and Mexico untU Central America is reached.

The Caribs were the Haidas of the Caribbean Sea and Northern South America. Their craft would vie in form, in size, and seaworthiness with those of the North Pacific coast. The catamaran and the reed boat were known to the Peruvians. The tribes of Vene- zuela and Guiana, according to Im Thurn, had both the dugout and the built-up hull. The simplest form of navigation in Brazil was the woodskin, a piece of bark stripped from a tree, and crimped at the ends. The sangada, with its platform and saU, belonging to the Brazilian coast, is spoken of as a good seaworthy

craft. Finally, the Fuegian bark canoe, made in three pieces so that it can be taken apart and transported over hills .and sewed together, ends the series. The American craft was propelled by poling, paddling, and by rude sails of matting.

The aesthetic arts of the American aborigines cannot be studied apart from their languages, industries, social organizations, lore, and worships. Art was limited most of all by poverty in technical appli- ances. There were just as good materials and inspira- tions, but what could the best of them do withaut metal tools ? One and all, skilful to a surprising degree — weavers, embroiderers, potters, painters, engravers, carvers, sculptors, and jewellers — they were wearied by drudgery and overpowered by a never-absent, weird, and grotesque theology. The Eskimo engraved poorly, the Den^ em- broidered, the North Pacific tribes carved skilfully inborn, slate, and cedar, the California tribes had nimble fingers for basketry, the Sioux, like the Mexicans, gloried in feathers. The mound builders, Pueblo tribes, middle Americans, and Peruvians, were potters of many schools, gorgeous colour fascinated the Amazonians, the Patago- nians delighted in skins, and even the Fuegians saw beauty in the pretty snail shells of their desolate island shores. Of the Mexican and Central American sculpture and archi- tecture a competent judge says that

Yucatan and the southern states of Mexico are not rich in sculptures, apart from architecture ; but in the valley of Mexico the human figure, animal forms, fanciful life motives in endless variety, were embodied in masks, yokes, tablets, calendars, cylinders, disks, boxes, vases, and ornaments. The Nahuatl lapidary had at hand many varieties of workable and beautiful stone ; onyx, marble, limestone, quartz and quartz crystal, granite, syenite, basalt, trachyte, rhyolite, diorite, and obsidian, the best of material prepared for them by nature ; while the Mayas had only limestone, and hard, tenacious rock with which to work it, and timber for burning lime. However, looking over the whole field of North American achievement, architectural and non-architectural, composite and monolithic, the palm for boldness, magnitude of proportions, and infinity of labour, must go to the sculptured mosaics of Yucatan. Maya architecture is the best remaining index of the art achievements of the American race. The construction of such buildings as the palace at Uxmal and the castillo at Chichen indicates a mastery in architectural design. There is lack of unity in plan and grouping, and an enor- mous waste of material as compared with available room. At Uxmal the mass of masonry is to chamber space about as forty to one. The builders were " ignorant of some of the most essential principles of construction, and are to be regarded as hardly more than novices in the art " (Holmes). As for the marvels of Peru, the walls of the temple of the sun in Cuzco, with their circular form and curve inward, from the ground upward, are most imposing. Some of the gates without lintels are beautiful, and the geometric patterns in the walls extremely effective. The samfe objection to over-massiveness might not apply here as in Mexico, owing to volcanic activity.

Institutions in Europe and America have gathered abundant material for an intelligent comprehension of American Indian sociology. The British Associa- tion has had a committee reporting during ""'"logy. many years on the tribes of North-west Canada. The American Museum in New York has prepared a series of monographs on the tribes of the North Pacific coast, of Northern Mexico, and of the Cordilleras of South America. The reports of the Bureau of Ethnology in Washington cover the Eskimo, east and west, and all the tribes of the United States. In Mexico the former

labourers of Pimentel and Orozcoy Berra are supplemented by those of Bandelier,

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Penafiel, Herrera, and Cicero. Otto StoU's studies in Guatemala, Berendt's in Central America, Ernst's in Venezuela, Im Thurn's in Guiana, those of Ehrenreich, von den Steinen, Meyer in Brazil, or of Bandelier, Bastian, Briilil, Middendorf, von Tschudi in Peru, afford the historian of comparative sociology aipple groimdwork for a comprehensive grasp of South American tribes. In all parts of the western hemisphere society was organized on cognate kinship, real or artificial, the unit being the clan. There were tribes where the basis of kinship was agnate, but these were the exceptions. The headship of the clan was sometimes hereditary, sometimes- elective, but each clan had a totemic name, and the clans together consti- tuted the tribe, the bond being notland, but blood. Women could adopt prisoners of war, in which case the latter be- came their younger sons. When a confederacy was or- ganized under a council, intermarriage between tribes sometimes occurred; an artificial kinship thus arose, in which event the council established the rank of the tribes as elder and younger brother ; grandfather, father, and sons, rendering the relationship and its vocabulary most intri- cate, but necessary in a social system in which age was the predominant consideration and etiquette most exacting.

The Eskimo have a regular system of animal totem marks and corresponding gentes. Powell sets forth the laws of real and artificial kinship among the North American tribes, as well as tribal organization and govern- ment, the formation of confederacies, and the intricate rules of artificial kinship by which rank and courtesy were established. Bandelier declares that in Mexico existed neither state nor nation, nor political society of any kind, but tribes representing dialects, and

autonomous in mat- ters of government, and forming confederacies for the purposes of self-defence and conquest. The ancient Mexi- can tribe was composed of twenty autonomous kins. According to Brinton the social organization of ancient Peru was a government by a council of the gentes. The Inca was a war chief elected by the council to carry out its commands. Among the Caribs a like social order pre- vailed ; indeed, their family system is identical with the totem system of North American Indians. Dominated by the rule of blood relationship, the Indians regulated all co-operative activities on this basis. Not only marriage, but speech and common industries, such as rowing a boat or chasing a buffalo, were under its sway. It obtrudes itself in fine art, behaviour, law-making, lore, and religion. In larger or smaller numbers of cognate kindred, for shorter or longer periods of time, near or far from home, the abori- gines developed their legislatures, courts, armies, secret societies, and priesthoods.

In organization, engineering, strategy, offence, and defence, the art of war was in the barbarous and the savage status or grade. One competent to judge ^^°' asserts that peace, not war, was the normal ^ ' intertribal habit. They held frequent inter-

course, gave feasts and presents, and practised unbounded hospitality. Through this traffic objects travelled far from home, and now come forth out of the tombs to perplex archaeologists. Eemembering the organization of the tribe everywhere prevalent, it is not difficult to under- stand that the army, or horde, that stands for the idea, , was assembled on the clan basis. The number of men ' arrayed under one banner, the time during which they might cohere, the distances from home they could march, their ability to hold permanently what they had gained, together form an excellent metric scale of the culture grade in the several American provinces, and nowhere, even in the most favoured, is this mark high. With the Mexicans war was a passion, but warfare was little above the raid (Bandelier). The lower tribes

Lore.

hunted their enemies as they hunted animals. In their war dances, which were only rehearsals, they disguised themselves as animals, and the

pantomime was a mimic hunt. They had striking, slashing, and piercing weapons held in the hand, fastened to a shaft or thong, hurled from the hand, from a sling, from an atlatl or throwing- stick, or shot from a bow. Their weapons were aU indi- vidual, not one co-operative device of offence being known among them, although they understood fortification.

The term " slavery " is often applied to the aboriginal Apierican tribes. The truth of this depends upon the definition of the word " slave." If it means the capture of men, and especially of women, and adoption into the tribe, this existed everywhere; but if subjection to a personal owner, who may compel service or sell the indi- vidual, slavery was far from universal. Nieboer finds it only on the North Pacific coast ^ as far south as Oregon, among the Navajo and the Cibola pueblos, and in a few tribes of Middle and South America.

The thoughtlife of the American aborigines is expressed in their practical knowledge and their lore. The fascina- tion which hangs around the latter has well- nigh obscured the former. As in medicine theory is one thing and practice another, so among these savages must the two be carefully discriminated. Dorsey, again, draws a distinction between lore narratives, which can be rehearsed without fasting or prayer, and rituals which require the most rigid preparation. In each culture province the Indians studied the heavenly bodies. The Arctic peoples regulated their lives by the long day and night in the year ; among the tribes in the arid region the place of sunrise was marked on the horizon for each day ; the tropical Indians were not so observant, but they worshipped the sun god above all. The Mayas had a calendar of 360 days, with intercalary days ; this solar year was intersected by their sacred year of twenty weeks of thirteen days each, and these assembled in bewildering cycles. Their knpwledge of the air and its properties was no less profound. Heat and cold, rain and drought, the winds in relation to the points of the compass, were nearest their wants and supplies, and were never out of their thoughts. In each province they had found the best springs, beds of clay, paint, soapstone, flinty rock, friable stone for sculpture, and hard, tenacious stone for tools, and used ashes for salt. The vegetal kingdom was no less familiar to them. Edible plants, and those for dyes and medicines, were on their lists, as well as wood for tools, utensils, and weapons, and fibres for textiles. They

knew poisonous plants, and could eliminate noxious properties. The universal reliance on animal life stimu- lated the study of the animal kingdom. Everywhere there were names for a large number of species; industries and fine arts were developed through animal substances. Society was organized in most cases on animal clans, and religion was largely zoomorphic. The hunting tribes knew well the nature and habits of animals, their anatomy, their migrations, and could interpret their voices. Out of this practical knowledge, coupled with the belief in personeity, grew a folk-lore so vast that if it were written down the world would not contain the books.

The religion of the American aborigines, so far as it can be made a subject of investigation, consisted (1) in what the tribes believed about spirits, or shades, and the spirit world — its organization, place, activi- '^^"""' ties, and relation to our world ; and (2) in what they did in response to these beliefs. The former was their creeds, the latter their cults or worships. In these worships, social organization, religious dramas and paraphernalia, amusement and gambling, and private religion or f etichism, found place. In order to obtain an intelligent grasp of

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the religion of tribes in their several culture provinces, it must be understood: (1) That the form of belief called animism by Tylor (more correctly speaking, personeity), was universal ; everything was somebody, sSive, sentient, thoughtful, wilful. This personeity lifts the majority of earthly phenomena out of the merely physical world and places them in the spirit world. Theology and science are one. All is supernatural, wakafl. (2) That there existed more than one self or soul or shade m any one of these personalities, and these shades had the power not only to go away, but to transform their bodily tenements at will ; a bird, by raising its head, could become a man; the latter, by going on all fours, could become a deer. (3) That the regulative side of the spirit world was , the natural

outcome of the clan social system and the tribal government in each tribe. Even one's personal name had reference to the world of ghosts. The affir- mation that American aborigines believed in an all-pervad- ing, omnipotent Spirit is entirely inconsistent with the very nature of the case. (4) Worship was everywhere dramatic. Only here and there among the higher tribes were bloody sacrifices in vogue, and prayers were in pantomime.

In the culture areas the environment gave specific characters to the religion. In the Arctic province the over- powering influence of meteorological phenomena mani- fested itself both in the doctrine of shades and in their shamanistic practices. The raven created the world. The Dene myths resemble those of the Eskimo, and all the hunting tribes of Eastern Canada and United States and the Mississippi Valley have a mythology based upon their zootechny and their totemism. The religious con- ceptions of the fishing tribes on the Pacific coast between Mount St Elias and the Columbia river are worked out by Boas; the transformation from the hunting to the agricultural mode of life was accompanied by changes in belief and worship quite as radical. These have been carefully studied by Cushing, Stevenson, and Fewkes. The pompous ceremonials of the civilized tribes of Mexico and the Cordilleras in South America, when analysed, reveal only a higher grade of the prevailing idea. Im Thurn says of the Carib: "All objects, animate and inanimate, seem exactly of the same nature, except that they differ in the accident of bodUy form." These mytho- logical ideas and symbols of the American aborigines ' were woven in their textiles, painted on their robes and furniture, burned into their pottery, drawn in sand mosaics on deserts, and perpetuated in the only sculptures worthy of the name, in wood and stone. They are inseparable from industry ; language, social organization, and custom wait upon them : they explain the universe in the savage mind.

The archaeology of the western hemisphere should be divided as follows : (1) that of Indian activities ; (2) the question of man's existence in a prior geological period. There is no dividing line between first- contact ethnology and pre-contact archaeology. Historians of this time, both north and south of Panama, described tools and products of activities similar to those taken from beneath the soil near by. The archaeologist

recovers his specimens from waste places, cave deposits, abandoned villages, caches, shell-heaps, refuse heaps, en- closures, mounds, hut rings, earthworks, garden beds, quarries and workshops, petroglyphs, trails, graves and cemeteries, cliff and cavate dwelliugs, ancient pueblos, ruined stone dwellings, forts and temples, canals or reservoirs. The relics found in these places are material records of language, iudustries, fine arts, social life, lore, and religion.

Here and there in the Arctic province remains of old village sites have been examined, and collections brought

away by whalers and exploring expeditions. Two facts are established — namely, that the Eskimo lived formerly farther south on the Atlantic coast, and that, aboriginally, they were not specially adept in carving and etching. The old apparatus of hunting and fishing is quite primi- tive. The Dini province in Alaska and North-western Canada yields nothing to the spade. Algonkin-Iroquois Canada, thanks to the Geological Survey and the Depart- ment of Education in Ontario, has revealed old Indian camps, mounds, and earthworks along the northern drainage of Lakes Erie and Ontario, and pottery in a curved line from Montreal to Lake of the Woods. Throughout Eastern United States shell-heaps, quarries, workshops, and camp sites are in abundance. The Sioux and the Muskhogee province is the mound area, which extends also into Canada along the Eed river. The forms of these are earth-heaps, conical mounds, walls of earth, rectangular pyramids, and effigies. Thomas sums up the work of the Bureau of Ethnology upon the structure, contents, and distribution of these earth monuments, over a vast area from which adobe, building stone, and stone-working material were absent. No writings have been recovered, the artizans shaping small objects in stone were specially gifted, the potters in only a few places approached those of the Pueblos, the fine art was poor, and relics found in the mounds do not indicate in their makers a grade of culture above that of the Indian tribes near by. The archaeology of the Pacific slope, from the Aleutian Islands, is written in shell-heaps, village sites, caves, and burial-places. The relics of bone, antler, stone, shell, and copper are of yester- day. Even the Calaveras man

is no exception, since his skull and his polished conical pestle, the latter made of stone more recent than the auriferous gravels, show him to have been of Digger Indian type. In Utah begin the ruins of the Pueblo culture. These cover Arizona and New Mexico, with extensions into Colorado on the north and Mexico on the south. The reports of work done in this province for several years past form a library of text and illustration. Cliff dwellings, cavate houses, pueblos, and casas are all brought iuto a series without a break by Bandolier, Cushing, Fewkes, Holmes, Mindeleff, Norden- skiold, Powell, and Stevenson. From Casa Grande, in Chihuahua, to Quemada, in Zacatecas, Lumholtz found survivals of the cliff dwellers. Between Quemada and Copan, in Honduras, is an unbroken series of mural structures. The traditions agree with the monuments, whatever may be objected to assigning any one ruin to the Toltec, the Chichimec, or the Nahuatl, that there are distinct varieties in ground-plan, motives, stone-craft, wall decorations, and sculptures. Among these splen- dours in stone the following recent explorers must be the student's guide: — Charnay, Forstemann, Goodman, Gordon, Holmes, Maudslay, Mercer, Sapper, SavUle, Seler, Thomas, Thompson. A list of the ruins, printed in the handbook on Mexico published by the Department of State in Washington, covers several pages. The special characteristics of each are to be seen partly in the skill and genius of their makers, and partly in the exigencies of the site and the available materials. A fascinating study in this connexion is that of the water-supply. The cenotes or underground reservoirs were the important factors in locating the ruins of Northern Yucatan. From Honduras to Panama the urn burials, the pottery, the rude carved images, and, above all, the grotesque jewellery, absorb the archaeolo- gist's attention.

Beyond Chiriqui southward is El Dorado. Here also bewildering products of ancient metallurgy tax the imagina- tion as to the processes involved, and questions of accultura- tion also interfere with true scientific results. The fact remains, however, that the curious metal craft of the

narrow strip along the Pacific from Mexico to Titicaca is the greatest of archaeological enigmas. Bandelier, Holmes, Seler, and Uhle have taken up the questions anew. Beyond Colombia are Ecuador and Peru, where, in the widening of the continent, architecture, stone-working, pottery, metallurgy, textiles, are again exalted. Among the Cordilleras in their western and interior drainages, oyer a space covering more than twenty degrees of latitude, the student comes again upon massive ruins. The materials on the coast were clay and gravel, wrought into concrete, sun-dried bricks, and pise or rammed work, cut stalks of plants formed' with clay a kind of staff, and lintels were made by burying stems of cana brava {Qynerium saccharoides) in blocks of pisd On the uplands structures were of stone laid up in a dozen ways. Walls for buildings, garden terraces, and aqueducts were straight or sloping. Doorways were usually square, but corbelled archways and gateways surmounted with sculptures were not uncommon. Ornamentation was in carving and in colour, the latter far more effectively used than in Middle America. A glance at the exquisite textiles reveals at once the inspiration of mural decorations. The most pro- lific source of Peruvian relics is the sepulchres or huacas, the same materials being used in their construction as in building the houses. Here, owing to a dry climate, are the dead, clad and surrounded with food, vessels, tools, and art products, as in life. The textiles and the pottery can only be mentioned ; their quality and endless varieties astonish the technologist. In the Carib province there are no mural remains, but the pottery, with its excessive on- laying, recalls Mexico and the jewellers of Chiriqui. The polished stone work is superb, finding its climax in Puerto Kico, which seems to have been the sacred island of the Caribs. For the coasts of South America the vast shell- heaps are the repositories of ancient history.

Since 1880 organized institutions of anthropology have taken the spade out of the hands of individual explorers in order to know the truth concern- ^laoiubic j^g Glacial or Pleistocene man. The geo- logist and the trained archaeologist are asso- ciated. In North America the sites have been examined by the Peabody Museum and the Bureau of Ethnology, with the result that only the Trenton gravels have any standing. The so-called palaeolithic implements are every- where. The question is one of geology, simply to decide whether those recovered at Trenton are ancient.

Putnam and Wright maintain that they are ancient, Chamberlain and Holmes that they are post-Glacial, and comparatively recent. In South America the shell-heaps, of enormous size, are supposed to show that the animals have under- gone changes in size and that such vast masses require untold ages to accumulate. The first is a biological problem. As for the second, the elements of savage voracity and wastefulness, of uncertainty as to cubical contents on uneven surface, and of the number of mouths to fill, make it hazardous to construct a chronological table on a shell heap. Hudson's village sites in Patagonia contain pottery, and that brings them all into the territory of Indian archaeology. Ameghino refers deposits in Pata- gonia, from which undoubted human bones and relics have been exhumed, to the Miocene. The question is of the age of the sediments from which these were taken^ The

bones of other associated animals, says Hatcher, demon- strate the Pleistocene nature of the deposits, by which is not necessarily meant older Quaternary, for their horizons have not been differentiated and correlated in South America. Hatcher believes that "there is no good evidence in favour of a great antiquity for man in Pata- gonia." In a cave near Consuelo Cove, southern Pata- gonia, have been found fragments of the skin and bones of a large ground-sloth, Grypotherium (Neomylodon) listai, associated with human remains. Ameghino argues that this creature is still living, while Dr Moreno advances the theory that the animal has been extinct for a long period, and that it was domesticated by a people of great antiquity, who dwelt there prior to the Indians. Hauthal, Eoth, and Nitsche review their' work with the conclusion, not unanimously held by them, that man co-existed here with all the other animals whose remains were found during an inter-Glacial period. Woodward reviews the question in Proceedings of the Zoological Society of London, closing with this sentence: "If we accept the confirma- tory evidence afforded by Mr Spencer Moore, we can hardly refuse to believe that this ground-sloth was kept and fed by an early race of men." These are individual opinions, subject to revision by that court of appeals, the institutional judgment.

Authorities. — A valuable endowment of research in specimens, literature, and pictures, deposited in libraries, museums, and galleries

since 1880 will keep ethnologists and archseologists em- ployed for many years to come. The scientific inquirer will find a mass of material in the papers and reports contributed to the various societies and institutions which are devoted to anthropolo- gical research. The following short list of works includes, however, a few authorities which have made use of recent discoveries gener- ally : — H. H. Bancroft. Native It aces of the Pacific States of North America, vols. i.-v. 1874-1876. New York. — D. G. Beinton. Library of Aboriginal American Literature, vols, i.-viii. 1882-1890. Philadelphia. ITie American Bace. New York, 1891. — Gustav Brijhl. Die Oulturvolker Amerikas. Cincinnati, 1889. — Desire Chaenat. The Anciera Cities of the New World. New York, 1887. — F. S. Dellenbaugh. The North Americans of Yesterday . New York, 1901. — J. Denikee. The Races of Man. London, 1900. — Paul. Ehrenreich. Die V'olkerstdmme Brasiliens. Berlin, 1892. Anthropologische Studien uber die Vrbewohner Brasiliens. Berlin, 1897.— J. W. Fewkes. a Journal' of American Ethnology and Archmology, vols, i.-iv. Boston, 1891-94. — E. FOrstemann. Zur Entzifferung der Maya Handschriften, Parts i.-vii. Dresden, 1880, 1 1898. Die Maya-JSandschrift der Eonigl. 'offent. Bibliothek zu Dresden. Leipzig, 1880 ; Dresden, 1891. — E. F. Im Thuen. Among the Indians of Guiana. London, 1883. — A. H. Keane. Ethnology. Cambridge, 1896. Man, Fast and Present. Cam- bridge, 1899. — 'Washington Matthews. Navajo Legends. Cambridge, Mass., 1897. — Anne Caet Maudslat and Alfred Percival. a Glimpse at Guatemala, and some Notes on the Ancient Monuments of Central America. London, 1899. — H. C. Mercee. The Sill Caves of Yucatan. Philadelphia, 1896. — Marquis db Nadaillac. L'Amirique prkhistorique. Paris, 1888. — H. J. NiEBOER. Slavery as an Industrial System. Ethno- logical researches. The Hague, 1900. — G. Noedbnskiold. The Cliff Dwellers of the Mesa Verde, Colorado. Stockholm, 1893. — Edward John Payne. History of the New World called America, vol. i. 1892, vol. ii. 1899. Oxford. — DiisiEi Pectoe. Notes sur VAmericanisme; Quelques-unes de ses lacunes en 1900. Paris, 1900.— J. W. Poweli.. The United States of America. Ed. by N. S. Shaler. New York, 1894.— Cyeus Thomas. Intro- duction to the Study of North American Archceology. Cincinnati, 1898. — Justin 'Winsoe. Narrative and CrjMeal History of America. Boston, 1889.— G. F. 'Wright. The Ice Age in North America. New York, 1896, (o. t. M.)

America Islands. See Polyj^tesia.

American Literature. See under United States.

Americus, a city of Georgia, U.S.A., the capital

of Sumter county, situated in the south-western part of the state at an altitude of 360 feet. It is in an agri- cultural region which produces cotton and corn, and is on the Central of Georgia and the Georgia and Alabama railways. The population in 1880 was 3635, in 1890 it was 6398, and in 1900 it was 7674.

Amersham, or Agmondesham, a market-town and railway station in the Wycombe parliamentary division of BuckinghamsMre, England, 26 miles W.N.W. of London. Area of parish, 6119 acres. Population (1881), 2500; (1901), 3209. Eural district area, 39,800 acres; population (1891), 12,501; (1901), 13,641.

Amesbury, a town of Essex county, Massachvi- setts, U.S.A., situated in north-eastern Massachusetts on the north bank of the Merrimac river, six miles from its mouth. Its area is fourteen square miles and its surface is hilly. The principal village, bearing the same name as the town, and noted as being the home of Whittier, lies at the mouth of the Powow river, and is on the Boston and Maine railway. The population of the town (1880) was 3356; (1890), 9798; (1900), 9473.

Amhara. See Abyssinia.

Amherst, a district and town within the Tenas- serim division of Lower Burma, lying .between .the Indian Ocean and the hills which separate Burma from Siam. The area of the district is 7062 square miles, with, in 1891, a population of 233,539. The number of villages in the district was 660, and the revenue paid in 1898-99 was Rs.8,76,819. In 1891 the population comprised 191,241 Buddhists and Jains, 19,415 Hindus,

15,611 Mahommedans, 2897 aborigines, mostly Karens, and 4374 Christians. Of the total area of 4,519,680 acres, there were 312,908 acres under cultivation in 1898-99, 14,694 acres were fallow, 77,912 acres were cultivable, and 3,670,276 acres were not capable of cultivation. The chief town is Moulmein, with a population of 55,785. Amherst town, about 30 miles to the south, has not grown to any appreciable extent and remains a mere bathing-place for Moulmein. The rainfall for the district in 1898-99 was 199-68 inches. This is below the average.

Amherst, the county town of Cumberland county and port of entry in Nova Scotia, at the head of Chig- necto Bay and on the Intercolonial railway, 138 miles from Halifax. It contains county and railway build- ings, six churches, an iron foundry and several factories, and shops for the manufacture of railway carriages. In 1900 the exports were f 338,626, and the imports $219,- 422. The population in 1891 was 3781, and was esti- mated in 1900 at 6600.

Amherst, a town of Hampshire county, in central Massachusetts, U.S.A., with an area of 26 square miles. It is situated on the east side of Connecticut Valley, im- mediately north of Holyoke Range. The village of the same name is entered by two railways, the Boston and Maine and the Central Vermont. Amherst College had in 1899 a faculty of 32 professors and instructors, and was attended by 380 students. Its property was valued at $2,400,000, and its income was $100,000. The state Agricultural College had in 1899 a teaching staff of 19 professors and 140 students. The population in 1880 was 4298, in 1890 it was 4612, and in 1900 it was

5028.

Amiel, Henri Frederic (1821-1881), Swiss phi- losopher and critic, was born at Geneva, 27th September 1821. He was descended from a Huguenot family, which had been driven to Switzerland by the revocation of the Edict of Nantes. He lost both his parents at an early age ; when he grew up he devoted himself principally to travel, mingling with the most intellectual circles throughout Europe, and in particular studying German philosophy at Berlin. In 1849 he was appointed professor of aesthetics at the academy of Geneva, and in 1854 became professor of moral philosophy. Notwithstanding his high quali- fications, these

appointments turned out unfortunately for him. They had been conferred by the democratic party,

then dominant in Geneva, and he was in consequence entirely ignored by the aristocratic party, which com- prised nearly all the culture and refinement of the city. This painful isolation nevertheless inspired the one book by which Amiel lives, the Journal Jntime, which, pub- lished after his death, obtained a European reputation and was translated into English by Mrs Humphry Ward. Did not "second-rate" seem to imply a slur, this book might be well described by the title of one of Tennyson's early poems, " The Confessions of a Second-rate Sensitive Mind ill at ease with itself." Although, however, second- rate as regarded productive power, Amiel's mind was of no inferior quality, and his journal, as a candid record of the yearnings and meditations of a thoughtful, affectionate, and wounded spirit, gained a sympathy which the author had failed to obtain in his life. He also wrote studies on Erasmus, Madame de Stael, and other literary personages, and several volumes of poems. Amiel died in Geneva on the 27th of December 1881. (e. g.)

Amiens, the ancient capital of Picardy, and chief town of the department of Somme, France, situated on the river Somme, 81 miles from Paris by the Paris-Calais rail- way. It has also railway communication with Arras, Lille and Belgium, Tergnier and Rheims, Rouen and Normandy, Doullens, Beauvais and Cr^py-en-Valois. The chief industries of the town are manufactures of cotton-velvet (value of annual production, £400,000) and Utrecht velvet (20,000 pieces, value £200,000 to £240,000 a year), cotton-spinning, wool-spinning (50,000 spindles), hemp- and flax-spinning (24,000 spindles), weaving, manufactures of hosiery, carpets, machinery, chemicals, sugar, and nouveautis, brewing, tanning, printing, and founding. The population of the town in 1886 was 68,177 ; in 1896, 74,808 (commune, 88,731) ; in 1901, 90,768.

Ammunition. See ^bopellants, and Ord- nance.

Amoy, a town and treaty-port on the small island of Hiamen, province of Fuhkien, China. It has dry docks and an excellent anchorage. The trade in 1870 was: imports, £1,915,427; and exports, £1,440,000. In 1899 the figures were: imports, £2,180,000; and exports, £363,000. The falling off

of exports is- due to the decreased demand for China tea, for which Amoy was one of the chief centres. The native population is now estimated at 300,000, and the foreign residents number about 280. A large part of the trade is that carried on with the neighbouring island of Formosa, now Japanese. The province of Fuhkien is claimed by the Japanese as their particular sphere of influence.

Amphibia. — The "arguments adduced by Huxley, in his article on this subject in the ninth edition of the Encyclopcedia BHtannica, for applying this name to those lung-breathing, pentadactyle vertebrates which had been first severed from the Linnaean Amphibia by Brongniart, under the name of Batrachia, have not met with universal acceptance. Although much used in text-books and anatomical works in Great Britain and in Germany, the 'former name has been discarded in favour of the latter by the principal authors on systematic herpetology, such as Peters, Gilnther, and Cope, and their lead is followed in the present article. Bearing in mind that Linnaeus, in his use of the name Amphibia, was not alluding to the branchiate and pulmonate periods through which most frogs and newts pass in the course of their existence, but only wished to convey the fact that many of the constituents of the group resort to both land and water {e.g., crocodiles), it seems hard to admit that the term may be thus diverted from its original signification, especially when such a

change results in discarding the name expressly proposed by Bronguiart to deuote the association which has ever since been universally adopted either as an order, a sub- class, or a class. Many authors ■who have devoted special attention to questions of nomenclature therefore think Beptilia and Batrachia the correct names of the two great classes into which the Linnsean Amphibia have been divided, and consider that the latter term should be reserved for the use of those who, like that great authority, the late Professor Peters, down to the time of his death in 1883, would persist in regarding reptiles and batrachians as mere sub-classes (1). However extraordinary it may appear, especially to those who bring the living forms only into focus, that opposition should still be made to

Huxley's primary division of the vertebrates other than mammals into Sauropsida (birds and reptiles) and Ichthyopsida (batrachians and fishes), it is certain that recent discoveries in palaeontology have reduced the gap between batrachians and reptiles to such a minimum as to cause the greatest embarrassment in the attempt to draw a satisfactory line of separation between the two ; on the other hand the hiatus between fishes and batrachians remains as wide as it was at the time the article " Amphibia " was written. When we turn to the defini- tion given in that article (Ency. Brit. vol. i. p. 750), we find that one of the essential characters — " two occipital con- dyles, the basi-occipital region of the skull either very in- completely, or not at all ossified" — may require revision, if it be true, as held by some authors, that the bone on which the occipital condyles have been found . most developed, in some labyrinthodonts (2), represents a large basi-oceipital bone yielding the two knobs for the articu- lation of the skull, whilst the skull of the batrachians of the present day has lost the basi-occipital, and the condyles are furnished by the exoccipitals. More than this, some reptiles are now known to have the occipital condyle divided, into two, and produced either by the basi- occipital (e.g., Amphisbcenidce, in some of which the double condyle resembles very closely that of the labyrinthodont Bothnceps), or by the exoccipitals (e.g., Uroplatidoe). When we remember that the supposed condition of the occipital condyles was not very long ago thought sufficient to point to a possible direct descent of the mammals from the batrachians, we shall realize the full importance of the more correct information now available on this point. As a result of his researches on the anomodont reptiles and the Stegocephalia (3), as the extinct order that includes the well-known labyrinthodonts is now called, we have had the proposal by Seeley (4) to place the latter with the reptiles instead of with the batrachians ; whilst Credner (5), basing his views on the discovery by him of various annectent forms between the Stegocephalia and the Khynchocephalian reptiles, has proposed a class, Eotetrapoda, to include these forms, ancestors of the batrachians proper on the one hand, of the reptiles proper on the other. Yet, that the Stego- cephalia, notwithstanding their great affinity to the repti^les, ought to be included in the batrachians as commonly understood, seems sufficiently obvious from the mere fact of their passing through a branchiate condition, i.e., undergoing metamorphosis (6), The outcome of our

present knowledge points to the Stegocephalia, probably themselves derived from the Crossopterygian fishes (7) having yielded on the one hand the true batrachians (retro- gressive series), with which they are to a certain extent connected through the Gaudata and the ^jsocJa, on the other hand the reptiles (progressive series), through the Rhyn- chocephalians and the Anomodonts, the latter being believed, on very suggestive evidence, to lead to the mammals (8). The division of the class Amphibia, or Batrachia, into

four orders, as carried oUt by Huxley, is maintained, with,

however, a change of names : ‘ Stegocephalia, for the

assemblage of minor groups that cluster round the Lahy-

rinthodonta of Owen, which name is restricted to the forms

for which it was originally intended ; Peromela, Urodela,

Anura, are changed to Apoda, Caudata, Ecaudata, for

the reason that (unless obviously misleading, which is not

the case in the present instance) the first-proposed name

should supersede all others for higher groups as well

as for genera and species, and the latter set have the

benefit of the law of priority. In the first subdivision of

the batrachians into two families by Dumdril in 1806 (Zool.

Anal. pp. 90-94) these

are termed “Anoures”

and ” Urodeles ” in

French, Ecaudati and

Caudati in Latin.

When Dum^ril's pupil,

Oppel, in 1811 (Ordn.

Bept. p. 72), added the

Cseeilians, he named the

three groups Apoda,

Ecaudata, and Caudata.

The Latin form being

the only one entitled to

recognition in zoological

nomenclature, it follows

that the last-mentioned

names should be

adopted for the three

orders into which recent

batrachians are divided.

I. Stegocephalia (9). — Tailed, lacerti- form,

batrachians,

temporal region of the skull roofed over by postorbital, squamosal, and supratemporal plates similar to the same bones in Crossopterygian fishes,

and likewise with paired bones (occipitals and post- temporals) behind the parietals and supratemporals. A parietal foramen; scales or bony scutes frequently present, especially on the ventral region, which is protected further by three large bony plates — interclavicle and clavicles, the latter in addition to cleithra.

Extinct, ranging from the Upper Devonian to the Trias. Our knowledge of Devonian forms is still extremely meagre, the only certain proof of the existence of pentadaotyle vertebrates at that period resUng on the footprints discovered in Pennsylvania and descrihed by Marsh (10) as THnopus antiquus. Sundry remains from Belgium, as to the identification of which doubts are still entertained, have been regarded by Lohest (11) as evidence of these batrachians in the Devonian. Over 200 species are now distin- guished, from the Carboniferous of Europe and North America, the Permian of Europe, North America, and South Africa, and the Trias of Europe, America, South Africa, India, and Australia. The forms of batrachians with which we are acquainted show the vertebral column to have been evolved in the course of time from a notochordal condition with segmented centra similar to that of early bony Ganoid fishes (e.jr. , Caturus, Eurycormus) to biconcave centra, and finally to the socket-and-ball condition that prevails at the present day. However, owing to the evolution of the vertebral column in various directions, and to the inconstant state of things in certain annectent groups, it is not possible, it seems, to apply the vertebral characters to taxonomy with that rigidity which Cope and some other recent authors have attempted to enfprce. This is particularly evident in the case oiE the Stegocephalians ; and recent batrachians, tailed and tailless, showthe mode of articulation ofthe vertebrss, whether amphiccelous, opisthocoelous, or proccalous, to be of but secondary systematic importance in dealing with these lowly vertebrates. The following division of the Stejgocephalians into five sub-orders is therefore open to serious criticism ; but it seems on the whole the most natural to adopt in the light of our present knowledge.

or perpentiform Fk. l. — Upper ™w of ArchecfosmmU with the J^ech&ni. (OutUneB after Credner.) pm^ prfemaxUla ; n, nasal; m, maxilla ; 7, laciy- mal; »/■, prsefrontal ;/, frontal ; j^ jugal ; pif^ postfrontal ; », parietal ; e^, supratemporad; 8Qf squamosal; pio,

postorbital; gj^ quadra- tojugal; 0, occipital; pi, post-temporal, g, quadrate.

AMPHIBIA

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A. Rhachitomi (Figs. 1, 2), in which the spinal cord rests on the notoohord, which persists uninterrupted and is surrounded by three bony elements in addition to the neural arch : a so-called pleurocentrum on each side, which appears to represent the centrum proper of reptiles and mammals, and an intercentrum or hypocentrum below, which may extend to the neural arch, and probably answers to the hypapophysis, as it is produced into

Fig. 2. — A, Dorsal vertebra. B, Caudal vertebra of Arohegoamtrua. (Outline after Jaekel.) na, neural arch ; cA, chorda ; pi, pleurocentrum ; ic, inter- centrum.

chevrons in the caudal region. Mostly large forms, of Carboni- ferous and Permian age, with a more 91 less complex infolding of the walls of the teeth. Families : Archegosackid^, Ektopid^, Trimeborhachid^, DissoRHOPHiD.a;. The last is remarkable for an extraordinary endo- and exo-skeletal carapace, Dissorhophus being described by Cope (12) as a "batrachian armadillo."

B. Embolomeri, with the centra and intercentra equally developed discs, of which there are thus two to each neural arch ; these discs perforated in the middle for the passage of the notochord. This type may be directly derived from the preceding, with which it appears to be connected by the genus Diplospondylus, Fam. : Cricotid^, Permian.

C. tabyrinthodonta, with simple biconcave vertebral discs, very slightly pierced by a remnant of the notochord and supporting the loosely articulated neural arch. This condition is derived from that of the Bhaehitomi, as shown by the structure of the vertebral column in young specimens. Mostly large forms from the Trias (a few Permian), with true labyrinthic dentition. Families :

liABYRrNTHODONTID^, AnTHRACOSAURID^, DEld)RERPETID^,

Ntraniid^.

D. Uicrosauria, nearest the reptiles, with persistent notochord completely surrounded by constricted cylinders on which the neural

arch rests. Teeth hollow, with simple or only slightly folded walls. Mostly of small size and abundant in the Carboniferous and Lower Permian. Fami- lies : Urocordtlid^,

LlMNERPETID^, HtLO-

NOMID«, (Fig. 3) MlCROBKACHID^, DOHCHOSOMATID^ ;

the latter serpentiform, apodal.

E. Branchiosanria, nearest to the true batrachians ; with per- sistent, non-constricted notochord, surrounded by barrel-shaped, bony cylinders formed by the neural arch above and a pair of inter- centra below, both these elements taking an equal share in the formation of a trans- verse process on each side for the support of the rib. This plan of structure, apparently evolved out of the rhachitomous type by suppression of the pleurocentra and the downward extension of the neural arch, leads to that characteristic of frogs in' which, as development

Fio. S.— A, Dorsal vertebra of HylonomiM (side view and front view). B, Dorsal vertebra of iromoAio- sawrua (side view and ftont view). (After Credner.) «, neural canal ; eh, chorda.

shows, the vertebra is formed wholly or for the greater part by the neural arch (13). Small forms from the Upper Carboni- ferous and Permian formations. A single family: Branohio-

SAURID.aE.

II. Apoda (14). — No limbs. Tail vestigial or absent. Frontal bones distinct from parietals; palatines fused vrith. maxillaries. Male with an intromittent copulatory organ. Degraded, worm-like batrachians of still

obscure aifinities, inhabiting tropical Africa, South-eastern Asia, and tropical America. Thirty-three species are known. No fossils have yet been discovered. It has been at- tempted of late to do away with this order altogether and to make the Csecilians merely a family of the Urodeles. This view has originated out of the very remarkable superficial resemblance between the Ichthyo- phis-\a,vva. and the Amphiuma. Cope (15) regarded the Apoda as the extremes of a line of degeneration from the Salamanders, with Amphiuma as one of the annectent forms. In the opinion of the cousins Sarasin (16), whose great work on the development of Ichthyophis is one of the most important recent contributions to our knowledge of the batrachians, Amphiuma is a sort of neotenic Csecilian, a larval form become sexually mature while retaining the branchial respiration. If the absence of limbs and the reduction of the tail were the only characteristic of the group, there would be, of course, no objection to unite the Csecilians with the Urodeles ; but, to say nothing of the scales, present in many genera of Apodals and absent in all Caudates, which have been" shown by Credner to be identical in structure with those of Stegocephalians, the Csecilian skull presents features which are not shared by any of the tailed batrachians. Q. M. Winslow (17), who has made a study of the chondrocranium of Ichthyo- phis, concludes that its condition could not have been derived from a Urodele form, but points to some more primi- tive ancestor. That this ancestor was nearly related to, if not one of the Stegocephalians, future discovery will in all probability show.

III. Caudata (18).— Tailed batrach- ians, with the frontals distinct from the parietals and the palatines from the maxillary. Some of the forms breathe by gills throughout their exist- ence, and were formerly regarded as establishing a passage from the fishes to the air-breathing batrachians. They are now considered as arrested larvae descended from the latter. One of the most startling discoveries of the decade 1890-1900 was the fact that a number of forms are devoid of both gills and lungs, and breathe merely by the skin and the buccal mucose membrane (19). Three blind cave-forms are known : one terrestrial — Typhlotriton, from North America, and two perennibranchiate — Proteus in Europe and Typhlomolge (Tig. 4) in North America.

This order contains about 150 spiecies, referred to five families :

HTLiEOBATRACHID^, SALAMANDRIDiE, AMPHIUMn)^, PrOTEID^, SlRENin^.

Fossil remains are few in the Upper Eocene and Miocene of Europe ind the Upper Cretaceous of North America. The oldest Urodele known is HylOBobatrachus, Dollo (20) from the Lower Wealden of Belgitun. At present this order is confined to the northern hemisphere, vrith the exception of two Spelerpes from the Andes of Ecuador and Peru, and a Plethodon from Argentina.

IV. EcATjDATA (21). — ^Frogs and toads. Four limbs and no tail. Eadius confluent with ulna, and tibia with fibula ; tarsus (astragalus and calcaneum) elongate, forming an

Fig. 4.— l)/phlmnolge raihbv/ni.

Fio. 5.— Vertebral column of Hym&noahWus (ven- tral view).

additional segment m the hind limb. Caudal vertebrae fused into a urostyle or coccyx. Frontal bones confluent with parietals.

This order embraces about 1300 species, of which some 40 are fossil, divided into two sub-orders and sixteen families : —

A. Aglossa. — ^Eustachian tubes united into a single ostium pharyngeum ; no tongue. Dacttlbthbid.s;, Pipidjd.

B. Phaneroglossa. — Eustachian tubes separated ; tongue present. Discoqlossid^e, Pelobatidje, HEMiPHRACTiD.a;, Am-

PHIGNATHODONTIDJB, HtlID.!, BtTFONIDiE, DENDEOPHKTNISCIDa;, CTSTIGNATHIDiE,*

DTScopHiD.ffi;, 6BNT0PHRYNiD.a:, Engt-

STOMATIDiE, CeHATOBATKACHID., RaNI- D2B, DENDKOBATID.a;.*

The Phaneroglossa are divided into two groups : Arcifera and Firmisternia, repre- senting two stages of evolution. The fam- ily characters are mainly derived from the dilatation or non-dilatation of the sacral diapophyses, and the presence of teeth in one or both jaws, or their absence. The DiscoglossidcB are noteworthy for the pres- ence of short ribs to some of the vertebrae, and in some other points, also, they ap- proach the tailed batrachians ; they may be safely regarded as, on the whole, the most generalized of known Ecaudata. Dis- tinct ribs are present at an early age in the Aglossa, as discovered by Bidewood (22). The recent addition of a third genus of Aglossa, Hymenochirus (28) from tropical Africa, combining characters of Pipa and JCenopus, has removed every doubt as to the real affinity which connects these gen- era. Hymenochirus is further remarkable for the presence of only stz distinct pieces in the vertebral column, which is thus the most abbreviated among all vertebrata (Fig. 5).

Apart from a few unsatisfactory remains from the Eocene of Wyoming, fossil tailless batrachians are only known from the Oligocene, Miocene, and Pliocene of Europe and India. These forms differ very little from those that live at the present day in the same part of the world, and some of the genera (^Discoglossus, Bufo, Oxyglossus, Band) are even identical. Palosohatrachus (24), of which a number of species represented by skeletons of the perfect form and of the tadpole have been described from Miocene beds in Germany, Bohemia, amd France, seems to be referable to the Felobattdce ; this genus has been considered as possibly one of the Aglossa, but the absence of ribs in the larvae speaks against such an association.

Since the publication of the article Amphibia numerous additions have been made to our knowledge of the development and nursing habits, which are extremely varied, some forms dispensing with or hurrying through the metamorphoses and bopping out of the egg in the perfect condition (26).

(1) On the use of the names Batrachia and Amphibia, cf. E. D. Cope, Geol. Mag. (3) ii. 1885, p. 675 ; G. Bauk, Science (2) vi. 1897, pp. 170, 372; B. G. Wildek, t. c.p. 295 ; T. Gill, {. c. p. 446 ; O. P. Hat, t. e. p. 773. (2) E. Fhaas, "Die Labyrinthodonten der Schwabischen Trias," Falceontogr. xxxvi. 1889, p. 1. (3) E. D. Cope, "Synopsis of the Extinct Batrachia of North America." Froc. Ac. Fhilad. 1868, p. 208. (4) "Researches on the Structure, Organization, and Classification of the Fossil Reptilia, vii." Fhit Trans, clxxxiii. (B) 1892, p. 311. (5) " Die Urvierf ussier (Hotetra- poda) des Sachsischen Rothliegenden." Allgem. verstandl. naturh. Abh., Berlin, 1891, No. 15. (6) H. Chednek. " Die Entwioklungs- geschichte von Branchiosaurus amblystomus." Zeitschr. Deutsch. Geol. Ges. 1886, p. 516. (7) C. Emery. " Ueber die Beziehungen des Chiropteiygium zum Ichthyopterygium. " Zool. Am. x. 1887, p. 185. — E. D. Cope. " On the Phylogeny of the Vertebrata." Froc. Amer.Fhilos. Soc. xxx. 1892, p. 280.— H. B. Pollard. "On the Anatomy and Phylogenetio Position of Folypterus." Zool. Jahrb. ~~Area. V. 1892, p. 414. — G.Baue. " The Stegocephali : aPhylogene~~ tic Study," Anat. Anz. xi. 1896, p. 657.— L. Dollo. " Sur le Phy- loggnie des Dipneustes." Mem. Soc. Beige Geol. ix. 1895, p. 79.— T. Gill. ' ' On the Derivation of the Pectoral member in Terrestrial Vertebrates." JJep. Sri«.s. 1897, p. 697. (8)B.D.Cope. "The Origin of the Mammalia." 2Voc. Amer. Fhilos. Soc. xxii. 1884, p. 43. — Cf. Discussion on Origin of Mammals, Froc. Intern. Congr. Zool. , Cambridge, 1898. (9) A. Fritsoh. Fauna der Gaskohle und der Kalksteine der Permformation Bdhm,ens. Vols. i. and ii. Prague : 1879-85, 4to. — H. Credner. " Die Stegocephalen aus dem Rothliegenden des Plauenschen Grundes bei Dresden." Zeitschr. Deiifsch. Geol. 9es. 1881-1894.-. W. Dawson. " On the Results of Recent Explorations of Erect Trees containing Animal Remains in the Coal Formation of Nova Scotia." Fhil. Trans, clxxiii. 1882,

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Amphioxus. — ^Amphioxus has been briefly treated under the headings Ichthtologt, Lancblet, and Verte- brata in the ninth edition of this work. Such, however, is its importance in the present zoological system that a more extended notice is desirable. The theoretical interest of Amphioxus depends upon a variety of circumstances. In its manner of development from the egg, and in the constitution of its digestive, vascular, respiratory (bran- chial), excretory, skeletal, nervous, and muscular systems it

exhibits what appears to be a primordial condition of vertebrate organization, a condition which is, in fact,

partly recapitulated in the course of the embryonic stages of craniate vertebrates. In comparative morphology it provides many illustrations of important biological prin- ciples (such, for example, as substitution and change of function of organs), and throws new light upon, or at least points the way to new ideas of the primitive relations of different organic systems in respect of their function and topography. One of the most puzzling features in its structiire, and, at the same time, one of the greatest obstacles to the view that it is essentially primitive and not merely a degenerate creature, is the entire absence of the paired organs of special sense, olfactory, optic, and auditory, which are so characteristic of the higher verte- brates. Although it is true that there is a certain amount of gradation in the degree of development to which these organs have attained in the various orders, yet.it is hardly sufficient to enable the imagination to bridge over the gap which separates Amphioxus from the lowest fishes in regard to this-feature of organization.

Classification. — On account of the absence of anything in the na- ture of a skull, Amphioxus has heen regarded as the type of a divi- sion, Acrania, in contrast with the Craniota which comprise all the higher Chordata. The ordinal name for the genera and species of Amphioxus is Cephalochorda, the term referring to the extension of the primary backbone or notochord to the anterior extremity of the body; the family name is JBrancftiosiomidcB. The amount of generic divergence exhibited by the members of this family is not great in the mass, but is of singular interest in detail. There are two prin- cipal genera — 1. Branchiostoma Costa, having paired sexual organs (gonadic pouches) ; 2. Heteropleuron Kirkaldy, with unilateral gon- ads. Of these, the former includes two subgenera, Amphioxus (a. str.) Yarrell and Dolichorhynchus Willey. The species belonging to the genus Heteropleuron are divided among the three subgenera Faramphioxus Haeckel, Epigonichthys Peters, and Asymmetron Andrews. The generic characters are based upon definite

modifi- cations of form which affect the entire fades of the animals, while the specific diagnoses depend upon minor characters, such as the number of myotomes or muscle-segments.

Habits and Distribution. — With regard to its habits, all that need be said here is that while Amphioxus is an expert swimmer when occasion requires, yet it spends most of its time burrowing in the sand, in which, when at rest, it lies buried with head pro- truding and mouth wide agape. Its food consists of microscopic organisms and organic particles ; these are drawn into the mouth together with currents of water induced by the action of the vibratile cilia which are abundant along special tracts on the sides and roof of the vestibule of the mouth and in the walls of the perforated pharynx (" ciliary ingestion "). Amphioxus favours a littoral habitat, and rarely if ever descends below the 50-fathom line. Species occur in all seas of the temperate, tropical, and subtropical zones. The European species, A. lanceolatus, is found in the Black and Mediterranean Seas, and on the coasts of France, Great Britain, and Scandinavia, while a closely allied species or sub-species, A. caribxus, frequents the Caribbean region from

Fio. 1. — Epigonioh(lMis eultettm from below and from the left side. (SligMy altered from Kirkaldy.) rm and Im, right and left metapleur; at, atriopore; an anus; e, "eyespot" at anterior end of neuroohord projecting beyond the myotomes (my);n, notoehord ; ryo, gonads of right side only showing through by transparency ; goW, the last gonad ; dfr, dorsal fin with fin-chambers and fln- rays ; vfo, ventral fin-chambers.

Chesapeake to La Plata. A. californiensis occurs on the coast of California, and A. belcheri extends its area of distribution from Queensland through Singapore to Japan. A recently described species, Dolichorhynchus indieus, characterized by the great length of the prseoral lobe or snout, has been dredged in the Indian Ocean. Faramphioxus bassanus occurs on the coast of Australia from Port Phillip to Port Jackson ; P. cingalensis at Ceylon. Epigonichthys

cultellus (Fig. 1) inhabits Torres Strait, and has also been found at Temate. Asymmetron lucayanum is the Bahaman representa- tive bf the family, with a sub-species, A. caudatum, in the South Pacific from New

Guinea to the Loyalty Islands. The Peruvian species, Branchiostoma elongatum, with nearly 80 myotomes, can- not at present be assigned to its proper sub-genus.

External Form. — The following description, unless otherwise stated, refers to A. lanceolatus, which has been already figured in side view, in section, and in dissection in the article Vbetebeata {Ency. Brit. vol. ixxiv.). Amphioxus is a small fish-like creature attaining a maximum length of about 3 inches, semi-transparent in appearance, showing iridescent play of colour. The body is narrow, laterally compressed and pointed at both ends. The main musculature can be seen through the thin skin to be divided into about sixty pairs of muscle-segments (myotomes) by means of com- ma-shaped dissepiments, the myocommas, which stretch between the skin and the central skeletal axis of the body. These myotomes enable it to swim rapidly with characteristic serpentine undulations of the body, the movements being effected by the alternate contrac- tion and relaxation of the longitudinal muscles on both sides. Apparently correlated with this peculiar locomotion is the anatom- ical fact of the alternation of the myotomes on the two sides. Symmetrical at their first appearance in the embryo, the somites (from which the myotomes are derived) early undergo a certain distortion, the effect of which is to carry the somites of the left side forwards through the length of one half-segment. For example, the twenty -seventh myotome of the left side is placed opposite to the twenty-sixth myocomma of the right side. The back of the body is occupied by a crest, called the dorsal fin, consisting of a hollow ridge, the cavity of which is divided into about 250 com- partments or fin-chambers, into each of which, with the exception of those near the anterior and posterior ends of the body, projects a stout pillar composed of characteristic laminar tissue, the fin-ray.

The dorsal crest is continued round both extremities, becoming expanded to form the rostral fin in front and the caudal fin behind. Even in external view, careful inspection will show that the body • is divisible into four regions, namely, cephalic, atrial, abdominal, and caudal. The cephalic region includes the rostrum or praeoral lobe and the mouth. As already stated, the notochord extends beyond the mouth to the tip of the rostrum. The mouth consists of two portions, an outer vestibule and an inlier

apertura oris ; the latter is surjfounded by a sphincter muscle, which forms the so- called velum. The vestibule of the mouth is the/fepace bounded by the oral hood ; this arises by secondary down-growth of lip-like folds over the true oral aperture, and is provided with a fringe of tentacular cirri, each of which is supported by a solid skeletal axis. The oral hood with its cirri has a special nerve-supply and musculature by which the cirri can be either spread out, or bent inwards so that those of one side may interdigitate with those of the other, thus completely closing the entrance to the mouth. The velum is also provided with a circlet of twelve tentacles (in some species sixteen) which hang backwards into the phar- ynx ; these are the velar tentacles. The atrial region extends from the mouth over about two-thirds of the length of the body, terminating at a large median ventral aperture, the atriopore; this is the exourrent orifice for the respira- tory current of water and also serves for the evacuation of the generative products. This region is really the branchiogenital region, although the fact is not apparent in external view. The ventral side of the body in the atrial region is broad and convex, so

that the body presents the appearance fio. 2.~~AmpMoayua,lcmeeolatuii of a spherical triangle in transverse laid_open yentrally. (After section, the apex being formed by the dorsal fin and the angles bordered by two hollow folds, the meta~~ pleural folds, each of which con- tains a continuous longitudinal lymph- space, the metapleural canal. In the genus, Branchiostoma the metapleural folds terminate symmetrically shortly behind the atriopore, but in Hetero- pleuron the right metapleur passes uninterruptedly into the median crest of the ventral fin (Fig. 1). In this connexion it may also be mentioned that in all cases the right half of the oral hood is directly continuous with the rostral fin (Fig. 2).

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Eathke, slightly altered.) ,™, mouth appearing as an elon- gated slit when relaxed (as in the lamprey); p, perforated pharynx; 6, en^ostyle; g, gonads; I, liver; at, level of atriopore; i, intestine; an, anus. In this species the atrium is produced as an asym- metrical blind pouch behind the atriopore as far as the anus.

AMPHIOXUS

The abdominal region comprises a short stretch of body between atriopore and anus, the termination of the alimentary canal. It is characterized by the presence of a special development of the lophioderm or median fin-system, namely, the ventral Jin, ■which is composed of two portions, a lower keel-like portion, which underlies an upper chambered portion, each chamber con- taining typically a pair of gelatinous fln-rays. Finally, the caudal region comprises the post-anal division of the trunk. The keel of the ventral fln is continued past the anus into the expanded caudal fln, and so it happens that the anal opening is displaced from the middle line to the left side of the fln. In Asymmetron the caudal region is remarkable for the curious elongation of the noto- chord, which is produced far beyond the last of the myotomes.

Alimentary, Bespiratory, and Excretory Systems. — Although the function of the two latter systems of organs is the purification of the blood, they are not usuaUy considered together, and it is therefore the more remarkable that their close association in Amphioxus renders it necessary to treat them in common. The alimentary canal is a perfectly straight tube lined throughout by ciliated epithelium. As food particles pass in through the mouth they become enveloped in a slimy substance (secreted by the endostyle) and conveyed down the gut by the action of the vibratile cilia as a continuous food-rope, the peristaltic movements of the gut^wall being very feeble. The first part of the alimentary canal consists of the pharynx or branchial sac, the side walls of which are perforated by upwards of sixty pairs of elongated slits, the gill-clefts. Each primary gill-cleft becomes divided into two by a tongue-bar which grows down secondarily from the upper wall of the cleft and fuses with the ventral wall. New clefts continue to form at the posterior end of the pharynx during the adult life of the animal. The gill-clefts open directly from the cavity of the pharynx into that of the atrium and so give egress to the respira- tory current which enters the mouth wil^ the food (Fig. 2). The atrium or atrial chamber is a peripharyngeal cavity of secondary origin effecting the enclosure of the gill-clefts, which in the larva opened directly to the exterior. The atrium is thus analogous to the opercular cavity of fishes and tadpoles, and, as stated above, remains in communication with

the exterior by means of the atriopore. The primary and secondary bars which separate and divide the successive gill-clefts from one another are traversed by blood-vessels which run from a simple tubular contractile ventral branchial vessel along the bars into a dorsal aorta. The ventral branchial vessel lies below the hypobranchial groove or endostyle, and is the representative of a heart. As water for respiration streams through the clefts, gaseous interchange takes place between the circulating colourless blood and the percolating water. The pharynx projects freely' into the atrium ; it is sur- rounded at the sides and below by the continuous atrial cavity, but dorsally it is held in position in two ways. Firstly, its dorsal wall (which is grooved to form the hyperpharyngeal groove') is closely adherent to the sheath of the notoohord ; and secondly, the pharynx is attached through the intermediation of the primary bars. These are suspended to the muscular body-wall by a double membrane, called the ligamentum denticulatum, which forms at once the roof of the atrial chamber and the floor of a per- sistent portion of the original body-cavity ot ccelom (the dorsal cmlomie canal on each side of the pharynx). The ligamentum denn ticulatum is thus lined on one side by the epiblastic atrial epithelium, and on the other by mesoblastio coelomic epithelium. Now this ligament is inserted into the primary bars some distance below the upper limits of the gill-clefts, and it there- fore follows that, corresponding with each tongue-bar, the atrial cavity is produced upwards beyond the insertion of the liga- ment into a series of bags or pockets, which may be called the atrial pouches. At the top of each of these pouches there is a minute orifice, the aperture of a small tubule lying above each pouch in the dorsal ccelom. These tubules are the excretory tubules or nephridia. They communicate with the ccelom by severaropenings or nephrostomes, and with the atrium by a single opening in each case, the nephridiopore. It is important to em- phasize the fact that in Amphioxus the excretory tubules are coextensive with the gill-clefts. The perforated pharynx terminates some distance in front of the atriopore. At the level of its posterior end a pair of funnel-shaped pouches of the atrium are produced forwards into the dorsal ccelom. These are the atrio-coelomic funnels or brown funnels, so called on account of the characteristic pigmentation of their walls. There are reasons for supposing that these funnels are vestiges of an ancient excretory system, which has given way by substitution to the excretory tubules described

above. In the same region of the body, namely, close behind the pharynx, a large diverticulum is given oft from the ventral side of the gut. This is the hepatic ccecum (Fig. 2, 1), which is quite median at its first origin, but, as it grows in length, comes to lie against the right wall of the pharynx. Although within the atnal cavity, it is separated from the latter by a narrow coelomic space, bounded towards the atrium by coelomic and

atrial epithelium. No food passes into the hepatic caecum, which has been definitely shown on embryological and physiological grounds to be the simplest persistent form of the vertebrate liver.

Nervous System.— As has been already indicated, a solid sub- cylindrical elastic rod, the notochord, surrounded by a sheath of laminar connective tissue, the chordal sheath, lies above the ali- mentary canal in contact with its dorsal wall, and extends beyond it both in front and behind to the obtusely pointed extremities of the body. This notochord represents the persistent primordial skeletal axis which, in the higher Craniota (though not so in the lower), gives way by substitution to the segmented vertebral cplumn. Immediately above the notochord there lies another subcylindrical chord, also surrounded by a sheath of connective| tissue. This^ chord is neither elastic nor solid, but consists of nerve tissue,' fibres, and ganglion cells, surrounding a small central canal. For the sake of uniformity in nomenclature this nerve chord may be called the neurochord. It is the central nervous system, and con- tains within itself the elements of the brain and spinal marrow of higher forms. The neurochord tapers towards its posterior end, where it is coextensive with the notochord, but ends abrtiptly in front, some distance behind the tip of the snout. The neurochord attains its greatest thickness not at its anterior end but some way behind this region ; but the central canal dilates at the anterior extremity to form a thin-walled cerebral vesicle, in the front wall of which there is an aggregation of dark pigment cells constituting an eye-spot, visible through the transparent skin (Fig. 1). There are two pairs of specialized cerebral nerves innervating the prsBoral lobe, and provided with peripheral ganglia placed near the termination of the smaller branches. Corresponding with each pair 01 myotomes, and subject to the same alternation, two pairs of spinal nerves arise from the neurochord, namely, a right and left pair of compact dorsal sensory roots without

ganglionic enlargement, and a right and left pair of ventral motor roots composed of loose fibres issuing separately from the neurochord and passing directly to their termination on the muscle-plates of the myotomes. The flrst dorsal spinal nerve coincides in position with the myocomma which separates the first myotome from the second on each side, and thereafter the successive dorsal roots pass through the substance of the myocommata on their way to the skin ; they are therefore septal or intersegmental in position. The ventral roots, on the contrary, ire myal or segmental in position. In addition to the cerebral eye- spot there are large numbers of minute black pigmented bodies beside and below the central canal of the neurochord, com- mencing from the level of. the third myotome. It has been determined that these bodies are of the nature of eyes {Bech- eraugen, Hesse), each consisting of two cells, a cup-shaped pig- ment cell and a triangiilar retinal cell. These may be called the spinal eyes, and it is said that they are disposed in such a way as to receive illumination prefer- entially from the right side, although this fact has no re- lation with the side upon which Amphioiius may lie upon the sand. When kept in cap- tivity the animal often lies upon one side on the surface of the sand, but on either side indifEerently. Over the cere- bral eye there is a small orifice placed to the left of the base of the cephalic fln, leading into a pit which extends from the sur- face of the body to the surface of the cerebral vesicle ; this is known as Kolliker's olfactory pit.

Beproductive System. — The sexes are separate, and the male or female gonads, which are exactly similar in outward ap- pearance, occur as a series of gonadic pouches projecting into the atrial cavity at the base of the myotomes (Fig. 2). At the breeding season the walls of the pouches burst and the sexual elements pass into the atrium, whence they are discharged through the atriopore into the water, where fertilization takes place.

Development. — The development of Amphioxus possesses many

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Flo. 8.— Diagram of embryo of Amphi- oxus seen from above in optical section. (Adapted from Hat&chelt.) po, pree- chordal head-cavity of embryo ; cc, . collar-cavity (first somite) ; my, meso- dermlc somites (myoccelomic or arch- enteric pouches) ; ch, notochord with the neural tube (neurochord) lying upon It ; np, anterior neuropore f^ie, position of posterior neurenteric canal.

•features of interest, and cannot fail to retain its importance as an introduction to the study of embryology. The four principal phases in the development are : (1) Blastula, (2) Gastrula, (3) Flagellate Embryo, (4) Larva. The segmentation or cleavage of the ovum VThich followys upon fertilization terminates in the achievement of tti.6 blastula form, a minute sphere of cells surrounding a central cavity. Then follows the phenomenon of gastrulation, by which one-haif of the blastula is invaginated into the other, so as to oblit- erate the segmentation cavity. The embryo now consists of two layers of cells, epiblast and hypoblast, surrounding a cavity, the archenteron, which opens to the exterior by the orifice of invagina- tion or blastopore. One important fact should be noted with regard to the gastrula, in which it seems to differ from the gastrulse of in- vertebrata. After invagination is completed, the embryo begins to elongate, the blastopore becomes narrower, and the dorsal wall of the

gastrula loses its convexity and becomes flattened to form the dorsal plate, the outer layer of which is the primordium of the neurochord, and the inner layer the primordium of the notochord. While stiU within the egg-membrane the epiblastic cells become flagellated, and the gastrula rotates within the membrane. About the eighth hour after commencement of development the membrane ruptures and the oval embryo escapes, swimming by means of its flagella at the surface of the sea for another twenty-four hours, during which the principal organs are laid down, although the mouth

Fig. 4. — Anterior region of two pelagic larvse of A. lanoeolatus obtained by the tow-net in 8-10 fathoms, showing: the asymmetry of the large lateral sinistral mouth with its ciliated margin ani and the dextral series of simple primary gill-slits (Xps~14ps). The larvae swim normally like the adult or suspend themselves by their flagella (not shown in the figures) vertically in mid-water. There is nothing in their mode of life which will afford an explanation of the asymmetry which is a developmental phenomenon. Lettering of v/pp&r Jigv/re. — anp, anterior neural pore ; &c, rudiment of buccal skeleton ; c, cilia ; c&, ciliated band ; CG, ciliated groove ; ctti, cCia at margin of mouth ; gl, external opening of club-shaped gland ; Hn^ Hatschek's nephridium ; Ini, left metapleur ; ti, notochord ; pp, prsaoral pit ; ps, primary gill-slits, 1, 5, and 13 ; rwi, right metapleur showing through. Lettering of low&r figure, — a, atrium ; ctZ, alimentary canal ; 6«, blood- vessel ; c"B, cerebral vesicle ; df^ dorsal section of myocoel (=fin-8paces') ; e, " eye- spot " ; end, endostyle ; gl, club-shaped gland ; /nt, edge of left metapleur ; m, lower edge of month ; % notochord ; nt, pigmented nerve-tube ; ps, primary gill- slits, 1, 9, and 14 ; ro^ renal cells on atrial floor ; rm, edge of right metapleur ; so, sense organ opening into prsBoral pit ; 86, thickenings, the rudiments of the row of secondary gill-slits.

does not open until the close of this period. The primordium of the neurochord (neural or medullary plate) referred to above be- comes closed in from the surface by the overgrowth of surrounding epiblast, and its edges also bend up, meet, and finally fuse to form a, tube, the medullary or neural tube. An important fact to note is that the blastopore is included in this overgrowth of epiblast, so that the neural tube remains

for some time in open communication with the archenteron by means of a posterior neurenteric canal. It is still longer before the neural tube completes its closure in front, exhibiting a small orifice at the surface, the anterior neuropore. It is thus possible that the neurenteric canal is due to the conjunction of a posterit)r neuropore with the blastopore, i.e., it is a complex and not a simple structure. Paired archenteric pouches meanwhile appear at the sides of the axial notochordal tract, the mesoblastio somites. The first of these differs in several respects from those which succeed, and has been called the collar cavity (MacBride). In front of the latter there remains a portion of the archenteron, which becomes constricted off as the head cavity. This becomes divided into two, the right half forming the cavity of the rostrum, while the left acquires an opening to the exterior, and forms the prmoralpit of the larva, which subsequently gives rise to special ciliated tracts in the vestibule of the mouth mentioned above. The larval period commences at about the thirty-sixth hour vvith the perforation of the mouth, first gill-cleft, and anus. The larva is

curiously asymmetrical, as many as fourteen gill-clefts appearing in an unpaired series on the right side, while the mouth is a large orifice on the left side, the anus being median. The adult form is achieved by metamorphosis, which cannot be further described here. One point must not be omitted, namely, the homogeny of the endo- style of A. and the thyroid gland of Cranipta.

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^MacBride. “The Early Development of Amphioxus,” Quart. J. Micr. Sci. xl. 1897, p. 589, and iiii. 1900. — Morgan and Hazen. ” The Gastrulation of Amphioxus,” J. Morphol. xvi. 1900, p. 569. — Sammassa. ” Studien ttber den Einfluss des Dotters auf die Gastrulation und die Bildung der primaren Keimbiatter der Wirbelthiere : iv. Amphioxus,” Arch. EntwicJcmeeh. vii. 1898, p. 1. — Schneider. ” Einiges Tiber Resorption und Excretion bei Am- phioxus lanceolatus,” Anat. Am. xvi. 1900, p. 601. — Sobotta. “Die.Reifung und Befruchtung des Eies von Amphioxus lanceola- tus,” Arch. mikr. Anat. 1. 1897, p. 15. — Weiss. “Excretory Tu- bules in Amphioxus lanceolatus,” Quart. J. Micr. Sci. xxxi. 1890, p. 489. — WiLLET. Amphioxus and the Ancestry of the Vertebrates, 1894; “Remarks on some recent Work on the Protochorda,” Quart. J. Micr. Sci. xlii. 1899, p. 223 ; ” Dolichorhynchus indicus,” ibid., 1901. — Benham. ” Heteropleuron of New Zealand,” ibid., 1901. — Burchardt. ” Finer Anatomy of Amphioxus,” with bib- liography, Jena Zeitschr. xxxiv. 1900, p. 719. (a. “W.)*

Ampthill, Odo William Leopold Russell,

1st Babon (1829-1884), British diplomatist and ambassa- dor, was born in Florence on the 20th of February 1829. He was the son of Major-General Lord George William Knssell, by Elizabeth Ann, niece of the marquess of Has- tings, who was governor-general during the final struggle with the Mahrattas. His education, like that of his two brothers — Hastings, who became eventually ninth duke of Bedford, and Arthur, who sat for a generation in the House of Commons as member for Tavistock — was carried on entirely at home, under the general direction of his mother, whose beauty was celebrated by Byron in Beppo. Lady William Russell was as strong-willed as she was beautiful, and certainly deserved to be described as she was by Disraeli, who said in conversation, “I think she is the most fortunate woman in England, for she has the three nicest sons.” If it had not been for her strong will it is as likely as not that all the three would have gone through the usual mill of a public school, and have lost half their very peculiar charm. In March 1849 Odo was appointed by Lord Malmesbury attache at Vienna. From 1850 to 1852 he was temporarily employed in the Foreign Office, whence he passed to Paris. “■ He remained there, however, only about two months, when he was

transferred to Vienna. In 1853 he became second paid attache at Paris, and in August 1854 he was transferred as first paid attache to Constantinople, where he served under Lord Stratford de EedclifEe. He had charge of the embassy during his chief's two visits to the Crimea in 1855, but left the east to work under Lord Napier at Washington in 1857. In the following year he became secretary of legation at Florence, but was detached from that place to reside in Rome, where he remained for twelve years, till August 1870. During all that period he was the real though un- official representative of England at the Vatican, and his consummate tact enabled him to do all, and more than all, that an ordinary man could have done in a stronger position. A reference, however, to his evidence be- fore a committee of the House of Commons in 1871 will make it clear to any unprejudiced reader that

those were right who, during the early 'fifties, urged so strongly the importance of having a duly accredited agent at the Papal Court. The line taken by him during the Vatican Council has been criticized, but no fault can justly be found with it. Abreast as he was of the best thought of his time — the brother of Arthur Eussell, who, in,ore perhaps than any other man, was its most ideal represen- tative in London society — he sympathized strongly with the views of those who laboured to prevent the extreme partisans of papal infallibility from having everything their oivn way. But in his capacity of clear-headed observer, whose business it was to reflect the actual truth ■upon the mind of his Government, he was obliged to make it quite clear that they had no chance whatever, and in conversing with those whose opinions were quite unlike his own, such as Cardinal Manning, he seems to have shown that he had no illusions about the result of the long debate. In 1868 Odo Eussell married Lady Emily Theresa VHliers, the daughter of Lord Clarendon. In 1870 he was appointed assistant under-secretary at the Foreign Office, and in November of that year was sent on a special mission to the headquarters of the German army, where he remained till 1871. A little later in the

same year he received the well-deserved reward of his labours by being made ambassador at Berlin.

During the months he passed at the Foreign Office he was examined before the committee of the House of Commons, already alluded to, and had an opportunity of stating very distinctly in public some of his views with regard to his profession. It was before the same com- mittee that he said that "if you could only organize diplomacy properly, you would create a body of men who might influence the destinies of mankind and ensure the peace of the world." In these words we have the key to the thought and habitual action of one of the best and wisest public servants of the time. If more people could be converted to his views, the diplomatic service suffi- ciently increased, the means of getting adequate informa- tion from abroad impj-oved, and that information properly digested, the cost of some regiments and not a few iron- clads might be saved.

Lord Ampthill remained at Berlin, with only brief inter- vals of absence, from 16th October 1871 till his death at Potsdam on the 25th August 1884. He was third plenipo- tentiary at the Berlin Congress, and is generally credited with having prevented, by his tact and good sense, the British prime minister from making a speech in French, which he knew very imperfectly and pronounced abominar l)ly. In 1874 Odo Eussell received a patent of precedence Taising him to the rank of a duke's son, and after the Con- gress of Berlin he was offered a peerage by the Conserva- "tive Government. This he naturally declined, but accepted the honour when it was offered by the Liberals. He became a privy councillor in 1872 and was made a G.C.B. somewhat later. At the conference about the Greek frontier, which followed the Congress of Berlin, he was the only British representative. During all his long so- journ in the Prussian capital, he did everything that in him lay to bring about close and friendly relations between Great Britain and Germany. He kept on the best of terms with Bismarck, carefully avoiding everything that could give any cause of offence to that most jealous and most unscrupulous minister, whom he, however, did not liesitate to withstand when his unscrupulousness went the length of deliberately attempting to deceive. What might have happened if Lord Ampthill's life had been prolonged, and the Emperor Frederick had come to the throne at about the period of

life at which it would have been natural for him to do so, in the first half of the 'seventies, it is iiftpossible to say. The death in 1888 of the Emperor

Frederick was, as has been truly said, "Not the death of a man but of a generation." (m. g. d.)

Amraoti, or Umrawattee, a town and district of India, iiL Berar or the Haidarabad Assigned Districts, under British administration. The town is 1222 feet above the sea ; the railway station is 6 miles from Badnera junction on the Great Indian Peninsula line. ^Popular tion (1881), 23,550; (1891), 28,946, excluding 4709 in the civil station. Amraoti raw cotton is quoted on the Liverpool Exchange. There are 11 cotton presses with an out-turn of 70,000 bales ; and a mill at Badnera, with 248 looms and 18,900 spindles, employing 1186 hands, which, in 1897-98, produced 5796 bales of twist and yarn, and 2442 bales of cloth. There are two high schools, with 354 pupils ; and a school for European boys and girls, maintained by a Eoman Catholic mission. The town has four printing-presses, one issiung a vernacular newspaper.

The district of Ameaoti has an area of 2759 square miles ; population (1881), 575,328 ; (1891), 665,645; (1901), 630,245, showing a decrease of 4 per cent. The land revenue and rates in 1897-98 were Es.17,01,357, the incidence of assessment being E.l : 1 : 4 per acre ; the cultivated area was 1,414,361 acres, of which 8745 are irrigated from wells ; the number of police was 623 ; the number of boys lat school in 1896-97 was 14,065, being 27-5 per cent, of the male population of school-going age ; the registered death-rate in 1897 was 60-5 per thousand. The district is crossed by the main line of the Great Indian Peninsula railway. In 1899-1900 it suffered severely from drought.

Amravati, a villagp of British India, in the Kistna district of the Madras Presidency. It is situated in 16° 34′ N. lat. and 80° 24′ E. long., on the right bank of the river Kistna, near the head of its delta. Here are, or rather were, the ruins of the finest Buddhist monument in India. It was a stupa, or " tope," built to enshrine a relic of Gautama Buddha. It is enthusiastically de- scribed by Hwen Thsang, the Chinese pilgrim, who visited it in 639. In the beginning of the 19th century ela- borate excavations and drawings were made by Colin Mackenzie. The sculptures

subsequently carried off by Sir Walter Elliot now line the great staircase of the British Museum, and are figured in Fergusson's Tree and Serpent Worship (1868). Further researches were con- ducted on behalf of the Government in 1877 and 1882, and the best of the remaining sculptures were taken to Madras. A handsome memoir by Dr James Burgess was published in 1887, as one of the volumes of the Arch^o- logical Survey of Southern India.

Amritsar (Umeitsub), a city and district of British India, in the Lahore division of the Punjab. It has a station on the North-western railway 32 miles east of Lahore. Population (1881), 151,896; (1891), 136,766; (1901), 162,648, showing an increase of 19 per cent. Municipal income (1897-98), Es.4,42,372; death-rate (1897), 36 per thousand. A Sikh college for university education was opened in 1897. The' other public build- ings include two churches, a town hall, and a hospital. There are also a municipal college; 5 high schools for boys ; 3 secondary schools for girls ; 17 printing presses, issuing 10 newspapers and periodicals ; Hindu, Sikh, and Mahommedan literary institutions.

The area of the district of Ameitsar is 1601 square miles; population (1881), 893,266; (1891), 992,697, show- ing an increase of 11 per cent., and an average density of 620 persons per square mile ; (1901), 1,023,902, showing an increase of 3 per cent. The land revenue and rates in 1897-98 amounted to Es.12,44,644, the incidence

of assessment being E.l : 5 : 0 per acre ; the cultivated area was 772,724 acres, of which 543,068 were irrigated, includ- ing 247,465 from government canals ; the number of police was 852; the number of schools in 1896-97 was 895, attended by 15,376 boys, being 17-4 per cent, of the boys of school-going age; the death-rate in 1897 was 28 per thousand. The principal crops are wheat, pulse, maize, millet, with some cotton and sugar-cane. There are two factories for ginning and pressing cotton.

Amroha, a town of British India, in the'Morada- bad district of the North-west Provinces, is situated in 28° 54′ JSr. lat. and 78° 31′ E. long. It contains the tomb of Shaikh Saddu, and has been for many centuries a Mahommedan centre. It has a high school. In 1897-98 the municipal income was Rs.25,687. Population (1891),

Amsterdam, the capital and one of the two chief commercial centres of the Netherlands, in the province of North Holland, on the Y inlet of the Zuyder Zee; con- nected by the Ymuiden Canal with the North Sea. The money market is of importance, and is the headquarters of companies formed to promote the cultivation of colonial produce. A central station has been erected (1888), a new theatre (1894), a new post ofBce (1898), a music hall, a new exchange (1901), and an abattoir. To scientific and artistic institutions have been added a school of navigation (1879), a school of engineering (1879), a school for teachers (1878), a school of industrial art; the " Quellinus " (1880)„ a university (1877), which took the place of the Athenaeum, a free university (1883), the State Museum (Ryksmuseum, 1876-85), in which are collected, from various other museums, pictures, drawings, prints, sculpture, and casts, and the Museum Suesso Lopez, for modern paintings (1895). The progress of navigation and commerce has been promoted by the construction of a canal to the North Sea (1876), with a depth of 30 to 33 feet ; the Commercial or Handels dock ; the railway, wood, and petroleum (1880-90) docks ; the Merwede Canal, con- necting the town with the great rivers (1893), and the new Entrep6t dock (1900). The tonnage of ships enter- ing and clearing the port in 1870 was 808,042 tons (metric), which in 1899 had risen to 4,310,000 tons (16-6 per cent, of that of the whole kingdom). In 1899, 9988 ships of 15,680,000 tons passed through the North Sea Canal. In 1899, 2029 vessels entered with the foUowiug imports: — 163 ship loads of timber, 142 of ore, 177 of coal and coke, 312 of piece goods, 34 of rice and other grain, 25 of petroleum, 4 of linseed, and the remaining 1172 of ballast and miscellaneous goods. Of late years Sumatra tobacco has ranked first among the exports of colonial produce; but tea, cocoa, and Peruvian bark (cinchona) are also important. The supply of tea for the Amsterdam market, which in 1888 amounted to 5,002,000 lb, had risen in 1897 to 10,738,225 lb ; the supply of cinchona ia 1889, 171,207 lb, had risen in 1897 to 580,722 lb. The value of Sumatra

tobacco imported in 1865 was £3333; in 1896, £2,687,500. Since 1874 railways have been constructed connecting Amsterdam with Belgium (vid Utrecht, Bois-le-Duc, and Maestricht) and with Prussia (vid Hilversum and Zutphen). Eegular steamers maintain communication with sixty-one places in the Netherlands. The tonnage of this inland naviga- tion, carried in 80,000 vessels, amoimted in 1899 to 4,310,000 cubic metres (the register ton is equal to 2-83 cubic metres). To the industries have been added of late years shipbuilding and the manufacture of machinery and stearine candles. The population in 1874 was 285,000 ; in 1890, 408,061 ; in 1900, increased by that of Neuwer Amstel (annexed in 1896 ; population, 25,000), 523,557,

about 100,000 of whom are Ecfenan Catholics and about 50,000 Jews.

See Teb Gonw, Amstelodamiana. Amsterdam, 1873-74. — Sbqueiha. Amsterdam, Guide descriptive, historique et topogra- phigue. Amsterdam, 1877. — Ter Gonw. Qeschiedenis van Am- sterdam. Amsterdam, 1886. — Kalfp. Oud en Nieuw Amsterdam. Amsterdam, 1880. (c. m. k.)

Amsterdam, a city of Montgomery county. New York, U.S.A., situated in 42° 67′ N. lat. and 74° 11′ W. long., on the north bank of Mohawk river, at an altitude of 277 feet. Its site is hilly and the plan is irregular. It is divided into seven wards. Two railways enter it, the New York Central and Hudson River, and the West Shore. It has an excellent water supply and good drainage. The population in 1880 was 9466, in 1890 it was 1,7,336, and in 1900 it was 20,929.

Amu-daria, a great river of Central Asia, tributary of Lake Aral (see Oxus), and also the name of a separate administrative division (Amvrdariinskiy OtdyeV) of the Syr-daria province of Russian Turkestan. (See Turk- estan, Syr-dakia, and Aeal-Caspian Region.)

Amur, an extensive province of Siberia, Russia in Asia, on the left bank of the Amur river, which was conceded to Russia by China by the treaties of 1857 and 1858. It includes the basins of the01doi,Zeya,andBureya, left bank tributaries of the Amur, and has the provinces of Transbaikalia in the W., Yakutsk in the N., Maritime in the E., and Manchuria in the S.W. and S. Area, 172,848 sq. miles. Immense districts are quite uninhabited.

All its north-western part is occupied by the High plateau, bordered by the Great Khingan border range, whose exact position in the region is not yet definitely settled. Next comes a belt of fertile high plains, inhabited ma,inly by Nonconformist emigrants from Russia, and limited on the east by the Little Khingan, or Dousse-alin, a picturesque well-wooded range, which stretches in a north-easterly direction from Kirin across Manchuria, is pierced by the Amur, and continues on its left bank, separating the Bureya from Amgun. To the east of it stretches in the same direction a belt of marshy lowlands, which includes also farther south the lower course of the Sungari. Pre- quent inundations, resulting from torrential rains occBr sioned by the monsoons, present great difficulties to the development of the belt. In the ranges which rise above the surface of the high plateau in the north-west, in the vicinity of the Stanovoi watershed, gold-mines of great richness are worked. Gold was also f oimd in the fabulously rich mines of the Zheltuga (Manchuria) where a sort of free republic of Russian and Chinese miners was formed in 1880-82. Coal of inferior quality is known to exist on the Oldoi, Zeya, and Bureya. The Russians are repre- sented by the Amur Cossacks, whose villages are situ- ated at about 17 to 20 miles from each other along the whole course of the river (Albazin, Kumara, Ekaterino- Nikolskaya, and Mikhailo-Semenovskaya are the chief ones) ; by peasant immigrants, chiefly Nonconformists, who are the wealthiest part of the population; and by a floating population of workers in the mines. Some Chinese have remained in the province, and consider themselves under Chinese rule; Tungus (Orochons), Manegres, and Golds lead a nomadic life along the rivers, living by hunting and fishing. Steamers ply regularly along the Amur for 6^ months, from Khabarovsk to Sryetensk, on the Shilka (terminus of the Trans-Siberian Railway); but only light steamers having from 2 to 3 feet draught can navigate the upper Amur and Shilka. In the winter the frozen river is the usual high- way. Rough roads and bridle-paths only are found in the interior. The great engineering difficulties in building a

railway along the Amur induced the Russian Govern- ment to obtain from China permission to build a railway through Manchuria. For the navigation on the Amur there are now 112 steamers of 29,300 horse-power, and 152 barges of 37,000 tons. The Amur province has a con-tinental climate, the yearly average at Blagovyeschensk (50° N. lat.) being 30° Fahr. (January -17°, July 70°). It experiences the influence of the monsoons, and has mostly cold north-west winds from October to March, while in July and August it receives torrential rains, resulting in a sudden and very considerable rise of water in the Amur and all its r.b. tributaries. The chief and in fact the only town of the province is Blagovyeschensk, but the chief centre of the administration of the Amur region is now Khabarovsk. Thei settled popu-i lation in 1897 was 118,570 (61,975 women), of whom 31,515 lived in towns. (p. a. k.)

Anaconda, a city of Montana, U.S.A., the capital of 'Deer Lodge county, situated in the mountains on the west side of Deer Lodge Valley, in the south-western part of the state. It is entered by the Montana Central, a branch of the Great.Northern, and the Butte, Anaconda and Pacific railways. ~~Its chief industry is the smelting of copper ores, obtained from mines in the neighbour~~ hood. The population in 1890 was 3976, and in 1900 it was 9463.

Anam, or Ann-am. See Cochin China.

Anamalai Hills, a range of mountains in Southern India, in the Coimbatore district of Madras, lying between 10° 13' and 10° 31' N. lat., and between 76° 62' and 77° 23' E. long., forming a portion of the Western Ghats, after this range has been broken by the PalghafPass, south of the Nilgiris. They really consist of a forest-clad and grassy tableland, with summits rising above 8000 feet. Their geological formation is meta- morphic gneiss, veined with felspar and quartz, and inter- spersed with reddish porphyrite. The lower slopes yield valuable teak and other timber ; and some land has been taken up for coffee-planting. 'The only inhabitants are a few wild tribes, who live by hunting and collecting jungle produce.

Ananieff, a district town of Eussia, government of Kherson, on Tiligul river, 118 miles N.W. of Odessa, 12 miles from Zherebkovo, a station of

the South-Western railway. It has trade in corn and cattle. It was annexed 'to Eussia in 1792. Population (1897), 16,713 — Eussians, Jews, and Moldavians.

Anantapur, a town and district of India, in the Madras presidency, situated in 14° 41' N. lat. and 77° 39' E. long. It has a station on the Madras railway, 62 miles south-east from Bellary. Population (1891), 6994. The municipal income in 1897-98 was Es.20,410. There is a municipal high school.

The district of Anantapur was constituted in 1882 out of the unwieldy district of Bellary. It has an area of 6725 square miles, and its population in 1891 was 708,649, being 134 persons per square mile ; in 1901, 788,896, showing an increase of 8 per cent. The land revenue and rates were Es.9,63,538, the incidence of assess- ment being E.0 : 12 : 5 per acre ; the number of police was 702. In 1897-98, out of a total cultivated area of 1,428,404 acres, 169,656 were irrigated, including 34,723 from government canals ; the principal crops are millet, rice, other food grains, pulse, oil-seeds, and cotton. There are three steam factories for pressing cotton. Two railways traverse the district. The number of schools in 1896-97 was 577, with 11,636 pupils ; the proportion of boys at school to the population of school-going age being 19 '5

per cent., and the proportion of girls 2 per cent. The registered death-rate in 1897 was 26-9 per thousand.

Anarchism, a theory of politics, according to which all forms of organized government, except the free com- mune, are objectionable, since the individual should be a law to himself; and a theory of economics, accord- ing to which land and capital ought to be the common property of society. There is also a propaganda of revolution by violence. The principal writers who treat of the theory of anarchy in its different aspects are Proud- hon, Elisee Eeclus, Herbert Spencer, Kropotkin, and Bakounine. In America, Mr Benjamin E. Tucker has published since 1882 a journal named Liberty, which is devoted to philosophical anarchism. In the congress of the International Working People's Association, at the Hague, September 1872, the followers of Bakounine sepa- rated themselves from those of Karl Marx. This was the definitive beginning of the anarchist

propaganda. The Bakounine party organized the " Federation Jurassienne," and established a paper at Geneva, IJAvant Garde. This journal was, in 1878, siicceeded by La Bivolte, founded by Eeclus and Kropotkin. Eevolutionary organizations of working men were also formed in France, Spain, Italy, Switzerland, Belgium, Germany, England, and the United States. Between 1882 and 1886, in France, Prince Kro- potkin, Louise Michel, and others were imprisoned, and their journal suppressed. In England, Most, one of the German anarchist leaders, founded JDie Freiheit, and, for defending in it the assassination of Alexander II. at St Petersburg, was sentenced to eighteen months' imprison- ment with hard labour. After this he moved to the United States, and re-established his paper there in New York, in May 1886. During this period there were several anarchist congresses • in the United States. In one at Albany, in 1878, the revolutionary element, led by Justus Schwab, broke away from the others ; at Allegheny City, in 1879, again there was a rupture between the peaceful and the revolutionary sections. The Voice of the People at St Louis, the Arbeiter Zeitung at Chicago, and the Anarchist at Boston, were the organs of fhe revolutionary element. In 1883, at Pittsburg, a congress of twenty- eight delegates, representing twenty-two towns, drew up an address to the working men of America. The pro- gramme it proposed was as follows : —

Mrst, Destruction of the existing class rule by all means, i.e. energetic, relentless, revolutionary, and international action.

Second, Establishment of a free society, based upon co-operative organization of production.

Third, Free exchange of equivalent products by and between the productive organizations, without commerce and proflt-mongery.

Fourth, Organization of education on a secular, scientific, and equal basis for both sexes.

Fifth, Equal rights for all, without distinction of sex or race.

Sixtli, Regulation of all public affairs by free contracts between the autonomous (independent) communes and associations, resting on a

fede'ralistic basis.

This, together With an appeal to the working men to organize, was published in Chicago, November 1883, by a local committee of four, representing French, Bohemian, German, and English sections, the head of the last being August Spies, who was hanged in 1887 for participation in the Haymarket affair in Chicago, 4th May 1886. This affair was the culmination of a series of encounters between the Chicago working men and the police, which had covered several years.. The meeting of 4th May was called by Spies and oth«6 to protest against the action of the police, by whom several working men had been killed in collisions growing out of the efforts to introduce the eight hours' day. The mayor of the city attended the meeting, but, finding it peaceful, went home. The meet- ing was subsequently entered by the police and commanded

to disperse. A bomb was thrown, several policemen being killed and a number wounded. For this crime eight men were tried in one panel and condemned, seven — Spies, Parsons, Engel, Fischer, Fielden, Schwab, and Ling — ^to death, and one — Neebe — to imprisonment for fifteen years. The sentences on Fielden and Schwab were commuted by Governor Oglesby to imprisonment for life, on the recommendation of the presiding judge and the prosecuting attorney. Ling committed suicide in jail, and Spies, Parsons, Engel, and Fischer were hanged, 11th November 1887. On 26th June 1893 an unconditional pardon was granted the survivors, Fielden, Schwab, and Neebe, by Governor Altgeld. The reasons for the pardon were stated by the governor to be that, upon an examina- tion of the records, he found that the jury had not been drawn in the usual manner, but by a special bailiff, who made his own selection, and had summoned a " prejudiced jury" ; that the " state had never discovered who it was that threw the bomb which killed the policemen, and the evidence does not show any connexion whatever between the defendants and the man who did throw it," ... or that this man " ever heard or read a word coming from the defendants, and consequently fails to show that he acted on any advice given by them." Judge Gary, the

judge at the trial, published a defence of its procedure in the Century Magazine, vol. xxiii. p. 803.

There have been a number of outbreaks in recent years attributed to the propaganda of reform by revolution, like those in Spain and France in 1892, in which Eavachol was a prominent figure. In 1893, a bomb was exploded in the French Chamber of Deputies by Vaillant. The spirit of these men is well illustrated by the reply which Vaillant made to the judge who reproached him for

endangering the lives of innocent men and women: " There can be no innocent bourgeois." In 1894 there was an explosion in a Parisian cafe, and another in a theatre at Barcelona. For the latter outrage six men were executed. President Carnot of the French Republic was assassinated by an Italian at Lyons in the same year. The Empress Elizabeth of Austria was assassinated in September 1898. These events led to the passage by the United States Legislature of a law, in 1894, to keep out foreign anarchists, and to deport any who might be found in the country, and also to the assem- blage of an international conference in Eome, in 1898, to agree upon some plan for dealing with these revolutionists. It was proposed that their offences should no longer be classed as political, but as common-law crimes, and be made subject to extradition. The suppression of the revo- lutionary press and the international co-operation of the police were also suggested. The results of the conference were not, however, published ; and the question of how to deal with the campaign against society fell for a while into abeyance. More recently the attempt made by the youth Sipido on the (then) Prince of Wales at Brussels in 1900 recalled attention to the subject. The acquittal of Sipido, and the failure of the Belgian Government to see that justice was done in an affair of such inter- national importance, excited considerable feeling in Eng- land, and was the occasion of a strongly-worded note from the British to the Belgian Government. The murder of King Humbert of Italy in July 1900 renewed the outcry against Italian anarchists. But even greater horror and indignation were excited by the assassination of Presi- dent McKinley by Czolgoscz on the 6th September 1901, at Buffalo, U.S.A. (h. d. l.)*

A]^ A T 0 M Y.

Modern' Aspects an'd Methods.

THE acceptance of the doctrine of evolution has wrought cardinal changes in the position of anatomy as a branch of biology. So long as differing species of animals were believed to be genetically independent, resemblances in structure could only be interpreted upon some transcendental hypothesis, and no intelligible explanation could be given of the changes in form Em^d arrangement which take place in almost every part during the process of embryonic development, or of such common phenomena as those of variation. The doctrine of com- munity of descent has made possible a philosophic theory of morphology, which unifies and renders intelligible the otherwise incoherent facts of descriptive anatomy, and has opened up new fields of research.

The bent of the new Comparative Anatomy has been mainly genealogical. Assuming that resemblances in structure are due to community of descent, its Pbyio- progress has been stimulated by the endeavour teadeatdes. *° determine the phyla or genealogical trees of allied forms on the basis of a comparison of the sum-total of resemblances in structure and organi- zation. For this purpose the elaboration of a complete anatomical ontology is necessary. The field of research in this direction has been widely cultivated by Professor Gegenbaur and his school. The method of embryology is useful as a supplement and check to the teachings of ontology. Every animal begins existence as an egg, a single cell, from which is derived by a gradual process of growth and differentiation the complete organic structure of the adult state. As the eggs of most metazoan animals are constructed on the same plan, and as with each suc-

cessive stage of development the range of resemblance in detail becomes more and more restricted, it has been supposed that the embryology of each individual is a recapitulation of the stages of the ontology of its ancestral forms. This serves as an excellent working hypothesis for purposes of classification.

Anthropotomy, in Great Britain at least, has hitherto profited less than any other branch of anatomy by the development of a philosophical morphology. The majority of those who study the subject are interested in it only so far as it is a handmaid to practical medicine and surgery, and its teaching is chiefly conducted by those who regard it from the professional standpoint, and by whom, natu- rally, the morphological aspect is subordinated to the technical. Attempts to'remodel the nomencla- /„^,. ture so as to bring human and comparative national anatomy into line have not hitherto been en- fomenc/a- couraged by those authorities "who exercise dominant influence in directing anatomical examinations. The spirit of the age will doubtless in time prove too strong for this obscurantism. On the Continent an effort has been made, especially by German teachers, to frame a uniform system of anatomical nomenclature. The names adopted by the Congress at Basel are largely those used by the school of Gegenbaur, and are not in all respects satisfactory. In England and France this nomenclature has been adopted by a few teachers only, and is used in a very few text-books. (For the best illustrated exposition of the Basel nomenclature, see Spalteholz, Hand Atlas der Anatomie, Leipzig, 1896.)

The importance of the study of the human type as a ground- work for morphological investigation has been admitted by all who are competent to judge. The body of

man has been scrutinized with the greatest minuteness by- hundreds of workers, and knowledge of its details and of its variations is far more extensive and more accurate than that of the body of any other animal.

The methods of anatomical study are of two sorts — those whereby the structures are unravelled as far as it is Methods, possible to discriminate them by the naked eye, and those whereby the finer texture of the tissues is displayed and examined by the aid of the microscope. The procedures for either microscopic or macroscopic study are twofold— dissection and the cutting of sections. The former is the art of separating the component

parts, and of rendering them available for study by the removal of the conaective tissues and fat which envelop them, while by the latter the relative anatomy of the parts can be best exhibited. Macroscopic sections are made of the whole body or limb, by freezing and cutting the sections with a fine saw, or by hardening the parts by the injection of formalin, and cutting with a large and sharp knife (Fig. 1). The topography of regions can be most satisfactorily made out by the examina-

Fia.

1. — Section through the thorax on the level of the nipple, showing the position of the heart and lungs. (Merkel.)

tion and comparison of successive sections made at short distances from each other. Sections for microscopic examination are most easily made of small parts of organs or whole organs hardened and embedded in some support- ing material, such as paraffin wax or celloidin. These are cut into transparent films by means of a section- cutter, various patterns' of which are in use. The best of these have an adjustment by means of which the sections can be cut of any required thickness, and the successive sections are preserved in the order in which they, are cut. (The works of Braune, Rildinger, and Symington give excellent plates of macroscopic sections of the body.) In preparing parts for dissection, it is of advantage that the tubular systems should be filled with some injected material, such as paint, wax, or starch. (Details of the modern methods in use are given by Gronroos, Anat. Anzeiger, 1898.) Microscopic sections are usually stained with certain soluble pigments, such as carmine, logwood, or eosin, which have the property of differentiating special tissues, such as protoplasm, cartilage, muscle, &c., colouring some and leaving others unstained. In modern a,natomical technology, the number of such stains in use is large. (These methods of preparation are described in the text-books of histology by Sehafer, Stirling, Bolles Lee, &c.)

In recent years, great progress has been made in the knowledge of the details of human structure. Many parts, such as the convolusions of the brain, the folds of the intestine, &c., formerly supposed to be indefinitely variable as if they were arranged at haphazard, have been shown to be built up, even in their most minute

details, in a definite manner capable of formulated description; indeed, it is probable that no structure is so completely variable that its different conditions are incapable of reduction to law. (Of modern text-books, those of Bardeleben and Gegenbaur in German, of Poirier and Testut in French, are the best ; English text-books, such as Gray, Morris and Gerrish are excellent from the descriptive side, but almost completely ignore mor- phology. Quain's work in its latest edition is of the nature of a compromise between the morphological and the descriptive.)

Ultimate Analysis of the Body.

*The human body ultimately consists of form-elements of three sorts — cells, intercellular substance, and fibres. In its earliest form the whole organism was a single cell, and the first processes of growth * *"*

consist in the multiplication of cells by division. A cell

Fio. 2 — ^The cell and its process of division. A, Cell showing the network of spongioplasm ; c, centrosome; n, nucleus; n\ nucleolus. B, First stage of division formation of chromatin wreath. C, Monaster stage with spindle and centrosomes at the poles. D, Chromatin star of this stage, seen ft-om above. E, Formation of diaster. F, The beginning of division and of the reconstruction of the nuclei. G, Stage of division nearly completed.

is not a homogeneous speck of protoplasm, but is a special- ized structure exhibiting a comparatively complex organi- zation (Fig. 2). The chief mass of the cell substance con- sists of a cytomiton, or network of protoplasmic threads, each of which often contains granules of some substance derived from the metabolism of protoplasm, the meshes of which are filled with a more fluid material or enchylema. The nucleus also is complex and enclosed by an apparently structureless limiting membrane, within which is a net- work of at least two kinds of material. One portion is capable of being stained by carmine, and on that account is called chromatin. The other part of the karyomiton or nuclear net is incapable of being stained. Although

apparently casual in its form of meshwork, there is reason to believe that there are definite architectural laws according to which the chromatin filament is arranged, and some of these peculiarities in arrangement become obvious when a cell is "about to divide (see Eivyy. Brit. vol. XX. pp. 416-417). In that condition the nuclear mem- brane disappears, and the chromatin filament forms a wreath through which a spindle of achromatin passes, at each pole of which a definite achromatic mass or centro- some accumulates, surrounded by a series of rays of achromatin. The equatorial chromatic wreath resolves itself into loops arranged with their closed ends directed inwards towards a central point and their free ends out- wards. These loops undergo horizontal cleavage from looped to free end, and the looped ends pass along the surface of the spindle towards pole and antipole. When thus separated, the cell becomes mesially constricted and ultimately divides. Cells may be of very varied shapes and differ among themselves in structure and function, as noted in subsequent sections of this article ; but they are, in the respects above enumerated, built on a common plan.

Fig. 3. — Connective tissue, showing cells, fibres, and gronnd-snbstance. X 350. (Szymnowicz.) c, cell ; 6, elastic fibril ; /, white fibril.

(For further particulars on cell-structure, see the text- books of histology above quoted, also the text-books of embryology of v. Kolliker, Minot, Kollmann, and Hert- wig, and the several numbers of Camoy's periodical La GeUule.)

The structureless material known as intercellular ground-substance varies in quantity in different tissues of the body, being sometimes only a slight cement Inter- layer joining contiguous cells, sometimes a Tabs^ce. copious substance in which cells are embedded. In all cases it has originated either by the exudation of material from cells or by the transformation of the periphery of a cell. Chemically, it is made up of some protoplasm-derivate, which varies in its nature in different tissues.

Fibres are not, strictly speaking, a single category comparable with cells. A fibre is an elongated, thread- like form-element, but fibres of different

kinds have . different morphological values. Some, such as nerve fibres, are elongated processes of cells, made of the same material as the cell-body, and often en- closed in a tubular sheath of the nature of an investing layer of intercellular material. Others, such as muscle fibres, are elongated cell-bodies whose cytomiton is so ar-

Flbres.

ranged that the contraction of the protoplasm of the cell can only act in one direction, shortening the fibre along its long axis. Fibres in connective tissue (Fig. 3) are for the most part of a different kind, consisting of elongated threads of intercellular substance differentiated from the material around them by virtue of the deposit of rows of granules or linear masses of some particular protoplasm-derivate. The nature of these granules deter- mines the kind of fibre formed, and they are in this way marked off from the formless ground-substance with which they are surrounded, being usually separate from the processes of the branched connective tissue cells. It is possible, however, that some fibres in areolar tissue may be derived from elongated cell processes which have lost their connexion with a cell-body.

Histology.

Form-elements when aggregated into continuous masses make up tissues, which may be classified according to their embryological history, their position, and their properties into four great classes — epi- f^'^g"" thelicd, nei-vous, muscular, and connective. Epi- thelial tissue (see Ency. JBrit. vol. i. p. 847 and xii. 5) is the lineal descendant of the superficial and the deepest of the three primary laminae of the embryo (lb. vol. xx. p. 418). It is usually disposed as the boundary layer of a free surface, preventing the leakage of the lymph or nutritive fluid in the underlying intercellular spaces. The amount of intercellular substance in epithelium is minimal, usually only represented by a layer of cement between contiguous cells. Epithelial tissues differ widely among themselves in properties according to the situation which they occupy ; with these physiological variations are correlated morphological differences in the forms and structure of the cells.

The conditions determining divergence are degree of superficial pressure, of lateral tension, the nature of the material in contact with their free surfaces, and their de- gree of nutrition. When stratified in comparatively thick masses, as in the epidermis, the intermediate layers consist of prickle cells (see vol. i. p. 897), whose surfaces are beset with processes which join similar processes of other cells, leaving between them lymph spaces for nutrition. In some such cases, it appears from the observation of Cleland and Thomson that the most active cell multiplication is in this layer. In general, however, epithelial masses are sparingly provided with lymph channels, and cell growth proceeds from the deepest cells towards the surface.

Epithelial cells, whose surfaces are in contact with currents of air or of fluid, which requires to he passed on and not absorbed, are beset by cilia (see vol. i. p. 847). Recently it has been shown that the organization of these cells is much more complex than had been supposed (see Heidenhain, .4reaf. Anzeiger, 1899, No. 5), and that the cilia are connected with specialized portions of the reticulum of the cell substance, so that their motion is really a part of the motion of the whole reticulum. Such cilia are found in the nostrils, pulmonary air-passages, Eustachian and Fallopian tubes, and a few other places. (For further particulars concerning cilia, see Henneguy, Archives d^Anat. microscop. 1898 ; Studnicka, Sitzb. d. kgl. bohmischen Gesellsch. 1899; Gurwitsch, Anat. Anzeiger,

1900.)

Nerve-endings are minute and with difficulty traceable in ordinary epithelium ; but in some cases there is a much more abundant ner- vous supply, which reaches its climax in the organs of the special senses. The essential character of each of these is the presence of one or more layers of sensory epithelium, whose component cells are elongated on their free surface into one or more exceedingly fine rod-like processes. These and the reticulum of the cell-body are organized in a more or less complex manner according to the nature of the impulse to which they are designed to respond by vibration, and each cell is in direct connexion with a nerve-ending. The forms of sensory epithelium are described in connec- tion

with the specific sense organs (vol. i. p. 884 et seqq.). (For further researches, see Ramto y Cajol, " Le ratine des

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ANATOMY

aland- cells.

Nervous tissue.

vert6br6s," La Cellule, ix. 1893; Retzius, Biologische Untersuch. 1893, and Lenhoss^k, Anat. Anzeiger, 1893.) IJmbryologioally, each sense-organ is a specialized area of dermal epithelium (except perhaps in the case of the tongue, whose surface is originally hypoblastio).

Epithelial cells whicli line pits or are otherwise placed ia positions where they receiye an abundant supply of nutrition (gland-cells) are usually highly meta- bolic, and have the power of separating from their substance by some process as yet unknown certain enzymes or other derivative material which they extrude, dissolved in some of the ipore fluid parts of the cell-content. These secreting cells undergo a physical change during their condition of activity, altering in appearance and reaction ; but as yet no intelligible phys- ical explanation has been given of this process, or of the correlation which exists between the specific enzyme pro- duced by each gland and the physiological necessity of the part of the organism in which the gland lies. Some- times single gland-cells occur in a continuous epithelium, as, for example, the mucus-secreting goblet-cells on the villi of the small intestines ; but, generally, gland-cells are arranged at the bottom of tubular pits for the convenience of nutrition and of the accumulation of the secretion. The forms of the several kinds of glands depend on the degree of branching of these gland tubes. (On the struc- ture of glandular epithelium, see Langley, Joum. of Physiol. 1889 ; and Nicolaides, Centrcdblatt fur Physiol.

1889.)

Nervous tissue is the recipient of all stimuli, the seat of all sensations, the starting-point of all motor impulses, the regulator of vascular and other activities, and the controller of the processes of nutrition and secretion. It is connected with every organ, and its terminations are distributed in almost every tissue of the body. It is not to be wondered at, therefore, that its structure is of aniazing complexity, or that our knowledge of it is as yet imperfect and frag- mentary. The morphological conception of the organ- ization of nervous tissue has undergone fundainental modifications in recent years, as the structure of its com- ponent form-elements has become better understood. The methods of staining introduced by Golgi and Weigert have rendered it evident that these elements are distinct from each other, and that their communications are indirect. The unit of structure which is called a neurone (Fig. 4) consists of three parts : — (1) A cell-body or perikaryon, containing a nucleus with a complex Tcaryomiton ; around this nucleus are other chromophile elements called JSTissl bodies, capable of being stained by methylene blue, while the rest of the perikaryon consists of a twofold achromatic substance, a fibrillar or spongioplasm-element, supposed to be conductive, and a fundamental or trophoplasm-element, supposed to be the seat of metabolic chemical changes. (2) A single filament or axon, starting from the perikaryon by a cone o:£ origin containing no chromatic elements. After a course of variable length this becomes coated with a sheath of myelin, and passes, often far afield, to its ultimate destination, terminating by branching into a short tuft of filaments which may be included in a muscle fibre or other end organ, or else may be in close proximity to, but not in contact with, the second order of processes, about to be described, of another perikaryon. On its way to its terminal tuft an axon may give off collateral filaments, which also may end in one or another of these ways. (3) From the other end of the perikaryon, usually from a part containing chromophile elements, there arises a series of one or more short, repeatedly-branching fila- ments, called dendrites, which form an arborescent out- growth from the nerve-cell, and are related to the terminal tufts of the axons of contiguous cells. At the ends of

the dendrites are small enlargements called gemmules, and . sometimes sharp-pointed processes called thorns. It has been supposed that the nerve currents in the dendrites are cellipetal and in the axons cellifugal. The

motor nerves are all axons of cells, arid it has been supposed that the sensory fibres are elongated dendrites.

The aggregations of neurones derived from the epiblast of the dorsal groove of the embryo make up the nervous centres. Other peripherally distributed neurones make up ganglia. In different parts of the nervous system the arrangement of the neurones varies in grades of com- plexity. In the simplest cases the dendrites carry the

Fia. 4,— Diagram lUustratiTe of the neurone theory. Each neurone consiets of perikaryon (5, c, d, e), axon (/ g), and dendrites. A, Simple arc of two neu- rones, one having its dendriteB as sensory recipient fibres in the skin (3), and its axon ending in branches forming a synapsis with the dendrites of the motor cell (c), whose axon ends in the muscle fibre (8). B, Arc in which a ganglionic neurone C^) is interposed between the sensory and the motor neurones. C, Arc in which an additional or associatiye neurone (e) is interposed between the ganglionic and the motor neurones. D, Arc in which the perikaryon of the sensorjr cell is in the recipient epithelium of a special sense organ (1) such as the retina, A ganglionic neurone (d) is interposed between this and the motor neurone. E, A similar arc with an associated neurone between the ganglionic neurone and the motor.

sensory impulse to the nerve-cell, wherein the wave of nerve force is in some unknown way reinforced, possibly by metabolic change in the trophoblast or the chromatic element, and is discharged as a motor impulse centrifu- gally along the axon to the muscle in which it ends. Sometimes the circuit consists of two neurones, one receiv- ing and transmitting the sensory stimulus by its axon to the vicinity 6i the dendrites of the cell whose axon goes to the muscle. Sometimes a third or even a fourth as- sociation-system of neurones may be interposed between the tuft of the first axon and the dendrites of the last or motor cell. The method of relationship between the neurone networks is called synapsis; and there is reason to believe that the degree of approximatiotf of the fila- ments in these is nof always constant, but that sometimes the contiguity of some groups of processes may become close, while in other instances they may recede from each

other, and thereby the conveyance of whatever influence travels from neurone to neurone may be accentuated or hindered. The detaUs of these groupings and of nerve- endings will be considered in connexion with the splanch- nology of the nervous system. (For further particulars of the neurone theory, see Hoche, Die Neuronenlehre, Berlin, 1899.)

Each bundle of processes which leaves the central masses of nerve-tissue in its course towards its peripheral termination is Nerves called a nerve. The courses oi these nerves can be followed by dissection, but the modes in which they end can only be ascertained by methods of staining, section-cutting, and microscopical examination. Within the central masses of nerve-tissue the courses of the fibres are intricate and obscure, and methods of staining and section give only imperfect differential criteria whereby individual bundles may be traced. The two methods which are most instructive are those which may be re- spectively called the experimental and the embryological : — (1) When an axon is detached from its cell it degenerates through all its length to its terminal tuft; so by dividing the axons coming from any group of cells their course, as distinguished from other- wise arising axons, becomes apparent in a series of successive sections stained to show such as are degenerated. (2) It is found by observation on developing nerves that some fibres acquire their myelin sheath sooner than others ; so by making successive sections of an immature part, and staining the myelin sheath, any group of fibres already myelinated can be differentiated from those not as yet invested with this layer.

Muscle is contractile tissue derived from the cells of the middle embryonic layer and consisting of elongated

fibre-like cells, whose reticulum is regularly dis- tissue^" posed, and whose enchylema or trophoplasm is

charged with myosin and other proteids. These protoplasm-elements are so organized that when the cell contracts its two extremities are

approximated. The three varieties of muscle — unstriped, cardiac, and striped — as well as some of the views which are currently held respect- ing their minute structure have been referred to in vols. i. p. 856 and xii. p. 8 ; but as yet the real nature of its organiza- tion has not been made out, and it is not improbable that many of the appearances described by observers are facti- tious, produced by the actions of reagents. The observar tions of Eam6n y Cajol and van Gehuchten have led them to regard the fibre as consisting of a reticulum compaipable with the cytomiton of a cell in whose interstices is an inter-reticular enchylema. KoUetfc, on the other hand, regards the reticulum as being composed of partitions of non-contractile sarcoplasm around a series of contractile sarcostyles. Merkel and Engelmann believe that the fibre consists of alternating masses of two materials which differ in their optical properties. One of these is anisotropous, and this may possibly during contraction absorb, or during relaxation discharge, a fluid yielded to it by the isotropous band, altering thereby its width and surface tension. In view of the conflict of opinion new methods of research are required before any positive pronouncement can be made as to the ultimate histological analysis of the muscle fibre. (For discussions of these views, see van Gehuchten, Anat. Anz. 1888-89; v. 'K&Q.iSs.&s,. Qewebelehre, 1890; Eollett; Wiener Sitzungsber. 1889; Engelmann in Hermann's Physiology, i. 2; and M'Dougall, Journ. of Anat. Jan. 1898.)

Whatever may be their intrinsic structure, the mode of grouping of striped or volimtary fibres is easily ascertained. They are surrounded by a fine areolar tissue, called endomysium, Structure jj, -syhich the nutrient capillary vessels ramify and by ""^^ means of which they are united into bundles. Each

muscle. g^^j^ fascicle of fibres is surrounded by an areolar sheath or perimysium. Groups of these bundles are united into larger masses, which are so arranged as to be capable of acting as motor units in the economy of the body. Each of these is invested with an areolar sheath, and is called a muscle. The ends of each muscular fibre are attached to the connective tissues with which they are in contact. In general, there is a filament of white fibrillar tissue firmly united to the end of each fibre, and the collective masses of these filaments at the extremities of a muscle

are called its tendons. By these the muscle is tied to the parts of the skeleton, from and on which it acts. The lengths of the fleshy fascicles of muscular tissue are proportional to the mobility of the point of insertion, being just long enough to draw that part to the extreme of its possible excursion ; so, if the distance between origin and insertion exceed this, the tendons at either or both ends are of sufficient length to occupy the remaining space. It must be remembered, however, that, embryonically, tendon and muscle arise independently, and that their connexion is secondary.

Muscles are apt to degenerate from want of use. In extreme cases the contractile tissue vanishes, leaving its connective frame- work as a fibrous mass. This takes place by natural selection, as muscle is an expensive structure to maintain owing to the amount of nutrition it requires. On this account, also, the fleshy bellies of muscles tend to become accumulated as near the base of supplies as possible ; that is, as near the main vessel of the limb or the axis of the body.

The arrangement of the fascicles is not the same in all muscles. In some they run in direct lines, from origin to insertion, as in the rectus abdominis ; in others, such as the pectorals, they converge from a wide origin to a narrow insertion so as to concentrate their useful work in moving one point. Muscles of the former group are called prismatic or bandlike ; those of the latter, triangular or pyramidal. In a third group the fibres pass obliquely from origin to insertion, so that their action is decomposable into two components, one of approximation and one of translation, the rela- tive sizes of which depend on the angle of the slant of the fibre with regard to the axis of the bone into which they are inserted. Owing to the exigencies of the formation of the skeleton most muscles belong to some species or other of this third class of rhomboidal muscles. A very common special case of this group is that otpenniform muscles, in which a large number of short fibres are attached obliquely to an elongated tendon, as the barbs of a feather are to its axis. By this formation the number of short fibres in a slender muscle can be greatly increased without its becoming unduly thickened at any point. There is a certain small loss of useful work owing to the obliquity of the fibres, but this approximation-element is generally a negligible quantity, being only

equal to the product of the force into the sine of the angle, which is usually very small.

One or more nerves or blood-vessels enter into each muscle. The point of entrance is at that spot at which the muscle moves least on the contiguous structures, and is usually on the aspect which is farthest from the surface, and, in Nervous the case of the vessels, nearest to the main artery of “”’^ the limb. The nerve on entering breaks up into s™’^v branches in various ways, the exact pattern of division Wv-

depending on the arrangement of the fibres in the muscle. (See Disse in Journ. of Anat. Oct. 1897.) Ultimately, a nerve-twig passes into each muscular fibre and terminates in an end plate. The proportion between the number of nerve fibres entering a muscle and that of muscle fibres is in the external rectus oculi 1 : 8, in the soleus 1 : 350. In general, the nerve to each muscle comes from a single «ource, but in a few cases muscles are diploneural. Thus the brachialis anticus is supplied both by median and musculo-spiral nerves. The double supply generally indicates the fusion of two muscle germs, which have originated independently. When the area of origin of a muscle includes parts which are discontinuous or independfently movable, the portion arising from each such part remains partially separate from the rest, and the muscle becomes two-headed. This condi- tion may also occur from the interjection of a vessel or nerve, or from the synthesis of separate segmental elements in the one muscle. In like manner, a double insertion may arise from the separate mobility of the structures into which the muscle is in- serted. Some muscles present two or more successive fleshy bellies, and are called in consequence digastric or polygastric. In such cases the several bellies have been separate morphological units, and have independent nerve-supplies.

Connective tissues are derived from the middle embry- onic lamella and make up more than two-thirds of the body, forming its framework and the supporting skeleton of the more metabolic and physiologi- fyf^lf^g^ cally active elements of each organ. Every epithelial layer is based on a lamella of this tissiie; every muscular fibre is sheathed by a connective layer, and is attached to, or acts on, the connective tissues around its extremity. In

this tissue there are three form-elements — (1) cells, which are usually flattish, often processed, rarely or never contractile, and consist of a distinct cell-wall and a comparatively small amount of protoplasm; (2) inter- cellular substance, copious in amount and traversed by

numerous lymph canals ; and (3) fibres, which may be of two kinds, either white, non-exte'nsile, arranged in more or less wavy bundles of parallel fibres, or yellow, highly ex- tensile and resilient, arranged in frequently dividing and uniting bundles.

There are many varieties of connective tissue in, the animal body (see i. 849 and xii. 6). The typical form is that called areolar tissue (Fig. 3). This consists of irregularly-interlaced wavy bundles of white and yellow fibres in a copious ground-substance, through which are scattered a number of flattish or branched cells. When immature the ground-substance is continuous and abun- dant; but in the adult it diminishes and becomes broken up by the formation of gaps or spaces, which give it a somewhat spongy texture, so that it can be in- flated with air or infiltrated with fluid. This tissue is almost universally diffused in the body, varying in texture in each part according to local requirements. Under each layer of epithelium it forms a dense, almost structureless, basement membrane. In some organs its meshes are numerous and fine, containing entangled in them large masses of white lymph-cor- puscles, which congregate and multiply in these spaces. This form is known as adenoid tissue. In some regions groups of connective tissue-cells are closely packed together, and their cell-contents become charged with oily or fatty material. Masses of this nature make up adipose tissue. In other cases the fibre elements, either white or yellow, preponderate. The white fibrillar is the toughest tissue in the body ; a thread of it, measuring 1 square milli- metre in section, bore without rupture a weight of 8940 grammes, while a cord of yellow tissue broke with a weight of 4040 grammes. Cartilage and bone are special varieties of connective tissue. In the former the tissue makes solid masses, in which the cells, either separate or in small clusters, are embedded in a hyaline matrix of ground-sub- stance with or without fibrous elements. In

some inverte- brates and lower vertebrates a form of cartilage exists which contains mucin instead of chondrogen, recognized by its staining yellow with thionin. Bone is characterized by the calcification of its ground-substance, which °” becomes infiltrated with lime salts, while for the most part the fibres and the branched connective corpuscles remain uncalcified (see vol. i. p. 852). The physical prp- perties of bone fit it in an eminent degree to form the skeleton of the animal body. AVhen its specific gravity, its breaking limit with tensile strain, its crushing limit when subjected to pressure, and its modulus of elasticity are compared with those of other materials, this superiority becomes apparent. (See Lesshaft, Theoret. Anat. Leipzig,*

1892.)

In the following table the numbers In the second and third columns are the weights in pounds avoirdupois required to break or crush a square rod of the material 1 mm. in diameter. The modulus of elasticity is the weight In pounds which, if these sub- stances were perfectly elastic, woiild be required to lengthen the square rod to twice its original length. To compare these so as to determine the skeleton-building suitability of each material, the number in each column should be divided by the specific gravity of the material : —

Substance.

Steel. . . . Wrought-iron Cast-iron . . Bone . . . Oak . . . .

8p. 6r.

7-816 7-788 7-207 1-870 0-845

Tensile.

226 90 28 26 14

Crushing

319

48 160

33

10-5

Elasticity.

46,300 41,887

5,291 2,425

The important factor that the skeleton must present a surface of sufficient extent to give attachment to the muscles of the body makes it necessary that the material of which it is made must be of comparative lightness. Bone is the most vascular form of con- nectiire tissue and the most active in nutritive changes. In general^ connective tissues are low in vitality ; their elements con-

tain but little protoplasm, and in consequence they easily sufEer necrosis.

All forms of connective tissue begin as an indifferent embryonic mesenchyma, whose subsequent differentiations are reactions due to the influence of environing chemistry conditions, which are usually definite and recog- otconnec- nizable. Hence the history of the connective ""« "«"«• tissues of the body forms an important chapter in dynamical ontogeny. The chemical relations of the different forms of connective tissue are generally charac- teristic. The white fibrils and ground-substance of areolar and white fibrillar tissue yield gelatine on boiling, cartilage yields chondrin, and yellow tissue consists of a substance which resists acetic acid and boiling water, and is named elastin. The animal part of bone in most respects agrees with that of white fibrillar tissue. The process of ossification has been described in vol. i. p. 855, where it is noted that it may take place either in cartilage or in membrane. This is an important consideration in the determination of bony homologies, for a bone which was originally cartilaginous is morpho- logically of a different order from one which started as a membrane. The reason is not far to seek. It is not that the processes differ intrinsically, but the early*

stages of the ancestral history recapitulated in its embryogeny must be diverse as the embryonic tissue has become so diversely differentiated. The history of the progress of ossificatiot has been greatly elucidated by the use of the Kontgen rays, whereby the bony nuclei can be detected at their first formation, and their growth and union can be traced in the living adolescent.

In some cases in which large clefts occur in masses of areolar tissue the tissue forming the boundaries of such clefts consists mainly of flattish connective cells, which in some cases are close enough to simulate pave- Formation ment epithelium. Such a layer is called endothe- of cavities. Hum to distinguish it from the true epithelium. This term, though etymologically objectionable, is in the main con- venient, and is in general use. These clefts are of four kinds — joint cavities, bursse, sheaths of tendons, and serous cavities. In Joint cavities the surfaces of the bone are covered with cartilage, and have no endothelial coating, but the ligamentous side-wall of the joint is lined with a, specially smooth con- nective layer, named syn- ovial membrane (Fig. 5). On the surface there are often patches of endothe- lium, although never a continuous layer of such cells. Groups of endo- thelial cells, however, are often clustered on fringes at the margin of the bones in these cavities, and these secrete a mucilaginous exudation called synovia (vol. i. p. 833). Bursce are clefts between planes of firm areolar or fibrillar tissues which glide on each other. These are also lined by synovial membrane, but never present a continuous endothelium ; indeed, in many bursse these are only represented on a few of the synovia-secreting processes. The same is true of the sheaths of tendons. Serous membrames form a separate category, for, while in

'• — 6

FiG.^ B. — Vertical section through knee- joint, with the bones somewhat drawn apart, showing the synovial cavity of the joint ij) and the burses (6) in its vicinity.

the higlier vertebrae the coelom or body cavity which they line is formed by a splitting of the mesoblast, the compara- tive embryology of this cavity shows that originally in the most archaic vertebrates it was formed by the outgrowth of diverticula from the primitive gastrseal cavity. It is consequently possible to sustain the thesis that the apparent delamination in the higher forms is due to the superposi- tion of a series of processes of development which occur successively in the lower, but simultaneously in the higher vertebrate. Hence it is conceivable that the lining material of the ccelom may be not an endothelium, but a true epithelium. The same may possibly be the case in the great blood-vessels. At the same time it must be re- membered that it is not possible to draw hard-and-fast lines between, the derivatives of the several germ layers, whose distinction the one from the other is not so definite as was once imagined. Serous membrane is always lined by a continuous layer of pavement cells, resembling pave- ment epithelium in almost every respect, and the same is the case with the blood and lymph vessels.

Splanchnology.

A mass made up of various tissues united so as collec- tively to discharge some special function is called an organ. Proximately the human body consists of an ass'emblage of organs arranged in a definite manner, and the study of the structure of these organs and of their relative positions constitutes the subject-matter of Descriptive Anatomy. Organs may be classified physiologically according to their _ respective ofiS.ces into seven groups — (1) those of

protection and support (skeletal) ; (2) of motion (muscles) ; (3) of sensation, the seats of the reactions dependent on and related to sensation and psychic process (nervous) ; (4) those wher-eby food is taken in and assimi- lated (digestive) ; (5) those whereby the nutritive material is distributed to the tissues (circulating) ; (6) those whereby waste products are got rid of (eliminative) ; and (7) those by which reproduction takes place. Morphologically, organs may be divided into two groups, according to their relation to the originally segmented constitution of the body. The human body, like that of all vertebrate animals, is made up of a chain of segments,, each of which is more or less built on a common plan. The

organs of the 1st, 2nd, 3rd, 6th, and some of those of the 6th group are segmental in original plan, although in the course of development this characteristic has become obscured. Those of the 4th and 7th, and some of those of the 6th group show no sign of ever having been segmented at any stage in their ontogeny.

I. Organs of Protection and Support. — All the active tissues of the body are supported on a framework of con- nective tissues, or else are contained in spaces bounded by lamellae of these tissues, which thus constitute the skeleton of the organism. (The word skeleton is popularly limited to the bony framework, but, morphologically, all the con- nective tissues are equally parts of the vertebrate skeleton.) A layer of extremely condensed areolar tissue invests the whole body, forming the true skin, cutis or dermis. This is truly skeletal, and in some lower vertebrates is the only tissue in which ossification occurs. Beneath this is a laxer layer, also of areolar tissue, differing from the last chiefly in its lesser density, in its containing more or less fat in its meshes, and in its being traversed by vessels and nerves, which do not end in it as they do in the denser cutis which invests it. This layer is called superjidal fascia, and, like the skin, it is continuous over the whole body.

Beneath the superficial fascia there is in most parts of the body a firm, thin layer of white fibrillar tissue, which covers the muscles and is attached "to those prominences

of bone which project beneath the skin. To this the name deep fascia is given. Partitions of this material dip in between groups of muscles, and are called intermuscular septa. Other lamellae form sheaths for vessels, nerves, and viscera. The deeper connective tissues forming the main axis of the body, to which the name skeleton is commonly limited, are composed of bone, cartilage, and fibrous tissues, and are disposed segmentally. They con- sist (1) of the vertebral column, and (2) of the skeletal walls of the two great tubes of which the vertebrate body is made up, the dorsal or neural, and the ventral or visceral. The walls of these tubes are united to the in- vesting layers of deep fascia by four longitudinal parti- tions— one mediodorsal, one medioventral, and two

lateral — subdividing the body wall into four areas, two dorso- lateral and two ventrolateral.

*At their first appearance in the embryo the continuity and seg- mental arrangement of these connective masses and partitions is obvious ; but in their later conditions, when parts of this skeletal apparatus are transformed into cartilage and bone, though to some extent appearances of segmentation still persist, yet these are often of derivative origin, and do not coincide with the primary segmental divisions. For in the course of development the primary intersegmental clefts are in part seen to fade and a secondary series to appear ; these, instead of coincid- Segment- ing, are for the most part alternate vsrith them. This *”’”’• secondary segmentation occurs especially in the tissue around the notochord or unsegmented axial rod (vol. i. p. 830). This noto- ohord is no part of the skeleton ; it was originally a canal, but in the absence of any animal which preserves this structure as such it is difficult to understand what was its original function (Fig. 6).*

Notochord.

Epiblast.

Fig. 6. — Diagram constructed from several sectioDS of the vertebral region of the embryo shark. Showing the formation of vertebral bodies (v.6.) around the notochord, by the rearrangement of the Bcleroblasts or inner cells of the original protovertebra, the lines of segmentation of these rearranged segments being alternate with those of the original protovertebra, as shown between the muscle plates (m.p.) and cutis plates (cu.)i from which the muscular system and dermis are respectively developed. The epiblast gives rise to the cuticle. Betweeh the muscle layer and the cutis layer is the segmented portion of the coelom.

It probably was an archaic form of alimentary canal, around which were disposed the segmented skeletal and other tissues. The con- nective tissues which surround it become the successive vertebral bodies, and their

uniting fibrous discs, from the former of which the neural arches project dorsally, and the costal or rib arches ventrally.

To the description of the vertebral column in vol. i. p. 821 it is only necessary to add that the morphological relationships of the parts in successive vertebrae are not so simple vertebrse as they appear at first sight. Each vertebral body originates as two separate elements — one a perichordal ring, arising in two symmetrical parts, one on each side of the noto- chord, and a second or hypochordal arch connected with the bases of the neural and visceral arches, lying on the ventral side of the perichordal elements and on a level with the interval between contiguous perichordal rings. This hypochordal element merges with the perichordal in all vertebrae, except the first cervical. In this it remains separate and ossifies as the anterior arch of the atlas, while the corresponding perichordal ring be- comes the odontoid process of the axis. The successive vertebrae

throughout the whole column consist of comparable parts modi- fled in each region to suit the mechanical condition of the region. The most variable portion of each vertebra is the transverse process, an outgrowth from the base of the neural .arch, which is usually multiple. It is not so much a morphological unit as a variably-arranged area for the attachment of oblique intervertebral muscles. In the cervical region it is tripartite— (1) its dorsal portion existing as a mere roughness on tha- dorsal side of the articular mass for muscular attachment ; (2) its ventral portion is fused with the rudimental costal process ; and (3) its intermediate part, which projects into the lateral septum, is joined at its lateral end, to the ventral portion, bounding with it a hole for the ascent of the vertebral artery. In the thoracic region the parts corre- sponding to the 1st and 3rd of these elements unite into a single transverse process, while the ventral part is flattened into a costal articular facet. The ribs, which are detached extensions of these costal processes, do not really articulate with the bodies of the vertebrae, but in foetal vertebrse it can be seen that the entire rib articulation is on the neural side of the suture

between the neural arch and the centrum or body. The three elements are distinct in the 12th thoracic vertebrae. In the lumbar region the ventral part is, as in the cervical, inseparable from the costal element, making with it the process that is usually erroneously described as the transverse process. The two others exist as rough spurs, called respectively the mammiUary and accessory processes. The human vertebral column in its earliest stage consists of thirty- eight vertebrae. Of these the two hindmost vanish before chondri- flcation talies place, and the four which precede these unite into an irregular mass, the last of the four pieces of the coccyx.

The appendicular skeleton is described in vol. i. p. 838. The morphological nature of the vertebrate limb is still a disputed „ . point ; but the balance of evidence is in favour of

WmAs " Balfour's theory, that each limb is the surviving part, anterior or posterior, of a lateral ridge, which originally extended along the side of the vertebrate body, and each consists of material derived from at' least seven successive segments. Gegenbaur, however, has made out a plausible case for the hypoth- esis that the limbs are modiflcations of the processes of a gill arch, and Graham Kerr has proposed to regard the limbs as derived from external gills {Proc. Camb. Philosoph. Soc. 1889).*

The parts of the skeleton of the human forelimb present certain character^ which distinguish them from those of other mammals. The scapula is longitudinally elongated and transversely short, so that its maximum breadth only equals about 0-70 of the length. This "scapular index" is usually greater in the black races, and is higher in the foetus than in the adult. The humerus in man exceeds the radius in length as 1 : 0-7, the numerical relation being known as the humero-radial index. This also is larger in the lower races. The human thumb is perfectly opposable to the other digits, as is that of no other vertebrate. There are normally eight bones in the human carpus, but embryonically a ninth or OS centrale is present in vestige, fusing at an early period with the scaphoid or semilunar, and only remaining distinct as a rare anomaly, although its rudiment is by no means uncommon. The pisiform bone of the human carpus is in all probability the reduced vestige of an obsolete sixth digit,

and is not, as has been supposed, a sesamoid bone. The hip-bone presents markedly different characters in the two sexes, which can be recognized as early as the flfth month of foetal life. On account of these differences the shape of the cavity of the pelvis bounded by these bones is also distinctive, even in the foetus. In the males of the white races of mankind the sagittal (antero-posterior) length of the pelvis is, in average cases, to the coronal (transverse) length as 80 : 100 ; but in those of the black races it is related as 95 : 100. A slight difference has been observed in the level of the articulation of the hip-bone with the sacral vertebras at different periods of life, the tendency being for the former to rise to a higher level as development advances. In the earliest period of foetal life at which these elements can be distinguished the first sacral vertebra is not at all involved in the articulation ; but as age advances it gradually becomes included in the joint, and occasionally the twenty-fourth vertebra becomes also on one or both sides directly articulated to the hip-bone, and correspondingly incorporated in the sacrum.

The femur constitutes usually about 0-275 of the individual stature ; but this proportion is not constant, as this bone forms a larger element in the stature of a tall than of a short man. The human femur presents also a concave popliteal surface, thus differ- ing from that of Pithecanthropus, whose popliteal surface is convex. In the bones of some races the dorsal ridfee of the thigh-bone (linea aspera) projects as a prominent crest causing the bone to appear "pilastered," a condition the amount of which is indicated by the increased relative length of the sagittal to the coronal diameter_ of -the bone. Pilastering, though characteristic of lower and primitive races of man, is never found in the anthropoids. The u^per third – of the "femur in some races is sagittally flattened, a condition which

is cailei platymeria. Its degree is indicated by the excess of the coronal over the sagittal diameter in this region.

The tibia in most civilized races is triangular in the section of its shaft, but in many savage and prehistoric races it is two- edged. The condition is named platycnemia, and is indicated by the proportional excess of the sagittal over the coronal diameter. The fcetal tibia has its head slightly bent backwards with regard to the shaft, a condition which usually

disappears in the adult, but which is shown by the prehistoric tibiae found in the cave of Spy. In races that squat on their heels the front margin of the lower end of the tibia is marked by a small articular facet for the neck of the astragalus.

The fibula is a variable bone. In prehistoric and savage races its several surfaces are often deeply channelled. In foetal life its lower ankle-swelling is smaller than the inner ankle of the tibia, but this relation becomes reversed in the adult. The human foot is plantigrade, the metatarsal bone of the great toe being nearly parallel to those of the other toes, unlike those of the anthropoids. Very often in the adult the second and third phalanges of the little toe are ankylosed together. This is no new thing nor is it necessarily a product of civilization. The writer has found it thirty times in the feet of aricient Egyptians, and once in those of an aboriginal Australian. The intermembral relation of humerus and femur is important in physical anthro- pology, as are also the relative lengths of the femur and tibia.

The varieties of cranial shape which are distinctive of the different races of mankind are due especially to the interaction of four factors — (1) brain size and shape ; (2) dental size and degree of development of the muscle of mastication ; (3) s""*

the sizes of the several sense organs ; and (4) the sizes and extents of certain muscular areas. The methods commonly in use for estimating these varieties are numerical indexes, which are the centesimal relations of certain measurements. These are con- venient although often fallacious. Thus, for example, brachy- cephally or broad-headedness, indicated by the breadth being more than -80 of the length, may be due to the survival of an infantile character, as in Negritos, or to a secondary increase in the width of the hinder part of the frontal cerebral lobes, as in the Teutonic Europeans. Similarly dolichocephaly (with the breadth -75, or under, of the length) may be due to increased length of frontal and parietal areas of the brain (indicated by increased preauricular length), or to diminution of the parietal width and increased occipital length. Most other composite cranial measurements hitherto made are equally faulty.

The human skull is frequently the subject of deformation, due to premature union of some of its sutures constraining its growth. Thus, if the two parietals unite in fcetal life or infancy, the skuU becomes scaphocephalic, as represented in vol. i. p. 832, Fig. 14. When the union is of the coronal suture, the skull becomes short and high, or thyrsocephalic ; if the halves of the frontal unite before birth, it is wedge-sliaped or trigonocephalic. The vertebral theoiy of the skull has been discussed (vol. i. p. 831) , and is now definitely abandoned by all morphologists. On the other hand the original segmentation of the cephalic region has been abund- antly demonstrated; the only difference of opinion among observers has been in the estimation of the number of segments in the cephalic region of the primitive vertebrate. These segments, however, had lost their distinctness even before the cartilaginous cranium had become developed, so that there is no real segmental value in the elements of this, still less in those of the bony skuU. The only place in which segmental elements can be distinguished is in the occipital region, which is in structure transitional between the head and the vertebral column. (For an excellent account of the human skull, in which the many new morpho- logical details due to recent investigation are set forth, see Graf Spee in Bardeleben's Handbuch der Anat. i. 2.)

To the account of the joints and ligaments of the human body in vol. i. p. 834, it need only be added that the ligaments are not all of the same morphological value. The capsules of most of the joints are derived from the connective Jolais. tissue which forms the circumference of the primary articular cleft in the embryo (vol. i. p. 833, Fig. 16) ; but the accessory or Uteral ligaments are often of secondary formation, derived from displaced tendinous appendages to muscles or intermuscular septa, or- they may even be the connective sheaths of muscles which have lost their fleshy substance. The function of ligaments is chiefly to supplement the muscles in protecting joints. They are generally weak where the muscles are strong, and it is noteworthy that joints are more frequently dislocated at the places where the muscles are feeblest, irrespective of the strength of the ligaments. The menisci, whose formation has been referred to and illustrated in vol. i. (p. 833, Fig. 17), are not always the simple survivals of an interjected layer of the capsule ; in some cases, as in the triangular cartilage between the ulna and carpus, the cartilage may

contain a vestigial skeletal element, and the same may be true of the sterno-clavicular cartilage.

ANATOMY

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II. Muscular System (see vol. i. p. 834 sq.). — The volun- imtary muscles of the body may be grouped in three series — ^those derived from the muscle plate of the proto- vertebrse ; those originating in the somatopleure ; and those originating in the nephromere or region of the seg- mental organs. The muscles arising in the splanchno- pleure are the unstriped muscles of the viscera.

From the muscle plate arise the axial muscles of the dorsal series, including the deeper layers of the muscles of the_ back. The orbital muscles also originate from cephalic muscle plates. In the trunk this series is tri- laminar, including (a) the longitudinal muscles of the spinal column, (6) the intermediate oblique series of semi- spinales and multifidi, and (c) the deep, short inter- spinal and rotator muscles, which stretch from vertebra to vertebra. All these are innervated by the dorsal branches of spinal nerves, and they are limited dorsally by the strong dorsal fascia, and ventrally by the lateral inter- muscular septum.

The somatopleural muscles originate in the body wall beyond the edge of the muscle plate. As it is from this structure that the limbs are outgrowths, these muscles may be divided into two series — ^those of the trunk (ven- troaxial), and those of the limb (appendicular). They are all innervated from the ventral branches of the spinal nerves and lie on the ventral side of 'the lateral septum. These muscles are divided into laminae. A superficial external oblique layer is continued in the thoracic region over the ribs. A second or internal oblique layer becomes intercostal in the thorax. A third or transverse layer lies on the visceral side of the ribs. On either side of the medio-ventral line these three layers are represented by a continuous mass, the rectus abdominis, from which, some- times, the pyramidalis is a superficial and partial delami- nation. Occasionally there is a superficial lamellaattached to the skin — the panniculus, or skin muscle — which is only a delamination of the superficial layer, as shown

by its development and innervation. The limb muscles are con- tinuations of the supracostal stratum, modified by their connexions with the bony parts of the limb. They are throughout divisible into a dorsal and a ventral series, each of which is innervated by branches derived respec- tively from posterior and anterior divisions of the ventral trunks of the spinal nerves of the segments represented in the limbs. Those who hold the Gegenbaur or Graham Kerr hypothesis regard the multiple innervation of the limb as evidence of the secondary annexation of other nerves, in consequence of a gradual slipping backwards of the limb. These dorsal and ventral muscles of the limb are grouped into those attached to the limb girdle and those which extend to the first, second, or to the terminal elements of the limb ray. There is a. certain general resemblance between the muscles of the two limbs as they arise from similar muscle-sheets; but as in all land-animals the fore and hind limbs are of necessity different in their mechanical relations, the rdle of the fore and hind limbs being essentially different in quadrupedal progres- sion, these sheets from the first have undergone cleavage in different ways. , Therefore, it is not possible precisely to homologate the different muscles of one limb with their equivalents in the other. The innervation of these sheets of muscle, however, shows that around the shoulder or hip there are four groups, which may generally be called abductor, adductor, flexor, and extensor ; in those around the elbow as well as in those of the hand or foot there are three series, although two of these are confluent in the leg, where also the radial marginal group of muscles is absent. An important difference is to be noted between the muscles of the hand and foot in the position of the axis of move- ment of the digits. In the hand the short muscles are arranged so as to adduct to, or to abduct from, an axis

-■passing down in the line of the middle finger, whereas in the foot the axis from and to which the muscles draw the toe passes down in the line of the second toe.

The muscles which are derived from the nephromeric region, sometimes called hypaxial or hyposkeletal muscles, are a few, small aberrant somatopleural slips which lie on the ventral face of the" vertebral bodies and pedicles, such as the longus colli and others on the same horizon.

They are innervated by branches from the ventral divisions of the segmental nerves.

The muscles of the human body exhibit very many varieties, an exhaustive study of which is given in Le Double's Variations du syst&me musculaire de I'homme,

1897.

III. The Nervous System. — Considerable advances in knowledge and some changes in interpretation have been made since the writing of the remarks in vol. i. pp. 858- 884. The vertebrate body in its early embryonic stages is made up of a succession of segments, in each of which there is a segmental nerve distributed to the parts of the segment. In process of development irregularities in the growth of the component elements obliterate or obscure the definition of the primitive division ; but there is reason to suppose that the nerve constituents are more constant in arrangement, and furnish more accurate indi- cations of the original segmentations than do the other tissues or organs. In the head, where the traces of original segm-entation are practically obliterated, owing to the rapidity with which change succeeds change in early embryogeny, almost our only guide to unravel the morpho- logical history is that furnished by the cranial nerves. The course of a typical segmental nerve is described in vol. i. p. 867. Such a nerve traced centripetally resolves itself into two roots, a dorsal and a ventral, close to its place of connexion with the spinal cord. The fibres making up the ventral root enter the spinal cord along its antero-lateral groove, are continued into the grey matter of the anterior horn, and prove to be the axons of the large branching cells of that horn. These neurones form the efferent or motor system whose terminal tufts are enclosed in the fibres of the voluntary muscles and other structures throughout the body. Some of the efferent axons of a spinal nerve end in tufts beside the dendrites of nerve-cells clustered in small visceral ganglia, which are arranged in a chain on the ventral surfaces of the vertebral bodies. To these the name sympathetic ganglia is given. The axons of these cells are distributed to viscera and vessels. The fibres making up the dorsal root are in essence processes of cells which form a series of ganglia close to the postero-lateral groove of the cord.

Each cell of these ganglia gives off a short process, which divides into two branches that diverge from each other nearly at right angles, like the component halves of the horizontal stroke of the letter T. One of these is the fibre we have traced from the periphery as the sensory element of the spinal nerve; the other passes into the spinal cord, there to break up and to be connected synap- tically with the neurones of other systems. The pri- mordial segmentation of the vertebrate nervous centres has become overlaid and masked by the development of groups of neurones, which combine, co-ordinate, and otherwise influence the relations of the segmental nerve-cells. This is true of the spinal cord, but much more so of the brain.

As an account of the spinal cord has been given in vol. i. p. 865, it is only necessary here to trace the courses of the component systems of neurones in terms of the parts of the cord there described : — (1) Around the dendrites of the large cells of the anterior horn are the end-tufts of axons, which can be traced up to the medulla oblongata. These collectively

spinal cord.

form a thick white band, the crossed pyramidal tract, that lies on the lateral side of the dorsal horn. When it reaches the apex of the pyramid in the medulla oblon- gata the component fibres cross to the opposite side, de- cussating ~~with those of the corresponding bundle of that side and ascending in the pyramid of the opposite side (vol. i. p. 870) ; then passing forward through the pons, crus cerebri, and through the middle of the corpus stri~~ atum, they end in perikaryons in the cerebral cortex. These. cortical cells are closely linked together by numer- ous commissural and association neurones, to be described hereafter. By these fibres the cortex cerebri is brought into relation with the voluntary muscles, there being but two interruptions in the circuit. (2) Other axons, end- ing about the same group of anterior horn cells, pass across at once to the opposite side of the spinal cord, and then ascend in the mesial part of the white tract border- ing the ventral fissure. They run up in the pyramid of their own

side, and otherwise follow a course comparable with those of tha last set. These make the direct py- ramidal tract. (3) A wide curved band of white spinal cord substance stretches from the outside of the direct pyramidal tract outside, and in front of the ventral horn, as far as the edge of the crossed pyramidal tract. This consists of the axons of shorter neurones, which begin in nerve-cells in the grey matter of the cord at different levels. Some of these axons cross in the anterior commissure to. the opposite side, while others pass down in this tractate end by. synapsis with the dendrites of the cells of the ven- tral horn thus, although this ventrolateral association tract is apparently a continuous mass, it is made up of shorter and more varied axons than the foregoing. These three tracts agree in being descending tracts coming from nerve- cells on a higher level and in being connected with the ven- tral horn-cells by synapses, and thereby with the motor nerve roots arising from them. (4) Two groups of axons, mostly ascending, are closely relatad to these, and spring from the cells of the lateral cell column of Clarke (vol. i. p. 866), whose dendrites are contiguous with those of cells in the ventral part of the column. These axons form a thin layer on the lateral surface of the cord be- tween the dorsal and ventral nerve roots, and they extend on the same side into the restiform body of the medulla oblongata above, by which they pass into the cerebellum. By this cerebellar tract the neurones of the cerebellum are associated with the spinal nerve system ; and it hg,s been inferred from experiment that these are connected, in some way as yet unknown, with the co-ordination of mus- cular actions. (5) From the cells of the ganglia above described, which form the segmental origins of the sen- sory fibres constituting the dorsal roots of the spinal nerves, we have already seen that T-shaped processes arise. The inner brlanch of each of these passes cen- tripetally, and forms the link between the ganglion of the root and the spinal cord. The continuations of these form almost all the white matter that lies internal to the dorsal roots. Most of these fibres run upwards, but some descend to form synapses with dorsal horn-cells on a lower level. These send, as they pass along, collateral branches into the grey matter of the dorsal horn to end around the nerve- cells there. Neurones of this grey mat- ter in turn send axons, which terminate above in tufts about the cells of the posterior columns of the medulla oblongata, and these again send axons in the fillet of the crus cerebri, to end, after interruptions in the thalamus, in tufts about some of

the smaller, deeper cells of the cerebral cortex. Thus the effect of an efferent impulse, while for the most part propagated upwards, may be to some extent continued downwards, sometimes causing re- flex action by affecting the region below it. By means of these bundles of fibres in the cord, the segmental

nerves are linked together and so controlled as to act as component parts of a functional whole (Fig. 7).

The spinal cord is essentially bilateral. In the embryo it is formed of the lateral thickenings of the sides of the neural canal, and no neuroblasts (embryonic nerve-cells) arise either in the ventral or dorsal median portion of the wall of the canal. Whatever fibres at a later stage cross from s^de to side are invasions from lateral structures.

The medulla oblongata or bulb is developed from the

Fio. 7.— Diagram of the connexions of tlie motor and sensory nerves witli tlie nerve centres. 1, Descending axons from the perikaryons of the motor cen- tres in the cerebrum, decussating in the bulb, and united synaptically to the motor neurones in the cord ; 2, axons which descend without decussating until they reach the level of the motor neurones, then crossing on the anterior white commissure of the cord ; S, associative neurones ; 4, associallve neurones con- nected with the cerebellum ; 5, ascending axons from sensory cells, interrupted at the bulb ; 6, ascending axons to cerebellum, ending by synapsis with associ- ative neurones which connect cerebellum with cerebrum (9) ; 7, optic fibres from neurones in retina to corpora quadri gemina ; 8, optic fibres to occipital region of cerebrum. OP, ophi thalamus ; OE, crus cerebri ; DG, ganglion of dorssj root ; SEN, sensory nerve.

wall of that part of the neural canal which formed the hinder cranial vesicle, and lies immediately within the foramen magnum of the skull. In it the' dilated '

neural canal forms the fourth ventricle, which dorsally is for the most part closed by a membrane, the superior me- dullary velum, as well as by the cerebellum. Through the medulla pass the ascending and 'descending

axons of the various cerebro-spinal association systems, fix it are also the segmental nuclei of the nerves of the series of nine hinder cranial segments, which have become secondarily grouped into the V.~~XII. nerves of Human Anatomy. The cere~~ bellum (vol. i. p. 871) lying on the dorsal side of the ven- tricle has originated by two lateral ingrowths derived from

the tissues on either side, which ultimately fuse in the medio-dorsal line. With the neurones of this body the cerebellar tracts of the cord and several other series of association fibres passing to the mid-brain and thalamus are connected. The mid-brain, lying in front of the bulb, is the thickened wall of the second cranial vesicle (Fig. 7, STL v.), which in man has contracted into a canal, the aqueduct of Sylvius. Its thickened floor is the pons Varolii, mostly made up of — (1) commissural cerebellar fibres crossing from side to side, traversed longitudinally by (2) bundles of the descending fibres of the pyramids passing between the cerebrum and the spinal cord. These longitudinal fibres pass forwards on each side from the hemisphere to the pons, forming a large part of the crura cerebri. (3) Between the bundles of fibres are many nerve-cells, with which some of these fibres are directly and synaptically connected. In the ventral floor of the canal in this region are the segmental nuclei of the third, fourth and part of the fifth nerve. The relations of the nerve roots to the cranial vesicles show that the latter are not primitive morphological features, but only second- ary mouldings of the brain mass superinduced after the fusion of the original segments of the cephalic region. The quadrigeminal bodies, which in the human brain form the dor sail wall of the second cranial vesicle, are con- densations into one irregular mass of several organically distinct series of neurones and their processes connected directly or indirectly — (1) with ascending axons from the dorsal roots of the spinal nerves, (2) with the wall of the anterior cranial vesicle, and (3) witn the optic nerves. The original cavity of the fore-brain or anterior cranial vesicle becomes in the adult the third ventricle. Its side walls are thickened and form grey masses, the optic thalami. Its roof is membranous and contains no neurones, forming the velum interpositum.

Median pouches of this cavity project — (1) upwards and backwards, and (2) downwards and forwards. The former has at its end the pineal gland or epiphysis, the vestige of a median eye, which is functional in Sphenodon and a few other reptiles; the latter, which is named the infundibulum, projects towards the sella turcica or fossa above the body of the sphenoid, and there thickens to form the posterior lobe of the hypophysis, or pituitary body. This thalamic region is apparently related to the segment of the head which originally bore the eyes. The front of the fore- brain is a membranous area, the lamina terminalis..

The part of the brain which lies above and in front of the thalamic region is the cerebrum (vol. i. p. 872), whose . enormous growth in the higher mammals has

caused it to overlap and alter the relations of the neighbouring parts of the brain. Its structure presents many obscure and difficult points, especially in the higher mammalia. The cerebrum consists of two hemispheres, originally separate from each other. These are at first hollow outgrowths from the upper, anterior, and lateral angle of the fore-brain, containing evaginations of the third ventricle, which are called the lateral ventricles. These communicate with the parent ventricle by an aperture, the foramen, of Monro, in front of which is the lamina terminalis. The composition of the wall of the cerebral hemisphere can only be understood by a careful compara- tive study of its ontology, traced from the lowest verte- brates to the highest mammals (Fig. 8). In the former this wall of the hemisphere on the medial aspect, in front of the lamina terminalis and above it, consists of — (1) a grey area, the corpus paraterminalis. Above this a faint line of demarcation (sulcus limitans) maps out (2) a second area, the hippocampus, which in some lowly-organized mammals forms the entire of the remaining part of the medial wall of the hemisphere. On the outer wall above there is (3) a definite area, the pallium, very

small in lower vertebrates, enormous in the higher mammals. This is limited below and latterly by a rhinal fissure, which marks off (4) the rhinencephalon, or smell area, that makes up the rest of this wall. Above, the pallium extends to the margin of the hemisphere, where it is

conterminous with the hippocampus. The floor of the hemisphere consists of (5) a grey mass, the corpus striatum, in front of which projects (6) a lobule, the olfactory "bulb and pedicle, the latter of which often extends backwards, spreading around the corpus striatum to touch the paraterminal body and hippocampus on the inner side, and to form a pyriform lobe on the outer side, separated by the rhinal fissure from the pallium. All these parts in front of the rhinal fissure are included in the name rhinencephalon. Between the two hemispheres, as they grow, commissural neurones arise and send their axons across in the substance of the lamina terminalis,

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Fra. 8. — Scheme of the mammalian cerebral hemisphere. A, Lateral aspect, rh. /., rhinal fissure ; olf. ir., olfactory tract ; olf. hulb^ olfactory bulb ; tub. ol.^ olfactory tubercle. B, Medial aspect. v.h., vestigia hippocampi ; f.h., hippo- campal fissure; /.d., fascia dentata; /.y fimbria; 7,p,, pyriform lobe; parat., paraterminal body ; m., foramen of Monro ; o.p.^ olfactory peduncle.

linking together the hemispheres. These become grouped in two bundles — one a dorsal commissure, the fornix or psalterium, which joins together the two hippocampal areas, and which in higher forms consists of longitudinal as well as transverse fibres. The other is ventral, and its fibres cross the basal region and rhinencephalon, consisting among others of the commissural fibres of the pallial area. In some animals a third commissure, the eommissura aberrans, crosses the roof of the third ventricle behind the foramen of Monro (not to be con- founded with the eommissura mollis of an adult human brain). In such animals the roof of the third ventricle consists of the velum interpositum, a delicate epithelial layer attached on each side to the ventral lip of the paraterminal bodies. The lateral margins, of this project into the foramen of Monro and constitute choroid plexuses.

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These are, therefore, not parts of the wall of the hemi- sphere but of the fore-brain, and behind them is the aberrant commissure, which separates the choroid plexus from the membranous roof behind it (paraphysis), and lies at the caudal end of the paraterminal body. Behind the paraphysis is the commissure of the habenula in front of the pineal eye.

*The predominant characteristic of the brains of man and of the higher mammals is the enormous overgrowth of Character. *^6 pallium, which consists of those neurones isucsot that govern the lower mechanisms and whose br^nf functions are to initiate actions. Coincidentally with this growth, remarkable changes take place in the other areas of the cerebral surface. The hippo- campus becomes indented by the development of a longitudinal sulcus on its median aspect, and is differen- tiated in structure from the surrounding parts by the formation within it of a compact layer of pyramidal cells. The bottom of this sulcus projects into the lateral ventricle, and there makes a swelling to which the name hippo-campus is often limited, while the part containing the column of cells at the margjn of the hippocampal area which still remains on the median surface of the hemi- sphere close to the paraterminal body is called fascia dentata. These pyramidal cells are probably receptive cells connected with the olfactory nerve fibrils. The growth of the pallium towards the paraterminal body pushes the hippocampus backwards and causes its anterior end to become rudimentary, a mere pre-commissural vestige of the part which in the reptile and amphibian made up almost the whole mesial and part of the lateral wall of the hemisphere. With this enormous growth of the governing mechanism of the pallium there is correlated a growing necessity for bilateral co-operation, and therefore an increased growth of commissural neurones. But the space through which the original pallial commissural axons (in the ventral commissure) pass is limited by the growth of the ganglionic masses of the corpus striatum and their approximation to the thalamus (wall of the fore-brain). These new axons must therefore seek a new and more direct path, and they find this along the track occupied by the fibres of the now much reduced dorsal commissure. This newly-developing pallial commissure or corpus callosum, which is peculiar to the eutherian brain, is quite distinct from*

the hippocampal dorsal commissure, whose place it to some extent takes, and which it exceeds in size in proportion to the predominance of the pallium over the hippocampus. A portion of the paraterminal body is intercepted between the corpus callosum and the fornix, becoming the septum lucidum (vol. i. p. 876), which is thus not pallial but paraterminal in its nature. A fissure which runs from the margin of the olfactory bulb to the genu of the corpus callosum is the real boundary of the pallium, and the band which borders this furrow above, the gyrus sub-callosus, is also a surviving part of the para- terminal body. The ventral commissure, which continues to carry the uniting axons of the pyriform tubercle and olfactory bulb, is separated in the human brain by the anterior commissure. From these the paUial fibres which accompanied them in the marsupials as the most dorsal band of the ventral commissure have in the eutheria followed in their increase a course of least resistance and occupied the space vacated by the recession of the hippo- campi. This change is foreshadowed in the brains of diprotodont marsupials by the separation of this band of the anterior commissure from the rest and its passing to the pallium through the internal capsule, as if to re- lieve the tension of the area of the anterior commissure.

The convolutioning of the surface of the adult cerebral hemisphere has been described at length in vol. i. p. 873. These convolutions are folds produced by the enormous growth of the grey surface of

the pallium, and first appear about the fourth month of foetal life. Arnold and others have described a series of transitory fissures which they supposed to arise and to become obliterated before the growth of the permanent set, but these have been shown to be the result of accident and reagents by Hochstetter and Elliot Smith. (For further particulars concerning the cerebrum see Cunningham, Trans. Boyal Irish Acad. 1892, and the numerous papers in the Journal of Anatomy by Elliot Smith, 1898-1901. Eor the visceral nerves and their courses see Harman's papers, Journal of Anat. 1898, 1899, 1900. For views as to the general constitution of a nerve see Gaskell, Journ. of Physiol. 1886. For the distribution of sensory nerves see Head, Brain, 1893-94. The anatomy of the sense organs has been sufficiently treated in Enq). Brit. vol. i. pp. 884-

899. An excellent account of recent work on the subject is given by Schafer In Quain“s Anat. iii. 1894.)

IV. Organs of Assimilation.— ¥1001 appearances pre- sented in the early stages of the vertebrate embryo, it is probable that there were two preceding forms of alimentary canal which were functional at different periods in the archaic ancestry of the group before the evolution of the existing or hypoblastic digestive organs. Of the earlier a vestige remains in the central canal of the spinal cord ; of the second the notochord is possibly a trace. When the hypoblastic digestive canal becomes closed in, it has at first no communication with the outer surface, being closed both at the head and tail ends ; but within the first few weeks of existence two superficial pits form, one on the ventral side of the fore-brain region and one on the ventral side of the tail. These, too, by the rupture of the membranes which separate them from the gut become respectively the mouth and the cloacal opening. The former of these pits is called the Stomodceum, and gives rise to the cheeks and lips, the alveolar arches, and the nasal passages. In it the palate arises as a horizontal partition, which grows from each side across its cavity, dividing the nasal from the oral cavity. Sometimes .this partition fails to unite with its fellow in the middle line, giving rise to the malformation called cleft palate. The bottom part of the pouch of the stomodseum projects through the tissue which is forming the base of the skull, and fuses with the hypophysis to form the pituitary body.

The pharynx (see vol. vii. p. 222) is the part of the alimentary canal which lies in front of the continuous coelomic cavity, having on each §ide of it the remains of the primitive upper aortic arches, which in man have become the carotid arteries. It was in early embryonic life the region of visceral clefts like those which persist in fishes, but these disappear in man, except the first, which remains as the outer ear passage and the Eustachian tube. The teeth, described in vol. vii. ^. 232, are papillae of the same order as those of the skin, only differentiated because they are more discrete, larger, and arise on the dermis covering the jaw arches. Investi- gators are not agreed as to the nature of heterodontism — some (Osborn and Cope) teaching that the multituber- culate molar has originated from the development of secondary tubercles on an originally

simple protocone. Others, like Rose, believe the compound teeth to arise from the fusion of several papillae. The balance of evidence is in favour of the latter view. Some mammals, such as the porpoise and other toothed whales, have but one dentition of homodont teeth ; these are all animals with long narrow jaws and simple dental papillae. In others, which are heterodont, all the first set persist together with several premolars of a secondary set. In others the milk set of teeth are replaced ; but the permanent molars, which are the latest part of the primary dentition, persist and are not replaced, as in man. Man is descended from mammals which had three incisors on each side of each jaw, and three premolars. In all the primates, how- ever, the lateral incisor has aborted, leaving only two ; and likewise the hindmost of the premolars has generally

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vanished, althougli a rudimental tootli in this position has been described by Fraser as a not uncommon anomaly among black races (Proc. Oamb. Philos. Soc. 1900). In the lower races of mankind the teeth are large, and this can be measured by the comparison of the length of the five molar teeth with that of the basicranial axis. The former is over 44 per cent, of the latter in the black races ; under 42 per cent, in the whites. The human soft palate has a uvula (vol. vii. p. 223), which is absent in most mammals. This pendant acts as a sentinel at the passage from the mouth to the pharynx, and is needed because of the upright position of man and because in him the glottis, or top of the air passage, is not prolonged up so as to project into the nasal region of the pharynx above the velum, as it is in the majority of animals.

Concerning other parts of the digestive canal, further research on the oesophagus will be found in the papers of Birmingham, Journal of Anat. xxKiii. p. 10, and Strahl, Arch. f. Anat. u. Phys. 1889. For the minute structure of the stolnach, see Langley, Journal of Phys. 1882, and Miiller,

Verhandl. d. biol. Verein, Stockholm, 1891-92. For a discussion on the position of the stomach, see Lesshaft in Virchow's Archiv, 1882. On the caecum see Treves, Hunterian Lectures, 1885. Recent descriptions of the structure of the villi of the small intestine will be found in Paneth, Arch. f. mikrosp. Anat. 1888 ; and on the study of the pancreas see Podrwyszotzky, Arch. f. mikrosp. Anat. 1882. The lobes of the liver and their embryonic relations have been described by Thomson, Joum. of Anat. xxxiii. p. 546 ; on the structure of the liver see Retzius, Biol. Untersuch., Stockholm, 1892, and Shore, Joum. of Physiol. 1889.

In the foetal intestine the duet of the umbilical vesicle communicated with the region which becomes in the adult the lower part of the small intestine. In general it disappears completely, but occasion- aily the terminal part of the duct persists as a short blind tube which is called Meckel's diverticulum. The difEeren- tiation of the lower end of the alimentary canal as a large intestine begins in the lower vertebrates. That part which in the quadruped is lowest and most depending becomes distended by the accumulation of waste or faecal materials, and when this differentiation is established, the*

beginning of the large gut is usually marked by the development of a blind pouch or ccecum. In the human embryo this is a tapering conical sac, but when, after the assumptiojp. of the upright position, the caecum changes its position and sinks down on the right side into the iliac fossa, the base of this becomes dis- tended and is called the caecum, while the originally fusiform extremity narrows and becomes the vermiform appendix (Fig. 9), often the seat of a painful and danger- -another of the penalties we pay for the advantage of the upright position.

*A series of peculiar glandular masses in the body differ from the true secreting glands in having no separate ducts. It is generally believed that these pour "/Mds** their secretions directly into the blood, and it gan s. .^ certain that in most cases disease or ablation of these organs produces specific effects on the composition of the blood and on local nutrition. These organs are (1) the spleen (vol. i. p. 907), whose essential structure (Fig. 10) consists of a mass of adenoid connective tissue, with a fibro-*

muscular capsule, into whose meshes capillary and other blood-vessels open (a good description of its tis-

*Fie. 9.— Caecum and vermiform appendix of humau intestine^*

ous inflammatory process-

FiG. 10. — Section of the spleen, seen under a low power. A, fibrous capsule ; b, trabeculfe ; c, Mal- pighian corpuscles ; d, blood-Tessels ; e, spleen- pulp.

sue is given by Klein, Quart. Joum. of Micros. Sc. 1875) ; (2) the thyroid body, which arises as a diverticulum from the fourth branchial cleft on each side and medially from the fundus of a pouch whose opening remains in vestige on the back of the ^ __ tongue, as in the foramen caecum. It consists essentially of a number of closed follicles lined with epithe- lium, embedded in a vascular connec- tive-tissue matrix (see Baber, Phil. Trans. 1876; Biondi, Archiv. Ital. de Biol. 1892). (3) Embedded in the thyroid are the para thyroid bodies, of which there are two on each side, differing in the details of structure from the thyroid (see Welsh, Joum. of Anat. xxxii. 292). (4) The thymus, transitory in man, but persistent in other animals, is derived from a diverticulum of the third branchial cleft (see Watney, Phil. Trans. 1882 ; and Symington, Joum. of Anat. xxxii. 278). (5) The suprarenal body, placed above and on the inner side of the kidney. (For its structure see RoUeston, and for the development, Minot, Embryology, p. 485.) (6) The pituitary body above the body of the sphenoid is formed partly from the end of the infundibulum of the brain and partly from the fundus of the stomodaeum. For its structure see Schone- mann in Virchow's Archiv, 1892. Other structures of the kind which are rudimentary in man are (7) the carotid gland, and (S') the coccygeal body. (Described by Lusehka, Virchow's Archiv, 1860; Eeichert's Archiv, 1862; and Schaper, Schultze's Archiv, 1892. See also Arnold, Vir- chow's Archiv, 1866.) The hcemolymph glands which lie in the hilum of the kidney are also structures of this class. (See Drummond, Joum. of Anat. 1900.)

V. The vascular system has been described in vol. i. p. 899, and most additions to our knowledge have been in matters of detail. The

development of the heart has been revised by Born. The morphology of the venous system has been carefully studied in detail by Hochstetter {Anat. Anz. 1887-88 ; Morpholog. Jahrb. 1891). For the arterial system see Eichholz in Joum. of Anat. 1895, and Mackay, Proc. Philos. Soc. Glasgoiv, 1887.

The histological elements of blood are described in vol. i. p. 845. It has since been shown that white corpuscles do not constitute a homogeneous category, but under this name at least six diverse forms are present in healthy blood. The points of difference are size, shape, and disposition of nucleus ; nature of cell reticulum ; and compositjion of the contained granules as shown by their different reactions with staining media. The following are the chief varieties : —

(1) About 70 per cent, of the corpuscles have polymorphic, many- lobed nuclei which often seem to break up into three or four distinct masses (hence these have been numed polynuclear). The cells are moderately large and stain readily, the protoplasm reacting to acid stains while the granules are neutrophile. (2) About 2 per cent, of corpuscles, similar to the last in most aspects, differ by containing a peripheral stratum of granules which stain deeply with eosin. (3) About 1 per cent, are mononuclear, of much larger size, the single nucleus being large, oval, and exoentrio ; the proto- plasm is free from granules and weakly basophile. (4) About 4 per cent, of the total are intermediate in characters between those of the first and third orders ; they are smaller than the typical mono- nuclear leucocytes, and have a bilobed nucleus which stains more

deeply thaa that of the last group. Neutrophils granules are sparingly present in the protoplasm. (5) A very small number (less than 0-5 per cent.) are sharply marked off from the first order by possessing intensely basophile granules unequal in size and irregular in distribution ; when

acted on by certain stains they exhibit tints characteristically different from those which the same stains produce in other corpuscles. (6) Lymphocytes (about 23 per cent.) are bodies quite distinct from any of the foregoing orders. They are small, about the size of red corpuscles, and con- tain a large round nucleus, marked as if made of concentric layers, and staining uniformly. It is surrounded by a thin protoplasmic layer whose reticular structure is easily brought out by basic stains. The discrimination of these various forms and their abnormal modifications is regarded as important in modem pathology (see Ehrlich-Lazarus, Ancemie. Vienna, 1898, pt. 1).

VI. Miminative Organs. — The urinary aiid reproductive organs are inseparably united in man as in all vertebrates. The former consist of the kidneys "and their ducts — the ureters, the urinary bladder, and the urethra. The latter, in the male, of the testes, vesiculce seminales, vasa deferentia, and the prostatic and anteprostatic glands. In the female the organs are ovary. Fallopian tube, uterus, and vagina, and the several folds which bound the vaginal openi'ng. There is embryological evidence that the kidneys are specialized organs which have originated at a compara^- tively late period of vertebrate phylogeuy. In the element- ary condition of urogenital organs found in segmented invertebrates the sex-gland is only a specialized area of the lining epithelium of the ccelom (vol. xx. p. 408), and the sex-products, ova or spermatozoa, arising from the germinal epithelium are shed into the body cavity. A communicar- tion between the body cavity and the surrounding medium exists in the form of a segmental tube or nephridium on each side of each segment. These are not only the chan- nels of escape of the sex-products, but are also, in general, excretory organs. In the earlier stages of the lower vertebrates the presence of segmental nephridia can be demonstrated, one portion, a head-kidney or pronephros, arising in some of the antierior segments, and a second, or mesonephros, in the segments at a level farther back. These segmental tubules open internally into the ccelom and outwardly into a lateral canal which runs lon- gitudinally and ends posteriorly by opening into the cloaca. The longitudinal tube connected with the pronephros is known as the pronephric or MilUerian duct, that connected with the mesonephros or Wolf&an body is named the mesonephriQ or Wolffian duct. In man, as in all the amniota, there arises at an early period of

development a third group of nephridial tubules, the metanephric, which by their aggregation make up the metanephros or kidney. That these are the result of a high degree of specialization is obvious from the fact that, while in the cases of the pronephros and mesonephros the nephridia and the longitudinal ducts arise independently and unite after they have attained a considerable degree of development, in the metanephros the tubules are from the first offsets from the metanephric duct or ureter, which itself arises as an offset from the mesonephric duct. In man there is never any trace of a pronephros, but the pronephric duct is distinct. The mesonephric tubules rapidly lose all traces of their sepreting portions, and appear only as a vestigial structure, rudimentary in the female; but they become in the male specialized as channels for the transmission of the sex-products. The kidneys are two bean-shaped granular masses, firm in consistence and reddish-brown -in colour, about 4^ inches long, and placed obliquely behind the other abdominal viscera — one on each side of the last thoracic and three upper lumbar vertebrae. Each is imperfectly covered on its ventral surface by peritoneum, and is moulded to some extent by the viscera which press on it.' Around them there is usually a considerable amount of fat and areolar tissue, by which as well as by the peritoneum and by the

presence of the surrounding viscera, the kidneys are re- tained in their place. In rare cases the kidney may slip from its usual place in the loins to a lower position, and may even be movable in the abdominal cavity — a condition often productive of serious consequences. The kidney in the foetus is lobulated, but the intervals "■"*■ between the lobes become smoothed out in later years of childhood. Each gland is invested by a firm, closely- adherent, fibrous capsule, under which is an imperfect lamina of unstriped muscle. The inner and ventral margin of each kidney is concave, and into this hUum or concavity the renal artery from the aorta passes. Here also the renal vein escapes and joins the vena cava inferior. The ureter or metanephric duct, always behind and below the blood- vessels, emerges here and passes backwards to the bladder. When the kidney is longitudinally divided from hilum to outer edge, the cut surface is seen to consist of two parts — an outer cortical layer, and an inner or medullary mass (Fig. 11). The latter consists of a series of eight to sixteen*

Fio. 11.— Vertical Bection through the kidney. A, branch of renal artery; U, ureter. 1, cortical substance with cortical pyramids, and labyrinth substance of tortuous tubes ; 2 and 8, medullary pyramids of straight tubides ; 4, fetty masses around blood-vessels (6) ; 6, papilla ; T, peMs.

pyramids, whose bases and sides are invested with cortical matter and whose apices or papillae project into the hilum, where they are severally surrounded by membranous tubes (calyces), which by their union make up the ureter. The part of the ureter situated in the hilum is dilated, and is named the pelvis of the kidney.

In minute structure the kidney is the most complex gland in the body. Each of the papillae consists of a large number of straight tubes which open by pores on its surface. When these are traced into the pyramid they are seen to divide several times, their fine end-branches projecting in little tufts into the cortical matter at the base of each pyramid. Here the branches coming from the tube change in structure and become convoluted in the cortex. Next, each suddenly dips back again as a long straight loop into the pyramid, reaching nearly to the papillary region ; then turning sharply on itself, passes back straight to the cortex, where it again becomes con- voluted, ultimately ending by dilating into a flask-like bulb. The renal artery, after breaking up into branches-

between the pyramids, ends in minute end-arteries in the cortex. Each of these pierces into one of the flasks just described, and there becomes branched, the branches being collected into a little ball or glomerulus which nearly fills the flask. From this an efferent vessel escapes, which, joining with its neighbouring vessels of the same kind, makes a close network around the convoluted tubes, ultimately ending in the renal vein. It is supposed that the different constituents of the urine are eliminated in different parts of these tubes — some, especially the watery parts, in the flask, and some, especially the more solid constituents, in the convoluted tubular apparatus. A peculiar form of glandular epithelium lines the two convoluted areas of the tubes, and the limb of the loop nearer the straight or collecting tubes.

The ureter or duct of the kidney begins at the hilum and descends on the back wall of the abdominal cavity to open into the bladder. It is usually about 12 inches in length and as thick as a goose quill. At its termination it passes obliquely through the coats of the bladder, so that when the bladder is distended the lumen of its end is closed. The urinary bladder is a membranous bag lying in the pelvic cavity directly behind and above the dorsal surface of the pubes. In the if cetus and infant, however, the bladder lies in the abdomen, not in the pelvis. During life it is seldom distended so as to hold more than about 10 oz., but when the abdomen is opened it can be dilated to more than double that size. When distended it rises and is applied closely against the back of the ventral

Bladder

and

urethra.

YiQ. 12. — ^Vertical section through pelvis, showing minarr bladder and rectum in situ. 1, peritoneum ; 2, pubic symphysis ; 8, muscular coat of bladder ; 6, mucous membrane folded and wrinkled ; 6, openings of ureter ; 8, prostate ; 10, Tena dorsalis penis ; 12, corpus spongiosum ; 14,

*testis in its sac ; 15, bulbo- cavernosus muscle ; 16, bulb ; 17, sphincters of the anus ; 22, anal opening ; 80, coccyx ; *, vesicnla seminalis.*

abdominal wall. The bladder has a strong muscular investment of unstriped muscle in several layers, which are innervated by branches from the sacral nerves. It has a peculiar epithelial lining of several strata, the superficial cells of which are cubical when the sac is collapsed, but become flattened and scale-like when it is distended. The bladder is developed from the portion of the sac of the embryonic allantois, which is in contact with the cloaca. The two ureters open by small oblique apertures into its base, closely behind the opening of the urethra. The urethra or excretory channel from the bladder is a narrow tube, 8^ inches long in the male,

whose walls are in apposition except when fluid is passing along it. It begins at the lowest part of the bladder and for its first inch and quarter passes through the prostate gland and is directed vertically downwards. The hinder wall of this portion is raised into a ridge, the colliculus seminalis, on each side of which the seminal ducts open. The second part is membranous, about f inch in length, and directed forwards below the pubes, where it is fixed by passing through the triangular interpubic ligament. The third part is that which lies in the penis, and it is surrounded below and laterally by an erectile enveloping body, the corpus spongiosum urethrce. This body begins behind in a thickening, the bulb of the urethra, and ends in the glans penis, which is perforated by the urethra. Above the urethra in this stage lie the two coipora cavernosa penis. The urethral orifice is usually the narrowest part of the canal. The female urethra is only 1^ inch in length, and is comparable only with that part of the male urethra which extends from the bladder to the openings of the seminal ducts (Fig. 12).

VII. Reproductive Organs. — In the human male these are the testes and their ducts, the latter being the modified mesonephric or Wolffian tubules and ducts of the foetus. In the female they consist of the ovaries and the tubular system appended to them, which are formed from the modified Miillerian ducts. In each sex the tubular system which is not functional is represented in rudiment. Both ovary and testis are specializations of the

*area of germinal epithelium of the foetal coelom. In the ovary these germinal cells become grouped in numerous clusters,' in the centre of each of which is a *"""" *' cavity, the Graafian vesicle, containing a central cell larger than the others, which is a primitive ovum. Each of these is about -j-J^ inch in diameter, and it has been computed that there are about 30,000 in each ovary of a female child at birth. These Graafian vesicles are embedded in a mass of connective tissue which is called the stroma of the ovary, the whole ovary being a small oval body about l^inch long by about \ inch in thickness. The ovaries are placed one on each side in the pelvic cavity, each within a fold of peritoneum, called the broad ligament. Close to each ovary lies the open and fringed end of a duct, the Fallopian tube, which is contained in the upper edge of the broad ligament and directed inwards to open into the uterus. This is a pyriform organ lying in the middle of the pelvic cavity, having the bladder on its ventral aspect, the rectum on its dorsal, and the two broad ligaments one on each side. The uterus, when not containing a foetus, is about 3 inches in length, nearly 2 inches in breadth, and 1 inch in thickness. It has a very 4hick wall, mostly made up of unstriped muscle, and a very small cavity which appears somewhat triangular in vertical section. Its lateral basal angles are at the openings whereby the Fallopian tubes communicate with it, and its apical inferior angle is at the neck or cervix uteri. This cervix projects into the upper part of the vagina, which is a membranous passage that opens on the surface. The uterus and Fallopian tubes are modifications of the Miillerian ducts and of the part of the cloaca into which these ducts open. The vagina and the folds which surround its external opening are the modifications of the urogenital sinus and its marginal folds to be referred to below.*

The ova are during mature life periodically shed by rupture of the Graafian follicles when these become ripe. These are received into the open mouths of the Fallopian tubes, by which canals they are conducted into the uterus, where if fertilized they develop, but if not fertilized they are extruded. Before fertilization each ovum undergoes a process of cell division by which it extrudes a portion of its nuclear substance and particularly a portion of its

cliromosomes. Tlie act of fertilization consists in the reception by the ovum of certain nuclear masses, including chromosomatic substance, which unites with the nuclear substance and chromosomes of the ovum to form a new complete nucleus.

*The testis or male sex gland is also developed from the germinal area of the ccelom. Nests of cells derived from the germinal epithelium become clustered and surrounded with a stroma of mesoblast into which the Wolffian tubules penetrate, ultimately becoming a tubular system, whose terminal roots enclose the cell nests as a * *■ lining epithelium. When first formed the testes*

lie in the lumbar region of the foetal abdomen above and internal to the kidneys, but from this site they begin to migrate about four months before birth. They reach the abdominal wall in the groin in two months, and there each passes through an oblique canal (the inguinal canal) in the muscular and fibrous wall of' the abdomen and descends into the scrotum, which is a loose bag of- skin formed by the lateral lips of the urogenital sinus (which long before this period have united medially). This descent is generally completed a month before birth. Along with the testis a tubular pouch of the serous lining of the abdomen is prolonged into the scrotum, which, when the descent is complete, becomes obliterated at the place where it traverses the abdominal wall, though remaining below as an envelope of the testis. The region of the inguinal canal is always the weakest spot in the abdominal wall, and it is along the track of the descended testis that those protrusions of' the abdominal viscera, called hemioe, are most liable to occur. As it is the assumption of the upright position which places the inguinal canal at the lowest part of the abdomen, this tendency to hernia is another of the penalties which man pays for the advantages of a bipedal progression.

The testis in the adult is made up of a great mass of convoluted tubules arranged in about 200 lobules, and the whole mass is included in a tough fibrous tunic. The lining epithelium of these seminal tubes by a special method of cell division gives rise to the male elements or spermatozoa, which are minute thread-like bodies consisting of a small oval head,

about -sT^-jth inch long, a slender middle-piece nearly as long, and a hair-like flagellum or tail tapering to a fine point and measuring -B-j-jth inch. The tubular system whereby these and the fluid in which they float are conveyed away is derived from the Wolffian tubules, which open into the Wolffian duct, now called vas deferens. Owing to the new position assumed by the testis, this duct has to ascend from the scrotum, to pass through the inguinal canal, and then to descend into the pelvic cavity in order to gain the first part of the urethra, into which it opens. Close to the urethral extremity of each vas deferens, and on its outer side, is an irregularly pyrif orm pouch, the vesicula seminalis, to store the secretion from the testis.

In early foetal life the terminal openings of all the excretory tubes — intestinal, urinary, and genital — unite and reach the surface by a single slit-like orifice. This condition, which is persistent in the monotremata and lower vertebrates, is transitory in man and the fiMoaof higher mammals. When first formed, the hinder external end of the gut, with its appended allantois, has sex organs. ^^ external aperture, but at aii early date in the embryonic history a pit of the surface integument, which is named the proctodceum, dips in on the ventral side of the vertebral column, and its bottom layer comes in contact with the gut close to its extreme blind end. Soon the membrane separating this pit from the gut ruptures, and the cloaca is formed. IDuring the second month of foetal life a transverse ridge, formed by a

downgrowth of the ventral wall of the lower end of the gut, shuts off the allantois from the intestine and divides the cloaca into a ventral or urogenital region, and a dorsal or anal. By the third month this partition has thick- ened into a definite band of integument which is called the perinoeum. The urogenital sinus is a slit-like space into which open the allantois, the Wolffian and MilUerian ducts and the ureters. At the ventral end of its aperture an eminence, the tuberculum genitale, rises, deeply grooved on its dorsal surface ; and from the lower edge of each lip of the groove a marginal vestibular ridge descends on each side of the opening of the sinus to unite with its fellow at its dorsal extremity. On each side, external to this vestibular ridge, the skin at the margin of the urogenital sinus forms a prominent lip, making the opening appear as a longitudinal

fissure. So far the process of development is identical in the two sexes, but at this point differentiation occurs. In the female the tuberculum genitale becomes the clitoris, and the vestibular and marginal folds respectively the labia majora and minora. In the male the vestibular folds unite in the median line, except at their ventral extremity, thus closing in the canal which forms the second and third parts of the urethra, and in the com- bined under-wall thus constituted erectile tissue develops, forming the corpus spongiosum urethrse above de- scribed. The terminal ventral opening becomes the meatus urinarius. The two cutaneous outer lips also fuse together medially, making the scrotum. The bilateral tuberculum genitale becomes by the development of erectile tissue the corpora cavernosa penis. In each sex the tubular system which does not become functional leaves vestiges which discharge no function. In the female the Wolffian tubules remain as a series of linear streaks in the substance of the broad ligament, the epoophoron. In the male the Milllerian ducts leave two vestiges, a minute saccule appended to the top of the testis, and a minute pouch, the sinus pocularis, in the coUiculus seminalis of the urethra. This latter corresponds to the cavity of the uterus in the female, a correspondence which is rendered more striking as this pouch and the adjoin- ing portion of the urethra are surrounded by a mass of unstriped muscle, with some gland tubes included in it, to which the name prostate is given. This organ is about the size and shape of a chestnut.

Variability of the Human Body.

!N'o two human bodies are alike in their organization, and there is no organ in the body which is not liable to vary. Some parts, however, are especially liable to abnormalities, more especially those which have the most complicated developmental history, those which derive their origin from more than one component, which pass through several stages and are late in arriving at their full development. Of those organs which occur in series, the terminal members are more variable than the intermediate. Organs do not vary indifferently in every direction ; there are some conceivable forms of variety which never occur, others which are common. Nor can variations be reduced to a continuous series. Some of them are sudden breaks, between which and the normal no intermediate links are known.

_ Most varieties are individualistic, depending on condi- tions of nutrition or environing circumstances affecting development. A few, such as the development of a third incisor or third premolar, seem to be atavistic, but atavism has been invoked in many cases to which it does not apply. The vascular system is the most, and the nervous the least, variable. The muscular and skeletal systems occupy intermediate positions. The literature of anomalies is very large. The general subject is dealt with in the Robert

Boyh Lecture, Oxford, 1894; see also Monster (Ency. Brit. vol. xvi. p. 762) and Bateson, Materials for the Sttidy of Variation, 1895.

Sistory of Anatomy.— To the detailed history given in vol. i. pp. 799 et seqq. , it is only necessary to add that recent researches on the early history of anatomy will he found in the several articles entitled " Archaaologia Anatomica " in the Journal of Anatomy for 1898, 1899, and 1900. (j^_ ma!)

Anatomy of Plants.

The term "Anatomy," originally employed in biological science to denote a description of the facts of structure revealed on cutting up an organism, whether with or with- out the aid of lenses for the purpose of magnification, is restricted in the present article, in accordance with a com- mon modern use, to those facts of internal structure not concerned with the constitution of the individual cell, the structural unit of which the plant is composed. For a description of the cell itself, the article Cytology must be consulted. In all but the very simplest forms the plant-body is built up of a number of these cells, associ- ated in more or less definite ways. In the higher (more complicated) forms the cells differ very much among themselves, and the body is composed of definite systems of these units, each system with its own characteristic structure, depending partly on the characters of the com- ponent cells and partly on the method of association. Such a system is called a tissue-system, the word tissue being

employed tor any collection of cells with common structural, developmental, or functional characters to which it may be conveniently applied. The word is derived from the general resemblance in the texture of plant substance to that of a textile fabric, and dates from a period when the fundamental constitution of this sub- stance from individual cells was not yet discovered. The study of tissues is known as Histology, and it is with this that the present article is necessarily mainly concerned. The method of treatment will be evolutionary ; that is to say, an endeavour will be made to trace the gradual steps through which the more complicated tissue-systems of the various groups of plants have been developed from simple cell-collections, duringthat descent of the more complicated from the simpler plants which constitutes the fundamental postulate of the comparative study of form in modern biology. The terms morphology and morphological wiQ be used throughout wherever such comparative consideration with this evolutionary implication is involved. It must be understood, however, that the evolution of form is invari- ably governed by the vital needs of the organism, so that a consideration of the vital relations of the plant to its surroundings, and of the actions and functional relations of its organs and tissues, is an indispensable condition of the construction of a real and intelligible morphology. In this way our outline of morphological anatomy will involve an outline of physiological anatomy.

It will easily be realized that since the plant-body con- sists entirely of tissues, through which all its functions are performed, an account of the evolution of plant-tissues is nearly equivalent to an account of the evolution of plants. Our task will be simplified, however, by the omission of direct reference to the tissues of the specialized reproduc- tive organs, for which the reader is referred to the articles on the different groups of plants. Even so it must be apparent that in the present article nothing but the barest sketch of the subject, in which much is left out and many topics are treated dogmatically, is at all possible. The ai-ticles Botany {Ency. Brit. vol. iv. pp. 85-93, and 99-108), and Histology, Vegetable (vol. xii.), give good general accounts of the nature of vegetable tissues, particularly in the flowering plants, and in the former are many figures, for the most part admirable, illustrating histological

structure, which the reader may consult with advantage. Much of the terminology and some of the descriptions are, it is true, out of date, a result that must always soon occur in a very rapidly advancing branch of science, as plant anatomy was twenty years ago. The morphological point of view, as sketched above, has been fully applied to plant- tissues only in very, recent years, so that in an article of earlier date it is only natural that the provisional nature of descriptive terminolbgy should becopie very apparent after the lapse of a few years.

An account of the structure of plants naturally begins with the cell, which is the proximate unit of organic structure. The cell is essentially an individualized mass of protoplasm containing a differentiated protoplasmic body, called a nucleus. But all cells which are permanent tissue-elements of the plant-body possess, in addition, a more or less rigid limiting membrane or cell-wall, consist- ing primarily of cellulose or some allied substance. It is ‘ the cell-walls which connect the different cells of a tissue, and it is upon their characters (thickness, sculpture, and constitution) that the qualities of the tissue largely depend. In many cases, indeed, after the completion of the cell-wall (which is secreted by the living ceU-body) the protoplasm dies, and a tissue in which this has occurred consists solely of the dead framework of cell-walls, enclosing in the cavities or lumina originally occupied by the protoplasm simply water or air. In such cases the characters of the adult tissue clearly depend solely upon the characters of the cell-walls, and it is usual in plant anatomy to speak of the wall with its enclosed cavity as ” the cell,” and the contained protoplasm «or other substances, if present, as cdl-coTVtents. This is in -accordance with the original use of the term ” cell,” which was applied in the 17th century to the cavities of plant-tissues on the analogy of the cells of honeycomb. The use of the term to mean the individualized nucleated mass of living protoplasm, which, whether with or without a limiting membrane, forms primi- tively the proximate histological element of the body of every organism, dates from the second quarter of the 19th century. We proceed to a systematic account of the anatomy, of the different groups of plants, beginning with the simplest, and passing to the more complicated forms.

Thallophyta.

The simplest members of both the Algae and the Fungi (g.u), the two divisions of the Thallophyta, the lowest of the four great groups into which the plant-kingdom is divided, have their bodies each composed of a single cell. In the Algae such a cell consists essentially of — (1) a mass of protoplasm provided with (2) a nucleus; and (3) an assimilating apparatus consisting of a coloured proto- plasmic body, ^Ued a chromatophore, the pigment of which in the pure green forms is chlorophyll, and which may then be called a cMoroplast. The whole is covered by the cell-membrane (Fig. 1 A). It is from such a living and assimilating cell, performing as it does all the vital functions of a green plant, that, according to current theory, all the different cell-forms of a higher plant have been differentiated in the course of descent.

*Among the Green Algae the differentiation of cells is compara- tively slight. Many forms, even when multicellular, have all their cells identical in structure and function, and are often spoken of as "physiologically unicellular." The cells ^^tland are commonly joined end to end in simple or branched '**"e d//- filaments. Such diflerentiation as exists in the higher /n'"™ types mainly takes two directions. In the fixed forms, the cell or cells which attach the plant to the substratum often have a peculiar form, containing less chlorophyll, and constituting a rudimentary fixing organ or rhizoid (Fig. 1 C). In certain types living on damp soil, the rhizoids penetrate the substratum, and in addition to fixing the plant absorb food substances (dissolved salts) from the substratum (CEdocladium, Fig. 1 D).*

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Fig. 1. — IiXAHPLi;a of the Diffebentiatioit of Tisbve m Flahts.

A, Cell (Indivlduftl) of the unicellular Green Alga Flem-ococeua, as an example of an undifferentiated autonomous assimilating cell, pr.^ Cell proto- plasm ; n,f nucleus ; cA2., chloroplast ; c.w., cell-wall,

B, Plant of the primitive Siphoneous Green Al^a Proto»iphon boiryoides. The primitive cell sends colourless tubelets (rhizoids, rh.) into the mud on which It grows. The suhaerial part is tubular or ovoid, and contains the chloroplast (chl.). There are several nuclei.

C, Base of the multicellular filamentous Green Alga OhcBtomorpha mrea. The basal cell has less chlorophyll than the others, and is expanded and fixed firmly to the rock on which the plant grows by the basal surface, rh., thus forming a rudimentary rhizoid.

D, Part of branched filamentous thallus of the multicellular Green Alga (Edodacl/iwm proton&ma. or, ax.^ Green axis creeping on the surface of damp

'soil ; r^., colourless rhizoids penetrating the soil ; aae. ax.^ ascending axes of green cells.

E/ Yertical section of frond of the complicated Siphoneous Green Alga Salimeda, The substance of thp fi:ond is made up by a single much-branched tube, with interwoven branches.^ ctmd. med.. Longitudinally running com- paratively colourless central (medullary) branches, which conduct food sub- stances and support the {aas. oor.) green assimilating cortical branches, which are the ends of branches fi-om the medulla and fit tightly together, forming the continuous surface of the plant.*

F, Section through the surface tissue of the Brown Alga Owlleria mMlUflda, showing the surface layer of assimilating cells densely packed vrith phseo- plasts. The layers below have progressively fewer of these, the central cells being quite colourless.

G, Section showing thick-walled cells of cortex in Brown Alga (sea-weed). Simple pits (p.) enable conduction to take place readily from one to another.

H, Two adjacent cells (leptoids) of a food-conducttog strand in Fu&m (a Brown seaweed). The wall between them is perforated, giving passage to coarse strands of protoplasm.

I, End of hydroid of the thalloid Liverwort Palla/oidnia, showing the thick lignlfied wall penetrated by simple pits.

J, End of hydroid of the Moss MMwrn, showing particularly thin oblique end-wall. No pits.

K, Optical section of two adjacent leptoids of the Moss PolytriahMm jwtii-perinum. The leptoids are living and nucleated. They bulge in the neighbour- hood of the very thin cross-wall. Note resemblance to S and B,

L, Optical section of cell of conducting parenchyma in the same moss. Embedded in the protoplasm are a number of starch grains.

M, Part of elongated stereid of a Moss. Note thick walls and oblique slit-Uke pits, with opposite inclination on the two sides of the cell.

N, One side of end of hydroid (ti-acheid) of Pteridophyte, with soalariform pits.

O, Optical section of two adjacent leptoids (sieve-tnbe segments) of Pteri-dophyte, with sieve plates (». pi.) on oblique end-wall and side-walls.

P, Part of spiral hydroid (tracheld) of Phanerogam.

Q, Three segments of a ” pitted ” vessel of Phanerogam.

E, Optical section of leptoid (sieve-tube segment) of Phanerogam, with two proteid (companion) cells. «. pi., sieve-plate.

8, Optical section of part of thick-walled stereid of Phanerogam, with almost obUterated cavity and narrow slit-like oblique pits.

T, Part of vertical section through blade of typical leaf of Phanerogam. «.«., Upper epidermal cells, with (c) cuticle, {p.) assimilating (palisade)

cells. sp,. Assimilating (spongy) cells, with large laounse. I.e., Lower epidermis, with St., stoma.

IT, Absorbing cell, with process (root-hair) iVom pUiferous layer of root of Phanerogam. ^ , ,. ^ ,. ,

V, Endodermal cell of Phanerogam, with suberized central band on radial and traflsTerse walls.

The second type of differentiation is that between supporting axis and assimilating appendages. The cells of the axis are com- monly stouter and have much less chlorophyll than those of the appendages. This differentiation is parallel with that between stem and leaf of the higher plant. In the group of the SiphoneBB both these types of differentiation may exist in the single, long, branched, tube-like, and multinucleate cell which here forms the plant-body. Frotosiphon (Fig. 1 B) is an example parallel, with (Edocladium ; Bryopsis, with Draparnaldia. In Caulerpa the imitation of a higher plant by the differentiation of fixing, supporting, and assim- ilating organs (root, stem, and leaf) from different branches of the single cell is strikingly complete. In the Siphoneous family of GodiaceoB (Fig. 1 E) the branches of the primitive cell become con- siderably interwoven one with another, so that a dense tissue-like structure is often produced. In this we get a further differentiation between the central tubes (branches of the primitive cell), which run in a longitudinal direction through the body, possess little or no chlorophyll, and no doubt serve to conduct food substances from one region to another, and the peripheral ones, which are directed perpendicularly to the surface of the body, ending blindly there, contain abundant chlorophyll, and are the assimilating organs.

None of the existing Red Seaweeds has a unicellular body. The thallus in all cases consists of a branched filament of cells placed end to end, as in many of the Green Algse. Each branch grows simply by the transverse division of its apical cell. The branches may be quite free or they may be united laterally to form a solid body of more or less firm and compact consistency. This may have a radial stem-like organization, a central cell- thread giving off from every side a number of short sometimes unicellular branches, which together form a cortex round the central thread, the

whole structure having a cylindrical form which only branches when one of the short cell-branches from the central thread grows out beyond the general surface and forms in its turn a new central thread, from whose cells arise new short branches. Or the thallus may have a leaf-like form, the branches from the central threads which form the midrib growing out mainly in one plane and forming a lamina, extended right and left of the midrib. Numerous variations and modifications of these forms exist. In any case, while the internal threads which bear the cortical branches consist of elongated cells with few chromatophores, and no doubt serve mainly for conduction of food substances, the superficial cells of the branches themselves are packed with chromatophores and form the chief assimilating tissue of the plant. In the bulky forms colourless branches frequently grow out from some of the cortical cells, and, pushing among the already-formed threads in a longitudinal direction, serve to strengthen the thallus by weaving its original threads together. The cells belonging to any given thread may be recognized at an early stage of growth, because each cell is connected with its neighbours belonging to the same thread by two depressions or pits, one at each end. The common wall separating the pits of the two adjoining cells is pierced by strands of protoplasm. The whole structure, consisting of the two pits and tiie wall between, is known as a genetic pit. Other pits, connecting cells not be- longing to the same branch, are, however formed at a later stage.

Ma^y of the lower forms of Brovyn Seaweeds have a thallus consisting of simple or branched cell threads, as in the green and red forms. The lateral union of the branches to form a solid thallus is not, however, so common, nor is it carried to so high a pitch of elaboration as in the Rhodophyoese. In a few of the lower> forms (Sphacelariacese), and in the higher forms which possess a solid thallus often of very large size, the plant-body is no longer formed entirely of branched cell threads, but consists of what is called a true parenchymatous tissue, a solid mass of cells, that is to say, formed by cell division in all directions of space. In the Laminariacese this tissue is formed by cell division at what is called an intercalary growing point, i.e., a meristematic (cell- dividing) region occupying the whole of a certain zone of the thallus, and cutting off new cells to add to the permanent tissue on both sides. In the Fucacese, on the other hand, there is a single prismatic apical cell situated at the bottom of

a groove at the growing apex of the thallus, which cuts off cells from its sides to add to the peripheral, and from its base to add to the central permanent cells. The whole of the tissue of' the plant is formed by the division of this apical cell. In what- ever way the tissues are originally formed, however, the main features of their differentiation are the same. According to a law which applies also to the green and red forms, the superficial cells are packed with chromatophores and form the assimilating tissue. In these brown types with bodies of considerable thick- ness (Laminariacese and Fucacese) there is, however, a further differentiation of the internal tissues. The cells immediately subjacent to the superficial assimilating layer form a colourless, or nearly colourless, parenchymatous cortex, which acts as a food storage tissue, and surrounds a central medulla of elongated conducting cells. The latter are often swollen at the ends, ao

that the cross-wall separating two successive cells has a larger surface than if the cells were of uniform width along their entire length. Cells of this type are often called trumpet-hyphcB, and in some genera of Laminariacese those at the periphery of the medulla simulate the sieve-tubes of the higher plants in a striking degree, even developing the peculiar substance callose on or in the per- forated cross-walls or sieve-plates. A specialized conducting tissue of this kind, used mainly for transmitting organic nitro- genous substances, is always developed in plants where the region of assimilative activity is local in the plant-body. This is the case in the Fucacese, and in a very marked degree in the LaminariacesB in question, where the assimilative frond is borne at the end of a long supporting and conducting stipe. The tissue developed to meet the demands for conduction in such cases always shows some of the characters described. It is known as leptom, each constituent cell being a leptoid. In addition to the cell types described, it is a very common occurrence in these bulky forms for rhizoid-like branches of the cells to grow out mostly from the cells, at the periphery of the medulla, and grow down between the cells, strengthening the whole tissue, as in the

RhodophyoesB. This process may result in a considerable thick- ening of the thallus. In many LaminariaoeBB the thallus also grows regularly in thickness by division of its surface layer, which thus forms a secondary meristem.

The simpler Fungi, like the simpler Green Algse, consist of single cells or simple or branched cell threads, but among the higher kinds a massive body is often formed, particu- rf/^”” larly in connexion with the formation of spores, and tla^’“/ *^^ ‘”’^y exhibit considerable tissue-differentiation. Puiull ” ^ characteristic feature of the fungal vegetative plant- body {mycelium) is its formation from independent coenocytic tubes or cell threads. These branch, and may be packed or interwoven to form a very solid structure ; but each grows in length independently of the others and retains its own individuality, though its growth in those types with a definite external form is of course correlated with that of its neighbours, and is subject to the laws governing the general form of the body. Such an independent coenocytic branch or cell thread is called a hypha. Similar modes of growth occur among the Siphoneous green and also among the red seaweeds. A solid fungal body may usually be seen to consist of separate hyphse, but in some cases these are so bent and closely interwoven that an appearance like that of ordinary parenchymatous tissue is obtained in section, the structure being called pseudoparenchyma. By the formation of numerous cross-walls the resemblance to parenchyma is increased. The surface-layer of the body in the massive Fungi differs in char- acter according to its function, which is not constant throughout the class, as in the Algse, because of the very various conditions of life to which different Fungi are exposed. In many forms its hyphse are particularly thick-walled, and may strikingly resemble the epidermis of a vascular plant. This is especially the case in the lichens (symbiotic organisms composed of a fungal mycelium in association with algal cells), which are usually exposed to very severe fluctuations in external conditions. The formation of a massive body naturally involves the localization of the absorptive region, and the function of absorption (which in the simpler forms is earned out by the whole of the vegetative part of the mycelium penetrating a solid or immersed in a liquid sub- stratum) is subserved by the outgrowth of the hyphse of the sur- face-layer of that region into rhizoids, which, like those*

of the Algse, living on soil, resemble the root-hairs of the higher plants. The internal tissue of the body of the solid higher Fungi, particularly the elongated stalks (stipes) of the fructifications of the Agarics, consists of hyphsB running in a longitudinal direction, which no doubt serve for the conduction of plastic food substances, just as do the " trumpet-hyphse," similar in appearance, though not in origin, of the higher brown seaweeds. (In one genus (Lactarius) "milk-tubes," recalling the laticiferous tubes of many vascular plants, are found.) These elongated hyphse are frequently thick- walled, and in some cases form a central strand, which serves to resist longitudinal pulling strains. This is particularly marked in certain lichens of shrubby habit. The internal tissues, either con- sisting of obvious hyphse or of pseudoparenchyma, may also serve as a storehouse of plastic food substances.

Looking back over the progress of form and tissue- differentiation in the Thallophyta, we find that, starting from the simplest unicellular forms with no external differ- entiation of the body, we can trace an increase in complexity of organization everywhere determined by the principles of the division of physiological labour and of the adaptar tion of the organism to the needs of its environment. In the first place there is a differentiation of fixing organs, ■which in forms living on a soft nutrient substratum

penetrate it and become absorbing organs. Secondly, in the Algae, which build up their ovni food from inorganic materials, we have a differentiation of supporting axes from assimilating appendages, and as the body increases in size and becomes a solid mass of cells or interwoven threads, a corresponding differentiation of a superficial assimilative system from the deep-lying parts. In both Algae and Fungi the latter are primarily supporting and food-con- ducting, and in some bulky Brown Seaweeds where assimi- lation is strongly localized some of the deep cells are highly specialized for the latter function. In the higher forms a storage and a mechanically-strengthening system may also be developed, and in some aerial Fungi an external protective tissue. The "hyphal" mode of growth, i.e., the formation of the thallus, whatever its external form, by branched, continuous or septate, coenocytic tubes (Siphoneae and Fungi) , or by simple or branched cell threads, in both cases growing mainly or entirely at the apex of each branch, is almost universal in the

group, the exceptions being met with almost entirely among the higher brown seaweeds, in which is found parenchyma produced by the segmentation of an apical cell of the whole shoot, or by cell division in some other type of meristem.

Bryophyta.

The Bryophyta, the first group of mainly terrestrial plants, exhibit considerably more advanced tissue differ- entiation, in response to the greater complexity in the conditions of life on land. But the lowest Hepaticae have an extremely simple vegetative structure, little more ad- vanced than that found in some of the higher Green Algae and very much simpler than in the large red and brown seaweeds. The thallus, however, always consists of true parenchyma, and is entirely formed by the cutting off of segments from an apical cell.

A sufficient description of the thallus of the Liver- worts, e.g., Fegatella, will be found in the article Muscine^ (Ency. Brit. vol. xvii.). We may note the universal occurrence on the lower surface of the thallus of fixing and absorbing ^'"fT"

rhizoids in accordance with the terrestrial life on soil worts.

{cf. (Edocladium among the Green Algse). The Marchantiacese (see article Muscinbjs) show considerable tissue-differentiation, possessing a distinct assimilative system of cells, consisting of branched cell threads packed with chloroplasts and arising from the basal cells of large cavities in the upper part of the thallus. These cavities are completely roofed by a layer of cells; in the centre of the roof is a pore surrounded by a ring of special cells. The whole arrangement has a strong resemblance to ttie lacunse, mesophyll and stomata, which form the assimilative and tran- spiring (water-evaporating) apparatus in the leaves of flowering plants. The frondose (thalloid) Jungermanniacese show no such differentiation of an assimilating tissue, though the upper cells of the thallus usually have more chlorophyll than the rest. In three genera — Pallamcinia, Symphyogyna, and Symenophyton — there are one or more strands or bundles consisting of long thick- walled fibre-like cells, pointed at the ends and running longitudi- nally through the thick midrib. The walls of

these cells are strongly lignifled (i.e., consist of woody substance) and are irregularly but thickly studded vrith simple pits (see Cytology), which are usually arranged in spirals running round the cells, and are often elongated in the direction of the spiral (Fig. 1 I). These cells are not living in the adult state, though they sometimes contain the disorganized remains of protoplasm. There is little doubt that their function is to conduct water through the thallus, the assimilating parts of which are in these forms often raised above the soil and comparatively remote from the rhizoid-bearing (water- absorbing) region. Such differentiated water-conducting cells we call hydroids, the tissue they form hydrom. The sporogonium of the liverworts is in the simpler forms simply a spore-capsule with arrangements for the development, protection, and distri-bution of the spores. As such it falls outside the scheme of this article, but in one small and peculiar group of these plants, the Anthocerotece, a distinct assimilating and transpiring system is found in the wall of the very long cylindrical capsule, clearly enabling the sporogonium to be largely independent of the supply of elaborated organic food from the thallus of the mother plant (the gametophyte). A richly chlorophyllous tissue with numerous intercellular spaces communicates with the exterior by stomata, strikingly similar to those of the vascular plants (see below). If

the axis of such a sporogonium were prolonged downwards into the soil to form a fixing and absorptive root, the whole structure would become a physiologically independent plant, exhibiting in many though by no means all respects the leading features of the sporophyte or ordinary vegetative and spore-bearing individual in Pteridophytes and Phanerogams. These facts have led to the theory, plausible in many respects, of the origin of this sporophyte by descent from an Anthoceros-like sporogonium (see Pteri- dophtta). The facts, however, give us no warrant for asserting homology (i.e. identity by descent) between the tissues of an Anthocerotean sporogonium and those of the sporophyte in the higher plants.

In the Mosses the>>plant-body (gametophyte) is always separable into a radially organized, supporting and conducting axis (stem) Mosses ^^^ '^^°' ^^' assimilating, and transpiring appendages (leaves). [For the histology of the comparatively simple but in many respects aberrant Bog-mosses (Sphagnacese), see MusciNE^, Ency. Brit. vol. xvii.] The stems of the other mosses resemble one another in their main histological features. In a few cases there is a special surface or epidermal layer, but usually all the outer layers of the stem are composed of brown, thick-walled, lignifled, prosenchymatous, fibre-like cells forming a peripheral stereom (mechanical or supporting tissue) which forms the outer cortex. This passes gradually into the thinner-walled parenchyma of the inner cortex. The whole of the cortex, stereom and parenchyma alike, is commonly living and its cells often contain starch. The centre of the stem in the forms living on soil •'is occupied by a strand of narrow elongated hydroids, which differ from those of the liverworts in being thin-walled, unlignifled, and very seldom pitted. The hydrom strand has in most cases no connexion with the leaves, but runs straight up the stem and spreads out below the sexual organs or the foot of the sporogonium. It has been shown that it conducts water with considerable rapidity. In the stalk of the sporogonium there is a similar strand, which is of course not in direct connexion with, but continues the conduction of water from, the strand of the gameto- phytio axis. In the aquatic, semiaquatio, and xerophilous types, where the whole surface of the plant absorbs water, perpetually in the first two cases and during rain in the last, the hydrom strand is either much reduced or altogether absent. lu accordance with the general principle already indicated, it is only where absorption is localized (i.e., where the plant lives on soil from which it absorbs its main supply of water by means of its basal rhizoids) that a water-conducting (hydrom) strand is developed. The leaves of most mosses are flat plates, eaoh consisting of a single layer of square or oblong assimilating (chlorophyllous) cells. In many cases the cells bordering the leaf are produced into teeth, and very frequently they are thick-walled so as to form a supporting rim. The centre of the leaf is often occupied by a midrib consisting of several layers of cells. These are elongated in the direction of the length of the leaf, are always poor in chlorophyll, and form a channel for conducting the products of assimilation away from the leaf into the stem. This is the first indication of a conducting foliar strand

or leaf bundle, and forms an approach to leptom, though it is not so specialized as the leptom of the higher Phseophycese. Associated with' the conducting parenchyma are frequently found hydroids identical in character with those of the central strand of the stem, and no doubt serving to conduct water to or from the leaf according as the latter is acting as a transpiring or water-absorbing organ. In a few cases the hydrom strand is continued into the cortex of the stem as a leaf-trace bundle (the anatomically demonstrable trace of the leaf in the stem). This in several cases runs vertically downwards for some distance in the outer cortex, and ends blindly the lower end or the whole of the trace being band-shaped or star- shaped so as to present a large surface for the absorption of water from the adjacent cortical cells. In other cases the trace passes inwards and joins the central hydrom strand, so that a connected water-conducting system between stem and leaf is established.

In the highest family of mosses, Polytrichacese, the differentia- tion of conducting tissue reaches a decidedly higher level. In addition to the water-conducting tissue or hydrom there is a well- developed tissue inferred to be a conducting channel for nitrogenous substances or leptom, not indeed so highly differentiated as in the most advanced Laminariacese, but showing some of the characters of sieve-tubes with great distinctness. Each leptoid is an elon- gated living cell with nucleus and a thin layer of protoplasm lining the wall. The whole cavity of the cell is sometimes stuffed with proteid contents. The end of the cell is slightly swollen, fitting on to the similar swollen end of the next leptoid of the row exactly after the fashion of a trumpet-hypha. The end-wall is usually very thin, and the protoplasm on artificial contraction commonly sticks to it just as in a sieve-tube, though no perforation of the wall has been found. Associated with the leptoids are similar cells without swollen ends and with thicker cross walls. Besides the hydrom and leptom, and situated between them, there

is a tissue which probably serves to conduct soluble carbohydrates, and whose cells are ordinarily full of starch. This may be called amylom. The stem in this family falls into two divisions, an underground portion bearing rhizoids and scales, the rhizome, and a leafy aerial stem forming its direct upward continuation. The leaf consists of a central midrib,

several cells thick, and two wings, one cell thick. The midrib bears above a series of closely set, verti- cal, longitudinally-running plates of green assimilative cells over which the wings close in dry air so as to protect the assimilative and transpiring plates from excessive evaporation of water. The midrib has a strong band of stereom above and below. In its centre is a band-shaped bundle consisting of rows of leptom, hydrom, and amy- lom cells. This bundle is continued down into the cortex of the stem as a leaf trace, and passing very slowly through the scleren- chymatous external cortex and the parenchymatous, starchy internal cortex to join the central cylinder. The latter has a central strand consisting of files of large hydroids, separated from one another by very thin walls, each file being separated from its neighbour by stout, dark-brown walls. This is probably homo- logous with the hydroid cylinder in the stems of other mosses. It is surrounded by (1) a thin-walled, smaller-celled hydrom mantle ; (2) a suberized amylom sheath ; (3) a leptom mantle, interrupted here and there by starch cells. These three concentric tissue mantles are evidently formed by the conjoined bases of the leaf traces, each of which is composed of the same three tissues. As the aerial stem is traced down into the underground rhizome portion, these three mantles die out almost entirely — the central hydrom strand forming the bulk of the cylinder and its elements becoming mixed with thick- walled stereids ; at the same ,time this central hydrom-stereom strand becomes three-lobed, with deep furrows between the lobes in which the few remaining leptoids run, separated from the central mass by a few starchy cells, the remains of the amylom sheath. At the periphery of the lobes are some comparatively thin-walled living cells mixed with a few thin-walled hydroids, the remains of the thin-walled hydrom mantle of the aerial stem. Outside this are three arcs of large cells showing characters typical of the endodermis in a vascular plant ; these are interrupted by strands of narrow, elongated, thick-walled cells which send branches into the little brown scales borne by the rhizome. The surface layer of the rhizome bears rhizoids, and its whole structure strikingly resembles that of the typical root of a vascular plant. In Atrichum undulatum the central hydrom cylinder of the aerial stem is a loose tissue, its interstices being filled up with thin-walled, starchy parenchyma. In Dawsonia superba, the finest of all known mosses, the hydroids of the central cylinder of the aerial stem

are mixed with thick- walled stereids forming a hydrom-stereom strand somewhat like that of the rhizome in other Polytrichacese.

The central hydrom strand in the seta of the sporogonium of most mosses has already been alluded to. Besides this there is usually a living conducting tissue, sometimes differentiated as leptom, forming a mantle round the hydrom, and bounded ex- ternally by a more or less well-differentiated endodermis, abutting on an irregularly cylindrical lacuna ; the latter separates the central conducting cylinder from the cortex of the seta, which, like the cortex of the gametophyte stem, is usually differentiated into an outer thick-walled stereom and an inner starchy parenchyma. Frequently, also, a considerable differentiation of vegetative tissue occurs in the wall of the spore-capsule itself, and in some of the higher forms a special assimilating and transpiring organ situated just below the capsule at the top of the seta, with a richly lacunar chlorophyllous parenchyma and stomata like those of the wall of the capsule in the Anthocerotean liverworts. Thus the histological differentiation of the sporogonium of the higher mosses is one of considerable complexity ; but there is here even less reason to sup- pose that these tissues have any homology (phylogenetic community of origin) with the similar ones met with in the higher plants.

The facts of histological structure in the Bryo- phytic series are all such as we should expect to be developed in response to the exigencies of increasing adaptation to terrestrial life on soil, and of increasing size of the plant-body. In the liverworts we find fixation of the thallus by water-absorbing rhizoids; in certain forms with alocalized region of water-absorption the development of a primitive hydrom or water-conducting system ; and in others with rather a massive type of thallus the diflerentiar tion of a special assimilative and transpiring system. In the more highly developed series, the mosses, this last division of labour takes the form of the differentiation of special assimilative organs, the leaves, commonly with a midrib containing elongated cells for the ready removal of the products of assimilation ; and in the typical forms with

a localized absorptive region, a well-developed hydrom in the axis of tlie plant, as -well as similar hydroid strands in the leaf -midribs, are constantly met ~~with. In higher forms the conducting strands of the leaves are continued down~~ wards into the stem, and eventually come into connexion with the central hydroid cylinder, forming a complete cylindrical investment, apparently distinct from the latter, and exhibiting a differentiation into hydrom, leptom, and amylom which almost completely parallels that found among the true vascular plants. Similai-differentiation, differing in some details, takes place independently in the other generation, the sporogonium. The stereom of the moss is found mainly in the outer cortex and in the mid- rib of the leaf.

Vascular Plants.

The body of the sporophyte in the great majority of the vascular plants (Pteridophytes and Phanerogams) shows a considerable increase in complexity over that found in the Bryophytes. The principal new feature in the external conformation of the body is the acquirement of ” true ” roots, the nearest approach to which in the lower forms we saw in the ” rhizome ” of Polytrichacese. The primary root is a downward prolongation of the primary axis of the plant. Prom this, as well as from various parts of the shoot system, other roots may originate. The root differs from the shoot in the characters of its surface tissues, in the arrangement of its vascular system, and in the mode of growth at the apex, all features which are in direct relation to its normally subterranean life and its fixative and absorptive functions. Within the limits of the sporophyte generation the Pteridophytes and phanerogams also differ from the Bryophytes in possessing special assimilative and transpiring organs, the leaves, though these organs are also developed in the gameto-phyte of many liverworts and of all the mosses. The leaves, again, have special histological features adapted to the performance of their special functions.

Alike in root, stem, and leaf, we can trace a three-fold division of tissue-systems, a division of which there are indications among the lower plants, and which ”^Se’ ^^ ^^ expression of the fundamental conditions ^ ‘ of the evolution of a bulky differentiated plant- body. From the primitive*

uniform mass of undiffer- entiated assimilating cells, there is, on the one hand, a specialization of a surface layer regulating the immediate relations of the plant with its surroundings. In the typi- cally submerged algse and in submerged plants of every affinity this is the absorptive and the main assimilative layer, and may also by the production of mucilage be of use in the protection of the body in various ways. In the terrestrial plants it differs in the subterranean and subaerial parts, being in the former pre-eminently absorp- tive, and in the latter protective — ^provision at the same time being made for the gaseous interchange of oxygen and carbon dioxide necessary for respiration and feeding. This surface layer in the typically subaerial " shoot " of the sporophyte in Pteridophytes and Phanerogams is known as the epidermis, though the name is restricted by some writers, on accovmt of developmental differences, to the surface layer of the shoot of Angiosperms, and by others extended to the surface layer of the whole plant in both these groups. On the other hand, we have an in- ternal differentiation of conducting tissue, the main features of which have already been fully described. The remaining tissue of the plant-body, a tissue that we must regard phylogenetically as the remnant of the undifferen- tiated tissue of the primitive th^us, but which often undergoes further differentiation of its own, the better to fulfil its characteristically vital functions for the whole plant, is known, from its peripheral position in relation

to t^ie primitively central conducting tissue, as the cortex. The remaining important function for which provision has to be made in any plant-body of considerable size, especially when raised into the air, is that of support. Special tissues may be. developed for this purpose in the cortex, or in immediate connexion with the conducting system, according to the varying needs of the particular type of plant-body.

In relation to its characteristic function of protection, the epidermis, which, as above defined, consists of a single layer of cells, has typically thickened and cuticularized outer walls. These serve not only 'to protect the plant 'P'"""^- against slight mechanical injury from without, but also and especially to prevent the evaporation of water from within, and to protect the internal tissues from the soaking in of rain, &o. At intervals it is interrupted by pores leading from the air outside to the intercellular

space system below. These stomata are each surrounded by a pair of peculiarly modified epidermal cells called guard-cells, which open and close the pore according to the need for transpiration. The structure of the stomata of the sporophyte of vascular plants is fundamentally the same as that of the stomata on the sporogonium of the true mosses and of the liverwort Anthoceros, a striking fact that lends countenance to the theory which would derive the Pteridophytic sporophyte from the sporogonium of an AnthocerosAike ancestor. The stomata serve for all gaseous interchange between the plant and the surrounding air. The guard-cells contain chlorophyll, which is absent from typical epidermal cells, the latter acting as a tissue for water storage. Sometimes the epidermis is considerably more developed by tangential division of its cells, forming a many- layered water-tissue. The extremely various modifications of the epidermis, especially in connexion with the occurrence of hairs of the most various kinds, and the numberless differences in the distribution of the stomata, and their relation to the general surface of the epidermis, are concisely treated as to the lead- ing facts in Botany (Ency. Brit. vol. iv. pp. 89-91), and in Histology (vol. xii. p. 17). Mention may be made here of a class of epidermal organ, the hydathode, the wide distribution and variety of which have been revealed by recent research. These are special organs usually situated on foliage f, ii th h leaves for the excretion of water in liquid form "yoataoaes. when transpiration is diminished so that the pressure in the water-channels of the plant has come to exceed a certain limit. They are widely distributed, but are particularly abundant in the tropics. In one type they may take the form of specially- modified single epidermal cells or multicellular hairs without any direct connexion with the vascular system. The cells concerned, like all secreting organs, have abundant protoplasm with larger nuclei, and sometimes, in addition, part of the cell- wall is modified as a filter. In a second type they are situated at the ends of tracheal strands and consist of groups of richly protoplasmic cells belonging to the epidermis (leaves of many ferns), or to the subjacent tissue (the commonest type in flowering plants) ; in this last case the cells in question are known as epithema. The epithema is penetrated by a network of fine intercellular spaces, which are normally flUed with water and debouch on one or more intercellular cavities below the epidermis. Above each cavity is situated a so-called water-stoma, no doubt derived phylogenetically

from an ordinary stoma, and enclosed by guard- cells which have nearly or entirely lost the power of movement. The pores of the water-stomata are the outlets of the hydathode. The epithema is frequently surrounded by a sheath of cuticu- larized cells ; in other cases the epithema may be absent altogether, the tracheal strand debouching directly on the lacunae of the mesophyll. This last type of hydathode is usually situated on the edge of the leaf. Some hydathodes are active glands, > secreting the water they expel from the leaf. Many other types of glands also exist, either in connexion with the epidermis or not, such as nectaries, digestive glands, oil, resin and mucilage glands, &c.

The surface layer of the root, sometimes included under the term epidermis, is fundamentally diflerent from the epidermis of the stem. In correspondence with its water- absorbing function it is not cuticularized, but remains usually thin-walled ; the absorbing surface is increased by its cells being often produced into delicate tubes which curl round and adhere firmly to particles of soil, thus at once fixing the root firmly in the soil, and enabling the hair to absorb readily the thin films of water ordinarily surrounding the particles. The root-hair ends blindly and is simply an outgrowth from a surface cell, having no cross walls. It corresponds in function with the rhizoid of a bryophyte. At the apex of a root, covering and protecting the delicate tissue of the growing point, is a special

root-cap consisting of a numlper of layers of tissue whose cells break down into mucilage towards the outer surface, thus facilitating the passage of the apex as it is pushed between the particles of soil.

The cortex, as has been said, is in its origin the remains of the primitive assimilating tissue of the plant, after differentiation Cortex ° ”^^ surface layer and the conducting system. It consists primitively and mainly of typical living parenchyma; but its differentiation may be extremely varied, since in the complex body of the higher plants its functions are very various. In all green plants, where there is a special*

protec- tive epidermis, the cortex of the shoot has to perform the primitive fundamental function of carbon assimilation. In the leafy shoot this is mainly localized in the cortical tissue of the leaves, known as mesophyll, which is essentially a parenchy- matous tissue containing chloroplasts, and penetrated by a lacunar system so that the surfaces of the assimilating cells are brought into contact with air to as large an extent as possible in order to facilitate gaseous interchange between the assimilating cells and the atmosphere. At the same time the cells of the mesophyll are transpiring cells — i.e., the evaporation of water from the leaf goes on from them into the intercellular spaces. The only pathways for the gases which thus pass between the cells of th? mesophyll and the outside air are the stomata. A typical land plant has always to protect itself against over-tran- spiration, and for this reason the stomata are placed mainly or exclusively on the lower side of the leaf, where the water-vapour that escapes from them, being lighter than air, cannot rise away from the surface of the leaf, but remains in contact with it and thus tends to check further transpiration. The stomata are' in direct communication with the richest lacunar system, which is found in the loosely arranged mesophyll (spongy tissue) on that side. This is the main transpiring tissue, and is protected from direct illumination and consequent too great evaporation. The main assimilating tissue, on the other hand, is under the upper epidermis, where it is well illuminated, and consists of oblong cells densely packed with chloroplasts and with their long axes perpendicular to the surface (palisade tissue'). The intercellular spaces are here fewer and narrower. The whole lacunar system thus forms a kind of funnel, with its narrow end in the palisade and its wide end under the stomata, so that the double necessity for the limi- tation of transpiration and the illumination of the palisade cells lessens the amount of carbon dioxi/ie which can reach the latter. Leaves whose blades are placed vertically possess palisade tissue and stomata on both sides (isohilateral leaves), since there is no difference in the illumination, while those which are cylindrical or of similar shape (centrio leaves) have it all round. The leaves of shade plants have little or no differentiation of palisade. In fleshy leaves which have little or no chlorophyll, the central mesophyll is abundant and acts as water-storage tissue. The cortex of a young stem is usually green, and plays a more or less important part in the assimilative function. It also always possesses a well-developed

lacunar system communicating with the external air through stomata (in the young stem) or lenticels (see below). This lacunar system not only enables the cells of the cortex itself to respire, but also forms channels through which air can pass to the deeper-lying tissues.. The cortex of the older stem and of the root frequently acts as a reserve store-house for food, which generally takes the form of starch, and it also assists largely in providing the stereom of the plant. In the leaf-blade this often appears as a layer of thickened subepidermal cells, the hypoderm, often also as subepidermal bundles of sclerenohymatous fibres or of similar bundles extending right across the leaf from one epidermis to the other, and thus acting as struts. Isolated cells (idioblasts), thickened in various ways, are not uncommonly found supporting the tissues of the leaf. In the larger veins of the leaf, especially the midrib, in the petiole and in the young stem, an extremely frequent type of mechanical tissue is coUenchyma. This consists of elongated cells with cellu- lose walls, which are locally thickened along the original comers of the cells, reducing the lumen to a cylinder, so that a number of vertical pillars of cellulose connected by comparatively thin walls form the framework of the tissue. This tissue remains living and is usually formed quite early just below the epidermis, where it provides the first peripheral support for a still growing stem or petiole. Sclerenchyma may be formed later in various positions in the cortex, according to local needs. Scattered single stereids or bundles of fibres are not uncommon in the cortex of the root.

The innermost layer of the cortex, abutting on the central cylinder of the stem or on the bundles of the leaves, is called the

phloeoterma, and is often differentiated. In the leaf- Phloeo- blade it takes the form of special parenchymatous terma. sheaths to the bundles. The cells of these sheaths are

often distinguished from the rest of the mesophyll by containing little or no chlorophyll. Occasionally, however, they are particularly ridi in chloroplasts. These bundle sheaths are important in the conduction of carbohydrates away from the

assimilating cells to other parts of the plant. Rarely in the leaf, fairly frequently in the stem (particularly in Pteridophytes), and universally in

the root, the phloeoterma is developed as an endo- dermis (see below). In other cases, it does not difler histologi- cally from the parenchyma of the rest of the cortex, though it is often distinguished by containing particularly abundant starch,' in which case it is known as a starch sheath.

One of the most striking characters common to the two highest groups of plants, the Pteridophytes and Phanerogams, is the possession of a double (hydrom-leptom) conducting system, such as we saw among the highest mosses. Vascular but with sharply characterized and peculiar features, system. almost certainly indicating common descent throughout both these groups. It is confined to the sporophyte, which forms the leafy-plant in these groups and is known as the vascular system. Associated with it are other tissues, consisting primi- tively of parenchyma, mainly starchy, and in the Phanerogams particularly, of special stereom. The whole tissue system is known as the Stelar system. It has no direct phylogenetic con- nexion with that of the mosses. The origin of the Pteridophyta (q.v.) is very obscure, but it may be regarded as certain that it is not to be sought among the mosses, which are an extremely specialized and peculiarly differentiated group. Furthermore, both the hydrom and leptom of Pteridophytes have marked peculiarities to which no parallel is to be found among the Bryophytes. Hence we must conclude that the conducting system of the Pteridophytes has had an entirely separate evolution. All the surviving forms, however, have a completely established double system with the specific characters alluded to, and since there is every reason to believe that the conditions of evolution of the primitive Pteridophyte must have been essentially similar to those of the Bryophytes, the various stages in the evolution of the conducting system of the latter are liffji jr. very useful to compare with the arrangements met with in the former. The hydroid of a Pteridophyte or of a Phanerogam is characteristically a dead, usually elongated, cell con- taining air and water, and either thin-walled with lignifled spiral or annular thickenings, or with thick lignifled walls, incompletely perforated by pits (usually bordered pits) of various shapes. ■When a number of such cells, called tracheids, placed end to end, have open communication with one another, the resulting cell- fusion is called a vessel. Vessels are very rare among Pteri- dophytes, though common among Phanerogams. The tracheids or*

vessels, indifEerently called tracheal elements, together with the immediately associated cells (usually amylom in Pteri- dophytes) constitute the xylem of the plant. This is a morpho- logical term given to the particular type of hydrom found in both Pteridophytes and Phanerogams, together with the parenchyma 01 stereom, or both, included within the boundaries of the hy(i-om tissue strand. The leptoid of a Pteridophyte is also an elongated cell, with a thin lining of protoplasm, but destitute of a nucleus, and always in communication with the next cell of the leptom strand by relatively large perforations (in Pteridophytes often not easUy demonstrable), through which pass strings of protoplasm. These are often converted into a peculiar substance called callose, which is also frequently formed over the surface of the perforated, often extremely oblique, end-walls. The structure formed by a number of such cells placed end to end is called a sieve-tube (obviously comparable with a xylem-vessel), and the end -wall or area of end-wall occupied by a group of perforations, a sieve-plate (see Cttologt). The sieve-tubes, with their accompanying paren- chyma or stereom, constitute the tissue called phloem. This is like- wise the term for a morphologically defined tissue system, i.e. the lep- tom found in Pteridophytes and Phanerogams with its associated cells, and is entirely parallel with the xylem. The sieve-tubes difler, however, from the tracheids in being immediately associated, appa- rently constantly, not with starchy parenchyma, but with parenchy- matous cells containing particularly abundant proteid contents which seem to have a function intimately connected with the conducting function of the sieve-tubes, and which we may call proteid-cells.*

*The xylem and phloem are nearly always found in close asso- ciation in strands of various shapes in all the three main organs of the sporophyte — root, stem, and leaf — and form a connected tissue-system running through the whole ^^rrange- body. In the primary axis of the plant among Pteri- ”” ’” dophytes and many Phanerogams, at any rate in its **”•”*■■ first formed part, the xylem and phloem are associated ^/wfr?, in the form of a cylinder, with xylem occupying the monostele. centre, and the phloem (in the upward growing part or primary stem) forming a mantle at the periphery (Fig. 3). In the downward growing part of the axis (primary root), however, the peripheral mantje of phloem is interrupted, the xylem coming to the surface of the cylinder along (usually) two or*

(sometimes) more vertical lines. Such an arrangement of vascular tissue is called radial, and is characteristic of all roots (Figs. 2 and 9). The cylinder is surrounded by a mantle of one or more layers of

parenchymatous cells, the pericycle, and the xylem is separated from the phloem in the stem by a similar layer, the mesocycle (corresponding with the hydrom sheath in mosses). The peri- cycle and mesocycle together form the conjunctive tissue of the stele. In the root the mesocycle, like the phloem, is interrupted, and runs into the pericycle where the xylem touches the latter (Fig. 2). The whole cylinder is enclosed by the peculiarly diflerentiated innermost cell-layer of the cortex, known as the endodermis. This layer has its cells closely united and sealed to one another, so to speak, by the conversion of the radial and transverse Walls (which separate each cell from the other cells of the layer), or a band running in the centre of these, into corky substance, so that the endodermal cells cannot be split apart to admit of the formation of intercellular spaces, and an air-tight sheath is formed round the cylinder. Such a vascular cylinder is called a protostele, and the axis containing it is said to be proto- monostelic. In the stele of the root the strands of tracheids along the lines where the xylem touches the pericycle are spiral or an- nular, and are the xylem elements first formed when the cylinder is developing. Each strand of spiral or annular first-formed tracheids is called a protoxylem strand, as distinct from the metaxylem or rest of the xylem, which consists of thick-walled tracheids, the pits of which are usually scalariform. The stele is called monarch, diarch, . . . polyarch according as it contains one, two, ... or many protoxylems. Wheri the protoxylem strands are situated at the periphery of the stele, abutting on the pericycle, as in all roots, and many of the more primitive Pterido- phyte stems, the stele is said to be exarch. When there is a single protoxylem strand in the centre of the stele, or when, as is more commonly the case, there are several protoxylem strands situated at the internal limit of the xylem, the centre of the stem being occupied by parenchyma, the stele is endarch. This is the case in the stems of most

Phanerogams and a few Pteridophytes. When the protoxylems have an intermediate position the stele is mesarch (many Pteridophytes and some of the more primitive Phanerogams). In many cases extemaX protophloem, usually con- sisting of narrow sieve-tubes often with swollen walls, can be distinguished from metaphloem. As the primitive stele of an exarch Pteridophyte is traced upwards from the primary root into the stem, the phloem and mesocycle become continuous round the xylem. At the same time the stele becomes more bulky, all its elements increasing in number. Very frequently the number of prQtoxylem strands increases by branching of the original ones that have come up from the root. Soon a bundle goes off to the first leaf. This consists of a protoxylem with a few metaxylem elements, a segment of mesocycle, phloem, pericycle, and usually an arc of endodermis, which closes round the bundle as it detaches itself from the stele. Thus such a leaf-bundle contains parts of all the tissues of the stele, and is hence called a meristele. It is primitively bilaterally symmetrical like the leaf it supplies, though it may acquire a radial symmetry of its own, while the stele of the stem is primitively radially symmetrical like the stem itself. As the stele is traced farther upwards it becomes bulkier, as do the successive leaf-bundles which leave it. In many Pteri- dophytes the solid protostele is maintained throughout the axis. In others a central parenchyma or primitive pith — a new region of the primitive stelar conjunctive — appears in the centre of the xylem. In many ferns internal phloem appears associated with this primitive pith ; and at a higher level, after the stele has ■ increased greatly in diameter, a large-celled true pith or medulla, resembling the cortex in its characters and usually quite distinct from conjunctive, appears in the centre. ‘ This is often separated from the conjunctive by an internal endodermis. Where internal phloem is present this is separated from the internal endodermis by an endocycle or “internal pericycle,” as it is sometimes called, and from the xylem by an internal mesocycle — these two layers, together with the outer mesocycle and pericycle, constituting the conjunctive tissue of the now hollow cylindrical stele. (The con- junctive frequently forms a connected whole with bands of starchy isylem-parenchyma, which, when the xylem is bulky, usually appear among the tracheids, the phloem also often being penetrated by similar bands of phloem-parenchyma.) To this type of stele, whether with or without internal phloem, is given the name siphonostele to distinguish it from the solid protostele characteristic of the

root, of the first-formed por- tion of the stem, and in the more primitive Pteridophytes of the whole of the axis. The siphonostele is, as it is found among many of the lower ferns, broken by the departure of a leaf-bundle, the outer and inner' endodermis joining so that the stele becomes horseshoe-shaped and the cortex continuous with the pith (Fig. 4). •Such a break is known as a leaf-gap. A little above the departure of the leaf-bundle the stele again closes up, only to be again broken by the departure of the next meristele. Where the leaves are ' ' Poly- crowded and the phyllotaxy is high, a given leaf-gap is not stely. " closed before the next ones appear, and the siphonostele ■thus becomes split up into a number of segments, sometimes band-

shaped or semilunar, sometimes isodiametric in cross-section (Fig. 5). Each segment of the siphonostele frequently resembles a pro- tostele, the segments of inner endodermis, pericycle, phloem, and mesocycle joining with the corresponding outer segments to form a concentric structure. For this reason a stem in which the vascular system has this type of structure is spoken of as polystelic, the term " stele " being transferred from the primary central cylinder of the axis and applied to the vascular strands just described. In tbis use the term loses, of course, its morphological value. Where the " steles " are few and band-shaped on cross-section, the structure is spoken of as "gamostelic "; where they are numerous, and run in- dependently for considerable distances, it is "dialystelic." The splitting up of the vascular tube or siphonostele into separate strands does not depend wholly upon the occurrence of leaf-gaps. In the extremely dialystelic forms the leaf-gaps are very broad and long, and are filled by a network of slender strands, some of which run out to the leaf, while others form cross connexions between these and with the strands separating the gaps, which, though stouter than the leaf -gap steles, are reduced to comparatively narrow bands. In some cases the strands separating the gaps are themselves split up, further increasing the dialystely. Finally, the original dialystelic cylinder may be supplemented by additional internal or external strands or both, joining by frequent connexions the primary ones. The leaf -trace consists of a single strand only in some of the protostelic and more primitive siphonostelic forms, in the latter (where it is simply a detached segment of the siphonostele) having the shape of a crescent or horse-shoe in cross-sebtion with the

convexity outwards, and in the petiole downwards. In the more complex forms, as already indicated, the trace is itself split up into a number of strands which leave the base and sides of the leaf-gap independently. In the petiole these may increase in number by branching and sometimes form a complicated system resembling that of the stem, but usually reducible to the primi- tive bilateral horse-shoe type. The protostelic, siphonostelic, and "polystelic" conditions are mainly found among the Pteri- dophytes. There is good reason to suppose that the protostelic con- dition is primitive in evolution. Essentially the same type was found in the primitive conducting system of the gametophyte of the mosses. No doubt the siphonostele came next, sometimes perhaps in relation to the necessity for the formation of a hard peripheral supporting cylinder, but often owing to factors not yet understood, and by the crowding of the leaf-gaps and other factors the "poly- stelic" state was reached. Thus in tracing the stelar system of a "polystelic" fern, for instance, upwards from the primary root, the various stages which have led to the evolution of this type are passed through. In a few Pteridophytes and the great majority of the Phanerogams, the protostele of the primary root dilates either immediately upon entering the stem, or at a higher level, acquires a true medulla, and the vascular cylinder breaks into a number of separate collateral bundles (i.e., with xylem towards the centre and phloem towards the periphery of the stem) which pass out of the cylinder to supply the leaves after having given off branches {continuation bundles) which continue their course in the cylinder of the stem. The lowest collateral bundles of the typical Phanerogamic stem are frequently directly continuous with the (often separate) strands forming the stele of the primary root, so that no siphonostelic condition of the type always found near the base of the stem of a higher Pteridophyte is passed through. But the collateral bundles of the stem stele are usually united laterally by conjunctive tissue, so that a hollow cylinder of stelar tissue is maintained, and the pith is isolated from the cortex except at the leaf-gaps. This modified siphonostele is very characteristic of the Phanerogamic stem. In the great majority of cases there is a fairly wide pericycle outside the phloem, and this is partially or wholly converted into scleren- chyma, usually of the prosenchymatous (fibrous) type. In this way an efficient peripheral supporting cylinder is secured, and it is no doubt largely owing to the need for this mechanical sup- port that the modified siphonostele is

maintained in the Phanero- gamic stem. As it is, the single collateral bundle often asserts its individuality while still within the stele, the conjunctive being obviously arranged' round them as centres — the sclerized pericycle, for instance, taking the form of a number of bands, arc-shaped in cross-section, capping the phloems of the bundles, and the cortex and medulla frequently intruding between two adjacent ones (Fig. 6). In some cases, indeed, the modified siphonostele breaks up altogether, the cortex and medulla becoming continuous between the bundles, each of which is sur- rounded by its own investment of tissue corresponding with con- junctive, but now called peridesm, the isolated segment of the mesocycle being knovm as mesodesm. This is the condition of astely, entirely parallel with polystely except that the separate strands are usually all or mostly leaf -traces.' Astely,' The difference between the concentric and the collateral structure of the strands, depending mainly on the presence or absence of internal phloem, and the difference between the rounded "stele"

of the polystelic Pteridophyte with its tendency to radial organ- ization, and the unipolar wedge-shaped "bundle" of the Dicotyledon usually with its cap or sheath of peridesmic stereom, depending on the different characters of the siphonostele from which the two types have been respectively evolved, though

Fig. 2.

striking and characteristic enough, are of comparatively minor importance. The characteristic type of arrangement of vascular strands found in monoootyledonous stems depends on a similar extreme assertion of the individuality of the single leaf-trace bundle, combined with an often enormous increase in the number

Pericycle

FJg.3-

Fig; A

Fig. 4.

Fig. 5.

of bundles present at any given level. The result is a dilation of the stele till it occupies the whole or nearly the whole of the axis, the cortex being reduced to a narrow cylinder or disappearing altogether. The pericycle usually forms a sclerized band at or near the periphery of the stem, and the leaf-trace bundles are scattered in a definite though not superficially obvious order through a general parenchymatous ground tissue, each bundle being commonly capped or surrounded by its own sheath of stereom. ^i a few cases among the Phanerogams (e.g., Auricula)

^S- 7

Fig=-9.

Figs. 2-9. — Diaobams of the Main Ttpbb of Arrangement of the Stelak TiBSTiEB IN Ftekidophytbb ani> PHANEROGAMS (as 86611 In transTerse section).

The xylem is cross-hatched, the phloem shaded diagonally, protoxylem and protophloem shaded darkly, parenchymatous conjunctive tissue left white, 8clerench3Tna dotted.

Fig. S.^Diarch root-stele, with axial metaxylem plate joining the two proto- xylems ; the commonest type of prxEnary root-stele.

Fig. 3. — Solid exarch protost^e (represented as pentarch) :. base of most Pteridophyte stems, and throughout stem of more primitive forms.

Fig. 4.— Tjrpical siphonostele (represented as mesarch) with internal phloem, broken by departure of a meristelic leaf-tree on the right. Characteristic ol basfr of stem in most ferns, and of whole axis in many.

Fig. 5. — Simple dialystelic type ; mesarch siphonostele represented as broken by two opposite leaf-gaps (right and left), each containing ttiree

meristelic leaf- traces, simulating protosteles and usually known as steles. Characteristic ot the stems of most of the higher ferns.

Fig. 6. — Modified siphonostele with collateral endarch bundles separated laterally by conjunctive tissue. The regions of the latter outside the phloems- are sclerized, as is usually the case. Characteristic of the dicotyledonous stem.

Fig. 7.— Separate collateral endarch bundle of an^ astelic form surrounded by its peridesm which may be partly or wholly sclerized. Xylem and phloem separated by mesodesm. Some dicotyledonous stems.

Fig. 8. — Meristelic arc of collateral bundles, united by conjunctive. Common in petioles of Dicotyledons.

Fig. 9. — Large polyarch root-siphon ostele, showing radial arrangement ot primary xylem and phloem in alternate strands, and also additional internal- metazylem, mostly in the form of large vessels. Found In many Monocoty' ledons. Most roots show some form intermediate between this and that represented in Fig. 2.

a polystelic condition originates secbndarily in evolution by the association of supplementary internal inversely oriented bundles with detached arcs of the original stele. This is another method of increasing the vascular supply to the leaves when the needs of these exceed the capacity of the original dilated and broken central cylinder. In other cases polystely may originate in a completely astelic type by the association of bundles round common centres (^Nympkcea). In the foregoing description of the evolution of the stelar

system in vascular plants, account has been taken only of what Aberrant ^^^™ ^^^ principal and more easily interpreted lines fyrms. °^ descent. Among some of the Pteridophytes

(Selaginella), a type of polystely is found which is not directly traceable to the breaking up of a primitive siphonostele by the crowding of leaf-gaps. Among the Cycadofllices also, a great group of extinct forms occupying the borderland between Ferns and Gymnosperms, side by side with monostehc types which furnish a most interesting sequence leading from the protost^e so common among modern Pteridophytes to the modified siphono- stele characteristic of modern Cycads, Conifers, and Dicotyledons, there are a number of siphonostelic and polystelio types (the MedullosecE and allied forms) in which the breaking of the siphonostele does not depend upon the departure of leaf-traces. The structures presented are often of considerable complexity, and their origin and relationship with the more easily intelligible types are frequently obscure. '

In the blade of a typical leaf of a vascular plant — essentially a thin plate of assimilating tissue — the vascular system takes the form of a number of separate, usually branching and tissue of anastomosing strands. These with their associated leaf root stereom form a kind of framework which is of great gfc/ ' importance in supporting the mesophyll ; but also, and chiefly, they provide a number of channels, penetrating every part of the leaf, along which water and dissolved salts are conveyed to, and elaborated food-substances from, the mesophyll cells. Each bundle is a branch of an original meristele that left the cylinder of the stem. It is always collateral (the phloem being turned downwards and the xylem upwards), even in Ferns, where the meristele or meristelesof the petiole ("petiolar steles") are concentric, and it has the ordinary mesodesm and peridesm of the collateral bundle. The latter is often sclerized, especially opposite the phloem, and to a less extent opposite the xylem, as in the stem. As a bundle is traced towards its blind termination in the mesophyll the peridesmic stereom first disappears, the sieve- tubes of tiie phloem are replaced by narrow elongated parenchyma cells, which soon die out, and the bundle ends with a strand of tracheids covered by the phloeotermic sheath.

The structure of the stele of the primary root as it is found in most Pteridophytes and many Phanerogams has been already described (Fig. 2). The radial structure is characteristic of all root-steles, which have in

essential points a remarkably uniform structure throughout the vascular plants, a fact which is no doubt largely dependent on the very uniform conditions under which they live. The larger root-steles are usually poly arch, and seldom have the centre filled up with xylem, this being replaced by a large-celled pith so that the siphonostelic structure is acquired (Fig. 9). Sometimes, however, the centre of a bulky root stele has strands of metaxylem (to which may be added strands of metaphloem) scattered through it, the interstices being fiUed with conjunctive. The conjunctive of a root-stele possess- ing a pith is often sclerized between the pith and the pericycle. Sometimes all the parenchyma within the stele undergoes this change. In the roots of some palms the siphonostele breaks up into arcs, which may each acquire a "stelar" structure by the bending in and joining of the edges.

For " latioif erous tissue," see Cttologt.

The body of a vascular plant is dev^eloped in tlie first place by repeated division of the fertilized egg and the . _ growth of the products of division. The body ment'ot ^^is formed is called the embryo, and this primary develops into the adult plant, not by continued tissue. growth of all its parts as in an animal, but by localization of the regions of cell-division and growth, such a localized region being called a growing-^oint. This localization takes place first at the two free ends of the primary axis, the descending part of which is the primary root, and the ascending the primary shoot. Later, the axis branches by the formation of new growing-points, and in this way the complex branch system of axes form- ing the body of the ordinary vascular plant is built up. In the flowering plants the embryo, after developing up to a certain point, stops growing and rests, enclosed within the seed. It is only on germination of the latter that the development of the embryo into the free plant is begun. In the Pteridophytes, on the other hand, development from the egg is continuous.

The triple division of tissues is laid down in most cases at a very early period of development — in the flowering plants usually before the restmg stage Is reached. In many Pteridophytes the first leaf is formed very early, and the first vascular strand is

developed at its base, usually becoming continuous with the cylinder of the root ; the strand of the second leaf is formed in a similar way, and runs down to join that of the first, so that the stem stele is formed by the joined bases of the leaf-traces. In other cases, however, a continuous primitive stele is developed, extending from the primary stem to the primary root, the leaf- traces arising later. This is correlated with the comparatively late formation and small development of the first leaves. The evidence scarcely admits of a decision as to which of these methods is to be regarded as primitive in descent. In the seed- forming plants {Phanerogams) one or more primary leaves (cotyledons') are already formed in the resting embryo. In cases where the development of the embryo is advanced at the resting period, traces run from the cotyledons and determine the symmetry of the stele of the primitive axis, the upper part of which shows stem-structure, in some respects at least, and is called the hypocotyledonary stem or hypocotyl, while the lower part is the primary root (radicle). On germination of the seed the radicle first grows out, increasing in size as a whole, and soon adding to its tissues by cell division at its apical growing-point. The hypocotyl usually elongates by its cells increasing very greatly both in number and size, so that the cotyledons are raised into the air as the first foliage-leaves. Further. growth in length of the stem is thenceforward confined to the apical growing-point situated between the cotyledons. In other cases this growing-point becomes active at once, there being little or no elongation of the hypocotyl and the cotyledon or cotyledons remaining in the seed.

The structure of the growing-points or apical meristems varies much in different cases. In most Pteridophytes there is a single large apical cell at the end of each stem and root axis. This usually has the form of a tetrahedron, with its ^^g' base occupying the surface of the body of the axis and its apex pointing towards the interior. In the stem, segments are successively cut off from the sides of the tetrahedron, and by their subsequent division the body of the stem is produced. In the root exactly the same thing occurs, but segments are cut off also from the base of the tetrahedron, and by the division of these the root^cap is formed. In both stem and root early walls separate the cortex from the stele. The epidermis in the stem and the surf ace layer of the root soon becomes differentiated from the underlying tissue. In some Pteridophyte stems the apical cell is

wedge-shaped, in others prismatic ; in the latter case segments are cut off from the end of the prism turned towards the body of the stem. In other cases, again, a group of two or four prismatic cells takes the place of the apical cell. Segments are then cut off from the outer sides of these initial cells. In most of the Phanero- gams the apical (or primary) meristem, instead of consisting of a single apical cell or a group of initials, is stratified — i. e., there is more than one layer of initials. Throughout the Angiosperms the epidermis of the shoot originates from separate initials, which never divide tangentially, so that the young shoot is covered by a single layer of dividing cells, the dermatogen. Below this are the initials of the cortex and central cylinder. Whether these are always in layers which remain separate is not known, but'it is certain that in many cases they cannot be distinguished. This, however, may be due to irregularity of division and displacement of the cells by irregular tensions destroying the obvious layered arrangement. In some cases there is a perfectly definite line of separation between the young cylinder (plerome) and young cortex (^periblem), the latter having one or more layers of initials at the actual apex. This clear separation between periblem and plerome is mostly found in plants whose stem-apex forms a naked cone, the leaves being produced relatively late, so that the stele of the young stem is obvious above the youngest leaf-traces. Where the leaves are developed early, they often quite overshadow the actual apex of the stem, and the rapid formation of leaf tissue disturbs the obviousness of, and perhaps actually destroys, the stratified arrangement of the shoot initials. In this case also, the differentiation of leaf-bundles, which typically begins at the base of the leaf and extends upwards into the leaf and downwards into the stem, is the first phenomenon in the development of vascular tissue, and is seen at a higher level than the formation of a stele. The latter is produced (except m cases of complete astely where a cylinder is never formed) after a number of leaf-traces have appeared on different sides of the stem so as to form a circle as seen in transverse section, the spaces intervening between adjacent bundles becoming bridged by small-celled tissue closing the cylinder. In this tissue fresh bundles may become differen- tiated, and what remains of it becomes the rays of the fully- formed stele. Many cases exist which are intermediate between the two extreme types described. In these the stele becomes obvious in transverse section at about the same level as that at which the fiirst leaf-traces are developed. Where, a large-

celled pith is developed this often becomes obvious very early, and in some cases it appears to have separate initials situated below those of the hollow vascular cylinder or modified siphonostele.

In some cases where there is apparently a well-marked plerome at the apex, this is really the young pith, the distinction between the stelar and cortical initials, if it exists, being, as is so often the case, impossible to make out. The young tissue of the stelar cylinder, in the case of the modified siphonostele characteristic , of the dicotyledonous stem, differs from the adjoining pith and cortex in its narroyv elongated cells, produced by the stopping of transverse and the increased frequency of longitudinal divisions. This is especially the. case in the young vascular bundles them- selves (desmogen strands). The protoxylem and protophloem are developed a few cells from the inner and outer margins of the desmogen strand, desmogenio tissue left over giving rise to the segments of endocycle and pericycle capping the bundle. Differen- tiation of the xylem progresses outwards, of the phloem inwards, but the two tissues never meet in the centre. Sometimes develop- ment stops altogether, and a layer of undifferentiated parenchyma, the mesodesm, islef t between them ; or it may continue indefinitely, the central cells keeping pace by their tangential division with the differentiation of tissue on each side. In this case the formation of the primary bundle passes straight over into the formation of secondary tissue by a cambium, and no line can be drawn between the two processes. The differentiation of the stelar stereom, which usually takes the forms of a sclerized peri- cycle, and may extend to the endocycle and parts of the rays, takes place in most oases later than the formation of the primary vascular strand. In the very frequent cases where the bundles have considerable individuality, the fibrous pericyclic cap very clearly has a common orighj from the same strand of tissue as the vascular elements themselves-.

The separation of layers in the apical meristem of the root is usually very much more obvious than in that of the stem. The outermost is the calyptrogen, which gives rise to the root cap, and in Dicotyledons to the

piliferous layer as well. The periblem, one cell thick at the apex, produces the cortex, to which the piliferous layer belongs in Monocotyledons ; and the plerome, which is nearly always sharply separated from the periblem, gives rise to the vascular cylinder. In a few cases the boundaries of the different layers are not traceable. The protoxylems and the phloem strands are developed alternately, just within the outer limit of the young cylinder. The differentiation of metaxylem follows according to the type of root-stele, and, finally, any stereom there may be is developed. Differentiation is very much more rapid— ie., the tissues are completely formed much nearer to the apex than is the case in the stem. This is owing to the elongating region (in which protoxylem and protophloem alone are differentiated) being very much shorter than in the stem. The root hairs grow out from the cells of the piliferous layer immediately behind the elongating region.

The branches of the stem arise by multiplication of the cells of the epidermis and cortex at a given spot, giving rise to a pro- tuberance, at the end of which an apical meristem is established. The vascular system is connected in various ways with that of the parent axis by the differentiation of bundle-connexions across the cortex of the latter. This is known as exogenous branch-forma- tion. In the root, on the other hand, the origin of branches is endogenous. The cells of the pericycle, usually opposite a proto- xylem strand, divide tangentially and give rise to a new grow- ing-point. The new root thus laid down burrows through the cortex of the mother-root and finally emerges into the soil. The connexions of its stele with that of the parent axis are made across the pericycle of the latter. Its cortex is never in con- nexion with the cortex of the parent, but with its pericycle. Adventitious roots, arising from the stems, usually, take origin in thB pericycle, but sometimes from other parts of the conjunctive.

In most of the existing Pteridophytes, in the Mono- cotyledons^ and in annual plants among the Dicotyledons,

there is no further growth of much structural Secondary importance in the tissues after differentiation

from the primary meristems. But in nearly all perennial Dicotyledons, in all dicotyledonous and gymno- spermous trees and shrubs, and in fossil Pteridophytes belonging to all the great groups, certain layers of cells remain meristematic among the permanent tissues, or after passing through a resting stage reacquire meri- stematic properties, and give rise to secondary tissues. Such meristematic layers are called secondary meristems. There are two chief secondary meristems, the cambium and the phellogen. The formation of secondary tissues is charac- teristicofmostwoody plants, towhatever class they belong. Every great group or phylum of vascular plants, when it has become dominant in the vegetation of the world, has produced members with the tree habit arising by the forma-

tion of a thick woody trunk, in most cases by the activity of a cambium.

The cambium in the typical case, which is by far the most frequent, continues the primary differentiation of xylem and phloem in the desmogen strand (see above), or arises in the resting mesodesm or mesocycle and adds new (secondary) xylem, and phloem to the primary tissues. New tangential walls arise in the cells which are the seat of cambial activity, and an initial layer of cells is established which cuts off tissue-mother-cells on the inside and outside, alternately contributing to the xylem and the phloem. A tissue-mother-cell of the xylem may, in the most advanced types of Dicotyledons, give rise to— (1) a tracheid ; (2) a segment of a vessel ; (3) a xylem-fibre ; or. (4) a vertical file of xylem-parenchyma cells. In the last case the mother-cell divides by a number of horizontal walls. A tissue-mother-cell of the phloem may give rise to — (1) a segment of a sieve-tube with its companion cell or cells ; (2) a phloem-fibre ; (3) a single phloem-parenchyma (cambiform) cell, or a vertical Hie of short parenchyma cells. At certain points the cambium does not give riSfe to xylem and phloem elements, but cuts off cells on both sides which elongate radially and divide by horizontal walls. When a given initial cell of the cambium has once begun to produce cells of this sort it continues the process, so that a radial plate of parenchyma cells is formed stretching in one straight line through the xylem and phloem. Such a cell- plate is called a medullary ray. It is essentially a living tissue, and serves to place all the living cells of the secondary vascular tissues in

communication. It conducts plastic substances inwards from the cortex, and its cells are frequently full of starch, which they store in winter. They are accompanied by intercellular channels serving for the conduction of oxygen to, and carbon dioxide from, the living cells in the interior of the wood, which would otherwise be cut off from the means of respiration. The xylem and phloem parenchyma consist of living cells, funda^ mentally similar in most respects to the medullary ray cells, which sometimes replace them altogether. The parenchyma is often arranged in tangential bands between the layers of sieve- tubes and tracheal elements.' The xylem parenchyma is often found in strands associated with the tracheal elements. These strands are not isolated, but form a connected network through the wood. The xylem-parenchyma cells are connected, as are the medullary ray cells, with the tracheal elements by one-sided bordered pits — i.e., pits with a border on the tracheal element side, and simple on the parenchyma cell side. The fibres are frequently found in tangential bands between similar bands of tracheae or sieve-tubes. The fibrous bands are generally formed towards the end of the year's growth in thickness. The fibres belong to the same morphological category as the parenchyma, various transitions being found between them ; thus there may be thin-walled cells of the shape of fibres, or ordinary fibres may be divided into a number of superposed cells. These intermediate cells, like the ordinary parenchyma, frequently store starch, and the fibres themselves, though usually dead, sometimes retain their protoplasm, and may also be used for starch accumulations. The vessels and traoheids are very various in size, shape, and structure in different plants. . They are nearly always aggregated in strands, which, like those of the parenchyma, are not isolated, but con- nected with one another. In a few cases some of the tracheids have very thick walls and reduced cavities, functioning as mechanical rather than water-conducting elements. All transitions are found between such forms and typical tracheids. These fibre-tracheids are easily confused on superficial view with the true wood-fibres belonging to the parenchymatous system ; but their pits are always bordered, though in the extreme type they are reduced to mere slits in the wall. The sieve-tubes of the secondary phloem usually have very oblique end-walls bearing a row of sieve-plates ; plates also occur on the radial side- walls.

The tissue-elements just described are found only in the more complicated secondary vascular tissues of certain Dicotyledons. A considerable evolution in complexity can be traced in passing from the simplest forms of xylem and phloem found in the primary vascular tissues both a'mong Pteridophytes and Phan- erogams to these highly differentiated types. In the simplest condition we have merely trachese and sieve-tubes, respectively associated with parenchyma, which in the former case is usually amylom, and in the latter consists of proteid cells. This type is found in nearly all Pteridophytes and, so far as is known, in Cycadofllices, both in primary and secondary tissue. The stereom is furnished either by cortical cells or by the tracheal elements, in a few cases by fibres which are probably homologous with sieve- tubes. Among Gymnosperms the secondary xylem is similarly simple, consisting of tracheids which act as stereom as well as hydrom, and a little amylom ; while the phloem-parenchyma sometimes undergoes a differentiation, part being developed as amylom, part as proteid cells immediately associated with the sieve-tube. In other oases the proteid cells of the secondary

phloem do not form part of the phloem-parenchyma, but occupy the top and bottom cell-rows of the medullary rays, the middle rows consisting of ordinary starchy cells. The top and bottom rows of the xylem rays are often developed as irregularly-thickened radially- elongated tracheids which serve for the radial conduction of water, and communicate with the ordinary tracheids of the secondary xylem by large bordered pits. The primary vascular tissues of Angiosperms are likewise nearly always simple, consisting merely of tracheae and sieve-tubes often associated with amylom. A char- acteristic peculiarity, both in the primary and secondary tissue, is that the proteid cells of the phloem are here always sister- cells of the leptoids and are known as companiorircells. In the secondary tissues of Dicotyledons we may have, as already described, consid- erably more differentiation of the cells, all the varieties being refer- able, however, on the one hand to the tracheal or sieve-tube type, on

the other to the parenchyma type. The main feature is the de- velopment of special vascular stereom and storage tissue. In some cases special secreting tissues, resin ducts, oil glands, laticiferous tissue, crystal sacs, &c., may be developed among the ordinary secondary vascular elements.

The limit of each year's increment of secondary wood, in those plants whose yearly activity is interrupted by a regular winter or dry season, is marked by a more or less distinct line, Annual which is produced by the sharp contrast between the rings. wood formed in the late summer of one year (char-

acterized by the sparseness or small diameter of the tracheal elements, or by the preponderance of fibres, or by a com- bination of these characters, giving a denseness to the wood) and the loose spring wood of the next year, with its absence of fibres, or its numerous large trachese. The abundance of water-conducting channels is in relation to the need for a large and rapid supply of water to the unfolding leaves in the spring and early summer. In Gymnosperms, where vessels and fibres are absent, the late summer wood is composed of radially narrow thick-walled tracheids, the wood of the succeeding spring being wide-celled and thin-walled, so that the limit of the year's growth is very well marked. The older wood of a large tree forming a cylinder in the centre of the trunk frequently undergoes marked changes in character. The liv- ing elements die, and the walls of all the cells often become hard- ened, owing to the deposit in them of special substances. Wood thus altered is known as heart-wood, or duramen, as distinguished from the young sap-wood, or alburnum, which, forming a cylinder next the cambium, remains alive and carries on the active functions of the xylem, particularly the conduction of water. The heart- wood ceases to be of any use to the tree except as a support, but owing to its dryness and hardness it alone is of much use for in- dustrial purposes. The great hardness of teak is due to the silica deposited in the heart-wood, and the special colouring matters of various woods, such as yellow wood, ebony, &c., are confined to the heart-wood. In some cases the heart-wood, instead of becom- ing specially hard, remains soft and easily rots, so that the trunk of the tree frequently becomes hollow, as is commonly the case in the willow. Heart-wood is first formed at very

different epochs in the life of a tree, according to the species — e.g., after fifteen to twenty years in the oak, forty years in the ash, etc.

In many annual plants no cambium is formed at all, and the same is true of most perennial Pteridophytes and Monocotyledons. When the vascular tissue of such plants is arranged Cambium in separate bundles these are said to be closed. The In stems, ^undies of plants which form cambium are, on the contrary, called open. In stems with open bundles the formation of cambium and secondary tissue may be confined to these, when it is said to be entirely fascicular. In that case either very little secondary tissue is formed, as in the gourds, some KanunculacesB, &c., or a considerable amount may be pro- duced (clematis, barberry, ivy). In the latter event the cells of the primary rays are either merely stretched radially, or they divide to keep pace with the growth of the bundles. If this division occurs by means of a localized secondary meristem con- necting the cambial layers of adjacent bundles, an interfascicular is formed in addition to the fascicular cambium. The inter- fascicular cambium may form nothing but parenchymatous tissue, producing merely continuations of the primary rays. Such rays are usually broader and more conspicuous than the secondary rays formed within the wedges of wood opposite the primary bundles, and are distinguished as principal rop from these narrower sub- ordinate or fascicular rays. This is the typical case in most trees where the primary bundles are close together. Where the primary bundles are farther apart, so that the primary rays are wider, the interfascicular cambium may form several fairly broad (principal) secondary rays in continuation of certain radial bands of the primary ray, and between these, wedges of secondary xylem and phloem: or, finally, secondary xylem and phloem may be formed by the whole circumference of the cambium, fascicular and interfascicular alike, interrupted only by narrow secondary rays, which have no relation to the primary ones.

In a good many cases, sometimes in isolated genera or species, sometimes characteristic of whole families, so-called anomalous cambial layers are formed in the stem, either as an extension of, or in addition to, the original cambial cylinder. They are frequently associated with irregularities in the activity of the original cambium. Irregularity of cambium occurs in various families of woody dicotyledonous plants,

mostly among the woody climbers, known as lianes, characteristic of tropical and sub- tropical forests. In the simplest cases the cambium produces xylem more freely along certain tracts of the circumference than along others, so that the stem loses its original cylindrical form and becomes elliptical or lobed in section. In others the second- ary phloem is produced more abundantly in those places where the xylem is deficient, so that the stem remains cylindrical in section, the phloem occupying the bays left in the xylem mass. Sometimes in such cases the cambium ceases to be active round these bays and joins across the outside of the bay, where it resumes its normal activity, thus isolating a phloem lake, or, as it is usually called, a phloem island, in the midst of the xylem. The significance of these phenomena, which present many minor modifications in different cases, is not fully understood; but one purpose of the formation of phloem promontories and islands seems to be the protection of the sieve-tubes from crushing by the often considerable peripheral pressure that is exercised on the stems of these lianes. Sometimes the original cambial ring is broken into several arcs, each of which is completed into an inde-^ pendent circle, so that several independent secondary vascular cylinders are formed. The formation of additional cambial cylinders or bands occurs in the most various families of Dicoty- ledons and in some Gymnosperms. They may arise in the pericycle or endocycle of the stele, in the cortex of the stem, or in the parenchyma of the secondary xylem or phloem. The activity of the ne^ cambium is often associated with the stoppage of the original one. Sometimes the activity of the successive cambiums simply results in the formation of concentric rings or arcs of secondary xylem and phloem. In other cases a most intricate arrangement of secondary tissue masses is produced, quite impos- sible to interpret unless all stages of their development have been followed. Sometimes in lianes the whole stem breaks up into separate woody strands, often twisted like the strands of a rope, and running into one another at intervals. An ordinary cam- bium is scarcely ever found in the Monocotyledons, but in certain woody forms a secondary meristem is formed outside the primary bundles, and gives rise externally to a little secondary cortex, and internally to a secondary parenchyma in' which are developed numerous zones of additional bundles, usually of concentric struc- ture, with phloem surrounded by xylem.

The cambium in the root, which is found generally in those plants which possess a cambium in the stem, always begin in the conjunctive tissue internal to the primary phloems, and forms new (secondary) phloem in contact with ”i the primary, and secondary xylem internally. In roots which thicken but slightly, whose cambium usually appears late, it is confined to these regions. If the development of secondary tissues is to proceed further, arcs of cambium are formed in the pericycle external to the primary xylems, and the two sets of cambial arcs join, forming a continuous, wavy line on transverse section, with bays opposite the primary phloems and promontories opposite the primary xylems. Owing to the resistance offered by the hard first-formed secondary xylem, the bays are pushed out- wards as growth proceeds, and the wavy line becomes a circle. Opposite the primary xylems, the cambium either (a) forms parenchyma on both sides, making a broad, secondary (principal) ray, which interrupts the vascular ring and is divided at its Inner extremity by the islet of primary xylem ; or (6) forms secondary xylem and phloem in the ordinary way, completing the vascular ring. In either case, narrow, secondary rays are formed at intervals, just as in the stem. Thus the structure of an old thickened root approximates to that of an old thickened stem, and so far as the vascular tissue is concerned can often only be distinguished from the latter by the position and orientation of the primary xylems. The cambium of the primary root, together with the tissues which it forms, is always directly continuous with that of the primary stem, just in the same way as the tissues of the primary stele. The so-called anomalous cambiums in roots follow the same lines as those of the stem.

In nearly all plants which produce secondary vascular tissues by means of a cambium there is another layer of secondary meristem arising externally to, but in quite the same fashion as, the cambium, and producing ™e”

intended to replace the epidermis as the external protective layer of the plant when the latter, incapable as it is of further growth after its original formation, is broken and cast oft by the increase in thickness of the stem through the activity of the cambium. Cork is also formed similarly in the root after the latter has passed through its primary stage as an absorptive organ, and has its struc- ture assimilated to that of the stem. The internal tissue formed by the phellogen is known as phelloderm, and consists usually of ordinary parenchyma. The phellogen may arise, in the first place, in any tissue of the axis external to the actual^ vascular tissues — I.e., in the epidermis itself (rarely), in any layer of the cortex, or in the pericycle. Its most usual seat of origin in the stem is the external layer of the cortex immediately below the epidermis ; in the root, the pericycle. All the tissues external to the cork are cast off by the plant. The extent of development of the phelloderm is dependent upon whether the phellogen has a super- ficial or a deep-seated origin. In the former case the formation of phelloderm is trivial in amount ; in the latter, considerable, since this tissue has to replace the cast-ofi cortex, as a metabolic and particularly a storage tissue. Provision is made for gaseous interchange between the internal tissues and the external air after the formation of cork, by the development of lenticels. These are special organs which interrupt the continuity of the impermeable layer of ordinary cork-cells. A lenticel is formed by the phellogen at a given spot dividing very actively and giving rise to a loose tissue of rounded cells which soon lose their con- tents, and between which air can pass to the tissues below. A lenticel appears to the naked eye as a rounded or elongated scar, often forming a distinct prominence on the surface of the organ. The lenticels of the stem are usually formed beneath stomata, whose function they take up after the stomata have been ruptured and cast oft with the rest of the epidermis. Both cork and phelloderm may be differentiated in various ways. The former often has its cells lignified, and may consist of alternate layers of hard and soft cells. The latter may develop stereom, and may also be the seat of origin of new formations of various kinds — e.g., supplementary vascular bundles, anomalous cambial zones, etc. It is often enormously developed and forms a very important tissue in roots. In the stem of a tree the original phellogen is replaced by successive new phellogenic layei-s of deeper and deeper origin, each forming its own layer of cork. Eventually the new phellogens reach the level of the secondary phloem, and are

formed in the parenchyma of the latter, keeping pace in their inward march with the formation of fresh secondary phloem by the cam- bium. The complex system of dead and dying tissues out off by these successive periderms, together with the latter themselves — in fact, everything outside the innermost phellogen, constitutes what is often known botanically as the bark of the tree. Jihy- tidome is, however, a preferable term, as the word bark has long been established in popular usage to mean all the tissue that can easily be peeled off — i.e., everything down to the wood of the tree. The rough surface of the bark of many trees is due to the succes- sive phellogens' not arising in regular concentric zones, but forming in arcs which join with the earlier-formed arcs, and thus causing the bark to come off in flakes or thick chunks. A layer of cork is regularly formed in most Phanerogams across the base of the petiole before leaf fall, so as to cover the wound caused by the separation of the leaf from the stem. Special "wound-cork" is also often formed round accidental injuries so as to prevent the rotting of the tissues by the soaking in of rain and the entrance of fungal spores and bacteria. A peculiar modification of periderm is formed by the phellogen in the submerged organs (roots or stems) of many aquatic or marsh-loving plants. This may take various forms and may cover the whole of the organ or be localized in special regions ; but its cells are always living and are separated by very large intercellular spaces. This tissue is called aerenchym, and no doubt its function is to facilitate the respiration of the organs on which it is formed and to which the access of oxygen is difficult. In other cases, a similar formation of spongy but dead periderm cells may occur for the same purpose in special patches, called pneumatodes, on the roots of certain trees living in marshy places, which rise above the soil in order to obtain air.

History and Bibliography. — The study of plant anatomy was begun in the middle of the seventeenth century as a direct result of the construction of microscopes, with which a clear view of the structure of plant tissues could be obtained. The Englishman Grew and the Italian Malpighi almost simultaneously published illustrated works on the subject, in which they described, for the most part very accurately, vvhat they saw with the new instru- ments. The subject was practically dormant for nearly a century and a half, largely owing to the dominance of classificatory botany under

the influence of LinnKus. It was revived by several German workers, prominent among whom were Treviranus and Link, and later Moldenhawer, as well as by the Frenchman Mirbel, at the beginning of the nineteenth century. The new work largely centred round a discussion of the nature and origin of vessels,

conspicuous features in plant tissues which Acquired an import- ance quite out^of proportion to their real place in the construction of the vascular plant. The whole of the writings of this time are dominated by a preoccupation with the functions of the dif- ferent tissues, in itself an excellent standpoint for investigation, but frequently leading in the case of these early investigatora to one-sided and distorted views of the facts of structure. The pioneer of modern plant anatomy was Hugo von Mohl (fl. 1840), who carefully investigated and described the facts of anatomical structure without attempting to fit them into preconceived views of their meaning. He produced a solid body, of accurately de- scribed facts which has formed the secure groundwork of sub- sequent advance. From Mohl down to the eighth decade of the century the study of anatomy was entirely in the hands of a group of German investigators, prominent in which are the names of several of the most eminent founders of modem scientific botany — such, for instance, as Nageli, Sanio, and De Bary. To the first we owe the secure foundation of our knowledge of the structure and .course of the vascular strands of the higher plants ("Ueber den Ban und die Anordnung der Gefassbilndel bei den Stamm und Wurzel der Phanerogamen," Beitrdge zur Wissen- schaftlichen Botanik, Heft i., Leipzig, 1859) ; to the second the establishment of the sound morphological doctrine of the central cylinder of the axis as the starting-point for the consideration of the general arrangement of the tissues, and the first clear distinc- tion between primary and secondary tissues (Botanische Zeitung, 1861 and 1863) ; to the last the putting together of the facts of plant anatomy known up to the middle of the eighth decade of the century in that colossal encyclopaedia of plant anatomy, the Vergleichende Anatomie der Vegetationsorgane bei den Phanero- gamen und Farnen, Stuttgart, 1876. (English translation : Com- parative Anatomy of the Vegetative Organs of the Phanerogams and Ferns, Oxford, 1882.) In 1870-71, Van Tieghem published his great work, "Sur la Racine," Ann. Sci^ Nat. Bot., Paris. This was not only in itself an

important contribution to plant anatomy, but served as the starting-point of a series of researches by Van Tieghem and his pupils, which have considerably advanced our knowledge of the details of histology, and also culminated in the foundation of the doctrine of the stele (Van Tieghem and Douliot, "Sur la Polysteiie," Ann. Sci. Nat. Bot. 1887 ; Van Tieghem, Traite de Botanique, 2nd ed. Paris, 1889-91), which has had a most im- portant effect on the development in recent years of morphological anatomy. In the progress of the last quarter of a century, since the publication of De Bary's great work, four main lines of advance can be distinguished. First, the knowledge of the details of his- tology has of course advanced greatly in every direction through the ceaseless activity of very numerous, but mainly German, workers, though no fundamentally new types of tissue have been discoyered. Secondly, the histology of fossil plants, particularly woody plants of the carboniferous period, has been placed on a sound basis, assimilated with general histological doctrine, and has considerably enlarged our conceptions of plant anatomy as a whole, though again without revealing any entirely new types of structure. This branch of the subject, founded by Corda, Gop- pert, Stenzel and others in Germany, was enormously advanced by Williamson's work on the Coal Measures plants, recorded in the magnificent series of memoirs, "Researches on the Organization of Fossil Plants of the Coal Measures," Phil. Trans. Boy. Soc. i.-xix., 1871-93. The work of Solms Laubach in Germany, Renault and Bertrand in France, and in quite recent years, of Zeiller in France, and Scott and Seward in England, has advanced our knowledge of the anatomy of fossil plants in an important degree. While convincing us that the plants of past ages in the earth's history were exposed to very similar conditions of life, and made very much the same adaptive responses as their modem repre- sentatives, one of the main results of this line of work has been to reveal important data enabling us to fill various gaps in our morphological knowledge and to obtain a more complete picture of the evolution of tissues in the vascular plants. One of the most striking incidents in the progress has been the recognition within the last few years of the existence of an extinct group of plants lying on-the borderland between Ferns and Gymnosperms, and known as the Cycadofilices, a group in which, curiously enough, the reproductive organs have not yet been discovered, but the anatomy of whose members affords sufficient evidence

of their true affinities. Thirdly, we have to record very considerable progress in our knowledge of that distinctively morphological anatomy to which reference was made in the introduction to this article. The Russian plant-anatomist, Russow, may be said to have founded the consideration of plant tissues from the point of view of descent (Vergleichende Untersuchungen uber die Leitbundel- kryptogamen. St Petersburg, 1872 ; and Betrachtungen uber Leitbundel und Grundgewebe. Dorpat, 1875). He has been ably followed by Strasburger (Ueber den Bau und die Verrichtungen der Leitungsbahnen in den J^anxen, Jena, 1891), Haberlandt and others. The explicit adoption of this point of view has had

the effect of clearing up and rendering definite the older morpho- logical doctrines, -which for the most part had no fixed criterion by which they could be tested. This has been conspicuously the case ~~with regard to "Van Tieghem's famous doctrine of the stele, ■which has quite lately been severely criticised from this point of view in England and America, where morphological anatomy is at the present time being actively pursued by Scott, Gwynne~~ Yaughan, Jeffrey, and others. Fourthly, we have to record the

foundation of the modern study of physiological anatomy by Schwendener (^Das mechanische Princip im Bau der Monocotylen, 1874, and other works), followed by numerous pupils and others, among whom Haberlandt {Physiologisohe J^anzen-Anatomie, Leip- zig, 1st ed. 1884, 2nd ed. 1896, and other works) is pre-eminent. The pursuit of this study has not only thrown valuable light on the economy of the plant as a whole, but forms an indispensable condition of the advance of morphological anatomy.

(a. g. t.)

Anazarba, Anazhrbus or Coesarea ad Anazarbum, the metropolis of Cilicia Secunda, situated N.E. of Adana in the rich Cilician plain at the foot of an isolated ridge of rock upon which stood its acropolis. In the

12th century it was for a time the capital of Lesser Armenia, and its ruins are striking and interesting.

Ancachs, a coast department. of central Peru, with an area of 16,562 square miles, and a population ofBciaUy estimated at 428,703. It embraces seven provinces, Santa, with the town of Santa (population, 3000) ; Pallasca, with the town of Samanco' (2000) ; Pomabamba, with the town of Huarmey (1500) ; Huaraz, with the town of Huaraz (8000); Huaylas, with the town of Huaylas (6000); Huari, and Cajartambo. In the sierra are the important towns of Caraz (6000) and Carhuaz (5000).

Anchor, the instrument which, secured to a ship by a cable, enables her to ride in safety, and therefore forms one of the most important articles in the vessel's equipment. Until the beginning of the 19th century

anchors were of im- perfect manufacture, the means of effect- ing good and efilcient welding being absent and the iron poor, whilst the arms, being straight, gen- erally parted at the crown, when weigh- ing from good hold- ing ground. Mr Pering in the early part of the century introduced curved ™ . T .. « ..^ . V ^"is ; and twenty-

*F^.L-Improyed Martin Anchor. g^^ ^^^^^ ^^^^^ ^^^*

Admiralty anchor, under the direction of the Board, was supplied to H.M. ships, follgwed by Lieutenant (after- wards Captain) Eod- ger's anchor, with well-formed arms, shank, and crown, the points or pees to the palm being blunt. Ttis anchor had an excellent rep- utation amongst nau- tical men of that period. The Com- mittee on Anchors, appointed by the Admiralty in 1852, placed at the head

of the list Trotman •^™' 2.— improved Msrtin-AdelpM Anchor.

and Eodger's anchors. In the former a great departure from previous anchors was made, the arms in one piece pivoted on a bolt through a fork-shaped shank; later came the self-canting and close-stowing Martin anchor,

which, passing through successive improvements in de- sign and manufacture, is largely used in the Eoyal Navy and mercantile marine.

The improved Martin anchor (Fig. 1) is made of forged iron; a projection in the centre of the arms works in a recess at the heel of the shank ; the arms when in position . are secured by side plates close to the heel of the shank ; the vacancies outside the shank are filled by blocks bolted through on each side and are fiush with the side plates, the latter keeping the flukes in position. The introduction of cast-steel in 1894 led to the improved Martin- Adelphi pattern (Pig. 2). The crown and arms are caSt in one, and, with the stock, are made of cast-steel, the shank remain- ing of forged iron ; a projection in the crown works in a recess (lower Fig.. 2), secured in its place by a forged

Fig. 3. — Hall's Stockless Anchor.

Fig. 8a.— Hall's Stockless Anchor stowed.

steel pin passing through crovm and heel of shank; a nut with washer is fitted to the pin. Stockless anchors are ex- tensively used in the British mercantile marine and in

some foreign navies ; their advantages are — handiness, absence of davits, and a clear fore- castle for right ahead gun fire or for work- ing ship. Should ex- perience prove that a stockless anchor pos- sesses the same holding power as a stocked one, T, .. T.„ > o. 1., A V i "^11 supersede the*

Fia. 4.— Blley's stockless Anchor. ■• j. tt H, , T

latter. Hall's stock- anchor is shovm in Figs. 3 and 3a, and Ki- ley's in Fig. 4. The latter is made in three pieces

— a shank, a fast fluke, and a loose one; the fast fluke has a square end cast on the neck, and is passed through the shank, and the loose one is riveted and pinned on to the square end ; a deep vertical rib or flange is cast at the back of the flukes, and, together with the stops on the shank, serves to tilt the flukes at an angle for taking the ground. To stow an anchor in a modern

Tio. 5.— Anchor stowed.

man-of-war it is hove up close to the forefoot, and the inner end of a ground chain which is stopped and secured to the cable wUl be inside the hawse pipe, whilst its outer end is secured to a balancing (gravity) band, con- sisting of an iron strap and shackle on thf shank of the anchor. Before weighing, the outer end of the catting chain is rove through ,an iron leading block on the cat davit, and the iron swivel block (Fig. 5, AA) at the cat-

Fie. 6.— Anchor stowed 4 Cock Bill.

head, and taken in through the hawse pipe; when the inner end of the ground chain is sufficiently inboard, the ground and catting chains are joined and the latter br6ught to the capstan, and the anchor hoisted up horizontally and placed by the cat davit, which pivots at its base (Fig. 5, B) on the bill-board, and secured by chains; an end of eacli chain passing over a roct with lever for letting go ;

additional chains are employed for securing at sea. For right ahead flre and for sea, the cat davit hinged (Fig. 5, B) is stowed in position indicated by the dotted line (Fig. 5, C). Gfround and catting chains are being superseded in some ships by a wire pendant and cat hook, the anchor being hove close up to the hawse pipe. To avoid cutting away a portion of the forecastle, anchors are stowed k Cock Bill (Fig. 6), the crowns resting on iron shoes secured to the ship's side, the flukes being fore and aft; the cat-heads are short. To let go, the securing chains are cleared away, except the shank painters, which are freed by the rod A, actuated by the lever B ; additional securing chains and bolts (EE and EE) are used for sea. A difficulty is experienced in stowing the anchor when pitching or rolling heavily. Fig. 7 illustrates an anchor

Fig, 7.— Anchor Crane.

with cat davit or anchor crane used in the P. & 0. S. !N". Company steamers (" India class 8000 tons ") ; for sea the anchor' is stowed inboard by the anchor crane. The equip- ment of anchors for this class is : bowers — ^two Rodger's box stocked 58 cwt. and two Hall's stockless 66 cwt. ; stream — one Hall's 28 cwt. ; kedges^one Martin, 13^ cwt., two Martin, 8 cwt., and one Martin,. 6 cwt. Stern, stream, and kedge anchors are usually stowed by special davits. A portable anchor suitable for small yachts is the invention of Mr Louis Moore ; the shank passes through the crown of the anchor like the handle of a pickaxe, and the stock over the head of the shank ; at the end of the stock are loose pawls ; there are no keys or bolts, and the only fastening is for the cable ; the anchor takes to pieces readily and stows snugly. In 1890 Colonel Bucknell also invented a portable anchor for small yachts. Iron buoy sinkers (Fig. 8) used by the Trinity House Corporation are from 8 to 40 cwt.; the specified weight is cast on them Fi^TS^ron Buoy sinter, in large raised figures ; the cast and wrought iron used is of special quality ; samples are pre- viously submitted to the engineer-in-chief.

The tests for anchors supplied to H.M. ships are in tons proportionate to their weights in cwts. ; new anchors are supplied by contractors, but repairs afterwards are made in H.M. dockyards, and by stamping a record is kept on the anchor of its repairs. In "Anchors and Cables Act, 1899," a list is given of authorized testing establishments, with their distinctive marks and charges, and testing houses for foreign-owned vessels are in table 22 pf Lloyd's Register of British and Foreign Shipping. Cast-steel anchors, in addition to the statutory tests, are subjected to percussive, hammering, and bending tests, and are stamped "annealed steel." . " (j. w. d.) .

Anchovy (Engraulis encrasicholus), a fish of the herring family, easily distinguished by its deeply cleft mouth, the angle of the gape being behind the eyes. The pointed snout extends beyond the lower jaw. The fish

resembles a sprat in having a forked tail and a single dorsal fin, but the body is round and slender. The maxi- mum length is 8^ inches. Anchovies are abundant in the Mediterranean, and are regularly caught on the coast of Sicily, Italy, France, and Spain. The range of the species also extends along the Atlantic coast of Europe to the south of Norway. In winter it is common off Devon and Cornwall, but has not hitherto been caught in such num- bers as to be of commercial importance. Off the coast of Holland in summer it is more plentiful, entering the Zuyder Zee in such numbers as to give rise to a regular and valuable fishery. It is also taken ra the estuary of the Scheldt. There is reason to believe that the anchovies found at the western end of the English Channel in No- vember and December are those which annually migrate from the Zuyder Zee and Scheldt in autumn, returning .thither in the following spring ; they must be held to form an isolated stock, for none come up from the south in summer to occupy the English Channel, though the species is resident on the coast of Portugal. The explanation appears to be that the shallow and land-locked waters of the Zuyder Zee, as well as the sea on the Dutch coast,, be- come raised to a higher temperature in summer than any part of the sea about the British coasts, and that therefore anchovies are able to spawn and maintain their numbers in these waters. Their reproduction and development were first described by a Dutch naturalist from observa- tions made on the shores of the Zuyder Zee. Spawning takes place in June and July, and the eggs, like those of the majority of marine fishes, are buoyant and trans- parent, but they are peculikr' in having an elongated, sausage-like shape, instead of being globular. They resemble those of the sprat and pUchard in having a segmented yolk, and there is no oil globule. The larva is hatched two or three days after the fertilization of the egg, and is very minute and transparent ; its further de- velopment has not been traced. In August young speci- mens 1^ to 3^ inches in length have been taken in the Zuyder Zee, and these must he held to have been derived from the spawning of the previous summer. There is no evidence to decide the question whether all the young anchovies as well as the adults leave the Zuyder Zee in autumn, but, considering the winter temperature there, it is probable that they do. The eggs have also been obtained from the Bay of Naples, and near Marseilles, also off the coast of Holland, and once at least off the coast of Lancashire. The occurrence of anchovies in the English Channel has been carefully studied at the

laboratory of the Marine Biological Association at Plymouth. They were most abundant in 1889 and 1890. In the former year considerable numbers were taken off Dover in drift nets of small mesh, used for the capture of sprats. In the following December large numbers were taken together with sprats at Torquay. In November 1890 a thousand of the fish were obtained in two days from the pilchard boats fishing near Ply-mouth ; these were caught near the Eddystone. When taken in British waters anchovies are either thrown away, or sent to the market fresh with the sprats. If salted in the proper way, they would doubtless be in all respects equal to Dutch anchovies, if not to those imported from Italy. The supply, however, is small and inconstant, and for this reason English fish-curers have not learnt the proper way of preparing them. The so-called " Nor- wegian anchovies" imported into England in little wooden kegs are nothing but sprats pickled in brine with bay-leaves and whole pepper. (j. t. c.)

Ancona, one of the sixty-nine provinces of the kingdom of Italy, bounded on the N. by the Province ©f Pesaro-Urbino ; on the W. by Pesaro-Urbino and

Umbria ; on the S. by the Province of Macerata ; and on the E. by the Adriatic Sea. It has an area of 788 square miles and a population of (1901) 302,460. Owing largely to the mezzadria or mitayer system, under which products are equally divided between the owners and the cultivators of the land, the soil is highly cultivated ; and through the abundant harvests the people enjoy greater prosperity than in most of the other provinces. Fowls are largely exported to England. The silk cultivation provides occupation for the urban population, and several small cities, like Opino, Jesi, and Chiaravalle, depend almost entirely upon this industry. Another important branch of activity is the paper industry. Chiaravalle possesses one of the largest tobacco factories of the Italian Bigie. Limestone quarries and sulphur mines supply building stone and sulphur to the regions of Central Italy. The Adriatic shore and the adjacent districts provide the wealthy with favourite summer resorts. As regards maritime trade the province possesses facilities in the port of Ancona, the canal port of Sinigaglia, and bther smaller harbours chiefly used by fishing boats. Fishing is carried on by the entire coast population,

which furnishes a large contingent of sailors to the Italian navy. The character of the country population is quiet and peaceable. All are f erveiit Eoman Catholics.

Ancona, an Italian city, capital of the province of the same name, pleasantly situated upon the Adriatic about 124 miles from Bologna and more than 186 miles from Rome. The extensive works undertaken by the Italian Government in order to enlarge the fortifications and to purify some quarters of the city have considerably changed its aspect, which is now rendered more pleasing by wide streets and esplanades. The Gothic faqade of the cathedral is among the most beautiful in Italy. There is a lazzaretto begun by Pope Clement XII. and finished by Pius VI., to whom is also due the finest street of the city and an arch (Porta Pia), by Vanvitelli. The chief monuments are those to Clement XII. and to Cavour. The municipal palace dates from 1270, and contains a valuable picture gallery and library. The Merchants' Guild and the Theatre of the Muses display exquisite workmanship. Several large bathing establishments, thoroughly modernized, are thronged by visitors in the summer months. The smaller triumphal arch erected near to that in honour of Trajan is dedicated to Pope Clement XIV., who reconstructed and enlarged the harbour and declared Ancona a free port (it is so no longer) in the 18th century. Its two moles and dredging works confer upon the port (which is furnished with a powerful lighthouse) great security and a considerable anchorage. There is an arsenal and a dockyard. Numbers of mercan- tile steamships are constructed, and important commis- sions are executed for the Italian navy every year. Trade has now regained its former volume, and the receipts of the Customs House are but little inferior to those of Venice. In 1898 commerce comprised 235,000 tons of seaborne and 32,000 tons of land imports ; 48,000 tons of exports by sea and 23,000 tons by land; steamers visiting the port, 599 (of which 60 were British) ; sailing vessels, 468. Ancona is in direct steamship communication with the chief European countries, as well as with Asia Minor, Tunis, India, and South America. The chief manu- factures are metallurgy (the arsenal alone employs 2000 workmen), sugar refining (1000 workmen), com- pressed coal, soapmaking, tanning, and silk-spinning. Though the great majority of the people belong to the monarchical party, Ancona is

considered the headquarters of anarchism. According to Pliny, Ancona was founded by the Dorians about 1500 b.c. Population (1901),

66,825.

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ANDAMAN ISLANDS

Andaman Islands.— These islands lie in the Bay of Bengal, 120 miles from Cape Negrais in British Burma. The southernmost, Little Andaman (26 mUes by 16), is separated by a passage 31 miles wide from Eutland Island (11 miles long), which in turn is the southernmost of a group of five main islands together forming the Great Andaman. North of Eutland Island is South Andaman (49 miles), and for 17 miles from the north end, and parallel to the east shore of this, runs an island called Baratang. Beyond these again stretch Middle Andaman (59 mUes) and North Andaman (51 miles). Between the North and Middle Andamans lies Austen Strait ; between Middle Andaman and the north extremities of South Andaman and Baratang, Homfray's Strait ; between South Andaman and Baratang, Middle (or Andaman) Strait ; and between South Andaman and Rutland Island, Mac pherson's Strait, the only one of the four navigable by ocean-going vessels. ' The sea all around is most diflcult of navigation, but there are a number of safe harbours and anchorages around Great Andaman, and the charts generally were much improved by a survey in 1888-89, the chart resulting from which is in turn being con- tinually amended. The whole group was completely surveyed topographically in 1883-86, when accurate maps on the scale of 2 miles to the inch were produced. The neighbourhood of Port Blair was mapped on a scale eight times as large.

Geology. — ^Preliminary examinations undertaken by ofiBcial ex- perts have afforded all that is yet known of the geology. The submarine ridges forming these islands contain much that is characteristic of the Arakan Yomas and formations common to the Nicobars, Sumatra, and the islands off Sumatra. The older rocks are probably early Tertiary or late Cretaceous, but there are no fossils to indicate age. The newer rocks are in the Archipelago chiefly and contain radiolarians and f oraminif era. A

theory of the subsidence of the islands seems established ; it appears to be of recent origin and signs of its continuance are to be found at several places. Though lying along a recognized subterranean line of weakness, the islands have, since the British occupation (1858) at least, been entirely free from earthquakes of great violence, but shocks are, felt at more or less frequent intervals. Narcondam (extinct) and Barren Island are volcanoes of the general Sunda group. The sea-shells are not especially distinctive, but the land- shells are more noteworthy.

Meteorology. — Rarely affected by a cyclone, though within the influence of practically every one that blows in the Bay of Bengal, the Andamans are of the greatest importance because of the accurate information relating to the direction and intensity of storms which can be communicated from them, better than fi-om any other point in the Bay, to the vast amount of shipping in this part of the Indian Ocean. Trustworthy information, also, regarding the weather which may be expected in the north and east of India is obtained at the islands, and this proves of the utmost value to the controllers of the great trades, dependent upon the rainfall. A well-appointed meteorological station has been established at Fort Blair since 1868. Speaking generally, the climate of the Andamans themselves may be described as normal for tropical islands ^f similar latitude. Not only does the rainfall at one place vary from year to year, but there is an extraordinary difference in the returns for places quite close to one another. The of&cial figures in inches for the station at Fort Blair, which is situated in by far the driest part of the settlement, were :

1895.

1896.

1897.

1898.

1899.

125-64

107-28

136-41

127-22

87-01

The mean highest temperature in the shade in 1895 (April) was 90-1° F. ; in 1897 (April), 94° F. ; in 1899 (March), 91-8° F. The mean lowest temperature in the shade in 1895 (February) was 70-9° F. ; in 1897 (January), 72-5° F. ; in 1899 (February), 71-2° F. A tidal observatory has also been maintained at Port Blair since 1880.

Forests. — ^In the forests which cover the Great Andaman the timber available for economic purposes is both plentiful and varied, and the Supply is only limited by the difficulty of obtaining laboui;. A section of the general forest department of India has been established in the islands, and 166 square miles have been

formally set apart for regular forest operations in the neighbour- hood of Fort Blair. There is, however, no indigenous labour whatever, and the working of this area is entirely carried out by the convicts in the penal settlement. There is an export trade in timber both to Calcutta and to Europe, and the Andaman Fadouk is so highly valued in European markets as a substitute for mahogany that a spurious imitation known as African Fadouk has been exploited. Tea is grown in considerable quantities, and the cultivation is under a department of the penal settlement. The output in 1895 was 145,203 lb ; in 1897, 121,056 ft ; in 1899, 154,004 R).

Animals. — Of imported animals, cattle, goats, asses, and dogs thrive well ; ponies and horses, indifferently ; sheep, badly, though some success has been achieved in breeding them.

Aborigines. — The policy of conciliation unremittingly pursued for the last forty years has now secured a friendly reception for shipwrecked crews at any port of the islands except the south and west of Little

Andaman and North Sentinel Island. The population is not susceptible of census, but probably it has always been small. Local expert guesses do not now place it higher than from 2600 to 3500, and though it is- commonly asserted that the natives are going down before superior civilization, it is doubtful whether, except in the immediate neighbourhood of the penal settlement, there is as yet any permanent change in their numbers. Though all descended from one stock, there are ten distinct tribes of the Andamanese, each with its own clearly defined locality, its own distinct variety of the one fundamental language, and to a certain extent its own separate habits. Every tribe is divided into septs fairly well defined. The tribal feeling may be expressed as friendly within the tribe, courteous to other Andamanese if known, hostile to every stranger, Andamanese or other. Another division of the natives is into Aryauto or long-shore-men, and the Eremtaga or jungle-dwellers. The habits and capacities of these two differ, owing to surroundings, irrespectively of tribe. Yet again the Andamanese can be grouped according to certain salient characteristics : the forms of the bows and arrows, of the canoes, of ornaments and utensils, of tattooing, and of language. The average height of males is 4 ft. 10^- in. ; of females, 4 ft. 6 in. Being accustomed to gratify every sensation as it arises, they endure thirst, hunger, want of sleep, and bodily discomfort badly. The skin varies in colour from an Intense sheeny black to a reddish-brown on the collar-bones, cheeks, and other parts of the body. The hair varies from a sooty black to dark and light brown and red. It grows in small rings, which give it the appearance of growing in tufts, though it is really closely and evenly distributed over the whole scalp. The figures of the men are muscular and well-formed, and generally pleasing ; a straight, well-formed nose and jaw are by no ineans rare, and the young men are often distinctly good- looking. The only artificial deformity is a depression of the skull, chipfly among one of the southern tribes, caused by the pressure of a strap used for carrying loads. The pleasing appearance natural to the men is not a char- acteristic of the women, who early have a tendency to stoutness and ungainliness of figure, and sometimes to pronounced prognathism. They are, however, always bright and merry, are under no special social restrictions, and have considerable influence. The women's heads are shaved entirely, and the men's into fantastic patterns. Yellow and red ochre mixed with grease are coarsely smeared over the bodies, grey in coarse patterns, and white in

fine patterns resembling tattoo marks. Tattoo- ing is of two distinct varieties. In the south the body is slightly cut by women with small flakes of glass or quartz in zigzag or lineal patterns downwards. In the north it is deeply cut by men with pig-arrows in lines across the body. The male matures when about fifteen years of age, marries when about twenty-six, begins to age when about i^orty, and lives on to sixty or sixty-five

if lie reaches old age. Except as to the marrying age, these figures fairly apply to women. Before marriage free intercourse between the sexes is the rule, though certain conventional precautions are taken to prevent it. Marriages rarely produce more than three children, and often none at all. Divorce is rare, unfaithfulness after mar- riage not common, and incest unknown. By preference the Andamanese are exogamous as regards sept and en- dogamous as regards tribe. The children are possessed of a bright intelligence, which, however, soon reaches its climax, and the adult may be compared in this respect with the civilized chUd of ten or twelve. The Andama- nese are, indeed, bright and merry companions, busy in their own pursuits, keen sportsmen, naturally indepen- dent, and not lustful, but when angered, cruel, jealous, treacherous, and vindictive, and always unstable— ^in fact, a people to like but not to trust. There is no idea of government, but in each sept there is a head, who has at- tained that position by degrees on account of some tacitly admitted superiority and commands a limited respect and some obedience. The young are deferential to their elders. Offences are punished by the aggrieved party. Property is communal, and theft is only recognized as to things of absolute necessity, such as arrows, pig's flesh, and fire. Fire is the oiie thing they are really careful about, not knowing how to renew it. A very rude bar- ter exists between tribes of the same group in regard to articles not locally obtainable. The religion consists of fear of the spirits of the wood, the sea, disease, and ancestors, and of avoidance of acts traditionally displeas- ing to them. There is neither worship nor propitiation. An anthropomorphic deity, Puluga, is the cause of all things, but it is not necessary to propitiate him. There is a vague idea that the "

soul ” will go somewhere after death, but there is no heaven nor hell, nor idea of a cor- poreal resurrection. There is much faith in dreams, and in the utterances of certain ” wise men,” who practise an embryonic magic and witchcraft. The great amusement of the Andamanese is a formal night dance, but they are also fond of simple games. The bows differ altogether with each groujf, but the same two kinds of arrows are in general use : (1) long and ordinary for fishing and other purposes ; (2) short with a detachable head fastened to the shaft by a thong, which quickly brings pigs up short when shot in the thick jungle. Bark provides material for string, while baskets and mats are neatly and stoutly made from canes, and buckets out of bamboo and wood. Ifone of the tribes ever ventures out of sight of land, and they have no idea of steering by sun or stars. Their canoes are simply hollowed out of trunks with the adze and in no other way, and it is the smaller ones which are outrigged’; they do not last long and are not good sea boats, and the story of raids on Car Nicobar, out of sight across a stormy and searrippled channel, must be discred- ited. Honour is shown to an adult when he dies, by wrapping him in a cloth and placing him on a platform in a tree instead of burying him. At such a time the encampment is deserted for three months. The Andar man languages are extremely interesting from the philo- logical standpoint. They are agglutinative in nature, show hardly any signs of syntactical growth, though every indication of long etymological growth, give expression to only the m«st direct and the simplest thought, and are purely colloquial and wanting in the modifications always necessary for communication by wiiting. The sense is largely eked out by manner and action. Mincopie is the first word in Colebrooke’s vocabulary for ” Andar man Island, or native country,” and the term has thus become a persistent book-name for the people. It, or something like it, was probably one of the tribal names when Colebrooke wrote 120 years ago, and may be used

now, but this cannot be ascertained. Attempts to civil- ize the Andamanese have met with little success either among adults or children. The home established near Port Blair is used as a sort of free asylum which the native visits according to his pleasure. The policy of the government is to leave the Andamanese alone, while doing what is possible to ameliorate their condition.

Penal Settlement. — The point of enduring interest as regards the Andamans is the penal system, the object of which is to turn the lije-sentence and few long-sentence convicts, who alone are sent to the settlement, into honest, self-respecting men and women, by leading them along a continuous course of practice in self-help and self-restraint, and by offering them every inducement to take advantage of that practice. After ten years' graduated labour the convict is given a ticket-of-leave and becomes self-supporting. He can farm, keep cattle, and marry or send for his family, but he cannot leave the settlement or be idle. With approved conduct, however, he may be absolutely released after twenty to twenty-five years in the settlement ; and throughout that time, though possessing no civil rights, a quasi-judicial procedure controls aU punishments inflicted upon him, and he is as secure of obtaining justice as if free. There is an unlimited variety of work for the labouring convicts, and some of the establishments are on a large scale. The general and marine steam and hand workshops employ 574 men ; 72,000 burnt bricks are turned out daily during the sea^- son ; in building the Cellular Jail some 30,000,000 bricks were used. Very few experts are employed in supervision ; practically every- thing is directed by the officials, who themselves have first to learn each trade. Under the Chief Commissioner, who is the supreme head of the settlement, are a deputy and a staff of assistant super- intendents and overseers, almost all Europeans, and sub-overseers, who are natives of India. All the petty supervising establish-ments are composed of convicts. The garrison consists of 140 British and 300 Indian troops, with a few local European volun- teers. The police are organized as a military battalion 643 strong. The number of convicts has somewhat diminished of-late years, and in 1900 stood at something over 11,000. The total population of the settlement, consisting of convicts, their guards, the super- vising, clerical, and departmental staff, with the families of the latter, also a certain number of ex-convicts and trading settlers and their families, numbers about 13,000 males and 2000 females. The labouring convicts are distributed among four jails and nineteen stations ; the self -supporters in thirty-eight villages. The elemen- tary education of the convicts' children is compulsory. There are four hospitals, each under a resident medical officer, under the gen- eral supervision of a senior officer of the Indian Medical Service, and medical aid is given free to the whole population. The harbour of Port Blair is well

supplied with buoys and harbour lights, and is crossed by ferries at fixed intervals, while there are several launches for hauling local traffic. On Ross Island there is a lighl^ house visible for nineteen miles. A complete system of signalling by night and day on the Morse system is worked by the police. Local posts are frequent, but there is no telegraph, and the mails are irregular. A system of wireless telegraphic communication vrith India is in contemplation. In 1898 there vfere among the convicts 86 Christians, 2752 Mahommedans, 6585 Hindus, 1758 Buddhists, and 70 others. The convict death-rate was 25 per 1000, and 173 were set free after twenty to twenty-five years' average transportation. 265 children attended the school. Of 88 applications for permission to marry, 47 were granted. The total receipts (actual cash from timber, &c., apart from the value of the convict labour as such) in 1898 amounted to £36,359, as compared with only £27,826 in 1894, but with £50,421 in 1897. Expendi- ture, on the other hand, in 1898 amounted to £103,861, as com- pared with only £93,963 in 1894, but with £112,170 in 1897. Thus the net cost to Government in 1898 was £67,502 ; and the net annual cost per convict, £6-1. The variation in the amounts for different years is largely due to the fact that the forest year does not coincide with the revenue year, and to the great distance from London, whence payments are made.

Authorities. — Since 1875 there has been extensive research into the Andamanese and their country. The foUovring books will be found to contain most of the necessary references : — Man. Aboriginal Inhabitants of the Andaman Islands. London, 1883. — PoRTMAN. History of our Helations with the Andamanese. Cal- cutta, Government, 1899 ; Notes on the Languages of the South Andaman Oroup of Tribes. Calcutta, Government, 1898 ; and Secord of the Andamanese. xi. vols. MS. India Office, London, and Home Department, Calcutta. — De Eolin. Mollusques des lies Andamans. Bordeaux, 1879. — Temple. Commercial Value of Wireless Telegraphic Communication loith the Andaman and Nicobar Islands. Calcutta, 1899. (r. c. t.)

Anderlecht, a town of Belgium, in the province of Brabant, 3 miles W. of Brussels, with numerous manu- factures.. It was formerly a part of Brussels, but was erected into a separate commune in 1895. Population (communal) (1897), 41,862.

Andersen, Hans Christian (1805-1875), Danish poet. and fabulist, born at Odense, in Funen, on the ,2nd of April 1805. He was the son of a sickly young shoemaker of twenty-two, and his still younger wife: the whole fam- ily lived and slept in one little room. Andersen very early showed signs of imaginative temperament, which was fos- tered by the indulgence and superstition of his parents. In 1816 the shoemaker died, and the child was left entirely to his own devices. He ceased to go to school ; he built himself a little toy-theatre, and sat at home making clothes for his puppets, and reading all the plays that he could borrow ; among them were those of Holberg and Shake- speare. At Easter 1819 he was confirmed at the church of St Kund, Odense, and began to turn his thoughts to the future. It was thought that he was best fitted to be a tailor ; but as nothing was settled, and as Andersen wished to be an opera- singer, he took matters into his own hand, and started for Copenhagen in September 1819. There he was taken for a lunatic, snubbed at the theatres, and nearly reduced to starvation, but he was befriended by the mu- sicians Weyse and Siboni, and afterwards by the poet Guldberg. His voice failed, but he was admitted as a danc- ing pupil at the Eoyal Theatre. He grew idle, and lost the favour of Guldberg, but a new patron appeared in the per- son of Jonas Collin, the director of the Eoyal Theatre, who became Andersen's life-long friend. King Frederick VI. was interested in the strange boy, and sent him for some years, free of charge, to the great grammar-school at Slag- else. Before he started for school he published his first volume. The Ghosirat Palnatoke's Grave, 1822. Andersen, a very backward and unwilling pupil, actually remained at Slagelse and at another school in Elsinore until 1827; these years, he says, were the darkest and bitterest in his life. Collin at length consented to consider him educated, and Andersen came to Copenhagen. In 1829 he made a con- siderable success with a fantastic volume entitled A Jour- ney on Foot from Holman's Canal to the East Point of Amager, and he published in the same season a farce and a book of poems. He thus suddenly came into request at the moment when his friends had decided

that no good thing would ever come out of his early eccentricity and vivacity. He made little further progress, however, until 1833, when he received a small travelling stipend from the king, and made the first of his long European jour- neys. At Le Locle, in the Jura, he wrote Agnate and the Merman; and in October 1834 he arrived in Rome. Early in 1835 Andersen's novel, The Improvisatore, ap- peared, and achieved a real success ; the poet's troubles were at an end at last. In the same year, 1835, the earliest instalment of Andersen's immortal Fairy Tales (Eventyr) was published in Copenhagen. Other parts, completing the first volume, appeared in 1836 and 1837. The value of these stories was not at first perceived, and they sold slowly. Andersen was more successful for the time being with a novel, 0. T, and a volume of sketches. In Sweden ; in 1837 he produced the best of his romances. Only a Fiddler. He now turned his attention, with but ephemeral success, to the theatre, but was recalled to his true genius in the charming miscellanies of 1840 and 1842, the Picture-Book without Pictures, and A Poet's Bazaar. Meanwhile the fame of his Fairy Tales had been steadily rising; a second series began in 1838, a third in 1845. Andersen was now celebrated throughout Europe, altjiough in Denmark itself there was still some re- sistance to his pretensions. In June 1847 he paid his

first visit to England, and enjoyed a triumphal socia^ suc- cess; when he left, Charles Dickens saw him off from Eamsgate Pier. After this Andersen continued to publish much; he still desired to excel as a novelist and a drama- tist, which he could not do, and he still disdained the enchanting Fairy Tales, in the composition of which his unique genius lay. Nevertheless he continued to write them, and in 1847 and 1848 two fresh volumes appeared. After a long silence Andersen published in 1857 another romance. To be or not to be. In 1863, after a very inter- esting journey, he issued one of the best of his travel- books, In Spain. His Fairy Tales continued to appear, in instalments, until 1872, when, at Christmas, the last stories were published. In the spring of that year Andersen had an awkward accident, falling out of bed and severely hurting himself. He was never again quite well, but he lived till the 4th of August, 1875, when he died very peacefully in the house called Eo- lighed, near Copenhagen. (e. g.)

Anderson, the capital of Madison county, Indiana, U.S.A., situated on the west fork of White river; a manufacturing city, at the intersection of three railways. Population (1900), 20,178.

Anderson, the capital of Anderson county, South Carolina, U.S.A., situated in the western part of the state, and surrounded by a fertile region, largely devoted to the production of cotton, of which this is a shipping point'. It has three railways. Population (1900), 5498.

Anderson, Elizabetii Garrett (1836-),

English medical practitioner, daughter of Newson Gar- rett, of Aldeburgh, Suffolk, was born in 1836, and edu- cated at home and at a private school. In 1860 she resolved to study medicine, an unheard-of thing for a woman in those days, and one which was regarded by old-fashioned people as almost indecent. Miss Garrett managed to obtain some more or less irregular instruc- tion at the Middlesex Hospital, London, but was refused admission as a full student both there and at many other schools to which she applied. Finally she studied anatomy privately at the London Hospital, and with some of the professors at St Andrews University, and at the Edinburgh Extra-Mural School. She had

no less difBculty in gaining a qualifying diploma to practise medicine. London University, the Eoyal Col- leges of Physicians and Surgeons, and many other ex- amining bodies, refused to admit her to their examinar tions ; but in the end the Society of Apothecaries, London, allowed her tb enter for the License of Apothecaries' Hall, which she obtained in 1866. In 1866 she was ap- pointed general medical attendant to St Mary's Dis- pensary, a London institution started to eifeble poor women to obtain medical help' from qualified practitioners of their own sex. The dispensary soon developed into the New Hospital for Women, and there she worked for over twenty years. In 1870 she obtained the Paris degree of M.D. The same year she was elected to the first London School Board, at the head of the poll for Marylebone, and was also made one of the visiting physicians of the East London Hospital for Children ; but the duties of these two positions she found to be incompatible with her principal work, and she soon resigned them. In 1871 she married Mr. J. G. S. Anderson, a shipowner, but did not give up practice. She worked steadily at the development of the New Hospital and (from 1874) at the creation of a com- plete School of Medicine in London for women. Both in- stitutions have since been handsomely and suitably housed and equipped, the New Hospital (in the Euston Eoad) be- ing worked entirely by medical women, and the School (in Hunter Street, W.C.) having over 200 students, most of them preparing for the medical degree of London University,

whicli ~~was opened to women in 1877. In 1897 Mrs Gar~~ rett Anderson was elected president of the East Anglian branch of the British Medical Association. The move- ment for the admission of women to the medical profes- sion, of which she was the indefatigable pioneer in England, has extended not only to every part of the United Kingdom and the British Colonies, but to every European country except Spain and Turkey.

Andersonville, a village of Sumter county, Georgia, U.S.A., on the Central of Georgia railway. During the Civil War it was the site of a Confederate prison for Federal soldiers. It is now the site of a national cemetery.

Andes. — The Andes form a continuous chain of mountainous highland along the western coast of South America, which, roughly speaking, may be regarded as 4400 miles long, 100 mUes wide in some parts, and of an average height of 13,000 feet. The connexion of this system with that of the Eocky Mountains, which has been pointed out by many writers, has received much support from the discovery of the extensive eruptions of granite during Tertiary times, extending from the southern ex- tremity of South America to Alaska. The Andean range is composed of two great principal chains with a deep in- termediate depression, in which, and at the sides of the great chains, arise other chains of minor importance, the chief of which is that called the Cordillera de la Costa of Chile. This starts from the southern extremity of the continent, and runs in a northerly direction, parallel with the coast, being broken up at its commencement into a number of islands, and afterwards forming the western boundary of the great central valley of Chile. To the north this coastal chain continues in small ridges or isolated hills along the Pacific as far as Colombia, always leaving the same valley more or less visible to the west of the western great chain. These mountains were the objects of important investigations during the last quarter of the 19th century.

Of the two principal chains, the eastern is generally called Los Andes, and the western La Cordillera, in Colombia, Pera, and Bolivia, where it is likewise known as Cordillera Real' de Los Andes, whilst to the south of parallel 23° S. lat. in Chile and Argentina, the western is called Cordillera de los Andes.. The eastern disappears in the centre of Argentina, and it is therefore only the Cordillera de los Andes that is prolonged as far as the south-eastern extremity of the continent. The Cordillera de la Costa begins near Cape Horn, which is composed principally of crystalline rocks, and its heights are inconsiderable when compared with those of the true Cordillera of the Andes. The latter, as regards its main chain, is on the northern coast of Beagle Channel, in Tierra del Fuego, bounded on the north by the deep de- pression of Lake Fagnano and of Admiralty Sound. Staten Island appears to be the termination to the east. The Cordillera of the Andes in Tierra del Fuego is formed of crystalline schists, and cul- minates In the snow-capped peaks of Mount Darwin and Mount Sarmiento (7200 feet), which contains glaciers of greater extent than those of Mont Blanc. Sir Martin Conway recently ascended the

latter. The extent of the glaciers is considerable in this region, which, geographically, is more complex than has hitherto been supposed. Although, in the explored portion of the Fuegian chain, the volcanoes which have been mentioned from time to time have not been met with, there seems to have existed to the south, on the islands, many neo-volcanic rocks, some of which appear to be con- temporaneous with the basaltic sheet that covers a part of Eastern Patagonia. The insular region between Mount Sarmiento and the Cordillera de los Andes, properly so called, i.e., that which extends from Magellan Strait northwards, has not been explored, and all that is known of it is that it is principally composed of the same rocks as the Fuegian section, and that the greater part of its upper valleys is occupied by glaciers that reach down to the sea amid dense forest.

As Admiralty Sound and Lake Fagnano, the extent of which is still unknown, bound the Cordillera to the north in Tierra del Fuego, so at the eastern side of the Cordillera in' Patagonia there is

a longitudinal depression which separates the Andes from some independent ridges pertaining to a secondary parallel broken chain called pre-Cordillera. This depression is occupied in a great part by a series of lakes, some of these filling transversal breaches in the range, whilst others are remains of glacial reserv(5irs, bordered by morainio dams, extending as far as the eastern tableland and corresponding in these cases with transversal depressions which reach the Atlantic Ocean. Between the larger lakes, fed by the Andine glaciers of the eastern slope of the Southern Andes, are Lakes Maravilla, 100 square miles, and Sarmiento, 26 square miles, 51° S. lat., which overflow into Last Hope Inlet ; Argentine, 570 square miles, 50° S. lat. ; and Viedma, 450 square miles, 49° 30' S. lat., which empty into the river Santa Cruz ; the fiordian Lake San Martin, 49° S. lat. ; and Lakes Nansen, 18 square miles ; Azara, 8 square miles ; and Belgrano, 18 square miles, which are depend- ants of Lake San Martin (380 square miles), and Lakes Pueyrredon (98 square miles) and Buenos Aires (700 square miles), and which now overflow into the Pacific, through one of the remarkable inlets that are found throughout the Cordillera, the Calen Inlet, which is the largest western fiord of Patagonia. To the north of Lake Buenos Aires there is Lake

Elizalde, which, while situated on the eastern slope, sends its waters to the Pacific Ocean, and Lakes Fontana (30 square miles) and La Plata (34 square miles), 45° S. lat., which feed the river Senguerr, which flows to the Atlantic. Lake General Paz (66 square miles), on the eastern slope of the Andes, at 44° S. lat. , is the principal source of the Pa- lena river, which cuts all the Cordillera, while Lakes Fetalauquen (20 square miles), Menendez (28 square miles), Eivadavia (10 square miles), and other smaller lakes, also situated between 43° 30′ and 42° 30′ S. lat. on the eastern slope, send their waters to the Pacific by the river Fetaleuf u, which cuts through the Andes by a narrow gorge. The waters of Lake Puelo (18 square miles) like- wise flow into the same ocean through the river of that name, which also cuts the Cordillera, and of which the principal affluent likewise drains the waters of a system of small lakes, the largest of which, Lake Mascardi, measures 17 square miles, which in com- paratively recent times formed part of the basin, of Lake Nahuel-Huapi (207 square miles), 41° S. lat. An extensive area of glacial deposits shows that a sheet of ice formerly covered the whole eastern slope to a great distance from the mountains. To the west another sheet reached at the same time the Pacific Ocean.

From the Strait of Magellan up to 52° S. lat., the western slope of the Cordillera does not, properly speaking, exist. Abrupt walls overlook the Pacific, and great longitudinal and transversal chan- nels and fiords run right through the heart of the range, cutting it generally in a direction more or less oblique to its axis, the result of movements of the earth's crust.

The mountains forming the Cordillera between Magellan Strait and 41° S. lat. are higher than those previously mentioned in Tierra del Fuego. Generally composed of granite, gneiss, and Palaaozoic rocks, covered in many parts by rugged masses of vol- canic origin, their general height is not less than 6500 feet, while Mount Geikie is 7500 feet and Mount Stokes 7100 feet high. To the north are Mounts Mayo, 7600 feet ; Agassiz, 10,600 feet ; and Fitz Roy, hi 49° S. lat., 11,120 feet high. The section from 52° to 48° S. lat. is a continuous ice-capped mountain range, and some of the glaciers extend from the eastern lakes to the western channels, where they reach the se£u-level. The level of the lakes commences at 130 feet at Lake

Maravilla and gradually ascends to near 700 feet at Lake San Martin. Passing the breach through which Lake San Martin empties^itseU into Calen Inlet, in 48° S. lat., is found a wide oblique opening in the range, through which flows the river Las Heras, fed by Lake Pueyrredon, which is only 410 feet above the sea-level to the east of the Andes, while Lake Buenos Aires, immediately to the north, is 710 feet. The Andes continue to be to the west an enormous rugged mass of ice and snow of an average height of 9000 feet, sending glaciers to all the eastern fiords.

Mount San Lorenzo, detached from the main chain in the pre- Cordillera, is 11,800 feet high. Mount San Valentin, 12,700 feet, is the culminating point of the Andes in the region extending from 49° to 46° S. lat., where another breach occurs, that of the river Huemules, which is supposed to be the outlet of Lake Elizalde to the east, and is followed by that of the river Aysen. These two breaches have emptied a large system of lakes, which, in pre-Glacial times, occupied the eastern zone, thus forming a region suitable for colonization in the broad valleys and hollows, where the rivers, as is the case with those in the north, cut through the Andes by narrow gaps, forming cataracts and rapids between the snowy peaks. Volcanic action is still going on in these latitudes, as the glaciers are at times covered by ashes, but the predominant rocks to the east are the Tertiary granite, while to the west gneiss, older granite, and Palaeozoic rocks prevail. The highest peaks, however, seem to be of volcanic origin. Farther north, up to 41° S. lat., the water gaps are situated at a lesser distance one from the other, owing mainly to

more continuous erosion, this section of the continent being the region of the maximum rainfall on the western coast to the south of the equator. Between the gaps of the river Aysen and river Cisnes or Frias, which also pierces the chain, is found a huge mountain mass, in which is situated Mount La Torre, 7150 feet. These form the continental watershed, but in this region erosion is taking place so rapidly that the day is not far distant

when Lakes La Plata and Tontana, situated to the east at a height of 3000 feet, and now tributaries of the Atlantic, may become tributaries of the Pacific. Already flltrations from the former go to feed western affluents through the granitic masses. To the north of Mount La Torre flows in the river Cisnes, 44° 48′ S. lat., across another water gap, continuing the range to the north with high peaks, as Alto Nevado, 7350 feet, and Cacique, 7000 feet. Theglaciers reach almost the western channels, as-is the case at river Quelal. The northern glaciers, descending nearly to sea-level, are situated at 43° 40′ S. lat. To the north of 45° S. lat. a well-defined western longitudinal valley, at some recent time occupied by lakes and rivers, divides the Cordillera into two chains, the eastern being the main chain, to which belong Mounts Alto Nevado, Cacique, Dentista, Maldonado, Serrano, each over 7000 feet high ; Torrecillas, 7400 feet ; Ventisquero, 7500 feet; and Tronador, 11,180 feet; while the western chain, broken into imposing blocks, con- tains several high volcanic peaks such as Mounts Tanteles, Corcovado, Minchimahuida, Hornopiren, and Yates. The rivers Palena, with its two branches, Pico and Carrenleufu, Fetaleufu, Puelo, and Manso, cut the two chains, while the rivers Eefiihue, Bodadahue, and Cochamo have their sources in the main eastern ridge. Mention has been made of active volcanoes in 51°, 49°, and 47° S. lat. , but these have not been properly located. The active volcanoes south of 41°, concerning which no doubt exists, are the Huequen, in 43° lat., and the Calbuco, both of which have been in eruption during recent years.

The surroundings of Mount Tronador, consist- ing of Tertiary granite and basalt, form one of the most interesting regions in the Patagonian Andes for the mountaineers of the future. To the east extends the large and picturesque lake of Nahuel-Huapi, to the west is Lake Todos Los Santos (50 square miles), to which the access is easy and of which the scenery is of surpassing beauty. Between 41° and 38° S. lat., among other smaller lakes, are Lakes Traful (45 square miles), Lacar (32 square miles), which, properly belong- ing to the system of Atlantic lakes, empties itself by the only water gap that occurs in this zone of the Cordillera into the river Valdivia, a tribu- tary of the Pacific, Lake Lolog (15 square miles), Hueohu-lafquen (45 square miles), and Lake Alumine (21 square miles). The volcanoes of Lanin, 12,140 feet; Qnetropillan, 9180 feet; Vil- larica,

10,400 feet ; Yaimas and Tolhuaca are all more or less active ; the first is in the main chain, while the others are on the western slope. The scenery in the neighbourhood is magnificent, the snowy cones rising from amidst woods of araucaria, and being surrounded by blue lakes. WhUe the scenery of the western slope of the Andes is exceedingly grand, vnth its deep fiords, glaciers, and woods, yet the severity of its climate detracts considerably from its charm. The climate of the eastern slope, however, is milder, the landscapes are mag- nificent, with wooded valleys and beautiful lakes. The valleys are already partly settled by colonists. Between 52° and 40° S. lat. the erosion (fractures of the earth's crust) has carried the watershed of the continent from the summit of the Cordillera to the eastern plains of Patagonia.

Between 38° and 33° S. lat. the Andes have been somewhat extensively explored during the last ten years by the Argentine and Chihan Boundary Commissions. The highest peaks are vol- canic, and their eruptions have sensibly modified the character of the primitive ridges. Outflows of lava and tufa cover the mountain sides and ffll up the valleys. The Jurassic and Creta- ceous formations, which, in the Southern Cordillera are situated outside of the range to the east, form to a considerable extent the mass of the great range, together with porphyric quartz, the Tertiary, granite, and other eruptive rocks, which have been observed along all the chain in South America up to Alaska in the north- Gneiss is seldom met with, but there are crystalline rocks, belonging chiefly to the pre-Cordillera of the eastern, and

Scheme op the Andes Kaitoe.

to the Cordillera 4e la Costa on the western side. Silurian, Devonian, and Carboniferous rocks contribute to the formation of the pre-Cordillera, between 80° and 33° S. lat.

Whilst the axis of the Cordillera de los Andes from the south as far as 38° S. lat. is crystalline, to the north of this latitude the geological features change. At this point the range takes a vast transversal development, dividing itself into three separate groups, the easternmost being composed of Jurassic-Cretaceous beds, the central of Mesozoic layers and old eruptive rocks, the western of Tertiary granitic formation, with neo-

voloanic lavas and active volcanoes on its western border. From the volcano of Copahue (height 9787 feet) the Andes take a great transversal extension ; there are no wide intermediate valleys between the different ridges, but the main ridge is perfectly defined. Vol- canic cones continue to predominate, the old crystalline rocks almost disappear, while the Mesozoic rocks are most common. The higher peaks are in the main chain, whilst the Domuyo (15,317 feet) belongs to a lateral eastern ridge. The principal peaks between this and Mount Tupungato at 33° S. lat. are : Mount Cochico, 8255 feet; Campanario, 13,140 feet; Peteroa, 13,297 feet ; Tinguiririca, Castillo,16,535 feet; Volcano Maipu, 17,676 feet; Alvarado, 14,600 feet; AmariUo, 15,821 feet; Volcano San Jose, 19,849 feet; Piuquenes, 17,815 feet; and Volcano Bravard, 19,619 feet.

North of Maipu volcano, ascended by Dr Guss- feldt in 1883, the Cordillera is composed of two very huge principal ridges which unite and ter- minate in the neighbourhood of Mount Tupun- gato. The valley between them is 9000 feet high; and in that part of the Cordillera are situated the highest passes south of 33° S. lat., one of which, the Piuquenes Pass, reaches 13,333 feet, whilst the easiest of transit and almost the lowest is that of Pichachen, 6505 feet, which is the most frequented during winter. Throughout these regions the passes are numerous and of easy access in summer, but in winter they are gene- rally dangerous.

To judge by certain features of this section of the Andes, it would seem that down to modem times, there existed across these mountains very low passes, through which some representatives of the Pampean fauna, such as the Mastodon and Equus, reached Chile, the remains of which have been discovered in the central valley of that country. The Andean glaciers at that time spread themselves down to the plain at the foot of the two slopes which then contained vast lakes, . and where now exist extensive moraines and large erratic boulders. Mount Tupungato reaches 22,829 feet, according to Argentine meas- urement. To the north of this mountain, situ- ated at the watershed of the Andes, extends a lofty region comprising peaks such as Chimbote, 18,645 feet, and Mount PoUeras, 20,266 feet. The Pircas Pass is situated at a height of 16,962 feet. The gaps of Bermejo and Iglesia, in the TJspaUata road, the best known of all

the passes between Argentina and Chile, are at 13,025 feet and 13,412 feet altitude respectively, while the nearest peaks, those of Juncal and Tolorsa, are 19,358 and 20,140 feet high. Mounts Tupungato, Aconcagua, 23,393 feet, ascended lately by Mr Fitzgerald, Mr' Vines, and Sir Martin Conway, and Mercedario, 21,982 feet, are the highest peaks of the central Argentine-Chilian Andes. These three peaks are formed of eruptive rocks, surrounded by Jurassic beds which have undergone a thorough metamorphosis. While in the west of the Andes, from the latitude of Aconcagua, the central valley of Chile runs without any notable interruption to the south end of the_ continent, a valley which almost disappears to the north, leaving only some rare inflexions which are considered by the Chilian geographers and geologists to be a continuation of the same valley ; to the east in Argentine there commenced a longitu- dinal valley perfectly characterized, which runs along the eastern foot of the Cordillera separating this from the pre-Cordillera, which is parallel to the Cordillera de la Costa of Chile. Between Acon- cagua and Mercedario are the passes of Espinacito, 14,803 feet, and Los Patos or Valle Hermoso, 11,736 feet, chosen by the Argentine General San Martin, when he made his memorable passage across the chain during the War of Independence. North of Valle Hermoso the Andean ridges, while very high, are not abrupt, and the passes are more numerous than in the south; some of them descending 10,000 feet, but most of them carrying between 13,000 and 14,000 feet. Pass

Quebrada Grande is 12,468 feet in altitude ; Cencerro, 12,944 feet : Meroedario, 13,206 feet ; Ojota, 14,304 feet ; Paohon, 14,485 feet : wtUe Gordito is 10,318 feet. Farther north the passes are higher. Barahona Pass is 15,092 feet ; Temera, 15,912 feet ; San Lorenzo, 16,420 feet, while the peak of the volcano reaches 18,143 feet ; Mount Olivares, 20,472 feet; Porongos, 19,488 feet: Tortolas, 20,121 feet; and Potro, 19,367 feet.

As far as 28° S. lat. the Cordillera de los Andes has been prin- cipally formed by two well-defined ridges, but to the north, recent voloanio action has greatly modified its orography. Only a single line of passes

characterizes the main ridge, and amongst them are the passes of Ollita, 15,026 feet; Pefias Negras, 14,435 feet; Pircas Negras, 13,615 feet; La Gallina, 16,240 feet; Tres Quebradas, 15,535 feet ; and Aguita, 15,485 feet. To the north of Mount Potro the peaks in the Cordillera are not very prominent as far as the great mass of Tres Quebradas, but here are to be met with some that may be considered as amongst the highest of the whole range. Mount Aguita is 20,600 feet, and the cul- minating peak of those of Tres Cruces reaches 22,658 feet. To the east of the eastern longitudinal valley, at 27° S. lat., commences a high voloanio plateau between the CordUlera and the southern prolongation of the Bolivian Cordillera Real, which contains lofty summits, such as Mount Veladero (20,998), Mount Bonete (21,980), Mount Reclus (20,670), Mount Pissis (22,146), Mount Ojo del Salado (21,653), and Incahuasi (21,719). To the north of Tres Cruces is a transversal depression in the Cordillera, which is considered to be the southern termination of the high plateau of the Puna de Atacama. The Cordillera of the Andes borders the Puna to the west, while the Bolivian Cordillera Real bounds it to the east. In that region the Cordillera of the Andes is of comparatively recent origin, being principally constituted by a line of high volcanoes, the chief summits being those of Juncal, Panteon de Aliste, Azufre or Listarria (18,636), Lullaillaco (21,720), Mifliques (19,357), Socompa (19,948), Licancaur (19,685), Visoachuelas (20,605), Tapaquilcha (19,520), Oyahua (19,242), Ancaquilcha (20,276), Oloa (19,159), Mino (20,112), Sillilica (21,100), Perinacota (20,918), Sa^ama (22,339), Tacona (19,740), Misti (19,029) ; to the east closes in the mtermediary high plateau which commences at 28° S. lat. in Argentina. The principal peaks of the Bolivian Andes and its prolongation from south to north, are Famatina, in the centre of Argentina (20,340 feet), Laguna Blanca (18,307), Diamante (18,046), Caohi (20,000), Granadas, Lipez (19,680), Guadalupe (18,910), Chorolque (18,480), Cuzco (17,930), Enriaca (18,716), Junari. (16,200), Michiga (17,410), Quimza^Cruz (18,280), lUimani (21,190), and Sorata (21,490), the last two of which were climbed by Sir Martin Conway.

While the western range of the Cordillera is principally formed by volcanic rocks, the eastern (to the east of the range is Cerro Potosi, 15,400 feet) Andes of Bolivia are chiefly composed of old crystalline rocks. Between the ranges in the high plateau north to 27° are numerous

isolated volcanoes Which have been in activity in recent times, such as Peinado (18,898 feet), San Pedro (18,701), Antoco (19,029), Antofalla (20,014), Rincon (17,881), Paatos Grandes (17,553), Zapaleri (17,553), Suniquira (19,258), Tahue (17,458) ; volcanoes which have been eleyated from a lacustrine basin, which very recently occupied the whole extension, and the remains of which are in the south, the liaguna Verde, at 28°, and in the north Lake Titicaca. The discovery of great Pampean mammals in the Pleistocene beds of that region shows that this upheaval of the latter is very recent, for in the heart of the Cor- dUlera, as well as on the west coast of Bolivia and Pern, there have been discovered, in very recent deposits, the remains of some mammals which cannot have crossed the high range as it now exists.

The two Cordilleras that formed the Andes to the north of 28° S. lat. are continued in Peru, with the same characteristics — the western, chiefly volcanic, while its basis is crystalline ; and the eastern, composed of green mica slate, primitive clay-slate, and granite, the more important of the two, which is cut by many large rivers, affluents of the Amazon, and which abuts on Ecuador. The western, which reaches an altitude of about 10,000 feet, then ceases to exist as a continuous chain, there remaining only a short, high ridge, called by Whymper the "Pacific range of the equator," and between this ridge and the crystalline Andean axis, the " avenue of volcanoes," to use his words, arises amidst majestic scenery. Chimborazo, which is not in the main chain, reaches 20,517 feet, Cotopaxi (19,580 feet), Antisana (19,260 feet), Coyambo (19,200 feet), are in the eastern range, with many other peaks of over 16,000 feet, which still contain glaciers. Under the equator, Sangay, 17,380 feet, according to Wolff, appears to be the most active volcano in the world. Pichincha, 15,804 feet, and Cotocachi, 16,297 feet, are the loftiest volcanoes of the western range. The Colombian Andes have recently been liie subject of careful exploration. The three prin- cipal chains are continuations of those under the equator, but show very slight traces of volcanic action. In the western chain, which is remarkable for its regularity, the feighest peak is

11,150 feet, and the lowest pass 6725 feet. The longitudinal valley of Canca forms the middle depression. The two chains appear to unite in the

mountains of Antioquia. The eastern chain, separated from the central chain by the Magdelena de- pression, beginning no^'th of the equator at 6000 feet, gradually rises to the height of Nevado, 14,146 feet. Pan de Azucar, 12,140 feet, and in the Sierra Nevada de Cochi attains to peaks of 16,700 feet. The predominant rocks are gneiss, crystalline slate, and granite, and some Cretaceous and Tertiary shales. The central chain is unbroken, and . is the more important of the two, owing to its greater altitudes, and is of volcanic character. To the south, near the equator, are Mounts Arapul, 13,360 feet, and Chumbul, 15,720 feet. The volcanoes Campainero, 12,470 feet, and Paste, 14,000 feet, are also in that zone. Farther north is the volcano Purace, which presents a height of 16,000 feet; then come Huila, 18,000 feet; Santa Catalina, 16, 170 feet; and Tolima, 18,400 feet; Santa Isabel, 16,760 feet; Ruiz, 17,390 feet ; and Hervas, 18,340 feet.

*Authorities. — John B. Minchin. "Journey in the Andean Tableland of Bolivia," I*roceedings of Geographical Society, 1882. — Dr Paul Gussfeldt. Seise in den Gentralen Chileno-Argenti- nischen Andes. Berlin, 1884. — John Ball. Notes of a Naturalist in South America. London, 1887. — ^Dr Alfred Hettner. Eeisenin den Colombianischen Andean. Leipsio, 1888. — Edward Whymper. Travels amongst the Great Andes of the Equator. London, 1892. — Teodoro Wolfp. Geografia y Oeologia del Ecuador. Leipsic, 1892. — ^E. A. Fitzgerald. The Highest Andes. London, 1899. — Sir Martin Conway. "Explorations in the Bolivian Andes," Geographical Journal. London, 1899. — Dr Carl Burckhard. "Expedition g^ologique dans la Region Andine, 38°-39° S. lat."— -Dr Leg Wehrli. "CordiUfere Argentino-Chilienne, 40° et 41° S. lat.," Sevista del Museo de La Plata, 1899. — F. P. Moreno. "Explorations in Patagonia," Geographical Journal. London, 1900. — Hans Steffen. "The Patagonian Cordillera and its Main Rivers, between 41° and 48° S. lat." Geographical Journal. London, 1900. — Paul Eruger. Die Chilenische Benihue Expedition. Berlin, 1900. — Carl Burck- hard. " Profils gfiologiques transversaux de la Cordillera Argentino-Chilienne," Anales del Museo de La Plata, 1900; Argentine-Chilian Boundaries in the Cordillera de los Andes, Argentine Evidence. London, 1900. (p. p. m.)*

Andes, Los, a state of Venezuela, formerly bounded on the N. by the states of Zulia and Lara, on the S. and E. by the state of Zamora, and on the W. by Colombia and a portion of Zamora. It had an area of 14,719 square miles, and a population estimated at 366,000. This area was recently divided into two states, Los Andes and Trujillo.

Andijan, a dictrict town of Eussian Turkestan, pro- vince of Ferghana, terminus for a time of the Transcaspian and Turkestan railway, lying 73 miles E.N.E. of Kokand on the left bank of the upper Syr-daria ; altitude 1510 feet. It was formerly the residence of the Khans of Kokand, and is described as one of the most pleasant cities of Ferghana, on account of its beautiful gardens and large park situated in the midst of the town. A canal derived from the Syr waters these gardens, as well a^ the fields round the town. The cotton-tree being much grown in the district, Andijan is a centre for the trade in raw cotton, and has moreover nearly twenty factories for cot- • ton cleaning, and several important firms. Andijan mer- chants, with their goods, are met with all over Central Asia. Population (1897), 46,680.

Andorra, or Andoeeb, a small neutral, autonomous, semirindependent state, with an area of 191 square miles, situated chiefly on the peninsular side of the Pyrenean chain. Its population, according to some estimates in 1887, was between 6000 and 12,000, but no trustworthy census exists. Its six parishes are subdivided into fifty- two pueblos or hamlets. The Andorrans are fond of the chase and of fishing in their streams. The more well-to-do classes now talk French fluently, and get their children educated in France. During the coldest winter months their communications are much easier with Spain thaji through the snow-clad passes leading into the Arifege. The local industries are of the most primitive kind,

merely domestic, as in the Middle Ages. Lack of capital, of coal, and of good means of communication, prevents the inhabitants from making use of the iron and lead mines that abound in their mountains. They rear

flocks of sheep, goats, cattle, and some pigs. The only roads are bridle-paths, and one municipal road by the Balire Valley, connecting Andorra with the highroad to Seo de Urgel and Tarruga. There is a scheme for extending a branch of the projected NoguerarPallaresa railway to Seo de Urgel, close to Andorra. The climate is cold in general, and bitterly so in winter. There are some sheltered spots on the southern side of the Pyrenean chain, called Solanas, where the climate is milder, and there the soil is better cultivated, producing some fruit and agricultural products for a small export trade. Milk, butter, hams, skins, and wool are sent to Prance. The French viguier is taken from the French department of Arifege and appointed for life, but the viguier of the bishop must be an Andorran, holding office for three years and re-eligible. There are notaries and clerks, auditors for each parish elected by the heads of families, police agents and bailiffs, chosen and sworn in, like all the above officers, by the councU. general. The archives are mostly kept in the " house of the valley " in the capital, Andorra Vicilla, a struggling village of 600 inhabitants. This Government house has no merit beyond the fact that in it the council general meets and has a chapel, and in it the aldermen, viguiers, and judge of appeal administer justice and assemble for all purposes of administration. Two magistrates, styled rahanadores, are appointed by the council general to see that viguiers and judges preserve the customs and privileges of Andorra. The parishes have a permanent patrol of six armed men, besides the militia. Spain and the bishop of Urgel are very jealous of French encroachments, and claim to have a better right to annex the little state some day. In the meanwhile it continues to pay each of the " coprincipes " £40 a year, levied by a tax on pastures.

Berthet. Levald^Andorre. Paris, 1879. — Moieas. Ooutumes du pays d' Andorre. 1882. — Baddon de Mouy. Origines historiques de la question d^ Andorre. 1885.^ — Vuiluer. Le val d Andorre. The Valley of Andorre. Riverside Press, Cambridge, with good map. (a. e. h.)

Andover, a municiparborough and railway station, in the Andover parliamentary division of Hampshire, England, on the Anton, 12 miles N.W. by K". of Win- chester. In 1889 a recreation ground was opened. In

1891 the waterworks were acquired by the corporation. Area of borough (a parish), 8662 acres; population

(1881), 5653; (1891), 6852; (1901), 6000.

Andover, a town of Essex county in north-eastern Massachusetts, U.S.A., having an area of 33 square miles. It is situated on the south bank of the Merrimac, where the surface of the country is broken by small Glacial hUls. The Theological Seminary here had in 1898 eight instruc- tors and 41 students, and Phillips Academy had af acuity of twenty professors and was attended by over 400 students. Population (1880), 5169; (1890), 6142; (1900), 6813. ”

Andovoranto. See Madagascak.

Andrassy, Julius, Count (1823-1890), Hun- garian statesman, was born at Zemplin in the north-east of Hungary, 18th March 1823. His father. Count Charles (the representative of a family which had been settled in Hun- gary about 250 years), was a man of considerable literary and scientific attainments, and was therefore (as were all who cared for the prosperity of the country) a member of the national and Liberal opposition to the deadening government of the Austrian bureaucracy. Julius and his elder1)rother Emmanuel were therefore, from their earliest

years, brought up to believe in the excellence of political liberty, and they were enabled by travelling to become acquainted with countries which enjoyed the free exercise of those institutions which the Government of Metternich refused to Hungary. His political master was Count Szechenyi, who has been called the greatest of the Hungarians. The two brothers were elected in 1847 members of the Hungarian Diet ; they joined the Oppo- sition, which was led by Louis Batthyany, Deak, and Kossuth. Andrassy soon distinguished himself by his speeches ; he was one of those who first claimed to use Magyar. He had a charm of manner and gallantry which would have made him a favourite anywhere, and com- pletely won the hearts of the susceptible Hungarians. As the differences between the aristocratic party and Kossuth became serious, Andrassy was on the side of Kossuth ; he supported him through all the stormy events of 1848, and he accepted the post of prefect of the county of

Zemplin in order to carry out the internal reforms which the democratic party desired; he paid special attention to the organization of the militia. In the civil war of 1848 against the Croatians he took part at the head of the corps he had, organised, and was present at the battle of Schwechat, when the Hungarians crossed the frontier and attacked the imperial troops on Austrian soil. He continued his association with the Government of national independence, and in 1849, when the in- terference of Bussia became imminent, he went on a mission to Constantinople to ask for the aid of the Turks. In this he failed, but the Sultan promised to protect Hungarian refugees, a promise which was honourably kept, and which the Hungarians have not forgotten. Andrassy escaped the fate of many of his colleagues by flying from the country, but he was condemned to death under martial . law and hanged in effigy. He spent the next years of exile in France and England, and acquired a very thorough knowledge of the customs and institutions of these coun- tries ; like so many of his countrymen he was an excellent linguist. He was pardoned by the emperor in 1856 ; on his return to Hungary he joined the party of Deak, who claimed the independence of the country, but hoped to attain it by reconciliation with the house of Hapsburg, a policy which was bitterly opposed by Kossuth and his followers. He sat in the Diet of 1861, but refused to recognize it as a substitute for an independent parliar ment, and during the following years he was very active in gaining support to the principles of the Moderates. His opportunity came in 1866. He took a leading part in the negotiations which led to the establishment of the "Ausgleich"; he was greatly instrumental in winning the confidence of the emperor and empress, and is said to have suggested the peculiar form taken by the Common Parliament or "Delegations." Deak was offered the post of minister-president of Hungary under the new constitution, but refused to take office; he suggested the name of Andrassy, who, he said, had been « sent by Pro- vidence." There was no one who could rival Andrassy's claims to be the first national Hungarian minister. As an old revolutionary he could command- the adhesion of his former companions in exile ; his birth and his early connexions won for him the support of the Liberal aristocracy, and he had the confidence of the emperor. He held this office for over four years, and quickly made political liberty and constitutional Government a reality, introducing full freedom of the press and of public meet- ings, granting political freedom to the Jews, and

establish- ing the national militia or Honved, in which he took great personal interest. He exercised considerable influence on the foreign policy of the empire, and helped to keep in check the anti-German influences at Vienna. In 1870 he threw his weight decisively on the side of a public

declaxation of neutrality. In 1871 lie was called to Vienna to use his influence in order to prevent the emperor accepting the federalistic scheme of Hohenwart. Andrassy represented that it would destroy the organi- zation of the dual monarchy, and offered his resignation if it was carried out. The result of the crisis was that Hohenwart was dismissed, and Andrassy received the portfolio for foreign affairs for Austria-Hungary after the fall of Beust. The most important achievement of his policy in the new post was the establishment of a close understanding with Germany. Th^ beginnings of this had been laid by the friendly relations which Bismarck had already established with the Hungarians. This led also to a better understanding with Russia, and Andrassy was much attacked in Hungary for his Eussophile policy. He succeeded, however, in averting a war with Eussia, which might easily have arisen out of the Balkan compli- cations ; by the " Andrassy Note " of 1876 he attempted to settle these by agreement with Eussia. The summon- ing of a European congress to discuss the terms of peace imposed on Turkey by Eussia was to a great extent owing to his initiative, and he brought it about that the admin- istration of Bosnia and Herzegovina should be offered to Austria-Hungary. His policy in this was strongly attacked at home, both by the Hungarians and Germans, and the discontent was increased by the difficulties with which the occupation of the provinces was attended; he had failed to anticipate the opposition with which the Aus- trian troops were met. It was partly this discontent which led him in the summer of 1879 to offer his resig- nation, a step which has also been attributed to private reasons ; he was, moreover, dissatisfied that he was unable to have some internal reforms carried in Hungary. It is probable that he did not expect his resignation to be accepted; or if it was, he undoubtedly hoped

soon to return to office. His position as the first of living states- men in the dual monarchy was so assured that he might well believe he was indispensable. His resignation was, however, accepted. Before he left office, he completed the work he had already begun by arranging with Bis- marck a formal alliance of Germany and Austria-Hungary for mutual defence against Eussia. By this he had placed the European position of his country on a secure basis. The best proof of the wisdom of his policy is that it has been continued by all his successors.

Andrassy lived till 1890 ; he was never again offered office ; he could have forced his way back to power had he chosen to use his great popularity for this purpose ; but, with a magnanimity which is not too common, when he spoke in the parliament it was to help and support his successors ; his criticisms he reserved for private inter- course. He died 18th February 1890. Andrassy is undoubtedly one of the most interesting figures of recent history. It has often been said of him that he cared more for the appearance than the reality ; he thought too much of outward effect. He had little patience for the details and routine of departmental work, and was intol- erant of slowness and stupidity. He had, however, a quick power of seizing the essential factors in a situa- tion; his mind was eminently sober and practical; he saved his country from the dangers into which it would have fallen had full freedom been given to the ideals of Kossuth and his followers, or to the anti-Eussian pas- sions which were so strong. He is identified with two great political achievements, the system of dualism and the alliance with Germany ; both have justified them- selves by the test of experience. More than this, it is largely ^due to his personal infiuence that from the begin- ning it was made apparent that in the partnership between Austria and Hungary the latter was the stronger mem- ber ; and so long as he was foreign minister he secured

for the dual monarchy a position in European affairs which it had not had for many years.

(j. W. HE.)

Andrews, Thomas (1813-1885), Irish chemist and physicist, was born on 19th December 1813 at Belfast, where his father was a linen merchant. After attending the Belfast Academy and also the Academical Institution,

he went to Glasgow to study chemistry under Professor Thomas Thomson, and thence migrated to Trinity College, Dublin, where he gained distinction in classics as well as in science. He next spent some time in Paris, in the laboratory of the famous chemist Dumas, and finally, having graduated as M.D. at Edinburgh in 1835, settled down to a successful medical practice in his native place. Ten years later he was appointed vice-president of the newly-established Queen's College, Belfast, and professor of chemistry, and these two offices he held till 1879, when failing health compelled his retirement. He died 26th November 1885. Andrews first became known as a scientific investigator by his work on the heat developed in chemical actions, the Eoyal Society awarding him a Eoyal medal in 1844. Another important research was devoted to proving that ozone is a definite body, an allo- tropic form of oxygen, containing ,three atoms in the molecule instead of two, as is the case with the ordinary gas. But the work on which his reputation mainly rests and which best displayed his skill and resourcefulness in experiment was concerned with the liquefaction of gases. He carried out a very complete inquiry into the laws expressing the relations of pressure, temperature, and volume in carbonic acid gas, in particular establishing the conceptions of critical temperature and critical press- ure, and showing that the gas passes from the gaseous to the liquid state without any breach of continuity.

Angers, chief town of department Maine-et-Loire, France, and an important centre for several railway lines, 188 miles S.W. of Paris. There is a HStel-Dieu, now a civil and military hospital; but it is the Hopital-Ste-Marie, a large modern buUding with 1600 beds, that takes the place of the ancient H6tel-Dieu or Hospice St Jean, said to have been founded by Henry II., which i& now occupied by the archaeological museum. The public library, contained in a fine edifice dating from the 15th century, has been much enlarged. Palseontological and antiquarian museums are also housed in ancient buddings of considerable interest. A 12th-eentury clock tower is part of the ancieiit abbey of St Aubin. The Palais de Jus- tice is a modern building in the Champ de Mars. Amongst educational institution's may be noted a national school of arts and handicrafts, a free school of design, and a •school of pharmacy. Manufactures of umbrellas, boots and shoes, iron goods, cables, and copper ware, have become

important. In the vicinity are many nursery gardens. Large stoct fairs are held, and there is con- siderable trade in hemp, flax, and other agricultural produce. Electric tramways connect with the suburbs. Population (188*1), 68,571; (1891), 62,391; (1896), 69,484, (comm.) 71,119.

Angiosperms. — ^The term " Angiosperm " (ayyciov, receptacle, and a-iripfm, seed) was coined in the form Angiospermae by Paul Hermann in 1690, as the name of that one of his primary divisions of the Plant Kingdom which included flowering plants possessing seeds enclosed in capsules, in contradistinction to his Gymnospermse or flowering plants with achenial or schizocarpic fruits — the whole fruit or each of its pieces being here regarded as a seed and naked. The term and its antonym were maintained by Linnaeus with the same sense, but with restricted application, in the names of the orders of his

class Didynamia. Its use ^ith any approacli to its modern scope only became possible aiter Eobert Brown had established, in 1825, the existence of truly naked seeds in the Cycadeae and Coniferse entitling them to be correctly called Gymnosperms. From that time onwards, so long as these Gymnosperms were, as was usual, leckoned as dicotyledonous flowering plants, the term Angiosperm was used antithetically by botanical writers, but with varying limitation, as a group-name for other dicotyledonous plants. The advent in 1861 of Hofmeis-ter's brilliant discovery of the changes proceeding in the embryo-sac of flowering plants, and his determination of the correct relationships of these with the Cryptogamia, fixed the true position of Gymnosperms as a class dis- tinct from Dicotyledones, and the term Angiosperm then gradually came to be accepted as the suitable designation for the whole of the flowering plants other than Gymnosperms, and as including therefore the classes of Dicotyledones and Monocotyledones. This is the sense in which the term is nowadays received and in which it is used here.

The Angiosperms and the Gymnosperms together compose the group of Spermophytes — ^also named Phan- erogams— Seed Plants or Flowering Plants. The expres- sions seed plant and flowering plant convey the essential character of the group. The seed is the product of the flower — ^the conception of the flower implies that of the seed. In no other group of plants is there a seed or a flower, although the terms are sometimes loosely used with reference to plants of lower organization. The trend of the evolution of the plant kingdom has been in the direction of the establishment of a vegetation of fixed habit and adapted to the vicissitudes of a life on land, and the Angiosperms are the highest expression of this evolution and constitute the dominant vegetation of the earth's surface at the present epoch. There is no land-area from the poles to the equator, where plant- life is possible, upon which Angiosperms may not be found. They occur also abundantly in the shallows of rivers and fresh-water lakes, and in less number in salt lakes and in the sea ; such aquatic Angiosperms are not, however, primitive forms, but are derived from immediate land-ancestors. The varying climatic or enviroimiental conditions to which Angiosperms may be ^^^"^^ exposed in their wide distribution, including those of the soU, edaphic, those of the atmosphere, epedaphic, and those of water, aquaiic, find their response within the limits of phylogeny, in the external form and internal structure exhibited by the plants. Angio- sperms of a tropical forest, for example, are manifestly of different form from those of an alpine region,, or again Angiosperms growing submerged in a lake have features readily separating them from plants of a desert plain ; the differences are not confined to points of their out- ward form, but obtain throughout their internal structure. The study of the relationships of Angiosperms, as well as of other plants, to their environment has in recent years become a fascinating and productive fi.eld of botanical work to which has been given the designation " CEcology " (sometimes written " Ecology "). Prom the standpoint of their relation to environment Angiosperms fall into the three main categories of Oeophytes, Aerophytes, Hydro- phytes. Geophytes are plants adapted to a land-life with fixation in the soil, and therefore they are subject to the influence of both edaphic and epedaphic factors of en- vironment. Aerophytes are adapted to a land-life with fixation upon another plant, and are therefore subject to the influence of epedaphic factors of environment only. Hydrophytes, being adapted to life*

in water, whethef f ree or 'fixed, are subject to the influence of the aquatic environment alone. These categories are not altogether

sharply distinguishable, and many plants have the capa- city of dual adaptation; e.g., Batrachian Ranunculi may be either hydrophilous or gec^hilous ; Ficus bengalensisaa a juvenile is aerophilous, but geophilous when adult.

I. Geophytes. — Geophytes overwhelmingly predomi- nate in the world, and from them we derive our concept of the typical Angiosperm, which for the per- formance of its life-work has two series of ^^^^/'^^ vegetative organs severally adapted to the tion.'"' media — soil and atmosphere — in which they are exposed. They are the root or descending system and the shoot or ascending system composed of stem and leaf. To the root belongs the special work of fixing the plant in the soil and of absorbing material for food in a liquid state. To the shoot is assigned the special task of taking in material for food in a gaseous form from the atmosphere and of absorbing the radiant en- ergy of the sun.

The primary root formed at the base of the embryo pierces the soil as a main radially-constructed orthotropous root, from which lateral endogenetio plagiotropous rootlets branching like the mother proceed. Roots elongate by means of an intercalary pluricellular growing point covered by a protecting root-cap, and bear over a short distance close behind the point a covering of short-lived active hairs, the agents alike of fixing and absorbing.

The depth to which the root-system of Angiosperms penetrates the soil is apparently conditioned by the needs of respiration, and even in plants with highest shoot- development in temperate regions is not over 4 feet, save in exceptional conditions. The growth in length of the main root is therefore soon arrested. The horizontal extension of the lateral roots is practically indefinite. The elongation and persistence of the primary root is a characteristic feature of dicotyledonous Angiosperms, and is in marked contrast with what is commonly found in Monocotyledones and in Pteridophytes, and is evidently correlated with their more elaborate

develop- ment of shoot. Where the primary root elongates in Monocotyledones it rarely persists for any time, even in cases where there is a considerable bulk in the shoot- system ; the root-system is then provided by adventitious roots from the stem.

The primary shoot-axis has two portions — the hypocotyl with its cotyledon or cotyledons, the portion first formed in the embryo, and the epicotyl, which in the embryo exists as the plumular'bud. The latter elongates as a radial orthotropous axis, with a terminal pluricellular growing point of indefinite growth covered more or less by incipient leaves, both scale-leaves and foliage-leaves, to form a leaf-bud, and these arise from nodal points as exogenetic outgrowths, commonly dorsiventral and of limited intercalary basipetal growth. Branches like the parents, but plagiotropous and often dorsiventral, arise exogenetically in the axils of the leaves. The leaves (as also their axillary branch) have a definite position — spiral or cyclic — upon the stem.

The degree to which the shoot is developed and its duration above ground have given origin to the popular designations herb, 'shrub, tree, and these terms, although not capable of scientific definition,, for ^^' the forms they indicate pass one into the otter, are nevertheless landmarks in outward form development — growthrforms — in relation to climatic factors, and are therefore of cecological value. To them may be added liane, as the designation of a subsidiary form of wide- spread occurrence. A herb being a plant — annual or perennial — which loses and renews its shoot-growth from year to year, and often also loses and renews its root- system, does not rise to any great height above the soil. It is therefore not greatly exposed to air-currents, and it may for a considerable portion of the year be subterranean and consequently under more equable conditions than when above ground ; it dwells in 1a moist stratum of the

atmosphere and may readily be overshadowed % other plants. Herbaceous growth makes a carpet of vegetation upon all areas of the

earth's surface, but is essentially a feature of temperate regions. Trees, on the other hand, have a persistent agrial trunk with copious shoots, and they are therefore woody and may be evergreen or have deciduous leaves. Their growth brings them into atmo- spheric strata drier than those near the soil, where they are more exposed during the whole year to air currents and to every change of temperature, and where they are not liable to be overshadowed except by their fellows. Tree-growth then may be said to affect moist sheltered areas ; cold dry wind-swept regions, for instance the polar and alpine, are treeless. As the intermediate form between herbs and trees the shrub merges into both, and is found along with or replacing them in all areas. The liane may partake of the character of each of the preceding forms, but its special feature is that rooting in the soil it makes use of the support of other plants to secure an extension and exposure in the atmosphere, and in this way may attain a length of many yards. To this end it may adopt the habit of a twining stem, or it may climb by means of modifications of its organs, such as prickles, hooks, leaf- tendrils of various degrees of conversion, and stem-tendrils of kinds. Liane-growth is found in all areas of vegeta- tion, except, and for obvious reasons, in polar and alpine regions, but it reaches its maximum development in the tropics, where woody twining stems and stem-tendrils are specially developed.

A fundamental character of Angiosperms, as indeed it is of all plants excepting the unicellular Protophytes, but one which is too often lost sight of in the Colonial study of their economy, is their colonial organi- «oa. zation. The living plurinucleated protoplasm of

the plant-body is spread over the skeletal sup- port furnished by the cells of the root and shoot, and in the more highly differentiated forms occupies but a small area of the whole body of the plant. Each living cell encloses an energid (a portion of the protoplasm dominated by a nucleus) which is connected by protoplasmic threads piercing the cell-membrane with the adjacent energids, and thus the protoplasmic body forms one continuous whole in the plant. (See Cttologt.) Accorduig to their position in the organism, the primary cells become devoted to the formation of special tissues building up the organs required for the discharge of the several lif e-fimctions of the plant, but nevertheless each living cell must

be regarded as a potential protophyte, whilst its actual destiny is determined by its relations to the other cells. This colonial organiza- tion of the Angiosperm enables it to have growth pro- longed in one direction whilst this is arrested in anottier, to throw off effete and old parts of its body without mutilar tion, and to renew or replace them as required ; all tissues which pass out of the sphere of active life are not, however, thrown off, for it is a marked feature of Angiosperms that such tissues, and many excreta also, may be enclosed by the living ones and remain unchanged so long as they are unex- posed to the putrefactive influences of the atmo- oi'me"" sphere. The fixedorganism as awhole is endowed with what we may term potential immortality — a character in sharp contrast with the relatively short period of life of the motile individuals of the higher mem- bers of the animal kingdom. We have but little accurate information bearing upon the actual longevity of Angio- sperms by which to judge whether their theoretical ex- pectation of life may come to realization. Perennating herbs and under shrubs probably approach most nearly to its fulfilment. Shrubs and trees expose themselves by their aerial growth to many accidents which militate against great length of life ; nevertheless there are authen- tic instances of trees, for instance Ficus religiosa, whose

years must be cotmted by thousands. On the other hand many Angiosperms are pronouncedly short-lived, passing through birth, vegetation, reproduction, and death within a few months.

For an account of the internal organization of Angiosperms, see Anatomy of Plants. The primary disposition of the permanent tissues in an Angiosperm is determined hy the necessity of pro- viding an ample mechanism for carrying water from the absorb- ing ends of the roots to the other seat of absorption of food material m the leaves, and to all growing points for the mainte- nance of turgidity ; the carrying system therefore dominates the anatomy, its position and form in each organ having relation to the strain to which the organ is liable. In Dicotyledones the monostelic system adniits of an indefinite extension of the area of the carrsdng system to keep pace with the growth aijd extension of the often ample perennating shoot-system, and this has con- tributed largely to the establishment of tiie group as the dominant vegetation of our day. The

polystelic condition so common in Pteridophytes is occasionally found, but only in forms which are not progressive. The absence of this capacity of increase of the carrying system in Monocotyledones is probably one of the factors- which have led to their insignificant development as tree-forms as compared with Dicotyledones.

Though the geophyte responds in some degree in the configuration of its vegetative organs to all the physical and chemical conditions of it's environment, we „ have as yet but little certain knowledge of the meat and effect to be ascribed to some of these or of the contigura- manner of their operation. Nor are we able as ""•• yet, even in the case of those factors of which we know most, to determine clearly in every instance how far their influence is controlled by intrinsic causes, expressed for instance in correlation, or is modified in combined action with other factors. We know that the direction and dis- position of the parts of the root and shoot are directly influenced by the stimulus of gravity, and also that radial and dorsiventral constructions are often conditioned by light which also may induce anisophylly and the flatten- ing of organs ; light also may be a direct cause in provok- ing a difference in form between the juvenile and adult foliage, with the result that the organs concerned in car- bon-dioxide-assimilation and in the absorption of energy are exposed in the most favourable manner to illumination. The direct influence of light in formation of chlorophyll is well known. Configuration appears to be but little directly influenced by temperature excepting perhaps by extreme cold, and we can seldom say by consideration of its outside whether a plant inhabits a warm or a cold cli- mate, notwithstanding the paramount influence tempera- ture exerts in the distribution of specific forms. The most influential environmental factor in relation to form and structure is unquestionably water. Water-carriage within the plant determines its anatomy, and the safeguarding of the water-supply alike at its intake in the root-system and at its outgo by transpiration and by transudation in the shoot, is a prime concern of the vegetative organization of geophytes, and is modified in relation to the amount of water available for the functional purposes of the plant. This does not always correspond with the actual amount of water in the physical environment, and a plant may be in a condition of physiological drought in the midst of an abundance of water. When there is a risk of physiological drought — as in areas

*where the absorption of water from the soil is hindered, *™" ^' e.g., by a scant amount of water, by too much dissolved salt, by humus, or by low temperature, as well as where transpiration and transudation are facilitated, e.g., by the dryness or high temperature of the atmosphere, by low barometric pressure, and by intense light — the plant responds and means are developed to promote the intake and check the outgo. For the former there may be an increase of the whole root-system and of the absorbing*

hairs, as well as of the carrying vasa ; for the latter there is great variety of method in relation to other cecological factors. There may be a reduction in the amount of the transpiration-surface by the shortening and thickening of the stem and the foliage-leaves, or even by the suppression of the latter (aphylly) leading to stem-assimilation, the development of cladodes, and the production of non- transpiring thorns, while by the formation of vertical leaves and phyllodes the effect of insolation is restricted. Obstacles to transpiration are created by increase in thickness and in cutin-content of the outer wall of the epidermal cells, by the sinking of the stomata, by the development of a covering of hairs, or in compound leaves by collapsing movements. In many cases water-storage of kinds is provided, from which loss may be supplied and succulence of stem {chylocavJLy) or of leaf (chylophylly) is developed. An increase in the sclerenchyma-tissue of stem (sderocauly) or of leaf (sderophylly) and an elonga- tion of the palisade-cells of the leaf are also accompani- ments of this adaptation. Such adaptations are termed aoerophilous, and plants exhibiting them are Xerophytes. The conditions which induce the xerophilous structure are conspicuously and most typically found in desert areas, but they also, in varying degree, surround plants growing on the surface of rocks {Lithophytes), in rock-fissures {Ghasmophytes), on sandy porous ground (Psammophytes), on the shore (Halophytes), on peat-moors (Ericophytes), and elsewhere. In marked contrast with xerophilous configuration and structure are the

hygrophilous features which characterize Hygrophytes or plants Hygrop ly. ^j^j^^jj g^pg jjq^^ qj Qjjiy rarely and temporarily,

liable to any danger from deficiency of water-supply. Here the presence of a feeble absorptive root-system and an extended surface of the shoot for transpiration and transudation are the outstanding points. The latter is exhibited in the elongated stems which do not bear thorns, although prickles are not uncommon, the large surface and the thinness of the leaves which frequently have ” dropper tips ” or other arrangements for quickly throwing off water, the large air canals, abundant and exposed stomata, and many hydathodes. The risk to hygrophytes lies in their exposure to strong insolation or to prolonged air currents, and these may cause flagging of the organs ; but loss from such causes is soon recovered, and may be provided against by water-storage in or near the epidermis. Hygrophytes occur in moist areas, and are particularly abundant in the tropics. The degree to which xerophilous or hygrophilous construction is developed varies, and some plants exhibit ‘ a seasonal alternation of these characters, and Tropopbiiy. j^^ve been therefore termed Tropophytes. In the wet or warm season they are hygrophilous, in the dry or cold season they are xerophilous. The feature dis- tinguishing them is the casting of the greater portion of their transpiration-surface at the beginning of the period when there is a risk of physiological drought, by the dying down of the anniial shoots of herbs, and by leaf-fall and branch-fall of shrubs and trees. That this is a pre- paration for physiological drought every gardener may see when he transplants such an evergreen as a holly. Deciduous-leaved trees and shrubs of temperate regions have hygrophilous foliage, but the stems are xerophi- lous, being protected by cork, and the buds are envel- oped in scales, resin, and so forth. Evergreens of temperate regions have xerophilous leaves, their young leaves alone showing hygrophilous characters. Any one of the growth-forms — herb, shrub, tree, liane — ^may ex- hibit features of xerophily, hygrophily, or troj)ophily, and their adaptations upon these lines determine the physiognomy of vegetation within the thermal zones of the globe.

Angiosperms (like Gymnosperms) are heterosporous, as

are some of the Pteridophytes, but unlike these they do not spread by the scattering of the megaspores. g^„g. On the contrary the megasporangium remains genetic persistently closed and attached to the spori- nproduc- ferous plant, whilst the megaspore which it ”””• contains (for there is commonly but one) germinates within it and produces the structures which are the homo- logues of the female gametophyte of the Pteridophytes with its female gametes. Nor does this intrasporal development cease here. Conjugation of the male and female gametes takes place within the spore, as does also the subsequent segmentation of the resulting zygote, and its further development through the stage of pro- embryo to the formation of the perfect embryo of a sporophyte. There is thus produced in the position of the original mega- sporangium a body consisting, in its simplest form, of a, coat to the outside composed of the wall of the mCgar sporangium and of the wall of the megaspore, bothof them much altered, and within of au embryo sporophyte. This body is the seed. For a longer or shorter time it remains attached to the sporiferous plant, and its ultimate separa- tion provides for the spread of the angiospermous plant. It is this character — of a closed megasporangium and the development of seed — which separates sharply the Angio- sperms and the Gymnosperms from all other classes in the plant kingdom, and which makes so apt their designation in one group — ^the Spermophytes. The exigencies of their adaptation as a land-vegetation have made the develop- ment of sexual cells in them not a first charge upon an independent or nearly independent organism arising from a spore, as is the case in the Pteridophytes, but these appear as late products on a vast vegetative structure through which the outcome of their coalescence, the embryo, can be nourished for a time, and from which it is subsequently shed, well protected in the seed-coat to withstand climatic vicissitudes yet ready to take its position as a new plant whenever environmental conditions permit. The risk of failure of sexual reproduction through non-propinquity of the essential energids overhangs the higher Pteridophytes at two stages of their life history, and frequent actual failure may have hastened their retro- gression as a dominant vegetative type ; there is first of all thatof non-association on the same nidus of the fortuitously distributed microspores and megaspores, and second that of a missing of coalescence of the male and female gametes, inasmuch as the act involves a sufBciency of moisture

for germination, and through which the male gamete must actively move to its goal. In the Angiosperms this risk is, to their advantage, reduced to a single one, that of a mishap in pollination, for the avoidance of which have been developed the elaborate contrivances which make up the flower of to-day.

The part of the Angiosperm through which the format tion of seed takes place is the flower. This is a shoot, bearing sporangia which contain spores, both sporangia and spores being concerned in the pro- duction of the seed. Function as well as struct- ure is therefore involved in the conception of flower. Sporangiferous shoots resembling those of some Angio- sperms are found outside the Spermophytes in, for ex- ample, Selaginella, and they have the structural features of flower, but they do not form seed, and are therefore not flower. Nowhere, except in the Gymnosperms and Angio- sperms, do we find such sporangiferous shoots implicated in the physiological processes which result in the seed. Thfe microsporangia (pollen-sacs) containing microspores (_pollen-grains) and the megdsporangia (ovules) contain- ing megaspores (embryo-sacs) are enclosed in leaves, respectively, the microsporophylls (stamens) and the mega- sporophylls (carpels) attached to the axis (torus) of the flower.

The flower.

These leaves may be together on the same torus (hermaphrodite flower), or on separate ones (unisexual flower). The stamen has typically a petiolar portion (filament), and a laminar ^portion (anther), and -within the latter the pollen-sacs, of which there are commonly four, each containing many pollen-grains, are embedded. The carpel is a leaf folded upon itself to form an ovary invest- ing the ovules. These arise, each with its embryo-sac, from the tissue of the placenta placed either upon the carpel (foliar) or upon the torus (axial) which projects into the cavity of the ovary ; in epigynous flowers the torus shares more or less in the formation of the wall of the cavity. The apex of the carpel is more or less pro- longed as the style upon which a special papillar or hairy secreting

germinating surface of varying extent, the stigma, is developed. Upon this stigmatic surface the pollen-grains which are carried to it (jpollination) from their mother pollen-sacs, continue their germination, and then through the pollen-tube the male gametes they pro- duce are conveyed to the female gamete enclosed in the megaspore. The anther-wall enclosing the pollen-sacs is commonly no more than an epidermis in the greater part of its extent, and usually contains parasolar colouring sub- stances which protect the developing pollen-grains. It forms with the . walls of the pollen-sacs a hygroscopic mechanism, through which it is ruptured in definite areas for the escape of the pollen-grains at the period when these are mature. The ovarian wall is green, or possesses at least some chlorophyll and frequently meristem, and thereby is fitted for the subsequent developments through which it becomes the fruit, enclosing for a longer or shorter period the seeds into which the ovules develop. The number, form, size, colour, cohesion, adhesion, branch- ing of the sporophylls give manifold variety of flower- structure, but the features in the sporophylls which are of significance from the phyletic standpoint, and by which the Angiosperms as a whole are distinguished from the Gymnosperms are — (1) the greater protection afiforded to the ovules by their enclosure within the ovary of the car- pel, and (in the higher forms) within the torus itself, and to the pollen-sacs by their investment in the anther ; and (2) the provision of a carpellary germinating surface in the stigma for the pollen-grains, with the correlated specialization of the stamen into filament and anther. The flower may be cohstituted by the sporan- giferous portion alone, and the sporophylls are sometimes spoken of as its essential organs. But the parts which give conspicuousness to most flowers, and which are indeed in the popular and gardening sense of the term " flower " the important ones, are the flower- envelopes — calyx of sepals and corolla of petals. One of these only may be present. Their presence is a mark of angiospermous structure, the flower in Gymnosperms hav- ing only obscure homologues. Sepals are typically green, and share therefore in the assimilation-work of the plant, no doubt aiding in meeting the very great demands made upon the plant-energy by spore-formation in the flower and its consequences. They are frequently persistent and active in this way during the whole period of matu- ration of the seed. Whilst in the earlier stages of the flower-development they serve as protecting structures to the parts within, they also when persistent

provide a pro- tection, or it may be an aid in dissemination, to the fruit or seed. The brilliant colours of the flower are most fre- quently located in the petals, although the sepals and sporophylls and adjacent parts are also often coloured. With the calyx the corolla serves as a protection to the young sporophylls, especially from wet. Once expanded the petals may remain so until they are shed, as they usually are after pollination has been effected, or they may with the calyx close over the sporophylls and open

Flower- envelopes,

again, more than once, in response to various external stimuli. Their colours, primarily parasolar, appear to be attractive to birds and insects, and these by their visits aid in the pollination of the flower, and have been agents in the intensification of the colours through selection. The leaves of the flower-envelopes vary in every way more than do the sporophylls, and show frequently extreme specialization in their forms, which in many cases appear to be correlated with the visits of birds and insects. Another accessory feature present in many flowers, and especially in thpse with colour, is the secretion of f^gctaries. honey, with the associated odour, from nectaries. These nectaries, often termed nuptial, to distinguish them from similar ones which occur upon parts of the plant away from the flower (extranuptial), may arise upon the torus independently of the flower-leaves, or may be pro- duced by any one of these leaves. The secretion is usually discharged from the nectaries, but in some cases is retained, and can only be secured by puncture. Odour appears to be the most potent attraction to birds and insects pos- sessed by flowers.

The flower has primarily a radial construction with a spiral or cyclic (or these combined) disposition of the flower-leaves ; the terminal flower of an inflorescence is always radial. Lateral flowers may he radial, but are frequently dorsiventral, a con- struction which, primarily an adaptation to physical needs, has been intensified by insects-agency. The relative number and positions of the different kinds of flower-leaves are characteristic features, and in lateral flowers have a definite relationship to the mother-axis of the flower, as well as to the prophyUs — the common trimery of Monocotyledones showing typically an anterior sepal

in relation to the one posterior prophyll, whilst in the pentamery and dimery of Dicotyledones there is usually a posterior sepal with a pair of lateral prophyUs. All these relationships (and they are of great varietyVof the .flower-leaves are of considerable value in the estimation of the genetic relationships of the families of Angiosperms. The formation of flower concludes the growth in length of the axis to which it belongs. If this be the primary, or relatively primary axis the plant is monaxial; the majority of plants are, however, pluriaxial, the flowers belonging to axes of higher degree. In both cases there is a tendency to aggregation of the flowers in inflorescences, whereby small flowers become more conspicuous and the function of the flower is promoted. The posi- tion of the sporophylls at the end of their axis gives them promi- nence, and the whole arrangement of flower, whether solitary or in inflorescences, at the extremity of shoots, and its projection, as is common, beyond the vegetative organs, is of obvious advantage. In contrast with the usual relation, cauliflorous trees are not xincommon in the tropics. In the^ the flowers, which have often somewhat fleshy flower-envelopes, and are always odorous, appear singly or in groups upon small short-lived twigs, which develop from piersistent axillary buds, or are found issuing from " latent eyes" in the bark. Their position close to the seat of reserve- food is evidently an economical one, and may have a relation to pollination, and their occurrence in tropical trees and absence from those of temperate regions may be made possible by the thinner bark developed upon trees in the tropics. The antago- nism observable between vegetative and reproductive functions is well known, and environmental conditions such as physiological drought and low temperature, which are unfavourable to vegetative activity, are not so unfavourable to, and even favour, reproduction. Periodicity in flowering is most marked where there is seasonal growth, and flowering commonly concludes a vegetative period in which takes place an accumulation of energy sufficient to supply the demands made in the seed-formation, the exhausting nature of which is shown by the long intervals for recuperation, often a dozen years, between successive full crops in such trees as beech. When flower is produced before seasonal vegetative activ- ity begins, a store of reserve-food from a preceding year is avail- able for its formation. Where seasonal growth is not sharply marked, as in parts of the tropics, there may be continuance of flower during the whole year, but not from the same shoots. The action

of light in intensifying the colour and odour of alpine flowers is well known.

The sporogenous tissue is formed within each of the four sporangia, two of which are in each lobe of the anther, though there may be two only, or there may be more. Each sporangium has the usual tapetum ^^5um.°” and wall-layers, and these are eventually more or less absorbed, as are also certain of the tissues of the

anther itself betwixt adjacent sporangia, so that their cavities unite. In the ripe anther, therefore, the traces of the original sporangia are somewhat obliterated. The spores are produced in tetrads, each within a sporocyte, by two successive bipartitions of its energid. In mono- cotyledonous plants each partition is completed by for- mation of a cell-membrane around the daughter-energids, whilst in dicotyledonous plants the partition of the mother-energids into four dau’ghter-energids is effected be- fore these are invested by cell-membrane — a hastening of development observable also elsewhere. The spores when mature commonly become separated one from the other, but may remain united in tetrads, which may themselves re- main coherent. Even when isolated the spores do not always form a dry powder, but may be entangled by con- necting threads of the d^ris of the sporangial and an- therine tissue. Of various shapes, the mature spores have the usual wall of two layers, here called the exine and inline. The exine, more or less cuticularized, may be smooth, but more frequently exhibits a pattern through local thickenings, and there are usually small areas where it is thin and less cuticularized, the so-called germ-pores, through which the intine, which is a delicate cellulosic membrane, will protrude in the later germination of the spore. All these conditions of shape, pattern, freedom, coherence of the spores, are of infinite variety; in this respect they markedly contrast with the spore-features in the Pteridophytes, and find their explanation in the work of pollination. WhUst still within the pollen-sac the spore reaches a stage ©f

development at which its germination can begin. Its energid divides, but the daughter-energids are not of equal dimensions, and neither of them in Di- cotyledones becomes invested by cell-membrane; in Monocotyledones this may be formed. One, the larger, has a purely nutritive destiny, and is termed therefore the vegetative energid; the other, smaller, is the mother of the male gametes, and is termed the generative energid. In many dicotyledonous plants this generative energid divides in the spore to form two daughter-energids, each of which is a functional male gamete, and the spore there- fore within the pollen-sac contains three energids. In .monocotyledonous plants this further division of the generative energid may be postponed to a later phase of germination. These changes within the pollen-grain present us with the reduced homologues of the male gametophyte and its products in the Pteridophytes, and the reduction is much greater than in Gymnosperms. The pollen-grain in this condition is ready for pollination, and unless this occurs no further change normally takes place in it, although if the pollen-grains within the anther be wetted, say by rain, one or more futile pollen-tubes may be sent out. It is to guard against this that so many protective arrangements to the pollen are provided in the flower.

The destiny of the ovule as the nursery of the embryo in Spermophytes imposes the necessity of a more elaborate construction than is found in megasporangia '^a^fum" unconnected with seed-formation, and this aag urn. gjj^g expression in its envelopes and the water- carrying system and food-store they provide. The ovule arises as a cellular papilla upon the placenta, and as it gradually acquires its mature form, from atropous to anatropous, and with or without a conspicuous funide, its nucellus becomes invested by one or two envelopes, the integuments, which, growing out from beneath 'its base, form, by their upward extension, a micropyle at its apex. The vascular bundle-system of the placenta is prolonged into the base of the nucellus, but future nucellar develop- ment precludes its further extension therein ; it is there- fore arrested expanding to a varying degree, or it spreads with often intricate ramifications in the integu-

ment— usually in the outer if there be two. These in- teguments are then ovular (sporangial) outgrowths which primarily construct the normal

channel of entrance of the pollen-tube, ajid permit of the elaboration of the water- carrying system of the ovule, but, retaining more or less their meristematic character, they subsequently, when sharing in the formation of the seed-coat, alter their struc- ture and may form arils of kinds. In holoparasites which form ovules the integument is often absent. In most gamopetalous Dicotyledones there is only one, but in Monocotyledones and most polypetalous Dicotyledones there are two. The significance of this is not apparent. That the integuments are structures of slight phyletic import is shown not only by their somewhat varied struc- ture and points of origin, but by the fact that in some families, for instance, the Eanunculacese and the Eosar cese, genera are unitegminous, whilst others are bitegmin- ous. As the nucellus develops, spore-formation proceeds within it. The sporogenous tissue is usually a Short sub- apical hypodermal axile row of cells, one of which be- comes the megaspore or embryo-sac. There are in some cases several embryo-sacs which may develop, up to a certain point, when one takes the lead and the others are absorbed by it. The embryo-sac begins to enlarge at a very early period of the growth of the nucellus and elon- gates in the axis of this and towards its base, absorbing the nucellar tissue. It also enlarges laterally by the same method. As its enlargement proceeds, so do changes in its energid, which divides in the transverse plane of the sac. The daughter-energids recede to the respective poles of the elongated sac, and there each divides by two suc- cessive bipartitions to form a group of four. Of the basal polar group three invest themselves with cell-mem- brane and constitute the antipodal cells of the mature embryo-sac, the fourth moves upwards towards the equa- tor of the sac. Of the apical polar group three remain at the apex, but do not invest themselves with cell- membrane, and constitute the so-called egg-apparatus, one of them larger than the others being the female gamete or egg, the others the synergidce or help-cells; the fourth, which is the sister of the egg, moves downwards towards the equator of the sac, and meets the detached fourth member of the basal polar group, with which it sooner or later coalesces to form the definite energid of the embryo- sac. Viewing the embryo-sac as a megaspore, an obvious interpretation of these changes within it is that they are the consequence of its germination, and are therefore the homologues of the endospermic prothallus of Gymnosperm s and of the female gametophyte in the Pteridophytes ; this explanation has received very general acceptance.

The antipodal cells would be cells of a reduced prothallus ; of the three energids of the egg-apparatus, one alone is normally functional as the egg, but the synergidse may, it has been said, function as eggs. The crux is, however, the interpretation of the definite energid, and its forma- tion has been explained as a case of reinvigoration of a dec9,dent vegetative organ by coalescence similar to what is frequently observed elsewhere in the plant kingdom, notably amongst the Fungi. It would be then an element of the prothallus. Other interpretations have traced a sexual act, and a conjugation of male and female gametes jn the formation of the definite energid, or a concrescencexjf two female gametes. It is, however, unnecessary to discuss these, because recent researches have brought to notice altogether neW facts in the history of /the changes in the embryo-sac in fertilization, and to them reference will presently be made ; these, though they do not clear up the difficulties of interpretation of the formation of the definite energid, must be taken as a starting-point in any explanation that may be advanced. The embryo-sac in most ovules has arrived at the stage of development above

described when pollmation is effected. But this is not always the case. The embryo-sao may not be formed, the ovule itself may hardly be visible when the pollen-grain reaches the style, and in these cases it is through the stimulus of the growth of the pollen-grain that the changes in the embryo-sac are initiated. '

The pollen-grains escape from the anther by its rupture through differences in drying between its epidermal layer and the fibrous wall of the pollen-sacs within. As a rule the pollen-grains are simply exposed by this rupture, but in other cases the relations of the stamens and the flower-envelopes give rise to an explosive mechanism, brought into action either from the inside by the natural expansion of the flower, or by mechanical disturbance from without, by which the pollen-grains, which in such a case are always dry and powdery, are shot out to some distance

from the flower. The destination of the pollen-grains is the stigmatic surface of the carpel, to which they cohere partly through the viscid secretion exuded from it, pajtly through en- tanglement amongst the stigmatic papillae, and to this outgrowths of the exine may contribute. The proximity of the stamens and carpels in a hermaphrodite flower, and the fact of their ripening, as is common, at the same time, render possible the direct application of the pollen to the stigma either by contact of anther and stigma, by its falling from anther upon stigma, or in other ways, within the one flower. This is self-pollina- tion, and it takes place undoubtedly with frequency iu nature, and may be said to be the raison d'6tre of the hermaphrodite flower. It is often called self-fertiliza- tion or avtogamy, but in using these terms and other terms of similar form, and they are common, it must be remembered that pollination is only a spore-distribu- tion, and a step on the way towards the accomplish- ment of the sexual act which is fertilization, and which indeed may not result after pollination. When the flowers are unisexual, whether on the same plant (mo- naecism) or on separate ones (diaecism), such facile pol- lination is precluded, and it must be effected by the conveyance of pollen from the stamens of one flower to the stigma of another. This is cross-pollination, often termed cross-fertilization or allogamy. Experiment has, however, shown that even in hermaphrodite flowers cross-pollination may be the more effective process in its ultimate result after fertilization has been effected, and that the progeny of a cross-pollinated hermaphrodite flower is often better than that of one self-pollinated. Cross-pollination is also frequently preferred even when the flower is hermaphrodite and/ self - pollination might be possible, for there are arrangements of different kinds which may either altogether prevent self-pollination or at least promote cross-pollination in the first instance. Thus the relative position of anthers and stigma and the form of the pollen may be such as to place a barrier to self-pollination (hercogamy), or the periods of rupture of anthers and of maturation of stigma may be different (dichogamy, either protandrous or protogynous). At the same time, in many hermaphrodite flowers which are normally cross-pollinated, self-pollination becomes possi- ble before withering, and may take place should cross- pollination have failed. On the other hand, there are flowers which are so constructed as entirely to exclude the chance of cross-pollination, inasmuch as they do not open, and self-pollination is therefore a necessity (cleistogamy).

The agencies by which cross-pollination is effected in Geophytes are wind and animals, and their flowers have been classed as anemopMlous and zooidiophilous, in con- formity with their adaptation to pollination by one or other of these agencies.

Anemophllous flowers are characterized by the prodigal pro-

duction of powdery pollen, much of which never reaches its proper destination, and fiie pollen-grains themselves are „ . . . smooth and light. The anthers as the distributing /^g, organs are freely ezposed, and the outgo of the pginaa- pollen-grains in suitable weather is facilitated by such ^j,j,_ means as the assemblage of the flowers in catkins, their hanging from slender pedicels, long slender filaments to the anther, explosive mechanisms in the flower, and similar arrangements. The reception of the pollen is aided by a free and extensive entangling stigmatic surface, produced by copious branching of the style. Bright colours, nectar-glands giving honey, odour, and generally conspicuousness, are more or less absent. Many flowers, however, which are anemophllous may be also zooidiophUous. There is no doubt that the fertilization of many flowers is effected by animals in their transit over the areas upon which the plants are growing. Such pollinations are, however, entirely fortuitous. On the other hand, the majority of flowers are regularly visited by insects of many kinds, and these insects effect pollination. Such flowers are entomophilous, and are the chief zooidiophilous ones. Here conspicuousness of some kind is a primary requirement for the securing of insect- visits, and this may be effected in various ways, for example, by size and form of individual flower, by aggregation of flowers in inflorescences, by coloured and glistening surfaces in the flower or in tie neighbouring parts. Doubtless the most potent lure is odour, and aSke in connexion with it and with colour it is pro- bable our senses do not appreciate scents and colours which are recognizable by insects. The gain to the insect by its visit is the honey, which is often protected in elaborate fashion, so that only insects of special form can secure it, and the pollen itself. In seeking for the honey the insect becomes dusted with pollen-grains from the anthers — which are found in positions in relation to the whole form of the flower such that this dusting of the body of a suitable insect is readily effected, the

pollen-grains themselves having commonly more or less tuberculated surfaces, and being somewhat sticky — and it carries them to the stigma of flowers subsequently visited. Birds sometimes effect pollination of flowers (jarnithophUous), snails are also sometimes the agents {maalcophilous), and other animals — in all of these cases the attraction of food brings the animal to the flower. The relationships of flowers to animals, especially insects, are infinite in variety, and are the subject of a copious literature. Pollination by insects is a prevalent method of cross-pollinatioq at the present epoch, and stands in correlation with the evolution . of the angiospermous flower. It is manifestly a more certain and more economical one than pollination by wind. Its hazard is the absence of the proper insect, especially in cases where the form-development is such that but few species of insects can effect it. Pollination by wind is a more primitive method. Pollination in the ways described must often result in the application of pollen-grains of one species upon the stigma of another. Such foreign pollen is frequently sterile upon the stigma, and no result follows. There is also a prepotency in its own pollen, belonging to every species, and the application of one grain of it will render futile the germination of any foreign pollen upon its stigma. If such pollination by foreign pollen is followed by the completion of the sexual act, and an embryo is formed, the offspring will be a hybrid. In nature such hybrids between allied forms are common, and they are readily produced in cultivation. They may in time be the starting-point of specific forms. Generic hybrids are not so common in nature, but in certain families of Angiosperms quite a number have been produced in horticultural practice.

Pollination having been effected, the pollen-grain moistened by the viscid secretion upon the stigma resumes active growth. The intine investing second the vegetative energid is protruded through germiaa- one of the germ-pores as the pollen-tube, and "o" ot apparently under chemiotactic influence grows ^^' downwards through the style, dissolving its tissue by the aid of an enzyme. The vegetative energid is found at the tip of the tube, and in dicotyledonous plants is followed out of the spore by the male gametes, in monocotyledonous plants by the generative energid which then divides in the tube and forms a pair of gametes. The pollen-tube reaches the cavity of the ovary and commonly passes along the placenta,

guided by projections or hairs, to the micropyle of the ovule ; this it enters, and dissolving its wa;^ through any cells of the nucellus intervening between it and the apex of the embryo-sac, it pierces the latter. This piercing, however, is not always necessary, for the egg-apparatus may have developed so as to rupture the embryo-sac, and even the apex of the

nucellus, sothatitprojectsintoor beyond themicropyle. By this time the two male gametes have passed the degenerated vegetative energid and are at the apex of the tube, and this now being softened they escape into the plasm of the embryo-sac. The gametes, as observed in recent investigations, have vermiform nuclei somewhat thickened at the end, and exhibit a finely porose structure ; they are not unlike the spermatozoids of some Pteridophytes, and they are sometimes so named, but their independent movement, without or by means of cilia, has not been observed. One of the male gametes thus discharged, reaches the egg and impregnates it. The fate of the other was until ma. '"' recently not traqed, and it was supposed to dis- integrate in the plasm of the embryo-sac, or , occasionally to coalesce w|th synergidse. We now know, however, that in several plants it passes downwards, perhaps passively transported by the streaming of thd protoplasm in the embryo-sac, to the two polar energids which have not yet coalesced, and it unites with the apical polar one, or it may await their coalescence, and then uiiite with their combination — the definite energid of the embryo-sac. The fusion of the second male gamete apparently precedes the impregnation of the egg by the first inale gamete. This remarkable double fertilization as it has been called, although only recently discovered, has been proved to take place in widely separated families, ■ and both in Monocotyledones and Dicoty led ones, and there is every probability that, perhaps with variations, it is the normal process in Angiosperms. It gives a history of the second male gamete. Whilst the pollen-tube normally reaches the apex of the embryo-sac through the micropyle (aarogamy or porogamy), it may pierce the embryo-sac at the chalazal end or at the side (basigamy or chalazogamy)*

by entering the base of the nucellus and making its way upwards, using as passages, it may be, the cavities of aborting embryo-sacl. After impregnation the fertil- ized egg segments to form the embryo, the synergidse having long before disintegrated, and the impregnated definite energid also enters sooner or later upon division which results in the formation of endosperm ; the anti- podal cells often disintegrate at the same time, though they may undergo multiplication first. It has long been known, that after fertilization of the egg has taken place the formation of endosperm begins from the definite energid, and this had come to be regarded as the recom- mencement of the development of prothallus after a pause following the reinvigorating union of the polar energids. This view is still maintained by those who differentiate the two fertilizations within the embryo-sac, and regard that of the egg by the first male gamete, as the true or generative fertilization, and that of the polar energids by the second male gamete as a vegetative fertilization which gives a stimulus to development in correlation with the other. If, on the other hand, the endosperm is the product of an act of fertilization as definite as that giving rise to the embryo itself, we have to recognize that twin plants are produced within the embryo-sac — one, the embryo, which becomes the angiospermous plant, the other, the endosperm, a short-lived undifferentiated nurse to assist in the nutrition of the former, even as the subsidiary embryos in a pluriembryonic Gymnosperm may facilitate the nutrition of the dominant one. If this is so, and the endosperm like the embryo is normally the product of a sexual act, hybridization will give a hybrid endo- sperm as it does a hybrid embryo, and herein (it is sug- gested) we may have the explanation of the phenomenon of xenia observed in the mixed endosperms of hybrid races of maize and other plants regarding which it has only been possible hitherto to. assert that they were indi- cations of the extension of the influence of the pollen beyon4 the egg and its product. This would not, how-

ever, explain the formation of fruits intermediate in size and colour between those ,of crossed parents. The signification of the coalescence of the polar energids is not explained by these new facts, but it is note- worthy that the second male gamete is said to unite sometimes ‘ with the apickl polar energid, the sister of the egg, before the union of this with the

basal polar one. The idea of the endosperm as a second subsidiary plant is no new one ; it was suggested long ago in ex- planation of the coalescence of the polar energids, but it was then based on the assumption that these energids were male and female gametes, for which there was no evidence, and which was inherently improbable. The proof of a coalescence of the second male gamete with the definite energid gives the conception a more stable basis.

By the segmentation of the fertilized egg, now invested by cell-membrane, the embryo-plant arises. A varying number of transverse segment-walls transform it into a pro-embryo — a cellular row of which the f^^"' micropylar cell becomes attached to the apex of the embryo-sac, and thus fixes the position of the develop- ing embryo, and the terminal cell is projected into its cavity. In Dicotyledones the shoot of the embryo is wholly derived from the terminal cell of the pro-embryo, from the next cell the root arises, and the remaining ones form the suspensor. In many Monocotyledones the ter- minal cell appears to form the cotyledonary portion alone of the shoot of the embryo, its axial part and the root being derived from the adjacent cell ; the cotyledon would thus be a terminal structure and the apex of the primary stem a lateral one — a condition in marked contrast with that of the Dicotyledones. It is known, however, that in many Monocotyledones the cotyledon is not really terminal. The primary root of the embryo in all Angio- sperms points towards the micropyle. The developing embryo at the end of the suspensor grows out to a vary- ing extent into the forming endosperm, from which by surface absorption it derives plastic material for growth ; at the same time the suspensor probably plays a direct part as a carrier of nutrition and may even develop, where perhaps no endosperm is formed, special absorptive "suspensor roots" which invest the developing embryo or pass out into the body and coats of the ovule, or even into the placenta. In some cases the embryo or the embryo-sac sends out hanstoria into the nucellus and ovular integujnent. As the embryo develops it may absorb all the plastic material available, and store either in its cotyledons or in its hypocotyl what is not immediately required for growth as reserve-food for use in germination, and by so doing it increases in size until it may fill entirely the embryo-sac; or its absorp- tive power at this stage may be limited to what is neces- sary for growth and it remains of relatively small size,

occupying but a small area of the embryo-sac which is otherwise filled with endosperm in which the reserve- food is stored. There are also intermediate states. The position of the embryo in relation to the endosperm varies, sometimes it is internal, sometimes external, but the significance of this has not yet been established. Apogamy sometimes occurs in Angiosperms. As a rule the embryonic shoots are developed from the nucellar wall, or from the synergidae, or from the antipodal cells, and polyembryony is the result. In Erythronium, how- ever, polyembryony js the result of a process recall- ing features of Gymnosperms, for the embryos arise from the segmentation of the terminal cell of the sus- pensor— ^that which normally produces the one embryo. True parthenogenetic apogamy is said to occur in An- tennaria alpina.

The formation of endosperm starts, as has been stated,

from the definite energid of the embryo-sac, and the process of double fertilization ^ above described gives new interest to its development. The segmen- ”” ■ tation of the fertilized definite energid always begins before that of the egg, and thus there is timely preparation for the nursing of the young embryo. If in its extension to contain the new formations within it the embryo-sac remain narrow, endosperm formation pro- ceeds upon the lines of a cell-division, but in wide em- bryo-sacs the endosperm is first of all formed as a colony of energids (coenobium), and only gradually acquires a pluricellular character, the change starting from the sides or ends of the embryo-sac. The function of the endosperm is primarily that of nourishing the embryo, and its basal position in the embryo-sac places it favourably for the absorption of plastic material en- tering the ovule. Its duration varies with the pre- cocity of the embryo. It may be wholly absorbed by the progressive growth of the embryo within the em- bryo-sac, or it may persist as a definite and more or less conspicuous constituent of the seed. When it persists as a massive element of the seed

its nutritive function is usually apparent, for there is accumulated within its cells reserve-food, and according to the dominant substance it may be starchy, oily, cellulosic, aleuronic, and so forth. In cases where the embryo has stored reserve-food within itself and thus provided for self-nutrition, such endosperm as remains in the seed may take on other f uncticjns, for instance that of water-absorption.

*As the development of embryo and endosperm proceeds within the embryo-sac, its wall enlarges and commonly absorbs the substance of the nuceUus (which is likewise enlarging) to near its outer limit, and combines with it and the integument to form the seed-coat; or the whole nucellus and even the integu- ment may be absorbed. In some plants the nucellus is not thus absorbed, but itself becomes a seat of deposit of re-serve-food constituting the perisperm which may coexist with endosperm, or may alone form a food-reserve for the embryo. Endospermic food-reserve has evident advan- tages over perispermie, and the latter is comparatively rarely found and only in non-progressive series. Seeds in which endosperm or perisperm or both are said to exist are commonly called albuminous, those in which neither is found are termed exalbuminous. These terms, extensively used by systeraatists, only refer, however, to the grosser features of the seed, and indicate the more or less evident occurrence of a food-reserve ; many so-called exalbuminous seeds show to microscopic examination a distinct endosperm which may have other than a nutri- tive function. The character of the seed-coat bears a defi- nite relation to that of the fruit which is derived from the ovary, and it may be from accessory parts as well. Their function is the twofold one of protecting the em- bryo and of aiding in dissemination ; they may also di- rectly promote germination. If the fruit is a dehiscent one and the seed is therefore soon exposed, the seed-coat has to provide for the protection of the embryo and may also have to secure dissemination. On the other hand indehiseent fruits discharge these functions for the em- bryo, and the seed-coat is only slightly developed. Dis- semination is effected by the agency of water, Dissemina- q£ g^jj,^ qJ animals — and fruits and seeds are *”” therefore grouped in respect of this as hydro-*

philous, anemophilous, and zooidiophilous. The needs for these are obvious — buoyancy in water and resistance to wetting for the first, some

form of parachute for the second, and some attaching mechanism or attractive structure for the third. The methods in which these are provided are of infinite variety, and any and every

tlon ot seed.

part of the flower and of the inflorescence may be called into requisition to supply the adaptation. Special out- growths, arils, of the seed-coat are of frequent occurrence. In the feature of fruit and seed by which the distribution of Angiosperms is effected we have a distinctive character of the class. In Gymnosperms w,e have seeds, and the carpels may become modified and close around these, as in Pinus, during the process of ripening to form an imita^ tion of a box-like fruit ^which subsequently opening allows the seeds to escape ; but there is never in them the closed ovary investing from the outset the ovules, and ultimately forming the groundwork of the fruit.

Their fortuitous dissemination does not always bring seeds upon a suitable nidus for germination, the primary essential of which is a suf&ciency of moisture, and the duration of vitality of the embryo is a Germina- point of interest^ Some seeds retain vitality for a period of many years, though there is no warrant for the popular notion that genuine "mummy wheat" will germinate; on the other hand some seeds lose vitality in little more than a year. Turther, the older the seed the more slow as a general rule will ger- mination be in starting, but there are notable exceptions. This pause, often of so long duration, in the growth of the embryo between the time of its perfect development within the seed and the moment of germination, is one of the remarkable and distinctive features of the life of Spermophytes. The aim of germination is the fixing of the embryo in the soil, effected usually by means of the root, which is the first part of the embryo to appear, in preparation for the elongation of the epicotyledonary portion of the shoot, and there is infinite variety in the details of the process. In albuminous Dicotyledones the cotyledons act as the absorbents of the reserve-food of the seed and are commonly brought above ground (epi- geous), either withdrawn, from the seed-coat or carrying it upon them, and then they serve as the first green organs of the plant. The hypocotyl commonly plays the greater part in bringing this

about, Exalbuminous Dicotyledones usually store reserve-food in their cotyledons, which may in germination remain below ground (hypogeous). In albuminous Monocotyledones the cotyledon itself, prob- ably in consequence of its terminal position, is commohly the agent by which the embryo is thrust out of the seed, and it may function solely as a feeder, its extremity developing as a sucker through which the endosperm is absorbed, or it may become the first green organ, the terminal sucker dropping off with the seed-coat when the endosperm is exhausted. Exalbuminous Monocotyle- dones are either hydrophytes or strongly hygrophilous plants and have often peculiar feati^res in germinar tion.

It has been possible here only to depict what appear to be general features of sexual reproduction in Angiosperms, and these after all rest upon observation within only a limited circle of forms. A new chapter in the history of our knowledge of the changes in the embryo-sac is opened by the discovery of double fertilization, and the whole subject requires reinvestigation.

Distribution by seed appears to satisfy so well the re- quirements of geophilous Angiosperms that distribution by vegetative buds is only an occasional process. Agamo- At the same time every bud on a shoot has the genetic capacity to form a new plant if placed in suit- ‘—‘ able conditions, as the horticultural practice of ” ”■ propagation by cuttings shows ; in nature we see plants spreading by the rooting of their shoots, and buds we know may be freely formed not only on stems but on leaves and on roots. Where detachable buds are pro- duced, which can be transported through the air to a distance, each of them is an incipient shoot which may

have a root, and there is always reserve-food stored in some part of it. In essentials such a bud resembles a seed. A relation between such vegetative distribution buds and production of flower is usually marked. Where there is free formation of buds there is little flower and commonly no

seed, and the converse is also the case. Viviparous plants are an illustration of substitution of vegetative buds for flower.

II. Aerophytes. — The oecological category of Aero- phytes is a much smaller one than that of Geophytes, and, unlike the latter, they are not affected by edaphic environment. An aerophyte is an autotrophic plant growing upon another, to which it is commonly fixed by its roots. The term epiphyte, commonly given to them, is so frequently used to designate the position of sapro- phytes and parasites upon host-plants, that it is better avoided as the name of the oecological category we are dealing with. Aerophytes are found amongst both Di- cotyledones and Monocotyledones and in many families. They may be herbs, shrubs, or trees. They are derived from geophytes, and their mode of life, while it enables them to reach better conditions of light, makes them de- . pendent wholly upon epedaphic environment, and their distribution over the world is markedly contingent upon a supply of atmospheric moisture. Their home is the damp woods of the tropics and of the warm temperate regions. The conditions of life of an aerophyte make its supply of water somewhat precarious; it has there- fore to provide for the protection of what it secures, and for the rapid absorption of any coming within reach. For the former of these purposes it most commonly has some form of water-storage which gives it succulence in leaf or stem ; the cuticle is thick, and the stomata are sunk, and a coating of hairs is found occasionally though rarely. For the latter purpose the roots, which are fre- quently copious, often have a velamen ; exposed to light they form chlorophyll and become accessory organs of carbon-dioxide-assimilation, or they may take on the whole duty of this, the leaves being then suppressed. .Sometimes in rootless forms absorptive hairs enable the plant to take water by its whole surface. The seed of an aerophyte usually germinates upon the supporting plant, and it is rare for a geophyte subsequently to become an aerophyte; on the other hand several cases are known of a juvenile aerophyte becoming a geophyte when older, and smothering its nurse as it descends to the soil. These plants are therefore only hemiaerophytes. In some aerophilous Bromeliads the rosette of leaves forms a cup in which water collects; into this debris both organic and inorganic falls, and produces a nutrient solution in which hydrophytes like Utricularia may live. The Bromeliad absorbs this fluid by special hairs, and is therefore a partial

saprophyte; its roots are only anchoring organs. Such plants are called Tank Aero- phytes. A somewhat similar condition, differing only in soil being collected instead of water, is seen in Nest Aerophytes. Here some roots or leaves form, with the stem of the supporting plant, a receptacle in which debris accumulates and makes a soil into which feeding roots from the aerophyte pass ; in this case there is an approach to the geophytes. Many aerophytes have brill- iant flowers highly specialized for entomophilious pol- lination. The seeds are small and light, or have flight arils or a succulent fruit-envelope, and can readily enter a crack of tree-bark. Dissemination is anemophilous or zooidiophilous, sometimes also the rain may be the agent. Vegetative propagation hardly exists, but por- tions of the shoot of Tillandsia usneoides are said to be carried by wind and birds.

IIJ. Hydrophytes. — Plants of the oecological category of Hydrophjrtes dwell in a more uniform environment than

is the lot of Geophytes or Aerophytes, and hydrophilous features are found in many cycles of affinity amongst Di- cotyledones and Monocotyledones. Typical hydrophytes live submerged in water. Their general physiognomy is that of delicate flexible herbs which rapidly shrivel on exposure to the air. In their environment their water- supply is not a first charge upon the organization, because diffusion can take place at every point, but the gaseous supply, owing to the slow diffusion of air in "water, and the supply of radiant energy, owing to the feeble penetra- tion of light, are matters of first moment. Further, the density of the medium reduces the need of intrinsic support. To those conditions hydrophytes are adapted first of all by an extension of the shoot-surface, seciu-ed by elongation of the leaves into a riband form in moving water, or by their division into filiform segments in stiU water; at the same time the system of air-canals is greatly developed. Then the chlorophyll apparatus lies in the peripheral layers of the organism, palisade-tissue being absent, and the strengthening tissue is always reduced in amount, and so forth. In the absence of transpiration there is a reduction or, it may be, a suppression of the root- system, and it is often only developed as an anchoring organ. No stomata are formed upon the shoot, and the cuticle is everywhere only feebly formed. The carrying system too is greatly simplified, both by

reduction of the number of vasa and of their area, and it is concentrated as a central strand in the axis, just as it is in ordinary roots, and thus is favourably placed in relation to the pulling strains to which the shoot is subjected under the currents of water. The growing points are frequently in- vested by mucilage, which acts as a protection to them. Many of these features of hydrophytes are observable in hygrophilous geophytes, and there are all stages of tran- sition between the two types. Thus when in hydrophytes the flowers are brought above the surface of the water, one or more flat floating leaves may be developed to support the plant at the surface, or the floating leaves may pre- dominate. Floating plants also occur in which the leaves are variously modified to act as floats. In all cases where parts of the shoot reach the air they develop more or less geophytie features. Amongst the most remarkable of hydrophytes are the Podostemacese — tropical dicotyledo- nous plants of cascades and rapidly flowing water. They have the habit of Bryophytes. The root forms a branched dor si ventral chlorophyllous thallus-like structure, at- tached by hairs and special branches {hcuj^tera) to rocks, and it is the chief structure for the assimilation of carbon dioxide. The shoots, which are also commonly dorsiven- tral, arise as outgrowths from it and bear small, usually divided, leaves. Marine hydrophytes which are subject to exposure between tides have often some of the xerophilous features of halophytes. In their flower-structure typical hydrophytes show great simplification where the flowers are persistently submerged. They are frequently uni-sexual and the flower-envelopes are reduced. For sub- aqueous pollination the pollen is often vermiform of about the same specific gravity as the water, whilst the styles are long and filiform so as to increase the chances of the act being accomplished. Sometimes pollin'ation takes place on the surface of the water, and then in various ways the pollen is brought to the surface, where it comes in contact with the stigmas. Often the flowers are raised in the air above the water, and then they exhibit the features of anemophily or zooidiophily. Many hydrophytes have embryos of peculiar form and remarkable germination. Amongst Monocotyledones most hydrophytes are exalbu- minous and the embryos are macropodous through storage of food-material. Vegetative propagation by the detach- ment of portions of th^ shoots or of definite buds is- not uncommon amongst hydrophytes, and these, readily

carried by water-currents, serve as a means of distribution. To this circumstance is probably due the wide area of distribution of many hydrophytes.

*A typical Angiosperm is an autotrophic (prototrophic) plant. By this we mean that it is able to build up its Autotro- organic food-material within itself from inor- pbism and ganic substauccs taken by it from without. In "hism^' *^^ ^^^^^ juvenile phases of their life, however, " **"■ many such autotrophic Angiosperm s are hetero- trophic, that is to say, they take in their organic food- material from without, inasmuch as they feed in germination upon reserve-food stored up within the seed, frequently by means of a special sucker produced by the cotyledon. This is after all only a case of prolongation of the nursing process common to all embryos, and of the drawing of food from one set of cells to another which is characteristic of the higher plants in consequence of their colonial organization. On the other hand some Angio- sperms are persistently heterotrophic, either as saprophytes (metatrophic) or as parasites (paratrophic), and this manner of life involves some kind of symbiosis. Between truly autotrophic Angiosperms and truly heterotrophic ones there are all degrees, and such intermediate forms have been designated mixotrophic.*

A typical saprophyte is a plant which derives its food- material from dead organic matter. This method of feeding is associated with the presence of the mycelium of a ^^' fungus attached to the absorbing system and form- pnyasm. ^^ ^ mycorhiea, and there is a reciprocal symbiosis between the Angiosperm and the fungus which is endophytic, only rarely ectophytic. Keduction of the vegetative system of the Angiosperm accompanies this. The subterranean portion of the plant is small and the roots may be absent. In the shoot chlorophyll is suppressed, and commonly a brown pigment, the use of which is unknown, is present; there are only scale- leaves, and the carrying system is rudimentary. Such typical saprophytes are holosaprophytes. Where chlorophyll is present in small amount the plant is able to manufacture some at least of its carbonaceous food and is

then a hemisaprophyte. Angiospermous holosaprophytes are not common. They are known amongst Gentianeae and Monotropese only of Dicotyle- dones, and most of them are Monoootyledones of the OrchidesB, Burmanniacese, and Triuridese. They are derived from auto- trophic forms and do not appear to be associated with any special climatic conditions, but, as their structure would suggest, are most of them plants of shade and moisture. A large number of Angiosperms which appear to be independent autotrophic forms are now known to engage in a form of symbiosis, the exact relations in which are not yet determined. More or fewer of their rootlets have their extremities invested by a weft of hyphal mycelium as an ectophytic mycorhiza. This is not constant in one species, nor do all rootlets of one plant show it. Its frequency, however, indicates some reciprocal relation between the Angio- sperm and the fungus. The occurrence of Mycodomatia upon the roots of plants of Leguminosse as well as of other families is a result of a symbiosis, and is of supreme importance in agriculture on account of the accumulation of nitrogenous material that takes place within them. The fact known to gardeners that, as the wood of tubs in which large plants are grown gradually decays, the roots of the occupant spread into it and there develop myoorhiza, usually endophytic, points in the direction of the facultative saprophytism of all Angiosperms. The habit possessed by a few plants of different cycles of afiSnity of capturing insects in traps of various kinds, enables them to obtain an accession to their supply of nitrogen. In some of them a proteolytic enzyme brings about the digestion of the insect for the benefit of the plant (Droseracese, Nepenthacese), in other cases there appears to be no enzyme, and the plant absorbs soluble nitrogenous sub- stances formed in normal putrefaction (Sarraceniaceee). Some carnivorous plants are hydrophytes (Utricularia). The flower- structure of typical saprophytes has no feature of special interest, but it is much to be wished that we had full knowledge of the changes in the embryo-sac and of the phases of embryogeny.

A parasite takes all or a portion of its food-material from a living host into which it penetrates. The degree of connexion between the two and the dependence of the parasite Parasitism. ^pQjj jjjg jj^gj yg^jy between the completeness of that of holoparasitic Rhizanths, in which little more than the flower of the parasite is visible upon the outside of the stem of the host

and the parasitism is absolute, and the limitation of that of the hemiparasitic Bhinanthese, in which to all appearance there is an

independent autotrophic geophyte, for it possesses chlorophyll and its union with the host is confined to isolated points below ground. The seat of attachment of the parasite may be either the root or the stem of the host ; sometimes, in the case of twining parasites, the leaf may also be made use of. In the simplest cases the parasite develops a sucker {haustorium) , from the centre of which piercing connexions of kinds proceed, and it then maintains its individual shoot development, which may be that of a herb (annual or perennial), shrub, tree, or liane, outside the host. But in the more advanced conditions of parasitism the reduction of the vegetative system of the parasite is so great that its individuality outside the host is lost, and it appears as a web of threads running within and blending with the tissues of the host, in the manner of a mycelium, or forming with the tissue of the host a tuberous conjoint stock from which the reproductive system shoots. AH Angiospermous parasites are derived from autotrophic forms, but the modification in the form and structure of their organs — both vegetative and reproductive — induced by the parasitism, makes the relation of holoparasitic groups some- what obscure. Parasitism is unknown amongst Monoootyledones, but has appeared more than once amongst Dicotyledones. Cytineae, Balanophorese, Orobanchacese, Lennoaceae, are families of differing position which are characteristically holoparasitic. LoranthacesB and Santalacese are chiefly hemiparasitic, as are most of the parasitic Scrophularineae. Parasitism is not associated with any special epedaphic conditions, and there are no hydrophilous parasites. It occurs in all regions of the world, and in the varying environment of dark damp tropical woods, arid plains of warm regions, tropophil woods of temperate regions, and Alpine slopes. Accordingly both xerophilous and hygro- philous features appear. The host in some cases seems to have no particular attraction to the parasite, and any species of plant may be offied by the same specific parasite, even its own body being acceptable ; 6n the other hand, there are parasitic species which are only known upon one kind of host. Of the factors which co-operate in bringing about the attachment of a parasite to its host we know nothing beyond the fact that chemiotactic and contact stimuli are, as in all cases of infection, concerned in it. The life of the host may or may not

be affected by the parasite. Species of Cuscuta, if they ^o not kill, may so arrest the growth of their host-plant as to bring about results disastrous in agriculture, and by the penetration of loranthaceous plants deformities of stem and branches are produced in trees, which then become useless for timber. It has been claimed that in the case of chlorophyllaceous parasites, the symbiosis may not be antagonistic but reciprocal, but even if this be so to some extent, the amount of aid rendered to the host does not compensate for the drain upon its resources made by the parasite. So con- spicuous is this that legislation restricting the cultivation of mistletoe, on account of the damage caused by it in orchards, has been deemed necessary in some districts in Europe. In the more recently derived parasites, those of bicarpellate gamopetalous Dicotyledones, most of which are hemiparasitic and epirhizal, the flower-structure and seed-formation retain in the main their immediate ancestral features, but in the families of the Lo- ranthales, to which all evidence concurs in ascribing a far back origin, many modifications in the way of reduction are found. The inflorescence may be endogenetic, the ovule may consist of nuoellus alone, and frequently there is no ovule — ^the embryo-sacs, of which there are many, being then developed in the torus or- in the ovarian wall. The formation of endosperm offers many features of interest, one of the most remarkable being that seen in Balanophora, where the apical polar energid alone of the energids within the embryo-sac survives disintegration, and then, in the absence of fertilization, segments to form a pluricellular endosperm upon which an embryo apogamously buds. The history of few forms is well known, and these require re-study in the light of the recently-acquired knowledge of fertilization. There is no more promising field for investigation than that of the embryogeny of parasites.

Intimate relations between Angiosperms and the animal kingdom have been shown to exist in the work of pollination, of dissemination, and of the feeding of carni- vorous plants. Another relation of which the '^y™ecopiiUy. facts are clear enough, but of which the evolution is doubtful, is that known as Myrmecophily. Species of ants make their home on tropical plants, living in hoUows of stem, petiole, or stipule, which are commonly enlarged and may form tuberous cushions. They feed upon either the secretion of extra-floral nectaries, or upon the richly nitrogenous contents of modified glands (Muller"s corpuscles), which are

boroe upon some part of the leaves, and which are continuously renewed during the' life of the leaf. These ants act as a bodyguard to their home against the inroad of leaf-cutting ants collecting material for their fungus-gardens. These remarkable relationships have naturally led to the assump- tion that there is causal connexion between the ants and the

plant-structures, a view for whibh there is, however, no sufficient evidence.

The position of Angiosperms as the highest plant-group is unassailable, but of the point or points of their origin

from the general stem of the plant kingdom, and'"—"' and of the path or paths of their evolution, we taxonomy. Can as yet say j||ttle. Until well on in the

Mesozoic period geological history . tells us nothing about Angiosperms, and then only by their "vegetative organs. We readily recognize in them now- a-days the natural classes of Dicotyledones and Mono- cotyledones, distinguished alike in vegetative and in reproductive construction, yet ' showing remarkable parallel sequences in development ; and we see that the Dicotyledones are the more advanced and show the greater capacity for further progressive evolution. But there is no sound basis for the assumption that the Dicotyledones are derived from Monocotyledon es ; indeed, the palseonto- logical evidence seems to point to the Dicotyledones being the older. This, however, does not entitle us to assume the origin of Monocotyledones from Dicotyledones, although there is manifestly a temptation to connect helobic forms of the former with ranal ones of the latter. There is no doubt that the phylum of Angiosperms has not sprung from that of Gymnosperms.

Within each class the flower- characters as the essential feature of Angiosperms supply the clue to phylogeny, hut the uncertainty regarding

the construction of the primitive angio- spermous flower gives a fundamental point of divergence in attempts to construct progressive sequences of the families. Simplicity of flower-structure has appeared to some to he always primitive, whilst by others it has been taken to he always derived. There is, however, abundant evidence that it may have the one or the other character in different cases. Apart from this, botanists are generally agreed that the concrescence of parts of the flower-whorls — in the gynaeceum as the seed-covering, and in the corolla as the seat of attraction, more than in the andrcecium and the calyx — is an indication of advance, as is also the concrescence that gives the condition of epigyny. Dorsi- ventrality is also clearly derived from radial construction, and anatropy of the ovule has followed atropy. We should expect the albuminous state of the seed to be an antecedent one to the exalbuminous condition, and the recent discoveries in fertiliza- tion tend to confirm this view. Amongst Dicotyledones the gamopetalous forms are admitted to be the highest develop- ment and a dominant one of our epoch. Advance has been along two lines, markedly in relation to insect-pollination, one of which has culminated ‘ in the hypogynous epipetalous bicar- pellate forms with dorsiventral often large and loosely arranged flowers, and the other in the epigynous bicarpellate small- flowered families of the Aggregatse. In the polypetalous forms progression from hypogyny to epigyny is generally recognized, and where dorsiventrality with insect-pollination has been established, a dominant group has been developed as in the Legu- minossB. The starting-point of the class, however, and the position within it of apetalous families with frequently unisexual flowers have provoked endless discussion, and there is no uniformity in opinion upon these matters. In Monocotyledones a similar advance from hypogyny to epigyny is observed both in a geo-aerophilous and in a hydrophilous series, but the class does not appear to be now progressive. In this connexion it Is noteworthy that so many of the higher forms are adapted as bulbous geophytes, or as aerophytes to special xerophilous conditions. The Graminese offer a prominent example of a dominant self-pollinated or wind- pollinated family, and this may find explanation in a multiplicity of factors.

From an early period in the century systematists have been endeavouring- to group the families of the two classes of Angio- sperms in larger

associations under such designations as Alliance, Cohort, Series, and such endeavours were in the direction of discovering real phyla — although in the pre-Darwinian period the idea was not always present. The relationship of some families is so clear that there has never been any doubt about their forming phyletic groups, but on the other hand there are many, either isolated or of reduced type, the position of which has been and in very many cases is still open to discussion, and consequently the limits of these phyla — like the limits of families, genera, and species — have been variously assigned by different botanists according to their particular views and to the knowledge of their time. The arrangement by botanists of these phyla in

larger groups has given us different systems which, if they all lay claim to associating in some measure natural groups, vary in the degree to which convenience or genetic relation — real or imagined — has influenced them. In Great Britain the system adopted by Bentham and Hooker — itself framed upon that of De CandoUe, which in turn owed its origin to Jussieu— holds sway, with some modification, fortified as it is by the detailed description in their magnificent work — the Genera Plantarum — of all genera known at the time of writing. It is : —

Dicotyledones.

f Thalamiflorae.

POLTPBTALiE .(DiSCifiOTCB.

I Calyciflorae. (Inferx. GAMOPETALiE) < Heteromeriz. (Bicarpellatx.

MOIIOCHLAMTDE.ffi. GTIIN0SPEBM2E:.

Monocotyledones.

The inclusion of Gymnosperms amongst Dicotyledones was more a conforming with conventional practice than the expression of an opinion of genetic relationships which were recognized as cryptogamic. Apart from this, the grouping in the Polypetalae and Gamopetalse indicates in the main the lines of progression of Angiosperms ; the juxtaposition of

Inferse and Calyciflorse being adopted to bring into prominence the similarities 6f facies between the flower-features of the highest Polypetalae and the aggregate Gamopetalse. The Monochlamydese, on the other hand, was retained as a convenient group for apetalous and often unisexual families, the relationships of many of which were and are doubtful, although the connexion of some of them with polypetalous families was clearly pointed out. In Germany there has recently been completed Die Naturlichen lyianzenr- familien — a book made possible by Bentham's and Hooker's labours — the combined work of many botanists under the edi- torial guidance of Engler and Prantl. It gives brief diagnoses of all known genera. The system adopted in it is : —

Dicotyledones.

Akohichlamtde^ {Choripetalx and Apetaloe). Metachlamyde^ (Sympetalce). Monocotyledones. In this system the Apetalse disappear as a group, and the families are assigned their positions in the several phyla or series, as they are termed, to vrhich in the views of the writers they belong. The series are arranged in genetic sequence, so , far as a linear arrangement permits of this, beginning with Casuarineae and Piperacese, which are regarded as the most primitive forms extant. As an attempt at a phylogenetic arrangement this system is now preferred by many botanists, particularly in America. More recently a startling novelty in the way of system has been produced by Van Tieghem, as follows : —

Monocotyledones. Liorhizal Dicotyledones. Dicotyledones.

Insemine^.

^EMINEiE.

UnitegminecB. Bitegmineae.

The most remarkable feature here is the class of Liorhizal Dicotyledoiies, which includes only the families of Nymphseacese and Graminese. It is based upon the fact that the histological differentiation of the epidermis of their root is monocotyledonous, whilst they have two cotyledons — the old view of the epiblast as a second cotyledon in Graminese being

adopted. But recent in- vestigation shows that the embryo of Nymphseacese is monocotyle- donous, and the adult root-character is only confirmation of this, and whatever the epiblast be it is not a constant feature of grass-embryos. Ovular characters determine the grouping in the Dicotyledones, "Van Tieghem supporting the view that the integument, the outer if there be two, is the lamina of a leaf of which the funicle is the petiole, whilst the nucellus is an out- growth of this leaf, and the inner integument, if present, an indusium. The Inseminese include forms in which the nucellus is not developed, and therefore there can be no seed. The plants included are, however, mainly well-established parasites, and the absence of nucellus is only one of those characters of reduction to which parasites are liable. Even if we admit Van Tieghem's interpretation of the integuments to be correct, the diagnostic mark of his unitegminoxis and bitegminous groups is simply that of the absence or presence of an indusium, not a character of great value elsewhere, and, as we know, the number of the ovular coats is inconstant within the same family. At the same time the groups based upon the integuments are of much the

same extent as the Polypetalse and Gamopetalse of other systems. We do not yet know the significance of this correlation between number of integuments and union of petals.

The reader will find in the following works detaUs of the sub- ject and references to the literature: — De Bakt. Comparative Anatomy of Phanerogams and Ferns. English ed. Oxford, 1884. — ^Bentham and Hooker. Genera Plantarum. London, 1862-83. — EicHLEE. Bluthendiagramme. Leipzig, 1875-78. — Englbr and Peanti.. Die naturliohen ^ansenfamilien. Leipzig, 1887-99.— GoBEEL. Organography of Plants. English ed. Oxford, 1900 (Part L). — Habeelandt. Physiologische J^anzeanatomie. Aufl. u. Leipzig, 1896. — Knuth. Handbuch der BlUtenbiologie. Leipzig, 1898, 1899, — Nawaschin. "Ueber die BefruchtungsvorgSnge bei einigen Dicotyledonen," Ber. d. deutsch. botan. Gesellsch., June 1900. — Penzig.

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Angkor, Wat. See Sibmrat and Cambodia.

Anglesea or Anglesey, an insular comity of North Wales, separated from Carnarvon by tlie narrow channel known as the Menai Strait.

Area and Population. — ^The area of the ancient and administrative county is 175,836 acres or 275 square miles, with a population in 1881 of 51,416, and in 1901 of 50,690, the number of persons per square mile being 184, and of acres to a person 3'48. The area of the registration county is 120,199 acres with a population in 1891 of 34,219. Within this area the increase of population between 1891 and 1901 was 1-0 per cent. The excess of births over deaths between 1881 and 1891 was 2392, and the decrease in the resident population was 908. The following table gives the number of marriages, birtbSj and deaths, with the number and percentage of illegitimate births for 1880, 1890, and 1899 : —

Tear.

Marriages.

Births.

Deaths.

Illegitimate Births.

No.

Per- centage.

1880 1890 1899

217 199 241

1023 800 894

1023 729 592

74 73

58

7-3

91

6-5

In 1891 there were in the county 129 natives of Scotland, 409 natives of Ireland, and 71 foreigners, while 2509 could speak English, 23,200 Welsh, and 7281 English and Welsh.

Constitution and Government:.— ATiglesea, returns one member to parliament, and it has now no parliamentary borough. There is one municipal borough, Beaumaris (2310). The following are urban districts : Holyhead (10,072), Llangefni (1751), and Menai Bridge (1600). It is in the North Wales circuit, assizes being held at Beaumaris. There are forty-four ecclesiastical districts or parishes, aU in the diocese of Bangor.

Education. — The number of elementary schools on 31st August 1899 was 64, of which 39 were board and 25 voluntary schools, the latter including 22 Church of England schools, 1 Roman Catholic, and 2 "British and other." The average attendance at board schools was 4060, and at voluntary schools 2330. The total school board receipts for the year

ending 29th September 1899 were over £14,242. The income under the Agricultural Rates Act was £825.

Agriculture. — About six-sevenths of the total area of the county is under cultivation, and of this, more than half is in permanent

Area under

Corn

Green

Permanent

Cultivation.

Crops.

Crops.

Pasture.

1880

147,011

26,389

9,468

26,431

84,389

333

1885

148,006

26,639

10,004

27,203

83,975

185

1890

149,451

26,188

10,062

31,724

81,421

50

^1895

152,004

24,798

9,305

28,219

89,592

76

1900

152,478

21,712

9,095

44,721

76,810

107

pasture. Less than 8000 acres are hiU pasture, and only a little more than 2000 acres are under woods. Almost the whole acreage

under com crops is occupied by oats ; more than half the green crop acreage is under turnips, and considerably more than a fourth under potatoes. A few acres of flax are usually grown. The preceding table gives the larger main divisions of the cultivated area at intervals of five years from 1880.

The following table gives particulars regarding the principal live stock for the same years : —

Tear.

Total Horses.

Total Cattle.

Cows and

Heifers in Milk

or in Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1900

7108 7040 6947 7604 8367

43,740 47,299 47,753 49,249 56,653

15,047 16,299 15,951 15,884 17,264

46,735 47,268 64,382 59,315 82,145

13,986 15,579 20,028 18,560 15,438

Industries and Trade. — ^According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in 1897 in textile and non-textile factories and work- shops was 997, the number in 1896 being 929 ; 751 of the 997 were engaged in non-textile factories. The mining industries have been gradually declining, and in 1899 only employed 549 persons. Copper has almost ceased to be worked, but some zinc is still obtained. In 1899 there were raised 61,557 tons of limestone and 23,711 of sandstone.

JFish are plentiful round the whole coast. The flsh landed at Holyhead in 1899 amounted to 17,708 cwt., valued at £3288 ; and the total value, including shell-fish, was £3562.

See Rowland, Mona Antiqua Eestaurata. , Dublin, 1723 ; 2nd edition, London, 1726. History of Anglesey (serving as supple- ment to Rowland's work). London, 1775. See also the various guide-books to North Wales.

Angleur, a town of Belgium, 3 miles by rail S.E. of ,Li^ge on the river Vesdre. ' It is the headquarters of the mining association known as the Vieille Montague, which has zinc foundries here. Population (communal)

(1866), 2554; (1880), 4357; (1890), 5902; (1897), 8001.

Anglican Communion. — The Anglican com- munion consists of the churches of England and Ire- land, the Scottish Episcopal Church, and the daughter . churches which have sprung from them and are in full communion with them ; chief amongst these latter being, of course, the Protestant Episcopal Church of the United States of North America. Until the 19th century these latter were so few in number and so insignificant

in size that such a phrase might well have seemed need- less : to-day the churches of the Anglican Communion are a power throughout the world. Together they constitute one of the three great historical divisions of Christendom ; the others, of course, being the churches of the Eoman obedience and those of the Orthodox east. The church of England was already, in the 8th century, a "mother of churches" on the mainland of Europe, through the work of Willibrord, Boniface, and their followers : after this, however, it suffered from the general stagnation, so far as aggressive work was concerned, which overtook most of western Christendom. Nor did it readily emu- late'the example of missionary activity shown in the 16th century by the Jesuits. Some care was taken to provide for the immediate spiritual needs of English colonists in America, and many isolated efforts were made to convert the Indians. But the predominant Calvinistic theology was not conducive to missionary work, whilst supposed legal difftculties, and the current theory of Church and State, long prevented the consecration of bishops for the Colonies. Archbishop Laud attempted to obtain a bishop for Virginia. A nomination was actually made by Charles II., and other efforts were put forth in the early part of the 18th century ; but they all came to nothing. In spite of increasingly urgent petitions, the Colonies still remained unprovided for. Meanwhile they were theoretically under the care of the bishops of London, who from time to time sent commissaries to America, and ordained young men who were sent to England for the

purpose. At length came the War of Independence ; and as soon as peace was declared, the church people of Connecticut sent Dr Samuel Seabury to England with a petition to the archbishop of Canterbury for his conse- cration. But as there were, not unnaturally, political obstacles. Archbishop Moore refused; and they were compelled to turn to the Scottish bishops, by three of whom Dr Seabury was consecrated bishop of Connecti- cut on 14th November 1784. Soon afterwards, at the initiative of the archbishop, the supposed legal difficulties were removed (26 Geo.

III. c. 84) ; and on being satisfied as to the doctrines of the church, and as to the liturgical changes which were then under discussion in a convention at Philadelphia, the two English archbishops proceeded to consecrate William White and Samuel Prevoost to the sees of Pennsylvania and New York on 14th February 1787. Thus the Protestant" Episcopal Church in the United States was properly equipped; and since then its progress has been constant. At the time of Seabury's consecration there were barely 100 Anglican clergymen in the United States : to-day there are in all 91 American bishops and over 5000 clergymen, working either at home or abroad. The American church has never proceeded to the organization of provinces. The presiding bishop is the senior by consecration, and the House of Bishops elects its own chairman.

On 12th August 1787 Dr Charles Inglis was conse- crated bishop of Nova Scotia, with jurisdiction over all the British possessions in North America. In Church 1793 the see of Quebec was founded ; Jamaica In the and Barbadoes followed in 1824, and Toronto Colonies. ^^^ Newfoundland in 1839. Meanwhile the needs of India had been tardily met, on the urgent representations in Parliament of William Wilberf orce and others, by the consecration of Dr T. F. Middleton as bishop of Calcutta, with three archdeacons to assist him in his labours. In 1817 Ceylon was added to his charge ; in 1823 all British subjects in the East Indies and the islands of the Indian Ocean ; and in 1824 " New South Wales and its dependencies " ! Some five years later, on the nomination of the Duke of Wellington, William Broughton was sent out to work in this enormous juris- diction as Archdeacon of Australia. Soon afterwards, in 1835 and 1837, the sees of Madras and Bombay were founded; whilst in 1836 Broughton himself was conse- crated as first bishop of Australia. Thus down to 1840 there were but ten colonial bishops ; and of these several were so hampered by civil . regulations that they were little more than government chaplaius in episcopal orders. In April of that year, however, Bishop Blomfield of London published his famous letter to the archbishop of Canter- bury, declaring that " an episcopal church without a bishop is a contradiction in terms," and strenuously advocating a great effort for the extension of the episcopate. It was not in vain. At a meeting held at Willis's Eooms in London, early in 1841, the plan was taken up with enthusiasm, and large subscriptions were promised; and on Whitsun Tuesday of that year the

bishops of the United Kingdom met and issued a declaration which inaugurated the Colo- nial Bishoprics Council. Subsequent declarations, in 1872 and 1891', have served both to record progress and to stimulate to new effort ; and since 1841 a sum of about £800,000 has been raised and applied to this object. The diocese of New Zealand was" founded in 1841, being en- dowed by the Church Missionary Society through the Council, and George Augustus Selwyn was chosen as the first bishop. Since then the. increase has gone on, as the result both of home effort and of the action of the local churches. Thus St John's Zaffraria wus founded by the Scottish Episcopal Church ; the foundation of a

see in Japan by the Canadian church is in contemplation ;, and the colonial churches have all done their share. Moreover, the fuller realization of the nature and value of the episcopal office has led to the sending out of bishops to inaugurate new missions, instead of waiting until there is already a large body of clergy and lay people: this procedure has been followed in the cases, amongst others, of the Universities' Mission to Central Africa, Lebombo, Corea, and New Guinea ; and the missionary jurisdictions so founded develop in time into dioceses. And thus, instead of the ten colonial jurisdictions of 1841, there are now about a hundred foreign and colonial jurisdic- tions, in addition to those of the church of the United States. The see of Carpentaria in Australia was founded in 1900, and scarcely a year passes without the addition of one or more to the list. It was only very gradually that these dioceses acquired legislative independence and a determinate organization. At first, sees were created and bishops were nominated by the Crown by means of letters patent ; and in some cases an income was assigned out of public funds. In fact, such was the theory of the crown officers as to its inherent rights as the " fount of honour" that Bishop Selwyn only managed by great exertions to prevent the insertion of a clause in his own letters patent reserving the appointment of his arch- deacons to the Crown! Moreover, for many years aU bishops alike were consecrated in England, took the customary "oath of due obedience" to the archbishop of Canterbury, and were regarded as a species of extrar territorial suffragans of his. But by degrees changes have been made on all these points.

(1) Local conditions soon rendered necessary sonie- thing of the nature of a provincial organization, and it was gradually introduced. The bishop of Calcutta received letters patent as metropolitan Provincial of India when the sees of Madras and Bombay zauon. were founded ; and fresh patents were issued to Bishop Broughton in 1847 and Bishop Gray in 1853, as metropolitans of Australia and South Africa respectively. Similar action was taken in 1858, when Bishop Selwyn became metropolitan of New Zealand ; and again in 1860, when, on the petition of the Canadian bishops to the Crown and the colonial legislature for permission to elect a metropolitan, letters patent were issued appoint- ing Bishop Fulford of Montreal to that office. Since then metropolitans have been chosen and provinces formed by regular synodical action. The process has been greatly encouraged by the resolutions of the Lambeth confer- ences on the subject; and in 1901 the formation of a province of Queensland was in contemplation, with Brisbane as its metropolitan see. The constitution of these provinces is not uniform. In some cases, as South Africa, New South Wales, and Queensland, the metro- politan see is fixed : a practice which is not only in accordance with most ancient precedents, but which secures the inestimable benefit of an unbroken history. Elsewhere, as in Canada and New Zealand, where no single city can claim pre-eminence, the metropolitan is either elected or else is the senior bishop by consecration, whatever his see may be. Two further developments must be mentioned, (a) The creation of diocesan and provin- cial synods, the first diocesan synod to meet being that of New Zealand in 1844, whilst the formation of a provincial synod was foreshadowed by a conference of Australasian bishops at Sydney in 1850. (6) In recent years the title of archbishop has been given to the metropolitans of several provinces. It was first assumed by the metropolitans of Canada and Rupert Land, at the desire of the Canadian General Synod, in 1893 ; and subsequently, in accordance with a resolution of the

Lambeth Conference of 1897, it was given to the metro- politans of New South Wales and South Africa by their synods. Civil obstacles have

hitherto delayed its adop- tion by the metropolitan of India.

(2) By degrees, also, the colonial churches have been

freed from their rather burdensome relations with the

state. The church of the West Indies was

‘“Zt disestablished and disendowed in 1868 (Estab-

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control. LisHMENT). in 1857 it was decided, m Begina V. Eton College, that the Crown could not claim the presentation to a living when it had appointed the former incumbent to a colonial bishopric, as it does in the ease of an English bishopric. In 1861, after some protest from the Crown lawyers, two missionary bishops were consecrated without letters patent for regions out- side British territory : C. F. Mackenzie for the Zambezi region and J. C. Patteson for Melanesia, by the metro- politans of Cape Town and New Zealand respectively. In 1863 the Privy Council declared, in Long v. The Bishop of Cape Town, that ” the Church of England, in places where there is no church established by law, is in the same situation with any other religious body.” In 1865 it adjudged Bishop Gray’s letters patent, as metropolitan ■of Cape Town, to be powerless to enable him “to exercise any coercive jurisdiction, or hold any court or tribunal for that purpose,” since the colony of South Africa already possessed legislative institutions when they were issued ; and since there was no formal compact of obedience be- tween them, his deposition of Bishop Colenso was declared to be ” null and void in law.” This apparent disaster, as Bishop S. Wilberforce at once foresaw, proved to be ” the ■charter of freedom of the colonial church.” The South African bishops forthwith surrendered their patents, and formally accepted Bishop Gray as their metropolitan, an example followed in 1865 in the province of New Zear land. In 1862, when the diocese of Ontario was formed, the bishop was elected in Canada, and consecrated under a royal mandate, letters patent being by this time en- “tirely discredited. And when, in 1867, a coadjutor was •chosen for the bishop of Toronto, an application for a royal mandate produced the reply from the Colonial Sec- retary that ” it

was not the part of the Crown to inter- fere in the creation of a new bishop or bishopric, and not •consistent with the dignity of the Crown that he should advise Her Majesty to issue a mandate which would not be worth the paper on which it was written, and which, having been sent out to Canada, might be disregarded in the most complete manner." And at the present day the colonial churches are entirely free in this matter. This, however, is not the case with the church in India. Here the bishops of sees foimded down to 1879 receive a stipend from the revenue (with the exception of the bishop of Ceylon, who no longer does so). They are not only nominated by the Crown and consecrated under letters patent, but the appointment is expressly subjected "to such power of revocation and recall as is by law vested " in the Crown ; and ~~vsrhen additional oversight was neces~~ sary for the church in Tinnevelly, it could only be secured by the consecration of two assistant bishops, who worked under a commission from the archbishop of Canterbury which was to expire on the death of the bishop of Madras. Since then, however, new sees have been founded which are under no such restrictions; by the creation of dioceses either in native states (Travancore and Cochin), or out of the existing dioceses (Chota Nagpur, Lucknow, &c.). In the latter case there is no legal sub- division of the older diocese, the new bishop administer- ing such districts as belonged to it under commission from its bishop, provision being made, however, that in all matters ecclesiastical there shall be no appeaJ but to the metropolitan of India. But this is an obvious

anomaly, and it is likely that matters wUl be simplified in the future.

(3) By degrees, also, the relations of colonial churches to the archbishop of Canterbury have changed. It was at first assumed, as has been said, that a colo- nial bishop was an extra-territorial suffragan of f^^„omy. the archbishop. Until 1865 no colonial bishop was consecrated outside the British Isles, the first in- stance being Dr MaeDougall of Labuan, consecrated in India under a commission from the archbishop of Canter- bury ; and until 1874 it was held to be imlawful for a bishop to be consecrated in England without taking the suffragan's oath of due obedience. This necessity was re- moved by the Coloiiial Clergy Act of 1874 (37 and 38 Vict, c. 77, sec. 12), which permits the archbishop at his discre- tion to dispense with the oath. This, however, has not been done in

all cases ; and as late as 1890 it was taken by the metropolitan of Sydney at his consecration. But natu- ral as it is that the oath should be taken by a colonial bishop holding mission from the archbishop of Canter- bury, that it should be taken by the suffragan of another province, or still more by a metropolitan, is an obvious anomaly, and one which will doubtless be modified in course of time. Thus the constituent parts of the Angli- can communion gradually acquire autonomy : missionary jurisdictions develop into organized dioceses, and dioceses are grouped into provinces with canons of their own. But the most complete autonomy does not involve isolation. The churches are in full communion with one another, and act together in many ways ; missionary jurisdictions and dioceses are mapped out by common arrangement, and even transferred if it seems advisable : e.g., the diocese Honolulu (Hawaii), hitherto under the jurisdiction of the archbishop of Canterbury, was transferred in 1900 to the church of the United States on account of political changes. There is a strong affection for and deference to the see of Canterbury, which shows itself by ;frequent consultation and interchange of greetings ; there is also a strong common life which has been emphasized in recent years by common action (Lambeth Conferences), and seems likely to be even more significant in the future.

The Anglican Communion consists of the following : (1) The Church of England, 2 provinces, Canterbury and York, with 23 and 10 dioceses respectively. (2) The Church of Ireland, 2 provinces, Armagh and Dublin, with 7 and 6 dioceses respectively. (3) The ScottiSi Episcopal Church, with 7 dioceses. (4) The Protestant Episcopal Church of the United States, with 81 dioceses and missionary jurisdictions, including North Tokyo, Kyoto, Shanghai, Cape Palmas, and the independent dioceses of Hayti and Brazil. (5) The Canadian Church, consisting of (a) the province of Can- ada, with 10 dioceses ; (6) the province of Rupert Land, with 8 dioceses, of which 2, Saskatchewan and Calgary, are at present united. (6) The Church in India and Ceylon, 1 province of 11 dioceses. (7) The Church of the West Indies, 1 province of 8 dioceses, of which Barbadoes and the Windward Islands are at present united. (8) The Australian Church, 1 province of 6 dioceses and 9 (at present) unorganized dioceses, which, how- ever, are united under the General Synod of Australia. (9) The Church of New Zealand, 1 province of 6 dioceses, together with the

missionary jurisdiction of Melanesia. (10) The South African Church, 1 province of 10 dioceses, with the two mission- ary jurisdictions of Mashonaland and Lebombo. (11) Nearly 30 isolated diocesfes and missionary jurisdictions holding mission from the see of Canterbury.

Apthorities. — Official Tear-book of the Church of England.— Phillimoee. JEcclesiastical Law, vol. ii. London, 1895. — Digest of S. P. G. Records. London, 1893. — E. Stock. History of the Church Missionary Society. 3 vols. London, 1899. — H. W. TncKER. TTie English Church in Other Lands. London, 1886. — A. T. WiKGMAN. The Church and the Civil Power. London, 1893.

(w. E. Co.)

Anglican Orders. — The attacks which Eoman Catholic controversy has made upon the orders of the English Church have varied greatly in character, and shifted their ground from time to time; but all maybe

reduced to two classes : (i.) historical objections, and (ii.) ecclesiastical objections.

(i.) The difficulty began with the repudiation of papal supremacy by Henry VIII., when, according to Eoman theory, the English Church became schismatical and its orders marred by the taint of schism. A further alienation took place when the Edwardine English ordinal of 1650 and 1552 superseded the old Latin ponti- fical, and orders were thereupon conferred by a newly- reformed rite. At Mary's accession the pontifical was restored, and eventually Cardinal Pole reconciled the Eng- lish Church with the Holy See. The exact effect of his action is a matter of controversy. There is no question that he reconciled the schism to the Pope's satisfaction, and therefore that objection to the Henrician and Edward- ine orders came to an end ; but it is a disputed question both how he was authorized by his papal faculties to deal with the orders conferred by the Prayer Book rite and, also, how in fact he did deal with

them. Historical in- quiry shows that for a short period before Pole's advent a small number of reordinations took place, but subsequently they almost entirely ceased; and it is contended that in other cases the orders were tacitly allowed, possibly after some slight supplemental ceremony, and that Pole's in- structions were designedly vague. The contention is sup- ported by the fact that, while a vast number of parochial clergy were deprived in 1553-54, no case is known of a deprivation on the ground of Edwardine orders. In an- swer to this Anglican contention an attempt is made to extract from Pole's instructions a definite condemnation of the Edwardine orders, and to maintain that all such clergy as were allowed to minister in Mary's reign must have been reordained. When the Prayer Book was re- stored under Elizabeth the question returned again, and there is no doubt that since the latter half of the 16th century the Eoman Catholics have continually treated Anglican orders as null and void. Still there was no adverse decision. The orders were vaguely attacked, and after 1570 reordinations took place abroad, and in 1608 at Rome ; but there was little definite justification offered for this till the Nag's Head fable was invented in 1604, and it was seriously maintained that Archbishop Parker — the main channel of Elizabethan orders — ^had had no better consecration than a mock ceremony in a tavern. This fable has had great influence on the controversy. In 1616 doubts were cast on the consecration of Barlow, Parker's chief consecrator. There was more justification for this, but both these historical objections have broken down. They were not, as it now appears, seriously enter- tained at the first official inquiries into the question at Kome in 1685 and 1704 ; and though they survived until recently as large factors in 'popular controversy, they bid fair now to disappear, and the battle is shifted to other ground.

(ii.) The theological or ecclesiastical objections fall into three classes. First and earliest came the objection to the orders on the ground of the repudiation by the English Church of the theory of papal supremacy. This has figured largely in the earlier and the less scientific phases of the controversy; but, accurately speaking, it is no objection to the validity but only to the regularity of the orders, and it merely forms part of the general sub- ject of the relation of the English Church to the J^apacy, and affects Anglican orders on the same ground as the orders of the Orthodox

Church. The other two points touch the question of the ordinal in English, which in 1550 took the place of the old English pontificals in Latin, and with slight modifications remains the ordinal of the Anglican communion to-day. Objection is raised to this on the ground: (a) that it is, in "form," deficient in the

essentials required for a valid ordination ; and (/3) that the "intention," which lies behind it, and with which the Church uses it, is also deficient, (a) The criticism of the " form " of the ordinal has taken many shapes, and several charges have been made, only to be withdrawn as inad- missible. It has been maintained that the mere giving up of the Latin pontifical was in itself a final departure from the "form of the Church": but the Church Catholic has no one single form for holy order; it has used, and still uses, many forms. The absence of any "porrection of instruments " after 1552 has been made a grave objection, because Eugenius IV. defined this (1439) to be the essen- tial matter of ordination. But his definition was never universally accepted, and since the work of P6re Morin (1686) has been recognized to be erroneous. Other and more subtle objections to the Anglican form have been raised ever since the question was first officially examined at Eome in 1685, and again, for the Gordon Case in 1704. The documents of these two inquiries have been only recently and incompletely published, and the precise nature of the objections raised is not clear. But they were probably the same as those raised in the bull ApostolicoB CuroB in 1896, viz., that the words accompany- ing the imposition of hands are an insufficient form to de- fine the action which is going on. Attention is called to the fact that the words were made more explicit (both for priests and bishops) at the revision of the Prayer Book in 1661. To this it is replied : that the alteration was made to refute a Presbyterian construction of the forms; that the defining is at least as clear as in the Eoman rite, where no words at all necessarily accompany the imposition of hands; that the whole service defines beyond any doubt what the action is, and what the order is that is being conferred; and that the mere imperative formulae of 1650 do in fact define the order in Biblical terms, and are more explicit than some of the early ordination prayers, which do not define at all. All these objections as to "form" are comparatively modern, for the English ordinal was used in Edward's time by some of the Marian bishops ; and

even according to the most modern papal interpretation of Pole's instructions it would seem that orders conferred by them using this form were to be held valid, i.e., the form was in itself not insufficient. The Eoman attack is thus inconsistent with itself, as well as with the Eoman rite and the history of Eoman ordina- tions. (yS) The question of intention is raised partly as a general objection, and partly with reference to the actual ordinal and the Anglican doctrine of orders. To the gen- eral objection that unsoundness of views invalidates the ordinations, it is replied — first, that this is not true of individual views, but that the intention to be taken into account is the intention of the Church; and, secondly, that the general intention of the English Church with regard to orders is expressed in the preface to the ordinal as an intention to continue in valid sequence the orders that have been in the Church since a'postolic times, and is there- fore unexceptionable. Further, the special objection is raised that the English Church fails to express"the inten- tion in the case of the priesthood, because it makes no special mention at the ordination of the power of offer- ing sacrifice. To this it is replied that — ^first, such men- tion is only a mediaeval addition to the Latin pontifical, and therefore is unessential ; and, secondly, the ordinal mentions the whole work of the priesthood, and not only one side of it, and thus expresses a more comprehensive and fuller intention than the Latin pontifical.

The controversy is thus still undecided. The Roman decision has not met witji full approval from learned men in that communion, and has been repudiated not only by Anglican but by Orthodox writers.

ANGLING

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The older phases of the controversy have been superseded by recent action at Rome and in England. The older books which still are valuable are two :— On the Roman side— Ebtoodkt, Question of Anglican Ordinations, 1893 ; on the English side— Denny and Lacby, Be Sierarchia Anglicana, 1896, and Supplement, 1896. The latest phase begins with the publication of the bull Apostolicce Curx, Rome, 1896. The principal pamphlets and books are :— On the Roman side— ^

Vindication of the Bull, by the Roman Catholic bishops, 1898 ; Brandi, Soma e Canterbury, Rome, 1897 : on the English side—The Answer of the Archbishops of England, 1897 ; A Treatise on the Bull, 1896 ; and Priesthood in the English Church, 1898 ; A. BuLGAKOFF, Question of Anglican Orders, 1899. These three are tracts xix., xli., and liv. of the Church Historical Society. Also, A. Lowndes, Vindication of Anglican Orders, 2 vols. New York, 1897, is a useful general summary.

(w. H. F.)

Angling. — Strictly speaking, angling should mean tlie capture of fish with the hook, as distinguished from netting, spearing, or trapping ; for " angle " is an old English word applied to the hook, which in very ancient times appears to have been made in angular form. Such angular hooks are still used by the natives in tropical seas. In modern times, however, angling is the term used to denote tlie various forms of fishing, recognized as sportsmanlike, with rod, liae, and hook.

The principal British fishes which are sought after by the sportsman naturally divide themselves into two classes. In the first class are the members of the salmon family which yield sport to the fly-fisher; namely the salmon itself, the sea-trout, the brown trout, tisb^'^ and the grayling. To these may perhaps be added the char; but this very delicate and highly esteemed fish, in English waters at any rate, rises badly, and is not often caught except on spinning baits fished at a considerable depth. In Scandinavia, on the other hand, it rises exceedingly well in many lakes, and grows to a large size. The smelt is also a member of the salmon family, and ascends rivers to spawn, but it can hardly be reckoned among the sportsman's fish. The second class are commonly spoken of as " coarse fish," and include those species which are found in most of our rivers, lakes, and ponds. They are the pike, barbel, bream, perch, carp, tench, chub, roach, rudd, dace, and gudgeon. Of these, chub, dace, and rudd yield sport to the fly-fisher, and, in certain waters, roach and even perch will take a fly freely in the summer time. Instances are recorded from time to time of other coarse fish taking flies, but, generally speak-ing, they are fished for with natural baits of various kinds. Perch, while not despising such baits as worms, feed more particularly on the young of

other fish ; while the fish of the carp famUy, which includes the roach, rudd, dace, chub, barbel, bream, tench, and gudgeon, feed mainly on vegetable growths, worms, water insects, and, sundry pastes when proffered by the angler, and are usually captured on float or leger tackle, by the process known as bottom-fishing. Pike, on the other hand, are fished for with natural or artificial baits kept in movement a few feet from the bottom if dead, while live baits are usually suspended by a float, or used by means of the paternoster or leger methods, which will" be described later.

Returning now to the game fish; the salmon first of all claims our attention by reason of its size, snorting qualities, and excellence as food. This fish is Saimoa. rapidly disappearing from the rivers of England and Wales, and has seriously diminished in numbers in most of the fivers of Scotland aad Ireland. The primary cause of the decrease of salmon is undoubtedly the increase of the population in the British Isles generally, which demands such an increased fish supply that the salmon, which fetches high prices, is eagerly sought

Coarse tisb.

after by professional fishetmen and others for the market. The demand is, in consequence, largely in excess of the natural supply; and the natural supply itself is diminished in many cases by pollution which destroys the eggs of the salmon, by manufacturers' turbines, water-wheels, and other apparatus which destroy the young of the salmon and hinder the travels of the spawning fish up stream; and by the capture by poachers of the large salmon themselves when on the spawning \beds. In the sea, in the estuaries of rivers, and even in the narrow fresh-water rivers themselves, salmon are ruthlessly netted for market purposes. It is a striking peculiarity of the salmon that while it must, in view of its rapid growth, feed largely in the sea, it is rarely caught in salt water by the angler. In rivers, on the other hand, where it rises to the angler's fly and takes his prawn, worm, gudgeon, or other bait, it rapidly gets out of condition and is believed to feed, but little. In most salmon rivers there is, as a matter of fact, little food to sustain such large fish. The most sportsmanlike method of catching salmon is undoubtedly with the fly, though, generally

speaking,' the combination of feathers, tinsel, and wools which go to make up this lure, does not represent any insect known to entomologists. What are termed fancy flies are possibly taken by the fish for the young of some marine creature, or simply for some unknown thing struggling to escape. To the present day trout are fished for in Norway with a piece of red rag trailed behind a boat, and it can hardly be suggested that the fish regard this as any known item of food, or that it is absolutely necessary that artificial flies or baits should represent iexisting insect or animal life. Grilse, which is the name given to salmon on their first return to, the river before spawning, will rise to such flies as the March brown; and even a full-grown salmon will occasionally take quite a small fly. Salmon rise most readily when first leaving the sea and entering the river. After being in fresh water a little time they apparently settle down to a period of inactivity and feed badly, though a rise of water will generally set them moving upwards, and on reaching a new pool they may often be induced to rise. It shovild be mentioned here that in some rivers salmon are running up from the sea all the year round ; and it is one of the problems connected with this remarkable fish to explain why, in the Tay, for instance, it should enter the river in January, seeing that the principal purpose for which it comes into fresh water, namely spawning, is not carried out until the following autumn at the earliest. These January fish, moreover, have apparently not spawned during the months preceding their entry into the river, and unless it is assumed that they are all barren fish, which is unlikely, it would appear that the salmon or some members of the species do not spawn every year. In the majority of salmon rivers there is a spring run of salmon ; in July and August shoals of grilse enter the river ; while in September there is the autumn run of big fish, which have evidently come up for spawning and no other purpose. About the beginning of September, netting, as a rule ceases, the dates varying in different rivers; but angling with rod and line is still allowed for a few weeks, as otherwise the proprietors of the upper reaches of the river, who protect the salmon on the spawning beds, would obtain no sport at all. In November angling entirely ceases, and the salmon soon go on the gravelly shallows, where the female deposits her eggs, a few of them only being vivified by mUt from the male. The fish cover their eggs by sweeping gravel over them. In the course of a few weeks the eggs hatch, and the

resulting frjr remain in the river about two years, very much resembling the small trout in appearance.

They then begin to grow silvery, descend to the sea herring-size, and return -weighing from 3 lb to as much as 14 lb. The salmon on its first return to the river is termed grilse, as we have said ; but in Ireland the corresponding name is peal, which should be distinguished from the same word used in the west country, where it is always applied to sea-trout. The capture of the smolts is illegal, but a good many are killed in mistake for trout.

There is an endless variety of flies used for salmon fishing, but the angler need not supply himself with a

very great variety, so long as he is provided Piynsh' "vsrith flies of various sizes, as size is regarded, sSmoa. ^7 experienced salmon fishermen, as being even

more important than colour. Speaking gener- ally, the flies used in early spring are large, and they diminish in size as the season grows older. In autumn quite small flies are used for the fish which have been some time in the river, and, as a general rule, the lower the water, the snaaller should be the fly used, and the deeper should it be fished. For very bright weather and clear water, lightly dressed flies, which are mainly light yellow in colour, are standard favourites, such as the Sun-fly and the Mystery. But undoubtedly the most generally favoured of all the salmon flies, and one which can be reasonably relied upon to kill, if dressed of the right size, and if the salmon are in taking humour, is ^ the Jock Scott. It perhaps owes its reputation largely to the fact that it is a particularly suitable fly for use when the rivers are clearing after a spate ; and as this is quite the best time for salmon fishing with the fly, the Jock Scott, as a result, kills perhaps more fish than any other fly known to anglers. The tackle of the salmon fly-fisher is simple, but somewhat expensive, as the fish are so strong, and of such value when captured, that to use weak or

indifferent faekle is properly re- garded as a foolish proceeding. The rod itself may vary in length from 12 feet to 18 feet, according to the strength and height of the user, and is usually made of either split cane, with or without a steel centre, or of greenheart. It should have plenty of wood in the top joint, to give it lifting power. It should bend right away down to the butt when the cast is made, but must on no account be weak in the middle, for the salmon fisher sometimes has to refuse the fish even an inch of line, which places an enormous strain upon the rod. The line is usually of plaited silk, and waterproofed, with an oil dressing. It should be what is termed solid, that is, not plaited round a core, nor with a centre left hol- low. At the end of the line comes the 3 yards of strong salmon gut, the upper part of which may be twisted or plaited, and then the fly. In big, fast-running rivers, treble or double gut is sometimes required right down to the fly. Salmon flies are now very commonly tied on eyed hooks, but many salmon fishers believe that they swim- better if there is simply a small gut loop whipped on at the end of the shank. To the eye or the loop is tied a short length of gut which, in its turn, is looped on to the cast. There are many kinds of excel- lent salmon reels made in England, the mechanism of which varies. The angler should see that there is a good strong check, and that the reel itself is strongly made and durable. f

In working the salmon fly, the angler fishes either from a boat or from the bank, according to the river, and casts over pools and other places which are known by experience to be frequented by salmon. As a rule, only one fly is used, and the cast is made across and a little down stream, the current bringing the fly round, when the fly is drawn up stream a little and a fresh cast is made. When grilse are in the river two flies are

often used, particularly if the fish run small; and in some pools the flies are cast up stream and drawn quickly down or across, the dropper fly being worked along the surface. There are many rules which are firmly believed in by old salmon fishers, but the salmon are constantly breaking them ; as, for instance, by tak- ing a fly floating on the surface, and by risiug in pools where, according to local tradition, salmon are never caught. The height of the water has a very great deal to do with success in salmon fishing, and while, at a cer- tain level, certain pools will hold rising fish, if the water falls or rises a little these pools may become

useless, and other pools come into ply. In big rivers the salmon fly is often harled, that is to say, allowed to trail out behind a boat which is rowed backwards and forwards across the stream, being dropped a few yards at each crossing. By this means the fish sees the fly before being alarmed by the boat passing over it. In lakes salmon are usually fished for with two flies, the dropper being worked along the surface. Both in lakes and rivers, the angler who fishes the hardest, other things being equal, generally succeeds the best ; and it must not be supposed that the fish will not rise because the pool has been fished over two or three times. Sooner or later the psychological moment arrives and the salmon rises. When a salmon misses the fly it is good policy to rest him for two or three minutes and then fish for him again, starting a lit- tle above him and gradually working down. If he again misses the fly, a smaller size of the same pattern may be tried, and a still smaller one if he rises and misses this. Then other patterns may be tried if necessary. In playing the salmon the rod should be kept well up, with the butt resting against the hip and the left hand grasping the rod a little above the reel. The line should not be touched by the left hand. The right hand should be kept on the handle of the reel, and the line should be wound up at every opportunity, if only a few inches, and allowed to run off the reel if the salmon makes rushed or heavy plung^. The angler should follow the fish, running or walking, as far as the bank will allow, and never give an inch more line than he is obliged to, of course having due regard to the strength of the tackle. If it can be done without bringing the fish into a dangerous position, the salmon shoi:dd be worked down stream. Thus the angler when playing a salmon maintains a position on the bank a little below the fish if he can. It is an almost impos- sible thing to draw a very heavy fish up stream against a strong current. A very sulky fish may be handplayed. Salmon are also fished for with various baits, such as the prawn, worm, minnow, stone loach, gudgeon, and artificial spinning baits of which the phantom and spoon are the best. The spinning baits are usually harled in large rivers. The prawn is, as a rule, cast out and allowed to float down stream at about mid-water, but sometimes it is harled. It is a/ieadly bait in clear water. A bunch of worms is used in thick water, while a single worm on two-hook tackle may be cast up stream in low clear water.

Trout, which most modern authorities consider spring from a common ancestor, vary remarkably in size and appearance. In a Devonshire brook they may average^ a fifth of a pound, while in lakes they '^"' grow to' over 20 lb. The Thames grows the largest in England. One was caught in Loch Stennes which weighed 29 ft. A cast of this remarkable fish is preserved in the smoking-room of the Fly-fishers' Club, London. Trout may be divided broadly into two kinds: those which live permanently in river or lake, and those which pass the greater portion of their lives in the sea, visiting the rivers in summer and autumn, and while there pro-*

pagating their species in much the same manner as the salmon. Sea-trout (Salmo trutta), sometimes called salmon- trout, and known in Ireland as white trout, of which the bull-trout is a variety, afford sport of the highest class to the fly-fisher. They are found in many salmon rivers and smaller streams, and exhibit a partiality for lakes connected with the sea. They are caught both in the tidal portions of the rivers, and in the upper reaches. Fly-fishing for them is carried on in almost identically the same manner as what is termed wet-fly fishing for brown trout ; except where the fish run, large and small salmon flies are used, in which case the flies are cast and worked much as they would be for salmon. Sea-trout Sea-troat ^^^ notorious short risers, and both for these

and for salmon jrhich have been some time in the river and rise warily, a long-shanked double hook, small in the bend, is now largely used. It is known as the Bickerdyke " Salmo irritans" hook, Salmo irritans being a name humorously conferred upon the fish which just touch the fly without being hooked. Sea-trout are found in the pools of rivers, in small eddies, and gen- erally in many of the places favoured by brown trout ; but they show a great partiality for a long rippling run of a few feet in depth, while in the tidal portions of a river a shoal will frequently be found collected round a sandy spit in only a foot or two of water. They are generaUy fished for with rather gaudy flies with a mixed wing, the body composed of mixed seal's fur (such as olive with a little crimson and blue), with a ribbing of flat silver tinsel and a short red tuft at the tail like

the Zulu. They will at times take all the ordinary brown trout and loch flies such as are used both on river and lake, and in tidal pools there are few better flies than a silver-doctor tied exceedingly small, while small Alex- andras are also killing. The angler should be guided as to the size of his fly by the nature of the water, in a heavy stream a larger fly being used than in a quiet one ; while in the pools, if there is a good ripple, a slightly larger fly should be used than if the ripple is trifling. In lakes, seartrout are found scattered over all the shallower portions, but favourite spots will be round the edges of weeds and at the inlet and outlet of a stream. Sea-trout will take small spinning baits and worms, and are often fished for with a worm used on spinning tackle. A favourite artificial bait on the east coast rivers of Scotland is a very small tube of indiarrubber threaded on a hook, and cast by means of the fly-rod.

So far as fly-fishing is concerned, the non-migratory trout are angled for by two very distinct and characteristic

methods. On most of the English south-country Noa- rivers, and in not a few of those in the Midlands

^^IJ. ’” and farther north, the various flies of the

Ephemeridse family are very abundant, and as they come floating down the river the trout rise to the surface, take up a position, and seize fly after fly. To capture the trout in such circumstances the dry-fly method of fishing has been invented. The flies resemble the natural insect, are tied with cocks’ hackles which are somewhat stiff, and axe frequently moisteied with paraffin to make them float. A single fly is used ; the line, a heavy and tapered one, is greased; and the rod is usually a short but powerful weapon of about 10 feet in length. A feeding fish having been marked down, the angler stalks him very carefully, keeping well below him, and casting the fly with great precision about a yard above him so that it floats down over his nose, when the trout may or may not take it. Dry-fly fishing has become exceedingly popular of late years and has many enthusiastic professors. Though imitations of ‘the Ephemeridse are most generally used, sedges, alders, palmers, and other flies find places in the dry-fly fisher’s book ; and when the spring fishing

is over most of the trout are caught in the evening by means of sedges of various kinds. In wet-fly fishing the angler regards wind as a necessity nsblag. on the more quiet pools, but in dry-fly fishing the trout are caught in absolutely calm water. The secrets of success lie, firstly, in being able to mark down feeding fish ; in selecting those which are under the bank rather than out in the middle ; in keeping within casting distance of the fish without being observed ; in choosing the right fly, and casting with precision. The difficulties of capturing fish idepend very largely on the amount of fishing done in any particular river. If, for instance, it is a club water which is heavily fished, and large num- bers of small trout are constantly being returned, the fish become exceedingly shy and difficult of capture ; and it is quite possible that a Certain proportion of them, find- ing surface feeding a dangerous amusement, turn their attention to the vast wealth of crustacean and other natural food which is found among the weeds of the chalk streams. Among the flies which are general favourites with dry-fly fishers are the blue dun, red or claret quUl, medium olive quill, iron blue, dark olive dun, gold-ribbed hare's ear, silver sedge, orange sedge, cinnamon quill, little marryat, pale olive quill, detached badger, alder, Wickham's fancy, pink Wickham, and the May-fly.

Wet-fly fishing is more particularly appropriate to streams where there is no considerable amount of sur- face food, where the water is shallow and of a broken character. Here the trout are ever on tj^tinx the look-out for passing particles of food, and the angler walks up stream casting one, two, or three flies ahead of him, allowing them to drift back with the current and striking if he perceives the least check of the line. On some big rivers, where the water is coloured, it is a common practice to fish down stream with a long line, but the up stream method is generally the most successful. ■ Even in low water, on hot, bright, sunny days, a basket of fish may be made by wading up stream, using a single fly, casting it in little runs behind rocks and stones and in every nook and cranny likely to hold trout ; and it is astonishing to find what very small places will hold trout of a very respectable size. In such circumstances down stream fishing would be absolutely useless. For the trout of the smaller English, Irish, and Welsh rivers, and the Scottish bums, very fine tackle should be used, and, within reasonable limits, the lighter the rod the better, for it allows of more delicate manipulation. The trout run small, rarely

exceeding half a pound, but the fishing, when there are several miles of breezy moorlands to be walked, is of a very delightful character, and the charm of the surroundings and the healthiness of the exercise will fully compensate for the lack of weight on the part of the quarry. There are some streams which possess the characteristics of both wet-fly and dry-fly waters ; such, for instance, is the Dove. Here there are many quiet reaches of no great depth where there is an abundance of surface food, and the dry-fly fisher can pass many happy and profitable hours ; while between them there are long rippling shallows, swirling eddies, and miniature falls, where the wet-fly fisher has every opportunity of killing fish with his own particular method. To fish such a river it is desirable that the angler should be acquainted with both methods, using each in its appropriate place. In fact, an angler can hardly be said to be a finished fly-fisher until he is as expert with the dry fly as he is with the wet fly. It is impossible here to give a complete list of the flies used by trout fishermen, but among the general favourites are the red and black palmers, coch-y-bondhu, black gnats, the governor, the coachman, duns of various colours, Greenwell's glory, March brown, redspin-

ner, alder, &c. For wet-fly fishing the fly. should, as a rule, be sparsely dressed, and the hackles should be soft. For low, bright water, where the fiSh are at all educated, some of the very best flies are those used on Yorkshire streams. But now and again one happens upon a river where the trout show a decided preference for big heavily- dressed flies. In common language, they appear to like a big mouthful.

Fishing with the May-fly is a thing of itself. On some rivers these large species of the Ephemeridse rise in

extraordinary quantities, and the trout take «^iag. them very freely ; in fact, in rivers containing.

coarse fish the trout generally run large, and, as a general rule, refuse the fly at any other time. The big rise of May-fly, however, tempts them to the

surface, and a goodly number are captured during the first week or two of June. Like the duns, the May-fly is fished either wet or dry, but more often dry than wet. It sometimes happens, however, that the wet fly will kill better than the dry. As the fly goes through its various changes the artificial should be altered to correspond to it. First we have the greendrake; then this sheds its skin and becomes the greydrake; and, lastly, the greydrake dies and floats down with wings expanded on the water, when it is known as the spent gnat. The fly-fishing on a river is usually rather poor for a week before the May-fly appears and for a week or two after it has disappeared, and by some anglers the presence of the fly is on this account objected to. On the other hand, the May-fly has a splendid feeding effect on the trout, putting them into finest possible condition.

*Lake trout, except where there is an abundance of coarse fish or bottom-feeding, generally rise much better Lak i t *° *^® ^^ than river trout, and are usually*

captured when there is a breeze to ripple the water, and the day is not too bright. The fish lie round islands, off rocky points, by the sides of weeds, and over shallow ground generally, but are not much fished for with the fly in the deeper portions unless there is a rise of May-fly or other insects to bring them to the surface. The common practice is to row the boat to windward of some likely spot, then drift over it. The anglers, if there are two, sit at each end of the boat and take alternate casts. Short casts are better than long ones, for the trout will rise close to the boat, and it is, generally speaking, important to let at least one of the flies drag along the surface of the water. When a fish rises at the fly and misses it, he should be cast over again instantly, and may often be caught. Indeed, the writer has on more than one occasion known a fish to rise in front of the boat, miss the fly, the boat go over the fish, and the angler to take a cast behind the boat and secure the trout. Some lakes are not suited for drifting, and it is better for the attendant to row the boat, putting it near likely spots for fish. One great point in successful loch-fishing is to let the wind work the flies as much as possible. This can only be accomplished with rather a long rod, 12 feet or 13 feet being a good length. The line is cast out side-ways, and the wind, bearing out the line, drags the flies in the same

direction as the boat is drifting. By this means the flies are given the natural motion of drifting with the wind. When they are drawn against the wind the motion is unnatural, and a large fish will often refuse to take them. The flies used in lake fishing are mostly of a fancy character, lake trout showing considerable taste in the matter of colour, to which, in Ireland par- ticularly, great importance is attached. There pigs' wools and silks, furs of various hues, including olives, russets, reds, browns, &c., are used, either alone or mixed. The usual wing is cut from the breast feather of a mall9,rd.

and the hackle, red or black. A fly tied with red body and teal wing is a standing favourite. Large lake trout often show a preference for a claret-bodied fly with a dark mallard wing and black hackle. The size of fly used should vary according to the wave or ripple, and whether the day is bright or otherwise. The rougher and darker the day, the liarger and darker the fly. On a bright day, with a small ripple, small brightly-coloured flies should be used. Different lakes, however, have their own peculiarities, and if there is a rise of any particular fly on a lake, that fly should of course be imitated. The moorlands have peculiar flies of their own, and on lakes situated among them, imitations of those flies should, if possible, be used. On several of the big Irish lakes there is a considerable rise of May-%, when the fish will take the artificial, but are more readily caught with the natural insect, one or two of which are impaled on a No. 6 or No. 7 hook and allowed to drift along the surface, the tackle being simply 2 feet of fine gut, above which is about 10 yards of floss silk, and then a fine running line. With a fair breeze the floss silk can be dispensed with, and an ordinary twisted silk, undressed line used. The most expert lake dappers prefer a short line to a long one. In a very faint air trout may sometimes be caught in this way by tying a goose's breast feather into the floss silk line about 4 feet above the hook. By this means, if the rod is a long one, the May-flies can be got out sufficiently' far to secure an occasional rise. " In addition to the fly, the two other most common methods of catching trout are with a natural or artificial spinning bait, and with the worm. The most sportsmanlike of these, in the sense that it **"

*requires most skill, is what is termed clear-water * ^ut fishing with the worm. On three small hooks, placed at short intervals at the end of the cast, and commonly known as Stewart tackle, is impaled a well- scoured red worm, and this, when the water is ,low and bright, the angler casts, wading up stream and fishing every hole and corner in much the same manner as is already recommended for the single fly, used under similar conditions. Grilse and sea-trout are also caught in this way, and occasionally a salmon. The difficulty, of course, is to cast or swing out the bait without causing it to break away from the hooks. The worming, which is done when the river is in flood, is of a very different character. Here a piece of lead is fixed on the line above a good-sized hook, and a big worm is let down in eddies close to the bank, where sooner or later a fish takes it. Minnows, which may be either imitations such as the phantom or Devon, or the natural minnow fresh from the stream, or one which has been preserved in formalin or other preservative, are cast across the stream, the line being drawn rapidly in towards the angler. About 3 yards of gut is desirable above the bait, and at least 2 yards from the minnow should be placed a very small lead, immediately below which is a double swivel. It is important that the lead should hang a little below the level of the line to prevent it from twisting. This ensures all the spinning taking place below the lead and the swivels doing their duty. A considerably stiffer rod is required for this method than fot fly-fishing, as muc*h more pressure is required to get the triangles which are used into the trout than the single hook on which the fly is mounted. In the Thames bleak and small dace are used for spin- ning, and it is a common practice to use live bait for the larger trout which in that river approximate in size to salmon. The Thames live-bait tackle is tn'^ag. extremely simple. It consists merely of a very small cork, nothing being better than that taken from a chemist's vial, with a slit down it in which ^the line is placed. A yard and a half below this are three or four*

No. 1 shot, and a yard and a half below the shot a lip hook and a small triangle. It will be seen that the bait plays near the surface, for near the

surface are the trout when feeding. Success largely depends 'on knowing the whereabouts of the fish. Many trout take up their position after early spring in the more quiet reaches of the river, but most of the fishing is done in the weir-pools and on the shallows below them.

In lakes, spinniag is usually termed trolling, and is commonly carried on by trailing the bait some distance behind the boat. In this case, as there is no casting to be done, the lead should he placed as far as possible from the bait ; one of the best tackles for the purpose is a small Chapman spinner. Large trout which are never caught with the fly, except in the May-fly season, may be caught by trolling. They_ are, as a rule, on the shallows in March and April ; about June they begin to move into deeper water and remain there until September, when they are found round the mouths of tributary rivers and streams up which they will by and by run for spawning. The deep waters of lakes are not sufiiciently fished, perhaps because the labour of working them properly is consider- able. As much as a pound of lead may be required to get down to the depths where the big fish lurk, and so that this lead may not alarm the wary old trout it has to be placed not less than 12 feet from the bait. Among the best baits used are small trout, minnows, g^iidgeon, bleak, and stone loach (called collochs in Ireland). A fish firmly believed in by many Scottish loch-fishers is Salmo ferox, which is caught usually by trolling. It is, as a rule, a big-headed, ugly, dark old fish, and modern ichthyolo- gists are of opinion that it is simply a lake trout of con- siderable age and usually a male. Trout vary so much in appearance, according to their age, sex, food, and the nature or the soil over which they swim, and .other local conditions, that many alleged species have from time to time been discovered, which, in the end, turned out to be simply local varieties of the ordinary brown trout. Rainbow trout (Salmo irideus) have now been so largely introduced into England, that they certainly claim atten- tion. As regards their beauty, sport-giving and edible qualities, they rival the sea-trout, while they grow with astonishing rapidity when well furnished with food. They are easily reared, and are certainly a great acquisition. They have not yet had time to become acquainted with the methods of English fly- fishers, and rise freely at any fly and take all the ordinary trout baits. They succeed particularly well in lochs and other enclosed sheets of water. They appear to have migratory tendencies, but it has not yet been

deflnitely ascertained whether this migration is simply in search of food from streams and rivers where they find themselves starved, or whether it is an instinct. A quantity which were placed in the Dove have, to the knowledge of the writer, remained there three years. They have disap- peared from many streams.

The grayling {Salmo thymallus), which is foimd in many of the trout streams, is, like the trout, a mem- ber of the salmon family. It spawns in the arayiiag. spring, gets rapidly into condition, but is more commonly fished for in autumn than in summer. On the whole, it frequents somewhat quieter waters than the trout. In the chalk streams it is taken by the ordinary dry-fly methods, and elsewhere with both the wet and dry fly. It is less easily alarmed than the trout, and will rise again and again from the bottom, a peculiarity of the fish. Two of the best grayling flies are a very small apple-green dun and the red tag ; but a good imitation of any fly on the water will usually take this fish. Many grayling are caught in the north of

Rainbow trout

England by means of light worm tackle worked with an exceedingly small float and a single shot. This is cast out here and there in rippling streams, the angler striking at the slightest bite. A method which is gradually dying out is the so-called grasshopper, a good-sized hook weighted with lead and the shank bound round with green silk, a straw placed on each side of the bend of the hook, and the point covered with gentles. This arrange- ment is worked with a sink-and-draw motion, and can hardly be termed a sportsmanlike method, for the grayling is a very sport-giving "fish.

*Pike, or jack (Esox lucius), are usually fished for with a dead or live bait, according to the season of the year and the condition of the water. When the weeds are down, or at any time in such places as weir- *'*

pools, a live bait on float tackle is a deadly method, pro- vided the bait can be made to travel, and be brought under the observation of a number of fish. Tor very small baits a single hook is used, placed through the lip of the bait. Eor those of medium size, two triangles, placed within about an inch and a half of each other, are preferred. The hook of the upper of

these is caught in the back fin of the bait, while the hook of the lower triangle, usually made small for the purpose, and sometimes reversed, is afiixed to the bait near the shoulder. This is commonly known as the Jardine tackle. Eor larger baits the Bickerdyke tackle is one of the best made. This is saddle-back in character, arming both sides of the bait. A single hook is stuck through the back fin and whipped on to the two links of gimp bearing the side hooks, where they join. One of these side triangles hangs down loosely under the back fin, while the other, which is on a longer piece of gimp, is brought up to the shoulder of the bait and held there by means of a reversed hook. Thus, when a pike is struck the tackle is usually pulled away from the bait into the fish's mouth. Live baiting with gorge tackle is quite out of date, snap tackles of the kind described having proved far more effective. Paternostering is another method of pike fishing with live bait much favoured by modern anglers. The pike paternoster consists simply of a two-ya«i length of stout gut, at the end of which is a half-ounce weight, bullet- or pear-shaped. About two feet from the weight a loop is tied in the gut, and to this is looped a short length of gimp which bears the hook. A long, rather light bamboo rod should be used for swinging out this tackle. The angler fishes entirely by feel; drops his bait in likely places, and, on getting a run, should strike without delay. Spinning is regarded as one of the most sportsmanlike methods of taking pike, and, particularly in lakes, is one of the most successful. The best method of mounting the bait is either on a Bromley-Pennell flight or a Chapman spinner, and the bait may be a small dace, gudgeon, bleak, or sprat, while in very fine, low water a big minnow will sometimes be successful when larger baits fail. Artificial pike baits are legion, but the spoon and phantom still hold their place among the best of them. It is extremely important to have a properly constructed salmon-gut trace, the lead being hung a little below the level of the gut, so that no twisting takes place above it. Immediately below the lead should be a pair of brass swivels, and absolutely none others are required. Such traces are not always kept by tackle dealers, so that the angler frequently has to make them up for himself. The line should be just strong enough to hold the biggest pike likely to be caught, and stouter where many weeds are present than in opeh water. The rod should be rather stiff, the rings large, and the reel of the Nottingham type with an optional check. With this reel

the pike spinner can cast in the Nottingham fashion, or, if he prefers it, in the old-

fashioned way which is still practised W the Thames and many other rivers. The bait should be spun slowly, and always as near the haunts of the fish as possible, care being taken to spin it deep enough. In big lakes it is usually trailed behind a boat, just in the way that big trout are fished for. Trolling with the dead gorge bait is prohibited on most waters where pike are preserved, as all fish, little and big, caught _ by this cruel method are destroyed; but a snap-trolling tackle has been devised which gives very good results. It hooks the fish immediately it seizes it. A leaded spike is forced into the bait from head to tail. At the end of the spike is an eye which projects just beyond the tail, and through this the gimp of the hook is threaded, and two triangles lie alongside the bait. The arrangement is shot quickly down into holes between weeds and worked once or twice with a rather sharp sink-and-draw motion. Pike flies are not much used, except in some of the Irish lakes, but pike take them readily enough on those days when they are feeding close to the surface. The haunts of pike, it may be mentioned, are in running water at the beginning of the season, while as the year advances they get into the deeps, hidiiig away among rushes, reeds, and weed-beds, ever ready to pounce out on any passing fish. In the winter they lie in quieter waters, particularly in eddies ; but it may be taken as a pike-fishing maxim that wherever small fish abound, there will the pike be found.

Except for the fact that tackle has been much improved, our knowledge and methods of capturing coarse-fish by The minor ”^hat is commonly known as bottom-fishing have coarse- not much advanced during the past half -century ; flsA. \y^i jf QQg fact concerning these fish has become

more strongly emphasized than others, it is that to make a handsome creel of barbel (Barbus vulgaris), tench {Tinea vulgaris),hreajn.

(Abramisbrama), or carp (Cj(prinMS carpio), it is necessary to ground-bait very heavUy in advance of the day's sport. The best ground-bait consists of worms, and the best worms come from Nottingham. There seems something peculiar about the soil of that locality which makes the worms specially attractive to the fish. When fishing a baited hole it is good policy to allow the worm and the shot of the float-tackle to lie on the bottom, or a very light leger may be used with or without a float. Worms nowadays are not usually crowded on to a hook, but quite a small hook is used which is merely caught in the taU, head, or middle of the worm. The bait is thus rendered much more attractive than it would otherwise be, and the fish care little for the visible hook. Success very largely depends on keeping quiet, and, so far as possible, out of sight of the fish. Chub (Leudscus cephalus) may be fished for in many ways; but the Nottingham method, by means of which float-tackle is let down to a swim perhaps 20 yards distant, is one of the most deadly, and has become a great favourite with the modem angler. The line used is exceedingly fine, and- the operation a very artistic one. The chub, as is well known, also rises to a fiy, and may be caught by various baits, such as frogs, slugs, gentles, cockchafers, &c., cast under the boughs by means of a powerful fly-rod. In fish- ing for roach (Leuciscus rutilus) there has been practically no advance in our knowledge of late years. Tackle-makers provide us with finer gut and better hooks, while the roach bite as shyly as ever. Eor dace (Leuciscus vulgaris), how- ever, and sometimes for roach, it has become quite a com- mon practice in some of the larger rivers to rake the bottom behind the punt before commencing to fish. This not only thickens the water slightly, which usually brings fish up into the swim, but also dislodges a quantity of minute fish food which serves as a natural ground-bait. Dace, it has been found, rise well to the dry fly, when rising at all, and njay be caught on an absolutely placid surface by this

method when the wet fly is useless. (See also Sea- fishing.)

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(«J. B.”)

Angola, the general name of the Portuguese pos- sessions on the west coast of Africa lying south of the equator, and embracing Angola proper, which stretches from the mouth of the Congo to the mouth of the Cunene, and the enclave of Cabinda, immediately north of the Congo. Its boundaries are: — On the N., Prench Congo and the Congo Pree State ; on the E., the latter and British South Africa; on the S., German South-West Africa ; and on the W., the Atlantic. Area, 484,370 square miles; population, estimated at 4,200,000. It embraces part or whole of the basins of the Congo, Kwanza, and Cunene (flowing west), and of the Kubango and Zambezi (flowing east). Of these streams the Congo and Kwanza alone are navigable at their mouths. The coast-line, partly low, partly broken by rocky promontories, possesses the ports of Loanda, Lobito, Benguela, Mossamedes, Porto Alexandre, and Bahia dos Tigres. There. are various moun- tain chains and tablelands running generally parallel to the coast, as Tala Mugongo (4400 feet), Chella and Vis- s^cua (5260 to 6500 feet). In the region of Bailundo are the highest points of the province, viz., Lovili (7780 feet), in 12° 6′ S. lat., and Mt. Elonga (7550 feet). South of the Kwanza is the volcanic Mt. Caculo-Cabaza (3300 feet).

With the exception of the district of Mossamedes, the coast districts (the palm country) are unsuited to Europeans. On the interior plateau, above 3300 feet, the temperature and rainfall, together with malaria, decrease southwards as far as the lower course of the Cunene. The mean annual temperature at S5o Salvador do Congo is 72°-6 Fahr. ; at Loanda, 74°‘3 ;

and at Caconda, 67°‘2. The climate is greatly influenced by the prevailing winds, which are west, south-west, and S.S.W. Two seasons are distinguished— the cool, from June to September ; and the rainy, from October to May. The heaviest rainfall occurs in April, and is accompanied by violent storms. The minerals comprise copper at Bembe, on the M’Brije and the Cuvo ; iron, at Ociras (on the Lucalla) and in Bailundo ; petroleum in Dande and Quinz^o ; gold in Lombije and Cassinga; and mineral salt at Quissama. Behind a region of intermingled grassy plains and palms (especially the Guinea palm, Flaeis guineensis) follows a region of savannahs proper and low hills with scanty vegetation. In the south this latter region merges into a barren sandy desert, with Welwitsehia mirabilis and Bauhinia. Amongst the culti- vated pr^ucts are the sugar-cane, cotton tree, cofiee, and tobacco ; and the exports include coffee, india-rubber, wax, vegetable oils, cocoa-nuts, brandy, cotton, and iT;ory. In 1896 the cofiee crop weighed 4907 tons, and was valued at £329,650, as compared with 1142 tons in 1870 ; and in the same year the india-rubber crop weighed 2245 tons, valued at £525,550. The yield of wax was valued at £68,450. Industry is not greatly developed ; but distilling, and the manufacture of tobaccb, bricks, and tiles, and cottons, and the salting of flsh are carried on. In 1896 the exports reached a total value of £1,025,100 ; and to this must be added £222,250, as the annual average exportation of the Congo district, or in all £1,247,350. In the same year the imports totalled £766,700, the principal item being textiles (£368,900, of which £174,900, or nearly one-half, pame from Lisbon). In 1899 the exports reached £1,768,554, and the imports totalled £1,536,049. The total commerce of the province has nearly quadrupled since 1870, i.e., it has increased from £827,800 (1870) to £3,304,603 (1899). In 1897 the ports of the province were entered and cleared by an

aggregate of 3384 vessels of 1,123,289 tons. There is a railway ■ from Loanda to Ambaca ; including this line, and others building, the province possesses 200 miles of railway. There are 670 miles of telegraphs. Thenative population consists of Bushmen, Jagas or laccas (Bangala),

and Bantus. The province is divided into five districts — Congo, Loanda, Benguela, Mossamedes, and Lunda. The province, the capital of which is Loanda (or Luanda), is ad- ministered by a governor-general. It forms a bishopric of the ecclesiastical province of Lisbon.

See E. DE Vasconcbllos. As Colonias Portuguesas. Lisbon, 1896-97. (e. de v.)

Angora, (1) a Turkish vilayet in north-central Asia Minor, which includes most of the ancient Galatia. It is an agricultural country, depending for its prosperity on its grain and the mohair obtained from the Angora goats — average annual clip 3,300,000 lb. The only im- portant industry is carpet-weaving at Kir-shehr and Kaisarieh. There are mines of silver, copper, lignite, and salt, and many hot springs, including some of great repute medicinally. Average annual exports, 1896-98, £920,762; imports, £411,836. Population, 900,000 (Moslems, 766,000 ; Christians, 135,000). (2) The chief town of the vilayet, classical Ancyra, Turkish Enguri, situated on the left bank of the Enguri Su, a tributary of the Sakaria, on the slopes of a rocky hill which rises 600 feet above the plain, and is crowned by the ruins of the old citadel.

Christianity was probably introduced at an early date, but there is no evidence that the Ancyran church was founded by St Paul, or that he ever visited North Galatia. The town was captured by the Persians, the Arabs, the Seljiik Turks, and the Crusaders before it passed to the Osmanli Turks. In 1832 it was taken by the Egyptians. Angora is connected \^ith Constantinople by railway, and exports mohair, grain, and yellow berries. Mohair cloth is manufactured, and the town is noted for its honey and fruit. From 16-39 to 1768 there was an agency of the Levant Company at Angora, and there is now a British consul. ‘ Population, 30,000 (Moslems, 18,000 ; Christians, chiefly Roman Catholic^ Armenians, 11,500 ; Jews, 500). (c. w. W.)

Angostura. See Ciudad Bolivab.

Angouleme, chief town of the department of Charente, France, 277 miles S.S.W. of Paris, on the rail- way from Paris to Bordeaux. Seven suburbs surround the town — Honmeau, Saint Ausonne, St Martin, St Cybard, la

Bussatte, les Beziers, and St Eoch. In addi- tion to other industries it has manufaqbures of boots and shoes and gloves, wire drawing and rolling mills, and copper founding. Great commerce is carried on in wine, brandy, and paper, and the " pierres d'Angoul§me " quar- ried in the neighbourhood. Population (1881), 25,750;

(1891), 28,615; (1896), 30,616; (1901), 37,660.

Anguilla, or Snake, a small island now included in the Presidency of St Kitts-Nevis in the British colony of the Leeward Islands. The destruction of trees by charcoal burners has resulted in the almost complete de- forestation of the island. Nearly all the land is in the hands of peasant proprietors, who cultivate sweet potatoes, peas, beans, corn, &c., and rear sheep and goats. Salt is still exported. The population in 1891 amounted to 3699 (123 white, 757 coloured, 2819 negroes).

An halt, a duchy of Germany, situated on the Elbe and Saale, and almost surrounded by the Prussian pro- vince of Saxony. Agriculture supports some 71,170 of the population, i.e., 24 per cent, of the whole. The principal crops grown are beetroot (for sugar) and potatoes ; then come hay, rye, barley, wheat, oats, and tobacco. In 1897 there were in the duchy 18,516 horses, 67,100 cattle, 90,815 pigs, and 91,815 sheep. In 1895, out of a total of 32,280 farms, no less than 22,192, or 68-7 per cent., were less than 2\ acres in area, 7630 between 2^ and 25 acres, 2393 between 25 and 250 acres, and only 165 more than 260 acres. In 1898-99 the sugar refineries produced

83,718 tons of sugar, the breweries 10,472,000 gallons of beer, and the distilleries (1897) 763,000 gallons of pure alcohol. In 1897 the mines produced 1,219,704 tons of lignite, valued at £169,500 ; 208,664 tons of coal, valued at £42,350; and 44,712 tons of chloride of potassium, valued at £339,100. The population was 232,592 in 1880, 271,963 in 1890, and 316,085 in 1900, of whom 165,185 were males and 160,900 females. All the popu- lation, except (1896) 8639 Roman Catholics and 1611 Jews, were members of the Eeformed church. In the period 1891-98 inclusive, 101 persons on an average emigrated every year. In the year 1900-1901 the revenue and expenditure balanced at £1,384,823. The public debt

amounted in 1899 to £9376, and the state contribution to the empire in 1900 to £127,710.

Ani, an Armenian city of importance in the Middle Ages, now in Eussian territory, situated between the Arpa Chai, Harpasus, and a deep ravine. In the 9th century it became the capital of the Bagratid kings of Armenia, and when yielded to the Byzantine emperor, 1046, it was a populous city. Soon afterwards it was taken by the Seljiik Turks, and its ruin was completed by the Mongols in the 13th century. Its remains are of great interest, especially those of its churches, which throw much light on the Church architecture of Armenia.

Aniches, an industrial town of France, department of Nord, in the arrondissement of Douai, 12 miles S. by E. of Lille, on railway from Cambrai to Valenciennes. It has rich coal mines and is the seat Of one of the most important glass-works in France. Population (1881), 4967; (1891), 6296; (1896), 6437, (comm.) 6924.

Animal Heat. See Physiology.

Anjer, formerly a seaport town on the strait of Sunda, Java, 60 miles W. of Batavia. It was destroyed by the inundation caused by the eruption of Krakatao in August 1883. The telegraph cable between Java and Sumatra terminates at Anjer Kidoel, or New Anjer, 3 miles south of the old site.

Anklam, a town of Prussia, province Pomerania, near the mouth of the river Peene, 53 miles N.W. from Stettin by the railway to Stralsund. The church of St Mary (12th century) has a new tower 336 ft. high. There is here a military school. The industries consist of iron- foundries and factories for sugar and soap. Population

(1885), 12,786 ; (1895), 13,560; (1900), 14,602.

Ankober. See Abyssinia.

Annaberg, a town of Germany, Saxony, 6 miles from the frontier of Bohemia, 18^ miles S. by E. of Chemnitz by rail. It has an industrial

female school, besides schools for lace, agriculture, commerce, and music. The mining industry has greatly declined. Population

(1890), 14,960; (1900), 15,967.

An nam. See Tongking, Cochin-China, and Indo- China.

Annan, a royal and parliamentary burgh (Dumfries group), and port of Dumfriesshire, Scotland, standing on the east bank of the river Annan, 93^ miles S.S.E. of Glasgow by rail. A harbour trust was constituted in 1897, and the harbour accommodation has been improved. The town hall has been rebuilt. Among the industries are sandstone quarrying, cotton manufacture, distilling, boat-building, and nursery gardening. Large marine en- gineering works have been established in the vicinity. Population of town in 1891, 4860; in 1901, 5804.

Annapolis, a city and seaport of Maryland, U.S.A.,

the capital of the state and of Anne Arundel county. It is connected by rail with Washington and Baltimore. The U.S. Naval Academy buildings' - were being rebuilt in 1901, the improvements consisting of Cadets' quarters, armoury, boat-house; and a new sea-wall, the whole esti- mated to cost $8,000,000, the sum authorized by Con- gress. In 1900 there were 280 cadets at the Academy. Population (1880), 6642 ; (1890), 7604 ; (1900), 8402.

Ann Arbor, a city of Michigan, U.S.A., the capital of Washtenaw county. It is situated in the south-eastern part of the lower peninsula, at an altitude of 771 feet. It is divided into six wards, and is entered by two railways, the Ann Arbor and the Michigan Central. It is a university town, with little in the way of manufactures or commerce. Population (1880), 8061; (1890), 9431;

(1900), 14,509.

Annecy, chief town of the department of Haute Savoie, France, 401 miles S.E. of Paris, on railway from Aix-les-Bains to Geneva, situated at the north end of Lake Annecy, partly on small islands formed by three canals known as the Thioux. Its library, noteworthy as being the oldest in Savoie, contains 12,000 volumes, and there is a fine public garden with a statue of BerthoUet, a native of this place. Its manufactures, less important than formerly, include paper and felt hats. Population (1881), 9144; (1896), 9436 (comm.), 10,009; (1901),

13,611.

Annelida is a term now seldom used in modern zoology. In 1875, when the article under that name appeared in the ninth edition of this work, it represented a class of organisms of which even at that date our know- ledge had so far advanced as to make it impracticable to give a satisfactorily sharp-cut definition of the term. It then included the following orders : —

i. PoLTCHiETA (marine worms).

ii. Oligochjeta (land and fresh-water worms),

iii. Onychophoea (Peripatus).

iv. DiscoPHORA (leeches).

V. Gephykea.

These have now been redistributed, and the following table represents a widely accepted view of their classifica- tion, and also shows the headings under which reference will be found in the Ency. Brit, (ninth edition or Supple- ment) : —

Classes and Orders.

i. Ca«!TOPODA —

a. Polychseta.

b. Archiannelida,

c. Myzostomida.

*d. Oligochseta. ii. BcHiuEOiDEA = Gbphybea *

AEMATA. J iii. HlBUDINEA = DlSCOPHORA. iv. SlPCNCCLOIDEA > GePHYREA V. PRIAPnLOIDEA) INERMIA.

vi. Onychophora=Protrachbata.

}

Articles. Worm.

bchiuroidea. Leech.

SlPtTNOULOlDBA.

Peripatus.

The first three of these six classes have been shown on anatomical and embryological grounds to have consider- able affinity to one another, and are generally admitted to have been derived from a common ancestor of marine habit and chaetopodan type-^hsetopodan in its segmenta- tion, in the possession of a true excretory coelom and of setae (chaetse) formed in ectodermal sacs, and in certain definite characters of the nervous and circulatory systems. The second two groups, which are now placed apart from the Echiuroidea, with which they were formerly united as Gephyrea, may prove to be less closely allied to one another ; the affinities of Sipunculoidea are perhaps to be soughlj, with Phoronis and the Hemichorda. As to the

position of Peripatus in the animal kingdom, in spite of most complete studies of the anatomy and embryology of numerous species, no general agreement can be said to have been reached by zoologists ; its affinities seem to point on the one hand to a chaetopodan origin, on the other to relationship with Tracheata (see Arthbopoda, Peripatus).

Anniston, a city of Calhoun county, Alabama, U.S.A., situated in 33° 39′ N. lat. and 85° 60′ W. long., at an altitude of 693 feet. For a time it grew rapidly as a centre of iron manufacture , in which it is favoured by having ore, coal, and limestone in close proximity. It has several blast furnaces and rolling mills, besides numerous other establishments for the manufacture of iron and steel. It has two railways, the Southern and the Louisville and Nashville. Population (1880), 942;

(1890), 9998; (1900), 9695.

Annuities, Terminable (British Govern- ment).— Terminable Annuities were introduced into, and have been employed in, the system of British public finance as a means of reducing the National Debt. This result is attained by substituting for a perpetual annual charge (or one lasting until the capital which it represents can be paid off en bloc), an annual charge of a larger amount, but lasting for a shorter term. The latter is so calculated as to pay off, during its existence, the capital which it replaces, with interest at an assumed or agreed rate, and under specified conditions. The theoretical bases of such calculations are explained in the article "Annuities" in the ninth edition of this work. The practical effect of the substitution of a terminable annuity ' for an obligation of longer currency is to bind the present generation of citizens to increase its own obligations in the present and near future in order to diminish those of its successors. This end might be attained in other ways ; for instance, by setting aside out of revenue a fixed annual sum for the purchase and cancellation of debt (Pitt's method, in intention), or by fixing the annual debt charge at a figure sufficient to provide a margin for reduction of the principal of the debt beyond the amount required for interest (Sir Stafford Northcote's method), or by providing an annual surplus of revenue over ex- penditure (the "old Sinking Fund"), avail able for the same purpose. All these methods have been tried in the course of British financial history, and the second and third of them are still employed; but on the whole the method of terminable annuities has been the one preferred by Chancellors of the Exchequer and by Parliament.

Terminable annuities, as employed by the British Government, fall under two heads : — (o) Those issued to or held by private persons ; (6) those

held by Govern- ment departments, or by funds under Government control. • The important difference between these two classes is that an annuity under (a), once created, cannot be modified except with the holder's consent, i.e., is practically unalter- able without a breach of public faith ; whereas an annuity under (6) can, if necessary, be altered by inter-departmental arrangement under the authority of Parliament. Thus . annuities of class (a) fulfil most perfectly the object of the system as explained above ; while those of class (6) have the advantage that in times of emergency their operation can be suspended without any inconvenience or breach of faith, with the result that the resources of Government can on such occasions be materially increased, apart from any additional taxation. For this purpose it is only necessary to retain as a charge on the income of the year a sum equal to the (smaller) perpethal charge which was originally replaced by the (larger) terminable charge, whereupon the difference between the two amounts is temporarily released, while ultimately the increased charge

IS extended for a period equal to that for which it is suspended. The terminable annuities of class (6) were dealt with in this manner in 1886-86 and in 1900-1901.

Annuities of class (a) were first instituted in 1808, but are at present mainly regulated by an Act of 1829. They may be granted either for a specified life, or two lives, or for an arbitrary term of years ; and the consideration for them may take the form either of cash or of Government stock, the latter being cancelled when the annuity is set up. The total amount of permanent debt cancelled by these means from 1808 to 31st March 1890 was about 77-^ millions: the charge on the Exchequer for such annuities in the year 1898-99 was £1,284,000; the amount of stock and cash applied in the same year to the purchase of fresh annuities was £1,119,000 ; and the annuities issued are valued at about ten years' purchase. These figures consist almost wholly of annuities for lives. It may be inferred from the published returns that the net reduction of debt since 1890 by this channel has amounted on the average to nearly

£900,000 a year, so that the total reduction of debt by this means, up to 1900, must have been about 86 millions.

Annuities (6) held by Government departments date from 1863. They have been created in exchange for permanent debt surrendered for cancellation, the principal operations having been effected in 1863, 1867, 1870, 1874, 1883, and 1899. The amount so cancelled up to 1883 inclusive was £118,242,000, and as the capital value of the terminable annuities of this class outstanding on 31st March 1899 was £22,765,000, it may be con- cluded that nearly 100 millions of permanent debt will have been extinguished by this method at the end of the century. The amount of permanent debt cancelled and converted into terminable annuities in 1899 was twenty- eight millions.

Annuities of this class (6) do not affect the public at all, except of course in their effect on the market for Govern- ment securities. They are merely financial operations between the Government, in its capacity as the banker of savings banks and other funds, ^and itself, in the capacity of custodian of the national finances. Savings bank depositors are not concerned with the manner in which Government invests their money, their rights , being con- fined to the receipt of interest and the repayment of deposits upon specified conditions. The case is, however, different as regards forty millions of consols (included in the above figures), belonging to suitors in Chancery, which were cancelled and replaced by a terminable annuity in 1883. As the liability to the suitors in that case was for a specified amount of stock, special arrangements were made to ensure the ultimate replacement of the precise amount of stock cancelled.

Altogether, therefore, it appears that during the 19th century over two hundred millions of the permanent national debt of the United Kingdom were cancelled or put in course of cancellation by means of terminable annuities.

See Beport of the Proceedings of the Commissioners for the Se- duction of the National Debt, 1891, Parliamentary Paper, C. 6539.

(s. B. S.-K.)

Ansbach, a town of Bavaria, Germany, district Middle Franconia, 27 miles by rail S.W. from Nurem- berg. There are a new municipal museum and a special technical school. Ansbach possesses monuments to the native poets Platen and Uz, and to Casper Hauser, the « vrild boy," who died here in 1833. Population (1885), 13,936 J (1896), 16,883; (1900), 17,655.

Ansonia, a town and city of New Haven county, Connecticut, U.S.A. It is situated on the Naugatuck, just above its junction with the Housatonic, in the

southern part of the state, 12 miles north-west of 'New Haven. It is divided into five wards, and its plan is quite irregular. The New York, New Haven, and Hart- ford railway furnishes communication. Its manufactures, depending on the river for water-power, are chiefly in brass and iron. Its clocks have long been well known. Population (1890), 10,342 ; (1900), 12,681.

Anstruther, Easter and Wester, a fishing town and railway station of Fifeshire, Scotland, in the St Andrews group of parliamentary burghs, 9 miles S.S.E. of St Andrews. The harbour was completed in 1877 at a cost of over £80,000. An endowed higher-class school was opened in 1886. Population, 2000.

Antalo. See Abtssinia.

Antananarivo, the capital of Madagascar, situ- ated centrally as regards the length of the island, but only about 90 miles distant from the eastern coast, in 18° 65′ S. lat. and 47° 31′ E. long. The city occupies a commanding position, being chiefly built on the summit and slopes of a long and narrow rocky ridge, which extends north and south for about two and a half miles, and rises at its highest poyit to nearly 700 feet above the extensive rice-plain to the west, which is itself 4000 feet above sea-level. For long only the principal village of the Hova chiefs, Antananarivo advanced in importance as those chiefs made themselves sovereigns of Madagascar until it became a town of some 80,000 inhabitants. Until 1869 all buildings within the city proper were of wood or rush, but even then it possessed several timber palaces of con- siderable size, the largest

being 120 feet high. Since the introduction of stone and brick for building, the whole city has been rebuilt, and it now contains numerous structures of some architectural pretensions, the royal palaces, the houses of the prime minister and nobles, the French residency, the Anglican and Roman Catholic cathedrals, several stone churches (as well as others of brick), colleges, schools, hospitals, courts of justice and other Government buildings, and hundreds of good dwell- ing-houses. Since the French conquest in 1895 good roads have been constructed throughout the city, and the central space, called "Andoh&o," has become a handsome place, with walks and terraces, flower-beds, and trees. Water is obtained from several springs at the foot of the hill, but the supply is scanty. The popular tiou is now about 60,000, but varies somewhat at different periods. The city is guarded by two forts built on hills to the east and south-west respectively. (j. si.)*

Antarctic. See Polar Eegions.

Antelope. — Our knowledge of the group of rumi- nants, commonly known as antelopes, has greatly in- creased of late years, and a new treatment of the subject is now necessary. There is some uncertainty as. to the origin of the name, but it is not improbably derived from Pantholops, the old Coptic term for the unicorn. It properly denotes the Indian black buck, which alone constitutes the genus Antilope, with the title of A. cervi- capra, but the term has been extended to embrace a very large group of hollow-horned ruminants, or Bovidce, which do not come under the designation of oxen, sheep, or goats — the prong-buck of America {Antilocapra ameri- cana) being, however, excluded, and forming a family by itself. The group, which scarcely admits of exact defini- tion, is divided into several subfamilies, the majority of which are restricted to Africa (or Africa and Arabia), where more than one hundred different species are known to exist.

The first subfamily (Bubalinx) includes the hartebeests (^Bubalis and Damaliscus) and the gnus or wildebeests (Coranoc^cEies), all of which are large antelopes confined to Africa, with the exception of

one Arabian species. Tlie typical hartebeests (Bubalis) are short- haired animals, with high withers, long faces, and sharply bent ridged horns, but in the blesbok and its allies (Damaliscus) the last three features are less marked. Heavy heads, smooth horns, long manes, and horse-like tails sufficiently characterize the gnus. The second subfamily, or Gephalophince, includes small or medium- sized species, represented oiiy by the duikers or "divers " (Oepha- lophus) of Africa, and the four-homed antelope (Tetraceros) of India. All have naked muzzles, elongated face-glands or tear- pits, false hoofs, and four mammae, but there are no hair-tufts at the knees. The short and upright horns are generally present in both sexes. A third group, OreotragincB, exclusively African, is represented by a number of small forms, such as the tiny dik- diks (Madoqua), oribis (Orifeio), sunis (Nesotragus), steinboks (,Ilhapkiceros) , and the active klipspringer (Oreotragus) . Of much larger size are the African water-bucks and kobs (Coins) and reed- buck (Cervicapra), which constitute the subfamily CeroicaprincB, and include some of the handsomest of all antelopes, among them being the black Cobus maria and C. leucotis of the swamps of the White Nile. The muzzle is naked and the females are hornless. The Vaal rhebok (^Pelea) likewise belongs to this group. In the typical subfamily or AntilopincB, in which the females are also generally without horns, are included the Indian black buck (Antilope), the graceful African pala {JEpyceros), the puffy-nosed saiga (Saiga) of Central Asia, the long-horned chiru {Pantholops) of Tibet, the South African spring-buck {Antidoreas), the numer- ous and widely-spread group of gazelles (Gazella), and the dibatag (Ammodorcas), the long-necked gerenuk (Lithocraniiis), and the tiny beira (Dorcotragus) of Somalilaud and East Airica. Widely

different from all the foregoing is the African group of Hippotra- ginoe, all the members of which are of large size and have long horns in both sexes. Among these are the sable and the roan antelope (Hippotragus), with S3.bre-like horns, the straight-horned gemsbok and beisa (Oryx), and the long-haired and spiral-homed addax of the Sahara. The last group of what may be termed trae antelopes is the TVagelaphince, in which the size is mostly large, and the spirally twisted boms are, excepting

in the elands, restricted to the males. The sole non-African representative of the group is the Indian nilgai (Boselaphus), in which the horns are much shorter than in the rest. The African forms include the beautiful bush-bucks or harnessed antelopes (Tragelaphus), in which the females are often more brightly coloured than the males, the striped kudus (Strepsiceros), and the elands (Taurotragus), which are the largest of all antelopes. The remaining group (Bupicaprinae), which indicates a transition towards the goats, is represented by the chamois (Bupicapra), of the mountains of Southern Europe, the gorals (Urotragus) , and serows (Nemorhmdus) of Eastern Asia, the takin (Budorcas) of the Mishmi Hills and Tibet, and the so-called Rocky Mountain goat (Oreamnus) of North America, which is the sole transatlantic representative of the antelopes, if indeed it be entitled to be called an antelope at all. (r. Ii.)*

Antequera, a city of Spain, province of Malaga, 28 miles N. of Malaga. Since 1890 a thriving industry has been created by beetroot and cane-sugar factories, em- ploying several thousand hands. Population, 24,387.

AIS^THOZOA.

ALTHOUGH corals have been familiar objects since the days of antiquity, and the variety known as the precious red coral has been for a long time an article of com- merce in the Mediterranean, it was only in the 18th century that their true nature and structure came to be understood. By the ancients and the earlier naturalists of the Chris- tian era they were regarded either as petrifactions or as plants, and many supposed that they occupied a position midway between minerals and plants. The discovery of the animal nature of red coral is due to J. A. de Peyssonel, a native of Marseilles, who obtained living specimens from the coral fishers on the coast of Barbary and kept them alive in aquaria. He was thus able to see that the so-called ” flowers of coral ” were in fact nothing else than minute polyps resembling searanemones. His discovery, made in 1727, was rejected by the Academy of Sciences of France, but eventually found acceptance at the hands of the Royal Society of London, and was published by that body in 1751. The structure and classification of polyps, however, were at that time very imperfectly under- stood, and it

was fully a century before the true anar tomieal characters and systematic position of corals were placed on a secure basis.

The hard calcareous substance to which the name coral is applied is the supporting skeleton of certain members of the Anthozoa, one of the classes of the phylum Ccelen- tera. The most familiar Anthozoan is the common sea- anemone. Actinia equina, L., and it will serve, although it does not form a skeleton or corallum, as a good example of the structure of a typical Anthozoan polyp or zooid. The individual animal or zooid of Actinia equina has the form of a column fixed by one extremity, called the base, to a rock or other object, and bearing at the opposite extremity a crown of tentacles. The tentacles surround an area known as the peristome, in the middle of which there is an elongated mouth-opening surrounded by tumid lips. The mouth does not open directly into the general cavity of the body, as is the case in a hydrozoan polyp, but into a short tube called the stomodceum, which in its turn opens below into the general body-cavity or ccelenteron. In Actinia and its allies, and most generally, though not invariably, in Anthozoa, the stomodseum is not circular but ist compressed from side to side so as to be oval or slit-

like in transverse section. At each end of the oval there is a groove lined by specially long vibratile cilia. These grooves are known as the sulcus and sulculus, and will be more particularly described hereafter. The elongation of the mouth and stomodeeum confer a bilateral symmetry on the body of the zooid, which is extended to other organs of the body. In Actinia, as in all Anthozoan zooids, the ccelen- teron is not a sim- ple cavity, as in a Hydroid, but is di- vided by a number of radial folds or curtains of soft tis- sue into a corre- sponding number of radial chambers. These radial folds are known as me- senteries, and their position and rela- tions may be under- stood by reference

to Pigs. 1 and 2. ^'O' l.— Diagrammatic longitudinal section of an

Ti'anVi iv.QaQT.fQ-i.rr -io Authozoan zooid. m, mesentery; i, tentacles;

JzidiKjll ineseuTJery is st, stomodseuln ; sCf sulcus ; r, Botteken^s muscle ;

*attached bv its Un- *> ^‘o^a ; hn, longitudinal muscle ; d, diagonal*

.J , .r muscle ; go, gonads.

per margin to the

peristome, by its outer margin to the body-wall, and by its lower margin to the basal disc. A certain num- ber of mesenteries, known as complete mesenteries, are attached by the upper parts of their internal margins to the stoniodseum, but below this level their edges hang free in the ccelenteron. Other mesenteries, called incomplete, are not attached to the stomodseum, and their internal margins are free from the peristome to the basal disc. The lower part of the free edge of every mesentery, whether complete or incomplete, is thrown into numerous puckers or folds, and is furnished with a glandular thickening known as a mesenterial JUament. The repro- ductive organs or gonads are borne on the mesenteries, the germinal cells being derived from the inner layer or endoderm. In common with all Coelenterate animals, the walls of

Fio. 2. — 1, Portion of epithelium from the ten- tacle of an Actinian, snowing three supporting cells and one sense cell (so). 2, A cnidoblast with enclosed nematocyst fi:om the same specimen. 8 and 4, Two forms of gland c^U from the stomodseum. 5a, 66, Epithello-

the columnar body and also the tentacles and peristome of Actinia are composed of three layers of tissue. The external layer, or ectoderm, is made up of cells, and con- tains also muscular and nervous elements. The pre- ponderating elements of the ectodermic layer are

elongated columnar cells, each containing a nuclejis, and bearing cilia at their free ex- tremities. Packed in among these are gland cells, sense cells, and cnidoblasts. The last- named are specially numerous on the ten- tacles and on some other regions of the body, and produce the well – known ” thread cells,” or nemato-cysts, so characteristic of the

Coelentera. The inner layer • or endoderm is also a cellular layer, and is chiefly made up of columnar cells, each bearing a cilium at its free Extremity and ter- minating internally in a long muscular fibre. Such cells, made up of epithelial and mus- Kpitneiio- cular components, are

muscular cells from the tentacle' in different kuOWn aS epithclio-

stotes of contraction. 5o, An eplthello-mus- on lo nolTo Tn

cular cell from the endoderm, containing a muSCUiar CCIXS. Xn

symbiotic zooxanthella 6, A ganglion cell Actinians the Cpithe-

from the ectoderm of the peristome, (After . . . ii n

O. and K. Hertwig.) llO-mUSCular Cells 01

the endoderm are crowded with yellow spherical bodies, which are uni- cellular plants or Algae, living symbiotically in the tissues of the zooid. The endoderm contains in addition gland cells and nervous elements. The middle layer or mesogloea is not originally a cellu- lar layer, but a gelatinoid struc- tureless substance, secreted by the two cellular layers. In the course of development, how- ever, cells from the ectoderm add endoderm may mi- grate into it. In Actinia equina the mesogloea con- sists of fine fibres imbedded in a homogeneous ma- trix, and between the fibres are

minute branched or spindle-shaped cells. For further details of the structure of Actinians, the reader should consult the work of 0. and E. Hertwig (9).

The Anthozoa are divisible into two sub-classes, sharply marked off from one another by definite anatomical char- acters. These are the Alctonabia and the Zoanthaeia.

Fio. 8. — An expanded Alcyonarlan zooid, showing the mouth surrounded by eight pinnate tentacles, st, stomodffium in the centre of the

transparent body ; m, mesenteries ; rzsm, asulcar mesenteries ; B; spicules, enlarged.

To the first-named belong the precious red coral and its allies, the sea-fans of Gorgoniae; to the second belong the white or Madreporarian corals.

Alcyonaria. — In this sub-class the zooid (Fig. 3) has very con- stant anatomical characters, differing in some important respects from the Aotinian zooid, which has been taken as a type. There is only one ciliated groove, the sulcus, in the stomodseum. There are always eight tentacles, which are hollow and fringed on their sides, with hollow projections or pinnae ; and always eight mesen- teries, all of which are complete, i.e. , inserted on the stomodseum. The mesenteries are provided with well-developed longitudinal retractor muscles, supported on longitudinal folds or plaits of the mesogloea, so that in cross-section they have a branched appear- ance. These muscle-banners, as they are called, have a highly characteristic arrangement ; they are all situated on those faces of the mesenteries which look towards the sulcus (Fig. 4). Each mesentery has a filament ; but two of them, namely, the pair farthest from the sulcus, are longer than the rest, and have a differ- ent form of filament. It has been shown that these asulcar fila- ments are derived from the ectoderm, the remainder from the endoderm. The only exceptions to this structure are found in the arrested or modified zooids, which occur in many of the colonial Alcyonaria. In these the tentacles are stunted or suppressed and the mesenteries are ill-developed, but the sulcus is unusually large and has long cilia. Such modified zooids are called siphonozooii^, their function being to drive currents of fluids through the canal- systems of the colonies to which they belong. With very few exceptions a calcareous skeleton is present in all Alcyonaria ; it usually consists of spicules of carbonate of lime, each spicule being formed within an ecto- dermic cell (Fig. 3, B). Most commonly the spicule-f orming cells pass out of the ectoderm and are imbedded in the mesogloea, where they may remain separate" from one another or may be fused together to form a strong mass. In ad- dition to the spicular skeleton an organic horny skeleton is fre- quently present, either in the form of a horny ex- ternal investment

(Comularia), or an internal axis (Gorgonia), or it may form a matrix in which spicules are imbedded (Keroeides, Melitodes).

Nearly all the Alcyonaria are colonial. Four solitary species have been described, viz., Haimea funebris and 3. hyalina, Bartea elegans, and Monoxenia Darwinii; but it is doubtful whether these are not the young forms of colonies. For the present the solitary forms may be placed in a grade, Protalcyonacea ; and the colonial forms may be grouped in another grade, Synalcyonacea. Every Alcyonarian colony is developed by budding from a single parent zooid. The buds are not direct outgrowths of the body-wall, but are formed on the courses of hollow outgrowths of the base or body ~~wall, called solenia. These form a more or less complicated candil system, lined by endoderm, and communicating with the cavities of the zooids. The most simple form of budding is found in the genus Comularia, in which the mother zooid gives ofi from its base one or more simple radiciform outgrowths. Each out~~ growth contains a single tube or solenium, and at a longer or shorter distance from the mother zooid a daughter zooid is formed as a bud. This gives off new outgrowths, and these, branching and anastomosing with one another, may form a network, adhering to stones, corals, or other objects, from which zooids arise at inter- vals. In Olavularia and its allies each outgrowth contains several solenia, and the outgrowths may take the form of flat expansions, composed of a number of soWnial tubes felted together to form a lamellar surface of attachment. Such outgrowths are called stolons, and a stolon may be simple, i.e., contain only one solenium, as in Comularia, or may be complex and built up of many solenia, as in Glavularia. Further complications arise when the lower walls of the mother zooid become thickened and interpenetrated with solenia, from which buds are developed, so that lobose, tufted, or branched colonies are formed. The chief orders of the Syn-

FiG. 4. — Transverse section of an Alcyonarian zooid. mm, mesenteries ; mTtj muscle banners ; sCf sulcus ; at, stomodeeum.

alcyonacea are founded upon the different architectural features of colonies produced by different modes of budding. We recognize six orders — the Stolonipeea, Alcyonacea, Psbudaxonia, Axi- PERA, Stelbchotokea, and Coenothecalia.

In the order Stolonifeea the zooids spring at intervals from branching or lamella stolons, and are usually free from one another, except at their bases, but in some cases horizontal solenia, arising at various heights from the body-wall may place the more distal

portions of the zooids in communication with one another. In the genus Tubipora these hori- zontal solenia unite to form a series of hori- zontal platforms (Fig. 5). The order comprises the families Oornulariidae, Syringoporidm, Tuhipo- ridos, and Favositidoe. I In the first-named the zooids are united only by their bases and the A «-r:^— fg»if«««yi>«OT7«B|!HW» >/' J9V Skeleton consists of loose*

P'"'^^^^\X^l^wBl>Wr spicules. In the Tubipo-

ridce the spicules of the proximal part of the body-wall are fused to- gether to form a firm tube, the corallite, into which the distal part of the zooid can be re- tracted. The corallites are connected at inter-

Fio. 5.A, Skeleton of a young colony of TuM Y^ls ^J horizontal plat- vora purpurea, at. stolon ; p, platform. B, forms COUtainmg SOlenia, Diagrammatie longitudinal section of a coral- and at the level of each lite, showing two platforms, p, and simple nlntfrirm thn rnvitv of ani cup- Shaped tabufe, t. (AftSr Hicfcson.) piatlorm tne oaviiy or

the corallite is divided by a transverse calcareous partition, either flat or cup-shaped, called a tabula. Formerly all corals in which tabulae are present were classed together as Tabulata, but Tubipora is an undoubted Alcyo- narian with a lamellar stolon, and the structure of the fossil genus Syringopora, which has vertical corallites united by horizontal solenia, clearly shows its affinity to Tubipora. The Favositidse, a fossil feimUy from the Silurian and Devonian, have a massive corallum composed of numerous polygonal corallites closely packed together. The cavities of adjacent corallites communicate by means of numerous perforations,

which appear to represent solenia, and numerous transverse tabulae are also present. In Favosites hemisphcerica a number of radial spines, projecting into the cavity of the corallite, give it the appearance of a madreporarian coral. In the order Alcyonacea the colony consists of bunches of elongate cylindrical zooids, whose proximal portionsare united by solenia and compacted, by fusion of their own walls and those of the solenia, into a fleshy mass called the coenenchyma. Thus the ccenencbyma forms a stem, sometimes branched, from the surface of which the free portions of the zooids project. The skeleton of the Alcyonacea consists of separate calcareous spicules, which are often, especially in the Nephthyidse, so abundant and so closely interlocked as to form a tolerably firm and hard armour. The order comprises the families ^eniidx, Al- cyonidce, and Nephthy- idcB. Alcyonium digi- tatum, a pink digitate form popularly known as "dead men's fin- gers," is common in 10-20 fathoms of water off the English coasts.

In the order PsBtrn- AxoNiA the colonies are upright and branched, consisting of a number of short zooids whose proximal ends are im- bedded in a ccenen- cbyma containing numerous ramifying ^'°- "■ solenia and spicules. The coenenchyma is further differentiated into a medullary por- tion and a cortex. The latter contains the proximal moieties of the zooids and numerous but separate spicules. The medullary portioih is densely crowded with spicules of different shape from

~~Portion of a colony of OoralHum nibrmn, showing expanded and contracted zooids. In the lower part of the figure the cortex has been cut away to show the axis, ate, and the longi~~ tudinal canals, la, surrounding It.

Fio. 7. — ^The sea-fen (fforgomia CavolinUJ.

those in the cortex, and in some forms the spicules are cemented together to form a hard supporting axis. There are four families of Pseudaxonia — the Briareidx, Sclerogorgidce, Melitodidx, and Corallidx. In the first- named the medulla is penetrated by solenia and forms an indistinct axis; in the remainder the medulla is devoid of solenia, and in the Melitodidoe and Oorallidx it forms a dense axis, which in the Melitodidm consists of alternate cal- careous and homy joints. The precious red coral of

commerce, Corallium rubrum (Fig. 6), a member of the family Corallidoe, is found at depths varying from 15 to 120 fathoms in the Mediter- ranean Sea, chiefly on the African coast. It owes its commercial value to the beauty of its hard red calcareous axis, which in life is covered by a cortex in which the proximal moieties of the ziooids are imbedded. Coral- lium rubrum has been the subject of a beauti- fully-illustrated me- moir by de Lacaze Duthiers, which should he consulted for details of anatomy.

The AxiPEKA com- prises those corals that have a horny or calci- fied axis, which in posi- tion corresponds to the axis of the Pseudaxonia, hut, unlike it, is never formed of fused spic- ules ; the most familiar example is the pink sea-fan, Qorgonia Cavo- linii, which is found in abundance in 10-25 fathoms of water off the English coasts (Fig. 7) . In this order the axis is formed as an ingrowth of the' ectoderm of the base of the mother zooid of the colony, the cavity of the ingrowth being filled by a

homy substance secreted by the ectoderm. In Qorgonia the axis re- mains homy throughout life, but in many forms it is further strengthened by a dejjosit of calcareous matter. ' In the family IsidincB the axis consists of alternate segments of homy and calcareous sub- stance, the latter being amorphous. The order contains six families— the DasygorgidoB, Isidas, Prim- noidoe, Muriceidx, Plex- auridce, and Oorgonidce.

In the order Stelb- chotokea the colony con- sists of a stem formed by a greatly-elongated mother zooid, and the daughter zooids are borne as lateral . buds on the stem. In the section Asiphonacea the colonies are upright and branched, springing from membranous or ramify- ing stolons. They re- semble and are closely alUed to certain families of the CornulariidEB, dif- fering from them only in mode of budding and in the disposition of the daughter zooids round a central, much-elongated mother zooid. The sec- tion contains two families, ■A, Colony of Pennatula phoaphorea the Telestidx and the

peduni^f Ts'tS'ol^thrrl^^isbe^aknl"^ Go^logorgidm. _ The second single pinna, a, axis; b, metai'aohi^l, section comprises the PeM- o, prorachidial, d, pararaohidial stem canals, natutacea Or sea-pens,

which are remarkable from the fact that the colony is not fixed by the base to a rock or other object, but is imbedded in sand or mud by the proximal portion of the stem known as the peduncle. In the typical

Pio. 8.- itam

genus, Pennatula (Fig. 8), the colony looks like a feather having a stem, divisible into an upper moiety or raohis, bearing lateral central leaflets (pinnse), and a lower peduncle, which is sterile and embed- ded in sand or mud. The stem represents a gready enlarged and elongated mother zooid. It is divided longitudinally by a partition separating a so-called "ventral" or prorachidial canal from a so-called " dorsal " or metarachidial canal. A rod-like supporting axis of peculiar texture is developed in the longitudinal partition, and a longitudinal canal is hollowed out on either side of the axis in the substance of the longitudinal partition, so that there are four stem-canals in all. The prorachidial and metarachidial aspects of the rachis are sterile, but the sides or pararachides bear numerous daughter zooids of two kinds— (1) fully-formed autozooids, (2) small stunted siphonozooids. The pinnse are formed by the elongated autozooids, whose proximal portions are fused together to form a leaf-like expansion, from the upper edge of which the distal ex- tremities of the zooids project. The siphonozooids are very numerous and lie between the bases of the pinnse on the pararachides; they extend also on the prorachidial and metarachidial surfaces. The calcareous skeleton of the Pennatulacea consists of scattered spicules, but in one species, Protocaulon molle, spicules are absent. Although of great interest the Pennatulacea do not form an enduring skeleton or "coral," and need not be considered in detail in this place.

The order C

Fig. 9. — A, Portion of the surfece of a colony of Meliopora cmrulea magnified, showing two calices and the Bnrrounding coenencnyinal

tubes. B, Single zooid with the adjacent soft tissues as seen after removal of the skeleton by decalcification. Z, the distal, and Z^, the proximal or intracallcular portion of the zooid ; eo, ectoderm ; ci^ coenenchymal tubes ; ap^ superficial network of solenia.

of two kinds, viz., larger star-shaped cavities, called calices, in which the zooids are lodged, and very numerous smaller rotmd or polygonal apertures, which in life contain as many short unbranched tubes, known as the ccBnenehymal tubes (Fig. 9, A). The walls of the calices and coenenchymal tubes are formed of flat plates of calcite, which are so disposed that the walls of one tube enter into the composition of the walls of adjacent tubes, and the walls of the, calices are formed by the walls of adjacent coenenchymal tubes. Thus the architecture of the Helioporid colony differs entirely from such forms as Tubipora or Favosites, in which each oorallite has its own distinct and proper wall. The cavities both of the calices and coenenchymal tubes of Heliopora are closed below by horizontal partitions or tabulce, hence the genus was formerly included in the group Tabulata, and was supposed to belong to the madreporarian corals, both because of its lamellar skeleton, which resembles that of a Madrepore, and because each calicle has from twelve to fifteen radial partitions or septa projecting into its cavity. The structure of the zooid of Heliopora, however, is that of a typical Alcyonarian, and the septa have only a resemblance to, but no real homology with, the similarly-named structures in madre- porarian corals. Heliopora ccerulea is found between tide-marks on the shore platforms of coral islands. The order was more abundantly represented in Palliaeozoic times by the Heliotidse from the Upper and Lower Silurian and the Devonian, and by the Thecidse from the Wen- lock limestone. In Heliolites porosus the colonies had the form of spheroidal masses ; the calices were furnished with twelve pseudosepta, and the coenenchymal tubes were more or less regularly hexagonal. Zoantharia. — In this sub-class the arrangement of the mesenteries is subject to a great deal of variation, but all the types hitherto observed may be referred to a common plan, illustrated by the living genus Sdwardsia (Fig. 10, A, B). This is a small solitary Zoantharian which lives embedded in sand. Its body is divisible into three portions, an upper capitulum bearing the mouth and tentacles, a median scapus covered by a friable cuticle, and a terminal physa which is

rounded. Both capitulum and physa can be retracted within the scapus. There are from sixteen to thirty-two simple

tentacles, but only eight mesenteries, all of which are complete. The stomodsBum is compressed laterally, and is furnished with two longitudinal grooves, a sulcus and a sulculus. The arrangement of the muscle-banners on the mesenteries is characteristic. On six of the mesenteries the muscle-banners have the same position as in the Alcyonaria, namely, on the suloar faces ; but in the two remain- ing mesenteries, namely, those which are attached on either side of the sulcus, the muscle-banners are on the opposite or sulcular faces. It is not known whether all the eight mesenteries of Edwardsia are developed simultaneously or not, but in the youngest form which has been studied all the eight mesenteries were present, but only two of them, namely the sulco-laterals, bore mesenterial filaments, and so it is presumed that they are the first pair to be developed. In the common sea^anemone. Actinia equina (which has already been quoted as a type of Anthozoan structure), the mesenteries are numerous and are arranged in cycles. The mesen- teries of the first cycle are complete (i.e., are attached to the stomodsBum), are twelve in number, and arranged in couples, distinguishable by the position of the muscle-banners. In the four couples of mesenteries which are attached to the sides of the elongated stomodssum the muscle-banners of each couple are turned towards one another, but in the sulcar and sulcular couples, known as the directive mesenteries, the muscle-banners are on the outer faces of the mesenteries, and so are turned away from one another (see Fig. 10, C). The space enclosed between two mesen-

Fia. 10. — A, Bdwa/rdsia clapareeUi (after A. Andres), cap, capitulum ; «c, scapus ; p/t^ physa. B, Transverse section of the same, showing the arrangement of the mesenteries. 8, sulcus ; «2, sulculus. 0, Transverse section of Balcampa. d, dj directive mesenteries ; ,6^, stomodffium.

teries of the same couple is called an entocoele ; the space enclosed between two mesenteries of adjacent couples is called an exocoele. The second cycle of mesenteries consists of six couples, each formed in an exocoele of the primary cycle, and in each couple the muscle- banners are

vis-a-vis. The third cycle comprises twelve couples, each formed in an exocoele between the primary and secondary couples, and so on, it being a general rule (subject, however, to exceptions) that new mesenterial couples are always formed in the exocceles, and not in the entocoeles.

While' the mesenterial couples belonging to the second and each successive cycle are formed simultaneously, those of the first cycle are formed in successive pairs, each member of a pair being placed on opposite sides of the stomodsenm. Hence the arrangement in six couples is a secondary and not a primary feature. In most Actinians the mesenteries appear in the following order : — At the time when the stomodseum is formed, a single pair of mesenteries, marked I, I in the diagram (Fig. 11, A), makes its appearance, divid- ing the coelenteric cavity into a smaller sulcar and a large sulcular chamber. The muscle-banners of this pair are placed on the sulcar faces of the mesenteries. Next, a pair of mesenteries, marked II, II in the diagram, is developed in the sulcular chamber, its muscle-banners facing the same way as those of I, I. The third pair is formed in the sulcar chamber, in close connexion with the sulcus, and in this case the muscle-banners are on the sulcular faces. The fourth pair, having its muscle-banners on the sulcar faces, is developed at the opposite extremity of the stomodseum in close connexion with the sulculus. There are now eight mesen- teries present, having exactly the same arrangement as in Edwardsia. A pause in the development follows, during which no new mesen- teries are formed, and then the six-rayed symmetry characteristic of a normal Actinian zooid is completed by the formation of the mesenteries V, V in the lateral chambers, and VI, VI in the sulco- lateral chambers, their muscle-banners being so disposed that they form couples respectively with II, II and I, I. In Actinia

equina the Edwardsia stage is arrived at somewhat differently. The mesenteries second in order of formation form the sulcular directives, those fourth in order of formation form with the fifth the sulculo-lateral couples of the adult.

Fia. 11. — A, Diagram showing the sequence of mesenterial development in an Actinian. B, Diagrammatic transverse section of QonaGUtiia prolifera.

As far as the anatomy of the zooid is concerned, the majority of the stony or madreporarian corals agree exactly with the soft-bodied Actinians, such as Actinia equina, both in the number and arrange- ment of the adult mesenteries and in the order of development of the first cycle. The few exceptions will be dealt with later, but it may be stated here that even in these the first cycle of six couples of mesenteries is always formed, and in all the cases which have been examined the course of development described above is followed. There are, however, several groups of Zoantharia in which the mesenterial arrangement of the adult differs widely from that just described. But it is possible to refer all these cases with more or less certainty to the Edwardsian type.

The order Zoanthidea comprises a number of soft-bodied Zoantharians generally encrusted with sand. Externally they resemble ordinary sea-anemones, but there is only one ciliated groove, the sulcus, in the stomodseum, and the mesenteries are arranged on a peculiar pattern. . The first twelve mesenteries are disposed in couples, and do not differ from those of Actinia except in size. The mesenterial pairs, I, II, and III, are attached to the stomodseum, and are called macromesenteries (Fig. 12, B), but IV,

Fio. 12.— A, Zoanthld colony, showing the expanded zoolds. B, Diagram showing the arrangement of mesenteries in a young Zoanthld. C, Diagram showing the arrangement of mesenteries in an adult Zoanthld. 1, 2, 8, 4, ^Edwardsian mesenteries.

V, and "VI are much shorter, and are called micromesenteries. The subsequent development is peculiar to the group. New mesen- teries are

formed only in the sulco-lateral exocoeles. They are formed in couples, each couple consisting of a macromesentery and a micromesentery, disposed so that the former is nearest to the sulcar directives. The derivation of the Zoanthidea from an Edwardsia form is sufficiently obvious.

The order Cehianthidea comprises a few soft-bodied Zoan- tharians with rounded aboral extremities pierced by pores. They have two circlets of tentacles, a labial and a marginal, and there is only one ciliated groove in the stomodssum, which appears to be the sulculus. The mesenteries are numerous, and the longitudinal muscles, though distinguishable, are so feebly developed that there are no muscle-banners. The larval forms of the type genus Cerianthus float freely in the sea, and were once considered to belong to a separate genus, Arachnactis. In this larva four pairs of mesenteries having the typical Edwardsian arrangement are developed, in the same sequence as in Rhodactis, but the fifth and sixth pairs, instead of forming couples with the first and second, arise in the sulcar chamber, the fifth pair inside the fourth, and,the sixth pair inside the fifth. New mesenteries are continually added in the sulcar chamber, the seventh pair within the sixth, the

eighth pair within the seventh, and so on (Fig. 13). In the Cerianthidea, as in the Zoanthidea, much as the adult arrangement of mesenteries differs from that of Actinia, the derivation from an Edwardsia stock is obvious.

Fig. 18.— A, Cerianthus aolitaiHus (After A. Andres). B, Transverse section of the BtomodfiBum, showing the sulculus, sl^ and the arrangement of the mesen- teries. 0, Oral aspect of AraeTmacMs braehiolata, the larva of Cerianthus, with seven tentacles. D, Transverse section of an older larva. The numerals indicate the order of development of the mesenteries.

The order Antipathidba is a well-defined group whose afBnities are more obscure. The type form, Antipathes diohotoma (Fig. 14), forms arborescent colonies consisting of numerous zooids, arranged in a single series along one surface of a branched horny axis. Each zooid has six tentacles; the stomodaeum is elongate, but the sulcus and sulculus are

very feebly represented. There are ten mesenteries in which the musculature is so little developed as to be almost indistinguishable. The sulcar and sulcular pairs of mesenteries are short, the sulco-lateral and sulculo-lateral pairs are a little longer, but the two transverse are very large and are the only mesenteries which bear gonads. As the development of the Antipathidea is unknown, it is impossible to say what is the

Fig. 14.— a, Portion of a colony of AnUpathea diehotoma. B, Single zooid and axis of the same magnified, m, mouth ; m/, mesenterial filament ; am, axis. 0, Transverse section through the oral cone of AnUpathella minor, st, stomodseum ; oij, ovary. '

sequence of the mesenterial development, but in Leiopathes glaber- rima, a genus with twelve mesenteries, there are distinct indica- tions of an Edwardsia stage.

There are, in addition to these groups, several genera of Actinians whose mesenterial arrangement differs from the normal type. Of these perhaps the most interesting is Oonactinia prolifera (Fig. 11, B), with eiglit macromesenteries arranged on the Edwardsian plan. Two pairs of micromesenteries form couples with the first and second Edwardsian pairs, and in addition there is a couple of micromesenteries in each of the sulculo-lateral exocoeles. Only the first and second pairs of Edwardsian macromesenteries are fertile, i.e., bear gonads.

The remaining forms, the Actiniidea, are divisible into the MalacactiniBB, or soft-bodied sea-anemones, which have already been described sufficiently in the course of this article (pp. 454-6), and the Scleraotinise (=Madreporaria), or true corals.

All recent corals, as has already been said, conform so closely to the anatomy of normal Actinians that they cannot be classified apart from them, except that they are distinguished by the possession of a calcareous

skeleton. This skeleton is largely composed of a number of radiat- ing plates or septa, and it differs both in origin and struc- ture from the calcareous skeleton of all Alcyonaria- except Heliopora. It is formed, not from fused spicules, but as a secretion of a special layer of cells derived from the basal ectoderm, and known as calicoUasts. The skeleton or corallum of a typical solitary coral — the common Devonshire cup-coral Oaryophyllia Smithii (Figr 15) is a

Fig. 15. — Corallum of Caryophyllia; semi-diagraminatic. sp, septa ; p, paluB ; col, columella.

theca; t', costo;

good example — exhibits the following parts: — (1) The iasal plate, between the zooid and the surface of attach- ment. (2) The septa, radial plates of caleite reaching from the periphery nearly or quite to the centre of the coral- cup or calicle. (3) The theca or wall, which in many corals is not an independent structure, but is formed by the conjoined thickened peripheral ends of the septa. (4) The columella, a structure which occupies the centre of the calicle, and may arise from the basal plate, when it is called essential, or may be formed by union of trabecular offsets of the septa, when it is called unessential. (5) The costce, longitudinal ribs or rows of spines on the outer surface of the theca. True costae always correspond to the septa, and are in fact the peripheral edges of the latter. (6) Epitheca, an offset of the basal plate which surrounds the base of the theca in a ring-like manner, and in some corals may take the place of a true theca. (7) Pali, spinous or blade-like upgrowths from the bottom of the calicle, which project between the inner edges of certain septa and the columella. In addition to these parts the following structures may exist in corals : — Dissepiments are oblique calcareous partitions, stretching from septum to septum, and closing the interseptal chambers below. The whole system of dissepiments in any given calicle is often called endotheca. Synapticulce are calcareous bars uniting adjacent septa. Tabulae are stout horizontal partitions traversing the centre of the. calicle and dividing it into as many superimposed cham- bers. The septa in recent corals always bear a definite relation to the mesenteries, being found either in every entocoele or in every entoccele and exocoele. Hence

in corals in which there is only a single cycle of mesenteries the septa are correspondingly few in number ; where several cycles of mesenteries are present the septa are correspond-

ingly numerous. In some cases — e.g., in some species of Mddrepora — only two septa are fully developed, the remainder being very feebly represented.

Though the corallum appears to lie within the zooid, it is morphologically external to it, as is best shown by its developmental history. The larvae of corals are free swim- ming ciliated forms known as planulse, and they do not acquire a corallum until they fix themselves. A ring- shaped plate of caleite, secreted by the ectoderm, is then formed, lying between the embryo and the surface of attachment. As the mesenteries are formed, the endo- derm of the basal disc lying above the basal plate is raised up in the form of radiating folds. There may be six of such folds, one in each entoccele of the primary cycle of mesenteries ; or, there may be twelve, one in each exoccele and entocoele. The ectoderm beneath each fold becomes detached from the surface of the basal plate, and both it and the mesogloea are folded conformably with the endo- derm. The cells forming the limbs of the ectodermic folds secrete nodules of caleite, and these, fusing together, give rise to six (or twelve) vertical radial plates or septa. As growth proceeds new septa are formed simultaneously with the new couples of secondary mesenteries. In some corals, in which all the septa are entocoelic, each new system is embraced by a mesenteric couple ; in others, in which the septa are both entocoelic and exoccelic, three septa are formed in every chamber- between two pri- mary mesenterial couples, one in the entocoele of the newly-formed mesenterial couple of the secondary cycle, and one in each exoccele between a primary and a second- ary couple. These latter are in turn embraced by the couples of the tertiary cycle of mesenteries, and new septa are formed in the exocoeles on either side of them, and so forth.

Fig. 16. — Tangential section of a larva of Aairoid^e calieularis which has iixed itself on a piece of cork. 6C, ectoderm; dn, endoderm ; mg^, mesoglcea; m, m, mesenteries ; «, septum ; &, basal plate formed of

ellipsoids of carbonate of mne secreted by the basal ectoderm ; ep, epitheca. (After von Eoch.)

It is evident from an inspection of Figs. 16 and iV that every septum is covered by a fold of endoderm, mesogloea, and ectoderm, and is in fact pushed into the cavity of the zooid from without. The zooid then is, as it were, moulded upon the corallum. When fully extended, the upper part of the zooid projects for some distance out of the calicle, and its wall is reflected for some distance over the lip of the latter, forming a fold of soft tissue extending to a greater or less distance over the theca, and containing in most cases a cavity continuous over the lip of the calicle with the coelenteron. This fold of tissue is known as the edge-zone. In some corals the septa are solid imperforate plates of caleite, and their peripheral ends are either firmly welded together, or are united by interstitial pieces so as to form an imperforate theca. In others the periph-eral ends of the septa are united only by bars or trabe- cule, so that the theca is perforate, and in many such perforate corals the septa themselves are pierced by numerous perforations. In the former, which have been called aporose corals, the only communication between the cavity of the edge-zone and the general cavity of the zooid is by way of the lip of the calicle ; in the latter, or perforate corals, the theca is permeated by numerous branching and anastomosing canals lined by endoderm, which place the cavity of the edge-zone in communication with the general cavity of the zooid.

A large nmnber of corals, both aporose and perforate, are colonial. The colonies are produced either by budding or division. In the former case the young daughter zooid, with its corallum, arises ~~wholly outside the cavity of the parent zooid, and the component parts of the young corallum, septa, theca, columella, &c., are formed anew in every individual produced. In division a vertical con~~ striction divides a zooid into two equal or unequal parts, and the several parts of the two corals thus produced are severally derived from the corresponding parts of the dividing corallum. In colonial corals a bud is always formed from the

edge-zone, and this bud develops into a new zooid with its corallum. The cavity of the bud in an aporose coral (Pig. 18, A, C) does not communicate directly with that of the parent form, but through the medium of the edge-zone.

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Pio. IT.— Transverse section through a zooid of Oladocora. The corallum shaded with dots, the mesogloea represented by a thick lin?. Thirty-two septa are present, six in the entocoeles of the primary cycle of mesenteries, I ; six in the entocoeles of the secondary cycle of mesenteries, II; four in the entocceles of the tertiary cycle of mesenteries, 111, only four pairs of the latter being developed ; and sixteen in the entocoeles between the mesenterial pairs. I>, D, directive mesenteries ; 8t, stomodseum. (After Dnerden.)

As growth proceeds, and parent and bud become sepa- rated farther from one another, the edge-zone forms a sheet of soft tissue, bridging over the space between the two, and resting upon projecting spines of the corallum. This sheet of tissue is called the cienosarc. Its lower surface is clothed with a layer of calicoblasts which continue to secrete carbonate of lime, giving rise to a secondary deposit which more or less fills up the spaces between the indi- vidual coralla, and is distinguished as coenenchyme. This coenenchyme may be scanty, or may be so abundant that the individual corallites produced by budding seem to be immersed in it. Budding takes place in an analogous manner in perforate corals (Fig. 18, B), but the presence of the canal system in the perforate theca leads to a modi- fication of the process. Buds arise from the edge-zone which already communicate with the cavity of the zooid by the canals. As the buds develop the canal system becomes much extended, and calcareous tissue is de- posited between the network of canals, the confluent edge-zones of mother zooid and bud forming a ccenosarc. As the process continues a number of calicles are formed, imbedded in a spongy tissue in which the canals ramify, and it is impossible to say where the theca of one

coral- lite ends and that of another begins. In the formation of colonies by division a constriction at right angles to the long axis of the mouth involves first the mouth, then thp peristome, and finally the calyx itself, so that the pre- viously single corallite becomes divided into two (Fig. 18, E). After division the corallites continue to grow up- wanis, and their zooids may remain united by a bridge of soft tissue or ccenosarc. But in some cases as they grow

farther apart, this continuity is broken, each corallite has its own edge-zone, and internal contiuuity is also broken by the formation of dissepiments within each calicle, all organic connexion between the two zooids being eventu-, ally lost. Massive meandrine corals are produced by continual repetition of a process of incomplete division, involving the mouth and to some extent the peristome : the calyx, however, does not divide, but elongates to form a characteristic meandrine channel containing several zooid mouths.

Corals have been divided into Aporosa and Perforata, according as the theca and septa are compact and solid, or

Fio. 18. — A, Schematiclongitudlnal section through a zooid and bud of i.„.„ phora digitaia. In A, B, and O the thick black lines represent the soft tissues ; the corallum is dotted. «, stomodaaum ; o, c, ccenosarc ; co?, colu- mella ; T, tabulae. B, Similar section through a single zooid and bud otAstroi- des oaUoularis. 0, Similar section through three corallites of LophoheUa proUfera. «s, edge-zone. D, Diagram illustrating the process of budding by unequal division. E, Section through a dividing calicle of Mussa, showing the union of two septa in the plane of division, and the origin of new septa at right angles to them. (C, original ; the rest after von Koch.)

are perforated by pores containing canals lined by endo- derm. The division is in many respects convenient for desc^riptive purposes, but recent researches show that it does not accurately represent the relationships of the different families. Various attempts have been made to classify corals according to the arrangement of the septa, the characters of the theca, the microscopic structure of the corallum, and the anatomy of the soft parts. The last-named method has proved little more than that

there is a remarkable similarity between the zooids of all recent corals, the differences which have been brought to light being for the most part secondary and valueless for classi- ficatory purposes. On the other hand, the study of the anatomy and development of the zooids has thrown much light upon the manner in which the corallum is formed, and it is now possible to infer the structure of the soft parts from a microscopical examination of the septa, theca, &c., with the result that unexpected relationships have been shown to exist between corals previously supposed to stand far apart. This has been particu- larly the case with the group of Palaeozoic corals, formerly classed together as Bugosa. In many of these so-called rugose forms the septa have a characteristic arrangement, differing from that of recent corals chiefly in the fact that they show a tetrameral instead of a hexameral symmetry. Thus in the family Stauridm there are four chief septa whose inner ends unite in the middle of the calicle to form a false columella, and in the ZaphrentidxB there are many instances of an arrangement, such as that depicted in Fig. 19, which represents the

Fio. 19. — Diagram of tie arrangement of the septa in a Zaphrentid coral, 9n, main septum ; c, counter Beptmn ; t, t, alar septa.

septal arrangement of Streptelasma comiculum from the lower Silurian. In tkis coral the caliole is divided into quadrants by four principal septa, the main septum, counter septum, and two alar septa. The remaining septa are so disposed that in the quadrants abutting on the chief sep- tum, they converge towards that septum, whilst in the other quadrants they converge towards the alar septa. The secondary septa show a regular gradation in size, and, assuming that the smallest were the most recently formed, it will be noticed that in the chief quadrants the youngest septa lie nearest to the main septum ; in the other quadrants the youngest septa lie nearest to the alar septa. This arrangement, however, is by no means characteristic

even of the Zaph- m rentidee, and in the

family Oyathophyl- Udce most of the genera exhibit a rar dial symmetry in which no trace of the bilateral arrangement de- scribed above is recognizable, and in- deed in the genus Oyathophyllum itself a radial arrange- ment is the rule. The connexion be- tween the Cyatho- phyllidse and mod- ern Astrseidse is shown by Moseleya laiisteUata, a living reef-building coral from Torres Strait. The general structure of this coral leaves no doubt that it is closely allied to the Astraeidse, but in the young cali- cles a tetrameral symmetry is indicated by the presence of four large septa placed at right angles to one another. Again, in the family Amphiastrmidce there is commonly a single septum much larger than the rest, and it has been shown that in the young calicles, e.g., of Thecidiosmtlia, two septa, corresponding to the main- and counter-septa of Streptelasma, are first formed, then two alar septa, and afterwards the remaining septa, the latter taking on a generally radial arrangement, though the original bilat- erality is marked by the preponderance of the main septum. As the microscopic character of the corallum of these extinct forms agrees with that of recent corals, it may be assumed that the anatomy of the soft parts also was similar, and the tetrameral arrangement, when present, may obviously be 'referred to a stage when only the first two pairs of Edwardsian mesenteries were present and septa were formed in the intervals between them.

Space forbids a discussion of the proposals to classify corals after the minute structure of their coralla, but it will suffice to say that it has been shown that the septa of all corals are built up of a number of curved bars called trabeculse, each of which is composed of a number of nodes. In many secondary corals (Gydolites, Thamiv- astrcea) the trabeculse are so far separate that the individual bars are easily recognizable, and each looks something like a bamboo owing to the thickening of the two ends of each node. The trabeculse are united together by these thickened internodes, and the result is a fenestrated septum, which in older septa may become solid and aporose by continual deposit of calcite in the f enestrse. Each node of a trabecula may be simple — i.e., have only one centre of calcification, or may be compound. The septa of modern perforate corals are shown to have a structure nearly identical with that of the secondary forms, but the trabe-

culse and their nodes are only apparent on microscopical _, examination. The aporose corals, too, have a practically identical structure, their compactness being due to the union of the trabeculse throughout their entire lengths instead of at intervals, as in the Perforata. Further, the trabeculse may be evenly spaced throughout the septum, or may be grouped together, and this feature is probably of value in estimating the affinities of corals.

In the present state of our knowledge the Zoantharia, in which a primary cycle of six couples of mesenteries is (or may be inferred to be) completed by the addition of two pairs to the eight Edwardsian mesenteries, and succeeding cycles are formed in the exocceles of the pre-existing mesenterial cycles, may be classed in an order Actibtiidba, and this may be divided into the sub-orders Malacactinice, comprising the soft-bodied Actinians, such as Actinia, Sagartia, Bunodes, &c., and the Scleractinim, comprising the corals. The Scleractinise may best be divided into groups of families which appear to be most closely related to one another, but it should not be forgotten that there is great reason to believe that many if not most of the extiact corals must have differed from modern Actiniidea in mesenterial characters, and may have only possessed Edwardsian mesenteries, or even have possessed only four mesenteries, in this respect showing close affinities to the Stauromedusse. Moreover, there are some modern corals in which the secondary cycle of mesenteries departs from the Aetinian plan. For example, Duerden has shown that in Porites the ordinary zooids possess only six couples of mesenteries arranged on the Aetinian plan. But some zooids grow to a larger size and develop a number of additional mesenteries, which arise either in the sulcar or the sulcular entocoele, much in the same manner as in Cerianthus. Bearing this in mind, the following arrange- ment may be taken to represent the most recent knpwledge of coral structure : —

■ *Family 1. ZAPHKENTiD^a!. — Solitary Palseozoio corals with an epitheoal wall. Septa numerous, arranged pinnately ~~with regard to four principal septa. Tabulae present. One or more pits or fossulse present in the oalicle. Typical genera — Zaphrentis, Kaf. Amplexus, M. Edw. and H. Streptel~~ asma, Hall. Omphyma, Raf.*

Family 2. TnEBiNOLiDiE. — Solitary, rarely colonial corals, with radially arranged septa and without tabulae. Typical genera — Mabellum, Lesson. Turbinolia, M. Edw. and H. Caryophyllia, liamarck. Sphenotrochus, Moseley, &c.

Family 3. Amphiastr^zeid^. — Mainly colonial, rarely solitary corals, with radial septa, but bilateral arrangement indicated by persistence of a main septum. Typical genera — Amphi- astrcea, ifetallon. Thecidiosmilia.

Family 4. Sttlinid^s). — Colonial corals allied to the Amphi- astraeidae, but with radially symmetrical septa arranged in cycles. Typical genera — Stylina, Lamarck (Jurassic). Oonvexastrcea, D'Orb. (Jurassic). Isastrma, M. Edw. and H. (Jurassic). Ogilvie refers the modern genus Qalaxea to this family.

■ *Family 5. OcuLiNiD.«i. — ^Branching or massive aporose corals, the calices projecting above the level of a 'compact coenen- chyme formed from the coenosarc which covers the exterior of the corallum. Typical genera — Lophohelia, M. Edw. and H. Oculina, M. .Edw. and H.*

Family 6. PooiLLOPOKiniE. — Colonial branching aporose corals, with small calices sunk in the cosnenohyme. Tabulae pre- sent, and two larger septa, an axial and abaxial, are always present, with traces of ten smaller septa. Typical genera — Pocillopora, Lamarck. Seriatopora, Lamarck.

Family 7. MADEEPOKiD.a;. — Colonial branching or palmate perforate corals, with abundant trabecular ooenenchyme. Theoa porous ; septa compact and reduced in number. Typical genera — Madrepora, Linn. Turhinaria, Oken. Montipora, Quoy and G.

Family 8. PoBiiiDiE. — Incrusting or massive colonial per- forate corals; calices usually in contact by their edges, sometimes disjunct and immersed in coenenchyme. Theca and septa perforate. Typical genera — Porites, M. Edw. and H. Goniopora, Quoy and G. Bhodarcea, M. Edw. and H.

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Family 9. Cyathophtllid^. — Solitary and colonial aporose coralSf Tabulae and vesicular endotheca present. Septa numerous, generally radial, seldom pinnate. Typical genera — Cyathophyllum, Goldfuss (Devonian and Carboni- ferous). Moseleya, Queloh (recent).

Family 10. AsxRa:iD.a;. — Aporose, mainly colonial corals, massive, branching, or mseandroid. Septa radial ; dissepi- ments present ; an epitheca surrounds the base of massive or mseandroid forms, but only surrounds individual coral- lites in simple or branching forms. Typical genera — &oni- astrma, M. Edw. and H. Heliastrcea, M. Edw. and H. Mmandrina, Lam. Codoria, M. Edw. and H. Favia, Oken.

Family 11. FnNGiD.as. — Solitary and colonial corals, with numerous radial septa united by synapticulse. Typical genera — Lophoseris, M. Edw. and H. Thamnastrxa, Le Sauvage. Leptophyllia, Reuss (Jurassic and Cretaceous). Fungia, Dana. Siderastraia, Blainv.

‘ Family 12. Eupsajhmid.;. — Solitary or colonial perforate corals, branching, massive, or encrusting. Septa radial ; the primary septa usually compact, the remainder perforate. Theca perforate. Synapticula present in some genera. Typical genera — Steph’anophyllia, Michelin. Eupsammia, M. Edw. and H. Astroides, Blainv. Bhodopsammia, M. Edw. and H. JDendrophyllia, M. Edw. and H.*

‘ Family 13. Cystiphtllid.. — Solitary corals with rudimentary septa, and the calicle filled with vesicular endotheca. Genera — Oystiphyllum, Lonsdale (Silurian and Devonian). Gonio- phyllum, M. Edw. and H. (In this Silurian genus the calyx is provided with a movable operculum,*

consisting of four paired triangular pieces, the bases of each being attached to the sides of the calyx, and their apices meeting in the middle when the operculum is closed.) Calceola, liam. (In this Devonian genus there is a single semicircular operculum furnished with a stout median septum and numerous feebly developed secondary septa. The calyx is triangular in sec- tion, pointed below, and the operculum is attached to it by hinge-like teeth.)

Coral formations.

Many species of corals are widely distributed, and are found at all depths both in warmer and colder seas. Lophohelia proUfera and DendrophylUa ramea form dense beds at a depth of from 100 to 200 fathoms off the coasts of Norway, Scotland, and Portugal, and the Challenger and other deep-sea dredging expeditions have brought up corals from great depths in the Pacific and Atlantic oceans. But the larger number of species, par- ticularly the more massive kinds, occur only in tropical seas in shallow waters, whose mean temperature does not fall below 68° Fahr., and they do not flourish unless the temperature is considerably higher. These conditions of temperature are found in a belt of ocean which may roughly be indicated as lying between the 28th N. and S. parallels. Within these limits there are numerous reefs and islands formed of coral intermixed with the cal- careous skeletons of other animals, and their formation has long been a matter of dispute among naturalists and geologists.

Coral formations may be classed as fringing or shore reefs, barrier reefs, and atolls. Fringing reefs are plat- forms of coral rock extending no great distance from the shores of a continent or island. TJie seaward edge of the platform is usually somewhat higher than the inner part, and is often awash at low water. It is intersected by numerous creeks and channels, especially opposite those places where streams of fresh water flow down from the land, and there is usually a channel deep enough to be navigable by small boats between the edge of the reef and -the land. The outer wall of the reef is rather steep, but descends into a comparatively shallow sea. Since corals are killed by fresh water or by deposition of mud or sand, it is obvious that the outer edge of the reef is the region of most active coral growth, and the boat channel and the parages leading into it from the

open sea have been formed by the suppression of coral growth by one of the

above-mentioned causes, assisted by the scour of the tides and the solvent action of searwater. Barrier reefs may be regarded as fringing reefs on a large scale. The great Australian barrier reef extends for no less a distance than 1260 miles from Torres Strait in 9-5° S. lat. to Lady Elliot island in 24° S. lat. The outer edge of a barrier reef is much farther from the shore than that of a fringing reef, and the channel between it and the land is much deeper. Opposite Cape York the seaward edge of the great Australian barrier reef is nearly 90 miles distant from the coast, and the maximum depth of the channel at this point is nearly 20 fathoms. As is the case in a fringing reef, the outer edge of a barrier reef is in many places awash at low tides, and masses of dead coral and sand may be piled up on it by the action of the waves, so that islets are formed which in time are covered with vegetation. These islets may coalesce and form a strip of dry land lying some hundred yards or less from the extreme outer edge of the reef, and separated by a wide channel from the mainland. Where the barrier reef is not far from the land there are always gaps in it opposite the mouths of rivers or considerable streams. The outer wall of a barrier reef is steep, and frequently, though not always, descends abruptly into great depths. In many cases in the Pacific Ocean a barrier reef surrounds one or more island peaks, and the strip of land on the edge of the reef may encircle the peaks with a nearly complete ring. An atoll is a ring-shaped reef, either awash at low tide or surmounted by several islets, or more rarely by a complete strip of dry land surrounding a central lagoon. The outer wall of an atoll generally descends with a very steep but irregular slope to a depth of 500 fathoms or more, but the lagoon is seldom more than 20 fathoms deep, and may be much less. Frequently, especially to the leeward side of an atoll, there may be one or more navigable passages leading from the lagoon to the open sea.

Though corals flourish everywhere under suitable con- ditions in tropical seas, coral reefs and atolls are by no means universal in the torrid zone. The Atlantic Ocean is remarkably free from coral formations, though there are numerous reefs in the West Indian islands, off the 'south coast of Florida, and on the coast of Brazil. The Bermudas also are coral

formations, their high land being formed by sand accumulated by the wind and cemented into rock, and are remarkable for being the farthest removed from the equator of any recent reefs, being situated in 32° N. lat. In the Pacific Ocean there is a vast area thickly dotted with coral formations, extending from 5° N. lat. to 25° S. lat., and from 130° E. long, to 145° W. long. There are also extensive reefs in the westernmost islands of the Hawaiia-n group in about 25° N. lat. In the Indian Ocean, the Laccadive and Maldive islands are large groups of atolls off the west and south-west of India. Still farther south is the Chagos group of atolls, and there are numerous reefs off the north coast of Madagascar, at Mauritius, Bourbon, and the Seychelles. The Cocos-Keeling Islands, in 12° S. lat. and 96° E. long., are typical atolls in the eastern part of the Indian Ocean.

The remarkable characters of barrier reefs and atolls, their isolated position in the midst of the great oceans, the seemingly unfathomable depths from which they rise, their peaceful and shallow lagoons and inner channels, their narrow strips of land covered with cocoa-nut palms and other vegetation, and rising but a few feet above the level of the ocean, naturally attracted the attention of the earlier navigators, who formed sundry speculations as to their origin. The poet-naturalist Chamisso was the first to propound a definite theory of the origin of atolls and encircliDg reefs, attributing their peculiar features to the

natural growth of corals and tlie action of the waves. He pointed out that the larger and more massive species of corals flourish best on the outer sides of a reef, whilst the more interior corals are killed or stunted in growth by the accumulation of coral and other debris. Thus the outer edge of a submerged reef is the first to reach the surface, and a ring of land being formed by materials piled up by the waves, an atoll with a central lagoon is produced. Chamisso's theory necessarily assumed the existence of a great number of Submerged banks reaching nearly, but not quite, to the surface of the sea in the Pacific and Indian oceans, and the difiB.culty of accounting for the existence of so many of these led Darwin

~~to reject his views and bring forward an explanation which may be called the theory of subsidence. Starting from the well~~ known premise that reef-building species of corals do not flourish in a greater depth of water than 20 fathoms, Darwin argued that all coral islands must have a rocky base, and that it was inconceivable thatj in such large tracts of sea as occur in the Pacific and Indian oceans, there should be a vast number of submarine peaks or banks all rising to within 20 or 30 fathoms of the surface

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ViQ. 20. — Diagram showing the formation of an atoU during subsidence. (After Barwin.) The lower part of the £gure represents a barrier reef surrounding a central pea^. A, A, Outer edges of the barrier reef at the sea-level ; tiie coooanut tr^es indicate dry land formed on the edges of the reef; L, L, lagoon channel; A', A', outer edges, of the atoll formed by up- growth of the coral during the subsidence of the peak ; L'. lagoon of the atoll. The vertical scale is considerably exaggerated as compared with the horizontal scale.

and none emerging above it. But on the supposition that the atolls and encircling reefs were formed round land which was undergoing a slow movement of subsidence their structure conld easily be explained. Take the case of an island consisting of a single high peak. At first the coral growth would form a fringing reef clinging to its shores. As the island slowly subsided into the ocean the upward growth of coral would keep the outer rim of the reef level with or within a few fathoms of the sur- face, so that, as subsidence proceeded, the' distance between the outer rim of the reef and the sinking land would continually increase, with the result that a barrier- reef would be formed separated by a wide channel from the central peak. As corals and other organisms with calcareous skeletons live in the channel, their remains, as well as the accumulation of coral and other debris thrown over the outer edge of the reef, would maintain the channel at a shallower depth than that of the ocean outside. Finally, if

the subsidence continued, the central peak would disappear beneath the surface, and an atoll would be left consisting of a raised margin of reef surrounding a central lagoon, and any pause during the movement of subsidence would result in the formation of . raised islets or a strip of dry land along the margin of the reef. Darwin's theory was published in 1842, and found almost universal acceptance, both because of its simplicity and its applicability to every known type of coral-reef formation, including such difficult cases as the Great Chagos Bank, a huge submerged atoll in the Indian Ocean.

Darwin's theory was adopted and strengthened by Dana, who had made extensive observations among the Pacific*

coral reefs between 1838 and 1842, but it was not long before it was attacked by other observers. In 1851 Louis Agassiz produced evidence to show that the reefs ofE the south coast of Florida were not formed during subsidence, and in 1863 Karl Semper showed that in the Pelew islands there is abundant evidence of recent upheaval in a region where both atolls and barrier-reefs exist. Lattej'ly, many instances of recently upraised coral formations have been described by Wharton, Guppy, Gardiner, and others, and Alexander Agassiz and Murray have brought forward a mass of evidence tending to shake the /Subsidence theory to its foundations. Murray has pointed out that the deep-sea soundings of the Tuscarora and Challenger have proved the existence of a large number of submarine elevations rising out of a depth of 2000 fathoms or more to within a few hundred fathoms of the surface. The existence of such banks was unknown to Darwin, and removes his objections to Chamisso's theory. For although they may at first be too far below the surface for reef-building corals, they afford a habitat for numerous echinoderms, molluscs, Crustacea, and deep- sea corals, whose skeletons accumulate on their summits, and they further receive a constant rain of the calcareous and silieiqus skeletons of minute organisms which teem in the waters above. By these agencies the banks are gradually raised to the lowest depth at which reef -building corals can flourish, and once these establish themselves they will grow more rapidly on the periphery of the bank, because they are more favoiirably situated as regards food-supply. Thus the reef will rise to the surface as an atoll, and the nearer it approaches

the surface the more will the corals on the exterior faces be favoured, and the more will those in the centre of the reef decrease, for experiment has shown that the minute pelagic organisms on which corals feed are far less abundant in a lagoon than in the sea outside. Eventually, as the margin of the reef rises to the surface and material is accumulated upon it to form islets or continuous land, the coral growth in the lagoon will be feeble, and the solvent action of sea- water and the scour of the tide will tend to deepen the lagoon. Thus the considerable depth of some lagoons, amounting to 40 or 60 fathoms, may be accounted for. The observations of Guppy in the Solomon Islands have gone far to confirm Murray's conclusions, since he found in the islands of Ugi, Santa Anna, and Treasury and Stirling islands unmistakable evidences of a nucleus of volcanic rock, covered with soft earthy-bedded deposits several hundred feet thick. These deposits are highly fossiliferous in parts, and contain the remains of pteropods, lamellibranchs, and echinoderms, imbedded in a foraminiferous deposit mixed with volcanic debris, like the deep-sea muds brought up by the Challenger. The flanks of these elevated beds "are covered with coralline limestone rocks varying from 100 to 16 feet in thickness. One of the islands, Santa Anna, has the form of an upraised atoll, with a mass of coral limestone 80 feet in vertical thickness, resting on a friable and sparingly argillaceous rock resembling a deep-sea deposit. A. Agassiz, in a number of important researches on the Florida reefs, the Bahainas, the Bermudas, the Fiji Islands, and the Great Barrier- reef of Australia, has further shown that many of the peculiar features of these coral formations cannot be explained on the the6ry of subsidence, but are rather attributable to the natural growth of corals on banks formed by prevailing currents, or on extensive shore plat- forms or submarine flats formed by the erosion of pre- existing land surfaces.

In face of this accumulated evidence, it must be admitted that the subsidence theory of Darwin is inapplicable to a large number of coral reefs and islands, but it is hardly

possible to assert, as Murray does, that no atolls or barrier-reefs have ever been developed after the manner indicated by Darwin. The most recent research on the structure of coral reefs has also been the most thorough and the most convincing. It is obvious that, if Murray's theory were correct, a bore hole sunk deep into an atoll would pass through some 100 feet of coral rock, then through a greater or less thickness of argillaceous rock, and finally would penetrate the volcanic rock on which the other materials were deposited. If Darwin's theory is correct, the boring would pass through a great thick- ness of coral rock, and finally, if it went deep enough, would pass into the original rock which subsided be- low the waters. An expedition sent out by the Eoyal Society of London started in 1896 for the island of Funafuti, a typical atoll of the EUice group in the Pacific Ocean, with the purpose of making a deep boring to test this question. The first attempt was not success- ful, for at a depth of 105 feet the refractory nature of the rock stopped further progress. But a second at- tempt, under the management of Prof. Edgeworth David of Sydney, proved a complete success. With improved apparatus, the boring was carried down to a depth of 697 feet (116 fathoms), and a third attempt carried it down to 1114 feet (185 fathoms). The boring proves the existence of a mass of pure limestone of organic origin to the depth of 1114 feet, and there is no trace of any other rock. The organic remains found in the core brought up by the drill consist of corals, foraminifera, calcareous algse, and other organisms. The results of the examination of the core had not been published at the time this article was written, but, by the courtesy of Pro- fessor Judd, the writer has been able to examine the core and satisfy himself as to the truth of the above statements. A boring was also made from the deck of a ship into the floor of the lagoon, which shows that under 100 feet of water there exists at the bottom of the lagpon a deposit more than 100 feet thick, consisting of the remains of a calcareous alga, HaMmeda opuntia, mixed with abundant foraminifera. At greater depths, down to 245 feet, the same materials, mixed with the remains of branching madrepores, were met with, and further progress was stopped by the existence of solid masses of coral, fragments of porites, madrepora, and heliopora having been brought up in the core. These are shallow-water corals, and their existence at a depth of nearly 46 fathoms buried beneath a mass of halimeda and foraminifera, is clear evideneeof recent subsidence. Halimeda grows abundantly over the floor of the

lagoon of Funafuti, and has been observed in many other lagoons. The writer collected a quantity of it in the lagoon of Diego Garcia in the Chagos group. The boring demonstrates that the lagoon of Funafuti has been filled up to an extent of at least 245 feet (nearly 41 fathoms), and this fact accords well with Darwin's theory, but is incompatible with that of Murray. In the present state of our knowledge it seems reasonable to conclude that coral reefs are formed wherever the conditions suitable for growth exist, whether in areas

of subsidence, elevation, or rest. .A considerable number of reefs, at all events, have not been formed in areas of subsidence, and of these the Florida reefs, the Bermudas, the Solomon islands, and possibly the great barrier-reef of Australia are examples. Funafuti would appear to have been formed in an area of subsidence, and it is quite probable that the large groups of low-lying islands in the Pacific and Indian oceans have been formed under the same conditions. At the same time, it must be remem- bered that the atoll or barrier-reef shape is not necessarily evidence of formation during subsidence, for the obser- vations of Semper, A. Agassiz, and Guppy are sufficient to prove that these forms of reefs may be produced by the natural growth of coral, modified by the action of waves and currents in regions in which subsidence has certainly not taken place.

*AuTHOBiTi^s. — The following list contains only the names of the more important and more general works on the structure and classification of corals and on coral reefs. Tor a fuller biblio- graphy the works marked with an asterisk should be consulted ;^ 1. *A. Andres. Fauna und Flora des Gfolfes von Neapel, ix. 1884. — 2. H. M. Berttaed. " Catalogue of Madreporarian Corals " in Brit. Museum, ii. 1896, iii. 1897.— 3. »G. C. Bodhne. "An- thozoa," in Lankester's Treatise on Zoology, vol. ii. 1900. Lon- don, A. and C. Black. — 4. G. Brook. " Challenger Reports," Zoology, xxxii. 1899. (Amtipaiharia.') — 5. "Cat. Madrep. Corals," Brit. Mus. i. 1893.— 6. D. C. Danielssen. "Report Norwegian North Atlantic Exploring Expedition," Zoology, xix. 1890. — 7. P. M. Duncan. Journ. Linnean Soc. xviii. 1885. — 8. P. H. GossB. Actinologia britannica. London, 1860. — 9. O. and R. Hebtwig. Die Actinien. Jena, 1879. — 10. R. Hehtwig. '"■Challenger Reports," Zool. vi. 1882, and xxvi. 1888. —*

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Anthrax. See Experiments on Animals.

Anthropology. — The following additional ob- servations, supplementing the article Antheopo'logy in Ency. Brit, 9th ed., vol. ii., are placed under headings corresponding to those previously adopted.

Man's Place in Nature. — In the original article use is made of the exposition of the theory of human de- velop&ent, as viewed on its physical side, by Professor

Huxley (see his Man's Place in Nature, 1863 ; reprinted in Collected Essays, vol. vii.). Huxley's argument has, on the whole, stood its ground, and a reproduction of his series of skeletons is given in our Plate (Fig. 2) as serving better than a detailed anatomical statement. Its significance in the problem of human descent requires some explanation. The acknowledgment of man's struc- tural similarity with the anthropomorphous species nearest approaching him was made by Linnaeus, who, in his

Systema Naturae. (1735) grouped them together as the highest order of Mammalia, to which he gave the name of Primates. The Anw^nitates Academics (vol. vi., Leyden, 1764), published under the auspices of Linnaeus, contains a remarkable picture which illustrates a discourse by his disciple Hoppius, and is here reproduced in the Plate, Fig. 1. In this picture, which shows the crudeness of the zoological notions current in the 18th century both as to men and apes, there are set in a row four figures : (ct) a recognizable orang-utan, sitting and holding a staff; (6) a chimpanzee, absurdly humanized as to head, hands, and feet ; (c) a hairy woman, with a tail a foot long ; (cJ) an- other woman, more completely coated with hair. The great Swedish naturalist was possibly justified in treating the two latter creatures as quasi-human, for they seem to be grotesque exaggerations of such tailed and hairy himian beings as really, though rarely, occur, and are apt to be ex- hibited as monstrosities (see Bastian and Hartmann, Zeit- schriftjur Ethnologie, Index, "Geschwanzte Menschen"; Gould and Pile, Anomalies and Curiosities of Medicine, 1897). To Linnaeus, however, they represented normal anthropomorpha or man-like creatures, vouched for by visitors to remote parts of the world. This opinion of the Swedish naturalist seems to have been little noticed in Great Britain till it was taken up by the learned but credulous Scots judge. Lord Monboddo (see his Origin and Progress of Language, 1774, &c. ;

Antietvt Metaphysics, 1778). He had not heard of the tailed men till he met with them in the work of Linnaeus, with whom he entered into correspondence, with the result that he enlarged his range of mankind with races of sub-human type. One was founded on the description by the Swedish sailor Niklas Koping of the ferocious men with long tails inhabiting the Nicobar Islands. Another comprised the orang-utans of Sumatra, who were said to take men captive and set them to work as slaves. One of these apes, it was related, served as a sailor on board a Jamaica ship, and used to wait on the captain. These are stories which seem to carry their own explanation. When the Nicobar Islands were taken over by the British Government two centuries later, the native warriors were still wearing their peculiar loin-cloth hanging behind in a most tail-like manner (E. H. Man, Journal Anthropological Institute, vol. XV. p. 442). As for the story of the orang-utan cabin boy, this may even be verbally true, it being, borne in mind that in the Malay languages the term orang-utan, " man of the forest," was originally used for inland forest natives and other rude men, rather than for the miyas a,pes to which it has come to be generally applied by Europeans. The speculations as to primitive man con- nected with these stories diverted the British public, headed by I)r Johnson, who said that Monboddo was " as jealous of his tail as a squirrel." Linnaeus's primarily zoological classification of man did not, however, suit the philosophical opinion of the time, which responded more readUy to the systems represented by Buffon, and later by Cuvier, in which the human mind and soul formed an impassable wall of partition between him and other mam- malia, so that the definition of man's position in the animal world was treated as not belonging to zoology, but to meta- physics and theology. It has to be borne in mind that Linnaeus, plainly as he recognized the likeness of the higher simian and the human types, does not seem to have en- tertained the thought of accounting for this similarity by common descent. It satisfied his mind to consider it as belonging to the system of nature, as indeed remained the case with a greater anatomist of the following century, Eichard Owen. The present drawing, which under the authority of Linnaeus shows an anthropomorphic series from which the normal type of man, the homo sapiens, is

conspicuously ‘absent^ brings zoological similarity into view without suggesting kinship to account for it. There are few ideas more ingrained in ancient and low civiliza- tion than that of relationship by descent between the lower animals and man. Savage and barbaric religions recognize it, and the mythology of the world has hardly a more universal theme. But in educated Europe such ideas had long been superseded by the influence of theol- ogy and philosophy, with which they seemed too incom- patible. In the 19th century, however, Lamarck’s theory of the development of new species by habit and circum- stance led through Wallace and Darwin to the doctriues of the hereditary transmission of acquired characters, the survival of the fittest, and natural selection. Thence- forward it was impossible to exclude a theory of descent of man from ancestral beings whom zoological similarity connects also, though by lines of descent not at all clearly defined, with ancestors of the anthropomorphic apes. In one form or another such k theory of human descent has in our time become part of an accepted frame- work of zoology, if not as a demonstrable truth, at any rate as a working hypothesis which has no effective rival.

The new development from Linnaeus’s zoological scheme which has thus ensued appears in Huxley’s diagram of sim- ian and human skeletons (Fig. 2, (a) ^bbon; (6) orang; (c) chimpanzee; (d) gorilla; (e) man). Evidently suggested by the Linnean picture, this is brought up to the modern level of zoology, and continued on to man, forming an intro- duction to his zoological history hardly to be surpassed. Some of the main points it illustrates may be briefly stated here, the reader being referred for further information to Huxley’s Essays. In tracing the osteological characters of apes and man through this series, the general system of the skeletons, and the close correspondence in number and arrangement of vertebrae and ribs, as well as in the teeth, go far towards justifying the opinion of hereditary con- nexion. At the same time, the comparison brings into view differences in human structure adapted to man’s pre- eminent mode of life, though hardly to be accounted its chief causes. It may be seen how the arrangement of limbs suited for going on all-fours belongs rather to the apes than to man, and walking on the soles of the feet rather to man than the apes. The two modes of progression overlap in human life, but the child’s tendency when learning is to rest on the soles

of the feet and the palms of the hands, unlike the apes, which support themselves on the sides of the feet and the bent knuckles of the hands. With regard to climbing, the long stretch of arm and the grasp with both hands and feet contribute to the arboreal life of the apes, contrasting with what seem the mere remains of the climbing habit to be found even among forest savages. On the whole, man's locomotive limbs are not so much specialized to particular purposes, as generalized into adaptation to many ends. As to the mechanical conditions of the human body, the upright posture has always been recognized as the chief. To it contributes the balance of the skull on the cervical verte- brae, while the human form of the pelvis provides the necessary support to the intestines in the standing attitude. The marked curvature of the vertebral column, by break- ing the shock to the neck and head in running and leap- ing, likewise favours the erect position. The lowest coccygeal vertebrae of man remain as a rudimentary tail. While it is evident that high importance must be attached to the adaptation of the human body to the life of diversi- fied intelligence and occupation he has to lead, this must not be treated as though it were the principal element of the superiority of man, whose comparison with all lower genera of mammals must be mainly directed to the intel-

lectual organ, the brain. Comparison of the brains of vertebrate animals brings into view the immense differ- ence between the small, smooth brain of a fish or bird and the large and convoluted organ in man. In man, both size and complexity contribute to the increased area of the cortex or outer layer of the brain, which within the last few years has been fully ascertained to be the seat of the mysterious processes by which sensation furnishes the groundwork of thought. Schaf er {Textbook of Physiology, vol. ii. p. 697) thus defines it : " The cerebral cortex is the seat of the intellectual functions, of intelligent sen- sation or consciousness, of ideation, of volition, and of memory." Not to enter into the difficult details of pomparison of the extent of this thinking layer in the higher apes and

man, it may suffice to compare the absolute quantity of brain in the gorilla and aver- age man, which has been estimated as 1 to 2. So evident is the preponderance, that it is plainly seen in the present series of skeletons which have already served so many purposes, and where the outside of the brainpan in each gives a rough measure of the brain contained within.

The wide acceptance of the Darwinian theory, as applied to the descent of man, has naturally roused anticipation that geological research, which provides evidence of the animal life of incalculably greater antiquity, would furnish fossil remains of some comparatively recent being inter- mediate between the anthropomorphic and the anthropic types. This expectation has hardly been fulfilled, but of late years the notion of a variety of the human race, geologically ancient, differing from any known in historic times, and with characters approaching the simian, has been supported by further discoveries. To bring this to the reader's notice, top and side views of three skulls, as placed together in the human development series in the Oxford University Museum, are represented in the Plate, for the purpose of showing the great size of the orbital ridges, which the reader may contrast with his own by a touch with his fingers on his forehead. The first (Fig. 3) is the famous Neanderthal skull from near Dilsseldorf, de- scribed by Schaaf hausen in MtiUer's ArcMv, 1858 ; Huxley in Lyell, Antiquity of Man, p. 86, and in Man's Place in Nature. The second (Fig. 4) is the skull from the cavern of Spy in Belgium (De Puydt and Lohest, Oompte Rendu du Congr&s de Namur, 1886). The foreheads of these two skulls have an ape-like form, obvious on comparison with, the simian skulls of the gorilla and other apes, and visible even in the small-scale figures in the Plate, Fig. 2. Among modem tribes of mankind the forehead of the Australian aborigines makes the nearest approach to this type, as was pointed out by Huxley. This brief description will serve to show the importance of a later discovery. At Trinil, in Java, in an equatorial region where, if anywhere, a being intermediate between the higher apes and man would seem likely to be found, Dr Dubois in' 1891-92 excavated from a bed, considered by him to be of Sivalik formation (Pliocene), a thighbone ■which competent anatomists decide to be human, and a remarkably depressed calvaria or skull-cap (Fig. 5), bear- ing a certain resemblance in its proportions to the

corre- sponding part of the simian skull. These remains were referred by their discoverer to an animal intermediate between man and ape, to which he gave the name of Pithecanthropus erectus, but the interesting discussions on the subject showed divergence of opinion among leading anatomists. At any rate, classing the Trinil skull as human, it may be described as tending towards the sim- ian type more than any other known (Eug. Dubois, Pithe- canthropus erectus, Batavia, 1894; Trans. ofBoyal Dublin Soc. vol. vi. 1898 ; Journal Anthropological Institute, vol. xxv.-p. 240; Nature, vol. li. 1895).

Development of Civilization. — ^In recent years no such fundamental alteration has taken place in scientific views as to man's age on the earth, as had been brought about previously by the extension of his antiquity back from history into geology. It was an immense change in current opinion to substitute for a chronology of centuries a vague computation of hundreds of thousands of years. The new views, however, met with comparatively little opposition, partly because the way had been already broken by geology assigning to the strata of the earth an incalculable antiquity, and still more because the extension of the human period was no merely speculative doctrine, but rested on visible fact. It was an object-lesson on the largest scale to look across a valley like that of the Thames, and to imagine the vast time required for its excavation by the waters since the river drift-gravels were left high on the slopes, containing rude stone implements lying with the bones of the mammoth and rhinoceros, which plainly showed man to have been their contemporary. These stone implements in the Quaternary drift-gravels, and other relics of human art in the cave deposits, while furnishing the main proof of man's high antiquity, contain also evidence of his then state of culture. His drawings on bone or tusk found in the caves show no mean artistic power, as appears by the three specimens copied in the Plate. That representing two deer (Fig. 6) was found so early as 1852 in the breccia of a limestone cave on the Charente, and its importance recognized in a remarkable letter by Prosper Mdrim^e, as at once historically ancient and geologically modern (Congr&s d'Anthropologie et d'Archiologie Prihistoriques, Copenhagen, 1869, p. 128). The other two are the famous mammoth from the cave of La Madelaine, on which the woolly mane and huge tusks of Elephas primigenius are boldly drawn (Fig. 7) ; and the group of man and horses

(Fig. 8). There has been found one other contemporary portrait of man, where a hunter is shown stalking an aurochs.

That the men of the Quaternary period knew the savage art of producing fire by friction, and roasted the flesh on which they mainly subsisted, is proved by the fragments of charcoal found in the cave deposits, where also occur bone awls and needles, which indicate- the wearing of skin clothing, like that of the modern Australians and Fuegians. Their bone lance-heads and dart-points were comparable to those of northern and southern savages. Particular attention has to be given to the stone imple- ments used by these earliest known of mankind. The division of tribes in the stone implement stage into two classes, according to their proficiency in this most important art, furnishes in some respects the best means of determining their rank in general culture. In order to put this argument clearly before the reader, a few selected implements are figured in the Plate. The group in Fig. 9 contains tools and weapons of the Neolithic or New Stone Age, such as are dug up on European soil ; they are evident relics of ancient populations who used them till replaced by metal. The stone hatchets are symmetrically shaped and edged by grinding, while the cutting flakes, scrapers, spear and arrow heads, are of high finish. Direct knowledge of the tribes who made them is scanty, but implements so similar in make and design having been in use in North and South America until modern times, it may be assumed for purposes of classification that the Neolithic peoples of the New World were at a similar barbarous level in industrial arts, social organization, moral and religious ideas. Such comparison, though needing caution and reserve, at once proved of great value to anthropology. When, however, there came to light from the drift-gravels and limestone caves of Europe the Palaeolithic imple- ments, of which some types are shown in the group (Fig.

Kg. 1.

Fig. 2.

Fig. 6.

Fig. 7.

Fig. 3.

Fig. 5.

Fig. 11

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Fig. 12.

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10), the difficult problem presented itself what degree of general culture these rude implements belonged to. On mere inspection, their rudeness, their unsuitability for being hafted, and the absence of shaping and edging by the grindstone, mark their inferiority to the Neolithic implements. Their immensely greater antiquity was proved by their geological position and their association with a long-extinct fauna, and they were not, like the Neoliths, recognizable as corresponding closely to the implements used by modern tribes. There was at first a tendency to consider the Palaeoliths as the work of men ruder than savages, if, indeed, their makers were to be accounted human at all. Since then, however, the prob- lem has passed into a more manageable state. Stone implements, more or less apprpaching the European Palaeolithic type, were found hi Africa from Egypt south- wards^ where in such parts as Somaliland and Cape Colony they lie about on the ground, as though they had been the rough tools and weapons of the rude inhabitants of the land at no very distant period. The group in Fig. 11 in the Plate shows the usual Somaliland types. These facts tended to remove the mystery from Palaeolithic man, though too little is known of the ruder ancient tribes of Africa to fui'nish a definition of the state of culture which might have co-existed with the iise of Palaeolithic imple- ments. Information to this purpose, however, can now be furnished from a more outlying region. This is Tas- mania, where, as in the adjacent continent of Australia, the survival of marsupial animals indicates long isolation from the rest of the world. Here, till far on into the 19th century, the Englishmen could watch

the natives striking off flakes of stone, trimming them to convenient shape for grasping them in the hand, and edging them by taking off successive chips on one face only. The group in Fig. 12 shows ordinary Tasmanian forms, two of them being finer tools for scraping and grooving. (For further details reference may be made to H. Ling Eoth, The Tasmanians, 2nd ed. 1899 ; R. Brough Smyth, Aborigines of Victoria, 1878, vol. ii. ; Papers and Proceedings of JRoyal Society of Tasmania; and papers by the present writer in Journal of the Anthropological Institute.) The Tasmanians, when they came in contact with the Euro- pean explorers and settlers, were not the broken out- casts they afterwards became. They were a savage people, perhaps the lowest in culture of any known, but leading a normal, self-supporting, and not unhappy life, which had probably changed little during untold ages. The accounts, imperfect as they are, which have been preserved of their arts, beliefs, and habits, thus present a picture of the arts, beliefs, and habits of tribes whose place in the Stone Age was a grade lower than that of Palaeolithic man of the Quaternary period.

The Tasmanian stone implements, figured in the Plate, show their own use when it is noticed that the rude chipping forms a good hand-grip above, and an effective edge for chopping, sawing, and cutting below. But the absence of the long-shaped implements, so characteristic of the Neolithic and Palaeolithic series, and serviceable as picks, hatchets, and chisels, shows remarkable limitation in the mind of these savages, who made a broad, hand-grasped knife their tool of all work to cut, saw, and chop with. Their weapons were the wooden club or waddy notched to the grasp, and spears of sticks, often crooked but well balanced, with points sharpened by tool or fire, and sometimes jagged. No spear-thrower or bow and arrow was known. The Tas- manian savages were crafty warriors and kangaroo- hunters, and the women climbed the highest trees by notching, in quest of opossums. Shell-fish apd crabs were taken, and seals knocked on the head with clubs, but neither fish-hook nor fishing-net was known, and

indeed swimming fish were avoided as food. Meat and vegetable food, such as fern-root, was broiled over the fire, but boiling in a vessel was unknown. The fire was produced by the ordinary savage fire-drill.

Ignorant of agriculture, with no dwellings but rough huts or break- wiuds of sticks and bark, without dogs or other domestic animals, these savages, until the coming of civilized man, roamed after food within their tribal bounds. Logs and clumsy floats of bark and grass enabled them to cross water under favourable circumstances. They had clothing of skins rudely stitched together with bark thread, and they were decorated with simple necklaces of kangaroo teeth, shells, and berries. Among their simple arts, plaiting and basket-work was one in which they ap- proached the civilized level. The pictorial art of the Tas- manians was poor and childish, qiiite below that of the Palaeolithic men of Europe. The Tasmanians spoke a fairly copious agglutinating language, well marked as to parts of speech, syntax, and inflexion. Numeration was at a low level, based on counting fingers on one hand only, so that the word for man (puggana) stood also for the number 5. The religion of the Tasmanians, when cleared from ideas apparently learnt from the whites, was a simple form of animism based on the shadow (warrawa) being the soul or spirit. The strongest belief of the natives was in the power of the ghosts of the dead, so that they carried the bones of relatives to secure them- selves from harm, and they fancied the forest swarming with malignant demons. They placed weapons near the grave for the dead friend's soul to use, and drove out disease from the sick with the intruding ghost which had caused it. Of greater special spirits of Nature we find something vaguely mentioned. The earliest recorders of the native social life set down such features as their pre- vious experience of rude civilized life had made them judges of. They notice the self-denying affection of the mothers, and the hard treatment of the wives by the husbands, polygamy, and the shifting marriage unions. But when we meet with a casual remark as to the tendency of the Tasmanians to take wives from other tribes than their own, it seems likely that they had some custom of exogamy which the foreigners did not understand. Meagre as is the information preserved of the arts, thoughts, and customs of these survivors from the lower Stone Age, it is of value as furnishing even a temporary and tentative means of working out the development of culture on a basis not of conjecture but of fact. (e. b. t.)

Anthropometry is a system of identifying and classifying individuals by measurement, invented for police purposes about 1880 by M. Bertillon of

the Service de la SiVret& or criminal department of the prefectu.re of police in Paris, and since adopted in some form by nearly every civilized government. The system rests upon two assumptions, which may be taken to have been proved. The first is that the dimensions of certain bones and bony structures remain practically constant in the individual throughout adult life; and the second is that such dimensions vary so much in different persons that if several bones be measured very few individuals will be found to have all the measurements absolutely the same. Taken together, these facts provide the basis for an exact method of identifying at any future time a person who has once been measured, and of distinguishing between that person and others. Such a method might obviously be useful in any situation in which it is desirable to establish identity or prevent personation, but its most important application is in dealing with crime, and especially with " recidivists " or old offenders who have been previously convicted, and who endeavour to escape .recognition by giving false accounts of themselves, and by

every other means in their power. In the case of small communities and local crime personal identification is usually a simple matter and presents little diificulty to the police, who are more or less familiar with all the per- sons with whom they are called upon to deal; but it becomes difficult or impossible with persons who travel from place to place, as the more important professional criminals do, and in great cities by sheer excess of num- bers. Previously to the introduction of the Bertillon system the means relied upon were (1) the memory of warders and policemen, who often had to travel to distant places to view prisoners, (2) photographs, (3) written descriptions, with special reference to marks or other peculiarities. These things have their uses still, but by themselves they formed a very imperfect means of iden- tification. The chief defects in prmice were (1) frequent failure to identify, (2) liability to mis-identification — not very common but of the greatest importance to the inno- cent, (3) time, labour, and expense involved in searching records and circulating descriptions.

Anthropometry was designed to overcome all these , defects. The great advantage claimed for it lies in the systematic recording on a uniform plan of the distinctive features of each criminal, and the classification of these records on the numerical basis afforded by measurement. The principle of classification may be explained as follows : — ^Five dimensions are taken as a basis, namely (1) length of head, (2) breadth of head, (3) length of left middle finger, (4) length of left foot, (5) length of left forearm. These were chosen by M. Bertillon chiefly on the ground that they are the most constant in the indi- vidual and the easiest to take accurately ; but they may be varied without affecting the principle. Each of these is then divided into three classes : — (1) long, (2) medium, (3) short. Thus heads upwards of 191 millimetres in length are classed "long," those of 185 to 190 millimetres are " medium," and those of less than 185 are " short." Similarly with the breadth of head, length of middle finger, and so on. This division of the five dimensions into three classes each gives 3′ or 243 classes, which are assumed to be approximately equal. Supposing, now, it is required to keep a register of 90,000 criminals, as contemplated by M. Bertillon, each represented by a card containing personal details, photograph, and other particulars. The first division by length of head will divide the 90,000 cards into three sections of 30,000 each ; these are subdivided by breadth of head into nine subsections of 10,000 each, and again by the remainiag measurements successively into 27 sets of 3300 each, 81 of 1100 each, and 243 of 370 each. The cards are kept in a cabinet, which is divided into sections and subsec- tions corresponding to the measurements described, and eventually into drawers, representing the last subdivision. There are, therefore, 243 drawers, each containing about 370 cards. Then a further subdivision of the cards in each drawer is given by the height, the length of the little finger, and lastly by the colour of the eye. The height gives three subdivisions of 124 each, which are further divided into groups of 41 by the little finger, and finally into packets of 6 by the colour of the eye, of which seven varieties are distinguished. The prac- tical working of the system can be readily understood. A prisoner is brought into the Prefecture; the police require to know his record, and whether previously convicted or not. He gives a name which is not found in the alphabetical register, kept in addition to the anthropometric register. Let us suppose that the name is false, and that he is really an old offender. In order to

find out it is necessary to search the records. It is here that the anthropometric classification comes Instead of searching through photographic albums

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and voluminous records, at the cost of much time and labour, and with a doubtful result, the authorities can, theoretically at least, lay their bands with certainty on the document required within a few minutes even among 90,000 others. The man is measured, and his head-length is found to be over 191 millimetres. He therefore falls under the " longs," and two-thirds of the registration cabinet, or 60,000 records, are at once elimi-nated. The head-breadth in like manner eliminates 20,000 moreX and so on until the search comes down to a bundle of six or so, among which the suspect's card is found, with photograph, description, &c. The whole thing is entirely independent of names. The actual identification is made by means of the photograph and distinctive marks, if any. Some additional measure- ments, including the dimensions of the ear, a^e taken by M. Bertillon, but they are not essential. The system is still undergoing modification and improvement by the introduction of new features. An important addition is the finger-print process, described below.

The weak point in the system is the margin which has to be allowed for error in the measurements. M. Bertillon himself allows 1 millimetre, but with less skil- ful or less careful officers than those at the Paris Prefec-ture it may be necessary to allow more. This introduces a doubt into the classification, rendering it uncertain to which of two sections measurements near the dividing line really belong, and so increasing the area of search to a corresponding degree. In practice, however, the system has proved highly successful in France. A striking result is the great diminution in the number of habitual criminals who attempt to evade recognition ; the infer- ence is that they have learnt to regard the endeavour as futile. '

In 1893 a departmental committee was appointed by the British Home Office to inquire into the anthropometric system and also into finger-prints. It reported in the fol- lowing year, recommending the adoption of anthropometric classification by means of the five primary measurements

described above; 'but for the further classification and actual identification it recommended the finger-print sys- tem elaborated by Mr Francis Galton in preference to the Bertillon secondary measurements, as being more sci- entific and more accurate. These recommendations were provisionally adopted with some modifications, and have been in use in England ever since. The actual measure- ments now taken are the following : — (1) head length, (2) head breadth, (3) face breadth, (4) left middle finger, (5) left cubit, (6) le:^t foot, (7) height. These are entered on a form together with other details, including age, name, complexion, hair, eyes, and distinctive marks. The prisoner's photograph is also affixed in a space left vacant for the purpose. The reverse side of the same piece of paper is devoted to the finger-prints. Impres- sions of the thumb and four fingers of each hand are taken, both with the fingers together and each in a separate space. The papers are classified and arranged in sections to form a register in the manner already explained. It is to be noted, however, that owing to difference of judicial procedure the system is carried out in a somewhat different way in Great Britain, and is used to a much less extent than in France. The French law permits the arrest, detention, and interrogation of persons on mere suspicion, and the identification of "recidivists!' at this stage is of great importance, because it places a powerful weapon in the hands of the police and of the examining magistrate in working up the case. It is also important for the protection of the innocent. AH persons arrested are therefore measured at once by the police as a matter of routine, and this is done by specially trained and skilled officers at the identification bureau. The

English law only permits it to be done to persons com- mitted for trial or under remand at the formal request of a chief constable. The measurements, therefore, are not taken by the police, but by prison of&cials, and the sys- tem is only applied to a comparatively small number of criminals. It is carried out, however, under the super- vision of a central office attached to the metropolitan police, where the register is kept. Some 200 officers in the different gaols throughout the United

Kingdom have been instructed in Anthropometry. In Glasgow it is used by the police.

Finger Points. — ^In 1823 Purkenje, the eminent physio- logist of Breslau, drew attention to the subject of finger impressions. He distinguished nine types, and suggested a system of classification, but it wsls not followed up. The first practical application of the method was made by Sir William Herschel, of the Indian Civil Service, who introduced it iuto the district of Hooghly, in Bengal, as a means of identification, to meet the practice of persona- tion prevalent in all the courts. He wrote a report recom- mending its general adoption in India, but his advice was not followed, and the practice lapsed in the Hooghly dis- trict after his departure. The subject was afterwards taken up as an anthropological study by Mr Francis Galton, and very fully worked out. It is thus explained in brief by Mr G. K. Henry, inspector-general of police, Lower Provinces : —

The palmar surface of tlie hand and the sole of the foot are traversed by iniiamerable ridges, forming many varieties of pattern, and by creases. The ridge patterns and the ridge characteristics persist throughout the whole period of human life, and are so dis- tinctive as to dlHerentiate each individual from aJJ others. An accurate reproduction of these ridges is obtained by inking the finger bulb and pressing it on paper, the impression thus recorded being a reversal of the pattern on the finger. All impressions may be arranged under one of four types, namely, arches, loops, whorls, composites. Arches subdivide into arches and tented arches ; clear definitions demarcate arches from tented arches, and both from loops. Loops may be ulnar or radial, and are further differ- entiated from each other by ridge counting and by their ridge characteristics. Whorls are single- or double-cored ; impressions of this type differ conspicuously from each other, owing to the in- numerable varieties of pattern they present, but further demarca^ tion is provided by ridge tracing. Composites include central pockets, lateral pockets, twinned loops, accidentals.

From this it vrill be seen that the classification is somewhat complicated and technical. For further ex- planation and for the practical application

of the method the reader is referred to Mr Henry's book on Finger Prints (1900").

In 1892 Anthropometry was introduced into Bengal, and then into other provinces ; but after some years' experience certain defects in working became apparent, and attention was turned to the alternative use of finger- prints, on which the Home Office, as previously men- tioned, had reported favourably in 1894. Experiments in identification by finger-prints only were made in Bengal, and were so successful that in 1897 the govern- ment of India appointed a committee to examine both systems. It recommended the adoption of finger-prints on the Bengal plan "as being superior to the anthro- pometric method — (1) in simplicity of working ; (2) in the cost of apparatus ; (3) in the fact that aU skilled work is transferred to a central or classification office; (4) in the rapidity with which the process can be worked ; and (5) in the certainty of the results." Vari- ous theoretical objections to finger-prints have been raised, but they have no particular value. Obliteration of the ridges by injury is possible, but it would in itself be suspicious, and would constitute a most distinctive personal mark ; obscuration by manual labour is not found to be a serious drawback. In June 1897 a resolu- tion of the governor-general in council directed the adop-

tion of the finger-print system throughout India, and its gradual substitution for the previously existing anthro- pometric system has since been carried out. Its use is not confined to the police department, but extends to all branches of public business.

It is probable that different systems may suit different conditions. Foreign governments now use for police pur- poses combinations of Anthropometry and finger-prints similar to that adopted in England. There are minor differences, but the systems are sufficiently alike to be available for dealing with international crime. The full advantage of scientific identification, however, will not be reaped until judicial procedure recognizes more clearly the distinction between professional and accidental crimi- nals. On this point the committee of 1894 remarked : — " As there are some criminals who ought never to be sent to prison, there are others who ought never to be released; and when this distinction

is established and provided for by legislation, it will be of even greater importance than at present to have an exact record of each criminal's offences."

Literature. — Bertillon. — Instructions SignaUtiques. Henry. — Classification and Uses of Finger Prints. Spearman. — Fort- nightly Beview, March 1890 ; New Beview, July 1893. Blue Book. — " Report on best Means available for identifying Habitual Crimi- nals," 1894. (a. s.)

Antibes, a small seaport of France,'department of Alpes Maritimes, in the arrondissement of Grasse, 11 miles in direct line S.S.W. of Nice, on the railway from Toulon, to Nice. The ramparts are being demolished. A state horticultural college was established in 1891. Industries include perfume distilling. Population (1881),

3810; (1891), 4926; (1896), 4956; (1901), 6600.

Anticosti, a barren island of Quebec, Canada, situ- ated in the northern portion of the Gulf of St Jiawrence. It has been converted into an immense preserve for game of all kinds.

AntigO, a city of Wisconsin, U.S.A., the capital of Langlade county, situated in the north-eastern part of the state, on a branch of the Chicago and North- Western rail- way, at an altitude of 1483 feet. Its industries consist mainly in the manufacture of lumber. Population (1885),

1979; (1895), 5002; (1900), 5145.

Antigua, an island of the British West Indies, the largest member of the outer coralline chain, east of Nevis and north of Montserrat, with an area of 108 square miles. In 1881 the population was 34,000, and in 1891, 36,200, St John, the capital, containing 7938. It forms, with Barbuda and Eedonda, one of the five presidencies into which the Leeward group is divided, and is the seat of the general governing body. The local legis- lative council ceased to send four unofficial members to the Federal Legislative Council in 1898, when the legislature, in consideration of pecuniary assistance from the British Government, passed an act abrogating the semi-elective constitution which had existed since 1866.

The island is now, like the other, presidencies of the Leeward Islands colony, administered as a Crown Col- ony, and the legislative council consists of eight offi- cial and eight non-official members, all nominated by the governor. Education is by law compulsory, and there are many elementary schools throughout the island. There is a grammar school for boys and one for girls, and the Cambridge local examinations are held annually, as are the examinations of the University of London. AgricultiKal training is given under the Gov- z' ermnent at Skerrett's school. The Mico training in- stitution was closed in 1899, and students are now trained in the Mico training college in Jamaica. The Anglican, Wesley an, and Moravian churches are the

most numerous. There is a small volunteer defence force. The island has direct steam communication with Great Britain, New York, and Canada, and is connected with the West India and Panama Telegraph Company's cable. The decline of the sugar industry has had a serious effect on the prosperity and public finances of the island ; and, as in many other West Indian colonies, considerable retrenchments in public expenditure had to be effected during the last few years of the century, which were also marked by. hurricane and drought. Sweet potatoes, yams, maize, and guinea-corn are grown for home consumption, and pine-apples are exported to a small extent. The lands were in 1899 classified as follows : — Cultivated in sugar-cane, 14,860 acres ; other crops, 1660 acres ; pasture, 22,350 ; uncultivated, 19,910 ; mountain and waste land, 10,495; total (estimated) 69,275 acres. In 1896 the exports, chiefly cane-sugar and pine-apples, were £131,000 ; in 1898, £79,000 ; and in 1899, £121,832. The imports in 1896 were £135,600; in 1898 they fell to £105,000, but in 1899 they showed improvement, standing at £109,031. The revenue in 1899 was £42,822, and the expenditure £51,959. The debt stood at £137,500 in 1900. 'Trade is chiefly with the United States. The tonnage entered and cleared at the various ports of the island was in 1898 — steam, 409,122 (all British) ; sailing, 20,046 (of which 13,612 was British).

The islands Barbuda (680) and Eedonda (120) produce phosphates of alumina.

Antilles, a term of somewhat doubtful origin now generally used, especially by foreign writers, as synony- mous with the expression ” West India Islands.” Like ” Brazil,” it dates from a period anterior to the discovery of the New World, ” Antilia” being one of those mysterious lands of the Gloomy Ocean, which figured on the mediaeval charts sometimes as an archipelago, sometimes as continu- ous land of greater or lesser extent, constantly fluctuating in mid-ocean between the Canaries and East India. But it came at last to be identified with the land discovered by Columbus. Later, when this was found to consist of a vast archipelago enclosing the Caribbean sea and Gulf of Mexico, Antilia assumed its present plural, form,

Antilles, which was collectively applied to the whole of this -archipelago. This theory fails to account for the origin of the term itself, which is supposed by some to be a corrupt form of the still older and more famous Atlantis. For the islands and groups now comprised under this designation, see West Iijdibs, and the separate entries — Cuba, Jamaica, &c.

Antioch, (1) on the Orontes. The’moiiem town, Antdkia, stands in the north-western quarter of the ancient city, on the left bank of the el-Asi, Oi-ontes, on level ground at the foot of the rugged range of Mount Casius. More than half the town was destroyed by an earthquake in 1872, and the houses were rebuilt with material from the old walls. A marshy lake, in the fertile plain to the north, makes the town unhealthy, and the trade, in maize and liquorice root, is small. There is a British vice-consulate. The population consists of Moslems and Ansarieh, 16,000 ; Christians and Jews, 8000.

(2) PisiDiAN Antioch was situated on the lower southern slopes of the Sultan Dagh, about 1^ mile east of Yalovach, in the Konia vilayet of Asia Minor, on the right hank of a stream, ancient Anthius, which flows into the Hoiran Genl. It was probably founded, on the site of a Phrygian sanctuary, by Seleucus Nicator, 301-280 B.C., and was made a free city by the Eomans in 189 b.c. It was a thoroughly Hellenized, Greek-speaking

city, in the midst of a Phrygian people, with a mixed population that included many Jews. Before 6 b.c. Augustus made it a colony with the title Csesarea, and connected it with Lystra by the "Royal Road." Under Claudius a.d. 41-54, when visited by Paul and Barnabas it was the civil and military centre of South Galatla, and a place of importance. In 1097 the Crusaders found rest and shel- ter within its walls. The ruins are interesting, and show that Antioch was a strongly-fortified city of Hellenic and Roman type (Ramsay, St. 'Paul the Traveller : Sistorical Commentary on the ffalatians, 1899).

Antioquia, a department of the republic of Colom- bia, bounded on the N. by the Colombian departments of Bolivar and Cauca, on the E. by that of Santander and Boyaca, on the S. by those of Tolima and Cauca, and on the W. by Cauca. It has an area of 22,316 sq. miles, and its population is roughly estimated at about 600,000. The population of the capital, Medellin, is estimated at 40,000. The other principal towns are Marinilla, Sonson, Salamina, Santa Rosa, and Puerto Berrio.

Al^TI-SEMITISM.

IN the political struggles of the concluding quarter of the 19th century an important part was played by a religious, political, and social agitation against the Jews, known as " Anti-Semitism." The origins of this remark- able movement already threaten to become obscured by legend. The Jews contend that anti-Semitism is a mere atavistic revival of the Jew-hatred of the Middle Ages. The extreme section of the anti-Semites, who have given the movement its quasi-scientific name, declare that it is a racial struggle — an incident of the eternal conflict between Europe and Asia — and that the anti-Semites are engaged in an effort to prevent what is called the Aryan race from being subjugated by a Semitic immigration, and to save Aryan ideals from being modified by an ,alien and demoralizing oriental AnSchauung. There is no essential foundation for either of these contentions. Religious prejudices reaching back to the dawn of history have been reawakened by the anti-Semitic agitation, but they did not originate it, and they have not entirely controlled it. The alleged racial divergence is, too, only a linguistic hy- pothesis on the physical evidence

of which anthropologists are not agreed (Tppinard, Anthropologie, p. 444 ; Taylor, Origins of Aryans, cap. i.), and, even if it were proved.

it has existed in Europe for so many centuries, and so many ethnic modifications have occurred on both sides, that it cannot be accepted as a practical issue. It is true that the ethnographical histories of the Jews and the nations of Europe have proceeded on widely diverging lines, but these lines have more than once crossed each other and become interlaced. Thus Aryan elements are at the beginnings of both; European morals have been ineradicably semitized by Christianity, and the Jews have been Europeans for over a thousand years, during which their character has been modified and in some respects transformed by the ecclesiastical and civil poli- ties of the nations among whom they have made their permanent home. Anti-Semitism Is then exclusively a question of European politics, and its origin is to be found, not in the long struggle between Europe and Asia, or between the Church and the Synagogue, -v^hich filled so much of ancient and mediaeval history, but in the social conditions resulting from the emancipation of the Jews in the middle of the 19th century.

If the emancipated Jews were Europeans in virtue of the antiquity of their western settlements, and of the character impressed upon them by the circumstances of

their European history, they none the less presented the appearance of a strange people to their Gentile fellow- countrymen. They had been secluded in their ghettos for centuries, and had consequently acquired a physical and moral physiognomy differentiating them in a measure from their former oppressors. This peculiar physiognomy "was, on its moral side, not essentially Jewish or even Semitic. It was an advanced development of the main attributes of civilized life, to which Christend'om in its transition from feudalism had as yet only imperfectly adapted itself. The ghetto, which had been designed as a sort of quarantine to safeguard Christendom against the Jewish heresy, had in fact proved a storage

chamber for a portion of the political and social forces which were destined to sweep away the last traces of feudalism from central Europe. In the ghetto, the pastoral Semite, who had been made a wanderer by the destruction of his nationality, was steadily trained, through centuries, to become an urban European, with all the parasitic activi- ties of urban economics, and all the democratic tendencies of occidental industrialism. Excluded from the army, the land, the trade corporations, and the artisan guilds, this quondam oriental peasant was gradually transformed into a commercial middleman and a practised dealer in money. Oppressed by the Church, and persecuted by the State, his theocratic and monarchical traditions lost their hold on his daily life, and he became saturated with a passionate devotion to the ideals of democratic politics. Finally, this former bucolic victim of Phoenician exploitation had Ms wits preternaturally sharpened, partly by the stress of his struggle for life, and partly by his being compelled in his urban seclusion to seek for recreation in literary exer- cises, chiefly the subtle dialectics of the Talmudists (Loeb, Juif de I'Histoire ; Jellinek, Jiidische Stamm). Thus, the Jew who emerged from the ghetto was no longer a Palestinian Semite, but an essentially modern European, who differed from his Christian fellow-countrymen only in the circumstances that his religion was of the older Semitic form, and that his^ physical type had become sharply defined through a slightly more rigid exclusive- ness in the matter of marriages than that practised by Protestants and Roman Catholics (Andree, Volkskunde der Juden, p. 58).

Unfortunately, these distinctive elements, though not very serious in themselves, became strongly accentuated by concentration. Had it been possible to distribute the emancipated Jews uniformly throughout Christian society, as was the case with other emancipated religious denomi- nations, there would have been no revival of the Jewish question. The Jews, however, through no fault of their own, belonged to only one class in European society — the industrial bourgeoisie. Into that class all their strength was thrown, and owing to their ghetto preparation, they rapidly took a leading place in it, politically and socially. When the mid-century revolutions made the bourgeoisie the ruling power in Europe, the semblance of a Hebrew domination presented itself. It was the exaggeration of this apparent domination, not by the bourgeoisie itself,

but by its enemies among the vanquished reactionaries on the one hand, and by the extreme Radicals on the other, which created modern anti-Semitism as a political force. '

The movement took its rise in Germany and Austria. Here the concentration of the Jews in one class of the population was aggravated by their excessive numbers. While in France the proportion to the total population was, in the early 'seventies, 044 per cent., and in Italy, 0-12 per cent., it was 1-22 per cent, in Germany, and 3-85 per cent, in Austria-Hungary ; Berlin had 4-36 per cent, of Jews, and Vienna 6'62 per cent. (Andree, Volks- kunde, pp. 287, 291, 294, 295). The activity of the Jews

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consequently manifested itself in a far more intense form in these countries than el sewhere. This was apparent even before the emancipations of 1848. Towards the middle of the 18th century, a limited number of wealthy Jews had been tolerated as Schutz-Juden outside the ghe'ttos, and their sons, educated as Germans under the influence of Moses Mendelssohn and his school (Jews, Modern, Ency. Brit, xiii. p. 680), supplied a majority of the leading spirits of the revolutionary agitation. To this period belong the formidable names of Ludwig Boerne (1786-1837), Heinrich Heine (1799-1854), Edward Ganz (1798-1839), Gabriel Riesser (1806-1863), Ferdinand Lassalle (1825-1864), Karl Marx (1818-1883), Moses Hess (1812-1875), Ignatz Kuranda (1811-1884), and Johann Jacoby (1805-1877). When the revolution was completed, and the Jews entered in a body the national life of Germany and Austria, they sustained this high average in all the intellectual branches of middle-class activity. Here again, owing to the accidents of their history, a further concentration became apparent. Their activity was almost exclusively intellectual. The bulk of them flocked to the fijiancial and the distributive (as distinct from the productive) fields of industry to which they had been confined in the ghettos. The sharpened faculties of the younger generation at the same time carried every- thing before them in the schools, with the result that they soon crowded the professions, especially medicine, law, and journalism (Npssig, Statistik des Jild. Stammes, pp. 33-37; Jacobs, Jew. Statistics, pp. 41-69). Thus the " Semitic

domination," as it was afterwards called, became every day more strongly accentuated. If it was a long time in exciting resentment and jealousy, the reason was that it was in no sense alien to the new conditions of the national life. The competition was a fair one. The Jews might be more successful than their Christian fellow-citizens, but it was in virtue of qualities which complied with the national standards of conduct. They were as law-abiding and patriotic as they were intelligent. Crime among them was far below the average (Nossig, p. 31). Their complete assimilation of the national spirit was brilliantly illustrated by the achievements in German literature, art, and science of such men as Heinrich Heine and Berthold Auerbach (1812-1882), Felix Mendelssohn (1809-1847), and Jacob Meyerbeer (1794-1864), Jacoby the mathematician (1804-1851), Valentin the physio- logist (1808-1883), and Lazarus (b. 1824) and Steinthal (1823-1892) the national psychologists. In politics, too, Edward Lasker (1829-1884) and Ludwig Bamberger (b. 1823) had shown how Jews could put their Qountry before party, when, at the turning-point of German Imperial history in 1866, they led the secession from the Fortschritts-Partei and founded the National Liberal party, which enabled Prince Bismarck to accomplish German unity. Even their financiers were not behind their Christian fellow-citizens in patriotism. Prince Bismarck himself confessed that the money for carrying on the 1866 campaign was obtained from the Jewish banker Bleichroeder, in face of the refusal of the money- market to support the war. Hence the voice of the old Jew-hatred — for in a weak way it was still occasionally heard in obscurantist corners — was shamed into silence, and it was only in the European twilight — in Russia and Rumania — and in lands where medisevalism still lingered, such as northern Africa and Persia, that oppression and persecution continued to dog the steps of the Jews.

The signal for the change came in 1873, and was gi^en unconsciously by one of the most distinguished Jews of his time, Edward Lasker, the gifted lieutenant of Bennigsen in the leadership of the National Liberal party. The unification of Germany in 1870, and the

rapid payment of the enormous Prencli War indemnity, had given an unprecedented impulse to industrial and financial activity throughout the empire. Money became cheap and speculation became universal. A company mania set in which was favoured by the Government, who granted railway and other concessions with a prodigal hand. The inevitable result of, this state of things was first indicated by Jewish politicians and economists. On the 14th-January 1873, Edward Lasker called the atten- tion of the Prussian Diet to the dangers of the situation, while his colleague, Ludwig Bamberger, in an able article in 'the Preussischen Jahrbiicher, condemned the policy which had permitted the milliards to glut the country instead of being paid on a plan which would have facilitated their gradual digestion by the economic machinery of the nation. Deeply impressed by the gravity of the impending crisis, Lasker instituted a search- ing inquiry, with the result that he discovered a series pf grave company scandals in which financial promoters and aristocratic directors were chiefly involved. Undeterred by the fact that the leading spirit in these abuses. Bethel Henry Strousberg, was a Jew, Lasker presented the results of his inquiry to the Diet on the 7th February 1§73, in a speech of great power and full of sensational disclosures. The dramatic results of this speech need not be dwelt upon here (for details see Blum, Deutsche Reich zur Zeit Bismarcks, pp. 163-181). It must suflB.ce to say that in the following May the great Vienna " Krach " occurred, and the colossal bubble of speculation burst, bringing with it all the ruin foretold by Lasker and Bamberger. From the position occupied by the Jews in the commercial class, and especially in the financial section of that class, it was inevitable that a considerable number of them should figure in the scandals which followed. At this moment an obscure Hamburg journalist, Wilhelm Marr, who as far back as 1862 had printed a still-born tract against the Jews (JudenspiegeV), published a sensational pamphlet entitled Der Sieg des Jwdenthums uher das Germanenthum (" The Victory of Judaism over Germanism"). The book fell upon fruitful soil. It applied to the nascent controversy a theory of nationality which, under the great sponsor- ship of Hegel, had seized on the minds of the German youth, and to which the stirring events of 1870 had already given a deep practical significance. The state, according to the Hegelians,

should be national, and the nation should be a unit comprising individuals speaking the same language and of the same racial origin. Heterogeneous elements might be absorbed, but if they could not be reduced to the national type they should be eliminated. This was the pseudo-scientific note of the new anti- Semitism, the theory which differentiated it from the old religious Jew-hatred and sought to give it a rational place in modern thought. Marr's pamphlet, which re- viewed the facts of the Jewish social concentration with- out noticing their essentially transitional character, proved the pioneer of this teaching. It was, however, in the passions of party politics that the new crusade found its chief sources of vitality. The enemies of the bourgeoisie at once saw that the movement was calculated to discredit and weaken the school of Manchester Liberalism, then in the ascendant. Agrarian capitalism, which had been dethroned by industrial capitalism in 1848, and had burnt its fingers in 1873, seized the opportunity of pay- ing off old scores. The clericals, smarting under the Kulturkampf, which was supported by the whole body of Jewish liberalism, joined heartily in the new cry. In 1876 another sensational pamphlet was published. Otto Glagau's Der Boersen und Cfrundergeschwindel in Berlin (" The Bourses ^nd the Company Swindles in Berlin "),

dealing in detail with the Jewish participation in the scandals first revealed by Lasker. The agitation gradually swelled, its growth being helped by the sensitiveness and caco'ethes scribendi of the Jews themselves, who contributed two pamphlets and a much larger proportion of news- paper articles for every one supplied by their opponents (Jacobs, Bibliog.. Jew. Question, p. xi.). Up to 1879, however, it was more of a literary than a political agita- tion, and was generally regarded only as an ephemeral craze or a passing spasm of popular passion.

Towards the end of 1879 it spread with sudden fury over the whole of Germany. This outburst, at a moment when no new financial scandals or other illustrations of Semitic demoralization and domination were before the public, has never been fully explained. It is impossible to doubt, however, that the secret springs of the new agitation were more or less directly supplied by Prince Bismarck himself. Since 1877 the relations between the chancellor and the National Liberals had gradually become

strained. The deficit in the budget had compelled the Government to think of new taxes, and in order to carry them through the Reichstag the support of the National Liberals had been solicited. Until then the National Liberals had faithfully supported the chancellor in nursing the consolidation of the new empire, but the great dream of its leaders, especially of Lasker and Bamberger, who had learnt their politics in England, was to obtain a con- stitutional and economic rigime similar to that of the British Isles. The organization of German unity was now completed, and they regarded the new overtures of Prince Bismarck as an opportunity for pressingtheir constitutional demands. These were refused, the Eeichstag was dissolved, andvPrince Bismarck boldly came forward with a new fiscal policy, a combination of protection and state socialism. Lasker and Bamberger thereupon led a powerful secession of National Liberals into opposition, and the chancellor was compelled to seek a new majority among the ultrar Conservatives and the Roman Catholic Centre. This was the beginning of the famous "journey to Canossa." Bismarck did not hide his mortification. He began to recognize in anti-Semitism a means of "dishing" the Judaized liberals, and to his creatures who assisted him in his press campaigns he dropped significant hints in this sense (Busch, Bismarck, ii. 453-64, iii. 16). He even spoke of a new Kulturkampf against ^the Jews {ibid. ii. p. 484). How these hints were acted upon has not been revealed, but it is sufficiently instructive to notice that the final breach with the National Liberals took place in July 1879, and that it was immediately followed by a violent revival of the anti-Semitic agitation. Marr's pamphlet was reprinted, and within a few months ran through nine further editions. The historian Treitschke gave the sanction of his great name to the movement. The Conservative and Ultramontane press rang with the sins of the Jews. In October an anti-Semitic league was founded in Berlin and Dresden (for statutes of the league see Nineteenth Century, February 1881, p. 344).

The leadership of the agitation was now definitely as- sumed by a man who combined with social influence, oratorical power, and inexhaustible energy, a definite scheme of social regeneration and an organization for carrying it out. This man was Adolf Stoecker (b. 1835), one of the Court Preachers. He had embraced the doc- trines of Christian Socialism which the Roman Catholics, under the guidance of Archbishop Ketteler, had

adopted from the teachings of the Jew Lassalle (Nitti, Catholic Socialism, pp. 94-96, 122, 127), and he had formed a society called "The Christian Social Working-man's Union." He was also a conspicuous member of the Prussian Diet, where he sat and voted with the Conserva-

tiyes. He found himself in strong sympathy with Prince Bismarck's new economic policy, which, although also of Lassallian origin (Kohut, Ferdinand Lassalle, pp. 144 et seq.), was claimed by its author as being essentially Chris- tian (Busch, p. 483). Under his auspices the y^ears 1880- 81 became a period of bitter and scandalous conflict with the Jews. The Conservatives supported him, partly to satisfy their old grudges against the Liberal bourgeoisie and partly because Christian Socialism, with its anti- Semitic appeal to ignorant prejudice, was likely to weaken the hold of the Social Democrats on the lower classes. The Lutheran clergy followed suit, in order to prevent the Roman Catholics from obtaining a monopoly of Christian Socialism, while the Ultramontanes readily adopted anti-Semitism, partly to maintain their monopoly,, and partly to avenge themselves on the Jewish and Liberal supporters of the Kulturkampf. In this way a formidable body of public opinion was recruited for the anti-Semites. Yiolent debates took place in the Prussian Diet. A petition to exclude the Jews from the national schools and universities and to disable them from hold- ing public appointments was presented to Prince Bis- marck. Jews were boycotted and insulted. Duels between Jews and anti-Semites, many of them fatal, became of daily occurrence. Even unruly demonstrations and street riots were reported. Pamphlets attacking every phase and aspect of Jewish life streamed by the hundred from the printing-press. On their side the Jews did not want for friends, and it was owing to the strong attitude adopted by the Liberals that the agitation failed to secure legis- lative fruition. The crown prince (afterwards Emperor Frederick) and crown princess boldly set themselves at the head of the party of protest. The crown prince publicly declared that the agitation was " a shame and a disgrace to Germany." A manifesto denouncing the movement as a blot on German culture, a danger to

German unity, and a flagrant injustice to the Jews them- selves, was signed by a long list of illusttious men, including Herr von Forckenbeck, Professors Mommsen, Gneist, Droysen, Virchow, and Dr Werner Siemens {Times, Nov. 18, 1880). During the Eeichstag elections of 1881 the agitation played an active part, but without much effect, although Stoecker was ele'cted. This was due to the fact that the great Conservative parties, so far as their political organizations were concerned, still re- mained chary of publicly identifying themselves with a movement which, in its essence, was of socialistic tendency. Hence the electoral returns of that year sup- plied no sure guide to the strength of anti-Semitic con- victions among the German people.

The first severe blow suffered by the German anti- Semites was in 1882, when, to the indignation of the whole civilized world, the barbarous riots against the Jews in Russia and the revival of the mediaeval Blood Accusation in Hungary (see infra) illustrated the liability of unreasoning mobs to carry into violent practice the incendiary doctrines of the new Jew-haters. From this blow anti-Semitism might have repovered had it not been for the divisions and scandals in its own ranks, and the artificial forms it subsequently assumed through facti- tious alliances with political parties bent less on perse- cuting the Jews than on profiting by the anti-Jewish agitation. The divisions showed themselves at the first attempt to form a political party on an anti-Semitic basis. Imperceptibly the agitators had grouped themselves into two classes, economic and ethnological anti-Semites. The impracticable racial views of Marr and Treitschke had not found favour with Stoecker and the Christian Socialists. They were disppsed to leave the Jews in peace so long as they behaved themselves properly, and although they carried on their agitation against Jewish

malpractices in a comprehensive form which seemed superficially to identify them with the root-and-branch anti-Semites, they were in reality not inclined to accept the racial theory with its scheme of revived Jewish dis- abilities (Huret, La Question Sociale — interview with Stoecker). This feeling was strengthened by a tendency on the part of an extreme wing of the racial anti-Semites to extend their campaign against Judaism to its offspring, Christianity. In 1879 Professor Sepp, arguing that Jesus was of no human raCe, had proposed that Christianity should reject the

Hebrew Scriptures and seek a fresh historical basis in the cimeiform inscriptions. Later Dr Dilhring, in several brochures, notably Die Judenfrage als Eacen, Sitten und Cultur Frage (1881), had attacked Christianity as a manifestation of the Semitic spirit which was not compatible with the theological and ethical conceptions of the Scandinavian peoples. The philoso- pher Friedrich Nietzsche had also adopted the same view without noticing that it was a reductio ad absurdum of the whole agitation. (Menschliches, AUzumenschliches (1878), Jenseits von Out und Bose (1886), Genealogie der Moral (1887).) With these tendencies the Christian Socialists could have no sympathy, and the consequence was that when in March 1881 a political organization of anti-Semitism was attempted, two rival bodies were created, the " Deutsche Volksverein," under the Conserv- ative auspices of Herr Liebermann von Sonnenberg (b. 1848) and Herr Foerster, and the "Sociale Eeichs- verein," led by the racial and Radical anti-Semites, Ernst Henrici (b. 1854) and Otto Boeckl (b. 1859). In 1886, at an anti-Semitic congress held at Cassel a reunion was effected under the name of the " Deutsche antisemitische Verein," fcut this only lasted three years. In June 1889 the anti- Semitic Christian Socialists under Stoecker again seceded. Meanwhile racial anti-Semitism with its wholesale radical proposals had been making considerable progress among the ignorant lower classes. It adapted itself better to popular passions and inherited prejudice than the more academic conceptions of the Christian Socialists. The latter, too, were largely Conservatives, and their points of contact with the proletariat were at best artificial. Among the Hessian peasantry the inflammatory appeals of Boeckl secured many adherents. This paved the way for a new anti-Semitic leader, Herrmann Ahlwardt (b. 1846), who, towards the end of the 'eighties, eclipsed all the other anti- Semites by the sensationalism and violence with which he prosecuted the campaign. Ahlwardt was a person of evil notoriety. He was loaded with debt. In the Manche decoration scandals it was proved that he had acted first as a corrupt intermediary and afterwards as the betrayer of his confederates. His anti-Semitism was adopted originally as a means of chantage, and it was only when it failed to yield profit in this form that he came out boldly as an agitator. The wildness, unscrupulousness, and full-bloodedness of his propaganda enchanted the mob, and he bid fair to become a powerful democratic leader. His pamphlets, full of scandalous

revelations of alleged malpractices of eminent Jews, were read with avidity. No fewer than ten of them were written and published during 1892. Over and over again he was prosecuted for libel and convicted, but this seemed only to strengthen his influence with his followers. The Roman Catholic clergy and newspapers helped to inflame the popular passions. The result was that anti-Jewish riots broke out. At Neustettin the Jewish synagogue was burnt, and at Xanton the Blood Accusation was revived, and a Jewish butcher was tried on the ancient charge of murdering a Christian child for ritual purposes. The man was, of course, acquitted, but the symptoms it revealed of reviving medisevalism strongly stirred the liberal and cultured mind of Germany. All protest,

lio-wever, seemed powerless, and the barbarian movement appeaj-ed destined to carry everything before it.

German polities at this moment were in a very intricate state. Prince Bismarck had retired, and Count Caprivi, with a programme of general conciliation based on Liberal principles, was in power. Alarmed by the non-renewal of the anti-Socialist law, and by the conclusion of commercial treaties which made great concessions to German industry, the landed gentry and the Conservative party became alienated from the new chancellor. In January 1892 the split was completed by the withdrawal by the Government of the Primary Education Bill, which had been designed to place primary instruction on a religious basis. The Conservatives saw their opportunity of posing as the party of Christianity against the Liberals and Socialists, who had wrecked the Bill, and they began to look towards Ahlwardt as a possible ally. He had the advantages over Stoecker that he was not a Socialist, and that he was prepared to lead his apparently large follow- ing to assist the agi-arian movement and weaken the Social Democrats. The intrigue gradually came to light. Towards the end of the year Herr Liebkneeht, the Social Democratic leader, denounced the Conservatives to the Reichstag as being concerned ” in

using the anti-Semitic movement as a bastard edition of Socialism for the use of stupid people" (1st December). Two days later the charge was confirmed. At a meeting of the party held on 3rd December the following plank was added to the Conservative programme: " We combat the oppressive and disintegrating Jewish influence on our national life ; we demand for our Christian people a Christian magistracy and Christian teachers for Christian pupils ; we repudiate the excesses of anti-Semitism." In pursuance of this resolution Ahlwardt was returned to the Reichstag at a by-election by the Conservative district of Arnswalde-Friedeberg. The coalition was, however, not yet com- pleted. The intransigeant Conservatives, led by !Barou von Hammerstein, the editor of the Kreuz-Zeitung, justly felt that the concluding sentence of the resolution of 3rd December repudiating "the excesses of anti-Semitism" was calculated to hinder a full and loyal co-operation between the two parties. Accordingly on 9th December another meeting of the party was summoned. Twelve hundred members met at the Tivoli Hall in Berlin, and with only seven dissentients solemnly expunged the offending sentence from the resolution. The history of political parties may be searched in vain for a parallel to this discreditable transaction.

The capture of the Conservative party proved the high- water mark of German anti-Semitism. From. that moment the tide began to recede. All that was best in German national life was scandalized by the cynical tactics of the Conservatives. The emperor, strong Christian though he was, was shocked at the idea of serving Christianity by a compact with unscrupulous demagogues and ignorant fanatics. Prince Bismarck growled out a stinging sarcasm from his retreat at Friedrichsruh. Even Stoecker raised his voice in protest against the " Ahlwardtismus " and " Boeckelianismus," and called upon his Conservative colleagues to distinguish between "respectable and dis- reputable anti-Semitism." As for the Liberals and Socialists, they filled the air with bitter laughter, and declared from the housetops that the stupid party had at last been overwhelmed by its own stupidity. The Conservatives began to suspect that they had Ta.^Ae a false step, and they were confirmed in this belief by the conduct of their new ally in the Reichstag. His d^ut in parliament was the signal for a succession of disgrace- ful scenes. His whole campaign of

calumny was trans- ferred to the floor of the house, and for some weeks the Reichstag discussed little else than his so-called revela-

tions. The Conservatives listened to his wild charges in uncomfortable silence, and refused to support him. Stoecker opposed him in a violent speech. The Radicals and Socialists, taking an accurate measure of the shallow vanity of the man, adopted the policy of giving him " enough rope." Shortly after his election he was con- demned to five months' imprisonment for libel, and he would have been arrested but for the interposition of the Socialist party, including five Jews, who claimed for him the immunities of a member of parliament. When he moved for a commission to inquire into his revelations, it was again the Socialist party which supported him, with the result that all his charges, without exception, were found to be absolutely baseless. Ahlwardt was covered with ridicule, and when in May the Reichstag was dis- .solved, he was marched off to prison to undergo the sentence for libel from which his parliamentary privilege had up to that moment protected him.

His hold on the anti-Semitic populace was, however, not diminished. On the contrary, the action of the Con- servatives at the Tivoli Congress could not be at once eradicated from the minds of the Conservative voters, and when the electoral campaign began it was found impossible to explain to them that the party leaders had changed their minds. The result was that Ahlwardt, although in prison, was elected by two constituencies. At Amswalde-Friedeberg he was returned in the teeth of the opposition of the ofiicial Conservatives, and at Neu-Stettin he defeated no less a person than his anti- Semitic opponent Stoecker. Seventeen other anti- Semites, all of the Ahlwardtian school, were elected. This, however, represented the extreme strength of the anti-Semitic party in Germany; for henceforth it had to stand alone as one of the many minor factions in the Reichstag, avoided by all the great parties, ayd too weak to exercise any influence on the main course of affairs.

During the subsequent seven years it became more and more discredited. The financial scandals connected with Foerster's attempt to found a Christian Socialist colony in Paraguay, the conviction of Baron von Hammerstein, the anti-Semitic Conservative leader, of forgery and swind-

ling (1895-96), and several minor scandals of the same unsavoury character, covered the pai'ty with the very obloquy which it had attempted to attach to the Jews. At the same time the Christian Socialists who had remained with the Conservative party also suffered. After the elections 6f 1893, Stoecker was dismissed from his post of Court Preacher, and publicly reprimanded for speak- ing familiarly of the empress. Two years later the Christian Socialist Pastor Neumann, observing the ten- dency of the Conservatives to coalesce with the moderate Liberals in antagonism to Social Democracy, declared against the Conservative party. The following year the emperor publicly condemned Christian Socialism and the " political pastors," and Stoecker was expelled from the Conservative party for refusing to modify the socialistic propaganda of his organ. Das Volk. His fall was com- pleted by a quarrel with the Evangelical Social Union. He left the Union and appealed to the Lutheran clergy to found a new Church social organization, but met with no response. Another blow to anti-Semitism came from the Roman Catholics. They had become alarmed by the unbridled violence of the Ahlwardtians, and when in 1894 Foerster declared in an address to the German anti-Semitic Union that anarchical outrages like the murder of Presi- dent Carnot were as much due to the " Anarchismus von oben" as the "Anarchismus von unten," the Ultramontane Gerinania publicly washed its hands of the Jew-baiters (1st July 1894). Thus gradually German anti-Semi- tism became stripped of every adventitious alliance;

and although at the general election of 1898 it managed still to return twelve members to the Eeichstag, it had ceased to be regarded as a serious element in politics.

The causes of the decline of German anti-Semitism are not difficult to determine. While it remained a theory of nationality and a fad of the metaphysicians, it made con- siderable noise in the world, but without exercising much practical influence. When it attempted to play an active part in politics it became submerged by the ignorant and superstitious voters, who could not understand its scientific justification, but who were

quite ready to declaim and riot aga,inst the J^w bogey. It thus became a sort of Jacquerie which, being exploited by unscrupulous demagogues, soon alienated all its respectable elements. Its moments of real importance were due not to inherent strength but to the uses made of it by other political parties for their own purposes. These coalitions are no longer possible, not only because anti-Semitism has ceased to be respect- able, but because, in face of the growing strength of Democratic Socialism, all supporters of the present organization of society have found it necessary to sink their differences. The new social struggle has eclipsed the racial theory of nationality. The Social Democrat is now the enemy, and the new reaction counts on the sup- port of the rich Jews and the strongly individualist Jewish middle class to assist it in preserving the existing social structure. i

More serious have been the effects of German anti- Semitic teachings on the political and social life of the countries adjacent to the empire — Russia, Austria, and France. In Russia these effects were first seriously felt owing to the fury of autocratic reaction to which the tragic death of the Tsar Alexander II. gave rise. This, however, like the Strousberg KroLch in Germany, was only the proximate cause of the outbreak. There were other elements which had created a milieu peculiarly favourable to the transplantation of the German craze. In the first place the mediaeval anti-Semitism was still an integral part of the polity of the empire. The Jews were cooped up in one huge ghetto in the western pro- vinces, "marked out to all their fellow-countrymen as aliens and a pariah caste set apart for special and degrading treat- ment" (Persecution of the Jews in Russia, 1891, p. 5). In the next place, owing to the emancipation of the serfs which had half ruined the land-owners, while creating a free but moneyless peasantry, the Jews, who could be neither nobles nor peasants, had found a vocation as money-lenders and as middlemen between the grain producers and the grain consumers and exporters. There is no evidence that this function was performed, as a rule, in an exorbitant or oppressive way. On the contrary, the fall in the value of cereals on all the provincial markets, after the riots of 1881, shows that the Jewish competition had previously assured full prices to the farmers (Schwabacher, Denkschrift, 1882, p. 27). Nevertheless, the Jewish activity or " exploitation," as it was called, was resented, and the ill-feeling it

caused among land-owners and farmers was shared by non- Jewish middlemen and merchants who had thereby been compelled to be satisfied with small profits. Still there was but little thought of seeking a remedy in an organized anti-Jewish movement. On the contrary, the abnormal situation aggravated by the dis- appointments and depression caused by the Turkish war, had stimulated a widespread demand for constitutional changes which would enable the people to adopt a state- machinery more exactly suited to their needs. Among the peasantry this demand was promoted and fomented by the Nihilists, and among the l9,nd-owners it was largely adopted as a means of checking what threatened to become a new Jacquerie (Walcker, Oegenwartige Lage Russlands,

1873; Innere Krisis Russlands, 1876). The tsar, Alex- ander II., strongly sympathized with this movement, and on the advice of Count Loris Melikoff and the council of ministers a rudimentary scheme of parliamentary govern- ment had been drafted and actually signed when the emperor was assassinated. Meanwhile a nationalist and reactionary agitation, originating like its German ana- logue in the Hegelianism of a section of the lettered public, had manifested itself in Moscow. After some ~~early vi~~ cissitudes, it had been organized, under the auspices of Alexis Kireieff, Chomjakoff, Aksakoff, and Koeheleff, into the Slavophil party, with a Romanticist programme of reforms based on the old traditions of the pre-Petrine epoch. This party gave a great impetus to Slav national- ism. Its final possibilities were sanguinarily illustrated by Muravieff's campaign in Poland in 1863, and in the war against Turkey in 1877, which was exclusively its handi- work (Statement by General Kireieff : Schiitz, Das heutige Russland, p. 104). After the assassination of Alexander II. the Slavophil teaching, as expounded by Ignatieff and Pobyedonostzeff, became paramount in the Government, and the new tsar was persuaded to cancel the constitu- tional project of his father. The more liberal views of a section of the Slavophils under Aksakoff, who had been in favour of representative institutions on traditional lines, were displaced by the reactionary system of Pobye- donostzeff, who took his stand on absolutism, orthodoxy, and the racial unity of the Russian people. This was the situation on the eve of Easter 1881. The hardening nationalism above, the increasing discontent below, the economic activity

of the Hebrew heretics and aliens, and the echoes of anti-Semitism from oyer the western border were combining for an explosion.

A scufile in a tavern at Elisabethgrad, in Kherson, sufi&ced to ignite this combustible material. The scufle grew into a riot, the tavern was sacked, and the drunken mob, hounded on by agitators, who declared that the Jews were using Christian blood for the manufacture of their Easter bread, attacked and looted the Jewish quarter. The outbreak rapidly spread. On 7th May there was a similar riot at Smiela, near Czergassy, and the following day there was a violent outbreak at Kieff, which left 2000 Jews homeless. Within a few weeks the whole of Western Russia, from the Black Sea to the Baltic, was smoking with the ruins of Jewish homes. Scores of Jewish women were dishonoured, hundreds of men, women, and children were slaughtered, and tens of thousands were reduced to beggary and left without a shelter. Murderous riots or incendiary outrages took place in no fewer than 167 towns and villages, including Warsaw, Odessa, and Kieif. Europe had witnessed no such scenes of mob savagery since the Black Death massacres in the fourteenth century. As the facts gradually filtered through to the western capitals, they caused a thrill of horror everywhere. An indignation meeting held at the Mansion House in London, under the presidency of the Lord Mayor, was the signal for a long series of popular demonstrations condemning the persecutions, held in most pi the chief cities of England and the Continent.

Except as stimulated by the Judeophobe revival in Germany the Russian outbreak in its earlier forms does not belong specifically to modern anti-Semitism. It was essentially a mediaeval uprising animated by the religious fanaticism, gross superstition, and predatory instincts of a people still in the mediaeval stage of their development. This is proved by the fact that, although the Russian peasant was supposed to be a victim of unbearable Jewish " exploitation," he was not moved to riot until he had been brutalized by drink and excited by the old fable of the Blood Accusation. The modern anti-Semitic element Same

from above, and followed closely on the heels of the riots. It has been freely charged against the Russian Government that it promoted the riots in 1881 in order to distract popular attention from the Nihilist propaganda and from the political disappointments involved in the cancellation of the previous tsar's Constitutional project (Lazare, L'AntisSmitisme, p. 211). This is an hypothesis which will not stand the test of investigation. It is true that the local authorities, both civil and military, favoured the outbreak, and took no steps to suppress it, but this may be accounted for by the fact that the feudal bureaucracy had just escaped a great danger, and were consequently not sorry to see the discontented populace venting their passions on the Jews. In the higher circles of the Govern- ment different views prevailed. The tsar himself was at first persuaded that the riots were the work of Nihilists, and he publicly promised his protection to the Jews. On the other hand, his ministers, ardent Slavophils, thought they recognized in the outbreak an endorsement of the nationalist teaching of which they were the apostles, and, while reprobatihg the acts of violence, came to the con elusion that the most reasonable solution was to aggravate the legal disabilities of the persecuted aliens and heretics. To this view the tsar was won over, partly by the clamor- ous indignation of Western Europe, which had woimded his national amour propre to the quick, and partly by the strongly partisan report of a commission appointed to in- quire, not into the administrative breakdown which had allowed riot to run loose over the western and southern provinces, but into the "exploitation" alleged against the Jews, the reasons why "the former laws limiting the rights of the Jews " had been mitigated, and how these laws could be altered so as " to stop the pernicious conduct of the Jews" (Rescript of 3rd September 1881). The result of this report was the drafting of a " Temporary Order concerning the Jews " by the Minister of the In- terior, Count Ignatieff, which received the assent of the tsar on the 3rd' May 1882. This order, which was so little temporary that it has not yet been repealed, had the effect of creating a number of fresh ghettos within the pale of Jewish settlement. The Jews were cooped up within the towns, and their rural interests were arbitrarily confiscated. The doubtful incidence of the order gave rise to a number of judgments of the Senate, by which all its persecuting possibilities were brought out, with the result that the activities of the Jews were completely paralysed,, and they became a prey

to unparalleled cruelty. As the gruesome .effect of this legislation became known, a fresh outburst of horror and indignation swelled up from Western Europe. It proved powerless. Count Ignatieff was dismissed owing to the protests of high- placed Russians, who were disgusted by the new Kvltur- kampf, but his work remained, and, under the influence of M. Pobyedonostzeff, the Procurator of the Holy Synod, the policy of the " May Laws," as they were significantly called, was applied to every aspect of Jewish life with pitiless rigour. The temper of the tsar may be judged by the fact that when an appeal for mercy from an illus- trious personage in England was conveyed to him at Fredensborg through the gracious medium of the tsaritza, his Majesty angrily exclaimed within the hearing of an Englishman in the ante-room who was the bearer of the message, "Never let me hear you mention the name of that people again ! "

The Russian May Laws are the most conspicuous legis- lative monument achieved by modern anti-Semitism. It ia true that they re-enacted regulations which resemble the oppressive statutes introduced into Poland through the influence of the Jesuits in the 16th century (Sternberg, Oesch. d. Juden. in Polen, pp. 141 et seqq.), but their

orthodox authors were as little conscious of this irony of history as they were of the Teutonic origins of the whole Slavophil movement. These laws are an experimental application of the political principles extracted by Marr and his German disciples from the metaphysics of Hegel, and as such they afford a valuable means of testing the practical operation of modern anti-Semitism. Their result was a widespread commercial depression which was felt all over the empire. Even before the May Laws were definitely promulgated the passport registers showed that the anti-Semitic movement had driven 67,900 Jews across the frontier, and it was estimated that they had taken with them 13,000,000 roubles, representing a minimum loss of 60,000,000 roubles to the annual turnover of the country's trade. Towards the end of 1882 it was calcu- lated that the agitation had cost Russia as much as the whole Turkish war of 1877. Trade was evei-ywhere paralysed. The enormous increase of bankruptcies, the transfer of investments to foreign funds, the consequent fall in the value of the rouble and the prices of Russian stocks, the suspension of farming operations owing to advances on growing crops

being no longer available, the rise in the prices of the necessaries of life, and lastly, the appearance of famine, filled half the empire with gloom. Banks closed their doors, and the great provincial fairs proved failures. When it was proposed to expel the Jews from Moscow there was a loud outcry all over the Sacred City, and even the Orthodox merchants, real- izing that the measure would rxdn their flourishing trade with the south and west, petitioned against it. The Moscow Exhibition proved a failure. Nevertheless the Government persisted with its harsh policy, and Jewish refugees streamed by tens of thousands across the western frontier to seek an asylum in other lands. In 1891 the alarm caused by this emigration led to further pro- tests from abroad. The citizens of London again assembled at Guildhall, and addressed a petition to the tsar on behalf of his Hebrew subjects. It was handed back to the Lord Mayor by the Russian Am- bassador, with a curt intimation that the emperor declined to receive it. At the same time orders were defiantly given that the May Laws should be strictly en- forced. Meanwhile the Russian Minister of Finance was at his wits' ends for money. Negotiations for a large loan had been entered upon with the house of Rothschild, and a preliminaiy contract had been signed, when, at the instance of the London firm, M. Wyshnigradski, the Finance Minister, was informed that unless the persecu- tions of the Jews were stopped the great banking-house would be compelled to withdraw from the operation. Deeply mortified by this attempt to deal with him de puissance d, puissance, the tsar peremptorily broke off the negotiations, and ordered that overtures should be made to a non-Jewish French syndicate. In this way anti-Semitism, which had already so profoundly influenced the domestic politics of Europe, set its mark on the inter- national relations of the Powers, for it was the urgent need of the Russian Treasury quite as much as the termi- nation of Prince Bismarck's secret treaty of mutual neu- trality which brought about the Franco-Russian alliance (Daudet, Hist. Dipl. de I' Alliance Franco-Busse, pp. 259 et seqq.).

For nearly three years more the persecutions continued. Elated by the success of his crusade against the Jews, M. Pobyedonostzeff extended his persecuting policy to other non-Orthodox denominations. The legislation against the Protestant Stundists became almost as unbearable as that imposed on the Jews. In the report of the Holy Synod, presented to the

tsar towards the end of 1893, the pro- curator called for repressive measures against Roman

Catholics, Moslems, and Buddhists, and denounced the rationalist tendency of the whole system of secular educar tion in the empire {Neue Freie Presse, 31st January 1894). A year later, however, the tsar died, and his successor, without repealing any of the persecuting laws, let it gradually be understood that their rigorous application might be mitigated. The country was tired and ex- hausted by the persecution, and the tolerant hints which came from high quarters were acted upon with significant alacrity. This tolerant tendency has since been strength- ened by a new political movement, inaugurated by Prince Oukhtomsky, the apostle of Eussian Asiatic Imperialism. The Prince dreams of a future when the tsar will rule over the whole of Asia, but he realizes that this mission must be based on the most generous principles of religious toleration (Leger, Riisses et Slaves 3"' Sivie, pp. 79-81). As a personal friend of the new tsar his teachings in this sense have produced considerable effect throughout Eus- sian society, and have helped to mitigate the terrible lot of the Jews.

The only other country in Europe in which a legalized anti-Seifiitism exists is Eumania. The conditions are very similar to those which obtain in Eussia, with the important difference that Eumania is a constitutional country, and that the Jewish persecutions are the work of the elected deputies of the nation. Like the Bourgeois Gentilhomme^ who wrote prose all his life without know- ing it, the Eumanians practised the nationalist doctrines of the Hegelian anti-Semites unconsciously long before they were formulated in Germany. In the old days of Turkish domination the lot of the Eumanian Jews was not conspicuously unhappy. It was only when the nation began to be emancipated, and the struggle in the East assumed the form of a crusade against Islam that the Jews were persecuted. Eumanian politicians preached a nationalism limited exclusively to indigenous Christians, and they were strongly supported by sdl who felt the commercial competition of the Jews.

amana. rpj^^g^ although the Jews had been settled in the land for many centuries they were by, law declared aliens. This was done in defiance of the Treaty of Paris of 1856 and the Convention of 1858 which declared all Eumans to be equal before the law. Under the influence of this distinction the Jews became persecuted, and san- guinary riots were of frequent occurrence. The realiza- tion of a Jewish question led to legislation imposing disabilities on the Jews. In 1878 the Berlin Congress agreed to recognize the independence of Eumania on condition that all religious disabilities were removed. Eumania agi'eed to this condition, but ultimately per- suaded the Powers to allow her to carry out the emanci- pation of the Jews gradually. During the years which have elapsed since then, the condition of the Jews has been in no way improved. Their emancipation is as far off as ever, and their disabilities are heavier than those of their brethren in Eussia. For this state of things the example of the anti-Semites in Germany, Eussia, Austria, and France is largely to blame, since it has justified the intolerance of the Eumans. Owing, also, to the fact that of late years Eumania has become a sort of annexe of the Triple Alliance, it has been found im- possible to induce the signatories of the Berlin Treaty to take action to compel the state to fulfil its obligations under that treaty.

In AustriarHungary the anti-Semitic impulses came almost simultaneously from the North and East. Already in the 'seventies the doctrinaire anti-Semitism of Berlin had found an echo in Budapest. Two members of the Diet, Victor Istoczy and Geza Onody, together with a publicist named Georg Marczianyi, busied themselves in making known the doctrine of Marr in Hungary.

Marczianyi, who translated the German Judeophobe pam- phlets into Magyar, and the Magyar works of Onody into German, was the chief medium between the northern and southern schools. In 1880 Istoczy ^^a«^«y. tried to establish a "Nichtjuden Bund" in Hungary, with statutes literally translated from those of the German anti-Semitic league. The movement, how- ever, made no progress, owing to the stalwart Liberalism of the predominant political parties, and of the national principles inherited from the Eevolixtion. The large part played by the Jews in the struggle of 1848, and the fruitful patriotism with which they

had worked for the political and economic progress of the country, had created, too, a strong claim on the gratitude of the best elements in the nation. Nevertheless, among the Ultra- montane clergy, the higher aristocracy, the ill-paid minor officials, and the ignorant peasantry, the seeds of a tacit anti-Semitism were latent. It was probably the aversion of the nobility from anything in the nature of a demar gogic agitation which for a time prevented these seeds from germinating. The news of the uprising in Eussia and the appearance of Jewish refugees on the frontier, had the effect of giving a certain prominence to the agitation of Istoczy and Onody and of exciting the rural communities, but it did not succeed in impressing the public with the pseudo-scientific doctrines of the new anti-Semitism. It was not until the agitators resorted to the Blood Accusation — that never-failing decoy of ob- scurantism and superstition — that Hungary took a defi- nite place in the anti-Semitic movement. The outbreak was short and fortunately bloodless, but while it lasted its scandals shocked the whole of Europe.

Dr August Eohling, Professor of Hebrew at the Univer- sity of Prague, a Eoman Catholic theologian of high position but dubious learning, had for some years assisted the Hungarian anti-Semites with richav.ff6s of Eisen- menger's Entdecktes Judenthum (Frankfurt a/M 1700). In 1881 he made a solemn deposition before the Supreme Court accusing the Jews of being bound by their law to work the moral and physical ruin of non-Jews. He followed this up with an offer to depose on oa,th that the murder of Christians for ritual purposes was a doctrine secretly taught among Jews. Professor Delitzsch and other eminent Hebraists, both Christian and Jewish, exposed and denounced the ignorance and malevolence of Eohling, but were unable to stem the mischief he was causing. In April 1882 a Christian girl named Esther Sobymossi was missed from the Hungarian village of Tisza Eszlar, where a small community of Jews were settled. The rumour got abroad that she had been kid- napped and murdered by the Jews, but it remained the burden of idle gossip, and gave rise to neither judicial complaint nor public disorders. At this moment the ques- tion of the Bosnian Pacification credits was before the Diet. The unpopularity of the task assumed by Austria- Hungary, under the Treaty of Berlin, which was calculated to strengthen the disaffected Croat element in the empire, had reduced the Government majority to very small

pro- portions, and all the reactionary factions in the countiy were accordingly in arms. The Government was violently and unscrupulously attacked on all sides. On the 23rd May there was a debate in the Diet when M. Onody, in an incendiary harangue, told the story of the missing girl at Tisza Eszlar, and accused ministers of criminal indul- gence to races alien to the national spirit. In the then excited state of the public mind on the Croat question, the manoeuvre was adroitly conceived. The Government fell into the trap, and treated the story with lofty disdain. Thereupon the anti-Semites set to work on the case, and M. Joseph Bary, the magistrate at Nyiregyhasa, and a noted anti-Semite, was induced to go to Tisza Eszlar and

institute an inquiry. All the anti-Liberal elements in the country now became banded together in this effort to discredit the Liberal Government, and for the first time the Hunga'rian anti-Semites found themselves at the head of a powerful party. Fifteen Jews were arrested and thrown into prison. No pains were spared in prepar- ing the case for trial. Perjury and even forgery Vera freely resorted to. The son of one of the accused, a boy of fourteen, was taken into custody by the police, and by threats and cajoleries prevailed upon to give evidence for the prosecution. He was elaborately coached for the terrible rdle he was to play. The trial opened at Nyire- gyhasa on the 19th June, and lasted till the 3rd August. It was one of the most dramatic causes ciUbres of the century. Under the brilliant cross-examination of the advocates for the defence the whole of the shocking conspiracy was gradually exposed. The public prose- cutor thereupon withdrew from the case, and the four judges — ^the chief of whom held strong anti-Semitic views — ^unanimously acquitted all the prisoners. The case proved the death-blow of Hungarian anti-Semitism. Although another phase of the Jewish question, which will be referred to presently, had still to occupy the public mind, the shame brought on the nation by the Tisza Eszlar conspiracy effectually prevented the anti-Semites from raising their voices with any effect again. Meanwhile a more formidable and complicated out- burst was preparing in Austria

itself. Here the lines of the German agitation were closely followed, but with far more dramatic results. It was exclusively political — ^that is to say, it appealed to anti- Jewish prejudices for party purposes while it sought to rehabilitate them on a pseudo-scientific, racial, and economic basis. At first it was confined to sporstdic pamphleteers. By their side there gradually grew up a school of Christian Social- ists, recruited from the ultra-clericals, for the study and application of the doctrines preached at Mayence by Archbishop Ketteler. This constituted a complete Aus- trian analogue to the Evangelical-Socialist movement started in Germany by Herr Stoecker. For some years the two movements remained distinct, but signs of ap- proximation were early visible. Thus one of the first complaints ,of the anti-Semites was that the Jews were becoming masters of the soil. This found an echo in the agrarian principles of the Christian Socialists, as expounded by Rudolph Meyer, in which individualism in landed property was admitted on the condition that the land-owners were " the families of the nation " and not " cosmopolitan financiers." A further indication of anti-Semitism is found in a speech delivered in 1878 by Prince Alois von Liechtenstein (b. 1846), the most pro- minent disciple of Rudolph Meyer, who denounced the national debt as a tribute paid by the state to cosmopoli- tan rentiers (Nitti, Catholic Socialism, pp. 200, 201, 211, 216). The growing disorder in parliament, due to the bitter struggle between the German and Czech parties, served to bring anti-Semitism into the field of practical politics. Since 1867 the German Liberals had been in power. They had made enemies of the clericals by tam- pering with the concordat, and they had split up their own party by the federalist policy adopted by Count Taaffe. The Radical secessionists in their turn found it difficult tp agree, and an ultra-national German wing formed itself into a separate party under the leadership of Ritter von Schonerer (b. 1842), a Radical nationalist of the most violent type. In 1882 two anti-Semitic leagues had been founded in Vienna, and to these the Radical nationalists now appealed for support. The growing importance of the party led the premier, Count Taaffe, to angle for the support of the clericals by accept- ing a portion of the Christian Socialist programme. The

hostility this excited in the Liberal press, largely written by Jews, served to bring the feudal Christian Socialists and Radical anti-Semites together. In

1891 these strangely assorted factions became consolidated, and during the elections of that year Prince Liechtenstein came forward as an anti-Semitic candidate and the acknowledged leader of the party. The elections resulted in the return of fif- teen anti-Semites to the Reichsrath, chiefly from Vienna.

Although Prince Liechtenstein and the bulk of the Christian Socialists had' joined the anti-Semites with the support of the clerical organ, the Vaterland, the clerical party as a whole still held aloof from the Jew-baiters. The events of 1892-95 put an end to their hesitation. The Hungarian Government, in compliance with long-standing pledges to the Liberal party, introduced into the Diet a series of ecclesiastical reform Bills providing for civil marriage, freedom of worship, and the legal recognition of Judaism on an equality with other denominations. These proposals, which synchronized with Ahlwardt's turbulent agitation in Germany, gave a great impulse to anti- Semitism and served to drive into its ranks a large num- ber of clericals. The agitation was taken in hand by the Roman Catholic clergy, and the pulpits every Sunday re- sounded with denunciations of the Jews. One clergyman. Father Deckert, was prosecuted for preaching the Blood Accusation and convicted (1894^. Cardinal Schlauch, bishop of Grosswardein, declared m the Hungarian House of Magnates that the Liberals were in league with " cos-mopolitans" for the ruin of the country. In October 1894 the Magnates adopted two of the ecclesiastical Bills with amendments, but threw out the Jewish Bill by a majority of six. The crown sided with the Magnates, and the ministry resigned, although it had a majority in the Lower House. An effort was made to form a clerical cabinet, but it failed. Baron Banffy was then entrusted with the construction of a fresh Liberal ministry. The announcement that he would persist with the ecclesiasti- cal Bills, lashed the clericals and anti-Semites into a fury, and the agitation broke out afresh. The pope addressed a letter to Count Zichy encouraging the Magnates to re- sist, and once more two of the Bills were amended, and the ' third rejected. The papal nuncio, Mgr. Agliardi, now thought proper to pay a visit to Budapest, where he allowed himself to be interviewed on the crisis. This in- terference in the domestic concerns of Hungary was deeply resented by the Liberals, and Baron Banffy requested Count Kalhoky, the imperial minister of foreign affairs, to protest against it at

the Vatican. Count Kalnoky re- fused and tendered his resignation to the emperor. Cleri- cal sympathies were predominant in Vienna, and the emperor was induced for a moment to decline the count's resignation. It soon became clear, however, that the Hungarians were resolved to see the crisis out, and that in the end Vienna would be compelled to give way. The emperor accordingly retraced his steps. Count Kalnoky's resignation was accepted, the papal nuncio was recalled, a batch of new Magnates were created, and the Hungarian ecclesiastical Bills passed.

Simultaneously with. this crisis another startling phase of the anti-Semitic drama was being enacted in Vienna itself. Encouraged by the support of the clericals the anti- Semites resolved to make an effort to carry the Vienna municipal elections. So far the alliance of the cleri- cals with the anti-Semites had been unofficial, but on the eve of the elections (Jan. 1895) the pope, influenced partly by the Hungarian crisis and partly by an idea of Cardinal RampoUa that the best antidote to Democratic Socialism would be a clerically controlled fusion of the Christian Socialists and anti-Semites, sent his blessing to Prince Liechtenstein and his followers. This action alarmed the Government and a considerable body of the

higher episcopate, who felt assured that any permanent encouragement given to the anti-Semites would strengthen the parties of sedition and disorder in the end. Cardinal Schoenborn was despatched in haste to Eome to expostulate with the pontiff, and his representations were strongly supported by the French and Belgian bishops. The mischief was, however, done, and although the pope sent a verbal message to Prince Liechtenstein excluding the anti-Semites from his blessing, the elections resulted in a great triumph for the Jew-haters. The municipal council was immediately dissolved by the Government, and new elections were ordered, but these only strength- ened the position of the anti-Semites, who carried 92 seats out of a total of 138. A. cabinet crisis followed and the premiership was entrusted to the Statthalter of Galicia, Count Badeni, who assumed office with a pledge of war to the knife against anti-Semitism. In October the new municipal council elected as burgomaster

of Vienna Dr Karl Lueger (b. 1844), a vehement anti-Semite, who had displaced Prince Liechtenstein as leader of the party. The emperor declined to sanction the election, but the council repeated it in face of the imperial dis- pleasure. Once more a dissolution was ordered and for three months the city was governed by administrative commissioners. In February 1896 elections were again held and the anti-Semites were returned with an increased majority. The emperor then capitulated; and after a temporary arrangement, by which for one year Dr Lueger acted as vice-burgomaster and handed over the burgomastership to an inoffensive nominee, permitted the municipal council to have its way. The growing anarchy in parliament at this moment served still further to strengthen the anti-Semites, and their conquest of Vienna was speedily followed by a not less striking conquest of the landtag of Lower Austria (November 1896). The zenith of their power was reached in March 1897, when, at the general election for the Reichsrath, twenty-eight anti-Semites and forty-one German clericals were elected.

Since then a reaction of sanity has gradually but surely asserted itself. For five years the anti-Semites have (1901) governed Vienna, and, although they have accom- plished much mischief, the millennium of which they were supposed to be the heralds has not dawned. On the con- trary, the commercial interests of the city have suffered and the rates have been enormously increased {Neue Freie Presse, 29th March 1901), while the predatory hopes which secured them office have only been realized on a small and select scale. The spectacle of a clerico-anti-Semitic Tam- many in Vienna has strengthened the resistance of the better elements in the country. Time has also shown that Christian Socialism is only a disguise for high Toryism, and that the German radicals who were originally induced to join the anti-Semites have been victimized by the cleri- cals. The fruits of this disUlusion began to show them- selves in the general elections of 1900-01, when the anti- Semites lost six seats in the Reichsrath and the clericals four, while the national German Radicals, rallied again into an independent and anti-clerical party under Ritter von Schbnerer, gained thirteen seats. Three of the con- stituencies lost to the anti-Semites were in Vienna, and the total poll in their favour all over the city showed an enormous reduction. The elections were followed (26th January 1901) by a papal encyclical on Christian democ- racy, in which

Christian Socialism was declared to be a term unacceptable to the Church, and. the faithful were adjured to abstain from agitation of a demagogic and revo- lutionary character, and " to respect the rights of others."

The last country in Europe to make use of the teach- ings of German anti-Semitism in its party politics was France. The fact that the movement should have struck root in a republican country, where the ideals of demo-

cratic freedom have been so passionately cultivated, has been regarded as one of the paradoxes of our latter-day history. As a matter of fact, it is more surprising that it was not adopted earlier. AH the social and political conditions which 'produced anti-Semitism in Germany were present in France, but in an aggravated form due primarily to the very republican rigime which at first sight seemed to be a guarantee against it. In the monarchical states the dominance of the hour- France. geoisie was tempered in a measure by the power of the Crown and the political activity of the aristocracy, which carried with them a very real restraining influence in the matter of political honour and morality. In France these restraining influences were driven out of public life by the republic. The nobUity both of the ancien rigime and the empire stood aloof, and politics were abandoned for the most part to professional adventurers, while the bourgeoisie assumed the form of an omnipotent plutocracy. This naturally attracted to France all the financial adventurers in Europe, and in the train of the immigration came not a few German Jews, alienated from their own country by the agitation of Marr and Stoecker. Thus the bourgeoisie was not only more powerful in France than in other countries, but the obnoxiousness of its Jew- ish element w;as accentuated by a tinge of the' national enemy. The anti-clericalism of the bourgeois republic and its unexampled series of financial scandals, culmi- nating in the Panama Krach, thus sufficed to give anti- Semitism a strong hold on the public mind.*

Nevertheless, it was not until 1882 that the anti-Jewish movement was seriously heard of in France. M. Paul Bontoux (b. 1820), who had formerly been in the employ of the Rothschilds, but had been obliged to

leave the firm in consequence of his disastrous speculations, had joined the Legitimist party, and had started the Union Generale with funds obtained from his new allies. M. Bontoux promised to break up the alleged financial monopoly of the Jews and Protestants and to found anew plutocracy in its stead, which should be mainly Roman Catholic and aris- tocratic. The bait was eagerly swallowed. For five years the Union Generale, with the blessing of the pope, pur- sued an apparently prosperous career. Immense schemes were undertaken, and the 125 fr.-shares rose gradually to 3200 francs. The whole structure, however, rested on a basis of audacious speculation, and in January 1882 the Union Generale failed, with liabilities amounting to 212,000,000 francs. The cry was at once raised that the Erach was due to the manoeuvres of the Jews, and a strong anti-Semitic feeling manifested itself in clerical and aris- tocratic circles. In 1886 violent expression was given to this feeling in a book since become famous. La France Juive, by M. Edouard Drumont (b. 1844). The author illustrated the theories of German anti-Semitism with a chronique scandaleuse full of piquant personalities, in which the corruption of French national life under Jewish influences was painted in alarming colours. The book was read with avidity by the public, who welcomed its expla- nations of the obviously growing debauchery. The Wilson scandals and the suspension of the Panama Company in the following year, while not bearing out M. Drumont's anti-Semitism, fully justified his view of the prevailing corruption. Out of this condition of things rose the Boulangist movement, which rallied all the disaffected elements in the country, including M. Drumont's following of anti-Semites. It was not, however, until the'flight of General Boulanger and the ruin of his party that anti- Semitism came forward as a political movement.

The chief author of the rout of Boulangism was a Jewish politician and journalist, M. Joseph Reinach (b. 1866), formerly private secretary to M. Gambetta, and one of the ablest men in France. He was a Frenchman by birth and

education, but his father and uncles were Germans, who had founded an important banking establishment in Paris. Hence he was held to personify the alien Jewish dominar tion in France, and the ex-Boulangists turned against him and his co-religionists with fury. The Boulangist agita- tion had for a second time involved the Legitimists in heavy pecuniary losses, and under, the leadership of the marquis de Mores they now threw all their influence on the side of M. Drumont. An anti-Semitic league was estab- lished, and with Eoyalist assistance branches were organ- ized all over the country. The Franco-Russian alliance in 1891, when the persecutions of the Jews by M. Pobyedo- nostzefE were attractiag the attention of Europe, served to invest M.. Drumont's agitation with a fashionable and patriotic character. It was a sign of the spiritual ap- proximation of the two peoples. In 1892 M. Drumont founded a daily anti-Semitic newspaper, La Libre Parole. With the organization of this journal a regular campaign for the discovery of scandals was instituted. At the same time a body of aristocratic swashbucklers, with the mar- quis de Mor6s and the count de Lamase at their head, set themselves to terrorize the Jews and provoke them to duels. At a meeting held at Keuilly in 1891 M. Guerin, one of the marquis de Mor^s's lieutenants, had demanded rhetorically un cadavre de Juif. He had not long to wait. Anti-Semitism was most powerful in the army, which was the only branch of the public service in which the re- actionary classes were fully represented. The republican law compelling the seminarists to serve their term in the army had strengthened its clerical and Royalist elements, and the result was a movement against the Jewish offi- cers, of whom 500 held commissions. A series of articles in the Libre Parole attacking these officers led to a number of ferocious duels, and these culminated in 1892 in the death of an amiable and popular Jewish officer. Captain Armaud Mayer, of the Engineers, who fell, pierced through the lungs by the marquis de Morfes. This tragedy, rendered all the more painful by the discovery that Captain Mayer had chivalrously fought to shield a friend, aroused a great deal of popular indignation against the anti-Semites, and for a moment it was believed that the agitation had been killed with its victim.

Towards the end of 1892, the discovery of the wide- spread corruption practised by the Panama Company gave a fresh impulse to anti-Semitism.

The revelations were in a large measure due to the industry of the Libre Parole ; and they were all the more welcome to the read- ers of that journal since it was discovered that three Jews were implicated in the scandals, one of whom, baron de Reinaeh, was uncle and father-in-law to the hated destroyer of Boulangism. The escape of the other two, Dr Herz and M. Arton, and the difficulties experienced in obtainiiig their extradition, deepened the popular convic- tion that the authorities were implicated in the scandals, and kept the public eye for a long time absorbed by the otherwise restricted Jewish aspects of the scandals. In 1894 the military side of the agitation was revived by the arrest of a prominent Jewish staff officer. Captain Alfred Dreyfus, on a charge of treason. From the beginning the hand of the anti-Semite was flagrant in the new sen- sation. The first hint of the arrest appeared in the lAbre Parole ; and before the facts had been officially com- municated to the public that journal was busy with a campaign against the war minister, based on the appre- hension that, in conspiracy with the Juiverie and his republican colleagues, he might exert himself to shield the traitor. Anti-Semitic feeling was now thoroughly aroused. Panama had prepared the people to believe any- thing; and when it was announced that a court-martial, sitting in secret, had convicted Dreyfus, there was a howl o^ execration against the Jews from one end of

the country to the other, although the alleged crime of the convict and the evidence by which it was sup- ported were quite unknown. Dreyfus was degraded and transported for life amid unparalleled scenes of public excitement.

The Dreyfus Case registers the climax not only of French, but of European anti-Semitism. It was the most ambitious and most unscrupulous attempt yet made to prove the nationalist hypothesis of the anti-Semites, and in its failure it afforded the most striking illustration of the dangers of the whole movement by bringing France to the verge of revolution. For a few months after the Dreyfus court-martial there was a comparative lull ; but the highly-strung condition of popular passion was illus- trated by a violent debate on " The Jewish Peril " in the Chamber of Deputies (25th April 1895), and by two outrages with explosives at the Rothschild Bank in Paris. Meanwhile the family of Dreyfus, absolutely

con- vinced of his innocence, were casting about for the means of clearing his character and securing his liberation. They were wealthy, and their activity unsettled the public mind and aroused the apprehensions of the con- spirators. Had the latter known how to preserve silence, the mystery would perhaps have been yet unsolved ; but in their anxiety to allay all suspicions they made one false step, which proved the beginning of their ruin. Through their friends in the press they secured the pub- lication of a facsimile of a document known as the Bordereau— z, letter supposed to be in Dreyfus's hand- writing and addressed apparently to the military attache of a foreign power, which was alleged to constitute the chief evidence against the convict. It was hoped by this publication to put an end to the doubts of the so-called Dreyfusards. The result, however, was only to give them a clue on which they worked with remarkable ingenuity. To prove that the Bordereau was not in Dreyfus's hand- writing was not difficult. Indeed, its authorship was recog- nized almost on the day of publication ; but the Dreyfus- ards held their hands in order to make assurance doubly sure by further evidence. Meanwhile one of the officers of the general staff, Colonel Picquart, had convinced him- self by an examination of the dossier of the trial that a gross miscarriage of justic& had taken place. On men- tioning his doubts to his superiors, who were animated partly by anti-Semitic feeling and partly by reluctance to confess to a mistake, he was ordered to the Tunisian hinterland on a ~~dangerous expedition. Before leaving Paris, however, he took the precaution to confide his dis~~ covery to his legal adviser. Harassed by their anxieties, the conspirators made further communications to the newspapers; and the Government, questioned and badgered in parliament, added to the revelations. The new disclosures, so far from stopping the Dreyfusards, proved to them, among other things, that the conviction had been partially based on documents which had not been communicated to the counsel for the defence, and hence that the judges had been tampered with by the Ministry of War behind the prisoner's back. So far, too, as these documents related to correspondence with foreign military attaches, it was soon ascertained that they were forgeries. In this way a terrible indictment was gradually drawn up against the Ministry of War. The first step was taken towards the end of 1897 by a brother of Captain Dreyfus, who, in a letter to the minister of war, denounced Major Esterhazy as the real author of the Bordereau. The

authorities, supported by parliament, declined to re-open the Dreyfus Case, but they ordered a court-martial on Esterhazy, which was held with closed doors and resulted in his acquittal. It now became clear that nothing short of "an appeal to public opinion and a full exposure of all the iniquities that had been perpetrated would secure justice

at the hands of the military chiefs. On behalf of Dreyfus, M. Zola, the eminent novelist, formulated the case against the general staff of the army in an open letter to the president of the republic, which by its dramatic accusa- tions startled the whole world. The letter was denounced as wild and fantastic even by those who were in favour of revision. M. Zola was prosecuted for libel and convicted, and had to fly the country ; but the agitation he had started was taken in hand by others, notably M. Clemenceau, M. Eeinach, and M. Yves Guyot. In August 1898 their efforts found their first reward. A re-examination of the docu- ments in the case by M. Cavaignac, then minister of war, showed that one was undoubtedly forged. Colonel Henry, of the Intelligence Department of the War Of&ce, then confessed that he had fabricated the document, and, on being sent to Mont Valerien under arrest, cut his throat.

In spite of this damaging discovery the War Office still persisted in believing Dreyfus guilty, and opposed a fresh inquiry. It was supported by three successive ministers of war, and apparently an overwhelming body of public opinion. By this time the question of the guilt or inno- cence of Dreyfus had become an altogether subsidiary issue. As in Germany and Austria, the anti-Semitic crusade had passed into the hands of the political parties. On the ' one hand the Radicals and Socialists, recognizing the anti- republican aims of the agitators and alarmed by the clerical predominance in the army, had thrown in their lot with the Dreyfusards; on the other the reactionaries, anxious to secure the support of the army, took the oppo- site view, denounced their opponents as sans patrie, and declared that they were conspiring to weaken and degrade the army in the face of the national enemy. The contro- versy was, consequently, no longer for or against Dreyfusy but for or against the

army, and behind it was a life- or-death struggle between the republic and its enemies. The situation became alarming. Rumours of military plots filled the air. Powerful leagues for working up public feeling were formed and organized; attempts to discredit the republi^c and intimidate the Government were made. The president was insulted ; there were tumults in the streets, and an attempt was made by M. Deroulfede to induce the military to march on the Elysee and upset the republic. In this critical situation France, to her eternal honour, found men with sufficient courage to do the right. The Socialists, by rallying to the Radicals against the reactionaries, secured a majority for the defence of the republic in parliament. M. Brisson's Cabinet trans- mitted to the Court of Cassation an application for the revision of the case against Dreyfus ; and that tribunal, after an elaborate inquiry, which fully justified M. Zola's famous letter, quashed and annulled the proceedings of the court-martial, and remitted the accused to another court-martial, to be held at Rennes. Throughout these proceedings the military party fought tooth and nail to impede the course of justice; and although the innocence of Dreyfus had been completely established, it concentrated all its efforts to secure a fresh condemnation of the prisoner at Reimes. Popular passion was at fever heat, and it manifested itself in an attack on M. Labori, one of the counsel for the defence, who was shot and wounded on the eve of his cross-examination of the witnesses for the prose- cution. To the amazement and indignation of the whole world outside France, the Rennes court-martial again found the prisoner guilty ; but all reliance on the conscientious-ness of the verdict was removed by a rider, which found "extenuating circumstances," and by a reduction of the punishment; to ten years' imprisonment, to which was added a recommendation to mercy. The verdict was evi- dently an attempt at a compromise, and the Government resolved to advise the president of the republic to pardon

Dreyfus. This lame conclusion did not satisfy the accused ; but his innocence had been so clearly proved, and on poli- tical grounds there were such urgent reasons for desiring a termination of the affair, that it was accepted without pro- test by the majority of moderate men. The explanation of the whole case is that Esterhazy and Henry were the real culprits ; that they had made a trade of supplying the German Government with military documents ; and that, when the Bordereauyras

discovered, they availed themselves of the anti-Semitic agitation to throw suspicion on Dreyfus.

The rehabilitation of Dreyfus did not pass without another effort on the part of the reactionaries to turn the popular passions excited by the case to their own advan- tage. After the failure of M. Deroulfede's attempt to overturn the republic, the various Royalist and Boulangist leagues, with the assistance of the anti-Semites, organized another plot. This was discovered by the Government, and the leaders were arrested. M. Jules Guerin, secretary of the anti-Semitic league, shut himself up in the league offices in the Rue Chabrol, Paris, which had been fortified and garrisoned by a number of his friends, armed with rifles. For more than a month the anti-Semites held the authorities at bay, and some 6000 troops were employed in the siege. The conspirators were all tried by the Senate^ sitting as a high court, and M. Guerin was sentenced to ten years' imprisonment. The evidence showed that the anti-Semitic organization had taken an active part in the anti-republican plot (see the report of the Commission d'Instruction in the Petit Temps, 1st November 1899). This vigorous action of the Government, together with the moral effect of the Dreyfus Case, has seriously weakened the anti-Semitic movement in France, and it has now completely lost its hold on the public outside Paris.

In sympathy with the agitation in France there has been a similar movement in Algeria, where the European population have long resented the admission of the native Jews to the rights of French citizenship. The agitation has been marked by much violence, and most of the anti-Semitic deputies in the French parliament, including M. Drumoiit, have found constituencies in Algeria. As the local anti-Semites are largely Spaniards and Levantine riff-raff, the agitation has not 'the peculiar nationalist bias which characterizes Continental anti-Semitism. Before the energy of the authorities it has lately shown signs of subsiding.

While the main activity of anti-Semitism has manifested itself in Germany, Russia, Rumania, Austria-Hungary, and France, its vibratory influences hav^ been felt in other countries when conditions favourable to its extension have presented themselves. In England more than one

attempt to acclimatize the doctrines of Marr andTreitschke has been made. The circumstance that at the time of the rise of German anti-Semitism a premier of Hebrew race, Lord Beaconsfield, was in power ^^* first suggested the Jewish bogey to English eu^’”’ political extremists. The Eastern Crisis of 1876-78, which was regarded by the Liberal party as primarily a struggle between Christianity, as represented by Russia, and a degrading Semitism, as represented by Turkey, accentuated the anti- Jewish feeling, owing to the anti-Russian attitude adopted by the Government. Violent expression to the ancient prejudices against the Jews was given by Sir J. G. Tollemache Sinclair {A Defence of Russia, 1877). Mr T. P. O’Connor, in a life of Lord Beaconsfield (1878), pictured him as the instrument of the Jewish people, “moulding the whole policy of Christendom to Jewish aims.” Professor Goldwin Smith, in several articles in the Nineteenth Century (1878, 1881, and 1882), sought to synthetize the growing anti-Jewish feeling by adopting the nationalist theories of the German anti-Semites. This movement did not fail to find an

equivocal response in the speeches of some of the leading Liberal statesmen ; but on the country generally it pro- duced no effect. It was revived when the persecutions in Russia threatened England with a great influx of Polish Jews, whose mode of life was calculated to lower the standard of living in the industries in which they were employed. All danger was, however, averted by the Jewish communal authorities, who, by dint of great pecuniary sacrifices and an excellent international organiza- tion, managed to control the immigration. In 1883 Herr Stoecker visited London, but received a very unflattering reception. Equally abortive attempts to acclimatize anti- Semitipm have been made in Switzerland, Belgium, Greece, and the United States.

Anti-Semitism has made a great deal of history during the last thirty years, but it has left no permanent mark on the social and political

evolution of Europe. ‘ It is the fruit of a great etlmographic and political error, and it has spent itself in political intrigues of transparent dishonesty. Its racial doctrine is at best a crude hypothesis ; its nationalist theory has only served to throw into striking relief the essentially economic bases of modem society, while its political activity has revealed the vulgarity and ignor- ance which constitute its main sources of strength. So far from injuring the Jews, it has really given Jewish racial separatism a new lease of life. Its extravagant accusations, as in the Tisza Eszlar and Dreyfus cases, have resulted in the vindication of the Jewish character. Its agitation gener- ally, coinciding with the revival of interest in Jewish history, has helped to transfer Jewish solidarity from a religious to a racial basis. The bond of a common race, vitalized by a new pride in Hebrew history and spurred on to resistance by the insults of the anti-Semites, has given a new spirit and a new source of strength to Judaism at a moment when the approximation of ethical systems and the revolt against dogma were sapping its essentially religious foundations. In the whole history of Judaism, perhaps, there have been no more numerous or remarkable instances of reversions to the faith than during the last thirty years. The reply of the Jews to anti-Semitism has taken two interesting practical forms. In the first place there is the so-called Zionist movement, which is a kind of Jewish nationalism and is vitiated by the same errors that distinguish its anti-Semitic analogue. It aims at the re-establishment of the Jewish state; and, under the leader- ship of Dr Theodor Herzl (b. I860) and Dr Max Nordau (b. 1849) it has found no fewer than a quarter of a million supporters, who are now definitely organized. In the second place, there is a movement represented by the Maccabseans’ Society in London, which seeks to unite the Jewish people in an effort to raise the Jewish character and to promote a higher consciousness of the dignity of the race. It lays no stress on orthodoxy, but welcomes all who strive to render Jewish conduct an adequate reply to the theories of the anti-Semites. Both these movements are elements of fresh vitality to Judaism, and they are probably destined to produce important fruit in the near future. A splendid spirit of generosity has also been displayed by the Jewish community in assisting and relieving the victims of the Jew-haters. Besides countless funds raised by public subscription. Baron de Hirsch founded a colossal scheme for transplanting persecuted Jews to new

countries under new conditions of life, and endowed it with no less a sum than £9,000,000 (see Hiksch, Mobitz de).

Though anti-Semitism has been unmasked and dis- credited, it is to be feared that its history is not yet at an end. While there are in Eussia and Rumania six millions of Jews who are being systematically degraded, and who periodically overflow the western frontier, there will con- tinue to be a Jewish question in Europe ; and while there are weak Governments, as in Austria and France, and

ignorant and superstitious elements in the enfranchised classes of those countries, that question wiU seek to play a part in politics.

Literature. — TSo impartial history of modem anti-Semitism has yet been written. The most comprehensive works on the sub- ject, Israel among the Nations, by A. Lbrot-Beaulibu (1895), and L'Antisimitisme, son Histoire et ses causes, by Bernard Lazare (1894) , are collections of studies rather than histories. M. Lazare's work will be found most useful by the student on account of its detached standpoint and its valuable bibliographical notes. A good list of works relating to Jewish ethnography will be found at the end of M. Isidore Loeb's valuable article, " Juifs," in the Diction- naire Universel de Giograpkie (1884). To these should be added Jellinbk, DerJudische Stamm (1869); CHwoLSON,2)ie Semitischen Volker (1872); Nossig, Materialien sur Statistik (1887); Jacobs, Jewish Statistics (1891); and Andbeb, Zur Volkskunde der Juden (1881). A bibliography of the Jewish question from 1875 to 1884 has been published by Mr Joseph Jacobs (1885). Useful additions and rectifications will be found in the Jewish World, 11th Sep- tember 1885. During the last fifteen years the anti-Semitic move- ment has produced an immense pamphlet literature. Some of these productions have already been referred to ; others will be found in current bibliographies under the names of the personages mentioned, such as Stoecker, Ahlwardt, &c. On the Russian per- secutions, besides the works quoted by Jacobs, see thft pamphlet issued by the Busso-Jewish c3ommittee in 1890, and the annual reports of the Russo-Jewish Mansion House Fund; Les Juifs de Biissie (Paris, 1891); Beport of the Commissioners of Immigration upon the Causes which incite Immigration to the United States (Washington, 1892); The New

Exodus, by Harold Frederic (1892); Les Juifs Susses, by Leo Erbbra (Brussels, 1893). The most valuable collection of facts relating to the persecutions of 1881-82 are to be found in the Feuilles Jaunes (52 nos.), compiled and circulated for the information of the European press by the Alliance Israelite of Paris. Complete collections are very scarce. On the Rumanian question, see BLtrKTScHLi, Boumania and the Legal Status of the Jews (London, 1879); Wir Juden (Zurich, 1883); ScHLOss, The Persecution of the Jews in Boumania (London, 1885); Scmi,oss, Notes of Information (1S8G); Sincerhs, Juifs en Boumanie (London, 1901); Plotkb, Die Bumdnischen Juden unter dem Fiirsten u. KSnig Karl (1901); Dehn, Diplo- matic u. Hochflnam m der Bumdnischen Judenfrage (1901); CoNTBEARE, Boumariia as a Persecuting Power {Nat. Bev. February 1901). On Hungary and the Tisza Eszlar Case, see, besides the references in Jacobs, Nathan, Der Frozess von Tisza Eszlar (Berlin, 1892). On this case and the Blood Accusation generally, see "Wright, "The Jews and the Mali- cious Charge of Human Sacrifice " (Nineteenth Century, 1883). The origiris of the Austrian agitation are dealt with by Nitti, Catholic Socialism (1895). This work, though inclining to anti-Semitism, should be consulted for the Christian Socialist elements in the whole Continental agitation. The most valuable source of informa- tion on the Austrian movement is the Oesterreichische Wochen- schrift, edited by Dr Bloch. See also pamphlets and speeches by the anti-Semitic leaders, Liechtenstein, Luecer, Schoenebeb, &c. The case of the French anti-Semites is stated by E. Dbumont in his France Juive, and other works ; the other side by Isidor Loeb, Bernard Lazare, Leonce Reynaud, &c. Of the Dreyfus Case there is an enormous literature ; see especially the reports of the Zola and Picquart trials, the revision case before the Court of Cassation, and the proceedings of the Rennes court-martial; also the valuable series of volumes by Captain Paul Marin, MM. Clemenceau, Reinach, Lazare, Yves Guyot, Paschal Grousset, Urbain Gohier, De Haime, De Pressens6, and the remarkable letters of Deetpus {Lettres d'un innocent). An English history of the case has been published by Mr Conybeare, whose articles and those of Sir Godfrey Lushington and Mr Maxse in the National Beview, 1897-1900, will be found invaluable by the student. On the Algerian question, see M. Wahl m the Revue des JStvdes Juives; L. Forest, Naturalisation des Israelites Alg&riens ; and E. Audinet in the Bevue Oenerale de Droit International Publique, 1897, No.

4. A good summary of the aims and literature of Zionisn;i will be found in the Nineteenth Century, August 1897. On the history of the anti- Semitic movement generally, see the annual reports of the Alliance Israaite of Paris and the Anglo-Jewish Association of London, also the annual summaries published at the end of the Jewish year by the Jewish Chronicle of London. The connexion of the movement with general party politics must be followed in the newspapers. The present writer has worked with a collection of newspaper cuttings numbering several thousands and ranging over twenty years. A skeleton guide may be obtained by a careful ^tudy of Seignobos, Histoire Politique de VEurope Contemporaine (1897), s.ided'by Hazell's Annual, and Schdlthess, Europdischer Geschichtskalender. (l w)

A N T I T 0 X I N — A N T E I M

Antitoxin. See Bacteeiologt, II.

Antiyari, or Bar, so called from its position oppo- site Bari in Italy, once a town of Turkish Albania, now Montenegrin, situated near the Adriatic Sea, 18 miles N.W. of Scutari, and surrounded by a dense forest of oliye trees. Its old Venetian castle suffered gi-eatly from the siege by the Montenegrins in 1878, and is now in ruins. There is a good harbour (Pristan) for vessels of light draught, and a beautiful residence for the prince one hour distant from the town, which had at one time a con- siderable trade in the products of Albania, but is now of little importance. It is the seat of a Eoman Catholic archbishop. Population, about 1500, mostly Albanians^

Antofagasta, a town and port on the Pacific and the capital of the Chilian province and department of the same name, situated in 23*^38′ 39″ S. lat. and 70° 24′ 39″ W. long., about 768 miles N. of Valparaiso. It belonged to Bolivia until occupied ih 1879 by Chile, then at war with the former country; its occupation was agreed to by Peru in 1884, and it was definitely ceded to Chile by the treaty of 1885. The population in 1895 was 13,530; in 1898 it was estimated at 16,795. It is the head of the railway to Oruro in Bolivia, and most of the Bolivian export trade passes throjagh it. The total value of the exports in 1897 was (Chilian currency) $4,237,841; of the imports, $2,187,171. In the same year the shipping which entered had a tonnage of 75,224 tons. The value of the Bolivian mineral products ex- ported through it in 1898 was $29,994,914 (Chilian currency). The province of Antofagasta has an area of 47,918 square miles, and had in 1895 a population of 44,085. It is divided into three departments. In 1898 the marriages numbered 253, the births 1561, and the deaths 1093.

Antoneili, Clacomo (1806-1876), Italian Cardinal, was born at Sonnino, 2nd April 1806. He was educated for/ the priesthood, but, after taking orders, preferred an administrative career. Created secular prelate, he was sent as apostolic delegate to Viterbo, where he early manifested his reactionary tendencies in an attempt to stamp out Liberalism. Recalled to Home in 1841, he entered the office of the papal secretary of state, but

four years later was appointed pontifical treasurer-general. Created car- dinal (11th June 1847), he was chosen by Pius IX. to preside over the council of state entrusted with the draft- ing of the constitution. On 10th March 1848 Antoneili became premier of the first constitutional ministry of Pius IX., a capacity in which he displayed unscrupulous du- plicity. Upon the fall of his cabinet Antoneili created for himself the governorship of the sacred palaces in order to retain constant access to and influence over the Pope. After the assassination of Pellegrino Eossi (15th Novem- ber 1848) he arranged the flight of Pius IX. to Gaeta, where he was appointed secretary of state. Kotwithstanding promises to the Powers, he restored absolute government upon returning to Eome (12th April 1860) and violated the conditions of the surrender by wholesale imprisonment of Liberals. In 1855 he narrowly escaped assassination. As ally of the Bourbons of Naples, from whom he had received an annual subsidy, he attempted, after 1860, to facilitate their restoration by fomenting brigandage on the Neapolitan frontier. To the overtures of Eieasoli in 1861, Pius IX., at Antonelli's suggestion, replied with the famous "Nonpossumus," but subsequently (1867) accepted, too late, Eicasoli's proposal concerning ecclesiastical property. After the September Convention (1864) Anto- neili organized the Legion of Antibes to replace French troops in Eome, and in 1867 secured French aid against Garibaldi's invasion of papal territory. Upon the reoccu- pation of Eome by the French after Mentana, Antoneili

again ruled supreme, but upon the entry of the Italians in 1870 was obliged to restrict his activity to the manage- ment of foreign relations. He wrote, with papal approval, the letter requesting the Italians to occupy the Leonine city, and obtained from the Italians payment of the Peter's pence (5,000,000 lire) remaining in the papal exchequer, as well as 50,000 scudi — the first and only instalment of the Italian allowance ever accepted by the Holy See. At Antonelli's death in 1876 the Vatican finances were found to be in disorder, with a deficit of 45,000,000 lire. His personal fortune, accumulated during office, was consider- able, and was bequeathed entirely to members of his family. From 1850 until his death he interfered little in affairs of dogma and church discipline, although he addressed to the Powers circulars enclosing the Syllabus (1864) and the acts of the Vatican Council (1870). His activity was devoted almost

exclusively to the political aspects of the struggle between the papacy and the Ital- ian Eisorgimento. (h. w. s.)

Antrim, a maritime county of Ireland, province of Ulster, bounded on the N. and N.E. and E. by the North Channel, on the S. by Co. Down, on the S.W. by Lough Neagh, and on the W. by Co. Londonderry.

Population. — The area of the administrative county in 1899 was 711,487 acres, of which 225,926 were tillage, 358,080 pasture, 747 fallow, 6140 plantation, 24,170 turf bog, 6538 marsh, 51,896 barren mountain, and 37,990 water, roads, fences, &c. The new admin- istrative county under the Local Government (Ireland) Act, 1898, includes the portion of the town of Lisbum formerly situated in Down, and the town of Carrickfergus, formerly a separate county, but does not include the portion of the city of Belfast formerly situated in Antrim. The population in 1881 was 421,943, and in 1891, 428,128, of whom 200,514 were males and 227,614 females,^ divided as follows among the different religions : Presbyterians, 180,375 ; Roman Catholics, 106,390 ; Protestant Episcopalians, 106,244 ; Methodists, 14,745 ; other denominations, 20,162. The increase of population between 1881 and 1891 was 1-47 per cent., the largest percentage of increase in Ireland. The average number of persons to an acre was ~~56. Of the total population 176,923 in~~ habited the rural districts, being an average of 205 persons to each square mile under crops and pasture. In 1901 the population was 461,240, showing an increase of 7 per cent.

Education. — The following table gives the degree of education in 1891 (excluding Belfast and Carrickfergus) : —

Males.

remales.

Total.

Percentage.

E.G.

Pr. Epis.

Presb.

Bead and write . Eead only . imterate .

68.487

10;786

8,202

70,920 16,806 9,322

1B9,S57

27,542 17,524

64-6 17-3

18-1

71-8 16-8 11-4

80\5 lS-8

5-7

In 1881 the percentage of illiterates among Boman Catholics was 24-0. In 1891 in the whole county there were 53 superior schools with 3470 pupils (613 Eoman Catholics and .2857 Protestants), and 735 primary schools with 67,446 pugils (15,419 Roman Catholics and 52,027 Protestants). The number of pupils on the rolls of the national schools on 30th September 1899 was 8p,943, of whom. 18,200 were Roman Catholics and 62,743 Protestants.

The following table gives the number of births, deaths, and marriages in various years : —

Tear.

Births.

Deaths.

Marriages.

1881 1891 1899

12,869 12,459 < 13,374

8484 9586 9982

2631 3255 3582

In 1899 the birth-rate per 1000 was 31-0, and the death-rate 23-2 ; the rate of illegitimacy was 4-3 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1899 was 249,354, of whom 144,588 were males and 104,766 females. The chief towns in the county are Belfast, 348,965 ; Lisburn, 11,459 ; Carrickfergus, and Bally- mena.

Administration. — The county is divided into four parliamentary divisions — ^north, mid, east, and south ; the number of registered electors in 1900 being respectively 8600, 8219, 8886, and 10,381. The rateable valuation in 1900 was £693,685, the county borough

of Belfast being now rated separately. By the Local Government ([Ireland) Act, 1898, the fiscal and administrative duties of the grand jury (and to a less extent) of other bodies were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises six urban and eight rural sanitary districts. The same Act abolished the separate county of the town of Carrickfergus and constituted the city of Belfast a separate county.

Agriculture. — The following tables show the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1899. The figures for 1899 are for the new ad- ministrative county : —

Wheat.

Oats.

Barley,

Beans,

etc.

Potatoes.

Turnips.

Other green Crops.

Flax.

Meadow

and Clover.

Total.

1881 1891 1895 1899

4442

1967

741

1859

76,445 67,640 67,868 66,020

8892 2380 1599 1711

46,027 41,598 40,251 87,498

9,471 10,402 11,419 12,148

8044 1962 1518 2228

17,662

16,010

15,878

8,012

87,347 90,168 98,022 96,955

248,880 281,022 236,281 225,926

In 1899 the total value of the cereal and other crops was esti- mated by the Registrar-General at £1,768,536. The number of acres under pasture in 1881 was 340,120 ; in 1891, 345,554 : and in

1899, 358,080.

Horses and

Mules.

Asses.

Cattle.

Sheep.

Pigs.

Goats.

Poultry.

U881

1891 1895 1899

29,748 32,147 34,876 38,512

676

676

‘ 687

752

138.519

l.’)7,560

158,662

156,38^

56,849 122,428

98,226 100,346

46,821 65,885 61,205 60,860

6074 6359 5892 5825

460,180 678,384 600,865 714,596

The number of milch cows in 1891 was 64,365, and in 1899, ‘64,875. It is estimated that the total value of cattle, sheep, and pigs in 1899 was £2,305,016.

In 1899 the number of hbldings not exceeding 1 acre was 2678 ; Ijetween 1 and 5, 2000 ; between 5 and 15, 5346 ; between 15 and 30, 5992 ; between 30 and 50, 3646 ; between 50 and 100, 2374 ; between 100 and 200, 556 ; between 200 and 500, 155 ; and above 500, 46 — total, 22,793. The total number of loans issued (the number of tenants being the same as the number of loans) under the Land Purchase Acts, 1885, 1891, 1896, up to 31st March 1900, was -3521, amounting to £1,134,873. The number of loans sanctioned ior agricultural improvements under sect. 31 of the Land Act, 1881, between 1882 and 1900 was 132, and the amount issued was £11,416. The total amount issued for all classes of works under the Land Improvement Acts from the commencement of operations in 1847 to 31st March 1900 was £138,203.

Minerals. — The following were the outputs of the various mines in 1899, — coal, 6111 tons, iron ore, 102,262 tons, value £16,015 ; lock salt, 47,055 tons, value £13,319 ; and alum clay, 8099 tons, value £1871. The output of iron ore has been almost continually increasing, and the production of alumina from alum clay forms a new branch of industry. The alumina is prepared at works near Lame ; 1500 tons, value £28,000, having been extracted in 1899.

Fisheries. — In 1899, 231 vessels, employing 476 hands, were registered in the deep sea and coast fishing districts of Ballyoastle :and Capiokfergus. 212 persons were employed in the salmon fish- ing district of Ballyoastle in the same year.

Antrim, a town in the above county, on the Six-mile Water,. 13 miles N.W. of Belfast by rail, on the Great Northern railway. It is governed by town commission- •ers, but, under the Local Government (Ireland) Act, 1898, can apply to be constituted an urban sanitary district. Area, 198 acres. Population (1891), 1385 ; (1901), 1825.

Antwerp (French Anvers), a city, port, and strong- hold of Belgium, capital of the province of the same name, on the right bank of the Scheldt, about 60 miles from the sea and 26 N. of Brussels by rail. The wall which, since the old fortifications were demolished in 1860, has shut in the city wherever unprotected by the river, encloses the suburbs of Borgerhout and Berchem, and measures over 8^ miles ; seventeen gates give entrance

to the city, and twelve forts serve for the defence. The city has spread rapidly within recent years ; a new quarter has sprung up all along the line of the old fortifications, containing many handsome erections such as the new Art Gallery, the Law Oourts, the National Bank, the National Theatre, and the

Athenaeum. But it is the commercial importance of Ant- werp which above all else distinguishes the city. In this direction the dock accommodation is still insuf&cient for the vast and still growing trade, though considerable ex- tensions have been carried out, and the quays now stretch along the Scheldt for 2^ miles. These are backed by large warehouses, on the top of which a fine promenade has been constructed, and behind these again open out thirteen basins of various sizes. Sixty shipping lines have their headquarters at Antwerp, and in conjunction with numer- ous other lines whichmake it aportof call place the city in communication with every part of the world. In 1880, 4495 vessels (2292 Brit- ish) of 3,063,825 tons entered the port; in 1899, 6613 (3013 British) of 6,872,848 tons. Im- ports were valued at £49,700,000 in 1880, and £65,027,600 in 1899 ; exports at £16,533,000 in 1880, and £32,615,000 in 1899. The principal im- ports are now, in order of importance, grain of all kinds, raw textile materials (wool, cotton, flax, &c.), mineral ores and metals, provisions, rice, animal products, and guano; the principal exports are glass-ware, wrought metal, rail- way carriages, cement,- worsted and thread. Antwerp proper has nearly doubled its population within the last twenty-five years. In 1875 there were 148,800 inhabit- ants ; in 1880, 169,100 ; in 1890, 224,000 ; and in 1899, 282,000. Including the two suburbs of Borgerhout and Berchem, the total population in 1899 was 338,800.

The province of Antwerp (Ft. Anvers), Belgium, between the Netherlands on the N. and E., the province of Limbourg on the E., Brabant on the S., and East Flanders on the W.,' is formed of the ancient territories of the marquisate of Antwerp and the lordship of Malines and of a part of the ancient duchy of Brabant. The land spreads Out flat and low. In large part Antwerp belongs to the sandy region known as the Campine. A ■ canal from Antwerp to Maastricht joins the basin of the Scheldt to that of the Meuse. Besides its important com- mercial centre of Antwerp, the

province carries on the in- dustries of shipbuilding, paper-making, woollen textiles, and cement. It is divided into the three administra- tive arrondissements of Antwerp, Malines, and Turn- hout. The province covers 1093 square miles, with a population in 1899 of 826,000 (or 763-7 to a square mile) against 531,750 in 1875. The arrondissement of Antwerp had a population in 1899 of 613,500, or 1367-6 per square mile.

See Mertens et Tokfs. Geschiedenis van Antwerpen. — Euo. Gens. Histoire de la ville d" Anvers. — G^nabd. Anvers a, travers les &ges. — Bapportde la Chambre de Commerce d^ Anvers, 1898 ; and Annuaire statistique de la Belgique, 1899. (j. uu p.)

Anuradhapura, the chief town in the north- central province of Ceylon, and the ancient capital of the island for twelve centuries from 437 b.c. It is an extensive " buried city," now being gradually excavated under an archaeological survey by the government of Ceylon. Its dagabas and other Buddhist ruins excite much interest. It can be visited by rail and coach in two days from Colombo ; but the^ railway is about to be extended all the way. Population— town, 3000 ; province, 79,022.

Anzin, a town of France, department of Nord, in the arrondissement of Valenciennes, 1-^ miles N.W. of that town, of which it is a suburb, on the railway from Somain to Peruwelz. Its metallurgical industries are very exten- sive, and include several large establishments engaged in the manufacture of steam engines, machinery, chain-cables, and a great variety of heavy iron goods. The number of puddling furnaces in operation in Anzin and Denain in 1899 was 26. The output of coal in the same year

from the mines under the control of the Soci^te d'Anzin was 2,973,000 tons, and the number of persons employed •was 12,200. Population (1891), 11,394; (1896), 12,606 ; (comm.), 12,768.

Apamea, (1) a treasure-city, and stud-depot of the Seleucid kings in the valley of the Orontes. Destroyed by Chosroes in the 7th century a.d. ; partially rebuilt and known as Fdmia by the Arabs ; and overthrown by an earthquake in 1152. The acropolis hill is now occupied by the ruins of Kalat el-Mudik. (2) In Phrygia. Pounded by Antiochus Soter, near, but on lower ground than, Celsense. It was situated at the exit of the Marsyas from the hUls, and became a seat of Seleucid power, and a centre of Greco-Eoman civilization and commerce. Por a long period it was one of the greatest cities of Asia Minor, but when the trade routes were diverted to Con- stantinople it rapidly declined, and its ruin was completed by an earthquake. An early Christian tradition, possibly arising from a name, Cibotus (ark), which the town bore, identified the neighbouring mountain with Ararat. The site is now partly occupied by Dineir, which is connected with Smyrna by railway, and there are extensive remains. (3) On the left bank of the Euphrates, at the end of a bridge of boats {zeugma). The Til-Bar sip of the Assyrian inscriptions, now Birejik. (4) The earlier Myrlea of Bithynia, now Mudania, the port of Brusa.

HiRSCHFELD, " tlber Celainai-Apameia-Kibotos," in Transac- tions of Berlin Academy, 1876. — Hogabth, in Journal of Hellenic Studies, 1888. — ^Bamsat, Cities and Bishoprics of Phrygia, vol. ii. Oxford.

Apeldoorn, a flourishing village in the Netherlands, in the province of Gelderland, 17 mUes north of Arnhem. The Protestant church, burned down in 1890, has been restored, and an aqueduct built (1894) from the neigh- bouring hills. Population (1900), 25,761.

Apennines, the mountain backbone of Italy, some 800 miles long by 70 to 80 miles in maximum width. The central chain, or main axis, of the Apennines may perhaps be regarded as a flanking range of a primeval central mass now sunk beneath the Tyrrhenian Sea, and the Apuan Alps, a western outlier of the Northern Apen- nines, and the mountains of Calabria, which are the oldest parts oL the system, being composed almost entirely of crystalhne rocks, as surviving fragments of the same primeval Tyrrhenian mainland. Apart from the Apuan Alps, the Northern Apennines consist principally of older Tertiary formations and younger members of the Cretaceous epoch, chiefly sandstones and marly slates,

broken through in many places by rounded protrusions of gabbro and serpentine. These serpentine outflows occur again in the " compartment " of Potenza (province, Basili- cata) in the south, but do not appear in the Central Apennines. The Central Apennines may be briefly described as consisting of a series of vast ellipsoidal out- crops of the limestone core (Cretaceous to Triassic) of the system, thrust up above the broad base of younger for- mations, which flank it on east and west. South of the Esino valley and the AnconarSpoleto railway there are two clearly marked continuing ranges, with parallel strikes, the western prolonging the Catria chain and the eastern culminating in Monte San Vieino. On the whole of the east side of the Sibilline Mountains, one of the principal constituents of the Central Apennines, there has been a gigantic subsidence, the face of the rupture showing a sheer vertical altitude of some 6500 ft. The culminating peaks of this constituent range reach an altitude of 8125 ft. in Monte de Pretara and 8010 ft. in Monte Vettore. There are snow-fields on various peaks of the Gran Sasso d'ltalia, the next (going south) con- stituent chain of the Central Apennines, as on Monte Corno (above 8530 feet), on Pizzo Intermesole (above

8585 ft.), and on Monte Corvo (above 8550 ft.) ; and it is on the same chain, or rather mountain-knot, that the only glaciers, though in a rudimentary form, occur in the Apennines. They lie in the high valleys above the sources of the Arno, at altitudes of 5400 ft. and upwjcrds, and in the valleys which feed the Venaquaro (i.e., the Vomano), at altitudes of 6400 ft. and above. It may be mentioned that the last surviving chamois on the Gran Sasso is believed to have been shot in 1880. Monte Amaro, the culminating peak of the Majella Mountains, the next constituent chain, reaches an altitude of 9170 ft. Except for small quantities of anthracite and sulphur, the Apen- nines contain no minerals, but possess several mineral springs, of which the best known are those at Lucca, Montecatini, San Casciano, Porretta, and Telese. In very many cases the valleys on the east of the Apennines differ from those on the west, in that they are not only shorter, but run transversely to the main axis of the system ; whereas, on the west or Mediterranean side, they frequently lie parallel to the axis. The most notable examples of the latter are the upper valleys of the Arno and the Tiber. Above 3000 ft. the Apennines are in general bare and barren of vegetation, except for a little scrub and some

scanty pasture in summer ; but below that limit their slopes are as a rule the reverse, being well planted with vines, olives, chestnuts, orange, citron, and other fruit trees, besides yielding the usual crops. Of the Apennine lakes. Lake Pucino was drained and. made amenable to cultivation in 1876, after more than twenty years' labour, and Lake Trasimeno was prdvided with a second outlet in 1896-98. The project of draining the latter, originally suggested by Napoleon I., has been repeatedly under consideration, but as yet has come to nothing. The lakes of Bolsena, Vico, Bracciano, and Albano lie west of the main chain, and are volcanic-crater lakes. The central ranges of the Apennines exercise, as might be expected, an important influence upon the local climatic conditions on both the Adriatic and Atlan- tic versants. One consequence of their position is that the extremes of temperature diminish as one descends towards the coast, as well as proceeds towards the south. On the Adriatic side, that is, in the provinces of Emilia (part), Umbria, the Marches, and the Abruzzi, the annual mean does not exceed 57° P., the January mean 384°, or the July mean 75-2°. The difference between the absolute maximum of 100-4° (at Porli) and the absolute fiiininmm of 5° (at Camerino) amounts to 95-4°. The higher parts, as represented by Urbino (1481 ft. above sea-level) and Camerino (2177 ft.), have naturally a lower annual mean (53°) than places near the coast, such as Porli (163 ft.), Jesi (332 ft.), and Ancona (52 ft.), who^e annual mean is 59'6°. On the Mediterranean! side the annual mean is somewhat higher than the general mean of the Adriatic side, namely, 57-7° (Perugia, at 1706 ft., having a mean of 55-2°, and Leghorn, at 78 ft., 69-7°) ; but the January mean is appreciably higher, namely, 41-5°, though the July mean is practically the same, 75-4°. The range between the extremes — 1054° at Plorence and 12-2° also at Plorence — is also less, namely, 92-9°. Farther south, in Apulia, Basilicata, and Calabria, the annual mean is 584° (Potenza, 2711 ft., 50-2° ; Lecce, 236 ft., 61-9°) ; the January mean, 42-9°; and the July mean, 754°. The extremes lie at 93-9° (Lecce), and 13-6° (Potenza). The heaviest rainfall occurs as a rule in the higher mountain- ous parts; for instance, at Urbino, an average of 39-^ inches falls annually (period of observations, 43 years) ; at Camerino, 38|- in. (47 years); at Siena, 30^ in. (55 years) ; at Plorence, 34^ in. (65 years) ; and at Cosenza, 42 in. (19 years). But to this there are some exceptions ;

for instance, at Aquila, under the shelter of the Gran Sasso, the annual average is only 25^ in. (20 years) ; and

at Potenza, in the valley of the Basento, it is 24 in. (15 years). On the west side of the peninsula the rainfall is relatively heavier than on the east : at Rome, 30^ in. (69 years) ; and Naples, 32 in. (73 years) ; as compared with 26^ in. at Ancona (30 years), and 23 in. at Lecce (19 years). The main chain of the Apennines is now crossed or pierced by a dozeD railway lines, e.g., by the line from Genoa to Alessandria, Savoua to Turin, Spezia to Parma, Pistoja to Bologna, Ancona to Rome, the SulmonarPescara line, Naples to Foggia, Salerno to Tarento, and others. The inhabitants of the once inaccessible Abruzzis have

now almost entirely abandoned their brigand habits, and are taking to the breeding of silkworms and the spinning of silk. Many of them, being still desperately poor, emigrate every summer as labourers to the big estates of the Agro Romano, between the Tiber and Civitavecchia.

See Pabtsch, in Verhandlungen d. Ges. f. Erdkunde zu Berlin, vol. i. (1889). — Maeinelli, in Atti of the first Italian Geog. Con- gress, vol. ii. 2, pp. 637 et seq. ; Globds, vol. Ixxvi. (1899) ; and for the meteorology, Annuario Statistico Italiano, 1895 (Rome,

(j. T. BE.)

APOCALYPTIC AND APOCRYPHAL LITERATURE.

THE apocalyptic and apocryphal books of Scripture have been generally treated under two distinct heads, but such a method is certainly unadvisabje, since the former literature constitutes in reality a subdivision of the latter. For a general introduction to both these literatures the reader should consult Ency. Brit. ii. 174- 184; Ency. Biblica, i. 213-216, 249-250 ; Hastings' Diction- ary of the Bible, i. 109-123 ; Kautzsch, Apokryphen u. Pseudepigraphen, i. pp. xi.-xxiii.

Biblical Apocrypha. — These books will be dealt with under their appropriate heads. They tand in the English Bible in the following order : — 1 Esdras, 2 Esdras, Tobit, Judith, Additions to Esther, Wisdom of Solomon, Ecclesi- asticus, Baruch, Epistle of Jeremy, Additions to Daniel (Song of the Three Holy Children, History of Susannah, and Bel and the Dragon), Prayer of Manasseh, 1 Maccabees, 2 Maccabees. It is hardly possible to form any classifica- tion which is not open to some objection. In any case the classification must be to some ex- tent provisional, since scholars are still divided as to the original language, date, and place of composition of some of the books which must come under our classifi- cation. In the first place, we must treat separately the Old Testament and the New Testament literature of this nature. In the next place we must discriminate (I.) the Palestinian and (II.) the Hellenistic literature of the Old Testament. The former was generally written in Hebrew or Aramaic, and seldom in Greek ; the latter naturally in Greek. Next, within these literatures we shall distinguish three or four classes according to the nature of the subject with which they deal. Thus the books of which we have to treat will be classed as — (i.) Historical, (ii.) Legendary ([HaggadicV (iii.) Apocalyptic, (iv.) Sapiential, or belong- ing to the Wisdom Literature.

Old Testament Apocalvptic and Apocbtphal

LiTEBATUBE.

ClassWca' tloa.

I. — Palestinian Jewish

LiTEKATIJEB.

(i.) Historical. _ 1 Ezra. ~.

1 Maccabees. History of Johannes Hyrcanus.

(ii.) Legendary. Book of Baruch. Kest of the Words of Baruch. Martyrdom of Isaiah. Book of Jubilees. Judith. Pseudo-Philo's Liber Antiquita-

tum. Book of Adam. Jannes and Jambres. Joseph and Asenath. '

(iii.) Apocalyptic.

Apocalypse of Abraham.

Apocalypse of Baruch.

Ethiopic Book of Enoch.

4 Ezra.

Assumption of Moses.

Book of Noah.

Testament of the XII Patriarchs.

Psalms of Solomon.

Prayer of Joseph.

Book of Eldad and Modad.

Apocalypse of Elijaht

Apocalypse of Zephaniah.

(iv.) Wisdom Literature.

Pirke Aboth. Sirach.

1 Thus some of the additions to Daniel and the Prayer of Manasseh are most probably derived from a Semitic original written in Palestine, yet in compliance with the prevailing opinion they are classed under HeUeaiistic Jewish literature. Again, the Slavonic Enoch goes back

undoubtedly in parts to a Semitic original, though most of it was written fcy a Greek Jew in Egypt.

II. — Hellenistic Jewish

LiTEBATUBE.

(i.) Historical and Legendary. Additions to Daniel. Additions to Esther. Epistle of Jeremy.

2 Maccabees.

3 Maccabees. Prayer of Manasseh. Tobit.

(ii.) Apocalyptic.

Slavonic Enoch. Oracles of Hystaspes. Testament of Job. Testaments of the III Patriarchs. Sibylliae Oracles.

(iii.) Wisdom Literature,

4 Maccabees. Wisdom of Solomon.

I. — ^Palestinian- Jewish Literatueb. (i.) Historical.

1 Ezra or Esdras. — This book called "crSpas <£ in the LXX. and "Liber tertius Esdrse" in the Vulgate (see Ency. Brit. viii. 541-542) may safejly be regarded as a translation from a Hebrew-Aramaic original with the exception of the independent section iii. 1-v. 6, which is probably from the Greek (see Nestle, Marginatien und Materialien, 1893, pp. 23-29; Thackeray in Hastings' Bible Diet. i. 758-763; Volz in Ency. Biblica, ii. 1488-1494). Since, with the above-named exception, this book is an early translation from a text superior in many instances to that of the canonical books of 2 Chronicles, Ezra, and Nehemiah, so far as these deal with the rebuilding of the temple, it is of no little value in the critical emendation of the texts of those books (Driver, Introd. to Literature of O.T. p. 554). Gwynn and Thackeray adduce some grounds for the view that this translation and that of the LXX. of Daniel are from the same hand (see

Diet. Christ. Biog. iv. 977 note). Sir H. Howorth's opinion (ITie Academy, 1893, pp. 13, 60, 106, 174, 326, 524) that this book is more trustworthy than the canonical Ezra has much to be said in its favour. Its date is very uncertain. Schiirer contents himself with saying that its composition must be placed before the time of Josephus. Fritzsche declares that it cannot be earlier than the 1st century b.c. (so Ewald, De Wette).

1 Maccabees. — To the account of this work in Ency. Brit. XV. 131, it will not be necessary to add more than a few facts. The general credibility of the book is recog- nized by recent as well as by earlier research. Willrich {Juden und Griechen vor der Makkab. Erhebung, 1895) has given good grounds for assuming that the thirteen letters reproduced in the book have been added by its Greek trans- lator from a, collection of such authorities in Jerusalem.

Greek M8S. and Texts.— Ihe following MSS. contain 1 Macca- bees : N, A, Codex Venetus, and 15 cursives. There are several editions of the text. The textus receptus is found in the Slxtine edition of the LXX. 1587, which is based on the Cod. Venetus and on certain unnamed cursives. This text is followed by Pareons and Holmes (^Vetus Testamentum Greece, 6 vols. 1798-1827), who append the variants of 16 cursives, and Tischendorf (V. T. Greece, 2 vols. 1887). Fritzsche {Libri apoe. V. T. 1871) gives an inde- pendent text based on «, A, Cod. Ven. and the cursives in Parsons and Holmes's edition. Finally Swete prints A with variants from N and Cod. Ven. {The Old Testament in Greek according to the Septuagint, 3 vols. 1887-94).

APOCALYPTIC AND APOCEYPHAL LITEEATUEE

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Syriac and Latin Versions. — There Is no ancient Ethiopio version, but there are Syrfao and Latin versions. The Syriac appears in two forms : the first is that in the Peshitto from the Greek text of Lucian (preserved in the cursives 19, 64, 93) ; the second is that published by Ceriani, from a 6th-century MS. The latter agrees more closely with the Greek, and is probably the result of a revision of the older text with the help of a Greek text (see G. Schmidt, Zeitschrift. f. d. alttest. Wissensch. 1897, xvii. 1-47,

233-262). There are also two forms of the old Latin version : the first is that of the Vulgate, and the second is found in a Complutensian MS. in the Milan Library.

Translations and Commentaries. — The most trustworthy English translations are those in the Variorum Bible and in the Revised Version, and the best commentaries those of Rawlinson in the Speaker's Apoorypha and Fairweather and Black, The First Book of Maccabees, 1897. In German there is nothing equal to Kautzsch's translation (Apok. und Pseud. 1900, i. 24-81) and to Grimm's Das erste Buch der Maccabder erkldrt, 1853. On the literature generally see Schiirer, Oesch. d. Jud. Volkes^, iii. 141-146.

History of Johannes Hyrcanus. — TMs work is mentioned in 1 Mace. xvi. 23, 24, but no trace of its existence has been discovered elsewhere.

(ii.) Legendary or Haggadic Works.

Book ofBaruch. — Recent criticism has in some respects diverged from the account of this book in Ency. Brit. iii. 404-405. Thus most scholars, such as Tritzsche, Hitzig, Kneucker, Hilgenf eld, Reuss, agree in assuming that i.-iii. 8 and iii. 9-v. 9 are from distinct writers. But some critics have gone further. Thus Rothstein (Kautzsch, Apok. und Pseud, i. 213-215) holds that there is no unity in iii. 9-v. 9, but that it is composed of two independent writings — ^iii. 9-iv. 4 and iv. 5-v. 9. Marshall (Has- tings' Bible Diet. i. 251-254) gives a still more complex anal- ysis. He finds in it the work of four distinct writers — i. 1-14, i. 15-iii. 8, iii. 9-iv. 4, iv. 5-v. 9. Though most mod- ern writers, as Cornill, GifEord, Schiirer, &c., advocate a Hebrew original of i.-iii. 8 and a Greek original of the rest, Rothstein, Kneucker, and Konig hold fast to the view of the older exegesis that the whole book is derived from the Hebrew. Marshall, on the other hand, argues for the view that i.-iii. 8 is translated from the Hebrew, iii. 9-iv. 4 from the Aramaic, and that iv. 5-v. 9 was originally written in Greek.

Commentaries, &c. — In addition to those enumerated in Ency. Brit. iii. 405, the most valuable of the more recent works is Kneucker's Das Buch Baruch, 1879 ; Gifford's in Speaker"s Apoc. ii.

Date. — The dates of the various constituents of this book are quite uncertain. Ewald, followed by Gifford and Marshall, assigns i.-iii. 8 to the period after the conquest of Jerusalem by Ptolemy I. in 320 B.C. ; Reuss to some decades later ; and Fritzsche, Schrader, Keil, to the times of the Maccabees. Hitzig, Kneucker, and Schiirer assume that it was written after a.d. 70. Ryle and James (Psalms of Solomon, pp. Ixxii.~~lxxvli.) hold that iv. 31~~ v. 9 is de- pendent on the Greek version of Ps. xi., and that accordingly Baruch was reduced to its present form after a.d. 70.

Best of the Words of Baruch. — This book is most prob- ably of Jewish authorship and its present form due to a Christian hand, as Kohler (Jewish Quarterly Review, 1893, pp. 407-419) has shown. It has been preserved in Greek, Ethiopic, Armenian, and Slavonic (see Schiirer', iii. 286, 287). The Greek was first printed at Venice in 1609, and next by Ceriani in 1868 under the title " Paralipomena Jeremise" in his Monumenta Sacra, v. 11-18, and by Rendel Harris in 1889. Harris regards it in its present form as an Eirenicon addressed to the Jews by a Christian after the rebellion of Bar-Cochba.

Martyrdom of Isaiah. — This Jewish work has been in part preserved in the Ascension of Isaiah. To it belong i. 1, 2", 6»-13- ; ii. 1-8, 10-iii. 12 ; v. 1°-14 of that book. It is of Jewish origin, and recounts the martyrdom of Isaiah at the hands of Manasseh. For the Christian elements of the Ascension of Isaiah, see " Testament of Hezekiah " and " Vision of Isaiah."

Original Language and Date.— This was most probably written in Hebrew or Aramaic, but there is not sufficient evidence to determine this question definitely. As regards the date we may safely conclude that it was written not later than the 1st century A.D. Thus it was well known to Origen (Ep. ad Africanum, ix., Lommatzsch, xvii. 31 ; In Matt, xxiii. 37, Lommatzsoh, iv. 237, &c.). Still earlier it was known to Tertullian (£>e Pat. 14) and to Justin Martyr (Dial. c. Tryph. cxx.). Thus it was current early in the 2nd century. It was probably known to the writer of the Epistle to the Hebrews (xi. 37). This brings us, if the last reference is trustworthy, to the 1st century a.d., and this no doubt is the right date, for

it is highly improbable that Jewish writings of the 2nd century should gain currency in the Christian Church.

Cfreek Version. — The Greek version, as edited in the Ascension, has in part been just recovered and published by Grenfell and Hunt (Amherst Papyri, 1900, i. 1-22) ; see also Charles, Ascension of Isaiah, 1900, pp. xxii.-xxxiii. 84-96), where this text is critically edited and compared with all other existing authorities. This martyrdom was known to the writer of the Opus Imperfectum (see Montfauoon's edition of Chrysostom, vi. pp. xx. xxi.) in its original form before it was incorporated in the Ascension (see Charles, op. cit. pp. xl.-xlii., xliv. 8, 9).

Ethiopic Version. — ^This was first edited by Laurence in 1819 from one MS., in 1877 by Dillmann from three (Ascensio Isaiae JEthiopice et Latine), and in 1900 by Charles from a more accurate collation of the same three MSS., together with the other versions. This version admirably represents the original. Two of the three MSS. are excellent.

Latin Version. — Of this ii. 14-iii. 13 was discovered and edited in 1828 by Mai. This was reprinted by Dillmann in 1877 in his edition of the Ascension, and in 1900 by Charles a:fter a fresh collation of the Vatican palimpsest. On the relation of the various versions, see Charles, pp. xviii.-xxxiii.

Modern Translations. — Besides Laurence's Latin and English translations, which are not trustworthy, there are Oillmann's Latin translation, Bassett's French (D ascension d'lsaie, 1894), Beer's German (Apok. und Pseud, ii. 124-127), and Charles's English (op. cit. pp. 1-18, 40-42). For bibliography, see also Schiirer, Gesch. des Jud. Volkes », iii. 284-285.

Jubilees. — This book is variously entitled to. 'Im^riXata, ol Ico^SiyXatoi, ij Aettt^ rej/etris, rot AeirTa Tevtcem^, Mtxpo- yevetxLi in Greek, and "The Book of the Division" in Ethiopic. It is really an Haggadic commentary on Genesis, and is practically the sole monument of legalistic Pharisaism belonging to the latter half of the 2nd cen- tury B.C., and is a characteristic example of that form of religion against which the Pauline dialectic was directed (see Ency. Brit. ii. 176-177). It

has a secret apologetic aim. It defends and justifies the assumption of the high priesthood by the Maccabees.

Original Language. — This book, as the production of a strict Pharisee, was naturally written in Hebrew. This Hebrew was not free from Aramaic forms, as we infer from the formation of the proper name " Mastema " and from the statement of Jerome (Ep. ad Eabiol, 78 ; mansione, 18). On the other hand, a large number of passages cannot be intelligibly translated unless on the pre- supposition of a Hebrew original (see Charles, Ethiopic Version of Sebrew Book of Jubilees, pp. ix. x. ; Littmann in Kautzsch's Apok. und Pseud, ii. 34, 35). Fragments of the original Hebrew are stiU found in certain Midrashim.

Versions : Gfreek, Syriac, Ethiopic, and Latin. — Large fragments of the Greek version have come down to us in Epiphanius and such annalists as Syncellus and Cedrenus. Only a few lines survive of the Syriac. Both these were made from the original. As regards the two latter versions, which are derived from the Greek, the whole of the Ethiopic survives and about one-fourth of the Latin. The latter was first published by Ceriani in 1861, next by Ronsch (Das Buch der Jubilaen) in 1874, and by Charles in his edition of the Ethiopic text.

Ethiopic Text and jnranslations.— This text was first edited by Dillmann from two MSS. in 1859, and in 1895 by Charles from four. In the latter edition, the Greek and Latin fragments are printed together with the Ethiopic. The book was translated into German by Dillmann from one MS. in Ewald's Jahrbucher, ii. iii. 1850, 1851, and by Littmann (in Kautzsch's Apok. und Pseud, ii. 39-119) from Charles's Ethiopic text ; in English by Schodde (Bibl. Sacr. 1885) from Dillmann's text, and by Charles (Jewish Quarterly Meview, Oct. 1893, July 1894, Jan. 1895) from the text afterwards published in 1895.

Date and Author. — Jubilees was written after 135 b.c, when J. Hyrcanus became ecclesiastical and civil head of the nation, and before 95 b.c, when the entire body of the Pharisees was at strife with his successor Jannaus (see Bousset, Zeitschr. f. NT-

liche Wissenschaft, 1900, pp. 198-201). The author was not a Hellenistic Jew, as Frankel supposes, nor a Samaritan, as Beer thought, nor yet an Bssene, but essentially a Hiarisee in the most rigorous sense of the term (see Ency. Biblica, i. 232 ; Kautzsoh, op. cit. ii. 36-37).

Bibliography.— See Ency. Brit. ii. 177 ; Schurer, Gesch. d. Ju^. Volkes, iii. 277-280. The first commentary on the whole text, by Charles, was published in 1902.

Judith. — This book (see Ency. Brit. xiii. 765-766) ■was written originally in Hebrew. This is shown not only by the numerous Hebraisms, but also by mistranslar tions of the Greek translation, as in ii. 2, iii. 9, and other passages (see Fritzsche and Ball in toe), despite the state- ment by Origen {Ep. ad Afric. 13) that the book was not received by the Jews among their apocryphal writings. In his preface to Judith, Jerome says that he based his Latin version on the Chaldee, which the Jews reckoned among their Hagiographa. Ball (Speaker's Apocrypha, i. 243) holds that the Chaldee text used by Jerome was a free translation or adaptation of the Hebrew. The book exists in two forms. The. shorter, which is preserved only in Hebrew (see under Hebrew Midrashim below), is, accord- ing to Scholz, Lipsius, Ball, and G aster, the older. The longer form is that contained in the versions. ,

Chreek Version. — ^This is found in three recensions : (1) in A B, k ; (2) in codices 19, 108 (Lucian's text) ; (3) in cod. 58, the source of the old Latin and Syriac.

Syriac and Latin Versions. — Two Syriac versions were made from the Greek-=|the first, that of the Peshitto ; and the second, that of Paul of Telia, the so-called Hexaplaric. The Old Latin was derived from the Greek, as we have remarked above, and Jerome's from the Old Latin, under the control of a Chaldee version.

Later Hebrew Midrashim. — ^These are printed in Jellinek's Bet ha-Midrasch, i. 130-131 ; ii. 12-22 ; and by Gaster in Proceedings of the Society of Biblical Archaeology, 1894, pp. 156-163.

Date. — The book in its fuller form was most probably written in the 1st century, before the Christian era. The writer places his romance three centuries earlier, in the time of Ochus, as we may reasonably infer from the attack made by Holofemes and Bagoas on Judeea; for Artaxerxes Ochus made an expedition against Phoenicia and Egypt in 350 e.g., in which his chief generals were Holofemes and Bagoas.

Becent Literature. — Ball, Speaker^s Apocrypha, 1888, an excel- lent piece of work ; Scholz, Das Buch Judith ", 1896 ; Lohr, Apok. und Pseud. 1900, ii. 147-164 ; Porter in Hastings' Bible Diet. ii. 822-824 ; Gaster, Ency. Biblica, ii. 2642-2646. See Ball, pp. 260-261, and Schurer, in. loc, for a full bibliography.

Pseudo-Philo's Liber Antiquitatum Biblicarum. — Though the Latin version of this book was thrice printed in the 16th century (in 1527, 1550, and 1599), it was practically unknown to modern scholars till it was recognized by Conybeare and discussed by Cohn in the Jewish Quarterly Review, 1898, pp. 279-332. It is an Haggadio revision of the Biblical history from Adam to the death of Saul. Its chronology agrees frequently with the LXX. against that of the Massoretic text, though conversely in a few cases. The Latin is undoubtedly translated from the Greek. Greek words are frequently transliterated. While the LXX. is occasionally followed in its translation of Bibli- cal passages, in others the Massoretic is followed against thfe LXX., and in one or two passages the text presup- poses a text different from both. On many grovmds Cohn infers a Hebrew original. The eschatology is similar to that taught in the similitudes of the Book of Enoch. In fact, Eth. En. Ii. 1 is reproduced in this connexion. Prayers of the departed are said to be valueless. The book was written after a.d. 70 ; for, as Cohn has shown, the exact date of the fall of Herod's temple is predicted.

Lost Legends— The Adam Boohs. — That there was a Jewish book or books of Adam, which recounted the life of Adam and Eve after the Fall, we must conclude from the host of Christian apocr3rphs which have this subject for their theme. These are found in Greek, Syriac, .

Ethiopic, Arabic, Armenian. A Jewish book of Adam is i mentioned in the Talmud and likewise in the Constitvr tiones Apost. vi. 16. See Smith's

Dictionary of Christian Biography, i. 34-39; Ency. Bibl. i. 253; Schurer, Qesch. d. Jild. Volkes, iii. 287-289.

Jannes and Jambres. — These two men are referred to in 2 Tim. iii. 8 as the Egyptian magicians who withstood Moses. The book which treats of them is mentioned by Origen {ad Matt, xxiii. 37 and xxvii. 9 [^Jannes et Mambres lAberJ), and in the Gelasian Decree as the Poenitentia Jamnis et Mambre. The names in Greek are generally "lawTJs kol 'la/i/Sp^s (= o'l^n'i o'^O as in the Targ.- Jon. on Exod. i. 15 ; vii. 11. In the Talmud they appear as N-iDDi'jnv. Since the western text of 2 Tim. iii. 8 has Ma/t^S/aiJs, Wescott and Hort infer that this form was derived from a Palestinian source. These names were known not only to Jewish but also to heathen writers, such as Pliny and Apuleius. The book, therefore, may go back to pre-Christian times. (See Schilrer ', iii. 292-294 ; Ency. Biblica, ii. 2327-2329.)

Joseph and Asenath. — The statement in Gen. xli. 45, 60 that Joseph married the daughter of a heathen priest naturally gave offence to later Judaism, and gave rise to the fiction that Asenath was really the daughter of Shechem and Dinah, and only the foster-daughter of Potipherah (Targ.-Jon. on Gen. xli. 45 ; Tractat. Sopherim, xxi. 9 ; Jalkut Shimoni, c. 134. See Oppenheim, Fabula Josephi et Asehethae, 1886, pp. 2-4). Origen also was, acquainted with some form of the legend (Selectain Gene- sin, ad Gen. xli. 45, ed. Lommatzsch, viii. 89-90). The Christian legend, which is no doubt in the main based on the Jewish, is found in Greek, Syriac, Armenian, Slavonic, and mediaeval Latin. Since it is not earlier than the 3rd or 4th century, it will be suflBcient here to refer to Smith's Diet, of Christ. Biog. i. 176-177 ; Hastings' Bible Diet. i. 162-163 ; Schilrer, iii. 289-291.

(iii.) Apocalyptic Literature.

Apocalypse of Abraham. — This book is found only in the Slavonic (edited by Bonwetsch, Studien zur Geschichte d. Theologie und Kirche, 1897), a translation from the Greek. It is of Jewish origin, but in part worked over by a Christian reviser. The first part treats of Abraham's conversion, and the second forms an apocalyptic expansion of Gen. xv. This book was possibly known to the author of the Clem. Becognitions, i.

32, a passage, however, which may refer to Jubilees. It is most probably distinct from the dwoKaXvil/K *Ay8paa/i used by the Gnostic Sethites (Epiphanius, Hcer. xxxix. 5), which was very heretical. On the other hand, it is probably identical with the apocryphal book 'A^padfu. mentioned in the Stichometry of Nicephorus, and the Synopsis Athanasii, together with the Apocalypses of Enoch, &c.

Syriac Apocalypse of Baruch. — This apocalypse has survived only in the Syriac version, of which Ceriani dis- covered a 6th-century MS. in the Milan Library. Of this he published a Latin translation in 1866 (Monumenta Sacra, I. ii. 73-98), which Eritzsche reproduced in 1871 (Libri Apocryphi V. T. pp. 654-699), and the text' in 1871 (Mon. Sacra, V. ii. 113-180), and subsequently in photo-lithographic facsimile in 1883. Chaps. Ixxviii.- Ixxxvi., indeed, of this book have long been known. These constitute Baruch's epistle to the nine and a-half tribes in captivity, and have been published in Syriac and Latin in the London and Paris Polyglots, and in Syriac alone from one MS. in Lagarde's Libri V. T. Apocryphi Syr. 1861 ; and by Charles from ten MSS. (Apocalypse of Baruch, 1896, pp. 124-167). The entire

book -was translated into English, by tbe last-named writer (op. dt. pp. 1-167), and into German by Eyssel (Kautzscb's ApoJc. und Pseud. 1900, ii. pp. 413-446). The Syriac is translated from the Greek ; for Greek words are occasionally transliterated, and passages can be explained only on the hypothesis that the wrong alternative meanings of certain Greek words were followed by the translator. The Greek in turn is derived from the Hebrew, for un- intelligible expressions in the Syriac can be explained and the text restored by retranslation into Hebrew. Many paronomasicB discover themselves in the course of such retranslation (see Charles, Apoc. Bar. pp. xliv.liii.). The necessity of postulating a Hebrew original was first shown by the present writer, and has since been maintained by Wellhausen (Skizzen u. Vorarbeiten, vi. 234) and by Byssel (Apok. und Pseudepig. A. T. 1900, ii. 411). The final editor of the work writes in the

name of Baruch, the son o Neriah. The time extends from the eve of the capture of Jerusalem by the Chaldees till after its accom plishment. If the letter to the tribes in captivity (Ixxviii.- Ixxxvi.) be disregarded, the book falls into seven sections separated by fasts, save in one case (after xxxv.) where the text is probably defective. These sections, which are of unequal length, are— (1) i.-v. 6 ; (2) v. 7-viii. ; (3) ix.-xii. 4; (4) xii. 5-xx. ; (6) xxi.xxxv.; (6) xxxvi.xlvi. ; (7) xlvii. Ixxvii. These treat of the Messiah and the Messianic king dom, the woes of Israel in the past and the destruction of Jerusalem in the present, as well as of theological questions relating to original sin, free will, works, the number of the saved, the nature of the resurrection body, &c. The views expressed onseveral of theabove subjects are often conflict- ing. In one class of passages there is everywhere manifest a vigorous optimism as to Israel's ultimate well-being on earth, and the blessedness of the chosen people in the Messianic kingdom is sketched in glowing and sensuous colours (xxix., xxxix.-xl., Ixiii.-lxxiv.). Over against these passages stand others of a hopelessly pessimistic character, wherein, alike as to Israel's present and future destiny on earth, there is written nothing save " lamentation, and mourning, and woe." The world is a scene of corruption, its evils are irremediable, its end is nigh, and the advent of the new and spiritual world at hand. The first to draw attention to the composite elements in this book was Kabisch (Jahrbiicher f. protest. Theol. 1891, pp. 66-107). This critic regarded xxiv. 3-xxix., xxxvi.-xL, and liii.lxxiv. as independent sources written before the fall of Jerusalem, A.D. 70, and his groundwork, which consists of the rest of his book, with the exception of a few verses, as composed after that date. All these elements were put together by a Christian contemporary of Papias. Many of these conclusions were arrived at independently by a Trench scholar, De Faye {Les Apocalypses Juives, 1892, pp. 2 28, 76-103, 192-204). The present writer {Apocalypse of Baruch, 1896, pp. liii.lxvii.), after submitting the book to a fresh study, has come to the following

~~conclusions: — The book is of Pharisaic authorship and composed of six in~~ dependent writings— A', A=, A?, B\ B\ W. The first three were composed when Jerusalenj was still standing and the Messiah and the Messianic kingdom were expected: A', a mutilated apocalypse =xxvii.-xxx. 1; A^, the Cedar and Vine Vision =xxxvi.-xl.; A', the Cloud Vision = liii.-lxxiv. The last three were written after A.D. 70, and probably before 90. Thus B'=lxxxv. was written by a Jew in exile, who, despairing of a national restoration, looked only for a spiritual recompense in heaven. The rest of the book is derived from B^ and W, written in Palestine after a.d. 70. These writings belong to very different types of thought. In B^ the earthly Jerusalem is to be rebuilt, but not so in B' : in the former the exiles are to be restored, but not in the latter ; in the former a Messianic kingdom without a Messiah

is expected, but no earthly blessedness of any kind' in the latter, &c. B^=i.-ix. 1, xxxii. 2-4, xliii.~~xliv. 7, xlv.~~ xlvi., Ixxvii.-lxxxii., Ixxxiv., Ixxxvi.-lxxxvii. B^=ix.-xxv., XXX. 2-xxxv., xli.-xlii., xliv. 8-15, xlvii.-lii., Ixxv.-lxxvi., Ixxxiii.

The above critical analyses were attacked and rejected by Clemen {Stud, und Krit. 1898, 211 sqq^. He fails, however, in many cases to recognize the difficulties at issue, and those which cannot be ignored he sets down to the conflicting apocalyptic traditions on which the author was obliged to draw for his subject-matter. Though Ryssel (Kautzsch, Apok. u. Pseud, des A. T. ii. 409) has followed Clemen, neither has given any real explanation of the disorder of the book as it stands at present.

Belation to 4 Ezra. — The afflnities of this book and 4 Ezra are so numerous (see Charles, opi cit. 170-171) that Ewald and Ryle assumed identity of authorship. But their points of divergence are so weighty (see op. cit. pp. Ixix.-lxxi.) that this "view cannot be sustained. Three courses still remain open. If we assume that both works are composite, we shall perforce admit that some of the constituents of 4 Ezra are older than the latest of Baruch and that other constituents of Baruch are decidedly older than the remaining ones of 4 Ezra. On the other hand, if we assume unity of authorship, it seems impossible to arrive at finality on the chronological relations of these two works. Langen, Hilgenfeld, Wieseler,

Stahelin, Eenan, Hausrath, Drummond, DUlmann, Eosenthal, Gunkel, have maintained on various grounds the priority of 4 Ezra ; and Schtirer, Bissell, Thomson, Deane, Kabisch, De Eaye, Wellhausen, and Ryssel the priority of Baruch on grounds no lesfe convincing.

Integrity of the Book. — In Ixxvii. 19 it is said that Baruch wrote two epistles, one to the nine and a-haU tribes and the other to the two and a-half at Babylon. The former is found in Ixxviii.-lxxxvi.; the latter is lost, but is probably preserved either wholly or in part in the Book; of Baruch, iii. 9-iv. 29 (see Charles, op. cit. pp. Ixv.- Ixvii.). On the other hand, it is not necessary to infer from Ixxv. that an account of Baruch's assumption was to be looked for m the book.

Literature. — In addition to the works cited above, see Rosenthal, Vier apokryphische Bucher, 1885, pp. 72-103 _; Deane, Pseudepi- grapha, 1891, pp. 130-162. For a full bibliography see Schtirer, Gesch. d. Jud. Volkesfi, 1898, iii. 223-232, and Charles {op. cit. pp.' xxx.-xlii.).

Ethiopic Book of Enoch. — This is the most important of all the apocryphal or pseudepigraphal writings for the history of religious thought (see Charles, Book of Enoch, 33-53, 312-317, Eschatology : Hebrew, Jewish, and Chris- tian, 1899, pp. 182-192, 203-219). It is quoted by name as a genuine production in the Epistle of Jude 14 sq., and it lies at the base of Matt. xix. 28 and John v. 22, 27, and other passages. It had also a vast indirect influence on the Palestinian literature of the 1st century of our era. Like the Pentateuch, the Psalms, the Megilloth, the Pirke Aboth, this work was divided into five parts, with the critical discussion of which we shall deal below. Modern scholars are agreed' that Enoch was originally written in Hebrew or Aramaic. Halevy, Journal Asiatique, 1867, pp. 352-395, is in favour of the former view ; but the latter is now more generally advocated on the ground of Aramaic, forms in the Gizeh Greek fragment, (jiovKa, xviii. 8, from riis (MvSo^apa in xxviii. 1, and ISa/SSrjpa in xxix. 1, from •la-ip and xepovpiv in xiv. 11, 18. On the other hand, it must be remembered that some Aramaic forms are found in the LXX. and in the Ethiopic version of the Old Testa- ment. Hence, in the face of the powerful arguments of Halevy for a Hebrew original, the question cannot be regarded as yet settled. The Semitic

original was trans- lated into Greek. It is not improbable that there were two distinct Greek versions. Of the one several frag— ments have been preserved in Syncellus (a.d. 800), vi.- ix. 4, viii. 4-x. 14, xv. 8-xvi. 1 ; of the other i.-xxxii. in the Gizeh Greek fragment discovered in Egypt and published by Bouriant, Fragments grecs du livre d' Enoch, in 1892, and subsequently by Lods, Dillmann, Charles, Swete, and finally by Flemming and Radermacher. In addition to these fragments there is that of Ixxxix. 42-49 (see Gildemeister in the ZDMG, 1865, pp.

621-622, and Charles, op. cit. 238-240). Of the Latin version only i. 9 surYives, being preserved in the Pseudo- Cyprian's Ad Novatianum and cvi. 1-18 discovered by James in an 8th-century MS. of the British Museum (see James, Apoc. Anecdota, 146-150, Charles, op. cit. 372-375). This version is made from the Greek. The Ethiopic version, -which is a very faithful translation of the Greek, alone preserves the entire text. It was edited by Laurence in 1838 from one MS. and in 1851 by Dillmann from five. The present -writer has imdertaken a text based on a study of t- wenty-five MSS.

Translations and Commentaries. — ^Laurence, The Book of Enoch, Oxford, 1821 ; Dillmann, Das Buck Henoch, 1853 ; Schodde, The Book of Enoch, 1882 ; Charles, The Book of Enoch, 1893 ; Beer, " Das Buch Henoch " in Kautzsch's Apok. u. Pseud, des A. T. 1900, 11. 217-310 ; Flemming and Radermacher, Das Buch Henoch, 1901. Critical Inquiries. — The Bibliography will be found in Sohtlrer, Gesch. d. Jiidischen Volkes\ ill. 207-209, and a short critical account of the most important of these in Charles, op. cit. pp.

9-21.

We have remarked above that the Book of Em^ch is di- vided into five parts — i.-xxxvi., xxxvii.-lxxi., Ixxii.-lxxxii., Ixxxiii.-xc, xci.-c-Nriii. Some

of these parts constituted originally separate treatises. In the course of their reduction and incorporation into a single work they suffered much mutilation and loss. From an ea.rly date the compositeness of this work was recognized. Scholars have varied greatly in their critical analyses of the work (see Charles, op. cit. 6-21, 309-311 ; Hastings' Dvst. of the Bible, i. 706 ; Ency. Biblica, i. 221-222 ; Schodde, Book of Enoch, 1882, pp. 19-32). The analysis which gained most acceptation was that of Dillmaan (Herzog's Real Enkyk.^ xii. 360-362), according to whom the present books consist of — (1) the groundwork, i.e., i.-xxxvi., Ixxii.-cv., written in the time of John Hyrcanus ; (2) xxxvii.-lxxi., xvii.-xix., before 64 b.c. ; (3) the Noachic fragments, vi. 3-8, viii. 1-3, ix. 7, x. 1, 11, xx., xxxix. 1, 2», liv. 7-lv. 2, Ix., Ixv.-lxix. 25, cvi.-cvii. ; and (4) cviii. from a later hand. With much of this analysis there is no reason to disagree. The similitudes are undoubtedly of different authorship from the rest of the book, and certain portions of the book are derived from the Book of Noah. On the other hand, the so-called groundwork has no existence unless in the minds of earlier critics and some of their belated followers in the present. It springs from at least four hands, and may be roughly divided into four parts, corresponding to the present actual divisions of the book. Of these we shall deal with the easiest first. Ch. Ixxii.- lxxxii. constitutes a work in itself, the writer of which had very different objects before him from the writers of the rest of the book. His sole aim is to give the law of the heavenly bodies. His work has suffered disarrangements and interpolations at the hands of the editor of the whole work. Thus Ixxx. sq. are intrusions, and Ixxxii. should stand before Ixxix., for the opening words of the latter suppose it to be already read. Chaps. Ixaxdii.-xc. — This section was written before 161 b.c, for " the great horn," who is Judas the Maccabee, was still warring when the author was -writing. (Dillmann, Schilrer, and others take the great horn to be John Hyrcanus, but this interpretation does violence to the text.) These chapters recount three visions : the first two deal with the first-world judgment ; the third - with the entire historjr of the world till the final judgment. An eternal Messianic kingdom at the close of the judgment is to be established under the Messiah, -with its centre in the New Jerusalem set up by God Himself. Chaps, xci.civ. — In the preceding section the Maccabees were the religious champions of the nation anH the friends of the Chasids. Here

they are leagued with the Sadducees, and are the declared' foes of the Pharisaic party. This

section was written therefore after 134 b.c, when the breach between John Hyrcanus and the Pharisees took ' place and before the savage massacres of the latter by Janneeus in 95 B.C. ; for it is not likely that in a book dealing with the sufferings of the Pharisees such a refer- ence would be omitted. These chapters indicate a revo- lution in the religious hopes of the nation. An eternal Messianic kingdom is no longer anticipated, but only a temporary one, at the close of which the final judgment will ensue. The righteous dead rise not to this kingdom but to spiritual blessedness in heaven itself — to an immor tality of /the soul. This section also has suffered at the hands of the final editor. Thus xci. 12-17, which describe the last three weeks of the Ten-Weeks Apocalypse, should be read immediately after xciii. 1-10, which recount the first seven weeks of the same apocalypse. But, further- more, the section obviously begins with xcii. " Written by Enoch the scribe," &c. Then comes xci. 1-10 as a natural sequel. The Ten-Weeks Apocalypse, xciii. 1-10, xci. 12-17, if it came from the same hand, followed, and then xciv. The attempt (by Clemen and Beer) to place the Ten- Weeks Apocalypse before 167, because it makes no reference to the Maccabees, is not successful ; for where the history of mankind from Adam to the final judgment is despatched in sixteen verses, such an omission need cause little em- barrassment, and still less if the author is the deter- mined foe of the Maccabees, whom he would undoubtedly have stigmatized as apostates, if he had mentioned them at all, just as he similarly brands all the Sadducean priest- hood that preceded them to the time of the captivity. This Ten-Weeks Apocalypse, therefore, we take to be the work of the writer of the rest of xci.-civ. Chaps, i.-xxxvi. — This is the most difficult section in the book. It is very composite. Ch. vi.xi. is apparently an independent frag ment of the Enoch Saga. It is itself compounded of the Semjat;a and Azazel myths, and in its present composite form is already presupposed by Ixxxviii.-lxxxix. 1 ; hence its present form is earlier than 166 b.c It represents a primitive and very sensuous view of the eternal Messianic kingdom on earth, seeing that the righteous beget 1000 children before they die. In the next place xii.-xvi. stand quite apart from the rest of i.xxxvi. owing to the tran scendent picture they give of God as

contrasted with what is given in the rest of the section. Likewise they represent what Enoch saw in a dream, whereas xvii.-xxxvi. recount Enoch's actual journeys through the heavens. These chapters were probably an independent fragment of the Enoch Saga. Again, xvii.-xix. stand in a peculiar relation to xx.-xxxvL, since both sections deal with the same subjects. Thus xvii. 4=xxiii. ; xvii. 6=xxii. ; xviii. l=xxxiv.-xxxvi. ; xviii. 6-9=xxiv.-xxv., xxxii. 1-2; xviii. 11, xix.=xxi. 7-10; xviii. 12-16 =xxi. 1-6. They belong to the same cycle of tradition and cannot be independent of each other. Chap. xx. appears to show that xx.~~xxxvi. is fragmentary, since only four of the seven angels mentioned in xx. have anything to do in xxi.~~ xxxvi. Chaps, xxxvii.~~lxx. — These constitute the well~~ known similitudes. They were written before 64 b.c, for Eome was not yet known to the writer, and after 96 B.C., for the slaying of the righteous, of which the writer complains, was not perpetrated by the Maccabean princes before that date. This section consists of three similitudes— xxxviii.-xliv., xlv.-lvi^., Iviii.~~lxix. These are in~~ troduced and concluded by xxxvii. and Ixx. There are many interpolations — Ix., Ixv.-lxix. 25 come confessedly from the Book of Noah ; most probably also liv. 7-lv. 2. Whence others, such as xxxix. 1, 2», xli. 3-8, xliii. sq., spring is doubtful. Ch. 1., Ivi. 6-lvii. 3°' are likewise insertions, and Ixxi. an addition, at vsiriance with the thought of the section. The Messianic doctrine and eschatology of this section is unique. The Messiah is here for the-first time

described as the pre-existent Son of Man, -who possesses uniTersal dominion and is the Judge of all mankind. After the judgment there will be a new heaven and anew earth, which will be the abode of the blessed.

4 Ezra. — This apocryph had a very wide circulation among the Greek and Latin fathers. In the Latin version it consists of sixteen chapters, of which, however, only iii.-xiv. are found in the other versions. To iii.-xiv., accordingly, the present notice is confined. After the example of most of the Latin MSS. we designate the book 4 Ezra (see Bensly-James, Fourth Book of Ezra, pp. xxiv.-xxvii.). In the first Arabic and Ethiopic versions it

is called 1 Ezra ; in some Latin MSS. and in the English Authorized Version it is 2 Ezra, and in the Armenian 3 Ezra. Chapters i.~~ii. are sometimes called 3 Ezra, and xv.~~ xvi.5Ezra. All the versions go back to a Greek text. This is shown by the late Greek apocalypse of Ezra (Tischen-dorf. Apocalypses Apocryphoe, 1866, pp. 24-33), the author of which was acquainted with the Greek of 4 Ezra ; also by quotations from it in Barn. iv. 4; xii. 1=4 Ezra xii. 10 sqq. V. 5 ; Clem. Alex. Strom, iii. 16 (here first expressly cited^=4 Ezra, v. 35, &c. (see Bensly-James, op. dt. pp. xxvii.~~xxxviii.). In his Messias Judaeorum, 1869, pp. 36~~ 110, Hilgenfeld has given a reconstruction of the Greek text. Till 1896 only Ewald believed that 4 Ezra was written originally in Greek. In that year Wellhausen (Qiitt. Gel. Anz. pp. 12-13) and Charles (Apoc. Bar. p. IxxiL) pointed out that a Hebrew original must be assumed on various grounds ; and this view the former established in hi§ Skizzen u. Vorarbeiten, vi. 234-240, 1899. Of the numerous grounds for this assumption it wUl be neces-sary only to adduce such constructions as ” de quo me interrogas de eo,” iv. 28, and xiii. 26 “qui per semet ipsum liberabit” (=^3”i^t<)=" through whom he will deliver, " or to point to such a mistranslation as vii. 33, "longanimitas congregabitur," where for "congregabitur " (= lONi) yfQ require " evanescet," which is another and the actual meaning of the Hebrew verb in this passage. The same mistranslation is found in the Vulgate in Hosea iv. 3. This view has been adopted in Gunkel's German translation of Ezra (Kautzseh, Apok. u. Pseud, d. A. T. ii. 332-33^).

Latin Version. — ^All the older editions of this version, as those of Fabricius, Sabatier, Volkmar, Hilgenfeld, Fritzsche, as well as in the older editions of the Bible, are based ultimately on only one MS., the Codex Sangermanensis (written a.d. 822), as Gilde- meister proved in 1865 from the fact that the large fragment between verses 36 and 37 in chapter vii., which is omitted in all the above editions, originated through the excision of a leaf in this MS. A splendid edition of this version based on MSS. containing the missing fragment, which have been subsequently discovered, has been published by Bensly-James (pp. cit.). This edition has taken account of all the important MSS. known, save one at Leon in Spain.

Syriac Version. — ^This version, found in the Ambrosian Library in Milan, was translated into Latin by Ceriani, Monumenta sacra et profana, II. ii. pp. 99-124, 1866. Two years later this scholar edited the Syriac text, op. dt. V. i. pp. 4^111, and in 1888 repro- duced the MS. by photo-lithography (Translatio Syra Peshitto V. T. IL iv. pp. 553-572). Hilgenfeld incorporated Ceriani's Latin trans- lation in his Messias Judceorum. This translation needs revision and correction.

Ethiopia Version. — First edited and translated by Laurence, Primi Ezrm Libri Versio ^thiopica, 1820. Laurence's Latin translation was corrected by Prsetorius and reprinted in Hilgen- feld's Messias Judceorum. In 1894 Dillmann's text based on ten MSS. was published — V. T. .^Hh. Libri Apocryphi, v. 153-193.

Arabic Versions. — The first Arabic version was translated from a MS. in the Bodleian Library into English by Ockley (in Whiston's Primitive Christianity, vol. iv. 1711). This was done into Latin and corrected by Steiner for Hilgenfeld's Mess. Jud. The second Arabic version, which is independent of the first, has been edited from a Vatican MS. and translated into Latin by Gildemeister, 1877.

Armenian Version. — First printed in the Armenian Bible, 1805. Translated into Latin by Petermann for Hilgenfeld's Mess. Jud.

Relation of the above Versions. — These versions stand in the

order of worth as follows : — Latin, Syriac, Ethiopic. The remain- ing versions are pai'aphrastic and less accurate, and are guilty of additions and omissions. AU the versions, save the second Arabic one, go back to the same Greek version. The second Arabic version presupposes a second Greek version.

Modern Versions. — All the English versions are now antiquated, except those in the Variorum Apocrypha and the Revised Version of tie Apocrypha, and even these are far from satisfactory. Similarly, all the German versions are behindhand, except the excellent version of Gunkel in Apok. u. Pseud, ii. 252-401, which, however, needs oocasioujal correction.

The book (iii.-xiv.) consists of seven visions or parts, like the apocalypse of Baruch. They are : (1) iii. 1-v. 19 ; (2) V. 20-vi. 34 ; (3) vi. 35-ix. 25 ; (4) ix. 26-x. 60 ; (5) xi. 1-xii. 51 ; (6) xiii. ; (7) xiv. These deal with (1) religious problems and speculations (2) and eschatological ques- tions. The first three are devoted to the discussion of relig- ious problems affecting in the main the individual. The presuppositions underlying these are in many cases the same as those in the Pauline Epistles. The next three visions are principally concerned with eschatological problems which relate to the nation. The seventh vision is a fragment of the Ezra Saga recounting the rewriting of the Scriptures, which had been destroyed. This has no organic connexion with what precedes. According to Gunkel {Apok. u. Pseud, ii. 336-352) the whole book is the work of' one writer. Thus down to vii. 16 he deals with the problem of the origin of suffering ia the world, and from vii. 17 to ix. 25 with the question who is worthy to share in the blessedness of the next world. As regards the first problem the writer shows, in the first vision, that sufferiag and death come from sin — ^no less truly on the part of Israel than of all men, for God created man to be immortal ; that the end is nigh, when wrongs wUl be righted ; God's rule will then be recog- nized. In the second he emphasizes the consolation to be found in the coming time, and in the third he speaks solely of the next world, and then addresses himself to the second problem. The fourth, fifth, and sixth visions are eschatological. In these the writer turns aside from the religious problems of the first three visions and concerns himself only with the future national supremacy of Israel. Zion's glory will certainly be revealed (vision four), Israel will destroy Eome (five) and the hostUe Gentiles (six). Then the book is brought to a close with the legend of Ezra's restoration of the lost Old Testament Scriptures.

In the course of the above work there are many incon- sistencies and contradictions. These Gunkel explains by admitting that the writer has drawn largely on tradition, both oral and written, for his materials. Thus he con- cedes that eschatological materials in v. 1-13, vi. 18-28, vii. 26 sqq., also ix. 1 sqq., are from this source, and ap- parently from an originally independent work, as Kabisch urges, but that it is no longer possible to separate the borrowed elements from the text. Again, in the four last visions he is obliged to make the same concession on a very large

scale. Vision four is based on a current novel, which the author has taken up and put into an allegorical form. Visions five and six are drawn from oral or written tradition, and relate only to the political expectations of Israel, and seven is a reproduction of a legend, for the independent existence of which evidence is furnished by the quotations in Bensly-James, pp. xxxvii.xxxviii. Thus the chief champion of the unity of the book makes so many concessions as to its dependence on previously exist ing sources that, to the student of eschatology, there is little to choose between his view and that of Kabisch. In fact, if the true meaning of the borrowed materials is to be discovered, the sources must be disentangled. Hence the need of some such analysis as that of Kabisch {Das vierte Buck ^z?-a, 1889): S=an Apocalypse of Salathiel, ciro. A.D. 100, preserved in a fragmentary condition, iii. 1-31,

iv. 1-61, V. 136-vi. 10, 30-vii. 25, vii. 45-viii. 62, ix. 13- X. 67, xii. 40-48, xiv. 28-36. E = an Ezra Apocalypse, circ. 31 B.C., iv. 62-v. 13a, vi. 13-28, vii. 2644, viii. 63- ix. 12. A = an Eagle Vision, circ. a.d., 90, x. 60-xii. 36. M = a Son-of-Man Vision, xiii. E^ = an Ezra fragment, circ. A.D. 100, xiv. l-17a, 18-27, 36-47. All these, accord- ing to Kabisch, were edited by a Zealot, circ. 120, who supplied the connecting links and made many small additions. In the main this analysis is excellent. If we assume that the editor was also the author of S, and that such a vigorous stylist, as he shows himself to be, recast to some extent the materials he borrowed, there remains but slight difference between the views of Kabisch and Gunkel. Neither view, however, is quite satisfactory, and the problem still awaits solution. Other attempts, such as Ewald's {Oesch. d. Volkes IsraeP, vii. 69-83) and De Eaye's (Apocalypses Juives, 165-165), make no contribution.

Time and Place. — The work was written towards the close of the 1st century (iil. 1, 29) and somewhere In the east.

Literature. — In addition to the authorities mentioned above, see DiUmann, Herzog's Seal Enkyh.^ xii. 353 eqq. ; Schiirer, Oesch. des Jud. Volkes^, iil. 246 sqq. ; and the articles on 4 Esdras in Hastings' Bible

Dictionary and the Encyclopcedia Biblica by Thackeray and James respectively.

The Assumption of Moses. — This book was lost for many centuries till a large fragment of it was discovered and published by Ceriani in 1861 {Monummia Sacra, 1. i. 55-64) from a palimpsest of the 6th century. Very little was known about the contents of this book prior to this discovery. One passage found in this fragment is quoted in the Acta Synodi Niccenoe, ii. 18. Most of the other references relate to the strife of Michael and Satan about , the body of Moses, and ascribe it the Ascensio Mosis, i.e., 'Avd\ri\j/L^ McoDtre'ojs. (Various other works have been attributed to Moses, such as the Petirath Moshe, the)8i)8\os \6ya>v Mv

Editions and Translations. — In addition to those men- tioned in Ency. Brit. ii. 177, the only complete edition has been published by Charles, The Assumption of Moses, 1897. A German translation, with notes by Clemen, will be found in Kautzsch's Apok. und Pseud, ii. 311-331. That our Latin text is derived from the Greek there can be no question. Thus Greek words are transliterated, as " chedrio " from KeSpom, " heremus " from tp^juos ; Greek idioms are reproduced, as "usque nos duoi captivos "= Icos Tov ■^fiai al)(fuiX.

The present book is possibly the long-lost Aia^ijio; Mojuo-ectfs mentioned in some ancient lists ; for it never speaks of the assumption of Moses, but always of his natural death (i. 15, iii. 13, x. 14). About a half of the original Testament is preserved in the L^itin version. The latter half probably dealt with questions about the Creation. (See Fabric. Cod. Psewd. V. T. ii. 844 ; Acta Synodi Mcoence, ii. 20.) With this "Testament" the "Assumption," to which almost all the patristic references an^ that of Jude are made, was subsequently edited. The book has been assigned to most periods between the

death of Herod the Great and that of Bar-Cochba. But the text precludes any date after a.d. 70. The true date appears to lie between 4 b.c. and a.d. 30. Herod is already dead (vi. 6), hence it is after 4 b.c. ; and Herod's sons are to rule for shorter periods than their father, hence it must have been composed before these princes had reigned thirty-four years — i.e., before a.d. 30. It may also > be shown that a.d. 7 is probably the earlier limit (see Charles, op. cit. pp. Iv.-lviii.). As for the author, he was no Essene, for he recognizes animal sacrifices and cherishes the Messianic hope ; he was not a Sadducee, for he looks forward to the establishment of the Messianic kingdom(x.); nor a Zealot, for the quietistic ideal is upheld (ix.) and . the kingdom is established hj God Himself (x.). He is therefore a Chasid of the ancient type, and glorifies the ideals which were cherished by the old Pharisaic party, but which were now being fast disowned in favour of a more active role in the political life of the nation. He pours his most scathing invectives on the Sadducees, who are described in vii. in terms that recall the anti-Sadducean Psalms of Solomon. His object, therefore, is to protest against the growing secularization of the Pharisaic party through its adoption of popular Messianic beliefs and political ideals.

See Ency. Brit. ii. 177; Ency. Bibl. i. 233-236; Burkitt in Hastings' Bible Diet. iii. 448-450 ; Charles, Assumption of Moses, 1897; Schiirer, &esch. d. Jud. Volkes», 1900, pp. 213-222.

Book of Noah. — Though this book has not come down to us independently, it has in large measure been incorporated in the Ethiopic Book of Enoch, and (jan in part be reconstructed from it. The Book of

Noah is mentioned in Jubilees x. 13, xxi. 10. Ch. Ix., Ixv.-lxix. 25 of the Ethiopic Enoch are without question derived from it. Thus Ix. 1 runs : " In the year 500, in the seventh month ... in the life of Enoch." Here the editor simply changed the name Noah in the context before him into Enoch, for the statement is based on Gen. v. 32, and Enoch lived only 366 years. Chapters vi.-xi., cvi.-cvii. of the same book are probably from the same source ; likewise liv. 7-lv. 2, and Jubilees vii. 26-39, x. 1-16. In the former passage of Jubilees the subject-matter leads to this identification, as well as the fact that Noah is represented as speaking in the first person, although throughout Jubilees it is the angel that speaks. Possibly Eth. En. xii. 3-8, xliii.- xliv., lix., are from the same work. The book may have opened with Eth. En. cvi.-cvii. On these chapters may have followed Eth. En. vi.-xi., Ixv.-lxix. 26. Ix., xii. 3-8, xliii.-xliv., liv. 7-lv. 2; Jubilees vii. 26-39, x. 1-16. Since some of these chapters are earlier than Eth. En. Ixxxiii.-xc. and Jubilees, the original work is not later than 166 b.c. (See Hastings' Bible .Diet. iii.

686-587.)

*The Hebrew Book of Noah, a later work, is printed in Jellinek's Bet horMidrasch, iii. 165-156, and translated into German in Eonsch, Das Buch der Jubilaen, 386-387. It is based on the part of the above Book of Noah which is preserved in Jubilees. The portion of this Hebrew work which is derived from the older work is reprinted in Charles's Ethiopic version of the Hebrew 5ooifc of Jubilees, p. 179. -^*

Testaments of the XII Patriarchs.— The earliest reference to this book is found in Origen in his Horn. in Josuam, xv. 6 (Ed. Lommatzsch, xi. 143): "In aliquo quodam libello qui appellatur testamentum duodecim patriarcharum, quamvis non habeatur in canone, talem tamen quendam sensum invenimus, quod per singulos peccantes singuli Satanse intelligi debeant" (c/. Eeuben, iii.). The Testaments are mentioned simply as Uarpiapxai- in the Stichometry of Nicephorus,the Synopsis Athanasii, and the anonymous list of books edited by Montfaucon and others. From this period the Testaments

APOCALYPTIC AND APOCEYPHAL LITEEATURE

were lost sight of till the 13th century, when they were translated into Latin from a 10th-century MS. (now in Cambridge) by Grosseteste, bishop of Lincoln. The work consists of the dying commands of the twelve sons of Jacob to their children. Each> testament treats of a special virtue or vice which finds illustration in the life of the particular patriarch. Three elements are dis- tinguishable in each testament : — (1) The patriarch in each gives an account of his life, dwelling with particular emphasis on his particular virtues or vices. In many respects these accounts are of the nature of a Midrash on the Biblical notices concerning him, but in some instances they are in sharp conflict with them. (2) After the historical or legendary notices just referred to the patriarch gives appropriate exhortations, naturally suggested by the qualities conspicuous in his own career. (3) Finally he appends a series of predictions.

‘ Grabe (Spidleg. Patrum\ 1714, i. 129-1,44, 335-374) was the first to suggest that the work was written by a Jew and subsequently interpolated by a Christian. Most subsequent writers, however, rejected Grabe’s view, and so the exegesis of the book became a mere series of fruitless logomachies till Schnapp revived Grabe’s hypothesis in an excellent piece of work, Die Test, der XII Pair, untersvxht, 1894, Halle. This cri1;ic has tried to prove, firstly, that in its original form the book consisted of biographical details respecting each of the patriarchs, and exhortations suggested by these details : next, that this work was revised by a Jew, who added the portions of an apocalyptic or predictive nature : and thirdly, that the book thus enlarged was revised by a Christian, who modified some passages and in others introduced inter- polations. The third thesis has been confirmed by Cony- beare’s collation of the Armenian version (Jewish Quarterly Review, 1893, 387 sqq.; 1896, 260 sqq., 471 sqq.) which omits most of the Christian passages in the Greek version. But Bousset has overthrown Schnapp’s second thesis and shown that the apocalyptic sections belonged to the origi- nal work : see ” Die Testamente der Zwolf Patriarchen ” in the second number of Preuschen’s Zeitschr. f. d. NTliche Wissenschaft.

Till the last few years it has been generally believed that the Testaments were originally written in Greek. But this appears most improbable, and there are good grounds for supposing a Semitic original. In the first place, the greater part of the work cannot be later than 100 B.C. In the next the Greek is thoroughly Semitic in character. Gaster has published a Hebrew text of the Testament of Naphtali, which he holds to be the original of the Greek. That this is not so, the present writer has shown in Ency. Biblica, i. 239-240. Gaster's text, which is a late compilation possessing some materials in common with the Greek, is nevertheless of service in explaining through the Hebrew how one hopelessly corrupt passage in the Greek arose. Furthermore, in favour of a Hebrew original, it may be jirged that — (1) Hebrew constructions are frequent ; (2) paronomasiae, which are lost in the Greek but can be restored by re-translation, are frequent ; and (3) certain passages which are unintelligible in the Greek become clear on re- translation. On the other hand, see Pass and Arend- zen's " Fragment of an Aramaic Text of the Testa- ment of Levi" in Jewish Quarterly Review, 1900, pp.

651-661.

Versions. — The Greek version was edited by Sinker from two MSS. in 1869 and the variants of two other MSS. in an appendix in 1879. This scholar has long promised a new edition from six MSS., and another is sa\d to be in preparation by von Gebhardt. There were also early Syriac and Armenian versions. Of the former only a small fragment survives. The latter was published at Venice in 1896. Most of its variants have been made accessible through Conybeare in the Jewish Quarterly Beview above referred

to, and through "Preuschen's Die armenische Uebersetzung der Testamente der zwblf Patriarchen" in the second number of Preuschen's Z. f. d. NTliche Wissensch. u. d. Kunde d. Urchris- tenthums, 1900.

Date. — Excluding the Christian additions, which were made at different dates down to the 5th century, the work was composed . towards the close of the 2nd century B.C., with the exception of Levi X. xiv.-xvi., Judah xxii.-xxv., and certain fragments in Dan. V. and Zebulon ix., which belong to the 1st century b.c. See Bousset in Preuschen's review

(mentioned above), 1900, pp. 142-175, 187-209, and the articles by Charles, in loc, in incy. Biblica, i. 237-241, and Hastings' Bible Dictionary, iv.

Psalms of Solomon. — These psalms, in all eighteen, enjoyed but small consideration in early times, for only six direct references to them are found in early literature. Their ascription to Solomon is due solely to his scribes, for no such claim is made in any of the psalms.

There are only three valuable editions of the text : — Ryle and James, S^oX/noi ZoXo/ttfli/Tos, The Psalms of the Pharisees, 1891, from five MSS.; Swete, The Old Testament in Oreek, iii. 1894, 765-787, from six MSS. ; Gebhardt, St'oX/ioi 2oXo/iiS»Tos — Die Psalmen Salomonis zum ersten Male mit Benutzung d. Athoshand- sehriften und d. Cod. Casanatensis, 1895, from five MSS., three of which are used for the first time. The best recent translation into English is that of Ryle and James. It has been done into German by Wellhausen in the appendix to his Die Pharisder u. Sadducaer, 1874, and recently by Kittel in Kautzsch's Apok. u. Pseud, des A. T. ii. 130-148. The latter translation is based on Gebhardt's text.

The second psalm was written soon after 48 b.c, for it contains a triumphant reference to Pompey's death, ii. 29-31. Pss. i., viii., and xvii. fall between 63 and 48 ij.c, for they presuppose Pompey's capture of Jerusalem, but show no knowledge of his death. Pss. v., vii., ix.,. xiii.^ XV., belong apparently to the same period, but iv. and xii. to an earlier one. On the whole Ryle and James are no doubt right in assigning 70-40 b.c. as the limits within which the psalms were written. The authors were Pharisees. They divide their countrymen into two classes — "the righteous," ii. 38-39, iii. 3-5, 7, 8, &c., and "the sinners," ii. 38, iii. 13, iv. 9, &c. ; "the saints," iii. 10, &c., and "the transgressors," iv. 11, &c. The former are the Pharisees ; the latter the Sadducees. They pro- test against the Asmonsean house for usurping the throne of David and laying violent hands on the high priest- hood, xvii. 5, 6, 8, and proclaim the coming of the Messiah, the Son of David, who is to set all things right and establish the supremacy of Israel. . Pss. xvii.-xviii. and i.-xvi. cannot be assigned to the same authorship. The hopes of the Messiah are confined to the

former, and a somewhat different eschatology underlies the two works (see Charles, Eschatology : Hebrew, Jewish, and Christian, 220-225). There can be no doubt that Hebrew was the original language. This would follow from the fact that they were sung in the 'public worship of the synagogue, as we infer from the inscriptions. But independently of this fact it is impossible to translate the Greek intel- ligibly, save on this hypothesis : see the excellent com- mentary of Ryle and James, pp. Ixxvii.-lxxxvii. Since the Psalms were written in Hebrew, and intended for public worship in the synagogues, it is most probable that they were composed in Palestine. Besides, not a shred of evidence can be adduced in favour of any other country.

In addition to the literature mentioned above and in Ryle and James's edition, Schiirer's Gesch. des. JUd. Volkes% iii. 150 sqq., see Ency. Biblica, i. 241-245.

Lost Apocalypses : Prayer of Joseph. — The Prayer of Joseph is quoted by Origen [/w Joann. II. xxv. (Lom- matzsch, i. 147, 148) ; in Oen. III. ix. (Lommatzsch, viii. 30-31)]. The fragments in Origen represent Jacob as speaking and claiming to be " the first servant in God's presence," " the first-begotten of every creature animated by God," and declaring that the angel who wrestled with Jacob (and was identified by Christians with Christ) was

only eighth in rank. The work was obviously anti-Chris- tian. (See Schlirer ', iii. 266-2660

Booh of Eldad and Modad. — ^This book was written in the name of. the two prophets mentioned in Num. xi. 26-29. It consisted, according to the Targ. Jon. on Num. xi. 26-29, mainly of prophecies on Magog's last attack on Israel. The Shepherd of Hermas quotes it Vis. ii. 3. (See Marshall in Hastings' Bible Dictionary,

Apocalypse of Elijah. — This apocalypse is mentioned in two of the lists of books. Origen, Ambrosiaster, and Euthalius ascribe to it 1 Cor. ii. 9. If they are right, the apocalypse is pre-Pauline. The peculiar form in which 1 Cor. ii. 9 appears in Clemens Alex. Protrept. x. 94, and the Const. Apost. vii. 32 shows 'that both have the same source, probably this apocalypse. Epiphanius {Hoer. xlii. ed. Oehler, vol. ii. 678) ^ascribes to this work Eph. v. 14. Isr. Levi (Bevue des Etudes Juives, 1880, i. 108 sqq.) argues for the existence of a Hebrew apocalypse of Elijah from two TaJmudic passages. A late work of this name has been published by Jellinek, Bet ha- Midrasch, 1855, iii. 65-68 and Buttenwieser in 1897. Zahn, Gesch. des NTKanons, ii. 801-810, assigns this apocalypse to the 2nd century a.d. (See Schlirer ', iii.

267-271.)

Apocalypse of Z^haniah. — Apart from two of the lists this work is known to us in its original form only through a citation in Clem. Alex. Strom, v. 11, 77. A Christian revision of it is probably preserved in the two dialects of Coptic. Of these the Achmim text is the original of the Sahidic. These texts and their translations have been edited by Steindorff, Die Apohalypse des Elias, eine un- bekannte Apohalypse und Bruchstiiche der Sophonias-Apohor lypse, 1899. As Scburer {Theol. Literaturzeitung, 1899, No. I. 4-8) has shown, these fragments belong most prob- ably to the Zephaniah apocalypse. They give descriptions of heaven and hell, and predictions of the Antichrist. In their present form these Christianized fragments are not earlier than the 3rd century. (See Schlirer, Gesch. des JU. Volkes\ iii. 271-273.) ■

(iv.) Wisdom Literature.

The Pirhe Aboth. — These sayings of the Jewish fathers are preserved in the 9th Tractate of the Fourth Order of the Mishna. They are attributed to some sixty Jewish teachers, and the collection is divided into five chapters. These teachers belong for the most part to the years A.D. 70-170, though a few of them are of a much earlier date. (See P. Ewald's Pirhe Aboth, 1825; Strack, Die Spruche der Vater', 1888; Taylor, Sayings of the Jewish Fathers", 1899.)

Sircich or Ecclesiasticus. — This book bore the name “Proverbs” (a’Ve’D), according to Jerome. It was also known as “The Wisdom of Jesus, the son of ^rach” (So^ta ‘Ii/o-oS vtoi? SojoaX) o^j iiiore shortly, So<^ta Seipax). In the Latin Church the book was, so far as we know, first ■called Ecdesiasticus in Cyprian (Testim. ii. 1 ; iii. 1, &c.). The expression " Libri ecclesiastici " in Church writers •designates the apocryphal books of the Old Testament in ■contradistinction from the canonical books. Among such books Ecclesiasticus was the Church book, kot i^ox^v. The name of the author is given in the Greek of 1. 27 as "Jesus, the son of Sirach," but in the Hebrew of 1. 27 and Ii. 30 as " Simon, son of Joshua, son of Eleazar, son of Sira."

The prologue states that the Sirach’s grandson went to Egypt in the 38th year of Euergetes. Since of the two Ptolemies who bore the surname of Euergetes, the first reigned only twenty-five years, it must be the second that is referred to here, i.e., Ptolemy VII. Physcon Euergetes II. This prince began to reign in 170 b.c.

Hence 132 is the date of the arrival of Sirach’s grandson in Egypt, and the composition of Sirach’s work would be from forty to seventy years earlier. Thus the date would lie between 200 and 170 b.o. This date would harmonize well with the apparently contemporary account of the High-priest Simon II. in 1. 1-26, who was in office about 200 B.C. Edersheim {Speaker’s Apocrypha, ii. 4-9) and others contest this view. See, , however, Ryssel (Kautz^ch’s Apok. u. Pseud, i. 234-239 ; Ency. Biblica, ii. 1170-1171). That this book was written in Hebrew is stated by Jerome ; but, with the exception of occasional sentences in the Talmud, it was lost to modern scholarship tUl 1896, when chaps, xxxix. 15-xlix. 11 were published by Cowley and Neubauer. This large fragment of the ori^nal text was found in a synagogue in Cairo. The discovery and publication of further fragments have fol- lowed in fast succession. In 1899 Schechter and Taylor edited chaps, iii. 6-vii. 29 ; xi. 34 ; xii. 2-xvi. 26 ; xxx. 11-xxxi. 11 ; xxxii. 1-xxxiii. 3 ; xxxv. 9-20 ; xxxvi. 1-21 ; xxxvii. 27-xxxviii. 27 ; xlix. 12-li. 30. In the same year G. Margoliouth published in the Jewish Quarterly Seview chaps, xxxi. 12-31 ; xxxvi. 22-xxxvii. 26 ; and on pp. 462- 465 of the same review in 1900 appeared further frag- ments discovered by Schechter, i.e., iv. 236, 30-31 ; v. 4-7, 9-13; XXV. 8&, 13,

17-24; xxvi. l-2ffl; xxxvi. 19a; and on pp. 466-480 fragments discovered by Adler, vii. 29-xi. 33 ; xii. 1 ; and on pp. 688-702 fragments discovered by Gaster, xviii. 31-xix. 2; xx. 5-7; xxxvii. 19, 22, 24, 26; xx. 13; and finally in the Bevue des Etudes Juives, 1900, pp. 1-30, the fragments discovered by Levi — xxxvi. 24-26 ; xxxvii 1-xxxviii. 1. Margoliouth's theory that these frag- ments are not part of the original Hebrew text, but of a mediaeval Hebrew version, is rejected almost universally, both by Jewish and Christian scholars.

Versions — Cfreek and Syriac. — These versions are from the Hebrew. The Greek is preserved in n A B C and Cod. Ven. of the UnciaJs, and in a large number of cursives. All these MSS. go back to the same Greek text, for they all attest the remarkable transposition in xxx.-xxxvi. The right order is preserved in the Syriao, Latin, and Arabic versions. We should, therefore, place xxx. 26-xxxiii. 13a after xzxiii. 136-xxxvi. 160. The right order appears, it is true, in Cursive 248, but the form of the text shows that the dislocation existed in the text from which it was derived, and was set right subsequently. The Greek and Syriac are invaluable in the criticism of the Hebrew fragments.

Latin and Other Versions. — The Latin version, which preserves the right order in xxx.-xxxvi., and is herein followed by the English version, was made from the Greek before these chapters were dislocated. This version dates from a.d. 200-250. ' It occa- sionally preserves the right text where the Greek has since become corrupt. The Syro-Hexaplaric, Ethiopio, Armenian, and Coptic versions were derived from the Greek after the transposition of chaps, xxx. -xxxvi.

Literature. — Owing to the recent discoveries and innumerable studies on the Hebrew texts and the various versions, all the earlier works are to a great degree antiquated. The best are Fritzsche's IHe Weisheit Jesus-Sirachs, 1859, and Edersheim's commentary in the Speaker^s Apocrypha, ii. 1-239. In the latter work and Schiirer's Oesch. des Jud. Volkes^, iii. 161-166, a full bibliography will be found. See particularly Toy in Ency. Bib. ii. 1164-1179. Smend has promised a comprehensive edition, taking into account all the most recent discovery and criticism.

II. — Hellenistic Literatuee.

(i.) Historical and Legendary.

Additions to Danid. — These are three in number: Susannah and the Elders, Bel and the Dragon, and The Song of the Tliree Children. Of these the two former have no organic connexion with the text. The case is otherwise with regard to the last. In some respects it helps to fill up a gap in the canonical text between Vferses 23 and 24 of chapter iii. And yet we find Polychronius, early in the 5th century, stating that this song was not found in the Syriac version.

Song of the Three Children. — This section is composed of the Prayer of Azaxiah and the Song of Azariah, Ananias, and Misael, and was inserted after iii. 23 of the canonical text of Daniel. According to Fritzsche, Konig, Schiirer, &c., it was composed in Greek and added to the Greeli translation. On the other hand, Delitzsch, Bissell, Ball, &c., maintain a Hebrew original. The latter view has been recently supported by Rothstein, Apok. und Pseud, i. 173-176, who holds that these additions were made to the text before its translation in Greek. These additions still preserve, according to Rothstein, a fragment of the original text, i.e., verses 23-28, which came between verses 28 and 24 of chapter iii. of the canonical text. They certainly fill up excellently a manifest gap in this text. "The Song of the Three Children" was first added after the verses just referred to, and subsequently the Prayer of Azariah was inserted before these verses.

Susannah. — This addition was placed by Theodotion before chap, i., and "Bel and the Dragon" at its close, whereas by the LXX. and the Vulgate it was reckoned as chap. xiii. after the twelve canonical chapters, Bel and the Dragon as xiv. Theo- dotion's version is the source of the Peshitto for all three additions, and the IiXX. is the source of the Syro-Hexaplaric, which has been published by Ceriani (iKbn. Sacr. vii.). The source of the story may, according to Ewald (Gescft.', iv. 636), have been suggested by the Babylonian legend of the seduction of two old men by the goddess of love. Daniel appears in this addition as a youthful judge. Notwithstanding

tJie paronomasiee on Greek words in verses 54-55, 58-59, to which attention was called by Julias Afrioanus and Porphyry, it is by no means certain that the original was Greek. We may have here a free rendering of a Semitic original (see Bludau, Die Alexandrinische Uebersetzung des Buches Daniel, 1897).

Bel and the Dragon. — We have here two independent narratives, in both of which Daniel appears as the destroyer of heathenism. The latter had a much wider circulation than the former, and is most probably a Judaized form of the old Semitic myth of the destruction of the old dragon, which represents primeval chaos ^ee Ball, Speaker' s^Apocr. ii. 346-348; Gunkel, Schopfung und Ghaos, 320-323). Most scholars maintain a Greek original, but this is by no means certain. Marshall (Hastings' Bible Diet. i. 268) argues for an Aramaic, and regards Gaster's Aramaic text (^Pro- ceedings of the Society of Biblical Archteology, 1894, pp. 280-290, 312-317 ; 1895, 75-94) as of primary value in this respect.

Additions to Esther: — These seven additions, written originally in Greek, ~~were interpolated in the Greek trans~~ lation of the Book of Esther. ^They consist of an edict of Haman, prayers of Mordecai and Esther, &c., and are so skilfully interpolated as to make no interruption in the history, though they occasionally contradict the canonical text. The Greek text appears in two widely- differing recensions. The one is supported by A B t«, and the other — a revision of the first — by codices 19, 93", 108'. The latter is believed to have been the work of Lucian. For an account of the Latin and Syriac versions, the Targums, and the later Rabbinic literature connected with this subject, and other questions relating to these addi- tions, see Fritzsche, Exeget. Handbuch zu den Apok. 1851, i. 67-108; Schurer, iii. 330-332; Fuller in Speaker's Apocr. i. 360-402; Eyssel, Kautzsch, Apok. u. Pseud. i. 193-212.*

Epistle of Jeremy. — This letter (see Ency. Brit. iii. 405-406) purports to have been written by Jeremiah to the exiles who were already in Babylon or on the way thither. Recent research has not done much to elucidate the difficulties of this writing (see Fritzsche, Handb. zu den Apok. 1851; Gifford, Speaker's Apocr. ii. 286-303; Marshall, Hastings' Bible Diet. ii. 578-579).

2 Maccabees. — This book (see Ency. Brit. xv. 131) was written in the Pharisaic interest, probably by an Alexandrian Jew, although his work shows no trace of distinctively Alexandrian Judaism. Its aim is religious rather than historical, and where it comes into collision with 1 Mace, its evidence is generally set aside as worth- less. On the other hand, it has undoubtedly a value of its own ; and at times, in accord with Josephus, who was unacquainted with it (cf. iv. ; vi. 2 ; xiii. 3-8 ; xiv. 1 ; see Grimm, Exeget. Handbuch, 1857, p. 13), it furnishes us, where 1 Mace, is silent, with historical materials of great worth. Geiger held that it was written as a deliberate

polemic against 1 Mace, and Kosters (Theol. Tijdschrifi, 1878, pp. 491-568) further argued that the so-called epito- mizer was the actual author, and merely assumed the mask of Jason's name for controversial purposes. Al- though Kamphausen {Apok. und Pseud, i. 84) follows Kosters' lead, this view is preposterous. That a writer who wished to advocate the doctrines of Pharisaism should seek authentication by appealing to the work of an African Jew, unless such a work were actually in exist- ence, would be without parallel in pseudepigraphic litera- ture. Moreover, the eschatological details which appear in its narrative are just such as fit in with the eschato- logical systems of the 2nd century B.C., and were certainly not the current views when the epitomizer wrote between 60 B.C. and a.d. 1.

3 Maccabees. — This so-called book of Maccabees (see Ency. Brit. xv. 131) is a piece of fiction, recording an attempted massacre of the Jews under Ptolemy IV. Philo- pator, and based in part on an old legend preserved in Josephus, Contra Apion, ii. 6. The date is quite uncertain — sometime between 100 b.o. and a.d. 70 (see Grimm's Exeget. Handbuch zu den Apok. 1853, vol. iii.; Bissell, Apocrypha, 1880, pp. 616-637 ; Kautzsch's Apok. u. Pseud. 1900, i. 119-135; Fairweather in Hastings' Bible Diet. iii. 192-194).

Prayer ofManasseh. — Scholars are not yet agreed as to the original language of this penitential psalm. Most take it to have been written in Greek, and with these Fritzsche, Schiirer, and Eyssel (Kautzsch, Apok. u. Pseud, i. 166-168) agree. On the other hand, Ftlrst,' Ewald, Ball, and

Budde argue for a Hebrew original. From the statements in 2 Chron. xxxiii. 12, 13, 18, 19, it follows that the chronicler found this prayer in Hebrew in his sources. The History of the Kings of Israel and The History of the Seers. Ewald regards the Greek as an actual translation of the lost Hebrew, but Ball more wisely takes it as a free rendering of a lost Haggadic narrative founded on the older docum-ent from which the chronicler drew his information. This view he supports by showing that there was once a considerable literature in circula/- tion regarding Manasseh's later history. Fritzsche, Ball, and Ryssel agree in assigning this psalm to the Maccabean period. Its eschatology and doctrine " of divine forgive- ness" may point to an earlier date. The best short account of the book is given by Ball (Speaker's Apo- crypha, ii. 361-371) ; see also Porter in Hastings' Bible Dictionary, iii. 232-233.

Tobit. — To the excellent account of this book in Ency. Brit, xxiii. 427-428, it will not be necessary to make any great addition. Notwithstanding the arguments of Gratz (Monatsschr. f Gesch. des Judenthnms, 1879, pp. 145 sqq., 386 sqq., 433 sqq., 609 sqq.), and of Rosenthal (Vier apo-kryphische BUcher, 1885, pp. 104-160), and of Fuller (Wace's Apocrypha, i. 1888, pp. 164-171) for a Hebrew original, the original language is generally, with Noldeke {Monatsberickte d. Berliner Akad. 1879, 46 sqq.), taken to be Greek. The following table constructed by the last-named scholar will explain most briefly the relations of the many versions of this book :

A (= Codex Alexandrinus) B. and c. Syriac (first halt) Ethiopic Hebrew of Fagius

Chaldee in

its original form

Old Latin

I Jerome's Version

Syriac (second half)

r

1

Bodleian Chaldee Hebrew of Miinster

The Hebrew texts published by Gaster, Proceedings of

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the Society of Bibl. Archmology, 1896, pp. 208-222, 259- 271 ; 1897, pp. 27-38, have no more claim to represent the original than those above referred to.

Place and Date. — The book was most probably written in Egypt subsequently to the Maccabean rising and before the building of the Herodian temple 26 b.c.

On the literary connexion with the story of Aehikar, see art. " Achiacharus " in Ency. Bibl.

(ii.) Apocalyptic Literature.

Slavonic Book of Enoch; or, the Booh of the Secrets of Enoch. — This new fragment of the Enochic literature has only recently come to light through five MSS. discovered in Eussia and Servia. Since about a.d. 500 it has been lost sight of. It is cited without acknowledgment in the Book of Adam and Eve, the Apocalypses of Moses anil Paul, the Sibylline Oracles, the Ascension of Isaiah, the Epistle of Barnabas, and referred to by Origen and Irenseus (see Charles, The Book of the Secrets of Enoch, 1895, pp. xvii.xxiv.). For Charles's editio princeps of this work, in 1895, Professor MorfiU translated two of the best MSS., as well as Sokolov's text, which is founded on these and other MSS. In 1896 Bonwetsch issued his Das slavische Henochbuch, in which a German translation of the above two MSS. is given side by side, preceded by a short intro duction. The main part of the book was written in Greek. This follows from the

fact that in xxx. 13 it is said that Adam's name is derived from the four quarters of the earth : that is, from the initial letters of dvaroX-^, Swts, &pKTXII. Patriarchs, which was written in Semitic and belongs to the 2nd and 1st centuries b.c. The book in its present form was written in Egypt, for many of its speculations are characteristic of Philo and other Hellenistic writers : its account of the creation, xxv. sq., betrays Egyptian elements, as well as its description of such creations as the Phoenixes and Chalkydries. Since this book quotes Ecclesiasticus, the Ethiopic Book of Enoch, and Wisdom (?), the terminus a qua cannot be earlier than 30 b.c, and the terminus ad quern must be assumed as earlier than A.D. 70, for the temple is still standing. The author was an orthodox Hellenistic Jew, who lived in Egypt. Thus he believed in sacrifices, xlii. 6, lix. 1, Ixvi. 2 ; in the law, lii. 9, 10 ; and in an immortality of the blessed, in which the righteous should be clothed in " the raiment of God's glory," xxii. 8. The writer is an eclectic. Platonic (xxx. 16), Egyptian (xxv. 2), and Zend (Iviii. 4-6) elements aJe incorporated in his system.

Oracles of Hystaspes. — See under N. T. Apocalypses..

Testament of Job. — This book was first printed from one MS. by Mai, Scnpt. Vet. Nov. Coll. 1833, vii. i. 180, and translated into Erench in Migne's Diet, des Apocryphes, ii. 403. An excellent edition from two MSS. is given by M. R. James, Apocryplm Anecdota, ii. pp. Ixxii.~~cii. 104~~ 137, who holds that the book in its present form was written by a Christian Jew in Egypt on the basis of a Hebrew Midrash on Job in the 2nd or 3rd century a.d. It is a cleverly-written work, but not of much value.

Testaments of the III Patriarchs. — ^Eor an account of these three Testaments (referred to in the Apost. Const, vi. 16), the first of which only is preserved in the Greek and is assigned by James to the 2nd century a.d., see that scholar's " Testament of Abraham," Texts and Studies, ii. 2, 1892, which appears in two recensions from six and three MSS. respectively, and Vassiliev's Anecdota Grceco- Byzantina, 1893, pp. 292-308, from one MS. already used by James. This work was written in Egypt, according to James, and survives also in Slavonic, Roumanian, Ethiopic,

and Arabic versions. It deals with Abraham's reluctance to die and the means by which his death was brought about. James holds that this book

is referred to by Origen (Hom. in Luc. xxxv.), but this is denied by Schtlrer, who also questions its Jewish origin. With the exception of chaps, x.-xi., it is really a legend and not an apocalypse. An English translation of James's texts will be found in the Ante-Nicene Christian Library, Clark, 1897, pp. 185- 201. The Testaments of Isaac and Jacob are still pre- served in Arabic and Ethiopic (see James, op. cit. 140-

161).

Sibylline Oracles. — We must here content ourselves in the main with referring the reader to Ency. Brit- ii. 177- 179, xxii. 13-14, for the treatment of this subject. Not much has been done for the exegesis of this book of recent years. The most important contributions are those of Zahn, "Ueber Ursprung und religiosen Charakter der Sibyllinischen Bilcher, iv. ; v. ; viii. 1-216 ; xii. ; xiii." in the Zeitschrift fiir kirchl. Wissensch. und kirchl. Leben, 1886, pp. 32-45, 77-87 ; Hirsch, Jewish Quarterly Beview, 1890, pp. 406429; Deane, Pseudepigrapha, 1891, pp. 276-344; Harnack, Gesch. der cdtchristl. Ldtteratur, i. 762, 861-863; ii. 1, 681-589; Charles, Eney. Biblica, i. 245-250; Schiirer', iii. 421-450; Blass in Kautzsch's Apok. u. Pseud, ii. 177-184. The best edition of the text is that of Ezach, Oracula Sibyllina, 1891. A Latin translation is appended to Alexandre's edition of the text and a German to that of Eriedlieb. A translation in English blank verse has been made by Terry, The Sibyl- line Oracles, 1899. A literal prose rendering, with some exegetical notes an^ a critical introduction, is a desideratum.

(iii.) Wisdom Literature.

4 Maccabees. — ^This book (see Ency. Brit. xv. 131) bears a distinctly philosophic character. It has the form of a sermon of the synagogue ; for, as Ereudenthal points out, it presumes the presence of an audience (i. 1, xviii. 1). On the other hand, it was undoubtedly composed with a view to publication in Jewish circles (xviii. 1), for its abstruse style is unfitted for an ordinary congregation. The author is a Hellenistic Jew, but his conception of Judaism is strongly influenced by Stoicism. He teaches that the true Stbic ideal is possible only in Judaism : the passions are to be mastered, not exterminated, by reason ; that is, by pious reason. Besides the Hellenistic view that only the soul can attain to a blessed immortality

(xiii. 16, XV. 2, xvii. 18) this writer teaches that the martyrdom of the righteous atones for the sjin of the people (vi. 29, xvii. 21). Eusebius's ascription of the book- to Josephus (H. E. III. x. 6) is certainly wrong. The more recent literature on this book comprisies Bensly's edition of the Syriac version of this book. The Fourth Book of Maccabees . . . in Syriac, first edited . . . by the Me R. L.Bensly,with an introduction and translations by Barnes, 1895 ; Swete's Old Testament in Greek, 1894, iii. 729 sqq. Swete gives the text of A and variants from K, the Cod. Ven., and certain fragments of Tischendorf. A German translation based on the above materials will be found in Kautzsch, Apok. u. Pseud, ii. 152-177.

5 Maccabees. — See Ency. Brit. xv. 131.

Wisdom of Solomon. — This pseudepigraph claims to have been written by King Solomon (vii.-ix., cf. ix. 7-8). The writer shows a close acquaintance with the canonical books bearing the name of Solomon. Siegfried (Kautzsch, Apok. u. Pseud, i. 476) is of opinion that this work is a deliberate polemic against the Epicurean-minded author of Ecclesi-astes, and seeks to present Solomon as an example of Jewish piety. The book was written in Greek by an Alexandrian Jew. Though the Greek has many

Hebraisms (see Grimm, Buck der Weisheit, 1860, p. 5 ; Earrar, Speaker's Apocrypha, i. 404) the author displays a remarkable mastery in his use of it. Margoliouth has sought to show that it was composed not in Greek but in later Hebrew (Journal of the Royal Asiatic Society, 1890, pp. 263-297). But the strongly idiomatic character of its language, the philosophic cast of the thought, its Hellenistic theology and eschatology (Charles, Eschatology : Hebrew, Jewish, and Christian, 1899, pp. 251-258) prove incon- testably its original composition in Greek (see Freuden- thal's review of Margoliouth in the Jewish Quarterly Review, 1S91, pp. 722-753). The author was a Jew well versed in Greek literature. Occasionally, it is true, he uses words in a non-Greek sense ; but on the other hand he is so thoroughly at home in Greek that, like Philo, he ventures to coin new

compound words and phrases. Furthermore, he was a student of Greek philosophy, especially of Plato and the Stoics, and uses familiarly the technical language of the schools (Grimm, op. cit. pp. 19- 20 ; , Farrar, op. cit. i. 407). The references to Egyptian animal-worship in xv. 18, 19, xvi. 1, 9, and the Hellenistic type of eschatology point to Egypt as the home of the author. The book is later than Ecclesiasticus, and probably earlier than Philo's writings. Hence in all likelihood it originated at some time within the years 150 B.C. and a.d. 10. The writer's object is to warn men against the folly of ungodliness, and particularly of idolatry. He takes his stand on the current dogmas of Platonic philosophy as to the essentially evil nature of matter and the pre-existence of the soul. Hence he teaches not the resurrection of the body but the immortality of the soul. This consummation can be attained only through the life of wisdom.

Texts, Versions, and Editions. — In The Old Testament in Greek, ii., Swete follows B, and gives in the notes the variants of n, A and C. Fritzsohe, in his Libri Apocryphi V. T. Greece, 1871, gives, in addition to the documents of the above MSS., those of Cod. Ven., the cursives and the versions ; but his collation of B is untrust- worthy. In The Book of Wisdom, 1881, Deane gives the Greek text (agreeing mostly with Fritzsohe) , the Latin version, and an English translation and commentary. Besides the Latin there are Syriac, Ethiopic, Armenian, and Arabic versions. Of these the Ar- menian is said to be the most faithful. For literature generally, see Sohiirer, iii. 382-383.*

New Testambn-t Apocktphal Liteeatueb.'

(i.) Gospels.

Gospel according to the Egyp- tians. Fayum Gospel Fragment. Gospel according to the Hebrews. Protevangel of James. The Logia (?). Gospel of Nicodemus. Gospel of Peter. Gospel of Thomas. Gospel of the Twelve.

(ii.) Acts and Teachings of the Apostles.

Acts of Andrew.

Acts of John.

Acts of Paul.

Acts of Paul and Thecla,

Gnctetic Acts of Peter.

Preaching of Peter.

Acts of Thomas.

Teaching of the Twelve Apostles.

(iii.) Hpistles.

The Abgarus Epistles.

Epistle of Paul to the Laodloeans.

Third Epistle of Paul to the Co- rinthians, and the Epistle of the Corinthians to Paul.

(iv.) Apocalypses.

Greek Apocalypse of Baruch. Testament of Hezekiah. Oracles of Hystaspes. Vision of Isaiah. Apocalypse of Peter.

I. — Gospels.

Gospel according to the Egyptians. — This gospel is first mentioned by Clem. Alex. (Strom, iii. 63, 93), subse- quently by Origen (Horn, in Luc. i.) and Epiphanius (Hcer. Ixii. 2), and a fragment is preserved in the so-called epistle of Clem. Rom. xii. It circulated among various heretical circles : amongst the Encratites (Clem. Strom.

1 Only such works as were written or are supposed to have been written before ajj. 170 will be considered here.

iii. 9), the Naassenes (Ps. Orig. Philos. v. 7), and the Sabellians (Epiph. H(xr. Ixii. 2). Only three or four fragments survive ; see Lipsius (Smith

and Wace, Diet, of Christ. Biog. ii. 712, 713) ; Zahn, Gesch. d. NTlichen Kanons, ii. 628-642; Preuschen, Reste d. ausserkanoni- schen Evangelien, 1901, p. 2, which show that it was a product of pantheistic Gnosticism. Lipsius and Zahn assign it to the middle of the 2nd century.

Fayum Gospel Fragment. — This small fragment contains two sayings of Christ and one of Peter, such as we find in the canonical gospels, Mt. xxvi. 31-34, Mki xiv. 27-30. The papyrus, which is of the 3rd century, was discovered by Bickell among the Raines collection, who characterized it (Z. f kath. Theol. 1885, pp. 498-504) as a fragment of one of the primitive gospels mentioned in Luke i. 1. On the other hand, it has been contended that it is merely a fraginent of an early patristic homily. (See Zahn, op. cit. ii. 780-790 ; Harnack, Texte und Untersuchungen, v. 4 ; Preuschen, op. cit. p. 19.)

Go^el according to the Hebrews. — This gospel was cited by Ignatiiis (Ad Smymoeos, iii.) according to Jerome (Viris illus. 16, and in Jes. lib. xviii.), but this is declared to be untrustworthy by Zahn,. op. cit. i. 921 ; ii. 701, 702. It was written in Aramaic in Hebrew letters, according to Jerome (Adv. Pelag. iii. 2), and translated by him into Greek and Latin. Both these translations are lost. A collection of the Greek and Latin fragments that have survived, mainly in Origen and Jerome, will be found in Hilgenfeld's NT extra Canonem receptum, Nicholson's Gospel according to the Hebrews (1879), Westcott's Introd: to the Gospels, and Ziahn's Gesch. des NTlichen Kanons, ii. 642-723 ; Preuschen, op. cit. 5-11. This gospel was regarded by many in the first centuries as the Hebrew original of the canonical Matthew (Jerome, in Matt. xii. 13 ; Adv. Pelag. iii. 1). With the canonical gospel it agrees in some of its sayings ; in others it is independent. It circulated among the Nazarenes in Syria, and was composed, accord- ing to Zahn (op. cit. ii. 722), between the years 135 and 150. Jerome identifies it with the Gospel of the Twelve (Adv. Pelag. iii. 2), and states that it was used by the Ebionites (Comm. in Matt. xii. 13). Zahn (op. cit. ii. 662, 724) contests both these statements. The former he traces to a mistaken interpretation of Origen (Horn. I. in Luc). Lipsius, on the other hand, accepts the statements of Jerome (Smith and Wace, Diet, of Christian Biography, ii. 709-712), and is of opinion that this gospel in the form in which it was known to Epiphanius, Jerome, and Origen, was " a

recast of an older original," which, written origin- ally in Aramaic, was nearly related to the Logia used by St Matthew and the Ebionitic writing used by St Luke, " which itself was only a later redaction of the Logia."

Protevangel of James.— This title was first given in the 16th century to a writing which is referred to as The Book of James (^ Bi^Koi 'laKw^au) by Origen (tom. xi. in Matt.). The narrative extends from the Conception of the Virgin to the Death of Zacharias. Lipsius shows that in the present form of the book there is side by side a strange " admixture of intimate knowledge and , gross ignorance of Jewish thought and custom," and that accord- ingly we must " distinguish between an original Jewish Christian writing and a Gnostic recast of it." The former was known to Justin (Dial. 78, 101) and Clem. Alex. (Strom, vii. 16), and belongs at latest to the earliest years of the 2nd century. The Gnostic recast Lipsius dates about the middle of the 3rd century. From these two works arose independently the Protevangel in its present form and the Latin pseudo-Matthaeus. The Evangelium de NcUivitate Marice is a redaction of the latter. (See Lipsius in Smith's Diet, of Christ. Biog. ii. 701-703.) Zahn (Gesch. Kanons, i. ^Sh, 499, 602, 504, 539; ii. 774-780) assigns the Protevangel to the first decade of the 2nd century.

Tlie Logia (q.v.). — This name is given to the sayings contained in a papyrus leaf by its discoverers Grenf ell and Hunt. They think the papyrus was probably written about A.D. 200. According to Harnack, it is an extract from the Gospel of the Egyptians.

Gospel of Nicodemus. — This title is first met with in the 13th century. It is used to designate an apocryphal writing entitled in the older MSS. " viroiivrumTo. tou KvpLOV ■^/j.Siv 'Iijo-oB XpiiTTOv TTpaxOivTa e-irl TIovTiau HtXaTOv : " also "Gesta Salvatoris Domini . . . inventa Theodosio magno imperatore in Jerusalem in prsetorio Pontii, Pilati in codicibus publicis." See Tischendorf, Evan- gelia Apocrypha', pp. 333-

*335. This work gives an account of the Passion (i.-xi.), the Eesurrection (xii.-xvi.), and the Descensus ad Inferos (xvii.-xxvii.). Chapters i.~~xvi. are extant in the Greek, Coptic, and two Armenian versions. The two Latin versions and a Byzantine re~~ cension of the Greek contain i.-xxvii. (see Tischendorf, Evangelia Apocrypha^, pp. 210-458). All known texts go back to A.D. 425, if one may trust the reference to Theodosius. But this was only a revision, for as early as 376 Epiphanius (JSaer. i. 1) presupposes the existence of a like text. In 325 Eusebius {H. E. ii. 2) was acquainted only with the heathen Acts of Pilate, and. knew nothing of a Christian work. Tischendorf and Hofmann, however, find evidence of its existence in Justin's reference to the*AKTa JliXaTov (Apol. i. 35, 48), and in Tertullian's mention of the Acta Pilati (Apol. 21), and on this evidence attribute our texts to the first half of the 2nd century. But these references have been denied by Scholten, Lipsius, and Lightfoot. Eecently Schubert has sought to derive the elements which are found in the Petrine Gospel, but not in the canonical gospels, from the original Acta Pilati, while Zahn exactly reverses the relation of these two Works. Eendel Harris (1899) advocated the view that the Gospel of Nicodemus is a prose version of the Gospel of Nico- demus, written in Homeric centones as early as the 2nd century. Lipsius and Dobschiitz relegate the book to the 4th century. The question is not settled yet (see Lipsius in Smith's Diet, of Christ. Biography, ii. 708- 709, and Dobschiitz in Hastings' Bible Dictionary, iii.*

544-547).

Gospel of Peter. — Before 1892 we had some knowledge of this gospel. Thus Serapion, bishop of Antioch (a.d. 190-203), found it in use in the church of Ehossus in Cilicia, and condemned it as Docetic (Eusebius, H. E. yi. 12). Again Origen (in Matt. tom. xvii. 10) says that it represented the brethren of Christ as His half-brothers. In 1885 a long fragment was discovered at Akhmlm, and published by Bouriant in 1892, and subsequently by Lods, Kobinson, Harnack, Zahn, Schubert, Swete. Harnack holds that Justin used this gospel, and hence assigns its composition to the beginning of the 2nd century ; Sanday to 125, Zahn to 130, and Swete and Chase to 150.

*Gospel of Thomas. — This gospel professes to give an account of our Lord's boyhood. It appears in two recen- sions. The more complete recension bears the title ®o>/*a 'ItTpar/XiTov $tXo(7d<^pu piyra as Ta iraiSiKo, ToS Kvpiou, and treats of the period from the 7th to the 12th year (Tischendorf, Evangelia Apocrypha', 1876, 140-157). The more fragmentary recension gives the history of the childhood from the 5th to the 8th year, and is entitled "Siuyypap.pxL Toiv dyiov aTrocTToAou 0o)/ia 'Trepl ttJ's irmSiK^s Avaa-Tpo^^i Tov Kvpiov (Tischendorf, op. cit. pp. 158-163). Two Latin translations have been published in this work by the same scholar — one on pp. 164-180, the other under the wrong title, Pseudo-Matthcei Evangelium, on pp. 93^ 112. A Syriac version, with an English translation, was published by Wright in 1875. This gospel was originally still more Docetic than it now is, according to Lipsius. Its pre§ent form is due to an orthodox revision which*

discarded, so far as possible, all Gnostic traces. Lipsius (Smith's Diet, of Christ. Biog. ii. 703) assigns it to the latter half of the 2nd century, but Zahn (Gesch. Kan. ii. 771), on good grounds, to the earlier half. The latter scholar shows that probably it was used by Justin (Dial. 88). At all events it circulated among the Marcosians (Irenseus, Hoer. i. 20) and the Naasenes (Hippolytus, Befut. v. 7), and subsequently among the Manichseans, and is frequently quoted from Origen downwards (Horn. I. in Luc). If the stichometry of Nicephorus is right, the existing form of the book is merely fragmentary compared with its origi- nal compass.

Gospel of the Twelve. — This gospel, which Origen knew (Horn. I. in Luc), is not to be identified with the Gospel according to the Hebrews (see above), with Lipsius and others, who have sought to reconstruct the original gospel from the surviving fragments of these two distinct works. The only surviving fragments of the Gospel of the Twelve have been preserved by Epiphanius (Haer. xxx. 13-16, 22 : see Preuschen, op. cit. 9-11). It began with an account of the baptism. It was used by the Ebionites, and was written, according to Zahn (op. cit. ii. 742), about a.d. 170.

II. — Acta and Teaxihings of the Apostles.

Acts of Andrew. — These acts (referred to by Euseb. H. E. iii. 25 ; Epiph. H(Br. xlvii. 1, &c.) are ascribed to the authorship of Leucius. For a

complete discussion of the various documents see Lipsius, Apokryphen Apostel- geschichten, i. 543-622; also James in Hastings' Bible Diet. i. 92-93. The best texts are inBonnet's Acta Aposto- lorum Apocrypha, 1898, II. i. 1-127.

Acts of John. — These acts (c/. Eusebius, H. E. iii. 25 ; Epiph. fleer, xlvii. 1), which recount many marvellous acts of John, his exile, and death, spring from the same period and authorship as the Acts of Peter. For a dis- cussion of this work see Zahn, Gesch. Kanons, ii. 856- 865 ; Lipsius, Apok. Apostelgesch. i. 348-542. The only complete text is to be found in Bonnet, Acta Apost. Apocrypha, 1898, pp. 151-216. See James, Anecdota, ii. pp. i.-xxv., 1-25 (1897).

Acts of Paul. — These acts, which claim to have been written by Linus, are assigned by Zahn to the years 150-180. See Gesch. Kanons, ii. 865-891, and Lipsius, Acta Apost. Apoc 1891 ; Apok. Apostelgesch. ii. 70 sqq.

Acts of Paul and Tliecla. — These were written, according to Tertullian (De Baptismo, 17), by a presbyter of Asia, who was deposed from his ofiBce on account of his forgery. This, the earliest of Christian romances (probably before A.D. 150), recounts the adventures and sufferings of a virgin, Thecla of Iconium. Lipsius discovers Gnostic traits in the story, but these are denied by Zahn (Gesch. Kanons, ii. 902). See Lipsius, op. cit. ii. 424-467 ; Zahn (op. cit. ii. 892-910). The best text is that of Lipsius, Acta Apost. Apoc 1891, i. 235-272. There are Syriac, Arabic, Ethiopic, and Slavonic versions.

Gnostic Acts of Peter. — These acts are first mentioned by Eusebius (H. E. iii. 3) by name, and first referred to by the African poet Commodian about a.d. 250. Yet Harnack assigns their composition to this period mainly on the ground that Hippolytus was not acquainted with them ; but even were this assumption true, it would not prove the non-existence of the acts in question. The literary relationship between these acts and the Leucian Acts of John have been shown by Lipsius, Zahn, and James. According to Photius, moreover, the Acts of Peter, also, were composed hj this same Leucius Charinus, who, according to Zahn (Gesch. Kanons, ii". 864), wrote about 160 (op. cit. p. 848). These acts deal with Peter's victorious conflict with Simon Magus, and his subsequent

martyrdom at Eome uiider Nero. They are edited by Lipsius and Bonnet, Acta Apostolorum Apocrypha, 1891. See Zahn, op. dt. 832-855 ; James, Apoc. Anec. ii. pp. xxiv.-xxviii. ; and Chase, in Hastings' Bible Diet. iii. 773-774. ^

Preaching of Peter.— This book (HeTpou Kijpuy/iia) gave the substance of a series of discourses spoken by one person in the name of the apostles. Clement of Alex- andria quotes it several times as a genuine record of Peter's teaching. Heracleon had previously used it (see Origen, In Evang. Johann, tom. xiii. 17). It is spoken unfavourably of by Origen (De Prin. Praef. 8). It was probably in the hands of Justin and Aristides. Hence Zahn gives its date as 90-100 at latest ; Dobschutz, as 100-110 ; and Harnack, as 110-130. The extant fragments contain sayings of Jesiis, and warnings against Judaism and Polytheis^i. They have been edited by Hilgenfeld : Nov. Test, extra Can. 1884 , iv. 51-65, and by von Dob- schiltz. Das Kerygma Petri, 1893. Salmon {Diet. Christ. Biog. iv. 329-330) thinks that this work is part of a larger work, A Preaching of Peter and a Preaching of Paul, implied in a statement of Lactantius {Inst. Div. iv. 21) ; but this view is contested by Zahn, see Gesch. Kanons, ii. 820-834, particularly pp. 827-828 ; Chase, in Hastings' Bible Diet. iv. 776.

Acts of Thomas. — This is one of the earliest and most famous of the Gnostic acts. It has been but slightly tampered with by orthodox hands. The Greek and Latin texts were edited by Bonnet in 1883, the Greek also by James, Apoc. Anec. ii. 28-45, and the Syriac by Wright. Photius ascribes their composition to Leucius Charinus — therefore to the 2nd century, but Lipsius assigns it to the early decades of the 3rd. (See Lipsius, Apokryphen Apostdgeschichten, i. 225-347.)

Teaching of the Twelve Apostles (g.u). — This important work was discovered by Philotheos Bryennios in Constanti- nople and published in 1883. Since that date it has been frequently edited. The bibliography can be found in Schaff's and in Harnack's editions. The book divides itself into three parts. The first (i.-vi.) contains a body of ethical instruction

which is founded on a Jewish and probably pre-Christian document, which forms the basis also of the Epistle of BamaJbas. The second part consists of vii.-xv., and treats of church ritual and discipline ; and the third part is eschatological, and deals with the Second Advent. The book is variously dated by different scholars : Zahn assigns it to the years a.d. 80-120 ; Harnack to 120-165 ; Lightfoot and Funk to 80-100; Salmon to 120. See Salmon in Did:, of Christ. Biog. iv. 806-815.

III. — Epistles.

The Abgarus Epistles. — These epistles are found in Eusebius {H. E. i. 3), who translated , them from the Syriac. They are two in number, and purport to be a petition of Abgar Uchomo, king of Edessa, to Christ to visit Edessa, and Christ's answer, promising after His ascension to send one of His disciples, who should " cure thee of thy disease, and give eternal life and peace to thee and all thy people." Lipsius thinks that these letters were manufactured about the year 200. (See Diet. Christ. Biog.'iv. 878-881, with the literature there mentioned.) The above correspondence, which appears also in Syriac, is inwoven with the legend of Addai or Thaddaeus. The best critical edition of the Greek text will be found in Lipsius, Acta Apostolorum Apocrypha, 1891, pp. 279-283.

Pauline Epistles to the Laodieeans and the Alexandrians. — The first of these is found only in Latin. This, according to Lightfoot (see Colossians, 272-298) and Zahn, is a translation from the Greek. Such an epistle is mentioned in the Muratorian canon. See Zahn, op. cit.*

ii. 566-585. The Epistle to the Alexandrians is mentioned only in the Muratorian canon. (See Zahn, ii. 586-592.)

iliird Epistle of Paul to the Corinthians, and Epistle from the Corinthians to Paul. — These letters, which are still preserved in Armenian and Latin, are declared by Zahn to belong to the Acts of Paul. See Gesch. Kanons, ii. 592- 611. On the Latin text see Carri^re and Berger, Corre- spondence apoer. de S. P. et des Corinthiens, 1891 ; Vetter, Der apokryphe 3 Korintherbrief, 1894.

IV. — Apocalypses.

The five apocalypses in Tischendorf 's Apocalypses Apo- cryphoe, 1866 — Apoc. Mosis (which belongs to the Adam literature), Apoc. Esrce, Apoc. Pauli, Apoc. Johannis, Dormitio Mariae. — are of too late a date to be considered here, though they are in some respects valuable as con- taining ancient elements.

Greek Apocalypse of Baruch. — This work is referred to by Origen, De Princip. II. iii. 6: " Denique etiam Baruch prophetee librum in assertionis hujus testimonium vocant, quod ibi de septem mundis vel cselis evidentius indicatur." This book survives in two forms in Slavonic and Greek. The former was edited by Bonwetsch in 1896, in the Nachrichten von der konigl. Ges. der Wiss. zu Gott. pp. 91-101 ; the latter by James in 1897 in Anecdota, ii. 84-94, with an introduction (pp. li.-lxxi.). Neither work represents exactly the book of which Origen writes, for the Slavonic mentions only two heavens and. the Greek only five. As the original work is based on the Syriac Apocalypse of Baruch and the Best of the Words of Baruch, its composition falls between a.d. 136 and 200, if we accept the date assigned by Eendel Harris to the latter. A German translation of the Greek appears in Kautzsch's Apok. u. Pseud, ii. 448-457.

Testament of Hezekiah. — This writing is fragmentary, and has been preserved merely as a constituent of the Ascension of Isaiah. To it belongs iii. 13'-iv. 18 of that book. It is found under the above name, Aiad^Kij "E^eKiou, only in Cedrenus i. 120-121, who quotes par- tially i v. 12, 14, and refers to iv. 15-18. This evidence is supported by i. 2'5" ~~of the book, which describes the con~~ tents of Hezekiah' s Vision, and which was inserted by the editor to prepare for the vision recounted in iii. 13'-iv. 18. This vision is definitely said to be Hezekiah's in i. 2, 4, and in the Greek Legend, i. 2, which is built on the Ascension of Isaiah. The book may have in part a Semitic background, as Semiticisms are found in iii. 27. It was written between a.d. 88 and 100. The ground for the earlier date is furnished by the form of the Antichrist myth which it attests. We have here Beliar incarnated as Antichrist in the form of the dead Nero. The terminus ad quem is supplied by iv. 13, according to which few of the personal disciples of Christ were stUl living when the author wrote. Hence we may reasonably fix this limit at a.d. 100 .at latest. See Charles, Ascension of Isaiah, 1900. (For versions, editions, &c., see section on

“Martyrdom of Isaiah,” and Charles, Ascension of Isaiah, pp. xvi., xix.xxviii.). This work gives us a sketch of the Church at the close of the 1st century. It bewails the fewness of the prophets, the prevalence of heresies, and the sad declension in Christian character. It touches incidentally on the Guilds, whose object was to keep believers in readiness for the advent of Christ, but expect ing actually to experience first the dreaded coming of the Antichrist.

Grades of Hystaspes. — This eschatological work (XpT/o-as Yo-Tao-TTov : so named by the anonymous 5th-century writer in Buresch, Klaros, 1889, p. 95) is mentioned in conjunction with the Sibyllines by Justin {Apol. i. 20), Clement of Alexandria {Strom, vi. 5), and Lao-

tantius {Inst. VII. xv. 19; xviii. 2-3). According to Lactantius, it prophesied the overthrow of Eome and the advent of Zeus to help the godly and destroy the wicked, but omitted all reference to the sending of the Son of God. According to Justin, it prophesied the destruction of the world by fire. According to the Apocryph of Paul, cited by Clement, Hystaspes foretold the conflict of the Messiah with many kings and His advent. Finally, an unknown 5th-century writer (see Buresch, Klaros, 1889, pp. 87-126) says that the Oracles of Hystaspes dealt with the incarnation of the Saviour. The work referred to in the last iwo writers has Christian elements, which were absent from it in Lactantius’s copy. The lost oracles were therefore in all probability originally Jewish, and subse- quently re-edited by a Christian.

Vision of Isaiah. — This writing has been preserved in its entirety in the Ascension of Isaiah, of which it constitutes chaps, vi.-xi. Before its incorporation in the latter work it circulated independently in Greek. Thus we have independent versions of these chapters in Latin and Slavonic. In the course of its incorporation in the Ascension of Isaiah it underwent certain changes to which we shall advert later. This work was written in Greek. In the 4th century two distinct recensions of this work already existed. The later of these, which contained 1 Cor. ii. ,9 in xi. 34, was known to Jerome. This recension (now lost) was translated into Latin and Slavonic. The earlier recension is that which appears in

the Ascension of Isaiah, of which large fragments are preserved in the Greek Legend. This recension, which preserves several passages which are either abbreviated or omitted by the later recension, was translated into Ethiopic and Latin. Most of the latter version is lost. The original work was used by Ignatius and the author of the Actus Petri Vercellenses, and in part preserved in Epiphanius. Accordingly we assign its composition to the close of the 1st century a.d. (For the various texts, the translation and interpretation, see Charles, Ascension of Isaiah, 1900.) The Vision of Isaiah is valuable for the knowledge it affords us of Ist-century beliefs in certain circles as to the doctrines of the Trinity, the Incarnation, the Resurrection, and the Seven Heavens. (For the bibliography, see section on " Martyrdom of Isaiah," p. 487.)

Apocalypse of Peter. — Till 1892 only some five or more fragments of this book were knqwn to exist. These are preserved in Clem. Alex, and in Macarius Magnes (see Hilgenfeld, JV. T. extra Can. iv. 74 sqq.; Zahn, Qesch. Kanons, ii. 818-819). It is mentioned in the Muratorian Canon, and according to Eusebius (H. E. vi. 14. 1) was commented on by Clement of Alexandria. In the frag- ment found at Akhmim there is a prediction of the last things, and a vision of the abode and blessedness of the righteous, and of the abode and torments of the wicked. For further information see the editions of James, Lods (1892), Harnack, and Dieterich (1893).

((e. h. c.)

Apolda, a town of Germany, in the grand-duchy of Saxe- Weimar, 9 miles by rail E. by N. from Weimar. Population (1886), 18,061 ; (1895), 20,798.

Apostles, Teaching of the.

OP THE Apostles.

See Teaching

Apostolical Constitutions. — The Apostoli- cal Constitutions (AwTayat or AiaTo^cis t

*the Gospels themselves, and superior in authority to the epistles of single apostles, some parts of them being our Saviour's own original laws delivered to the apostles, and the other parts the public acts of the apostles " (Historical preface to Primitive Christianity Revived, pp. 85-86). Others, however, realized their composite character from the first, and by degrees some of the component documents became known. Bishop Pearson was able to say that "*the eight books of the Apostolic Constitutions have been after Epiphanius's time compiled and patched together out of the didascaliae or doctrines which went under the names of the holy apostles and their disciples or successors" (Vind. Ign. i. cap. 5); whilst a greater scholar still, Archbishop Usher, had already gone much further, and concluded, forestalling the results of modern critical methods, that their compiler was none other-than the compiler of the spurious Ignatian epistles {Epp. Polyc. et Ign. p. Ixiii. f., Oxon. 1644). The Apostolical Constitu- tions, then, are spurious, and they are one of a long series of documents of like character. But we have not really gauged their significance by saying that they are spurious. They are the last stage and climax of a gradual process of compilation and crystallization, so to speak, of unwritten church custom ; and a short account of this process will show their real importance and value.*

These documents are the outcome of a tendency which is found inevery society, religious or secular, at some point in its history. The society begins by living in accordance with its fundamental principles. origin By degrees these translate themselves into ap- propriate action. Diflaculties are faced and solved as they arise ; and when similar circumstances recur they will tend to be met in the same way. Thus there grows up by degrees a body of what may be called customary law. Plainly, there is no particular point of time at which this ' customary law can be said to have begun. To all appear- ance it was there from the first in solution and gradually crystallizes out; and yet it is being continually modified as time goes on. Moreover, the time comes whea

and real nature.

the attempt is made, either by private individuals or by the society itself, to put this "customary law" into writ- ing. Now when this is done, two tendencies will at once show themselves, (a) This "customary law" will at once become more definite : the very fact of putting it into writing will involve an effort after logical complete- ness. There will be a tendency on the part of the writer to fill up gaps ; to state local customs as if they obtained universally ; to intrpduce his personal equation, and to add to that which is the custom that which, in his opinion, ought to be. (&) There will be a strong tendency, to fortify that which has been written with great names, especially in days when there is no very clear notion of literary property. This is done, not always with any de- liberate consciousness of fraud (although it must be clearly recognized that truth is not one of the " natural virtues," and that the sense of the obligations of truth- fulness was far from strong), but rather to emphasize the importance of what was written, and the fact that it was no new invention of the writer's. In a non-literary age fame gathers about great names; and that which, ex hypothesi, has gone on since the beginning of things is naturally attributed to the founders of the society. Then come interpolations to make this ascription more prob- able, and the prefixing of a title, then or subsequently, which" states it as a fact. This is precisely the way in which the Apostolical Constitutions and other kindred documents have come into being. They are attempts, made in various places and at different times, to put into writing the order a?id discipline and character of the Church ; in part for private instruction and edification, but in part also with a view to actual use ; frequently even with an actual reference to particular circumstances. In this lies their importance, to a degree which has scatcely been adequately realized yet. They contain evidence of the utmost value as to the order of the Church in early days ; evidence, however, which needs to be sifted with the greatest care, since the personal pref- erences of the writer and the customs of the local church to which he belongs are continually mixed up with things which have a wider prevalence. It is only by careful in- vestigation, by the method of comparisons, that these elements can be disentangled ; but as the number of docu- ments of this class known to us is continually increasing, their value increases even more than proportionately. And whilst their local and fugitive character must be

fully recognized and allowed for, it is unjustifiable to set them aside or leave them out of account as heretical, and therefore negligible.

It will be sufficient here to mention shortly the chief collections of this kind which came into, existence during

the first four centuries ; generally as the work tf T” ° private individuals, and having, at any rate,

no more than a local authority of some kind, (a) The earliest known to us is the Didache or Teaching of the Twelve Apostles, itself compiled from earlier mar terials, and dating from, at any rate, the earlier half of the 2nd century [Tbachiitg of the Apostles]. (6) The Apostolic Church Order (apostolisehe Kirchenordnung of German writers) ; ” Ecclesiastical Canons of the Holy Apostles ” of one MS. ; Sententiae Apostolorum of Pitra : of the 3rd century, and epianating probably from Upper Egypt. Its earlier part, cc. 1-14, depends upon the Didache, and the rest of it is a book of discipline in which Harnack has attempted to distinguish two older frag- ments of church law (Texte u. Unters. ii. 5). (c) The so- called Canones Hippolyti, probably Egyptian or Eoman and of the beginning of the 3rd century. It will be ob- served that these make no claim to apostolic authorship ; but otherwise their origin is like that of the rest, unless indeed, as has been suggested, they represent the work

of an actual Roman synod, {d) The so-called Egyptian Church Order, now extant only in a fragmentary Latiij. version recently published by Hauler, and as part of two larger collections; the former (sometimes called the Egyptian Church Ordinances) being cc. 31-62 of the Sahidic Ecclesiastical Canons, and the latter being stat. 21-71 of the Ethiopic Statutes of the Apostles. It is apparently of the end of the 3rd century or beginning of the 4th. (e) The recently-discovered Testament of the Lord, which is somewhat later in date, and likewise depends upon the Canones Hippolyti [Testament of the Lord]. (/) The so-called Canons of Basil. [On the relations between the four last-named, see Caitons op Hippoiytus.] {g) The Didascalia Apostolorum, originally written in Greek, but known through a Syriac version and a fragmentary Latin one published by Hauler. It is of the middle of the 3rd century — in fact, a passage in the

Latin trans- lation seems to give us the date a.d. 254. It emanates from Palestine or Syria, arid is independent of the docu- ments already mentioned ; and upon it, as we shall see, the Constitutions themselves very largely depend, (h) A number of shorter fragments, published by ■ Lagarde, Pitra, and others, (i) The Apostolical Constitutions. — ^At a later date various collections were made of the docu- ments above mentioned, or sdrhe of them, to serve as law- books in different churches — e.g., the Syrian Octateuch, the Egyptian Heptateuch, and the Ethiopic Sinodos. These, however, stand on an entirely different footing, since they are simply collections of existing documents, and no attempt is made to claim apostolic authorship for them.

The Constitutions themselves fall into three main di- visions, (i.) The first of these consists of books i.vi., ~~and throughout runs parallel to the Didascalia. Bickell, indeed, held that this latter was an~~ ‘”<«' abbreviated form of books i.vi. ~~; but it is now agreed on all hands that the Constitutions are based on the Didas~~ calia and not vice versd. (ii.) Then follows book vii., the first thirty-one chapters of which are an adaptation of the Didache, whilst the rest contain various liturgical forms of which the origin is still uncertain, though it has been acutely suggested by Achelis, and with great probalbility, that they originated in the schismatical congregation of Lucian at Antioch. (iii.) Book viii. is more composite, and falls into three parts. The first two chapters, -n-epl yapuTiiAraiv, may be based upon a lost work of St Hippo- lytus, otherwise known only by a reference to it in the pre- face of the Latin version of the Egyptian Church Order; and an examination shows that this is highly probable. The next section, cc. 3-27, -rrcpl x”poTovt5v, and cc. 28-46, TTcpt Kovoviiyv, is twofold, and is evidently that upon which, the writer sets most store. The apostles no longer speak jointly, but one by one in an apostolic council, and the section closes with a joint decree of them all. They speak of the ordination of bishops (the so-called Clementine Liturgy is that which is directed to be used at the conse- cration of a bishop, cc. 5-16), of presbyters, deacons, dea- conesses, sub-deacons, and lectors, and then pass on to confessors, virgins, widows, and exorcists ; after which fol- lows a series of canons on various subjects, and liturgical formulae. With regard to this section, all that can be said is that it includes materials which are also to be found elsewhere — in the Egyptian Church Order

and other docu- ments already spoken of — and that the precise relation be- tween them is at present not determined. The third sec- tion consists of the Apostolic Canons already referred to, the last and most significant of which places the Con- stitutions and the two epistles of Clement in the canon of Scripture, and omits the Apocalypse. They are derived in part from the preceding Constitutions, in part from the canons of the councils of Antioch, 341, Nicaea, 325, and possibly Laodicaea.

A comparison of the Constitutions with, the material upon which they are based will illustrate the compiler's method, (a) To begin with the Didasealia. It is un- methodical and badly digested, homiletical in style, and abounding in Biblical quotations. There is no precise arrangement ; but the subjects, following a general intro- duction, are the bishop and his duties, penance, the administration of the offerings, the settlement of disputes, the divine service, the order of widows, deacons and deaconesses, the poor, behaviour in persecution, and so forth. The compiler of the Constitutions finds here material after his own heart. He is even more discursive and more homiletical in style ; he adds fresh citations of the Scriptures, and additional explanations and moral reflex- ions ; and all this with so little judgment that he often leaves confusion worse confounded (e.g'., in ii. 57, where, upon a symbolical description of the Church as a sheep- fold, he has superimposed the further symbolism of a ship). (6) Passing on to books vii. and viii., we observe that the compiler's method of necessity changes with his new material. In the former book he still makes large additions and alterations, but there is less scope for his prolixity than before ; and in the latter, where he is no longer dealing with generalities, but making actual defi- nitions, the Constitutions of necessity become more pre- cise and statutory in form. Throughout he adopts and adapts the language of his sources as far as possible, " oidy pruning in the most pressing cases," but towards the end he cannot avoid making larger alterations from time to time. And his alterations throughout are not made aimlessly. Where he finds things which would obviously clash with the customs of his own day, he un-

hesitatingly modifies them. An account of the Passion, with a curiously perverted chronology, the object of which was to justify the length of the Passion-tide fast, is en- tirely revised for this reason (v. 14) ; the direction to observe Easter according to the Jewish computation is changed into the exact contrary for the same reason (v. IT) ; and whei'e his archetype lapses into speaking of a lull in persecution he naively informs us that the Romans have now given up persecuting and have adopted Christianity (vi. 26), forgetting altogether that he is speaking in the character of the apostles. Above all, he both magnifies the ofB.ce of the Christian ministry as a whole and alters what is said of it in detail (for example, the deaconess lo"Ses rank not a little), to make it agree with the circumstances of his day in general, and with his own ideas of fitness in particular. It is here that his evidence is at once most valuable and needing to be used with the greatest care. To give one striking example of the value of these documents. The Ganones Hippolyti (vi. 43) provide that one who has been a confessor for the faith may be received as a presbyter by virtue of his confessorship and not by the laying on of the bishop's hands ; but if he be chosen a bishop, he is to be ordained. This provision passes on into the Egyptian Ecclesiastical Canons and other kindred documents, and even into the Testamentum Domini. But the corresponding passage in the Apostolical Constitutions (viii. 23) entirely reverses it: " A confessor is not ordained, for he is so by choice and patience, and is worthy of great honour. . . . But if there be occasion, he is to be ordained either a bishop, priest, or deacon. But if any one of the confessors who is not or- dained snatches to himself any such dignity upon account of his confession, let the same person be deprived and re- jected ; for he is not in such an ofiice, since he has denied the constitution of Christ, and is worse than an infidel." Who, then, is the author of the Constitutions, and what can be inferred with regard to him ? (i.) By separating off the sources which he used from his own additions to them, it at once becomes clear that the latter are the

work of one man: the style is unmistakable, and the method of working is the same throughout. The compiler of books i.vi. is also the compiler of books vii., viii. (ii.) As to his theological position, differ '"""""]: ent views have been held.. Funk suggests Apol- l„a'Ja^' linarianism, which is the refuge of the destitute ; and Achelis inclines in the same direction. But the*

affinities of the author are quite otherwise, the most pro- nounced of them being a strong subordination ist tendency, denial of a human soul to Christ, and the like, which sug- gest not indeed Arianism but an inclination towards Arianism. Above all, his polemic is directed against the dying heresies of the 3rd century ; and he writes with an absence of constraint which is not the language of one who lives amidst violent controversies or who is conscious of being in a minority. All this points to the position of a "conservative" or semi-Arian of the East, one who belongs, perhaps, to the circle of Lucian of Antioch and writes before the time of Julian. It is hard to think of any other time or circumstances in which a man could write like this, (iii.) The indications of time have been held to point to a different conclusion. On the one hand, the fact that the attempt to rebuild the temple by Julian in 363 is not mentioned in vi. 24 points to an earlier date ; and the fact the KcmiaTM are not mentioned amongst the church officers points in the same direction, fot else- where they are first mentioned in a rescript of Constan- tius in A.D. 357. On the other hand, in the cycle of feasts occur the names of several which are probably of later date — e.g., Christmas and St Stephen, which were intro- duced at Antioch c. a.d. 378 and 379 respectively. Again, Epiphanius (c. a.d. 374) appears to be unacquainted with it; he still quotes from the Didasealia, and elabo- rately explains it away where it is contrary to the usages of his own day. But as regards the former point, it is possible that the Apostolical Constitutions actually gave rise to these f estivaSs ; or, on the other hand, that the two passages were subsequently introduced either by the writer himself or by some other hand, when the last book of the Constitutions was being used as a law-book. And as re- gards the latter, the fact that, Epiphanius does not use the Constitutions is no proof that they had not yet been compiled, (iv.) As to the region of composition there is no real doubt. It was clearly the East, Syria or Palestine. Many indications are against the latter, and Syria is strongly suggested by the use of the Syro-Macedonian '^calendar. Moreover, the writer represents the Roman Clement as the channel of communication between the apostles and the Church. This fact both supplies him with the name by which he is commonly known, Pseudo-Clement, and also furnishes corroboration of his Syrian birth ; since the other spurious writings bearing the name of Clement, the Homi- lies and Recognitions, are likewise of Syrian origin. More- over, the spurious Ignatian epistles,

which are also Syrian, depend throughout upon the Constitutions, (v.) But this is not all. It was long ago noticed that Pseudo-Clement bears a very close resemblance to Pseudo-Ignatius. Usher, as we have seen, identified them, and modern criticism ac- cepts this identification as a fact (Lagarde, Harnack, Funk, Brightman). Lightfoot, indeed, still hesitated (Ap.FatJiers II. i. 266 n.) on the ground that Pseudo-Ignatius occasionally misunderstands the Constitutions, that the two writings give the Roman succession differently, and that Pseudo- Clement shows no knowledge of the Christological con- troversies of Nicaea. But as regards the first of these, it is rather a case of condensed citation than of misinterpre- tation ; the second is explained by the writer's carelessness as shown in other passages, and all are solved if a con- siderable interval of time elapsed between the compilation of the Constitutions and the spurious Ignatian epistles. It is clear then that the compiler was a Syrian, and that

he also wrote the spurious Ignatian epistles ; he was like- wise probably a semi-Arian of the school of Lucian of Antioch. His date is given by Harnack as a.d. 340-360, with a leaning to 340-343 ; by Lightfoot as the latter half of the 4th century; by Brightman, 370-380; and by Funk as the beginning of the 5th century. The present writer holds to the first-named of these— i.e., 340-360.

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Appalachian Mountains. See Amebica, North.

Appendicitis. — In medical nomenclature the ter- mination " itis " is used to signify inflammation, and is arbitrarily tacked on to the end of any word, whether of Greek or Latin origin. On this principle " appendicitis " has been coined to designate inflammation connected with that/part of the intestine which is known as the " appendix." There is no reason to suppose that the affection is mo^e common than it used to be ; but it is now better under- stood and more frequently recognized, and the development of modern abdominal surgery has brought it into pro- minence. It was formerly included under the term " peri- typhlitis " — that is, inflammation connected with the "caecum," a portion of the large intestine, — and some authorities still prefer that term as more scientifically accurate ; but it is now generally recognized that in the vast majority of cases the inflammation begins in the appendix, not in the intestine proper. From the appendix it extends to the surrounding peritoneum and sets up a localized peritonitis, which in the worst cases may become general. i

The appendix is a narrow tube, normally about the size of a goose quill, and from 1 inch to 5 or 6 inches in length. The average length is 3 inches. It terminates

in a blunt point, and from its worm-like shape is called the appendix vermiformis. It is an appendage of the large intestine, into which it opens. It is not known to perform any functions, and is re- garded as the degenerate relic, surviving in man and other mammals, of an earlier form of intestine. Owing to its shape, character, and situation the appendix is frequently the seat of morbid changes. They have been observed in one- third of a number of bodies examined post mortem. Inflammation is set up in various ways. Foreign bodies passing down the intestinal canal may find their way into the appendix and lodge there. This was formerly

b^ieved to be the chief cause of mischief ; hence the warning, familiar to every child, against the danger of swallowing cherry stones

Labsx Ihtestinb 8HOWINO Vebmitokm Appbhdis («.a.) AND CaouM (o.).

and other small, hard objects. Extended knowledge, how- ever, has shown that such foreign bodies are only present in a small minority of cases. More frequently the tube is found blocked by hardened faeces or undigested' particles of food, such as nuts, cheese, fibrous vegetable matter, and other imperfectly masticated substances. Sometimes calcareous concretions are formed round a nucleus furnished by some small body. Inflammation may occur, however, without any of these things. The tube may be twisted or otherwise strangulated, leading to gangrene ; or the orifice may be closed in a similar manner, so that the tube becomes greatly distended with mucus, which can find no outlet ; or ulceration of tuberculous origin may occur. In all cases inflammation started in the appendix is liable to spread to the surrounding membranes, and herein lies the gravity of the affection.

For clinical purposes several varieties of appendicitis may conveniently be distinguished according to the degree and course of the inflammation : (1) simple inflammation, commonly called "catarrhal"; (2) ulcerative; (3) per- forative ; (4) relapsing ; (5) chronic.

The symptoms vary accordingly within wide limits, ranging from slight pain and sickness, which pass off in a day or two, to an exceedingly violent illness, which may cause death in a few hours. (1) Simple inflammation. In a well-defined case the onset is sudden. Pain is felt in the beUy, low down on the right side (the right iliac fossa), or across the front; it is often described as " radiating." There is some fever, the temperature rising to 101° or 102° F., with constipation, nausea, and very likely vomiting. The abdomen is tender to pressure, and the tenderness may be referred to a particular spot. Some swelling may also be made out. The attack lasts for two, three, or four days, and ihen subsides. There are, how- ever, other cases less well defined, in which the mischief pursues a latent course, producing little more than a vague abdominal uneasiness, until it suddenly advances into a more violent stage. (2) The illness assumes a more acute form, and all the symptoms are more severe. There

may be an initial rigor ; the temperature rises to 104° or higher, with great prostration, severe pain, and complete loss of appetite. An unpleasant taste in the mouth is often observed; vomiting may persist and become fsecal. Abdominal tenderness is more marked and general, and swelling more obvious. The patient lies with legs drawn up, so as to ease pressure on the abdomen and lessen pain. The attack may subside or go on to the suppuration and the formation of an abscess. (3) If the abscess break into the general abdominal cavity, there is sudden and violent pain with collapse. The condition is one of extreme gravity. Death usually follows within forty-eight hours, and recovery is very rare. (4) Some persons are subject to recurrent attacks of appendicitis, and to this variety of the disease the term " relapsing " is applied. Such attacks do not differ in character from those previously described. They are no doubt due to some standing condition of the appendix coupled with imperfect performance of the digestive functions, but they only occur at intervals, and between the attacks the patient is well. (5) The chronic form of appendicitis differs from the relapsing in that the patient is never well, but always suffers from more or less uneasiness, which is liable to develop into an acute attack.

With regard to treatment it is obvious that, however mild an attack may be, an affection liable to assume such grave forms is not to be trifled with and demands early medical assistance. In the milder cases the measures indicated are rest in bed, hot fomentations or poultices to the abdomen, and opiates to relieve pain and keep the intestine quiet. Leeches over the abdomen give much relief. Food should be hot, fluid, and given in small

quantities. Ice and milk are not suitable. Solid food should not be given until fever has abated and distinct improvement set in. Great care should be exercised in the administration jof aperients, and as this is a matter which patients or their friends are apt to take into their own han\is it is necessary to give an emphatic warning against the practice so long as the symptoms described are present. The safest course is to eschew aperients

altogether. In cases of moderate severity it may be desirable to open the bowels, but this is best accomplished by enemata.

In the majority of cases the foregoing measures will suffice, but when the attack pursues an unfavourable course the question of operative interference arises. There is a considerable difference of opinion among surgeons on the point. Some advocate early operation in all cases ; others, of a more conservative tendency, prefer to give the inflam- mation an opportunity of subsiding without interference, and hold that in uncomplicated cases it only becomes necessary when the symptoms persist after the fifth day. Perhaps the soundest rule is to operate in all doubtful cases. Eemoval of the appendix in persons liable to recurrent attacks has been practised with great success, and may be regarded as one of the triumphs of modern surgery. The danger of relapse may, however, be guarded against by less drastic means. Persons who have had an attack should attend to their mastication and be careful about diet. In particular, they should .avoid indigestible substances^ and counteract any tendency to constipaition. Exercise and abdominal massage are recommended, but the advisability of the latter is open to question.

The prognosis in appendicitis is generally favourable. The "case mortality" is believed to be about 6 per cent., but in the graver forms it is very much higher. Men are said to be more liable to attack than women. It has been suggested that some constitutional states, such as a rheumatic or gouty tendency, predispose to appen- dicitis, but the theory is not supported by any sub- stantial evidence. ' '

Affections with which appendicitis is liable to be con- founded are acute intestinal obstruction, typhoid fever, renal and gall-stone colic. The first of these resembles it most closely, and diagnosis is sometimes very diffi- cult. In typhoid fever the characteristic temperature, the general condition of the patient, and the presence of delirium are differentiating signs of importance ; in renal and gall-stone colic the situation and more paroxysmal character of the pain are usually distinctive. (See also

SURGEKT.) (A. SL.)

*Appenzell, one of the Swiss cantons, since 1597 divided into the two half cantons of Ausser Ehoden and Inner Ehoden, the joint total area of which is 161-8 sq. miles. Of this Ausser Ehoden claims 100^ sq. miles, 97-8 sq. miles being classed as "productive," forests covering 18-1 sq. miles, and vineyards -01 sq. mile, while of the 2-7 "unproductive" sq. miles, eternal snows cover 0-3 sq. mile. Inner Ehoden has an area of 61-3 sq. miles, of which 56*7 sq. miles are classed as "productive," forests covering 2-7 sq. miles, while of the "unproductive" 4-6 sq. miles '38 is occupied by eternal snows. The population of Ausser Ehoden was in 1880, 51,963; in 1888, 54,109; and in 1900, 65,284, or 551 per sq. mile; of Inner Ehoden the popu- lation was in 1880, 12,874; in 1888, 12,874; and in 1900, 13,486, or 220 per sq. mile. The rate of density in the former is only exceeded in Switzerland by Geneva, and Basel Stadt (Bale Ville). In 1900 there were in Ausser Ehoden but 580 Italian-speaking (in Inner Ehodffli, 78) and 86 (in Inner Ehoden only 4) French-*

speaking inhabitants, the rest being German-speaking. The religious statistics are as follows: (1900), Ausser Ehoden — Protestants, 49,741; Eomanists, 6501; Jews, 31; Inner Ehoden — Protestants, 830 ; Eomanists, 12,653. The loftiest point in the canton, is the Santis, 8216 feet, now crowned by an observatory and an inn. The political capital of Ausser Ehoden is Herisau, while that of Inner Ehoden is Appenzell. Both halves of the can- ton still preserve their primitive democratic assemblies. In 1897, the state revenue of Ausser Ehoden was 640,162 francs (an increase of 100 per cent, since 1885), and the state expenditure 613,337 francs (an increase of 61 per cent, since 1885), while in 1898 the surplus was 18,490 francs ; the state debt in 1897 was nil. In 1897, Inner Ehoden had a state revenue of 181,932 francs (an increase of nearly 72 per cent, since 1886), and a state expenditure of 165,409 francs (an increase of 64 per cent, since 1886), but in 1898 there was a deficit of 24,644 francs ; in 1897 there was no public debt. In 1899, the mountain pastures or "alps " of Inner Ehoden were 168 in number, and capa- ble of supporting 4008 cows, while the capital value was put at 2,682,956 francs ; accurate statistics have not yet been published as regards Ausser Ehoden.

Appenzell, the chief town of the above canton, sit- uated in Inner Ehoden. The two convents are both Capuchin, that of the men dating from 1588,

and that of the women being a few years later in date. The ” Teuf el ” flag was captured from the Tyrolese in 1406 at Imst, near Landeck. In 1888, the population of Appenzell (which is rather a large village than a town) was 4472, and in 1899 was put at 4369.

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Appleby, a municipal borough (1885), market-town and county town of “Westmoreland, England, oh the Eden, 13 miles S.E. of Penrith, in the Appleby parliamentary division of the county. Station on the Midland railway. The bridge over the Eden has been rebuilt. Two Wes- leyan chapels and new grammar school buildings are modern erections. Area, 1866 acres ; population (1881),

1855; (1891), 1776; (1901), 1764.

Appleton, a city of Wisconsin, U.S.A., the capital of Outagamie county, situated in 44° 16′ N. lat. and 88° 24′ “W. long., at an altitude of 718 feet, in the eastern part of the state, at the Grand Chute on Lower Fox river, which supplies excellent water-power for lumber and paper manufactures. The plan of the city is regular, and it is divided into six wards. It is entered by the Chicago and North-western and the Chicago, Milwaukee, and St Paul railways. It is the seat of Lawrence University. The city received its name from Samuel Appleton, who was one of its founders, and a leading spirit in the organiza- tion of Lawrence University. Population (1880), 8005;

(1890), 11,869; (1900), 15,086.

Appomattox, a village of Appomattox county, Virginia, U.S.A., formerly the capital. It is situated in southern Virginia, on the Norfolk and Western railway. It is noted as the scene of the surrender of the army of northern

Virginia under General Lee to the Federal forces under Grant on 9th April 1865.

Apportionment.— The term "apportionment" is used in law in a variety of senses : — (i.) Sometimes it is employed, roughly and with no technical meaning, to

indicate the distribution of a benefit (e.y., salvage), or tbe incidence of a duty {e.g., obligations as to the main- tenance of bighways) ; (ii.) In its strict legal interpreta- tion it falls into two classes, " apportionment in respect of estate" and "apportionment in respect of time." Where a lessee is evicted from, or surrenders, or forfeits posses- sion of part of the property leased to him, he becomes liable at common law to pay only a rent apportioned to the value of the interest which he still retains. So where the person entitled to the reversion of an estate assigns part of it, the right to an apportioned part of the rent incident to the whole reversion passes to his assignee. In each of these cases there is said to be " apportionment in respect of estate." Apportionment of this description may be brought about not only, as in the cases above noted, by the act of the parties, but also by operation of law, or by the " act of God " (as, for instance, where part of an estate is submerged by the encroachments of the sea) ; and to the same category belongs the apportionment which takes place under various statutes (e.g., the Lands Clauses Act, 1845), when land is required for public pur- poses. Under the Apportionment Act, 1870, rents, annui- ties, dividends, and other payments at fixed periods, are to be considered as accruing from day to day, and to be apportionable accordingly. This is " apportionment in re- spect of time." The cases to which it applies are mainly cases of either (a) apportionment of rent due under leases where at a time between the dates fixed for payment the lessor or lessee dies, or some other alteration in the position of parties occurs ; or (b) apportionment of income between the representatives of a limited owner and the remainder- man when the limited interest determines at a time be- tween the date when such income became due. (a. w. e.)

Apulia, Italian Puglia, a territorial division of Italy, stretching from Monte Gargano to the extremity of the "heel," and embracing the provinces of Bari, Foggia, and Lecce, with an area of 7376 sq. miles and a popula- tion of 1,589,064 (1881), and 1,929,723 (1899). It is a treeless plain, growing corn and feeding sheep, the prin- cipal wealth of the inhabitants. The products next in importance are oats, barley, olives, wine, lemons, oranges, tobacco, and figs. Salt, limestone, and other building stone are extracted. Wool is a source of wealth. Dis- tilleries (66 in 1899, producing 146,775 gallons of pure spirit), olive-oil mills, the manufacture of casks and porcelain, iron-works and foundries are the most im- portant of the industries. The principal ports are Brindisi, Gallipoli, Taranto, Bari, Barletta, Molfetta, Manfredonia, Trani, Biscegli^, Mola di Bari, and Mono- poli. Apart from these, the more important towns are Lecce, Foggia, Bitonto, San Severo, Cerignola, Andria, and Terlizzi.

Apure. See Orinoco.

Apurimac, an interior department of southern Peru, with an area of 8187 square miles and a population officially estimated at 177,387 in 1896. It embraces five provinces, Andahuaylas, Abaneay, Cotabambas, Ayma- raes, and Antabamba. The principal towns are Anda- huaylas and Abaneay.

Aquaria for a marine flora and fauna, which in 1875 (the date of the article on this subject in the ninth edition of this Encyclopaedia) were little more than domestic toys, or show-places of a popular character, have of late years not only assumed a profound scientific importance for the convenient study of anatomical and physiological problems in marine botany and zoology, but have also attained an economic value, as offering the best opportunities for that study of the habits and environment

of marketable food-fish without which no steps for the improvement of sea-fisheries can be safely taken. The numerous " zoological stations " which have sprung up, chiefly in Europe and the United States, but also in the British colonies and Japan, often endeavour to unite these two aims, and have in many cases become centres of ex- perimental work in problems relating to fisheries, as well as in less directly practical subjects.

Of these stations, the oldest and the most important is that at Naples, which, though designed for purely scientific objects, also en- courages popular study by means of a public aquarium. The following account of this station from the pen of Dr Giesbrecht, a member of the staff, will serve to show the methods and aims, and the complex and expensive equipment of a modern aquariuih : —

The zoological station at Naples is an institution for the advance- ment of biological science — that is, of comparative anatomy, zoology, botany, physiology. It serves this end by providing the biologist with the various objects of his study and the necessary appliances ; it is not a teaching institution. The station was founded by Dr Anton Dohm, and opened in the spring of 1874 ; it is the oldest and largest of all biological stations, of which there are now about thirty in existence. Its two buildings are situated near the sea^ shore in the western town park (Villa Nazionale) of Naples. The older and larger one, 33 metres long, 24 m. deep, 16 m. high, contains on the ground floor the aquarium, which is open to the public. On the first floor there is, facing south, the principal library, ornamented with fresco paintings, 'and, facing north, a large hall containing twelve working tables, several smaller rooms, and the secretarial ofBces. On the second floor is the physiological laboratory, and on the third floor the small library, a hall with several working tables, and the dark rooms used in developing, photographs. The ground floor of the smaller building, which was finished in 1887, contains the rooms in which the animals are delivered, sorted, and preserved, and the fishing tackle kept, together with the workshop of the engineer ; on the first and second floors are work-rooms, amongst others the botanical labora- tory ; on the third floor are store-rooms. In the basement of both buildings, which is continued underneath the court, there are sea-water cisterns and filters, engines, and store-rooms. The materials for study which the station offers to the biologist are specimens of marine animals and plants which abound in the western part of the Mediterranean, and especially in the Gulf of Naples. To obtain these, two screw-steamers and several rowing boats are required, which are moored in the harbour of Mergellina, situated close by. The larger steamer, Johannes Muller (15 m. long, 2 J m. wide, 1 m. draught), which can steam eight to ten English miles per hour, is provided with a steam dredge working to a depth of eighty fathoms. From the small

steamer, Frank Balfour, and the rowing boats, the fishing is done by means of tow-nets. Besides these there are fishermen and others who daily supply living material for study. The plankton (small floating animals) is distributed in the morning, other animals as required. The animals brought in by the fishermen are at once distributed amongst the biologists, whereas the material brought up by the dredges is placed in flat revolving wooden vessels, so as to give the smaller animals time to come out of their hiding-places. The stu- dents who work in the station have the first claim on specimens of plants and animals ; but specimens are also supplied to mu- seums, laboratories, and schools, and to individuals engaged in original research elsewhere. Up to the present time about 4000 such parcels have been despatched, and not infrequently live speci- mens of animals are sent to distant places. This side of the work has been of very great value to science. The principal appliances for study with which the station provides the biologist are work- rooms furnished with the apparatus and chemicals necessary for anatomical research and physiological experiments and tanks. Every student receives a tank for his own special use. The large tanks of the principal aquarium are also at his disposal for pur- poses of observation and experiment if necessary.

The water in the tanks is kept fresh by continual circulation, and is thus charged with the oxygen necessary to the life of the organisms. It is not pumped into the tanks directly from the sea, but from three large cisterns (containing 300 cubic metres), to which it again returns from the tanks. The water wasted or evaporated during this process is replaced by new water pumped into the cisterns directly from the sea. The water flows from the large cisterns into a smaller cistern, from which it is dis- tributed by means of an electric pump through vulcanite or lead pipes to the various tanks. The water with which the tanks on the upper floors are filled is first pumped into large wooden tanks placed beneath the roof, thence it flows, under

almost constant pressure, into the tanks. The water circulated in this manner contains by far t^e largest number of such ani- mals as are capable of living in captivity in good condition. Some of them even increase at an undesirable rate, and it some- times happens that young Mytilus or Ciona stop up the pipes; in laying these, therefore, due regard must be had to the aiTangements for cleaning. For the cultivation of very delicate animals it is necessary to keep the water absolutely free from harmful bacteria ; for this purpose large sand-fllters have lately been placed in the system, through which the water passes after leaving th^ cisterns. Each of the smaller cisterns, which are fixed in the work-rooms, consists of two water-tanks, placed one above the other ; their frames are of wrought iron and the walls generally of glass. Vessels containing minute animals can be placed be- tween these two tanks, receiving their water through a siphon from the upper tank ; the water afterwards flows away into the lower tank.

The twenty-six tanks of the public aquarium (the largest of which contains 112 cubic metres of water) have stone walls, the front portion alone being made of glass. As the tanks hold a very large number of animals in proportion to the quantity of water, they require to be well aerated. The pipes through which the water is conducted are therefore placed above the surface of the water, and the fresh supply is driven through them under strong pressure. A large quantity of air in the form of fine bubbles is thus taken to the bottom of the tank and distributed through the entire mass of water. Should the organisms which it is desired to keep alive be very minute, there is a danger of their being washed away by the circulating water. To obviate this, either the water which flows away is passed through a strainer, or the water is not changed at all, air being driven through it by means of an apparatus put into motion by the drinking-water supply.

The library contains about 9000 volumes, which students use with the help of a slip catalogue, arranged according to authors. The station has published at intervals since 1879 two periodicals treating of the organisms of the Mediterranean. One is Fauna und Flora des Golfes von Neapel, the other Mtttheilungen aus der Zoologischen Station zu Neapel. The former consists of mono- graphs in which special groups of animals and plants

are most exhaustively treated and the Mediterranean species portrayed according to life in natural colours ; up to the present time twenty-one zoological and five botanical monographs have ap- peared, making altogether 1200 4to sheets with about 400 plates. Of the Mtttheilungen, which contain smaller articles on organisms of the Mediterranean, fourteen volumes in 8vo have been pub- lished. The station also publishes a Zoologischer Jahresberieht, which at first treated of the entire field of zoology, but since 1886 has been confined principally to Comparative Anatomy and Ontogeny ; it appears eight to nine months aft^r the end of the year reported. The Chiide to the Aquarium, with its descriptions and numerous pictures, is meant to give the lay visitor an idea of the marine animal world.

There are about forty ofBcials, amongst them six zoologists, one physiologist, one secretary, two draughtsmen, one engineer. The station is a private institution, open to biologists of all nations under the following conditions : there are agreements with the Governments of Austria, Baden, Bavaria, Belgium, Hamburg, Holland, Hesse, Italy, Prussia, Russia, Saxony, Switzerland, Hungary, Wurtemburg, the province of Naples, and the Universities of Cambridge, Oxford, Strassburg, Columbia Col- lege (New York), and the British Association for the Advance- ment of Science, the Smithsonian Institute, and a society of women in the United States of North America (formerly also with Bulgaria, Rumania, Spain, the Academy of Sciences in Berlin, Wil- liams College, University of Pennsylvania), by virtue of which the Governments and corporate bodies named have the right, on payment of £100 per annum, to send a worker to the station ; this places at his disposal a "table" or workplace, furnished with all the necessary appliances and materials as set down in the agreement. At present there are agreements for thirty-three tables, and since the foundation of the station nearly 1200 biolo- gists have worked there. The current expenses are paid out of the table-rents, the entrance fees to the public aquarium, and an annual subvention paid by the Gerinan Empire.

In England a station on similar lines, but on a smaller scale, is maintained at Plymouth by tbe Marine Biological Association of the

United Kingdom, -with the help of subsidies from the Government and the Fishmongers' Company.

Little difficulty is experienced in maintaining, breeding, and rearing fresh-water animals in captivity, but for many various reasons it is only by unremitting attention and foresight that most marine animals can be kept even

alive in aquaria, and very few indeed can be maintained in a condition healthy enough to breed. Much experi- ence, however, has been gained of late years at consider- able expense, both at home and abroad. In starting a marine aquarium of whatever size, it should be obvious that the first consideration must be a supply of the purest possible water, as free as may be, not only from land- drainage and sewage, but also from such suspended mat- ters as chalk, fine sand, or mud. This is most ideally and economically secured by placing the station a few feet above high-water mark, in as sheltered a position as pos- sible, on a rocky coast, pumping from the sea to a large reservoir above the station, and allowing the water to cir- culate gently thence through the tanks by gravity (Ban- yuls). At an inland aquarium (Berlin, Hamburg), given pure water in the first instance, excellent if less com- plete results may nevertheless be obtained. The next consideration is the method by which oxygen is to be supplied to the organisms in the aquarium. Of the two methods hitherto in use, that of pumping a jet of air into tanks otherwise stagnant or nearly so (Brighton), while supplying sufficient oxygen, has so many other disadvantages, that it has not been employed regularly in any of the more modern aquaria. It is, however, still useful in aerating quite small bodies of water in which hardy and minute organisms can be isolated and kept under control. In the other method, now in general use, a fine jet of water under pressure falls on to the surface of the tank ; this carries down with it a more than suffi- cient air-supply, analysis showing in some cases a higher percentage of oxygen In aquarium water than in the open sea.

This water supply is best effected by gravity from reservoirs placed above the tanks, but may be also achieved by direct pumping from low reservoirs, or from the sea to the tanks. Provided that an unlimited supply of pure water can be obtained cheaply, the overflow from the tanks is best

run to waste ; but in aquaria less fortu- nately placed, it returns to a storage low-level reservoir, from which it is again pumped, thus circulating round' and round (Naples, Plymouth). The storage reservoirs should be in all cases very large in comparison with the bulk of water in circulation ; & practicable, they should be excavated in rock, and lined with the best cement. There is no reason why they should not be shallow, ex- posed to light and air, and cultivated as rock-pools by the introduction of searweeds and small animals, but they must then be screened from rain, cold, and dust. The pumps used in circulation will be less likely to kill minute animals if of the plunger or ram type, rather than rotary, and should be of gun-metal or one of the new bronze- alloys which take a patina in salt water. For the circu- lating pipes many materials have been tried. Vulcanite is not only expensive and brittle, but has other disadvan- tages ; common iron pipes, coated internally with cement or asphalt, or glazed internally, with all unions and joints cemented, have been used with more or less success. Probably best of all is common lead piping, the joints being served with red-lead; water should be circulated through such pipes till they become coated vsrith insoluble carbonate, for some time before animals are put into the tanks. For small installations glass may be used, the joints being made with marine glue or other suitable cement.

In building the tanks themselves, regard must be had to their special purposes. If intended for show-tanks for popular admiration, or for the study of large animals, they must be large with a plate-glass front ; for ordinary scien- tific work small tanks with all sides opaque are preferable from every point of view. According to their character, size, and position, fixed tanks may be of brick-work, masonry, or rock, coated in each case with cement;

asphalting the sides offers no particular advantages, and often gives rise to great trouble and expense. All mate- rials, and espscially the cements, must be of the finest quality procurable. For smaller and movable tanks, slate slabs bolted or screwed together have some dis- advantages, notably those of expense, weight, and brittle- ness, but are often used. Better,

cheaper, and lighter, if less permanent, are tanks of wood bolted together, pitched internally. Glass bell-jars, useful in ■ particular cases, shoidd generally have their sides darkened, except when required for observation. Provision should always be made for cleaning every part of the tanks, pipes, and reservoirs; all rock-work in tanks should therefore be removable. As regards the lighting of fixed tanks, it should always be directly from above. In all tanks with glass sides, whether large or small, as much light as possible should be kept from entering through the glass ; otherwise, with a side-light, many animals become restless, and wear themselves out against the glass, affected by even so little light as comes through an opposite tank.

In cases where distance from the sea or other causes make it impracticable to allow the overflow from the tanks to run to waste, special precautions must be taken to keep the water pure. Chemically speaking, the chief character of the water in an aquarium circulation, when compared with that of the open sea, lies in the excessive quantity of nitrogen present in various forms, and the reduced alka- linity ; these two being probably connected. The excess of nitrogen is referable to dead animals, to waste food, and to the excreta of the living organisms. The first two of these sources of contamination may be reduced by care and cleanliness, and by the maintenance of a flow of water sufficient to prevent ihe excessive accumulation of sedi- ment in the tanks. The following experiment shows the rapid rise of nitrogen if unchecked. A tank with a con- siderable fauna was isolated from the general circulation and aerated by four air-jets, except during hours 124-166 of the experiment; column I. shows per 100,000 the nitrogen estimated as ammonia, column II. the total inor- ganic nitrogen: —

Sea water at source of original supply

Aquarium water in tank at com- mencement of experiment

After 22J hours „ 75

I.

II.

0-001

0-003

0 012

0-400

0-020

■ •<

0 025

1-200

0-019

...

0 012

...

0-015

2-200

0-025

• • ■

0-025

■ •■

0-012

...

„ *93*

„ *1214* „*141*

„ *165* „ *169* „ *189*

During this time the alkalinity was reduced to the equivalent of 30 mg. CaCOa per litre, ocean water having an alkalinity equivalent to 60-55 mg. per litre. It has been suggested that the organic nitrogen becomes oxidized into nitrous, then into nitric acid, which lowers the carbonate values. A great deal of reduction of this nitrogenous contamination can be effected by filtration, a method first introduced successfully at Hamburg, where a most thriving aquarium has been maintained by the local Zoological Society for many years on the circulation prin- ciple, new water being added only to compensate for waste and evaporation. The filters consist of open double boxes, the inner having a bottom of perforated slate on which rests rough gravel ; on the latter is fine gravel, then coarse, and finally fine sand. Filtration may be either upwards or downwards through the inner box to the outer. Such filters, intercalated between tanks and reservoir, have been shown by analysis to stop a very large proportion of nitrogenous matter. It is doubtful whether aquarium

water will not always show an excess of nitrogenous compounds, but they must be kept down in every way, pos- sible. In small tanks, well lighted, sea-weeds can be got to flourish in a way that has not been found practicable in large tanks with a circulation; these, with Lamelli- branchs

*and small Crustacea as scavengers, will be found useful in this connexion. Slight or occasional circulation should be employed here also, to remove the film of dust and other matters, which otherwise covers the surface of the water and prevents due oxygenation. **

In such small tanks for domestic use the fauna must be practically limited to bottom-living animals, but for purposes of research it is often desired to keep alive larval and other surface-swimming animals (plankton). In this case a further difficulty is presented, that of help- ing to suspend the animals in the water, and thus to avoid the exhaustion and death which soon follow their unaided efforts to keep off the bottom; this duty is effected in nature by specific gravity, tide, and surface current. In order to deal with this difficulty a simple but efficient apparatus has been devised by Mr E. T. Browne; a " plunger," generally a glass plate or filter funnel, moves slowly up and down in a bell-jar or other small tank, with a period of rest between each stroke ; the motive power is obtained through a simple bucket-and-siphon arrangement worked by the overflow from other tanks. This appa- ratus (first used at the Plymouth Laboratory of the Marine Biological Association in 1897, and since intro- duced into similar institutions), by causing slight eddies in the water, keeps the floating fauna in suspension, and has proved very successful in rearing larvae and in similar work. (g. h. fo.)

Aqueduct. — The term aqueduct, although properly including artificial works of every kind by means of which water is conveyed from one place to another, is generally used in a more limited sense. It is, in fact, rarely employed except in cases where the work is of con- siderable magnitude and importance, and where the water flows naturally by gravitation.

The most important purpose for which aqueducts are constructed is that of conveying pure water, from sources more or less distant, to large masses of popula- tion. Where towns are favourably situated the Maedacts aqueduct may be very short and its cost bear "p^' a relatively small proportion to the total outlay upon a scheme of water supply, but where distant sources have to be relied upon the cost of the aqueduct becomes one of the most important features in the scheme, and the quantity of water obtainable must be considerable to justify the outlay.

Hence it is that only very large towns can undertake the responsibility for this expenditure, though, either voluntarily on the part of the promoters, or by the action of Parliament, smaller sanitary districts near the aqueduct are allowed to become customers for the water. In Great Britain it has, in fact, in all large schemes become a condition that, when a town is permitted to go outside its own watershed, it shall, subject to a priority of a certain number of gallons per day per head of its own in- habitants, allow local authorities, any part of whose dis- trict is within a certain number of miles of the aqueduct, to take a supply on reasonable terms. The first ease in which this principle was adopted on a large scale was the Thirlmere scheme, sanctioned by Parliament in 1879, for augmenting the supply of Manchester. The previous supply was derived from a source only about 15 miles distant, and the cost of the aqueduct, chiefly cast-iron pipes, was insignificant compared with the cost of the impounding reservoirs. But Thirlmere is 96 miles distant from the service reservoir near Man- chester, and the cost of the aqueduct was more than

90 per cent, of the total cost. As a supply of about 50,000,000 gallons a day is available the outlay was justifiable, and the water is in fact very cheaply obtained. Liverpool derives a supply of about 40,000,000 gallons a day from the river Vyrnwy in North Wales, 68 miles distant, and Birmingham is constructing works for im- pounding water in Radnorshire, and conveying it a dis- tance of 74 miles^ the supply being about 75,000,000 gallons a day. In the year 1899 an Act of Parliament was passed authorizing the towns of Derby, Leicester, Sheffield, and Nottingham, jointly to obtain a supply of water from the head waters of the river Derwent in Der- byshire. Leicester is 60 miles distant from this source, and its share of the supply is about 10,000,000 gallons a day. For more than half the distance, however, the aqueduct is common to Derby and Nottingham, which together are entitled to about 16,000,000 gallons a day, and the expense to Leicester is correspondingly reduced. These are the most important eases of long aqueducts in England, and all are

subsequent to 1879. It is obvious, therefore, how greatly the design and construction of the aqueduct have grown in importance, and what care must be exercised in order that the supply upon which such large populations depend may not be interrupted, and that the country through which such large volumes of water are conveyed may not be flooded in consequence of the failure of any of the works.

Practically only two types of aqueduct are used in England. The one is built of concrete, brickwork, &c., the other of cast-iron (or, in special circumstances, steel) pipes. In the former type the water sur- face coincides with the hydraulic gradient, and the conditions are those of an artificial river ; the aqueduct must therefore be carefully graded throughout, so that the fall available between source and termination may be economically distributed. This condition requires that the ground in which the work is built shall be at the proper elevation ; if at any point this is not the case, the aqueduct must be carried on a substructure built up to the required level. Such large structures are, however, extremely expensive, and require! elaborate devices for maintaining watertightness against the expansion and con- traction of the masonry due to changes of temperature. They are now only used where their length is very short, as in cases where mountain streams have to be crossed, and even these short lengths are avoided by some engineers, who arrange that the aqueduct shall pass, wherever practicable, under the streams. Where wide valleys interrupt the course of the built aqueduct, or where the absence of high ground prevents the adoption of that type at any part of the route, the cast-iron pipes hereafter referred to are used.

The built aqueduct may be either in tunnel, or cut-and- cover, the latter term denoting the process of cutting the trench, building the floor, side-walls, and roof, ^'^ed'cts ^^^ covering with earth, the surface of the "'" " " ground being restored as before. For works conveying water for domestic supply, the aqueduct is in these days, in England, always covered. Where, as is usually the case, the water is derived from a tract of mountainous country, the tunnel work is sometimes very heavy. In the case of the Thirlmere aqueduct, out of the first 13 miles the length of the tunnelled portions is 8 miles, the longest tunnel being 3 miles in length. Con- ditions of time, and the character of the rock, usually re- quire the

use of machinery for driving, at any rate in the case of the longer tunnels. For the comparatively small tunnels required for aqueducts, two percussion drilling machines are usually mounted on a carriage, the motive power being derived from compressed air sent up the tunnel in pipes. The holes when driven are charged with

explosives and fired. In the Thirlmere tunnels, driven through very hard Lower Silurian strata, the progress was ^bout 13 yards a week at eacK face, i!^rk being car- ried on continuously day and night for six days a week. Where the character of the country through which the aqueduct passes is much the same as that from which the supply is derived, the tunnels need not be lined with con- crete, &c., more than is absolutely necessary for retaining the water and supporting weak places in the rock ; the floor, however, is nearly always so treated. The lining, whether in tunnel or cut-and-cover, may be either of con- crete, or brickwork, or of concrete faced with brickwork. To ensure the impermeability of work constructed with these materials is in practice somewhat difficult, and no matter how much care is taken by those supervising the workmen, and even by the workmen themselves, it is im- possible to guarantee entire freedom from troume in this respect. With a wall only about 15 inches thick, any neglect is certain to make the work permeable ; frequently the labourers do not distribute the broken stone and fine material of the concrete uniformly, and no matter how excellent the design, the quality of materials, &c., a leak is sure to occur at such places (unless, indeed, the pressure of the outside water is superior and an inflow occurs). A further cause of trouble lies in the water which flows from the strata on 'to the concrete, and washes away some of the cement upon which the work depends for its watertightness; before it has time to set. For this reason it is advisable to put in the floor before, and not after, the side-walls and arch have been built, otherwise the only outlet for the water in the strata is through the ground on which the floor has to be laid. Each length of about 20 feet should be completely constructed before the next is begun, the water then having an easy exit at the. lead- ing end. Manholes, by which the aquedtict can be entered, are usually placed in the roof at convenient intervals ; thus, in the case of the Thirlmere aqueduct, they occur at every quarter of a mile.

In some parts of America aqueducts are frequently constriicted of wood, being then termed fliunes. These are probably more extensively used in California than in any other part of the world, for con- ”’“‘f . veymg large quantities of water which is re- quired for hydraulic mining, for irrigation, for the supply of towns, and for transporting timber. The flumes are frequently carried along precipitous mountain slopes, and across valleys, supported on trestles. In Fresno county, California, there is a flume 52 miles in length for trans- porting timber from the Sierra Nevada Mountains to the plain below ; it has a rectangular V-shaped section, 3 feet

7 inches vride at the top, and 21 inches deep vertically. The boards which form the sides are 1^ inches thick, and some of ^;he trestlework is 130 feet high. The steepest grade occurs where there is a fall of 730 feet in a length ‘ of 3000 feet. About 9,000,000 feet of timber were used in the construction. At San Diego there is a flume 35 miles long for irrigation and domestic supply, the capacity being 50 feet per second; it has 315 trestle bridges (the longest of which is that across Los Coches Creek, 1794 feet in length a,nd 65 feet in height) and

8 tunnels, and the cost was $900,000. The great bench flume of the Highline canal, Colorado, is 2640 feet in length, 28 feet wide, and 7 feet deep; the gradient is 5-28 feet per mile, and the discharge 1184 feet per second.

As previously stated, the type of aqueduct built of con- crete,, &c., can only be adopted where the ground is suffi- ciently elevated to carry it, and where the quantity of water to be conveyed makes it more economical than pip- ing. Where the falling contour is interrupted by valleys too wide for a masonry structure above the surface of the

Wooden Pipe AqnEDUCT, with WRonGHT-iRON Rings.

Wooden Aqueduct ckossing a Valley on a Trestle.

The Nadkai Aqiteduct.

Wooden Aqceduct ok Flume.

*ground, the detaxshed portions of the built aqueduct must be connected by rows of pipes laid beneath, and follow- ing the main undulations of, the surface. In inlmn'^ such cases the built aqueduct terminates in a piping. chamber of suf&cient size to enclose the mouths of the several pipes, which, thus jiharged, carry the water under the valley up to a corresponding chamber on the further hillside, from which the built aqueduct again carries on the supply. These connecting pipes are sometimes called siphons, although they have nothing whatever to do with the principle of ^ siphon, the water simply flowing into the pipe at one end and out at the other under the influence of gravity, and the pressure of the atmosphere being no element in the case. The pipes are almost always made of cast-iron, except in such cases as the lower part of some siphons, where the pressure is very great, or where they are for use abroad, when considerations of weight are of importance, and when they are made of rolled steel with riveted or welded seams. It is frequently necessary to lay them in deep cuttings, in which case cast-iron is much better adapted for sustaining a heavy weight of earth than the thinner steel, though the latter is more adapted to resist internal pressure. Mr D. Clarke in the Trans. Am. Soc. G. E. vol. xxxviii. p. 93, gives some particulars of *a riveted steel pipe 24 miles long, 33 to 42 inches' diameter, varying in thickness from 0-22 inch to 0-375 inch. After a length of 9 miles had been laid, and the trench refilled, it was found that the crown of the pipe had been flattened by an amount vary- ing from \ inch to 4 inches. Steel pipes suffer more ' from corrosion than those made of cast-iron, and as the metal attacked is much thinner the strength is more seriously reduced. These considerations have prevented any general change from cast-iron to steel.*

Mr Clemens Herschell has made some interesting remarks (^Proc. Inst. C. E. vol. cxv. p. 162) as to the circumstances in which steel pipes have been found preferable to cast-iron. He says that it had been demonstrated by practice that cast-iron cannot compete with wrought-iron or steel pipes in the States west of the Rocky Mountains, on the Pacific slope. This is

due to the absence of coal and iron ore in these States, and to the weight of the imported cast-iron pipes compared with steel pipes of equal capacity and strength. The works of the East Jersey Water Company for the supply of Newark, N.J,, include a riveted steel conduit 48 inches in diameter and 21 miles long. This conduit is designed to resist only the presstire due to the hydraulic gradient, in contradistinc- tion to that which would be due to the hydrostatic head, this arrangement saving 40 per cent, in the weight and cost of the pipes. For the supply of Rochester, N.Y., there is a riveted steel conduit 36 inches in diameter and 20 miles long; and for Allegheny City, Pennsylvania, there is a steel conduit 5 feet in diameter and nearly 10 miles long. The works for bringing the water from La Vigne and Vemeuil to Paris, include a steel main 5 feet in diameter between St Cloud and Paris.

Cast-iron pipes rarely exceed 48 inches in diameter, and even this diameter is only practicable where the pressure of the water is low. In the Thirlmere aqueduct the greatest pressure is nearly 180 ft) on the square inch, the pipes where this occurs being 40 inches in diameter and If inches thick. These large pipes, which are usually made in lengths of 12 feet, are generally oast with a socket at one end for receiving the spigot end of the next pipe, the annular space being run with lead, which is prevented from flowing into the interior of the pipe by a spring ring subsequently removed ; the surface of the lead is then caulked all round the outside of the pipe. A wrought-iron ring is sometimes shrunk on the outer rim of the socket, previously turned to receive it, in order to strengthen it against the wedging action, of the caulking tool. Sometimes the pipes are cast as plain tuBes and joined with double collars, which are run with lead as in the last case. The reason for adopting the latter type is that the stresses set up in the thicker metal of the socket by unequal cooling are thereby avoided, a very usual place for pipes to crack under pressure being at the back of the socket. The method of turning and boring a portion, slightly tapered, of spigot and socket so as to ensure a watertight junction by close annular metallic contact, is not suitable for large pipes, ■though very convenient for smaller diameters in even ground. Spherical joints are sometimes used where a line of main has to be laid under a large river or estuary, and where, therefore, the pipes

must be jointed before being lowered into the previously dredged trench. This was the case at the Willamette river, Portland, Oregon, where a length of 2000 feet was required. The pipes are of cast-iron 28 inches in diameter, 1^ inches thick, and 17 feet long. The spigots were turned to a spherical surface of 20 inches' radius outside, the inside of the sockets being of a radius f inch greater. After the insertion of the spigot into the socket, a ring, 3 inches deep, turned inside to correspond with the socket, was bolted to the latter, the annular space then being run with lead. These pipes were laid on an inclined cradle, one end of which rested on the bed of the river and the other on a barge where the jointing was done ; as the pipes were jointed the barge was carefully advanced, thus trailing the pipes into the trench (TVaJis. Am. Soc. C. E. vol. xxxiii. p. 257). As may be conjectured from the pressure which they have to stand, very great care has to be taken in the manufacture and handling of cast-iron pipes of large diameter, a care which must be unfailing from the time of casting until they are jointed in their final position in the ground. They are cast vertically, socket downwards, so that the densest metal may be at the weakest part, and it is advisable to allow an extra head of metal of about 12 inches, which is subsequently cut ofl in a lathe. An inspector representing the purchaser watches every detail of the manufacture, and if, after being measured in every part and weighed, they are fouJld satisfactory they are proved with internal fluid pressure, oil being preferable to water for this purpose. While under pressure, they are rapped from end to end with a hand hammer of about 5 lb in weight, iu order to discover defects. The wrought-iron rings are then, if required, shrunk on to the sockets, and the pipes, after being made hot in a stove, are dipped vertically in a composition of pitch and oil, in order to preserve them from corrosion. All these operations are performed under cover. A record should be kept of the history of the pipe from the time it is oast to the time it is laid and jointed in the ground, giving the date, number, diameter, length, thickness, and proof pressure, with the name of the pipe-jointer whose work closes the record. Such a history sometimes enables the cause (which is often very obscure) of a burst in a pipe to be ascertained, the positipn of every pipe being recorded.

Cast-iron pipes, even when dipped in the composition referred to, suffer considerably from corrosion caused by the water, especially soft water,

flowing through them; One pipe may be fomid in as good a conditioi^i as when made, while the next may be covered with nodules of rust. The effect of the rust is twofold : it reduces the area of the pipe, and also, in consequence of the resistance offered by the rough surface, retards the velocity of the water. These two results, especially the latter, may seriously diminish the capability of discharge, and they should always be allowed for in deciding the diameter. Automatic scrapers are sometimes used with good results, but it is better to be independent of them as long as possible. In one case the discharge of pipes, 40 inches in diameter, was found to diminish at the rate of about

1 per cent, per year ; in another case, where the water was soft and where the pipes were 40 inches in diameter, the discharge was diminished by 7 per cent, in ten years. An account of the state of two cast-iron mains supplying Boston with water is given in the 7}rans. Am. Soc. O. E. vol. xxxv. p. 241. These pipes, which were laid in 1877, are 48 inches in diameter and 1800 feet long. When they were examined in 1894-95, it was estimated that the tubercles of rust covered nearly one-third of the interior surfaces, the bottom of the pipe being mpre incrusted than the sides and top. They had central points of attachment to the iron, at which no doubt the coating was defective, and from them the tubercles spread over the surface of the surrounding coating. In this case they were removed by hand, and the coating of the pipes was not injured in the process. Cast-iron pipes must not be laid in contact with cinders from a blast furnace with which roads are sometimes made, because these corrode the metal. Mr Russell Aitken (^Proc. ,Inst. C. E. vol. cxv. p. 93) found in India that cast-iron pipes buried in the soil rapidly corroded, owing to the presence of nitric acid secreted by bacteria which attacked the iron. The large cast-iron pipes conveying the water from the Tansa reservoir to Bombay are laid above the surface of the ground. Cast-iron pipes of these large diameters have not been in existence sufficiently long to enable their life to be predicted. A main, 40 inches in diameter, conveying soft water, has been in existence fifty years at Manchester, and is apparently as good as ever. In 1867 Mr J. B. Francis found that no apparent deterioration had taken place in a cast-iron main, 8 inches' diameter, which was laid in the year 1828, a period of thirty-nine years {Trans. Am. Soc. C. E. vol. i. p. 26). These two instances are probably not exceptional.

Pipes in England are usually laid with not less than

2 feet 6 inches of cover, in order that the water may not be frozen in a severe winter. Where they are laid in deep cutting they should be partly surrounded with con- crete, so that they may not be fractured by the weight of

earth above them. Angles are turned by means of special bend pipes, the curves being made of as large a radius

as convenient. In the case of the Thirlmere ona^ag. aqueduct, double socketed castings about 12

inches long (exclusive o;f the sockets) were used, the sockets being inclined to each other at the required angle. They ~~were made to various angles, and for any particular curve several virould be used con~~ nected by straight pipes 3 feet long. As special cast- ings are nearly double the price of the regular pipes, the cost was much diminished by making them as short as possible, while a curve, made up of the slight angles used, offered practically no more impediment to the flow of water in consequence of its polygonal form, than would be the case had special bend pipes been used. In all cases of curves on a line of pipes under internal fluid pressure, there exists a resultant force tending to displace the pipes. When the curve is in a horizontal plane and the pipes are buried in the ground, the side of the pipe trench offers sufficient resistance to this force. Where, however, the pipes are above ground, or when the curve is in a vertical plane, it is necessary to anchor them in position. In the case of the Tansa aqueduct to Bombay, there is a curve of 500 feet radius near Bassein Creek. At this point the hydrostatic head is about 250 feet, and the engineer, Mr Gierke, mentions that a tendency to an outward movement of the line of pipes was observed. At the siphon under Kurla Creek the curves on the approaches as originally laid down were sharp, the hydrostatic head being there about 210 feet ; here the outward movement was so marked that it was considered advisable to realign the approaches with easier curves (Proc.

Inst. G. E. vol. cxv. p. 34). In the case of the Thirlmere aqueduct the greatest hydrostatic pressure, 410 feet, occurs at the bridge over the river Lune, where the pipes are 40 inches in diameter, and in descending from the bridge make reverse angles of 31°. The displacing force at each of these angles amounts to 54 tons, and as the design includes five lines of pipes, it is obvious that the anchoring arrangements must be very efficient. The steel straps used for anchoring these and all other bends were curved to fit as closely as possible the castings to be anchored. Naturally the metal was not in perfect contact, but when the pipes were charged the disappearance of all the slight inequalities, showed that the straps were ful- filling their intended purpose. At every summit on a line of pipes one or more valves must be placed in order to allow the escape of air, and they must also be provided on long level stretches, and at changes of gradient where the depth of the point of change below the hydraulic gradient is less than that at both sides, causing what may be called a virtual summit. It is better to have too many than too few, as accumulations of air may cause an enormous diminution in the quantity of water delivered. In all depressions discharge valves should be placed for emptying the pipes when desired, and for letting off the sediment which accumulates at such points. Automatic valves are frequently placed at suitable distances for cutting off the supply in case of a burst. At the inlet mouth of the pipe they may depend for their action on the sudden loweriag of the water (due to a burst in the pipe) in the chamber from which they draw their supply, causing a float to sink and set the closing arrangement in motion. Those on the line of main are started by the increased velocity in the water, caused by a burst on the pipe at a lower level. The water, when thus accelerated, is able to move a disc hung in the pipe at the end of a lever and weighted so as to resist the normal velocity ; this lever releases a catch, and a door is then gradually revolved by weights until it entirely closes the pipe. Eeflux valves on the ascending leg of ia siphon prevent water from flowing back in case

of a burst below them; they have doors hung on hjnges, opening only in the normal direction of flow. Due allow- ance must be made, in the amount of head allotted to a pipe, for any head which may be absorbed by such mechanical arrangements as those described where they offer oppositi«n to the flow of the water. These large mains require most

careful and gradual filling with water, and constant attention must be given to the air-valves to see that the gutta-percha balls do not wedge themselves in the openings. A large mass of water, having a consider- able velocity, may cause a great many bursts by water- ramming, due to the admission of the water at too great a speed. In places where iron is absent and timber plentiful, as in some parts of America, pipes, even of large diameter and in the most important cases, are sometimes made of wooden staves hooped with iron. A description of two of these will be found below.

The Thirlmere Aqueduct, to which reference has iDeen made above, is capable of conveying 50,000,000 gallons a day from Thirlmere, in the English lake district, to Manchester. _^ . The total length of 96 miles is made up of 14 miles ’”■”“«• of tunnels, 37 miles of cut-and-cover, and 45 miles of cast- iron pipes, five rows of the latter being required. The tunnels where lined, and the cut-and-cover, are formed of concrete, and are 7 feet in height and width, the usual thickness of the concrete being 15 inches. The inclination . is 20 inches per mile. The floor is flat from side to side, and the side-walls are 5 feet high to the springing of the arch, which has a rise of 2 feet. The water from the lake is received in a circular well 65 feet deep and 40 feet in diameter, at the bottom of which there is a ring of wire-gauze strainers. Wherever the concrete aqueduct is intersected by valleys, cast-iron pipes are laid ; at present only one of the five rows 40 inches in diameter has been laid, as the city does not yet require its present supply to be augmented by more than 10,000,000 gallons a day. AU the elaborate arrange- ments described above for stopping the water in case of a burst have been employed, and have perfectly fulfilled their duties in the few cases in which they have been called into action. The water is received in a service reservoir at Prestwich, near Manchester, from which it is supplied to the city. The supply from this source was begun in 1894. The total cost of the complete scheme will not be far short of £5,000,000, of whiqh rather under £3,000,000 had been spent up to the date of the opening.

The Vyrnwy Aqueduct was sanctioned by parliament in 1880 for the supply of Liverpool from North Wales, the quantity of water obtainable being at least 40,000,000 gallons a day. „ A tower built in the artificial lake from which the ’” ”’■ supply is derived, contains the inlet and

arrangements for strain- ing the water. The aqueduct is 68 miles in length, and for nearly the whole distance will consist of three lines of cast-iron pipes, one of which, varying in diameter from 42 inches to 39 inches, is now in use. As the total fall between Vyrnwy and the termina- tion at Prescot reservoirs is about 550 feet, arrangements had to be made to ensure that no part of the aqueduct be subjected to a greater pressure than is required for the actual discharge. Balanc- ing reservoirs have therefore been constructed at five points on the line, advantage being taken of high ground where available, so that the total pressure is broken up into sections. At one of these points, where the ground level is 110 feet below the hydraulic gradient, a circular tower is built, making a most imposing archi- tectural feature in the landscape. At the crossing of the river Weaver, 100 feet wide and 15 feet deep, the three pipes, here made of steel, were connected together laterally, floated into position, and sunk into a dredged trench prepared to receive them. Tinder the river Mersey the pipes are carried in a tunnel, from which, during construction, the water was excluded by compressed air.

Denver Aqueduct. — The new supply to Denver City, initiated by the Citizens Water Company in 1889, is derived from the Platte river, rising in the Rocky Mountains. The first aque- duct constructed is rather over 20 miles in length, of Denver. which a length of 16^ miles is made of wooden stave pipe, 30 inches in diameter. The maximum pressure is that due to 185 feet of water ; the average cost of the wooden pipe was ^1.36 J per foot, and the capability of discharge 8,400,000 gallons a day. Within a year of the completion of the first conduit, it became evident that another of still greater capacity was required. This was completed in April 1893 ; it is 34 inches in diameter and will deliver 16,000,000 gallons a day. By increasing the head upon the first pipe, the combined discharge is 30,000,000 gallons a day. An incident in obtaining a temporary supply, without waiting for the completion of the second pipe, was the construction of two wooden pipes, 13.

inches in diameter, crossing a stream witli a span of 104 feet, and havmg no support other than that derived from their arched form. One end of the arch is 24^ feet above the other end, and, when filled vyith vrater, the deflection with eight men on it was only I of an inch. A somewhat similar arch, 60 feet span, occurs on the 34-inch pipe where it crosses a canal. Mr Schuyler points out (Trans. Am. Soc. C. E. vol. xxxi. p. 148) that the fact that the entire water supply of a city of 150,000 inhabitants is conveyed in wooden mains, is so radical a departure from all precedents, that it is deserving of more than a passing notice. He says that it is manifestly and unreservedly successful, and has achieved an enor- mous saving in cost. The sum saved by the use of wooden, in preference to cast-iron pipes, is estimated at $1,100,000. It is perhaps necessary to state that the pipe is buried in the ground in the same way as metal pipes. T^e edges of the staves are dressed to the radius with a minute tongue fj inch high on one edge of each stave, but with no corresponding groove in the next stave ; its object is to ensure a close joint when the bands are tightened up. Leaks seldom or never occur along the longitudinal seams, but the end shrinkage caused troublesome joint leaks. The shrinkage in California redwood, which had seasoned 60 to 90 days before milling, was frequently as much as 3 inches in the 20 staves that formed the 84-inch pipe, and the space so formed had to be filled by a special closing stave. Metallic tongues, f inch deep, ara inserted at the ends of abutting staves, in a straight saw cut. The bands, which are of mild steel, have a head at one end and a nut and washer at the other ; the ends are brought together on a wrought-iro" shoe, against which the nut and washer set. The Staves forming the lower half of the pipe are placed on an outside, and the top staves on an inside, mould. While the bands are being adjusted the pipe is rounded out to bring the staves out full, and the staves are carefully driven home on to the abutting staves. The spacing of the bands depends on circum- stances, but is about 150 bands per 100 feet. With low heads the limit of spacing was fixed at 17 inches. The outer surface of the pipe, when charged, shows moisture oozing -slightly over the entire surface. This condition Mr Schuyler considers an ideal one for perfect preservation, and the staves were kept as thin as possible to ensure its occurrence. Samples taken from pipes in use from three to nine years are quite sound, and it is concluded that the wood vrill last as long as cast-iron if the pipe is kept constantly charged. The bands are the only

perishable portion, and their life is taken at from fifteen to twenty years. Other portions of the second conduit for a length of nearly 3 miles were formed of concrete piping, 38 inches' diameter, formed on a mould in the trench, the thickness being 2J to 3 inches. So successful an instance of the use of wooden piping on a large scale, is sure to lead to a large development of this type of aqueduct in districts where timber is plentiful and iron absent.

Pion^r Aqueduct, Utah. — The construction of the Pioneer Aque- duct, Utah, was begun in 1896 by the Pioneer Electric Power Company, near the city of Ogden, 35 miles north of J'''''** Salt Lake City. The storage reservoir, from which it Utah. draws its water, will cover an area of 2000 acres, and*

contain about 15,000 million gallons of water. The aqueduct is a pipe 6 feet in diameter, and of a total length of 6 miles ; for a distance of rather more than 5 miles it is formed of wooden staves, the remainder, where the head exceeds 117 feet, being of steel. It is laid in a trench and covered to a depth of 3 feet. The greatest pressure on the steel pipe is 200 lb per square inch, and the thickness varies from f to ^J inch. The pipe was constructed according to the usual practice of marine boiler-work for high pressures, and each section, about 9 feet long, was dipped in asphalt for an hour. These sections were supported on timber blocking, placed from 5 to 9 feet apart, and consisting of three to six pieces of 6 x 6 inch timbers laid one on the top of the other ; they were then riveted together in the ordinary way. The wooden stave-pipe is of the type successfully used in the Western States for many years, but its diameter is believed to be unequalled for any but short lengths. There were thirty-two staves in the circle, 2 inches in thickness, and about 20 feet long, hooped with round steel rods f inch in diameter, each hoop being in two pieces. The pipe is supported at intervals of 8 feet by sills 6×8 inches and 8 feet long. The flow through it is 250 cubic feet per second.

The Santa Ana Canal was constructed for irrigation purposes in California, and is designed to carry 240 cubic feet of water per second (^TVans. Am. Soc. C. E. vol. xxxiii. p. 99). The Santa Aaa. grggg section of the flumes shows an elliptical bottom and straight sides consisting of

wooden staves held together by iron and steel ribs. The width and depth are each 5 feet 6 inches, the intended depth of water being 5 feet. The staves are held by T-iron supports resting on wooden sills spaced 8 feet apart, and are compressed together by a framework. They were caulked with oakum, on the top of which, to a third of the total depth, hot asphalt was run. The use of nails was altogether avoided except in parts of the framework, it being noticed that decay usually

starts at nail holes. It was found possible to make the flume absolutely watertight, and in case of repair being necessary at any part the framework is easily taken to pieces so that new staves can be inserted. The water in the flume has a velocity of 9-6 feet per second. The Warm Springs, Deep, and Morton, caflons on the line are crossed by Vooden stave pipes 52 inches in diameter, bound with round steel rods, and laid above the surface of the ground. The work is planned for two rows of pipes, each capable of carrying 123 cubic feet per second ; of these one so far has been laid. The lengths of the pipes at each of the three cafions are 561, 964, and 756 feet respectively, and the maximum head at any place is 160' feet. The pipes are not painted, and it has been suggested that they would suffer in their exposed position in case of a bush fire, a contingency to which, of course, flumes are also liable.

Aqueducts of New York. — There are three aqueducts in New York— the Old Croton Aqueduct (1837-43), the Bronx River Con- duit (1880-«5), and the New Croton Aqueduct (1884-93), discharg- ing respectively 95, 28, and 302 million U.S. gallons a day ; their combined delivery is therefore 425 million '^^^ Vork. gallons a day. The Old Croton Aqueduct is about 41 miles in length, and was constructed as a masonry conduit, except at the Harlem and Manhattan valleys, where two lines of 36-inch pipe were used. The inclination of the former is at the rate of about 13 inches per mile. The area of the cross-section is 53-34 square feet, the height is 8J feet, and the greatest width 7 feet 5 inches ; the rqof is semi-circular, the floor segmental, and the sides have a batter on the face of i inch per foot. The sides and invert are of concrete, faced with 4 Inches of brickwork, the roof being entirely of brickwork. There is a bridge over the Harlem river 1450 feet in length, con- sisting of fifteen semicircular arches; its sofBt is 100 feet above high water, and its cost was $963,427.

The construction of the New Croton Aqueduct was begun in 1885, and the works were sufl- ciently advanced by 15th July 1890 to allow the supply to be begun. The lengths of the various parts of the aqueduct are as follows : —

Miles.

Tunnel 29-75

Cut-and-oover 1-12

Cast-iron pipes, 48 inches diameter, 8 rows . 2-38

Croton Inlet to Central Park

33-25

The length of the tunnel underpressure (circular form) is 7 -17 miles, and that not under pressure (horse-shoe form) 23-70 miles. The maximum pressure in the former is 55 ft) per square inch. The width and height of the horse-shoe form are each 13 feet 7 inches, and the diameter of the circular form (with the exception of two short lengths) is 12 feet 3 inches. The reason for constructing the aqueduct in tunnel for so long a distance was the enhanced value of the low-lying ground near the old aqueduct. The tunnel deviates from a straight line only for the purpose of intersecting a few transverse valleys at which it could be emptied. For 25 miles the gradient is 0-7 foot per mile ; the tunnel is then depressed below the hydraulic gradient, the maximum depth being at the Harlem river, where it is 300 feet below high water. The depth of the tunnel varies from 50 to 500 feet from the surface of the ground. Forty-two shafts were sunlc to facilitate driving, and in four cases where the surface of the ground is below the hydraulic gradient these are closed by watertight covers. The whole of the tunnel is lined with brickwork from 1 to 2 feet in thickness, the voids behind the lining being filled with rubble-in-mortar. The entry to the old and new aqueducts is controlled by a gate- house of elaborate and massive design, and the pipes which take up the supply at the end of the tunnel are also commanded by a gate-house. The aqueduct, where it passes under the Harlem river, is worthy of special notice. As it

approaches the river it has a considerable fall, and eventually ends in a vertical shaft 12 feet 3 inches in diameter (where the water has a fall of 174 feet), from the bottom of which, at a depth of .300 feet below high-water level, the tunnel under the river starts. The latter is circular in form, the diameter being 10 feet 6 inches, and the length is 1300 feet ; it terminates at the bottom of another vertical shaft also 12 feet 3 inches in diameter. The depth of this shaft, measured from the floor of the lower tunnel to that of the upper tunnel leading away from it, is 321 feet ; it is continued up to the surface of the ground, though closed by double watertight covers a little above the level of the upper tunnel. Adjoining this shaft is another shaft of equal diameter, by means of which the water can be pumped out, and .there is also a communication with the river above high-water level, so that the higher parts can be emptied by gravitation. The cost of the Old Croton Aqueduct was $11,500,000 ; that of the new aqueduct is not far short of $20,000,000.

The Nadrai Aqueduct Bridge, opened at the end of 1889, is the largest structure of its kind in existence. It was built to carry the water of the Lower Ganges canal over the Kali jv rf / Naddi, in connexion with the irrigation canals of the "aara. north-west provinces of India. In the year 1888-89 this canal

had 564 miles of main line, with 2050 miles of minor distributaries, and irrigated 519,022 acres of crops. The new bridge replaces one of much smaller size (five spans of 35 feet), which was completely destroyed by a high flood in July 1885. It gives the river a waterway of 21,000 square feet, and the canal a waterway of 1040 square feet, .the latter representing a discharge of 4100 cubic feet per second. Its length is 1310 feet, and it is carried on fifteen arches having a span of 60 feet. The width between the faces of the arch«s is 149 feet. The foundations below the river-bed have a depth of 52 feet, and the total height of the structure is 88 feet. It cost 44J lakhs of rupees, and occupied four years in building. The foundations consist of 268 circular brick cylinders, and the fifteen spans are arranged in three groups, divided by abutment piers ; the latter are founded on a

double row of 12-f eet cylinders, and the intermediate piers on a single row of 20-feet cylinders, all the cylinders being hearted with hydraulic lime concrete filled in with skips. This aqueduct-bridge has a very fine appearance, owing to its massive proportions and design.

For an account of the New York aqueduct see the Beport of the Aqueduct Commissioners, 1887-95, and The Water Supply of the City of New York, 1896, by Wegmann. For accounts of other aqueducts, see the Transactions of the Societies of Engineers in the different countries, and the Engineering Journals. (b. P. H.)*

Aquila, a town anfl. bishop's see of Italy (Abruzzi and Molise), capital of the province of Aquila, situated in the Central Apennines, at the S.W. foot of the knot of Gran Sasso d'ltalia, 145 miles N.E. from Eome by rail. There are two picture galleries, one in the town hall, the other in the Dragonetti (formerly De Torres) Palace, and an industrial arts and sciences school. University classes are held here. Owing to its altitude (2366 ft.), it is a favourite summer resort of the Italians. Population of commune (1881), 18,426 ; (1901), 21,215 ; of province (1881), 353,027 ; (19^1), 397,645.

Arabi Pasha (more correctly Ahmad 'Arabi, to which in later years he added the epithet al-Misri, " the Egyptian "), Egyptian soldier and revolutionary leader, was born m Lower Egypt in 1S39, of a fellah family. Having entered the army as a conscript he was made an officer by Said Pasha in 1862, and was employed in the transport department in the Abyssinian campaign under

Ismail Pasha. A charge of peculation was made against him in connexion with this expedition and he was placed on half-pay. During this time he joined a secret society formed by Ali Eoubi with the object of getting rid of Turkish officers from the Egyptian army. In 1878 he was employed by Ismail in fomenting a disturbance against the ministry of Nubar, Wilson, and De Blignik-es, and received in payment a wife from Ismail's harem and the command of a regiment. This increased his influence with the secret society, which, under the feeble government of Tewfik Pasha and the Dual Control, began to agitate against Europeans. A military demonstration on 8th September 1881, led by Arabi, forced the Khedive to

increase the numbers and pay of the army, to substitute Cherif Pasha for Eiaz Pasha as prime minister, and to convene an assembly of notables. Arabi became under- secretary for war at the beginning of 1882, but continued his intrigues. The Assembly of Notables claimed the right of voting the budget, and thus came into conflict with the foreign controllers who had been appointed to guard the interests of the bondholders in the management of the Egyptian finances. Cherif fell in February, and Arabi (created a pasha) became minister of war. Fortified by the honours bestowed on him by the sultan, Arabi, after a brief fall from office, acquired a dictatorial power that alarmed the British Government. His arming of the forts at Alexandria was held to constitute a menace to the fleet. On the refusal of France to co-operate, the British fleet bombarded the forts (11th July), and a British force, under Sir Garnet Wolseley, defeated Arabi on 13th September at Tel-el-Kebir. Arabi surrendered, and was tried (3rd December) for the crime of rebellion. In accordance with an understanding made with the British representative. Lord Dufferin, Arabi pleaded guilty, and the formal sentence of death was immediately commuted to one of banishment for life to Ceylon. After his exile had lasted for nearly twenty years, however, the Khedive, Abbas II., exercised his prerogative of mercy, and in May 1901 Arabi was permitted to return to Egypt.

ARABIA.

DUEING the last quarter of the 19th century several notable journeys were made through Northern, Central, and Southern Arabia which, although they have led to no essential modification of previous views regard- ing the general physiography of that country, have added considerably to our knowledge of its topographical detail. Very little systematic survey has been possible in a country so remote from the centres of scientific movement, and so hostile to foreign interference. The eastern coast has been connected with the Indian system of triangulation across the Strait of Hormuz; and from Aden a local topo- graphical survey has been carried into the southern off- shoots of the Yemen Mountains by officers of the Indian Survey, based on a triangulation which is independent of India. Amongst recent investigations the researches of Dr Walker in the Sinai Peninsula have thrown new light on

the coral formations of the western coast, and have elucidated some interesting problems in connection with A^bian desert formations. According to this authority, the change in surface configuration of the desert sands of Northern Arabia is due to no change in climatic factors. It is governed by the same laws to-day as it was thousands of years ago. Sand formations are produced by the differ- ences of temperature (50° to 80° F.), to which the surface rock is daily exposed. The rock is first broken up by these differences into small fragments which are polished

and rounded by the action of wind-blown sand. Granite, especially, disintegrates rapidly on account of the differ- ence in the specific heat of its constituent parts. Then the wind action again separates the component parts and forms broad spaces in the desert, of which the sand par- ticles may consist uniformly either of mica or of quartz. But as regards recent illustration of the conformation and geology of the Arabian continent generally, it is to the Researches of Doughty and Blunt, between the years 1876 and 1878, and to those of Theodore Bent subsequently, that we are most indebted for fresh material from English sources.

Doughty accompanied the annual pilgrimage, or "haj," from Damascus to Mecca, stopping at Medyin Salih (some 150 miles north-west of Medina) to copy Nabathaean in- scriptions and explore the monuments of El Hajr. During the spring of 1877 he visited Nejd, returning again to El Hajr and exploring the cool and lofty Harrat during the summer. He afterwards journeyed northwards to Teyma, in the Nefud, and eastwards to Hail, the residence and capital of the Emir Ibn Eashid. From Hail he returned south-west to Khaybar, crossing an upland region of lava- fields and extinct volcanoes, which he believes to be the true water-parting between east an(i west in Northern Arabia. In the spring of 1878 he again returned to Nejd, visiting Aneyza and Boreyda, which he describes as its two most

important towns. Then recrossing the continent and traversing the elevated steppe which is the wandering ground of the great Bednin tribe,

Ateyba, he finally reached Jidda, exhausted by the hardships and vicissitudes of his journey. It is worthy of note that he travelled openly as a Christian and an Englishman, and that he survived to write a standard work on Arabia ; whilst Huber, who traversed much the same country in 1883- 84, paid the penalty of the venture with his life. In 1878-79 Mr Wilfrid Blunt, accompanied by his in- trepid wife. Lady Anne Blunt, travelled from Syria south-east to Jebel Shammar, skirting the great Wadi Sirhan depression to Jof, and thence crossing the^efud. He thus followed a route approximately parallel to that of Doughty, at a distance of about 80 miles from it. On his return journey from Nejd he joined the bands of Persian pilgrims returning from Mecca, travelling nearly due north to Ker- bela and Baghdad, passing through the country of the DafSr Beduins, so that be- tween these two travellers we have a fairly connected account of the physiography of all Northern Arabia, differing in some important details from the earlier descrip- tions of Palgrave (Arabia, Eruyy. Brit. ii. 235-265). Mr Bent, who was also accom- panied by his wife, visited the Bahrein islands, on the east coast of Arabia, in 1888, and added much to our knowledge of this cradle of the Phoenician race. In 1893-94 he made an adventurous journey into the main valley of Hadramut, and later again visited the Southern Arabian coast, starting from Muskat, but was not successful in penetrating into the interior of the continent. Colonel S. B. MUes ex- plored Oman and visited Dhofar, on the southern coasts of Arabia, in 1884. Yemen was traversed as late as 1892 by W. B. Harris, who travelled in disguise from Aden to Sanaa, the capital, where he was imprisoned by the Turkish authorities, and whence he was deported under an escort to Hodeida. In such circumstances he was not able to add much to the scientific information gained by previous travellers ; but he gave an excellent descriptive ac- count of the wonderful fertility and beauty of Arabia Felix. Stimulated by a journey of the French botanist Defiers in 1888, Dr Schweinfurth made a botanical exploration of Yemen in the winter of 1888-89, and Herr Eduard Glaser, about the same time, visited Mareb, the capital of the old Sabsean empire, and brought home with 'him numerous manuscripts. To the researches of these travellers in Northern, Central, Southern, and Western ^Arabia, we may add such matters of historical interest affecting Arabia as have been brought to light by the labours of the offi- cers of the Indian Survey

working in Baluchistan and Makr^n. They undoubtedly open up a new chapter in Arabian commercial (if not military) history.

From Doughty we learn that the geology of Arabia is of truly Arabian simplicity. A central core of Plutonic rocks is overlaid by sandstones, and these again by limestones, ^ome- Pbyslo- times accompanied with flints. This is a similar forma- grapby. ^^^^ ^ ^^^^ *which appears again between the Dead Sea and Jerusalem, and probably underUes all Palestine. The " nefuds," or deep sandy deserts, are composed of material derived from the sandstones. The occurrence of volcanic rocks upon plateaux throughout Central Arabia was previously unrecorded,*

but there appears to be a doubt whether the volcanic cones on the surface of the lava-flows of the "harrats" can geologically be con- nected with these flows. In the north-west the platform of sand- stone which flanks the pilgrim route to Mecca from Damascus for about 150 miles, with its western edge approximately parallel to the Red Sea coast at a distance of about 100 miles, and which terminates southwards near El Hajr, is not the true watershed between the sand-plains of Teyma and the sea ; for the drainage strikes across it from eastwards, and is possibly antecedent to the formation of the plateau. The surface of this great "harrat," or upland, which crowns the mountainous highlands -of the coast, and is flanked on the east by a long extended depression, has been embedded by stream after stream of basaltic lava, and is studded with numerous extinct volcanoes. The highest of these volcanoes is estimated to be as much as ,1000 feet above the plateau level. Between Shammar and Khaybar, striking south-west across the continent, the central districts consist of an upland space of lava- fields and extinct volcanoes (called " hilli-hillian " by the Arabs) rising to about 6000 feet above sea—level, forming another ' ' harrat " known as the Harrat Khaybar. This was ascertained to be the

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Map of Arabia.

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true water-parting of this part of the country ; the waters flowing eastwards to the Wadi e' Rumma (which would be an afluent of the Euphrates if it were a perennial stream instead of a dry trough flushed once in a generation) and westwards to the Wadi el Humth (previously unknown) which has its mouth on the Red Sea coast.

Blunt describes the harrats or upland plains, closely adjoining the frontiers of Syria and Arabia to the south of Damascus, as a vast expanse of boulder-strewn desert, " a bleak and gloomy region across which it is difficult to travel with camels on account of the narrowness and intricacy of thg paths which wind in and out amongst the boulders." Prom this region of black stones, extend- ing south-eastwards for upwards of 300 miles to Jof, is the great depression of the Wadi Sirhan (probably an ancient arm of the sea) which is estimated to be less than 2000 feet above sea^level, and is flanked to the eastward by the vast gravelly plain of El Hamad on a higher level of 500 feet. Jof is a walled town of about 500 houses, which stands on the northern edge of the Nefud or red sand-plain of the interior. This plain extends for 200 miles to the foot at the Jebel Shammar, beneath which lies Hail, which Blunt places at the foot of the northern slopes to the

east of Jebel Aja, and Doughty shows to the south of that range. The rocky hills of the Nefud, like those of Jof , are of sandstone, varying in colour from yellow to red and purple, but weathered black on the upper surface. Jebel Shammar itself is composed of red' granite. The general characteristics of these mountains and of their vegetation seem to be similar to those of Mount Sinai. The plain level at Hail is estimated by Blunt to be 4000 feet above sea-level, and the summits of the Shammar Mountains to be 2000 feet higher. The character of the Nefud plains apparently difiers essentially from that described by Palgrave. The Nefud is now said to consist of a wide spread of coarse red sand, well clothed with shrubs, and after a rdSny winter covered with grass and flowers. A

few irregular low ridges exist in the Nefud, but they are not a prominent feature. On the other hand, the whole plain is pitted with deep hollows, shaped like a horse-shoe, with their points all set with great regularity towards the same point of the compass. These depressions are called by the Arabs "fulj," and vary in depth from 20 to 200 feet, and proportionately in width ; the widest being about a quarter of a mile across. Another natural phenomenon which was previously described in consider- able detail, but which Blunt found to be unsupported by local evidence, is the occurrence of the simoom, or poisonous wind, in these plains. Sandstorms are of frequent occurrence ; but they are not poisonous. The deadly poison blast, which not merely suffocates by mechanical means, but which absolutely disseminates a poisonous vapour or gas, must be dissociated from the plains of the Nefud. The expression "nejd" is ascertained to be purely geographical, and in no sense political. In Arabia it is applied to all the high-level districts lying within the Nefuds. It includes the three provinces of Jebel Shammar, Kasim, and Aared. As employed by the Turks, the name is applied to their latest conquests on the seaboard^of El Hasa, and so has led to a misappre- hension as to the extent of Turkish sovereignty in Arabia. The plain of the Hamad, which Blunt crossed from Jebel Shammar to the borders of Arabia at Nejef, south of Babylon, has a uniform upward grade from the Sea of Nejef to Shammar. This slope is estimated to be about 10 feet per mile, and is not unbroken. It is due to "a series of shelves terminating in abrupt edges one above the other, the edges facing the line of descent." The Nefud of Eastern Arabia, as described by Sir Lewis Pelly, differs from the Nefud north of Shammar in some essential particulars. It con- sists of a series of huge sand ranges trending curvilinearly in a north- west and south-east direction, stretching roughly parallel to the Arab littoral of the Persian Gulf southwards from Jebel Shammar. Between the ridges are wide spaces of hard level plain, as much as from 7 to 8 miles in width. The central plateau commences to rise into Nejd proper from the district of Sedair. The route from the Persian Gulf westward, crossing this eastern Nefud, terminates at Riad (the Wahabi capital), 250 miles to the south-east of Hail.

Bent's expeditions to the south coast of Arabia and Hadramut geographically place these regions in an entirely new light. Hadramut is

no longer to be regarded simply as a Hadramut southern district of Arabia intervening between the Southern ®^^ coast and the central desert, but as a broad central Arabia artery running for a hundred miles or more parallel to the coast, through whichr the valleys of the high Arabian plateau discharge their scanty supplies of water to the sea near Saihut, towards which point the whole system gradually slopes. Into this hotbed of fanaticism but one European (Herr Leo Hirsch) had succeeded in penetrating before Bent, and he travelled in disguise. Theodore Bent and his wife travelled without disguise, and with a considerable train of followers. It seems to be clearly proved by the Himyaritic inscriptions found in the Valley, that for five centuries b.c. the term Hadramut applied to this valley only, the meaning of it being the "Valley of Death." Here from time immemorial existed the historic trade in frankincense and myrrh, which centred in Shibam (a place of some importance even now), from whence the produce of the valley was conveyed westwards by the great frankincense road across Arabia of which an account is given to us by Claudius Ptolemseus.

The narrow coast-line of this part of Arabia is termed Sahil, and between Mokalla and Saihut it is described as a "most uncompromisingly arid country." Hot springs exist at intervals, pointing to the volcanic origin of the region, and where they are found they are utilized for the purposes of cultivation ; but their occurrence is rare, and the coast generally is marked by an extended waste of barren sterility. Mokalla, Shehr, and Kosair are the chief coast towns. They carry on an active trade by means of their dhows and buggalows with Aden, Muskat, Bombay, and the Somali coast. A curious geological feature of the coast are the basalt fields near Kosair, which spread across the flat country in a stratum of black rock-like lava. The Arabs attribute this basaltic effusion to the destruction of pagan cities. Probably it is the source from whence Egypt and Assyria derived material for statuary art. The highlands beyond the strip of low coast are called Akaba. The approaches to them

are formed by a series of short water-course valleys, which con- tain the flrst stages of the caravan routes into the interior. The Akaba consists of a wide expanse of flat, featureless plateau, without a habitation or even sign of life— waterless and waste

^but broken by occasional masses of flat tableland formation,

which lie superincumbent on the lower plain about 80 feet high. On the top level of the Akaba (a little over 4000 feet above sea), is a wide scattering of small black basaltic stones, which rest on the sandstones and limestones of which the range is formed. In the gullies cut out of these tableland formations (which are the higher level or upper flats of the Akaba), as also in the valleys approaching the plateau, the myrrh and frankin- cense trees, with various forms of mimosa, are to be found. It is curious that the Beduins, who own the plateau, do not them- selves gather the produce of the trees, but let districts out to the Somalis, who come in due season to collect the frankincense. The air of the plateau is fresh, keen, and invigorating. The similarity of its conformation to some parts of Abyssinia is striking ; and it appears that many points of similarity are also to be noted between the coasts of Southern Arabia and those of Southern Baluchistan. From the Akaba many valleys dip with rapid and sudden descent, flanked by steep red sandstone cliffs, into the main central dtepression of Hadramut. So steep, and so different from T^Ueys whose formation is due to erosion, are these gates of Hadramut, that it seems possible that they are but branches of a fiord, or arm of the sea, which once filled in the whole Hadramut depression^ The upper valley of the Hadramut, round about its capital of Shibam and the courtly residence of its chief at Al Katan, is a land of cultivation and prosperity, of palm groves and towns and palaces, flourishing chiefly on the basis of wealth acquired in India. The sultan, who is the head of the Al Kaiti family of the Tafi tribe, is jemadar or general of the Arab regiments in the service of the Nawab of Haidarabad. This con- nexion with India is the secret of the wealth of the Al Kaiti family. The dwellers in the towns, and the cultivators of Hadramut belong to races of Arabs who are of later importation into the country than the Beduin. The chief tribes are the Tafi, Ketiri, Minhali, Amri, and Tamini, who are constantly at war with the Beduin. The Beduin, who are scattered in wild tribes all over the country, are the caravan leaders and the carriers, rearing their own camels, and owning large territories in the highlands. They are numerous and powerful, never living in tents like the northern Beduin. The richer amongst them occupy houses, and the poorer, caves. The Sharifs and Salads are an important hierarchy, tracing their descent from the prophet,

and exacting the homage of all who are under their widespread influence. They boast a pedigree purer than that of any other Saiad family in Arabia. They are dwellers in towns and cities. The half-bred and imported African slaves form the fourth class of this mixed community. They are all of theni Mahommedans, many of them wealthy, and some superior in education to their masters. The tillers of the soil, personal servants, and soldiers of the chiefs mostly belong to this class.

The name Ad is given in the Koran to the Sabsean inhabitants of Southern Arabia, and is still recognized by the modern inhabitants. Within the limits of the coast district there is no evidence of Addite ^”««”-ruins, a circumstance “which confirms the opinion that the ancient trade in frankincense was carried on chiefly by the caravan road passing eastwards from Aden to Hadramut and Oman, very little use being made of the harbours and ports ofHhe sterile coast. The movable, wind-blown sand which collects in masses in the centre of the valleys, has probably long ago buried such ancient ruins as date from Himyaritic tiihes, and all that is now observable is to be found on more elevated sites above the plain. A distinct connexion is to be traced between some of the rude stone relics of the past on which inscriptions exist, and those evidences of sun-worship which were found by Bent at Zimbabwe in Mashonaland, where the arrangement of rocks and stones ‘ possesses a similar system of orientation. Of the inti- mate connexion, if not actual relationship, which existed many centuries before our era between the Sabseans of Southern Arabia and those Arab people who worked the gold-mtaes of Mashona, and built forts to protect them, there can be little doubt. In the Wadi Sher, which leads northwards from the head of the Hadramut into the central districts, there exist the remains of at least one great Himyaritic town, with traces of megalithic buildings

and a rock exhibiting Himyaritic inscriptions. This appears to have been an important position on the great caravan toute between east and west. Large unhewn stones of the dolmen type, decorated on the inside with geometric patterns similar to those found in Mashonaland, together with

buildings of extreme antiquity far anterior to those of other Himyaritic remains around them, also exist in the Wadi Sher. The general result of these discoveries is greatly to enlarge our views of the extent of ancient Sabsean colonization in the Eastern world, a result which is still further supported by the remarkable similarity which exists between the great irrigation works to be found in Yemen and those which yet require further investigation in Southern Baluchistan.

The remarkable connexion between the fauna and the flora of Arabia and those of the Somali country and Abyssinia, no less than the curious analogies between geological and topographical construction in the physio- logy of the two countries, points to a prehistoric land connexion between them on the south, as well as the north, of the Eed Sea, which may possibly have been coeval with the land connexion between India and South- ern Africa. The link forged in geologic ages never seems to have been entirely broken, and nothing has served to give emphasis to previous evidence on this subject more than the Zimbabwe discoveries of Theodore Bent. It is certain that the ruins and the relics in them (amongst which were found fragments of Persian and Celadon china, such as may still be found in quantities on the coast of Makran and of the Persian Gulf) are not in any way connected with any African race. We also know that for many centuries before our era the Eed Sea was alive with the ships and commerce of Arabia. Arab ships brought spices from India and the " Cania " tree from China; and "Arabian" gold is celebrated in the writings of the very earliest historians. Very little gold ever came from Arabia, but in Africa it was produced in large quantities (both from alluvial and quartz sources) from the earliest ages. There can be little doubt that the builders of Zimbabwe came from the Arabian Peninsula.

Although no recent travels or explorations in Yemen ^have added greatly to the mass of scientific information collected by Glaser, Schweinfurth, and Playfair, Yemen. ^^ have acquired a better knowledge of the chief geographical features of that country from the adventurous journey of W. B. Harris in 1892, supple- mented by the researches of the Indian surveyors in the Aden district about the same period, and the earlier travels of General F. T. Haig in 1887, than we formerly possessed.

The countay is split up intb the two great natural divisions of the interior highlands or Jebel, and low-lying sandy deserts and plains of the seaboard. The latter are from 30 to 100 miles in breadth, skirting the highlands on the west and south, and are only broken where a spur from the mountains approaches the southern outlet of the Eed Sea, forming the headland of Sidi Sheikh, exactly opposite to the island of Perim. There are many indications that this seaboard strip of desert was, until a geologi- cally recent period, below sea-level. These plains of Yemen are called Tehdma. They are subject to drought, the rainfall being extremely small, but there are, nevertheless, scattered about them, oases where cereals can be reared with success, and water may be obtained in the nullah beds by sinking wells sufficient to supply the flocks and herds of the Bedtiin. It is in these arid plains that some of the best of Arabian camels are bred. The chief towns of the Tehiima are Hodeida and Mokha, on the western coast, and Aden (g.u.) on the south. Hodeida lies on the north-east side of a large bay, sheltered by a promontory to the north-west. It is a large and flourishing town containing about 30,000 inhabit- ants, with a Turkish garrison. It possesses a climate which is inimical to European existence. At certain seasons of the year it is subject to frightful epidemics of fever. Mokha has lost its im- portance as a trade port since Aden has been occupied by the British. It owes its existence to the trade in coffee. Early in the

17th century English and Dutch established factories at Mokha, and a century later the Trench followed their example, so that for some two centuries Mokha became renowned for its wealth. On the British occupation of Aden in 1839 trade left Mokha, and since then the town has fallen into decay.

From Aden, northwards, a stretch of some 30 miles of desert separates the volcanic rocks and ridges of the coast from the green and fertile highlands of Yemen. These highlands present a most cm-ious contrast to the arid sterility of the TehSLma. Ranges of mountains rise abruptly from the plains to great altitudes (esti- mated at 10,000 to 12,000 feet, or even higher, but there is no absolute determination of the height of any of the most prominent peaks) and assume a general formation of parallel ranges, with a strike from north-west to south-east, sheltering lateral

valleys, which are wide and fertile, highly cultivated, and teeming with agricultural wealth. It is here that coffee and indigo are chiefly grown. Here, in Arabia Felix, English vegetables and many kinds of fruit reach perfection in a climate of which the average mean shade temperature may vary between 60° and 70° F. A line drawn from Aden northwards for 170 to 180 miles will pass not very far from the main water-parting of the plateau, of which the average level is 7000 or 8000 feet, and not far east of the great caravan road which connects Sanaa, the capital of Yemen, with the great southern port. It is on this route that the towns of Kataba, Terim, and Bamar are situated, and it has probably been through all ages the great central trade-route of Yemen. It is remarkable that whilst the Teh£lma is sfibject to a most uncertain rainfall, there should be two regular wet seasons in the highlands, corre- sponding to the spring and autumn "monsoons" of Harrar and the GaUa country. Rain is said to fall daily during the recur- rence of these wet seasons, but with intermittent periods of bright sunshine. Of the beauty of the scenery in the Yemen hill-country, Harris gives us a most vivid description. " Tom into all manner of fantastic peaks, the rocky crags add a wildness to the view that otherwise possesses the most peaceful charms. Rich green valleys, well timbered in places, and threaded by silvery streams of danc- ing water ; sloping fields gay with crops and wild flowers ; the terraced or jungle-covered slopes — all are so luxuriant, so verdant, that one's ideas as to the nature of Arabia are entirely upset." Colonel Wahab, who surveyed the hills north of Lahej in the Aden district, describes the wealth of green terraces, sloping in steps of graceful contour down the spurs of the mountains, as re- calling the beauty of Himalayan scenery in the valleys of the Jumna and Sutlej. Sanaa, the capital of Yemen, lies at an eleva- tion of nearly 7800 feet above sea-level, about 250 mUes by road to the north of Aden, an^ 180 by road north-east of Hodeida, on the Red Sea coast. Between Sanaa and Aden are the three principal towns of Damar, Terim, and Kataba, the last marking the south- ern frontier of Turkish occupation in the highlands. Damar, 9300 feet above sea-level, is described by Harris as being an unwalled town, but protected by small mud forts placed at intervals — an obviously Turkish innovation denoting recent con- struction. Many of its houses are well built of stone, and deco- rated with considerable taste. A peculiarity in their construction is the use of slabs of alabaster for the windows, which, being carved in relief, admits

of a peculiarly soft and varying light. There is an open square about the centre of the town, the bazaars and narrow streets around it being full of life and busy with trade. • As usual, the Jews occupy a separate quarter. The effects of Turkish misrule are everywhere strongly marked in Damar. Terim, 80 miles from Sanaa, is comparatively a new, and essentially a poor, town, built chiefly of sun-dried bricks. It lies between 7000 and 8000 feet above sea-level.

Two notable examples of the engineering skill of the Sabsean and Himyaritic Arabs exist in Yemen ; one at Hirran, near Damar (which Harris believes to be the Haran of Biblical record), and the other at Mareb or Saba. The storage tanks at Hirran, which are supplemented by deep wells, were obviously built for the purpose of providing water for the garrison of an ancient fortress which encloses them. Two spurs of a hill have been joined by an enormous wall, whereon there is space sufficient to drive " a. carriage and pair." This wall is 150 yards long and 20 feet high, and is built with the peculiar cement which is typical of early Arab construction. Harris recognized in it many points of similarity to a gigantic wall, dating from early Arab times, which exists at Mekinez in Morocco. Within the wall is a well of which the lower part is sunk in the solid rock, and above the northern end are a series of three tanks reached by a stairway. Hirran, or HaU Hirran, as the hill is also called, is perforated with excavations, and abounds in sepulchral ruins and masses of broken pottery. The great dam of Mareb (_Sheba or Saba) possibly dates from 170O years B.C., for its construction is attributed to the father of Himyar, the founder of the Himyaritic dynasty. It is certainly of vast antiquity. M. d'Arnaud describes its ruins as comprising a gigantic wall 2 miles long and 175 paces wide, connecting two hills. The water which was stored by means of this enormous dam was

allowed to escape by dykes, or openings, at different levels, so tliat irrigation oould be maintained, no matter at wliat level the water of the tank might stand. It is ^supposed to have been burst under exceptional pressure about a.d. 100.

The system of storing water in tanks, and the evidences of its antiquity, are abundant throughout South Arabia, and these evi- dences may supply a key to the mystery of those strange construc- tions in Southern Baluchistan and Makrdn which for ages have presented an interesting problem to investigators. Throughout Makrin, but perhaps more especially in the districts of Panjgur and Kolwah, there are relics of walls of enormous thickness, and sometimes of considerable height, which are only known to the local inhabitants as Ghorbasta, or Ghabrbasta, the name indicating merely that they were built by a race of sun- or fire- worshippers. No modern Baluchi acknowledges any connexion with them. They possess, in fact, no history — no tradition even ; but the peculiarities of their construction distinctly point to the same race of people for their origin as those who terraced the hillsides and revetted the fields round about them with similar masonry.

Those " Asiatic Ethiopians " whom Herodotus places in Southern Baluchistan 500 years B.C. have disappeared, and the Arab influ- ences which now pervade the country from end to end are of later date and diflerent origin ; but there can be little doubt that the Sabsean or Himyaritio races of dusky Arabs who fenced round their gold mines in Afric^ with strange fortifications and built up the vast protective works for water storage in South Arabia, are responsible for many works designed on the same principles and of similar construction on the eastern side of the Persian Gulf. (See Baluchistan.)

A certain amount of fresh light has been thrown on the ancient connexion between Ethiopia and South Arabia by the researches of Glaser. This connexion was evidently so close as to approach to the affinity of blood relationship. Egyptians, Syrians, and Greeks traded with Arabia for frankincense for more centuries before our era than we can clearly count. "In the most primitive times," says McCrindle, " the merchants of Arabia traded to Gaza and Egypt, and the producers of incense in Africa followed their e:^mple." What the Greeks called Ethiopia the Egyptians called Punt (or Pwent), Habash, and Kash. Punt certainly referred to both sides of the Red Sea, but the name never occurs in Himyaritic inscriptions. Habash (or Habashat) does occur, and, according to Glaser, the word means " collector " — i.e., collector of

incense, and applied equally to Africans and Arabians — to Abys- sinia and Somaliland as well as to Hadramut.

The condensed history of the Arab nation from the very earliest ages, - which is to be found in the articles

" Arabia " and " Yemen " of the ninth edition ^^ of the Encyclopaedia Britannica, sufficiently

illustrates the expansion of Arab trade and Arab colonization in those days when Ethiopia and Southern Arabia seem to have been united in the closest bonds of commercial af&nity, and gold and frankincense and myrrh ' formed the chief articles of commercial quest. But whilst the spread of Arab (or Himyaritic) influence to the west and north can be more than faintly estimated from clas- sical records and ancient inscriptions, there is very little said about eastern fields of enterprise, and it is only since the waste places of Baluchistan and the shores of Matron have been brought under the close scrutiny of the Indian surveyor that evidence-has been collected which proves that Arab enterprise, if not Arab empire, included a vast area of Asia to the east of the Persian Gulf, just as it in- cluded a vast area of Africa to the -svest of the Eed Sea.

Herodotus refers to Asiatic Ethiopians, but makes no confusion Tjetween Africa and Asia as some modern historians suggest. The historians of Alexander's campaigns throw a casual light on the existence of a trade in incense which oould only have been carried on by Arab merchants. In enumerating the inhabitants of ! Southern Gedrosia (Baluchistan), Ptolemy mentions Arbitse, Par- fiidae (or Parsirse), and Ehamnse, whose names are too suggestive of the Arab, Persian (or Tajak), and Dravidian ethnic occupation of the same nature that now exists to be altogether accidental. But it is to that invaluable anonymous record, the Periplus, and to the discovery of many relics of the ancient trade in Egyptian or Phoenician glass (the 'TdXos dpy^ of the Periplus), which are to be found in abundance on the cbast of Makrd,n, that we are chiefly indebted for the identification of many of the trading ports of the Arabian Sea which would otherwise be subjects of conjecture.

Long before the rise of Mahommed, Semitic colonies had planted theipselves in Asia to the east of the Persian Gulf, and from the days (early in the 1st century of our era) that the pilot Hippalus

worked out the problem of a regular passage between India to Africa by making use of the monsoon winds, Arabia competed with Egypt on the commercial highways of the ocean. The Christian Topography of the Universe, by Cosmas Indicopleusles (about A.D. 535-547), continues the story of the Periplus about 400 years later, and gives an account of the trade with Malabar and the Eastern Archipelago, which is taken up again by Arab geographers of the next seven centuries. A trading colony of Sabsean Arabs existed at Canton at the beginning of the 7th century. Arabian science influenced Chinese astrology, meteoro- logy, and astronomical instruments, according'to a learned Chinese authority. Colonies of Arabs and Jews settled early in our era on the southern coasts of Bombay, where their descendants are to be found to this day. When Mahommedan Arabs resorted thither in after ages they met with a friendly reception similar to that which their Sabsean predecessors had obtained, and they shared the honoured name of Moplah together with Christians.

With the rise of Mahommed and the universal acceptance of the creed of Islam, the second chapter in the history of Arabia opens. Hitherto Semitic instincts for trade and barter had been the moving spirit of an extension of Semitic, if not of Arab influence over the whole of the then kno-wn world. It was the enormous acquisition of geographical knowledge, supplemented by commercial wealth — the accumulation of centuries of trade, initiated no doubt by the southern or Himyaritic races, but gradually shared by the northern or more distinctly Semitic tribes — that paved the way for tho unprecedented success of Arab arms in the cause of " tfehad " or holy war. The chief military movements directed against Europe, Northern Africa, and Persia, under the influence of Islamitio religious fervour, and the almost unbroken success which attended these movements, are already briefly recorded. But in this record no note is made of that most remarkable episode in Arab history which culminated in the conquest of Sind, stamped out Greek influences On the Indus, and proved to be the one occasion in history when India was successfully

invaded from the west. Very early in the Mahommedan era, if not before it, Arabs from the north — i.e., from Syria — ^had overrun and occupied Makrdn and Sist^n. Several attempts to invade India were made before the successful expedition of Mahommed Kasim in a.d. 710. According to latest history (Major Jarrett's translation of Az Siynti), Makrdn was subjugated in 644, and in 663 Kirmdn, Sistd,n, and the western mountain districts of Makrdn were conquered. Two attempts to capture Debal, the port of Sind, were unsuccessful. In the Caliphate of Moawiah, AbduUa bin Suwad invaded Kaikanan (i.e., the Kalat highlands) and attempted to reach Sind that way ; but the attempt failed, and there may still be seen near Kalat the traditional graveyard of the Arabs who fell in the attempt. Frequent Arab incursions were made Indiawards, but they were all by land follovying the Kirmdn and Makrdn route from Syria. Buddhism, which prevailed all through Sind and the mountainous districts to the west, had given place to Brahmanism about the middle of the 7th century, when the Brahman Chach usurped the throne of Sind. But it still held its own in Bela, between Sind and Makrdn, and in the border province of Gandava (sometimes called Kandahar by Arab geographers), which was known as Budh at the beginning of the 8th century. There were great Arab cities and a flourishing trade between east and west before the Arabs conquered Sind. Kandabel (Gandava), Armail (Las Bela), Kanazbun (Panjgur), were certainly in existence before Sind was conquered, and it is probable that many of the other towns and cities of Makrdn which subsequently rose to fame and opulence, when the great trade route to India passed through that country, were already founded, if not already famous.

The conquest of Sind originated in the efforts of Walid (sixth Caliph) to punish the Karak and Med pirates who had piundered vessels from / Ceylon laden with presents for the Caliphate. These Karaks (who have left their name ™eS/n(f at Karachi) were of Scythic origin, and their ethnic ™™”” affinities may be traced on the Euxine to this day. They have disappeared from the coasts of Baluchistan. The Meds are still there, a humble and starved race of fisher folk now, but once a powerful tribe in the Punjab and on the Indus. They, too, hailed originally from the north. Thus the expedition finally became partly military and partly naval; and it appears to be the first Arab naval expedition in the eastern seas, although*

they were about the same time occupied in the conquest of Spain from the shores of Africa. It was not until two unsuccessful attempts had been made to reach Debal that Hajjaj, the governor of Irak and Makrdn, appointed his relative, the boy-general Mahommed Kasim, to the command of a fresh force, with the conquest of Sind in immediate view, but with the ulterior object of reaching China from the Indus. At the same time another general, Kutaiba, left the Oxus for the same goal, and the governorship of China was promised to whichever of the two reached that country first.

With a force of 6000 picked cavalry, 6000 camel-men, and 3000 baggage animals, Mahommed Kasim traversed Makrdn, sending

at the same time five catapults by sea for the purpose of reducing Debal. He passed through Makrdn from west to east, destroying the Buddhist city of Armail (Las Bela) en route, and finally captured Debal on the 1st May 712. From that point his onward progress was triumphant. He enlisted Meds and Jats into his army, and by the time he had reduced Sadusan (Haidarabad) and reached MuMn he had 50,000 men under him. He extended his conquests northward to the borders of Kashmir, and established an Arab dynasty in Sind which lasted for three centuries. The Caliph Walid died in 715 (after substituting Arabic for Greek as the language of the Indus pro- vinces), and the tragic end of Mahommed Kasim is one of the epics of Arab history. These three centuries of Arab occupation of the Indus valley mark the zenith of Arab ascendency in Asia. In 770 the governor of Sind became governor of Africa, and again in 800 there was a similar transfer. Amrdn was perhaps the most famous governor. His control of Sind lasted from 833 to 841. Before the end of the 9th century Arab rule had commenced to decline ; and then arose the cities of Multdn and Mansura.

Throughout these centuries Sind maintained regular commercial communication with the rest of the Mahommedan empire; with the regions of the upper Oxus by way of Kabul and Bamian; with the Central

Asian khanates through Zabulistan, Kanda- har, and Herat; with Persia and Syria and Europe through Makrdn : and a host of Arab geographers arose who have partly recounted their own experiences as travellers, and partly (as in the case of the best known of them, Edrisi) acted as geographical compilers. From them we learn the enormous extent of that vast network of commercial routes which was then spread over the face of Asia — a system of roads, caravanserais, and mercantile centres which has left its traces plainly written in spite of the sweeping waves of destruction poured across it by Moghul and Tatar. The skeletons of ancient towns and the dry channels of great irriga- tion worses in the valley of the Helmund and the plains of Sist^n witness to the former wealth of these regions under Arab rule ; and from Quetta to Herat, and from Herat through Badghis and Afghan Turkestan to the Oxus, there are stiU to be encountered evidences of Arab occupation in acres of ancient ruins.

One or two of their more famous cities may be mentioned. Tiz, now a heap of ruins and a waste of graveyards on Chahbar bay, was once a great port of debarkation on the Makrdn coast for India. It is well situated so as to avoid the full blast of the monsoon winds across the Arabian sea. From Tiz to the fertile valley of Kiz (or Kej), and from Kej to Kanazbun (Panjgur), Armail (Las Bela), Manhabari (Manja, or Mugger, Fir), and Bebal, the ancient Indus port (the ruins of which are now far inland), the most frequented of these trade routes extended its length. Kiz and Kanazbun are described as large cities — as large as Mult^; and the merchants of Kanazbun were famous for their wealth and their fair dealing. In the Indus valley such cities as Sadusan, Mansura, and Brahmanabad outrivalled the glories of any of our modern Indus towns.

It was doubtless during these three centuries that the Arabs developed their genius for shipbuilding and acquired that command of the eastern seas which was followed by the complete Arabia as domination of the Mediterranean. As traders, Semitic races had held their own on the seas from the earliest dawn of history, and although they fell before the naval power of Rome, they reasserted themselves in full force, as Saracens, during the Middle Ages, even in the "West. In the East they struggled long for supremacy with the Turks and finally lost it, but they were the

first sea-power on the Indian Ocean and in the Persian Gulf. The lines they originally laid down for the con- struction of their sear-going vessels may be as distinctly traced in the early ocean sailing ships of Portugal, Spain, Holland, and England, as their nautical terms and astronomical nomenclature may be found in the mouth of the modern sailor. Many naval terms and nearly all the astronomical divisions of the heavens are of Arab origin. During the sovereignty of the early Caliphs an immense impetus was given in the Baghdad schools to the study of mathematics and the exact sciences. Borrowing their numerals from India and the compass (as well as gunpowder) from China, the Arabs had evolved for themselves systems of navigation and instruments for determining the value of latitude and longitude, before the close of the 12th century. About the time that Roger, king of Sicily, employed the geographer Edrisi in the compilation of a geographical map of the world, Abdul Hassan Ali of Morocco wrote a treatise on astronomy which included a detailed account of the use of instruments already well known and in the hands of Arab navigators. Amongst them was that ingenious instrument the astrolabe, by means of which observations for latitude could be obtained. Longitude was determined then, as now, by the differences between clock and sun time. It seems, indeed, almost incredible that the route to India vid, the Cape of Good Hope should have been left to Portuguese navigators to discover ; for the Arabs certainly knew how to traverse the Indian Ocean centuries before the arrival of Vasco de Gama. It is possible that that great

a naval power.

Portuguese adventurer made use of Arab pilots in his voyages of discovery. With the rise of schismatics and the birth of those heresies which, under the name of Khariji, Khesaja, Shariite, Ismailite, Karmatian, &c., spread their roots afar from Syria to Mecca and from Mecca to the Indus, the power of the Arab in the East rapidly waned. Chief amongst these sects were the Karmatians. We hear of them first in the days when the power of the Cali- phate was declining, ere the reign of Al Muktadar (908-932), by which time the Turks were already aggressive. By then the Karmatian heretics had brought themselves into prominence by plundering Kufa, Basra, and Samara, and even carried off the sacred

stone from Mecca. They are not mentioned by Ibn Haukel as being in the Indus valley in the. 10th century, but it could not have been long afterwards that they appeared as refugees from Bahrein and El Hasa. About 985 they founded new settlements on the Indus, and shortly afterwards were in possession of Multdn and Mansura. Mahmud of Ghazni captured Mansura, about 1036, on his return from Somnat, being already in possession of Khozdar (Kalat) and MuMn, and thus practically closed the era of Arab ascendency in Sind. He restored the old mosque at MuMn, built by the Ummayide Caliphs and destroyed by the Karmatians. There is a peculiar interest attaching to these "people of the veil," for they were in close communication with the mediaeval schismatics of Syria, the Hashashin, the Ismail- ites, the Druses, and others of those mystical sects who were indebted to the Bast for their philosophy and theology and those mystic creeds which ended in pure atheism. The Ghazni rule did not last long. It was soon replaced by the Sumra dynasty of Mahommedan Rajputs, which lasted for three centuries. One of the Sumra rajahs at least was a Karmatian. Pure-bred Arabs had almost disappeared from Sind ere the rise of the Karmatians. It is said that the first Ghaznivide governor of MuMn found but very few Arab families remaining ; but Baluchistan ptill continued to attract them, and although the Arabic tongue has disappeared from the regions east of Persia, there is not a tribesman who boasts the title of "asl" or "pure" Baluch, who does not claim Arab descent and associate his ancestry with the tribe of Khorpish. In many cases this claim is obviously without foundation, but there is still a powerful confederation of tribes calling themselves Bind, whose appearance, manners, and traditions are undoubtedly Semitic. They exist in the lower parts of the Kej valley of Makrto, separated by the country of the Brahui from the Indus border Rinds, who occupy the highlands south and east of Quetta under the name of Marris, Bugtis, Bozdars, &c. The Arab tribes (or tribes of Arab extraction) on the Baluch borderland include the best and finest amongst the many peoples of varied origin who occupy positions of independence in the frontier hUls.

There is but little to record of evidences in stone and brick of the Arab conquest of Sind. Long lines of tombs, stone-built and massive, are to be seen at Tatta, all of which are of Mahommedan design, but probably of later date than the days of Mansura and Brahmanabad. The best known

and the most interesting relics are the curious double-chambered tombs (the two chambers forming a double storey), richly ornamented with geometric designs, and decorated with the true Saracenic arch, which exist in groups throughout southern Sind and the Las Bela borderland. They always exist apart from the visible remains of destroyed cities, being themselves often in a remarkable state of preservation, and cbn- spicuous objects in the landscape by reason of the elevated sites which have been selected for their building. These are attributed to an Arab race called Kalmati, who are said to have originally migrated through Makrd,n from Oman and who, in the course of thjsir migration, settled on the shores of the Kalmat Khaur, one of the harbours of the southern coast near Pasni. The name Kalmat is so old as to be recognized as the " Kalama " of Nearkos ; so that it is probable that the comparatively recent tribe of southern Arabian origin, who, under that name, formed a powerful community in southern Sind within historic times, and have left behind them by far the most perfect Arab monuments to be found on the borders of India west of the Indus, adopted the name of their temporary resting-place in Makrdn. Scattered remnants of the tribe are said still to be found in Sind.

*Turkisli sovereignty is now paramount through all Western Arabia, from Palestine to the strait of Babel- Mandeb, as well as through Eastern Arabia, from * Basra, on the Euphrates, to the boundaries of ^1^1^ Oman. The cultivated districts of the southern coast are divided between British occupation and that of independent tribes ; the central deserts are still the home of the Beduin ; and the highlands of Nejd are divided between two independent chiefships, each of which is of doubtful territorial extent, but considerable political significance.*

The condition of Arabia about the middle of the 19th century.

when the Wahabi stretched his rule across the peninsula from the Red Sea to the Persian Gulf ; when Hasa, Harik, the whole of Nejd, Kasim, Asir, and the provinces adjoining Yemen on the north were united under

the sceptre of Feysul, has been well described by Pal- grave. In 1870 Feysul, aged and blind, was assassinated, and dis- sensions arose which led immediately to the decline of Wahabi power, and gave opportunity to the Turk. A Turkish force was despatched into the province of Hasa on the east, and occupied its capital, Hofhuf; and about the same time Turkish interference asserted itseU on the west in Asir (between Yemen and Hejaz), and in the inland provinces of Shammar. In 1871 a Turkish army from Syria tentatively established Ottoman sovereignty in Yemen, at the invitation of the Yemenis themselves ; but Palgrave consid- ered ([with good reason at the time he wrote) that Yemen would not remain long under Turkish rule. The Turks have, however, not only retained their hold on Yemen, but they have rather consoli- dated than weakened their authority in the Shiah province of Asir, and extended it indefinitely into the hinterland which borders the central desert on the east of Yemen. In Hejaz their authority has never been doubtful, so that all the fertile and populous districts of Western Arabia bordering the Red Sea are now under Ottoman rule ; and this rule is only limited on the south by the British occu- pation of Aden and the consequent extension of British influence into the adjoining districts. No definite boundaries exist ; but the southern frontier of Turkish Arabia is placed by the most authorita- tive maps in a position a little to the south of Kataba. Kataba is about eighty miles due north of Aden, well within the limits of the moun- tain districts, which here attain to altitudes of 7400 and 7700 feet above sea, as determined by the latest Indian surveys. From a point south of Kataba, which roughly forms the apex of the trian- gular division of Southern Arabia included within Aden jurisdiction, the partition line between Turkish Arabia and the Aden districts runs irregularly past Tez (a town south of Ibb on the main northern caravan route) to a point on the coast line of the promontory of Sheikh Said, about seventy miles to the west of Aden. Here the Turks have constructed a fort and established a permanent militaiy post at Turba. The guns of the fort do not command Perim, and the object of the occupation is doubtful. It is to this position that the French have advanced a shadowy claim. On the east the divi- sion between Aden and Yafi territory reaches from Kataba to the coast, near Shukra, about sixty miles east of Aden. From this point to the borderland of the fertQe province of Oman, which occupies the south- eastern corner of the peninsula, the cultivated and habita- ble districts of

the southern coast are under the independent rule of local chiefs who boast (according to Palgrave) an independence of barbarism and poverty which is in great contrast to the organized and progressive governments of the Arab sheikhs of Central Arabia. This hardly agrees with the latest illustration of the conditions of Arab existence in Hadramut afforded by the explorations of Bent. Hadramut is in direct tpuch with civilizing influences at Haidara- bad in the Deccan of India ; and in that city many of its chiefs are to be found serving the Nizam. Indigenous Arab government, un- disturbed by Ottoman rapacity or by internal dissensions, invaria- bly demands respect. In Southern Arabia, at the present time, it is probably to be found at its best. The province of Oman has always succeeded in maintaining its independence of Turkey, and is now under the rule of a member of the same Yemenite dynasty of Imams that has existed since the province was first delivered from the yoke of Persia, about the middle of the 18th century. The Turks are as flrmly,established in El Hasa, to the north of Oman, as they are in Hejaz, in Western Arabia. Hofhuf, the capital of El Hasa, is about 40 miles from Ajer, on the coast, and from 90 to 100 from Katif . Here, and at El Bidia, is a small garrison of reg- ular Turkish troops. At Katif, where there is nothing but an old fort facing the sea, a force of zaptieh (Turkish gendarmerie) rep- resents Ottoman authority. El Hasa is governed by a Turkish lieutenant-governor under the Wall of Basra. In 1886 the Turks commenced the construction of a fort at Fao, nearly opposite Mohamrah, on the lower Euphrates, which effectually dominated the channel of that river. This was in direct contravention of their treaty engagements with Persia. In consequence of representations made to the Porte by the British Government, the work was sus- pended some years ago, and guns were never placed in position; but the enceinte of the fort remains exactly as first constructed. In the Nejd or highlands of Central Arabia the political divisions of the country are represented by two independent Arab states, gov- erned by the emirs of Jebel Shammar and Riad respectively. Ibn Rashid of Jebel Shammar, lately deceased, was reckoned to be the most important political personage amongst Arab chiefs of the present day. He was said to possess a bodyguard of 1000 mounted negroes, whose steeds are arrayed in silver harness. He is undoubtedly a strong and capable ruler. The two emirs or sheikhs are independent of each other ; but both admit Turkish influence, whilst they repudiate Turkish sovereignty. The

Turks themselves, for political reasons, still include all the Wahabi territory which they once dominated vunder the term Nejd in their official documents, and they maintain

their nominal rights as conquerors over the country. Practically, they do not interfere with the local Arab governments, which appear to be strong, progressive, and equitable.

Turkish authority in Yemen has never been established on the firm basis which supports it in El Hasa and Hejaz. Turkish misrule and oppression have, no doubt, much to answer for in promoting the rebellions and disturbances which, Jf^Xf”” ’ vrith but intermittent periods of rest from exhaustion, have harassed Yemen since 1891. But it must be remembered that the province of Asir, north of Yemen, in which these rebellions commenced, ‘is a Shiah district, allied by religious principles to Yemen rather than to the orthodox province of Hejaz, and that there are some 600,000 Wahabis, as well as upwards of 2,000,000 Shiites in Yemen who do not recognize the Caliphate of the sultan in any way, and who will always dispute Ottoman sovereignty when an opportunity may arise which promises success. The easy and slack government of the Shiah Imam of Yemen had terminated in something approaching to general anarchy in the country in 1871, when the Yemenites rashly invited Turkish intervention. The Turks came from Hodeida, and, more suo, they came to stay. Although the Imam survived the Turkish occupation of Sanaa, the capital of Yemen, he existed only as a Turkish pensioner, and the Arab tribespeople soon found themselves little better than Turkish slaves. Acts of oppression and violence on the part of the Turkish authorities led to a revolt which commenced with resistance to tax- collecting on the part of an Asir tribe, the Beni Meruan, in 1891. Turkish rule had never been more than nominal in Asir, and so long ^s the Beduin rulers of Hejaz withheld their support it was of no great political significance. But the first reverse sustained by the Turkish troops (who took the field unprepared, and were defeated with a loss of 400 men in the early stages of the rebellion) set all Yemen aflame, and in a very short time the insurrection included all tribes south of Asir, excepting the Beduin of the Tehama. A Turkish force which landed at Hodeida under Ahmad Feizi Pasha — ^formerly governor of Mecca — checked its progress for a time.

*Manakha was retaken, Sanaa relieved, and Ismail Pasha was despatched to crush the rebellion in the south. Here a rapid collapse of the insurrection ensued, and, with 40,000 Turkish troops in Yemen, it appeared in 1893 as if resistance was at an end.. The northern mountain districts, however, were but half subdued, and with but small provocation the flame has burst out again and again with intermittent persistency ever since. In May 1895 the British vice-consul was mtirdered. Early in 1896 fight- ing between the Ateyba and Harb tribes was reported; and the disturbances culminated with a partially successful assault upon Yambo (where the governor was wounded in the conflict) and in a mutiny at Jidda. It was decided to build forts at Jidda, and to despatch further reinforcements; but the record of the next two years still continued to be one of local disturbance through- out the country, and of more or less organized rebellion in certain parts of it. The plundering propensities of the Wall, and the unrest which is the invariable sequel of famine, led to another serious rising in 1899, and to the despatch of 22,000 troops and 7 batteries of artillery from Mecca. In May 1899 the Turks suffered a severe reverse at the hands of the Beduin, led by the Imam; but another hard-fought battle took place in June, in which the Turks were successful. In October of the same year 35 regiments, each 400 strong, left Constantinople for Upper Yemen ; and since then, although, according to report, there have been inter- mittent fighting and active rebellion from time to time, it is clear that on the whole the Turks have not only maintained their position but have annexed new country and extended their occu- pation to the eastern hinterland of Yemen. Turkish occupation has doubtless favoured the interests of Great Britain in Yemen by affording some sort of guarantee for the safety of trade routes. The greater part of the Yemen trade now flows to Aden. The anarchy which preceded Turkish rule'*affected not only local trade but the importation of European goods from the Persian GuU.*

As might be expected from the close connexion which exists between commercial Arabia and India, trade prospects have suffered considerably from the influences of famine and plague of late years. The Jidda trade in 1897 showed a falling off ""'• of nearly £51 , 780 (or 8 per cent.) , reducing the total import value to about £645,000. On the other hand, trade with Egypt (which, curi- ously enough, includes the importation of a*

considerable amount of Brazilian coffee) is increasing rapidly. The chief imports are rice, wheat, and manufactured goods. The decrease in the value of the latter alone amounted to £35,740. Exports (chiefly hides, gum, and mother-of-pearl) also show a decrease, the total value only amount- ing to £19,250. Hodeida has suffered equally from the general depression of trade, although the want of a harbour must be reckoned as a permanent drawback to trade with this port. The total imports (piece goods, food stuffs, spices, and dates, chisfly) were valued in 1897 at £705,200, and the exports at £712,660. The latter are mostly coffee and hides, the value of the coffee export alone being over half a million. The products

of Yemen are almost exclusively agricultural. CoHee, dates, vegetables, and fruit from the hills, with rock-salt, iron, and coal from the Tehama and lowlands, are the chief items in the trade reports, the lowland productions being inconsiderable. The Yemenis (estimated at 3,000,000 souls) weave a kind of coarse cloth, and they dye American cloth goods, and build ships ; but they have apparently no other industries. Eastern Arabia con- ■ tributes something to the trade of the Persian Gulf. Bahrein is answerable for an export of nearly half a million in value, and an import of £550,000. The former includes dates, rice, pearls, and specie as the principal items, the value of the pearl export in 1898 being nearly £300,000. The imports include coffee, dates, piece-goods, rice (in large quantities from India, and of the very best quality, much of which is exported to the main- land), pearls, and metals. Of the total export value of £387,000 from the Arab coast ports in 1898, £357,700 worth went to Persia, and of that amount £343,750 is included under the head " pearls." This indicates that Linja, on the Persian coast, is the great trade mart for pearls of the Gulf ; and that Arab trade, independently of this valuable item, is inconsiderable. The rice trade with India is that which figures most largely in the general commercial record of trade with ports outside the Gulf, and this, no doubt, is important. (For Aden trade see Aden.)

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(t. H. H.)*

Arabistan, formerly known as KMzistan, a province of Persia, bounded on the S. by the Persian Gulf, on the W. by Turkish territory, on the N. by Luristan, and on the E. by the Bakhtiari district and Fars. It is now subdivided into the- districts of Mu- hamrah {q.v.), Fellahiyeh (the old Dor^k), E^m-Hormuz (popularly known as Eamiz), Havizeh, Shushtar, and Dizful, has a population of a.bout 200,000 (mostly Arabs), and pays a yearly revenue of about £30,000. The soil is very fertile ; but since the dam over the Karun at Ahvaz was swept away, and the numerous canal^ which diverted the waters of the Karun and other rivers for irrigation were neglected and became useless, a great part of the province is uncultivated, and most of the crops depend for water on rainfall or the overflowing of the rivers.

The district of Shushtae, with the city of same name, 22 vil- lages, and about 3700 families of the Kunduzlii, Sdd, Anaffjeh, and Al-i-Kethir tribes, has a population of about 40,000, and pays a yearly revenue of about £6000. The city, with a population of about 15,000, is situated at an elevation of 400 feet at the point where the Karun river bifurcates into the Ab-i-Gerger and Shutait, in 32° 3′ N. lat. and 48° 53′ E. long.

The district of DizfiJl, vrith the city of same name, 12 villages, and 1000 families of the Al-i-Kethlr tribe, has a population of about 40,000, and pays a yearly revenue of about £6000. The city h^as a population of about 25,000, and is situated on the left bank of the Ab-i-Diz at an elevation of 600 feet in 32° 25′ N. lat, and 48° 28′ E. long. (a. h.-s.)

Arabkir, a prosperous town of Asia Minor, in the Memuret el-Aziz, or Kharpiit vilayet, situated on an elevated plateau, near a small tributary of the Euphrates. Its large Armenian population suffered severely during the massacres of 1895. Population, before 1895, 20,000 (Moslems, 11,000; Christians, 9000).

Aracaju, a city and port of Brazil, capital of the state of Sergipe. The town was founded in 1855, and has now a population of about 10,000. It has a hospital, high school, normal school, a number of churches, and other public buildings.

Aracaty, a town and port of Brazil, in the state of Ceara, with a population of 18,000. It is an important commercial centre, visited by several lines of coastwise steamers.

AKACHIN^IDA.

AEACHliriDA is the name given in 1815 by Lamarck ((jreek, apaxyri, a spider) to a class which he insti- tuted for the reception of the spiders, scorpions, and mites previously classified by Linnaeus in the order Aptera of his great group Insecta. Lamarck at the same time founded the class Crustacea for the lobsters, crabs, and water-fleas, also until then included in the order Aptera of Linnaeus. Lamarck included the Thysanura and the Myriapoda in his class Arachnida. The Insecta of Lin- naeus was a group exactly equivalent to the Arthropoda founded a hundred years later by Siebold and Stannius. It was thus reduced by Lamarck in area, and made to comprise only the six-legged, wing-bearing " Insecta." For these Lamarck proposed the name Hexapoda; but that name has been little used, and they have retained to this day the title of the much larger Linnaean group, viz., Insecta. The position of the Arachnida in the great sub-

phylum Arthropoda, according to recent anatomical and embryological researches, is explained in another article (Arthropoda). The Arachnida form a distinct class or line of descent in the grade Euarthropoda, diverging (perhaps in common at the start with the Crustacea) from primitive Euarthropods, which gave rise also to the separate lines of descent known as the classes Diplopoda, Crustacea, Chilbpoda, and Hexapoda.

lAmulus an Arachnid. — Modern views as to the classifi- cjation and affinities of the Arachnida have been determined by the demonstration that Limulus and the extinct Eury- pterines (Pterygotus,&c.) are Arachnida; that is to say, are identical in the structure and relation of so

many important parts with Scorpio, whilst differing in those respects from other Arthropoda that it is impossible to suppose that the identity is due to homoplasy or convergence, and the con- clusion must be accepted ttat the resemblances arise from

close genetic relationship. The view that Limulus, the king-crab, is an Arachnid was maintained as long ago as 1829 by Straus-Dnrkheim (1), on the ground of its posses- sion of an internal cartilaginous sternum — also possessed by the Arachnida (see Figs. 1, 2, 3, 4, 5, and 6)— and of the similarity of the disposition of the six leg-like append- ages around the mouth in the two cases (see Figs. 46 and 63). The evidence of the exact equivalence of the seg- mentation and appendages of Limulus and Scorpio, and of a number of remarkable points of agreement in their

Fig. 1. — Entosternum, entoaternlte or plastron ofI4muhiapolyph6mus,'L&tr.J)oTBB,l surfkce. LAP, left anterior procesB ; RAP, right anterior proceBS ; PhN, pharyn- geal notch; ALE, anterior lateral rod or tendon ; PLE, posterior lateral rod or tendon ; PLP, posterior lateral process. Natural size. (From Lankester, Q. J. Mia. Sai. N.S. vol. xxiv. 1884.)

structure, was furnished by Lankester in an article pub- lished in 1881 (" Limulus and Arachnid," Qitart. Journ. Micr. Sd. vol. xxi. N.S.), and in a series of subsequent memoirs, in which the structure of the entosternum, of the coxal glands, of the eyes, of the veno-pericardiac muscles, of the respiratory lamellae, and of other parts, was for the first time described, and in which the new facts discovered were shown uniformly to support ihe hypothesis that Limulus is an Arachnid. A list of these memoirs is given at the close of this article (2, 3, 4, 6, and

rMP.

"FHP.

Fio. 2.— Ventral surface of the entosternum of Zimulua polyphemua, Latr. Letters as in Fig. 1 with the addition of NF, neural fossa protecting the aggregated ganglia of the central nervous system ; FVP, left posterior ventral process ; PMP, posterior median process. Natural size. (From Lankester.)

13). The Eurypterines (Gigantostraca) were included in the identification, although at that time they were supposed to possess only five pairs of anterior or pro- somatic appendages. They have now been shown to possess six pairs (Fig. 47), as do Limulus and Scorpio.

The various comparisons previously made between the structure of Limulus and the Eurypterines on the one hand, and that of a typical Arachnid, such as Scorpio, on the other, had been vitiated by erroneous notions as to the origin of the nerves supplying the anterior appendages of

Limulus (which were finally removed by Alphonse Milne- Edwards in his beautiful memoir (6) on the structure of that animal), and secondly by the erroneous identification of the double sternal pla'tes of Limulus, called " chilaria," by Owen, with a pair of appendages (7). Once the identity of the chilaria with the pentagonal sternal plate of the scorpion is recognized — an identification first insisted on by Lankester — the whole series of segments and ap- pendages in the two, animals, Limulus and Scorpio, are seen to correspond most closely, seg- ment for segment, with one another (see Figs. 7 and 8). The structure of the prosomatic ap- pendages or legs is also seen to pre- sent many signifi- cant points of agreement (see fig- ures), but a curious

Fig. 8. — Entosternum of Scorpion Palmrmmia indita, Tie Geer : dorsal surface, asp, paired an- terior process of the sub-neural arch ; snj>, sub- neural arch ; ap, anterior lateral process (same as EAP and LAP in Fig. 1) : Imp, lateral median pro- cess (same as ALE and TLE of Fig. 1) ; pp, poste- rior process (same as PLP in Fig. 1) ; ijA posterior flap or diaphragm of Newport ; m mam', perfora- tions of the diaphragm for the passage of muscles ; J)E, the paired dorsal ridges ; GO, gastric canal or

foramen ; AC, arterial canal or foramen. Magnified five times lineal'. (After Lankester, loe. cii.)

discrepancy existed in the six-jointed structure of the limb in Limulus, which differed from the seven-jointed limb of Scorpio by the defect of one joint. Mr E. I. Pocoek of the British Museum has lately observed that in Limulus a marking exists on the fourth joint, which apparently indicates a previous division of this segment into two, and thus establishes the agreement of Limulus and Scorpio in this small feature of the n,umber of seg- ments in the legs (see Fig. 11).

It is not desirable to occupy the limited space of this article by a full description of the limbs and segments of Limulus and Scorpio. The reader is referred to the com- plete series of figures here given, with their explanatory legends (Figs. 12, 13, 14, 15). Certain matters, how- ever, require com- ment and explanation to render the com- parison intelligible. The tergites, or chiti- nized dorsal halves of the body rings, are fused to form a "prosomatic cara- pace," or carapace of the prosoma, in both Limulus and Scorpio (see Pigs. 7 and 8). This region corre- sponds in both cases to six somites, as indicated by the presence of six pairs of limbs. On the surface of the carapace there are in both animals a pair of central eyes with simple lens and a pair of lateral eye-tracts, which in Limulus consist of closely-aggregated simple eyes, form- ing a " compound " eye, whilst in Scorpio they present*

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Fig. 4. — ^Ventral sur&ce of the same ento- sternum as that drawn in Fig. 3. Letters as In Fig. 8 with the addition of NO, neural canal or foramen. (After Lankester, loe. cit.)

1 The discussion of the segmentation or metamerism of the Arachnida in this article should De read after a perusal of the article Artbbofoda hy the same author.

AKACHNIDA

several separate small eyes. The microscopic structure of the central and the lateral eyes has been shown by Lankester and Bourne (5) to differ ; but the lateral eyes

Fio. 5. — Entosternum of one of the my^omorphous spiders ; dorsal sur-&ce. Ph.K., pharyngeal notch. The three pairs of rod-like tendons cor-respond to the two similar pairs in Umulus, and the posterior median process with Its repetition of tri- angular segments closely resembles the same process in Limulus. Magnified five times linear. (From Lankester, U>c. mt^

Fig. 6.— Yentral surface of the same entosternum as that 'drawn in Fig. 6. Ph.N., phalangeal notch. Behind it on the body of the entosternnm is seen the neural fossa, as in Fig. 2. (After Lankester, loo. oit.)

of Scorpio were shown by them to be similar in structure to the lateral eyes of Limulus and the central eyes of Scorpio to be identical in structure with the central eyes of Limulus (see below).

Following the prosoma is a region consisting of six segments (Figs. 14 and 15), each carrying a pair, of plate- like appendages in both Limulus and — ^ Scorpio. This region is called the mesosoma. The tergites of this region and those of the following region, the metasoma, are fused to form a second or posterior carapace in Limulus, whilst remaining free in Scorpio. The first pair of f oliaceous appendages in each animal is the genital operculum; beneath it are

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found the openings of the genital ducts. The second pair of meso- somatic appendages in Scorpio are known as the "pectens." Each con- sists of an axis, bearing numerous blunt tooth-like processes arranged in a series. This is represented in Limulus by the first gill-bearing appendage. The leaves (some 150 in number) of the gill -book (see figure) correspond to the tooth-like processes of the pectens of Scorpio. The next four pairs of appendages (completing the mesosomatic series of six) consist, in both

Scorpio and Limulus, of a base carrying each 130 to 150 blood-holding, leaf-like plates,' lying on one an- other like the leaves of a book. Their minute structure is closely similar in the two cases ; the leaf- like plates receive blood from the great sternal sinus, and serve as respiratory organs. The difference between the gill-books of Limulus and the lung-books of Scorpio de- pends on the fact that the latter are adapted to aerial respiration, while the former serve for aquatic respiration. The appendage carry- ing the gill-book stands out on the surface of the body in Limulus, and has other portions developed

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Fio. 8.— Diagram of the dorsal surface of a Scor- pion to compare with Fig. 7. Letters and Bo- man numerals as in Fig. T, excepting that VII is here certainly the tergum of the first somite of the mesosoma — the genital somite— and is not a sur- vival of the embryonic prffi-genltal somite. (From Lankester, loc. ait,) The anus (not seen) is on the sternal surface.

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Fia. t.— Diagram of the dorsal surface of lA/mulut polyphemu). oe, Lateral compound . eyes; oc', central monomenlscous eyes; PA, post-anal spine; I to VI, the six appendage-beujng somites of the prosoma ; VII, usually considered to be the tergum of the genital somite, but suggested by Mr Pocock to be that of the otherwise suppressed prae-gehital somite ; VIII to XIII, the six somites of the mesosoma, each with a movable pleural spine and a pair of dorsal entopophysis or muscle-attaching Ingrowths ; XIV to XVIII, the confluent or unexpressed six somites of the metasoma. (From Lankester, Q. J. Miar. Sci. vol. xxi. 1881.) According to the system of numbering explained In the text, if VII la the tergum of the prae-genital somite (as is probable) it should be labelled Prg without any number, and the somites VIII to XIII should be lettered 1 to 6, Indicating that they are the six normal somites of the mesosoma ; whilst XV to XVIII should be replaced by the numbers 7 to 12— an additional suppressed segment (making up the typical six) being reckoned to the metasomatic ftision.

Fig. 9. — Ventral view of the posterior carapace or meso-meto-somatlo (opisthosomatlc) ftislon of Zitnulus poVyph&mus. The soft Integument and limbs of the mesosoma have been removed as well as all the viscera and muscles, so that the inner surface of the terga of these somites with their entopophyses are seen. The unsegmented dense chitlnous sternal plate of the metasoma (XIII to XVIII) is not removed. Letters as in Fig. 7. (After Lankester, loc. alt.)

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besides the gill-book and its base ; it is fused with its fellow of the opposite side. On the other hand, in Scorpio, the gill-book-bearing appendage has sunk below the sur- face, forming a recess or chamber for itself, which com- municates with the exterior by an oval or circular "stigma " (rig. 10, stg). That this in-sinking has taken place, and that the lung-books or in-sunken gill- books of Scorpio really represent ap- pendages (that is to say, limbs or parar podia) is proved by their developmental history (see Figs. 17 and 18). They ap- pear at first as out- standing processes on the surface of the body.

The exact mode in which the in- sinking of super- ficial outstanding limbs, carrying gill- lamellae, has histori- cally taken place

*Fia. lO.^Ventral view of a Scorpion, Pa^amnfBKS r^ Koo-n a ~~ma+for imdw.DeGeer, to show the arrangement of the •"<*o oeen. . d. lUdDLtJi 00X8B of the limbs, the sternal elements, genital of much SpeCula~~ plate and pectens. M, month behind the oval . . ~~j, 4~~ V»*

median camerostone ; I, the cheliceree ; II, the tion, J.t WaS tO DC chelee ; III to VI, the fourpau-s of walking legs ; VII°, the genital somite or first somite of the mesosoma with the genital operculum (a fused pair of limbs) ; VIIIj) the pectiniferous somite ;

ai

-XUgr

*L~Mtl^*

pal] IXi

\stg to Xileig, the four palmonar7 somites ;

hoped that the specimen of the Silurian Scorpion

met, the pentagonal metasternlte of the prosoma PalsBOphonuS from behind all the cozse; x, the sternum of the A .i S ■■/ •

pectiniferous somite ; y, the broad first somite OCOtlanCl, snowmg

of the metasoma. ^^^ ventral surf acc

of the mesosoma (Fig. 49), would throw light on this matter; but the specimen recently carefully studied by the writer and Mr Pocock reveals neither gill-bearing limbs nor stigmata. The probability appears to be against an actual introversion of the appendage and its lamellae, as was at one time suggested by Lankester. It is probable that such an in-sinking as is shown in the accompanying dia^ gram has taken place (Fig. 15) ; but we are yet m need of evidence as to the exact equivalence of margins, axis, &c., obtaining between 5

*thp lune-book of Fig. H.—Thhrd leg of i*mti««j)0ij5)A6m«8, showing ” • J 4-1, the division of the fourth segment of the leg by a*

Scorpio ana tne groove S into two, thus giving seven segments to ffill-book of Limu- ‘^ ‘^^ ^ ^ Scorpion. (From a drawing by Mr P n 1 • J. Pocock.) ^

lus. Zoologists are

familiar with many instances (fishes,’ crustaceans) in

which the protective walls of a water-breathing organ

or gill-apparatus become converted into an air-breathing

organ or lung, but there is no other case known of the

conversion of gill processes themselves into air-breathing

plates.

The identification of the lung-books of Scorpio with the gill-books of Limulus is practically settled by the existence of the pectens in Scorpio (Fig. 14, VIII.)

on the second mesosomatio somite. There is no doubt that these are parapodial or limb appendages, car- rying numerous imbricated secondary processes, and therefore comparable in essential structure to the leaf- bearing plates of the second mesosomatio somite of Limu- lus. They have remained unenclosed and projecting on the surface of the body, as once were the appendages of the

Fib. 12.— The prosomatlc appendages of Idmulw polyp?temua (right) and Scorpio (left), Palam/nmu8 indus compared.-^ The corresponding appendages are marked with the same £oman numerals. The Arabic numerals indicate the segments of the legs, cox, coxa or basal segment of the legs ; sic, the sterno-coxal process or jaw-like up-growth of the coxa; epc, the articulated movable outgrowth of the coxa, (»lled the epi-ooxite (present only in III of the Scorpion and III, IV, and V of Limulus) ; eoi^, the exopodite of the sixth limb of Limulus ; a, 7>, c, d, movable processes on the same leg (see for some suggestions on the morphology of this leg, Pocock in Quwi'l. Jov/m. Micr. Sd. March 1901 ; see also Fig. 60 below and explanation.) (From Lankester, loa. cii.)

four following somites. But they have lost their respira- tory function. In non-aquatic life such an unprotected organ cannot subserve respiration. The " pectens " have become more firmly chitinized and probably somewhat altered in shape as compared with their condition in the aquatic ancestral scorpions. Their present function in scorpions is not ascertained. They are not specially sensitive under ordinary conditions, and may be touched or even pinched without causing any discomfort to the scorpion. It is probable that they acquire special

sensibility at the breeding season and serve as "guides " in copulation. The shape of the legs and the absence of paired terminal claws in the Silurian Pa,l8eophonus (see Figs. 48 and 49) as compared with living scorpions

*soft tissues of the sternal region so that the lamellae cannot be detached and presented as standing out from it. The apparent axis or basal support of the scorpion's lung-books shown in the figures, is a false or secondary axis and merely a part of the iufolded surface which forms the air-chamber. The maceration of the soft parts of a scorpion preserved in weak spirit and the cleaning- of the chitinized ingrown cuticle give rise to the false^*

Pio. 18.— DiBgrams of the meta'~~Bternlte st, with genital oper~~ culum op, and the first lamelllgerous pair of appendages ga, with uniting sternal element stof Scorpio (lefQ and limiSus (right). (From Lankester, loe. oit.)

(see Eig. 10) show that the early scor- pions were aquatic, and we may hope some day in better-preserved specimens than the two as yet discovered, to find the respiratory organs of those creatures in the condition of projecting appendages serving aquatic respiration somewhat as in Limulus, though not necessarily re- peating the exact form of the broad plates of Limulus.

It is important to note that the series of lamellse of the lung-book and the gill- book correspond exactly in structure, the narrow, flat, blood- space in the lamellse being interrupted by pillar-like junc- tions of the two surfaces in both cases (see Lankester (4)), and the free surfaces of the adjacent lamellae being covered with a very delicate chitinous cuticle which is diavm out into delicate hairs and processes. The elongated axis which

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Fig. 14. — The first three pairs of mesosomatic appendages of Scorpio and Limulus compared. VII, the genital operculum ; VIII, the pectens of Scorpio and the first branchial plate of Limulus ; IX, the first pair of lung-booEs of Scorpio and the second branchial plate of Limulus ; gp, genital pore ; epai epistigmatic sclerite ; stff, st^ma or orifice of the hollow tendons of the branchial plates of Umnlns. (After Lankester, loo. cit.)

opens at the stigma in Scorpio and which can be cleared of soft, surrounding tissues and coagulated blood so as to present the appearance of a limb axis carrying the book- like leaves of the lung is not really, as it would seem to be at first sight, the limb axis. That is necessarily a blood-holding structure and is obliterated and fused with

FiQ. 15. — ^The remaining three pairs of mesosomatic appendages of Scorpio and Limulus. Letters as in Fig. 14. nSO indicates that there are 180 lamellse in the Scorpion's lung-book, whilst HSO indicates that 150 similar lamellse are counted in the gill of Limulus. (Aiter Lankester, 2oc.

oit.)

appearance of a limb axis carrying the lamellae. JChe margins of the lamellse of the scorpion's lung-book which are lowermost in the figures (Fig. 15) and appear to be free are really those which are attached to the blood-holding axis. The true free ends are those nearest the stigma.

Passing on now from the mesosoma we come in Scorpio to the metasoma of six seg- ments, the first of which is broad whilst the rest axe cylindrical. The last is perforated by the anus and carries the post-anal spine or sting. The somites of the metasoma carry no parapodia. In Limulus the metasoma is practically suppressed. In the allied ex- tinct Eurypterines it is well developed, and resembles that of Scorpio. In the embryO' Limulus (Fig. 42) the six somites of tiie mesosoma are not fused to form a carapace at an early stage, and they are followed by three separately marked metasomatic somites ; the other three somites of the metasoma, have disappeared in Limulus, but are rep- resented by the unsegmented prse-anal region. It is probable that we have in the metasoma of Limulus a case of the disappearance of once clearly demarcated somites. It would be possible to suppose, on the other hand, that new somites are only beginning to make their appearance here. The balance of various considerations is against the latter hypothesis. Following the metasoma. in Limulus, we have as in Scorpio the post-anal spine — ^in this case not a sting, but a powerful and important organ of locomotion, serving to turn the animal over when it has. fallen upon its back. The nature of the post-anal spine has been strangely misinterpreted by some writers. Owen (7) maintained that it represented a number of coalesced

Pig. 16. — Diagram to show the -way in which an outgrowing gill-process bearing bipod-holding lamellsB, may give rise, if the sternal body waU sinks inwards, to a lung-chamber with air-hold- ing lamellee. 1 is the embryonic condition ; ba, blood sinus ; L is the condition of outgrowth with gl^ gill lamellffi ; A is the condition of in- sinking of the sternal surface and consequent enclosure of the lamelliferous surface or the appendage in a chamber with narrow orifice — the

C nonary air-holding chamber ; pl^ pulmonary ellsB ; OBt blood sinus. (After Kingsley.)

somites, regardless of its post-anal position and mode of development ! The agreement of the grouping of the somites, of the form of the parapodia (appendages, limbs)

in each region, of the position of the genital aperture and operculum, of the position and character of the eyes, and of the powerful post-anal spines not seen in other Arthropods, is very convincing as to the affinity of Limulus and Scorpio. Perhaps the most important general agreement of Scorpio com- pared with Limu- lus and the Eury- pterines is the division of the body into the three re- gions (or tagmata) — prosoma, meso- soma, and meta- soma — each consist- ing of six segments, the prosoma having leg-like appendages, the mesosoma hav- ing foliaceous ap- pendages, and the metasoma being destitute of ap- pendages.

In 1893, some years after the identification of the somites of Limulus with those of Scorpio, thus indicated, had been pub- lished, zoologists were startled by the discovery by a Japanese zoologist, Mr Kishinouye (8) of a seventh prosomatic so- mite in the embryo of Limulus longispina. This was seen in lon- gitudinal sections, as shown in Fig. 19. The simple identification of somite with somite in Limulus and Scorpio seemed to be threatened by this discovery. But in 1896 Dr August Brauer of Marburg (9) discov- ered in the embryo of Scorpio a seventh proso- matic somite (see VIL PrG, Figs. 17 and 18), or, if we please so to term it, a prce- genital somite, hitherto unrecognized. In the case of Scorpio this segment is indicated in the embryo by the presence of a pair of rudimentary appendages, carried by a well-marked somite. As in Lim- ulus, so in Scorpio, this unexpected somite and its append- ages disappear in the course of development. In fact, more or less complete " excalation " of the somite takes

Fio. 17.— Embryo of Scorpion, ventral view showing somites and appendages, age, frontal groove ; sa, rudiment of lateral eyes; oil, camerostome (upper lip); so, sense-organ of Patten. PrQaJ>p\ rudi-

*ment of the appendage of the prss-genital somite which disappears ; abp', rudiment of the right half of the genital operculum : dbp^, rudiment of the right pecten ; abp**

*to aop'', rudiments of the four append- ages which carry the pulmonary lamellEe ; I to VI, rudiments of the six limbs of the prosoma ; VIIPrG, the evanescent prse-genital somite ; VIII, the firstmesoso- matic somite or genital somite; IX, the second mesosomatic somite or pectin- iferous somite; X to XIH, the four pulmoniferous somites; XIV, the first metasomatic sotiaite. * (After Brauer, Zeitach. wiaa. Zool. vol. ax. 1^896.)*

VllPrO

Fig. 18. — ^Portion of a similar embryo at a later stage of growth. The prte-genital som- ite, VIIPrG, Is still present, but has lost its rudimentary appendages; go, the genital operculum, left half; Em, the left pecten ; abp to abp'', the rudimentary appendages of the lung-sacs. (After Brauer, loe. ait.)*

place. Owing to its position it is convenient to term the somite which is excalated in Limulus and Scorpio "the'prse-genital somite." It appears not improbable that the sternal plates wedged in between the last pair of legs in both Scorpio and Limulus, viz., the pentagonal sternite of Scorpio (Fig. IQ) and the chilaria of Limulus (see Figs. 13 and 20), may in part represent in the adult the sternum of the excalated prse-genital somite. This has not been demonstrated by an actual following out of the development, but the position of these pieces and the fact that they are (in Limulus) supplied by an independent segmental nerve, favours the view that they may comprise the sternal area of the vanished prae-genital somite. This in- terpretation, however, of the "metasternites" of Limulus and Scorpio is opposed by the coexistence in Thelyphonus (Figs. 56, 67, and 58) of a similar metasternite with a complete prse-genital somite. Hansen (10) has recognized that the "prse-genital somite" per- sists in a rudimentary condition, forming a " waist " to the series of somites in the Pedipalpi and Aranese. The present writer is of opinion that it will be found most convenient to treat this evanescent somite as something special, and not to attempt to reckon it to either the prosoma or the meso- soma. These will then remain as typically composed each of six

appendage-bearing somites — the prosoma comprising in addition the ocular prosthomere. When the prse-genital somite or traces of it are present it should not be called "the seventh prosomatic" or the "first mesosomatic," but simply the " prse-genital somite." The first segment of the mesosoma of Scorpio and Limulus

thus remains the first seg- ment, and can be identified as such throughout the Eu- arachnida, carrying as it always does the genital apertures. But it is nec- essary to remember, in the light of recent discoveries, that the sixth prosomatic pair of appendages is car- ried on the seventh somite of the whole series, there being two prosthomeres or somites in front of the mouth, the first carrying the eyes, the second the chelicerse ; also that the first mesosomatic or geni- tal somite is not the sev- enth or even the eighth of the whole series of somites which have been histori- cally present, but is the ninth, owing to the pres-> ence or to the excalation of a prse-genital somite. It seems that confusion and trouble will be best avoided by abstaining from the introduction of the non-evident somites, the ocular and the prse-genital, into the numerical nomenclature of the component somites of the three great body regions. We shall, therefore, ignoring the ocular somite, speak of the first, second, third, fourth, fifth, and

Fig. 19.— Section through an early em- bryo otX^/mulue longtspina, showing seven transverse divisions in the re- gion of the unsegmented anterior cara- pace. The seventh, VII, is anterior to the genital operculum, ap, and is the cavity of the pree-genital somite which is more or less completely suppressed in subsequent development, possibly indicated by the area marked VII. in Fig. 7 and by the great entopophyses of the prosomatic carapace. (After Kishinouye, Jowm. Sei. Coll. Japan, vol. v. 1892.)

1 See the article Abtheopoda for the use of the term " prostho- mere."

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sixth leg-bearing somites of the prosoma and indicate the appendages by the Eoman numerals, I., II., III., IV., V., VI., and whilst ignoring the prse-genital somite we shall speak of the first, second, third, &c. somite of the meso- soma or opisthosoma (united mesosoma and metasoma) and indicate them by the Arabic numerals.

There are a number of other important points of structure besides those referring to the somites and appendages in which Limulus agrees with Scorpio or other Arachnida and differs from other Arthropoda. ■oam The chief of these are as follows : —

1. ITie Com/position of the Head (that is to say, of the anterior part of the prosoma) with especial Reference to the ■ meta Region in Front of the Mouth. — It appears (see Artheopoda) _. „„ ^. , , that there is embryological evi-

Fio. 20. — Tiew of the ventral , ji ±x. ■ l j; j.„

surface of the mld-llne of the dence 01 tne existence 01 two

E^TflS" "^? "' ■"*Tf?f somites in Arachnida which were*

polyphemua. The coxae of the .... , -, -, i_ -l

five pairs of Bmbs following the origmaUy post-oral, but navc tt^Z erchV;beTween"'the bccome prae-oral by adaptational

mouth, M, and the metasternites, shifting of the Oral aperture.

meta. s/, The sub-frontal median rrru F ji T __j "j

sclerite ; Oh, the chelioerai ; oam, Ihcse f Or Wardly-slippcd SOmitCS

the camerostome or upper hp ; are Called " nrosthomercs." The

M, the mouth; pmai, the pro- .n., . i i.'j

mesosternal sclerite or chitinous nrst 01 tneSC has, in AraCnnidS

ff •,eft-"Sst:rt^s'U'Se- as in other Arthropods, its pair sponding to the similarly placed of appcndagcs represented by the*

pentagonal sternite of Scorpio. rm_ j i. £ 'j. _ •_

Natu/al size. (After Lankester.) eyCS. The SCCOnd haS lOr itS pair

of appendages the small pair of limbs which in all living Arachnids is either chelate or retrovert (as in spiders), and is known as the cheli- cerse. It is possible, as maintained . by some writers (Patten and others), that the lobes of the cerebral nervous mass in Arachnids indicate a larger num- ber of prosthomeres as having fused iin this region, but there is no embryological evidence a|; present which justifies us in assuming the existence in Arach- nids of more than two prosthomeres. The posi- tion of the chelicerse of Limulus and of the ganglionic nerve-masses from which they re- ceive their nerve-supply, is closely similar to

limitations of the cerebrum, whilst embryological re- searches have done as much for Scorpio. Limidus thus agrees with Scorpio and differs from the Crustacea, in which there are three prosthomeres — one ocular and two carrying palpiform appendages. It is true that in the lower Crustacea (Apus, &c.) we have evidence of the gradual movement forward of the nerve-ganglia belonging to these palpiform appendages, But although in such lower Crustacea the nerve-ganglia of the third prosthomere have not fused with

*the anterior nerve- ^^*

mass, there is no ques- tion as to the prae-oral position of two ap- pendage-bearing ;?^ '^ somites in addition to the ocular prostho- mere. The Crustacea have, in fact, three prosthomeres in the head and the Arach- nida only two, and Limulus agrees with the Arachnida in this fig,

respect and differs from the Crustacea. The central nervous systems of Limulus and of Scorpio present closer agreement in structure than can be found when a Crustacean is compared with either. The wide divari- cation of the lateral cords in the prosoma and their connexion by transverse commissures, together with the "attraction" of ganglia to the prosomatic ganglion group which properly belong to hinder segments, are very nearly identical in the two animals. The form and disposition of the ganglion cells are also peculiar and closely similar in the two. (See Patten (42) for important observations on the neuromeres, &c., of Limulus and Scorpio.)

Section through the lateral eye of £hiaaorpiua iiaUcua. leTia, Cutlcular lens ; nervJOf retinal cells (nerve-end cells) ; rTiabd, rhabdomes ; nerv^, nerve fibres of the optic

nerve ; int. Intermediate cells (lying between the bases of the retinal cells). (After Lankester and Bourne from Parker and Haswell's Text-book of

Fia. 21. — Development of the lateral eyes of a Scorpion. A, epi- dermic cell-layer ; mea, mesoblastic connective tissue ; n, nerves ; II, 111, IV, V, depressions of the epidermis in each of which a cuticnlar lens will be formed. (From Korechelt and Helder, after Laurie.)

that of the same structures in Scorpio. The cerebral mass is in Limulus more easily sepa- rated by dissection as a median lobe distinct from the laterally-placed ganglia of the cheli- ceral somite than is the case in Scorpio, but the relations are practically the same in the two forms. Formerly it was supposed that in Limulus both the chelicerae and the next following pair of appendages were prosthomerous, as in Crustacea, but the dissections of Alphonse Milne-Edwards (6) demonstrated the true

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Tia. 2!.— Section through a portion of the lateral eye of Limulus, showing three omma- tidla---A, B, and 0. hyp, The epidermic cell-layer (so-called hypodermis), the cells of which increase in volume below each lens, I, and become nerve-end cells or retinula- oells, r ; in A the letters*

*rh point to a rhabdomere secreted by the cell ri ; c, the peculiar central spherical cell ; n, nerve fibres; mea, mesoblastic skeletal tissue; ch, chitinoas cuticle. (From Korschelt and Holder after Watase.^^*

2. The Minute Structure of the Central Eyes and of the Lateral Eyes. — Limulus agrees with Scorpio not only in having a pair of central eyes and also lateral eyes, but in the microscopic structure of those organs which differs in

the central and lateral eyes respectively. The central eyes are ” simple eyes,” that is to say, have a single lens, and are hence called ” monomeniscous.” The lateral eyes are in Limulus ” compound eyes,” that is to say, consist of many lenses placed closed together ; beneath each lens

Fio. 21.— Diagrams

A, early conditioa

B, diagram showing lCWIUABU VJC , rv, v^.uv.u^iw

cell-layer ; r,‘the retinal portion of the same which, owing to the infolding, Ues between gl^ the corneagen or lens-forming portion, and pr^ the post-retinal or capsular portion or fold ; ^, cnticnlar lens ; fff line separating lens from the lens-forming or corneagen cells of the epidermis ; n, nerve fibres ; rA, rhab- domeres. (From Eorschelt and Heider.) How the inversion of the nerve-end cells and their con- nexion with the nerve-fibres is to be reconciled with the condition found in the adult, or with that of the monostichouB eye, has not hitiierto been explained.

is a complex of protoplasmic cells, in which the optic nerve terminates. Each such unit is termed an “ommati- dium.” The lateral eyes of Scorpio consist of groups of separate small lenses each with its ommatidium, but they do not form a continuous compound eye as in Limulus. The ommatidium (soft structure beneath the lens-unit of a compound eye) is

very simple ^n both Scorpio and Limulus. It consists of a single layer of cells, continuous with those which secrete the general chitinous covering of the prosoma. The cells of the ommatidium are a good deal larger than the neighbouring common cells of the epidermis. They secrete the knob-like lens (Fig. 22). But they also receive the nerve fibres of the optic nerve. They are at the same time both optic nerve-end cells, that is to say, retina cells and corneagen cells or secretors of the chitinous lens-like cornea. In Limulus (Fig. 23) each ommatidium has a peculiar ganglion cell developed in d, central position, whilst the ommatidium of the lateral eyelets of Scorpio shows small intermediate cells between the larger nerve-end cells. The structure of the lateral eye of Limulus was first described by G-renacher, and further and more accurately by Lankester and. Bourne (5) and by Watase ; that of Scorpio by Lankester and Bourne, who showed that the statements, of von Graber were erroneous, and that the lateral eyes of Scorpio have a single cell-layered or "monostichous" ommatidium like that of Limulus. Watase has shown, in a very conviuc- ing way, how by deepening the pit-like set of cells beneath a simple lens the more complex ommatidia of the com- pound eyes of Crustacea and Hexapoda may be derived from such a condition as that presented in the lateral eyes of Limulus and Scorpio. (For details the reader is referred to Watase (11) and to Lankester and Bourne (5).) The structure of the central eyes of Scorpio and Spiders and also of Limulus differs essentially from that of the lateral eyes in having two layers of cells (hence called diplo- stichous) beneath the lens, separated from one another by a membrane (Figs. 24 and 25). The upper layer is .the corneagen and secretes the lens, the lower is the retinal layer. The mass of soft cell-structures beneath a large

lens of a central eye is called an "ommatceum." It shows in Scorpio and Limulus a tendency to segregate into minor groups or " ommatidia." It is found that in embryological growth the retinal layer of the central eyes forms as a separate pouch, which is pushed in laterally beneath the corneagen layer from the epidermic cell layer. Hence ^ it is in origin double, and consists of

a true retinal layer and a post-retinal layer (Fig. 24, B), though these are not , separated by a membrane. Accord- ingly the diplostichous

ommatceum or soft tissue of the Arachnid's central eye should strictly be called "triplo- stichous," since the deep layer is itself doubled or folded. The retinal cells of both the lateral and central eyes of Limulus and Scorpio produce cuticular structures on their sides; each such piece is a rhabdomere and a number (five or ten) uniting form a rhabdom (Fig. 26). In the specialized ommati- dia of the compound eyes of Crustacea and Hexapods the rhabdom is an important structure. It is a very significant fact that the lateral and central eyes of Limulus and Scorpio not only agree each with each in re- gard to their monostichous and diplo- stichous structure but also in the formation in both classes of eyes of rhab- domeres and rhabdoms in which the component pieces are five or a multiple of five (Fig. 26). Whilst each unit of*

con. tisa.

ret.

Fio. 25.— Section through one of the central eyes of a young Limulus. L, cuticu- lar or corneous lens; Aj^, epidermic cell-layer; corn., its corneagen portion immediately underlying the lens ; ret, retinula cells ; »/, nerve fibres ; con. Mm., connecbye tissue (mesoblastic skeletal tissue). (After Lankester and Bourne, Q. J. Mie. Sai. 1888.)

the lateral eye of Limulus has a rhabdom of ten pieces*

1 See Fig. 11 in the article Abtheopoda.

' Though ten is the prevailing number of retinula cells and ihabdo- meres in the lateral eye of Limulus, Wataae states that they may be as tew as mue and as many as eighteen.

formmg a star-like ohitinous centre in section, each lateral eye of Scorpio has several rhabdoms of five or less rhab- domeres, indicating that the Limulus lateral eye-unit is more specialized than the detached lateral

eyelet of Scor- pio, so as to present a Coincidence of one lens with one rhabdom. Numerous rhabdomeres (grouped as rhabdoms in Limulus) are found in the retinal layer of the central eyes also.

Whilst Limulus agrees thus closely with Scorpio in regard to the eyes, it is to be noted that no Crustacean has structures corresponding to the peculiar diplostichous central eyes, though these occur again (with differences in detail) in Hexapoda. Possibly, however, an investigation of the development of the median eyes of some Crustacea (Apus, Palaemon) may prove them to be diplostichous in origin.

3. The so-called " Coxal Glands."— In 1882 (Proc. Boy. Soc^ No. 221) Lankester described under the name " coxal

Via. 26.— A, diagram of a retinulu of fhe central eye of a Scorpion conBlstlng of five retina-cells {ret.), with adherent branched pigment cellB (piff.) ; B, rhabdom of the same, consisting of five confluent rhabdomeres ; O, transverse section of the rhabdom of a retinula of the Scorpion's central eye, showing its five constltaent rhabdomeres as rays of a star ; D, transverse section of a retinula of the lateral eye of Limulus, showing ten retinula cells, ret., each bearing a rhabdomere, rlCab. (After Lankester.)

glands " a pair of brilliantly white oviform bodies lying in the Scorpion's prosoma immediately above the coxse of the fifth and sixth pairs of legs (Tig. 27). These bodies had been erroneously supposed by Newport (12) and other observers to be glandular outgrowths of the alimentary canal. They are really excretory glands, and communicate with the exterior by a very minute aperture on the posterior face of the coxa of the fifth ,limb on each side. When examined with the micro- scope by means of the usual section method, they are seen to consist of a labyrinthine tube- lined with peculiar cells, each cell having a deep vertically striated border on the siu'face farthest from the lumen, as is seen in the cells of some renal organs. The coils and branches of the tube are packed by connective tissue and blood spaces. A similar pair of coxal glands, lobate instead of ovoid in shape, was described by Lankester in Mygale, and it was also shown by him that the structures in Limulus called "brick-red glands" by Packard have the same structure and position as the coxal glands of

Scorpio and Mygale. In Limulus these organs consist each of four horizontal lobes lying on the coxal margin of the second, third, fourth, and fifth prosomatic limbs, the four lobes being connected to one another by a transverse piece or stem (Fig. 28). Microscopically their structure is the

same in essentials as that of the coxal glands of Scorpio (13). Coxal glands have since been recognized and de- scribed in other Arachnida. It has lately (1900) been shown that the coxal gland of Limulus is provided with a very delicate thin-walled coiled duct which opens, even in the adult condition, by a minute pore on the coxa of the fifth leg (Patten and Hazen, 13a). Pre- viously to this, Lankester's pupil Gulland had shown (1885) that in the embryo the coxal gland is a com- paratively simple tube, which opens to the exterior in this position and by its other extremity into a ccelomic space. Similar observations were made by-Laurie (17) in Lankester's laboratory (1890) with regard to the early condition of the coxal gland of Scorpio, and by Bertkau ^41) as to that of the spider Atypus. H. M. Bernard (13b) showed that the opening remains in the adult Scorpion. In all the embryonic or permanent opening is on the coxa of the fifth pair of prosomatic limbs. Thus an organ newly discovered in Scorpio was found to have its counterpart in Limulus.

The name " coxal gland " needs to be carefully distin- guished from " crural gland," with which it is apt to be confused. The crural glands, which occur in many terres- trial Arthropods, are epider- mal in origin and totally dis- tinct from the coxal glands. The coxal glands of the Arach- nida are structures of the same nature as the green glands of the higher Crus- tacea and the so-called " shell glands " of the Entomostraca. The latter open at the base of the fifth pair of limbs of the Crustacean, just as the coxal glands open on the coxal joint of the fifth pair of limbs of the Arachnid. Both belong to the category ^'VlrS'e^rai "^^d^s^f^'a^ let

of " COSlomoduCts," namely, pwn, jB«iftw«_a'W«

tubular or funnel-like por- tions of the coelom opening to the exterior in pairs in each somite(potentially), and usually persisting in only a few

somites as either “uro- ccels” (renal organs) or “gonoccels” (genital tubes).

In Peripatus they occur in every somite of the body. They have till recently been very generally identified with the nephridia of Chsetopod worms, but there is good reason for considering the true nephridia (typified by the nephridia of the Earthworm) as a distinct class of organs (see Lankester in vol. ii. chap. iii. of A Treatise on Zoology, 1900). The genital ducts bf Arthropoda are like the green glands, shell glands, and coxal glands, to be regarded as coelomoducts (gonoccels). The coxal glands do not establish any special connexion between Limulus and Scorpio, since they also occur in the same somite in the lower Crustacea, but it is to be noted that the coxal glands of Limulus are in minute structure and probably in function more like those of Arachnids than those of Crustacea.

4. The Entostemites and their Minute Structure. — Straus- Durkheim (1) was the first to insist on the’ affinity between Limulus and the Arachnids, indicated by the presence of a free suspended entosternuin or plastron or entosternite in both. We have figured here (Figs. 1 to 6) the entostemites of Limulus, Scorpio, and Mygale. Lan- kester some years ago made a special study of the histology

tion to the legs, diaphragm, (ento- sternal flap), and the gastric cseca. 1 to 6, The bases of the six proso- matic limbs ; A, prosomatic gastric gland (sometimes called salivary) ; B, coxal gland ; C, diaphragm of Newport=fibrous flap of the ento- sternum ; D, mesosomatic gastric Cffica (so-called liver) ; E, alimentary canal. (From Lankester, Q. J. Mic. Sci. vol. xxiv. N.8. p. 152.)

(3) of these entosternites for the purpose of comparison, and also ascertained the relations of the very numerous muscles which are inserted into them (4). The ento- sternites are cartilaginous in texture, but they have nei- ther the chemical character nor the microscopic structure of the hyaline cartilage of Vertebrates. They yield chitin in place of chondrin or

gelatin— as does also the cartilage of the Cephalopod's endoskeleton. In microscopic struc- ture they all present the closest agreement with one another. We find a firm, homogeneous or sparsely fibrillated matrix in which are embedded nucleated cells (corpuscles of protoplasm) arranged in rows of three, six, or eight, parallel with the adjacent lines of fibrillation.

A minute entosternite having the above-described struc- ture is found in the Crustacean Apus between the bases of the mandibles, and also in the Decapoda in a similar position, but in no Crustacean does it attain to any size or importance. On the obher hand, the entosternite of the Arachnida is a very large and important- feature in the structure of the prosoma, and must play an important part in the economy of these organisms. In Limulus (Figs. 1 and 2) it has as many as twenty-five pairs of

muscles attached to it, coming to it from the bases of the surround- ing limbs and from the dorsal carapace and from the pharynx. It consists of an oblong plate two inches in length and one in breadth, with a pair of tendinous outgrowths standing out from it at right angles on each side. It "floats" be- tween the prosomatic nerve centres and the alimentary canal. In

Fia. 28.— The right coxal eland oi lAmuhispoly- phemue, Latr. a to a*, ~ '*

, Posterior borders of the chitinous bases of the eoxs of the second, third, fourth, and fifth prosomatic limbs ; b,

longitudinal lobe or stolon of the coxal gland ; „„„„>, or,m\^-a nf 4->,q w^o c, its four transverse lobes or outgrowths cor- "'~' bonillt! OI Xlie me- responding to the four coxae. (From Lan- SOSOma is a Small, free sester, loe. cit, after Paoljard.) . . . . , .'

entosternite having a similar position, but below or ventrad of the nerve cords, and having a smaller number of muscles attached to it. The entosternite was pr9bably in origin part of the fibrous connective tissue lying close to the integument of the sternal surface — giving attachment to muscles cor- responding more or less to those at present attached to it.

It became isolated and detached, why or with what ad- vantage to the organism it is diflcult to say, and at that period of Arachnidan development the great ventral nerve cords occupied a more lateral position than they do at present. We know that such a lateral position of the nerve cords preceded the median position in both Arthropoda and Chsetopoda. Subsequently to the float- ing off of the entosternite the approximation of the nerve cords took place in the prosoma, and thus they were able to take up a position below the entosternite. In the mesosoma the approximation had occurred before the entosternites were formed.

In the Scorpion (Figs. 3 and 4) the entosternite has tough membrane-like outgrowths which connect it with the body-wall, both dorsally and ventrally forming an oblique diaphragm, cutting off the cavity of the prosoma from that of the mesosoma. It was described by New- port as " the diaphragm." Only the central and horizon- tal parts of this structure correspond precisely to the entosternite of Limulus : the right and left anterior pro- cesses (marked ap in Figs 3 and 4, and EAP, LAP, in Figs. 1 and 2) correspond in the two animals, and the

median lateral process Imp of the Scorpion represents the tendinous outgrowths ALE, PLE, of Limulus. The Scorpion's entosternite gives rise to outgrowths, besides the great posterior flaps, pf, which form the diaphragm, unrepresented in Limulus. These are a ventral arch forming a neural canal through which the great nerve cords pass (Figs. 3 and 4, snp), and further a dorsal gas- tric canal and arterial canal which transmit the alimen- tary tract and the dorsal artery respectively (Figs. 3 and 4, GC, DE).

In Limiilus small entosternites are found in each somite of the appendage-bearing mesosoma, and we find in Scorpio, in the only somite of the mesosoma Which has a well-developed pair of appendages, that of the pectens, a small entosternite with ten pairs of muscles inserted into it. The supra-pectinal entosternite lies ventrad of the nerve cords.

In Mygale (Figs. 5 and 6) the form of the entosternite is more like that of Limulus than is that of Scorpio. The anterior notch Ph.N. is similar to that in Limulus, and the three pairs of upstanding tendons on the dorsal

surface correspond to the two similar pairs in Limulus, whilst the imbricate triangular pieces of the posterior median region resemble the similarly-placed structures of Limulus in a striking manner.

It must be confessed that we are singularly igfaorant as to the functional significance of these remarkable organs — the entosternites. Their movement in an upward or downward direction in Limulus and Mygale must exert a pumping action on the blood contained in the dorsal arteries and the ventral veins respectively. In Scorpio the completion of the horizontal plate by oblique flaps, so as to form an actual diaphragm shutting off the cavity of the prosoma from the rest of the body, possibly gives to the organs contained in the anterior chamber a physiological advantage in re- spect of the supply of arterial blood and its separation from the venous blood of the meso- soma. Possibly the movement of the diaphragm may deter- mine the passage of air into or out of the lung-sacs. Mus- cular fibres connected with the suctorial pharynx are in Limulus inserted into the entosternite, and the activity of the two organs may be correlated.

5. The Blood and the Blood- vascular System. — The blood fluids of Limulus and Scorpio are very similar. Not only are the blood corpuscles of Limulus more like in form and granulation to those of Scorpio than to those of any Crustacean, but the fluid is in both animals strongly impreg- nated with the blue-coloured respiratory proteid Hsemocy- anin. This body occurs also in the blood of Crustacea and of Molluscs, but its abundance in both Limulus and Scorpio is very marked, and gives to the freshly-shed blood a strong indigo-blue tint.

The great dorsal contractile vessel or "heart" of Limulus is closely similar to that of Scorpio ; its ostia or incurrent orifices are placed in the same somites as those

Pio. 29.— Diagram of the arterial sys- tem of A, Scorpio, and B, Limulus. The Boman numerals Indicate the body somites and the two figures are adjusted for comparison, cd. Cere- bral arteries; sp, supra-spinal or medullary artery ; o, caudal artery ; 2, lateral anastomotic artery of Lim- ulus. The figure B also shows the peculiar neural investiture formed by the cerebral arteries In Limulus and the derivation from this of the

arteries to the limbs. III, IV, VI, whereas in Scorpio the latter have a separate origin fl:oin the anterior aorta. (Prom Lankester, ” Limulus an Arachnid.”)

tsn

of Scorpio, but there is one additional posterior pair. The origin of the paired arteries from the heart differs in Limulus from the arrangement obtaining in Scorpio, in that a pair of lateral commissural arteries exist in Limulus (as described by Alphonse Milne-Edwards (6)) leading to a suppression of the more primitive direct connexion

of the four pairs of pos- terior lateral arteries, and of the great median pos- terior arteries with the heart itself (Pig. 29). The arterial system is very completely developed in both Limulus and Scorpio, branching repeatedly until minute arterioles are formed, not to be distinguished from true capillaries ; these open into irregular swollen ves- sels which are the veins or venous sinuses. A very remarkable feature in Limulus, first described by Owen, is the close accom- paniment of the prosomatic nerve centres and nerves Ti-„ on -iri «.„ K 1 » a ! by arteries, so close indeed

Fig. 80. — View from below of a Scorpion ^ , .-x . t

(B. occitanuB) opened and dissected so that the great ganglIOU maSS

*mus”^e*ut?Xa&Tnd\he and its Outrunning nerves*

tergo-sternalnmsclea. PEO, prosoma ; are actually SUnk in Or in- (toTTi, dorso-plastral muscle : art j. j t j. • mi.

lateral artery; temJ, tergo-Bternal veSted by arteries. ine

muaoie Oabeiied ^t) in Fig. SI) of the connexion Is not SO intimate

*second (peetiniferoua) mesosomatic . ^ .... ,^*

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■V.PM VPM^*

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muscles (labelled pv in Fig. 01). There VClopcd, 6.

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muscles in Scorpio ; this would mate arthrOStraCOUS

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the number in Limulus. (After Lau- it SeemS that tUCrC IS a

kester, Tran». Zooi. Soc. vol. xi. 1883.) primitive tendency in the Arthropoda for the arteries to accompany the nerve cords, and a "supra-spinal" artery^hat is to say, an artery in close relation to the ventral nerve cords — has been described in several cases. On the other hand, in many Arthropods, especially those which possess tracheae, the arteries do not have a long course, but soon open into wide blood sinuses. Scorpio certainly comes nearer to Limulus in the high development of its arterial system, and the intimate relation of the anterior aorta and its branches to the nerve centres and great nerves, than does any other Arthropod.

An arrangement of great functional importance in regard to the venous system must now be described, which was shown in 1883 by Lankester to be common to Limulus and Scorpio. This arrangement has not hitherto been detected in any other class than the Arachnida, ajid if it should ultimately prove to be peculiar to that group, would have considerable weight as a proof of the close genetic affinity of Lii6ulus and Scorpio.

The great pericardial sinus is strongly developed in both animals. Its walls are fibrous and com- plete, and it holds a considerable volume of blood when the heart itself is contracted. Opening in pairs in each somite, right and left into the pericardial sinus are large veins, which bring the blood respectively from the gill-books and the lung-books to that chamber, whence it passes by the ostia into the heart. The blood

is brought to the respiratory organs in both cases by a great venous-collecting sinus having a ventral median position. In both animals the wall of the pericardial sinus is connected by vertical muscular bands to the wall of the ventral venous sinus (its lateral expansions around the lung-books in Scorpio) in each somite through which the pericardium passes. There are seven pairs of these veno-pericardiac vertical muscles in Scorpio, and eight in Limulus (stee Figs. 30, 31, 32). It is obvious that the contraction of these muscles must cause a depression of the floor of the pericardium and a rising of the roof of the ventral blood sinus, and a consequent increase of volume and flow of blood to each. Whether the peri- cardium and the ventral sinus are made to expand simultaneously or all the movement is made by one only

ad. w4 PY'

Fie. 81.— Diagram of a lateral view of a longitudinal section of a Scorpion. (2, chelicera ; cA, chela ; cam, camerostome ; Tti, mouth ; ent, entosternum ; p, pecten ; s^i^^, first pulmonaiy aperture: sHg, fourth pulraonary aperture; da/m, muscle from carapace to a proeoral entosclerlte ; «' to pv", the seven veno-pericardiac muscles of the right side (labelled VPM In Fig. 80). (After Beck, Trans. Zool. Soc. vol. xi. 1888.)*

of the surfaces concerned, must depend on conditions of tension. In any case it is clear that we have in these muscles an apparatus for causing the blood to flow differentially in increased volume into either the peri-cardium, through the. veins leading from the respiratory organs, or from the body generally into the great sinuses which bring the blood to the respiratory organs. These muscles act so as to pump the blood through the respirsr tory organs.

It is not surprising that with so highly developed an arterial system Limulus and Scorpio should have a highly developed mechanism for determining the flow of blood to the respiratory organs. That this is, so to speak, a need of animals with localized respiratory organs is seen by the existence of provisions serving a similar purpose in other animals, e.g., the branchial hearts of the Cephalopoda.

The veno-pericardiac muscles of Scorpio were seen and

Per

VPM'

go.

Fie. 82.— Diagram of a lateral view of a longitudinal section of Limulus. iS'uc, suctorial pharynx ; al, alimentary canal ; Ph, pharynx j M, mouth ; Mst, entosternum ; VS. ventral venous sinus ; oM, chilaria; go, genital operculum; 6yi to 6r', branchial

appendages ; met, unsegmented metasoma ; Jl>iitap, fourth dorsal entapopbysis of left side ; tsm, tergo-sternal muscles, six pairs as in*

Scorpio (labelled dv in Fig. 81) ; VPM' to VPM', the eight pairs of veno-pericardiac muscles (labelledp'!) in Fig. 81). VPMi is probably represented in Scorpio, though not marked in Ilgs. 80 and 81. (After Benham, Trans. Zool. Soc. vol. xi. 1888.)

figured by Newport but not described by him. Those of Limulus were described and figured by Alphonse Milne- Edwards, but he called them merely " transparent liga- ments," and did not discover their muscular structure. They are figured and their importance for the first time

recognized in tlie memoir on the muscular and skeletal systems of Limulus and Scorpio by Lankester, Beck, and Bourne (4).

6. Alimentary Caned and Gastric Glands. — The ali- mentary canal in Scorpio, as in Limulus, is provided with a powerful suctorial pharynx, in the working of which extrinsic muscles take a part. The mouth is relatively smaller in Scorpio than in Limulus — in fact is minute, as it is in all the terrestrial Arachnida which suck the juices of either animals or plants. In both, the alimentary canal takes a straight course from the pharynx (which bends under it downwards and backwards towards the mouth in

Limulus) to the amis, and is a simple, narrow, cylindrical tube (rig. 33). The only point in which the gut of Limulus resembles that of Scorpio rather than, that of any of the Crustacea, is in pos- sessing more than a single pair of ducts or lateral out- growths connected with rami- fied gastric glands or gastric caeca. Limiilus has two pairs of these, Scorpio as many as six pairs. The Crustecea never have more than one pair. The minute microscopic struc- ture of the gastric glands in the two animals is practically identical. The functions of these gastric diverticula have never been carefully investi- gated. It is very probable that in Scorpio they do not serve merely to secrete a diges- a tive fluid (shown in other

I Arthropoda to resemble the

y pancreatic fluid), , but that

they also become distended by the juices of the prey sucked in by. the Scorpion — as cer-

pharynx; »ai, proBomfttic pair of tainlv mUSt OCCUT in the CaSC gastnc caeca In Scorpio, called r> ,a ‘ -, i in

salivary glands by some writers ; of the Simple unbranched gaS-

tric caeca of the Spiders.

The most important differ- ence which exists between the structure of Limulus and that of Scorpio is found in the hinder region of the aliment- ary canal. Scorpio is here provided with a single or double pair of renal excretory tubes, which have been identified by earlier authors with the Malpighian tubes of the Hexapod and Myriapod insects. Limulus is devoid of any such tubes. We shall revert to this subject below. ‘

7. Ovaries and Spermaries : Gonoccels and Gonoducts. — The scorpion is remarkable for having the specialized portion of coelom from the walls of’ which egg-cells or sperm-cells are developed according to sex, in the form of a simple but extensive network. It is not a pair of simple tubes, nor of dendriform tubes, but a closed network. The same fact is true of Limulus, as was shown by Owen (7) inregard to the ovary, and by Benham (tl4) in regard to the testis. This is a very definite and remarkable agreement, since such a reticular gonocoel is not found in Crustacea (except in the male Apus). Moreover, there is a significant agreement in the character of the spermatozoa of Limulus and Scorpio. The Crustacea are — with the exce^ion of the Cirrhipedia — remarkable for having stiff,

Fi&. 83.— Tlie alimentary canal and gastric glands of a Scorpion (A) and of Limulus (B). pBy Muscular suctorial enlargement of the

vary glai o^, and c^, the anterior two pa: of gastric cseca and ducts of the mesosomatic region ; cfl, c^, and c^, caeca and ducts of Scorpio not represented in Limulus ; M, the Malpighian or renal csecal diverti- cula of Scorpio ; pro, the prooto- dceum or portion of gut leading to anus and formed embryologically by an inversion of the epiblast at that orifice. (From Lankester, "Limulus and Arachnid.")

motionless spermatozoids. In Limulus Lankester found (15) the spermatozoa to possess active flageUiOorm "tails," and to resemble very closely those of Scorpio which, as are those of most terrestrial Arthropoda, are actively motile. This is a microscopic point of agree- ment, but is none the less significant.

In regard to the important structures concerned with the fertilization of the egg, Limulus and Scorpio differ entirely from one another. The eggs of Limulus are fer- tilized in the sea after they have been laid. Scorpio, being a terrestrial animal, fertilizes by copulation. The male possesses elaborate copulatory structures of a chitinous nature, and the eggs are fertilized in the female without even quitting the place where they are formed on the wall of the reticular gonocoel. The female scorpion is viviparous, and the young are pro- duced in a highly developed condition as fully formed scorpions.

Differences between Limvlus and Scorpio. — We have now passed in review the principal structural features in which Limulus agrees with Scorpio and differs from other Arthropoda. There remains for consideration the one important structural difference between the two animals. Limulus agrees with the majority of the Crustacea in being destitute of renal excretory caeca or tubes opening into the hinder part of the gut. Scorpio, on the other hand, in common with all air-breathing Arthropoda except Peripatus, possesses these tubules, which are often called Malpighian tubes. A great deal has been made of this difference by some writers. It has been considered by them as proving that Limulus, in spite of all its special agreements with Scorpio (which, however, have scarcely been appreciated by the writers in question), really belongs to the Crustacean line of descent, whilst Scorpio, by pos- sessing Malpighian tubes, is declared to be unmistakably tied together with the other

Arachnida to the tracheate Arthropods, the Hexapods, Diplopods, and Chilopods, which all possess Malpighian tubes.

It must be pointed out that the presence or absence of such renal excretory tubes opening into the intestine appears to be a question of adaptation to the changed physiological conditions of respiration, and not of morpho- logical significance, since a pair of renal excretory tubes of this nature is found in certain Amphipod Crustacea (Talorchestia, &c.) which have abandoned a purely aquatic life. This view has been accepted and supported by Pro- fessors Korschelt and Heider (16). An important fact in its favour was discovered by Laurie (17), who investigated the embryology of two species of Scorpio under Lankester's direction. It appears that the Mal- pighian tubes of Scorpio are developed from the mesen- teron,' viz., that portion of the gut which is formed by the hypoblast, whereas in Hexapod insects the similar caecal tubes are developed from the proctodaeum or in-pushed portion of the gut which is formed from epiblast. In fact it is not possible to maintain that the renal excretory tubes of the gut are of one common origin in the Arthro- poda. They have appeared independently in connexion with a change in the excretion of nitrogenous waste in Arachnids, Crustacea, and the other classes of Arthropoda when aerial, as opposed to aquatic, respiration has been established — and they have been formed in some cases from the mesenteron, in other cases from the proctodaeum. Their appearance in the air-breathing Arachnids does not separate those forms from the water-breathing Arachnids which are devoid of them, any more than does their appear- ance in certain Amphipoda separate those Crustaceans from the other members of the class.

Further, it is pointed out by Korschelt and Heider that the hinder portion of the gut frequently acts in Arthro- poda as an organ of nitrogenous excretion in the absence

of any special excretory tubules, and tiat the production of such caeca from its surface in separate lines of descent does not involve any elaborate

or unlikely process of growth. In other words, the Malpighian tubes of the terrestrial Arachnida are homoplastic with those of Hexa- poda and Myriapoda, and not homogenetic with them. We are compelled ,to take a similar view of the agree- ment between the tracheal air-tubes of Arachnida and other tracheate Arthropods. They are homoplasts (see 18) one of another, and do not owe their existence in the various classes compared to a common inheritance of an ancestral tracheal system.

Conclusions arising from the Close Affinity of Limulus and Scorpio. — When we consider the relationships of the various classes of Arthropoda, having accepted and estab- lished the fact of the close genetic affinity of Limulus and Scorpio, we are led to important conclusions. In such a consideration we have to make use not only of the fact just mentioned, but of three important generalizations which serve as it were as implements for the proper estimation of the relationships of any series of organic forms. First of all there is the generalization that the relationships of the various forms of animals (or of plants) to one another is that of the ultimate twigs of a much-branching genealogical tree. Secondly, identity of structure in two organisms does not necessarily indicate that the identical structure has been inherited from an ancestor common to the two organisms compared (homogeny), but may be due to independent development of a like structure in two different lines of descent (homoplasy). Thirdly, those members of a group which, whilst exhibiting undoubted structural characters indic- ative of their proper assignment to that group, yet are simpler than and inferior in elaboration of their organization to other members of the group, are not necessarily representatives of the earlier and primitive phases in the development of the group — ^but are very often examples of retrogressive change or degeneration. The second and third implements of analysis above cited are of the nature of cautions or checks. Agreements are not necessarily due to common inheritance ; simplicity is not necessarily primitive and ancestral.

On the other hand, we must not rashly set down agreements as due to '.' homoplasy " or " convergence of development " if we find two or three or more concurrent agreements. The probability is against agreement being due to homoplasy when the agreement involves a number of really

*separate (not correlated) coincidences. Whilst the chances are in favour of some one homoplastic coin- cidence or structural agreement occurring between some member or other of a large group a and some member or other of a large group 6, the matter is very different when by such an initial coincidence the two members have been particularized. The chances against these two selected members exhibiting another really independent homoplastic agreement are enormous ; let us say 10,000 to 1. The chances against yet another coincidence are a hundred million to one, and against yet one more " coin- cidence " they are the square of a hundred million to one. Homoplasy can only be assumed where the coincidence is of a simple nature, and is such as may be reasonably supposed to have arisen by the action of like selective conditions upon like material in two separate lines of descent.^*

1 A great deal of superfluous hypothesis has lately been put forward in the name of " the principle of convergence of characters " by a certain school of palaeontologists. The horse is su{)posed by these writers to have originated by separate lines of descent in the Old World and the New, from five-toed ancestors! And the important consequences following from the demonstration of the identity in structure of Limulus and Scorpio are evaded by arbitrary and even phantastic

So, too, degeneration is not to be lightly assumed as the explanation of a simplicity of structure. There is a very definite criterion of the simplicity due to degeneration which can in most cases be applied. Degenerative sim- plicity is never uniformly distributed over all the structures of the organism. It affects many or nearly all the structures of the body, but leaves some, it may be only one, at a high level of elaboration and complexity. Ancestral simplitjity is more uniform, and does not coexist with specialization and elaboration of a single organ. Further : degeneration cannot be inferred safely by the examination of an isolated case ; usually we obtain a series of forms indicating the steps of a change in structure — and what we have to decide is whether the movement has been from the simple to the more complex, or from the more complex to the simple. The feathers of a peacock afford a convenient example of primitive and degenerative simplicity. The highest point of elaboration in colour, pattern, and form is shown by the great eye- painted tail feathers.

From these we can pass by gradual transitions in two directions, viz., either to the simple lateral tail feathers with a few rami only, developed only on one side of the shaft and of uniform metallic coloration — or to the simple contour feathers of small size, with the usual symmetrical series of numerous rami right and left of the shaft and no remarkable colouring. The one-sided specialization and the peculiar metallic colouring of the lateral tail feathers mark them as the extreme terms of a degenerative series, whilst the symmetry, likeness of constituent parts inter se, and absence of specialized pigment, as well as the fact that they differ little from any average feather of birds in general, mark the contour feather as primitively simple, and as the starting-point from which the highly-elaborated eye-painted tail feather has gradually evolved.

Applying these principles to the consideration of the Arachnida, we arrive at the conclusion that the smaller and simpler Arachnids are not the more primitive, but that the Acari or Mites are in fact a degenerate group. This was maintained by Lankester in 1878 (19), again in 1881 (20) ; it was subsequently announced as a novelty by Claus in 1885 (21). Though the aquatic members of a class of animals are in some instances derived from terrestrial forms, the usual transition is from an aquatic ancestry to more recent land-living forms. There is no doubt, from a consideration of the facts of structure, that the aquatic water-breathing Arachnids, represented in the past by the Eurypterines and to-day by the sole survivor Limulus, have preceded the terrestrial air-breathing forms of that group. Hence we see at once that the better- known Arachnida form a series, leading from Limulus-like aquatic creatures through Scorpions, Spiders, and Har- vestmen to the degenerate Acari or Mites. The spiders are specialized and reduced in apparent complexity, as compared with the Scorpions, but they cannot be regarded as degenerate, since the concentration of structure which occurs in them results in greater efficiency and power than are exhibited by the Scorpion. The determination of the relative degree of perfection of organization attained by two animals compared is difficult when we introduce, as seems inevitable, the question of efficiency and power, and do not confine the question to the perfection of morphological development. We have no measure of the degree of power manifested by various animals — ^though it would be possible to arrive at some conclusions as to how that

“power” should be estimated. It is not possible here to discuss that matter further. We must

invocations of a mysterious transcendental force which brings about “convergence” irrespective of heredity and selection. Morphology becomes a farce when such assumptions are niade.

be content to point out ftiat it seems that the Spiders, the Pedipalps, and other large Arachnids have not been derived from the Scorpions directly, but have inde- pendently developed from aquatic ancestors, and from one of these independent groups — probably through the Harvestmen from the Spiders — the Acari have finally resulted.

Leaving that question for consideration in connexion with the systematic statement of the characters of the various groups of Arachnida which follows below, it is well now to consider the following question, viz., seeing that Limulus and Scorpio are such highly developed and specialized forms, and that they seem to constitute as it were the first and second steps in the series of recognized Arachnida — what do we know, or what are we led to suppose with regard to the more primitive Arachnida from which the Eurypterines and Limulus and Scorpio have sprung ? Do we know in the recent or fossil condition any such primitive Arachnids ? Such a question is not only legiti- mate, but prompted by the analogy of at least one other great class of Arthropods. The great Arthropod class, the Crustacea, presents to the zoologist at the present day an immense range of forms, comprising the primitive Phyllo- pods, the minute Copepods, the parasitic Cirrhipedes and the powerful Crabs and Lobsters, and the highly -elaborated Sand-hoppers and Slaters. It has been insisted, by those who accepted Lankester’s original doctrine of the direct or genetic aflnity of the Chsetopoda and Arthropoda, that Apus and Branchipus really come very near to the ancestral forms which connected those two great branches of Ap- pendieulate (Parapodiate) animals. On the other hand, the Land Crabs are at an immense distance from these simple forms. The record of the Crustacean family-tree is in’ fact a fairly

.complete one — the lower primitive members of the group are still represented by living forms in great abundance. In the case of the Arachnida, if we have to start their genealogical history with Limulus and Scorpio, we are much in the same position as we should be in dealing with the Crustacea, were the whole of the Entomostraca and the whole of the Arthrostraca wiped out of existence and record. There is no possibility of doubt that the series of forms corresponding in the Arachnidan line of descent to the forms distinguished in the Crustacean line of descent as the lower grade — ^the Entomostraca — ^have ceased to exist, and not only so, but have left little evidence in the form of fossils as to their former existence and nature. It must, however, be admitted as probable that we should find some evidence, in ancient rocks or in the deep sea, of the early more primitive Arachnids. And it must be remembered that such forms must be expected to exhibit, when found> differences from Limulus and Scorpio as great as those which separate Apus and Cancer. The existing Arachnida, like the higher Crustacea, are " nomomeristic," that is to say, have a fixed typical number of somites to the body. Further, they are, like the higher Crustacea, "somato- tagmie," that is to say, they have this limited set of somites grpuped in three (or more) " tagmata " or regions of a fixed number of similarly modified somites — each tagma differing in the modification of its fixed number of somites from that characterizing a neighbouring " tagma." The most primitive among the lower Crustacea, on the other hand, for example the Phyllopoda, have not a fixed number of somites, some genera — even allied species — have more, some less, within wide limits; they are " anomomeristic." They also, as is generally the case with anomomeristic animals, do not exhibit any conformity to a fixed plan of " tagmatism " or division of the somites of the body into regions sharply marked off from one another; the head or prosomatic tagma is followed by a trunk con- sisting of somites which either graduate in character as we

pass along the series or exhibit a large variety, in different genera, families, and orders, of grouping of the somites. They are anomotagmic, as well as anomomeristic.

When it is admitted — as seems to be reasonable — ^that ^the primitive Arachnida would, like the primitive Crus- tacea, be anoniomeristio and

anomotagmic, we shall not demand of claimants for the rank of .primitive Arachnids agreement with Limulus and Scorpio in respect of the exact number of their somites and the exact grouping of those somites ; and when we see how diverse are the modifications of the branches of the appendages both in Arachnida and in other classes of Arthropoda {q.v.), we shall not over-estimate a diffei^ence in the form of this or that appendage exhibited by the claimant as compared with the higher Arachnids. With those considerations in mind, the claim of the extinct group of the Trilobites to be considered as representatives of the lower and more primitive steps in the Arachnidan genealogy must, it seems, receive a favourable judgment. They diffei? from the Crustacea iii that they have only a single pair of prse- oral appendages, the second pair being definitely developed as mandibles. This fact renders their association with the Crustacea impossible, if classification is to be the expres- sion of genetic af&nity inferred from structural coinci- dence. On the contrary, this particular point is one in which they agree with the higher Arachnida. But little is known of the structure of these extinct animals ; we are therefore compelled to deal with such special points of resemblance and difference as their remains still ex- hibit. They had lateral eyes' which resemble no known eyes so closely as the lateral eyes of Limulus. The general form and structure of their prosomatic carapace are in many striking features identical with that of Limulus. The trilobation of the head and body — due to the expansion and flattening of the sides or " pleura " of the tegumentary skeleton — is so closely repeated in the young of Limulus that the latter has been called " the Trilobite stage " of Limulus (Fig. 42 compared with Fig. 41). No Crustacean exhibits this trilobite form. But most important of the evidences presented by the Tri- lobites of afilnity with Limulus, and therefore with the Arachnida, is the tendency less marked in somd, strongly carried out in others, to form a pygidial or telsonic shield — a fusion of the posterior somites of the body, which is precisely identical in character with the meta- somatic carapace of Limulus. Wheh .to this is added the fact that a post-anal spine is developed to a large size in some Trilobites (Fig. 38), like that of Limulus and Scorpio, and that lateral spines on the pleura of the somites are frequent as in Limulus, and that neither metasomatic fusion of somites nor post-anal spine, nor lateral pleural spines are found in any Crustacean, nor all three together in any

Arthropod besides the Trilobites and Limulus — the claim of the Trilobites to be considered as representing one order of a lower grade of Arachnida, comparable to the grade Entomostraca of the Crustacea, seems to be established.

The fact that the single pair of prse-oral appendages of Trilobites, known only as yet in one genus, is in that par- ticular case a pair of uni-ramose antennse — does not render the association of Trilobites and Arachnids improbable. Although the prse-oral pair of appendages in the higher Arachnida is usually chelate, it is not always so; in Spiders it is not so ; nor in many Acari. The bi-ramose structure of the post-oral limbs, demonstrated by Beecher in the Trilobite Triarthrus, is no more inconsistent with its claim to be a primitive Arachnid than is the foliaceous modifica-

1 A pair of round tubercles on the labrnm (camerostome or hypo- stoma) of several species of Trilobites has been described and held to be a pair of eyes quite recently (22). Sense-organs in a similar position were discovered in Limulus by Patten (42) in 1894.

tion of the limbs in Phyllopods inconsistent -with their relationship to the Arthrostracous Crustaceans such as Gammarus and Oniscus.

Thus, then, it seems that we have in the Trilobites the representatives of the lower phases of the Arachnidan pedigree. The simple Anomomeristic Trilobite, with its equi-formal somites and equi-formal appendages, is one term of the series which ends in the even more simple but degenerate Acari. Between the two and at the highest point of the arc, so far as morphological differen- tiation is concerned, stands the Scorpion ; near to it in the Trilobite's direction (that is on the ascending side) are Limulus and the Eurypterines — ^with a long gap, due to obliteration of the record, separating them from the Trilo- bite. On the other side — tending downwards from the Scorpion towards the Acari — are the Pedipalpi, the Spiders, the Book-Scorpions, the Harvest-men, and the Water-Mites.

The strange Nobody-Crabs or Pycnogonids occupy a place on the ascending half of the arc below the Eurypterines and Limulus. They are strangely modified and degenerate, but seem to be (as explained in the systematic review) the remnant of an Arachnidan group holding the same relation to the Scorpions which the Laemodipoda hold to the Podophthalmate Crustacea.

We have now to offer a classification of the Arachnida and to pass in review the larger groups, with a brief statement of their structural characteristics.

In the bibliography at the close of this article (referred to by leaded arable numerals in brackets throughout these pages), the titles of works are given which contain de- tailed information as to the genera and species of each order or sub-order, their geographical distribution, and their habits and economy so far as they have been ascer- tained. The limits of space do not permit of a fuller treatment of those matters here.

Tabular Classificatioit ^ op the Aeachnida.

Ci-Ass. ARACHNIDA

Grade A. AN0M0MERI8TICA. Sub-Class. TRILOBIT.X.

Orders. Not satisfactorily determined. Grade B. N0M0MEBI8TICA. Sub-Class I. PANTOPODA. Order i. Nymphonomorpha. „ ■^. Ascorhynchotnorpha. „ 3. Pycnogonomorpha. Sub-Class II. EU-ARACHNIDA.

Grade a. delobranchia, Lankester (vel. hysko-

PNEUSTEA, POCOCk).

Order i. Xiphosura. „ 2. Gigantostraca. Grade b. eubolobbanchia, Lankester (ve2. aero-

PNEUSTEA, PoOOOk).

Section a, Pectinifera. Order i. Scorpionidea.

Sub-order a. Apoxypoda. „ 6. Dionychopoda.

i^Tie writer is indebted to Mr E. I. Pocock, assistant in the Natural History departments of the British Museum, for valuable assistance in the preparation of this article and for the classification and definition of the groups of Eu-arachnida here given. The general scheme and some of the details have been brought by the writer into agreement with the views maintained in this article. Mr Pocock accepts those views in all essential points and has, as a special student of the Arachnida, given to them valuable expansion and confirmation. The writer also desires to express his thanks to Messrs Macmillan for permission to use Figs. 22, 43, 44, and 45, which are taken from Parker and Haswell's Text-book of Zoology ; and to Messrs Swan Sonnenscbein and Co. for the loan of several figures from the trans- lations published by them of the admirable treatise on Embryology by Professors Korschelt and Heider ; also to the publishers of the treatise on JPalaeontology by Professor Zittel, Herr Oldenbourg and Macmillan and Co. of New York for several cuts of extinct forms.

Section p. Epectinaia.

Order 2. Pedipalpi.

Sub-rorder a. Uropygi.

Tribe 1. Urotricha. „ 2. Tartarides. Sub-order 6. Amblypygi. Order 3. Araneae.

Sub-order a. Mesothelss. „ &. Opisthothelse.

Tribe 1. Mygalomorphss. „ 2. ArachnomorphsB. Order 4. Palplgradi (=Microthelyphonida). , Orders. Solifugse (=Mycetophorae). Order 6. Pseudoscorpiones (=Chelonethi). Sub-order a. Panctenodactyli.

„ 6. Hemictenodaotyli. '

Order 7. Podogona (=MerTdogastra). Order 8. Oplliones.

Sub-order a. Laniatores. ,, 6. Palpatores. ,, c. Anepignathi. Order g. Rhynchostomi (=Acari). Sub-order a. Cryptostigmata. ,, b. Metastigmata. ,, c. Prostigmata. , ,, d. Astigmata. ,, e. Vermiformia. ,, /. Tetrapoda.

Class. ARACHNIDA.— Euarthropoda having two prosthomeres (somites which have passed from a post-oral to a prsB-oral position), the appendages of the first represented by eyes, of the second by solitary rami which are rarely antenniform, more usually chelate. A tendency is exhibited to the formation of a metasomatic as well as a prosomatic carapace by fusion of the tergal surfaces of the somites. Intermediate somites forming a mesosoma occur, but tend to fuse superficially with the metasomatic carapace or to become co-ordinated with the somites of the metasoma, whether fused or distinct to form one region, the opisthosoma (abdomen of authors). In the most highly-developed forms the two anterior divisions (tagmata) of the body, prosoma and mesosoma, each exhibit six pairs of limbs, pediform and plate-like respectively, whilst the metasoma consists of six limbless somites and a post-anal spine. The. genital apertures are placed in the first somite following the prosoma, excepting where a prsegenital somite, usually suppressed, is retained. Little is known of the form of the appendages in the lowest archaic Arachnida, but the tendency of those of the prosomatic somites has been (as in the Crustacea) to pass from a generalized bi-ramose or multi-ramose form to that of uni-ramose antennse, chelae, and walking-legs.

The Arachnida are divisible into two grades of structure — accord- ing to the fixity or non-fixity of the number of somites building up the body : —

Grade A {of the Arachnida) . ANOMOMEBISTICA— Extinct archaic Arachnida, in which (as in the Entomostracous Crustacea) the number of well-developed somites may be more or less than eighteen and may be grouped only as head (prosoma) and trunk or may be further differentiated. A telsonic tergal shield of greater or less size is always present, which may be imperfectly divided into well-marked but immovable tergites indicajting incompletely differ- entiated somites. The single pair of palpifbrm appendages in front of the mouth has been found in one instance to be antenniform, whilst the numerous post-oral appendages in the same genus were bi-ramose. The position of the genital

apertures is not known. Compound lateral eyes present ; median eyes wanting. The body and head have the two pleural regions of each somite fiattened and expanded on either side of the true gut-holding body-axis. Hence the name of the sub-class signifying tri-lobed, a condition realized also in the Xiphosurous Arachnids. The members of this group, whilst resembling the lower Crustacea (as all lower groups of a branching genealogical tree must do), differ from them essentially in that the head exhibits only one prosthomere (in addition to the eye-bearing prosthomere) with palpiform appendages (as in aU Arachnida) instead of two. The Anomomeristic Arachnida form a single sub-class, of which only imperfect fossil remains are known.

Sub-class (of the Anomomeristica) . TRILOBIT.^:.— The single sub-class Tf ilobitBB constitutes the grade Anomomeristica. It has been variously divided into orders by a number of writers. The greater or less evolution and specialization of the metasomatic carapace appears to be the most important basis for classification — but this has not been made use of in the latest attempts at drawing up a system of the Trilobites. , The form of the middle and lateral regions of the prosomatic shield has been used, and an excessive importance attached to the demarcation of certain areas in that structure. Sutures are stated to mark off some of these pieces, but in the proper sense of that term as applied to the skeletal structures

of the Vertebrata, no sutures exist in the chitinous cuticle of Arthropoda. That any partial fusion of originally distinct chitin- ous plates takes place in the cephalic shield of Trilobites, com- parable to the partial fusion of - bony pieces by suture in Vertebrata, is a suggestion contrary to fact. The Trilobites are known only as fossils, mostly Silurian and

appearance to the free somites. The genus Agnostus, which be- longs to the last category, occurs abundantly' in Cambrian strata and is one of the earliest forms known. This would lead to the supposition that the great development of metasomatic carapace is a primitive and not a late

character, were it not for the fact that Faradoxides and Atops, with an inconspicuous telsonic carapace

Fio. a^.—IHarthrua BecM, GreetR Dorsal view of sec- ond thoracic leg with and without setee. 6», Inner ramus ; eeei. outer ramus. (After Beecher.)

ViQ. 34, — Bestoratlon of 7^arihru8 Sficki, Green, as determined by Mr Beecher from specimens obtained from the Utlca Slates (Ordovidan), New York. A, dorsal; B, ventral surface. In theilatter the single pair of antennsB springing up from each side of the camerostome or hypostome or npper lip-lobe are seen. Four pairs of appendages besides these are seen to belong to the cephalic tergum. All the appendages are pedlform and bi-ramrose; all have prominent gnathobase, and in aU the exopodite carries a comb-like series of secondary processes. (After Beecher, from Zlttel.)

Pig. 87. — Deiplwn Forbesiif Barr.) One of the GheiruridsB. Silurian Bohemia. (From Zittel's Palaonlology.)

prse-Silurian ; a few are found in Carboniferous and Permian strata; As many as two thousand species are known. Genera with small metasomatic carapace consisting of three to six fused segments distinctly marked though not separated by soft membrane, are Harpes, Paradoxides, and Triarthrus (Fig. 34). In Calymene, Homalonotus, and Phacops (Fig. 38) from six to sixteen segments are clearly marked by ridges and grooves in the metasomatic tagma, whUst in Ilsenus the shield so formed is large but no somites are marked out on its surface. In this genus ten free somites (mesosoma) occur between the prosomatic and metasomatic cara-

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Fw. 85. — Tria/t'thrua BecM^ Green, a, Restored thoracic limbs in transverse sec- tion of the animal ; 6, section across a posterior somite ; c, section across one of the sub-terminal somites. (After Beecher.)

paces. Asaphus and Megalaspis (Fig. 39) are similarly constituted. In Agnostus (Fig. 40) the anterior and posterior carapaces con- stitute

almost the entire body, the two carapaces being connected by a mid-region of only two free somites. It has been held that the forms with a small number of somites marked in the posterior carapace and numerous free somites between the anterior and posterior carapace, must be considered as anterior to those in which a great number of posterior somites are traceable in the metaso- matic carapace, and that those in which the traces of distinct somites in the posterior or metasomatic carapace are most com- pletely absent must be regarded as derived from those in which somites' are well marked in the posterior carapace and similar in

and numerous free somites, are also Cambrian in age, the latter indeed anterior in horizon to Agnostus.

On the other hand, it may well be doubted whether the pygidial or posterior carapace is primarily due to a fusion of the

Fio. 88. — Dalma/iUUB lim- vZuruB^ Green. One of the Pbacopidffi, from the Silurian, New York. (From Zlttel.)

Fio. Z9.— Megalaspis esctenua- ius. One of the Asaphidss allied to Ilsenus, from the Ordovlcian of East Gothland, Sweden. (From Zlttel.)

tergites of somites which were previously movable and well developed. The posterior carapace of the Trilobites and of Lim- ulus is probably enough in origin a telsonic carapace — that is to say is the tfirgnm of the last segment of the body which carries the anus. From the front of this region new segments are produced in the first instance, and are added during grovrth to the existing

series. This telson may enlarge, It may possibly even become internally and stemally developed as partially separate somites, and the tergum may remain without trace of somite formation, or, as appears to be the case in Limulus, the telson gives rise to a few well-marked somites (mesosoma

and two others) and then enlarges without further trace of segmentation, whilst the chitinous integu- ment which develops in increasing thickness on the terga as growth advances welds together the unsegmented telson and the somites in ftront of it, which were previously marked by separate tergal thick- enings. It must always be remembered that we are liable (espe- cially in the case of fossilized integuments) to attach an unwarranted interpretation to the mere discontinuity or continuity of the thick- ened plates of chitinous cuticle on the back of an Arthropod. These plates may fuse, and yet the somites to which they belong may remain distinct, and each have its pair of appendages well de-

FiG. 40. — Four stages in the development of the trilohlte Agnoeius nudus. A, youngest stage with no meso- somatic somites ; B and G, stages with two mesosomatic somites between the proso- matic and teisonic carapaces ; D, adult condition, still with only two ftee mesoso- matic somites. (From Korschelt and Heider.)

veloped. On the other hand, an unusually large tergal plate, whether terminal or in the series, is not always due to fusion of the dorsal plates of once-separate somites, but is often a case of growth and enlargement of a single somite without formation of any trace of a new somite. For the literature of Trilobites see (22) .*

€h-ade B {of the Arachnida) NOMOMEIiISTIOA.—ATa,chmda in which, excluding from consideration the eye-bearing prostho- mere, the somites are primarily (that is to say, in the common ancestor of the grade) grouped in three regions of six — (a) the " prosoma " with palprCorm appendages, (6) the " mesosoma " with plate-like appendages, and (c) the "metasoma" with suppressed appendages. A somite placed between the prosoma and mesosoma — ^the prse-genital somite — appears to have belonged originally to the prosomatic series (which with its ocular prosthomere and pal- piform limbs [Pantopoda] would thus consist of eight somites), but to have been gradually reduced. In living Arachnids, except- ing the Pantopoda, it is either fused (with loss of its appendages) with the prosoma (Limulus,i Scorpio), after embryonic appear- ance, or is retained as a rudimentary, separate, detached somite in front of the mesosoma, or disappears idtogether (excalation).*

Fio. 41.— Five stages in the" development of the trilohlte Sao hirauia. A, young- est stage ; B, older stage with distinct pygidial carapace ; C, stf^e with two free mesosomatic somites between the proso- matic and teisonic carapaces ; D, stage with seven firee in- termediate somites ; E, stage with twelve free somites ; the tei- sonic carapace has not increased in size; a, lateral eye ; ff, so- called facial "suture" (not really a suture); p^ teisonic carapace. (From Korschelt and Heider, after Bar- rande.)

The atrophy and total disappearance of ancestrally well-marked somites frequently take place (as in all Arthropoda) at the pos- terior extremity of the body, whilst excalation of somites may occur at the constricted areas which often separate adjacent " regions," though there are very few instances in which it has been recognized. Concentration of the organ-systems by fusion of neighbouring regions (prosoma, mesosoma, metasoma), previously distinct, haa frequently occurred, together with obliteration of the muscular and chitinous structures indicative of distinct somites. This concentration and obliteration of somites, often accompanied

1 Mr Pocock suggests that the area marked vii. in the outline figure of the dorsal view o£ Limulus (Fig. 7) may be the tergum of the suppressed prse-genital somite. Embryologlcal evidence must settle whether this is so or not.

by dislooation of important segmental structures (such as append- ages and nerve-ganglia), may lead to highly-developed specializa- tion (individuation, H. Spencer), as in the Aranese and ()piliones, and, on the other hand, may terminate in simplification and degen- eration, as in the Acari.

The most important general change which has affected the struc- ture of the nomomeristic Arachnida in the course of their historic development is the transition from an aquatic to a terrestrial life. This has been accompanied by the conversion of the lamelliform

Fio. 42. — So-called " trilobite stage " of lAmulue poVyphmvua. A, dorsal, B, ventral view. (From Korschelt and Heider, after Leuckart.)

gill-plates into lamelliform lung-plates, and later the development from the limg-chambers, and at independent sites, of tracheae or air-tubes (by adaptation of the vasifactive tissue of the blood-vessels) similar to those independently developed in Peripatus, Diplopoda, Hexapoda, and Chilopoda. Probably trachese have developed in- dependently by the same process in several groups of tracheate Arachnids. The nomomeristic Arachnids comprise > two sub- classes— one a very small degenerate offshoot from early ancestors ; the other, the great bulk of the class.

Sub-class I (of the Nomomeristica). PANTOPODA.— Nomo- meristic Arachnids, in which the somites corresponding to meso- soma and metasoma have entirely aborted. The seventh leg-bear- ing somite (the prse-genital rudimentary somite of Eu-arachnida) is present and has its leg-like appendages fully developed. Mono- meniscous eyes vrith a double (really triple) cell-layer formed by invagination, as in the Eu-arachnida, are present. The Pantopoda stand in the same relation to Limulus and Scorpio that Cyamus holds to the thoracostracous Crustacea. The reduction of the or- ganism to seven leg-bearing somites, of which the first pair, as in so many Eu-arachnida, are chelate, is a form of degeneration con- nected with a peculiar quasi-parasitic habit resembling that of the crustacean Lsemodipoda. The genital pores are situate at the base

Fig. 4S. — One of the Nymphonomorphous Pantopoda, JNyTwphonhispidwm, show- ing the seven pairs of appendages 1 to 7 ; ab, the rudimentary opisthosoma ; a, the mouth-bearing proboscis. (From Parker and Haswell's Text-iook of Zool- ogy^ after Hoek.)

of the 7th pair of limbs, and may be repeated on the 4th, 5th, and 6th. In all known Pantopoda the size of the body is quite minute as compared with that of the limbs : the alimentary canal sends a long csBcum into each leg (c/. the Aranesa) and the genital pi-oducts are developed in gonocoels also placed in the legs.

The Pantopoda are divided into three orders, the characters of which are dependent on variation in the presence of the full num- ber of legs.

Order i (of the Pantopoda). Nymphonomorpha, Pocock (nov.) (Fig. 43). — In primitive forms belonging to the family Nymphoni- dsB the full complement of appendages is retained — ^the 1st (man- dibular), the 2nd (palpiform), and the 3rd (ovigerous) pairs being well developed in both sexes. In certain derivative forms consti- tuting the family Pallenidse, however, the appendages of the 2nd pair are either rudimentary or atrophied altogether.

Two families: 1. Nymphonidae (genus Nymphon), and 2. Pallenidae (genus Pallene).

Order 2. Ascorhynchomorpha, Pocock (nov.). — Appendages of the 2nd and 3rd pairs retained jind developed, as in the more primitive types of Nymphonomorpha ; but those of the 1st pair are either rudimentary, as in the Ascorhynchidse, or atrophied, as in the Colossendeid%. In the latter g, further specialization is shown in the fusion of the body segments.

Two families : 1. Asoorhynchidae (genera Ascarhynchus and Ammothea) ; 2. Colossendeidse (genera C'olossendeis and Disco- arachne).

Order 3. Pycnogonomorpha, Pocock (uov.)- — Derivative forms in which the reduction in number of the anterior appendages is carried farther than in the other orders, reaching its extreme in the Pyonogonidae, where the 1st and 2nd pairs are absent in both sexes and the 3rd pair also are absent in the female. In the Hannoniidse, however, which resemble the Pycnogonida in the absence of the 3rd pair in the female and of the 2nd pair in both sexes, the 1st pair are retained in both sexes.

Two families : 1. Hannoniidae (genus Hannonia) ; 2. Pycno- gonidae (genera Pycnogonum and Fhoxichilus) .

Hemarks. — The Pantopoda are not known in the fossil condition. They are entirely marine, and are not uncommon in the coralline zone of the sea^ooast. The species are few,, not more than fifty (23) . Some large

species of peculiar genera are taken at great depths. Their movements are extremely sluggish. They are especially remarkable for the small size of the body and the extension of viscera into the legs. Their structure is eminently that of degenerate forms. Many frequent growths of coralling Algae and Hydroid polyps, upon the juices of which they feed, and in some cases a species of gall is produced in Hydroids by the penetration of the larval Pantopod into the tissues of the polyp.

Sub-Class II (of the Nomomeristic Arachnida). EU-ARACH- NIDA. — These start from highly developed and specialized aquatic branchiferous forms, exhibiting prosoma with six pediform pairs of appendages, an intermediate prae-genital somite, a mesosoma of six somites bearing lamellitorm pairs of appendages, and a metasoma of six somites devoid of appendages, and the last provided with a post-anal spine. Median eyes are present, which are mono- meniscous, with distinct retinal and corneagenous cell-layers, and placed centrally on the prosoma. Lateral eyes also may be present, arranged in lateral groups, and having a single or double cell- layer beneath the lens'. The first pair of limbs is often chelate or prehensile, rarely aritenniform ; whilst the second, third, and fovirth may also be chelate, or may be simple palps or walking legs.

An internal skeletal plate, the so-called " entostemite " of fibro-cartilaginous tissue, to which many muscles are attached, is placed between .the nerve-cords and the alimentary tract in the prosoma of the larger forms (Limulus, Scorpio, Mygale). In the same and other leading forms a pair of much-coiled glandular tubes, the coxal glands (coelomodoels in origin), is found with a duct opening on the coxa of the fifth pair of appendages of the prosoma. The vascular system is highly developed (in the non-degenerate forms) ; large arterial branches closely accompany or envelop the chief nerves ; capillaries are well developed. The blood-corpuscles are large amcebiform cells, and the blood-plasma is coloured blue by haemooyanin.

The alimentary canal is uncoiled and cylindrical, and g^ves rise laterally to large gastric glands, which are more than a single pair in number (two to six pairs), and may assume the form of simple caeca. The mouth is minute and the pharynx is always suctorial, never gizzard-like. The

gonadial tubes (gonoccels or gonadial coelom) are originally reticular and paired, though they may be reduced to a simpler condition. They open on the first somite of the mesosoma. In the numerous degenerate forms simplification occurs by obliteration of the demarcations of somites and the fusion of body-regions, together with a gradual suppression of the lamelliferous respiratory organs and the substitution for them of tracheae, which, in their turn, in the smaller and most reduced members of the group, may also disappear.

The Eu-araciinida are divided into tjwo grades with reference to the condition of the respiratory organs as adapted to aquatic or terrestrial life.

G-rade a (of the Eu-arachnida). delobkanchia (Hydropneustea).

Mesosomatic segments furnished with large plate-like appendages, the 1st pair acting as the genital operculum, the remaining pairs being provided with branchial lamellae fitted for breathing oxygen dissolved in water. The prae-genital somite partially or wholly obliterated in the adult. The mouth lying far back, so that the basal segments of all the prosomatic appendages, excepting those of the 1st pair, are capable of acting as masticatory organs. Lateral eyes consisting of a densely-packed group of eye-units ("com- pound" eyes).

Order i. Xiphosura. — ^The prae-genital somite fuses in the embryo with the prosoma and disappears (see Pig. 19) . Not free-swimming,

none of the prosomatic appendages modified to act as paddles ; segments of the mesosoma and metasoma (=opisthosoma) not more than ten in number, distinct or coalesced. Family — Limulidse (^Limulus)

,, Belinuridae (^Belinurus, Aglaspis, Prestwichia). „ Hemiaspidse {Hemiaspis, Bunodes). Bemarks. — The Xiphosura are marine in habit, frequenting the shore. They are represented at the present day by the single genus Limulus (Figs. 44 and 45 ; also Figs. 7, 9, 11, to 16 and 20), which

FiQ. 44.— Dorsal view of lAmAiMe

Pia. 48. — Ventral yiemai lAmaVaa poVyphemue, one-fourtli the natural size, linear. 1 to 6, the six prosomatic pabs of appendages ; abd, the solid opisthosomatio carapace ; UU, the post-anal spine (»o< the telson as the lettering would seem to imply, but only its post-anal portion) ; ooero, the fused first pair of mesosomaUo appendages forming the genital operculum. (From Parker and Haswell, Teatr book of Zoology, after Leuckart.)

occurs on the American coast of the Atlantic Ocean, but not on its eastern coasts, and on the Asiatic coast of the Pacific. The Atlantic

species (Z. polyphemus) is common on the coasts of the United States, and is known as the King-crab or Horse-shoe Crab. A single specimen was found in the harbour of Copenhagen in the 18th century, having presumably been carried over by a ship to which it clung.

A species of Limulus is found in the Buntersandstein of the Vosges ; L. "Walchi is abundant in the Oolitic lithographic slates of Bavaria.

The genera Belinurus, Aglaspis, Prestwichia, Hemiaspis, and Buuodes consist of small forms which occur in Palaeozoic rocks. In none of them are the appendages known, but in the form of the two carapac'es and the presence of free somites they are distinctly Intermediate between Limulus and the Trilobitae. The young form of Limulus itself (Mg. 40) is also similar to a Trilobite so far as its segmentation and trilobation are concerned. The lateral eyes of Limulus appear to be identical in structure and position with those of certain Trilobitse.

Order 2. Gigantostraca (Figs. 46, 47). — Free-swimming forms, with the appendages of the eth or 5th and 6th pairs flattened or

Fis. 46. — EarypUma FUcheri, Eichwald. Sllarian of Bootzlkll, Bestoratlon after Schmictt, half the size of nature. The dorsal aspect is presented show- ins the prosomatic shield with paired componnd eyes and

the prosomatlc appendages II to VI. The small first pair of appendages is concealed from view by the carapace. 1 to 12 are the somites of the opisthosoma ; 13, the post-anal spine. (Fi-om Zittel's TeaM)ook of Paloeontology. Maomillans, New York, 1896.)

lengthened to act as oars ; segments of mesosoma and metasoma

(= opisthosoma), twelve in number."

Appendages of anterior pair very large and chelate.

Sub-order Pterygotomorpha, Pterygotidse {Fterygotua). Appendages of anterior pair minute and chelate.

f StylonuridsB {Stylonurus). Sub-order Eurypteromorpha i. Eurypteridae {Eurypterus,

(. Slimonia). Bemarks. — ^The Gigantostraca are frequently spoken of as " the Eurypterine." Not more than thirty species are known. They became extinct in i'alaeozoic times, and are chiefly found in the Upper Silurian,though extending upwards as far as the Carboniferous. They may be regarded as ' ' macrourous ' ' Xiphosura ; that is to say, Xiphosura in which the nomomeristic number of eighteen well- developed somites is present and the posterior ones form a long tail-like region of the body. There still appears to be some doubt whether in the sub order Eurypteromorpha the first pair of prosomatic appendages (Eig. 46) is atrophied, or whether, if present, it has the form of a pair of tactile palps or of minute chelae. Though there are indications of lamelliform respiratory appendages on mesosomatic somites foUovsing that bearing the genital operculum, we cannot be said to have any proper &ow

ledge as to such appendages, and further evidence with regard to them is much to be desired. (For literature see Zittel, 22.)*

Fig. 47. — Ptwygotiia osHiefWia^ Schmidt. 8Uurian of Bootziklll. Bestoration of the yenual surface, one-third the natural size, after Schmidt, a, cameroBtome or epistoma ; m, chilarium or metastemite of the prosoma (so-called metastoma); oo^ the compound eyes; 1 to 8,

segments of the sixth prosomatic appendage; I' to V, first fire opisthosomatic somites; 7', sixth opisthosomatic somite. Oberre the powerml gnathobases of the sixth pair of prosomatic limbs and the median plates behind m. The dotted Une on somite I indicates the position of the genital operculum which was probably provided with branchial lamellse. (From Zittel's Pala- owtology.)

Grade 6 (of the Eu-araehnida), embolobrahchia (Aeropneustea).

Li primitive forms the respiratory lamellse of the appendages of the 3rd, 4th, 5th, and 6th, or of the 1st and 2nd mesosomatic somites are sunk beneath the surface of the body, and become adapted to breathe atmospheric oxygen, forming the leaves of the

Fio. 48.— Dorsal view of a restoration of Pal

so-called lung-books. In specialized forms these pulmonary sacs are wholly or partly replaced by tracheal tubes. The appendages of the mesosoma generally suppressed ; in the more primitive forms one or two pairs may be retained as organs subservient to repro- duction or silk-spinning. Mouth situated more forwards than in Delobranchia, no share in mastication being taken by the basal

segments of the 5th and 6th pairs of prosomatic appendages. Lateral eyes, when present, represented by separate ocelli.

The prse-genital somite, after appearing in the embryo, either is obliterated (Scorpio, Galeodes, Opilio, and others) or is retained as a reduced narrow region of the body, the " waist," between prosoma and mesosoma. It is represented by a full-sized tergal plate in the Pseudo-scorpiones. .

Section a. Pectinifera. — The primitive distinction between the mesosoma and the metasoma retained, the latter consisting of six somites and the former of six somites in the adult, each of which is furnished during growth with a pair of appendages. Including the prsB-genital somite (Kg. 16), which is suppressed in the adult, there are thirteen somites behind the prosoma. The appendages of the 1st and 2nd mesosomatic somites persisting as the genital operculum and pectones respectively, those of the 3rd, 4th, 5th, and 6th somites (? in Palceophonus) sinking below the surface during growth in connexion with the formation of the four pairs of pulmonary sacs (see Fig. 17). Lateral eyes monostichous.

Order i. Scorpionidea. — Prosoma covered by a single dorsal shield, bearing typically median and lateral eyes ; its sternal elements reduced to a single plate lodged between or behind the basal segments of the 5th and 6th pairs of appendages. Append- ages of 1st pair tri-segmented, chelate ; of 2nd pair chelate, with their basal segments subserving mastication ; of 3rd, 4th, 5th, and 6th pairs similar in form and function, except that in recent

Fio. 49. — Ventral ~~view of a restoratloii otPalwopTiOivus Sunteri, Pooock, the Silu~~ rian Scorpion from Le&ma- hago, Scotland. Bestored by Mr E. I. Pocock. The meet- ing of the coxee of all the prosomatic limbs in front of the pentagonal sternum ; the space for a genital operculum ; the pair of pectens, and the absence of any evidence of pulmonary stigmata are noticeable in this specimen. (See Pocock, Quart. Jour. Mior. Sci. 1901.)

and Carboniferous forms the basal segments of the 3rd and 4th are provided with sterno-coxal (maxillary) lobes, those of the 4th pair meeting in the middle line and underlying the month. The five posterior somites of the metasoma constricted to form a ” tail,” the post-anal sclerite persisting as a weapon of ofEenoe and pro- vided with a pair of poison glands (see Figs. 8, 10, 12, 13, 14, 15, 21, and 22).

Sub-order Apoxypoda. — The 3rd, 4th, 5th, and 6th pairs of appendages short, stout, tapering, the segments about as wide as long, except the apical, which is distally slenden, pointed, slightly curved, and without distinct movable claws.

Family— Palaeophonidse, Palaeophonus (Figs. 48 and 49). Sub-order Dionychopoda.— The 3rd, 4th, 5th, and 6th pairs of appendages slender, not evenly tapering, the segments longer than wide ; the apical segment short, distally truncate, and provided with a pair of movable claws. Basal segments of the 6th and 6th pairs of appendages abutting against the sternum of the prosoma (see Fig. 10 and Figs. 51, 52, and 53).

Family — Pandinidse (Pandinus, Opisthophthalmus,Urodacus).

,, Vejovidse (^VcBjovis, Jurus, Euscorpius, Broteas).

,, Bothriuridse (^Bothriurus, Cercophonius).

,, ButhidsB (Buthus, Oentrurus).

*,, *Cyo\o^h.th.sXra\&?s {Cyclophthalmus) "tCarbon-*

*,, *EoscorpiidaB {Eoscorpius, Centromachus^ j iferous. Bemarks on the Order Scorpionidea. — The Scorpion is one of the great animals of ancient lore and tradition. It and the crab are the only two invertebrates which had impressed the minds of early men sufflciently to be raised to the dignity of astronomical representation. It is all the more remarkable that the scorpion proves to be the oldest animal form of high elaboration which has persisted to the present day. In the Upper Silurian two specimens of a sconiioii have been found (Figs. 48, 49), one in Gothland and one in Scotland, which would be recognized at once as true*

scorpions by a child or a savage. The Silurian scorpion, Palmo- phonus, differs, so far as obvious points are concerned, from a modern scorpion only in the thickness of its legs and in their terminating in strong spike-like joints, instead of being slight and provided with a pair of terminal claws. The legs of the modern scorpion (Fig. 10 : Fig. 51) are those of a terrestrial Arthropod, such as a beetle ; whilst those of the Silurian scorpion are the legs of an aquatic Arthropod, such as a crab or lobster. It is probable that

Fio. 60. — Comparison of the sixth prosomatic limb of a recent Scorpion (B), of Palaeophonus (C), and of Limulus (A), show- ing their agreement

in the number of segments ; in the existence of a mov- able spine, Sp, at the distal border of the fifth segment ; in the corre- spondence of the two claws at the free end of the limb of Scorpio with two spines similarly placed in Limulus ; and lastly, in the correspond- ence of the three talon-like spines carried on the distal margin of segment six of recent Scorpions with the four larger but similarly situated spines on the leg of Limulus ; e, groove dividing the ankylosed segments 4 and 6 of the Limulus leg into two. (After Pooock, Q. J. Mia. &i. 1901.)

the Silurian scorpion was an aquatic animal, and that its respiratory lamellae were still projecting from the surface of the body to serve as branohise. No trace of "stigmata," the orifices of the lung- chambers of modern scorpions, can be found in the Scottish speci- men of PalsBophonus, which presents the ventral surface of- the animal to view. On the other hand, no trace of respiratory appendages excepting the pectens can be detected in the specimen (see Fig. 49).

Fossil scorpions of the modem type are found in the Coal Measures. At the present day scorpions of various genera are found in all the warm regions of the world. In Europe they occur as far north as Bavaria and the south of France. The largest species measure

Fig. B1. — Drawing from life of the desert Scorpion, Buthus australis, Lin., from Biskra, N. Africa. (From Lankester, Journ. Linn. Soe. Zool. vol. xvl.

1881.)

9 inches from the front of the head to the end of the sting; and qcour in "> tropical India and Africa. Between 200 and 300 species are known. The scorpions use their large chelae for seizing prey and for fighting with one another. They never use the sting when (as frequently happens) they attack another scorpion, because, as was ascertainedby A. G. Bourne (24), the poison exuded by the sting has no injurious effect on another scorpion nor on th e scorpion itself. The stories of a scorpion stinging itself to death when placed in a circle of burning coals are due to erroneus observation. "When placed in such a position the scorpion faints and becomes inert. It is found (Bourne, 24) that some species of scorpion

faint at a temperature of 40° cent. They recover on being removed to cooler conditions. A scorpion having seized its prey (usually a large insect, or small reptile or

*mammal) -with the large ohelss brings its tail over its head, and deliberately punctures the struggling yiotim twice with its sting (Fig. 52). The poison of the sting is similar to snake-poison (Calmette), and rapidly paralyses animals which are not immune to it. It is probably only sickly adults or young children of the human race who can be actually killed by a scorpion's sting. When the scorpion has paralysed its prey in this way, the two short cheliceras are brought into play (Fig. 53) . By the crushing action of their pincers, and an alternate backward and forward movement, they bring the soft blood-holding tissues of the victim close to the minute pin-hole aperture *rhich is the scorpion's mouth. The muscles acting on the bulb-like pharynx now set up a pumping action (see Huxley, 26); and the juices — but no solid matter, excepting such as is*

reduced to pbwder — are sucked into the scorpion's alimentary canal. A scorpion appears to prefer for its food another scor- pion, and will suck out the juices of an individual as large as itself. When this has taken place, the gorged scorpion be- comes distended and tense in Pre. 52.— Drawing from Ufe of the Italian the mesosomatic region. It is Scorpion Mmcorpius italioug, Herbst, certain that the absorbed juices holdingablue-bottlefly with its left chela, J r, „. nppiinv t>ip nlimpTitarv and careftiUy piercing it between head and ^° °° Occupy tne alimentary thorax with its sting. Two Insertions of canal alone, but pass also mtO the sting are effected and the fly is in- its CSSCal ofE-sets, which are the stantly par^ysed by the poison so Intro- ^^^tg ^f the gastric glands (see duced into its body. (From Lankester, ^ „a\ s””””^” 6””””= v.”””*

Jotim. Linn. Soc.) ^^S- o”)-

All Arachnida, including Lim- ulus, feed by suctorial action in essentially the same way as Scorpio. Scorpions of various species have been observed

to make a hissing noise when disturbed, or even when not disturbed. The sound is produced by stridulating organs developed on the basal joints of the limbs, which differ in position and character in different genera (see Pooock, 27). Scorpions copulate with the ventral surfaces in contact. The eggs are fertilized, practically in the ovary, and develop ire situ. The young are bom fully formed and are carried by the mother on her back. As many as tHrty have been counted in a brood. For information as to the embryology of scorpions, the reader is re- ferred to the works named in the bibliography below. Scorpions do not possess spinning organs nor form either snares or nests, so far as is known. But some species inhabiting sandy deserts form extensive burrows. The fifth pair of prosomatic appendages is used by these scorpions when burrowing, to kick back the sand as the burrow Is excavated by the great chelee.

References to works dealing with the taxonomy and geographical distribution of scorpions are given at the end of this article (28).

Section p. Epectinata. — The primitive distinction between the mesosoma and the metasoma wholly or almost wholly obliterated, the two regions uniting to form an opis- thosoma, which never consists of more than twelve somites and never bears appendages or breathing-organs behind the 4th somite. The teeathing-organs of the opisthosoma, when present, re- presented by two pairs of stigmata, opening either upon the 1st and 2nd (Pedipalpi) or the 2nd and 3rd somites (SolifugsB, Pseudo-scorpiones), or by a single pair upon the 3rd (? 2nd) somite (Opiliones) of the opisthosoma, there being rarely an additional stigma on the 4th (some Solifugse). The append- ages of the 2nd somite of the opis- thosoma absent, rarely minute and bud- like (some Amblypygi), never pectini-form. A prsB-genital somite is often present either in a reduced condition forming a waist (Pedipalpi, Aranese, Palpigradi) or as a full-sized tergal plate (Pseudo-scorpiones); in some it is entirely atrophied (Solifugas, Holo- somata, and Khynchostomi). Lateral Fio, eyes when present diplostiohous.

iJemarifcs.-^The Bpectinate Arachnids do not stand so close to the aquatic ancestors of the Embolobranchia as do the Pectiniferous scorpions. At the same time we are not justified in supposing that the

scorpions stand in any way as an intermediate grade between any of the existing Epectinata and the Delobranchia. It is probable that the Pedipalpi, Araneae, and Podogona have been separately evolved as distinct lines of descent from the ancient aquatic Arachnida. The Holosomata and Khynchostomi are probably ofi-shoots from the stem of the Aranese, and it is not unUkely (in view of the

- The same Scorpion carrying the now paralysed fly held in its cheUcerss, the chelse liberated for attack and defence. Drawn from life. (From Lan- kester, Jov/m. Li/wfi. Soc.)

structure of the prosomatic somites of the Tartarides) that the Solifugae are connected in origin with the Pedipalpi. The appear- ance of trachesB in place of luug-saos cannot be regarded as a start- ing-point for a new line of descent comprising all the tracheate forms ; tracheae seem to have developed independently in different lines of descent. On the whole, the Epectinata are highly special- ized and degenerate forms, though there are few, if any, animals which surpass the spiders in rapidity of movement, deadliness of attack, and constructive instincts.

Order 2. Pedipalpi (Figures 54 to 69). — Appendages of 1st pair bisegmented, without poison gland ; of 2nd pair prehensile, their basal segments underlying the proboscis, and furnished with

Fig. 64. — ThelyplnynAis, one of the Pedipalpi. A, ventral view; I, chellcera (detached); II, chelae; III, palpiform limb; IV to VI, the walking legs; etc, sterno-coxal process (gnathobase) of the chelae ; s^, anterior sternal plate of the prosoma ; 8^, posterior sternal plate of the prosoma ; preg&n, position of the prce- genital somite (not seen): I, l, position of the two pulmonary sacs of the right side ; 1 to 11, somites of the opisthosoma (mesosoma plus metasoma) ; ms^, stig- 'mata of the tergo-sternal muscles ; an. anus. B, dorsal view of the opisthosoma of the same ; preg&n, the prae-genital somite ; «, the tergal stigmata of the tergo- stemal muscles ; paf^ post-anal segmented filament corresponding to the post- anal spine of Llmulus. (From Lankester, Q. J. Mia. Sd. N.S. vol. xxl. 1881.)

stemo-coxal (maxillary) process, the apical segment tipped with a single movable or immovable claw; appendages of 3rd pair different from the

remainder, tactile in function, with at least the apical segment many-jointed and clawless. The ventral surface of the prosoma bears prosternal, metasternal, and usually mesosternal chitine-plates (Fig. 55). A narrow prse-genital somite is present between opisthosoma and prosoma (Figs. 55, 67). Opisthosoma consisting of eleven somites, almost wholly without visible appendages. Intromittent organ of male beneath the genital operculum (= sternum of the 1st somite of opisthosoma).

Fig. 55. — Thelyphomis «p. Ventral view of the anterior portion of the bodj^ to show the three prosomatic sternal plates a, h, c, and the rudi-mentary sternal element of the prae-genital somite ; opisth 1, first somite of the opistho- soma. (From a drawing made by Mr Plckard – Cambridge, under the direction of Mr B. I. Pocock.)

opisth 1 "■'

Note. — The possibility of another interpretation of the an- terior somites of the mesosoma and the prse-genital somite must be borne in mind. Possibly, though not probably, the somites carrying the two lung -sacs correspond to the .first two lung-bearing somites of Scorpio, and it is the genital opAiing which has shifted. The same caution applies in the case of the Aranese. Excalation of one or of two anterior mesosomatic somites, besides the prse-

genital somite, would then hive to be supposed to have occurred also.

Suh-order a. Uropygi. — ^Prosoma longer than wide, its sternal area very narrow, furnished with a large prosternal and meta- stemal plate, and often with a small mesosternal sclerite. Append- ages of 2nd pair with their basal segments united in the middle line and incapable of lateral movement ; appendages of 3rd pair with only the apical segment many-jointed. Opisthosoma without trace of appendages ; its posterior somites narrowed to form

epistho 2

m.

Fig. 66. — Thebyphowas aasam&ieis c^. Ventral surface of the anterior region of the opisthoaoD^a, the first somite being pushed upwards and forwards so as to expose the subjacent structures, opiotho 1, First samite of the opisthosoma ; opintho % second do. ; g, genital aperture ; I, edges of the lamellie of the lung- books ; m, stigmata of tergo-sternal muscles. (Original drawing by Mr Pocock.)

a movable tail for the support of the post-anal sclerite, which has no poison glands.

Tribe 1. Urotricha. — Dorsal area of prosoma covered with a single shield (^ t-wo in Qeralinurd), bearing median and lateral eyes. Post-anal sclerite modified as a long, many-jointed feeler. Appendages of 2nd pair folding in a horizontal plane, completely chelate, the claw immovably united to the sixth segment. Re- spiratory organs present in the form of pulmonary sacs,

*Family — Thelyphonidae (Thelyphonus (Fig. 54), *Geralinura).*

Tribe 2. Tartarides. — Small degenerate forms with the dorsal area of the prosoma furnished with two shields, a larger in front

gen

11 opisih”^’

Pig. ST. — ScMsomus eraaai- ccmdatua, one of the Tar- ‘ tarid Pedipalpi. Ventral view of a female with the append- ages cut short near the base, a, Frostemum of prosoma ; &, nletastemum of prosoma; prc^gm,, the prae-genital somite ; 1 opisth, first somite of the opisthosoma ; U opiathj eleventh somite of the opisthosoma; pa^ post-anal lobe of the female (compare the jointed filament in TKeVg- phorms, Fig. 64). (Original drawing by Mr Plckard- Cambridge, directed by Mr Pocock.)

Fig. 58. — SaMeonma eraa- aiecmdatua, a Tartarid Pedi- palp. Dorsal view of a male with the appendages cut short. 1 to VT, the proso- matic appendages ; a, anterior plate, and &, posterior plate of the prosomatic carapace ; prce-gen, tergum of the prse-

. genital somite; 11, the eleventh somite of the opistho- soma ; pa, post-anal lobe of the male— a conical body with narrow basal stalk. (Original as above.)

covering the anterior four somites, and a smaller behind covering the 5th and 6th somites ; the latter generally subdivided into a right and left portion ; rarely there is a pair of narrow sclerites interposed between the anterior and posterior shields. Eyes evanescent or absent. Appendages of ^ 2nd pair folding in a ver- tical plane, not chelate, the claw long and movable. Fost-anal sclerite short and undivided. No distinct respiratory stigmata behind the sterna of the 1st and 2nd somites of the opisthosoma.

Family — Hubbardiidse (^Schisomus, Huhbardia) (Figs. 57-59).

Sub-order 6. AmblypygL — ^Prosoma wider than long, covered

above by a single shield bearing, median and lateral eyes, which have diplostichous ommatea. Sternal area broad, with prosternal, two mesosternal, and metasternal plates, the presternum project- ing forwards beneath the coxae of the 2nd pair of appendages. Appendages of 2nd pair folding in a horizontal plane ; their basal segments freely movable ; claw free or fused ; basal segments of 4th and 5th pairs widely separated, by the sternal area ; appendages of 3rd pair with all the segments except the proximal three, form- ing a many-jointed flagellum. Opisthosoma without post-anal

Fig. W.—Sahieomns craaaiccmdatua, one Of the Pedipalpi. Lateral view of a male. 11 to VL the prosomatic appendages, the first being concealed (see Fig. 68) ; 6, the fifth, and 11, the eleventh tergites of the oplsi£oBoma ; pa, the conical post-anal lobe. (Original as above.)

sclerite and posterior caudal elongation : with frequently a pair of small lobate appendages on the sternum of the 3rd somite. Re- spiratory organs,

as in Urotricha.

Family — Phrynichidae (Phrynichus, Damon). ,, Admetidse {Admetus, JSeterophrynug). „ Charontidse {Charon, Sarax). (Family ?) — •Geraphrynus. Remarks. — ^The Pedipalpi are confined to the tropics and warmer temperate regions of both hemispheres. , Fossil forms occur in the Carboniferous. The small forms knovm as Schizomus and Sub-bardia are of special interest from a morphological point of view. The Pedipalpi have no poison glands. (Reference to literature

(29).)

Order 3. Araneae (Figs. 60 to 64). — Prosoma covered with a single shield and typically furnished with median and lateral eyes of diplostichous structure, as in the Amblypygi. Its sternal surface wide, continuously chitinized, but with prosternal and

Fig. m.—lApMahus deaulior, SchiOdte, one of the Araneoe Mesothete. Dorsal view I to VI, the prosomatic appendages ; 4,5, 6, the fourth, fifth, and sixth tergites of the opisthosoma. Between the bases of the sixth pair of limbs and DehlJid tlie prosomatic carapace is seen the tergite of the small nrffi-eenital somite. (Origmal bf Pickard-Oambridge and Pocock.)

metasternal elements generally distinguishable at the anterior and posterior ends respectively of the large mesostemum Pro- sternum underlying the proboscis. Appendages of 1st pair have two segments, as in Pedipalpi, but are furnished with poison gland, and are retroverts. Appendages of 2nd pair not underlying the mouth, but freely movable and, except in primitive forms fur- nished with a maxillary lobe ; the rest of the limb like the legs, tipped with a single claw and quite unmodified (except In |)

Remaning pairs of appendages similar in form and function, each tipped - with two or tliree claws. Opisthosoma when segmented showing the same

number of somites as in the Pedipalpi ; usually imsegmented, the prse-genital somite constricted to form the waist ; the appendages of its 3rd and 4th somites retained as spinning mammillae. Respiratory organs (see Fig. 63, stg) , as in the Ambly- pygi, or with the posterior pair, rarely the anterior pair as well, replaced by tracheal tubes. Intromittent organ of male in the apical segment of the 2nd prosomatic appendage. _ Sub-order a. Mesothelae (see Figs. 60 to 62).— Opisthosoma dis- tinctly segmented, furnished with 11 tergal plates, as in the Ambly- pygi ; the ventral surface of the 1st and 2nd somites with large sternal

I—M

*Fis. 6i.—LiphiBtiu« deaultor. Ventral view with the prosomatio appendages cut short , excepting the chelicerae (1) whose sharp retrorerts are seen. Between the bases of the prosomatic limbs an anterior and a posterior sternal plate (black) are seen. 1, the sternum of the first opisthosomatic or genital somite covering the genital aperture and the first pair of lung-sacs. In ft*ont of it the narrow waist is formed by the soft sternal area of the prse-genital somite ; 2, the sternite of the second opisthosomatic somite covering the posterior pair of lung-sacs ; S and 4, the spinning appendages (limbs) of the opis- thosoma ; a, inner, &, outer ramus of the appendage; 11, sternite of the eleventh somite of the opisthosoma : in tcont of it other rudimentary sternites; an^ anus. (Original as above.)*

plates, covering the genital aperture and the two pairs of pulmonary sacs, the sternal plates from the 6th to the 11th somites repre- sented by integumental ridges, weakly chitinized in the middle. The two pairs of spinning appendages retain their primitive position in the middle of the lower surface of the opisthosoma far in advance of the anus on the 3rd and 4th somites, each appendage consisting of a stout, many-jointed outer branch and a slender, unsegmented inner branch. Prosoma as in the Mygalomorphae, except that the mesosternal area is long and narrow.

*Family — ^Liphistiidee (^Liphistius, *Arthrolycosa).*

Sub-order 6. Opisthothelse (see Fig. 63). — Opisthosoma without trace of separate terga and sterna, the segmentation merely repre- sented

posteriorly by slight integumental folds and the sterna of the 1st and 2nd somites by the opercular plates of the pulmonary sacs. The spinning appendages migrate to the posterior end of the opisthosoma and take up a position close to the anus ; the inner branches of the anterior pair either atrophy or are represented homogenetically by a plate, the cribellum, or by an undivided membranous lobe, the oolulus.

Tribe 1. Mygalomorphse. — The plane of the articulation of the appendages of §ie 1st pair to the prosoma (the retrovert) vertical, the basal segment projecting straight forwards at its proximal end, the distal segment or fang closing backwards in a direction sub- parallel to the long axis of the body. Two pairs of pulmonary sacs.

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11

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I 11 HE IV V VI I . i . j

Prosoma t 5 l I l

pne-gen 12 8 4

Fio. t2.—Zdphiaiiu3 desuUor. Lateral view. I to VI, appendages of the prosoma cut off at the base ; o, ocular tubercle ; pra-gen, the prie-genital somite ; 1 and 2, sternites of the first and second opisthosomatic somites ; 8 and 4, appendages of the third and fourth opisthosomatic somites, which are the spinning organs, and in this genus occupy their primitive position instead of migrating to the anal region as In other spiders ; 6, tergite of the fifth opisthosomatic somite; 11, eleventh opisthosomatic somite; an, anus. (Original.)

Families — TheraphosidsB(4i)icMtoia, Pcecitoi^ena) . Barychelidse (Barychelus, Plagiobothrus). Dipluridae {Diplum, Macrothele). Ctenizidae {Cteniza, Nemesia). Atypid {Atypus, Calommatd).*

Tribe 2. Arachnomorphse. — The plane of the articulation of the appendages of the 1st pair to the prosoma horizontal, the basal segment projecting vertically downwards, at least at its proximal end, the distal segment or fang closing inwards nearly or quite at right angles to the long axis of the body. The posterior pulmonary sacs (except in Mypochilus) replaced by tracheal tubes ; the anterior and posterior pairs replaced by tracheal tubes in the Caponiidse.

Principal families— Hypochilidse (Bypochilus). Dysderidse (Dys- dera Segestria). baponiidse ((7apo«ia, Nops). Filistatid8B(j;YZistofa). Ulob'oridEB (Uloborus, DUopis). ArgiapidK (Nephila, Qasteracan- thd) Pholcidae (Fholcus, Artema). Agelenidse {Tegenaria).

LycosidsB (Lycosa). Clubionidse (Olubiona, Olios, Sparassus). Gnaphosidae (Gnaphosa, Hemiclma). Thomisidse {Thomisus). Attidae (^Salticus). Urocteidse {Uroctea). Eresidse (JEresus).

Bemarks on the Aranece. — The Spiders are the most numerous and diversified group of the Arachnida ; about 2000 species are known. No noteworthy fossil spiders are known ; the best pre- served are in amber of Oligocene age. Protolycosa and Arthroly- cosa occur in the Carboniferous. Morphologically, the spiders are

Fio. 68.— Ventral view of a male inygalomorphous Spider. I to VI, the six pairs of prosomatic ap- pendages ; a, copulatory apparatus of the second appendage ; b, process of the fifth joint of the third appendage; M, mouth; pro, prosternite of the prosoma ; mes, mesoster- nite of the prosoma : observe the contact of the coxes of the sixth pair of limbs behind it ; compare Llphistlas (Fig. 61) where this does not occur; atg, lung aperture ; gn, genital aperture ; a, anus with a pair of bacfcwardly mi- grated spinning append- ages on each side of it ; compare the position of these appendages in Liphistius (Fig. 61). (From Lankester, "Li- mulus an Arachnid.")

remarkable for the concentration and specialization of their structure, which is accompanied with high physiological efficiency. The larger species of Bird's Nest Spiders (Avicularia), the opisthosoma of which is as large as a bantam's egg, undoubtedly attack young birds, and M'Cook

gives an account of the capture in its web by an ordi- nary house spider of a small mouse. The ‘ ‘ retrovert ‘ ‘ or bent-back first pair of appendages is provided with a poison gland opening on the fang or terminal segment. Spiders form at least two kinds of constructions — snares for the capture of prey and nests for the preservation of the young. The latter are only formed by the female, which is a larger and more powerful animal than the male. Like the scorpions the spiders have a special tendency to can- nibalism, and accordingly the male, in approaching the female for the purpose of fertilizing her, is liable to be fallen upon and sucked

Fis. 64. — UpMaUus deeultor. Under side of the uplifted genital or first opisthosomatic somite of the female; g, genital aperture; p, pitted plate, probably a gland for the secretion of adhesive material for the eggs ; \ the edges of the lamelles of the lung-books of the first pair. (Original drawing by Pooook.)

dry by the object of his attentions. The sperm is removed by the male from the genital aperture into a special receptacle on the terminal segment of the 2nd prosomatic appendage. Thus held out at some distance from the body, it is cautiously advanced by the male spider to the genital aperture of the female.

For an account of the courtship and dancing of spiders, of their webs and floating lines, the reader is referred to the works of M’Cook (30) and the Peckhams (31), whilst an excellent account of the nests of trap-door spiders is given by Moggridge (32) . References to systematic works wiU also be found at the end of this article (38).

Order 4. PaIpigradi=Microthelyphonida(seeFig. 65). — Prosoma covered above by three plates, a larger representing the dorsal ele- ments of the first four somites, and two smaller representing the dorsal elements of the 5th and 6th.

Its ventral surface provided vrith one prosternal, two meso- Bternal, and one metasternal plate. Appendages of 1st pair con- sisting of three segments, completely chelate, without poison gland ; of 2nd pair slender, leg-like, tipped with three claws, the

IIIIIITVTI Proaoma

Fig. 65. — KoMiervia Tn^abiUa^ Grass! one of the Palpigradi. A, ventral view of prosoma and of anterior region of oplsthosoma with the appendages cut off near the base ; a and A, prosternites ; c, mesoBternite ; and d, metastfflr- nlte of the prosoma ; /, Tentral surface of the prse-genital somite ; g, Bternite of the genital somite (first opisthosomatic somite). B, dorsal yievr. 1 to YI, proBomatio appendages ; 1 o^sih, genital somite (first opisthoso- matic somite). C, lateral view. 1 to VI, prosomatic appendages : a, &, c, the three tergal plates of the prosoma; prm-g&n, the prse-genital somite; 1 to 10, the ten somites of the oplsthosoma, B, chelicera. (Original drawing by Focock and Flckard-Cambridge, after Hansen and Sorensen.)

basal segment without stemo-cozal process taking no share in mastication, and widely separated from its feUow of the opposite side ; 3rd, 4th, 6th, and 6th appendages similar in form to the 2nd and to each other.

Proboscis free, not supported from below by either the presternum or the basal segments of the appendages of the 2nd pair.

Oplsthosoma consisting of only ten somites, which have no tergal and sternal elements, the prse-genital somite contracted to form a "waist," as in the Pedipalpi ; the last three narrowed to form a caudal support for the many-jointed flagelliform telson, as in the Urotricha. Eespiratory organs atrophied. Family — Koeneniidse (icemema).

Bemarks. — An extremely remarkable minute form originally described by Grassi (34) from Sicily, and since further described by Hansen (35). Recently the genus has been found in Texas, U.S.A. Only one genus of the order is known.

Order 6. SolifugaB=Mycetophor8e (see Kgs. 66 to 69).— Dorsal area of prosoma covered with three distinct plates, two smaller representing the terga of the 5th and 6th somites, and a larger representing those of the anterior four somites, although the reduced terga of the 3rd and 4th are traceable behind the larger plate. The latter bears a pair of median eyes and obsolete lateral eyes on each side. Sternal elements of prosoma almost entirely absent, traces of a presternum and metastemum alone remaining. Rostrum free, not supported by either the presternum or the basal segments of the appendages. Appendages of Ist pair large, chelate, bisegmented, articulated to the sides of the head-shield ; appendages of 2nd pair simple, pediform, with protrusible (? suc- torial) organ, and no claws at the tip ; their basal segments united in the middle line and furnished with stemo-ooxal process. Remain- ing pairs of appendages with their basal segments immovably fixed to the sternal surface, similar in form, the posterior three pairs furnished with two claws supported on long stalks ; the basal segments of the 6th pair bearing five pairs of tactile sensory organs or malleoli. The prse-genital somite is suppressed. Opisthosoma composed of ten somites. Eespiratory organs tracheal, opening upon the ventral surface of the 2nd and 3rd, and sometimes also of the 4th somite of the opisthosoma. A supplementary pair of

tracheae opening behind the basal segment of the 4th appendage of the prosoma.

(? Intromittent organ of male lodged on the dorsal side of the 1st pair of prosomatic appendages.)

ramilies — Hexisopodidse (JHexisopus). Solpugidse (Solpuga, Shagodes). Galeodidse (^&aleodes).

Pia. e6. — 6aleodea, tp., one of the Solifagee. Ventral view to show

. legs and somites. I to Yl, the six leg-beuing somites of the prosoma; opisth 1, first or genital somite of the opistho- soma ; ^fi,"site of the gen- ital aperture ; at, thoracic tracheal aperture; 2, an- terior tracheal aperture of the opisthosoma in somite 2 of the opistho- soma ; /B, tracheal aper- ture in somite 8 of the opisthosoma ; a, anus. (Prom Lankester, "Lim- uluB an Arachnid.")*

FiQ. 67. — Galeodea,

Fio. 68. — Saleodea, ap., one of the Bolifugae. Dorsal view. I to YI, bases of the prosomatic ap- pendages ; 0, eyes ; a, lateral region of the cephalic plate to which the first pair of append- ages are articulated ; b, cephalic plate with median eye ; c, dorsal element of somites bearing third and fourth pairs of appendages ; d, second plate of the prosonoa with fifth ^ pair of appendages ; », third or hindermost plate of the proBoma beneath which the sixth pair of legs Is articulated ; 1, 2, 9, 10, first, second, ninth,, and tenth somites of the opistho- soma ; an, anus. (OriginEU.)

Semarks.— These most strange-looking Arachnids occur in warmertemperate, and tropical regions of Asia, Africa, and America. Their anatomy has not been studied, as yet, by means of freshly-

failed matenai, and is imperfectly known, though the presence of the coxal glands was determined by Macleod in 1884. The pro- portionately enormous chelae (chelicerse) of the first pair of append- ages are not provided with poison glands : their bite is not ven- omous.

Galeodes has been made the means of a comparison between the structure of the Arachnida and Hexapod insects by Haeckel and other - writers, and it was at one time suggested that there was a

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Opiaihoaoma Proawna ^

Pio. 69.—GaJeodea, ap., one of the Solifugaj. I to VI, the six prosomatio hmbs cut short ; o, the eyes ; 5, c, demarcated areae of the cephalic or first pro- somatic plate correspondmg respectively to appendages I, II, III and to append- Jg? IV (see Pig. 68) ; d, second plate of the prosoma-

carrying appendage" ; «, third plate of the prosoma-oarrymg appendage VI. The prse-genital somite is absent. 1, first somite of the opisthosma ; 2, second do. ; S, prosomatic tracheal aperture between legs IV and V ; S' and S", oplsthosomatio tracheal apertures ; 10, tenth opisthosomatic somite ; an, anus. (Original.)

genetic afBnity between the two groups — through Galeodes, or extinct forms similar to it. The segmentation of the prosoma and the form of the appendages bear a homoplastic similarity to the head, pro-, meso-, and meta-thorax of a Hexapod with mandibles, maxillary palps and three pairs of walking legs ; whilst the opisthosoma agrees in form and number of somites with the ab- domen of a Hexapod, and the tracheal stigmata present certain agreements in the two cases. Reference to literature (86).

Order 6. Pseudoscorpiones=Chelonethi, also called Chernetidia (see Figs. 70, 71, 72) . — ^Prosoma covered by a single dorsal shield, at most furnished with one or two diplostichous lateral eyes ; sternal elements obliterated or almost obliterated. Appendages of the 1st pair bisegmented completely chelate, furnished with peculiar organs, the serrula and the lamina. Appendages of 2nd pair very large and completely chelate, their basal segments meeting in the middle line.

Fio. n.—Qarypus Utoralia, one of the Pseudoscorpiones. Dorsal view. I to VI, the prosomatic appendges ; o, eyes; prm-gen, prte-genital so- mite ; 1, tergite of the genital or first opisthosomatic somite ; 10, tergite of the tenth somite of the opistho- soma ; 11, the evanescent eleventh somite of the opisthosoma; an, anus. (Original.)

Fig. 70. — Garypua KtoraJda, one of the Pseudoscorpiones. Ventral view. I to VI, prosomatic appendages ; o, sterno-coxal process of the basal segment of the second appendage; 1, sternlte .of the genital or first opisthosomatic somite; the prse- genital somite, though represented by a tergum, has no separate sternal plate ; 2 and 3, sternites of the second and third somites of the opisthosoma, each showing a tracheal stigma; 10 and 11, sternites of the tenth and eleventh Semites of the opisthosoma; an, anus. (Original by Pocock and Pielcard-Cambridge.)

as in the Uropygj, and provided in front with membranous lip-like processes underlying the proboscis. Appendages of the 3rd, 4th, 5th, and 6th pairs similar in form and function, tipped with two claws, their basal segments in contact in the median ventral line. The prsB-genital somite wide, not constricted, with large tergal plate, but with its sternal plate small or inconspicuous. Opis- thosoma composed, at least in many cases, of eleven somites, the 11th somite very small, often hidden within the 10th. Respiratory organs in the form of tracheal tubes opening by a pair of stigmata in the 2nd and 3rd somites of the opisthosoma. Intromittent organ of male beneath sternum of the 1st somite of the opisthosoma. Sub-order a. Panctenodaotyli. — Dorsal plate of prosoma (cara-

pace) narrowed in front ; the appendages of the 1st pair small, much narrower, taken together, than the posterior border of the carapace. Serrula on movable digit of appendages of 1st pair fixed through- out its length, and broader at its proximal than at its distal end ; the immovable digit with an external process.

Family— CheliferidserCAeit/flJ- (Figs. 66, 67, 68), Ghiridium).

,, GarypidsB {Garypus).

Sub-order &. Hemictenodaotyli. — Dorsal plate of prosoma scarcely

narrowed in front ; the appendages of the 1st pair large, not much

narrower, taken together, than the posterior border of the cara-

o prm-gen 12 3

I II in IV V VI 1 2 8

Proaoma

Fig. 72. — Ga/rypua HtoraUa, one of the Pseuodoscorpiones. Lateral view. I to VI, basal segments of the six prosomatic appendages ; o, eyes ; prm-gen, tergite of the prse-genital somite ; 1, genital or first opisthosomatic somite ; 2, 8, 10, the second, third, and tenth somites of

the opisthosoma ; 11, the minute eleventh somite ; an, the anus. (Original.)

pace. The serrula or the movable digit free at its distal end, narrowed at the base ; no external lamina on the immovable digit.

Family — Obisiidae (Obisium, Pseudobisium).

,, Chthoniidae {Chthohius, Tridenchthonius).

Jtemarks. — The Book-scorpions — so-called because they were, in old times, found not unf requently in libraries — are found in rotten wood and under stones. The similarity of the form of their ap- pendages to those of the scorpions suggests that they are a degen- erate group derived from the latter, but the large size of the prae-genital somite in them would indicate a connexion with forms preceding the scorpions. Reference to literature (37) .

Order 7. Podogona=Meridogastra (see Figs. 73 to 76). — Dorsal area of prosoma furnished with two shields, a larger behind repre- senting, probably, the tergal elements of the somites, and a smaller in front, which is freely articulated to the former and folds over the

IV .. Ill —

Fig. 78. — Cryptoatenwia KwraehM, one of the Fodogona. Dorsal view of male, enlarged five times linear. Ill to VI, the third, fourth, fifth, and sixth ap- pendages of the pro- soma; a, movable (hinged) sclerite (so-called hood) over- hanging the first pair of appendages ; 0, fused terga of the prosoma followed by the opisthosoma of four somites; an, C an anus ; E, extremity or

the fifth appendage of the male modified to subserve copulation. (Original

drawing by Pocock and Pickard-Gambridge.)

appendages of the 1st pair. Ventral area without distinct sternal plates. Appendages of 1st pair, tri-segmented, completely chelate. Appendages of

2nd pair, with their basal segments uniting in the middle line below the mouth, weakly chelate at apex. Append- ages of 3rd, 4th, 6th, and 6th pairs similar in form ; their basal segments in contact in the middle line and immovably welded, except those of the 3rd pair, which have been pushed aside so that the bases of the 2nd and 4th pairs are in contact with each other. A movable membranous joint between the prosoma and the opisthosoma, the generative aperture opening upon the

IV III I

Fig. 1i.—Cryptoatenmia EaracMi, anterior aspect of the prosoma with the "hood" removed. I to IV, first to fourth appendages of the prosoma ; a, basal segment of the second pair of appendages meeting its fellow in the middle line (see Fig. 75). (Original drawing by Pocock and Pickard-Gambridge.)

ventral side of the membrane. Prse-genital somite suppressed ; the opisthosoma consisting of only four visible somites, in addition to a tubular ring round the anal orifice. Respiratory organs un- known. Intromittent organ of male placed at the distal end of the appendage of the 5th pair.

Family — Cryptostemmidee {Cryptostemma) (^Anthracomartus) Carboniferous.

Bemarks on the Fodogona. — ^The name given to this small but

fifth pair of append- ages of the female for comparison with that of the male E

remarkable group has reference to the position of the male intro- I a

Fig. 75. — Cryptoatemma Karsdfidi, one of the Fodogona. Yentral view. I to TI, the six pairs of appendages of the prosoma, the last three cat short ;

1, 2, 8, 4, the four somites of the opisthoBoma ; a, hood overhanging tne first pair of appendages ; o, position of the genital orifice ; c, part of 8rd ap- pendage ; dt fourth segment of 2nd appendage. Observe that the basal segment of appendage III does Tiot 'meet its fellow in the middle line. (Original drawing by Pocock and Fickard-Cambridge.)

.mittent organ (Fig. 73, e). They are small degenerate animals

with a relatively firm integument. Not more

than four species and twice that number of

specimens are known. They have been found

in "West Africa and South America. A fact of

special interest in regard to them is that the

jgenus Anthracomartus, from the Coal Measures,

appears to be a member of the same group. The

name Cryptostemma, given to the first-known

genus of the order, described by Gu6rin-M6n6-

vUle, refers to the supposed concealment of the

eyes by the movable cephalic sclerite. Reference

to literature (38). r, ». ^

Order 8. Opiliones (see Fig 77).-I)orsal. areaJi'j; ~~/del>~~ ^,^~~: of prosoma covered by a smgle shield, beanng a Extremity of the pair of median eyes, or one or two pairs of lateral eyes. Sternal elements much reduced. Append- ages of 1st pair large, three segmented, and com- pletely chelate ; of 2nd pair either simple and in Fig. 78. pediform, or prehensile and subchelate ; of re- '~~

maining four pairs, similar in form, ambulatory in function. Mouth lying far back, the basal segment of the aijd, 3rd, and sometimes of the 4th pairs of appendages furnished with sterno- coxal (maxillary) lobe. Opisthosoma confluent throughout its breadth with the prosoma, with the dorsal plate of which its anterior tergal plates are more or less confluent ; nine opisthosomatic somites traceable ; the generative aperture thrust far forwards be- tween the basal segments of the 6th or 5th and 6th appendages. Prse-genital somite suppressed. Respiratory organs, tracheal open- ing by a pair of stigmata situated immediately behind the basal segments of the 6th pair of appendages on what is probably the sternum of the 3rd opisthosomatic somite, and also in some cases upon the 5th segment of the legs.

Intromittent organ of male lying within the genital orifice.

Sub-order a. Laniatores. — ^The area between the mouth below and the basal segments of the appendages of the 1st pair above occupied by two unpaired skeletal pieces, the clypeus and labrum. Sternal area of prosoma occupied by a relatively long and very narrow sclerite, composed of prosternal and metasternal elements, and lying between the coxae of the appendages of the 5th pair, and interposing between the mouth and generative orifice ; the latter lodged between the basal segments of the appendages of the 6th pair. Appendages of 2nd pair strong, generally spiny, and armed with a powerful claw. Appendages of 3rd and 4th pairs armed with a single claw ; those of 5th and 6th with two claws. Sterno-coxal process of 3rd pair of appendages coalesced with the basal segment ; that of the 4th pair not or scarcely developed. Principal families — Gonyleptidss (Gonyleptes, Qoniosoma). Biantidse {Biantes). EpedanidsB (^Epedanus, AcrohuWus). Assamiidae {Assamia, Pygoplus). Oncopodidse {Oncopus, Pelitnus). Cosmetidse {Gosmetus).

Sub-order 6. Palpatores. — Resembling the Laniatores, but with the sternal area of prosoma very short, the metasternal sclerite represented by a short transverse plate more or less overlapped by the forwardly-projecting sternal element of the opisthosoma that covers the genital orifice and intervenes between the basal segments of the appendages of the 5th and 6th pairs. The genital orifice thus lies far forwards, close

behind the mouth and on a level with the space between the basal segments of the appendages of the 5th pair. Appendages of 2nd pair small, weak, in no sense prehensile, unspined, the claw weak or absent ; the 3rd-6th pairs of appendages armed with a single claw. Sterno-coxal process of 3rd appendage movably articulated ; a similar lobe generally present on basal segment of 4th appendage.

Principal families — Phalangiidae (Phalangium, Liohunun).

Nemastomidas {Nemastoma, Jschyropsalis). Trogulidse (Trogulus, Anelasmocephalus).

Sub-order c. Anepignathi. — Basal segments of appendages of 2nd pair meeting in the middle line across the area that lies between the mouth below and the basal segments of the appendages of the 1st pair above, to the partial or total exclusion of the unpaired skeletal pieces, known as the clypeus and labrum. Genital orifice lying between the basal segments of the appendages of the eth pair, and separated from the mouth by a relatively long space occupied by the inner extremities of the basal segments of the 3rd, 4th,

Fig. 77. — Styloeellus au- matranue, one of the Opiliones; after Thorell. Enlarged. A, dorsal view ; I to VI, the six proBo- matic appendages ; B, ventral view of the proso- ma and of the first somite of the opisthosoma, with the appendages I to YI cut ofr at the base ; a, tracheal stigma ; mx^ maxillary processes of the coxse of the third pair of appendages ; g, genital aperture. G, ventral surface of the prosoma and opisthosoma ; a, tracheal stigma; 2>, last somite. I>, lateral view^ of the first and second

Eair of appendages. E, bteral view of the whole body and two first ap- pendages, showing the ihsion of the dorsal ele- ments of the prosoma into a single plate, and of those of the opisthosoma into an imperfectly segmented plate continuous with that of the prosoma.

5th, and 6th pairs of appendages, the sternal sclerites being evanes- cent. Appendages of 2nd-6th pairs short and strong, furnished with a single claw. Family — Cyphophthalmidae {^Cyphophthalmus, Styloeellus, Pet- talus) . Bemarks on the Opiliones. — These include the Harvest-men,

sometimes called also Daddy-long-legs, with round undivided bodies and very long, easily-detached legs. The intromittent organs of the male are remarkable for their complexity and elaboration. The confiuence of the regions of the body a,nd the dislocation of aper- tures from their typical position are results of degeneration. The Opiliones seem to lead on from the Spiders to the Mi,tes. Reference to literature (39).

Order 9. Khynchostomi = Acari (see Fig. 78). — Degenerate Arachnids resembling the Opiliones in many structural points, but chiefiy distinguishable from them by the following features : — The basal segments of the appendages of the 2nd pair are united in the middle line behind the mouth ; those of the 3rd, 4th, 5th, and 6th pairs are widely separated and not provided with sterno-coxal (maxillary) lobes, and take no share in mastication ; the respiratory stigB^i^ta, when present, belong to the prosoma, and the primitive segmentation of the opisthosoma has entirely or almost entirely disappeared.

Sub-order a. Oryptostigmata. — ^Integument hard, strengthened by a continuously chitinized dorsal and ventral sclerite. Trachess typically opening by stigmata situated in the articular sockets (acetabula) of the 3rd, 4th, 5th, and 6th pairs of appendages. Family — Oribatidae (Oribata, Nothrus, Soplophora). Sub-order 6. Metastigmata. — Integument mostly like that of the Oryptostigmata. Trachese opening by a pair of stigmata situated above and behind the base of the 4th or 5th or 6th pair of appendages.

Families — Gamasidse (Gamasiis, Pteroptus). Argasidse (^Argas, Ornithodoros). IxodidsB (Ixodes, Bhipicephalus). Sub-order c. Prostigmata. — Integument soft, strengthened by special sclerites, those on the ventral surface of the prosoma apparently representing the basal segments of the legs embedded in the skin. Trachese, except in the aquatic species in which they are atrophied, opening by a p^ir of stigmata situated close to or above the base of the appendages of the 1st pair (mandibles). Families — Trombidiidse (Trombidium, Tetranychus). Hydrachnidse (Sydrachna, Atax). HalacaridsB (Halacarus, Leptognathus). Bdellidas {Bdella, Eupodes). Sub-order d Astigmata. — Degenerate, mostly parasitic forms approaching the Prostigmata in the development of

integumental sclerites and the softness of the skin, but with the respiratory system absent.

Families— TyroglyphidsB (Tyraglyphus, Bhizoglyphus).

SarcoptidBB {Sarcoptes, Analges).

Sub-order e. Vermiformia. — Degenerate atracheate parasitic

forms with the body produced posteriorly into an annulated caudal prolongation, and the 3rd, 4th, 5th, and 6th pairs of appendages short and only three-jointed.

Family — Demodicidse {Demodex).

Sub-order/. re«rapo(Za.— Degenerate atracheate gall-mites, in ■which the body is produced posteriorly and annulated, as in Bemodex, but in which the appendages of the 3rd and 4th pairs are long and normally segmented, and those of the 5th and 6th pairs entirely absent.

Family— EriophyidsB (JSriophyes Phyllocoptes).

Bemarhs on the JShynchostomi.— The Aoari include a number of forms which are of importance and special interest on account of their parasitic habits. ‘ The ticks (Ixodes) are not only injurious as blood-suckers, but are now credited with carrying the germs of Texas cattle-fever, just as mosquitoes carry those of malaria.

Fig. 78. — Uoloth/yrus niUdiasimue, one of the Acari ; after Thorell. En-larged fifteen times linear. A, lateral view with appendages III to VI removed ; 1 plate covering the whole dorsal area, representing the ftised tergal sclerites of the prosoma and opisthosoma ; 2, similarly-formed ventral r plate ; 3, tracheal stigma. B, dorsal view of the same animal ; 11 to Yl, second to sixth pairs of appendages. The first pair of appendages both in this and in G are retracted. 0, ventral view of the same ; 11 to VI

as in B ; a, genital orifice ; &, anus ; a, united basal segments of the second pair of appendages ; d, basal segment of the sixth prosomatic appendage of the right side. The rest of the appendage, as also of app. Ill, IV, and V, has been cut away. (Original drawing by Focock and Fickard-Cambrldge.)

The itch-insect {Sarcoptes scabiei) is a well-known human parasite, so minute that it was not discovered until the end of the 18th tentury, and "the itch" was treated medicinally as a rash. The female burrows in the epidermis much as the female Trap-door Spider burrows in turf in order to make a nest in which to rear her young. The male does not burrow, hut wanders freely on the surface of the skin. Demodex folliculorum is also a common parasite of the sebaceous glands of the skin of the face in man, and is frequent in the skin of the dog. Many Acari are parasitic on marine and freshwater molluscs, and others are found on the feathers of birds and the hair of mammals'. Others have a special faculty of consuming dry, powdery vegetable and animal refuse, and are liable to multiply in manufactured products of this nature, such as mouldy cheese. A species of Acarus is recorded as infest- ing a store of powdered strychnine and feeding on that drug, so poisonous to larger organisms. Reference to literature (40).

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(e. e. l.)

Arad, Old, a municipal town of Hungary, on the river Maros, 145 miles S.E. of Budapest ; capital of the county of Arad; a well-equipped modern town, with a considerable trade, includrag a large distillery. After the surrender of Gorgey at VilSigos, the thirteen captured Hungarian

generals were here put to death. A statue of liberty has been erected to their memory, and the anniversary of their death is annually celebrated with great solemnities. There is a museum composed of relics of the war of national independence of 1848-49. Popu- lation in 1901, 65,987; of the neighbouring village of New Arad, 6044.

Araguay, River. See Amazon.

Arakan. — This division of Lower Burma on the eastern seaboard of the Bay of Bengal continues to be divided into four districts — ^Akyab, Northern Arakan Hill Tracts, Sandoway, and Kyaukpyu, which nan;© has been substituted for the older Eamri. Its area is 18,540 square miles, and the population in 1891 was 673,190. The population at the time of its annexation in 1826 did not exceed 100,000. In 1898-99 there were 4014 villages, and the revenue paid was Es.23,83,406. Akyab remains the only town of importance in the division. Of the 11,865,600 acres in the division, 6,207,270 acres are not capable of cultivation, and in 1898-99 only 800,720 acres were cultivated. . The great proportion of the cultivable but not cultivated area was in the Northern Arakan HiU Tracts district, which is under a superintendent, who is usually a police officer with headquarters at Paletwa. The area of the Hill Tracts is 5233 square miles, with a population in 1891 of 14,627, and containing 317 villages. Of the population 13,039 were aborigines — ^mostly Chins, 1204 were Buddhists and Jains, 366 tvere Hindus, and 18 were Mahommedans. Only 10,451 acres were culti- vated out of the total area of 3,349,120 acres. The rain- fall at Paletwa in 1898-99 was 123-91 inches. Sixty-five police maintain order in the district.

Aral (Khtaeezm, Abal-dbnghiz), a large lake of Central Asia, situated to the E. of the Caspian Sea, between 43° 41' to 46° 45' N. lat., and 58° 19' to 61° 47 E. long., and by its area the second inland salt sea of the world. It covers 26,166 square miles, and has nearly the same length as width, namely, about 170 miles, if its northern gulf (Kichkine-Denghiz) be left out of account.

Its depth, is insignificant, attaining 222 feet only in a depression in the north-west, and 90 feet in the middle, so that notwithstanding its wide area it contains only eleven times as much water as Lake Leman. Its

altitude is 246 feet above the Caspian (Tillo), i.e., about 160 feet above the ocean.

There is no doubt that in recent historical times Lake Aral had a much greater extension than it has now, and that its present area is diminishing at a rapid rate. Erom a map of 1741 it appears that its north-eastern gulf, Sary-chaganak, protruded about 53' miles farther than it does now, and this is confirmed by what Meyendorff heard in 1820 from the Kirghiz, namely, that, forty years before, the lake reached some hills which are now forty miles from the shore. Moreover, the large Aibughir Gulf on the southern shore, which was full of water in 1858, is now quite dry, and the Laudan, the most western branch of the Amu, which entered this gulf in 1848 and 1859, has quite dried up since. The salinity of its water is much less than that of the ocean, containing only 0-012 of salt (only 0-006 of chloride of sodium), and the lake freezes every year for a great distance from its shores. The opinion that Lake Aral periodically disappeared, which was for a long time countenanced by Western geographers, loses more and more of its probability now that it becomes evident that at a relatively recent period the Caspian Sea extended muo^ farther eastward than it does now, and that Lake Aral communicated with it through the Saiy-Kamysh depression. The present writer is even inclined to think that besides this southern communication with the Caspian, Lake Aral may have been, even in historical times, connected with the Mortvyi Kultuk Gulf of the Caspian, dis- charging part of its water into that sea, through a depression of the TJst-Urt plateau, which is marked by a chain of lakes (Chnmyshty, Asmantad, &o.). In this case it might have been easily confounded with a gulf of the Caspian (by Jenkinson). That the level of Lake Aral was much higher in post-Pliocene times is proved by the finding of shells of their characteristic species of Pecten and Mytilus in the Karar-kum, 33 miles from the lake at an altitude of 70 feet above its present level, and perhaps even up to 200 feet (by Syevertsoff ; see Mushketofi's Turkestan). The fishes of Lake Aral belong to fresh-water species, and in some of its rapid tributaries the interesting Scaphirhynchui, which represents a survival from the Tertiary epoch, is found. The fish ing is very productive, and about 1000 tons of fish are ex- ported yearly to Turkestan, Merv, and even Russia. The shores of the lake are uninhabited, and the nearest settlements are Kazalinsk (7600

inhabitants), 35 miles east, on the Syr, and Chim- bai and Kungrad in the delta of the Amu.

Authorities.— The modem works are: MAKsntEPp's "De- scription of Lake Aral," and Kaulbabs' " Delta of the Amu," in Zapiski of Buss. Geogr. Soc, 1st series, v., and hew series, ix.— Grimm's Studies of the Aral-Caspian Expedition.— SimohSKY^s "Eishing in Lake Aral," in Bivestia, Buss. Geogr. Soc, 1887.— Prof. MnsHKETOFF, Turkestan, vol. i. 1886, which contains rich bibliographical indications. (p a K ")

Aral Caspian Region (or Depkession) is the name which is given by geographers to the lowlands in the east of the Caspian Sea, and, by extension, to all the territory comprised between the Lower Volga, the Aral Irtysh water-parting, the Dzungarian Alatau, and the Hiadu Kush. These were also the limits given to it in an excellent work on the geo- botany of this region by the Russian botanist, Borschoff. (See Teanscaspiajt Tekeitoey.) Owing to its special geological structure and vegetation, the general aspect of its steppes, ex- posed to the powerful disintegrating agency of the wind, and its sandy deserts alternating with prairies and oases (see Kaea-kum), it represents a distinct geogra- phical type. Large areas are covered with the character- istic Aral-Caspian deposits, wjiich spread as a thiu layer, attaining a maximum thickness of 90 feet, but are very much destroyed by the rivers, which have often changed their courses in recent times, and by the winds, which, freely blow over this flat, open territory. They attain their fullest development in the part of the Aral-Caspian region which lies to the east of the Caspian Sea, and con- sist nearly always of a yellow-grayish clay, occasionally taking the character of a more or less compact sandstone of the same colour. Their typical fossils are shells of species still living in both the Caspian and the Aral, but in the shallow parts of them only ; namely, according to Mushketoff, Cardium edule, L., Dreyssena polymorpha, V. Bened., Neritina liturata, Eichw., Adacna vitrea, Eichw., Hydrdbia stagnaMs, L., in the Kara-kum ; and Lithoglyphus caspms,Krynitz., Hydrobia stagnalis, Anodonta ponderosa, Pfr., and the sponge,

Metschnikowia tuberculata, Grimm, in the Kyzyl-kum. All these are inhabitants of the littoral zone, and only the lAtTvoglyphus ccLspius is found at greater depths, not exceeding, however, 100 fathoms in the Caspian Sea. The exact limits of the great Aral-Cas- pian Post-Pliocene Sea are not yet settled, except in the north-west, where the Ergheni hills of the Kalmyk steppe are a distinct barrier. As to its northern limits, the same Aral-Caspian deposits are known to exist 80 miles, but not more than from 130 to 200 miles, north of Lake Aral. They quite certainly do not cross the Aral-Irtysh water- parting. Their eastern limit lies some 100 mUes from Lake Aral, but Severtsoff maintained that they extend also into the drainage area of Lake Balkhash {q.v.). In the south the same deposits, containing the same species of Cardium, Dreyssena, Neritina, and Hydrobia, are known to spread without interruption, 160 miles from Lake Aral, as far as the Bala-ishem wells, in the Sary-kamysh depres- sion (whose surface is below the level of the Caspian), and up the Uzboi for 100 miles from the Caspian. As to their exact extension up the Amu and the Syr, it is not yet known. It is thus concluded that the Aral-Caspian basin had, in Post-Pliocene times, a very wide extension, but that it contained very large islands — Ust-Urt, &c. — which divided it into several parts, its eastern portion communicating with the western, but by one or two nar- row straits. These channels, which were formerly taken for old beds of the Amu-daria, have only dried up at a recent epoch, and most probably they existed in historical times.

See MnsHKETOFP's Turkestan, St Petersburg, 1886, where all in- dications of literature are given. (p. a. K.)

Aran Isiands, South ; three islands — Inishmore, Inishmaan, and Inisheer — flying across Galway Bay on the W. coast of Ireland. The Congested Districts Board has of recent years made efforts to improve the condition of the inhabitants, especially by introducing better methods of fishing. A curing station has been established at Killeany. Population about 3000.

Ararat, (1) Assyrian Urardhu, the country in which

the Ark rested after the Deluge (Gen. viii. 4), and to which the murderers of Sennacherib fled (2 Kings xix. 37; Isaiah xxxvii. 38). The name

Urardhu, originally that of a principality which included Mount Ararat and the plain of the Araxes, is given in Assyrian inscriptions from the 9th century b.o. downwards to a kingdom that at one time included the greater part of the later Armenia. The native name of the kingdom was Biainas, and its capital was Dhuapas, now Van. The first king, Sarduris I. (circ. 833 B.C.), subdued the country of the Upper Euphrates and Tigris. His inscriptions are written in cuneiform, in Assyrian, whilst those of his successors are in cuneiform, in their own language, which is neither Aryan nor Semitic. The kings of Biainas extended their kingdom eastward and westward, and defeated the Assyrians and Hittites. But Sarduris II. was overthrown by Tiglath Pileser II. (743 B.C.), and driven n6rth of the Araxes, where he built Armavir, Armauria. Interesting specimens of Biainian art have been found on the site of the palace of Rusas II., near Van. Shortly after 645 e.g. the kingdom fell, possibly conquered by Cyaxares, and a way was thus opened for the immigration of the Aryan Armenians. The name Ararat is unknown to the Armenians of the present day. The limits of the Biblical Ararat are not known, but they must have included the lofty Armenian plateau which overlooks the plain of the Araxes on the north, and that of Mesopotamia on the south. It is only natural that the highest and most striking mountain in the district should have been regarded as that upon which the Ark rested, aQd that the old name of the country should have been trans- ferred to it. According to the Babylonian account of the Deluge, the resting-place of the Ark was " on the mountain of Nizir," which some writers have identified with Mount Eowanduz, and others with Mount Elburz, near Tehran. The Kurds, Syrians, and Nestorians regard Jebel Judi, on the left bank of the Tigris, near Jezire, as the mountain.

Satcb, "Cuneiform Inscriptions of Lake Van," in Journal of Boyal Asiatic Society, vols, xiv., xx., and xxvi. — Maspeeo, Histoire ancienne des peuples de V Orient classique, torn iii. Les Empires, Paris, 1899. — Articles, "Ararat," in Smith's Dictionary of the Bible, Hastings' Dictionary of the Bible, and Encyclc^cedia Bibliea.

(2) Aeaeat, Armenian Massis, Turkish Egri Dagh, "Painful Mountain," Persian, Koh-i-Nuh, "Mountain of Noah," is the name given to the culminating point of the Armenian plateau which rises to a height of

17,100 feet above the sea. The massif of Ararat rises on the north and east out of the alluvial plain of the Araxes, here from 2500 feet to 3000 feet above the sea, and on the south-west sinks into the plateau of Bayezid, about 4500 feet. It is thus isolated on all sides but the north- west, where a col about 6900 feet high connects it with a long ridge of volcanic mountains. Out of the massif rise two peaks, " their bases confluent at a height of 8800 feet, their summits about 7 miles apart." The higher. Great Ararat, is " a huge broad-shouldered mass, more of a dome than a cone"; the lower. Little Ararat, 12,840 feet, on which the territories of the Tsar, the Sultan, and the Shah meet, is "an elegant cone or pyramid, rising with steep, smooth, regular sides into a comparatively sharp peak" (Bryce). Both peaks are entirely composed of igneous rock, but all eruptive activity has long ceased. On the north and west tlie slopes of Great Ararat are covered with glittering fields of unbroken niv4. The only true glacier is on the north-east side, at the bottom of a large chasm which runs into the heart of the mountain. The great height of the snow-line, 14,000 feet, compared with the average of the Alps, 8500-9000 feet, is due to the small rainfall and the upward rush of dry air from the plain of the Araxes. The middle zone of Ararat, 5000-

11,500 feet, is covered with good pasture ; tlie upper and lower zones are for the most part sterile. Many traditions connected with the Deluge gather round Ararat. The garden of Eden is placed in the valley of the Araxes ; Marand is the burial-place of Noah's wife ; at Arghuri, a village near the great chasm, was the spot where Noah planted the first vineyard, and here were shown Noah's vine, and the monastery of St James, until village and monastery were overwhelmed by a fall of rock, ice, and snow, shaken down by the earthquake of 1840. Since 1856 Ararat has been climbed by Bryce (1876), Markoff (1888), Pastuchow and Lynch (1893).

Bhtcb. Transcaucasia and Ararat, 4th ed. 1896. — Lynch. Armenia. London, 1901. (o. w. w.)

Ararat, a municipality and railway station in Aus- tralia, Victoria, in the county of Kipon, 131-^ postal miles N.W. of Melbourne, with which it is connected (vid Ballarat) by rail. It is the commercial centre of the north-western grain and wool producing district, and is also noted for its quartz and alluvial gold mines. Excellent wine is made. The district also yields the best timber in great quantity. Granite, bluestone, limestone, and slate abound in the neighbourhood. It has a large lunatic asylum, and is an assize town. Altitude, 1072 feet. Eainfall (14 years) 24-37 inches. Population (1881),

2740; (1891), 3151; (1901), 3580.

Aras, Araxes, a river which rises in the Bin-geul Dagh, south of Erzerum, and, after flowing eastward through the territories of Turkey and Russia, forms the boundary between Persia and Russia. It formerly joined the Kur, but since 1897, when it changed its lower course, it has run direct to the Kizil Agach Bay of the Caspian.

Arauan. See Sahaba.

Arbela, now Erbil, a small town east of the Tigris, in the Mosul viMyet. The battle in which Alexander defeated Darius was fought at Gaugamela, on the Bumo- dus, now Khazr Su, a tributary of the Greater Zab, and not at Arbela. In the 14th century the Christians were massacred and almost exterminated. Population, 4000.

Arbitrage. — Arbitrage is the terra applied to the system of equalizing prices in different commercial centres by buying in the cheaper market and selling in the dearer. These transactions, or their converse, are mainly confined to stocks and shares, foreign exchanges, and bullion ; and are for the most part carried on between London and the Continental capitals, and largely with New York. When prices in London are affected by financial or political causes, all other markets are sooner or later influenced, as London is the banking and financial centre for the com- merce of the world. It may, however, also occur that some local event of importance initiates a rise or fall in a particular market which must ultimately affect other countries. For instance, a revolution or a threat of one in France would immediately depress all French securities, and by

exciting the fears of capitalists would stimulate transfers of funds and raise all the exchanges against France.

In ordinary times those engaged in arbitrage operate with a very small margin of profit. The great improve- ment in postal, telegraphic, and telephonic communication enables operators to close transactions with amazing rapidity, while competition reduces the margin of profit to a minimum. Operations in American stocks and shares are carried on between London and New York on a vast scale, while transactions in African mining shares are undertaken to a considerable extent between London and Paris. The frequent fluctuations in the prices of

the latter securities offer a large and fruitful field to bold operators possessed of large resources, while those who have small means often succumb in a commercial crisis. As regards foreign exchange and bullion, arbitrage operators stand on a fairly safe foundation, the fiuctuations being slight and involving little or no risk, although they yield a very small margin of profit. In fact arbitrage be- tween London and the continent of Europe has dwindled, owing to competition, to almost vanishing point, but operations with distant countries such as India are large and mainly profitable. Arbitrage with India consists chiefly in buying bills of exchange in London, such as India Council rupee bills amounting to about 16 millions stetling annually, and commercial bills drawn against goods exported to India. The counter-operation consists in purchasing in India, for short or long delivery, sterling bills drawn against exports to Great Britain of Indian produce, such as cotton, tea, indigo, jute, and wheat. These operations greatly facilitate trade and the moving of produce from the interior of India to the seaports. With- out this assistance Great Britain's enormous trade could not be carried on, and she would have to revert to the primitive system of barter. The same advantages are afforded to her vast trade with China and Japan, with the material difference that the supply of Government council bills is confined to the Indian trade. The balance of trade with all countries is generally Settled by specie shipments ; hence, with the Far East, silver and gold play an import- ant part in arbitrage.

It is impossible to imagine the diificulties and confusion which would arise in the absence of the arbitrageur. It is the system of arbitrage, based on principles swiich are the ne,cessary outcome of successful commerce, which renders vast operations possible, and greatly facilitates the enormous British export and import trade, while main taining those international connexions which tend to secure general peace and prosperity. (s. m.)

Arbitration. — Since the publication of the ninth edition of this work the law as to arbitration has, both in England and Scotland, undergone considerable modifica- tion. The principal changes in the English law have been made by the Arbitration Act, 1889. This statute — which, it should be noted, is an express code as to proceedings in all arbitrations — subdivides its subject matter into two headings: — I. References by consent out of court; II. References under order of court.

I. Beferences by Consent out of Court. — Here the first matter to be dealt with is the submission. A submission is defined as a written agreement (which must be signed by both parties or their authorized agents) to submit present or future differences to arbitration, whether a par- ticular arbitrator is named in it or not. Under the law prior to the Act of 1889, (a) an agreement to refer disputes generally, without naming the arbitrators, was always irrevocable, and an action lay for the breach of it, although the court could not compel either of the parties to proceed under it; (6) an agreement to refer to a particular arbi- trator was revocable, and if one of the parties revoked that particular arbitrator's authority he could not be compelled to submit to it; (c) when, however, the parties had got their tribunal fixed, and were proceeding to carry out the agreement to refer, the Act 9 and 10 Will. III. c. 15 pro- vided that the submission might be made a rule of court, a provision which gave the court power to assist the parties in the trial of the case, and to enforce the award of the arbitrators; (d) the statute 3 and 4 Will. IV. c. 42 put an end to the power to revoke the authority of a particular arbitrator after the reference to him had been made a rule of court ; and— a liability which existed also under the Act of 9 and 10 Will. III. c. 15— any person revoking

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the appointment of an arbitrator after the submission had been made a rule of court might be attached. The Arbi- tration Act, 1889, provides that a submission, unless a contrary intention is expressed in it, is irrevocable except by leave of the court or a judge, and is to have the same effect in all respects as if it had been made an order of court. The object of this enactment was to save the expense of making a submission a rule of court by treating it as having been so made, and it leaves the law in this position that while the authority of an arbitrator, once appointed, is irrevocable, there is no power — any more than there was nnder the old law — to compel an unwilling party to proceed to a reference, except in cases specially provided for by sections 5 and 6 of the Act of 1889. The former of these sections deals with the power of the court, the latter with the power of the parties to a reference, to appoint an arbitrator in certain circumstances. Section 5 provides that where a reference is to be to a single arbi- trator, and all the parties do not concur in appointing one, or an appointed arbitrator refuses to act or becomes inca- pable of acting, or where the parties or two arbitrators fail, when necessary, to appoint an umpire or third arbitrator, or such umpire or arbitrator when appointed refuses to act, or becomes incapable of acting, and the default is not rectified after seven clear days' notice, the court may supply the vacancy. Under section 6, where a reference is to two arbitrators, one to be appointed by each party, and either the appointed arbitrator refuses to act, or becomes incapable of acting, and the party appointing him fails, jdfter seven clear days' notice, to supply the vacancy, or such party fails, after similar notice, to make an original appointment, a binding appointment (subject to the power of the court to set it aside) may be made by the other party to the reference. The court may compel parties to carry out an arbitration not only in the above cases by directly appointing an arbi- trator, &c., or by allowing one appointed by a party to proceed alone with the reference, but also indirectly by staying any proceedings before the legal tribunals to determine matters which come within the scope of the arbitration. The court will generally stay proceedings where the agreement to refer stipulates that the submission of a dispute to arbitration shall be a condition precedent to the right to bring an action in regard to it. On the other hand, the court will refuse to interfere if the

subject matter of the litigation falls butside the scope of the reference, or there is some serious objection to the fitness of the arbitrator, or some other good reason of the kind exists.

An arbitrator (and the following observations apply mutatis mutandis to an imipire after he has entered on his duties) has power to administer oaths to, or take the afilrmations of the parties and their witnesses ; and any person who wilfully -gives false evidence before him may be prosecuted and punished for perjury. At any stage in the reference he may, and shall if he be required by the court, state in the form of a special case for the opinion of the court any question of law arising in the arbitration. The arbitrator may also state his award in whole or in part as a special ca^, and may correct in an award any clerical mistake or error arising from an accidental slip or omission. The costs of the reference and the award are in his discretion, and he has a lien on the award and the submission for his fees, for which, apparently — unless upon an express promise to pay them — he cannot sue.

If there is no express provision on the point in the submission, an award under the Arbitration Act, 1889, must .be made within three months after the arbitrator has entered on the reference, or been called upon to act by notice in writing from any party to the submission.

The time may, however, be extended by the arbitrator or by the Court. An umpire is required to make his award within one month after the original or extended time appointed for making the award of the arbitrators has expired, or any later day to which he may enlarge it. The court may by order remit an award to the arbitrators or umpire for reconsideration, in which case the reconsidered award must be made within three months after the dat^ of the order. An award may be set aside where the arbitrator has misconducted himself (an arbitrator may also be re- moved by the court on the ground of misconduct), or where it is ultra vires, or the arbitrator has been wilfully deceived by one of the parties, or some such state of things exists. Otherwise it is final. An award may, by leave of the court, be enforced in the same manner as a judgment or decree to the same effect. Under the Stamp Act, 1891, duties ranging from 3d. up to £1, 15s. are payable on awards in England or Ireland.

Provisions for the arbitration of special classes of disputes are contained in many Acts of Parliament (see, e.g., the Local Govern- ment Acts, 1888 and 1894, and the Workmen's Compensation Act,

1897).

It may also be noted here that the Conciliation Act, 1896, provides machinery for the prevention and settlement of trade disputes, and that in 1892 a chamber of 'arbitration for business disputes was established by the joint action of the Corporation of the City of London and the London Chamber of Commerce.

II. References under Order of Court. — The court or a judge may refer any question arising in any cause or matter to an oflBcial or special referee, whose report may be enforced like a judgment or order to the same effect. This power may be exercised whether the parties desire it or not. The official referees are salaried officers of court. The remuneration of special referees is determined by the court or judge. An entire action may be referred, if all parties consent, or if it involves any prolonged examination of documents, or scientific or local examination^ or consists wholly or partly of matters of account.

Scotland. — 'Pie law of arbitration has been modified by the Arbitration (Scotland) Act, 1894. An agreement to refer to a. person not named or to be named by another person, or to the holder for the time being of any office, is now valid. The court (i.e., any lord ordinary of the Court of Session or sheriff) may appoint an arbiter, on the failure of one of the parties on whom the obligation rests to concur in or make such an appointment. Where arbiters differ in opinion, they, or (if they fail to agree on the point) the court, on the application of either party, may nominate an oversman whose decision is to be final.

The provisions of the English Arbitration Act, 1889, have in substance been adopted by the Indian Legislature (see Act No. 9 of 1899), and by many of the Colonies (see, e.g., Act No. 13 of 1895, Western Australia ; No. 24 of 1898, Natal ; No. 20 of 1899, Bahamas).

United States. — Arbitration is ordinarily conducted out of court, but in most States an agTeement to settle a'con- troversy in this way may be filed in court, and enforced by its authority. There are also statutes of the United States providing facilities for adjusting disputes between certain classes of employers and workmen in this way. The United States law allows arbitration proceedings between corporations engaged in commerce, between the States and their employees, to take place before official arbitrators and at the public expense (30 United States statutes at large, 424).

Authorities. — Rdssell, Arbitration, London, 1900 ; Annual Practice, London, 1901. — Redman, Arbitration, London, 1897. — Ckbwe, Arbitration Act of 1889, London, 1898. As to Scots Law, Green" s Encyclopoedia of Scots Law, vol. i. s.v. " Arbitration," Edinburgh, 1896.

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ARBITRATION AND CONCILIATION IN LABOUR DISPUTES.

THE terms " arbitration and conciliation," as em- ployed in this article, are used to describe a group of methods of settling disputes between employers and work- people or among two or more sets of work-people, of which the common feature is the intervention of some outside party not directly affected by the dispute. If the parties agree beforehand to abide by the award of the third party, the mode of settlement is described as " arbitration." If there be no such agreement, but the of&ces of the mediator are used to promote an amicable arrangement between the parties themselves, the process is described as " concilia- tion." The third party may be one or more disinterested individuals, or a joint-board representative of the parties or of other bodies or persons.

The process here termed " arbitration " is rarely an arbi- tration in the strict legal sense of the term (at least in Hie United Kingdom), because of thedefective legal personality of the associations or groups of individuals who are usually parties to labour disputes, and the consequent absence in the great majority of cases of a valid legal " submission" of the difference

to arbitration. Trade unions, whether consisting of employers or workmen, in the United Kingdom are not corporate bodies capable of entering through their agents into legally binding contracts. Consequently a written agreement on the part of the repre- sentatives of employers and workmen to submit a dispute to the decision of a third party is of no legal force except as regards the actual signatories.^ Broadly speaking, there- fore, the provisions of the Arbitration Act, 1889, which consolidated the law relating to arbitration in general, would as a rule have no application to the settlement of collective disputes between employers and workmen, even if the Act had not been expressly excluded by section 3 of the Conciliation Act of 1896 in the case of disputes to which that Act applies. Besides the absence of a legal "submission," labour arbitrations differ from ordinary arbitrations in the fact that the questions referred often (though by no means always) relate to the terms on which future contracts shall be made, whereas the vast majority of ordinary arbitrations relate to questions arising out of existing contracts. The defective " personality " of the parties to labour disputes also prevents the enforcement of an award by legal penalties. Since, however, difficulties of enforcement affect not only settlements arrived at by arbitration, but all agreements between bodies of employers and work-people with regard to the terms of employment, they are most appropriately considered at a later stage of this article.

The term " conciliation " is ordinarily used to cover a large number of methods of settlement, shading off in the one direction into "arbitration" and in the other into ordinary direct negotiation between the parties. In some cases conciliation only differs from arbitration in the absence of a previous agreement to accept the award. The German " Gewerbegerichten," when dealing with labour disputes, communicate a decision to both parties, who must notify their acceptance or otherwise (see below). The State Board in Massachusetts sometimes takes similar action.

The conciliation boards established under the New Zealand Arbitration Act of 1894 (see below) make recom-

1 The House of Lords decided, id the Taff Vale Railw^ case (1901), that trade unions may be sued in tort, but the decision does not refer to their status as regards contracts.

mendations, though either side may decline to accept them and may appeal to the Court of Arbitration, which in that colony has compulsory powers. Most frequently, however, in Great Britain the mediating party abstains from pronouncing a definite judgment of his own, but confines himself to friendly suggestions with a view of removing obstacles to an agreement between the parties. On the other hand, it is not easy to define how far the " outside party " must be independent of the parties to the dispute, in order that the method of settlement may be properly described as " conciliation." There is a sense in which a friendly conversation between an employer or his manager and a deputation of aggrieved workmen is rightly described as " conciliation," but such an interview would certainly not be covered by the term as ordinarily used at the present day. Again, when the parties are represented by agents (e.g., the officials of an employers' association and of a trade union) the actual negotiators or some of them may not personally be affected by the particular dispute, and may often exercise some of the functions of the mediator or conciliator in a manner not clearly to be distinguished from the action of an outside party. It seems best, however, to exclude such negotia- tions from our purview so long as those between whom they are carried on merely act as the authorized agents for the parties affected. In the same way a meeting arranged ad Aoc between delegates of an employers'- asso- ciation and a trade union,, for the purpose of arranging differences as to the terms on which ^e members of the association shall employ members of the union, is not usually classed as " conciliation," unless the meeting is held in the presence of an independent chairman or con- ciliator, or in pursuance of a permanent agreement between the associations laying down the procedure for the settle- ment of disputes. If, however, the dispute is considered and arranged not by a casual meeting between two com- mittees and deputations appointed ad hoc, but by a per- maneiitly organized "joint committee" or board with a constitution, rules of procedure, and officers of its own, the process of settlement is by ordinary usage described as " conciliation," even though the board be entirely repre- sentative of the persons engaged in the industry. Such joint

boards, as will be seen, play a most important part in conciliation at the present day, and they almost always have attached to them some machinery for the ultimate decision by arbitration of questions on which they fail to agree. Another form of conciliation is that in which the mediating board represents a wider group of industries than those affected- by the dispute (e.g., the London and other "district" boards referred to below). Moreover, in some of the most important cases of settlement of disputes by conciliation,- the me- diating party has not been a permanent board but a disinterested individual, e.g., the mayor, county court judge, government official, or member of parliament. As will be seen below, the Conciliation Act now pro- vides for the appointment of "conciliators" bv the Board of Trade.

Voluntary trade boards, however (i.e., permanent joint boards representing employers and work-people in particu- lar trades), are at once the most firmly established and the most important agencies in Great Britain for the prevention and settlement of labour disputes. Among the earliest of such bodies was the board of arbitration in the Maccles- field silk trade, formed in 1849, in imitation of the French " Conseils des Prud'hommes," but which only lasted four years. The first board, however, which attained any

degree of permanent success was that established for the hosiery and glove trade in Nottingham in 1860, through the efforts of Mr Mundella. In 1864 a board was estab- lished in the Wolverhampton building trades, with Mr (afterwards Sir) Eupert Kettle as chairman, and in 1868 boards were formed for the pottery trade, the Leicester hosiery trade, and the Nottingham lace trade. Of the above boards only the last-named is still actively in existence, though a joint committee still exists for set- tling minor questions in the pottery trade. In 1869, however, there was formed one of the most important of the still existing boards, viz., the board of arbitration and conciliation in the manufactured iron and steel trades of the north of England, with which the names of Eupert Kettle, David Dale, and others are associated. In 1872 joint committees were formed in the Durham and North- umberland coal trades to deal with local questions.

The Leicester boot and shoe trade board, the first of an elab- orate system of local boards in this trade, was founded in 1875. From about 1870 onwards there was a great movement for the establishment of " sliding scales " in the coal and iron and steel trades, which by regulating wages automatically rendered unnecessary the settlement of general wages by conciliation or arbitration. These sliding scales, however, usually had attached to them joint committees for deeding with disputed questions. A sliding scale arranged by Mr (since Sir) David Dale was attached to the manufactured iron trade board in 1871. A sliding scale for the' Cleveland blast furnacemen came into force in 1879. Sliding scales were also adopted in the coal trade in many districts, e.g., South Wales (1875), Durham (1877), and Northumberland (1879). The move- ment was, however, followed by a reaction, and several of the sliding scales in the coal trade were terminated between 1887 and 1889.

The formation on a large scale of conciliaition boards in the coal trade to fix the rate of wages dates from the great miners' dispute of 1893, one of the terms of settle- ment agreed to at the conference held at the Foreign Of&ce under Lord Eosebery being the formation of a conciliation board covering the districts affected. Northumberland followed in 1894, Durham in 1895, Scotland in 1900.

The first general district board to be formed was that established in London in 1890, throughr the London Chamber of Commerce, as a sequel to the Mansion House committee which mediated in the great London dock strike of 1889. The example has been followed by several large towns, but the action taken by the boards in some of these provincial districts has been very limited.

The most typical form of machinery for the settlement of disputes by voluntary conciliation is a joint board con- sisting of equal numbers of representatives of constita- employers and employed. The members of the actioas board are usually elected by the associations of otvoiun- employers and workmen, though in some cases tary con- (e.g., in the manufactured iron trade board) the 'boanb? workmen's representatives are elected not by their trade union but by meetings of workmen employed

at the various works. The chairman may be an independent person, or, more usually, a representative of the employers, the vice-chairman being a representar tive of the workmen. In the arbitration an(conciliation boards in the boot and shoe trade, provision is made by which the chair may be occupied by representatives of the employers and workmen in alternate years. An inde- pendent chairman usually has a casting vote, which practically makes him an umpire in case -of equal voting, but where there is no outside chairman there is usually provision for reference of cases on which the board cannot agree to an umpire, who may either be a permanent officer of the board elected for a period of time (as in the

case of several of the boards in the boot and shoe trade), or selected ad hoc by the board or appointed by some out- side person or body. Thus the choice of the permanent chairman or umpire of the miners' conciliation board, formed in pursuance of the settlement of the coal dispute of 1893 by Lord Eosebery, was left to the Speaker of the House of Commons. Since the passing of the Con- ciliation Act, several conciliation boards have provided in their rules for the appointment of umpires by the Board of Trade.

Conciliation boards constituted as described above usually have rules providing that there shall always be equality of voting as between employer and workmen, in spite of the casual absence of individuals on one side or the other. In order to expedite business it is sometimes provided that all questions shall be first considered by a sub-committee, with power to settle them by agreement before coming before the full board. Boards of conciliar tion and arbitration conforming more or less to the above type exist in the coal, iron and steel, boot and shoe, and other industries in the United Kingdom. A somewhat different form of organization has prevailed in the cotton- spinning trade (since the dispute of 1892-93) and in the engineering trade (since the engineering dispute of 1897-98). In these important industries there are no permanent boards for the settlement of general questions, but elaborate agreements are in force between the employers' and workmen's organizations, which among other things prescribe the mode in which questions at issue shall be dealt with

and if possible settled. In the first place, if the question cannot be settled between the employer and his workmen, it is dealt with by the local associations or committees or their ofB.cials, and failing a settlement in this manner, is referred to a joint meeting of the executive committees of the two associations. In neither agreement is there any provision for the ultimate decision of unsettled questions by arbitration. The agree- ment in the cotton trade is known as the "Brooklands Agreement," and a large number of questions have been amicably settled under its provisions. . In the building trade, in which (with the exception of the plumbers' hoard) there are at present no national arrangements for conciliation and arbitration, it is very customary for the local " working rules," agreed to mutually by employers and employed in particular districts, to contain "conciliation rules" provid- ing for the reference of disputed questions to a' joint committee with or without an ultimate reference to arbitration. Yet another form of voluntary board is the " district board," consisting in most cases of representa- tives elected in equal numbers by the local chamber of commerce and trades council respectively. In the case, however, of the London Conciliation Board the workmen's representatives are elected, twelve by specially summoned meetings of trade union delegates and two by co-optatipn. The functions of district boards are to deal with dispufes in any trade which may occur within their districts, and of course they can only take action with the consent of both parties to the dispute, in this respect differing from the majority of "trade" boards, which, as a rule, are empowered by the agreement under which they are constituted to deal with questions on the application of either party. Another interesting type of board is that representing two or more groups of workmen and some- times their employers, with the object of settling " demar- cation" disputes between the groups of workmen (i.e., questions as to the limits of the work which each group may claim to perform). Examples of such boards are those representing shipwrights and joiners on the Clyde, Tyne, and elsewhere. While the arrangements for vol- untary conciliation and arbitration differ in this way in various industries, there is an equally wide variation

in the character and range of questions which the boards are empowered to determine. For example, some boards in the coal trade {e.g., the conciliation boards in North- umberland and the so-called " Federated Districts ") deal solely with the general rate of wages. Others, e.g., the "joint committee" in Northumberland and Durham, confine their attention solely to local questions not affect- ing the counties as a whole. The Durham conciliation board deals with any general or county questions. This distinction between • " general " and " local " questions corresponds nearly, though not entirely, to the distinction often drawn between questions of the terms of future employment and of the interpretation of existing agree- ments. Some conciliation boards are unlimited as regards the scope of the questions which Jhey may con- sider. This was formerly the case with the boards in the boot and shoe trade, but under the "terms of settle- ment " of the dispute in 1895 drawn up at the Board of Trade, certain classes of questions {e.g., the employment of particular individuals, the adoption of piece-work or time-work, &c.) were wholly or partially withdrawn from their consideration, and any decision of a board contra- vening the " terms of settlement " is null and void. A special feature in the procedure for conciliation and arbitration in the boot and shoe trade, is the deposit by each party of £1000 with trustees, as a financial guar- antee for the performance of agreements and awards. A certain class of conciliation boards, mostly in the Midland metal trades,, were attached to "alliances" of employers and employed, having for their object the regulation of production and of prices {e.g., the Bedstead Trade Wages Board). Some of these alliances, however, have been dissolved.

At all events up to the year 1896, the development of arbitration and conciliation as methods of settling labour ^Legislation disputes in the United Kingdom was entirely la the independent of any legislation. Previously to

United the Conciliation Act of 1896 (described below) Kingdom, gg^gj-g^^ attempts had been made by parliament to promote arbitration and conciliation, but with little or no practical result, and the Act of 1896 repealed all previous legislation on the subject, at the same time excluding the operation of the Arbitration Act of 1889 from the settlement of "any

difference or dispute to which this Act applies." The laws repealed by the Con- ciliation Act need only a few words of mention. During the 18th century the fixing of wages by magistrates under the Elizabethan legislation gradually decayed, and the Acts 20 Geo. II. c. 19 and 31 Geo. II. c. 11, gave summary jurisdiction to justices of the peace to determine disputes between masters and servants in certain circumstances, although no rate of wages had been fixed that year by the justices of the peace of the shire. These and other laws, relating specially to disputes in the cotton- weaving trade, were consolidated and amended by the Arbitration Act of 1824. This Act seems chiefly to have been aimed at disputes relating to piece-work in the textile trades, though applicable to other disputes arising out of a wages contract. It expressly excluded, however, the fixing of a rate of wages or price of labour or work- manship at which the workmen should in future be paid unless with the mutual consent of both master and work- men. The Act gave compulsory powers of settling the disputes to which it relates on application of either party to a court of arbitrators representing employers and workmen nominated by a magistrate. The award could be enforced by distress or imprisonment. The Act was subsequently amended in detail, and by the " Councils of Conciliation Act " of 1867 power was given to the Home Secretary to license " equitable councils of conciliation and arbitration " eqaally representative of masters and work-

men, who should thereupon have the powers conferred by the Act of 1824. The Act contains provisions for the appointment of conciliation committees, and other details which are of little interest seeing that the Act was never put into operation. Another amend- ment of the Act of 1824 was made by the Arbitration (Masters and Workmen) Act of 1872, which contem- plated the conclusion of agreements between employers and employed, designating some board of arbitration by which disputes included within the scope of the former Acts should be determined. A master or work- man should be deemed to be bound by an agreement under the Act, if he accepted a printed copy of the agreement and did not repudiate it within forty-eight hours. Like the previous legislation, however, the Act of 1872 was inoperative. The evidence given before the Eoyal Com- mission on Labour (1891-94) disclosed the existence of a considerable body of opinion in favour of some further action by the state*

for the prevention or settlement of labour disputes, and some impetus was given to the move- ment by the settlement through official mediafton of several important disputes, e.g., the great coal-miners' dispute of 1893 by a conference presided over by Lord Eosebery, the cab-drivers' dispute of 1894 by the media- tion of the Home Secretary (Mr Asquith), and the boot and shoe trade dispute of 1895 by a Board of Trade conference under the chairmanship of Sir Courtenay Boyle. In these, and a few other less important cases, the intervention of the Board of Trade or other depart- ment took place without any special statutory sanction. The Conciliation Act passed in 1896 was framed with a view to giving express authorization to such action in the future.

This Act is of a purely voluntary character. Its most important provisions are those of section 2, empowering the Board of Trade in cases " where a difference exists or is apprehended between any .employer, or any class of employers, and workmen, or between different classes of workmen," to take certain steps to promote a settlement of the difference. They may of their own initiative hold an inquiry or endeavour to arrange a meeting between the parties under a chairman mutually agreed on or appointed from the outside, and on the application of either party they may appoint a conciliator or a board of conciliation who shall communicate with the parties and endeavour to bring about a settlement and report their proceedings to the Board of Trade. On the application of both parties the Board of Trade. may appoint an arbitrator. In all cases the Board of Trade has discretion as to the action to be taken, and there is no provision either for compelling the parties to accept their mediation or to abide by any agree- ment effected through their intervention. There are other provisions in the Act providing for the registration of voluntary conciliation boards, and for the promotion by the Board of Trade of the formation of such boards in districts and trades in which they are deficient. During the first five years after the passage of the Act {i.e., up to the middle of 1901) the number of cases arising under section 2 (providing for action by the Board of Trade for the settlement of actual or apprehended disputes) was 113, and the number of settlements effected 70. Of the 43 disputes not settled under the Act, 10 were settled between the parties during the negotiations, and in 33 cases the applications were refused by the Board of Trade, or their efforts to effect a settlement were

unsuccessful. Of the 70 settlements, 32 were effected by conciliation and 38 by arbitration. At present, however, the number of cases of arbitration under the Act appears to be increas- ing compared with those of conciliation, and several voluntary conciliation boards formed or reorganized since the passage of the Act provide in theii^ rules for an

appeal to the Board of Trade to appoint an umpire in case of a deadlock. Eighteen boards are known to have already adopted this course. The figures given above show- that the Conciliation Act of 1896 has by no means, like previous legislation, been a dead letter, though the number of actual disputes settled is naturally small compared with the total number annually recorded. In spite of the com- plete discretion given to the Board of Trade as regards the offer of its services and to the parties as regards acceptance of its intervention, experience in the great engineering dispute of 1897 and the South Wales coal dispute of 1898, appears to show that public opinion may put pressure on the Board to attempt mediation in a dispute which has attracted popular attention, whatever may be the attitude of the parties directly concerned ; and there has been a ten- dency in some cases to make the action or inaction of the Department a subj ect of parliamentary debate. Ulider these conditions intervention must sometimes lead to disappoint- ment, and the danger must also be borne in mind that the expectation of official intervention may occasionally lead the losing side to prolong a hopeless dispute. If, however, direct official mediation in labour disputes is attended with difficulties, these do not apply to the appointment by the Board of Trade of umpires and arbitrators, on an applica- tion by both parties or by a voluntary conciliation board. Arbitration and conciliation in labour disputes as prac- tised in the United Kingdom are entirely voluntary, both

as regards the initiation and conduct of the Proposals negotiations and the carrying out of the agree- puision. ment resulting therefrom. In all these respects

arbitration, though terminating in what is called a binding award, is on precisely the same legal footing as conciliation, which results in a mutual agreement. Various proposals have been made (and in some cases carried

into effect in certain countries) for introducing an element of compulsion into this class of proceeding. There are three stages at which compulsion may conceivably be intro- duced. (1) The parties may be compelled by law to submit their dispute to some tribunal or board of concili- ation; (2) the board of conciliation or arbitration may have power to compel the attendance of witnesses and the production of documents ; (3) the parties may be compelled to observe the award of the board of arbitration. The most far-reaching scheme of compulsory arbitration in force in any country is that embodied intheNewZealandlndustrial Conciliation and Arbitration Act of 1894. Bills have been introduced into the BritishHouse of Commons for clothing voluntary boards of conciliation and arbitration, under cer- tain conditions, with powers to require attendance of wit-, nesses and production of dofeuments, without, however, compelling the parties to submit their disputes to these boards or to abide by their decisions. In the United King- dom, however,more attention has recently been given to the question of strengthening the sanction for the carrying out of awards and agreements than of compelling the parties to enter into such arrangements. An interesting step towards the solution of the difficulty of enforcement in certain cases is perhaps afforded by the provisions of the terms of settlement of the dispute in the boot and shoe trade drawn up at the Board of Trade in 1895. Under this agreement £1000 was deposited by each party with trustees, who were directed by the trust-deed to pay over to either party, out of the money deposited by the other, any sum which might be awarded as damages by the umpire named in the deed, fbr the breach of the agree- ment or of any award made by an arbitration board in consonance with it. Up to the present only one claim for damages has been sustained under this agreement, the amount of the damages given against the union being £300. Nevertheless it cannot be doubted that the

pecuniary liability of the parties has given stability to the work of the local arbitration boards, and the satis- faction of both sides with the arrangement is shown by the fact that the trust-deed, which lapsed in March 1900, was renewed for a further period of two years. Theoretically a trust deed of this kind can only offer a guarantee up to the point at which the original deposit on one side or the other is exhausted, as it is impossible to compel either party to renew the deposit. A proposal was

made by the Duke of Devonshire and certain of his colleagues on the Bioyal Commission on Labour for empowering associations of employers and employed to acquire, if they desired it, sufficient legal personality and corporate character to enable them to sue each other or their own members for breach of agreement. This would give the association aggrieved by a breach of award the power of suing the defaulting organization to recover damages out of their corporate funds, while each association could exact penalties from its members for such a breach. For this reason the suggestion has met with a good deal of support by those interested in arbitration, and conciliation.

Apart, however, from any suspicions entertained of it by workmen's associations, the question is not free from difficulties. The object of the change would be to convert what are at present only morally binding understandings into legally enforceable contracts. But apart from the possibility that some of such contracts would be held by the courts to be void as being "in restraint of trade," the tendency might be to give a strict legal interpretation to working agreements which might de- ' prive them of some of their effectiveness for the settle- ment of the conditions of future contracts between employers and workmen, while possibly deterring associ- ations from entering into such agreements for fear of litigation. , Individuals, moreover, could avoid liability by leaving their associations. Many persons are therefore of opinion that the present imperfect sanction for agreements and awards must be accepted as the lesser of two evils. In countries like New Zealand, where the parties are compelled to submit their differences to arbitration, some of the above objections do not apply.

The following statistics are based on the reports of ' the Labour Department of the Board of Trade on Strikes and Look-outs. The number of boards of conciliation and arbitration known to have statistics settled disputes in 1899 was 53, of which 50 %Zc,"f,^ come under the head of " trade," 2 of " district," and 1 of "general" boards. So far as known about 139 boards are in existence, but several of these did no active work in 1899. Of the 50 trade boards, 11 are connected with the boot and shoe trade, 9 with engineering and shipbuilding, 7 with coal-mining, 13 with iron and steel and other metal trades, 7 with the building trades, and the

others with various miscellaneous industries. The importance of the questions dealt with by these boards differs so very greatly — ranging from the classifi- cation of a sample to an alteration of wages affecting hundreds of thousands of men — that the statistics of the number of cases settled tend to be somewhat misleading. Nevertheless the following figures may be of some interest. Altogether, 1232 cases were considered by the boards in 1899, of which 606 were withdrawn or settled inde- pendently of the boards, and 61 were still unsettled at the end of the year. The remaining 675 cases were settled, 503 by the board or committees and 172 by arbitrators or umpires. The great majority of the cases settled were purely local questions. Thus 350 cases — or more than half the total— were dealt with by the "joint committees " in the Northumberland and Durham coal trades, which confine their action to local questions, such

as fixing the " hewing prices " for new seams. Of the remaining 325 cases, 125 are accounted for by the boot and shoe trade. Here again a large majority of the cases were questions of classifying sample boots, shoes, or materials, i.e., of determining under what heading of the existing piece-work lists a new pattern of boot or a new quality of material ought properly to be classified. During the year, however, several more general questions, e.g., rates of a minimum wage and overtime payment, affecting considerable bodies of men, were determined by the boot and shoe trade boards or their umpires. Thirty- nine cases were settled by a board for the tailoring trade in Aberdeen — all of minor importance. The iron and steel trades account for 30 cases, and engineering and shipbuild- ing for 81. Among the latter are included a considerable number of " demarcation disputes," i.e., disputes between two bodies of workmen as to the limits of the work to be performed by each. Four joint boards representing ship- wrights and joiners on the Tyne, Tees, and Clyde respectively, settled 67 such cases in 1899,, of which only 4 were, relegated to umpires. The great majority of the 'above cases did not actually involve stoppage of work, the most useful work of these permanent boards being the prevention rather than the settlement of

strikes and lock-outs. During 1899 only 10 strikes were settled by permanent boards — in 1898 the number being 19, and in 1897, 12. In none of these years were any of these strikes of great importance. A certain number of disputes are settled every year by the mediation or arbitration of disinterested individuals, e.g., the local mayor or county court judge. The number of strikes so settled in 1899 was 26, and in the previous year 16.

The operations under the Conciliation Act have been separately described above. Altogether, if the work of all agencies for conciliation and arbitration be included, the number of strikes and lock-outs settled by these means in 1899 was 38. During the five years 1894-99 the annual number of strikes so settled varied between 38 and 45. The number of work-people affected by these disputes in 1899 was 11,705, or about 6 per cent, of the persons involved in all the 719 disputes recorded in that year. It is clear from the above figures that the most im- portant and most hopeful part of the work of agencies for conciliation and arbitration is theadjustment of differences that might otherwise lead to stoppage, rather than the settlement of actual strikes.

The extent to which the methods of arbitration and conciliation can be expected to afford a substitute for strikes and lock-outs is one on which opinions Pttture differ very widely. The difficulties arising limits. from the impossibility of enforcing agreements or awards by legal process have already been discussed. Apart from these, however, it is evident that both methods imply that the parties, especially the work- people, are organized at least to the extent of being capable of negotiating through agents. In some industries (e.g., agriculture or domestic service) this preliminary condition is not satisfied ; in others the men's leaders possess little more than consultative powers, and employers may hesitate to deal either directly or through a third party with individuals or committees who have so little authority over those whom they claim to represent. And even where the trade organizations are strong, some employers object in any way to recognize the representative character of the men's officials. Recent cases of this kind that attracted attention were Lord Penrhyn's refusal to recognize the Quarrymen's Union or the quarry committee as repre- senting his quarrymen, and the refusal of several important

ra,ilway companies to deal with the Amalgamated Society of Railway Servants. The question of the ” recognition ”

of trade unions by employers is a frequent cause of dis- putes and is further referred to in the article on Steikes AND Lock-outs. It may be observed, however, that it fre- quently occurs that in cases in which both employers and employed are organized into associations which are accus- tomed to deal with each other, one or both parties enter- tain a strong objection to the intervention of any outside mediator, or to the submission of differences to an arbitrator. Thus the engineering employers in 1897 were opposed to any outside intervention, though ready to negotiate with the delegates chosen by the men. On the other hand, the cotton operatives have more than once opposed the pro- posal of the employers to refer the rate of wages to arbitration, and throughout the great miners’ dispute of 1893 the opposition to arbitration came from the men. Naturally, the party whose organization is the stronger is usually the less inclined to admit outside intervention. But there have been several recent cases in which em ployers, who refused to deal directly with trade union officials, have been willing to negotiate with a mediator who was well known to be in communication with these officials (e.g., in some of the recent railway disputes).

Apart, however, from the disinclination of one or both parties to allow of any outside intervention, we have to consider how far the nature of the questions in dispute may in any particular case put limits to the applicability of conciliation or arbitration as a method of settlement. Since conciliation is only a general term for the action of a third party in overcoming the obstacles to the conclusion of an agreement by the parties themselves, there is no class of questions which admit of settlement by direct negotiation which may not equally be settled by this method, provided of course that there is an adequate supply of sufficiently skilful mediators. As regards arbi- tration the case is somewhat different, seeing that in this case the parties agree to be bound by the award of a third party. For the success of arbitration, therefore, it is important that the general principles which should govern the settlement of the particular question at issue should be admitted by both sides. Thus in the manufactured iron trade in the north of England, it has throughout been

understood that wages should depend on the prices realized,, and the only question which an arbitrator has usually had to decide has been how far the state of prices at the time warranted a particular change of wage. On the other hand, there are many questions on which disputes arise (e.g., the employment of non-union labour, the restriction of piece-work, &c.) on which there is frequently no com- mon agreement as to principles, and an arbitrator may be at a loss to know what considerations he is to take into account in determining his award. Generally speaking, employers are averse from submitting to a third party questions involving discipline and the management of their business, while in some trades workmen have shown themselves opposed to allowing an arbitrator to reduce- wages beyond a certain point which they wish to regard as a guaranteed " minimum."

Another objection on the part of some employers and workmen to unrestricted arbitration is its alleged tendency to multiply disputes by providing an easy way of solving them without recourse to strikes or lock-outs, and so diminishing the sense of responsibility in the party ad-vancing the claims. It is also sometimes contended that arbitrators, not being governed in their decisions by a definite code of principles, may tend to " split the differ- ence," so as to satisfy both sides even when the demands on one side or the other are wholly unwarranted. This, it is said, encourages the formulation of demands purposely put high in order to admit of being cut down by an arbi- trator. One of the chief practical difficulties in the way of

the successful working of permanent boards of conciliation, consisting of equal numbers of employers and employed, with an umpire in case of deadlock, is the difficulty of inducing business men whose time is fully occupied to devote the necessary time to' the work of the boards, especially when either side has it in its power to compel recourse to the umpire, and so render the work of the conciliation board fruitless. In spite of all these difficulties the practice of arranging differences by conciliation and arbitration is undoubtedly spreading, and it is to be remembered that even in cases in which theoretically a basis for

arbitration can scarcely be said to exist, re- course to that method may often serve a useful purpose in putting an end to a deadlock of which both parties are tired, though neither cares to own itself beaten. Colonial Reference must now be made to some of the and forefen principal laws relating to arbitration and con- legisiation. ciliatiou outside the United Kingdom.

^ew Zealand. — The New Zealand Industrial Concilia- tion and Arbitration Act, 1894 (amended in detail by several subsequent Acts), provides for the incorporation of associations of employers or workmen under the title of iadustrial unions, and for the creation in each district of a joint conciliation board, elected by these industrial unions, with an impartial chairman elected by the board, to which a dispute may be referred by any party, a strike or lock-out beiQg thenceforth illegal. If the recommen- dation of the conciliation board is not accepted by either party, the matter goes to a court of arbitration consisting of two persons representing employers and workmen re- spectively, and a judge of the supreme court. The award of this court is enforceable by legal process, financial penalties up to £500 being recoverable from defaulting associations or individuals. If the property of an associa- tion is insufficient to pay the penalty, its members are individually liable up to £10 each. During the year 1899-1900 thirty-four cases were considered by the con- ciliation boards, and twenty were sent to the arbitration court. In addition, nine cases of breach of award or agreement were dealt with.

The above is only an outline of the principal provisions of this interesting Act, under which questions of wages, hours, and the relations of employers and workmen generally in New Zealand are now practically the subject of state regulation. Whatever may be the result of the Act when its indirect effects have had time to develop, it is clear that it goes far beyond the mere settlement of strikes, and is more properly to be judged as a measure for the state regulation of industry.

Mw South Wales}— In New South Wales a ” Concilia- tion and Arbitration Act” was passed in 1899, resem- bling the United Kingdom Act in the general character of its provisions, except that an arbitrator or

investigator appointed by Government is invested with compulsory powers of summoning witnesses, entering premises, and examining on oath.

Canada.— In 1900 a Conciliation Act was passed by the Dominion Parliament resembling the United Kingdom Act in most of its features.

France. — The French Conciliation and Arbitration Law of December 1892 provides that either party to a labour dispute may apply to the juge de paix of the canton, who informs the other party of the application. If they concur within three days, a joint committee of conciliation is formed of not more than five representatives of each party, which meets in the presence of the juge de paix, who, however, has no vote. If no agreement results the parties are invited to appoint arbitrators. If such arbitrators

1 Since this article was written a compulsory Arbitration Law has been passed in New South Wales (December 1901).

are appointed and cannot agree on an umpire, the president of the civil tribunal appoints an umpire. In the case of an actual strike, in the absence of an application from either party it is the duty of the juge de paix to invite the parties to proceed to conciliation or arbitration. The results of the action of the juge de paix and of the con- ciliation committee are placarded by the mayors of the communes affected. The law leaves the parties entirely free to accept or reject the services of the juge depaix. During the seven years 1893-99 the Act was put in force in 778 cases — viz., 425 on application of workmen, 23 of employers, 18 of both sides, and 312 without application. Altogether, 204 disputes were settled — 88 per cent, by coUcHiation and 12 per cent, by arbitration.

Germany. — In several Continental countries, courts or boards are established by law to settle cases arising out of existing labour contracts — e.g., the French " Conseils des Prud'hommes," the Italian " Probi Viri," and the German " Oewerbegerichten," — and some of the questions which come before these bodies are such as might be dealt with in England by voluntary boards or joint committees. The majority, however, are disputes between individuals as to wages due, &c., which would be determined in the United Kingdom by a court of summary jurisdiction. It is note- worthy, however, that the German industrial courts

(Oewerbegerichten) are empowered under certain conditions to offer their services to mediate between the parties to an ordinary labour dispute. In the case of a strike or lock- out the court must intervene on application of both parties, and may do so of its own initiative or on the invitation of one side. Failing a settlement at a conferen6e between the parties in the presence of the president and assessors of the court, the court arrives at a decision on the merits of the dispute which is communicated to the parties, who are allowed a certain time within which to notify their accept- ance or rejection. The court has no power to compel the attendance of the parties or the observance of its decision. During 1896 there were 44 applications for the inter- vention of the Industrial Courts. Eighteen agreements were brought about and 11 decisions were pronounced by the courts, of which 2 were accepted by both parties and 9 were rejected. In 8 cases the courts made unsuccessful attempts to promote settlements without pronouncing decisions. The above figures are taken from a statement prepared for the Eeichstag commission for considering petitions (1897-98).

Switzerland. — The canton of Geneva enacted a law in 1900 providing for the settlement by negotiation, con- ciliation, or arbitration of the general terms of employ- ment in a trade, subject, however, to special arrangements between employers and workmen in particular cases. The negotiations are to take place between delegates chosen by the associations of employers and employed, or failing them, by meetings summoned by the Council of State on sufficient applications. Failing settlement, the Council of State, on application from either party, is to appoint one or more conciliators from its members, and if this fail the central committee of the " Prud'hommes," together with the delegates of employers and workmen, is to form a board of arbitration, whose decision is binding. Any collective suspension of work is illegal during the period covered by the award or agreement.

United States. — In the United States several States have legislated on the subject of conciliation and arbitration, among the first of such Acts being the "Wallace" Act of 1883, in Pennsylvania, which, however, was almost inopera- tive. Altogether, 24 States have made constitutional or statutory provision for mediation in trade disputes, of which 17 contemplate the

formation of permanent State boards. The only State laws which require notice are

those of Massachusetts and New York providing for the formation of State boards of arbitration. The Massa- chusetts board, founded in 1886, consists of one employer, one employed, and one independent person chosen by both. The New York board (1886) consists of two representatives of different political parties, and one member of a bonorfide trade organization within the State. In both States it is the duty of the board, with or without application from the parties, to proceed to the spot where a labour dispute has occurred, and to endeavour to promote a settlement. The parties may decline its services, but the board is em- powered to issue a report, and on application from either side to hold an inquiry and publish its decision, which (in Massachusetts) is binding for six months, unless sixty days' notice to the contrary is given by one side to the other. Several States (including Massachusetts and New York) provide not only for State boards, but also for local boards.

In Massachusetts, during 1899, the State board had its attention directed to 25 disputes (several, as in previous years, being in the boot and shoe trade). Of these it settled 1 by arbitration, and in 6 others promoted a settlement by conciliation. The remaining cases were settled independently of the Board, or were unsettled when the Keport was issued.

Federal legislation can only touch the question of arbi-

tration and conciliation so far as regards disputes affecting commerce between different States. Thus an Act of June 1898 provides that in a dispute involving serious inter- ruption of business on railways engaged in inter-State commerce, the Chairman of the inter-State Commerce Commission and the Commissioner of Labour shall, on application of either party, endeavour to effect a settlement or to induce the parties to

submit the dispute to arbitra- tion. While an arbitration under the Act is pending a strike or lock-out is unlawful.

Authorities. — For the recent development of arbitration and conciliation in the United Kingdom, see the Annual Reports of the Labour Departtnent of the Board of Trade on Strikes and Lock-outs from 1888 onwards. Since 1890 these reports have contained special appendices on the work of arbitration boards. See also the Labour Gazette (the monthly journal of the Labour Department) from 1893 onward. The Beports of the Boyal Commission on Labour (1891-94) contain much valuable information on the subject. For the working of the Conciliation Act see the Keports of the Board of Trade on their proceedings under the Conciliation Act, 1896. For the earlier history in the United Kingdom — Crompton, Industrial Conciliation (1876) ; Pkice, Industrial Peace (1887). For foreign and colonial developments — the Report of the French Office du Travail, De la Conciliation et de VArbitrage dans les Conflits Collectifs entre Patrons et Ouvriers en France et a V Stranger (1893) ■ the Annual Reports of the same Department on Strikes, Lock-outs, and Arbitration; the Beports of the Massa- chusetts and New York State Arbitration Boards, and of the New Zealand Department of Labour ; and the Labour Gaeette.

ARBITRATION U^TERJ^^ATIOJVTAL.

INTERNATIONAL arbitration is a proceeding in which two nations refer their differences to one or more selected persons, who, after affording to each party an opportunity of being heard, pronounce judgment on the matters at issue. It is understood, unless otherwise ex- pressed, that the judgment shall be in accordance with the l&w by which civilized nations have agreed to be bound when- ever such law is applicable. An international arbitrator may be the chief of a friendly power, or he may be a private individual. When he is an emperor, a king, or a president of a republic, it is not expected that he will act person- ally; he may by tacit consent appoint a delegate or delegates to act on his behalf, and avail himself of their labours and views, the ultimate decision being his only in name. In this respect international arbitration differs from civil arbitration, since a private arbitrator cannot delegate his office without

express authority. The analogy between the two fails to hold good in another respect also. In civU arbitration the decision or award may be made a rule of court, after which it becomes enforceable by writ of execution against person or property. An international award cannot be enforced directly; in other words, it has no legal sanction' behind it. Its obligation rests on the good faith, of the parties to the reference, arid on the fact that public opinion can, with the help of a world-wide press, always be brought to bear on any state that may seek to evade its moral duty. The obligation of an ordinary treaty rests on precisely the same foundations. True it is that an international award may be disregarded for excess of jurisdiction, ambiguity of language, or corrupt conduct on the part of the arbitrator. But each of these flaws would be equally fatal to a private award. We have said that it is the duty of an international arbitrator to decide in accordance with international law. The eminent jurist, M. Bluntschli, considers that if he does not the award may be set aside. To admit this doctrine would, however, lead to endless disputes, since international law has never been codified. A fresh arbitration might have to be entered on in order to decide, first, what the law was.

and, secondly, whether it applied to the matter in hand. As a matter of fact, there is but a single instance on record of an award being repudiated, viz., that of the king of Holland in 1831 with regard to the north-eastern boundary of the State of Maine. That case was, however, a very peculiar one. The arbitrator was unable to draw the frontier line by reason of the imperfection of the maps then extant, and his direction for a further topographical inquiry was beyond the terms of the reference. The award was, there- fore, void for excess just as a private award would have been.

An account of this subject divides itself naturally into four parts: a brief sketch of past history; an examination of a few selected instances in which international arbitrar tion has been successfully resorted to; an account of the various treaties and projects for securing its future employ- ment; and a short discussion of the limits outside which it appears to be inapplicable.

In the sense in which the term is now used, international arbitration is essentially a modem product, since the very exist- ence of international relations is modem. The nearest approach to it before the Christian era was intermuni- ^‘s^iy. cipal arbitration, as practised in ancient Greece. For example, the Amphictyonic Councils occasionally acted as arbitrators between one town and another ; in this way a dispute was settled between Athens and Delos with regard to a right of precedence in the temple of Apollo in 344 b.c. The ancient Greek towns also sometimes referred their differences to a third town, or even to private individuals. Thus Sparta arbitrated between Athens and Megara.with regard to the possession of Salamis; Periander between Athens and Mitylene with regard to the promontory of Sigeum; and Themistocles between Corinth and Corcyra with regard to the island or (as it formerly was) the peninsula of Leucadia. At the period of the Peloponnesian war, the practice ot arbitration had become so well recognized that Thucydides (i 85) pute into the mouth of Archidamus, king of Sparta, the words.

It IS impossible to attack as a wrong-doer any one who is willing to answer before an arbitral tribunal." But in all these cases the arbitration was between two Hellenic communities. It would have been no more possible for a Greek to arbitrate with a "barbarian" than to sacrifice at the same altar with him.

The exclusiveness which checked the development of arbi- tration m Greece told against it with tenfold force in Rome.

ARBITEATION, INTEENATIONAL

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Republican Rome dealt with non-Romans as modern European governments have dealt with inferior native races. When in 445 B.C. the Republic was chosen to arbitrate between the towns of Ardea and Aricia, she settled the question by taking the disputed land for herself. The same thing occurred in 180 b.c, when a territorial difference between Neapolis and Nola was referred to the Roman Senate. Under the Caesars, frequent recourse was had to civil or private arbitration, the procedure of which was perfected by the best intellects of the day, but any othfer kind was

from the nature of things impossible. The vastness of the territory of Imperial Rome was such that she had practically nothing external to herself. She proudly claimed to be "the arbiter of the universe," so that the notion of her arbitrating with an outside power involved a contradiction in terms.

The Middle Ages may not inaptly be characterized as a period of perpetual conflict — between absolutism and democracy, between' great feudal lord and rebellious vassal, between Guelph and GhibeUine, between Catholic and Protestant. Amid this clash of arms the Popes were not infrequently appealed to, and there are several instances of their having acted either in that character or as mediators. Witness the intervention of Innocent III. between King John and his barons ; of Boniface VIII. between Edward I. and Philippe le Bel ; of Leo X. between Maximilian and the doge of Venice. A similar r61e was filled by the mediaeval sovereigns, notably by the kings of France. In 1603 a scheme for establishing a Greneral Council was projected by Sully, the minister of Henry IV., to which the fifteen states, into which Europe was to be parcelled out, were to submit all their differ- ences. Needless to say, the scheme came to nothing. In truth, its object was not so much to establish an arbitration tribunal as to disestablish and disendow the House of Austria — a I'esult which was reached after the Thirty Years' War, when northern Protestant Germany was severed from the Catholic monarchy of the south. A century after the publication of Sully's " Grand Design," a more disinterested and more elaborate scheme was prepared by the Abbfi St Pierre for settling all international disputes by means of a General League of Christendom. Rous- seau says of it that it failed "because it was madness in its author to be wise when the majority of people were fools." However this may be, the seed sown by the good abb, although it fell on barren ground, was not destined to perish. It pro- duced a crop of other schemes later. Jeremy Bentham, in 1789, advocated the formation of a

Greneral Biet — or Congress — to which each of the powers should send two deputies, and he sug- gested making its decisions coercive by putting any refractory state under the ban of Europe. Immanuel Kant, in 1795, proposed to base all international right on a Federation of Free States, the civil constitution of each of which was to be made republican. Both Bentham and Kant were, indeed, as " voices crying in the wilderness," for Europe had no "ears to hear" after the war of the French Revolution had broken out and had deluged her in blood. Yet no sooner had that struggle ended than organized efforts on behalf of arbitration began to manifest themselves in various ways. The first of such efforts was made in 1816 by the Society of Friends in New York. In 1835 the American Peace Association presented a petition to the Senate of Massachusetts for establishing a "standing Court of Nations." Similar petitions were presented subsequently in Maine and Vermont. The subject was brought before the United States Senate in December 1837, and was referred to the Committee of Foreign Affairs, which reported it to be premature. In 1839 the same association presented ' a fresh petition for a similar purpose. This met with the same fate. In 1853 the United States Senate voted in favour of inserting arbi- tration clauses in treaties, "the arbitrators to be eminent jurists, having little or no connexion with politics." In 1849 Mr Richard Cobden advocated a similar proposition in the British House of Commons, and moved for an address to the crown praying that the Queen would instruct her ForeigA Secretary to see that it was carried out. He maintained that a treaty for general arbitra- tion would be as binding as any other, and that a country which did not fulfil its obligation to refer would enter on war " with the brand of infamy stamped upon its banners." The motion for an addressN was opposed by Lord Palmerston, then first minister, who carried "the previous question " by a majority of 176 to 79. In 1873 Mr Henry Richard re-introduced the subject jn a some- what different form by urging an invitation to forei^ powers to concur in a general and permanent system. In spite of mucli cold water thrown by Mr Gladstone, who had now become premier, Mr Richard obtained a majority of ten in his favour. The Representative Assembly at Westminster had thus, like the Senate at Washington, undergone a change of sentiment in the coarse of a single generation. Motions substantially similar to Cobden's were carried in the Italian Chamber in August 1873, in the Dutch Chamber in November 1874, in

the Belgian Chamber in January 1875. Almost contemporaneously with Mr Richard's success in Parlia-

ment, fresh impulse was given to the movement by bodies of public or learned men associated together, not for humanitarian purposes, but for the elucidation of international legal principlea The foremost of these was the Institute of International Law {L'Institut de droit international), which is composed of men of different nationalities, distinguished in that department of learning. ' Its first conference was held at Ghent on 18th Sep- tember 1873, when a committee was appointed with special instruc- tions to study the question. On this committee the United States were represented by Mr Dudley Field, Belgium by M. de Laveleye, Italy by Signer Pierantoni, Germany by Herr Gold- schmidt. Great Britain by Sir William Vernon Harcourt (then Professor of International Law at Cambridge). In the same year there was founded in London an "Association for the Reform and Codification of the Law of Nations," which put international arbitration in the forefront of its programme. Its first meeting was held at Geneva in 1874. The name of this body was altered in 1895 to "The International Law Association." In 1888 a third association was formed under the style of "The Permanent Parliamentary Committee in favour of Arbitration and Peace," or, as it is sometimes called for shortness, " The International Parliamentary Union." This union has a permanent office at Berne. Its first meeting was held in Paris in June 1889, under the presidency of the late M. Jules Simon, and was attended by 129 members from England and the United States. In July 1890 the union met again in London under the presidency of the late Lord Herschell, and a committee was then formed to organize similar bodies on the Continent and in America. The meetings of the union continue to take place yearly.

The disputes which have been determined by inter- national arbitration may be arranged in two main groups — ^A. Those which have arisen between state and state in their sovereign capacities ; B. Those in which one state has made a demand upon another state, ostensibly in its sovereign capacity, but really on behalf of some individual or set of individuals whose interests it was bound to pro- tect. To the former group belong territorial disputes, e.g., questions of boundaries on land and of

fisheries at sea ; to the latter pecuniary claims in respect of acts alleged to have been wrongfully done to one or more subjects of one state by, or with the authority of, another state. Such acts comprise, amongst other things, (a) breaches of neu- trality, by aiding and abetting a belligerent power or by permitting hostile operations to take place on neutral soil ; (6) unlawful arrests and seizures. The remaining cases are of a miscellaneous character, and do not admit of separate classification.

(A.) " Territorial disputes," says Alexander Hamilton, the eminent American statesman, in the Federalist, " have at all times been found one of the most fertile sources of hostility among nations." "Perhaps," he adds, "the greatest portion of the wars that have desolated the earth have sprung from this origin." This sentiment, true enough at the close of the 18th century, is fortunately no 1 onger correct. The settlement of territorial disputes by arbitration has of late been the rule rather than the exception. We begin with one which was a serious disappointment to Great Britain, having been marred by a mistake in the form of the reference, but in which, notwithstanding, she loyally acquiesced. The treaty of Washington of 1846 provided that the north-western frontier of the United States near the parallel of 49° N. should run in a westerly direction along that parallel to the middle of the channel which separates the continent from Vancouver Island, and thence in a southerly direc- tion through the middle of the same channel and of Fuca Strait to the Pacific Ocean. The dispute was as to the precise way in which this southern line was to be drawn. It was referred to the German emperor to decide whether the line should pass through Rosario Strait or through the Canal de Haro. The emperor appointed a geog- rapher, a jurist, and a diplomat to study the subject and to report to him. This they did, and on the 21st October 1872 he made an award by which the channel of Haro was divided equally between the contending parties, the United States being declared entitled to exclusive

possession of all the other channels to the north of the Strait of Fuca, together with the island of San Juan and several small islets.

The facts of the territorial dispute between Great Britain and the Republic of Venezuela with regard to British Guiana — dating back to 1841 and not settled until 1899— are as follows : —

The British claimed title through the Dutch, the Venezuelans claimed title through Spain. The Dutch in the course of their war of independence had established settlements Venezuela, along the coast of Guiana, of which the most im- portant was Kijkoveral, situated at the point where the Cujrnni, the Massanmi, and the Essequibo rivers unite. In 1648, by the treaty of Munster, they were confirmed in the possession of the territory which they then held. Subsequently they extended their posts along the coast as far as the mouth of the Amakuru, and inland along the courses of the three rivers above named. The British claimed that their rights extended to the whole Cuyuni basin, but the boundary actually insisted upon was a line, laid out by Sir Robert Schomburgk in 1840, and ■ known as the Schomburgk line, which included the district of Barima and so much of the basin of the Cuyuni as lies to the west of the main stream. This claim was based upon Dutch occupa- tion, actual or constructive, of territory previously unoccupied. The Venezuelans claimed the whole country as far as the Esse- quibo, that is to say, more than half of the colony of British Guiana, as shown on the latest maps. They alleged that the bull of Alexander VI. of 1493 had granted to Spain all territory that she might discover west of a line drawn 100 leagues west of the Azores, and that at the date of the bull the papacy was universally recognized as a competent international authority, particularly in matters affecting territory reclaimed from the heathen. They further alleged that the Spaniards had discovered Guiana, and had thus obtained, even without the bull, an inchoate title, which they had perfected by exploration and acts of sovereignty.

In 1850 it was arranged between the two Governments that neither should enter into or encroach upon the territory in dis- pute ; but subsequently the Venezuelans disregarded this arrange- ment, and in 1883-84 made grants and concessions in the territory claimed by the British. In November 1886 the British Govern- ment issued a notice to the effect that these concessions were invalid; and in consequence of this notice, and of other differ- ences concerning the proposed erection of a lighthouse upon

Barima Point, the Venezuelan Government in 1887 broke off diplomatic relations. In 1890 they suggested arbitration, which Great Britain refused on the ground that, as regarded the terri- tory comprised within the Schomburgk line, the British title was clear and there was nothing to arbitrate about. In July 1895 Mr Secretary Olney, on behalf of the United States, addressed a lengthy despatch to the British Government, urging that the refusal to arbitrate should be reconsidered, and intimating that any attempt to put hostile pressure upon Venezuela would be considered by his Government as an infringement of the Monroe doctrine. To this Lord Salisbury replied that Great Britain could not consent to go to arbitration in respect of territory actually settled and occupied by British subjects. On 17th December President Cleveland, in his message to Congress, announced that Great Britain having refused arbitration, he intended to appoint a commission which should report upon the respective rights of the parties, and he added : " When such report is made and accepted, it wiU, in my opinion, be the duty of the United States to resist by every means in its power, as a wilful aggression upon its rights and interests, the appropriation by Great Britain of any lands, or the exercise of any governmental jurisdiction over any territory, which, after investigation, we shall have determined of right to belong to Venezuela." The effect of this message was to call forth in the United States a great display of warlike en- thusiasm, and to occasion a fall in the value of American securities amounting to $400,000,000. In England it was received with considerable astonishment but without active resentment, the public mind being almost immediately diverted to the troubles arising out of Dr Jameson's raid into the Transvaal. In January 1896 the United States appointed their commission, and invited the British Government to furnish a statement of their case. The British Government declined to recognize the juris- diction Of this commission. Fresh negotiations were then entered into for arbitration, on the understanding that the rights of Great Britain in the settled territory should be protected. In February 1897 a treaty was signed at Washington between Great Britain and Venezuela, in which four arbitrators were named, viz., Lord Herschell and Sir Richard Henn Collins on behalf of Great Britain, and Chief-Justice Fuller and Mr Justice Brewer, both of the Supreme Court of the United States, on behalf of

Venezuela. A fifth arbitrator was to be appointed by these four, or, in the event of their failure to agree, by the king of Sweden and Norway. The four arbitrators agreed to appoint as their colleague M. de Martens, privy councillor and member of the Ministry of Foreign Affairs in Russia. Lord Herschell having died in March 1899, the Lord Chief-Justice of England, Lord Russell of Killowen, was appointed in his place. The court so constituted assembled in Paris in June 1899. On 3rd October the arbitrators published their award. By it Venezuela obtained the district of Barima as far as Point Flaya, and a strip of country between the Wenamu and Cuyuni rivers; elsewhere the new boundary coincided with the Schomburgk line. Barima, which is a district strategically important to Venezuela, but otherwise of little value, had been offered to her by the British Government at least three times in the prolonged course of the negotiation. The free navigation of the rivers Amakuru and Barima was secured to Great Britain, which had every reason to be satisfied with the result.

*Of disputes with regard to fisheries, the two most im- portant in recent times are the Newfoundland and the Bering Sea cases. The Newfoundland dis- pute is a very old one, and is not yet closed. Newtound- By the treaty of Utrecht of 1713 a right was t^hery. reserved to French subjects to catch fish and to dry them on that part of Newfoundland which stretches from Cape Bonavista to the northern point of the island, and from thence coming down by the western side reaches as far as Cape Eiche. By the treaty of Versailles of 1783 France renounced the fishery from Bonavista to Cape St John on the east coast, receiving in return extended rights upon the west coast as far as Cape Eay. Neither treaty purported to grant exclusive right, but there was annexed to the treaty of Versailles a declaration to the effect that "His Britannic Majesty will take the most positive measures for preventing his subjects from inter- rupting in any manner by their competition the fishery of * the French during the temporary exercise of it which is granted to them upon the coasts of the island of New- foundland, and he will for this purpose cause the fixed settlements which shall be formed there to be removed." Upon this declaration the French founded a claim to exclusive fishing rights within the limits named. Various conventions were entered into with a view to defining these rights in 1864, 1884, and*

1886, but they remained inoperative, the consent of the Newfoundland Legislature — to which they were made subject — having been hitherto refused. Meanwhile the French Government granted a bounty to the French fishermen which enabled them to undersell the colonists. In 1887 the Newfoundland Leg- islature passed an Act forbidding the sale of bait, which struck a severe blow at the French industry. This was not, however, the whole cause of difference between Great Britain and France. At the date of the treaty of Utrecht, and for more than a century afterwards, the French fished in this region almost entirely for cod, but subsequently they also fished there for lobsters, and about the year 1886 they erected factories for "tinning" or "canning" lobsters at Port au Choix on the north-west coast of the island. This, it was contended, was not within the treaty, which only contemplated cod fishing, and gave no landing rights except in respect of that species of fish. Moreover, the colonial fishermen had, prior to 1886, erected lobster factories of their own on that part of the coast which is known as "the French shore," so that their trade was directly interfered with by the factories at Port au Choix. Mutual protests and remonstrances ensued, each party appealing to their respective governments to expel the intruders. At length, in March 1891, a treaty was signed between Great Britain and France by which the two nations agreed to refer the lobster dispute to a tribunal composed of three jurists named by the two countries in common, and four delegates, two from each country, who were to act as intermediaries between their respective

governments and the other arbitrators. The arbitration tribunal had held no sitting down to the time of writing (1900), but a modus vivendi was arranged in 1890 by which no lobster fisheries which were not in operation in July of that year were to be permitted, except with the joint consent of the commanders of the British and French naval stations. This arrangement has been renewed from year to year, and has been the means of keeping the peace. Another important fishery dispute arose between Great Britain and the United States with regard to the fur seals in Bering Strait. The facts are as follows :—

In the year 1867 the United States Government had pur- chased from Russia all her territorial rights in Alaska and

the adjacent islands. The boundary between the Bering two powers as laid down by the treaty for purchase Sea. was a line drawn from the middle of Bering Strait

south-west to a point midway between the Aleutian and Komandorski Islands, dividing Bering Sea into two parts, of which the larger was on the American side of this line. This portion included the Pribyloff Islands, which are the principal breeding grounds of the seals frequenting those seas. By certain Acts of Congress, passed between 1868 and 1873, the killing of seals was prohibited upon the islands of the Pribyloff group and in "the waters adjacent thereto," except upon certain specified conditions. No definition of the meaning of the words "adjacent waters" was given in the Act. In 1870 the exclusive right of killing seals upon these islands was leased by the United States to the Alaska Commercial Company, upon conditions limit- ing the numbers to be taken annually, and otherwise providing for their protection. As early as 1872 the operations of foreign sealers attracted the attention of the United States Government, but any precautions then taken seem to have been directed against the capture of seals on their way through the passages between the Aleutian Islands, and no claim to jurisdiction beyond the threer mile limit appears to have been put forward. On 12th March 1881, however, Mr French, acting secretary of the United States Treasury, in answer to a letter asking for an interpretation of the words " waters adjacent thereto " in the Acts of 1868 and 1873, stated that all the waters east of the boundary line were con- sidered to be within the waters of Alaska territory. In March 1886 this letter was communicated to the San Francisco Customs by Mr Manning, secretary of the Treasury, for publication. In the same summer three British sealers, the Carolena, Onward, and Thornton, were captured by an American revenue cutter sixty miles from land. They were condemned by the district judge on the express ground that they had been sealing within the limits of Alaska territory. Diplomatic representations followed and an order for release was issued, but in 1887 further captures were made and were judicially supported upon the same grounds. The respective positions taken up by the two governments in the controversy

which ensued may be thus indicated. The United States claimed as a matter of right an exclusive juiasdiction over the sealing industry in Bering Sea; they also contended that the protection of the fur seal was, upon grounds both of morality and interest, an international duty, and should be secured by international arrangement. The British Government repudiated the claim of right, but were willing to negotiate upon the question of international regulation. Between 1887 and 1890 negotiations were carried on between Russia, Great Britain, and the United States with a view to a joint convention. Unfortunately the parties were unable to agree as to the principles upon which regulation should be based. The negotiations were wrecked upon the question of pelagic sealing. The only seal nurseries were upon the Pribyloff Islands, wliich belonged to the United States, and the Komandorski group, which belonged to Russia. Con- sequently to prohibit pelagic sealing would have been to exclude Canada from the industry. The United States, nevertheless, in- sisted that such prohibition was indispensable on the grounds — (1) that pelagic sealing involved the destruction of breeding stock, because it was practically impossible to distinguish between the male and female seal when in the water ; (2) that it was un- necessarily wasteful, inasmuch as a large proportion of the seals so killed were lost. On the other hand, it was contended by Great Britain that in all known cases the extermination of seals had been the result of operations upon land, and had never been caused by sealing exclusively pelagic. The negotiations came to nothing, and the United States fell back upon their claim of right. In June 1890 it was reported that certain American revenue cutters had been ordered to proceed to Bering Sea. Sir Julian Pauncefote, the British ambassador at Washington, having failed to obtain an assurance that British vessels would not be interfered with, laid a formal protest before the United States Government.

Thereupon followed a diplomatic controversy, in the course of which the United States developed the contentions which were afterwards laid before the tribunal of arbitration. The claim that Bering Sea was mare clausum was abandoned, but It was asserted that Russia had formerly exercised therein rights of exclusive jurisdiction which had passed to the United States, and they relied inter alia upon the ukase of 1821 by which foreign vessels had been forbidden .to approach within 100 Italian miles

of the coasts of Russian America. It was pointed out by Great Britain that this ukase had been the subject of protest both by Great Britain and the United States, and that by treaties similar in their terms, made between Russia and each of the protesting powers, Russia had agreed that their subjects should not be troubled or molested in navigating or fishing in any part of the Pacific Ocean. The American answer was that the Pacific Ocean did not include Bering Sea. They also claimed an interest in the fur seals, involving the right to protect them outside the three-mile limit. In August 1890 Lord Salisbury proposed that the question at issue should be submitted to arbitration. This was ultimately assented to by Mr Secretary Blaine on the under- standing that certain specific points, which he indicated, should be laid before the arbitrators. On 29th February 1892 a definitive treaty was signed at Washington. Each power was to name two arbitrators, and the president of the French Republic, the king of Italy, the king of Norway and Sweden, were each to name one. The points submitted were as follows : — (1) What exclusive jurisdiction in the sea now known as Bering Sea, and what exclusive rights in the seal fisheries therein, did Russia assert and exercise prior, and up to the time of, the cession of Alaska to the United States ? (2) How far were her claims of jurisdiction as to the, seal fisheries recognized and conceded by Great Britain ? (3) Was the body of water now known as Bering Sea included in the phrase "Pacific Ocean," as used in the treaty of 1825 between Great Britain and Russia, and what rights, if any, in Bering Sea were held exclusively exercised by Russia after the said treaty ? (4) Did not all the rights of Russia as to jurisdiction and a& to the seal fisheries in Bering Sea east of the water boundary, in the treaty between the United States and Russia of the 30th March 1867, pass unimpaired to the United States under that treaty ? (5) Had the United States any and what right of protection over, or property in, the fur seals frequenting the islands of Bering Sea when such seals are found outside the three-mile limit ? In the event of a determination in favour of Great Britain, the arbitrators were to determine what con- current regulation^ were necessary for the preservation of the seals, and a joint commission was to be appointed by the two powers to assist them in the investigation of the facts of seal life. The ques- tion of damages was reserved for further discussion, but either party was to be at liberty to submit any question of fact to the arbitrators, and to ask for a finding thereon. The tribunal was to sit at Paris. The

treaty was approved by the Senate on 2913i March 1892, and ratified by the President on 22nd April.

The United States appointed as arbitrator Mr John H. Harlan, a Justice of the Supreme Court, and Mr John T. Morgan, a member of the Senate. The British arbitrators were lord Hannen and Sir John Thompson. The neutral arbitrators were the Baron de Couroel, the Marquis Visconti Venosta, and Mr Gregers Gram, appointed respectively by the president of the French Republic, the king of Italy, and the king of Norway and Sweden. The sittings of the tribunal began in February and ended in August 1893. The main interest of the proceedings lies in the second of the two claims put forward on behalf of the United States. This claim cannot easily be stated in language of precision; it is indicated rather than formulated in the last of the five points specially submitted by the treaty. But its general character may be gathered from the arguments addressed to the tribunal. It was suggested that the seals had some of the characteristics of the domestic animals, and cpuld therefore be the subject of some- thing in the nature of a right of property. They were so far amenable to human control that it was possible to take their increase without destroying the stock. Sealing upon land was legitimate sealing ; the United States being the owners of the land, the industry was a trust vested in them for the benefit of mankind. On the other hand, pelagic sealing, being a method of promiscuous slaughter, was illegitimate ; it was contra bonos mores and analogous to piracy. Consequently the United States claimed a right to restrain such practices, both as proprietors of the seals and as proprietors and trustees of the legitimate in- dustry. It is obvious that such a right was a novelty hitherto unrecognized by any system of law. Mr Carter, therefore, as counsel for the United States, submitted a theory of international jurisprudence which was equally novel. He argued that the determination of the tribunal must be grounded upon " the principles of right," that "by the rule or principle of right was meant a moral rule dictated by the general standard of justice upon which civilized nations are agreed," that "this international

standard of justice is but another name for "international law," that the particular recognized rules were but cases of the applica^ tion of a more general rule, and that where the particular rules were silent the general rule applied. The practical effect of this contention appears to be that an international tribunal can make new law and apply it retrospectively. In spite of this ingenious argument, which was strenuously opposed by Sir Charles Russell, the leading counsel for Great Britain, the judgment of the arbi- trators was in favour of Great Britain on all points. It only remained for the arbitrators to consider the question of regulation which had also been submitted to them. Upon this point the arguments of the American counsel were allowed their due weight. A close time was appointed for sealing, the use of firearms was forbidden in Bering Sea, and pelagic sealing was prohibited within sixty miles of the PribylofE Islands. The award was signed and published on 15th August 1893. The question of damages which had been reserved was ultimately settled in 1897 by a joint commission appointed by the two powers in February 1896, the total amount awarded to the British sealers being $473,151 .26.

(B.) We pass now to State action on behalf of individuals. The following is an illustration of a dispute of this class, which was settled by arbitration nearly forty years after the occasion which gave rise to it. On the night of 26th The September 1814, during the war between Great

"Oeaerai Britain and the United States, the General Arm- Ann- ^^ strong) an American privateer, fired upon the strong."]3Qa^^g qJ g^ British squadron which had just entered the port of Fayal, an island of the Azores group. The British squadron retaliated next day by cannonading the privateer within the limits of the port, and managed to destroy her. Fayal and its port were then, as now, Portuguese territory, and the United States claimed to be indemnified by the Portuguese Government for the loss of the privateer, on the ground that the local authorities had committed a breach of neutrality in not interfering on her behalf when the British squadron opened fire. By treaty of 26th February 1851, it was agreed to submit this claim to arbitration, and Louis Napoleon, then president of the French Republic, was chosen arbitrator. It was proved that the governor of Fayal was aware on 27th February of what was going on, but it was also proved that his protec- tion had not

been invoked by the American skipper until after the firing had commenced, and that he then at once sent a remonstrance to the British captain requiring him to cease hostilities. It was further shown that the guns of the fort were insuflftcient to allow of an armed interven- tion by the Portuguese. In these circumstances the arbi- trator, while recognizing the principle that a neutral power is bound to make compensation to a belligerent whose property has been lost or destroyed within the neutral jurisdiction by the hostile action of theopposite belligerent, by his award of 30th November 1852 absolved the Portu- guese Government from blame (partly on the ground that the appeal to the local authorities was too late, and partly on the ground that the governor had no force sufficient to enable him to interfere with effect).

This arbitration had an interesting sequel. When the United States Government failed to obtain redress from the Portuguese, the owners of the privateer demanded it at the hands of their own Government, alleging that by espousing their cause in the arbitration proceedings the United States had admitted the claim against themselves. They succeeded in procuring both the House of Representatives and the Senate of the United States to pass a vote in their favour, but the claim was rejected by the Supreme Court on the grounds that it was bad, both in law and in morals. It Is obvious that to have allowed it would have been to make a very awkward precedent. Governments would have to be very shy in future of arbitrating in such cases in the interests of private persons, if whenever the award proved adverse they were bound to compensate their clients out of the national exchequer.

A far more famous arbitration on breaches of neutrality took place twenty years afterwards between the United States and Great Britain. It is instructive both from the historical and the legal point of view, and is, therefore, worth stating at some length.

In 1861, as is well known, the southern states of North America

seceded from the rest on the slavery question and set up a separate government under President Jefferson Davis. Hostilities ,

began with the capture of Fort Sumter by the Confeder- u~.,, ates on 13th April 1861. On 19th April President Abraham Lincoln declared a blockade of the southern ports. On 14th May the British Government issued a proclamation of neutrality, by which the Confederates were recognfzed as belli- gerents. This example was followed shortly afterwards by France and other nations. The blockade of the southern ports was not at first effective, and blockade-running soon became an active industry. The Confederates established agencies in England for the purchase of arms, which they despatched in ordinary merchant vessels to the Bahamas, whence they were transhipped into fast steamers specially constructed for the purpose. But this was not all. In February 1862 they contracted for a gunboat, which they called the Oreto, to be built for them at Liverpool. Mr C. F. Adams, the United States Minister, having brought this circumstance to the notice of the British Government, an inquiry was ordered and the report was that the Oreto was a fast steamer, pierced for four guns and generally suitable for warlike purposes, but that she was destined for a firm in Palermo. This was enough to rouse suspicion, but no positive evidence was obtainable. On 22nd March the Oreto left Liverpool and was next heard of, not at Palermo, but at Nassau in the Bahamas. There she was seized by the Colonial Government, acting upon representations made by the British naval authorities. She was, however, released by the local courts on the ground that there was no conclusive evidence ‘ against her. She left Nassau in the company of a British-built ship, from which she received her armament at Green Kay, and entered the port of Mobile, whence she afterwards emerged under the name of the Florida as a fully equipped man-of-war commissioned by the Confederate Government. In October 1865 she was captured in Brazilian waters by a vessel of the United States.

The case of the Alabama was still more remarkable. In June 1862 this ship, originally known as “No. 290,” was being built by Messrs Laird at Birkenhead. She was then nearly completed and was obviously intended for a man-of-war. On 23rd June Mr Adams forwarded to Earl Russell a letter from the United States Consul at Liverpool, giving certain particulars as to her character. This letter was laid before the law officers, who advised that, if these particulars were correct, the vessel ought to be detained. On 21st July sworn evidence, which was supplemented on 23rd

July, was obtained and laid before the Commissioners of Customs (who were the proper authorities to enforce the provisions of the Foreign Enlistment Act of 1819), but they declined to move. On 23rd July the same evidence was laid before the law officers, who advised that there was sufficient ground for detention. By some accident, which has never been satisfactorily explained, but was probably connected with the severe illness of Sir John Harding, the Queen's Advocate, the papers were not returned till 29th July. Instructions were then issued to seize the vessel, but she had already sailed on the evening of the 28th. Although she remained ^ for two days off the coast of Anglesey, there was no serious attempt at pursuit. She afterwards made her way to the Azores, where she received her armament, which was brought from Liverpool in two British stips. Captain Semmes there took command of her under a commission from the Confederate Government. After a most destructive career she was sunk off Cherbourg by the Eear- sarge on 19th June 1864.

Another vessel, the Sea King, which had been employed as a merchant ship, left London in October 1864 and was met at Madeira by the Laurel from Liverpool with men, arms, and officers. Her name was then changed to Shenandoah and the Confederate flag was hoisted on board her. After a cruise of ninety days, during which she destroyed certain North American vessels, she put into Melbourne on 25th January 1865. In spite of the protest of the United States Consul she was allowed to remain till 18th February to effect repairs and to take on board considerable sup- plies of coal and provisions. She also contrived to enlist forty-five men. Some investigation was made by the colonial authorities, but they were satisfied with her captain's assurance that he had enlisted no one since her arrival. After a cruise in the Arctic Seas she returned to Liverpool in November 1865 and was afterwards handed oyer to the United States.

On these facts the United States Government alleged against Great Britain two grievances, or sets of grievances. The first was the recognition of the southern states as belligerents and a general manifestation of unfriendliness in other ways. The second was in respect of breaches of neutrality in allowing Con- federate vessels to be built and equipped on British territory. Correspondence ensued extending over several years. At length in February 1871 a commission was appointed to sit at Washington

in order, if possible, to arrive at some common understanding as to the mode in which the questions at issue might be settled. With respect to the Alabama claims the British commissioners suggested that they should be submitted to arbitration. The

American commissioners refused "unless the principles which should govern the arbitrators in the consideration of the facts could be first agreed upon." After some discussion the British commissioners consented that the three following rules should apply. A neutral government is bound — (1) to use due diligence to prevent the fitting out, arming, or equipping within its juris- diction of any vessel, which it has reasonable ground to believe is intended to cruise or to carry on war against a power with which it is at peace, and also to use like diligence to prevent the departure from its jurisdiction of any vessel intended to cruise or carry on war as above, such vessel having been specially adapted, in whole or in part, within such jurisdiction, to warlike use ; (2) not to permit or sufier either belligerent to make use of its ports or waters as the base of naval operations against the other, or for the purpose of the renewal or augmentation of mUifary supplies or arms or the recruitment of men ; (3) to exercise due diligence in its own ports and waters, and as to all persons within its jurisdic- tion to prevent any violation of the . foregoing obligation and duties. The arrangements made by the commission were embodied in the treaty of Washington, which was signed on 8th May 1871, and approved by the Senate on 24th May. Article 1, after expressing the regret felt by Her Majesty's Government for the escape, in whatever circumstances, of the Alabama and other vessels from British ports, and for the depredations committed by these vessels, provided that "the claims growing out of the acts of the said vessels, and generically known as the Alabama claims" should be referred to a tribunal composed of five arbi- trators, one to be^named by each of the contracting parties and the remaining three by the king of Italy, the president of the Swiss Confederation, and the emperor of Brazil respectively. By Article 2 all questions submitted were to be decided by a majority of the arbitrators,

and each of the contracting parties was to name one person to attend as agent. Article 6 provided that the arbi- trators should be governed by the three rules quoted above, and by such principles of international law not inconsistent there- with as the arbitrators should determine to be applicable to the case. By the same article the parties agreed to observe these rules as between themselves in future, and to bring them to the knowledge of other maritime powers. Article 7 provided that the decision should be made within three months from the close of the argument, and gave power to the arbitrators to award a sum in gross in the event of Great Britain being adjudged to be in the wrong.

The treaty was, on the whole, welcomed in England. The United States appointed Mr C. F. Adams as arbitrator, and Mr J. C. Bancroft Davis as agent. The British Government ap- pointed Sir Alexander Cockbum as arbitrator, and Lord Tenter- den as agent. The arbitrators appointed by the three neutral powers were Count Sclopis (Italy), M. Staempfli (Switzerland), Baron d'ltajuba (Brazil). The first meeting of the tribunal took place on 15th December 1871 in the H6tel de Ville, Geneva. As soon as the cases had been formally presented, the tribunal adjourned till the following June. There followed immediately a controversy which threatened the collapse of the arbitration. It was found that in the American case damages were claimed not only for the property destroyed by the Confederate cruisers, but in respect of certain other matters known as " indirect losses," viz., the transference of the American marine to the British flag, the enhanced payments of insurance, the expenses of pursuit, and the prolongation of the war. But this was not all. The American case revived the charges of " insincere neutrality" and "veiled hostility" which had figured in the diplomatic correspondence, and had been repudiated by Great Britain. It dwelt at length upcm such topics as the premature recognition of belligerency, the unfriendly utterances of British politicians, and the material assistance afforded to the Con- federates by British traders. The inclusion of the indirect losses, and the other matters just referred to, caused great excitement in England. That they were within the treaty was disputed, and it was urged that, if they were, the treaty should be amended or denounced. In October 1872 Lord Granville notified to General Schenck, the United States Minister, that the British Government did not consider that the indirect losses were within the

submission, and in April the British counter- case was filed without prejudice to this contention. On the 15th of June the tribunal reassembled and the American argument was filed. The British agent then applied for an adjournment of eight months, ostensibly in order that the two governments might conclude a supplemental convention, it having been meanwhile privately arranged between the arbitrators that an extras-judicial declaration should be obtained from the arbitrators on the subject of the direct claims. On 19th June Count Sclopis intimated on behalf of all his colleagues that, without intending to express any opinion upon the interpretation 'of the treaty, they had arrived at the conclusion that "the indirect claims did not constitute upon the principles of international law applicable

to such cases a good foundation for an award or computation of damages between nations." In consequence of this intimation Mr Bancroft Davis informed the tribunal on 25th June that he was instructed not to press those claims ; and accordingly on 27th June Lord Tenterden withdrew his application for an adjournment, and the arbitration was allowed to proceed. The discussion turned mainly on the question of the measure of "due diligence." The United States contended that it must be a diligence commensurate with the emergency or with the magnitude of the results of negligence. The British Govern- ment maintained that while the measure of care which a govern- ment is bound to use in such cases must be dependent more or less upon circumstances, it would be unreasonable to require that it should exceed that which the governments of civilized states were accustomed to employ in matters concerning their own security or that of their citizens. The tribunal adopted the view suggested by the United States. The vessels complained of were the Florida and her tenders the Clarence, Tacony, and Archer; the Alabama and her tender the Tuscaloosa; the Shenandoah ; the Georgia, the Sumter, the Nashville, the Talla- hassee, the Chickamauga, the Sallie, the Jefferson Davis, the Music, the Boston, and the V. H. Joy. The tribunal found that Great Britain was responsible for all the depredations of the Florida and Alabama, and for those committed by the Shenan- doah after she left Melbourne. In the case of the Alabama the court was unanimous ; in the case of the Florida Sir A. Cockbum alone, and in the case of the Shenandoah both he and Baron d'ltajuba, dissented from the majority.

The tenders were held to follow in each case the fate of their principals. In the cases of the other vessels the judgment was in favour of Great Britain. The tribunal decided to award a sum in gross, and (Sir A. Cockburn again ‘ dissenting) fixed the damages at $15,500,000. On 14th September the award was formally published and signed by aJl the arbitrators except Sir A. Cockburn, who filed a lengthy statement of his reasons. This document contained an elaborate reply to certain attacks which had been made upon the good faith of the British Government — attacks which had better have been left unnoticed. They formed no part of the issue ; and if they were to be refuted that task was for the British coiusel, not for the British arbitrator.

The stipulation that the three rules should be jointly submitted by the two powers to foreign nations has never been carried out. iFor this the British Government has been blamed by some. But there appears to have been a general impression upon both sides, as well as among Continental publicists, that the language of the rules was not sufficiently precise to admit of their being generally accepted as a canon of neutral obligations.

Of instances of arbitration on unlawful arrests and seizures we may specially note the following. On 7tli June 1863 tliree officers of a British ship, the

Forte, stationed on the coast of Eio Janeiro, had

H.M.S. ” Porte.’

a fracas with a Brazilian sentinel, and were in consequence arrested by the police and lodged in prison. This being notified to the British Consul, he explained to the authorities who the prisoners were, whereupon they were at once liberated. The British Government took up the matter and demanded redress from the Brazilian GoYcrnment. The dispute threatened to be serious. It was referred, by consent, to the arbitration of the king of Belgium, who pronounced against the officers, on the ground that as they were not in uniform when arrested, no insult to the British Navy could possibly have been intended;

In September 1854 the steamer Benjamin Franklin and the barque Catherine Augusta, both the property of Carlos Butterfield and Co., cleared at New York for the port of St Thomas in the Danish West fi^^f^" Indies. The Catherine Augusta was laden with cannon and other war material. At that time revolution was supposed to be imminent in Venezuela, and there were grounds for suspecting'iihat these two vessels were destined to aid the insurgents. On the voyage the Catherine Augusta was much damaged by a storm, so that it became necessary for her to land her cargo for repairs. The Danish governor, who had received a communication from Venezuela, insisted on her giving, as a condition of her landing, security to the extent of $20,000 that no breach of the neutrality of the port was in- tended. To this the owners were compelled to agree.

The original expedition, whatever its design, appears to have been S- bandoned, since the two vessels remained in the port awaiting the event of some negotiations for their sale to Mexico. In the meanwhile the Benjamin FranMin had been chartered by the Royal British Mail Steamship Company for a voyage to Barbadoes and back. She neglected to provide herself before starting with the permit required by the local regulations, and was accordingly fired at from one of the Danish forts. One shot struck her, but did little injury, and her voyage was only delayed a day. In 1860 Mr Secretary Cass brought to the notice of the Danish Government a claim by Carlos Butterfield and Company in respect of the detention of the two ships and of the firing into the Benjamin Franklin. After protracted negotiations, the matter was ultimately referred to Sir Edmund Monson, then British Minister at Athens. He made his award on 22nd January 1890, and decided that both claims were unfounded.

In 1888 a Dutch craft, the property of an Amboynese firm, drifted from her moorings in the Malay archipelago and was carried to the island of Buru, no one ne " Costa t)eing on board at the time. Shortly afterwards

p^ket" the owners were informed that she had been taken possession of by a whaling-vessel called the Costa Bica Packet (John Carpenter, a British subject, being master), then on his way from New South Wales, and that Carpenter had transferred the cargo to his own ship and had sold it at Batchian. A complaint was at once lodged against the master before the oflieials at Macassar, and they, considering that a prima facie case against the master had been made out, issued a warrant for his arrest. Accordingly, on the arrival of the Packet at Ternate, Carpenter was seized and brought to Macassar to be tried — ^his ship proceeding to Batavia without him. When the facts came to be further inquired into at Macassar, it became evident that the wrongful appropria- tion, if any such there had been, had taken place on the high seas, more than three miles from land. The court therefore held, in conformity with the wcU-known rule, that it had no jurisdiction to interfere. Carpenter being answerable for his acts to the British Government alone. It therefore ordered his discharge. It was now Car- penter's turn to complain. When he was set free the Batavian mail had just left Macassar ; he was consequently forced to remain there over three weeks, and when at last he reached Batavia, it was too late to take advantage of the whaling season in the southern seas. The Packet being useless except as a whaling-vessel had to be sold at Singapore at a loss. Heavy damages were claimed against the Netherlands Government by all the parties interested, and a correspondence ensued between that Government and the British which extended over four years. At length, in May 1896, both Governments signed an arbitration treaty by which they agreed to invite a third power to nominate a jurist of undoubted reputation who should settle the points iii difference. The power chosen was Eussia, and the Emperor Nicholas II. nominated, as arbitrator. Professor F. de Martens. He, by his award in 1897, declared the Netherlands Government liable to pay £8550, distributed as follows : — £3800 to the owners of the Packet; £3150 to Carpenter; £1600 to the remaining officers and the crew; each of these amounts to carry interest at 5 per cent, as from the date of Carpenter's arrest.

The latest arbitration on illegal seizure is that known as the Delagoa Bay Eailway case, of which the facts are as follows :^-

In December 1883 the Portuguese Government granted to Colonel M'Murdo, an American citizen, a concession for the constmption and wftrking during ninety-nine years of a railway

from Lorenzo Marques, the port of Delagoa Bay, to the frontier of the Transvaal. It was a term of the concession neiamw that the Portuguese Government should not construct paij^ or allow within the district of Lorenzo Marques any ^'

other railway from the coast to the Transvaal parallel to the M'Murdo line within a distance of sixty miles. It was further provided that the concessionaire should have the absolute right of fixing the charges both for passengers and goods. In further- ance of his scheme Colonel M'Murdo formed a Portuguese company, but this company being unable to raise sufBcient capital delegated its powers and transferred the bulk of its property to an English company, formed in March 1887 and called " The Delagoa Bay and East African Railway (Limited)." The last-named company issued shares and bonds which were largely taken up by Colonel M'Murdo and by English investors. Before the grant of the concession of 1883 an agreement had been made between the South African Republic and Portugal whereby the former bound itself, whenever the Delagoa Bay Railway should reach the Transvaal frontier, to continue the line as far as Pretoria. At this period the frontier of the Transvaal had not been finally delimited, but the Portuguese of&cials placed it in their maps at about 80 kilometres from the coast. The Portuguese Government agreed that, if this distance was increased, the company which liad undertaken to make the railway to the frontier should be allowed a reasonable extension of time. On 17th May 1884 the Portuguese Government promised to the Transvaal Government a concession for a steam tramway parallel to the projected railway in case the English company failed to complete the railway by the prescribed date, and also promised that the steam tramway should be used both for passengers and goods if the Portuguese Government failed to agree with the English company as to the through rates to be charged on the railway. This promise was embodied in a commercial treaty negotiated by President Kruger (who made a special visit to Lisbon for the purpose), and was kept secret from Colonel M'Murdo and the shareholders and creditors of the English company. The frontier line of the Transvaal was

ultimately drawn through Komati Poort, a point about five miles farther from the coast than that shown on the Portuguese maps. The Portuguese Government thereupon required that the railway from Lorenzo Marques should be continued up to the new frontier, eight, extra months (of which five were in the rainy season) being allowed for the extension. This was an unreason- able term, and was not, and could not be, complied with. At the end of the eight months the Portuguese Government declared Colonel M'Murdo's concession forfeited, and seized the nearly completed railway.

The Governments of Great Britain and the United States re- monstrated in the interest of the widow of Colonel M'Murdo and the other creditors of the English company, the British Govern- ment going so far as to despatch a gunboat to Delagoa Bay and threaten to back its remonstrance by force. Here in truth was a casus belli with Portugal, for that country appeared to have broken its pledges under pressure from, and in deference to the political aims of, the South African Republic. Happily pacific counsels prevailed. An agreement was come to between Great Britain, the United States, and Portugal, whereby it was referred to arbitrators to be named by the Federal Council of Switzerland to determine the compensation to be paid by Portugal to the parties interested in the forfeited undertaking, the illegality of the proceedings of the Portuguese Government being admitted by the form of the reference. The subsequent dates are remark- able. The arbitrators were named in 1890, and in that year Portugal paid £28,000 on account. The court began to sit at Berne in 1892 ; the pleadings closed in 1896. It was then decided to appoint a commission of experts to make local inquiries and to report. When the report came in, the sittings were resumed, and were not concluded until the summer of 1898. The award (which was unanimous) was published on 29th March 1900. It directed Portugal to pay to the Governments of Great Britain and the United States, within six months from the publication of the award, the sum of £612,500 (in addition to the £28,000 paid in 1890), together with interest at 5 per cent, per annum from 25th June 1889 down to the time of payment, making a total of nearly £1,000,000 sterling. This sum was to be employed in ^mpensating the bond-holders and other creditors of the Delagoa Bay Railway Company according to their several priorities, such priorities to be settled by arrangement between the claimants themselves. The costs of the

arbitration were to be borne equally by the three governments, that is to say, one-third by each.

Closely akin to international arbitration is the pro- ceeding by Mixed Commission, on which all the parties in difference are represented. Such commissions have been most frequently resorted to for settling the indemnities to

be paid to non-combatants in respect of losses occasioned by war. Amongst the earliest of these commissions was that Mixed appointed under the treaty of 19th November aunmis- 1794, negotiated with Lord Grenville by Mr John sioas. j^y^ ^jjg distinguished American lawyer and statesman, and known as "The Jay Treaty," the object of

which was to settle the indemnities to be paid by Great Britain and the United States respectively to owners of merchant ships captured during the American revolutionary war. Similar commissions were appointed in pursuance of the treaty of Vienna of 20th November 1816. In 1843, wholesale claims for indemnity were settled by a mixed

Table I. Territorial Disputes.

Date of Agreement to refer.

Parties.

Arbitrating Authority.

Subject Matter.

Besult.

24th Dec. 1814

Great Britain and

Mixed commission

Islands in Passamaquoddy

24th Nov. 1817.— Dispute settled

(Treaty of Ghent)

United States

Bay near the mouth of the St Croix river

Do.

Do.

Do.

Northern boundary of U.S.

18th June 1822.— Delimitation effected

29th Sept. 1827

Do.

King of the Netherlands

North-east boundary of U.S.

9th Aug. 1842.— Award not accepted by U.S., but dispute settled by Webster-Ashburton Treaty

13th Jan. 1868

Great Britain and

General Ulysses S. Grant,

Sovereignty over island of

21st April 1870.— In favour of

Portugal

President of U.S.

Bulama, ofi west coast of Africa

Portugal

1871

Great Britain and United SUtes

Mixed commission

Nova Scotia fisheries

23rd Nov. 1871.— $5,500,000 awarded to Great Britain, the American commissioners dis- senting. Congress, however, voted the full amount

Sept 1872

Great Britain and

President of French Re-

Territories and islands in Del-

24th July 1875.— In favour of

Portugal

public

agoa Bay

Portugal

31st Dec. 1873

Italy and Switzer-

Mixed commission

Boundary between Italy and

23rd Sept. 1874.— In favour of

land

Canton of Ticino

Italy

1874

Persia and Afghan-

Generals Goldsmid and R.

Boundaries on north-west

Delimitation efEected

istan

Pollock (British officers)

frontier of India

3rd Feb. 1876

Argentine Kepublic and Paraguay

President of United States

Frontier dispute

12th Nov. 1878.— In favour of Paraguay

1878

Argentine Republic

Ministers of U.S. in the

Strait of Magellan and land

Sept. 1881.— Delimitation

and Chile

two countries

boundaries

efEected

13th July 1878

Turkey and Greece

Representatives of Great

Territorial sovereignty

1st July 1880.— Thessaly and

(Treaty of Berlin)

Britein, France,, Ger- many, Austria, Russia

part of Epirus to be ceded to Greece. Decision embodied in treaty of 14th June 1881

14th Sept. 1881

Colombia and Ven-

KingAlf onsoXn. of Spain,

Boundary dispute

May 1891.— In favour of Co-

ezuela

and on his death the Queen Regent Christina

lombia

lOth Sept. 1885

Great Britain and Russia

Mixed commission

Afghan boundary

21st May 1886.— Delimitation efiected

24th Dec. 1886

Nicaragua and

President Cleveland

Right of navigation in San

21st March 1888.— Mainly m

Costa Rica

Juan river, &c.

favour of Costa Rica

1st Aug. 1887

Peru and Ecuador

King of Spain, and on his death the Queen Regent

Territory east of Rio Bamba

Delimitation efEected

29th Nov. 1888

France and Hol-

Emperor of Russia

Boundaries of French and

25th May 1891.— In favour of

land

Dutch Guiana

Holland

Jan. 1891

Persia and Afghan- istan

Viceroy of India

Frontier of the Hashtadan district

Delimitation effected

1893

Great Britain, Russia, and Af- ghanistan

France and Ger-

Anglo-Russian com- mission

Use of waters of river Kushk

Dispute settled

1897

Mixed commission

Hinterland of Togo,GoldCoaBt

11th July 1897.— Dispute settled

many

of Africa

AprU 1897

France and Brazil

Federal Council of Swit-

Boundary between Brazil and

1st Dec. 1900.— Awarded to

zerland

French Guiana

Brazil 147,000 square miles of the disputed territory to the Araguay river on the S. and France about 3000 square miles to the N. of the Tumuo Huniac mountains. Practically in favour of Brazil

12th Nov. 1898

ArgentineRepublic,

Mixed commission

Boundary of the province of

25th March 1899.— Delimitation

Chile, and Bolivia

Atacd,ma

efEected

commission after certain preliminary points had been de- cided by arbitration in the following circumstances. France had found it necessary to take punitive measures against certain Moorish tribes on the West Coast of Africa in order to protect her colonies at Senegal from the arbitrary exactions by which they were oppressed. With this view she blockaded the coast of Portendic, but failed to notify the fact to the owners of the British vessels who traded •with the nations in gum and other exports. The result

was that the commercial arrangements of the British owners were upset and they claimed compensation at the hands of their Government. Correspondence on the sub- ject with the French Government went on for four years. It was finally agreed to refer to the king of Prussia the determination of two questions, one of fact, the other of law. (1) Did the blockade occasion losses to the British tradersintheexerciseof their lawful calling? (2) If yea, was France bound to make these losses good ? The king

of Prussia decided both questions in the affirmative. A l damages to be paid to the traders. They were fixed at mixed commission was then appointed to assess the | 41,770 francs 89 centimes. The precision of these figures

Table II. Claims in respect of Seizures and Arrests.

Date of Agreement to refer.

Parties.

Arbitrating Authority.

Subject Matter.

Result.

14th Feb. 1851

France and Spain

King of the Netherlands

Claims and cross-claims in re- spect of seizures of vessels in

1823-24

Claims adjusted

1864

Great Britain and Peru

Senate of Hamburg

Imprisonment by Peru of Capt.

T. Melville White, a British

subject Seizure of American s.s. Colonel

Claim disallowed

16th June 1870

IJnited States and

Mixed commission

15th Nov. 1870.— $19,170,250

Spain

Lloyd Aspinwall

awarded to U.S.

1872

Japan and Peru

Emperor of Russia

Seizure of Peruvian barque Maria Lus

17th May 1876.— In favour of Japan

17th Aug. 1874

United States and

Mixed commission

Seizure of American s.s. Mon-

27th June 1885.— $33,401

Colombia

tijo by insurgents of Panama

awarded to U.S.

16th Oct. 1879

France and Nicar- agua

French court of cassation

Seizure of French ship Le Phare

29th July 1880.-40,320 francs awarded to France

26th March 1881

The Netherlands

President of French Ee-

Seizure of Dutch ship The

16th March 1883.-140,000

and Hayti

public

Havana Packet

francs awarded to the Nether- lands 27th June 1885.— $5,167,407

28th Feb. 1885

United States and

Italian minister at Madrid

Seizure of American s.s. The

Spain

Masonic at ManUa

awarded to U.S.

28th Feb. 1893

United States and Ecuador

British minister at Quito

Arrest of an American citizen at Quito

In favour of U.S.

1896

Great Britain and

President of French court

Arrest of Mr Ben. Tillett, a

Jan. 1899.— In favour of

Belgium

of cassation

British subject

Belgium

Table III. Miscellaneous Claims for Damages.

Date of Agreement to refer.

20th Oct. 1818 11th April 1889

18th July 1850

10th Nov. 1858 15th July 1864

14th March 1870

1873

23rd July'l873

1874

24th -May 1884 24th Feb. 1891

Parties.

Great Britain and United States

United States and Mexico

Great Britain and Greece

United States and Chile

Great Britain and Argentine Repub- lic

United States and

Brazil Great Britain abd

Brazil

Great Britain and France

China and Japan

United States and Brazil

France and Vene- zuela

Arbitrating Authority.

Emperor of Russia King of Prussia

Mixed commission

King of the Belgians

President of Chile

British Minister at Wash- ington

Envoys of U.S. and Brazil at Bio de Janeiro

Mixed commission

British minister at PeMng

Hon. Wm. Strong, ex- judge of the supreme court of U.S.

President of Swiss Con- federation

Subject Matter.

Obligation to restore slaves in possession of the British

Losses of U.S. citizens during war between France and Mexico

Losses of British subjects dur- ing riots in Athens

Seizure of specie on board the U.S. brig Macedonian by Lord Cochrane, then admiral of Chilian fleet

Losses arising out of decree of Argentine Government pro- hibiting vessels from Monte "Video to enter Argentine ports

Loss of whale-ship Canada

Claims by earl of Dundonald in respect of services rendered by his father, Admiral Coch- rane, to Brazil during her war of independence

Duties levied in France on mineral oils

Murder of Japanese citizens by Chinese in islands of For- mosa

Claims in respect of law pro- ceedings in Hayti against two American citizens

Claim by French contractor in respect of a judgment ob- tained by him in Venezuelan courts, of which execution was refused by the execu- tive

Besult.

21st April 1822.— In favour of U.S.

Claims only partially settled, and war between U.S. and Mexico in 1846

Claims settled, the most re- markable being that of Don Paoiflco, a native of Gibraltar, and therefore a British subject, who demanded £21,296 and was awarded £150 only

16th May 1863.— Chile to re- fund three-fifths of the value of the specie with interest

1st Aug. 1870.— In favour of Argentine Republic

11th July 1870.— $10,070,494

awarded to U.S. 6thOot.l873.— £38,176awarded

to Earl Dundonald

6th Jan. 1874.-314,393 francs awarded to British claimants

600,000 taels awarded to Japan

14th June 1885.— In favour of U.S., but award not enforced

30th Dec. 1896.-4,346,656 francs awarded to French plaintiff

shows that the indemnity was for actual losses sustained and proved, and not, as in the Alabama case, a round sum awarded, as between state and S'tate, to satisfy claims to

be ascertained thereafter. Another mixed commission with very extensive powers was appointed under the treaty of "Washington of 15th January 1880 between the

ARBITRATION, INTERNATIONAL

United States and France. This treaty dealt both with claims and counterclaims, namely — (1) claims by Ameri- can citizens against the Trench Government for damages sustained by them during the last war between France and Mexico, or during that of 1870-71 between France and Germany, or during the insurrection of the Com- mune ; (2) counterclaims by French citizens against the United States Goyernment for damages sustained at the hands of American citizens during the War of Secession of 1861-65. The commission was composed of three per- sons, one named by the French Government, one by the president of the United States, and the third by the emperor of Brazil. The losses sustained by French sub- jects during the war between Chile and Peru were ascer- tained in the same manner in pursuance of a treaty of 2nd November 1862. Examples of similar commissions might be easily multiplied, but the practice is too well established to make it worth while to particularize them here.

A large number of international differences, without reckoning those already specially noted or the war-in- demnity claims just referred to, have been adjusted, or put in trim for adjustment, either by arbitration or by mixed commissions, since the pacification of 1815. The majority of these cases are summarized in the preceding tables, which have been compiled in part from the volumes of Professor Moore and in part from Dr Evans Darby's revised list, respectively mentioned, at the end of this article.

Up to this point we have only dealt with arbitrations on what may be termed specific differences. There are, aeaerai however, in existence several conventions which coavea- provide for the settlement by international arbi- tions. tration not merely of specific differences, but of

all differences, present and future, which may arise be- tween the contracting parties as regard certain subjects, e.g., commerce or navigation. Clauses to this effect (clauses compromissoires) have been agreed to since 1862 between Great Britain on the one hand, and Italy, Greece, Portugal, Mexico, Uruguay respectively on the other hand ;

between Belgium on the one hand, and Italy, Greece, Sweden, Norway, and Denmark respectively on the other hand; between France and Korea; between Italy and Mon- tenegro; between Austria-Hungary and Siam; between Spain and Sweden and Norway ; between Denmark and Venezuela; between the Netherlands and Eumania; between Japan and Siam. The conventions of the Postal Union of 1874 and 1891, and of 1890 for the inter- national transport of goods by rail, are instances of the same class. There are also in existence conventions for settlement by international arbitration of all differences without exception. Such are the treaties of Guadelupe- Hidalgo of 1848 between the United States and Mexico ; of Belgium with Hawaii and Siam in 1862 and 1868 re- spectively ; with Venezuela in 1884, and Ecuador in 1887 ; of 1888 between Switzerland and San Salvador and Ecuador; and of 1894 between Spain on the one hand, and Honduras and Colombia on the other.

So much has been actually accomplished. Other schemes for general arbitration have been mooted and carried to a certain point, although they have not yet been realized. When, in December 1882, President Garfield announced in his annual message his willingness to assist any measure which might tend to secure peace, the Swiss Government responded by ofEering to agree to a general arbitration treaty with the United States. A draft treaty was accordingly prepared, and submitted to the Swiss Federal Council, which adopted it on 24th July 1883 ; but owing to the death of Mr Secretary Prelinghuysen, who had been the principal American negotiator, the project fell through. A similar proposal was brought forward at the Inter-American Con- gress held at Washington 1889-90, which was attended by delegates from the United States and seventeen Republics of Central and South America. It took the form of a solemn recom- mendatioa by the delegates to their respective governments "to

adopt arbitration as a principle of American international law for the settlement of the differences, disputes, or controversies that might arise between two or more of them." A treaty to this effect was signed by delegates from the United States and also from Guatemala, Honduras, Nicaragua, San Salvador, Venezuela, Ecuador, Brazil, and Bolivia, but was not ratified by the governments named in it within the prescribed

time. An attempt to revive it was made by the smaller states in 1891 but without success.

In 1896 an effort was made by the representatives of Great Britain and the United States to provide for the submission to arbitration of "all questions in difference between those countries which might fail to adjust themselves by diplomatic negotiations." A treaty to this effect was prepared and signed on 11th January 1897 by the British ambassador (Sir Julian Pauncefote) and Mr Secretary Olney. It presented three forms of procedure, one for pecuniary claims or groups of pecuniary claims which did not in the aggregate exceed £100,000 ; a second for pecuniary claims beyond that amount, and a third for territorial claims, includ- ing rights of navigation and of access to fisheries. For the settlement of the first set of claims, each of the contracting parties was to nominate one arbitrator who was to be a jurist of repute, and the two arbitrators so nominated were to select a third, who was to be the president of the tribunal. The award of the majority was to be final. The second set of claims was to be referred to a tribunal similarly constituted, but in this case the award was only to be final if the tribunal was unanimous. If not unanimous, either of the contracting parties might demand a review of the award within six months from its date. In such case, the matter in controversy was to be submitted to a tribunal consisting of five jurists, no one of whom was to be a member of the original tribunal whose award was to be reviewed. The five jurists were to be nominated as follows: — two by each of the contracting parties, and one to act as umpire by the four thus nominated. The award of the majority of the members was to be final. The third set of claims (territorial) was to be submitted to a tribunal composed of six members, three of whom, subject to a particular exception, were to be judges of the Supreme Court of the United States or justices of Circuit Courts to be nominated by the president of the United States, the other three being judges of the British Supreme Court of Judicature or members of the Judicial Committee of the Privy Council nominated by the British Crown. The award in this case was to be final if made by a majority of five to one. In the event of its being less than five to one, it was not to be binding if protested against by either party within three months of publication. IE so protested against, or if there was no award by reason of the numbers being equally balanced, there was to be no recourse to

hostile measures of any description until the mediation of one or more friendly powers had been invited by one of the contracting parties. In spite of the elaborate care and caution with which this treaty was drawn, it remains a dead letter for want of ratification by the respective governments on whose behalf it was signed. It may be that its very elaborateness has proved a bar to its success, just as a parade of too many safety appliances on the eve of a mountaineering expedition is apt to unbrace our nerves and enhance our sense of danger.

The plan of establishing a standing arbitration tribunal advocated by Jeremy Bentham has been already referred to. In 1838 the New York Peace Society proposed to estaWish a Board of International Arbitration, and the idea was further worked out in 1842 by James Mill. Subsequently Mr Dudley Field in America, Dr Gold- schmidt in Germany, Sir Edmund Hornby and Mr Leone Levi in England, successively produced draft rules of pro- cedure by which, unless otherwise agreed, the permanent court was to be bound. Dr Goldschmidt's rules were revised and adopted by the Institute of International Law in 1876, and again considered by the Inter-Parliamentary Conference held at Brussels in 1895. All these efforts, however, excellent as they wpre in their generation, have been thrown into the shade by the work of the Peace Con- ference initiated in 1898 by the emperor of Hague Russia, and held at the Hague in the following Con^r- year. On 24th August 1898 Count Murayieff «"«• handed to all the foreign representatives accredited to the court of St Petersburg a circular informing them that the Tsar proposed to their respective governments the holding of a Conference " which should occupy itself with the grave question of the excessive armaments which

weighed upon all nations with a view of putting an end to their progressive development." This circular was shortly followed by another s'etting forth a preliminary draft programme for the Conference, which embraced not only the reduction of armaments and the more humane conduct of warfare, but also "the employment of good oifices of mediation and arbitration in cases lending them- selves thereto." The Conference

met on 18th May 1899 at the Hague, and was attended by delegates from nineteen states under the presidency of Baron de Staal, the Russian ambassador at London. Other well-known delegates were Sir Julian Pauncefote (afterwards Lord Pauncefote), British ambassador at Washington ; Mr Seth Low, presi- dent of Columbia University, New York ; M. Leon Bour- geois, ex-premier of Prance, Count Munster, German ambassador at Paris. The Conference was divided into two sections, the province of the first being to deal with the limitation of armaments; of the second, with the laws of warfare ; of the third, with mediation and arbi- tration. At one of the early sittings of the third section (over which M. Bourgeois presided). Baron de Staal pro- duced a draft convention ftfr rendering arbitration com- pulsory in certain cases and optional in others. Under the compulsory class were ranged disputes relating to pecuniary damages sustained by a state owing to the illegal or negligent action of another state — disputes re- lating to the interpretation of postal, telegraph, and rail- way conventions, of conventions relating to the navigation of international rivers, and divers other matters. To this convention (officially described as the " Russian project ") was appended a draft code of procedure closely resem- bling that under which the Venezuelan arbitration was at that moment being conducted in Paris. Sir Julian Pauncefote took a bolder line. He urged, in a few pithy sentences, the importance of organizing a permar nent international tribunal, the services of which might be called into requisition at wUl, and produced to the committee a short sketch of the mode in which such a tribunal might be set up. His proposition met with general acceptance, and the committee then proceeded to settle the necessary details for carrying it oxi£, adopt- ing in the main the code of procedure which had been suggested by Russia.

The result was embodied in twenty-seven articles, of which only the most important can be noted here. (Art. 23) Each of the signatory powers is to designate within three months from the ratification of the Convention four persons at the most, of recog- nized competence in international law, enjoying the highest moral consideration, and willing to accept the duties of arbi- trators. Two or more powers may agree to nominate one or more members in common, or the same person may be nominated by difierent powers. Members of the court are to be appointed for six years, and may

be re-nominated. (Art. 25) The signatory powers desiring to apply to the tribunal for the settlement of a difference between them are to notify the same to the arbitrators. The arbitrators who are to determine this difference are, unless otherwise specially agreed, to be chosen from the general list of members in the following manner : — each party is to name two arbitrators, and these are to. choose a chief arbitrator or umpire {sur-arbitre). If the votes are equally divided the selection of the chief arbitrator is to be entrusted to a third power to be named by the parties. (Art. 25) The tribunal is to sit at (he Hague when practicable, unless the parties otherwise agree. (Art. 27) "The signatory powers consider It a duty in the event of an acute conflict threatening to break out between two or more of them to remind these latter that the permanent court is open to them.« This action is only to be considered as an exercise of good ofBces."

The procedure of , the court is proposed to be regulated by twenty- seven articles, in which the following points are the most im- portant. The agent of each party is first to communicate to the court and to the opposite party all deeds and documents on which it proposes to rely, one copy at least being in the language which the court authorizes to be used before it. After the documentary evidence has been lodged, the oral argument is to begin. This is to be taken down in writing, but it is only to be made public with the consent of the parties. The members of the tribunal may

question the agents and counsel on any point which they desire to have cleared up. The tribunal is to be the sole judge of the extent of its own jurisdiction and of the rules of international law, if any, which are applicable to the case. The deliberations of the court are to take place with closed doors. The decision is to be that of the majority, and is to set forth the reasons on which it is based. It is to be in writing and signed by all the members, the minority members when appending their signature being at liberty to signify their dissent. There is to be no appeal ; but if a new fact is discovered, which was unknown at the time both to the tribunal and to the party alleging It, and the fact be such that had it been then known it might have exercised a decided influence on the decision, that decision may be revised. Before, however, revision can be had, the tribunal must

recognize the existence' of the new fact or facts and admit them to have the characteristics just mentioned.

The Hague arbitration Convention was signed on 29th July 1899, on behalf of France, Russia, the United States, and thirteen other powers. It was also signed a few days later on behalf of Great Britain. On 4th September 1900, all the powers represented, with the exception of China, duly deposited formal ratifications of the Convention at the foreign office of the Dutch Government. Several of the powers nominated members of the Permanent Arbi- tration Court, pursuant to Art. 23 mentioned above, those nominated on behalf of Great Britain being Lord Paunce- fote, Sir Edward Malet, Sir Edward Fry, and Professor Westlake.

*Although, in some of the treaties and most of the projects enumerated above, the range of matters proper to be dealt with by international arbitration is assumed to be iinlimited, there is a general p^^^** consensus of opinion amongst specialists that some limitation there must be. Bluntschli, Rouard de Card, Goldschmidt, Kamarowski, Ferdinand Dreyfus, Michel Revon, all exclude questions of national inde- pendence, and some of them also exclude questions of "national honour" and of "territorial integrity." The language in which these reservations are couched is not, however, particularly happy, since it is open to more in- terpretations than. one. What, for instance, is meant by the phrase " national independence " in this connexion ? If it be taken in its strict acceptation of autonomous state sovereignty, the exception is somewhat of a truism. No self-respecting power would, of course, consent to submit to arbitration a question of life or death. This would be as if a man were to commit suicide in order to avoid fight- ing a duel. On the other hand, if the exception be taken to exclude all questions which, when decided adversely to a state, impose a restraint on its freedom of action, then the exception is too wide, since it would exclude such a question as the true interpretation of an ambiguous treaty, a subject with which experience shows international arbi- tration is well fitted to deal. Again, we may ask, what is meant by the phrase " national honour " ? It was thought at one time that the honour of a nation could only be vindicated by war, though all that had happened was the slighting of its flag or its accredited representative during some sudden ebullition of local feeling. France*

once nearly broke off peaceful relations with Spain because her ambassador at London was assigned a place below the Spanish ambassador, and on another occasion she de- spatched troops into Italy because her ambassador at Rome had been insulted by the friends and partisans of the Pope. The truth is that the extent to which national honour is involved depends on factors which have nothing to do with the immediate subject of complaint. So long as general good feeling subsists between two nations, neither will easily take offence at any discourteous act of the other. But when a deep-seated antagonism is concealed beneath an unruffled surface, the most trivial incident will bring it to the light of day. "Outraged national honour" is a highly elastic phrase. It may serve as a pretext for a

serious quarrel whether the alleged " outrage " be great or small. A similar criticism may be passed on the phrase " territorial integrity." Every boundary dispute is a dis- pute about territory, and nothing is easier than for a state to declare that the tract of land it covets forms, or — ^like the angulus ille of Horace — ought to form, an integral part of its dominions. Yet, as we have seen, this class of dispute is just that which has been most frequently arbitrated on, and in nearly every case successfully.

Weighing, then, each of these exceptions in the balance, and finding them all wanting in precision, we prefer to discard them altogether and to cast about for a fresh classification. M. Despagnet has suggested oneinhis work on Public International Law (Paris, 1894) which is both convenient and complete. All state differences, this writer points out, may be classed, as regards their subject matter, under one of two heads — (1) those which have a legal character, (2) those which have a political character. Under " legal differences " may be ranged as many as are capable of being decided, when once the facts are ascer- tained, by settled, recognized rules, or by rules not settled nor recognized but (as in the Alabama case) taken to be such for the purpose in hand. Boundary cases and cases of indemnity for losses sustained by non-combatants in time of war, of which

we have already mentioned several instances, belong to this class. To it also belong those cases in which arbitrators have to adapt the provisions of an old treaty to new and altered circumstances, somewhat in the way in which English courts of justice apply the doctrine of cypres. Of these last the Newfoundland fishery case is an illustration. "Political differences," on the other hand, are such as affect states in their external relations or in relation to their subjects or dependants who may be in revolt against them. Some of these differences may be slight, whilst others may be vital, or (which amounts to the same thing) may seem to the parties to be so. All differences falling under the first of these two general heads appear to be suitable for international arbitration. Differences falling under the second general head are for the most part unsuitable, and may only be adjusted (if at all) through the mediation of a friendly power.

The interesting problem of the future is. Are we to regard this condition of things as permanent or as transi- tory ? The answer depends on several considerations which can only be glanced at here. It may be that, just as the usages of civilized nations have slowly crystal- lized into international law, so there may come a time when the political principles that govern states in relation to each other will be so clearly defined and so generally accepted as to acquire something of a legal or quasi-legal character. If they do, they vsdll pass the line which at present separates arbitrable from non-arbitrable matter. This is the juridical aspect of the problem. But there is also an economic side to it by reason of the conditions of modern warfare. As M. de Bloch has explained at some length in his monumental treatise on the subject, war has become much more terrible now than formerly, in con- sequence of the increase of armaments and the greater

perfection of weapons of destruction. Already the nations are groaning under the burdens of militarism, and are for ever diverting ei^ergies that might be employed in the furtherance of useful productive work to purposes of an opposite character. The interruption of maritime intercourse, the stagnation of industry and trade, the rise in the price of the necessaries of life, the impossibility of adequately providing for the families of those — call them reservists, landwehr, or what you will — who are torn away from their daily toil to serve in the tented field, — these are considerations that may well make us pause before we abandon

a peaceful solution and appeal to brute force. Lastly, there is the moral aspect of the problem. In order that international arbitration may do its perfect work, it is not enough to set up a standing tribunal, whether at the Hague or elsewhere, and to equip it with elaborate rules pf procedure. Tribunals and rules are,, after all, only machinery. If this machinery is to act smoothly we must improve our "motive power, the source of which is human passion and sentiment. Although religious animosities between Christian nations have died out, although dynasties may now rise and fall without rousing half Europe to arms, the springs of warlike enter- prise are still to be found in commercial jealousies, in imperialistic ambitions, and in the doctrine of the survival of the fittest which lends scientific support to both. These must one and all be cleared off the world's stage before we can enter on that era of universal peace towards the attain- ment of which the Tsar declared, in his famous circular of 1898, the efforts of all governments should be directed.

Authorities. — Amongst special treatises are — Kamabowskt, Le tribunal international (ttaduit par Serge de Westman), Paris, 1887 ; EouARD de Cakd, Les destinies de Varbitrage international, depuis la sentence rendue par le tribunal de Geneve, Paris, 1892 ; Michel Eevon, Varbitrage international, Paris, 1892 ; Ales- SANDRO CoBsi (Marchese), Arbitrati Internazionali, Pisa, 1894 j Ferdinand Dreyfus, Varbitrage international, Paris, 1894 (where the earlier authorities are collected) ; A. Merignhac, Traite de Varbitrage international, Paris, 1895 ; Le Chevalier Descamfs, Essai sur V organisation de Varbitrage international, Bruxelles, 1896 ; Peraud-Giraud, " Des traitfe d'arbitrage inter- national gfo^ral et permanent," Bevue de droit international, Bruxelles, 1897. Of similar works in English there is a singular dearth. The most important is by an American, J. B. Mookb, History of the International Arbitrations to which the United States has been a Party, Washington, 1898. The Appendices to this work (which is in six volumes) contain, with much other matter of great value, lull historical notes of arbitrations between other powers. Arbitration and Mediation wiU be found briefly noticed in Phillimore's International Law; in Sir Hbhrt Maine's Lectures delivered in Cambridge in 1887 ; in W. E. Hall's International Law (Clarendon Press, Oxford) ; and more at length in an interesting paper contributed by Mr John Westlake to the International Journal of Ethics, Oct. 1896,

which its author has reprinted privately. A London journal. The Herald of Peace and International Arbitration, issued some years ago a list of instances in which arbitration or mediation had been successfully resorted to during the 19th century. The late Mr Dudley Field, of New York, subsequently enlarged this list, which has been revised down to 1899 by Dr W. Evans Darby, and is published, along with the texts of several projects for unlimited arbitration, at the offices of the Peace Society, 47 New Broad Street, London. A History of the Hague Conference, 1899, has been published by the International Arbitration Association, 40 Outer Temple, London. (m. H. C.)

Arboretum. — That part of a botanical garden which is reserved for the growth and display of trees is technically called an Arboretum. The term, in this restricted sense, was seemingly first so employed in 1838 by J. C. Loudon, in his book upon arboreta and fruit trees. Professor Bayley Balfour, P.R.S., the Begins Keeper of the Royal Botanic Garden in Edinburgh, has

described an arboretum as a living collection of species and varieties of trees and shrubs arranged after some definite method — it may be properties, or uses, or some other principle, — but usually after that of natural likeness. The plants are intended to be specimens showing the habit of the tree or shrub, and the collection is essentially an educational one. According to another point of view.

■ which is favoured by Mr Charles Jordan, the Super- intendent of Regent's Park, London, an arboretum should be constructed with regard to picturesque beauty rather than systematically, although it is admitted that for scien- tific purposes a systematic arrangement is a sine qud non. In this more general respect, an arboretum affords shelter, improyes local climate, renovates bad soils, cdnceals objects unpleasing to the eye, heightens the effect of what is agreeable and graceful, and adds value, artistic and other, to the landscape. What Loudon called the " gardenesque " school of landscape naturally makes particular use of

trees. By common consent the arboretum in the Eoyal Botanical Gardens at Kew is the finest in the world. Its begin- nings may be traced back to 1762, when, at the suggestion of Lord Bute, the Duke of Argyll's trees and shrubs were removed from Whitton Place, near Hounslow, to adorn the Princess of Wales's garden at Kew. The Duke's collection was famous for its cedars, pines, and firs. Most of the trees of that date have perished, but the survivors embrace some of the finest of their kind in the gardens. The botanical gardens at Kew were thrown open to the public in 1841 under the directorate of Sir William Hooker. Including the arboretum, their total area did not then exceed 11 acres. Pour years later the pleasure grounds and gardens at Kew occupied by the king of Hanover were given to the nation and placed under the care of Sir William for the express purpose of being converted into an arboretum. Hooker rose to the occa- sion, and, zealously reinforced by his son and successor. Sir Joseph— jsatre claro Jilius clarior, — established a collection which is alike the envy and admiration of the botanists of every country. The Kew nursery dates from 1850 and the new pinetum from 1870. Of the total acreage (250) of the Gardens, no fewer than 180 acres are monopolized by the arboretum. Of the more specialized arboreta in the United Kingdom the next to Kew are those in the Koyal Botanic Garden in Edinburgh and the Glasnevin Garden in Dublin. The gardens of the Eoyal Botanical Society in London are beautifully wooded, but owing to the limited space at its disposal (18 acres), the Society has not been able to make a speciality of trees. This is also true of the oldest botanical garden in Great Britain, at Oxford, which was founded in 1632. The quaint " Physic " garden at Chelsea, which Sir Hans Sloane gave to the Apothecaries' Society, is devoted to medicinal plants and herbs. In the Botanical Gardens at Glasgow, where Sir W. J. Hooker laboured before his transference to Kew, there are many choice trees, and in Bournemouth the gardens of the Evergreen Valley constitute to all intents and purposes an arboretum, even to the labelling of the specimens. In the United States the Arnold Arboretum at Boston ranks next to Kew for size and completeness. It takes its name from its donor, the friend of Emerson. It was originally a well-timbered park, which, by later additions, now covers 222 acres. Practically, it forms part of the park system so characteristic of the city, being situated only four miles from the centre of population. There is a fine arboretum in the botanical gardens at Ottawa, in Canada (65 acres). On the continent of Europe the classic

example is still the Jardin des Plantes in Paris, where, however, system lends more of formality than of beauty to the general effect. Of course superb collections of trees were made before arboreta, as such, were devised. Noblemen and other wealthy amateurs collected trees, as other rich men collected paintings or books. They spared neither pains nor money in acquiring speci mens, even from distant lands, to which they sent out expert collectors at their own charges. This, too, the Eoyal Horticultural Society (founded, 1804; charter, 1809) was once wont to do, with fruitful results, as in the case of Mr David Douglas's remarkable expedition to North

America in 1823-24. It will be remembered that when the Laird of Dumbiedikes lay dying (The Heart of Midlothian, chap, viii.) he gave his son one bit of advice which Bacon himself could not have bettered. " Jock," said the old reprobate, "when ye hae naething else to do, ye may be aye sticking in a tree ; it will be growing, Jock, when ye're sleeping." Sir Walter assures us that a Scots earl took, this maxim so seriously to heart that he planted a large tract of country with trees, a practice which in these days is promoted by the English and Royal Scottish Arboricultural Societies.

For the cultivation of trees, iDoth in its technical and economic sense, the reader is referred to the exhaustive article on Asbori- ouLTURE in the ninth edition of this work and the article on FoBESts In this Supplement. (j. a. m.)

Arbroath, a royal and parliamentary burgh (Mon- trose group), seaport and manufacturing town of Forfar- shire, Scotland, 77 miles N.N.E. of Edinburgh by rail. Spinning and weaving factories number over 30, and there are engineering works, boot factories, and chemical works. In 1877 the old harbour was converted into, a wet dock, and the new harbour and entrance deepened. There is a shipbuilding yard, and at the end of 1898, 11 vessels of 1959 tons were registered as belonging to the port. En- trances and. clearances were: — 1898, entered 243 vessels of 30,588 tons, cleared 246 vessels of 29,435 tons. Recent erections include two churches, parish church (rebuilt), free library, guild hall (rebuilt), and academy. Popu- lation (1881), 21,995; (1901), 22,372.

Arcachon, a modem sea-side town of Prance, department of Gironde, arrondissement of Bordeaux, 37 miles W.S.W. of that city. It comprises two distinct parts, the summer town, extending for three miles along the shore on a firm sandy beach, and the winter town, more inland, with numerous villas scattered amongst pine woods, resorted to by consumptive patients. The neigh- bouring forest has an area of about 1300 square miles. The principal industries are oyster-culture and fishing. The former is conducted on a very large scale ; there are 5900 oyster parks, covering an area of over 8000 acres, yielding, in 1898, 319,772,100 oysters, of the total value of £112,000. The port has trade with Spain and England. Population, 8000.

Arch, Joseph (1826), founder of the Nar

tional Agricultural Labourers' Union, was born at Bar- ford, a village in Warwickshire, 10th November 1826. His parents belonged to the labouring class. He inherited a strong sentiment of independence from his mother ; and his objections to the social homage expected by those whom the catechism boldly styled his " betters " made him an "agitator." Having educated himself by unre- mitting exertions, and acquired fluency of speech as a Methodist local preacher, he founded in 1872 the National Agricultural Labourers' Union, of which he was president. A rise then came in the wages of agricultural labourers, but this had the unforeseen effect of destroying the union; for the labourers, deeming their object gained, ceased to " agitate." Mr Arch nevertheless retained sufficient popu- larity to be returned to parliament for North-west Norfolk in 1885 ; and although defeated next year owing to his advocacy of Irish Home Rule, he regained his seat in 1892, and held it in 1895, retiring in 1900. He was deservedly respected in the House of Commons ; seldom has an agitator been so little of a demagogue. A biography written by himself or under his direction, and edited by Lady Warwick (1898), tells the story of his career.

ARCHJEOLOGY (CLASSICAL).

IT is proposed in the present article to give some account of the progress and the results of archaeological inves- tigation in regard to the monuments of ancient Greece and Eome in the years since the publication of the ninth edition of this work. The articles on classical archaeo- logy and architecture were published in 1875, that on gems in 1879, that on pottery in 1885, that on terra- cottas in 1888. Generally speaking, therefore, we have to report the progress of twenty-five years. It is not intended here to re-discuss questions considered in the articles above mentioned, except so far as this may be made necessary by the discovery of new materials. For an account of the excavations carried on at various classical sites in recent years, the reader is referred to special articles in the present publication. Especially we must mention the articles on Athens, Eleusis, Mycenae, Cyprus, Epidaurus, Megalopolis, Dodona, Eome, Delphi. In the present article the results of these excavations will be considered, not on the topographic or architectural side (see Akchitectuee, II.), but only in so far as they have extended our knowledge of ancient art, especially of sculp- ture. We begin with a general account of the progress made in institutions, in publications, and in excavations connected with classical archaeology ; afterwards we shall give, under periods, a more detailed account of recently discovered monuments and works of art, with the informa- tion to be derived from them.

Archceological Institutes. — ^Perhaps in no respect has the activity of the last quarter of the 19th century been more marked than in the founding and organization of institutions for the forwarding of archaeological research. The old international "Instituto di Corrispondenza Archeologica " has been' transmuted into the Eoman branch of the German Archaeological Institute. That great institution, which is the main centre of archaeo- logical activity, has its headquarters at Berlin, with branches at Eome and Athens. The French have also schools at Eome and Athens, as have now the English and Americans. Austria has recently established a powerful institute, with various branches. The Society for the Promotion of Hellenic Studies in England, the Archaeological Institute in America, the Accademia dei Lincei in Italy, and the Greek Archaeological Society, are all active in publishing journals, in finding the funds^for excavations, and the scholars to take charge of them, and in extending archaeological knowledge. France,

Germany, and Austria provide from the public purse bursaries to trained archaeological students, enabling them to stay for a term of years at the schools of Athens and Eome for purposes of study and research. In Germany also a certain number of teachers in the schools are every year provided with the means of making archaeological tours in Greece aind Italy, under the guidance of the best specialists ; while in the great museums of Germany holiday courses are annually arranged for the benefit of students who wish to keep abreast of the progress of archaeological discovery. In England and America efforts are made to work by private subscription in the same direc- tion in which so much is done by the governments of the Continent with public funds. Travelling studentships at the universities, and bursaries awarded by the Committee of the British School at Athens, avail to prevent England from being entirely left behind in the movement ; and the fun ds of the American Institute have in recent years enabled Amer- ican students to do much excellent work in exploration.

Naturally also the great museums of Europe are not only centres of research, and keenly alive to the necessity of pro-

curing fresh objects, but also are awake to the dut/"of pub- lishing in a systematic way the works of ancient art which they contain. Besides the publicmuseums, we may mention, in this connexion, the Ny-Carlsberg collection at Copen- hagen, the Tyszkiewicz collection, and the Barracco col- lection, the contents of which are published in excellent form.

Journals. — The most important periodicals in connex- ion with classical archaeology are now the following: — Published in English: the Journal of Hellenic a t, . Studies, the Annual of the British School at logical Athens, Archaeologia, the American Journal of pabiica- Archaeology. Published in French: Bulletin de ”’”’• Correspondance HelUnique, Revue ArcMologique, Monu- ments et Mimoires, Plot. Published in German : Jahrbuch des Arch. Instituts, Mittheilungen des Arch. Instituts, Bo- mische Ahtheilung and Athenische Abtheilung, Jahreshefte des oesterreich. Arch. Instituts. Published in Italian: Monumenti Antichi and Atti dell' Accad. dei Lincei, Bulletino delta Commiss. Archeol. Comunale di JSoma. Published in Greek: Ephemeris ArchaiologiM, Deltion*

Archaiologikon. To the subject of coins in particular, numismatic journals are dedicated in almost all countries of Europe ; among them the English Numismatic Chronicle occupies a satisfactory position.

Books. — ^To give any complete account, or even a bare list, of important works on classical archaeology published during the last twenty-five years would exceed the space at our disposal. We can select only a few works of special value, mentioning more particularly those which are published in English.

(1) General Handbooks. — Manuals of Classical Archseology have been published by Mr A. S. Murray and Mr Talfourd Ely. There is also a new brief History of Greek Art by Prof. F. B. Tarbell. Miss J. E. Harrison has published some Introductory Studies in Greek Art. A more complete Griechische Kunstgeschichte by Prof. Brunn, begun in 1893, does not come down below the archaic period. Sittl's Klassische Kunst-Archdologie is useful as a com- pendium. A new edition by Wernicke (recently deceased) of C. O. Milller's Denkmaler der alten Kunst is in progress. Of the greatest value to the ordinary scholar is Baumeister's Denkmaler, a dictionary of archaeological evidence suited for easy reference. To those who wish to procure a mass of archaeological material at moderate cost, it is safe to commend M. S. Reinaoh's Repertoire de la statuaire greeque et romaine and Bepertoire des vases peints grecs et etrusques, published at five francs a volume, with his other cheap reprints of expensive works.

(2) Architecture. — There is no recent systematic work in English on classical architecture, but Mr Penrose's Principles of Athenian Architecture (new edition) is a work of importance. Besides the handbooks already mentioned, which give chapters to architecture, we may refer to the seventh volume of Perrot and Chipiez's IfisfoiVe de I'art dans Vantiquitk (La Grece archaique), Botticher's Tektonik der Hellenen, and Uhde's Architekturformen des class. Alterthums, as well-illustrated and standard works.

(3) Sculpture. — A. S. Murray's History of Greek Sculpture and E. A. Gardner's Handbook of Greek Sculpture are important works ; as is also H. Stuart Jones's Ancient Writers on Greek Sculpture. There are also valuable histories of Greek sculpture in French by CoUignon, and in

German by Overbeck (4th edit. 1898). Among recent books on sculpture in English may be mentioned Waldstein's Essays on the Art of Pheidias, Furt- ■wangler's Masterpieces of Greek Sculpture, Michaelis's Ancient Marbles in Great Britain, and P. Gardner's Sculptured Tombs of Hellas. The German literature of the subject is very extensive.

(4) Vases. — A good book on Greek vases is at present a crying need. The most useful general book on the subject is Rayet and Collignon's Histoire de la ceramique greeque. For archaic vases, Dumont and Chaplain's Ceramiques de la Gfrece propre is valuable, though somewhat out of date (1888). Prof. Furtwangler has just issued the first par't of a great work on Greek vases, the plates of which are executed with great care, so as faithfully to represent the style of the vases. We have in English, Harrison and Maoooll's Cfreeic Vase Paintings, and A. S. Murray's Designs from

Greek Vases in the British Museum, and White Athenian Vases ; also the illustrated catalogues of vases in the British Museum, the Ashmolean and Fitzwilllam Museums, and the Louvre. Three small works in German by W. Klein, Euphronios, Vasen mit Meistersignaturen, and Vasen mit Lieblingsinschriften, are indis- pensable to the student. The best general collection of vase- paintings is still Gerhard's Auserlesene Vasenbilder, 1810.

(5) Terra-Cottas. — Two small works can be recommended: E. Pottier's Statuettes de terre cuite, and Miss C. A. Button's Greek Terra- Cotta Statuettes, which is published with A. S. Murray's Cfreek Bronzes.

(6) Gems. — A recent work is J. H. Middleton's Engraved Gems of Glassical Times. But quite recently A. Furtwangler has pub- lished a large work on Greek gems, Antike Oemmen, which is the product of vast learning, and must needs form the basis of future study.

(7) Coins. — TSo bra,nch of archaeology has been more completely transformed in the last quarter of a century than numismaticsi Previously, coins had been treated, much as gems are, as individual works of art, beautiful in themselves, and giving valuable information as to ancient mythology and geography. But in recent years the close and intimate relations wMoh prevail between the coins of ancient cities and the history of those cities have been more closely regarded, from which point of view the exact dates and weights of the coins become most important. The strictly historic treatment of Roman coins was begun by Mommsen in his Geschichte des romischen Munswesens. A similar treatment of Greek coins is attempted by Mr B. V. Head in his Bistoria Numorum, a work in which an endeavour is made to arrange the coins of all Greek cities under periods, in close connexion with the history of those cities. The British Museum Catalogue of Greek Coins, which is dominated by the same purpose, is now approaching completion. The Historia Numorum is the most usefii work to a collector of Greek coins. To a collector of Boman coins M. Babelon's editions of Cohen's

^ Monnaies de la ripublique romaine, and Monnaies de I'empire romain are necessary. Mr G. F. Hill's Handbook of Greek and Boman Coins is an excellent summary. Prof. Ridgieway has published a work on the Origin of Currency and Weight- Standards. P. Gardner's 7)/pes of Greek Coins deals mainly with the art of coins.

(8) Corpuses. — The Academies of Berlin and Vienna have done much in recent years in the way of publishing vast collections and compendia of ancient monuments, each of which is a Corpus, that is, contains all' known monuments of the class dealt with. It is impossible to overrate the value of these monumental publications, each of which, being complete up to the . date of publication, relieves the student from the necessity of hunting through books of an earlier date. ' The Corpus of Greek Inscriptions by Boeckh, and the more recent Corpus of Roman Inscriptions and Corpus of Attic Inscriptions are well known. To these are now added, a Corpus of Attic Sepulchral Monuments (nearly complete), a Corpus of Sarcophagi, a Corpus of Terra-Cottas, a Corpus of Greek Coins, all in course of gradual publication. ' Other works of the same class are in preparation. The labour of producing these works is

enormous, and for the most part it is tmpaid, German archaeologists freely spending their lives in the effort to advance scientific knowledge.

(9) Other Works. — Besides the works mentioned, we may set down a few books of a more general character: C. Biehl's Excursions in Greece, P. Gardner's New Chapters in Greek History, D. G. Hogarth's Authority and Archceology, Sacred and Profane, Lady Evans's Greek Dress, and the dictionaries of classical antiquities.

The valuable translation of and commentary on Pausanias' Description of Greece, by J. G. Frazer, has enabled the English reader for the first time to grasp >the results of the great intellectual activity of the archseologists at Athens. The edition of Pliny's Chapters on the History of Art, by Misses Jex-Blake and Sellers, is also important. In the matter of bringing ancient monuments into relation vnth Greek mythology, the books of C. O. Mttller have been succeeded by far more elaborate and completer works. Most comprehensive of all these is Overbeok's Kunstmythologie. The collection here made of monuments bearing on the cults of Zeus, Hera, Demeter, Poseidon, and Apollo is enormous; unfortunately, the completion of the work has been prevented by Prof. Overbeok's death. For monuments relating to other deities, we have to go to the Lexicons of Baumeister and Roscher. Mr L. R. Famell has published in English a work called Cults of the Cfreek States, which deals in detail with the art representations of some of the Greek deities.

Research and Excavation. — Three sites of the first im- portance in Greece proper have been carefully excavated in the last quarter of a century, besides those like Troy,

Tiryns, and Mycenae, wh!ich have yielded mainly pre- historic monuments. These are Olympia, the Athenian Acropolis, and Delphi. The excavation at Olympia was carried out at great cost by the German Government ; and the results are published in a series of vast and costly volumes, which are epoch-making in the development of archaeology. It must not be forgotten that in the thorough investigation of a great site like Olympia, which was for ages one of the chief centres of Greek life and art, the whole result is far greater than the sum of the separate discoveries. It is not merely that we have gained a knowledge of the plans

of buildings and of their archi- tectural details, a series of valuable works of sculpture and bronzes, and the text of a number of important documents recording treaties and decrees and public honours. We further discover the relations of these monu- ments among themselves. Their very situations and the level of their bases show us their respective dates and their comparative importance. We find ourselves in a museum, but in a museum not arranged on any arbitrary principle, but, so to speak, by the hands of history herself, affording us almost infinite opportunities for comparing, inferring, and connecting the remains which have come down to us with ancient belief and custom.

Of Delphi it is too early to speak, as the excavators to whom the task of its exploration has been confided by the French Government have as yet published but few of their results. But enough is known to assure us that the harvest on this site also is very.rich. The topography of the site and the position of the main buildings and the principal dedications can be determined with accuracy. In sculpture of the end of the 6th and the early part of the 5th century, the site is certainly very rich, and the inscriptions are already known to be very numerous and of great historic value. (See Delphi.)

The acropolis of Athens {q.v.) has been carefully and completely excavated by the Greek Archaeological Society. The great importance of the finds is mainly due to an event which, at the time, must have seemed fatal to all record of the city's beauty — the havoc wrought by the Persians, when they occupied the rock-fortress in 480 b.c. When the Athenians in the next year, after the victory of Plataea, returned to their citadel, they found it a mass of ruins, and nothing remain^ but to bury out of sight the shattered fragments of their shrines and the works of art which had been dedicated to their goddess. But their loss has been our gain, for the wreck of the ruined Athens of the early 5th century has rested quietly in the ground from that day to this, and has only now been dragged forth and ranged in the Athenian museums. To the archaeologist, nothing seems more desirable than to secure a fixed date for a series' of monuments. And on this site the year 480 is defined by the circumstances of the case as the time below which all the monuments to be found in certain strata cannot be brought. We are thus able to reconstruct in

imagination, at all events in outline, the surface of the Acropolis as it existed in the days of Pisi- stratus and of Themistocles.

The extensive precinct of the god .^sculapius in the neighbourhood of Epidaurus has also been cleared by the Greek archaeologists under M. Kavvadias. Here the main interest, besides that which belongs to recovered fragments of buildings and series of sculptures, arises from the fact that Epidaurus was a sort of Baden of antiquity, a resort of those who were out of health and sought recovery either at the hands of the physician-god or from the natural salubrity of the place and its healthful regimen. We find on the spot not only shrines of the deities, but covered seats shielded from all the winds, an abundant supply of water for baths, porticoes as a refuge from summer heat, and a theatre and a stadium for the refresh-

ment of the mind and the exercise of the body. (See

EpiDAUEtJS.)

Many other sites in Greece proper have yielded valu- able results. At Megalopolis, a party of English students have recovered the plans of various buildings, in particular of the theatre and the hall of assembly where the repre- sentatives of the cities of Arcadia met in conclave. The ground plan of Corinth is being rapidly recovered by American archaeologists', who' have also succeeded in revealing the phases which the Argive Herseum passed through 'in the course ,of long ages. The temples of Apollo Ptoos in Boeotia, of Athena Alea at Tegea, of the great goddesses at Lycosura, have also been in part brought to light, with happy results for the history of Greek sculpture. Of these results we shall have to speak further in the course of this article.

Among the islands of the ;^gean, there has been of late years much research and excavation. The results belong in great part to the prehistoric age of Greece, and are spoken of in the article on Mxcbn^an

Civilization. But Delos in particular has furnished us not only with the foundations of temples and the plans of private houses, but also with some very important examples of sculpture, which may be said to give us the clue to the history of the rise of the art.

Mr Petrie's important excavations in Egypt, and the more recent and equally striking discoveries of Mr A. J. Evans in Crete, have been valuable as fixing the dates of early classes of ^gean and Mycenaean pottery, and revealing to us the nature of the early .SIgean civili- zation. And the site of Naucratis in particular, excavated by Mr Petrie and Mr Ernest Gardner in 1884-86, has given us dates for various kinds of early Ionian pottery, as well as furnished us with valuable data for recovering the history of the Greek alphabet.

Partial excavations have been made on the sites of some of the great-Ionian cities of Asia Minor. At Ilphesus, the researches of Wood, which have enriched' the British Museum with many architectural ai^d sculptural fragments from the great temple of Artemis, have been resumed by the Austrian Government. The temple of Apollo at Miletus has been explored by MM. Eayet and Thomas ; further excavations are taking place on this site. The Americans have made extensive excavations at Assos. The site of Pergamon, which has been occupied by the German Archaeological Institute, has yielded results which have added an important chapter to Greek art, and shown us the sculptors of Greece working under new conditions and in a new style. Clazomenae and other cities have furnished us from their burying-grounds sarcophagi and painted vases which throw light on the origin and early history of Ionian art. It is unnecessary to proceed further with this enumeration; what has been written will be sufficient to give the reader some idea of the energy with which excavation has been carried on in Greece of late years, and of the richness and variety of the results which it has attained.

Turning to Italy, we naturally think first of Eome. In that centre of the world, the main interest of all excava- tion must be topographic and historic, and for results of this character the reader must turn to the article Rome. But in the course of investigation a great number of important works of ancient sculpture and painting have been brought to

light, most of which now adorn the museums of the Capitol and the new museum of the Terme. We may instance the wonderful bronze figures of a Hellenistic king and of a pugilist, and the wall-paintings of the house at Prima Porta. Of other excavations in Italy, an excellent summaiy will be found in Prof, von Duhn's article in vol. xvi. of the Journal of Hellenic

Studies. At Locri two Ionic temples have been discovered. The building of an arsenal at Tarentum has been the occasion of the discovery of very rich deposits of terrarcotta votive offerings. At Pompeii a house of great beauty and interest, which bears the nameof the Vettii, has been foimd, and has furnished a number of fresh paintings. Excavations at Ealerii deserve a particular mention, because their results are separately arranged in a special museum at Eome, that of the Villa Papa Giulio, giving us materials for tracing the artistic history of the city from period to period. _At this museum is also a very at- tractive restoration of a Greek temple, with its decoration in terra-cotta and its brilliant colouring.

The researches of Signor Orsi in Sicily on the sites of Megara and Syracuse have resulted in the establishment of an archaeological history of Sicily, which may be traced in the museums of Syracuse and Palermo from the earliest days down to the period of Greek invasion, and onwards to the Eoman age. The site of Selinus, which has long been a valuable mine of sculpture of the early period, has again in recent years furnished us with metopes from its temples of great interest ; and the plan of the city has now been in great measure laid bare, as well as of lie fortifi- cations erected by Hermocrates, when at the end of the 6th century he turned the ruins of the town into a fortress whence to wage war against the Carthaginians. No country is more full of the memorials of history than Sicily; but we cannot pursue this subject; we must refer the reader to the ample and most interesting history of Sicily by Mr Freeman, a writer who fully understood how much light existing remains may cast on the past history of a city.

A class of ancient bnildings "which has received special attention in recent years is the great open-air theatres with which every Greek city was provided. _, Fresh theatres have been excavated at Piraeus, Eretria, Delos, Megalopolis, Epidaurus, and other plaqes ; and the model of all

such erections, the theatre of Dionysus at Athens, has been most carefully investigated. In this work the leading part has been taken by Dr Dorpfeld of Athens. The result has been the setting forth by Dr Dorpfeld, with, the utmost skill, of the view that there was no stage in use in Greek theatres, but that the actors and the chorus performed together in the space at the back of the orchestra, and in front of the stage buildings. (See Dorpfeld and Eeisch, Deis griechische Theater.) This novel view has met with severe criticism in Germany, and especially in England. The arguments against it are set forth by Haigh, in his ^ttic Theatre. It is likely, that scholars will long be divided in their opinions as to the existence or non-existence of a stage among the Greeks. In the opinion of the present writer it can be proved from extant remains that a stage was in use in Greek theatres of the 3rd century b.c, and although we cannot demon- ‘ stratethat the same was the case in the days of the great Attic tragedians, it is by far the most likely supposition. However this be, the researches and the book of Dr Dorpfeld have enabled us to approach all questions in regard to the staging of Greek plays with far greater knowledge.

The materials for a reconstruction of the private houses of the Greeks have also been rapidly accumulating. At Delos, at Assos, at Priene, and on other sites, the plans of ancient houses have been brought to ““ses-light. At present, few of these plans have been published ; but it has become clear that we have hitherto been misled by Vitruvius into the belief that Greek houses were of uniform plan, like the temples ; whereas they varied greatly according to the ground, the fortune of the builder, or the fashion of the district. For gaining a sense of the

external conditions of ancient life, Pompeii is still by far the most useful site. The recent book on Pompeii by Man, translated by Kelsey, is by a writer who has an unequalled knowledge of the site ; and the more ambitious work of C. Weichardt {Pompei vor der Zerstoerung) brings

before the reader's eyes, by means of skilled restorations, the actual state of Pompeii before its sudden destruction.

We propose next to treat briefly of the advances made by recent discovery in our knowledge of 'Greek and Eoman monuments and art, dividing our account into the same periods which Mr Murray has adopted in his article, CLASSICAL Aech^ologt, in the ninth edition of this Encyclopaedia.^ ^

The periods accepted are the following: — I. 900-700 B.C. II. 700480 B.C. III. 480-400 b.o. IV. 400-320 b.o. V. After 320 b.c.

Period I. 900-700 B.C.

In Mr A. S. Murray's earlier article the art of the later prehistoric age of Greece, now usually called the Mycenaean age, is included with that of historic Greece, to which indeed it naturally serves as an introduction. But for our present purposes the art of Mycenae is reserved for separate treatment (see Mycenaean Civilization). We have therefore to deal only with the art which succeeded that called Mycenaean, beginning about the year 900 b.c The fact is now generally allowed that the Mycenaean civilization was for Ahe most part destroyed by an invasion from the north. This invasion appears to. be that called in Greek tradition the Dorian immigra^ tion. Archaeological evidence abundantly proves that it was the conquest of a more by a less rich and civilized race. In the graves of the period 900-700 b.o. we find none of the wealthy spoil which has made cele- brated the tombs of Mycenae and Baphion (Vaphio). The character of the pottery and the bronze-work which is found in these later graves reminds us of the art of the necropolis of Hallstadt in Austria, and other sites belong- ing to- what is called the bronze age of North Europe. Its predominant characteristic is the use of geometrical forms, the lozenge, the triangle, the maeander, the circle with tangents, in place of the elaborate spirals and plant- forms which mark Mycenaean ware. For this reason the period from the 9th to the 7th century in Greece passes by fke name of 'f the Geometric Age." It would seem that in the remains of the Geometric Age we may trace the influence of the Dorians, who, coming in as a hardy but uncultivated race, probably of purer Aryan blood than the previous inhabitants of Greece, not only brought to an end

the wealth and the luxury which marked the Mycenaean age, but also replaced an art which was in .character essentially Oriental by one which belonged rather to the North and the West. The great difficulty inherent in this, view, a difficulty which has yet to be met, lies in the fact that some of the most abundant and characteristic remains of the geometric age which we pos- sess come, not from Peloponnesus, but from Athens and Bceotia, which were never conquered by the Dorians.

The geometric ware is for the most part adorned with painted patterns only. We engrave (Fig. 1) a characteristic example, a small two-handled vase from Ehodes aeometric £jj ^j^g Ashmolean Museum, the adornment of which consists in zigzags, circles with tangents, and lines of water-birdsjperhaps swans. Other geometric vases will be found in Ency. Brit. vol. xix. p. 607, Fig. 16. Solnetimes, however, especially jn the case of large vases

I It Is not to be supposed that the present writer agrees with all the views set forth by Mr Murray in that article ; on many oi the subjects of which he treats scholars will always differ among them- selves.

from the cemetery at Athens which adjoins the Dipylon gate, scenes from Greek life are depicted, from daily life, not from legend or divine myth. Especially scenes from the lying in state and the burial of the dead are i)revalent. We engrave an excerpt from a Dipylon vase (Fig. 2), in which is seen a dead man on his couch surrounded by

Fio. 1.— Geometric vase from Bhodes. Ashmolean Museum.

mourners, male and female. Both sexes are apparently represented naked, and are distinguished very simply; some of them, hold branches to sprinkle the corpse or to keep away flies. , It will be seen how primitive and con- ventional is the drawing of this age, presenting a wonder- ful contrast to the free drawing and realistic modelling of the Mycenaean age. In the same graves with the pottery are sometimes found plaques of gold or bronze,

Fio. 2. — Corpse with mourners. Mon. d. Mat. ix.

and towards the end of the geometric age these sometimes bear scenes from mythology, treated with the greatest simplicity. For example, in the museum of Berlin are the contents of a tomb found at Corinth, consisting mainly of gold work of geometric character. But in the same tomb were also found gold plates or plaques of repoussi work bearing subjects from Greek legend.

Fig. 8.— Gold plaques: Corinth. Arch, Zeit. 1884, 8.

Two of these (Fig. 3) we engrave. On one plate Theseus is slaying the Minotaur, while Ariadne stands by and encourages the hero. ” The tale could not have been told in a simpler or more straightforward way. On another plate we have an armed warrior with his charioteer in a chariot drawn by two horses. The

FiQ. 4.— Handle of tripod : Olympia, iv. 88.

treatment of the Imman body is here more advanced than

on the vases of the Dipylon. On the site of Olympia, ■where Mycenaean remains are not found, but the ear- liest monuments seem to belong to the Dorian age, a quantity of dedica- tions in bronze have been found, the dec- oration of which belongs to this style. We engrave (Fig. 4) the handle of a tripod from Olympia, which is adorned with geo- metric patterns and surmounted JDy the

figure of a horse. In the 7th century, however, it was

not unusual to adorn votive

tripods and coffers with

mytholpgic representations.

Especially interesting is one

plate of bronze, also from

Olympia, used for some such

purpose (Fig. 5), and show- ing in repcMssi work, finished

with the graving tool, a

vsringed Artemis grasping

two lions, and Herakles

shooting a centaur, whose

front legs are human, not

equine. In the upper lines of

the relief are pairs of eagles

and grifBns. Another similar

plate represents again Her- akles shooting. More than

one breastplate has come

from Olympia engraved by,

the tool with scenes such as

one finds on early vases.

Votive models of animals are

also abundant. In fact, the

history of Greek art from 800 to 500 b.c. can be nowhere

better traced than in the plates of Furtwangler's great

work on the bronzes of Olympia.

Period II. 700-480 b.c.

It was in the 6th oentiuy that the genius of the Greeks, almost suddenly, as it seems to us, emancipated itself from the thraldom of tradition and passed beyond the limits with which the nations of the East and West had hitherto been content, in a free and bold effort towards the ideal. Thus the 6th century mark^ the stage in art in which it may be said to have become definitely Hellenic. The Greeks stUl borrowed many of their decorative forms, through Phcenician agency, from the old-world empires of Egypt and Babylon, but they used those forms freely to express their own meaning. And gradually, in the course of the century, we see both in the painting of vases and in sculpture a national spirit and a national style forming under the influence of Greek religion and mythology, Greek athletic training, Greek worship of beauty. We must here lay emphasis on the fact, which is sometimes overlooked in an age which is greatly given to the Dar- winian search after origins, that it is one thing to trace

Fig. 5. — Bronze plate : Olympia.

Ionian vases.

back to its original sources the nascent art of Greece, and quite another thing to follow and to understand its grad- ual embodiment of Hellenic ideas and civilization. The immense success with which the veil has in late years been lifted from the prehistoric age of Greece, and the clearness with which we can discern the various strands woven into the web of Greek art, have tended to fix our attention rather on what Greece possessed in common with all other peoples at the same early stage of civilization than on what Greece added for herself to this common stock. In many respects the art of Greece is incomparable — one of the great inspirations which have redeemed the world from medi- ocrity and vulgarity. And it. is the searching out and appreciation of this unique and ideal beauty in all its phases, in idea and composition and execution, which is the true task of Greek archaeological science.

In very recent years it has been possible, for the first time, to trace the influence of Ionian painting, as repre- sented by vases, on the rise of art. The dis- coveries at Naucratis and Daphnae in Egypt, due to the keenness and pertinacity of Mr Petrie, opened a new light in this matter. It became evident that when those cities were first inhabited by Ionian Greeks, in the 7th century, they used pottery of several distinct but allied styles, the most notable feature of which was the use of the lotus in decoration, the presence of con- tinuous friezes of animals and of monsters, and the filling up of the background with rosettes, lozenges, and other forms. We engrave a vase found in Rhodes (Fig. 6) to illustrate this Ionian decoration. The sphinx, the deer, and the swan are prominent on it, the last-named serving as a link between the geometric ware and the more brilliant and varied ware of the Ionian cities. The assignment of the many species of early Ionic ware to various Greek locali- ties, Miletus, Samos, Phocaea, and other cities, is a work of great dif&culty, which is now closely occu- pying the attention of 'archaeologists. For the results of their studies the reader is referred to two recent German works, Boeh- lau's Aus ionischen und italisclien Nekro- polen, and Endt's Bei- trage zur ionischen Vasenmalerei. The feature which is most interesting in this pottery from our present point of view is the way in which representations of Greek myth and legend gradually make their way, and relegate the mere decoration of the vases to borders and neck. One of the earliest examples of representation of a really Greek subject is the contest of Menelaus and Euphorbus on a plate found in Ehodes (Ency. Brit. xix. p. 611, Fig. 24). On the vases of Melos, of the 7th century, which are, however, not Ionian, but rather Dorian in char acter, we have a certain number of mythological scenes, battles of Homeric heroes, and the like. One of these we engrave (Fig. 7). It represents Apollo in a chariot drawn by winged horses, playing on the lyre, and accompanied by a pair of Muses, meeting his sister Artemis. It is notable that Apollo is bearded, and that Artemis holds her stag

Fie. 6 Jug from BhodeB. Mua. J/apolSon, 67.

by the horns, much in the manner of the deities on Baby- lonian cylinders ; in the other hand she carries an arrow ; above is a line of water-birds.

Some sites in Asia Minor and the islands adjoining, such cities as Samoa, Cameirus in Ehodes, and the Ionian colonies on the Black Sea, have furnished us with a mass

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Fio. T.— Vase pidntiiig : Melos. Conze, Mel. Thonge/daae, 4.

of ware of the Ionian class, but it seldom bears interesting subjects ; it is essentially decorative. For Ionian ware which has closer relation to Greek mythology and history we must turn elsewhere. The cemeteries of the great Etruscan cities, Caere in particular, have preserved for us a large number of vases, which are now generally recog- nized as Ionian in design and drawing, though they may in some cases be only Italian

imitations of Ionian im- ported ware. Thus has been filled up what was a blank page in the history of early Greek art. The Ionian painting is unrestrained in character, characterized by a license not foreign to the nature of the race, and wants the self-control and moderation which belong to Doric art, and to Attic art after the first.

Some of the most interesting examples of early Ionic painting are found on the sarcophagi of Clazomense. In that city in archaic times an exceptional custom prevailed of burying the dead in great coffins of terra-cotta adorned with painted scenes from chariot-racing,, war, and the chase. The British Museum possesses some remarkable specimens, wliich are published by Mr Murray in his Terra-Cotta Sarcophagi of the British Museum. On one of them he sees depicted' a battle between Cimmerian invaders and Greeks, the former accompanied to the field by their great war-dogs. In some of the representations of hunting on these sarcophagi the himters ride in chariots, a way of hunting quite foreign to the Greeks, but familiar to us from Assyrian wall-sculptures. We know that the life of the lonians before the Persian con- quest was refined and not untingedwith luxury, and they borrowed many of the stately ways of the satraps of the kings of Assyria and Persia.

In Fig. 8 we engrave a curious product of the Ionian workshops, a fish of solid gold, adorned with reliefs which

-Fish of Gold. Purtwangler, Goldfund v. Velterafeld6.

represent a flying eagle, lions pulling down their prey, and a monstrous sea-god among his fishes. This relic is

the more valuable on account of the spot where it was found—Vettersfelde in Brandenburg. It furnishes a proof that the influence and perhaps the commerce of the Greek colonies on the Black Sea spread far to the north through the countries of the Scythians and other bar-barians. The fish dates from the 6th century e.g.

From Ionia the style of vase-painting which has been called by various names, but may best be termed the " orientalizing," spread to Greece proper. Its main home here was in Corinth ; and small Corinthian

unguent-vases bearing figures of swans, lions, monsters, and human beings, the intervals between which are filled by rosettes, are found wherever Corinthian trade penetrated, nptaHy in the cemeteries of Sicily. For the larger Corinthian vases, which bore more elaborate scenes from mythology, we must again turn to the graves of the cities of Etruria. Here, besides the Ionian ware, of which mention has already been made, we find pottery of three Greek cities clearly defined, that of Corinth, that of Chalcis in Eubcea, and that of Athens. Corinthian and Chalcidian ware is most readily distinguished by means of the alphabets used in the inscriptions (see Ency. Brit. xix. p. 609), which have distinctive forms easily to be identified. Whether in the paintings coming from the various cities any distinct differences may be traced is a far more difficult question, into which we cannot now enter. The subjects are mostly from heroic legend, and are treated with great simplicity and directness. There is a manly vigour about them which distinguishes them at a glance from the laxer works of Ionian style. We figure (Fig. 9) a group from a Chalcidian vase which represents the conflict over the

Jia. 9.— Fight over the body of Achilles. Mon. d. Inst, i, 51.

dead body of Achilles. The corpse of the hero lies in the midst, the arrow in his heel. The Trojan Glaucus tries to drag away the body by means of a rope tied round the ankle, but in doing so is transfixed by the spear of Ajax, who charges under the protection of the goddess Athena Paris on the Trojan side shoots an arrow at Ajax. The other combatants of the group we omit for want of space. In Fig. 10 is a scene from a Corinthian vase. Ajax falls on his sword in the presence of his colleagues, OdysseuS and Diomedes. The short stature of Odysseus is a well- known Homeric feature. These vases are black-figured ; the heroes are painted in silhouette on the red ground of the vases. Their names are appended in archaic Greek letters.

*The early history of vase-painting at Athens is com- plicated. It was only by degrees that the geometric style gave way to, or developed into, what is known as the black-figured style. It-would seem that ^”**’”’ unto the age of Pisistratus Athens was not notable in the world of art, and nothing could be ruder than some of the vases of Athens in the 7th century, for*

example that here figured, on one side of which are represented the winged Harpies (Fig. 11) and on the other Perseus accompanied by Athena flying from the pursuit of the Gorgons. This vase retains in its decoration some features of geometric style; but the lotus and rosette, the lion and sphinx.

wliich appear on it, belong to the wave of Ionian in- fluence. Although it involves a departure from strict chronological order, it will be well here to follow the course of development in pottery at Athens until the

FiQ. 10. — Suicide of ^ax. Mut, Ifapolion, 66.

end of our period. Neighbouring cities, and especially Corinth, seem to have exercised a strong influence at Athens about the 7th century. We have even a class of vases called by archaeologists Corintho- Attic. But in the course of the 6th century there is formed at Athens a

Fig. 11 Harpies : AtUo vase. Areh. Zeit. 1882, 9.

distinct and maiked black-figured style. The most re- markable example of this ware is the so-called Franqois vase at Munich, by Clitias and Ergotimus, recently smashed by a madman, which contains, in most careful and precise rendering, a number of scenes from Greek

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Fio. 12.— Foot-race : Panathenaic vase. Mon. d. Mat. x. 48 m.

myth. One of these vases is dated, since it bears the name and the figure of Callias in his chariot (Mon. dell' Inst. iii. 45), and this Callias won a victory at Olympia

in 564 B.C. We engrave (Fig. 12) the reverse of a some- what later black-figured vase of the Panathenaic class, given at Athens as a prize to the winner of a foot-race at the Panathensea, with the foot-race (stadion)

represented on it. A large number of Athenian vases of the 6th century have reached us, which bear the signatures of the potters who made, or the artists who painted them ; lists of these will be found in the useful work of Klein, Oriechische Vasen mit Meistersignaturen. The recent excavations on the acropolis have proved the erroneousness of the view, strongly maintained by Brunn, that the mass of the black- figured vases were of a late and imitative fabric. We now know that, with a few exceptions, vases of this class are not later than the early part of the 6th century. The same excavations have also proved that red-figured vase-painting, that is, vase-painting in which the background was blocked out with black, and the figures left in the natural colour of the vase {Ency. Brit. xix. p. 613) originated at Athens in the last quarter of the 6th century. We cannot here give a detailed account of the beautiful series of Athenian vases of this fabric. Many of the finest of them are in the British Museum. We engrave, as an example (Fig. 13), a group by the painter Pamphseus, representing HerOules- wrestling with the river-monster Achelous, which belongs to, the age of the

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Fie,

Herakles and Achelous. Wi&ner Vorlegebldtier, D. 6.

Persian wars. The clear precision of the figures, the vigour of the grouping, the correctness of the anatomy, and the delicacy of the lines are all marks of distinction. The student of art will perhaps find the nearest parallel to these vase-pictures in Japanese drawings (q.v.J. The Japanese artists are very inferior to the Greek m their love and understanding of the human body, but equal them in freshness and vigour of design. At the same time began the beautiful series of white vases made at Athens for the purpose of burial with the dead, and found in great quantities in the cemeteries of Athens, of Eretria, of Gela in Sicily, and of some other cities. They are well represented in the British Museum, and that of Oxford.

We now return to the early years of the 6th century, and proceed to trace, by the aid of recent discoveries, the rise of architecture and sculpture. The

Greek temple in its character and form gives the clue to the whole character of Greek art. It is the abode of the deity, who is represented by his sacred image ; and the flat surfaces of -the temple offer a great field to the sculptor for the depicting of sacred legend. The process of discovery has emphasized the line which divides Ionian from Dorian architecture and art. We will speak first of the temples and the sculpture of Ionia. The lonians were a people

far more susceptible than the Dorians to the influences of Oriental civilization. The dress, the art, and the luxury of Western Asia irresistibly attracted them, and ■we may suspect that Ionian workmen in the service of Asiatic rulers contributed largely to the adornment and the beauty of the palaces of Nineveh and Persepolis. Two of the great Ionian temples, dating from the 6th century, have been excavated in recent years. At Miletus, the labours of Messrs Eayet and Thomas have succeeded in discovering the plan of the great temple of Apollo, and even of the underground oracular chamber which lay beneath it, but the architectural fragments which they have brought to light belong all to a later co'nstruction ; and the only figures which can be con sidered as belonging to the original temple destroyed by Darius are the dedicated seated statues, some of which, brought away by Sir Charles Newton, are now preserved at the British Museum. At Ephesus Mr Wood has been

more successful, and has recovered considerable fragments of the temple of Artemis, to which, as Herodotus tells us, Croesus presented many columns. The lower part of one of these columns, bearing , figures in relief of early Ionian style, has been put together at the British Museum (Fig. 14); and remains of 'in- scriptions recording the presentation by Croesus are still to be traced. Re- liefs from a cornice of somewhat later date are also to be found at the British Museum. Among the jEgean islands, Delos has furnished us with the most important remains of early art. French ex- cavators have there found a very early statue of a woman

dedicated by one Nicandra to Artemis (Fig. 16), a figure which may be instructively compared with another from Samos, dedicated to Hera by Cheramnes. The Delian statue is in shape like a flat beam ; the Samian, which is headless, is like a round tree. The arms of the Delian figure are rigid to the sides ; the Samian lady has one arm clasped to her breast (Fig. 15). A great im- provement on these helpless and inexpressive figures is marked by another figure found at Delos, and connected, though without absolute certainty, with a basis recording the execution of the statue by Archermus and Micciades, two sculptors who stood, in the middle of the 6th century, at the head of a sculptural school at Chios. The repre- sentation (Fig. 17) is of a running or flying figure, hav- ing six wings, like the seraphim in the vision of Isaiah, and clad in long drapery. It may be a statue of Nike or Victory, who is said to have been repre- sented in winged form by Archermus. The figure, with its neatness and precision of work, its expressive face and strong outlines, certainly marls^s great progress in the art of sculpture. When we examine the early sculpture of Athens, we find reason to think that the Chian school had great influence in that city in the days of Pisistratus.

At Athens, in the age 660-480, we may trace two quite distinct periods of architecture and sculpture. In the earlier of the two periods, a rough limestone was used

Fia. 14.— Sculptured pillar : Ephesus. Brit. Museum,

alike for the walls and the sculptural decoration of temples; in the later period it was superseded ^^^^^^ by marble, whether native or imported. Every sculpture. visitor to the museum of -the Athenian acropolis stands astonished at the recently recovered groups which decorated the pediments of Athenian temples before the Page of isisti-atus — groups of large size, rudely cut in soft

Fio. 16.— Figure dedicated to Hera ; Paris.

Fio. 16.— Figure dedicated to Artemis: Athens.

stone, of primitive workmanship, and painted with bright red, blue, and green, in a fashion which makes no attempt to follow nature, but only to

produce a vivid result. The two largest in scale of these groups seem to have belonged to the pediments of the early 6th century temple of Athena. One repreg^nts the combat between Zeus and Hercules, who kneel back to back in the middle of the

Fie. 17.— Nike of Chian school, restored.

group, and their monstrous opponents Typhon and his wife Echidna ; the other represents the struggle between Hercules and Triton in the presence of the serpent-footed Cecrops, first king of Attica. On other smaller pediments, perhaps belonging to shrines of Hercules and Dionysus, we have again conflicts of Hercules with Triton or with other monstrous foes. It is notable how fond the Athenian artists of this early time are of exaggerated

muscles and of monstrous forms, which combine the limbs of men and of animals ; the measure and moderation which mark developed Greek art are as completely absent as are skill in execution or power of grouping. We engrave (Fig. 18) a small pediment in which appears in relief the slaying of the Lernsean hydra by Hercules. The hero strikes at the many-headed water-snake, somewhat in- appropriately, with his club. lolaus, his usual com-

FiQ. 18. — Athenian pediment : Herakles and Hydra. Athrni. Miitheil. x. 2S7.

panion, holds the reins of the chariot which awaits Her- cules after his victory. On the extreme left a huge crab comes to the aid of the hydra.

There can be little doubt that Athens owed its great start in art to the influence of the court of Pisistratus, at vrhich artists of all kinds were welcome. We can trace a gradual transformation in sculpture, in which the influ- ence of the Chian and other progressive schools of sculp- ture is visible, not only in the substitution of island marble for native stone, but

in increased grace and truth to nature, in the toning down of glaring colour, and the appearance of taste in composition. A transition between the older and the newer is fiurnished by the well-known statue of the calf-bearer, an Athenian preparing to sacri- fice a calf to the deities, which is made of marble of Hymettus, and in robust clumsiness of forms is not far removed from the limestone pediments. The sacrificer has been commonly spoken of as Hermes or Theseus, but he seems rather to be an ordinary human votary of the goddess.

In the time of Pisistratus or his sons a peristyle of columns was added to the old temple of Athena; and this necessitated the preparation of fresh pediments. These were of marble. In one of them was represented the battle between gods and giants ; in the midst Athena herself striking at a prostrate foe (Fig. 19). In these

Fio. 19. — Pediment; Athena and giant. Athen. Mitth&il. xxli, 8.

figures no eye can fail to trace remarkable progress. Oh about the same level of art are the charming statues of votaresses of Athena, dedicated to her, which were set up in the latter half of the 6th century in the acropolis.

whose graceful though conventional forms, and delicate colouring, make them one of the great attractions of the Acropolis Museum. We engrave (Fig. 20) a figure which, if it be rightly connected with the basis on which it stands, is the work of the sculptor Antenor, who was also author of a celebrated group representing the tyrant-slayers, Harmodius- and Aristo- _geiton. To the same age belong many other votive reliefs of the acropolis, re- presenting horsemen, scribes, and other votaries of Athena.

Prom Athens we pass to the seats of Dorian art. And in doing so we find a complete change of character. In place of draped goddesses ^^j^^^, and female figures, we find nude male forms. In place of Ionian softness and elegance, we find hard rigid outlines, strong muscular development, a greater love of and faithfulness to the actual human form — the influence of the palsestra rather than of the harem. To the known series of archaic male figures, recent years have added many examples. We may especially mention a series of figures from the temple of Apollo Ptoos in

Boeotia, probably re- presenting the god himself. Still more noteworthy are two colossal nude figures of Apollo, remarkable both for force and for rudeness, foimd at Delphi, the inscriptions of which prove them to be the work of an Argive sculptor. From Crete we have acquired the upper part of a draped figure (Fig. 21), whether male or female is not

Fig. 20.— Flguie nf Antenor, restored.

Fio. 21.— Bust from Crete.

certain, which should be an example of the early Dsedalid school, whence the art of Peloponnesus was derived ; but we can scarcely venture to treat it as a characteristic pro- duct of that school ; rather the likeness to the dedication of Nicandra (Fig. 16) is striking.

Next in importance to Athens, as a find-spot for works of early Greek art, ranks Olympia. Olympia, however, did not suffer like Athens from sudden violence, oiympia, and the explorations there have brought to light sparta, a continuous series of remains, beginning with Seiinus. the bronze tripods of the geotaetric age already mentioned,

and ending at the barbarian invasions of the 4th century A.D. Notable among the 6th-century stone-sculpture of Olympia are the pediment of the treasury of the people of Megara, in which is represented a battle of gods and

giants, and a huge rude head of Hera (Fig. 22), ^hich seems to be part of the image wor- shipped in the Herseum. Its flatness and want of style are noteworthy. Among the temples of Greece proper the Herseum of Olympia stands almost alone for antiquity and interest, its chief rival, besides the temples of Athens, being the other temple of Hera at Argos. It appears to

have been originally constructed of wood, for which stone was by slow de-grees, part by part, sub- T. oo H J fti ..ni„™,^i. stituted. In the time

Fia. 22.— Head of Hera : Olympia. . j. . i

of Pausanias one ot the pillars was still of oak, and at the present day the varying diameter of the columns and other structural irregularities bear witness to the process of constant renewajl which must have taken place. The early small bronzes of Olympia form an important series, figures of deities standing or striding, warriors in their armour, athletes with exaggerated muscles, and women draped in the Ionian fashion, which did not become unpopular in Greece until after the Persian wars. Excavations at Sparta have not produced any sculptures admirable in an artistic way ; but they have revealed interesting monuments belonging to the worship of ancestors, which seems in the conservative Dorian states of Greece to have been more strongly developed than else- where. On some of these stones, which doubtless belonged

to the family cults of . Sparta, we see the ancestor seated holding a wine-cup, accompanied by his faithful horse or dog; on some we see the ancestor and ancestress seated side by side (Fig. 23), ready to receive the gifts of their descendants, who appear in the corner of the relief on a much smaller scale. The niale figure holds a wine-cup, in allusion to the liba^ tions of wine made at the tomb. The

FIG. 23. -Spavtan tombstone: Berlin. female figure holds

her veil and the pomegranate, the recognized food of the dead. A huge serpent stands erect behind the pair. The style of these sculptures is as striking as the subjects; we see lean rigid forms with severe outline carved in a very low relief, the surface of which is not rounded but flat. The name of Selinus in Sicily, an early Megarian colony, has long been associated with some of lie piost curious of early sculptures, the metopes of

ancient temples, representing the exploits of Hercules and of Perseus. Even more archaic metopes have m recent years been brought to light, one representing a seated sphinx, one the journey of Europa over the sea

on the back of the amorous bull (Fig. 24), a pair of dolphins swimming beside her. In simplicity and in rudeness of work these reliefs remind us of the limestone pediments of Athens (Fig. 18), but yet they are of another and a severer style ; the Ionian laxity is wanting. , ,. ,

When the results of the recent French excavations at Delphi are published, there is no doubt that we shall be able to add a new and important chapter to the jjg,pi,,^ history of 6th-century art. Of three treasure- houses, those of Sicyon, Cnidus, and Athens, the sculptural adornments have been in great part recovered. These sculptures form a series almost covering the century 570- 470 B.C., and include representations of some myths of which we have hitherto had no example. Although the results of the excavations at Delphi are not yet published, we say here a few words as to the sculpture which has been discovered, leaving to the article Delphi an account of the topography and the buildings of the sacred site. Of the

Fie. 24.— Metope ; Europa on Bull : Palermo.

archaic temple of Apollo, built as Herodotus tells us by the Alcmseonidse of Athens, the only sculptural remains which have come down to us are some fragments of the pedimental figures. Of the treasuries which contained the offerings of the pious at Delphi, the most archaic of which there are remains is that belonging to the people of Sicyon. To it appertain a set of exceedingly primitive metopes. One represents Idas and the Dioscuri driving off cattle ; another, the ship Argo ; another, Europa on the bull; others merely animals, a ram or a boar. The treasury of the people of Cnidus (or perhaps Siphnos) is in style some half a century later. To it belongs a long frieze representing a variety of curious subjects : a battle, perhaps between Greeks and Trojans, with gods and goddesses looking on ; a giganto- machy in which the figures of Poseidon, Athena, Hera, Apollo, Artemis, and Cybele can be made out, with their opponents, who are armed like Greekhoplites ; Athena and Hercules in a chariot ; the carrying off of the daughters of Leucippus by Castor and Pollux ; .^olus holding the winds in sacks. The Cnidian treasury was restored in the French Exposition of 1900. The cornice of the front was supported by two archaic figures of Caryatids ; a sphinx and two running*

Victories stand on the top of the pediment as acroteria, while within the pediment is represented the struggle between Apollo and Hercules for the possession of

the Delphic tripod. The treasury of the Athenians, erected at the time of the Persian wars, was adorned with some metopes of singularly beautiful and clear-cut style, representing the deeds of Hercules and Theseus. Besides the decoration of the treasuries, and the charioteer men- tioned below, there were found two very rude figures of Apollo naked, by Argive artists, a colossal sphinx on a lofty pillar dedicated by the people of Naxos, and other statues.

Period III. 480-400 ko.

On the age of the great early masters of sculpture, of Myron, Phidias, and Polycleitus, much light has been thrown in the last quarter of a century, partly by means of new excavation, but also, in a scarcely less degree, through the careful re-examination of known monuments. Under this period, the first place certainly belongs to the great temple of Zeus at Olympia. The statue by Phidias which once occupied the place of honour in that temple, and was regarded as the noblest monument of Greek religion, has of course disappeaijed, nor are we able with Olympia: Confidence to restore it. But the plan of the Temple at temple, its pavement, some of its architectural ■^^*' ornaments, remain. The marbles which occupied

the pediments and the metopes of the temple have been in large part recovered, having been probably thrown

down by earthquakes and gradually buried in the alluvial soil. The utmost ingenuity and science of the archaeologists of Germany have been employed in the recovery of the composition of these groups; and although doubt remains as to the places of some fig- ures, and their precise attitudes, yet we may fairly say that we know more about the

sculpture of the Olympian temple of Zeus than about the sculpture of any other great Greek temple. The exact date of these sculptures is not certain, but we may with some confidence give them to the middle of the 6th century or a few years earlier. (In speaking of them we shall mostly follow the opinion of Dr Treu, whose masterly work in vol. iii. of the great German publication on Olympia is a model of patience and of science.) In the eastern pediment (Fig. 25), as Pausanias tells us, were repre- sented the preparations for the chariot-race between (Enomaus and Pelops, the result of which was to determine whether Pelops should find death, or a bride and a king- dom. In the midst, invisible to the contending heroes, stood Zeus the supreme arbiter. On one side of him stood aSnomaiis with his wife Sterope, on the other Pelops and Hippodameia, the daughter of OEnomalls, whose position at once indicates that she is on the side of the new-comer, whatever her parents may feel. Next on either side are the four-horse chariots of the two competitors, that of

Fig. 26.— £ast pediment : Olympia. Two restorations.

CEnomails in the charge of his perfidious groom Myrtilus, who contrived that it should break down in the running, that of Pelops tended by his grooms. At either end, where the pediment narrows to a point, reclines a river- god, at one end Alpheus, the chief stream of Olympia, at the other end his tributary Cladeus. Only one figure remains, not noticed in the careful description of Pausanias, the figure of a handmaid kneeling, perhaps one of the attendants of Sterope. Our engraving gives two conjectural restorations of the pediment, that of Treu and that of Kekule, which differ principally in the arrangement of the corners of the composition; the position of the central figures and of the chariots can scarcely be called in question. The moment chosen is one, not of action, but of expectancy, perhaps of preparation for sacrifice. The arrangement is undeniably stiff and formal, and in the figures weT note none of the trained perfection of style which belongs to the sculptures of the Parthenon, an almost contemporary temple. Faults abound, alike in the rendering of drapery and in the representation of the human forms, and the sculptor has evidently trusted to the painter who was afterwards to colour his work, to remedy some of his clumsiness, or to make clear the ambiguous. Nevertheless there is in the whole a dignity, a sobriety, and a

simplicity which reconcile us to the knowledge that this pediment was certainly regarded in antiquity as a noble work, fit to adorn even the palace of Zeus. In the other, the western, pediment (Fig. 26), the subject is the riot of the Centaurs when they attended the wedding of Pirithous in Thessaly,

and, attempting to carry off the bride and her comrades, were slain by Pirithous and Theseus. In the midst of the pediment, invisible like Zeus in the eastern pediment, stands Apollo, while on either side of him Theseus and Pirithous attack the Centaurs with weapons hastily snatched. Our engraving gives two possible restorations. The monsters are in various attitudes of attempted violence, of combat and defeat; with each grapples one of the Lapith heroes in the endeavour to rob them of their prey. In the corners of the pediment recline female figures, perhaps attendant slaves, though the farthest pair may best be identified as local Thessalian nymphs, looking on with the calmness of divine superiority, yet not wholly unconcerned in what is going forward. Though the composition of the two pediments differs notably, the one bearing the impress of a parade-like repose, the other of an overstrained ac- tivity, yet the style and execution are the same in both, and the shortcomiugs must be attributed to the inferior skill of a local school of sculptors compared with those of Athens or of jEgina. It even appears likely that the designs also belong to a local school. Pausanias, it is true, tells us'that the pediments were the work of Alcamenes, the pupil of Phidias, and of Pseonius,.a sculptor of Thrace, respectively ; but it is almost certain that he was misled by the local guides, who would naturally be anxious to connect the sculptures of their great temple with well-known names. The metopes of the temple are in the same style of art as the pediments, but the defects of awkwardness and want of mastery are less conspicuous, because the narrow

limits of the metope exclude any elaborate grouping. The subjects are provided by the twelve labours of Hercules ; the figures introduced in each metope are but two or at most three; and the action is simplified as much as possible. The example figured (Fig. 27) represents Her-

cules holding up the sky on a cushion, with the friendly aid of a Hesperid nymph, while Atlas, whom he has relieved of his usual burden, approaches, bringing the apples which it was the task of Hercules to procure. Another of the fruits of the excavations of Olympia is

Tig. 26.— West pediment: Olympia. Two restorations.

the floating Victory .by Pseonius, unfortunately faceless (Fig. 28), which was set up in all probability in memory of the victory of the Athenians and their Messenian allies at Sphacteria in 425 b.c. The inscription states that it was dedicated by the Messenians and people of Naupactus from the spoils of their enemies, but the name of the enemy is not mentioned in the inscription. The statue of Paeonius, which comes floating down through the air with drapery borne backward, is of a bold and innovating type.

them. In style the figure is very notable, tall and slight beyond all contemporary examples. The contrast between the conventional decorousness of face and drapery and the lifelike accuracy of hands and feet is very striking, and indicates the clashing of various tendencies in art at the time when the great style was formed in Greece.

On the works of Phidias recent discovery has thrown some light, though but little which is direct. Much interest was aroused in 1880 by the find-

p],' ing at Athens of a marble reduction, a yard high, of the great Parthenos statue of Phidias (Fig. 30) ;

Fig. 27.— Metope : Olympia ; restored. Olympia, ili. 46.

and we may trace its influence in many works of the next.

Among the discoveries at Delphi none is so striking and valuable to us as the life-size statue in bronze of a charioteer holding in his hand the reins. This °fc? te has been shown by M. HomoUe to be part of a • ghariot-group set up by Polyzalus, brother of Gelon and Hieron of Syracuse, in honour of a victory won in the chariot-race at the Pythian galmes at Delphi (Fig. 29). The charioteer is evidently a high-bom youth, and is clad in the long chiton which was necessary to protect a driver of a chariot from the rush of air. The date would be about 480-470 b,c. Bronze*

groups repre- senting victorious chariots with their drivers v^ere among the noblest and most costly dedications of antiquity ; the present figure is our only satisfactory representative of

Fis. 28.— Nike of Paeonius ; restored. Olympia, ili. 48.

but cooler consideration has forced us to allow that though the new statuette may be an authority as to some details of the Phidian statue, such as the decoration of the helmet, the attitude of the small figure of Victory, and the position of the snake, it is not to be implicitly trusted. The pillar which is introduced to support the weight of the figure of Victory seems to most artists a device un- worthy of the genius of Phidias, though there is other evidence of its actual existence. In any case, this statuette cannot serve to give us any adequate notion of the great statue as a whole. Prof. Furtwangler has of late largely contributed to Phidian literature. He believes

himself to have discovered at Dresden copies of the Lem- nian Athena, one of the most noted of the works of Phidias. The reasons for the identification are set forth in his Masterpieces ofGh-eek Sculpture. In the same work and the later Intermezzi will be found very ingenious

Poly- deltas.

Pio. 29.— Bronze Charioteer: Delphi. Mimoires, Pioi, 189T, 16.

attempts to reconstruct and to explain the pediments of the Parthenon. But safer guides for the restoration of the wonderful sculptural decoration of the noblest of Greek temples will be found in Dr Sauer's careful researches into the evidence to be won on the spot from the existing backgrounds and bases of the pediments, from which one may judge of the positions and attitudes of some of the figures. And the finding of the head of Hebe in the Parthenon frieze is a most fortunate event, as giving us a well-preserved girl's head of the Phidian school.

To our knowledge of the art of Polycleitus many addi- tions have been made. Among the bases discovered at Olympia, whence the statues had been removed, are three or four which bear the name of Poly- cleitus, and the definite evidence furnished by these bases as to the position of the feet of the statues which they once bore has enabled archaeologists, especially Prof. Furtwangler, to identify copies of those statues

among known works. Also newly dis- covered copies of Polycleitan works have made their ap- pearance. At Delos there has been found a copy of the cele- brated Diadumenus, which is of much finer work than the well-known statue in the British Museum from Vaison. The museum of Boston has secured a very beautiful statue of a young Hermes, who but for the wings on the temples might pass as a boy athlete of Polycleitan 'style (Fig. 31). In fact,

Fia.S0.-8tataette of Athena ParthenoB. instead of relying aS

regards the manner of Polycleitus on Eoman copies of the

Doryphorous and Diadumenus, we have quite a gallery of athletes, boys and men, who all claim relationship, nearer or more remote, to the school of the great Argive master. It might have been hoped that the recent excavations, made under the leadership of Prof. Waldstein at the Argive Heraeum, would have enlightened us as to the style of Polycleitus. Just as the sculptures 'of the Parthenon are the best monument of Phidias, so it might seem likely that the sculptural deco- ration of the great temple which contained the Hera of Polycleitus would show us at large how his school worked in marble. Unfor- tunately the fragments of sculpture from the Heraeum are few. The most remark- able is a female head, which may perhaps come from a pediment (Pig. 32). But archaeologists are not m agree- ment whether it is in style Polycleitan, or whether it rather resembles in style Attic works. Other heads and some highly-finished fragments of bodies come apparently from the metopes of the same temple. (See also under Aegos.)

The series of known Lycian tombs, most of which were secured by Sir Charles Fellows for the British Museum, has been enriched through the acquisition by the museum of Vienna of the sculptured friezes

Pro. 81.-

-TorBo of young HenneB: Boston.

Lycla.

which adorned a hereon near Gyeul Bashi. In the midst

■Female head : Ueroium.

of the enclosure was a tomb, and the walls of the enclosure itself were adorned within and without with a great series of reliefs, mostly of my.thologic purport. Many subjects which but rarely occur in early Greek art, the siege of Troy, the adventure of the Seven against Thebes, the carrying off of the daughters of Leucippus, Ulysses shoot- ing down the Suitors, are here represented in detail. Prof. Benndorf, who has published these sculptures in an admi- rable vblume, is disposed to see in them the influence of the Thasian painter Polygnotus. Any one can see their

kinsBp to painting,, and their subjects recur in some of the great frescoes painted by Polygnotus, Micon, and others for the Athenians. Like other Lycian sculptures, they contain non-Hellenic elements ; in fact Lycia forms a link of the chain which extends from the wall-paintings of Assyria to works like the columns of Trajan and of Antoninus, but is not embodied in the more purely idealistic works of the highest Greek art. The date of the Vienna tomb is not much later than the middle of the 5th century. We engrave a small part of the frieze of this monument (Fig. 33). It will be seen

Fiti. 88.— OdyBseus and suitors , hunting of boar. Tryea, PI. T.

Hereon qf Qy vl SaaM,

that in this fragment there are two scenes, one directly above the other. In the upper line Ulysses accompanied by his son Telemachus, is in the act

of shooting the suitors, who are reclining at table in the midst of a feast; a cup-bearer, possibly Melanthius, is escaping by a door behind Ulysses. In the lower line is the central group of a frieze which represents the hunting of the Calydonian boar, which is represented, as is usual in the best time of Greek art, as an ordinary animal and no monster.

Perhaps earlier than 400 b.c. are certain groups found at Delos which represent respectively the carrying away of the Athenian girl Oreithyia by the wind-god Boreas, and the carrying off of the hunter Cephalus by the Goddess of the Dawn. These fine groups, full of energy, but un-fortunately fragmentary, are supposed to have once adorned the roof of the great temple of Apollo at Delos. They are now preserved at Athens, and are , the best examples we possess of the groups which frequently stood on the tops of the pediments of Greek temples.

Archaeologists are now beginning to pay more attention to an interesting branch of Greek art which had until Portraits recently been neglected, that of sculptured por- traits. The known portraits of the 5th century now include Pericles, Herodotus, Thueydides, Anacreon, Sophocles, Euripides, Socrates, and others. As might be expected in a time when style in sculpture was so strongly pronounced, these portraits, unless later unfaithful copies, are notably ideal. They represent the great men whom they portray not in the spirit of realism. Details are neglected, expression is not elaborated ; the sculptor tries to represent what is per- manent in his subject rather than what is temporary. Hence these portraits do not seem to belong to a particular time of life ; they only represent a man in the perfection of physical force and mental energy. And the race or type is clearly shown through individual traits. In some cases it is still disputed whether, statues of this age represent deities or mortis, so notable are the repose and dignity whicli even human figures acquire under the hands of

6th-century masters. The Pericles after Cresilas in the British Museum, and the athlete-portraits of Polycleitus are good examples.

It is now generally held, in consequence of evidence furnished by tombs, that the 5th century saw the end of the making of vases on a great scale at Athens for export to Italy and Sicily. And in fact ^^|°”” few things in the history of art are more re- markable than the rapidity with which vase-

painting at Athens reached its highest point and passed it on the downward road. At the beginning of the century black- figured ware was scarcely out of fashion, and the masters of the severe red-figured style, Pamphseus, Epictetus, and their contemporaries, were in vogue. The schools of Euphronius, Hiero, and Duris belong to the age of the Persian wars. With the middle of the century the works of these makers are succeeded by unsigned vases of most beautiful design, some of them showiug the influence ‘ of the great Thasian painter Polygnotus, In the later years of the century, when the empire of Athens was approaching its fall, djawing becomes laxer and more careless, and in the treatment of drapery we frequently note the over-elaboration of folds, the want of simplicity, which begins to mark con- temporary sculpture. Unfortunately we cannot here illustrate these changes of style, which can only be satis-factorily followed in the vase rooms of the British Museum, or other treasuries of Greek art.

Period IV. 400-320 b.c.

Until about the year 1880, our knowledge of the great Greek sculptors of the 4th century was derived mostly from the statements of ancient writers and from Roman copies, or what were supposed to be copies, of their works. We are now in a far more satisfactory position. We now possess an original work of Praxiteles, and sculptures executed under the immediate direction of, if not from the hand of, other great sculptors of that age — Scopas, Timotheus, Damophon, and others. Among all the discoveries made at Olympia, none has become so familiar to the artistic world as that of the Hermes of Praxiteles. It is the first time that ”” ”’ we have become possessed of a first-rate Greek original by orie of the greatest of sculp-tors. Hitherto almost all the statues in our museums have been either late copies of Greek works of art, or else the mere decorative sculpture of temples and tombs, which was by the ancients themselves but little regarded. But we can venture without misgiving to submit the new Hermes to the strictest examination, sure that in every line an’d touch we have the work of a great artist. This is more than we can say of any of the literary remains of an- tiquity— poem, play, or oration. Hermes is repre-sented by the sculptor (Fig. 34) in the act of carrying the young child Dionysus

to the nymphs who were Fio. 84.— Hermes of Praxiteles,

charged with his rearing. ^stored, ois^mpio, m. 68.

On the journey he pauses and amuses himself by holding out to the child-god a bunch of grapes, and watching his eagerness to grasp them. To the modern eye the child is

not a success ; only tlie latest art of Greece is at home in dealing with children. But the Hermes, strong without excessive muscular development, and graceful without leanness, is a model of physical formation, and his face expresses the perfection of health, natural endowment, and sweet nature. The statue can scarcely be called a work of religious art in the modern or Christian sense of the word religious, but from the Greek point of view it is religious, as embodying the result of the harmonious development of all human faculties and life in accordance with nature. The discovery of the Hermes has naturally set archaeo; logists searching in the museums of Europe for other works which may from their likeness ~~to it in various respects be set down as Praxitelean in character. In the case of many of the great sculptors of Greece — Cresilas, Silanion, Calamis, and others — it is of little use to search for copies of their works, since we have little really trust~~ worthy evidence on which to base our inquiries. But in the case of Praxiteles we really stand on a safe level. Naturally it is impossible in these pages to give any sketch of the results, some almost certain, some very doubtful, of the researches of archaeologists in quest of Praxitelean works. But we may mention a few works which have been claimed by good judges as coming from the master himself. Prof. Brunn claimed as work of Praxiteles a torso of a satyr in the Louvre, in scheme identical with the well-known satyr of the Capitol. Prof. Furtwangler puts in the same category a delicately beautiful head of Aphrodite at Petworth. And his translator, Mrs Strong, regards, with greater probability, the Aberdeen head of a young man in the British Museum as the actual work of Praxiteles. Certainly this last head does not suffer when placed beside the Olympian head of Hermes.

At Man- tinea has been found a basis whereon stood a group of Latona and her two children, Apollo and Artemis, made by Praxiteles. This base bears reliefs representing the musical contest of Apollo and Marsyas, with the Muses as spectators, reliefs very pleasing in style, and quite in the manner of Attic artists of the 4th century. But of course we must not ascribe them' to the hand of Praxiteles himself; great sculptors did not themselves execute the reliefs which adorned temples and other monu- ments, but reserved them for their pupils. Yet the grace- ful figures of the Muses of Mantinea suggest how much was due to Praxiteles in determining the tone and character of Athenian art in relief in the 4th century. Exactly the same style which marks them belongs also to a mass of sepulchral monuments at Athens, and such works as the Sidonian sarcophagus of the Mourning Women, to be presently mentioned.

Excavation on the site of the temple of Athena Alea at Tegea has resulted in the recovery of works of the school of Scopas. Pausanias tells us that Scopas was s^i"^ the architect of the temple, and so important in the case of a Greek temple is the sculptural decoration, that we can scarcely doubt that the sculpture of the temple at Tegea was under the supervision of Scopas, especially as he was more noted as a sculptor than as an architect. In the pediments of the temple were repre- sented two scenes from mythology, the hunting of the Calydonian boar, and the combat between Achilles and Telephus. To one or other of these scenes belong two heads of local marble discovered on the spot, which are very striking from their extraordinary life and animation. Unfortunately both are so much injured that they can scarcely be made intelligible except by the help of restor- ation ; we therefore engrave one of them, the helmeted head, as restored by a German sculptor (Fig. 35). The strong bony frame of this head, and its depth from front to back, are not less noteworthy than the parted lips and deeply set and strongly shaded eye ; the latter features

impart to the head a vividness of expression such as we have found in no previous work of Greek art, but which sets the key to the developments of art which take place in the Hellenistic age. The head of the Calydonian boar, which was found at the same time, is a curious work ; the sculptor has transferred to the representation of a boar too much of his special style, and made it but little like an actual wild beast. Until these heads

were found, Scopas was known to us, setting aside literary records, only as one of the sculptors who had worked at the Mausoleum. But it has now become possible to detect his style in many extant statues, such as the Meleager of the Vatican and the Hercules of the Lansdowne Gallery. It is also by no means unlikely that Scopas may have had a share in the carving of those sculptured pillars from the 4th-century temple of Artemis at Ephesus with which the spade of Mr Wood enriched the British Museum.

Fie. 85. — Head of warrior, restored : Tegea.

The interesting precinct of .ffisculapius at Epidaurus has furnished us with specimens of the style of an Athenian contemporary of Scopas, who worked Yimotbeas with him on the Mausoleum. An inscription Bryaxis, which records the sums spent on the temple of Leocbares, the Physician-god, informs us that the models '^'"“'p'"'"- for the sculptures of the pediments, and one set of acro- teria or roof adornments, were the work of Timotheus. Of the pedimental figures and the acroteria considerable fragments have been recovered, and we may with con- fidence assume that the models for these at all events were by Timotheus. It is strange that the unsatisfactory arrangement whereby a noted sculptor makes models and some local workmen the figures enlarged from those models, should have been tolerated by so artistic a people as the Greeks. The subjects of the pediments appear to have been the common ones of battles between Greek and Amazon and between Lapith and Centaur. We possess fragments of some of the Amazon figures, one of which is here engraved (Fig. 36) striking downwards at an enemy. Their attitudes are vigorous and alert ; but the work shows no delicacy of detail. Figures of Nereids riding on horses, which were found on the same site, may very probably be roof ornaments (acroteria) of the temple. We have also several figures of Victory, which probably were acroteria on some smaller temple, perhaps that of Artemis. A base found at Athens, sculptured with figures

of horsemen in relief, bears the name of Bryaxis, and was probably made by a pupil of his. Probable conjec- ture assigns to Leochares the originals copied in the Ganymedes of the Vatican, borne aloft by an eagle, and the noble statue of Alexander the Great at Munich. Thus we may fairly say that we are now acquainted with

Fig. 86, — Amazon fi-om Epidanrus.

the work of all the great sculptors who worked on the Mausoleum — Seopas, Bryaxis, Leochares, and Timotheus ; and are in a far more advantageous position than were the archaeologists of 1880 for determining the artistic problems connected with that noblest of ancient tombs. As regards the plan and architecture of the Mausoleum, contributions have been made by Mr Oldfield (Archoe- ologia, 1895-97), and Dr Adler (Das Mausoleum) ; but no generally accepted conclusion has been reached. Another great 4th-century artist, Damophon of Messene, is now known tp us from his actual works. He set up in the

shrine of the Mistress – (Despcena) at Lycosura in Arcadia a great group of figures consisting of Despcena, Demeter, Ar- temis, and the Titan Anytus. Three colossal heads found on the spot probably belong to the three last-mentioned dei- ties. We engrave the head of Anytus, with wild disordered hair and turbulent expression (Fig. 37). Dr Dorpfeld has argued, on architec- tural grounds, that shrine and images alike must be given to a later time than the 4th century; and in consequence some archaeologists are of opinion that Damophon must have worked in the Eoman age, or at all events in Hellenistic times. It is difficult to accept this view, because Damophon is spoken of by Pausanias as author of a statue of the City of Thebes, and of many works in the cities established in Peloponnesus at the time of the Theban hegemony

Fio. ST.— Head of Anytus : Lycosnra.

early in the 4th century. We prefer to retain Damophon as a sculptor of the 4th century, and even find no great difficulty in reconciling the style of his works with that date.

This may be the most appropriate place for mention- ing the remarkable find made at Sidon in 1886 of a number of sarcophagi, which once doubtless contained the remains of kings of Sidon. They ^^n?' ^re now in the museum of Constantinople, and are admirably published by Hamdy Bey and T. Eeinach (Une nicropole royale d Sidon, 1892-96). The sarcophagi in date cover a considerable period. The earlier are made on Egyptian models, the covers shaped roughly in the form of a huiiian body or mummy. The later, however, are Greek in form, and are clearly the work of skilled Greek sculptors, who seem to have been employed by the grandees of Phoenicia in the adornment of their last resting-places. Four of these sarcophagi in particular claim attention, and in fact present us with examples of Greek art of the 6th and 4th centuries in several of its aspects. To the 6th century belong the tomb of the Satrap, the reliefs of which bring before us the activities and glories of some unknown king, and the Lycian sarcophagus, so called from its form, which resembles that of tombs found in Lycia, and which is also adorned with reliefs which have reference to the past deeds of the hero buried in the tomb, though these deeds are represented, not in the Oriental manner directly, but in the Gr^ek manner, clad in mythological forms. To the 4th century belong two other sarcophagi. One of these is called the Tomb of the Mourn- ing Women. On all sides of it alike are ranged a series of beautiful female fig- ures, separated by Ionic pillars, each in a somewhat different attitude, though all attitudes denoting grief (Fig. 38). The pediments at the ends of the cover a.re also closely ^connected with the mourning for the loss of a friend and protector, which is the theme of the whole decoration of the sarcophagus. We see depicted in them the telling of the news of the death, with the results in the mournful attitude of the seated figures. The mourning women must be taken, not as the representation of any persons m particular, but generally as the expression of the feeling of a city. Such figures are familiar to i^s in the art of the second Attic school ; we could easily find' parallels to the sarcophagus among the 4th-century sepulchral reliefs of Athens. We can scarcely be mistaken in attributing the workmanship of this beautiful sarcophagus to some sculptor trained in the school of Praxiteles. And it is a conjecture full of probability that it once contained the body of Strato, king of Sidon, who ruled about 380 b.c, and who was proxenos or public friend of the Athenians.

More celebrated is the astonishing tomb called that of Alexander, though there can be no doubt that, although it commemorates the victories and exploits of Alexander, it was made not to hold his remains, but those of some ruler of Sidon who was high in his favour. Among all the monuments of antiquity which have come down to us,

Fig. 88. — ^Tomb of mourning women : Sidon. Hamdy et Beinach, micropoU & Sidon, PI. 7.

frieze is now one of the treasures of thevEoyal Museums of Berlin, and it cannot fail to impress visitors by the size of the figures, the energy of the action, and the strong vein of sentiment which pervades the whole, giving it a certain air of modernity, though the subject is strange to the Christian world. In early Greek art the Giants where they oppose the Gods are represented as men armed in full panoply, " in shining armour, holding long spears in their hands," to use the phrase in which Hesiod describes them. But in the Pergamene frieze the Giants are strange compounds, having the heads and bodies of wild and fierce barbarians, sometimes also human legs, but sometimes ia the place of legs two long serpents, the heads of which take with the Giants themselves a share in the battle. Some- times also they are winged. The Gods appear in the forms which had been gradually made for them in the course of Greek history, but they are usually accompanied

by the animals sacred to them in cultus, be- tween which and the serpent-feet of the Giants a weird combat goes on. We can con- jecture the source whence the Pergamene artist derived the shaggy hair, the fierce expression, the huge muscles of his Giants (Fig. 40); probably these features came originally from the Galatians, who at the time had settled in Asia Minor, and were spread- ing the terror of their name and the report of their savage devasta- tions through all Asia Minor. The victory

Fi«.40.-G«.nt from great altar: Pergamon.^^^^ the Giants dearly

stands for the victory of Greek civilization over Gallic bar- barism ; and this meaning is made more emphatic because the Gods are obviously inferior in physical force to their opponents, indeed, a large proportion of the divine com- batants are goddesses. Yet everywhere the Giants are overthrown, writhing in pain on the ground, or transfixed by the weapons of their opponents ; everywhere the Gods are victorious, yet in the victory retain much of their divine calm. The piecing together of the frieze at Berlin has been a labour of many years, and is even yet incomplete. We still await a final and monumental publication of it. Some of the groups, however, have become famil- iar to students from photographs, especially the group which represents Zeus slaying his enemies with thunder- bolts, and the group wherein Athena seizes by the hair an overthrown opponent, who is winged, while Victory runs to crown her, and beneath is seen Gaia, the earth- goddess who is the mother of the Giants, rising out of the ground, and mourning over her vanquished and tortured children. Another and smaller frieze which also decorated the altar-place gives us scenes from the history of Telephus, who opposed the landing of the army of Agamemnon in Asia Minor and was over- thrown by Achilles. This frieze, which is quite fragmentary, is put together by Dr Schneider in the Jahrbuch of the German Archaeological Institute for

1900.

Since the Eenascence Rome has continually produced a crop of works of Greek art of all periods, partly originals brought from Greece by conquering generals, partly copies

Fig. 41. — Bronze boxer ; Borne. Ant, DwikmMer des Inst. Fl. 4.

made by Greek artists for wealthy Roman amateurs. The extensive excavations and alterations which have ^^^^ taken place at Rome in recent years have been very fruitful in this way; the results may be found partly in the palace of the Conservatori on the Capitol, partly ia the new museum of the Terme. Among recently found statues none excel in interest some bronzes of large size dating from the Hellenistic age. We engrave (Pig. 41) the figure of a seated boxer, in scale somewhat ex- ceeding life. Attitude and gesture are expres- sive. Evidently the boxer has fought al- ready, and is awaiting a further conflict. His /face is cut and

swollen; on his hands are the ter- rible csestus, here made of leather, and not loaded with iron, like the csestus described by Virgil. The figure is of astounding force; but though the face is brutal and the expression savage, in the sweep of the limbs there is nobility, even ideal beauty. To the last the Greek artist could not set aside his admiration for physical perfection. Another bronze figure of more than life-size is that of a king of the Hel- lenistic age standing leaning on a spear. He is absolutely nude, like the athletes of Polycleitus. Another large bronze presents us with a Hellenistic type of Dionysus.

Sculpture of the Roman age has not in recent years been discovered to the same extent. We have gained rather by a closer and more exact study of monuments already known than from the discovery of fresh monu- ments. The columns of Trajan and of Antoninus have been re-published in a series of excellent photographic plates. Many provincial monuments, such as the Roman tomb at S. Remy, the arch of Beneventum, the monument of Adam Klissi, have been more carefully published. Many additions have been made to our already vast series of Roman portraits, and the gigantic publication of Arndt on Greek and Roman portraits has for the first time put together the necessary materials for a more satisfactory arrangement of portraits, as well as for their identification. Unfortunately, at present the great mass of portraits, both Greek and Roman, have to be labelled "unknown person." In Italian and other museums it has been the custom to assign names to portraits for reasons which will not bear investigation. Bernoulli's Romische Ikonogra/phie is, how- ever, a scientific work ; a similar work by Bernoulli on Greek iconography is now in course of publication : the book of Visconti is quite out of date and untrustworthy.

The most important discovery at Pompeii, during the last quarter of a century, has been that of the Domus Vettiorum, a house whereof the walls are adorned with an unusually important series of paintings, partly scenes from Greek mythology, partly scenes which give us glimpses of daily life. Among the former are Achilles in Scyros, the punishment of Dirce, the death of Pentheus, Daedalus and Pasiphag. Among the latter we especially note the series of scenes in which Cupids are represented as engaged in various kinds of manufacture and commerce, a Hellenistic fashion of introducing the actual in a manner

not too literal. Other paintings found at Rome range with or even excel those of Pompeii, notably the re- markable wall-paintings representing artificial gardens with shrubs and flowers, which have been found at Prima Porta.

The whole subject of Eoman art has been recently- discussed by Prof. Wickhoff of Vienna in an essay trans- lated into English by Mrs Strong. This writer claims for the art of Italy and of Eome greater independence and more importance than had been conceded to it by other writers. / He regards the art of the Augustan age as the last efftorescence of the Greek creative genius, which at that time had passed by a reaction against the strained and theatrical tendencies of the Pergamene school to a somewhat dry and insipid naturalism, a style of which the portraits of Augustus, the reliefs of the Ara Pacis at Eome, and some of the paintings of Pompeii are good examples. Against the jejuneness of this art the national spirit of Italy, which had for long been expressed in a series of portraits, lifelike if somewhat coarse, revolted towards the end of the 1st century. The result is to be observed in the portraits of the Flavian age, which are far more vivid than those of the Caesars, as well as in the remarkable reliefs of the arch of Titus and the column of Trajan. In this national Eoman art, Prof. Wickhoff does not hesi- tate to see Ulusionism, as opposed to the typical art of Greece, and the naturalism of the early empire. Its chief features are the attempt to produce a vivid and individ- ual effect, often worked by very simple means, and the continuous method of representation of events, a method according to which successive scenes of a transaction follow one another without any separation, and the actors appear again and again in the same relief. Thus Trajan appears eighty-five times over in the continuous scroll of relief which adorns his column ; and on Eoman sarcophagi the successive scenes of a" mythical tale follow one another without division. It was, according to Prof. Wickhoff, from illusionist Eoman art that the earliest Christian art took its origin; hence its effects lasted far on into the Middle Ages. It is evidently impossible in this place to criticize these novel views ; their importance lies in the fact

that they are perhaps the first attempt to set forth the course of Eoman art as a valuable development rather than as a mere process of degeneration ; but most readers will think that Dr Wickhoff overvalues Eoman, and undervalues Greek art. (p. g.)

Archangel. See Abchaitgelsk.

Arch bald, a borough of Lackawanna county, Penn- sylvania, U.S.A., in the anthracite coal region in the north-eastern part of the state, on several railways. Population (1890), 4032 ; (1900), 5396.

Arches, Court of the. — The court of the Arches is the court of appeal of the archbishop of Canterbury as metropolitan of the province of Canterbury from all the consistory and commissary courts in the province, and its decisions are in most cases appealable to the judicial committee of the Privy Council. (See Ency. Brit. vol. ii. p. 378.) The judge (known as the dean of the Arches) was until 1874 appointed by the archbishop of Canter- bury by patent which, when confirmed by the dean and chapter of Canterbury, conferred the office for the life of the holder. He took the oaths of office required by the 127th canon. But by the Public Worship Eegulation Act, 1874 (37 and 38 Vict. c. 85), the two archbishops were empowered, subject to the approval of the sovereign by sign-manual, from time to time to appoint a judge for the purpose of exercising jurisdiction under that Act, and it was enacted (sec. 7) that on a vacancy occurring in the office of dean of the Arches, the judge so to be appointed should become ex officio dean of the Arches. In this way the late Lord Penzance became dean on the retirement of Sir Eobert Phillimore in 1876. Lord Penzance received in 1878 a supplemental patent as dean from Archbishop Tait, but did not otherwise fulfil the conditions observed on the appointment of his predecessors. On Lord Pen- zance's retirement in 1899, his successor, Sir Arthur Charles, was appointed dean by patent from the archbishop of Canterbury, and he took the oaths of office according to the practice before the Public Worship Eegulation Act. He was subsequently and separately appointed judge under that Act.

Under the Clergy Discipline Act, 1892 (56 and 56 Vict. c. 32, sec. 4) an appeal lies from the judgment of a consistory court under that Act, in respect of fact by leave of the appellate court, and in respect of law

without leave, to either the court of the Arches or the judicial committee of the Privy Council at the option of the appellant. Under the Benefices Act, 1898 (61 and 62 Vict. c. 48, sec. 3 (4)), the official principal of the archbishop is required to institute a presentee to a benefice if the tribunal constituted under that Act decides that there is no valid ground for refusing institution and the bishop of the diocese notwithstanding fails to institute him. For many years past there has been but little business in the court of Arches. On the rare occasions when a sitting of the court is necessary, it is held in the Library of Lambeth Palace, or at the Church House. (l. t. d.) •

ARCHITECTURE.

I. MODEEK.

BOTH in England and in the United States, the last quarter of the 19th century was a period of unusual interest and activity in architectural development. Whil e other nations have been content to carry on their archi- tecture, for the most part, on the old scholastic lines which had been prevalent since the Eenaissance, in the two countries named there has been manifest a spirit of unrest, of critical inquiry into the basis and objects of architecture; an aspiration to make new and original creations in or applications of the art, without example in any other period in the modern history of architecture. In England, the " note " — ^heard with increasing shrillness of crescendo towards the very last year of the century —

has been the cry for originality, for throwing off the trammels of the past, for rendering architecture more truly a direct expression of the conditions of practical requirement and of structure. This was no dou^t to some extent the effect of a reaction. During the greater part of the century architectural strength had been spent in revivals of past styles. First came the Greek revival, of which the best result was St George's Hall at Liverpool, and the worst the formation of the tower of St Pancras Church in London by piling three Greek temples or shrines one upon another. Then followed the Gothic revival, which gained an immense impetus from the fact that it coincided with the spiritual and ecclesiological revival of

the English church — and indeed it is rather difficult to apportion cause and effect between

the spiritual and the axchitectural revival. At all events, donec-templa i-efecimus -was the motto of the day. The land was covered with modern mediaeval churches, and with Gothic town halls and residences ; and the business of restoring cathedrals was carried to an extent which deprived some of them of most of their value, and which an after generation has had to regret when regret was unavailing.

It was in 1869, just before the period we are here dealing with, that the great competition for the London Ootbic ^^^ Courts took place ; and Street's building,

completed a few years afterwards, was the last great national building erected in the revived Gothic style ; as was observed shortly after its completion, it was " the grave of modem Gothic architecture," at least as regarded important secular buildings. Churches indeed, up to the close of the century, continued to be built, for the most part, in revived Gothic ; but this was owing to special clerical influence, which saw in Gothic a style specially consecrated to church architecture, and would be satisfied, as a rule, with nothing else. Efforts have been made by architects to modify the mediaeval church plan into something more practically suited to modern congregational worship, by a system of reducing the side aisles to mere narrow passages for access to the seats, thus retaining the architectural effect of the arcade, while keeping it out of the way of the seated congregar tion; and there have been occasional reversions to the ancient Christian basilica type of plan, or sometimes, as in the church in Davie s Street, London, attempts to treat a church in a manner entirely independent of architectural precedent ; but in the main, Gothic has continued to rule for churches. Apart from this special class of building, however, revived Gothic began to droop during the 'seventies. All had been copied that could be copied, and the result, to the architectural mind, was not satis- faction but satiety. Gothic began to be regarded as " played

out." The immediate result, however, was not an organized attempt to think for ourselves, and make our own style, but a recourse to another class of precedent, represented in the type of early 18th-century building

which became known as " Queen , Anne," and '^^^? which, like Gothic before it, was now to be

recommended as "essentially English," as in fact it is. It can hardly, horf-ever, be called an archi- tectural style ; it would have no right to figure in

and in plain materials, in many cases shorn of its columnar features, and reflecting faithfully enough the prim rationalistic taste, in literature and art of the England of the 18th century.' Though not to be dignified as a style, it was, however, a recognizable and consistent manner in building ; it made extensive use of brick, a material inexpensive and at the same time very well suited to the English climate and atmosphere ; and it was generally carried out in very solid proportions, and with very good workmanship. To a generation tired of imitating a great style at second hand, this unpretending and simple model was a welcome relief, and led to the erection of a considerable number of modem buildings, dwelling-houses especially, the obvious aim of which was to look as like 18th-century buildings as possible. A typical example is the large London house by Mr Norman Shaw, at the corner of Queen's Gate and Imperial Institute Eoad. The Chelsea Vestry Hall (Fig. 1), by Mr Brydon, is a good example of a public building in the revived Queen Anne style.

A change of front from copying a great style like the mediaeval, to copying what is at best a bastard one, if a style at all, might not seem to promise' very much for the emancipation of modern architecture ; yet there turned out to be one element of progress in it, resting on the fact that the comparatively simple detail of the 18th- century buildings formed a kind of vernacular of building workmanship, which could be comprehended and carried out by good artisans as a recognized tradition. Now, to reduce architecture to good sound building and good^ workmanship seemed to promise at any rate a better basis to work upon than the mere imitation of classic or mediaeval detail ; it might conceivably furnish a new starting-point. This was the element of life in the Queen Anne revival, and it had, as we shall see, an influence beyond

the circle of the special revivers of the style. But almost concurrently with, or following hard upon, the ” Queen Anne ” movement arose the idea of a modem architecture, founded on a free and unfettered treatment of the materials of our earlier Eenaissance architecture, as illustrated in buildings of the Stuart period. This new ideal was styled ” free classic,” and it gave the prevailing tone to English architecture for ” ^«e ^^ the last fifteen years of the century, though it had its commencement in certain characteristic build- ings a good many years earlier than that. In 1873, for instance, there arose a comparatively small front in ‘ Leadenhall Street, under the name of “New Zealand Chambers” (Fig. 2), and designed by Mr Norman Shaw, E.A., which excited more attention, and had more influ- ence on contemporary architecture, than many a building of far greater size and importance. This represented the playful and picturesque possibilities of “free classic.” Its more re- strained and refined achievements were early exemplified in Mr Bodley’s design for the front of the London School Board Offices on the Thames Embankment ; ^ a comparatively small building which also exercised a con- siderable influence. There were no details here, however, but what could be found in Stuart (or, as it is more often called, Jaco- bean) architecture, but the building, and the ^ ^ „ ,,„ ^ „ ,, __ , -„ J „rv A .1 /r ir D J < promineucc of its architect's name, helped to

Fio. 1.— Chelsea Vestry Hall— Example of Modern ” Queen Anne.” iX M. Brydon.) 5 j.i i- i .i t •■.•,’ “■‘i”„ ””

draw attention to the possibilities of the style, and it has been discovered that free classic is

any work illustrating the great architectural styles of the world. It was, in fact, the last dying phase of the English Eenaissance ; the architecture of the classic order reduced to a threadbare condition, treated very simply

1 The western half of the present front ; the design was duplicated afterwards, on the extension of the building, but Mr Bodley originated it.

susceptible of a great deal of original treatment based on Eenaissance elements. As an example, we may cite a street front built some twenty years later by another academician-architect; viz., the offices of the Chartered Accountants in the City, by Mr J. Belcher, A.R.A. More dignified and more monumental than New Zealand Chambers, more original than the School Board Offices, this front contains some details and a general treatment which may be said to be absolutely new; it affords another example of a piece of street architecture which attracted a great deal of attention, and has had an effect

Fig. 2.— New Zealand Chambers. (iJ. Norman Shaw, E.A.)

quite disproportionate to its size and importance as a building ; and it gives a general measure of the progress of the " free classic " idea. During the last decade of the century "free classic" has been almost the recognized style in English architecture, and has been illustrated in many town halls and other large and important build- ings, among which the Imperial Institute is a prominent example.

Concurrently with this tendency towards a free classic style there has arisen another movement which has had a

considerable influence already on English archi- ne allied lecture, and which will probably have a further

influence in the future, viz., an increased per- ception of the importance of decorative arts — sculpture,

painting, mosaic, &c. — in alliance with architecture, and of the architect and the decorative artist working together and in harmony. This is no more than what has lonig been understood and acted on in France, but it has been a new light to modern English architecture, in which, until a comparatively recent period, decorative painting was hardly thought of, and decorative sculpture, where it was introduced, was too often, or indeed generally, the mere work of some trading firm- of masons. But of late years sculpture has taken a far more prominent place in connexion with architecture ; it has become a habit with the best architects to rely largely on the in- troduction of appropriate and symbolic sculp- ture to

add to the ‘interest of their buildings, and to associate with them eminent sculptors, who, instead of regarding their work only in the light of isolated statues or groups for the exhibition room and the art gallery, are will- ing to give their best efforts to produce high- class sculpture for the decoration of an archi- tectural design which forms the framework to it.

Notice should be taken, however, of another movement in English architecture during the closing years of the 19th century. Keference has already i^ecnMs- been made to one idea which 1^1 ” prompted the culture of the ” Queen Anne ” type of architecture : that it pre- sented a simple vernacular of constructiou and detail, in which solid workmanship was a more prominent element than elaboration of what is known as architectural style. To a small group of clever and enthusiastic architects of the younger generation it ap- peared that this idea of reducing archi- tecture to the common-sense of construction might be carried stUl further; that as all the revivals of styles since the Renaissance had failed to give permanent satisfaction and had tended to reduce architecture to a learned imitation of the work of former epochs, the real chance for giving life to architecture as a modern art was to throw aside all the conventionally accepted insignia of architectural style — columns, pilasters, cornices, buttresses, &c. — and to begin over again with mere workmanship — wall-building and carpentry — and trust that in process of time a new decorative detail would be evolved, indebted to no precedent. The building artisans, in fact, were collectively to take the place of the architect, and the form of the building to be evolved by a natural process of growth. This was a fa- vourite idea also with William Morris, who insisted that mediaeval art — the only art which he recog- nized as of any value (Greek, Eoman, and Renaissance being alike contemptible in his eyes) — ^was essentially an art of the people, and that in fact it was the modern architects who stood in the way of our having a genuine architecture of the 19th century. Con- sidering how much of merely formal, conventional, and soulless architecture has been produced in our time under the guidance of the professional architect, it is impossible to deny that there is an element of truth in this reasoning; at all events, that there have been a good many modern architects who have done more harm than good to architecture. But when we come to follow out this reasoning to its logical results, it is

obvious that there are serious flaws in it. Morris's idea ■that mediaeval architecture alone was worthy the name, we may, of course, dismiss at once ; it was the prejudice of a man of genius whose sympathies, both in matters social and artistic, were narrow. Nor can we regard the mediaeval cathedrals as artisan's architecture. The name of "architect" may have been unknown, but that the personage was present in some guise, the very individuality and variety of our English cathedrals attest. Peterborough front was no mere mason's conception.

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Fig. 8. — American Type of Country-houae Architecture.

And when we come to consider modem conditions of building, it is perfectly obvious that with the complicated practical requirements of modern building, in regard to planning, heating, ventilation, &c., the planning of the whole in a complete set of drawings, before the build- ing is begun, is an absolute necessity. We are no longer in mediaeval times; modern conditions require the modern architect. The real cause of failure, as far as modern architecture is a failure, lies partly in the fact that it is practised too much as a profession or business, too little as an art; partly in the deadening

Fig. 4.— American Seaside Villa. (Bruae, J'riee.)

effect of public indifference to art in Britain. If the public really desired great and impressive works of architecture they would have them; but neither the British public, nor its mouthpiece the Government, care

anything about it. Their highest ambition is to get convenient and economical buildings. And as to the theory of the new school, that we should throw over- board all precedent in architectural detail, that is intellectually impossible. We are not made so that we can invent everything de novo, or escape the effect on our minds of what has preceded us; the attempt can only lead to baldness or eccentricity. Every great style

of architecture of the past has, in fact, been evolved from the detail of preceding styles; and some of the ablest and most earnest architects of the present day are, indeed, urging the desirability of clinging to traditional forms in regard to detail, as a means of maintaining the continuity of the art. This does not by any means imply the absence of original architecture ; there is scope for endless origination in the plan and the general design of a building. The Westminster Houses of Parliament (one of the greatest buildings of modern times) is a promi- nent example. The detaU is a reproduc- tion of Tudor detail, forced upon the archi- tect by order of the Government ; the plan and the general conception are absolutely original, and resemble those of no other pre-existing building in the world.

It is necessary to take account of all these movements of opinion and principle in English architecture to appre- ciate properly its position and prospects at the time with which we are here dealing. Turning now from England to the United States, which, as already observed, is the only other important country in which there has been a general new movement in architecture, we find, singular to say, that the course of development has in Amer- ica been almost the reverse of what has taken place in England. The rapidity of architectural development in America, it may be observed, during the last quar- ter of a century, has been something astonishing ; there is no parallel to it anywhere else. Some thirty years ago, or even less, the currently accepted architecture of the American Republic was little more than a bad repetition of the English Gothic and Classic types of revived architecture. At the present day no nation, except perhaps France, takes so keen an interest in archi- tecture and produces so many noteworthy buildings ; and it may be observed that in the States the public and the o£B.cial authorities seem really to have some enthusiasm on the subject, and to desire fine buildings. But the stirring of the dry bones

began in America where it ended in England. The first symptoms ” of ,an original spirit operating in Ameri-

can architecture showed themselves in do- mestic architecture, in town and country houses, the latter especially; and the form which the movement took was a desire to escape conventional architectural detail and to return to the simplest form of mere building; rock-faced masonry, sometimes of material picked up on the site; chim- neys which were plain shafts of masonry or brickwork; woodwork simply hewn and ” ‘~—’- squared; but the whole arranged with a

view to picturesque effect (Figs. 3 £&d 4). This form of American house became an incident in the course of modem architecture ; it even had a recognizable influence on English architects. About the same time an impetus of a more special nature was given to American architecture by a man of genius, the late H. H. Richardson, who, falling back on Romanesque and Byzantine types of architecture as a somewhat unworked fleld, evolved from them a type of architectural treatment so distinctly his own (though its origines were of course quite traceable) that he came very near the credit of having personally invented a style ; at all events he invented a manner, which was so largely admired and imitated that for some ten or fifteen

years American architecture showed a distinct tendency to become ” Richardsonesque ” (Fig. 5, see Plate). As with all architectural fashions, however, people got tired of this, and the influence of another very able American architect, the late R. Morris Hunt, who had received his educa-

Fia. 7. — ^American Modern High Building (American Sorety Co., New York).

tion at the ificole des Beaux-Arts of France, coupled perhaps with the proverbial philo-Gallic tendencies of the modern American, led to the American architects, during the last decade of the century, throwing

them- selves almost entirely into the arms, as it were, of France ; seeking their education as far as possible in Paris, and adopting the theory and practice of the !ficole des

Beaux-Arts so completely that it is often impossible to distinguish their designs, and even their methods of drawing, from those of French architects brought up in the strictest regime of the "]ficole." By this French move- ment the Americans have, on the one hand, shared the ad- vantages and the influence of what is undoubtedly the most complete school of architectural training in the world ; but, on the other hand, they have foregone the opportunity which might have been afforded them of developing a school or style of their own, influenced by the circumstances of their own requirements, climate, and materials. Fig. 6 (see Plate) shows an example of recent American architecture of the European classic type. Thus, in the two countries which during the last quarter of a century have shown the most activity and restlessness in their architectural aspira- tions, and given the most original thought to the subject, England has constantly tended towards throwing off the yoke of precedent and escaping from the limits of a scho- lastic style ; while America, commencing her era of archi- tectural emancipation with an attempt at first principles , and simple but picturesque building, has ended by a pretty general adoption of the highly-developed scholas- tic system of another country. The contrast is certainly a curious one. Only one original contribution to the art has been made by America in recent days — one arising directly out of practical conditions, viz., the "high buildings " in cities ; a form of architecture which may be said to be due directly to the fact that New York is built on a peninsula, and extension of the city is only possible vertically and not horizontally. The tower-like buildings, served internally by lifts, to which this condition of things has given rise (Fig. /T), form a really new contribution to architecture, and have been handled by some of the American architects in a very effective manner ; though, unfortunately, the rage for rapid building in the cities of the States has led to the adoption of a system of running up such structures in the form of a steel framing, cased with a mere skin of masonry or terra cotta for appear- ance' sake, which in reality depends for its stability on the steel framing. This is not only a false system of archi- tectural design, but may probably prove to be a danger- ous form of

building. It must be admitted, however, to be a new contribution to architecture, and renders New York, as seen from the harbour, a " towered city " in a sense not realized by the poet.

Some sketch of the state of architectural thought or endeavour in England seemed essential to the subject, since it is there that what may be called the philosophy of architecture has been most debated, and that thought has had the most obvious and most direct effect on architectural style and movement. That this has been the case has no doubt been largely due to the influence of Ruskin, who, though his architectural judgment was on many points faulty and absurd in the extreme, had at any rate the effect of setting people thinking — not without result. In other countries architecture continued to pursue, up to the close of the century, the scholastic ideal impressed upon it by the Renaissance, without exciting doubt or controversy unless in a very occasional and par- tial manner, and without any changes save those minor ones arising from changing habits of execution and use of material. In Germany there appears to be a certain tendency to a greater freedom in the use of the mate- rials of classic architecture, a certain relaxation of the bonds of scholasticism ; but it has hardly assumed such proportions as to be ranked as a new movement in architecture.

Turning from the critical to the historical aspect of the subject, we find that in England the chief activity has been in public buildings and in street architecture. As already observed, church architecture has for the most

part followed, under clerical influence, the old lines of the mediaeval reyival ; and there have been comparatively

fewer churches built than in the middle portion British Qf ^]^Q century, nor has the general interest in churches.' church architecture been of late by any means

what it was during the earlier revival, the enthusiasm of which has in fact to a great extent burned itself out. 'There are, however, some incidents worth spe- cial notice. The building of a new cathedral is an event which stands alone in modern England. It is true that Truro Cathedral, designed by the late Mr Pearson, E.A., is not completed, but it has been carried further towards

completion than was first hoped, and is perhaps the most remarkable and most successful example, in a scholastic sense, of revived Gothic, being internally almost (if one may say so) more mediaeval than a mediaeval cathedral itself, as far as detail is concerned, though not without original features, and externally showing the distinct impress of its architect's special feeling. One may regret that a great modern cathedral should not have been planned and de- signed on more modern lines ; but it is a study in Gothic which speaks the thorough capacity and knowledge of its architect, and which no other country could have pro- duced. Some of Mr Pearson's parish churches, as those of

Fig. 8. — Interior, St Clare's, Liverpool. {Leonard Sto/cen.)

Eed Lion Square and Kilbum, London, are among the best and most striking modern buildings of their type. The addition of new naves to two mediaeval churches — ^that of Bristol, by Street, that of St Saviour's, Southwark, by Blomfield, is an interesting achievement, and in these cases the use of revived Gothic was quite justified, for reasons of architectural consistency. In opposition to such work may be mentioned the curious and characteristic incident of the delivery of St Albans Abbey (now St Albans Cathedral), one of the most interesting and most valuable of the ancient mediaeval monuments of the country, into the hands of a wealthy lawyer with a taste for playing the architect, the fact of his providing the funds being apparenjily accepted by public opinion as a quite sufB.cient

reason for allowing, him to do what he liked with a build- ing which is a national possession. There is probably no other civilized country in which such a proceeding would be possible. Among , other events connected with the much-vexed question of restoration may be mentioned the repairing of the north transept of Westminster Abbey by Mr Pearson ; in

this case an excusable proceeding, as the archaeological as well as architectural value of the faqadehad already been entirely destroyed by bad restora- tion earlier in the century, and Mr Pearson merely sub- stituted good modern Gothic for bad. The taking down and rebuilding of the upper portion of the front of Peter- borough Cathedral, rendered absolutely necessary on account of its structural condition, will be long remem-

bered on account of the opposition raised against it by archaeologists, who were unable, or did not choose, to

understand the practical necessity of the case. The last years of the 19th century witnessed the progress to an

Fia. 9.— Exterior, Modem English Ohurcli, {James Broohs.)

Fio. 11. — Stalrcsse, Imperial Institute. (OollcuU.)

advanced stage of the most remarkable piece of, English church architecture of the period, the Eoman Catholic Cathedral at Westminster, by Mr Bentley; a building

which is not a Gothic revival, but goes back to earlier (Byzantinei) precedents ; not, however, without a consid- erable element of novelty and originality in the design.

In ordinary cliurcli areMtecture, thougli tljere is still a good deal of mere imitation mediaeval work carried out, we have not been without examples of a new and origi- nal application of Gothic materials. The interior of the

church of St Glare, Liver- pool, by Mr Leonard Stokes (Fig. 8), is a good example of the modified treatment of the three-aisled mediaeval plan already referred to, the side aisles being reduced to passages; and also of the tendency in

recent years to simplify the treatment of

Gothic, in contrast to the florid and over- ~^^

carved churches of the Gothic revival. The churches of Mr Brooks have shown many examples of a solid plain treatment of Gothic, yet with a great deal of character (Fig. 9) ; and the late J. D. Sedding buUt some showing great originality ; among which the interior of his church of the Holy Redeemer, Clerkenwell, affords also an interesting example of the modern free treatment of forms derived from classic architecture.

In the architecture of public buildings one of the earliest incidents in the period was the completion of the Albert Hall, which, though the wo;rk of an engineer, and

with a solid masonry dome, instead of a huge dish- cover of glass and iron, there would have been little to find fault with in its general conception. It was

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Fig. 12.— Plan of a Master's House, New Christ's Hospital. (Webb and Bell.)

also the first modern Eng- lish building of importance to be decorated externally with symbolical fig-

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Public buildings.

FiQ. J5.— Sheffield Town Hall. (MamUforcl.)

commonplace in detail, is in the main a fine and novel architectural conception, and a practical success (consider- ing its abnormal size) as a building for musical perform- ances. Had its constructor been bold enough to roof it

ure composition, in the shape of the large frieze in a coarse mosaic of terra cotta, which is car- ried round the upper portion of the exterior. Connected with this, both historically and in archi- tectural grouping, is the Albert Memorial, the work ‘ of Scott, intended as a ” shrine ” on a great scale, which both for originality and beauty claims more credit than it has gener- ally received. Its worst fault is that the angle piers are not adequate for the thrust of the arches, which are secured by concealed iron ties. Here again we had an early (modern) example of the sculptor working in harmony with the archi- tect ; and though there has been a great advance in English sculpture during the last quarter of the century, much of that on the Albert Memorial still commands admiration; the colossal central figure, entirely out of scale with the rest, being unfortunately the weakest

portion of tlie work. The subject of the Government Offices in London forms in itself an important chapter in recent architectural history. The Home and I’oreign Office block was finished in 1874 ; a sumptuous, but weak

Fig. 16.— Oxford Town Hall, (flare.)

Eia. 17. — Northampton Institute. (Mbimtford.)

Fis. 18. — Oragslde. (iS. Sorman Shaw, B.A.)

and ill-planned building designed by Scott, invitd Minervd, in a style alien to his own predilections. In 1884 took place the great competition for the

War and Admiralty Offices conjointly, won by a commonplace but admirably drawn design, presenting some good points in planning.

The building was to stand between Whitehall and St James's Park, with a front both ways. The competition came to nothing, and the successful architects were event- ually employed to build the new Admiralty as it now stands, a mean and commonplace building with no street frontage, in. which economy was the main consideration, and totally dis- creditable to the greatest naval power in the world. In 1898-99 it was at last resolved to build a War Office and other Govern- ment Offices much needed, and an irregu- lar site opposite the Horse Guards was selected for the War Office and one in Great George Street for the others. In this case there was no competition, but the Government selected two architects after inquiry as to their works ("classic" archi- tecture being a sine qud non) ; Mr Young for the- War Office, and Mr Brydon for- the Great George Street block. The War Office site is inadequate and totally uu- symmetrical, the boundary of the building being settled by the boundary of the street curb, and the inner courtyards will be of very mean proportions compared with the great courtyard of the Home and For- eign Office. Both architects have produced grandiose designs, but in regard to the War Office at least the Government have thrown away a great opportunity. Unfort- unately, throwing away great opportunities has been the history of the Government buildings ever since the Houses of Par- liament, a really fine building, was com> pleted.

There can only be further enumerated a few of the more important buildings carried out in England during the later years of the 19th century, and mention made of the general course which architecture has taken in regard to special classes of buildings. The Natural History Museum (Fig. 10, see Plate), completed in 1881 by Mr Alfred Waterhouse, may stand as a type of the taste for the employment of terra cotta, with all its dangerous facilities in orna- mental detail, which that architect speci- ally set the example of. Detail is certainly overdone here, but the building is strik- ingly original ; a point not to be overliDoked in these days of architectural copying. The Imperial Institute, the result of a competition among six selected architects, represents also a type of architecture which its architect, Mr CoUcutt, may be said to have matured

for himself, and which has been extensively imitated; a refined variety of free classic, always quiet and delicate in detail, though perhaps rather wanting in architectonic force (Fig. 11). The next great architectural competition was that for the completion of the South Kensington Museum, the bare brick ex- terior of which, waiting for architectural completion, had long been a national dis- grace. The competition produced some fine and strik- ing designs, some of them perhaps more so than the selected one by Mr Aston Webb, whose fine plan, how- ever, justified the selection. Another competition which excited general interest was that in 1894, for the rebuild-

ing on a country site of Christ's Hospital Schools, also gained by Mr Webb (in collaboration with Mr Ingress Bell), by a design which, in its arrangement of schoolhouses in detached blocks (Fig. 12), but in a symmetrical group- ing, opened up a new idea m public school planning, and struck a blow at the picturesque but insanitary quadrangle system. Among notable public buildings of the period ought to be mentioned Mr Norman Shaw's New Scotland Yard, built in a style neither classic nor^ Gothic, but par-

taking of the elements of both (Figs. 13 and 14, see Plate) ; a work which has perhaps been a little over-praised, just as it has been very superficially condemned, but which is a remarkable example of novel and picturesque design, though most of the details, taken separately, are imitative..

In recent years there has been a great movement for building town halls ; towns rather vying with each other in this way. Of late nearly all of these have been carried

Fia. 19.— City Bank, Ludgate Hill. iCollcutt.)

out in some variety of free classic. Among the more im- portant in point of scale is that of ShefB.eld, by Mr Mount- ford (Fig. 15) ; among smaller ones, those of Oxford, by Mr Hare (Fig. 16), and Colchester, by Mr

*Belcher, are particularly good examples of 'recent architecture of this class, the former distinguished also by an exceptionally good plan. The merit of excellent planning also belongs to Messrs Aston Webb and Ingress Bell's Birmingham Law Courts, one of the modern terra-cotta buildings of some- what too florid detail, though picturesque as a whole. Among public halls the M'Ewan Hall at Edinburgh, completed in 1898 from the designs of Dr Eowand Ande*son, deserves mention as one of the most original*

and most carefully designed of recent buildings in Great Britain.

The various new buildings erected in connexion with the University of Oxford, those by Mr T. G. Jackson especially, form an important incident in modern English architecture. Mr Jackson has succeeded to a remarkable degree in designing new buildings which are in harmony with the old architecture of the university city; some- times perhaps a little too imitative of it, but at any rate he has the credit of having added rather extensively to Oxford without spoiling it j while his school buildings in different parts of the country have a refinement and domesticity of feeling which is the true note of school

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architecture. ^Among buildings of an educational class, tlie move in technical education has led to the erection of

Fig. 20.— House, Buckingham Gate. (.X. BlomfiOaL.)

a good many large polytechnic and similar institutions, which in many cases have been well treated architecturally; the Northamp- ton Institute at Clerkenwell (Fig. 17), by Mr Mountford, being perha.ps one of the boldest and most effective of recent public buildings. In the building of ^hospitals and asylums much has been done, and great progress made in the direction of hygienic and practical planning and construction, but the tendency has been (perhaps rightly) towards making this practical efficiency the main consideration, and reducing architectural treatment to the simplest character. The well-known St Thomas’s Hospital, at Lam- beth, exemplifies the treatment of hospital architecture at the

commencement of our period ; the separate pavilion system had been already adopted on practical grounds, but the building is treated in a sumptuous architectural style, as if representing so ^%f<;;;Sfn many detached mansions ; a treatment which seoretarjr! would now be deprecated as an expenditure foreign to the main purpose of the building.

Henman, combines architectural effect with the latest hygienic improvements, and is the first large hospital in Great Britain in which the system of mechanical ventilation has been completely and consistently carried out.

In theatre building there has been an immense improve- ment in regard to planning, ventilation, and fire-proof construction, but little to note in an architectural sense, since theatres in England are never designed by eminent architects, the financial and practical aspects being alone considered.

In domestic architecture the tendency has been to quit picturesque irregularity for a more formal and more dig- nified treatment. Such a house as Mr Norman Shaw's " Cragside," built in the earlier part of our period (Pig. 18), however its picturesque treatment may still be admired, would hardly be built pow on a large scale ; its architect himself has of late years shown a preference for a symmetrical and regular treatment of house architec- ture, sometimes to the extent of making the mansion look too like a barrack. In street architecture, however, the tendency has been towards a more characteristic and more picturesque treatment ; nor is there any class of building in which the improvement in English architecture during the last quarter of a century has been more marked and more unquestionable. Many of the new residential streets in the west end ■ of London present a really picturesque ensemble, and many shops and other commercial street buildings have been erected with admirable fronts from the designs of some of the best architects of the day. Mr Norman Shaw's. building at the corner of St James's Street and Pall Mall was one of the first, and is still one of the best examples of modern street architecture. As later examples may be cited Mr CoUcutt's City Bank in Ludgate Hill (Fig. 19), and Mr E. Blomfield's narrow house-front in Buckingham Gate (Fig. 20). The introdhction of sculpture in street fronts

is also beginning to receive attention; and a simple house-front recently erected in a London street, from the design of Mr Beresford Pite (Fig. 21, see Plate), is an excellent example of the use of sculpture in connexion 'with ordinary street architecture. It is significant of the increased attention accorded to street architecture, that the most important architectural event in England at the very close of the 19th century, was the outlay of £2000 by the London County Council, in

of Hfltel de Vflle, Paris. A, Salle des P6te8 ; B, Salle & manger; 0, Salons de D, Council Chamber; E, Grand Staircase; F, Salle des Gariatides; G, General H, Prefect ; K, Committee Booms ; L, Public Works ; M, Corridor ; N, President of boauoil'; O, Library; P, Refreshment Boom.

One

recent hospital, however, that at Birmingham, by Mr

I fees to eight architects for designs for the front of a I proposed new street.

Tiirning to the Continent, we find in Trance, still the lead- ing artistic nation of the world, that the art of architecture has been in a most flourishing and most active state during the last quarter of a century. It is true that P there is not the same variety as in

modern English architecture, nor have there been the same discussions and experiments in regard to the true aim and course of architecture which have excited so much interest in England; because the French architects, unlike the English, know exactly what they want. They have a "school" of architecture; they adhere to the scholastic or academic theory of archi- tecture as an art founded on the study of classic models ; and on this basis their archi- tects receive the most thorough training of any in the world. This predominance of the academic theory deprives their architecture, no doubt, of a good deal of the element of variety and

picturesqueness; a French archi- tect pwr sang, in fact, never attempts the pic- turesque, unless in a country residence, and then the results are such that one wishes the attempt had not been made. But, on the other hand, modern French architecture at its best has a dignity and a style about it which no other nation at present reaches, and which goes far to atone for a certain degree of sameness and repetition in its motives; and living under a Government which recognizes the importance of national architecture, and is willing to spend public money .liberally on it (with the full approbation of its

portant events in connexion with archite(5,ture, for even the temporary buildings erected for them showed an amount of architectural interest and originality which

Fig. 25. — ^cole de Midedne, Piiria. {Ginain.)

public) the French architects have opportunities which English ones but seldom enjoy — the predominant aim with a British Government being to see how little they can spend on a public building. The two great Paris exhibitions of 1889 and 1900 may be regarded as im-

could be met with nowhere else, and which in each case left its mark behind it, though with a difference ; for while in the 1889 exhibition the main object was to treat temporary structures — ^iron and concrete and terra cotta — in an undisguised but artistic manner, in those of the 1900 exhibition the effort was to create an arclii- teptural .coup d'ceil of apparently monumental structures of which the actual construction was dis- guised. In spite of some eccen- tricities, the amount of invention and originality shown in these temporary buildings was most re- markable; but fortunately the exhibition left something more permanent behind it in the shape of the two Art-palaces and the new bridge over the Seine. The two palaces are triumphs of modern classic architecture; the larger one (by MM. Thomas, Louvet, and Deglane) is to some extent spoiled by the apparently unavoidable glass roof; the smaller one, by M. Girault, escapes this drawback, and, still more refined than its greater opposite, is one of the most beautiful buildings of modern times; while the

architectural which flank

pylons, with their accompanying sculpture, the entries to the bridge, are worthy of the

Fio. 26.— OpSra Oomique, Paris. (Vernier.)

best period of French Renaissance. Thus much, at least, has the 1900 exhibition done for architecture.

At the beginning of our period stands one of the most important of modern French buildings, the Paris H6tel de Ville, commenced shortly after the war, from the designs of MM. Ballu and Deperthes, planned on an immense scale, and on the stateliest and most monu- mental lines (Figs. 22, 23). The central block is, externally, a restoration of the old H5tel de VUle, the remainder carried out in an analogous but somewhat more modern style. The interior has been the scene of sumptuous pictorial decora- tion, in which all the first artists of the day were employed — ^unfortunately in too scattered a manner, and on no pre- dominant or consistent scheme. During the period one of the most characteristic architectural efforts of the French has consisted in the erection of the various smaller HStels-de-ville or Mairies, in the city and suburban districts of the capital; as at Pantin, Lilas, Suresnes, and in vari- ous arrondissements within the city proper (Fig. 24, see Plate). Nothing shows the quality of modern French architecture better, or perhaps more favourably, than this series of district town halls ; all have a distinctly municipal character and a certain family resemblance of style amid their diversity of details; all are refined specimens of pre-eminently civilized archi- tecture. Among the greater architectural efforts of France during the last decade or two are the immense block of the new Sorbonne, by M. Nenot, a building sufBcient in itself for an architectural reputation; and the great church of the

in progress for many years, from the designs of the late M. Abadie, and in the year 1900 was still unfinished. In church architecture gener- ally France has not shone very much during the latter part of the century ; all

her finest modem classic churches date from before the war. Among smaller French buildings of peculiar merit may be mentioned the Mus^e Galliera, in the Trocad^ro quarter of Paris, designed by M. Ginain — a work of pure art in archi- tecture such as we should nowadays look for in vain out of France ; the £cole de Mddecine, by the same refined architect (Fig. 25) ; and the chapel in Eue Jean Goujon (Guilbert), erected as a memorial to the victims of the bazaar fire, again a notable instance of a work of pure thought in architecture — a new conception out of old materials. The new Opera Comique (Bernier) should also be mentioned (Fig. 26), the rather disappointing result of a competition which excited great interest at the time. Street architecture has been carried out of late in Paris in a sumptu- ous style (Fig. 27), with great stone fronts

Fis. 2T.— Example of Paris Street Arcliitecture.

Sacre Coeur, overlooking Paris from the hill of Mont- 1 and a profusion of carved ornament, such as we know martre, an erection of such monumental massiveness nothing of in England ; and though there is a rather as we never see in modern England, which was | monotonous repetition of the same style and character

throughout the new or newly-built streets, it is impos- sible to deny the effect of palatial dignity they impart to the city. In the matter of country houses the rrench architect is less fortunate; when he attempts what he regards as the rural picturesque, his good taste seems entirely to desert him, and the inaison de campagne (Kg. 28) is generally a mere riot of gimcrack.

"The great military success of Germany in 1870, and the founding of the German empire, gave, as is usual in

such crises, a decided impetus to public architecture, of which the central and most important visible sign is the German Houses of Parliament, by Professor Wallot, whose design was selected in a com- ^""“‘y- petitioii.

There is something essentially German in the quality of this national building; classic architecture minus its refinement. The detail is coarse ; the finish of the end pavilions of the principal front absolutely un-meaning— mere architectural rodomontade; the central

Pio. 29.— Interior, Houses of Parliament, Berlin. (^Wallot.)

cupola of glass and iron, on a square plan, probably the ugliest central feature on any great building in Europe ; and yet there is undeniable power about the whole thing ; it is the characteristic product df a conquering nation not reticent in its triumph. The interior of the vestibule is shown in Fig. 29. The new cathedral ‘ at Berlin, by Professor Easchdorff, is the other most important German work of the period (Fig. 30); a building very striking and unusual in plan, but absolutely commonplace in its architectural detail ; school classic of the most ordinary typi, without even any of those elements of originality

which are to be found in the Houses of Parliament. A curious feature in the plan (Pig. 31) is that the building, alone of any cathedral we can recall, has its principal general entrance at the side, the end entrance being re- served for a special imperial cortege on special occasions, the cathedral also serving the second purpose of an imperial mausoleum. Theatre building has been carried on very largely in Germany, and among its productions the Lessing Theatre at Berlin (Fig. 32) (von der Hude and Hennicke) is a favourable example of German classic at its best, besides being, like most modern German

theatres, very well planned (Fig. 33). Hamburg has had Its new municipal buildings (Herr Grotjan), a florid Renaissance building with a central tower, showing in i/fcs general effect and grouping a good deal of Gothic feeling. Mention may also be made of the new Law Courts at Leipzig (Herr Hoffmann), a building with no more charm

Fic. 28. — ^French ” Maiaon de Campagne ” (mild type).*

about it, externally, than the Berlin Parliament Houses, but with some good interior effects (Fig. 34). The new Post Offices in Germany have been an important under- taking, and are, at all events, buildings of more mark than those in England. There has also been a great deal of new development in street architecture, which shows an immense variety, and a constantly evident determina- tion to do something striking ; but we find in it neither the dignity of Parisian street architecture nor the refine- ment of modern London work; there is an element of the bombastic about it.

No modern building on the European continent is more remarkable than the Brussels Law Courts, built in the early years of our period, from the designs of the late M. Poelaert, an original genius in architecture, who had the good fortune to be appreciated and given a free hand by his Government. The design is based on classic architecture, but with a treatment so completely individual as to remove it almost entirely from the category of imitative or revival architec- ture; somewhat fantastic it may be, but as an original architectural creation it stands almost alone among mod- ern public buildings. In Vienna the scholastic classic style has been retained with much more purity and refine- ment than in the German capital (Fig. 35, see Plate). Budapest, on the other hand, which has almost sprung into existence since 1875 as the rival of the Austrian capital, has erected a great Parliament building of florid

other coaatrles.

character (Fig. 36, see Plate), in a style in which the Gothic element is prevalent, though the central feature is a dome. The plan (Fig. 37, see Plate) is obviously based on that of the Westminster building ; the exterior design, however, has the merit of clearly indicating the position of the two Chambers as part of the architectural design, the want of which is the one serious defect of Barry's nobl structure. In Italy modern architecture is at a very low ebb; the one great work which comes within our period has been the building of the facade to the Duomo at Florence, from the design of the late De Fabris, who did not live to see its completion. As the completion in modern times of a building of world-wide fame, it is a work of considerable interest, and, on the whole, not unworthy of its position ; that it should harmonize quite satisfactorily with the ancient structure*

was hardly to be expected. It was probably the completion of this faqade which led the city of Milan to start a great architectural competition, a few years since, for the erection of a new facade to its celebrated cathedral, not because the facade had never been completed, but because it had been spoiled and patched with bad 18th-century work. The ambition was a legitimate one, and the competition, open to all the world, excited the greatest interest ; but the young Italian architect, Brentano, to whom the first premium was awarded, died shortly afterwards, and other causes, partly financial, led to the postponement of the

Fis. 84.— Interior of Leipzig Law Courts. (,Boffmcmn.)

scheme, though it is understood that there is still an intention of carrying out Brentano's design under the direction of the official architectural department of the city. / ^

AuTHOEiTiBS. — The literature of architecture as a modem art is limited, the most important publications of recent times being mainly devoted to the study and illustration of ancient architecture. The following, however, may be named : — James Febgusson. History of Modern Architecture (2nd edition). London, John Murray, 1873. — T. G. Jackson. Modern Gothic Architecture. London, H. S. King, 1873.— J. T. Micki,ethwaitb. Modern Parish Churches. London, 1874.— E. E. Robson. School Archi- tecture. London, John Murray, 1874.— J. J. Stevenson. House

The real literature of modem architecture, how- ever, is to be found mainly in the articles and illustrations in the best periodical architectural publications of various countries. Among these Italy has none worth mention, and France, with all her architectural enthusiasm, has had no first- class architeoturai periodical since the extinction, about 1890, of the Bevue g&n&rale de V Architecture, conducted for more than fifty years by the late C&ar Daly, and in its day the first periodical of its class in the world. The following are the best publications at present : — The Architec- tural Record (quarterly). New York. — The Architectural Seview (monthly). Boston, U.S.A. — The Allgemei,ne Bauzeitung (quarterly). Vienna. — The Berlin Architekturwelt (monthly).

Pie. 31.— Plan of Berlin Oathedral. Architecture. London, Macmillan, 1880. — E. B. ViOLLET-LE-Duc. Sow to buHd a House (translated from the French). London, 1874. — Lectures on Architecture (translated). Lon- don, 1881. — H. C, BuKDETT. Sospitals and Asylums of the World. London, ChurchiU, 1892-93. — Professor Oswald Kuhn. Kranken- hauser. Stuttgart, 1897. — E. O. Sachs. Modern Opera-Houses and Theatres. London, Batsford, 1897-99.— E. Wtndham Tarn. The Mechanics of Architecture. London, Crosby Lockwood and Son, 1893.— E. Nohman Shaw, K.A., T. G. Jackson, R.A. (and others). Architecture, a

Profession or an Art (a collection of essays). London, John Murray, 1892. — W. H. White. The Architect and his Artists. London, 1892. — Architecture and Public Build- ings in Paris and London. London, King and Son, 1884. — H. H. Statham. Architecture for General Readers. London, Chapman and Hall, ^ 1895. — Modern Architecture. London, Chap- 9 man and Hall, 1898. — Heeemann MtriHESius. ‘ Bie Englische Baukunst der Gegenwart. Berlin and Leipzig, 1900. — ^Dbe Aechitbkten Vebbin

Fio. 80.— Berlin Cathedral. (Basehdorff.)

.Fig. 38. Plan of Leseing Theatre, Berlin.

Fio. 82.— Leasing Theatre, Berlin, (Von der Mude and HemUahe.)

zu Beelin. Berlin und Seine Bauten.t Berlin, Ernst und Sohn, 1896.

Berlin.— 3%e Builder (weekly). London La Construction

Moderne (weekly). Paris. (h. h. s.)

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II. Kecent Arch^ological Discoveries.

Archaeological research since 1875 has not only en- riched the museums of Europe with priceless treasures, but, by the adoption of a much more scientific system of excavation, has been able to complete and rectify the dis- coveries of earlier explorers, and to fill up the gaps ia the history of the origin and development of the earlier archi- tectural styles. In two of these — viz., the Egyptian and the Greek — ^the researches of Professor Flinders Petrie in Egypt,andof Dr Schliemann, Dr Dorpfeld, and MrHomoUe in Greece, have placed the archaeological history of archi- tecture on a surer and better-defined basis than heretofore.

Egyptian.

Taking the earliest structures first, we learn from Professor Flinders Petrie's work on The Pyramids and Temples of Gfizeh, that the oldest pyramids known are those of Sakkara and Medum (Meidoun), and these were not only

A A ORrOINAtMASTABA. ~I1 ■ ^^^ SCALE I INCH TO 100 rECT.

Fig. 1.— Pyramid of Medum (Meidoun).

of different construction from any of the others, but when the latter was completed it reached the form afterwards adopted in the true pyramids. The kernel of the Sakkara and Medum pyramids belong to the class known as Mastaba tombs. The term mastaba (Arabic for "bench") has been given to the sloping-sided tombs, of about 76° angle and from

10 to 20 feet in height (Fig. 1). In their origin they are prob- ably copies in stone of the crude brick dwellings of the Egyp- tians, the walls of which must be much thicker at the bottom than at the top, to carry the superincumbent weight. Both the pyramids above named are known as cumulative or superposed mastabas ^—i.e., successive enlargements have been made to them, having been after each completion again enlarged by another coat of rough masonry with another fine polished casing outside. The pyramid of Sakkara was never completed, and has retained the stepped form which these successive casings gave to it. In the Medum pyramid the tower-like appearance, at present, of the centre portion is due to two of the lower enlargements having fallen away (Fig. 2). Before the final casing the successive enlargements had resulted in seven steps, the outer angles of which were pyramidal ; the last process was to add a smooth casing to one slope from base to top. The angle thus formed was about 62°. These two pyramids are the only ones built in this way ; in all the others the full size was settled from the first, though a change from the original size seems to have been made during its construc- tion, in the third pyramid of Menkaura.

From Professor Flinders Petrie's measurements of the Great Pyramids, the original dimensions have now been ascertained exactly. The external dimensions of the first pyramid, that of Khufu, are 755 ft. 8 in. as the mean of the four sides, with an extreme difference of 1-7 of an inch. The

height from the level of the artificial pavement round the pyramid to the apex was 481 ft. 4 in., and the angle of casing, 51-62°. In the second pyramid, Khafra, the lowest course was in granite, and had a vertical base 11 in. high, 'against which the artificial pavement- was laid. The side dimensions were 706 ft. 3 in. as a mean, with an extreme difference of 5 in. The height was 472 ft., and the angle of casing 53-10°. The third pyramid, Menkaura, was never quite completed, the mean length of the sides was 346 ft., the height 215 ft. and the angle 61-10°. The lower portion of this pyramid was cased with granite to about one- fourth up, and the rough surface of the granite casing was never worked off. Part of the outer casing still remains on the second pyramid. The casing stones were not simply triangular blocks filling up the angles formed by the receding steps, but from 7 to 10 feet in depth, so that their bedding must have begun at the bottom.

Fig. 2.— Pyramid of Medum.

In the course of his researches at Gizeh in 1881-82, Professor Flinders Petrie made a minute examination of the granite blocks inside the Great Pyramid, and of the debris in granite chips and diorite on the site of the work- shops of the masons who built the Pyramids, and ascertained that the typical method of working hard stones, such as

granite, basalt, and diorite, was by means of bronze tools set with cutting points, probably of corundum, as the diamond is not known in Egypt, and that the masons employed straight and circular saws and tubular drills.

^ It still retains a portion of its original casing at the top (see Kg. 2).

The pyramid of Medum, already mentioned, was built by Sneferu, the first king of the fourth dynasty, e. 3998-3969 B.C. ; and on the east side Professor Petrie discovered a small temple attached to it, consisting of two chambers roofed over in stone with two steles and an altar between on the roof. Traces of other temples have since been found on the east side of the

Great Pyramids; and from the temple of the second pyramid a, causeway led down to the granite temple, known as the temple of the Sphinx (Fig. 3), the earliest temple known, and, according to Professor Petrie, built by Khafra after the completion of his pyrsr mid. The temple, though now buried, was originally a free-standing building on the plain at the foot, of the hill. The tablet referring to the restoration of the Sphinx by Khufu is now recognized as a forgery of the twentieth dynasty. No mention is made of the Sphinx on any monulnent of the old kingdom, and Professor Petrie places its date between the sixth and the tenth dynasties.

Pyramid of Khafra.

Of the famous Labyrinth built by Amenemhat III., c. 2622-2578 B.C., nothing remains but the site, about 1000 X 800 feet — the masses of buildings described by Lepsius are, according to Professor Petrie, the brick houses of a Eoman village built on the site. The Hawara pyramid on the north side was erected hj the same king. It was built in crude brick and coated with a fine limestone casing like the other pyramids; its dimensions are about 334 feet wide and 197 feet high. In the interior of this pyramid Professor Petrie discovered a pointed arch 3 feet in depth and composed of three rings of bricks, which was employed to take off the weight of the upper part of the pyramid from the roof of the tomb chamber. The Pyramid of lUahun, buUt by Usertasen II., c. 2684-2660 B.C., to the ^outh-east of, and situated about a mile from the Labyrinth, was partly composed of solid rock about 40 feet high, isolated by the cutting away of the rock round it. The upper portion consisted of cross walls of stone, fitted in with crude

Sphinx.

Pyramid of Khufu.

Jig. 3.— Temple of the Sphinx.

brick and cased afterwards with limestone. It was near this pyramid that Professor Petrie discovered the town of Kahun, erected to house the overseers and workmen who built the pyramid, and deserted by them on its completion. The walls were all of crude brick, and where J:he rooms

exceeded 8 or 9 feet in width columns of wood or stone were employed to assist in carrying the roof. The lower portion of a column fluted like those at Benihassan was found on its stone base.

The pyramidal form given to the stone pylons of Egyptian temples is now generally acknowledged to have been derived from the material in which the earlier ex- amples were built, viz., crude brick, the raking sides aris- ing from the fact that these crude brick walls are always, for reasons already given, much thicker at the bottom. Even at the present day the pigeon-houses built on the roof of the modern Egyptian dwelling-houses take the same shape, and in the distance are often mistaken for temples.

During 1894 and following years excavations have been carried out under the direction of Mr Naville at Deir- el-Bahri, the splendid temple built by Queen Hat'shepsut,

1616-1503 B.C., and by the removal of the superincumbent earth a great portion of the temple foundations have been exposed. In that part buried by the falling in of the rock above at the north-east end, the hypostyle hall land colonnade are almost perfect. Since the plan was measured by Professor Brune in 1866 and published by Mariette, with some incorrect alterations, the principal architectural discovery has been that of the great altar in the north-east court, the only complete example found in Egypt, its preservation being due to the falling in of the rock above. Professor Brune's restorations made in 1866-67, and published by Mariette, give an excellent idea of the aspect of this remarkable temple, which was built on a series of terraces ; except that the later discoveries have shown the north-east corner to have been different in plan from the north-west corner.

In 1891-92 Professor Petrie excavated and uncovered the remains of the Palace of Khu-en-aten (Amen-hotep IV.), 1383-1365 B.C., who not only made changes in the religious worship of the country, but in the decoration of his palace departed from the conventional art of the period, and intro-

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duced a reform therein. la the pavement and frescoes of the walls the subjects are selected from out-of-door life, and birds, insects, and water-plants are depicted with marvel- lous fidelity to nature. The temple of Luxor has also been cleared out under Mr Maspero, so that those por-tions of the plan which were covered over and hidden by modern buildings are now exposed.

Persian.

Mr Marcel Dieulafoy's excavations at Susa in 1884-86 have confirmed those made by Sir Kenneth Loftus in 1860 as regards the three great porticoes and the Apadana, or Hall of Columns of the Palace of Artaxerxes Mnemon. The walls enclosing the hall and flanking the porticoes, as con- jectured by Fergusson, no-longer existed, being probably built in unburnt brick ; but the discovery of fragments of the pavement inside the hall and in the rear of the north and west porticoes, which stopped on the lines where the walls (16 feet thick) should have been found, is a sufficiently clear proof of their existence. The fourth or south side of the Apadana opened on to a court, and facing the hall, on the right and left of the court, were two walls, which were decorated with the famous frieze of archers now in the Louvre. The wall had apparently fallen down on its face, and thus preserved more or less intact this frieze, which was executed in enamel in bright colours on beton blocks. Farther to the south Mr Dieulafoy found the grand staircase lead- ing to the palace similar to the well-known example at Persepolis, except that the walls were here decorated with enamelled beton blocks. At Persepolis in 1891 Mr Weld Blundell ascertained, firstly, that the drain which was supposed to run under the site of what in Pergusson's restoration should be a wall was carried between the wall and the ' first row of columns; secondly, that two of the vertical stone rain-water pipes rose above the pavement of the terrace, proving that they were brought down inside the wall from the roof above the Hall of Columns ; and, thirdly, that the three porticoes were flanked by towers, .the foundations of which were traced below the hard lime crust which had been mis- taken for the solid rock, thus confirming Fergusson's restoration.

Greek.

Although the excavations made by Dr Schliemann in Troy, Mycenae, and Tiryns have in the main an archaeo- logical rather than an architectural value, the discovery of the plan of the Palace of Tiryns has enabled Dr Dorpf eld to trace the origin of many of the characteristic features of Greek architecture. The propylaea or entrance gateways were of the same plan as that subsequently developed into the Hexastyle porticoes of the Propylaea at Athens and other sacred enclosures. In the megaron or men's hall of the palace, with its Portico-in-antis and vestibule, Dr Dorpfeld recognizes the model of the cella of the Greek Doric Temple. The researches revealed that the primitive construction consisted of a foundation wall about 3 feet in height, built in rubble masonry laid in clay mortar, and of such thickness as to suggest that the upper part of the walls was built in crude or unburnt brick. In order to protect the face of the antae of the Portico-in-antis, and in conjunction with the two columns of the portico, to carry the architrave, vertical posts or planks of wood were em- ployed, secured by wooden dowels to a stone base. The two columns of the Portico-in-antis were in timber, their

trace being shown on the stone bases still in situ, which were raised two inches above the pavement, a precaution taken to protect the base of a wooden column. This timber construction was afterwards copied in stone, and is the origin, according to Dr Dorpfeld, of the slightly pro- jecting antae employed afterwards decoratively in all Greek temples. Further evidence of the correctness of this theory has been found in the temple of Hera at Olympia, which was excavated by the German Government in 1875-85. Here the lower part of the walls was in masonry of small dimensions carrying a superstructure in crude brick, and the antae were protected and strengthened by vertical posts of timber, traces of which were found on the stylobate or upper step. Here also, as in Tiryns, the doorposts of the entrance doorway were in timber. In the Heraion, however, that which at Tiryns constituted the megaron had become the cella of the temple, and a further development had taken place by the surrounding of the same with a peristyle of columns to protect the ex- ternal wall of the cella, and probably its stucco face and painted decoration. The variety of profile shown in the stone capitals found on the

site, and the fact that Pausanias mentions his having seen a wooden column in

Fia. 4.— The Theatre of Epidauras.

the opisthodomus, have led to the conclusion that origi- nally all the columns of this temple were in wood, being replaced gradually by copies in stone. Their wide inter- columniation proves also that the entablature was in wood, and the discovery of some of the terra-cotta tiles and ^ntefixae shows that the wooden roof was covered with tUes. The probable date of the foundation of the temple is placed by Dr Dorpfeld in the 11th cent. B.C. ; four centuries, therefore, before the earliest stone temples known, viz., those of Apollo and of Zeus at Syracuse. '

The excavations at Olympia have laid bare the whole site of the Altis or sacred enclosure, and some of the structures of later date round the same. It may be pointed out that the preservation and recovery of the famous statue of Hermes by Praxiteles is due to its having been thrown down by, and buried in, the clay of the crude brick walls of the cella; when that happened no one knows, but it is strange that so ephemeral a material as unburnt brick should, if our dates are correct, have been preserved for thirteen or fourteen centuries. The re- searches of Blouet and other explorers in the earlier part of the 19th century had made known to us the plan of the Temple of Zeus, which was Hexastyle Doric with thirteen columns in the flanks, and of the usual type, with pronaos, epinaos, and cella. The entire clearance of all the

superincumbent earth lias, however, revealed many other features in the plan which bear out Pausanias' description. First, within the entrance to the cella were staircases leading to the galleries, " through which there is an approach to the image." On the pavement were seen the traces of the barrier across the cella between the second column on each sid^ and pf other barriers restricting the passage to the side aisles. In front of the pedestal which carried the famous chrys- elephantine statue of Zeus, by

Phidias, were found the traces of the black stone paving with the raised margin of Parian marble to hold the oil which, according to Pausanias, was kept there to preserve the ivory, a pre- caution rendered necessary by the dampness of ^he Altis. The position of this sunk space filled with oil quite disposes of the hypsethron, and there is no doubt that in this temple the statue was lighted only through the open door.

In the Byzantine church, outside the Altis, have been recognized the lower parts of the waUs of the workshop of Phidias, mentioned by Pausanias. It was of the same size as ihe cella of the temple.

In order to carry out systematically the explorations

Fia. 5.— Conjectural Bestoration of the East IVont of the Temple of Biana at Ephesue, by Dr Murray.

at Delphi, begun in 1891 by the Trench School at Athens, it was found necessary to expropriate the inhabit- ants of Kastri, a small village built on the sacred en- closure, providing accommodation for them elsewhere. This, combined with the labour involved in clearing away the superincumbent earth and the debris of the village, and conveying it some distance, necessarily delayed the work. Here, as at Olympia, the writings of Pausanias have been of the greatest value in the nomenclature of the various buildings and monuments the foundations of which were found on either side of the sacred way. This, owing to the steepness of the hill, winds round at a gentle slope from the entrance of the sacred enclosure at the south-east, rising across the same to the west and return- ing to the foot of the steep ascent leading to the raised terrace on which the Temple of Apollo was built. The excavations have exposed the whole of the peribolos or wall surrounding the temenos or sacred enclosure, the, foundations of all the treasuries and votive monuments, and the terrace waU ; the latter, carrying the platform of the temple, is one of the finest examples known of polygonal masonry. Comparatively little was found of the architectural features of the Temple of Apollo, but those of .the several Treasuries are of importance in one

case, that of the Siphnians allowing of a more or less com- plete conjectural restoration. The Siphnian treasury is supposed to date from

the end of the 6th cent. b.c. ; in the magnificent carving of the architectural ornament it may be said to rival that of the Erechtheum. Although built in Parian marble, it was richly decorated in colour, of which vivid traces still exist. Among other finds were the remains of four caryatid figures of colossal size, each with a calathos or polos on the head ; these, accord- ing to Mr Homolle, seem to have supported a tribune like the caryatid portico of the Erechtheuni, and probably served as the prototype of the arrephoroi of that building. Further remains have been found of the Sphinx of archaic character, and of the Ionic capital of early date which carried it, suf&cient now to complete their restoration. The remains also of a triangular votive column were found, triangular in the sense that as it supported originally a tripod there were three caryatid figures at the top carrying the same ; and the decorations of the column, with widely-projecting and finely-carved acanthus leaves, are grouped in triplets, which constitute the capital and base of the column. These acanthus leaves are the earliest known, and are certainly the

most vigorous examples ever carved.

At Epidaurus, where ex- cavations were systemati- cally begun in 1881 by the Greek Archaeological Society under Mr Kawadias, the sacred temenos has been laid bare, exposing the plans of the stoa or colonnade where the patients were housed, of the temple of Asclepius (sin- gular in having no epinaos), and of the famous Tholoa by Polycleitus the Younger, a circular building with a peri- style of twenty-six Doric columns round tiie exterior, and a circle of fourteen Co- rinthian columns inside, the capitals of these columns in] Parian marble being of great ‘ beauty and among the earliest Corinthian examples known. The famous Theatre has also been cleared out, displaying a circular orchestra and the foundations of a stage of late date, which, from the remains found, seem to have been 12 feet high, with the front decorated with Ionic semi-detached columns, all the capitals having angle volutes (Fig. 4).

The researches made since 1885 on the Acropolis of Athens have resulted in discoveries of more value to the archaeologist than to the architect. The founda- tions of the old Temple of Athene, destroyed by Xerxes in 479 b.c, have been found close to the Erechtheum, and below the level of the same

were discovered two stone bases considered to have sup- ported the wooden pillars of the House of Ei-ech- theus. In 1884-86 Mr F. C. Penrose undertook for the Dilettanti Society a series of investigations rela- tive to the Olympieion or temple of Zeus Olympics, which proved that the temple had eight columns in front and rear, and not ten, as had been thought, owing to a misreading of Vitruvius ; that the fifteen columns which remain belong to the edifice designed by Cossutius, the Eoman architect, 174 b.c, and that Hadrian's share in the work was confimed to the

completion of the structure, including the new columns in

the cella, the original examples having been carried away by Sulla for the decoration of the Temple of the Capitol at Eome. Mr Penrose arrived at his conclusions from the great beauty of the Corinthian capitals of the Peri- style, many of which he thought were of a purer type than any likely to have been carved during the reign of Augustus when the work of completion of Cossutius's temple was again taken up, and still less likely to be of Hadrian's time.

The main results of the late Mr Wood's discovery of the site and remains of the Temple of Diana at Ephesus were made known as far back as 1876. Since then the remains brought to England and placed in the British Museum have attracted the attention of many archaeo- logists, who have attempted to make restorations of the plan embodying the chief features. Amongst these, by far the most trustworthy and most important has been that put forward by Dr Murray in a communication to the Bioyal Institute of British Architects in 1895. The same paper contains drawings representing a restoration of the carved drum of one of the columns belonging to the archaic temple, built 560 b.c, of which CrcEsus contributed most of the cost. By a fortunate accident the lower part of this drum is inscribed with his name. The fragments found have been set up in the Museum, and are interest- ing as showing the first conception of a scheme of decora- tion which exists in no other Greek temple. The Ionic

capital of this archaic temple was brought over by Mr Wood, and the oblong form of its abacus is an additional proof of the theory which is now held that the Ionic capital was originally what is known as a bracket-capital, copied from the oblong piece of timber placed on a pillar to support the wooden architrave of a portico.

Returning to the later Temple described by Pliny, the two most difficult problems were — (1) where to place the square sculptured pedestals, and (2) how to dispose of the thirty-six " columnse ccelatae " spoken of by Pliny. Dr Murray solves the problem by placing the square pedes- tals (the cornices of which range with the raised platform on which the temple was built), eight at the east and eight at the west end, on a stylobate of four steps, which were carried round the whole building. On these pedestals he places sixteen of the " columnae ccelatae " ; of the remain- ing twenty he places eight at the east and eight at the west end behind those raised on the square pedestals, resting on the stylobate of the platform ; and the remain- ing four he places in antse to the pronaos and epinaos. The nine steps required to reach the platform (there were thirteen in all) Dr Murray puts between the first and second rows of columns of the east and west porticoes (Fig. 5). In determining the plan of the temple, he ar- ranges a vestibule beyond the pronaos, the west wall of which was found by Mr Wood. Then follow the cella, with its double row of columns inside to assist in carrying the roof, and behind it the opisthodomus and the epinaos or posticum (Fig. 6).

The excavations made by the British School at Athens in 1890-91 at Megalopolis have exposed the principal portions of the theatre said by Pausanias to have been the largest in Greece, and have enabled the explorers to trace the plan of the Thersilion or Assembly Hall of the 10,000 Arcadians. The haU. covered an area of 35,000 square feet, and is remarkable for its plan, inasmuch as the columns which crowned its roof and which were on three sides of the hall were placed so as to radiate towards the tribune, and thus form the least possible obstruction to the view from any portion of the hall. The bases of the columns, which alone remained in situ, proved also by their levels that the floor of the assembly hall sloped towards the tribune. The intercolumniation of the columns

varied from 29 to 17 feet, which shows that they carried wooden beams only. The columns were probably

in stone, but no remains of any capitals were found. In front of the hall was a portico of sixteen Doric columns, fourteen in the front and one behind each of the angle columns.

The complete excavation of the temenos at Eleusis by the Archaeological Society of Athens in 1883 has solved the problem relative to the exact plan of the Hall of the Mysteries. Three successive buildings have occupied the site, and additions and restorations were made to the third hall, designed about 420 b.c. by Ictinus, the architect of the Parthenon. The foundations of the third haU show that the building was 183 feet square, with forty-two

*Scale of Feet «P4 f tp f^ jp *p if sp 7p ap sp f^*

Fio. 6. — Film of the Temple of Diana at Ephesna.

columns ranged in seven rows of six each ; round the walls were rock-hewn steps for the spectators. The Doric por- tico of fourteen columns, twelve in front and two behind the angle cohimns, was added by Philon, the architect of the Arsenal of the Piraeus, about 310 b.c. No architectu-ral remains of the hall were found. The- temenos was entered through two Propylaea, the outer one of which was hexastyle and similar in plan to the Propylaea at Athens. The sanctuary of the Temple of Apollo in the island of Delos was explored by the Archaeological Society of Athens in 1877-83, under the direction of Mr Homolle. The whole site has been cleared, revealing, as at Olympia and Delphi, the foundations of all the temples, treasuries, and other votive monuments. Of the temple of ApoUo sufficient was found to enable a complete conjectural

restoration of it. It was of the Doric order, but the columns were not fluted.

In 1879-86 the German Government carried out excava- tions at Pergamon in Asia Minor, under the direction of Herr Humann. Although of comparatively late date, for the principal monuments of the acropolis were only com- menced by Eumenes II., 191-159 b.c, the sculpture of the great altar of Zeus, now in the Berlin Museum and representing the battle of the Gods and the Giants, is of exceptional vigour and magnificence, and the splendour of the series of temples raised on successive terraces seems well to have merited the praise of Pliny, who calls it " the mpst celebrated town in Asia." The principal monument, of which the remains were found, was that of the great altar of Zeus, which was raised on a platform 93 X 90 feet, and 20 feet high, round which at a height of 8 feet from the level of the terrace was carried the great frieze of the " gigantomachia," 7 feet high. A wide flight of steps led up to the altar, which was surrounded by an Ionic peristylje open on the front and three sides ; on the walls of the court enclosing the altar was a smaller frieze. On a terrace beyond were the remains of the Doric temple of Athene Polias, with a porticus round two sides of the court, and beyond, the iamous Library and the Temple of Rome and Augustus. In the side of the hill was the Theatre, with the great Terrace, ter- minated at the north end by a beautiful Ionic temple.

Bomcm.

The immense difference between the levels of ancient and modern Rome, in some cases amounting to from 65 to 70 feet, and the extensive area of the archaeological stratum (at least 9 square miles), give some idea of the immense labour and cost of investigations in Eome. Since 1871, according to Professor Lanciani, an area of about 4 square miles has been turned up, with results of the greatest interest and value. Foremost amongst these must be placed the excavations on the Palatine, which have revealed the plans of the greater portions of the palaces built by succeeding emperors. The platform of the hill was selected by Augustus first for his imperial residence. Tiberius, Caligula, and Nero added considerably to it. The Flavian emperors united the various portions built by raising structures bej;ween those already erected, and rebuilt the House of Augustus, which had been destroyed by fibre; and Septimius Severus added largely at the south-east angle of the hUl. The excavations

were begun by Napoleon III. in 1860, and since 1871 have been carried out by the Italian Government. The palace begun by Vespasian and completed by Domitian, being destined for state receptions and banquets, was in some respects the most magnificent. The throne room was 160 feet long and 120 feet wide, with a vault the clear span of which exceeded 100 feet. Twelve immense columns of pavonazzetto marble and giallo antico assisted in carrying the vault, and flanked the great doorways and niches ; the latter, with smaller columns of porphyry on the east side, held colossal statues or groups, many of which now enrich various museums.

Next in interest come the excavations made on the line of the Via Sacra, which since 1882 has been laid bare from the Forum to the Colosseum. Many of the buildings on either side have always been known; but the removal of the superincumbent earth has not only exposed the bases of the same, but brought to light the complete plans, and in some cases the architectural remains of other structures, such as the Basilica Julia, the Eostra on the Forum, the Temple of Vesta, the house of the Vestal virgins, the Porticus Margaritaria, and the temple of Venus and Eome with its surrounding Porticus, &c.' Of these the most interesting was the "Atrium Vestae," ^he house of the

Vestals, excavated in 1883-84, which has proved to be the most important example of- domestic architecture yet found, surpassing in completeness any of the Pompeian houses in consequence of its having a great portion of the upper storey preserved. According to Dr Middleton, the house was evidently rebuilt by Hadrian on a much enlarged scale. It consisted of a large open peristyle measuring 200 feel; by 72 feet in two storeys, with rooms in the rear, and at one end the tablinum covered over with a semicircular barrel vault. The whole house was richly ornamented, the floors and walls being covered with Oriental marbles, of which numerous remains were found. The upper part of the walls was decorated with mosaic of coloured glass tesserae. Staircases were found leading to the upper storey, in which the bedrooms and bathrooms were placed; the walls were lined with marble slabs in the lower part, and above were painted in brilliant colours with panels, wreaths, and garlands.

One of the most valuable discoveries made in Eome of late years is that relating to the date of the Pantheon, which has always been a much-contested point among archaeologists. In consequence of serious cracks in the dome which had allowed the rain-water to penetrate ‘ through the vault, Mr Chedanne, Grand Prix of the French Academy at Eome, was allowed to make use of the scaffolding which had been erected in 1892 and examine the structure of the vault. On taking out some of the bricks he found them stamped with dates of the time of Hadrian. This led to a further examination of bricks in other parts of the building, on which in every case Hadrian stamps were found, the dates extending from a.d. 115-125. This decided the question at once that the circular portion of the Pantheon was built by Hadrian. Further researches showed that 6 feet below the existing pavement was another pavement of marble which sloped from the centre to the circumference, belonging, therefore, to a circular area exposed to rain ; and outside the walls of the existing building, concentric with them, and on the same level as this pavement, was a circular wall of masonry of early date surrounding this open area. A similar pavement was found under the Portico and, at a lower level 3 feet under this, was found another pavement, and a substructure in travertine masonry, larger and of different design. The results of these discoveries are considered to prove that — (1) the original Temple of Agrippa was rectangular; (2) the Portico of Agrippa faced the south instead of the north (which is the aspect of Hadrian’s Portico) ; (3) the original Portico was decastyle, viz., with ten columns in front ; (4) the rectangular temple on plan resembled the temple of Concord, the front being on the longer side; (5) not only were the columns of Agrippa’s portico ‘ used again by Hadrian, but also portions of the en- tablature and pediment; and (6) in front of Agrippa’s temple was an immense circular area surrounded by a wall. This latter suggests that Hadrian or his architect, having this site to build on, conceived the notion of covering the whole area and making the build- ing circular.

Of the later discoveries at Pompeii, those made in 1894^ 95, when the House of the Vettii was excavated, are by far the most important. The house is comparatively small in size, but in the preservation of its peristyle and its richly-decorated walls it forms the most important repre- sentative of its class. It differs in plan from other examples in having no tablinum;

the atrium opened directly on to the peristyle. The large room on the north side of the perisl^le, richly decorated with cupids and Psyches, may possibly have served as the drawing- or sitting-room of the house.

Origin of the Pointed Arch.— The various theories put forward as to the origin of pointed-arch architecture and ita introduction into

Europe through the Crusaders may be considered now as disposed of by the work of M. de Vogufi on the churches of the Holy Land, from which it will be seen that they all date from a period long subsequent to the regular employment of the pointed arch and barrel vault in the south of France for constructional reasons. For proper consideration of the question the subject should, be divided into two parts— (1) that which has to do with its im- mediate constructional object ; and (2) its constant employment for almost every form of arch and vault during the Middle Ages. The earliest example of the pointed arch known is that found by Professor Flinders Petrie in the Pyramid of Hawara, 2622-2578 b.c. The second was that discovered in the drains of the palace of Khorsabad built by the Assyrians c. 721 b.o. In Egypt its first appearance is in the Kilometer of the Island of Koda, a.d. 861 ; and after the erection of the Mosque of Toulon, a.d. 879, it was always employed. From there it was probably imported into Sicily which the Saracens occupied from 941 to 1072. Unfortunately no example of that date re- mains ; but when the Normans conquered Sicily, 1072, they employed the Mahommedan work- men, so that the Saracenic style lingers throughout the buildings erected in Sicily for more than a century. The pointed arch, therefore, was univer- sally adopted in Sicily, and we find it in the church of S. Giovanni de' Leprosi outside Palermo, 1072, and in the Ponte dell' Ammiraglio, built in 1110, the arches of the bridge are of two orders, the lower ring of the arches being recessed slightly behind the upper ring. Of later buildings the church of S. Giovanni degli Fremiti and the Cappella Palatina, both built before 1132, and the church of La Mar- torana, completed 1143, are all built with pointed arches. Passing now to the south of France, in the church of St Stephen at P6rigueux, the western bay, erected 1014, still preserves a

portion of its dome and pendentives built on pointed arches. The churches of Brantdme, St Jean de Cole, and Cahors were all built with similar features before the close of the century, and the Cathedral of Angoulgme (first bay), and the church of Fontevrault before 1130. It should be pointed out that in the domed churches of PSrigord and Angoumois the setting out of the pendentives and its construction in hori- zontal courses is entirely different from Byzantine dome construction in the East. Throughout Pro- vence the churches were vaulted with pointed-barrel vaults, all in the llth century, the finest ex- ample being that of the church at Carcassonne,

1090.

In Palestine, prior to the crusades, all the doors and windows had circular arches, the vaults only, for constructional reasons, being pointed. The earliest churches built by the Crusaders in Pales- tine were those of Tortosa and Beyrout, in both of which the naves are covered wittl pointed-barrel vaults similar to that of Carcassonne, and probably carried out under the direction of the monks of Climy. From 1142 onwards the Cru- saders introduced the dome over the crossing of nave and transepts, pointed arches carrying pen- dentives and dome, and the construction of the latter is the same as that employed in P^rigord, and quite different from that of the Byzantine dome and pendentives of the Greek churches. The arches of the naves of these churches are pointed and of two orders, like the bridge already referred to near Pa- lermo ; and the masonry bears so close a resemblance to Sicilian work as to lead us to suppose that Sicilian masons, whose lan- guage-was either Greek or Arabic, were taken over to Palestine, as they would be better able to direct the native labour of the country. The masons' marks found in the Holy Land are either French or Italian ; English or German masons' marks have not been found. There is a natural tendency in M. de Vogue's work to ascribe to French masons the design and erection of all the Crusaders' churches ; and in the more important, it is true, we recognize the genius of the French sculptor. The portals of the south doorway of the church of the Holy Sepulchre are iden- tical with examples in the south of France (Fig. 7). On the other hand the mouldings of the west portal of the Church of the Resur- rection at Nablus are of Early English section and associated

with the dog-tooth ornament. The only characteristic difference between the Crusaders' churches and those in Europe are that the former

have (1) flat roofs over the aisles and sometimes over the nave,

which were possible in the East ; and (2) the exterior of the apses

was occasionally polygonal, in imitation of those of the Greek Church.

A New Christian Style.— A second work by M. de Vogu§ on the

architecture of Central Syria, published in 1867, revealed the existence of a new Christian style of architecture, religious and secular, hitherto unknown, which, though developed by the Greek Christians of Palestine, is based more directly on the Roman remains in the country. The only parallel to it found in Europe is that which exists in Burgundy in the churches of Autun and Langres, based similarly on Roman work ; but there is a difference of five or six centuries in date, and as these towns and villages in Central Syria were deserted during the Mahommedan invasion in the 7th century, and being in the centre of Syria were never even approached by the Crusaders, there can never have' been any connexion between the two. M. de Vogufe's book is not confined to Christian work. Many earlier buildings of Herodian and Roman work are illustrated in it, and amongst them the stone buildings of the Hauran, which, owing to the absence of timber, are entirely — ^roofs, doors, and windows —

'i&. 7. — South Doorway of the Church of the Holy Sepulchre, Jerusalem.

built in stone. These had been visited and described by Burckhart, the Rev. J. L. Porter, and other travellers ; but it has only been from the engraved illustrations in M. de Vogue's book that a fair idea has been given of their design and remarkable construction.

St MarVs, Venice. — Discoveries in the archives of Venice since 1890 have led to a revised date being given for the construc- tion of the five domes within the basilican church of St Mark's, Venice, restored only by

Orseolo in 976. The late Professor Cattaneo arrived at the conclusion that these domes were not built till 1063. It follows, therefore, that the five-domed church of St Front at P^rigueux, which was copied from it, is not the first domed church in France, as St Stephen's in Pferigueux, and other domed churches, were built in the first half of the llth century. A more careful examination of the so-called Latin church which stands on the western side of the five-domed church at P&igueux, has revealed features dating from the first half of the llth century, so that this was the church burnt down in 1120. Moreover, the five-domed church is entirely in stone, so that no such conflagration could have taken place as is recounted in the chronicle. From the fact that the bodies of the saints were not brought back till 1171 to be placed in the new church of St Front, it is probable that it was

not commenced till 1160 ; and this is borne out by the excellence of the masonry throughout, which presented a marked contrast with that of St Stephen's, built in 1014. Instead of being the first domed church therefore, it was the last, of any magnitude.

The following additions require to be made to the glossary given in the ninth edition : —

Apophtgb — (a) the inverted cavetto or concave sweep taken by the lower part of the shaft in the Ionic and Corinthian orders before its junction with the base. (6) The hollow or sootia beneath the Doric echinus forming the junction between the capital and the shaft. Atrium — (a) the open court of a Eoman house, surrounded by a colonnade or partially roofed over by projecting eaves. (6) The court in front of a church, surrounded by colonnades or arcades. Cblla, the sanctuary of a Greek or Roman temple, enclosed by

walls and entered from the pronaos = i'aiis in Greek. EpifJAOs, the open vestibule behind the naos or cella, sometimes called the opisthodomus, as it was occasionally enclosed with metal grilles and contained the properties of the temple.

Helix, term given to the spiral of the Ionic volute and the tendrils

of the Corinthian capital. Opisthodomus (Greek, from ttrurBsv, behind, and Sbpos, a house),

an enclosed chamber behind the naos and entered from the

epinaos, employed to store the treasury of the temple. PoETicns, a building with its roof supported by one or more rows

of columns, either in one straight line or enclosing a space

(Greek, o-roii).- Stereobate, the substructure of rough masonry beneath a temple. Sttlobate, the upper of the three steps on which the Greek temple

stands ; generally applied to the three steps. Temenos, the sacred enclosure round a temple. Tholos, term given to Greek circular buildings with or without a

peristyle. Velakium, the curtain or awning extended above the auditorium

of the Roman theatre to protect the spectators from sun or rain. Xo'anon, a rude and primitive image carved in wood. ZoopHORus, a continuous frieze sculptured in relief, with the figures

of human beings and animals. (e. P. S.)

Arcot, a town of British India, which gives its name to two districts in the Madras presidency. The town has now lost its manufactures and trade, and preserves only a few mosques and tombs as traces of its former grandeur.

The district of North Aecot has an area of 7616 square miles. In 1891 its population was 2,180,487, being 286 persons per square mile; in 1901 the

popula- tion was 2,208,391, showing an increase of 4 per cent. The administrative headquarters are at Chittur, but the largest towns are VeUore (the military station), Tirupati (a great religioiis centre), and Wallajapet and Kalahasti (the two chief places of trade). The land revenue and rates in 1897-98 were Es.32,60,842, the incidence of assessment being Rs.2 : 7 : 0 per acre ; the cultivated area was 828,396 acres, of which 366,245 were irrigated, including 49,783 from government canals ; the number of police was 1284 ; the boys at school in 1896-97 numbered 42,509, being 26 per cent, of the male population of school-going age; the registered death-rate ia 1897 was 20-2 per thousand.

The district of South Aecot has an area of 5217 square milesr In 1891 its population was 2,162,851, being 414 persons per square mile; in 1901 the popula- tion was 2,350,365, showing an increase of 9 per cent. The admiaistrative headquarters are at Cuddalore, close to the site of Fort St David. I'he land revenue and rates in 1897-98 were Es.46,82,820, the incidence of assessment being Es.2 : 7 : 9 per acre ; the cultivated area was 1,456,961 acres, of which 470,363 were irrigated from tanks, &c., including 141,210 from government canals ; the number of police was 963 ; the boys at school in 1896-97 numbered 36,464, being 22-5 per cent, of the male population of school-going age ; the registered death- rate in 1897 was 21-2 per thousand. The principal crops in both districts are rice, millet, other food grains, oil- seeds, and indigo.

Arctic Ocean. See Folab Eegioi^s.

Arctic Regions. See Folae Eegioits.

Arcueii, a town of France, department of Seine, in the arrondissement of Sceaux, and 2^ miles N.E. of that town, on the railway from Faris to Sceaux. It takes its name from a Eoman aqueduct, the Arcus Juliani, some traces of which still remain. Two superimposed aqueducts now supply water to Paris. Starch, vermicelli, bottle capsules, patent leather, and other articles are manu- factured. There are important quarries. Fopulation (1881), 5529; (1891), 5863; (1896), 6418, (comm.) 6494.

Ardebii, or Aedabil, chief town and seat of govern- ment of a district, or sub-province of the province of Azer- b^ij^n, in north-western Persia, in

lat. 38° 14′ N., long. 48° 21′ E., and at an elevation of 4600 feet. It is situated

on the Baluk Su (fish-river), a tributary of the Kara SI (Black river), which flows northwards to the An'as,and in a fertile plain iDounded on the west by the SavaMn Dagh, a volcanic mountain with an altitude of 15,792 feet (Eussian triangulation), Ardebii has a population of about 10,000, a garrison of half a battalion of infantry, and post and telegraph oflBlces. Its trade, principally in the ' hands of Armenians, is still important, but is chiefly a transit trade between Persia and Eussia by way of Astara, a port on the Caspian 30 miles N.E. of Ardebii (Dr F. San-e, "Eeise von Ardebii," &c., in Petermann's Mitteilungen, September 1899). Plans and photographs of the shrine and mosques were taken in 1897 by Dr F. Sarre of Berlin.

European and Chinese merchants resided at Ardebii in the Middle Ages, and for a long time the city was a great emporium for Central Asian and Indian merchandise, which was forwarded to Europe by way of the Caucasus and the Volga, and also vi& Tabriz and Trebizond. Since the 16th century, when Persia fell under the sway of the Safavi dynasty, the place has been much frequented by pilgrims, who come to pay their devotions at the shrine of Shaikh Safi, the ancestor of Shah Ismail, who was the founder of the dynasty, and the shrine is a richly-endowed establishment, with mosques and college attached. It has also a fine library, containing many rare and valuable MSS. presented by Shah Abbas at tie beginning of the 17th century ; but most of these MSS. were carried off by the Russians in 1828, and are now in St Petersburg. The grand carpet, which had covered the floor of one of the mosques for three centuries, was purchased by a traveller some years ago for about one hundred pounds, and was finally acquired by the South Kensington Museum for many thousands.

Ardeche, a department of the S. of France, traversed by- the Cevennes and watered by the Ehone and its afQuent the Ardeche.

Area, 2145 square miles, with 31 cantons and 339 communes. The population declined to 375,472 in 1886 and 363,501 in 1896. In 1899 the births numbered 8465, of which 170 were illegitimate, the deaths 8437,

and the marriages 2625. The chief towns are Privas (7843 inhabitants in 1896), Largenti6re, Tournon, and Annonay. In 1896 there were 1171 primary schools, with 61,178 pupils ; 8 per cent, of the population was illiterate. The surface imder cultivation comprised 938,499 acres, or more than three- fifths of the department, but the plough-land made up only 480,871 acres. The vine, attaining a fair range of cultivation, had 36,628 acres. In 1899 the wheat crop reached the value of £247,625, and the vine about a seventh more. Ardfeche is one of the departments in which the mulberry grows most abundantly. The crop of leaves amounted in 1899 to nearly 73,000 cwts., and sericulture has developed in proportion, yielding 33,000 cwts. of cocoons, of the value of about £199,000. There were 25,000 sericulturists, and only Drdme and Gard have a greater number. The live stock in 1899 numbered 14,170 horses, 10,450 mules and asses, 97,760 cattle, 229,690 sheep, 102,140 pigs, and 128,580 goats. The mining production is inconsiderable, yielding in 1898, 50,000 tons of coal and 48,000 tons of iron. The working in metals realized in 1898 only some 23,000 tons of iron. The principal industries are paper manufacture (Annonay) , tanning, and weaving.

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Ardennes, a department in the N.E. of France, bordering on Belgium. It is covered -with the wooded mountains of Ardennes, and traversed by the Meuse, the Semoy, and the Aisne.

Area, 2028 square miles, distributed among 31 cantons and 603 communes. The population decreased from 332,759 in 1886 to 316,589 in 1901. Births (1899), 6523, of which 492 were illegiti- mate ; deaths, 6754 ; marriages, 2437. The principal towns are Meziferes, which, with Charleville, has a population of more than 25,000 souls, Sedan, Rethel, Vouziers, and Rocroi. In 1896 there were 833 schools, with 43,815 pupils. Two per cent, of the population was illiterate. The total surface under cultivation comprised 1,224,455 acres, but the forests alone occupied 271,700 acres, and the plough-land was confined to 669,370 acres. The climate does not allow the cultivation of the vine. In 1899 wheat yielded a value of £748,678. Oats also gave excellent returns. Among the industrial

cultures, beetroot is alone deserving of notice, producing in 1898, 2,090,585 owts. In 1899 the live stock amounted to 47,370 horses, 109,040 cattle, 271,950 sheep, and 49,890 pigs. There are no coal-pits in the department of Ardennes, but iron-mines are found between Mezi6res and Rethel. The valley of the Meuse produces enormous quantities of slate. ‘ The working of metals (nails, bolts, machines) is highly developed all along the valley of the Meuse (Montherm^, Revin, Givet), yielding in 1898, 96,000 tons of cast iron and of iron, and 46,000 tons of steel, of the value of £995,000. The produce of the other metals amounts to the value of £255,000. ^dan is celebrated for the making of cloth. In the production of sugar, Ardennes takes the eighth rank among the departments, yielding in 1898, 255,893 cwts. ‘

Ardglass, a village in the county of Down, Ireland, 7 miles S.S.E. of Downpatrick, with which it is now con- nected by a light railway. It is noted for its herring fisheries, the quantity caught in 1899 having been 15,519 cwt., valued at £5744. Population, 554.

Ardmore, a town of Chickasaw Nation, Indian Ter- ritory, U.S.A., situated on the Gulf, Colorado, and Santa Te railway, at an altitude of 870 feet. Like other towns of this territory, it has no corporate existence, nor are any lots owned in fee by the occupants, with the exception of those lying within the right of way of the railway. The site was originally a squatter’s claim, and 16ts are held by quit-claim deeds or leases under it. The population con- sists almost entirely of whites, the Indians, keeping remote from the railway and large towns. The adjacent region is a rich farming country, producing cotton, grain, and cattle, with the shipping of which the town is mainly concerned. Population (1900), 6681.

Ardrossan, a seaport, burgh of barony, and police burgh of Ayrshire, Scotland, 14^ miles N.K.W. of Ayr by water. It has stations on the Glasgow and South-Western and Lanarkshire and Ayrshire railways. The dock ac- commodation has been greatly extended. In 1898 the port register contained 63 vessels of 25,129 tons ; and the tonnage entered was, in 1888, 2429 vessels of ^247,425 tons; 1898, 3440 vessels of 734,320 tons; cleared in 1888, 2347 vessels of 243,398 tons, and in 1898, 3393 vessels of 737,155 tons. Imports were valued at £66,540 in 1888, and

£463,015 in 1898 ; exports at £12,919 in 1888, and £202,068 in 1898. In 1898, 477,082 tons of coal were exported and 60,351 tons of iron. One of the public schools is an academy. Population (1881), 4098 ;

(1891), 5294 ; (1901), 5933.

ArecibO. — ^A city near the west end of the north coast of Porto Eico, founded in 1788. It commands the trade of the adjacent portions of the island, and ships large quantities of sugar and coffee. Near by are the famous caverns of Consejo. The harbour is poor. Popu- lation (1899), 8008.

Arendal, or Aendal, a seaport town of Norway, co. Nedenas, on the S. coast, 36 nules N.E. from Christian- sand. It possesses a relatively large commercial fleet (212 vessels of 117,250 tons aggregate), principally en-

gaged in exporting timber (2 to 2^ million cubit feet annually to Great Britain), wood-pulp, sealskins, and felspar. In 1879 Arendal ranked second (after Chris- tiania) as a ship-owning port ; in 1899 it had dropped to the fifth place. In and near the town are factories for wood-pulp, paper, cotton, and joinery; and at -Fevig, 8 miles to the north-east, a shipbuilding yard and engineer- ing works. Population (1875), 4132; (1891), 4578; including suburbs (1899), about 10,000.

Arequipa, a coast department of southern Peru, containing seven provinces, Arequipa, Camana, Islay, Unidn, Caylloma, Condesuyos, and Castilla. Its area occupies 21,947 square miles and its population in 1896 was officially estimated at 229,007. The capital, Are- quipa, has a population of 35,000. The foreign trade of lie town is carried on by the port of Mollendo, distant ninety miles, with which it is connected by rail (107 miles) ; the exports are mainly sheep's wool and alpaca, coca leaves, and borate of lime.

Arezzo, a, town and episcopal see of Tuscany, capital of the province of Arezzo, 55 miles S.E. from Florence, Italy. The church of St Francis (1322) contains frescoes by Piero della Francesca and Spinello Aretino. Other notable edifices are the churches of SS. Annunziata and Sta Maria della Pieve (llth-14th cent.), the town hall (now converted into a jail), the

ceramic Museum Funghini, the house in which Petrarch was born, the house of Vasari, and the municipal museum. There are a techni- cal school and an academy of sciences, arts, and letters. Silks, gunpowder, pottery, and macaroni are manufac- tured, and tanning and printing are carried on. Popular tion: commune (1881) 38,960, (1901) 44,350; province

(1881) 238,744, (1901) 272,369.

Argao. — A town of 34,000 inhabitants, on the east coast of Cebu, Philippine Islands, in latitude 10° 3′ N. It was founded in 1608. Its products are rice, Indian corn, and cacao. The latter is of superior quality and is produced in large quantities. A limited amount of cot- ton is raised and woven into cloth. The language is Cebu-Visayau.

Argentan, chief town of arrondissement, depart- ment of Orne, France, 27 miles N.N.W. of AleuQon, on railway from Caen to Mans. One of the two principal churches contains fine wood-carving and 16th-century glass. Manufactures include stained glass. Oolitic lime- stone, quarried in the vicinity, is used in the construction of local buildings. The historian Mezeray and Charlotte Corday were bom here. Population (1876), 4831, (comm.)

5365 ; (1896), 6070 ; (1901), 6291.

Argenteuil, a town of France, department of Seine- et-Oise, arrondissement of Versailles, 3^ miles N.W. of outer circle of Paris, on railway from Paris to Mantes. Asparagus and figs are cultivated in the district, and heavy iron goods, chemical products, , and plaster are manufactured. At Choix-du-Dbsebt, between Argenteuil and Epernay, a large tumulus was opened in 1866, and found to contain over 200 skeletons, and a large quantity of arms and utensils. Population (1881), 9456 ; (1891),

11,362; (1896), 13,847; (1901); 17,424.

‘ Argentine, a city of Wyandotte county, Kansas, U.S.A., situated in the eastern part of the state, five miles west of Kansas City, Missouri, on the

south bank of the Kansas and just above its mouth, in 39° 04′ N. lat. and 94° 38′ W. long., at an altitude of 750 feet. Its streets run irregularly up the steep face of the river bluffs. It is entered by the Atchison, Topeka, and Santa F^ railway. Its chief business is the smelting of ores of the precious metals, lead, and copper from mines in the Rocky Mountains. Population (1890), 4732 ; (1900), 6878.

ARGENTIIN^E EEPUBLIO.

I. Geogbapht and Statistics

THE only considerable portion of the Argentine inland frontier which has not been in dispute in recent years is that formed by the lower waters of the river Uruguay, separating it from the Uruguayan Bouaa- Eepublic and the southern portion of Brazil. , "■ In accordance with a treaty of 1889 between

the Argentine Republic and Brazil, and the arbitration award made by President Cleveland of the United States in 1894, the boundary line leaves the Uruguay river at its confluence with the Pequiry, and after ascending this stream northwards passes in a straight line to the source of the San Antonio, which it descends to its confluence with the Iguassu, and thence to the confluence of the Iguassu and Parana. From this point the Argentine and Paraguayan republics are conterminous. . The boundary, by treaty of 3rd February 1876, follows the course of the Paranti to its junction with the Paraguay, which it ascends as far as the mouth of the Pilcomayo river. Formerly the Argentine Republic claimed territory north of the Pilcomayo, while the Paraguayan Republic asserted that the Bermejo was the boundary river ; but by the treaty of 1876 and the arbitration award of President Hayes of the United States, given on 13th November 1878, the frontier line ascends the Pilcomayo as far as the frontier of Bolivia. The Argentine-Bolivian bound- ary (demarcated in accordance with the treaty of 1889) starts from the point where the Pilcomayo cuts the parallel of 22° S. lat., and runs due west to the Tarija, which it descends to the Juntas de San Antonio, whence it ascends the Bermejo. Leaving this river it proceeds to the Quiaca ravine, and thence

to a point on the San Juan river opposite Esmoraca. After ascending the San Juan, it runs to the Cerro de Granados, to Incahuasi, and to Sapal'egui on the Chilian frontier. The Argentine- Chilian frontier is still, for the most part, undetermined. On 17th April 1896 an agreement was signed provid- ing for its delimitation as far south as the parallel of 52° S. lat., " the crests of the Andes that form the watershed " being stated as defining the boundary line. From 23° to 26° 52' 45" S. lat. the demarcation has been carried out, but in its continuation southwards disputes arose which were referred for arbitration to the British Government. At a point in 52° S! lat. the boundary (in accordance with a treaty with Chile, made in 1881) runs eastwards till it reaches the meridian of 70° W. long., and then south- eastwards to Cape Dungeness, at the eastern entrance of the Strait of Magellan. On the opposite side of the strait, which, by the treaty, is neutralized and free to the ships of all nations, the boundary lies in the meridian of 68° 34' W. long, from Cape Espiritu Santo to Beagle Channel, and then follows the channel to the Atlantic. The portion of Tierra del Fuego, and some small islands, including Staten Island, lying to the east of this line, belong to the Argentine Republic ; the land and islands to the west and south belong to Chile.

Climate. — In the riparian provinces of Buenos Ayres and Santa F6 there are great areas of almost flat land, which consists of deep, rich loam formed from the alluvial deposits of the Eio de La Plata and the Rio ParanA, and which for stock-breeding and agricultural purposes cannot be surpassed. A temperate climate is not the least of the many advantages this section of the country can claim, for an average rainfall of some 34 inches provides abundant moisture for vegetation, and the many days of bright sunshine ensure the ripening of the cereal crops. The southern portion of the province of Cordova, closely resembling the provinces of Buenos Ayres and ^antaF€, likewise contains large areas of arable

land. These three provinces have other important features. In the south of Buenos Ayres is the Sierra Ventana, an extensive mountain range ; the north-east of Santa F6 contains much valu- able timber ; in the northern and eastern sections of Cordova are great mountainous areas, the mineral wealth of which was worked by the early Spanish settlers. The climate of

the Andean pro- vinces of Mendoza and, San Juan is eminently suitable for the cultivation of the vine. The valleys of the And^s open out at Mendoza into plains requiring only irrigation to produce abundant vegetation; the rivers, supplied by the melting snows at the higher elevations, provide the necessary water, and every year the area of cultivation increases. On these plains there is a rainfall of only six inches annually, snow rarely falls, and frosts are never severe. To the north of San Juan are the provinces of La Bioja and Catamarca, mountainous and heavily wooded, and intersected

Map of the Argentine Ebpublio.

with well-watered fertile valleys. Between Cordova and Tucuman are great saline plains covered with a white alkaline crust, which glitters in the sunlight like an inland sea. At Tucuman tropical vegetation appears, although frosts occur regularly in winter, not however of sufaoient severity to prevent the growth of the sugar- cane. Salta and Jujuy, situated farther north amongst the wooded spurs of the lower Andean ranges, possess a climate tropical in the valleys, temperate on the higher plateau. To the north-east of Salta, and bordering on the republic of Bolivia, is the territory known as the Chaoo, where the characteristic features are dense tropical forest interspersed with open, park-like grass- lands. Still farther to the east, and adjoining Paraguay and Brazil, is the territory of the Misiones, covered with tropical jungle and watered by the river Uruguay, which passes in enor- mous volume over the Iguassu Falls and ultimately forms with the Rio Parani, the great estuary of the river Plate. The southern

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AEGENTINE EEPUBLIC

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territories of Argentina, comprising tlie basin of the Rio Negro, tlie district of Nenquen, and tlie little-ltnown land of Patagonia, through wliich tlie Chubut, Santa Cruz, and Gallegos rivers flow to the Atlantic, are of a very different character (see Patagonia). Prom Neuquen

southwards along the eastern slopes of the Andes lie valleys of great fertility, with magnificent ~~timber on the mountain sides, and a series of great lakes 'beginning at Nahuel~~ huapi, the headwaters of the Rio Limay, extends some 500 miles towards the Strait o^ Magellan. In the centre of Patagonia, where the steppes open out into rolling grass-land, heavy snowstorms and a low temperature generally prevail during the long winter, from May to the end of September. Near the Atlantic seaboard the climate again becomes more temperate. Prom Chubut to the Strait of Magellan snow falls frequently in winter, but not, as a rule, in sufficient quantities to interfere seriously with pastoral and agricultural industry.

Harbours. — In spite of some natural disadvantages Buenos Ayres remains, and will probably long remain, the principal port of Argentina, on account of the convenient and commanding position it holds for the river trade. Rosario and Santa P6 are centres of great grain-growing districts, and large quantities of wheat are annually shipped from them direct to Europe. Six hundred miles to the south of Buenos Ayres is the port of Bahia Blanca, with a shipping trade which might be largely increased by a comparatively small expenditure on the harbour works. Still farther to the south, and only some 20 miles distant from the mouth of the Rio Negro, is the natural harbour of San Bias. Near the Chubut river is Port Madrin, and between that place and the Strait of Magellan are harbours at the mouths of the Santa Cruz and Gallegos rivers.

Area and Population. — The subjoined table shows the area and population of the republic, and its provinces and territories.

Administrative Diyisions.

Area, Square Miles.

Pop. 1895.

Pop. per Square Mile.

Provinces.

Buenos Ayres .

117,850

1,585,022

13

Santa F6 .

50,915

397,188

7

Entre Rios

28,784

292,019

10

Corrientes.

33,579

239,618

7

Cordova ....

62,160

351,223

6

San Luis ....

28,534

81,450

3

Santiago ....

39,764

161,502

4

Mendoza ....

56,501

116,1.36

2

San Juan ....

33,715

84,251

3

Rioja ....

34,546

69,502

2

Catamarca

47,532

90,161

2

Tucuman ....

8,926

215,742

24

Salta

62,185

118,015

2

Jujuy ....

18,975

49,713

3

Territories.

Misiones ....

11,282

33,163

3

Formosa ....

41,401

4,829

Chaco ....

52,741

10,422

Pampa ....

56,320

25,914

Neuquen ....

42,345

14,517

Rio Negro ….

76,924

9,241

Chubut ....

93,427

3,748

Santa Cruz

109,142

1,058

Tierra del Fuego

Total .... Population not in census .

8,298

477

1,113,846

3,954,911

3

60,000

Indian population .

Total .... Grand total

30,000

90,000

4,044,911

In 1869 the population was 1,830,214, showing an average annual increase up to 1895 of 4-98 per cent. Of the total population in 1895, 2,088,919 were males and 1,865,992 females. The foreign element numbered 1,004,527, of whom 492,636 were Italian, 198 685 Spanish, 94,098 French, 48,650 Uruguayan, 24,725 Brazilian, 21,788 British, 20,594 Chilian, 17,143 German, 15,047 Russian, 14,789 Swiss, 14,562 Paraguayan, and 12,803 Austrian, many other nationalities being represented by smaller numbers. Immigration and Emigration.— la. the 43 years, 1857-99, 2,564,391 immigrants entered, and 882,599 emigrants departed from the ports of the republic. In the 10 years, 1880-89, the arrivals and departures were respectively 1,020,907 and 175,038; in 1890-

99, 928,865 and 552,175. In 1899 the immigrants by ocean steamers numbered 84,442, and the emigrants 38,397. In 1900 the numbers were respectively 84,851 and 38,334. In 1900 there were 52,143 immigrants from Italy, 20,383 from Spain, 3160

from France, 2119 from Russia, and 2024 from Austria. In 1897, 27,593 availeij themselves of the immigration laws with respect to taking up public lands. . Owing to the buying up of accessible land by corporations and speculators the central and southern provinces have, so far, not attracted colonists.

Chief Towns. — The principal towns are as follows : —

PopulatioTi.

824,303

Population.

Buenos Ayres (1900)

Corrientes .

16,129

Rosario

91,669

Chivilcoy .

14,632

Cordova

47,609

Gualeguaychd

13,282

La Plata .

46,410

San Nicolas . . v

12,650

Tucuman .

34,306

Concordia .

11,695

Mendoza

28,302

Rio Cuarto .

10,825

Parand

24,098

San Juan .

10,410

Santa F6 .

22,244

Barracas al Sur .

10,186

Salta .

16,672

The present constitution of the Argentine Republic dates from 25th September 1860. The legislative power is vested in a Congress of two chambers — ^the coastuu- Senate, composed of members (two from each Hon and province and two from the capital) elected by govern- the provincial legislatures for a term of nine "" years, and the Chamber of Deputies, elected for four years by direct vote of the people, one deputy for every 20,000 inhabitants. To the Chamber of Deputies exclusively belongs the initiation of all laws relating to the raising of money and the conscription of troops. It has also the exclusive right to impeach the president, vice-president. Cabinet ministers, and federal judges before the Senate. The executive power is exercised by the president, elected by presidential electors from each province chosen by direct vote of the people. The president and vice- president are voted for by separate tickets. The system closely resembles that followed in the United States. The president must be a born citizen of the Argentine Eepublic, a Eoman Catholic, not under thirty years of age, and must have an annual income of at least $2000. His term of office is six years, and neither he nor the vice-president is eligible for the next presidential term. All laws are sanctioned and promulgated by the president, who is invested with the veto power, which can be over- ruled only by a two-thirds vote. The president, with the advice and consent of the Senate, appoints judges, diplomatic agents, governors of territories, and officers, of the army and navy above the rank of colonel. All other officeis and officials he appoints and promotes without the consent of the Senate. , The Cabinet is composed of five ministers — ^the heads of the Government departments of the interior; foreign affairs; finance; war and marine; and justice, worship, and education. They are appointed by and may be removed by the president.*

Provincial Government. — The provinces, under the constitution, retain all the powers not delegated to the Federal Government. Each province enacts its own constitution, which must be re- publican in form and in

harmony -with that of the nation. Each felects its governor, legislators, and provincial functionaries of all classes, without the intervention of the Federal Government. Each may conclude with the knowledge of the Federal Congress such partial treaties as may be necessary for the administration of justice, the regulation of financial interests, or the carrying out of public works. Each may promote by means of protective laws its own industries, may regulate immigration into its territories, and deal with similar local economic questions.

*Justice. — Justice is administered by a Supreme Federal Court of five judges and an attorney-general, which is also a court of appeal, and by a number of inferior and local courts. Each state has also its own judicial system. Trial by jury is established by the con- stitution, but never practised. Civil and criminal courts are both corrupt and dilatory. In May 1899 the minister of justice stated in the Chamber of Deputies that the machinery of the courts in the country was antiquated, unwieldy, and incapable of performing its duties ; that 50,000 cases were then waiting decision in the minor courts, and 10,000 in the federal division ; and that a reconstruc- tion of the judiciary and*the judicial system had become necessary. In June 1899 he sent his project for the reorganization of the legal procedure to Congress, but no action has yet been taken beyond referring the Bill to a committee for examination and report.*

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Beligion. — The Argentine constitution recognizes the Eoman Catholic religion as that^of the state, but tolerates all other re- ligions. The state pays the clergy, builds churches, &c., controls ^11 ecclesiastical appointments, and decides on the passing or rejection of all decrees of the Holy See. In 1895 there were 1019 Catholic churches, or one for every 4000 inhabitants. There were also sixty- eight Protestant churches, three masonic halls, one Spiritualists' church, and one Russian Orthodox

church. Of the Protestant churches twenty-flve are in the territory of Chubut, which was largely colonized from Wales. In 1895 the population was divided as follows, according to religion : —

Argentine.

Foreign.

Total.

Catholics Protestants . Jews Others .

2,944,397

5,597

195

190

976,739

21,158

5,890

745

3,921,136

26,755

6,085

935

Total

2,950,379

1,004,532

3,954,911

Erom this it appears that 991 per 1000 are Catholics, 7 per 1000 are Protestants, and 2 per 1000 are Jews, the Jews being entirely of Russian origin, sent into the republic since 1891 by the Jewish Colonization Association.

Education. — ^The number of schools and colleges in 1899 was 8884, and of professors and teachers 11,001. The number of pupils under instruction was 280,930. Of these 192,060 attended elementary schools, 66,399 private establishments, 13,313 normal schools, and the remainder the higher educational course at the universities and at the various national advanced colleges. The national colleges are sixteen in number, and there are normal schools, a school of mines, a college of agriculture, two military schools (one with 125 cadets, the other for the instruction of non- commissioned officers), and three naval schools (one for officers and two for artificers and mechanics). The national universities are at Buenos Ayres and Cordova, and provincial universities are at La Plata, Santa P6, and Parand,. The total number under instruc- tion represents only 7 per cent, of the population, as compared with 23 per cent, in the United States and 20-3 per cent, in the United Kingdom. The cost of education to the state in 1899 was extremely heavy, no less a sum than £1,000,000 being devoted nominally to that purpose, an average of nearly £5 for each pupil attending the public educational institutions.

The Army. — ^The regular army, at the beginning of 1899, con- sisted of 1463 officers and 12,867 non-commissioned officers and men. In the ranks were then serving 2157 recruits of twenty years of age, drawn under the conscription law in connexion with the liability of Argentine citizens to be called upon for military service. The army comprised one regiment of engineers, two of mountain artillery, six of light artillery, twelve of infantry, eleven of cavalry, and two of Andean sharpshooters. There is also the president's escort. On 31st December 1898 the number of men enrolled in the National Guard, including the entire male population between the ages of eighteen and forty-five years, with certain exceptions, was 233,945 on the list for active service, 90,924 on the reserve list, and

13,780 on the territorial list; 5323 men liable to service were excused on special grounds. The total number of men the Govern- ment can call to arms to assist the regular troops is, therefore, . 343,^972. Under Law No. 3318 all youths of the age of twenty years are required to undergo a regular training and to serve two years in the army, if necessary. In 1898 the number of youths coming under this category was 34,000 ; but of these only 12,000 underwent the authorized instruction of sixty days with the colours, the remainder not -being called out from motives of economy. The main body of the National Guard is paraded and drilled on all holidays and Sundays, attendance being compulsoi-y for two months in every year until a citizen is twenty-five years of age. The number of horses in service in 1899 was 14,432, and of mules 4169. The artillery armament is from Krupp.

The Navy. — A marked development has taken place in the navy since 1874, when the Government ordered from British ship- builders two ironclads, four monitors, and two gunboats. In 1881 the Almirante Brown was purchased in England, and in 1886 the Patagonia and Argentina were added to the list. In 1892 the Independencia and Libertad were acquired, then the cruiser 25 de Mayo, and the 9 de Julio. The fear of war with Chile induced the purchase of the Buenos Ayres in 1896, of the Cktribaldi in 1897, and of the San Martin, Puerryedon, and General Belgrano in 1898. A torpedo division was also created with four flrst-class sea-going torpedo boats, two torpedo gunboats, and twenty-one torpedo boats. At La Plata there is a dock for the use of the torpedo division, and on the river Tigre a slip and workshops for repairs have been erected. A school-ship, the Sarmiento, has also been added to the navy list. The officers on the list in 1899 numbered 640 of all ranks and classes, and the petty officers and seamen 5105. A navaVport is being constructed at Belgrano, some 27 miles from

Bahia Blanca, for the use of the men-of-war, and there will be sufficient draught of water at this port to admit the dockmg of vessels up to 12,000 tons. The estimated cost of the construction of the new port exceeds £1,000,000. The machine guns and rifles now in use in the navy are all'of the most recent pattern.

Finance.— The revenue of the republic is derived mainly from customs and excise, and the largest branch of expenditure is the service of the debt. In 1878 the revenue amounted to the equi- valent of £3,680,000; in 1881, to £4,260,000, the expenditure in the latter year reaching the amount of £6,670,000. The following table shows approximately the revenue and expenditure in 1893 and onwards, conversions being made at the rate of $5.04 to £1 for gold, and at the average rate of each year for paper. These average rates are shown in the last column of the table. Tor the years 1900 and 1901 the budget estimates are given :—

Tear.

Bevenne.

Expenditure.

Paper Dollars to£l.

£

£

1893

7,592,880

8,493,220

16-32

1894

6,995,940

6,973,760

17-85

1895

7,555,450

9,479,310

17-50

1896

8,677,140

12,034,200

14-86

1897

10,223,040

12,187,530

14-61

1898

18,672,568

24,044,245

12-95

1899

14,503,140

15,325,230

11-29

1900

12,859,000

12,996,100

11-36

1901

13,078,000

12,975,000

11-36

The abnormal increase of revenue and expenditure in 1898 and 1899 was due to the warlike preparations made on account of the ■ boundary disagreement with Chile. In 1900 a 10 per cent, addi- tional tax, which had been imposed on imports, was abolished to the extent of one-halt, the remaining half being made applicable to the formation of a fund for the conversion, of the paper money.

The debt of the republic in 1889 amounted to about £24,000,000, and in the following year financial difficulties arose. In 1891 a funding loan, limited to £7,630,680, was issued, and the proceeds were applied to the service of external loans and obligations. In 1893 the Romero arrangement was made between the National Government and the bondholders for the suspension of amortiza- tion and the temporary reduction of interest. The payment of full interest was resumed in 1898. In the years 1896-99 the issue of • railway guarantee rescission bonds amounting to £11,607,100 was authorized for the purpose of settling railway guarantees in arrears ; and in 1897-1900 the issue of bonds amounting to £20,284,600 was authorized, that arrangements might be made between the provinces and municipalities and their creditors. A considerable amount of the public debt arose from national mortgage bank cedulas, for which the Government had made itself responsible. In the year 1900 the ^outstanding and authorized debt of the republic was as follows : — External debt — £

Original national loans 45,738,708

Assumed provincial, &c 31,891,657

National cedulas 9,946,143

Total external Internal debt —

87,575,508

« 6,375,000 gold \ g ggg 3g4

98,751,300 paper/ »,B»o,d!»

Moating debt, &c. —

$23,852,751 gold 1 5 564 000

9,012,804 paper I t),0D4,uuu

Paper currency, $291,326,263

25,600,000

The total obligations of the nation — external, internal, floating, and currency — ^thus amount to over £128,000,000.

*According to an estimate given in the twenty-seventh annual report of the Foreign Bondholders'Council the cost of the service of the whole debt (exclusive of expenses) in 1900 amounted to £6,301,419. *

The paper currency forms an important part of the internal debt. By the emission of vast sums of paper money President Celman entered on the course which led to the financial ruin of Argentina, and by further emissions, in reality neither more nor less than forced loans, subsequent presidents hastened the collapse. The assumption by the National Government of the provincial external indebtedness was only an act of justice. These provincial loans were contracted under the law of 3rd November 1887, an Act more commonly known as the Fred Banking Law.

The various pro- vinces made loans abroad to the amount of £27,000,000, and de- posited the specie with the National Government through the Caisse de Conversion, the gold to remain intact as security for the value of the notes issued by the provincial banks. In return for the gold deposited in the Caisse de Conversion the provinces were entitled to receive internal gold bonds bearing 4J per cent.

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interest, the bonds remaining In the custody of the Caisse de Con- version, which was authorized to attend to the annual service. But President Celman sold the gold specie, and the provincial bank notes immediately lost their value. The National Government has to some extent made good the loss caused by the action of Celman.

Mimrals. — The principal mineral deposits of the republic are found in the provinces of San Juan, La Rioja, Mendoza, Jujuy, Salta, San Luis, and Catamarca, and in the territories of Santa Cruz, Chubut, Pampa, Neuquen, Tierra del Fuego, and Rio Negro, the richest being that of Jujuy. Gold and silver are found in many places, but the only rich deposits now being worked are in the Famatina region in La Rioja. Lead is found in some veins in La Rioja, Cordova, Mendoza, and San Luis. Copper has been discovered in the provinces of San Juan, La Rioja, Cordova, Cata- marca, Mendoza, Salta, and Jujuy. Most of the ore contains considerable quantities of gold and silver. Iron, of poor quality, has been found in Mendoza, Cordova, La Rioja, and San Juan, but there are no smelting works in the country. Coal has been dis- covered in the department of San Rafael in Mendoza, in Neuquen, the Arroyo Malo, and San Juan in the district Morado. Some small petroleum springs have also been discovered in the depart- ment of Anta in the province of Salta, and near the town of Oran.

Agriculture and Stock-raising. — In 1878 the production of wheat wjs insufficient for home consumption, the amount of maize grown barely

covered local necessities, and the only market for live stock was in the saladero establishments where the meat was turned into jerked beef for the Brazilian and Cuban markets. But three years later the actual economic development began. In 1881 President Roca offered for public purchase by auction the lands in the south-west of the province of Buenos Ayres, the Pampa Central, and the Neuquen district, these lands having been rendered habi- table after the campaign of 1878 against the Indians. The upset- price was £80 sterling per square league of 6669 acres, and, as the lands were quickly sold, an expansion of the pastoral industry im- mediately ensued. The demand for animals for stock-breeding purposes sent up prices, and this acted as a stimulus to other branches of trade, so that, as peace under the Roca regime seemed assured, a steady flow of immigration from Italy set in. The de- velopment of the pastoral industry of Argentina since those days has been remarkable. In 1878 the number of cattle was 12,000,000 ; of sheep, 65,000,000 ; and of horses, 4,000,000 : in 1899 the num- bers were— cattle, 25,000,000 ; sheep, 89,000,000 ; and horses, about 4,500,000. Originally the cattle were nearly all of the long- horned Spanish breed and of little value for their meat, except to the saladero establishments. Gradually Durham and Hereford stock were introduced to improve the native breeds, with results so satisfactory that now herds of three-quarters bred cattle are to be found in all parts of the country. Not only has the breed of cattle been improved, but the system of grazing has completely altered. Vast areas of land (probably 8,000,000 acres) have been ploughed and sown with lucerne, and magnificent permanent pasturage has been created where there were coarse and hard grasses in former days. In 1889 the first shipment of Argentine cattle, consisting altogether of 1930 steers, was sent to England. The results of these first experiments were not encouraging, owing mainly to the poor class of animals, but the exporters persevered, and the busi- ness steadily grew in value and importance until in 1898 the num- ber of live cattle shipped was 130,351. In 1899 the number fell to 103,566, of which 83,364 were shipped to England, 3290 to Prance, and 11,688 to Brazil. Large quantities of frozen meat were ex- ported in 1899, profitable prices being tealized. Dairy farming is making rapid strides, and the development of sheep-farming has been remarkable. In 1878, 65,000,000 sheep yielded 230,000,000 pounds' weight of wool, or an average persheep of about ,3J pounds. In the season 1899-1900 the wool exports weighed 420,000,000

pounds, and averaged more than 5 pounds per sheep. The extra weight of fleece was owing to the very great improvement due to the large importation of rams from Europe and Australia. The ex- port, moreover, of live sheep and of frozen mutton to Europe has become an important factor in the trade of Argentina. In 1892 the number of live sheep shipped for foreign ports was 40,000 ; in 1898 the export reached a total of 619,378 ; and in 1899, 462,013. In 1892 the frozen mutton exported was 25,500 tons, and this had increased in 1898 to 29,776 tons.

The advance made in agricultural industry is also of very great importance. In 1872 the cultivated area was about 1,430,000 acres ; in 1888, 6,074,000 acres ; in 1895, 12,083,000 acres ; in 1899, 16,055,000 acres. In 1899 the wheat exports exceeded 60,000,000 bushels, and the maize 40,000,000 bushels. The area under wheat in 1899 was 5,500,000 acres ; maize, 6,000,000 acres ; linseed, 200,000 acres. The farming industry is ~~not, however, on a satis~~ factory basis. No national lands in accessible districts are avail- able for the application of a homestead law, and the farmer too often has no interest in the land beyond the growing crops, a per- centage of the harvest being the -rent charged by the owner of the property. This system is mischievous, since, if a few consecutive

bad seasons occur, the farmer moves to some more favoured spot. The principal wheat and maize-producing districts lie in the pro- vinces of Santa F6, Buenos Ayres, Cordova, and Entre Rios, and the average yield of wheat throughout the country in 1899 was, in round numbers, 12 bushels to the acre. Little attention is paid to methods of cultivation, and the farmer has no resources to help him if the cereal crops fail. In the Andean provinces of Mendoza, San Jiian, Catamarca, and La liioja viticulture is widely practised, and the area of the vineyards now exceeds 150,000 acres. Wine is manufactured in large quantities, but the output is not yet sufBcient to meet the home demand. In the province of Tucuman the main industry is sugar-growing and manufacture. In 1899 the produc- tion of sugar was 110,000 tons, the total consumption of Argentina being estimated at 80,000 tons annually. The sugar manufacture, however, is a protected and bounty-fed industry. Other products are tobacco, olives, castor-oil, and fruit and vegetables for export to Brazilian markets.

The pastoral and agricultural industries have been hampered by fluctuations in the value of the currency, farm products being sold at a gold value for the equivalent in paper, while labourers are paid in currency. The existing system of taxation also presses heavily upon the provinces, as may be seen from the fact that the national, provincial, and municipal exactions together amount to £7 per head of population, while the total value of the exports in 1898 was only £6 in round numbers.

Manufactures. — Manufacturing enterprise in Argentina, in spite of the protection afforded by a high tariff, does not make any sub- stantial progress. The reason put forward is the lack of coal or other available cheap fuel. At Cordova a central power station for the distribution of electricity obtained from water-power was erected in 1897 ; but so far very little use of this convenience has been made by factories. In Buenos Ayres several companies have established stations for distributing electric power generated by steam ; but the cost is high, and the power has hitherto only been applied for lighting and for the electric tramways.

Commerce. — The rapid development of the foreign trade of the republic since 1881 is shown in the following table, the values of imports and exports being given in pounds sterling for the years named. In the period 1886-90 the trade was abnormally inflated, the average annual imports during the five years being of the value of £25,919,000, and of the exports £17,813,000.

Tear.

Imports.

Exports.

£

£

1881

11,100,000

11,580,000

1886

19,100,000

14,000,000

1891

13,442,000

20,644,000

1896

22,433,000

23,360,000

1898

21,486,000

26,766,000

1899

23,360,000

36,980,000

1900

22,697,000

30,920,000

The principal imports are textiles and raw materials, valued in 1900 at £7,519,570; iron and iron goods, £3,810,810; food stuffs, £2,090,670;

glass and earthenware, £1,778,700. The values of the principal groups of exports were — pastoral products, £14,250,- 800 ; agricultural products, £15,485,200 ; forest products, £441,- 700 ; various, £701,800. Of the pastoral products the more important exports were — ox-hides, 3,359,460 in number; horse- hides, 120,100 in number; sheep-skins, 28,200 tons ; wool, 112,105 tons ; tallow, 353,880 cwts. ; foreign wethers, 2,372,970 in number. The agricultural produce exported comprised 2,042,164 tons of wheat and 740,685 tons of maize. Of the imports in 1900 34 per cent, in value came from the United Kingdom, 14 per cent, from Germany, 13 per cent, from Italy, 12 per cent, from the United States, and 9 per cent, from France. Of the exports 15 per cent, in value were shipped to the United Kingdom, 13 per cent, to- Germany, 12 per cent, to France, and 11 per cent, to Belgium. More than half the foreign trade of the republic goes through the port of Buenos Ayres. The commercial community has been passing through a most difficult period. Between 1880 and 1890 immense sums of Euro- pean capital were invested in railways and other undertakings. The Mortgage Bank of the province of Buenos Ayres lent money recklessly in the form of cedulas nominally secured on landed pro- perty, credit was given far and wide, and the import trade rapidly developed. In 1890 a financial crisis came, credit contracted, the value of property depreciated, and imports decreased. The con- stant fluctuations in the value of the currency were also an adverse factor. But recent commercial statistics indicate that the volume of trade is once more increasing. Credit is now sounder than for several years, and shows signs of further improvement. Many of the larger retailers now import their wares direct from Europe, and thus save the interthediate commission charges. Present diffi- culties arise mainly from the appreciation of the currency and recent additions to taxation. In consequence of these two factors

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the expenses of a trading establishment are now, with a premium on gold of only 127 per cent., greater than they were when the premium stood at

300 per cent.

Shipping and Navigation.— The shipping under the Argentine flag in 1898 consisted of 1416 sailing ships of a total tonnage of 118,894 tons and 222 steamships of 36,323 tons. The shipping en- tered at Argentine ports in the foreign trade in 1891 had a total tonnage of 5,275,094; in 1896, 7,115,467: in 1897, 6,185,062: in 1898, 6,555.128 ; in 1899, 6,939,567.

Railways. — The rapid development of the railway system is in- dicated by the following figures, which shoin^ the length of line open in various years from 1880 : —

Tear.

Miles Open.

Tear.

Miles Open.

1880 1885 1890

1,485 2,820 5,745

1895 1898 1899

8,887'

9,885

10,285

The trans-Andean line is open to Santa Rosa, but 46 miles are re- quired to unite the Argentine and Chilian sections.

In 1900 the capital invested in the railways amounted to £105,328,324, of which £10,991,750 corresponded with the state lines, and the remainder with the private lines. In the course of 1900 the railways carried 17,898,961 passengers and 12,719,297 tons of goods, the average working

expenses of all the lines in operation being (1898) 62 per cent, of the gross receipts.

In consequence of the action of competing undertakings, the companies, without any National Government guarantee on the capital they employed, were compelled to extend their works, and expansion was only checked when the financial crisis of 1890 de- stroyed for a time the credit of Argentina in the money markets of Europe. The concessions granted during the tenure of office of President Roca from 1880 to 1886 had the specific object of uniting outlying districts with the capital, and could be justified on political as well as economic grounds. Those issued broadcast by President Celman had no such raison d'etre and were simply political jobs, which brought the guaranteed railway system into disrepute.

Tramways. — In 1895 there were in operation 460 miles of tram- ways, 86 miles in construction and 32 miles projected. These lines had a capital of $84,000,000 paper, and in 1894 carried 88,306,866 passengers. In 1895 there were 179 stage-coach companies travel- ling over 11,940 miles of road.

Telegraphs. — In 1896 the Argentine Republic had 25,345 miles of telegraph lines and 1237 offices. The national telegraph lines had a length of 11,023 miles with 23,572 miles of wire; the rail- way lines, 7070 miles with 18,717 miles of wire ; companies' lines, 4428 miles with 7462 miles of wire ; other lines, 2824 miles with 9309 miles of wire^ The despatches sent numbered 4,953,887.

Posts. — The Argentine Republic joined the Postal Union in 1878. In four years the national post offices handled mail pieces to the followingnumbers :— In 1894, 127,564,667 pieces ; 1895, 142,436,240 ; 1896, 177,641,001 ; 1897, 190,506,860. In 1897 the internal corre- spondence amounted to 167,634,383 letters and papers, and the foreign to 22,872,487. Ih 1897 there were 1716 post offices. The revenue derived from the post offices, including the telegraphs, in 1897 was $15,257,966 ; the expenditures, $30,347,390.

Credit. — By law of 16th October 1891 the old National Bank was placed in liquidation, and the Banco de la Nacion Argentina was opened. Within

the republic there are many other banks, both state and private. The National and Provincial Hypothecary Banks, in the spendthrift period between 1886 and 1890, exercised a disastrous influence on Argentine credit. The fundamental principle of these mortgage banks was sound enough, the idea being that the bonds issued {cedulas) should be a first charge on real estate of approved value, and that their face value should not represent more than 75 per cent, of the approved value of the property. But in the "boom" of 1887-89 cedulas were issued on the nominal value of property and through political influence, so that many millions of dollars were obtained on waste and worth- less lands. When the true condition of affairs came to light it was found that cedulas amounting to some $400,000,000 had been issued by the Provincial Hypothecary Bank, and to about $120,000,000 by the National Bank. In the case of the Provincial Bank the security of the lands mortgaged was found to represent only about .10 per cent, of the nominal value of the cedMas issued. The guarantee of the Provincial Government had been attached to these bonds, but the province was in a bankrupt condition. Un- fortunately, the cedulas had been largely botight in Europe under the impression that they were secured upon valuable real es- tate. When their price fell, nearly all landowners in possession of, valuable properties and owing monpy to the bank at once bought up the bonds at depreciated values and cancelled their indebted- ness. . The bank was, therefore, left with only the mortgages that

were worthless, and practically the $250,000,000 of cedulas now out- standing in Europe and Argentina are without intrinsic value. By careful management the affairs of the National Hypothecary Bank were brought to a fairly sound flnancial condition, but this was in great part owing to the fact that the charter of the bank practi- cally con Qned all mortgages to the municipality of Buenos Ayres, where property has steadily risen in value for some years past.

The development of the resources of Argentina is effected largely by means of foreign capital. In a consular report of July 1900, the foreign capital invested in undertakings within the country is estimated at £122,865,000, of which £119,018,000 is for railways and tramways, and

the interest annually paid to capitalists out- side the republic is put at about £4,900,000.

The paper money in circulation on 31st December 1899 amounted to $291,326,000, or about £25,600,000, gold being at a premium of 127 per cent. On 4th November of that year a law was passed for the conversion of the paper currency into gold dollars at the rate of 44 cents gold per paper dollar, provision being made for the for- mation of a conversion fund. In April 1900 the fund amounted to $3,200,000 gold, or £640,000. It is anticipated that five years must elapse before the fund can reach an amount sufficient for an attempt to carry out the conversion.

The metric system has been nominally compulsory since 1887, but the old Argentine system is not yet abandoned.

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II. Ebcent History. The history of Argentina since the time of its emanci- pation from Spain is a confused, wearisome story of political intrigues, party struggles, civil wars, and mili- tary revolutions. In 1875 the temporary lull led many people to believe that the period of civil strife was at an end and that no new revolutionary movements would be attempted for a long time to come. These sanguine ex- pectations were not destined to be realized. During the presidency of Dr Avellaneda, who had succeeded Sarmi- ento in the office of chief magistrate, political feeling in the city and province of Buenos , Ayres began to show unmistakable signs of forcing to an issue the question as to what position Buenos Ayres was to hold for the future in regard to the remaining provinces of the confederation. Before retiring from office, the Presi- dent endeavoured to sBcure the election of General Julio Eoca as his successor, and on this point hinged the prin- cipal political events of 1879, leading to the civil war of 1880, by which the power of Buenos Ayres was crushed. When, in 1879, the people of Buenos Ayres perceived that

the decentralization party had determined to leave no stone unturned to secure the election of General Eoca, and so make sure that the provinces became the dominant element in the political situation, an agitation was

im- mediately set on foot. Mass meetings were held and a committee was appointed for the purpose of considering what action should be taken to defeat the ambitious designs of the provincials. Under the direction of this committee, the association known as the " Tiro Nacional " was formed, with the avowed object of training the able-bodied citizens of Buenos Ayres in military exercises and creating a volunteer army, ready for service, if called upon, to resist by force the pretensions of their opponents. The establishment of the Tiro Nacional was enthusiastically received by all classes in Buenos Ayres, the men turning out regularly to drill and the women aiding the movement by collecting subscriptions for the purpose of armament and other necessaries. On the 13th of February, 1880, the Minister of War, Dr Pelle- grini, summoned the principal military officers connected with the Tiro Nacional, and warned them that as officers of the national army they owed obedience to the National Government and would be severely punished if concerned in any revolutionary outbreak directed against the con- stituted authorities. The reply to this threat was the immediate resignation from the army of all the officers connected with the Tiro Nacional. Two days later, the National Government occupied with a strong force of in- fantry and artillery the parade ground at Palermo used by the Buenos Ayres volunteers for drill purposes. A great meeting of the citizens was then called and marched through the streets. President Avellaneda, finding hie position insecure, made a compromise and ordered the troops to be withdrawn. Negotiations were now opened between the National Government and the provincial authorities for the disarmament of the city and province of Buenos Ayres, but without result. Matters became still further strained on account of outrages committed by the national troops, and the gradual development of the situation brought about such violent bitterness of feeling between the two factions that an appeal to arms became inevitable.

In the month of March, 1880, President Avellaneda and his Ministers left Buenos Ayres, and this act was con- sidered tantamount to a declaration of war. The National Government and the twelve provinces, forming the Cor- dova League, were on one side ; the province and city of Buenos Ayres and the province of Corrientes on the other. The National Government troops were well armed with Remington rifles, provided with abundant ammunition, equipped with artillery, and supported by the fleet.

In the city and province of Buenos Ayres plenty of volun- teers offered their services, and an army of some 30,000 men was quickly raised, but they were armed with old- fashioned weapons and there was only a limited supply of ammunition. Feverish attempts were made to remedy the lack of warlike stores, but difficulty was experienced on account of the fleet blockading the entrance to the After several skirmishes, the contending armies

river.

met in force on the 20th of July, 1880, in the outskirts of Buenos Ayres, General Roca commanding the national troops. Two days' fighting took place, and the Buenos Ayres forces were finally outmatched at all, points. On the 23rd of July the surrender of the city was demanded and obtained. The terms of the surrender were that all the principal men of the revolution should be removed from positions of authority, all Government employes im- plicated in the movement dismissed, and the forces in the province akd city of Buenos Ayres at once disarmed and disbanded. The power of Buenos Ayres was thus com- pletely broken and at the mercy of the Cordova League,

represented by their favourite candidate for the presidency, General Julio Eoca. Buenos Ayres was no longer in a position to take any active part in the nomination of a successor to President Avellaneda, and the o^cial candi- date, General Eoca, was declared to be duly elected with- out opposition. He assumed office in October, 1880. Hitherto, General Eoca had been regarded only in his capacity of a soldier, and not from the point of view of an administrator. In the campaign against the Indians in the south-west of the province of Buenos Ayres and the valley of the Rio Negro and the Neuquen district, he had gained much prestige; the victory over the forces at Buenos Ayres added to his fame, and secured his authority in the outlying provincial centres. One of the first most notable acts of the Roca Administration was to declare the city of Buenos Ayres the property of the National Government, and no longer under the control of the provincial authorities. Some compensation was granted to the province in consideration of this change, but nothing that was given could adequately represent the political loss which it suffered. A further

blow was dealt at its supremacy in 1884, when the town of La Plata was declared to be the provincial capital, and the Provincial Government was moved to that place.

Considering the circumstances in which General Roca assumed office, it must be aclmitted that he showed great moderation, and that on the whole his administration was fairly succe'ssful. Public affairs were conducted quietly so far as the National Government was concerned, and the influence and prestige of Roca throughout the provinces acted as a deterrent to pronunciamientos and outbreaks against the provincial authorities. The danger of these internal dissensions was permanently lessened, though by no means entirely removed, by the extension of railways. Unfortunately, the last two years of Roca's administration were characterized by two grave errors, which subsequently caused widespread suffering and distress throughout the country. The first of these mis-takes was a measure making the currency inconvertible, whichjwas adopted without any consideration as to its effect on the national credit. The second was the nomination of Dr Miguel Juarez Celman for the presidential term commencing in October, 1886. The nomination was brought about by the Cordova clique, and Roca lacked the moral courage to oppose the decision of this group, though he was well aware that Celman, who was his brother-in-law, was neither intellectually nor morally fitted for the post. No sooner had President Juarez Celman come into power, towards the close of 1886, than the respectable portion of the community began to feel alarmed at the methods practised by the new president in his conduct of public affairs. At first it was hoped that the influence of General Roca would serve to check any serious extravagances on the part of Celman. " This hope, however, was doomed to disappointment, and before many months had elapsed it was clear that the President would listen to no prudent counsels from Roca or any one else. The men of the old Cordova League became dominant in all branches of the Govern- ment, and carpet-bagging politicians occupied every official post. In their hurry to obtain weal,th, this crowd of office-mongers from the provinces lent themselves to all kinds of bribery and corruption. The public credit was pledged at home and abroad to fill the pockets of the adventurers, and the wildest excesses were committed un-der the guise of administrative acts. What followed in the second and

third years of the Celman Administration can only adequately be described as a debauchery of the national honour, of the national resources, of the rights of Argentines as citizens of the Republic. Buenos Ayres was still prostrate under the crushing blow of the misfortunes

of 1880, and lacked the strength and power of organization necessary to raise any effective protest against the pro- ceedings of Celman and his friends when the true char- acter of these proceedings was first understood. The conduct of public affairs, however, at length became so scandalous that action on the part of the more sober- minded and more conservative sections was seen to be absolutely imperative if the country was to be saved from speedy and certain ruin. In 1889, the association of the "Union Civica" was founded, and the organization undertaken by Dr Leandro Alem, Dr Aristobulo del Valle, Dr Vicente Lopez, Dr Lucio Lopez, and other leading citizens. Mass meetings were held in Buenos Ayres, and Dr del Valle, a most able orator, clearly ex- plained the terrible danger threatening the Eepublic in consequence of the irresponsible and corrupt character of the Administration. Subsidiary clubs afiiliated to the central association were formed throughout the length and breadth of the country, and millions of leaflets and pamphlets were distributed broadcast to explain the im- portance of the movement. President Celman underrated the strength of the new opposition and relied upon his armed forces promptly to suppress any sign of open hos- tility. No change was made in oificial methods, and the condition of affairs drifted from bad to worse until the temper of the people, so long' and so sorely tried, showed plainly that the situation had become insufferable. The Union Civica then decided to make a bold bid for freedom by attempting forcibly to eject Celman and his clique from ofiice.

On the night of the 26th of July, 1890, the Union Civica called its members to arms. It was joined by some regiments of the regular army, and received the support of the fleet. Barricades were thrown up in the principal streets, and the surrounding houses were occupied by the insurgents. Two days of desultory street fighting ensued, daring which the fleet began to bombard the city, but was compelled to desist by the interference of foreign men-of-war, on the ground that the bombardment was causing unnecessary damage to the life and property of non-combatants. A suspension of hostilities then took place and negotiations were opened between the contend- ing parties. Celman, acting under the advice of General Koca, who recognized the strength of public opinion in the outbreak and foresaw a more powerful movement looming in the distance, placed his resignation in the hands of Congress on the 31st of July. A scene of immense enthusiasm followed, and Buenos Ayres was enfMe for the following three days. Vice-President Carlos Pellegrini succeeded to the office vacated by Juarez Celman and to the administrative confusion resulting from the iniquitous methods of conducting public affairs during the previous four years.

Great expectations were formed of the ability of Presi- dent Pellegrini to establish a sound Administration and to introduce a system of government ensuring the peace and progress of the Eepublic. General Roca tendered his services for the duties of Minister of the Interior, and his influence in the provinces was of very great assistance to the national authorities. Dr Vicente Lopez undertook the post of Minister of Finance, an onerous task in view of the financial complications resulting from the previous reckless extravagance. In short, all the most respectable elements in the country showed willingness to co-operate in the restoration of a normal condition of affairs and the establishment of political order, but the result did not come up to public expectation. Pellegrini proved a fail- ure. Of great natural intelligence, and with "the advan- tages of a sound education at Harrow, combined with much charm of manner and widespread personal popula- rity, he showed himself during his term of office merely a

politician, with no genuine statesmanlike qualities. The new Government made no attempt to initiate a strong policy of reform in administration or

finance; it became a Government of expedients, drifting helplessly on a sea of financial troubles, and seeking merely to prevent serious political disturbances. This unsatisfactory state of affairs moused the hostility of the Eadical wing of the Union Civica, and Dr Alem preached far and wide the doctrine of opposition to the Government and the neces- sity of reform in the methods of administering the country. The more conservative section of the Union Civica refused to join in this opposition movement, and Dr Alem was arrested and exiled.

In' 1892, Pellegrini's term of office expired and a suc- cessor had to be chosen. General Bartolome Mitre was proposed by the Buenos Ayres faction as their candidate. He had been absent from Argentina on a journey to Europe, and it was on his return in April, 1891, when a popular reception was given to him at which 60,000 persons attended, that he had formally accepted the candidacy for the presidential office. His partisans found themselves confronted by a compact provincial party. who proposed to put forward General Eoca, or, failing his acceptance, seine other representative to oppose the Buenos Ayres candidate. There was no doubt that if both sides persisted in the struggle on the lines indicated a civil war must inevitably result. General Mitre disapproved of any measures likely to involve bloodshed and sought to effect a compromise. A meeting between him and General Eoca resulted in an acuerdo, by which the two gen- erals agreed to support a neutral candidate having no direct connexion with either of the political parties. The final selection for the candidacy fell upon Dr Saenz Pena, a Judge of the Supreme Court, and a man univer- sally respected, who had never tak^n part in political life. In May, 1892, the presidential elections were held ; Dr Saenz Pena was declared duly elected, and Senor Uri- buru, then Argentine Minister in Chili, was chosen as Vice-President.

The idea of President Saenz Pena was to conduct the government op common-sense and business-like lines. He had no political training, no political party in Congress to support him ; he was simply a straightforward, honour- able man trying to do his duly in a position which had been forced upon him, and was in no sense of the word of his own seeking. No sooner was he installed in office than difficulties began to crop up on all sides, and he quickly discovered that no help could be

expected from the two political factions which had brought him into power to suit their own convenience. To govern without a majority in Congress was a practical impossibility, and before twelve months of the presidential term had run public affairs had drifted to a deadlock. This was the opportunity of Dr Alem, the Eadical leader of the Union Civica, and he was not slow to profit by the occasion. Embittered by his treatment in 1892, he openly preached the advisability of an armed rising and the overthrow of the existing Ad- ministration. The unscrupulous acts of corruption on the part of Dr Julio Costa, then Governor of the province of Buenos Ayres, strengthened the movement. A number of officers of the naval and military forces agreed to lend assistance to the revolutionary outbreak, and towards the end of July, 1893, matters came to a head. The popula tion of the province of Buenos Ayres assembled in armed bodies with the avowed intention of turning the Governor out of office and electing in his stead a man who would give them a just Administration. At the commencement of the movement, Governor Costa imagined himself strong enough to hold his own with the aid of his police and several battalions of provincial troops quartered at La Plata; but as the insurrection spread he

appealed for aid to the National Government. President Saenz Pena professed to doubt his authority to interfere in provincial affairs, and deliberated for many days before he took action in the matter. Eventually, the interven- tion of the National Government was decided upon, and troops -were despatched to the scene of the disturbance ; but there was no serious fighting. Negotiations were soon opened, and resulted in the resignation of Governor Costa and the dispersal of thte armed insurrectionary forces.

While these political disturbances were in progress in Buenos Ayres, another revolutionary rising took place in the province of Santa Fe. Dr Alem, preaching his gospel of a reform of the national Administration, induced a number of his co-religionists of the Union Civica to take up arms. Several military and naval of&cers joined the movement, and a gunboat and one or two torpedo boats were seized by the insurgents. The scene of the insurrec- tion was the vicinity of Eosario, and this city was in possession of the insurgents for a few days. After a few skirmishes, the revolt was suppressed by the national authorities in September, 1893, and Dr Alem and the other conspirators were captured. He and his civilian friends were sentenced to banishment to Staten Island during the pleasure of the Federal Government, and were immediately transported to that isolated spot. Of the naval and military officers, some were condemned to be shot and the others to serve various terms of imprisonment. This, severity on the part of the Court-martial brought about fresh troubles. President Saenz Pena was deter- mined that the sentences should be carried out. Con- gress was equally decided that the death penalty should not be inflicted. The Ministry at first supported the President in a half-hearted manner and then deserted him as the opposition in the Chambers gathered strength. The struggle between Congress and the Executive con- tinued for some weeks, the former refusing to vote the Budget or any supplies unless the President conformed to the desires of the Chambers in

the matter of the officers implicated in the Santa Fe outbreak. On the 21st of January, 1895, the President found his position no longer tenable, and preferred to resign rather than act against his convictions. That the government of Dr Saenz Pena was weak and vacillating is not to be gainsaid ; but he himself was honest in his intention of doing his duty in the trust confided to him, and the chief cause of his unpopularity was probably the fact that he belonged to no distinct political party and consequently commanded no following among the members of Congress. His resig- nation was at once accepted by the Chambers, and the Vice-President, Dr Uriburu, became President of the Republic for the remainder of the period of six years for which Dr Saenz Pena had been elected in 1892.

President Uriburu was neither a politician nor a states- man ; he had spent the greater portion of his life abroad in the Argentine diplotnatic service, and could count on no political following in his own country. It was, indeed, on account of his belonging to no political party that he had been elected Vice-President. During his term of office the boundary question with Chile was the subject which chiefly attracted public attention. Internal politics were dwarfed in comparison with this important issue. The strain on both Governments was extremely severe. On both sides, from time to time, the populace clamoured for an appeal to arms. The resources of both countries were squandered in military preparations, and the National Guards were called out and constantly drilled in order to be ready in case of an emergency. In August, 1898, matters reached a climax. The choice lay between war and arbitrar tion. The tendency of both nations was to decide the dis- pute by force of arms, but wiser counsels finally prevailed

and arbitration was agreed upon. The question of the Puna of Atacama was referred to a tribunal composed of the United States Minister to Argentina, one Argentine and one Chilian delegate ; that of the southern territory in Patagonia was referred to the British Crown. The decision of the representative of the United States was given in April, 1899. Although the Chilians professed to be dissatisfied with the award, no active opposition was raised and the terms were duly notified. Up to the end of 1900 the decision of the Arbitration Commission appointed by the British

Government had not been given. Further details regarding certain points were required, and, in order to obtain these, Argentine and Chilian ex- peditions were sent to Patagonia. In view of the occupa- tion of Ultima Esperanza, part of the disputed territory, by Argentine colonists, the Governments of Chile and Argentina signed a protocol on 27th December agreeing to take no aggressive action, and to instruct the local authorities to maintain the previous position. No other boundary disputes can now arise, as the question with Brazil was settled by the award of President Cleveland in 1894, and subsequently accepted and ratified by the Argentine and Brazilian Governments.

In 1898 there was again a presidential election. Public opinion, excited by the prospect of a war with Chile, naturally supported the candidature of General Roca, and he was elected without opposition (12th October, 1898). Before he had been many weeks in office he arranged to meet the President of the Chilian Eepublic in the Strait of Magellan, and held a conference with him which confirmed the amicable solution of the frontier question.' In his Message to Congress on the 1st of May, 1899, General Eoca spoke strongly of the immediate necessity of a reform in the methods of administering justice, the expediency of a revision of the electoral law, and the im- perative need of a reconstruction of the Department of Public Instruction. Justice, he said, had come to so low a level as to be practically non-existent. Of the necessity of electoral reform the following may serve as an illustra- tion:— In March, 1899, elections were held for Deputies for the Provincial Chamber of Buenos Ayres, and resulted in the return of a substantial majority opposed to the Governor. They were at once annulled, and at the new elections the supporters of the Governor had a decided majority. On 31st August of the same year. President Eoca sent to Congress a series of proposals for dealing with the currency question and certain branches of finance connected with the national revenue and expenditure. The scheme included the conversion of the currency at the rate of 44 cents gold for eacli paper dollar. The President declared that he was determined to make every effort to reduce the national expenditure, adding that the object of fixing the rate of the relation of gold to currency was to do away with the violent fluctuations in the value of the paper dollar, which caused so much damage to commerce and all classes of industry. In spite of the adverse feeling which

prevailed in many quarters, the Conversion Bills were passed by the Senate and the Chamber of Deputies, and became law on 6th November.

In 1900 considerable anxiety was caused in Argentina by what was regarded as the aggressive attitude of Chile towards Bolivia. Dr Campos Salles, the President of Brazil, paid a visit to Buenos Ayres in October and was very warmly received. The result of the conversations between the two Presidents was an understanding that instructions should be sent to all Argentine and Brazilian representatives abroad to lose no opportunity to advocate the maintenance of peace in South America, and to discountenance the idea of any South American Govern- ment acquiring an extension of territory by force of arms.

The city and province of Buenos Ayres have been rapidly recovering by natural causes the political predominance which they lost in 1880. Representation in the Argentine Congress is accorded to the various provinces in proportion to their population. Until 1896 the number of seats in the Chamber of Deputies was based upon the census of 1869, which gave the provinces a large majority over the city and province of Buenos Ayres. Under the census of 1895 the increase of population in Buenos Ayres entitled the capital and province to a greater number of seats, and no fewer than 47 members for city and province together

are returned out of the total number of 116 for the whole Eepublic.

The chief political question agitating the people of Argentina is that of heavy protective duties as_ against a moderate tariff — practically, protection versus free trade. The farmers of all classes, agricultural and pastoral, demand a reduction of the tariff; while the manu- facturers of sugar an other articles, which thrive only in consequence of the prohibitive duties, use all their poli- tical influence to maintain the existing system.*

(o. E. A.)

Argenton, a town of France, in the arrondissement of Chateauroux, department of Indre, on the R. Creuse, 18 miles S.S.W. of Chateauroux on the railway to Le Blanc. Excellent wine is produced ; tanning, the manufacture of boots and shoes, and linen goods, are leading industries. The actual site of the ancient Argentomagus lies a little to the north, and is occupied by St Maecel. Population (1881), 5167; (1891), 5503; (1901), 6281, (comm.) 5978.

Argon. — For more than a hundred years before 1894. it had been supposed that the composition of the atmos- phere was thoroughly known. Beyond variable quanti- ties of moisture and traces of carbonic acid, hydrogen, ammonia, &c., the only constituents recognized were nitrogen and oxygen. The analysis of air was conducted by determining the amount of oxygen present and assum- ing the remainder to be nitrogen. Since the time of Cavendish no one seemed even to have asked the ques- tion whether the residue was, in t];uth, all capable of conversion into nitric acid.

The manner in which this condition of complacent ignor- ance came to be disturbed, is instructive. Observations undertaken mainly in the interest of Front's law, and ex- tending over many years, had been conducted to determine afresh the densities of the principal gases — ^hydrogen, oxygen, and nitrogen. In the latter case, the first pre- parations were according to the convenient method devised by Vernon Harcourt, in which air charged with ammonia is passed over red-hot copper. Under the influence of the heat the atmospheric oxygen unites with the hydrogen of the ammonia, and when the excess qf the latter is removed with sulphuric acid, the gas properly desiccated should be pure nitrogen, derived in part from the ammonia, but principally from the air. A few concordant determinar tions of density having been effected, the question was at first regarded as disposed of, until the thought occurred that it might be desirable to try also the more usual method of preparation in which the oxygen is removed by actual oxidation of copper without the aid of ammonia. Determinations made thus were equally concordant among themselves, but the resulting density was about T^nnr P^"^* greater than that found by Harcourt's method (Rayleigh, Nature, vol. xlvi. p. 512, 1892). Subsequently when oxygen was substituted for air in the first

method, so that all (instead of about one-seventh part) of the nitrogen was derived from ammonia, the difference rose to one-half per cent. Further experiment only brought out more clearly the diversity of the gases hitherto assumed to be identical. Whatever were the means employed to rid air of ac- companying oxygen, a uniform value of the density was arrived at, and this value was one-half per cent, greater than that appertaining to nitrogen extracted from com- pounds such as nitrous oxide, ammonia, and ammonium nitrite. No impurity, consisting of any known substance, could be discovered capable of explaining an excessive weight in the one case, or a deficiency in the other. Storage for eight months did not disturb the density of the chemically extracted gas, nor had the silent electric

discharge any influence upon either quality. ("On an Anomaly encountered in determining the Density of Nitrogen Gas," Proc. Boy. Soc, April 1894.)

At this stage it became clear that the complication depended upon some hitherto unknown body, and prob- ability inclined to the existence of a gas in the atmosphere heavier than nitrogen, and remaining unacted upon during the removal of the oxygen — a conclusion afterwards fully established by Rayleigh and Ramsay. The question which now pressed was as to the character of the evidence for the universally accepted view that the so-called nitrogen of the atmosphere was all of one kind, that the nitrogen of the air was the same as the nitrogen of nitre. Refer- ence to Cavendish showed that he had already raised this question in the most distinct manner, and indeed, to a certain extent, resolved it. In his memoir of 1788 he writes : —

As far as the experiments hitherto published extend, we scarcely know more of the phlogisticated part of our atmosphere than that it is not diminished by lime-water, caustic alkalies, or nitrous air ; that it is unfit to support fire or maintain life in animals ; and that its specific gi-avity is not much less than that of common air ; so that,- though the nitrous acid, by being united to phlogiston, is converted into air possessed of these properties, and conse- quently, though it was reasonable to suppose, that part at least of the phlogisticated air of the atmosphere consists of this

acid united to phlogiston, yet it may fairly be doubted whether the whole is of this kind, or whether there are not in reality many different subrtances confounded together by us under the name of phlogisticated air. I therefore made an experiment to determine whether the whole of a given portion of the phlogisticated air of the atmosphere could be reduced to nitrous acid, or whether there was not a part of a different nature to the rest which would re- fuse to undergo that change. The foregoing experiments, indeed, in some measure decided this point, as much the greatest part of air let up into the tube lost its elasticity ; yet, as some remained unabsorbed, it did not appear for certain whether that was of the same nature as the rest or not. For this purpose I diminished a similar mixture of^dephlogistioated [oxygen] and common air, in the same manner as before [by sparks over alkali], till it was re- duced to a small part of its original bulk. I then, in-order to decompound as much as I could of the phlogisticated air [nitro- gen] which remained in the tube, added some dephlogisticated air to it and continued the spark until no further diminution took place. Having by these means condensed as much as I could of the phlogisticated air, I let up some solution of liver of sulphur to absorb the dephlogisticated air ; after which only a small bubble of air remained unabsorbed, which certainly was not more than j^ of the bulk of the dephlogisticated air let up into the tube ; so that, if there be any part of the dephlogisticated air of our atmosphere which differs from the rest, and cannot be reduced to nitrous acid, we may safely conclude that it is not more than j^^ part of the whole.

_ Although, as was natural. Cavendish was satisfied with his result, and does not decide whether the small residue was genuine, it is probable that his residue was really of a different kind from the main bulk of the " phlogisti- cated air," and contained the gas afterwards named Argon. The announcement to the British Association in 1894 by Rayleigh and Ramsay of a new gas in the atmosphere was received with a good deal of scepticism. Some doubted the discovery of a new gas altogether, while others denied that it yas present in the atmosphere. Yet there was

nothing inconsistent with any previously ascertained fact in the asserted presence of 1 per cent, of a non-oxidizable gas about half as heavy again as nitrogen. The nearest approach to a difficulty lay in the behaviour of liquid air, from which it was supposed, as the event proved errone- ously, that such a constituent would separate itself in the solid form. The evidence of the existence of a new gas (named Argon on account of its chemical inertness), and a statement of many of its properties, were communicated to the Royal Society (see Phil. Trans, clxxxvi. p. 187) by the discoverers in January 1895. The isolation of the new substance by removal of nitrogen from air was effected

by two distinct methods. Of these the first is merely a development of that of Cavendish. The gases were con- tained in a test-tube A (Fig. 1) standing over a large quantity of weak alkali B, and the current was conveyed in wires insulated by U-shaped glass tubes CC passing through the liquid and round the mouth of the test-tube. The inner platinum ends DD of the wire may be sealed into the glass insulating tubes, but reliance should not be placed upon these sealings. In order to secure tightness in spite of cracks, mercury was placed in the bends. With a battery of five Grove cells and a Euhmkorff coil of medium size, a somewhat short spark, or arc, of about 5 mm. was found to be more favourable than a longer one. When the mixed gases were in the right proportion, the rate of absorption was about 30 c.c. per hour, about thirty times as fast as Cavendish could work with the electrical machine of his day. Where it is available, an alternating

electric current is much superior to a battery and break. This combination, introduced by Spottiswoode, allows the absorption in the apparatus of Fig. 1 to be raised to about 80 c.c. per hour, and the method is very convenient for the purification of small quantities of Argon and for determinations of the amount present in various samples of gas, e.g., in the gases expelled from solution in water. A convenient adjunct to this apparatus is a small volta- meter, with the aid 'of which oxygen or hydrogen can be introduced at pleasure. The gradual elimination of the nitrogen is tested at a moment's notice with a miniature spectroscope. For this purpose a small Leyden jar is connected as usual to the secondary terminals, and if necessary the force of the discharge is moderated by the

insertion of resistance in the primary circuit. When with a fairly wide slit the yellow line is no longer visible, the residual nitrogen may be considered to have fallen below 2 or 3 percent. During this stage the oxygen should be in considerable excess. When the yellow line of nitrogen has disappeared, and no further contraction seems to be in progress, the oxygen may be removed by cautious introduction of hydrogen. The spectrum may now be

43

45

46

47

48

49 5000

_L

1 1 1

1

1

1

1 .

Argon

_*. Bed.

Zinc

1

Sydrogeri

Sy

F

further examined with a more powerful instrument. The most conspicuous group in the Argon spectrum at atmo- spheric pressufe is that first recorded by Schuster (Fig. 2). Water vapour and excess of oxygen in moderation do not interfere seriously with its visibility. It^is of interest to note that the Argon spectrum may be fully developed by operating upon a miniature scale, starting with only 5 c.c. of air {Phil. Mag. vol. i. p. 103, 1901)..

The development of Cavendish's method upon a large scale involves arrangements different from what would at first be expected. The transformer w^orking from a public supply should give about 6000 volts on open circuit, although when the electric flame is established the voltage on the platinums is only from 1600 to 2000. No sufiicient advantage is attained by raising the pressure of the gases above atmosphere, but a capacious vessel is necessary. This may consist of a glass sphere of 50 litres' capacity, into the neck of which, presented downwards, the neces- sary tubes are fitted. The whole of the interior surface is washed with a fountain of alkali, kept in circulation by means of a small centrifugal pump. In this apparatus, and with about one horse-power utilized at the transformer, the absorption of gas is 21 litres per hour (" The Oxidar tion of Nitrogen Gas," Trans. Chem. Soc, 1897).

In one experiment, specially undertaken for the sake of measurement, the total air employed was 9250 c.c, and the oxygen consumed, manipulated with the aid of partially de-aSrated water, amounted to 10,820 c.c. The oxygen contained in the air would be 1942 c.c. ; so that the quantities of atmospheric nitrogen and of total oxygen which enter into combination would be 7308 c.c. and 12,762 c.c. respectively. This corresponds to N -f 1-76 0, the oxygen being decidedly in excess of the proportion

required to form nitrous acid. The Argon ultimately found was 75-0 c.c, or a little more than.l per cent, of the atmospheric nitrogen used. A subsequent determinar tion over mercury by Kellas {Proc. Roy. Soc. lix. p. 66, 1896) gave 1-186 c.c. as the amount of Argon present in 100 c.c. of mixed atmospheric nitrogen and Argon. In the earlier stages of the inquiry, when it was important to meet the doubts vs^hich had been expressed as to the presence of the new gas in the atmosphere, blank experi- ments were executed in which air was replaced by nitrogen from ammonium nitrite. The residual Argon, derived doubtless from the water used to manipulate the gases, was but a small fraction of what would have been obtained from a corresponding quantity of air.

The other method by which nitrogen may be absorbed on a considerable scale is by the aid of magnesium. The metal in the form of thin turnings is charged into hard glass or iron tubes heated to a full red in a combustion furnace. Into this air, previously deprived of oxygen by red-hot copper and thoroughly dried, is led in a continu- ous stream. At this temperature the nitrogen combines with the magnesium, and thus- the Argon is concentrated. A still more potent absorption is afforded by calcium, prepared in situ by heating a mixture of magnesium dust with thoroughly dehydrated quick-lime. The density' of Argon, prepared and purified by magnesium, was found by Professor Ramsay to be 19-941 on the 0 = 16 scale. The volume actually weighed was 163 c.c. Subsequently large-scale operations with the same apparatus as had "been used for the principal gases gave an almost iden- tical result (19-940) for Argon prepared with oxygen.

Argon is soluble in water at 12° C. to about 4-0 per •cent., that is, it is about 2^ times more soluble than nitrogen. We should thus expect to find it in increased proportion in the dissolved gases of rain-water. Experi- ment has confirmed this anticipation. The weight of a mixture of Argon and nitrogen prepared from the dis- solved gases showed an excess of 24 mg. over the weight of true nitrogen, the corresponding excess for the atmos- pheric mixture being only 11 mg. Argon is contained in the gases liberated by many thermal springs, but not in special quantity. The gas

collected from the King's Spring at Bath gave only one-half per cent., i.e., half the atmospheric proportion.

The most remarkable physical property of Argon re- lates to the constant known as the ratio of specific heats. When a gas is warmed one degree, the heat which must be supplied depends upon whether the opera- tion is conducted at a constant volume or at a constant pressure, being greater in the latter case. The ratio of specific heats of the principal gases is .1-4, which, according to the kinetic theory, is an indication that an important fraction of the energy absorbed is devoted to rotation or vibration. If, as for Boscovitch points, the whole energy is translatory, the ratio of specific heats must be 1-67. This is precisely the number found from the velocity of sound in Argon as determined by Kundt's method, and it leaves no room for any sensible energy of rotatory or vibrational motion. The same value had previously been found for mercury vapour by Kundt and Warburg, and had been regarded as con- firmatory of the monatomic character attributed on chemical grounds to the mercury molecule. It may be added that helium has the same character as Argon in respect of specific heats (Kamsay, Proc. Boy. Soc. 1. p.

86, 1895).

The refract] vity of Argon is -961 of that of air. This low refractivity is noteworthy as strongly antagonistic to the view at one time favoured by eminent chemists that Argon was a condensed form of nitrogen represented by, Na. •The viscosity of Argon is 1-21, referred to air, some-

what higher than for oxygen, which stands at the head of the list of the principal gases ("On some Physical Properties of Argon and Helium," Proc. Boy. Soc. vol. lix. p. 19g, 1896). ...

The spectrum shows remarkable pe9uliarities. Ac- cording to circumstances, the colour of the light obtained from a Plucker vacuum tube changes "from red to a rich steel blue," to use the words of Crookes, who first described the phenomenon. A third spectrum is dis- tinguished by Eder and Valenta. The red spectrum is obtained at moderately low pressures (5 mm.) by the use of a RuhmkorfE coil without a jar or air-gap. The red lines at 7056 and 6965 (Crookes) are characteristic. The

blue spectrum is best seen at a somewhat lower pressure (1 mm. to 2-5 mm.), and usually requires a Leyden jar to be connected to the secondary terminals. In some conditions very small causes effect a transition from the one spectrum to the other. The course of electrical events attending the operation of a, RuhmkorfE coil being extremely complicated, special interest at- taches to some experiments conducted by Trowbridge and Richards, in which the source of power was a secondary battery of 5000 cells. At a pressure of 1 mm. the red glow of Argon was. readily obtained with a voltage of 2000, but not with much less. After the discharge was once started, the difference of potentials at the terminals of the tube varied from 630 volts up- wards.

The introduction of a capacity between the terminals of the Geissler tube, for example two plates of metal 1600 sq. cm. in area separated by a glass plate 1 cm. thick, made no difference in the red glow so long as the connexions were good and the condenser was quiet. As soon as a spark-gap was introduced, or the con- denser began to emit the humming sound peculiar to i^, the beauti- ful blue glow so characteristic of Argon immediately appeared. {Phil. Mag. xliii. p. 77, 1897.)

The behaviour of Argon at low temperatures was in- vestigated by Olszewski (Phil. Trans., 1895, p. 253). The following results are extracted from the table given by him : —

Name.

Critical

Tempecature,

Cent.

Critical Pressure, Atmos.

BoiUng Point, Cent.

Freezing Point,

Cent.

Nitrogen . Argon Oxygen .

-146-0 -121-0 -118-8

35-0 50-6 50-8

-194-4 -187-0 -182-7

-214-0

-189-6

?

The smallness of the interval between the boiling and freezing points is noteworthy.

Erom the manner of its preparation it was clear at an early stage that Argon would not combine with magnesium or calcium at a red heat, nor under the influence of the electric discharge with oxygen, hydrogen, or nitrogen. Numerous other attempts to induce combination also failed. Nor does it appear that any well-defined com- pound of Argon has yet been prepared. It was found, however, by Berthelot that under the influence of the silent electric discharge, a mixture of benzole vapour and Argon underwent contraction, with formation of a gummy product from which the Argon could be recovered.

The fafcts detailed in the original memoir led to the conclusion that Argon was an element or a mixture of elements, but the question between these alternatives was left open. The behaviour on liquefaction, however, seemed to prove that in the latter case either the propor- tion of the subordinate constituents was small, or else that the various constituents were but little contrasted. An attempt, somewhat later, by Ramsay and Collie to separate Argon by diffusion into two parts, which should have different densities or refractivities, led to no distinct effect. More recently

Ramsay and Travers have obtained evidence of the existence in the atmosphere of three new gases,

A E G 0 S

623

besides helium, to whicli have been assigned the names of Neon, Krypton, and Xenon. These gases agree with Arg9n in respect of the ratio of the specific heats and in being non-oxidizable under the electric spark. As origin- ally defined, Argon included small proportions of these gases, but it is now preferable to limit the name to the principal constituent and to regard the newer gases as "companions of Argon." The physical constants asso- ciated with the name will scarcely be changed, since the proportion of the " companions " is so small. Professor Ramsay considers that probably the volume of all of them taken together does not exceed - j^th part of that of the Argon. The latest information with respect to the physical properties of these gases is conveyed in the following table {Proc. Boy. Soc. 67, p. 331, 1900) :—

Helium.

Neon.

Argon.

Krypton.

Xenon.

Refractivities

(air=l) Densities

(0=16)

Boiling-points

at 760 mm.

•1238

1-98

?

-2345 9-97

?

■968

19-96

86-9° abs.

1-449

40-88

121-83° abs.

2-364

64

163-9° abs.

Critical temper- atures

?

below 68° abs.

155-6° abs.

210-5° abs.

287-7° abs.

Critical pres- sures

?

?

40-2

metres.

41-2f4 metres.

43-5

metres.

Weight of 1 C.C. of liquid

?

?

1-212

gm.

2-155

gm.

3-52

gm.

The glow obtained in vacuum tubes is highly charac- teristic, whether as seen directly or as analysed by the spectroscope. (e.)

Argos. — Kecent investigation has added consider- ably to our knowledge concerning the Argive Heraeum or Heraion, the temple of Hera, which

stood, according to Pausanias, "on one of the lower slopes of Eubcea." The term Eubcea did not designate the eminence upon which the Heraeum is placed, or the mountain-top behind the Heraeum only, but, as Pausanias distinctly indicates, the group of foothUls of the hilly district adjoining the mountain. When once we admit that this designated not only the mountain, which is 532 metres high, but also the hilly district adjoining it, the. general scale of distance for this site grows larger. The territory of the Herseum was divided into three parts, namely Eubcea, Akraia, and Prosymna. Pausanias tells us that the Heraeum is 15 stadia from Mycenae. Strabo, on the other hand, says that the Heraeum was 40 stadia from Argos and 10 from Mycenae. Both authors under- estimate the distance from Mycenae, which is about 25 stadia, or a little more than 3 miles, while the distance from Argos is 45 stadia, or a little more than 5 miles. The distance from the Heraeum to the ancient Midea is slightly greater than to Mycenae, while that from the Hera3um to Tiryns is about 6 miles. The Argive Heraeum was the most important centre of Hera and Juno worship in the ancient world ; it always remained the chief sanctuary of the Argive district, and was in ail probability the earliest site of civilized life in the country inhabited by the Argive people. In fact, whereas the site of Hissarlik, the ancient Troy, is not in G-reece proper, but in Asia Minor, and can thus not furnish the most direct evidence for the earliest Hellenic civilization as such ; and whereas Tiryns, Mycenae, and the city of Argos, each represent only one definite period in the successive stages of civilization,, the Argive Heraeum, holding the central site of early civilization in Greece proper, not only retained its importance during the three periods marked by the supremacy of Tiryns, Mycenae, and

the city of Argos, but in all probability antedated them as a centre of civilized Argive life. These conditions alone account for the extreme archaeological importance of this ancient sanctuary.

According to tradition the Heraeum was founded by Phoroneus at least thirteen generations before Agar memnon and the Achaeans ruled. It is highly probable that before it became important merely as a temple, it was the fortified centre uniting the Argive people dwell- ing in the plain, the citadel which was superseded in this function by Tiryns. There is ample

evidence to show that it was the chief sanctuary during the Tirynthian period. When Mycenae was built under the Perseides it was still the chief sanctuary for that centre, which super- seded Tiryns in its dominance over the district, and which this temple clearly antedated in construction. According to the Dictis Oretensis, it was at this Heraeum that Agamemnon assembled the leaders before setting out for Troy. In the period of Dorian supremacy, in spite of the new cults which were introduced by these people, the Heraeum maintained its supreme importance : it was here that the tablets recording the succession of priestesses were kept which served as a chronological standard for the Argive people, and even far beyond their borders ; and it was here that Pheidon deposited the obeliskoi when he introduced coinage into Greece.

We learn from Strabo that the Heraeum was the joint sanctuary for Mycenae and Argos. But in the 5th century the city of Argos vanquished the Mycenaeans, and from that time onwards the city of Argos becomes the political centre of the district, while the Heraeum remains the religious centre. And when in the year 423 B.C., through the negligence of the priestess Chryseis, the old temple was burnt down, the Argives erected a splendid new temple, built by jEupolemos, in which was placed the great gold and ivory statue of Hera, by the sculptor Polycleitus, the contemporary and rival of Phidias, which was one of the most perfect works of sculpture in antiquity. Pausanias describes the temple and its contents (ii. 17), and in his time he still saw the riiins of the older burnt temple above the temple of Eupolemos.

All these facts have been verified and illustrated by the excavations of the American ArchsBological Institute and School of Athens, which were carried on from 1892 to 1895. In 1854 Ehangabfi made tentative excavations on this site, digging a trench along the north and east sides of the second temple. Of these excavations no trace was to be seen when those of 1892 were begun. The excavations have shown that the sanctuary, instead of con- sisting of but one temple with the ruins of the older one above it, contained at least eleven separate buildings, occupying an area of about 300 metres by 100 metres.

On the uppermost terrace, defined by the great Cyclopean sup- porting wall, exactly as described by Pausanias, the excavations revealed a layer of ashes and charred wood, below which were found numerous objects of earliest date, together with some remains of the walls resting on a polygonal platform — all forming part of the earliest temple. Immediately adjoining the Cyclopean wall and below it were found traces of small hpuses of the rudest, earliest masonry which are pre-Mycenaean, if not pre-Cyclopean.

We then descend to the second terrace, in the centre of which the substructure of the great second temple was revealed, together with so much of the walls, as well as the several architectural mem- bers forming the superstructure, that it will be possible for the architects to design a complete restoration of the temple. On northern side of this terrace, between the second temple and the Cyclopean supporting wall, a long stoa or colonnade runs from east to west abutting at the west end in structures which evidently contained a well-house and waterworks ; ,while at the eastern end of this stoa a number of chambers were erected against the hill, in front of which were placed statues and inscriptions, the bases for which are still extant. At the easternmost end of this second terrace a large hall with three rows of columns in the interior, with a porch and entrance at the west end facing the temple, is built upon elaborate supporting walls of good masonry.

Below the second terrace at the south-west end a large, and complicated building, with an open courtyard surrounded on three

sides by a colonnade and with chambers opening out towards the north, may have served as a gymnasium or a sanatorium. It is of good early Greek architecture, earlier than the second temple. A curious, ruder building to the north of this and to the west of the second terrace is probably of much earlier date, perhaps of the Mycensean period, and may have served as propylsea.

Immediately below the second temple, at the foot of the elevation on which this temple stands, towards the south, and thus facing the city of Argos, a splendid stoa or colonnade, to which large flights of steps lead, was erected about the time of the building of the second temple. It is a part of the great plan to give worthy access to the temple from the city of Argos. To the east of this large flights of steps lead up to the temple proper.

At the western extremity of the whole site, immediately beside the river bed, we again have a huge stoa running round two sides of a square, which was no doubt connected with the functions .of this sanctuary as a health resort, especially for women, the goddess Hera presiding over and protecting married life and childbirth.

Finally, immediately to the north of this western stoa there is an extensive house of Roman times also connected with baths.

While tlie buildings give archaeological evidence for every period 'of Greek life and history from the pre- Mycensean period down to Eoman times, the topography itself shows that the Herseum must have been constructed before Mycense and without any regard to it. The foot- hills which it occupies form the -western boundary to the Argive plain as it stretches down towards the sea in the Grulf of Nauplia. While it was thus probably chosen as the earliest site for a ditadel facing the sea, its further relation points towards Tiryns and Midea. It could not have been built as the sanctuary of Mycense, which was placed farther up towards the north-west in the hills, and could not be seen from the Herseum, its inhabitants again

Plan of the HER.etTM {swrviyed and drawn by Edward L. Tilton), I, Old Temple; II, Stoa; III, Stoa; IV, East Building; V, 5th-Century Temple; VI, South Stoa; VII, West Building; VIII, North-West Building;

IX, Koman Building; X, Lower Stoa; XI, Phylakeion ; A, B, 0, D, E, F, Cisterns.

not being able to see their sanctuary. The west building, the traces of bridges and roads, show that at one time it did hold some relation to

Mycense ; but this was long after its foundation or the building of the huge Cyclopean supporting wall which is coeval with the walls of Tiryns, these again being earlier than those of Mycense. There are, moreover, traces of still more primitive walls, built of rude small stones placed one upon the other without mortar, which are in character earlier than those of Tiryns, and have their parallel in the lowest layers of Hissarlik.

Bearing out the evidence of tradition as well as archi- tecture, the numerous finds of individual objects in terra- cotta figurines, vases, bronzes, engraved stones, &c., point to organized civilized life on this site many generations before Mycense was built, d, fortiori before the life as depicted by Homer flourished — nay, before, as tradition has it, under Prcetus the walls of Tiryns were erected. We are aided in forming some. estimate of the chrono- logical sequence preceding the Mycenaean age, as suggested by the finds of the Herseum, in the new distribution which Dorpfeld has been led to make of the chronological stratification of Hissarlik in his most recent excavations

of that site. For the lay^er," which he now assigns to the Mycensean period, is the sixth stratum from below. Now, as some of the remains at the Herseum correspond to the two lowest layers of Hissarlik, the evidence of the Argive temple leads us far beyond the date assigned to the Mycensean age, and at least into the second millen- nium B.C. (see also MYCEN.ffi!AN Civilization).

This sanctuary still holds a position of central import- ance as illustrating the art of the highest period in Greek history, namely, the art of the 6th century b.c. under the great sculptor Polycleitus. Though the excavations in the second temple have clearly revealed the outlines of the base upon which the great gold and ivory statue of Hera stood, it is needless to say that no trace of the statue itself has been found. From Pausanias we learn that "the image of Hera is seated and is of colossal size : it is made of gold and ivory, and is the work of Polycleitus." Based on the computations made by the architect of the American excavations, Mr Tilton, on the ground of the height of the nave, the total height of the image, including the base and the top of the throne, would be about 8 metres, the seated figure of the goddess herself about 5-50 metres.

It is probable that the face, neck, arms, and feet were of ivory, while the rest of the figure was draped in gold. Like the Olympian Zeus of Phidias, Hera was seated on an elaborately decorated throne, holding in her left hand the sceptre, surmounted in her case by the cuckoo (as that of Zeus had an eagle), and in her right, instead of an elaborate figure of Victory (such as the Athene Parthenos and the Olympian Zeus held), simply a pomegranate. The crown was adorned with figures of Graces and the Seasons. A Roman imperial coin of Antoninus Pius shows us on a reduced scale the general composition of the figure ; while Antoninus Argive coins of the 5th century give a fairly adequate rendering of the head. A further attempt has been made to identify the head in a beautiful marble bust in the British Museum hithetto known as Bacchus (Waldstein, Journal of Hellenic Studies, vol. xxi. 1901, pp. 30 seq.).

We also learn from Pausanias that the temple was decorated with "sculptures over the columns, representing some the birth of Zeus and the battle of the gods and giants, others the Trojan war and the taking of Ilium." It was formerly supposed that the phrase "over the columns " pointed to the e:^tence of sculptured metopes, but no pedimental groups. JFinds made in the excavations, however, have shown that the temple also had pedimental groups. Besides numerous fragments of nude and draped figures belonging to pedimental statues, a well-preserved' and very beautiftil head of a female diviuity, probably Hera, as well as a draped female torso of excellent work- manship, both belonging to the pediments, have been discovered. Of the metopes also a great number of fragments have been found, together with two almost complete metopes, the one containing the torso of a nude warrior in perfect preservation, as well as ten well- preserved heads. These statues bear the same relation to the sculptor Polycleitus which the Parthenon marbles hold to Phidias ; and the excavations have thus yielded most important material for the illustration of the Argive art of Polycleitus in the 5th century b.c.

See the official publication of the Excavations of the Argive Sermum ; Waldstein; Excavations of the American School of Athens at the Heraion

of Argos, 1892 ; and numerous reports and articles in the American Archaeological Journal since 1892.

(c. w.)

Argostoii. See Greece (loifiAN Islands). ■

Argyll, George John Douglas Campbell,

8th Duke of (1823-1900), British statesman, was born 30th April 1823, and succeeded his father, the 7th duke, in April 1847. He had then already obtained notice as a writer of pamphlets on the disruption of the Church of Scotland, which he strove to avert, and he rapidly became prominent on the Liberal side in Parlia- mentary politics. He was a frequent and eloquent speaker in the House of Lords, and sat as Lord Privy Seal (1852) and Postmaster-General (1855) in the Cabinets of Lord Aberdeen and Lord Palmerston. In Mr Gladstone's Cabinet of 1868 he was Secretary of State for India and infelicitously signalized his term of ofiSce by his refusal, against the advice of the Indian Government, to promise the Ameer of Afghanistan support against Russian aggression, a course which threw that ruler into the arms of Russia and was followed by the second Afghan war. With all the duke's activity and disposition to assert himself, this seems the only memorable political act recorded of him, except his resignation of the office of Lord Privy Seal, which he held in Mr Gladstone's Administration of 1880, from his inability to assent to the Irish land legislation of 1881. He opposed the Home Rule Bill with equal vigour, though Mr Gladstone subsequently stated that, among all the old colleagues who dissented from his course, the duke was the only one whose personal

relations with him remained entirely unchanged. De- tached from party, the duke took an independent position, and for many years spoke his mind with great freedom in letters to the Times on public questions, especially such as concerned the rights or interests of landowners. He was no less active oh scientific questions in their relation to religion, which he earnestly strove to reconcile with the progress of discovery. With this aim he published The Beign of Law (1866), Primeval Man (1869), The Unity of Nature (1884), and numerous essays in literary and scientific journals.

*He also wrote on.the Eastern Question, with especial reference to India, the history and antiquities of lona, patronage in the Church of Scotland, and many other subjects. The duke died 24th April 1900. He was thrice married : first (1844) to a daughter of the sec- ond duke of Sutherland (c^. 1878) ; secondly (1881) to a daughter of Bishop Claughton of St Albans (d. 1894) ; and thirdly (1896) to Ina Erskine M'Neill. His eldest son, then marquess of Lome (&. 1845), married in 1871 the Princess Louise, fourth daughter of H.M. Queen Victoria. Eew men of the duke's era displayed more versatility, and as an orator he ranked very high ; but his treatment of the various themes he handled, if always impressive, was rarely conclusive ; and while doing something to illustrate every subject and promote every cause which he made his own, and retaining for a generation before he died the deepest public respect — duenot only tohis career asa public man, but also to his position as the foremost Scottish noble, and the father-in-law of one of his Sovereign's daughters — he can hardly be said to have left any abiding reputation either as politician, thinker, or man of science, (h. g.) **

Argyllshire, a maritime Highland county of W. Scotland, embracing a number of the Hebrides or Western Isles, bounded on the N. by Inverness, on the E. by Perth and Dumbarton, Loch Long and the Firth of Clyde, on the S. by the Irish Sea, and on the W. by the Atlantic, it is the second largest county in Scotland. ,

Area and Population. — In 1891 the Argyll parts of the parishes of Kilmallie and Small Isles were transferred to Inverness-shire. According to the latest official estimate the area of the county (foreshore excluded) is 2,025,154 acres, or about 3165 square miles. The population was in 1881, 76,440 ; in 1891, 75,003— on the above area, 74,085, of whom 36,292 were males and 37,793 females ; on the old area, taking land only (2,056,402 acres or 3213'1 square miles), the number of persons to the square mile in 1891 was 23, and the number of acres to the person 27-4. In the registration 'county the population decreased between 1881 and 1891 by 1-8 per cent. Between 1881 and 1891 the excess of births over deaths was 6588, and the decrease of the resident population 1451. In 1901 the population was 73,665, a decline of 420. The following table

gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 : —

Tear.

MarriageB.

Births.

Deaths.

Percentage of Illegitimate.

1880 1890 1899

299'

282

303

2108 1803 1749

1557 1360 1338

7-9

6-66

7-6

The birth-rate, death-rate, and marriage-rate were all below those for Scotland. The following table gives the birth-rate, death-rate, and marriage-rate per thousand of the population for a series of years : —

“■ I

18S0.

1881-90.

1890.

1891-98.

1399.

Birth-rate . Death-rate . Marriage-rate .

26-13

19-30

3-71

25-24

17-01

3-88

22-69

17-11

3-54

22-09

16-63

3-86

22-46

17-18

3-89

In 1891 the number of Gaelic-speaking persons in the county was 36,014, of whom 6998 spoke Gaelic only, and there were 52 foreigners. Valuation in 1889-90, £431,554; in 1899-1900, £439,975.

Administration. — The county returns a member to parliament. Inveraray (735) and Campbeltown (8234) are royal burghs, and

Oban (5374) is a parliamentary burgh ; all three belong to the Ayr group of parliamentary burghs. Dunoon, with Kirn and Hunter's Quay, is the principal police burgh (6772). There are 39 civil parishes, 26 of which are divided among four combinations of Islay, Lochgilphead, Lorn, and Mull, with poorhouses at Oban, Lochgilphead, Bowmore, and Campbeltown. The number of paupers and dependants in May 1899 was 2383.' Argyllshire is a sheriffdom, and there are resident sheriffs-substitute at Inveraray, Campbeltown, Oban, and Fort-William, and courts are held also at Tobermory, Lochgilphead, Bowmore in Islay, and Dunoon.

Education.— Foity-sis. school boards manage 159 schools, which had an average attendance of 11,117 in 1898-99, while 10 vol- untary schools, of which 4 are Episcopal and 2 Roman Catholic, had 677. Campbeltown, Dunoop, and Oban have secondary schools, Tarbert public school has a secondary department, and 19 other schools earned grants in 1898 for giving higher educa^ tion. Part of the "residue" grant is spent by the county council in subsidizing navigation and other classes in various schools, short courses in agriculture for farmers, and in providing bursaries.

Agriculture. — The greater part of the soil is moor or moss, in-susceptible of cultivation, and utilized as grouse and deer forest. The acreage under crops in 1898 w only 6-6 per cent, of the whole. Argyllshire is one of the crofting counties, but crofting is by no means universal. It is

predominant in the island of Tiree and the western district of the mainland, but elsewhere farms of moderate size are the rule. In 1895 the average size of the 3272 holdings was 41 acres ; the percentage under 5 acres was 32-64; between 5 and 50 acres 47-10, and over 50 acres 20-26. The number of farms between 50 and 100 acres was 304 ; between 100 and 300, 305 ; between 300 and 500, 30 ; and over 500, 24. Oats are the principal corn crop, only about 1500 acres of barley being sown, and there is no wheat at all. Besides stock-raising there is a good deal of dairying in Kinfcyre, the leading agricultural district. The following table gives the prin- cipal acreages at intervals of five years from 1880 : —

Tear.

Area under Crops.

Corn Crops.

Green Crops.

Clover.

Perma- nent Pasture.

Fallow.

1880 1885 1890 1895 1899

119,219 124,797 133,005 134,063 134,709

23,548 22,830 21,486 20,444 19,912

12,761 11,673 11,282 10,644 10,348

20,180 25,112 27,328 26,999 27,807

61,097

■*63,866*

72,389 75,222 76,137

1597

1316

505

725

460

The following table gives particulars of the live stock during the same years : —

Tear.

Total Horses.

Total Cattle.

Cows or

Heifers in

Milk or Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1899

7204 6930 6662 7025 6367

59,976 62,235 59,627 60,005 61,698

22,385 23,106 22,747 22,446 22,888

1,021,948 1,000,653 1,008,279 1,026,712 984,304

3758 4645 4981 4905 4285

The acreage under wood in 1895 was 48,412, of which 2068 had been planted since 1881. From the commencement of the opera- tion of the Crofters' Act in 1886 down to the end of 1898, 1097 applications to fix fair rent were dealt with by the Commission, and rents airiounting to £6949 were reduced to £4825, and of £12,075 of arrears £7548 were cancelled. The Commissioners have dealt with 146 applications for enlargement of holdings, and have added 4663 acres to existing crofts. At the census of 1891 the number of persons engaged in agriculture was 8234 men and 900 women. Deer forests covered 232,698 acres in 1899, an in- crease of 16,000 since 1883, and their annual value was £7434.

Industries and Trade. — Coarse woollens are still made for home use. The following table gives particulars of the mineral in- dustry for 1885 and 1895 ; the figures showing the output of coal cover Dumfries as well as Argyll : —

Tear.

Coal.

Slate.

Granite.

Tons.

Value.

Tons.

Value.

Tons.

Value.

1885 1895 1899

105,733 113,945 154,786

£24,671 £28,486 £58,690

17,938 34,340 30,580

£25,364 £60,977 £62,440

37,211 66,128

£13,401 £19,156

Fishing is the most important industry. Argyllshire ports and creeks are represented in four fishery districts, but as the Rothesay district comprises only a few Argyll ports, statistics may best be given' for the fishery districts of Inveraray and

Campbeltown, which are exclusively Argyll, and Fort- William, which has 19 Argyll ports out of 26. The following table gives particulars of these three districts in 1890, 1898, and 1899 :—

Tear.

Boats.

Value of Gear.

Eesident Fishermen and Boys.

Total Value of all Fish.

No.

Tons.

Value.

1890 1898 1899

1537 1062 1023

6622 4367 3716

£35,807 £20,000 £20,225

£31,189 £20,823 £20,682

4122 2570 3464

£105,175

£87,929

£101,066

£82,902 of the total value of fish in 1899 was the v,aluB of herrings only; £6992 the value of shell-fish. In the greater part of tlje districts the herrmg fishing is an autumn one. The Lochfyne fishing, which is the most important, lasts from June to January. White fishing is carried on at one or other of the ports all the year round. The number of persons employed in the three districts in connexion with the various branches of the sea fisheries in 1898 was 3873. The railway mileage has been increased by about 56 miles since. 1875, and a light railway (18| m.) from Loch Long to Loch Fyne has been sanctioned.

Authorities. — The (Eighth) Duke of Akgyll. Commercial Principles Applied to the Hire of Land. London, 1877. — Crofts and Farms in the Hebrides. Edinburgh, 1883.— Jorea. Edinburgh, \9,%Q.— Scotland as it Was and Is. Edinburgh, 1S8T.— House of Argyll. Glasgow, 1871. — A. Brown. Memorials of Argyllshire. Greenock, 1889. — Harvie- Brown and Buckley. Vertebrate Fauna of Argyll and the Inner Hebrides. Edinburgh, 1892. — D. Clerk. "On the Agriculture of the County of Argyll" {Trans. ofH. and A Soc. 1878).— T. Gray. Week at Oban. Edinburgh, 1881. — Stewart. Collection of Views of Campbeltown.

(w. W.)

Argyrokastro, or Eegeei, a town of Turkey, on the river Drina in South Albania (Epirus). It is the chief town of the sanjak of the same name, which is one of the four composing the vilayet of Janina as reduced by the annexation of Thessaly to Greece. Its population numbers 9000.

Arica or San Marcos de Arica, a town aad port in the Chilian province of Tacna and capital of the department of Arica, situated in 18° 28′ 8″ S. lat. and 70° 20′ 46″ W. long. Its population in 1895 was 2853. It is the centre of a great mining district, and is connected with Tacna by rail. The territory of Arica and of Tacna fell into Chilian hands during the war of 1879 with Peru. In 1898, 295 vessels of 493,447 tons entered, and 296 of 494,784 tons cleared. The customs dues on imports into Arica in 1897 were 144,713 pesos (gold), and in

1898, 99,084.

Ariege, a department in the S. of France, resting on the Pyrenees and watered by the Ariege.

Area, 1893 square miles. The population declined to 237,619 in 1886 and 219,641 in 1896. Births in 1899, 4004, of which 149 were illegitimate ; deaths, 4374 ; marriages, 1543. The chief towns are Foix, Pamiers, and St Girons. In 1896 the schools numbered 776, with 32,000 pupils. Eight per cent, of the popula- tion was illiterate. The area cultivated was 917,839 acres, of which 353,269 acres was plough-land. The mountains give very good pasture. In 1899 wheat yielded a return of the value of £226,037. Maize is also a profitable culture, as are likewise potatoes, which gave a return of 2,035,145 cwts. in 1898. Among the industrial cultures flax is ‘the only noteworthy one. In 1899 the live stock numbered 573,560 head. Ari6ge produced in 1898 26,000 tons of iron ore, and 23,000 tons. of copper, argentiferous lead, and manganese (mines of Nicdessos). The metallurglo industry yielded 48,000 tons of iron, cast-iron, and steel, of the value of £304,000. The other industries, with the exception of the manufacture of paper, are inconsiderable.

Arish. See Arabia.

Aristides, Apology of.— Until 1878 our knowledge of Aristides was confined to the statement of Eusebius that he was an Athenian philosopher who presented an apology "concerning the faith" to- the Emperor Hadrian. In. that year, however, the Mechi- tarists of S. Lazzao at Venice published a fragment in Armenian from the beginning of the apology; and in 1889 Dr Rendel Harris found the whole of it in a Syriac version on Mount Sinai. While his edition was

passing througli the press, it was observed by the pres- ent writer that all the while the work had been in our hands in Greek, though in a slightly abbreviated fctrm, as it had been imbedded as a speech in a religious novel written about the 6th century and entitled "The Life of Barlaam and Josaphat." The discovery of the Syriac version reopened the question of the date of the work. For although its title there corresponds to that given by the Armenian fragment and by Eusebius, it begins with a formal inscription to "the Emperor Titus Had- rianus Antoninus Augustus Pius": and Dr E. Harris is followed by Harnack and others in supposing that it was only through a careless reading of this inscrip- tion that the work was supposed to have been ad- dressed to Hadrian. If this be the case; it must be placed somewhere in the long reign of Antoninus Pius (138-161). There are, however, no internal grounds for rejecting the thrice^attested dedication to Hadrian his predecessor, and the picture of primitive Chris- tian life which is here found points to the earlier rather than to the later ^date. It is possible that the apology was read to Hadrian in person when he visited Athens, and that the Syriac inscription was prefixed by a scribe on the analogy of Justin's Apology, a mistake being made in the amplification of Hadrian's name.

The Apology opens thus: "I, 0 king, by the provi- dence of God came into the world ; and having beheld the heaven, and the earth, and the sea, the sun and moon, and all besides, I marvelled at their orderly disposition; and seeing the world and all things in it, that it is moved by compulsion, I understood that He that moveth and govemeth it is God. For whatsoever moveth is stronger than that which is moved, and what- soever govemeth

is stronger than that which is governed." Having briefly spoken of the divine nature in the terms of Greek philosopliy, Aristides proceeds to ask which of all the races of men have at all partaken of the truth about God. Here we have the first attempt at a systematic comparison of ancient religions. For the purpose of his inquiry he adopts an obvious threefold division into idolaters, Jews, and Christians. Idolaters, or, as he more gently terms them in addressing the Emperor, "those who worship what among you are said to be gods," he subdivides into the three great world-civilizations — Chaldeans, Greeks, and Egyptians. He chooses this order so as to work up to a climax of error and absurdity in heathen worship. The direct nature- worship of the Chaldeans is shown to be false, because its objects are works of the Creator, fashioned for the use of men. They obey fixed laws and. have no power over themselves. "The Greeks have erred worse than the Chaldeans . . . calling those gods who are no gods, according to their evil lusts, in order that having these as advocates of their wickedness they may commit adultery, and plunder and kill, and do the worst of deeds." The gods of Olympus are challenged one by one, and shown to be either vile or helpless, or both at once. A heaven of quarrelling divinities cannot inspire a reasonable worship. These gods are not even respectable : how can they be adorable ? " The Egyptians have erred worse than all the nations; for they were not content with the worships of the Chaldeans and Greeks, but introduced, moreover, as gods even brute beasts of the dry land and of the waters, and plants and herbs. . . . Though they see their gods eaten by others and by men, and burned, and slain, and rotting, they do not under- stand concerning them that they are no gods."

Throughout the whole of the argument there is strong common-sense and a stem severity unrelieved by con- scious humour. Aristides is engaged in a real contest;

he strikes hard blows, and gives no quarter. He cannot see, as Justin and Clement see, a striving after truth, a feeling after God, in the older religions, or even in the philosophies of Greece. He has no patience with attempts to find a deeper meaning in the stories of the gods. "Do they say that one nature underlies these diverse forms? Then why does god hate

god, or god kill god? Do they say that the histories are myth- ical ? Then the gods themselves are myths, and nothing more."

The Jews are briefly treated. After a reference to their descent from Abraham and their sojourn in Egypt, Aristides praises them for their worship of the one God, the Almighty Creator ; but blames them as worshipping angels, and observing "sabbaths and new moons, and the unleavened bread, and the great fast, and circum- cision, and cleanness of meats." He then proceeds to the description of the Christians. He begins with a statement whi(?h, when purged of glosses by a comparison of the three forms in which it survives, reads thus : "Now the Christians reckon their race from the Lord Jesus Christ ; and He is confessed to be the Son of God Most High. Having by the Holy Spirit come down from heaven, and having been born of a Hebrew virgin. He took flesh and appeared unto men, to call them back from their error of many god-s; and having completed His ■HTonderful dispensation. He was pierced by the Jews, and after three days He revived and went up to heaven. And the glory of His coming thou canst learn, 0 king, from that which is called among them the evangelic scripture, if thou wilt read it. He had twelve disciples, who after His ascent into heaven went forth into the provinces of the world and taught His greatness ; whence they who at this day believe their preaching are called Christians." This passage contains striking correspondences with the second section of the Apostles' Creed. The attribution of the Crucifixion to the Jews appears in several 2nd-century documents; Justin actually uses the words " He was pierced by you " in his dialogue with Trypho the Jew.

" These are they," he proceeds, " who beyond all the nations of the earth have found the truth : for they know God as Creator and Maker of all things, and they worship no other god beside Him ; for they have His command- ments graven on their hearts, and these they keep in expectation of the world to come. . . . Whatsoever they would not should he done unto them they do not to another. . . . He that hath supplieth him that hath not without grudging : if they see a stranger they bring him-under their roof, and rejoice over him, as over a brother indeed, for they call not one another brethren after the fl^sh, but after the spirit. They are ready for Christ's sake to give up their own lives; for His commandments

they securely keep, living holily and righteously, according as the Lord their God hath com- manded them, giving thanks to Him at all hours, over all their food and drink, aud the rest of their good things." This simple description is fuller in the Syriac, but the additional details must be accepted with caution : for while it is likely that the monk who appropriated the Greek may have cut it down to meet the exigencies of his romance, it is the habit of certain Syriac translators to elaborate their originals. After asserting that "this is the way of truth," and again referring for further information to " the writings of the Christians," he says : " And truly this is a new race, and there is something divine mingled with it." At the close we have a passage which is found only in the Syriac, but which is shown by internal evidence to contain original elements : " The Greeks, because they practise foul things . . . turn the ridicule of their foulness upon the Christians." This is

an allusion to the charges of Thyestean banquets and other immoralities, which the early apologists constantly rebut. "But the Christians offer up prayers for them, that they may turn from their error ; and when one. of them turns, he is ashamed before the Christians of the deeds that were done by him, and he confesses to God, saying : 'In ignorance I di^ these things ' ; and he cleanses his heart, and his sins are forgiven him, because he did them in ignorance in former time, when he was blaspheming the true knowledge of the Christians."

These last words point to the use in the composition of this Apology of a lost apocryphal work of very early date, The PreaxMng of Peter. This book is known to us chiefly by quotations in Clement of Alexandria: it was widely circulated, and at one time claimed a place within the Canon. It was used by the Gnostic Heracleon and probably by the unknown writer of the epistle to Diognetus. From the fragments which survive we see that it contained: (1) a description of the nature of God, which closely corresponds with Arist. i., followed by (2) a warning not to worship according to the Greeks, with an exposure of various forms of idolaliry ; (3) a warning not to worship according to the Jews — although they

alone think they know the true God — for they worship angels and are superstitious about moons and sabbaths, and feasts, copip.. Arist. xiv. ; (4) a descrip- tion of the Christians as being "a third race," and worshipping God in "a new way" through Christ; (5) a proof of Christianity from Jewish prophecy; (6) a promise of forgiveness to Jews and. Gentiles who should turn to Christ, because they had sinned " in ignorance " in the former time. Now all these points, except the proof from Jewish prophecy, are taken up and worked out by Aristides with a frequent use of the actual langu.age of The Preaching of Peter. A criterion is thus given us for the reconstruction of the Apology, where the Greek which we have has been abbreviated, and we are enabled to claim with certainty some passages of the Syriac which might otherwise be suspected as interpolations.

*The style of the Apology is exceedingly simple. It is curiously misdescribed by Jerome, who never can have seen it, as "Apologeticum pro Christianis contextum philosophorum sententiis." Jts merits are its recognition .of the helj)lessness of the old heathenism to satisfy human aspiration after the divine, and the impressive simplicity with which it presents the unfailing argument of the lives of Christians. **

The student may consult 2Tie Apology of Aristides, Syriao text and translation (J. B.. Habbis), with an appendix containing the Greek texts, Texts and Studies, i. 1, (1891), and a critical discussion by E. Sebbeeg in Zahn's Forschungen, v. 2 (1893) ; also, brief discussions by Habnack, Altchristl: jEdtteratur, i. ^ff., Chronologie, i. 271 ff., where references to other writers maybe found. (j. A. B.)

Arithmetic. See ZSTumbee.

Arizona. — A territory of the United States, lying on the south-western ^border, between 37° and from 32° -8 to 33° -5 N. lat., and 109° and from 114° -8 to 114° W. long.; and bounded on the E". by Utah, on the E. by New Mexico, on the S. by Mexico, and on the W. by California and Nevada. It is traversed from the north-west to the south-cast, a distance of about 450 miles, by mountain ranges of the Great Basin system, which form the main axis of elevation. On the north- east side, the great Colorado Plateau, with an average elevation of from 6000 to 8000 feet, stretches away into Utah and New Mexico. The southern margin of this

plateau, marked by a line of cliffs, divides the head waters of the Colorado Chiquito from those of the Gila. The pla|eau is donmnated in its middle southern portion,

north of Williams and Flagstaff, by a series of extinct volcanic cones, reaching in San Francisco Mountain an altitude of nearly 13,000 feet, from which in late Tertiary time great floods of lava flowed, chiefly to the southward and westward, forming a protecti'ng cov- ering to the foundation of nearly horizontal sediment- ary rocks through which, on the north side, the Colorado carved the Great Canon. Southward and westward from the central mass of mountains the sur- face slopes away to the Gulf of California in a series of wide valleys, separated by isolated mountain ranges, preserving a general parallelism in a north-west and south-east direction. Of the approximate total area of 113,000 square miles, about 39,000 are below the altitude of 3000 feet ; about 27,000 are from 3000 to 6000 feet, and 47,000 are over 6000 feet. The central mountain ranges are largely formed of granitic, por- phyritic, and other plutonic rocks in great variety, including volcanic outfloT^s and tufas. There are areas of Archaean gneiss and pre-Cambrian slates flanked by Palasozoic formations, especially by the Devonian and Carboniferous. Great beds of Palaeozoic conglomerate and breccias give evidence of continental areas, shal- low oceans, and beaches in the earlier ages, with cur- rents of great volume and power. Well-marked horizons of the Devonian occur in the Santa Catalina and the Santa Eitas. Carboniferous limestones and sandstones are widely distributed in the southern isolated moun- tain ranges and are uplifted, flexed, and faulted. Beds of graphitic coal with much ash and of little or no value for fuel have been found, and show the far west- ward extension of the flora of the Coal Measures. Sand- stones of the Permian underlie a part of the lava of San Francisco Mountain, and Mesozoic . beds crop in many places towards the south and west. Fossil bones and teeth of both the mammoth and the mastodon, and of a giant species of Bos, show, that some at least of the large extinct mammals roamed over the Pleistocene plains a£d valleys.

Shut in on all sides from the ocean by mountain ranges and wide areas of land, Arizona -is without rain for the greater part of the year. The air is clear, and the rays of the unclouded sun have great power. At night the

radiation is unobstructed and the temperature falls rapidly. Owing to the extreme dryness of the air the evaporation from all moist surfaces is rapid, and the high temperatures shown by the dry-bulb thermometer are less oppressive than much lower temperatures in a humid atmosphere. There is a short Season of rain in the spring, and one in midsummer, and the accumulation of snow on the mountains in winter gives rise to springs, rivulets, and forest growth.

The native plants, especially upon the lower levels, are characteristic of arid and semi-desert regions. They are Sonoran rather than Californian in aspect and group- ing. Altitude, with its increasing moisture conditions and lower temperature, is a greater factor in the geographic distribution than latitude. Thorny shrubs, cactacese, and yuccas abound on the plains, together with the mezquite and paloyerde, wherever their deeply-extended roots can reach moisture or water. The Larrea Mexicana, the ever- green shrub with aromatic glossy leaves and bright yellow flowers, is rarely absent and thrives under the most adverse conditions. Of Cacti there are no less than seventy-five species. The giant columnar cactus (Cereus giganteus), sometimes 40 feet high, is a striking object. Along the streams the cottonwood, sycamore, ash, willow, and walnut give verdure and shade. At an elevation of about 4000 feet oak trees appear in cafions and on the foot hills, giving the country the aspect of an artificial park. In the Huachuca Mountains there are eleven

species of oak, most of them evergreen. At higter levels junipers, cedars, and cypress appear and give place in the region of snow to furs and pines which crown the summits of most of the mountain ranges, attaining their greatest development and commercial importance on the Colorado plateau. This is known as the Coconino Forest, and is one of the most extensive forest areas in the United States, a large part of which has been reserved by the Government. The trees are mostly the yellow pine (Pinus ponderosa), and its varietal forms, the most widely disseminated and most abundant tree of the interior forest area, and practically the only tree of com- mercial importance for lumber. It is estimated that the total quantity

of pine lumber fit for sawing within the limits of Arizona is not less than 8,000,000,000 feet B.M. The principal lumber mills are at Flagstaff and Williams in Coconino county.

The manufactures are few and of comparatively small value, excepting lumber. A large flouring mill has been erected at Tucson, and there are also extensive railway repair shops, a foundry, and mining machinery plant. At Phoenix onyx marble is cut and polished by machinery and Indian labour. The Navajo and the Moqui Indians make woollen blankets and rugs, and the Pimas baskets.

There are four chief regions of valleys of great fertility especially adapted to agriculture : the Salt Eiver Valley, the Upper Gila and its tributaries, the Lower Gila and the Colorado, and the Santa Cruz. The Salt Eiver Valley has one of the largest known tracts of irrigable land in one body, estimated at 1,500,000 acres. Numer- ous irrigating canals have partly redeemed it from the desert-like condition to which it relapsed after the dis- appearance of the ancient Aztec population. It is a region of beautiful farms, gardens, and orchards. Alfalfa, the staple forage and hay crop, thrives luxuriantly, and as many as five cuttings a year are possible. In 1898 some 35,000 cattle, fattened on alfalfa, were shipped from this valley. Corn, wheat, and barley are grown, but the region is chiefly celebrated for its early crops of citrus fruits, grapes, figs, dates, pomegranates, and olives. The date-palm flourishes. The most desirable varieties have been introduced. Considerable promise attends the cultivation of the sugar-beet and the experiments upon canaigre as a source of tannin. Excluding farms of Indians, there were in 1900, 4040 farms, containing 1,891,985 acres (of which 12 per cent, were improved land), valued, with improvements, at f 13,088,550. Over 72 per cent, of the total farm acreage in the territory and nearly 20 per cent, of the value of farm property were credited to 71 farms of 1000 acres or more each. In 1899 there were 2052 farms devoted principally to producing hay and grain, and 2343 to live stock. The average value of all farms in the territory was $5148, and of products in 1899 not fed to live stock, per farm, f 1064.. In 1900 there were on farms and ranges 7,042,635 neat cattle, 125,063 horses, 4077 mules, 4625 asses, 861,761 sheep, 18,103 swine, and 98,403 goats. Of the neat cattle nearly 98 per cent, and of the

sheep nearly 100 per cent, were pastured wholly or in part upon the public domain. The value of all live stock was $15,458,717, or 15-7 per cent, of the total capital invested in agriculture. It has been estimated that Arizona is capable of maintaining 8,000,000 head of cattle, but in the past an overstocking of the ranges has caused much loss and suffering, and the almost total eradication of the fine native grasses over extended areas. The total value of all farm crops in 1899 was $2,474,296, of which the hay and forage crops amounted to $1,361,422. The total value of all farm products, in- cluding animals sold or slaughtered for food ($3,204,768), was $6,997,097. Of the total improved land (227,890

acres) outside of Indian reservations in 1899, 81 per cent, was irrigated land; the total increase of irrigated land from 1890 to 1900 was 119,575 acres. In J899 there were 1492 miles of irrigation ditches, the construc- tion cost of which was $4,408,168. The raising of ostriches for their feathers is successful.

The production of copper increased from 17,398 tons in 1890 to 55,412 tons in 1898, and over 76,000 tons in 1899, The chief centres of production are Bisbee, Jerome, Clifton, and Globe. Several gold-mines are worked to a great depth. The production of gold and silver, chiefly gold, was approximately $4,600,000 in value for 1899. Wolframite, an ore of tungsten, occurs in quantity and has been successfully worked. There are also valuable ores of molybdenum and vanadium. Quarries of onyx marble have been opened, and some fine gems of peridot, garnet, and turquoise have been found.

Two transcontinental systems of railways, the Southern Pacific and the Santa ¥6 Pacific, traverse the state from east to west, and are connected from north to south by several lines. There are in all 999-5 miles of railway, with an assessed valuation of $4,189,075.20 on which taxes are paid, and 464 miles of road exempt from taxa- tion for a term of years. A standard gauge railway has been laid from Williams to the Grand Canon.

On 1st July 1899 the county and city funded indebted- ness was $1,634,027.67, and the bonded debt of the terri- tory $1,041,972.43. There are five national banks with an aggregate capital of $400,000, deposits $2,194,773 ; and seven territorial banks, capital $219,700, deposits

$1,364,475.

According to the census of 1890 the population was 69,620. In 1900 it was 122,212, showing an increase for the decade of 62,592, or 104-9 per cent. The increase was due in part to the fact that there were 28,623 Indians or other persons on Indian reservations in 1890, but not included in the general population as shown by the census bulletins. The average number of persons per square mile was 1-0 in 1900, as compared with 0-6 in 1890. The three principal cities. Phoenix (the capital), Tucson, and Prescott, have respectively 6644, 7631, and 3559 inhabitants. The Indian population in 1890 was 68,640. In 1899 the number enrolled at the five Govern- ment agencies and under instruction was 39,744. Many friendly Papagoes in Papagueria are not included. Of the total, 20,600 are upon the Navajo reservations and 2641 at the Hopi Pueblo. The Territorial prison; located at Yuma, had in 1898, 214 male prisoners.

The public-school system was established iu 1871, and is modelled after that of California. There are primary, grammar, and high schools, and two normal schools, one at Tempo in Maricopa county and one at Flagstaff. In 1900 there were 373 teachers, 261 women and 122 men, of whom 120 were graduates of normal schools ; the total number of enrolled students was 16,898, and the average daily attendance 9396. The total expenditure for the school year ending 30th June 1899 was $238,741. The Territorial University, including the School of Mines and the laboratories of the Agricultural Experiment Station, was established at Tucson in 1885 and was opened in October 1891. It has about 20 professors and instructors, and from 140 to 160 students. It is well equipped for instruction and investigation, and is sustained chiefly by the Morrill and Hatch funds amounting to about $45,000 annually. A school for Indians at Phoenix, and one at San Carlos, are sustained by the United States. One at Tucson, with an average of 160 boys and girls, is sup- ported by the Presbyterian Home Mission. There are 63 or more newspapers ; 11 daily and 42 weekly, including 3 published in Spanish. There is an important and well-

selected reference library at the university. The Carnegie Library building, under construction, will receive the valuable Territorial Library collection of some thousands of volumes.

Th? Territorial Assembly meets biennially. A new Capitol of granite and white tufa has been erected at a cost of about $150,000. There have been fourteen dif- ferent governors between 1863 and 1900. There are four •judicial districts, in which court is held twice a year. One chief justice and foui; associates are appointed by the president.

The early Spanish colonists of Mexico were incited to the exploration and settlement of the region by the reports of its wealth of precious metals and precious stones. In 1539 Padre Marco de Niza passed through the valley of the Santa Cruz, and was followed in 1540 by Coronado. A mission was established at Guevaiz, south of Tucson, in 1687, and thirty-three years later there were nine missions within the limits of the territory now known as Arizona. The converts were mostly from the Pima tribe, and after baptism were called Papago. New Mexico, which in- cluded all of Arizona north of the Gila river, was ceded to the United States in 18^8. The strip of country south of the Gila, known as the Gadsden Purchase, was acquired in 1853. Arizona was set off from New Mexico and organized as a territory in 1863.

See Hamilton. Resources of Arizona, 8d edit. 1884. — Beport of the Governor of Arizona to the Secretary of the Interior, 1899. For Grand Canon : Dctton. Tertiary History of the Grand Canon District, 4to. 1882. U.S Gaol. Sur. — Powell. Exploration of the Colorado Biver. 1875. Cattle Industry : Camekon. Beport Gov. Arizona. 1896. Agriculture and Horticulture : Toumbt. Beport Gov. Arizona. 1898.

(w. P. B.)

Arkansas, one of the Southern States of the American Union, situated between 36° 30′ and 33° N. lat., and 89° 49^ and 94° 30′ W. long., and bounded on the W. by the Mississippi, on the S. by Louisiana, on the,E. by Texas and Indian Territory, and on the N. by Missouri. Before 1875, because of the natui'e of its physical features — being swampy in the lowlands, every- where covered with forests, and mountainous in the

north- west— and because, too, of the political conditions after the Civil War, Arkansas attracted but little of the great stream of immigration that had peopled the flat lands to the north and the prairies to the south. The main development of the state dates from 1890. If a line be drawn from where the Black Eiver cuts the northern boundary to where the Red cuts the western, east of it will lie the lowlands and forests, and to the west will lie the mountains. North of the Arkansas river, in the re- gion of the Boston mountains and the Ozarks, the coun- try is very broken. The general elevation of the land is between 800 and 1200 feet above sea-level ; the moun- tains are scattered in broken ridges and spurs as if flung from a gigantic hand, and there are few peaks of imposing height, the loftiest being Boat Mountain and Lost Mountain, each 2200 feet above sea-level. South of the Arkansas, the mountains lie in long high ranges east and west, separated by low fertile valleys, and at times rising into fine and imposing peaks. Magazine Mountain, 2823 feet above sea-level and 2350 feet above the surrounding country, is the loftiest point between the Alleghanies and Rockies, and in beauty and grandeur surpasses the famous Lookout. Blue Mountain, 2800 feet, and Mt Mena (Eich Mountain), 2760 feet, each rises 2100 feet over its valley. The state is well watered, and there are 3000 miles of navigable rivers. Locks have been constructed on White River, a fine stream, navigable 300 miles of its length. In its passage through the mountains White River may be compared with the Hudson for beauty of scenery. Its name it takes from the clearness of its waters, which it remarkably pre- serves through the alluvial lands even to its mouth.

The mineral history of the state may be dated from 1887, when the larger operations in coal began. The coal area covers 9100 square miles in the western part of the state, and extends into the Indian Territory over 20,000 square miles. Its quality is semi-anthracite and semi- bituminous, and, being hard and smokeless, is valuable for domestic and steam uses. From an output of 129,000 short tons in 1887, the production 'had swollen to 1,173,804 tons in 1898. The development is very rapid : in 1901 the daily output was about 10,000 short tons, with an employment of 3020 miners. The production from the adjacent coal-fi4lds of the Indian Territory about doubles that of Arkaiisas. In the northern part of the state 2199 square milesjof lead and zinc fields have been opened, the zinc

fieldslundoubtedly constituting one of the richest deposits in tile world. Between 1888 and

1892 Prof. John C. Braunlr made an exhaustive geolo- gical survey, the result^. <|f which have been published by the state ; and his ar Jpnt of the location, extent, and economic value of mirnP^l deposits has, in several in- stances, led to their practToal development. His reports show that one of the " moat valuable deposits of manga- nese in North America" lies in the north-east, that payable quantities of iron i ,re found in the same section, that 4450 square miles o : marble equal to the best Tennessee varieties are sit' lated in the north, that lime- stone valuable for lime is to be had in inexhaustible quantities, that granites s iperior to any known exist near Little Rock, that themnest novaculites and whet- stones yet found are in abundance in the southern mountains, that antimony knd bauxites are found in abundance, that clays and kaolin fit for manufacture of the best grade of porcelain jexist in great quantities in the south central portion,! and that the greensand, gypsum, and chalk marls In the south, if properly utilized, " will be of more va.ue to the state than all the gold dug within the bounds of California has been to that state." A large deposit of true chalk has been utilized by a company which produces Portland cement. Gold and silver are also to be i°ound, but not in extensive or valuable quantities.

*The alluvial bottoms are exceedingly productive, and the soil and climate of the higher regions are peculiarly adapted to fruit-growing. The *,hief staple is cotton. In 1899, 1,726,000 acres produced 770,000 bales, valued at $30,800,000. In 1897, 922,000 were raised, and the crop of 1900, with an acreage of 1,899,000, was 'estimated at over 900,000 bales, valued at $35,000,000. Other agri- cultural products, in order of value, are corn, oats, wheat, rye, hay, millet, fruits (particularly apples, berries, and peaches), potatoes, field peas, sugar-cane, sorghum, broom corn, and rice. It is estimated that in 1898 the fruit and vegetable shipments were as follows : — Apples, 2400 carloads ; berries, 1000 ; peaches, 500 ; and potatoes, 1200 carloads. The fruit is of finest quality, especially the apples, to which the first prize has been awarded in every competition since 1885, including the World's Fair in*

1893 at Chicago. Lumber has been extensively cut, and in 1898 the shipments amounted to over 50,000 carloads. The annual output of forest products is valued at over $20,000,000. The forests cover oyer 25,000,000 acres.

There are 54 railways (includinjg branches and leased lines worked under distinct name^k with a total of 3052 miles, and an assessed value qf principal systems are the St Loui; Southern, which with branches -an: miles; the St Louis South-Wester:^ and Memphis, 282; the Kansas Oity, Port Scott,/ and Memphis, 162; the Kansas City SoVthern, 153; aiid the St Louis and San Francisco, 108.1 The total assessed value of real estate in 1899 wtls $127,062,908; of

$24,051,139. The Iron Mountain, and eased lines has 1069

412; the Chq6taw

personal property, $62,936,142; total, $189,999,050. The rate of taxation for state purposes was 2^ mills for general revenue, 2 mills for common schools, 1 mill for sinking fund, and ^ of a mill for pensions ; total, 5i mills. The constitution limits taxation by the state to 10 mills, and by counties for county purposes to 5 mills. The statutes limit taxation for city purposes to 5 mills, and for schools to 6 mills. The annual general expenses of the state government average about f 600,000. The total revenue from all sources in 1897 was $2,229,682.

The growth in population is shown by the following table : —

Year.

Whites.

Negroes.

Total.i

1870 1880 1890 1900

362,116 591,631 818,752 944,580

122,169 210,666 309,117 366,856

484,471

802,525

1,128,179

1,311,4.36

The increase for the last decade of the 19th century was 16-25 per cent. The total land surface is approximately 53,045 square mUes, and the average number of persons to the square mile was, therefore, 24-73 in 1900, as compared with 21-27 ten years earlier. Of the cities or towns in the state nineteen had in 1900 a population in excess of 2000, and five in excess of 6000. These five were Little Kock with 38,307, Port Smith with 11,587, Pine Bluff with 11,496, Hot Springs with 9973, and Helena with 5550. The blacks are confined to the eastern part of the state ; slavery never penetrated the mountainous portion, and the conditions there more nearly resemble those of Missouri than of the Gulf States.

The common school system is well developed ; the number of school-houses in 1898 was 4926 ; the value of school properties was $2,294,396. The scholastic popular tion in 1898 was 336,168 whites and 129,397 blacks ; total, 465,565. The total enrolment in 1898 was 224,247 whites and 79,561 blacks ; total, 303,808. The state supports an agricultural and industrial university at Fayetteville. A number of sectarian and private colleges and academies have been established. In 1898 there were in all eight institutions for higher education, all co- educational; the students, including those in the pre- paratory departments, numbered 1072 men and 664 women ; the teachers, 78 men and 30 women. There were 22,708 volumes in the libraries. The state supports a lunatic asylum, a blind school, and a deaf mute institute at Little Eock.

In 1900 there were 7 national banks, with a capital of $1,070,000 ; 104 state banks, with a capital and surplus of $3,855,761 ; 6 private banks, with a capital and sur- plus of $196,291 ; and 2 loan and trust companies, with capital and surplus of $79,000.

There were 3791 church edifices, and the church property was valued at $3,266,663. The communicants or members numbered 296,208, of whom 128,724 were Baptists, 123,316 Methodists, 18,022 Presbyterians, and 14,385 Disciples of Christ.

After the Eeconstniction Act of 1867, all offices, state and county, fell into the hands of " carpet-baggers," who inaugurated a reign of force and corruption. The native whites, practically disfranchised, fell under a rule of strangers, based on a suffrage conferred on their former slaves. In political self-defence, they responded with force and with frauds against the ballot. Secret societies were formed, such as the Ku Klux Klan on the one side, and the Brothers of Freedom on the other. The reconstruction governor organized a militia and declared martial law in several counties, but this only aggravated the mischief. In 1873, the "regular" Republicans elected Elisha Baxter as governor over

1 Including Indians and Chinese.

Joseph Brooks, the nominee of the reform Republicans. The Democrats had no candidate, but supported Brooks. Govei-nor Baxter, by an honest and just conduct of the administration, soon alienated the affections of the " regular " Republicans who had elected him. Deserting him, they joined Brooks in a legal contest for the office. The Republican Court, in which the contest was filed on 15th April 1874, entered judgment for Brooks in the absence of Baxter and without notice. Brooks in person, accom- panied by a guard, went to the State House, ousted Baxter, and entrenched himself there. The Democrats, espousing Baxter's cause, flew to arms. The turmoil that followed is known as the Brooks-Baxter War. The matter was referred to the President, and the attorney-general delivered an opinion favourable to Baxter. On 15th May the President issued a proclamation de- claring him entitled to the office, and ordering the Brooks forces to disperse. Since then, the state has been in the hands of the Democratic party. (e. e. b.)

Arkansas City, a city of Cowley county, Kansas, U.S.A., situated in 37° 04′ N. lat. and 97° 03′ W. long., near the southern boundary of the state, on the north bank of the Arkansas, at an altitude of 1073 feet. Its site is a level bottom land, and its streets are laid out according to a regular plan. It is a supply point for a rich agricul- tural region and is entered by four lines of railway, the Atchison, Topeka, and Santa Fe ; the Missouri Pacific ; the St Louis and San Francisco ; and the Kansas South- Western railways. Population (1900), 6140.

Arkhangelsk, or Archangel, a government of N. Russia, on the Arctic Ocean. Area, 331,505 sq. miles. Population (1897), 347,589. The peninsula of Kola, as also th« islands Kolguev, Vaigach, and Novaya Zemlya, belong to it. In 1899, 170,640 acres were under cereals. Forests cover nearly one-half of the total area, and provide hunting, as well as an opportunity for various important industries connected with wood (timber, pitch, and tar, etc.). Cattle-breeding is at a low stage ; but there were in 1897, 42,600 horses, 105,760 cattle, and 126,000 sheep, and the race of Kholmogory cows is kept in high repute. The coasting trade between the town of Arkhangelsk and the Murman or Norman coast and St Petersburg has lately been on the increase, but the value of foreign ex- ports has declined (£1,234,390 in 1874, and £833,823 in 1898 ; imports, £130,000). Archangel is divided into ten districts, of which the chief towns are — Arkhangelsk (population, 20,933 in 1897), now connected by a railway (625 miles) with Yaroslavl; Kem (1825); Kola (616); Kholmogory (1465) ; Mezen (2040) ; Onega, (2700) ; Ust Tzylma, in Pechora district ; Pinega (1000) ; and Shen- kursk (1308). A new military harbour has been established on the Murman coast at Alexandrovsk, in the unfreezing Ekaterininskaya Bay.

Arklow, a maritime town in the county of Wicklow, Ireland, 50 miles south of Dublin by rail. In 1882 an Act was passed providing, for the improvement of the harbour and for the appointment of harbour commis- sioners. The town hall and the new Protestant church (1899) were both the gift of the Earl of Carysf ort. Cordite works have recently been established. The number of vessels registered in the fishing district in 1898 was 170, employing 808 men and boys. Population, 4172.

Arlington, (1) a town of Middlesex county, in eastern Massachusetts, U.S.A., traversed by the Boston and Maine railway ; known until 1867 as West Cam- bridge. Population (1900),' 8603. (2) A soldiers' cemetery under the control of the U.S. Government, situated in northern Virginia, in Alexandria county, on the bluffs of the south bank of the Potomac, opposite the city of Washington. Sixteen thousand victims of the Civil War, among them numerous prominent officers, including General Sheridan, are buried here.

The place was formerly the estate of the Lee family, and was confiscated by the Government, the family finally receiving payment for it. The grounds are beautifully laid out, and the old Lee mansion remains unchanged.

Armagh, an inland county of Ireland, province of Ulster, bounded on the N. by Lough Neagh, on the W. by Down, on the S. by Louth, and on the W. by Monaghan and Tyrone.

Population. — The area of tlie administrative county in 1899 was 312,659 acres, of whicli 132,269 were tillage, 141,456 pasture, 514 fallow, 3141 plantation, 6416 turf bog, 2493 marsh, 7473 barren mountain, and 18,898 water, roads, fences, &c. The new adminis- trative county under the Local Government (Ireland) Act, 1898, does not include the portion of the town of Newry, formerly situated in Armagh. Population (1881), 163,177; (1891), 143,289 ; (1901), 125,238, of whom 59,687 were males and 65,551 females, divided as follows among the different religious sects : — Roman Catholics, 56,707 ; Protestant Episcopalians, 40,853 ; Presbyterians, 20,029 ; Methodists, 5066 ; and other denominations, 2683. The decrease of population between 1881 and 1891 was 12-19 per cent, and between 1891 and 1901 it was 9-2 per cent. Of the total population in 1891, 107,180 persons inhabited the rural districts, an average of 256 persons to each square mile under crops and pasture.

Education. — The following table gives the degree of >education in 1891 :—

Males.

Females.

Total.

Percentage.

B.C.

Pr. Epis.

Presb.

Bead and write . Read only . . lUiterate . . .

41,979 8,078 10,864

42,881 12,824 13,120

84,860 20,402 28,984

65-9 17-3 26-8

68-1 16-6 15-8

82-6

11-3

6-1

In 1881 the percentage of illiterates among Roman Catholics was 32-6. In 1891 there were 19 superior schools with 428 pupils (133 Roman Catholics and 296 Protestants), and 290 primary schools with 20,655 pupils (8996 Roman Catholics and 11,659 Protestants). The number of

pupEs on the rolls of the national schools on 30th September 1899 was 24,332, of whom 10, 795 were Roman Catholics and 13,537 Protestants.

The following table gives the number of births, deaths, and marriages in various years : —

Tear.

Births.

Deaths.

Marriages.

1881 1891 1899

4874

3394 2842

3665 2926 2480

982 694 683

In 1899 the birth-rate per 1000 was 20-6, and the death-rate 18-0 ; the rate of illegitimacy was 3-6 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1899 was 93,620, of whom 52,339 were males and 41,281 females. The following are the chief towns in the county, with their populations in 1901 : — Armagh, 7569 ; Lurgan, 11,777 ; Portadown, 10,046. A portion of the borough of Newry was formerly in Armagh, but in 1898 it was added to Down.

Administration. — The county is divided into three parliamentary divisions, north, middle, and south, the number of registered electors in 1900 being respectively 10,114, 7363, and 7152. The rateable value in 1900 was £430,162. By the Local Govern- ment (Ireland) Act,, 1898, the fiscal and administrative duties of the grand jury and (to a less extent) of other bodies were trans- ferred to a county council, urban and rural

district councils were established, and under that Act the county now comprises four urban and five rural sanitary districts.

Agriculture. — The following tables show the acreage under crops, including meadow and clover, and the. amount of live stock in 1881, 1891, 1896, and 1899. The ^ures for 1899 are for the new ad- ministrative county : —

Horses

and Mules.

Asses.

Cattle.

Sheep.

Pigs.

Goats.

Poultry.

1881 1891 1896 1899

18,988 14,969 16,867 14,001

2124 2469 2382 2894

77,008 88,624 86,887 88,748

8,970 25,216 18,674 21,093 ,

21,888 31,442 27,957 26,960

9,250

10,686

9,216

8,689

896,256 470,678 640,099 616,914

Wheat.

Oats.

Barley,

Beans,

etc.

Potatoes.

Turnips.

Other green Crops.

Flax.

Meadow

and Clover.

Total.

1881 1891 1895 1899

7161 2758 1204 1463

68,165 61,055 49,054 46,844

879 846 237 179

28,150 26,484 24,602 22,870

7789 8049 8198 8227

2075 2592 1965 1729

16,012 4,966 8,244 1,881

45,172 49,971 53,121 60,121

165,358 146,171 146,620 182,269

Por 1899 the total value of the cereal and other crops was estimated by the Registrar-General at £866,848. The number of acres under pasture in 1881 was 112,655 ; in 1891, 126,130 ; and in

1899, 141,466.

The number of milch cows in 1891 was 31,311, and in 1899, 30,848. It IS estimated that the total value of cattle, sheep, and pigs in 1899 was £1,158,077. In 1899 the number of holdings not exceeding 1 acre was 1690 ; between 1 and 6, 3735 ; between 6 and 15, 8365 ; between 15 and 30, 4334 ; between 30 and 50, 1401 ; between 50 and 100, 532 ; between 100 and 200, 95 ; between 200 and 600, 20 ; and above 500, only 1 — total 20,163. The number of loans issued (the number of tenants being the same as the num- ber of loans) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1900, was 1360, amounting to £337,101. The number of loans sanctioned for agricultural improvements under sect. 31 of the Land Act, 1881, between 1882 and 1900 was 99, and the amount issued, £5203, the smallest amount issued in any Irish county. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations to 31st March 1900 was £22,363, also the smallest amount issued in any Irish county, (- w^. h. p.)

Armagh, a city in the above county, 64 miles N. of Dublin, and 30 S.W. of Belfast by rail. It ceased to be a parliamentary borough in 1885. The corporation was abolished in 1841, and the administration since 1898 has been in the hands of an urban district council. The Callan, which flows

into the Blackwater, passes near the town, and tKe Ulster canal is within 4 miles. There are frequent markets and a fair once a month. Population

(1881), 10,070; (1891), 7438; (1901), 7569.

Armavir. Two places of this name must be men- tioned. (1) The ruins of the old capital of Armenia, on the S.E. slope of the extinct volcano Ala- ghoz, built by Armais, a grandson of Haik, in 1980 b.c. and the capital of the Armenian kings till the 2nd century a.d. Now a small village, Tapadibi, occupies its seat. (2) A district town of Russia, Northern Caucasia, province of Kuban, on Kuban river, and on the main line of the Caucasia,n rail- way, 40 miles by rail west of Stavropol, built in 1848 for the settlement of Armenian mountaineers, and now a wellr built, growing town with 8000 inhabitants, the merchants of which carry on a lively trade.

Armenia (old Persian Armina, AnaemsLO. Hayasdan, or Haikh) is the popular name of a district south of the Caucasus and Black Sea, which formed part of the old Armenian kingdom. The name, which first occurs in the cuneiform inscriptions of Darius Hystaspis, supplanted the earlier Urardhu, or Ararat, but its origin is unknown. In its widest extent Armenia stretched from 37° to 49° E. longitude, and from 37° to 41i° N. latitude ; but this area was never, or only for a brief period, united under one king. Armenia is now divided between ‘ Persia, Russia, and Turkey, and the three boundaries have a common point on Little Ararat.

Geographically, Armenia is a continuation westward of the great Iranian plateau. On the north it descends abruptly to the Black Sea ; on the south it brpaks down in rugged terraces to the lowlands of Mesopotamia ; and on the east and west it sinks more gradually to the lower plateaux of Persia and Asia Minor. Above the general level of the plateau, 6000 feet, rise bare ranges of mountains, which run from north-east to south-west at an altitude of 8000-12,000 feet, and culminate in Ararat, 17,100 feet. Between the ranges are broad elevated valleys, through which the rivers of the plateau flow before enter- ing the rugged gorges that convey their waters to lower levels. Geologically, Armenia consists of archaic rocks uponwhich, towards the north, are superimposed Palseozoio

and towards tlie south later sedimentary rocks. The last have been pierced by volcanic outbursts that ex- tend southward to Lake Van. Amongst the higher mountains are the two Ararats; Ala-geuz Dagh, north of the Aras ; Bingeul Dagh, south of Erzeriim ; and the peaks near Lake Van. The rivers are the Euphrates, Tigris, Aras, Choruk Su, and Kelkit Irmak, all rising on the plateau. The more important lakes are Van, 5100 feet, about twice the size of the Lake of Geneva, and Urmia, 4000 feet, both salt; Gokcha or Sevan, 5870 feet, discharging into the Aras; and Chaldir, into the Kars Chai. The aspect of the plateau is dreary and monotonous. The valleys are wide expanses of arable land, and the hills are for the most part grass-covered and treeless. But the gorges of the Euphrates and Tigris, and their tributaries, cannot be surpassed in wildiess and grandeur. The climate is varied. In the higher districts the winter is long and the cold severe ; whilst the summer is short, dry, and hot. In Erzerum the temperature ranges from —22° to 84° F., and snow sometimes falls in June. In the valley of the Aras, and in the western and south- ern districts, the climate is more moderate. Most of the towns lie high, from 4000 to 6000 feet. The villages are usually built on gentle slopes, in which the houses are partially exca- vated as a protection against the severity of the weather. Many of the early towns were on or near the Araxes, and amongst their ruins are the remains of churches which throw light on the history of Christian archi- tecture in the east. Ar- menia is rich in mineral wealth, and there are many hot and cold mineral springs. The vegetation varies ac- cording to the locality. Ce- reals and hardy fruits grow on the higher ground, whilst rice is cultivated in the hot, well-watered valley of the Araxes. The summer is so hot that the vine grows at much higher altitudes than it does in Western Europe, and the cotton tree and all southern fruit trees are cultivated in the' deeper valleys. On the fine pasture lands which now sup- port the flocks of the Kurds, the horses and mules, so celebrated in ancient times, were reared. Trout are found in the rivers, and a small herring in Lake . Van.

Population. — ^Accurate statistics cannot be obtained ; but it is estimated that in the nine vild,yets, which include Turkish Armenia, there are 925,000 Gregorian, Roman Catholic, and Protestant Armenians, 645,000 other Christians, 100,000 Jews, Gypsies, &c., and 4,460,000 Moslems. The Armenians, taking the most favourable estimate, are in a majority in nine kazas or sub-districts only (seven near Van, and two near Miish) out of 159. In Russian Armenia there are 960,000 Armenians, and in Persian Armenia 130,000. According to an estimate made by General Zelenyi for the Caucasus Geographical Society (Zapiski, vol. xviii., Tiflis, 1896, with map), the population of the nine Turkish vilayets, Erzerum, Van, Bitlis, Kharput, Diarbekr, Sivas, Aleppo, Adana, and Trebizond, was 6,000,000 (Armenians, 913,875, or 15 per cent.; other Christians, 632,875, or 11 per cent.; and

Moslems, 4,453,250, or 74 per cent.). In the first five vilayets, which contain most of the Armenians, the popu- lation was 2,642,000 (Armenians, 633,250, or 24 per cent. ; other Christians, 179,875, or 7 per cent. ; and Moslems, 1,828,875, or 69 per cent.) ; and in the seven Armenian kazas the population was 282,375 (Armenians, 184,875, or 65 per cent. ; other Christians, 1000, or 0-3 per cent. ; and Moslems, 96,500, or 34-7 per cent.). In 1897 there were 970,656 Armenians in Russia, of whom 827,634 were living in the provinces of Erivan, Elizabethpol, and Tiflis.

History.— The history of Armenia has been largely in- fluenced by its physical features. The isolation of the valleys, especially in winter, encouraged a tendency to separation, which invariably showed itself when the central power was •^eak. The rugged mountains have always been the home of hardy mountaineers impatient of control, and the sanctuary to which the lowlanders fled for safety in times of invasion. The country stands as an open doorway between the east and the west. Through its long valleys run the roads that connect the Iranian

iff. V.Darbiskire Sr.O.J.R.Howarth .

EnglMiks ^

SKETCn Map of Abmehu.

plateau with tha fertile lands and protected harbours of Asia Minor, and for its possession nations havS contended from the remotest past.

The early history of Armenia, more or less mythical, is partly based on traditions of the Biainian kings (see Arakat), and is interwoven with the Bible narrative, of which a knowledge was possibly obtained from captive Jews settled in the country by Assyrian and Babylonian monarchs. The legendary kings are but faint echoes of the kings of Biainas; the story of Semiramis and Ara is but another form of the myth of Venus and Adonis ; and tradition has clothed Tigranes, the reputed friend of Cyrus, with the transient glory of the opponent of LucuUus. The fall of the Biainian kingdom, perhaps overthrown by Cyaxares, was apparently soon followed by an immigration of Aryan (Medo-Persian) races, including the progenitors of the Armenians. But they spread slowly, for the "Ten Thousand," when crossing the plateau to Trebizond, 401400 b.c, met no Armenians after leaving the villages four days' march beyond the Teleboas, now Kara Su. Under the Medes and Persians Armenia was a satrapy governed by a member of the reigning family ; and after the battle of Arbela, 331 B.C., it was ruled by Persian governors histo^. appointed by Alexander and his successors. Ardvates, 317-284 b.c, freed himself from Seleucid control ;

and after tlie defeat of Antioohus the Great by the Eo- mans, 190 B.C., Artaxias (Ardashes), and Zadriades, the governors of Armenia Major and Armenia Minor, became independent kings, ~~with the concurrence of Rome. Artax~~ ias established his capital at Artaxata on the Araxes, and his most celebrated successor was Tigranes (Dikran), 94- 66 B.C., the son-in-law of Mithradates. Tigranes founded a new capital, Tigranocerta, in Northern Mesopotamia, which he modelled on Nineveh and Babylon, and peopled with Greek and other captives. Here, and at Antioch, he played

the part of " great-king " in Asia until his refusal to surrender his father-in-law involved him in war with Eome. Defeated, 69 b.c, by LucuUus beneath the walls of his capital, he surrendered his conquests to Pompey, 66 B.C., who had driven Mithradates across the Phasis, and was permitted to hold Armenia as a vassal state of Rome. The campaigns of LucuUus and Pompey brought Rome into delicate relations with Parthia. Armenia, although politically dependent upon Rome, was connected with Parthia by geographical position, a common language and faith, intermarriage, and similarity of arms and dress. It had never been Hellenized, as the provinces of Asia Minor had been; the Roman provincial system was never applied to it; and the policy of Rome towards it was never consistent. The country became the field upon which the East and the West contended for mastery, and the strug- gle ended for a time in the partition of Armenia, a.d. 387, between Rome and Persia. The Roman portion was soon added to the Diocesis Pontica. The Persian portion, Pers- Armenia, remained a vassal state under an Arsaicid prince until 428. It was afterwards governed by Persian and Armenian noblemen selected by the "great- king," and entitled marzbans. Before the partition, Tiri- dates, converted by St Gregory, "the Illuminator," had established Christianity as the religion of the state, and set an example followed later by Constantine. After the partition, the invention of the Armenian alphabet, and th^ translation of the Bible into the vernacular, 410, drew the Armenians together, and the discontinuance of Greek in the Holy OfiBlces relaxed the ecclesiastical dependence on Constantinople, which ceased entirely when the Patri- arch, 491, refused to accept the decrees of the Council of Chalcedon. The rule of the marzbans was marked by relentless persecution of the Christians, forced conver- sions to Magism, frequent insurrections, and the rise to importance of the great families founded by men of Assyrian, Parthian, Persian, Syrian, and Jewish origin, and in some cases of royal blood, who had been govern- ors of districts, or holders of fiefs under the Arsacids. Amongst the marzbans were Jewish Bagratids and Per- sian Mamegonians ; and one of the latter family, Vartan, made himself independent (571-578), with Byzantine aid. In 632 the victories of Heraelius restored Armenia to the Byzantines; but the war that followed the Arab inva- sion, 636, left the country in the hands of the khalifs, who set over it Arab and Armenian governors (pstikans). One of the governors, the Bagratid Ashod I., was cro-^rned

king of Armenia by the khalif Mutamid, 885, and founded a dynasty which ended with Kagig II. in 1079. A little later the Ardzrunian Kagig, governor of Vaspuragan or Van, was crowned king of that province by the khalif Muktadir, 908, and his descendants ruled at Van and Sivas until . 1080. 10Mi Bagratids founded dynasties at Kars, 962-1080, and in Georgia, which they held until its absorption, 1801, by Russia. From 984 to 1085 the country from Diarbekr to Melasgerd was ruled, under the suzerainty first ol Arabs, then of Byzantines and Seljuks, by the Mervanid dynasty of Kurds, called princes of Abahuni ("ATraxouv^s). The Arab invasion drove many Armenian noblemen to Constantinople, where they inter-

married with the old Roman families or became soldiers of fortujie. Artavasdes, an Arsacid, usurped the Byzan- tine throne for two years ; Leo V., an Ardzrunian, and John Zimiskes, became emperors; whilst Manuel, the Mamegonian, and others were amongst the best generals of the empire. In 991, and again in 1021, Basil II. in- vaded Armenia, and in the latter year Senekherim, king of Vaspuragan, exchanged his kingdom for Sivas and its territory, where he settled down with many Armenian emigrants. Basil's policy was to make the great Arme- nian fortresses, garrisoned by imperial troops, the first line of defence on his eastern frontier; but it failed in the hands of his feeble successors, who thought more of converting heretical Armenia than of defending its fron- tier. The king of Ani, Kagig II., was compelled to ex- change his kingdom for estates in Cappadocia. The country was raided by Seljuks and harried by Byzantine soldiers, and the miseries of the people were regarded as gain to the Orthodox church. After the defeat and cap- ture of Romanus IV. by Alp Arslan, 1071, Armenia formed part of the Seljiik empire until it split up, 1157, into petty states, ruled by Arabs, Kurds, and Seljuks, who were in turn swept away by the Mongol invasion, 1235. For more than three centuries after the appear- ance of the Seljuks, Armenia was traversed by a long succession of nomad tribes' whose one aim was to secure good pasturage for their flocks on their way to the richer lands of Asia Minor. The cultivators were driven from the plains, agriculture was destroyed, and the country was seriously impoverished when its ruin was completed by the ravages and wholesale butcheries of Timiir. Many Armenians fled to the mountains where they embraced IsMm, and intermarried with the

Kurds, or purchased security by paying blackmail to Kurdish chiefs. Others migrated to Cappadocia or to Cilicia, where the Bagratid Rhupen had founded, 1080, a small principality which, gradually extending its limits, became the kingdom of Lesser Arnjenia. This Christian kingdom in the midst of Moslem states, hostile to the Byzantines, giving valu- able support to the leaders of the Crusades, and trading with the great commercial cities of Italy, had a stormy existence of about 300 years. Internal disorders, due to attempts by the later Lusignan kings, to make their sub- jects conform to the Roman Church, facilitated its con- quest by Egypt, 1375. The memory of Kiligia (Cilicia) is enshrined in a popular song, and at Zeitiin, in the recesses of Mount Taurus, a small Armenian community has hith- erto maintained almost complete independence. After the death of Timur, Armenia formed part of the territo- ries of th^ Turkoman dynasties of Ak- and KararKoyunlu, and under their milder rule the seat of the Katholikos, which, during the Seljiik invasion, had been moved first to Sivas, and then to Lesser Armenia, was re-established, 1441, at Echmiadzin.

In 1514, the Persian campaign of Selim I. gave Armenia to the Osmanli Turks, and its reorganization was entrusted to Idris, the historian, who was a Kiird of Bitlis. Idris found the rich arable lands almost deserted, and the mountains brist- ling with the castles of independent chieftains, of Kurd, Arab, and Armenian descent, between whom there were long-standing feuds. He compelled the Kiird^ to settle on the vacant lands, and divided the country into small sanjaks which in the plains were governed by Turkish offi- cials, and in the mountains by local chief s. This policy gave rest to the country, but favoured the growth of Kurd in- fluence and power, which by 1534 had spread westwards to Angora. Armenia was invadfed by the Persians in 1575, and again in 1604, when Shah Abbas transplanted many thousand Armenians from Julfa to his new capital

Modem times.

Isfahan. In 1639, the province of Erivan, which included Echmiadzin, was assigned by treaty to Persia, and it remained in her hands until it passed to Russia, 1828, under the treaty of Turkman-chai. The Turko-Eussian war of 1828-29, which advanced the Russian frontier to the Arpa Chai, was followed by a large emigration of Armenians from Turkish to Russian territory, and a smaller exodus took place after the war of 1877-78, which gave Batum, Ardahan, and Kars to Russia. In 1834 the independent power of the Kurds in Armenia was greatly curtailed; and risings under Bedr Khan Bey in 1843, and Sheikh ObeiduUah in 1880, were firmly suppressed.

Gregorian Armenians. — After the capture of Constanti- nople, 1453, Muhammad II. organized his non-Moslem subjects in communities, or millets, under ecclesiastical chiefs to whom he gave absolute authority in civil and religious matters, and in criminal offences that did not come under the Moslem religious law. Under this sys- tem the Armenian bishop of Brusa, who was appointed patriarch of Constantinople by the Sultan, became the civil, and practically the ecclesiastical head of his com- munity {Ermeni millet), and a recognized officer of the Imperial Government with the rank of vizier. He was assisted by a council of bishops and clergy, and was rep- resented in each province by a bishop. This imperium in imperio secured to the Armenians a recognized position before the law, the free enjoyment of their religion, the possession of their churches and monasteries, and the right to educate their children and manage their munici- pal affairs. It also encouraged the growth of a community life, which eventually gave birth to an intense longing for national life. On the other hand it degraded the priesthood. The priests became political leaders rather than spiritual guides, and sought promotion by bribery and intrigue. Education was neglected and discouraged, servility and treachery were developed, and in less than a century the people had become depraved and degraded to an almost incredible extent. After the issue, 1839, of the Hatt-i-Sherif of Giil- khaneh, the tradesmen and artisans of the capital freed themselves from clerical control. Under regulations, approved by the Sultan in 1862, the patriarch remains the official representative of the com- munity, but all real power has passed into the hands of clerical and lay councils elected by a representative assembly of 140 members. The "community," which

excluded Roman Catholics and Protestants, was soon called the "nation," "domestic" became "national" af- fairs, and the "representative" the "national" assembly.

Roman Catholics. — The connexion of "Lesser Ar- menia " with the Western Powers led to the formation, 1335, of an Armenian fraternity, " the Unionists," which adopted the dogmas of the Roman church, and at the council of Florence, 1439, was entitled the "United Armenian Church." Under the millet system the unionists were frequently persecuted by the patriarchs, but this ended in 1830, when, at the intervention of France, they were made a community {KatoluTc millet), with their own ecclesiastical head. The Roman Cath- olics, through the works issued by the Mekhitarists at Venice, have greatly promoted the progress of educa- tion and the development of Armenian literature. They are most numerous at Constantinople, Angora, and Smyrna.

Protestants. — The Protestant movement, initiated, 1831, at Constantinople by American missionaries, was opposed by the patriarchs and Russia. In 1846 the patriarch anathematized all Armenians with Protestant sympar thies, and this led to the formation of the " Evangelical Church of the Armenians," which was made, after much opposition from France and Russia, a community {Prot- estant millet), at the instance of the British ambassador.

The missionaries afterwards founded colleges on the Bosporus, at Kharpiit, Marsivan, and Aintab, to supply the needs of higher university education, and they opened good schools for both sexes at all their stations. Every- where they supplied the people with pure, wholesome literature, and represented progress and religious liberty.

When Abdul Hamid came to the throne, 1876, the condition of the Armeaians was better than it had ever been under the Osmanlis ; but with the close of the war of 1877-78 came the "Armenian ^^^^ Question." By the Treaty of San Stefano, Turkey engaged to Russia to carry out reforms " in the provinces inhabited by the Armenians, and to guarantee their security against the Kurds and Circassians." By the Treaty of Berlin, 13th July 1878, a like engagement to the six signatory Powers was substituted for that to Russia. By the Cyprus Convention, 4th June 1878, the Sultan

promised Great Britain to introduce necessary reforms " for the protection of the Christians and other subjects of the Porte " in the Turkish territories in Asia. The Berlin Treaty encouraged the Armenians to look to the Powers, and not to Russia for protection; and the Convention, which did not mention the Armenians, was regarded as placing them under the special protection of Great Britain. This impression was strengthened by the action of England at Berlin in insisting that Russia should evacuate the occupied territory before reforms were introduced, and so removing the only security for their introduction. The presentation of identic and col- lective notes to the Porte by the Powers, in 1880, produced no result, and in 1882 it was apparent that Turkey would only yield to compulsion. In 1881 a circular note from the British Ministry to the five Powers was evasively answered, and in 1883 Prince Bisftiarck intimated to the British Government that Germany cared nothing about Armenian reforms and that the matter had better be allowed to drop. Russia had changed her policy towards the Armenians, and the other Powers were indifferent. The so-called "Concert of Europe" was at an end, but down to 1894 British ministries called the atten- tion of the Sultan to his obligations under the Berlin Treaty.

Russia began to interest herself in the Armenians when she acquired Georgia in 1801 ; but it was not until 1828-29 that any appreciable number of them became her subjects. She found them necessary to the poih^." development of her new territories, and allowed them much freedom. They were permitted, within certain limits, to develop their national life; many became wealthy, and many rose to high positions in the military and civil service of the state. After the war of 1877-78 the Russian Consuls in Turkey encouraged the formation of patriotic committees in Armenia, and a project was formed to create a separate state, under the supremacy of Russia, which was to include Russian, Persian, and Turkish Armenia. The project was favoured by Loris Melikof, then all-powerful in Russia, but in 1881 Alexander II. was assassinated and shortly afterwards a strongly anti- Armenian policy was adopted. The schools were closed, the use of the Armenian language was discouraged, and attempts were made to Russify the Armenians and bring them within the pale of the Russian Church. All hope of practical self-

government underf||fbian protection now ceased, and the Armenians of Tiflis turned their attention to Turkish Armenia. They had seen the success of the Sclav committees in creating disturbances in the Balkans, and became the moving spirit in the attempts to produce similar troubles in Armenia. Russia made no real effort to check the action of her Armenian subjects, and since 1884 she has steadily opposed any active interference by Great Britain in favour of the Turkish Armenians. When

Eclimiadzin passed to Eussia, in 1828, the Katholikos began to claim spiritual jurisdiction over the whole Ar- menian Church, and the submission of the patriarch of Constantinople was obtained by Eussia when she helped Turkey in her war with Egjrpt. Eecently Eussia has secured the submission of the independent Katholikos of Sis, and has thus acquired a power of interference in Ai-menian affairs in all parts of the world. During 1900 Eussia showed renewed interest in Turkish Armenia by securing the right to construct all, railways in it, and in the Armenians by pressing the Porte to restore order and introduce reforms.

, The Berlin Treaty was a disappointment to the Gregorian Armenians, who had hoped that Armenia and Cilicia would have been formed into an autonomous province administered by Christians. But the formation of such a province was impossible. The Gregorians were scattered over the empire, and, except in a few small districts, were nowhere in a majority. Nor were they bound together by any community of thought or senti- ment. The Turkish-speaking Armeniaps of the south could scarcely converse with the Armenian-speaking people of the north ;> and the ignorant mountaineers of the east had nothing in common, except religion, with the

highly-educated townsmen of Constantinople Revoia- an,j Smyrna. After the change in Eussian movement policy and the failure of the Powers to secure

reforms, the advanced party amongst the Armenians, some of whom had been educated in Europe and been deeply affected by the free thought and Nihilis- tic tendencies of the day, determined to secure their object by the production of disturbances such as those that had given birth to Bulgaria. Societies were formed at Tiflis and in several European capitals for the circulation of pamphlets and newspapers, and secret societies, such as the Huntchagist, were instituted for more revolutionary methods. An active propaganda was carried on in Turkish Armenia by emissaries, who tried to introduce arms and explosives, and represented the ordinary incidents of Turkish misrule to Europe as serious atrocities. The revolutionary movement was joined by some of the younger men, who formed local committees on the Mhilist plan, but it was strongly opposed by the Armenian clergy and the American missionaries, who saw the impossibility of success; and its irreligious tendency and the self-seeking ambition of its leaders made it unacceptable to the mass of the people. Exas- perated at their failure, the emissaries organized attacks on individuals, wrote threatening letters, and at last posted revolutionary placards, 6th January 1893, at Yuzgat, and on the walls of the American College at Marsivan. In the last case the object of the Huntcha- gists was to compromise the missionaries, and in this they succeeded. The Americans were accused of issuing the placards ; two Armenian professors were imprisoned ; and the girls' school was burned down. Outbreaks, that were easily suppressed, followed, at Kaisarieh and other places.

One of the revolutionary dreams was to make the ancient Daron the centre of a new Armenia. But the movement met with no encouragement, either amongst the prosperous peasants on the rich plain of Mush or in the mountain villages of Sasiin. In the summer of 1893, an emissary was captured near Miish, and the governor, hoping to secure others, ordered the Kurdish Irregular Horse to raid the mountain district. The Armenians drove off the Kiirds,^ and, when attacked in the spring of

1 The ArmenlanB and Kilrds have lived together from the earliest times. The adoption of Islam by the latter, and by many Armenians, divided the

people ^arply into Christian and Moslem, and placed the Chrisflian in a position of inferiority. But the relations between the

1894, again held their own. The Vali now called up regu- lar troops from Erzingan ; and the Sultan issued a firman calling upon all loyal subjects to aid in suppressing the revolt. A massacre of a most brutal character, in which Turkish soldiers took part, followed ; and aroused deep indignation in Europe. In November 1894 a Turkish commission of inquiry was sent to Armenia, and was accompanied by the Consular delegates of Great Britain, France, and Eussia, who elicited the fact that there had been no attempt at revolt to justify the action of the authorities. Throughout 1894 the state of the country bordered upon anarchy, and during the winter of 1894-95 the British Government, with lukewarm support from France and Eussia, pressed for administrative reforms in the vilayets of Erzeriim, Van, Bitlis, Sivas, . Memuret-el- Aziz (Kharpiit), and Diarbekr. The Porte made counter- proposals, and officials concerned in the Sastin massacres were decorated and rewarded. On 11th May 1896 the three Powers presented to the Sultan a complicated scheme of reforms which was more calculated to increase than to lessen the dif&culties connected with the government of Armenia ; but it was the only one to which Eussia would agree. The Sultan delayed his answer. Great Britain wa? in favour of coercion, but Eussia when sounded, replied that she " would certainly not join in any coercive meas- ures " and she was supported by France. At this mo- ment, 21st June 1896, Lord Eosebery's Cabinet resigned, and when Lord Salisbury's Government resumed the ne- gotiations in August, the Sultan appealed to France and Eussia against England. During the negotiations the secret societies had not been inactive. Disturbances oc- curred at Tarsus ; Armenians who did not espouse the " national " cause were murdered ; the life of the patriarch was threatened; and a report was circulated that the British ambassador wished some Armenians killed to give him an excuse for bringing the fleet to Constantinople. On the 1st October 1895 a number of Armenians, some armed, went in procession with a petition to the Porte and were ordered by the police to disperse. Shots were fired, and a riot occurred in which many Armenian and some Moslem lives were lost. The British ambassador now pressed the scheme of reforms upon the Sultan, who accepted it on the 17th October. Meanwhile there had been a massacre at Trebizond (8th October), in

which armed men from Constantinople took part, and it had become evident that no united action on the part of the Powers was to be feared. The Sultan refused to publish the scheme of reforms, and massacre followed massacre in Armenia in- quick succession until 1st January 1896. Nothing was done. Eussia'refused to agree to any meas- ure of coercion, and declared (19th December) that she would take no action except such as was needed for the pro- tection of foreigners. Great Britain was not prepared to act alone. In the summer of 1896 (14th-22nd June) there were massacres at Van, Egin, and Niksar ; and on the 26th August the Imperial Ottoman Bank at Constantinople was seized by revolutionists as a demonstration against the Christian Powers who had left the Armenians to their fate. The project was known to the Porte, and the rab- ble, previously armed and instructed, were at once turned loose in the streets. Two days' massacre followed, dur- ing which from 6000 to 7000 Gregorian Armenians perished. Soon afterwards the attention of the Turkish Government was fully occupied by the course of events in Crete.

The massacres wej?e apparently organized and carried out in accordance vsith a well-considered plan. They

two sects were not unfriendly previously to the Russian campaigns in Persia and Turkey. After 1829, the relations became less friendly ; and later, when the Armenians attracted the sympathies of the European Powers after the war of 1877-78 they became bitterly hostile.

occurred, except in six places, ia the vilayets to which the scheme of reforms was to apply. At Trebizond they took place just before the Sultan accepted that sacres. ' Scheme, and after his acceptance of it they spread rapidly. They were confined to Grego- rian and Protestant Armenians. The Eoman Catholics were protected by France, the Greek Christians by Russia. The massacre of Syrians, Jacobites, and Chaldees at Urf a and elsewhere, formed no part of the original plan. Orders were given to protect foreigners, and in some cases guards were placed over their houses. The damage to the American buildings at Kharpiit was due to

direct dis- obedience of orders. The attacks on the bazdirs were made without warning, during business hours, when the men were in their shops and the women in their houses. Explicit promises were given, in some instances, that there would be no danger to those who opened their shops, but they were deliberately broken. Nearly all those who, from their wealth, education, and influence, would have had a share in the government under the scheme of reforms, were killed and their families ruined by the destruction of their property. Where any attempt at defence was made the slaughter was greatest. The only successful resistance was at Zeitiin, where the people received honourable terms after three months' fighting. In some towns the troops and police took an active part in the massacres. At Kharput artillery was used. In some the slaughter commenced and ended by bugle-call, and in a few instances the Armenians were disarmed beforehand. Wherever a superior official or army officer intervened the massacre at once ceased, and wherever a governor stood firm there was no disturbance. The actual perpetrators of the massacres were the local Moslems, aided by Lazis, Kurds, and Circassians. A large majority of the Moslems disapproved of the massacres, and many Armenians were saved by Moslem friends. But the lower orders were excited by reports that the Armenians, sup- ported by the European Powers, were plotting the over- throw of the Sultan ; and their cupidity was aroused by the prospect of wiping out their heavy debts to Armenian pedlars and merchants. No one was punished for the massacres, and many of those implicated in them were re- warded. In some districts, especially in the Kharput vUdr yet, the cry of " Isldim or death " was raised. Gregorian priests and Protestant pastors were tortured, but preferred death to apostasy. Men and women were killed in prison and in churches in cold blood. Churches, monas- teries, schools, and houses were plundered and destroyed. In some places there was evidence of the previous activity of secret societies, in others none. The number of those who perished, excluding Constantinople, was 20,000 to 25,000.^ Many were forced to embrace Islam, and numbers were reduced to poverty. The destruction of property was enormous, the hardest-working and best tax-paying element in the country was destroyed, or impoverished, and where- the bread-winners were killed the women and children were left destitute. Efforts by Great Britain and the United States to alleviate the distress were opposed by the authorities, but met with some

success. Since the massacres the number of students in the American schools and colleges has increased, and many Gregorian Armenians have become Roman Catholics in order to obtain the protection of France.

Ethnology. — The original inhabitants of Armenia are unknown, but, about the middle of the 9th century b.c, the mass of the people belonged to that great famUy of tribes which seems to have been spread over Western Asia and to have had a common non-Aryan language. Mixed

1 According to some estimates the number killed was 50,000 or more.

with these proto- Armenians, there was an important' Semitic element of Assyrian and Hebrew origin. In the 7th century b.c, between 640 and 600, the country was conquered by an Aryan people, who imposed their language and possibly their name, upon the vanquished, and formed a military aristocracy that was constantly recruited from Persia and Parthia. Politically the two races soon amalgamated, but except in the towns, there was apparently little intermarriage, for the peasants in certain districts closely resemble the proto-Armenians, as depicted on their monuments. After the Arab and Seljiik invasions, there was a large emigration of Aryan and Semitic Armenians to Constantinople and Cilicia; and all that remaiued of the aristocracy was swept away by the Mongols and Tatars. This perhaps explains the diversity of type and characteristics amongst the modern Armenians. In the recesses of Mount Taurus the peasants are tall, handsome, though somewhat sharp-featured, agile, and brave. In Armenia and Asia Minor they are robust, thick-set, and coarse-featured, with straight black hair and large hooked noses. They are good cultivators of the soil, but are poor, superstitious, ignorant, and un- ambitious, and they live in semi-subterranean houses as their ancestors did 800 years b.c. The townsmen, espe- cially in the large towns, have more regular features — often of the Persian type. They are skilled artisans, bankers, and merchants, and are remarkable for their industry, their quick intelligence, their aptitude for business, and for that enterprising spirit which led their ancestors, in Roman times, to trade with Scythia, China, » and India. The upper classes are polished and well educated, and many have occupied high positions in the public service in Turkey, Russia, Persia, and Egypt. The , Armenians are essentially an

Oriental people, possessing, like the Jews, whom they resemble in their exclusiveness and widespread dispersion, a remarkable tenacity of race and faculty of adaptation to circumstances. They are frugal, sober, industrious, and intelligent, and their sturdiness of character has enabled them to preserve their nationality and religion under the sorest trials. They are strongly attached to old manners and customs, but have also a real desire for progress which is full of promise. On the other hand they are greedy of gain, quarrelsome in small matters, self-seeking, and wanting in stability; and they are gifted with a tendency to exaggeration and a love of intrigue which has had an unfortunate influence on their history. They are deeply separated by religious differences, and their mutual jealousies, their inordinate vanity, their versatility, and their cosmopolitan character must always be an obstacle to the realization of the dreams of the nationalists. The want of courage and self-reliance, the deficiency in. truth and honesty sometimes noticed in connexion with them, are doubtless due to long servitude under an unsympa- thetic Government.

The total number of Armenians is estimated at 2,900,000 (in Turkey, 1,500,000; Russia, 1,000,000; Persia, 160,000 ; Europe, America, and East Indies,

250,000).

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(o. W. W.)

AEMENTIERE S — A R M I E S

Arnrentieres, a town of France, department of Nord, arrondissement of Lille, 10 miles W.N.W. of that town, on the railway from Lille to Dunkirk. It has a communal college for boys and one for

girls, a national professional school, hospital, museum, and small library. It is an important centre of textile manufactures. Population (1896), 26,714; (1901),

29,401.

AKMIES.

Introductort.

THE last quarter of the 19th century saw a great de- velopment of military forces, but no organic changes. Armies have steadily grown in size, and the severe com- petition for predominance in numbers has led to reduc- tions in the period of service with the colours. At the same time the principle of universal liability to service has been rigorously enforced by all the great powers of Europe. Relatively to that of France the population of Germany has been steadily increasing, and the former country, unless the period of service is still further curtailed, must soon find its army considerably inferior in numeri- cal strength to that of the latter. Whether or not such further reduction is compatible with military efficiency appears to be doubtful. The tendency of modern war is to increase the demand for careful training of all ranks, and two years of continuous military life is barely sufficient to make the average man into a thoroughly competent infantry soldier, while the technical branches of an army cannot be adequately instructed in so short a time. Systems of national education, by developing the recep- tivity of the recruit and sharpening his faculties, have undoubtedly facilitated military training ; but habits of discipline, the mutual reliance and mutual knowledge of officers and men, and the many qualities necessary to the making of effective military bodies, need time for their development. While,

therefore, the standard of general intelligence of a population, other national characteristics being equal, may to some extent regulate the period of service necessary to ensure military efficiency, there is evidently a rttinimum in every case which cannot be passed without danger. The relatively low ‘ intelligence of the Russian population would probably render it im- possible to transform the recruit into a trained soldier in two years, and in the Russian army, as in the British, the period is long, compared with that accepted in other great Euopean forces. What the irreducible minimum, is in any particular case cannot at present be stated. There have been signs that the short-service system does not confer the solidarity which existed in the older professional armies. The Franco-German war produced an almost unbroken series of successes for the German arms. The sense of military superiority conferred by the early victories on the frontier and maintained by subsequent experience was a moral factor of supreme importance. The system brought to perfection by the Germans can- not, however, be said to have been tested by defeat, and there were ugly symptoms of panic during the fighting around Metz, which, in less favourable circumstances, might have spread with disastrous results. Since this war, the period of service has been reduced in both Germany ^nd France ; and while in both countries careful consideration has been given to all that is implied in the term organization, and the military machine, as such, has therefore gained greatly in efficiency, the result, as effect- ing the solidarity of a great army in the field, remains to be shown. Where the constitution of two armies is practically the same, and where numbers and military skill are practically equal, the issue of a contest would turn upon the characteristics of the race or of the nation. On the other hand, it is possible that an army more

solidly constructed than those of modern Europe might be found to possess qualities of cohesion and of endurance which would, to a great extent, compensate for numerical deficiency. It can only be said with certainty that modern war makes increasing demands upon military training in every branch, enhances the value of individual military capacity, and imposes more and more strain upon the nerve and endurance of the soldier. At the same time, the race for numerical strength increases the difficulty of obtaining the necessary qualities without an inordinate growth of military expenditure and a consequent

disloca- tion of the machinery of civil life entailed when masses of men are called up for periodical training. The problem of the future is to effect a satisfactory compromise be- tween these conflicting conditions.

Military systems practically fall into two categories — the short-service, or German system, which is universal among great European powers, and which has now ex- tended to Japan ; and the militia system, which in Eng- land dates back to Saxon times, and which has reached its most complete development in Switzerland. The first system aims at sweeping the mass of the able-bodied manhood of a nation into the ranks for a short period of continuous training, followed by a long period of furlough and a further period of liability to service in a national reserve. During the period .of furlough the soldier may be recalled from time to time to the colours for instruc- tion. The militia system, on the other hand, imposes an initial training of six or eight weeks, followed by a gen- eral annual training of the whole force for a fixed period during several years, and by a further period in a national reserve. It is evident that, if the period of service with the colours in the first system is steadily reduced, there must come a point at which the second system may pro- vide the best means of military training. This point may not have been yet reached; but some authorities, watching present tendencies, have been led to believe that the militia system may ultimately supersede that devjsed by Scharnhorst, with the powerful support of Stein, for the military regeneration of Prussia after the disasters of 1806.

The experience of recent years has gone far to modify the view, cherished in Great Britain, that universal service is destructive of the industrial vigour of a nation. Under a rigid system, relentlessly applied, Germany has pre- sented the spectacle of an amazing commercial develop- ment. It has even been contended that the habits of order, of discipline, and of self-reliance inculcated by military training, wisely administered, have played a part in equip- ping the German people for the industrial competition upon which they have entered with the most marked success. In face of facts which cannot be disputed, it will be difficult in future to maintain that the burden of compulsory military service necessarily impedes the in- dustrial progress of a nation and breaks up its civil organ- ization. The management of public business in Germany and the

handling of great questions of national defence stand in marked contrast to British methods. Military training, as enforced upon the best manhood of Germany, has not benumbed its intellectual vigour, and may have increased its capacity for the. orderly transaction of busi- ness. Personal service is a higher test of patriotism than

pecuniary contributions, and it is not easy to determine whieli of the two imposes the greater drain upon national resources. The British nation must shortly decide be- tween compulsion and greatly ~~increased expenditure ; and while an army habitually required to serve abroad in peace time cannot be recruited by conscription in any form, there is a growing tendency to believe that the ap~~ plication of the ballot for recruiting a militia army may be justified. The past twenty-five years have witnessed the results of organic changes in the British army which began in 1870. It cannot be said that these changes have produced all that was claimed by their advocates or that the criticisms expended upon them were entirely without foundation. The British army has undergone a searching test in the ^outh African war. Grave defects of many kinds have been plainly revealed, and a strong demand for radical reorganization has been the result.

The wars of the past quarter-century have not provided any specially striking military lessons, but all have pre- sented points of interest and have emphasized the vital' importance of organized preparation in time of peace. The Russo-Turkish wax of 1877-78 illustrated the great defensive power of breech-loading small arms, and showed many tactical defects in the training of the Russian in- fantry. This war, like the war in South Africa of 1899 and 1900, was entered upon with a totally inadequate idea of the military requirements. In both cases certain disabilities on the part of the opposing forces — whether Turks or Boers — gave time which enabled the initial de- feats to be redeemed. In the Servo-Bulgarian war of 1885, the militia army of Servia was opposed to a Bul- garian force organized on the German principles and sup- plemented by Rumelian militia. This conflict presented the remarkable feature that the whole of

the superior officers of the Bulgarian army, being Russians, were sud- denly withdraMm on the outbreak of hostilities. To the personal leadership of Prince Alexander, to the soldierly qualities of the Bulgarians, and to the remarkable march- ing power of the Rumelian militia, the victory over the Servians was directly due. A small-bore rifle in the modern sense was employed for the first time by the Ser- vians, and the Bulgarian field artillery opposed time shrapnel to common shell with notable success. The China-Japan conflict of 1894 revealed in the most striking way the great fighting power of the newly-organized Japanese army and the marked ability with which it had been prepared for war. A new military nation may be said to have come into existence, which must play an important part in the affairs of the Far East. The 'brief Spanish-American war of 1898 plainly indicated the weak- ness of volunteer organizations and the heavy cost en- tailed by want of preparation. The small standing army of the United States was not organized for offensive war ; but the excellent quality of the troops averted disaster at Santiago. The Spanish forces in Cuba showed little en- terprise or capacity ; but local conditions had tended to deteriorate their military qualities, and they did not fairly represent the army of Spain. The principal result of this war was to bring about the over-sea expansion of the United States. This has already entailed a considerable increase in their military forces. The Act of Congress of February 1901 authorizes the President to maintain a standing army of 100,000 men, and to raise local forces in the Philippine Islands. In the Greco-Turkish war, loose discipline, bad leading, and want of organization combined to cause the collapse of the Greek army. The conduct of the campaign by the Turks proved that pro- gress had been attained under German instruction since the conflict with Russia; but certain disabilities, which appear to be inherent in Turkish armies, were again

manifested. Great Britain has been engaged in military operations of a varied character in many parts of the world, thus receiving lessons which were not in all cases turned to full account. A long series of minor campaigns, beginning at Alexandria in 1882, ended at Khartum in 1898. Two considerable wars, in Afghanistan and on the north-west frontier, were carried on by the Goverhment of India. The South African war severely strained British military resources and proved that the standard

of preparations had not been adjusted to meet national requirements. No Power has, during the past twenty-five years, acquired experience of warlike operations compa- rable in extent and variety to that which the British army now has at its disposal. South America has been the scene of several conflicts, of which the ChUian civil war of 1891 was, perhaps, the most importaift. In this case a military force was organized ad hoc by a German expert and equipped with magazine rifles, which were used for the first time on a large scale.

The period, regarded as a whole, has been marked by a great expansion of military forces and by successive and costly re-armaments, both of artillery and infantry. Great attention has been generally devoted to organization and all that is implied in preparation for war. The armies of to-day are larger, better equipped, and more carefully trained than previously ; and except in Italy, and possibly in Russia, there are no clear signs that the burdens of military service and of military expenditure are at present pressing with unbearable severity upon the population of Europe. ‘ (g. s. g.)

British Akmt.

*The moment at which the following article was com- pleted (November 1901) was necessarily an exceptional one in the history of the British army. The _ ^ whole system of administration which was in- ana con- troduced after 1870 had undergone many modi- duions of fications, and was about to undergo many more. **”’”**•*

In its general features, nevertheless, the recruiting system remained that which was introduced by Mr Card- well in the years following 1870. It was adopted in the belief that a much larger number of recruits could be ob- tained if they had the option of leaving after a compara- tively short period with the colours. It was assumed that after three years’ service, at all events in the infantry, a man had learnt all that he was likely to learn, and that it was more economical for the country after that time to pay him for some years a small retaining fee, and call him up only for war. The necessity of sending troops to India and to distant British colonies did not admit of a strict application of this principle to the whole army. Whilst, therefore, the Guards, who do not serve during peace time in distant parts

of the empire, and the Army Service Corps, which requires large expansion for war and is not required in India which has its own transport and supply department, have now for a long period been enlisted for three years with the colours and nine years in the Reserve, — ^the Line, the Artillery, and the Cavalry are mostly enlisted for seven years with the colours and five more in the Reserve. From time to time, however, enlistment for the line for three years has been allowed concurrently with the longer period.

The pay of the soldier has been slightly improved. First he was given in 1876 an allowance known as " deferred pay." A daily addition to his pay of 2d. a day was credited to him in his accounts ; but he i^as not entitled to receive it till he took his discharge. There was a considerable conflict of evidence as to whether the money was valuable to the soldier in enabling him to start in civil life, or whether it was merely wasted. The

vast preponderance of the evidence of non-commissioned officers and men was in its favour. There was, however, a strong demand that the soldier should be given not only a free ration of meat and bread, as he h^ had for many years, but that all his food should be provided for him. The promise of a free ration was said to create the false impression that the men would have nothing to pay for their food, whereas a stoppage was made from their pay to provide groceries. In 1899, therefore, an allow-ance of 3d. was granted to provide what was absolutely necessary for the whole messing. At the same time the deferred pay ceased for those who accepted the messing allowance. Men serving when the change was made were allowed to choose whether they would prefer the free messing or the deferred pay. Some chose one, some the other. The actual conditions of service in these circum- stances are as shown in Table C.

Another change has gradually been introduced. The canteens, which were formerly let out to tenants, and became, in fact, regulated public-

houses and grocery shops within the barracks, have been placed under the management of a committee of officers, and are worked for the benefit of the men. Where they are well looked after very large profits accumulate. These are employed pa^rtly in adding to the comfort of the men's messes, partly in providing for emergencies, such as when the men are sent out on an early movement and require breakfast before they start, or on the sudden arrival from abroad or from out-stations of parties of men or of their families. In various other ways the money is used to provide for contingencies that can hardly be dealt with at the public expense, such as the provision of cricket and football implements.

Private benevolence has added greatly to the comfort of the soldier. Soldiers' " Homes " and " Institutes," set up by private subscription, give an opportunity for well- conducted entertainments and for quiet reading and writing such as would not be possible in the barrack- room. Some of the best of these are, in fact, excellent clubs, with good hot and cold water baths, billiard-rooms, and halls for concert and other performances.

The effect of the short-service system has been neces- sarily to throw annually upon civil life a very much larger number of men seeking employment than was the case formerly. It was some time before adequate agencies for assisting the men in this respect were brought into existence, but on the whole the machinery is now very complete. Partly through the colonels of brigade dis- tricts, partly through the officers of the recruiting depart- ment, partly through the organizations which have been established in most well-managed regiments, the men have much help from the army itself in obtaining situa- tions. The "National Society for the Employmenti of Soldiers " and the " Soldiers' Help Society " have agencies which spread into every district of the country. More- over, the earlier age at which soldiers now leave the army has this effect, that most of them have parents or other near relatives still alive, many of whom are in regular employment, or are able to assist the men in obtaining situations. The " Soldiers' and Sailors' Fami- lies Association," with an agency in every garrison, is most useful to the married soldier during peace time. During the strain of the South African war it was invaluable.

Altogether the " conditions of service " of the well- conducted soldier, though they still leave much to be desired,are beyond all comparison better than those of any army except that of the United States, in which the rates of pay are incomparably higher, although in other respects the physical comfort of the men is not so carefully pro- vided for. In civil life a man has to pay for his own hair b&ng cut and for repairs to his clothing, but he does this

at his own good pleasure. The orderly appearance of the soldier is a necessity of discipline, and undoubtedly the fact that these minor payments are not matters entirely of his own option gives colour to an idea that when he has to pay for them he has not had the whole of the cash he expected. It is not a question of a broken prom- ise to him, but the system will probably be modified in its working.

The test of an army is not peace, but war. Gauged by that standard it is not too much to say that, relatively to the facility with which the British empire is able to provide men for war on a large scale, f^^^" the supply of officers has failed. The ordinary sources of the supply of officers to the army during peace time are, as they have been for many years, Sandhurst College for those of the Cavalry, Guards, and Infantry of the line ; Woolwich for the Artillery and Engineers ; and, as a further source of supply for all, the Militia. In addi- tion, a certain number of commissions are given in all branches of the service to cadets of the Royal Military College at Kingston, Ontario, and to other colonies, while a few are given to men from the ranks. Commissions have during the war in South Africa been given freely through universities, public schools, and other institutions. During peace time, as will be seen when we speak of "the organization of the higher units for war," the staffs necessary for these and for the " lines of communication " in the field have not been maintained. The loss of officers in war is enormous. The consequence has been that everywhere, whether' in the field or at home, the supply of officers has been wholly inadequate, and the battalions and regiments have been left deplorably short. At home, when it was necessary to create new units, the men could be obtained, but officers, especially experienced captains and, subalterns, were wanting. A nominal "re- serve of officers " existed in the sense that officers who had retired on their pensions were

liable to be recalled to service; but changes in army training have proceeded with immense rapidity of late years, and when officers, who had left the army for some years, returned to it they found the conditions to which they had been accustomed greatly modified. Captains and majors who returned in those ranks were the contemporaries in age of men who occupied the higher ranks in the army.

The disproportion between the officers with the British army in this and in former times may be best shown thus : — In 1816, at Waterloo, Seton's famous battalion, about 1000 strong, had forty-two subalterns on parade ; in the battle its front was never more than about 500 paces. In 1901 a garrison of 5800 men at Woolwich had for sbme months seventeen captains and subalterns, all told, of whom ten were second lieutenants too young to serve on a court-martial. At Driefontein (10th March 1900) the Buffs, including regimental staff, had one officer per com- pany. Companies often covered more than 1000 yards.

A very large number (2700) of second lieutenants were commissioned during the Boer war. Many of these from the universities, from the Colonies, from various technical colleges, were men of an excellent stamp, but they have for the most part (except those from Kingston) had no previous military training. Some of them were twenty-six years of age. So far as their future prospects are concerned this is a serious matter, because, in order to keep the various ranks of officers young enough to be fit for their work, the rule now is that a

Captain (unless he is a brevet-major) must retire at 45 years of age.

A major „ „ 48 „

Lieutenant-colonel . . . i „ „ 55 „

Colonel „ „ 57 „

Major-general .... „ „ 62 „

Lieutenant-general or General . „ „ 67

British]

ARMIES

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As a rule this is a scale which corrects itself to some extent, since, if promotion has for a time been very slow, many men in the senior ranks have to retire, and more rapid promotion is given to the juniors. The effect of a war on so large a scale as that in South Africa is to upset this condition. Large numbers of officers in the senior ranks are relatively young. The accession of the immense number of subalterns of the same age as those much senior to them will force these junior officers out of the service in large numbers. The circumstances for some years, therefore, will be very exceptional.

As regards the general question of the supply of officers, it must be realized that one of the exceptional advantages of Great Britain as a military power is that it possesses a larger class of the type from which effective officers can be drawn than any other country. What restricts the supply for war is solely that, as a question of economy, the policy of Great Britain has always been during peace time to reduce to a minimum the number of officers actually employed. Many posts are occupied by officers who are borne on the strength of their regiments and counted as if they were effective. The result of not main- taining during peace time the staff appointments required for war, and of filling a considerable proportion of those that are maintained with officers who are thus counted twice, is obviously to leave a very small proportion of the men who might be utilized available for war. Very large" numbers of officers are " specially employed " in all parts of the empire. These cannot be recalled for a war in a particular part of it. They are borne on the lists of cer- tain regiments as subalterns or captains, and after a time they are "seconded," that is to say that, their names be- ing placed in italics, their places are filled up by the pro- motion of other officers. They retain their position in the regimental list, and may or may not at some time or other be brought back into the regiment. The demands of the staff in such a campaign as that in South Africa are so enormous that the same process has necessarily been applied to fill it. The effect is that there are many regiments of which the

nominal establishment is, say, twelve captains, which actually bear on their lists twenty- four, of whom twelve are thus " seconded." The whole subject is undoubtedly one that requires immediate attention.

Since 1870 enormous reductions have been made in the numbers of the higher ranks of the army. Thus, excluding the Indian army, which had its own list in 1870, and the Indian Staff Corps, which as to officers was the corresponding body in 1901 —

The Generals have been reduced from 71 to 10. The Lieutenant-generals ,, 116 ,, 25.

Major-generals ,, 188 ,, 74.

At the same time the pay of all the higher appointments in the army has been greatly reduced. In the first place, the colonel-commandantships (worth per annum £1800 for a general from the Household cavalry, £2000 for a general from the Foot Guards, £1000 for infantry, £994 for the Artillery, and £990 for the Engineers) have all been abolished. These formerly were held in addition to the pay of the higher appointments. The actual pay of the higher appointments — commander-in- chief, adjutant-general, quartermaster-general, governors of Woolwich and Sandhurst, &c. — have all been reduced by many hundreds a year each. It will be seen, therefore, that from the increase of the army contemporary with these reductions in the higher ranks, the transference of expenditure from the higher to the lower ranks has been large, and that, actuarially, from the great increase in the number of junior officers, the prospects held out to an

officer of reaching the higher ranks have been greatly reduced. A royal warrant, which came into operation on 1st January 1901, still further reduced the higher ranks. From that date no promotion from major-general to lieu- tenant-general was to take place except as a reward for distinguished service in the field or to fill an actual a,ppointment. As the number of appointments held by lieutenant-generals had been much reduced, this further reduced the number of lieutenant-generals to fourteen.

It follows inevitably from the fact that officers, other than regimental officers, have not hitherto during peace time been employed in the positions which they will occupy in war, that they have not nearly all been trained in the specific duties of those positions. The staff is trained at the "Staff College" as far as that is possible without the discharge of the actual l/^g^^rs functions that have to be learnt. The number of officers that gain this functional training is very small. There is a great standing camp at Aldershot which normally in peace time has had the staff for one cavalry brigade, for three infantry brigades, and for one " brigade division " of horse with two of field artillery, besides the standing staff of the district. These numbers have been usually increased during the drill season, partly by bring- ing in from other stations regular troops, and partly by the addition of large bodies of militia and volunteers. All branches of the service go through a regular course of regimental training each year. This is specially designed to give each company-commander of an infantry battalion, each squadron-commander of a cavalry regiment, the opportunity of working up his unit before the whole are brought together for work under the lieutenant-colonel commanding the battalion or regiment. The several bat- talions, regiments, batteries, companies, and squadrons are inspected by their commanding officers and by the gen- erals under whom they are serving. There is also a special technical inspection for the Cavalry and Army Service Corps by the inspector-general of Cavalry, and for the Artillery by the generals of Artillery at Aider- shot, Woolwich, and Portsmouth. Musketry instruction has of late years been given under the general superintend- ence of musketry instructors and the supreme regulation of the head of the school at Hythe, but in detail by the captains of companies. This has been a great improve- ment in the training of the officers themselves. The com- petition between battalion and battalion and between company and company has been keen.

Between each rank, from subaltern to captain, from captain to major, up to the rank of lieutenant-colonel, an officer is required to pass an examination before a board of officers, who have to certify that he is fit for promotion. The examinations involve answers on paper and also the handling of troops on ground. As a rule, all the paper questions are only such as an officer might actually have to deal with when in command of

troops. Thus the system of " training," apart from special arms, has con- sisted rather in ascertaining that officers have trained themselves than in any very systematized method for giving them that training. The "Staff College," the " Ordnance College," each train special classes of officers. Officers on the staff are detailed for "garrison instruc- tion," but in the main the training has depended on battalion commanders, the effect being afterwards tested.

The training of men is mainly involved in and con- nected with that of the training of officers; but it is necessary to add that, in the recruit stage of late years, the most important change has been gf^^Jn^ the large development of gymnastic instruction on a methodical system, devised for the development of the several parts of the body. The tendency has been

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more and more to substitute this for what used to be known as " setting up " drill, which was too formal for modern requirements, and did not combine the suppleness with the smartness needed for military purposes nearly so well as the modern gymnastic course. Moreover, since one of the great objects of modern training, both for officers and men, is to carry organization in working down into the smallest fractions of an army, the training of comparatively small gymnastic squads in orderly move- ment by their own company 'officers affords important facilities for this purpose.

Shortly before the beginning of the Boer war, in the course of 1897, the cavalry underwent a new organization. oreaniza- '^^^ Cavalry regiments had been despatched to aonaaT' South Africa. There were then left in the special United Kingdom eight regiments on a higher ofca'vafry. establishment and eight on a lower, which were each by this organization made up into three service squadrons and one reserve squadron. The

higher establishment regiments had 670 men and 465 horses each, the lower 556 men and 343 horses. The 1st cavalry divi- sion was composed of five regiments on the higher estab- lishment and a composite regiment of household cavalry. The 6th regiment of line cavalry was detailed as corps cavalry for the 1st army corps. Each squadron was 140 strong including officers. The object of this reorganiza- tion was to enable the regiments to start on a campaign without drawing on other regiments for non-commissioned officers and men. When the regiments went abroad the "reserve squadrons" left behind became in fact each regimental depots. There are always about 200 "non- grooming " men in a cavalry regiment required for various purposes, so' that this proportion of horses to men was deliberately arranged. During the war a great strain was thrown on the " reserve squadrons." As recruits and remounts were poured into them they virtually came to be, in point of men and horses to be trained, equal in numbers to a cavalry regiment. The supply of officers and non-commissioned officers and the " office " were wholly inadequate for dealing with such numbers. There can be little doubt that considerable modification will necessarily be made in this provision for any future emergency.

The Boer war, in which the power of the new weapons made itself so conspicuous, has naturally led to much discussion as to the future role of cavalry. There is a disposition to assume that cavalry should abandon its old position of looking upon manoeuvring facility and the arme blanche as its ruling metier, and should become, like the American cavalry of the civil war, a manoeuvring mounted infantry. It is, however, premature ~~to draw con~~ clusions from the incidents of a very exceptional struggle, and until the question can be more fully discussed it should not be prejudged. On one point all the experi- ence of the past may doubtless be trusted. It is necessary to decide definitely whether cavalry is to rely on a knowledge of ground, on horsemanship, skill in manoeuvring, and the arme blanche, or whether it is to trust to dismounted fire. To train men both to charge home and to believe in victory in so doing, and at the same time to think that their only safety lies in dis- mounted fire, is a contradiction in terms. It would be wholly contrary to human nature if such training proved successful. That cavalry, if in the proper use of their arm they are to act effectively, must be supported and aided by mounted infantry, is not a new

experience, though it has been ip.uch emphasized by the South African war. The immense numbers of mounted men ultimately employed were a necessary consequence of the peculiar nature of the contest, and not necessarily a certain element of future war under normal conditions.

The changes of late years both in the organization and training of artillery have been very numerous. In the first place the old ” royal regiment ” has been ^^^„ divided into two distinct branches, so that the promotion of officers is no longer carried out in one long list. The officers for the field and horse artillery stand now on one seniority list for promotion, the garrison and mountain batteries on another. Within each branch im- portant changes of organization have been also made. In the field branch of the regiment, both for ” field ” and “horse” artillery, the batte^^y is no longer the one “unit” for all purposes. A lieutenant-coloners com- mand, which for the present bears the anomalous name of a ” brigade division,” has been created. It consists of a group in the horse artillery of two, in the field artillery of three batteries. As yet, the organization is not carried to its logical conclusion. The lieutenant-colonels belong to particular stations, the batteries move from station to station. Thus the elements composing the ” brigade divisions ” are “continually changing. Moreover, the “staff” of the brigade division is only formed by taking officers from the batteries temporarily attached to the command. It is much to be hoped that this may soon be modified, and a beginning has been made by the appointment of warrant officers as sergeants-major of the brigade division. For the training of the horse and field artillery a large area of ground on the wild open country of Dartmoor, near Okehampton, has for some years been utilized. A similar school has been started at Glen Imaal in Ireland. There it is possible, to a large extent, to combine the actual firing with service ammunition, the bursting of shells and the practice at dummies represent- ing artillery, cavalry, and infantry, with training in rapid changes of formation and field movements. For these purposes the brigade divisions move together and are trained together. An elaborate system of ” fire discipline “■ has been worked out in order to bring the whole fire of a battery completely under the control of the officer com- manding the battery, so that the officer commanding the brigade division may be able to use his unit for such pur- poses as may be required by the general’s combinations. During

the winter and early months of the year the batteries are trained in elementary work at their own stations. During the summer the brigade divisions give practical effect to the training either by preference at- Okehampton, or if there be not time for all to go there, then some have hitherto been sent to Shoeburyness. A new training ground has been opened on the area re- cently purchased at Salisbury. There also actual firing with service ammunition is combined with field move- ments. This promises to become the most valuable field artillery school the army possesses. Similarly, with the- garrison artillery, a much more perfect system has been devised for the regulation and practice of the fire of a. fortress. The whole personnel of the artillery within coast fortresses is now organized so that the fire can be brought to bear upon the positions likely to be taken up- by a hostile fleet. The invention and adoption of instru- ments known as " position finders " and " depression range- finders " enables the fire to be directed with great precision upon given spots likely to be passed by ships. To a large- extent the actual organization of the defence depends on the special nature of the fortress. The organization of the defence of a fortress like Gibraltar or Malta must obviously differ from that of a tortuous channel such as gives approach to the harbour of Harwich. In general terms the manning of the searboard guns of the British islands depends upon militia and volunteer artillery, with only a small stiffening of regular garrison artillery and a proportion of officers of the royal garrison artillery. The

militia and volunteer artillery are periodically trained in tlie different works to wMcli they are assigned. A prac- tice school for the garrison artillery has been established at Lydd, but the various coast fortresses themselves carry out regular practice with service ammunition.

It is one of the peculiar characteristics of the service

of the British army that, from the extent and dispersion

of the empire over the world, it is alrnost

nantry. g^j^j^yg j ^^j, ^^ ^ greater or less scale. If

the temple of Janus were, as an indication of peace, closed for one year, it would have the next to be opened at four doors for four different wars. Thus in 1900, independently of Indian frontier expeditions, of which there were more than one in the year. Great Britain had war in the Egyptian Sudan, war on the West Coast of Africa, two expeditions in East Africa, and war iri China, whilst the war in South Africa was going on. The practical training of the British infantry more than that of any other army is necessarily affected by this fact. Not only are the experiences through which ofB.eers and men pass in these wars very important in their effect on the preparation which they give for future war, but they have a great influence on the per- manent training of the army, and especially of the infan- try, during peace time. Now even in this one year, 1900, no two of the wars were alike in their circumstances; and, unless the comparison be made between some two Indian frontier expeditions, hardly in the thirty wars of the thirty years 1870-1901 would it be possible to find two of which the tactical conditions were identical. In these circumstances the actual views which dominate British schools of training are apt to be modified consid- erably by the most recent experience. This modification finds expression to some extent in the successive drill books which are issued. It is in reality much more important in its influence through the decisions given by umpires and the comments on field days. The influ- ence of the experience of the great war between France and Germany in 1870 showed itself in the training of the British army for some years in a much more open order of fighting, in the continual study of ground with a view to cover, and in carefully-arranged turning move- ments. The influence of wars in which Zulus and Mah- dists showed the power of determined attacks pushed home regardless of loss, had its effect on our training in a tendency to encourage frontal attacks provided that a certain numerical superiority was attained at a given point. The actual training imparted at any given period in the camps at Aldershot or Salisbury has oscillated much between these extremes. The training of the other arms being largely dependent on the principles adopted for infantry in defence and attack, it is safe to say that

there is this necessary contrast between the adequate training of the British army and that of any other European Power, that with the British army the oificers at least, and to some extent the men, require to be prepared for many varied circumstances and condi- tions, whereas in the training of other European armies the conditions under which they will enter upon war are fixed and well known beforehand. The extent to which a British army is prepared by training for a given war must depend on the extent to which all the conditions of that war have been studied beforehand. In one respect, however, so far as the infantry is concerned, all wars are alike. In every war the most important power of infantry depends on the efficiency of its training in the use of the rifle. In this respect several changes of impor- tance have been made of late years in the British army. First, the actual detail training of the men has been put into the hands of the company officers, and they have been made responsible for it. Secondly, at Bisley and other places

a system of "field-firing " has been introduced. This con- sists in a most valuable combination between manoeuvring to take up the right position from which to bring fire to bear, and the actual shooting at dummies placed to repre- sent different bodies of troops arranged so that they can be made to appear unexpectedly in a position previously unknown. Further, the combination between drill ma- noeuvres and shooting has been improved by requiring the actual orders for all firing to be given during the course of drill manoeuvres in such a way as to determine the object to' be fired at, the range, and the nature of the fire. Nevertheless, recent experience makes it almost certain that, under the present conditions of war, almost all firing will become individual and independent. The purchase of a large area of ground near Salisbury has given scope for manoeuvres on a much larger scale than was possible formerly. As, independently of this, an Act has been passed to give facilities for the carrying out of manoeuvres on varied ground to be chosen from time to time, it is to be hoped that when events at home resume their normal course, annual manoeuvres may be carried out in different parts of the country. The sys- tem of training at present consists

during the winter in regularly graduated route-marches, accustoming the troops to carry their equipment and arms for long dis- tances. At the same time indoor and barrack-yard in- struction is given in elementary duties, in the principles of scouting and protection on the march, and in such other matters as may tend to interest the men in their work, such as the nature of their weapons, accounts of what the battalion has done in the field, and of other incidents of war. In the spring each company in suc- cession is relieved of all other duties in order that it may go through a course of systematic instruction under its company officers. After the different companies have been inspected by the lieutenant-colonel and em- ployed against one another in minor field days, the bat- talion is worked together as a whole. ' At Aldershot, the Curragh, and at special camps, the brigades of infantry are then worked together, after which the training ceases to be arm training and becomes that of the combined arms. In principle, and according to the instructions issued from headquarters, all training is conducted on the principle of giving great latitude to the company com- manders, accustoming them to decide for themselves, and to train the subordinates under them to exercise similar responsibility. In practice it is to be feared that old habit and military conservatism have tended to keep all responsi- bility and power too closely in the hands of the lieutenant- colonel. Probably one of the most important effects of the South African war wiU be to bring before the eyes of the army the indispensable necessity of training all officers to exercise an increased responsibility. In any case training for war depends much more upon the spirit which in these respects anim ates an ar my than upon any formal regul ations. The special training of the Engineers is mainly given at Chatham, and embraces a very great variety of sub- jects, practically all the technical work of the army as described in the article

ENGnsrEEKS. As “ ”^”• an ” arm of the service ” it is a common delusion to speak of the engineers as essentially ” defensive.” The experi- ence of the South African war has perhaps tended to mod- ify this popular error. Strategically the offensive action of the army there, as always in modern wars, has depended on the rapid construction of railways, the restoration of destroyed bridges, and generally on those means of rapidly improved facilities for advance for which an army depends on the engineers. For that reason, even in Napoleon’s time, engineers have always been present with the ad- vanced parties of every column when moving forward with an army. Without the pontoon train, bridging

detachments, and the parties for removing obstacles, an army would be incessantly delayed, independently of the necessity for much larger operations on great rivers and on the general lines of railway. The changes that have taken place and are continually taking place in the detail of engineer organization and equipment simply consist in the adaptation to military purposes of the progressive ad- vance of science. Otherwise there is little to note in any changes of organization in the corps. The development of hasty entrenchment in connexion with the movement of armies in action has become and promises to become still more one of the most marked features of the present phase of war. It is at least as important on the offensive as on the defensive side.

The Boer war has concentrated attention on the ex- treme importance of the rapid transfer of shooting power from point to point of a field of battle or of a campaign. The exceptional circumstances of the campaign have perhaps tended to leave an undue impression, both of the degree in which this is a novelty and of the extent to which it promises to domi- nate future warfare. Napoleon gained most of his exceptionally brilliant battles during the 1814 campaign, when with a handful of men, he was keeping

back the overwhelming masses of Allied Europe by this very means. He moved from side to side of the theatre of war the whole of his brigade of guards on country carts. It must be understood that the horses or cobs that are employed with the detachments of infantry, who have been trained at Aldershot and elsewhere, are only in- tended to supply the place of Napoleon's country carts. It may for various reasons be doubted whether under most conditions of warfare the cart is not the vehicle to be preferred. It is a question of circumstance. The Boers were a nation of trained riders and trained shots. In its Colonial troops and in some of the home yeomanry the British Empire possesses similar material. It is obviously desirable to utilize this material. The question is altogether apart from that change of the equipment, r61e, and training of the cavalry arm, which has been discussed under cavalry. At present there is no organ- ized body of mounted infantry as such as a peace branch of the British army. For the purposes of the Boer war regularly formed brigades of mounted infantry have been created out of the various contingents of mounted in- fantry furnished by home battalions and the Colonial corps.

There can be no doubt that, especially in a country like England of numerous and excellent roads giving immedi- ate access to favourable ground in which to ”’’ * ‘ delay and puzzle an invading enemy, the bi- cycle has established itself as a most valuable agent in war. It is certain that the tendency of time will be greatly to enhance its importance not merely for the pur- poses for which it has been fre.quently used, those of saving horses by its use for orderlies and for scouting, but for delivering more considerable bodies within the fighting area. There are such large numbers of men available who can both shoot and ride, or who can do one and would easily learn to do the other, that it is impossible that this valuable material should be long left to go to waste. Only practice and organization are needed to de- velop a most useful auxiliary in the defence of the country, and the volunteer companies that have been started prom- ise to be the forerunners of a new arm for the British army.*

The transport and supply departments have been formed into the Army Service Corps, organized by com- panies with senior officers locally appointed. Army very much as is done in the case of the royal Service artillery. The Army Service Corps is adminis- ”’”’‘ tered through these

senior oflcers directly from the' Wax Office, under the orders of the several general-

officers commanding districts. The officers appointed to the Army Service Corps after a probation from regiments of the line, during peace time undertake the purchase of forage, and have under their immediate supervision such transport as is kept up during peace time. They have the privilege of being appointed to the staff for what are known as B duties, that is, virtually for the work of the quartermaster-general's department — food-supply and transport for man and beast. Contracts for these are made by them under the authority of general-officers. They superintend the bakery establishments and the abattoirs.

Hitherto in the matter of transport one large branch has been distributed to battalions under the title of "regimental transport." It was' taken charge of and cared for by the battalions. It would seem probable, from the reports on the subject made by Lord Eoberts, that this arrangement will be modified. Originally it was designed to enable regiments to have transport al- ways available for their immediate needs on the march, and to bring up their supplies from the local depot. This was objected to in Africa, because it deprived the army at large of the services of that part of the transport which belonged to battalions not at the time on the move.

The Army Ordnance department was reconstituted on 31st March 1900. The Army Ordnance Corps is immedi- ately under the director-general of ordnance, and consists, as to officers, of a principal ord- nance officer ranking as major-general, of eight Istrclass ordnance officers ranking as colonels, of fifteen 2nd-class ordnance officers ranking as lieutenant-colonels, of twenty- five 3rd-class ranking as majors, of fifty-three 4th-class, of commissaries of ordnance, deputy commissaries of ordnance, assistant-commissaries of ordnance. It is charged with providing, receiving, holding, and issuing munitions of war, military stores, clothing for use in camps, and both clothing and necessaries for use in the field. The corps consists of eleven companies with a depot company. It is, so far as the personnel of these companies with their non-commissioned officers and men is concerned, administered from Woolwich by the ord- nance officer, 2nd class, who is in command of the depot there. He acts for this

purpose as staff-officer to the director-general of ordnance. It is, however, difficult to say whether the functions of this department are more important at home or in the field. Some estimate of the nature of its functions may be formed by the following list of articles sent out to South Africa before the fall of Pretoria. We have not the figures of a later date, but obviously the special strain was prior to that event. Afterwards it became simply a question of keeping up such further supplies as were asked for. We record the ■ figures chiefly because we believe them for a despatch to a campaign 7000 miles off to be unique in the world's history.

Ammunition.

Over 105,000 rounds for the 12-pr. horse artillery gun

„ 330,000 „ „ „ 15-pr. field gun „ 30,000 „ „ „ 5-in. howitzer

„ 20,000 „ „ „ 5-in. gun

Nearly 21,000 „ „ „ 4-7 gun

„ 380,000 „ „ „ pom-pom (37 millimetres)

Drab suits Khaki suits Boots (pairs) . Woollen drawers Jerseys . Worsted socks Cotton socks . Mannel belts . Flannel shirts .

Clothing.

much over 200,000 about 80,000 over 370,000 „ 400,000 „ 200,000

„ 850,000

„ 170,000 „ 400,000 „ 500,000

BRITISH]

ARMIES

645

Circular tents Blankets

Waterproof sheets Camp kettles Horse rugs

General Stores.

18,000 or thereabouts

over 420,000

„ 300,000

„ 37,000

about 100,000

Medical depart- ment

Sets of ten or six spare mule harness, nearly 6,000

The medical department is administered from the War Office by a director-general and his staff. It is now formed into the Royal Army Medical Corps, to which officers are gazetted with commissions. The Army Medical Staff consists of ten surgeons- general. The Eoyal Army Medical Corps con- sists of colonels, lieutenant-colonels, majors, captains, and lieutenants. There are about 900 officers in all, besides 50 quartermasters. There are 36 warrant officers, 336 staff-sergeants and sergeants, and before the war rather more than 2000 rank and file. These were supplemented during the war by civil surgeons specially engaged for the war, both in South Africa and at home, and by the employment of volunteer medical orderlies. The chief general hospitals are at Netley, Woolwich, and Aldershot. There are also station hospitals, lunatic hospitals, and hospitals for women and children.

For service in the field, bearer companies, field hospitals, station hospitals, base hospitals, and general hospitals at Various points on the lines of communication have been set up. Convalescent homes, both for officers and men, were found necessary in the South African campaign, and would probably be always used in any protracted operations. In the

army corps organization one bearer company and one field hospital is attached to each brigade of cavalry or infantry, one field hospital to each of the divisions as such, and one field hospital to the corps troops. With the army corps there are six bearer companies, ten field hospitals. During a campaign a medical officer is attached to each unit and has especial charge of the regimental stretcher-bearers.

Each " general hospital " has a staff of women nurses, consisting of one superintendent, eight nursing sisters, two female servants.

An attempt has been made of late years to connect the militia and volunteers more closely with the regular forces by constituting every corps, whether of militia or volunteers, as a " battalion " in name at least of a particular regiment of which other regular battalions formed part. As the several battalions of regulars and militia or volunteers are never or only accidentally associated, the arrangement is little more than a paper one. Independently of this the volun- teers have been nominally formed into brigades under "brigadiers." These officers have little or nothing to connect them with their brigades except on those few occasions when the brigade is, as a whole, brought out to a camp of exercise. Normally during peace time all the work of inspecting and carrying on the correspondence of Volunteer battalions and batteries is done by the colonel of the " regimental district," who has under him the depot of the regulair battalions and all the militia and volun- teers of the territorial region to which the regiment is assigned. He in fact constitutes the link between the several auxiliary forces and the regular battalions. The adjutants of the volunteers, and the adjutants and quarter- masters of the militia, and the non-commissioned officers forming the " permanent staff " of the militia, and the instructors of the volunteers, are detailed from the reg- ular battalions of the regiment, but at that point the con- nexion has hitherto stopped. The numbers of militia on the 1st January 1901 were 92,741, and of volunteers, 277,900. During the year 1900, in consequence of the Boer war, the whole of the militia were embodied, that is to say, called up for home service and regularly brought

Auxiliary forces.

on pay. Thirty-five battalion^, having volunteered for service abroad, were sent to South Africa^ St Helena, or the Mediterranean. This has been the customary practice of war in relation to the militia, and constitutes them an exceedingly valuable force for setting free the active army in the field. Unfortunately during peace time their opportunities for rifle practice had been so limited that comparatively few if any of these men had been through any musketry training before they sailed for their foreign station.

In the case of the volunteers the patriotic zeal of the year 1899-1900 led to a new departure, and created a new link between them and the regular battalions of the " regi- ments" to which they both belonged. Seven thousand volunteers joined by companies the regular battalions, and were enlisted as regular soldiers for the year, while 2163 volunteers enlisted in the army reserve.

Seeing that the " British army " is the army as it is in war, it appears advisable to show in the following Table A, taken from the report of the inspector-general of recruiting, the different sources from which the ^"'■' number of regularly enlisted forces for home and colonial service had been increased from 290,914, at which it stood on 1st January 1900 after the general mobilization, to 406,443 by the 1st January 1901. This shows only non-commissioned officers and men, and allows for loss by death (10,163) and other causes, in all, including deaths, 37,269. It is put after the auxiliary forces because it will be seen how largely they contributed to swell the total. The regular forces on the Indian establishment of all arms and ranks are given in the army estimates at 63,023. These, the total establishment of officers, the militia (100,008), various colonial militia, the remainder of the army reserve after mobilization, the native Indian regiments (22,313), the yeomanry (8657), the volunteers (277,900), and the numbers on the general staff have to be added to those in Table A. Together they make up a total, exclusive of the local forces of the self-governing colonies, of about 840,000. I

Table A. — Home and Colonial Establishment (Bank and File).

British army.

Effective on

1st January 1900.

Ist January 1901.

Household cavalry

1,244

1,518

Cavalry of the line

21,389

30,075

Imperial Yeomanry .

8,824

Eoyal Artillery —

Horse and Field

25,888

34,046

Garrison ....

21,982

24,886

Royal Engineers

9,436

12,780

Foot Guards

11,740

13,845

Infantry of the line

178,745

216,221

Infantry, reserve regiments

...

17,961

Colonial troops .

8,512

30,221

City of London Imperial

Volunteers 1 .

...

Aimy Service Corps .

5,069

7^536

Army Ordnance Corps

1,593

1,984

Royal Army Medical Corps

4,068

5,551

Army Pay Corps

558

621

Army Post Office Corps

160

374

All arms . . . 290,384 406,443

The term ” mobilization ” is one which is in fact due to the short-service system. It implies the calling up of the ” reserve ” created by relegating to civil life the trained soldiers who are held to serve when called upon. It implies the complete equip- ment and clothing of all that part of the army which is ” mobilized ” with eqiiipment and clothing not necessary for peace service, but kept ready for war. It implies a

Mobiliza- tion.

1 Effective (1900) less than one year, 1664.

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vast increase in tlie number of horses required by the army brought in from civil proprietors who have their names registered for the purpose. It implies the creation of a new ” reserve ” to keep up the numbers of the units in the field. This new reserve is formed in the following way : — “When the ” reserve ” soldier’s are called up to the colours those young soldiers who are not sufficiently trained to take their places in the ranks, or are not yet of a suitable age to be sent out, are relegated to depots left at home, their place beiag taken by the men from the reserve. There are also a large number of the ” reserve” who are not required to fill up the vacancies in the battalion going out. These become what are known as ” excess numbers.” Naturally, the men left behind are at various stages of training. Some of them will in a month or so have com- pleted their musketry training, and will then be quite fit to take their places in the ranks. Others have been laid up by some temporary accident or passing malady. It results from this that every month there are always coming on fresh men ready to take their places in the army at the front. The ” excess numbers ” of the reserve help largely to supply any deficiency. In this way, as a matter of fact, the numbers in units at the seat of war, as they have suffered from the attrition that wears them down in the field, have been kept during the South African campaign more regularly supplied with drafts than has been the case in any other in which the British army has ever been engaged, and much more perfectly than is recorded as the ordinary condition of most armies during a cam- paign. It is therefore a point not worth discussing whether the term ” reserve ” is or is not properly applied to the particular men who are called the reserve (because, as it is said, a ” reserve ” ought not to consist of men who are, many of them, at once put into the ranks in the field) . That mistake, if it be a mistake, has been made by every nation in Europe ; biit in any case, the reserve behind the front, the reserve which fills up the losses of a campaign, has been provided more perfectly by this system than by any other that Great Britain has ever ha!d. Moreover, for the purposes of keeping up a uniform strength at the front, it is one that continually and automatically renews itself, because, by the time that the ” excess numbers ” and the earlier lists of young soldiers who have been gradually sent out to the war in drafts have been exhausted, this reserve is supplied

from fresh sources. Men wounded in the early stages of the campaign, or indisposed without being very seriously Ul, begin to arrive at the depots after convalescence. The recruits enlisted since the war are, many of them, beginning to come to maturity. The interest and excitemeint of the war has drawn back into the ranks older trained soldiers who have offered themselves. In short, from various causes the drafts can be filled up month by month. This, of which we have given such an ideal sketch as presented itself to the minds of the f ramers of the scheme, is precisely what happened during the South African war. That was the value and importance of those 90,000 odd soldiers of whom we have heard as exist- ing in England after the main army had been sent to South Africa, who, though they were not an army fit to take the field because they were only " details," were yet an invalu- able element in keeping up the fighting strength of the army.

It is necessary further to observe that, whereas for Germany or France the time which mobilization ought to take depends on a competition in readiness with a neighbour across a frontier, for Great Britain that time depends on quite a different consideration. If the men are completely ready to embark as soon as the ships can be made ready for them, that represents the time and the only time at which there is any object in aiming for any other purpose than that of home defence.

The organization of an army for war is designed to make it a body as flexible and mobile as possible in the hands of its commander. The ideal army that Wellington had formed by the end of the Pen- °^t insular war was one that could, as he expressed higher it, "go anywhere and do anything." The or- unUstor ganization of the British army during peace time ^^• has hitherto been essentially an organization by stations— a stationary organization. The units composing the several garrisons of the stations are in a continual state of flux and reflux. There has hitherto been no higher organiza- tion anywhere maintained as a whole complete in all its parts for more ihan a short time. In part this is an inevitable consequence of the different conditions of service between the army of a world-wide empire and that of countries like France and Germany, which have all their peace duties within a ring-fence of the borders of their fatherland. The corps which in Germany occupies a particular district is

designed to move as a whole when it is required for war. The troops, which in England are stationed in a certain locality, have two entirely distinct functions. The several units are on a roster for foreign service, and will each in their due turn go to India or the Colonies, being replaced by other units from abroad. In the event of war they have hitherto been formed with other units into brigades, divisions, and army corps, but they have not been in these organizations prior to the preparation of the expeditionary ariny. The generals to command and the staffs to direct them have been appointed for the special purpose. To this there are two slight exceptions to be made. At Aldershot, in addition to the stationary headquarters staff of the general in command, there have been stationary briga- dier-generals with their staffs. The units composing the brigades have been in the same condition of flux and reflux as the other parts of the British army. Aldershot iwas, up to the time of the acquisition of the ground at Salisbury, the one great training-place of the British army in England, just as the Curragh is in Ireland. It is still the principal training school of the army. Therefore, in order that all parts of the army may share in this training, battalions and batteries have been only kept there for a short tour and then either gone out to stations abroad or taken their turn at other stations at home.

Thus the permanent peace organization of the higher parts of the British army has remained as described in the ninth edition of this Encyclopaedia, one of district commands. The organization for war has been a paper organization, different in practice for each campaign, according to its nature, but having as a basis the tabular statement of units given in Table B, which is at present the paper organization of an army corps.

The other exception to the rule of perpetual flux and reflux has been the brigade of Guards. The three regi- ments of the Grenadier, the Coldstream, and the Fusilier Guards, to which was added in 1900 the regiment of Irish Guards, are not liable to ordinary or colonial service. Therefore, their organization at home remains constant, and they are available as a whole for active service in the same organization in which they are trained in peace. The close connexion by short steam journey with Gibraltar caused that fortress to be treated for a short time as a home

station, and garrisoned by the Guards in order to reduce the number of line battalions abroad in proportion to those at home. That arrangement was soon given up, and it may therefore be treated as a temporary episode, but it did not very materially affect the broad distinction between the permanency of the Guards' organization and the perpetual change of all other units. The new scheme laid before the House of Commons by Mr Brodrick in 1901 was an attempt

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to meet the difficulty which has hitherto prevented the training at home of bodies such as are at once required for action in the field. It is pointed out in the ninth edition of this work that "as the battle-field is the ultimate object of aU preparation, administrative con- siderations must give way to tactical ones where they clash, and all organization must conform to the tactical requirements of the day." Unfortunately, the adminis- trative difficulties which attend a vast empire, a free constitution, and voluntary service, and the indispens- able condition of presenting an economical budget, have hitherto prevented the practical application of this sound principle. In order to create the reserve for filling up the ranks for war, and to provide for the colonial reliefs, it was arranged 'that there should be a battalion at home which shoidd supply the battalion of the same regiment abroad with the annual draft required. This consideration became so paramount, that the importance for the purpose of training staffs for their work in war, and, therefore, of having constituted staffs to train, fell into the background at a time when the nation only calculated upon having to prepare for minor operations. There can be no doubt that the South African campaign plainly showed that trained staffs, accustomed to work together, and each to know its own particular share of the work, are indispens- able to the smooth working of a large organization. The plea that it is frequently necessary to send out forces no larger than a division, and, therefore, that an army corps is not wanted, is not a strong one, because a division, or a force of similar strength, will not be the less effective because it is taken out of a larger body habitually

associated with it, and out of which it can be supplemented by other troops with which it has regularly worked.

We give in Table B the ordinary composition of a British army corps, because it is well that the term should be understood ; but, ever since this form of organization for armies was created, army corps have been of an infinite variety of form. All that the term implies is that it is a little army complete in itseK, formed of every branch of the service, and being made up with all that is necessary to enable it to take its place in the field : that in itself it stands ready for war as soon as it has been mobilized. An army made up of army corps consists of several as- sociated small armies, each capable of independent action in aU respects. The " divisions," though called " infantry divisions," in fact cobsist of all arms, and frequently the several, arms have been distributed throughout the divisions to form what are called " mixed divisions." In the German army there is a double organization by which, while the several arms are associated together, unit by unit, larger bodies of each arm are for the pur- pose of working in larger bodies of the arm associated together.

The great difficulty which encounters any attempt to associate large bodies of troops in England without flux or reflux, lies in the necessity of making pro- San'iyof yjgJQn for the constant interchange and relief for India between the units at home and abroad. The and the ii f,j.j of the exiles " is too strong to permit of coioaies. ¯^^ being left abroad for more than a reason- able number of years, and experience has shown that there are grave disadvantages in allowing two separate systems to grow up in different parts of the empire. On the whole, it has proved better for the training of drafts that they should not be sent direct from depots to India, but that, after a few months with the depot, they should be passed to battalions which will, in turn, later in the year, send on a draft to the sister battalion in India. In order that this may not injure the home battalion it is necessary that the draft should bear only a limited proportion to the strength

of the nucleus of the battalion, and that the draft supplied early in the year to the home battalion from the depot should considerably exceed the draft to be sent out later to India; but, if provision be made to that effect,

the system appears to work best for both battalions. A similar allowance is necessary for the cavalry, and even more for the artillery, because in the case of batteries it becomes a question, if the draft is too severe, of the loss of specially trained men. Independently of the movement of drafts, the change in units will involve special provision if the value of the permanent organization by army corps is not to be lost.

Table B. — TJie Army Corps.

Warrant

Officers.

aod

If .-0. Officers

and Men.

TotaL

Staff

34

137

171

3 Infantry Divisions .

978

29,124

30,102

1 Cavalry Regiment .

25

506

531

Headquarters Cavalry Begiment .

7

44

51

Corps Artillery (6 field, 2 horse

batteries)

60

1,639

1,699

Anununition Park

20

672

692

Regimental Staff Corps Engineers

2

6

8

1 Pontoon Troop .

5

208

213

1 Telegraph Division .

6

238

244

1 Balloon section ….

3

51

54

1 Field company ....

7

205

212

1 Field Park ....

1

44

45

1 Railway company

5

153

158

1 Battalion Infantry .

29

981

1,010

Supply Column ....

6

145

151

Supply Park ....

9

531

540

Field Bakery ....

5

312

317

Field Hospital .... Grand total with Field Force . Detail left at base .

5

56

61

1207

35,052

36,259

37

3,299

3,336

Transport — Horses, riding „ draught Pack animals

2837

7234

76

Total 10,147

Vehicles — Carts, 1 horse „ 2 horses Waggons, 4 horses)i 6 „ .

Total

55 309 514 523

1401

The War Office, as at present constituted under the supreme and absolute authority of the Secretary of State for war, is regulated, so far as its

military per- sonnel is concerned, by an Order in Council of ™f ^^ the 7th March 1899. That Order, altering in ““n^^i certain respects the Order in Council of 21st adminis- November 1895, which is cancelled by it, pro- ^^^‘o” “ vides for the distribution of the military branch ”” into five great departments — those of the commander-in- chief, of the adjutant-general, of the quartermaster- general, of the inspector-general of fortifications, and of the director-general of ordnance. Each of these officers ” advises the Secretary of State ” directly on all questions connected with the duties of his department.*

The several officers are assigned duties which may be summarized thus : —

Commander-in-Chief. — “Principal adviser” and”general superintender ” of military departments. He is charged with the issue of army orders, inspections, the distri- bution of and ” mobilization ” of the land forces, with schemes of offensive and defensive warfare and military

information, with recommending for commissions and proposing officers for promotion, honours, appointments, and rewards.

Adjutant-General. — ^Discipline, military education and training, patterns of clothing and necessaries, returns and statistics of personnel, enlistment and discharge, and establishments. In the absence of commander-in-chief, acts for him.

Quartermaster-General.— ^Food, forage, fuel, light, quar- ters, land and water transport, remouhts, movement, distribution of stores and equipment, the administrar tion of the Army Service Corps and Pay Department, sanitation.

Inspector-General of Fortifications. — Fortifications, bar- racks, and store-buildings, inspection of ordnance fac- tory buildings, military railways and telegraphs. War Office lands and unoccupied buildiugs, submarine mining stores. Estimates for Engineer services, appointment and removal of officers Royal Engineers, technical instruction of Eoyal Engineers.

Director-General of Ordnance. — Warlike stores, equip- ment, clothing, the direction of the ordnance committee and manufacturing departments. Armament patterns, inventions and designs, inspection of all stores. The administration of the Army Ordnance Department and Army Ordnance Corps ; annual estimates for these services.

The most important part of the War Office is, however, not mentioned in the Order in Council. The " sinews of war" have at all' times Been money, without which neither could the army exist nor any military operation in peace or war be undertaken. It is true that, as a kind of appendix to the Order in Council, the statement is made that " the financial secretary is charged with the whole finance of the army in gross and detail " ; but it is not mentioned that the " War Office " is a great per- manent civil service, which has both independent offices, with its own heads, and also permeates the whole of the five departments. The Secretary of State has under him, in addition to the officers charged with the five departments and the financial secretary, a parliamentary under- secretary, who represents him in the House to which he himself does not belong, and a permanent under-secretary, who is the head of the permanent civil service of the War Office.

The enormous relative power of the civil service within the War Office, as compared with the military heads of departments, depends on the fact that these latter are appointed for five years at a time, and pass and repass through the War Office, while the War Office civil service is a permanent body which preserves all the traditions of decades, and can cite at will the records of opinion given at different epochs by soldiers who have temporarily occupied chairs in the office. Soldiers, like doctors, lawyers, and parsons, when called in to diagnose a case, do not always exhibit an absolute and instant agreement in the statement of their views. A

Secretary of State holding all authority is necessarily much more likely to be impressed with the consistency and weight, and the method of a carefully collected catena of opinions^ than with the comparatively casual dicta of men, very much overworked as compared with the officers of any other department of the kind in Europe, and relatively un- familiar with the office aspect of a question. The prac- tical result is, that the ordinary conviction of nearly every soldier employed within the office has been that he was helplessly in the hands of the permanent officials. This is altogether apart from the question of the supreme authority of the Secretary of State as the representative of the Cabinet.

The committee which in 1901 reported on the re- organization of the War Office appears to have taken this

view of the question, and to have considered that a better state of things would be produced if the authority of the War Office were largely devolved upon the army corps commanders to be created under Mr Brodrick's scheme. The practical possibility of this would appear ultimately to depend upon the extent to which Parliament will be content to accept reference to the army corps commanders as a final one as long as they are sustained, in office. It is obvious that if the Secretary of State is to answer in Parliament for every incident that takes place in every army corps no practical independence can be left to any of them. Everything must be reported to the War Office in order to satisfy the demands of the House. It is a large question which can only be judged in its practical outcome.

In accordance with the recommendations of the com- mittee on War Office Reorganization presided over by Mr Clinton Dawkins in 1901, the Secretary of State directed that in future the " War Office Council " should be con- stituted as follows : — President — the Secretary of State for War. Members — the Commander-in-Chief ; the Par- liamentary Under-Secretary of State; the Permanent Under-Secretary of State ; the Financial Secretary ; the Quartermaster-General ; the Inspector-General of For- tifications ; the Director-General of Ordnance ; the Adjutant-General ; the Director-General of Mobilization and Military Intelligence; the Director-General, Army Medical Department (for medical and

sanitary questions); the Secretary of the Council ; and such other members of the staff of the War Office as may be specially sum- moned from time to time. In the absence of the Secre- tary of State, the Commander-in-Chief acts as president.

A Permanent Executive Committee of the War Office was also appointed, with the object of co-ordinating the business of the office and of ensuring that combined action might be taken in matters affecting more than one department. It consists of the following : — ^the Per- manent Under-Secretary of State, or, in his absence, the Assistant Under-Secretary of State, chairman; the Deputy Adjutant-General, or, in his absence, an officer selected by the Adjutant-General; the Assistant Quartermaster-General, or officer selected by the Quartermaster-General ; a Deputy Inspector-General of Fortifications, or an officer selected by the Inspector-General of Fortifications ; the Deputy Director-General of Ordnance, or an officer selected by the Director-General of Ordnance ; an officer of the Mobilization section of the department of the Director-General of Military Intelligence ; an officer of the Intelligence section of the department of the Director- General of Military Intelligence ; the Deputy Accountant- General, or an Assistant Accountant-Gen eral ; the Deputy Director-General, Army Medical Department, or an officer selected by the Director-General ; the Assistant Director of Contracts ; the Secretary of the War Office Council, who will act as secretary of the executive committee.

In addition to the above, the " Army Board," which consists of the Commander-in-Chief, the Adjutant- General, the Quartermaster-General, the Inspector- General of Fortifications, the Director-General of Artillery, with usually the military secretary, as assessor, and the Director-General of the Army Medical Depart- ment now added, meets at such times as may be fixed by the Commander-in-Chief.

Table G. — Terms of Service.

Corps.

Boys .

Household Cavalry- Cavalry of the Line Royal Artillery .

With the In the Colours. Reserve.

12

12

7

7

BRITISH]

A E M I E S

649

Table C. — Terms of Service — continued.

■*With the Colours.*

Corps.

Royal Engineers —

Sappers for Companies and for 1st and 2nd Divisions Telegraph Battalion

Sappers for Bridging Battalion

Drivers

Military Mechanists

Railway Reserve .

Telegraph Reserve

Submarine Mining Reserve Foot Guards —

Bandsmen ... . .

Other Recruits

Infantry of the Line ....

Royal Army Medical Corps

Army Service Corps ....

Army Ordnance Corps — Armourer, Machinery Artificer Sections Other Recruits

Daily Bate of Pay of Lowest, Bank.

Royal Horse Artillery —

Gunner

Driver ....

Household Cavalry ... . .

Cavalry of the Line

Royal Field Artillery —

Gunner

Driver

Royal Garrison Artillery —

Gunner .

Royal Engineers —

Sapper

Foot Guards . ....

Infantry of the Line

Army Service Corps

Royal Army Medical Corps

Army Ordnance Corps

Boys, all corps, until they

ofl8 .

7

3

3

12

12

7

or 3

7

or 3

7

or 3

3

12

7

In the Beserve.

8. d.

^

1 2}

1

0 0 2 2

attain the age

The new scheme.

0 8

With an addition, in all corps, of 3d. a day messing allowance on obtaining a certificate of military efficiency from the commanding officer.

The actual working out of Mr Brodrick's new scheme for having six army corps organized in the United King- dom had not been promulgated at the time when it was necessary for this article to go to press. It was only known that Aldershot, Salisbury, and Dublin were to be the headquarters of the three active army corps, and Colchester, York, and Edinburgh of what may be called the three sedentary army corps. The scheme had involved much labour, but, even on paper, the detailed distribution of the several units of the army into their brigades, divisions, and army corps, and the definition of the territorial limits of the commanders' authority, did not appear to have reached its final stage. It has, we believe, been decided that there wUl be one marked difference between the new army corps and those which are known as such on the Continent. In Russia, France, Germany, and Austria the several ranks of senior officers have direct relation to the functions which they fulfil. Normally the army corps is commanded by a general, the division by a lieutenant-general, the brigade by a major-general, the regiment forming an intermediate link between the brigade and the battalion. In England this intermediate link

does not exist as a part of the pro- gressive expansion of the army from its smaller to its larger organism. The regiment form s the connecting link between the battalions at home and those abroad, and in some sort between the regular and auxiliary battalions. It is not intermediate between the battalion and the brigade. It appeared, from the indications furnished, to be intended to appoint colonels as brigadier-generals to

command the brigaldes, major-generals to command the divisions, while three full generals (Sir Eedvers Buller, Sir Evelyn Wood, and the duke of Connaught) were ap- pointed to the first command of the three active army corps, though, on Sir Eedvers BuUer's retirement in October 1901 his successor in the command of the 1st Army Corps, Sir John French, was a major-general with the local rank of lieutenant-general. If this be so, the rank of lieutenant-general would virtually disappear from the ordinary course of the military hierarchy during peace time. As experience has shown in South Africa, it be- comes a very necessary link in any considerable war, and major-generals have been appointed with " local and tem- porary " rank as lieutenant-generals accordingly. This step as to the peace organization would have the further importance of greatly limiting the possibility of promoting major-generals during peace time. The royal warrant already referred to makes that promotion dependent upon there being a specific appointment to which the promotion is made. The filling up by major-generals of the specific appointments which in foreign armies are reserved for lieutenant-generals, obviously affects this question very materially, and practically would produce the result that nearly all officers who reached the rank would terminate their career as major-generals.

Two departments, each of which provecl during the Boer war to be inadequate for the work assigned to it, have been the subjects of recent and special investigation, viz., the army medical department and the remount de- partment. Experience has shown that the attractions offered by army medical service have not been adequate. Briefly, the new scheme is as follows : — The department is to be administered by an " Advisory Board " of nine members under the chairmanship of the Director-General. Two of these are to b^ officers of R.A.M.C., two civil physicians, two civil surgeons, one representative of the War Office, one

representative of the India Office. It advises on all medical army matters, including promotion of officers, thus superseding the " promotion board," which hitherto has dealt with that subject. The scale of pay is to be —

Lieutenant "on probation" and Lieuten- ant, in all .... . Captain (after 3 years' total service)

»» »» ^" »J)J w

Major „ 12 „ „ „

Major (after 3 years as such) Lieut. ~~Colonel (after 20 years' service) „ (selected to an establish~~

ment of 50) Colonel .

Surgeon-General .... Director-General ....

£328 10 0 per

379 15 2

400 0 0

477 15 2

637 12 10

632 12 10

713 15 4

804 15 4

953 10 10

1500 0 0

2000 0 0

Candidates must be British subjects of unmixed European blood, under 28 years of age, with good references and a registrable qualification to practise. Provision is made for examinations prior to appointment and promotion to each rank. Previous to each of these the candidate will have the opportunity of attending, partly at Netley, partly at selected civil hospitals, courses of instruction in the special subjects in which he is required to pass. Before promotion to captain and before promotion to major, he may, by passing exceptionally well, obtain an acceleration of promotion varying from 3 to 18 months. Brevet pro- motion may be given either for distinguished service in the field or other exceptional service not in the field. The creation of an instructional military hospital and military medical staff college is proposed. A retaining fee of £26 per annum is proposed for such medical officers as, after 3 years' service as lieutenants, go to a reserve of officers.

S. I. — 82

650

A E M I E S

[BRITISH COLONIAL

The nursing service is to be called " The Queen Alex- andra's Imperial Military Nursing Service," and governed by a board under the Queen as president. The pay ranges from the matron-in-chief, from £260 to £300 per annum (by £10 annual increments), with lodging allowance, to nurses, £25 a year to £35 (by £2, 10s. annual incre- ments). The ranks are principal matrons (from £110), matrons (from £70), sisters (from £37, 10s.), nurses, and female servants.

An almost equally elaborate scheme had been proposed for the reconstruction of the army remount department, but it would appear that financial considerations caused it to be abandoned. No department within the scope of its possibilities accomplished harder or more valuable work during the South African war. (j. f. m.)*

British Colonial Forces.

The British colonial forces proper are those raised and maintained by the colonies at their own expense, either for local purposes or as a voluntary contribution towards imperial defence. The relative prominence of these two objects necessarily depends mainly on the position and population of individual colonies or groups. Canada must maintain a considerable land force for the defence of a long land frontier, while fortunately the chance of hostilities with the United States is sufficiently remote to enable the empire to count on Canadian troops under other conditions. Newfoundland, being little liable to attack and having small financial resources, has not hitherto kept up any military force beyond a few armed police ; advantage has, however, now been taken of the exceptional advantages the colony offers as a source of supply of men for the royal navy in war. The Australian states, including New Zealand, derive security from their position against organized invasion so long as British naval supremacy is maintained in Far Eastern waters. Though in a maritime war their land forces would in part be required for protecting their ports against predatory raids, they would doubtless be largely available for offensive operations in aid of imperial strategy. In the West Indies the function of local troops, largely native, must be looked upon as entirely local defence ; in Bermuda and Jamaica they are auxiliary to imperial garrisons; in the Leeward Islands, Barbados, Trinidad, British Guiana, and British Honduras, they secure internal tranquillity in peace and guard against any possible raiding attack from a cruiser in war. A small white corps in the Falkland Islands has been raised to serve the latter purpose. In West Africa considerable forces of armed natives are maintained to secure the peaceful administration of the more turbulent parts of Sierra Leone, the Gold Coast, Lagos, and Northern and Southern Nigeria. In St Helena, the eastern colonies of Ceylon, the Straits Settlements, and Hong Kong, colonial volunteers, mainly European or of European descent, form valuable auxiliaries to the regular garrisons of the imperial coaling stations in these colonies. There are also native armed police in the two last, and a Sikh force, maintained by the confederated Malay States, would in war furnish assistance to the Singapore garrison. Armed police in Labuan and Fiji, assisted by white volunteers in the latter colony, maintain order in peace and would resist

predatory attack in war. An armed constabulary of Papuans secures the internal quiet of British New Guinea.

In the self-governing colonies the colonial forces are administered by a defence department, which in Canada, Victoria, and New Zealand, is under a minister of defence ; in ISfatal, under the minister of lands and works, and in

the other colonies under the prime minister or the chief or colonial secretary. In Canada, West Australia, Queensland, and New Zealand, the forces are commanded by imperial officers lent to the colonial Governments ; in South Australia, Victoria, and Tasmania, by officers of the local forces. In Cape Colony and Natal their command in war devolves on the generals commanding the imperial troops. This is also the case in crown colonies where there are imperial troops permanently stationed. In the Lee- ward Islands, Trinidad, and British Guiana, the militia or volunteer forces are commanded by an officer who has also the armed police of the colony under him, and the same arrangement was proposed for the volunteer force raised for Barbados to replace the imperial troops withdrawn from that island. A few imperial officers, in addition to the commandant, are employed on the headquarters staffs of several of the self-governing colonies, and the frontier forces of West Africa are almost entirely officered from the imperial regular or militia service.

The permanent troops of Canada, corresponding to the regular forces of the imperial army, consist of 2 squadrons of cavalry, 2 field batteries, and 2 garrison companies of artillery, and 4 companies of infantry. The North-West Mounted Police, though enrolled under civil law, are practically a fine military force. The only permanent forces of Cape Colony and Natal are the Cape Mounted Rifles and the Natal Police, who have proved themselves most efficient soldiers. There are armed police organized as a military force in Bechuanaland, Basutoland, and Rhodesia. In Australia and New Zealand the regular troops consist of forces of artillery and engineers, and a small staff of officers and non-commissioned officers for other branches. In the West Indies the permanent forces are armed native police, and in West Africa, native

constabulary organized on an entirely military basis. There are armed police at the Straits Settlements, Lar buan. Hong Kpng, Fiji, and British New Guinea, and the Malay States Guides in the Federated Malay States are permanent troops.

The establishments of permanent troops in the different groups of states are approximately as follows : —

North America South Africa . Australasia . Mediterranean (Cyprus) West Indies . West Africa . Eastern colonies .

Total

1,700 3,200 2,000 700 2,800 8,000 3,400

21,800

These figures do not include the armed police of the Australian states and of New Zealand, of which certainly the mounted branch could be made available in war, and would be highly efflcient as mounted infantry.

The pay of a private soldier in the permanent forces in Canada is 2s. OJd. (J dollar) a day. In South Africa it is 5s. or 6s., in New South Wales and Queensland, 2s. 3d., in Victoria, 3s. 6d., and in New Zealand, 5s. or 6s. The native armed police in the West Indies receive at the rate of 2s. to 3s. a day, the frontier forces of West Africa, Is. or Is. 3d., and the armed police and constabulary in the eastern colonies from 8d. to Is.

In Canada, Natal, West Australia, and Queensland, men enlist in the permanent forces for three years, in Tasmania for five, in Cape Colony for five in the first instance, and afterwards for fresh periods of three years at the expiration of each former period, and in Victoria and New South Wales for five years, with the option of re-engagement for a further period of five years. The periods for which natives enlist in the armed police forces of the different West Indian colonies vary from one to six years. It has been proposed to make the term of enlistment in the West African frontier forces a uniform one of seven years, and to en- courage

re-engagement. ;Five years is the usual period in the East African colonies.

The colonial forces, apart from the permanent troops dealt with above, comprise the following units of cavalry, mounted infantry, infantry, artillery, and engineers, partially paid and unpaid.

BRITISH colonial]

A E M I E S

651

1^2

Inftntry.

2 • “^

° b/-^

i^

Colony.

w

III

^|i

o-jS

ii

Btns.

Coya.

Canada

37

1

89

9

17

31

2

Jamaica

...

6

2

Leeward Islands

“i

3

Trinidad .

“i

8

Britisli Honduras

...

2

„ Guiana .

...

4

...

Falkland Islands

1

Gold Coast

...

3

St Helena .

...

1

Cape of Good

...

13

“7

9

2

Hope

Natal .

...

26

2

1

Ceylon

...

1

...

13

1

Straits Settle-

...

...

1

ments

Hong Kong

• *•

1

1

W. Australia

...

...

8

2

S. Australia

8

..

18

2

2

Victoria

9

6

10

3

7

1

New S. Wales .

2 Regts.

4

8

...

2

4

2

Queensland

...

12

5

“2

2

3

Tasmania .

...

3

...

2

1

New Zealand

18

9

“9

6

9

5

Fiji .

...

...

5

There are also medical services, including officers and men, in Canada, Cape Colony, South Australia, New South Wales, Queens- land, New Zealand, and Ceylon. One or two of the colonies have the nucleus of an Army Service Corps.

The establishments of partially paid and unpaid troops in the dlEEerent groups of colonies are approximately as follows : —

North America South Africa Australasia . West Indies . West Africa Eastern colonies

34,700 9,800

28,600

3,000

400

1,900

78,400

These numbers, representing approximate peace establishments, are capable, especially in the first three groups, of large expansion in war by the accession of men who, from tiieir ordinary conditions of life, possess considerable military aptitude.

Service in aU the forces is at present entirely voluntary, in the sense that there is no man now serving who has been compelled to enrol, but the actual laws governing the forces in Canada, South Australia, Queensland, Tasmania, New Zealand, Jamaica, the Leeward Islands, and British Guiana provide for the ballot, if authorized establishments cannot otherwise be kept up, or in war. In Canada, Cape Colony, and New Zealand, all male inhabitants of fighting age can be called out for a levee en masse.

Apart from the permanent troops, the whole of the forces of Canada, Natal (though called volunteers), West Australia, South Australia, Jamaica, and British Guiana, are partially paid, i.e., all ranks receive pay during peace according to the mUitary duties they perform. Those of Cape Colony, Tasmania, New Zealand, the Leeward Islands, Trinidad, British Honduras, the Falkland Islands, St Helena, the Gold Coast, Ceylon, the Straits Settle- ments, Hong Kong, and Fiji are unpaid, except when called out for active service, though most of the corps receive capitation grants for efficients. In Victoria, New South Wales, and Queens- land, though the bulk of the troops are partially paid, there are also unpaid corps. The forces in Jamaica, though termed militia, do not receive pay for the ordinary drills laid down by law. The general tendency of late years has been to substitute partially paid or militia for unpaid or purely volunteer troops, as with the former it is found possible, under the

conditions which obtain in most of the colonies, to get greater efficiency than with the latter.

In Canada the daily rate of pay for a militiaman during training is 2s. O^d. In Natal a volunteer, it mounted, 6s., and if dii^ounted, 5s. for each day's training. In South and West Australia a man receives 5s. for each of a certain number of paid drills. Militia- men in Victoria, New South Wales, and Queensland, can by at- tendance at specified parades, and by efficiency, earn £6 : 5s., £6: 8s., and £7 per annum respectively. The daily rate of pay for a militiaman in Jamaica, daring continuous training as distinct from ordinary drills, is 2s.

The period of service as laid down in Militia or Volunteer Acts of Canada, Natal, West Australia, Victoria, Queensland, Tasmania,

Jamaica, Trinidad, and British Guiana, is three years. In South Australia it is two years in the active force, and three in the re- serve. For the Cape and New Zealand it is not less than one year. For New South Wales, and for the colonies not mentioned above, where the local forces are entirely volunteers, no period of service has been laid down, men being allowed to cease serving on giving notice varying from fourteen days to three months.

There is considerable variation in the amount of annual training undergone by the various colonial auxiliary forces. As far as it is provided for by legislative enactment, the average number of days' training in the year is about twelve. In Canada, Queensland, and Tasmania, eight days is laid down as the minimum and sixteen as the maximum period, but in Queensland the maximum does not include eight days' continuous training which may be ordered by the governor. In South Australia the maximum for the active force is twenty-four days, and the minimum twelve of five hours ; for the reserve twelve days' training is required. In New Zealand 168 hours is the maximum. In all the Australasian states the partially paid troops frequently hold voluntary parades. The regulations for the unpaid volunteers in Cape Colony require for efficiency twenty-seven drills in the first year's service, and eigh- teen in subsequent years ; those for the paid volunteers in Natal lay down ten days in camp or twenty-four drills. In Jamaica the Militia Act provides for

twelve ordinary drills, in addition to target practice and inspection parades, and in British Guiana for twelve days' drill a year.

All the colonies have already, or are now acquiring, rifles of the same calibre as those used in the imperial army, and the greater number of these rifles are of Lee-Metford or Lee-Enfield pattern. In field artillery there is more diversity, but this is likely to be remedied in the future. With reg;ard to fixed armaments, apart from those provided by the imperial Government at the imperial fortresses and coaling stations, the Governments of Natal, of the six Australian states, and of New Zealand, have mounted power- ful guns at their principal ports. British Guiana has defended Greorgetown,' and Trinidad and Barbados are likely to follow suit when the state of their finances makes it possible for them to do this in addition to maintaining defence forces. Canada has con- tributed largely to the protection of Esquimalt ; and Ceylon, the Straits Settlements, and Hong Kong, to the defended coaling stations in these colonies. For the supply of war material the colonies are still largely dependent on Great Britain, but Canada has a cartridge factory, and shell foundry, and there are private ammunition factories in Australia and New Zealand, capable of manufacturing ammunition for Government small arms.

Colonial naval forces are practically confined to South Australia, Victoria, New South Wales, and Queensland. South Australia owns a protected cruiser, Victoria an armoured turret-ship and five torpedo boats, New South Wales two torpedo boats, and Queensland two gun-vessels and two torpedo boats. To man these ships there are altogether some 200 permanent and 1400 partially paid or unpaid officers and men. In view of the fact that a considerable imperial squadron, to which the Australian states and New Zealand contribute £126,000 annually, is always maintained in Australasian waters, and that the states have also provided by fiixed defences against the raiding attacks of cruisers on their ports, it is difficult to say what function is played by the local naval defences of Australia. There is undoubtedly a desire in Australia to make some contribution in personnel as well as in money to the naval forces of the empire, and the question as to how this can most effectively be done by men thoroughly trained at sea will require consideration. New Zealand,

besides contributing to the imperial navy, keeps up naval volunteers, but these are really military forces trained in the duties of garrison artillery and submarine mining. The preventive service in Canada, which includes some 500 ofBcers and men, cannot at present be looked upon as a fighting force. Arrangements are being made for utilizing the fishermen of Newfoundland for the royal naval reserve. Cape Colony makes an annual money contribution of £30,000 to the imperial navy, free of all conditions. Natal makes a contribution of 12,000 tons of coal. It has also naval volunteers ; but these, though they have given proofs of their excellence in manning guns of position, have no sea training, and are more properly included in the military forces of the colony.

[INDIA

The following table shows the colonial military and naval expenditure as taken from the latest estimates and accounts : —

Military and

Group.

MiUtary and

Population

Naval Ex-

Colony. ^

Naval Ex-

(estimated

penditure

Eemarks.

penditure.

81/12/97)-

per liead of Population.

Mediterranean .

Gibraltar

£

20,699

«. d.

J)

Malta

5,709

177,745

0 6

Contribution.

■NT _lT.“a

Cyprus

25,990

229,286

2 3

Armed police. >

North Amenca .

Canada

502,709

5,185,990

1 11

Permanent^ and Militia force and North-west Mounted Police.

»1 M

Newfoundland

8,275

208,000

0 9

Armed police.

„” ”

Bermuda

16,098

West Indies

Bahamas

2,000

52,000

0 9

Armed police.

)) I)

Jamaica

67,401

706,394

1 11

Armed police, Militia, and allowance to Imperial troops.

n »1

Leeward Islands

11,235

129,751

1 8

Armed police and defence force.

n)i

Windward Islands

, 9,500

154,543

1 2

Armed police.

” yi

Barbados

23,972

190,000

2 6

Armed police and allowance to Imperial troops.

II 11

Trinidad

57,689

275,363

4 2

Armed police and Volunteers.

11 11

British Honduras

6,863

34,277

4 0

11 11

11 11

„ Guiana

54,296

286,484

4 0

Armed police and Militia.

11 11

Falkland Islands

150

2,050

1 0

Volunteers.

West Africa

Gambia

4,816

13,057

8 4

Armed police.

11 11

Sierra Leone

24,299

C No trust- worthy

■••

Armed constabulary and allowance to Imperial troops.

11 11

Gold Coast

53,163

statistics

>••

Armed constabulary and Volunteers.

11 II

Lagos

35,049

at present

..*

Armed constabulary.

11 11

Southern Nigeria

45,077

available

11 11 .

11 11

Northern „

...

for these . colonies. .

...

Expenditure on armed constabulary at present covered by grant from Imperial Exchequer.

11 11

St Helena

95

3,897

0 6

Volunteers.

South Africa

Cape of Good Hope

309,504

2,143,100

2 10

Cape Mounted Rifles ; Volunteers ; contribution to Navy and allowance to Imperial troops.

II 11

Natal

117,452

811,189

2 10

Natal police. Volunteers ; contribution to Navy and allowance to Imperial troops.

11 11

Basutoland

13,137

250,000

1 0

Armed police.

11 11

Bechuanaland

...

£49,425 covered by grant from Imperial Exchequer.

11 11

Bhodesia

238,487

...

...

Armed police and Volunteers (British South Africa

Company). Contribution and allowance to Imperial troops.

A '•' "

Mauritius

27,630

377,856

1 5

Asia ,

Ceylon

145,399

3,298,342

0 10

Volunteers, contribution, and allowance to troops.

II

Straits Settlements (including Malay States)

Labuan and British

142,266

1,175,656

2 4

Malay States Guides, armed police. Volunteers, and contribution.

11

(not known)

V ■••

Armed police.

North Borneo

• ” i , .

Hong Kong

88,321

248,710

7 1

Armed police. Volunteers, and contribution.

Australasia

West Australia

16,635

155,749

2 1

Military forces and contributions to Navy, and to Federal fortresses in Australia.

South Australia

32,776

361,045

1 9

Victoria .

179,392

1,176,268

3 0

Military and Naval forces, contributions to Navy and to Federal fortresses in Australia.

New South Wales

233,997

1,335,800

3 6

Queensland

94,401

484,700

3 10

Tasmania New Zealand

13,996 169,944

171,719 768,910

1 7 4 5

Military forces and contribution to Navy.

Fiji

2,283

121,798

3 4

Armed police and Volunteers.

British New Guinea

3,044

3,350,000

...

Armed police.

Besides Colonial forces proper there are what are officially known as Colonial corps, consisting of troops raised in the Colonies and India, and paid by the Imperial Government for garrison duty at the Imperial fortresses and coaling stations. The Colonial corps at the present time comprise the West India regiment (three battalions). West African regiment, British Central African regi- ment. Hong Kong regiment, and Chinese regiment ; the Royal Malta artillery, the West Indian, West African, and East African companies of artillery, submarine miners, and fortress engineers ; the Royal Malta militia, the Bermuda militia artillery ; and the Bermuda volunteer rifle corps. . These corps number altogether some 10,000 regular, 2500 militia, and 300 volunteer troops, and are under the direct control of the War Ofiice. In addition to these Colonial corps under the War Office there are certain other troops of the Empire which also, not being properly Colonial forces, call only for brief mention. These are the military forces of the British Central Africa, British East Africa, Uganda and Somaliland Protectorates. They number altogether some 4500 regular native soldiers, under Imperial officers lent by the War Office, and are administered by the Foreign Office. (m. n.)

India. After the transfer of the Government of ^ India to the Crown in 1858, the whole military organization was re-

cast. The local European army was abolished.. The artillery became wholly British, with the exception of a few native mountain batteries. The Company's European artillery, engineers, cavalry, and infantry were amalga- mated with the royal army. The total strength of the British troops, all of the royal army, was largely in- creased, while that of the native troops was largely diminished. Three distinct native armies — ^those of Ben- gal, Madras, and Bombay— were still maintained. The reduced Indian armies consisted of cavalry and infantry only, distributed as follows, with a few artillery : —

_, Battalions, Infentry. Eeglments, Cavalry.

Bengal ... 49 ... 19 Madras . . . 40 . . . 4 Bombay . . . 30 . . ! 7

Punjab force . . 12 . . '. 6

Total . .131 36

There were also three sapper battalions, one to each army.

The Punjab force, which had 5 batteries of native

artillery attached to it, continued under the Punjab Government. In additiod, the Hydrabad contingent of 4 cavalry, 6 infantry regiments, and 4 batteries native artillery, and a local force in Central India of 2 regiments cavalry and 6 infantry, were retained under the Govern- ment of India. After all the arrangements had been completed the army of India consisted of 62,000 British and 125,000 native troops.

The Company's military college at Addiscombe was closed in 1860, and the direct appointment of British officers to the Indian local forces ceased in 1861. In that year a staff corps was formed by Koyal Warrant in each Presidency " to supply a body of officers for service in India, by whom

various offices and appointments hitherto held by officers borne on the strength of the several corps in the Indian forces shall in future be held." Special rules of pay, pension, and promotion were-laid down; the principle of the last being promotion by length of service in the various ranks from second lieutenant up to lieut.- colonel. The corps was at first recruited partly from officers of the Company's service and partly from the royal army, holding staff appointments (the new regimental employment being considered as staff duty) and -all kinds of political and civU posts; afterwards by young officers from the British service, and recently in addition by second lieutenants drafted direct from the Eoyal Military College, Sandhurst. The native artillery and sappers and miners were to be officered from the Royal Artillery and Royal Engineers. The only English warrant and non-commissioned officers now to be em-ployed in the native army were to be those of the Royal Engineers with the sappers and miners. Officers of the old Indian army who did not accept .service in the artillery, engineers, and new line regiments transferred to the British army on the amalgamation, remained in their former cadres for promotion. Now all have dis- appeared from the active list except a few generals.

A radical change in the regimental organization of all the native armies was effected in 1863. The Punjab Frontier Eorce was from the first organized on the irregular system, which was there seen at its best, as also were the new regiments raised during the Mutiny. This system was now applied to the whole army, each regiment and battalion having seven British officers attached to it for command and administrative duties, the immediate command of troops and companies being left to the native officers. Thus was the system reverted to which was initiated by Clive, in the early days, of a few British officers only being attached to each corps for the higher regimental duties of command and control. Time had shown that this was more effective than the regular system instituted in 1796 of British officers commanding troops and companies.

Selection for all regimental commands was now the order. A new spirit was breathed into the army. The supremacy of the commandant was the main principle. He was less hampered by the imbending regulations en-joined upon the old regular regiments, had greater powers of reward and

punishment, was in a position to assume larger responsibility and greater freedom of action, and was supported in the full exercise of his authority. The system made the officers.

Up to 1881 the native army underwent little change, but in that year financial considerations prevailed and 18 regiments of infantry and 4 of cavalry were broken up, while the rank and file of the rest were increased. Almost the same number of men were maintained as before, but in fewer and stronger regiments and better organized for war. The only reduction made in the British troops was in the Royal Artillery, which was diminished by 11 batteries. The events of 1885, how-

ever, on the Russo-Afghan frontier led to an augmenta- tion of the army. The 11 batteries Royal Artillery were brought back from England, each of the 9 British cavalry regiments in India received an addition of a fourth squadron ; each of the British infantry battalions was increased by 100 men and 3 battalions were added. The native cavalry had a fourth squadron added to each regiment; three of the four regiments broken up in 1881 were re-raised, while the native infantry was increased in regimental strength, and 9 new battalions raised composed of Gurkhas, Sikhs, and Punjabis. The addition in all amounted to 10,600 British, and 21,200 native troops. In 1890 the strength of the army of India was 73,000 British, and, including irregiilars, 147,500 native troops.

Many important changes have taken place since 1885, which have vastly iniproved the efficiency of the native army. Seven Madras infantry regiments were converted into regiments for local service in Burma, composed of Gurkhas and hardy races from Northern India; six Bengal and Bombay regiments were similarly converted into regiments of Punjabis, Pathans, and Gurkhas ; the native mountain batteries have been increased to ten ; the system of linked battalions has been introduced with the formation of regimental centres for mobiliza- tion; and reserves for infantry and mountain artUlery have been formed. The number of British officers • present with each regiment has been increased to nine, and the two wing commands in battalions have been con- verted into four double-company commands of 250 men each, under a British commander, who is responsible to the commandant for their training and

efficiency, the command of the companies being left to the native officers., This system, which is analogous to the squadron command in the cavalry, admits of closer individual at- tention to training, and distributes among the senior British regimental officers effective responsibility of a personal kind.

An addition to the army of five native b9.ttalions at the expense of the imperial Government was made in 1900 as the result of India being called upon to furnish garrisons for Mauritius and other colonial stations over sea. These new battalions are raised from such war- like and hardy races as Sikhs, Punjabi Mahommedans, Jats, and hUlmen in Northern India. Of these three are included in the Punjab army, and two in that of Bengal.

The unification of the triplicate army departments in the different Presidential armies was completed in 1891, all being brought directly under the supreme Government ; and the three separate staff corps of Bengal, Madras, and Bombay were fused into one in 1891 as the Indian Staff Corps. These measures prepared the way for the new system of army organization, which, by authority of Parliament, abolished divided control and placed the whole army of India under the Governor-General and the Commander-in-Chief in India.

On the 1st April 1895 the army of India was divided into four great commands — Punjab, Bengal, Madras, Bombay. These com- mands are under lieutenant-generals, styled as commanding the forces therein, all under the direct command of the Commander- in-Chief, and the control of the Government of India. The Punjab command includes the whole of the Punjab province. The Bengal command includes the territories under the civil governments of Bengal, Assam, the North-West Provinces and Oude, and part of the Central Provinces. The Madras command includes the Madras Presidency, Burma, and the Belgaum district. The Bombay com- mand includes the Bombay Presidency, Baluchistan, and parts of Rajputana, Central India, and the Central Provinces.

The two local cavalry regiments and six battalions in Central India are now included In the Bengal and Bombay commands. The Hydrabad

contingent remains as a separate force under the direct orders of the Government of India. It is commanded by a

654

A E M I E S

[INDIA

^general ofloer and garrisons a district of the Hydrabad state, but js available for general service.

The unified army is now organized on the territorial principle. The old Madras and Bombay armies are included in the Madras and Bombay commands, and recruit with some exceptions within the territories of these commands. The Bengal army was divided into two parts. All that portion of it which recruits in the Punjab is included in the Punjab command, while that which recruits in North-West India and neighbourhood is included in the Bengal command. The Gurkha battalions, a foreign element, are divided between the Punjab and Bengal commands, with one battalion in Burma. All the troops, though they have a home connexion with their particular commands, are interchangeable and liable to serve anywhere in and outside India.

The composition of the several commands is as follows : —

Indian Army.

1

Native Troops.

Punjab.

Bengal.

Madras.

Total.

Cavalry regiments Artillery batteries

(10 mountain) Sappers and miners Infantry battalions

15

7

44

11 2

1 26

3

1 32

7 2

1 ,31

4 4

6

40 15

3 139

Strength, includ-“) ing officers j

52,600

32,900

30,300

31,200

7,600

154,600

The Indian Staff Corps, consisting of a corps of British officers for . regimental employment in the native army, for staff, departmental, and other duties, numbers at present 2600 effectives, with a tendency to increase. Of these 26 are general officers.

The Indian Medical Service numbers 700 officers of all ranks, with a subordinate establishment of 500 military assistant surgeons.

The present establishment of British troops in India numbers 73,600. They are periodically relieved from home, the tour of service varying from 9 years for cavalry up to 15 years for artillery and infantry ; and are generally distributed in the several com- mands as follows : —

Punjab.

Bengal.

Madras.

Bombay.

Total.

Cavalry regiments . Artillery horse batteries . „ field batteries

3 4 8

3 3

14

2 2 8

1

2 12

9 11

42

,, heavy batteries . , , mountain batteries

2 5

1

1 1

“2

4 8

,, garrison batteries Infantry battalions .

3 16

8 17

3

8

9 11

23 61

Royal Engineers, Submarine Miners, etc., one company in the commands.

The regular troops, British and native together, number 228,100, the strength of the several arms being as follows : —

British.

Native.

Total.

Cavalry .... Infantry .... Artillery .... Guns ....

6,600

52,600

13,400

390

24,700

122,000

3,200

76

30,300

174,600

16,600

466

The Native Army Active Reserves, mainly infantry, are growing, and at present number about 21,000, nearly half of whom belong to the Punjab command. They consist of men who have served with the colours from five to twelve years, and are called out annually for one month's training at regimental centres. There is also a large garrison reserve of all arms, consisting of old soldiers who have served twenty-one years, and are on the pension estab- lishment. The auxiliary forces consist, in round numbers, of

Volunteers (British) 31,000

Imperial Service Troops (Native) 18,000

North-West Frontier Irregular Corps (Native) . . 6,000 Burma and Assam Military Police Battalions (Native) 15,000 The volunteers are drawn from the British element of the popula- tion ; organized in corps in the different commands — rifles, mounted and foot, light horse, and artillery — ^under district general officers. Well armed and trained, they are of great defensive value.

The Imperial Service Troops came into existence in 1888, when the principal feudatory chiefs spontaneously offered men and money towards 50-operation in imperial defence. Portions of their forces, under the instruction of a staff of British inspecting officers, have been raised to such a pitch of general efficiency as to

fit them to take a place in line with the army of India. At present they consist of 8000 caValry, 8000 infantry, with pioneers, mountain artillery, camel and transport corps, and have done good service in the field at Gilgit, on the Punjab frontier, and in China. They are under the orders of the Government of India.

The North-West frontier Irregular Troops are organized in eight corps as rifles and militia, under two and three British officers to each corps, and form an efficient advanced frontier force for service in the tribal countries beyond the administrative border. They are under the political authorities of the frontier province, and are recruited from the Afridi and other mountain clans along the border.

The Burma and Assam Military Police are organized in battal- ions under British officers, seconded from their regiments for this duly. They are recruited from the best material in the Punjab and neighbourhood, and form a very efficient irregular force for service on the eastern frontiers. They are under the provincial civil governments.

The supreme military power in India is vested by law in the Governor-General in Council, subject to the control of the Secretary of State for India. The business of the army is conducted through the military branch of the Government secretariat, which is immediately under the military

member of Council. The secretary of this branch, like all the others, holds a position somewhat above that of an under-secretary of' state in England, as, apart from his responsibility to the military member, the duty rests with him of personally bringing to the knowledge of the Viceroy every matter of special importance. The execu- tive head of the army is the Commander-in-Chief in India. He is responsible for its efficiency, is the adviser of Government in all military matters, and is an extraor- dinary member of Council with a voice in it, and precedence next after the Viceroy. Besides the great department of command and discipline of which he is the head, there are various army departments, for the most part spending — ordnance, works, accounts, commis- sariat-transport, Indian medical service, army remount, clothing. These, together with what comes up from the Commander-in-Chief, make up the whole business of the army, and are administered in the military department of the Government by the military member of Council. All orders are issued by the secretary of this department in the name of the Governor-General in Council.

The Commander-in-Chief nominates 'to all appointments in the combatant branches subject to regulations, the action of Govern- ment being limited to confirming his nominations, which in all important cases are the result of communications which obtain the Viceroy's approval beforehand. The military member nominates to all appointments in the departments under him. As a matter of fact, the disposal of questions of equipment, armament, and defence, is the result of deliberation between the two authorities previous to submission to the supreme authority. Communication between the Commander-in-Chief and the military department is carried on through the adjutant-general and quartermaster-general. The Commander-in-Chief has under him a personal office, of which his military secretary is head, dealing with appointments and promotion. Also under him is the adjutant-general's department, which includes the inspector-generals of royal artillery and cavalry, staff officers for musketry and royal engineers, &c., with the quartermaster-general's department, including mobilization, intelli- gence, army signalling, &c. Other heads at army headquarters are the surgeon-general, army and Indian medical staff, director military education, judge-advocate-general, principal veterinary officer.

The division of the army into four great commands with com- plete army and departmental staff, all under lieutenant-generals, vested with large responsibilities and powers, has relieved the Commander-in-Chief of much detail, and left him free to exercise general supervision over the army — to watch it in peace and direct it in war, and to consider the important military questions of the day. Comprised in the commands are thirty military districts. All the general officers and staff are selected according to a fixed proportion from both services, British and Indian.

The establishment of units of the British army in India is :

Cavalry : 29 officers, 601 other ranks— total 630, in 4 squadrons. Artillery, horse and field ; 5 officers each, 167 other ranks— total,

162.

„ mountain : 5 officers, 106 other ranks — 111. „ heavy : 6 officers, 96 other ranks — 100.

Artillery, garrison : 5 officers, 140 other ranks — 145. Infantry battalion : 29 officers, 1003 other ranks— 1032, in 8 companies.

The peace establishment of the Indian cavalry regiment is 11 British officers, 17 native officers, 608 other ranks— total 636, organized in 4 squadrons. Their armament is sword, lance, and Lee-Enfleld carbine. Of the 40 cavalry regiments 25 are lancers. The British officers in each regiment fill the grades of commandant, squadron commanders (one of them second in command), adjutant, and squadron officers. Native officers are in command of half squadrons, and one of them is native adjutant as assistant to the British adjutant. That of the infantry battalion is 11 British officers, 16 native officers, other ranks 896 — total 923, organized in 8 com- panies under native officers, and in 4 double

companies under British officers. The British officers fiU the grades of commandant, double- compaay commanders (one of them second in command), adjutant, quartermaster, and double-company officers. One of the native officers is native adjutant. The armament is the Lee-Enfield rifle. There are 9 battalions of pioneers, trained and armed as infantry, and instructed as pioneers, with a special equipment. The 3 corps . of sappers and miners are organized in companies. They are armed as infantry and trained and equipped as engineers. They vary in strength ; that of Bengal being 20 officers Royal Engineers, with 31 warrant and non-commissioned officers, 23 native officers, other ranks, 1414 — total, 1488 : that of Madras, 22 officers and 34 wawaut arid non-commissioned officers R.E., 24 native officers, 1490 other ranks — total, 1570 : that of Bombay, 14 officers and 20 warrant and non-commissioned officers R.E., 15 native officers, 886 other ranks— total, 935. The R.E. officers fill the grades of commandant, superintendents, instruction, park and train, adjutant, company commanders, and company officers. The native mountain battery consists of 4 officers Eoyal Artillery, 3 native officers, 253 other ranks — ^total, 260. They are armed with 2-5" guns. All army accoutrements are of brown leather manufactured in India. The grades of the cavalry native officers are risaldar-major (one to each regiment), risaldars and ressaidars in command of troops, and under them jemadars ; those in the infantry are subadar-major (one to each battalion), subadars in command of companies, and under them jemadars. Promotion is made by selection. Selected non-commissioned officers are promoted to the commissioned grades, and direct commissions are also given to native gentlemen of rank and position, who are required to serve a probationary period before confirmation. Many members of old military aristocratic families serve in the ranks in order to win a commission.

The full dress of the Indian army varies in colour — ^red, blue, dark green, and drab. The fighting and working dress of all is of " khaki " colour. Khaki uniform, which ias now been adopted in the imperial army, was used first by the Punjab Frontier Force in 1849. It developed during the campaign in India in 1857, and became general during the Afghan war. The word is derived from the Persian "khak," meaning dust, ashes.

A medical officer of the Indian Medical Service is permanently attached to each corps. The establishment of British officers includes absentees on leave. All appointed to the staff or other duty for a term of years, are seconded in their regiments. Their army rank is regulated by substantive rank in the staff corps or by brevet. The temporary rank of lieutenant-colonel is given to a major selected for the appointment of commandant, and that of major to a captain for that of second in command. The principle which it is endeavoured to preserve is that none but approved British officers should be appointed to native regiments. They are first trained and tested in British regiments before appointment to the staff corps. '

Annual field-training is carried out first by squadrons and double companies under their own commanders, followed by that of the regiment, and of larger bodies of the combined arms at every station where available. Camps of exercise are a great feature in India, where unrivalled facilities exist close at hand for training the troops in every kind of country, which are taken full advantage of. Musketry is a strong point in the training. The course is a very practical one, and the result is that the Indian soldier soon develops into a first-class shot.

■ *Recruiting is conducted by British recruiting staff officers at -various centres throughout the commands, and also at regimental headquarters where men offer themselves, particularly cavalry. Subject to certain restrictions as to active service, a man may claim his discharge after three years' service, but it is optional with him to serve on for pension, or to pass to the reserve after five years' service. The army draws its recruits as a rule from the peasant or yeoman class, men of good physique, hardy, enduring, and courageous. There is no lack of them. The service is very popular and well paid, and has a liberal system of pensions for long service and wounds, and also family pensions for widows or orphans in case of death on active or foreign service, an attractive feature which appeals to the homes. It would be difficult in any*

country to find finer fighting material than that furnished by Gurkhas, Sikhs, Pathans, Rajputs, and Jats, men who have on many a field stood shoulder to shoulder with the best and bravest of the British force. There

is hardly any practical limit to the number of excellent soldiers that in case of necessity can be raised at short notice from the martial races of India, who possess great aptitude for military training.

The Indian army is heterogeneous as a whole but homogeneous in its units. The variation in race of these units is great. About one-third of the regiments are composed of one class — tribe, caste, or religion — such as Gurkhas, Sikhs, Rajputs, Jats, Mahommedans, hillmen, &c., while the rest are composed of class squadrons and companies of the above and other races. Their languages differ, but there is one common to all which they soon acquire — the Oordoo or Hindustani — the language of the camp or lingua franca at India, which originated with the old-time Mahommedan in- vasions of India, and is a mixture of Persian, Arabic, and Hindi. It is obligatory upon all staff corps officers to pass in Hindustani, and upon the regimental officer to pass in the language peculiar to the men in his regiment.

In India the transport and supply services are termed the com- missariat-transport department. It is under the control of a com- missary general-in-chief (a major-general) who has directly under him a commissary-general for transport only. Each command has a commissary-general. Under them are assistant and deputy assistant commissary-generals. All these appointments are held by Indian staff corps officers. This department feeds and clothes the army in the field, and the British troops in quarters. All native troops in India during peace are independent of the commissariat for food and forage, making their own arrangements regimentally, as their pay includes the provision of these items. The transport consists of corps of mules and camels, trains of pony and bullock carts, with elephants for special work. Regiments and corps on the mobilization roster keep in charge a proportion of mule transport.

The ordnance department, under a director-general of ordnance (a major-general), is officered from the Royal Artillery. There is an inspector-general to each command. The military works services, under a director-general (a major-general), is officered from the Eoyal Engineers. There is a chief engineer in each command.

The organization for war is by brigades and divisions. Regiments and batteri^ on the mobilization roster are required to keep up a special equipment for field service, and on receipt of orders to mobilize know precisely what to do. Besides the divisions (four) which are always maintained in a state of readiness, there are other troops specially detailed for the lines of communication. When regiments move in course of relief to stations outside the mobilization area, their place in the list is taken by the relieving corps to which they make over their special equipment.

The number of the military forces of the many native states of India, great and small, is now returned at 90,000, mostly ill-armed and iU-trained, one-third of which are cavalry. This total does not include the 18,000 well armed and organized imperial service troops furnished by twenty-three of these states. Kashmir has a force of Dogra Rajput infantry, hardy, inured to hill marching, and valuable in protecting the far north corner of that state about Gilgit and Chitral. A considerable part of the Gwalior and Hydra- bad forces is fairly well drilled, and possesses some equipped batteries of artillery. The Sikh states have good Sikh troops, well drilled and fairly officered. They are very loyal to their chiefs. Raj- putana could supply a large force of cavalry, all members of a military class. There is much excellent material among these troops which, under the hands of British officers, could be made useful in escort duty and keeping open lines of communication. Among the states guns abound of all sorts, sizes, and conditions. They may be put down at 500, all smooth-bores of old pattern, half of them movable. Very little of their artillery is organized.

Nepal is not included in the native states of India. It pays no tribute. This mountainous state, the homeland of the Gurkhas, has maintained close and friendly relations with the Indian Government since the accession to power of the Jung Bahadur in 1846, especially after he had, to use his own expression, " stood on London Bridge." In 1857 he personally led a strong Gurkha force of infantry and artillery to co-operate with the British army at Lucknow. Nepal has an army of 48,000 infantry, capable of expansion, and about 600 guns of various kinds.

The maintenance of the 18,000 imperial service troops costs the states concerned about £420,000, the outlay of the Indian Govern- ment on

them for inspection being £14,000.

The personal cost of the British garrison of India to Indian revenues is about £4,400,000 a year, while the net expenditure of the whole army of India is about 15J millions. (j. j. h. G.)

The United States.

The regular army of the United States has always been small. During the Civil War the several States furnished

over 2,800,000 men, organized into volunteer regiments bearing State designations. The officers, except general and staff officers, were appointed by the Governors of the respective States. The maximum authorized strength of the regular army never, during the war, exceeded 40,000 men ; and the number in the field, especially towards the close of the war, was very much less. The States, ia order to obtain men to fill their quotas, offered liberal bounties to induce men to enlist, and it therefore became very difficult to obtain recruits for the regular army, for which no bounties were given. The regular regiments accordingly dwindled away to skeletons. The number of officers present was also much reduced, since many of them, while retaining their regular commissions, held higher rank in the volunteer army. After the close of the Civil War the volunteers were mustered out ; and by the Act of Congress of 28th July 1866 the line of the army was made to consist of 10 regiments of cavalry of 12 troops each, 5 regiments of artillery of 12 batteries each, and 45 regiments of infantry of 10 companies each. The maximum enlisted strength was 51,606. The Act of 3rd March 1869 reduced the number of infantry regiments to 25 and the enlisted strength of the army to 35,036. This was still further reduced, without change in organiza- tion, to 32,788 in 1870 and to 25,000 in 1874. The latter number remained the maximum for twenty-four years. The number allotted to a regiment of cavalry, artillery,

or infantry was published in orders, and was changed from time to time to meet the needs of the service.

In March 1898 the artillery was increased by 2 regiments, and ia April 2 companies were added to each infantry regiment, giving it 3 battalions of 4 companies each. The strength of batteries, troops, and companies was increased, the maximum enlisted -streng^ reached during 1898 being over 63,000. A volunteer army was also organized. Of this army, 3 regiments of engineer troops, 3 of cavalry, and 10 of infantry were United States volunteers, all the officers beiug ccgnmissioned by the President. The other organizations came from the States, the officers being appointed by the respective Governors. As fast as they were organized and filled up, they were mustered into the service of the United States. The total number furnished for the war with Spain was 10,017 officers and 213,218 enlisted men. All general and staff officers were appointed by the President. Three hundred and eighty-seven officers of the regular army received volunteer commissions. After the conclusion of hostilities with Spain, the mustering out of the volunteers was begun, and by June 1899 all the volunteers, except those in the Philippines, were out of the service. The latter, as well as those serving elsewhere, having enlisted only for the war, were brought home and mustered out as soon as practicable.

The Act of 2nd March 1899 added 2 batteries to' each regiment of artillery. On 2nd February 1901 Congress passed a Bill providing that the regular army, including existing organizations, should consist of 15 regiments of cavalry, a corps of artillery, 30 regiments of infantry, 1 lieutenant-general, 6 major-generals, 15 brigadier-generals, an adjutant-general's department, an inspector-general's department, a judge-advocate-general's department, a quartermaster's department, a subsistence department, a medical department, a pay department, a corps of engineers, an ordnance department, a signal corps, the officers of the record and pension office, the chaplains, the officers and enlisted men of the army on the retired list, the professors, corps of cadets, the army detachments, and band at the United States Military Academy, Indian scouts as now authorized by law, and such other officers and enlisted men as might be thereinafter provided for.

The head of tjie military establishment is the Secretary

of War, a member of the Cabinet. The supply, payment, and recruitment of the army, and the direction of the expenditure of the appropriations for its support, are by law entrusted to him. He exercises control through the bureaus of the War Department. The lieutenant-general commands the army, but al

The Act of 2nd February 1901 provided that, so long as there should remain any officers holding permanent appointments in the adjutant-general's department, the inspector-general's department, the quartermaster's de- partment, the subsistence department, the pay depart- ment, the ordnance department, and the signal corps, they should be promoted, according to seniority, in the several grades, and whenever a vacancy should thereafter occur, it should be filled by detail from the same grade in the line of the army, the length of the detail being four years. Any such officer, below the rank of lieutenant-colonel, who shall have served four years in the staff, is not again eligible for detail until he shall have served two years in the line. When a vacancy occurs in the position of chief of any staff corps or department, the President may appoint to such vacancy an officer of the army at large, not below the rank of lieutenant-colonel, and such officer, while holding said position, shall have the rank, pay, and allowances formerly provided for the chief of the corps or department. Appointments to the lowest grade in the judge-advocate's department are made from the army or from civil life ; in the engineer corps, from the Military Academy at West Point, or by transfer of lieutenants of the line after ex- amination ; in the medical department, from civil life.

The adjutant-generaVs department is the bureau of orders and records of the army. Orders and instructions emanating from the War Department or army headquarters, and all general regulations, are communicated to troops and individuals in the military service through the adjutant-general. His office is the repository for the records of the War Department which relate to the personnel of the permanent military establishment and the militia in the service of the United States, to the military history of every commissioned ofBcer and soldier thereof, and to the movements

and operation of troops. The adjutant-general is charged, under the direction of the Secretary of War, with the management of the recruiting service, the collection and classification of military information in regard to the United States, and foreign countries, the preparation of instructions to officers detailed to visit encampments of militia, and the digesting, arranging, and preserving of their reports. The sphere of inquiry of the ins/pector-generaVs department includes, every branch of military affairs except when specially limited in regulations or orders. Inspectors-general and acting inspectors- general exercise a comprehensive and general observation within their respective districts over all that pertains to the effloiency of the army, the condition and state of supplies of all kinds of arms and equipments, the expenditure of public property and monies, the condition of accounts of all disbursing officers of every branch of the service, and the conduct, discipline, and efficiency of officers and troops ; and they report with strict impartiality in regard to all irregularities that may be discovered. They make such suggestions as may appear to them practicable for the cure of any defect that may come under their observation. The jiidge- advocate-generaVs department is the bureau of military justice. The judge-advocate-general is the custodian of the records of all general courts-martial, courts of inquiry, and military commissions, and of all papers relating to the title of lands under the control of the War Department. The officers of this department render opinions upon legal questions when called upon by proper authority. They act as prosecutors in important military trials.

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and sometimes represent the Government when cases affecting the army come up in civil courts. The pay department has charge of the supply and distribution of and accounting for funds for the payment of the army, and such other financial duties as may be specially as- signed to it. The staff departments above enumerated have no en- listed personnel. The quartermaster's department is charged with the duty of providing means of transportation of every character, either under contract or in kind,

which may be needed in the move- ment of troops and material of war. It furnishes all public animals employed in the service of the army, the forage consumed by them, waggons and all articles necessary for their use, except the equip- ment of cavalry and artillery. It furnishes clothing, camp and garrison equipage, fuel, barracks, storehouses, and other buildings ; constructs and repairs roads, railways, bridges ; builds and charters ships, boats, docks, and wharves needed for military purposes ; and attends to all matters connected with military operations which are not expressly assigned to some other bureau of the War Depart- ment. Subsistence, ordnance, signal, medical, and hospital stores are procured and issued by other bureaus of the War Department, but the quartermaster's department transports them to the place of issue and provides storehouses for their preservation until consumed. The subsistence department has charge of the purchase, inspection, storage, and issue of food supplies for troops. It has one function which, especially at isolated posts, has been found very beneficial, and which is not common to other armies. It keeps for sale at cost to officers and men, in addition to the ration, a large list of other stores. The ration is abundant. Its composition is fixed by the President. In order to obtain variety and meet the necessities of varying climates, such parts of the ration as are not desired are, under direction of company commanders, sold back to the subsistence department at cost, and funds are thus provided for the purchase of articles of diet not included in the ration. The men's messes are improved through another agency, the post exchange. This has been in existence but a few years. It is practically a soldiers' club, mider the supervision of officers, in which many articles desired by the men are sold. The profits are periodically distributed among the organizations serving at the post for the improvement of the messes. The enlisted personnel of the subsistence and quartermaster's departments consists of a number of sergeants appointed, after examination, from the line. Clerks, teamsters, labourers, &c., are furnished by temporary detail from the troops or by hire of civilians. The medical department is charged with the duties performed by the medical staff in all armies. It has charge of hospitals both at stations and in the field, of ambulances, and of hygiene. It has an enlisted personnel, as large as may be deemed necessary, in addition to the authorized strength of the army. This force is called the hospital corps, and performs all hospital service in garrison and in the

field. Its non-commissioned officers, termed hospital stewards and acting hospital stewards, are appointed after examination. A knowledge of pharmacy is required. There is also a nurse corps (female) consisting of one superintendent and such number of nurses as may be needed. The surgeon-general is authorized to employ, under contract, dental surgeons, not to exceed thirty in number. The officers, in addition to their other duties, give instruction by lectures and practical demonstration on "First Aid to the Injured" to all lieutenants of the line and to such captains as may volunteer. Company officers in turn are required to give this instruction to their men four hours a month. There is thus always in every company a number of men able to supplement the work of the hospit^ corps in the field, or to give the first cares to the wounded in the absence of medical attendance. The signal corps is charged with the construction, repair, and operation of military telegraph lines, with the supervision of such instruction in military signalling and telegraphy as may be prescribed by the War Department, and with the procurement, preservation, and distribution of the necessary supplies. A line officer is appointed signal officep at each mili- tary post, and supervises instruction, which must be continued until there are in each company at least 1 officer and 4 en- listed men proficient in signalling by flag, torch, and heliograph. The signal corps has an enlisted personnel of 760, of which number 350 are non-commissioned officers. The duties of the corps of engineers comprise reconnoitring and surveying for mihtary purposes, selection of sites and formation of plans and estimates for military defences, construction and repair of fortifications and their accessories, planning and superintending of defensive or offensive works of troops in the field, examination of routes of communications for supplies and for military movements, and construction of military roads and bridges, execution of river and harbour improvements assigned to it, and such other duties as the President may order. There are three battalions of engineer troops. They form a part of the line of the army, and are officered by officers of the engineer corps assigned temporarily. The prin- cipal engineer station is Willets Point, New York Harbour, where there is an engineer school of instruction. A field officer of engineers

commands the station and school. The captains, in addition to performing the routine duties of a military post, act as instructors. Lieutenants of engineers, after serving for about a year after grad- uating at West Point, are assigned to companies, and constitute the class. The course lasts two years, and comprises instruction supple- mentary to that given at West Point, where the same subjects are studied, in military and civil (including electrical) engineering, and in astronomical work. The ordnance department is charged with the duty of procuring, by purchase or manufacture, and distributing the necessary ordnance and ordnance supplies for the Government, and establishes and maintains arsenals and depots for their manufacture and safe-keeping. Infantry small-arms, carbines, swords, sabres, horse equipments, field-gun carriages, and most of the accoutrements, such as haversacks, knapsacks, canteens, &c., are manufactured at the various arsenals. Cannon of all calibres are constructed by the ordn?inc6, department, the rough forgings being furnished by private firms. Powder is purchased, but the cartridges are made at an arsenal. Revolvers are purchased. Most of the sea-coast gun-carriages and sea^coast mortars are made by private firms. The ordnance department has a proving ground at Sandy Hook, New York Harbour, where experiments are made and guns are tested. The record and pension office has but two officers. It has in charge the records of all volunteers, not only of those who served in the war with Spain, but in former wars. The chaplains are of various religious denominations. One is allowed to each regiment of infantry and cavalry, and twelve to the artillery corps.

An officer of engineers or ordnance, or of the adjutant-general's, inspector-general's, judge-advocate-general's, quartermaster's, or subsistence department, or of the signal corps, though eligible to command according to his rank, shall not assume command of troops unless put on duty imder orders which specially so direct by authority of the President. An officer of the pay or medical department cannot exercise command except in his ovm depart- ment, but by virtue of his commission he may command all enlisted men like other commissioned officers.

When the United States adopted a policy of liberal appropria- tions for sea-coast defence, the need was felt of a single body of experts to decide

upon what was needed and how the money should be spent. Congress accordingly passed a law creating a board of ordnance and fortification whose duty it was "to make all needful and proper purchases, experiments, and tests to ascertain, with a view to their utilization by the Government, the most effective guns, small-arms, cartridges, projectiles, fuses, explosives, torpedoes, armour-plates, and other implements and engines of war." The membership of this board comprises the lieutenant-general commanding the army (who is its president), one officer each from the corps of engineers and the ordnance depart- ment, two from the artillery, and one civilian. An officer of the army is detailed as recorder of the board.

By the Act of 2nd February 1901 each regiment of cavalry con- sists of 1 colonel, 1 lieutenant-colonel, 3 majors, 15 captains, 15 first lieutenants, and 15 second lieutenants; 2 veterinarians, 1 sergeant-major, 1 quartermaster-sergeant, 1 commissary-sergeant, 3 squadron sergeants-major, 2 colour-sergeants, 1 band, and 12 troops organized into 3 squadrons of 4 troops each. Each troop of cavalry consists of 1 captain, 1 first lieutenant, 1 second lieu- tenant, 1 first sergeant, 1 quartermaster-serg:eant, 6 sergeants, 6 corporals, 2 cooks, 2 farriers and blacksmiths, 1 saddler, 1 wagoner, 2 trumpeters, and 43 privates. Each regiment of in-fantry consists of 1 colonel, 1 lieutenant-colonel, 3 majors, 15 captains, 15 first lieutenants, and 15 second lieutenants ; 1 sergeant- major, 1 quartermaster-sergeant, 1 commissary-sergeant, 3 battalion sergeants-major, 2 colour-sergeants, 1 band, and 12 companies, organized into 3 battalions of 4 companies each. Each infantry company consists of 1 captain, 1 first lieutenant, 1 second lieu- tenant, 1 first sergeant, 1 quartermaster -sergeant, 4 sergeants, six corporals, 2 cooks, 2 musicians, 1 artificer, and 48 privates. The regimental organization of the artillery arm of the United States army is discontinued, and that arm is constituted and designated as the artillery corps. It comprises 2 branches, the coast artillery and the field artillery. The coast artillery is defined as that, portion charged with the care and use of the fixed and movable elements of land and coast fortifications, including the submarine mine and torpedo defences ; and the field artillery as that portion accompanying an army in the field, and including field and light artillery proper, horse artillery, siege artillery, mountain artillery, and also machine-gun

batteries. All officers of artillery are on one list, in respect to promotion, according to seniority In their several grades, and are assigned to coast or to field artillery ac- cording to their special aptitude for the respective services. The artillery corps consists of a chief of artillery, selected and detailed by the President from the colonels of artillery, to serve on the staff of the general officer commanding the army, and his duties are prescribed by the Secretary of War ; 14 colonels, 1 of whom shall be the chief of artillery ; 13 lieutenant-colonels, 39 majors, 195 captains, 196 first lieutenants, 195 second lieutenants, 21

sergeants-major (senior grade), 27 sergeants-major (junior grade), 1 electrician sergeant to each coast artillery post having electrical appliances, 30 batteries of field artillery, 126 batteries of coast artillery, and 10 bands. The strength of batteries and companies is fixed by the Secretary of War, but the aggregate number of en- listed men for the artilleiy shall not exceed 18,920. Captains and lieutenants of cavalry, artillery, and infantry, not required for duty with troops, batteries, or companies, are available for regimental Btafl or other details.

The above organization provides for an enlisted strength of about 58,000 men. In case of emergency the President is authorized to enlarge it, so that the maximum shall not exceed 100,000 men. This increase is to be efflected by augmenting the number of men in a company, troop, or battery, without adding to the number of organizations or of ofiB.cers.

The cavalry is armed with the Krag-Jorgensen carbine, cal. 30, the revolver, cal. 38, and the sabre. The thimble waist-belt of woven web carries 100 carbine and 12 revolver cartridges. The infantry and coast artUlery have the Krag-Jorgensen rifle, cal. 30. The woven waist-belt carries 100 cartri(j[ges. Horse and mountain batteries may be organized,

but- there are none at present in service. With the exception of one siege battery of 5-inch guns and one of 7-inch howitzers, all the field batteries have the 3-2 B.L. rifle. When mountain guns are needed, they are issued to regular field batteries, or batteries are temporarily formed by details from other organizations. Each man has a revolver, non-com- missioned officers and trumpeters having also a sabre.

Promotion in the line of the army is exclusively by seniority in the arm, a vacancy among the majors of cavalry, for instance, being filled by the senior captain of cavalry. Examination for promotion obtains up to the grade of major. An officer found physically dis- qualified from causes incidental to the service is retired with the grade to which his promotion would have entitled him. Should he fail in the educational examination,^ he is suspended from promotion for a year, when he is again examined. Should he again fail, he is dropped from the rolls of the army. Retirement of all officers is compulsory at the age of 64 years. Officers have the right to retire on their own application after forty years' service, and may do so, on their own application, in the discretion of the President, after thirty years'. An officer may be retired at any period of his service for physical disability should a board of officers so recommend. Officers goiijg on the retired list in any of the ways mentioned re- ceive three-fourths of the full pay of their grade. In time of war retired officers may be employed on active duty, other than in com- mand of troops, and they then receive full pay and allowances.

The army is recruited entirely by voluntary enlistment. Recruiting officers are maintained in the , principal cities and towns, fix ordinary circumstances each regiment ~~furnishes one of^cer for a two years' tour of recruiting duty, but during active service in the field this duty is largely performed by convalescent officers.~~ These officers report direct to the ad- jutant-general. The principal requirements for enlistment are that the applicant for first enlistment must be between the ages of 18 and 36 ; must be of good character ; must be able to read and write the English language ; must be a citizen of the United States or have legally declared his intention to become such ; and must pass a rigid physical examination. The records for a number of years show that over 80 per cent, of applicants for enlistment are rejected. The term of enlistment is

three years. The pay of a soldier ranges from that of a private (13 dollars a month) up through the various grades to that of a chief musician (60 dollars a month). The third year a dollar a month is added, the fourth year (should the soldier re-enlist) two dollars a month, the fifth year three dollars a month, and the sixth year five dollars a month. Thereafter a dollar a month is added for each five years' service. After thirty years' service the soldier is entitled to go on the retired list with three-fourths of pay and allowances. The soldier has a liberal allowance of clothing, and his food is furnished, so that his pay is almost all spending money. Retired officers and men form a part of the army and are paid by army paymasters. Pensions, in regard to which the country is very liberal (they call for about 140,000,000 dollars annually) are paid to persons no longer in the service, and the money is not disbursed by the War Department.

The principal source from which officers are supplied to the army is the Military Academy at West Point. The President has thirty appointments of cadets at his disposal, which Officers. g^j.g generally given to sons of army and navy officers. Each senator and each representative and delegate in Congress has one. These appointments are not made annually, but as vacancies occur through gi-aduation of cadets, or their discharge before graduation. The maximum number of cadets is 481. The com-manding officer of the academy has the title of superintendent.

1 That Is, an examination in English grammar, mathematics, geography, history, constitutional and international law.

He is detailed from the army, and has the temporary rank of colonel. The corps of cadets is organized as a battalion, and is commanded by an officer detailed from the army, having the title of commandant of cadets. He has the temporary rank of lieu- tenant-colonel. An officer of engineers and of ordnance are de- tailed as instructors of practical military engineering and of ordnance and gunnery respectively. The heads of the other departments of instruction have the title of professors. They are selected generally from officers of the army, and their positions are permanent. The officers above mentioned, and the professors, constitute the academic board. The military staff and assistant in- structors are officers of the army. The course of instruction covers four years, and is

very thorough. Theoretical instruction comprises mathematics, French, Spanish, English, drawing, physios, astron- omy, chemistry, ordnance and gunnery, art of war, civil and mil- itary engineering, law (international, constitutional, and military), history, and drill regulations of all arms. Practical instruction com- prises the service drills in infantry, cavalry, and artillery, survey- ing, reconnaissances, field engineering, construction of teinporary bridges, simple astronomical observations, fencing, gymnastics, and swimming. Cadets are a part of the army, and rank between second lieutenants and the highest grade of non-commissioned officers. They receive from the Government a rate of pay sufficient to cover all necessary expenses at the academy. About 50 per cent, of those entering are able to complete the course. The graduating class each yea,r numbers, on an average, about 60. A class, on graduating, is arranged in order according to merit, and its members are assigned as second lieutenants to corps and arm, according to the recommen- dation of the academic board. A few at the head of the class go into the corps of engineers ; the next in order generally go into the artil- lery, and the rest of the class into the cavalry and infantry. The choice of graduates as to arm of service and regiments is consulted as far as practicable. Any enlisted man who has served honestly and faithfully not less than two years, who is between 21 and 30 years of age, unmarried, a citizen of the United States and of good moral character, may aspire to a commission. To obtain it he must pass an educational and physical examination before a board of five officers. This board must also inquire as to the character, capacity, and record of the candidate. Many well-educated young men, unable to obtain appointments to West Point, enlist in the army for the express purpose of obtaining a commission. Vacancies in the grade of second lieutenant remaining, after the graduates of the Military Academy and qualified enlisted men have been ap- pointed, are filled from civil life. To be eligible for appointment a candidate must be a citizen of the United States, unmarried, be- tween the ages of 21 and 27 years, and must be approved by an examining board of five officers as to habits, moral character, physical ability, education, and general fitness for the service. In time of peace very few appointments from civil life are made, but in time of war there is a large number.

There are, in addition to the Engineer School already mentioned, four service schools for officers. These are : the Artillery School at Fort Monroe, Virginia ; the Infantry and Cavalry School at Fort Leavenworth, Kansas; the Cavalry and Light Artillery School at Fort Riley, Kansas ; the Army Medical School at Wash- ington. The commandants, staffs, and instructors at these schools are officers specially selected. The garrison at Fort Monroe is composed of several companies of coast artillery. The lieu- tenants constitute the class. They are relieved and replaced by others on 1st September of each year. The course of instruction comprises the following subjects: artillery, ballistics, engineering, steam and mechanics, electricity and mines, chemistry and explosives, military science, practical military exercises, photography, telegraphy, and cordage (the use of ropes, the making of various kinds of knots and lashings, rigging shears, &c., for the handling of heavy guns). July and August of each year are ordinarily devoted to artillery target practice. The course at the Infantry and Cavah-y School is for two years. The class of student officers is made up of one lieutenant from each regiment of infantry and cavalry, and such others as may be detailed. They are assigned to the organizations compris- ing the garrison, normally a regiment of infantry, a squadron (four troops) of cavalry, and a battery of field artillery. The depart- ments of instruction are : military art, engineering, law, infantry, cavalry, military hygiene. Much attention is paid to practical work in the minor operations of war, the troops of the garrison being utilized in connexion therewith. At the close of the final , examinations of each class at Fort Monroe and Fort Leavenworth, those officers most distinguished for proficiency are reported to the adjutant-general of the army. Two from each class of the Artillery School, and not more than five (the number to be determined by the lieutenant-general commanding the army) from each class at the Infantry and Cavalry School, are thereafter, so long as they re- main in the service, noted in the annual army register as "honour graduates." The work of the Cavalry and Light Artillery School at Fort Riley is mainly practical, and is carried on by the regular

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ARMIES

garrison, which usually, in time of peace, consists of two squad- rons of cavalry and three field batteries. The Government reserva- tion at Fort Riley comprises about forty square miles of varied ten-ain, so that opportunities are afforded, and taken advantage of, for all kinds of field operations. The Army Medical School is established at Washington. The faculty consists of four or more professors selected from the senior officers of the medical depart- ment. The course of instruction covers a period of five months, beginning annually in November. The student ofScers are re- cently-appointed medical officers, and such other medical officers, available for detail, as may desire to take the course. Instruction is by lecture and practical work, special attention being given to the following subjects: duties of medical officers in peace and war; hospital administration ; military medicine, surgery and hygiene ; microscopy and bacteriology ; hospital corps drill and first aid to the wounded.

The territory controlled by the United States, at home and abroad, is divided into territorial departments. These are established and their commanders assigned by direction of the President. In time of peace, army corps, divisions, or brigades are not formed except for purposes of instruc- tion. The commander of a military department controls all the military forces of the Government within its limits, whether of the line or staff, which are not specially ex- cepted. The exceptions include the Military Academy, the Artillery School, the schools at Forts Leavenworth and Riley in matters pertaining to the courses of instruc- tion, the engineer establishment at Willets Point, arsenals, general depots of supply, general service recruiting sta^ tions, permanent fortifications in process of construction, and officers employed on special duty under the Secretary of War. But when an emergency demands it, all military men and material within the limits of their jurisdiction come under their control. A department commander is charged with the administration of all the military affairs of his department, and the execution of all orders from higher authority. He reports to the Commanding General of the Army all matters relating ^o the general ■welfare of his command, including such change of station of troops as he may deem desirable, but must obtain approval of the Commanding General of the Army before

ordering the movement. If it be necessary to move troops to meet emergencies, such movements, and all the circumstances connected with them, must be reported at the earliest possible moment. The personal staff of a department commander consists of the authorized aids. The department staff is limited to the officers detailed by the Secretary of War from appropriate staff depart- ments or corps, or of officers of the line detailed by the same authority to act in their stead, and their official designations are as follows: adjutant-general, chief quai'termaster, chief commissary, chief surgeon, chief pay- master, judge advocate, and artillery inspector; also, when necessary, an engineer officer, an ordnance officer, and a signal officer, each detailed from his corps.

There are in the United States proper, including Alaska, about one hundred military posts. The garrisons of a majority of them, even when large forces are not needed out of the country, are necessarily small. The various staff positions at a post, such as adjutant, quartermaster, commissary, signal officer, and ordnance officer, are usually filled by lieutenants of the garrison temporarily detailed. At a post having the headquarters of a regiment, the first three positions above mentioned are filled by the regi- mental adjutant, quartermaster, and commissary respec- tively. The regimental adjutant, quartermaster, and commissary are selected from the captains, and the tour is limited to four years. As the great majority of officers of the line have, before obtaining their captaincies, filled one or more of the various staff positions, in ad.dition to having taken the course at a service school, there is always available a large number of officers thoroughly qualified to fill any staff position.

The Act of 2nd March 1899 authorized the President to raise a volunteer force of 35,000 men for service in the Philippines, to continue in service not later than 30th June 1901, on which date the strength of the regular army, with the exception of the artillery, was to be reduced. to the numbers in service prior to the outbreak of the war with Spain. On 5th July 1899 the President ordered the organization of ten regiments of volunteer infantry ; on 18th July 1899, of two regiments of volunteer infantry and a regiment of volunteer cavalry (the three last-named regiments to be organized and recruited in the Philippine Islands) ; on 17th August 1899, of ten additional regiments of'volunteer infantry ; and

on 9th September 1899, of two additional regiments of volunteer infantry (the enlisted men and company officers of the two last regiments to be coloured). Each regiment was organized at. an army post. The men were recruited by regular army recruiting officers throughout the country, and were sent at once to the nearest regimental rendezvous. The time required, under each order, was about six weeks. All the colonels; nearly all the lieutenant-colonels and majors, and a few of the captains, were selected officers of the regular army. ‘ Most of the other officers and a large percentage of the men, had served, in the regulars or volunteers, in the war with Spain. The training of the men began at once on arrival at rendezvous, special attention being given to instruction in duties of guards and outposts, to fighting in extended order, and to target practice. The physical examinations were rigid, and the character of the accepted personnel was excellent. The result was the best volunteer force ever raised in the United States. The first regiment sailed for Manila, 8th September, 1899, and the last, 21st December. They were at once ready to take, the field on arrival, and did most excellent service. One instance is the remarkable and energetic pursuit of the insurgents by volunteer troops, through the mountainous, heavily- wooded, entirely unknown country of northern Luzon, where transportation of supplies was at all times difficult and in many cases impracticable.

The Act of 2nd February 1901 repealed so much of the Act of 2nd March 1899 as provided for a reduction of force, 30th June 1901, and put the regular army on a permanent basis. It authorized the raising of 12,000 (provided the maximum of 100,000 for the entire army was not exceeded) Philippine native troops, organized into companies and battalions; the majors and cap- tains being selected from the next lower grades in the line of the army. It also provided for a three-battalion native Porto Eican regiment, the field officers and captains to be selected as for the Philippine native troops.

The United States has never had a satisfactory system of increasing its armed strength for war. The subject has received a great deal of attention, and much legislation has been proposed, but the form of government makes the question very difficult of solution. The militia, number- ing about 115,000 officers and men, is distributed through the various States,

constitutes State troops, and is inde- pendent of the general government. Disorders within the limits of a State are to be dealt with by the State authori- ties, and the Constitution expressly prohibits the use of United States troops in such cases, except upon the formal application of the State authorities. The several States are very jealous of their prerogatives and never call for federal troops except as a last resort. The method adopted for raising the twenty-five regiments of volunteers for Phil- ippine service proved very satisfactory, but might not be feasible for the sudden creation of a large army. It would require much time, and there would not be a large enough number of regular officers available. The practice both in the Civil War and in the war with Spain was for

the President to decide upon the number of men required, and then call upon Governors of States to furnish each their quota, according to population. Regiments were then organized in the several States, either by filling up organizations of the militia already existing, or by creat- ing entirely new ones. The ofiS.cers were appointed by the respective Governors. The troops thus organized did not come under federal control until formally mustered into the service of the United States ; and this means of rapidly raising a large army has been found by experi- ence to be inelBBLcient and expensive. (w. a. s.)

Germany.

The liability to service in the German army is universal, and lasts from the 17th to the 45th year. Liability to active service begins on the 1st January of the year in which the man completes his 20th year, and is divided into service in the standing army, its reserve, and the landwehr of the 1st and 2nd bans. Liability to serve in the standing army lasts for three years from the date of joining (usually in October), for men posted to the cavalry and horse artillery, and for two years for the other arms; but these latter may also be held to serve three years. Thereafter, men belong to the

reserve for four years, and are passed to the 1st ban of the landwehr in the spring following the date on which they complete seven years' service. Service in the 1st ban lasts five years, and in the 2nd is prolonged to the 31st March of the year in which the man completes his 39th year, i.e., for the most part, six years. Men who serve three years with the colours only pass three years ia the 1st ban of the landwehr. Dur- ing their period of reserve service, men are liable to two trainings of eight weeks each, though the vast bulk only do one of fourteen days, and during their service in the 1st ban of the landwehr to two trainings of eight to fourteen days, the bulk being, however, only called out once for fourteen days. The men of the 2nd ban of the landwehr are liable neither to training nor to periodical control musters. To the landsturm belong all males liable to service, and not otherwise belonging to the army or navy, from their seventeenth to their forty-fifth year; its 1st ban comprising those of thirty-nine years and under, its 2nd the others. Its men are not trained in peace. /

Volunteers are taken, from among men who have com- pleted their seventeenth year, to serve for three years in the cavalry and horse artillery, and for two years in the other arms. These men may choose their own regi- ments ; so that volunteering is preferred by men who either desire to make the army a profession, or, for private reasons, wish to complete their active service earlier, or have a fancy for a particular regiment. A special category is formed by the one-year volunteers, who must pass a high educational test or have gone through certain classes in the schools. These receive no pay, clothe and equip themselves, and in the mounted branches find their own fiorses, in consideration of which they only serve one year actively. They are supernumerary to the establishment, and their number is unlimited. Both categories of volunteers pass into the reserve, &c., with men of their own age recruited compulsorily.

Eeoniiting is managed by committees of officers and civil officials in each recruiting ' (landwehr) district. These draw up lists, decide on exemptions allowed by law, and conduct the medical examinations. All men passed as liable and fit draw lots for numbers, and the lowest numbers are taken up to the con- tingent required. No substitution is allowed.

Non-commissioned officers (corporals and above) are obtained from two classes — (a) from the two- or three-year volunteers mentioned above, or (6) from the non-commissioned officers' schools, which youths of seventeen to twenty years of age volun- tarily join. Their course there lasts three (in exceptional cases, two)

years, and they are bound to serve four years in the army after leaving the school. Non-commissioned officers are encouraged to remain in the army by a promise of employment in the gendarmerie after nine, or in the civil service after twelve years ; and on leaving the army they receive a gratuity which varies from 50s., after five, to £60 after twelve years' service. Pensions are given to invalids.

Officers are obtained from two sources — (a) cadets, and (6) two- or three-year volunteers. Cadets join a provincial cadet-house between ten and fifteen years of age, and afterwards pass two and a half years in the Central Institution, near Berlin. At about eighteen years of age, they are appointed ensigns {JPahnrich, an intermediate rank between officer and non-commissioned officer) direct. Those volunteers who desire to become officers must be approved of by their commanding officer, and pass an examination or produce equivalent school certificates. They are private soldiers, but are known as aspirants to commissions (^Fahnenjunker); they may live at the officers' mess, and may wear when off duty uniforms of finer cloth. After five months' actual service, and being passed pro- fessionally, they may be promoted ensigns. All ensigns must pass through a "war school," at which the course (military subjects, both theoretical and practical instruction) lasts nine months ; after which they pass their "officers' examination," and are nominated lieutenants as vacancies arise. They must, however, be first balloted for and accepted by the officers of the regiment they are to join.

Officers of the reserve come, for the most part, from former one- year volunteers, who, after their one year's service, do two train- ings of eight weeks each, and pass an examination. The one-year volunteers who do not become reserve officers become non-com- missioned offibers of the reserve.

There are four separate armies^ — those of Prussia and of the minor states, Bavaria, Saxony, and Wtirtemberg — each administered separately by its own War Ministry, but all bound to conform as regards organization, formation, training, pay, command, mobiliza- tion, and (to a great extent) clothing, to fixed regulations. The minor states have concluded military conventions with Prussia, and their contingents are administered by its War Ministry. By the law of 25th March 1899 the army was to be raised from the 1st October 1899 onwards to a strength of 495,500 lance-corporals and privates, which figure was to be attained in 1903, and at this strength it was to remain till 31st March 1904. It is divided into the following units, the figures in brackets showing those actually existing after the new formations of 1st October 1899 were com- pleted : — Infantry, 625 (624) battalions ; cavalry, including mounted rifles, 482 (472) squadrons ; field artillery, 674 (541) batteries j foot artillery, 38 (37) battalions ; pioneers, 26 (24) battalions ; com- munications troops, 11 (10) battalions ; train, 23 (22) battalions. The infantry consists of 175 regiments of 3 battalions, 41 regiments of 2 battalions, and 18 rifle battalions. Each battalion has 4 companies. A number of those on the frontiers have an establish- ment of 640 non-commissioned officers and men, the remainder have one of 570 only. The infantry is armed with magazine rifles of 8 millimetres' calibre, loaded by packets of 6 cartridges at a time, and bayonets. In marching order, each man carries 120 rounds of ammunition and his share of a portable tent equipment. The cavalry consists of 93 regiments of 5 squadrons each, of which 14 are heavy, 25 medium (lancers), and 54 light (dragoons and hussars). A regiment has 681 non-commissioned ofBcers and men, and 667 horses, but those on the frontiers are slightly stronger. The armament of all cavalry consists of steel-shafted lances (for both ranks), carbines of the same construction as the infantry rifle, and swords. The mounted rifles consisted in 1900 of 7 squadrons, and 10 more were to be raised. Each has 133 non- commissioned officers and men, and 132 horses. They are armed with swords and revolvers, and are used as orderlies, scouts, &c., and attached to various staffs. The field artillery, consisting in 1900 of 85 regiments, was to attain its full strength of 94 regiments in 1901, each regiment having 6 batteries in two brigade divisions of 3 batteries each. In 6 regiments (one of these brigade divisions), and in 2 other regiments, one of the 6 batteries is of horse artillery. Eleven of the

regiments have each an extra brigade division of 2 horse artillery batteries, which, on mobilization, would join the cav- alry divisions. In each army corps (see below) one brigade division of one of the regiments consists of 3 field howitzer batteries. About one-third of the field batteries are on a higher establishment of 116 non-commissioned officers and men, 60 horses, and 6 guns (there are 12 batteries on a still higher establishment) ; the remainder having 102 men, 44 horses, and 4 guns horsed. The horse batteries for the cavalry divisions have 121 non-commissioned officers and men, 120 horses, 6 guns, and 2 waggons horsed ; the others, 92 men, 76 horses, and 4 guns. The guns are of 1896 pattern, nickel-steel quick-loaders of 7-7 cm. calibre, and the howitzers of 1898 pattern of 10-5 cm. calibre. Both fire shrapnel shell and shell filled with high explosives. A battalion of foot artillery has 4 companies with 596 non-commissioned officers and men, Two (in 2 cases 3) bat- talions form a regiment. This arm is trained for siege and inland

fortress duties (except 3 battalions as coast artillery), and also mans the heavy position and howitzer batteries of the field army. The pioneers are organized in single battalions of 4 companies, with 611 non-commissioned ofBcers and men, and are armed as infantry. They are trained in field and siege works and bridging. The com- munications troops consist of 3 railway regiments of 2 battalions each, and 1 independent battalion, 3 telegraph battalions, and a balloon company (to be expanded to a battalion of 2 companies). The train battalions correspond to the transport branch of the British Army Service Corps, and have each 3 companies,, with 299 non- commissioned ofloers and men, and 190 horses. To 8 of them are attached sections of 59 men and 57 heavy draught horses for batteries of position.

The army is divided into 23 army corps. Twenty-two of these are assigned to certain territorial districts for recruiting, and the Prussian Guard Corps is recruited from the whole kingdom. Of these 22 (21) corps, 16 are

furnished by Prussia, &c., 3,(2) by Bavaria, 2 by Saxony, and 1 by Wurtemberg. There are exceptions in many cases, but the usual composition of an army corps, when the artillery had reached its full strength, was to be : 2 divisions each of 2 (in 9 divisions, 3) brigades of infantry, each of 2 regiments, 1 brigade of cavalry of 2 regiments, and 1 brigade of field artillery of 2 regiments, besides which the corps would have 1 squadron of mounted rifles, 1 battalion of rifles, 1 foot artillery regiment, 1 pioneer battalion, and 1 train battalion. The 1st and 14th corps have each 3 divisions. In the various War Ministries mentioned above, the administration of the armies is conducted. Prussia and Bavaria have in addition a " Great General Staff," in which the preparation of the army for war and its employment in the field are studied. There is, further, in each State a " Military Cabinet," in which all questions of the promotion and appointment of officers are dealt vrith. The heads of these three departments are indepen- dent of each other, and are directly subordinate to the sovereign. Great independence is allowed to generals commanding army corps, who are directly responsible to the sovereign for the training and preparation for war of their troops.

The standing army would take the field as it stands in peace, except that the bulk of the cavalry would be formed into independent cavalry divisions, each of 6 regiments and 2 batteries of horse artillery, and that certain units of its artillery and engineers serve as cadres for 2nd line formations. An infantry battalion on the war footing has 26 officers and officials, 1031 other ranks, 46 horses, 15 carriages ; a cavalry regiment of 4 squadrons (one of the squadrons being left behind as a depot), 31 officers, &c., 665 men, 741 horses, and 17 carriages ; a horse bat tery, 5 officers, 166 men, 236 horses, 6 guns, 9 ammuni- tion waggons, and 5 other carriages ; and a field battery, 5 officers, 171 men, 150 horses, and carriages as in a horse battery. A normal army corps would have 25 to 29 battalions, 4 or 5 squadrons, 21 batteries, 3 pioneer com- panies, &e., or a total fighting strength of 25,000 to 29,000 infantry, 600 to 750 cavalry, 126 guns, and 750 pioneers, with a ration strength of 37,000 to 41,000 men and 12,000 horses. A cavalry division with 24 squadrons and 2 batteries would have a ration strength of about 4800 men and 5100 horses. It is not known to what ex- tent reserve and landwehr troops would be formed, but it is generally assumed that a division of all arms of

each category, 12,000 to 20,000 strong, would be formed in each army corps, which would give a 2nd line army equal in strength to the mobilized standing army, about half of which might easily be employed in 1st line. Eoughly speaking, without calling on the landsturm, Germany could put 2,000,000 men in the field, and keep another 1,000,000 for home garrisons and depots.

The total budgetary strength of the German army for 1899 was : — ^23,730 o&cers, 79,873 non-commissioned of- ficers, 491,826 men, 2155 surgeons, 2805 paymasters, veterinary surgeons, armourers, and saddlers, and 101,065 troop horses. The above figures are exclusive of the colonial troops, which are insignificant in number, there being in South-west Africa a force of about 750 Germans, in East Africa about 130 Germans and 1600 natives, in Togoland 3 Germans and 150 natives, and in Cameroon 15 Germans and 300 natives. Kiaoohow is held by marines from the Imperial Navy. (j. m. Ge.)

France.

Every Frenchman becomes liable to military service at the a^e of 20. This liability dates from the conscription law passed at Jourdan's instance on 5th September 1798. But the principle of universal service was soon impaired by the admission of substitutes, authorized by the decree of 7th March 1800, and at length abolished by the re- cruiting law of 27th July 1872. Thi% was replaced on 15th July 1889 by a new law, which extended the total period of military service from 20 to 25 years, but reduced the term of service with the colours from 5 years to 3. This term was to be followed by 7 years in the reserve of the active army, 6 years in the territorial army, and 9 years in the reserve of the territorial army. Exemptions for family or educational reasons were withdrawn, and those who had hitherto been allowed the benefit of them were required to serve for one year with the colours. Those who are physically unfit to bear arms may be employed in the auxiliary services in time of war. To adjust the strength of the standing army to the annual budget, the minister of war is given power to release three-years' men when they have completed .one year's service. The average annual contingent is about 200,000 able-bodied men, of whom about one-third are released at the end of the first

year. There are also about 20,000 volunteers who serve for one year, and may prolong their service to five years. The law of 1889 was modi- fied on 19th July 1892, the term of service in the re- serve of the standing army being prolonged to 10 years, and that in the reserve of the territorial army reduced to 6 years. In the infantry and cavalry more than half the subaltern officers are from the ranks, the rest being from the military schools. In the artillery and engineers about three-fourths come from the schools. Promotion is partly by seniority, partly by selection. The latter method is applied to one-third of the promotions to the rank of captain, to one-half of those to the next grade (battalion, or squadron, commander), and to all above that rank.

The organization of the army is based upon the law of 24th July 1873, which fixed the territorial system, sup- plemented by the cadre law of 13th March 1875, which defined the number of units. But there have been several changes since. At present the units of the standing army are as follows : —

Infantry. — 173 regiments, viz., 163 of the line, 4 of Zouaves, 4 of Algerian rifles, and 2 foreign.' The regiments are nominally of 4 battalions, but some fourth battalions are wanting. The Zouave and foreign regiments have 5 battalions, and 3 of the Algerian rifles have 6. Each battalion consists of 4 companies, which, in line regiments, have a peace strength of 127 men, in the Zouave and foreign regiments of 151, and in the Algerian rifles of 164. There are 30 battalions of chasseurs a pied, each consisting of 6 com- panies. Twelve are mountain battalions, and have 150 men per company; the others have 133 men. There are 5 battalions of African light infantry, each having 6 companies of 250 men. There are 4 disciplinary companies of variable strength.

Cavalry. — Eighty-nine regiments, viz., 13 of cuirassiers, 31 of dragoons, and 45 of light cavalry (chasseurs, hussars, chasseurs d'Afrique and spahis). The regiments' generally have 5 squadrons of 150 men ; the 4 spahi regiments have 22 squadrons in all, of 178 men. There are also 8 remount companies.

Artillery. — Eighteen battalions of foot (or fortress) artillery, comprising 105 batteries, with a peace strength of 129 men each. Twenty brigades (40

regiments) of field and horse artillery, com- prising 442 field and 52 horse batteries of 103 men, and 14 moun- tain batteries of 156 men. When serving in Algeria the batteries are of higher strength.

Engineers. — Seven regiments, including 1 railway regiment. Two are of 4 battalions, the others of 3 battalions. There are 4 companies to each battalion, the railway companies having a strength of 160, and the others of 108 men. Each regiment has also a company of "train." The engineer staff numbers 460 officers and 868 subordinates.

[ITALY

The infantry are armed with the " Lebel rifle " of 1886, 8 mm. (0-315 in.) in calibre. It is sighted to 2000 metres, and has a magazine for 8 cartridges in the stock. The batteries— field, horse, and mountain— are of 6 guns each. The field artillery gun is of 90 mm. (3-54 in.) calibre ; the horse artillery gun is of 80 mm. (3-15 in.) calibre. A quick-firing gun of 75 mm. (3 in.) is being rapidly introduced. It is of nickel steel, and weighs with its carriage about 19 cwt., rather more than the horse artillery gun. It is said to have a range of 7000 metres, and to be capable of firing 20 rounds a minute. The weight of its shell is 16 J lb. A field howitzer of 120 mm. (4-7 in.) calibre has also been adopted. It weighs, with its'carriage, 29 cwt., and has a range of 6000 metres. Besides shrapnel, it fires long shells weighing 45 Bb, with a bursting charge of 13 ft) of melinite.

Two regiments of infantry or cavalry form a brigade ; 2 infantry brigades, .with 6 field batteries, 1 company of engineers, &c., form an infantry division; and, as a rule, 2 infantry divisions, with a battalion of chasseurs, a brigade of cavalry, 8 batteries of field and horse artillery, &c., form an army corps. The foot artillery is allotted to those army corps which have fortresses within their regions. France is divided into 19 army corps regions, and Algeria forms an additional one. The prin cipal elements of the field army corps, with the staff and the cadres of the territorial army, are, as a rule, quartered ' in the region assigned to it, though its recruits

are not necessarily drawn from its region. Outside the army corps there are 7 independent cavalry divisions of 3 brigades and 3 horse batteries each. The Algerian army corps (numbered xix) has 3 divisions. It consists mainly of Zouave and African regiments, but draws its artillery and engineers from regiments in Erance. There is also a separate division in Tunis. The effective strength of the standing army in 1898 was 544,000 officers and men. On mobilization for war the strength of the companies of infantry of the line and chasseurs is raised to 260 men, of engineer companies to 262 men, of field batteries to 180, and horse batteries to 190 men. There is little 'change in the squadrons of cavalry. On a war footing a cavalry brigade numbers about 1200 men, an infantry brigade 6000, an army corps nearly 40,000 men. As a fighting force it may be reckoned at 25,000 infantry, 1200 cavalry, and 120 guns. Armies (the commanders of which are designated beforehand) would be formed by groups of three or more corps, and the cavalry divisions would be attached to them. The territorial army would be used chiefly for garrisons and on lines of communica- tion. The strength of its units when mobilized is gener- ally the same as that of similar units of the active army, but it is not at present organized in brigades. Each army corps region would furnish 8 regiments of infantry, 8 squadrons of cavalry, 1 regiment of artillery, and 1 battalion of engineers. The total war strength of the active army and its reserve would be nearly 2^ millions, and the territorial army with its reserve would raise this total to about 4-^ millions of trained men when the present laws have had their full effect (viz., in 1915). This is more than 11 per cent, of the population. (b. m. l.)

Italt.

The Italian military organization is governed by laws enacted in 1883, 1884, 1887, and 1888. The armed strength consists of (1) the active army, (2) the mobile militia, (3) the territorial militia. The annual contingent for service with the colours is determined by Parliament, and selected by lot from the men who reach the age of 20 in each year ; the rest pass at once into the reserve ; men exempted from service in the active army, but fit to bear arms, pass into the territorial militia. The liability to service lasts from the age of 20 to 39, and the 19 years may be spent as follows: —

Active Abht.

MniTiA.

With Colours.

Eeserve.

Mobile.

Territorial.

Tears.

3

Tears.

6 8

Tears.

4 4

Tears.

7

7

19

Cavalry. — There are 24 regiments, each of 6 squadrons, and a depot. Twelve regiments are told off, one to each army corps ; the rest would be formed into 3 cavalry divisions of 2 brigades of

2 regiments. All regiments have a territorial title as well as a number. The war strength is 43 ofificei's and 845 men, of whom 740 are mounted.

Artillery. — There is 1 horse artillery regiment, consisting of 6 batteries of 6 guns. The battery at war strength contains 4 officers, 150 N.C.O.‘s and men, and 166 horses. The regiment would form 3 brigades of 2 batteries to act with the 3 cavalry divisions. The field artillery comprises 24 regiments — 12 divisional and 12 corps artillery. Each regiment contains 2 brigades of 4 batteries and a depot battery. A divisional regiment contains 47 officers, 904 men, and 428 horses ; a corps regiment has 53 officers, 997 men, and 458 horses. The light battery is armed with a gun firing a 9J ft shell. The total weight of the gun and limber is 30J cwt. The heavy batteries are equipped with guns firing a 14-9 shell, and the weight behind the team is about 41 J owt. A heavy brigade is attached to each infantry division, and a mixed brigade of 2 heavy and 2 light batteries is allotted to each, army corps. The mountain artillery is organized in 1 regiment of 9 batteries of 6 guns and a depot. On a war footing each battery has 4 officers, 160 men, and 63 pack animals. The garrison artillery forms 3 regiments, each of 12 companies, and 1 depot, and 2 regiments of 16 companies and 1 depot. A company con- tains 3 officers and 100 men. The garrison artillery supplies the personnel for siege parks, for fortresses, or fortified positions, and for coast batteries.

Infantry. — ^The infantry of the line forms 2 regiments of grenadiers and 94 other regiments, organized in 48 brigades bearing local titles, and 24 divisions. A regiment has 3 battalions of 4 companies and a depot. The strength of a regiment and a battalion is : —

„„ F.O.O.‘s

””■ and Men.

T,„ .„„„. /Peace 61 1299

Regiment |^^ ^g 2811

■Rott»n,,^ f Peace 15 400

Battalion j^^^^ 34 918

In addition to line infantry, there are 12 regiments of bersaglieii, which are not brigaded, and 7 regiments of Alpini, specially trained for mountain warfare. The regular infantry is armed with the Mannlicher magazine rifle, calibre 0-257 inch, weighing with bayonet 9 R> 2 oz.

JSngineera. — These form 2 regiments, each of 16 sapper or field companies ; 1 regiment of 7 sapper companies, 6 telegraph com- panies, 3 transport companies, and 1 specialist company ; 1 regiment of 8 pontoon companies, 2 special lagoon companies for service at Venice, 4 railway companies, and 3 transport companies. Each of the 4 regiments has a depot. The sapper or field com- panies furnish 1 company and 1 pontoon section to each division in the field, 1 engineer park to each army corps, 1 brigade of

3 companies to each field army. They also supply detachments for sieges or for work in fortresses. The telegraph companies furnish a telegraph park to each army corps and to each army in the field. The pontoon companies furnish to an army one or more bridging trains, each carrying about 200 yards of bridge.

Higher Organization. — ^An infantry division is composed of 2 brigades of infantry of 12 battalions, 1 brigade oi artillery of 4 battalions of 6 guns, 1 company of engineers, 1 pontoon section, 1 ammunition column. It numbers at war strength 276 officers and 12,705 N.C.O.‘s and men. A cavalry division comprises 2 brigades of 2 companies, and 2 horse artillery batteries numbering 213 officers and 3820 N.C.O.‘s and men, together with an ammunition column and administration units. An army corps con- tains 2 divisions, with corps troops consisting of 1 regi- ment (3 battalions) of bersaglieri, 1 cavalry regiment of 6 squadrons, 2 artillery brigades (48 guns), the whole numbering 943 officers and 30,387 N.C.O.‘s and men. There are also 1 corps ammunition column, 1 engineer

AUSTRIA-HUNGARY]

ARMIES

park, 1 telegraph park, and administration units. The active army can supply 12 army corps.

Mobile Militia. — The mobile militia is organized in 144 infantry battalions of 4 companies, 18 battalions of bersaglieri, and 22 companies of Alpini. In addition there are 12 brigades of field artillery, each of 4 bat- teries, 34 companies of garrison artillery, 9 of mountain artillery, 30 companies of engineers; 4 field batteries and 2 companies of garrison artillery for Sicily; together with 9 battalions of line infantry, 1 battalion of bersaglieri, 1 squadron of cavalry, 2 batteries of field, and 1 company of garrison artillery for Sardinia.

Territorial militia is organized in 320 battalions of infantry, 75 companies of Alpini, 100 companies of garrison artillery, and 30 companies of engineers.

Colonial Troops. — A special force exists for the garri- sonirfg of Eritrea, composed of volunteers from the active army or reserve and of native troops.

The armed strength of Italy numbers about : —

Active army and reserve Mobile mUitia Territorial militia .

Total

Officers.

19,450 3,600 5,200

28,250

N.O.O.'a and Men.

805,000

295,500

1,617,000

a,717,500 (g. S. C.)

AUSTEIA-HUNGART.

The military forces of Austria-Hungary consist of (1) the active army with its reserves, (2) the landwehr, (3) the landsturni. The active army is superintended by a single war ministry for the whole monarchy ; but the land- wehr and landsturm are under two separate ministries of national defence, — one for the troops of Hungary, Croatia, and Slavonia (the ” Honved ” troops), the other for the remaining states. Liability to military service was made universal in 1868. The law at present regulating it was passed in 1889. Except in “the occupied provinces,” Bosnia and Herzegovina, which have special treatment in several respects, substitutes are not allowed. The lia- bility begins at the age of 20, and the term of service is 12 years ; but the nature of the service varies. Out of 180,000 able-bodied men annually available, over 100,000 are taken for the army, and after 3 years in its ranks, spend 7 years in the reserve and 2 years in the landwehr. About 23,000 serve their whole term in the landwehr. The remainder go to the ersatz (depot) reserve of the army or the landwehr as supernumeraries. The destina- t^n of the recruits is determined partly by lot, partly by their claims to consideration. Young men of good educar tion are admitted as ” one-year volunteers ” at their own cost, or sometimes at the cost of the state. All men between the ages of 18 and 42 are further bound to serve in the landsturm, or general levy, if not otherwise enrolled; but the landsturm is not called out during peace, and in war only when the landwehr and ersat&reserves are insufficient. Young men who are found unfit for service have to pay a military tax, according to their means, for the benefit of disabled soldiers, or of the widows and orphans of soldiers. The officers of the standing army are drawn from the military schools. Promotion is mainly by seniority, subject to tests of qualification, but selection is not excluded. The reserves are officered by retired officers and one-year volunteers. The units of the standing army (omitting depot cadres, &c.) are as follows: —

Infantry. — 102 regiments ol the line, 4 regiments of Tyrolese rifles, 4 Bosnian-Herzegovinian regiments, all of 4 battalions ; also 26 independent rifle battalions ; making a total of 466 battalions. There are

four companies to each battalion, and their normal peace strength is 4 officers and 93 men.

663

— ^Forty-two regiments, viz., 15 dragoon, 16 hussar, and U uhlan. Each regiment has 6 squadrons and a pioneer section. The peace strength of a squadron is 5 officers and 166 men. The dragoons are recruited from the Austrian provinces, the hussars from Hungary, the uhlans mainly from Galicia. They are all armed alike with sabres and repeating carbines.

Artillery. — Fourteen brigades of field artillery, each consisting of 1 corps regiment and 3 divisional regiments. Iii.each regiment there are 4 field batteries with a peace strength of 4 officers, 101 men, and 4 guns (to be raised to 8 guns in time of war). Attached to regiments of the corps artillery there are 8 divisions of horse artillery, making 16 horse batteries of 5 officers and 122 men each, and 11 batteries of mountain artillery of 2 officers and 60 men each. There are also 3 additional mountain batteries which form a separate division. Of fortress artillery there are 6 regi- ments and 3 independent battalions, making 18 battalions in all. In each battalion there are 4 field companies of 4 officers and 98 men.

Engineers, &c. — Fifteen pioneer battalions, each having 5 com- panies of 5 officers and 107 men. The 5th company is expanded into 3 fortress companies in war. The train includes bridge- equipment. There is a railway and telegraph regiment of 3 battalions, each having 4 companies of 50 officers and 118 men. The engineer staS comprises 146 officers.

f

The general staff of the army numbers 481 officers, of whom 276 belong to the staff corps, and the rest are at- tached. There are 29 infantry regiments (to be increased to 32) of Austrian landwehr, and 28 of Hungarian, mak- ing 195 battalions in all. Each battalion has 4 companies of about 55 men. The landwehr cavalry consists of 6 regi- ments of uhlans and 10 regiments of Hungarian hussars, of 6 squadrons each, and there are also 3 squadrons of Tyrolese and Dalmatian mounted infantry. The peace strength of the squadrons is from 43 to 65 men. There

are no landwehr artillery or engineers. The infantry are armed with the Mannlicher magazine rifle of 8 mm. (0-315 inch) calibre, the latest pattern being of 1895. It is sighted to 3000 paces. The magazine holds 6 cartridges which are inserted simultaneously in a clip. The field and horse batteries are armed with steel-bronze guns of 9 cm. (342 inch) calibre, the field gun weighing 9^ cwt., and that of the horse artillery about 8 cwt. The pattern is of 1875, and no provision has yet been made for sub- stituting quick-firing guns ; but something has been done to check recoil and make the present guns more effective.

- *The higher units of the army are of variable strength. Ah infantry brigade consists of 6 to 9 battalions ; a cavalry brigade of 2 or 3 regiments. Two brigades form a division. An infantry division comprises also 3 or 4 squadrons of cavalry, and a regiment (4 batteries) of field artillery. A cavalry division has 2 batteries of horse artillery and one or two battalions of rifles. A corps is ordinarily made up of 2 infantry divisions, a cavalry brigade, a regiment of corps artillery, and technical troops. The territory of Austria-Hungary (including Bosnia and Herzegovina) is divided into 15 corps districts and 1 divisional district (Zara in Dalmatia). There are 6 cavalry divisions, of which 2 are attached to the 11th corps (in East Galicia) and the other 3 to the 1st, 2nd, and 10th corps. The total peace strength of the regular army is about 283,000 men, and of the landwehr about 49,000, making 350,000 in all, officers included. The war strength of the various xmits is not published now, but the field troops available on mobilization would prob- ably amount to 800,000 men, the landwehr to 320,000, the ersatz-reserves of army and landwehr to 480,000. It is reckoned that another million of trained men could be found in the landsturm. (b. m. l.)*

Russia.

Since the war of 1877-78 many changes have been introduced into the Eussian army, which was not pre- viously organized in higher units than the division.

A E M I E S

[bxjssia

Under the law of Jan. 13, 1874, modified by that of June 14, 1888, and Jan. 19, 1893, liability to service ex- tends from the beginning of the 21st to the end of the 43rd year of age. The first 18 years are passed in the stand- ing army, the rest in the militia. Service with the colours lasts for 5 (in practice 4) years, the remaining term being spent in the reserve, which entails two train- ings of six weeks each for the entire period. The army mobilized for war is composed of (1) field troops, (2) reserve troops, (3) depot troops, (4) fortress troops, (5) local troops, (6) militia.

(1) The field troops are composed of the standing army made up to war strength by calling out the reserves. (2) The reserve troops are formed by the expansion of reserve cadres maintained in peace. (3) Depot troops are formed upon cadres detached at the outbreak of war from the standing army. Their function is to keep the field units up to strength. (4 and 5) Fortress and local troops are brought up to war strength in the same way as reserve troops, but are intended to be employed only on garrison duties. (6) The militia comprises all men physically fit for military purposes between the ages of 21 and 43 inclusive, and is divided into two bans. The 1st ban con- tains the men who have served with the colours, and those who have not been included in the annual contin- gents, but are wholly fit for active service. It may be used to complete the field army, or to form militia units for home defence. The 2nd ban includes men exempted on special grounds from service with the colours, and those regarded as not wholly fit for operations in the field. Military service in Finland was regulated by the law of Jan. 13, 1881, which prescribed 3 years with the colours and 2 with the reserve, the rest of the military period up to the end of the 43rd year of age being passed in the militia. The conditions have, however, been as- similated to those of the empire. Cossacks serve under special regulations for 20 years, beginning with the completion of the 18th year of age. The first 4 years are spent with the colours, the next 4 on leave. During the last 5 years they are only liable for service in case of war.

Infantry. — The^e are 209 regiments, each of 4 battalions, of 4 companies and a non-combatant company. These regiments com- prise 12 of imperial guard, 16 grenadiers, 181 line infantry. Guard regiments have titles only, the rest (1 to 16 grenadiers and 1 to 180 line) have a geographical title as well as a number. The peace and war establishments of a regiment are as follows : —

Officers ....

N.C.O.‘s and men (combatants)

Horses

Carriages ....

Peace.

70

1816

25

War.

79

3874 158

77

Bifles are regarded as light troops, and are supplied with recruits of superior stamp. They consist in peace of 36 two-battalion regiments and 32 independent battalions, having on mobilization 4 four-battalion regiments, 32 two«battalion regiments, and 32 independent battalions. The magazine rifle, 1891 pattern, calibre 0-299 in., weighs with bayonet 9 R) 12 oz., has a muzzle velocity of 2000 f.s., and is sighted to 3000 paces. Eveiy infantry regiment carries in the field 1280 light and 256 heavy spades, 320 light and 128 heavy axes. The Cossack infantry consists in

war of 16 Kuban and 4 Transbaikal battalions. The reserve infantry cadres maintained in peace consist of 82 battalions in Europe, 26 bat- talions in the Caucasus, and 15 battalions in Asia, to be expanded on mobilization to 264, 74, and 51 battalions respectively. The fortress infantry is organized in peace in 1 regiment of 5 and 17 regiments of 2 battalions, each of 5 companies. On mobilization these expand into 31 regiments of 5 battalions. The regiment takes its title from its fortress. The militia is intended to be organized in 640 battalions in war, and to be brigaded in 2 cate- gories, each of 320 battalions.

Cavalry.— The regular cavalry consists of 68 regiments of 4 or 6 squadrons, and 2 independent Asiatic divisions of 2 squadrons. The egtablisbment'of regiments is as follows : —

Peace,

War.

4 squad- rons.

6 squad- rons.

4 squad- rons.

6 squad- rons.

Of&cers . • . N.C.O.'s and men (com- batants) .... Horses .... Carriages ....

32

706 586 ...

38

1027 905

30

629

676

23

36

920

1016

29

Each squadron carries 20 light spades and 20 light axes on the saddle. Pioneer detachments with a demolition equipment are provided in the case of regiments on the western frontier. The Cossack cavalry supplies 317 squadrons in peace and 905 in war. Bach regular regiment has a depot cadre, which on mobilization forms 2 squadrons. The Cossack establishments supply in war 43 depot squadrons, to train men and horses for the active units. On general mobilization it is contemplated to form 80 squadrons of militia cavalry.

Artillery. — The field and mountain artillery consists of 52 brigades — 3 guard, 4 grenadier, 45 line — attached to infantry divisions, together with 53 batteries, of which 7 form the Turkestan brigade, and 12 form 2 East Siberian brigades, the re- mainder being classed as ” independent.” An artillery ” brigade ” varies in strength from 9 batteries (guard, grenadier) to 4 bat- teries (2nd East Siberian). Batteries are classed according to their armament as heavy, light, mountain, and howitzer. Bat- teries of the first 3 classes have each 8 guns ; howitzer batteries have 6. The following are the particulars of the equipments : —

Heavy.

Light.

Mountain.

Howitzer.

Calibre (in.) Shrapnel (lb) . Muzzle velocity (f.s.) Projectiles carried Load behind team (cwt.) .

4-2

28

1450

108

3-42

15-4

1700

150

37^

2-5 8-9 1143 128 194*

6

59t

760 92

41i

- ***Weight of gun, ib.***

t High explosive shell.

A field battery carries 32 spades, 24 axes, and 4 pickaxes for entrenching purposes. New equipments are being tried and will be gradually introduced. The howitzer artillery consists of 7 regiments, of which 1 to 5 have 4 batteries each, and the remainder 2 batteries. There are also 2

batteries forming part of the 1st East Siberian brigade. The regular horse artillery num- bers 28 batteries (5 guard) and 3 independent horse mountain batteries. The horse batteries are organized in divisions of 2 batteries and attached to cavalry divisions. The Cossack horse artillery batteries number 20 in peace and 38 in war. The reserve field artillery in peace consists of 7 brigades, each of 2 divisions of 2 or 3 batteries, in all 41 batteries, expanding on mobilization to 164 batteries. The depot field artillery force is organized in peace cadres, forming 3 brigades of 3 batteries, 5 independent batteries, and 1 horse artillery battery, expanding in war to a total of 56 batteries. It is proposed, when the militia is called out, to form 80 militia batteries, organized in 40 regiments attached to the 40 divisions of infantry. The fortress artillery contains 56 battalions of 4 companies, 4 siege battalions of 4, 3, or 2 companies, 10 independent companies, and 5 sortie (field) batteries expanding into 16 batteries. The establishment of a fortress or siege battalion is : —

/,

Peace.

War.

Company,

]

2 Cos.

battalions o 8 Cos.

f

4 Cos.

OfHcers .... N.C.O'.'s and men (com- batants) ....

3

112

11 654

16 983

21 1310

The siege ordnance consists of 4-2-in., 6-in., 8-in. guns, and of 3-4-in., 8-in., and 9-in. (screw) mortars. The garrison and coast defence ordnance includes 14-in., 11-in., and 9-in. guns (1877), 11-in. (1886) , 10-in. (1895) , and 6-in. Q. P. (Canet) guns. A militia force of foot artillery, consisting of 10 battalions, each numbering 24 officers and 1308 N.C.O.'s and men, is to be formed in war. Engineers.— The sapper and pontoon battalions and the

turkey]

ARM

Peace.

War.

22

26

488

937

14

321

■ ••

119

engineer parks are in peace time administered in 7 brigades. In ■war the units are distributed among the field and other troops. There are 25 sapper battalions in Europe and 4 in Asia, 8 pontoon battalions and 7 field parks. The sapper battalion has usually 3 sapper companies and 1 telegraph company. Its usual establish- ment strength is : —

Officers

N.C.O.‘s and men (combatants) .

Horses

Carriages

A pontoon battalion carries from 340 to 400 yards of bridge equip- ment. There are 7 railway battalions, 4 in Europe and 3 in Asia. The latter are kept at war strength : 30 to 35 officers and 1300 to 1560 N.C.O.‘s and men combatants. There is in peace an instruc- tional balloon park, which would form detachments in war for armies in the field.

Higher Organization for War. — The active army in Europe and the Caucasus supplies 24 army corps composed of 51 infantry and 23 cavalry divisions and 2 rifle brigades. There are also 1 independent rifle division, 5 independent rifle brigades, and 2 in- dependent cavalry brigades, together with a large body of active trpops not included in the higher units. The empire is divided into 12 military districts and 1 province, subdivided into 23 local brigades.

The approximate total strength of the combatant forces on a war footing is as follows : —

Battalions

N.C.O.‘s

or

Guns.

Officers.

and

Squadrons;

Men.

I. Field Army —

Infantry .

985

...

19,454

952,708

Cavalry

730

3,728

109,916

Artillery .

»..

3782

4,484

164,096

Engineers . Total . n. Field Beseroes —

...

...

1,076

39,981

3782

28,742

1,266,701

Infantry .

...

10,572

631,152

Cavalry .

...

2,236

85,090

ArtUlery .

...

1420

1,403

51,196

Engineers . Total . m. Fortress Troops —

137

6,001

1420

14,348

773,439

All arms .

...

128

4,357

235,861

IV. Local Troops —

(field)

Cavalry and

Infantry

...

...

379

29,690

V. Depot Troops—

All arms .

...

462

5,814

• 330,826

VI. Militia—

All arms .

Grand total

...

-640

10,752

673,686.

1715

6432

64,392

3,310,203

The conditions of the Russian empire render a rigid territorial system such as that of Germany impossible. Large Asiatic garrisons have to be provided, which, until the completion of the Siberian railway, must be mainly transported and supplied by sea. Native troops in con- siderable numbers are maintained, and have to be brought into the general system. Thus the military problems of Russia approximate more closely to those of Great Britain than to those of any other Power. (g. s. c.)

Turkey,

The Turkish military forces are organized on a territorial system, the empire being divided into 6 districts (ordu), of which the headquarters are (1) Constantinople, (2) Adrianople, (3) Monastir, (4) Erzinjan, (6) Damascus, (6) Baghdad. The Yemen and Hejaz form a separate ordu, whose troops are recruited from (4) and (5). On account of the defective state of the internal communica- tions and other circumstances, the territorial system is not rigidly adhered to, and even in peace time there is a con- siderable interchange of troops in the military districts.

I E S 665

All Mussulmans are liable to military service, but the nomad Arab tribes are not regularly recruited, and many of their men evade the conscription. Liability to service commences at the age of 20, and lasts 20 years. The armed strength is divided into 3 categories, in which the period of service is nominally as follows : —

I. Nizam (active f with colours . . 4 years.

army) \ in reserves . . 2 ,,

II. Eedif (landwehr) . . . . 8 ,,

III. Mustahflz (landsturm) . . . 6 ,,

The period of 4 years with the colours is sometimes varied, and the nizam reserve is liable to be recalled at any time; Between 130,000 and 140,000 men become liable to service in each year, and about 50,000 join the nizam force. Those not drawn are exempted from colour service, but receive some small training.

Cavalry. — The nizam cavalry forms 38 regiments of the line and 2 of the guard, each consisting of 4 squadrons and 1 depot squadron. Regiments 1 to 36 form 6 cavalry divisions, one for each of the 6 ordus. There is no redif cavalry, but a tribal militia force (Hamidieh), consisting of 48 regiments, is formed somewhat on the lines of Cossacks, the tribes

supplying their own horses and equipment, and arms being provided by tiie Government. The war establishments of nizam cavalry are : —

OfiSoers. N.C.O.‘s and Men. Squadrons 6 153

Eegiments . . . . 39 ‘ 647

Peace establishments are generally low and vary considerably, especially in Hamidieh reginients.

Artillery. — The Turkish artillery has been generally the most efficient of the three arms. Each of the ordus 1 to 5 has 1 battalion of horse artillery and 3 brigades of field and mountain artillery. A brigade consists of 2 regiments of 2 battalions of 3 batteries. The battery on a war footing has 6 guns. Thus each of these ordus should have —

Batteries. Guns.

Horse artillery 3 18

Field „ 30 180

Mountain,, ... 6 36

Total . . 39 234

To the 6th ordu 2 regiments of 2 battalions are allotted, each regiment having 12 field and 2 mountain batteries. Eor the Yemen and Hejaz divisions 2 field and 3 mountain batteries are provided. The total number of batteries is approximately : — Horse, 15 ; field, 169 ; mountain, 42.

A field battery on a war establishment is supposed to contain 4 officers, 133 N.C.O.‘s and men, and 100 horses. Peace establish- ments vary considerably in the different ordus. Horse artillery is armed with 7-5-om. guns, field artillery with 8-7-cm. guns, and mountain artillery with 6-9-cm. guns, all of Krupp manufacture. Fortress artillery is partly raised ia the several ordus, and partly recruited specially for the ordnance department. The ordus are supposed to provide 64 companies, the ordnance department 20 battalions, comprising 74 companies. The

fortress artillery is mainly concentrated at Constantinople, in the Bosphorus and Dardanelles defences, in the Bulair lines and at Erzeroum.

Infantry. — The nizam infantry consists of 69 regiments, 15 rifle battalions, and 1 battalion of mountain infantry. In all there are about 284 nizam battalions. There are 12 local battalions of militia in Tripoli. A brigade consists of 2 regiments of 4 battal- ions ; a division consists of 2 brigades and 1 rifle battalion. Each ordu contains 8 line regiments and 2 rifle battalions. The nominal war establishments of line and rifles are : —

Officers. N.C.O.'s and Men. Company 4 223

Battalion 24 898

Eegiment 106 3658

The redif infantry is organized in 88 regiments and 352 battal- ions. Each of the ordus supplies 8 regiments of 4 battalions. Redif troops nominally belong to the 2nd line, but are frequently embodied in peace time, and employed outside their territorial districts. Small peace cadres are permanently maintained. The war establishment is intended to be the same as that of the nizams, but redif battalions may be 1200 strong. The nizam infantry is armed with the Mauser magazine rifle, calibre 0-302 inch, weighing with bayonet 10 ft 7f oz. Other forces are not yet fully re-armed with recent weapons.

Engineers, like artillery, are partly organized in the ordus and partly recruited from the ordnance department. The ordus 1 to 4

provide each 1 battalion of 4 companies of pioneers, and 1 telegraph ^°"Paiiy ; the remaining ordus have each 1 company only. The 2nd ordu has in addition a pontoon train under the ordnance department. There are two regiments of 3 battalions of 2 com- panies and 1 torpedo battalion. The establishment of an engineer company is about 200 men of all ranks, and of a telegraph company about 106.

Higher Organization.— E,axi\ ordu is supposed to form a nizam army corps of 2 divisions, and ordus 1 to 5 also supply 4 divisions of redifs. A nizam division would probably consist of 16 battalions of infantry, 1 battalion of rifles, and 1 regiment of field artillery. A cavalry division might consist of 6 regiments and 1 battalion of borse artillery — ^24 squadrons and 18 guns. A nizam army corps would comprise 2 infantry divisions and 1 cavalry division. The redif divisions would depend on the nizam army for their artillery, and there is not sufficient nizam cavalry to enable them to be formed into army corps. The army corps organization, however, has not been wholly naturalized in the Turkish empire, and is not well suited, to its conditions. The combatant forces of Turkey number about 700,000 men, exclusive of a large number of mustahfiz, who cannot be said to be organized, but who would provide able-bodied men partly trained.

(g. s. c.) switzeeland.

The Swiss army is a purely militia force, receiving only periodical training, but based upon the principle of uni- versal service. Liability begins at the age of 20 and lasts for 25 years. Cavalry men receive a recruit's course of 80 days' training on joining, and subsequently a re- petition course of 10 days in each year, until the end of the 11th year. Artillery and infantry undergo recruits' courses of 55 and 45 days respectively, and a repetition course of 18 and 16 days in every alternate year till the end of the 12th year, when they pass into the landwehr, and receive 6 and 5 days' training every fourth year. The Confederation supplies certain units which are recruited throughout the country. The rest of the army is recruited in 8 territorial districts. The armed strength consists of (1) the active army ; (2) the fortress garrison ; (3) the landwehr; (4) the landsturm. The active army is organized in four army

corps which draws only to a small extent upon the landwehr. The fortress garrisons are made up of active troops {Mite) and landwehr. The rest of the landwehr is organized in regiments, squadrons, companies of position artillery and engineers, and admin- istrative units. The landsturm includes all able-bodied men between 17 and 50 who are not included in the active army and landwehr, volunteers under 17 and over 50, and officers up to 55 years of age. It is divided into two classes, of which the first consists of all men under 20, who on mobilization join the active army as recruits. The 2nd class, consisting of men of 20 and upwards, is divided into j;he " armed landsturm " and the " auxiliary troops." The armed landsturm forms 96 fusilier battalions of 3, 4, or 5 companies, 23 carabinier companies, and 26 companies of position artillery. It is inspected and drilled on one day in each year. The " auxiliary troops " form 410 pioneer companies about 200 strong, and " special detachments " for administrative services.

Cavalry. — The cavalry of the active army consists of 24 squad- rons of dragoons and 12 companies of guides, the former being organized in 8 regiments of 3 squadrons. The landwehr cavalry supplies the same number of units, but has no horses. A dragoon regiment has 17 officers and 358 N.C.O.'s and men. Of the 12 companies of guides, 8 are attached to divisions and have the same strength as a squadron of dragoons. Cavalry horses are kept for a year in the remount depots before being Issued to recruits. After passing through the recruit's course, the cavalry man takes his horse to his home, paying half its cost as security. This sum is repaid by the state in '"'yearly instalments," and at the end of the 10 years' service the horse becomes the property of the man.

Dragoons are armed with sword and a magazine carbine, weighing 7-05 lb, calibre 0-295 in., muzzle velocity 1800 f.s. The Swiss cavalry, on account of its brief training, is intended to be em- ployed almost wholly in reconnaissance and as mounted infantry.

Artillery. — The active artillery comprises 56 iield and 4 moun- tain batteries, each of 6 guns ; there is no horse artillery. For fortress work there are 8 companies, 3 observation companies, and 2 machine gun. detachments. The landwehr provides parks, am- munition trains, and 15

position companies. The 56 field batteries form 12 regiments, 8 of which, each consisting of 2 brigade divisions of 2 batteries, are attached to the 8 divisions. The remaining 4 regiments each consist of 2 brigade divisions of 3 batteries, allotted as corps artillery to the 4 army corps. A regiment of 4 batteries contains 23 officers and 652 N.C.O.'s and men, with 340 horses and 24 guns. The field artillery is armed with a 3'31-in. Krupp gun, firing a 14 8 R) shrapnel, with a muzzle velocity of 1590 f.s. The mountain gun, calibre 2-95 in., fires a shrapnel of 10-14 lb, with a muzzle velocity of 1004 f.s. There are 5 brigade divisions of position artillery, each composed of 2 active companies and 3 of landwehr. A brigade division numbers 41 officers and 778 N.C.O.'s and men. Its armament consists of 16 12-cm. guns, 12 12-cm. mortars, and 12 6-cm. guns. Of the position artillery, 1^ brigade divisions are allotted to the St Gothard and St Maurice defences ; the rest is available for employment with the field array. There are 3 brigade divisions of fortress artillery attached to the defences above mentioned. Artillery horses and those of the train are hired when required.

Infantry. — TTie active infantry consists of 96 fusilier and 8 cara^ binier battalions, each containing 25 officers and about 730 N.C.O.'s and men, or 720 combatants in all. A fusilier regiment consists of 3 battalions. The landwehr infantry consists of 66 fusilier and 8 carabinier battalions. Throughout the army there is only one establishment — that laid down for war. The active army and landwehr infantry are armed with the Schmidt magazine rifle, calibre 0-295 in., weight with bayonet 10-43 lb, muzzle velocity 1900 f.s. The landsturm infantry have the Vetterli rifle, calibre 0-410 in., weight with bayonet 11-46 ft, muzzle velocity 1411 f.s.

Engineers. — ^The engineers of the active army comprise 8 half-battaUons of 2 companies of sappers, 4 bridging detachments of 2 pontoon companies, 4 telegraph companies, 1 railway battalion of 4 companies, 1 balloon company, and 3 fortress companies. The landwehr provides 16 sapper companies, 2 bridging detach- ments, 4 telegraph companies, and 4 railway companies.

Higher Organization. — The fleld army is organized in four army corps of 2 divisions, with corps troops. Each division contains 2 infantry

brigades of 2 regiments of 2 battalions, together with 1 guide company, 2 brigade divisions of field artillery, a carabinier battalion, and half a battalion of engineers. The 8 divisions are recruited in 8 territorial districts. On mobilization the active army absorbs 230 officers and 5736 N.C.O.‘s and men from the landwehr. The approximate total strength of establishments is as follows : —

Oflioers.

, N.C.O.‘s and Men.

Total.

Active army .... Active landwehr Fortress garrison Fortress landwehr . Landwehr troops

Total . ...

4522 230 224 314

1751

97,169 5,736 5,085 8,462

43,159

101,691

5,966

5,309

8,776

44,910

7041

159,611

166,652

In addition, the "armed landsturm" numbers about 53,500 men of all ranks. The pioneer companies supply about 104,000 men, and the special detachments about 114,000 men. The former have received extremely little training, the latter consist of men told off as , far as possible for miscellaneous duties to which they are accustomed.

The Swiss army is a highly organized force, which, regarded as a militia, has no equal. The amount of train- ing imparted to it is necessarily limited, but is made as thorough as possible ; and the results obtained, as shown by manoeuvres, are surprising. Against the small amount of actual drill must be set the long service of 11 or 12 years passed in the same unit. "The men thus acquire a solidarity which cannot be at once attained in bodies made up from reserves on mobilization. Composed of mature and hardy men inured to the conditions of a mountainous country, the army is unquestionably a powerful defensive force.

japan]

reflecting the sturdy national patriotism of the Swiss, and capable of offering a strong resistance to external aggression. The total annual military expenditure of Switzerland is under £1,000,000, which approximately represents the cost of the British volunteers.

(g. s. 0.) Japan. Japanese military organization on Western lines may be held to date from 1873. Involving as it did the dis- appearance of the samurai, or feudal soldier par excellence, the altered state of things occasioned some trouble at first, but within three years the new model got into fair working order and has now been accepted with sober en- thusiasm by the people. At the beginning an advisory board of British experts was set up. Then this gave way to the mission militaire of French officers and Italian artillerists in the arsenal at Osaka. These were in turn replaced by a staff of German specialists. Finally, since the period of the

Chinese -war, the Japanese have felt strong enough to dispense with all foreign assistance and to organize their army for and by themselves.

Conscription. — Every male of the age of twenty is liable to the conscription, provided he is passed by the doctor, is not (under safeguards) the sole breadwinner of his family, suffers from no per- manent illness or disablement, is not a criminal, and is not under- going a very specialized curriculum of education. The conscripts are chosen by lot. The minimum height for the Infantry, cavalry, a,nd army service corps is 5 feet 2 inches ; for the artillery and en- gineers, 5 feet 4 inches. The number of eligibles is estimated at 427,000 a year, of whom 60,000 are actually taken for the colours, and 131,300 for the depot or supernumerary forces. There is an elaborate system of volunteering, devised to secure the thorough training of the exempted students and of natives who have been resident in foreign lands, who on their return to Japan at the age of thirty-two are drafted into the territorials.

Service. — There are four grades of service, namely — (a) with the colours for three years ; (&) with the first reserves for 4^ years, who are called up twice during their full term for three or four weeks at a time ; (c) with the second reserves for five years (the Zatidwehr), who are called out twice for two weeks at a spell during their full term ; and (d) with the territorial troops (the landsturm) up to the age of forty. Besides these grades there are two classes of supernumeraries (the depot) , the first comprising men who, though physically qualified and otherwise liable to serve, have not been called up for service with the colours ; the second, men who have not only escaped the lot for the colours, but also service with the iirst supernumeraries. The first depot serve for 7| years, with 150 ■days' training during the full term, of which ninety days are usually required during the first year ; the second depot serve for IJ years, without any training, as a nile, during the period. Ulti- mately both classes pass into the territorial army. Their chief purpose is to fill such vacancies as occur in the ranks of the regulars. Personnel. — The conscript private becomes first a second-class soldier, then first-class, then upper, promotion depending upon proficiency and good conduct. The non-commissioned steps are corporal, sergeant, sergeant-major, and special sergeant-major, with specified periods of service in each grade,

promotion resting solely upon merit. Officers are recruited from graduates at the Officers' College — ^to which students go up either directly from one of the six local preparatory schools or the central preparatory school at Tokyo, after passing an examination in either case — ^but no com- mission is issued until the Staff Council are satisfied of the candi- date's competence and progress. For the higher and specialized training and education of commissioned officers there are several schools, of which the most important is the Army College, in which instruction is given for the superior ranks and staff appointments. Others of these institutions are the Toyama School of Musketry and Strategy, the School of Artillery and Engineers, the Field Artillery School, the Garrison Artillery School, the Cavalry Prac- tical School, the Army Service School, the Army Medical School, the Veterinary School, the Arsenal School, and the School of Mili- tary Music. The ranks of officers are, in their order, second- Ueutenant, first-lieutenant, captain, major, lieutenant-colonel, colonel, major-general, lieutenant-general, general, and field- marshal. Up to and including the grade of captain, promotion is partly by seniority and partly by merit; but above that rank promotion takes place by merit alone. An officer who never rises beyond his captaincy is compulsorily retired at the age of forty- eight. The pay of a private runs from Is. lOd. per mensem for a second-class to 3s. O^d. for an upper soldier ; of a non-commissioned officer from 9s. 2d. per mensem fijr a second-class corporal to

28s. 6d. for a first-class special sergeant-major, besides rations, uni- form, and quarters. Officers are paid at rates varying from £34 per annum for a second-lieutenant to £71 for a captain, £115 for a major, £238 for a colonel, and £600 for a general.

Organization. — Taking the army as a whole, it is composed of twelve divisions, numbered 1 to 12, and one division of guards (the Imperial Guard). Each division is commanded by a, lieutenant- general, is stationed permanently in an assigned district, comprises four regiments of infantry, one regiment of cavalry, one regiment of field artillery, one battalion of engineers, one battalion of army service, and is in itself a complete fighting unit. An infantry regi- ment is made up of four battalions of three companies each ; a cavalry regiment of either three or

four squadrons, with 100 sabres to each ; and a field artillery regiment of six batteries of six guns each. A battalion of engineers is composed of three companies, or 600 men ; a battalion of army service of 300 men. The normal strength of a division is thus made up, excepting the division of guards, which is somewhat smaller : —

Infantry

. 9,600

Cavalry

. 300

Engineers .

600

Army Service

300

10,800 men and 36 guns.

Of mountain artillery there are six regiments, or 216 guns in alL The total force of field artillery amounts to seventeen regiments, or 612 guns ; whilst the total strength of cavalry stands at about 5000 sabres. Over and above their normal strength, several of the divisions (the Imperial Guard, and the First, Fourth, Fifth, Sixth, Seventh, Tenth, and Twelfth) are furnished with extra corps, mostly of artillery, for the garrisoning of the forts at Tokyo, Yura, Kure, Geiyo, Saseho, Tsushima, Hakodate, Maizuru, and Shimonoseki ; the additional complement of the guards consisting of a brigade (two regiments) of cavalry, a brigade (three regiments) of field ar- tillery, and one battalion of railway engineers. The present peace footing may be taken at 100,000 men ; but in 1905, when the whole scheme of readjustment will be completed, the pea/ie strength will amount to 150,000 men of all ranks and 30,000 horses, the war strength to 500,000 men and 100,000 horses. The guards are re- cruited from every

part of the empire ; the divisions, from the districts to which they are attached. Formosa is garrisoned by a mixed brigade, supplied by the divisions in rotation, composed of two regiments of infantry, two squadrons of cavalry, three bat- teries of field artillery, half a battalion of engineers, and half a battalion of army service. Testimony is universal to the exceptional efficiency of the Medical Service Corps, which is distributed in the proportion of 100 surgeons to each division, with a complete equip- ment for field hospitals, bandaging stations, special hospitals, and the like. There is also a Bed Cross Society, in addition to a great hospital at Tokyo, a large staff of trained nurses of both sexes, and two hospital ships designed and furnished for the transport of the wounded. The total cost of the whole army is a trifle over 37,000,000 yen, or £3,700,000 per annum.

Staff. — Supreme control is vested in the emperor, who is the commander-in-chief, but he is actively assisted by a general staff (with a field-marshal for chief and a general or lieutenant-general for vice-chief), the War Office, and a board of field-marshals. In addition to the transaction of general business, the general staff supervises the survey, trigonometry, cartography, and topography departments, and directs the Army College. The head of the War Office is a general on the active list, who has ex officio a seat in the Cabinet and is not affected by ministerial changes. There is a Tokyo Defence Office, under a lieutenant-general, specially charged with the defence of Tokyo Bay, and similar duties in regard to the other forts are entrusted to three major-generals, with headquarters respectively at Yokohama, Shimonoseki, and Yura. All questions concerning arms and ammunition are referred to expert committees of artillery and engineering, and there is besides a Remount Office. For military purposes the whole empire is divided into eastern, western, and central districts, each under the command of a general or lieutenant-general.

Arms. — ^Excepting in time of war, the Japanese are able to make all their munitions in the arsenals at Tokyo, Osaka, and Taipeh (Formosa). The infantry carry the repeating rifle designed by Colonel Arisaka, and the field and horse artillery are at present (new weapons, Arisaka pattern, are in hand) equipped with field guns (weight about 6 cwts.) and

mountain guns (weight, 2 cwts.) of the same calibre (2‘955 inches) and firing similar ammunition, of which the common shell weighs about 9 J R).

For a full account of the military system under the ancien regime and further details about the existing organization, see under Japan.

[For Egyptian Army see Egtpt. For other Armies see imder the separate headings for each country.]

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ARMOUR.

1. Body Armour.

SIKCE the publication of the article in the ninth edition of this work on “Arms and Armour,” the subject has been closely studied by experts, and is better understood generally than was the case five-and-twenty years ago. The tendency at present is to appreciate beauty of design and excellence in workmanship rather than hi storic interest

or sentiment. This tendency, which especially exists among Continental collectors, may give place some day to a demand for pieces which speak more directly of the warrior fighting in the field than of the skill of the artificer in the workshop ; but the entire value of such pieces depends on their genuine character, and this is more difficult to estab- lish in plain than in elaborate workmanship. Suits of armour which embody both skill and sentiment can hardly

Fig. 1. — Gothic style of armour. Monument of Count Otto IV. von Henneberg.

fail to be sought after at all times. Of these, putting aside the question of armour known to have belonged to some celebrated man, the suits which are of by far the most value are those few which still remain of the 15th century, commonly called Gothic suits. These are appreciated not only on account of their rarity, but because of their singular beauty in design and

excellence of manufacture. A few of these exist in the Tower of London, but the most beautiful suit in England is a mounted one in the Wal- lace collection. The monument of Count Otto IV. von Henneberg, executed after 1480, furnishes a very good example of 15th-century armour of the highest class. The

Fie. 2.— Suit by Jacob Topf, nearly complete ; the gorget does not belong to it. Below is the placcate.

photograph from which Fig. 1 was reproduced is from the cast in the South Kensington Museum. The effigy of Earl Eichard in Warwick chapel is another beautiful example. Of this Mr Starkey Gardner says that it looks like the work of nature rather than art. Most readers must be familiar with another example in Albert Durer's print of " the Knight, Death, and the Devil." Armour culminated as to completeness, though it lost in beauty, at the end of the 16th century, when the so-called Maximilian type came in. In this the pointed toe gave place to one of extravagant width. Of this armour many fine examples exist, as the Tower of JLondon includes several suits

which belonged to Henry VIII. Most high-class armour up to this time was made on the European Continent ; that represented in the Warwick effigy is Italian, while the armour of Henry VIII. is chiefly German. Fig. 2, however, shows a beautiful suit or half-suit, still extant, which belonged to Sir Christopher Hatton, and was the work of a celebrated English armourer, Jacob Topf. The different classes of armour may be broadly distin- guished as follows: — (1) War harness was seldom com- plete for the rider, and little was used on the horse in actual war. On foot, little armour could be worn below the knee — Sir Christopher Hatton's is an example of a very handsome suit for a mounted knight in war. (2) Tournament armour. — In the lists, not only would com- plete armour be used, but additional pieces of special weight. For jousting, the rider required to be quite rigid, in order to deliver the impetus of horse and man in a sharp blow through the end of the lance, so as to strike the

adversary out of his saddle, or break the lance. Aim was generally taken at the helm (see a paper by Lord DUlon in the ArchceoCogical Journal). The rider sat against the cantle of the saddle with straight knees and stirrups home. Hence the helm in the 15th century was a rigid steel case resting on the shoulder. In the 16th this was superseded by extra pieces, chiefly one termed the grand guard or volant piece, protecting the chest and part of the face. (3) For Jigliting in the lists on foot, the armour was eventually carried inside the legs and arms, and under the seat, in plates fitting so closely that a penknife would scarcely find entrance. Of this an admirable example may be seen at the Tower in a suit made for Henry VIII.

The following examples of armour may be specially noted : —

The Tower of London. — ^The above-mentioned suits of Henry VIII., mounted and dismounted, especially that made by Conrad Seusenhofer; also Leicester's suit; a German tilting saddle in which the rider sat, or rather stood, with his legs in sockets; a few samples of jacks or brigantines, consisting of plates sewn to texture, one on an Elizabethan archer ; also, two long bow staves recovered from the Mary Bose sunk at Spithead.

The Wallace Collection. — The Gothic suit above mentioned, and many suits possessing their original appearance in unusual meas- ure, owing to careful preservation and gentle cleaning.

The Rotunda Museum, Woolwich. — Armour left behind in a guard-room at Rhodes by the knights on their evacuation in 1522, which constitutes the greatest recent " find." It consists" chiefly of salades and 15th-century pieces. The Brocas tilting helm, unsurpassed by any, is also at Woolwich.

Windsor Castle. — Tilting pieces and armour about the close of the 15th century.

Warwick Castle. — Curious old closed chamfron.

Canterbury Cathedral. — ^Tilting helm, a short surcoat termed a jupon or cyclas, and gauntlets of the Black Prince ; the last are perhaps the

earliest extant.

Westminster Abbey. — Saddle and shield of Henry "V. In the Chapter House is the only known sample of an old English arrow. Most of the armour placed over tombs and in churches is " mortu- ary," i.e., made specially for the purpose and generally good for nothing, but some beautiful pieces have been thus deposited.

Armour ceased to be used by combatants generally in the 17th century, but it has never been entirely given up, and has in exceptional cases been used up to the present day. The cuirasses worn by heavy cd,valry are undoubtedly only used for display — ^the Life Guards left them behind when they went on active service to Egypt and South Africa ; but helmets are retained for protection against sword cuts in hand-to-hand fighting, and it seems unlikely that anything can supersede them. The growing power of fire-arms, however, drove out armour. First, it was given up for the limbs, and thickened so as to be bullet-proof for the breast ; when horsemen engaged hand to hand, with pistol and sword, bullet-proof armour must continually have saved life. Breastplates of the 17th century frequently have indentations made by bullets. Some of these are no doubt proof marks, but by no means

all. One pair of plates at Dover Castle has three bullet marks. In the siege of Athlone in 1691, complete armour was worn by a special body of men. Very heavy helmets and back plates were worn by sappers. A picture of the siege of Eome in 1848 shows a sapper in a special helmet worn for protection under fire. Hard steel breastplates were produced by Dowe, Maxim, and others in 1894. They stopped modern bullets, but weighed over ten pounds, which is too heavy for wear. Still, portable shields might be used in siege works, and steel shields are employed on gun-carriages and mountings. Against sword cuts, especially the sharp draw-cuts of an Eastern blade, mail is an efficient protection. Dervish warriors wore mail in the battle pf Omdurman in 1898. Mail has been recently applied to the shoulders of the British cavalry, ' and one incident showing the value of mail may be recorded. In Egypt in 1885 an officer's wife purchased a patch of chain mail, which she insisted in sewing inside the breast of the uniform worn by her husband^ a lieutenant of the 6th Bengal Cavalry.

This regiment was engaged hand to hand shortly afterwards, and a spear-thrust aimed at his breast was stopped by the mail ; he came out unharmed, with the spear-head broken off and hanging in it. Lastly, mail has been specially made of hard steel rings for gold-diggers, and the English, detective department possesses such mail for wearing, if needed, inside a coat.

II. Ships and Fokts.

The fact that armour for the defence of the soldier's body had failed to resist musket balls, and had gone out of use, probably tended to prevent its being proposed and tried on a larger scale for the protection of ships and forts. Nevertheless experiments were made with regard to both in the United States in 1812, 1841, and 1853, and in England in 1827 and 1840. In 1855 the French employed floating batteries at Kinbum ; and before the end of the Prussian war both France and Great Britain had iron-plated batteries afloat. The British Warrior and French Gloire classes were ordered in 1858, and the United States coast vessels, termed monitors, were begun in 1861. The future use of armoured ships was indeed assured by the havoc wrought among unarmoured vessels by the Confederate ship Merrimac, protected by impromptu armour made of railway iron rails. The application of armour plates to vessels is dealt with under Ship Construction, the object of the present article being to trace the development of the actual armour itself, whether intended for ships, coast defences, or inland forts.

For many years after the introduction of armour neither plate nor shot gave promise of the powers since attained. The shock of impact shattered or flattened the shot, and the harder plates were fractured to such an extent that wrought iron was adopted. For many years the only improvements made consisted in rolling plates of increased thickness and size, and in employing with them such bolts and backing as best enabled them to bear attack. Thus plates were applied in several thicknesses, sandwiched with thin layers of wood between them, and the so-called " Palliser English" bolt was introduced, ingeniously devised to avoid nipping and local strain, with a spherical head which accommodated itself to any slight displacement of the plate. This soft armour encouraged

the development of hardness rather than toughness of shot ; consequently, although steel projectiles held together better than those of cast iron, the latter, when made on Palliser's system with points and heads hardened by chilling, penetrated so well that they were largely adopted by all Powers, and no fundamental change either in shot or armour took place in naval armaments till 1876. In 1868, however, an entirely new form of armour for land defences had been devised,

which, although it has never attracted much attention in ^ngland, is used almost universally in European coast forts. it was proposed and made by Gruson of Magdeburg, and consists of massive shields of chilled cast iron, which are easily made of any required form. No tracking or bolts are used, the shield being built up of heavy blocks, if possible cast on the spot, which are keyed together, and constitute the entire parapet (see Fig. 3). The metal can be made

of thickness varying according to the supposed needs of each part of face or roof, and the breech-loading ordnance, at that time existing on the Continent, but not in England, allowed the use of shields sloping down forward at the gun forts in curves well adapted to cause shot to glance off them.

In British coast forts vertical walls were adopted, covered with wrought-iron plates, either applied in a single thickness, or in successive layers sandwiched with wood or concrete (see Fig. 4). Thus British coast

ssss«m|,Sa,9?,SiV^V:.'•;.i^J:;•iiV•7"%!";•■.■^■i•■••

Fig. 4.

armour differed fundamentally from that employed by other nations, and this difference is maintained to the present time. These two kinds of coast shields deserve attention as furnishing examples of the opposite extremes in character, and as justifying the classification of armour plates into

“soft” and “hard” kinds, a distinction which must be kept in view in order to understand the power of artillery fire, and the behaviour of armour when attacked

by it. Soft armour plates, such as those of good wrought iron, do not break under the impact of shot, but yield by perforation. Thus a projectile with sufficient striking energy passes through soft armour, making a more or less clean hole, but leaving the plate practically as strong as before. A shot, however, that fails to perforate, effects nothing, lodging harmlessly in the shield. Hard armour, on the other hand, of which chilled iron furnishes the most extreme example, refuses to yield by perforation, and breaks up the shot on impact ; but it gradually become& disintegrated, the whole mass before long parting in frag- ments. Hard armour offers a complete defence against a few rounds from very heavy guns, men and ordnance covered by it being entirely protected until their shield is destroyed. On this account chilled iron shields have been used to protect coast artillery from the few rounds that the heavy guns of men-of-war may be expected to deliver during an attack of limited duration. Notable examples of Gruson’s shields and forts are the St Marie battery near Antwerp (see Fig. 3), cupolas at the entrance of the Weser near Bremerhaven, and two turrets defending Spezia harbour, each mounting two 119-ton Krupp guns (see Fig, 5). The joints shown in this figure indicate that the

Fig. 5.

turret roof is built up of fifteen sector-shaped pieces and two centre plates of semicircular form. Before adoption a sector piece was subjected to three blows from projectiles fired from an Elswick 100-ton breech-loading gun. A fourth round indeed was afterwards delivered, as well as some rounds from 15-cm. (;5-9 in.) guns. This shield was fractured in several directions, but the fragments remained in situ, and the defensive power of the shield was probably but little diminished, and would continue until some large fragments should become displaced. Soft armour, until recently best exemplified by wrought iron, but now by soft nickel steel, exhibits its capacity most fully in inland fortifications, where it may be called upon to resist the breaching attack of siege guns of such limited

weight and power as not to be able to perforate it com- pletely. First-class soft armour might bear such an attack for hours and days, or perhaps even for weeks. The continued breaching attack of inland forts by siege guns of limited weight, and the brief attack of coast shields by the very heavy guns of battleships, illustrate the condi- tions which bring out most completely the powers of soft and hard armour. Between these lie innumerable

cases ; for example, the armoured belt of a cruiser and that of a battleship. The former is the thinner, and more liable to be overmatched' by a shot, but a cruiser is not likely to be long exposed to attack. The thick belt of a battleship is less likely to be overmatched, but the vessel is more likely to be kept in continuous close action ; con- sequently the belt of the cruiser might preferably be made harder than that of the battleship ; and though such a distinction has never been recognized, and may be re- garded as a refinement, it may have had influence, especially in retarding the adoption of nickel in medium armour, noticed hereafter The power of guns to destroy hard and soft armour is greatly affected by the fact that the former requires to be shattered, the latter perforated. So far as the shot holds together on impact, shattering depends on its striking energy, while perforation depends directly on the energy, but nearly inversely on the calibre of the shot and consequent size of hole to be made. Thus for many years a new type 6-inch and an old type 10-inch gun were on board the Nettle at Portsmouth. The energy of the latter was about double that of the former, and its shattering power was probably propor- tionately greater, i.e., about double ; but its velocity was less, and the perforating power of the two projectiles was nearly the same. Thus against Gruson's shields the old heavy gun would deliver far the heavier blow, while the new type light gun would perforate any ship's side that was open to the attack of the 10-inch

gun- As noticed above, British coast armour is made of wrought iron, and is consequently liable to some evils from which G-ruson's chilled iron is free ; that is to say, it is conceivable that it might be perforated, though it

is made thick enough to make this unlikely. Bolts might fly under a heavy blow, and injury might be done by these and other pieces of metal, or debris forming what is termed ” longridge.” On the other hand, the plate upon plate or sandwich system lends itself to futufe alterations and additions that are impossible with Gruson’s armour, which has finality stamped on it, and might become a trouble- some hindrance. Every preparation is, in fact, made for the addition of extra front plates to the armour on British coast forts, which can be removed, altered, or strengthened with the least conceivable labour. The best armour now made is intermediate between hard and soft, but generally yields by perforation more than fracture. Steel armour plates, although tried from time to time, long proved brittle, and gave little promise of success. In October 1876, however, was commenced at Spezia a series of trials which undoubtedly led to the immediate adoption of steel in one or another form by the principal Powers. In these trials targets representing the proposed belts of the Italian battleships DuUio and Dandolo (then under construction) were erected. All were made of the same thickness, i.e., nearly 22 inches of metal, but differed in the fact that iron and steel were used by different makers. These shields were attacked first by 10-inch, and subsequently by 17-72 inch (100-ton) guns. The lighter projectiles lodged harm- lessly in the soft iron, but produced serious cracks and fractures in the steel. On the other hand, the enormous 2000-flb projectiles of the 100-ton gun passed through the wrought-iron plates very easily, while the steel plates stopped them, though at the cost of their own complete destruction. The resisting power of steel was seen to be so disproportionate to that of iron that its adoption in some form was a mere question of time. In England the liability to fracture was thought so objectionable that great efforts were made to secure toughness in some form; and the Sheffield makers, Cammell and Brown, brought forward what are termed compound or hard-faced plates, each kind consisting of a hard steel face cemented to a

soft wrought-iron back or foundation. This armour pos- sessed the advantage of a harder face than ” all steel ” plates of that date, combined with a tenacious back, and was adopted and largely made on the Continent ; but long courses of competitive trials eventually proved that the ” all steel ” plates inade by Schneider, and subsequently by other

makers, were superior to the compound, mainly because the soft wroughtriron foundation gave insufficient support, though in one trial at Shoeburyness when fixed on granite a remarkable result was obtained.

In 1890 important competitive experiments in Russia and America brought out the value of two features of an entirely different character : first, a hard surface, and secondly, the ingredient nickel in steel. These are so important that they deserve to be dealt with separately.

The steel face of the compound plate was, as above noticed, harder than that of early " all steel," but this hardness was due to the employment of a front plate of harder steel throughout its mass than was deemed suitable for the foundation. Efforts were now made to impart excessive hardness to the a'ctual surface or skin of a plate by the application of water-jets on a system proposed by Captain Tresidder, who found that water thus projected against hot metal came in actual contact with it, and produced a degree of hardness which was prevented in ordinary plunging by the formation of steam. About the same time Harvey in America per- fected a process of carbonization applied to the front of armour plates. This could be extended to some inches in depth, and with it was associated an application of water to the face, but of a less perfect kind than on the Tresidder plan. It was found that a shot which would perforate a plate with an ordinary untreated face might be completely broken and defeated by a very hard skin. Successful resistance apparently depends on the fracture of the shot point or extreme tip on first contact. On the fracture of the tip, penetration becomes much more difficult, while the shot is still laterally unsupported, so that the latter may break outwards on the same prin- ciple as an arch may yield laterally under pressure applied to the centre. Palliser chilled shot indeed often broke on ordinary plates so completely that white radiating splashes were made by the minute particles flying across the plate face. At the date when Harvey and Tresidder plates came in steel projectiles had superseded those of chilled iron. These steel projectiles had tough bodies, with heads hardened by water or oil, and combined the penetration possessed by a hard point with considerable power to remain intact, so that steel shot would strike an ordinary steel plate at a fairly high velocity, penetrate to a considerable depth (perhaps more than a calibre), then bound back a long way towards

the firing point, and yet siiffer such inappreciable deformation or internal injury as to be capable of being repeatedly fired at armour, and of repeatedly behaving in the manner described.

On faces hardened by the Harvey and Tresidder pro- cesses, which soon became combined, excellent steel projectiles not only broke, but became so completely disintegrated at times that the white splash mentioned as characteristic of the defeat of chilled iron shot was seen ; and a very curious device has been adopted to enable the shot to hold together, namely, a wrought-iron or steel cap applied to the shot point. It had been discovered acci- dentally at Shoeburyness in 1877 that a chilled shot which was defeated by a certain compound shield would perfo- rate it when an additional plate of wrought-iron 2^ inches thick was added in front of the shield, the explanation being that the additional resistance afforded by this soft plate by no means compensated for the fact that the shot point entered easily, and was well supported and saved from fracture before it encountered the steel. Colonel

(tken Lieutenant) English suggested that a wrought-iron cap on the shot point might give the same result. This did not prove successful with compound plates, but when the experiment took place with very much harder, but necessarily thin, water-hardened skins in Russia in 1894, the same device of iron or steel caps was tried with success. Similar results have been obtained since in America and England, and it is probable that such caps may be used iu actual war. Mg. 6 (see Plate) shows the back of a plate of Beardmore's recently attacked. A capped shot point nearly bored its way through, opening the metal in a star-shaped tear at 7. Uncg,pped shot were set up, and acted as punches, partially dislodging discs of plate, as seen at 2, 3, and 5. Harveyed armour was adopted in Great Britain ia 1892.

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Fig. 10.

In 1890 a Schneider lO^inch steel plate, containing nickel, behaved well at Annapolis under the attack of 6-inch and 8-inch guns, exhibiting great toughness, and nickel was introduced soon afterwards in American armour. In England considerable delay took place, because nickel plate, till thoroughly understood, appeared to be capricious in its behaviour, and the supply of armour- was then being pressed forward to meet the demands arising from the increase in the British Navy. Nickel was, however, adopted in 1896. As above men- tioned, nickel used with judgment imparts toughness to armour without interfering with face hardening. _ Eig. 7 (see Plate) shows the .front of a good specimen 'of un- hardened 6-inch Krupp nickel plate after attack by 12, 15, and 17 cm. (4-7, 5-9, and 6-7 inch) guns. A fringed lip, characteristic of soft steel, rises up round each shot hole, but no cracking is visible ; the projectiles have rebounded from their holes owing to the elasticity of plate and shot. This plate is the hmu (dial of armour for inland forts. Krupp had manufactured armour for some little time, but first became known as the inventor ol a special process at the World's Eair in Chicago in

1893,' where he exhibited a plate which had borne very severe attack admirably. In 1895 a series of experi- ments took place with Krupp process armour, in which remarkable results were obtained, the most important being that shown ia Fig. 8 (see Plate), which depicts the front of a plate 11-8 inches thick after attack by three 12-inch projectiles. These have broken, leaving their heads lodged in the plate without cracking it. The highest striking velocity was 1993 feet per second. The shot weighed, 712-7 ft, and it would, have perforated an iron plate 26-9 inches thick. The remarkable feature is the scale on which this success was achieved; for while a 12-inch plate may resist perforation by a 12-uich shot nearly as well as a 6-inch plate resists -that of a 6-inch shot, the strain in the way of fracture greatly increases in the thicker plate, for the width of the thick plate is often not very much greater than that of the thin one. In these trials the 12-inch plate was about 6 feet wide, and the 6-inch nearly 5 feet, so that whUe the 6-inch shot head formed a wedge little more than one-tenth of the width of the plate attacked, the 12-inch plate was attacked with a wedge nearly one-sixth of its width. The figure indeed shows what enormous wedges are driven into the plate, and the excellence of metal bearing such a strain is apparent. At the end of 1896 the three great

SheflBeld armour-making firms. Brown," Cammell, and Vickers, pur- chased Krupp's process. Eig. 9 (see Plate) shows an ad- mirable 6-nich plate submitted by Victers for trial in March 1897. This entirely defeated the attack of six 6-inch projectiles striking with a velocity of about 1960 feet per second. AU the armour at present made for the feritish Navy is practically on the Krupp process, al- though modifications may be introduced by each firm based on their own experience. Messrs Beardmore in Scot- land have recently made armour by a process of their own, of about the same quality as Harveyed armour.

Excellent armour-piercing projectiles are made by Elswick on the American Wheeler Sterling patent, and Elswick and Eirth have made large deliveries of shot on Eirminy's patent. Many years ago Whitworth steel shot stood first in quality. Holtzer's subsequently became best known, and have been used so universally as to furnish a sort of standard of comparison. Ki'upp makes excellent projectiles, so does the firm of St Chamond. Carpenter shot in America are hardly in- ferior to those of Wheeler Sterling, or to a notable shot recently made by Johnson. The latter have probably obtained the greatest known penetration, but as they are generally made solid and fired with caps, comparison with others is difiBcult. In England Hadfields deserve special notice as having by special processes developed admirable projectiles, and especially as having made cast steel of a quality rivalling good forged steel. Lastly, the Eoyal Laboratory has also made excellent armour-piercing projectiles.

Before leaving the subject of the behaviour of armour under fire, one or two rough rules of thumb, which are based on calculation, may be given. The thickness of wrought iron which a projectile may perforate is about one calibre for each 1000 feet of striking velocity ; that is to say, a 6-inch shot with 2000 feet velocity may. perforate two calibres or 12 inches of iron, with 1500 feet it may perforate 9 inches, and so on. The equivalent thickness of the best steel plate now known is rather less than half that of wrought iron, so that a 6-inch shot will require something over 2000 feet velocity to perforate 6 inches of treated steel, while 1000 feet velocity will hardly carry it through 3 inches.

Attempts have been made to destroy armour by shells containing powder and high explosives, but hitherto it may be said that unless the projectile gets its head well

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intaihe plate before explosion takes place, the effect is small. Consequently only those shells whose calibre con- siderably exceeds the thickness of the armour attacked can be used with good effect, and the preponderance should be greater with high explosives than with powder. In consequence of the destructive effect of shells charged with melinite and other high explosives on stone or earthworks, armoured structures have been adopted for inland defences on the Continent. ‘ These

generally take the forms of cupolas and shielded mountings, which may be fixed, disappearing, or even portable. Fig. 10 shows a disappear- ing shielded mounting. The gun is protected by a' steel armoured curved roof A, fixed on a central pillar Bd and DE, on which the whole system revolves. The gun is shown in action, the weight being held up by a counter- weight Gr at the end of a lever Fh. The gun can be run back inside the port, and the roof lowered to rest flush with the " glacis glate " or " vorpanser " CH. When thus taken out of action the gun is hardly open to attack of any kind.

With regard to manufacture, the newest and most inter- esting processes depend on delicate methods of treatment, which are carefully kept secret, so that information of a general character only can be given. Wrought iron is formed from scrap worked into slabs, and piled and rolled in so many successive processes that an 8-inch plate was said to have been rolled out of a column nearly 100 feet high. Specially soft fibrous iron was used. It was considered not only that great power of drawing out, but of doing so easily was necessary, because some metal, which might draw out weU slowly, might tear in preiference under a blow. Steel has been used of all descriptions, from something closely resembling wrought iron to really hard metaJ. Molecular displacement occurs round the

point of impact, and metal becomes heaped up and heated, and cracking may take place many minutes after impact. In Fig. 7 may be noticed round each point of impact a concentric circle of lighter shade than the rest of the plate, which extends gradually, and has been likened to the swelling of a black eye. Badly-made plates have been known to break spontaneously, and steel shot have done the same. Compound armour was made by running molten steel on to a white hot foundation plate of rolled wrought iron on Wilson's process, or by attaching a thin steel face plate to a wrought-iron foundation by running molten steel in between them on Ellis's process. In the Harvey process the face is carbonized by contact with carbon at a high temperature, kept up for several days, the face being finally water-hardened. There is some difficulty in bringing such plates to the exact curve required for the ship's side, because face hardening causes contortion. It is possible to flatten a plate slightly by compressing the hard face, but not to bend it further by stretching it. Until

recently, armour under 5 inches thick could not be Harveyed, because contortion could not be controlled. In the Krupp process carbonization may be produced by the action of gas, but not necessarily so. Some of the stages of manufacture require much experience, so that great expense and waste of material are apt to be involved in first adopting the process, especially with thick plates. It is said that in this process metal is at times used which would be expected to prove brittle, but whidh, after being subjected to treatment that would be likely to render it still worse, is eventually made very tough. Up to the present it has probably owed some' of its qualities to the presence of nickel. It has been said that nickel would be dispensed with, but such reports have hitherto been 'con- tradicted, (c. O.-B.)

Armstrong, William George Armstrong,

Baron (1810-1900), British inventor and founder of the Elswick manufacturing works, was born on 26th November 1810, at Newcastle-on-Tyne, and was edu- cated at a school in Bishop Auckland. The profession which he adopted was that of a solicitor, and for a number of years he was engaged in active practice in Newcastle as a member of the firm of Donkin, Stable, & Armstrong. His sympathies, however, were always with mechanical and scientific pursuits, and several of his inventions date from a time anterior to his final abandonment of the law. In 1840 he published a paper on the electricity of effluent steam. This subject he was led to study by the experience of a colliery engineman, who noticed that he received a sharp shock on exposing one hand to a jet of steam issuing from a boiler with which his other hand was in contact, and the inquiry was followed by the invention of the " hydro-electric " m achine, a powerful generator of electricity, which was thought worthy of careful investigation by Faraday. The question of the utilization of water-power had engaged his atten- tion even earlier, and in 1838 he made his first contiribu- tion to hydraulic engineering by inventing a rotary water motor. Soon afterwards he designed a hydraulic crane, which contained the germ of all the hydraulic machinery for which he and Elswick were subsequently to become famous. This machine depended simply on the pressure of water acting directly in a cylinder on a piston, which was connected with suitable multiplying gear. In the first example, which was

erected on the quay at Newcastle in 1846, the necessary pressure was obtained, from the ordi- nary water mains of the town ; but the merits and advan-

tages of the device soon became widely appreciated, and a demand arose for the erection of cranes in positions where the pressure afforded by the mains was insufficient. Of course pressure could always be obtained by the aid of special reservoirs, but to build these was not always desir- able, or even practicable. The first way in which Arm- strong attempted to meet the difficulty was by the use of an air vessel, but this did not prove very satisfactory in the few cases in which it was tried. Hence, when in 1850 a hydraulic installation was required for a new ferry sta- tion at New Holland, on the Humber estuary, the absence of water mains of any kind, coupled with the prohibitive cost of a special reservoir owing to the character of the soil, impelled him to invent a fresh piece of apparatus, the " accumulator," which consists of a large cylinder con- taining a piston that can be loaded to give any desired pressure, the water being pumped in below it by a steam- engine or other prime mover. This simple device may be looked upon as the crown of the hydraulic system, since by its various modifications the installation of hydraulic power became possible in almost any situation. In par- ticular, it was rendered practicable on board ship, and its application to the manipulation of heavy naval guns and other purposes on warships was not the least important of Armstrong's achievements.

The Elswick works were originally founded for the manufacture of this hydraulic machinery, biit it was not long before they became the birthplace of a revolution in gunmaking; indeed, could nothing more be placed to Armstrong's credit than their establishment, his name would still be worthy of remembrance, for they have con- tributed enormously to the progress of the world in the

aliechanical arts, both of war and of peace. Modern artillery d&,tes from about 1856, when Armstrong's first gun made its appearance. Of this weapon it may be af&rmed that it embodied all the essential features which distinguish the ordnance of to-day from the cannon of the Middle Ages — ^it was built up of rings of metal shrunk upon an inner steel barrel ; it was loaded at the breech ; it was rifled ; and it threw, not a round ball, but an elongated projectile with ogival head. Big guns, as Armstrong found them, were really nothing more than blocks of metal bored with a circular hole, their makers generally working on the assumption that their strength was proportionate to the thickness of the walls of the tube. But he saw that the greatest resistance to bursting was not to be obtained from a given weight of metal in this fashion, since the inner portions of the material composing a cylinder, which is subjected to high internal pressure, may be strained be- yond the bursting-point before the outer ones have reached it. Hence he adopted the "shrinkage" principle of construction. Starting with a steel tube to form the barrel, he made a . homogeneous cylindrical jacket by winding a bar of wrought-iron round a mandril slightly smaller than the barrel, and welding the turns together. This, when cold, was naturally too small to pass over the barrel ; it could, however, be slipped on if expanded by heat, and, if it were then allowed to cool, its contraction brought about a condition of compression in the metal forming the inner layers of the gun, together with one of tension in those composing the outer ones, which theory indicated would offer the most advantageous disposition of metal as regards resistance to bursting. The guns which Armstrong constructed on this principle yielded such excellent results, both in range and accuracy, that they were adopted by the British Government in 1859, ho himself being appointed Engineer of Eifled Ordnance and receiving the honour of knighthood. Great Britain thus originated a principle of gun construction which has since been imiversally followed, and obtained an armament superior to that possessed by any other country at that time. But while there was no doubt as to the shooting capacities of these guns, defects in the breech mechanism soon became equally patent, and in a few years caused a reversion to muzzle-loading. Armstrong resigned his position in 1863, and for seventeen years the Government's expert advisers remained faithful to the older method of loading, refusing to see the improvements which experi- ment and research at Elswick and

elsewhere had during that period produced in the mechanism and performance of heavy guns. But at last Armstrong's results became too good to be ignored ; and the official eye being no longer able to blink the fact that his long breech-loaders pos- sessed advantages unobtainable with the obsolete type of muzzle-loaders, breech-loading guns were received back into the service in 1880. It should be mentioned that the use of steel wire for the construction of guns was also one of Armstrong's early ideas. He perceived that to coil many turns of thin wire round an inner barrel was a logical extension of the large hooped method already mentioned, and in conjunction with Brunei, the engineer, was preparing to put the plan to practical test when the discovery that it had already been patented caused him to abandon his intention for many years. This incident well illustrates the ground of his objection to the British system of patent law, which he looked upon as calculated to stifle invention and impede progress ; the patentees in this case did not manage to make a practical success of their invention themselves, but the existence of prior patents was sufficient to turn him aside from a path which conducted him to valuable results, when after- wards, owing to the expiry of those patents, he was free tp, pursue it as he pleased.

Lord Armstrong, who was raised to the peerage in 1887, was the author of A Visit to Egypt (1873) and Electric Movement in Air and Water (1897), besides many professional papers. He died on 27th December 1900, at Eothbury, Northumberland. (h. m. r.)

Arnhem, the chief town of the province of Gelder- land, Netherlands, 9 miles N. by E. of Nimeguen. Popu- lation, 31,626 in 1870, 66,812 in 1900. This increase is due to the beautiful situation of the town on the slope of the Veluwe Hills, its proximity to the fertile Betuwe district, the meeting of the Ehine and Ysel near the town, and its flourishing markets and shipping. A new Eoman Catholic Church was founded in 1894; in 1880 a building to contain the archives was erected, and in 1893 an hospital. The large assembly hall {Musis Sacrum) was rebuilt in 1889, and the gasworks in 1892-3. A wharf for building and restoring iron steamers was con- structed on the Ehine in 1889.

Arnim, Harry Karl Kurt Eduard von, Count (1824-1881), German diplomatist, was a member of one of the most numerous and most widely spread families of the Prussian nobility. . He was born in Pomerania on the 3rd of October 1824, and brought up by his uncle Henry von Arnim, who was Prussian ambassador at Paris and foreign minister from March to June 1848, while Count Arnim of Boytzenburg, whose daughter Harry von Arnim afterwards married, was minister- president. It is noticeable that the uncle was brought before a court of justice and fined for publishing a pamphlet directed against the ministry of Manteuffel. After holding other posts in the diplomatic service Arnim was in 1864 appointed Prussian envoy, and in 1867 envoy of the North German Confederation at the Papal Court. In 1869 he proposed that the Governments should appoint representatives to be present at the Vatican Congress, a suggestion which was rejected by Bismarck, and foretold that the promulgation of papal infallibility would bring serious political difficulties. After the recall of the French troops from- Eome he attempted unsuccess- fully to mediate between the pope and the Italian Govern- ment. He was appointed in 1871 German commissioner to arrange the final treaty with Prance, a task which he carried out with such success that in 1871 he was ap- pointed German envoy at Paris, and in 1872 received his definite appointment as ambassador, a post of the greatest difficulty and responsibility. Differences soon arose be- tween him and Bismarck; he wished ^to support the Monarchical party which was trying to overthrow Thiers, while Bismarck ordered him to stand aloof from all French parties ; he did not give that implicit obedi- ence to his. instructions which Bismarck required. Bismarck, however, was unable to recall him because of the great influence which he enjoyed at court and the confidence which the emperor placed in him. He was looked upon by the Conservative party, who were trying to overthrow Bismarck, as his successor, and it is said that he was closely connected with the court intrigues against the chancellor. In the beginning of 1874 he was recalled and appointed to the embassy at Constantinople, but this appointment was immediately revoked. A Vienna newspaper published some correspondence on the Vatican council, including confidential despatches of Arnim's, with the object of showing that he had shown greater foresight than Bismarck. It was theA found that a considerable number of papers were missing from the Paris embassy, and on 4th October Arnim

was arrested on the charge of embezzling state papers. This recourse to the criminal law against a man of ,his rank, who had held one of the most important diplomatic posts, caused great astonishment. His defence was that the

papers, were not official, and he was acquitted on the charge of embezzlement but convicted of undue delay in restoring official papers and condemned to three months' imprison- ment. On appeal the sentence was increased to nine months. Arnim avoided imprisonment by leaving the country, and in 1875 published anonymously a pamphlet entitled "Pro Nihilo," in which he attempted to show that the attack on him was caused by Bismarck's personal jealousy. For this he was accused of treason, insult to the emperor, and libelling Bismarck, and in his absence condemned to five years' penal servitude. From his exile in Austria he published two more pamphlets on the ecclesiastical policy of Prussia, " Der Nuntius Kommt " and " Quid faciamus nos ? " He made repeated attempts, which were supported by his family, to be allowed to return to Germany in order to take his trial afresh on the charge of treason; his request had just been granted when he died on the 19th of May 1881.

In 1876 Bismarck carried an amendment to the criminal code making it an offence punishable with imprisonment or a fine up to £250 for an official of tibe Foreign Office to communicate to others official documents, or for an envoy to act contrary to his instructions. These clauses are commonly spoken of in Germany as the "Arnim paragraphs." (j. w. he.)

Arnold, Sir Edwin (1832-), British poet,

orientalist, and man of letters, was born on 10th June 1832 and educated at King's College, London, and University College, Oxford, where in 1852 he gained the Newdigate prize for a poem on Belshazzar's Feast. He spent some years in India as principal of the Government Sanscrit College, Poena, and upon his return in 1861 became connected with the Daily

Telegraph newspaper, upon whose editorial staff he has ever since held an important position. He is nevertheless best known for his travels in India and Japan, and his endeavours to introduce Eastern thought to Europeans by a succession of works in prose and verse on Oriental subjects, both origiQal and translated. The best known of these, The lAghtof Asia, an epical poem on the life and teaching of Buddha, entirely derived from native soiu-ces, has gone through more than sixty English and eighty American editions since its first publication in 1879. His other principal volumes of poetry are With Sa'di in the Garden, The Light of the World, Potiphar's Wife, Adzuma. In 1877, on the proclamation of Queen Victoria as Empress of India, the Companionship of the Star of India was conferred upon him ; and in 1888 he was created K.C.I.E.

Arnold, Matthew (1822-1888), English poet, liter- ary critic, and inspector of schools, was born at Laleham, near Staines, 24th December 1822. When it is said that he was the son of the famous Dr Arnold of Rugby, and that Winchester, Eugby, and Balliol College, Oxford, contributed their best towards his education, it seems superfluous to add that, in estimating Matthew Arnold and his work, training no less than original endowment has to be considered. A full academic training has its disadvantages as well as its gains. In the individual no less than in the species the history of man's development is the history of the struggle between the impulse to express original personal force and the impulse to make that force bow to the authority of custom. Where in any individual the first of these impulses is stronger than usual, a bomplete academic training is a gain ; but- where the second of these impulses is the dominant one, the effect of the academic habit upon the mind at its most sensitive and most plastic period is apt to be crippling. In regard to Matthew Arnold, it would be a bold critic of his life and his writings who should attempt to say what

his work would have been if his training had been different. In his judgments on Goethe, Wordsworth, Byron, Shelley, and Hugo, it may be seen how strong was his impulse to bow to authority. On the other hand, in Arnold's ingenious reasoning away the conception of Providence to "a stream of tendency not ourselves which makes for righteousness," we see

how strong was his natural impulse for taking original views. The fact that the very air Arnold breathed during the whole of the impressionable period of his life was academic is therefore a very im- portant fact to bear in mind.

In one of his own most charming critical essays he con- trasts the poetry of Homer, which consists of " natural thoughts in natural words," with the poetry of Tennyson, which consists of " distilled thoughts in distUled words."

Matthew Aenold. {From a pJu>iograp/i by EUioU and Fry, London.) '

" Distilled " is one of the happiest words to be found in poetical criticism, and it may be used with equal aptitude in the criticism of life. To most people the waters of life come with all their natural qualities — sweet or bitter — undistilled. Only the ordinary conditions of civilization, common to all, flavoured the waters of life to Shakespeare, to Cervantes, to Bums, to Scott, to- Dumas, and those other great creators whose minds were mirrors-^broad and clear — fof reflecting the rich drama of life around them. To Arnold the waters of life came distilled So care- fully that the wonder is that he had any originality left. A member of the upper stratum of that " middle class " which he despised, or pretended to despise — the eldest son of one of the mb'st a,ccopiplished as well as one of the most noble-tempered nlen of his time — Arnold from th moment of his birth drank the finest distilled waters that can be drunk even in these days. Perhaps, on the whole, the surprising thing is how little he suffered thereby. Indeed, those who had formed an idea of Arnold's personality from their knowledge of his "culture," and especially those who had been delighted by the fastidious and feminine delicacy of his prose style, used to be quite bewildered when for the first time they met him at a dinner-table or in a friend's smoking-room. His prose was so self-conscious that what people expected to find in the writer was the Arnold as he was conceived by certain " young lions " of journalism whom he Satirized — a some- what over-cultured peiJi-maMre — almost, indeed, a coxcomb of letters. On the other hand, those who had been

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captured by his poetry expected to find a man whose sensitive or^jiism re&ponded nervously to every uttered -word as an ^Eolian harp answers to the faintest breeze. What they found was a broad-shouldered, manly — almost burly — Englisjiman with a fine countenance, bronzed by the open air of England, wrinkled apparently by the sun, wind-worn as an English skipper's, open and frank as a fox-hunting squire's — and yet a countenance whose finely chiselled features were as high-bred and as com- manding as Wellington's or Sir Charles Napier's. The voice they heard was deep-toned, fearless, rich, and frank, and yet modulated to express every nuance of thought, every movement of emotion and humour. In his prose essays the humour he showed was of a some- what thin-lipped kind ; in his more important poems he showed none at all. It was here, in this matter of humour, that Arnold's writings were specially mislead- ing as to the personality of the man. Judged from his poems, it was not with a poet like the writer of " The Northern Earmer," or a poet like the writer of "Ned Bratts," that any student of poetry would have dreamed of classing him. Such a student would actually have been more likely to class him with two of his contem- poraries between whom and himself there were but few points in common, the " humourless " William Morris and the " humourless " Eossetti. Eor, singularly enough, between him and them there was this one point of re- semblance: while all three were richly endowed with humour, while'all three were the very lights of the sets in which they moved, the njoment they took pen in hand to write poetry they became sad. It would almost seem as if, like Eossetti, Arnold actually held that poetry was not the proper medium for humour. No wonder, then, if the ab- sence of humour in his poetry did much to mislead the student of his work as to the real character of the man.

After a year at Winchester, Matthew Arnold entered Eugby School in 1837. He early began to write and print verses. His first publication was a Eugby prize poem, Alaric at Borne, in 1840. This was followed in 1843, after he had gone up to ' Oxford in 1840 as a scholar of Balliol, by his poem Cromwell, which won the Newdigate prize. In 1844 he graduated with second- class honours, and in 1845 was elected a fellow of Oriel College, where among his colleagues was A. H. Clough, his friendship with whom is commemorated in that exquisite elegy Thyrsis. Erom 1847

to 1851 he acted as private secretary to Lord Lansdowne; and in the latter year, after acting for a short time as assistant- master at Eugby, he was appointed to an Inspectorship of Schools, a post which he retained until two years before his death-. He married, in June 1851, the daughter of Mr Justice Wightman. Meanwhile, in 1848, appeared Tlie Strayed Eeveller, and other Poems, by A, a volume which gained a considerable esoteric reputation. -In 1852 he published another volume under the same initial, Empedodes on Etna — as undramatic a poem, perhaps, as was ever written in dramatic form, but studded with lyrical beauties of a very high order. Other poems accompanied this. In 1853 Arnold published a volume under his own name. This consisted partially of poems selected from the two previous volumes. A second series of poems was published in 1855. So great was the impression made by these in academic circles that in 1857 Arnold was elected professor of poetry at Oxford, and he held the chair for ten years. In 1858 he published his classical tragedy, Merope. Nine years afterwards his New Poems were published. While he held the Oxford professorship he publjshed several series of lectures, which gave him a high place as a scholar and critic. The essays On Translating Homer, published in 1861, and On the Study of Celtic' Literature, published in 1867, were full of subtle and brilliant

if not of profound criticism. So were the two series of Essays in Criticism, the first of which appeared in 1865, and the second, edited by Lord Coleridge, in 1888. His poetic activity almost ceased after he left the chair of poetry at Oxford. He was several times sent by Gov- ernment to make inquiries into the state of education in Erance, Germany, Holland, and other countries ; and his reports, with their thorough-going and searching criticism of Continental methods, as contrasted with English methods, showed how conscientiously he had devoted some of his best energies to the work.^ In 1883

1 The followmg appreciation of Arnold's educational work is kindly contributed by Sir Joshua Fitch, one of his colleagues in the Education Office :—

The fame of Matthew Arnold as a poet and a literary critic has some- what overshadowed the fact that he was during thirty-five years of his life

— ^from 1851 to 1886 — employed in the Education Department as one of H.M. Inspectors of Schools. His literary work was achieved in such intervals of leisure as could be spared from the public service. At the time of his appointment the Government, by arrangement with the religious bodies, entrusted the inspection of schools connected with the Church of England to clergymen, and agreed also to send Roman Catholic inspectors to schools managed by members of that communion. Other schools — ^those of the British and Foreign Society, the Wesleyans, and undenominational schools generally — were inspected by laymen, of whom Arnold was one. There were only three or four of these officers at first, and their districts were necessarily large. It is to the experi- ence gained in intercourse with Nonconformist school managers that we may attribute the curiously intimate knowledge of religious sects which furnished the material for some of his keen though good-hum- oured sarcasms. The Education Act of 1870, which simplified the ad- ministrative system, abolished denominational inspection, and thus greatly reduced the area assigned to a single inspector. Arnold took charge of the district of Westminster, and remained in that office until his resignation, taking also an occasional share in the inspection of training colleges for teachers, and in conferences at the central office. His letters, passim, show that some of the routine which devolved upon him was distasteful, and that he was glad to entrust to a skilled as- sistant much of the duty of individual examination and the making up of schedules and returns. . But the influence he exerted on schools, on the Department, and on the primary education of the whole country, > was indirectly tar greater' than is generally supposed. His annual reports, of which more than twenty were collected into a volume by his friend and official chief. Sir Francis (afterwards Lord) Sandford, attracted, by reason of their freshness of style and thought, much more of public attention than is usually accorded to Blue-book litera- ture; and his high aims, and his sympathetic appreciation of the efforts and difficulties of the teachers, had a remarkable effect in raising the tone of elementary education, and in indicating the way to improvement. In particular, he insisted on the formative elements of school education, on literature and the " humanities," as distinguished from the collection of scraps of information and " useful knowledge " ; and he sought to impress all the young teachers with the necessity of broader mental cultivation than was

absolutely required to obtain the Government certificate. In his reports also he dwelt often and forcibly on the place which the study of the Bible, not the distinctive formularies of the churches, ought to hold in English schools. He urged that besides the religious and moral purpose of Scriptural teach- ing, it had a literary value of its own, and was the best instrument in the hands even of the elementary teacher for uplifting the soul and refining and enlarging the thoughts of young children.

On three occasions Arnold was asked to assist the Government by making special inquiries into the state of education in foreign coun- tries. These duties were especially welcome to him, serving as they did as a relief from the monotony of school inspection at home, and as opportunities for taking a wider survey of the whole subject of edu- cation, and for expressing his views on principles and national aims as well as administrative details. In 1859 he prepared for the Duke of Newcastle's Commission a report which was afterwards reprinted in a volume entitled Popular Education in France, with Notes of that of Holland and Switzerland. In 1895 he was again employed as assistant- commissioner by the Schools Inquiry Commission under Lord Taunton ; and his report on this subject was subsequently reprinted under the title Schools and Universities on the Continent. Twenty years later he was sent by the Education Department to make special inquiries on certain specified points — e.g. free education, the status and training of teachers, and compulsory attendance at schools. The result of this investigation appeared as a parliamentary paper in 1886. He also contributed the chapter on ," Schools " to the second volume of Mr Humphry Ward's Reign of Queen Victoria.

AH these reports form substantial contributions to the history and literature of education in the Victorian age. They have been quoted

a pension of £250 was, conferred on him in recognition of his literary merits. In the same year he went to the United States on a lecturing tour, and again in 1886, his subj ects being " Emerson " and the " Principles

and Value of Nunibers." The success of these lectures, though they were admirable in matter and form, was marred by the lecturer's lack of experience in delivery. It is sufiBcient, further, to say that Culture and Anarchy appeared in 1869 ; St Paul and Protestantism, 1870; Friendship's Garland, 1871; Literature and Dogma, 1873 ; God and the Bible, 1875 ; Last Essays on OJiurch and Bebellion, 1877 ; Mixed Essays, 1879; Irish Essays, 1882; and Discourses on America, 1885. Such essays as the first of these, embodying as they did Arnold's views of theological and polemical subjects, attracted much attention at the time of their publication, owing to the state of the intellectual atmo- sphere at the moment; but it is doubtful, perhaps, whether they will be greatly considered in the near future. Many severe things have been said, and will be said, concerning the inadequacy of poets like Coleridge and Wordsworth when confronting subjects of a theo- logical or philosophical kind. Wordsworth's High Church Pantheism and Coleridge's disquisitions on the Logos seem farther removed from the speculations of to-day than do the dreams' of Lucretius. But these two great writers lived before the days of modern science. Arnold, living only a few years later, came at a transition period when the winds of tyrannous knowledge had blown off the protecting roof that had covered the centuries before, but when time and much labour were needed to build another roof of new materials — a period when it was impossible for the poet to enjoy either the quietism of High Church Pantheism in which Wordsworth had basked, or the sheltering protection of German meta- physics under which Coleridge had preached — a period, nevertheless, when the wonderful revelations of science were still too raw, too cold and hard, to satisfy the yearnings of the poetic soul. Objectionable as Arnold's rationalizing criticism was to contemporary orthodoxy, and questionable as was his equipment in point of theo- logical learning, his spirituality of outlook and ethical purpose were not to be denied. Yet it is not Arnold's views that have become current coin so much as his liter- ary phrases — his craving for " culture " and " sweetness and light," his contempt for " the dissidence of Dissent and the Protestantism of the Protestant religion," his " stream of tendency not ourselves making for righteous- ness," his classification of " Philistines and barbarians " — and so forth. His death, at Liverpool, of heart failure, 15th April 1888, was suddpn and quite unexpected.

Arnold was a prominent figure in that great galaxy of Victorian poets who were working simultaneously — Tenny- son, Browning, Rossetti, William Morris and Mr Swin- burne-^poets between whom there was at least this con- necting link, that the quest of all of them was the old- fashioned poetical quest of the beautiful. Beauty was their watchword, as it had been the watchword of their

often, and have exercised marked influence on subsequent changes and controversies. One great purpose underlies them all. It is to bring home to the English people a conviction that education ought to be a national concern, that it should not be left entirely to local, or private, or irresponsible initiative, that the watchful jealousy so long shown by Liberals, and especially by Nonconformists, in regard to State action was a grave practical mistake, and that in an enlight- ened democracy, animated by a progressive sjpirit and noble and generous ideals, it was the part of wisdom to invoke the collective power of the State to give effect to those ideals. To this theme he constantly recurred in his essays, articles, and official reports. "Porro unum est neeessarium. One thing is needful ; organize your secondary education." This is an object not yet fully attained; but the influ- ence of his stimulating appeals to the intelligence and conscience of his countrymen, and the practical value of many of his detailed sug- gestions, are likely to be more and more fully recognized.

immediate predecessors — ^Wordsworth, Coleridge, Keats, Shelley, and Byron. That this group of early 19th century poets might be divided into two — those whose primary quest was physical beauty, and those whose pri- mary quest was moral beauty — is no doubt true. Still, in so far as beauty was their quest they were all akin. And so with the Victorian group to which Arnold belonged. As to the position which he takes among them opinions must necessarily vary. On the whole, our opin- ion is that his place in the group will be below all the others. The question as to whether he was primarily a poet or a prosateur has been often asked. If we were to try to answer that question here, we should have to examiae his poetry in detail — we should have to inquire whether his primary impulse of expression was to seize upon the innate suggestive power of words," or whether his primary impulse was to rely upon the logical power of the sentence. In nobility of temper, in clearness of state- ment, and especially

in descriptive power, he is beyond praise. But intellect, judgment, culture, and study of great poets may do much towards enabling a prose-writer to write what must needs be called good poetry. What they cannot enable him to do is to produce those magical effects which poets of the rarer kind can achieve by seizing that mysterious, suggestive power of words which is far beyond all mere statement. Notwithstanding the exquisite work that Arnold has left behind him, some critics have come to the conclusion that his primary impulse in expres- sion was that of the poetically-minded prosateur rather than that of the born poet. And this has been said by some who nevertheless deeply admire poems like "The Scholar Gypsy," "Thyrsis," "The Forsaken Merman," « Dover Beach," "Heine's Gra,ve," "Eugby Chapel," " The Grande Chartreuse," " Sohrab and Eustum," " The Sick King iu Bokhara," " Tristram and Iseult," &c. We need not go nearly so far as that. But it would seem that a man may show all the endowments of a poet save one, and that one the most essential — the instinctive mastery over metrical effects.

In all literary expression there are two kinds of em- phasis, the emphasis of sound and the emphasis of sense. Indeed the difference between those who have and those who have not the true rhythmic instinct is that, while the former have the innate faculty of making the emphasis of sound and the emphasis of sense meet and strengthen each other, the latter are without that faculty. But so imper- fect is the human mind that it can rarely apprehend or grasp simultaneously these two kinds of emphasis. While to the born prosateur the emphasis of sense comes first, and refuses to be more than partially conditioned by the em- phasis of sound, to the born poet the emphasis of sound comes first, and sometimes will, even as in the case of Shelley, revolt against the tyranny of the emphasis of sense. Perhaps the very origin of the old quantitative metres was the desire to make these two kinds of emphasis meet in the same syllable. In manipulating their quantita- tive metrical system the Greeks had facilities for bring- ing one kind of emphasis into harmony with the other such as are unknown to writers in accentuated metres. This accounts for the measureless superiority of Greek poetry in verbal melody as well as in general harmonic scheme to all the poetry of the modem world. In writers so diverse in many ways as Homer, .^schylus, Sophocles, Pindar, Sappho, the harmony between the emphasis of sound and the emphasis of sense is

so complete that each of these kinds of emphasis seems always begetting, yet always born of the other. When in Europe the quantita- tive measures were superseded by the accentuated measures a reminiscence was naturally and inevitably left behind of the old system ; and the result has been, in the English

language at least, that no really great line can be written in ~~which the emphasis of accent, the emphasis of quantity, and the emphasis of sense,, do not meet on the same syllable. Whenever this junction does not take place the weaker line, or lines, are always introduced, not for make~~ shift purposes, but for variety, as in the finest lines of Milton and Wordsworth. Wordsworth no doubt seems to have had a theory that the accent of certain words, such as _" without," "within," &c., could be disturbed in an iambic line ; but in his best work he does not act upon his theory, and endeavours most successfully to make the emphasis of accent, of quantity, and"" of sense meet. It might not be well for a poem to contain an entire sequence of such perfect lines as

or

"I tjiought of Chatterton, the marvellous boy,' " Thy soul was like a star and dwelt apart,"

for then the metricist's art would declare itself too loudly and weaken the imaginative strength of the picture. But such lines should no doubt form the basis of the poem, and weaker lines — Klines in which there is no such com- bination of the three kinds of emphasis — should be sparingly used, and never used for make-shift purposes. Now, neither by instinct nor by critical study was Arnold ever able to apprehend this law of prosody. If he does write a line of the first order, metrically speaking, he seems to do so by accident. Such weak lines as these are constantly occurring —

" The poet, to whose raighty heart Heaven doth a quicker pulse impart. Subdues that energy to scan Not his own course, but that of man."

Much has been said about what is called' the " Greek temper " of Matthew Arnold's muse. A good deal depends upon what is meant by the Hellenic spirit. But if the Greek temper expresses itself, as is generally supposed, in the sweet acceptance and melodious utterance of the beauty of the world as it is, accepting that beauty without inquiring as to what it means and as to whither it goes, it is diflScult to see^here in Arnold's poetry this temper declares itself. Surely it is not in Empedocles on Etna, and surely it is not in Merope. If there is a poem of his in which one would expect to find the joyous acceptance of life apart from questionings about the civilization in which the poet finds himself environed (its hopes, its fears, its aspirations, and its failures) — such questionings, in short, as were for ever vexing Arnold's soul — it would be in " The Scholar Gypsy," a poem in which the poet tries to throw himself into the mood of a "Romany Rye." The great attraction of the gypsies to Englishmen of a certain temperament is that they alone seem to feel the joyous acceptance of life which is supposed to be specially Greek. Hence it would have been but reason- able to look, if anywhere, for the expression of Arnold's' Greek temper in a poem which sets out to describe the feelings of the student who, according to Glanville's story, left Oxford to wander over England with the Romanies. But instead of this we get the old fretting about the unsatisf actoriness of modern civilization. Glanville's Ox- ford student, whose story is glanced at now and again in the poem, flits about in the scenery like a cloud-shadow on the grass ; but the way in which Arnold contrives to avoid giving us the faintest idea either dramatic or pictorial of the student about whom he talks so much, and about the gypsies with whom the student lived, is one of the most singular feats in poetry. The reflections which come to a young Oxonian lying on the grass and longing to escape life's fitful fever without shuffling off this mortal coil are, no doubt, beautiful reflections beautifully ex- pressed, but the temper .they show is the very opposite of

the Greek. To say this is not in the least to disparage Arnold. " A man is more like the age in which he lives," says the Chinese aphorism, " than he is like his own father and mother," and Arnold's polemical writings

alone are sufficient to show that the waters of life he drank were from fountains distilled, seven times distilled, at the topmost slope of 19th-century civilization. Mr George Meredith's " Old Chartist " exhibits far more of the temper of acceptance than does any poem by Matthew Arnold.

His most famous critical dictum is that poetry is a "criticism of life." What he seems to have meant is that poetry is the cifowning fruit of a criticism of life ; that just^as the poet's metrical effects are and must be the result of a thousand semi-conscious generalizations upon the laws of cause and effect in metric art, so the beautiful things he says\ about life and the beautiful pictures he paints of life are the result of his generalizations upon life as he passes through it, and consequently that the^ value of his poetry consists in the beauty and the truth of his generalizations. But this is saying no more than is said in the line —

" Eien n'est beau que le vrai ; le vrai seul est almable" —

or in the still more famous lines —

" ' Beauty is truth, truth beauty,' — that is all Ye know on earth, and all ye need to know."

To suppose, that Arnold confounded the poet with the writer of pensees would be absurd. Yet, having decided that poetry consists of generalizations on human life, in readin:g poetry he kept on the watch for those generaliza- tions, and at last seemed to think that. the less and not the more they are hidden behind the dramatic action, and the more unmistakably they are intruded as generaliza- tions, the better. For instance, in one of his essays he quotes those lines from the "Chanson de Roland" of Turoldus, where Roland, mortally wounded, lays himself down under a pine-tree with his face turned towards Spain and the enemy, and begins to " call many things to re- membrance ; all the lands which his valour conquered, and pleasant France, a,nd the men of his lineage, and Charlemagne, his liege lord, who nourished him " —

"De plusurs choses Si remembrer If prist, De tantes teres cume li bers cunquist, De dulce France, des humes de sun ligu, De Carlemagne sun

seignor ki I'nurrit."

" That," says Arnold, " is primitive work, I repeat, with an undeniable poetic quality of its own. It deserves much praise, and such praise is sufflcienj; for it." Then he contrasts it with a famous passage in Homer — ^that same passage which has been quoted in the Encyclopcedia Britannica (see Art. Poetey, vol. xix.) for the very opposite purpose to that of Arnold's — quoted indeed to show how the epic poet, leaving the dramatic action to act as chorus, weakens the dTrarij of the picture — the passage in the Iliad (iii. 243-4) where the poet, after Helen's pathetic mention of her brother's comments on the causes of their absence, " criticizes life " and gener- alizes upon the impotence of human intelligence, the ' impotence even of human love, to pierce the darkness in which the web of human fate is "woven. He appends Dr Hawtrey's translation : —

fis 0(iro • Tois S' ijdri Kdrfx^" 0ucr£{loos ata iv AaKedalfMvi aiOi, l\ri iv irarpldi 70(5.

" So said she ; they long since in Earth's soft arms were reposing There, in their own dear land, their fatherland, Lacedsemon."

" We are here," says Arnold, " in another world, another order of poetry altogether; here is rightly due such supreme praise as that which M. Vitel gives to the Chanson de Boland. If our words are to have any

meaning, if our judgments are to have any solidity, we must not heap that supreme praise upon poetry of an order immeasurably inferior." He does not see that the two passages cannot properly be compared at all. In the one case the poet gives us a dramatic picture ; in the other, a comment on a dramatic picture.

Perhaps, indeed, the place Arnold held and still holds as a critic is due more to his exquisite felicity in express- ing his views than to the

penetration of his criticism. Nothing can exceed the easy grace of his prose at the best. It is conversational and yet absolutely exact in the structure of the sentences ; and in spite of every vagary, his distinguishing note is urbanity. Keen-edged as his satire could be, his writing for the most part is as urbane as Addison's own. His influence on contemporary criticism and contemporary ideals was considerable, and generally wholesome. His insistence on the necessity of looking at "the thing in itself," and the need for acquainting oneself with " the best that has been thought and said in the world," gave a new stimulus alike to originality and industry in criticism ; and in his own selection of subjects — such as Jouhert, or the de Cruerins — he opened a new world to a larger class of the better sort of readers, exercising in this respect an awakening influence in his own time akin to that of Walter Pater a few years afterwards. The comparison with Pater might indeed be pressed further, and yet too far. Both were essentially products of Oxford. But Arnold, whose description of that " home of lost causes, and forsaken beliefs, and unpopular names, and impossible loyalties," is in itself almost a poem, had a classical austerity in Jlis style that savoured more inti- mately of Oxford tradition, and an ethical earnestness even in his most flippant moments which kept him notar bly aloof from the more sensuous school of aesthetics.

(t. w.-d.)

Arnstadt, a town and watering-place of Germany, in the principality of Schwarzburg-Sondershausen, 14 miles by rail S.S. W. from Erfurt, on the river Gera. The church of Our Lady was restored in 1884-86. Its manufactures embrace gloves, shoes, iron safes, confectionery, and especially beer and market-gardening. Arnstadt possesses an industrial school, and is much frequented in summer for its saline and other baths. It dates back to the 8th century. Population (1885), 11,537 ; (1895),

13,595.

Arques, a town and railway station, arrondissement of St Omer, department of Pas-de-Calais, France, 37 miles in direct line N.W. of Arras. Near Arques, on the Canal de Neuffosses, is the Ascenseur des Fontinettes, a great hydraulic lift, completed in 1888, by which canal

boats are enabled to avoid the series of locks constructed on the slope of the Fontinettes hill, to connect the Neuffosses with the Aa, at a difference of level, of about 40 feet. Population, (1881), 2105; (1891), 1972; (1896), 2216, (comm.) 4365.

Arrah, a town of British India, headquarters of Shahabad district, in the Patna division of Bengal, situated on a navigable canal connecting the river Sone with the Ganges. It is a station on the East Indian railway, 368 miles from Calcutta. In 1891 the popular tion was 46,905. It has a high school with over 400 pupils. Arrah is famous for an incident in the Mutiny, when a dozen Englishmen, with 50 Sikhs, defended an ordinary house against an army of many thousand insurgents. A British regiment, despatched to their assistance from Dinapur, was disastrously repulsed ; but they were ultimately relieved, after eight days' continu- ous fighting, by a small force under Major (Sir Vincent) Eyre.

Arran, an island of Buteshire, Scotland, situated in the Firth of Clyde. The area is 165 square miles. Agriculture and the entertainment of summer visitors are the principal industries, and herrings, haddocks, whitjngs, and lobsters are fished ; in 1898 there were 39 boats in the island, manned by seventy-three fishermen, and the value of the catch was £1220. There is an extensive steamer service connecting with the Caledonian and Glasgow and South-Western railways. Many improve- ments have been carried out in the principal villages, and Lamlash, in particular, has been largely extended. Popu- lation (1901), 4779.

Arras, chief town of department Pas-de-Calais, France, 109 miles N.N.E. of Paris, on railway from Paris to Dunkirk and Boulogne. Amongst public buildings to be noted are the restored Hotel de Ville, the HSpital'St Jean, and the railway station. The last-named stands at one end of a fine thoroughfare, in the new quarter formed since the demolition of the fortifications. There are new boulevards, and statues of Vauban and of the Abbe Halluin (d. 1895). The manufacture of oils, especially poppy oil, and artistic and other metallurgical work, are now the leading industries, while textile manufactures are represented chiefly by hosiery. Population (1876), 21,689, (comm.) 21,689; (1886), 21,492; (1896), 20,599, (comm.) 21,086; (1901), 25,813.

A r rasa. See Ebitbea.

Art Galleries. — An art gallery epitomizes so many phases of human thought and imagination that it connotes much more than a mere collection of paintings. In its technical and aesthetic aspect the gallery shows the treat- ment of colour, form, and composition. In its historical aspect we find the true portraits of great men of the past ; we can observe their habits of life, their manners, their dress, the architecture of their times, and the religious worship of the period in which they lived. Regarded collectively, the art of a country epitomizes the whole development of the people that produced it. Most import- ant of all is the emotional aspect of painting, which must enter less or more into every picture worthy of notice. To take examples from the British National Gallery : Pathos in its most intense degree will be found in Francia's "Piet^" ; dignity in Velasquez' portrait of Admiral Pareja ; homeliness in Van Ey ck's portrait of Jan Arnolfini and his wife ; the interpretation of the varying moods of nature in lihe work of Turner or Hobbema ; nothing can be more devotional than the canvases of Bellini or his Umbrian contemporaries. So also the ruling sentiments of man- kind— ^mysticism, drama, and imagination are the key- notes of other great conceptions of the artist. All this may be at the command of those who visit the art gallery ; but without patience, care, and study the higher meaning will be lost to the spectator. The picture which " tells its own story " is often the least didactic, for it has no inner or deeper lesson to reveal ; it gives no stimulus or training to the eye, quick as that organ may be — segnius irritant animos — to translate sight into thought. In brief, the painter asks that his ^flos may be shared as much as pos- sible by the man who looks at the painting — ^the art above all others in which it is most needful to share the master's spirit if his work is to be fully appreciated. So, too, the art gallery, recalling the gentler associations of the past amidst surroundings of harmonious beauty and its attend- ant sense of comfort, is essentially a place of rest for the mind and eye. In the more famous galleries where the wealth of paintings allows a grouping of pictures according to their respective schools, one may choose the country, the epoch, the style, or even the emotion best suited to one's taste. According to this theory, though

imperfectly realized owing to the paucity of examples, the philosophic influence of art galleries is becoming more widely extended ; and in its further development will be found an ever-growing source of interest, instruction, and scholarship to the community. The most suitable method of describing art galleries is to classify them by their types and contents, rathei^than by the various countries to which they belong. Thus the great representative gal- leries of the world which possess works of every school are grouped together, followed by State galleries which are not remarkable for more than one school of national art. Municipal galleries are divided into those which have general collections, and those which are notable for special collections. Churches which have good paintings, together with those which are now secularized, are treated separ- ately ; while the collections in the Vatican and private houses are described together. The remaining galleries, such as the Salon or the Eoyal Academy, are periodical or commercial in character, and are important in the devel- opment of modern art.

state galleries of Inter- national schools.

The collections most worthy of attention are the State galleries representative of international schools. Their number is restricted, not more than a dozen being in the very first rank. Among these the British National Gallery holds a high place. Though the collection is small and modern, having been founded in 1824 by the acquisition of the Angerstein pictures, it is among the most representative of State galleries. Its accessions are governed by the parliamentary grant of £5000 to £10,000 a year, a sum which has occasionally been enlarged to permit special purchases. Thus, in 1871, the Peel collec- tion of seventy-seven pictures was bought for £75^000, and in 1885 the Ansidei lladonna (Eaffaelle) and Van Dyck's portrait of Charles I. were bought, the one for £70,000 and the other for £17,500. In 1890 the Govern- ment gave £25,000 to meet a gift of £30,000 made by three gentlemen to acquire three portraits by Moroni, Velasquez, and Holbein. The most important gifts were the Vernon gift in 1847, the Turner bequest in 1856, and

North Vestibule, Early Italian Schools ; I, Tuscan School (15th and 16th centuries) ; II, Sienese School, &o. ; III, Tuscan School ; IV, Early Flemish School ; V, Ferrarese and Bolognese Schools ; VI, Umbrlan School, &c. ; VIl, Venetian and Bresoian Schools; VIII, Paduan and Early Venetian Schools ; IX, Schools of Lombardy and Parma ; X, Dutch and Flemish Schools ; XI, Dutch and Flemish Schools; XII, Dutch and Flemish Schools (including the Peel Collection) ; XIII, Late Italian Schools ; XIV, Spanish School ; XV, German Schools ; XVI, French School; XVII, French School; XVIII, Old British School ; XIX, Old British School ; XX, British School ; XXI, Modern British School ; XXII, Turner Collection ; Octagonal Hall, Miscellaneous ; East Vestibule, Old British School ; West Vestibule, Old British School.

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Fio. 1.— Plan of the National Sallery, London.

the Wynne-Ellis legacy in 1876. The gallery contains very few poor works, and all schools are well represented with the sole exception of the French school. This, how- ever, can be amply studied at Hertford House, which, besides Dutch, Spanish, and British pictures of the highest value, contains twenty examples of Greuze, fifteen by Pater, nineteen by Boucher, eleven by Watteau, and fifteen by Meissonier. The Royal Gallery at Berlin (Old Museum), like the British National Gallery, is remarkable for its variety of schools and painters, and for the select type of pictures shown. During the last twenty-five years of the 19th century, the development of this collection was even more striking than that of the English gallery. Italian and Dutch examples are specially numerous, though every school but the British (here as elsewhere) is really well seen. The purchase grant is considerable, and is well applied. Two other German capitals have collections of international importance — Dresden and Munich. The former is famous for the Sistine Madonna by Eaffaelle, a work of such supreme excellence that there is a tendency to overlook other Italian pictures of celebrity by Titian, Giorgione, and Correggio. Munich (Old Pinakothek) has examples of all the best masters, the South German school being particul&rly noticeable. The arrangement is good.

and the methods of exhibition make this one of the most pleasant galleries on the Continent. Vienna has the Imperial Gallery, a collection which in point of number cannot be considered large, as there are not more than 1700 pictures. This, however, is in itself a safeguard, like the wise provision enabling the English authorities to dispose of pictures "unfit for the collection, or not required" (19 and 20 Vict. c. 29). It avoids the undue multiplication of canvases, and the overcrowding so notice- able in many Italian galleries where first-rate pictures hang too high to be examined. Thus the Viennese gallery, besides the intrinsic value of its pictures (Albert Diirer's chief work is there), is admirably adapted for study. The best gallery in Eussia (St Petersburg, Hermitage) was made entirely by royal efforts, having been founded by Peter the Great, and much enlarged by the Empress Catharine. It contains' the collections of Orozat, Bruhl, and Walpole. There are about 1800 works, the schools of Flanders and Italy being of signal merit ; and there are at least thirty-five genuine examples by Eembrandt. The French collection (Louvre Palace, Paris) is one of the most important of all. In 1880 it was undoubtedly the first gallery in Europe, but its supremacy has since been menaced by other establishments where acquisitions are

made more frequently and witli greater care, and where the system of classification is such that the value of the pictures is enhanced rather than diminished by their dis play. In 1900 it was partly rearranged with great effect. The feature of the Louvre is the Salon Carre, a room in which the supposed finest canvases in the collection are kept together, pictures of world-wide fame, representing all schools. It is now generally accepted that this system of selection not only lowers the standard of individual schools elsewhere by withdrawing their best pictures, but

does not add to the aesthetic or educational value of the masterpieces themselves. In Florence the Tribuna of the Ufiizi gallery is a similar case in point, while in London the danger that such a central gallery should be made within the national collection passed away thirty years ago. Probably the two most widely known pictures in the Louvre are Watteau's

second " Embarquement pour Cythere" and the " Mona Lisa," a portrait by Leonardo da Vinci, but each school has many unique examples. The original drawings should be noted, being of equal importance to

Fi». 2. — Plan of the first and second floors of the Imperial Gallery, Vienna.

the collection preserved at the British Museum. The last collection to be mentioned under this heading is that known as the Eoyal Galleries in Florence, housed in the Pitti and Uffizi palaces. In some ways this collection does not represent general painting suflciently to justify its inclusion with the galleries of Berlin, Paris, and London. On the other hand, the great number of Italian pictures of vital importance to the history of international art makes this one of the finest existing collections. The two great palaces, dating from the 16th and 16th centuries, are joined together and contain the Medici pictures. They form the largest gallery in the world, and though many of the rooms are small and badly lighted, and although many paintings have suffered from thoughtless restoration, there is a charm and attraction which certainly

make them the most popular galleries in Europe. The Pitti has ten Raffaelles, and excellent examples of Andrea del Sarto, Giorgione, and Perugino. The UfiBzi is more representative of non-Italian schools, but is best known for its works by Botticelli, Leonardo da Vinci, Michael Angelo, and Sodoma, the schools of Tuscany and Umbria forming the bulk of both collections. Admission to the galleries is by payment, and the small income derived from this source (in 1890 all the galleries and museums in Florence only received £4000) is devoted to maintaining and enlarging the collections.

As to the groimd plans of the National Gallery, London (Fig. 1), and of the Eoyal Gallery at Vienna (Fig. 2), it will be observed that while the former has the ad- vantage of uniform top-light, the new galleries at Vienna

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possess the most ample facilities for minute classification, small rooms or ” cabinets^’ opening from each large room. Special rooms are also provided for drawings and water- colours, while special ranges of rooms are used by copyists and those responsible for the repair and preservation of the pictures.

Though not so comprehensive as the great collections just described, the State galleries showing national schools state 9^ painting and little else are of striking

^a/zer/es o/ i’^terest. In England the National Gallery of national British Art (known as the Tate Gallery) contains schools. British pictures. The corresponding collection of niodern French art is at Paris (Luxembourg Palace), Berlin, Eome, Dresden, Vienna, and Madrid having analogous galleries. The Victoria and Albert Museum has also numerous British pictures, especially in water- colour, and the National Portrait Gallery, founded in 1856, and since 1896 housed in its permanent home, is instructive in this connexion, though many of its pictures are the work of foreign artists. The national collec- tions at Dublin and Edinburgh may be mentioned here, though most schools are represented. Brussels and Antwerp are remarkable for fine examples of Flemish art — ^Matsys, Memlinc, and Van Eyck of the primitive schools, Eubens and Van Dyck of the later period. The collections at Amsterdam (Ryks Museum) and the Hague (Mauritshuis) are a revelation to those who have only studied Eembrandt, Franz Hals, Van der Heist, and other Dutch portrait painters outside Holland; and in the former gallery especially, the pictures are arranged in a manner showiug them to the best advantage. The Museo del Prado is even more noteworthy, for the fifty examples of Velasquez (outrivalling the Italian pictures, important as they are) make a visit to Madrid imperative to those who wish to realize the achievements of Spanish art. Christiania, Stockholm, and Copenhagen have large col- lections oiE Scandinavian art,, and the cities of Budapest and Bale have galleries of some importance. In Italy the State maintains twelve collections, mainly devoted to pic- torial art. Of these the best are situated at Bologna, Lucca, Parma, Venice, Modena, Turin, and Milan. In each

ease the local school of painting is fully represented. In Rome the Corsini and Borghese Galleries, the latter being the most catholic inthe city, contain superb examples, some of them accepted masterpieces of Italian art ; there are also good foreign pictures, but their number is limited. The Accademia at Florence should also be noted as the most important State gallery of early Italian art. The central Italian Renaissance can be more adequately studied here than in the pitti. The " Primavera " of Botticelli, and the " Last Judgment " by Fra Angelico are perhaps the best known works. The large statue of David by Dona- tello is also in this gallery, which, on the whole, is one of the most remarkable in Italy. Speaking broadly, these national galleries scattered throughout the country are not well arranged or classified; and though some are kept in fine old buildings, beautiful in themselves, the lighting is often indifferent, and it is with difficulty that the pictures can be seen. In nearly every case admission fees are charged every day, festivals and Sundays excepted ; few pictures are bought, acquisitions being chiefly made by removing pictures from churches.

Many towns own collections of well-merited repute. In Italy such galleries are common, and among them may be noted Siena, with Sodoma and his school ; gJife'ri^ Venice with Tintorettd (Doge's Palace) ; Genoa, at special with the great palaces Balbi and Rosso ; Vicenza schools. (Montagna and school), Ferrara (Dosso and school), Bergamo and Milan (north Italian schools). Other civic collections of Italian art are maintained at Verona,

Pisa, Rome, Perugia, and Padua. In Holland, Haarlem, Leyden, Rotterdam, and the Hague have galleries supple- mental to those of the State, and are remarkable in showing the brilliance of artists like Grebber, De Bray, and Rave- steyn, who are usually ignored. Birmingham and Man- chester have good examples of modern British art. Moscow (Tretiakoff collection) has modern Russian pictures, and contemporary German and French work will be found in all the galleries of these two countries included in the municipal group. Collections of French work are found at Amiens, Rouen, Nancy, Tours, Lemans, and Angers, but large as these civic collections are, sometimes contain- ing six and eight hundred canvases, few of their pictures are really good, many being the

enormous patriotic can- vases marked " Don de I'ifitat," which do not confer dis- tinction on the galleries. Cologne has the central collection of the early Rhenish school ; Nuremberg is remarkable for early German work (Wohlgemut, &c.). Stuttgart, Cassel (Dutch), and Hamburg (with a considerable number of British pictures) are also noteworthy, together with Brunswick, Hanover, Augsburg, Darmstadt, and Diissel- dorf where German and Dutch art preponderate. Seville is famous for twenty-five examples of Murillo, and there are old Spanish paintings at Valencia, Cordova, and Cadiz.

In Great Britain the best of the municipal galleries of general schools are at Liverpool (early Flemi sh and British) , and at Glasgow (Scottish painters, Rembrandt, Municipal Van der Goes, and Venetian schools). In France galleries there are very large galleries at Tours, Mont- "^^^ff"' pellier, Lyons (Perugino, Rubens), Dijon, and Grenoble (Italian), Valenciennes (Watteau and school), while Rennes, Lille, and Marseilles have first-rate collec- tions. Nantes, Orleans, Besanqon, Cherbourg, and Caen have also many paintings, French for the most part, but with occasional foreign pictures of real importance, pre- sented by the State during the Napoleonic conquests, and not returned on the declaration of peace as were the works of art amassed in Paris. Some of the American collec- tions, though still in their early stages of development, have very good pictures. At Boston (Museum of Fine Arts) all schools are represented, so too at the Metropolitan Museum of Art in New York, which is strong in Italian and Dutch works. Modern French and Flemish art is a feature of the Academy at Philadelphia, at the Lenox Library (New York), and at Chicago, where there are good examples of Millet, Constable, and Rembrandt. The Corcoran bequest at Washington is of indifferent worth. The best civic collection in Germany of this class is the Stadel Institute at Frankfort (Van Eyck, Christus, early Flemish and Italian).

As the great bulk of religious painting was executed for church decoration, there are still numberless churches which may be considered picture galleries. Thus at Ant- . werp Cathedral the Rubens paintings are remark- able; at Ghent, Van Eyck; at Bruges (hospital of St John), Memlinc ; at Pisa, the Campo Santo (early Tuscan schools) ; at Sant'

Apollinare, Ravenna, primitive Italo-Byzantine mosaics; at Siena, Pinturrichio. Examples could be multiplied indefinitely — in Italy alone there are 80,000 churches and chapels, in all of which pictorial art has been employed. In Italy, besides the church " galleries " still used for religious services, there are some which have been secularized and are now used as museums, e.g., Certosa at Pavia, and San Vitale at Eavenna (mosaics) ; at Florence, the Scalzi (Andrea del Sarto) ; San Marco (Fra Angelico) ; the Riccardi and Pazzi chapels (Gozzoli and Perugino) ; at Milan, in the Santa Maria delle Grazie, the " Last Supper," by Leonardo, and at Padua, the famous Arena chapel (Giotto).

The Vatican galleries, though best known for their

statuary, have fine examples of painting, chiefly of the Private Italian school; the most famous easel picture and semi- is EaffacUe's " Transfiguration," but the Stanze, '"'irri apartments entirely decorated by painting, are ga etes. ^y^j^ more famous. In England three royal .palaces are open to the public — Hampton Court (Man- tegna), Windsor (VanDyck, Zuccarelli), and Kensington (portraits). At Buckingham Palace the Dutch pictures are admirable, and Queen Victoria lent the celebrated Eaffaelle cartoons to the Victoria and Albert Museum. Semi-private collections belong to Dulwich College (Velas- quez and Watteau), Oxford University (Italian drawings), the Soane Museum (Hogarth and English school), and the Royal Academy (Leonardo). Among private collec- tions the most important are the Harrach, and Prince Liechtenstein (Vienna), the Six Gallery (Amsterdam), Mrs J. Gardner, of Boston (Italian), Prince Corsini (Tlorence). In Great Britain there are immense riches in private houses, though many collections have been dis- persed. The most noteworthy belong to the dukes of Devonshire and Westminster, Lord Ellesmere, Captain Holford (including the masterpiece of Cuyp), Mr L. Mond, Lord Lansdowne, Miss Rothschild. The finest private collection belongs to Lord Cowper, his gallery of Van Dyck's work being quite the best in the world.

Many galleries are devoted to periodical exhibitions in London ; the Royal Academy is the leading agency of Periodical ^^^^ character, having held exhibitions since and com- 1769. Its loan exhibitions of Old Masters are menial. most important. Similar enterprises, heralded by the Grosvenor Gallery, are the New Gallery, opened in 1888, the Grafton Gallery, and others. There are also old-established societies of etchers, water-colourists, &c. A feature common to these exhibitions is that the public always pays for admission, though they differ from the commercial exhibitions, becoming more common every year, in which the work of a single school or painter is shown for profit. But the annual exhibitions at the Guildhall, under the auspices of the Corporation, are free. The great periodical exhibition of French art is known as the Salon, and for some years it has had a rival in the Champ de Mars exhibition. These two so- cieties are now respectively housed in the Grand Palais and Petit Palais, in the Champs Elysees, which were erected in connexion with the Paris Exhibition of 1900, but with the ultimate object of being devoted to the service of the two Salons. Berlin, Rome, Vienna, and other Con- tinental towns have regular exhibitions of original work.

The best history of art galleries is found in their oflBcial aijd other catalogues, see article Museums. See also L. Viakdot, Les musees d'ltalie, &c., 3 vols. Paris, 1842, 1843, 1844.— Annual Reports, official, of National Portrait Gallery, National Galleries of England, Ireland, and Scotland ; Civil Service Estimates, class iv. ofBcial. See also the series edited by Lafbnkstre and E. Richtenberger : Le Louvre, La Belgique, Le HoUande, Florence, Belgique.—A. Lavice. Bevue des musees de France, . . . d^Allemagne, . . . d"An- gleterre, . . . d'E^agne, . . . d'ltalie, . . . de Belgique, de Sollande et de Bussie. Paris, 1862-72.— E. Michel. Les musies. d'Alle- magne. Paris, 1886.— Kate Thompson. Fublic Picture Galleries of Europe, 1880.— C. L. Eastlake. Notes on Foreign Picture Galleries.— IjO^J) Ronald Gower. Pocket Guide to Art Galleries (public and private) of Belgium and Holland, 1875 ; and many works, albums, and so forth, issued mainly for the sake of the illustrations. (b.)

Art Museums. See Museums.

Art Sales.— The practice of selling objects of art by auction in England dates from the latter part of the 17th century, when in most cases the names of the auctioneers were suppressed. Evelyn (under date 21st June 1693) mentions a " great auction of pictures {Lord Melford's) in the Banquetting House, Whitehall," and the practice is frequently referred to by other contemporary and later

writers. Before the introduction of regular auctions the practice was, as in the case of the famous collection formed by Charles I., to price each object and invite purchasers, just as in other departments of commerce. But this was a slow process, especially in the case of pictures, and lacked the incentive of excitement. The first really important art collection to come under the hammer was that of Edward, Earl of Oxford, dispersed by Cock, under the Piazza, Covent Garden, on 8th March 174142 and the five following days, six more days be- ing required by the coins. Nearly all the leading men of the day, iucluding Horace Walpole, attended or were represented at this sale, and the prices varied from five shillings for an anonymous bishop's "head" to 165 guineas for Van dyck's group of " Sir Kenelm Digby, lady, and son." The next great dispersal was Dr Rich- ard Mead's extensive collection, of which the pictures, coins, and gems, &c., were sold by Langford in Feb- ruary and March 1754, the sale realizing the total, unprecedented up to that time, of' £16,069. The thirty- eight days' sale (1786) of the Duchess of Portland's collection is very noteworthy, from the fact that it included the celebrated Portland vase, now in the Brit- ish Museum. Many other interesting and important 18th-century sales might be mentioned. High prices did not become general until the Calonne, Trumbull (both 1795), and Bryan (1798) sales. As to the quality of the pictures which had been sold by auction up to the latter part of the 18th century, it may be assumed that this was not high. The importation of pictures and other objects of art had assumed extensive proportions by the end of the 18th century, but the genuine ex- amples of the Old Masters probably fell far short of 1 per cent. England was felt to be the only safe asylum for valuable articles, but the home which was intended to be temporary often became permanent. Had it not been for the political convulsions on the Continent, Eng- land, instead of being one of the richest countries in the world in art treasures, would have been one of the poor- est. This fortuitous circumstance had, moreover, another effect,

in that it greatly raised the critical knowledge of pictures. Genuine works realized high prices, as, for example, at Sir William Hamilton's sale (1801) when Beckford paid 1300 guineas for the little picture of " A Laughing Boy" by Leonardo da Vinci; and when at the Lafontaine sales (1807 and 1811) two Rembrandts each realized 5000 guineas, " The Woman taken ia Adul- tery," now in the National Gallery, and " The Master Shipbuilder," now at Buckingham Palace. The Beckford sale of 1823 (41 days, £43,869) was the forerunner of the great art dispersal of the 19th century ; Horace Wal- pole's accumulation at Strawberry Hill, 1842 (24 days, £33,450), and the Stowe collection, 1848 (41 days, £75,562), were also celebrated. They comprised every phase 01 art work, and in all the quality was of a very high order. They acted as a most heal^y stimulus to art collecting, a stimulus which was further nourished by the sales of the superb collection of Balph Bernal in 1853 (32 days, £62,690), and of the almost equally fine but not so comprehensive collection of Samuel Rogers, 1856 (18 days, £42,367). Three years later came the dispersal of the 1600 pictures which formed Lord Northwick's gal- lery at Cheltenham (pictures and works of art, 18 days, £94,722).

Towards the latter part of the first half of the 19th century an entirely new race of collectors gradually came iato existence ; they were for the most part men who had made, or were making, large fortunes in the various industries of the midlands and north of England and other centres. They were untrammelled by " collecting" traditions, and their patronage was almost exclusively

extended to the artists of the day. The dispersals of these collections began in 1863 with the Bicknell Gfallery, and continued at irregular intervals for many years, e.g., Gillott (1872), Mendel (1876), Wynn. Ellis and AlheH Levy (1876), Albert Grant (1877), and Munro of Novar (1878). These patrons purchased at munificent prices either direct from the easel or from the exhibitions not only pictures in oils but also water-colour drawings. As a matter of investment their purchases frequently realized far more than the original outlay; sometimes, however, the reverse

happened, as, for instance, in the case of Landseer's " Otter Hunt," for which Baron Grant is said to have paid £10,000 and which realized shortly afterwards only 5650 guineas. One of the most strik- ing features of the sales of the 'seventies was the high appreciation of water-colour drawings. At the Gillott sale 160 examples realized a total of £27,423, when Lord Dudley paid 3150 guineas for Turner's "Bam- borough Castle"; and three years later at the Quilter sale (1875), when David Cox's "Hayfield," for which a dealer had paid the artist 50 guineas in 1850, realized 2810 guineas. Water-colour drawings have never re- covered the inevitable effect of the "boom" in the 'seventies, but even within late years prices at auction indicate a distinctly upward tendency; in 1895 David Cox's "Welsh Funeral" (which cost about £20) sold for 2400 guineas, and in the same sale Sir Edward Burne- Jones's "Hesperides" realized 2560 guineas. The de- mand for works by modern artists, whose works sold at almost fabulous prices thirty years ago, has greatly de- clined ; bul; during all its furore there was still a small band of collectors to whom the works of the Old Masters more especially appealed. The dispersal of such collec- tions as the Bredel (1875), Watts Russell (1875), Foster of Olewer Manor (1876), the Hamilton Palace (17 days, £397,562) — the greatest art sale in the annals of Great Britain— SaZe (1882), Leigh Court (1884), and Dudley (1892) contained, as did many minor collections sold each season, many very fine examples of the Old Masters which found eager purchasers at high prices. It has been frequently said that the Old Masters are no longer in fashion with collectors, but the fact is that first-rate examples are now rarely offered for sale ; when they do occur prices are invariably high. Scarcely a season passes without affording a proof of this, the most striking one of all being the £24,250 realized by the pair of Vandyck portraits of a Genoese senator and his wife in the Peel sale, 1900.

The chief feature of the picture sales of the last quarter of the 19th century was the demand for workS' — more particularly female portraits — by Eeynolds and his contemporaries. The origin of this fashion is perhaps traceable to the exhibitions held at South Kensington, 1867 and 1868, and the annual winter exhibitions at Burlington House, which revealed an unsuspected wealth and charm in the works of many English artists who had almost fallen into oblivion. The prices which have been

paid at auction during recent years for such pictures can only be described as fabulous, and a few of .the records may be quoted — Eeynolds's "Lady Betty Delm^," 1894, 11,000 guineas ; Romney's " The Ladies Spencer," 1896, 10,500 guineas; Gainsborough's "Duchess of Devon- shire " (the picture which so mysteriously disappeared a few days after the sale, and which was as mysteriously restored to its owners, Messrs Agnew, in April 1901), 1876, 10,100 guineas ; Consfbable's " Stratford Mill," 1895, 8500 guineas ; and Turner's " Wreckers," 1897, 7600 guineas. Since 1880 works of the modern Continental schools — more especially the French — have become popular with English collectors, and high prices have accordingly fibred in auction sales. The "appreciation" is, how-

ever, circumscribed, and perhaps does not extend much beyond a dozen well-known names, of which the principal

^ith a few of their chief pictures — are Eosa Bonheur,

"Denizens of the Highlands," Bolckow sale, 1888,5550 guineas ; Jules Breton, whose " Girls going to the First Communion " realized £9100 in New York in 1886 ; Corot, Fortuny, Gallait, GerSme, Greuze, Israels; Meissonier (of whose works sold by auction two may be mentioned) : " Napoleon I. in the Campaign of Paris," 12J inches by 9^ inches, for which Mr Euskin gave 1000 guineas in 1869 and which realized 6800 guineas in 1882, and " The Sign Paintpr," which in the Bolckow sale of 1891 realized 6450 guineas ; Munkacsy, Troyon, and Verboeckhoven.

" Specialism " is the one important development in art collecting which has manifested itself during the last half century. This accounts for and explains the high average quality of the Wellesley (1866), the Buccleuch (1888), and the Holford (1893) collections of drawings by the Old Masters ; for the Sibson Wedgwood (1877), the Due de Forli Dresden (1877), , the ShuldJiam blue and white porcelain (1880), the Warwick enamels (1896), the Dudley porcelain (1886), the Massey-Mainwaring gold boxes (1897), and also for the objects of art collected by Mr Magniac (1892) and by Herr Heckscher (1898). Very many other illustrations in nearly every department of art collecting might be quoted — the superb series of Marl-borough gems (1875 and 1899) might be included in this category but for

the fact that it was formed chiefly in the 18th century. The appreciation — commercially at all events — of mezzotint portraits and of portraits printed in colours, after masters of the early English school, was one of the most remarkable features in art sales during the last years of the 19th century. The shillings of fifty years before were then represented by pounds. The Fraser collection (4th to 6th December 1900) realized about ten times the original outlay, the mezzotint of the " Sisters Frankland," after Hoppner, by W. Ward, selling for 290 guineas as against 10 guineas paid for it about thirty years previously. The H. A. Blyth sale (11th to 13th March 1901, 346 lots,. £21,717: 10s.) of mezzotint portraits was even more remarkable, and as a collection it was the choicest sold within recent times, the engravings being mostly in the first state. The record prices were numerous, and, in many cases, far surpassed the prices which Sir Joshua Eeynolds received for the original pictures ; e.g., the exceptionally fine example of the first state of the " Duchess of Eutland," after Eeynolds, by V. Green, realized 1000 guineas, whereas the artist re- ceived only £160 for the painting itself. Even this un- precedented price for a mezzotint portrait was exceeded on 30th April 1901, when an example of the first published state of "Mrs Carnac," after Eeynolds, by J. E. Smith, sold for 1160 guineas. Such prices as these and many others which might be quoted are exceptional, but they were paid for objects of exceptional rarity or quality. The demand for the finest works of art of all descriptions is much greater than the supply. As an illustration of the magnitude of the art sale business it may be men- tioned that. the "turnover" of one firm in London alone has occasionally exceeded £1,000,000 annually.

Bibliography.— The chief compilations dealing with art sales in Great Britain are— 4rt Sales, by G. Eedford (1888), and Memorials of Christie's, by W. Roberts (1897) ; whilst other books containing much important matter are W. Buchanan's Memoirs of Painting ; The Tear's Art, 1880 and each succeeding year ; TJie Connoisseur, by F. S. Robinson ; and Les ventes de tableaux, dessins et objets d'art au XIX' Siecle (chiefly French), by L. Souni:6. /.^^ jj_#

Art Societies. — In banding, themselves intosocie; ties and associations artists have always been especially remarkable. The fundamental motive of such leaguing

together is apparent, for, by tlie establisliineiit of socie- ties, it becomes possible for tbe working members of these to hold exhibitions and thereby to obtain some compensation or reward for their labours. With the growth of artistic practice and public interest, however, art societies have been instituted where this primary object "is either absent or is allied to others of more general scope. The furtherance of a cult and the special- izing of work have also given rise to many new associa- tions in Great Britain, besides the Eoyal Academy (q.v.). At the outset, therefore, it wiU be well to mention the leading art societies thus described. The (now Boyal) Society of Painters in Water Colours, founded in 1804, and the (now RoyaT) Society of British Artists (1823), are typical of those societies which exist merely for purposes of holding exhibitions and conferring diplomas of mem- bership. The Artists' Society formed in 1830, has for its object the providing of facilities to enable its members to perfect themselves in their art. To this end there is a good library of works on art, and abundant opportunities are afforded for general study from the life. In the further- ance of a cult the Japan Society, devoted to the encourage- ment of the study of the arts and industries of Japan, is atypical example ; and the Society of Mezzotint Engravers is representative of those bodies formed in the interests of particular groups of workers. One of the remarkable features in the history of art in Great Britain has been the rapid increase of the artistic rank and file. Taking the number of exhibitors at the principal London and provincial exhibitions, it is found that in the period 1885- 1900 the ranks were doubled. At the end of the 19th cen- tury it was estimated that there were quite 7000 practis- ing artists. Coincident with this astonishing development there has been a corresponding addition of new art socie- ties and the enlargement of older bodies. For instance, the membership of the Boyal Society of British Artists ad- vanced in the period mentioned from 80 to 150. Similar extensions can be noted-in other societies, or in such a case as that of the Boyal Institute of Painters in Water Colours, where the membership has remained fixed, it is to be noticed that more space is given to the works of outsiders. But the expansion of older exhibiting societies has not proved sufficient. Portrait

painters, pastellists, designers, minia- turists, and women artists have felt the necessity of form- ing separate coteries. Interesting though these movements from within may be, the growth of societies originating in the spirit of altruism associated with such names as BusMn and Kyrle is equally instructive. Nearly all these are the products of the last quarter of a century and include the Sunday Society, which in 1896 secured the Sunday opening of the National Museums and Galleries in the Metropolis.

The specializing of study and work has also given rise to much artistic endeavour. For a long time archaeology — British and Egyptian — claimed almost exclusive atten- tion. Latterly the arts of India and Japan have engaged much notice, and societies have been organized to further their study. Finally, bands of workers in particular branches of art have felt the need of clubbing together in order to protect their special interests. A slight suspicion of trade-unionism is attached to some of these ; but on the whole the establishment of such bodies as the Society of Illustrators, the Society of Designers, and the Society of Mezzotint Engravers has been with a view to advancing the public knowledge of -the merits of these branches of artistic enterprise.

Exhibiting Societies. — (a) Old Established. — These in London are: The Boyal Academy, the Boyal Water Colour Society, the Boyal Institute of Painters in Water Colours, the Society of Oil Painters, and the Boyal Society of British Artists. In the provinces, the Birmingham Boyal Society of Artists has been in existence seventy-

four years, and has a life academy with professors attached. (6) Modem. — In this category are many which reflect the freshness and spirit of the enterprise shown during the last twenty-five years. Such a body as the New English Art Club, founded in 1885 as a protest against all other art societies, achieves its purpose by exhibition only. The Boyal Society of Painter-Etchers and Engravers, consisting of fellows and associates, not exceeding 160 in all, conserves the interests of a numer- ous body of workers, and, in addition to holding exhibi- tions, confers diplomas (E.E. and A.E.E.) on the exhibi- tors of meritorious etchings or engravings. The Society of Women Artists (formerly the Society of Lady Artists) is wholly

devoted to the display of works by female artists, and in 1891 the Society of Portrait Painters was formed to carry out the object cbnveyed in its title. Two associations advance the art of the miniature painter, and the Pastel Society, formed in 1898, holds displays of members' work at the Eoyal Institute Galleries. In Scot- land there is the, Boyal Scottish Academy. The Boyal Scottish Society of Painters in Water Colours (Glasgow) grants the title E.S.W. to its members, and the Society of Scottish Artists (Edinburgh), foimded in 1891, has a membership of nearly 600 young artists. Other exhibit- ing societies which call for mention are : The Yorkshire Union of Artists (Leeds), which consolidates many local societies; the Nottingham Society of Artists, which also encourages drawing from the living model ; and similarly the Liver Sketching Club (Liverpool), founded nearly thirty years ago, which, in addition to holding an annual exhi- bition, devotes four nights a week to drawing from life.

Societies of Instruction and Populak Encourage- ment.— It is under this head that the chief evidence of the modern art revival will be found. First it should be noted that there are very few societies designed for the artistic improvement of artists. The Artists' Society has already been mentioned; and the Art Workers' Guild, which meets at Clifford's Inn Hall, provides meetings, from which the public is excluded, where profitable dis- cussions take place on questions of craft and design. But, as a rule, the art society, of which only artists are members, is organized for exhibition purposes or for the protection of interests. With regard to those societies of popular and educational intention the old Society of Arts in the Adelphi, founded in 1764, enjoys a good record. Numerous lectures on art subjects have from time to time been given, and in 1887 a scheme was devised by which awards are made to student-workers in design. The Society for the Encouragement of the Fine Arts (Con- duit Street) has also laboured during the last half-century to increase a technical knowledge, its members holding conversazioni at various picture galleries. The Artists' and Amateur^ Conversazione, instituted in 1831, which used to meet at the Piccadilly Galleries and is now defunct, carried out a similar plan. Two other societies, now obsolete, should be mentioned whose methods were directly educational. The Arundel Society, "Vhich for many years promoted the knowledge of art by copying and publishing

important works of ancient masters, issued to its members on payment of annual subscriptions, was eventually wound up on the last day of 1897. The International CJialcographical Society, formed for the study of the early history of engraving — its committee consist- ing of Messrs Sidney Colvin, Georges Duplessis, F. Lipp- mann, and Baron Edmond de Eothschild — also did useful work. Another association of painters, sculptors, archi- tects, and engravers, the Graphic Society, ceased on the 29th October 1890. This was one of the most interesting of societies, and its meetings, at which rare works of art were exhibited and discussed, were held in the Flaxman Gallery at University College. A very active educational

body, originated in 1888, namely the Royal Drawing Society, has for its definite object the teaching of draw- ing as a means of education. The methods of instruction are based on the facts that very young children try to draw before they can write, and that they have very keen perception and retentive memory. The society aims, therefore, at using drawing as a means of developing these innate characteristics of the young, and already nearly 300 important schools follow out its system. Lord Leighton, Sir John Millais, and Sir Edward Burne- Jones took an active part in the society's labours. The Art for Schools Association, founded in 1883, has also done steady work in endeavouring to provide schools with works of art. These are chiefly reproductions of standard works of art or of historical and natural subjects. The wave^ of enthusiasm aroused by Mr Kuskin's teachings caused Societies of the Rose to be founded in London, Manchester, Shefiield, Birmingham, Aberdeen, and Glas- gow ; but some of these eventually ceased active work, to be revived again, however, by the Buskin Union, formed in the year of the great writer's death (1900). Most of these societies were formed in 1879 ; but it should not be forgotten that two years earlier the Kyrle Society was started with the object of bringing the refining and cheer- ing influences of natural and artistic beauty to the homes of the people. Under the presidency of Eai-l Brownlow, the Home Arts and Industries Association continues a work

which was started in 1884, and anticipated much of the present system of technical education. Voluntary teachers organize classes for working people, at which a practical knowledge of art handiwork is taught. In remote or poor districts isolated workers are also assisted. Training classes for voluntary teachers are held in such varied pursuits as bent iron work, spinning, embroidery, and smocking. An interesting type of society has been established in Bolton, Lancashire^ Under the title of an Arts Chiild the members, numbering over 200, devote themselves to the advancement of taste in municipal im- provements. '

Societies oe Special Study, Practice, and Peotbc- TiON. — Under this head should be placed those associa- tions which affect a cult, or are composed of particular workers, or which protect public or private interests. Perhaps the chief of the first kind is the Jaipan Society, which, since its inception in 1892, has been joined by over 900 members interested in matters relating to Japanese art and industries. The Diirer Society, formed in 1897, has for its main object the reproduction of works by Albert Diirer, and his German and Italian contemporaries, and is in a way the successor to the defunct Arundel Society. In this category of special study the Society for the Encouragement and Preservation of Indian Art may Also be placed, and the Egypt Exploration Fund. The Buskin Union may also be mentioned again in this connexion. Of the societies of special practice it has already been notibed that some are purely exhibiting associations, such as the Portrait Painters, the Pastel Society, and the two miniature bodies.' The formation of the Society of Mezzotint Engravers in 1898 is an example of the leaguing together of particular workers to call attention to their interests. Original and translator en- gravers, together with collectors and connoisseurs, com- prise the membership. The decaying art of wood engrav- ing is also fostered by the International Society of Wood Engravers, and the Society of Designers, founded in 1896, safeguards the interests of professional designers for applied art, without holding exhibitions. Special practice and protection are also considered by the Society of Illus- trators, composed of artists who work in black and white foj the illustrated press. This society was inaugurated in 1894, and fifteen of the members of the committee

must be active workers in illustration. As an instance of the tendency of art workers to combine, the Society of Art Masters is a good illustration. This is an association of teachers of art schools, controlled by the art branch of the Board of Education, and has a membership of over 200. Good work of another kind occupies the National Trust for Places of Historic Interest or Natural 'Beauty. The Council of the Trust includes representatives of such bodies as the National Gallery, the Eoyal Academy, the Royal Society of Painters in Water Colours, the Society of Antiquaries, the Eoyal Institute of British Architects, the Universities, Kyrle Society, Society for the Protec- tion of Ancient Buildings, and the Selborne Society.

FoRBiGM- Art Societies. — The following are brief par- ticulars of the chief art societies elsewhere than in Great Britain : —

Austria. — ^Vienna, Vereinigung bildender Kuenstler Osterreichs (Society of Austrian Painters) and tlie Association of Viennese Artists (L' Association des artistes de Vienna).

Belgiom. — Brussels, Society des Beaux Arts, the Libre Esthd- tique, Sociite des Aquarellistes et Pastellistes, Society royale Beige des Aquarellistes, and numerous private societies (cercles) in Brus- sels, Antwerp, Li6ge, Ghent, and other cities.

France. — Paris, the Societe des Artistes Franmis (The Salon), Societe Nationale des Beaux Arts (The New Salon), Sociite des Aquarellistes. Exhibiting societies are the SoeiHe des Artistes Independants, Societe des Orientalistes, and Salon des Pastellistes.

Gbrmant. — The small local societies are affiliated to one large parent body, the Deutsche Kunstlergenossenschafi, in Berlin under the presidency of Anton von Werner. The Deutsche Illustrato- renverband watches over the interests of illustrators and designers. In jMunich there are two bodies — the Old Society of Artists, hold- ing its exhibitions in the Glaspalast, and the Secession.

Italy. — Four exhibiting societies : Eome, Society in Arte Libertas, Seuela degli Aquarellisti; Milan, Famiglia Artistica, Societa degli Artiste ;

Florence, Oircolo Artistica ; Naples, Instituti di Belli Arti.

Portugal. — Sociedade promotora das Bellas-Artes and Cfremio Artistico.

Russia. — There is no exclusively art society of importance, but there is at St Petersburg the SociUi Litteraire et Artistique.

Spain. — Madrid, L^ Association des Artistes E^agnols.

Sweden. — Stockholm, Svenska Koustuareruas Forening.

Switzerland. — Berne, La Sociite des Peintres et Sculpteurs

United States. — New York, the Academy of Fine Arts, the French Institute; Boston, Massachusetts Institute of Technology (founded 1861). (a. 0. R. C.)

Art Teaching. — It is the tendency of all depart- ments of the human mind to outgrow their original limits. Traditions of teaching are long-lived, especially in art, and new ideas only slowly displace the old, so that art teach- ing as a whole is seldom abreast of the ideas and practice of the more advanced artists. The old academic system adapted to the methods and aims iu art in the 18th century, which has been carried on in the principal art schools of Great Britain with but slight changes of method, con- sisted chiefly of a course of drawing from casts of antique statues in outline, and in light and shade, without back- grounds, of anatomical drawings, perspective, and drawing and painting from the living model. Such a training seems to be more or less a response to Lessing's definition of painting as " the imitation of solid bodies upon a plane surface." It seems to have been influenced more by the sculptor's art than any other. Indeed, the academic teach- ing from the time of the Italian Renaissance was no doubt principally derived from the study of antique sculpture; the proportions of the figure, the style, pose, and sentiment being all taken from Greeco-Roman and Roman sculptures, discovered so abundantly in Italy from the 16th century onwards. As British ideas of art were principally derived from Italy, British academies endeavoured to follow the methods of teaching in vogue there in later times, and so the art student in Great Britain has had his attention and efforts directed

almost exclusively to the representation of the abstract human form in abstract relief. Traditions in

art, however, may sometimes prove helpful and beneficial, and preservative of beauty and character, as in the case of certain decorative and constructive arts and handicrafts in common use, such as those of the rural waggon-maker and wheelwright, and horse-harness maker (see Academy, Eotal).

Some schools of painting, sculpture, and architecture have preserved fine and noble traditions which yet allowed for individuality. Such traditions may be said to have been characteristic of the art of the Middle Ages. It often happens, too, when many streams of artistic infiuence meet, there may be a certain domination or ascendency of the traditions of one art over the others, which is injurious in its effects on those arts and diverts them from their true path. The domination of individualistic painting and sculpture over the arts of design during the last century or two is a case in point.

With the awakening of interest in industrial art — sharply separated by pedantic classification from fine art — which began about the middle of the 19th century, schools of design were established which included more varied studies. Even as early as 1836 a Government grant was made towards the opening of public galleries and the establishment of a normal school of design with a museum and lectures, and in 1837 the first school o;f design was opened at Somerset House. In 1840 grants were made to establish schools of the same kind in provincial towns, such as Manchester, Birmingham, Glasgow, Leeds, and Paisley. The names of G. Wallis in 1847, and Ambrose Povnter in 1850, are associated with schemes of art in- stracuon adopted in the Government art schools, and

the year 1851, the year of the Great Exhibition, was also marked by the first public exhibition of students' works, and tae lirdt institution of prizes and scholarships. In 1852 " thi Department of Practical Art‘ was constituted, and a museum of objects collected at Marlborough House which afterwards formed the nucleus of the future museum at South Kensington. In 1853 "The Depart- ment of Science and Art " was established, and in 1857, under the auspices of Henry Cole, the offices of the department and the National Art Training School were removed from Marlborough House to South Kensington. Classes for instruction in various crafts had been carried on both at Somerset House and Marlborough House, and the whole object of the Government schools of design was to give an artistic training to the designer and craftsman, so that he could carry back to his trade or craft improved taste and skill. The schools, however, became largely filled by students of another type — ^leisured amateurs who sought to acquire some artistic accomplishment, and even in the case of genuine designers and craftsmen who developed pictorial skill in their studies, the attraction and superior social distinction and possibility of superior commercial value accruing to the career of a painter of easel pictures, diverted the schools from their original purpose.

For some time after the removal to South Kensington, during the progress of the new buildings, and under the direction of Godfrey Sykes and F. W. Moody, practical decorative work both in modelling and painting was car- ried out in the National Art Training School ; but on the completion of these works, the school relapsed into a more or less academic school on the ordinaiy lines, and was regarded chiefly as a school for the training of art teachers and masters who were required to pass through certain stereotyped courses, and execute a certain series of drawings in order to obtain their certificates. Thus model-drawing, freehand outline, plant-drawing in outline, outline from the cast, light and shade from the cast, drawing of the antique figure, still life, anatomical draw- ings, drawing and painting from the life, ornamental

design, historic studies of ornament, perspective, and geometry, were all taken up in a cut-and-dried way, as isolated studies, and with a view solely to obtaining the certificate or passing an examination. This theoretic kind

of training though still in force, and though it enabled the department to turn out certificated teachers for the schools of the country of a certain standard, and to give to students a general theoretic idea of art, has been found wanting, since, in practice, when the student in design leaves his school and desires to take up practical work as a designer or craftsman, he requires special knowledge, and specialized skill in design for his work to be of use ; and though he may be able to impart to others what he himself has laboriously acquired, the theoretic and general character of his training proves of little or no use, face to face with the ever shifting and changing demands of the modern manufacturer and the modern market.

A growing conviction of the inadequacy of the schools of the Science and Art Department (now the Board of Education), considered as training grounds for practical designers and craftsmen, led to the establishment of new technical schools in the principal towns of Great Britain. The circumstance of certain large sums, diverted from their original purpose of compensation to brewers, being available for educational purposes and at the disposal of the county councils and municipal bodies, provided the means for the building and equipment of these new technical schools, which in many cases are under the same roof as the "^.rt school in the provincial towns, although the connexion between the two is not so close as might be desirable. The art schools formerly managed by private committees and supported by private donors, assisted by the Government grants, are now, in the principal industrial towns of Great Britain, taken over by the municipality. Birmingham is singularly well organ- ized in this respect, and its art school has long held a leading position. The school is well housed in a new building with class-rooms with every appliance, not only for the drawing, designing, and modelling side, but also for the practice of artistic handicrafts such as metal repousse, enamelling, wood-carving, embroidery, &c. The municipality have also established a jewellery school, so as to associate the practical study of art with local industry. Manchester will shortly have a large new technical school, intended to combine the work of the existing technical school in Princess Street and the weaving school in Peter Street under one roof, with special classes for design; while the art school in Cavendish Street, with its museum, may remain as a high school of design, painting, and

modelling. In Glasgow, which has now a distinct place in the modern development of art, both decorative and pictorial, under the headmastership of Mr Francis H. Newbery, the art schools are also under municipal management, and large new premises have been completed for the extension of work in the technical and practical direction. Leicester has an admirably equipped and organized art school' in a fine building.

The important change involved in the incorporation of the Science and Art Department with the Board of Education has also led to a reorganization of the Eoyal College of Art. A special Council of Advice on art matters has been appointed, consisting of representatives of painting, sculpture, architecture, and design, who deal with the Royal College of Art, and appoint the professors . who control the teaching in the classes for architecture, design and handicraft, decorative painting and sculpture, modelling, and carving. The council decide upon the curriculum, and examine and criticize the work of the college from time to time. They also advise the Board in

regard to the syllabus issued to the art schools of the country, and act as referees in regard to purchases for the museum. New buildings for the Eoyal College of Art will be added to the new museum building now in course of erection. There will be a lower and a higher school in the college, and provision will be made for the practice "of the artistic handicrafts. An etching and en- graving class has existed since 1864. A stained-glass class was instituted in 1899, and these will be followed by classes for stone and marble carving, for metal work, and for pottery, while others will be added as space and organization admit.

Of other institutions for. the teaching of art, outside the Scierice and Art Department, the following may be named: The Eoyal Drawing Society of Great Britain and Ireland, which was formed principally to promote the teaching of drawing in schools as a means of educa- tion. The system therein adopted differs from the ordinary drawing courses, and favours the use of the brush. Brush-work has generally been adopted for

elementary work, too, by London school-board teachers, drawing being now a compulsory subject. Remarkable results have been obtained by the Alma Road board schools in the teaching of boys from eight to twelve by giving them spaces to fill with given forms — leaf shapes — from which patterns are constructed to fill the spaces, brush and water-colour being the means em- ployed. At the Female School of Art in Queen Square, London, classes in drawing and painting from life are held, and decorative design is also studied. At the Herkomer Incorporated School, at Bushey, directed by Prof. H. von Herkomer, E.A., according to his own methods, students are instructed in drawing, painting, and engraving. The school is limited to 100 students. The City and Guilds of London Institute has two depart- ments for what is termed " applied " art, one at the South London School of Technical Art, and the other at the Art Department in the Technical College, Finsbury. There are also the Eoyal School of Art Needlework ; the School of Art Wood-carving; and the School of Art at the Crystal Palace. The Slade School of Drawing, Painting, and Sculpture, University College, Gower Street, confines itself to drawing and painting from the antique and life, and exercise in pictorial composition. There are also lectures on anatomy and perspecjbive. The Slade Pro- fessorships at Oxford and Cambridge Universities are concerned with the teaching and literature of art, but they do not concern themselves with the practice. There are also, in addition to the schools of art named and those in connexion with the Board of Education in the various districts of London and the country, many and various private schools and clubs, such as the Langham and " Heatherley's," chiefly concerned in encouraging draw- ing and painting from the life, and for the study of art from the pictorial point of view, or for the preparation of candidates for admission into the Eoyal Academy or other schools.

A general survey, therefore, of the various institutions which are established for the teaching of art in Great Britain gives the impression that the study of art is not neglected, although, perhaps, further inquiry might show that, compared to the great educational establishments, the proportion is not excessive. With the board schools teaching art, as well as the mimicipal art schools and schools in connexion with tho Board of Education, the danger is of waste of energy and of overlapping in the various courses. This danger suggests that a well-defined progressive

system might be arranged so that a school- board scholar who shows artistic ability might be enabled to pass on from the elementary classes in one school to the higher art and technical schbols, secondary and advanced,

without retracing his steps, thus escaping the depression of going over old ground.

The general movement of revival of interest iii the arts of deco- rative design and the allied handicrafts, with the desire to re- establish their influence in art-teaching, has been due' to many causes, among which the work of the Arts and Crafts Exhibition Society may count as important. From the leading members of this body the London County Council Technical Education Board, when it was face to face with the problem of organizing its new schools and its technical classes, sought advice and aid. Success has attended their schools, especially the Central School of Arts and Crafts at Morley Hall, Regent Street. The object of ,the school is to provide the craftsman in the various branches of decorative design with such means of improving his taste and skill as the workshop does not afford. It does not coticeru itself with the amateur or with theoretic drawing. The main difference in principle adopted in this school in the teaching of design is the absence of teaching design apart from handicraft. It is considered that a craftsman thoroughly acquainted with the natural capacities of his material and strictly understanding the conditions of his work, would be able, if he had any feeling or invention, to design appropriately in that material, and no desiring can be good apart from a knowledge of the material in which it is intended to be carried out. It should be remembered too that graphic skill in representing the appearances of natural objects is one sort of skill, and the execu- tive skiU of the Craftsman in working out his design, say, in wood or metal, is quite another. It follows that the works of drawing or design made by the craftsman would be of quite a different charac- ter from a pictorial drawing, and might be quite simple and abstract, while clear and accurate. The training for the pictorial artist and for the craftsman would, therefore, naturally be different.

The character of the art-teaching adopted in any country must of course depend upon the dominant conception of art and its function and purpose. If we regard it as an idle accomplishment for the leisured few, its methods will be amateurish and superficial. If we regard art as an important factor in education, as a language of the intelligence, as an indispensable companion to literature, we shall favour systematic study and a training in the power of direct expression by means of line. We shall value the symbolic drawing of early civilizations like the Egyptian, and symbolic art generally, and in the history of decorative art we shall find the true accom- paniment and illustration of human history itself. From this point of view we shall value the acquisition of the power of draw- ing for the purpose of presenting and explaining the facts and forms of nature. Drawing will be the most direct means at the command of the teacher to explain, to expound, to demonstrate where mere words are not sufBciently definite or explicit. Drawing in this sense is taking a more important place in our education, especially in primary education, though there is no need for it to stop there, and one feels it may be destined to take a more im- portant position both as a training for the eye and hand and an aid to the teacher. Then, again, we may regard art more from its social aspect as an essential accompaniment of human life, not only for its illustrative and depicting powers, but also and no less for its pleasure-giving properties, its power of awakening and stimu- lating the observation and sympathy with the moods of nature, its power of touching the emotions, and above all of appealing to our sense of beauty. We shall regard the study of art from this point of view as the greatest civilizer, the most permeating of social and human forces. Such ideas as these, shared no doubt by all who take pleasure and interest in art, or feel it to be an important element in their lives, are crossed and often obscured by a multitude of mundane considerations, and it is probably out of the struggle for ascendency between these that our systems of art teaching are evolved. There is the demand of the right to live on the part of the artist, and the teacher of art. There is the demand on the part of the manufacturer and salesman for such art as will help him to dispose of his goods. In the present commercial rivalry between, nations this latter demand is brought into promi- nent relief, and art is apt to be made a minister, or perhaps a slave to the market. These are but accidental relationships with art. All who care for art value it as a means of

expression and for the pleasure and bea.uty it infuses into all it touches, or as essential and inseparable from life itself. Seeing then the im- portance of art from any point of view, individual, social, com- mercial, intellectual, emotional, economic, it should be important to us in our systems of art-teaching not to lose sight of the end in arranging the means — ^not to allow our teaching to be dominated by either dilettantism or commercialism, neither to be feeble for want of technical skill, nor to sacrifice everything to technique. The true object of art-teaching is very much like that of all educa- tion— to inform the m^nd, while you give skill to the hand — not to impose certain rigid rules, or fixed recipes and methods of work, but while giving Instruction in definite methods and the use of materials, to allow for the individual development of the student

and enable him to acquire the power to express himself through different media without forgetting the grammar and alphabet of design. Practice may vary, but principles remain, and there is a certain logic in art, as well as in reasoning. All art is con- ditioned in the mode of its expression by its material, and even the most individual kind of art has a convention of its own by the very necessities and means of its existence. Methods of expression, conventions, alter as each artist, each age seeks some new interpre- tation of nature and the imagination — the well-springs oiE artistic life, and from these reviving streams continually flow new harmonies,

new inventions, and reconfbinations, taking form and colour accord- ing to the temperaments which give them birth. (W. Ce.)

Arta, a town of Thessaly, in Greece, in the province of Arta, 59 miles N.N.W. of Mesolonghi, on the river Arta, which enters the Gulf of Arta some distance south of the town. The battle of Actium was fought near the mouth of the gulf in 29 b.o. The population is now about

7000.

ARTHROPODA.

ARTHKOPODA is the name of one of the three sub- phyla into which one of the great phyla (or primary branches) of ccelomoccBlous animals — the Appendiculata — is divided ; the other two ^eing respectively the Chseto- poda and the Rotif era. The word ” Arthropoda ” was first used in classification by Siebold and Stannius {Lehrbuch der vergleich Anatomie, Berlin, 1845) as that of a primary division of animals, the others recognized in that treatise being Protozoa, Zoophyta, Vermes, MoUusca, and Verte- brata. The names Condylopoda and Gnathopoda have been subsequently proposed for the same group. The word refers to the jointing of the chitinized exo-skeleton of the limbs or lateral appendages of the animals included, which are, roughly speaking, the Crustacea, Arachnida, Hexa- poda (so-called “true insects”). Centipedes, and Milli- pedes. This primary group was set up to indicate the residuum of Cuvier’s Articulata when his class Annelides (the modern Chsetopoda) was removed from that ” embranchement.” At the same time Siebold and Stannius renovated the group Vermes of Linnaeus, and placed in it the Chsetopods and the parasitic worms of Cuvier, besides the Eotifers and Turbellarian worms.’

The result of the knowledge gained in the last quarter of the 19th century has been to discredit altogether the group Vermes, thus set up and so largely accepted by German writers even at the present day. We have, in fact, returned very nearly to Cuvier’s conception of a great division or branch, which he called Articulata, including

1 As a matter of fact the group Arthropoda itself, thus constituted, was precisely identical In its area with the class Insecta of Linnaeus, the Entoma of Aristotle. But by causes which it is not easy to trace the word “Insect” had become limited since the days of Linnaeus to the Hexapod Pterygote forms to the exclusion of his Aptera. Lamarck’s penetrating genius is chiefly responsible for the shrinkage of the word Insecta, since it was he who, forty years after Liniseus’s death, set up and named the two great classes Crustacea and Arachnida (included by Linnaeus under Insecta as the order ” Aptera “), assign- ing to them equal rank with the remaining Insecta of Linnaeus, for which he proposed the very

appropriate class-name " Hexapoda." Lamarck, however, appears not to have insisted on this name Hexa- poda, and so the class of Pterygote Hexapods came to retain the group-name Insecta, which is, historically or etymologically, no more appropriate to them than it is to the classes Crustacea and Arachnida. The tendency to retain the original name of an old and comprehensive group for one of the fragments into which such group becomes divided by the advance of knowledge — instead of keeping the name for its logical use as a comprehensive term, including the new divisions, each duly provided with a new name— is most curiously illustrated in the history of the word Physiology. Cicero says, "Physiologia naturae ratio," and such was the meaning of the name Physiologus, given to a cyclopaedia of what was known and imagined about earth, sea, sky, birds, beasts, and fishes, which for a thousand years was the authori- tative source of information on these matters, and was translated into every European tongue. With the revival of learning, however, first one anil then another special study became recognized— anatomy, botany, zoology, mineralogy, until at last the great comprehensive term Physiology was bereft of all its once-included subject-matter, excepting the study of vital processes pursued by the more learned members of the medical profession. Professional tradition and an astute perception on their part of the omniscience suggested by the terms, have left the medical men in English-speaking lands in undis- turbed but illogical possession of the words physiology, physic, and physician.

the Arthropoda and the Chsetopoda (Annelides of Lamarck, a name adopted by Cuvier), and differing from it only by the inclusion of the Eotifera. The name Articulata, in- troduced by Cuvier, has not been retained by subsequent writers. The same, .or nearly the same, assemblage of animals has been called Entomozoaria by De Blainville (1822), Arthrozoa by Burmeister (1843), Entomozoa or Annellata by Milne-Edwards (1855), and Annulosa by M'Leay (1819), who was followed by Huxley (1866). The character pointed to by all these terms is that of a ring-like segmentation of the body. This, however, is not the character to which we now ascribe the chief weight as evidence of the genetic af&nity and monophyletic (uni- ancestral) origin of the Chsetopods, Eotifers, and Arthro-, pods. It is the existence in each ring of the body of a pair of hollow lateral appendages or parapodia, moved by

intrinsic muscles and penetrated by blood-spaces, which is the leading fact indicating the affinities of these great sub-phyla, and uniting them as blood-relations. The parapodia (Eig. 7) of the marine branchiate worms are the same things genetically as the "legs" of Crus- tacea and Insects (Figs. 9 and 10). Hence the term Appendiculata was introduced by Lankester (preface to the English edition of Gegenbaur's Comparative Ana- tomy, 1878) to indicate the group. The relationships of the Arthropoda thus stated are shown in the sub- joined table: —

f Sub-phylum 1. Rotifera. Phylum-AppENDiCDLATA -I ,, 2. Chsetopoda.

L „ 3. Arthropoda.

The RoTiFEKA are characterized by the retention of what appears in Molluscs and Chsetopods as an embry- onic organ, the velum or ciliated prseoral girdle, as a locomotor and food-seizing apparatus, and by the reduc- tion of the muscular parapodia to a rudimentary or non-existent condition in all present surviving forms except Pedalion. In many important respects they are degenerate — reduced both in size and elaboration of structure.

The Chsetopoda are characterized by the possession of horny epidermic chsetse embedded in the integument and moved by muscles. Probably the chsetse preceded the development of parapodia, and by their concentration and that of the muscular bundles connected with them at the sides of each segment, led directly to the evolution of the parapodia. The parapodia of Chsetopoda are never coated with dense chitin, and are, therefore, never converted into jaws ; the primitive " head-lobe " or prosto- mium persists, and frequently carries eyes and sensory tentacles. Further, in all members of the sub-phy- lum Chsetopoda the relative position of the prostomium, mouth, and peristomium or first ring of the body, re- tains its pririiitive character. We do not find in Chseto- poda that parapodia, belonging to primitively postoral rings or body-segments (called "somites," as proposed

by H. Milne-Edwards), pass in front of the mouth by adaptational shifting of the oral aperture. (See, how- ever, 8.) ^ '

The Akthropoda might be better called the " Gnatho- poda," since their distinctive character is, that one or more pairs of appendages behind the mouth are densely chitin- ized and turned (fellow to fellow on opposite sides) towards one another so as to act as jaws. This is facilitated by an important general change in the position of the parapodia ; their basal attachments are all more ventral in position than in the Chaetopoda, and tend to approach from the two sides towards the mid-ventral line. Very usually (but notintheOnychophora=Pen>afMs)allthe parapodia are plated with chitin secreted by the epidermis, and divided into a series of joints — giving the " arthropodous " or hinged character.

There are other remarkable and distinctive features of structure which hold the Arthropoda together, and render it impossible to conceive of them as having a polyphyletic origin, that is to say, as having originated separately by two or three distinct lines of descent from lower animals ; and, on the contrary, establish the view that they have been developed from a single line of primitive G-natho- pods which arose by modification of parapodiate annulate worms not very unlike some of the existing Chsetopods. These additional features are the following — (1) All existing Arthropoda have an ostiate heart and have undergone " phleboedesis," that is to say, the peripheral portions of the blood-vascular system are not fine tubes as they are in the Chaetopoda and as they were in the hypo- thetical ancestors of Arthropoda, but are swollen so as to obliterate to a large extent the ccelom, whilst the separate veins entering the dorsal vessel or heart have coalesced, leaving valvate ostia(see Fig. 1) by which the blood passes from a pericardial blood-sinus formed by the fused veins into the dorsal vessel or heart (seeLankester's Zoology, part ii., introductory chapter. A. & C. Black, 1900). The only exception to this is in the case of minute degenerate forms where the heart has disappeared altogether. The rigidity of the integument caused by the deposition of dense chitin upon it is intimately connected with the physiological ac- tivity and form of all the internal organs, and is undoubt-*

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Fis. 1. — Diagram to show the gradual formation of the Arthropod pericardial blood-sinus and "ostiate" heart by the sw'elling up (phleboedesis) of the veins entering the dorsal vessel or heart of a Ghsstopod-like ancestor. The figure on the left represents the condition in a Ghsetopod, that on the right the condition in an Arthropod, the other two are hypothetical intermediate forms. (After Lankester, Q. J. Mia. Sal. vol. xxxiv. 1898.)*

edly correlated with the total disappearance of the circular muscular layer of the body-wall present in Chsetopods. (2) In all existing Arthropoda the region in front of the mouth is no longer formed by the primitive prostomium or head-lobe, but one or more segments, originally post-oral, with their appendages have passed in front of the mouth (prosthomeres). At the same time the prostomium and its appendages cease to be recognizable as distinct elements of the head. The brain no longer consists solely of the,nerve- ganglion-mass proper to the prostomial lobe, as in Chaeto- poda, but is a composite (syncerebrum) produced by the

fusion of this and the nerve-ganglion-masses proper to the prosthomeres or segments which pass forwards, whilst their parapodia (= appendages) become converted into eye-stalks, and antennae, or more rarely grasping organs. (3) As in Chaetopoda, coelomio funnels (ccslomoducts) may occur right and left as pairs in each ring-like segment or somite of the body, and some of these are in all cases retained as gonoducts and often as renaL, excretory organs (green glands, coxal glands of Arach- niyia, not crural glands, which are epidermal in origin); but true nephridia, genetically identical with the nephridia of earthworms, do not occur (on the subject of ccelom, ccelomoducts, and nephridia, see the intro- ductory chapter of part ii. of Lankester's Treatise on Zoology).

Tabular Statement of the Grades, Classes, and Sub- classes of the Arthropoda. — It will be convenient now to give in the clearest form a

statement of the larger sub- . divisions of the Arthropoda which it seems necessary to, recognize at the present day. The justification of the arrangement adopted will form the substance of the rest of the present article. The orders included in the various classes are not discussed here, but are treated of under the following titles : — Pbkipatus (Onychophora), Myeiapoda (Diplopoda and Chilopoda), Aeachnida, Insbcta (Hexapoda), and Ckustacea.

Sub-Phylum AETHEOPODA (of the Phylum Appendiculata).

Grade A. Hyparthropoda (hypothetical forms connecting an- cestors of Chaetopoda with those of Arthropoda). Grade B. Protarthropoda. Class Ontchophoka. Ex. — Peripatus. Grade C. Euarthropoda. Class 1. Diplopoda.

Ex. — Julus. Class 2. Akaohitida.

Grade a. Anomomeristica.

Ex. — Phacops. Grade 6. Nomomeristioa. (a) Pantopoda.

Ex. — Pycnogonum. (6) Euarachnida.

Ex. — lAmulus, Scorpio, Mygale, Acarus. Class 3. Ceustacea.

Grade a. Entomostraca.

Ex. — Apus, Branchipus, Cyclops, Balanus. Grade 6. Malacostraca.

Ex. — Nebalia, Astacus, Oniscus, Gammarus. Class 4. Chilopoda.

Ex. — Scolopendra. Class 5. Hexapoda (syn. Insecta Pterygota).

Ex.— ZocMsto, Phryganea, Papilio, Apis, Musca, Cimez, Lucanus, Mdchilis.

Jftcertce sedis— Tardigrada, Pentastomidae (degenerate forms).

The Segmentation of the Body of Arthropoda. — The body of the Arthropoda is more or less clearly divided into a series of rings, segments, or somites which can be shown to be repetitions one of another, possessing identical parts and organs which may be larger or smaller, modified in shape or altogether suppressed in one somite as compared with another. A similar constitution of the body is more clearly seeri in the Ghsetopod worms. In the Vertebrata also a repetition of units of structure (myotomes, vertebree, «&c.)— which is essentially of the same nature as the repetition in Arthropods and Chsetopods, but in many respects subject to peculiar developments — is observed. The name ” metamerism ” has been given to this structural phenomenon because the ” meres,” or repeated units, follow one another in line. Each such ” mere ” is often called a ” metamere.” This is not the place in which to discuss the origin and essential nature of “metamerism” or ” metameric segmentation.” Nevertheless, a satisfactory

consideration of the structure of the Arthropoda demands a knowledge of what may be called the laws of metamerism. These are not so fully ascertained or formvilated as might be expected. The repetition of parts, which we note as metamerism, is, as Haeckel, Bateson, and others have recognized, only a special case of a tendency of the organic body to repetition of structural units or parts which finds one expression in bilateral symmetry. In certain worms (the Cestoidea and some Planarians) metameric segmen- tation is accompanied by the separation of the completed metameres one by one from the older (anterior) extremity of the chain (strobilation), but it by no means follows that metameric segmentation has a necessary origin in such completion and separation of the “meres.” On the contrary, metamerism seems to arise from a property of organisms which is sometimes more (eumerogenesis) and sometimes less (dysmerogenesis) fully exhibited, and in some groups not exhibited at all. The most complete and, at the same time, simplest instances of metameric segmen- tation are to be seen in the larger Chsetopods, where some hundreds of segments succeed one another —

each practi- cally indistinguishable in structure from ,the segment in front or from that behind ; muscles, right and left append- age or parapodium, colour-pattern of the skin, gut, blood- vessels, coelom, nephridia, nerve-ganglion, and nerves are precisely alike in neighbouring segments. The segment which is least like the others is the first, for that carries the mouth and a lobe projecting beyond it — the prosto- mium. If (as sometimes happens) any of the hinder seg- ments completes itself by developing a prostomium, the chain breaks at that point and the segment which has developed a prostomium becomes the ficst or head-bearing segment of a new individual. Compare such an instance of metameric segmentation with that presented by one of the higher Arthropods — e.g., the crayfish. Here the somites are not so clearly marked in the teg^mentary structures ; nevertheless, by examining the indications given by the paired parapodia, we find that there are twenty-one somites present — a limited definite number which is also the precise number found in all the higher Crustacea.

We can state as a First Law^ of metamerism or somite formation that it is either indefinite in regard to number of metameres or somites produced or is definite. Animals in the first case we call anomomeristic ; those in the second case, nomomeristic. The nomomeristic condition is a higher development, a specialization, of the anomomeristic condition.

The Second Law, or generalization, as to metamerism which must be noted is that the meres or somites (excepting the first with its pro- stomium) may be aU practically alike or may differ from one another greatly by modification of the various constituent parts of the mere or somite. Metamerized animals are either homoeomeric or heteromeric. The reference to the variation in the form of the essential parts contained in a " metamere " or " somite " Introduces us to the necessity of a general term for these constituent or subordinate parts; they may be called "meromes" (itipos). The meromes present in a metamere or somite differ in different annulate or segmented animals according to the general organiza- tion of the group to which th^ animal belongs. As a matter of convenience we distinguish in the Arthropod as meromes, first, the tegumentary chitinized plates called terga, placed on the dorsal aspect of the somites; second, the similar sternal plates. In Chsetopods we should

take next to these the masses of circular and longitudinal muscular fibres of the body-wall and the dorso- ventral muscles. The latter form the third sort of merome present in the Arthropods. The fourth kind of merome is constituted by the parapodia or appendages ; the fifth by the coelomic pouches and their ducts and external apertures (ooelomoducts), whether renal or genital. The sixth by the blood-vessels of the somite ; the seventh by the bit of alimentary tract which traverses it; and the eighth by the neuromere (nerve ganglion pair, commissures, connectives, and nerve branches).

iThe word "Law" is used in this summary merely as a con- venient heading for the statement^of a more or less general propo- sition.

It becomes apparent from this enumeration that there are a good many important elements or ' ' meromes ' ' in an. Arthropod metamere or somite which can become the subject of heteromerism, or, to use a more apt word, of " heterosis." It is all the more necessary to insist upon this inasmuch as there is a tendency in the discus- sion of the segmentation of the Arthropod body to rely exclusively upon the indications given by the tegumentary chitinous plates and the parapodia.

The Thikd Law of metamerism is that heteromerism may operate in such a way as to produce definite regions of like modification of the somites and their appendages, differing in their modification from that observed in regions before and behind them. It is convenient to have a special word for such regions of like m eres, and we call each a tagma (ray/m, a regiment). The word " tagmosis " is applicable to the formation of such regions. In the Chsetopods tagmosis always occurs to a small extent so as to form the head. In some Chsetopods, such as Chsetopterus and the sedentary forms, there is marked tagmosis, giving rise to three or even more lagmata. In Arthropods, besides the head, we find very frequently other tagmata developed. But it is to be noted that in the higher members of each great class or line of descent, the tagmosis becomes definite and characteristic just as do the total number of meres or somites, whilst in the lower grades of each great class we find what may be regarded as varying examples of tentative tagmosis. The terms nombtagmio and

anomotagmic are applicable with the same kind of implication as the terms nomomeristic and anomo- meristic.

The rocKTH Law of metamerism (auto-hetorosis of the meromes) is that the meromes of a somite or series of somites may be separately and dissimilarly affected by heteromerism. It is common enough for small changes only to occur in the inner visceral meromes whilst the appendages and terga or sterna are largely changed in form. But of equal importance is the independent "heterosis" of these visceral meromes without any corresponding heterosis of the body-wall. As instances, we may cite the gizzards of various earthworms and the special localization of renal, genital, and gastric meromes, with obliteration elsewhere, in a few somites in Arthropoda.

The Fifth Law, relating also to the independence of the meromes as compared with the whole somite, is the law of autorhythmus of the meromes. Metamerism does not always manifest itself in the formation of complete new segments ; but one merome may be repeated so as to suggest several metameres, whilst the remaining meromes are, so to speak, out of harmony with it and exhibit no repetition. Thus in the hinder somites of the body of A pus the Crustacean we find a series of segments corresponding apparently each to a complete single somite, but when the appendages are examined we find that they have multiplied without relation to the other meromes of a somite ; we find that the somites carry from two to seven pairs of appendages, increasing in number as we pass backwards from the genital segment. The appendages are autorhythmic meromes in this case. They take on a quasi-independent metamerism and are produced in numbers which have no relation to the numbers of the body-rings, muscles, and neuro- meres. This possibility of the independent metameric multiplication of a single merome must have great importance in the case of dislocated meromes, and no doubt has application to some of the metameric phenomena of Vertebrates.

A case which appears at first sight to be one of " autorhythmus " of the parapodia is that of the Diplopods (Julus, etc.), in which each apparent somite carries two pairs of legs or parapodia. It looks at first as though

this were due to the independent multi- plication of the legs ; but it is not. Contrary to, what obtains in Apus, we find in Julus that there is a well-marked somite in the embryo corresponding to each pair of legs and that the adult condition arises from a fusion of the tegumentary meromes of adjacent somites (see below " Fusion").

The Sixth Law is the law of dislocation of meromes. This is a very important and striking phenomenon. A merome, such as a pair of appendages (Aranese) or a neuromere or a muscular mass (frequent), may (by either a gradual or sudden process, we cannot always say which) quit the metamere to which it belongs, and in which it Originated, and pass by actual physical transference to an- other metamere. Frequently this new position is at a distance of several metameres from that to which the wandering merome belongs in origin. The movement is more usual from behind forwards than in the reverse direction ; but this, probably, has no profound significance and depends simply on the fact that, as a rule, the head must be the chief region of development on account of its containing the sense organs and the mouth.

In the Vertebrata the independence of the meromes 's more fully developed than in other metamerized animals. Not only do we get auto-heterosis of the meromes on a most extensive scale, but the dislocation of single meromes and of whole series (tagmata) of meromes is a common phenomenon. Thus, in fishes the pelvic fins may travel forwards to a thoracic and even jugal position in

front of the pectoral fins ; the branohiomeromes lose all relation to the position of the meromes of muscular, skeletal, coelomio, and nervous nature, and the heart and its vessels may move backwards from their original metameres in higher Vertebrates carrying nerve- loops with them.

The Seventh Law of metamerism is one which has been pointed out to the writer by Mr E. S. Goodrich of Merton College, Oxford. It may be called the law of "translation of heterosis." Whilst actual physical transference

of the substance of meromes undeniably takes place in such a case as the passage of the pelvic fins of some fishes to the front of the pectorals, and in the case of the backward movement of the opisthosomatic appendages of spiders, yet the more frequent mode in which an alteration in the position of a specialized organ In the series or scale of metameres takes place is not by migration of the actual material organ from somite to somite, but by translation of the quality or morphogenetio peculiarity from somite to somite accompanied by correlative change in all the somites of the series. The phenomenon may be compared to the transposition of a piece of music to a higher or lower key. It is thus that the lateral fins of fishes move up and down the scale of vertebral somites ; and thus that whole regions (tagmata), such as those indicated by the names cervical, thoracic, lumbar, and sacral, are translated (accompanied by terminal increase or decrease in the total number of somites) so as to occupy differing numerical positions in closely allied forms (cf . the varying number of cervical somites in allied Eeptiles and Birds) .

What, in this rapid enumeration, we will venture to call the Eighth Law of metamerism is the law of homoeosis, as it is termed by Bateson (1). Homoeosis is the making of a merome into the likeness of one belonging to another metamere, and is the opposite of the process of "heterosis" — already mentioned. We cite this law here because the result of its operation is to simulate the occurrence of dislocation of meromes and has to be carefully dis- tinguished from that process. A merome can and does in individual cases of abnormality assume the form and character of the corre- sponding merome of a distant somite. Thus the antenna of an insect has been found to be replaced by a perfectly well-formed walking leg. After destruction of the eye-stalk of a shrimp a new growth appears, having the form of an antenna. Other cases are frequent in Crustacea, as individual abnormalities. They prove the existence in the mechanism of metamerized animals, of structural conditions which are capable of giving these results. What those structural conditions are is a matter for separate inquiry, which we cannot even touch here. . It is not improbable that homoeosis of dis- tant meromes may have given rise to permanent structural changes characteristic of whole groups of Arthropoda, supposing the abnor- mality once established to be favoured by natural selection. Pos- sibly the chelate condition of the prse-oral appendages of

Arachnida may be due to homoeosis transferring the chelate form of post-oral limbs to what were previously antennif orm rami.

We now come to the questions of the production of new somites or the addition of new somites to the series, and the converse prob- lem of the suppression of somites, whole or partial. We state as the Ninth Law of metamerism "that new somites or metameres are added to a chain consisting of two or more somites by growth and gradual elaboration — ^what is called ' budding ' — of the anterior Ijorder of the hindermost somite. This hindermost somite is there- fore different from all the other somites and is called the 'telson.' However long or short; or heteromized the chain may be, new metameres or somites are only produced at the anterior border of the telson, except in the Vertebrata.' ' That is the general law. But amongst some groups of metamerized animals partial exceptions to it occur. It is probably absolutely true for the Arthropoda from lowest to highest. It is npt so certain that it is true for the Chsetopoda and would need modification in statement to meet the oases of fissiparous multiplication occurring among Syllids and Naidids. In the Vertebrata, where tagmosis and heterosis of meromes and dislocation of meromes and tagmata are, so to speak, rampant, new formation of metameres (at any rate as represented by important meromes) takes place at more than one point in the chain. Such points are found where two highly diverse " tagmata" abut on one another. It is possible, though the evidence at present is entirely against the supposition, that at such points in Arthropoda new somites may be formed, i Such new somites are said to be " intercalated." The question of the intercalation of vertebrse in the Vertebrata has received some attention. It must be remembered that a vertebra even taken with its muscular, vascular, and neural accessories is only a partial metamere — a merome, and that, so far as complete metameres are concerned, the Vertebrata do conform

1 The curious case of superabundant parapodia in the hinder so- mites of Apus has already been cited and referred to as an example p{ autorhythmic multiplication of meromes. There is some reason for regarding the extra pairs of legs as being "intercalated" after the formation of the somite as a single unit or merome by growth from the telson.' Supposing, as appears to be the ease, that as the Apus increases

to the same law as Xhe Arthropods. Intercalation of meromes, branchial, vertebral, and dermal (fin-supports) seems to have taken place in Vertebrata in the fishes, while in higher groups intercala- tion of vertebrae in large series has been accepted as the only possible explanation of the structural facts established by the comparison of allied groups. The elucidation of this matter forms a very im- portant part of the work lying to the hand of the investigator of vertebrate anatomy, and it is possible that the application of Goodrich's law (the seventh of our list) may throw new light on the matter.

In regard to the diminution in the number of somites m the course of the historical development of those various groups of metamerized animals, which have undoubtedly sprung from ances- tors with more numerous somites than they themselves possess, it appears that we may formulate the following laws as the tenth, eleventh, twelfth, and thirteenth laws of metamerism.

jhe Tenth Law is that individual somites tend to atrophy and finally disappear as distinct structures, most readily at the anterior and the posterior ends of the series constituting an animal body. This is very generally exhibited in the head of Arthropoda, where, however, the operation of the law is largely modified by fusion (see below). With regard to the posterior end of the body, the atrophy of segments does not, as a rule, affect the telson itself so much as the somites in front of it and its power of producing new somites. Sometimes, however, the telson is very minute and non-chitinized (Hexapoda).

The "Eleventh Law may be stated thus : any somite in the series which is the anterior or posterior somite of a tagma may become atrophied, reduced in size, or partially aborted by the suppression of some of its meromes ; and finally, such a somite may disappear and leave no obvious trace in the adult structure of its presence in ancestral forms. This is called the escalation of a somite. Frequently, however, such " excalated " somites are obvious in the embryo or leave some merome (e.g., neuromere, muscle, or chitin-plate) which can be detected by minute observa- tion (microscopic) as evidence of their former existence. The somite of the maxillipede (third post-oral appendage) of Apus

oancriformis is a good example of a somite on its way to excala- tion. The third prse-oral and the premaxillary somites of Hexapod insects are instances where the only traces of the vanished somite are furnished by the microscopic study of early embryos. The praegenital somite of the Arachnida is an example of a somite which is preserved in some members of the group and partially or entirely excalated in other cases, sometimes with fusion of its remnants to neighbouring somites.

The Twelfth Law of metamerism might very well be placed in logical order as the first. If is the law of lipomerism, and asserts that just as the metameric condition is produced by a change in the bodies of the descendants of unisegmental ancestors, so highly metamerizedforms— i.e., strongly segmented forms with specialized regions of differentiated metameres — may gradually lose their metamerized structure and become apparently and practically unisegmental animals. The. change here contemplated is not the atrophy of terminal segments one by one so as to reduce the size of the animal and leave it finally as a single somite. On the contrary, no loss of size or of high organization is necessary. But one by one, and gradually, the metameric grouping of the bodily structures disappears. The cuticle ceases to be thickened in rings — the muscles of the body-wall overrun their somite boundaries. Internal septa disappear. The nerve-ganglia concentrate or else become diffused equally along th^ cords ; one pair of renal coelomoducts and one pair of genital coelomoducts grow to large size and remain — the rest disappear. The appendages atrophy or become limited to one or two pairs which are widely dislocated from their ancestral position. The animal ceases to present any indication of metameric repetition of parts in its entire structure. Degrees in this process are frequently to be recognized. We certainly can observe such a change in the posterior region of some Arthropods, such as the hermit-crabs and the spiders. Admitting that the Echiurids are descended from Chsetopoda, such a change has taken place in them, amounting to little short of complete lipomerism, though not absolutely complete.

Recent suggestions as to the origin of the MoUusca involve the supposition that such an effacement of once well-marked meta^- merism has occurred in them, leaving its traces only in a few structures such as

the multiple gill-plumes and shell-shields of the Chitons and the duplicated renal sacs of Nautilus.

A further matter of importance in this connexion is that when the old metameres have been effaced a new secondary segmentation

m size, the number of extra pairs of legs on a non-terminal somite increases in number, these added meromes are certainly intercalated and represent incomplete intercalated metameres. The Intercalation of new elements does not really go much further than this in Verte- brata, for a vertebra with its myoskeletal tissues is only a merome and not a complete metamere.

may arise, as in the jointed worm-like body of the degenerate Acarus, Demodex folUculorum.

Such secondary annulation of the soft hody calls to mind the secondary annulation of the metameres of leeches and some earth- worms. Space does not permit of more than an allusion to this subject ; but it is worth while noting that the secondary annuli marking the somites of Leeches and Lumbricidse in definite number and character are perhaps comparable to the redundant pairs of appendages on the hinder somites of Apus, and are in both cases examples of independent repetition of tegumentary meromes — a sort of ineffectual attempt to subdivide the somite which only prevails on the more-readily susceptible meromes of the integument.

The development of secondary metameric annulations within the area of a complete somite is not recorded among Arthropoda. It deserves distinct recognition as "hypo-metamerism" or formation of "somatidia."

The last law of metamerism which we shall attempt to formulate here, as the Thirteenth, relates to the fusion or blending of neigh- bouring somites. There are without doubt a large number of important

generalizations, to be arrived at hereafter from the further study of the metamerism of Vertebrata and the peculiar phenomena exhibited by the dislocated meromes of the vertebrate's somites. But this is not the place in which to attempt an outline of the special laws of vertebrate metamerism. IFusion of adjacent somites has often been erroneously interpreted in the study of Arthropoda. There are, in fact, very varying degrees of fusion which need to be carefully distinguished. The following generaliza- tion may be formulated. "The homologous meromes of two or more adjacent somites tend to fuse with one another by a blending of their substance. Very generally, but not invariably, the fused meromes are found as distinct separated structures in the embryo of the animal, in which they unite at a later stage of growth." The fusion of neighbouring meromes is often preceded by more or less extensive atrophy of the somites concerned, and by arrest of development in the individual ontogeny. Thus, a case of fusion of partially atrophied somites may simulate the appearance of incipient merogenesis or formation of new somites, and, vice versQ., incipient merogenesis may be misinterpreted as a case of fusion of once separate and fully-formed somites. Moreover, the two pheno- mena, merogenesis and fusion of meromes, actually occur side by side in some cases as in the pygidial shields of the Trilobitse and Limulus.

The most commonly-noted cases of fusion of metameres are sim- ply cases of the fusion of the tegumentary meromes — ^usually the terga only. Such a fusion has really very serious morphological import- ance, although superficial, and readily acquired. It amounts to no more than the disposition of chitinous cuticle of equal thickness over the area of the terga of the somites concerned instead of the thinning of the cuticular deposit at the adjacent borders of the somites. The somites consequently lose their hinge ; they can no longer be flexed one on the other. Atrophy of the muscles related to such flexure necessarily follows. The mesosomatic portion of the posterior carapace of Iiimulus is no more than such a superficial fusion : the other meromes of the ankylosed somites (appendages, neuromeres, blood-vessels, &c.) are unaffected. Such, too, is the case with the pygidial shields of many Trilobites. On the other hand, the telson, which is joined in both these cases with the superficially fused segments by a fusion of its chitinous cuticle with that of its last-formed or budded somite, can only take part in the fusion as a

result of arrest in its activity, which amounts to a late supervening atroph/. This arrest of the telson's special bud-growth may take place very early, in which case we get a large telsonic shield and only a very few somites in front of it — none soldered to the telson as in Agnostus and Ilenus ; or it may take place later when eight post-cephalic (opisthosomatic) somites have been formed as in Limulus — ^the last two incompletely. Or, again, thirty or more somites may have been produced before the arrest takes place and fifteen of these may be ankylosed with the telson to form the pygidial shield (Phacops, &o.).

A more complete fusion of somites is that seen in the head of Arthropoda. The head or prosoma of Arthropoda is a tagma con- sisting of one, two, or three prosthomeres or somites in front of the mouth and of one, two, three, up to five or six opistho- meres. The cephalic tagma or prosoma may thus be more or less sharply divided into two subtagmata, the prae-oral and the post -oral.

The shifting of the mouth backwards in Arthropoda so as to allow segments which once were post-oral to take up a prse-oral position, as prosthomeres, must be regarded as a case of dislocation of the meromes concerned (Sixth law), like the forward travelling of a fish's pelvic fins. The anus does not appear to he liable to such dislocation in Arthropoda ; but it certainly does travel away from its parental metamere in the Vertebrata, and may possibly do so in Chsetopoda when what must be called "lipomerism " or general obliteration of a metameric ordering of parts sets in. Such

"lipomerism" must be supposed to have affected the Chsetopod ancestors of the Sipunoulids, if those latter worms are to be traced genetically to the former, and the anus has shifted to the anterior third of the body. However that may be, the conception (first put forward by Lankester in 1875, 2) of the backward movement of the mouth in Arthropoda from the first somite to the second, third, or even fourth in the original post-oral series, is not only justified by embryological observation of the shifting in question, but finds its parallel in other instances of the law of dislocation of meromes.

The fusion of the cephalic or prosomatio somites not only extends to tegumentary structures but to muscles, blood-vessels, and markedly to neuromeres. However, in the embryo of many Arthropoda the original neuromeres of the prse-oral somites can be distinguished, and in many cases the coelomio cavities. Also it is a noteworthy fact that the tegumentary fusion (cephalic carapace, prosomatic carapace) appears sometimes to break down secondarily (e.g., squilla among Crustacea and Galeodes and Tarassidae among Arachnida). It appears that we must recognize as a principle that such fusions as the carapaces of Arthropoda can revert to the condition of free movable plates — and therefore we must not assume that forms with fused tergal plates are necessarily later, genetically, than allied forms with free movable tergal plates.

When such reversion to a movable series of dorsal plates occurs it must not be assumed that any corresponding change takes place in the deeper meromes. On the whole, fusion and ankylosis of somites is not in itself necessarily a deep-seated or far-reaching process. It may or may not be accompanied by dislocation of im- portant meromes or by lipomerism ; whilst, as for instance in the opisthosoma of the spiders, opiliones and acari, dislocation and lipo- merism may occur without /itsioji of tegumentary plates, and with, on the contrary, a dwindling, and eventual atrophy of such plates.

The general considerations as to metamerism set forth above will enable us to proceed to a consideration of the characters which distinguish the various groups of Arthropoda, and to justify the classification with which we started.

The Theory of the Arthropod Head. — The axthropod head is a tagma or group of somites which differ in number and in their relative position in regard to the mouth, in different classes. In a simple Chsetopod (Fig. 1) the head consists of the first somite only ; that somite is perforated by the mouth, and is provided with a pro- stomium or prse-oral lobe. The prostomium is essentially a part or outgrowth of the first somite, and cannot be regarded as itself a somite. It gives rise to a nerve-ganglion mass, theprostomial ganglion. In the marine it,i—‘^™„t°;fJJ Chsetopods (the Polychseta) (Fig. 2), of an ougochat chseto-*

r. S ,1 ^ •' .■ i' 2 i. Po4 'P'". tli6 prostoin-

we find the same essential structure, lum ; m, the month ; a, but the prostomium may give rise to ^^.P^/S'Sfam i two or more tactile tentacles, and to i, ii, in, coeiom of the the vesicular eyes. The somites have fj^*ites'™'(r'rom"Goo'?- well-marked parapodia, and the second rich, Q^.mcr. sd. vol. and third, as well as the first, may "'■ give rise to tentacles which are directed forward, and thus contribute to form " the head." But the mouth remains as an inpushing of the wall of the first somite.

The Arthropoda are all distinguished from the Chseto- poda by the fact that the head consists of one or more somites which lie in front of the mouth (now called pros- thomeres), as well as of one or more somites behind it (opisthomeres). The first of the post-oral somites invari- ably has its parapodia modified so as to form a pair of hemignaths (mandibles). Twenty-five years ago the question arose as to whether the somites in front of the mouth are to be considered as derived from the pro- stomium of a Chsetopod-like ancestor. Milne-Edwards and Huxley had satisfied themselves with discussing and establishing, according to the data at their command, the number of somites in the Axthropod head, but had not considered the question of the nature of the prse-oral somites. Lankester (2) was the first to suggest that (as is actually the fact in the Nauplius larva of Crustacea) the prse-oral somites or prosthomeres and their appendages

were ancestrally post-oral, but have become pree-oral " by adaptational shifting of the oral aperture." This has proved to be a sound hypothesis and is now accepted as the basis upon which the Arthropod head must be inter- preted , (see Korschelt and Heider (3)). Further, the morphologists of the 'fifties appear, with few exceptions, to have accepted a preliminary scheme with regard to the Arthropod head and Arthropod segmentation generally, which was misleading and caused them to adopt forced conclusions and interpretations. It was conceived by Huxley, among

others, that the same number of cephalic somites would be found to be char- acteristic of all the diverse classes of Arthropoda, and that the somites, not only of the head but of the various regions of the body, could be closely compared in their numerical sequence in classes so distinct as the Hexapods, Crus- taceans, and Arachnids.

The view which it now appears necessary to take is, on the con- ^^^7^^^„nil}lv^w trary, this— viz., that all the Ar-

*and adjacent region of a Poly- n *^ -, ‘ ■, -,*

ch«t chajtopod. Letters as thropoda are to be traced to a T.filtomti’f‘nSiP^f common ancestor resembling a parapodium. (From Good- Chsetopod worm, but differing from it in having lost its chsetas and in having a prosthomere in front of the mouth (instead of prostomium only) and a pair of hemignaths (mandibles) on the parapodia of the buccal somite. Erom this ancestor Arthropods with heads of varying degrees of complexity have been developed characteristic of the different classes, whilst the parapodia and somites of the body have become variously modified and grouped in these different classes. The resemblances which the members of one class often present to the members of another class in regard to the form of the limb-branches (rami) of the parapodia, and the formation of tagmata (regions) are not hastily to be ascribed to common inherit- ance, but we must consider whether they are not due to homoplasy — that is, to the moulding of natural selection acting in the different classes upon fairly similar elements under like exigencies.

The structure of the head in Arthropods presents three profoundly separated grades of structure dependent upon the number of prosthomeres which have been assimilated by the prse-oral region. The classes presenting these distinct plans of head-structure cannot be closely associated in any scheme of classification professing to be natural. Peripatus, the type-genus of the class Onychophora, stands at the base of the series with only a single prosthomere (Fig. 3). In Peripatus the prostomium of the Chsetopod- like ancestor is atrophied, but it is possible that two pro- cesses on the front of the head (FP) represent in the embryo

the dwindled prostomial tentacles. The single prosthomere carries the retractile tentacles as its ” para- podia.” The second somite is the buccal somite (II, Fig. 3) ; its parapodia have horny jaws on their ends, like the claws on the following legs (Fig. 8), and act as hemignaths (mandibles). The study of sections of the embryo estab- lishes these facts beyond doubt. It also shows us that the neuromeres, no less than the embryonic coelomic cavities, point to the existence of one, and only one, prosthomere in Peripatus, of which the ” Protocerebrum,” P, is the neuromere, whilst the Deuterocerebrum, D, is the neuromere of the second or buccal somite. A brief indication of these facts is given by saying that the Onychophora are ” deuterognathous ” — that is to say, that the buccal somite carrying the mandibular hemi- gnaths is the second of the whole series.

ant

mi . p

Fig. S. — Diagram of the head and ad- jacent region of Peripatus. Mono- prosthomerous, m, mouth ; I, ccelom of the first somite which carries the antennsB and is in front of the mouth ; II, coelom of the second somite which carries the mandibles (hence deutero- gnathous) ; III and IV, coelom of the third and fom-th somites ; JKP, rudi- mentary frontal processes perhaps representing the prostomial tentacles- of Folycheeta ; Ani^ antenna or tactile tentacle; Md, mandible; Op, oral papilla; P, protocerebrum or fore-

most cerebral mass belonging to the first somite; D, deuterocerebrum, consisting of ganglion cells belonging to the second or mandibular somite. (After Goodrich.)

What has become of the nerve-ganglion of the pro- stomial lobe of the Chsetopod in Peripatus is not clearly ascertained, nor is its fate indicated by the study of the embryohio head of other Ar- thropods so far. Probably it is fused with the Proto- cerebrum, and may also be concerned in the history of the very peculiar paired eyes of Peripatus, which are like those of Chsetopods in struc- ture— viz., vesicles with an intra-vesicular lens, whereas the eyes of all other Ar- thropods have essentially another structure, being ” cups ” of the epidermis, in which a knob-like or rod-

like thickening of the cuticle is fitted as refractive medium. In Diplopoda (Julus, &c.) the results of embryological study point to a composition of the front part of the head exactly similar to that which we find in Onychophora. They are deutero- gnathous.

The Arachnida present the first stage of progress. Here embryology shows that there are two prosthomeres (Fig. 4), and that the gnathobases of the chelae which act as the first pair of hemignaths, are carried by the third somite. The Arachnida are therefore tritognathous. The two prosthomeres are indicated by their ccelomic cavities in the embryo (I and II, Fig. 4), and by two neuromeres, the Protocerebrum and the Deuterocerebrum. The appendages of the first prosthomere are not present as tentacles, as in Peripatus and Diplopods, but are

possibly represented by the eyes or possibly altogether aborted. The appendages of the second prosthomere are the well-known chelicerse of the Arachnids, rarely, if ever, antenniform, but modified as "retroverts" or clasp-knife fangs in spiders.

The Crustacea (Fig. 5) and the Hexapoda (Fig. 6) agree in having three somites in front of the mouth, and it is

it-self are, as here dr^^, JJtVTaU^ proba,ble though not aSCCr-

in ftont of the mouth; JS, lateral tained, that the Chllopoda

*eye; Ch, chelicera; m, mouth; P, /(a„„l„„Q_ J_„ X^n\ „■„« ;„ •(-T,^*

protooerebram;D,deuterooerebnim; (OCOlOpCndra, &C.) are in the

1, II, III, IV, coelom of the first, same casc. The three pros- second, third, and fourth somites. . t i ■■ • ,*

(After Goodrich.) thomeres Or prae-oral somites

of Crustacea due to the sink- ing back of the mouth one somite farther than in Arachnida are not clearly indicated by coelomic cavities in the embryo, but their existence is clearly established by the development and position of the appendages and by the neuromeres.

The eyes in some Crustacea are mounted on articulated stalks, and from the fact that they can after injury be replaced by antennae-like appendages, it is inferred that they represent the parapodia of the most anterior pros- thomere. The second prosthomere carries the first pair of antennae and the third the second pair of antennae. Sometimes this pair of appendages has not a merely tactile jointed ramus, but is converted into a claw or

Fia. 4.— Diagram of the head and ad- jacent region of an Arachnid. Dipros- thomerous in the adult condition, though embryologically the append- ages of somite 11 ; ‘ ”

clasper. Three neuromeres — a proto-, deutero-, and trito- cerebrum — corresponding to those three prosthomeres are sharply marked in the embryo. The fourth somite is that in which the mouth now opens, and which accord- ingly has its appendages converted into hemignathous mandibles. The Crustacea are tetartognathous.

The history of the development of the head has been carefully worked out in the Hexapod insects. As in Crustacea and Arachnida, a first

prosthomere is indicated by the paired eyes and the protocerebrum ; the second prosthomere has a well-marked ccelomic cavity, carries the antennae, and has the denterocerebrum for its neuromere. The third prosthomere is represented by a well-marked

Fig. 5. — Diagram of the head of a Grastacean. Triprosthomerous. FP, frontol processes (observed in Cir- rhiped nauplius – larvae) probably representing the prostomial ten- tacles of Ghsetopods : «, eye ; AnP-, first pair of antenniB ; An&^ second pair of antennae ; md, mandible ; maji, mas", first and second pairs of maxiilas ; m, mouth ; I, II, and 111, the three prosthomeres ; IV, V, VI, the three somites following the mouth ; P, protocerebrum ; D, denterocerebrum ; T, tritocerebrum. (After Groodrich.)

Fig. 6. — Diagram of the head of a Hexa- pod Insect. 6, eye ; a/nt^ antenna; md, mandible ; mtc, first maxilla ; mx^, second maxilla ; m, mouth; I, region of the first or eye-bearing pros- thomere ; II, ccelom of the second antenna – bearing prosthomere ; III, ccelom of the third prosthomere devoid of appendages ; IV, V, and VI, cffilom of the fourth, fifth, and sixth somites ; P, protocerebrum belonging to the first prosthomere ; D, deuterocerebrum belonging to the second prosthomere ; T, tritocerebrum belonging to the third prosthomere. (After Goodrich.)

pair of ccelomic cavities and the tritocerebrum (III, Fig. 6), but has no appendages. They appear to have aborted. The existence of this third prosthomere corre- sponding to the third prosthomere of the Crustacea is a strong argument for the derivation of the Hexapoda, and with them the Chilopoda, from some offshoot of the Crustacean stem or class. The buccal somite, with its mandibles, is in Hexapoda, as in Crustacea, the fourth : they are tetartognathous.

The adhesion of a greater or less number of somites to the buccal somite posteriorly (opisthomeres) is a matter of importance, but of minor importance, in the theory and history of the Arthropod head. In Peripatus no such adhesion or fusion occurs. In Diplopoda two opistho- meres— ^that is to say, one in addition to the buccal somite — are united by a

fusion of their terga with the terga of the prosthomeres. Their appendages are respec- tively the mandibles and the gnathochilarium.

In Arachnida the highest forms exhibit a fusion of the tergites of five postoral somites to form one continuous carapace united with the terga of the two prosthomeres. The five pairs of appendages of the postoral somites of the head or prosoma thus constituted all primitively carry gnathobasic projections on their coxal joints, which act as hemignaths : in the more specialized forms the man- dibular gnathobases cease to develop.

In Crustacea the fourth or mandibular somite never has less than the two following somites associated with it by the adaptation of their appendages as jaws, and the ankylosis of their terga with that of the prosthomeres. But in higher Crustacea the cephalic "tagma" is ex- tended, and more somites are added to the fusion, and their appendages adapted as jaws of a kind.

The Hexapoda are not known to us in their earlier or more primitive manifestations ; we only know them as

possessed of a definite number of somites arranged in definite numbers in three great tagmata. The head shows two jaw-bearing somites besides the mandibular somite (V, VI, in Fig. 6) — thus six in all (as in some Crustacea), including prosthomeres, all ankylosed by their terga to form a cephalic shield. There is, however, good em- bryological evidence in some Hexapods of the existence of a seventh somite, the supra-lingual, occurring between the somite of the mandibles and the somite of the first maxillae (4). This segment is indicated embryologically by its paired ccelomic cavities. It is practically an exca- lated somite, having no existence in the adult. It is probably not a mere coincidence that the Hexapod, with its two rudimentary somites devoid of appendages, is thus found to possess twenty-one somites, including that which carries the anus, and that this is also the number present in the Malacostracous Crustacea.

The Segmental Lateral Appendages or Limbs of Arthro- poda. — It has taken some time to obtain any general acceptance of the view that the

parapodia of the Chaeto- poda and the limbs of Arthropoda are genetically identical structures ; yet if we compare the parapodium of Tomopteris or of Phyllodoce with one of the foliaceous limbs of Branchipus or Apus, the correspondences of the two are striking. An erroneous view of the fundamental morphology of the Crustacean limb, and consequently of that of other Arthropoda,- came into favour owing to the acceptance of the highly modified limbs of Astacus as typical. Protopodite, endopodite, exopodite, and epi- podite were considered to be the morphological units of the crustacean limb. Lankester (5) has shown (and his views have been accepted by Professors Korschelt and Heider in their treatise on Embryology) that the limb of the lowest Crustacea, such as Apus, consists of a corm or axis which may be jointed, and gives rise to outgrowths, either leaf-like or filiform, on its inner and outer margins (endites and exites). Such a corm (see Figs. 9 and 10), with its outgrowths, may be compared to the simple parapodia of Chsetopoda with cirrhi and branchial lobe (Fig. 7). It is by the specialization of two*

Fig. 7.— Diagram of the somite-appendage or parapodium of a Polyohaet Chte- topod. The chaetse are omitted. Ax, the axis ; nr.c, neuropodial cirrhus ; nr.P-, nr.P, neuropodial lobes or endites; nt.a, notopodial cirrhus ; ni.l', ~~nt.P, noto~~ podial lobes or exites. TJie parapodium is represented with its neural or ventral surface uppermost. Original.

"endites" that the endopodite and exopodite of higher Crustacea are formed, whilst a flabelliform exite is the homogen or genetic equivalent of the epipodite (see Lankester, " Observations and Eeflections on Apus Can- criformis," Q. J. Micr. ScL). The reduction of the out- growth-bearing " corm " of the parapodium of either a Chaetopod or an Arthropod to a simple cylindrical stump, devoid of outgrowths, is brought about when mechanical conditions favour such a shape. We see it in certain

Cliaetopods {e.g., Hesione) and in the Artliropod Peri- patus (Fig. 8). The conversion of the Arthropod's limb into a jaw, as a rule, is effected by the

development of an

endite near its base into a hard, chitinized, and often toothed gnathobase (see Figs. 9 and 10, en'). It is not true, that aJl the biting processed of the Arthropod limb are thus produced — for instance, the jaws of Peri- patus are formed by the axis or corm itself, whilst the poison-jaws of Chilopods, as also their maxillae, appear to be formed rather by the apex or terminal region of the ramus of the limb ; but the op- posing jaws (=hemignaths) of Crustacea, Arachnida, and Hexapoda are gnathobases, and not the axis or corm. The endopodite (correspond- ing to the fifth endite of the limb of Apus, see Fig. 9) becomes in Crustacea the '<• walking leg" of the mid- region of the body; it be- comes the palp or jointed ;^ocess of anterior segments. A second ramus, the " exopo- dite," often is also retained in the form of a palp or feeler. In Apus, as the figure shows, there are four of these " antenna-like " palps or fila- ments on the first thoracic limb. A common modificar tion of the chief ramus of the Arthropod parapodium is the chela or nipper formed by the elongation of the penultimate joint of the ramus, so that the last joint works on it — as, for instance, in the lobster's claw. Such chelate rami or limb-branches are independently de- veloped in Crustacea and in Arachnida, and are carried by somites of the body which do not correspond in position in the two groups. The range of modification of which the rami or limb-branches of the limbs of Arthro- poda are capable is very large, and in allied orders or even families or genera we often find what is certainly the palp of the same appendage (as determined by numerical position of the segments) — in one case antenniforra, in another chelate, in another pediform, and in another

Fig. 8. — Three somite-appendages or parapodiaofPdW^a^ufi. A, awalk- mg leg ; p^ to p, the characteristic "pads"; /, the foot; cP-, cH^, the two claws. B, an oral papilla, one of the second pair or post-oral appendages. C, one of the iirst post-oral pair of appendages or mandibles ; cP, cP, the greatly enlarged claws, (Compare A.) The appendages are represented with the neural or ventral surface upper- most. Original.*

Tig. 9. — The second thoracic (fifth post-oral) appendage of the left side of ApiM eanoriformiaf placed with its ventral or neural surface

uppermost to compare with jigs. 7 and 8. 1, 2, The two segments of the axis ; e«A, the gnathobase; en^ to en', the five following " endltes " ; J2, the flabellum or anterior e^te ; 6r, the bract or posterior exlte. (After Lankester, Q. J.

- Mic. Sc4. vol. xxl. 1881.)

reduced to a mere stump or absent altogether. Very probably the power which the appendage of a given seg- ment has of assuming the perfected form and proportions previously attained by the appendage of another segment

must be classed as an instance of " homceosis," not only where such a change is obviously due to abnormal de- velopment or injury, but also where it constitutes a differ- ence permanently established between allied orders or smaller groups, or between the two sexes.

The most extreme- disguise assumed by the Arthropod parapodium or appendage is that of becoming a mere

Fig. 10.— The first thoracic (fourth post oral) appendage of Apus eanariformie (right side). Aai^ to jtiu, the four seg- ments of the axis with muscular bands ; En?, gnathobase; .EW to Enfi, the elon- gated jointed endites (rami) ; En, the rudimentary sixth endite (exopodite of higher Crustacea) ; Fl, the flabellum which becomes the epipodite of higher forms; Br, the bract devoid of muscles and res- piratory in function. (After Lankester, Q. J. Mia. Sci. vol. xxi. 1881.)*

*stalk supporting an eye — a fact which did not obtain general credence until the experiments of Herbst in 1895, who found, on cutting off the eye-stalk of Palsemon, that a jointed antenna-like appendage was regenerated in its place. Since the eye-stalks of Podopthalmate Crustacea represent appendages, we are forced to the conclusion that the sessile eyes of other Crustacea and of other Arthropoda generally, indicate the position of appendages which have atrophied.^*

From what has been said, it is apparent that we cannot, in attempting to discover the affinities and divergences of the various forms of Arthropoda, attach a very high phylogenetic value to the coincidence or divergence in form of the appendages belonging to the somites compared with one another.

*The principal forms assumed by the Arthropod parapodium and its rami may be thus enumerated:^*

(1) Axial corin well developed, unsegmented or with two to four segments; lateral endites and exites (rami) numerous and of various lengths (certain limbs of lower Crustacea).

(2) Corm, with short unsegmented rami, forming a flattened foliaceous appendage, adapted to swimming and respiration (trunk- limbs of Phyllopods).

(3) Corm alone developed ; with no endites or exites, but pro- vided with terminal chitinous claws (ordinary leg of Peripatus) , with terminal jaw teeth (jaw of Peripatus), or with blunt extremity (oral papilla of same) (see Fig. 8).

(4) Three of the rami of the primitive limb (endites 5 and 6, and exite 1) specially developed as endopodite, exopodite, and epipodite — the first two often "as firm and strongly chitinized, segmented, leg-like structures ; the original axis or corm reduced to a basal piece; with or vrithout a distinct gnathobase (endite 1) — ^typical tri-ramose limb of higher Crustacea.

1 H. Milne-Edwards, who was followed by Huxley, long ago formu- lated the conclusion that the eye-stalks of Crustacea are modified ap- pendages, basing his argument on a specimen of Palinurus (figured m Bateson's book (1), in which the eye-stalk of one side is replaced by an antenniform palp. Hofer (6) m 1894: described a similar case in Astacus.

(5) One ramus (the endopodite) alone developed— the original axis or oorm serving as its basal joint with or without gnathobase. This is the usual uni-ramose limb found in the various classes of Arthropoda. It varies as to the presence or absence of the jaw-process and as to the stoutness of the segments of the ramus, their number (frequently six, plus the basal corm) , and the modification of the free end. This may be filiform or brush- like or lamellate when it is an antenna or palp; a simple spike (walking leg of Crustacea, of other aquatic forms, and of Chilopods and Diplopods) ; the terminal joint flattened (swimming leg of Crustacea and Gigantostraca) ; the terminal joint provided with two or with three recurved claws (walking leg of many terrestrial forms— e-gr., Hexapodaand Araehnida) ; the penultimate joint with a process equal in length to the last joint, so as to form a nipping organ (chelae of Crustaceans and Arachnids) ; the last joint reflected and movable on the penultimate, as the blade of a clasp-knife on its handle (the retrovert, toothed so as to act as a biting jaw in the Hexapod Mantis, the Crustacean 'Squilla, and others ; with the last joint produced into a needle-like stabbing process in spiders).

(6) Two rami developed (usually, but perhaps not always, the equivalents of the endopodite and exopodite) supported on the somewhat elongated oorm (basal segment). This is the typical "biramose limb" often found in Crustacea. The rami may be flattened for swimming, when it is "a biramose swimmeret," or both or only one may be filiform and finely annulate ; this is the form often presented by the antennse of Crustacea, and rarely by prae-oral appendages in other Arthropods.

(7) The endopoditic ramus Is greatly enlarged and flattened, without or with only one jointing, the corm (basal segment) is evanescent; often the plate-like endopodites of a pair of such appendages unite in the middle line with one another or by the in- termediary of a sternal up-growth and form a single broad plate. (These are the plate- like swimmerets and opercula of Gigantostraca and Limulus among Arachnids and of Isopod Crustaceans. They may have rudimentary exopodites, and may or may not have branchial filaments or lamellae developed on their posterior faces. The simplest form to which they may he reduced is seen in the genital operculum of the Scorpion.)

(8) The gnathobase becomes greatly enlarged and not separated by a joint from the corm ; it acts as a hemignath or half-jaw working against its fellow of the opposite side. The endopodite may be retained as a small segmented palp at the side of the gnathobase or disappear (mandible of Crustacea, Chilopoda, and Hexapoda).

(9) The corm becomes the seat of a development of a special visual organ, the Arthropod eye (as opposed to the Chsetopod eye). Its jointing (segmentation) may be retained, but its rami disappear (P6dophthalmous Crustacea) . Usually it becomes atrophied, leaving tiie eye as a sessile organ upon the prse-oral region of the body. (The eye-stalk and sessile lateral eyes of Arthropoda generally, exclusive of Peripatus.)

(10) The forms assumed by special modification of the elements of the parapodium in the maxillse, labium, &c., of Hexapods, Chilopods, Diplopods, and of various Crustacea, deserve special enumeration, but cannot be dealt with without ample space and illustration.

It may be pointed out that the most radical difference presented in this list is that between appendages consisting of the oorm alone without rami (Onyohophora) and those with more or less developed rami (the rest of the Arthropoda). In the latter class we should distinguish three phases : (a) those with numerous and compara- tively undeveloped rami; (6) those with three, or two highly developed rami, or with only one — ^the corm being reduced to the dimensions of a mere basal segment ; (c) those reduced to a secondary simplicity (degeneration) by overwhelming development of one segment (e.g., the isolated gnathobase often seen as "mandible" and the genital operculum).

There is no reason to suppose that any of the forms of limb observed in Arthropoda may not have been independently developed in two or more separate diverging lines of descent.

Branchiae. — In connexion with the discussion of the limbs of Arthropods, a few words should be devoted to the gill-processes. It seems probable that there are branchial plumes or filaments in some Arthropoda (some Crustacea) which can be identified with the distinct branchial organs of Chaetopoda, which lie dorsad of the parapodia and are not part

of the parapodium. On the other hand, we cannot refuse to admit that any of the processes of an Arthro- pod parapodium may become modified as branchial organs, and that, as a rule, branchial out-growths are easily developed, de novo, in all the higher groups of animals. Therefore, it seems to be, with our present knowledge, a hopeless task to analyse the branchial organs of Arthropoda and to identify them genetically in groups.

A brief notice must suffice of the structure and history of the Eyes, the Tracheoe, and the so-called Malpighian

tubes of Arthropoda, though special importance attaches to each in regard to the determination of the affinities of the various animals included in this great sub-phylum.

The Eyes. — The Arthropod eye appears to be an organ of special character developed in the common ancestor of the Euarthropoda, and distinct from the Chaetopod eye, which is found only in the Onychophora where the true Arthropod eye is absent. The essential difference between these two kinds of eye appears to be that the Chsetopod eye (in its higher developments) is a vesicle enclosing the lens, whereas the Arthropod eye is a pit or series of pits into which the heavy chitinous cuticle dips and enlarges knob- wise as a lens. Two distinct forms of the Arthropod eye are observed — the monomeniscous (simple) and the poly- meniscous (compound). The nerve-end-cells, which lie below the lens, are part of the general epidermis. They show in the monomeniscous eye (see article Aeachwida, Fig. 26) a tendency to group themselves into "retinulse," consisting of five to twelve cells united by vertical deposits of chitin (rhabdoms). In the case of the polymeniscous eye (Fig. 23, article Arachnid a) a single retinula or group of nerve-end-eells is grouped beneath each associated lens. A further complication occurs in each of these two classes of eye. The monomeniscous eye is rarely provided with a single layer of cells beneath its lens ; when it is so, it is called monostichous (simple lateral eye of Scorpion, Fig. 22, article Arachnid a). More usually, by an infold- ing of the layer of cells in development, we get three layers under the lens; the front layer is the corneagen layer, and is separated by a membrane from the other two which, more or less, fuse

and contain the nerve-end- cells (retinal layer). These eyes are called diplostichous, and occur in Araehnida and Hexapoda (Fig. 24, in article Arachnid a).

On the other hand, the polymeniscous eye undergoes special elaboration on its lines. The retinulse become elongated as deep and very narrow pits (Fig. 11 and

Fis. 11.— Diagram to show the de- rivation of the unit or "om- matidium" of the compound eye of OiMistacea and Hexapoda, C, from a simple monomeniscous monostichous eye resembling the lateral eye of a Scorpion, A, or the unit of the compound lateral eye of Limulus (see article Akaoh- NiDA, Figs. 22 and 23). B repre- sents an intennediate hypothetical form in which the cells beneath the lens are beginning to be super- imposed as corneagen, vltrella, and retinula, instead of standing side by side in ' horizontal series. The black represents the cuticular prpduct of the epidermal cells .of the ocular area, talking the form either of lens, cl, of crys- talline body, cry, or of rhabdom, rhab ; hy, hypodermis or epi- dermal cells; coTTi^-, laterally- placed cells in the simpler stage, A, which like the nerre-end-cells, vii^ and reP-, are corneagens or lens- producing; corm., specialized corneagen or lens-

g reducing cells ; «i^, potentiw vitrella cells with cry\ potential crystalline ody now indistinguishable from retinula cells and rhabdomeres; vU, vltrella cell with cry, its contained cuticular product, the crystalline cone or body; reP, rhai^i retinula cells and rhabdom of scorpion undifferentiated from a^acent cells, ~~Bii^M T6i, retinula cell ; rhab, rhabdom ; nf, optic nerve~~ flbres. (Modified from Watase.)

explanation), and! develop additional cells near the mouth of the narrow pit. Those nearest to the lens are the cor- neagen cells of this more elaborated eye, and those between the original retinula cells and the corneagen cells become firm and transparent. They are the crystalline cells or vitrella (see Watase, 7). Each such complex of cells underlying the lenticle of a compound eye is called an "ommatidium"; the entire mass of cells underlying a monomeniscous eye is an " ommatseum." The ommatseum, as already stated, tends to segregate into retinulse which correspond potentially each to an ommatidium of the compound eye. The

ommatidium is from the first segregate and consists of few cells. The compound eye

of the King-Crab (Limulus) is the only recognized instance of ommatidia in their simplest state. Each can be readily compared with the single-layered lateral eye of the Scorpion. In Crustacea and Hexapoda of all grades ■we find compound eyes with the more complicated omma- tidia described above. We do not find them in any Arachnida.

It is difficult in the absence of more detailed knowledge as to the eyes of Chilopoda and Diplopoda to give full value to these facts in tracing the affinities of the various classes of Arthropods. But they seem to point to a community of origin of Hexapods and Crustacea in regard to the complicated ommatidia of the compound eye, and to a certain isolation of the Arachnida, which are, however, traceable, so far as the eyes are concerned, to a distant common origin with Crustacea and Hexapoda through the very simple compound eyes (monostichous,polymeniscous) of Limulus.

The TrachecB. — ^In regard to tracheae the very natural tendency of zoologists has been until lately to consider them as having once developed and once only, and therefore to hold that a group of "Tracheata" should be recognized, including all tracheate Arthropods. We are driven by the conclusions arrived at as to the derivation of the Arachnida from branchiate ancestors, independently of the other tracheate Arthropods (see article Arachnida), to formulate the conclusion that tracheae have been inde- pendently developed in the Arachnidan class. We are also, by the isolation of Peripatus and the impossibility of tracing to it all other tracheate Arthropoda, or of regarding it as a degenerate offset from some one of the tracheate classes, forced to the conclusion that the tracheae of the Onychophora have been independently acquired. Hav- ing accepted these two conclusions, we formulate the generalization that tracheae can

be independently acquired by various branches of Arthropod descent in adaptation to a terrestrial as opposed to an aquatic mode of life. A great point of interest therefore exists in the knowledge of the structure and embryology of tracheae in the differ- ent groups. It must be confessed that we have not such full knowledge on this head as could be wished for. Tracheae are essentially tubes like blood-vessels — appar- ently formed from the same tissue elements as blood- vessels— which contain air in place of blood, and usually communicate by definite orifices, the tracheal stigmata, with the atmosphere. They are lined internally by a cuticular deposit of chitin. In Peripatus and the Diplo- pods they consist of bunches of fine tubes which do not branch but diverge from one another ; the chitinous lin- ing is smooth. In the Hexapods and Chilopods, and the Arachnids (usually), they form tree-like branching structures, and their finest branches are finer than any blood-capillary, actually in some cases penetrating a single cell and supplying it with gaseous oxygen. In these forms the chitinous lining of the tubes is thickened by a close- set spiral ridge similar to the spiral thickening of the cellulose wall of the spiral vessels of plants. It is a note- worthy fact that other tubes in these same terrestrial Arthropoda — namely, the ducts of glands — are similarly strengthened by a chitinous cuticle, and that a spiral or annular thickening of the cuticle is developed in them also. Chitin is not exclusively an ectodermal product, but occurs also in cartilaginous skeletal plates of meso- blastic origin (connective tissue). The immediate cavities or pits into which the tracheal stigmata open appear to be in many cases ectodermic in sinkings, but there seems to be no reason (based on embryological observation) for regarding the tracheae as an ingrowth of the ectoderm. They appear, in fact, to be an air-holding modification of the vasifactive connective tissue. Tracheae are abundant jusl in proportion as blood-vessels become suppressed.

They are reciprocally exclusive. It seems not improbable that they are two modifications of the same tissue- elements. In Peripatus the stigmatic pits at which the tracheee communicate with the atmosphere are scattered and not definite in their position. In other cases the stigmata are definitely paired and placed in a few seg- ments or in several. It seems that we have to suppose that the vasifactive tissue of Arthropoda can readily take the form of air-holding instead of blood-holding tubes, and that this

somewhat startling change in its character has taken place independently in several instances — viz., in the Onychophora, in more than one group of Arach- nida, in Diplopoda, and, again, in the Hexapoda and Chilopoda.

The Malpighian Tubes. — This name is applied to the numerous fine caecal tubes of noticeable length developed from the proctodaeal invert of ectodermal origin in Hexa- pods. These tubes are shown to excrete nitrogenous waste products similar to uric acid. Tubes of renal excretory function in a like position occur in most terrestrial Arthro- poda— viz., in Chilopoda, Diplopoda, and Arachnida. They are also found in some of the semi-terrestrial and purely aquatic Amphipod Crustaceans. But the conclusion that all such tubes are identical in essential character seems to, be wifliout foundation. The Malpighian tubes of Hexapods are outgrowths of the proctodaeum, but those of Scorpion and the Amphipod Crustacea are part of the metenteron or endodermal gut, though originating near its junction with the proctodaeum. Hence the presence or absence of such tubes cannot be used as an argument as to affinity with-' out some discrimination. The Scorpion's so-called Malpighian tubes are not the same organs as those so named in the other Tracheata. Such renal caecal tubes seem to be readily evolved from either metenteron or proctodaeum when the conditions of the out-wash of nitro- genous waste-products are changed by the transference from aquatic to terrestrial life. The absence of such renal caeca in Limulus and their presence in the terrestrial Arachnida is precisely on a parallel with their absence in aquatic Crustacea and their presence in the feebly branchiate Amphipoda.

We shall now pass the groups of the Arthropoda in review, attempting to characterize them in such a way as will indicate their probable affinities and genetic history.

Sub-Phtltjm arthropoda.— The characters of the sub- phylum and those of the associated sub-phyla Chsetopoda and Roti- fera, have been given above, as well as the general characters of the phylum Appendiculata which comprises these great sub-phyla.

Grade A. — Hyparthropoda. Hypothetical forms.

Grade B.— Protarthropoda.

(a) The Integument is covered by a delicate soft cuticle (not firm or plated) which allows the body and its appendages great range of extension and contraction.

(6) The paired claws on the ends of the parapodia and the fang- like modifications of these on the first post-oral appendages (man- dibles) are the only hard chitinous portions of the integument.

(c) The head is deuterognathous — ^that is to say, there is only one prosthomere, and accordingly the first and only pair of hemi- gnaths is developed by adaptation of the appendages of the second somite.

(d) The appendages of the third somite (second post-oral) are clawless oral papillae.

(e) The rest of the somites carry equi-formal simple appendages, consisting of a corm or axis tipped with two chitinous claws and devoid of rami.

(/) The segmentation of the body is anomomeristic, there being no fixed number of somites characterizing all the forms included.

(g) The pair of eyes situated on the prosthomere are not of the Euarthropod type, but resemble those of Chsetopods (hence Nereid-ophthalmous).

(h) The muscles of the body-wall and gut do not consist of trans- versely-striped muscular fibre, but of the unstriped tissue observed also in Chaetopoda.

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(i) A pair of coelomoducts is developed in every somite including the prosthomere, in which alone it atrophies in later development.

(j) The ventral nerve-cords are widely separated— in fact, lateral in position.

(fc) There are no masses of nerve-cells forming a ganglion (neuro- mere) in each somite. (In this respect the Protarthropoda are at a lower stage than most of the existing Chsetopoda.)

(ly The genital ducts are formed by the enlargement of the ccelomoducts of the penultimate somite.

Class (Unica). — Ontchophora.

With the characters of the grade : add the presence within the body of fine unbranched tracheal tubes, devoid of spiral thickening, opening to the exterior by numerous irregularly scattered tracheal pits. ♦

Genera— Eoperipatus, Peripatopsis, Opisthopatus, &c.

Grade C (of the Arthropoda).— Euarthropoda.

(a) Integument heavily plated with firm chitinous cuticle, allow- ing no expansion and retraction of regions of the body nor change of dimensions, except, in some cases, a dcffso-ventral bellows move- ment. The separation of the heavier plates of chitin by grooves of delicate cuticle results in the hinging or jointing of the body and its appendages, and the consequent flexing and extending of the jointed pieces.

(6) Claws and fangs are developed on the branches or rami of the parapodia, not on the end of the axis or corm.

(c) The head is either deuteroguathous, tritognathous, or tetar- tognathous.

*(d) Rarely only one, and usually at least two, of the somites following the mandibular somite car*y appendages modified as jaws (with exceptions of a secondary origin).*

(e) The rest of the somites may all carry appendages, or only a limited number may carry appendages. In all cases the append- ages primarily

develop rami or branches which form the limbs, the primitive axis or corm being reduced and of insignificant size. In the most primitive stock all the post-oral appendages had gnathobasic outgrowths.

(/) The segmentation of the body is anomomeristic in the more archaic members of each class, nomomeristic in the higher members.

{g) The two eyes of Chsetopod structure have disappeared, and are replaced by the Euarthropod eyes.

(ft) The muscles in all parts of the body consist of striped mus- cular fibre, never of unstriped muscular tissue.

(i) The ccelomoducts are suppressed in most somites, and retained only as the single pair of genital ducts (very rarely more numerous) and in some aJso as the excretory glands (one or two pairs).

(j) The ventral nerve-cords approach one another in the mid- ventral line behind the mouth.

(Jfc) The nerve-cells of the ventral nerve-cords are segregated as paired ganglia in each somite, often united by meristio dislocation into composite ganglia.

(I) The genital ducts may be the coelomoducts of the penultimate or antepenultimate or adjacent somite, or of a somite placed near the middle of the series, or of a somite far forward in the series.

Class 1 (of the Euarthropoda). — Diplopoda.

The head has but one prosthomere (monoprosthomerous), and is accordingly deuteroguathous. This carries short-jointed antennae (in one case -biramose) and eyes, the structure and development of which require further elucidation. Only one somite following the first post-oral or mandibular segment h^ its appendages modified as jaws.

The somites of the body, except in Pauropus, either fuse after early development and form double somites with two pairs of appendages

(Julus, &c.), or present legless and leg-bearing somites alternating.

Somites, anomomeristic, from 12 to 150 in the post-cephalic series.

The genital ducts open in "the fourth, or between the fourth and fifth post-oral somite.

Terrestrial forms with small-jointed legs formed by adaptation of a single ramus of the appendage. Tracheae are present.

JVofe.— The Diplopoda include the Juliformia, the Symphyla (Scolopendrella), and Pauropoda (Pauropus). They were until recently classified with the Chilopoda (Centipedes), with which they have no close aflSnity, but only a superficial resemblance. (Compare the definition of the class ChUopoda.)

The movement of the legs in Diplopoda is like that of those of Peripatus, of the Phyllopod Crustacea, and of the parapodia of Chaetopoda, symmetrical and identical on the two sides of the body. The legs o,f Chilopoda move in alternating groups on the two sides of the bo'dy. This implies a very much higher develop- ment of nerves and muscles in the latter.

Class 2 (of the Euarthropoda). — Aeachnida. Head tritognathous and diprosthomerous — ^that is to say, with two prosthomeres, the first bearing typical eyes, the second a pair

of appendages reduced to a single ramus, which is in more primi- tive forms antenniform, in higher forms chelate or retrovert. The ancestral stock was panto-gnathobasio — i.e., had a gnathobase or jaw process on every parapodium. As many as six pairs of ap- pendages following the mouth may have an enlarged gnathobase actually functional as a jaw or hemignath, but a ramus is well developed on each of these appendages, either as a simple walking leg, a palp, or a chela. In the more primitive forms the appendage of every post-oral somite has a gnathobase and two rami ; in higher specialized forms the gnathobases may be atrophied in every appendage, even in the first post-oral.

The more primitive forms are anomomeristic ; the higher forms nomomeristic, showing typically three groups or tagmata of six somites each.

The genital apertures are placed on the first somite of the second tagma or mesosoma. Their position is unknown in the, more primitive forms. The more primitive forms have branchial re- spiratory processes developed on a ramus of each of the post-orai appendages. In higher specialized forms these branchial processes become first of all limited to five segments of the mesosoma, then sunk beneath the surface as pulmonary organs, and finally atrophied, their place being taken by a well-developed tracheal system.

A character of great diagnostic value in the more primitive Arachnida is the tendency of the chitinous investment of the tergal surface of the telson to unite during growth with that of the free somites in front of it, so as to form a pygidial shield or posterior carapace, often comprising as many as fifteen somites (Trilobites, Limulus).

A pair of central monomenisoous diplostichous eyes is often present on the head. Lateral eyes also are often present which are monostichous with aggregated lenses (Limulus') or with isolated lenses (Scorpio), or are diplostichous with simple lens {Pedipalpi, Araneae, &c.).

Class 3 (of the Euarthropoda). — Ceustacea.

Head tetartognathous and triprosthomerous — that is to say, with three prosthomeres : the first bearing typical eyes, the second a pair of antenniform appendages (often biramose), the third a pair of appendages usually antenniform, sometimes claw-like. The ancestral stock was (as in the Arachnida) pantognathobasic, that is to say, had a gnathobase or jaw-process on the base of every post-oral appendage.

Besides tlie first post-oral or mandibular pair, at least two succeed- ing pairs of appendages are modified as jaws. These have small and insignificant rami, or none at all, a feature in which the Arachnida differ from them. The appendages of four or more additional following somites

may be turned upwards towards the mouthj and assist in the taking of food.

The more primitive forms (Entomostraca) are anomomeristic, presenting great variety as to number of somites, form of append- ages, and tagmatic grouping ; the higher forms (Malacostraca) are nomomeristic, showing in front of the telson twenty somites, of which the six hinder carry swimmerets and the five next in front ambulatory limbs. The genital apertures are neither far forward nor far backward in the series of somites, e.g., on the fourteenth post-oral in Apus, on the ninth post-oral in female Astacus and in Cyclops.

With rare exceptions, branchial plates are developed either by modification of a ramus of the limbs, or as processes on a ramus, or upon the sides of the body. No tracheate Crustacea are known, but some terrestrial Isopoda develop pulmonary in-sinkings of the integument. A characteristic, comparable in value to that presented by the pygidial shield of Arachnida, is the frequent development of a pair of long appendages by the penultimate somite, which with the telson form a trifld, or, when that is small, a bifid termination to the body.

The lateral eyes of Crustacea are polymeniscous, with highly specialized retinulae like those of Hexapoda, and unlike the simpler compound lateral eyes of lower Arachnida. Monomenisoous eyes are rarely present, and when present, single, minute, and central in position.

N'ote. — The Crustacea exhibit a longer and more complete series of forms than any other class of Arthropoda, and may be regarded as preserving the most completely represented line of descent.

Class 4. — Chilopoda. Head triprosthomerous 1 and tetartognathous. The two somites following the mandibular or first post-oral or buccal somite carry

1 Embryological evidence of this is still wanting. In the other classes of Arthropoda we have more or less complete embryological evidence on the subject. It appears from observation of the embryo that whilst the first prosthomere of Centipedes has its appendages reduced and represented

only by eye-patches (as in Arachnida, Crustacea, and Hexapoda), the second has a rudimentary antenna, which disappears, whilst the third carries the permanent antennae, which accordingly correspond to the second antennae of Crustacea, and are absent in Hexapoda.

appendages modified as maxillse. The fourth post-oral somite has its appendages converted into very large and powerful hemignaths, V7hich are provided with poison-glands. The remaining somites carry single-clawed, walking legs, a single pair to each somite. The body is anomomeristic, showing in different genera from 17 (inclusive of the anal and genital) to 176 somites behind that which bears the poison-jaws. No tagmata are developed. The genital ducts open on the penultimate somite.

TrachesB are developed which are dendriform and with spiral thickenmg of their lining. Their trunks open at paired stigmata placed laterally in each somite of the trunk or in alternate somites. Usually the trachese open by paired stigmata placed upon the sides of a greater or less number of the somites, but never quite regularly on alternating somites. At most they are present on all the pedigerous somites excepting the first and the last. In Scutigera there are seven unpaired dorsal stigmata, each leading into a sac ■whence a number of air-holding tubes project into the pericardial blood-sinus.

Renal csecal tubes (Malpighian tubes) open into the proctodseum.

Class 5. — Hexapoda.

- Head shown by' its early development to be triprosthomerous and consequently tetartognathous. The first prosthomere has its appendages represented by the compound eyes and a protocerebrum, the second has the antennae for its appendages and a deutocerebral neuromere, the third has suffered suppression of its appendages (which corresponded to the second pair of antennae of Crustacea), but has a tritocerebrum and coelomic chamber. The mandibular somite bears a pair of gnathobasio

hemignaths without rami or palps, and is followed by two jaw-bearing somites (maxillary and labial). This enumeration would give six somites in all to the head. — three prosthomeres and three opisthomeres. Eeoent investi- gations (Folsom, 4) show the existence in the embryo of a prse-maxillary or supra-lingual somite which is suppressed during development. This gives seven somites to the Hexapod's head, the tergites of which are fused to form a cephaRc carapace or box. The number is significant, since it agrees with that found in Edriophthalmous Crustacea, and assigns the labium of the Hexapod to the same somite numerically as that which carries the labium- like maxillipedes of those Crustacea. >

The somites following the head are strictly nomomeristic and nomotagmic. The first three form the thorax, the appendages of which are the walking legs, tipped with paired claws or ungues (compare the homoplastic claws of Scorpio and Peripatus). Eleven somites follow these, forming the abdominal " tagma," giving thus twenty-one somites in all (as in the higher Crustacea). The somites of the abdomen all may carry rudimentary appendages in the embryo, and some of the hinder somites may retain their appendages in a modified form in adult life. Terminal telescoping of the abdominal somites and exoalatibn may occur in the adult, reducing the obvious abdominal somites to as few as eight. The genital apertures are median and placed far back in the series of somites, viz., the female on the seventh abdominal (seventeenth of the whole series) and the male on the ninth or ante-penultimate abdominal (nineteenth of the whole series). The appendages of the eighth and tenth abdominal somites are modified as gonapophyses. The eleventh abdominal segment is the telson, usually small and soft ; it carries the anus.

The Hexapoda are not only all confined to a very definite dis- position of th'e somites, appendages, and apertures, as thus indicated, but in other characters also they present the specializa- tion of a narrowly-limited highly ~~developed order of such a class as the Crustacea rather than a range from lower more generalized to higher more specialized forms such as that group and also the Arachnida present. It seems to be a legitimate conclusion that the most primitive Hexapoda were provided with wings, and that the term Pterygota might be used as a synonym of Hexapoda.~~

Many Hexapoda have lost either one pair or both pairs of wings ; cases are common, of wingless genera allied to ordinary Pterygote genera. Some Hexapods which are very primitive in other respects happen to be also Apterous, but this cannot be held to prove that the possession of wings is not a primitive character of Hexapods (com pare the case of the Struthious Birds) . The wings of Hexapoda are lateral expansions of the terga of the second and third thoracic somites. They appear to be serial equivalents (homogenous meromes) of the tracheal gills, which develop in a like position on the abdominal segments of some aquatic Hexapods.

The Hexapoda are all provided with a highly developed tracheal system, which presents considerable variation in regard to its stigmata or orifices of communication with the exterior. In some a serial arrangement of stigmata comparable to that observed in Chilopoda is found. In other cases (some larvse) stigmata are absent; in other cases again a single stigma is developed, as in the smaller Arachnida and Chilopoda, Mn the median dorsal line or other unexpected position. When the facile tendency of Arthropoda to develop tracheal air-tubes is admitted, it becomes

probable that the trachese of Hexapods do not all belong to one original system, but may be accounted for by new developments within the group. Whether the primitive tracheal system of Hexapoda was a closed one or open by serial stigmata in every somite remains at present doubtful, but the intimate relation of the system to the wings and tracheal gills cannot be overlooked.

The lateral eyes of Hexapoda, like those of Crustacea, belong to the most specialized type of " compound eye," found only in these two classes. Simple monomeniscous eyes are also present in many Hexapods.

Renal excretory cseca (Malpighian tubes) are developed from the proctodseum (not from Mesenteron as in Scorpion and Amphipoda).

OoncludiTig Remarks on the BelationsMps to one another of the Classes of the Arthropoda. — Our general conclusion from a survey of the Arthropoda amounts to this, that whilst Peripatus, the Diplopoda, and the Arachnida represent terrestrial offshoots from successive lower grades of

primitive aquatic Arthropoda w^hich are extinct, the Crustacea alone present a fairly full series of representar tives leading upwards from unspecialized forms. The latter were not very far removed from the aquatic ancestors (Trilobites) of the Arachnida, but differed essentially from them by the higher specialization of the head. We can gather no indication of the forefathers of the Hexapoda or of the Chilopoda less specialized than they are, whilst possessing the essential characteristics of these classes. Neither embryology nor palaeontology assists us in this direction. On the other hand, the facts that the Hexa- poda and the Chilopoda have triprosthomerous heads, that the Hexapoda have the same total number of somites as the nomomeristic Crustacea, and the same number of opisthomeres in the head as the more terrestrial Crustacea, togetherwith the same adaptation of the form of important appendages in corresponding somites, and that the com- pound eyes of both Crustacea and Hexapoda are extremely specialized and elaborate in structure and identical in that structure, all lead to the suggestion that the Hexa- poda, and with them, at no distant point, the Chilopoda, have branched off from the Crustacean main stem as specialized terrestrial lines of descent. And it seems probable that in the case of the Hexapoda, at any rate, the point of departure was subsequent to the attainment of the nomomeristic character presented by the higher grade of Crustacea. It is on the whole desirable to recognize such af&nities in our schemes of classification. We may tabulate the facts as to head-structure in Chaetopoda and Arthropoda as follows : —

Grade x (below the Arthropoda). — Agnatha, Aprosthomeba.

Without parapodial jaws ; without the addition of originally

post-oral somites to the pree-oral region, which is a simple prostomial

lobe of the first somite ; the first somite is perforated by the mouth

and its parapodia are not modified as jaws.

= CH.a:TOPODA.

Grade 1 (of the Arthropoda). — Monoonatha, Mono-

PSOSTROMEBA.

With a single pair of parapodial jaws carried by the somite which is perforated by the mouth ; this is not the first somite, but the second. The first somite has become a prosthomere, and carries a pair of extensile antennae.

=Ontchophoba (^Peripatus, &o.).

Grade 2 (of the Arthropoda).— Dignatha, Monopbosthomeba.

The third somite as well as the second develops a pair of para- podial jaws ; the first somite is a prosthomere carrying jointed antennae. .„

= Diplopoda.

Grade 3 (of the Arthropoda). — Pantognatha, Dipbosthomeka. A gnathobase is developed (in the primitive stock) on every pair of post-oral appendages ; two prosthomeres present, the second somite as well as the first having passed in front of the mouth, but only the second has appendages.

=Aeachnida. Grade 4 (of the Arthropoda).— Pantogitatha, Tbipbosthomeba. The original stock, like that of the last grade, has a gnathobase on every post-oral appendage, but three prosthomeres are now present, in consequence of the movement of the oral aperture from the third to the fourth somite. The lateral eyes are polymenisoous,

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■with specialized vitreUse and retinul» of a definite type peculiar to this grade.

=Ckustacba, Chilopoda,! Hexapoda.

According to older views the increase of the number of somites in front of the mouth would have been regarded as a case of intercalation by new

somite-budding of new prse-oral somites in the series. We are prohibited by a general consideration of metamerism in the Arthropoda (see a previous section of this article) from adopting the hypothesis of intercalation of somites. However strange it may seem, we have to suppose that one by one in the course of long historical evolution somites have passed forwards and the mouth has passed backwards. In fact, we have to suppose that the actual somite which in grades 1 and 2 bore the mandibles lost those mandibles, developed their rami as tactile organs, and came to occupy a position in front of the mouth, whilst its previous jaw-bearing function was taken up by the next somite in order, into which the oral aperture had passed. A similar history must have been slowly brought about when this second mandibulate somite in its turn became agnathous and passed in front of the mouth. The mandibular parapodia may be supposed during the successive stages of this his- tory to have had, from the first, well-developed rami (one or two) of a palp-like form, so that the change required when the mouth passed away from them would merely con- sist in the suppression of the gnathobase. The solid palp- less mandible such as we now see in some Arthropoda is, necessarily, a late specialization. Moreover, it appears prob- able that the first somite never had its parapodia modified as jaws, but became a prosthomere with tactile append- ages before parapodial jaws were developed at all, or rather pari passu with their development on the second somite.

It is worth while bearing in mind a second possibility as to the history of the prosthomeres, viz., that the buccal gnathobasic parapodia (the mandibles) were in each of the three grades of prosthomerism only developed after the recession of the mouthand the addition of one, of two, or of three post-oral somites to the prae-oral region had taken place. In fact, we may imagine that the characteristic adaptation of one or more pairs of post-oral parapodia to the purposes of the mouth as jaws did not occur until after ancestral forms with one, with two, and with three pros- thomeres had come into existence. On the whole the facts seem to be against this supposition, though we need not suppose that the gnathobase was very large or the rami undeveloped in the buccal parapodia which were destined to lose their mandibular features and pass in front of the mouth.

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Arthur, Chester Alan (1830-1886), twenty- first president of the United States, was born in Fairfield, Vt., 5th October 1830. His father, William Arthur, when eighteen years of age, emigrated from Coimty Antrim, ' Ireland, and, after teaching in various places in Vermont and Lower Canada, became a Baptist minister. WiUiam Arthur had married Malvina Stone, an American girl who lived at the time of the marriage in Canada, and the numerous changes of the family residence afforded a basis for allegations in 1880 that the son Chester was born not in Vermont, but in Canada, and was therefore ineligible for the presidency. Chester entered Union College as a sophomore, and graduated with honour in 1848. He then became a schoolmaster, at the same time studying law. In 1853 he entered a law office in New York City, and in the following year was admitted to the bar. In politics he was actively associated from the outset with the Republican party. When the Civil War began he held the position of engineer-in-chief on Governor Morgan's staff, and afterwards became acting quartermaster-general of the state troops, in which capacity he showed much administrative efficiency. At the close of Governor Morgan's term, 31st December 1862, General Arthur resumed the

practice of his profession, remaining active, however, in party politics in New York City. In Novem- ber 1871 he was appointed collector of customs for the port of New York. The custom-house had long been con- spicuous for the most flagrant abuses of the "spoils system " ; and though General Arthur admitted that the evils existed and that they rendered efficient administration

1 The eyes of Chilopoda are not thoroughly understood, and may or may not be capable of interpretation as fitting in v^ith those of Crustacea and Hexapoda.

impossible, he made no extensive reforms. In 1877 President Hayes began the reform of the civil service with the New York custom-house. A non-partisan commission appointed by Secretary Sherman recommended sweeping changes. The president demanded the resignations of Arthur and his two principal subordinates. General Arthur refused, on the ground that to retire " under fire " would be to acknowledge wrong-doing, and claimed that as the abuses were inherent in a widespread system he should not be made to bear the responsibility alone. His cause was espoused by Senator Conkling, for a time successfully; but on 11th July 1878, during a recess of the Senate, the collector was removed, and in January 1879, after another severe struggle, this action received the approval of the Senate. In 1880 General Arthur was a delegate at large from New York to the Republican National Convention. In common with the rest of the " Stalwarts " he worked hard for the nomination of Grant. Upon the triumph of Garfield, the necessity of conciliating the defeated faction led to the hasty acceptance of Arthur for the second place on the ticket. His nomination was coldly received by the public ; and when, after his election and accession, he actively engaged on behalf of Conkling in the great con- flict with Garfield over the New York patronage, the impression was widespread that he was unworthy of his position. Upon the death of President Garfield, 19th September 1881, Arthur took the oath as his successor. Contrary to the general expectation, his appointments were as a rule unexceptionable, and he earnestly promoted the Pendleton law for the reform of the civil service. His use of the veto in the cases of a Chinese Immigration Bill and a River and Harbour Bill in 1882 confirmed the favourable impression which had been made. His

administration -was lacking in political situations of a dramatic character, but on all questions that arose his ;^olicy was sane and dignified. In 1884 he allowed his name to be presented for renomination in the Eepublican Convention, but he was easily defeated by the friends of Mr Blaine. At the expiration of his term he resumed his residence in New York City, where he died on 18th November 1886. (w. a. d.)

Artillery. — Originally this word was applicable not only to missiles in general, but to the instruments or machines from which they were discharged — slings, bows and arrows, tormenta, &c. In the following article, how- ever, we shall confine ourselves to the introduction of modern artillery and the progress of the bodies of men attached to its service.

The earliest recipe we possess for gunpowder is that of Dr John Andeme, who began to practise before 1350, and in his old age was appointed surgeon to Henry IV. It was recovered from his MSS. (now among the Sloane papers) by Mr Albert Way, and given in his edition of the Promptorium Parvulorum, an English- Latin vocabulary of the year 1440, in a note under ” Gunne.” This recipe is :— Saltpetre, 66-6 parts; charcoal, 22-2' parts; sulphur, 17-7' parts. The remarkable point about this recipe is, that it is identical with that given for rocket composition in the MS. of Marcus Grseous, who lived long before Friar Roger Bacon ; and rocket composition will not project a round shot. The difficulty is easily explained. The fizzing rocket composition prepared with the Greek’s impure ingredients became an explosive when prepared with the comparatively pure ingredients of a later age in the same proportions. If Bacon could refine nitre — a matter that hardly admits of a doubt — ^there may be a sub- stratum of truth in the legend of the destruction of his Brazen Head. He and Priar Bungey, having mixed the pure ingredients in the old proportions, lay down to sleep. Their servant, Miles, from idle curiosity, applied fire to it, and produced an unexpected explosion which broke some of the chemical apparatus and terrified all three of them. If this view of the case be accepted gun- powder was*

invented by accident. It is not known who invented cannon, and we must fall back on the tradition that assigns the invention to a German monk, one Berthold Schwartz. There is good evidence to show that the Germans used guns at the siege of Cividale in Italy, 1331, and England had guns, both of iron and brass) in her navy in 1338. She was the first nation to bring guns into the open fields (at Cressy). Froissart calls these guns in one place kanons, in ahother hombardiaulx ; but Andeme ex- pressly says they were called gonnes (in England), and Chaucer and Langland apply to them this word which had previously been used to denote the ancient tormenta.

For some three and a half centuries after the introduction of cannon artillerymen in all countries were civilians. Matters came to such a pass in England in the middle of the 16th century, that Henry VIII. had to employ Dutch gunners to instruct the men. In the time of Elizabeth the ages of some of the Tower gunners ranged from 64 to 92 years. The first to attempt any organization of the arm was Gustavus Adolphus. This great man clearly saw that the fundamental principle of all artillery organization is a twofold division, the gunners who follow an army into the field, and those who do not — field artillery and garrison artillery, and he reorganized his artillery accordingly ; but he does not appear to have taken any step towards making them a military body. When the Great Rebellion broke out, loud were, the complaints about the scarcity and inefficiency of the gunners. In 1638, Wemyss, master gunner of England, reported that there were "few good gunners in the kingdom . . . who understand the several ranges of ordnance or use of the mortar "; Norton refers in 1643 to "the penury of expert gunners "; and Eldred denounces "the idle laziness of the gunners," for which he had little or no power to punish them. Things became at length so intolerable that a warrant, dated 22nd August 1682, put the gunners under military discipline. Strange to say, the master gunners were shown as part of the "civil" establishment as late, as 24th January 1783, in the establishment warrant of the ordnance. The ordnance officials had now some power over the gunners, yet their position was still so doubtful that a clause had to be inserted in their com- missions in 1694 to place it beyond all doubt. These events were followed by the establishment of two permanent companies of artillery, 26th May 1716, and the formation of the. (present)

Royal Regiment of Artillery, 1st April 1722. Notwithstanding these improvements. Colonel Forbes Macbean, F.R.S., 'R.A., declares that the English artillery did not begin to assume a mili- tary appearance until the Flanders campaigns of 1748-49.

The officers of the French artillery before Louis XIV.'s time were only officers in the sense that they held an office. They were without rank in the army, and had no troops under their command. Only when war broke out were these officials united and supplied with the necessary matkriel. At length Vauban pro- tested against their position as helpless civilians, and they received military rank when Vallifere reorganized the artillery in 1732.

" When Frederick the Great assumed the crown he found the army in a very good condition, excepting the corps of artillery and engineers, which consisted chiefly of mechanics and artisans, scarcely looked on by the rest of the army and the officers with- out commissions. His Majesty immediately drafted all the illiterate officers into the garrison regiments, supplying their places with gentlemen of examined capacity ; gave them all commissions, rank with the officers of the guards, and an extra-ordinary pay." 1 It is strange that Capt. Smith, who was inspector of the Royal Military Academy, Woolwich, should have made no reference to the Prussian horse artillery. In 1773 the king formed a depot at Potsdam for the horse artillery (first formed 21st April 1759), consisting of 1 captain, 1 lieutenant, 10 non-commissioned officers, and 60 gunners. It is almost certain His Majesty had no intention of making it a corps d^elite.

Owing to the great progress made during the 18th century by those arts and sciences on whicfi the efficiency of artillery essen- tially depends, it increased rapidly in numbers, and colleges were everywhere founded for the instruction of officers and others. The Royal Military Academy at Woolwich was opened in 1741. With regard to numbers, the four . companies England possessed in the early years of the century were represented in Capt. Smith's time by four battalions ; and these 3000 to 4000 men had swollen to 42,000 offioers^and men in 1899. Other artilleries Increased in similar proportions.

The organization of the artilleries of the Great Powers is described under " Armies." A few remarks may be offered on the funda^ mental principles on which all these organizations are more or less based. Before the 18th century only one man can be named, the great Gustavus Adolphus, who clearly understood the first principle of all artillery organization — the separation of the personnel into two distinct bodies : (a) those who follow the army into the field, and (6) those who do not. This primary division of the artillery has long been practically acknowledged on the Continent and has been partially adopted in England. British garrison artillery con- sists of two branches: (a) the garrison artillery proper, or the gunners who defend a besieged fortress ; and (6) the siege artillery, or the gimners who attack an enemy's fortress. Occasionally in a battle in the field guns of the 40-pr. type are used, taking up a fixed position which they occupy during the day. Whether these guns of position should be manned by garrison or field artillery is purely an academic question. The various subdivisions of the field artillery arise naturally from the nature of the duties they have to perform ; while the nature of the ordnance with which they are severally armed is determined by the axiom, that the proper gun for any duty is the heaviest gun by which it can be carried out. The main body of the field artillery, the field batter- ies, are intended to support the infantry ; and, in order to do so they must be capable of moving at a trot (and occasionally a gallop), the gunners being carried on the gun-carriages and limber, or the off-horses of the gun-team. Experience shows that guns of the 15-pr. type, drawn by six horses, are the most suitable for this branch. Similarly, guns of the 7-pr. type, carried on mules, are the best adapted for moiintain artillery. For years there was much difficulty in organizing a body of field artillery to sup- port cavalry. At length Frederick the Great solved the question by the creation of horse artillery, so called, not because the guns are drawn by horses, but because the gunners accompanying their gun are mounted on horses of their own distinct from the gun- team. At present the British equipment consists of guns of the 12-pr. type, each drawn by six horses.

For some five centuries the word "Artillery" in England meant simply garrison artillery ; the field artillery only existed in time of war. When war broke out a train of artillery was organized, consisting of a certain number of field (or siege) guns, manned by garrison gunners ; and when

peace was proclaimed the train was disbanded, the matiriel being returned into store, and the gunners reverting to some fort or stronghold. The first per- manent body of field artillery in England were A and B troops of the royal horse artillery raised in 1793, the drivers of which (as well as the gunners) were enlisted under the military oath. In the early years of the nineteenth century a separate driver corps, under its own officers, was formed for the field batteries, but it was with good reason disbanded after Waterloo. The first per- manent force of field batteries may be dated from the camp at Cobham, 1853. It is impossible to say on what principles the reorganization in 1899 of the artillery was based. This arm

1 Universal Military Dictionary. Capt. G. Smith, R.A. London, 1779.

now consists of two large separate branches : "(a) the royal horse artillery and the field batteries, and (&) the siege artillery, heavy field batteries, garrison artillery proper, and mountain artillery. There are 28 service batteries of horse artillery, armed with 12-pr. B.L. guns ; 100 service field batteries armed with 15-pr. B.L. guns ; and 12 service field batteries armed with 5-in. B.L. rified howitzers — in all cases 6 pieces per battery. The formation of the latter was necessitated by the comparative flat- ness of the 12-pr. and 15-pr. trajectories, and the want of a shell, with a large angle of descent, to act upon troops under cover of earthworks, &c. The officers for each rank of the horse artillery are selected from the field batteries, to which they return on promotion to the next higher rank, a system which gives rise to a constant interchange of officers. The garrison artillery consists of 104 service companies, of 199 officers and men each, on war strength, of which 7 companies are attached to siege train batteries, and 4 to heavy field batteries for Indian service.*

A siege train battery for India consists of four 5-in. B.L. guns and two 6-in. B.L. howitzers. For service in South Africa, four 7-in. B.L. guns have been substituted for 6-in. B.L. guns. An Indian heavy field battery is armed with four 30-pr. B.L. guns and two 5'4-in. B.L. howitzers. A

mountain battery is armed with six 2-5-in. screw R.M.L. guns, the projectile of which weighs 7 lb. A lO-pr. gun is under consideration. In addition to the foregoing there are in India 10 mountain batteries armed with 2-5-in. R.M.L. guns, 11 inanned by natives, and 4 field batteries of the Haidarabad contingent armed with two 6-pr. S.B. guns and two 12-pr. S.B. howitzers. Finally, there are 13 com- panies of local artillery ; at Kohat, 1 company ; at Hong-Kong, 4 f at Singapore, 1 ; in Ceylon, 2 ; in Mauritius, 2 ; at Sierra Leone, 1 ; at Jamaica, 1 ; and at St Lucia, 1. (h. w. l. H.)

Arts and Crafts. — The arts of decorative design and handicraft are comprehended under this title — all those arts and crafts, it may be said, which, in association with the mother-craft of building (or architecture) go to the making of the house beautiful. Ajts and crafts are also associated with the movement generally understood as the 'English revival of decorative art, which has char- acterized the years since about 1875. The title itself only came into general use when the Arts and Crafts Exhibition Society was founded, and held its first ex- hibition at the New Gallery, London, in the autumn of 1888, since which time arts and crafts exhibitions have been common all over Great Britain. The idea of form- ing a society for the purpose of showing contemporary work in design and handicraft really arose out of a move- ment of revolt or protest against the exclusive view of art encouraged by the Koyal Academy exhibitions, in which oil paintings in gilt frames claimed almost exclusive attention — sculpture, architecture, and the arts of dec- orative design, being relegated to quite subordinate po- sitions. In 1886, out of a feeling of discontent among artists as to the inadequacy of the Eoyal Academy ex- hibitions, considered as representing the art of Great Britain, a demand arose for a national exhibition to in- clude all the arts of design. One of the points of this demand was for the annual election of the hanging com- mittee by the whole body of artists. After many meet- ings the group representing the arts and crafts (who belonged to a larger body of artists and craftsmen called the Art-workers' Guild, founded in 1884),^ perceiving that the painters, especially the leading group of a school not hitherto well represented in the Academy exhibitions, only cherished the hope of forcing certain reforms on the Academy, and were by no means prepared to lose their chances of admission to its privileges, still less to

run any risk in the establishment of a really comprehensive national exhibition of art, .decided to organize an ex- hibition themselves in which artists and craftsmen might show their productions, so that contemporary work in decorative art should be,/ displayed to the public on the same footing, and with the same advantages as had hitherto been monopolized by pictorial art. For many

1 Whose members, comprehending as they do the principal living designers, architects, painters, and craftsmen of all kinds, have played no inconsiderable part in the aforesaid English revival.

years previously there had been great activity in the study and revival in the practice of many of the neglected decorative handicrafts. Amateur societies and classes were in existence, like the Home Arts and Industries Association, which had established viUage classes in wood-carving, metal-work, spinning and weaving, needle- work, pottery, and basket-work, and the public interest was steadily growing in handicraft. The machine pro- duction of an industrial century had laid its iron hands upon what had formerly been the exclusive province of the handicraftsman, who only lingered on in a few obscure trades and in forgotten corners of England for the most part. The ideal of mechanical perfection dom- inated British workmen, and the factory system, first by extreme division of labour, and then by the further specialization of the workman under machine production, left no room for individual artistic feeling among crafts- men trained and working under such conditions. The demand of the world-market ruled the character and quality of production, and to the few who would seek some humanity, simplicity of construction, or artistic feeling in their domestic decorations and furniture the only choice was that of the tradesman or salesman, or a plunge into costly and doubtful experiments in original design. From the 'forties onward there had been much research and study of mediaeval art in England ; there had been many able designers, architects, and antiquaries, such as the Pugins and Henry Shaw, and later William Burges, Butterfield, and G. E. Street and others. The school of prse-Eaphaelite painters, by their careful and thorough methods, and their sympathy with mediaeval design, were among the first to turn attention to beauty of design, colour, and significance in the accessories of daily life,

and artists like D. G. Kossetti, Ford Madox Brown, and W. Holmap. Hunt themselves designed and painted furniture. The most successful and most practical effort indeed towards the revival of sounder ideas of construction and workmanship may be said to have arisen out of the work of this group of artists, and may be traced to the workshop of William Morris and his associates in Queen Square, London. William Morris, whose name covers so large a field of artistic as well as literary and social work, came well equipped to his task of raising the arts of design and handicraft, of changing the taste of his countrymen from ^he corrupt and vulgar ostentation of the Second Empire, and its cheap imitations, which prevailed ia the 'fifties and 'sixties, and of winning them back, for a time at least, to the massive simplicity of plain oak furniture, or the delicate b^uty of inlays of choice woods, or the charm of painted work, the richness and frank colour of formal floral and heraldic pattern in silk textiles and wall-hang- ings and carpets, the gaiety and freshness of printed cot- ton, or the romantic splendour of arras tapestry. Both William Morris and his artistic comrade and life-long friend, Edward Burne-Jones, were' no doubt much influ- enced at the outset by the imaginative insight, the passion- ate artistic feeling, and the love of mediaeval romance and colour of Dante Gabriel Eossetti, who remains so remark- able a figure in the great artistic and poetic revival of the latter half of the 19th century. To William Morris him- self, in his artistic career, it was no small advantage to gain the ear of the English public first by his poetry. His verse- craft helped his handicraft, but both lived side by side. The secret of Morris's great influence in the revival was no doubt to be attributed to his way of personally mas- tering the working details and handling of each craft he took up in turn, as well as to his power of inspiring his helpers and followers. He was painter, designer, scribe, illuminator, wood-engraver, dyer, weaver, and finally printer and pa,per- maker, and having mastered these crafts, he could effectively direct and criticize the work of others.

His own work and that of Burne-Jones were well known to the public, and in high favour long before the Arts and Crafts Exhibition Society was formed, and though largely helped and inspired by the work of these two artists, the aims and objects of the society rather repre- sented those of a younger generation, and were in some measure a fresh development both of the social and the artistic ideas which were represented by Euskin, Eossetti, and Morris, though the society includes men of different schools. Other sources of influence might be named, such as the work of Norman Shaw and Philip Webb in architecture and decoration, of Lewis Day in surface pattern, and William de Morgan in pottery. The demand for the acknowledgment of the personality of each re- sponsible craftsman in a co-operative work was new, and it had direct bearing upon the social and economic con- ditions of artistic production. The principle, too, of regarding the material, object, method, and purpose of a work as essential conditions of its artistic expression, the form and character of which must always be controlled by such conditions, had never before been so emphatically stated, though it practically endorsed the somewhat vague aspirations current for the unity of beauty with utility. Again, a very notable return to extreme simplicity of design in furniture and surface decoration may be re- marked; and certain reserve in the use of colour and ornament, and a love of abstract forms in decoration generally, which are characteristic of later taste. Not less remarkable has been the new development in the design and workmanship of jewellery, gold- and silver-smiths' work, and enamels, with which the names of Alexander Fisher, Henry Wilson, Nelson Dawson, and C. E. Ashbee are associated. Among the arts and crafts of design which have blossomed into new life in recent years^-and there is hardly one which has not been touched by the new spirit — book-binding must be named as having attained afresh and tasteful development through the work of Mr Cobden-Sanderson and his pupils. The art and craft of the needle also must not be forgotten, and its progress is a good criterion of taste in design, choice of colour, and treatment. The work of Mrs Morris, of Miss Burden (sometime instructress at the Eoyal School of Art Needlework, which has carried on its work from 1875), of Miss May Morris, of Miss Una Taylor, of Miss Buckle, of Mrs Walter Crane, of Mrs Newbery, besides many other skilled needlewomen, has been fre- quently exhibited. Good work is often seen in the national competition works of the students of the English art schools,

shown at South Kensington in July. The increase of late years in these exhibitions of designs worked out in the actual material for which they were intended is very remarkable, and is an evidence of the spread of the arts and crafts movement (fostered no doubt by the increase of technical schools, especially of the type of the Central School of Arts and Crafts under the Technical Education Board of the London County Council), of which it may be said that if it has not turned all British craftsmen into artists or all British artists into craftsmen, it has done not a little to expand and socialize the idea of art, and (perhaps it is hot too much to say) has made the tasteful English house with its furniture and decorations a model for the civilized world. (w. ck.)

Aru (Dutch Aroi) Islands, a group in the Dutch residency of Amboyna, S. of New Guinea, in 5° 18′ to T 6′ S. and 134° 8′ to 134° 66′ E. The larger islands (Wokan, Kobrur, Maikor, and Trangan) and certain of the lesser ones are regarded by the Malays as one land mass which they call tana, besar (" great land "). Their area is 2442 square miles, not densely populated by about 13,000 inhabitants, of whom 681 are Christians

and 409 Mahommedans. The chief town, Dobbo, is visited by steamers of the Eoyal Steam Packet Company. The natives are governed by rajas (orang kajas), the Dutch Government being represented by a, posthouder.

Aruwimi, R. See Congo.

Arzamas, a district town of Eussia, government and 81 miles S.W. of Nijni Novgorod, on the Tesha river. It is an important centre of trade, and has fifteen tan- neries, twenty oil-works, flour-miUs, and tallow-melting houses, and kaitting is an important domestic industry. Population, 10,691.

Asbjdrnsen, Peter Christen (1812-1885), and Moe, Jdrgen Engebretsen (1813-1882), the eminent collectors of Norwegian folklore, were so closely united in their life's work that it is unusual to name them apart. Asbjornsen was born in Christiania on the 16th January 1812 ; he belonged to an ancient family of the Gudbrandsdal, which is believed to have died with him. He became a student at the university in 1833, but as early as 1832, in his twentieth year, he had begun to collect and write

down all the fairy stories and legends which he could meet with. Later he began to wander on foot through the length and breadth of Norway, adding to his stores. Moe, who was born at Mo i Hole parson- age, in Eingerike, on the 22nd April 1813, met Asbjornsen first when he was fourteen years of age. A close friend- ship began between them, and lasted to the end of their lives. In 1834 Asbjornsen discovered that Moe had started independently on a search for the relics of national folklore ; the friends eagerly compared result^, and determined for the future to work in concert. By this time, Asbjornsen had become by profession a zo- ologist, and with the aid of the university made a series of investigating voyages along the coasts of Norway, particularly in the Hardanger fjord. Moe, meanwhile, had devoted himself to the study of theology, and was making a living as a tutor in Christiania. In his holidays he wandered through the mountains, in the most remote districts, collecting stories. In 1842-43 appeared the first instalment of the great work of the two friends, under the title of Norwegian Popular Stories, which was received at once all over Europe as a most val- uable contribution to science as well as literature. A second volume was published in 1844, and a new collection in 1871. In 1845 Asbjornsen published, without help from Moe, a collection of Norwegian fairy tales (huldree- verUyr og fplkesagn). In 1866 the attention of Asbjornsen was called to the deforestation of Norway, and he induced the Government to take up this important question. He was appointed forest-master, and was sent by Norway to examine in various countries of the north of Europe the methods observed for the preservation of timber. From these duties, in 1876, he withdrew with a pension ; he died in Christiania on the 6th January 1885. From 1841 to 1852 Moe travelled almost every summer through the southern parts of Norway, collecting traditions in the mountains. He had, however, long intended to take holy orders, and in 1863 he did so, becoming for ten years a chaplain in Sigdal, and then (1863) parish priest of Bragernes. He was moved in 1870 to the parish of Vestre Aker, near Christiania, and in 1875 he was appointed bishop of Christianssand. In January 1882 he resigned his diocese on account of failing health, and died on the following 27th March. Moe has a special claim on critical attention in regard to his lyrical poems, of which a small collection appeared in 1860. He wrote little original verse, but in his slender volume are to be found many pieces of exquisite delicacy and freshness.

Asbjornsen and Moe had the advantage of an admirable style in narrative prose. It was usually said that the

vigour of it came from Asbjornsen and the charm from Moe, but the fact seems to be that from the long habit of writing in unison they had come to adopt almost precisely identical modes of literary expression. (e. g.)

Ascension, an island situated in the Atlantic Ocean, 800 miles north-west of St Helena. It is described in the Keports of the CJiallenger as ” a series of extinct volcano cones.” Ascension was compared by Darwin “to a huge ship kept in first-rate order.” It is under the jurisdiction of the Admiralty, is garrisonedby marines, and is rated as a ship of war. The bare hills have been covered with plants and shrubs, a road has been constructed for six miles from the landing-place, and a good water supply secured. The average rainfall is slight, March and April being the rainy months. Population, about 160 sailors, marines, and Krumen from the Liberian coast. Fish, turtle, and edible birds’ eggs are the chief products.

Asch, a manufacturing town of Bohemia, in the government district of Eger, near the Saxon and Bavarian frontiers, and a station on the Bavarian State Railway. Population in 1890, 16,556; in 1900, 19,146 (all German — 70 per cent. Protestant, 30 per cent. Roman Catholic). It is the seat of a Protestant superintendent, whose jurisdiction extends over fourteen villages, of which six are in Bavaria. It contains monuments to Luther and to the Germanizing and liberal Austrian emperor, Joseph II. Important textile industry employs 11,000 hands, and there are manufactures of knitted goods (23,000 hands), leather, machinery, bleaching, dyeing, brewing, &c.

Aschaffenburg, a town of Bavaria, Germany, district Lower Franeonia, on the right bank of the Main, 26 miles S.E. from Frankfort by rail. The parish church of Our Lady and the church of St Agatha have been lately restored. There is an archaeological museum. Ready-made clothing, paper, cellulose, tobacco, lime, and liqueurs are manufactured.

Population (1900), 18,091. In March and July 1901 two suburbs were incorporated, raising the total population to 22,181.

Aschersleben, a town of Prussia, province of Saxony, 36 miles by rail N.W. from Halle. There are iron, zinc, and chemical manufactures, and the cultivation of agricultural seeds. Here are brine springs and baths. Population (1885), 21,519; (1900), 27,245.

Ascoli Piceno, a town and bishop's see of Italy (the Marches), capital of the province of Ascoli, situated on the E. side of the Apennines, 57 miles by rail S. from Ancona. The cathedral was restored in 1888, and is adorned with modern frescoes. There are an antiquarian museum, an agricultural school, and a training school for female teachers. The industries of Ascoli include silk- worm breeding, flour-mills, brickworks, limekilns, pot- teries, and factories for furniture and vehicles. Population, commune (1881), 23,225, (1901), 28,882; province (1881),

209,185, (1901), 245,883.

Ashanti. See Gold Coast.

Ashby-de-la-Zouch, a market-town and railway station, in the Bosworth parliamentary division of Leices- tershire, England, 16 miles N.W. by W, of Leicester. The old church of St Helen has been restored and enlarged, a Queen Eleanor cross erected to the Countess of Loudoun, a grammar school built, the charity Bluecoat and Green- coat schools have been enlarged, and a cottage hospital has been opened. Area of urban district (co-exten§ive with parish), 6061 acres; population (1901), 4722.

Asheville, a city of North Carolina, U.S.A., and capital of Buncombe county. It is situated in the western, mountainous part of the state, in 35° 35′ N. lat. and

82° 33′ W. long., on a terrace above the French Broad, on the north bank, at the mouth of the Swananoa, and at an altitude of 2000 feet. The site is uneven and the plan is irregular. It is noted as a winter health resort, par- ticularly for Northern people. It is entered by the Southern railway, by which it has connexions eastward and westward. It is the seat of Asheville

Female College. Near it is Mr G. W. Vanderbilt's estate, Biltmore, of 100,000 acres, mainly forest land, on which tree culture has been conducted on a large scale. Population (1900),

14,694.

Ashford, a market-town and railway station in the Ashford parliamentary division of Kei\t, England, on the Esshe, a branch of the Stour, 14 miles S. W. of Canterbury. Ashford has agricultural implement works, breweries, and locomotive and carriage works. Area of urban district, 2860 acres; population (1891), 10,728; (1901), 12,808.

Ashland, a city of Boyd county, Kentucky, U.S.A., situated in the north-eastern part of the state, on the south bank of the Ohio and on the Chesapeake and Ohio railway, at an altitude of 537 feet. It has important iron manu- factures and considerable commerce, especially by river. Population (1900), 6800.

Ashland, a borough of Schuylkill county, in eastern Pennsylvania, U.S.A., situated in the anthracite coal region, at an altitude of 866 feet; a coal-mining place on the Lehigh Valley and the Philadelphia and Reading railways. Population (1900), 6438.

Ashland, a city of Wisconsin, U.S.A., and capital of Ashland county, situated in the northern part of the state, at the head of Chaquamegon Bay, an arm of Lake Sliperior. It is in 46° 35′ N. lat. and 90° 58′ W. long., at an altitude of 678 feet. It was founded in 1885 by the discovery of the Gogebic Range iron mines, 40 miles south-east. Its plan is regfular. The Northern Pacific, the Wisconsin Central, the Chicago, St Paul, Minneapolis, and Omaha, and the Chicago and North- Western railways serve it; and it has also an extensive lake commerce, principally in lumber and iron ore. Population (1890),

9956; (1895), 12,310; (1900), 13,074.

Ashtabula, a city of Ashtabula county, Ohio, U.S.A., in the north-eastern part of the state, near the shore of Lake Erie ; altitude, 647 feet. It is an important railway centre, being traversed by two great trunk lines and the

terminus of a third. Having a fine harbour, it is a considerable lake port, shipping vast quantities of iron ore, in transport from the iron ranges of Lake Superior to Pittsburg for smelting. Population (1900), 12,949.

Ashton- in- Makerfield, a township in the Newton parliamentary division of Lancashire, England, 7 miles N. by W. of Warrington. The district is rich in minerals and has large collieries, and a colliery company's institute; iron goods are manufactured. Area of urban district, 6250 acres. Population (1901), 18,687.

Ashton-under-Lyne, a municipal and parlia- mentary borough (one member) of Lancashire, England, on the Tame, 6|- miles E. of Manchester by rail. Modern structures are a church, a Congregational chapel (£50,000), a theatre, a technical school, a school of art and free library, a children's hospital, and a new post-office. The market- place and town hall have been enlarged. There is a public park of 64 acres. Population of municipal borough in 1881, 37,040; in 1891, 40,463; in 1901, 43,890. In November 1898, a portion of the urban district of Dukin- field in Cheshire was added to the borough of Ashton- under-Lyne, and part of the borough was transfei?red to Dukinfield. As rearranged, the municipal borough has an area of 1396 acres..

ASIA.

"VTEXT to Africa, we shall probably find in Asia, oldest J_\| of the Old World continents, a greater store of new facts presented to us, or,, it may be, of old facts ^^ges in ■'"^ ^^^ features revealed by the light of modern continental scientific research, than in any other quarter pbysio- of the globe. It is in the realm of physical grap y. geography, and its collateral branches of science, that we have chiefly to mark important accessions of knowledge ; and the knowledge thus acquired is, through- out the continent, given to us rather in the form of more exact information than as absolutely new discovery which might lead to. any large correction of preconceived ideas.*

Genercd Expansion of Exact Surveys.

The progress of geodetic surveys in Russia had long ago extended across the European half of the great empire, Petersburg being connected with Tiflis on the southern slopes of the Caucasus by a direct system of triangulation carried out with the highest scientific precision. Peters- burg, again, is connected with Greenwich by European systems of triangulation; and the Greenwich meridian has been adopted by Russia as the zero for all her longi- tude values. But beyond the eastern shores of the Caspian no system of direct geodetic measurement by first-class triangulation has as yet been possible, and the surveys of Asiatic Russia are separated from those of Europe by the width of that inland sea. The arid nature of the trans- Caspian deserts has so far proved an insuperable obstacle to those rigorous methods of geodetic survey which dis- tinguish Russian methods in Europe, so that Russian geography in Central Asia is dependent on other means than that of direct measurement for the co- ordinate values in latitude and longitude for any given point. The astronomical observatory at Tashkent is adopted for the initial starting- point of the ti-ans-Caspian triangulation of Russia ; the triangulation ranks as second class only, and now extends to the Pamir frontier beyond Osh. The longi- tude of the Tashkent observatory has been determined by telegraph differentially with Pulkova as follows : —

In 1875 vi& Ekaterinburg and Omsk „ 1891 „ Saratow „ Orenburg

„ 1895 „ Kiew „ Baku

H. M. B.

2 35 52-151

2 35 52-228

2 35 51-997

With these three independent values, all falling within a range of 0’-25,.it is improbable that the mean value has an error as large as O’-IO.

*Exact surveys in Russia, based upon triangulation, extend as far east as Chinese Turkestan in longitude about 75° E. of Greenwich. In India geodetic tri- exat^sar- angulation furnishes the basis for exact surveys veys In as far east as the eastern boundaries of Burma '**'*• in longitude about 100° E.*

■ , The years since 1875 have witnessed the forging of the final links in the great geodetic triangulation of India, so far as the peninsula is concerned. Further geodetic con- nexion with the European systems still remains to be accomplished. Since 1890 further and more rigorous application of the telegraphic method of determiuing longitudes differentially with Greenwich has resulted in a slight correction (amounting to about 2" of arc) to the previous determination by the same method through Suez. This last determina,tion was effected through four arcs as follows : —

I. Greenwich — Potsdam. II. Potsdam — Teheran. III. Teheran — Bu shire. IT. Bushire — Karachi.

Each arc was measured with every precaution and a multi- tude of observations. The only element of uncertainty was caused by the retardation of the current, which between Potsdam and Teheran (3000 miles) took 0=-20 to travel; but it is probable that the final value can be accepted as correct to within 0"-05.

The final result of, this latest determination is tb place the Madras observatory 2' 27" to the west of the position adopted for it on the strength of absolute astronomical determinations.

But whilst we have yet to wait for that expansion of first-class geodetic triangulation which will bring Asia into connexion with Europe by the direct process coanexioii of earth measurement, we have already effected between a topographical connexion between Russian and Russian Indian surveys which sufficiently proves that |^^"j^^ the deductive methods employed by both countries for the determination of the co-ordinate values of fixed points so far agree that, for all practical purposes of future Asiatic cartography^ no difficulty in adjustment between Indian and Russian mapping need be appre- hended. This connexion was effected

near Lake Victoria during the Pamir Boundary Commission of 1895. The final values determined in longitude for the initial pillar of the boundary by the Russian and English surveyors respec- tively differed by about 1-0" only, a difference which will never lead to serious diflculties in mutual map adjust- ment. In connexion with the Indian triangula- „ , ,

, . ■ 1 j_ r Extension

tion minor extensions carried out on systems ofgeo-

*involving more or less irregularity have been graphical pushed outwards on all sides. They reach «”””’«’«• through Afghanistan and Baluchistan to the eastern dis- tricts of Persia, and along the coast of Makr^n to that of Arabia. They have long ago included the farther moun- tain peaks of Nepal, and they now branch outwards towards Western China and into Siam. These far exten- sions furnish the basis for a vast amount of exploratory survey of a strictly geographical character, and they have contributed largely towards raising the standard of accuracy in Asiatic geographical surveys to a level which was deemed unattainable fifty years ago. There is yet a vast field open in Asia for this class of surveys. Whilst at the close of the 19th century Western Asia (exclusive of Arabia) may be said to be freed from all geographical perplexity, China, Mongolia, and Eastern Siberia stiU include enormous areas of which our geographical knowledge is in a primitive stage of nebulous uncertainty. Of scientific geographical exploration in Asia (beyond the limits of actual surveys) the period since •1870 has been so prolific that it is only possible to refer in barest outline to some of the principal Bxplora- expeditions, most of which have been directed ”””^ either, to the great elevated tableland of Tibet, or to the central depression which exists to the north of it. In Southern Tibet the trans-Himalayan explorations of the native surveyors attached to the Indian survey, notably pundits Nain Sing and Kishen f”^”” Sing, have added largely to our knowledge **’”””*”■ of the great plateau. Nain Sing explored the sources of the Indus and of the Upper Brahmaputra in the years 1865-67; and in 1874-75 he followed a line from the eastern frontiers of Kashmir to the Tengri Nor lake and thence to Lhasa, in which city he remained for some months. Kishen Sing’s remark- able journey in 1879-82 extended from Lhasa north- wards*

through Tsaidam to Sachu, or Saitu, in Mongolia. He subsequently passed through Eastern Tibet to

the town of Darchendo, or Ta Chien Lu, on the high road between Lhasa and Peking, and on the borders of China. Failing to reach India through Upper Assam he returned to the neighbourhood of Lhasa, and crossed the Himalayas by a more westerly route. Both these explorers visited Lhasa.

In 1871-73 the great Russian explorer, Prjevalski, crossed the^ Gobi desert from the north to Kansu in Western China. He first defined the geography of Tsaidam, and mapped the hydrography of that remarkable region,

from which emanate the great rivers of China, Siam, and

Burma. He penetrated southwards to within a month's

march of Lhasa. In 1876 he visited the Lob

Nor and discovered the Altyn Tagh range. In g”pfj^„,

1879 he followed up the Urangi river to the

Altai mountaias, and demonstrated to the world the

extraordinary physical changes which have passed over

the heart of the Asiatic continent since Chenghiz Khan

massed his vast armies in those provinces. He crossed,

and named, the Dzungarian extension of the Gobi desert,

.Long 40’East of Greenwich 60"

*London. Stmnfont^ Geog! Eat^b^*

Sketch Map of Asia.

and then traversed the Gobi itself from Hami to Sachu, which became a point of junction between his journeys and those of Kishen Sing. He visited the sources of the Hoang-ho (Yellow river) and the Salween,,and then re- turned to Russia. His fcJurth journey in 1883-85 was to Sining (the great trade centre of the Chinese borderland), and thence through Northern Tibet (crossing the Altyn Tagh to Lob Nor), and by the Cherchen-Ziria trade route to Khotan. From Khotan he followed the Tarim

to Aksu. FoUowingPrjevalski the Russian explorers,Pevtsoff and

Koborovski, in 1889-90 (and again in 1894) have added

greatly to our knowledge of the topography of Western Chinese Turkestan and the northern borders of Tibet; all these Russian expeditions being

conducted on scientific principles and yielding results of the highest value.

Although the establishment of a lucrative trade between India and Central Asia had been the dream of many suc- cessive Indian viceroys, and much had been done towards improving the approaches to Simla from the north, very little was really known of the high- lands of the Pamirs, or of the regions of the great central depression, before the mission of Sir Douglas Forsyth to Yarkand in 1870. Shaw and Hay-

ward were the European pioneers of geography into the central dominion of Kashgar, arriving at Yarkand within a few weeks of each other in 1868. Shaw subsequently accompanied Forsyth's mission in 1870, when Trotter made the first maps of Chinese Turkestan. The next great accession to our knowledge of Central Asiatic geography was gained with the Eusso-Afghan Boundary Commission of 1884-86, when Afghan Turkestan and the Oxus regions were mapped by surveyors under Holdich; and when Ney Elias crossed from China through the Pamirs and Badak- shan to the camp of the commission, identifying the great "Dragon Lake," Eangkul, on his way. About the same time a mission, under Lockhart, crossed the Hindu Kush into Wakhan, and returned to India by the Bashgol valley of Kafiristan. This was Woodthorpe's opportunity, and he was then enabled to verify the results of M'Nair's previous explorations, and to determipe the conformation of the Hindu Kush. In 1885 Carey and Dalgleish, fol- lowing more or less the tracks of Prjevalski, contributed much that was new to the map of Asia; and in 1886 Younghusband completed a most adventurous journey across the heart of the continent by crossing the Muztagh, the great mountain barrier between China and Kashmir. It was in 1886-87 that Bonvalot, accomp9,nied by Prince Henri d'Orl^ans, crossed the Tibetan plateau from north to south, but failed to enter Lhasa. In 1889-91 Tibetan jjjig American traveller, Eockhill, commenced his tioas. Tibetan journeys, and also attempted to reach Lhasa, without

success. By his writings, as much as by his explorations, Eockhill has made his name great in the annals of Asiatic research. In 1891 Bower made his famous journey from Leh to Peking. He, too, failed to penetrate the jealously guarded portals of Lhasa; but he secured (with the assistance of a native surveyor) a splen- did addition to our previous Tibetan mapping. In 1891- 92-93 the gallant French explorer, De Ehins, was in the field of Tibet, where he finally sacrificed his life to his work ; and the same years saw Curzon in the Pamirs, and Littledaleon his first great Tibetan journey, accompanied by his wife. Littledale's first journey ended at Peking ; his second, in 1894-95, took him almost within sight of the sacred walls of Lhasa, but he failed to pass inside. Greatest amongst recent Asiatic explorers (if we 'except Prjevalski) is the brave Swede, Sven Hedin, whose travels through the deserts of Takhla Makan and Tibet, and whose investigations in the glacial regions of the Sarikol mountains, occupied him from 1894 to 1896. His is a truly monumental record. From 1896 to 1898 we find two British cavalry of&cers taking the front position in the list of Tibetan travellers — ^Wellby of the 18th Hussars, aud Deasy of the 16th Lancers, each striking out a new line, and each rendering most valuable service to geography. The latter continued the Pamir triangula- tion, which had been carried across the Hindu Kush by Holdich and Wahab during the Pamir Boundary Com- mission of 1895, into the plains of Kashgar and to the sources of the Zarafshan.

Meanwhile, in the farther east so rapid has been the progress of geographical research since the first beginnings of investigation into the route connexion be- chiaese twecn Burma and China in 1874 (when the brave Margary lost his life), that a gradually in- creasing tide of exploration, setting from east to west, and back again, has ctdmiriated in a flood of inquir- ing experts intent on economic and commercial develop- ment in China, essaying to unlock those doors to trade which are hereafter to be propped open for the benefit of humanity. Gi^l, of the Indian survey, first made his way across China to Eastern Tibet and Burma, and subse- quently delighted the world with his story of the River of Golden Sand. Then followed another charming writer,

explora' lloas.

Baber, who, in 1877-78, unravelled the geographic mys- teries of the western provinces of the Celestial empire. Mark Bell crossed the continent in 1887, and illustrated its ancient trade routes, following the steps of Colquhoun, who wandered from Peking to Talifu in 1881. Meanwhile, the acquisition of Burlna and the demarcation of bound- aries had opened the way to the extension of geographical surveys in directions hitherto untraversed. Woodthorpe was followed into Burmese fields by many others ; and amongst the earliest travellers to those mysterious moun- tains which hide the sources of the Irrawaddy, thre Sal- ween, and tbe Mekong, was Prince Henri d'Orl^ans. Burma was rapidly brought under survey ; Siam was already in the map-making hands of M'Carthy, whilst Curzon and Warrington Smyth added much to our know- ledge of its picturesque coast districts.

Turning our attention westwards, no advance in the pro- gress of scientific geography is more remarkable than that recorded on the northern and north-western fron- tiers of India. Here there is little matter, of /^j^"^„_ exploration. It has rather been a wide extension Afghani- of scientific geographical mapping. The Afghan stan, Baiu- war of 1878-80; the Eusso-Afghan Boimdary ^^'^'J" Commission of 1884^85 ; the occupation of Gilgit and Chitral ; the extension of boundaries east and north of Afghanistan, and again, between Baluchistan and Persia — these, added to the opportunities afforded by the systematic survey of Baluchistan which has been steadily progressing since 1880 — have combined to pro- duce a series of geographical maps which extend from the Oxus to the Indus, and from the Indus to the Euphrates.

In these professional labours the Indian surveyors have been assisted by such scientific geographers as Houtoum Schindler, Vaughan, and Sykes in Persia, and by Eobert- son and Cockerill in Kafiristan and the Hindu Kush.

In still more western fields of research much addi- tional light has been thrown since 1875 on the physio- graphy of the great deserts and oases of Arabia. The labours of Doughty and Blunt in Northern Arabia in 1877-78 were followed by those of Schwein- furth and Glaser in the south-west about ten years later. In 1884-85 Mills made his adventurous journey

through Oman, whilst Bent threw searchlights back- wards into ancient Semitic history by his investigations in the Bahrein Islands in 1888, and in Hadramut in

1894-95.

In Northern Asia it is impossible to follow in detail the results of the organized Eussian surveys. The vast steppes and forest-clad mountain regions of Siberia have ^vorfltern assumed a new geographical aspect in the light Asia, of these revelations, and already promise a new Siberia, world of economic resources to Eussian enter- *”■ prise in the near future. A remarkable expedition by Baron Toll in 1892 through the regions watered by the Lena, resulted in the collection of material which wUl greatly help to elucidate some of the problems which beset the geological history of the’ world, proving inter alia the primeval existence of a boreal zone of the Jurassic- Sea round the North Pole. The distinguished scientist, Eicht- hofen, has enriched the world by the results of his investi- gations into the physiography of the North-East in China, Korea, and J|3,pan.

It is not possible further to follow the footsteps of that great company of geographers of all nations who have searched for new material for the illustration of Asiatic geography, geology, and history. In no period of the world’s history, of equal length of time, has so much scientific enterprise been directed towards the field of Asiatic inquiry as during the last quarter of the 19th century.

ASIA

General Physiography of the Asiatic Contineiit.

Asia is divided laterally along the parallel of 40° N. lat. by a depression which, commencing on the east of the desert of Gobi, extends westwards through Mongolia to Chinese Turkestan. To the west of Kashgar the central depression is limited by the meridional range of Sarikol and the great elevation of the Pamirs, of which the Sarikol is the eastern face. The

level of this depression (once a vast inland sea) between the mountains which enclose the sources of the Hoang-ho and the Sarikol range probably never exceeds 2000 feet above sea, and modern researches tend to prove that in the central portions of the Gobi (about Lob Nor) it may be actually below sea-level. A vast proportion of the continent north of this central line is but a few huiidred feet in altitude. Shelving gradually upward from the low flats of Siberia the general conti- nental level rises to a great central water-parting, or divide, which stretches from the Black Sea through the Elburz and the Hindu Kush to the Tian Shan mountains in the Pamir region, and hence to Bering Strait on the extreme north-east. This great divide is not always marked by well-defined ranges facing steeply either to the north or south. There are considerable spaces where the strike, or axis, of the main ranges is transverse to the water- parting, which is then represented by intermediate highlands forming lacustrine regions with an indefinite watershed. Only a part of this great contineiital divide (including such ranges as the Hindu Kush, Tian Shan, Altai, or Blhangai) rises to any great height, a consider- able portion of it being below 5000 feet in altitude. South of the divide the level at once drops to the central depression of Gobi, which forms a vast interior, almost waterless, space, where the local drainage is lost in deserts or swamps. South of this enclosed depression is a second great hydrographic barrier which parts it from the low plains of the Amur, of China, Siam, and India, sinking into the shallows of the Yellow Sea and the shoals which enclose the islands of Japan and Formosa, all of them once an integral part of the continent. This second bar- rier is one of the most mighty upheavals in the world, both by reason of its extent and its altitude. Starting from the Amur river and reaching along the eastern margin of the Gobi desert towards the sources of the Hoang-ho, it merges into the Altyn Tagh and the Kuen Lun, forming the northern face of the vast Tibetan high- lands which are bounded on the south by the Himalaya. This great lacustrine plateau averages 15,000 feet above sear-level. The Pamir highlands between the base of the Tian Shan mountains and the eastern buttresses of the Hindu Kush unite these two great divides, ‘ enclosing the Gobi depression on the west ; and they would again be united on the east but for the transverse valley of the Amur, which parts the Kinghan mountains from the Yablonoi system to the east of Lake Baikal.

If we consider the whole continent to be divided into three sections, viz., a northern section with an average altitude of less than 5000 feet above sea, where all' the main rivers flow northward to the Mediterranean, the Arctic Sea, or the Caspian ; a central section of depression, where the drainage is lost in swamps or " hamuns," and of which the average level probably does not approach 2000 feet above sea ; and a southern section divided between highly elevated tablelands from 15,000 to 16,000 feet in altitude, and lowlands of the Arabian, Indian, Siamese, and Chinese peninsulas, with an ocean outlet for its drainage, we find that there is only one direct connexion between northern and southern sections which involves no moun- tain passes, and no formidable barrier of altitudes. That one is afforded by the narrow valley of the Hari Rud to the west of Herat. From the Caspian to Karachi it is

possible to pass without encountering any orographic obstacle greater than the divide which separates the valley of the Hari Kud from the Helmund "hamiin" basin, which may be represented by an altitude of about 4000 feet above sea-level. This fact possesses great significance in connexion with the development of Asiatic railways.

Hydrography. — If we examine the hydrographic basins of the three divisions of Asia thus indicated we find that the northern division, which includes the drainage falling into the Arctic Sea, the Aralo-Caspian depression, or the Mediterranean, embraces an area of about 6,394,500 square miles, as follows : —

Sq. miles.

Area of Arctic river basins . . . 4,367,000

„ Aralo-Caspian basin . . . 1,759,000

„ Mediterranean 268,500

Total . . . 6,394,500 The southern division is nearly equal in extent —

Pacific drainage Indian Ocean

Total

Sq. miles.

3341,000 2,873,000

6,514,000

The interior or inland basins, including the lacustrine regions south of the Arctic watershed, the Gobi de- pression, Tibetan 'plateau, the Iranian (or Perso-Afghan) uplands, the Syro-Arabian inland basin, and that of Asia Minor, amount to 3,141,500 sq. miles, or about half the extent of the other two.

By far the largest Asiatic river basin is that of the Ob, which exceeds 1,000,000 sq. miles in extent. On the east and south the Amur embraces no less than 776,000 sq. miles, the Yang-tse-kiang including 686,000, the Ganges 409,500, and the Indus 370,000 sq. miles.

The laJces of Asia are innumerable, and vary in size from an inland sea (such as Lakes Baikal and Balkash) to a highland loch, or the indefinitely extended swamps of Persia. Many of them are at high elevations (Lake Victoria, 13,400 feet, being probably the most elevated), and are undoubted vestiges of an ancient period of gla- ciation. Such lakes, as a rule, show indications of a gradual decrease in size. Others are relics of an earlier geological period, when land areas recently emerged from the sea were spread at low levels with alternate inun- dations of salt and fresh water. Of these Lob Nor and the Helmund "hamuns" are typical. Such lakes (in common with all the plateau "hamuns" of S. W. Balu- chistan and Persia) change their form and extent from season to season, and many of them are impregnated with saline deposits from the underlying strata. The " kavirs," or salt depressions, of the Persian desert are more frequently widespread deposits of mud and salt than water-covered areas.

Geology. — Over a great part of Asia, including the Caspian depression, the Central Asian Khanates, Turkestan, Tibet, China, Siberia, and India, geological research has been closely, and, in many regions, soientifloally pursued. The results of such investi- gations are at present too

disconnected and fragmentary to afford material for the construction of a continuous geological history of the formation of the whole continent. They have mainly, been directed to those regions v7hose economic development seems possible, and whose resources of mineral wealth may be expected to enrich the world.

The great Caspian depression and its extension to the Aral Sea has been examined by Russian scientists, and the old theory of the former Oxus contribution to the Caspian finally dismissed. Whilst the extent and nature of these beds of an ancient western ocean have been under investigation, the Central Sea to the east of the Pamirs, represented by the Gobi Sands, the Tarim desert, and by the shallow lakes and swamps of Lob Nor, has also received much attention ; but it has not yet been exhaustively explored, and we await the results of Sven Hedin's expedition to decide the position and extent of its possible survival in the existing lake system. Geological researches in Siberia have proved the existence

of almost boundless sources of mineral wealth in the north. Explorations in China have opened up new and vast fields for mining industry in the east ; and the plains of India and Burma appear in a new light under the display of economic possibilities which the systematic labours of the Geological Survey of India have revealed. Never perhaps in the world's history has the importance of investigating old fields by the newest lights of science been so fully illustrated as in Asia during the last quarter of the 19th century. Changes in the configuration of the continent, due to slow processes of upheaval and subsidence, have been proved not only to have taken place in the past, cbaniKsin ^^^ thereby modified climatic conditions, and to the bulb's ^^^® sensibly affected the history of the human race in crust Asia, but their continued action can be traced in

the present, and in one instance at least (in Turkestan) the actual measurement of the progress in upheaval has been found possible.

One of the most remarkable discoveries of the last decade of the

19th century is the continuation westwards through Baluchistan to

the Persian border of that line of volcanic activity

o canoes, ■^^ich, commencing in Kamchatka, and following the eastern coast-line of Asia to the Malay archipelago, there turns westward to the Sea of Bengal and is arrested in Arakan. No trace of it is to be found in the line of depression formed by the Indo-Gangetic alluvial plain across the width of the Indian peninsula, but it is again manifest in the active mud volcanoes of the Makrin coast, and continues trending slightly north of west to the Persian frontier, where in (approximate) lat. 28° 30′ N. and long. 61′ E. it culminates in a giant inland volcano called the Koh-i-Taftan, or ” burning” mountain; The highest peak of this mountain is 13,480 feet above sea-level, and from it there issues a perpetual pillar of smoke, which hangs heavily above the snow-clad summit. This volcano, (which has been ascended by Captain Sykes) is, so far as is known at present, the only inland volcano in Asia. Its position has been well fixed from the Baluchistan survey bases.

In India geological science has shaped the historical outline for the evolution of geography from the early ages, when a land con- nexion existed between India and Africa, to the gradual bfto f -‘^ ^^°^ process of Himalayan upheaval, and the form- Init^ ” 3’tioii of t^6 Himalayan valleys, by erosion, in the form in which we now see them. The entire peninsular area, including the north-west borderlands and Burma, are shown to have been submerged when the greater part of the peninsula (including the Gangetic basin) existed in die form of dry land, and the fascinating theory of a continuous sea which united the basins of the Indus and Ganges has to be given up. Many of the shifting changes which have occurred in the channels of great rivers are matters of history, as are some of the alterations in the coast-line, which can be readily traced on the Makran seaboard and between Bombay and Karachi.

Climate. — Although the general nature of those influences which govern the phenomena of climate over the broad area of the Asiatic

continent have been fairly well established, yet the improvements in the methods of meteorological science and the establishment of centres for the record of observed phenomena over, a very wide extent of Southern and Western Asia have much improved our knowledge of local cause and effect, and have especially assisted in supplying those data which enable meteorologists to determine the probable course and duration of disturbances, or, in other words, to make "weather forecasts." Improved means of telegraphic communication have added greatly to the facilities with which such prevision is rendered possible. For instance, the atmospheric con- ditions prevailing in early summer in the neighbourhood of the Seychelles Islands indicate the probable force and fulness of the monsoon on which the prospects of Indian agriculturists so largely depend ; and much loss of life and property is undoubtedly averted by the comparative facility with which the probable course of hurricanes and cyclones can be foreseen and the necessary pre- cautions signalled. In the field of investigation into climatic influ- ence on the conditions of lite, and ultimately of human existence, considerable advance has been made of late years, with results that will be more beneficial than they are at present when the theories which support them become more fully confirmed and recognized. The proposition that malarial fever is directly propagated by a special breed of mosquito is one of the theories which is new to science at present, and can now be said to be fully accepted. _ It is one of several which emanate from closer research into the intimate rela- tions between atmospheric and biological conditions.

Tides. — Collaterally with investigation into the movements of great air- currents special study has been directed to tidal phenom- ena along the coasts of Western Asia. Tidal stations have been established on the coasts of India, at Aden and Suez, where a graphic form of registration supplies those data from which tidal elements can be calculated and curves representing momentary variation in the height of sea-level during any period can be

constructed. In connexion with these tidal observations extensive levelling operations in" India have been carried out to ascertain whether there is any appreciable diflerence in mean sea^level at various points. The immediate practical benefit of these tidal de- terminations to the science

of navigation is obvious. One of the ultima..e results of them will be to supply a more assured basis than exists at present for the determination of altitudes over the land surface of Southern Asia.

Recent Investigations.— The first great result of recent geographi- cal research has been to modify pre-existing ideas of the orography of the vast central region represented by Tibet and Mongolia. The great highland plateau which stretches from the Himalaya north- wards to Chinese Turkestan, and from the frontier of Kashmir eastwards to China, has now been defined with comparative geo- graphical exactness. The position of Sachu (or Saitu) in Mongolia may be taken as an obligatoiy point in modern map construction. The longitude value now adopted is 94° 54′ E. of Greenwich, which is the revised value given by Prjevalski in the map accompanying the account of his fourth exploration into Central Asia. Other values are as follows : —

Prjevalski, by his second and third explorations 94° 26′

Krishna 94° 23′

Carey and Dalgleish 94° 48′

Littledale 94° 49′

Kreitner (with Szecheny's expedition) . 94° 58′

The longitude of Darohendo, or Ta Chien Lu, on the extreme

east, may be accepted as another obligatory point. The adopted

value by the Royal Geographical Society is 102° 12".

Krishna gives 102° 15″

Kreitner 102° 5″

Baber 102° 18″

South and west the bounding territories are well fixed in geo- graphical position by the Indian survey determinations of the value of Himalayan peaks. On the north the Chinese Turkestan explorations are now being brought into survey connexion with Kashmir and India.

No longer do we regard the Kuen Lun mountains, which extend from the frontiers of Kashmir, north of Leh, almost due east to the Chinese province of Eansu, as the southern limit of the Gobi or Turkestan depression. This very remarkable longitudinal chain is undoubtedly the northern limit of the Chang Tang, the elevated highland steppes of Tibet; but from it there branches a minor system to the north-east from a point in about 83° E. longitude, which culminates in the Altyn Tagh, and extends eastwards in a continuous water-divide to the Nan Shan mountains, north of the Koko Nor basin. Thus between Tibet and the low-lying sands of Gobi we have, thrust in, a system of elevated valleys (Tsaidam), 8000 to 9000 feet about sea^level, forming an intermediate steppe between the highest regions and the lowest, east of Lob Nor. AH this is comparatively new geography, and it goes far to explain why the great trade routes from Peking to the west were pushed so far to the north.

On the western edge of the Kashgar plains, the political boundary between Russia and China is now d&fined by the meridional range of Sarikol. This range (known to the ancients as Taurjis, and in mediaeval times as Bolor), like many ?"f®"' others of the most important great natural mountain IZ f' divisions of the world, consists of two parallel chains, of """"'"'y' which the western is the water-divide of the Pamirs, and the eastern (which has been known as the Kashgar or Kandar range) is split at intervals by lateral gorges to allow of the passage of the main drain- age from the eastern Pamir slopes. It is on this eastern ridge that the highest peaks at present known north of the Himalaya have been fixed. Here is the Muztagh Ata of Sven Hedin (not to be confounded with the Muztagh range on the Kashmir frontier), whose height has been determined to be 24,000 feet above sea-level ; and there are other peaks on this eastern ridge which may possibly be found to approach this value closely, when their altitude has been scientifi- cally determined.

The Sarikol range marks the position of the great water-divide between the Aralo-Caspian basin and the central system of i hydro- graphy terminating in the Lob Nor depression. Im- mediately between the Sarikol and the Kashgar (or Tbe central Kandar) are the lowlands of the Sarikol valley, of which """tlnenial the Taghdumbash Pamir forms a southern extension. Ji^'g The tri-junction of the boundaries of three great empires — Russia, China, and British India — is not inappropriately situated near the tri-junction of three great Asiatic mountain systems where the Sarikol range, reaching southwards to a junction with the Hindu Kush and the Muztagh ranges, defines the head of the Tagh- dumbash Pamir.

From this point the Hindu Kush trends westwards and south- westwards, overlooking the narrow valley of the Panja (one of the main Oxus affluents on the north) till it merges beyond Kabul into Jhe mountains which separate Afghanistan from Afghan Turkestan.

From the same point the Muztagh mountains stretch eastwards and southwards, separating the sources of the Zarafshan, or river Hindu °^ Yarkand, from tlie gigantic glacier region of North-

*Kash and ®™ Kashmir. Much has been done towards elucidating Muztagh *^® exact configuration of both of these important ranges. ranges. The Hindu Kush has been crossed at several*

points, and it is only where it passes through the unex- plored wilderness of Kafiristan that the position of the main water-divide is at all doubtful. The Muztagh has been crossed once (by Younghusband) at a point where its passage may be con- sidered to be ordinarEy impracticable, not far from the gigantic peak Godwin Austen, which ranks as second only to Everest in the scale of Himalayan altitudes. Much practical gain (political and military) has been derived from a better appreciation of the physical characteristics of the mass of mountainous country which intervenes between the north of India and the southern borders of Asiatic Russia ;

and much has been attained in the more western regions, which include Northern Afghanistan and Persia.

In Western Asia we have learned the exact value of the moun- tain barrier which lies between Merv and Herat, and have mapped . .. its connexion with the Elhurz of Persia. We can now

bnnOers— ^^^^ appreciate the factor in practical politics which Ateban- ^ definite but somewhat irregular mountain system tstan, &c represents which connects the water-divide north of*

Herat with the southern abutment of the Hindu, Kush, near Bamian. Every pass of importance is known and recorded ; every route of significance has been explored and mapped ; Afghanistan has assumed a new political entity by the demarcation of a boundary ; the value of Herat and of the Pamirs as bases of aggression has been assessed, and the whole intervening space of mountain and plain thoroughly examined.

Although within the limits of Western Asiatic states, still under Asiatic government and beyond the active influence of European

interests, the material progress of the Eastern world has Persia. appeared to remain stationary, yet large accessions to

geographical knowledge have at least been made, and in some instances a deeper knowledge of the surface of the country and modem conditions of life has led to the straightening of many crooked paths in history, and a better appreciation of the slow pro- cesses of advancing civilization. The steady advance of scientific inquiry into every comer of Persia, backed by the unceasing efforts of a new school of geographical explorers, has left nothing unex- amined that can be subjected to superficial observation. The geo^ graphical map of the country is fairly complete, and with it much detailed information is now accessible regarding the coast and har- bours of the Persian Gulf, the routes and passes of the interior, and the possibilities of commercial development by the construction of trade roads uniting the Caspian, the Karun, the Persian Gulf, and India, via Sistan. Persia has assumed a comprehensible position as a factor in future Eastern politics. (See Persia.)

*In Arabia progress has been slower. Little more is known of the wide spaces of interior desert than has already been given to the world in the works of Burton, Palgrave, and Pelly Arabia. amongst Englishmen, and Niebuhr, Burckhardt, Vis- conte, Hal^vy and others, amongst foreign travellers. Doughty and Blunt have visited and illustrated the district of Nejd, and described the waning glories of the Wahabi empire. But extended get^aphical knowledge does not point to any great practical issue. Commercial relations with Arabia remain much as they were in 1875. (See Arabia.) **

in Asia Minor, Syria, and Mesopotamia there is little to record of progress in material development beyond the promises held

out by the Euphrates Valley railway concession to a^ ^" . German company. The exact information obtained by Minor, &c r^ researches of English surveyors in Palestine and beyond Jordan, or by the efforts of explorers in the regions that lie between the Mediterranean and the Caspian, have so far led rather to the elucidation of history than to fresh commercial enterprise or the possible increase of material wealth.

*Asiatic Russia, especially Eastern Siberia and Mongolia, have been brought within the sphere of Russian exploration, vidth results so surprising as to form ha epoch in the history of Russia In gj Here there has been a development of the '**"*• resources of the Old World which parallels the best*

records of the New. Further references to the results of recent Russian enterprise will be made when considering the general question of Asiatic progress.

The great central depression of the continent which reaches from the foot of the Pamir plateau on the west through the Tarim desert

to Lob Nor and the Gobi is still under examination. Chinese This vast area of low elevation centres about Lob Nor, Turkestan ^jjere we find, in a lake system (the full details of md Oxus ^jj jgji g^jg not yet fully known, although much has been

recorded of them by Prjevalski and Sven Hedin), the last surviving evidences of a gi-eat inland sea. The depression westward of the Caspian and Aral basins, and the original con-

nexion of these seas, has also come under the close investigation of Russian scientists, with the result that the theory of an ancient connexion between the Oxus and the Caspian has been displaced by the more recent hypothesis of an extension of the Caspian Sea eastwards into trans-Caspian territory within the post-Pleiocene age. The discovery of shells (now living in the Caspian) at a distance of about 100 mfles inland, at an altitude of 140 to 280 feet above the present level of the Caspian, gives support to this hypothesis, which is further advanced by the ascertained nature of the Kara-kum sands, which appear to be a purely marine formation exhibiting no traces of fluviatile deposits which might be considered as delta deposits of the Oxus.

In the discussion of this problem we find the names of Kaulbars, Anneukoff, Lessar, and Konshin prominent. Further matter of interest in connexion with the Oxus basin was elucidated by the researches of Griesbaeh in connexion with the Russo-Afghan Boundary Commission. He reported the gradual formation of an anticlinal, or ridge, extending longitudinally through the great Balkh plain of Afghan Turkestan, which effectually shuts off the northern affluents of that basin from actual junction with the river. This evidence of a gradual process of upheaval still in action may throw some light on the physical (especially the climatic) changes which must have passed over that part of Asia since Balkh was the "mother of cities," the great trade centre of Asia, and the plains of Balkh were green with cultivation. In the restoration of the outlines of ancient and mediaeval geography in Asia Sven Hedin's discoveries of the actual remains of cities which have long been buried under the advancing waves of sand in the Takla Makan desert, cities which flourished in the comparatively recent period of Buddhist ascendency in High Asia, is of the very highest interest, filling up a blank in the identification of sites mentioned by early geographers and illustrating more fully the course of old pilgrim routes.

With the completion of the surveys of Baluchistan and Makrdn much light has also been thrown on the ancient connexion between east and west ; and the final settlement of the southern boundaries of Afghanistan has led to the reopening of Baluchi- one at least of Jhe old trade routes between Sistan and ^? f” India. (See Baluchistan.) auran.*

Farther east no part of Asia has been brought under more care- ful investigation than the hydro’graphy of the strange mountain wilderness that divides Tibet and Burma from China. In this field the researches of travellers already men- d^^^^” tioned, combined with the more exact reconnaissance of ^^^ China. native surveyors and of those exploring parties which have recently been working in the interests of commercial projects, have left little to future inquiry. We know now for certain that the great Tsangpo of Tibet and the Brahmaputra are one and the same river ; that north of the point where the great countermarch of that river from east to west is effected are to be found the sources of the Salween, the Mekong, the Yang-tse-kiang, and the Hoang- ho, or Yellow river, in order, from west to east ; and that south of it, thrust in between the extreme eastern edge of the Brahmaputra basin and the Salween, rise the dual sources of the Irrawaddy. From the water-divide which separates the most eastern affluent of the Brahmaputra, eastwards to the deep gorges which enclose the most westerly branch of the upper Yang-tse-kiang (here running from north to south), is a short space of 100 miles ; and within that space two mighty rivers, the Salween and the Mekong, send down their torrents to Burma and Siam. These three rivers flow parallel to each other for some 300 miles, deep hidden in narrow and precipitous troughs, amidst some of the grandest scenery of Asia ; spreading apart where the Yang-tse takes its course east- wards, not far north of the parallel of 25°.

The comparatively restricted area which still remains for close investigation includes the most easterly sources of the Brahmaputra, the most northerly sources of the Irrawaddy, and some 300 miles of the course of the Upper Salween.

Ancient Trade Boutes and Modern Bailways. No branch of knowledge gained by the results of recent Asiatic research is more instructive than the comparison of ancient means of trade communication with modem,

the directions along which the wealth of East and West has been interchanged at various epochs in the world's history, and the means and methods of its propulsion. "The struggle for these trade routes forms a key to the policy and the wars of many nations " ; and even if the command of them was " the expression rather than the cause of the aggrandize- ment of a nation," examples in which "the possession of Asiatic trade i has marked high water in the history of empire and its loss marked the ebb of the tide " are so frequent and so conspicuous in the world's great chronicle that no general consideration of the physiography of the continent of Asia can be regarded as complete without a reference to them. The two earliest civilized communities that created a demand for trade were, undoubtedly, Egypt on the

1 Hunter, Hist, of India, vol. i.

*west and China on the east ; and thus from the earliest historical times there has not only existed a right-of-way to traders across the entire continent of Asia, but we can faintly trace the dawn of a > sea-borne traffic in the records of Egyptian fleets in the Red Sea * and of Chinese junks east of Ceylon. The great development of Asiatic trade has, however, been in hands that are neither Egyp- tian nor Mongolian, but which belonged io Semitic races— Jews, Phoenicians, or Sabaean Arabs ; and clear history only begins with those early days when Arabs were masters of the Eastern seas, with settlements on the coast of India, in Ceylon, in the Straits, and China, as well as on the shores of Eastern Africa — if indeed they were not planted in the interior of that continent. Egypt, Assyria, Babylon, Persia, Macedonia, had each secured the right of trade to Eastern Asia in turn and each in turn had lost it when Rome appeared in %he field, aiid for seven centuries (from 1st century e.g. to the 6th a.d.) held more or less complete command of the regions Intervening between Eastern Asia and the Mediter- ranean. But Egyptians were busy with their ships whilst Rome held command on land. The Arabs gradually superseded the Egyptians on the high seas, and ere the days of Islam had already established themselves as the greatest*

nation of traders that the world had ever seen. The conquest of Sind (in the 8th ^^^j!^ century a.d.) led to the establishment of aland route to lailia. tlirough Makrdn, north of the Arabian Sea, to the Indus valley. The port of Tiz, in the bay of Chabar, was the terminus of the voyage eastwards of the Arab merchantman, and from Tiz through Kiz, or Kej, to Bela and the Indus valley the journey was performed on land. From the far Bast the clumsy Chinese junk met the buggalow of the Arab at Ceylon. Here cargoes were exchanged, and thus for centuries the trade between East and West was maintained by sea till the Cape route was dis- covered by a Portuguese explorer and the whole traffic of the East diverted into new channels. From prehistoric days the routes of ^^^^ routes of Asia have remained much the same Asia. through the eastern parts of the continent. The

geographical position of Kashgar, almost on the same parallel of latitude as Peking, with nearly 2000 miJes of low-lying desert and steppe intervening, and forming a long narrow area of depression between the Tibetan plateau and the Tian-Shan mountains, a depression which, so far as we know, between Kashgar and the Upper Amur never rises above 2000 feet above sea-level and may sink to less than 500, renders it an almost obligatory point in any line of trade connecting China and the Caspian. All recent travellers have confirmed its importance, and we find several routes from the east gathering themselves at Kashgar before diverging again westwards. Only one route of any importance passes to the north of Kashgar, i.e., that which, foEowing the modern track between Peking and Hami, strikes ofi from the latter place to Urumtsi and Kulja, instead of passing through Aksu, south of the Tian-Shan, to Kashgar. Another route which was much used by the silk traders from Central China passes through Sining-fu-(eastof Koko Nor), and skirts the northern foot of the Altyn Tagh and the southern edge of the Tarim desert. From Kashgar westwards over the elevated region of the Pamirs the most direct route follows the Kashgar river to its source, and, crossing the great continental water-divide by the passes which lead into the Altai valley, makes its way by the fertile banks of the Surkhab to the Oxus. But from the southern towns of Chinese Turkestan, which group themselves along the foot of the Kuen Lun and once spread into the plains of Lob Nor and the Takla Makan desert, the road to the Oxus lay through

Tashkurghan (the ” stone tower ” of mediaeval geography) and by the passes of the Sarikol to the great Pamirs and Lake Victoria. There can be little doubt that this was a much-traversed Khafila route during the middle centuries of our era. From Lal^ Victoria it passes to Ishkashim and across Badakshan to Afghan Turkestan and Herat or Mashad.

The route from India vid, Kandahar, Kirman, and Babylon was well enough known in Alexander’s time, but it is only lately that the facilities of it have been fully demonstrated. In later years trade found its way from the Indus valley to the Oxus ■»iS Kabul and Balkh, and thence passed north of the Caspian into Russia, or else by Tabriz and Tiflis to the Black Sea and Constantinople. When the Arabs prevailed in Asia, and Baghdad became the capital of the Caliphs, the Euphrates valley and Syria again were filled with Eastern merchan- dise. Then the Saracen gave place to the Crusader, and the command of the greatest trade routes of Asia was in the hands of Christians. In 1258 Baghdad fell before the Mogul, and by the commencement of the 15th century Turks and’Mongols had blocked the Syrian outlet. For 200 years previously Venetians and Genoese had developed the overland trade between India and Europe vi& the Black Sea, and rendered themselves supreme in the Mediterranean. Venetian In- fluence may still be traced along the coast districts of Persia and Makr^n to Western India. In Makrdn Venetian gold coins were till quite recently recognized as the only gold currency.

It was the barrier set by the Mogul that started the Portuguese quest for a new sea route, and thus was initiated that line of sea

traffic round the Cape of Good Hope which revolutionized the whole system of Eastern trade. Now, once again has the Red Sea resumed its pre-eminence in the commercial geography of the world. The ships of Tarshish are replaced by the modern ocean liners. But no developments corresponding in space have Sea distinguished the methods of land transport. For a vast routes. part of Asia the slow-moving camel is still the mainstay of the merchant traveller ; and there is as yet no land connexion be- tween Europe and Eastern Asia that will compete with the facilitated sea route. But we are within a measurable distance of witnessing such an overland connexion, and we are meanwhile already in pos- session of

such perfected systems of local communication in India as render her railway developments of the last quarter of the 19th century distinguished in the annals of the world's progress.

The first great continental line of railway which wiU bring Western Europe into touch with Eastern Asia will be that of Siberia. The Russian system connects St Petersburg jt„gg,g„ with the Asiatic frontier by a line which is rather more railways. than 1700 miles in length, passing through Moscow. From the Asiatic frontier eastwards, the Western Siberia line now extends to beyond the 90th meridian of east longitude, linking up with the Central Siberian line, which will touch Lake Baikal at Irkutsk. So far the traflic returns have shown a steady increase as the various sections of the line have been opened, and so great an expanse of trade is anticipated that the line is now being adapted for the service of at least eight pairs of trains, instead of the three for which the original calculations were framed. From Irkutsk eastwards the trans-Baikal and Manchurian sections of this great continental line will extend to a junction with the Usuri railway of the Amur river basin, of which the terminal port is at Vladivostok, on the Pacific coast. A part of the Usuri line is already complete. It was initiated by the present emperor on the 19th May 1891. The Baltic and Pacific wiU thus be connected by a line which will be little short of 6000 miles in length, covering nearly a quarter of the circumference of the globe. A remarkable feature in this enterprise is that the railway traverses those vast steppes and wide uplands which have historically been regarded as the waste lands of Asia, passing far to the north of the teeming districts whose wealth has been the desire of the nations from time immemorial. Undoubtedly it will eventually be connected with Central China and Peking, but at present the tardily recognized resources of Siberia alone are held amply to justify the construction of this magnificent line. Farther south, the ports of the Caspian have been connected by rail with the Central Asian Khanates by a line which passes along the foot of the northern slopes of the Persian Elburz to Merv, Bokhara, and Samarkand. Here, again, the advent of the railway is marked by enormous commercial developments, and the province of Ferghana already reproduces the smiling landscapes of Central Asia ere the days of Mogul devastation.

Whilst Russia has been so busy, India (strictly within the limits of her own borders) has effected even more in actual length of railway extension. An extent of line which would nearly circle the globe (about 23,000 miles) represented ”’™” the railway traffic capabilities of India at the close of the “ ”’^*’ 19th century, and of this amount three-fourths at least have been brought into existence since 1875. The record of the many schemes which have resulted in so great an accession of trade arteries belongs to the annals of India. They can hardly be called continental, for as yet no definite proposal has taken practical shape which will end in linking India with Europe. Between India and China there is indeed a prospect of the evolution of a practical scheme of connexion. The extension of Burmese railways north- wards to Mogaung, in the Upper Irrawaddy basin, and north-east- wards from Mandalay to the Kunlon ferry on the Salween, points the way to further extensions which will unite Dibrugarh, in Upper Assam, with Mogaung, and the Kunlon ferry with Talifu, in the Chinese province of Yun-nan. But at present, with all the wealth of interior railway development which has distinguished the close of the century, both within the peninsula of India and in Burma, the two still remain unconnected and, in a measure, isolated from the rest of the world.*

China. — In China we find perhaps the most noteworthy record of Asiatic national evolution that the history of the 19th century can show. It is not a long record, but it is a most surprising one. The old order has changed ; the con- Chhiese servatism of her political principles is disappearing ; ” ly^sys. the bulwark of national antipathy to foreign innovations has been broken through, and the sacred seclusion that hedged aboul; the Imperial Court has been invaded. The birth of a new century will herald the birth of a new era for China — an era of railways and company projectors, and mining developments ; the scattering of empire ; the burial of prehistoric isolation and dignity. The record .of China’s late achievements in material progress so far is not a long one, but its promise is great, for it is a practical indica- tion that the hostility of China to the introduction of railways has at last disappeared. The first railway from Shanghai to

Wusung (on the coast) -was laid in 1876, and was eagerly utilized. The following year it was torn up by the authorities. The next temporary line (which Upped the Kaiping collieries and extended to the Taku forts) is now replaced by a permanent connexion between these (now demolished) forts and Tientsin, and extends north-east- wards into Manchuria. In 1897 a line was laid from Peking to Tien- tsin— 73 miles — and it is already doubled. Another railway is under construction by a Belgian company which will ultimately connect Peking with Hankow on the Yang-tse-kiang, and a new line now links Shanghai with Wusung. These, with a few short industrial lines for the conveyance of material in the Yang-tse basin, are all that exist. The great extent of waterways in China undoubtedly reduces the prospective profits of railway undertakings, as they have formed the great natural trade arteries of the country from time immemorial. But considering the length of the great river channels and the volume of the river discharge, the length of the actual waterway is comparatively small. Explorations have only lately been carried into the basins of the Upper Yang-tse tributaries by the agents of European syndicates to determine their possible value as lines of internal trade communication either by rail or river, and the result will probably be a development of steam navi- gation in the Min and Kialing aflluents of the Yang-tse, and a possible railway connexion between Burma and Central China. An extension from the Russian-Siberian system into Manchuria, and a connexion between the Central Siberian railway and Central China, are the chief continental projects now before the world.

Persia.— The development of roads in Persia has been slow, but not unimportant. Railways do not exist. The opening of the Karun river to navigation in 1889 was the first step towards an awakening of commercial speculative interest in Persia, which has not been altogether unt)roductive of benefit to the country. Hitherto this country, which includes more than half a million square miles of territory without navigable rivers (except about 200 miles of the Karun), and nine millions of intelligent and industrious inhabitants, has had to “carry on its foreign trade and local trafBc along mule tracks, the like of which are hardly to be met with in any other part of the world, however backward.” In 1880 a cart road was

constructed between Tehran (or Teheran, the latter being more popular but less correct) and Kasvin (96 miles); in 1883 Tehran was connected with Kum (97 miles)^ ; and in 1890 Mashad and Askabad, in Russian territory, were' united by a more or less metalled road 150 miles in length. Concessions have been granted for the construction of roads between Tehran and Ahwaz, with a branch road to Ispahan from Burujird ; between Tehran and Baghdad ; Tabriz and Astara ; Tabriz and Bayazid ; Zinjan and Burujird ; Kazvin and Hamadan ; and Kazvin and Resht ; but only the last, the concession for which was granted in 1893, has become a fait accompli so far. This road has been engineered by Russians, and has largely widened the circle of her Persian trade. It has also shortened the distance between Europe and Tehran, which place can now be reached from London, in case of urgency, within two weeks vid, Baku and Resht. The road from Tehran to Ahwaz (530 miles) has advanced as far as Kum, and the opening of a trade route between Shuster and Ispahan through the Bak- tiari country has been secured politically ; but much remains to be done on both these lines. A new route from which great trade results are anticipated has been opened between Persia and India. This connects Mashad with Quetta on the Indian rail- way system by way of Sistan and Nushki, passing through the Helmund desert. On the north-west, Russian railways are rapidly approaching Persia ; and the completion of the Tiflis, Alexandropol- Kars line, with a branch line from Alexandropol to Erivan, will greatly affect the current of Persian trade. The result of these railway developments on the north-west of Persia will be to increase the importance of Tehran as a trade centre, and to draw away traffic from the southern ports.

In Asia Minor and Syria progress in railway development has been slow, but the recent concession to an Anatolian company for the Euphrates valley line may reawaken commercial activity in this part of Asia. A line from the Bosporus to Angora, and another from Smyrna to Konieh, represent the chief railway systems of Asia Minor at present. In Syria the Beirut-Damascus and- Jaffa- Jerusalem lines exhibit little prospect of extension.

JEconomic Developments and Commercial Enterprise in Asia.

It will be found, as might naturally be expected, that increase of material wealth and of commercial importance amongst Asiatic countries has been coincident with the development of trade routes and railways. Although Asia is the oldest amongst the histori- cally recognized continents of the world, and although it was in Asia that the " cradle of civilization " was rocked, it has remained for the later centuries of our era, and especially for the latter part of the 19th century, to witness a display of natural resources such as could never have been imagined by those who first grasped at the wealth of the East. Russia, India, China, Japan, and in a less degree Persia, have all developed hidden capabilities and economic

possibilities such as must inevitably affect the world's commercial history. In this field the most surprising advance has undoubtedly been made by Russia.

*In 1875 Russia was astride of the Caspian, but as yet only strain- ing her eyes across the eastern Turkman deserts. . Bi 1880 she was knocking at the gates of Merr. Pive years later she was setting a limit to the northern borders of Afghanistan. '"®^fL- To-day she books her passengers from the Caspian to P™/*****- Samarkand by rail, and has completed two sections of a trans-Asiatic line which will link her capital of St Petersburg with Vladivostok, on the shores of the Pacific. Already one may cross Asia by steam. With these railways have arisen those local commercial develop- ments which support them, and which were awaiting them. Fer- ghana is once again a garden in Asia, rich in cereals and fruit, and rapidly developing a most important cotton trade. Siberia and the lands of the Amur have been found to be rich beyond all previous conjecture. Here five millions of square miles are inhabited by four million inhabitants, but the tide of immigration has set in with a steady flow which promises soon to adjust the balance. In 1898 400,000 immigrants were numbered, and the numbers are increas- ing. It is said that "this vast territory, long looked on as a barren waste, is destined to be one of the world's richest and most productive sections." Here wheat ripens with Agrlcal- phenomenal rapidity, and in the Irkutsk country the alth t*

frost period only lasts for 100 days. Transbaikalia and Liberia" the Usuri regions are essentially fitted for agricultural development, and the wheat

production of the empire has already been sensibly increased since the opening of the Central Siberian railway. Rice is also now largely grown in Russia, its cultivation having commenced about; the year 1880. In the Caucasus, Trans- baikal, and Turkestan regions, rice is sown in the same way as wheat. The demand for it is increasing throughout European Russia. Rice grown in Asia is shipped uncleaned to the Caspian p^orts, and there sold to commission agents. In late years the annual export from Baku has amounted to nearly 50,000 tons.

The mineral resources of Western Siberia are boundless. Between Tomsk and Kooznesk lie 23,000 square miles of coal lands fls yet untouched. In Eastern Siberia 400 places are known in which gold is to be found, and iron, graphite, and ^ea/tft lapis-lazuli deposits are all awaiting development.

The industries of Siberia are growing rapidly. Chemicals, sugar, and paper mills are already paying well. Manchuria looks to Russia for the development of its natural wealth. The Ob and the Yenisei both carry their fleets of “““s””””- steamers, and Russian merchantmen are busy oij the Pacific between the Usuri coast and Japan. A strange industry has arisen on the Arctic shores of Siberia, where mammoth ivory is found preserved in layers of underground ice. It is coUeoted by the primitive Tangut inhabitants for the market. These people depend for their living on the migrations of animals. They come with the reindeer herds to the Arctic coast in summer, and return to the protection of the southern forests in winter.

Russian explorations in Manchuria in connexion with the Siberian railway project, no less than English explorations in the upper basin of the Yang-tse, have largely increased our knowledge of the resources of Eastern Asia. Manchuria has been called the Canada of China, and is found capable of increasing largely her capacities for the supply of food stuff and agricultural products in support of that increased popula- tion of the north-eastern provinces of China which will attend the development of the great northern coalfields in the province of Shansi, and the collateral industries which will arise therefrom.

Although the resources of China in silk, tea, and opium have long been known, and although much further material progress in agriculture is hardly to be expected from a country which has been highly cultivated by a swarming and ^^f^„, industrious population throughout historical ages, it is cblna. only lately that these vast resources of mineral wealth have been exhibited which require the development of the many rail- way schemes which have been already floated to give them practical effect. Vast fields of as yet untouched coal and anthracite exist in the northern, western, and central provinces of China. Copper, iron, mercury, silver, lead, and tin are amongst her mineral products, and salt is found in the upper valleys of the Yang-tse-kiang, or Kinsha.

The modern history of Japan shows steady progress in scientific and philosophic culture. Her arts and industries have received a certain impetus since the conclusion of the war with japaa

China in 1894, but it is chiefly in the direction of that material advancement which now places Japan in the position of an important military and naval power that the end of the 19th century has to regard Japanese progress. Japan already possesses 3420 mUes of railway and 562 miles of telephone: Her army Includes 125,000 regulars and 407,000 reserves, and her navy 31 war-ships. (See Japan.)

India, Burma, and Ceylon. — ^No part of the Asiatic continent has been so prolific in contribution to the general wealth of the

Forest conserv- ancy.

■world as India, and no countries have been so systematically and continuously drained of their wealth as the Eastern posses- sions of Great

Britain. And yet it may be doubted Material jf g^jjy century of their chequered history can show a In'ladla. °^ astonishing record of agricultural and industrial development than the 19th, and especially the conclud- ing decades of it. It is a record which can only be referred to here in BufBcient detail to illustrate the part played by India, Burma, and Ceylon in the economy of the Asiatic continent as a whole.

*The main arteries of Indian railway communication connecting Bombay with Calcutta, Calcutta with Lahore in the extreme north- west, togetljpr with a part of the Madras system, were nlltavs *l"6a*

The advancement of irrigation works has also been notable, especially on the Punjab, where for one million acres that were

„„^„„_ irrigated in 1868 no less than 5,200,000 were irrigated irrigation, ^^ggg

The result of the increase in the area of production has been a

general increase in agricultural products, and a special develop-

ment of the growth of wheat for exportation. Under

*^*7V . the indirect influence of a depreciation of the silver cur-*

progress. ^ency of India, the wheat of the Punjab has been lately

able to compete successfully with that of other countries

in the English markets, and to undersell that of home production.

Tea has lately superseded coffee cultivation in Ceylon, and cocoa

has superseded cinchona. Many districts in India have been found

suitable for tea growth which in 1880 were still under forest. More

than half a million of acres are now taken up with tea industry in

India alone.

The conservation of forests has gradually expanded to the dimen- sions of a state department with most gratifying results. Out of the 960,000 square miles which constitute British India (apart from the native states) 114,000 square miles are now under the control of the Forest Department. The exports from India to foreign ports amount to over 64,000 tons of teak wood alone, and the forest revenue is yearly expanding. Many special woods from Burma have found their special application in England, and the forests of Burma (as yet undeveloped) promise to be a fruitful source of future revenue. (See India and Burma.)

The recent researches of the Greological Survey of India have proved that country to be rich in mineral wealth. Vast areas known to be covered with rocks that are the matrix of Geological gold, copper, lead, tin, iron, coal, salt, oil, &c., have “”” been mapped out, and actual mining operations on

many of these areas have proved that the geologists are not mistaken. Since 1890 the coal production of India has increased from a million and a half to four million tons per annum. Enormous tracts of country are auri- ferous ; but of these all that is being worked is one small patch in Mysore, and yet from this patch gold to the value of 222 lakhs of rupees (a million and a half sterling) was mined in 1899. Petroleum to the extent of 19 million gallons was extracted in the same year, chiefly from the Burma oil wells. The salt mines of the Punjab yielded 66,000 tons of rock salt. , Mica to the value of £85,000 was exported from the mines at Hazaribagh, and rubies worth £50,000 to £60,000 were removed from the gem- bearing strata of Mogok (Burma). The mining industry of India is still in its infancy, and yet it employs 263,000 persons, and turns out material to the value of three millions per year. This development of the mineral resources of India is of very recent date, and yet but a fractional part of the vast deposits of coal, gold, and other minerals has been touched. New indus- trial developments in many other directions remain to be recorded. (See India.)

The Political Geography of Asia.

The period since 1875 has been an era of boundary-marking in Asia, of defining the politico-geographical limits of empire, and of determining the responsibilities of governments. Russia, Southern Persia, Afghanistan, Baluchistan, India, and China boundary t^^^ g^jj revised their borders, and with the revision the In As^la!^ political relations between these countries have acquired a new and more assured basis.

The advance of Russia to the Turkman deserts and the Oxus demanded a definite boundary between her trans-Caspian conquests and the kingdom of Afghanistan. This was determined on the north-west by the Eusso-Afghan Boundary Commission of 1884-86. A boundary was then fixed between the Hari Eud (the river of Herat), and the Oxus, which is almost entirely artificial in its construction. Zulflkar, where the boundary leaves the Hari Eud, is

mineral develop- ments.

about 70 miles south of Sarakhs, and the most southerly point of the boundary (where it crosses the Kushk) is about 60 miles north of Herat. Trom the junction of the boundary with the Oxus at Khamiab, about 150 miles above the crossing-point of the Russian Trans-Caspian railway at Charjui, the main channel of the Oxus river becomes the northern boundary of Afghanistan, separating that country from Russia, and so continues to its source in Victoria Lake of the Great Pamir. Beyond this point the Anglo- Russian Commission of 1895 demarcated a line to the snowfields and glaciers which overlook the Chinese border. Between the Russian Pamirs and Chinese Turkestan the rugged" line of the Sarikol range intervenes, the actual dividing line being still indefinite. Beyond Kashgar the southern boundary of Siberia follows an irregular course to the north-east, partly defined by the Tian-Shan and Alatau mountains, till it attains a northerly point in about 53° N. lat. marked by the Sayan range to the west of Irkutsk. It then deflects south-east till it touches the Kunlon affluent of the Amur river at a point which is shown in unofficial maps as in about 117° 30′ E. long, and 49° 20′ N. lat. Prom here it follows this affluent to its junction with the Amur river, and the Amur river to its junction with the Usuri. It follows the Usuri to its head (its direction now being a little west of south), and finally strikes the Pacific Coast on about

42° 80' N. lat. at the mouth of the Tumen river 100 miles south of the Amur bay, at the head of which lies the Russian port of Vladivostok. At two points the Russian boundary nearly approaches that of provinces which are directly under British suzerainty. Where the Oxus river takes its great bend to the north from Ishkashim, the breadth of Afghan territory intervening between that river and the main water-divide of the Hindu Kush is not more than 10 or 12 miles ; and east of the Pamir extension of Afghanistan, where the Beyik Pass crosses the Sarikol range and drops into the Taghdumbash Pamir, there is but the narrow width of the Karachukar valley between the Sarikol and the Muztagh. Here, however, the boundary is again undefined. Eastwards of this the great Kashgar depression, which includes the Tarim desert, separates Russia from the vast sterile highlands of Tibet ; and a continuous series of desert spaces of low elevation, marking the limits of a primeval inland sea from the Sarikol meridional, watershed to the Khinghan mountains on the western borders of Manchuria, divide her from the northern pro- vinces of China. From the Khinghan ranges to the Pacific, south of the Amur, stretch the rich districts of Manchuria, a province which connects Russia with the Korea by a series of valleys formed by the Sungari and its affluents — a land of hill and plain, forest and swamp, possessing a delightful climate, and vast undeveloped agri- cultural resources. Over this land of promise leading to the sea- girt peninsula of Korea, Russian influence is rapidly extending ; as it is also over the western Chinese province of the new dominion, including Kashgar and Sarikol.

Coincident with the demarcation of Russian boundaries in Turkes- tan was that of Northern Afghanistan. Prom the Hari Rud on the west to the Sarikol mountains on the east her northern limits were set by the Boundary Commissions of 1884- ■^ft”” 86 and of 1895 respectively. Her southern and eastern P”—”’^ boundaries have been further defined by a series of ““J”””” minor commissions, working on the basis of the Kabul ”” **’ agreement of 1893, which lasted for nearly 4 years, terminating with the Mohmand settlement at the close of an expedition in 1897.*

The Pamir extension of Afghan territory to the north-east reaches to a point a little short of 75° E. long., from whence it follows the water-divide to the head of the Taghdumbash Pamir, and is thence- forward defined by

the water-parting of the Hindu Kush. It leaves the Hindu Kush near the Dorah Pass at the head of one of the minor Chitral affluents, and passing south-west divides Kafiristan from Chitral and Bajaor, separates the sections of the Mohmands who are within the respective spheres of Afghan and British sover- eignty, and crosses the Peshawur-Kabul route at Landi-Khana. It thus places a broad width of independent territory between the boundaries of British India (which have remained practically, though not absolutely, untouched) and Afghanistan ; and this inde- pendent belt includes Swat, Bajaor, and a part of the Mohmand territory north of the Kabul river. (See Afghanistan.) The same principle of maintaining an intervening width of neutral territory between the two countries is now definitely established throughout the eastern borders of Afghanistan, along the full length of which a definite boundary has been demarcated to the point where it pouches the northern limits of Baluchistan on the Gomul river. From the Gomul Baluchistan itself becomes an intervening state between British India and Afghanistan, and the dividing line between Baluchistan and Afghanistan has been laid/ down with all the precision employed on the more northerly sections of the demarcation. (See Baluchistan.)

Baluchistan can no longer be regarded as a distinct entity amongst Asiatic nations, such as Afghanistan undoubtedly is. Baluchistan independence demands qualification. There is British Baluchistan par excellence, and there is the rest of Baluchistan

which exists in various degrees of independence, but which is every- where subject to British control. British Baluchistan officially in- cludes the districts of Peshin, Sibi, and of Tal-ChotiaU. As these Balu- districts had originally been Afghan, they v^ere trans-

cblstan. ^srred to British authority by the treaty of Gandamak

in 1879, although nominally they had been handed over to Kalat forty years previously. Now they form an official province of British

Baluchistan within the Baluchistan Agency ; and the agency extends from the Gomul to the Arabian Sea and the Persian frontier. Within this agency there are districts as mdependent as any in Afghanistan, but the political status of the province as a whole is almost precisely that of the native states of the Indian peninsula. The agent to the governor-general of India, with a staff of political assistants, practically exercises supreme control.

The increase of Kussian influence on the northern Persian border and its extension southwards towards Sistan have led to the appoint- Klrman ™6nt of a British consul at Kirman, the dominating

town of Southern Khorassan, directly connected with Mashad on the north ; and the acquisition of rights of adminis- tration of the Nushki district has secured to Great Britain the trade between Sistan and Quetta by the new Helmund desert route.

Whilst British India has so far avoided actual geographical con- tact with one great European power in A^ia on the north and west

she has touched another on the east. The Mekong Political river which limits British interests in Burma limits ftoimrfao' also those of Prance In Tongking. The eastern bound- ^^^" aries of Burma are not yet fully demarcated on the and India. Chinese frontier. At a point level in latitude with

Moganng, near the northern termination of the Bur- mese railway system, this boundary is defined by the eastern watershed of the Nmaika, the eastern of the two great northern affluents of the Irrawaddy. Then it follows an irregular course southwards to a position south-east of Bhamo in lat. 24°. It next defines the northern edge of the Shan States, and finally strikes the Mekong river in lat. 21° 46' (approximately). Prom that point southwards the river becomes the boundary between the Shan States and Tongking for some 200 miles, the channel of the river defining the limits of occupation (though not entirely of interest) between French and British subjects. Approximately on the parallel of 20° N. lat. the Burmese boundary leaves the Mekong to run westwards towards the Salween, and

thereafter following the eastern watershed of the Salween basin it divides the Lower Burma provinces from Siam.

More important, however, than the geographical relationship of Great Britain and Prance in the wilds of Eastern Burma

is that of Great Britain and Russia still farther east. Political The occupation of Port Arthur by the Russians at the boundaries gjoge of the war between China and Japan in 1894 'pHh It plS'Ced Russia in a position favourable for further ^^ strategic developments. A line joining Vladivostok

with Port Arthur shuts off Korea from the rest of Asia, dominating the peninsula to the south as effectually as it dominates Manchuria to the north. It further commands the entrance to the Gulf of Pe-cheli, and thus might serve to close the seaward gates of Peking. British occupation of Wei-hai-Wei on the opposite side of the strait connecting the Yellow Sea with the Pe-cheli Gulf ensures the due maintenance of British interests on that coast ; but it not only places Great Britain in closer geogra- phical proximity to Russia here than has ever occurred yet in Asiatic history, but this juxtaposition is effected at a point where aU the engines of naval warfare might be brought into action at a day's notice.

The following table gives a list of the different political divisions of Asia, classified according as they are independent of European Powers or otherwise, with the approximate area and population : —

I. Independent, ok nominally Independent.

Name of Country.

Persia

Afghanistan . . . • Arabia . . . •

China:

(1) China Proper

(2) Manchuria .

(3) Mongolia

(4) Tibet ....

(5) Dzungaria .

(6) Turkestan .

Total Chinese Territories

Japan

Siam

Total Independent Asia

Area in square miles.

628,000 215,500 960,000

1,336,850 362,310

1,288,000

” 652,000 147,950 431,800

4,218,910 152,000 200,000

Population.

9,000,000 4,000,000 2,000,000

386,000,000

7,500,000

2,000,000

6,000,000

600,000

580,000

402,680,000

46,500,000

5,000,000

6,374,410 469,180,000

11. Dependent Tebeitories.

Name of Country. “^laUe’s?”” Population.*

Turkish Sphere. Asia Minor, Armenia and Kurdistan, Mesopotamia, Syria, &c. . . . 650,000 16,800,000

Russian Sphere.

Caucasus 180,843 9,248,695

Central Asia 1,548,825 7,721,684

Siberia 4,833,496 5,727,100

Bokhara 92,000 2,500,000

Khiva 22,320 700,000

Kwang Tung (Port Arthur) .

Total Asiatic Bussia 6,677,484 25,897,479

British Sphere.

British India 964,993 221,172,952

Native States 610,836 65,706,253

Baluchistan 130,000 500,000

Sikkim 28,020 38,458

Andaman and Nicobar Islands . . 3,135 20,000

Laccadive Islands 80 14,440

Aden 80 41,910

Bahrein Islands … 25,000

British Borneo 97,000 720,000

Ceylon 26,333 3,009,460

Hong Kong and Kowloon . . . 430 258,000

Straits Settlements and Dependencies . 28,000 1,000,000

Wei-hai-Wei

Total British Asia 1,887,907 292,506,473

Prench Sphere.

India 197 279,100

Indo-Chinese Peninsula . . . 363,000 23,000,000

Total French Asia 363,197 23,279,100

German Sphere. Kiaochow 200 60,000

PORTUGTTESE SPHERE.

India 1,390 495,000

Damao 168 77,450

Indian Archipelago 7,460 300,000

Macao 4 78,630

Total Portuguese Asia …. 9,022 961,080

Dutch Sphere. Sumatp, Borneo, Java, Celebes, Mo- lucca, Timor, and smaller islands . 584,00p 34,000,000

United States Sphere. Philippine Islands 115,300 8,000,000

Totfil Dependent Asia . . . 10,287,110 401,494,132

Grand Total, all Asia, Continental' AND Insular ' 16,661,520 870,674,132

The total area of Continental Asia alone is 17,800,000 miles, and its roughly estimated population, 823,000,000.

The Ethnography of Asia.

Although no systematic inquiry into the ethnographical condi- tions of British Asia has been instituted of late years, collateral information has been acquired during the progress of late poli- tical missions and military campaigns which has assisted to illustrate some of the more complex of Asiatic race problems. Within the limits of the continent vast emigrations have taken place periodically, originated partly by the increase of populations in certain districts, and the diminution of food supply in others due to change of climatic conditions ; and partly by the lust of conquest, resulting in the irruption of savage hordes into districts already brought under civilized conditions of existence. These irruptions occurred in days when war was not relegated to a portion of the population set apart as the military caste, but when entire nations joined the movement, and their tides swept east and west in fierce currents of swarming humanity for which we can find no parallel later. Combining with the peoples whom they swamped in their course, they have survived in com-

munities all over Southern Asia in conditions so mixed that the problem of individual origin is involved in the greatest entanglement.

The result of trans-border surveys to the north and west of India has been to establish the important geographical fact that it is by two gateways only, one on the north-west and one on the west of India, that the Central Asiatic tides of immigration have flowed into the peninsula. The Kabul valley indicates the north- western entrance, and Makr4n indicates that on the west. By the Kabul valley route, which includes at its head the group of passes across the Hindu Kush which extend from the Khawdk to the Kaoshd,n, all those Central Asian hordes, be they Sacse, Yuchi, Jats, Goths, or Huns, who were driven towards the rich plains of the south, entered the Punjab. Some of them migrated from districts which belong to Eastern Asia, but none of them pene- trated into India by eastern passes. Such tides as set towards the Himalaya broke against their farther buttresses, leaving an inter- esting ethnographical flotsam in the northern valleys ; but they never overflowed the Himalayan barrier. And more recently most of the historic invasions of India from Central Asia followed the route which leads directly from Kabul to Peshawur and Delhi.

By the western gates of Makran prehistoric irruptions from Mesopotamia broke into the plains of Lower Sind, and either passed on towards the central provinces of India or were absorbed in the highlands south of Kalat. In later centuries the Arabs from the west reached the valley of the Indus by this western route, and there established a dynasty which lasted for 300 years. The identification of existing peoples with the various Scythic, Persian, and Arab races who have passed from High Asia into the Indian borderland, has opened up a vast field of ethnographical inquiry which has hardly yet found adequate workers for its investigation. To such-fields may be added the yet more com- plicated problems of those reflex waves which flowed backwards from India into the border highlands.

By far the greater part of the population of Asia is Mongolian. In the form of nomadic and comparatively peaceful cpmmunitieithey extend through the ice-bound steppes of Siberia and the sterile sands of the central deserts to the plains north of the Caspian, and through Eastern Asia, China, and Tibet to Burma and Northern India. We now know that to the Tibeto-Chinese modifications of the pure Mon- golian type all the Eastern Burmese tribes — Chins, Kachins, Shans, &c. — belong (as indeed do the Burmese themselves), and that a cog- nate race occupies the Himalaya to the eastern limits of Kashmir.

Some new light has been thrown on the connexion between the Tibetan race and certain tribes of Central India, the Bhils and Kdls ; and it seems more probable that these tribes are the remnants of a Mongolian race which first displaced a yet earlier Negroid popu- lation, and was then itself shouldered out by a Caucasian irruption, than that they entered India by any of the northern passages within historic times. Mongolian settlements have lately been found very much farther extended into the border countries of North-west India than has been hitherto recognized. The Mingals, who, conjointly with the Brahuis, occupy the hills south of Kalat to the limits of the Rajput province of Lus Bela, claim Mongolian descent, and traces of a Mongolian colony have been found in Makrin.

Considerable progress has been made in the classification of the various races which occupy the continent to the west of the great Mongolian region. The ancient Sacse, or Soyths, are now recog- nized in the Aryan population, who may be found in great numbers and in their purest form in the more inaccessible mountains and glens of the central highlands. These Tajiks (as they are usually called) form the underlying population 'of Persia, Baluchistan, Afghanistan, and Badakshan, and their language (in the central districts of Asia) is found to contain words of Aryan or Sanskrit derivation which are not known in Persian. They have been for the most part dispossessed of their country by Turkish immigra- tion and conquests, but they still retain their original intellectual superiority over the Turkish and other mixed tribes by which they are surrounded. Uzbeks and Kirghiz have but small affinity with the Mongol element of Asia. They are the representatives of those countless Turkish irruptions which have taken place through all history. Of the two divisions (Kara Kirghiz

aind Kassak Kirghiz) into which the Kirghiz tribes are divided by Russian authorities, the Kassak Kirghiz is the more closely allied to the Mongol type ; the Kara Kirghiz, who are found principally in the valleys of the Tian-Shan and Altai mountains, being unmistakably Turkish. The Kipchaks are only a Kirghiz clan. The language of the Kirghiz is Turki and their religion that of Mahommed. As » nomadic people they have great contempt for the Sarts, who represent the town dwellers of the tribe. The Kalmuks are a Buddhist and Mongolian people who originated in a confederacy of tribes dwelling in Bzungaria, migraited to Siberia, and settled on the Lower Volga. From thence they returned late in the 18th century to the reoccupation of their old ground in Kuldja under the Chinese. The Turkman is the purest form of the Turk ele- ment, and his language is the purest form of the Turkish tongue, which is represented at Constantinople by a comparatively mongrel, or mixed, dialect. Recent ethnographers have traced a connexion between the Turkman of Central Asia and the Teutonic races of

Europe, based on a similarity of national customs and immemorial usage. Evidence of an original affinity between Turkman and Rajput has also been found in the mutual possession by these races of a ruddy skin, so that as ethnographical inquiry advances the Turk appears to recede from his Mongolian affinities and to ap- proach the Caucasian. Turks and Mongols alike were doubtless included under the term Scyth by the ancients, and as Tatars by- more modern writers, insomuch that the Turkish dynasty at Delhi, founded by Babar, is usually termed the Mogul dynasty, although there can be no distinction traced between the terms Mogul and Mongol. The general results of recent inquiry into the ethno- graphy of Afghanistan is to support the general correctness of Bellew's theories of the origin of Afghan races. The claim of the Durani Afghan to be a .true Ben-i-Israel is certainly in no way weakened by any recent investigation. The influence of Greek culture in Northern India is now fully recognized, and the distri- bution of Greek colonies previous to Alexander's time is attested by recent praptical knowledge of the districts they were said to occupy. The habitat of the Nysseans, and the identity of certain tribes of Kafiristan with the descendants of these pre-Alexandrian colonists from the west, are also well established. To this, day hymns are unwittingly sung to Bacchus in the dales and glens of Kafiristan. The

ethnographical status of the mixed tribes of the mountains that lie between Chitral and the Peshawur plains has been fairly well fixed by Biddulph, and much patient inquiry in the vast fields of Baluchistan by Mockler, Tate, and others has resulted in quite a new appreciation of the 'tribal origin of the great conglomeration of Baluch peoples.

The recent bibliography of Asia, including the works of travellers and explorers since 1880, is voluminous. It is impossible to refer to all that has been written in the Survey Reports and Recent Gazetteers of the Government of India, or in the records bIbUo- of the Eoyal Asiatic Society, or the Asiatic Society, grapby Bengal; but amongst the more important popular of Asia. works are the following: —

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Asia, the first Roman province east of the Mgean, was formed 133 b.c. out of the kingdom left by the will of Attains, king of Pergamos, to the Romans. It included Mysia, Iiydia, Caria, and Phrygia. In 84 B.C., on the close of the Mithradatic war, Sulla reorganized the pro- vince, and it was then or later divided into conventus. In 27 B.C. it was made a senatorial province under a pro- consul. By the reorganization of Diocletian, a.d. 297, Asia was broken up into several small provinces, and one of. these, of which the capital was Ephesus, retained the name of the original province.

Asia iVIinor, the peninsula on the extreme west of Asia, bounded on the N. by the J Black Sea, on the W. by the .^gean, and on the S. by the Mediterra- nean, and at its N.W. extremity is only parted from Europe by the narrow straits of the Bosporus and Dar- danelles. On the E. no

natural boundary separates it from the Armenian plateau, but, for descriptive purposes, it will suffice to take a line drawn roughly from the Giaour Dagh, east of the Gulf of Alexandretta, to the Black Sea, east of Trebizond. The terin Anatolia is sometimes used by geographers as synonymous with Asia Minor; and the same country, excluding Cilicia, is locally called B'dm, a name which perpetuates the memory of Rome. The greater portion of Asia Minor consists of a plateau rising gradually from west to east, 2500 feet to 4500 feet, until, east of the Kizil Irmak, the ground rises more sharply to the highlands of Armenia (see Armenia). On the south the plateau is buttressed by the Taurus range, which stretches in a broken irregular line from the ^gean to the Persian frontier. On the north, it is supported by a range of varying altitude, which follows tke southern coast of the Black Sea and has no distinctive name. On the west the edge of the plateau is broken by broad valleys, and the deeply-indented coast-line throws out long rocky promontories towards Europe. On the north, excepting the deltas foruaed by the Kizil and Yeshil Irmaks, there are no coast plains, no good harbours except Sinope, and no islands. On the west there are narrow coast plains of limited extent, deep gulfs, which offer facilities for trade and commerce, and a fringe of protecting islands. On the south are the plains of Pam- phylia and Cilicia, the almost land-locked harbours of Marmarice and Makri, the broad bay of Adalia, the deep- seated gulf of Alexandretta or Iskanderum, and the islands of Rhodes, Castelorizo, and Cyprus. The geology of Asia Minor is imperfectly known. The Taurus range is, for the most part, formed of Cretaceous limestones, and the Black Sea coast range of saccharine limestones, mica schists, and metamorphic rocks. The interior is partly occupied by a vast plain of Tertiary lacustrine formation ;

igneous rocks are found in nearly every part of the peninsula. In the south-west, serpentine occurs ; round Kiila and in the Phrygian monument country there are extensive volcanic deposits ; and in the north-west there are granites and various fprms of trachyte. In the south-east a remarkable series of volcanic mountains, apparently of ^;he Tertiary period, stretches from Mount Argseus to Kara Dagh, and around them are soft volcanic rocks in which dwelling-places have been cut from a remote period.

Mountains. — The Taurus range, perhaps the most im- portant feature in Asia Minor, attains in Lycia altitudes of 9800 and 10,500 feet, and in the Bulgar Dagh of 8000 and 9000 feet. East of the Bulgar Dagh the continuity of the range is broken by the Sihiin and Jihiin, and their tributaries. The principal passes across the range are those over which Roman or Byzantine roads ran : — From Laodicea to Adalia; from Apamea or from Pisidian Antioch to Adalia ; from Laranda to Germanicopolis, and thence to Anemourium or Kelenderis ; from Laranda to Claudiopolis, and thence to Kelenderis or Seleuceia ; from Iconium or Caesarea-Mazaca through the Cilician Gates to Tarsus ; from Caesarea over Anti- Taurus to the valley of the Sarus, and thence to Flaviopolis on the Cilician Plain ; from Csesarea over Anti-Taurus to Kokusos, and thence to Germanicia. Large districts on the southern slopes of the Taurus chain are covered with forests of oak and fir, and there are numerous " yailas " or " alps," with abundant pasturage, to which villagers and nomads move with their flocks during the summer months. Anti-Taurus is the line of heights and mountain peaks which separates the waters running to the Black Sea and the Anatolian plateau from those falling to the Persian Gulf and the Mediterranean. It has its origin in the high land, near the source of the Kizil Irmak, and thence runs south-west to the volcanic district of Mount Argseus. Here it loses its distinctive character, but southwards it terminates in the lofty sharp-peaked ridge of Ala Dagh. South of Sivas a line of bare hills connects Anti-Taurus with a range of high forest-clad mountains, which loses itself southwards in the main mass of Taurus. This range, held to be the true Anti-Taurus by some geographers, throws off, in the latitude of Kaisarieh, a third, the Binboa Dagh, which separates the waters of the Sihun from those of the Jihiiu. The principal passes are those followed by the old roads : — From Sebasteia to Tephrike and the Euphrates ; from Sebasteia to Melitene ; and from Caesarea to Arar bissus. The range of Amanus (Giaour Dagh) is sharply separated from the mass of Taurus by the deep gorge of the Jihun, whence it runs S.S.W. to R^s el-Khanzir, forming the limit between Cilicia and Syria. It attains its greatest altitude in Kaya Duldul, 6500 feet, which

xises abruptly from the bed of the Jihtin, and it is crossed by two celebrated passes — the Amanides Pylse (Baghche Pass), through which ran the road from the Cilician Plain to Apamea-Zeugma, on the Euphrates; and the Pylse Syrise (Beilan Pass), through which passed the great Roman highway from Tarsus to Syria. On the western edge of the plateau several short ranges, running approxi- mately east and west, rise above the general level: — Salbakus-Kadmus, 8000 feet ; Messogis, 3600 feet ; Tmolus, 4000 feet; Dindymus, 8200 feet; Ida, 5800 feet ; and the Mysian Olympus, 7600 feet. The valleys of the Mseander and Hermus facilitate communication between the plateau and the ^Egean, and the descent from Dorylseum to the Sea of Marmora presents no difficulties. The northern buttress of the plateau is formed by a succession of forest-clad mountain ranges, which have a general east and west direction, and rise progressively as they approach the interior until they culminate in the Galatian Olympus, 8200 feet. East of the Kizil Irmak, although the ground is in places over 7000 feet high, there is no distinct mountain chain. The best routes from the plateau to the Black Sea are those followed by the E,oman roads from Tavium and Sebasteia to Amisus. Several minor ranges rise above the level of the plateau, and in its south-east quar- ter groups of volcanic peaks and cones ex- tend for about 150 mUes from Kaisarieh to Karaman. The most important are M. Argaeus, 13,100 feet; Ali Dagh, 6200 feet ; Hassan Dagh, 8000 feet; Karaja Dagh; and Kara Dagh, 7500 feet. The centre of the plateau is occu pied by a vast treeless plain, the Axylon of the Greeks, in which lies a large salt lake; Tuz Geul. The plain is fertile where culti- vated, fairly supplied vnth deep wells, and in many places covered with good pasture. Enclosed between the Taurus and Amanus ranges and the sea is the fertile plain of Cilicia, con- sisting in great part of a rich, stoneless loam, out of which rise rocky crags that are crowned with the ruins of Greco-Roman and Armenian strongholds.

Hirers. — The rivers of Asia Minor are of no great im- portance. Some do not flow directly to the sea ; others find their way to the coast through deep rocky gorges, or are mere torrents; and a few only are navigable for boats for short distances from their mouths. The most important rivers

which flow to the Black Sea are:— the Iris (Yeshil Irmak), with its tributaries the Lycus (Kelkit Irmak), which rises on the Armenian plateau, the Chekerek ~~Irmak,' which has its source near Yuzgat, and the Tersakan Su. The Halys (Kizil Irmak), the largest river in Asia Minor, with its tribu~~ taries the Delije Irmak, Cappadox, which flows through the eastern part of Galatia, and the Geuk Irmak, which has its sources in the mountains above Kastamuni. With the exception of Sivas, no town of importance lies in the valley of the Kizil Irmak throughout its course of over 600 miles. The Sangarius (Sakaria) rises in the Phrygian mountains and, after many changes of direc- tion, falls into the Black Sea, about 80 miles east

Sketch Map op Asia Minok.

of the Bosporus. Its tributaries are the Pursak Su (Tembris), which has its source in the Murad Da^, and, after running north to Eski-shehr, flows almost due east to the Sakaria, and the Enguri Su, which Joins the Sakaria a little below the junction of the Pursak. To the Black Sea, about 40 miles east of Eregli, also flows the Billffius (Filiyas Chai). Into the Sea of Mar- mora run the Rhyndacus (Edrenos Chai), and the Maces- tus (Susurlu Chai), which unite about 12 miles from the sea. The most celebrated streams of the Troad are the Granicus (Bigha Chai) and the Scamander (Men- dere Su), both rising in Mount Ida (Kaz Dagh). The former flows to the Sea of Marmora; the latter to the Dardanelles. The most northerly of the rivers that flow to the iEgean is the Caicus (Bakir Chai), which runs past Soma, and near Pergamos, to the Gulf of Chanderli. The Hermus (Gediz Chai) has its principal sources m the Murad Dagh, and, receiving several streams on its way, runs through the volcanic district of Katakekau- mene to the broad fertile valley through which it flows past Manisa to the sea, near Lefke. So recently as about 1880 it discharged into the Gulf of Smyrna, but the shoals formed by its sUt-laden waters were so obstructive to navigation that it was turned back into its old bed. Its

principal tributaries are — ^the Phrygius (Kum Chai), which receives the waters of the Lycus (Geurduk tUhai), and the Coga- mus (KiTzu Chai), which in its upper course is separated from the valley of th'e Mseander by

hUls that were crossed by the Roman road from Pergamos to Lao- dicea. The Caystrus (Kuchuk Mendere) flows through a fer- tile valley between M. Tmolus and Mes- sogis to the sea near Ephesus, where its silt has filled up the port and advanced the coast-line between 2 and 3 mUes. The Mseander (Mendere Chai) takes its rise in a cele- brated group of springs near Dineir, and after a winding course enters the broad valley, through which it mean- ders to the sea. Its deposits have long since filled up the harbours of Miletus, and converted the islands which protected them into mounds in a swampy plain. Its principal tributaries are the Glaucus, the Senarus (Banaz Chai), and the Hippurius, on the right bank. And on the left bank are the Lycus (Churuk Su), which flows westwards by Colossse through a broad open val- ley, that affords the only natural approach to the ele- vated plateau ; the Harpasus (Ak Chai), and the Marsyas (China Chai). The rivers that flow to the Mediterranean, with two exceptions, rise in Mount Taurus, and have short courses, but in winter and spring they bring down large bodies of water. In Lycia are the Indus (Gereniz Chai), and the Xanthus (Eshen Chai). The Pamphylian plain is traversed by the Cestrus (Ak Su), the Eurymedon (Keupri Su), andtheMelas (Menavgat Chai), which, where it enters the sea, is a broad, deep stream, navigable for about 6 miles. The Calycadnus (Geuk Su) flows south-east, near Miit, and enters the sea a deep rapid river about 12 miles below Selefke. West of Mtit it is joined by a large stream which runs below Ermenek. The Cydnus (Tersus

Chad) is formed by the junction of three streams that rise in Mount Taurus, and one of these flows through the narrow gorge known as the Cilician Gates. After passing Tarsus, the river enters a marsh which occupies the site of the ancient harbour. The Cydnus is liable to floods, and its deposits have covered Eoman Tarsus to a depth of 20 feet. The Sarus (Sihiin) is formed by the junction of the Karmalas (Zamanti Su), which rises in the Uziin YaUa, and the Sarus (Saris), which has its sources in the hills to the south of the same plateau. The first, after

entering Mount Taurus, flows through a deep chasm walled in by lofty precipices, and is joined in the heart of the range by the Saris. Before reaching the Cilician Plain the river receives the waters of the Kerkhun Su, which cuts through the Bulgar Dagh, and opens a way for the roads from the Cilician Gates to Konia and Kaisarieh. After passing Adana, to which point small craft ascend, the Sihiin runs south-west to the sea. There are, however, indications that at one period it flowed south-east to the Pyramus. The Pyramus (Jihiin) has its principal source in a group of large springs near Albistan ; but before it enters Mount Taurus it is joined by the Sogutli Irmak, the Khurman Su, and the Geuk Su. The river emerges from Taurus, about 7 miles west of Marash, and here it is joined by the Ak Su, which rises in some small lakes south of Taurus. The Jihiin now enters a remarkable defile which separates Taurus from the Giaour Dagh, and reaches the Cilician Plain near Budriim. Prom this point it flows west, and then south-west past Missis, until it makes a bend to discharge its waters south of Ayas Bay. The river is navigable as far as Missis. In the central and southern portions of the plateau the streams either flow into salt lakes, where their waters pass off by evaporation, or into fresh-water lakes, which have no visible outlets. In the latter cases the waters find their way beneath Taurus in subterranean channels, and reappear as the sources of rivers flowing to the coast. Thus the Ak Geul supplies the Cydnus, and the Beishehr, Egirdir, and Kestel lakes the rivers of the Pamphylian Plain.

Lakes. — The salt lakes are Tuz Geul, which lies in the great central plain, and is about 60 miles long and 10 to 30 miles broad ; Buldur Geul, 2900 feet above sea-level ; and Aji-tuz Geul, 2600 feet. The sweetwater lakes are Beishehr Geul, 3770 feet, a fine sheet of water 30 miles long, which discharges south-east to the Soghla Geul; Egirdir Geul, 2850 feet, which is 30 miles long, and noted for the abundance and variety of its fish. In the north- west portion of Asia Minor are Isnik Geul, Abulliont Geul, and Maniyas Geul.

Springs. — Asia Minor is remarkable for the number of its thermal and mineral springs. The most important are: — Yalova, in the Ismid sanjak; Brusa, Chitli, Terje, and Eski-shehr, in the Brusa; Tuzla, in the Karasi; Cheshme, Ilija, Hierapolis, and Alarshehr, in the Aidin ; Terzili

Hammam, in the Angora; Boli and Iskelib, in the Kasta muni ; and Khavsa, in the Sivas vilayet.

The climate is varied, but systematic observations are wanting. On the plateau the winter is cold, and in the northern districts there is much snow. The summer is very hot, but the nights are usually cool. On the north coast the winter is cold, and the winds, sweeping across the Black Sea from the steppes of Russia, are accompaniedby torrents of rain and heavy falls of snow. East of Samsiin, where the coast is partially protected by the Caucasus, the climate is more moderate. In summer the heat is damp and enervating, and, as Trebizond is approached, the veg^tion becomes almost subtropical. On the south coast the winter is mild, with occasional frosts and heavy rain ; the summer heat is very great. On the west coast the climate is moderate, but the influence of the cold

north winds is felt as far south as Smyrna, and the winter at that place is colder than in corresponding latitudes in Europe.

The mineral wealth of Asia Minor is very great, but few mines have yet been opened. The minerals known to exist are — alum, antimony, arsenic, asbestos, boracide, chrome, coal, copper, fuller's earth, gold, iron, kaolin, lead, lignite, magnetic iron, manganese, meerschaum, nickel, rock-salt, silver, sulphur, and zinc. The vegetation varies with the climate, soil, and elevation. The moun- tains on the north coast are clothed with dense forests of pine, fir, cedar, oak, beech, &c. On the Taurus range the forests are smaller, and there is a larger proportion of pine. On the west coast the ilex, plane, oak, valonea oak, and pine predominate. On the plateau willows, poplars, and chestnut trees grow near the streams. On the south and west coasts the fig and olive are largely cultivated. The vine yields rich produce everywhere, except in the higher districts. The apple, pear, cherry, and plum thrive well in the north ; the orange, lemon, citron, and sugar-cane in the south ; styrax and mastic in the south-west ; and the wheat lands of the Sivas vilayet can hardly be surpassed. The most important vegetable productions are — cereals, cotton, gum tragacanth, liquorice, olive oil, opium, rice, saffron, salep, tobacco, and yellow berries. Silk is produced in large quantities in the vicinity of Brusa and Amasia. The wild animals include bear, boar,

chamois, fallow, red and roe deer, gazelle, hyaena, ibex, jackal, lynx, moufflon, panther, wUd sheep, and wolf. Amongst the domestic animals are the buffalo, the Syrian camel, and a mule camel, bred from a Bactrian sire and Syrian mother. Large numbers of sheep and Angora goats are reared on the plateau, and fair horses are bred on the Uzun Yaila ; but no effort is made to improve the quality of the wool and mohair, or the breed of horses. Good mules can be obtained in several districts, and small hardy oxen are largely bred for ploughing and transport. The larger birds are the bittern, great and small bustard, eagle, francolin, goose; giant, grey, and red-legged partridge; pelican, pheasant, stork, and swan. The rivers and lakes are well supplied with fish, and the mountain streams abound with trout.

History. — Asia Minor owes the peculiar interest of its history to its geographical position. " Planted like a bridge between Asia and Europe," it has been from the earliest period a battle-ground between the east and the west. The central plateau, 2500 to 4500 feet above the sea, with no navigable river and few natural approaches, with its monotonous scenery and severe climate, is a con- tinuation of Central Asia. The west coast, with its alter- nation of sea and promontory, of rugged mountains and fertile valleys, its bright and varied scenery, and its fine climate, is almost a part of Europe. These conditions are unfavourable to permanence, and the history of Asia Minor is that of the march of hostile armies, and the rise and fall of small states, rather than that of a united state under an independent sovereign. At a very early period Asia Minor appears to have been occupied by non- Aryan tribes or races which differed little from each other in reli- gion, language, and social system. Since 1875 much light has been thrown upon one of these races — the "Hittites " or " Syro-Cappadocians," who, after their rule had passed away, were known to Herodotus as "White Syrians," and whose descendants can stUl be recognized in the villages of Cappadocia.^ The centre of their power was Boghaz Keui (Pteria), east of the Halys, whence roads radiated to the harbours on the ^gean, to Sinope, to Northern Syria,

1 The people, Moslem and Christian, are physically one and appear to be closely related to the modern Armenians. This relationship is noticeable

in other districts, and the whole original population of Asia Minor has been characterized as Porto-Armenian or Armenoid.

and to the Cilician Plain. Their strange sculptures and inscriptions have been found at Boghaz Keui, Euyuk, Fraktin, Ivriz, and other places between Smyrna and the Euphrates (see Hittites, in the ninth edition of this work). When the great Aryan immigration from Europe com- menced is unknown, but it was dying out in the 11th and 10th centuries B.C. In Phrygia the Aryans founded a kingdom, of which traces remain in various rock tombs, forts, and towns, and in legends preserved by the Greeks. The Phrygian power was broken in the 9th or 8th century B.C. by the Cimmerians, who entered Asia Minor through Armenia ; and on its decline rose the kingdom of Lydia, with its centre at Sardis. A second Cimmerian invasion almost destroyed the rising kingdom, but the invaders were expelled at last by Alyattes, 617 b.c. The last king, Croesus, 660-546 b.c, carried the boundaries of Lydia to the Halys, and subdued the Greek colonies on the coast. The date of the foundation of these colonies cannot be fixed; but at an early period they formed a chain of settle- ‘ ments from Trebizond to Ehodes, and by the 8th century B.C. some of them rivalled the splendour of Tyre and Sidon. Too jealous of each other to combine, and too demoralized by luxury to resist, they fell an easy prey to Lydia ; and when the Lydian kingdom ended with the capture of Sardis by Cyrus, 546 b.c, they passed, almost without resistance, to Persia. Under Persian rule Asia Minor was divided into four satrapies, but the Greek cities were governed by Greeks, and several of the tribes in the interior retained their native princes and priest-dynasts. An attempt of the Greeks to regain their freedom was crushed 500 b.c, but later the tide turned and the cities were combined into a league for defence against the Persians. The weakness of Persian rule was disclosed by the expedition of Cyrus and the Ten Thousand Greeks, 402 b.c ; and in the fol- lowing century Asia Minor was subdued by Alexander, 334 B.C.

The wars which followed the death of Alexander gave Asia Minor to Seleucus, but none of the Seleucid ‘kings were able to establish their rule

over the whole peninsula. Ehodes became a great maritime republic. An independ- ent kiugdom was founded at Pergamos, 283 b.c, which gave its name to a school of sculpture, and lasted until Attalus III., 133 B.C., made the Eomans his heirs. Bithynia became an independent monarchy, and Cappadocia and Paphlagonia tributary provinces under native princes. In Southern Asia Minor the Seleucids founded Antioch, Apar mea, Attaleia, Laodicea, Seleuceia, alid other cities as centres of commerce, and some of them afterwards played an important part in the Hellenization of the country and in the spread of Christianity. During the 3rd century, 278-277 B.C., certain Gallic tribes crossed the Bosporus and Hellespont, and established a Celtic power in Central Asia Minor. They were confined by the victories of Attalus I. of Pergamps, circ: 232 b.c, to a district on the Sangarius and Halys to which the name Galatia was applied ; and after their defeat by Manlius, 189 b.c, they were subjected to the suzerainty of Pergamos (see Galatia).

The defeat of Antiochus the Great at Magnesia, 190 B.C., placed Asia Minor at the mercy of Eome ; but it was not until 133 that the first Eoman province, Asia, was formed. Errors in pplicy and in government facilitated the rise of Pontus into a formidable power under Mithra- dates, who was finally driven out of the country by Pompey, and died 63 b.c Under the settlement of Asia Minor by Pompey, Bithynia-Pontus and Cilicia became provinces, whilst Galatia and Cappadocia were allowed to retain nominal independence under native kings. A long period of tranquillity followed, during which the Eoman dominion grew, and all Asia Minor was divided into provinces. The boundaries were often changed ; and about

A.D..297, in Diocletian's reorganization of the empire, the power of the great military commands was broken, and the provinces were made smaller and united in groups called dioceses. A great change followed the introduction of Christianity, which spread first along the main roads that ran north and west from the Cilician Gates, and especially along the great trade route to Ephesus. In some districts it spread rapidly, in others slowly. With its advance the native languages and old religions gradually disappeared, and at last the whole country was thoroughly Hellenized, and the people united by identity of language and religion.

At the close of the 6th century Asia Minor had be- come wealthy and prosperous ; but centuries of peace and over-centralization had affected the morale of the people and weakened the central Government. During the 7th century the provincial system broke down, and the coun- try was divided into themes or military districts. Erom 616 to 626 Persian armies swept unimpeded over the land, and Chosroes II. pitched his camp on the shore of the Bosporus. The victories of Heraclius forced Chosroes to retire ; but the Persians were followed by the Arabs, who, advancing with equal ease, laid siege to Constantinople, A.D. 688. It almost appeared as if Asia Minor would be annexed to the dominion of the Caliph. But the tide of isonquest was stemmed by the iconoclast emperors, and the Arab expeditions, excepting those of Hariin er-Eashid, 781 and 806, and of el-Motasem, 838, became simply pre- datory raids. In the 10th century the Arabs were ex- pelled. They never held more than the districts along the main roads, and in the intervals of peace the country rapidly recovered itself. But a more dangerous enemy was soon to appear on the eastern border.

In 1067 the Seljiik Turks ravished Cappadocia and Cilicia ; in 1071 they defeated and captured the Emperor Eomanus, Diogenes ; and in 1080 they took Nicsea. One branch of the Seljuks founded the empire of Eum, with its capital first at Mcsea and then at Iconium. The empire, which at one time included nearly the whole of Asia Minor, with portions of Armenia and Syria, passed to the Mongols when they defeated the sultan of Rum in 1243, and the sultans became vassals of the Great Khdn. The Seljuk sultans were liberal patrons of art, literature, and science, and the remains of their public buildings and tombs are amongst the most beautiful and most interesting in the country. The march of the Crusaders across Asia Minor left no permanent impression. But the support given by the Latin princes to the Armenians in Cilicia facilitated the growth of the small warlike state of Lesser Armenia, which fell in 1376 with the defeat and capture of Leo VI. by the Memli^k sultan of Egypt. The Mongols were too weak to govern the country they had conquered, and the vassalage of the last sultan of Eum, who died in 1307, was only nominal. On his death the governors of his western provinces drove out the Mongols and asserted their independence. A contest for supremacy followed, which eventually ended in favour of the Osmanli Turks. In 1400

Sultan Bayezid I. held all Asia Minor west of the Euphrates; but in 1402 he was defeated and made prisoner by Timur, who swept through the country to the sh,ores of the j3Egean. On the death of Timur, Osmanli supremacy was re- established after a prolonged struggle, which ended with the annexation by Muhammad II. (1461-81) of Kara- mania and Trebizond, and the abandonment of the last of the Italian trading settlements which had studded the coast during the 13th and 14th centuries. The later history of Asia Minor is that of the Turkish ei%ire. The most important event was the advance (1832-33) of an Egyptian army, under Ibrahim Pasha, through the Cilician Gates to Konia and Kutaya.

The defeat of the Emperor Eomanus (1071) initiated a change in the condition of Asia Minor which was to be complete and lasting. A long succession of nomad Turkish tribes, pressing forward from Central Asia, wan- dered over the rich country in search of fresh pastures for their flocks and herds. They, did not plunder or ill-treat the people, but they cared nothing for town life or for agricultural pursuits, and as they passed onward they left the country bare. Large districts passed out of cultivar tion and were abandoned to the nomads. The peasants either became nomads themselves or took refuge in the towns or the mountains. The Mongols, as they advanced, sacked towns and laid waste the agricultural lands. Timur conducted his campaigns with a ruthless disregard of life and property. Entire Christian communities were mas- sacred, flourishing towns were completely destroyed, and all Asia Minor was ravaged. From these disasters the country never recovered, and the last traces of Western civilization disappeared with the enforced use of the Turkish language and the wholesale conversions of Isl£im under the Osmanli sultans. The large increase of the Greek population in the western districts, the construction of railways, and the growing interests of Germany and Eussia, seem, however, tg indicate that the tide is again turning in favour of the Westi'

Population. — ^None of the conquering races that invaded Asia Minor, whether from the east or from the west, wholly expelled or exterminated the race in possession. The vanquished retired to the hills or absorbed the victors. In the course of ages race distinction has been almost obliterated by fusion of blood ; by the complete Helleni- zation of the country, which followed the introduction of Christianity ; by the later acceptance of Islam ; and by migrations due to the occupation of cultivated lands by the nomads. It will be convenient here to adopt the modern division into Moslems, Christians, and Jews : — .(a) Moslems. The Turks never established themselves in such numbers as to form the predominant element in* the population. Where the land was unsuitable for nomad occupation the agricultural population remained, and it still retains some of its original characteristics. Thus in Cappadocia the facial type of the non-Aryan race is common, and in Galatia there are traces of Gallic blood. The Zeibeks of the west and south-west are ap- parently representatives of the Carians and Lycians; and the peasants of the Black Sea coast range, of the people of Bithynia, Paphlagonia, and Pontus. Wher- ever the people accepted Islam they called themselves Turks, and a majority of the so-called " Turks " belong by blood to the races that occupied Asia Minor before thrf Seljuk invasion. Turkish and Zazarspeaking Kurds (see Kurdistan) are found in the Angora and Sivas vilayets. There are many large colonies of Circassians and smaller ones of Noghai Tatars, Georgians, Lazis, Cossacks, Albanians, and Pomaks. East of Boghaz Keui there is a compact population of Kizilbash, who are partly descendants of Shia Turks transplanted from Persia and partly of the indigenous race. In the Cilician Plain there are large settlements of Ansarieh who have migrated from the Syrian mountains (see Stria). The nomads and semi-nomads are, for the most part, representatives of the Turks, Mongols, and Tatars who poured into the country during the 350 years that followed the defeat of Eomanus. Turkomans are found in the Angora and Adana viMyets ; Avshars, a tribe of Turkish origin in the valleys of Anti-Taurus ; and Tatars in the Angora and Brusa viMyets ; Yuruks are most numerous in the Konia viMyet. They speak 'Turkish and profess to be Moslems, but have no mosques or im^ms. The Chepmi and Takhtaji, who live chiefly in the Aidin vilayet, ap- pear to be derived from one of the early, races. (&) Chris-

tians. The Greeks are in places the descendants of colo- nists from Greece ; but most of them belong by blood to the indigenous races. These people became ” Greeks ” as being subjects of the Byzantine empire and members of the Eastern Church; and at the present day every Turkish subject who belongs to the Orthodox Church is officially a ” Greek.” On the west coast, in Cappadocia, in Pontus, and in the mining villages, the language is Eomaic ; on the south coast and in many inland villages it is either Turkish, which is written in Greek characters, or a Greco- Turkish jargon. In and near Smyrna there are large colonies of Hellenes. Armenians are most numerous in the eastern districts, where they have been settled since the great migration that preceded and followed the Seljuk invasion. In Central and Western Asia Minor they are the descendants of colonists from Persia and Armenia (see Armenia). (c) The Jews live chiefly on the Bosporus ; and in Smyrna, Brusa, and other western towns. Gypsies — some Moslem, some Christian — are also nu- merous.

In the absence of trustworthy statistics, only the follow- ing rough estimate can be given : — Moslems, 6,800,000 ; Armenians, 560,000; Greeks, 780,000; other Christians, 45,000; Jews, gypsies, foreigners, &c., 150,000; total, 8,335,000. This does not include the population of the islands — Moslems, 27,600; Greeks, 342,000; other Christians, 3000; Jews and foreigners, 2000; total,

374,500.

Administration. — The modem division of the country and the present system of administration are treated elsewhere (see Turkey). The modern towns rarely occupy the sites of the ancient cities, a point well brought out by Eamsay {Hist. Geog. pp. 82-88). All Turkish subjects who are not Moslems must belong to one of the recognized millets or religious communities — Armenian, Greek, Jewish, Latin, Protestant, &c. The most striking educational feature is the great influence for good exer- cised by the schools and colleges of the American Board of Missions. The Greeks and Armenians haye good schools for both sexes.

The principal manufactures are :^Carpets, rugs, cotton, mohair and silk stuffs, soap, wine, and leather. The exports are; — Cereals, cotton, cotton

seed, dried fruits, drugs, fruit, gall nuts, gum tragacantl\, liquorice root, maize, nuts, olive oil, opium, rice, sesame, sponges, storax, timber, tobacco, valonea, walnut wood, wine, yellow berries, carpets, cotton yarn, cocoons, hides, leather, mohair, silk, silk stuffs, rugs, wax, wool, leeches, live stock, minerals, &c. The imports are : — Coffee, cotton cloths, cotton goods, crockery, dry salteries, f ezzes, glass- ware, haberdashery, hardware, henna, iron-ware, jute, linen goods, manufactured goods, matches, petroleum, salt, sugar, woollen goods, yarns, &c.

Communications. — There are few metalled roads, but on the plateau light carts can pass nearly everywhere. The lines of railway now open are : — (1) From Haidar Pasha to Ismid^ Eski-shehr, and Angora, to be extended to Kir-shehr atid Kaisarieh. (2) From Mud^nia to Brusa.

(3) From Eski-shehr to Afiun Kara-hissar and Konia.

(4) From Smyrna to Manisa, Ala^shehr and Afiun Kara- hissar, with a branch line from Manisa to Soma. These lines are worked by the German Gesellschaft der Anatolischen Msenbahn. (5) From Smyrna to Aidin and Dineir, constructed and worked by an English company. (6) Mersina to Tarsus and Adana. The German company has power to extend its system to Baghdad, but the route by which the line will cross the Taurus has not yet been decided. There are thus two competing routes — one running inland from Constantinople (Haidar Pasha), the other from Smyrna. The first is prac- tically connected with the European railway system;

the second, with the great sea routes from Smyrna to Trieste, Marseilles, and Liverpool. The right to construct ^all rail-ways in Armenia and north-eastern Asia Minor has heen conceded to Russia.

Authorities. — Siiioe 1870 Asia Minor has been visited by many travellers, who have brought back valuable information ; excava- tions

have been carried out at a few places ; and special questions have been studied on the spot by qualified explorers. Valuable papers have been published by Anderson, Benndorf , Bent, Crowfoot, Fouoart, Headlam, Hicks, Hogarth, Myres, Eamsay, Schuchhardt, Smith, Wilson, &c., in the Proceedings B. Oeog. Society, Jourl. Hellenic Society, in Maspeeo's Becueil, vols. xiv. xv., &c., the American Journ. of Archmology, Journal of Philology, Mitt, des kais. d. arch. Inst. Athen. Abth., Bull, de Corr. HelUnique, Wiener Vorlegebldtter, &c. Fuller works are :— Chantkb, E. Becherches archkologiques. Mission en Cappadocie. Paris, 1898. — Clar£e, J. T. "Investigations at Assos," in Jour, of Archwol. Inst, of America. Boston, 1882. — Cuistbt. La Turquie d'Asie. Paris, 1890.— Davis, E. J. Anatolica. Lond., 1874.— £j/e in Asiatic Turkey. Lond., 1879. — Hikschfeld. " Vorlauflger Eeisebericht," in Berlin Monatsbericht. 1879.— Hogarth, D. G. Wandering Scholar in the Levant. Lond., 1896. — Humann and PuoHSTBiN. Beisen in Kleinasien u. Nordsyrien. Berlin. — HtJMANN, K. Altertumer v. Hierapolis. Berl., 1898.— Alter v. Pergamon, in pubs. Rl. Mus., Berl., 1895.— Lanckoronski, C. StOdte Pamphyliens u. Pisidiens. Vienna, 1890. — Murray. Handbook for Travellers in Asia Minor, &c. Lond., 1895.— Naumans-. Vom Q-oldenen Horn zu den Quellen des Euphrat. Munich, 1893. — ^Perrot and Guillaumb. Expln. Archl. de la Galatie. Par., 1862-72. — Perkot and Chipiez. Hist, of Art in Phrygia,&c. Lond., 1892. — Ramsay, W. M. Historical Geography of Asia Minor, in sup. papers, R. G. S., vol. iv.— Church in the Boman Empire. Lond., 1893. — Cities and Bishoprics of Phrygia. Oxford, 1895. — Reclds, E. Nouvelle Geographie, vol. ix. Paris, 1884. — Sterrett. Epigraphical Journey in Asia Minor; Wolfe Expedition to Asia Minor. Boston, Mass., 1888. — Tomaschek. "Zur historischen Topographic v. Kleinasien in Mittelalter," in Sitzungsber. d. AJcad. d. Wissensch. in Wien, 1891. — Tozer. Turkish Armenia and Eastern Asia Minor. Lond., 1§81. — ^Von Dibst und Anton. " Neue Forschungen in nordlichen Klein- asien," in Vergdnzungsheft, 116. Pet. Mit. Gotha, 1896. — Jensen. Hittiter und Armenier. Strasbourg, 1898. — Von Luschau. Beisen insudwest. Kleinasien. 1888. — Maspbro. Hist, aneienne. 3 vols. — Eakl Percy. Ifotes from a Diary in Asiatic Turkey, 1898 ; Highlands of Asiatic Turkey. ■ 1901.

Maps. — Kiepert. Nouvelle carte generale des provinces asiatiques, de VEmpire Ottoman. Berlin, 1894. — Specialkarte v. West-Kleinasien, 1890. /o. w. W.)

Askabad, or Askhabad, a town of Russian Central Asia, capital of the Transcaspian province, 345 miles by rail S.E. of Krasnovodsk and 602 from Samarcand, situated in a small oasis of the same name at the foot of the Kopetdagh range. In 1881 it consisted of merely 500 tents, but it has increased rapidly since it became the chief town of the province. It has three Russian churches, one Armenian church, three mosques, a public library, a progymnasium for boys and another for girls, a technical railway school, and several charitable insti- tutions. It has also a daily newspaper, and strikes the traveller by its relatively good hotels and shops. There are several cotton-cleaning works, as also tanneries, brick- works, and " mineral waters " factory. The trade with Persia, Merv, and Khiva is valued at £250,000 a year. The population, 4000 in 1889, was 19,428 in 1897.

Asmara. See Ebitbea.

Asnieres, a town of France, department of Seine, arrondissement of St Denis, 4 miles S.W. of that town, on the railway to Havre and the river Seine. The town, which has grown rapidly in recent years, is a favourite boating-centre for the Parisians. The industries include the manufacture of bicycles, pianos, trellis-work, per- fumery, and boat-building. Population (1881), 10,666; (1896), 23,931, (comm.) 23,931 ; (1901), 30,881.

Aspen, a city of Colorado, U.S.A., and capital of

Pitkin county, situated in the western, mountainous portion of the state, in 39° 12′ N. lat. and 106° 49′ W. long., in the valley of Roaring Fork, a branch of the Grand river. The site of the city is level and its plan is regular. It has two railways, the Denver and Rio Grande and the Colorado Midland. The altitude is 7853 feet. The surrounding country contains many mines, principally of silver, but owing to the depres- sion in the price of this metal, the prosperity of the district has been seriously affected. Population (1890),

5108; (1900), 3303.

Aspinwall. See Colon.

Assab. See Ebitbba.

Assam, a province of British India, under the administration of a chief commissioner, situated on the extreme north-east frontier, being almost surrounded on two sides by semi-independent tribes. The administrar tive headquarters are at the station of Shillong, in the Khasi Hills. Assam is naturally divided into three distinct tracts : first, the valley of the Brahmaputra, from where that river forces its way through the Himalayan range to where it debouches on the plain of Northern Bengal. To this tract alone is the name of Assam strictly applicable, being derived from the Ahom dynasty whidb.

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*X.TJixrH>hiniiOJ.B,Bmarth :BnsiTjcatt.^*

Sketch Map of Assam.

O^ow^tgof

formerly ruled here, and here alone is the Assamese language spoken. The second tract is the valley of the Surma or Barak, which is really an extension of the Bengal delta, enclosed by hills on three sides. Between these two valleys lies the third tract, consisting of a series of hill ranges, inhabited by a number of different tribes, entirely unconnected with either the Assamese or the Bengalis. There is still a border line along the north and the east, beyond which only vague political influence is exercised. The Southern Lush^i Hills were added to the province in 1898. The numerous democratic chiefs of the Khasi Hills enjoy a certain measure of independence. The native state of Manipur, on the eastern border, is subordinate to Assam. Frontier troubles occasionally arise with the Akas, Dallas, Abors, and Mishmis along the northern border, arising out of raids into British territory. A military expedition had to be sent against the Mishmis in the winter of 1899-1900.

Population.— The following table gives the area and population of the several districts of Assam, according to the census of loyi : —

ASSAM

723

Area and Population of Assam, 1891.

Divisions.

Distrlots.

Area

in Square

Mites.

Number of

Towns and

Villages.

Population, Censas of 1891.

Density of Population to Square Mile.

Males.

Females.

Total.

Surma Valley . Brahmaputra Valley

Hill Districts .

Grand total

Cachar Plains .

Sylhet ....

Goalpara

Kamrup ....

Darrang .

Nowgong ....

Sibsagar ....

Lakhimpur

North Cachar .

Garo Hills

Khasi and Jaintia Hills .

NagaHUls

North Lushai (civU and

North Lushai (estimated)

2,472 5,414

639 6,520

194,373 1,100,938

173,169 1,053,655

367,542 2,154,593

149 398

7,886

7,159

1,295,311

1,226,824

2,522,135

319

3,954 3,660 3,418 3,258 2,855 3,724

1,100 1,567 1,117

910 1,309

783

236,629 321,029 161,381 177,791 240,995 136,404

215,675 313,220 146,380 166,350 216,279 117,649

452,304 634,249 307,761 344,141 457,274 254,053

114 173

90 106 160

68

20,869

6,786

1,274,229

1,175,553

2,449,782

117

1,728 3,270 6,041 5,710

• 3,500

210 1,005 1,330

641

1 ‘

(25

9,306 61,313 94,606 62,199

2,044

20,667

9,635

60,357

103,298

60,668

20,923

18,941

121,670

197,904

122,867

2,044

41,590

10 37 33 21

12

20,249

3,215

250,135

254,881

506,016

25

49,004

17,160

2,819,675

2,657,258

5,476,933

112

Since 1881 the population increased by 11 per cent., which cannot be considered a high rate when we take into consideration the large amount of waste land and also the continuous immigra- tion of tea coolies. Classified according to religion, Hindus numbered 2,997,072, or 54-7 per cent, of the total population ; Mahommedans numbered 1,483,974, or 27 per cent.; Christians numbered 16,844, or -31 per cent.; aboriginal tribes numbered 969,765, or 17-7 per cent. ; Buddhists numbered 9065, or -16

per cent. ; and "others," 122. The Mahommedans are mostly found in the two old Bengal districts of Sylhet and Goalpara; the Christians in the Khasi and Jaintia HUls, where the Welsh Calvinistic Mission has been most successful. Europeans numbered 1687 and Eurasians 392, leaving 14,765 for native converts.

The provisional figures for the census of 1901 returned the total population of Assam as 6,122,201, including 283,957 for Manipur and 82,344 for the Lushai Hills, neither of which was comprised in the census of 1891. Deducting this additional area, the rate of increase for the province is 6 per cent., compared with 11 per cent, for the previous decennial period. The increase is confined to the tea districts. The lower districts of the Brahmaputra valley, which have suffered severely from a fatal form of fever, show a heavy decrease.

Agriculture. — The greater part of the two districts of Sylhet and Goalpara were permanently settled, with the rest of Bengal. The Brahmaputra valley has a temporary settlement of its own known as mauzawari, the average incidence of assessment being about Rs.2:8:0 per acre. Agricultural statistics are confined to the temporarily settled tract. In 1897-98, out of a total culti- vated area of 2,472,734 acres, no less than 1,614,292 acres were under rice, which is everywhere the staple crop, 310,826 acres under tea, and 169,223 acres under mustard. Jute is grown to some extent in Sylhet and Goalpara. The Brahma- putra valley does not produce sufficient rice for its own con- sumption, large quantities being imported to feed the tea coolies.

Tea Plantations.— Tea. is,the staple industry of Assam, in both the Brahmaputra and the Surma valleys. The following table shows the progress of the industry at various years between 1883 and 1897:—

Statistics.

Area under

Area under

Number of

Number of

Tear.

Mature

Immature

Gardens.

Adult

Labourers

Plants.

Plants.

Labourers.

per 100 Acres.

Acres.

Acres.

Acres.

1883

161,707

27,746

923,664

153,739

81

1890

200,658

30,380

994,497

250,113

108

1895

234,909

41,105

995,787

334,298

121

1896

247,655

44,254

968,895

366,460

125

1897

263,313

47,337

1,014,017

402,205

129

The following table gives the statistics of the tea industry, according to districts, for 1897, which was not a very prosperous year : —

District.

Number

of Tea

Gardens.

Total Area of Gardens.

Area under

Mature and

Immature

Plants.

Total Yield.

Out- turn per Acre.

Cachar Sylhet . Khasi Hills . Goalpara Kamrup Darrang Nowgong Sibsagar Lakhimpur .

Total .

191

137

1

3

31

89

50

171

149

Acres.

282,583

150,614

100

852

18,785

108,067

49,884

231,475

171,657

Acres.

61,190

70,200

30

410

5,873

33,984

12,659

70,644

55,560

22,031,593

26,153,168

4,000

140,798

753,228

11,154,360

4,019,795

24,021,294

18,988,096

lb

406 474 133 371 132 407 356 391 399

822

1,014,017

310,550

107,266,332

408

In 1897 the average price per H) was E.0 : 5 : 11 '(say 6d.) in the Surma valley, and K.0 : 7 : 8 (say 7Jd.) in the Brahmaputra valley. The labour

*required on the- tea gardens is almost entirely imported, as the natives of the province are too prosperous to do such work. The importation of coolies is controlled by an elaborate system of legislation, which provides for the registration of contracts, the medical inspection of coolies during the journey, and supervision over rates of pay, &o., on the gardens. A revised Immigration Act for Assam was passed by the Viceroy's council in March 1901. In 1897 the mean annual strength of the labour force was 630,107, of whom 227,902 were children. The total number of adults at the end of the year was 399,975, of whom 195,267 were women. In 1897 the total immigration was 95,931, compared with 81,115 in the preceding year, and with 36,080 in 1890. This large increase is ascribed mainly to the famine in the recruiting tracts, but partly to the demand for additional labour on the tea gardens. The mortality among the coolies during the journey was high, owing to an outbreak of cholera ; and the death-rate on the gardens was also high — 41*4 per thousand, compared with 32 in the preceding year.*

Minerals. — The mineral products of Assam include coal, petroleum, and limestone. The most valuable coal-mines are at the head of the Brahmaputra valley, in the neighbourhood of Makum, which is connected by railway with Dibrugarh on the river. The coal is the best found in India ; it is largely used for local purposes, and is also exported to Bengal. In 1897 the out- put was 197,499 tons, yielding to the Government a revenue of Rs. 33,065. In the same neighbourhood are oil-fields, yielding kerosene and parafBn. In 1897 the output was 222,077 gallons. Coal is also found in the Naga and the Khasi Hills. The lime- stone of the Khasi Hills is largely exported to Bengal. In 1896-97 the total out-turn was 1,630,000 maunds, yielding to the Government a revenue of Rs.18,000.

Bailways. — Assam is still unconnected with the general railway system of India, and the Brahmaputra valley entirely depends upon communications by steamer. The Assam-Bengal railway is intended to run from the seaport of Chittagong to the Surma

valley, and thence across the hills to Dibrugarh, at the head of the Brahmaputra valley, with a branch to Gauhati lower down the Brahmaputra. The hill section of this line has been found exceedingly difficult of construction, and extensive damage was done by the earthquake of 1897. . This railway is flnaboed by the Government, though worked by a company, and therefore ranks as a state line. Up to the end of 1898 the total length open for traffic was 379 miles; the gross earnings in that year were Ex. 130,812, and the working expenses Ex.125,357. There are several short lines of light railway, or tramway, in the province. The most important is the Dibru-Sadiya railway, at the head of the Brahmaputra valley, with a branch to the coal-fields. Its length is 78 miles; in 1898 its gross earnings amounted to Ex. 78, 141, and the working expenses were Ex.49,894.

Trade. — The external trade of Assam is conducted partly by steamer, partly by native boat, and to a small extent by rail. In the Brahmaputra valley steamers carry as much as 86 per cent, of the exports, and 94 per cent, of the imports. In the Surma valley native boats carry about 43 per cent, of both. In 1897-98 (which was a bad year, owing to the earthquake and a poor tea crop) the total exports were valued at Es.5,33,00,000, of which Es. 3, 13,00,000 came from the Brahmaputra and Es.2,20,00,000 from the Surma valley. The chief items were tea (Es.3,52,76,000), rice in the husk, oil-seeds, tea-seed, timber, coal, and jute. The im- ports (excluding treasure) were valued at Es. 4,04,00,000, of which Es.2,14,00,000 went to the Brahmaputra ana Es.1,90,00,000 to the Surma valley. The chief items were cotton piece-goods, rice not in the husk, sugar, grain and pulse, salt, iron and steel, tobacco, cotton twist and yarn, and brass and copper. No less than- three- fourths of the total trade is conducted with Calcutta. The traijs- frontier trade is insignificant; and most of it is conducted with the Bengal state of Hill Tipperah. In 1897-98 the total imports were valued at Rs.6,70,600, and the exports at Es.3,03,236.

Government. — The administrative staff for the province of Assam consists of a chief commissioner, appointed by the governor-general, who is assisted by a secretary, an assistant- secretary, and a personal assistant ; a district and sessions judge for Sylhet, who is also sessions judge for

Cachar ; a judge and commissioner for the Brahmaputra valley ; a conservator of forests ; a principal medical officer, who is also sanitary commis- sioner ; a director of public instruction ; a director-general of police and jails, who is also inspector-general of registration, commissioner of excise, and superintendent of stamps ; a director of land records and agriculture, with an assistant ; and thirteen deputy commissioners. The total number of civil and revenue courts is 68, and of criminal courts 102. The total strength of the police force consisted in 1897 of 2833 military police, 2253 civil police, and 6993 rural police. The proportion of civil police was one man to 19 square miles of area and to 2356 of population. The daily average number of prisoners in jail during 1897 was 1499. The total number of municipalities is 14, only one of which (Sylhet) has a populatioik exceeding 10,000. In 1897-98 the aggregate municipal income was Es.2, 51,819, of which Es.90,186 was derived from rates and taxes, and Es.88,844 from Government contributions. There are 19 local boards, with an ag- gregate income of Es.12,28,131, of which Es.6,46,000 was derived from rates. Of the expenditure, 64 per cent, was devoted to public works, 18 per cent, to education, and 8 per cent, to medical. In 1897 the military force in Assam consisted of three battalions of Gurkhas, one of which was stationed in Manipur, and one regiment of Bengal infantry. In addition, there are three volunteer corps : the Shillong Eifles (60 strong), the Assam Valley Light Horse (373 strong), and the Surma Valley Light Horse (350 strong).

The net revenue and expenditure of Assam for 1897-98 in tens of rupees (Ex.), distributed under the three heads of imperial, provincial, and local, was as follows — net revenue : imperial, Ex.416,626; provincial, Ex. 660, 100;. Jocal, Ex.63,953; total Ex.1, 140,679. Net expenditure : imperial, Ex.62,517 ; provin- cial, Ex.631,468; local, Ex. 92, 585 ; total, Ex.786,570. Surplus: imperial, Ex.354,109; provincial, Ex.28,632 ; local, Ex. – 28,632 ; total, Ex.354,109. During the previous ten years, the gross land revenue increased from Ex. 429,939 to Ex. 596, 123, excise from Ex.210,297 to Ex.276,791, and stamps from Ex.78,683 to Ex.87,051.

Education. — The following table gives 'the chief statistics of education in Assam for the three quinquennial years, 1886-87, 1891-92, and 1896-97. The figures show steady progress, the rate of increase being

*considerably higher than for India gener- ally. If we compare the number of pupils with the estimated population of school-going age (15 per cent, of the total popula- tion), the increase has been from 9-5 to 12-7 per cent. Taking cirls alone, the number at school increased from 5136 in 1891-92 xo 8276 in 1896-97, or by no less than 61 per cent. ; while the proportion to the female population of school-going age rose from 1*3 to 2-1 per cent. This improvement is mainly due to the Welsh missionaries in the Khasi Hills.*

‘

1886-8T.

1891-92.

1896-9T.

Schools.

Pupils.

Schools.

PupUs.

Schools.

Pupils.

Colleges . ^Secondary schools Primary schools Special schools Piivate institu- tions

Total .

‘ill

-1,915

18

245

10,574

53,801

529

4,826

112

2,365

,25 298

10,353

66,913

635

5,737

1 137

3,046

41

309

27 11,623

84,267

743

6,881

2,289

69,730

2,800

83,638

3,634

103,541

Earthquakes.— Assam is liable to earthquakes. By far the severest shock known is that which occurred on the evening of 12th June 1897. The area of this seismic disturbance extended over North-Eastern India, from Manipur to Sikkim ; but the focus was undoubtedly in the Khasi and Garo Hills. In the station of Shillong every masonry building was levelled to the ground. Throughout the country bridges were shattered, roads were broken up like ploughed fields, and the beds of rivers were dislocated. In the hills there were terrible landslips, which wrecked the little Cherrapunji railway and caused 600 deaths. The total mortality recorded was 1542, including two Europeans at Shillong. The damage done to public property is estimated at Es. 50,00,000. On the Assam-Bengal railway alone the cost of repairs was Es.13,84,000. (j. s. C.)

Assaying. —In its restricted sense the term assaying is applied to the determination of the amount of gold or silver in ores or alloys ; but in this article it will be used in its wider signification, and will include a description of the methods for the quantitative determination of those elements in ores which affect their value in metallurgical, operations. It would be impossible to give in detail here all the precautions necessary for the successful use of the methods, and the descriptions will therefore be confined to the principles involved and the general manner in which they are applied to secure the desired results.

Oold and Silver. — Ores containing gold or silver are almost in- variably assayed in the dry way ; that is, by fusion with appropriate fluxes and ultimate separation of the elements in the metallic form. One of the

customs which has grown out of our peculiar system of weights is the form of statement of the results of such an assay. In- stead of expressing the amounts of gold and silver in percentages of the weight of ore, they are expressed in ounces to the ton, the ounce being the Troy ounce and the ton that of 2000 avoirdupois pounds. To simplify calculation and to enable the assayer to use the metric system of weights eniployed in all chemical calculations, the "assay ton" (" A. T." =29-166 grammes) has been devised, which bears the same relation to the ton of 2000R) avoirdupois that one milligram does to the Troy ounce ; when one assay ton of ore is used, each milligram of gold or silver found represents one ounce to the ton.

The assay of an ore for gold or silver consists of two operations. In the first the gold or silver is made to combine or alloy with metallic lead, the other constituents of the ore being separated from the lead as slag. In the second, the lead button containing the gold or silver is cupelled and the resulting gold or silver button is weighed. The second operation has been fully described in ' the ninth edition of this work (vol. ii. p. 725) and need not be further considered. The first is conducted in one of two ways, known respectively as the crucible method and the scoriflcation method. The crucible method is generally used for ores containing gold in small amounts and for certain classes of silver ores. The amount of ore taken for assay is generally one-half " A.T.," but in very low grade ores one, two, and sometimes even four "A.T.s" are used. In the scorification method one-tenth of an " A.T." is the amount commonly taken. While in both methods the same result is sought, the means employed are quite different. In the scorifl- cation method the ore is mixed in the scorifler (a shallow dish of burned clay) with from ten to twenty times its weight of granulated metallic lead (test lead) and a little borax glass, and heated in a muffle, the front of which is at flrst closed. When the lead melts and begins to oxidize, the lead oxide or litharge, as it is called, combines or dissolves the non-metallic and readily oxidizable con- stituents of the ore, while the gold and silver alloy with the lead. As the slag thus formed flows off to the sides of the scorifler, the assay clears and the melted metallic lead forms an "eye" in the middle. The door of the muffle is then opened and the current of air which is drawn over the scorifler rapidly oxidizes

the lead, while the melted litharge gradually closes over the metal. When the " eye " has quite disappeared the door is closed and the temperature

raised to make the slag very liquid. The scorifier is taken from the muffle in a pair of tongs and the contents poured into a mould, the lead forming a button in the bottom while the slag floats on top. When cold, the contents of the mould are taken out and the lead button hammered into the form of a cube, the slag, -which is glassy and brittle, separating readily from the metal, which is then ready for cupellation. In the crucible method the ore is mixed with from once to twice its weight of flux, which varies in composition, but of

which the following may be taken as a type :

Sodium bicarbonate . ... 8 parts. Potassium carbonate . . . . 3 , ' Powdered borax . . 4 "

Hour ! ! 1 "

Litharge 9 ||

The mixture is charged into a round clay crucible from 100 mm. to 125 mm. high, and heated either in a muffle or in a crucible furnace 'at a gradually increasing heat for forty or fifty minutes. At the expiration of this time, when the charge should be perfectly liquid and in a tranquil state of fusion, the crucible is removed from the furnace and the contents are poured into a mould. The resulting lead button hammered into shape and carefully cleansed from slag is ready for the cupel. If the button is too large for cupellation, or if it is hard, it may be scorified either alone or mixed with test lead before cupellation. The character and amount of the flux necessarily depend upon the character of the ore, the object being to concentrate in the lead button all the gold and silver while dis- solving and carrying off in the slag the other constituents of the ore. Under the most favourable conditions there is a slight loss of gold and silver in the

fusion, the scorification, and the cupellation, both by absorption in the slag and by actual volatilization and absorption in the cupel. In ores containing much copper, this metal is largely concentrated in the lead button, making it hard and necessitating repeated scorifications, and in some cases a preliminary removal of the copper by solution of the ore in nitric acid. This leaves the gold in the insoluble residue, which is filtered off, and the silver "in the solution is thrown down by hydrochloric acid. The resulting precipitate of silver chloride is filtered, and the residue and the pre- cipitate are scorified together. Ores containing much arsenic or sulphur are generally roasted at a low heat and the assay is made on the roasted material.

Lead. — ^The "dry" or fire assay for lead is largely used for the valuation of lead ores, although it is being gradually replaced by volumetric methods. One part of the ore is mixed with from three to five parts of a flux of the following composition: —

Potassium carbonate . . . 40-6 per cent. Sodium bicarbonate …. 31-3 „

Borax 15'6 „

Plour 12-5 „

The mixture is charged into a clay crucible and heated for twenty itdnutes at a good red heat. When the mixture has been in a tranquil state of fusion for a few minutes it is poured into a mould. When cold, the button is hammered, cleaned carefully from slag, and weighed. The proportion is calculated from the amount of ore used, and the result is expressed in parts in a hundred or percentage of the ore. Various impurities, such as copper, antimony, and sulphur, go into the lead button, so that the result is generally too high. The most accurate method for the determination of lead in ores is the gravimetric method, in which it is weighed as lead sulphate after the various impurities have been separated. Nearly all lead ores contain more or less sulphur ; and as in the process of solution in nitric acid this is oxidized to sulphuric acid which unites with the lead to form the very insoluble lead sulphate, it is simpler to add sulphuric acid to convert all the lead into sulphate and then evaporate until the nitric acid is expelled. The salts of iron, copper, &c., are then dissolved in water and

ffltered from the in- soluble silica, lead sulphate, and calcium sulphate, which are washed with dilute sulphuric acid. The insoluble matter is treated with a hot solution of alkaline ammonium acetate, which dissolves the lead sulphate, the other materials being separated by filtration. The lead sulphate, re-precipitated in the filtrate by an excess of sulphuric acid and alcohol, is then filtered on an asbestos felt in a Gooch cru- cible, washed with dilute sulphuric acid and alcohol, ignited, and weighed. Lead sulphate contains 68-30 per cent, of metallic lead. There are several volumetric methods for assaying lead ores, but the best known is that based on the precipitation of lead by ammonium molybdate in an acetic acid solution. The lead sul- phate, obtained as described above and dissolved in ammonium acetate, is acidulated with acetic acid diluted with hot water and heated to boiling-point. A standardized solution of ammonium molybdate is then added from a carefully-calibrated burette. As long as the solution contains lead, the addition of the molybdate solution causes a precipitation of white lead molybdate. An excess of the precipitant is shown by a drop of the solution imparting a yellow colour to a solution of tannin, prepared by dissolving one part of tannin in 300 of water ; drops of this solution are placed on

a white porcelain plate, and as the precipitant is added to the lead solution a drop of the latter is removed from time to time on a glass stirring-rod and added to one of the drops on the porcelain plate. The appearance of a yellow colour shows that all the lead has been precipitated and that the solution contains an excess of molybdate.. From the reading of the burette the lead is calculated. The molybdate solution should be of such a strength that 1 cc. will precipitate 0-01 gramme of lead. It is standardized by dissolving a weighed amount of lead sulphate in ammonium acetate and pro- , ceeding as described above.

Zinc— Chemically the ores of zinc consist of the silicates, car- bonates, oxides, and sulphides of zinc associated with,other metalsj some of which complicate the methods of assay. The most modern and the most generally accepted method is volumetric, and is feased on the reaction between zinc chloride and potassium ferrocyanide, by which insoluble zinc ferrocyanide and soluble potassium chloride are formed ; the presence of the slight'est excess of potassium ferro- cyanide is shown by a brownish

tint being imparted by the solution to a drop of uranium nitrate. The ore (0-5 gramme) js digested with a mixture of potassium nitrate and nitric acid. A saturated solution of potassium chlorate in strong nitric acid is added, and the mass evaporated to dryness. It is then heated with a mi:$ture of ammonium chloride and ammonia, filtered and washed with a hot dilute solution of the same mixture. The filtrate diluted to 200 cc. is carefully neutralized with hydrochloric acid, an excess of 6 cc. of the strong acid is added, and the solution saturated with hydrogen sulphide, which precipitates the copper and cadmium, metals which would otherwise interfere. Without filtering, the standard solution is added from a burette, and from time to time a drop of the solution is removed on the glass stirring-rod and added to a drop or two of a strong solution of uranium nitrate, previously placed on a white porcelain plate. The appearance of a brown tint in one of 'these tests shows the end of the reaction. When cadmium is not present the copper may be precipitated by boiling the acidulated ammoniacal solution with test lead and titrating, as before described, without removing the lead and copper from the solution. The ferrocyanide solution is standardized by dissolving 1 gramme of pure zinc in 6 cc. of hydrochloric acid, adding ammonium chloride and titrating as before. This method is modi- fled in practice by the character of the ores, carbonates and silicates free from sulphides being decomposed by hydrochloric acid, with the addition of a little nitric acid.

*Copper.— The fire assay for copper ores was abandoned years ago and the electrolytic method took its place ; this in turn is now largely replaced by volumetric methods. In the electrolytic method from 0'5 to 5 grammes of ore are treated in a flask or beaker, with a mixture of 10 cc. of nitric and 10 cc. of sulphuric acid, until thoroughly decomposed. * When this liquid is cold it is diluted with cold water, heated until all the soluble salts are dissolved, transferred to a tall, narrow beaker, and diluted to about 150 cc. The electrodes are attached to a frame connected with the battery and the beaker is placed on a stool, which can be raised so that the electrodes are immersed in the liquid and reach the bottom of the beaker. The electrodes consist of two cylinders of platinum (placed one inside the other) about 75 mm. high, the smaller of the two 37 mm., and the larger 50 mm. in diameter, both pierced with 10 to 12 holes 5 mm. in diameter, evenly distributed over the surfaces to facilitate diffusion of the liquids.*

The surfaces of the cylinders are roughened with a sand blast to increase the areas and make the deposited metals adhere more firmly. Each cylinder has a platinum wire fused to the upper circumference to connect with a clamp from which a wire leads to the proper pole of the battery. The smaller cylinder is generally the negative electrode on which the copper is deposited. The framework carrying the clamps is ar- ranged so that a number of determinations may be made at one time, the wires from the clamps running from a rheostat, so arranged that currents of any strength may be used simultaneously. The cylinder, having been carefully weighed, is placed in position, the beaker containing the solution is adjusted, and the current passed until aU the copper is precipitated. This generally requires from two to twelve hours. The cylinders are then removed from the solution and washed with distilled water, the one holding the deposited copper being washed with alcohol, dried, and weighed ; the increase in weight represents the copper contents of the ore. The deposited copper should be firmly adherent and bright rosy red in colour. Silver, arsenic, and cadmium, if present, are precipi- tated with the copper and affect the accuracy of the results ; they should be removed by special methods.

Volumetric methods are more expeditious and require less appa- ratus. The pj)tassium cyanide method is based on the fact that, when potassium cyanide is added to an ammoniacal solution of a salt of copper, the insoluble copper cyanide is formed, the end – of the reaction being indicated by the disappearance of the blue colour of the solution. One gramme of the ore is treated in a flask with a mixture of nitric and sulphuric acids and evaporated until all the nitric acid is expelled. After cooling a little, water is added,

and then a few grammes of aluminum foil free from copper. On this foil the copper in the solution is all precipitated by electro- lytic action in a few minutes, and the aluminum is dissolved by the addition of an excess of sulphuric acid. Water is added, and as soon as the gangue and copper particles have settled the clear solution is decanted, and the residue

washed several times in the same way. The copper is then dissolved in 5 cc. of nitric acid ; if silver is present a drop or two of hydrochloric acid is added, the solution diluted to about 50 cc, and filtered. To the filtrate (or, if no silver is present, to the diluted nitric acid solution) 10 cc. of ammonia are added, and a standard solution of potassium cyanide is run in from a burette until the blue colour has nearly disappeared. The solution is filtered to get rid of the precipitate, and the titration is finished in the nearly clear filtrate, which should be always about 200 cc. in volume. The titration is com- plete when the blue colour is go faint that it is almost imperceptible after the flask has been vigorously shaken. The potassium cyanide solution is standardized by dissolving 0-5 gramme of pure copper in 5 cc. of nitric acid, diluting, adding 10 cc. of ammonia, and titrating exactly as described above.

When potassium iodide is added to a solution of cupric acetate, the reaction Cu(C2Hs02)2+2KI=CuI-f-2K(C2Hs02)+I takes place; that is, for each molecule of copper one molecule of iodine is liberated. If a solution of sodium hyposulphite is added to this solution, hydriodic acid and sodium tetrathionate are formed ; and if a little starch solution has been added, the end of the reaction is indicated by the disappearance of the blue colour, due to the iodide of starch. The amount of iodine liberated is therefore a measure of the copper in the solution, and when the sodium hyposulphite has been carefully standardized the method is extremely accurate. The ore is treated as described in the cyanide method until the copper precipitated by the aluminum foil has been washed and dissolved in 5 cc. of nitric acid ; then 0-25 gramme of potassium chlorate is added, and the solution boiled nearly dry to oxidize any arsenic present to arsenic acid. The solution is cooled, 50 cc. water added, then 5 cc. ammonia, and the solution is boiled for five minutes. Next 5 cc. of glacial acetic acid are added, the solution cooled, and 5 cc. of a solution of potassium iodide (300 grammes to the litre) and the standard solution of sodium hyposulphite run in from a burette until the brown colour has nearly disappeared. A few drops of starch solution are then added, and when the blue colour has nearly vanished a drop or two of methyl orange makes the end reaction very sharp. The hyposulphite solution is standard- ized by 'dissolving 0-3 to 0-5 gramme of pure copper in 3 cc. of nitric acid, adding 50 cc. of water and 5 cc. of ammonia, and titrating as above after

the addition of 5 cc. of glacial acetic acid and 5 cc. of the potassium iodide solution.

Iron. — The methods used in the assay for iron are volumetric, and are all based on the property possessed by certain reagents of oxidizing iron from the ferrous to the ferric state. Two salts are in common use for this purpose, potassium permanganate and potassium bichromate. It is necessary in the first place, after the ore is in solution, to reduce all the iron to the ferrous condition ; then the carefully standardized solution of the oxidizing reagent is added until all the iron is in the ferric state, the volume of the standard solution used, being the measure of the iron contained in the ore. The end of tlie reaction when potassium permanganate is employed is known by the change in colour of the solution. As the solution of potassium permanganate, which is deep red in colour, is dropped into the colourless iron solution, it is quickly decolour-ized, while the iron solution gradually assumes a yellowish tinge, the first drop of the permanganate solution in excess giving it a pink tint. With potassium bichromate solution, which is yellow, the iron solution becomes green from the chromium chloride or sulphate formed, and the end of the reaction is determined by re- moving a drop of the solution on the stirring-rod and adding it to a drop of a dilute solution of potassium ferrioyanide on a white tile. So long as the solution contains a ferrous salt, the drop on the tile changes to blue ; hence the absence of a blue coloration indicates the complete oxidation of all the ferrous salt and the end of the re- action. One gramme of ore is usually taken for assay and treated in a small flask or beaker with 10 cc. of hydrochloric acid. All the iron in the ore generally dissolves upon heating, and a white resi- due is left. Occasionally this residue contains a small amount of iron in a difficultly soluble form ; in that case the solution is slightly diluted with water and filtered into a larger flask. The residue in the filter is ignited and fused with a little sodium carbon- ate and nitrate, or with sodium peroxide. The product is treated with water, filtered, and the residue dissolved in hydrochloric acid and added to the main solution. This solution, which should not exceed 60 cc. or 75 cc. in volume, contains the iron in the ferric state and is ready for reduction.

.In the reduction by metallic zinc, about 3 grammes of granulated or foliated zinc are placed in the flask, which is closed with a small funnel ; when the iron is reduced, add 10 cc. of sulphuric acid, and as soon as all the zinc is dissolved the solution is ready for

titration. In the reduction by stannous chloride the solution of the ore in the flask is heated to boiling, and a strong solution of stan- nous chloride is added until the solution is completely decolourized; then 60 cc. of a solution of mercuric chloride (50 grammes to the litre) are run in and the contents of the flask poured into a dish containing 600 cc. of water and 60 cc. of a solution containing 200 grammes of manganous sulphate, 1 litre of phosphoric acid (1-3 sp. gr.), 400 cc. of sulphuric acid, and 1600 cc. of water. The solution is then ready for titration with the standard permanganate solution.

The permanganate or bichromate solution is standardized by dis- solving 0-6 of a gramme of pure iron wire in a flask in hydrochloric acid, oxidizing it with a little potassium chlorate, boiling off all traces of chlorine, deoxidizing by one of the methods described above, and titrating with the solution. As the wire always contains impurities, the absolute amount of iron in the wire must be determined and the correction made accordingly. Pure oxalic acid may also be used, which, in the presence of sulphuric acid, is oxi- dized by the standard solution according to the reaction : —

5 (H2C2O42H2O) + 3H2SO4 + K2Mn208 = lOCOj ~~I~~ 2MnS04

+K2SO4-I-I8H2O. The reaction in case of ferrous sulphate is : —

lOFeSOi + KaMnaOs + 8H2SO4 = 5Fe2 (SO4) s ~~f~~ KzSOi

-(~~2MnS04~~(-8H20;

that is, the same amount of potassium permanganate is required to oxidize 5 molecules of oxalic acid that is necessary to oxidize 10 molecules of iron in the f brm of ferrous sulphate to ferric sulphate, or 63 parts by weight of oxalic acid equal 56 parts by weight of metallic iron.

Ammonium ferrous sulphate may also be used j it contains one-seventh of its weight of iron. (k, a., b.)

Assche, a town of Belgium, in the province of Brabant, 8 miles N.W. by W. of Brussels, with a station on the line between Brussels and Termonde. It has breweries and soap-works. Population (communal)

(1890), 7063; (1897), 7524.

Assen, a town in the Netherlands, capital of the province of Drenthe, 16 miles S. of Groningen, on the railway Meppel-Groningen of the Netherlands State railways d>nd two canals. Peat-cutting is a considerable industry. In the neighbourhood are situated the mega- liths (Hunebedden) mentioned by Tacitus, and a large number of prehistoric remains have been discovered. The population in 1898 was 10,964.

Assiniboia. See North-West Territories.

Assinie. See Ivoet Coast.

Assisi, a town and bishop's see of the province of Perugia, Umbria, Italy, situated on the slope of Mt Subasio, 15 miles E. by S. from Perugia by rail, still sur- rounded by mediaeval walls, and celebrated as the birth-place of St Prancis, whose tomb, in the crypt (1818) of the church of the Franciscan monastery, attracts crowds of pilgrims every year. This church is a double structure, and consists of an upper church and a lower church, the latter begun in 1228, and botli finished in 1263. Both are adorned by frescoes and pictures by Giotto, Cimabue, and others. Down in the valley is the pilgrimage church of Santa Maria degli Angeli, begun by Vignola in 1569 over the oratory of St Francis, and finished about 1640 ; restored after the earthquake of 1832. It is decorated by works from the brush of the Delia Eohbias, Overbeck, and others. In the town there are, further, the cathedral, finished in 1140, and remodelled in the interior in 1672, with a marble statue of St Francis by Dupre and a Madonna and saints by Niccolo da Foligno; the new church, built in 1615 on the site of the house "in which St Francis was born; and the church of Santa Chiara (1257), containing the remains of St Clara, foundress of the order of the nuns of St Clare (1212). There are also an old castle and the

ruins of a Eoman amphitheatre. Assisi was also the birthplace of the poet Propertius (between 50 and 44 b.c). Population, about 7000 ; of commune, about 17,000.

Assiut, or Slut, th.e administrative capital of Upper Egypt, and the largest and best-built town in the Nile Valley south of Cairo, -with a population which rose from 32,000 in 1882 to 42,000 in 1900. It stands near the left bank of the Nile on the Nile Valley railway, of which it is an important station, 248 miles south of Cairo. Here is a large canal communicating during the floods with the Bahr Yusuf, which runs parallel with the Nile, and discharges its overflow into the Fayyum depression. The canal is now skirted by a magnificent embankment planted with shady trees leading from the river to the town. There are several bazaars, baths, and handsome mosques, one noted for its lofty minaret, and here the American mission has established a college for both sexes. Assiut is famous for its red and black pottery, which finds a ready market all over Egypt. In the neighbouring Libyan hills are numerous rock-tombs, where are often found the remains of wolf mummies, this animal having been the tutelar deity of the place, whence its Greek name of Lycopolis (" wolf - town ").

Assuan, or Aswan, a town of Upper Egypt on the right bank of the Nile, facing Elephantine Island below the First Cataract. It is a station on the Nile Valley railway, 590 miles from Cairo. In 1880, though the centre of a flourishing trade with the Sudan and Abyssinia — the annual value of the goods in transit was estimated at £2,000,000-=— its population was only about 4000. During the reign of the Khalifa it gained im- portance as the seat of the military government of the frontier provinces extending from Edfu-to Wadi Haifa, and numbered some 10,000 inhabitants. After the defeat of the Khalifa at Omdurman it became popular as a winter health-resort, and in 1901 had a population of about 25,000. The great barrage immediately above Aswan will place the agricultural prospects of the sur- rounding country on an entirely new and improved footing. In connexion with the work upon this undertaking and the reservoirs a town

of about 12,000 workmen has sprung into existence. Aswan gives its name to one of the three second-class administrative districts iiito which the Anglo-Egyptian Sudan was divided in 1899, and is the headquarters of the English military commandant.

Astara, a port on the Caspian, situated in 38° 27′ N. lat. and 48° 53′ E. long., on both sides of the river of the same name, which, according to the Turkmanchai treaty of 1828, is the frontier between Persia and Russia. Until the Mercury Steam Navigation Company made it a port of call, about 1860, it was an unimportant fishing village, but it has now a considerable trade, and much Russian merchandise is landed there and forwarded to AzerbaijSin and Tabriz via Ardebil, 30 miles south-west. In 1897, 77 vessels (76 steamers), with a tonnage of 43,101, entered the port, and 272 vessels (240 steamers), with a tonnage of 88,011, cleared it.

Asthma. See Pathology (Eespiratory Organs). ,

Asti, a town and episcopal see of the province of Alessandria, Piedmont, Italy, on the Tanaro, 22 miles W. from Alessandria by rail. Besides the cathedral, it has the interesting church of St Peter and the church of St John, both assigned to the Longobardic epoch (middle of 8th century, but remodelled in the 10th). There is a statue of Victor Emmanuel. Asti is famous for its wine. Population, about 19,000.

Astoria, a city of Oregon, U.S.A., and capital of Clatsop county, situated on the Columbia, near its mouth, in the north-western part of the state, and has an excel- lent harbour. It is connected with Portland by the Astoria and Columbia River railway and by steamboat lines. Its industries consist largely in salmon-canning and

in the manufacture of lumber, the surrounding country being densely forested with fir, cedar, and hemlock. It was founded in 1811, as a depot in the fur trade, by John Jacob Astor, after whom it is named. It was seized by the British in 1813, but restored in 1818. In 1821, while occupied by the North-West Fur Company, it was burned -and practically abandoned, leaving only a few settlers. Population (1880), 2803 ; (1890), 6184; (1900),

8381.

Astrakhan, a government of S.E. Russia, on the lower Volga. Area, 91,237 sq. miles, of which 6730 sq. miles are in the delta of the Volga and the brackish lagoons, and 62,290 sq. miles covered by the Kalmyk and the Kirghiz Steppes. The climate is very hot and dry, the average temperatures being for the year, 50° Fahr. ; for January, 21° ; for July, 78° ; yearly rainfall, 7-3; often no rain at all in summer. Population (1897), 1,002,316, of whom 485,517 were women, and 132,383 urban. About 132,000 Kalmyks and 260,000 Kirghiz are half nomad. There are besides nearly 44,000 Tatars, 7000 Armenians, 1350 Poles, and as many Jews. The average percentage of births is 6-7, and that of deaths 3-7. Primary educa- tion remains at a low level ; the total number of pupils in primary schools being only 12,337 (one school for every 2380 inhabitants). Fishing at the mouth of the Volga gives occupation to nearly 30,000 persons, as much as 278,000,000 herrings being caught in a good year. Salt is largely extracted. (300,000 tons) from lakes, chiefly at Baskunchak, which is now connected with the Volga by rail. Cattle breeding is an important industry ; in 1897 there were 1,075,600 horned cattle, 214,935 horses, and 3,521,000 sheep. Corn is imported, but gardening and the culture of mustard, melons, and fruit for export are on the increase. Agriculture is not much developed, there being (1899) only 1,007,300 acres under cereals, and the total cereal crop being on the average 149,600 tons. Forests cover only 430,000 acres. The Russian railways only touch the borders of the province. The government is divided into five^ districts, the chief towns of which are — Astrakhan, pop. 113,000; Enotaevsk, 2810 ; Krasnyi Yar, 4680 ; Tchornyi Yar, 5140 ; and Tsarev, 8900. Several villages are very populous, such as Niko- laevskaya Sloboda (17,800). The Kalmyk Steppe (pop. 127,776), and the Inner Kirghiz Horde (213,146), are under their own internal administration. So also is the territory of the Astrakhan Cossacks (pop. 26,600).

AsTBAKHAN, Capital of the above, on the left bank of the main branch of the Volga, and 60 miles from the Caspian Sea (68 feet below the level of the ocean) has, since the development of the naphtha industry and the opening of the Transcaspian railway, become a great centre for external

and internal trade, the yearly returns of which are estimated at 16,100,000 roubles for the former and 52,157,000 for the latter. The port is visited yearly by about 4000 vessels ; and 1242 vessels (90 steamers) belong to it. Population (1867), 47,839 ; (1897), 113,000. It is well provided with gymnasia for boys and girls and technical schools. Good public gardens and squares (one of which is adorned by a monument to Alexander II.) have been laid out.

Eight miles above Astrakhan, on the right hank of the Volga, are the ruins of two ancient cities, one above the other. In the upper layer, amidst all sorts of debris, charcoal, and bones, have been found gold and silver mints made by the Mongol Horde rulers, as well as various silver and gold ornaments. These ruins are sep- arated by a layer of earth from older and scantier ruins, supposed to be the remains of the large and prosperous city Atel, or Itil (Etel, Idl), of the Arabian geographers (Ibn Pozlan, Ibn Hankal, etc.), which was the residence of the Khan of the Khozars, and was de- stroyed by the Eusses in 969. The upper layer of ruins may rep- resent the old city of Balanjar (Balansar, Belender).

(p. A. K.)

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ASTROIN^OMY.

PAET I. of the. article on Astkonomt in the ninth edition of this Encyclqpsedia treats of the history of the science, and needs no supplement. In the first six chapters, of Part II. are developed those general principles and methods which form the basis of the science and are not subject to material revision. Our present purpose is to supplement the chapters from VII. onwards. We shall first treat the recent developments relating to the solar system, and afterwards briefly describe the progress of knowledge in regard to the fixed stars. In arranging the first subject we shall set forth the general results of tele- scopic and spectroscopic observations of the planets, in advance of results derived from the mathematical inves- tigation of their motions. The subject thus divides itself into three sections : —

I. The physical and other general features of the solar system.

II. G-ravitational and theoretical astronomy.

III. The recent development of our knowledge of the fixed stars.

I. Physical Fbatukes op the Solab System.

The development of this subject since 1880 is prin- cipally due to the increased power of our instruments and the more extended use of the spectroscope. Sixty

years ago the spectroscope was unknown, and Improve- ^jr^Q telescopes most used were from 4 to 9 inches telescopes. ™^ aperture. About 1840, the successors of

Fraunhofer made two telescopes of 14 inches' aperture for the observatories of Pulkowa and Harvard University. The extreme limit of size was then thought to be attained, but by 1880 the aperture was carried up to 26 inches, and now.it is 40 inches. The great Yerkes telescope of the university of Chicago gives about seven times the light of the Harvard and Pulkowa instruments. It might be thought that this enormous increase of power would have resulted in the final settlement of all. questions, formerly the subject of debate, as to the physical phenomena presented by the placets. But such is far from being the case, and the vast mass of observations that have been accumu- lated has thrown less light than might have been expected on the question of the rotation or physical constitution of these bodies, though, at the same timp, critical examination may show that the results to be derived are not so discordant or doubtful as might appear from the seeming divergence of the observations themselves. The observers who, since 1880, have made careful studies upon the appearance of the planets in the telescope, are so numerous that only a few of the best known can be mentioned. The systematic work of the British Astronomical Association, which has organized sections for the special study of particular objects, offers a good example of the energy with which a large and popular body may pursue scientific investigation. This body does not; however, command the instruments or enjoy the atmospheric conditions necessary to settle the

most difficult questions. Among the individual observers Schiaparelli may be assigned the first place, in view of his long-continued studies of the planets under a fine Italian sky, the conscientious minuteness of his examinations, and his eminence as an investigator. In what concerns the means and opportunities of observation, Barnard at the Lick Observatory enjoyed advantages offered to no other observer. The observatory at Flagstaff, Arizona, was founded by MrPercival Lowell, of Boston, for the special

purpose of studying the physical phenomena presented by the planets, particularly Mars, and its situation is believed to be one of the best as regards atmospheric conditions.

*Taking up the planets in order, we begin with Mercury. Only on rare occasions have observers succeeded in discern- ing any well-defined features on the disc of this planet. Up to 1890 the period of its rotation *”””• was generally said to be nearly twenty-four hours, a state- ment which rested mainly on observations made by Schroeter, the indefatigable observer of Lilienthal, about the beginning of the century. Cautious and conservative astronomers have been more and more sceptical as to the correctness of this period, on account of the failure of observers with better instruments than Schroeter’s to see permanent markings that could be followed from day to day. In 1882 Schiaparelli began a careful study of the face of the planet, with a refractor of 8 inches’ aperture, subsequently replaced by one of 18 inches’. His unexpected conclusion was that the rotation of Mercury resembles that of the moon, in having its period equal to that of the orbital revolution. As the moon always pre- sents the same face to the earth, so Mercury always pre- sents very nearly the same face to the sun. Schiaparelli also announced that the axis of rotation of the planet is very nearly perpendicular to the plane of its orbit. The rotation being uniform, while the orbital motion, owing to the great eccentricity of the orbit, is affected by a very large inequality, it follows that there is a libration in longitude of nearly 24° on each side of the mean position. Mr Lowell, iu 1897, took up the question anew by combining a long series of measured diameters of the planet with drawings of its apparent surface made from time to time. The latter showed long narrow markings similar in their general character to the sup- posed channels seen by Schiaparelli*

*upon Mars, and the constancy of these markings was considered to confirm the view of Schiaparelli as' to the slow rotation of the planet. The diameter was found to be 0*8" greater than the value which had before been generally accepted. The most curious result of Mr Lowell's work was that the body of the planet is possibly somewhat ellipsoidal, the longer axis being directed toward the sun. This, how- ever, cannot be regarded as established. It is worthy of remark that the larger diameter and the ellipsoidal form may be connected with a curious discrepancy found in discussing the meridian observations of the planet. This consists in the fact that in the general average, when the planet is east of the sun the right ascension derived from observations seems to be too small, and when west of the sun too great. In either case, it is impossible to observe the real centre of the planet, because the latter always shows a phase like that of the moon, being sometimes a crescent, sometimes a semicircle, and sometimes gibbous, according , to the position in the orbit. The observers sometimes directed their view upon the bright limb which, of course, was always towards the sun, and sometimes upon the apparent centre of the illuminated surface ; hence reduction from the point observed to the centre of the planet was necessary to derive the position of the centre supposed to be given by the observations. This reduction was necessarily a fraction of the assumed diameter of the planet, which had to be determined from other sources. The discrepancy shows that the reduction actually applied was, in the general average, too small by a considerable fraction of a second, but it is impossible to say with certainty whether this arose from a personal equation of*

the observers, due to the fact that the limb of the planet nearest the sun was so much brighter than the rest of the disc that the observers of the apparent centre set very nearly on the limb, or from the assumed diameter ' being too small, as supposed by Mr Lowell.

Schiaparelli made his well-known studies upon Venus contemporaneously with those upon Mercury, and his Venus conclusions were summed up in iive brief notes

read to the Milan Academy during the year 1890. The first four of these are devoted to a very full and exhaustive history of all existing telescopic observer tions'upon the supposed spots of the planet from the time of Bianchini (1728), the result being that no positive conclusions can be drawn from any of the observations, either as to permanent markings on the planet or its time of rotation. Herschel had devoted special attention to the subject, and, as is well known, could find no evidence of any well-defined period of rotation. The first definite clue to a conclusion which Schiaparelli could obtain, was suggested by the long continuance of two faint spots near the southern cusp of the planet. It is true that these spots were not always visible ; yet, under the best conditions, they could be seen at some hour every day for weeks at a time, and sometimes during several hours on the same day. He agreed with Herschel and others of ' ' the best astronomers in concluding that these spots were not really permanent, but disappeared at the end of a few weeks at most. At the same time the faint temporary spots which he succeeded in discerning remained immov- able for several hours in succession, thus precluding the idea of previous observers that the planet rotated in a period not very difEerent from twenty-four hours. More- over, their continued observation for several weeks seemed to show that their rotation must be very slow, and their period several months, perhaps equal to that of the re- volution of the planet round the sun. Lowell reached a similar but more definite conclusion, maintaining that the planet really did always present the same face to the sun. But in the opinion of the most conservative astrono- mers, the whole subject of the rotation, both of Mercury and Venus, is still in doubt. The supposed spots are so indefinite, that it is not safe to rest a positive conclusion on them. The most recent and most definite result is that of Belopolsky at Pulkowa, who determined by the spectro- graphic method the difference of the velocities with which various points of the circumference of the disc of Venus were moving to or from us. The mean of a great number of measures gave a velocity of rotation of 0-9 km. per second, corresponding to a period of twelve hours. So short a period seems incompatible with the absence of sensible ellipticity in the figure of the planet, yet the observa- tions greatly weaken Schiaparelli's conclusion (Ast. Nach. No. 3641).

Conejusive evidence that Venus is surrounded by a transparent, or at least a translucent atmosphere, was gathered at the transit of Venus in 1882, and scarcely less conclusive was the evidence that this atmosphere bears a great volume of clouds, which probably would completely obscure the surface of the planet. After one- half of the dark body of the planet had entered upon the disc of the sun, that portion of its outline without the sun became visible as a thin line of light extending around its border. This line can be attributed to no other cause than the refraction of the sun's rays produced by an atmosphere surrounding the planet. Had this atmosphere been quite transparent, we should have expected the line of light to make its first appearance at the most distant point A (see Fig. 1) of the circumfer- ence of the planet, owing to the fact that before the planet had half entered, the only rays that could be refracted to us would necessarily pass near this region.

From this point. A, the line of light should have extended in both directions, until, after more than half the planet was on the solar disc, it would have been seen complete. Instead of this the light first showed itself along a small arc at the point B. A few minutes later, small portions of it began to glimmer here and there around other parts

Fig. 1.

of the dark circumference, but it was not until the planet was almost entirely on the disc that the arc of light became plainly continuous. It is difficult to attribute this phenomenon to any other cause than clouds floating in the lower region of the atmosphere, and possibly an irregularly translucent condition of the latter rather than entire transparency.

Thfere is a class of telescopic observations which, at first sight, seem incompatible with those made about the time of a transit, At intervals of eight years before and after a transit, Venus passes very near the sun. On such an occasion, in 1866, Lyman, at New Haven, saw the entire outline of the planet as an exceedingly fine ring of light, and on l^t and 5th December 1890 Barnard saw the entire outline except about 20°.' An atmosphere refracting rays so strongly that the illumination of the. entire planet would be visible under such circumstances, ought to show a bright arc of light on the side farthest from the sun, whereas, in fact, this was

always the darkest portion of the outline. A very elaborate dis- cussion of all the observations of this class has been made by H. N. Russell {Astrophysical Journal, ix. 284), who proposes the explanation that the visible outline which we see is not the illuminated surface of the planet but the upper illuminated region of the atmosphere, bearing suspended particles of dust or fog. He also concludes that the atmosphere of Venus is decidedly rarer than that of the earth. This seems the best explanation of the seeming paradox that has yet been offered.

The earlier telescopic observers had no difficulty in discerning bright and obscure regions on the surface of Mars, and in concluding from the varying ^^^^ aspects of these regions that it rotated on its axis in a period of a little more than twenty-four hours. The only important a(|ditions to our knowledge of the surface between the time of Herschel and Schroeter, and the opposition of 1877, were embodied' in maps of the planet, which agreed in the main features, but differed greatly in details. At the opposition of 1877, the planet was unusually near the earth; and although its south declination was not favourable to observations in the northern hemisphere, Schiaparelli instituted a series of studies which, continued through several subsequent oppositions, have given rise to a large mass of literature on the subject. Observers had long seen, or fancied they could see, a remarkable resemblance between the surface of Mars and that of the earth. The brighter regions were supposed to be continents ; the darker ones oceans. Schiaparelli's great discovery was that these supposed oceans were connected by comparatively narrow streaks, to which he applied the term channels (canale), a word which, through an unfortunate misconception, has been translated into English as " canal," thus giving rise to

the impression that the features in question were the work of the inhabitants of Mars. The studies of these features by other observers have been so numerous that it is impossible even to summarize them. Some

have failed to see the channels at all, but the most successful in seeing and drawing them have been the observers at the Lowell Observatory. A careful comparison of the maps of Schiaparelli with each other, and with that of Lowell, shows that there is by no means a complete agreement as to these features. Schiaparelli depicts them as rather obscure and more or less diffused bands or streaks of appreciable breadth, whereas in Lowell's drawings they appear as sharp, fine, dark lines. The channels seen by Lowell are much more numerous than those seen by Schiaparelli, but at , the same time we cannot identify all of Schiaparelli's channels on Lowell's map. An additional characteristic of the latter is that the numerous junction points of the channels are fre- quently marked by round, dark spots, like circular lakes, which do not appear on Schiaparelli's map. The current interpretation of these features has been contested by Barnard, who seems to have seen the planet under much more favourable conditions than either of the two other observers. He had the advantage of the great aperture of the Lick telescope, and the very fine seeing now and then obtained at Mount Hamilton. In exceptionally favour- able circumstances he could see markings so minute, intricate, and abundant that it was impossible to delineate them. They were even more numerous on the so-called seas than on the broad continental regions. They were usually more or less irregular, consisting in delicate differences of shade. No straight and sharp lines were seen. Between the black spots which abounded in a certain region were seen diffuse hazy lines, rather irregu- larly formed {Monthly Notices B. A. S. vol. Ivi. 1896, p. 166). These discrepancies between the two observers are all the more noteworthy, in view of the skill of each, Schiaparelli being known for his conscientious care in avoiding every sort of illusion, and training his eye to see only what is existent, while Barnard is equally conscien- tious, and had at his disposition telescopic power far exceeding that of Schiaparelli.*

The apparent discrepancy can, we believe, be reconciled by some considerations on the psychology of vision. If we observe a stippled engraving of such an object as the human face from a certain distance, we see nothing but continuous light and shade. If we seek to draw what we see, we may form the best representation by lines repre- senting the outlines of the human features. But if, instead of studying the engraving at a distance, we look at it through a magnifying glass, we see no lines

whatever but only collections of points, perhaps without any well- defined arrangement, thicker in some regions than in others, and of various sizes. We thus learn that the eye possesses a property of representing collections and rows of points to the visual sense as continuous lines of light and shade. From this point of view it is quite natural that such features as those described by Barnard should, when seen with less sharpness, present to the eye the appearance shown on the maps of Schiaparelli. The discrepancy between the outlines, as drawn not only by the two observers, but by the same observer at various times, shows that there is something shadowy and in- definite, we may even say doubtful, in the objects depicted. Some of the channels are unmistakable. Of others the difference of shading is so slight that visual distinctness is scarcely possible, and none of them, perhaps, can be con- sidered as anything but the result of a combination of complex features too minute to be separately visible. In this connexion a short paper by Cerulli in the Astronom.

sphere of Mars.

Nach. (Bd. 146, S. 155) may be read with interest. This observer found that after having observed the channels of Mars for two years through a telescope, he was able, by looking at the moon through an opera-glass, to see similar lines upon its surface, but these seeming lines were shown by observations with the telescope to be unreal, being only the result of the unconscious action of the eye in joining together slight and irregular combina- tions of light and shade in such a way as to produce regular forms. As this action was the result of a long habit, the fact shows the possibility that long practice in' observing may result in an observer seeing objects in- correctly. Could we see Mars with an optical instrument bearing the same ratio to a common telescope that the latter does to an opera^glass, the result might be the same for Mars that Cerulli found for the moon. The doubling of the channels noticed from time to time by some observers must also be placed in the category of doubtful phenomena or probable illusions, and there is on this point an absence of agreement among the observers which must throw doubt on their conclusions. On Schiaparelli's map and in Lowell's drawing the double channels are simply parallel ones of equal strength, so far apart that they are distinctly separate objects, though others find the supposed duplicity

very difi&cult to make out. It is con- ceivable that an observer, under unfavourable conditions, might find these pairs of markings hard to separate ; but, were such the case, they would be seen as a very broad band and not as the narrow streaks commonly depicted.

The well-known fact that the j)olar regions of Mars are covered with a white deposit during the Martian winter, of which the greater part melts away in the course of the Martian summer, has given rise to ^^°, the belief that the planet has an atmosphere and oceans like our, own. Apparent changes in the visibility of .different spots at different times seem to confirm this view, by suggesting that portions of the planet are from time to time rendered invisible by clouds. But the telescopic observations of Lowell, and those made with a spectroscope by Campbell, both tend to weaken this view; Lowell, from his own observations, reached the conclusion that the atmosphere must be much rarer than that of the earth and comparatively cloudless, and Campbell, by comparing the spectra of Mars and the moon, could not certainly discern any well-marked differ- ence between them. It is known that the moon has no atmosphere sufiicient to produce an absorption spectrum. Hence Campbell's observations show that if the same thing is not absolutely true of Mars, it must be approxi- mately so, in that no spectral lines are strengthened by the atmosphere to an obvious extent. Just how dense an atmosphere ■ could exist without having any appreciable effect on the lines, especially how much aqueous vapour it might contain, we cannot state with precision, but we seem justified in concluding that the Martian atmosphere is much rarer and much more free from aqueous vapour than that of the earth. The problem of reconciling the supposed winter snow deposits with the great rarity of the atmosphere presents no difficulty. But there is real dif&culty in supposing that the summer temperature can be so high as to melt any considerable thickness of snow or ice. The most probable explanation of this pheno menon seems to be that the polar caps are in the nature of hoar frost deposited during the extreme cold that must prevail in a region completely cut off from the rays of the sun, and not warmed as our polar regions are by air currents from the warmer equatorial regions. Ice slowly evaporates at a temperature below the melting-point. It is not, therefore, necessary to suppose that the sun's rays warm the polar regions of Mars even up to the melting-*

point of water, in order to explain tlie evaporation of a thin deposit of frost during the Martian summer.

Our general conclusions as to the physical condition of the surface of Mars may be summed up as follows : (1) The dark regions on the planet are not oceans, as was formerly supposed, the more probable hypothesis being that the dark colour is simply that of the solid surface of the planet. The amount of heat received from the sun on each unit of surface is less than half that received by the earth, and it is commonly supposed that the surface of our globe is, in the general average, warmer than it would be if our atmosphere were less dense or less rich in aqueous vapour. It is therefore very unlikely that the surface of Mars can be warm enough to allow of the presence of large bpdies of water in the liquid state. (2) The so-called canals or channels are probably not the definite features that appear on the drawings, but rather the result of slight suggestions made to the eye by more or less irregular differences in the minute shadings and colour tints on the surface of the planet.

Probably no astronomical discovery since that of Nep- tune has so surprised the astronomical world as the announcement, made in August 1877, that Pro- fessor Asaph Hall had discovered two satellites of Mars. The most remarkable feature of these bodies is their minuteness, their estimated diameter being only 8 or 10 miles, and they are the smallest known bodies in our system, except possibly a few of the more recently discovered minor planets. Among satellites the inner' one is unique, in that its time of revolution round the planet is less than the Martian day, being in fact less than nine hours. The result is that to an ob- server on the planet it would rise in the west and set in the east. They are, of course, difiBcuIt objects to observe, especially at those oppositions when the planet is farthest from the sun ; but at the favourable oppositions, when Mars is near its perihelion, they may easily be seen with a telescope of 12 inches' aperture or upwards, if the observer takes the precaution to cut

off the light of Mars from his field of vision. Particulars relating to the elements and motions of these bodies are given on pages 744-5.

The number of known members of the group of minor planets now approaches 600, and is increasing so rapidly that no trustworthy estimate of its total can yet be made. The mean opposition magnitude of those most recently discovered generally lies between the 11th and 13th, and sometimes is of the 14th or 16th. New discoveries are now made entirely by photography. A sensitized plate is exposed in the focus of an equatorial photographic telescope, moved by clockwork so as to follow the stars in their diurnal motion, and on this when developed the stars appear as minute dark dots. But if the image of a planet is imprinted on the plate, it will appear as a short line, owing to the combined effect of its orbital motion and that of the earth. The ease with which such a plate can be examined under a microscope, renders this method much simpler and more expeditious than the old one of searching for the planet visually. One of the bodies recently added to the list is, in the character of its brbit, quite unique. The orbits of all the minor planets known up to 1898 were situated between those of Mars and Jupiter, but in August of that year, Witt, of Berlin, found a planet which at perihelion comes considerably within the orbit of Mars. The name of Eros has been assigned to it. A remarkable feature is that the two orbits, those of Eros and of Mars, arednter- linked in such a way that if both were material they would pass through each other like two links in a chain ; but the inclination of the orbits and the large eccentricity of Eros are such that, at present, there is no very near approach of the two orbits, though this could not always

Minor planets.

have been the case in the past, nor will it be the case in the future. One result of the secular variations must be that the two orbits will, at some period, actually intersect, and near this time Mars and Eros will approach so close to one another that the orbit of the latter may be com- pletely changed. Not unlikely this was the case at some unknown epoch in the past, previous to which the orbit of Eros may have been very different from what it is now. Approximate elements of this body referred to the equinox of 1900 are these : —

Epoch, 1898, August 31, 5 G.M.T.

Mean long, at epoch

. 342° 48′

„ anom. „

. 221° 37′

Long, of perihelion

. 121° 11′

„ node

. 303° 31′

Inclination .

10° 50′

Angle of eccentricity

12° 52′

Daily mean motion

. 2015-2826″

Log. mean distance

. 0-163798″

Eccentricity .

. 0-22276″

*From the mean distance and eccentricity it follows that the least distance * of thh planet from the sun is 1-1333 ; the greatest, 1-7829. At the*

descending node on the ecliptic its distance from the earth's orbit is only 0-149, a distance much less than that of any other ki^wn planet. The earth passes this point about 24th January of each year ; but it is only on rare occasions that the planet will be very near the corresponding part of its orbit at this date. A tantalizing fact for the astronomer is that such a passage occurred about 24th January 1894, before the planet was recognized, and that so near an approach will not occur. again until 1975. Oppositions not much less favourable than that of 1894 will occur in 1931 and 1938. The epochs of these nearest approaches can be utilized for more exact measures of the solar parallax than have yet been made. Seven years before and after each most favourable opposition another occurs at which, though less favourable, the planet comes so near as to offer an excellent opportunity for the measures in question.

A study of the distribution of the mean motions of these bodies shows a singular feature, apparently connected with their origin, on which it may throw some light. About 1870 it was noticed by Kirkwood that when these mean motions DIstrlba- are arranged in the order of their magnitude, gaps are "

found in the series corresponding to the points of com- anions. mensurability with the mean motion of Jupiter; that is to say, the period of Jupiter being in round numbers twelve

Distribution of 400 Minor Planets into Groups, according to Mean Motions and Mean Distances.

Limits of Mean

Limits of Mean

Breadth

No. of

Commens.

with

Jupiter.

Motion-.

Distance.

of Zone.

Planets.

Exceed 1000

Below 2-33

31

910 to 1000

2-33 to 2-48

•15

64

870 „ 910

2-48 „ 2-55

-07

6

3:1

790 „ 870

2-55 „ 2-72

-17

79

760 „ 790

2-72 „ 2-79

-07

65

750 „ 760

2-79 „ 2-82

-03

9

740 „ 750

2-82 „ 2-84

•02

1

5:2

710 „ 740

2-84 „ 2-92

-08

29

690 „ 710

2-92 „ 2-98

•06

5

7:3

610 „ 690

2-98 „ 3-24

-26

96

580 „ 610

3-24 „ 3-34

•10

0

2:1

540 „ 580

3-34 „ 3-52

•18

10

460 „ 540

3-52 „ 3-88

•36

0

5:3

400 „ 460

3-88 „ 4-28

•40

5

years, there are few or none of these bodies which have periods of one-half, one-third,- or two-fifths of twelve years. If therp were any of the group having any of these periods, it is known that the

1 Distances among the planets are expressed in radii of the earth's orbit.

perturbations produced by Jupiter would be greatly exaggerated in the course of centuries. It was therefore supposed that if there ever had been planets with these mean motions, their orbits would have been unstable and subjected to large and unknown changes. This conclusion, however, is misleading. The result in question follows when the integration of the equations of motion of the planet is only approximate, but a rigorous integration shows that commensurability of the kind in question does not lead to any instability. When Kirkwood made his investigation, only about 100 of these bodies were known, but a study of the 400 members of the group whose mean motions are fairly well determined shows the matter in another and more striking light. In the preceding table is shown the distribution of those members in zones of mean motion and mean distance.

A study of this table shows that what we see in the group are not gaps in an otherwise uniform series, but a tendency to cluster into zones, which are condensed near the middle of the regions between the lines of commensurability and thin out gradually towards those Unes. JFor the

*most part there is no absolute dividing line between the zones, the number being merely less ■ near the line of commensurability. This, however, is not the case with the two outer zones. In the region 3‘24 to 3-34 no planets are yet known, while in the next zone, 0‘18 in breadth, there are ten. Then follows a zone 0-36 in breadth, without any, outside of which there are five. That there is a causal connexion between this system of grouping and the lines of commensurability with Jupiter can scarcely be doubted, but, as already remarked, we cannot attribute the paucity of planets approaching to com.- mensurability to any want of stabUity in their motion. One cannot but suspect that the phenomenon has a cosmogonical origin, and a*ose from the formation of zones of different degrees of density in the original revolving nebulous mass from which these bodies were formed.*

The laws of secular variation of elements show that there is a certain mean plane around which the nodes of these bodies tend to be uniformly scattered, amd a certain mean longitude towards which the perihelia tend {Astronom. Nach. Iviii. S. 210). The position of the mean plane is: longitude of node, 91°; inclina- tion to elliptic, 1° 3’. The eccentricity and perihelion of the mean orbit are : eccentricity, 0‘0321 ; longitude of perihelion, 3°. This last result does not imply that we have here the mean of all the eccentricities, but that the mean value of the esinir and ecosTr for all the orbits will be very near the products of the eccentricity just given into the sine and cosine of 3°. The result may be otherwise expressed by saying that the action of each planet tends to bring the mean plane of the orbits of the small planets into its own plane, and to elongate the orbits in the direction of its own aphelion. As Jupiter exerts the most powerful action on the minor planets, a tendency thus arises among the latter to coin- cidence of their nodes and perihelia with the node and peri- helion of Jupiter.

The most notable addition to our recent knowledge of the Jovian system consists in the discovery of a minute additional satellite by Barnard in September fyJtem. 1^^2, with the 36-inch telescope of the Lick Observatory. It is much nearer the planet than the four previously known, and the only designation which it has thus far received is that of ” fifth satellite,” the order of distances of the satellites thus being the fifth, first,

second, &c. As regards visibility it is one of the most difficult objects — perhaps the most difficult — in the solar system, and has been seen only with a few of the largest telescopes. Its mean synodic period of revolution is 11 h. 51 m. 27‘635 s. It has been assiduously observed by its original discoverer, who finds ai quite appreciable eccwitricity in its orbit. Trom his observations, com- bined with a consideration of the theoretical effect of the ellipticity of Jupiter, its pericentre is found to revolve with a more rapid motion than that of any other known celestial body, making more than an entire revolution in a year. The four satellites formerly known have been found by Barnard and W. H. Picker- ing to exhibit singular anomalies of apparent form while in transit across the disc of Jupiter. The first sometimes appeared double on such occasions, although no such form had been seen at other times, and it became a question whether it could really consist of two bodies. After a careful study of the subject, Barnard reached the conclusion tifiat the appear-

ance was due to a bright band around the equatorial region of the satellite, while the poles were of a darker tint, the varied shading of the belts of Jupiter on whicli it was seen projected during the transit resulting sometimes in only the polar regions being visible. Anomalies of form noticed in the other satellites have not been eon- firmed by the observations of Barnard {Monthly Notices i2. A -S. liv. 1894, p. 134).

The ease with which the complex cloud-forms on Jupiter can be observed has led to a careful study of its surface by many observers. The British Astronomical Association has a special section devoted to this study. Although a great mass of observations has thus been collected, illustrative of the changes continually going on at the surface of the planet, it cannot be said that any radically new views respecting its constitution have been gained, nor that the observations have yet led to any researches • that would throw much additional light on the subject. The most noteworthy phenomenon of ,late years has been the garnet spot which appeared in middle southern latitude in 1878. For ten years no great changes were noticed in it ; then it gradually began to fade away. About 1892 it brightened up again, then again began to fade, and has been seen only occasionally and with difficulty since 1897. The most careful investi- gation of its motion has been made by Lohse, whose work embraced the

entire period of visibility from 1878 to 1897. His most remarkable conclusion is that the period of revolution of the spot has been undergoing a fairly continuous change. Tor several years beforehand after 1891, it was 9 h. 55 m. 41 s. But if with this motion its position is computed back during previous years, it will be found to have wandered over more than two-thirds the circumference of the parallel on which it is situated. This result emphasizes the fact already known, that if Jupiter has any solid nucleus it is invisible to us ; for had the spot in question been connected with such a nucleus, had it even been in the nature of an eruption from a volcano, its period of revolution would necessarily have been uniform. Granting — as seems to be unavoidable , — that the visible surface of the planet is either liquid or gaseous, the persistence of the spot through twenty years is remarkable. The most plausible hypothesis is that it is in the nature of an island fioating upon a liquid surface, but it does not seem at all probable that any formation floating in an atmosphere could have lasted through such an interval. Still, it is an open question whether the so- called belts of Jupiter indicate a liquid or gaseous condition of the visible suTface. The great difficulty in the way of the liquid hypothesis is the very great difference in the times of rotation of the equatorial portions of the planet and the spots in middle latitudes. It; is now found that while the latter, like the red spot, rotate in 9 h. 55 m. and a somewhat variable number of seconds, the equatorial markings make a revolution in about five minutes less time, or 9 h. 60 m. plus a varying number of seconds. In this respect Jupiter resembles the sun, whose rotation follows the same law. In the case of the planet, however, it is very remarkable that no intermediate times of rotation seem to have been well made out. Whether this arises from the fact .that observers' have not devoted to this subject the attention which it deserves, or whether the line between the two times of rotations is a narrow one, is a question which cannot yet be decisively answered. The important point is that the difference between the two times corresponds to a difference of about 7-5° in the motion round the planet during a terrestrial day. This corresponds to a linear motion on the surface of the planet of more than 30,000 miles per day, a motion which it seems difficult to reconcile with liquidity of the visible surface.

ASTRONOMY

The view expressed in the ninth edition of this work, that Jupiter shines partly by its own light, has not been confirmed by later researches. The complete disappearance of the satellites, even in the most powerful telescopes, while in the shadow of Jupiter, shows that they cannot receive sufficient light from that planet to be visible, and the uniform darkness of the shadow of the satellite when seen on the planet, shows that the latter cannot be self-luminous. It is also to be remarked that, were it only moderately self-luminous, the colour of the light which it sends to us would be red, such light being that first emitted from a heated body when its temperature is raised. While it is quite possible that a small quantity of such light may reach us from the planet, no facts to prove it have yet been adduced.

In April 1898, the probable discovery of a nintli satellite of Saturn by W. H. Pickering was announced from the Harvard College Observatory. The syitem!" new object was detected by means of four photographs of the region in the immediate neighbourhood of Saturn, taken on 16th, 17th, and 18th August 1898. A minute star was found on each of the plates, occupying a position' which was vacant on the other plates. The object was of the fifteenth magnitude, and therefore so faint as to be invisible to the eye by any but the most powerful telescopes. " Its position relative to Saturn could not be readily determined, because the long exposure necessary to bring out so faint an object resulted in the image of Saturn being completely " burned " out on the plates ; in fact, the planet andrings appeared only as a large, dark, faintly-defined blotch of light, several times larger than the planet itself. As- suming that the object in question was a satellite of Saturn, it must be at some distance outside of all the other satellites, and its time of revolution must be several months. As the object does not seem to have been cer- tainly detected at the following opposition, some doubt may yet exist as to its nature. The planet is now in a region rich in stars, and as so faint an object is easily lost among the hundreds which surround it, its detection is difi&cult.

The visible surface of Saturn bears a certain resem- blance to that of Jupiter, but the markings are so much fainter that it is difficult, if not

impossible, to locate and identify them vrith precision. There have been two notable exceptions to this rule. Sir William Herschel once saw a spot which lasted several weeks and enabled him to fix the time of rotation of the planet on its axis at 10 h. 16 m. The second case occurred in 1876. On 7th December of that year a bright white spot suddenly ap- peared in the equatorial region. It continued more than a month, gradually extending its dimensions in an east and west direction, so as to assume the form of a long streak, and at the same time growing fainter. From ob- servations of the brighter portion. Professor A. Hall fixed the time of rotation at 10 h. 14 m. The question whether any markings ordinarily exist on the planet strong enough to be certainly located is an open one among the best observers. Cautious students of the subject will probably give most weight to the negative side. (See Monthly Notices R. A. S., for observations and discussions, by WUliams and Barnard.)

The most noteworthy addition to our knowledge of the rings of Saturn has been made by Keeler. That these ap- pendages cannot be rings of continuous matter, ^^^™' either solid or liquid, has long been well estab- lished by theory, which shovired that the equilibrium of such an object would necessarily be unstable. The alternative hypothesis that the rings are a cloud of minute satellites, or perhaps mere particles, too small to be individually visible, but so numerous as to . look in our telescope like a continuous mass, was exhaust- ively investigated by J. Clerk Maxwell in his Adams prize essay published about 1860 ; but no direct evidence bearing on the question was obtainable until the spectro-*

scope was brought into requisition. By the aid of this instrument in its present refined form, the motion of a body to or from the earth can be made evident' by the change produced by the motion in the wave length of the spectral rays. The method is equally applicable whether the body is self-luminous or shines by the reflected light of the sun. By photographing the spectrum of Saturn and its rings when the image was thrown upon the narrow slit of a spectrograph, Keeler found that the lines across the spectrum were bent and broken in such a way as to show that the inner part of the rings revolved with greater velocity than the outer part, the motion of each part being that which would correspond to the motion of a satellite revolving at the same distance. The extreme thinness

of the rings was demonstrated in a more striking manner than ever before by Barnard and others in 1892, during one of those rare times at which the plane of the ring passes between the earth and the sun. In such a case the sun shines on one surface of the ring, while only the opposite surface is turned towards us. Considering it as a cloud of satellites, each of the latter should in such a case be fully illuminated by the sun, except so far as it might be in the shadow of those outside of it. The outer satellites of all would necessarily be fully illuminated and also be visible to us if we had sufficient telescopic power, because there would be nothing to hide their light. Now, it is a singular fact that, in these circumstances, the ring was completely invisible, even with the 36-inch telescope of the Lick Observatory. This shows £hat the entire ring must be so thin that its edge is completely invisible, even in the full light of the sun, at the distance which separates us from the planet. On the other hand, the objects composing it must be completely opaque, as is shown not only by their disappearance in the circum- stances we have mentioned, but by the darkness of the shadow which they cast upon the planet when the sun illuminates them obliquely. The cloud of satellites is so dense that a ray of light cannot penetrate the mass.

An interesting question still open is the nature of the so-called divisions of the rings. Are these divisions real or are they simply apparent, arising from a darker colour in the matter which composes them ? In the case of the sharpest and best-known division, to which the name of Cassini has been given from its first observer, there would seem to be little doubt that the division i^ real. But there is some doubt in the case of the other divi- sions. It is now well established that the dusky or crape ■ ring, which is on the inside of the brighter one, is really in the nature of an inner border of the bright ring, the one shading off imperceptibly into the other. While many excellent observers have sometimes thought they saw a complete separation between the bright aiid the crape rings, no such phenomenon has been seen in the great telescopes of our times, and it is almost certain that the dark colour of the crape ring arises merely from its tenuity and transparency. From Barnard's observation of the passage of Japetus through the shadow of Saturn and its rings it appears that the transparency gradually diminishes from the centre of this ring to its line of junction with the bright ring. If there should ever be a transit of Saturn

centrally past a bright star, many questions as to the constitution of the rings might be settled by noting the times at which the star was seen through the divisions of the ring.

The great distance of Uranus and Neptune, and the faintness of their illumination by the sun, have as yet prevented our reaching any well-defined views ij„„]a„ as to their physical constitution. Micrometric and Nep- measures seem to show that the globe of Uranus tunian is slightly elliptical, like that of the other outer "J''*™- planets ; this would indicate that the planet has a some-*

what rapid rotation. In the case of Neptune, although no ■well-ma.rked ellipticity has been observed, it has been established in a satisfactory though intricate way. The plane of the orbit of the satellite is found to be in con- tinuous motion, and the only cause to which this can be attributed is the ellipticity of the planet itself. The result of this cause would be that the axis of the orbital plane would perform a slow revolution around the axis of the planet. The observed motion is undoubtedly a revolution of this kind, but up to the present time the arc described has been so small that neither its radius nor its period can be determined.

Were the planets surrounded by comparatively dense atmospheres, especially atmospheres markedly different from that of the earth, that fact would be ff tft^" –° easily made known by the spectroscope, planets. since unknown substances in such an atmo- sphere would show absorption lines differing from those of the solar spectrum. A very dense atmos- phere of the same general character as that of the earth would be indicated by a strengthening of the telluric lines. We remark ia this connexion that the lines observed in the solar spectrum are of two classes — ^those which arise from the absorption of the gases surrounding the sun and those produced by our own atmosphere. The latter seem to be principally due to the aqueous vapour in the air. As the light which reaches us from a planet necessarily comes from the sun and passes*

through our atmosphere, we must expect to see all the lines of the solar spectrum in the spectrum of any planet, and the important question is whether any new lines or any changes in the strength of the known ones are also found. Studies with this end in view have been made by Huggins and Vogel. In the case of the planets Mercury, Venus, Mars, and Jupiter, the evidence of any well-marked modification of the solar spectrum does not seem con- clusive. If, as appears from what has just been said, the inferior and denser regions of the atmospheres of these bodies are mostly filled with clouds and vapour, we should not expect to gain much evidence in this way. In the case of Mars and Jupiter, Vogel thought he detected an increased absorption in the red region. The general conclusion from the studies of these two investigators seems to be that, at least in the case of the three inner planets, there is no evidence of an atmosphere differing materially from that of the earth. In the spectrum of Jupiter, however, a line was found in the red of wave length 6178 which does not belong either to the sun's or the earth's atmosphere. Vogel remarks that it may be doubtful whether this line arises from some new and un- known substance in the atmosphere of Jupiter or simply from some combination with which we are not familiar. The case with Uranus and Neptune is different. The ex- treme faintness of the light from these planets renders it difficult to distinguish the Traunhofer lines in their spec- tra, but a number of dark bands were found by Huggins, Keeler, and Vogel in the easily visible portion of the spec- trum of Uranus. The following is a list of the bands on whicJh the observers are substantially in agreement : —

Wave Length. 618. A broad band fading off towards tbe red. 596. A narrow faint band.

575. Darkest part of a broad band, extending from 578 to 565. 543. Middle of the darkest band. 486. A group of fine lines.

Vogel found a few faint bands above 486, and by photographing the spectrum from F into the ultra-violet Huggins was able to distinguish the stronger Fraunhofer lines. The spectrum of Neptune seems to be of the same general character as that of Uranus ; but the bands are more difficult to see, owing to the extreme faintness of

the light. The inference to be drawn from these studies is that these two planets are surrounded by very deep, dense atmospheres, probably materially different in constitution from our own ; but until we learn what combinations of known substances, if any, might be adequate to produce such bands as those just described, it is impossible to reach any conclusion as to the nature of those atmospheres.

While the photometry of the fixed stars has, in recent years, been placed on a definite scientific basis, the same can scarcely be said of that of the bodies of the solar system. This is _. ^ ,^ owing largely to the difficulty, if not the impossibility, „, °^”^ of establishing general laws as to the proportion of g™^,,,, light reflected from bodies at various angles of incidence and reflection. We must, therefore, confine ourselves to a statement of the apparent magnitude of the principal bodies of the solar system under mean conditions. A fundamental datum of the subject is an expression for the quantity of light received from the sun as compared with that from a fixed star of given magni- tude, a result which is best expressed in the form of a stellar magnitude of the sun. The results of attempts to fix this datum are so discordant that entire confidence cannot be felt in any of them. To express it as a stellar magnitude of the sun we remark that, on the photometric scale now adopted, an increase of a hundredfold in the quantity of light corresponds to a drop of 5 units of stellar magnitude in the body emitting the light. In general, a change of n stellar magnitudes is equivalent to a multi- plication or division of the amount of light by 10”“, a number whose common logarithm is 0-in. The best results for the stellar magnitude of the sun as thus defined seem to be — 26-6(Wollaston), — 25-8 (Bond), and — 26-6 (ZSllner). Giving Zollner’s result double weight, we have the stellar magnitude of sun = — 26 ‘4.

The two best determinations of the ratio of sunlight to that of the full moon seem to be those of Bond and Zollner, which are 470980 and 619000 respectively. Mtiller {Photometrie der Gestirne) estimates the best mean result to be 669500.

For the stellar magnitudes of the planets and satellites, we have room only to state what seem to be the best mean results. In the case of Mercury

and Venus, the variations are so great that definite results cannot be given.

Mars ; at mean opposition ;= Jupiter „ „ =

Saturn : without rings Uranus : at mean opposition Neptune „ „

Satellites of Mars : Phobos

,j „ Deimos

Satellites of Jupiter : First

„ „ Second

Third

„ „ Fourth

Satellites of Saturn : Mimas

„ „ Enceladus

Satellites of Uranus :

Mag.

-1-75 -2-23 0-88 5-75 7-84 12-8 13-1 6-0 6-1 5-6 6-6 11-19 11-4 10-5 10-6 9-9 8-5 12-8

Tethys

Dione

Rhea

Titen

Hyperion

Japetus — from .... 10”44 to 11-80

Titania .... 14-2 ,, ,, Oberon .... 14-5 Satellite of Neptune 13-3

For details respecting the new comets, especially periodic ones, which have been discovered since 1880, reference may be made to the article on that subject; what we are here concerned with is Comets. the general question of the prigin and con- stitution of these laodies. A striking confirmation of the view that the comets of short period from time to time become members of our system through the action of one of the larger planets, nearly always Jupiter, is afforded by the case of Comet V. of 1889, discovered by Brooks on 6th July of that year. It was soon found to be moving in an orbit with a period of about eight years, and when its motions were traced back it was ascertained to have pj|,ssed very near the planet Jupiter in June and July 1886. Attempts to compute its orbit previous to this approach were made by Chandler and Poor. The

former, from a preliminary investigation, readied tlie conclusion that the comet was probably identical with that of Lexell, which had been thrown into some new and unknown orbit by the action of Jupiter more than a century ago. Poor’s inquiry, however, which was made on more complete data, seemed to show that this view is untenable and that the comet had never before been seen. As to the origin of comets, the most important develop- ment has been the establishment of the general fact that they belong to the solar system, and are not stray wanderers through space, as was formerly thought possi- ble. Were the latter the case, they would not partake of the motion of the solar system through space. Conse- quently, as the sun pursued its journey more comets would be found coming from the direction of its motion than from the opposite direction. Those which did come from the former direction would in general move in de- cidedly hyperbolic orbits. Now we may regard it as established that no comet moves in such an orbit. It is true that some of the computed orbits have a hyperbolic character, this being shown by the eccentricity coming out slightly greater than unity ; but the excess, even in these exceptional

cases, is always so small that we can only regard it as the result of accidental errors of ob- servation on such ill-defined bodies. The fact being ac- cepted that these bodies, before their observed entry into OUT system, were accompanying the sun on its journey through space, we are led to the following very probable conclusions : — All comets are to be regarded as having been in the beginning outlying nebulous masses, belong- ing to the same mass of matter as that which formed the solar system, and moving with it, but mostly at such great distances from the sun that their periods of revolu- tion would be measured by tens or even hundreds of thousands of years. Were it not for the effect of plan- etary attraction long periods like these would be the gen- eral rule, though not necessarily universal. But at every return to perihelion a comet will be to some extent either accelerated or retarded in its movements by the action of Jupiter or any other planet in the neighbourhood of which it may pass. Commonly the action will be so slight as to have little influence on the orbit and the time of revo- lution. But should the comet chance to pass the orbit of Jupiter just in front of the planet, its motion would be retarded and the orbit would be changed into one of shorter period. Should it pass behind the planet, its mo- tion would be accelerated and its period lengthened. In such cases the orbit might be changed to a hyperbola, and then the comet would never return. It follows that there is a tendency towards a gradual but constant dimi- nution in the total number of comets. If we call A the amount by which the eccentricity of a cometary orbit is less than unity, A will be an extremely minute fraction in the case of the original orbits. If we call ± 8e the change which the eccentricity 1 — A undergoes by the action of the planets during the passage of the comet through our system, it will leave that system with the ec- centricity 1 — A± 8e. The possibilities are even whether Se shall be positive or negative. If negative, the eccen- tricity will be diminished and the period shortened. If positive, the minuteness of A may result in the eccen- tricity 1— A-j-8e being greater than unity, and then the comet will become for ever a wanderer through the stel- lar spaces.

Another discovery is that of the possibility of groups of comets moving in nearly the same orbit. It was formerly thought that only by a very improbable chance would two of these bodies be found describing the same orbit at a long interval of time, and, if an instance was noticed in

which such appeared to be the case, it -was supposed that what was observed on the second occasion

was a return of the former comet. In February 1880 a brilliant comet which was suddenly observed in the southern hemisphere was found to be moving in an orbit so nearly identical with that of the great comet of 1843 that no doubt of a relationship could be felt. Yet so slight could have been the deviation from a parabolic orbit in either case that the hypothesis of identity of the two bodies did not seem tenable. The question of possible identity was set at rest by the appearance of a third comet in the autumn of 1882 again describing nearly the same orbit. It now seems likely that these three bodies were parts of one original nebulous mass, situated far beyond the confines of our system, which gradually separated from each other in the course of suc- cessive revolutions round the sun.

The question whether the motions of Encke's comet are affected by a resisting medium is not yet conclusively settled. The careful and exhaustive researches of von Asten and Backlund seem to show that resistance is met with during some revolutions and not during others. This would scarcely be the case with a resisting medium, as this agency would always be present if it existed at all. Quite possibly the effect may be due to imperfec- tions in the computation of the perturbations.

There is perhaps no celestial object on which obser- vations are so much wanted as on the zodiacal light. Up to the present time the conclusions which can be definitely stated are somewhat general ^^^' in their nature. The sun is surrounded by an exceedingly rare cloud of matter of very indefinite out- line, lenticular in form, extending out somewhat beyond the orbit of the earth. ' This matter shines only by re- flected sunlight, a conclusion which, probable enough in itself, is strengthened by the spectroscopic studies of A. W. Wright, who found the spectrum to be continuous. In northern latitudes, this object can best be seen in the evenings of February and March and in the mornings of September and October. Observations made in the evening seem to show that the central axis of the appar- ent light is one or two degrees north of the plane of the ecliptic, and this would point to a slight inclination of the median plane of the whole mass to that of the eclip- tic. But it is impossible to reach any

definite conclu- sion as to the position of that plane until the apparent axis of the light among the stars has been carefully de- lineated night after night through an entire year by an observer in a very clear atmosphere within the tropics. It needs only a glance at the figure of the apparei^t fight in the neighbourhood of the horizon when it can first be seen, about the close of twilight, to show that its breadth at the horizon is very considerable, probably 40 degrees. Continuing the outline around the sun it seems prob- able that its visible border is nowhere less than 25 or 30 degrees from the sun. It follows that an observer stationed at a high elevation, in a very clear atmos- phere, in such a position that the sun should be about 20 degrees below his horizon at midnight, should see this portion of the light as a faint glow in the northern horizon.

The existence of the mysterious counter glow, or Gegen- schein, as it is commonly called, is now fully established. . It is a patch of light in the ecliptic opposite the sun, so faint and indistinct in outline that it can be seen only under the most favourable conditions, including absence of moonlight and a considerable elevation above the horizon. It is invisible when projected on the Milky Way. Barnard has observed it to be larger and more diffused in the autumn than in the spring. No well- marked deviation from the ecliptic or from the point directly opposite the sun in longitude has been detected. The phenomenon has sometimes been supposed to be

associated with the zodiacal light, which, on rare occa- sions and under the most favourable conditions, some ob- servers have thought could be traced near midnight all the way across the heavens, forming a complete arch from east to west. In that case the Gegenschein would be a small patch in this zodiacal arch, slightly brighter than elsewhere. Of the various explanations which have been propounded no one can be considered as sufficiently probable to merit acceptance. An ingenious suggestion, and one which it is equally difficult to prove or disprove, is that it is composed of nebulous matter thrown off from the earth, forming a tail to the latter like that of a comet. The quantity of such matter

necessary to pro- duce the phenomenon would be minute in the last degree. Similar appendages, if carried by the planets, would be entirely invisible to us, and that of our earth would be visible only because we see through it endways and on a dark sky.

Intimately associated with this subject is the question of the conditions necessary to the permanence of an at- mosphere round a planet. Dr Johnstone Stoney Planetary j^^g recently investigated these conditions, tak- spberes. i^^S ^^ the basis of his work the kinetic theory of gases (Trans. Boy. Dubl. Soc. vi. p. 305). On this theory every molecule of a gaseous mass is com- pletely disconnected from every other and is in rapid motion, its velocity, which may amount to one or more thousand feet per second, depending on the temperature and on the atomic weight of the gas. At any temperature the velocities of individual molecules may now and then increase without any well-defined limit. If at the bound- ary of an atmosphere the velocity should exceed a certain limit fixed by the mass and force of gravity of the planet, molecules might fly away through space as independent bodies. The absence of hydrogen from the atmosphere of the earth, and of an atmosphere from the moon, may be thus explained. If the fundamental hypotheses of Dr Stoney's investigations are correct and complete, it would follow that neither the satellites and minor planets of the solar system nor Mercury can have any atmosphere. If the separate molecules thus flying away moved accord- ing to the laws which would govern an ordinary body, they would, after leaving their respective planets, move round the sun in independent orbits. The possibility is thus suggested that the matter producing the zodiacal light may be an agglomeration of gaseous molecules moving round the sun ; but several questions respecting the intimate constitution of matter will have to be settled before any definite conclusions on this point can be reached. It is not to be assumed that a molecule would move through the ether without resistance as the minutest known body does, and there is probably a radical differ- ence between the minutest particle of meteoric matter and the molecide of a gas. The relations of identity or difference between such finelydivided matter as smoke and atmospheric haze and a true gas have yet to be fully established, and until this is done a definite and satisfac- tory theory of the subject does not seem possible.

II. Geavitational and Theoeetical Asteonomt.

The fundamental hypothesis of modern theoretical astronomy is that the motion of each heavenly body is determined entirely by the gravitation of 'other bodies. Assiiming such to be the case, it will be possible to pre- dict the celestial motions with entire precision, if certain fundamental data are given. Such data would be the mass of each body, and its position, velocity, and direc- tion of motion at some given instant. The problem would then be the construction of general formulse by which the position of each body at any moment whatever could be expressed in terms of the time. In practice we

do not use as fundamental data positions and velocities, but the elements of the orbits, including mean distance, eccentricities, position of orbit in space, mean ~~position of the planet at a given moment, and other quantities which do not vary with the time. When the differential equations expressing in a general way the effects of gravi~~ tation are integrated, the elements appear in the solution as arbitrary constants, to which values may be assigned at pleasure. The astronomer has then to assign such values that the observed positions of the bodies, whether planets or satellites, shall be accurately represented by the formulae. The mathematical processes by which the equations are integrated, values assigned to the elements, and the results compared with observation, are perhaps the most difficult and most complicated with which the mathematical astronomer has to deal, and only in com- paratively simple cases can he be sure that the minute deviations of the actual movement of a body from his predictions do not arise either from a^"^^ errors in his process or from errors of observa- from the tion. The equations of motion can be inte- i^wof grated only in the form of an infinite series of g^' complex terms of which all below a certain magnitude have to be dropped, and the difficulty is to be sure that no terms are omitted which could have a sensi- ble value. Generally, it is possible to secure the neces- sary precision, but in some cases the question whether every possible term which could affect the result has been included may be an open one. One

of the most interesting problems of the astronomer ^t present is whether the motions of the heavenly bodies, as deter- mined by our most refined methods of observation, go on in rigorous accordance with the law of gravitation. This question cannot be settled by a mere comparison of the predicted motion with observations. When differ- ences are found, the question will arise whether they may not be due to errors either in the fundamental ele- ments or in the theoretical computations ; in several instances supposed deviations have been found due to the latter cause. One notable case in history is that of the motion of the moon's perigee. This motion was found to be twice as great as was at first supposed to be due to the Newtonian theory, but Clairaut showed that when more rigorous methods were adopted the observed motion was represented. The general rule has been that, whenever an observed deviation has been well made out, 'it has been traced to the omission of some term of the algebraic formulse expressing the motion of a planet. To this rule there are two notable excep- tions : —

(a) In 1845 Leverrier found that the centennial motion of the perihelion of Mercury derived from observation was greater by 35" than it should be from the .

*gravitation of the other planets, and his result „/ nie has been mpre than confirmed by subsequent planetary investigations, the most recent discussion of pe**'**"* ■observations showing the excess of motion to be 43" per century. In this case there can be no question as to the correctness of the theoretical result, since the computation of the secular motion of the perihelion is a comparatively simple process. It follows that either Mercury must be acted upon by some unknown body or the theory of gravitation needs modification. The most natural ex- planation, and that offered by Leverrier, attributes the discrepancy to the action of a group of intrarMercurial planets. Tor some time, therefore, careful search was made for these planets. One or more has been thought from time to time to be detected, but every observation of the kind has been disproved by critical examination. The simplest and surest method of discovery is afforded by the consideration that these bodies, if they exist, must*

from time to time pass between us and the sun, and there- fore be visible as minute points on the disc of that body. But nothing of the sort has been brought to light by the photographs of the sun which have been constantly taken in recent years, nor by the observers who, during the last half century, have so assiduously watched the sun for spots. There is another difficulty in the way of accept- ing this explanation. A mass of bodies sufficiently large to produce the observed motion of the perihelion of Mer- cury would affect both the other elements of Mercury's orbit and the motions of Venus, but it is shown by the most refined discussions of the observations that these effects are not produced. The most recent surmise on the subject is that the law of gravitation may not act exactly according to the inverse square. A very simple hypoth- esis propounded by Professor Asaph Hall is that in the expression for the mutual gravitation of two bodies of masses m and m', which, according to the Newtonian law

mm

is of the form — —, the exponent 2 should be increased r

by a very minute fraction. The value of the exponent which would produce the observed effect is 2.000 000 1612, so that the discrepancy is removed if we suppose

the attraction to be of the form

mm

The effect

^.000 000 1612

of this modification would be insensible except in the motion of the pericentres of the heavenly bodies. The only cases in which it could be made evident by the cen- tury and a half of observations yet made are those of Mercury, the moon, and Mars. The Perihelion of Mars does actually seem to be affected by the corresponding increase, which is about

*5”*45 per century; but this ex- cess, though made very probable by the observations, is too minute to be conclusively established. In the case of the moon’s perigee the increase of motion Would be 150" per century, a quantity too large to escape observation ; but unfortimately the theoretical determination of this motion has not yet been made with such precision that it may not be affected by an error of this amount. The most refined determination is that recently made by Professor E. W. Brown, which does show a discrepancy of nearly the re- quired amount ; but the difficulties of the determination are such that a conclusive result has yet to be reached.*

We may sum up our conclusions on this point by say- ing that the discrepancy in the case of the perihelion of Mercury is well established, and that there is some reason to believe it a general rule that the motions of the pericentres of the moon and planets are somewhat greater than the gravitation of other bodies is competent to pro- duce. Furthermore, it may be said that the simplest way of explaining the excess of motion is to assume that gravitation increases at a minutely greater rate than the inverse square. Many other modifications of the New- tonian law have been suggested, especially some of a form analogous to that of electro-magnetic action, but none of these consistently represent all the phenomena. (6) The other exception to which we allude occurs in the apparent mean motion of the moon around the earth, which has now been observed with an approach to modern precision since the year 1676, and with less than modern precision from 1625 to 1676. We have also eclipses of the sun and moon recorded by Ptolemy in the Almagest, or observed by the mediaeval astronomers, by which the mean longi- tude of the moon may be followed for more than 2500 years. No amount of research has yet reconciled the results of these observations with gravitational theory. To make clear the existing state of the question, we re- mark that the inequalities in the motion of the moon are of two classes — ^those produced by the action of the sun.

The

moon’s mean motion.

which are always of comparatively short period, and those produced by the action of the planets, which in ex- ceptional cases are of long period. If, in a period of twenty, thirty, or fifty years, the moon is found to be, in the general average, ahead of her computed place, or behind it, we may say with certainty that the deviation is not due to the action of the sftn, because all the effects of this action would be compensated within eighteen years. It has been knQwn for a century that deviations of this character, which are called deviations of long period, really exist in the motion of our satellite. In the middle of the 19th century Hansen announced that he had discovered two inequalities produced by the action of Venus, which completely reconciled these deviations. The theoretical computation of one of these inequalities has been repeated by several investigators since Hansen, and his result confirmed ; but it has been shown that the other inequality has no existence in theory, and that it was the result of imperfections in the method employed by its discoverer. If any doubt could arise as to this conclusion, it is set at rest by the discovery that Hansen was in error in supposing that his two inequalities, singly or combined, would represent the observed deviations. Since 1870 the action of the planets on the moon has been exhaustively treated by several investigators with the special object of deciding whether their gravitation could produce any inequality of long period other than that of Hansen, but without result. The impossibility of any such inequality seems to be as well established as any proposition can be that relates to so complicated a subject. Another possible cause of apparent inequali- ties is to be examined, namely, variations in the earth's axial rotation. What we actually observe is not the ab- solute motion of the moon, but the relation of this motion to the rotation of the earth on its axis, on which we necessarily depend for our measure of time. Let us now siippose this time of rotation to be increased by a very minute amount. Then the day will be longer by this amount. The motion of the moon in one day will then seem to be greater than it was, though in fact there has been no real change in it. If the rate of rotation is accel- erated the opposite effect is produced, the day is shorter, the moon does not move so far in a day, and so seems to be retarded. The discrepancies in question can be ex- plained by variations always less than a second in a year, which, however, accumulate year after year, so that be- fore the end of half a century they might amount to twenty or thirty seconds of time.

A decision between these two causes can be reached only by observations on other bodies. In general, the celestial motions go on so slowly that their amount during so brief an interval as twenty ?”«’ *^ seconds cannot be certainly detected. Only the Mercury! ‘ moon, the planet Mercury, and Jupiter’s satel- lites move so rapidly that an accumulated error of this amount in our measure of time might be brought to light by them. In the case of Jupiter’s satellites we have to depend on the time of their eclipses, and the observations of these phenomena are so far from accurate that no con- clusive result has yet been derived from them. But transits of Mercury over the sun’s disc have been ob- served with greater or less, accuracy since 1677. The present state of the question is presented in the follow- ing tables. The first column gives the mean dates of eclipses or other observations of the moon, and the second the mean excess of her observed mean longitude over that computed from the theory of her motion about these dates. In the third column this excess is given in time, and shows how far we must suppose the actual earth to be in advance, of a uniformly revolving earth in order to account for the apparent excess.*

S. 1.-93

738

ASTKONOMY

Tear.

Ancient Eclipses.

DeTiation of longitude.

B.C. B.C. B.C. A.D.

687 381 189 134 846 926 986

41-0 12-1 11-6 5-2 0-9 3-1 0-4

II. Modern Observations,

1625 1650 1675 1700 1725 1750 1775 1800 1825 1850 1875 1900

15-7

1-0

0-0

3-7

7-2

14-5

21-6

21-2

19-7

9-0

00

6-7

Time In advance.

nt.

-76 -22 -21

- 9

- 2

- 6 + 1

s.

-26

- 2 0

- 7 -13 -26 -39 -38 -36 -16

0 +12

These numbers show that either the moon was moving more slowly, or the earth rotating more rapidly, through the whole 19th century, than during the period 1676 to 1775. To decide which was the case we must have recourse to trajisits of Mercury. The following table shows the excess of the observed times of the ingress and egress of Mercury in November transits over the sun's disc from 1677 to 1894. May transits are omitted, because they were not observed at the earlier dates. The last column gives the weights of the observations.

1666 I

„ E 1697 E 1728 I 1736 I „36 E 1743 I

„ B 1769 I

„ E 1789 I

„ E

1802 1

1822 I

„ E 1848 I

„ E 1861 I

„ E I E I

„ E 1894 I

.. E

1868

1^1

Seconds.

- 47 + 26

- 25

- 8

- 9 + 1

0

- 3

- 7

- 1 10

6

4

11

7

7_7

+ 12

+ 11

+ 2

- 5

- 6

- 2

- 6 + 2

Weight.

0-1 0-1 0-2 2-5 0-6 0-6 1-5 4-5 2-5 0-5 3-5 2-5 6-0 0-4 2-5 6-0 0-5 2-0 4-0 0-6 4-0 6 0 6 0 6 0 6 0

On the theory that the apparent variations in the motion of the moon really arise from changes in the earth's rotation, the numbers of this table should, in a general way, correspond to those in the last column of the table preceding. Evidently such is not the case, since, if we take the weighted means of the deviations during the three periods 1677-1743, 1769-1822, 1861-1894, the results are : — »

Sec.

Mean date 1737 A-|-= -4-5

„ 1795 „ -I-2-4

„ 1880 „ +0-6

We are therefore led to the conclusion that either the motion of the moon is affected by some other cause than the gravitation of other bodies, or mathematicians have not yet succeeded in rigorously computing the effect of this gravitation.

Units of measure.

Fundamental Astronomical Constants.

The term constant is used in astronomy in a relative sense, most of the quantities thus designated being really subject to variation. The term is applied because the variations of these quantities are so slow that the quanti- ties may be regarded as constant for the periods of time over

which computations usually extend. Some of these constants, especially those which relate to the motions of the earth and moon, are intimately related to the first principles of gravitational astronomy. We shall develop the fundamental principles of the subject, and show how, by means of them, the values of the constants may be derived.

We begin by defining the units of those physical quan- tities which enter into astronomy. It will be remai-ked that in physics three units are regarded as fundamental or arbitrary, while all others are derived from them by definition. These funda- mental units are those of length, mass, and time. In the system now most widely adopted for physical investi- gation— ^that known as the C.G.S. system — the centi- metre is taken as the unit of length, the gramme as that of mass, and the second as that of time. The same fun- damental units of length and time may be introduced in astronomy, but it will be more convenient to take the metre as the unit of length. The passage from the metre to the centimetre, and vice versd, is too simple to require discussion. The second may be taken as the unit of time for our present purpose ; but it is more convenient to take the unit of mass as a derived one. The astronomical units will then be as follows : —

The units of time and length are arbitrary, the second and the metre being chosen unless otherwise expressed.

Unit velocity is that which carries a point over unit space in unit time.

The unit of mass is that the gravitation of which axst- ing on an equal mass at distance unity would generate a unit of velocity in a unit of time.

The unit of force is that which would generate a unit of velocity by acting on unit mass during a unit of time.

To distinguish the preceding unit of mass from that of physics it is called the gravitational unit.

The physical unit of length, metre or centimetre, can be used in astronomy only to derive the values of certain astronomical constants, because, in practice, it is too short to use in expressing celestial distances. But by the use of logarithms we may extend our physical measures over

the celestial spaces without the use of unmanageably large numbers. Yet, in any case, the relations between the terrestrial measure and the distance of the earth from the sun must always remain more or less doubtful. Hence it is necessary to adhere to the usual astronomical unit, namely, the mean distance of the sun, in expressing dis- tances among all the heavenly bodies except the moon.

The relation between the arbitrary physical unit of mass, ‘ the gramme for example, and the gravitational unit, is a fundamental problem of physics. To ascertain it we must measure the gravitation ex- oravita- ercised by a known mass at a known distance, ^”^taat This will give us the attraction of a physical unit of mass at unit distance, a quantity known as the Newtonian constant of gravitation. Those older methods of determining this constant which rest upon the observed attraction of great masses of matter — mountains, for ex- ample— or upon the increase in the force of gravity found on descending into mines, are now entirely super- seded, owing to the uncertainty as to the density and arrangement of the masses whose action is measured. Ke- cent determinations depend entirely upon the attraction of portable masses, such as spheres or blocks of lead. It

is impossible mthin the space of the present article to describe ia detail the methods by ~~which these deter~~ minations have been made. There is probably no other physical experiment involving so many difficulties or requiring attention to such a multitude of minute details. Speaking in a general way, three methods have been applied in recent times. In the first, use is made of the torsion balance, consisting of a light rod suspended by its centre and carrying a ball at each end, which is attracted by leaden masses. This is known as the Cavendish experiment. The apparatus was described in the article on Astronomy in our ninth edition. The apparatus for the application of the second method is a pendulum suspended very slightly above its centre of gravity. This method is new, having so far only been employed by WUsing of Potsdam. The third method, which is also new, consists in determining the changes in the weight of bodies produced by the attraction of the leaden masses. In the application of this method a

change of weight of the small fraction of a millionth part is not only to be made evident, but actually measured; yet it has been successfully carried out by Poynting at the Cavendish Physical Laboratory, Cambridge. Two determinations by this method have also been made in Germany, one by Jolly and- the other by Eicharz and Krigar-Menzel.

Notwithstanding the extraordinary delicacy of Poynt- ing's work, the torsion balance seems better adapted to the purpose, owing to the horizontal direction of the minute force measured. The results reached by Mr C. V. Boys, F.E.S., at the Clarendon Physical Labora^ tory, Oxford, and Dr Carl Braun, S.J., at Mariaschein, Bohemia, are wonderfully accordant as well as self- consistent. Defining the gravitational constant as the attraction in C.G.S. units of one gramme of matter at one centimetre distance, they are : —

Boys: G.C. =6-65760-^108

Braun =6-65786-4-108

As to accuracy, Boys conceives that his factor 6-6576 cannot be more than 0-001, or at the outside 0-002, in error, while Braun estimates his probable error at ±0-00168. The agreement of the two results is much closer than we should expect from these probable errors, which we may regard as practically equal. The mean result —

6-65773^-10'

may therefore be accepted as the last word on the sub- ject. From this may be derived the mean density of the earth by a process which we shall include in a general determination of the astronomical constants which pertain to the mass figure and dimensions of the earth.

The latest complete investigation of the dimensions and figure

in question is that of Clarke, to be found in the Ency.

Mass ot Brit., ninth edition, article Eakth, Figure or. With

geoU. his numbers we give, for comparison, those of Bessel,

which are still to a certain extent in use : —

Polar axis

Equatorial axis

BUipticity

According to Helmert, the most recent measures of arcs in Europe and Asia indicate a diminution of Clarke's ellipticity to Bessel's value, but tend to confirm his larger value of the equatorial semi- axis. The datum which we need for the solution of our problem is the attraction which the earth would exert on a point at its surface if it were a perfect sphere composed of spherical layers of equal density. In deriving this quantity a theorem in the attraction of spheroids is introduced by which the force in question is found to be approximately equal to that of the actual earth at a point

the sine of whose geocentric latitude is — —. Eor this point we

have — vS

Geocentric latitude .... =35° 15′ 52″ Geographical latitude . . . =35° 26′ 43″

The geometric mean of Clarke's three axes is 6370997 metres.

Clarke.

Bessel.

C-B.

6356515 m.

6356079 m.

-f436

6378249 m.

6377397 m.

-1-852

1 —293-46

1-^299-15

His radius at geocentric latitude 0′ is

P=6367368 m. -1-10868 m. cos 2 0’(14 m. cos 4 #’.

For sin 0’=—- we then have

p= 6370980. Helmert’s general discussion of the length of the seconds pendulum gives for its value in terms of the geographical latitude 4>,

L=0-990918 m. (1-1-0-005310 sin2 0). This multiplied by tt^ gives f on the intensity of gravity

. fir=9-77997m. (1-1-0-005310 sin2 0).

This is the earth’s attraction diminished by the vertical component of the centrifugal force, of which the value is 0-03392 p cos < cos . This expression for the force of gravity gives for the actual attraction of the earth at the parallel of 35° 26′ 43″ 9-79743 m. -f-02253 m.=9-81996 m., which may be taken as the attraction of the whole mass of the earth, if concentrated at its centre or reduced to a sphere, upon a body at distance 6370980 metres. Taking the metre as the unit of length, we have for the mass of the earth in the astronomical units already defined 9-81996 x 63709802, which gives for the total mass of the earth in gravitational measure :

Logarithm of the earths mass= 14-600522. If, instead of the metre, we take the centimetre as the unit, we have —

Logarithm of the earth's TOass=20-e00522. In other words, this is the logarithm of the gravitation of the earth's mass at 1 centimetre distance expressed in C.G.S. units. The corresponding attraction of 1 gramme of matter being the number already stated, of which the logarithm is 8-823326, it follows that the logarithm ofjhe earth's mass in grammes is

20-600522 – 8 823326 =27 -777196.

Clarke's dimensions give for the logarithm of its volume 27-034711. It follows that we have —

*Logarithm ofearth*s deMS%=0-742485, whence density of earth =5-5270.*

This conclusion as to density supposes the whole mass included in the geoid. It will be diminished by allowing for the elevation of the continents, and increased if the ocean be excluded from the matter taken into account.

Some of the results for the density found by the other methods are as follows : —

Method of Weighing.

Poynting D=5-4934

JoUy ,,5-69

Bicharz and Menzel . . . . ,,5-505

Method of Pendulum.

• Wilsmg D=5-679

One of the most important astronomical applications of the preceding results is the determination of the mean distance of the moon from the earth. Knowing the Parallax masses m and m' of the earth and moon, and the mean of the motion n of the latter in one second, its mean distance moon. a follows at once from the well-known equation of the elUptio motion,

^_m+m' m (I-I-/1) "' W~~ ^ IJ. being the ratio of the masses. In one second of mean time the moon moves through an arc whose logarithm is 4-425159 — 10. We shall presently find ;i=l-4-81-65, and have just given the value of log. m from the seconds pendulum. We then find from the above equation i^g ^ .^ metres=8-585164 whence a=384737 kilometres.

The motion of the moon is so affected by the action of the sun that this number does not rigorously represent the actual mean distance of the moon. Moreover, what is used in astronomical practice is the horizontal parallax of the moon.

Gravitational theory shows that the constant of this quantity which we call jr,,, is connected with the above value of a by the

relation

sin7ro=l-000907-' a

p being the diameter of the earth. Using Clarke's equatorial diameter we find : —

Equatorial horizontal parallax of the moon=57' 2-76". This result is in good agreement with that of direct observations.

It is interesting to remark that if we regard the dimensions of the earth as unknown, observations of the seconds pendulum, combined with measures of the moon's parallax, would enable us to determine them. The form of the equations we have used to determine the earth's mass and the moon's distance show that, if we express the earth's radius in terms of the moon's parallax, it will come out in the form

p=k sia? ir,,,

k being a numerical constant. It follows from this form that the ratio of error in iro would be multiplied three times in the resulting value of p. As

a matter of fact we can determine p with greater proportional precision than the parallax, so that the logical course is to determine ttq from p rather than the reverse. The fundamental gravitational relations on which the motions

of precession and nutation depend may be stated as Precession follows: — We put P, P'=the portions of the lunisolar and precession in a Junian year, due to the action of the

nutation. moon and the sun respectively, N=the constant of

nutation, /t=the ratio of the mass of the moon to that

of the earth,)J=———-, A, C = the equatorial and polar moments

of inertia of the earth, g= , a quantity which may be called

the mechanical ellipticity of the earth, and e=:the obliquity of the ecliptic. L

The theory of the moon's motion- and of its action on the earth gives the following equations : —

N =[5-40289] p.' qoose 1

P = [5-975052] m' g cos e [(1)

P' = [3-72509] 3 cose J

In these expressions q and p' are absolute constants to be deter- mined, while e varies slowly, but is known. The values of N and of P+P' are given by observation. At a conference of the directors of four national astronomical ephemerides, held at Paris in 1896, it was' decided to adopt

N=9-210". By a discussion undertaken at the request of the same conference it was found that, for the epoch 1900,

P+P'=50-3722" (2)

For the same epoch the obliquity is

e=23° 27′ 8-26”. With these numerical values the equations (1) and (2) are four in number, which sufdce to determine /’, q, P, and P’ for 1900. The solution gives the following results : —*

Julian Tear. Solar Tear. Lunar precession for 1900 34-3877” 34-3870"

Solar „ „ „ 15-9842" 16-9838"

Lunisolar „

50-3719" 50-3708"

?=-

C-A

=0-0032813

; of moon^mass of earth=l-i-81-65. , Recent research enables us to compute the obliquity of the Obll itv ^”’P” ** P^s’ ^^^ future epochs with an error not «/ ecliptic s^ceeding 1" per century elapsed. The result is shown ■ in the following table : —*

Tear.

B.C.

Obliquity.

Tear.

A.D.

Obliquity.

3000

0

24

1

16-5

0

o

23

41

42-4

2900

24

0

44-1

100

23

40

57-9

2800

24

0

11-1

200

23

40

13-1

2700

23

59

37-5

300

23

39.

28-1

2600

23

59

3-5

400

23

38

42-8

2500

23

58

28-9

500

23

37

57-4

2400

23

67

53-7

600

23

37

11-8

2300

23

67

18-1

700

23

36

26-1

2200

23

56

41-9

800

23

36

40-2

2100

23

56

5-3

900

23

34

54-11

2000

23

56

28-2

1000

23

34

7-9

1900

23

54

50-6

1100

23

33

21-6

1800

23

64

12-5

1200

23

32

36-2

1700

23

63

34-0

1300

23

31

48-7

1600

23

52

65-1

1400

23

31

2-1

1600

23

52

16-8

1500

23

30

15-42

1400

23

51

36-0

1600

23

29

28-69

1300

23

50

55-9

1700

23

28

41-91

1200

23

50

16-3

1800

23

27

65-10

1100

23

49

34-4

1900

23

27

8-26

1000

23

48

531

2000

23

26

21-41

900

23

48

11-4

2100

23

25

34-66

800

23

47

29-4

2200

23

24

47-73

700

23

46

47-1

2300

23

24

0-91

600

23

46

4-4

2400

23

23

14-13

600

23

45

21-5

2500

23

22

27-40

400

23

44

38-2

2600

23

21

40-73

300

23

43

64-7

2700

23

20

54-13

200

23

43

10-9

2800

23

20

7-61

100

23

42

26-8

2900

23

19

21-19

0

23

41

42-4

3000

23

18

34-87

The obliquity was at a maximum about 7200 B.C., or 9100 years ago, when its value was 24° 13'. It will reach a minimum about 9600 years hence, when its value will probably be between 22° 30' and 22° 40', but cannot be more exactly stated.

The Solar Parallax.

The problem of the distance of tlie sun has always been regarded as the fundamental one of celestial measure- ment. T'he difficulties in the way of solving it are very great, and up to the present time the best authorities are not agreed as to the result, the effect of half a century of research having been merely to reduce the uncertainty within continually narrower limits. The mutations of opinion on the subject during the last fifty years have been remarkable. Up to about the middle of the 19th century it was supposed that transits of Venus across the disc of the sun afforded the most trustworthy method of making the determination in question; and when Encke in 1824 published his classic discussion of the transits of 1761 and 1769, it was supposed that we must, wait until the transits of 1874 and 1882 had been observed and discussed before any further light would be thrown on the subject. The parallax 8-6776" found by Encke was therefore accepted without question for several decades. Doubt was

first thrown on the accuracy of this number by an announcement from Hansen in 1862 that the observed parallactic inequality of the moon was irrecon- cilable with the accepted value of the solar parallax, and indicated the miich larger, value 8-97". This result was soon apparently confirmed by several other researches founded both on theory and observation, and so strong did the evidence appear to be that the value 8-95" was adopted in the Nautical Almanac for a number of years. The most remarkable feature of the discussion since 1862 is that the successive examinations of the subject have led to a continually diminishing value, so that at the present time it seems possible that the actual parallax of the sun is almost as near to the old value of Encke as to that which first replaced it.

Five fundamentally different methods of determining the distance of the sun have been worked out and applied. They are as follows : —

I. From measures of the parallax of either neOiods Venus or Mars the parallax of the sun can be o/ defer- immediately derived, because the ratios of dis- """^tion. tanees in the solar system are known with the last degree of precision. Transits of Venus and observations of various sorts on Mars are all to be included in this class.

II. The second method is in principle extremely simple, consisting merely in multiplying the observed ve- locity of light by the time which it takes light to travel from the sun to the earth. The dif&culty is to determine the time in question.

III. The third method is through the determination of the mass of the earth relative to that of the sun. In astronomical practice the masses of the planets are com- monly expressed as fractions of the mass of the sun, the latter being taken as unity. When we know the mass of the earth in gravitational measure, its product by the denominator of the fraction just mentioned gives the mass of the sun in gravitational measure. From this the distance of the sun can be at once determined by the fundamental equation of planetary motion.

IV. The fourth method is .through the parallactic inequality in the moon's motion. This method was. described in the ninth edition of the Ency. Brit.

V. The fifth method consists in obsefrving the displace- ment in the direction of the sun, or of one of the nearer planets, due to the motion of the earth round the common centre of gravity of the earth and moon. It requires a

precise knowledge of the moon's mass. The uncertainty of this mass impairs the accuracy of the method.

I. To begin with the results of the first method. The transits of Venus observed in 1874 and 1882 might be ex-

pected to hold a leading place in the discussion. of Venus. ^° purely astronomical enterprise was ever

carried out on so large a scale or at so great an expenditure of money and labour as was devoted to the observations of these transits, and for several years before their occurrence the astronomers of every leading nation were busy in discussing methods of observation and working out the multifarious details necessary to their successful application. In the preceding century reliance was placed entirely on the observed moments at which Venus entered upon or left the limb of the sun, but in 1874 it was possible to determine the relative positions of Venus and the sun during the whole course of the transit. Two methods were devised. One was to use a heliometer to measure the distance between the limbs of Venus and the sun during the whole time that the planet was seen projected on the solar disc, and the other was to take photographs of the sun during the period of the transit and subsequently measure the negatives. The Germans laid the greatest stress on measures with the heliometer ; the Americans, English, and French on the photographic method. These four nations sent out well-equipped expeditions to various quarters of the globe, both in 1874 and 1882, to make the required observations; but when the results were discussed they were found to be extremely unsatisfactory. It had been supposed that, with the greatly improved telescopes of modern times, contact observations could be made with much greater precision than in

1761 and 1769, yet, for some reason which it is not easy to explain completely, the modern observations were but little better than the older ones. Discrepancies dif&cult to account for were found among the estimates of even the best observers. The photographs led to no more definite result than the observations of contacts, except perhaps those taken by the Americans, who had adopted a more complete system than the Europeans ; but even these were by no means satisfactory. Nor did the measures made by the Germans with helio- meters come out any better. By the American photo- graphs the distances between the centres of Venus and the sun, and the angles between the line adjoining the centres and the meridian, could be separately measured and a separate result for the parallax derived from each. The results were : — '

/7T -, ^ lo-rA Distances; par. =8-888". Transit of mi: p^g. angles ; „ =8-873".

Transit of 1882

Distances ; Fos. angles ;

=8-873". =8-772".

The German measures with the heliometer gave ap- parently concordant results, as follows : —

Transit of ISU : par. =8-876". Transit of 1882 : „ ^8-879".

The combined result from both these methods is 8-857", while the combination of all the contact observations made by all the parties gave the much smaller result, 8-794". Had the internal contacts alone been used, which many astronomers would have considered the proper course, the result would have been 8-776".

In 1877 Gill organized an expedition to the Island of Ascension to observe the parallax of Mars with Planetary tlie heliometer. By measurements giving the parai- position of Mars among the neighbouring stars laxes. ^jj tjjg morning and evening, the effect of parallax could be obtained as well

as by observing from two different stations ; in fact the rotation of the earth carried the observer himself round a parallel of latitude,

so that the comparison of his own observations at dif- ferent times would give the same result as if they had been made at different stations. The result was 8-78”- The failure of the method based on transits of Venus led to an international effort carried out on the initiative of Sir David Gill to measure the parallax by observations on those minor planets which approach nearest the earth. The scheme of observations was organized on an extended scale. The three bodies chosen for observation were : Victoria, 10th June to 26th August 1889 ; Iris, 12th October to 10th December 1888 ; and Sappho, 18th September to 25th October 1888. The distances of these bodies at the times of opposition were somewhat less than unity, though more t(han twice as great as that of Mars in 1877. The drawback of greater distance was, however, in Gill’s opinion, more than compensated by the accuracy with which the observations could be made. The instruments used were heliometers, the construction and use of which had been greatly improved, largely through the efforts of Gill himself. The planets in question appeared in the telescope as star- like objects which could be compared with the stars with much greater accuracy than a planetary disc like that of Mars, the apparent form of which was changed by its varying phase, due to the different directions of the sun’s illumination. These observations were worked up and discussed by Gill with great elaboration in the Annals of the Cape Observatory, vols. vi. and vii. The results were for the solar parallax ir :

From Victoria. 7r=8-86l”±0-006”.

„ Sappho,’ 7r=8-798”±0-011”.

„ Iris, x=8-812”±0-009”.

The general mean result was 8-802”. From the meridian observations of the same planets made for the purpose of controlling the elements of motion of the planets Auwers found ir = 8-806”. All other methods of directly measuring the parallax fall so far behind this in certainty that we may regard GUI’s result as the best yet derived from measurement. But

the difiiculties of the measures are such that other methods may be yet better and in any case are not to be neglected. »

II. The velocity of light has been measured with all the precision necessary for the purpose. The latest result is 299860 kilometres per second, with a probable error of perhaps 30 kilometres ; that is, ofl^i^ about the ten-thousandth part of the quantity itself. This degree of precision is far beyond any we can hope to reach in the solar parallax. The other element which enters into consideration is the time required for light to pass from the sun to the earth. Here no such precision can be attained. Both direct and indirect methods are available. The direct method consists in observing the times of some momentary or rapidly vary- ing celestial phenomenon, as it appears when seen from opposite points of the earth's orbit, the only phenomena of the sort available being eclipses of Jupiter's satellites, especially the first. Unfortunately these eclipses are not sudden but slowly changing phenomena, so that they cannot be observed without an error of at least several seconds, and not infrequently important fractions of a minute. As the entire time required for light to pass over the radius of the earth's orbit is only about 500 seconds, this error is fatal to the method. The indirect method is derived from the observed constant of aber- ration or the displacement of the stars due to the earth's motion. The minuteness of this displacement, about 20-50", makes its precise determination an ex- tremely difficult matter. The most careful determiner tions are affected by systematic errors arising from those diurnal and annual changes of temperature, the effect of which cannot be wholly eliminated in astro-

nomical observation, and the recently-discovered variation of latitude lias introduced a new element of uncertainty into the determination. In consequence of it, the values formerly found were systematically too small by an amount which even now it is difficult to estimate with precision. Struve's classic number, universally accepted during the second half of the 19th century, was 20-445". Serious doubt was first cast upon its accuracy by the observations of Nyrfe with the same instrument during

the years 1880-82, but on a much larger number of stars. His result, from his observations alone, was 20-52" ; and taking into account the other Pulkowa results, he concluded the most probable value to be 20-492". In 1895 Chandler, from a general discussion of all the observations, derived the value of 20-50". Since then, two elaborate series of observations made with the zenith telescope for the purpose of determining the variation of latitude and the constant of aberration have been carried on by Professor Doolittle at the Flower Observatory near Philadelphia, and Professor Eees and his assistants at the observatory of Columbia College, New York. Each of these works is self-consistent and seemingly trustworthy, butthere is a difference between the two which it is diffi- cult to account for. Eees's result is 20-47" ; Doolittle's, 20-56"- This last value agrees very closely with a determi- nation made by Gill at the Cape of Good Hope, and most other recent determinations give values exceeding 20-50". On the whole it is probable that the value exceeds 20-50" ; and so far as the results of direct observation are con- cerned may, for the present, be fixed at 20-53". The corresponding value of the solar parallax is 8-777". In addition to the doubt thrown on this result by the dis- crepancy between various determiaations of the constant of aberration, it is sometimes doubted whether the latter constant necessarily expresses with entire precision the ratio of the velocity of the earth to the velocity of light. While the theory that it does seems highly probable, it cannot be regarded as fully established.

III. The combined mass of the earth and moon admits of being determiued by its effect in changing the position

*of the plane of the orbit of Venusi, The motion aVeartb °^ *^® node of this plane is found with grea;t*

exactness from observations of the transits of Venus. So exact is the latter determination that, were there no weak point in the subsequent parts of the pro- cess, this method would give far the most certain result for the solar parallax. Its weak point is that the apparent motion of the node depends partly upon the motion of the ecliptic, which cannot be determined with equal precision. Notwithstanding this drawback the elements of admissible error seem smaller by this method than by any

other. The derivation of the distance of the sun by it is of such interest from its simplicity that we shall show the com- putation.

From the observed motion of the node of Venus, as shown by the four transits of 1761, 1769, 1874, and 1882, is found

■»! t f -4.1. , \ Mass of sun

Mass of (earth + moon) = — „„„„„„^ — ^ ^ ■> 332600

We have already found in gravitational units of mass, based on the metre and second as units of length and time,

Log. earth's mass = 14-60052 „ moon's ,, =12-6895.

The sum of the corresponding numbers multiplied by 332600 gives

Log. sun's mass = 20-12773.

Putting a for the mean distance of the earth from the sun, and n for its mean motion in one second, we use the fundamental equation

fflSji^ = Mo t M',

Mo being the sun's mass, and M' the combined masses of the earth

and moon, which are, however, too small to afieot the result. For the mean motion of the earth in one second in circular measure, we have

2ir

31558149

; log. n = 7-29907

the denominator of the fraction being the number of seconds in the sidereal year. Then, from the formula

8^ Mo _ [2002773] " ji2 -15-59814

we find

Log. a in metres = 11-17663

Log. equat. rad. © 6-80470

Sine 0's eq. hor. par. 5-62817

Sun's eq. hor. par. 8-762".

The writer regards this as at present the most trustworthy of aD the methods of determiaing the distance of the sun.

IV. The determination of the solar parallax through the parallactic inequality of the moon's motion also involves two elements — one of observation, the other of purely mathematical theory. The inequality in ^°g°f "' question has its greatest negative value near the

time of the moon's first quarter, and the greatest positive value near the third quarter. Meridian observations of the moon have been heretofore made by observing the transit of its illuminated limb. At first quarter its first limb is illuminated ; at third quarter, its second limb. In each case the results of the observations may be systemati- cally in error, not only from the uncertain diameter of the moon, but in a still greater degree from the varying effect of irradiation and the personal equations of the observers. The theoretical element is the ratio of the parallactic inequality to the solar parallax. The determination of this ratio is one of the most difficult problems in the lunar theory. Using Hansen's determination, the values of the solar parallax derived from three independent series of observations of the moon are: — 8-802" (from Greenwich and Washington meridian observations) ; 8-789" (Battermann, from occultations of stars by the moon) ; 8-767" (Franz, from observations of a lunar crater). Giving these three results the respective weights 5, 2, and 1, the result is 8-794". But the most recent and as yet unfinished researches of E. W. Brown and G. W. Hill throw doubt on the precision of Hansen's theoreti- cal ratio. If the latter is corrected by the work of these investigators, the value of the solar parallax derived by this method is reduced to about 8-773".'

V. The fifth method is, as we have said, the most un- certain of all ; it will therefore suffice to quote the result, wtiich is

7r=8-818”.

Motion o/ earth.

The following may be taken as the most probable values of the solar parallax, as derived independently by the five methods we have described : —

!From measures of parallax

. 8-802"

„ velocity of light

. 8-777"

„ mass of the earth .

. 8-762"

„ par. ineq. of moon .

. 8-773"

„ unar equation

. 8-818"

The question of the possible or probable error of these results is one on which there is a marked divergence of opinion among investigators. Probably no general agree- ment could now be reached on a statement more definite than this; the last result may be left out of consideration, and the value of the solar parallax is probably contained between the limits 8-77" and 8-80”. The value 8-80" was chosen at the Paris conference of 1896, and is now gene- rally adopted in astronomical ephemerides. The most likely distance of the sun may be stated in round

numbers as 93,000,000 miles. It is possible that observations of Eros, the remarkable asteroid of which we have already

spoken, may settle the question ; but there is no prospect of its being soon settled in any other way.

Variaiiwi of Latitudes.

The development of an important; feature of the rotation of the earth is due very largely to the investigations of S. C. Chandler. This is a minute periodic change in the point at which the axis of rotation intersects the earth's surface ; that is, in the position of the pole of the earth. The result is a variability of the terrestrial latitudes generally.

To make clear the nature of the movement in question we must hegln with a statement of some results of theory. Let EQ (see Dvaamlcal ^^' ^^ represent the section of an oblate spheroid theory. through its shortest axis, PP. We may consider this spheroid to be that of the earth, the elliptioity being greatly exaggerated. If it is set in rotation around its axis of figure PP, it will continue to rotate around that axis for an indefinite time.

But suppose that instead of rotating around PP it rotates around some other axis, RB, making a small angle, FOR, with the axis of figure PP ; then it has been known since the time of Euler that the axis of rota- tion RR, if referred to the spheroid regarded as fixed, will gradually ro- tate round the axis of figure PP in a period defined in the following way: — If we put C=the moment of momentum of the spheroid around the axis of figure, and A =the corresponding moment around an axis passing through the equator EQ, then, calling one day the period of rotation of the spheroid, the axis RR will make a revolution around PP in a number of days represented by the fraction C/C— A. In the case of the earth we have found that the inverse of this ratio is 0-0032813. It follows that the period in question is 305 days. It has for more than half a century been

recognized as possible that the axis of rotation of the earth might not coincide with its axis of figure, and, in conse- quence, that such a rotation as this might be going on.

The latitude of a point on the earth, as determined by astronomical observations, is determined wilii respect to the axis of rotation RR, and not with reference to PP, because the latter cannot be fixed by any direct method. Hence, if such a change in this axis were going on, it was supposed that there would be a harmonic variation of the latitudes of all points of the earth's sur- face in a period of about 305 days. Up to 1890 the most careful observations and researches failed to afford evidence of a rotation in this period, thotigh there was strong evidence of a variation of latitude. Observations for the value of the constant of aberration made at Pulkowa and Berlin between the years 1880 and 1890 seemed to show that the latitudes of those places did actually change from time to time to the amount of about half a second of arc. Chandler, from an elaborate discussion of these and a great number of other observations, showed that there was really a variation of the latitude of the points of observation ; but, instead of the period being 305 days, it was about 428 days. At first sight this period seemed to be inconsistent with dynamical theory. But a defect was soon found in the latter, the correction of which reconciled the divergence. In deriving a period of 305 days the earth is regarded as an absolutely rigid body, and no account is taken either of its elasticity or of the mobility of the ocean. A study of Fig. 2 will show that the centrifugal force round the. axis RR will act on the equatorial protuberance of the rotating earth so as to make it tend in the direction of the arrows. A slight deformation of the earth will thus result ; and the axis of figure of the distorted spheroid will no longer be PP, but a line P'P' between PP and RR. As the latter moves round, P'P' will continually follow it through the incessant change of figure pro- duced by the change in the direction of the centrifugal force. Now the rate of motion of RR is determined by the actual figure at the moment. It is therefore less than the motion in an absolutely rigid spheroid in the proportion RP':RP. It is found that, even though the earth were no more elastic than steel, its

Kg. 2.

yielding combined with the mobility of the ocean would make this ratio about 2 :3, resulting in an increase of the period by one-half, making it about 467 days. Thus this small flexibility is even greater than that necessary to the reconciliation of observation with theory, and the earth is shown to be more rigid than steel— a conclusion long since announced by Kelvin, for other reasons.

Chandler afterwards made an important addition to the subject by showing that the motion was represented by the superposition of two harmonic terms, the first having a period of about 430 days, the other of one year. In order to £'«""«"« state his conclusion we have to express the position of "'"""'"• the pole of rotation on the earth's surface relative to the mean pole. Let us represent the fixed position of the latter by O, while P represents the position of the movable pole. We then have to express the position of P relative to 0 in terms of the time. Let us imagine two co-ordinate axes going out from O— the one towards Greenwich, the other in 90° E. longitude. We represent the co-ordmate in the direction of Greenwich by y, that in the direc- tion 90° E; by x. Then P revolves round O in a direction from west towards east in a curve such that the co-ordmates of P may be expressed in the form :*

x=r sin 6t+Q-\V' sin (G+60°) y=r cos W+0-11" cos©

G being the sun's mean longitude, and r and e quantities which Chandler believes to be slowly variable. He represents the varia- tions in terms of an angle x having a period of 24,000 days, or a daily motion of 0-015°, of which the value was 0° at the date 31st March 1865. At this date the pole P passed the meridian of Greenwich. If only the first terms of x and y are included, the other dates T of passage— that is, the dates when e« is a multiple of 360° — are by the equation

T= 1865 -25 +428 ~~6' E~~^55'» sin x,*

E being an entire number, expressive of the number of periods from 1865-25. He also finds

r=0-135"+0-05" sin x Period=428-6"+5-26 cos x 360° ~ Period'*

The angle x is a purely empirical quantity, introduced to represent past observations. There can be no certainty that it will repre- sent future ones.

If the supposed variation of r and P or e are unreal, the motion of the angle 6t is 0-843° per day, the period about fourteen months, and r=0-148". The expressions for x and y then become

a;=0-148" sin 0-843° i+0-11" sin (0+30°) 3/=0-148" cos 0-843° j+0-11" cos O,

the time t being counted in days from the day 2412646 of the Julian period or 1st July 1893. The difference of 30° between the sine and cosine arguments of the annual term shows that this term represents an elongated ellipse.

The variation of the latitude of any place of which the longitude east of Greenwich is X is given by the formula

*0— 0o=a; sin "K—y cos *

4> being the instantaneous, and <^o the mean latitude.

While there can be no doubt as to the reality of the fourteen-month term, there is not as yet a general agree- ment as to the amount and nature of the annual term. It is difficult to determine the latter Summary with certainty, because the effect of the diurnal cii^tans. variations of the temperature of the instrument and the atmosphere, which cannot be accurately ascertained and allowed for, might lead to minute apparent terms having a period of a year. The reason of this is, that the observations have to be made upon stars while they are crossing the meridian; in the case of any one star, the transit occurs at all hours of the day in succession in the course of twelve' months. For example, a star which at midsummer would be observed at six in the morning would, at midwinter, be observed at six in the evening, when the conditions might be materially different. The present state of the question, so far as theory is concerned, may be summed up as follows : —

(1) The fourteen-month term is an immediate result of the fact that the axes of rotation and figure of the earth do not strictly coincide, but make with each other a small angle of which the mean value is about 0-15". If

the earth remained invariable, without any motion of matter on its surface, the result of this non-coincidence would be the revolution of the one pole round the other in a circle of radius 0-15" in a period of about 429 days. This revolution is called the Eulerian motion, after the mathematician who discovered it. But owing to meteoro- logical causes the motion in question is subject to annual changes. These changes arise from two causes — the one statical, the other dynamical.

(2) The statical causes are deposits of snow or ice slowly changing the position of the pole of figure of the earth. For example, a deposit of snow in Siberia would bring the equator of figure of the earth a little nearer to Siberia and tjirow the pole a little way from it, while a deposit on the American continent would have the opposite effect. Owing to the approximate symmetry of the American and Asiatic continents it does not seem likely that the in- equality of snowfall would produce an appreciable effect.

(3) The dynamical causes are atmospheric and oceanic currents. Were these currents invariable their only effect would be that the Eulerian motion would not take place exactly round the mean pole of figure, but round a point slightly separated from it. But, as a matter of fact, they are subject to an annual variation. Hence the motion of the pole of rotation is also subject to a similar variation. The annual term in the latitude may be readily accounted for in this way. But it seems unlikely that a motion thus produced should have a sensible eccentricity. It therefore appears at present more likely that the seeming eccentricity of the annual motion is unreal and due to the cause already mentioned.

(4) Six Eulerian periods are very nearly seven years. In consequence, the effect of the annual change is to pro- duce an inequality in the amplitude

having a period of seven years. During one part of this period the distance of the two poles is nearly double, being increased toO-25" or 0-30". At another part of the period, three and a half years later, the motion almost ceases. Times of greatest motion were in 1890-92, and again in 1897-99 ; of least motion about 1894, 1901, 1908, &c.

Besides Chandler, Albrecht of Berlin has investigated the motion of the pole P. The methods of the two astronomers are in some points difierent. Chandler has constructed empirical formulae representing the motion, with the results already given, while Albrecht has determined the motion of the pole from observation simply, without trying to represent it either by a formula or by theory. It is noteworthy that the difference between Albreoht's numerical results and Chandler's formulse is generally less than

0-05".

Masses, &c., of the Planets and Satellites.

The elements, masses, and other particulars relating to the major planets and their satellites, so far as these were known in 1876, are given in the Sncy. Brit, ninth edition, vol. ii. pp. 782-83, and the adopted elements of most of these bodies have been so slightly changed that a repetition of them is not deemed necessary. What we shall now present is a risumi of the masses, diameters, and other more important constants which have been worked out to the present time, necessarily limiting our review to what may be considered the best-established results. For ordinary astronomical purposes the masses are not ex- pressed in terms of the gravitational units already defined, but as fractions of the sun's mass taken as unity. This

fraction is commdnly written in the form -, ^ being the

number of times that the sun's mass exceeds that of the planet. The masses of the satellites are expressed in the same form in terms of the mass of the primary.

The minuteness of the planet Mercury and the absence of a satellite make, the determination of its mass difficult

and uncertain. In the new planetary tables issued from the office of the American Nautical Almanac, and now most used, /x is taken as 6000000. Other values j„^„^^ of the mass are generally less than this, fi rang- ing up to 10000000 or more. G. W. Hill, from a con- sideration of the probable density, finds values ranging from 10194200 to 10826200.' The uncertainty of the diameter renders this result uncertain ; an increase of one- tenth in Hill's adopted diameter, 6-68", would increase the resulting volume by one-third and the mass by nearly one-half. The value 7500000 seems as likely as any. The best values of the diameter are those found during transits over the sun's disc. Todd, with double-image micrometer, found the value 6-604" (A=l), and Barnard, with filar micrometer, 6-126". Both results are liable to be too small from the effects of irradiation. Off the sun's disc, results of measures with the filar micrometer are Lowell at Flagstaff 7-4", and Barnard at Mount Hamilton

6-14".

The mass of the planet Venus derived from all the observations of the sun and Mercury, and adopted in the new planetary tables, is |w,=408000. It is not ^^^^^ likely to be in error by 1 per cent, of its amount. For the angular diameter at distance unity Auwers, from heliometer measures during the transits of 1874 and 1882, found the value 16-820" ; Newcomb, from double-image micrometer measures during the transit of 1882, that of 16-88"; Barnard, off the sun from measures near inferior conjunction, 17-397" ; and German observers, with the heliometer, 17-30". This difference between the results of measures on and off the sun might be attributed to irradiation ; but it is singular that a comparison of nu- merous measures made at widely different distances from the earth seems to indicate the anomaly of negative irra- diation, the diameters measured at the greater distances being proportionately too small instead of too large.

The mass of the moon has been already derived as one of the fundamental constants. The most exact value of the diameter is that derived from the occultar ^^^^ tions of groups of stars, especially when

the moon is totally eclipsed. From occultations of the Pleiades J. Peters found, for the mean semi-diameter 15′ 32-49″ ; Struve, from occultations during total eclipses, 15′ 32-65”; while the most likely value, as concluded by Peters, is 15′ 32-59”. As the apparent diameter varies with the distance, and can be computed only when the moon’s parallax is known, it is common to express the moon’s diameter in terms of that of the earth as unity. From the value of the parallax already found, it follows that

Diameter of moon £q. diam. of earth

=0-272480.

For particulars as to the motion of the moon, see article Moon. ‘

The motions of the orbital planes and of the peri- centres of the satellites of Mars offer interesting problems to both the observing and the mathematical astronomer. These problems have been most ^^“ra successfully attacked by Hermann Struve in a memoir presented to the St Petersburg Academy in 1898. The preliminary results of theory may first be set forth : —*

Let M (rig. 3) be the pole of rotation of Mars, 0 the pole of the orbit of that planet, and S the pole of the orbit of one of its satellites, all projected on the celestial sphere. The arc OM of the sphere will then be equal to that between the equator of Mars and the plane of its orbit ; SO will be equal to the inclination of the orbit of the satellite to that of the planet, and SM to the inclina- tion of the same orbit to the equator of Mars. In consequence of the action of the sun, the pole S moves constantly in a direction at right angles to OS, as shown by arrow a ; while the ellipticity of Mars gives it a much more rapid motion in a direction at right angles to MS, as shown by the other arrow 6. The actual motion

is the resultant of these two components, and is such as to carry S round in a circle, of which the centre is at a third point F. This centre is the pole

of a certain plane called' the "fixed plane " of the satellite orbit, which makes but a small angle with the plane of the planet's equator. The position of the plane of Mars's equator relative to the plane of the orbit has been found in two ways —

Fig. 3.

from measures on the polar spot, giving the position of the pole of rotation, and from observations of the satellites. The best result of this first method is derived by combining the results of SchiapareUi and Lohse. H. Struve has applied the second. The results are, for the inclination of the equator of Mars to that of the earth,

Jo=3642° (SchiapareUi and Lohse) Jo=37° 27-l'-0-239' (J-1880) (Struve);

and for the longitude of ascending node of equator on that of the

No=48-26° (SchiapareUi and Lohse) No=47° 5-7'+ 0-463' (<-1880) (Struve).

Strove also finds, from the motions of the pericentres of the satel- lites, ellipticity of Mars =1/190 -4 ; but owing to a doubt as to the revolutions of &ie pericentreof Phobos, this possibly should be 1/178.

In representing the elements of the orbits of the satellites, the following notation is used : —

*Ji, Nj., inclination and node of the "fixed plane" of the satellite's orbit, referred to the earth's equator for the epoch 1880 ; J, N, the same for the orbit of the satellite ; Lo, the mean longitude at the epoch 1894 October, 0-0 Greenwich mean time ; n, the tropical mean daily motion ; a, the angular semi-major axis of the orbit, as seen from distance unity; ir, the longitude of the perioentre on the equator of Mars ; e, the eccentricity ; K, an angle varying uniformly with the time, whose rate of motion is equal to that of the peiicentre, and of the node of the satellite's orbit on the fixed plane ; and *, the time in years from 1894-80.*

The numerical values of the elements as found by Struve

Deimos.

Phobos.

K . . . .

29-9° – 6-375° « .

358-7° -158°-0J

Ji .

36° 46-5′ .

37° 26-7′

Ni .

46° 2-6′ .

47° 5-0′

(ISr-Ni) sin J

1° 37-6′ sin K .

0° 53-1′ sin K

J-Ji . .

1° 37-6′ cos K .

0° 53-1′ cos K

Lo .

186-25° .

296-13°

n .

285-16198° .

1128-84396°

a .

32-373″

12-938°

IT .

231° + 6-375° S

272-6° -)-158°-0J

e .

0-0031

0-0217

From the values of a follows : —

M M.

a^ of Mars 1

iss of sun 3090000

^

Professor Hall's figure, now generally used in astronomy, is

1/3093500.

Schur has measured the diameters of Mars with the heliometer, Barnard with the filar micrometer. The results for the equatorial and polar diameters, as seen from distance unity, are : —

Equnt. Polar.

Schur 9-526" 9-325"

Barnard 9-673" 9-581"

Each value of the ellipticity is markedly greater than that found by Struve from the motion of the pericentre of Phobos.

The minor planets individually are too minute to exert a sensible action on the other planets ; but the question Mass of whether the mass of the entire group, which tbe minor may number thousands, can be sufficient to pro- pianets. duce an appreciable secular variation of the node and perihelion of Mars is an important one. A rude estimate of the total mass of the group may be made in the following way : — From the stellar magnitude of each known minor planet we may roughly infer its diameter,

and hence its probable mass. The statistical law of pro- gressive diminution of the magnitudes or volumes, as derived from the known members of the group, may be extended to the undiscovered members. That a law of progressive diminution extends to the unknown members may be inferred from the fact that, if there were a very great number above a certain limit of magnitude, the whole mass would be visible as a

band of light spanning the heavens. The writer has found that by no probable hypothesis as to the number and size of these bodies, con- sistent with the absence of this band, can the total mass be sufficient to exert any appreciable action on any other planet.

The mass and diameter of Jupiter can be determined in two ways — by measures of the satellites and by the action of Jupiter on other bodies. The satellites are not well adapted to give an accurate value of the ”” ”’ mass, as any proportional error in their mean distances from the planet is multiplied threefold in the result. The following are the results for the reciprocal of the mass reached by different methods, with the weight that may be assigned to each : —

Observations of the satellites . . ju=1047-82 “Wt. 1

Action on Payes’s comet (MSller) . /t=1047-79 ,, 1

,, Themis (Kroeger) . . . m=1047-54 „ 5

„ Saturn (Hill) ...,,■ ;tt=1047-35 „ 7

„ Winnecke’s comet (Haerdtl) . ^=1047-17 „ 10

„ Polyhymnia (Newoomb) . ;U=1047-34 „ 20

The mean result.

Mass of Jupiter_ 1

Mass of sun

1047-35±-05

is that now adopted in the planetary tables. In 1901 De Sitter published an important additional result derived from heliometer observations by Gill and Finlay at the Cape Observatory. This was —

^=1047-226±0-067.

No definitive changes have been made in the adopted elements of the satellites of Jupiter in recent times.

The measures of the diameter of Jupiter are very numerous, and the differences between the results must be regarded as due to personal equation and peculiarities of instrument rather than to accidental errors. The latest results by the two methods are : —

Equat. Polar.

Schur, from observations with the heliometer 37-40" 35-13' Barnard, from observations with the filar

micrometer 38-52" 36-11"

This difference between the results of the two methods appears to be common to all observers, the method of double images always giving a smaller diameter than the micrometer. It may be attributed to a certain softness of outline of Jupiter's disc, which is easily remarked by a careful observer.

The ball, rings, and satellites of Saturn show mechanical features of great interest, not found elsewhere in our system. One of the simplest of these is that the ^^^^^^ planes of Saturn's equator, of its rings, and of at least its seven inner satellites, have a common secular motion due to the action of the sun. If the latter acted on each of these bodies separately, the secular motions of the planes would be greater the farther the satellite is from the planet, and the motion of the nodes would take place around the plane of the orbit of the planet, the planes of the orbits preserving a nearly constant inclination of almost 27°. The ultimate result of the unequal motion would be that the nodes would be scattered all round the circle, and the planes of the several orbits of the satellites might have mutual inclinations to each other amounting to 63°. But the mutual interaction of the equatorial pro- tuberance of the planet, the rings, and the satellites keeps

the motion of the whole system nearly in the same plane, as if it were a rigid body. Especially is this the case with the ring, in the form of which not the slightest deviation from a plane can he detected, whereas, if each of its particles moved independently, the whole would form a mass so broad as to quite conceal the planet from our view.

The most remarkable features of this system are the cases of libration among the motions of the satellites, most of which are quite unique in form. We note for com- parison the well-known relation among three of the satellites of Jupiter : if L, L', and L" are the respective mean longitudes of the first, second, and third of these bodies, we find that they always move so as to satisfy the equation —

L-3L'-t-2L"=180°. .

Let us, for brevity, call W the combination L— SL'-t-2L". It was shown by Laplace that, if W differed slightly from 180°, there would be small residual forces arising from the mutual action of the three bodies, tending always to bring it towards 180°. That is, if W were less than 180°, the force would tend to increase it ; if greater, to diminish it, and thusWmight swing back andforth on each side of 180° as a pendulum swings on each side of the vertical. This swing would be a libration. As a matter of fact, the swing is too slight to be dtserved ; W stays at 180° as a pen- dulum might constantly hang in the vertical position.

The similar librations in the Saturnian system have the remarkable feature that not only the mean longitude, but also the longitudes of the pericentres come into ten equations. The first case of this sort noticed was between the sixth and seventh satellites, Titan and Hyperion — the latter being the outer one of the two, and the faintest of the eight known satellites. Its orbit has long been known to be the most eccentric of the system, the eccentricity being 0-10. Professor Hall, by comparing his own observations with those of his predecessors, showed that the pericentre of the orbit performs a complete revolution in about eighteen years in a

retrograde direction, this being bhe reverse of the siecular motion due to the action of a disturbing body. It was found that this seeming anomaly arises from a peculiar action of Titan, having its origin in a near approach to commensnrability between the mean motions of the two bodies, three times that of Titan being nearly equal to four times that of Hyperion. The motions are so adjusted that if we put L, L'=the mean longitude of Titan and Hyperion, ir' the longitude of the pericentre of Hyperion, and V=4L'— 3L— tt', then the angle V will never differ much from 180°, but will continually oscillate on- each side of this value, as just explained in the case of the angle W for Jupiter. The annual retrograde motion of TT is, from the observations of Hermann Struve, 18-663°, so that the period of its revolution is 19-3 years. The eccentricity of Titan has the effect of making all the elements of Hyperion go through a change in nearly this period, which is determined by the angular distance of the pericentres of the two satellites. The expression for the inequalities thus arising in the eccentricity and peri- centre of Hyperion are —

A7r' = 14-0°sin(7r-7r') A e'= 0-0230 cos (ir-ir')-

The motion in question has also been theoretically investigated by G. W. Hill and Ormond Stone. They have established it to determine the mass of Titan, which is shown to be about 1/4300 that of Saturn itself. This is remarkable, because it seems certain that the angular diameter of the satellite is much less than one second, while that of Saturn when nearest the earth is about t-enty seconds. The satellite would therefore seem to be*

less than 1/10000 the size of Saturn, so that the mass found by HiU and Stone shows its density to be at least t; wice that of the planet. The masses of the other satellites have been found by Struve to be very minute, varying from 1/250000, in the case of Rhea, to 1/13610000 in that of Mimas.

The determinations of the mass of Saturn have been singularly discordant. They are made by measures of the major axes of the orbits of the satellites and by the action of Saturn on Jupiter. From measures with the heliometer on the brightest satellite. Titan, Bessel Jound /«,=3501-6. A subsequent correction increases the number by one or two units.

Leverrier, from the action of Jupiter, found 3629-6 (Annales de V Observatoire de Paris, xii. p. 9). Asaph Hall, from measures of Japetus with the 26-incli Washington telescope, 3481-3 ±0-54 (Washington Observations for 1882, app., p. 70). The small probable error of this last value, the great power of the instrument, and the considerable mean distance of the satellite, more than 500", would seem to inspire confidence in it. It was strengthened by the use of two quite distinct methods of observing — one with the micrometer, the other by transits giving differences of R. A. between the planet and the satellite. But Hill, from the action on Jupiter, found a result in substantial agreement with Bessel's. To decide the question Asaph Hall, juni, observed Titan with the heliometer of the Yale Observatory, and obtained a result confirming Bessel's. Yet H. Struve, from measures of Japetus and Tifan with the Pulkowa 14-inch equatorial, found 3498; and from Titan and the nearer satellites, with the great 30-inch instrument, 3495-3. In Hill's tables of Jupiter, and the other tables of the American Ephemeris, the value 3501-6 is adopted. ■ Still, the preponderance of evidence at the present time seems to favour a number rather below than above 3500.

For the angular diameters of Uranus and Neptune Barnard found, with the filar micrometer :- Uranus, 4-040" at dist. 19-183 Neptune, 2-433" " 30-0551.

The masses adopted in the new tables are : — Uranus, / =22869 Neptune, /u,= 19314.*

III. The Fixed Stars.

Our knowledge of the fixed stars has in recent years been widened to an extent which would not have been deemed possible two generations ago. The revelations of the spectroscope have given rise to a branch of astronomy so wide in its scope that it is sometimes regarded as a new science, that of astrophysics — a term now applied to the results of studies on the physical constitution of the heavenly bodies generally, whether the planets or the stars. It is impossible to draw a sharp line between the results of this branch of study and those of the older methods of investigation, sometimes called astrometry, which includes all forms of celestial measurement, whether of distance, motions, or magnitudes ; as

astrophysics progresses, it necessarily enters this field. Its most remarkable discoveries have resulted from the measure- ments of motions in the line of sight, the results of which belong strictly to astrometry. Our summary of the advances in stellar astronomy may be introduced by a brief general view of activity in the field at large.

*One prominent feature of recent progress has been the study of the southern heavens. A natural result of the great preponderance of observatories and means of recent research in the northern hemisphere ‘’”” was that, before the present generation, our ”™‘”’**’ knowledge of the southern heavens lagged far behind that*

Vranut and Neptuae.

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of the northern ones. When we recall the expedition of Sir John Herschel to the Cape of Good Hope in 1832-34, and the rather limited work of the observatories at the Cape, Melbourne, Paramatta, &c., before 1870, we shall have included the most important researches in this part of the sky. The first step towards a marked extension of our knowledge in this field dates from the foundation of the National Argentine Observatory at Cordoba by Dr Gould in 1871. This observatory has, since its foundation, been devoted to the work of cataloguing and mapping the southern heavens with instruments of precision. The results of this work are found in the splendid volumes, now eighteen in number, published by th6 observatory. A few years later, Sir David Gill, F.R.S., on his appoint- ment as astronomer of the Cape Observatory, so enlarged the means of that establishment and gave such an impetus to its work that it is now one of the leading observatories of the world. In the field of astronomy his work has differed from that of the Cordoba Observatory in being directed very largely towards the most precise measure- ments of a limited number of stars, Cordoba having devoted most attention to cataloguing all the stars which could be advantageously reached with the instruments. Gill’s most remarkable work has been done with the heliometer, an instrument which he has done much to bring to its present state of perfection.

Determinations of stellar parallax have been pursued by him with such success that we have now, so far at least as the brightest stars are concerned, a better knowledge of this subject for the southern heavens than for the northern. Yet more recently the foundation of the Arequipa Observatory, a branch of the Harvard Observatory, has marked an epoch in stellar photometry, to which branch it has been very largely devoted. Through its work, our knowledge of the magnitudes of the stars of the southern heavens now surpasses that of the northern heavens as it was in 1880.

Another prominent feature of the advance we are making has been the application of photography to astronomical investigation. From the time, about 1840, that Dr Draper took a daguerreotype of the moon, up to the year 1882, the photographic art played only a minor part in astronomical work. Perhaps Rutherfurd's work, that of Gould at Cordoba in photographing clusters of stars, the practice of photographing the sun at Greenwich in order to have a record of the changes of its surface, and the application of the art to the transits of Venus in 1874 and 1882, were the most important astronomical applications of photography during this interval. In 1882 Gill, in having the great comet of that year photo- graphed with a portrait lens, found that all the stars in the field of view, down to the 9th or 10th magnitude, were imprinted upon the negatives. Following up the idea thus suggested, he undertook the enterprise of form- ing by photography a catalogue of all the stars down to the 10th magnitude between the south pole and 23° of south declination. This work has been brought to a completion with the aid of Professor Kapteyn of Gronin- gen, who, with a disinterestedness to which it would be difacult to find a parallel in any other field than that of science, has devoted years of patient toil to the measure- ments of the positions of the stars on Gill's plates. As a result of this work, and that of Thome, Gould's successor at Cordoba, it may fairly be said that the stars are now even more completely catalogued for the southern heavens than for the northern.

Gill's demonstration, and the use in photography of more sensitive chemicals than had formerly been known, led to the idea on the part of the Paris astronomers of photographing the entire heavens by an

international association of observatories. A conference to decide upon the methods of doing this was invited by Admiral

Mouchez, director of the Paris Observatory, in April 1887. Here was formulated the plan for the international Carte Photographique du Ciel, which was undertaken by some eighteen observatories in both hemispheres. The work is all being done with similar instruments on a uniform plan. The charts in question form two series — one including only the stars down to about the 11th magnitude, the positions of which were to be determined by measurement, so as to form a catalogue, and the other all the stars which could be photographed with the longest available exposure. This work is not yet finished. Some portions of it were undertaken by observatories which appear not to have had the means for its successful prosecution, but other portions have been brought nearly or quite to a completion.

The application of the photographic method has been a prominent feature in the remarkable work of the Harvard Observatory. On assuming the direction of that estab- lishment in 1876 Professor Pickering decided to make astrophysics its speciality. The munificence of those interested in his work has enabled him to command a wealth of appliances almost without example, and to devote to their use one of the largest and best-trained corps of assistants ever engaged in astronomical observer tion. Before the Paris Conference he had planned a work somewhat similar to that vmdertaken by the conference and begun to piit it in execution. His object was, however, in one point at least, essentially different from that of the international enterprise, for his main idea was to photograph the sky from time to time with a view of detecting at the earliest possible moment any^change that might take place among the stars. A striking result of this system has already been mentioned — the discovery of the new planet Eros on a great number of plates taken before the existence of the body was known. Another result has been the discovery of several so-called new stars which have suddenly blazed forth, although, up to the present time, none have become objects that would strike the ordinary spectator. Another speciality of this observatory has been the study of stellar spectra by photography. In this connexion, the aid afforded by the Draper Memorial Fund is worthy of mention. The wealth of material thus

accumulated is so vast that its complete publication is scarcely possible. Yet every spectrum photographed is subjected to careful scrutiny, and any remarkable peculiarity that may be exhibited is published and discussed. Photometry has been one of the main branches of Professor Pickering's work, and the volumes already published contain estimates of the magnitudes of stars measured photometrically, now including the entire heavens in the scope of their contents.

Two other important photometric works have appeared which are especially noteworthy, because made with instruments radically different from each other and from that of Pickering. The photometric work of the late Professor Charles Pritchard, F.E.S., at Oxford, was carried out by the use of the extinction wedge, of which a description will be found in the article Photometbt, Stellar. The same subject has been a leading feature of the work at the Astrophysical Observatory at Potsdam. The founding of this institution by the German Govern- ment soon after the close of the Franco-German war marked an epoch in the development of astrophysics, both because of being contemporaneous with the beginning and early growth of that science and because of the wisdom which has marked its administration. In stellar pho- tometry the special feature of its work has been a very careful determination, by two observers, of a list of stars more limited than that investigated at the Harvard Observatory. The field to be covered includes the

hemisphere between the equator and the northern celestial pole. It is divided into zones of 20° in breadth. The zones from the equator to 40° of declination have already been published.

The most remarkable work now done with the spectro- scope is the determination of the motions of stars in the line of sight. The earliest attempts at such measures were those made by Sir William (then Mr) Huggins ; and after the practicability of making such determinations was demonstrated by him, the work was taken up at the Eoyal Observatory at Greenwich. In these early researches only optical methods were used

which were not susceptible of the highest precision. The introduc- tion of more sensitive chemicals into photographic prac- tice led to the great improvement of photographing the spectra of stars instead of observing them visually. A twofold advantage is thus gained: fainter spectra can be photographed than can be measured with the eye, and the errors to which the eye observations are liable can be almost entirely done away with. The first extended application of the photographic method to this purpose was made by Dr Vogel at the Potsdam Obser- vatory; he measured the motions of forty-eight of the brighter stars in the line of sight with a precision that could not easily be reached by the optical method. The most interesting results of the new system of observation have been the discovery of binary systems among the stars. In this work, Campbell of the Lick Observatory has been remarkably successful ; the results reached by him, Deslan- dres, and others will be summarized in their proper con- nexion.

Parallaxes and Proper Motions of the Stars.

The methods of determining the parallax of a star are of two kinds. In the one the actual parallax is deduced from the annual change in the right ascension or declina- tion of the star produced by the motion of the earth round the sun, and shown by comparing observations with a meridian instrument of the highest precision. Parallaxes determined in this way are termed absolute. It is now found that, owing to the annual and diurnal changes in the instrument and in the air caused by the varying temperature of night and day, summer and winter, it is impQssible to determine precisely, even with the most refined appliances of modern astronomy, variations in the absolute position of a star so minute as its parallax. Efforts to determine absolute parallaxes have therefore been abandoned. The method now in universal use consists in referring the' displacement of the star whose parallax is measured to small stars lying in nearly the same direction. The. numbers thus obtained are the relative parallax between the star measured and those with which it is compared ; and if the stars of comparison are so distant as to have no appreciable parallax, the result will give the actual parallax required. Hbw far this is the case we cannot yet say with certainty ; but it is probable that, as a general rule, the stars of comparison have rarely any parallax amounting to a hundredth of a second. In recent times the heliometer has been the

most powerful instrument for such determinations ; and in the hands of Gill, Elkin, Peter, and others it has been applied in making a revision of many results previously obtained with other instruments, and in investigating suspected new cases of parallax. But at the present time it bids fair to be eventually supplemented or even superseded by the photographic telescope. The great advantage of the pho- tographic method lies in the ease with which a plate can be taken and the leisure with which the images of the stars can be measured upon it ; the attempts recently made in this direction seem to show that the precision is not markedly less than that attainable by the use of the heliometer.

It is difficult to make a selection of the stars whose parallax can be said to be determined, but, roughly speaking, we may state the number to be 100. Among these are several cases in which the instrument or method of using it was so imperfect that the results are more or less doubtful, and many others in which the apparent parallax is so minute that it is questionable whether the result may not be due to errors of measurement rather than parallax. Such is undoubtedly the case when the result comes out with a negative algebraic sign, as has happened with some apparently good determinations. The following is a list of the determinations which may be regarded as actual, including all which have been made with the heliometer, even when the result is so minute as to be doubtful. The letter g signifies that the result is one of an exceptionally good class reached under Gill's direction by the heliometer of the Cape Observatory. The probable error in these cases is gen- erally between 0-01" and 0-02". A colon indicates that the parallax is of a rather doubtful character, needing to be re-determined by modern methods, and two colons that it is among the more doubtful of this class. The results given without any indication may be supposed to be afEected by a probable error varying from 0-03" to 0-05".

Parallaxes of Stars.

Star.

Position for 1900. 1

E. A.

Deol.

Par.

h. m.

o

”

/3 Cassiopese .

0 4

-1-58 -6

-15

Gr. 34

0 13

-f-43-4

•30

f TucansB .

0 15

-65-5

•14

^ Hydri

0 20

-7-7-8

•13 g

o CassiopesB .

0 35

-)-56-0

-04:

11 CassiopesB .

0 43

-f57-2

-20

7 CaBsiopese .

0 50

+ 60-1

-01:

/* Cassiopese .

1 2

-1-54 -4

•14

Polaris

1 22

-f88-8

-06

o Eridani

1 34

-57-7

■04 g

T Ceti .

1 39

-16-5

-31 g

E Eridani

3 16

-43-5

•15 g

50 Persei

4 2

-1-37 -8

•04::

o2 Eridani .

4 11

- 7.8

•17 g

o Tauri

4 30

-1-16 -3

•11

C. Z. Vli. 243 .

5 8

-45-0

•31 g

o Aurigse

5 9

-1-45 ‘9

•09

, p Orionis

5 10

- 8-3

•00 g

o Orionis

6 50

1 7-4

•02

;8 Aurigse

5 52

-f44-9

•06:

a Argfis

6 22

-52-6

•00 g

X° AurigsB .

6 39

-1-43-7

•11

o Can. Maj. .

6 41

-16-6

■37 g

51 H. Cephei .

6 53

-f87-2

•03:

a Geminorum

7 28

-1-32-1

•20::

a Can. Min. .

7 34

1 5-5

•30

/3 Geminorum

7 39

-f28-3

•06

LI. 15290 .

7 47

+30-9

-02

I TJrs. Maj. .

8 52

-1-48-4

-13:

10 Urs. Maj. .

8 64

-t-42-2

-20

LI. 18115 .

9 8

-f53-l

-18

e Urs. Maj. .

9 26

-f52-2

■07

LI. 19022 .

9 37

+43-2

-06

20 Leo. min. .

9 55

+ 32-5

•06

o Leonis

10 3

+ 12-5

■02

Gr. 1618 .

10 5

+ 50-0

■18

Gr. 1646 .

10 22

+49-3

•10

Gr. 1657 .

10 27

+49-7

•04

LI. 20670 . , .

10 38

+47-7

•01:

LI. 21185 .

10 58

+36-6

•46

LI. 21258 .

11 0

+44-0

■22

S 1516 .

11 9

+ 74-0

•15

0. A. 11677 .

11 15

+ 66-4

•27:

S 1561 .

11 33

+45-7

•03

Gr. 1822 .

11 40

+48-2

•02

Gr. 1830 .

11 47

+38-5

•14

LI. 22632 .

11 57

+43-7

•00:

LI. 22810 .

12 4

+40-8

-06

o Crucis

12 21 <

-62-5

-05 g

/3 Cruois

12 42

-59-1

•00 g

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Parallaxes

of Stars — contitmed.

star.

Position for 1900.

E. A.

Decl.

Par.

h. m.

O

”

/3 ComsB

13 7

+28-4

•11

o Virginis

13 20

-10-6

■00 g

j8 Centauri –

13 57

+ 69-9

•03 g

a Bootis

14 11

+ 19-7

•03

o Centauri

14 33

-60-4

•75 g

LI. 27298

14 62

+ 54-1

•08

o Soorpii

16 23

-26-2

•02 g

ij Herculis

16 39

+39-1

•40 :

TT Herculis

17 11

+36-9

•11 :

S Herculis

17 11

+24-9

•05 :

V Draconis

17 30

+55-3

•32 :

0. A. 17415

17 37

+68-4

•22

70 OphiuoM

18 0

+ 2-5

•19

S XJrs. min.

18 5

+86-6

•03 :

a Lyrae

18 33

+ 38-7

•11

0. A. 18609

18 42

+ 59-5

•35 :

31 Aquilae

19 20

+ 11-7

•06

19 33

+ 69-5

•26 :

a AquilsB

19 46

+ 8-6

•23

o Cygni

20 38

+44-9

•00

61 Cygni

21 2

+38-2

•39

a Cephei

21 16

+62-1

•06 :

6 Indi

21 56

-57-2

•27 g

a Gruis

22 2

-47-4

•02 g

a Fiscis Austr.

22 52

-30-1

•13 i

Lac. 9352

22 59 .

-36-4

•28 g

Br. 3077

23 8

+ 56-6

•15

85 Pegasi

23 57

+26-6

•05

A desideratum of astronomy is a general survey of the heavens with a view of determining all the' stars which have an appreciable parallax. Such a survey Parallactic ^g ^^^ made possible by photography. To carry ■'" it out it is necessary to take two or three plates of each region of the heavens at those opposite seasons when the stai-s in the region have the maximum displace- ment by parallax in opposite directions. A comparison of the plates then shows whether any such displacement can be detected. The only attempt in this direction which has thus far been carried out was made by Pro- fessor Donner at Helsingfors, with the co-operation of Kapteyn, the photographic telescope being that used for the international chart of the heavens. Each jilate taken for parallax was exposed three times, at intervals of six months. At the first exposure three images were made on the plate in slightly different positions. At the sec- ond, six months later, six images were made in the same way. At the third, a year after the first, three more were made. Thus, twelve impressions of each star were taken, forming together a rectangle of three stars on one side and four on the other. On such a plate the detection of a parallactic displacement is very easy. Unfortu- nately, only a region little more than 2° square, extend- ing from 20 h. 1 m. to 20 h. 10 m. in right ascension, and from 35° to about 37° in declination, has yet been exam- ined. The plates were carefully measured by Kapteyn. In three or four cases there is some presumption of a parallax of O^l", but in no case is it so strongly

marked as to be beyond doubt. The probable error of a result from each plate is ©•034" ; but it^is quite in accord with the theory of probabilities that errors of three or four times this amount should occur in one or more of the re- sults. The extremely limited number of stkrs having a certainly measurable parallax renders it desirable to find other methods of estimating their distances. It was for- merly supposed that the actual magnitude of the stars did not differ greatly from each other, and, if that were the case, an approximate estimate of the distance could be obtained from the apparent brightness. But it is now known that this 4s so far from the case that brightness alone scarcely affords any clue to the distance of a star.

All that we can say with certainty is that, in the general average, the fainter stars are more distant than the brighter ones in a ratio which admits of approximate determination, a statement which tells us nothing abou.t the actual distance of any single star. More information is afforded by the proper motions of which we shall next speak.

The work of cataloguing the stars and determining their exact positions, which is now being pursued on so large a scale, naturally involves the determina- tions of their proper motions. Every star may ^fioas. be considered as having a proper motion of its own; but the number for which the proper motion has been determined is comparatively small, because, apart from the results of spectroscopic measurements of motion in the line of sight, which are necessarily extremely lim- ited, the motion can be detected only by a comparison of observations taken at long intervals of time. The longer the interval the slower the motion that may be detected. We have now an interval of more than a century in the case of the stars observed by Bradley at Greenwich, about the year 1750-63, and one of the greater part of a century in the case of several other catalogues. From Auwers's discussion of the Bradley stars, 3240 in number, it appears that a little more than one-half of these ob- jects have a proper motion of 5" per century or more. A little more than one-half of Bradley's stars are easily vis- ible to the naked eye, and the greater part of the remain- ing half are between the 6th and 7th magnitude. Con- sequently the conclusions derived from this work apply only to the brighter stars. Speaking in a general way, we may say that about one-half

of these stars are known to have a measurable proper motion. In the case of the fainter stars the proportion would undoubtedly be much smaller than this, but it cannot be exactly stated at pres- ent. A few stars have a proper motion so abnormally rapid that it could be detected within a single year. Of these the most rapid known up to a recent time was that of Groombridge 1830, pointed out by Argelander. In 1897 Gill and Innes, at the Cape of Good Hope, found a star of yet greater proper motion. This case was carefully investigated by Kapteyn, who, by a comparison of the Cape photographs and Cordoba observations, found the motion to be the greatest yet known. The following is a list of the stars now known to have a proper motion exceeding 3" per year : —

Name.

E.A.

1900.

Dec.

1900.

Prop. Motion.

Mag.

o

• ‘

C. Z. Vh., 243 .

5 8

-45^0

8^70

8^5

Gr. 1830 .

11 47

-(-38^4

7^04

6-9

Lao. 9352

22 59

-36-4

6^94

7-5

Cor. 32416

0 0

-37-8

6^07

8^5

61 Cygni .

21 2

-|-38^3

5-20

6-7

LI. 21185

10 58

4-36 ‘6

4 •76

7 3

e Indi

21 56

-57 ‘2

4^61

5-2

LI. 21258.

11 0

-|-44^0

4^41

8^7

0^ Eridani

4 11

- 7^8

4 06

4^6

M Cassiop

1 2

-f-54^4.

3^73

5^6

0. A. 15318 .

15 5

-le^o

3-68

91

0. A. 15320 .

15 5

-15^9

3-68

91

o Centauri

14 33

-60^4

3 60

10

Lao. 8760

21 11

-39^2

3^53

7^3

e Eridani

3 16

-43^4

3-12

4-4

0. Arg. 11677 .

11 15

+ 66^4

3 '02

9^0

This table presents two notable features. One is the minuteness of many of the stars. That the star having the most rapid motion yet known should be below the 8th magnitude is illustrative of the great range of abso- lute brightness among the starSj^ The other feature is that two fourths of the circle of right ascension, namely, those from 5 h. to 11 h. and from 16 h. to 21 h., scarcely

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contain any of the sixteen stars, except at their limits. This may be attributed to the effect of the solar motion in exaggerating the apparent motion of , stars far from its apex.

A desideratum of the present time is an exact know- ledge of how many stars in the heavens have a measurable proper motion, or, in greater detail, how many have proper motions of each order of magnitude. The data for completely solving this question are still wanting, but the most complete attempt in this direction is that of Auwers, who observed the zone of the " Astronomische Gesellschaft," 16°-20°, at Berlin. He made a compari- son of the 8000 stars in his zone with the older observa- tions as far as they were available, and the result was the discovery that 1200 of the stars had proper motions large enough to be detected. Assuming that in the whole heavens the number is proportional to the area, we may regard it as probable that 20,000 stars have a proper motion, extending 5" per century. Several astron- omers have made catalogues of stars having exception- ally large proper motion ; the most thoroughly worked up of these catalogues is that of Porter for 1890, Publi- cations of the Cincinnati Observatory, No. 12, but Bos- sert's in the Paris Observations for 1890 contains more stars — ^2675 in all.

That our sun is to be included among the stars having a proper motion has long been inferred from an apparent

motion of the stars in the opposite direction, motfon. called the parallactic motion. If we regard the

general mean position of the mass of stars as at rest, our solar system is relatively to this mean mov- ing toward a point, now known as the Solar Apex, which was long supposed to be situated in the constellation Hercules. Although the approximate situation of this point has been known since the time of the elder Her- schel, yet its exact determination is a matter of ex- treme difficulty, owing to the diversity of the actual motions of the stars and the irregular distribution of those which have

been determined. In the following summary of the results of recent researches, we put A for the right ascension of the apex and D for its declination. Professor Lewis Boss, from 279 stars of large proper motion in the zone 1° to 5°, derived A=283-3°; D= -|-44-l°. This result might be seriously influenced by the introduction of \ stars of abnormally large motions; had he excluded twenty-six motions exceeding 40" per century, the result would have been A =288 -7°; D= -1-51 5°. Porter of Cincinnati, and Stumpe of Berlin, have each made determinations based on all the well determined proper motions available at the time. Porter's list included 1300 stars, Stumpe's 996, the greater number of the stars being common to the two lists. Each investi- gator classified his material according to the proper motions of the stars. Stumpe excluded all motions less than 16" or greater than 128" per century. Between these limits they were divided into three groups : Group I., from 16" to 32" ; II., from 32" to 64"; III., from 64" to 128". The separate results were : —

Group I. (551 stars) A=287-4;

D= -1-45-0

„ II. (339 „) 287-2;

43-5

„ ITT, (106 „) 280-2;

33-5

Porter {Ast. Jour. xii. p. 89) divided his proper motions into four groups : I., those less than 30"; II., those be- tween 30" and 60" ; III., those between 60" and 120"; IV., those exceeding 120". The results were : —

Group I. (576 stars) A=281-9;

„ II. (533 „) 280-7;

„ III. (142 „) 285-2;

„ IV. (70 „) 277-0;

D=

+53-7 40-1 34-0 34-9

All three of these agree in the general conclusion that the smaller the proper motions used the greater the declination of the resulting apex, and, in a less degree, the greater its right ascension. But this conclusion needs farther examination before it can be accepted as fully estab- lished. Some doubt is thrown upon it by the fact that the position of the solar apex from all the stars of Brad- ley's catalogues having a small proper motion is A= 274-2°; D= -f-31-2°. The discrepancy, especially in the declination of the apex, is far outside the normal limits of error on any probable hypothesis, and suggests the necessity of a more thorough examination of the question than has been made. The general conclusion which may be drawn from these results is that our system is mov- ing toward the constellation Lyra, not Hercules. The point is probably near right ascension 280° and declina- tion -1-38°; but there is an uncertainty of several degrees in this position which cannot be removed until an im- proved method is applied.

An important and interesting point is that of the speed of the motion. The most obvious method of determining this is through the apparent parallactic motion of the stars whose parallaxes have been Speed ot actually measured. When we see a star at a m^'ion. known distance moving away from the sun's apex with a given angular velocity, the transformation of this given velocity into a linear velocity is ex- tremely simple, and gives the relative velocity between the sun and star. The measure of these results from all the stars included will give the speed of the sun relative to their mean position. In this way, from the list of stars whpse parallaxes have already been given, it would follow that the speed in question was 6 radii of the earth's orbit in a year, which would correspond to nearly 28 kilometres per second, about that of the earth in its orbit. But this result has an unavoidable defect arising from the fact that the stars selected for measures of par- allax have been those having large apparent proper motions. A star whose actual motion is in the opposite direction to that of the sun will have a large apparent motion, while one moving towards the solar apex may have little or no apparent

motion, though its actual angu- lar motion may be the same. In consequence, the selec- tion is biassed by including mainly those stars whose absolute motion is away from the apex. Consequently, the result is too large. The speed in question can also be derived from the observed motions in the line of sight or radial motions. Kapteyn has done this by a statistical method. From a study of the apparent angular motions of the stars can be derived the ratio between the velo- city of the sun and the mean velocity of the stars in general. This mean velocity is found in linear measure from the observed motions in the line of sight, and its product into the ratio derived from the angular motions gives the actual linear velocity of the sun. The resulting speed of the sun's motion was, in round numbers, 16 kilometres, or 10 English miles, per second. This result is now superseded by a recent research of Campbell, based on 280 radial motions {Astrophys. Jour. January 1901), giving a speed of 19-89 ±1-92 km. This speed is almost exactly 4 radii of the earth's orbit per year.

It will be seen that the apparent proper motion of a star is made up of two components — the actual motion relative to the mean of all the stars, sometimes called the motus pecvliaris, and the parallactic motion, which is only apparent, being due to the motion of the sun. It has been shown by Stumpe that, when we take a large number of stars and classify them according to their total proper motions, the ratio of the parallactic motion to that pecul- iar to each star is nearly the same, for large and for small

motions. The former is proportional to the sine of the angular distance of the star from the apex divided by its distance from the earth. It follows from the approach to uniformity in the ratio that the peculiar motions of the stars are also, in the general mean, inversely proportional to their distance from us. Consequently, the actual mean linear velocity of the motion may be taken as the same for stars of various distances, so tiiat the apparent motion will be inversely as the distance. Of course this equality ' in the general mean by no means implies any approxima- tion to equality in the case of individual sta'rs ; yet there is some reason to believe that it is only in exceptional cases that the linear velocity of motion of the stars

exceeds a certain limit which it is difficult to fix with precision, but which may be estimated at 40 or 60 kilometres per second. To such a limit there are two remarkable excep- tions, one of which has been known for some time, while the other is of recent discovery. Although the proper motion of the star 1830 Groombridge is, with one excep- tion, the greatest of any known, measures of its parallax show that it is by no means among the nearer stars. The combination of the parallax already given with the observed motion indicates a component of linear velocity perpen- dicular to the line of sight amounting to about 240 kilometres per second. The recent measures of Elkin on the parallax of Arctums indicate that its linear velocity is probably neetrly as great as and possibly much greater than that of the Groombridge star. The parallax found by Elkin was 0-016" ; but in view of the fact that other measures, though far less trustworthy, have given a larger value in the table, 0”03" has been assigned as the most probable parallax. This gives a linear velocity of some 350 kilometres per second.

One of the most interesting questions growing out of the proper motions of the stars is whether there is any

general law among them which indicates that i^vot they move in definite orbits and that the uni- fflotfon. verse as a whole forms a stable system. Up

to the present time nothing in the way of a general law has been discovered. In a few cases, some of which are mentioned in the original article in the ninth edition of the ‘Ency. Brit, stars in the same region are found to have a common proper motion, indicating that they may form a system among themselves, but these cases are so exceptional as to prove nothing : the general rule seems to be that the proper motion of a star has no connexion with its location in space or its relation to the universe in general. On no probable hypothesis that we can make respecting the mass of the stars could the attraction of all the known bodies of the universe hold either Arcturus or 1830 Groombridge in an orbit.

Variable Stars.

The study of variable stars has in recent times, in connexion with measures of motions in the line of sight, opened up a new and interesting branch of Sidereal Astronomy, and the number of these objects which have been made the subject of accurate observation is now so great that a classification according to the law and period of the variations is possible. The statistical basis on which such a classification must begin is found in Chandler's catalogues, of which the third was published in the Astronomical Journal, vol. xvi. Omitting from our con- sideration ri Argus and other irregularly variable stars, as well as the so-called new stars, we find in that catalogue 280 periodic stars, properly so called ; that is, such as go through all their changes in a definite period. Classify- ing the periods according to the length, we find them to be as follows : —

Periods. Stars.

Less than 50 days 63 s

50 to 100 „ 6

100 „ 160 „ 9

150 „ 200 „ 18

200 „ 250 „ 29

250 „ 300 „ 40

300 „350 „ 44

350 „400 „ 44

400 „450 „ 18

450 „ 500 „ 6

500 „ 550 „ 1

550 „ 600 „ 1

600 „ 650 „ 1

The most suggestive feature of thig tatble is the well- marked limitation of the period. From the maximum of about 350 days, the number of periods having a given length continually falls off until we reach 610 days. This is the longest yet known. It follows that there is some- thing in the constitution of these bodies, or in the cause on which their variation depends, which limits the period. It was formerly supposed that the eleven-years period in the magnitude and frequency of spots on the sun made the sun a variable star ; in fact, that the periodicity of the stars might be due to the same cause as that of the solar spots. But the great length of the sun-spot period, taken in connexion with this limitation, seems to disprove the analogy. Passing up towards the other end of the table we are struck by the rapid falling off towards the limit of 50 days and the great number less than 50 days. It might seem that we have here a sharp line of distinction between the two classes — those of long and those of short period. But an examination of the periods in detail does now show any such line. Eight periods are less than 1 day, and about 40 between 1 and 10 days, and from this point up to 100 days they are scattered with a fair approach to uniformity.

The law of change of a periodic star may be represented graphically by a curve. A straight horizontal line or axis of abscissae is taken to represent the time, and on it equal spaces represent equal times. At each point upon it an ordinate is erected proportional to the amount of light emitted by the star at the corresponding moment. A curve through the ends of these ordinates is the light curve of the variable star. It will be readily seen that, in the case of a star of constant brightness, the ordinates will all be equal, and the curve will be a straight hori- zontal line. Whatever the law, if the star be a periodic one, the ordinate will return to the same value at the end of a period, and the continuance of the curve through successive periods will be repetitions of the curve corre- sponding to the first period. It is therefore only necessary to continue the curve through a single period.

A classification of variable stars has been facilitated by the discovery of the cause of variation in certain classes of the stars of shorter periods.

The most distinctive class of such stars are those which remain constant during the greater part of the period, and then temporarily lose a portion of their light, soon to recover it again. The brightest and longest-known of this class being Algol or j8 Persei, stats which vary in this way are said to be of the "Algol type." The curve of such a type is a straight line with a depression at the end of each period. This feature strongly distinguishes the type from those in which the variation, whatever its law, is continuous, for in those cases, which include a great majority of variable stars, the curve is nowhere a straight line.

The great development of the subject in our times began with the discovery of the cause of the change in the case of stars of the Algol type. Ever since a, ,^ the variability of Algol was observed, it was '^'

suspected to be due to a partial eclipse of the star by the

interposition of a dark body nearly as large as the star revolving around it ; but this explanation remained only a surmise until Vogel of Potsdam, by repeated measurements of the motion of Algol in the line of sight, showed that the star is always receding from us before the loss of light, and approaching us afterwards. This was so exactly the result that would be" produced by the revolution of such a body as that supposed that no doubt could remain on the subject, and by a legitimate induction the variations of all stars of the Algol type are now assumed to be partial eclipses caused by the interposition of a dark companion moving around them. The number of stars of this class is small, only about 12 being yet known. This may be partly due to the- difficulty of detecting variations of the type. Owing to the temporary character of the loss of light, the magnitude of such a star might be observed a great number of times without the variation being detected, since it would be noticed only when the obser-vation happened to be made during the partial eclipse. The following list shows the main particulars relating to stars of this type, their positions, periods, magnitudes, and loss of light when eclipsed : —

Variable Stars

of the Algol Type.

Position.

Magnitude.

Dim-

Name.

Period.

inu- tion.

E. A.

Deo.

Usual

Min.

h. m.

o

d. h. m.

0 Cephel ....

0 63

+81 -8

2 11 49-6

7-1

9-2

2-1

p Persei ....

8 2

+40-6

2 20 48-9

2-3

8-6

1-2

K Taurl ....

8 55

+12-2

8 22 62-2

3-4

4-2

0-8

K Can. Maj. .

T15

-16-2

1 8 16-8

5-9

6‘7

0-8

S Canopi ....

8 8S

+19-4

9 11 87-8

8-2

9-8

1-6

S AntUa ....

9 28

-28-2

0 7 46-8

6-7

73

0-6

S Velorum

9 29

-44-8

5 22 24-4

7-8

9-8

1-5

S Libra ....

14 56

- 8-1

2 7 61-4

6-0

6-2

1-2

U Coronse ....

16 14

+82-0

8 10 61-2

7-6

8-9

1-4

R Ara . . . :

16 81

-56-8

4 10 12-7

6-9

8-0

1-1

Z Hercules

17 64

+16-1

3 23 49-5

71

8-0

0-9

ES Sagittaril

18 11

-84-1

2 9 68-6

6-4

7-5

1-1

Anonymous

19 48

+32-6

6 0 8-8

10-8

12-9

2-1

Anonymous

20 4

+46-0

4 18 45-0

9-0

11-7

2-7

W. Delphini .

20 83

+17-9

4 19 21-2

9-5

12-0

2-6

Another but analogous type of variation is that of /8 Lyrse. The characteristic of this type is that in each period there are two equal maxima and two' fi Lyrx unequal minima. The variation of light is ■ seemingly continuous. G-. W. Meyers {Astro-

physical Journal, vii.) has offered a theory of this type of variation which explains the phenomena so precisely that we cannot seriously doubt its correctness. Two un- equal bodies, so near together as to be almost in contact, revolve round each other. By their mutual attraction and the centrifugal force they are drawn out into prolate ellipsoids, each rotating in the same period as that of revolution, so that they revolve as a singly mass. Each star partially or wholly eclipses the other in each revolu- tion. When the line of centres is at right angles to our line of sight, the two bodies present to us their greatest apparent surface, and therefore send us their maximum of light. As the line becomes oblique from the revolution they are seen more and more foreshortened, and conse- quently diminish in brilliancy. Were the two bodies of equal surface brillia^ncy, the apparent magnitude of mini- mum would be the same whichever was eclipsed. The inequality of the alternate minima indicates a difference in magnitude and brilliancy. It will seem that this type resembles the Algol type in that the variations of light are due to the different aspects under which a pair of stars is seen as they revolve around each other, and especially by one star of the pair eclipsing the other, and not by any actual changes in the bodies themselves. It is now found that the two types merge into each other by insensible gradations. The principal intermediate type is one in whi^, calling the two stars A and B, A eclipses B and B

eclipses A at each revolution. In such a case, if the orbits were quite circular, it would be impossible by eye-observa- tion alone to distinguish this type from the Algol type, in which the eclipsing body is dark. But if the orbit is eccentric the alternate minima will occur at unequal intervals. Even if such is not the case, the period may be detected by spectroscopic measures of velocity in the line of sight, if only the star is bright enough to admit of its motion being determined in this way.

Systems of Stars, Clusters, and Nebulas.

Since 1880 there have been discovered great numbers of double stars, now more properly known as binary systems, which had formerly escaped detection, owing to the difficulty of ascertaining their f.^, Character with telescopes less perfect than those of our time. Few general facts, however, have been brought out by these discoveries. The advance of our knowledge has mainly consisted in the more accurate determination of the elements of the orbits and the times of revolution of those systems whose period of revolution is less than a century. The trend of recent research is towards extending the conception of systems of stars almost indefinitely in two opposite directions. Since, vrith every increase of telescopic power, closer binary systems of shorter and shorter periods are found in" constantly in- creasing numbers, we cannot set any limit either to the actual minuteness of such objects or to the shortness of the period. Far within the limit to which telescopic vision can ever extend, such systems are now being brought to light by the spectroscope. These systems appear as a connecting link between certain variable stars on the one hand and the telescopic double stars on the other. Stars of the class to which the Algol type of variables belongs will appear to us to vary in brightness only in the very exceptional cases when the plane of the orbit which one body describes around the other passes so near our sun that the one seems to pass over the other, and so causes an eclipse. lii all cases, except those in which the line of sight is nearly perpendicular to the plane of the orbit, the revolution of the two bodies around their common centre of gravity will result in a periodic variation of the motion of each in the line of sight. Such a motion may be detected by the spectroscope. If only one of the two bodies is luminous, its motion will be shown by a periodic change in the displacement of its spectral lines. This, so far as yet known, is the usual case. If both are luminous, especially if they do not differ much in brightness, the motion of revolution will be shown by a periodic doubling of the lines. When, were they visible, they would appear Jo us in conjunction, their spectra are merged into one, which will show nothing unusual ; but if one is moving from us and the other towards us, the spectral lines will be displaced in opposite directions, so that all of the lines strong enough to be seen in both spectra will appear double.

But while there is thus no well-defined inferior limit to the dimensions of systems of two stars, recent research shows that we cannot set any

superior limit to the number of stars which may form a system or to the dimensions of such a system. Considering those binary systems whose components are distant from each other, we may, at the first step, meet with a difficulty in deciding whether two stars apparently near each other really form a system, or appear to us together because they happen to be in the same line from us. If their distance is a very few seconds, the presumption would be in favour of a physical con- nexion. At greater distances the only evidence yet available is found in their relative motion. If the smaller star shares the proper motion of the brighter one, the

evidence bf connexion is nearly conclusive. If it does not, we assume that they are simply two isolated stars. In the article Astronomy {Ency. Brit. vol. ii. p. 820) it was shown that five stars of Ursa Major have a common proper motion, all moving nearly in the same direction and with equal velocity. But though no other case like this has yet been discovered, there are several cases of pairs of stars near each other betraying a relationship by their proper motion, which would never have been suspected on any other ground. The two most remarkable cases of this sort are — (1) a pair of stars in E. A. 15 hours 4 minutes Dec. – 16° 54', five minutes apart, and (2) A Ophiuchi, which has a star of the same proper motion following it about 13'. It is not unlikely that pairs like these form binary systems with very eccentric orbits and long periods of revolution.

It does not now appear that we can draw any sharp line as regards numbers of stars between the binary systems which we have been considering and clusters whose components are too numerous to be counted. Triple or quadruple stars have long been familiar ; of the latter 0 Orionis in the great nebula of Orion affords a typical example. In this case two other stars much more minute belong to the system. Sometimes it is possible to make an actual count of the stars in a cluster, as is the case with Preesepe, in Cancer, which appears to the naked eye as a nebula, and which the tele- scope shows to be composed of a definite number of com- paratively bright stars. We have also such agglomera- tions as the great cluster of Hercules, where a complete resolution into stars is just

possible with the best tele- scopic power yet reached. The application of photography to these objects has thrown much light on their general character. Many of them have been photographed at the Harvard Observatory, but even there it has not always been possible to separate all the individual stars in the densest clusters. Perhaps the most remarkable feature brought out has been the great number of variable stars in some of the clusters. The following statement is extracted from a Harvard circular : —

star clusters.

Cluster.

Stars examined.

Number ofTariables

(1) Centauri

3000

125

Messier 3

900

132

Messier 5

900

186

In all 509 variable stars were found among 19,050 examined ia twenty- three clusters, a number which exceeds that known to exist in the rest of the sky. Perhaps the most interesting questions suggested by these cluster systems is that of their stability. On any probable hypo- thesis that we can

make as to the constitution of the individual stars, their mutual attraction must be such as would bring them into a single mass in the course of a few thousand years. Why, then, have they not condensed into such a mass ? Perhaps the most plausible answer that can now be made is that the iadividual stars are all moving in irregular orbits under their mutual attraction. If such be the case, the motion would be made manifest by the comparison of photographs taken at intervals of twenty, fifty, or 100 years.

The questions which have arisen in our time respecting the constitution of various nebulae, the changes which they may undergo, their individual forms, and their Nebuis. relations to the stars seen among them, are so numerous that no discussion of them is possible within our present limits. The greatest addition to our means of knowledge has been made, as in many other cases, by the application of photography. Here the works of Dr Isaac Roberts, F.R.S., and Dr A. A. Common, F.E.S., are worthy of special study ; their results are for the most part to be found in the publications of the Eoyal

Astronomical Society. One fact brought out quite re- cently is the superiority of the reflecting telescope qver the refractor in this connexion, owing to the absence of chromatic aberration which, even in the secondary character it assumes in the best refracting telescopes, is very appreciable in the long exposures necessary. The great advantage of photography is due to the fact that, in a clear dark sky, it is possible to obtain images of objects which escape vision. This is the case not only with the smaller stars, but apparently in a still higher degree with the nebulae. Among the most remarkable objects brought out by photography is a great nebulous mass winding through a considerable portion of the con- stellation Orion, first discoved by W. H. Pickering, and afterwards confirmed by Barnard. Among other remark- able nebulosities of this sort is one in the region of p Ophiuchi, photographed by Barnard in 1894 ; while a third is the singular nebulosity surrounding the Pleiades, carefully studied by Barnard {Monthly Notices B. A. S. January 1900). Quite recently a surprising number of new nebulae have been photographed by the Crossley reflector of the Lick Observatory. Professor Keeler con- cludes that, judging from the number of these objects brought

out with this instrument, there must be as many as 100,000 in the heavens, an average of between two and three to every square degree. It would, therefore, scarcely be an overstatement to say that the heavens are to be regarded as filled with nebulae. The spectrum of these objects (see Ency. Brit. vol. ii. p. 821) seems to show that they are gaseous in constitution, as it consists laJmost wholly of a very small number of bright lines. An apparent exception is afforded by the great nebula of Andromeda, wMch gives a coptinuous spectrum ; but in interpreting such a spectrum it must be noted that a gaseous mass gives a bright line spectrum only when it is transparent through and through. If the mass is of such size that a ray of light cannot pass through it the spectrum will, in general, be continuous, like that of a solid body. If the superficial portions >are cooler and more tenuous than the interior, the continuous spectrum will be crossed by dark lines, as in the case of an incandescent body surrounded by a cool atmosphere. We conclude, therefore, that the continuous character of the spectrum of the Andromeda nebulae does not prove it to be composed of solid particles. The transparency of the nebulae in general, which would be evident even without spectroscopic analysis, shows how extremely tenuous these masses are. We cannot seriously doubt that as a general rule their distances from us are at least as great as those of the fixed stars, possibly much greater. In dimensions the most compact of them must far exceed our whole solar system ; probably the great majority, even if we omit the diffused masses to which we can assign no definite outline, may . exceed the diameter of the orbit of Neptune a hundredfold. Yet we have reason to believe that a ray of light would not suffer any sensible absorption, except selectively, in passing through them.

Constitution of the Stars and /Structure of the Heavens.

The view that the sun and stars are not bodies fitted to exist for ever in their present form is strengthened by ay. recent researches on their constitution. They are now regarded as bodies of intensely hot matter J}”,o„ in the gaseous state, continually losing energy by the radiation of their heat into space, and therefore con- tracting in volume. This view was first developed by J. Homer Lane in a paper published about 1865 in the American Journal of Science; but his results were merely emlDodied in

mathematical formulae, and not stated with such distinctness as to command attention at the time.

More recently Ritter has developed the subject with great fulness in a series of papers published in the Leipzig Anncden der Physik und Chemie. As we have not room for even an abstract of these researches, we can state only what seem to be the most obvious conclusions. That the sun and stars are masses of gas is shown not only by their density, so far as ascertained, but by the fact that solid or liquid masses would cool with such rapidity that they woidd cease to shine at the end of a few centuries. The superficial portions would first cool and eventually become solid. It was shown by Lane that a mass of gas, held in equilibrium by the mutual attraction of its parts, grows hotter through the loss of energy by radiation, because the temperature gained by the resulting contraction exceeds that lost by the radiation. The effect is analogous to that of a resisting medium upon a planet. The direct result would be to retard the motion of the planet, so that it would fall nearer to the s\m, but the velocity gained by the fall would exceed that lost by the resist- ance. As a planet would go faster by being resisted, so the temperature of a gaseous mass like a star rises as it contracts in volume. This rule ceases to hold when the attraction has become so great that liquefaction takes place, and then the radiation of light by the body is nearly at an end. Another result of the theory is that the greater the mass of a star the higher will be its temperature in a given stage of its development. There may, therefore, be a wide range among the temperatures of the stars, the older and the larger ones generally being the hotter.

The volume of a star is so great that its interior, though gaseous, is not transparent, and it therefore radiates heat only from its superficial portions. These are thus subject to a rapid cooling process ; they probably liquefy or solidify, and then by their superior gfravity sink into the interior and are replaced by gaseous masses from the interior. Thus a circulation

is constantly going on, the hot matter of the interior rising to the surface, and the cool matter of the surface sinking to take its place. A star cannot radiate heat more rapidly than the heat is supplied by this process; consequently, the superficial temperature is limited by the rapidity of circulation, which cannot go on at more than a definite rate, depending on the temperature and the nature of the gas. A necessary result of this view is that each star is constantly contracting" in volume, and must continue to do so until the interior becomes liquid or solid. At this stage the increased friction resisting the circulation will result in a continuous fall of the temperature of the surface, which in process of time must cease to radiate light. Recent discoveries give colour to the hypothesis of evolution implied in this view of the physical constitution of stars in general. Their agglomera- tion into systems is what we should naturally expect as the result of the condensation of irregular nebulous masses.

One of the most suggestive conclusions of recent science is that the stars differ greatly in density, and that, in the DensHy l^^rge majority of cases, the brighter ones at least of the are much rarer than the sun, probably even of stars. gaseous density. In the case of the Algol type of variable stars, we can, by the comparison of the dura- tion of the eclipse with' the periodic . time, form an approximate idea of the size of the star. If the elements of the orbit can be determined, the mass wUl also become known, and thus we may form an idea of the density. So far as this method has been carried out, the conclusion is that already stated. Revolving double stars, when the elements of the orbit become known, afford evidence that points in the same direction. Knowing the parallax of a star and the elements of the orbit of a companion moving around it, we can determine the mass of the two bodies. Their absolute brilliancy compared with that of

the sun is also known from the parallax and the apparent brilliancy ; and it is thus found that, while the mass of Sirius is a little more than double that of the sun, it emits some thirty times as much light. It is now known that a relation between the mass and brilliancy of a double star can be derived from the elements of the apparent orbit without a knowledge of the star's distance. Were aU these bodies of the same density and the same intrinsic brilliancy per square mile of surface as the sun, then to every

star of a given apparent magnitude, what- ever its distance, would correspond a certain relation between the periodic time and the apparent mean dis- tance of a companion revolving around it. Assuming the distance of the companion to be 1", its period on this hypothesis is shown for stars of various magnitudes in the following table : —

Magrnitude.

Period.

Magnitude.

Period

y.

y.

0

0-9

4

14-1

1

1-8

6

28-2

2

3-6

6

56-2

3

7-1

7

112-0

If the apparent mean distance is different from 1" the time of revolution is given by Kepler's third law in the form T^z=Ti" S', S being the mean distance in seconds, and Ti the period in the above table. In a large majority of double stars whose orbits have been approximately determined it is certain that the time of revolution is much greater than would result from this rule. It follows that the stars in general are either much less dense, or much more brilliant, than the sun. For reasons that we cannot state here it is likely that the former alternative is more usual than the latter. It is remarkable that, in the case of those bright stars the mass of whose faint companions has been determined, the brilliancy of the latter deviates in the opposite direction ; their masses are disproportional to their brightness. Thus the mass of the companion of Sirius is nearly half that of Sirius itself, although the latter gives several thousand times as much light as the companion. The same is probably true of the companion of Procyon, and, in a less degree, of 7] Cassiopeia. It would seem that in these cases the companion, being of the same age as the bright star, has cooled off more rapidly, and perhaps condensed to a solid or liquid.

The variety of spectra among the stars also emphasizes the diversity of their physical constitution. Sir W. Huggins (Publications of Sir W. Hugging s Observatory, vol. i. page 75) shows that the evidence of the spectro- scope agrees with the general evolutionary theory. The spectra of the stars may be made to fall into line, so as to form a series, leaving little room for doubt that the actual differences between them represent in the main successive epochs of star life rather than original differences of chemical constitution. When the spectra of close pairs of stars are examined, 'the difference between the two sets corresponds to the view

thd,t the fainter star of the two is in a more advanced stage of condensation.

*The problem of the structure of the heavens, if structure they may be said to have, may be regarded as the ultimate one of sidereal astronomy. Branches of this problem are the questions of the physical con- Distribu- stitution of the stars, their possible separation "ters""** into systems, the stability of those systems, and the duration and stability of the universe itself. The central question around which all the others may be grouped is that of the actual distribution of the stars in space. If we could determine the distance of a star as readily as we do its direction from us, this question would be immediately settled, and a geometric model of the universe could be constructed showing its form and*

UmU of universe.

arrangement. But, witli Uje exception of the few stars whose parallax can be measured, the distances of the individual stars are a matter of extremely vague and un- certain inference, and not even the mean distance of any- class or g;roup can be settled definitely by any one method of research.

It will conduce to clearness in bringing out the bearing of various facts on the problem in question if we state its main point in advance. The most definite form in which it may be considered by the astronomer is this : — As, by increasing the power of our telescopes, we see smaller and smaller stars — are the smallest that are brought into view no more distant than others already known ; are they i within the sphere of others already observed, or, does every increase of telescopic power bring into view stars farther away ? To put the question into another shape — Is the universe of stars limited in extent ? Intimately associated with this is the question of the actual distri- bution in space of the stars which we see with our tele- scopes. Whether the universe is finite or infinite, it is certain that the portion which we see is of finite extent. Has this visible portion a definite

boundary, and, if so, what is the figure of this boundary ? The statement of this question may suggest a doubt as to thd possibility of answering it. Since the range of vision of our telescopes is necessarily limited, is it not necessarily impossible for us to gather evidence of the finitude of the universe ? If with every increase of power we see smaller stars of which we cannot estimate the distance, how can we decide that we are not simply penetrating farther into a mass of infinite extent? An answer to this is reached by the following consideration : — So far as stars of various magnitudes have yet been counted there are about three times as many of each order as of the order next brighter. Tor example, there are. three times as many stars of the 7th magnitude as of the 6th, three times more of the 8th, and so on, to at least the 10th or 11th magnitude, a point beyond which the coimt is uncertain. An individual star of each order gives about four-tenths the light of one of the next brighter order. It follows that the total amount of light which we receive from all the stars of any one order continu- ally increases as we go to the fainter orders, the greater number of the stars more than compensating for the less amount of light received from each. Consequently, if the stars continued indefinitely so would the total amount of light received from them, and the heavens would be filled with a blaze as bright as the sun. As such is not the case, the series must stop. Where the stopping- point is, we cannot exactly say ; but, so far as we can judge from appearances, it can go little farther than the count has thus far extended, except perhaps in the Milky Way. We have therefore every reason to believe that by an increase in the power of our telescopes the number of new stars brought into view would begin to diminish, thus showing the total number to be limited. Hence we conclude that the universe of stars which we study has some bounding limit. The question now is. Can we form any conception of the limit and of the arrangement of the imiverse within it ?

Direct observation of the apparent distribution of the stars, irrespective of any question of their arrangement, makes one feature of the universe certain. The stars which compose it are not equally numerous in every direction ; a large majority lie in or near the zone of the Milky Way. What follows from this fact may be readily seen from Fig. 4, which we conceive to represent Form of g, section of the universe by a plane perpendicu- aoiverse. j^^ ^^ j^ jj^jj^^ 3^^ g ^eing the position of

the sun which, for the moment, we may conceive to be near the centre. What we actually observe is that a

very large majority of the stars are contained within the regions ASB and CSD, while the number contained within the larger angles, BSD and ASC, is relatively

small. An indefinite number of arrangements, all con- sistent with this fact, may be conceived ; but they are all in some way intermediate between the following : —

I. All, or at least the great mass of, the stars may be contained between two planes, AC and BD, parallel to the Milky Way. We see more stars in the region ASB and CSD, because there is, so to speak, a greater depth of stars there, while toward M and N we see only a com- paratively thin stratum. This was the view developed first by the elder Herschel and then by Struve in his Etudes d'Astronomie Stellaire.

II. The actual form of the universe may be spherical, the galaxy being formed by a dense ring of stars around the sphere.

III. The same hypothesis of a universe spherical in general form may be made, but, instead of being a ring, the galaxy is a number of clusters of stars mostly situated near one central plane.

The hypothesis that the boundary of the universe is spherical admits of being tested in a very simple way. Were such the case, the stars would be equally numerous throughout the regions ASC and BSD, the increase in their number beginning only when we reached the boundary of the Milky Way. But all the counts of stars yet made, from the time of Herschel till now, show that the number of stars per square degree continually increases from the two poles of the galaxy to the galaxy itself. Moreover, the rate of increase is as rapid as it would be if the boundary of the universe were two planes parallel to the galactic plane. Unless we make a very improbable hy- pothesis as to the distribution of the stars around us, this fact must lead us to the conclusion that we actually see to the limits of the universe in all directions away from the galaxy. For, if we did not, the increase in the num- ber of stars in the direction of the galaxy could not

be so rapid as it is. It would seem therefore that the first hypothesis of the form of the universe, that of Herschel and Struve, must be at least an approximation to the truth. But that it is not the whole truth will be evident on farther consideration.

We have room only to state in the briefest way the main facts, so far brought to light, on which our conclu- sion must be based. Beginning with the region immedi- ately around us, what evidence have we of the distribution of the stars, especially of their tendency to condense in the direction of the Milky Way ? If we consider that greater brilliancy of the stars implies greater nearness to us, then we should answer this question by considering the relation of the brighter stars to the galaxy. It is a remarkable fact that the condensation towards the galactic zone begins with the brighter stars — we might even say with those of the. first magnitude — ^though we can hardly conceive this to be anything else than the result of acci- dent. From Schiaparelli's maps of the distribution of the stars visible to the naked eye, the position of the Milky Way can be laid down with great exactness. But this

does not show that the condensation in the plane of the Milky Way begins with the nearest stars ; it only shows that some of the brighter stars are as far as the Milky Way, and emphasizes the extraordinary difference in their absolute brightness.

As we have already said, the proper motions of the stars afford the best index to their distance. Now it is a remarkable and suggestive fact that, when we make a count of the stars of known proper motion in every direction, we find them to be no more numerous in the region of the Milky Way than elsewhere. It appears therefore that the stars which compose the Milky Way are outside the limits within which proper motion has been detected, and that within thqse limits the stars are distri- buted with a fair approach to uniformity. A careful look at the Milky Way, especially the region south of Aquila, will sufilce to show that it suggests agglomerations of stars rather than a continuous zone in which there is a

uniform distribution of the stars. Moreover, it seems that our system is nearer to this part of the Milky Way than to the opposite; in other words, we are not centrally situated. It is a remarkable fact that in the intervals between the brighter portions of the Milky Way, about 17 hours of right ascension and between 20° and 22° of south declination, we have regions several degrees

square where the stars are comparatively few in number. This is in general true of the openings in this region. We conclude from this that in the latter we have a phenomenon distinct from that of merely increased star density arising from greater depth. Our general conclu- sions as to the structure of the universe may be summed up in these four propositions : —

1. The general form of the universe of stars to which our sun belongs is that of a flattened cylinder, or extreme oblate spheroid, as was supposed by Herschel and Struve.

2. The phenomenon of the Milky Way is not due alone to the fact that we see more stars in the equatorial regions of this spheroid, but to the fact that this region is occupied through its entire extent by a series of agglomerations of stars, within which space is richer in stars than in the interior where we are situated.

3. Our sun is situated near the central plane of the spheroid, but eccentrically so as to be nearer the boundary in a direction of perhaps 18 hours in right ascension, between the equator and 50° of south declination.

4. It is possible, but not yet certain, that we are so near the galactic stars in this region that we may soon be enabled to discover a proper motion among them.

(S. N.)

Astropalia, classical AstypcUcea, an island with good harbours, in the south part of the ^gean, situated in 36-5° N. lat. and immediately west of 26-6° E. long. The Roman emperors recognized it as a free state ; and in

the Middle Ages it was called Stampalia, and belonged to the noble Venetian family of Quirini. It was taken by the Turks in the 16th century, and is now noted for its sponges. The customs and dress of the people, who speak a patois of romaic origin, are interesting.

Asua, R. See I^ile.

Asuncion, or La Asuncion, capital of the Paraguay Republic, is situated on the left bank of the Paraguay river, in 25° i& 04" S. lat. and 67° 42' 40" W. long. The population in 1887 was 24,838, but it now exceeds 47,000. Railway communication has been established with Pirapd, and the town is rapidly becoming modernized. It is served by a tramway, has its principal streets lighted by electricity, and is well supplied with telephones. There are a National College, attended by over two hundred students, a public library, and, in the neighbourhood, an agricultural school with a model farm. Near the town, too, are several breweries, tanneries, flour mills, and factories for matches, soap, bricks, earthenware, palm-leaf hats, etc. In 1890 the imports were valued at $2,725,611 (gold), in 1899 at $2,147,838 ; exports were valued at f 2,901,589 in 1890 and $2,021,023 in 1899. Both imports and exports fluctuate considerably in value. In 1898 in the foreign trade only 418 vessels (mostly " liners ") entered, and 408 cleared.

Atbara, R. See Abyssixia.

Atchison, the capital of Atchison county, Kansas, U.S.A., in 39° 34' N. lat. and 95° 8' W. long., on the west bank of the Missouri. The river is navigable at this point. The elevation on the river bank is 795 feet, most of the city being situated at a higher level. The

city is divided into five wards, is regularly laid out, supplied with water by pumping from Missouri river, and is well drained. It is entered by four great railways, the Atchison, Topeka and Santa Fe, the Chicago, Bur-lington and Quincy, the Chicago, Rock Island and Pacific, and the Missouri Pacific. It is the site of Midland and St Benedict colleges. Founded in 1854, it at once grew rapidly, and four years late;r it received a city charter. Population (1880), 15,105: (1890), 13,963;

(1900), 15,722.

Ath, a town of Belgium, in the province of Hainaut, on the river Dender, about 30 miles by rail from Brussels. The tower of the church of Saint-Julien now lacks the high spire for which it was noted, and the andent Tour du Burbant has beconie ruinous. Population (communal)

(1880), 9301; (1890), 9868; (1897), 10,646.

Athabasca {Athapescow or Elk), a river of Alberta and Athabasca districts, Canada, rises in the Rocky Mountains in 52° 10′ K lat. and 117° 10′ W. long., and fiows in a north-easterly direction into the lake of the same name. It is 740 miles long and has a number of important tributaries, including the M'Leod, Pembina, Lesser Slave, and Clearwater. Athabasca Lake is 195 miles long, W. to E., from 20 to 32 miles wide, has an area of 3085 square miles, and is at an altitude of 690 feet above the sea. Shallow-draught steamers navigate the lake and river and Lesser Slave Lake and River with one interruption — at Grand Rapids near the mouth of the Clearwater river.

For Athabasca district see Nokth-Wbst Tekbitories.

Athenry, an inland town in the county of Galway, Ireland, 14 miles E. of Galway, on the Midland Great Western railway. The old Dominican monastery was extensively repaired by the Board of Works in 1893. Population, 910.

I. — Ancient Athens.

RECENT investigation on scientific lines has thrown a new and xmexpected light on the art, the monu- ments, and the topography of ancient Athens. Numerous and costly excavations haye been carried out by the Greek Government and by native and foreign scientific societies, while accidental discoveries have been frequently made during the

building of the modern town. The museums, enriched by a constant inflow of works of art and inscriptions, have been carefully and scientifically ar- ranged, and afford opportunities for systematic study de- nied to scholars of the past generation. Improved means of communication have enabled many acute observers to apply the test of scrutiny on the spot to theories and con- clusions mainly based on literary evidence ; five foreign schools of archaeology, directed by eminent scholars, lend valuable aid to students of all nationalities, and lectures are frequently delivered in the museums and on the more interesting and important sites. The native archaeolo- gists of the present day hold a recognized position in the scientific world ; the patriotic sentiment of former times, which prompted- their zeal but occasionally warped their judgment, has been merged in devotion to science for its own sake, and the supervision of excavations, as weU as the control of the art- collections, is now in highly com- petent hands. Athens has thus become a centre of learning, a meeting-place for scholars, and a basis for resea,rch in every part of the Greek world. The attention of many students has naturally been concentrated on the ancient city, the birthplace of European art and literature, and a great development of investigation and discussion in the special domain of Athenian archaeology has given rise to a voluminous literature. Many theories hitherto universally accepted have been called in question or proved to be unsound : the views of Leake, for instance, have been challenged on various points, though many of the conclusions of that great topographer have been justified and confirmed by modern research. The supreme importance of a study of Greek antiquities on the spot, long understood by scholars on the Continent and in America, is gradually coming to be recognized in England, where a close attention to ancient texts, not always adequately supplemented by a course of local study and observation, has hitherto fostered a peculiarly conservative attitude in regard to the problems of Greek archaeology. Since the foundation of the German Institute in 1874, Athenian topography has to a large extent become a speciality of German scholars, among whom Wilhelm Dorpfeld occupies a pre-eminent position owing to his great architectural attainments and unrivalled local knowledge. Many of his bold and novel theories have provoked strenuous opposition, while others have met with general acceptance, except among scholars of the more old-fashioned type.

Prehistoric Athens. — ^Numerous traces of the "My- cenaean" epoch have recently been brought to light in

Athens and its neighbourhood. Among the 'f^IY'^ monuments of this age discovered in the sur-

rounding districts are the rock-hewn tombs of Spata, accidentally revealed by a landslip in 1877, and the domed sepulchre at Menidi, near the ancient Acharnae, excavated by Lolling in 1879. Other " Mycenaean " land- marks have been laid bare at Eleusis, Thoricus, Halae, and Aphidna. These structures, however, are of comparatively

minor importance in point of dimensions and decoration; they were apparently designed as places of sepulture for local chieftains, whose domains were afterwards incorpo- rated in the Athenian realm by the irwoLKurfibi attributed to Theseus. The situation of the Acropolis, dominating the surrounding plain and possessing easy communication with the sea, favoured the formation of a relatively pow- erful state — inferior, however, to Tiryns and Mycenae; the myths of Cecrops, Erechtheus, and Theseus bear wit- ness to the might of the princes who ruled in the Athenian citadel, and here we may naturally expect to find traces of massive fortifications resembling in some degree those of the great Argolid cities. Such, in fact, have been brought to light by the recent excavations on the Acropolis (1885- 1889). Remains of primitive polygonal walls which undoubtedly surrounded the entire area have been found at various points a little within the circuit of the existing parapet. The best preserved .portions are at the eastern extremity, at the northern side near the ancient " royal " exit, and at the south-western angle. The course of the walls can be traced with a few interruptions along the southern side. On the northern side are the foundations of a primitive tower and other remains, apparently of dwelling-houses, one of which may have been the ttukij/os So/Aos 'Epex^°s mentioned by Homer {Od. vii. 81). Among the foundations were discovered fragments of "Mycenaean" pottery. The various approaches to the citadel on the northern side — the rock-cut flight of steps north-east of the Erechtheion, the stairs leading to the well Clepsydra, and the intermediate passage supposed to have furnished access to the Persians — are all to be

attributed to the primitive epoch. Two pieces of poly- gonal wall, one beneath the bastion of Nike Apteros, the other in a direct line between the Eoman gateway and the door of the Propylaea, are all that remain of the primitive defences of the main entrance.

These early fortifications of the Acropolis, ascribed to the primitive non-Hellenic Pelasgi, must be distinguished from the Pelasgicum or Pelargicum, which was in all probability an encircling wall, built If^^/^' round the base of the citadel and furnished with nine gates from which it derived the name of Enneapylon. Such a wall would be required to protect the clusters of dwellings around the Acropolis as well as the springs issuing from the rock, while the gates open- ing in various directions would give access to the sur- rounding pastures and gardens. This view, which is that of Curtius, alone harmonizes with the statement of Herodotus (vi. 137) that the wall was "around" (wepf) the Acropolis and that of Thucydides (ii. 17) that it was " beneath " (iiro) the fortress. Thus it would appear that the citadel had an outer and an inner line of defence in pre-historic times. The space enclosed by the outer wall was left unoccupied after the Persian wars in deference to an oracular response apparently dictated by military considerations, the maintenance of an open ^one being desirable for the defence of a citadel. A portion of the outer wall has been recognized in a piece of primitive masonry discovered near the Odeion of Herodes Atticus ; other traces will probably come to light when the northern and eastern slopes of the Acropolis have been completely explored.. Leake, whom Frazer follows, assumed the Pelasgicum to be a fortified space at the western end of the Acropolis ; this view necessitates the assumption that the nine gates were built one within the other, but early

antiquity f urnislies no instance of sucli a construction ; Pan to tlie sacred precinct of Asclepius. The well-known Dorpfeld believes it to have extended from the grotto of passage of Lucian (Piscator 47) cannot be regarded as

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decisive for any of the theories advanced, as any portion of the old enceinte dismantled by the Persians may have retained the name in later times.

To the Pelasgic era may also be referred (with Curtius

and Milchhofer) the terraces of the Pnyx with the wall of massive masonry supporting the lower platform: the theory of these scholars, how- * '^^' ever, that the whole precinct was a sanctuary of the

The Dlpylon.

Pelasgian Zeus cannot be regarded as proved, nor is it easy to abandon the generally received view that this was the scene of the popular assemblies of later times, notwith- standing the apparent unsuitability of the ground and insufficiency of room for a large multitude. These diffi- culties are met by the assumption that the Cyclopean retaining-wall rose to a considerable height, supporting a theatre-like structure capable of seating many thousand persons. The pre-historio rock-dwellings in this neigh- bourhood (the quarter of Melite) have been found to extend to a considerable distance towards the S.E. in the direction of Phaleron.

The Hellenic Period. — ^While modern research has added considerably to our knowledge of pre-historic Athens, a still greater light has been thrown on the architecture and topography of the city in the earlier historic or " archaic " era, the subsequent age of Athenian greatness, and the period of decadence which set in with the Mace- donian conquest. We must here group these important epochs together, as distinguished from

the later period of !Roman rule, and confine ourselves to a chronological record of the principal discoveries by which they have been illustrated in recent years.

In 1870, the Greek Archaeological Society undertook a series of excavations in the Outer Cerameicus, which had already been partially explored by various of res^uvA scholars. The operations, which were carried 1870-74. on at intervals until 1890, resulted in the discovery of the Dipylon Gate, the principal entrance of ancient Athens. The Dipylon consists of an outer and an inner gate separated by an oblong courtyard and flanked on each side by towers ; the gates were themselves double, being each composed of two apertures intended for the incoming and outgoing traffic. An opening in the city wall a little to the south-west, supposed to have been the Sacred Gate (leph. irvkrj), was in all probability an outlet for the waters of the Eridanus. This stream, which has hitherto been regarded as the eastern branch of the Ilissus rising at Ksesariane, has been identified by Dorpfeld with a brook descending from the southern slope of Lycabettus and conducted in an artificial channel to the north-western end of the city, where it made its exit through the walls, eventually joining the Ilissus. The channel was open in Greek times, but was afterwards covered by Eoman arches ; it appears to have served as the main drain of the city. Between this outlet and the Dipylon were found a boundary-stone, inscribed o/jos KepafieiKov, which remains in its place, and the foundations of a large rectangular building, possibly the Pompeion, which may have been a robing-room for the processions which passed this way. On both sides of the Dipylon the walls of Themistocles, faced on the outside by a later wall, have been traced for a considerable dis- tance. The excavation of the outlying cemetery revealed the unique " Street of the Tombs " and brought to light a great number of sepulchral monuments, many of which remain in situ. Especially noteworthy are the stelce or reliefs representing scenes of leave-taking, which, though often of simple workmanship, are characterized by a touching dignity and restraint of feeling. In this neighbourhood were found a great number of 7th cen- tury tombs containing pottery with geometric designs. A considerable portion of the district remains unex- plored.

Within the same period was carried out the complete excavation of the Dionysiac theatre. The site, which had ~ been accurately determined by Leake, was

Dionysiac explored by Strack in 1862, and the researches theatre. subsequently undertaken by the Greek Archaeo- logical Society were concluded in 1879. It was not,

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however, till 1886 that traces of the original Greek orchestra were pointed out by Dorpfeld. The arrange- ment of the stage arid orchestra as we now see them belong to Eoman times ; the cavea or auditorium dates from the administration of the orator Lycurgus (337-323 B.C.), and nothing is left of the theatre in which the plays of .^schylus and Sophocles were acted, save a few small remnants of polygonal masonry. These, however, are sufficient to mark out the circuit of the ancient orchestra, on which the subsequently-built proscenia encroached. The oldest stage-building was erected in the time of Lycurgus ; it consisted of a rectangular hall with square projections (■n-apaa-KT^via) on each side; in front of this was built in late Greek or early Eoman times a stage with a row of columns which intruded upon the orchestra space ; a later and larger stage, dating from the time of Nero, advanced still further into the orchestra, and this was finally faced (probably in the 3rd century a.d.) by the "bema" of Phsedrus, a platform-wall decorated with earlier reliefs, the slabs of which were cut down to suit their new position. The remains of two temples of Dionysus have been found adjoining the stoa of the theatre, and an altar of the same god adorned with masks and festoons : the smaller and earlier temple probably dates from the 6th century b.c, the larger from the end of the 6th or the beginning of the 4th century.

Immediately west of the theatre of Dionysus is the sacred precinct of Asclepius, which was excavated by the Archaeological Society in 1876-78. Here were discovered the foundations of the celebrated Asclepieion, together with several inscriptions and a great number of votive reliefs offered by grateful invalids and valetudinarians to the god of healing. Many of the reliefs belong to the best period of Greek art. A Doric colonnade with a double row of columns was found to have extended

along the base of the Acropolis for a distance of 64 yards ; behind it in a chamber hewn in the rock is the sacred well mentioned by Pausanias. The colonnade was a place of resort for the patients ; a large building close beneath the rock was probably the abode of the priests.

The great excavations on the Acropolis, begun in November 1885 and completed in December 1888, rank among the most surprising achievements of modern research. The results of these opera- g°™y^^„ tions, which were conducted by the Archseo- of the logical Society under the direction of Kavvadias d^^”*’ and Kawerau, must be summarized with the ‘ ‘ utmost brevity. The great deposits of sculpture and pottery now unearthed, representing all that escaped from the ravages of the Persians and the burning of the ancient shrines, afford a startling revelation of the development of Greek art in the 7th and 6th centuries. Numbers of statues — among them a series of draped and richly-coloured female figures — ^masterpieces of painted pottery, only equalled by the Attic vases found in Magna Grsecia and Etruria, and numerous bronzes, were among the treasures of art now brought to light. All belong to the ” archaic ” epoch ; only a few remains of the greater age were found, including somef ragments of sculptures from the Parthenon and Erechtheion. Among the inscriptions now discovered was a record of the gold and ivory bought for the great statue of Athena Parthenos, which enables us to determine the ratio of silver to gold in the age of Phidias. We are principally concerned, however, with the results which add to our knowledge of the topography and architecture of the Acropolis. The entire area of the summit was now thoroughly explored, the excavations being carried down to the surface of the rock, which on the southern

side was found to slope outwards to a depth of 14 metries. In the lower strata were discovered the rem- nants of Cyclopean or pre-historic architecture already- mentioned.

The foundations of the Parthenon were now for the first time completely investigated, as well as the area of the interior. The huge substruction, probably built under Cimon's administration soon after the Persian war, is 260 feet long by 106 feet broad ; it was designed for a longer and somewhat narrower building than the Parthenon, the stylobate of which measures 228 feet by 101. This earlier or Cimonian temple, which was never finished, was of Pentelic marble, with eight columns at the ends and nineteen at the sides ; only some of the lower drums, which are unfluted, have been found, and there is nothing to show that an upper portion ever existed. With regard to the interior of the

Parthenon much controversy exists ; the western compart— ment, which corresponds to the opisthodomos in other temples, appears to have been the TiapBtvoiv proper or " maiden's chamber," and like the eastern compartment, or " Hekatompedon," to have given its name to the whole building; the arrangement and interpretation of the sculptures have also been a fertile theme for discussion. For details regarding the Parthenon and the older temple the special authorities enumerated in the bibliography should be consulted. In the deep interval between the substruction and the south wall of the Acropolis ran a long retaining-wall constructed for temporary use during the building of" the temple. The lower portion of the sub- struction is believed by Penrose to have been the foundar tion of the ancient " Hekatompedon " destroyed by the Persians. The name was subsequently applied to the cella or eastern chamber of the Parthenon, which is exactly

Plan of thb Acbopolib, Athens. (_By permission of the Hellenic Society.)

Cyclopean Masonry.

100 feet long, and also became a popular designation of the temple itself.

The ancient Hekatompedon, however, may in all prob- ability be identified with an early temple, also 100 feet The old long, the foundations of which were pointed out temple ot in 1886 by Dorpfeld on the ground immediately Atbena. adjoiuing the south side of the Erechtheion. On this spot was apparently the primitive sanctuary of Athena, the rich temple (ttiW vjjds) of Homer, in which the cult of the goddess was associated with

that of Erech- theus (77. ii. 549) ; the Homeric temple is identified by Furtwangler with the ” compact house of Erechtheus ” {Od. vii. 81), which, he holds, was not a royal palace but a place of. worship, and traces of it may perhaps be recog- nized in the fragments of prehistoric masonry enclosed by the existing foundations. The foundations seem to belong to the 7th century, except those of the colonnade, which was added possibly by Pisistratus. According to Dorpfeld, this was the ” old temple ” of Athena Polias, frequently mentioned in literature and inscriptions, in which was housed the most holy image or ^oavov of the goddess which fell from heaven; it was burnt, but not completely destroyed, during the Persian war, and some of

its external decorations were afterwards ^uilt into the north wall of the Acropolis ; it was subsequently restored, he thinks, with or without its colonnade — in the former case a portion • of the peristyle must have been removed when the Erechtheion was built so as to make room for the poj-ch of the maidens ; the building was set on fire in 406 B.C. (Xen. Helt. i. 6. 1), and the conflagration is identical with that mentioned by Demosthenes (In Timocr. xxiv. 156) ; its opisthodomos served as the Athenian treasury in the fifth and fourth centuries ; the temple is the apxa-‘i’K vemi r^s IloXiaSos mentioned by Strabo (ix. 16), and it was still standing in the time of Pausanias, who applies to it the same name (i. 27. 3). The conclusion that the foundations are those of an old temple burnt by the Persians has been generally accepted, but other portions of Dorpfeld’s theory — more especially his assumption that the temple was restored after the Persian war — have provoked much controversy. Thus J. G. Prazer maintains the hitherto current theory that the earliest temple of Athena and Erechtheus was on the site of the Erechtheion; that the Erechtheion inherited the name apxai(K veois from its predecessor, and that the “opisthodomos” in which the treasures were kept was the west chamber of

the Parthenon; Plirtwangler and Milchhofer hold the strange view that the “opisthodomos” was a separate building at the east end of the

Acropolis, while Penrose thinks the buUdiag discovered by Dorpfeld was possibly the Cecropeion. Curtius and J. W. White, on the other hand, accept Dorpfeld's identification, but believe that only the western portion of the temple, or opisthodomos, was rebuilt after the Persian war. Admitting the identi- fication, we may perhaps conclude that the temple was repaired in order to provide a temporary home for the venerated image and other sacred objects : no traces of a restoration exist, but the walls probably remained stand- ing after the Persian conflagration. The removal of the ancient temple was undoubtedly intended when the Erechtheion was built, but superstition and popular feel- ing may have prevented its demolition and the removal of the ioavov to the new edifice. The temple consisted of an eastern cella with pronaos ; behind this was the opistho- domos, divided into three chambers — ^possibly treasuries — ^with a portico at the western end. The peristyle, if we compare the measurements of the stylobate with those of the drums built into the wall of the Acropolis, may be concluded to have consisted of six columns at the ends and twelve at the sides.

*The internal arrangements of the Erechtheion are still a subject of controversy. The peculiar design of the temple is attributable to the necessity tteion"**" imposed on the architect of including within the building a number of sacred places, and combining several cults. Within its precincts Pausanias (i. 26. 6) found altars to Poseidon, with whose worship that of Erechtheus was associated, to the hero Butes and to Hephaestus, also a well of salt water and the imprint of Poseidon's trident. Whether he also found here the ancient image of Athena and her ever-burning lamp is open to doubt owing to the vagueness of his language ; he may mean to attribute these objects either to the Erechtheion or to the old temple adjoining it. If he places them in the Erechtheion that name can strictly apply to only a portion of the existing building, the remainder of the temple, which he describes as " double," being the " sanctuary of Athena " (vaos r^s IloXiaSos) which he subsequently mentions. On this assumption the eastern and larger chamber of the Erechtheion has generally been identified with the shrine of Athena Polias. The western chamber adjoining the porch of the Maidens may possibly have contained the tomb of Cecrops, and the altars mentioned by Pausanias ; the identification . of the rock-hewn cistern*

beneath the pavement in this compartment with the salt well of Erechtheus is very doubtful. The mark of the trident is in the crypt beneath the north portico. The beautiful north door of the temple is held by E. Gardner and E. Schultz (Journal Sell. Stud. 1891) not to be identical with the original one, the present heavy door-jambs and the lintel being restorations.

The excavation of the Pandroseion or temenos of Pan- drosos, the daughter of Cecrops, which adjoins the Erech- theion on the west, has revealed no traces of rfroseiS^' a temple. The site of this precinct, in which andCbai- the sacred olive tree of Athena grew, has been cotbeke. almost certainly fixed by an inscription found in the bastion of Odysseus. At its north-western extremity is a platform of levelled rock which may have supported the altar of Zeus Hypsistus. The excavation of the ground immediately west of the Parthenon brought to light the remains of a large rectangular building, apparently fronted by a colonnade. This has been identi- fied with the Chalcotheke, a storehouse of bronze imple- ments and arms, which was formerly supposed to he against the north wall near the Propylsea. The site was

hitherto erroneously believed to be the temenos of Athena Ergane. The adjoining temple of Nike is proved by an inscription found in 1896 to have been built before ±he Propylaea.

During the course of the excavations on the Acropolis the bastion built by the Greek chieftain Odysseus, to protect the staircase leadiag down to the well jf^^gygi „/ Clepsydra below the north-western cliff, was historic demolished. The " Tower of the Pranks," •"""'"'■ an interesting remnant of the Middle Ages """'"'■ which stood near the temple of Nike, had been taken down in 1874, despite the protests of Preeman, Penrose, and other scholars. The projected removal of the Turkish minaret in the south-west corner of the Parthenon has happily not been carried out ; its preservation is essential to the stability of the adjoining 'masonry.*

In 1892 Dorpfeld began a series of excavations in the district between the Acropolis and the Pnyx with the object of determining the situation of the Excava- buildings described by Pausanias as existing '<"»« '" in the neighbourhood of the Agora, and more ^^'^■'- especially the position of

the Enneacrunus fountain. The Enneacrunus has hitherto been generally identified with the spring CaUirrhoe in the bed of the Ilissus, a little to the south-east of the Olympieion ; it is apparently placed by Thucydides (ii. 15) in proximity to that build- ing, as well as the temple of Dionysus Iv kLfivai's and other shrines which he mentions as situated to the south of the Acropolis. On the other hand Pausanias (i. 14. 1), who never deviates without reason from the topographical order of his narrative, mentions the Enneacrunus in the midst of his description of certain buildings which were undoubtedly in the region of the Agora, and unless he is guilty of an unaccountable digression the Enneacrunus which he saw must have lain west of the Acropolis. It is now generally agreed that the Agora of classical times covered the low ground between the hill of the "Theseion," the Areopagus, and the Pnyx; and Pau- sanias, in the course of his description, appears to have reached its southern end. The excavations revealed a main road of surprisingly narrow dimensions winding up from the Agora to the Acropolis. A little to the south- west of the point where the road turns towards the Propylsea was found a large rock-cut cistern or reservoir which Dorpfeld identifies with the Enneacrunus. The reservoir is supplied by a conduit of 6th-century tiles connected with an early stone aqueduct, the course of which is traceable beneath the Dionysiac theatre and the royal garden in the direction of the upper Ilissus. These elaborate waterworks were, according to Dorpfeld, con- structed by the Pisistratids in order to increase the supply from the ancient spring CaUirrhoe ; the fountain was furnished with nine jets, and henceforth known as Enneacrunus. This identification has been hotly contested by many scholars, and the question must still be regarded as undecided. An interesting con- firmation of Dorpfeld's view is furnished by the map of Guillet and Coronelli, published in 1672, in which the Enneacrunus is depicted as a well with a stream of running water in the neighbourhood of the Pnyx. The fact that spriag water is not now found in this locality is by no means fatal to the. theory: recent engineering investigations have shown that much of the surface water of the Attic plain has sunk to a lower level. In front of the reservoir is a small open space towards which several roads converge; close by is a triangular enclosure of polygonal masonry, in which were found various relics relating to the worship of Dionysus, a very ancient wine-press (\iyvds),

and the remains of a small temple. Built over this early precinct, which Dorpfeld identifies with the Dionyseion iv Aijuvais, or Lenseon, is a

basilica-shaped building of the Eoman period, apparently- sacred to Bacchus: in this was found an inscription con- taining the rules of the society of the lobacchi. There is an obvious difficulty in assuming that Xt/tmi, in the sense of "marshes," existed in this confined area, but stagnant pools may still be seen here in winter. Another enclosure, a little to the south, is proved by an inscrip- tion to have been a sanctuary of the hitherto unknown hero Amynus, with whose cult those of Asclepius and the hero Dexion were here associated ; under the name Dexion, the poet Sophocles is said to have been wor- shipped after his death. The whole district adjoining the Areopagus was found to have been thickly built over. The remains of the Stoa Basileios, in which the Archon BasUeus held his court and the Areopagus Council sat, were perhaps brought to light in the winter of 1897-98, when the excavations were extended to the eastern slope of the "Theseion" hill. Here was found a rectangular structure resembling a temple, but with a side door to the north: it possessed a portico of six columns. The north slope of the Areopagus, where a number of early tombs were found, was also explored, and the limits of the Agora on the south and north-west were approxi- mately ascertained. A portion of the main road leading from the Dipylon to the Agora was discovered.

In 1896 excavations with the object of exploring the whole northern and eastern slopes of the Acropolis were The begun by Kavvadias. The pathway between

orottoes the citadel and the Areopagus was found to be ot Pan and so narrow that it is certain the Panathenaic Apoi o. procession cannot have taken this route to the Acropolis. On the north-west rock the caves known as the grottoes of Pan and Apollo were cleared out : these consist of a

slight high-arched indentation immediately to the east of the Clepsydra and a double and somewhat deeper cavern a little farther to the east. In the first mentioned are a number of niches in which Trti/aifes or votive tablets were placed: some of these offerings, in- scribed with dedications to Apollo, have been discovered. The whole locality was the seat of the ancient cult of this deity, afterwards styled " Hypakraeos," with which was associated the legend of Creusa and the birth of Ion. The worship of Pan was introduced after the Persian wars, in consequence of an apparition seen by Pheidip- pides, the Athenian courier, in the mountains of Arcadia. Another cave more to the west was revealed by the demolition of the bastion of Odysseus. To the east a much deeper and hitherto unknown cavern has been revealed, which Kavvadias identifies with the grotto of Pan. Close to it are a series of steps hewn in the rock which connect with those discovered in 1886 within the Acropolis wall. Farther east is an underground passage leading eastwards to a cave supposed to be the sanctuary of Aglaurus; with this passage is connected a secret staircase leading up through a cleft in the rock to the precinct of the Errephori on the Acropolis. It is conceivable that the priestesses employed this exit when descending on their mysterious errand.

The Cynosarges, from earliest times a sanctuary of Heracles, later a celebrated gymnasium and the school of Antisthenes the Cynic, has hitherto been sargeslma generally supposed to have occupied the site gymnasium of the Monastery of the Angels (Asomati) on ot Hadrian, ^j^g eastern slope of Lycabettus; its situation, however, has been fixed by Dorpfeld at a point a little to the south of the Olympieion, on the left bank of the Ilissus. Here a series of excavations, carried out by the British School in 1896-97 under the direction of Cecil Smith, revealed the foundations of an extensive Greek building, the outlines of which correspond with those of a gytanasium; it possessed a large bath or*

cistern, and was flanked on two sides by water-courses. An Ionic capital found here possibly belonged to the palaestra. The identification, however, cannot be re- garded as certain in the absence of inscriptions. To the north-east were found the remains of a very large rec- tangular structure of the Roman epoch, bearing a striking resemblance in design and construction to the " Stoa," or Library of Hadrian, situated to the

north of the Acropolis : this may in all probability be identified with the Gym- nasium of Hadrian, the position of which was hitherto entirely unknown.

The Roman Period. — The most important achievement of recent research with regard to the Eoman period has been the uncovering of the new or Eoman Agora. In 1890 and 1891 the ground immediately to the west of the "Tower of the Winds" was 'excavated by the Archaeological Society, and though the operations have been interrupted, owing to the difficulty of expropriating the neighbouring owners, the dimensions of the Agora have been practically ascertained. It consisted of an open square surrounded by an Ionic colonnade, into which opened a number of shops or storehouses. The eastern gate was adorned with four Ionic columns on the outside and two on the inside, the western entrance being the well-known portico of Athena Archegetis. The whole conclave may be compared with the enclosed bazaars or khans of Oriental cities, which are usually locked at night. Immediately to the north of the new Agora is a vast rectangular building of Eoman date, the eastern side of which was explored in 1885-86. A portion of its western front, adorned with monolith unfluted Corinthian columns, is still standing — the familiar " Stoa " of Hadrian; another well-preserved portion, with six pilasters, runs parallel to the west side of iEolus Street. The interior consisted of a spacious court sur- rounded by a colonnade of 100 columns, into which five chambers opened at the eastern end. A portico of four fluted Corinthian columns on the western side formed the entrance to the quadrangle. This cloistered edifice may be identified with the library of Hadrian mentioned by Pausanias; the gymnasium, which he tells us also possessed 100 columns, being probably the buildings dis- covered by the British School near the Ilissus: the books were, perhaps, stored in a square building which occupied a portion of the central area. In 1883 the sub- structure of the gigantic Olympieion was excavated by Penrose, who proved the correctness of Dorpfeld's theory that the building was octostyle ; it possessed 104 Corin- thian columns, of which 48 stood in triple rows under the pediments, and 56 in double rows at the sides. Fragments of Doric columns and foundations were discovered, prob- ably belonging to the temple begun by Pisistratus, the orientation of which differed slightly from that of the later structure. In 1898 the peribolos of the temple was

ex- cavated without important results : it is to be hoped that the stability of the columns has not bepn affected by the operations. Numerous Eoman mosaics and other remains had already been found in the adjoining public garden over whichthe "city of Hadrian" extended. Excavations round the monument of Philopappus on the Museion Hill showed that the structure was nearly square, the curved front still remaining being only a portion of the building. On the Acropolis the foundations of the little circular temple of Eome and Augustus were laid bare during the excavations of 1885-88 : the temple was of white marble, and had a peristyle of nine Ionic columns. An inscription in bronze letters, attached in a.d. 61 to the eastern archi- trave of the Parthenon, has been successfully recovered by E. Andrews of the American School. The letters and the nails by which they were fastened have disappeared, but an accurate observation of the nail-marks enabled the

shapes of the letters to be determined. The inscription apparently records the erection of some monument by the Athenians ia honour of the Emperor Nero.

The Parthenon escaped without serious injury from the earthquakes of 1894. A piece of one of the drums of a column on the north side fell to the ground i^heaon. ^^^ ^ portion of one of the blocks in the archi- trave of the opisthodomos. These injuries, how- ever, fortunately attracted attention to the condition of the building. A committee composed of Greek and foreign architects was appointed to superintend the necessary repairs, and the opinion of three distinguished authorities, Joseph Durm, L. Magne, and F. C. Penrose, was invited. It was wisely decided to abstain from any attempt at restora- tion and only to employ new material when necessary for the preservation of the existing remains. The repairs were begun in 1896 under the supervision of the Greek architect Balanos. It was found that several of the blocks in the architrave of the opisthodomos were in a very defective con- dition, probably owing to the action of fire at some past time. One of these, which supported two slabs of the Pan- athenaic frieze, has been replaced by new marble, and the delicate

operation of removing and readjusting the sculp- tured slabs has been successf uUy carried out. Others of the blocks have been carefully pieced as well as some of the cap- itals of the inner row of columns. The broken lintel of the great western door will be replaced with a large new stone, and the brick masonry which encumbers the doorway will be removed. The operations, which were interrupted by the war of 1897, will probably extend over several years. It is proposed to clean out the crevices in the upper parts of the building and to fill them with cement or lead, special care being taken to prevent the percolation of rain water. The Panathenaic frieze has already suffered considerably from exposure to the weather. As the proposal to remove the sculptures to a museum and to replace them by casts will hardly be entertained, steps should be taken to protect them against rain and also to render them accessible to close iaspection.

II. Modern Athens.

At the conclusion of the War of Independence, Athens was little more than a village of the Turkish type, the poorly-built houses clustering on the northern and eastern slopes rae modem ^^ ^^ Acropolis. The narrow, crooked lanes of this ”^’ quarter still contrast with the straight, regularly laid-

ont streets of the modern city, which extends to the north-west, north, and east of the ancient citadel. The greater commercial advantages oflered by Nauplia, Corinth, and Patras were out- weighed by the historic claims of Athens in the choice of a capital for the newly-founded kingdom, and the seat of govern- ment was transferred hither from Nauplia in 1834. The new town was, for the most part, laid out by the German architect Schaubert. It contains several squares and boulevards, a large public garden, and many handsome public and private edifices. A great number of the public institutions owe their origin to the munificence of patriotic Greeks, among whom Andreas Syngros and George AverofE may be especially mentioned. The royal palace, designed by Gartner, is a tasteless structure ; attached to it is a beautiful garden laid out by Queen Amalia, which contains a well-preserved mosaic floor of the Roman period : the grounds, together with the adjoining public garden, lie within the

boundaries of the ancient Hadrianopolis, or Novm Athenoe. On the S.E. is the newly-built palace of the Crown Prince. The Academy, from designs by Hansen, is constructed of Pentelic marble in the Ionic style : the colonnades and pediments are richly coloured and gilded, and may perhaps convey some idea of the ancient style of decoration. Close by is the University, with a colonnade adorned with paintings, and the Vallianean Library with a handsome doric portico of Pentelic marble. The Observatory, which is connected with the University, stands on the summit of the Hill of the Nymphs ; like the Academy, it was erected at the expense of a wealthy Greek, Baron Sina of "Vienna. In the public garden is the Zappeion, a large building with a Corinthian portico, intended for the display of Greek industries ; here also is a monument to Byron, erected in 1896. The Boulfi, or parliamentrhouse, possesses a considerable library. Other public buildings are the Polytechnic Institute, built by con- tributions from Greeks of Epii-us, the theatre, the Arsakeion (aschool

for girls) , the Var vakeion (a gymnasium or boys ' school) , the military school ((TxoX^) eie\irlSav) , and several hospitals and orphanages. The Cathedral, a large modern structure, is devoid of architectural merit, but some of the smaller, ancient, Byzantine churches are singularly interesting and beautiful. Among the private residences, the majision built by Dr Schliemann, the discoverer of Troy, is the most noteworthy ; its decorations are in the Pompeian style.

The museums of Athens are daily growing in importance with the progress of excavation. They are admirably arranged, and the remnants of ancient art which they contain have fortu- nately escaped injudicious restoration. The National '""'""" Museum, erected in 1866, is especially rich in archaic sculptures and in sepulchral and votive reliefs. A copy of the Diadumenos of Polycleitus from Delos and temple-sculptures from Epidaurus, and the Argive Herseon are among the more notable of its recent acquisitions. It also possesses the famous collection of prehistoric antiquities found by Schliemann at Tiryns and Mycenae, other " Mycenaean " objects discovered at Nauplia and in Attica, as well as the still earlier remains excavated by Tsountas in the Cyclades and by the British School at Phylakope in Melos ; terra-cottas from Tanagra and Asia Minor ; bronzes from Olympia, Delphi, and else- where, and

numerous painted vases, among them the unequalled white lekythoi from Athens and Eretria. The Epigraphical Museum contains an immense number of inscriptions arranged by H. G. Lolling and A. Wilhelm of the Austrian Institute. The Acropolis Museum (opened 1878) possesses a singularly interesting collection of sculptures belonging to the "archaic " period of Greek art, all found on the Acropolis ; here, too, are some fragments of the pedi- mental statues of the Parthenon and several reliefs from its frieze, as well as the slabs from the balustrade of the temple of Nike. The Polytechnic institute contains a museum of interesting objects con- nected with modern Greek life and history. In the Academy is a valuable collection of coins superintended by Svoronos. Of the private collections those of Schliemann and Karapanos are the most interesting : the latter contains works of art and other objects from Dodona. There is a small museum of antiquities at the Pirseus. A museum of casts of the Greek masterpieces in foreign collections is much needed for the purposes of comparative study.

Owing to the numbers and activity of its institutions, both native and foreign, for the prosecution of research and the encouragement of classical studies, Athens has become once more an international seat of learning. The Greek Archaeological SclentUlc Society, founded in 1837, numbers some distinguished ^io„, scholars among its members, and displays great activity in the conduct of excavations. Important researches at Epidaurufe, Eleusis, Mycenae, Amyclse, and Ehamnus may be numbered among its principal undertakings, in addition to the complete exploration of the Acropolis and a series of investigations in Athens and Attica. The Fi'ench JScole d'Athenes, founded in 1846, is under the scientific direction of the Academie des Inscriptions et Belles Lettres. Among its numerous enterprises have been the extensive and costly excava- tions at Delos and Delphi, which have yielded such remarkable results. The monuments of the Byzantine Epoch have latterly occupied a prominent place in its investigations. The German Archaeological Institute, founded in 1874, has carried out excavations at Thebes, Lesbos, Paros, Athens, and elsewhere ; it has also been associated in the great researches at Olympia, Pergamos, and Troy, and in many other important undertakings. The British School, founded in 1886, has been unable, owing to insufficient endowment, to work on similar lines with the French

and German institutions : it has, however, carried out extensive excavations at Megalopolis and in Melos, as well as researches at Abae, in Athens (presumed site of the Cynosarges), in Cyprus, and at Naucratis. It has latterly taken part in the exploration of Knossos and other important sites in Crete. The American school, founded in 1882, is supported by the principal universities of the United States. In addition to researches at Sicyon, Plataea, Eretria, and elsewhere, it has under- taken two works of capital importance — the excavation of the Argive Herseon and the exploration of ancient Corinth. An Austrian Archaeological Institute was founded in 1898.

Notvrithstanding certain disadvantages inherent in its situation the trade and manufactures of Athens have considerably increased in recent years. Industrial and commercial activity is mainly centred at the Piraeus, where 9 cloth and »'s'«y cotton mills, 45 cognac distilleries, 14 steam flour ^j^„«~. mills, 5 soap manufactories, 13 shipbuilding and engineering works, chair manufactories, tanneries, and a dynamite factory have been established in recent years. Th e shipbuilding and engineering trades are active and advancing. The export trade is, however, inconsiderable, as the produce of the local industries is mainly absorbed by home consumption. The annual value of ex- ported cognac is about 1,400,000 francs, of raw hides about 700,000 francs. As a place of import, the Piraeus surpasses Patras, Syra, and all the other Greek maritime towns, receiving about 53 per cent, of all the merchandise brought into Greece. The principal imports are coal, grain, manufactured articles, and articles of luxury. The total value of exports in 1894 was 9,207,535 francs, of imports,

55,994,191 francs ; no later figures have been published. The customs revenue in 1899 was 18,036,425 drachmas. The number of ships entered and cleared in 1898 was 3866 with a tonnage of 3,449,895 tons, of which 217 with a tonnage of 284,365 tons were British.

The Piraeus, which had never revived since its destruction by the Romans in b.c. 86, was at the beginning of the last century a small j,^^ fishing

village Imown as Porto Leone. When Athens

Piraeus. became the capital in 1834 the ancient name of its port was revived, and since that time piers and quays have been constructed, and spacious squares and broad regular streets have been laid out. The town now possesses an exchange, a large theatre, a gymnasium, municipal buildings, and several hospitals and charitable institutions erected by private munificence. The harbour, in which ships of all nations may be seen, as well as great numbers of the pibturesque sailing craft engaged in the coasting trade, is somewhat difBcult of access to larger vessels, but will be improved by the construction of new breakwaters and dry docks. The port and the capital are now connected by railway with Corinth and the principal towns of the Morea : a line opening up com- munication with Northern Greece and Thessaly is in process of construction ; its eventual connexion with the Continental railway system will greatly enhance the importance of the Piraeus, already one of the most flourishing commercial towns in the Levant.

The population of Athens has rapidly increased. In 1834 it was below 5000 ; in 1870 it was 44,510 ; in 1879, 63,374 ; in 1889, _ . 107,251 ; in 1896, 111,486. The Piraeus, which in

J2n 1834 possessed only a few hundred inhabitants, in 1879

numbered 21,618 ; in 1889, 34,327 ; in 1896, 43,848. The total population of Athens, Piraeus, Phaleron, and the suburbs is now probably little short of 200,000.

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(j. D. B.)

Athens, a city in the northern part of Georgia, U.S.A., and capital of Clarke county; altitude, 680 feet. It is entered by several railways, and has extensive and growing manufactures, largely of cotton. It is the site of the University of Georgia and of the Lucy Cobb Institute. Population (1880), 6099; (1890), 8639;

(1900), 10,245.

Atherton, or Chowbent, a township in the Leigh parliamentary division of Lancashire, England, 13 miles W.N.W. of Manchester by rail. A new church has been built and another rebuilt. There is a volunteer hall. Population of urban district in 1881, 12,602; in 1891,' 16,833. In 1894 part of the township and urban district was transferred to the urban district of Leigh. Popula- tion (1891), on area thus altered, 13,720 ; (1901),, 16,211.

Athletic Sports. — Since 1875 the number of athletic meetings held throughout the United Kingdom has continued to increase, and the number of amateur athletes has become very much greater. The most notice- able feature of the increase during this period is that the movement has spread from the " classes" to the " masses." Except at the universities, public schools, and military colleges, where running and jumping competitions are still carried on with the greatest zest, and retain their social prestige, and in London, where the London Athletic Club still

continues to attract members of good standing, throughout the rest of the country the great majority of athletes who compete at meetings are not drawn from the upper or middle classes as was the case twenty or thirty years ago. The form of competitions has hardly varied at

all, the competitions at what are called athletic sports, in the limited sense of the word " athletic," being running at short, middle, and long distances, hurdle races, jumping (high and long), weight-putting, and hammer-throwing. The two last named have been falling into desuetude in most parts of England, though still ca,rried on in Scotland and Ireland. A new feature is the increase of what are called steeplechases — i.e., long-distance races over hurdles, water jumps, and other obstacles. A two-mile steeple- chase was introduced into the programme of the amateur championship meeting in 1879. Since 1880 the entire management of the amateur championship meeting has been in the hands of a representative body called the Amateur Athletic Association. It is divided into three branches — a northern, midland, and southern — and its general committee manages an annual championship meet- ing, issues laws, and governs the sport in the same manner as the Jockey Club governs horse-racing. No meeting can be held without the licence of this body, which also licenses the haridicappers who allot the starts in open events.'

The definition of an amateur adopted by this body is wide, and only excludes those who have competed for money or against a professional pedestrian. ' There are similar bodies which work under identical rules in Scotland and Ireland. The standard of excellence continues to improve. A carefully-tabulated set of British records is kept by the Amateur Athletic Association, and a copy is appended below. This list is confined to performances done in the United Kingdom.

Another feature of the progress of athletic sports is the growth of the movement in the United States

of America, and particularly in the colleges of that country (see below). A party of American athletes took part in the English Championship meeting of 1900 and won the majority of the events, being conspicuously the superiors of the Englishmen in the short-distance races. Indeed, the American records of every distance up to and including half a mile are slightly better than the English. In the longer distances the Englishmen seem more than, able to hold their own.

Except at the universities all the athletic meetings in England are now held in the summer months. During the winter the athletes occupy themselves with paper- chases and cross-country races. There are many scores of paper-chasing clubs throughout the country, and the popularity of cross-country running seems to be steadily upon the increase. The only other remaiMng feature in connexion with athletic sports which requires chronicling is the new method of starting in sprinting or short- distance races. The runner bends down and rests his hands lightly on the starting mark, and no longer "toes the scratch." When the pistol fires he pushes off from his hands and raises himself gradually in the first stride or two. There is no doubt that this is the quickest method of starting, and it is now almost universal.

Amateur Athletic Association Eecoeds. Running.

Distance.

Name. Becord made by

Time.

Date.

Tarda.

H. H.

O,

A. Wharton .

3 July

1886

C. A. Bradley

1 July

1893

100

A. E. Downer

10

4 May

1895

K. W. Wadsley .

2 July

1898

F. W. Cooper

2 July

1898

>.

C. R. Thomas W. P. PhilUps

^

f

8 March 1890 25 March 1882

120

C. A. Bradley

.

11*^

28 April

1894

A. R. Downer

11 May

1895

1 120 Hur.

Godfrey Shaw

15*

6 July

1895

150 -[

C. ‘G. Wood .

C. J. Monypenny .

\ i

X4S{

21 July 27 Feb.

1887 1892

(

E. H. Felling

28 Sept.

1889

200]

A. R. Downer

wd

11 May

1895

G. Jordan

16 March 1896 |

220

C. G. Wood .

21|

25 June

1887

300

.

31|

21 July

1887

440 ■[

H. C. L. TindaU .

I J

m{

20 June

1889

E. C. Bredin.

22 June

1895

2 440 Hur.

T. M. Donovan .

57^

13 June

1896

600

E. C. Bredin.

1

IH

10 June

1893

880

F. J. K. Cross

1

54?

9 March 1888 1

1000

W. E. Lutyens

2

14|

5 July

1898

1320

Alec. Nelson .

3

llf

26 Aug.

1899

MUes.

1

F. E. Bacon .

4

17

6 July

1895

^

S. Thomas .

6

53f

13 May

1893

2

W. G. George

9

17?

26 April

1884

3

S. Thomas . ‘ .

14

24

3 June

1894

4

E. C. Willers

19

33*

10 June

1894

6

S. Thomas .

24

53*

24 Sept.

1893

6

30

17f

22 Oct.

1892

7

.

35

364

»»

8

W. G. George

40

57?

28 July

1884

9

46

12

7 April

1884

10

,

51

20

H

12

S. Thomas .

1 2

43

22 Oct.

1892

15

,

1 22

15?

w

20

G. Crossland.

1 51

54

22 Sept.

1894

25

G. A. Dunning .

2 33

44

26 Dec.

1881

30

J. A. Squires

3 17

36J

2 May

1885

40

G. A. Dunning

4 50

12

26 Dec.

1879

50

J. E. Dixon .

6 18

26J

11 April

1885

100

No records.

2 Hurdle race on grass, over ten 3 ft. hurdles not less than thirty yards apart.

Walking.

Distance.

Name. Record made by

Time.

Date.

MUes.

H.

M.

s.

1

W. J. Sturgess

6

33|

26 Sept.

1896

2

»»

13

24J

10 Juy

1897

3

21

14

3 ‘July

1897

4

»» •

28

244

IJ

5

36

27

19 Oct.

1895

6

43

58f

7

I)

51

27

>)

8

58

56

»T

9

9

31?

3 Oct.

1896

10

17

38?

11

))

25

53?

))

12

34

34

23 Oct.

1897

13

»)

42

59|

J»

14

J. Butler

52

18f

23 Oct.

1897

15

2

0

48?

16

JJ

2

9

39

17

17

2

18

56?

18

2

28

52

19

2

39

3?-

20

{

8Tom Griffith

2

47

52

3 Dec.

1870

J. Sutler

2

49

26

23 Oct.

1897

21

ii

2

59

42?

H

25

W. E. N. Coston .

3

53

35

27 Dec.

1880

30

4

46

52

40

1

8A. W. Sinclair

6

38

3

14 Nov.

1879

J. A. Mcintosh

7

1

44

2 Oct.

1886

50

f

1

‘A. W. Sinclair

8

25

25i

14 Nov.

1879

J. A. Mcintosh

8

52

26

2 Oct.

1886

75

8A. W. Sinclair

14

10

0

27 Aug.

1881

100

8

19

41

50

11

Time Records.

Event.

2 hours' run . 1 hour walk .

3 hours' walk .

12 „ . .

London (Westminster

Clock Tower) to

Brighton (52J miles)

(walk)

Name. Becord made by

G. Crossland W. J. Sturgess J. Butler . A. W. Sinclair

J-E. Knott .

20^ ...

8 270

21 49

64 180

H, M. 8.

8 56 44

Date.

22 Sept. 1894 19 Oct. 1895

23 Oct. 1897 27 Aug. 1881

10 April 1897

Odd Events.

Event.

High jump

Pole jump

Long jump *

Putting the shot (16 ft)

Throwing the ham- mer (16 lb)

Name. Record made by

P. H. Leahy R. D. Dickenson W. J. M.Newburn D. Horgan.

T. F. Keily ‘ .

Distance.

6 4|

11 9

24 Oi

46 5i

151 11

6 Sept. 1898

1891

16 July 1898

15 Aug. 1894

25 July 1898

(m. S.)

United States. — The American adopted all his sports, except base-ball, from the English; but, as in the case of American political institutions, while the origins have been English the genius of the people has determined the lines of development. All forms of athletic contests tend in America to become shorter and more intense. The national game of base-ball, for instance, is nervous and rapid in its movement, as compared with cricket. A base-ball contest is decided in two hours, as against the day or more required for a game of cricket ; and instead of the two long innings there are nine short

^ In matches against time. 4 P. O'Connorjumped 24 ft. llj in. at Kilkenny, 15th July 1901.

innings, in the course of whicli the score may be half-a^ dozen times reversed. Again, in American football, which developed from the Eugby Union game, the contrast is equally striking, the American game having developed a thoroughly-planned and dramatic series of manoeuvres often of much copaplexity. In track and field athletics the performances of Americans are as excellent in all contests requiring a single burst of nervous energy, such as sprinting, hurdliag, and jumping, as those of English athletes are in the longer runs. It was not until shortly before the Civil War (1861-65) that there seemed to spring up something of athletic interest in America — boating being almost the only sport which until that time possessed any rules and permanent organi- zations. But the period of the war interrupted what might have been a speedy development along English lines. After peace was established, athletics appeared to take root once more, and in the succeeding decade (1870- 79) there was a rapid increase in general organization and interest. Eowiug, which had

been less interrupted during the war, and had had a longer existence than the other sports, came once more into prominence, and especial interest was added by the inter-collegiate regattas and by the centennial races (1876). Football was still in a chaotic stage, but the year 1876 saw the inauguration of the ErUgby Union rules, and with them the beginning of football as it is played to-day in the United States. Base-ball had for some half-dozen years been decidedly successful in the colleges, and among both amateurs and professionals outside. Track athletics, which had hitherto been only incidental to college boat-racing, had now made an independent place for itself. Thus in 1876 the four principal American sports had begun to push forward along the lines which were followed during the next quarter of a century.

In rowing, since the introduction of eight-oared shell racing over a four-mile course, there has been but little variation, this distance and this number of oars proving the most satisfactory. Upon several occasions there has been an agitation in favour of shortening the distance or of altering the methods in one way or another, but the movement has not met with more than temporary favour. In football the growth has been most rapid and most dis- tinctly American-^though here the rules adopted originally were those of the Eugby Union — and at first there was n"o legislation save where the rule failed specifically to cover a disputed point, and where there was only tradition to be relied upon. But with the growth of the gatae rule- t making became necessary, and the inventive genius of the American player developed special "plays" and formations until now the game is almost as distinctly American as base-baU. Track athletics had a very small beginning, but was taken up by an increasing number ,of colleges ; more events were added and greater interest was developed, until it grew in the last twenty years of the 19th century into a well-equipped and permanent branch of amateur sport. In fact, there is no branch which has as much strength among athletic clubs outside the colleges as track athletics. The new sports since 1875 are bicycling, tennis, and golf, together with the minor sports of basket ball, hockey, and polo. Tennis has both waxed and waned in the same period, but is now once more gaining in popularity, and bids fair to secure and maintain a permanent place. Golf has withdrawn many from the tennis ranks, and is probably as widely engaged in to-day as any sport in the country, largely

owing to the fact that it can be played by individuals who have passed the age for the more violent athletic sports.

In the country at large the percentage of men who engage in athletic pastimes has been almost inappreciable.

Professional sport is limited to. leagues of base-ball teams representing the great cities; and the main cultivation of amateur sport outside the universities is in the great athletic clubs which are now to be found in many of the large cities. These clubs differ from such organizations as the London Athletic Club in that they maintain large club-houses, which, in addition to expensively equipped gymnasiums, have luxurious lounging rooms, billiard rooms, and marble swimming baths. The ruling spirit is social rather than athletic. They have been strongly influenced ,by university sportsmen and sports, but the university element has never been dominant. The sports most successfully pursued are track and field athletics. Those sports which require more entensive organization and preparation, such as base-ball, football, and rowing, are practised with indifferent success. , The oldest and most characteristic development of sport has been, as in England, in the universities, but even the percentage of men engaged has not been large. Whereas in England almost 80 per cent, of the undergraduates engage in some athletic pastime, the percentage of Amer- ican undergraduate athletes had not until the closing decades of the 19th century exceeded 20 ; and even iii those universities in which athletics are most enthusi- astically pursued, the percentage is not yet even 40. This is in part due to the intensity characteristic of sports, and in part to the lack of that athletic rivalry within the uni- versity, and the consequent multiplication of contests, which is afforded in England by the division of the uni- versity into colleges. Whereas an English 'varsity crew is content to row together for a month or two, the candidates for an American crew that is to race in July usually train ia a gymnasium through the greater part of the preceding ' winter. And whereas in England football teams rely on practice games and a few informal " squashes," an Ameri- can team, in addition to one or two practice games a week, works hard every afternoon in developing complicated " plays " and in perfecting team work.

The methods of training and the spirit of sportsman- ship have shown a very character! stic development. Owing partly to the extremes of the climate and the severity of nervous tension induced by it, and partly to the lack of more general participation in sports, the training has become in all instances more elaborate and more thorough than in England, and the winning of athletic victories is considered of more importance. Eivalries have been, and still are, of great intensity. At the same time the athletic spirit has run into grave excesses. All college teams have at one time or another been under strong and well-founded suspicion of induciag athletes to play for them by improper means. Excessive partisanship has involved excessive training, crafty diplomacy in arranging games, and trick- ery. All of the objectionable features have been intensi- fied by the fact that the great games have often been held in the cities, where they are apt to take on the character of public gladiatorial contests. In the closing decade of the 19th century a marked reaction began. The publicity attending university sports gave occasion for a vigorous protest against all forms of unsportsmanship, and the members of the university faculties now exercise a strong and, in many cases, a wise supervision. Except in occa- sional instances, for which individuals only are responsible, the representatives of the eastern universities are amateurs in the full sense of the word ; and in the western univer- sities, where the development of sports was very sudden, and was attended by flagrant abuse, wise counsels prevail. The spirit of moderation has been strongly abetted by the abandonment of the old league championships in favour of independent meetings between one college and another, and this practice in turn tends to limit inter-university games to university grounds. The rapid increase, moreover, in

the popularity of minor sports has drawn ever-increasing numbers of men into active competition, and there is a strong tendency to develop contests within the university. On becoming more general, the athletic spirit has become less intense. Though American sports will doubtless always retain the peculiar strenuousness of the American character, the influences

controlling them are becoming more and more representative of the best spirit in American life.

The American amateur records for the events most commonly competed for in track and field athletics are as follows .

Eunning, 100 yards 94 sec

220 „ 2l| „ ■

,. 440 „ 47 ;;*

” 880 „ 1 rain. 531 „

Ijnile 4 „ 164 „

„ 3mUes 14 „ 24 „

Walking, 1 mile 6 „ 294 „

Hurdles, 120 yards (five hurdles, 3 ft. 6 in. high) 15i

„ 220 „ (ten hvirdles, 2 ft. 6 in. high) 234 \,

Jumping, standing lugh, without weights . . 5 feet 4 inches

„ running high, without weights . . 6 „ 5| „

„ running long, without weights . . 24 „ 7J „

Pole vault for height 11 „ lOi

Throwing the hammer, 16 ft head (thrown by

both hands from a mark; handle 4 feet long) 113 „ 11 „

Ditto from circle 176 4|.

Putting the shot, 16 ft 47 „

(w. OA.)

Athlone, a market town and urban sanitary district in the county of Westmeath, province of Leinster, Ireland, on both sides of the river Shannon, 76 miles west of Dublin by rail. It ceased to be a parliamentary borough in 1885. In 1898 the portion situated in Roscommon was added to Westmeath. A woollen mill has been recently established, in addition to the already existing factory. Population (1881), 6765 ; (1891), 6742 ; (1901),

6617.

Athol, a town of Worcester county, northern Massa- chusetts, U.S.A., having an area of 35 square miles. Its surface is quite irregular and hilly. The village of Athol is on the Miller river, at an altitude of 556 feet, and is entered by two railways, the Boston and Albany and the Fitchburg. The plan of the village is quite irregular. Athol was incorporated in 1762. Population (1880),

4307; (1890), 6319; (1900), 7061.

Athos, the most easterly of three peninsulas of Turkey in Europe, projecting at its south-western ex- tremity into the jEgean Sea. The north-western border is about 50 miles S.E. of Salonica, to which there is a bridle-path. The peninsula takes its name from Mount Athos (6350 feet), the extreme summit of a chain of heights occupying the peninsula ; and on account of the number of religious houses, now totalling about 1000, it is also known as "The Holy Mount." None but males are allowed access to the peninsula, and all the inhabitants are Christians, with the exception of one Turkish officer. The recluses number about 3000, with 3000 servants.

Authorities. — Kilet. Athos, or the Mountain of the Monks. London, 1887. — Bkockhaus. Die Kunst in den Athos-Elostern. Leipsic, 1891. — Lambkos. Catalogue of the Cfreek Manuscripts on Mount Athos. Cambridge, vol. i., 1895.— Meter. Die Hauptur- kundenfur die &eschichte der Athos-KVostern. Leipsic, 1894.

Atkinson, Major the Hon. Sir Harry Albert,

K.C.M.G. (1831-1892), British colonial statesman ; prime minister and Speaker of the legislative council, New Zealand; was born at Chester in 1831, and in 1855 emigrated to Taranaki, New Zealand, where he became a farmer. In 1860 the Waitara war broke out, and from its outset Atkinson, who had been selected as a captain of the New Plymouth Volunteers, distinguished himself

by his contempt for appearances and tradition, and by the practical skill, energy, and courage which he showed in leading his Forest Rangers in the tiresome and linger- ing bush warfare of the next five years. For this work he was made a major of militia, and thanked by the Government. Elected to the house of representatives in 1863, he joined Sir Frederick Weld's ministry at the end of November 1864 as minister of defence, and, during eleven months of office, was identified with the well- known "self-reliance" policy, a proposal to dispense with imperial regulars, and meet the Maori with colonials only. Parliament accepted this principle, but turned out the Weld ministry for other reasons. For four years Atkinson was out of parliament ; in October 1873 he re- entered it, and a year later became minister of lands under Sir Julius Vogel. Ten months later he was treas- urer, and such was his aptitude for finance that, except during six months in 1876, he thenceforth held that post whenever his party was in power. From October 1874 to January 1891, Atkinson was only out of office for about five years. Three times he was premier, and he was always the most formidable debater and fighter in the ranks of the Conservative opponents of the growing Eadical party which Grey, Stout, and Ballance led in succession. It was he who was mainly responsible for the abolition of the provinces into which the colony was divided from 1853 to 1876. He repealed the Ballance land-tax in 1879, and substituted a property-tax. He greatly reduced the cost of the public service in 1880, and again in 1888. In both these years he raised the customs duties, amongst other taxes, and gave them a quasi-protectionist character. In 1880 he struck 10 per cent, off all public salaries and wages; in 1887 he re- duced the salary of the governor by one-third, and the pay and number of ministers and members of parliament. By these resolute steps revenue was increased, expend-iture checked, and the colony's finance reinstated. Atkinson was an

advocate of compulsory national assur- ance, and the leasing as opposed to the selling of crown lands. Defeated in the general election of December 1890, he took the appointment of Speaker of the legis- lative council. There, whUe leaving the council chamber after the sittin'g of 28th June 1892, he was struck down by heart disease, and died in a few minutes. Though brusque in manner, and never popular, he was esteemed as a vigorous, upright, and practical statesman. He was twice married, and had seven children, of whom three sons and a daughter survived him. (w. p. e.)

Atlanta, the largest city of Georgia, U.S.A., capital of the state and of Fulton county. It is situated in the northern part of the state, in 33° 45′ N. lat. and 84° 24′ W. long., at an altitude of 1060 feet. Its mean annual temperature is 62°, and the annual rainfall is 45 inches. The city is regularly laid out, is divided into seven wards, is supplied with water by the Holly pumping system, and is well drained and paved. It is one of the principal railway centres of the south, being entered by six rail- ways, the Atlanta and West Point, the Central of Georgia, the (3^eorgia, the Seaboard Air Line, the Southern, and the Western and Atlantic, which meet at a union depot. Amongst several institutions for higher education are the Atlanta Baptist College, Atlanta University, Morris Brown College, and the State Normal School of Teqh- nology. Of its newspapers the Atlanta Constitution is well known throughout the Union. Among the many fine buildings of the city the State Capitol, erected at a dost of $1,000,000, should be mentioned. Atlanta is probably the most progressive city of the south, having made vast strides during the past generation. In 1890 it had 410 manufacturing establishments of all kinds, employing

f 9,600,000 of capital, and 8684 persons. Chief among these were cotton manufactories, in which $1,900,000 were invested, and foundries and machine shops, with nearly $1,000,000. Lumber and furniture factories are also of great importance. The assessed valuation of property, real and personal, was, in 1899, $52,240,058, the tax rate $21.60 per $1000, and the indebtedness of the municipality $2,808,910. The death-rate, 23-01

per 1000, is enhanced by the large proportion of negroes among the population. Since the Civil War, which practically destroyed' it, the city has grown with great rapidity. Population (1880), 37,409; (1890), 65,533; (1900), 89,872, of whom 2631 were foreign-born and 36,912 were negroes.

Atlantic, capital of Cass county, Iowa, U.S.A., situated on the East Nishnabotna river, at the intersection of the Chicago, Rock Island, and Pacific railway with a branch of the Chicago, Burlington, and Quincy railway. Population (1890), 4361 ; (1900), 5046.

^ Atlantic City, a city of Atlantic county, New Jersey, U.S.A., situated in 39° 22' N. lat. and 74° 26' W. long., on a sand-bar running parallel with the coast, and separated from the mainland by a strip of marsh about five miles in breadth. The city is but slightly elevated above tide-level, is regularly laid, and is divided into four wards. Water is supplied by pumping, the water-works being privately owned. It is a popular seaside resort both in summer and winter, especially with dwellers iu Philadelphia, with which city it is connected by two railways, the Atlantic City (Philadelphia and Eeading system^ and the West Jersey and Seashore (Pennsylvania system). It is a city of hotels and boarding-houses, aad in the summer season has a large floating population, estimated at 100,000. The first settlement was made about 1783, and the place received a city charter in 1852. Population (1880), 6477; (1890), 13,055; (1900), 27,838.

Atlantic Ocean. — The Atlantic Ocean forms a belt of water, roughly of an S-shape, between the west- ern coasts of Europe and Africa and the eastern coasts of North and South. America. It extends northwards to the Arctic Basin and southwards to the Great Southern Ocean. For purposes of measurement the polar boundaries are taken to be the Arctic and Antarctic circles, although in discussing the configuration and circulation it is impos- sible to adhere strictly to these limits. The Atlantic Ocean consists of two characteristic divisions, the geo- graphical equator forming a fairly satisfactory line of division into Korth and South Atlantic. The North Atlantic, by far the best known of the main divisions of the hydrosphere, is remarkable for the immense length of its coast-line

and for the large number of enclosed seas connected with it, including on the western side the Caribbean Sea and Gulf of Mexico, the Gulf of St Law- rence, and Hudson Bay, and on the eastern side the Mediterranean and Black Sea, the North Sea, and the Baltic. The North Atlantic is connected with the Arctic Basin by four main channels : (1) Hudson Strait, about 60 miles wide, communicating with the gulfs and straits of the North American Arctic archipelago; (2) Davis Strait, about 200 miles wide, leading ^o BafBn Bay ; (3) Denmark Strait, between Greenland and Iceland, 130. mUes wide; and (4) the "Norwegiaa Sea," about 400 miles wide, extending from Iceland to the Earoe Islands, the Shetland Islands, and the coast of Norway. The width of the North Atlantic in lat. 60°, approximately where it breaks up into the branches just named, is nearly 2000 miles ; in about lat. 50° N., the coasts of Ireland and Newfoundland approach to 1750 miles ; the breadth then incueases rapidly to lat. 40° N., and attains its maximum

of 4500 miles in lat. 25° N. ; farther south the minimum breadth is reached between Africa and South America, Cape Palmas being only 1600 miles distant from Cape St Eoque. In marked contrast to this, the South Atlantic is distinguished by great simplicity of coast-line ; inland seas there are none, and it attains its greatest breadth as it merges with the Southern Ocean ; in lat. 35° S. the width is 3700 miles.

The total area of the North Atlantic, not counting inland seas connected with it, is, according to Karstens, 36,438,000 square kilometres, or 10,588,000 square miles ; including the inland seas the area is 45,641,000 square kilometres, or 13,262,000 square miles. The area of the South Atlantic is 43,455,000 square kilometres, or 12,627,000 square miles. Although not the most extensive of the great oceans, the Atlantic has by far the largest drainage area. The " long slopes " of the continents on both sides are directed towards the Atlantic, which accordingly receives the waters of a large proportion of the great rivers of the world, including the St Lawrence, the Mississippi, the Orinoco, the Amazon, the rivers of the La Plata, the Congo,' the Niger, the Loire, the Rhine, the Elbe, and the great rivers of the Mediterranean and the Baltic. Murray estimates the total area of land draining to the Atlantic to be 13,432,000 square miles, or with the Arctic area nearly 20,000,000 square miles, nearly four times

the area draining to the Pacific Ocean, and almost precisely four times thje area draining to the Indian Ocean. Murray's calculations give the amount of precipitation received on this area at 16,800 cubic miles annually, and the river discharge from it at 3900 cubic miles.

*The dominant feature of the relief of the Atlantic basin is a submarine ridge running from north to south from about lat. 50° N. to lat. 40° S., almost exactly in the central line, and following the ST'aV S-shape of the coasts. Over this ridge the " * " average depth is about 1700 fathoms. Towards its northern end the ridge widens and rises to the plateau of the Azores, and in about 60° N. lat. it merges with the " Telegraph plateau," which extends across nearly the whole ocean from Ireland to Newfoundland. North of the fiftieth parallel the depths diminish towards the north-east, two long' submarine ridges of volcanic origin extend north-eastwards to the south-west of Iceland and to the Faroe Islands, and these, with their intervening valleys, end in a transverse ridge. connecting Greenland, , through Iceland and the Earoe Islands, with North- western Scotland and the continental mass of Europe. The mean depth over this ridge is about 260 fathoms, and the maximum depth nowhere reaches 600 fathoms. The main basin of the Atlantic is thus cut ofE from the Arctic basin, with which the area north of the ridge has complete deep-water communication. This intermediate region, which has Atlantic characteristics down to 300 fathoms, and at greater depths belongs more properly to the Arctic Sea, commonly receives the name of Norwegian Sea. On both sides of the central ridge deep troughs extend southwards from the Telegraph plateau to the Southern Ocean, the deep water coming close to the land all the way down on both sides. In these troughs the depth is seldom much less than 3000 fathoms, and this is exceeded in a series of patches to 'which Murray has given the name of "Deeps." In the eastern trough the Peake deep lies off the Bay of Biscay in 20° W. long., Monaco deep and Ghun deep off the north-west of Africa, Moseley deep off the Cape Verde Islands, Krech deep off the Liberian coast, and Buchanan deep off the mouth of the Congo. The western trough extends northwards into Davis Strait, forming a depression in the Telegraph plateau; to the south of Newfoundland*

ATLANTIC OCEAN

and Nova Scotia are Sigsbee deep, Thoulet deep, lAbbey deep, and Suhm deep, each of small area ; north-east of the Bahamas Nares deep forms the largest and deepest de- pression in the Atlantic, in -which a sounding of 4561 fathoms was obtained (70 miles north of Porto Rico) by the U.S. ship Blake in 1883. Immediately to the south of Nares deep lies the smaller Makaroff deep ; and off the coast of South America are Tizard deep and Havergal deep. South of 40° S. lat. the form of the sea-bottom changes considerably on account of the eastward trend taken by the alternate elevations and depressions. Between the south- ern extremity of South America and Graham. Land, in the Antarctic, the depth nowhere reaches 2000 fathoms, and a plateau of less depth extends eastward to South Georgia

and the Sandwich group. In 40° S. lat., 40° W. long., the 3000-f athoms line marks an offshoot of the great Ross deep, which runs south-eastwards to the main depression. East of this trough the depth is, generally, over 2000 fathoms, except where a bank, on which Bouvet Island stands, suggests a south-easterly prolongation of the main central ridge, which, but for this, would appear to end at Tristan da Cunha. From the south point of Africa south- eastwards to the Crozet Islands and Kerguelen the depth is less than 2000 fathoms, an ill-defined ridge separating the eastern margin of the Eoss deep from the main basin of the Indian Ocean (q.v.)

The foundations of our knowledge of the relief of the Atlantic basin may be said to have been laid by the work of H.M.S.

£. V.DaTtiiliiTt '^ O J R H^Wirlk.

Challenger (1873-76), of the German ship Gazelle (1|74-J6), the French expedition in the TramilUur (1880), and the U.b. stirveying vessel Blake (1877 and later). Large numbers of addi- tional soundings have been made in recent years by cable ships, by the expeditions of H.S.H. the Prince of Monaco, and by the German Valdivia expedition under Professor Chun (1898) ; but with the exception of the last-named none of

the later workers have seriously modified the contours outlined by the Challenger and Gazelle.

For the volume of the North Atlantic, Karstens giv^s the value 136,384,000 cubic kilometres, or 21,362,000 cubic miles, giving a mean depth of 2047 fathoms, if we include the enclosed seas, the North Atlantic has a volume of 150,415,000 cubic kilometres, or 23,560,000 cubic miles, giving a mean depth of 1800 fathoms. The South Atlantic has a total volume of 164,263,000 cubic kilometres, or 26,729,000 cubic miles, giving a mean depth of 2067 fathoms. The

Volume, mean depth, and bottom deposits.

following table, due to Murray, gives details of the area of the floor of the Atlantic basin, and the volume of water resting thereon, at different levels : —

Depth. Fathoms.

Ares.

Volume.

Square Miles.

Cubic Miles.

Between

0- 100

2,907,003

2,353,703

100- 500

2,404,482

8,370,611

500-1000

1,840,634

9,568,637

1000-2000

5,468,015

15,816,901

2000-3000

10,928,918

8,905,287

3000-4000

1,780,012

690,123

Over 4000

5,832

2,155

25,334,896

45,707,417

Mean depth, 1830 fathoms.

The Atlantic Ocean contains a relatively small number of islands. The only continental groups, besides some

islands in the Mediterranean, are Iceland, the British Isles, Newfoundland, the West Indies, and the Falklands, and the chief oceanic islands are the Azores, Madeira, the Canaries, the Cape Verde Islands, Ascension, St Helena, Tristan da Cunha, and Bouvet Island.

The greater part of the bottom of the Atlantic is covered by a deposit of Globigerina ooze, roughly the area between 1000 and 3000 fathoms, or about 60 per cent, of the whole. At a depth of about 3000 fathoms, i.e., in the " Deeps," the Globigerina ooze gradually gives place to red clay. In the shallower tropical waters, especially on the central ridge, considerable areas are covered by Pteropod ooze, a deposit consisting largely of the shells of pelagic molluscs. Diatom ooze is the characteristic deposit in high southern latitudes. The terrigenous deposits con- sist of blue muds, red muds (abundant along the coast of Brazil, where the amount of organic matter present is insufficient to reduce the iron in the matter brought down by the great rivers to produce blue muds), green muds and sands, and volcanic and coral detritus.

The question of the origin of the Atlantic basin, like ^ that of the other great divisions of the hydrosphere, is .still unsettled. Most geologists include the Atlantic with the other oceans in the view they adopt as to its age (see Geology and Ooeanogeaphy) ; but Suess and Neumayr, while they regard the basin of the Pacific as of great antiqtPity, belifeve the Atlantic to date only from the Mesozoic age. Neumayr finds evidence of the existence of a continent between Africa and South America, which protruded into the central North At- lantic, in Jurassic times. Kossmat has shown that the Atlantic had substantially its "present form during the Cretaceous period.

In describing the mean distribution of temperature in the waters of the Atlantic it is necessary to treat the Di t lb ■ northern and southern divisions separately. The tioa of heat equator, or line of maximum mean

surface tempera- temperature, starts from the African coast in ’”■ about 5° N. lat., and closely follows that parallel

to 40° W. long., where it bends northwards to the Carib- bean Sea. North of this line, near which the temperature is a little over 80° F., the gradient trends somewhat to the east of north, and the temperature is slightly higher on the western than on the eastern side until, in 45° N. lat., the isothermal of 60° P. runs nearly east and west. Beyond this parallel the gradient is directed towards the north- west, and temperatures are much higher on the European than on the American side. From the surface to 500 fathoms the general form of the isothermals remains the same, except that instead of an equatorial maximum belt there is a focus of maximum temperature off the eastern coast of the United States. This focus occupies a larger area and becomes of greater relative intensity as the depth increases until, at 500 fathoms, it becomes an elongated belt extending right across the ocean in about 30° N. lat. Below 500 fathoms the western centres of maximum disappear, and higher temperatures occur in the eastern Atlantic off the Iberian peninsula and North- western Africa down to at least 1000 fathoms; at still greater depths temperature gradually becomes more and more uniform. The communication between the Atlantic and Arctic basins being cut off, as already described, at a depth of about 300 fathoms, the temperatures in the Norwegian Sea below that level are essentially Arctic, usually below the freezing-point of fresh water, except where the distribution is modified by the surface circula- tion. The isothermals of mean surface temperature in the South Atlantic are in the lower latitudes of an cq -shape, temperatures being higher on the American than on the African side. In latitudes south of 30° S. the curved form tends to disappear, the lines running more and more

directly east and west. Below the surface a focus of maximum temperature appears off the coast of South America in about 30° S. lat,, and of minimum tempera- ture north and north-east of this maximum. This dis- tribution is most marked at about 300 fathoms, and disappears at 500 fathoms, beyond which depth the lines tend to become parallel and to run east and west, the gradient slowly diminishing.

The Atlantic is by far the saltest of the great oceans. Its saltest waters are found at the surface in two belts, one extending east and west in the North saiinity Atlantic between 20° and 30° N. lat., and another of almost equal salinity extending eastwards from the coast of South America in 10° to 20° S. lat. In the equatorial region between these belts the salinity is markedly less, especially in the eastern part. North of the NorthAtlantic maximum the waters become steadily fresher as latitude increases until the channels opening into the Arctic basin are reached. In all of these water of rela- tively high salinity appears for a long distance towards the north on the eastern side of the channel, while on the western side the water is comparatively fresh. In the higher latitudes of the South Atlantic the salinity diminishes steadily and tends to be uniform from east to west, except near the southern extremity of South America, where the surface waters are very fresh. Our knowledge of the salinity of waters below the surface is as yet very defective, large areas being still unrepresented by a. single observation. The chief facts already established are the greater saltness of the North Atlantic compared with the South Atlantic at all depths, and the low salinity at all depths in the eastern equatorial region, off the Gulf of' Guinea.

It is now generally admitted that the movements of the surface waters of the great oceans are primarily controlled by the winds, and the resulting circulation consists of (a) drift currents in the open sea, /j!^"' following the general wind directions, and (6) stream currents, which are independent of the local winds, but are due to inequalities of pressure produced by the interference of land masses with the movements of the drift currents. Quite recently Pettersson has shown that the formation and melting of polar ice must be regarded as a factor contributing a considerable portion of the energy of ocean currents, and this factor must be of great importance in the Atlantic. The wind circulation over the Atlantic is of a very definite character. In the South Atlantic the narrow land surfaces of Africa and South America produce comparatively little effect in disturbing the normal planetary circulation. The tropical belt of high atmospheric pressure is very markedin winter ; it is weaker during the summer months, and at that season the greater relative fall of pressure over the land cuts it off into an oval-shaped anticyclone, the centre of which rests on the coolest part of the sea surface in that latitude,

near the Gulf of Guinea. South of this anticyclone, from about the latitude of the Cape, we find the region where, on account of the uninterrupted sea surface right round the globe, the planetary circulation is developed to the greatest extent known ; the pressure gradient is exceed- ingly steep, and the region is swept continuously by strong westerly winds — the "roaring forties." This is merely the " polar eddy," which is probably arrested by ' the f rietional resistance of the land and the low tempera- tures in the higher Antarctic latitudes.

In the North Atlantic the distribution of pressure and resulting wind circulation are very largely modified by the enormous areas of land and frozen sea which surround the ocean on three sides. The tropical belt of high pressure persists all the year round, but the immense demand for air to supply the ascending currents over the heated land

surfaces in summer causes tlie normal descending move- ment to be largely reinforced, hence the " North Atlantic anticyclone" is much larger, and its circulation more vigorous, in summer than in winter. Again, during the winter months pressure is relatively high over North America, Western Eurasia, and the Arctic regions ; hence vast quantities of air are brought down to the surface, and circulation must be kept up by ascending currents over the ocean. The Atlantic anticyclone is therefore at its weakest in winter, and on its polar side the polar eddy becomes a trough of low pressure, extending roughly from Labrador to Iceland and Jan Mayen, and traversed by a constant succession, of cyclones. The net effect of the surrounding land is, in fact, to reverse the seasonal variations of the planetary circulation, but without destroyiag its type. In the intermediate belt between the two high-pressure areas the meteorological equator remains permanently north of the geographical equator, moving between it and about 11° N. lat.

The w;ind circulation may shortly be described thus from north to south : —

1. ” Iceland ” depression — ^low-pressure belt, traversed by numerous cyclones, some of great intensity, in winter ; abundant rainfall.

2. A belt of ” westerly variables,” the polar side of the Atlantic anticyclone, mergiag into (1).

3. Calm and dry belt, the, axis of the Atlantic anti- cyclone— the “horse latitudes,” or “calms of Cancer.”

4. Belt of K.E. and E. winds. These coming from a high-pressure area are dry, hence there is little rain- fall, and great evaporation from the sea surface, which attains its greatest salinity in this region; the “trade winds.”

5. Equatorial belt of calms and rains ; the “doldrums.”

6. Belt of S.E. and E. winds— the “trade winds.”

7. Tropical calm and dry belt, or ” calms of Capricorn.”

8. Belt of W. and N.W. winds, merging into the ” roaring forties.”

The part of this circulation which is steadiest in its action is the trade winds, and this is therefore the most effective in producing drift movement of the surface waters. The trade winds give rise, in the region most exposed to their influence, to two westward-moving drifts — the equatorial currents, which are separated in parts of their course by currents moving in the opposite direction along the equatorial belt. These last may be of the nature of “reaction” currents; they are collectively known as the equatorial counter-current. On reaching the South American coast, the southern equatorial current splits into two parts at Cape St Eoque: one Currents, ^jgjich, the Brazil current, is deflected south- wards and follows the coast as a true stream current at least as far as the Eiver Plate. The second branch proceeds north-westwards towards the West Indies, where it mingles with the waters of the northern equatorial; and the two drifts, blocked by the ^-shape of the land, raise the level of the surface in the Gulf of Mexico, the Caribbean Sea, and in the whole area outside the West Indies. This congestion is relieved by

what is probably the most rapid and most voluminous stream current in the world, the Gulf Stream, which runs along the coast of North America, separated from it by a narrow strip of cold water, the " cold wall," to a point off the south- east of Newfoundland. At this point the Gulf Stream water mixes with that from the Labrador current (see below), and a drift current eastwards is set up under the influence of the prevailing westerly winds: this is generally called the GMf Stream drift. When the Gulf Stream drift approaches the eastern side of the Atlantic it splits into two parts, one going southwards along the north-west coast of Africa, the Canaries current,

and another turning northwards and passing to the west of the British Isles. Most of the Canaries current re-enters the northern equatorial, but a certain proportion keeps to the African coast, unites with the equatorial return currents, and penetrates into the Gulf of Guinea. This last feature of the circulation is still somewhat obscure ; it is probably to be accounted for by the fact that on this part of the coast the prevailing winds, although to a con- siderable extent monsoonal, are off -shore winds, blowing the surface waters out to sea, and the place of the water thus removed is filled up by water derived either from lower levels or from " reaction " currents.

The movements of the northern branch of the Gulf Stream drift have been the object of more careful and more extended study than all the other currents of the ocean put together, except, perhaps, the Gulf Stream itself. The cruises of the Porcupine and Lightning, which led directly to the despatch of the Challenger expedition, were altogether within ' its " sphere of influence " ; so also was the great Norwegian North Atlantic expedition. More recently, the area has been further explored by the German expedition in the ss. National, the Danish Ingolf expedition, and the minor expeditions of .the Michael Sars, Jackal, Research, &c. Much has also been done by the discussion of observations made on board vesseFs belonging to the mercantile marine of various countries. It may now be taken as generally admitted that the current referred to breaks into three main branches. The first passes northwards, most of it between the Faroe and Shetland Islands, to the coast of Norway, and so on to the Arctic basin, which, as Nansen has shown, it fills to a great depth. The second, the Irminger stream, passes up the west side of Iceland ; and the

third goes up the Greenland side of Davis • Strait to Baffin Bay. These branches are separated from one another at the surface by currents moving southwards : one, the importance of which has only recently been recognized, to the east of Iceland ; the second, the Greenland current, skirts the east coast of Greenland ; and the third, the Lahrqdor current already mentioned, follows the western side of Davis Strait. Pettersson has recently shown that these cold surface currents are chiefly due to the melting of sea ice, caused by the influx of immense quantities of warm water from the Gulf Stream drift, and this result has been confirmed by Dickson, who shows, from an investigation of the seasonal changes of the circulation, that a drift of the kind described is inadequate to account for all. the facts. He maintains that, just as in the case of the equatorial currents, a heaping-up of water takes place off the south-west coast of Europe and the north-west of Africa, and that this heaping-up takes place especially in summer, when the Atlantic anticyclone produces its maximum effect. The heaped-up water escapes by stream currents of the same nature as the Gulf Stream ; and it is these currents, not the drifts, which are able to make their way into high latitudes, guided by the outline of the land. During winter, when the Atlantic anticyclone is at its weakest and the surface circulation is especially under the control of the cyclones of the Iceland depres- sion, a general drift circulation is set up, large quantities of water move south-eastwards from Davis Strait, cross the Atlantic, and pass north-eastwards into the Norwegian Sea.

The development of the equatorial and the Brazil currents in the South Atlantic has already been described. On the polar side of the high-pressure area a west wind drift is under the control of the "roaring forties," and on reaching South Africa part of this is deflected and sent northwards along the west coast as the cold Benguela current, which rejoins the equatorial. In the central parts of the two high-pressure areas there is practically no surface

circulation. In tlie North Atlantic this region is covered by enormous banks of gulf-weed (Sargassum bucdferum^, hence the name Sargasso

Sea. The Sargasso Sea is bounded, roughly, by the lines of 20°-36° N. lat. and 40°-76° W. long.

The sub-surface circulation in the Atlantic may be regarded as consisting of two parts. Whfere water is banked up against the land, as by the equatorial and Gulf Stream drift currents, it appears to penetrate to very considerable depths; the escaping stream currents are at first of great vertical thickness, and part of the water at their sources has a downward movement. In the case of the Gulf Stream, which is not much impeded by the land, this descending motion is relatively slight, being perhaps largely due to the greater specific gravity of the water; it ceases to be perceptible beyond about 500 fathoms. On the European-African side the descending movement is more marked, because the coast-line is much more irregular, aad the northward current is deflected against it by the earth's rotation; here the movement is traceable to at least 1000 fathoms. The northward movement of water across the Norwegian Sea extends down from the .surface to the Iceland-Shetland ridge, where it is sharply cut off ; the lower levels of the Nor- wegian SeS, are filled with ice-cold Arctic water, close down to the ridge. The south-moving currents originating from melting ice are probably quite shallow. The second part of the circulation in the depth is the slow " creep " of water of very low temperature along-the bottom. The North Atlantic being altogether cut off from the Arctic regions, and the vertical circulation being active, this movement is practically non-existent; but in the South Atlantic, where communication with the Southern Ocean is perfectly open, Antarctic water can be traced to the equator, and even beyond.

The tides of the Atlantic Ocean are of great complexity. The tidal wave of the Southern Ocean, which sweeps uninterruptedly round the globe from east to west, generates a secondary wave between Africa and South America, which travels north at a rate dependent only on the depth of the ocean. With this "free" wave is combined a " forced wave," generated, by the direct action of the sun and moon, within the Atlantic area itself. Nothing is known about the relative importance of these two waves. (h. n. d.)

Atlas Mountains. — Since the exploration of the western section by Hooker and Ball in 1878, this range has been visited and even crossed at more than one point by later travellers. Oscar Lenz, who surveyed a consider- able part of the Great Atlas north of Tarudant, and determined a pass south of'

clear idea of the hitherto imperfectly known Atlas system in its more important western (Moroccan) section, which bears the comprehensive Berber name of Adeae n'Dbebn, the " Deren Mountains." Here it forms not two or three chains, as hitherto supposed, but as many as five distinct ranges, all varying in length and height, but disposed parallel to one another in the normal direction from south- west to north-east, with a slight curvature towards the Sahara. Generally speaking, the northern more or less convex slopes, being exposed to the moist Atlantic winds, are in many places well wooded, while the southern flanks, which intercept the dry Saharan winds, are mainly destitute of vegetation. '

*The maiQ range, commonly known as the Geeat Atlas, occupies a central position in the system, and is by far the longest and loftiest chain, terminating, not in a plateau as often asserted, but in a sharply J^^**™"' outlined crest, and culminating between the Bibaw^n Pass and the Jebel Aishin. The fall towards the Dahra district at the north-east end is gradual and continuous, but 'precipitous at the opposite extremity facing the Atlantic between Agadir and Mogador. At several points the crest has been deeply eroded by old glaciers and running waters, and thus have been formed a number of passes, which, however, are little utilized for peaceful intercourse, the approaches on both slopes being mostly held and blocked rather than kept open by mutually hostile Berber tribes. The Aishin section, culminating in a peak nearly 16,000 feet high, maintains a mean altitude of 11,600 feet, and from this great mass of scjiists and sandstones a number of secondary ridges radiate in all directions, forming divides between the Um-er-H^bia, the Sebu, the Muluya, the Ghir, and the Draa, which flow respectively to the west, north-west, north-east, south-east, and south. Eastwards the Aishin terminates abruptly in the steep Jebel-Terneit cliffs, which rise some 6000 feet above the surrounding plains. Eor a distance of 100 miles it nowhere presents any passes accessible to caravans ; but south-westwards some gaps in the*

range afford communication between the Um-er-E.ebia and the Draa basins. In the same direction the Aishin is continued by a not yet named crest, which appears to maintain the same mean altitude of consider ably over 11,000 feet, and it is this south-western extension of the Moroccan system which gives it greater average height than the European Alps, although dominated by less elevated peaks. Yet a few summits in the extreme south-west still exceed 11,0D0 feet in the neighbourhood of Cape Ghir. Besides huge masses of old schists and sandstones, geologists have discovered extensive limestone, marble, diorite, basalt, and porphyry formations, while granite prevails on the southern slopes of the Aishin range. The presence of enormous glaciers in the Ice Age is attested by the moraines at the Atlantic end, and by other indications farther east. The best known passes are: (1) The Bibaw^n in the upper Wed-Sus basin (4160 feet according to Lenz) ; (2) the Tizi, i.e., the " Pass " in a pre-eminent sense, giving access from Marakesh to Tarudant, rugged and difficult, but low, and utilized by Lempri^re, Jackson, Lenz, and other travellers ; (3) Tizi n'Tameffut, leading down to the Draa valley ; (4) Tizi n'Glawi (7600 feet, Foucauld) ; (6) Tizi n'Telremt (7250 feet, Foucauld), leading down to the Wed-Ghir.

The Middle Atlas, skirting the north flank of the Great Atlas at some distance inland, is not visible from the coast, and is still but little known; but seems to run from the region north of Demnat ™ to the Dahra district beyond Debdon, presents %^sf^ a somewhat regular snowy crest between the Um-er-R^bia and the Wed el-Abid valleys, and is crossed*

by passes from 6000 to 6000 feet high. Both slopes are wooded, and its forests are the only parts of Morocco where the lion still survives.

The Little or Anti-Atlas running parallel to and south of the main range is one of the least elevated chains in the system, having a mean altitude of not more than 5000 feet, although some peaks and even passes exceed 6000 feet. At one point it is pierced by a gap scarcely five paces wide with polished walls of variegated marbles. Although in some winters nearly

free from snow. La Martini^re found the Little Atlas quite covered with a white mantle in 1890-91. The Atlas system is completed ,by two other less important ranges — the Jebel-Bani,

south of the Little Atlas, crossed several times by Foucauld, who describes it as a low, narrow, rocky ridge with a height of 3000 feet in its central parts ; and the Ulmess Eiata, south of the middle range, not a continuous range, but a series of broken mountain masses from 3000 to 3500 feet'high, and traversed by the rivers Sebu and Muluya.

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ATMOSPHERIC ELECTRICITY.

§ 1. Investigation into the early history of atmospheric electricity would be the province rather of the antiquary than of the scientific man. In pre-scientific days light- ning was usually regarded as the special vehicle of divine vengeance. Lucretius was perhaps the first who attempted to apply to its elucidation the scientific method; he pointed out that even temples Af Jupiter h^d not escaped the thunderbolt, which seemed to imply an incredible degree of inefiiciency in the department over which that divinity was supposed to preside. Like most modern scientific men who have considered the subject, Lucretius had a theory of his own, and he might almost be looked upon as the parent of the " electric fluid " phraseology still so prominent in popular writings. Even in 1749, when Franklin proposed the famous kite experiment to test the identity of natural and artificial electricity, the electric fluid theory was probably held by most scientific men in a fairly literal sense. The electric fluid was sup- posed to reside in the clouds, whence it was attracted by any sharp point held upwards. Shortly after 1750 the observations by Lemonnier and others of electric pheno- mena in the atmosphere in the absence of cloud led to some modification of ideas. It was only, however, with the

introduction of improved methods and apparatus after the middle of the 19th century, mainly by Lord Kelvin, that there was any approach to exact measurements of atmospheric electricity. To understand the different methods employed or recommended, a brief survey of the phenomena is necessary.

§ 2. At most places in dry weather the electric potential near the ground is normally positive relative to the earth, and increases with the height. The existence of earth currents shows that the earth, strictly speaking, may not be all at one potential ; but the potential differences between points on the earth's surface — say, 1 kilometre apart — are insignificant compared to the normal potential difference between the earth and a point 1 metre above it, and when considering this latter difference we may regard the earth as at a uniform zero potential. What is aimed at in ordinary observ£|,tions of atmospheric electricity is the measurement of the potential difference between the earth and a point at a given height above it, or else the differ- ence in potential between two points in the same vertical at a given distance apart.

Let a conductor — say, a metallic sphere — be supported by a metal rod of negligible capacity whose other end is earthed. Then the conductor must all be at lastra- ^ero potential, and consequently the sphere must " ■ have an induced charge which produces at its centre a potential equal, but opposite, to what would exist at the same spot in free air. This neglects any charge carried by the air displaced by the sphere, and assumes a statical state of conditions, and further, what in practice is

never wholly realized, that the conductor exerts no disturb- ing influence outside itself. Suppose now that the sphere's earth connexion is broken, and that it is carried by an in^ sulating handle inside a building at zero potential, where its potential (relative to the earth) is determined. If this potential is – V (volts), then, assuming no loss of electricity during the operations, the potential of the air at the spot occupied by the sphere was ┤V. This method under various forms was largely in use about the middle of the 19th century. It was followed for many years by Quetelet at Brussels, and in a modified form by Palmieri at Naples; in recent years it

has been employed at the suggestion of Elster and Geitel on the top of the Sonnblick.

Next, suppose that a fixed conductor is insulated from the ground, and that by some means it is kept at the poten- tial of the air which it displaces, then the measurement of its potential is equivalent to a measu rement of the potential of the air. This is the basis of various seeminglydifferent methods. Originally the conductor took the shape of long metal wires, supported by silk or other insulating material, and no artificial means were employed to bring them to the potential of the surrounding air. The addition of sharp points was a step in advance. But the method can hardly be said to have been a quantitative one until the sharp points were replaced by either a flame (fuse, gas, lamp) or a liquid jet breaking into drops. In either case the theory is the same. The matter leaving the conductor, whether it be the products of combustion of a fuse or the drops of a liquid, supplies the means of maintaining' equality of potential between the conductor and the air at the spot where the matter quits electrical connexion with the conductor. It is customary to apply the term collector to the flame or liquid apparatus, its funrition being, in popular language, to collect electricity.

§ 3. Several form s of flame-collector have been proposed, and two have been a good deal used, viz., Lord Kelvin's portable electrometer (Papers on Electrostatics and Magnet- ism, §§ 263, 277, &c.) with a fuse, and Exner's form of gold-leaf electroscope (Exner, Wien. Sitz.Yol. xciii. (Ab. ii.), 1886, p. 222 ; also Sitz. xcv., xcviii., xcix., &c. ; Elster and Geitel, Terrestrial Magnetism, vol. iv. p. 15, &c.) in con- junction with an oil lamp or gas flame. The latter is the instrunient employed in most of the recent work done by Exner, Elster and Geitel, and others in Austrig, and Germany. The most obvious defect of the ordinary flame- collector is the tendency in the flame to be blown out. This prevents the use of Exner's form on windy days, but Pellat (Soc. Franc. Phys. Bull. June 1899; Science Abstracts, 1706, for 1899) has invented a form which claims to have surmounted this dif&culty.

Of liquid collectors the representative is Lord Kelvin's " water-dropper." The water is contained in a tank stand- ing on insulated supports, and the

tube through which the

jet issues passes' through a hole in a window. Erom the tube, or the tank, an insulated wire passes to a quadrant electrometer. Readings can be taken by eye, or a contin- uous photographic record can be obtained. In the latter case, light reflected from the mirror attached to the elec- trometer needle falls on prepared paper, which is wound round a drum driven by clockwork. Installations of this kind are, or have been, in operation at a good many observ- atories, including Kew, Greenwich, Lyons, Perpignan, Lisbon, and Batavia ; of late years a water-dropper has been in operation during summer near the top of the Eifliel Tower. At Kew Observatory the water-dropper tube is connected to the needle of the electrometer, whose quadrants are connected, the one pair to the positive pole the other pair to the negative pole of a battery of cells, whose centre is earthed. The arrangement is shown diagrammatically in Fig. 1. The most obvious weak point in a water-dropper is the tendency to freeze in cold weather.

Water Tank on Insulators

Discliarge _

// Tubt

Centre ^— —j Earthed Fio. 1. — ^Diagram of the Water-dropper at Kew Observatory.

To remedy this, less easily frozen liquids have some- times been employed, or the water has been heated or the tube protected. By such means water-droppers were kept in continual operation at two of the stations (Sodankyla and Cape Thorsden) of the international polar year 1882-83 during very severe cold.

§ 4. Before passing to the observational data it is expedient to refer to various sources of uncertainty. As already stated, we may' iu this inquiry regard the earth as at a uniform zero potential. Above a limited area of a level plain of absolutely smooth surface, devoid of houses, ■trees, or grass, the equipotential surfaces under normal conditions would be horizontal planes, and if we could determine the potential at a point 1 metre above the ground we should have a definite measure of the potential gradient at the earth's surface. The presence, however, of apparatus or observers upsets the conditions, while above uneven ground, or near a tree or a building, the equipotential surfaces cease to be horizontal. In an ordinarily moist climate a building seems to be practically at the earth's potential ; near its walls the equipotential surfaces are far from being horizontal, and near a ridge they may lie very close together. The height of the walls in the various observatories possessing water-droppers, the height of the water-dropper tube above the ground, and the distance it projects from the wall, all vary largely. . Again, the tube may project from the centre of a long wall or from a Qpmer, and there may be external buildings or trees sufficiently near to iufluence the potential. An interesting

example of the influence of the situation is presented by Batavia Observatory. During the years 1887-90, with the water-dropper at a height of 2 metres above the ground, the mean of the potentials recorded was 79 volts ; but during 1890-95, with the water-dropper at a height of 7-8 metres, the mean voltage was 967. This will show the futility of comparing the absolute voltages met with at two stations, unless means exist of allowing for the difference in the environments of the apparatus. This is the principal reason why Tables I. and II., p. 675, give the ratios borne by individual hourly or monthly values to the mean value for the day or year.

§ 5. There are other sources of uncertainty. If the shape of the equipotential surfaces near the jet is influenced by trees, shrubs, or grass, the influence will vary throughout the year. _ Again, in winter, the varying depth of snow 6r tbe formation of icicles may exert an appreciable influence. There are further sources of trouble in the apparatus itself. Unless the insulation is perfect, the poten- tial recorded is not that of the atmosphere at the spot where the jet breaks. The action of the jet is

opposed by the leakage through imperfect insulation, and if this is greater at one hour of the day, or at one season of the year, than at another, there may be a ficti- tious element in the diurnal or annual variation. A similar result may arise from variability in the pressure under which the jet issues, especially if the insulation is indifferent. The potentials, that have to be dealt with are often hundreds, and sometimes thousands, of volts, and insulation troubles are more serious than is generally appreciated. As a check on the records from water- droppers, it is desirable that scale-value determinations should b6 regularly made, and that the curve readings should from time to time be compared with eye observations, taken with a portable electrometer or electroscope in a fixed position, at a sufficient dis- tance from buildings or shrubs. In interpreting the records from a water-dropper, allowance must be made for the existence of purely local phenomena. The necessity for this was shovm as long ago as 1860 at Glasgow (Kelvin, Papers on Electrostatics and Magnetism, § 392). Two water-droppers were kept running in the university buildings, at no great distance apart but at different levels, and it was found that they often did not show pronounced changes of potential simultaneously. From this Lord Kelvin drew the con- clusion— ^which more recent observations have only tended to con- firm— that there are often electrified portions of the atmosphere in motion close to the earth. What may be regarded as accidental temporary disturbances have probably little influence on the results found for mean diurnal or annual inequalities, but this is not the case with influences such as the site of the station, whether in a valley or on a hiU, near a river or the sea.

§ 6. When rain is falling the potential frequently changes rapidly. These changes are often too sudden to be satisfactorily dealt with by an ordinary electroineter, and they sometimes leave hardly a trace on the photographic paper. Again, the 12'f' , rain dripping from all parts of the efflux tube may potential. materially affect the situation. Tor these and other reasons, it is customary at some observatories to take no account of days on which there is an appreciable amount of rainfall, or else to form separate tables for " dry " or " fine " days, and for " all " days. In other cases negative potentials are excluded from certain of the taj)les. Speaking generally, the exclusion of days of rain and of negative potential comes pretty much to the same thing (see, however, § 15).

Of the accompanying tables (p. 775) the first gives the mean diurnal inequality at various stations for the whole year, while the second shows diurnal inequalities for "winter" and "summer." These each include six months, except at Sodankyla and Perpignan, when three months at midwinter and three at midsummer are meant. For reasons already stated in-§ 4, the hourly values are expressed as percentages of the mean value for the twenty-four hours. The height h of the efflux tube above the ground, and the distance I which it projects from the building, are in metres. The hours are in most cases mean local time. In the case of Florence, however, the entry under an hour is really the mean for the previous sixty minutes. At Sodankyla apparently a correction of about twenty-seven minutes would be necessary to give local time. The data employed in calculating the tables are derived from the following sources : Cape Thorsden (Observations faites^ au Cap Thorsden Spitzberg, par VExpedition Su&doise, tome ii. 2, par S. A. Andr^e, Stockholm, 1887) ; Sodankyla {Exp&dition Polaire Finlandaise, tome iii., Helsingfors, 1898) ; Kew Obseivatory (Everett, Phil. Trans, ica 1868, p. 347, and Whipple, Brit. Assoc. Seport for 1881, p. 448); Greenwich (annual volumes of Greenwich Magnetical and Meteorological Observations') ; Florence (Met. Zeit. for 1891, p. 357) ; Perpignan (Met. Zeit. for 1891, p. 113, and 1890, p. 319); Lisbon (annual volumes of Annaes do Obs. do Infante D. iMiz); Batavia (Observations made at the Mag. and Met. Obs. at Batavia, vol. xviii., 1895) ; Cape Horn (Hann, Met. Zeit. for 1889, p. 95) .

§ 7. Some of the results in Table II. are shown graphically in Fig. 2, along with some corresponding

Table I. Mean Diurnal Inequaliti

for the Tear.

station.

Cape Thorsden.

Sodankyla.

Kew Observatory.

Greenwich.

Florence.

Perpignan.

Lisbon.

Batavia.

Cape Horn.

Period.

1882-88.

1882-88.

1862-64.

1880.

1880.

1898-96.

1888-86.

1886-88.

1884-86.

188T-90.

1890-95.

1882-83.

Days.

Quiet.

All.

••

All.

Pos.

AU.

All.

Fine.

All.

Dry.

Dry.

POB.

h I

3-38

1-87

8-0 2-5

8-5

1-0

8-8 1-4

8-8 1-4

8-0

1-8

?

?

8-4 1-6

8-0

0-6

2

7-8

S-5

2-0

Hour.

1

2

3

4

6

6

7

8

9

10

11

Noon.

1

2

3

4

5

6

7

8

9 10 11 12

97

99

94

89

93

96

94

102

98

93

98

96

99

99

101

105

105

109

108

114

110

100

101

99

91

85

82

84

89

91

97

100

98

102

98

102

105

107

108

108

108

110

102

111

111

104

108

93

87

79

74

72

71

77

92

106

107

100

90

92

90

91

92

98

108

121

134

139

138

128

113

99

102

95

88

85

85

88

97

97

102

90

94

91

90

88

85

88

99

110

118

129

130

130

114

105

101

95

86

84

84

88

96

95

101

91

96

95

94

89

85

90

97

108

121

127

132

127

114

105

97

89

87

86

86

92

100

102

100

101

96

97

96

94

95

97

102

108

111

115

117

117

111

104

92

83

77

75

74

82

100

112

113

107

100

95

92

90

89

89

94

113

121

129

132

127

114

100

78

72

71

72

77

92

107

114

111

100

96

99

99

97

99,

105

113

126

131

129

120

109

97

86

84

80

78

81

83

92

101

105

104

104

102

108

111

114

109

108

108

111

116

114

109

102

92

86

147

141

135

128

127

137

158

104

67

42

35

30

30

30

33

41

67

91

120

137

146

148

151

147

125

114

109

102

101

117

147

119

82

55

46

43

42

43

46

63

73

108

145

155

155

147

143

130

82

73

86

81

85

95

106

118

119

123

123

115

112

94

89

88

84

110

107

123

112

99

85

98

Mean Talnein

TOltS.)

10

65

51

87

91

...

119

55

99

79

967

100

Table U. Diurnal Inequalities.

Station.

Cape Thorsden.

Sodankyla.

Kew Observatory.

Greenwich.

— — ^ p—

Perpignan.

Lisbon.

Batavia.

Period.

1882-83.

1882-88.

1880.

1894 and 1896.

1888.

1885-86.

(2 metres.)

1887-90.

(7‘8 metres.)

1890-95.

Jan. to

May to

Win-

Bum-

Winter.

Win-

Sum-

Win-

Sum-

Win-

Sum-

Win-

Sum-

Win-

Sum-

April.

-Aug.

ter.

mer.

ter.

mer.

ter.

mer.

ter.

mer.

ter.

mer,

ter.

mer.

Hour.

1

97

87

90

99

94

115

87

110

68

88

76

93

146

149

124

127

2

111

83

79

84

92

104

84

101

67

80

74

86

139

142

114

114

3

118

80

78

90

84

92

76

98

62

77

75

82

137

135

109

108

4

103

76

74

99

81

90

77

96

63

81

79

81

131

127

100

103

5

103

78

74

111

80

96

78

94

68

94

77

86

132

123

102

100

6

114

78

80

114

83

97

82

101

83

112

82

96

138

136

116

118

7

108

82

86

117

91

105

94

107

102

118

93

108

166

153

152

142

8

107

98

95

122

94

100

97

111

122

111

100

105

118

92

131

93

9

92

102

91

109

106

91

98

102

126

109

106

100

74

64

91

76

10

89

102

106

101

100

(71)?

102

98

112

101

109

97

43

40

57

64

11

97

101

98

97

97

93

103

86

100

102

108

96

36

36

47

46

Noon.

98

100

98

100

100

85

107

94

106

106

113

98

31

30

42

44

1

101

104

116

97

99

85

107

85

106

98

117

107

29

33

40

42

2

96

104

113

97

94

78

109

82

106

90

116

114

28

32

40

46

3

93

110

121

93

90

75

111

78

106

88

114

104

24

41

43

60

4

92

119

111

96

97

74

116

81

111

89

116

102

30

49

60

65

5

101

112

105

106

104

86

112

93

117

93

116

101

60

74

73

73

, 6

98

116

115

92

114

96

114

98

126

103

120

104

88

94

108

107

7

103

124

118

102

124

111

117

99

131

111

128

106

119

122

144

146

8

102

126

117

106

129

126

113

108

126

116

115

116

138*

135

153

156

g

95

126

115

90

128

144

111

118

117

119

105

115

145

147

152

157

10

86

98

112

90

120

144

110

124

104

115

98

110

148

148

146

150

11

90

103

113

103

106

130

102

120

93

106

86

97

149

152

140

145

12

102

89

96

85

97

121

93

116

80

95

75

96

148

146

126

133

results for the Bureau Central Metdorologique, the Eiffel Tower, and the College de France, Paris, the last based on diagrams in a paper by Chauveau (Siances de la Soc. Franc, de Physique for 1899, p. 91). In this paper Chauveau suggests that there are at ordinary stations two distinct types of diurnal variation, viz., a summer type

possessed of two distinct maxima and two distinct minima, and a winter type showing only one maximum (in the evening) and one minimum (in the morning), or else closely approaching this as an ideal. Arguing from the results on the Eiffel Tower and from those on a high staging at Trappes, Chauveau draws the conclusion that the afternoon

Winter

SUMME/I

minimum in summer arises from causes peculiar to ‘ stations near the ground, and that at moderate heights the winter type of inequality applies in all latitudes through- out the entire year. It should be remarked, however, that some of the results in Tables I. and II. hardly seem to fit this theory.

Some of the irregularities in Tables I. and II. would probably disappear if more years’ data were employed ; this is especially true in cases where the range is small,

as at Cape Thorsden in winter. In this instance, according to the data, the inequal- ity is almost the op- posite of that usually met with, the poten- tial being highest in the early morning hours, and at about its lowest value be- tween 9 and 11 P.M. In summer the morning minimum is as well marked as at ^ other places. It will Mid be noticed that the

n Mid S Nnn 6 Mid

Milht AM. P.« Ni|U A.H RM Nient

*evening maximum is ‘ ^” * decidedly less promi-*

nent at Greenwich than at Kew, especially in winter, and that the afternoon minimum in winter is distinctly present at Kew though hardly visible at Greenwich.

In considering such discrepancies it would be well to bear in mind the possibility, or rather probability, that atmospheric potential may, like thunderstorms and auroras, vary much from one year to the next. At Lisbon the summer inequality presents three fairly equal maxima. These are possibly fictitious, as the range is exceptionally small, but the phenomenon was exhibited by each of the three years included, and there is a suggestion of more than two maxima at some of the other stations. Narrowness of diurnal range is clearly no general attribute of low latitudes, for that at Batavia is most conspicuous. Some of the irregularities in the tables may be due to the in- teraction of conflicting agencies, of which ‘ one may be dominant at one time, another at another. Thus C. E. Andre (Comptes Rendus, 112 (1891), p. 1509), on separating quiet bright days at Lyons into two sets, according as the wind was northerly or southerly, con- cluded that the characteristics of the diurnal inequality were conspicuously different in the two cases. Andre’s diagrams show two well-marked maxima and minima (with small doubtful ones) in each instance, but with southerly wind the morning maximuin is much the larger, whereas with the wind northerly it is somewhat the smaller.

§ 8. The mean of the hourly ordinates of electrograms (electric potential curves) for a month gives the monthly mean, and the Intercomparison of the monthly means gives the annual inequality. For reasons already indicated, Table III. gives relative not absolute values for the twelve monthly means. The data are from the same sources as those utilized in Tables I. and II.

Table III. Annual Inequality ; Percentages of Mean Potential for the Year.

Jan.

Feb.

March.

AprU.

May.

June.

July.

August,

Sept.

Oct.

Nov.

Dec.

Cape Thorsden, 1882-83

153

86

147

209

178

63

65

79

13

7

Sodankyla, 1882-83 .

94

133

148

155

186

93

53

77

47

72

71

71

Kew 1880 /^^^^^y® • ^^^'^'**'"1. pes. only .

165

140

157

106

60

57

62

43

54

96

127

134

161

145 .

149

105

62

59

61

44

53

102

123

136

Greenwich, 1893-94, 1896 .

110

112

127

107

83

71

76

84

83

104

104

139 .

Florence, 1883-86

132

110

98

84

86

81

77

90

89

99

129

125

Perpignan, 1886-88 .

121

112,

108

89

91

■ ***92***

89

82

74

99

122

121

Lisbon, 1884-86 ....

104

105

104

92

91

93

87

92

100

99

115

117

Batavia (2 m.), 1887-90

97

115

155

127

129

105

79

62

69

79

90

93

Batavia (7-8 m.), 1890-95 .

100

89

103

120

98

103

85

99

73

101

117

112

At Sodankyla the year employed began with September 1882, at Cape Thorsden with November 1882. At the latter station there were only ten months' observations, and the results for November and December seem

hardly credible. The figures sug- gest that the rapid fall in potential observed at Kew and Greenwich in April and May takes place later in the far north, and somewhat earlier in Florence, Perpignan, and Lisbon. At the higher level at Batavia the annual inequality seems very irregular, notwith- standing that it is a mean from six years' results.

§ 9. Diurnal and annual inequalities have been published for a variety of places, which are based on eye observations with Exner's electroscope. Such results depend only on observations taken at certain hours of the day, sometimes only on bright days ; consequently they are not directly comparable with inequalities based on the continuous records of self-recording instruments. Two examples are given in Table IV. The Wolfenbuttel data are due to Elster and Geitel {Wien. Sitz. ci. Abth. ii., 1892, p. 703} ; the data for Ladenburg were obtained by Gockel {Met. Zeit. for 1897, p. 281) during tlfe years 1892-95. The figures are the monthly means in volts of the potential at a fixed point in the atmosphere.

in metres, the maximum and minimum values of the potential are in volts. The data for Paris and Trappes are from the paper by Chauveau already mentioned ; the others from the same sources as Tables I. and II. London is the mean of, Kew (1880) and Greenwich.

Table V.

Station.

Paris.

Trappes

Perpi- gnan.

l,ondon.

Bureau Central.

KifTel Tower.

Batavia.

Height . .

3

285

20

8-4 ■

2

7^8

Season . .

Tear.

Sum- mer.

Sum- mer.

Sum- mer.

Sum- mer.

Tear.

Tear.

Tear.

Maximum . Minimum . Max./mean Min./mean

1-24

•85

1-84

■76

172 102 1-29

, .77

2490

1740

1-18

•79

872

213

1-23

•70

72^8

39-0

1-81

•71

125

24

1-58

•80

1496 401

1-65

■42

Table IV

{Annual Inequality).

Jan.

Feb.

Mob.

April.

1ILs.y.

June,

July.

Aug.

Sept.

Oct.

Nov.

Deo.

Wolfenbuttel Lad%nburg

891. 897

839

687

294

148

138 66

110 62

102 60

128 60

121

121 78

188 116

260 106

470 184

§ 10. Table V. gives some data bearing on the question of how the amplitude of the diurnal inequality is influenced by the height of the water-dropper above the ground. The heights are

Perhaps all that can be said is that the results are not unfavour- able to the view that the relative importance of the diurnal inequality diminishes as the height above the ground increases.

§ 11. The diurnal inequality near the ground on the top of a mountain has no necessary relationship to that above a plain at the same height above the sea. Elster and Geitel {Met. Zeit. for 1891, p. 321) believe that on the top of a mountain the diurnal variation is small, basing their view partly on some observations of their own on the top of the Sonnbliok (3100 metres). The mean of these

ATMOSPHEEIC ELECTEICITY

for certain hours of the day, along with some corresponding date obtained by Michie Smith in January 1885 on Dodabetta (8642 feet), the highest summit of the Neilgherries in India {Trans. Ji.S.I!. vol. xxxii. p. 583), are given in Table VI. (afternoon hours dashed).

Table Vl

Hour.

6

8

10

Noon.

2'

4'

6'

Sonnblick Dodabetta .

200

218 55

240 .67

214 93

224 108

93

The unit in which the potential is measured is not the same in the two cases, and the hours are not exact local mean time. Elster and Geitel's results, except that for 6 p.m., depend on three days' observations ; Michie Smith's are means from five days nearly free from mist. In support of their view Elster and Geitel refer to a few observations by Exner on a hill near St Gilgen, and to a considerable number of observations made more recently, but with apparently somewhat primitive apparatus, on the Sonnblick. In view of the large variation observed on Dodabetta, more ex- periments on the subject are clearly wanted.

§ 12. Many of the data referred to below are taken from Le Cadet's interesting book Etude du champ ilectrique de I'AtmospMre, Paris, 1898. For small beiglits use may be made of captive balloons, provided viith. a burning fuse, and carrying a wire attached to an electroscope on the ground. With such apparatus Exner (Wien. Sitz. xciii., 1886, p. 222) found the potential gradient nearly uni- form up to heights of 30 or 50 metres above the ground. At gi-eat heights the potential differs so much from that of the earth that captive baUoons are unsuitable. Accord- ingly, in 1885 a free balloon ascent was made at Vienna by Lecher, at Exner's suggestion. The potential gradient was found by using two water-droppers, with their jets at a difference of 2 metres in level. The mean of the few measureiaents taken made the potential gradient at a height of 550 metres nearly double that at the ground. More recent experiments, however, tend to show that Lecher's observations, if correct, were exceptional. Per- haps the most important of these experiments are those due to Le Cadet himseK. Like Lecher he employed two collectors — either water-droppers or flame-collectors — but usually with an arrangement for altering their difference of level. Table VII. gives some of Le Cadet's results. Each value is usually the mean of a series of readings. H is the height of the balloon in metres, P the potential gradient in volts per metre.

Table VII. Balloon Observations by Le Cadet.

Date.

Aug. 1, f H

fi15

740

790

870

1005

1100

1150

1800

ms. 1 P

T5

4.”)

«5

26

29

‘At

88

88

Ang. 9, j H 1893 1 P

R?4

880

lOfiO

1255

1290

1745

1940

2080

2310

2520

87

4«

4a

41

42

84

25

21

18

16

%VMf

1140

1R7R

16S0

1914

2870

2786

8186

8864

3912

4085

42-6

88-0

82-6

25-8

21-7

21-2

18-8

18-'l

18-8

13-2

On 11th September the value found for P at the ground was 150. The marked tendency shown in the table for P to diminish as the height

increases is equally prominent in other observations by Le Cadet. Thus on 24th March 1897, at heights between 1680 and 2300 metres, P varied from 32 to 28, while its mean value at the ground as deduced from the simultaneous records of the Lyons water-dropper was 99. Similar results were observed in Germany by Baschin, during an ascent on 17th February 1894. Using two ” water-droppers “—with 65 per cent, alcohol in the^ water— he found for P values of 49, 28, and 13, answering to the heights of 760, 2400, and 2800 metres respectively. During the ascent the value of P at the ground varied from 98 to 181 at Pots- dam, and from 85 to 200 at Wolfenbiittel. In opposition to these results Tuma, during an ascent at Vienna in

1892, found P to increase as the height increased from 410 to 1900 metres; but several recent ascents (Met. Zeit. for 1899, p. 280, or Wien. Sitz., March 1899) lead him to the same conclusion as Le Cadet, viz., that under normal conditions the potential gradient diminishes as the height increases. The possibility that a free balloon may carry off a charge as it leaves the earth has been discussed by Bornstein (Met. .Zeit, 1898, p. 65), who shows how such a charge could be measured if the balloon carried three water-droppers at different levels. Supposing how- ever a charge to exist initially, it would tend, as Baschin points out, to disappear when ballaSt was discharged. Tuma, from experiments made on several of his recent ascents, concluded that no charge existed on the balloon.

‘ § 13. If V be the potential, p the density of free electricity at a point iH the atmosphere, at a distance r from the earth’s centre, we have, neglecting variations of V in horizontal directions, r-^dd/dr) {‘fidY/dr) - |-47rp=0.

Throughout the limited portion of the earth’s atmosphere open to experiment, we may for practical purposes treat ifi as constant in this equation, and so take p= — (\ /iir) {d/dr) {dV /dr) . Thus p is positive if, as recent experiments seem to show, the potential gradient, dV/dr, diminishes as we recede from the earth.

If

If we take a tube of force 1 cm. cross-section, and suppose it cut by the equipotential surfaces at the heights hi and hi above the ground, then under the conditions assumed above the total charge, M, included within the specified portion of the tube is given by

4,rM= idV/dr)r=R+k,- (<2V/dr),.=E+A,, where R is the earth's radius.

Le Cadet applies equivalent formulse to his balloon ascent of 11th September 1897, assuming the potential gradient to be 150 (volt/metre) at the ground, and 13-4 (volt/metre) at 4000 metres. Supposing a volt equal to ~~0033 C.G.S. electrostatic units, the charge on the ground per sq. cm. is — (150/100) x ■0033~~=-4ir, or ap- proximately —•000395 electrostatic unit (in coulombs —13×10-"). The charge in the unit tube of force between the ground and the height of 4000 metres works out at ~~. This is in~~ significant compared with the density of the charges recently given to air by Kelvin, Maclean, and Gait (see § 17). Trabert (Met. Zeit., 1898, p. 401) makes a similar calculation in discussing the probaloility of the existence of vertical earth-air currents of the order 17 x IO-12 amperes per sq. cm. The existence of such currents seems indicated by the researches of A. Schmidt and others, who have concluded that a portion of the earth's magnetic field cannot be accounted for by a Gaussian potential (see Magnetism, Terrestrial, § 24). Trabert takes 130 (volt/metre) as the most probable mean value of the potential gradient at the ground. Answering to this, a calculation similar to Le Cadet's makes the surface deiisity — 11 x 10~" coulombs per sq. cm. Thus Schmidt's hypothetical mean current would transmit in one second fully 150 times as much electricity as exists at the instant on the earth's surface. This would imply a rate of dissipation about one Inillion times larger than that found by Linss and by Elster and Geitel in the absence of photo-electric action (see § 18).

§ 14. Elster and Geitel have attempted to measure the charge brought down by rain falling into an insulated vessel, as well as the simultaneous potential gradient in the atmosphere (Met. Zeit, 1888, p. 95; Wien. Sitz. xcix. Abth. ii., 1890, p. 421 ; Terrestrial Magnetism, March 1899, p. 15). There are various serious difficulties — splashing of raindrops, influence of apparatus, surgings in the electrometer, &c. — and though Elster and Geitel have done their best to surmount these, they seem some- what

doubtful of their complete success. The conclusions indicated by the experiments are : (1) raindrops almost invariably carry a charge ; the sign may be positive or negative, and may change repeatedly- in the course of a single rainstorm ; (2) the charge is more often than not opposite in sign to the simultaneous value of the potential gradient near the ground. On 11th May 1892,

during a thunderstorm, the charge brought down by the rain, when greatest, was approximately at the rate of 76xl0~" coulombs per second per sq. cm. of earth's surface. This was the maximum met with. In their paper in Terrestrial Magnetism, Elster and Geitel give graphical illustrations of their results.

§ 15. At most stations a negative potential gradient is exceptional, except during rain or fog. During rain it is a frequent but by no means invariable phenomenon, and it seldom persists long without a recurrence to positive. The alternations of sign during heavy thunderstorm rain are often both frequent and sudden, and a similar pheno- menon is not unusually observed during thick fog. In some localities a negative potential gradient seems by no means uncommon, even on bright calm days. Thus Michie Smith {Phil. Mag. vol. xx. 1885, p. 456) observed numerous instances of negative potential at Madras during bright days in August and September. The phenomenon was quite common betwe.en 9.30 a.m. and noon, during westerly winds, which at Madras are very dry and usually dusty. The presence of dust seemed to Michie Smith a contributory cause, but dust in easterly winds was not accompanied by negative potential. At the Finnish polar station Sodankyla, in 1882-83, Lemstrom and Biese found that out of 255 observed occurrences of negative potential, 106 took place in the absence of rain or snow. The proportion of occurrences of negative potential under a clear sky was much above its average in autumn, and much below its average in spring and summer. In many cases Lemstrom and Biese observed no change of

sign to follow on rain or snowfall. At Polhem, in Spitzbergen, Wijkander is reported to have observed negative potentials almost as often as positive; but the potential gradients at Polhem seem to have been abnormally low. At the polar station Godthaab, in 1882-83, negative potential seemed sometimes to be associated with aurora (Paulsen, Bull, de I'Acad. . , . de Danemarke, 1894, p. 148).

§ 16. It has been found by Lenard, Elster, and Geitel and others, that the potential gradient is negative near a waterfall. The influence may extend to a considerable distance. Lenard (Wied. Ann. xlvi. 1892, p. 584), who has specially investigated Uie matter, concludes that when pure water falls upon water the air in the neighbourhood becomes negatively charged ; the presence of dust in the air is, he believes, unessential. The effect oan be pro- duced inside a closed space (Maclean and Goto, Phil. Mag. vol. xxx. 1890, p. 148), but under such circumstances the presence of dust seems to increase the effect. A little impurity in the water markedly diminishes the charge, and may alter its sign. More recent experiments by Kelvin, Maclean, and Gait (JPhU. Trans, vol. cxci. A, p. 187) hare shown that when air is charged by dropping water, as in Maclean and Goto's experiments, the charge is con- siderably greater in the air near the level of impact of the falling water than in that at a higher level, A sensible charge still remained, however, when the influence of the splashing was eliminated. In the opinion of Kelvin, Maclean, and Gait, this property of falling water renders an ordinary water-dropper un- suitable for use indoors, at least in a small room, though it constitutes no practical objection to its use out of doors. Bxner (Wien. Site. (2) 1896, p. 467) observed an electrical action in the case of breaking sea-waves, noticing the spray to be negatively electrified.

§ 17. Electrification is generally admitted to exist in the atmo- sphere, but some authorities have held that it is carried by dust, or by ice and water particles forming clouds. Lord Kelvin's view is that ordinary air, whether containing dust or not, can be elec- trified, either positively or negatively. This conclusion is supported by experiments by Kelvin and Maclean (Proe. Boy. Soc. vol. Ivi. 1894, p. 84 ; Phil. Mag. August 1894), and by more recent experi- ments by Kelvin, Maclean, and Gait (PM. Trans, cxci.

A, p. 187). In the earlier experiments the electrification was measured by means of a water-dropper. ■ In the more recent ones, for the reasons specified in § 16, other methods were employed, and by means of needle points attached to an electric machine a charge of density 37×10- C.G.S. electrostatic units was given on one occasion to ordinary air, while a density as great as 22 x 10- units was attained by means of an electrified hydrogen flame. After stopping the electric machine, the electrification gradually*

disappeared, but could be detected for many minutes. In the earlier experiments little difference was observed between very dusty air and air as dustless as possible. Negative electrification seemed to disappear, when the machine was stopped, more rapidly than positive. In the later experiments it was found possible to give a small electrification to air in other ways, e.g., by shaking it up with water or solutions of various kinds, or blovring it in bubbles through water or aqueous solutions.

§ 18. Linss (Met. Zeit. 1887, p. 352) found that an insulated paste-board cylinder, covered with tinfoil and charged either positively or negatively, lost its charge gradually when in the free atmosphere. The potential V existing after dissipation during time t was connected with the original potential Vo by a formula of the type V=Voe-s, where q though constant on a particular occasion varied appreciably from day to day. The formula implies that the rate of fall of the potential varies as its existing value (counting the earth's potential as zero). Linss's experiments have been repeated by Elster and Geitel (Terrestrial Magnetism, vol. iv. 1899, p. 213). Their dissipator consisted of a hollow cylinder of blackened copper, insensitive to any direct photo-electric effect. "When used out of doors, it was protected from rain, wind, and direct sunlight by an insulated hood. Regular daily observations were made for a long time, the loss during a given interval being measured for both positive and negative charges. In addition to numerous experiments at Wolfenbiittel, a considerable number were made on the Brocken and on the Alps, near Zermatt. Elster and Geitel denote the fraction of the charge lost per minute by E, distinguishing the sign of the charge by' the addition of 1 or — . In the lowlands they found on the average E±=l-3 per cent. In other words,*

positive and negative charges were lost, on the whole, equally fast, and on the average a charge of 100 units lost 1-3 units in one minute. This result agrees pretty well with that obtained by Linss. Neither wind nor mist was found to possess much influence, and, somewhat contrary to expectation, the most rapid loss of charge was observed on days when the air was specially clear and free from dust. In mountainous districts they found a change in the phenomena, as may be seen from the following typical results, obtained during the ascent of a peak near Zermatt : —

Position.

Zermatt valley On level ground . Near end of ridge Peak, Gorner Gratz

Height

above Sea.

Metres.

1620 2600 3000 3140

EC+).

Per cent.

4-5 4-4 2-7 0-7

E(-).

Per cent.

4-4 6-8 7-0 6-6

From these and similar observations Elster and Geitel conclude ; (1) that normally in valleys high above the sea the rate of dissipa- tion is greater than near sea-level, whilst remaining independent of the sign of the charge ; (2) that on mountains, especially near peaks, a negative charge is lost much more rapidly than a positive charge.

A diametrically opposite phenomenon was observed by them near waterfalls. Eor instance, near a fall at Zermatt they obtained 16-2 per cent, for E(ϟ) as against 1-9 per cent, for E(—).

They attribute the loss of charge to the existence of small positively and negatively charged masses in the atmosphere. In the lowlands or in mountain valleys the two species are equally numerous on the average, but positive masses largely predominate near mountain peaks and negative masses near waterfalls (cf. § 16),

§ 19. It has long been a disputed question whether vapour from a charged liquid carries off part of the charge ; it is rather a vital point in some theories respecting atmospheric electricity, such as that of Exner. Various experimenters {e.g., Blake, Mascart, Sohncke, Pellat) have advanced what they regarded as crucial evidence in favour of one view or the other. The question is discussed by J. J. Thomson, in his Recent Researches in Electricity and Magnetism, p. 64, and Trabert has treated it more recently in the Met. Zeit. for 1899, p. 377. Several supporters of the view that the vapour carries off a charge, e.g.. Lord Kelvin (JVoc. Roy. Soc. 31st May 1894, p. 84), have pointed out that if it be conceded that a drop of pure water can be charged and evaporated, the charge must be carried off by something which is either aqueous vapour or is unknown to science,

§ 20. In Exner's theory of atmospheric electricity aqueous vapour is the essential element. If, as before, P be the potential gradient in volts per metre, and q be the density of aqueous vapour present in the atmosphere, then, according to Exner, lP=A/(l + kq), where A and k are constants. In its extreme form the theory would imply that the above formula applied with A and k absolute constants in the case of every recorded value of P on clear days, Elster and Geitel, however, in their applications of the formula, seem generally to regard P and q as answering to the mean values during a day's observations. On other occasions

>'■

■ — Ji

TMOSPHEKIC ELECTRICITY

they hav __ attributed to A values differing from one series of exper- ™^” ..s, to another. Exner himself (Wien. Site. xcix. Abth. ii. 1891, p. 601) has applied his formula with A=1400 and ii;=l‘15 to observations at Vienna, WoUenbUttei; St Gilgen, and India. Arranging his observations in groups, each of which answers to a narrow range of vapour density, he compares the mean observed and calculated values of P for the^ several groups. The tendency for the mean P to be small when the mean q is large is decided. Elster and Geitel {Wien. Site. ci. 1892, p. 703) applied Exner’s formula to groups of observations made by them at WoUenbiittel on quiet, comparatively clear days. They found a fair general agreement between the observed and calculated mean values of P for the groups, but within the same vapour density group the individually observed values of P often differed conspicuously. This had been noticed previously by Exner himself. Independ- ent critical examinations of Exner’s theory have been made by Chree (Proc. Hoy. Soc. vol. Ix. 1896, p. 96), Braun (review Met. Zeit. 1896, p. [78]), Trabert (Met. Zeit. 1897, p. 106), and Gockel (Met. Zeit. 1897, p. 281), dealing respectively with observations at Kew, Bamberg, Meiningen, and Ladenburg. In each case the conclusion reached was that the relation between potential gradient and vapour density is not a unique and fundamental one, as Exner supposes. When observations taken at all seasons of the year are combined together, the great majority of instances of large vapour density (or of high temperature) will be found to have occurred in summer, when the potential gradient is normally low ; thus there can hardly fail to be a certain amount of agree- ment between observation and any theory which associates low potential with high vapour density (or high temperature).-

§ 21. .In 1887 Hertz (Wied. Ann. ■x.-xx.i. p. 983) found that the discharge between two poles was facilitated by the presence of

. ultra-violet light. Subsequent experimenters (see J. J.

~v . r Thomson’s Becent Besearches in Electricity, arts. 39 to

light. ^^) found that the seat of this action was the cathode,

and further, that various metallic substances — notably freshly-polished zinc — when insulated became positively electrified, or rapidly lost a negative charge when exposed to ultra-violet light from any source, including the sun. This species of dissipa- tion is confined to negative charges, and depends principally on the material of the charged surface and the freshness of its polish ; but it also depends on the nature of the surrounding gas and its pressure. The property, though prominent in potassium, sodium, and zinc, is inconspicuous in most common materials at the earth's surface ; Elster and Geitel, however (Wiefi. Ann. xliv. 1891, p. 722), found sensible traces of it in fluorspar and a few other minerals. The earliest recognition of ultra-violet light as a possibly important factor in atmospheric electricity, seems due to Arrhenius (Met. Zeit. 1888, pp. 297 and 348). Whilst mentioning the possible effect of ultra-violet light incident on the earth or on particles in the atmosphere, he relies mainly on its making the air it traverses conduct electrolytically. Elster and Geitel, on the other hand, attach main if not exclusive importance to its action at the earth's surface. Prom experiments with electric light they concluded that s, the rate of loss of a negative charge by a small sphere of freshly amalgamated zinc, was connected with J, the intensity of ultra violet light, by a linear relation z=a+b3 (Wien. Sitz. ci. Abth. ii. 1892, p. 703). Having found a and 6 experimentally, they determined J from day to day from the observed rates of loss of charge in sunshine. They tried several formulae connecting J with the potential gradient P, the simplest being of the type P=A/(a-(j3J), where A, o, /S, are constants. In comparing ob served and calculated values of P, they followed Exner's example, arranging the observations in groups according to the value of J. Whilst some of the series of observed and calculated mean group values show a surprisingly good agreement, individual observations within the same group often differ conspicuously. More recently Brillouin and Buisson (reviewed Met. Zeit. 1898, p. 38) have found that dry ice is sensitive to ultra-violet light, the iniluence being of the order of one-tenth

of that observed with zinc. As the ice surface melts, the effect rapidly diminishes, becoming vanisbingly small when a complete layer of water has formed. This discovery has been questioned by Benndorf. If confirmed, it would increase the probability that ultrar-violet light plays an important part in atmospheric electricity.

§ 22. Recently, owing mainly to the researches of C. T. E. Wilson, evidence has accumulated as to the existence in atmo- spheric air of nuclei — other than dust particles — which act as centres of condensation for water vapour, when supersaturation is produced artificially. Wilson found that ions acting as nuclei can be called into existence by Kontgen rays. Uranium rays, and ultrar-violet light acting on negatively charged zinc or even on moist air. J. J. Thomson (Phil. Mag. Dec. 1898, p. 533) pointed out that if the positive and negative ions should differ in their power of condensing water vapour, then a cloud might form round the one set of ions, and that as the cloud particles fell under gravity, electrical separation would take place. Wilson (Phil.

Trans, cxcili. p. 289) has found that ions produced by BSntgen rays do really show this difference, negative ions serving as con- densation nuclei under considerably less supersaturation than positive ions. He found, however, that the non-dust nuclei, always present in small numbers in the atmosphere, and the nuclei produced in moist air by ultra-violet light do not behave as free ions ; and whilst there is considerable reason to believe that ionization develops in these nuclei in the process of supersatura- tion this remains to be proved. Supposing ions to act as con- densation nuclei in the atmosphere, Wilson's experiments seem to indicate that this action would be chiefly limited to negative ions, and that the rain so formed would mainly carry down negative electricity. As he himself remarks, however, Elster and Geitel's experiments (§ 14) do not show any conspicuous preponderance of negative electricity in rainfall. Again, the supersaturation required before even negative ions act as condensation nuclei is considerable, and Aitken (Nature, March 1900, p. 514) believes that the number of dust particles usually present in the atmo- sphere is so large as to afford little opportunity for ions to act. Ulster and G«itel on the other hand (Terrestrial Magnetism, vol. iv. 1899, p. 213) regard the action

of ions, positive as well as negative, as in all probability a factor of importance.

§ 23. Everett (Phil. Trans. 1868, p. 347), in discussing the Kew atmospheric electricity results, specified certain points of resemblance between the diurnal variation and that of barometric pressure. The two elements agree in having two maxima and minima in their diurnal inequalities, and the times of their occurrence, at least at Kew, are fairly similar. Hann (Met. Zeit. 1889, p. 106 ; 1890, p. 29 ; 1891, p. 113) has dwelt on this resemblance in reviewing atmo- spheric electricity observations at various stations, and has further pointed out that the relative importance of the semi-diurnal as com- pared with the diurnal term in a Fourier analysis, in the case of elec- tric potential as in that of barometric pressure, appears less in arctic than in temperate latitudes, and is greatest in tropical stations.

§ 24. In the papers mentioned in § 20, Chree, Braun, Trabert, and Gockel all describe a closer association of high potential gradient with low temperature than with low vapour density. Trabert seems almost disposed to regard this association as funda- mental, in the absence presumably of disturbing causes such as rainfall. If this were the case, we ought to encounter exceptionally high potential gradients at arctic stations, especially at night in winter. At Cape Thorsden, however, st) far as the recorded posi- tion of the water-dropper enables one to judge, the potential gradient was exceptionally low. At Sodankyla, Lemstrom and Biese found that the mean potential gradient for the colder half of th4 day was considerably less than that for the warmer half during winter and spring, and that for the year as a whole, the mean gradient during the warmer hours stood to that during the colder hours in the ratio 823 : 735. Again, while the chief maximum in the diurnal inequality of the potential gradient usually occurs after sunset, the principal minimum at many stations occurs before sun- rise, when the temperature is at its lowest. Finally, whilst the diurnal inequality of the potential gradient usually shows two maxima and minima, that of temperature has normally but one.

§ 25. Observations by Elster and Geitel on 19th August 1887, and by Ludwig on 22nd January 1898 (Met. Zeit. 1888, p. 27, and 1899, p. 281), agreed in showing a diminution of potential gradient during the totality of a solar eclipse, followed by a smart rise after totality. These observations possess a certain signiflcance in con- nexion with the ultra-violet light theory of Arrhenius, to which they seem opposed. Sudden changes of potential gradient are, however, so frequent, that much weight cannot be assigned to observations so limited in number. Observations under somewhat analogous conditions, but pointing to an opposite conclusion, are described by Gockel (Met. Zeit. 1899, p. 481). During several days' observa- tions in a small oasis, El Mora near Biscra, he found a marked tendency in the potential gradient to rise rapidly just after sunset.

§ 26. Lemstrom (Brit. Assoc. Beport for 1898, p. 808) has been experimenting since 1885 on the influence of artificial electric fields or currents on the growth of plants. The influence is, he says, ip general highly beneficial ; for instance, it shortens the time required by strawberries and raspberries to ripen, and increases the yield. It may, however, be injurious, especially during bright days, unless abundance of water is provided. Lemstrom helieves atmospheric electricity to play an important part in the growth of vegetation in high latitudes, and he assigns a special role to the needles of flr and pine trees. E. H. Cook (Brit. Assoc. Beport for 1898, p. 809) describes experiments somewhat similar to Lemstrom's. He observed a beneficial effect on plants grown under a pole — especially the negative pole — of a Wimshurst machine or an induction coil. Cook refers to experiments aiming at the direct utilization of atmospheric electricity.

§ 27. The beginning and ending of thunderstorms at a station are seldom very clearly defined, and the duration is very variable, so that the exact significance to be at-

tached to figures showing the diurnal inequality of thunderstorms is open to a little uncertainty. The data Tbander- ^ Tables VIII. and IX. are all

quoted by storms. ‘ Arrhenius (JMet. Zeit. 1888, p. 348), except those for Edinburgh, ~~which are from a paper by Moss~~ man (Trans. B. S. E. vol. xxxix. p. 63). The data for Belgium are due to Lancaster, those for Italy to Ferrari ; in the latter case only storms lasting less than three hours are included. Thp data for the Eussian empire are due to Klossousky ; they are bas.ed on ten years’ observations, 1870-79. In all cases the figures represent percentages of the total number, afternoon hours are dashed.

Table VIII. Belative Diurnal frequency of Thunderstorms.

Table XI

Total deaths by Lightning.

=3

r

o

4

i

a

H

England and Wales

10

46

127

114

93

30

23

443

(24 years)

‘

United States

116

337

641

683

484

163

82

2496

(8 years)

Interval.

0—2

2-^

4—6

6-8

8—10

10-12

0’— 2'

2’— 4'

4’-6'

6’-8'

8’- 10' 10’-r-12'

Edinburgh Belgium . Italy

1-7 8-0 1-8

20 2-9 1-6

1-4 1-7 1-4

1-7 1-8 2‘0

4-7 2-0 8-0

14-2 ,6‘4

■^***8-5***

22‘4 12-9 19-5

23 ‘7 21-6 26-5

11-9 19-4 16-6

9 ‘2 15-8 9-8

6-1

S-4

8-3

a-0

4-1 •

1-6

Table IX. Melative Diurnal frequency of Thunderstorms.

Interval.

0-r8

8—6

6-9

9—12

0’— 8'

8’-6'

6’— 9'

9’— 12'

North Russia

1-9

3-8

11-3

28-3

22-6

24-5

7-6

Baltic Provinces,

3-3

2-5

4-1

14-1

23-3

29-5

14-9

8-3

Finland

West Russia

3-1

4-6

3-4

6-1

21-0

29-9

21-8

10-1

Central ,,

3-1

3-1

3-3

8-7

26-6

27-5

20-8

6-9

Ural

3-6

2-6

2-2

8-3

24-2

28-7

20-6

9-8

Siberia . . .

2-7

3-0

2-6

9-2

25-1

28-6

18-3

10-5

Caucasus .

4-5

1-2

0-9

4-1'

14-6

31-8

28-3

14-6

South Russia

5-5

4-9

11-6

12-9

25-8

16-6

11-7

11-0

Mean .

3-5.

3-0

3-1

8-5

23-6

28-3

20-4

9-6

§ 28. Table X. shows how the number of thunderstorms varies throughout the year. The figures are percentages of the total number recorded. The epochs covered and the sources of the figures are as follows : Edinburgh, 1770-1896, Mossman {Trans. B. S. E. vol. xxxix. p. 63) ;

Table X. Belative frequency of Thunderstorms throughout the Year.

April.

May.

June.

July.

Aug.

Sept.

Oct.

Nov.

Deo.

Jan.

Feb.

Mar.

Edinburgh .

8-8

12-6

20-8

28-5

18-8

7-2

2-2

0-9

0-9

1-8

1‘2

1-8

London

6-6

12-7

18-8

25-5

19-2

9-8

8-1

1-7

0-9

0-6

0-5

1-6

Paris .

7-6

14-9

21-6

22-0

17-0

9-9

3-5

0-4

0-4

02

0-4

2-8

Hungary

5-7

16-2

25-8

28-8

17-0

6-9

2-4

0-6

0-8

0-1

0-4

1-8

Batsvia West Siberia

10-5 0-8

7-9 11-5

6-5 28-0

4-8 86-4

8-8 20-1

5-4 30

8-8

12-2

10-9

10-4

9-2

11-1

0-2

North Russia

0-7

7-5

!!7-6

82-2

24-4

5-6

2-1

South „

8-8

14-2

27-8

26-4

15-2

8-»

6-8

Italy . .

7-4

7-2

19-1

17-2

16-5

14-6

18-2

London, 1763-1896, Mossman {Quarterly Journal of B. Met. Socy. vol. xxiv. 1898, p. 31) ; Paris (Pare St Maur), 1873-93, Renou {Met. Zeit. 1894, p. 277); Hungary, mean from numerous stations, 1871-96, H^jas {Met. Zeit. 1899, p. 219)pBatavia, 1867-95 {Mag. and Ma. Observa- tions, vol. xviii. 1895) ; Russian provinces, 1870-79, and Italy (1882-83) from Arrhenius {Met. Zeit. 1888, p. 348). In the last-mentioned cases the data for winter are lumped together, so for convenience the year starts with April.

Alongside this last table it is instructive to place the following particulars as to the number of persons killed by lightning in different months in England and Wales during the twenty-four years 1857-80 (E. Lawson, Quart. Journal B. Met. Soc. vol. xv. 1889, p. 140), with corre- sponding data in the United States during the eight years 1891-98 (Henry, Bull. No. 26, U.S. Dept. of Agriculture, 1899). The six winter months October-March are grouped together.

29. If we compare Tables VIII., IX., and X., with Tables I., II., and III., we see that to a certain extent high thunderstorm frequency and low potential gradient vary in parallel lines. Thus, thunderstorm freqtiency and intensity are greatest about midsummer, when potential gradient is least, and there is at most stations a minimum of potential gradient in the afternoon at about the same hour as the thunderstorm maximum. The connexion is, however, far from close. Thus we have the thunderstorm minimum occurring alongside of the early morning poten; tial gradient minimum; and the diurnal and annual variations in thunderstorms appear much more accentuated than the corresponding variations in potential gradient.

§ 30. When we consider the influence of geographical position, we also find thuudeistorm frequency more variable than potential gradient, at least so far as is at present known. If we accept Exner's observations of potential as representative, the mean potential gra- dient does indeed diminish as we pass from temperate to tropical climates, but we do not encounter such notable discrepancies as are presented in Table XII. The data are from the sources already mentioned.

Table XII.

Average Number of Thunderstorms in a Tear.

Edinburgh, London, Paris, Batavia,

, 1770-1896. 1768-1896. 1878-98. 1867-95.

6-4 10-7 27-3 120

It must be allowed that the drawing of safe conclusions from thunderstorm data is particularly difficult, owing to the diSerences between the records from stations in the same latitude. Instructive illustrations are afforded in Plate I. of the memoir by A. J. Henry, on United States thunderstorms mentioned above.

In some parts of the Pacific states the average annual number is put at from 1 to 6, as against 30 to 46 in some of the central and south-eastern states.

Even in some quite small areas, especially islands or coast districts containing high mountains, the dlSer- ences in thunderstorm frequency are great. There is the further consideration that a great deal may depend on the observer.

§ 31. Other thunderstorm data are more independent of the imagination, but all seem attended by sources of uncertainty. An illustration is afforded by the fol- lowing statistics from the paper by Lawson already mentioned!, giving the average number of persons killed annually per ten million inhabitants in various dis- tricts of England and Wales. The original treats separately the epochs 1852-61, and three following decades. Table XIII. gives only the final means. The letter M denotes "midland" ; N, north j S, south, &c.

Table XIII. Persons killed annually per Ten Million Inhabitants.

London. S.E. S.M. E. S.W. W.M. N.M. N.W. Tork. N. Wales.

1-3 80 12-3 12-7 5-6 10-7 18-0 6-6 11-4 10-4 9-1

The north-midland district (Leicester, Rutland, Lincoln, Not- tingham, and Derby) showed the largest proportion of persons killed during each decade, and London (metropolitan area) the least. Erom what is known otherwise, there can hardly be any doubt that one would be seriously in error if one supposed the figures in Table XIII. to be an exact measure of relative thunder- storm intensity. The figures are largely influenced by the fact that persons employed indoors have much less chanCe of being struck by lightning than those out of doors. As emphasizing this fact, Lawson mentions that between 1852 and 1880, only 104 females were killed by lightning, as against 442 males.

§ 32. Table XIV. gives the mean annual number of thunder- storms recorded per decade at Edinburgh, London, and Tilsit.

ATMOSPHEEIC ELECTEIClTY

781

The Edinburgh and London data are from the papers by Mossman already mentioned, those for Tilsit are due to Kassner fsee Met. Zeit. for 1894, p. 237).

Table XIV. /

Mean Annual Number of Thunderstorms.

Decade ending

ISOO

1810

1820

1S30

1840

1650

I860

ISTO

1880

1890

Edinburgh . London Tilsit .

4-0 7-9

4-9 9 ‘6

5-7 8-3

7-7 11-5 12-1

6-7 11-8 12-1

5-7 10-6 16-1

6-5 11-9 15-3

5-4

9-6

11-9

10-6 15-7 17-6

9-4 13-0 21-8

Mossman expresses the opinion that the apparent recent increase in the frequency of thunderstorms at Edinburgh and London is, to some extent at least, a true phenomenon. Unquestionably the two sets of figures show

corroborative features— notably the fall in the decade 1861 to 1870— but it is difBcult to feel certain that the notable extension in the limits of both cities may not have exercised an influence. The diminished intensity in the decade 1861-70 is, it may be added, in accord with Lawson's vital statistics. In Ger- many various authorities believe in a great recent increase in thunderstorms. Von Bezold {Berlin. Sitz. 1899, No. 16) has given a table showing the number per million of insured houses struck in Bavaria for each year from 1833 to 1897. Prior to 1868, the num- ber struck in one year never exceeded 78 per million ; between 1868 and 1883 it exceeded 100 per million in five, but only five, years ; since 1884 it has only once been less than 100 per million, and it exceeded 200 per million in 1895, 1896, and 1897. Kassner (re- viewed Met. Zeit. 1890, p. 385), dealing with similar insurance statistics for Central Germany, concluded that during the twenty- six years 1864 to 1889, destructive lightning strokes had increased 126 per cent, as against an increase of only 11 per cent, in houses. Von Bezold seems to accept a large increase in thunderstorm in- tensity in Germany as an undoubted fact, and he is disposed to associate it with the great increase in smoky factory chimneys, and in the number of wires and rails all over the country. It is possible, of course, that changes in the ordinary height or construc- tion of buildings, or influences which only an insurance expert could assess, may have had an efiect.

§ 33. Table XV. gives data based on the number of trees of different species struck by lightning during a series of recent years in the forests of Lippe, in Germany, as quoted by Henry (I.e.").

Table

XV.

Species of Tree.

Oak.

Fir.

Pine.

Beech.

Larcli.

Ash.

Btch.

Total struck . Mean liability .

159 57

69 39

20 5

21

1

7

5

4

In calculating the liability, allowance is made for the relative numbers of the different species. The different years are treated separately, the liability of beech to be struck being taken as unity throughout. Prohaska (see Met. Zeit. 1899, p. 128) gives somewhat analogous data for Styria. He concludes that oaks, poplars, and pear trees are especially liable to be struck, while beech is exception- ally safe. Jonesco (see Henry, I.e.) has concluded from experi- ments that fresh wood, rich in starch, but poor in fatty material, possesses the greatest electrical conductivity, and that the conduc- tivity in some species of living trees varies a good deal with the season of the year. He believes that the liability to be struck by lightning is greater the higher the conductivity. Allowance must, however, be made for the fact that different species of trees attain different heights, and that one species may be common in marshy, another on rocky ground. According

to Hellman (quoted by Henry), the liability to lightning stroke on different soils in Ger- many may be put at : chalk 1, clay 7, sand 9, loam 22. Differences of this kind might influence the apparent liability of different species of trees to be struck.

§ 34. Luminous discharges from, pointed objects are not infre- quent in mountainous districts, especially during thunderstorms. On the Sonnblick, where the phenomenon is of frequent occur- rence, St Elmo's fire has been' found to answer to a discharge sometimes of positive, sometimes of negative electricity (Elster and Geitel, Met. Zeit. 1891, p. 321, and 1894, p. [68]). The colour and appearance of the light difier in the two cases, red predominat- ing in a positive, blue in a negative discharge. Stade {Met. Zeit. 1898, p. 238) also describes the appearance of St Elmo's fire of difl^ent signs, as observed on the Brocken.

§ 35. A description of the more prominent features of aurora will be found in the Ency. Brit. vol. xvi. pp. 177, 178, 183. Table XVI. contains some statistics more recently published as to Auroras. ^^^ relative frequency of auroras in different months of the year. The data for Scotland and London are from papers by Mossman (see Met. Zeit. 1898, p. 307), the rest are quoted by Ekholm and Arrhenius {Kongl. Svenska Vetenkaps-Akademiens

Handlingar, Bd. 81, No. 2, 1898). the mean number for the year.

The figures are percentages of

Table XVI. Relative frequency of Auroras throughout the Year.

N.E. Scot-

United

Prom 16° S.

land (122 years).

{189 years).

(1861-95).

States (18T1-98).

to 89° 8.

(1788-1894).

January

10-9

8-6

11-5

6-3

4-6

February

12-7

10-5

15-2

9‘2

5-8

March

12-0

10-2

15-4

8-8

9-4

April

7^1

10-7

4-1

10-9

12-7

May

2-2

4-0

0-3

8-0

3-8

June

O'O

1-1

0-0

6-7

3-8

July

0-4

1-9

0-0

7-7

2-4

August

4-4

5-6

0-8

7-6

7-2

September | 12-9

14-5

9-6

10-9

11-9

October

15-8

16-9

16-2

10-3

21-1

November

12-0

9-6

15-0

7-8

10-4

December

9 6

6-4

11-9

5-8

6-9

Table XVI. is in general agreement with the statement in the Ency. Brit, that auroras are most frequent near the equinoxes. In comparing winter and summer data, especially in high latitudes, it must be remembered that faint auroras are invisible in twilight.

§ 36. Table XVII. may be regarded as a continuation of one in the Ency. Brit. vol. xvi. p. 178. It gives Wolf's relative gun-spot numbers alongside of numbers proportional to the frequency of auroras. In the case of Edinburgh the figures are the actual num- ber of auroras as given by

Mossman {I.e.). The other data are from a paper by Ekiolm and Arrhenius {K. Svenska Vet.-Akad. Hand. Bd. 31, No. 3, 1898).

Table XVIL Sun-spot and Auroral Frequency.

Tear.

Wolf's Number.

Auroral Frequency.

Sdinbargli.

N. America.

16° to 89° S.

1869

73-9

5

3

1870

139-1

19

123

1871

111-2

21

408

60

1872

101-7

8

565

105

1873

66-3

12

781

8

1874

44-6

10

1443

11

1875

17-1

4

741

6

1876

11-3

0

676

2

1877

12-3

2

877

1

1878

3-4

1

258

0

1879

6 0

0

405

1

1880

32-3

12

646

5

1881

54-3

2

804

17

1882

59-6

6

860

138

1883

63-7

2

686

28

1884

63-5

3

533

0

1885

52-2

5

728

2

1886

25-4

6

974

8

1887

13-1

0

610

3

1888

6-8

1

759

9

1889

6-3

0

336

1

1890

7-1

0

358

1

1891

35-6

7

732

1

1892

73-8

9

614

48

1893

84-9

2

1067

9

1894

78-0

8

...

12

§ 37. During the polar year, September 1882 to September 1883, numerous aurora observations were made at many of the stations. Those at the Finnish station, Sodankyla, have been discussed by Lemstrom and Biese {Exped. Polaire Finlandaise, t. iii., Helsing- fors, 1898). In addition to the more usual phenomena the Finnish observers noticed a variety of others. On a good many occasions, in the absence of ordinai-y aurora, they saw a yellovjish-white illu- mination, showing in the spectroscope the

characteristic auroral line (wave-length 5569×10-‘ mm., according to Lemstrom). On some occasions, in the absence of any phenomenon visible to the unaided eye, Lemstrom saw the auroral line wherever he turned the spectroscope. The most outstanding phenomena, however, de- scribed by Lemstrom and Biese are artificially produced luminosi- ties, in the shape usually of flames, but occasionally resembling auroral rays. The auroral line was usually detected, but was feeble. The apparatus consisted of a number of sharp points con- nected by wires carried on insulators, the whole enclosing an area of several hundred square metres on the top of one or other of a

senes of hills near Sodankyla. Sometimes a Holtz machine was introduced into the wire circuit, and when worlced it enhanced the effect, or even rendered it visible when previously unseen. Coloured illustrations represent the artificial phenomenon on several occasions as very prominent, and extending to a considerable height.

§ 38. At the Danish polar station, Godthaab, Paulsen saw on several occasions auroral sheets, which seemed to be suspended vertically like curtains and to sw’eep past with great velocity, travelling from magnetic south. At Paulsen’s suggestion, Lieut. Vedel of the Ryder Arctic Expedition, 1891, 1892, kept a lookout for this phenomenon, and was able on a variety of occasions to observe the declination magnet during its occurrence. According to these observations — made on an island in Scoresby Sound, 70° 27′ N. lat. — the needle moved to the west as the auroral curtain approached from the south, oscillated as the curtain passed over- head, and then moved to the east as the curtain receded towards the north (Paulsen, Bull, de VAcad. Soy. . . . de Danemark, 1894, p. 148). Paulsen believes the phenomenon to imply the existence of an electric current directed downwards in the space occupied, or seemingly occupied, by the auroral curtain.

§ 39. Numerous attempts have been made to determine the height of auroral displays. Simultaneous theodolite observations have frequently

been made from two stations at a con- siderable distance apart. The calculated heights in mean latitudes have often exceeded 100 kilometres. At Godthaab the calculations of the Danish observers often put au- roral arcs at heights under 10 kilometres, and occasionally under 2. From the observations at Sodankyla, Lemstrom thought it doubt- ful whether the objects seen from the two ends of the base were really the same. The question has been treated with great ful- ness of detail by Cleveland Abbe (Terrestrial Magnetism, vol. iii. 1898, pp. 5, 53, and 149) ; he seems disposed to doubt whether what the observer sees as aurora has an independent objective existence.

§ 40. The subject of lunar influence has been treated by Ekholm and Arrhenius in several papers dealing with a great mass of observations, and containing many useful references (R- Sven. Vet.- Akad. Hand., Bd. 19, No. 8 ; Bd. 20, No. 6 ; Bd. 31, No. 2). In the case alike of electric potential, thunderstorms, and auroras, they find a conspicuous tropical lunar period, 27-32 days. They conclude, however, that the synodic lunar period, 29-53 days, found by Fritz in auroras is not real, arising simply from the fact that

Height ot auroras.

moonlight affects the visibility of auroras. An investiga,tion by Polls (Met. Zeit, 1894, p. 230) seems to indicate a synodic lunar period in thunderstorms at Aachen. Investigations into thunder- storm data at Paris by Renou (Oomptes Eendus, cxviii. p. 140), and into similar data at Batavia (^Batavia Observations, vol. xviii. 1895), on the other hand, would indicate that if a lunar Influence exists it is small. Ekholm and Arrhenius {K. Sven. Vet.-Akad. Sand., Bd. 31, No. 3) have also examined into the existence of a period of approximately twenty-six days. They decide in favour of the existence of such a period, not merely for thunderstorms and auroras, but also for magnetic storms and for the amplitude of diurnal variation of magnetic elements. The most probable value for the period is, they find, 25-929 days. The methods and con- clusions of Ekholm and Arrhenius have been critically discussed by Schuster in several papers with somewhat unfavourable results. (See Magnetism, Terhestkial, § 14.)

Authorities. — Lord Kelvin (Sir W. Thomson). Papers on Electrostatics and Magnetism. — Georges le Cadet. Mtude du champ lElectrique de V Atmosphere. Paris, Lyon, 1898. — McAdie and Henry. ” Lightning and the Electricity of the Air,” Bulletin No. 26, U.S. Department of Agriculture, Weather Bureau. Washington, 1899. — ^Publications of Observatories running Water- droppers, e.g., Greenwich, Magnetical and Meteorological Observations; Batavia, Observations made at the Magnetical and Meteorological Observatory at Batavia (especially vol. xviii., for 1895) ; Lisbon, Annaes do Observatorio do Infante D. Luiz. — Publications descriptive of Observations of Aurora at Stations of International Polar Year 1882-83 (Fort Rae, Godthaab, &c.), more especially the two following, descriptive also of observations of potential gradient : Observations faites au Cap Thorsden Spitsberg, tome ii. Stockholm, 1887. Expedition Polaire Finlandaise (1882-84), tome iii. Helsingfors, 1898. The following, amongst somewhat numerous historical reviews of state of knowledge of atmospheric electricity, must also be noted : — Exner. Wien. Sitzungsberichte, xciii. (Abth. ii.), 1886, p. 222. — ^Arrhenius. Met. Zeitschrift, 1888, p. 297 and p. 348. — Elsteb and Geitbl. Met. Zeitschrift, 1890, p. 252, and Bull. No. 11, U.S. Weather Bureau, part ii., p. 510. Washington, 1895. — Schuster. Nature, vol. liii. 1896, p. 207.— Trabest. Met. Zeitschrift, 1898, p. 401.

(c. c.)

Atrek, a river rising in. the Persian province of Horassan, enters the S.E. corner of the Caspian Sea, after a course of nearly 300 miles. In its lower course it forms the frontier between Persia and Eussia.

Attleborough, a town of Bristol county in South-eastern Massachusetts, U.S.A. It has an area of 28 square miles, with a rolling surface, and contains a large rural population, with a village of considerable size, bearing the same name as the town. This has manufac- tures of a varied character, largely jewellery. It is on the New York, New Haven, and Hartford railway. It was incorporated in 1694. Population (1890), 7577 ;

(1900), 11,335.

Attock, a town and fortress of British India, on the Indus, in the Rawal Pindi district of the Punjab, 47 miles by rail from Peshawar. In 1883 an iron girder bridge of five spans was opened, which carries the North- ■western railway to Peshawar, and which also has a sub- ivay for wheeled traffic and foot passengers. The military importance of Attock has diminished, but it still has a garrison of artillery and infantry. St Peter's Church is a fine building. Population (1881), 4210 ; (1891), 2654.

Atu i . See Cook Islands.

Aube, a department in the E. of France, watered by the Seine and its tributary the Aube.

Area 2327 square miles, with 26 cantons and 446 communes. ■The population decreased from 257,374 in 1886 to 251,435 in 1896. The chief towns are Troyes (52,000 inhabitants in 1896), Bar-sur- Aube, Bar-sur-Seine, Nogent, Ards, and Romilly. Births (1899), 4547, of which 463 were illegitimate ; deaths, 5641 ; marriages, 1693. In 1896 there were 696 schools, with 32,000 pupils. One

per cent, of the population was illiterate. The land under cultiva- tion comprised 1,383,200 acres, of which 918,840 acres were plough-land, and 41,990 acres in vines. The wheat crop in 1899 yielded a value of £1,100,281. Bye, barley, oats, and mangold- wurzel also contribute to the agricultural wealth of the depart- ment. The production of vines in 1899 amounted to the value of £300,000. In 1899 the live stock numbered 31,220 horses, and 88,790 cattle. As it lacks both coal and iron, the department does little in the way of working metals, producing only cast-iron and steel to the value in 1898 of £60,000 ; but the textile industry has assumed large proportions around Troyes, where the cotton manufacture employs 24,000 looms and 70,000 spindles.

Aubervilliers-les-Vertus, a village, arron- dissement of St Denis, department of Seine, France, on the canal St Denis, 2 miles from right bank of Seine and 1 mile N. of the fortifications of Paris. Near it is a fort of the 2nd line. Manufactures include chemicals, glue, cardboard, printing, ink, and glass, and there are iron-works. Population (1881), 19,340: (1891), 24,757: (1896), 27,064; (comm.), 27,064. ,

Auburn, capital of Androscoggin county, Maine, U.S.A., situated on the Androscoggin river, which furnishes abundant water-power. It has communication by three railways, the Maine Central, the Grand Trunk, and the Portland and Eumford Palls. Its manufactures consist mainly of cotton goods and boots and shoes. Population (1880), 9655; (1890), 11,250; (1900), 12,951.

Auburn, capital of Cayuga county. New York, U.S.A., situated in 42° 65' N. lat. and 76° 36' W. long., at the outlet of Owasco lake, at an altitude of 673 feet. Though the site is hilly its plan is regular. The city is divided into ten wards, has a good water supply ptimped from the lake, and most of its streets are macadam-

ized. Its manufactures are extensive, in 1890 having a value of more than f 9,000,000, and consist largely of agricultural implements and boots and shoes. The city- is traversed by the New York Central and Hudson River and the Lehigh Valley railways. It was the home of William H. Seward, secretary of state during the Civil War and the period of reconstruction. Population (1880),

21,924; (1890), 25,858; (1900), 30,345.

Auch, chief town of department Gers, France, 426 miles S.S.W. of Paris, on railway from Agento Toulouse. There are a civil and military hospital and a large asylum. Important articles of commerce are wine, corn,' and wool ; poultry are extensively exported, and its pStes-de-foie (of duck) are esteemed; marble and spar are worked. Population (1881), 9560; (1891), 9273; (1896), 9313, (eomm.) 11,461.

Auckland, an important seaport, on the southern shore of Waitemata harbour, Eden county, in the province of Auckland North Island, New Zealand. It is the largest and most beautiful town in New Zealand. Its public library and art gallery owe much to the generosity of Sir George Grey and other citizens. Its museum shows the best existing collection of

Maori art. The extension of the city has not marred the charm of the surroundings. These, indeed, have been beautified by gardens and tree planting. The industries are substantial, among them being sugar-refining, shipbuilding, manufactures of rope and twine, bricks and tiles, while there are also timber works. The harbour accommodation is very good, and includes two graving docks, of which one (the Calliope) is 525 feet long, the other 312. The total trade in 1893 was £2,744,277; in 1896, £3,236,605; in 1899, £4,071,323. The registered tonnage of shipping in 1899 was — inwards, 311,827 tons; outwards, 214,351 tons. Population (1871), 18,000; (1881), 26,083; (1891, with suburbs), 51,287 ; and now estimated at 65,000.

Aude, a department in the S. of France, bordering on the Mediterranean. It is traversed by offshoots of the Pyrenees and of the Corbieres, and watered by the Aude.

Area, 2448 square miles, distributed among 31 cantons and 439 communes. The population declined from 332,080 in 1886 to 310,513 in 1896. The chief towns are Carcassonne, the capital, with a population of 30,000 in 1896, Castelnaudary, Limoux, and Narbonne (30,000 inhabitants). Births in 1899, 6233, of which 232 were illegitimate ; deaths, 6227 ; marriages, 2286. In 1896 the primary- schools numbered 836, with 45,000 pupils. Four per cent, of the population was illiterate. The surface under cultivation measured 975,650 acres, of which 476,710 acres were plough-land, and 284,000 acres laid out in vines. In this latter culture Aude holds the third rank in France, in respect of extent of cultivation. In 1899 the wheat crop yielded a value of £463,203 ; maize is one of the cultures next in importance. In 1899 the vines gave a gross return of the value of £4,040,000. The mulberry is also grown. In 1898 the live stock numbered 25,136 horses, and 31,080 cattle. Aude produces a little iron and (1898) 8000 tons of sea salt. There is no working in metals, and the other industries, giving way before all-engrossing viticulture, are quite inconsiderable.

Audenarde. See Ottdenaede.

Audran, Edmond (1842-1901), French musical composer, was born at Lyons in 1842. He studied music at the jScole Niedermeyer, where he won

the prize for composition in 1859. Two years later he accepted the post of organist of the church of St Joseph at Marseilles. He made his first appearance as a dramatic composer at Marseilles with L'Ours et le Pacha (1862), a musical version of one of Scribe's vaude-villes. This was followed by La Chercheuse d'esprit (1864), a comic opera, also pro-duced at Marseilles. Audran wrote a funeral march on the death of Meyerbeer, which was performed with some success, and made various attempts to win fame as a writer

of sacred music. He produced a mass (Marseilles, 1873), an oratorio, La Sulamite (Marseilles, 1876), and numerous minor works, but he is known almost entirely as a com- poser of the lighter forms of opera. His first Parisian success was made with Les Noces d' Olivette (1879), a work which speedily found its way to London and (as Olivette) ran for more than a year at the Strand Theatre (1880-81). Audran's music has, in fact, met with as much favour in England as in France, and all save a few of his works have been given in a more or less adapted form in London theatres. Besides those already mentioned, the following have been the most undeniably successful of Audran's many comic operas : Le Grand Mogol (Marseilles, 1876 ; Paris, 1884; London, as Tlie Grand Mogul, 1884), La Mascotte (Paals, 1880; London, as T/ie Mascotte, 1881), Gillette de Narhonne (Paris, 1882; London, as Gillette, 1883), La Cigale et la Fourmi (Paris, 1886 ; London, as La Cigale, 1890), Miss Hilyett (Paris, 1890 ; London, as Miss Decima, 1891), La Poup&e (Paris, 1896; London, 1897). Audran was one of the best of the successors of Offenbach. He had little of Offenbach's humour, but his music is distinguished by an elegAnce and a refinement of manner which lift it above the level of op^ra bouffe to the confines of genuine opera comique. He was a fertile if not a very original melodist, and his orchestration is full of variety, without being obtrusive or vulgar. Many of his operas. La Mascotte in particular, reveal a degree of musicianship which is rarely associated ■with'the ephemeral productions of the lighter stage. He died 17th August 1901. (k. a. s.)

Auerbach, Berthold (1812-1882), German nov- elist, was born on 28th February 1812, at Nordstetten in the Black Forest. His parents were Jews, and he was intended for the priesthood; but becoming estranged from

Jewish orthodoxy by the study of Spinoza, he devoted himself to literature, and made a fortunate beginning in a romance on the life of Spinoza (1837), so interesting in itself, and so close in its adherence to faJct, that it may be read with equal advantage as a novel or as a biography. A translation of Spinoza's works followed in 1841, and Auerbach turned to the class of fiction which^ has made him famous: the Dorf- geschichten, or stories of peasant life in the Black Forest, in which, as well as in BarfUssele, Edelweiss, and other novels of greater compass, he depicts the life of the south German peasant as Jeremias Gotthelf had painted the peasantry of S-witzerland, but in a much less realistic .spirit. When this vein was exhausted Auerbach returned to his first phase as a philosophical novelist, producing Auf der Hohe, Das Landhaus am Rhein, and other romances of profound speculative tendencies, turning on plots invented by himself. These were no exception to the general wearisomeness of long German novels, and Auerbach' s fame will continue to rest upon his Dorf- geschichten, impaired as the celebrity of even these has been by the gro"wing demand for a more uncompromising realism. Auerbach died at Cannes, 8th February 1882.

(E. G.)

Auersperg, Anton Alexander, Count (1806- 1876), after Grillparzer the most celebrated modern Austrian poet, was born at Laibach, 11th April 1806. Born to an ample fortune, he took a prominent part in public life, which became more active as the grip of absolutism gradually relaxed. At first the object of persecution and suspicion for his Liberal tendencies, he was in 1860 summoned by the Crown to represent Carinthia in the Diet, and was made a peer for life in the following year. His subsequent course was that of a determined opponent of federalism, but the current of events was too strong for him. He died at Gratz, on 12th September 1876. As a

poet Auersperg gained great reputation by tlie anonymous Walks of a Vienna Poet (1831), a collection of lyrics dis- playing the humour, tender feeling, and power of natural description which continued to characterize

him, and which excited especial attention by so pronounced a hostility to Metternich's despotic system that the author was obliged to print them at Hamburg. Subsequent volumes under the pseudonym of "Anastasius G-run" were no less success- ful, and in 1860 Auersperg further endeared himself to his countrymen by an epic of popular life, Der Pfaff von .Kohlenberg. If not the greatest of Austrian poets, he is the most typically national. Among his works is a version of the English ballads of the Eobin Hood cycle, (s. g.)

Augier, Cuillaume Victor Emile (1820-1889), French dramatist, who with Dumas JUs and Sardou may be said to have held the French stage during the second empire, was born at Valence in Dr6me on the 17th September 1820. He received a good education and studied for the bar. In 1844 he wrote a play in two acts and in verse. La Cigue, refused at the Theatre FrauQais, but produced with considerable success at the Odeon. This settled his carey. Thenceforward, at fairly regular intervals, either alone or in collaboration with some well- known writer — Musset, Sandeau, Labiche — he produced plays which were in their way eventful, and in the case of the Mis de Qiboyer — which was regarded as an attack on the clerical party in France, and only brought out by the direct intervention of the emperor — caused some political excitement. His last comedy, Les Fourchambault, belongs to the year 1878. After that date he wrote no more, restrained by an honourable fear of producing inferior work. The Academy had long before, on the 28th January 1858, elected him to be one of its members. He died in his house at Croissy on the 25th October 1889. Such, in briefest outline, is the story of a life which Augier himself describes as " without incident " — a life in all senses honourable. The man respected himself and his art, and his art on its ethical side — for he did not disdain to be a teacher — has high qualities of rectitude and self-restraint. Uprightness of mind and of heart, generous honesty, as M. Jules Lemaitre well said, constituted the very soul of all his dramatic work. Nor are exempli- fications far to seek. In the Mariage d'Olympe (1855) the courtesan is shown as she is, not glorified as in Dumas's Dame aux Camillas. In Gabrielle (1849) the husband, not the lover, is the sympathetic, poetic character. In the Lionnes pauvres (1858) the wife who sells her favours comes under the lash. Greed of gold, soeiaL demoralization, lust of power, these are satirized in Les Effrontis (1861),

Le Fils de Qiboyer (1862), Contagion (1866), Lions et Benards (1869) — which, with the Gendre de M. Poirier, reach the high-water mark of Augier's art; while in Jean de Thommeray (1873), brought out after the great reverses of 1870, the regenerating note of patriotism rings high and clear. But it would be unfair to suggest that Augier was a preacher only. He was a moralist in the great sense, the sense in which the term can be applied to Molifere and the great dramatists — a moralist because of his large and sane outlook on life. Nor does the interest of his dramas depend on elaborate plot. It springs from character and its evolution. His men and women move as personality, that mysterious factor, dictates. They are real, several of them typical. Augier's first drama. La Cigue, belongs to a time (1844) when the romantic drama was on the wane ; and his almost exclusively domestic range of subject scarcely lends itself to lyric outbursts of pure poetry. But his verse, if not that of a great poet, has excellent dramatic qualities, while the prose of his prose dramas is ~~admir~~ able for directness, alertness, sinew, and a large and

effective wit. Perhaps it wanted these qualities to enlist laughter on his side in such a war as he waged! against false passion and false sentiment. (f. t. m.)

Augsburg, a town and episcopal see of Bavaria, Germany, chief town of the district of Swabia, on the fiver Lech, 39 miles W.N.W. from Munich by rail. The newer buildings, all in the recently built W. quarter of the city, include law courts, theatre, and municipal library, with 150,000 vols. Augsburg is particularly well provided with special and technical schools. It has become a centre of the acetylene gas industry of Germany, and the number of artisans engaged in its various works now exceed 19,000. Population (1885), 65,905; (1900), 89,109.

Augusta, a fortified seaport of the province of Syracuse, Sicily, Italy, on an island on the S. side of Cape Santa Croce, on the E. coast of the island, 19 miles by rail N. from Syracuse. It is connected with the mainland by a bridge, and has a spacious harbour, fortified, with a small foreign and some coast- ing trade. The people cure fish, crush out olive oil, quarry chalk, burn lime, and extract salt. Population, about 14,000. The town was founded in 1232 by the emperor Frederick II., and is memorable for

the defeat (1676) of the Dutch admiral De Euyter by the French under Duquesne, in which De Euyter was mortally wounded.

Augusta, capital of Eichmond eounty, Georgia, U.S.A., in 33° 29′ N. lat. and 81° 51′ W. long., on the west bank of the Savannah, at the head of navigation and at the falls in the river. These afford a magnificent water-power, which is extensively utilized in manufactures. The city stands at 143 feet above searlevel, is divided into five wards, is well drained and lighted, and ‘ is supplied with water from the Savannah. It is the most important cotton-manufacturing centre of the south. In 1890 the cotton factories employed 4500 hands, and their annual product was valued at over $6,000,000. The assessed valuation of real and personal property in 1899 was $18,780,076, the net debt $1,896,469, and the tax rate $24.76 per $1000. Population (1880), 21,891; (1890), 33,300 ; (1900), 39,441, of whom 996 were foreign-born and 18,487 were negroes.

Augusta, capital of Kennebec county and of the state of Maine, U.S.A., on the Kennebec, at the head of tide and navigation. Its site is hilly, the land rising sharply from the river on both sides. The city is regularly laid out, and is entered by the Maine Central railway. Few of the streets are paved, and the drainage system is incomplete. There is a fine public library, and the state-house, a beautiful structure, stands on an emi- nence in the southern outskirts. It has considerable manufactures, chiefly in cotton, wool, and lumber, the falls in the river at this point furnishing water-power. It was settled under the name of Cushnoc in 1754, was afterwards a part of Hallowell, was incorporated as the town of Augusta in 1797, was made the capital in 1827, and received a city charter in 1849. Population

(1880), 8665 ; (1890), 10,627 ; (1900), 11,683.

Augusta, Marie Louise Catherine, Qubex OF Prussia and German Empress (1811-1890), born at Weimar on the 30th of September 1811, was the .second daughter of Charles Frederick, grand-duke of Saxe-Weimar-Eisenach, son of Karl August, the patron of Goethe and Schiller. In 1829 she married Prince William, second son of Frederick William III. of Prussia ; her elder sister. Princess Marie, had two years before married Charles, the third son of the king of Prussia, and

■was the mother of Prince Frederick Charles, the l^mous general. There were two children of the marriage, Frederick (q.v.), the future emperor, and Louise (6. 1838), who married the grand-duke of Baden. In 1840, on the death of his father. Prince William, who, as his elder brother was childless, was now heir-presumptive, took the title of Prince of Prussia; in 1868 he became Prince Regent, and in 1861 succeeded to the throne. In 1871 he assumed the title of German emperor. The princess brought with her from Weimar a keen interest in art and literature ; she continued to correspond with Goethe till his death. She also gave considerable attention to politi- cal affairs and was (again a tradition of the court of Wei- mar) more favourable to constitutional government and po- litical liberty than was quite consistent with the usual tone of the Prussian court. Aftej.- 1840 she and her husband generally lived at Coblenz, which always remained her favourite place of residence; but when in Berlin, especially after 1848, she became to some extent the centre of a Liberal opposition to the Government. This attitude she continued after Prince William had become king, and her influence was generally unfavourable to the policy and person of Bismarck, who in his posthumous memoirs has left a record of the dif&culties which he sometimes experienced from her opposition. She was greatly inter- ested in works of charity and benevolence and took an active part in the organization of the Eed Cross Society and the Good Samaritans, established for the relief of sufferers in time of war. The old Weimar traditions con- tinued to influence her to her latest years, and she had little sympathy with the military spirit which prevailed at the Prussian court or with the exaggeration of national feeling which became common after the great war. After 1870 again her dislike of Bismarck's policy was increased by his struggle with the Church, for though a Lutheran she always showed much interest in the Roman Catholic Church as in the worship of other religious denominar tions, especially that of the Anglican Church, in the ministrations of which she found much comfort in her declining years. She died in Berlin on the 7th of January 1890. (j. w. he.)

Augustowo, a district town of Russian Poland, 135 miles S. of Suwalki, on the canal of the same name (65 miles), connecting the Vistula with the Niemen by means of the Netta, Czernoganza, and several lakes. It has a considerable export trade to the Baltic Sea. Popu- lation (1897), 12,746.

Aulie-ata, a small district town and fort of Russian Turkestan, province of Syr-daria, 260 miles N.E. of Tashkent on the highway to Vyernyi, situated on the Talas river at the western end of the high Alexandrovskiy range, its altitude being 5700 feet. The inhabitants of the town are mostly Sarts and Tajiks trading in cattle, horses, hides, &c. The population in 1897 was 12,006.

Aumale, Due d'. See Orleans.

Aundh, a native state of India, in the Deccan division of Bombay, ranking as one of the Satara Jagirs. Its area is 447 square miles ; its population (65,146 in 1891) was 63,933 in 1901 ; its gross revenue in 1897-98 was Rs.1,89,311, of which Rs.31,779 was expended on public works ; the number of police was 65 ; the boys at school numbered 998. The chief, whose title is Pant Pratinidhi, is a Brahman by caste. The state has suffered severely from plague, the number of deaths down to July 1898 having been 661. The town of Aundh is situ- ated in 17° 32' N. lat. and 74° 22' E. long., 26 miles south-east of Satara. Population, about 3500. ,

Aurangabad, a town and district of India, in the north-west division of the dominions of the If izam of Haidar£ib£Cd, on the river Kaum. It is a railway station on the Haider^b^d-Godaveri line, 435 miles from Bombay. In 1891 the population, with military cantonments, was 33,887; in 1901 it was 26,165, showing a decrease of 23 per cent. It has a cotton mill, with 184 looms and 16,500 spindles, and employing 722 hands. The district of Aurang^bdd has an area of 6176 square miles. The population (1891) was 1,094,601., being 152 persons per square mile ; in 1901 it was 984,700, showing a decrease of 13 per cent., due to the famine of 1899-1900. It con- tains the famous caves of Ajanta, and also the battlefield of Assaye.

Auray (Breton Altac), a town of France, depart- ment of Morbihan, in the arrondissement of Lorient, 12 miles W. of Vannes by rail. Iron

manufacture and oyster culture are the chief industries ; mine props are sent to England. Population (1881), 5064 ; (1891), 5071 ; (1896), 5193, (comm.) 6099; (1901), 6485. ■

Aurelle de Paladines, Louis Jean BaptiSte d' (1804-1877), French general, was born at Malzieu, Loz^re, on the 9th of January 1804, was educated at St Cyr, and entered the army as sub-lieu- tenant of foot in 1824. He served with distinction in Algeria against the Arabs between 1841 and 1848 (lieut.- colonel, officer Legion of Honour) ; took part in the Roman campaigns of 1848 and 1849 (colonel) ; and served as general of brigade throughout the Crimean War of 1854-56 (general of , division, commander Legion of Honour). During Ihe campaign in Lombardy in 1859 he commanded the ninth division at Marseilles, and super- intended the despatch of men and stores to the seat of war (grand officer Legion of Honour). Placed on the reserve list in 1869, he was recalled to the Marseilles command on the outbreak of the Franco-German war of 1870-71. The revolution of the 4th September obliged him to leave Marseilles, but after the defeat of de la Motterouge and capture of Orleans by the Germans, he was appointed by the Government of National Defence, in November 1870, to the command of the army of the Loire. He was at first very successful against Von der Tann, winning the battle of Coulmiers and compelling the Germans to evacuate Orleans, but the capitulation of Metz had set free additional German troops to oppose him, and, after his defeat at Beaune la Rolande and subsequent unsuccessful fighting near Orleans, resulting in its recap- ture by the Germans in December, Aurelle retreated into the Sologne and was superseded. After the armistice he was elected to the National Assembly by the departments both of AUier and Gironde. He sat for Allier and was one of the fifteen officers chosen to assist in the peace negotiations. He was decorated with the grand cross of the Legion of Honour, and was given the command at Bordeaux, but retired in 1872. Elected a life senator in 1875, he supported the monarchical majority of 1876. He died at Versailles on the 17th of December 1877. He was the author of La Premiere Armie de la Loire, pub- lished in 1872. His fine qualities as a soldier were marred by indecision. (b. h. v.)

Aurillac, chief town of department Cantal, France, 366 miles S. of Paris by rail. 'There is a bronze statue (1883) of General Delzons. Its manufactures comprise copper wares, chemical products, umbrellas, goloshes, and sabots. Population (1881), 11,655; (1891), 12,587; (1896), 13,531, (comm.) 14,578 ; (1901), 17,459.

Aurora, a city of Kane county, Illinois, U.S.A., situated in 41° 46' N. lat. and 88° 17' W. long., on the Fox river, 39 miles W.S.W. of Chicago, at an altitude of

648 feet. Its plan is somewhat irregular, and it is divided into seven wards. Excellent railroad connexions are afforded by the Chicago, Burlington, and Quincy, the Chicago and North-Western and the Elgin, Joliet, and Eastern railways. Agricultural tools and machines are the chief manufactures. The shops of the Chicago, Bur- lington, and Quincy railway, employing upwards of 2000 hands, are situated here. The silver-plate works are also one of the largest industries in the city. It was settled in 1834. Population (1880), 11,873: (1890), 19,688:

(1900), 24,147.

Aurora, a city of Lawrence county, Missouri, U.S.A., on the St Louis and San Erancisco railway, at its junction with a branch of the Kansas City, Eort Scott, and Memphis railway, in the neighbourhood of a lead and zinc mining region. Population (1890), 3489 ; (1900), 6191.

Aurora polaris. See Atmosfhebic Electbicitt.

Aussig (Czech Ousti nad Ldbem), the chief town of a government district in Bohemia, Austria ; a considerable river port on the Elbe. Population in 1890, 23,723 ; in 1900, 40,000; almost exclusively German and Catholic (2 per cent. Czech, 6 per cent. Protestant, and 2 per cent. Jew- ish). The

adjoining communes of Kletsche and Schon- priesen were incorporated in 1899. In 1857 there were only 6404 inhabitants. All branches of industry and trade show great progress. The port, which was extended in 1891, was entered in 1896 by 1700 passenger and 1776 freight steamers, together with 7800 sailing vessels and towed barges. The principal articles forwarded are lignite, coal, sugar, stone and stoneware, corn, fruit, flour, cotton, rice, oil, fat, salt, and petroleum. In addition to the im- portant textile, chemical, and boat-building industries, &c., its manufactures now comprise paraf&n, oils, tar, colour- ing stuffs, machinery, glass, pianos, leather, malt, &c. Aussig was the birthplace of the painter Eaphael Mengs

(1728-79).

Austin, capital of Mower county, Minnesota, U.S.A., on the Eed Cedar river, at an altitude of 1200 feet. The plan is quite regular, and the city is on the Chicago and Great Western, and the Chicago, Milwaukee, and St Paul railways. Population (1880), 2305 ; (1890), 3901 ;

(1900), 5474.

*Austin, capital of T*ravis county, and of the state of Texas, U.S.A., in 30° 16′ N. lat. and 97° 43′ W. long., on the north bank of the Colorado. The river is not navi- gable. The city is divided into eleven wards ; the site is level and the plan regular. The surrounding country is a rich agricultural region, producing cotton as its principal crop. The finest building is the. capitol, which the state obtained by bartering 3,000,000 acres of land in the " Pan Handle." It is said to have cost $4,500,000. The city contains a number of * state institutions ; among them the Lunatic Asylum, the Deaf and Dumb Asylum, the Blind Asylum, and the University of Texas. The last had 65 instructors and 800 students in 1899. Austin has threerailways — the Houston and Texas Central, the International and Great Northern, and the Austin and North-Western. It received its name from Stephen Austin, a prominent man in the early history of Texas. Its site was selected, and the city built to serve as the capital, work on it having been commenced in 1839, immediately after the separation of Texas from Mexico. Population*

(1880), 11,013 ; . (1890), 14,575 ; (1900), 22,258.

Austin, Alfred (1835- – —), English Poet-laureate, was bom at Headingley, near Leeds, 30th May 1835. His father, Joseph Austin, was a merchant of the city of

Leeds ; his mother, a sister of Joseph Locke, M.P. for Honiton. Mr Austin was educated at Stonyhurst, Oscott, and London University, where he graduated in 1853. He was called to the bar four years later, and practised as a barrister for a short time ; but in 1861, after two com- paratively false starts in poetry and fiction, he made his first noteworthy appearance as a writer with a satire called The Season, which contained incisive lines, and was marked by some promise both in wit and observation. In 1870 he published a volume of criticism. The Poetry of the Period, which was again conceived in a spirit of satirical invective, and attacked Tennyson, Browning, Matthew Arnold, and Mr Swinburne in no half-hearted fashion. The book aroused some discussion at the time, but its judgments were "extremely uncritical. In 1881 Mr Austin returned to verse with a tragedy, Savonarola, to which he added Soliloquies in 1882, Prince Lucifer in 1887, England's Darling in 1896, and The Conversion of Winchelman'n in 1897. For several years he edited The National Beview, and has written many leading articles in the columns of The Standard. On Tennyson's death in 1892 it was felt that none of the then living poets, except Mr Swinburne or Mr William Morris, who were disqualified on other grounds, was of sufficient distinction to succeed to the laurel crown, and for several years no new Poet-laureate was nominated. In the interval the claims of one writer and another were much canvassed, but eventually, in 1896, Mr Austin was appointed. Since then he has written several occasional poems, suggested by contemporary events (in particular, the Jameson Eaid), which have not escaped criticism. The chief characteristic of Mr Austin's poetry, as of the best of his prose, is a genuine and intimate love of nature. His prose idyllsj The Garden that I love and In Veronica's Garden, are full of a pleasant, open- air flavour, which is also the outstanding feature of his English Lyrics. His lyrical poems are wanting in spontaneity and individuality, but many of them possess a simple, orderly charm, as of an English country lane. He has, indeed, a true love of England, sometimes not without a suspicion of insularity, but always fresh and ingenuous. In dramatic poetry he is less successful. His laureate poems have been considerably below the level of

his earlier achievements ; but it was a very unenviable task to assume the laurel in succession to two poets whose work is among the richest in English literature.

Australasia, a term used by English geographers in a sense nearly synonymous with the Oceania of Continental writers. It thus comprises all the insular groups which extend almost continuously from the south-eastern extremity of Asia to more than half-way across the Pacific. Its chief divisions are Malaysia with the Philippines; Australia with Tasmania and New Zealand; Melanesia, that js, New Guinea, New Britain, New Ireland, and York, the Solomons, New Hebrides, Santa Cruz, Fiji, Loyalties, and New Caledonia; Micronesia, that is, the Ladrones, Pelew, and Carolines, with the Marshall and Gilbert groups ; lastly, Polynesia, that is, Samoa, Tonga, Cook| Tahiti, the Marquesas, EUice, Hawaii, and all intervening clusters. The term is so far justified in that it harmonizes better than Oceania did with the names of the other continents, and also embodies the two essential facts that it is a south-eastern extension of Asia, and that its central and most important division is the great island-continent of Australia. In a more restricted stose the term Australasia corresponds to the large division including Australia, Tasmania, and New Zealand.

See Australasia, 2 vols. Stanford Compendium Series, new issue. London, 1893-94.

AUSTRALIA.

Physical Geogeapht.

AUSTRALIA is tlie only continent entirely in the southern hemisphere. A mostly unbroken coast- line faces the sea in majestic and stately curves, giving the •whole land a character of compactness, which likens it in some way to portions of the African continent. Quite one- half of its area is drained towards the interior. There are, however, no rivers like the Congo or Nile, and no snow- capped mountains to act as feeders. The average height of the land is not more than 300 feet, the highest point.

Mount Kosciusko, being only 7328 feet above sear-level, and well below the limits of perpetual snow. Australia lies between 10° 39′ and 39° 11|.’ south lat., and between meridians of 113° 6′ and 153° 16′ east long. Its greatest length is 2400 miles from east to west, and the greatest breadth 1971 miles from north to south. The area is, approxi- mately, 2,946,691 square miles, with a coast line measur- ing about 8850. This is equal to one mile to each 333 square miles of land, the smallest proportion of coast shown by any of the continents. The salient features of the Australian continent are its compact outline, the absence of navigable rivers communicating with the in- terior, the absence of active volcanoes or snow-capped mountains, its isolation from other lands, and its antiquity. Some of the most profound changes that have taken place on this globe in lifting mountains such as the Alps and the Himalayas, have taten place in Mesozoic times. Eocks high up on the shoulders of these great ranges were formed beneath the sea at a time when a great portion of the Australian continent was already dry land. Vast tracts of Europe and Asia have been submerged in Tertiary times. Australia has been for the most part above the sea since the period anterior to the great earth moveiftents named. In this sense Australia has been rightly referred to as one of the oldest existing land surfaces. It has been described as at once the largest island and the smallest continent on the globe. While in one sense a large island, it conforms iu general to the continental model. The general contours exemplify the law of geographers, as to having a high border.around a depressed interior, and as to having the highest mountains on the side of the greatest ocean. The main dividing range of Eastern Australia looks out upon the greatest and deepest water mass on the globe, the Tasman Sea and the South Pacific.

Australia stands up from the ocean depths in three fairly well marked shelves. The basal plain of these terraces is the bed of the Pacific, having an average depth of 15,000 feet. Erom this profound foundation rise Australia, New Guinea, and Melanesia, in varying slopes. The first ledge rising from the ocean floor has a depth averaging 8000 feet below sea-level. The outer edge of this basal ledge is roughly parallel to the coast of West Australia, and more than 150 miles from the land. Round the Australian Bight it continues parallel to the coast, until south of Spencer °f^^”^ Gulf (the basal ledge still averaging 8000 feet in depth) character,

.j. g^ggpg southwards to lat. 55°, and forms a submarine promontory 1000 mUes long. The edge of the abysmal area comes close to the eastern coasts of Tasmania and New South Wales, approaching to within 60 miles of Cape Howe. iThe terrace closest to the land, known as the continental shelf, has an average depth of 600 feet, and connects Australia, New Guinea, and Tasmania in one unbroken sweep. Compared with other continents, the Australian continental shelf is extremely narrow. There are points on the eastern coast where the land plunges down to oceanic depths with an abruptness rarely paralleled. Ofl the Queensland coast the shelf broadens, its outer edge being lined by the seaward face of the Great Barrier Reef. Prom Torres Strait to Dampier Land the shelf spreads out, and connects Australia with New Guinea and the Malay Archipelago. An elongation of the shelf to the south joins Tasmania with the mainland. The vertical relief of the land above the ocean is one of the chief factors in determining the climate as

well as the distribution of the fauna and flora of a continent. The land mass of Australia rises to a lesser mean height than that of any other continent. The chief mountain systems are parallel to, and not far from, the coast-line. Thus, taking the continent as a whole, it may be described as a plateau, fringed by a low-lying well-watered coast, with a depressed, and for the most part arid, interior. A great central plain covers quite 500,000 square miles of the continent. Although termed the Central Plain, it is situated a little to the east of a meridional line bisecting the continent. The vast bulk of this plain is situated to the' south of the 22nd degree, but portions of it reach very close to the low-lying flats south of the GuU of Carpentaria. The contour of the continent in the latitude of the Richmond River is as follows : — A short strip of coastal plain ; then a sharp incline rising to a mountain range 4000 feet above sea-level, at a distance of 40 miles from the coast. From this a gently-sloping plateau keeps deepening until nearly down again to the sea-level, in a line due north of Spencer GuU. Then there is a gentle rise to the Low Steppes, much of which country is spinifex desert 500 to 1000 feet above sea-level. A fur- ther gentle rise in the High Steppes leads to the mountains of the West Australian coast, and another strip of low-lying coastal land to the sea. The Great Central Plain is certainly Australia's most notable inland feature. Comparatively little of the rainfall over its vast extent ever

reaches the sea by any known river system. Indeed the river systems as shown on maps leave a false impression as to the actual condition of things. The absence of rivers connecting the coast-line with the interior has already been noticed. In keeping with this is the solid outline of the coast generally. On the north and north-west some notable indentations lead to the Fitzroy, the Victoria, the Daley, and the Roper rivers.

The network of streams forming the tributaries of the Darling and Murray system give an idea of a well-watered country. The so-called rivers have running water only after heavy rains, and very few of these tributaries ever reach the main drainage line. Flood waters disappear often within a distance of a few mUes, being absorbed by porous soil, stretches of sand, and sometimes by the underlying bed-rocks. The waters even of the Macquarie do not usually reach the Darling, hut break up into innumerable gutters, and spread out over vast flats. In flood times only, the river overflows its banks, and flooding the flat country for miles around, reaches the Darling. Oxley went down the Lachlan, 1817, during one of these periods of flood, and the great plains appeared to him to be the fringe of a vast inland sea. As a matter of fact, they are an alluvial deposit spread out by the same flood waters. The great rivers of Australia, draining inland for the most part, carve out valleys, dissolve limestone, and spread out their deposit over the plains when the waters become too sluggish to bear their burden farther. From a geological standpoint, the Great Australian Plain and the fertile valley of the Nile have had a similar origin. Taking the Lachlan as one type of Australian river, we find it takes its rise amongst the precipitous and almost unexplored valleys of the Main Dividing Range. With the help of its tribu- taries it acts as a denuding agent for 14,000 square miles of country, and carries its burden of sediment westwards. A point is reached about 200 miles from the Dividing Range, where the river ceases to act as a denuding agent, and the area of deposition begins. But the river is still about 1000 miles from the sea. The Darling is reckoned amongst the longest rivers in the world, for it is navigable, part of the year, from Walgett to its'confluence with the Murray, 1758 mUes, and then to the sea, a further distance of 587 miles, — ^making in all 2345 miles of navigable ■ water. But this gives no correct idea of the true character of the Darling, for it can hardly be said to drain its own watershed. From the sources of its various tributaries to

the town of Bourke, the river may be described as draining a watershed. But from Bourke to the sea, 550 miles in a direct line, the' river gives rather than receives water from the country it flows through.

The annual rainfall and the catchment area aflord no data whatever as to the size of a river in the interior of Australia. In Europe it has been estimated that from 20 per cent, to 50 per cent, of the rainfall flows away in rivers. The discharge of the Darling River at Bourke does not amount to more than 10 per cent, of the rainfall of its catchment area. It was this startling fact which first led to the idea that, as the rainfall could not be accounted for either by evaporation or by the river discharge, much of the unaccounted-for 90 per cent, must in part sink into the ground, and in part be absorbed by some underlying bed-rock. All Australian rivers depend entirely and directly on the rainfall. They are flooded after rain, and in seasons of drought become dry water-courses. Springs which equalize the discharge of rivers by continuing to pour water into their beds, long after a rainy season.

seem entirely absent in the interior. Neither are there any snow- fields to feed rivers, as in the other continents. More remarkable still, over large tracts of country the water seems disposed to flow away from, rather than to, the river-beds. As the low-lying plains are altogether an alluvial deposit, the coarser sediments accumulate in the regions where the river first overflows its banks to spread out over the plains. The country nearest the river receiving the heaviest deposit becomes in this way the highest ground, and so continues until a "break-away" occurs, when a new river-bed is formed, and the same process of deposition and accumulation is repeated. As the general level of the country is raised by succes- sive alluvial deposits, the more ancient river-beds become buried, but being still connected with the newer rivers at some point or other, they continue to absorb water. This underground network of old river-beds underlying the great alluvial plains must be filled to repletion before flood waters will

flow over the surface. Outside the great alluvial plain there is a vast tract of country

extending from the Musgrave Ranges west and north. This may be considered a plateau without any of the features of the plains. The bed-rock is nowhere far from the surface, thus forming a strong contrast with the great alluvial plain where the bed-rock is buried many hundred feet below the surface. Over the entire western half of Australia there is no leading drainage system, and we have here an area that is almost unique in the features of a continent. There is no high mountain, and probably over an expanse of 400,000 miles not a drop of the scanty rainfall ever reaches the sea.

The term desert applied to the Australian interior is somewhat misleading. Sand-hills there are, and vast stretches of sandy country. But much of the so-called desert will support animal life to some extent. Sturt's " Stony Desert " is not at all what the name would suggest. Peculiar water-worn and glazed boulders cover much of the surface, but there is also grass, and in good seasons the "gibber land" disappears under a waving carpet of meadow. Part of Sturt's "Stony Desert" is now a sheep-run,

no Ion|.U5°W.of 120'Or. 135'*

Sketch Map of Australia.

*Stanfards GeoQ^ 2r*5fdtS Xculon.*

with one sheep to 10 to 12 acres, but growing excellent wool. Genuine desert exists in the spinifex country. On the outskirts are shady bauhinia trees and bright-looking desert-apple trees. The treacherous spinifex, too, looks fair enough from the distance, and often puts on a coat of enticing verdure when the plains and downs are parched and withered. It will grow almost on the surface of a hard rock, and in most parts of the desert the bed- rook is covered with but a shallow coating of soil. The result is like a thousand knitting-needles thrown into a confused kind of tangle, with all the points sticking upwards, and this tangle grows larger and more formidable every year, until a bush fire happily sweeps it away and a new growth starts. Much of this part of the continent is now known as the

Australian Steppes. The Lower Steppes extend over an area corresponding mostly to the extent of the Cretaceous formation. Their prevailing aspect is characterized by fiat and terraced hills, capped by desert sandstone, with stone- covered flats stretching over long distances. The country round Lake Eyre, where some of the land is actually below sea-level, comes under this heading. The Higher Steppes, as far as they are known, consist of Ordovician and Cambrian rocks, with an average elevation of 1500 to 3000 feet above sea-level. Over this country water-courses are shown on maps. These run in wet seasons, but in every instance for a short distance only, and

sooner or later they are lost in sand-hills, where their waters disappear and a line of stunted gum-trees {Eitcalyptus rostrata) is all that is present to indicate that there may be even a soakage in these supposed rivers.

Another notable feature of the interior is the so-called lal^e area, a district stretching to the north of Spencer Gulf. These lakes are expanses of brackish waters that spread or contract as the season is one of drought or rain. In seasons of drought they are hardly more than swamps and mud flats,' which for a time may become a grassy plain, or desolate coast encrusted with salt. The country around is the dreariest imaginable, the surface is a dead level, there is no heavy timber and practically no settlement. Lake Torrens is sometimes 100 miles in length. To the north again stretches Lake Eyre, and to the west of Torrens Lake, Lake Gairdner. Some of these depressions are at, or slightly below, sea- level, so much so that a very slight depression of the land wovdd connect much of the interior with the Southern Ocean.

Along the entire coast there extends a succession of mountain ranges from Cape Howe to Cape York. These constitute a Cor- dillera stretching 1700 miles from north to south. Several points rise to heights of from 4000 to 5000 feet, mostly as isolated peaks. Towards the south-eastern corner of the continent the peaks come closer, clustering around

Mountain ranges.

exploeation]

Mount Kosciusko (7328 feet) , and are here known as the Australian Alps. North of Kosciusko the Main Divide merges into the Blue Mountains and Liverpool Range. The high land continues roughly parallel to the coast, and with generally diminishing altitude through Queensland to Cape York. Near the Queensland border Mount Lindsay rises to a height of 5500 feet. In the latitude of Brisbane the chain swei- ves inland; no other peak north of this reaches higher than Mount Bartle Frere in the Bellenden Ker Range (5438 feet). The Southern Ocean system of the Victorian Dividing Range hardly attains to the dignity of high mountains. An eastern system in South Australia touches at a few points a height of 3000 feet ; and the Stirling Range, belonging to the south- western system of South Australia, reaches to 2340 feet. There are no mountains behind the Great Australian Bight. On the west the Darling Range faces the Indian Ocean, and extends from Point d'Entrecasteaux to the Murchison River. North of the Murchison, Mount Augustus and Mount Bruce, with their con- necting highlands, cut ofi the coastal drainage from the interior ; but no point on the north-west coast reaches a greater altitude than 4000 feet. Several minor ranges, the topography of which is little known, extend from Cambridge Gulf, behind a very much broken coast-line, to Limmen Bight on the Gulf of Carpentaria. Nothing is more remarkable than the contrast between the aspect of the coastal ranges of the north-east, and on the south- east of the continent. The higher Australian peaks in the south-east just look what they are, the worn and denuded stumps of mountains, > standing for untold ages above the sea. Their shoulders are lifted high above the tree-line. Their summits stand out gaunt and lonely in an unbroken solitude. Having left the tree- line far behind him, nothing is visible to the traveller for miles aroixnd but barren peaks and torn crags in indescribable confusion. A verdure of herbage clothes the valleys that have been scooped from the summits downwards. But there are no perpetual snow-fields, no glaciers creep down these valleys, and no alpine hamlets ever appear to break the monotony. The mountains of the north-east, on the contrary, are clothed to their summits with a rich and varied flora. Naked crags, when they do

appear, lift themselves from a sea of green, and a tropical vegeta- tion, quite Malaysian in character, covers everything.

The absence of active volcanoes in Australia is a state of things, in a geological sense, quite new to the ccptinent. Some of the volcanoes of the western districts of Victoria have been in eruption probably subsequent to the advent of the black-fellow. In some instances the cones are quite intact, and the beds of ash and scoriae are as yet almost unaffected by denuding agencies. As late as 1859 an observer wrote in the Quarterly Journal of the Geological Society that, with one doubtful exception, Australia was a non- volcanic continent. The exception referred to is Mount Wingen. But even here there is nothing in the least resembling volcanic con- ditions. Some coal seams have been burning for years, giving out much smoke and steam. Mount Wingen was, in the eyes of the settlers, as it was in fact, a "burning mountain." Late in the Ter- tiary period vast sheets of lava poured from many points of the Great Dividing Range of eastern Australia. But it is notable that all recent volcanic action was confined to a wide belt parallel to the coast. No evidences of recent lava flows can be found in the interior over the Great Alluvial Plain, the Lower^ or the Higher Steppes. Nor has the continent, as a whole, in recent times been subjected to any violent earth tremors ; thoi^h in 1873, to the north of Lake Amadeus, in central Austraha, Giles records the occurrence of earth- quake shocks violent enough to dislodge considerable rock masses.

*The Barrier Reef forms the prominent feature off the north-east coast of Australia. Ranging for a length of 1200 miles, it is the greatest of coral reefs, ancient or modem. The channel Barrier between the reef and the coast is in places 70 miles in ***'■ width and 60 fathoms deep. Flinders described the*

Barrier Reef in his Voyage to Terra Aiistralis ; and the Admiralty charts give much information as to soundings, &c. Our knowledge of the fauna of this richest of huntmg grounds for the naturalist is very incomplete. Interest naturally centres in the coral polyp and its stony structure. Photographs have shown us what the physical features of the reefs are. The Hon. R. Abercromby's photographs, taken at Fiji, were probably the

fiist ; but Saville Kent, Agassiz, and other observers, have made us fairly well acquamted with the conditions presenting themselves on this great tract of growmg land. The first point to strike a visitor to the Barrier Reef is the abundance of soft coral, or branching polyp- aries without a stony nucleus, and the abundance of nullipores and other plant-Uke organisms. Much of the pmk and lilac- coloured patches that catch the eye prove on examination to be nullipores or coralline seaweeds. There are patches of pebbles and boulders and fine sand everywhere, but each particle is part of a living thing. The patches of coral grow more or less after the manner of fairy rings— the outer edges flourishing and the inner dvine and breaking into coral debris. The leading forms amongst the coral masses exposed at very low tides are the branching |

madrepores, the rounded masses of brain coral (meandrina), and porites. A field of madrepores is suggestive of miniature shrub- bery, with plants, having the aspect of young pines. The coral is of every hue and colour, and not a little is added to the splen- did scene by brilliant-hued fishes and bright and gaily-coloured sea-anemones (actinia), the latter often being more than 18 inches in diameter. The beautiful distichopora coccinea resembles some- what the true red coral and is very abundant ; but the red coral itself is not to be found. Heliopora ccerulea, the beautiful blue coral, is not rare. This remarkable species has the stony frame- work of a bright blue, the colouring matter of most corals being confined to the "fleshy " covering. On the reef there is always to be found a great abundance of shells, Uving and dead. In appear- ance, the living specimens of many of the handsome species are disappointing, but the crabs, star-fishes, and great clam sheUs are conspicuous. Sea-cucumbers abound, so much so that the b6che- de-mer fisheries bring in more than £20,000 a-year. These inter- esting holothurians are collected by hand at low water, and sent to the Chinese markets after being cured by drying and smoking. " Rock oysters," too, are plentiful, and the blocks thrown up by the waves are soon encrusted with the well-known and delicate species ostrea glomerata.

There is nothing to be seen on or around the Great Carrier Reef that might be urged as a serious objection to Darwin's well-known subsidence theory. Any facts noted as inconsistent with prolonged steady subsidence

might have been caused by a very slight upheaval. The few clear openings in the whole length of the outer rampart of the Great Barrier Reef are opposed to large estuaries. But being 30 to 90 miles away, they are not, in all probability, caused by fresh water from the land. Suc^ breaks, however, are strong evidence in favour of subsidence. The old river channels, already referred to as being below sea-level, as well as the former land-connexion with New Guinea, all point to the conditions assumed by Darwin.

EXPLOKATION.

By the end of the year 1873 the whole of the eastern por- tion of Australia had been explored, the unknown part of the continent being confined to the interior of West Australia and those districts of South Australia north of the Macdonnell Range and west of the overland telegraph line. Several attempts had been made to cross the colony of West Australia in the direction of east and west, but even Major Warburton's expedition, the most successful of these, had failed in the important particular of determining the nature of the country through which it passed. Major Warburton had virtually raced across from the Macdonnell Range in South Australia to the head waters of the Oakover river on the north-west coast, without allowing himself sufficient time to note the characteristics of the country. TTie next important expedition was differently conducted. John Forrest was despatched by the Perth Government with general instructions to obtain infor- mation regarding the immense tract of country out of which flow the rivers falling into the sea on the noMhern and western shores of West Austraha. Leaving Yewin, a small settlement about lat. 28° south, long. 116° east, Forrest travelled north-east to the Murchison river, and followed the course of that river to the Robinson Ranges ; thence his course lay generally eastward along the 26th parallel. Forrest and his party safely crossed the entire extent of West Australia, and entering South Australia struck the overland telegraph line at Peake station, and, after resting, journeyed south to Adelaide. Forrest traversed seventeen degrees of desert in five months, a very wonderful achievement, more especially as he was able to give a full report of the country through which he passed. His report destroyed all hope that pastoral settlement would extend to the spinifex region ; and the main object of subsequent

explorers was to determine the extent of the desert in the direction of north and south. Ernest Giles made several attempts to cross the Central Australian Desert, but it was not until his third attempt that he was successful. His journey ranks almost with Forrest's in the importance of its results and the success with which the appalling difficulties of the journey were overcome. Through the generosity of Sir Thomas Elder, of Adelaide, Giles's expedi- tion was equipped with camels. It started on the 23rd May 1876 from Port Augusta. Working westerly along the line of the 30th parallel,~~Giles reached Perth in about five months. After resting in Perth for a short time, he commenced the return journey, which was made for the most part between the 24th and 25th parallels, and again successfully traversed the desert, reaching the overland telegraph line in about seven months. Giles's jdumeys added greatly to our knowledge of the char~~ acteristics of West and South Australia, and he was able to bear out the common opinion that the interior of Australia west of 132° E. long, is a sandy and waterless waste, entirely unfit for settlement.

The list of explorers from 1875 to 1900 is a long one ; but after Forrest's and Giles's expeditions the main object ceased to be the

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discovery of pastoral country : a new zest had been added to the cause of exploration, and most of the smaller expeditions concerned themselves with the search for gold. Amongst the more important explorations may be ranked those of Tietkins in 1889, of W. Lindsay in 1891, of Wells in 1896, of Hubbe in 1896, and of the Hon. David Carnegie in 1896-97. Lindsay's expedition, which was fitted out by Sir Thomas Elder, the generous patron of Australian exploration, entered West Australia about the 26th parallel south lat., on the line of route taken by Forrest in 1874. From this point the explorer worked in a south-westerly direction to Queen Victoria Springs, where he struck the track of Giles's expedition of 1875. From the Springs the expedition went north- west and made a useful examination of the countiy lying between 119° and 115° meridians

and between 26° and 28° south lat. Wells's expeditipn started from a base about 122° 20′ east and 25° 54′ south, and worked northward to the Joanna Springs, situated on the tropic of Capricorn and near the 124th meridian. From the springs the journey was continued along the same meridian to the Fitzroy river. The country passed through was mostly of a for- bidding character, except where the Kimberley district was entered, and the expedition suffered even more than the usual hardships. The establishment of the gold-fields, with their large population, caused great interest to be 'taken in the discovery of practicable stock routes, especially from South Australia in the east, and from Kim- berley district in the north. Alive to theNimportance of the trade, the South Australian Government despatched Hiibbe from Ood- nadatta to Coolgardie. He successfully accomplished his journey, but had to report that there was no practicable route for cattle between the two districts.

One of the most successful expeditions which traversed West Australia was that led and equipped by the Hon. David Carnegie, which started in July 1896, and travelled north-easterly until it reached Alexander Spring; then turning northward, it traversed the country between Wells's track of 1896 and the South Australian border. The expedition encountered very many hardships, but successfully reached Hall Creek in the Kimberley district. After a few months' rest it started on the return journey, following Sturt Creek until its termination in Gregory's Salt Sea, and. then keeping parallel with the South Australian border as far as Lake MacDonald. Rounding that lake the expedition moved south-west and reached the settled districts in August 1897. The distance travelled was 5000 miles, and the actual time employed^was eight months. This expedition put an end to the hope, so long entertained, that it was possible to obtain a direct and practicable route for stock between Kimberley and Coolgardie gold-fields ; and it also proved that, with the possible exception of small isolated patches, the desert traversed contained no auriferous country.

Geology. All the great formations familiar in the northern hemisphere are represented in the geology of Australia, which is in no way exceptional, either in the character of the rocks or in the zones of life that characterize them. The oldest rocks are of pre- Cambrian age, but little of their life-

history is known. If differ- ences, rather than resemblances, be dwelt on, there are many points concerning Australian geology in strong contrast to much that European geologists have been accustomed to. As has already been said, there are no volcanoes on the continent, and all over the vast interior there is a general absence of igneous rooks other than granites. Basalt is almost unknown except on an outside belt of the country roughly parallel to the coast. There are no solfataras, fumeroles, or geysers, and very few hot springs. There is no such thing as perpetual snow, even on the highest mountain, no glaciers or glacier lakes, and not a single mountain range with an Alpine structure. There is a notable absence of magnesian limestones, and phosphate-bearing rocks are unknown. There is an equivalent of the red sandstones, but no salt beds and no gypsum. There is evidence of glacial action in Permo-Carboniferous times, during which period a great ice-sheet extended over a considerable'^ ^portion of Australia, and evidences of recent glaciation at Mount Kosciusko are most pronounced. In the matter of folding we find the Australian, Cambrian, Silurian, and Devonian, all giving evidence of earth movements. The Silurian rocks in particular have been so folded and so intensely compressed that we usually find them over wide areas, vertical or highly inclined, and almost invariably with a meridional strike. All over the continent other formations laid down subsequent to those named are spread out in vast sheets, never showing a high angle or dip, and nowhere resting at any great height ajiove sea- level. The Carboniferous rocks are also folded, but «b a lesser degree than the Devonian, and of course in a degree not to be compared with the Silurian.' The intense folding of the Silurian, taken together with the lithological character of its sediments, separates it at once from every other "formation" in the Australian geological column. So marked is this that throughout Australia rocks may be safely classed as Silurian if they show over consider-

able areas a " slaty " structure, a high angle of dip, and a meridional strike.

Against these facts may be placed others showing strong re- semblance between Australian and European geology. The physical geography and the life of the Palaeozoic and Mesozoic periods are in wonderful accord

with those of other continents. The great develop- ment of coal in the Upper Palaeozoic conforms to the northern con- ditions. The general types that characterize Cretaceous rooks are also present, plesiosaurs and chambered shells, such as ammonites, being as characteristic of the Australian Cretaceous as they are of the European. The forms of life, too, that occur in the Triassic of Europe, and even North America, find their countei^art here. In the shales round Sydney, which are admittedly of Triassic age, the remains of a giant labrinthodon have been unearthed, and, associated with it, fishes and plants quite in keeping with forms familiar in the European Triassic.

In using such terms as " Permian " or " Eocene " there is reason to suppose that these periods in Australia might not have been quite synchronous with the European equivalents. Indeed it is not desirable to correlate too minutely Australian and European stratified rocks. We may even go further and say that it is im- probable that any single life zone was laid down exactly at the same time that a similar life zone was being built up in northern Europe. One particular horizon in the Silurian is characterized by the interesting chain coral (halysites). No one would contend that the chain coral " reefs " in Australia and in Europe were exactly con- temporaneous. But the relative position of the halysites zone in the geological column is the same in Europe and in Australia, and the physical conditions that surround the growing coral are precisely similar.

Some reference is made under the heading Fauna to the presence of " living fossils " in Australia. Certain characteristic types, long extinct in the northern hemisphere, still linger in the Australasian area. The Trigoniaand the Heterodontus, the Marsupials, Myrme- cobius, Ceratodus, and certain conifers and cycads are examples. One genus of cycad (Zamia) is exceedingly common over all the moun- tain and coastal regions of eastern Australia. It is a near ally of one of the most characteristic forms of the fossil flora of the Oolitic and Lias. In the well-known " dirt bed " of the Portland quarries, Dorset- shire, the stems of these cycads are to be found in great abundance.

The last feature of general import is the distribution of meta- morphosed rocks. The lower series of the Palseozoic show a certain amount of

metamorphism in conjunction with their highly inclined position. The mesozoic rocks are much less altered from their original plane of deposition, and any metamorphism notable is of a limited and entirely local character. Certain sandstone beds of Cretaceous age have been much altered by the deposition of second- ary silica. No great alteration approaching to metamorphism is known to have taken place amongst Tertiary rocks. Schistose structure is confined altogether to the Lower Palaeozoic.

Principal AusiBALiAif Sedimentaky Formations, with boue

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Human boneB and Implements; re- mains of plants and animals of living species ; Dinomis, Aptornis, Ornitho- , rhynchns.

I)h)rotodon, Macropns, Thylacoleo, Thylacinus, Nothosaums, Megalania, Dromomis, Echidna, Meiolania, Palorchestes, Dromseas, Mytilns, Slphonalla.

Phascolomys, Procoptodon, Mac- ropus, Thylacinus, Thylacoleo, Di- protodon.

Spondylostrobus, Wllkinsonia, Pen- teune, and other fossil fruits, In old "leads."

Nassa, Marginella, Ancilla, Gancel- larla, ^atica, Leispyraea, Nucula, , Trlgonia, Chione, Meroe, Tellina.

Flabellum, Flacotrochus, Terebratu- lina, Cuculsea. Corbula, Nassa. Voluta, Marginella, Aturia, Murex^ (upwards 80 sp.), Triton, Mitra, Fubub, Natica, Gerithium.

Ichthyosaurus, FlesioBaurus, Am- monites, Belemnites, Cidaris, Avic- ula, Trlgonia^ Baculites, Otodus, .CImlioBaurus, Mactra, Inoceramus,

Taxites, Tseniopteris, Thinnfeldla, Podozamites, Spheuopteris, Lepto-

, lopls, Goccolepis, Aphnelepls.

- ***Tflsniopteris, Sagenopteris, Cycad- opteris, Alethopteris, Macrotseni- opteiis, S^enopteris, Pecopteris, Jeanpaulia* Fodozamites,***

Equisetum, Oleandrldium, Ottelia, Schlzoneura, Gingfco, Zamites, Thinnfeldia, Phyl- lotheca, Flatyceps, tJnionella, Es- tiieria, Tremanotus, Palseoniscus, Myriolepis, Mastodonsaurus, Unio, Pnstlsomua, Oleithrolepis.

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AUSTEALIA

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■ Fbbmo-Garbonifebotts

Caebonifekotts

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Devonian .

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GloBBopterls, Phyllotheca, Terte- braria, Spbenopterie, Annularia, Spirlfer, FachydomuB, Productus, Orthoceras, Conuloria, Martiniopsis, Eurydesma, Flatyceras, Leala, Gan-

famopteris, Ayiculopecten, Notomya, aD^uinolites.

Khacopteris, Lepidodendron, Cala- mltes, ArcheBopterfs, Blgillaria, Loxo- nema, Euomphalus, Spirifer, Orthis, __ Leptffina, Phyllotheca, Fenestella. ‘ Lepidodendron, GyoloBUgma, Spiri- fer, Bhynchonella, Atrypa, Orthis, Orthooeraa, AsterolepiB, PteroniteB, Murchisonia.

Atiypa, Fentamerus, HalyBiteB, GraptuIiteB, Phacops, Bronteue, Caly- mene, Cyathophyllniu, ppirifera, Dldymograptus, LingulocanB, Lin-

fula, Mucophyllum, Stromatopora, avosites, Heuoptayllum, PhillipBas- trea, Bhlzophyllum, Oolumnaria, Petraia, Lichas, Syringopora, C^clo-

nema, Bellerophon, F^seaBter, Niso, TrochuB, ABaphus, Beyrichia, Oyph- aBpis.

GonocephallteB, Dolichometopna, Dilcelocephalus, Dinesus, Olenellas, Salterella, Orthislna, Leperditla.

Table, showing the General Succession of Australian Strata.

Some Ttpioai. Exampub.

Eaised beaches. — Victoria and West Australia _ have Band loama for forming these.

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AS-JlTBA .

Pebmo – Cabboni-

FEBOFS .

CABBONIFEROirB

Devonian

Sn.ITBIAN

Cakbbian

. Pbe-Cambbian

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Alluvial flats and great plains of the interior. Balsed beaches of the north-west coast, TaBmania, , Large area in the south-east of South Australia.

Limestone creek beds, south-west Victoria, contain- ing about 80 per cent, of living mollusca. Volcanic ash beds of Mount Gambler. Mammaliferous sandy clays containing diprotodon, &o., Mammaliferous cave de-

goslts of New South Wales and Victoria ; freshwater mestones of the Geelong district. Newer basalts at ^ "Werribee, Geelong, and Camperdown, Victoria.

Marine sands of the Dry Greek and Croydon bores, South Australia. Oyster beds of the Murray river cliffs and Aldinga Bay, South Australia.

Calcareous sands and clays of Jemmy's Point, Gippsland, and the upper beds at Murray Creek, near Hamilton, West Victoria.

Generally— limestones, days, and sands from the Snowy river, Gippsland, to the Great Australian Bight; also from Geraldton to Shark Bay, Western Australia; and Table Cape, Tasmania (all marine). Plant beds of EmmavUle, New South Wales.

2^0 marine beds o/^ocene^ Miocene^ or Pliocene

' age are known east of the MaAit JHviding

Range in New South, Wdlee or Queenelan^d.

Upper Cretaceous. — Desert Bandstone of

Queensland. 4

Lower Cretaceous. — ^Rolling Downs for- mation of Queensland. Artesian water- bearing beds of north-western New South Wales. Kennedy Bange and Gascoyne river. West Aus&alla.

Beds with fossil fish, Talbragar river,

New South Wales. Oolitic limestone of

Champion Bay district. West Australia.

_ ^ — +- The HawkesbuiT sandstones and

H @ 3 "5 associated shales of New South Wales.

H ai -g Lower Mesozoic rocks of the Clarence

river. The Ipswich and Burrum beds of M>.^ . Queensland with 7'(S»iop<6/^8. The Upper S.S^'o •^o"' Measures of Tasmania, and the aa « s Collie Creek Coal Measures of West S S'f S Australia are considered to be of Meso- S,^% zoic age.

Coal Measures of New South Wales, Newcastle, Illawarra, and Lithgow, with Glosaopierie. Upper and Middle Bowen river formations, Queensland. Collie river and Irwin river. Wast Australia. Tas- manite beds, Mersey and coast about the estuary of the Derwent, Tasmania. ‘ Port Stephens district. New South Walesi Gympie, Lower Bowen, and Star formations, Queensland. Also the Lower Coal Measures of Tasmania.

Mount Lambie sandstones, Eydal, New South Wales. Avon river and Mount Tambo beds, Victoria. Burdekin beds, Queensland. Sandstones and grits, Kimberley, West Australia. Tingal slates, Tas- mania.

*Highly-inclined clay slates and talcose slates. New South Wales, South Australia, and West Australia and Victoria. Graptolite beds of Victoria. Tass and Molong limestones. New South Wales. “Lara- pintine” Dmestones, Macdonnell ranges. Queen river schists and slates, and the Gordon river group, Tasmania. _^*

Olenelius and Salieretta beds of Kimberley, West Australia. Ardrossan beds of South Australia. Ma- gog and Caroline creek groups, Tasmania. Torke’s Peninsula “series, South Australia. Kimberley, West Australia. Heathcote, Victoria.

Quartzite and some metamorphic rocks of Tasmania, Mount Lofty Ranges, South Australia.

Of the seven sub-kingdoms of liying things, no less than five are represented in the Australian Cambrian. If we except vertebrates, we have therefore at the very dawn of life representatives of the animal world as we know it to-day,— types which are in no sense

embryonic. We cannot here, any more than elsewhere, work back far enough to get near to the beginnings of life. The cmnbrlan animals on the Cambrian sea-shores were graded and grouped no less exactly and definitely than the invertebrate fauna of the present coast-line. Mammals, birds, reptiles, and fishes are, of course, absent ; but it must strike one as remarkable that fora- minifera, sponges, corals, hydrozoans, entomostraca, trilobites, brachiopods, lamellibranchs, gasteropods, and pteropods, should be present in that far-ofl epoch pretty much as we see

them to-day. Cambrian rocks are known in Yorke's Peninsula, South Australia, and near Leigh's Creek, 300 miles to the north of Adelaide. Cam- brian rocks have been described in the Kimberley district of West Australia containing such world-wide forms as Salterella and Olenellus. The Macdonnell ranges of Central Australia are con- sidered also of Cambrian age, and, like all the Australian Cam- brian, are of marine origin. Some of the Cambrian beds were laid down in shallow waters, as ripple-marked quartzites and current- bedded sandstones are known to occur. No contemporaneous igne- ous rocks are known. The Cambrian shows evidence of much fold- ing, and it is evident that the earth movements giving rise to the folds took place before the deposition of the succeeding Silurian. The Macdonnell Range, usually regarded as Cambrian, consists of conglomerates, limestones, and slates, and these conglomerates are the first evidence of the existence of any land in Australia.

The Silurian system is well represented over Australia. 'Quite one-thirtieth of Uie area of the continent is covered by rocks of this age. In the colony of Queensland, however, the Silurian is not developed to any considerable extent. sy/ur/aii. The Australian Silurian consists of sandstones, mud-stones, con- glomerates (rare), " slates," and limestones. Over a great area of the country highly inclined mud-stones are known as Silurian " slates." The cleavage of these rocks corresponds to the bedding planes, and they are, ttierefore, not true slates. Nowhere has the Australian Silurian been subjected to such intense metamorphism as to develop cleavages across the deposition planes. The Silurian beds have been tilted, folded, and broken : but the conditions necessary for the production of rocks resembling, say, the Bangor slates, were not present. The mud-stones of Victoria have yielded an abundance of Graptolites, and these interesting fossils have also been found in New South Wales. The richest fauna, however, has been discovered in the limestones. European forms, made familiar by text-books, are well represented, as, for instance — Halysites, Favosites, Syringopora, Phillipsastrea, amongst the corals ; Pha- cops, Sronteus, and Calymene, amongst the trilobites. Beceptacu- lites is also known, together with Fentamerus, and a number of Spirifers. So far as is knovni, the Silurian beds are marine. No contemporaneous igneous rocks have been discovered. In Vic- toria the

Upper and Lower Silurian have an aggregate thickness of 35,000 feet. In New South Wales a section has been measured at Molong showing a thickness of 3000 feet. The ” slates ” of Silurian age are often seen to rest directly on granite, their bedding planes standing vertically and rising directly from the granite. The gran- ite is not, therefore, the original bed-rock pn which the slates were laid down. There is abundant evidence to show that much of the granite was intruded amongst the ” slates ” after the latter were left highly inclined by intense folding’. These granites are therefore younger than Silurian, and, as they do not intrude on the Carbon- iferous higher up in the series, they are probably of Devonian age.

Some interesting caves have been discovered in the limestones of this age. The Australian black-fellow has left us no history in connexion with them. Certain rock shelters have been used by the aboriginals, but of the limestone caves they evidently made no use. The living aboriginal avoids even their vicinity. The Well- ington caves of New South Wales have been eroded through lime- stones of Silurian age. Breccias accumulated through openings from the surface, and yielded a series of most interesting giant marsupials, first drawn attention to by Sir Richard Owen. In fact, the whole importance of these caves lies in the scientific value attached to the fossils referred to. From a scenic point the caves are uninteresting. The Jenolan caves of New South Wales are also eroded from limestones of the same age. They have yielded no fossils of especial interest, but are widely known for their beauty. Geologically, the existence of the caves depends on the fact that a bar of limestone runs almost directly across a deeply eroded valley,— -water, the giant sculptor of mountains, having found it easier to make for itself a passage by dissolving the limestones than by eroding them to the valley level.

In Australia there is a great development of stratified rocks up to 23,000 feet in thickness, unconformable to the older Silurian and the overlying Carboniferous. The life of the period is _ also clearly distinct from that of the preceding and the “^™’”’”’- succeeding rocks. Here for the first time in the geological record we meet with contemporaneous igneous rocks. The Snowy river porphyries of Victoria and certain felsites in the

Braidwood district. New South Wales, must be considered the results of volcanic outbursts in Devonian times. In Queensland, Devonian

rocks quite 20,000 feet in thickness have been measured, forming one unbroken series. Devonian rocks are developed largely in Western Australia. There is one belt 200 miles long, from the Saw Ranges to the Lubbock Range. Interbedded igneous rooks, breccias, and ash-beds are known, up to 100 feet in thickness. In the Kimberley district of the same colony there are grits, conglom- erates, and limestones and slaty shales of Devonian age, 1100 feet in thickness. The earliest land plant indicating a land flora for Australia is Dicranophyllnm Australicum from the middle Devo- nian of Queensland. Remnants of old land areas which supported a land flora are also preserved near Mansfield in' Victoria, also near Twofold Bay, and at Rydal in New South Wales. Rocks with a thickness of quite 10,000 feet are developed at Rydal (New South Wales). They contain the well-known fossils, Spirifera disjuncta and Bhynchonella pleurodon, occurring mostly in quartzites. The series is made up for the most part of reddish and purple shales, mud-stones, grit, and conglomerates. These show a strong unconformability .yith the underlying Silurian. The occur- rence of Lepidodendron is remarkable, being found as it is exactly in the same horizon as the Spirifer named.

The Carboniferous of Europe is remarkable for the great devel- opment of workable coal-seams in the series. In Australia the Carbon- greatest accumulation of coal is found in a subsequent Iterous series of rock knovm as the Permo-Carboniferous. The Australian Carboniferous is characterized by such forms as Lepidodendron, Bhacopteris, Cordiates, Arehoeopteris, Sphen- opteris, and Paloeoniscid fish, and also by well-marked marine shells. The rocks are therefore partly marine and partly fresh- water, and evidence of contemporaneous igneous activity is left by a great variety of rocks ranging from felsites to basalt. Carbon- iferous beds rich in fossil plants can be traced from Queensland through New South

Wales. The Carboniferous rocks of Queens- land are conveniently divided into (1) Gympie series, which has been measured up to 21,000 feet in thickness, on the Hodgkinson gold-field. The chief fossils are the marine form s-rProJoreiepora ampla, Productus cora and Martinia auBradiato— associated with Lepidodendron : (2) the Star formation, made up of slates, con- glomerates, sandstones, and a thin band of limestone — the whole reaching up to a thickness of 1353 feet. Lepidodendron is also abundant, and Cyclostigma, with the marine forms, Phillipsia du- bia and Bhynchonella pleurodon. The Carboniferous rocks of West Australia consist of limestone beds interbedded with shales, layers of gypsum, and traces of rock salt 1000 to 1300 feet in thickness, and a series of freshwater sandstones, with a thickness of 1800 feet.

The Silurian, Devonian, and Carboniferous, with their associated igneous rocks, are the sources of all the metalliferous deposits in Australia, the alluvial leads being of course derived from the wear- ing down of these formations. The well-known Mount Morgan mine may perhaps be noted as an exception, for we have here a geyser deposit, of Upper Mesozoic or Tertiary age, in a Permo- Carboniferous area. No rocks newer than the Carboniferous are known to have had metalliferous deposits in the shape of lodes formed amongst them.

Permo-Carboniferous is a term originally proposed by Mr Robert Etheridge, jun., for a formation "distinguished by a copious marine fauna partaking of a Carboniferous and Permian nature, c'rh"' –"^ ^ flora froin which lycopodiaceous plants were liktmis' almost entirely absent." Anyone familiar with the Carboniferous rocks of Europe will remember that the most characteristic fossil plant is Lepidodendron. This is absent in the Coal Measures of Eastern Australia ; and in its place we find plants, and one form in particular, with quite a Mesozoic aspect. The fern referred to is Glossopteris. This beautiful fossil plant is found associated with workable Coal Measures over great areas of the continent. The Permo-Carboniferous rocks of Eastern Aus- tralia are quite 10,000 feet in thickness. The lower beds contain coarse conglomerates in great abundance and a very distinctive marine fauna. The upper beds are made up for the most part of finer materials and are of freshwater origin. The whole series is thus divided in the type district, Newcastle, as follows : —

The seams of coal worked at Newcastle belong to the Upper Coal Measures. The best known in the Nkwoastle Coal Measures are, In descending order— (1) Parbury's seam ; (2) Great Northern seam; (8) Burwood seam; (4) Tllity seam; (5) Yard seam; (6) Borehole seam, Glos9(ypt&r%s abundant. The Bbmfsey Series, 2000 feet in thickness, separate these coal seams from the underlying Tomago Goai. Measithes.

The Cfpeb Mabihb Bess are about 5000 feist in thickness. The following divisions are recognized in descending order: — (1) Beds with Crinolds and Swtiguim.oUt68 ; (2) beds with abundance of Spirlfers ; (8) Muree rock ; (4) con- _ glomerates,

' Gbeta Coai. MEAsmtES, with no marine shells. Fossil plants abundant. Gloasopierie common.

The Lowes Maeine Sebies Is about 2000 feet in thickness. Eurydemui eordata is chaisctMstic. <'■

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Quite fifteen seams of workable coal, with an aggregate thick- ness of 150 feet, have been opened up around Newcastle, New South Wales. It has been estimated that at the present rate of consumption the known coal beds would last 3000 years. The same series with similar fossils is known to occur in West Aus- tralia, Tasmania, and Queensland. A considerable amount of vol- canic activity manifested itself at many points over what is now East and West Australia in Permo-Carboniferous times.

Jurassic beds are said to underlie the Cretaceous to the north of Champion Bay, West Australia. Oolitic limestones, grits, sand- stones, and clay ironstones make up the series. Some fossils have been described from Shark Bay, where Jurassic. they occur in ferruginous and variegated

limestones, clays, and ironstones, not unlike rocks of the same age occurring in England. These interesting stratified rocks are all of marine origin. In other parts of Australia freshwater depo'feits containing abundant plant remains are classed as Jurassic. . A remnant of rocks of this age occurs near Gulgong (New South Wales). Here some yellow ferruginous shales were found to contain abundant fish remains. The fish belonged for the most part to the Lepto- lepidcB, and on the same slab could be seen land-shells, and im- pressions ot Txniopteris. The fossilifierous shales are in, situ, being laid down in an eroded hollow in the Hawkesbury sand- stone.

The type district for Triassic rocks in Australia is immediately around Sydney. Here the rocks are divided into three groups : (1) Wianamatta shales, 700 feet ; (2) Hawkesbury sandstone, 1000 feet; (3) Narrabeen shales, 1600 feet. Triassic The whole series is characterized by the absence of marine fossils and an abundant and decided Mesozoic flora. Fish remains have also been discovered. Much of the beauty of Sydney as a city is due to the excellent building material supplied by the Hawkesbury sandstone. Ascfending from Permo-Carboniferous to Triassic tocks we at once lose the characteristic Coal Measures fossil, Glossopteris. Quite another fern characterizes Triassic rocks — Tceniopteris. \ In searching for artesian water in Western New South Wales, Tceniopteris beds have been discovered (underlying Cretaceous) . After boring through these beds abundant supplies of artesian water were struck. The presumption, therefore, is that Triassic rocks, and not Cretaceous, are the source of artesian water, if not in Queensland, certainly in New South Wales.

Queensland has a great series of coal-bearing rocks, known as the Burrum formation. The lower Burrum coalfield extends along the eastern coast-line from Point Cartwrighj; on the south, to Littabella Creek on the north, and stretches Trias-Jura. inland for an average distance of 26 miles. Its area is estimated at 3000 square miles. The Coal Measures of this forma- tion contain several workable coal-seams, of excellent quality for steaming purposes. No marine fossils have been discovered, but plants of the usual Mesozoic aspect are plentiful. Newer than the Burrum is the Ipswich, also classed as Trias-Jura. This formation occupies an area of quite 12,000 square miles in the southeastern corner of Queensland. The

Ipswich formation contains excellent coal-seams. These beds contain no marine fossils, ;tbe whole^eing laid down under freshwater conditions. There is an abundant flora, prominent forms being — Equisetum, Sphenopteris, ThinnfeU dia, and Tceniopteris; but Glossopteris, so characteristic of the Newcastle Coal Measures, is absent. The Collie Creek Coal Measures of West Australia may be provisionally classed here. There is an important series of rocks in Tasmania, undoubtedly of Mesozoic age, composed mainly of variegated sandstones, shales, and blue and white clays. The series frequently contains seams of coal of good thickness and fair quality. There are no marine fossils but a great abundance of plant remains with a decidedly Mesozoic aspect. Mr R. M. Johnstone considers that these beds probably cover the whole period from the close of the upper Palae- ozoic Coal Measures to the beginning of the Tertiary period. Some of these beds are probably of the same age as the Trias-Jura of Queensland. Certain beds in Victoria, about Cape Paterson, Bara- bool Hills, and a series known as the Bellarane beds, consisting of sandstones, coal, and carbonaceous shales, may belong to this series. They contain an abundant fossil flora, but no marine fo&- ails. The leading forms are Tceniopteris, Alethopteris, and Zami- tes. These rocks occupy four distinct areas, and contain all the known coal-bearing rocks in Victoria. They cover, at least, 4000 square miles.

The Cretaceous rocks cover an immense area in New South Wales, Queensland, North, West, and Central Australia. They may be grouped into three series — the lower, developed chiefly in Western Australia ; the middle, in North- Cretaceous. Western New South Wales ; and the upper, in Queens- ‘ land and over Central Australia generally. The Upper Cretaceous, to which belongs the widely-spread formation knovni as desert sandstone, miist have covered more than one-fourth of the whole continent. This sandstone, it has been remarked, is a monument of the power of denudation. It is now found only in isolated fragmentary table-lands. Taken as a whole, the desert sandstones

vary greatly m composition, in texture, and in general appearance ; but individual beds preserve their characteristics over very large areas. In Western New South Wales deposits of excellent opal have been found in marls of Cretaceous age. These marls are undoubtedly of marine origin. The opal is found filling in seams m the marls ; but reptilean bones, wood, gasteropod shells and belemnites are also found converted into noble opal of first quality. The silica of the opal is probably derived from diatomaoeous and radiolarian tests in the marls. The Lower Cretaceous rocks of Queensland are believed to be sources of artesian water. The Cretaceous rocks of New South Wales were also supposed to yield artesian water. More recent investigation has shown that, although the artesian bores are in many instances put down tJirough Cretaceous rocks, the water-bearing strata belong to the underlying Triassic. The lower beds form the country known as the Rolling Downs. They consist of shales, Cretaceous sandstones, with no great de- velopment of calcareous rooks or limestones. The presence of ammonites and belemnites indicates a marine origin for these beds. Cretaceous rocks cover probably more than 300,000 square miles. It is estimated that the desert sandstone at one time covered an area of 500 square miles, but has now been reduced by denudation to isolated table-lands. The most striking feature in connexion with the Queensland Cretaceoiis rocks is their horizontal bedding, and their occurrence in flat-topped, step-cut hills. The desert sandstone plains present a most desolate appearance, and form some of the poorest, the driest, and the most inhospitable territory of the continent. The Cretaceous rocks have been very little dis- turbed by the intrusion of the igneous materials.

Marine beds of Eocene, Miocene, and probably Pliocene age occupy a large extent of country on the southern shores of the continent, extending from Gippsland away round Tertiary. to West Australia. Marine Tertiary must cover at least 20,000 square miles, and near Melbourne very considerable thicknesses of Eocene rocks have been found. The Croydon boring near Adelaide shows a thickness of fully 2.300 feet of pre-Pliocene Tertiary strata. They reach inland to the south- western comer of New South Wales, where they are over-lain by alluvial deposits of Pleistocene age. Tertiary marine beds are also known on the north coast of Tasmania. Quite a different set of beds occur inland in New South Wales, Victoria,

and Queensland. There are also rooks of Tertiary age, but they were laid down under inland and iresh water conditions. Some of the beds contain in abun- dance fossil plants strongly suggestive of some of the earlier Tertiary European flora. Sufficient is known now of the marine Tertiary beds of Australia to separate them into Eocene, Miocene, and Pliocene.

Eocene. — Eocene rocks are particularly rich in fossUs — the Eocene beds of Aldinga and Adelaide being notable for gasteropods, lamellibranchs, echinoderms, and corals. The Eocene beds at Muddy Creek, West Victoria, are even more prolific, 649 spepies of moUusos having been recorded. The Eocene beds are made up of clays, calcareous limestones, sandstones, bands of pebbles and grits, and shelly limestones. The proportion of living species of mollusca in Australian Eocene rooks nowhere exceeds 3J per cent., and the percentage is usually under two.

Miocene. — Miocene beds occur overlying Eocene rocks in the river Murray clifEs. At Aldinga bay and Hallet's Cove, on the east side of St Vincent Gulf, Miocene beds rest directly on the Eocene — ^in both cases the newer rooks lying on the eroded surface of the older. At Muddy Creek, in Western Victoria, Miocene beds are also found overlying the Eocene, and near the Gippsland Lakes they flank an Eocene escarpment. The Australian Eocene contains 15 per cent, of living forms. The rocks consist of blue clays, mottled sands, oalciferous sandstones, and sandy clays.

Pliocene. — ^Bores put down at Dry Creek in South Australia show the existence of strata with a fauna comprising 210 species, of which 150 are gasteropods, and 60 lamellibranchs. As the beds contain about 27 per cent, of living species. Professor Tate pro- visionally called these beds Older Pliocene, "though in this case the percentage system does not fully indicate the strong modem faoies exhibited in this collection of fossils." The Croydon bore, near Adelaide, passed through 406 feet of stratified rocks, some of which are of Pliocene Age. Some beds occurring in the south-west of Victoria, at Limestone Creek, have yielded an abundant fauna — the proportions of recent forms being 80 per cent. — and are con- sidered late-Pliocene. These rocks are wholly marine. Towards the centre of the continent, however, a totally different set of beds were laid down, mostly of lacustrine or alluvial origin. In Pliocene times much of

the present arid interior was a well-watered country, supporting a luxuriant vegetation. The fauna of this period included many animals of astonishing proportions and most remarkable stmctural characteristics. These larger forms were all marsupials, and are now extinct. Species of diprotodon, noto- therium, phascolomys, macropus, and protemnodon must have been plentifully distributed. To account for the existence of such huge herbivores, we must suppose a well-watered country, with a luxuriant vegetation, in place of the present desolate and arid region

of Central Australia. The lakes of the interior of Australia, which are for the most part simply dead levels of white salt, must in Pliocene times have been magnificent sheets of water, set amidst rich tropical forests. Herds of giant marsupials, birds as large the New Zealand moa, saurians 15 feet in length (_Nothosaurus), and gigantic monitors tenanted the country. Amongst the marsupials, Diprotodon was the most notable, with a head 3 feet in length. A kangaroo, with a skull as large as that of an ox, (Palorchestes asael) was the largest known member of the kangaroo family. Nototherium, another great marsupial, almost rivalled the diprotodon. The remains of a large extinct wombat, equalling a tapir in size, have also been described. Associated with these was a skull with extraordinary adze-shaped teeth. Their long chisel-like form suggested the name Sceparnodon. There was also an animal (Koalemus) probably the ancestral form of the living " native bear." The existing bear is an animal about 2 feet long, with a body made to look more clumsy by the almost complete absence of a tail. The bear of to-day weighs about 20 lb. The bear of Pliocene and post- Pliocene times was a similar animal, more clumsy and more un- wieldy, if such can be pictured. The fossil form was many times as large as the "native bear," and would turn the scale at 500 to 600 ft). The Sarcophilus, or "Tasmanian devil," is now extinct on the mainland, but its remains are very common in Pliocene and post-Pliocene drifts, from Victoria to Queensland. Another animal that lived in the days of the diprotodon, is Thylacoleo, a gigantic ally of the phalangers. The skull measured nearly a foot in length. Various theories have been advanced to explain the extinction of forms so vast and varied. The drying up of the lacustrine area had no doubt much to do with the change. Pliocene conditions con- tinued into post-Pliocene times. The absence of marine beds of this age over the continent makes our subdivisions of this

portion of the geological record somewhat arbitrary. The great alluvial plains are the work of rivers in post-Pliocene times, and much of the drifts and "leads" containing gold and tin-stone are of the same age. All the evidences of the presence of man are confined to recent deposits. But although, geologically considered, man is a recent arrival, yet measured in years his existfence is one of vast antiquity on the Australian continent.

Granites may be said to be well represented, and are almost everywhere associated with the older stratified rocks. Over the whole of the interior, there is a notable absence Platonic of basalt or recent lavas, and even of such intrusive rocks and rol- as diorites. Vast tracts of Cretaceous and Tertiary canlc. country show no igneous rocks for many hundreds of square miles. The Kosciusko plateau consists for the most part of gneissic granite, cut through sparingly by igneous dykes, and in one instance, by what seems to be a volcanic neck. The bulk of the Australian granites seem to have been intruded into Silurian and Devonian, and perhaps even into Carboniferous, but they are older than the Permo-Carboniferous. The first manifestations of igneous outpourings are noted as having occurred in Devonian times. In the succeeding Carboniferous and Permo-Carboniferous, volcanic activity was also very manifest, and is shown by many hundred feet of interstratified volcanic products. In Triassic times there is very little sign of volcanic action. The Cretaceous period, too, was one of quietude. The next outburst of volcanic fires occurred in the Tertiary, and this continued down almost to the advent of the aboriginals. In the western district of Victoria some remarkably fine craters remain quite fresh and very little cut into or denuded by atmospheric agencies. Here quite eight of the points of eruption have been counted which poured out the floods of basalt known in Victoria as newer volcanic.

As regards the distribution of recent volcanic rocks. New South Wales shows excellent types of trachytes in the Warrumbungle mountains, and also in the Canoblas, a point of eruption near Orange, about one hundred mUes west of Sydney. Along the slopes of the Main Dividing Bange, there is much basalt 6f the typical basic character. Many of the "leads" that have yielded so much alluvial gold are old river-beds buried under this basalt. Elat- topped basalt-covered hills are a marked character of the western slopes of the eastern Dividing Bange. These are remnants of lava

streams that flowed from long-extinct, but geologically recent, volcanoes. Basalt in these instances filled the old valleys, and the surrounding country rock being worn away, the basalt now remains above the general level. Thus the lines of the old rivers, once the lowest part of the country, now stand out as the highest ground. Water- worn pebbles, sand, and shingle — in other words, old river-drifts — are invariably found under these cappings. A leucite basalt of Tertiary age occurs in three different localities in New South Wales. No nephelin basalts have been discovered anywhere on the continent. Serpentines are well represented, in one case evidently derived from an olivine-bearing rock. Basaltic dykes are extremely common, cutting up through the whole geolog- ical series as high as the Triassic. In formations of a later age, dyke rocks are not so common. Rhyolites and true Andesites are rare as products of recent volcanic action in Australia.

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Floka. To understand the distribution of plants in Australia, one must always bear in mind that the central valleys and plateaux are surrounded by physical conditions totally different from those pre- vailing on the coastal plains, and that the northern part of the continent has been invaded by a number of plants characteristically Melanesian. This element was introduced vii Torres Strait, and spread down the Queensland coast, and also round the gulf of Carpentaria, but has never been able to obtain a hold in the more arid interior. Judging by the plants alone, and to a great extent by the animals, nobody could tell, when in a Queensland coast- jungle, whether he were in Australia or New Guinea. Travellers often describe the wonderful wealth of plant life in the eastern coast-line, but this must not be taken as indicating the nature of the flora inland in the same latitude. In the interior there is little change in the general aspect of the vegetation, from the Australian Bight to . the region of Carpentaria when the exotic element begins. Behmd the luxuriant

jungles of the Queensland coast, once over the Main Range, we find the purely Australian flora with its apparent sameness and sombre dulness. Physical surroundings rather than latitude determine the character of the flora. The contour lines showing the heights above sea-level are the directions along which species spread to form zones. Putting aside the exotic vegetation of the north and east coast-line, the Australian bush gains its peculiar character from the prevalence of the so-called gum-trees (Eucalyptus) and the acacias, of which last there are 300 species. But the euoalypts above all are everywhere. Stunted eucalypts fringe the tree limit on Mount Kosciusko, and the soakages in the parched interior, which pass on maps for rivers, are indicated by a line of the same trees, stunted and straggling. Over the vast continent from Wilson's Promontory to Cape York, north, south, east, and west — ^where anything can grow — %here will be found a gum-tree. The eucalypts, so typical of the Australian bush, are remarkable for the oil secreted in their leaves, and the large quantity of astringent resin of their bark. This resinous exudation (Kino) somewhat resembles gum, hence the name "gum" tree. It will not dissolve in water as gums do, but it is soluble in alcohol, as resin usually is. Many of the gum- trees throw off their bark, so that it hangs in long dry strips from the trunk and branches, a feature familiar in "bush" pictures. The bark, resin, and "oils" of the eucalyptus are well known as commercial products. As early as 1866, tannic acid, gallic acid, wood spirit, acetic acid, essential oil and euoalyptol, were pro- duced from various species of eucalyptus. The genus eucalyptus numbers more than one hundred and fifty species, and provides some of the most durable timbers known. The iron-bark of the eastern uplands is well known (Eucalyptus sideroxylon), and is so called from the hardness of the wood, the bark not being remarkable except for its rugged and blackened aspect. Samples of this timber have been studied after forty-three years' immersion in sea water. Portions most liable to destruction, those parts between the tide marks, were found perfectly sound, and showed not the slightest sign of the ravages of marine organisms. The well-known Jarrah (Eucalyptus marginata) of West Australia is one of the most durable of timbers ; 14,000 square miles of country are covered with this species. This tree has been known to grow to 10 feet in diameter and 120 feet in height. The timber is nearly impervious to the atftacks of the teredo. There is good evidence to show that, exposed to wear and weather, or

placed under the soil, or used as submarine piles, the wood remained intact after nearly fifty years' trial. The following figures show the high density of Australian timber: —

Australian

Specific

Australian

Specific

Timber.

Gravity.

Timber.

Gravity

Jarrah . ,

. 1-12

Tallow wood .

. 1-23

White iron-bark

. 1-17

Mahogany

. 1-20

Red iron-bark .

. 1-22

Grey gum

. -917

Forest oak

. 1-21

Red gum

. -995

European

Specific Gravity.

European

Specific

Timber.

Timber.

Gravity

Ash .

. -753

Ebony .

. 1-19

Beech

. -690

British oak .

. -99

Chestnut .

. -535

Various “scrubs” characterize the interior, differing very widely from the coastal scrubs. “Mallee” scrub occupies large tracts in South Australia and Victoria, covering probably an extent of 16,000 square miles. The mallee is a species of euca- lyptus growing 12 to 14 feet high. The tree breaks into thin stems close to the ground, and these branch again and again, the leaves being developed umbrella-fashion on the outer branches. The mallee scrub appears like a forest of dried osier, growing so close that it is not always easy to ride through it. Hardly a leaf is visible to the height of one’s head ; but above, a crown of thick leather^ike leaves shuts out the sunlight. The ground below is

perfectly bare, and there is no water. Nothing could add to the sterility and the monotony of these mallee scrubs. ‘ ‘ Mulga ‘ ‘ scrub is a somewhat similar thicket, covering large areas. The tree in this instance is one of the acacias, a genus distributed through all parts of the continent. Some species have rather elegant blossoms, known to the settlers as ” wattle.” They serve admirably to break the sombre and monotonous aspect of the Australian vegetation. Two species of acacia are remarkable for the delicate and violet-like perfume of their wood — ^myall and yarran. Proteaceous plants, although not exclusively Australian, are exceedingly characteristic of Australian scenery, and are counted amongst the oldest flowering plants of the world. The order is easily distinguished by the hard, dry, woody texture of the leaves and the dehiscent fruits. They are found in New Zealand and also in New Caledonia, their greatest developments being on the south-west of the Australian continent. Proteacese are found also in Tierra del Fuego and ChUe. They are also abundant in South Africa, where the order forms the most conspicuous feature of vegetation. The range in species is very limited, no one being common to eastern and western Australia. The chief genera are banksia (honeysuckle), and hakea (needle hush).

The well-known Moreton Bay pine (Araucaria Qunninghamii) is reckoned amongst the giants X)f the forest. The genus is associated with one long extinct in Europe. Moreton Bay pine is chiefly known by the utility of its wood. Another species, A. BidwilUi, or the bunya-bunya, afforded food in its nut-like seeds to the aborigines. A most remarkable form of vegetation in the north- west is the gouty-stemmed tree, one of the Malvaceae. It is related closely to the famous baobab of tropical Africa. The "grass-tree" (Xanthorrhvea) of the uplands and coast regions, is peculiarly Australian in its aspect. It is seen as a clump of wire- like leaves, a few feet in diameter, surrounding a stem, hardly thicker than a walking-stick, rising to the height of ten or twelve feet. This terminates in a long spike thickly studded with white blossoms. The grass-tree gives as distinct a character to an Australian picture as the agave and cactus do to the Mexican landscape. With these might be associated the gigantic lily of Queensland (Nymphosa gigantea) , the leaves of which float on water, and are quite eighteen inches across. There is also a gigantic lily (Doryanthes excelsa) which grows to a height of 15 feet, ^he " flame tree " is a most conspicuous feature of an lUawarra land- scape, the largest racemes of crimson red suggesting the name. The waratah or native tulip, the magnificent flowering head of which, with the kangaroo, is symbolic of the country, is one of the Proteacese. The natives were accustomed to suck its tubular flowers for the honey they contained. The "nardoo" seed, on which the aborigines sometimes contrived to exist, is a creeping plant, growing plentifully in swamps and shallow pools, and belongs to the natural order of Marsiliacese. The spore-cases remain after the plant is dried up and withered. These are collected by the natives, and are known over most of the continent as nardoo.

No speculation or hypothesis has been propounded to account satisfactorily for the origin of the Australian flora. As a step towards such hypothesis it has been noted that the Antarctic, the South African, and the Australian floras have many types in common. There is also to a limited extent a European element present. One thing is certain, that we have in Australia a flora that is a remnant of a vegetation once widely distributed. Heer has described such Australian genera as Banksia, Eucalyptus, Grevileea, and Hakea from the Miocene of Switzerland. Another point agreed upon is that the Australian flora is one of vast antiquity. We have

here genera so far removed from every living genus that many connecting links must have become extinct. The region extending round the south-western extremity of the continent has a peculiarly characteristic assemblage of typical Australian forms, notably a great abundance of the Proteacese. This flora, isolated by arid country from the rest of the continent, has evidently derived its plant life from an outside source, probably from lands no longer existing.

Fauna. More than a hundred marsupials, or about two-thirds of the known species, are natives of Australia. The kangaroo (Macropus), emblematic of the island continent, lives in droves in the open grassy plains of the interior. Several smaller forms of the same general appearance are known as wallabys, and are common every- where. Other terrestrial marsupials are the wombat (Phascolomys) , a large clumsy burrowing animal, not unlike a pig, which attains a weight of from 60 to 100 R) ; the bandicoot (Perameles), a rat-like creature whose depredations annoy the agriculturist ; the native cat (Dasyurus), noted robber of the poultry yard ; the Tasma^ian wolf (Thylacinus) , which preys on large game ; and the recently- discovered Notoryctes, a small animal which burrows like a mole in the desert of the interior. Arboreal species include the well-known opossums (Fhalanger); the extraordinary tree-kangaroo of the Queensland tropics ; the flying-squirrel, which expands a membrane between the legs and arms, and by its aid makes long sailing

jumps from tree to tree; and the native bear (^Phascolardus), an animal with no affinities to the bear, and having a long soft fur and no tail. More lowly organized than the foregoing are the two monotremes, the Platypus, and Echidna or native porcupine ; the former is fajous for seeming ” half bird, half beast,” and is much sought after for its exquisite fur. The dugong lives in the shel- tered inlets of the Queensland coast, and is

systematically hunted for its oil by natives and whites. Three kinds of seals occur upon the south coast.

The mammals of Australia are with a few exceptions marsu- pials ; that is, they difier profoundly in' structure from all other mammals and are lower in the scale of organization. The mar- supials of Australia have been isolated from the rest of the world from a period antedating the appearance of higher mammals in other lands. By this isolation they are spared those contests with stronger mammals which resulted in the extermination of the marsupials of other continents, with the exception of the opossums of America. We notice, however, a wonderful development of "groups," parallel with the development of the higher mammals in other lands : —

Flacentals of Europe.

1. Rodents.

2. Camivora.

S. Insect-eaters. 4. Hdofed beasts.

Marsupials of Australia.

1. Wombat and allies.

2. Native "cats."

3. Bandicoots.

4. Kangaroos.

5. Sloths and ant-eaters. 5. Native " bear " and echidna.

6. Mole. 6. Marsupial mole.

The geographical limits of the marsupials are very interesting. The opossums of America are marsupials, though not showing anomalies as great as kangaroos and bandicoots (in their feet), and myrmecobius (in

the number of teeth) . Except the opossums, no single living marsupial is known outside the Australian zoologi- cal region. The forms of life characteristic of India and the Malay peninsula come down to the island of Bali. Bali is separated from Lombok by a strait not more than 15 miles wide. Yet this narrow belt of water is the boundary line between the Australasian and the Indian regions. The zoological boundary passing through the Bali Strait is called " Wallace's line," after the eminent naturalist who was its discoverer. He showed that not only as regards beasts, but also as regards birds, these regions are thus sharply limited. Australia, he pointed out, has no woodpeckers and no pheasants, which are widely-spread Indian birds. Instead of these it has mould-making turkeys, honey-suckers, cockatoos, and brush-tongned lories, all of which are found nowhere else in the world.

The Myrmecobius of Western Australia is a bushy-tailed ant- eater about the size of a squirrel, and from its lineage and structure of more than passing interest. It is, Mivart remarks, a survival of a very ancient state of things indeed. It had ancestors in a flour- ishing condition during the Secondary epoch. Its congeners even then lived in England, as is proved by the fact that their relics have been found in the Stonesfleld oolitic rooks, the deposition of which is separated from that which gave rise to the Paris Tertiary strata by an abyss of past time which we cannot venture to express even in tiiousands of years.

Australia is rich in snakes, and has more than a hundred differ- ent kinds. Most of these are venomous, but aU are not equally dreaded. Five rather common species are certainly deadly — the death adder, the brown, the black, the superb, and the tiger snakes. During the colder months these reptiles remain in a torpid state. No certain cure has been or is. likely to be discovered for their poison, but in less serious cases strychnine has been used with ad- vantage. In tropical waters a sea snake is found, which, though very poisonous, rarely bites. Among the inoffensive species are counted the graceful green "tree snake," which pursues frogs, birds, and lizards to the topmost branches of the forest ; also, sev- eral species of pythons, the commonest of which is known as the carpet snake. These great reptiles may attain a length of 10 feet ; they feed on small animals, which they crush to death in their folds. In the

estuaries of the Northern Queensland rivers croco- diles abound. Some aged examples reach a length of 25 feet, and such are most dangerous. A small and inoffensive species is found near Port Darwin. Lizards occur in great profusion and variety. A monitor is popularly known as the "goanna," a name derived from iguana, an entirely different animal. The " frilled lizard " is a most remarkable creature. When brought to bay it stands erect on its hind-legs, extends an umbrella-like frill around its neck, and at the same time opens wide its jaws. The horned lizard of Western Australia (Moloch horridus) is reputed the ugUest of esstmg ani- mals, being covered all over with sharp spines, which give_ it a vicious and repulsive appearance ; really, however, it is most inof- fensive. Frogs of many kinds are plentiful, the brilliant green frogs being especially conspicuous and noisy.

Two other creatures may be ranked with myrmecobius, as of more than passing interest to the naturalist. The "mud-flsh" of

Queensland (Ceratodus Porsteri) belongs to an ancient order of fishes — the Dipnoi, only a few species of which have survived from past geological periods. The Dipnoi show a distinct transition between fishes and amphibia. For many years only two species were known to science ; Lepidosiren paradoxa of South America and Lepidosiren (Protopterus) annectens of Africa. Ee- cently, however, the Australian mud-flsh has been referred to the Dipnoi, — ^for it was seen that it was provided with a gill-like breathing apparatus, and also true lungs. The blood circulation is in a sense intermediate between that of frogs and fishes. The heart has one ventricle and two auricles. So far the mud-flsh is known only from the Mary and the Burnett rivers. Hardly of less scientiflo in- terest is the Port Jackson shark {Meterodontus). It is a harmless helmeted ground-shark, living on molluscs, and almost the sole survivor of a feenus abundant in the Secondary rocks of Europe. One of its remarkable characteristics is the pavement of crushing teeth with which the mouth is Uned. The beautiful Trigonia shell, so plentiful in Sydney harbour, is another genus originally believed to be extinct. The first descriptions were published from fossil forms. It was a welcome discovery to find Trigonia still surviving in Australian seas. There are only about five species living

to-day, and even these are not plentiful. In the Secondary period, however, they must have been extremely abundant ; they swarmed in Oolitic seas.

Another link connecting the present fauna of Australia with that of Secondary Europe has recently been discovered. For a consid- erable time a peculiar group of herrings {Diplomystus), character- ized by a row of scutes on the back, resembling those found in other types on the opposite aspect of the body, have been known from Cretaceous and early Tertiary rocks, their range including Brazil, Wyoming, and the Isle of Wight. Until recently these herrings were considered to be extinct, but they have now been found alive in certain rivers of New South Wales.

The origin of the fauna and flora of Australia has of late attracted considerable attention. Much accumulated evidence, biological and geological, has pointed to a southern extension of India, an eastern extension of South Africa, and a western extension of Aus- tralia into the Indian Ocean. The comparative richness of pro- taceous plants in Western Australia and South Africa flrst sug- gested a common source for these primitive types. Dr H. O. Forbes drew attention to a certain community amongst birds and other vertebrates, invertebrates, and amongst plants, on all the lands stretching towards the South Pole. A theory was therefore propounded that these known types were all derived from a conti- nent which has been named Antarctica. The supposed continent extended across the South Pole, practically joining Australia and South America. Just as we have evidence of a former mild climate in the Arctic regions, so a similar mild climate has been postulated for Antarctica. Modem ngituralists consider that many of the problems of Australia's remarkable fauna and flora can be best explained by the following hypothesis : — ^The region now covered by the Antarctic ice-cap was in early Tertiary times favoured by a mild climate ; here lay an Antarctic continent or archipelago. From an area corresponding to what is now South America there entered a fauna and flora, which, after uijdergoing modification, passed by way of Tasmania to Australia. These im- migrants then developed, with some exceptions, into the present Australian flora and fauna. This theory in the course of a decade has advanced from the position of a disparaged heresy to accept- ance by leading thinkers. The discovery as fossil, in South America, of primitive

or ancestral forms of marsupials has given it much support. One of these, Prothylacinus, is regarded as the forerunner of the' marsupial wolf of Tasmania. An interesting link between divergent marsupial families, still living in Ecuador, the Ownolestes, is another discovery of recent years. On the Aus- tralian side the fact that Tasmania is richest in marsupial types indicates the gate by which they entered. It is not to be supposed that this Antarctic element, to which Professor Tate has applied the name JSuronotian, entered a desert barren of all life. Pre- vious to its arrival Australia doubtless possessed considerable vege- tation and a scanty fauna, chiefly invertebrate. At a comparatively recent date Australia received its third and newest constituent. The islands of Torres Strait have been shown to be the denuded remnant of a former extension of Cape York peninsula in North Queensland. Previous to the existence of the strait, and across its site, there poured into Australia a wealth of Papuan forms. Along the Pacific slope of the Queensland Cordillera these found in soil and climate a congenial home. Among the plants the wild ba- nana, pepper, orange, and mangosteen, rhododendron, epiphytic orchids, and the palm ; among mammals the bats and rats ; among birds the cassowary and rifle birds ; and among reptiles the croco- dile and tree snakes, characterize this element. The numerous facts, geological, geographical, and biological, which, when linked together, lend great support to this theory, have been well worked out in Australia by Mr Charles Hedley of the Australian Museum, Sydney.

[statistics

Statistics.^ Climate. — The tropic of Capricorn divides Australia into two parts. Of these the northern or inter-tropical portion contains 1,145,000 square miles, comprising half of Queensland, the Northern Territory of South Australia, and the north-western divisions of West Australia. The whole of New South Wales, Victoria, and South Aus- tralia proper, half of Queensland, and more than half of West Australia, comprising 1,801,700 square miles, are without the tropics. In^a region so extensive very great varieties of climate are naturally to be expected, but it may be stated as a

general law that the climate of Aus- tralia is milder than that of corresponding lands in the Northern Hemisphere. During July, which is the cold- est month in southern latitudes, one half of Australia has a mean temperature ranging from 46° to 61° and the other half from 62° to 80°. The following are the areas subject to the various average temperatures during the month referred to : — '

Temperature Fahr.

Area in Square Miles.

45°-50° 18,800

50°-55° 596,300

55°-60° 681,800

60°-66° 834,400

65°-70° 515,000

70°-75° 275,900

75°-80° 24,500

The temperature in December ranges from 60° to above 95° Fahr., half of Australia having a mean temperature below 84°. Dividing the land into zones of average summer temperature, the following are the areas which would fall to each : —

Temperature Area Id

Falir. Square Miles.

60°-65° 67,800

65°-70° 63,700

70°-75° 352,300

75°-80° 439,200

80°-85° ...;.. 733,600

85°-90° 570,600

90°-95° 584,100

95° and over' 135,400

Judging from the figures just given, it must be conceded that a considerable area of the continent is not adapted for colonization by European races. The region with a mean summer temperature in excess of 96° Fahr. is the interior of the Northern Territory of South Australia north of the 20th parallel ; and the whole of the country, excepting the seaboard, lying between the meridians of 120° and 140°, and north of the 25th parallel, has a mean temperature in excess of 90° Fahr.

Kecent observations confirm the earlier opinions as to the dryness of the Australian (Aimate, and it may be taken that nearly 40 per cent, of the area of the con- tinent has not a greater annual rainfall than 10 inches. This dry area is shaped like a flattened oval lying between the 117th and 142nd meridian east and the parallels of 21° and 32° south. Very little of Queensland and New South Wales and no part of Victoria lie within this area. The following table shows the rainfall zones in square miles: —

Rainfall.

Rainfall Areas in Square Miles.

Under 10 inches 1,219,600

10 to 20 20 to 30 30 to 40 40 to 50 50 to 60 60 to 70 Over 70

Total

843,100

399,900

225,700

140,300

47,900

66,100

14,100

2,946,700

1 These statistics refei only to the continental states of the Federa- tion, not to Tasmania.

Population. — The Australian people are mainly of British origin, only 5 per cent, of the population of Euro- pean descent being of non-British race. It is certain that the aborigines are very much less numerous than when the country was first colonized, but their present numbers can be given for only a few of the states. At the census of 1891, 38,879 aborigines were enumerated, of whom 8280 were in New South Wales, 665 in Victoria, 23,789 in South Australia, and 6245 in West Australia. It has been asserted by the Queensland authorities that there are 70,000 aborigines in that state ; but this is a crude estimate, and may be far wide of the truth. In South Australia and the Northern Territory a large number are outside the bounds of settlenient, and it is probable that they are as numerous there as in Queensland. The census of West Australia included only those aborigines in the employment of the colonists; and as a large part of this, the greatest^ of the Australian states, is as yet unexplored, it may be presumed that the aborigines enumerated were very far short of the whole number of persons of that race in the state. Taking all things into consideration, the aboriginal population of the continent may be set down at something like 200,000. The Chinese number about 36,000, and are chiefly found in New South Wales and Queensland ; South Sea Islanders and other coloured races number probably about 16,000, and are to be found principally in Queensland. On the 1st January 1900 the population of Australia was 3,535,430, but this figure is exclusive of aborigines living outside the boundaries of settlement. The

increase of population since 1870 was as follows :— 1870, 1,549,706; 1880, 2,130,686; 1890, 3,013,790. The expansion has been due mainly to the natural increase ; that is, by reason of excess of births over deaths. Immigration to Australia has not been on a large scale since the first gold dis- coveries. The distance from Europe and the cost of the passage tend to prevent the flow of population, but added to this there has been lately a disinclination on the part of the Australian Governments, except those of Queens- land and West Australia, to encourage immigration, and provide for the welfare of the immigrants on their arrival. During the last ten years the inflow of popu- lation has not averaged more than four or five thousand a year, and in 1899 there was an actual excess of emi- grants to the number of 6189. The natural increase of population is about Mi- per thousand, a ratio very little higher than in Great Britain, where the excess of births over deaths is about 12 per thousand, and far below the average obtaining in these states a few years ago. In 1899 the births numbered 95,964 and the deaths 45,426, showing a ratio per thousand equal to 27-26 and 12-90 respectively. In 1891 the births numbered 105,215 and the deaths 45,187, giving the ratios of 34-42 and 14-78 per thousand respectively. There has been a very great falling-off in the proportion of births to marriages, to such an extent indeed that the rate of Aiistralia, which was formerly very high, has now dropped to the European level. This change has taken place since 1884. On the other hand there has been an improvement in the death-rates. The marriages in 1899 numbered 24,811, which gives a proportion of 7-05 per thousand inhabitants. This ratio is below the normal, and may be expected to be increased to about 7-50 per thousand, which was about the average for the years 1886 to 1890. The decline in the Australian marriage-rate was largely due to the bank failures which occurred in 1893, and from which the states have made a very slow recovery. . ■

Australia contains only four cities whose population ex- ceeds 100,000, and fifteen with over 10,000. The principal cities and towns are Sydney (pop. 489,000), Newcastle,

aborigines]

AUSTRALIA

Broken Hill, Parramatta, Goulbum, Maitland, Bathurst, Grafton, Albury, and Orange in New South Wales; Melbourne (pop. 494,000), Ballarat, Bendigo»Geelong, Warrnambool, Castlemaine, and Stawell in Victoria; Brisbane (pop. 120,000), Eockhampton, Maryborough, Townsville, Gympie, Ipswich, and Toowoomba in Queens- land ; Adelaide (pop. about 162,000, including Port Ade- laide) in South Australia; Perth (pop. 44,000) and Fre- mantle in West Australia.

Aborigines.

The aborigines of Australia are a single race throughout the whole continent. They are far removed in character from any other peoples, and have evidently been isolated from the rest of the human race from prehistoric times. Although their physical and mental characters stamp them as one, it is generally accepted now that the race is a blend of two or three different elements, intro- duced into Australia probably when the continent was still con- nected by dry land with New Guinea. If the aboriginal races be divided, as they conveniently may, into three classes, class A would be characterized as follows: — Hunters and fishers who dig for tubers, build crude canoes, have implements of rude design, have no fixed abode and no buildings. Class B would comprise hunters of a higher class, having finer-finished weapons, showing skill in carving, dressing neatly, and having habitations. Class C would include a higher grade, namely, those with fixed habitations, some rude method of agriculture, and some form of government. The Australian aborigines undoubtedly belong to the first or lowest class. They are typical hunters, ” in this respect unapproached by the Canadian trapper, the South African bushman, or any other people, savage or civilized.” Although in physical appearance the natives vary considerably, still they are clearly diflerentiated from any other race. The colour of the skin ranges from dusky copper to black. Muscle is usually not well developed”, the legs in particu- lar being notably destitute of calves. The physique of the aborig- ines of the central and more arid portions of the continent is not, as might be expected, up to that of the favoured tribes living on the coast or coastal uplands. Except in the arid interior the Australian black-fellow averages

5 feet 6 inches in height, while savages stand- ing 6 feet are not uncommon. There is usually an abundance of hair on the face and breast ; but towards the northern portions of the continent it has been noted that the aboriginal has a less luxuri- ant beard. The hair of the head is raven black and wavy ; this is somewhat modified where Papuan influence has been felt, the hair then being quite curly and frizzly. The peculiarities about the aboriginal's head are very marked. The skull is abnormally thick and the cerebral capacity small. The head is long and somewhat narrow, and the forehead recedes in a marked degree. He has usually excellent teeth, and the hands and feet are not strikingly large. The black-fellow's carriage is graceful and erect ; he walto vrith the head well thrown back, and his senses are always on the alert. His powers in tracking, stalking his prey, and hurling his spear are proverbial. His implements, offensive and defensive, have been well described by standard a^ithors, but little or no light has been thrown on the origin of that wonderful weapon, the boomer- ang. Some writers have taken the trouble to show that the boomerang was in use ages ago in Africa and in India ; but if we define the boomerang as an instrument which when projected into the air returns to its thrower, it may be safely said that we have no proof that any other race ever knew of such an implement. The boomerang that returns to the thrower is rarely if ever used for fighting purposes. The stone implements of the aborigines may be said to be crude in the extreme. But any good collection of their implements will show—(1) fiakes ; (2) knives, in many varieties ; (3) spear-heads ; (4) chisels ; (5) scrapers ; (6) needles or awls ; (7) hammers ; (8) anvils ; and (9) grinding stones. Tomahawks showing a high finish are sometimes found, but they were evidently rare. There is nothing specially distinctive about the stone imple- ments to distinguish them from those of other primitive peoples.

Closer study has not improved on previous estimates as to the paradoxical moral code of the aborigines. A wife will be beaten without mercy for unfaithfulness to her husband; but the same wife will have had to submit to the first-night promiscuity, a widespread revel which Roth shows is a regular custom in North-west Central Queensland. A husband claims his wife as his absolute property, but he has no scruple in handing her over for a time to another man. There is no proof that anything like community of women or unlimited promiscuity exists anywhere. It would

be wrong, however, to conclude that moral considerations have led up to this state of things. Of sexual morality, in the everyday sense of the word, there is none. Although not invariably cannibals, the ab- original relishes human flesh. In his treatment of women the aboriginal may be ranked lower than even the Fuegians. Early in

life the young girls are subjected to horrible mutilation (introcislon), which is in some obscure way associated with quite a different operation, "the terrible rite " or male introcislon, to which young men are subjected. The operation may be said to be confined to the tribes of Central and North-central Australia. The Tasmanians knew nothing of the rite, or of circumcision, and they are believed to represent the original stock that spread over the continent, and, being the most isolated, advanced but little.

The following description by Mr W. A. Horn will apply with little modification to the black-fellow over the whole continent : — "The Central Australian aboriginal is the living representative of a stone age, who still fashions his spear-heads and knives from fiint or sandstone, and performs the most daring surgical operations with them. His origin and history are lost in the gloomy mists of the past. He has no written records and few oral traditions. In appearance he is a naked, hirsute savage, with a type of features occasionally pronouncedly Jewish. He is by nature light-hearted, merry and prone to laughter, a splendid mimic, supple-jointed, with an unerring hand that works in perfect unison with the eye, which is as keen as that of an eagle. He has never been known to wash. He has no private ownership of land, except as regards that which is not over-oarefully concealed about his person. He cultivates nothing, and lives entirely on the spoils of the chase ; and although the thermometer frequently ranges from 15° to over 90° F. in twenty-four hflurs, and his country is by no means devoid of furred game, he makes no use of the skins for clothing, but goes about during the day and sleeps in the open at night per- fectly nude. He builds no permanent habitation and usually camps where night or fatigue overtakes him. He can travel from point to point for hundreds of miles through the pathless bush with unerring precision, and track an animal over rocks and stones, where a European eye would be unable to dis- tinguish a mark. He is a keen observer, and

knows the habits and changes of form of every variety of animal or vegetable in his country. Religious belief he has none, but is excessively super- stitious, living in constant dread of an Evil Spirit which is supposed to lurk around his camp at night. ‘ He has no gratitude except that of the anticipatory order, and is as treacherous as Judas. He has no traditions, and yet continues to practise with scrupulous exact- ness a number of hideous customs and ceremonies which have been handed down from his fathers, and of the origin or reason of which he knows nothing. Ofttimes kind and even affectionate to those of his children who have been permitted to live, he yet practises, without any reason except that his father did so before him, the most cruel and revolting mutilations upon the young’ men and maidens of his tribe.”

Every traveller on the Queensland coast must have noticed that, directly a boat puts off for the shore, smoke signals ascend from point to point as far as the eye can reach. It is now ascertained that information of a varied character can be conveyed over long distances by smoke signals. For the purpose of signalling, the Queensland blacks use a complicated system based on the following signals : — (1) The slender column of light-coloured smoke ; (2) a heavy column of smoke ; (3) a slender column of black smoke ; (4) interrupted or intermittent columns of smoke ; (5) groups or columns of smoke columns. Much attention has been given to the instrument known as ” bullroarer,” as being one of the few instru- ments used by the Australian aboriginal and far-distant primitive peoples. A flat piece of wood is attached at one end to a string and rapidly whirled in sling fashion. Vibrations are set up result- ing in a roar, which has an extraordinary effect upon the hearer. Women and children are never allowed to see the instrument ; and when in the absolute stillness of the forest the buzzing of the roar rises and falls, people unable to account for such weird sounds are awed beyond measure. Mr A. W. Howitt, writing on the subject, remarks: “The universality of its use, and under the same con- ditions, in world-wide localities, is one of the most puzzling ques- tions in this branch of anthropology, and can only, as it seems to me, point to its extreme antiquity.”

The most cursory observer of the aboriginal will notice that he makes no visible acknowledgment of a Supreme Being. He has no altar and no form

of sacrifice. The fear of any future punish- ment or the hope of any future reward is neither a deterrent nor an incentive. If he has a religion, it is something completely apart from morals. There is no evidence to show that a black-fellow is guided or influenced in any action by the knowledge of a Supreme Power to whom he is responsible.

The route by which the blacks arrived in Australia has not yet been placed beyond question. If the Tasmanians be accepted as the nearest approach to the primitive type, then we have a race that had neither a boomerang nor a shield. Their whole belong- ings consisted of stone tomahawks and a few crude spears. If this represents the stage to which primitive man had reached when the blacks first peopled Australia, then their coming must be placed far back in the early history of mankind. That they have been iso- lated for long ages may be taken for granted. They have derived

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little or nothing from the present races to the north of Torres Strait. Certainly the blacks of North Australia seem somewhat in advance of the aborigines generally. But no clear connexion exists either in language, or manners, or customs with Malays or Papuans. The sunny and playful disposition of the aboriginal points to Papuan rather than Malay blood, but the probability is that the natives were in possession, long before the present distribution of Papuan and Malay. The blacks on parts of the north coast use an outrigger to their canoes — an idea evidently introduced from be- yond Torres Strait. The bow and arrow are not known among the aborigines of Australia. The question arises as to whether they were ever acquainted with their use. Had they ever known such weapons, it is hardly likely that the knowledge of them could ever have been lost. Depending, as the Australian black-fellow did, on the chase, nothing could be better fitted for his wants. The ab- sence of these implements points conclusively to the fact that the ancestors of these people reached Australia before the bow and arrow became what they are now, implements in use by almost all races. It is not necessary that the

first-comers should have been skilful navigators. Possibly there was land connexion between Australia and New Guinea in post-Tertiary times, by means of which the aborigines made their way.

The study of the languages of the various tribes has so 'far yielded nothing of exceptional importance. As an instance of how a spoken tongue may vary in a short time the following is of inter- est : — In 1893 a wild tribe of natives was discovered in the Went- worth district of New South Wales. This tribe originated through a black-fellow hiding In some little-known country with a few gins for some thirty years. In that time the tribe had grown to thirty — men, women, and children. The country they were concealed in is known as mallee scrub, the most wretched kind of land known in the state. The tribe lived as only black-fellows can on kan- garoo, wild cat, and ant eggs. They used water bags made from the skins of kangaroo legs. They produced fire in the old way by rub- bing two sticks together, and their only weapons were spears, which were merely stems of mallee, roughly pointed and barbed. The remarkable fact is that the 'Station blacks had considerable difficulty in making the wild tribe understand them, although thirty years before they must have spoken the same language.

For purposes of comparison the aboriginal character, habits, and customs may be summed up as follows : —

Moral, Mental, and Social. — No moral code. A clear idea of individual ownership in property. A wife is held ais property. No idea of a Supreme Being. Unable to grasp abstract ideas. No idols, no altar, and no form of sacrifice. No form of prayer or supplication. Not in any way guided in their actions by the hope of future reward or future punishment. No written language. Build no houses. No pottery. No weaving. No idea of moral justice. No art, save the making of some plaited bags. Very fearful of unseen dangers and in constant dread of witchcraft. No ownership in land, but the tribes have a well-understood limit to their hunting-grounds. Beached only to thei "binary stage" in counting. Have a gesture speech, more or less perfected in various tribes, and often a complete code of smoke signals. In all that concerns hunting and the chase, their senses are far keener than those of civilized man.

Customs, &c. — Circumcision practised over most of the continent. The rite of male and female introclsion practised in a horrible man- ner by many tribes. Some tribes force the young women to submit to promiscuity after the operation, but this is a thing quite apart from "communal marriage" or general promiscuity. Mutual avoidance of mother-in-law and son-in-law. A complicated mar- riage relationship. No marriage ceremony. A wife is procured by purchase, as a gift from her parents, or occasionally by forcible abduction. Polygamy is recognized. Infanticide practised. Can- nibalism common. Typical hunters, but do not use the bow and arrow. Most tribes have a chief or head man, but his office is not hereditary, neither is a chief elected.

Implements, &c. — Stone chisels, hammers, and tomahawks. Barbed speara. The boomerang. A throwing stick for spears. Various clubs, and fighting boomerangs not made to return to the thrower. Make crude canoes and plait twine nets, bags, and armlets.

It is right to add that the black-fellow, when unspoiled by aggression and bad treatment, is docile, capable of kindness, and even of great affection. But even here he is inconstant. The early explorers found them an inoffensive people ; and even at the date of writing the tribes who practise the dreadful mutilations referred to are seldom hostile, and, when their womenfolk are not taken from them, they are disposed to be friendly.

Religion. — There is no state diurcli in Australia, nor is the teaching of religion in any way subsidized by the state. The Church of England claims as adherents 39 per eent. of the population, and the Eoman Catholic

Church 22 per cent. ; next in numerical strepgth are the Wesleyans and other Methodists, numbering 12 per cent., the varidtis branches of the Presbyterians 11 per cent., Congregationalists 2 per cent., and Baptists 2 per cent. At the beginning of the year 1900 it was estimated that there were in Australia 1,374,000 adherents of the Church of England, 783,000 Roman Catholics, 385,000 Presby- terians, 79,000 Congregationalists, and 81,000 Baptists.

Instruction. — Education is' very widely distributed, and in every state it is compulsory for children of school ages to attend school. The statutory ages differ in the various states :^in New South Wales and West Australia it is from 6 to 13 years, in Victoria 6 to 12 years, in Queensland 6 to 11 years, and in South Australia 7 to 12 years inclu- sive. Religious instruction is not imparted by the state- paid teachers in any state, though in certain states persons, duly authorized by the religious organizations, are allowed to give religious instruction to children of their own denomination where the parents' consent has been obtained. According to the returns for 1899 there were 6357 state schools, with 1-3,462 teachers and 585,556 pupils, iand the average attendance of scholars was 411,331. Besides state schools there were 2454 private schools, with 7778 teachers and 140,285 scholars, the average number of scholars in attendance being 109,389. The census of 1891 showed that about 76 per cent, of the whole population and more than 88 per cent, of the popu- lation over five years of age could read and write. There was, therefore, a residue of 12 per cent, of " illiterates," most of whom were not born in Australia. The marriage registers furnish another test of education. In 1899 only thirteen persons in every thousand married were unable to sign their names, thus proving that the number of illiterate adults of Australian birth is very small.

Puhlia Finance. — The public revenues and expenditures of the various Governments for the year ending June 1900 were:—

Kevenue. New South "Wales . . £9,973,736

"Victoria . Queensland South Australia West Australia

7,450,676 4,588,207 2,853,329 2,875,396

Expenditure.

£9,811,402

7,318,945 4,540,418 2,936,619 2,615,675

The chief sources of revenue are customs taxation, rail- ways, postal receipts, &c., and public lands. There are direct taxes on land and incomes in New South Wales, Victoria, and South Australia. .The siuns obtained dur- ing 1900 from the various sources named were : —

Customs and Excise Other Taxation Kailways, &c. Postal and Telegraphs Public Lands . Other sources .

£7,180,907

2,320,076

10,440,347 2,148,335 3,430,641 2,221,038

The expenditure may be grouped as follows :-

Railways and Working Expenses Postal and Telegraphs Public Instruction . Interest and Charges on Debts All other services

£6,397,686

2,095,810

1,760,207

7,274,923

^,694,433

The public debt of the states on 30th June 1900 was £186,813,712, thus distributed:—

New South Wales Victoria . Queensland South Australia West Australia

£66,332,993

49,324,885 34,349,414 26,131,780 11,674,640

About 80 per cent, of the whole public debt has been incurred for the purpose of constructing public works yielding a direct revenue ; but the proportion varies in each state, and the details of the debt will be found under

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the head of each particular state. The area of Australia is 2,946,691 square miles, or 1,885,882,240 acres ; of this area the states have sold or otherwise parted with nearly 107,000,000 acres, and have under lease 779,000,000 acres. The bulk of the best land has been sold, the area neither leased nor sold, which amounts to about 1,000,000,000 acres, being chiefly in West and South Australia, and for the most part outside the region of regular rainfall.

Defence. — Practically there is no standing army in Australia, as the total number of paid soldiers is only 1571. This small permanent force is supported by a partially- paid force of 14,066, and an unpaid or strictly volunteer force of 6063 men. There are in each state, besides the land forces, small corps of naval volunteers capable of being employed as light artillery land forces or upon the local war vessels. Although the regular military force of the states is very small, Australasia (including New Zealand) was able to despatch 8300 troops for service in South Africa, and of these 6310 belonged to Australia proper. The naval defence of Australia is entrusted to the Imperial Navy, and Sydney, the headquarters of the fleet, ranks as a first-class station.

Fisheries. — The only deep-sea fisheries liow carried on to any extent in Australia are the pearl fisheries in Queensland and West Australia. At one time whaling was an important industry on the coasts of New South Wales and Tasmania, and afterwards on the Western Australian coasts. The industry gravitated to New Zealand, and finally died out, chiefly through the wasteful practice of killing the calves to secure the capture of the mothers. Of late years whaling has again attracted attention, and a

small number of vessels prosecute the industry during the season. The diving for pearl shell is actively carried on in Torres Strait, and has become an im- portant industry, giving employment to nearly 2000 men, and the take in 1899 was 1200 tons of shell, valued at £130,105. Besides shell some b§che-de-mer and tortoise- shell is obtained. The pearl shell industry of West Australia is chiefly carried on along the north-west coast and in Shark Bay, but the production now shows a large falling-off owing to the exhaustion of the inshore banks. The value of pearls and pearl shell raised in 1899 amounted to £96,000, the banks at Shark Bay yielding only £3824, compared with £16,043 in 1890.

Timber Industi-y. — The timber industry is prosecuted on a large scale in West Australia and New South Wales, especially in the first-named state, where very extensive forests of splendid hardwoods exist. In 1899 the value of timber exported was — from West Australia £553,198, and New South Wales £102,218, the com- bined exports of the other three states only reaching £17,000. These figures do not indicate the whole value of the industry, especially in New South Wales, where a larger quantity is consumed locally than is exported.

Gfrazing and Agriculture. — The continent is essentially a pastoral one, and in 1899 depastured 72,625,000 sheep, 9,678,000 cattle, 1,639,000 horses, besides large numbers of swine ; the figures show a great falling-off from previous years, for in 1891 there were 104,800,000 sheep and 10,860,000 cattle depastured. The butter industry is making great progress, and there were, in 1899, 1,102,000 head of dairy cattle, and the butter made was little short of 100,680,000 ft. Next to the pastoral industry agricul- ture is the principal source of Australian wealth. In 1900 the area devoted to tillage was 8,441,000 acres, namely, wheat, 5,550,000 acres; maize, 336,000 acres; oats, 325,000 acres; other grains, 121,000 acres ; hay, 1,464,000 acres; potatoes, 112,000 acres; sugar-cane, 133,000 acres; vines, 61,000 acres ; and other crops, 349,000 acres. The chief wheat lands are in Victoria, South Australia, and

New South Wales ; the yield averages about 9 bushels to « the acre, and is lowest in South Australia. Maize and sugar-cane are grown in New South Wales and Queensland. The vine is cultivated in all the states, but chiefly

in South Australia, Victoria, and New South Wales. Australia produces abundant quantities and nearly all varieties of fruits ; but the kinds exported are chiefly oranges, pine- apples, bananas, and apples. Tobacco thrives well in New South Wales and Victoria, but kinds suitable for exportation are not largely grown. Compared with the principal countries of the world, Australia does not take a high position in regard to the gross value of the produce of its tillage, but in value per inhabitant it compares fairly well; indeed, some of the states show averages which surpass those of many of the leading agricultural countries. For 1900 the total value of agricultural produce estimated at the place of production was £17,000,000 sterling, or about £4, 16s. 7d. per inhabitant.

Mineral Production. — Australia is one of the great gold producers of the world, and its yield in 1899 was about £14,334,000 sterling, and the total value of its mineral production was approximately £19,663,000. Gold is found throughout Australia, and the present prosperity of the states is largely due to the discoveries of this metal, the development of other industries being, in a country of varied resources, a natural sequence to the acquisition of mineral treasure. !From the date of its first discovery, up to the close of 1899, gold to the value of £368,160,000 sterling had been obtained in Australia. Victoria, in a period of forty -eight years, contributed about £254,000,000 to this total, and is still a large producer, its annual yield being about 736,000 oz., 29,000 men being engaged in the search for the precious metal. Queensland's annual output is 705,000 oz. ; the number of men engaged in gold-mining is 10,000. In New South Wales the greatest production was in 1852, soon aftfer the first discovery of the precious metal, when the output was valued at £2,660,946; the production in 1899 was about 496,000 oz., valued at £1,752,000. UntU recently West Australia was considered to be destitute of mineral de-posits of any value, but it is now known that a rich belt of mineral country extends from north to south. The first important discovery was made in 1882, when gold was found in the Kimberley district; but it was not until a few years later that this rich and extensive area was developed. In 1887 gold was found in Yilgarn, about 200 miles east of Perth. This was the first of the many rich discoveries in the same district which have made West Australia the chief gold-producfer of the Australian group. At the present time there are eighteen goldfields in the state, and it is estimated

that over 20,000 miners are actively engaged in the search for gold. In 1899 the production amounted to 1,644,000 oz., as compared with 30,310 oz. in 1891. Of all the Australian states South Australia has produced the smallest quantity of gold, the total out- put from the commencement of mining operatiotis being valued at little more than £2,213,000 sterling. The following table gives the value of gold raised from the commencement of mining to the close of the year 1899: —

state.

New South Wales Victoria Queensland . Soutli Australia . West Australia .

Value Produced.

£47,646,000

254,157,000

47,338,000

2,213,000

16,906,000

The production of gold, which had been declining steadily for many years, reached the lowest point in 1886. Since then there has been a marked revival. The production of gold in each state in 1899 is given below : — '

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state.

New South Wales Victoria Queensland . South Australia . West Australia .

■*Weight. Oz.*

496,196

854,500

946,894

23,123

1,643,877

Value of Gold.

£1,761,815

3,418,000

2,838,119

79,041

6,246,733

The f oUowing shows the number of miners at -work :

state.

New South Wales Victoria .

Queensland South Australia West Australia

Minors Employed.

. 19,300 . 30,100 . 9,800 . 2,000 . 21,000

The greatest development of quartz reefing is found in Victoria, some of the mines being of great depth. There are seven mines in the Bendigo district over 3000 feet deep, and fourteen over 2500 feet deep. In Lansell's

180 Mine a depth of 3352 feet has been reached, and in Lazarus Mine 3424 feet. In the Ballarat district a depth of 2520 feet has been reached in the South Star Mine. •

Silver has been discovered in all the states, either alone or in the form of sulphides, antimonial and arsenical ores, chloride, bromide, iodide, and ohloro-bromide of silver, and argentiferous lead ores, the largest deposits of the metal being found in the last-mentioned form. The leading silver mines ate in New South Wales, the returns from the other states being comparatively insignificant. The fields of New South Wales have proved to be of immense value, the yield of silver during 1899 being £2,070,400, and the total output to the end of the year named £28,000,000. The Broken Hill field, which was discovered in 1883, extends over 2500 square miles of country, and has developed into one of the principal mining centres of the world. It is situated beyond the river Darling, and close to the boundary between New South Wales and South Australia. The lodes occur in Silurian meta- morphio micaceous schists, intruded by granite, porphyry, and diorite, and traversed by numerous quartz reefs, some of which are gold-bearing. The Broken Hill lode is the largest yet discovered. It varies in width from 10 feet to 200 feet, and .may be traced for several miles. Although indications of silver abound in all the other states, no fields of great importance have yet been discovered. Up to the end of 1899 Australia has produced silver to the value of £29,559,000, of which nearly £28,000,000 was obtamed from the fields of New South Wales.

Copper is known to exist in all the states, and has been mined extensively in South Australia, and on a much smaller scale in New South Wales and Queensland. The low quotations which have ruled for a number of years have had a depressing effect upon the industry, and many mines once profitably worked have now been closed. The discovery of .copper had a marked effect on the fortunes of South Australia at a time when the yoimg colony was surrounded by difficulties. The first important mine, the Kapunda, was opened up in 1842. It is estimated that at one time 2000 tons were produced annually, but the mine was closed in 1879. In 1845 the celebrated Burra Burra Mine was discovered. This mine proved to be very rich, and paid £800,000 in dividends to the origi- nal owners. For a

number of years, however, the mine has been suffered to remain untouched, as the deposits originally worked were found to be depleted. For many years the average output was from 10,000 to 13,000 tons of ore, yielding from 22 to 23 per cent, of copper. For the period of thirty years during which the mine was worked the production of ore amounted to 234,648 tons, equal to 51,622 tons of copper, valued at £4,749,924. The Wal- laroo and Moonta mines, discovered in 1860 and 1861, proved to be even more valuable than the Burra Burra, the Moonta mines employing at one time upwards of 1600 hands. The dividends paid t)y these mines amounted to about £1,750,000 sterling. The satisfactory price obtained during recent years has enabled re- newed attention to be paid to copper mining in South Australia, and the production of the metal in 1899 was valued at £406,000. The copper mining industry in New South Wales reached its highest point in 1883, when the production was valued at £472,982. The principal deposits of copper are found in the central part of the state between the Maoquarie, Darling, and Bogan rivers. Deposits have also been found in the New England and Southern districts, as well as at Broken Hill, showing that the mineral is widely distributed throughout the state. The more important mines are those of Cobar, where the Great Cobar Mine produced, in 1899, 3794 tons of refined copper, valued at £266,580. In Northern Queensland copper is found throughout the Cloncurry district, in the upper basin of the Star river, and the Herberton district. The returns from the copper fields in the state are at pr&ent small, owing' to the lack of suitable fuel for smelting pur-

poses, which renders the economic treatment 6t the ore difficult ; the development of the mines is also greatly retarded by the want of easy and cheaper communication with the coast. In West Australia copper deposits have been worked for some years. Very rich lodes of the metal have been found in the Northampton, Mur- chison, and Champion Bay districts, and also in the country to the south of these districts on the Irwin river. As in the other copper-producing states, there has been a revival of the industry in West Australia, the production in 1899 being valued at £36,000. The total value of copper produced in Australia up to the end of 1899 was £29,402,000 sterling, £21,936,000 having been obtoined in South Australia, £5,019,000 in New South Wales, and over £2,032,000 in Queensland.

Tin was known to exist in Australia from the first years of coloni- zation. The wealth of Queensland and the Northern Territory of South Australia in this mineral, according to the reports of Dr Jack, late Government geologist of the former state, and the late Rev. J. E. Tenison-Woods, appears to be very great. The most impor- tant tin mines in Queensland are in the Herberton district, south- west of Cairns ; at Cooktown, on the Annan and Bloomfleld rivers ; and at Stanthorpe, on the border of New South Wales. Herberton and Stanthorpe have produced more than three-fourths of the total production of the state. During the past few years the production has greatly decreased in consequence of the low price of the metal, but in 1899 a stimulus was given to the industry, and the produc- tion was valued at £77,000. In New South Wales lode tin occurs principally in the granite and stream tin under the basaltic country in the extreme north of the state, at Tenterfleld, Emmaville, Tingha, and in other districts of New England. The metal has also been discovered in the Barrier Eanges, and many other places. The value of the output in 1899 was set down at £90,000. The yield of tin in Victoria is very small, and until lately no fields of impor- tance have been discovered ; but towards the latter end of 1890 extensive deposits were reported to exist in the Gippsland district — at Omeo and Tarwin. In South Australia tin mining is unim- portant. In West Australia the production from the tin fields at Greenbushes was valued in 1899 at £25,000. The value of tin produced in Austifalia is about £100,000 per annum, and the total production to the end of 1899 was valued at £11,743,000, of which £6,383,000 was obtained in New South Wales and £4,526,000 in Queensland.

Iron is distributed throughout Australia, but for want of capital for developing the fields this industry has not progressed. In New South Wales there are, together with coal and limestone in unlim- ited supply, important deposits of rich iron ores suitable for smelting purposes ; and for the manufacture of steel of certain descriptions abundance of manganese, chrome, and tungsten ores are available. The most extensive fields are in the Mittagong, Wallerawang, and Bylstone districts, which are roughly estimated to contain in the aggregate 12,944,000 tons of ore, containing 6,853,000 tons of metallic iron. Magnetite, or magnetic iron, the richest of all iron ores, is found in abundance near Wallerawang in New South Wales. The proximity of coal-beds now being worked should

accelerate the development of the iron deposits, which, on an average, contain 41 per cent, of metal. Magnetite occurs in great abundance in West Australia, together with haematite, which would be of enormous value if cheap labour were available. Goethite, limonite, and hsematite are found in New South Wales, at the junction of the Hawkesbury sandstone formation and the Wianamatta shale, near Nattai, and are enhanced in their value by their proximity to coal- beds. Near. Lithgow extensive deposits of limonite, or clay-band ore, are interbedded with coal. Some samples of ore, coal, and limestone, obtained in the Mittagong district, with pig-iron and castings manufactured therefrom, were exhibited at the Mining i Exhibition in London and obtained a first award.

Antimony is widely diffused throughout Australia, and is some- times found associated with gold. In New South Wales the prin- cipal centre of this industry is HUlgrove, near Armidale, where the Eleanora Mine, one of the richest in the state, is situated. The ore is also worked for gold. In Victoria the production of antimony gave employment in 1890 to 238 miners, but owing to the low price of the metal, production has almost ceased. In Queensland the fields were all showing development in 1891, when the output exhibited a very large increase compared with that of former years ; but, as in the case of Victoria, the production of the metal seems to have ceased. Good lodes of stibnite (sulphide of antimony) have been found near Eoebourae, in West Australia, but no attempt has yet been made to work them.

Bismuth is known to exist in all the Australian states, but up to the present time it has been mined for only in three states, viz.. New South Wales, Queensland, and South Australia. It is usually found in association with tin and other minerals. The principal mine in New South Wales is situated at Kingsgate, in the New England district, where the mineral is generally associated with inolybdenum and gold.

Manganese probably exists in all the states, deposits having

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been found in New South Wales, "Victoria, Queensland, and West Australia, the richest specimens being founij in New South Wales. liittle,' however, has been done to utilize the deposits, the demands of the colonial markets being extremely limited. The ore generally occurs in the form of oxides, manganite, and pyrolusite, and contains a high percentage of sesquioxide of manganese.

Platinum and the allied compound metal Iridosmine have been found in New South Wales, but so far in inconsiderable quantities. Iridosmine occurs commonly with gold or tin in alluvial drifts.

The noble metal TeUurium has been discovered in New South Wales at Bingara an.d other parts of the northern districts, as well as at Tarana, on the western line, though at present in such minute quantities as would not repay the cost of working. At many of the mines at Kalgoorlie, West Australia, large quantities of ores of telluride of gold have been found in the lode formations.

Lead is found in all the Australian states, but is worked only

when associated with silver. In West Australia the lead occurs in the form of sulphides and carbonates of great richness, but the quantity of silver mixed with it is very small. The lodes are most frequently of great size, containing huge masses of galena, and so little gangue that the ore can very easily be dressed to 83 or 84 per cent. The association of this metal with silver in the Broken Hill mines of New South Wales adds very greatly to the value of the product. Up to the end of 1899 the quantity of lead in the ores raised is estimated to have been 623,000 tons.

Mercury is found in New South Wales and Queensland. In New South Wales, in the form of cinnabar, it has been discovered on the Cudgegong river, near Eylstone, and, it also occurs at Bingara, Solferino, Yulgilbar, and Cooma. In the last-named place the assays of ore yielded 22 per cent, of mercury.

Titanium, of the varieties known as octahedrite and brookite, is found in alluvial deposits in New South Wales, in conjunction with diamonds.

Wolfram (tungstate of iron and manganese) occurs in some of

ISO- .

MO IianfellS'W. of lao' Or. 125'*

Sketch Map or the Mining Fields op Austkalia.

*SUuTfitna Gw^yJiJ&fiiM°^fl^^*

the states, notably in New South Wales, Victoria, and Queens- land. ScheeUte, another variety of tungsten, is also found m Queensland. Molybdenum, in the form of molybdenite (sulphide of molybdenum), is found in New South Wales and Victoria, associated in the former state with tin and bismuth m quartz

Zinc ores, in the several varieties of carbonates, siUcates, oxide, sulphide, and sulphate of zmc, have been found in several of the Australian states, but have attracted little attention.

*Nickel, so abundant in the island of New Caledoma, has up to the present been found in none of the Australian states except Queensland. Few attempts, however, have been made to prospect systematically for this valuable mineral. . , ~ _^*

Cobalt occurs in New South Wales and Victoria, and efforts have been made in the former state to treat the ore, the nietal havme a high commercial value ; but the market is small, andno attei^t has yet been made to produce it on any large Male. The manganese ores of the Bathurst district of New South Wales often contlin a smaU percentage of cobalt, sufficient, indeed, to warrant further attempt! to work them. In New South Wales chromium is found in the northern portion of the state, m the Clarence and Tamworth districts, and also near Gundagai. It is i^ually associated with serpentine. In the Gundagai district the mdustry

was rapidly becoming a valuable one, but the low price of chrome has greatly restricted the output. In 1899 the production was valued at £17,000.

Arsenic, in its well-known and beautiful forms, orpiment and realgar, is found in New South Wales and Victoria. It usually occurs in association with other minerals in veins.

The Australian states have been boimtifully suppUed with mineral fuel. Five distinct varieties of black coal, of weU- characterized types, may be distinguished, and these, with the two extremes of brown coal or lignite and anthracite, form a perfectly continuous series. Brown coal, or lignite, occurs principally in Victoria. Attempts have frequently been made to use the mineral for ordinary fuel purposes, but its inferior quality has prevented its general use. Black coal forms one of the principal resources of New South Wales ; and in the other states the deposits of this valuable mineral are being rapidly developed. Coal of a very fair description was discovered in the basin of the Irwin river, in West Australia, as far back as the year 1846. It has been ascertained from recent explorations that the area of carboniferous formation in that state extends from the Irwin northwards to the Gascoyne river, about 300 miles, and probably all the way to the Kimberley district. The most important discovery of coal in the state, so f a,r, is that made in the bed of

the Collie river, near Bunbury, to the south of Perth. The coal has been treated and found to be of good quality, and there are grounds for supposing that there are 250,000,000 tons in the field. Dr Jack, late Government geologist of Queensland, considers the extent of the coal-fields of that state to be practically unlimited, and is of opinion that the Carboniferous formations extend to a considerable distance under the

Great Western Plains. It is roughly estimated that the Coal Measures at present practically es^ilored extend over an area of about 24,000 square miles. Coal- mining is an established industry in Queensland, and is progressing satisfactorily. The mines, however, are situated too far from the coast to permit of serious competition vfith Newcastle in an export trade, and the output is practically restricted to supplying local requirements. New South Wales still exports coal to Queensland. The production of the state is about 400,000 tons a year, three- fourths of which is obtained in the Ipswich district. The coal- fields of New South Wales are situated in three distinct regions — the northern, southern, and western districts. The first of these comprises chiefly the mines of the Hunter river districts; the second includes the lUawarra district, and, generally, the coastal regions to the south of Sydney, together with Berrima, on the table-land ; and the third consists of the mountainous regions on the Great Western Railway, and extends as far as Dubbo. The total area of the Carboniferous strata of New South Wales is estimated at 23,950 square miles. The seams vary in thickness. One of the richest has been found at Greta in the Hunter river district; it contains an average thickness of 41 feet of clean coal, and the quantity underlying each acre' of ground has been com- puted to be 63,700 tons. The coal mines in New South Wales give employment to 10,340 persons, of whom 6220 are employed underground and 2120 above ground, and the annual production is about 4,700,000 tons. Black coal has been discovered in Victoria, and about 250,000 tons are now being raised. The principal collieries in the state are the Outtrim Howitt, the Coal Creek Proprietary, and the Jumbunna. In South Australia, at liBigh's Creek, north of Port Augusta, coal-beds have been dis- covered. The quantity of coal extracted annually in Australia has now reached 5,250,000 tons, the estimated production ol each state up to the end of 1899 being as follows : —

Tons.

New South Wales 86,000,000

Victoria 1,500,000

Queensland 5,700,000

This industry gave direct employment in and about the mines to the foUowitg numbers of persons in the several states : —

Miners.

New South Wales 10,340

Victoria 900

Queensland 1,100

Kerosene shale (torbanite) is found in several parts of New South Wales. It is a species of cannel coal, somewhat similar to the Boghead mineral of Scotland, but yielding a much larger percentage of volatile hydro-carbon than the Scottish mineral. The richest qtiality yields about 100 to 130 gallons of crude oil per ton, or 17,000 to 18,000 cubic feet of gas, with an illuminating power of 35 to 40 sperm candles, when gas only is extracted from the shale. From the year 1865, when the mines were first opened, to the end of 1899, the quantity of kerosene shale raised has amounted to 996,000 tons, valued at £1,908,000.

Large deposits of alum occur close to the village of BuUadelah, 30 miles from Port Stephens, New South Wales. It is said to yield well, and a quantity of the manufactured alum is sent to Sydney for local consumption. Marble is found in many parts of New South Wales and South Australia. Kaolin, fire-clays, and brick-clays are common to all the states. Except in the vicinity of cities and townships, however, little use has been made of the abundant deposits of clay. Kaolin, or porcelain clay, although capable of application to commercial purposes, has not as yet been utilized to any extent, although fqjind in several places in New South Wales and in West Australia.

Asbestos has been found in New South Wales in the Gundagai, Bathurst, and Broken HiU districts— in the last-mentioned district in considerable quantities. Several specimens of very fair quality have also been met with in West Australia.

Many descriptions of gems and gem stones, have been discovered in various parts of the Australian states, but systematic search has been made principally for the diamond and the noble opal. Dia- monds are found in all the states ; but only in New South Wales have any attempts been made to work the diamond drifts. The best of the New South Wales diamonds are harder and much whiter than the South African diamonds, and are classified as on a par with the best Brazilian gems, but no large specimens have yet been found. The finest opal known is obtained in the Upper Cretaceous forma- tion at White Cliffs, near Wilcannia, New South Wales, and at these mines about 700 men find constant employment. Other pre- cious stQnes, including the sapphire, emerald, oriental emerald, ruby,

opal, amethyst, garnet, chrysolite, topaz, cairngorm, onyx, zircon, &c., have been found in the gold and tin-bearing drifts and river gravels in numerous localities throughout the states. The sapphire is found in all the states, principally in the neighbour- hood of Beechworth, Victoria. The oriental topaz has been found in New South Wales. Oriental amethysts also have been found in that state, and the ruby has been found in Queensland, as well as in New South Wales. Turquoises have been found near Wangar- atta, in Victoria, and mining operations are being carried on in that state. Chrysoberyls have been found in New South Wales ;^ spinel rubies in New South Wales and Victoria ; and white topaz in all the states. Chalcedony, carnelian, onyx, and cat's eyes are found in New South Wales ; and it is probable that they are also to be met with in the other states, particularly in Queens- land. Zircon, tourmaline, garnet, and other precious stones of little commercial value are found throughout Australia.

Commerce. — ^The shipping trade has expanded very greatly since 1871. In that year the tonnage entered in all the ports of Australia was only 1,679,700 tons; in 1899 it was upwards of 9,998,000 tons. These figures must be taken with qualification, as many of the steamers trading between Europe and Australia call at the principal ports of West Australia, South Australia, Victoria, and New South Wales, and are set down in the returns as entered at all these ports, so that the total tonnage is exaggerated ; but when every allowance is made on this score, it will be found that Australia

required nearly six times as much shipping in 1899 to carry its trade as it did in 1870. The value of goods imported into the various states in 1899 was £61,801,076; in 1891, £63,505,225; in 1881, £44,094,538; and in 1871, £26,195,760; and the ex- ports during the same period were— 1899, £74,488,792; 1891, £61,698,032; 1881, £41,111,798; 1871, £32,360,762. The im- ports in 1899 represent £17, lis. Od. and the exports £21, 3s. Id. per inhabitant. These figures, however, refer to the gross trade ; to arrive at the trade with countries outside Australia a considerable reduction will have to be made, as the value of re-exports in 1899 was approximately £18,636,000, equal to £5, 5s. lOd. per inhabit- ant; in that year the net imports amounted to £12, 5s. 2d. per inhabitant, and the net exports to £15, 17s. 3d. The bulk of the Australian trade is in British hands, about 35 per cent, of the im- ports are from Great Britain and about the same proportion of the exports are sent to that country. Australia has long been a favourite place for British investments, and under normal con- ditions the exports should exceed the imports to the extent of about £10,000,000 or £11,000,000 sterling, which is the amount of income derived from British investments in Australia ; but as the state Governments are constantly adding something to their indebtedness and capital is still being sent to Australia for investment, the excess of exports rarely equals the amount named. The principal items of export are wool, skins, tallow, frozen mutton, chilled beef, preserved meats, butter, and other articles of pastoral produce- timber, wheat, flour, and fruits ; gold, silver, lead, copper, tin, and other metals. The weight of wool exported was 458,783,000 Bb, which is less by 100,000,000 ft than the export in some previous years, the falling-off beiiig due to the effects of the dry seasons which have prevailed throughout Australia for nearly five years.

Bailways. — Almost the whole of the railway lines in Australia . are the property of the state Governments, and have been con- structed and equipped wholly by borrowed capital. There were on the 30th June 1900, 12,448 miles open for traffic, upon which £118,483,048 had been expended. The railways are of differ- ent gauges, the standard narrow gauge of 4 feet 8J inches prevailing only in New South Wales; in Victoria the gauge is 5 feet 3 inches; in South Australia 5 feet 3 inches and 3 feet 6 inches, and in the other states 3 feet 6 inches. Taking the year 1900, the gross earnings amounted to £10,094,431, the working expenses, exclusive

of interest, £6,164,402, and the net earnings £3,930,029 ; the latter figure represents 3‘3 per cent, upon the capital expended upon construction and equipment. In two of the states. New South Wales and South Australia proper, the railways yield more than the interest paid by the Government on the money borrowed for their construction ; in Victoria the return is equal to 2-8 per cent., in Queensland 2-7, New South Wales 3-6, West Australia 5”8, and South Australia proper 3‘9 per cent., but in the Northern Territory of the latter colony the working expenses have exceeded the gross earnings ever since the railways were constructed. The earnings per train mile vary greatly ; but for all the lines the average is six shillings, and the working expenses about three shillings and sixpence, making the net earnings two shillings and sixpence per train mile. The ratio of receipts from coaching traffic to total receipts is about 40 per cent., which is somewhat less than in the United Kingdom ; but the proportion varies greatly amongst the states themselves, the more densely-populated states approaching most nearly to the British standard. The tonnage of goods carried amounts to about 13,091,000 tons, or over 3-7 tons per inhabitant, which must be considered fairly large, especially as no great pro-

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portion of the tonnage consists of minerals on which there is usually a low freightage. Excluding coal lines and other lines not open to general traffic, the length of railways in private hands is only 382 miles, or about 3 per cent, of the total mileage open. Of this length, 277 miles are in West Australia. The divergence of policy of that state from that pursued by the other states was caused by the inability of the Government to construct lines, when the extension of the railway system was urgently needed in the interests of settlement. Private enterprise was therefore encouraged by liberal grants of land to undertake the work of construction ; but the changed conditions of the state have now altered the state policy, and the Government have already acquired one of the two trunk lines constructed

~~by private enter~~ prise, and it is not likely that any further concessions in regard to railway construction will be granted to private persons.

Posts and Telegraphs. — The postal and telegraphic facilities offered by the various states are very considerable. There are some 5800 post offices supported by the different Governments, or about one office to every 600 persons. The letters carried amount to about 54 per head, the newspapers to 27 per head, and the packets to 10 per head. The length of telegraph lines in use is 42,200 miles, and the length of wire about 2J times that distance. In 1899 there were about 7,745,000 telegraphic messages sent, which gives an average of two messages per inhabitant. The postal services and the telegraphs are administered by the Federal Government.

Banking. — Depositors in Savings Banks number about one-fourth of the whole population. In June 1900 the sum deposited was £27,111,360 to the credit of 851,000 persons. In the ordinary banks the amount on deposit was .£86,959,208, of which £50,562,108 bore interest. In 1871 the deposits in the Savings Banks amounted to £3,003,393 ; in 1881, £7,524,186 ; in 1891, £14,982,175 ; and in 1899, £27,111,360.

Ebcent History.

The history of Australia since 1873 is mainly comprised in its industrial progress, for, with the exception of the advent of the Labour party and the Federation Govern- ment, there have been no occurrences of such political importance as to call for special mention. The four east- ern states had the privilege of responsible government bestowed on them at various dates between 1855 and 1860. After the establishment of responsible government the main questions at issue were the secular as opposed to the religious system of public instruction, protection as opposed to a revenue tariff, vote by ballot, manhood suffrage, abolition of transportation and assignment of convicts, and free selection of lands before survey ; these, and indeed all the great questions upon which the country was divided, were settled before the' year 1873. With the disposal of these important problems, politics in Australia became a struggle for office between men whose political principles were very much alike, and the tenure of power enjoyed by the various Governments did not depend upon the principles of administration so much as upon the personal

fitness of the head of the ministry, and the acceptability of his ministry to the members of the more popular branch of the legislature. For the most part, therefore, the history of the colonies is a catalogue of their domestic events, such a thing as a foreign policy being quite unknovm. The leading politicians of all the states have felt the cramping effects of mere domestic legislation, albeit on the proper direction of such legislation depends the well-being of the people, and to this sense of the limitations of local politics is due, as much as to anything else, the movement towards federation, now happily consummated.

Taking the states as a whole, agrarian legislation has been the most important subject that has engrossed the

attention of their parliaments, and every state li^^Mioa ^^^ heen more or less engaged in tinkering with

its land laws. The main object of all such legislation is to secure the residence of the owners on the land. The object of settlers, however, in a great many, perhaps in the majority of instances, is to dispose of their

holdings as soon as possible after the requirements of the law have been complied with, and to avoid permanent settlement. This has greatly facilitated the formation of large estates devoted chiefly to grazing purposes, contrary to the policy of the legislature, which has everywhere sought to encourage tillage, or tillage joined to stock rearing, and to discourage large holdings. The importance of the land question is so great that it is hardly an exaggeration to say that it is usual for every parliament of Australia to have before it a proposal to alter or amend its land laws. Since 1870 there have been four radical changes made in New South Wales. In Victoria the law has been altered five times, and in Queensland and South Australia six times. Apart from the settlement of agrarian questions, recent Australian politics have concerned them- selves with the prevention or regulation of the influx of coloured races, the prevention or settlement of labour disputes, and federation. The agitation against the influx of Chinese commenced very soon after the gold discoveries, the European miners objecting strongly to the presence of these aliens upon the diggings. The allegations made concerning the Chinese really amounted to a charge of undue industry. The Chinese were hard-working

and had the usual fortune attending those who work hard. They spent little on drink or with the storekeepers, and were, therefore, by no means popular. As 'j^estlon. early as 1860 thete had been disturbances of a serious character, and the Chinese were chased off the goldfields of New South Wales, serious riots occurring at Lambing Flat, on the Burrangong goldfield. The Chinese difficulty, so far as the mining population was concerned, was solved by the exhaustion of the extensive alluvial deposits ; the miners' prejudice against the race, however, still exists, though they are no longer serious competitors, and the laws of some of the states forbid any Chinese to engage in mining without the express authority in writing of the Minister of Mines. The nearness of China to Australia has always appeared to the Australian democracy as a menace to the integrity of the white settlements ; and at the many conferences of representa- tives from the various states, called to discuss matters of general concern, the Chinese question has always held a prominent place, but the absence of any federal authority has made common action difficult. In 1888 the last important conference on the Chinese question was held in Sydney and attended by delegates from all the states. Previously to the meeting of the conference there had been a great deal of discussion in regard to the influx of Chinese, and such influx was on all sides agreed to be a growing danger. The conference, therefore, merely expressed the public sentiment when it resolved that, although it was not advisable to prohibit altogether this class of immigration, it was necessary in the public interests that the number of Chinese privileged to land should be so limited as to prevent the people of that race from ever becoming an important element in the commu- nity. The New South Wales parliament was considering, a Chinese Exclusion Bill when the conference of 1888 was summoned, and ultimately passed a law which in some respects went much beyond the agreement arrived at. Under the New South Wales law masters of vessels are for- bidden, under a heavy penalty, to bring to the colony more than one Chinese to every 300 tons, and a poll-tax of £100 is charged on every Chinese landing. In Victoria, Queens- land, and South Australia no poll-tax is imposed, but masters of vessels may bring only one Chinese to every 500 tons burden. West Australian legislation was until recently similar to that of the three last-named states, but has now been superseded by the Coloured Immigrants Eestriction Act. Tasmania allows one Chinese passenger to every 100 tons, and imposes a poll-tax of £10. These

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stringent regulations have had the effect of greatly re- stricting the influx of Chinese, but in Spite of all pre- cautions there is still some immigration. The only other alien race present in large numbers in Australia are the Polynesians in Queensland, where they number about 9000. Of late years there has been an influx of Hindoos and other Eastern races, sufficiently large to cause a feeling of uneasiness amongst the colonists ; and in some of the states the evil has been dealt with by parliament, and restrictive legislation has been passed which meted out to these immigrants somewhat similar treatment to that accorded to the Chinese. But a very large proportion of the Asiatics, whose entrance into the colonies it was desired to stop, were British subjects, and the Imperial Government refused to sanction any measure directly pro- hibiting in plain terms the movement of British subjects from one part of the empire to another. Eventually, the diffixjulty was overcome by the application of an educational test to the coloured races seeking admission to the states, ■whereby they are required to write out in some European language an application for permission to enter the colony in which they propose to reside. This provision is taken from an Act in operation in Natal, which is said to have been effectual in preventing an undue influx of Asiatics. An Act applying the educational test has been in force in West Australia since the beginning of 1898; more recently a similar Act was passed in New South Wales, while the other states have analogous legislation in opera- tion. The agitation which this restrictive legislation caused was promoted and kept alive almost entirely by the trades unions, and was the first legislative triumph of the Labour party, albeit that party was not at the time directly represented in parliament.

The Labour movement in Australia may be traced back to the early days when transportation was in vogue, and the free immigrant and the time- expired convict movement ol^jected to the Competition of the bond la- bourer. The great object of these early strug- gles being attained, Labour directed its attention mainly to securing shorter hours. It was aided very

materially by the dearth of workers consequent on the gold dis- coveries, when every man could command his own price. When the excitement consequent on the gold finds had subsided, there was a considerable reaction against the claims of Labour, and this was greatly helped by the congested state of the labour market ; but the principle of an eight-hours day made progress, and was conceded in several trades. In the early years of the 'seventies the colonies entered upon an era of well-being, and for about twelve years every man, willing to work and' capable of exerting himself, readily found employment. The Labour unions were able to secure in these years many concessions both as to hours and wages. In 1873 there was an im- portant rise in wages, in the following year there was a further advance, and another in 1876 ; but in 1877 wages fell back a little, though not below the rate of 1874. In 1882 there was a very important advance in wages; carpenters received lis. a day, bricklayers 12s. 6d., stone- masons lis. 6d., plasterers 12s., painters lis., black- smiths 10s., and navvies and general labourers 8s., and work was very plentiful. For five years these high wages ruled ; but in 1886 there was a sharp fall, though wages still remained very good. In 1888 there was an advance, and again in 1889. In 1890 matters were on the eve of a great change and wages fell, in most cases to a point 20 per cent, below the rates of 1885. In 1893 came the bank crisis and great restriction in trade. Almost the first effect of this restriction was a reduction in wages, which touched their lowest in 1895, and fell to a point belq,w that of amy year since 1860. Since then there has

been a marked recovery, and wages stood in 1900 at about the same level as in 1873. During the whole period from 1873 onwards, prices, other than of labour, have been steadily tending downwards, so that the cost of living in 1900 was much below that of 1873. Taking everything into consideration the reduction was, perhaps, not less than 40 per cent., so that though the nominal or money wages in 1873 and 1900 were the same, the actual wages were much higher in the latter year. Much of the improvement in the lot of the wage-earners has been due to the Labour organizations, yet so late as 1881 these organizations were of so little account, politically, that when the law relating to trades unions was passed in New South Wales, the English law was followed, and it was simply enacted that the purposes of any trades union shaU not be deemed

unlawful (so as to render a member liable to criminal prosecution for conspiracy or otherwise) merely by reason that they are in restraint of trade. After the year 1884 Labour troubles became very frequent, the New South Wales coal miners in particular being at war with the colliery owners during the greater part of the six years intervening between then and what is called the Great Strike. The strong downward tendency of prices made a reductidm of wages imperative; but the labouring classes failed to recognize any such necessity, and strongly resented any reductions proposed by em- ployers. It was hard indeed for a carter drawing coal to a gasworks to recognize the necessity which compelled a reduction in his wages because wool had fallen 20 per cent. Nor were other labourers, more nearly connected with the producing interests, satisfied with a reduction of wages because produce had fallen in price all round. Up to 1889 wages held their ground, although work had become more difficult to obtain, and some in- dustries were being carried on without any V^.P'^ profit. It was at such an inopportune time jggg^ that the most extensive combination of Labour yet brought into action against capital formulated its demands. It is possible that the London dockers' strike was not vrithout its influence on the minds of the Australian Labour leaders. That strike had been liberally helped by the, Australian unions, and it was confidently predicted that, as the Australian workers were more effectively organized than the English unions, a corre- sponding success would result from their course of action. A strike of the Newcastle miners, after lasting twenty-nine weeks, came to an end in January 1890, and throughout the rest of the year there was great unrest in Labour circles. On 6th September the silver mines closed down, and a week later a conference of employers issued a manifesto which was met next day by a counter-manifesto of the Intercolonial Labour Conference, and almost immediately afterwards by the calling out of 40,000 men. The time chosen for the strike was the height of the wool season, when a cessation of work would be attended with the maximum of inconvenience. Sydney was the centre of the disturbance, and the city was in a state of industrial siege, feeling running to dangerous extremes. Eiotous scenes occurred both in Sydney and on the coal-fields, and a large number of special constables were sworn in by the Government. Towards the end of - October 20,000 shearers were called out, and many other trades, principally concerned with the handling or shipping of wool, joined the

ranks of the strikers, with the result that the maritime and pastoral industries throughout' the whole of Australia were most injuriously disturbed. The Great Strike, as it was called, terminated early in November 1890, the employers gaining a decisive victory. The colonies were, however, to have other and bitter experiences of strikes before Labour recognized that of

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all means for settling industrial disputes strikes are, on the whole, the most disastrous that it can adopt. The strikes of the years 1890 and 1892 are just as important on account of their political consequences as from the direct gains or losses involTed.

As one result of the strike of 1890 a movement was set afoot by a number of enthusiasts, more Tisionary than

practical, that has resulted in a measure of more mis'‘ ° ®® disaster. This was the planting of a colony qaences. °^ communistic Australians in South America.

After much negotiation the leader, Mr William Lane, a Brisbane journalist, decided on Paraguay, and he tramped across the continent, preaching a new crusade, and gathering in funds and recruits in his progress. On the 16th of July 1893 the first little army of "New Australians " left Sydney in the Eoyal Tar, which arrived at Monte Video on the 31st of August. Other consign- ments of intending settlers in "Kew Australia" followed; but thotigh the settlement is still in existence it has com- pletely faUed to realize the impracticable ideals of its original members. The Queensland Government has as- sisted some of the disillusioned to escape from the para- dise which has proved a prison; some managed to get away on their own account ; and those that have remained have split into as many settlements almost as there are settlers. Another effect of the Great Strike was in a more practical direction. New

South Wales was the first country which endeavoured to settle its labour grievances through the ballot-box and to send a great party to par- liament as the direct representation of Labour, pledged to obtain through legislation what it was unable to obtain by strikes and physical force. The principle of one-man one-vote had been persistently advocated without arous- ing any special parliamentary or public enthusiasm until the meeting of the Federal Convention in 1891. The convention was attended by Sir George Grey, who was publicly welcomed to the colony by New Zealanders resident in Sydney, and by other admirers, and his reception was an absolute ovation. He eloquently and persistently advocated the principle of one-man one-vote as the bed-rock of all democratic reform. This subse- quently formed the first plank of the Labour platform. Several attempts had been made by individuals belonging

*to the Labour party to enter the New South Newr Wales parliament, but it was not until 1891 that Wa^. *^® occurrence of a general election gave the*

party the looked-for opportunity for concerted action. The results of the election came as a complete surprise to the majority of the community. The Labour party captured 35 seats out of a House of 125 members ; and as the old parties almost equally divided the remain- ing seats, and a fusion was impossible, the Labour repre- sentatives dominated the situation. It was not long, however, before the party itself became divided on the fiscal question ; and a Protectionist Government coming into power, about half the Labour members gave it con- sistent support and enabled it to maintain office for about three years, the party as a political unit being thus destroyed. The events of these three years taught the Labour leaders that a parliamentary party was of little practical influence unless it was able to cast on all im- portant occasions a solid vote, and to meet the case a new method was devised. The party therefore determined that they would refuse to support any person standing in the Labour interests who refused to pledge himself to vote on all occasions in such way as the majority of the party might decide to be expedient. This was called the " solidarity pledge," and, united under its sanction, what was left of the Labour party contested the general election of 1894. The result was a defeat, their numbers

being reduced from 35 to 19 ; but a signal triumph was won for solidarity. Very few of the members who re- fused to take the pledge were returned, and the adherents of the united party were able to accomplish more with their reduced number than under the old conditions.

The two features of the Labour party in New South Wales are its detachment from other parties and the control of the caucus. The caucus, which is the natural corollary of the detachment, determines by majority the vote of the whole of the members of the party, independence of action being allowed on minor questions only. So far the party has refrained from formal alliance with the other great parties of the state. It supports the Government as the power alone capable of promoting legislation, but its support is given only so long as the measures of the Government are con- sistent with the Labour policy. This position the Labour party has been able to maintain with great success, owing to the circum- stance that the other parties have been almost equally balanced.

The movement towards forming a parliamentary Labour party was not confined to New South Wales ; on the con- trary, it was common to all the colonies except West Australia, and its greatest triumphs have ^^ygg_ been achieved ,ia New Zealand and South Aus- tralia. Like the organization in New South Wales, the Labour party of South Australia owes its origin to the failure of the Great Strike of 1890. In that year the Trades and Labour Council of Adelaide summoned a conference of Labour representatives, at which a proposal for the formation of a parliamentary party was drawn up and adopted. The political programme of the new party was comprehensive and popular, and almost immediately on its adoption three representatives of Labour won seats in the Second Chamber (Legislative Council), and at the ensuing general election of 1893 the party secured 8 seats in the assembly out of a total of 54, and 6 out of 24 in the council, thereby gaining a controlling vote in both Houses. Two general elections have since taken place, and at each the party has maintained its position. In 1900 it controlled 12 votes in the popular House and 8 in the council. The members of the South Australian Labour party differ in one important respect from those of New South Wales. They are all persons who have worked for their living at manual labour, and this quali- fication of being an actual worker is

one that was strongly insisted upon at the formation of the party and strictly adhered to, although the temptation to break away from it and to accept as candidates persons of superior educa- tion and position has been very great. The South Aus- tralian Labour party has maintained the imity of. its ranks, notwithstandmg the fact that several of its mem- bers hold very diverse views on important questions of political reform, and it recently showed its power by dis- placing the Government of the Eight Honourable C. C. Kingston, and almost immediately afterwards ousting that of Mr V. L. Solomon, who succeeded Mr Kingston in the premiership. In Victoria the Labour party has not been so conspicuous as in New South Wales and South Australia. The members of the Victorian Assem- bly are not divided into such distinct parties as are the members of the popular houses of the other colonies, and the Labour party has therefore not been able to deter- mine the real balance of power. Nevertheless it wields an influence that is very much respected, as is evidenced by the large amount of advanced democratic legislation which has been proposed by the various governments that have held office since 1890, even by governments with strong Conservative leanings. In Queensland the Labour party numbered, in 1900, 21 out of 72 members in the elective branch of parliament, a larger proportion than in any other state ; but only for a brief period have parties been so evenly divided as to give the Labour party the balance of power.

The brief period mentioned was towards the close of 1899, when dissatisfaction had spread amongst the supporters of the Govern- ment of Mr Dickson. That Government was displaced on a motion moved by the leader of the Labour party, Mr Dawson, supported by the Opposition and by a number of members usually voting with the Government. Mr Dawson was called on to form a Government. He did so, and his ministry held ofBce for only two days, giving place to a government including all the leading members of the previous administration, as well as the leader of the former Opposition.

Australian Federation. — ^The question of federation ■was not lost sight of by the framers of the original constitution which was bestowed upon Nevr South Wales. In the report of the committee of the Legislative Council appointed in 1852 to prepare a constitution for that colony, the following passage occurs : — " One of the most prominent legislative measures required by the colony, and the colonies of the Australian group generally, is the establishment at once of a General Assembly, to make laws in relation to those intercolonial questions that have arisen or may hereafter arise among them. The questions which would claim the exercise of such a jurisdiction appear to be (1) intercolonial tariffs and the coasting trade; (2) railways, roads, canals, and other such works running through any two of the colonies; (3) beacons and lighthouses on the coast; (4) intercolonial gold regulations ; (5) postage between the said colonies ; (6) a general court of appeal from the courts of such colonies ; (7) a power to legislate on all other subjects which may be submitted to them by addresses from the legisla tive councils and assemblies of the colonies, and , to' appropriate to any of the above-mentioned objects the necessary sums of money, to be raised by a percentage on the revenues of all the colonies interested." This wise recommendation received very scant attention, and it was not until the necessities of the colonies forced them to it that an attempt was made to do what the framers of the original constitution suggested. Federa- tion at no time actually dropped out of sight. History of but it was uot until thirty-five years later that movement ^.ny practical steps were taken towards its accomplishment. Meanwhile a sort of make- shift was devised, and the Imperial Parliament passed a measure permitting the formation of a Federal Council, to which any colony that felt inclined to join could send delegates. Of the seven colonies New South Wales and New Zealand stood aloof from the council, and from the beginning it was therefore shorn of a large share of the prestige that would have attached to a body speaking and acting on behalf of a united Australia. The council had also a fatal defect in its constitution. It was merely a deliberative body, having no executive functions a^d possessing no control of funds or other means to put its legislation in force. Its existence was well-nigh for- gotten by the people of Australia until the occurrence of its biennial meetings, and even then but slight interest was taken in its proceedings. The council held eight meetings, at which many matters of intercolonial interest were discussed.

The last occasion of its being called together was in 1899, when the council met in Melbourne. In 1889 an important step towards federation was taken by Sir Henry Parkes. The occasion was the report of Major-Getieral Edwards on the defences of Australia, and Sir Henry addressed the other premiers on the desir- ability of a federal union for purposes of defence. The immediate result was a conference at Parliament House, Melbourne, of representatives from eiach of the seven colonies. This conference adopted an address to the Queen expressing its loyalty and attachment, a,nd sub- mitting certain resolutions which affirmed the desirability of an early union, under the Crown, of the Australasian colonies, on principles just to all, and provided that the

remoter Australasian colonies should be entitled to admission upon terms to be afterwards agreed upon, and that steps should be taken for the appointment of dele- gates to a national Australasian convention, to consider and report upon an adequate scheme for a federal conven- tion. In accordance with the understanding arrived at, the various Australasian parliaments appointed delegates to attend a national convention to be held in Sydney, and on the 2nd March 1891 the convention held its first meeting. Sir Henry Parkes was elected president, and he moved a series of resolutions embodying the principles necessary to establish, on an enduring foundation, the structure of a federal government. These resolutions were slightly altered by the conference, and were adopted in the following form : —

1. The powers and rights of existing colonies to remain intact, except as regards such powers as it may be necessary to hand over to the Federal Government.

2. No alteration to be made in states without the consent of the legislatures of such states, as well as of the federal parliament.

3. Trade between the federated colonies to be absolutely free.

4. Power to impose customs and excise duties to be in the Federal Government and parliament.

5. Military and naval defence forces to be under one command.

6. The federal constitution to make provision to enable each state to make amendments in the constitution if necessary for the purposes of federation.

Other formal resolutions were also agreed to, and on the 31st of March Sir Samuel Griffith, as chairman of the com- mittee on constitutional machinery, brought up a draft Constitution Bill, which was carefully considered by the convention in committee of the whole and adopted On the 9th of April, when the convention was formally dissolved. The BUI, however, fell absolutely dead. Not because it was not a good Bill, but because the movement out of which it arose had not popular initiative, and therefore failed to reach the popular imagination.' Even its authors recognized the apathy of the people, and parliamentary sanction to its provisions was not sought in any colony.

Although the Bill dxavTn up by the convention of 1891 was not received by the people with any show of interest, the federation movement did not die out ; on the contrary, it had many enthusiastic advocates, especially in the colony of Victoria. In 1894 an unofficial convention was held at Corowa, at which the cause of federation was strenuously advocated, but it was not until 1895 that the movement obtained new life, by reason of the proposals adopted at a meeting of Premiers convened by Mr G. H. Eeid of New South Wales. At this meeting all the colonies except New Zealand were represented, and it was agreed that the parliament of each colony should be asked to pass a Bill enabling the people to choose ten persons to represent the colony on a federal convention ; the work of such convention being the framing of a federal constitution to be submitted to the people for approval by means of the referendum. During the year 1896 Enabling Acts were passed by New South Wales, "Victoria, Tasmania, South Australia, and West Australia, and delegates were elected by popular vote in all the colonies named except West Australia, where the delegates were chosen by par- liament. The convention met in Adelaide on the 22nd of March 1897, and, after drafting a Bill for the consideration of the various parliaments, adjourned until the 2nd September. On that date the delegates reassembled in Sydney, and debated the Bill in the light of the sugges- tions made by the legislatures of the federating colonies. In the course of the proceedings it was announced

that Queensland desired to come within the proposed union; and in view of this development, and in order to give further opportunity for the consideration of the Bill, the convention again adjourned. The third and final session

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was opened in Melbourne on the 20th of January 1898, but Queensland was still unrepresented ; and, after fur- ther consideration, the draft Bill was finally adopted on the 16th of March and remitted to the various colonies for submission to the people.

In its main provisions the bill of 1898 followed generally that of 1891, yet with some very important alterations. It proposed to establish, under the Crown, a federal union of the Aus- BUt of tralasian colonies, to be designated the Commonwealth 1898. of Australia. A federal executive council was created,

to be presided over by a governor-general appointed by the Sovereign. The legislature was to consist of two houses — a Senate, in which each colony joining the federation at its inception was conceded the lequal representation of six members ; and a House of Representatives, to consist of, as nearly as possible, twice the number of senators, to which the provinces were to send members in proportion to population, with a minimum of five rep- resentatives for each of the original federating states. The prin- ciple of payment of members was adopted for the Senate as well as the House of Representatives. The nominative principle for the upper house was rejected, both houses being elective, on a suf- frage similar to that existing in each colony for the popular chamber at the foundation of the Commonwealth. The House of Representatives was to be elected for a period of three years, the term of office of senators was twice that period, but half the Senate was to retire every three years. The capital of the Common- wealth was to be established in federal territory. To the federal authority was assigned power to deal with a large number

of mat- ters, witii the provision that in case of conflict between federal and state law the former should prevail. Customs and excise were to be taken over on the establishment of the Commonwealth, and posts and telegraphs, naval and military defence, lighthouses and lightships, beacons and buoys, and quarantine, on dates to be pro- claimed, but without farther legislation. A uniform tariff of customs and excise was to be imposed within a period of two years, intercolonial trade then becoming absolutely free. Besides these were many subsidiary provisions usually found in federal constitutions, and provisions of a special character such as were needed to meet the peculiar conditions of the Australian states.

The constitution was accepted by Victoria, South Australia, and Tasmania by popular acclamation, but in New South Wales very great opposition was shown, the main points of objection being the financial provisions, equal representation in the Senate, and the diificulty in the way of the larger states securing an amendment of the constitution in the event of a conflict with the smaller states. As far as the other colonies were con- cerned, it was evident that the BUI was safe, and public attention throughout Australia was fixed on New South Wales, where a fierce political contest was raging, which it was recognized would decide the fate of the measure for the time being. The fear was as to whether the statutory number of 80,000 votes necessary for the acceptance of the Bill would be reached. This fear proved to be well founded, for the result of the referen- dum in New South Wales showed 71,695 votes in favour of the Bill and 66,228 against it, and it was accordingly lost. In Victoria, Tasmania, and South Australia, on the other hand, the Bill was accepted by triumphant ma- jorities. West Australia did not put it to the vote, as the Enabling Act of that colony only provided for joining a federation of which New South Wales should form a part. The existence of such a strong opposition to the Bill in the mother colony convinced even its most zealous advocates that some changes would have to be made in the constitution before it could be accepted by the people ; consequently, although the general election in New South Wales, held six or seven weeks later, was fought on the federal issue, yet the opposing parties seemed to occupy somewhat the same ground, and the question nar- rowed itself down to one as to which party should be entrusted with the

negotiations to be conducted on behalf of the colony, with a view to securing a modification of the objectionable features of the Bill. The new parlia- ment decided to adopt the procedure of again sending the Premier, Mr Eeid, into conference, armed with a

series of resolutions affirming its desire to bring about the completion of federal union, but asking the other col- onies to agree to the reconsideration of the provisions which were most generally objected to in New South Wales. The other colonies interested were anxious to bring the matter to a speedy termination, and readily agreed to this course of procedure. Accord- ingly a Premiers' conference was held in Mel- Premiers' bourne at the end of January 1899, at which ^p""'*' Queensland was for the first time represented. At this conference a compromise was effected, something was conceded to the claims of New South Wales, but the main principles of the Bill remained intact. The Bill as amended was submitted to the electors of each colony and again triumphantly carried in Victoria, South Aus- tralia, and Tasmania. In New South Wales and Queens- land there were still a large number of persons opposed to the measure, which was nevertheless carried in both colonies. New South Wales having decided in favour of federation, the way was clear for a decision on the part of West Australia. The Enabling Bill passed the various stages in the parliament of that colony, and the question was then submitted by way of referendum to the elect- ors. The result of the voting (in five colonies in 1899, and in West Australia in 1900) was as follows : —*

New South Wales Victoria Queensland . South Australia West Australia (1900) Tasmania

In accordance with this verdict, the colonial draft Bill was submitted to the Imperial Government for legislation as an Imperial Act ; and six delegates were sent to Eng- land to explain the measure and to pilot it through the Cabinet and Parliament. These delegates were — Mr Barton (New South Wales), Mr Deakin (Victoria), Mr Kingston (South Australia), Mr Dickson (Queensland), Mr Parker (West Australia), and Sir PhUip Eysh (Tasmania).

Under an Act of the British Parliament, dated 9th July 1900, passed under the auspices of Mr Chamberlain, Secretary of State for the colonies, a proclamation was issued, 17th September of the same year, declaring that, on and after 1st January 1901, the people of New South Wales, Victoria, South Australia, Queensland, Tasmania, and West Australia should be Cbnunon- united in a Federal Commonwealth under the name of the Commonwealth of Australia. The Act which gave authority for the issue of this proclama- tion embodied and established (with such variations as had. been accepted on behalf of the colonies) the constitu- tion agreed to at the Premiers' conference of 1899. It was cordially welcomed in the mother country, and though its passage was marked by certain difficulties, finally became law amid signs of general approval. The difficulties arose with regard to the right of appeal to the Queen in Council. By Clause 74 of the original Bill this right was very seriously curtailed ; Mr Chamberlain wished to pre- serve it as in the case of Canada, while, in order to dis- arm colonial opposition, he suggested that the judicial committee of the Privy Council should be strengthened by the appointment of four colonial members with the rank of lords of appeal. But after privately conferring with the Australian delegates he withdrew this suggestion,

ffor . ■ \ against .

1899. . 107,420

. 82,741

ffor . ■ \ against .

. 152,653

9,804

ffor . ■ . against .

. 35,181

. 28,965

ffor . • \ against .

. 65,990

. 17,053

ffor . ■ \ against .

. 44,704

. 19,691

/for . ■ \ against .

. 13,437

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wealth Act, 1900.

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and when the second reading of the Bill came on he announced that a compromise had been agreed upon. The final form of the disputed clause provided that in cases which involved non- Australian interests the right of appeal should be fully maintained, and that in questions between the Commonwealth and a single state, or between two states, leave to appeal might be given by the High Court of Australia. Mr Chamberlain indicated that this matter might receive further development at a future time, and that it was possible that after consulting with the colonies the Government might propose the establishment of a permanent court of appeal for the whole empire. Soon after the passage of the Bill the choice of governor-general of the new Commonwealth fell upon Lord Hopetoun, who had won golden opinions as governor of Victoria a few years before ; Mr Barton, who had taken the lead among the Australian delegates, became

first Prime Minister; and the Commonwealth was successfully inaugurated at the opening of 1901.

The six colonies entering the Commonwealth were denominated original states, and new states might be admitted, or might be formed by separation from or union of two or more states or parts of states ; and territories (as distinguished from states) might be taken over and governed under the legislative power of the Common- wealth. The legislative power is vested in a federal parliament, Provision insisting of the Sovereign, a senate, and a house of of the Act representatives, the Sovereign being represented by a governor-general. The Senate was to consist of the same number of members (not less than six) for each state, the term of service being six years, but subject to an arrangement that half the number would r^ire every three years. The House of Representatives was to consist of members chosen in the different states in numbers proportioned to their population, but never fewer than five. The first House of Representatives was to contain seventy- five members. For elections to the Senate the governors of states, and for general elections of the House of Representatives the governor- general, would cause writs to be issued. The Senate would choose its own President, and the House of Representatives its Speaker ; each house would make its own rules of procedure ; in each, one- third of the number of members would form a quorum ; the mem- bers of each must take oath, or make affirmation of allegiance ; and all alike would receive an allowance of £400 a year. The legislative powers of the parliament have a wide range, many matters being transferred to it from the colonial parliaments. The more important subjects with which it deals are trade, shipping, and railways ; taxation, bounties, the borrowing of money on the credit of the Commonwealth ; the postal and telegraphic services ; defence, census, and statistics ; currency, coinage, banking, bank- ruptcy ; weights and measures ; copyright, patents, and trade marks ; marriage and divorce ; immigration and emigration ; con- ciliation and arbitration in industrial disputes. Bills imposing taxation or appropriating revenue must not originate in the Senate, and neither taxation BiUs nor Bills appropriating revenue for the annual service of the Government may be amended in the Senate, but the Senate may return such Bills to the House of Representatives with a request for their amendment. Appropriation laws

must not deal with other matters. Taxation laws must deal with only one subject of taxation ; but customs and excise duties may, respec- tively, be dealt with together. "Votes for the appropriation of the revenue shall not pass unless recommended by the governor- general. The constitution provides means for the settlement of disputes between the houses, and requires the assent of the Sovereign to all laws. The executive power is vested in the governor-general, assisted by an executive council appointed by himself. He has command of the army and navy, and appoints federal ministers and judges. The ministers are members of the executive council, and must be, or within three months of their appointment must become, members of the parliament. The judicial powers are vested in a high court and other federal courts, and the federal judges hold office for life or during good behaviour. The High Court has appellate jurisdiction in cases from other federal courts and from the supreme courts of the states, and it has original jurisdiction in matters arising under laws majde by the federal parliament, in disputes between states, or residents in different states, and in matters affecting the representatives of foreign powers. Special

provisions were made respecting appeals from the High Court to the Sovereign in council. The constitution set forth elaborate arrangements for the administration of finance and trade during the transition period following the transference of departments to the Commonwealth. Within two years uniform customs duties were to be imposed ; thereafter the parliament of the Common- wealth had exclusive power to impose customs and excise duties, or to grant bounties ; and trade within the Commonwealth was to be absolutely free. Exceptions were made permitting the states to grant bounties on mining and (with the consent of the parliament) on exports of produce or manufactures — West Australia being for a time partially exempted from the prohibition to impose import duties. The constitution, parliament, and laws of each state, subject to the federal constitution, retained their authority j state rights were carefully safeguarded, and, an inter-state commission was given powers of adjudication and of administration of the laws relating to trade, transport, and other matters. Provision was made' for necessary alteration of the constitution of the Commonwealth, but so that no alteration could be effected unless the question had been directly submitted to, and the

change accepted by, the electorate in the states. The seat of government was to be within New South Wales, not less than 100 miles distant from Sydney, and of an area not less than 100 square miles. Until other provision was made, the governor-general was to have a salary of £10,000, paid by the Commonwealth. Respecting ithe salaries of tbie governors of states, the constitution made no provision.

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United States. BUILDING. George B. Post, Mem. Am. Soc. C.E.
BULGARIA. J. D. Bourchier, M.A., Correspondent of “The

T^ITTIPS ” St” A.tll6IlS

BULL-FIGHTING. A. E. T. Watson (“Rapier “), Editor of the ” Badminton Magazine” and “Badminton Library.”

BUOY. Captain J. Whitly Dixon, R.N.

BURGON. The Rev. J. J. Lias, Chancellor of Llandaff Cathe- dral.

BURIAL AND BURIAL ACTS. G. G. Phillimore, M.A.

BURMA. Sir J. G. Scott, G.C.I.E., Deputy Commissioner for Burma.

BURMESE WAR. Captain E. Peach, Indian Staff Corps.

BURNE-JONES. Laurence Binyon, British Museum.

BURTON. Stanley Lane-Poole, Litt.D., Professor of Arabic, Trinity College, Dublin.

BYRD. W. Barclay Squire, Editor of ” Byrd’s Masses.”

CABALLERO. J. Fitzmaueice-Kelly, Author of “A History of Spanish Literature.”

CADIZ. A. E. Houghton, Correspondent of the “Standard” in Spain.

CAIRNS. E. A. Armstrong.

CAIRO. Major H. G. Lyons, R.E., Public Works Department, Egypt.

CALIBRATION, CALORIMETRY. H. L. Callendak, LL.D., F.R.S., Prdfessor of Physics, Royal College of Science, Lon- don.

CALIFORNIA. Charles F. Lummis, Editor of the ” Land of Sunshine,” Los Angeles, California.

CAMBODIA. M. de Lanessan, formerly Governor-General of French Indo-China.

CAMPANOLOGY. The Rev. T. L. Papillon, M. A., late Fellow of New College, Oxford.

CAMPOS. A. E. Houghton.

CANADA. Geography, G. M. Dawson, LL.D., F.R.S. (the late), Director-General of the Canadian Geological Survey, and Molyneux St John ; Agriculture, Jas. W. Robert- son, Canadian Commissioner of Agriculture and Dairying ; History, G. R. Parkin, LL.D., C.M.G., Principal of Upper Canada College, Toronto.

CANALS AND INLAND NAVIGATION. Sir E. Leader Williams, M. Inst. C.E., Consulting Engineer of the Man- chester Ship Canal; United States, Gen. O. H. Ernst, Member of the U.S. Isthmian Canal Commission.

CANCER. Arthur Shadwell, M.D.

CANONS OF HIPPOLYTUS. The Rev. J. Aemitage Robin- son, Ph.D., D.D., Canon of Westminster.

CANOVAS DEL CASTILLO. A. E. Houghton.

CAPE COLONY. Geography, Professor R. Macwilliam, Gill College, Cape Colony; History, Alfred Hillier, M.D., Author of ” South African Studies,” &c.

CAPITAL PUNISHMENT. W. F. Craies, Editor of ” Statutes relating to Criminal Law,” &c.

CARICATURE. English, F. W. Whyte, Author of “Actors of the Century”; French, Armand Dayot, Inspector of Fine Arts, Paris ; German, Richard Muther, Professor of Art History, Breslau University ; American, Rupert Hughes.

CARLYLE. Leslie Stephen, Litt.D., Editor of “Dictionary of National Biography.”

CARTOON. M. H. Spielmann, Editor of the “Magazine of Art.”

CASTELAR. A. E. Houghton.

CATACOMBS. The Rt. Rev. W. R. Beownlow, D.D. (the late), R. C. Bishop of Clifton.

CAUCASUS. Prince Kropotkin.

CAYLEY. Major P. A. MacMahon, Sc.D., F.R.S.

CEMENT. Bertram Blount, Assoc. Inst. C.E., Consulting Chemist to the Crown Agents for the Colonies.

CENSUS. J. A. Baines, C.S.I., formerly Census Commissioner under the Indian Government ; United States, Walter F. Wilcox, Ph.D., Chief Statistician, Division of Methods and Results, 12th U.S. Census, and Professor of Social Science and Statistics, Cornell University.

CENTRAL AFRICA, BRITISH. Sir Harry Johnston, K.C.B., Special Commissioner for Uganda Protectorate.

CEYLON. J. Ferguson, Editor of ” Ceylon Observer.”

CHANNEL TUNNEL. W. Boyd Dawkins, D.Sc, F.R.S., Professor of Geology, Owens College, Manchester.

CHANT ABUN. H. Warington Smyth, M. A., Author of “Five Years in Siam.”

CHARITIES. C. S. Loch, Secretary of the’Charity Organiza- tion Society, London.

CHARTERED COMPANIES. W. B. Duffield.

CHEMISTRY. Henry E. Armstrong, Ph.D., LL.D., F.R.S,, Professor of Chemistry at the City and Guilds of London Central Institute.

CHERBULIEZ. Lord Crewe.

CHESS. L. HoFPER, Author of “Chess,” &c.

PREFATORY ESSAY.

A GENERAL SURVEY OP RECENT POLITICAL PROGRESS.

By Edward Dicey, C.B.

TO find any single phrase which could adequately describe the tendencies of human thought, policy, and statecraft during the last quarter of the 19th century is an obvious impossibility. But the nearest approximation to such a phrase would probably be to employ the phrase ” Conservative reaction ” as characterizing the period in question. This phrase, if used not in the way the expression is commonly employed, as referring to party politics, but in a wider sense, expresses a general phase of mind in most, if not all, the self-governing countries of the world, which, for good or bad, has of late years influenced their State policy in a uniform direction. To put the same idea in another, and perhaps simpler, manner, it may be said that the spirit of the times Avas progressive during the first three quarters of the 19th century, and unprogressive, if not reactionary, during the last quarter. The course of human affairs is not regulated by fixed laws, such as those which govern the rise and fall of the tides. It is therefore idle to discuss the exact date at which the movement in favour of progress reached its apogee, or the date at which reaction set in. But men whose memories extend over half a century will probably agree in saying that in Great Britain, as in all other countries where the conditions of public life are at all similar, the ideas which commended themselves to public approval in the first-named of these periods lost their sway during the years that have come and gone since the ninth edition of the Uncyoloprndia Britannioa first saw the light of day. The International Exhibition of 1851 formed the highwater mark of the progressive movement, though at the time it was commonly regarded as the commencement of a new and better era, in which wars were to cease, the progress of science was to ameliorate the fundamental conditions of human existence, and free democratic institutions were to unite the nations of the world in bonds of amity and goodwill. During the quarter of a century which followed the World’s Fair in Hyde Park, the belief in the progress of humanity retained its ground. Up to 1870, or even later, the creed of Liberalism was held, or at any rate professed, by the great majority of

thinking men in all countries, and in consequence its prestige continued long after the fervour of belief had passed away. The course of events had for many previous years been gradually undermining popular faith in the efficacy of democratic institutions, or of the discoveries of science to modify materially the lot of mankind upon the earth. Then, again, the doctrines on which the system of Free Trade was based had not succeeded in commanding general assent ; or, to speak more correctly, the results which its adoption was regarded as certain to produce had not been realized. Moreover, the working classes throughout the Old World and the New had had their faith in parliamentary institutions severely shaken by the fact that the general organization of society, in so far as labourers and artizans were concerned, remained much the same under democratic institutions as they had been under aristocratic or oligarchical rule.

In consequence, the hewers of wood and drawers of water had begun to lose their enthusiasm for political reform as a means of ameliorating their own condition, and to base their hopes on, Socialistic schemes for the regeneration of society, schemes which, whether sound or unsound, were diametrically opposed to the cardinal dogmas of old-fashioned Liberalism — that State intervention was an evil in itself ; that Capital and Labour would each thrive best by being at liberty to fight their own battles ; and that any effort on the part of the State to interfere with absolute freedom of contract, and to regulate the profits of Capital on the one hand, or the wages, hours, and conditions of Labour on the other, was foredoomed to failure. The growth of Socialist ideas amidst the working class had tended to dissolve the political alliance which had existed for so many years between the operative class and the lower middle class. Shop- keepers, clerks, small employers, and the less prosperous of the rate-paying classes had become alarmed at the Socialist schemes which had found favour with workmen and labourers ; while they also resented the growing authority of Trades Unions. In consequence, the vast class which lies between the poor and the wealthy had gradually gravitated towards Conservatism as distinguished from Liberalism. Moreover, it cannot be doubted that the tone

of modern thought and the consequent decay of dogmatic religious belief to some extent modified the aspirations and ideals of civilized mankind. Doubts as to the merits of unrestricted competition as a system capable of universal application ; a tendency to look to State action, rather than to individual effort, as the best remedy for social evils ; a fear of the supremacy of the masses by the property-owning part of the community; and a widespread desire for the reorganization of the world on the basis of social, as distinguished from political, reform, are some of the chief factors which influenced the policy of all progressive States during the last five-and-twenty years of the 19th century, and led to various changes in their internal fabric, and, in some instances, in their external relations with one another.

The shadow of the great Franco-German war of 1870-71 has lain over the years which have come and gone since the German armies entered Paris as conquerors. The direct results of the campaign are obvious enough. Germany became the leading State in continental Europe, while France was relegated to the second, if not to the third, place amidst the Great Powers of the mainland. Her loss of territory is insignificant as compared with her loss of authority ; and the authority she still exerts is mainly due to her grand traditions and to the alliance contracted with Russia. The indirect effects of the war of 1870-71, though less obvious, are certainly not less important. The outcome of the German victories throughout the length and breadth of France was to deal a death-blow to the common belief that the era of wars of aggression and conquest had come to an end, and that under free governments, in which the influence of the democracy was supreme, international issues would be settled by arbitration instead of by the brute force of arms. This belief, it may be urged, ought to have been already dispelled by the series of wars which had agitated the world for many years previous to 1870. But each one of these wars might be ascribed, not altogether without justice, to other causes than to the greed of conquest, the dynastic ambitions, or the lust of power, which, according to the leading popular teachers of the day, were solely responsible for the wars of a bygone period. The Franco-Italian war of 1859 was justified by the desire of France to assist Italy in recovering her national independence. The civil war in North America was regarded as a struggle for the abolition of slavery. The invasion of Denmark by Prussia and Austria was excused on

the plea that it was waged to uphold the principle of nationality, outraged, or alleged to be outraged, by the rule of the Danes in Schleswig-Holstein. The Seven Days' campaign, which ended at Sadowa, was supposed to have been due to the paramount neces- sity of creating a united Fatherland. Popular delusions die hard ; and all these indications that, now as heretofore, might is the supreme arbiter upon earth failed to shake the idea, embodied in the Exhibition of 1851, that the days of aggressive warfare had passed away never to return. But no faith, however robust, in the permanence of peace under democratic rule could withstand the shock given to this faith by the war between Germany and France. At the period of its outbreak the passions of onlookers were keenly enlisted on one side or the other, and partizans of either combatant contended that the responsi- bility for the war rested exclusively on the rulers of the State to which their own sympathies were opposed. But the more the inner history of the war became known, the clearer it became that its causa

causans was the jealousy between the German and French nations, or, to speak more accurately, their desire of attaining respectively certain objects, to whose attainment the subjugation of the other was an essential preliminary. Of course the personalities of Prince Bismarck, of Napoleon III., and of others played a large part in the actual conditions of the war. But when France had set her heart on remaining the dominant military power in Europe, and when Germany had made up her mind to convert a confederation of sovereign states into a united empire, an armed conflict between the two countries had become inevitable at no distant date. The outbreak of such a war as this — due to no serious provo- cation on either side, possessing far less obvious justification than any of the dynastic wars of the 17th and 18th centuries, and hailed with enthusiasm by the voice of the two nations about to engage in mortal combat — was utterly irreconcilable with the theory that modern civilization, the advance of science, and the progress of humanity, had rendered an aggressive war a practical impossibility. If wars were to be waged in the future, as they had been in the past, whenever any State had an interest in aggrandizing its power or extending its territories at the expense of its neighbours, and saw a favourable opportunity for so doing, certain conclusions followed logically,

whose weight no prudent nation could afford to over- look. The first of these conclusions was that any Power which was anxious to hold its own position and retain its own independence must be prepared to defend herself against any other Power, or combination of Powers, by whom she was likely to be attacked. The second conclusion was that if the leading States of the civilized world were to act upon the principle of extending their dominions or consolidating their power whenever they could do so with fair chance of success, any State which did not avail itself of every opportunity presented for aggrandizement without incurring serious danger of reprisals must of necessity fall behind in the struggle for life. It will be found, on examination, that both these convic- tions, in some instances consciously and, in many more, unconsciously, have influenced the course of events during the period under review. With respect to the first conviction, as to the necessity for increasing their military forces, there has been a marvellous accord on the part of all the leading Powers of the world. It is not an exaggeration to say that the chief occupation of the last twenty-five years of the 19th century, in as far as Governments were concerned, consisted in preparing for the possible eventuality of war. Reference to any record of national statistics will confirm this statement. For our present purpose it is suflicient to say that, in well-nigh every civilized country, the army and navy have been placed, in times of peace, on what at the commencement of the period in question would have been regarded as on the footing of war. All countries are burdened well-nigh to the full extent of their numerical and financial resources. Various minor States, such as Bulgaria and Servia, have been brought to the verge of bankruptcy by their military expenditure ; and it is open to question how long even powerful countries such as Italy, Russia, and Austria can continue to support the constant drain on their resources caused by the necessity, whether real or imaginary, of making themselves ready for war in times of peace.

In the majority of instances these military preparations were honestly made for defence, not for defiance. But it is only in accordance with human nature that the possession of power should engender a desire for its exercise. The period of increased armaments has therefore coincided with a period of annexation on the part of all the powerful States of the world. To cite only the main instances. Great Britain has acquired a virtual Protectorate over Egypt, and holds joint dominion with Egypt over the

Sudan ; has annexed Burma, the Transvaal, and the Orange Free State ; and has secured a leasehold of Cyprus, tantamount to a freehold. France has taken possession of Tunis, and has assumed the adminis- tration of Indo-China — comprising the formerly independent States of Annam, Cochin-China, Cambodia, and Tongking. Russia has annexed Bessarabia and the northern provinces of Armenia. Germany has planted her flag on the mainland of Zanzibar in Africa and at Kiao-Chow in China. Austria has possessed herself of Bosnia and Herzegovina. Italy has assumed the ownership of Massawa, and was only hindered from securing a Protectorate over Abyssinia by the disastrous campaign which ended in the defeat of Adowa. Belgium, in fact if not in name, has added the Congo Free State to hei' European dominions. The passion for territorial aggrandizement has not been confined to Europe. In the East, Japan has obtained a footing in Korea, and would have extended her territory into China

proper after her victories in the war with the Celestial Empire had she not been baffled by the inter- Yention of Russia, France, and Germany. In the West, the United States, as the reward of their war with Spain, hold Cuba within their grasp, and have actually annexed Porto Rico and the Philippines. "We might cite any number of smaller acquisitions of territory — chiefly, no doubt, on the part of Russia and Great Britain — in barbarous or semi-barbarous countries ; but it is unnecessary to do more than allude to the partition of Africa, one of the most striking illustrations of the earth-hunger which has had so great an influence on the course of events within the last few years, and which is likely to have far greater influence in the years to come. The Dark Continent, to whose existence, after the suppression of the slave trade, Europe had remained persistently indifferent, has since 1880 been partitioned out into so-called spheres of influence, over which various European States claim a right of predominance.

It may be contended with some plausibility that this earth-hunger is due solely, or at any rate mainly, to increased armaments, and to the bellicose frame of mind which these armaments have neces- sarily engendered amongst all progressive countries. This explanation, however, is inadequate. Aun^aC*' Even the most ardent opponents of militarism would hardly

dispute the assertion that, as a body, the civilized nations of the world have increased their armies and their navies on the principle. Si vis pacem para helium. The possession of augmented military power may have facilitated the subsequent annexations of territory. But the chief object for which the nations have submitted willingly to the burdens inseparable from so-called ” bloated armaments ” has assuredly not been solely an ambition of seizing on the waste places of the world. The truth is that the outburst of militarism has coincided fortuitously with what we may call the contraction of the earth. It need hardly be said that this contraction is moral, not material, and is due to the rapid increase of the world’s population, owing partly to improved sanitary and social conditions, but mainly to the discoveries of science. If by some convulsion of nature the various inhabited portions of .the globe could have been brought into close proximity to each other, the result of such a convulsion would hardly have differed materially from that produced by the agency of railways, steamships, and, above all, of electricity. Even as late as 1875 the system of world telegraphy was in its infancy as compared with its present development ; and it seems well-nigh certain that the 20th century will witness such an extension of the means of international locomotion and communication as to induce succeeding generations to regard themselves, with far more justice than we can do to-day, as the heirs of all the ages. It is not to be wondered at if this contraction of the earth should have increased the desire of aU leading nations to increase their area of available territory while there was yet time and opportunity. When the owner of a large and prosperous estate finds building going on all around him, in such a manner as to threaten ” the amenities ” of his property, he has only one course open to him if he is anxious to maintain his position. That course is to obtain possession of all adjacent land which is available for appropriation. The same instinct which leads the landowner to provide against the danger of being crowded out, has led the master nations of the day to appropriate, in as far as they can, all the unoccupied portions of the habitable globe. It is a significant fact that the two countries in which this land-greed has been most powerful should be Great Britain and Germany, which both have very dense and very rapidly increasing populations, and which are both to a considerable degree dependent upon foreign enterprise for the food of their people. In France, on the other hand, where the population barely holds its own in numbers, and where the produce of the soil is more than sufficient for native wants, the land-greed

has taken but small hold on popular imagination. This statement may seem hard to reconcile with the vigorous though spasmodic efforts made by France since the Franco-German war to extend her spheres of influence in various parts of the globe. A very slight acquaintance, however, with the French people is sufficient to convince any observant person that French-men know little and care less about colonial possessions in themselves, and only value them, if at all, from a sort of unreasoning impression that Great Britain owes her greatness to her colonies, and that if France had colonies of her own, she might become more powerful than Great Britain, or at any rate might cause that country trouble and annoyance.

Something may well be said here of the violent outburst of anti-British feeling which has manifested itself throughout Europe, and especially in France, and which forms one of the most notewprthy, though

least pleasing, incidents of the period under consideration. Be the rights or wrongs of the war between Great Britain and the Transvaal what they may, it is idle to imagine that the well-nigh universal con- demnation passed upon the former abroad was due to any genuine sympathy for the Boers or to any other sentiment than jealousy. The head and front of British offending lies in the jealousy ot fact of the extraordinary success and unparalleled prosperity of the British people, and the same is to a great extent true of the Continental jealousy towards the United States of America. It is difficult for Britons who have not lived in foreign lands to appreciate the irritation caused by the mere existence of their empire. That the small islands forming the United Kingdom should be the centre of a world-wide dominion, that the British flag should float in every quarter of the globe, that the English language should be spoken, as the master tongue, in so many parts of the world, that the trade of the universe should be mainly in British hands, and that the wealth of Great Britain should so greatly surpass that of other nations, seems to the non-British mind a violation of the laws of nature, an outrage upon the principles of eternal right. The explanation that this success and prosperity are due to certain superior qualities of the British race is one which foreigners can hardly be expected to accept. A more simple and a far more pleasing explanation is

afforded by the theory that British greatness is due either to sheer accident, or to a mixture in the British character of extreme selfishness and almost sublime duplicity. The world, for the most part, is convinced that Great Britain's proud position is a bubble, needing only to be pricked to disappear into thin air. The unexpected reverses of her troops at the outset of the war with the Transvaal seemed to foretell the probability of her collapse, and on that account the Boers commanded general sympathy. Of course there were exceptions. A few countries, and a minority of thinking men in every country, declined to admit that the Boers must be right because they were opposed to Great Britain. But if the questions at issue between the British Government and the Boer Republics could have been submitted to an international Court of Arbitration, or to a plebiscite of all Continental countries, no matter what might have been the intrinsic strength of the British case, the passing of an award in favour of the Boers would probably have been a foregone conclusion. If our explanation of the causes which practically ranged the nations of the European mainland on the side of the Boers, as the enemies of the British Empire, be admitted, it follows that whenever Great Britain is placed in a position of difficulty, she may count upon the sympathies of the vast majority of her neighbours being enlisted on the side adverse to British interests.

The recognition of this plain truth, unwelcome as it may be, has strengthened the growth of the Imperialist movement, which, in England at any rate, has been the most remarkable feature of the fourth quarter of the 19th century. There is no need to have reached an advanced age in order to remember the time when the formation of a Federated British Empire was regarded as an idle imperialism. dream of Utopia. Till the days of the fourth Lord Carnarvon, no statesman had ever come forward as the champion of Imperial Federation ; and even the Minister under whose auspices the Dominion of Canada became an accomplished fact was looked upon by his contemporaries as an amateur politician. The idea that the union of the scattered colonies of Great Britain beyond the seas could ever come within the domain of practical politics had hitherto met with no support from the leading statesmen of the Victorian era, whether Liberal or Conservative. Federation never formed part of the programme of either party — of the Liberals even less, if possible, than of the Conservatives. Why this should have been the case is obvious enough. In former days the first practical step

towards the creation of an Imperial Federation was deemed to be the establishment of a Customs Union, under which all parts of the British dominions, wherever situated, or whatever might be the nationality of their inhabitants, should not only enjoy free trade with one aijother, but should be advantaged, as against foreign nations, by being subject to lower duties than those imposed on foreign traders. To take such a step, to however small an extent, was deemed an infraction of Free Trade principles ; and up to a very recent period the theory that Free Trade was a system advantageous everywhere, at all times, and in all circumstances, was a cardinal tenet not only of the Manchester scho6l, but of the whole Liberal party. Amongst the causes to which the progress of the Federation movement is due, the decline of popular faith in the universal application of Free Trade principles cannot fairly be overlooked. The chief cause, however, is beyond

doubt the advance in the use of telegraphic communication. Any system of common government between the mother country and the British Colonies, other than that of a vague dynastic union, was manifestly impossible so long as communication between the parent State and her offspring was a matter of weeks or months. Of course, notwithstanding all the improvements in railway and steamship communication, the mileage distance between the mother country and her colonies forms a grave difficulty in the way of any possible Federation ; but this difficulty nowadays is insignificant compared with what it was in 1875. Thanks to submarine telegraphy, any event of public interest which occurs in Great Britain is known at once in every important colony. In the same way, the main incidents of colonial life are read and com- mented on at home almost simultaneously with their occurrence. The variations of public opinion in Great Britain and in all the self-governing colonies of Greater Britain are discussed simultaneously in every part of the British Empire. Joint administration conducted by telegraphy cannot, for various reasons, be ever as satisfactory as joint administration by oral methods and personal intercourse. Still, the former system of administration is conceivably possible, while the latter is at present manifestly impossible. What, however, is even more important than the increased facility of communicating between all parts of the British Empire is the extent to

which this facility of communication has tended to weld Great Britain and Greater Britain into one people, with common thoughts, common interests, and common ideas. All families which have relatives settled in the colonies must be aware that, though mutual affections might remain undiminished, the interest in each other's fortunes felt by the members of a family, residing some at home, some in the colonies, tended formerly to decrease with the lapse of years. But when the papers report every morning to every British town of importance in each quarter of the globe the news of what has passed on the preceding day, whether in the mother country or in her dominions beyond the four seas, the common interest in each other's doings and sayings, which binds together men of the same race and country, is far less liable than it was heretofore to diminish in strength. To a great extent the British race, whether at home or abroad, has, owing to the advance in telegraphy, become again one community, united by other ties besides those of a common language and a common ancestry. We have seen how this rapidity of communication works in practice by the experience of the South African War. It needs no saying that the war would not have excited the intensd sympathy displayed by the Colonies if the defeats, victories, sufferings, and triumphs, not only of the British army, but of the Colonial contingents, had not been made known to them day by day in the order of their occurrence. We must not seem to undervalue the military assistance afforded by these contingents, if we regard as a yet more important result the way in which this assistance has tended to strengthen the influences which work for Imperial Federation. There are grave practical difficulties which attend the formation of any working scheme for carrying out the idea of the Federation of the British Empire. But it is a striking fact that, for the first time in British annals, this idea has commended itself to popular favour both at home and in the colonies.

It has always seemed to the present writer that the political economists who contend that self- interest is the factor which determines national policy are equally in the wrong with the school who contend that sentiment — using the word in no offensive sense — is the mainspring of human action. It would be more correct to say that the world is governed by a combination of self-interest and sentiment, the relative power of each factor being subject to certain variations, but always tending to revert after each variation to a status of equality. Hostile critics would urge that the sentiment

which supports Federation cannot last, as it is based on no foundation of self-interest. In our view this assertion is erroneous. The British Colonies have manifestly an interest in Federation, on the assumption that it is essential to colonial independence and is calculated to facilitate a Customs Union. The working classes in the United Kingdom have at the first sight no interest in a Customs Union, which they have been led to believe would not only violate the principles of Free Trade, but would raise the price of the articles they mainly consume. Of late, however, there have been indications that this belief is no longer so widely or so enthusiastically entertained as it used to be by the electorate of the mother country. The British working man would be far more blind to his own interest than he is commonly supposed to be if he had failed to note the fact, that under unrestricted competition a number of British industries

have been shrivelling away, if they have not become absolutely moribund, which under a protective policy have gained ground in every leading foreign country. Market after market has been closed to British trade by the imposition of prohibitive duties abroad ; and though the rate of wages has kept up, the fear that any falling off in British industry may possibly lead to a general lowering of wages has for some time haunted the minds of labourers, mill hands, artizans, and miners. This fear has afforded an opening of which the partisans of Imperialism have not been slow to avail themselves. They advocated the necessity of providing fresh markets for British industry, by fostering colonial development, by ” pegging-out ” new claims, by subsidizing enterprises calculated to bring the colonies into closer communication with the mother country, and by adopting the policy of Federation, of which Mr Chamberlain has been the most prominent advocate. If once the British working classes get it into their heads, with or without reason, that a British ZoUverein — the probable result of Imperial Federation— would conduce to the augmenta- tion of their wages, or at any rate to the maintenance of the present rates of payment for labour, they would be led by self-interest to espouse the cause of Federation. The influence of self-interest would be augmented by the force of sentiment — of patriotism. Jingoism, or whatever one may choose to call it, — which is certainly not less powerful in the lower classes of British society than in the

upper. It is significant that the most important legislative act of the last year of the 19th century should have been the passing of the Act authorizing the Australian Colonies to form themselves into an Australasian Commonwealth. Whatever may have been the case in Australia, this measure was deemed in the old country to owe its chief importance to the fact that it was regarded as an initial step towards the ultimate formation of an Imperial Federation embracing all parts of the British Empire.

The note of Imperialism was first heard in British politics at the commencement of the period with which we are dealing. It was in the last days of 1875 that Disraeli purchased for Great Britain the Khedive Ismail Pasha's interest in the Suez Canal, and thereby committed her to an intervention in the affairs of Egypt, which gradually eventuated, as all intervention is apt to eventuate, in the establishment of a virtual Protectorate over the country in whose affairs the intervention was employed. A year later Queen Victoria, by Disraeli's advice, added to her titles that of Empress of India. In pursuance of the policy indicated by this change of appellation, the then Premier brought Indian troops to Europe in order to garrison Malta during the period when a war between Great Britain and Russia seemed to be on the cards in consequence of the invasion of Bulgaria by the armies of the Tsar. A further step towards the development of British Imperialism was taken in the attitude which Lord Beaconsfield adopted at the Berlin Conference, and by the convention he formed with Turkey, in virtue of which Great Britain obtained practical possession of Cyprus, and pledged herself to defend Asia Minor in the event of this portion of the Ottoman dominions being invaded by Russia. There can be no doubt that the acquisition of Cyprus was intended by its author to enable Great Britain to make Cyprus a, place d'armes, and thereby to forestall any possible despatch of French troops to Egypt, and to protect the port of Alexandretta, which was to have been the terminus of the .projected Euphrates Valley railway to the Persian Gulf. Lord Beaconsfield's Imperialist policy laboured under two fatal defects; first, that owing to advancing years he was not prepared to carry it through, in the face of the active antagonism of his opponents and the lukewarm sympathy of his supporters ; and, secondly, that the ideas which lay at the bottom of his policy had not yet appealed to public opinion at home. Indeed, popular sentiment, excited by the Bulgarian atrocities, had turned against any

alliance with Turkey ; and the result of Mr Gladstone's Midlothian campaign was the decisive defeat of the Conservatives at the General Election of 1880, and the return to power of the Liberal party under Mr Gladstone. For a time Imperialism was at a discount; indeed, it may fairly be said that to the end of his career the ideas which underlie Imperialism were distasteful to the great Liberal leader. But the force of events soon compelled a Liberal Government to resume the system of active intervention in foreign affairs, against which they had protested so warmly in the days of their predecessors. Two years after his accession to office Mr Gladstone had to send troops to Egypt in order to suppress the Arabi insurrection, to occupy Cairo, to abolish the Franco-British dual control, and to undertake the provisional administration of the country. We entertain no doubt as to the perfect good faith with which Mr Gladstone protested that the British

occupation of Egypt was not intended to be, and would not be, of a permanent character. It was not his fault if the logic of facts proved stronger than he had anticipated, and if the provisional domination of Great Britain in Egypt assumed, year after year, a character of greater permanence. The insurrection in the Sudan, the victories of the Mahdi over the Egyptian forces, the evacuation of the Sudan, to which Egypt was compelled to accede at the command of the British Government, the despatch of General Gordon to the Sudan to arrange for the withdrawal of the Egyptian garrison, and the subsequent investment of Khartum, compelled the British Government, sorely against their will, to send a British army to the Sudan in order, if possible, to effect the release of their envoy. Popular sentiment forced the hands of the Ministry, and resented the withdrawal of the Wolseley expedition, then almost within sight of Khartum, on learning that Gordon had already succumbed to fate. The force of this sentiment made itself manifest at the elections of 1885. Of all the baseless calumnies which have been brought against Great Britain abroad, the most baseless is the charge that her action in Egypt was dictated by a deliberate desire and purpose ta establish British supremacy in the valley of the Nile. Having been conversant with Egyptian affairs for many years, and having been personally, and in many cases intimately, acquainted with the leading

personages, native as well as foreign, in Egyptian public life from the date of the opening of the Suez Canal, the present writer can declare with confidence that until a very recent period British policy in Egypt was based on a genuine and honest, though, as he holds, a mistaken desire to quit Egypt and to get rid as soon as possible of the liabilities inseparable from military occupation. This desire was not a matter of party feeling. It was shared alike by Liberals and Conservatives; and if the British are still in Egypt, this is only in obedience to that manifest destiny which shapes the history of nations, and which in the case of Great Britain compels her to pursue her Imperial mission. In a similar way the Jameson Raid, which was undertaken without the knowledge, and most assuredly against the wishes, of either the Government or the people of Great Britain, placed that country in a position which forced her most reluctantly to go to war in order to protect her Imperial interests. Everybody who has studied the history of Great Britain is aware that wars of conquest have been of very rare occurrence in her annals. The story of almost all her acquisitions of territory has been substantially the same. The instincts of their race have led British subjects to settle in far-away lands, from desire of trade or adventure. The settlers have acquired interests in the countries where they have taken up their abodes, and these interests have been assailed either by the natives or by foreigners. Great Britain, as a trading nation, has had no choice except to protect the interests of her traders abroad. Wars have ensued ; territories have been annexed for the protection of trade; and, finally, the mother country has had to step in and place the territories in question under her rule and sway. In other words, the British Empire has been welded together, not in virtue of any distinct policy, but in obedience to the exigencies of its position as the chief trading nation of the world. It has grown unconsciously, not been created consciously. If this fact gives greater promise of permanence, it also renders the limitation of the British Empire a matter of extreme difficulty. The founders of empires created by conquest can in most cases say “Thus far and no farther.” But so long as the causes which have brought the British Empire into existence continue in full force of action. Great Britain has not the power, if she has the will, of altering her policy. We have dwelt at length on the development of British Imperialism because we regard it as the most important incident of recent years not only in regard to Great Britain, but in regard to the world at large ; but the same

note of Imperialism has influenced the policy of all the leading civilized nations of the world throughout the period under review.

The Latin proverb Inter arma silent leges applies with especial force, though not perhaps in its literal sense, to this period of militant Imperialism. There has been a lull in the department of constitutional

legislation. In Great Britain the only measure of grave constitutional importance was the ifon!*’”’ passing in 1885 of the Bill establishing Household and Lodger Suffrage in the counties. The

measure in question was the logical corollary of the “leap in the dark” taken under Lord Derby’s premiership in 1868, by which a system approximating very closely to adult manhood suffrage was established in the boroughs. The Liberals, by all the traditions of British party warfare, were bound in

sporting phrase, ” to go one better ” than the Conservatives ; and the responsibility for the reforms under which, for the first time in British history, supreme electoral power was entrusted to the hands of the most numerous, the poorest, and the least educated classes of the community, rests, for evil or for good, on the shoulders of both parties alike. So far the new agricultural franchise has told in favour of the Conservative party. In 1886, in 1895, and again in 1900, the constituencies returned large Conservative majorities. As long as the attention of the country is occupied with foreign or Imperial questions, or with issues not bearing, except indirectly, on labour and its relations to capital, the voice of the working-class electorate is likely, in normal circumstances, to be in favour of the Conservative party. Equal confidence is not possible as to what may be the result when foreign or Imperial questions may be in abeyance, and when party questions are raised on on&side or the other involving the acceptance or rejection Qf legislation calculated, in the opinion of the working-class electorate, to affect the real or supposed interests of Labour as opposed to Capital.

The British Parliament, for the last quarter of the 19th century, has been mainly occupied with the irrepressible Irish question. In its vicissitudes

were included the commencement of the Fenian outrages, the Prevention of Crimes Act, the Irish Land League, the assassination of Lord Frederick Cavendish in the Phoenix Park, the formation of a united Irish parliamentary party under Mr Parnell, the attempt to obstruct all legislation at Westminster by an abuse of the rules of the House, the enact- ment of the closure, the coalition between the Liberals and the Irish Nationalists, the introduction by Mr Gladstone of a Bill for the Repeal of the Union, its rejection owing to the secession of the Liberal Unionists, the Pigott trial, the downfall of Mr Parnell, the disruption of the National party, and the rejection of Mr Gladstone's second Home Rule Bill by the House of Lords, followed by his final retirement from public life. Great as was the interest caused by these events at the time of their occurrence, it may be doubted whether they modified materially the relations between Great Britain and Ireland. Their chief result was to show that the proposal to confer legislative independence upon Ireland excited little sympathy, and still less enthusiasm, among the British working class, and tended, in so far as they had any effect at all, to range them on the side of the Unionist party. The statement made by Lord Rosebery on his accession to the Premiership in 1894, to the effect that Home Rule could never be carried till the measure had commended itself to the opinion of the " predominant partner " in the Union, though it was afterwards explained away by its author, was approved by the good sense of the British public, and there seems as yet no prospect of any change of popular sentiment in England or Scot- land with reference to the inexpediency of any repeal of the Union, under which the United Kingdom has grown in strength and prosperity. In other respects the political machinery of the United Kingdom underwent but slight change during the last quarter of the 19tli century. But the reaction against " democratic " Liberalism has been conspicuously shown by the popular acquiescence in the apparent decline of the power of the House of Commons as such, and the concomitant increase in the power of the Cabinet. Very much the same significance must be attached to the fact that, in spite of the extension of the suffrage, and the multiplication of elections for local government, the main feature of the elections has always been the prevailing apathy of those entrusted with the privilege, or duty, of voting, and the comparatively small proportion of the electorate which is sufficiently interested to go to the poll.

In France, where constitutional changes are matters of far more common occurrence, the position remains much the same as it was on the downfall of the Second Empire after the surrender of Sedan. The Third Republic has remained in power for a longer period than any regime which held

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sway in France during the 19th century. The great majority of the present generation of develop- Frenchmen have been brought up under Republican institutions, and it is only a comparatively small and rapidly diminishing minority which can have any personal recollection of either Empire or Monarchy. Moreover, the deaths of the Comte de Chambord, the Comte de Paris, and the Prince Imperial removed the only representatives of the deposed dynasties who appeared likely to have any hold on French popular sympathies. In these circumstances, it would seem antecedently probable that the Republic should have taken firm foot in French soil. So far, however, this anticipation has not been realized. The French Republic, as it has existed since 1870, is a Parliamentary government ; and this form of

government, though in accordance with the political ideas and aspirations of Anglo-Saxon races, is, as the present writer ventures to think, incompatible with the opinions and ambitions of nations of Latin race. Be this as it may, the Third Republic has excited little or no enthusiasm in France. It is tolerated in default of any more congenial form of government, but it does not command the confidence or respect of its citizens. The absence of any statesmen of high eminence since the decease of Thiers and Gambetta, the Panama scandals, the hostility between the Church and the civil power, the Anti-Semitic agitation, the dread of Communism by the bourgeoisie, and the animosity against the employers of labour, which prevails so widely amongst the operatives and artizans, may all be cited as causes why the parliamentary rule of the Republic has not commanded popularity. That the Republic is still on its trial is patent from the fact that its safety was seriously imperilled by the appearance on the stage of politics of such a feeble antagonist as General Boulanger. It is commonly acknowledged in France that any general who might lead a French army to victory in a European war would be master of the situation in France. It is on this

account that the civilian Ministers of the Republic, no matter to what party they belonged, have been unanimous in deprecating any external war. It is on this account, too, that of late the French Ministry have made various overtures to the Socialist party, and have even admitted into their ranks colleagues who are associated with the traditions of the Commune. Moreover, the Franco- Russian alliance, however little practical benefit it has as yet conferred upon France, has undoubtedly gratified French national pride, while the fear of shipwrecking the fortunes of the Exhibition of 1900 paralysed all revolutionary agitation for the last two years of the century. Nevertheless, the position of the French Republic remains, as in 1875, one of unstable equilibrium.

In Germany, politically speaking, things have undergone but little external change. The first emperor of a united Fatherland was succeeded, after the brief reign of his son, Frederick III. , by his grandson William II. Prince Bismarck was dismissed and died; but the constitution of the empire remains substantially unaltered, and may perhaps best be described as a parliamentary government under which the Sovereign is his own Prime Minister, and is still the supreme authority in the State not only in name but in fact. How far this state of things is likely to be permanent is an open question. As things are, the high character and ability of the Kaiser, the prestige of the HohenzoUern dynasty, the traditions of German history, the power of the military element, and the popular distrust of France confer upon the head of the State an influence far beyond that possessed by the Parliament ; and so long as this influence is exerted firmly and wisely, as it has been in the main under the reigning emperor, it is not likely to be materially diminished. At present the German Parliament exercises a sort of general control, of which even an autocrat has got to take account; and there are not wanting indications that parliamentary government in Germany may be more of a reality in the near future than it has been in the past. ^ But so long as Germany, in the opinion of the German people, is threatened by the possibility of a hostile coalition between France on the west and Russia on the east, the conflict between the supremacy of the Parliament and the Crown is not likely to assume an active character. The great material progress made by Germany under the Empire has turned the thoughts of her citizens rather to industrial enterprise than to political reform. The trade interests of Germany, combined with her national pride, have led her to

support a policy of colonial extension and, as a necessary corollary, the formation of a powerful navy; wh,ile the disputes between the Agrarian and the Free Trade parties on the one hand, and between the ecclesiastical and civil authorities on the other, have excited little beyond local and sectarian interest.

In Austria the Triple Alliance has secured many years of peace, and has afforded an opportunity for the consolidation of her heterogeneous provinces. The opportunity, however, has not been improved, as there seemed reason to expect, by the extension of parliamentary institutions. Ever since the premature collapse of Count Rechberg's scheme for the creation of a national Parliament, in which every province under the rule of the House of Hapsburg was to be represented on equal terms, and whose authority was to be supreme throughout the empire, the process of internal disruption has made rapid progress. This process commenced when Hungary, on the recovery of her independence after Sadowa, declined to entertain any proposal for fusion with the other provinces of the empire, and insisted on the possession of a separate legislation, a separate Ministry, and a separate Executive. The example thus set was soon followed by the

various nationalities of the Empire of other than Teutonic race. The Czechs, the Croats, and the Italian population of the Adriatic Littoral have all set up claims to legislative independence . The Germans of Austria proper, who form the backbone of the empire, have resented these claims as an infraction of their supremacy.. If Hungary had been represented in a common Parliament at Vienna, the Hungarians and Germans could have formed a majority strong enough to overrule the representatives of the Slav and Latin nationalities. As it is, no Austrian Ministry since 1880 has succeeded in commanding the support of the Parliament except by concessions to one race or another, which tided over a temporary difficulty, but left the problem of Austrian reorganization more complicated, than it was before. The system of wanton obstruction adopted alike by Czechs and Germans, the coalitions between the Anti-Semite Liberals and the Clerical Conservatives, the virulence of the personal attacks made indiscriminately by every party in the Reichsrath, the constant fluctuations in Ministerial

policy, and the rapid succession of one Ministry after another — have all combined to discredit the system of parliamentary institutions in Austria, until the very existence of constitutional government in the Austrian half of the dual Monarchy is at stake. The personal esteem and affection entertained towards the Emperor Francis Joseph by all his subjects have given him an authority which no successor is likely to inherit, but no observer is able to contemplate without apprehension what may happen when his guiding hand is taken away.

In Italy, though from different causes, parliamentary government can hardly be said to have proved a success. The generation of statesmen of eminence possessed by Italy during the period of her unification has passed away and left but few successors. Owing to the influence of the Vatican, the wealthy classes have, as a body, abstained from public life ; and political power has fallen in consequence to the lower class of professional men, who look to a seat in the Chambers as a means of livelihood. The amalgamation, however, of the various provinces of the peninsula into one united kingdom has proved a less difficult task than was anticipated at the outset. The composition of the Italian Chambers has without doubt contributed largely to the mal-administration of public affairs, which within the last few years brought Italy to the verge of bankruptcy. But it may be doubted whether a differently constituted Parliament could have enabled Italy to bring her expenditure within her income. The Triple Alliance was joined by Italy in order to procure protection against intervention in Italian affairs on the part of the French Republic, an intervention which in 1887 was regarded as imminent, — and which is still looked upon by Italians as likely to occur whenever France has a free hand. Adhesion to the Kaiser-Bund necessarily involved the keeping on foot of a standing army large enough to render the military assistance of Italy useful to Germany and Austria in case of need ; and the maintenance of such an army could only be met either by extravagant borrowing or by exorbitant taxation. The tendency to reckless expenditure was increased by the demand for railways and other public works, deemed necessary for the development of the great resources of the kingdom, and also by the natural desire of the Italians to assert their position as a great Power, a desire which gave rise to the disastrous war with Abyssinia. When the borrowing powers of the country were exhausted, the deficit caused by the service of the public debt and the extravagant cost

of the administration had to be provided for by an increase of taxation, which told heavily on a population already overburdened in comparison with its resources. The result has been to strengthen the Republican party in the Peninsula, a party which, being closely connected with the French Socialists, entertains the belief that under a Republic Italy would have no cause to fear any interference with her independence on the part of France. The Church in Italy has done all in her power to throw discredit upon the system of representative government, which in her opinion presents an insuperable obstacle to any restoration of the temporal power of the Papacy. The net outcome of this state of things is that though the Italians are as determined as ever to uphold their national unity, they are not as convinced as their forefathers were that this unity can only be secured by parliamentary rule. With a young and inexperienced sovereign upon the throne the general outlook for Italy was not, at the openipg of the new century, as encouraging as her friends could desire.

In Russia the autocratic system of government remains unaltered. The agitation on behalf of parliamentary institutions has made little apparent progress. The parliamentary idea has never as yet taken hold on the Moujiks, who, in so far as they give any attention to politics, seem to prefer the

autocratic rule of the Tsars to any other form of government ; while the middle classes, who at one time favoured the Constitutional agitation, have been alienated by the excesses of the Nihilists. Meanwhile, whether under Alexander II., Alexander III., or Nicholas II., the policy of the Russian Government has been directed almost exclusively to the consolidation and extension of the Empire. The first object has been advanced by the incorporation of the Baltic provinces ; by the suppression of the independence guaranteed to Finland on her annexation just a century ago ; by the wholesale persecution of the Russian Jews, due not so much to religious prejudices as to a conviction that any separate racial nationalism impairs the homogeneity which Russia thinks is expedient should prevail throughout the length and breadth of the Tsar’s dominions ; and by the gradual destruction of every element in Poland which stands in the way of

her permanent Russification. The second object has been pursued by the wars waged on behalf of Servia and Bulgaria, — which, whatever else they have achieved or failed to achieve, have resulted in largely increasing Russian authority throughout the Balkan peninsula, — by the campaign against the independent Khanates in Eastern Asia, and by the construction of railroads which have practically made Russia the ruler of all the vast Northern area extending from the Baltic to the Pacific. A policy of this kind is only possible under an absolute autocracy. The experience of history teaches us that in empires, as in oceans, the tide must turn sooner or later, but during the period of which we write the tide of Muscovite aggrandizement has been flowing steadily in the same direction, and as yet there seems no sign of its receding.

In the United States of America a tendency towards what, for lack of a better word, we have called, in Europe, Conservative reaction has influenced the legislation of the years between 1875 and 1902.

It was in the first named of the above years that the popular outcry against Chinese States. immigration into the Western States assumed an active form. The resolution to prohibit the

entry of Chinese labourers into the Union, which was formally embodied in a Bill passed by Congress in 1888 under Mr Cleveland's presidency, may have been justified by local considerations. But it was a distinct violation of the fundamental principle, that the territory of the Great Republic was open "to the meanest of Adam's kin." In like manner, popular jealousy of foreign competition may have had no small share in securing the enactment, two years later, of the highly protective duties on foreign imports, recommended by Mr McKinley. From the earliest days of the Republic it had always been accepted as an axiom of State policy that the United States were not to intervene in any way in affairs lying outside the American continent, and as a necessary corollary of this axiom it was also held that the possession of colonies or foreign dependencies that would not ultimately become states in the Union was prohibited by the spirit, if not by the letter, of the Constitution. In foreign affairs up to a recent period non-intervention was the dominant principle of the administration, no matter which party might be in power. But during the last few years this principle has been openly

disregarded. Whatever view may be taken of the war with Spain, there is no disputing the fact that its outcome, as seen in the acquisition of foreign territory, especially in another hemisphere, was inconsistent with the theory of the Constitution held by the founders of the Republic. A series of decisions of the United States Supreme Court in 1901, delivered in cases that had originated in the collection of customs by the revenue officers upon imports from the Philippines, Porto Rico, and Hawaii, gave legal form and substance to the colonial idea. These decisions, which (it should in fairness be stated) were made by a bare majority of the Court, held that the new possessions were not within the clause of the Constitution which provides that ” all duties, imports, and excises shall be uniform throughout the United States ” the Court holding that, as here, ” territory belonging to the United States ” is not necessarily a part of the United States, and entitled to the same rights and privileges as the territory of the individual States composing the Union. In other words, a place is definitely made for colonies under the Constitution where many had thought no such place existed, and their government and treatment are thus entrusted solely to the legislation of Congress, under the clause of the Constitution which provides that ” the Congress shall have power to dispose of and make all needful rules and regulations respecting the territory or other property belonging to the United States.” Thus public sentiment and judicial interpretation alike have accepted the new state of affairs which has made America a colonial power.

PREFATOEY ESSAY XIX

The political transformation of Japan is of too recent a date for any trustworthy judgment to be formed as to its character, and still less as to its permanency. At the outset the revolution replaced the titular sovereign upon the throne, and was followed by the destruction of the feudal system under which the Tycoons had for nearly eight centuries governed Japan as a sort of Eastern ” Mayors of the Palace.” The restoration, therefore, of the spiritual emperor seemed calculated to bring about the revival of the old autocratic system of rule. As a matter of fact the revolution has turned out to be only the prelude to the creation of a Constitutional Monarchy, formed after the fashion of the Western world. Within the course of the years which have elapsed since the deposition of the Tycoon, Japan has been converted

into a civilized, progressive, self-governing commonwealth of the European type. During this period post offices, railways, telegraphs, ironclads, weapons of precision, things hitherto unknown, have been introduced into the Japanese Empire. Primary schools, compulsory education, the use of the European alphabet and of Roman characters, freedom of the press, religious toleration, vote by ballot, party government, and well-nigh all the mechanism of European administra- tion have been adopted by the subjects of the Mikado, who is still supposed to rule in virtue of his spiritual supremacy. The original Assembly, nominated in 1875 by the Mikado, has now been changed into a popular Parliament freely elected by the people. It is difficult to avoid a doubt how far the Japanese have imbibed the spirit, as well as adopted the forms, of constitutional government. Still, it must be said that in the course of a period so brief as scarcely to count in the history of a nation, they have not only made immense material progress, but have developed a spirit of individual nationality which augurs well for their future. Japanese youths have been sent to all parts of the civilized world, to study the languages, the armies, and the industries of every important nation. Foreign instructors have been brought into Japan ; but their services have as a rule been dispensed with as soon as their pupils had acquired sufficient knowledge to impart it as teachers to their fellow-countrymen. The motto of Japan might well be that of Italy in the Garibaldian eva,fard da se. The progress of Japan has already induced the European Powers to forego the right, guaranteed by the capitulation treaties, of having their subjects placed under Consular jurisdiction. Finally, Japan’s recent participation in the expedition of the Allied Powers for the rescue of the Ministers besieged in Pekin has raised the island empire of the East to the level of a Power of which account has to be taken in all international questions ; and this position was finally confirmed by the alliance between Japan and Great Britain at the opening of 1902.

It is sometimes said that all these questions of what — for lack of any exactly equivalent English term — may be best called la haute politique, do not interest the labouring classes, who under the general democratic tendencies of our time are gradually acquiring more and more political influence, and who in England, the United States, and the British self-governing colonies are practically labouring supreme whenever they choose to exert their power. But this, though true in regard to a “lasses. bygone

time,’ is at the best only a half-truth nowadays. The spread of education, the wider, even if super- ficial, acquaintance with foreign affairs created by the cheap press, the abolition of caste privileges, and the tone of modern thought, have all tended to render the civilized and self-governing nations of the world more homogeneous than they were wont to be. The sentiment of national pride is far more widely diffused, if not absolutely keener, nowadays than it was in bygone times. In consequence, popular opinion, whether intelligent or otherwise, plays a far larger part in public affairs than it did formerly. The result of this changed state of things must be to render the ideas which underlie Imperialism more intelligible and acceptable to the classes who live by manual labour than they were when the 19th century came into existence. Moreover, these classes are beginning to realize that their personal interests as wage-earners may be indirectly affected by questions of foreign or Imperial policy. Still, it may be fully admitted that, as a rule, questions which directly affect the sons of toil are those most calculated to enlist their sympathies. The so-called governing classes have already begun to take this fact into account, and to modify their tactics accordingly. During the discussions on parlia- mentary reform Lord Palmerston is reported to have replied to a friend, who remarked that in the reformed Parliament Ministers and members were much of the same class as they had been in the

pre-Reform era : ” Yes, the actors will be the same : the only difference will be, that they will play to the gallery instead of to the stalls.” Careful students of politics will probably agree that the legislation of the last twenty-five years has been largely influenced by what may fairly be described as ” playing to the gallery.” This tendency has been most marked in Great Britain, owing to the simple fact that the working man’s vote is, electorally speaking, more powerful there than it is elsewhere. The remedial legislation of Mr Gladstone with regard to Ireland, whether sound or unsound, was a distinct violation of the rights of property and of freedom of contract. The system of County Councils, by which local authority was transferred from the hands of the landed gentry to Boards elected in the main by artizans and labourers ; the appointment of a Government Commission authorized to determine the rent payable on any Irish estate by

an arbitrary process, instead of by open competition ; the substitution of State administration in domains hitherto left open to private enterprise; the preference shown in all fiscal arrangements for direct, as opposed to indirect, taxation ; the interference with the liquor trade ; the agitation against ground rents and in favour of the principle of betterment ; the obligation placed upon railway companies to provide working-men's trains at arbitrarily fixed rates ; the measures adopted to provide improved dwellings for the working classes at rentals lower than could be obtained by leaving the construction of such dwellings to be regulated by the laws of supply and demand ; the attempt to suppress usury by regulating the rate of interest the lender' might be entitled to charge and the borrower might be bound to pay — may be cited as a few of the measures which would never have been adopted if the working-class vote had not become of paramount importance. We express no opinion as to the wisdom or unwisdom, the justice or injustice, of these measures. Both parties. Liberals and Conservatives alike, are responsible for the principle that legislation must henceforward be in favour of the masses rather than of the classes. It is only fair to acknowledge that, so far, the working classes have exercised their power with moderation. On the other hand, strikes have increased in number and in effectiveness. These disputes, almost without exception, have been initiated by the workmen, either to demand an increase of wages or to protest against a proposed diminution of wages. If the aggregate loss occasioned by these interruptions of labour could be ascertained, it would be found to exceed by far any gains that individual trades may have derived from successful strikes. A demonstration, however, that the blank tickets in a lottery far exceed in value the winning prizes has never stopped the public from investing in lotteries ; and the fact that in the long run strikes are a losing business for the workmen will never deter Trade Unions from resorting to industrial warfare. The modifications of the Anti- Combination laws have facilitated the promotion of Trade Unions, and the material condition of the working classes has beyond doubt improved in all trades which have been able to form powerful labour organizations. It may be questioned whether wages would not have risen without Trade Unions, or whether the purchasing value of wages to-day corresponds with their nominal rise. Still, the broad fact remains that under Trade Unions British workmen earn a larger wage than they did in an older and freer era ; and the probability seems to be that these trade organizations will in coming years

become even more truly representative of the body of working men than they are at present. The doctrine of a “living wage,” which has gained much ground during the period under consideration, is manifestly unsound in the form it has taken, as it is obvious that no business can be carried on permanently at a loss occasioned by an excessive cost of labour, while it is by no means equally obvious that labour would not be forthcoming for a lower remuneration than that actually demanded on the score of the real or supposed necessities of the labourers. The idea so prevalent in the days of the Christian Socialist school, that aU labour difficulties could be solved by a system of co-operation, has been dispelled by the discovery that co-operation, as between capital and labour, means, when tested by experience, that the latter has the right to share in the profits when trade is good, but is unable to contribute towards the losses when trade is bad. The craze for compulsory arbitration in all labour disputes is equally fallacious, owing to the circumstance that no court of arbitration, however constituted, can compel capitalists to carry on mills, mines, or factories at a price they do not deem remunerative, or can coerce workmen into working for a wage they hold to be insufficient for their needs. In the future, as in the past, all trade disputes must be ultimately settled on the “pull devil, pull baker” principle, by strikes on the part of the men

and lock-outs on the part of the masters. We may reasonably hope tha,t the folly of unnecessary con- flicts between labour and capital will commend itself more strongly to all classes of the community, but the ultima ratio in industrial, as in all other disputes, must consist in an appeal to the relative strength of the two contending parties. Apart from the agitation for an eight hours’ day of labour, there is no evidence of any decided Socialist tendency on the part of the working classes in Great Britain. This may be attributed to certain very obvious causes. The first is, that under British laws and ideas the artizan enjoys an amount of independence and freedom without a parallel in other European countries, and in many respects in excess of that possessed by his class in the great Republic of the West. The second is, the extraordinary strength of the social organization in England, which almost precludes any revolutionary atetion on the part of the labouring classes, except at periods of intense popular excitement. The third and the most

potent is, the strong desire of the individual in English society, no matter what his position in life may be, to rise into a class superior to his own. The attainment of this desire is facilitated by the fact that any man of intelligence and energy can force his waj' from a humble origin to a comparatively exalted position. In consequence, the very men who otherwise, by virtue of their strength of will and character, would become class leaders, end as champions of the established social order. No other explanation accounts for the almost complete absence in recent times of any English leader of the proletariat who has risen to high note even amongst his own class. A similar remark applies, though with less force, to the working classes in all other communities of English race and origin.

On the other hand, the growth of the Socialist party in almost all continental countries cannot but be regarded as a marked feature in the period to which the foregoing remarks have reference. In Germany, in spite of — possibly in consequence of — repeated legislative attempts to suppress Socialism by force, the idea of founding a new social system on the negation of the right of am/ the individual to hold private, property has made rapid progress. The Socialists have now become a powerful party in the Reichsrath, and at each election have been returned in increasing numbers by Berlin and the other large industrial centres of Germany. In Austria the Socialist- Anti- Semite coalition has reduced parliamentary government to a nullity. In France the Socialists have compelled the Government to carry out legislation based on communist ideas, especially with regard to labour disputes between employers and workmen. In Ita,ly the Socialist movement has assumed proportions which seem to threaten the permanence of a monarchical form of Government, while in Russia they appear to have become the mainspring of all the Anti-Autocratic movements. In fact Anarchism and Nihilism owe their origin to Russia, and da^e their active existence from little more than a quarter of a century ago, when the Nihilist creed was propounded by Bakounine. Nihilism, in so far as any distinct opinion as to so nebulous a creed can be formed, is a repetition of Hamlet's saying, " The world is out of joint," supplemented by the corollary that the only way " to set it right " is to destroy all existing institutions — social, legal, or political. Logic would lead the holders of this creed to the conclusion that if the Creation has proved a hopeless failure, mankind would do wisely to terminate by universal self-immolation an experiment which has failed. Human nature,

however, even amidst Nihilists, is never rigidly logical, and the adherents of this faith of despair are still suiiiciently human to cherish the idea that if they could only get rid of the present social organizations they could call into being a new earth, if not a new heaven. The way by which this transformation is to be effected is by a series of outrages so appalling as to shake society to its very centre. The present writer's own observation of Russia, before even the name of Nihilism had become familiar to Western ears, led him to the conclusion that the colossal Empire of the North was an ideal soil for the growth of all insane revolutionary passions. In no part of the world is the contrast between the gorgeous luxury of the rich and the sordid, squalid misery of the poor so flagrant. Nowhere else are the material conditions of existence so hard for the masses ; nowhere is the line of cleavage between wealth and poverty cut so sharply. In Russia there may be said, in comparison with the size of the population, to be no middle educated class ; and in as far as such a class exists at all, it consists mainly of Germans and Jews. If this view is correct, it is not difficult to understand why the crudest theories and the most extravagant of beliefs should find a following in the dominions of the Tsar. No wish to extenuate in any way

a series of crimes which during the latter years of the 19th century have shocked humanity is conveyed by the admission that in Russia the outrages of Anarchism may to some extent be accompanied by not ignoble aspirations, and palliated in a degree by the wretchedness of their perpetrators. If Anarchism were confined to Russia there might be ground to hope that this form of mania might disappear as rapidly as it has arisen. Unfortunately the disease has spread all over the mainland of Europe, and has not only reached British shores in the form of the Fenian outrages, but has crossed the Atlantic and found a domicile under the Stars and Stripes. The explanation of this state of things possibly is that the conditions under which Anarchism sprang up in Russia exist, though in a far smaller degree, in all civilized communities. The inequalities of human existence, the contrast between wealth and poverty, the conflict between capital and labour, cannot fail to create a morbid state of mind amidst individual members of the classes which have not drawn prizes in life's lottery. Discontent with the established order of things is pardonable enough. But

when discontent develops into outrages on innocent individuals, whose sole offence is that they hold higher stations or are wealthier than their fellows, discontent becomes a crime, and must be crushed in the interests of civilization. Anarchism has driven the great mass of the middle class in all civilized countries to look with suspicion on all popular agitations, and this change of sentiment has been one of the main causes of the Conservative reaction which we Consider to have been the distinguishing feature of recent history.

To those who are old enough to remember the earlier days of the Victorian era, it is not altogether pleasant to note how many of the ideas and sympathies which held sway at that period have disappeared

from want of sustenance, just as plants die for lack of water. It may be worth while to recall wasions. ^ ^^^ °^ thesB dispelled illusions. Where is now the cult of foreign patriots ? If any

successor to the mantles of Kossuth, Garibaldi, Schamyl, Ledru RoUin, or Mazzini were to appear in England, he would be received with absolute indifference, or handed over to the police. If Dr Bernard were placed upon his trial nowadays, not all the successors of the late Mr Edwin James at the Bar could secure his acquittal by the verdict of a London jury. Where is the amiable belief that self- government under parliamentary institutions was a sort of universal panacea applicable to all countries at all times ? Some words used by the late Prince Consort during the Crimean campaign, to the effect that representative government was on its trial, raised a tremendous outcry at the time of their utterance. If His Royal Highness had stated that the Ten Commandments were u^en to criticism, he could hardly have been exposed to greater animadversion. But the parliamentary system no longer excites the admiration it formerly obtained, and even Englishmen as a body have drifted back towards the belief of their forefathers, that the system works well in England, but not equally well elsewhere. Again, why are we reminded no longer that ” the schoolmaster is abroad ” ? Since 1870 England has had as good a system of universal compulsory elementary education as British statesmanship could devise, but the most ardent educationalist would probably not deny that the results of the Board Schools have not fulfilled the expectations entertained at their inauguration.

The public at large have ceased to accept the doctrine that mental instruction is the one thing needful to raise the moral, intellectual, and material status of the masses. No doubt popular enthusiasm on behalf of popular education has been impaired by the expense of the School Boards and by the extent to which the ” Educational Parliaments ” — to use the phrase of a bygone day — have disregarded the limitations placed upon their functions as the purveyors of elementary education. Still, the cost of the Board School system would have been overlooked if the public had not learnt to distrust the theory on which the system was founded. The education acquired in virtue of the Act of 1870, whatever its other defects or shortcomings, has no doubt made the British people much more of a newspaper-reading community than they were previously, and has thereby rendered them better citizens and more ardent patriots. But a conviction that this is so does not suffice to restore the enthusiasm with which popular education was regarded at the time of its introduction into Englamd on the eve of the Franco-German War.

ENCYCLOPEDIA BRITANNICA.

(NEW VOLUMES.)

AUSTRIA-HUNGAEY.

Geography and Statistics. — 1. The Whole Monarchy.

THE Austro-Hungarian monarchy consists of two states : the ” kingdoms and lands represented, in the council of the empire (Eeichsrath),” unofficially also called Austria (Austria proper); and the “lands of St Stephen’s Crown,” unofficially called Hungary. Austria proper is composed of seventeen “lands,” called also “Crown lands.” Of these, three — namely, Bohemia, Galicia and Lodomeria,

Areas in

Population

Population in 1890. 1

Administrative Territories.

English

in 1 fifin

MUes.

in loDU.

Males.

Females.

Total.

Austria —

Lower Austria

7,630

2,330,621

1,307,913

1;353,886

2,661,799

Upper Austria

4,617

759,620

388,762

397,069

785,831

Salzburg

2,757

163,570

85,948

87,562

173,510

Styria ....

8,642

,1,213,597

635,967

646,741

1,282,708

Carinthia.

3,992

348,730

176,473

184,535

361,008

Camiola ....

3,844

481,243

238,011

260,947

498,958

Coast Territory

3,074

647,934

351,844

343,540

695,384

Tirol and Vorarlberg

11,287

912,549

454,769

474,000

928,769

Boliemia ….

19,997

5,560,819

2,821,989

3,021,105

5,843,094

Moravia ....

8,555

2,153,407

1,087,340

1,189,530

2,276,870

Silesia ....

1,981

565,475

288,908

316,741

605,649

Galicia ....

30,212

5,958,907

3,260,4.33

3,347,383

6,607,816

Bukovina

4,022

571,671

324,469

322,122

646,591

Dalmatia

Total . Hungary—

4,923

476,101

266,303

261,123

527,426

115,533

22,144,244

11,689,129

12,206,284

23,895,413

Hungary proper

108,015

13,812,330

7,548,012

7,683,515

, 15,231,527

Croatia and Salvonia

16,421

1,905,295

1,105,272

1,096,655

2,201,927

riume . . . Total . Austro-Hungarian Monarchy

8

21,634

14,691

15,446

30,337

124,444

15,739,259

8,667,975

8,795,616

17,463,791

239,977

37,883,503

20,357,104

21,001,900

41,359,204

Bosnia and’Herzegovina .

19,702

1,361,290

851,134

739,902

1,591,036

and Dalmatia — are kingdoms; two — ^Lower and Upper Austria — archduchies; six.— Salzburg, Styria, Carinthia, Carniola, Silesia, and Bukovina — duchies; two — Gorz-

Gradiska and Tirol — counties raised to principalities {gefilrstete grafshaften) ; two — Moravia and Istria — margraviates (march counties). Vorarlberg bears the title simply of “land.” Trieste, with its district, is a town treated as a special Crown land. For administrative purposes Trieste, with Gorz-Gradiska and Istria, con- stituting the Austro-Illyrian coast land, and Tirol and Vorarlberg, are each comprehended as one administrative territory. The remaining lands constitute each an

administrative territory by itself. The “lands of St Stephen’s Crown” are com- posed of — (1) the kingdom of Hungary, with which are in- corporated the former grand- principality of Tradsylvania (Siebenbilrgen), and a part of the military frontier; (2) the kingdom of Croatia- Slavonia, to which belongs the former Croato-Slavonian military frontier ; and (3) the ^town and district of Fiume. By the Berlin Treaty of 1878 the principalities of Bosnia and Herzegovina, owning Turkey as suzerain, are placed under the administration of Austria-Hungary ; while Aus- trian garrisons are stationed at three points in the Turkish sanjak of Novi-Bazar.

Area and Population. — The areas and the popula- tions, according to the cen- suses of 1880 and 1890, of the different administrative territories are given in the accompanying table. According to the census of 1900, the population of Austria was then some 26,120,000;

S. II. — I

A U S T R I A-H U N G A E Y

[dual monarchy

that of Hungary in the middle of 1898 was 18,862,269; so that the total population of the whole monarchy at the end of 1900, on these results, aggregated about 45 J- millions. The number of inhabitants to an English square mile in 1890 was, in Austria, 206 ; in Hungary, 140. The average yearly increase of population in Austria from 1869 to 1880 was 0-87, from 1880 to 1890, 0-76 per cent., and from 1890 to 1900, 0-94 per cent. ; in Hungary, from 1869 to 1880, 013, and from 1880 to 1890, 1-09 per cent. In Bosnia and Herzegovina, the number of inhabitants to an English square mile was 81, and the average yearly increase (1885-96) 1-7 per cent.

Government.-T-The present constitution of the Austro- Hungarian monarchy is based on the Pragmatic Sanction of the Emperor Charles VI. of 19th April 1722, whereby the succession to the throne is settled in the dynasty of Hapsburg-Lothringen, descending by right of primogeni- ture and lineal succession to male heirs, and, in case of their extinction, to the female line, and whereby the in- dissolubility and indivisibility of the monarchy are de- termined ; is based, further, on the diploma of the

Emperor Francis' Joseph I. of 20th October 1860, whereby the constitutional form of government is introduced ; and on the fundamental laws of the 21st December 1867, regulating the affairs common to all lands of the monarchy.

The unity of the monarchy is expressed in the common head of the state (emperor of Austria and apostolic king of Hungary) and in the declared community of certain state departments (Foreign Affairs and the Army), as also of the organs appointed for their maintenance — the Delegations, Common Ministry, Common Supreme Court of Exchequer. In other relations the two states of Austria and Hungary, composing th^ monarchy, are com- pletely independent, each having its separate parliament and separate Grovernment. The constitutional right of voting money applicable to the common affairs and of its political control is exercised by the Delegations, which consist each of sixty members, chosen for one year, one- third of them by the Austrian Herrenhaus (Upper House) and the Hungarian Table of Magnates (Upper House), and two-thirds of them by the Austrian and the Hungarian Houses of Representatives. The Delegations are annually summoned by the monarch alternately to Vienna and to Budapest. Each delegation 'has its separate sittings, both alike public. Their decisions are reciprocally communicated in writing, and, in case of non- agreement, their deliberations are renewed. Should three such interchanges be made without agreement, a common plenary sitting is held of an equal number of both dele- gations ; and these collectively, without discussion, decide the question by common vote. | The common decisions of both Houses require for their validity the sanction of the monarch. Each delegation has the right to formulate resolutions independently, and to call to account and arraign the common ministers. In the exercise of their office the members of both delegations are irresponsible, enjoying constitutional immunity.

For the administration of common affairs there are three ministries : the Ministry of the Imperial House of Foreign Affairs ; the Ministry of War, including the naval depart- ment ; and the Common Ministry of Finance. For the control of the common finances there is appointed a Common Supreme Court of Exchequer. The Ministry of Foreign Affairs can conclude international treaties. But commercial treaties and such state treaties as impose burdens on the state, or parts of the state, or involve a change of

territory,, require the parliamentary assent of both states. The Common Ministry of War is the highest authority for the administration of all military affairs, to the exclusion of the functions committed to the ministries

for national defence of the two states. For the military and administrative service of the army there are fifteen military territories (fourteen corps-commands and one military command), besides a special corps-command for Bosnia and Herzegovina. Under these territorial author- ities are the supplementary (Ergdnzungs) district-com- mands (103 for the army, three for the navy), whose business it is to fill up deficiencies in the army and to keep the register of the troops.

The army on a peace footing numbers 21,203 officers and military functionaries, 283,877 men, and 58,475 horses. The strength of the different bodies of troops is : —

Bodyguard Infantry

Infantry .

Chasseurs

Mounted Bodyguard

Cavalry .

Field Artillery

Fortress Artillery’

Pioneers .

Railway and Telegraph Regiment

Transport Service (train)

Other Services

Total

Extraordinary Force

Officers,

4

8,816

974

4

1,764

1,583

398

480

86

417

917

15,443

44

- Men.

129

161,002

16,491

132

45,726

25,502

7,762

8,430

1,487

3,309

5,863

275,833

4,533

Horses.

1,020

92

76

40,686

13,901

134

15

4

1,916

1,922

69,766

1,632

The navy on its peace footing consists of 811 officers, &o., and 2486 sailors for land service ; 638 officers and 5450 sailors for sea service ; total number of persons belonging to the navy, 9385. The fleet consists of : —

1

Number.

Displace- ment Tons.

Horse- Power.

Crew.

Battleships and cruisers .

Torpedo boats .

Transports

River boats

Ships &)r mission stations

and coast service Ships for special purposes

and ships of servitude Training ships . Hulks ....

Total .

27

75

3

6

15

10

10

5k

126,805

7,492

5,490

1,556

18,588

7J760

12,920 6,510

169,000

77,800

5,500

4,090

13,750

5,905

2,960

9,087

1,522

383

300

2,731

222

1,547 186 ,~

151

187,121

279,005

15,978

The Common Ministry of Finance has charge of the finances of common affairs, of the state debt, consisting of Treasury bills and bills guaranteed in common, and of the still standing common funds. The requisitions of

Expenditure — Foreign Affairs . War and Marine . Finance Board of Control

Totol Bevenue — For the above Departments Customs . . . . Proportional Contributions .

Total .

(In thousands sterling.)

18T6.

396 9005-4 154-2 10-5

9566-1

432 997-4 8136-7

9566-1

1885.

368-7 10085 167-2 10-6

10631-5

258-2

402-2

9971-1

10631-5

1895.

333 12539 170-4 10-7

13053-1

260-7 4476 8316-4

13063-1

the departments of common affairs are covered, first, by the revenues proper of the ministries and of the Common Supreme Court of Exchequer ; then by the net proceeds of the customs ; and the remainder by the proportional con-

Austria]

AUSTEIAHUNGARY

tributions of the two states (at present 66f|- per cent, being paid by the kingdoms and lands represented in the Eeichsrath, 33^ per cent, by the

lands of the Hungarian crown), 2 per cent, of the remainder being, however, previously debited to Hungary on account of the incor- poration of the former military frontier.

The budget for the common administration for the year 1900 was as follows : —

Ordinary.

Extra- ordinary.

Total.

MBpendifwre.

1. Ministry of Foreign Affairs

2. Ministry of War 1^^ •

8. Ministry of Finance 4. Board of Control

Total

Revenue.

1. Ministry of Foreign Affairs

2. Ministry of War

3. Ministry of Finance .

4. Board of Control ....

5. The Customs

6. Payment by Hungary on account

of Incorporation of Military Fron- tier

7. Austria’s Contribution (66U per

cent.)

8. Hungary’s Contribution (88^ per

cent.)

Total ....

£427,936

11,559,407

1,081,851

177,624

12,955

£8,422

585,867

579,119

799

£436,868

12,146,274

1,660,970

178,428

12,965

£13,269,773

£15,075

870,667

3,877

629

5,201,919

176,865

5,754,002 2,911,666

£1,174,207

£14,438,980

£16,075

370,557

8,877

529

5,201,919

176,865

5,754,002 2,911,666

£14,483,980

£14,433,980

Commerce. — On the basis of the customs and commercial agreement between Austria and Hungary, concluded in 1867 and renewable every ten years, the following affairs, in addition to the common affairs of the

monarchy, are in both states treated according to the same principles : — Commercial affairs, including customs legislation; legis- lation on the duties closely comiected with industrial production — on beer, brandy, sugar, and mineral oils; determination of legal tender and coinage, as also of the principles regulating the Austro-Hungarian Bank; ordinances in respect of such railways as affect the interests of both states. In respect, also, of the principles of the military system and of the yearly vote of the contingent of recruits, the laws passed in both states must always be in accord. In conformity with the customs and commercial compact between the two states, renewed last in 1899, the monarchy constitutes one identical customs and commercial territory, inclusive of the occupied provinces of Bosnia and Herzegovina and the principality of Liechtenstein. Outside of this customs and commercial territory, there are only the two free ports of Trieste and Fiume, and the two small com- munities of Tirol and Vorarlberg, which are consigned to the German customs territory. The foreign trade of the monarchy, in the scope defined by the inclusions and exclusions above specified, amounted in the three years 1889, 1898, and 1899, to the following respective values in millions sterling : —

Total Imports Total Exports

47-4 63-8

68-3 67-2

65-8 77-3

In 1889 and 1899 there was accordingly an excess of exports to the values of £16,400,000 and £11,500,000, whereas in 1898 the imports exceeded the exports by £1,100,000.

Of the total imports in 1899, wool and woollen yarns and goods composed 11-35 per cent. ; cotton and cotton yarns and goods, 8-63 per cent. ; wood, coal, and turf, 5-68 per cent. ; silk and silk goods, 5-50 per cent. ; animal products, 5-42 per cent. ; base metals and wares, 4-15 per cent. ; vegetables and fruit, 4-11 per cent. ; corn, pulse, and meal, 3-50 per cent. ; colonial goods, 2-97 per cent. ; leather and leather goods, 2-93 per cent. ; machinery and apparatus, 2-90 per cent. ; literary and artistic objects, 2-90 per cent. ;

instruments, watches, and hardware, 2-82 per cent. ; flax, hemp, jute, and wares, 2-73 per cent. ; drinks, 2-57 per cent. Of exports, wood, coal, and turf composed 17-08 per cent. ; sugar, 9-33

per cent. ; com, pulse, fruit, and meal, 7-94 per cent. ; aniihal pro- ducts, 7-80 per cent. ; animals for slaughter and beasts of burden, 5-94 per cent. ; vegetables and fruit, 5-38 per cent. ; wool, yarns, and textiles, 4-42 per cent. ; precious metals and coins, 3-82 per cent. ; leather and leather goods, 3-25 per cent. ; instruments, watches, and hardware, 3-13 per cent. ; glass and glass wares, 2-65 per cent. ; iron and iron wares, 2-43 per cent. ; wooden and bone articles, 2-43 per cent. ; drinks, 2-39 per cent. ; clothes, linen, finery, 2-31 per cent.

Of agricultural, forest, and fishery produce in the year 1899, the value of imports amounted to £31,300,000; of exports, £28,900,000. Of the products of the mining and smelting industries, the imports (1899) were £8,000,000 ; the exports, £5,500,000. The imports of the other industries valued £26,600,000; the exports, £42,900,000. Of the total imports about 10 per cent, came, of the total exports about 6 per cent, went, by sea ; the rest by land.

The most important place of derivation and of destination for the Austro-Hungarian trade is the German empire, with 35 per cent, of the impoi-ts and 54 p6r cent, of the exports. Great Britain's share is 12 per cent, of the imports and 9 per cent, exports ; Italy, 7 per cent, imports, 7 per cent, exports ; Russia, 7 per cent. impo*ts, 3 per cent, exports ; France, 3 per cent, imports, 3 per cent, exports ; the United States of America, 8 per cent, imports, 2 per cent, exports ; India, 6 per cent, imports, 2 per cent, exports. Important is the trade also with the Nether- lands, Rumania, Servia, Turkey, and Switzerland.

The Austro-Hungarian . Bank. — Common to the two states of the monarchy is the "Austro-Hungarian Bank," which possesses a legal exclusive right to the issue of bank notes. In virtue of the new bank statute of the year 1899 the bank is a joinl^stock company, with a stock of 210,000,000 crowns (£8,780,000). The bank's notes of issue must be covered to the extent of two-fifths by legal specie (gold and current silver) in reserve ; the rest of the paper circulation, according to bank usage. When

the amount of bank notes in circulation exceeds the specie in reserve by more than 400,000,000 crowns, the bank has to pay both states a tax of 5 per cent, on the surplus. The management of the bank and the supervision exercised over it by the state are established on a footing of equality, both states having each the same influence.

2. Austria Proper.

Austria proper comprises the “kingdoms and lands represented in the Eeichsrath,” covering an area alto- gether of 116,633 English square miles, with a population at the census of 31st December 1890 of 23,895,413, or 208 inhabitants per square mile. Of this population over 6,000,000 are distributed among 772 towns, and over 17,000,000 are scattered in 58,479 rural communities. In 1900 the largest towns were : — Vienna, with 1,639,811 inhabitants ; Prague, 197,000 ; Trieste, 167,000 ; Lemberg, , 142,000; Graz, 125,000; Briinn, 105,000. For every 1000 men there are 1044 women. Of the population 60-5 per cent, are single; 33-3 per cent, are married; the rest are widowers, widows, or ^a”’”’ divorced. For every 1000 inhabitants, again, there are 129 under 6 years of age ; 110, from 6 to 10 years old ; 103, from 10 to 15 years old ; 609, from 16 to 65 years old; and 49 above 66 years of age. Further, for every 1000 inhabitants 16 marry per year; 37 to 39 are born; and 26 to 28 die. Of persons marrying, 88 per cent, are single, and 12 per cent, widowers or widows. For every 1000 children born, 514 are males, 148 illegitimate, and 28 still-born. For every 1000 males that have died, 364 died in their first year and 607 at an age between 1 and 6 years ; for every 1000 females that have died, 299 died in their first year and 455 at an age between 1 and 5 years. The proportion of mar- riages, living births, and deaths for the years 1875, 1885, 1895, and 1898 is shown in the following table : —

Tear.

For every 1000 Inhabitants the number of

Marriages.

Born alive.

Deaths.

1875 , 1885 1895 1898

17-26 15-32 16-10 15-66

40-29 37-63 37-94 37-20

30-33 30-15 27-53 24-90

A U S T E I A-H U N G A R T

[AUSTRIA :

The transmarine emigration averaged per year, from 1889 to 1893, 38,240; from 1894 to 1898, 31,218 persons. Of these emigrants two-thirds went to North America, and almost all the rest to Brazil, Argentina, and Uruguay.

At the censuses of 1880 and 1890, the different races, as deter- mined by the different languages spoken by them, were represented as follows : —

In percentages of the Home-born

Germans

Population.

1S80. ‘

1890.

36-75

36-05

Bohemians, Moravians, Slovaks

23-77

23-31

Poles

14-86

15-84

Ruthenians

Slovenes

12-83

13-23

5-23

5-01

Servians and Croats

2-58

2-75

Italians and Ladini ….

3-07

2-88

Rumanians

0-88

0-89

Magyars

0-05

0-04

Of the Germans, 28 per cent, are in Lower Austria ; 25-5 per cent, in Bohemia; 10 per cent, in Styria; 9 per cent, in Upper Austria ; 8 per cent, in Moravia ; 5 per cent, in Tirol ; the rest being scattered over all the other Austrian lands. Of the Bohemians, Moravians, and Slovaks, 66 per cent, are in Bohemia ; 29 per cent, in Moravia; 2 per cent, in Silesia; 1-7 per cent, in Lower Austria. The Poles are found almost exclusively in Galicia (94-4 per cent.) and Silesia (4-8 per cent.). The Ruthenians occupy Galicia (91-3 per cent.) and Bukovina (8-6 per)cent.). Of the Slovenes 39-6 per cent, are in Camiola ; 34 per cent, in Styria ; 17-5 per cent, in the Coast Province; 8-6 per cent, in Carinthla. Of Servians and Croats, 77-7 percent, were counted in Dalmatia and 21-9 per cent, in the Coast Province. Of the Italians 53-2 per cent, are settled in Tirol ; 43-6 per cent, in the Coast Province ; 2-4 per cent, in Dalmatia. The Rumanians are confined almost exclusively in Bukovina (99-6 per cent.) . The Magyars belonging to the Austrian state are to be found only in Bukovina. Of Austrian lands. Lower and Upper Austria, Salzburg, and Vorarlberg. are almost purely German. In Styria 68 per cent, of the popular tion is German, and 32 per cent. Slovenes. In Carinthia, 71-5 per cent, of the population is German, against 28-5 per cent, of Slovenes. In Tirol 55 per cent, of the population is German and 45 per cent. Italian. In Silesia 48 per cent, of- the population is German, against 30 per cent, of Poles and 22 per cent, of Czechs. In Bohemia the Czechs preponderate to

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the extent of 63 per cent, of the population against 37 per cent, of Germans. Moravia is divided between 70 per cent. Czechs and

30 per cent. Germans. In Carinthia the Slovenes constitute 94 per cent, of the population, the Germans only 6 per cent. In the Coast Province 45 per

cent, of the population is Italian,

31 per cent. Slovenes, and 21 per cent. Serbo-Croats, the Germans composing only 2-3 per cent. Galicia has a population 53 per cent. Polish, 43 per cent. Ruthenian, and 3-5 per cent. German. In Bukovina the Ruthenians form 42 per cent, of the population.

side by side with a Rumanian population 32 per cent., a German population 21 per cent., Poles 3-7 per cent., and Magyars 1-3 per cent.

Of the total population 91 per cent, belong to the Catholic Church, and by far the greatest part of the Catholics are Catholics according to the E.oman rite. Catholics of the Greek and the Armenian rite are con-

statistics]

A U S T E I A-H U N G A E T

fined almost exclusively to Galicia and Bukovina; the former constituting 11-8 per cent, of the total population Religioa. ‘ °^ ^^^ s^’^, the latter 0-01 per cent. In addi- tion,- Old Catholics are to be found scattered about, making up a total strength of 0-03 per cent, of the population of Austria. The Greek {i.e., Oriental or Orthodox, not the united) Church is represented in far its greatest strength in Bukovina (70 per cent.) and in Dalmatia (16‘5 per cent.). The Protestants compose some 2 “per cent, of the total population ; nearly three- fourths of them belong to the Augsburg or Lutheran Confession, one-foui-th to the Eeformed, Calvinistic, or Helvetian Confession. The Protestants are most numerous in Silesia, where they form 14 per cent, of the population ; next in Carinthia (5 per cent.), Moravia (2-7 per cent.) Bukovina (2-5 per cent.), and Bohemia (2-2 per cent.). The adherents to the Augsburg Confession are most strongly represented in Silesia (27 per cent, of their total strength), Bohemia (19 per cent.), Lower Austria (14 per cent.), and Galicia (12 per cent.). Of the adherents to the Eeformed Confession, 55 per cent, are in Bohemia, 31 per cent, in Moravia, 6 per cent, in Lower Austria, and 4 per cent, in Galicia. Representa- tives of other Christian Confessions in Austria are Herrn- huters in Bohemia ; Anglicans in Lower Austria, Trieste, Bohemia, and Galicia ; Mennonites in Galicia ; Unitarians in Lower Austria ; Lippovanians in Bukovina. The

Jews compose 4-8 per cent, of the entire population, and are in greatest strength in Galicia, where there are 67-5 per cent, of their total number in Austria ; in Lower Austria, 11-3 per cent. ; in Bohemia, 8-3 per cent. ; in Bukovina, 7‘2 per cent. ; in Moravia, 4 per cent. The provinces in ■which the Jewish ingredient in the total population is most pronounced are Bukovina, where they constitute 12-8 per cent, of the total population ; Galicia, 11-7 per cent. ; Lower Austria, 4-8 per cent. The Catholic Church has 7 Latin archbishoprics, 1 Greek and 1 Armenian arch- bishopric ; 23 . Latin and 2 Greek bishoprics. The Greek Oriental Church has 2 archbishoprics and 2 bishoprics. The Evangelical Church has 5 superin- tendents of the Augsburg, 3 of the Helvetian, and 1 of Mixed Confession. The Israelitish Confession has 545 religious communities, most of th^m in Galicia, Bohemia, and Moravia. The Roman Catholic Church rules over (i895) 488 monasteries with 8630 monks and 647 nunneries with 15,616 nuns. The Greek Oriental Church has 3 monasteries with 48 members. The capital stock of the Catholic Church is authentically estimated at 283,500,000 florins; that of the cloisters and other church establishments at 126,000,000 florins.

Public instruction is organized in four groups of educa- tional institutions, high schools, middle schools, technical schools, and elementary schools. There are Education, gjgj^^ universities: — Vienna, Graz, Innsbruck^ Prague (German), and Czemowitz, in all which German is the language of instruction ; Prague (Bohemian) with Czech, Cracow and Lemberg with Polish, as the lan- guage of instruction. Each university has four faculties

Tear.

Teaching Staff.

Ordinary Pro- fessors in Teaching StafT.

Lectures.

Students.

Ordinary Stu- dents-among the Students.

1875

1885

1895

. 1898

689 1029 1262 1395

273 334 424 451

1091 1541 1925 2086

9,227 13,069 16,560 17,322

7,616 11,361 18,169 13,624

— ^theology, law and political science, medicine, and philosophy. In Czernowitz, however, the faculty of medicine is wanting. The theological faculties are all Roman Catholic, except in Czernowitz, where the theo-

logical faculty is Greek-Oriental. The preceding table gives summary figures for all the eight universities during the winter sessions of the years specified. The figures of 1875, however, do not include the universities of Bohemian Prague and Czernowitz. There are seven technical high schools in Vienna, Graz, Prague, Brlinn, in which German is the language of instruction; Prague and Brlinn with Czech, and Lem- berg with Polish, as the language of instruction. There is also one high school for agriculture in Vienna. At these high schools there are special technical depart- ments : — Engineering, building (above ground), machine- making, technical chemistry, and a general department. The building department is wanting in Brilnn (German), and the general department in Lemberg. The technical high school in Brlinn (Czech) was founded in 1899. The high school for agriculture includes a school of husbandry, of forestry, and of technical culture. The attendance at these institutions during the winter sessions was as follows : —

Tear.

Teaching Staff.

Ordinary Pro- fessors in Teaching Staff.

Lectures,

Students.

Ordinary Stu- dents among the Students.

1876 1885 1895 1898

287 372 416 449

102 120 130 135

441 846 678 692

3^70

2566 3144 4628

3152 2399 2803 4136

In addition there exist, in the character of high schools, 2 mining academies in Leoben and Pribram; 3 art schools in Vienna, Prague, and Cracow ; 2 Catholic theological faculties at Salzburg and Olmutz ; 1 evangeli- cal theological faculty at Vienna ; and 1 veterinary high school at Vienna. There are, further, 45 theological educational institutions ; among them one Greek-Catholic and 1 Armenian-Catholic, as also a Greek-Oriental, educational institution. As middle schools there are gymnasia, real-gymnasia, and real-schools. Gymnasia are intended for humane (or classical) culture ; the others for general culture. Their growth is shown in the following figures : —

Tear.

, Gymnasia and Eeal-Symnasia. ,

Eeal-Schools.

iTumber.

Teachers.

Pupils.

Number.

Teachers.

Pupils.

1875 1885 1895 1898

155 172 181 196

2527 3512 3756 3962

34,137 54,288 56,152 59,980

74 80 ,80 93

1362 1353 1610 1812

21,552 16,969 23,600 27,011

Eor the training of teachers of elementary schools, there are 50 institutions for male and 33 for female teachers. Further, there are 187 commercial schools and 940 industrial schools. Among the latter, 21 are national industrial schools and institutions of kindred character ; 158 are technical schools for particular industrial branches, 11 are general trades schools, and 750 are industrial adult schools. There are, moreover, 137 schools of agriculture and of forestry, 6 lower-grade mining schools, 3 nautical schools, 8 veterinary and horse-shoeing schools, 15 mid- wifery schools, 509 schools, for musical and dramatic culture, 612 schools for female hand-work and tailor- ing, and 802 other special teaching and educational institutions. Elementary instruction is given by the national schools

(Volksschulen), and, jn the larger towns, by the burgher schools. By virtue of a law passed in 1869 every community is, in general, bound to establish a public primary school. Apart from certain exceptions, attendance at school is obligatory on all, from the 6th to the 14th year of age. Side by side with the public schools, private schools are also allowed, which, if fulfilling the legal requirements, may

be accorded the validity of public primary schools. The progress of the primary and burgher schools is shown in the following table : —

Tear.

Public Schoola.

Private Schools.

Number.

Teachers.

Pupils.

Kumber.

1875 1885 1895 1898

14,257 16,440 18,285 18,747

27,677 54,467 69,776 74,783

2,050,808 2,679,638 3,260,852 3,359,509

909 976 987 988

Of the public primary schools in 1898, 42 per cent, had each but 1 class; 25 per cent., 2; 11 per cent., 3; 7 per cent., 4; 11 per cent., 6; 4 per cent., 6-8 classes of graduated ascension. In 40 per cent, of the public primary schools, German was the language of instruction; in 26 per cent., Czech; in 11 per cent., Polish; in 10 per cent., Ruthenian; in 4 per cent., Italian; in 4 per cent., Slovenian; in 2 per cent., Serbo-Croatian; in the rest of the schools, Rumanian or Magyar. For every 1000 square kilometres, there are 66, for every 100,000 inhabitants, 77 primary schools. To each primary school there are, on an average, 176-6 pupils; to each teacher, 50 pupils; for every 100 children under obligation to attend, there are 88 actually attending, school. i'jThe Eeichsrath exercises the legislative power for all ffie kingdoms and lands constituting the state. It consists

since 1861 of two Houses ; an Upper House (the mefl™' Herrenhaus) and a Lower House (the Abgeord-

netenhaus). The Upper House has continued unchanged in its composition ; the Lower House has un- dergone considerable changes in 1867, 1873, and 1892. Formerly, the members of the Lower House were returned by the diets of the various provinces; since 1873 they are appointed by the direct vote of the citizens. By an electoral law of the Reichsi-ath passed on the 14th June 1896, the Lower House consists of 425 representatives chosen in 5 curias : the first curia comprising the represent- atives of the large landed estates ; the second, represent- atives of the chambers of commerce and manufactures ; the third, representatives of the towns, market-places, and industrial localities; the fourth, representatives of the rural communities ; the fifth consists of 72 representatives of all duly-qualified citizens over 24 years of age. For this last curia, those also who have already exercised their electoral right in the four other curias are entitled to vote. The Government is constituted of the council of ministers, at whose head is the minister-president. The different ministries are the ministry of the interior, of national defence, of worship and instruction, of finance, of commerce, of agriculture, of justice, of railways. There are, further, two ministries without portfolio for Galicia and Bohemia. The civil administration in the different provinces is carried on by governors or stadhold- ers (Statthalter), and, in the smaller provinces, provincial governments ; subordinate to them are the heads of the various districts. For the administration of justice in the

provinces there are 8 upper provincial courts {Oberlandes- gerichte), under which are the provincial and district courts {Landes- und Kreis-gerichte) , as also the county courts (Bezirksgerichte). For the administration of the finances there are constituted financial provincial boards of directors (Finanz landesdirectionen), and, in the smaller provinces, financial boards of directors (Finanz directio- nen), under which are the financial county boards of di- rectors and the boards of inland revenue. The provincial representation in the 17 provincial diets of the different kingdoms and lands of the state is based on the provincial regulations of the year 1861. The autonomous provincial administration is discharged by the provincial committees of the separate diets. In Bohemia, Styria, and Galicia,

autonomous county representation is organized. Local self-administration is everywhere in the competence ,of the local communities. Among these are 33 with special statute, having, like heads of districts, the raanagement also of the civil administration. The growth of the Austrian budget is shown by the following figures : —

f

1875.

1885.

1895.

1900.

Expenditure

Revenue ....

£32,647,000 £32,647,000

£44,121,600 £43,714,666

£65,896,916 £67,446,091

£66,008,494 £66,020,476

The debt consists of the (earlier) general debt, the later consolidated debt, and the floating debt.

These debts for the four years specified were : —

General State Debt —

Consolidated

Floating ....

Other debt ....

Debts of the Lands of the

Beichsrath — Consolidated Floating ....

1875.

1885.

1895.

1899,

end of June.

(In millions sterling.)

223-33 7-95 1-13

223-61 6-28 1-13

45-81 0-12

225-02 3-52 1-13

119-25 0-26

222-76

. 3-00

1-13

134-37 1-26

232-41

276-95

349-18

862-52

The actual financial situation will be seen in detail in the following budget of the Austrian administration for 1900:— ^

Haipendiiwre.

Ordinary.

Extra- ordinary.

Total.

‘

Imperial Household ....

£387,177

.^

£387,177

Imperial Cabinet Chancery

6,669

6,669

Eeichsrath

99,984

£8,826

108,310

Imperial Court

2,085

2,035

Council of Ministers ....

114,881

83

114,414

Ministry of the Interior .

2,039,697

488,963

2,528,660

„ National Defence

2,282,688

22,755

2,255,398

,, Worship and Instruction

2,844,284

289,670

8,188,854

,, Finance

10,517,618

252,818

10,770,436

„ Commerce .

4,408,178

288,678

4,646,856

„ Eailwaya ....

9,072,425

436,295

9,608,720

,, Agriculture

1,488,012

164,287

1,672,249

„ Justice

2,560,111

198,605

2,748,716

Board of Control ....

17,819

17,319

Pensions, Grants, and Subsidies ,

2,596,104

266,170

2,861,274

Share of Interest on Public Debt

14,822,648

14,822,648

Administration of Public Debt .

68,990

10,888

64,828

Share of Expenditure on Common

Affairs

Total

Investments

10,660,284

198,717

10,858,951

S68,412,454

£2,691,040

£66,008,494

£2,828,372

JR&venue.

Direct Taxes

£11,188,605

£11,138,606

Customs Duties ....

4,772,848

4,772,848

Duties on Articles of Consumption

12,442,881

12,442,881

Salt Monopoly

Tobacco Monopoly ....

1,878,768

1,878,768

8,736,479

8,785,479

Stamps

2,381,390

2,881,890

•ludicial Fees . , . .

8,981,307

8,981,807

State Lottery . ....

1,818,022 214,080

1,818,022

Other Duties . . . .

214,080

State Property and Mint i

289,804

289,804

Domains and Forests

.584,672

£46

684,718

Mines ‘

719,845

719,845

Post Office and Telegraphs .

4,076,867

4,076,867

Miscellaneous

Total . Investments . .

18,196,560

451,811

18,647,361

£65,668,618

£461,867

£66,020,476

£47,889

Of the whole territory of the state — in round numbers, 30,000,000 hectares (or 74,100,000 acres) — about 29 per cent, is appropriated to large landed estates ; 71 per cent, is disposed of in nledium and smaller properties. Large landed property Lao^ed is most strongly represented in Bukovina, where it P’^peny- absorbs 46 per cent, of the whole territory. Large landed property

owns 30 to 40 per cent, of all the land of Salzburg, Galicia, Silesia, and Bohemia. In Moravia, Styria, Carinthia', Tirol, and Vorarlberg, Upper and Lower Austria, large landed estates claim 20 to 30 per cent, of the soil. Large landed property holds, in Carniola, 16 per cent, of the ground; In the Coast Province, 8 per cent. ; in Dalmatia, 3 per cent. To the state

statistics]

belongs 4J per cent, of the total territory. The Church, the com- munities, and the corporations are also in possession of large areas of land ; 4 per cent, (speaking roundly) of the territory of Austria is held on the tenure of fidei-commissum. Of the entire property in large landed estates, 59 per cent, is laid out in woods ; of the property in fidei-commissum, 66 per cent, is woodland ; of the entire forest land, about 10 per cent, is the property of the state ; 14-5 per cent, is communal property ; and 3-8 per cent, is the property of the Church. The whole of the territory in large landed estates includes 52 per cent, of the entire forest land. The forest land held under fidei-commissum amounts to over 9 per cent, of the entire forest land.

Agriculture, however, forms the most important source of income. Over 55 per cent, of the population draw their principal Agri- revenue from it. Of the whole area of the State,

culture. 35-45 per cent, is laid out in arable land; 10-26 per cent, in meadows ; 2-07 per cent, in gardens and vine- yards; 8-88 per cent, in pastures; 4-66 per cent, in mountain pastures; 82-59 per cent, in woods; 0-38 per cent, in lakes, marshes, and ponds ; 3 per cent, of the land is unproductive. The rest of the land is disposed of in other, not agricultural, uses. The lands having the largest proportions of arable soil are Bohemia, with 24-7 per cent. ; Moravia, with 11-4 percent. ; and Galioia, with 35-8 per cent. Of land laid out in vineyards, Dal- matia has 33 per cent. ; the Coast Province, 22-3 percent. ; Lower Austria, 16 per cent. ; and Styria, 13-7 per cent. Of mountain pastures, Tirol has the largest share, 55-6 per cent. ; Salzburg has 14-8 per cent. ; Carinthia, 12-6 per cent, of woodland; 20-7 per cent, falls to Galicia; 15-4 per cent, to Bohemia; 11-3 per cent, to Tirol ; 11 per cent, to Styria. Within the bounds of each pro- vince, Styria has the

greatest proportion of its surface under wood, namely, 47-9 per cent, of its whole area ; Carniola has 44-4 per cent. ; Carinthia, 44-2 per cent. ; Bukovina, 43-2 per cent.; Tirol, 38-8 per cent. The most thinly- wooded provinces are Galicia, with 25-8 per cent, of its surface in wood ; Moravia, with 27 -4 per cent. ; Bohemia, with 29 per cent. ; and Dalmatia, with 29-7 per cent.

The produce of the ploughed land does not, on the whole, sufBce for the home requirements. Considerable quantities, in particular of wheat and maize, are imported from Hungary for home consumption. Only barley and oats are usually reaped in quantity for export.

The respective areas of crop lands, the relative average yields and the total yields, in different crops, for different years, may be gathered from the following tables : —

Quinquennial Average in 1000 Acres.

1881-5.

1891-5.

1899.

Under wheat ....

2614

2677

2600

,, rye and spelt

4724

4675

4464

,, barley .

2609

2767

2883

„ oats

4367

4578

4532

,, maize .

861

861

817

,, pulse

640

674

(1898) 694

,, potatoes

2522

2677

2866

,, sugar beet

500

610

509

,, (cattle) turnip

349

398

386

For every acre of land the average produce in the different crops in bushels was : —

1881-5.

1891-5.

1899.

In wheat .....

15-51

15-81

18-6

,, rye and spelt

15-41

15-49

18-5

„ barley

17-72

19-61

22-3

„ oats

20-88

21-97

26-1

,, maize .....

18-72

18-93

16-8

„ potatoes ....

109-26

84-63

(1898) 108-0

For each acre in cwts. : —

1881-5.

1891-5.

1899.

In sugar beet .... ,, (cattle) turnip

157-03 107-50

169-54 121-01

(1898) 180-1 (1898) 132-1

The total produce in millions of bushels was accordingly :

1S81-5.

1891-5.

1899.

In wheat

41-8

48-5

50-0

,, rye and spelt

75-1

74-6

84-9

„ barley

47-6

56-1

66-5

,, oats

94-0

103-7

121-5

,, maize

16-5

16-8

14-1

,, pulse

7-4

8-6

(1898) 9-7

,, potatoes ....

284-1

282-4

319-3

In millions of cwts. :-

1810-6.

1881-5.

1891-5.

1S99.

In sugar beet >. ,, (cattle) turnip

47-4 26-6

80-8 38-6

112-8 50-2

(1898) 94-4 (1898) 52-6

Besides these principal crops, other crops of considerable magni- tude were : Buckwheat in Styria, Galicia, pamiola, and Carinthia ; rape and rape-seed in Bohemia and Galicia ; poppy in Moravia and Silesia ; flax in Bohemia and Moravia, Styria, and Galicia ; hemp in Galicia ; chicory in Bohemia ; tobacco in Galicia, Dalmatia, and Tirol ; fuller's thistle in Upper Austria and Styria ; chrys- anthemum in Dalmatia ; cabbage in Bohemia and Galicia, Lower Austria, and Styria ; hops in Bohemia, Galicia, and Moravia ; rice in the Coast Province ; chestnuts in the Coast Province and Tirol ; olive oil in the Coast Province and Dalmatia ; mulberry leaves in Tirol, Dalmatia, and the Coast Province ; the vine in Lower Austria, Styria, .the Coast Province, Tirol, and Dalmatia.

In the forest land tall timber predominates to the extent of 85 per cent., and consists of conifers much more than of green or leaved trees, in the proportion of 70 against 15 out of the 85 per cent, of the total forests laid out in tall forests. timber. Exceptions are the forest lands of the Karst, where, in the Coast Province, medium-sized trees and underwood occupy 80 per cent., and of Dalmatia, where underwood occupies 92-6 per cent., of the forest land. Green (or l«aved) wood is most prevalent in Carniola, where it forms 44-5 per cent, of the total forest ; in Galicia it has 24-5 per cent, of the forest ; in Bukovina, 22-1 per cent. ; in Lower Austria, 17 per cent. Scantiest in green tall timber is Tirol, where greenwood has only 2-2 per cent, of all the forest ; Bohemia, with 4 per cent, in greenwood out of the entire forest land ; Dalmatia, 4-1 per cent, of greenwood in its forest. Greenwood is poorly represented also in Salzburg and Carinthia, in whose forests its share is only 7 to 8 per cent.

The amount of live stock is registered every ten years along with the census of population. The numbers of the different kinds of live stock in 1869, 1880, Livestock. and 1890 were : —

1869.

1880.

1890.

Horses ....

1,389,623

1,463,282

1,548,197

Mules and asses

43,070

49,618

57,952

Cattle ....

7,425,212

8,584,077

8,643,936

Goats ....

979,104

1,006,675

1,035,832

Sheep ....

5,026,398

3,841,340

3,186,787

Pigs. . -.

2,551,473

2,721,541

3,549,700

Beehives . . / .

913,783

926,312

920,640

The average yearly increase accordingly in horses was 0-53 per cent. ; in mules and asses, 1-53 per cent. ; in cattle, 0-74 per cent. ; in goats, 0-28 per cent. ; in pigs, 1-82 per cent. ; in beehives, 0-04 per cent. Sheep, on the other hand, have diminished in number by 1-92 per cent, yearly average. Galicia has the greatest number of horses to the square kilometre, viz., 9-75, the horses in the whole of Austria averaging only 5-16 to the square kilometre. Upper Austria has 46-14 head of cattle to the square kilometre, against an average of 28-81 per square kilometre for the entire monarchy. Goats most abound in Dalmatia, numbering 14-04 to the square kilometre, against an average of 3-45 in the whole state. Sheep are most numerous in Dalmatia (61-16) and Istria (49-36), against 10-62 per square kilometre in the entire state. The rearing of pigs is carried on most largely in Styria, 28-43, in Lower and Upper Austria, 20-82 and 20-68 respectively, against 11-

83 to the square kilometre in the whole of Austria. The beehives to every square kilometre in Carinthia are 5-25 ; in Carniola, 4-95; in Styria, 4-48, against 3 07 in all Austria.’ Galicia has the greatest number of horses to every 100 inhabitants, viz., 11-59 ; Dalmatia, the greatest number of mules and asses, viz., 5-90 to every 100 inhabitants ; Salzburg, the greatest number of cattle, with 82-69, and Upper Austria with 70-38 ; Dalmatia, the greatest number of goats, with 34-15 ; Dalmatia, the greatest num- ber of sheep, with 148-80, and Istria, 76-98; Styria, the greatest number of pigs, with 49-71 ; Carinthia, with 38-36 ; and Upper Austria, with 31-55 ; Carinthia, the greatest number of beehives, with 15-03; and Carniola, with 10-06. Altogether, a very impor- tant source of revenue is the rearing of cattle, which is quite a characteristic feature in the husbandry of the land and regularly yields a large excess for export.

Mining is an industry of the greatest consequence on account not only of the manifold variety of its products, but of the great extension it has attained in certain branches. „, In quantity, the coal mines yield the heaviest output : ’”””’””• in 1899, 115 million metric centners (a centner is nearly -^ ton) of pit coal. Of this amount Silesia yielded 48 millions ; Bohemia, 41 millions; Moravia, 16 millions; and Galicia, 9 millions. Of

brown coal, the mines of Austria yielded 218 million metric cent- ners, of which Bohemia contributed 180 millions; Styria, 26 millions ; Upper Austria, 4 millions. Of iron ores, over 17 million metric centners were mined, Styria yielding ten millions ; Bohemia, 5 millions. 2-8 million metric centners of petroleum were pro- duced in Galicia ; 923,000 metric centners of quicksilver in Carniola. Austria yielded 318,000 metric centners of graphite, of which Bo- hemia produced 199,000 ; while Moravia, Styria, and Lower Austria also contributed their quotas. Of 371,000 metric centners of zinc ores for all Austria, Carinthia produced 219,000; Galicia, 71,000; Bohemia, 21,000; and Tirol, 43,000. Of alum and alum slate 199,000 metric centners were dug out in Bohemia ; 215,000 metric centners

of silver ores in Bohemia. Out of 135,000 metric centners of lead ores produced in Austria, 99,000 were the product of Carin- thia, and 19,000 of Galicia. Austria yielded 67,000 metric centners of copper ores, to which Salzburg contributed 58,000 ; and Tirol, 9000 metric centners. 69,000 metric centners of ozocerite were raised in Galicia ; 54,000 metric centners of manganese ores in Car- niola and Bukovina. Small quantities of gold ores are mined in Bohemia and Salzburg. Uranium, tin, bismuth, antimony, and wolfram ores are dug out in Bohemia ; pyrites in Tirol, Bohemia, and Styria ; asphalt in Tirol. The increase in the value of the mining products in the most important branches is seen in the fol- lowing table : —

1 ■—

• Minerals.

(In millions of florins.)

1875.

1886.

1895.

1899.

Pit coal

Brown coal . . ...

Iron ores

Petroleum ....

Ozocerite

Silver ores ....

18-2

15-1

2-8

0-7

24

22-2 17-8 2-2 1-6 0-2 3-2

34-1 34-9 3-0 4-5 1-9 2-3

47-7 47-6 4-9 3 0 0-9 1-8

The total annual value of the mining products amounts to about 100 million florins. The total value of the products of the found- ries amounts to 40 million florins. Of this amount, 32 millions represent the value of the fined iron and steel and pig-iron ; 1 -8 millions, of lead and litharge; 1-95 millions, of silver ; 1-2 millions, of quicksilver; 1-2 millions, of zinc. On account of the Govern- ment monopoly, the production of salt is wholly under state con- trol, and is therefore almost exclusively restricted to the satisfaction of the home demand. In 1899 somewhat over 3-3 million metric centners of salt were produced, of which 0i43 million metric cent- ners were rock-salt, obtained almost wholly from Galicia and Bukovina ; 1-85 million metric centners salt obtained by decoction from the salt-pits in the Salzkammergut, in Tirol, Galicia, and Bukovina ; 0*31 million metric centners sea-salt obtained in Istria and Dalmatia ; 0-66 million metric centners salt for manufacturing purposes, obtained principally in Galicia. On the basis of the prices, of the monopoly, the value of the yearly salt production is calculated at 25,310,000 florins.

Since 1875 industry has, in many branches, made very consider- able advance. Out of every 1000 persons there were in 1870 hardly 200 engaged in any industries; in 1880 the number per laaustry. ^q^q j^^^^^ ·j^^^ ^^ 228, and in 1890 to 258. The indus- trial development applies principally to the following branches : — For the production of raw iron wares there were in 1890, 74 blast furnaces at work, giving a yearly output of about 6 million metric centners of bloom-iron and 1 million metric centners of pig-iron.

The production of fined iron and steel amounted to about 5 million metric centners ; just as much was the amount of the production of the iron and steel refining works. A speciality are the rod-iron wares produced in the Alpine lands. For metallic alloys {Pack- fong or German silver, an alloy of nickel and copper, and another alloy of nickel and tin), the works in Lower Austria (particularly those at Berndorf) are celebrated. The manufacture of machinery employed in 1890, 304 works, chiefly in Lower Austria apd Bohe- mia. The industry in the means of transport (carriages and rail- way waggons) yields an excess for export. In the manufacture of musical and scientific instruments, and also in pottery wares, Austria plays an important part. The porcelain industry of the Eger district has a world-wide reputation. The glass industry, too, in Bohemia is richly developed, and rules the markets of the world. The production in bottle, plate, and mirror-glass amounts in round figures to one million metric centners yearly. The industry in wood, particularly in stylish furniture, has attained great develop- ment, and large supplies are exported. The manufacture of but- tons is also a very active branch of industry. The leather industry, which is widely extended, yields, particularly in gloves and fancy articles, excellent products also for export. The manufacture of silk and velvet goods employed in 1890 about 52,000 spindles (against 70,000 in 1880), 4900 handlooms (against 4000 in 1880),- and over 3000 power-looms (against 700 in 1880). Silk-spinning is

carried on only in Tirol and G6rz ; silk and velvet weaving princi- pally in Vienna. The woollen industry employed : —

1880.

1890.

Carded yarn spindles ....

670,000

392,000

Worsted yarn spindles .

73,200

262,256

Carded yarn handlooms

17,600

2,045

,, ,, power-looms .

3,130

6,351

Worsted yarn handlooms .

7,560

7,600

„ „ power-looms .

6,000

15,700

The woollen industry has its principal seats in Bohemia, Moravia, Silesia, and Lower Austria. The cotton industry employed : —

1880.

1890.

Fine spindles

Handlooms

Power-looms

(In connexion with the power-looms) handlooms

1,760,000

sijooo

62,000

3,121,000

5,200

48,000

21,300

The industry is mostly carried on in Bohemia, Lower Austria, and Vorarlberg. Handloom weaving is in fast decline.

The linen and jute industry has likewise reached a high degree of development, forming an important branch of the textile industry. It employed : —

1880.

1890.

Flax yarn and thread-fine spindles Power-looms for linen weaving .

Handlooms

Hemp and jute spindles Power-looms for hemp and jute .

320,000

500

• 36,500

12,696

873

356,000

1,560

11,150 ^

39,000

1,440

The most important places for linen spinning are in Bohemia (Trautenau), Moravia, and Silesia, where, too, linen weaving is also chiefly carried on. Both branches of the linen industry export their products in large quantities. The manufacture of ribbons, embroidery, and lace, the two latter being carried on principally as a professional house industry in Vorarlberg and in the Bohemian Erzgebirge, also thrives. The industry in stitched stuffs is espe- cially developed in Northern Bohemia. Ready-made men’s clothes and Oriental caps (fezes) are produced on a large scale in Bohemia and Moravia.

The industry in paper suffices also for export. The total production of paper in 1890 amounted to over 1,300,000 metric centners in 191 mills. Its principal seats are Bohemia, Moravia, Lower and Upper Austria. Of eatables and drinkables, besides flour products, there are manufactured sugar, Kaffee-surrogate and chocolate, beer and brandy. Of sugar factories there were in 1897 210, with a net pro- duction of more than 7 million metric centners. Of beer breweries there were 1553, producing more than 19 million hectolitres. Of brandy distilleries there were about 1100 large, 6000 medium, and 25,000 small establishments, yielding a total production of 1,400,000 hectolitres of alcohol. The sugar industry is carried on almost ex- clusively in Bohemia, Moravia, Silesia, and Galicia. Beer-brewing is most active in Bohemia, Lower Austria, Moravia, and Ui)per Austria. The manufacture of brandy is mainly conducted in Galicia, Bohemia, Moravia, and Lower Austria, which all produce large quantities for export.

Internal communication is effected by land, water, and railways. The highways by land have a total length of 67,500 miles. Of this 10,000 miles are highways belonging to the state ; 3560 miles belong to the provinces and districts ; the rest of Commual- the highways belong to the communes. The navigable “«”<"'*• waterways have a total length of 4080 miles, of which 60 per cent, are navigable only for rafts, 40 per cent, for ships. The water- ways of greatest value as means of intercommunication are the Danube, the Elbe, the Vistula, and the Dniester. On the Danube there ply 190 steamers of the Danube Steam Navigation Company and 10 other steamers, to which have to be added 3000 rowing craft and rafts. The total goods traffic on the Danube amounts to about 7,000,000 metric centners. The Elbe is a waterway for four steam navigation companies, running within its Austrian limits about 150 steamers altogether. In all, the shipping traffic on the Elbe comprises about 13,000 ships and 2000 rafts, with a total goods traffic of 27,000,000 metric centners down the river and 5,000,000 metric centners up the river. The traffic on the Vistula at all the stations gives a total of over 8000 vessels, more "than half of which, however, might be reckoned twice ; the goods traffic amounts to about 2,500,000 metric centners. Other rivers with a service of steamers and sailing vessels are the Arsa (in Istria), Kerka, Zermagna, and Narenta in Dalmatia. There is

further, shipping traffic on the Dniester, and raft trafdc on the Styrian courses of the Ems, Drave, Mur, Salza, Save, and Sann.

The Austrian railways in 1898 had a total length of 11,000 miles, more than half of which is under state management. The progress of railway communication is shown in the following figures ; —

(In statute miles.)

18T5.

1885.

1895.

1899.

Total length of railway Amount belonging to the

state Amount worked by the state For every 1000 sq. kilo- metres For every 100,000 inhabit- ants

64,600 1,207

719 21-5

31-7,

83,457 22,994

32,219 27-8

37-8

102,769 45,975

54,981 34-3

43-1

117,662 47,728

67,400 39-2

47-3

The work of the railways in 1899 comprised the carrip,ge of persons and goods over a distance, altogether, of 81 million miles. The invested capital employed in the total railways amounted in 1898 to, in round numbers, 3 milliards of florins.

The post office forwarded in 1899, 1194 million missives and 4-12 milliard florins in money and articles of value, and post-office orders for 584 million florins were paid in and for 650 million florins paid out ; 14,700,000 communications were sent by telegraph, and 83,400,000 conversations negotiated by telephone.

The strength of the commercial marine of Austria in 1900 was as follows : —

Number

of

Tonnage.

Crews.

Vessels.

Sea-going vessels, steamers

‘ 103

178,649

3,130

,, ,, sailing ships .

20

13,427

223

Large coasting vessels, steamers

20

5,300

262

,, „ „ sailing ships .

11

946

50

Small coasters, steamers .

72

6,649

517

,, ,, sailers

1,411

16,982

3,524

Fishing vessels, „ ...

3,673

8,606

13,401

Numbered barks, „ ... Total steamers

7,325

13,720

12,386

195

190,598

3,909

,, sailing vessels .... Total steamers and sailing vessels

12,440

53,681

29,584

12,635

244,279

33,493

1, 11)i)i >> 1878

7,381

257,652

26,297

The greatest navigation company is the Austrian Lloyd in Trieste, which in 1900 employed 70 ships of 165,430 tons, covered a distance of 2,000,000 nautical miles, and carried 275,000 passengers and 9,500,000 metric centners of goods.

Banks. — In Austria there were in 1898, 61 banking establish- ments ; 44 of them joint-stock banks, and 17 banks without joint stock. The largest

bank is the Austro-Hungarian Bank, common to Austria and Hungary, which possesses the monopoly of the issue of bank notes for the whole monarchy. Its joint stock amounted in 1899 to 180,000,000 crowns ; the reserve fund to 36,500,000 crowns; the bank note circulation to 1,458,000,000 crowns ; bullion to 1,018,000,000 crowns, of which 806,000,000 crowns were in gold and bills payable in gold. The total banks in 1898 had a balance of 6294 million crowns, with a joint stock of 671 million crowns. The Savings Banks, numbering 531, had in 1898 over 3,000,000 depositors, with a balance in their favour of 3518 million crowns.

For HuNGAKT and Bosnia and Herzegovina see under those heads.

The following is a list of the most important publications relat- ing to Austria-Hungary as a whole and to Austria proper : —

(a) Monarchy. — Czornig. Oesterreichs Neugestaltung, 1858. — Statistisches Handbuch der osterreich-ungarischen Monarchie, 1891. — Militdr-statistisches Jtzhrbtich, an annual publication. — Delega- tionen-Vorlagen und Protocolle. — Ulbrich. Das Staatsrecht der ost.~~ung. Monarchie, 1884. — Mischler and Ulbrich. Oesterreich~~ isches Staats Worterbuch, 1895. — Ficker. Die Volkerstamme der ost.-ung. Monarchie, 1869. — Sidney Whitman. The Bealm of the Habsburgs, 1898. — A. Beer. Die Finanzen Oesterreichs im 19 .Tahrh., 1877. — Compass. Finanzielles Jahrbuch, -^on B.eWQ’c smc& 1889. — Umlauft. Die oster.-ung. Monarchie, 1896. — Matlecovitz. Die ost.-ung. Mandelspolitik, 1899.

(&) Austria Proper. — Oesterreichische Statistik, since 1882. Statist. -Central-Commission. — Oesterr. -Statistisches Handbuch, since 1882. Statis{.-Central-Commission. — Statistische Monats- schrift, since 1875. Statist-Central-Commission. — Nachrichten

uber Industrien, Handel und Verkehr, since 1872. Handels minis- terium Statistisches Jahrbuch des Ackerbau Minist., since 1873. — Statistische Nachrichten aus dem Qesamtgebiete der Landwirth- schaft, since 1899. — Annuario marittimo. Trieste. Annual. — Navigazione e Commercio. Trieste. Annual. — Statistisches Jahr- buch der autonomenVenoaltung, I., 1900. — Oesterr. Stadtebuch 1-8, 1887 and subsequent years. — Sociale

Rundschau d. arbeitsstat. Am- tes, I., 1900. — Mittheilungen des Finanz ministeriums, since 1894.

(k. t. i.-s.)

History. — 1. TJie Whole Monarchy.

The war of 1866 began a new era in the history of the Austrian empire. By the treaty of Prague the emperor surrendered the position in Germany which his ancestors had held for so many centuries ; Austria and Tirol, Bohemia and Salzburg, ceased to be German, and eight million Germans were cut of from all political union with their fellow-countrymen. At the same time the surrender of Venetia completed the work of 1859, and the last remnant of the old-established Hapsburg domina- tion in Italy ceased. The war was immediately followed by a reorganization of the Government. The BsfabUsh- Magyar nation, as well as the Czechs, had ment oi refused to recognize the validity of the con- the dual stitution of 1861 which had established a “”’”“‘y- common parliament for the whole empire ; they demanded that the independence of the kingdom of Hungary should be restored. After the defeats on the field of battle their claim could no longer be resisted, and in the negotiations th Hungarian Diet was able to make its own terms. They recognized no union between their country and the other parts of the monarchy except that which was based on the Pragmatic Sanction of 1722. Ail recent innovations, all attempts made during the last hun>5red years to absorb Hungary in a greater Austria, were re\ oked. An agree- ment was made by which the emperor was to be crowned at Pest and take the ancient oath to the Golden Bull ; Hungary (including Transylvania and Croatia) was to have its own parliament and its own ministry ; Magyar was to be the official language ; the emperor was to rule as king; there was to be complete separation of the finances ; not even a common nationality was recognized between the Hungarians and the other subjects of the emperor ; a Hungarian was to be a foreigner in Vienna, an Austrian a foreigner in Budapest. A large party wished indeed that nothing should be left but a purely personal union similar to that between England and Hanover. Deak and the majority agreed, however, that the arrangements of 1722 implied, and the older consti- tutional practice allowed, that there should be certain institutions common to Hungary and the rest of the monarchy ; these were — (1) foreign affairs, including the diplomatic and

consular service ; (2) the army and navy ; (3) the control of the expenses required for these branches of the public service.

Eecognizing in a declaratory act the legal existence of these common institutions, they also determined the method by^which they should be administered. In doing so they carried out with great exactitude the principle of dualism, establishing in form a complete parity between Hungary on one side and the other territories of the king on the other. They made it a condition that there should be constitutional government in the rest of the monarchy as well as in Hungary, and a parliament in which all the other territories should be represented. From both the Hungarian and the Austrian ‘parliament there was to be elected a Delegation, consisting of sixty members ; to these Delegations the common ministers were tJons’’ to be responsible, and to them the budget was to be submitted. The annual meetings were to be held alter- nately in Vienna and in Pest. They were very careful that

1 For the use of this term, see section (2) on Austria below.

these Delegations should not overshadow the parliaments by which they were appointed. The Delegations were not to sit together ; each was to meet separately ; they were to communicate by writing, every document being accom- panied by a translation in Magyar or German, as the case might be ; only if after three times exchanging notes they failed to agree was there to be a common session ; in that case there would be no discussion, and they were to vote in silence ; a simple majority was sufficient. There were to be three ministers for common purposes — (1) for foreign affairs ; (2) for war ; (3) for finance ; these ministers were responsible to the Delegations, but the Delegations were really given no legislative power. The minister of war controlled the common army, but even the laws de- termining the method

by which the army was to be recruited had to be voted separately in each of the parlia- ments. The minister of finance had to lay before them the common budget, but they could not raise money or vote taxes ; after they had passed the budget the money required had to be provided by the separate parliaments. Even the determination of the proportion which each half of the monarchy was to contribute was not left to the Delegations. It was to be fixed once every ten years by separate committees chosen for that purpose from the Austrian Reichsrath and the Hungarian Reichstag, the so-called Quota-Deputations. In addition to these ” common affairs ” the Hungarians, indeed, recognized that there were certain other matters which it was desirable should be managed on identical principles in the two halves of the monarchy — namely, customs and excise currency ; the army and common railways. For these, however, no common, institutions were created ; they must be arranged by api cement ; the ministers must confer and then introduce identical acts in the Hungarian and the Austrian parliaments.

The main principles of this agreement were decided during the spring of 1867; but during this period the Austrians were not really consulted at all. The Piaaaciai negotiations on behalf of the court of Vienna were entrusted to Beust, whom the emperor appointed chancellor of the empire and also minister-president of Austria. He had no previous experience of Austrian affairs, and was only anxious at once to bring about a settlement which would enable the empire to take a strong position in international politics. In the shmmer of 1867, however (the Austrian Reichsrath having met), the two parliaments each elected a deputation of fifteen members to arrange the financial settlement. The first matter was the debt, amounting to over 3000 million gulden, in addition to the floating debt, which had been contracted during recent years. The Hungarians laid down the principle that they were in no way responsible for debts contracted during a time when they had been deprived of their constitutional liberties ; they consented, however, to pay each year 29|- million gulden towards the interest. The whole responsibility for the payment of the remainder of the interest, amounting annually to over a hundred million gulden, and the management of the debt, was left to the Austrians. The Hungarians wished that a considerable part of it should be repudiated. It was then agreed that the two states should form a Customs Union for the next ten years ; the customs were to be paid to the common exchequer; all sums required in aiddition to this to meet the expenses were to be provided as to 30 per cent, by Hungary and as to 70 per cent, by Austria. After the financial question had been thus settled, the whole of these arrangements were then, on 21st and 24th December 1867, enacted by the two parliaments, and the system of dualism was established.

The Acts were accepted in Austria out of necessity ;

settle’ weat

but no parties were really satisfied. The Germans, who accepted the principle of dualism, were indignant at the financial arrangements ; for Hungary, while gaining more than an equal share of power, paid less than one-third of the common expenses. On the other hand, according to British ideas of taxable capacity, Hungary paid, and still pays, more than her share, “the Ger- mans, however, could at least hope that in the future the financial arrangements might be revised ; the com- plaints of the Slavonic races were

political, and within the constitution there was no means of remedy, for, while the settlement gave to the Hungarians all that they demanded, it deprived the Bohemians or Galicians of any hope that they would be able to obtain similar independ- ence. Politically, the principle underlying the agreement was that the empire should be divided into two portions ; in one of these the Magyars were to rule, in the other the Germans ; in either section the Slavonic races — the Serbs and Croatians, the Czechs, Poles, and Slovenians — were to be placed in a position of political inferiority.

The logical consistency with which the principle of Dualism was carried out is shown in a change of title. By a letter to Beust of 14th November 1868 the emperor ordered that he should hence- forward be styled, not as before ” Emperor of Austria, King of Hungary, King of Bohemia, etc.,” but ” Emperor of Austria, King of Bohemia, etc., and Apostolic King of Hungary,” thereby signifying the separation of the two districts over which he rules. His shorter style is ” His Majesty the Emperor and King,” and ” His Imperial and Apostolic Royal Majesty”; the lands OVM’ which he rules are called “The Austrian-Hungarian Monarchy” or “The Austrian-Hungarian Realm.” The new terminology, ” Imperial and Royal ” {Kaiserlich und Koniglicti), has since then been applied to all those branches of the public service which belong to the common ministries ; this was first the case with the diplomatic service ; not till 1889 was it applied to the army, which for some time kept up the old style of Kaiserlich-Koniglich ; in 1895 it was applied to the ministry of the imperial house, and office always held by the minister for foreign affairs. The minister for foreign affairs was at first called the iJeicAsianzZer; but in 1871, when Andrassy succeeded Beust, this was given up in deference to Hungarian feeling, for it might be taken to imply that there was a single state of which he was minister. The old style Kaiserlich- Koniglieh, the ” K. K.” which has become so familiar through long use, is still retained in the Austrian half of the monarchy. There are therefore, e.g., three ministries of finance: the Kaiserlich und Koniglich for joint affairs ; the Kaiserlich-Koniglich for Austrian affairs ; the Koniglich for Hungary.

The settlement with Hungary consisted then of three parts : — (1) the political settlement, which was to be per- manent and has since remained part of the fundamental constitution of the monarchy ; (2) <^">on the

periodical financial settlement, determining the partition of the common expenses as arranged by the Quotas-Deputations and ratified by the parliaments ; (3) the Customs Union and the agreement as to currency — a voluntary and terminable arrangement made between the two Governments and parliaments. The history of the common affairs which fall under the management of the common ministries is, then, the history of the foreign policy of the empire and of the army. It is with this and this alone that the Delegations are occupied, and it is to this that we must now turn. The annual meetings call for little notice; they have generally been the occasion on which the foreign minister has explained and justified his policy; according to the English custom, red books, sometimes containing important despatches, have been laid before them ; but the debates have caused less embarrassment to the Government than is generally the case in parliamentary assemblies, and the army budget has generally been passed with few and unimportant alterations.

1 Baron H. de Worms. The Austro-Hungarian Empire. London 1876, and Beust's Memoirs. '

HI8T6ry]

A U S T E I A-H U N G A R Y

11

For the first four years, ~~while Beust was chancellor, the foreign policy was still influenced by the feelings left by the war of 1866. We do not know how far ^<$° there was a real intention to revenge Konig~~ gratz and recover the position lost in Germany. This would be at least a possible policy, and one to which Beust by his previous history would be inclined. There were sharp passages of arms with the Prussian Government regarding the position of the South German states; a close friendship was maintained with France ; there were meetings of the emperor and of Napoleon at Salzburg in 1868, and the next year at Paris ; the death of Maximilian in Mexico cast a shadow over the friendship, but did not destroy it. The opposition of the Hungarians an& financial difficulties probably prevented a warlike policy. In 1870 there were discussions preparatory to a formal alliance with France against the North German Confederation, but nothing was signed.' The war

of 1870 put an end to all ideas of this kind ; the German successes were so rapid that Austria was not exposed to the temptation of iriter- vening, a temptation that could hardly have been resisted had the result been doubtful or the struggle prolonged. The absorption of South Germany in the German empire took away the chief cause for friction; and from that time warm friendship, based on the maintenance of the established order, has existed between the two empires. Austria gave up all hope of regaining her position in Germany ; Germany disclaimed all intention of acquiring the German provinces of Austria. Beust's retirement in 1871 put the finishing touch on the new relations. His successor, Count Audrassy, a Hungarian, established a good understanding with Bismarck ; and in 1872 the visit of the Emperor Francis Joseph, accompanied by his minister, to Berlin, was the final sign of the reconciliation with his uncle. The Tsar was also present on that occa- sion, and for the next six years the close friendship be- tween the three empires removed all danger of war. Three years later the full reconciliation with Italy followed, when Francis Joseph consented to visit Victor Emmanuel in the city of Venice.

The outbreak of disturbance in the Balkans ended this period of calm. The insurrection in Bosnia and Herze- govina immediately affected Austria; refugees VaesUon"' ^ ^^'I'ge numbers crossed the frontier and had to be maintained by the Government. The political problem presented was a very difficult one. The sympathy of the Slavonic inhabitants of the empire made it impossible for the Government of Vienna to regard with indifference the sufferings of Christians in Turkey. Active support was impossible, because the Hungarians, among whom the events of 1848 had obliterated the remembrance of the earlier days of Turkish conquest, were full of sympathy for the Turks. It was a cardinal prin- ciple of Austrian policy that she could not allow the erection of new Slavonic states on her southern frontier. Moreover, the disturbances were fomented by Eussian agents, and any increase of Russian influence (for which the Pan-Slavonic party was working) was full of danger to 'Austria. For a time the mediation of Germany preserved the good understanding between the two eastern empires. In 1875 Andrassy drafted a Note, which was accepted by the Powers, requiring Turkey to institute the reforms necessary for the good government of the provinces. Turkey agreed to do this, but the insurgents required a guarantee from the Powers that Tu,rkey would keep her

engagements. This could not be given, and the rebellion continued and spread to Bulgaria. The lead then passed

1 See General Le Brun, Souvenirs Militaires, 1866-70. Paris, 1895 ; also, Baron de Worms, op. cit., and the article on Beust.

to Russia, and Austria, even after the outbreak of war, did not oppose Russian measures. At the beginning of 1877 a secret understanding had been made between the two powers, by which Russia undertook not to annex any territory, and in other ways not to take steps which would be injurious to Austria. The advance of the Russian army on Constantinople, however, was a serious menace to Austrian influence ; Andrassy therefore demanded that the terms of peace should be submitted to a European confer- ence, which he suggested should meet at Vienna. The Peace of San Stefano violated the engagements made by Russia, and Andrassy was therefore compelled to ask for a credit of 60 million gulden and to mobilize a small portion of the army ; the money was granted unanimously in the Hungarian Delegation, though the Magyars disliked a policy the object of which appeared to be not the defence of Turkey against Russia, but an agreement with Russia which would give Austria compensation at the expense of Turkey ; in the Austrian Deputation it was voted only by a majority of 39 to 20, for the Germans were alarmed at the report that it would be used for an occupation of part of the Turkish territory.'

The active share taken by Great Britain, however, relieved Austria from the necessity of having recourse to further measures. By an arrangement made beforehand, Austria was requested at the Con- f °^^e«e- gress of Berlin to undertake the occupation and govina. administration of Bosnia and Herzegovina — an honourable but arduous task. The provinces could not be left to the Turks ; Austria could not allow them to fall under Russian influence. The occupation was immediately begun, and 60,000 Austrian troops, under the command of General Philippovitch, crossed the frontier on 29th July. The work was, however, more dif&cult than had been anticipated; the Mahommedans offered a strenuous resistance ; military operations were attended with great difficulty in the mountainous country ; 200,000 men were required, and they did not succeed in crushing the resist- ance till after some months of obstinate fighting. The losses on either side

were very heavy ; even after the cap- ture of Serajevo in August, the resistance was continued; and besides those who fell in battle, a considerable number of the insurgents were put to death under military law. The opposition in the Delegations, which met at the end of the year, was so strong that the Government had to be content with a credit to cover the expenses for 1879 of less than half whatthey had originally asked, and the supplementary estimate of 40 million gulden for 1878 was not voted till the next year. In 1879, the Porte, after long delay, recog- nized the occupation on the distinct understanding that the sovereignty of the sultan was acknowledged. A civil administration was then established, the provinces not being attached to either half of the empire, but placed under the control of the joint minister of finance. The Government during the first two years was not very • successful ; the Christian population were disappointed at finding that they still had, as in the old days, to pay rent to the Mahommedan Begs. There were difficulties also between the Roman Catholics and the members of the Greek Church. In 1881 disturbances in Dalmatia spread over the frontier into Herzegovina, and another expedition had to be sent to restore order. When this was done Herr von Kallay was appointed minister, and under his judicious government order and prosperity were established in the provinces. In accordance with another clause of the Treaty of Berlin, Austria was permitted to place troops in the sanjak of Novi-Bazar, a district of great strategic importance^ which separated Servia and Montenegro, and through which the communication between Bosnia and Salonica passed. This was done in September 1879, an

the Irrc’ dentists.

agreement with Turkey having specified the numbers and position of the garrison. Another slight alteration of the frontier -was made in the same year, when, during the delimitation of the new frontier of Montenegro, the district of Spizza was incorporated in the kingdom of Dalmatia.

The Congress of Berlin indirectly caused some difiacul- ties with Italy. In that couiitry was a large party which,

under the name of the ” Irredentists,” demanded Haiy and ^^X those Italian-speaking districts. South Tirol,

Istria, and Trieste, which were under Austrian

rule, should be joined to Italy; there were public meetings and riots in Italy ; the Austrian flag was torn down from the consulate in Venice and the embassy at Rome insulted. The excitement spread across the frontier ; there were riots in Trieste, and in Tirol it was necessary to make some slight movement of troops as a sign that the Austrian Government was determined not to surrender any territory. Tor a short time there was apprehension that the Italian Government might not be strong enough to resist the movement, and might even attempt to realize these wishes by means of an alliance with Russia ; but the danger quickly passed away.

In the year 1879 the European position of the empire was placed on a more secure footing by the conclusion of

a formal alliance with Germany. In the autumn Alliance of that year Bismarck visited Vienna and Germany, arranged with Andrassy a treaty by which

Germany bound herself to support Austria against an attack from Russia, Austria pledging herself to help Germany against a combined attack of Prance and Russia ; the result of this treaty, of which the Tsar was informed, was to remove, at least for the time, the danger of war between Austria and Russia. It was the last achievement of Andrassy, who had already resigned, but it was maintained by his successor. Baron Haymerle, and after his death in 1880 by Count Kalnoky. It was strengthened in 1883 by the adhesion of Italy, for after 1881 the Italians required support, owing to the French occupation of Tunis, and after five years it was renewed. Since that time it has been the foundation on which the policy of Austria has depended, and it has survived all dangers arising either from commercial differences (as between 1880 and 1890) or national discord. The alliance was naturally very popular among the German Austrians ; some of them went so far as to attempt to use it to influ- ence internal policy, and suggested that fldelity to this alliance required that there should be a ministry at Vienna which supported the Germans in their internal struggle with the Slavs ; they

represented it as a national alliance of the Teutonic races, and there were some Germans in the Empire who supported them in this view. The Governments on both sides could of course give no coun- tenance to this theory ; Bismarck especially was very care- ful never to let it be supposed that he desired to exercise influence over the internal affairs of his ally. Had he done so, the strong anti-German passions of the Czechs and Poles, always inclined to an alliance with France, would have been aroused, and no Government could have maintained the alliance. After 1880, the exertions of Count Kalnoky again established a fairly good under- standing with Russia, as was shown by the meetings of Francis Joseph with the Tsar in 1884 and 1886, but the outbreak of the Bulgarian question in 1886 again brought into prominence the opposed interests of Russia and Austria. In the December of this year Austria indeed decisively interfered in the war between Bulgaria and Servia, for at this time Austrian influence predominated in Servia, and after the battle of Slivnitza the Austrian ambassador warned Prince Alexander of Bulgaria that if

[dual monarchy ;

he advanced farther he would be met by Austrian as well as Servian troops. But after the abdication • of Alex- ander, Count Kalnoky stated in the Delegations that Austria would not permit Russia to interfere with the independence of Bulgaria. This decided step was required by Hungarian feeling, but it was a policy in which Austria could not depend on the support of Germany, for — as Bismarck stated — Bulgaria was not worth the bones of a single Pomeranian grenadier. Austria also differed from Russia as to the position of Prince Ferdinand of Bulgaria, and during 1886-87 much alarm was caused by the massing of Russian troops on the Galician frontier. Councils of war were summoned to consider how this exposed and distant province was to be defended, and for some months war was considered inevitable ; but the danger was averted by the renewal of the Triple Alliance and the other deci- sive steps taken at this time by the German Government {vide Gekmany).^

Since this time the foreign policy of Austria has been peaceful and unambitious; the close connexion with Germany has so far been maintained, though during the last few years it has been increasingly

difficult to prevent the violent passions engendered by national enmity at home from reacting on the foreign policy of the empire ; it would scarcely be possible to do so, were it not that discussions on foreign policy take place not in the parlia- ments but in the Delegations where the numbers are fewer and the passions cooler. In 1896 Count Kalnoky had to retire, owing to a difference with Banffy, the Hungarian minister, arising out of , the struggle with Rome. He was succeeded by Count Goluchowski, the son of a well-known Polish statesman. In 1898 the expulsion of Austrian subjects from Prussia, in connexion with the anti-Polish policy of the Prussian Government, caused a passing irritation, to which Count Thun, the Austrian minister, gave expression. The chief objects of the Government in recent years have been to maintain Austrian trade and influence in the Balkan States by the building of rail- ways, by the opening of the Danube for navigation, and by commercial treaties with Rumania, Servia, and Bul- garia ; since the abdication of King Milan especially, the affairs of Servia and the growth of Russian influence in that country have caused serious anxiety.

The disturbed state of European politics and the great increase in the military establishments of other countries made it desirable for Austria also to strengthen her military resources. The bad condition of the ” ’”” ^’ finances rendered it, however, impossible to carry out aiiy very great measures. In 1868 there had been introduced compulsory military service in both Austria and Hungary; the total of the army available in war had been fixed at 800,000 men. Besides this joint army placed under the joint ministry of war, there was in each part of the monarchy a separate militia and a separate minister for national defence. In Hungary this national force or honved was kept quite distinct from the ordinary army ; in Austria, however (except in Dalmatia and Tirol, where there was a separate local militia), the Landwehr, as it was called, was practically organized as part of the standing army. At the renewal of the Ausgleich in 1877 no impor- tant change was made, but in 1882 the system of compul- sory service was extended to Bosnia and Herzegovina, and a reorganization was carried out, including the intro- duction of army corps and local organization on the Prussian plan. This was useful for the purposes of speedy mobilization, though there was some danger that the local and national spirit might penetrate into the

1 Sir Charles Dilke, TJie Present Position of European Polities, London, 1887.

army. In 1886 a law was carried in either parliament creating a Landsturm, and providing for the arming and organization of the whole male population up to the age of forty-two in case of emergency, and in 1887 a small increase was made in the annual number of recruits. A further increase was made in 1892-93. In contrast, how- ever, with the military history of other continental powers, that of Austria shows a ismall increase in the army es- tablishment. Of recent years there have been signs of an attempt to tamper with the use of German as the common language for the whole army. This, which is now the principal remnant of the old ascendency of German, and the one point of unity for the whole empire, is a matter on which the Government and the emperor allow no concession, but in the Hungarian parliament protests against it have been raised, and in 1899 and 1900 it was necessary to punish recruits from Bohemia, who answered the roll call in the Czechish “zde” instead of the German ” hier.”

In those matters which belong to the periodical and terminable agreement, the most important is the Customs Union, which was established in 1867, and it is ™« ‘ convenient to treat separately the commercial

unioa!’ policy of the dual state.^ At first the customs tariff ia Austria-Hungary, as in most other countries, was based on a number of commercial treaties with Germany, Trance, Italy, Great Britain, &c., each of which specified the maximum duties that could be levied on certain articles, and all of which contained a ” most favoured nation” clause. The practical result was a system very nearly approaching to the absence of any customs duties, and for the period for which these treaties lasted a revision of the tariff could not be carried out by means of legislation. After the year 1873, a strong move- ment in favour of protective duties made itself felt among the Austrian manufacturers who were affected by the competition of German,

English, and Belgian goods, and Austria was influenced by the general movement in economic thought which about this time caused the re- action against the doctrines of free trade. Hungary, on the other hand, was still in favour of free trade, for there were no important manufacturing industries in that country, and it required a secure market for agricultural produce. After 1875 the commercial treaties expired ; Hungary thereupon also gave notice to terminate the commercial union with Austria, and negotiations began as to the principle on which it was to be renewed. This was done during the year 1877, and in the new treaty, while raw material was still imported free of duty, a low duty was placed on textile goods as well as on corn, and the excise on sugar and brandy was raised. All duties, moreover, were to be paid in gold — this at once involving a consider- able increase. The tariff treaties with Great Britain and France were not renewed, and all attempts to come to some agreement with Germany broke down, owing to the change of policy which Bismarck was adopting at this period. The result was that the system of commercial treaties ceased, and Austria-Hungary was free to introduce a fresh tariff depending simply on legislation, an ” autono- mous tariff ” as it is called. With Great Britain, France, and Germany there was now only a “most favoured nation ” agreement ; fresh commercial treaties were made with Italy (1879), Switzerland, and Servia (1881). Dur- ing 1881-82 Hungary, desiring means of retaliation against the duties on corn and the impediments to the importation of cattle recently introduced into Germany, withdrew her

1 MatlekovitB. Die Zollpolitik des Oesterreichish-Ungarischen Monarchie, Leipzig, 1891, gives the Hungarian point of view.— Bazant. Die Handelspglitik Oesterreich-Ungarns, 1875-92. Leipzig,

1894.

opposition to protective duties ; the tariff was completely revised, protective duties were introduced on all articles of home production, and high finance duties on other articles such as coffee and petroleum. At the same time special privileges were granted to articles imported by sea, so as to foster the trade of Trieste and Fiume ; as in Ger- many, a subvention was granted to the great shipping companies, the Austrian Lloyd and Adria ; the area of the Customs Union was enlarged so as to include Trieste, Istria, and

Dalmatia, as well as Bosnia and Herzegovina. In 1887 a further increase of duties was laid on corn (this was at the desire of Hungary as against Eumania, for a vigorous customs war was being carried on at this time) and on woollen and textile goods. Austria therefore dur- ing these years completely gave up the principle of free trade, and adopted a nationalist policy similar to that which prevailed in Germany. A peculiar feature of these treaties was that the Government was empowered to im- pose an additional duty (Eetorsion Zoll) on goods imported from countries in which Austria-Hungary received un- favourable treatment. In 1881 this was fixed at 10 per cent. (5 per cent, for some articles), but in 1887 it was raised to 30 and 15 per cent, respectively. In 1892 Austria-Hungary joined with Germany, Italy, Belgium, and Switzerland in commercial treaties to last for twelve years, the object being to secure to the states of Central Europe a stable and extended market; for the intro- duction of high tariffs in Eussia and America had crippled industry. Two years later Austria-Hungary also arranged with Eussia a treaty similar to that already made between Eussia and Germany ; the reductions in the tariff secured in these treaties were applicable also to Great Britain, with which there still was a most favoured nation treaty. The system thus introduced gave commercial security till the year 1903.

The result of these and other laws was an improvement in financial conditions, which enabled the Government at last to take in hand the long-delayed task of reforming the currency. Hitherto the currency had been partly in [Retbrm silver (gulden), the “Austrian Currency” which had of the been introduced in 1857, partly in paper money, which currency, took the form of notes issued by the Austro-Hungarian Bank. This institution had, in 1867, belonged entirely to Austria ; it had branches in Hungary, and its notes were current throughout the monarchy, but the direction was entirely Austrian. The Hungarians had not sufficient credit to establish a national bank of their own, and at the settlement of 1877 they procured, as a concession to themselves, that it should be converted into an Austro-Hungarian bank, with a head office at Pest as well as at “Vienna, and with the management divided between the two countries. This arrangement was renewed in 1887. In 1848 the Government had been obliged to authorize the bank to suspend cash payments, and the wars of 1859 and 1866 had rendered abortive all attempts to renew them. The notes therefore formed an

inconvertible paper currency. The bank by its charter had the sole right of issuing notes, but during the war of 1866 the Government, in order to raise money, had itself issued notes (staatsnoten) to the value of 312 million gulden, thereby violating the charter of the bank. The operation begun in 1892 was there- fore threefold : (1) the substitution of a gold for a silver currency ; (2) the redemption of the staatsnoten ; (3) the resumption of cash payments by tbe bank.

In 1867 Austria-Hungary had taken part in the monetary conference which led to the formation of the Latin Union; it was intended to join the Union, but this was not done. A first step, howler, had been taken in this direction by the issue of gold coins of the value of eight and four guldens. No attempt was made, however, to regulate the relations of these coins to the ” Austrian” silver coinage; the two issues were not brought into connexion, and every payment was made in silver, unless it was definitely agreed that it should be paid in gold. In 1879, owing to the continued depreciation of silver, the free coinage of silver was suspended. In 1892 laws introducing a completely new coinage were carried in both parliaments, in accordance with agreements made by the ministers. The unit in the new issue was to be the krone, divided into 100 heller; the krone being almost of the same value as the franc. (The twenty-krone piece in gold weighs 6-775 gr., the twenty-franc piece 6‘453.) The gold krone was equal

to -42 of the gold gulden, and it was declared equal to -o of the silver gulden, so much allowance being made for the depreciation of silver. The first step towards putting this Act into practice was the issue of one-krone pieces (silver), which circulated as half guldens, and of nickel coins ; all the copper coins and other silver ■coins were recalled, the silver gulden alone being left in circulation. The coinage of the gold four- and eight-gulden was suspended. Nothing more pould be done till the supply of gold had been increased. The bank was required to buy gold (during 1892 it bought over forty M. gulden), and was obliged to coin into twenty- or ten-krone pieces

all gold brought to it for that purpose. Then a loan of 150 M. gulden at 4 per cent, was made, and from the gold (chiefly bar gold and sovereigns) which Eothschild, who undertook the loan, paid in, coins of the new issue were struck to the value of over 34 million krone. This was, however, not put into circulation ; it was used first for paying off the staatsnoten. By 1894 the state was able to redeem them to the amount of 200 million gulden, in- cluding all those for one gulden. It paid them, however, not in gold, but in silver (one-krone pieces and gulden) and in bank notes, the coin and notes being provided by the bank, and in exchange the newly-coined gold was paid to the bank to be kept as a reserve to cover the issue of notes. At the same time arrangements were made between Austria and Hungary to pay off about 80 million of ex- chequer bills which had been issued on the security of the Govern- ment salt-works, and were therefore called ” salinenscheinen. ” In 1899 the remainder of the staatsnoten (112 million gulden), were redeemed in a similar manner. The bank had in this way acquired a large reserve of gold, and in the new charter which was (after long delay) passed in 1899, a clause was introduced requiring the resumption of cash payments, though this was not to come into operation immediately. Then from 1st January 1900 the old reck- oning by gulden was superseded, that by krone being introduced in all Government accounts, the new silver being made a legal tender only for a limited amount. For the time, however, the old guldens were left in circulation, payments made in them, at the rate of two krone to one gulden, being legal up to any amount.

This important reform has thereby been brought to a satisfactory conclusion, and at a time when the political difficulties had reached a most acute stage. It is indeed remarkable that notwithstanding the complicated machinery of the dual monarchy, and the numerous obstacles which have to be overcome before a reform affecting both countries can be carried out, the financial, the commercial, and the foreign policy has been conducted since 1870 with success. The credit of the state has risen^the chronic deficit has disappeared, the currency has been put on a sound basis, and part of the un- funded debt has been paid off. , Universal military service has been introduced, and all this has been done in the presence of difficulties greater than existed in any other civilized country.

Each of the financial and economic reforms described above was, of course, the subject of a separate law, but, so

far as they are determined at the general settle- Tbe ment which takes place between Austria and

‘‘m^’’” Hungary every ten years, they are comprised Hungary, under the expression of “Ausgleich,” which

includes especially the determination of the Quota, and to this extent they are all dealt with together as part of a general settlement and bargain. In this set- tlement a concession on commercial policy would be set off against a gain on the financial agreement ; e.g., in 1877 Austria gave Hungary a share in the management of the bank, while the arrangement for paying the bonus on exported sugar was favourable to Austria ; on the other hand, since the increased duty on coffee and petroleum would fall more heavily on Austria, the Austrians wished to persuade the Hungarians to pay a larger quota of the common expenses, and there was also a dispute whether Hungary was partly responsible for a debt of 80 M. gulden to the bank. Each measure had therefore to l9e consid- ered not only on its own merits, but in relation to the general balance of advantage, and an amendment in one might bring about the rejection of all. The whble series of Acts had to be carried in two parliaments, each open to the influence of national jealousy and race hatred in its most extreme form, so that the negotiations have been conducted under serious difficulties, and the periodical settlement has always been a time of great anxiety. The first settlement occupied two full years, from 1876, when

the negotiations began, to June 1878, when at last all the Bills were carried successfully through the two parlia- ments ; and it was necessary to prolong the previous arrangements (which expired at the end of 1877) till the middle of 1878. First the two ministries had to agree on the drafts of all the Bills ; then the Bills had to be laid before the two parliaments. Each parliament elected a committee to consider them, and the two committees carried on long negotiations by notes supplemented by verbal discussions. Then followed the debates in the two parliaments; there was a ministerial crisis in Austria, because the House refused to accept the tax on coffee and petroleum which was recommended by the ministers; and finally a great

council of all the ministers, with the em- peror presiding, determined the compromise that was at last accepted. In 1887 things went better; there was some'tlifficulty about the tariff, especially about the tax on petroleum, but Count Taaffe had a stronger position than the Austrian ministers of 1877. Ten years later, on the third renewal, the difficulties were still greater. They sprang from a double cause. First the Austrians were determined to get a more favourable division of the com- mon expenses ; that of 1867 still continued, although Hungary had grown relatively in wealth.^ Moreover a proposed alteration in the taxes on sugar would be of considerable advantage to Hungary ; the Austrians there- fore demanded that henceforth the proportion should be not 68-6 : 31-4 but 68 : 42. On this there was a deadlock ; all through 1897 and 1898 the Quota-Deputations failed to come to an agreement. This, however, was not the worst. Parliamentary Government in Austria had broken down ; the opposition had recourse to obstruction, and no business could be done. Their object was to drive out the Badeni Government, and for that reason the obstruction was chiefly directed against the renewal of the Ausgleich; for, as this was the first necessity of state, no Government could remain in office which failed to carry it through. The extreme parties of the Germans and the anti-Semites were also, for national reasons, opposed to the whole system. When, therefore, the Government at the end of 1897 intro- duced the necessary measures for prolonging the existing arrangements provisionally till the differences with Hun- gary had been settled, scenes of great disorder ensued (see section Austria, pp. 26, 27), and at the end of the year the financial arrangements had not been prolonged, and neither the Bank Charter nor the Customs tJnion had been renewed. The Government, therefore (Badeni having re- signed), had to proclaim the necessary measures by impe- rial warrant. Kext year it was even worse, for there was obstruction in Hungary as well as in Austria ; the Quota- Deputations again came to no agreement, and the propo- sals for the renewal of the Bank Charter, the reform of the currency, the renewal of the Customs Union, and the new taxes on beer and brandy, which were laid before parliament both at Vienna and Pest, were not carried in either country ; this time, therefore, the existing arrange- ments had to be prolonged provisionally by imperial and royal warrant both in Austria and Hungary. During 1899 parliamentary peace was restored in Hungary by the resignation of Banffy ; in Austria, however, though there was again a change of ministry the only result was that the Czechs imitated

the example of the Germans and resorted to obstruction so that still no business could be done. The Austrian ministry, therefore, came to an agreement with the Hungarians that the terms . of the new Ausgleich should be finally proclaimed in Austria by

1 The only change was that as the military frontier had been given over to Hungary, Hungary in consequence of this addition of territory had to pay 2 per cent., the remaining 98 per cent, being divided as before, so that the real proportion was 31”4 and 68‘6.

imperial warrant ; the Hungarians only giving their assent to this in return for considerable financial concessions.

The main points of the agreement were : (1) the Bank Charter was to be renewed till 1910, the Hungarians receiving a larger share in the direction than they had hitherto enjoyed ; (2) the Customs Union so far as it was based on a reciprocal and binding treaty lapsed, both sides, however, continuing it in practice, and promising to do so until 31st December 1907. Not later than 1901 negotiations were to be begun for a renewal of the alliance, and if possible it was to be renewed from the year 1903, in which year the commercial treaties expire. If this is done, then the tariff Is to be revised before any fresh commercial treaties are made. If it is not done, then no fresh treaties are to be made extending beyond the year 1907, so that if the Commercial Union of Austria and Hungary is not renewed before 1907, each party will be able to determine its own policy unshackled by any previous treaties. ‘ These arrangements in Hungary received the sanction of the Reichstag ; but this could not be procured in Austria, and they were therefore proclaimed by imperial^ warrant; first of all, on 20th July, the new duties on beer, brandy, and sugar; then on 23rd September the Bank Charter, &c. In November the Quota Deputations at last agreed that Hungary should henceforward pay 33^^, a very small increase, and this was also in Austria proclaimed in the same way. The result is that a working

agree- ment has been made, by which the Union is preserved for a few years; the fact that this wals done, notwithstanding the political diflSculties, being the best proof of the great importance which the financial and commercial union has for the whole monarchy.

In Austria all classes regard with the most serious discontent an arrangement by which their share of the common expenses is so great. Even in such matters as the management and opening up of new railways, the Hungarians generally make terms very advantageous to themselves, e.g., in Bosnia the iirst railways built are those which open up Hungarian traffic, though Austria provides two-thirds of the capital. All protests on the part of the Austrians are, however, unavailing because of the weakness arising from the political quarrels between the different races. Experience shows that the Hungarian ministers can generally depend on the united support of all parties in their discussions with Austria ; in Austria

this is not the case, for while all parties com- ^e plain of the unfair burdens laid upon them, they

ofA^s^fa. ^^^ ^^^ 1°^^ *° support the ministry. It is this

political disunion which brings it about that in determining the policy of the joint state the Hungarians have more influence than the Austrians ; on those occa^ sions when the Delegations have been unable to agree, and a common meeting has been held, the Hungarian view has always prevailed, for all the Hungarian Delegation vote for the proposals of their own side, while the minority in the Austrian Delegation has voted against the proposals which have been adopted by the majority. This has happened because the political /principle on which the dual monarchy is founded does not correspond with facts. It was assumed that in the Austrian half of the empire the Germans would be sufficiently powerful to rule and control the other races as the Magyars do in the other ; but experience has shown that they are unable to do so, while in attempting the task they have brought about a condition of political disorganization bordering on civil war, and making them helpless in their relations with Hungary. For the causes of this state of things we must turn to the history of Austria.

2. Austria Proper.

As explained at the opening of the geographical section on the Whole Monarchy, the nan^ie Austria is used for convenience to designate those portions of the possessions of the house of Hapsburg, which were not included by the settlement of 1867 among the lands of the Hungarian

crown. The separation of Hungary made it necessary to determine the method by which these territories^ were henceforth to be governed. It was the misfortune of the country that there was no clear legal basis on which new institutions could be erected. Each of the territories was a separate political unit with a separate history, and some of them had a historic claim to a large amount of self- government; in many the old feudal estates had survived till 1848. Since that year the empire had been the subject of numerous experimehts in government ; by the last, which began in 1860, Landtags or Diets have been instituted in each of the territories on a nearly uniform system and with nearly identical powers, and by the constitution published in February 1861 (the February Constitution, as it is called), which is still the ^^^ ultimate basis for the Government, there was February instituted a Beichsrath or parliament for .the Constitu- whole empire; it consisted of a House of ”’”’■ Lords, in which sat the archbishops and prince bishops, members of the imperial family, and other members appointed for life, besides some hereditary members, and a chamber of deputies. The members of the latter for each territory were not chosen by direct election, but by the Landtags. The Landtags themselves were elected for six years ; they were chosen generally (there were slight local differences) in the following way : (o) a certain number of bishops and rectors of universities sat in virtue of their office ; (6) the rest of the members were chosen by four electoral bodies or curiae, — (1) the owners of estates which before 1848 had enjoyed certain feudal privileges, the so-called great proprietors ; (2) the chambers of commerce; (3) the towns; (4) the rural districts. In the two latter classes all had the suffrage who paid at least ten gulden in direct taxes. The districts were so arranged as to give the towns a very large representation in proportion to their popu- lations. In Bohemia, e.g., the Diet consisted of 241 members : of these five were eoe-officio members ; the feudal proprietors had seventy; the towns and chambers of commerce together had eighty-seven; the rural districts

seventy-nine. The electors in the rural districts were ■236,000, in the towns 93,000. This arrangement seems to have been deliberately made by Schmerling, so as to give greater power to the German inhabitants of the towns ; the votes of the proprietors would moreover nearly always give the final decision to the court and the Gov- ernment, for the influence exercised by the Government ovfer the nobility would generally be strong enough to secure a majority in favour of the Government policy.

This constitution had failed; territories so different in size, history, and circumstances, were not contented with similar institutions, and a form of self-government which satisfied Lower Austria and Salzburg didnot satisfy Galicia and Bohemia. The Czechs of Bohemia, like the Magyars, had refused to recognize the common parliament on the ground that it violated the historic rights of the Bohemian as of the Hungarian crown, and in 1865 the constitution of 1861 had been superseded, while the territorial Diets

2 It Is impossible to avoid using the word “Austria” to designate these territories, though it is probably incorrect. Officially the word ” Austria ” is not found, and though the sovereign is emperor of Austria, an Austrian empire appears not to exist ; the territories are spoken of in official documents as ” the territories represented in the Reichsrath. ‘ ‘ The Hungarians and the German party in Austria have expressed their desire that the word Austria should be used, but it has not been gratified. On the other hand, expressions such as ” Austrian citizens,” ” Austrian law,” are found. The reason of this peculiar use is probably twofold. On the one hand, a reluctance to confess that Hungary is no longer in any sense a part of Austria; on the other hand, the refusal of the Czechs to recognize that their country is part of Austria. Sometimes the word Brblande, which properly is applied only to the older ancestral dominions of the house of Hapsburg, is used for want of a better word.

remained. In 1867 it was necessary once more to summon, in some form or another, a common parliament for the whole of Austria, by which the settlement with Hungary could be ratified.

This necessity brought to a decisive issue the struggle between the parties of the Centralists and Federalists. The latter claimed that the new constitution ists aad must be made by agreement with the territories ; Federal- the former maintained that the constitution of ists. 1861 was still Valid, and demanded that in

accordance with it the Eeichsrath should be summoned and a ” constitutional ” Government restored. The dif- ference between the two parties was to a great extent, though not entirely, one of race. The kernel of the empire was the purely German district, including Upper and Lower Austria, Salzburg, Tirol (except the south), and Vorarlberg, all Styria except the southern districts, and a large part of Carinthia. There was strong local feeling, especially in Tirol, but it was local feeling similar to that which formerly existed in the provinces of France ; among all classes and parties there was great loyalty both to the ruling house and to the idea of the Austrian state ; but while the Liberal party, which was dominant in Lower Austria and Styria, desired to develop the central institutions, there was a strong Conservative and Clerical party which supported local institutions as a protection against the Liberal influence of a centralized parliament and bureaucracy, and the bishops and clergy were willing to gain support in the struggle by alliance ^vith the Federalists.

Very different was it in the other territories where the majority of the population was not German — and where there was a lively recollection of the time when ™e they were not Austrian. With Palacky, they

lands”” s^i^) “We existed before Austria; we shall continue to exist after it is gone.” Especially was this the ease in Bohemia. In this great country, the richest part of the Austrian dominions, where over three- fifths of the population were Czech, national feeling was supported by the appeal to historic law. A great party, led by Palacky and Eieger, demanded the restoration of the Bohemian monarchy in its fullest extfent, including Moravia and Silesia, and insisted that the emperor should be crowned in Prague as his predecessors had been, and that Bohemia should have a

position in the empire similar to that obtained by Hungary. Not only did the party include all the Czechs, but they were supported by many of the great nobles who were of German descent, including Count Leo Thun, his brother-in-law Clam- Martiniez, and Prince Schwarzenberg, Cardinal Archbishop of Prague, who hoped in a self-governing kingdom of Bohemia to preserve that power which was threatened by the German Liberals. The feudal nobles had great power arising from their wealth, the great traditions of their families, and the connexion with the court, and by the electoral law they had a large number of represent- atives in the Diet. On the other hand the Germans of Bohemia, fearful of falling under the control of the Czechs, were the most ardent advocates of centralization. The Czechs were supported also by their fellow-country- men in Moravia, and some of the nobles, headed by Count Belcredi, brother of the minister; but in Brunn there was a strong German party. In Silesia the Germans had a considerable majority, and as there was a large Polish element which did not support the Czechs, the Diet refused to recognize the claims of the Bohemians. The Poles of Galicia stood apart from the other Slavonic races. The German-speaking population was very small, consisting chiefly of Government officials, railway ser- vants, and Jews ; but there was a large minority (some 43 per cent.) of Euthenia,ns. The Poles wished to gain as

much autonomy as they could for their own province, but they had no interest in opposing the centralization of other parts ; they were satisfied if . Austria would sur- render the Ruthenians to them. They were little influenced by the pan-Slavonic agitation'; it was desirable for them that Austria, which gave them freedom and power, should continue strong and united. Their real interests were outside the monarchy, and they did not cease to look forward to a restoration of the Polish kingdom. The great danger was that they might entangle Austria in a war with Russia.

The southern Slavs had neither the unity, nor the or- ganization, nor the historical traditions of the Czechs and Poles ; but the Slovenians, who formed a large majority of the population in Carniola and a considerable minority in the adjoining territory of Carinthia and the south of Styria, demanded that their language should be used for purposes of government and education. Their political ideal was an "Illyrian" kingdom, including Croatia and all the south Slavonians in the coast district, and a not very suc-

cessful movement had been started to establish a so-called Illyrian language, which should be accepted both by Croatians and Slovenians. There was, however, another element in the southern districts, viz., the Serbs, who, though of the same race and language as the Croatians, were separated from them by religion. Belonging to the Orthodox Church they were attracted by Russia. They were in constant communication with Servia and Montenegro ; and their ultimate hope, the creation of a great Servian kingdom, was less easy to reconcile with loyalty to Austria. Of late years attempts have been made to turn the Slovenian national movement into this direction, and to attract the Slovenians also towards the Orthodox non-Austrian Slavs.

In th6 extreme south of Dalraatia is a small district which had not formed part of the older duchy of Dalmatia, and had not been joined to the Austrian empire till 1814 ; in former years part of it formed the republic of Ragusa, and the rest ■S”’”* belonged to Albania. The inhabitants of this part, ^*’”’«”«- who chiefly belonged to the Greek Church, still kept up a close connexion with Albania and with Montenegro, and Austrian authority was maintained with difficulty. Disturbances had already broken out once before; and in 1869 another outbreak took place. This district had hitherto been exempted from military service ; by the law of 1869, which introduced universal military service, those who had hitherto been exempted were required to serve, not in the regular army but in the militia. The inhabitants of the district round the Bocche de Cattaro (the Bocchese, as they are commonly called) refused to obey this order, and when a mili- tary force was sent it failed to overcome their resistance ; and by an agreement made at Knezlac in December 1869, Rodics, who had taken command, granted the insurgents all they asked and a com- plete amnesty. After the conquest of Bosnia another attempt was made to enforce military service ; once more a rebellion broke out, and spread to the contiguous districts of Herzegovina. This time, however, the Government, whose position in the Balkans had been much strengthened by the occupation of the new provinces, did not fear to act with decision. A considerable force was sent under Jovanowitch ; they were supported from sea by the navy, and after the taking of Crevoscia the rebellion was crushed. An amnesty was proclaimed, but the greater number of the insurgents sought refuge in Montenegro rather than submit to military service.

The Italians of Trieste and Istria were the only people of the empire who really desired separation from Austria; annexation to Italy was the aim of the Italianissimi, as they were called. The feeling was less strong in Tirol, where, except in the city of Trent, they seem chiefly to have wished for separate local institutions, so that they should no longer be governed from Innsbruck. The Italian- speaking population on the coast of Dalmatia only asked that the Government should uphold them against the pres- sure of the Slavonic races in the interior, and for this rea- son were ready to support the German constitutionalists.

The party of centralization was then the Liberal German party, supported by a few Italians and the Ruthenians ;

and as years went by it was to become the National German party. They hoped by a common parliament to create aermaa *^® feeling of a common Austrian nationality, by constitu- German schools to spread the use of the Ger- tfom/ man language. Every grant of self-government i”^’ to the territories must diminish the influence of the Germans, and bring about a restriction in the use of the German language ; moreover, in countries such as Bohemia, full self-government would almost certainly mean that the Germans woijld become the subject race. This was a result which they could not accept. It was intolerable to them that just at the time when the national power of the non-Austrian Germans was so greatly in- creased, and the Germans were becoming the first race in Europe, they themselves should resign the .position as rulers which they had won during the last three hundred years. They maintained, moreover, that the ascendency of the Germans was the only means of preserving the unity of the monarchy ; German was the only language in which the different races could communicate with one another ; it must be the language of the army, the civil service, and the parliament. They laid much stress on the historic task of Austria in bringing German culture to the half-civilized races of the east. They demanded, therefore, that all higher schools and universities should

remain German, and that so far as possible the element- ary schools should be Germanized. They looked on the German schoolmaster as the apostle of German culture, and they looked forward to the time when the feeling of a common Austrian nationality should obscure the national feeling of the Slavs, and the Slavonic idioms should survive merely as the local dialects of the peasantry, the territories becoming merely the provinces of a united and centralized state. The total German population was not quite a third of the whole. The maintenance of their rule was therefore only possible by the exercise of great political ability, the more so, since, as we have seen, they were not united among themselves, the clergy and Eeudal party being opposed to the Liberals. Their watchword was the constitution of 1861, which had been drawn up by their leaders ; they demanded that it should be restored, and with it parliamentary government. They called themselves, therefore, the Constitutional party. But the introduction of parliamentary government really added greatly to the difficulty of the task before them. In the old days German ascendency had been secured by the common army, the civil service, and the court. As soon, however, as power was trai^f erred to a parliament, the Germans must inevitably be in a minority, unless the method of election was deliberately arranged so as to give them a majority. Parliamentary discussion, moreover, was sure to bring out those national differences which it was desirable should be forgotten, and the elections carried into every part of the empire a political agitation which was very harmful when each party represented a different race.

The very first events showed one of those extraordinary changes of policy so characteristic of modern Austrian history. The decision of the Government on the con- stitutional question was really determined by immediate practical necessity. The Hungarians required that the settlement should be ratified by a parliament, therefore a parliament must be procured which would do this. It must be a parliament in which the Germans had a majority, for the system of dualism was directly opposed to the ambitions of the Slavs and the Federalists. Belcredi, who had come into power in 1865 as a Federalist, and had suspended the constitution on the 2nd January, ordered new elections for the Landtags, which were then to elect deputies to an extraordinary Reichsrath which should consider the Ausgleich. The wording of the decree

implied that the February Constitution did not exist as of law; the Germans and Liberals maintaining that it did exist, and that changes could only be introduced by a regular Eeichsrath summoned in accordance with it, protested against the decree, and, in some cases, threatened not to take part in the elections. As the Federalists were all opposed to the Ausgleich, it was clear that a Reichsrath chosen in these circumstances would refuse to ratify it, and this was probably Belcredi's intention. As the existence of the empire would thereby be endangered, Beust interfered ; Belcredi was dismissed, Beust himself became minister president in February 1867, and a new edict was issued from Vienna ordering the Landtags to elect a Eeichsrath, according to the constitution, which was now said to be completely valid. Of course, however, those Landtags in which there was a Federalist majority, viz., those of Bohemia, Moravia, Carinthia, and Tirol, which were already pledged to support the January policy of the Government, did not acquiesce in the February policy ; and they refused to elect except on terms which the Government could not accept. The first three were immediately dissolved. In the elections which followed in Bohemia the influence of the Government was sufficient to secure a German majority among the landed proprietors; the Czechs, who were therefore in a minority, declared the elections invalid, refused to take any part in electing deputies for the Eeichsrath, and seceded altogether from the Landtag. The result was that Bohemia now sent a large German majority to Vienna, and the few Czechs who were chosen refused to take their seat in the parliament. Had the example of the Czechs been followed by the other Slavonic races it would still have been difficult to get together a Eeichsrath to pass the Ausgleich. It was, however, easier to deal with the Poles of Beast's Galicia, for they had no historical rights to compact defend ; and by sending delegates to Vienna they with tbe would not sacrifice any principle or prejudice anyi ^'e*- legal claim; they had only to consider how they could make the best bargain. Their position was a strong one ; their votes were essential to the Government, and the Government could be useful to them ; it could give them the complete control over the Euthenians. A compact then was easily arranged.

Beust promised them that there should be a special minister for Galicia, ‘a separate board for Galician education, that Polish should be the language of in- struction in all secondary schools, that Polish instead of German should be the official language in the law courts and public offices, Euthenian being only used in the elementary schools under strict limita- tions. On these terms the Polish deputies, led by Ziemialkowski, agreed to go to Vienna and vote for the Ausgleich.

When the Eeichsrath met, the Government had a large majority ; and in the House, in which all the races except the Czechs were represented, the Ausgleich was ratified almost unanimously. This having been ™f ^’’- done, it was possible to proceed to special otiser. legislation for the territories, which were hence- forward officially known as ” the territories represented in the Eeichsrath.” A series of fundamental laws were carried, which formally established parliamentary govern- ment, with responsibility of ministers, and complete control over the budget, and there were included a number of clauses guaranteeing personal rights and liberties in the way common, to all modern constitutions. The influence of the Poles was still sufficient to secure considerable concessions to the wishes of the Federalists, since if they did not get what they wished they would leave the House, and the Slovenians, Dalmatians, and Tirolese,

would certainly follow them. Hence the German Liberals were prevented from introducing direct elections to the Eeichsrath, and the functions of the Reich srath were slightly less extensive than they had hitherto been. Moreover the Delegation was to be chosen not by the House as a whole, but by the representatives of the separate territories. This is one reason for the compara- tive weakness of Austria as compared with Hungary, where the Delegation is elected by each House as a whole ; the Bohemian representatives, e.g., meet and choose 10 delegates, the Galicians 7, those

from Trieste 1 ; the Dele- gation is therefore not representative of the majority of ‘ the Chamber of Deputies, but includes representatives of all the groups which there may be opposing the Govern- ment, and they can carry on their opposition even in the Delegation. So it came about in 1869, that on the first occasion when there was a joint sitting of the Delegations to settle a point in the budget, which Hungary had accepted and Austria rejected, the Poles and Tirolese voted in favour of the Hungarian proposal.

As soon as these laws had been carried (Dec. 1867), Beust retired from the post of minister-president ; and ~ in accordance with constitutional practice a

Burger parliamentary ministry was appointed entirely Minis- from the ranks of the Liberal majority; a teriaat. ministry generally known as the ” Burger Minis- terium ” in which Giskra and Herbst — the leaders of the German party in Moravia and Bohemia — were the most important members. Austria now began its new life as a modern constitutional state. From this time the main- tenance of the revised constitution of 1867 has been the watchword of what is called the Constitutional party. The first use which the new Government made of their power was to settle the finances, and in this their best work was done. Among them were nearly all the repre- sentatives of trade and industry, of commercial enter- prise and financial speculation ; they were the men who hoped to make Austria a great industrial state, and at this time they were much occupied with railway enter- prise. Convinced free-traders, they hoped by private energy to build up the fortunes of the country, parlia^ mentary government — which meant for them the rule of the educated and well-to-do middle class — being one of the means to this end. They accepted the great burden of debt which the action of Hungary imposed upon the country, and rejected the proposals for repudiation, but notwithstanding the protest of foreign bond-holders they imposed a tax of 16 per cent, on all interest on the debt. They carried out an extension of the commercial treaty with Great Britain by which a further advance was made in the direction of free trade.

Of equal importance was their work in freeing Austria from the control of the Church, which checked the in- _. tellectual life of the people. The co7icordat of

Liberals 1855 had given the Church complete freedom in and the the management of all ecclesiastical affairs ; concordat ^-^ere was full liberty of intercourse with Eome, the state gave up all control over the appointment of the clergy, and in matters of church discipline the civil courts had no voice — the clergy being absolutely subject to the power of the bishops, who could impose temporal as well as spiritual penalties. The state had even resigned to the Church all authority over some departments of civil life, and restored the authority of the canon law. This was the case as regards marriage ; all disputes were to be tried before ecclesiastical courts, and the marriage registers were kept by the priests. All the schools were under the control of the Church ; the bishops could forbid the use of books prejudicial to religion ; in elementary schools all teachers were subject to the inspection of the Church, and in higher schools only Eoman Catholics could be

appointed. It had been agreed that the whole education of the Eoman Catholic youth, in all schools, private as well as public, should be in accordance with the teaching of the Eoman Catholic Church. The authority of the Church extended even to the universities. Some change in this system was essential ; the Liberal party demanded that the government should simply state that the con- cordat had ceased to exist. To this, however, the emperor would not assent, and there was a difficulty in overthrow- ing an act which took the form of a treaty. The Govern- ment wished to come to some agreement by friendly discussion with Eome, but Pius IX. was not willing to abate anything of his full claims. The ministry there- fore proceeded by internal legislation, and in 1868 intro- duced three laws: (1) a marriage law transferred the decisions on all questions of marriage from the ecclesi- astical to the civil courts, abolished the authority of the canon law, and introduced civil marriage in those cases where the clergy refused to perform the ceremony;

(2) the control of secular education was taken from the Church, and the management of schools transferred to local authorities which were to be created by the Landtags ;

(3) complete civil equality between Catholics and non- Catholics was established. These laws, notwithstanding the protest of all the bishops, led

by Cardinal Eauscher, archbishop of Vienna, who appealed directly to the emperor, were carried through both Houses in May amid almost unparalleled excitement, and at once received the imperial sanction.

The ministry had the enthusiastic support of the German population in the towns. They were also sup- ported by the teaching profession, which desired emanci- pation from ecclesiastical control, and hoped that German, schools and German railways were to complete the work which Joseph II. had begun. But the hostility of the Church was dangerous. The pope, in an allocution of 22nd June 1868, declared that these ” damnable and abominable laws ” which were ” contrary to the concordat, to the laws of the Church, and to the principles of Christianity,” were “absolutely and for ever null and void.” The natural result was that when they were carried into effect the bishops in many cases: refused to obey. They claimed that the laws were inconsistent with the concordat, that the concordat still was in force, and that the laws were consequently invalid. The argu- ment was forcible, but the courts decided against them. Eudigier, bishop of Linz, was summoned to a criminal court for disturbing th^ public peace ; he refused to ap- pear, for by the concordat bishops were not subject to temporal jurisdiction; and when he was condemned to imprisonment the emperor at once telegraphed his full pardon. In the rural districts the clergy had much influence ; they were supported by the peasants, and the Landtags of Tirol and Vorarlberg, where there was a clerical majority, refused to carry out the school law.

On the proclamation of papal infallibility in 1870, the Government took the opportunity of declaring that the concordat had lapsed, on the ground that there was a fundamental change in the character of the papacy. Nearly all the Austrian prelates had been opposed to the new doctrine ; many of them remained to the end of the council and voted against it, and they only declared their submission with great reluctance. The New-Catholic movement, however, never made much progress in Austria. Laws regulating the posi- tion of the Church were carried in 1874. (For the concordat see Laveleye, La Prusse et VAutriche, Paris, 1870.)

During 1868 the constitution then was open to attack on two sides, for the nationalist movement was gaining ground in Bohemia and Galicia. In

Galicia the extreme party, headed by Smolka, had always desired to imitate the Czechs and not attend at Vienna ; they were outvoted,

history]

but all parties agreed on a declaration in which the final demands of the Poles were drawn up ; ‘ they asked that Natioaii- *^® powers of the Galician Landtag should be Ism In much increased, and that the members from oaiiciaand Gralicia should cease to attend the Eeichsrath on Bohemia, ^j^g discussion of those matters with which the Galician Landtag should be qualified to deal. If these demands were not granted they would leave the Eeichs- rath. In Bohemia the Czechs were very active ; while the Poles were parading their hostility to Russia in such a manner as to cause the emperor to avoid visiting Galicia, some of the Czech leaders attended a Slavonic demonstra- tion at Moscow, and in 1868 they drew up and presented to the Diet at Prague a ” declaration ” which has since been regarded as the o£B.cial statement of their oiaims. Tl^y asked for the full restoration of the Bohemian king- dom ; they contended that no foreign assembly was quali- fied to impose taxes in Bohemia ; that the Landtag was not qualified to elect representatives to go to Vienna, and that a separate settlement must be made with Bohemia similar to that with Hungary. This declaration was signed by eighty-one members, including many of the feudal nobles and bishops.^ The German majority de- clared that they had forfeited their seats, and ordered new. elections. The agitation spread over the country, serious riots took place, and with a view to keeping order the Government decreed exceptional laws. Similar events happened in Moravia, and in Dalmatia .the revolt broke out among the Bocchese.

Before the combination of Clericals and Federalists the ministry broke down; they were divided among them-

Parlla-

selves ; Counts TaafEe and Potocki wished

meatary to conciliate the Slavonic races — a policy breakdown recommended by Beust, probably with the sym- pathy of the emperor; the others determined to cripple the opposition by taking away the elections for the Eeichsrath from the Landtags. Taaffe and his friends resigned, but the majority did not long survive. In March 1870, after long delay, the new Galician de- mands were definitely rejected; the whole of the Polish club, followed by the Tirolese and Slovenians, left the House, which consequently consisted of 110 members — the Germans and German representatives from Bohemia and Moravia. It was clearly impossible to govern with such a parliament. Not four years had gone by, and the new constitution seemed to have failed like the old one. The only thing to do was to attempt a reconciliation with the Slavs. The ministry resigned, and Potocki and Taaffe formed a Government with this object. Potocki then entered on negotiations, hoping to persuade the Czechs to accept the constitution. Eieger and Thun were summoned to Vienna ; he himself went to Prague, but after two days he had to give up the attempt in despair. Feudals and Czechs all supported the declaration of 1868, and Vould accept no compromise, and he returned to Vienna after what was the greatest disappointment of his life. Govern- ment, however, had to be carried on ; the war between Germany and France broke out in July, and Austria might be drawn into it ; the emperor could not at such a crisis alienate either the Germans or the Slavs. The Eeichsrath and all the Landtags were dissolved. This time in Bohemia the Czechs, supported by the Feudals and the Clericals, gaiiied a large majority ; they took their seats in the Landtag only to declare that they did not regard it as the legal representative of the Bohemian kingdom, but merely an informal assembly, and refused to elect delegates for the Eeichsrath. The Germans in their turn now left the Diet, and the Czechs voted an address

1 The documents are printed in Baron de Worms, op. cit.

2 It is printed in the Europdischer Geschichtskalendar, 1868.

to the Crown, drawn up by Count Thun, demanding the restoration of the Bohemian kingdom. When the Eeichs- rath met there were present only 130 out of 203 mem- bers, for the whole Bohemian contingent was absent; tte Government then, under a law of 1868, ordered that as the Bohemian Diet

had sent no delegates, they were to be chosen directly from the people. Twenty-four Con- stitutionalists and thirty Declaranten were chosen; the latter, of course, did not go to Vienna, but the additional twenty-four made a working majority by which the Gov- ernment was carried on for the rest of the year.

But Potocki's influence was gone, and as soon as the European crisis was over, in February 1871, the emperor appointed a ministry chosen not from the Liberals but from the Federalists and Clericals, led by Count Hohen- wart and Schaffle, a German professor chiefly known for his writings on political economy. They attempted to solve the problem by granting to the Federalists all their demands. So long as parliament was sitting they were kept in check ; as soon as it had voted supplies and the Delegations had separated, they ordered new elections in all those Landtags where there was a Liberal majority. By the help of the Clericals they won enough seats to put the Liberals in a minority in the Eeichsrath, and it would be possible to revise the constitution if the Czechs cout sented to come. They would only .attend, however, on their own terms, which were a The ministry complete recognition by the Government of the ^^rt claims made in the Declaration. This was agreed to ; and on the 12th September, at the opening of the Landtag, the Governor read a royal message recogniz- ing the separate existence of the Bohemian kingdom, and promising that the emperor should be crowned. It was received with delight throughout Bohemia; and the Czechs drew a draft constitution of fundamental rights On this the Germans, now that they were in a minority, left the Landtag, and began preparations for resistance. In Upper Austria, Moravia, and Carinthia, where they were outvoted by the Clericals, they seceded, and the whole work of 1867 was on the point of being overthrown. Were the movement not stopped the constitution would be superseded, and the union with Hungary endangered. Beust and Andrassy warned the emperor of the danger, and the crown prince of Saxony was summoned by Beust to remonstrate with him. A great council was called at Vienna (Oct. 20), at which the emperor gave his decision that the Bohemian demands could not be accepted. The Czechs must come to Vienna, and consider a revision of the constitution in a constitutional manner. Hohenwart resigned, but at the same time Beust was dismissed, and a new Cabinet was chosen once more from among the German Liberals, under the leadership of Prince Anton

Auersperg, whose brother Carlos had been one of the chief members in the Burger Ministerium. For the second time in four years the policy of the Government had completely changed within a few months. On 12th September the decree had been published accepting the •Bohemian claims ; before the end of the year copies of it were seized by the police, and men were thrown into prison for circulating it.

Auersperg's minist^ held office for eight years. They began, as had the Burger Ministerium, with a vigor- ous Liberal centralizing policy. In Bohemia . they succeeded at first in almost crushing the p^^^m/n- opposition. In 1872 the Landtag was dis- 'stry, isn solved; and the whole influence of the Gov-'"'*^'' ernment was used to procure a German majority. KoUer, the governor, acted with great vigour. Opposition newspapers were suppressed; cases, in which Czech- ish journalists were concerned were transferred to the German districts, so that they were tried by a

hostile German jury. Czechish manifestoes were con- fiscated, and meetings stopped at the slightest appearance of disorder ; and the riots were punished by quartering soldiers upon the inhabitants. The decision between the two races turned on the vote of the feudal proprietors, and in order to win this a society was formed among the German capitalists of Vienna (to which the name of Chabrus was popularly given) to acquire by real or fictitious purchase portions of those estates to which a vote was attached. These measures were successful; a large German majority was secured ; Jews from Vienna sat in the place of the Thuns and the Schwarzenbergs ; and as for many years the Czechs refused to sit in the Landtag, the Government could be carried on without difficulty. A still greater blow to the Federalists was the passing of a new electoi^il law in 1873. The measure transferred the right of electing members of the Reichsrath from the Landtags to the direct vote of the people, the result being to deprive the Federalists of their chief weapon ; it was no longer possible to take a formal vote of the legal

representatives in any territory refusing to appoint depu- tieSj and if a Czechish or Slovenian member did not take his seat the only result was that a single constituency was unrepresented, and the opposition weakened. The measure was strongly opposed. A petition with 260,000 names was presented from Bohemia; and the Poles withdrew from the Eeichstag when the law was introduced. But enough members remained to give the legal quorum, and it was carried by 120 to 2 votes. At the same time the number of members was increased to 353, but the pro- portion of representatives from the different territories was maintained and the system of election was not altered. The proportion of members assigned to the towns was increased, the special representatives Of the Chambers of Commerce and of the landed proprietors were retained, and the suffrage was not extended. The artificial system which gave to the Germans a parliamentary majority continued.

At this time the Czechs were much weakened by quarrels among themselves. A new party had arisen, calling them- selves the Freisinige or Radicals, but generally known as the Young Czechs. They disliked the alliance with the aristocracy and the clergy ; they wished for universal suffrage, and recalled the Hussite traditions. They desired to take their seats in the Landtag, and to join with the Germans in political reform. They violently attacked Rieger, the leader of the Old Czechs, who maintained the alliance with the Feudalists and the policy of passive opposition. Twenty-seven members of the Landtag, led by Gregr and Stadkowsky, being out-voted in the Czechish Club, resigned their seats. They were completely defeated in the elections which followed’ but for the next four years the two parties among the Czechs were as much occupied in opposing one another as in opposing the Germans. These events, might have secured the-predominance of the Liberals for many years. The election after the Reform Bill gave them an increased majority in the Reichsrath. Forty-two Czechs who had won seats did not attend ; forty-three Poles stood’ aloof from all party combination, giving their votes on each occasion as the interest of their country seemed to require ; the real opposition was limited to forty Clericals and representatives of the other Slavonic races, who were collected on the Eight under the leadership of Hohen- wart. Against them were 227 Constitutionalists, and it seemed to matter little that they were divided into three groups; there were 105 in the Liberal Club under the

leadership of Herbst, 57 Constitutionalists, elected by the landed proprietors, and a third body of Radi- cals, some of whom were more democratic than the old Constitutional party, while others laid more stress

Czech dis- seaslotts.

on nationality. They used their majority to carry a num- ber of important laws regulating ecclesiastical affairs. Yet within four years the Government was obliged to turn for support to the Federalists and Clericals, and the rule of the German Liberals was overthrown. Their influence was indirectly affected by the great commercial crisis of 1873. For some years there had been Pinaaciai active speculation on the Stock Exchange; a %'^jf' great number of companies, chiefly banks and building societies, had been founded on a very insecure basis. The inevitable crisis began in 1872; it Was postponed for a short time, and there was some hope that the Exhibition, fixed for 1873, would bring fresh prosperity ; the hope was not, however, fulfilled, and the final crash, which occurred in May, brought with it the collapse of hundreds of undertakings. The loss fell almost entirely on those who had attempted to increase their wealth by speculative investment. Sound industrial concerns were little touched by it, but speculation had become so general that every class of society was affected, and in the investigation which followed it became apparent that some of the most distinguished members of the gov- erning Liberal party, including at least two members of the Government, were among those who had profited by the unsound finance. It appeared also that many of the leading newspapers of Vienna, by which the Liberal party was supported, had received money from financiers. For the next two years political interest was transferred from Parliament to the law courts, in which financial scandals were exposed, and the reputations of some of the leading politicians were destroyed.'

This was to bring about a reaction against the economic doctrines which had held the field for nearly twenty years ; but the full effect of the change was not seen for some time. What ruined the Government ”' “^ **« was the want of unity in the party, and their ^lalstry. neglect to support a ministry which had been taken from their own ranks. In a country like Austria, in which a mistaken foreign policy or a serious quarrel with Hungary might

bring about the disruption of the monarchy, parliamentary government was impossible unless the party which the Government helped in internal matters were prepared to support it in foreign affairs and in the commercial policy bound up with the settlement with Hungary. This the Constitutional parties did not do. During discussions on the Ausgleich in 1877 a large number voted against the duties on coffee and petroleum, which were an essential part of the agree- ment ; they demanded, moreover, that the treaty of Ber- lin should be laid before the House, and 112 members, led by Herbst, gave a vote hostile to some of its provisions, and in the Delegation refused the supplies necessary for the occupation of Bosnia. They doubtless were acting in accordance with their principles, but the situation was such that it would have been impossible to carry out their wishes; the only result was that the Aus- trian ministers and Andrassy had to turn for help to the Poles, who began to acquire the position of a Gov- ernment party, which they have kept since then. At the beginning of 1879 Auersperg's resignation, which had long been offered, was accepted. The Constitu- tionalists remained in power; but in the reconstructed Cabinet, though Stromeyer was president. Count Taaffe, as minister of the interior, was the most important member.

Parliament was dissolved in the summer, and Taaffe, by private negotiations, first of all persuaded the Bohemian feudal proprietors to give the Feudalists, who had long

1 See Wirth, Geschichte der Handelskrisen, Frankfurt, 1885 ; and "'^J^of'iP^ /|?!fj3y Sohaffle in the Zeitschnft /. Staatswissen- schaft, Stuttgart, 1874.

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A U S T K I AH U N G A R Y

21

Count Taaffe.

been excluded, a certain number of seats; secondly, he succeeded where Potocki had failed, and came to an agreement with the Czechs; they had

already, in 1878, taken their seats in the Diet at Prague, and now gave up the policy of “passive resistance,” and consented to take their seats also in the parliament at Vienna.

On entering the House they took the oath without reservation, but in the speech from the throne the emperor himself stated that they had entered without prejudice to their convictions, and on the first day of the session Rieger read a formal reservation of right. The Liberals had also lost many seats, so that the House now had a completely different aspect; the Constitutionalists were reduced to 91 Liberals and 54 Radicals ; but the Eight, under Hohenwart, had increased to 57, and there were 57 Poles and 54 Czechs. A combination of these three parties might govern against the Constitutionalists. Taaffe, who now became first minister, tried first of all to govern by the help of the Moderates of all parties, and he included representatives of nearly every party in his Cabinet. But the Liberals again voted against the Government on an important military bill, an offence almost as unpardonable in Austria as in Germany, and a great meeting of the party decided that they would not support the Govern- ment. Taaffe, therefore, was obliged to turn for support to the Eight. The German members of the Government resigned, their place was taken ‘by Clericals, Poles, and Czechs, Smolka was elected president of the Eeichsrath, and the German Liberals found themselves in a minority opposed by the “iron ring” of these three parties, and helpless in the parliament Of their own creation. For fourteen years Taaffe succeeded in maintaining the position he had thus secured. He was not himself a party man ; he had sat in a Liberal Government ; he had never assented to the principles of the Federalists, nor was he an adherent of the Clerical party. He continued to rule according to the constitution; his watchword was ” unpolitical politics,” and he brought in little contentious legislation. The great source of his strength was that he stood between the Eight and a Liberal Government. There was a large minority of Constitutionalists; they might easily become a majority, and the Eight was there- fore obliged to support Taaffe in order to avert this. They continued to support him, even if they did not get from him all that they could have wished, and the Czechs acquiesced in a foreign policy with which they had little sympathy. Something, however, had to be done for them, and from time to time concessions had to be made to the Clericals and the Federalists.

The real desire of the Clericals was an alteration of the school law, by which the control of the schools should be restored to the Church and the period of com- a”i I pulsory education reduced. In this, however, the Government did not meet them, and in 1882 the Clericals, under Prince Albert v. Liechtenstein, separated from Hohenwart’s party and founded their own club, so that they could act more freely. Both the new Clerical Club and the remainder of the Conservatives were much affected by the reaction against the doctrines of economic Liberalism. They began to adoptthepriniciplesof Christian Socialism expounded by Eudolf Mayer and Baron von Vogelfang, and the economic revolt against the influence of capital was with them joined to a half-reli’gious attack upon the Jews. They represented that Austria was being governed by a close ring of political financiers, many of whom were Jews or in the pay of the Jews, who used the forms of the constitution, under which there was no representation of the working classes, to exploit the labour of the poer at the same time that they ruined the people

by alienating them from Christianity in ” godless schools.” It was during these years that the foundation for the democratic clericalism of the future was laid. The chief political leader in this new tendency was Prince Aloys v. Liechtenstein, who complained of the political influence exercised by the chambers of commerce, and demanded the organization of working men in guilds. It was by their influence that a law was introduced limiting the rate of interest, and they co-operated with the Government in legislation for improving the material condition of the people, which had been neglected during the period of Liberal government, and which was partly similar to the laws introduced at the same time in Germany.

There seems no doubt that the condition of the workmen in the factories of Moravia and the oil-mines of Galicia was peculiarly unfortunate ; the hours of work were very long, the conditions were very injurious Social to health, and there were no precautions against «^f ’’ accidents. The report of a parliamentary in- quiry, called for by the Christian Socialists, showed the necessity for interference. In 1883 a law was carried, introducing factory inspection, extending to mines and all industrial undertakings. The measure seems to have been successful, and there is a general agreement that the inspectors have done their work with skill and courage. In 1884 and 1885

important laws were passed regulating the work in mines and factories, and introducing a maxi- mum working day of eleven hours in factories, and ten hours in mines. Sunday labour was forbidden, and the hours during which women and children could be employed were limited. Great power was given to the administrative authorities to relax the application of these laws in special cases and special trades. This power was at first freely used, but it was closely restricted by a further law of 1893. In 1887-88 laws, modelled on the new German laws, introduced compulsory insurance against accidents and sickness. These measures, though severely criticized by the Opposition, were introduced to remedy obvious, and in some cases terrible social evils. Other laws to restore guilds among working men had a more direct political object. Another form of State Socialism' was the acquisi- tion of railways by the state. Originally railways had been built by private enterprise, supported in some cases by a state guarantee; a law of 1877 permitted the acquisition of private lines ; when Taaffe retired the state possessed nearly 6000 miles of railway, not including these which belonged to Austria and Hungary conjointly. In 1899 a minister of railways was appointed. In this policy military considerations as well as economic were of influence. In every department we find the same reaction against the doctrines of laissez-faire. In 1889 for the first time the Austrian budget showed a surplus, partly the result of the new import duties, partly due to a reform of taxation.

For a fuller description of these social reforms, see the Jahrbuch fur Gesetzgebung, Leipzig, 1886, 1888, and 1894 ; also the annual summary of new laws in the Zeitschrift fur Staatswissenschaft,!^ Stuttgart. For the Christian Socialists, see Nitti, Catholic Social- ism, London, 1895.

Meanwhile it was necessary for the Government to do something for the Czechs and the other Slavs, on whose support they depended for their majority. The influence of the Government became . more J*® favourable to them in the matter of language, gueftfon! and this caused the struggle of nationalities to assume the first place in Austrian public life — a place which it has ever since maintained. The question of language becomes a political one, so far as it concerns the use of different languages in the public offices and law courts, and ip the schools. There never was any

general law laying down clear and universal rules, but since the time of Joseph II. German had been the ordinary language of the Government. All laws were published in German; German was the sole language used in the central public oifiees in Vienna, and the language of the court and of the army; moreover, in almost every part of the monarchy it had become the language of what is called the internal service in the pub- lic offices and law courts ; all books and correspondence were kept in German, not only in the German districts, but also in countries such as Bohemia and Galicia. The bureaucracy and the law courts had therefore become a network of German-speaking officialism extending over the whole country ; no one had any share in the Govern- ment unless he could speak and write German. The only exception was in the Italian districts ; not only in Italy itself (in Lombardy, and afterwards in Venetia), but in South Tirol, Trieste, Istria, and Dalmatia, Italian has always been used, even for the internal service of the Government offices, and it remains to this day the language of the Austrian navy. Any interference with the use of German would be a serious blow to the cause of those who hoped to Germanize the whole empire. Since 1867 the old rules have been maintained absolutely as regards the army, and German has also, as required by the military authorities, become the language of the railway administration. It remains the language of the central offices in Vienna, and is the usual, though not the only, language used in the Reichsrath. In 1869 a great innovation was made, when Polish was introduced throughout the whole of Galicia as the normal language of Government; and since that time the use of German has almost entirely disappeared in that territory. Similar innovations have also begun, as we shall see, in other parts.

Different from this is what is called the external service. Even in the old days it was customary to use the language of the district in communication between the Government offices and private individuals, and evidence could be given in the law courts in the language generally spoken. This was not the result of any law, but depended on ad- ministrative regulations of

the Government service ; it was practically necessary in remote districts, such as Galiciaand Bukovina, where few of the population understood German. In some places a Slavonic-speaking individual would him- self have to provide the interpreter, and approach the Gov- ernment in German. Local authorities, e.g., town councils and the Diets, were free to use what language they wished, and in this matter the Austrian Government has shown great liberality. The constitution of 1867 laid down a principle of much importance, by which previous custom became established as a riglit. Article 19 runs: “All races of the empire have equal rights, and every race has an inviolable right to the preservation and use of its own nationality and language. The equality of all customary (landesublich) languages in school, office, and public life, is recognized by the state. In those territories in which several races dwell, the public and educational institutions are to be so arranged that, without applying compulsion to learn a second Landessprache, each of the races receives the necessary means of education in its own language.” The application of this law gives great power to the Government, for everything depends on what is meant by landesUbUch, and it rests with them to determine when a language is customary. The Germans demand the recog- nition of German as a customary language in every part of the empire, so that a German may claim to have his business attended to in his own language, even in Dalmatia and Galicia. In Bohemia the Czechs claim that their language shall be recognized as customary, even in those districts such as Reichenberg, which are almost completely

German; the Germans, on the other hand, claim that Czechish shall only be recognized in those towns and districts where there is a considerable Czech population. What Taafiie’s Administration did was to interpret this law in a sense more favourable to the Slavs than had hitherto been the case.

Peculiar importance is attached to the question of education. The law of 1867 required that the education in the elementary schools in the Slavonic districts should be given in Czech, or Slovenian, as the case might be. The Slavs, however, required that, even when a small minority of Slavonic race settled in any town, they should not be compelled to go to the German schools, but should have their own school provided for them ; and this de- mand was granted by Prazak, minister of education under Count Taaffe. The Germans had always hoped that the people as they became educated

would cease to use their own particular language. Owing to economic causes the Slavonic races, who increase m ore rapidly than the Germans, tend to move westwards, and large numbers settle in the towns and manufacturing districts. It might have been expected that they would then cease to use their own language and become Germanized ; but, on the contrary, the movement of population is spreading their language, and they claim that special schools shall be provided for them, and that men of their own nationality should be appointed to Government offices to deal with their business. This has happened not only in many places in Bohemia, but in Styria, and even in Vienna, where there has been a great increase in the Czechish population and a Czechish school, has been founded. The introduction of Slavonic into' the middle and higher schools has affected , the Germans in their most sensitive point. They have always insisted that German is the Kultur-^prache. On one occasion Count A. Auersperg (Anastasius Grlin) entered the Landtag of Carniola carrying the whole of the Slovenian literature under his arm, as evidence that the Slovenian language could not well be substituted for German as a medium of higher education.

The first important regulations which were issued under the law of 1867 applied to Dalmatia, and for that country between 1872 and 1876 a series of laws and edicts were issued determining to what extent the Slavonic idioms were to be recognized. Hitherto all business had been done in Italian, the language of a small minority living in the seaport towns. The effect of these laws has been to raise Croatian to equality with Italian. It has been introduced in all schools, so that nearly all education is given in Croatian, even though a knowledge of Italian is quite essential for the maritime population ; and it is only in one or two towns, such as Zara, the ancient capital of the country, that Italian is able to maintain itself. Since 1882 there has been a Slavonic majority in the Diet, and Italian has been disused in the proceedings of that body. In this case the concessions to the Servo-Croatians had been made by the Liberal ministry ; they required the parliamentary support of the Dalmatian representatives, who were morte numerous than the Italian, and it was also necessary to cultivate the loyalty of the Slavonic races in this part so as to gain a support for Austria against the Russian party, which was very active in the Balkan Peninsula. It was better to sacrifice the Italians of Dalmatia than the Germans of Carinthia.' .

It was not till 1879 that the Slovenians received the support of the Government. In Carniola they succeeded, in 1882, in winning a majority in the Diet, and from this time while the Diet of Styria is the centre of the German, that of Carniola is the chief support of the Slovenian

1 For Dalmatia, see T. G. Jackson, Dalmatia, &a. Oxford, 1889.

agitation. In the same year they won the majority in the town council of Laibach, which had hitherto been German. They were able, therefore, to introduce lUyrian as the official language, and cause the names of the streets to be written up in lUyrian. This question of street names is, as it were, a sign of victory. Serious riots broke out in some of the towns of Istria when, for the first time, Illyrian was used for this purpose as well as Italian. In Prague the victory of the Czechs has been marked by the removal of all German street names, and the Czechish town council even passed a bye-law forbidding private individuals to have tablets put up with the name of the street in German. In consequence of a motion by the ^Slovenian members of the Eeichsrath and a resolution of the Diet of Carniola, the Government also declared Slovenian to be a recognized language for the whole of Carniola, for the district of Cilli -in Styria, and for the Slovenian and mixed districts in the south of Carinthia, and determined that in' Laibach a Slovenian gymnasium should be maintained as well as the German one.

The Germans complain that in many cases the Government acted very unfairly to them. They constantly refer to the case of Klagenfurt. This town in Carinthia had a population of 16,491 German-speaking Austrians ; the Slovenian-speaking population numbered 568, of whom 180 were inhabitants of the gaol or the hospital. The Government, however, in 1880 declared Slovenian a customary language, so that provision had to be made in public offices and law courts for dealing with business in Slovenian. It must he remembered, however, that even though the town was German, the rural population of the surrounding villages was chiefly Slovenian.

It was in Bohemia and Moravia that the contest was fought out with the greatest vehemence. The two races were nearly equal, and the victory of Czechish would mean that nearly two million Germans would be placed in a position of subordination ; but for the last twenty years there had been a constant encroachment by Czechish on German. This was partly due to the direct action of the Government. An ordinance of 1880 determined that henceforward all business which had been brought before any government ofB.ce or law court should be dealt with, within the office, in the language in which it was intro- duced; this applied to the whole of Bohemia and Moravia, and meant that Czechish would henceforward have a position within the Government service. It was another step in the same direction when, in 1886, it was ordered that ” to avoid frequent translations ” business intro- duced in Czechish should be dealt with in the same language in the high courts of Prague and Brunn. Then not only were a large number of Czechish elementary schools founded, but also many middle schools were given to the Czechs, and Czechish classes introduced in German schools ; and, what affected the Germans most, in 1882 classes in Czechish were started in the university of Prague — a desecration, as it seemed, of the oldest German university.

The growth of the Slavonic races was, however, not merely the result of Government assistance ; it had begun long before Taaffe assumed office ; it was to be seen in the census returns and in the results of elections. Prague was no longer the German city it had bfeen fifty years before ; the census of 1880 showed 36,000 Germans to 120,000 Czechs. It was the same in Pilsen. In 1861 the’ Germans had a majority in this town ; in 1880 they were not a quarter of the population. This same phenom- enon, which occurs elsewhere, cannot be attributed to any laxity of the Germans. The generation whicji was so vigorously demanding national rights had themselves all been brought up under the old system in German schools, but this b*id not implanted in them a desire to become German. It was partly due to economic causes— the

greater increase among the Czechs, and the greater migra- tion from the country to the towns ; partly the result of the romantic and nationalist movement which had arisen about 1830, and partly the result of establishing popular education and parliamentary government at the same

time. As soon as these races which had so long been ruled by the Germans received political liberty and the means of education, they naturally used both to reassert their national individuality.

It may be suggested that the resistance to the German language is to some extent a result of the increased national feeling among the Germans themselves. They have made it a matter of principle. In the old days it was common for the children of German parents in Bohemia to learn Czechish ; since 1867 this has ceased to be the case. It may almost be said that they make it a point of honour not to do so. A result of this is that, as educated Czechs are gen- erally bilingual, it is easier for them to obtain appointments in districts where a knowledge of Czechish is required, and the Ger- mans therefore regard every order requiring the use of Czechish as an order wljich excludes Germans from a certain number of posts. This attitude of hostility and contempt is strongest among the educated middle class ; it is not shown to the same extent by the clergy and the nobles.

The influence of the Church is also favourable to the Slavonic races, not so much from principle as owing to the fact that they supply more candidates for ordination than the Germans. There is no doubt, however, that the tendency among Germans has been to exalt the principle of nationality above religion, and to give it an absolute authority in which the Roman Catholic Church cannot acquiesce. In this, as in other ways, the Germans in Austria have been much influenced by the course of events in the German empire. This hostility of the Church to the German nationalist movement led in 1898 to an agitation against the Roman Catholic Church, and among the Germans of Styria and other territories large numbers left the Church, going over either to Protestantism or to Old Catholicism. This “Los von Rom” movement, which was caused by the continued alliance of the Clerical party with the Slavonic parties, is more of the nature of a political demonstration than of a religious movement.

[There is a very extensive literature on the question of languages and nationality in Austria. The best statement of the legal ques- tion will be found in Ulbrich and Mischlee, OesterreicMsches Staats-Worterbuch. See also Dummreichee, Sudostdeutsche Be- trachtungen. Leipzig, 1893. — Hainisch. Die Zuhunft der Deutsch. Oesterreicher. Vienna, 1892. —

Heeknbk. Die Zukunf I der Deutsch. Oesterreicher. Vienna, 1893. — Schlesingee. Die Nationalitats Verhdltnisse Bohmens. Prague, 1886. — LilGER. La Save, leDanube et le Balkan. Paris, 1884. — Beessnitz von Sydacofp, Die Pan- slavistische Agitation. Berlin, 1899.]

The Germans, so long accustomed to rule, now saw their old ascendency threatened, and they defended it with an energy that increased with each defeat. In 1880 they founded a great society, the Deut- °l’,f^ scher Schul-Verein, to establish and assist Ger- man schools. It spread over the whole of the empire ; in a few years it numbered 100,000 members, and had an income of nearly 300,000 gulden ; no private society in Austria had ever attained so great a success. In the Eeichsrath a motion was introduced, supported by all the German Liberal parties, demanding that German should be declared the language of state and regulating the con- ditions under which the other idioms could be recognized ; it was referred to a committee from which it never emerged, and a bill to the same effect, introduced in 1886, met a similar fate. In Bohemia they demanded, as a means of protecting themselves against the effect of the language ordinances, that the country should be divided into two parts ; in one German was to be the sole language, in the other Czech was to be recognized. A proposal to this effect was introduced by them in the Landtag at the end of 1886, but. since 1882 the Germans had been in a minority. The Czechs, of course, refused even to consider it ; it would have cut away the ground on which their whole policy was built up, namely, the indissoluble unity of the Bohemian kingdom, in which German and Czech should throughout be recognized as equal and parallel

languages. It was rejected on a motion of Prince Karl Schwarzenberg without discussion, and on this all the Germans rose and left the Landtag, thereby imitating the action of the Czechs in old days when they had the majority.

These events produced a great change on the character of the German opposition. It became more and more avowedly, racial; the defence of German nation- l^f^ ality was put in the front of their programme.

parlies. '^^'^ growing national animosity added bitter- ness to political life, and destroyed the possi- bility of a strong homogeneous party on which a govern- ment might depend. The beginning of this movement can be traced back to the year 1870. About that time a party of young Germans had arisen who professed to care little for constitutionalism and other "legal mummies," but made the preservation and extension of their own nation- ality their sole object. As is so often the case in Austria, the movement began in the university of Vienna, where a Lese- Verein of German students was formed as a point of cohesion for Germans, which had eventually to be sup- pressed. The first representative of the movement in parliament was Herr von Schoenerer, who did not scruple to declare that the Germans looked forward to usiion with the German empire. They were strongly influenced by men outside Austria. Bismarck was their national hero, the anniversary of Sedan their political festival, and approxima- tion to Germany was dearer to them than the maintenance of Austria. After 1878 a heightening of national feeling began among the Eadicals, and in 1881 all the German parties in opposition joined together in a club called the United Left, and in their programme put in a prominent place the defence of the position of the Germans as the condition for the existence of the state, and demanded that German should be expressly recognized as the of&cial language. The younger and more ardent spirits, however, found it diiflcult to work in harmony with the older constitutional leaders. They complained that the party leaders were not sufficiently decisive in the measures for self-defence. In 1885 great festivities in honour of Bismarck's eightieth birthday, which had been arranged in Gratz, were forbidden by the Government, and the Germans of Styria were very indignant that the party did not take up the matter with sufficient energy. After the elections of 1885 the Left therefore broke up again into two clubs, the Oerman Austrian, which included the more moderate, and the German, which wished to use sharper language. The German Club, e.g., congratulated Bismarck on his measures against the Poles ; the German Austrians refused to take cognizance of events outside Austria with which they had nothing to do. Even the German Club was not sufficiently decided for Herr von

Schoenerer and his friends, who broke off from it and founded a National German Union. They spoke much of GermMnenthum and ” Unverfillschtes Deutschthum,” and they advocated a political union with the German empire, and were strongly- anti-Hungarian and wished to resign all control over Galicia, if by a closer union with Germany they could secure German supremacy in Bohemia’ and the south Slavonian countries. They play the same part in Austria as does the “pan-Germanic Union” in Germany. When in 1888 the two clubs, the German Austrians and the Germans, joined once more under the name of the United German Left into a new club with eighty -seven members, so as the better to guard against the common danger and to defeat the educational demands of the Clericals, the National Germans remained apart with seventeen members. They were also infected by the growing spirit of anti-Semitism. The German parties had originally been the party of the capitalists, and comprised

a large number of Jews ; this new German party committed itself to violent attacks upon the Jews, and for this reason alone any real harmony between the different branches would have been impossible.

Notwithstanding the concessions about language the Czechs had, however, made no advance towards their real object — the recognition of the Bohemian kingdom. Per- haps the leaders of the party, who were now growing old, would have been content with the influence they had already attained, but they were hard pressed at home by the Young Czechs, who werfe more impatient. When Count Thun was appointed governor of Bohemia their hopes ran high, for he was supposed to favour the corona- tion of the emperor at Prague. In 1890, however, instead of proceeding to the coronation as was expected, Taaffe attempted to bring about a reconcilia- · tion between the opposing parties. The in- Ausgieicb fluence by which his policy was directed is not with quite clear, but the Czechs had been of recent ^”’■e”””- years less easy to deal with, and Taaffe had never really shown any wish to alter the constitution; his policy always was to destroy the influence of parliament by playing off one party against the other, and so to win a clear field for the Govei^nment. During the month of January conferences were held at Vienna, with Taaffe in the chair, to which were invited representatives of the three groups into which the Bohemian representatives were divided, the German party, the Czechs, and the Feudal

party. After a fortnight's discussion an agreement was made on the basis of a separation between the German and the Czechish districts, and a revision of the electoral law. A protocol enumerating the points agreed on was signed by all who had taken part in the conference, and in May Bills were laid before the Landtag incorporating the chief points in the agreement. But they were not carried ; the chief reason being that the Young Czechs had not been asked to take .part in the conference, and did not con- sider themselves bound by its decisions ; they opposed the measures and had recourse to obstruction, and a certain number of the Old Czechs gradually came over to them. Their chief ground of criticizing the proposed measures was that they would threaten the unity of the Bohemian country.^ At the elections in 1891 a great struggle took place between the Old and the Young Czechs. The latter were completely victorious ; Rieger, who had led the party, for thirty years, disappeared from the Reichsrath, The first result was that the proposed Ausgleich with Bohemia came to an end. But the disappearance of the Old Czechs made the parliamentary situation very insecure. The Young Czechs could not take their place ; their Radical and anti-Clerical tendencies alarmed the Feudalists and Clericalists who formed so large a part of the Eight; they attacked the alliance with Germany ; they made public demonstr&,tion of their French sympathies ; they entered into communication with other Slavonic races, especially the Serbs of Hungary and Bosnia; they demanded universal suffrage, and occasionally supported the German Radicals in their opposition to the Clerical parties, especially in educational matters; under their influence disorder increased in Bohemia, a secret society called the Umladina (in imitation of the Servian society of that name) was discovered, and stringent measures had to be taken to preserve order. The Government therefore veered round towards the German Liberals ; some of 'the ministers most obnoxious to the Germans resigned, arid their places were taken by Germans. For two years the Government seemed to waver, looking now to the Left,

1 On this see Menger, Der Ausgleich mit Biihmen, Vienna, 1891, where the documents are printed.

now to Hohenwart and his friends ; for a time Taaffe really had the support of all parties except the Young Cze^hs.

After two years he gave up his cautious policy and took a bold move. In October 1893 he introduced a Eeform Bill. Universal suffrage had long been demanded by the working men and the Socialists ; the Young Czechs also had put it on their programme, and many of the Christian Socialists and anti-Semites desired an alteration of the franchise. Taaffe's Bill, while keeping the Ourice of the feudal proprietors and the chambers of commerce as they were, and making no change in the number of members, pro- posed to give the franchise in both towns and rural districts to every one who could read and write, and had resided six months in one place. This was opposed by the Liberals, for with the growth of Socialism and anti-Semitism, they knew that the extension of the franchise would destroy their influence. On this Taaffe had prob- ably calculated, but he had omitted to inquire what the other parties would do. He had not even consulted Hohenwart, to whose assistance he owed his long tenure of power. Not even the pleasure of ruining the Liberals was sufficient to persuade the Conservatives to vote for a measure which would transfer the power from the well-to- do to the indigent, and Hohenwart justly complained that they ought to have been secure against surprises of this kind. The Poles also were against a measure which would give more influence to the Euthenians. The position of the Grovernment was hopeless, and without waiting for a division Taaf|e resigned.

The event to which for fourteen years the Left had looked forward had now happened. Once more they could have a share in the Government, which they always believed belonged to them by nature. Taught by experience and adversity, they did not scruple to enter into an alliance with their old enemies, and a coalition ministry was formed from the Left, the Clericals, and the Poles. The president was Prince Alfred Windisch-Gratz, grandson of the cele- brated general, one of Hohenwart's ablest lieutenants ; Hohenwart himself did not take office. Of course an administration of this kind could not take a definite line on any controversial question, but during

1894 they carried through the commercial treaty with Eussia and the laws for the continuance of the currency reform. The differ- ences of the clubs apjpeared, however, in the discussions on reform ; the Government, not strong enough to have a policy of its own, had referred the matter to a committee ; for the question having once been raised, it was impossible not to go on with it. This would probably have been fatal to the coalition, but the final blow was given by a matter of very small importance arising from the disputes on nationality. The Slovenians had asked that in the gymnasium at Cilli classes in which instruction was given in Slovenian should be formed parallel to the German classes. This request caused great excitement in Styria and the neighbouring districts ; the Styrian Diet (from which the Slovenian minority had seceded) protested. The Slovenians were, however, members of the Hohenwart Club, so Hohenwart and his followers supported the request, which was adopted by the ministry. The German Left opposed it ; they were compelled to do so by the popular indignation in the German districts ; and when the vote was carried against them (12th June 1895) they made it a question of confidence, and formally with- drew their support from the Government, which therefore at once resigned.

After a short interval the emperor appointed as minister- president Count Badeni, who had earned a grea,t reputation as governor of Galicia. He formed an administration the

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1893.

merit of which, as of so many others, was that it was to belong to no party and to have no programme. He hoped to be able to work in harmony with the mode- rate elements of the Left ; his mission was to ^^,“11^ carry through the Ausgleich with Hungary ; to this everything else must be subordinated. During 1896 he succeeded in carrying a Eeform Bill, which satis- fied nearly all parties. All the old categories of members were maintained, but a fifth curia was added, in which almost any one might vote who had resided six months in one place and was not in domestic service ; in this way seventy-two would be added to the existing members. This

matter having been settled, parliament was dissolved. The result of the elections of 1897 was the return of a House so constituted as to make any strong Government impossible. On both sides the anti-Semitic parties representing the extreme demagogic elements were present in considerable numbers. The United German Left had almost disappeared ; it was represented only by a few members chosen by the great proprietors ; in its place there were the three parties — the German Popular party, the German Nationalists, and the German Eadicals — who all put questions of nationality first and had deserted the old standpoint of the constitution. Then there were the fourteen Social Democrats who had won their seats under the new franchise. The old party of the Eight was how- ever also broken up ; side by side with forty-one Clericals there were twenty-eight Christian Socialists led by Dr Lueger, a man of great oratorical power, who had won a predominent influence in Vienna, so long the centre of Liberalism, and had quite eclipsed the more modest efforts of Prince Liechtenstein. As among the German National party, there were strong nationalist elements in his pro- gramme, but they were chiefly directed against Jews and Hungarians; Lueger had already distinguished himself by his violent attacks on Hungary, which had caused some embarrassment to the Government at a time when the negotiations for the Ausgleich were in progress. Like anti- Semites elsewhere, the Christian Socialists were reckless and irresponsible, appealing directly to the passions and prejudices of the most ignorant. There were altogether 200 German members of the Eeichsrath, but they were divided into eight parties, and nowhere did there seem to be the elements on which a Government could be built up.

The Parliamentary situation is best explained by the following . table showing the parties : —

German Liberals —

189T.

1901.

Constitutional Landed Proprietors

28

German Radicals ....

49

41

German Popular Party .

42

51

Sohoenerer Group ....

5

21

Kronawetter

1

. .

Democrat

1

126

141

Social Democrats . . . .

.

14

10

German Conservatives —

German Clericals . . . .

30

|37

Catholic Popular Party .

15

Christian Socialists

28

23

~

78

60

Federalist Great Proprietors

16

‘

16

Czechs —

Young Czechs . . . .

60-

53

Radical Young Czechs .

1

4

Clerical Czechs . . . .

1

2

Agrarian Czechs . . . .

1

6

63

65

Poles-

Polish Club

59

60

Stoyalovski Group

6

, ,

Popular Polish Party .

3

11

— ^

68

—

71

Carry forward

360

363

s

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26

A U S T E I AH U N G A E Y

[AUSTRIA :

1897. 1901.

360 363

Brought forward Slovenians — Clerical Slovenians . . . ” . 11 Radical ,, ...
5

_ 16 – 16

Italians —

Liberal Italians 14

Clerical ,, 5

— 19-19

Croatians 11 . . 9

Serbs 2 .. 2

Rutbenians —

Rutbenians 6

Young Rutbenians

11 — 11

Rumanians — Rumanians Young Rumanian

5 1

— 6

Total 425

425

The most remarkable result of the elections was the disappearance of the Liberals in Vienna. In 1879, out of 37 members returned in Lower Austria, 33 were Liberals. Now the Christian Socialists were first with 28, then the Socialists with 14, and the few remaining seats were divided between the Nationalists and the Eadicals. It was impossible to maintain a strong party of moderate constitutionalists, on whom the Government coultj depend, unless there was a large nucleus from Lower Austria. The influence of Lueger was very embarrassing ; he .had now a majority of two-thirds in the town council, and had been ejected burgomaster. The emperor had refused to confirm the election ; he had been re-elected, and then the emperor, in a personal interview, appealed to him to with- draw. He consented to do so ;

but, after the election of 1897 had given him so many followers in the Reichsrath, Badeni advised that his election as burgomaster should be confirmed. There was violent antipathy between the Christian Socialists and the German Nationalists, and the transference of their quarrels from the Viennese Council Chamber to the Eeichsrath was very detrimental to the orderly conduct of debate.

The limited suffrage had hitherto prevented Socialism from becoming a political force in Austria as it had in _ . [1]^ Germany, and the national divisions have always impeded the creation of a centralized Socialist party. The first object of the working classes necessarily was the attainment of political power ; in 1867 ‘ there had been mass demonstrations and petitions to the Government for universal suffrage. During the next years there was the beginning of a real Socialist movement in Vienna and in Styria, where there is a considerable indus- trial population; after 1879, however, the growth of the party was interrupted by the introduction of anarchical doctrines. Most’s paper, the Freiheit, was introduced through Switzerland, and had a large circulation. The anarchists, under the leadership of Peukert, seem to have attained considerable numbers. In 1883-84 there were a number of serious strikes, collisions between the police- and the workmen, followed by assassinations ; it was a peculiarity of Austrian anarchists that in some cases they united robbery to murder. The Government, which was seriously alarmed, introduced severe repressive measures; the leading anarchists were expelled or fled the country. In 1887, under the leadership of Dr Adler, the Socialist party began to revive (the party of violence having died away), and since then it has steadily gained in numbers ; in the forefront of the political programme is put the demand for universal suffrage. In no country is the 1st of May, as the festival of Labour, celebrated so generally.

Badeni after the election sent in his resignation, but the emperor refused to accept it, and he had therefore to do the best he could and turn for support to the o’ther nationalities. The strongest of them were the fifty-nine Poles and sixty Young Czechs ; he therefore attempted, as Taaffe had done, to come to some agreement with them. The Poles were always ready to support the Government ; among the Young Czechs the more moderate had already attempted to restrain the wilder spirits of the party, and they were

quite prepared to enter into negotiations. They did not wish to lose the opportunity which now was open to them of winning influence over the administration. What they required was further concession as to the language in Bohemia. In May 1897 Badeni therefore published his celebrated ordinances. They determined (1) that all correspondence and documents regarding j^^ every matter brought before the Government language ofacials should be conducted in the language in ”’^’”«’”«« which it was first introduced. This applied to ° the whole of Bohemia, and meant the introduction of Czech into the government offices throughout the whole of the kingdom ; (2) after 1903 no one was to be appointed to a post under the Government in Bohemia until he had passed an examination in Czech. These ordinances fulfilled the worst fears of the Germans. The GermanNationalists andEadicals declared that no business should be done till they were repealed and Badeni dis- missed. They resorted to obstruction. They brought in repeated motions to impeach the ministers, and parliament had to be prorogued in June, although no business of any kind had been transacted. Badeni had not anticipated the effect his ordinances would have ; as a Pole he had little experience in the western part of the empire. During the recess he tried to open negotiations, but the Germans refused even to enter into a discussion until the ordinances had been withdrawn. The agitation spread throughout the country ; great meetings were held at Eger and Aussig, which were attended by Germans from across the frontier, and led to serious disturbances ; the cornflower, which had become the symbol of German nationality and union with Germany, was freely worn, and the language used was in many cases treasonable. The emperor insisted that the Eeichsrath should again be summoned to pass the neces- sary measures for the Ausgleich ; scenes then took place which have no parallel in parliamentary history. To meet the obstruction it was determined to sit at night, but this was unsuccessful. On one occasion Dr Lecher, one of the representatives of Moravia, spoke for twelvd hours, from 9 P.M. till 9 a.m., against the Ausgleich. The opposi- tion was not always limited to feats of endurance of this kind. On 3rd November there was a free fight in the House ; it arose from a quarrel between Dr Lueger and the Christian Socialists on the one side (for the Christian Socialists had supported the Government since the con- firmation of Lueger as burgomaster) and the German Nationalists under Dr Wolff, a German from Bohemia, the violence of whose language had already caused Badeni to challenge him to a duel.

The Nationalists refused to allow Lueger to speak, clapping their desks, hissing, and making other noises, till at last the Young Czechs at- tempted to prevent the disorder by violence. On 24th November the scenes of disturbance were renewed. The president, Herrv. Abramovitch, an Armenian fromGaiicia, refused to call on Schoenerer to speak. The Nationalists therefore stormed the platform, and the president and min- isters had to fly into their private rooms to escape personal violence, until the Czechs came to their rescue, and by su- periority in numbers and physical strength severely pun- ished Herr Wolff and his friends. The rules of the House giving the president no authority for maintaining order, he determined, with the assent of the ministers, to propose

history]

Badeal resigns.

alterations in procedure. The next day, when the sitting began, one of the ministers, Count Falkenhayn, a Cleri- cal who was very unpopular, moved ” That any member who continued to disturb a sitting after being twice called to order could be suspended — for three days by the president, and for thirty days by the House.” The din and uproar was such that not a word could be heard, but at a pre-arranged signal from the president all the Eight rose, and he then declared that the new prder had been carried, although the procedure of the House re- quired that it should be submitted to a committee. The next day, at the beginning of the sitting, the Socialists rushed on the platform, tore up and destroyed all the papers lying there, seized the president, and held him against the wall. After he had escaped eighty police were introduced into the House and carried out the four- teen Socialists. The next day Herr Wolff was treated in the same manner. The excitement spread to the street. Serious disorders took place in Vienna and in Gratz ; the German opposition had the support of the people, and Lueger warned the ministers that as burgomaster he would be unable to maintain order in’ Vienna; even the Clerical Germans showed signs of deserting the Government. The emperor, hastily summoned to Vienna, accepted Badeni’s

resignation, the Germans having thus by obstruction attained part of their wishes. The new minister, Gautsch, a man popular with all parties, held office for three months ; he proclaimed the budget and the Ausgleich, and in February replaced the language ordinances by others, under which Bohemia Vas to be divided into three districts — one Czechish, one German, and one mixed. The Germans, however, were not satisfied with this ; they demanded absolute repeal. The Czechs also were offended ; they arranged riots at Prague ; the professors in the university refused to lec- ture unless the German students were defended from violence; Gautsch resigned, and Thun, who had been governor of Bohemia, was appointed minister. Martial law was proclaimed in Bohemia, and strictly enforced. Thun then arranged with the Hungarian ministers a com- promise about the Ausgleich.

The Reichsrath was again summoned, and the meetings were less disturbed than in the former year, but the Ger- mans still prevented any business from being done. The Germans now had a new cause of complaint. Paragraph 14 of the law of 1867 provided that, in cases of '^""tiict' pressing necessity, orders for which the assent bSween of the Reichsrath was required might, if the aermans Reichsrath were not in session, be proclaimed by the emperor ; they had to be signed by the whole ministry, and if they were not laid before the Reichsrath within four months of its meeting, or if they did not receive the approval of both Houses, they ceased to be valid. The Germans contended that the ap- plication of this clause to the Ausgleich was invalid, and demanded that it should be repealed. Thun had in con- sequence to retire, in September 1899. His successor, Count Clary, began by withdrawing the ordinances which had been the cause of so much trouble, but it was now too late to restore peace. The Germans were not suffi- ciently strong and united to keep in power a minister who had brought them the relief for ~~n^ich they had been clamouring for two years. The Czechs, of course, went into opposition, and used obstruction. The extreme Ger~~ man party, however, took the occasion to demand that paragraph 14 should be repealed. Clary explained that this was impossible, but he gave a formal pledge that he would not use it. The Czechs, however, prevented him passing a law on excise which was a necessary part of the agreements with Hungary ; it was therefore impos- sible for him to carry on the government without break-

and Czechs.

ing his word ; there was therefore nothing left for him to do but to resign, after holding office for less than three months. The emperor then appointed a ministry of officials, who were not bound by his pledge, and used paragraph 14 for the necessary purposes of state. They then made way for a ministry under Herr v. Korber. During the early months of 1900 matters were more peaceful, and Korber hoped to be able to arrange a com- promise ; but the Czechs now demanded the restoration of their language in the internal service of Bohemia, and on 8th June, by noise and disturbance, obliged the president to suspend the sitting. The Reichsrath was immediately dissolved, the emperor having deter- mined to make a ^nal attempt to get together a parlia- ment with which it would be possible to govern. The new elections on which so much was to depend did not take place till January. They resulted in a great in- crease of the extreme German Nationalist parties. Schoe- nerer and the German Radicals — the fanatical German party who in their new programme advocated union of German Austria with the German Empire — now num- bered twenty-one, who chiefly came froin Bohemia. They were able for the first time to procure the election of one of their patty in the Austrian Delegation, and threatened to introduce into the Assembly scenes of disorder similar to those which they had made common in the Reichsrath. All those parties which did not primarily appeal to national feeling suffered loss; especially was this the case with the two sections of the Clericals, the Christian Socialists and the Ultramontanes ; and the increasing enmity between the German Nationalists (who refused even the name German to a Roman Catholic) and the Church became one of the most conspicuous features in the political situation. The loss of seats by the Social- ists showed that even among the working men the national agitation was gaining ground ; the diminished ftifluence of the anti-Semites was the most encouraging sign.

Notwithstanding the result of the elections, the first months of the new Parliament passed in comparative peace. There was a truce between the nationalities. The Germans were more occupied with their opposition to the Clericals than with their feud with the Slavs. The Czechs refrained from obstruction, for they did not wish to forfeit the alliance with the Poles and Conservatives, on which their parliamentary strength depended, and the

Ger- mans used the opportunity to pass measures for promoting the material prosperity of the country, especially for an important system of canals which would bring additional prosperity to the coal-fields and manufactures of Bohemia. It is, however, impossible permanently to postpone the more contentious questions ; it remains to be seen whether the influence of the moderate parties, the authority of the government, and the personal influence of the emperor will be able to restrain another outbreak of those passions which for a short time have to some extent been kept in check.

AnTHOKiTiES. — Besides the special works already referred to see RoGGE. Oesterreich von Vildgos bis zur Gegenwart. Leipzig, 1872- 73 ; and Oesterreich seit der Katastrophe Hohenwart-Beust. Leipzig, 1879 ; by the same author. These two works give a full narrative to the year 1879. — Schulthess. Europdischer Geschichtskalendar, Nordlingen, 1866-99, gives a useful chronicle of events. See also W. MtJLLBR. Folitische Oeschichte der Gegenwart. Berlin, 1871- 99. The later volumes of Wukzeach, Biographisches Lexicon, Vienna, 1856-91, are useful. A good account of Austrian political parties is to be found in Lowell, Governments and Parties in Con- tinental Europe, London, 1896. See also Mischler and Ulbrich, Oesterreichisches Staats-Worterbuch, Vienna, 1895-97, some of the articles in which are of great assistance; also, the article on Austria in Marquardsen, Handbuch des Oeffentlichen Rechts, by -Ulbrich. Other works are Baron H. de Worms (Lord Pirbright), The Austro-Hungarian Empire, London, 1877. Count Julids Andrasst, Ungarns Ausgleich mit Oesterreich von Jahre, 1867. Leipzig, 1897. Lavelete, La Prusse et VAutriche depuis Sadowa, Paris, 1870, which contains a very useful account of the political

situation between 1867 and 1870. Leger, Histoire de VAutriche- Hongrie, Paris, 1895, a short sketch of the whole of Austrian history. Chelard, VAutriche Contemporaine, Paris, 1894. Beer, Der Staatskauskalt Oesterreiehe-Ungarns seit 1868, Prague, 1881. Bazant, Die Sandelspolitik Oesterreich Ungarns, 1875-92, Leipzig, 1892. Also, articles by Lanin, in the Contemporary Eeview, vol. Ixiii. 1893 ; Benoist, in the Bevue des deux Mondes, vols, cxliii.

and cxliv., 1897, and articles in the Annates de V Scale Ubre des Sciences Politiques for 1889 and 1891 by Kramak, and for 1894 by L. PiNKAS, explaining the position of the Young Czechs, also the volumes for 1897 and 1898 ; also an article in the Edinburgh Review, July 1898. See also the biographical articles elsewhere in this work on Emperor Pranz-Josei', Andbassy Beost, Taaffe, Thun, &c. (j. w. He.)

Austria, Lower (German, Niederosterreich or Oesterreich unter der Enns, i.e., Austria below the river Enns), an archduchy and crown land in the Cisleithan half of the Austro-Hungarian monarchy. It is bounded on the N. by Bohemia and Moravia, on the S. by Styria, on the E. by Hungary, and on the W. by Upper Austria. The chief town is Vienna, the capital of Austria, or the Cisleithan half of the dual monarchy. The original arch- duchy, which included the adjoining Upper Austria, is the birthplace and cradle of the Austrian empire, and the oldest possession of the House of Hapsburg in its present dominions. (For historical sketch see Ency. Brit. iii. 123.) Lower Austria has an area of 7654 square miles. It is divided into two parts by the Danube, which enters at its most westerly point and leaves at its eastern ex- tremity, near Pressburg. North of this line is the low hilly country of the northern Alpine foreland, lying at the foot of, and forming a continuation of, the system of the Bohemian and Moravian plateau. This constitutes towards the west the " Waldviertel," of which the highest point is the Paulstein (3478 feet) . Farther east there is a gradual decline in the altitude and frequency of the hills, which give place to larger valleys and comparatively fertile plains. In the main the southern division of the province is mountainous and hilly. Part of it is occupied by the northern or Austrian limestone Alps, of which the Schnee- berg (6808 feet) is the highest summit. With one ~~ex~~ ception UU the rivers are tributaries of the Danube. The most important are the Enns and the March. The lakes are comparatively few and of small extent. Of its mineral springs, the best known are those of Baden bei Wien and Deutsch Altenburg (sulphur), the iron springs of Pyra- warth, and the thermal baths of Voslau. Lower Austria is remarkable among the provinces of the empire for the variety of its flora. In general the climate, which varies with the configuration of the surface, is moderate and healthy, although subject to rapid changes of temperature. It is mildest in the northern part and generally in the valleys. The soil is of moderate fertility, and only 3| per cent, is unproductive. Woods occupy 34-

24 per cent, of the total area, 43-41 per cent, is arable, 13-16 per cent. , consists of gardens and meadows, 2 per cent, of vineyards, and 3-19 per cent, of pastures. Agriculture and forestry afford sustenance to about a quarter of the population. Cereals and vegetables of all kinds are cultivated. Some fair wine is grown on. the slopes of the Wiener Wald and elsewhere, averaging 874,000 hectolitres per annum.

In 1890 there were 120,755 horses, 554,154 horned cattle, 115,052 sheep, 81,772 goats, and 412,703 pigs. Large quantities of poultry are also bred, and game and flsh are plentiful. While mining is of comparatively slight significance (total value of pro- duct in 1897, £26,945), Lower Austria (including Vienna) is one of the most important industrial centres of the empire, surpassing in this respect all other provinces, excepting Bohemia and Moravia. It has 12 per cent, of the total number of factories, 13 per cent, of the motive power, and 16 per cent, of all the factory hands - employed in Austria. Of the total of 69,636 industrial firms registered in 1890, 1367 were factories employing 139,000 hands.

With the exception of its connexion with the sea at Triest, it is fairly well provided for in the matter of communications. In 1897 it had 1790 kilometres of railway (10-28 per cent, of the total length in Austria), 12,413 kms. of roads, and 319 kms. of navigable water- way. There were 698 post and 463 telegraph oflBces, with 3135 kms. of line and 14,601 of wire.

Population in 1869, 1,990,708 ; in 1880, 2,330,621 ; and in 1890,

including garrison of 31,363 men, 2,661,779, equivalent to 347-7 inhabitants per square mile. , Thus, Including Vienna, Lower Austria is the most populous Austrian province. Deducting the capital, however, with its population of 1,341,897, there are only 174 inhabitants per square mile. Proportion of females to males, 1036 to 1000. Reckoning according to the language in common use, 96-1 per cent, of the population is German, and 3-9 Slav. The latter, mostly Czechs, are settled in Vienna and on the Bohemian and Moravian border, while there are a number of Croatians in the Marchfeld. Nearly 93 per cent, are Roman Catholic, the rest consisting of 128,784 Jews, 50,691 Protestants, 1356 Old Catholics, 2654 members of the Greek Church, and 2268 persons of no religion. Population in 1900, 3,086,382. In 1896 the marriage-rate was 8-43 ; the birth-rate, 33-83, or

excluding still-births, 32-73; and the death-rate, 22-83 per thousand. Of the births 26-23 per cent, were illegitimate, an advancing ratio. The marriage-rate is rising, the birth- and death-rates are declining. Lower Austria sends 46 members to the Reichsrath, all of German nationality.

With the exception of Bohemia, Lower Austria is the most advanced province of the empire in the matter of elementary edu- cation. Both had the same proportion of illiterates in 1880 (8-5 per cent.), but in 1890 the improvement of Lower Austria (6-2 per cent.) was slightly behind that of Bohemia (5-8 per cent.). In the matter of higher education a comparison between the two would be unfair, in view of the special advantages enjoyed by the capita}. In addition to the Vienna University, Polytechnic, Sehool of Agri- culture, and academies of commerce and of art, there are 19 gym- nasia, 23 real gymnasia, 555 technical and special schools (of which a fifth are devoted to music and singing), and 1680 intermediate and elementary schools. Of the 1156 periodicals and newspapers published in 1898, 1102 were in German, 14 in French, 8 in Czech, 12 in other Slav languages, the rest being Italian, Hungarian, Hebraic, Spanish, and polyglott.

See Topographic von Niederosterreich, a publication begun in 1871 by the “Verein filr Landeskunde ” in Vienna. — M. A. Becker. Niederosterreichische Landschaften. Vienii:’ 1879. — Umlaupt. Das Erzherzogthiim Oesterreich. Vienna, 189b and Stcttistischer Bericht uber die Volkswirthschaftlichen Zustdnde des Brzherzog- thums Oesterreich fur das Jahr 1890. Published by the Vienna Chamber of Commerce in 1894. (^. o’n.)

Austria, Upper (German, Oberosterreich or Oester- reich oh der Enns, ” Austria above the river Enns “), an archduchy and crown land in the Cisleithan half of the Austro-Hungarian monarchy. It is bounded on the N. by Bohemia, on the S. by Salzburg and Styria, on the W. by Bavaria, and on the E. by the archduchy of Lower Austria, from which it is separated by the river Enns. It has an area of 4627 square miles, of which 262 are occupied by the Salzkammergut. Like Lower Austria, it is divided into two unequal par^ by the Danube, which flows through it from west to east, drain- ing the whole country, with the exception of a small portion adjoining Bohemia. Its principal tributaries are the Inn, Salzach, Traun, Enns, Steyr, and the Great

and Little Miihl rivers. The smaller northern part Of the province is a prolongation of the southern angle of the Bohemian forest. The Danube is approached from the south by the verge of the Alpine region (the Salz-kammergut and the Upper Austrian Alps). Towards the river there is a gradual decline in the altitude of the summits. Of the numerous and beautiful Alpine lakes, the most important are the Traunsee, and those of Hallstatt, Atter, Wolfgang, and Mond. There are about thirty mineral springs, the best known being the salt baths of Ischl and the iodine waters at Hall. The climate, which varies according to the altitude, is on the whole moderate, although slightly colder than that of Lower Austria, precluding the culture of the vine. In the north

it is somewhat severe, but is mild in the Salzkam- .mergut.

The most populous and most important towns are Linz, the capital (58,788 inhabitants) and Steyr (17,592), both autonomous municipalities, Wels(12,187), Gmunden (7126),Ischl, andHallstatt. The last two are important centres of the salt industry. The soil in the valleys and on the lower slopes of the hills is fertile, indeed 35-08 of the whole area is arable. Woods occupy 34-02 per cent., while 4-93 per cent, is unproductive or consists of lakes, ponds, and marshes. It has the largest proportion of njeadows in all Austria, 18-54, 2-49 per cent, of lowland and Alpine pasturage, and 1-99 per cent, of gardens. Agriculture and cattle breeding are both in an advanced state ; relatively large quantities of the priucipal cereals are produced. Cattle breeding is equally advanced. In 1890 there were 553,074 head of horned cattle (the largest proportion of any Austrian province), 60,404 horses, 60,310 sheep, 31,592 goats, 247,902 pigs, and 38,125 beehives. Pish is artificially cultivated, and the wealth of game in the Salzkammergut (red deer, chamois, &c.) is a considerable resource of the province, as is also the important timber trade. Salt (a state monopoly) is the most valuable mineral. In 1897, Upper Austria produced 29-13 per cent, of the total Austrian product, its share being valued at £620,570. Other important products are lignite (£80,466), gypsum, and a variety of valuable stones and clays. The principal industries are the iron and metal

manufactures, chiefly centred at Steyr, with its well-known small-arms factory. Next in importance are the machine, linen, cotton, and paper manufactures, the milling, brewing, and distil- ling industries, and shipbuilding. The principal articles of export are salt, stone (including the granite pavements of Vienna), timber, live stock, wooden and iron wares, &c. In 1897 there were 864 kilometres of railway, 8499 kms. of roads, and 618 kms. of water- way, of which only 249 kms. is available for floating timber. There were 370 post and 153 telegraph offices, with 1887 kms. of line, and 5428 kms. of wire.) Pop. in 1869, 731,579; in 1880, 759,620; in 1890, 785,831 ; which is equivalent to 169-8 inhabitants per square mile, the greatest density of any of the Alpine provinces. It is almost exclusively German and Koman Catholic, the Czechs forming less than J per cent., the Protestants 2-2 per cent., and the Jews 0-1 percent. Population (1900), 809,918. In 1896 the marriage-rate was 7-11, the birth-rate 32-21, or excluding still- births 30-95, and the death-rate 23-31 per thousand. Of the births 18-71 per cent, were illegitimate, a declining ratio. The death-rate is also declining. The province sends 20 represen- tatives to the Eeichsrath, all German. Elementary education is practically on a level with that of Lower Austria, the proportion of illiterates (6-3 per cent.) being but ^ per cent, less favourable. There are 534 elementary and 10 intermediate schools, 4 gymnasia, 2 real gymnasia, and 113 technical and special schools..

See PiLLWEiN. Geschichte, Geographie, und Statistik des Erzher- sogthums Oesterreich ob der Enns. Linz, 1827-39. Edlbachee. Landeskunde von Oberosterreich. Linz, 1883. . (je. o’n.)

Automatic Couplings. See Eailways.

Automobiles. See Motob Cabs.

Autun, chief town of arrondissement, department of Saone-et-Loire, France, 66 miles N.N.W. of Macon, on railway from Paris to Lyons. It is noted for its educar tional establishments. The H6tel de Ville, Palais de Justice, and theatre are modern buildings, and on the Promenade des Marhres is a bronze statue of Divitiacus (1893). The leading industry is now the extraction of mineral oil from bituminous schists; iron and bronze founding are also important. Population (1881), 10,695 ; (1896), 11,873, (comm.) 13,512 ; (1901), 15,764.

Auxerre, chief town of department Yonne, France, 105 miles S.E. of Paris, on railway from Laroche to Nevers. It has a tribunal and chamber of commerce. The ancient fortifications are replaced by boulevards. On the bridge over the Yonne is a statue of Paul Bert (d. 1886). The principal manufactures now are heavy iron goods, machinery, tools, waggons, and carriages, and there are important ochre works. Population (1881), 13,752 ;

(1891), 14,553; (1896), 15,082; (1901), 18,901.

Auxonne, a town in the arrondissement of Dijon, department of Cote d'Or, France, 19 miles E.S.E. of Dijon, on railway to Belfort. There is a tribunal of commerce. The artillery school has been removed to Besanqon.

Population (1881), 3002; (1891), 2938; (1896), 2873, (comm.) 4529 ; (1901), 7706.

Ava, formerly the capital of Burma for nearly 400 years, from 1364 to 1733, with a succession of thirty kings, but now merely a subdivision of the Sagaing district in the northern division of Upper Burma. It formed a separate district from the date of its annexation by the British (1886) until 1889, and was then amalgamated with Sagaing on the opposite bank of the Irrawaddy. For picturesque beauty it is unequalled in Burma, but it is now more like a park than the site of an old capital. The township had a population of '39,477 in 1891, and it is likely to remain what it was when the British first occupied it — a collection of cultivators' hamlets scattered amidst the remains of former greatness. Some of the pagodas were founded nearly a thousand years ago.

Avebury, John Lubbock, 1st Babok (1834- -), English banker, politician, and naturalist, was born

in London, 30th April 1834, being the son of Sir John William Lubbock, third baronet, himself a highly distin- guished man of science. John Lubbock was sent to Eton in 1845 ; but three years later (when only fourteen years of age) was taken into his father's bank and became a partner at twenty-two. In 1865 he succeeded to the baronetcy. His love of science kept pace with his increasing participation in public affairs. He served on commissions upon coinage and other financial questions ; and at the same time acted as president of the Entomo- logical Society, and of the Anthropological Institute. Early in his career several banking reforms of great importance were due to his initiative, while such works as Prehistoric Times (1865) and The Origin of Civilization (1870) were proceeding from his pen. In 1870, and again in 1874, he was elected member of Parliament for Maidstone. He lost the seat at the election of 1880 ; but was at once elected member for London University, of which he had been vice-chancellor since 1872. He held this seat until his elevation to the peerage in

1900. He carried numerous enactments in parliament, including the Bank Holidays -Act (1871), and bills dealing with absconding debtors, shop hours regulations, public libraries, open spaces, and the preservation of ancient monuments. He was elected the first president of the Institute of Bankers in 1879 ; in 1881 he was president of the British Association, and from 1881 to 1886 president of the Linnsean Society. He has received honorary degrees from the Universities of Oxford, Cambridge (where he was Eede lecturer in 1886), Edinburgh, Dublin, and Wurzburg ; and in 1878 was appointed a trustee of the British Museum. From 1888 to 1892 he was president of the London Chamber of Commerce; from 1889 to 1890 vice-chairman, and from 1890 to 1892 chairman, of the London County Council. During the same period he served on royal commissions on education and on gold and silver. In 1890 he was appointed privy councillor ; and was chairman of the committee of design on the new coinage in 1891. In January 1900 he was raised to the peerage, under the title of Baron Avebury. As a thoughtful popularizer of natural history and philosophy he has had few rivals in his day, as is evidenced by the number of editions issued of many of his writings, among which the most widely-read have been : The Origin and Metamorphoses of Insects (1873), British Wild Flowers (1875), Ants, Bees, and Wasps (1882), Flowers, Fruit, and Leaves (1886), The Pleasures of Life (1887), The Senses, Instincts, and Intelligence of Animals (1888), The Beauties of Mature (1892), The Uses of Life (1894).

Aveiro, a seaport town and episcopal see of Portugal, capital of the district of Aveiro, on a lagoon of the same

name and the principal arm of the Vouga. The in- dustries embrace the preparation of salt, the catching and curing of fish, and the gathering of aquatic plants (moligo). It was the birthplace of Joao Affonso, the dis-coverer, one of the first navigators to visit the fishing grounds of Newfoundland. The channel through the bar, which connects the lagoon with the sea, has a maximum depth of 33 ft. Population, 8860. The district of Aveiro is 48 miles long by 30 miles wide, with an area of 1146 sq. miles,

and population of 291,526, giving a density of 255 inhabitants to the sq. mile. It contains part of the fine wine district of Bairrada, and is a good grazing region. There are copper and lead mines.

Avellino, capital of the province of Avellino, Cam- pania, Italy, 59 miles by rail E.N.E. from Naples. On Monte Vergine, at the foot of which the town stands, is the monastery (1119) of Monte Vergine, which is visited at Whitsuntide and every 7th and 8th September by nearly 80,000 pilgrims, the attraction being a wonder- working image of the Virgin. At Avellino an ancient necropolis was discovered in 1898. There are schools of viticulture and the industrial arts. Population of town (1901), 23,790 ; of province (1901), 402,898.

Average. — Some considerable changes iii relation to General Average have to be noted since the appearance of the article on this subject in the ninth edition of this work. The difficulty, which then seemed nearly in- superable, of bringing together the rules in force in the several maritime countries has been to a large extent overcome — not by legislation, but by framing a set of rules covering the principal points of difference in such a manner as to satisfy, on the whole, those who are prac- tically concerned, and to lead them' to adopt these rules in their contracts of affreightment and contracts of insur- ance. The honour of this achievement belongs to a small „. . number of men who recognized the need of

the York- uniformity. The work began in May 1860 at Antwerp a congrcss held at Glasgow, under the presi- ”’*■ dency of Lord Brougham, assisted by Lord Neaves. Further congresses were held in London (1862), and at York (1864), when a body of rules known as the ” York Rules ” was agreed to. There the matter stood, until it was taken up by the ” Association for the Eeform and Codification of the Law of Nations ” at conferences held at the Hague (1875), Bremen (1876), and Antwerp (1877). S6me changes were made in the ” York Rules ” ; and so altered, the body of rules was adopted at the last- named conference, and was styled the ” York and Antwerp (or York-Antwerp) Rules.” The value of these rules was quickly perceived, and practical use of them followed. But they proved to be insufficient, or unsatisfactory, on some points ; and again, in the autumn of 1890, a con- ference on the subject was held, this time at Liverpool, by the same

Association, under the able presidency of Dr F. Sieveking, president of the Hanseatic High Court of Appeal at Hamburg. Important changes were then made, carrying further certain departures from English law, already apparent in the earlier rules, in favour of views prevailing upon the continent of Europe and in the United States. The new rules were styled the York- Antwerp Rules, 1890. In practice th6y quickly displaced those of 1877 ;. and in 1892, at a conference of the same Association held at Genoa, it was formally declared that the only International Rules of General Average having the sanction and authority of the Association were the York-Antwerp Rules as revised in 1890, and that the original rules were rescinded. It is this later body of rules which is now known as the York-Antwerp Rules. Reference is now to be found in most English contracts of carriage, and contracts of insurance, to these rules, as

intended to govern the adjustment of G. A. between the parties ; with the result that (so far as the rules cover the ground) adjustments do not depend upon the law of the place of destination, and so do not vary according to the destination, or the place at which the voyage" may happen to be" broken up, as used formerly to be the case.

The rules are as follows : —

Rule I. — Jettison op Deck Cargo. No jettison of deck cargo shall be made good as G. A. Every structure not built in with the frame of the vessel shall be considered to be a part of the deck of the vessel.

EnLE II. — Damage by Jettison and SaceiMce foe the Common Safety. Damage done to a ship and cargo, or either of them, by or in consequence of a sacrifice made for the common safety, and by water which goes down a ship's hatches opened, or other opening made for the purpose of making a jettison for the common safety, shall be made good as G. A.

EuLE III. — Extinguishing Eike on Shipboahd, Damage done to a ship and cargo, or either of them, by water or otherwise, including damage by beaching or scuttling a burning ship, in extinguishing a fire on board the ship, shall be made good as G. A. ; except that no compensation shall be made for damage to such portions of the ship and bulk cargo, or to such separate packages of cargo, as have been on fire.

EuLE IV. — Cutting away Wreck. Loss or damage caused by cutting away the wreck or remains of spars, or of other things which have previously been carried away by sea-peril, shall not be made good as G. A.

Rule V. — Voluntary Stranding. When a ship is intentionally run on sh6re, and the circumstances are such that if that course were not adopted she would inevitably sink, or drive on shore or on rocks, no loss or damage caused to the ship, cargo, and freight, or any of them, by such intentional running on shore, shall be made good as G. A. But in all other cases where a ship is intentionally run on shore for the common safety, the consequent loss or damage shall be allowed as G. A.

EuLE VI. — Carrying Press of Sail — Damage to or Loss OF Sails.

Damage to or loss of sails and spars, or either of them, caused by forcing a ship off the ground or by driving her higher up the ground, for the common safety, shall be made good as G. A. ; but where a ship is afloat, no loss or damage caused to the ship, cargo, and freight, or any of them, by carrying a press of sail, shall be made good as G. A.

Rule VII. — Damage to Engines in Refloating a Ship. Damage caused to machinery and boilers of a ship which is ashore and in a position of peril, in endeavouring to refloat, shall be allowed in G. A., when shown to have arisen from an actual intention to float the ship for the common safety at the risk of such damage.

Rule VIII. — Expenses op Lightening a Ship when Ashore, and Consequent Damage. When a ship is ashore, and, in order to float her, cargo, bunker coals, and ship’s stores, or any of them, are discharged, the extra cost of lightening, lighter hire, and reshipping (if incurred), and the loss or damage sustained thereby, shall be admitted as G. A.

Rule IX. — Cargo, Ship’s Materials, and Stores Burnt

FOR Fuel. Cargo, ship’s materials, and stores, or any of them, necessarily burnt for fuel for the common safety at a time of peril, shall be admitted as G. A. , when and only when an ample supply of fuel had been provided ; but the estimated quantity of coals that would have been consumed,

calculated at the price current at the ship’s last port of departure at the date of her leaving, shall be charged to the shipowner and credited to the G. A.

Rule X. — Expenses at Poet of Refuge, &c. (a) When a ship shall have entered a port or place of refuge, or shall have returned to her port or place of loading, in consequence of accident, sacrifice, or other extraordinary circumstances which render that necessary for the common safety, the expenses of entering such port or place shall be admitted as G. A. ; and when she shall have sailed thence with her original cargo, or a part of it, the corresponding expenses of leaving such port or place, conse- quent upon such entry or return, shall likewise be admitted as G. A.

(&) The cost of discharging cargo from a ship, whether at a port or place of loading, call, or refuge, shall be admitted as G. A., when the discharge was necessary for the common safety or to enable damage to the ship, caused by sacrifice or accident during the voyage, to be repaired, if the repairs were necessary for the safe prosecution of the voyage.

(c) Whenever the cost of discharging cargo from a ship is admissible as G. A., the cost of reloading and storing such cargo on board the said ship, together with all storage charges on such cargo, shall likewise be so admitted. But when the ship is con- demned or does not proceed on her original voyage, no storage expenses incurred after the date of the ship’s condemnation or of the abandonment of the voyage shall be admitted as G. A.

(d) If a ship under average be in a port or place at which it is practicable to repair her, so as to enable her to carry on the whole cargo, and if, in order to save expenses, either she is towed thence to some other port or place of repair or to her destination, or the cargo or a portion of it is transhipped by another ship, or otherwise forwarded, then the extra cost of such towage, transhipment, and forwarding, or any of them (up to the amount of the extra expense saved), shall be payable by the several parties to the adventure in proportion to the extraordinary expense saved.

KuLE XI. — Wages and Maiktenange of Ckew in Port of Refuge, &c.

When a ship shall have entered or shall have been detained in any port or place under the circumstances, or for the purposes of the repairs, mentioned in Rule X., the wages payable to the master, ofBcers, and crew, together with the cost of maintenance of the same, during the extra period of detention in such port or place until the ship shall or should have been made ready to proceed upon her voyage, shall be admitted as G. A. But when the ship is con- demned or does not proceed on her original voyage, the wS^es and maintenance of the master, officers, and crew, incurred after the date of the ship's condemnation or of the abandonment of the voyage, shall not be admitted as G. A.

Rule XII. — ^Damage to Cargo in Discharging, &o. Damage done to or loss of cargo necessarily caused in the act of discharging, storing, reloading, and stowing, shall be made good as G. A. when and only when the cost of those measures respectively is admitted as G. A.

Rule XIII. — Deductions prom Cost of Repairs. In adjusting claims for G. A., repairs to be allowed in G. A. shall be subject to the following deductions in respect of " new for old," viz.: —

In the case of iron or steel ships, from date of original register to the date of accident : —

Up to C All repairs to be allowed in full, except painting 1 year old < or coating of bottom, from which one-third is to be

(A)

Between 1 and 3 years-

Between

3 and 6 years^

(C.)

Between

Qand\Q years*

(2>.)

Betiween 10 & 15 years

Over 15 years

Generally

(_ deducted.

One-third to he deducted off repairs to and re- newal of woodwork of hull, masts, and spars, furni- ture, upholstery, crockery, metal and glassware, also sails, rigging, ropes, sheets, and hawsers (other than wire and chain), awnings, covers, and painting.

One-sixth to be deducted off wire rigging, wire ropes and wire hawsers, chain cables and chains, donkey engines, steam winches and connexions, steam cranes and connexions ; other repairs in full. Deductions as above under clause B, except that one-sjxth be deducted off ironwork of masts and spars, and machinery (inclusive of boilers and their mountings).

Deductions as above under clause C, except that one-third be deducted off ironwork of masts and spars, repairs to and renewal of all machinery (in- clusive of boilers and their mountings), and all hawsers, ropes, sheets, and rigging.

One-third to be deducted off all repairs and re- newals, except ironwork of hull and cementing and chain cables, from which one-sixth to be deducted.

[Anchors to be allowed in full.

C One-third to be deducted off all repairs and re- ■i newals. Anchors to be allowed in full. One-sixth

(_to be deducted off chain cables.

The deductions (except as to provisions and stores, machinery, and boilers) to be regulated by the age of the ship, and not the age of the particular part of her to which they apply. No painting bottom to be allowed if the bottom has not been painted within six months previous to the date of accident. No deduc- tion to be made in respect of old material which is repaired without being replaced by new, and pro- visions and stores which have not been in use.

I

In the case of wooden or composite ships : — When a ship is under one year old from date of original register, at the time of accident, no deduction ‘ ‘ new for old ‘ ‘ shall be made. After that period a deduction of one-third shall be made, with the following exceptions : —

Anchors shall be allowed in full. Chain cables shall be subject to a deduction of one-sixth- only.

No deduction shall he made in respect of provisions and stores which had not been in use.

Metal sheathing shall be dealt with, by allowing in full the cost of a weight equal to the gross weight of metal sheathing stripped off, minus the proceeds of the old metal. Nails, felt, and labour metalling are subject to a deduction of one-third. In the case of ships generally : — In the case of all ships, the expense of straightening bent ironwork, including labour of taking out and replacing it, shall be allowed in full.

Graving dock dues, including expenses of removals, cart- ages, use of shears, stages, and graving dock materials, shall be allowed in full.

Rule XIV. — Tempoeaet Repairs. No deductions “new for old” shall be made from the cost of temporary repairs of damage allowable as G. A.

Rule XV. — Loss op Freight. Loss of freight arising from damage to or loss of cargo shall be made good as G. A., either when caused by a G. A. act or when the damage to or loss of cargo is so made good. >

Rule XVI. — Amount to be made good for Cargo Lost or

Damaged by Sacrifice. The amount to be made good as G. A. for damage or loss of goods sacrificed shall be the loss which the owner of the goods has sustained thereby, based on the market values at the date of the arrival of the vessel or at the termination of the adventure.

Rule XVII. — Contributory Values. , The contribution to a G. A. shall be made upon the actual values of the property at the termination of the adventure, to which shall be added the amount made good as G. A. for property sacrificed ; deduction being made from the shipowner's freight and passage-money at risk, of such port charges and crew's wages as would not have been incurred had the ship and cargo been totally lost at the date of the G. A. act or sacrifice, and have not been allowed as G. A. ; deduction being also made from the value of the property of all charges incurred in respect thereof subsequently to the G. A. act, except such charges as are allowed in G. A.

Passengers' luggage and personal effects, not shipped under bill of lading, shall not contribute to G. A.

Rule XVIII. — Adjustment. Except as provided in th6 foregoing rules, the adjustment shall be drawn up in accordance with the law and practice that would have governed the adjustment had the contract of affreightment not contained a clause to pay G. A. according to these rules.

The above rules differ in some important respects from English common law, and from former English practice. They follow ideas upon the subject of G. A. which have pre- vailed in practice in foreign countries (though often in appar- ent opposition to the language of the codes), in preference to themore strict principle of the comnion law applied by Eng- lish courts. That principle requires that, in order to have the character of G. A., a sacrifice or expenditure must be made for the common safety of the several interests in the adventure, and under the pressure of a common risk. It is not enough thkt the sacrifice or expenditure is prudent, or even necessary to enable the common adventure to be completed. G. A., on the English view, only arises where the safety of the several interests is at stake. " The idea of a common commercial adventure, as distinguished from the common safety

from the sea," is not recognized. It is not sufBcient "that an expenditure should have been made to benefit both cargo owner and shipowner." ^

Thus expenses incurred after ship and cargo are in safety, say at a port of refuge, are not generally, by English law, to be treated as G. A.; although the putting into port may have been for safety, and therefore a G. A. act. If the put- 5* "' ting into port has been necessitated by a 6. A. saori- ™^s **' flee, as by cutting away the ship's masts, the case is different ; the port expenses, the expenses of repairing the G. A.

I Per Bowen, L. J., in Svensden v. Wallace, 13 Q.B.D. at p. 84.

damage, and-the incidental expenses of unloading, storing, and re- loading the cargo are, in such a case, treated as consequences of the original sacrifice, and therefore subjects for contribution. But where the reason for putting in is to avoid some danger, such as a storm or hostile cruiser, or to effect repairs necessitated by some accidental damage to the ship, the G. A. sacrifice is considered to be at an end when the port has been reached, if the ship and cargo are then in physical safety. The subsequent expenditure in the port is said not to flow from that sacrifice, but from the necessity of completing the voyage, and is incurred in performance of the shipowner's obligation under his contract. The practice of English average adjusters has indeed modified this strict view by treating the expenses of unloading as G.'A. ; but it may well be doubted whether that practice can be legally supported. Moreover, expen- diture in the port which is incurred in protecting the cargo as in warehousing it, is by English practice treated as a charge to be borne by the cargo for whose benefit it was incurred.

If we turn now to York- Antwerp, Rule X., it will be seen that a much broader view is adopted. Whatever the reason for putting into the port of refuge, provided it was necessary for the common safety, the expenses of going in, and thfe consequent expenses of getting out (if she sails again with all or part of her original cargo) , are allowed as G. A., Rule X. (a). Further, the cost of discharg- ing the cargo to enable damage to the ship to

be repaired, whether caused by sacrifice or by accident during the voyage, is to be allowed as G. A., ” if the repairs were necessary for the safe prosecution of the voyage,” Rule X. (6). And that is to be so even where such repairs are done at a port of call, as well as where done at a port of refuge. Again, when the cost. of- discharging is treated as G. A., so also are to bd the expenses of storing the cargo on shore, and of reloading and stowing it on board, after the repairs have been done (Rule X. (c)), together witH^ny damage or loss incidental to those operations (Rule XII.).

Further, by Rule XI. the wages of the master, officers, and crew, and the cost of their maintenance during the detention of a ship under the circumstances, or for the purpose of the repairs mentioned in Rule X., arfe to be allowed in G. A. It is questionable whether English law allows the wages and maintenance of the crew at a port of refuge in any case. Where the detention is to repair accidental damage it seems clear that they are not allowed. And in practice, under com- mon law, the allowance is never made ; so that Rule XI. is an impor- tant concession to the shipowner. Like the changes introduced by Rule X., it is a change towards the practice in foreign countries.

It may be noted that the rules do not afford equal protection to a shipper in the comparatively infrequent case of his being put to expense by the delay at a port of refuge. Thus a shipper of cattle is not entitled to have the extra wages and provisions of his cattlemen on board, nor the extra fodder consumed by the cattle during a stay at a repairing port, made good as G. A. under Rules XI. and X. (_Anglo-Argentine, &c. ^Agency v. Temperley Co. , 1899, 2 Q. B. 403) .

As to the acts which amount to G. A. sacrifices, as distinguished from expenditures, the York-Antwerp Rules do not much alter English common law. They do, however, make defi- Oeaeral j^jjg provisions upon some points on which authority sacrmces ^^ scanty or doubtful. (See Rules I.~~IX.) And in Rule I., as to jettison of deck cargo, a change is made from the common law rule, for the jettison is not allowed as G. A. even though the cargo be carried on deck in accordance with an es~~ tablished custom of the particular trade.

Rule III. deals vrith damage done in extinguishing fire on board a ship. Modern decisions have cleared away the old doubts whether such damage to ship or cargo should, at law, be allowed in G. A. But recent cases in the United States have raised the question whether the allowance should be made where the fire occurs in port, and is extinguished, not by the master, but by a public authority acting in the interests of the public. The Supreme Court of the United States decided against the allowance in 1894, in a case of Ralli V. Troup (157 U. S. 386). The ship had there been scuttled to put out a fire on board, by the port authority, acting upon their own judgment, but with the assent of the master. It was held that the damage suffered by ship and cargo ought not to be made good by G. A. contributions ; for the sacrifice had not been made “by some one specially charged with the control and safety of that ad- venture,” but was the compulsory act of a public authority. On the other hand, in the English case of Fapayanni v. Orampian S. S. Co. (I. Com. Ca. 448), Mathew, J., held that the scuttling of a ship at a port of refuge in Algeria, by orders of the captain of the port, was a G. A. act. It had been done in the interest of ship and cargo, and there was no evidence of any other motive.

Rule V. deals with the question whether, and under what conditions, a voluntary stranding of the ship is a G. A. act, in a manner which will probably be held to express the law in England when the matter comes up for decision.

Rules VI. and VII. deal with the damage sustained by the ship, or her appliances, in efforts to force her off the ground when she has stranded. Such efforts involve an abnormal use which is likely

to cause damage to sails and spars, or to engines and boilers ; and they are treated as acts of sacrifice. A recent case {The Bona, 1895, P. 125), in the court of appeal, shows that the rules are in accord with English law upon the point. The court held that both the damage sustained by the engines while worked to get the ship off, and the coal and stores consumed, were subjects for G. A. contribution at common law. »

Rule VIII. allows as G. A. any damage sustained by cargo when discharged and, say, lightered for the purpose of getting the ship off a strand. And the corresponding damage in the case of cargo dis- charged at a port of refuge

to enable repairs to be done to the ship is allowed by Rule XII. But in the latter case the allowance does not expressly extend to damage sustained while stored on land. Whether the law would require contribution to a loss of goods, say, by thieves or by fire, while landed for repairs, is not clear. Where the landing has been necessitated by a G. A. act, as cutting away masts, it would seem that the loss ought to be made good, as being a result of the special risks to which those goods have thereby been exposed. The risks which they would have run if they had remained on board throughout are taken into account, as will presently appear, in estimating how much of the damage is to be made good.

Where cattle were taken into a port of refuge in Brazil, owmg to accidental damage to the ship, with the result that they could not legally be landed at their destination (Deptford), and had to be taken to another port (Antwerp), at which they were of much less value, this loss of value was allowed in G. A.(_Anglo-Argentine, die., Agency v. Temperley Co., 1899, 2 Q. B. 403).

The case of a stranded ship and cargo often gives rise to difficulty as to whether the cost of operations to lighten the ship, and after- wards to get her floated, should be treated as G. A. expenditure, or as expenses separately incurred in saving the separate interests. The true conclusion seems to be that either the whole operation should be treated as one for the common safety, and the whole ex- pense be contributed to by all the interests saved, or else the several parts of the operation should be kept distinct, debiting the cost of each to the interests thereby saved. Which of these two views should be adopted in any case seems to depend upon the motives with which the earlier operations (usually the discbarge of the cargo) were presumably undertaken. It may, however, happen that this test cannot be applied once for all. Take the case of a stranded ship carrying a bulky cargo of hemp and grain, but carry- ing also some bullion. Suppose this last to be rescued and taken to a place of safety at small expense in comparison with its value. It may well be that that operation must be regarded as done in the interest simply of the bullion itself, but that the subsequent opera- tions of lightening the ship and floating her can only be properly re- garded as undertaken in the common interest of ship, hemp, grain, and freight. In such a case there will be a G. A. contribution towards those later operations by those interests. But the bullion will not contribute ; it will merely bear the

expense of its own rescue {Boyal Mail S. P. Co. v. English Bank of Bio, 19 Q. B. D. 362).

The York-Antwerp Rules have not only had the valuable result of introducing uniformity where there had been great variety, and corresponding certainty as to the principles which will be acted upon in adjusting any G. A. loss, but also they have introduced greater clearness and definiteness on points where there had been a want of definition. Thus Rule XIII. has laid down a car'eful and definite scale to regulate the deductions from the cost of repairs, in respect of "new for old," in place of the former somewhat uncer- tain customary rules which varied according to the place of adjust- ment; while at the same time the opportunity has been taken of adapting the scale of deductions to modern conditions of ship- building. And Rule XVII. lays down a rule as to contributory values in place of the widely varying rules of different countries as to the amounts upon which ship and freight shall contribute (cf. Gow, Marine Insurance, 305).

The adjustment of G. A., that is to say, the calculation of the amounts to be made good to and paid by the several interests, is a complicated matter. It involves much detail and arithmetic, and requires a full > Adjust- and accurate knowledge of the principles of alaerai the subject. Such adjustments are made by Averse. men who make the subject their profession. In Great Britain they are for the most part members of the Average Adjusters' Association, a body which has – done and is doing much careful work with \ view to making and keeping the practice uniform and in accord with right principles. This association has gradually formulated, at their annual meetings, a body of practical rules which the individual members undertake to observe. They will be found in the annual reports of the society (and see Gow, Marine Insurance, 330).^

A V E E A G E

33

It may be of interest to refer briefly to one or two main principles l^hich govern an adjustment. The fundamental idea is that the several interests at risk shall contribute in proportion to the benefits they have severally received by the completion of the adventure. Contributions are not made in

proportion to the amounts at stake when the sacrifice was made, but in proportion to the results when the adventure has come to an end. An interest which has become lost after the sacrifice, ‘ during the subsequent course of the voyage, will pay nothing ; an interest which has become depreciated will pay in proportion to the diminished value. The liability to contribute is inchoate only when the sacrifice has been made. It becomes complete when the adventure has come to an end, either by arrival at the destination, or by having been broken up at some intermediate point, while the interest in question still survives. To this there is one exception, in the case of Gr. A. expenditure. Where such expenditure has been incurred by the owner of one interest, generally by the shipowner, the repayment to him by the other interests ought not to be wholly de- pendent upon the subsequent safety of those interests at the ultimate destination. If those other interests or some of them arrive, or are realized, as by being landed at an intermediate port, the rule (as in the case of G. A. sacrifices) is that the contributions are to be in proportion to the arrived or realized values. But if all are lost the burden of the expenditure ought not to remain upon the interest which at first bo’re it ; and the proper rule seems to be that contributions must be made by all the interests which were at stake when it was made, in proportion to their then values.

Again, the object of the law of G. A. is to put one whose property is sacrificed upon an equal footing with the rest, not upon a better footing. Thus, if goods to the value of £100 have been thrown overboard for the general safety, the owner of those goods must rtot receive the full £100 in contribution. He himself must bear a part of it, for those goods formed part of the adventure for whose safety the jettison was made ; and it is owing to the partial safety of the adventure that any contribution at all is received by him. He therefore is made to con- tribute with the other saved interests towards his own loss, in respect of the amount “made good” to him for that. The full £100 is treated as the amount to be made good, but the owner of the goods is made to contribute towards that upon the sum of £100 thus saved to him.

The same principle has a further consequence. The amount to be made good will not necessarily be the value of the goods or other property in their condition at the time they were sacrificed; so to calculate it would in effect

be to withdraw those goods from the subsequent risks of the voyage, and thus to put them in a better position than those which were not sacrificed. Hence, in estimating the amount to be made good, the value of the goods or property sacrificed must be estimated as on arrival, with reference to the condition in which they would probably have arrived had they remained on board throughout the voyage.

The liability to pay G. A. contributions falls primarily upon the owner of the contributing interest, ship, goods, or freight. But in practice the contributions are paid by the insurers of the several interests. Merchants seldom have to concern themselves with the subject. And yet in an ordinary policy of insurance there is no express provision requiring the underwriter to indemnify the assured against this liability. The policy commonly contains clauses which recognize such an obligation, e.g., a warranty against average ” lurless general,” or an agree-

ment that G. A. shall be payable ” as per foreign state- ment,” or ” according to York-Antwerp Rules ” ; but it does not directly state the obligation. It assumes that. The explanation seems to be that the practice of the underwriter to pay the contribution has been so uniform, and his liability has been so fully recognized, that express provisions were needless. But one result has been that very differing views of the ground of the obligation have been held. One view has been that it is covered by the sue and labour clause of an ordinary policy, by which the insurer agrees to bear his proportion of expenses volunta- rily incurred ” in and about the defence, safeguard, and recovery ” of the insured subject. But that has been held to be mistaken by the House of Lords {Aitchison v. Lohre, 4 A.C. 755). Another view is that the underwriter impliedly undertakes to repay sums which the law may require the assured to pay towards averting losses which would, by the contract, fall upon the underwriter. Ex- penses voluntarily incurred by the assured with that object are expressly made repayable by the sue and labour clause of the policy. It might well be implied that pay- ments compulsorily required from the assured by law for contributions to G. A., or as salvage for services by salvors, will be undertaken or repaid by the under- writer, the service being for his benefit. But the decision in Aitchison v. Lohre negatives this ground also. The claim was against underwriters on a ship which had been so damaged that the cost of repairs

had exceeded her insured value. A claim for the ship's contribution to certain salvage and G. A. expenses which had been incurred, over and above the cost of repairs, was dis- allowed. The view seems to have been that the insurer is liable for salvage and G. A. payments as losses of the subject insured, and therefore included in the sum insured, not as collateral payments made on his behalf. This bases the claim against the insurer upon a fiction, for there has been no loss of the subject insured; in fact, the payment has been for averting such a loss. And it suggests that the insurer is not liable for salvage where the policy is free of particular average, which does not accord with practice.

An important question as to an insurer's liability for G. A. arose recently in the case of the Brigella (1893, P. 189), where a shipowner had incurred expenses which would have been the subject of G. A. contributions, but that he alone was interested in the voyage. There were no contributories. He claimed from the insurers of the ship what would have been the ship's G. A. contribution had there been other persons to contribute in respect of freight or cargo. The claim was disallowed on the ground that there could be no G. A. in such circumstances, and therefore no basis for a claim against the insurer. The liability of the insurer was thus made to depend, not upon the character of the loss, but upon the fact of contribution or possibility of contribution. But this was not followed in Montgomery v. Indemnity Co. (1900, 6 Com., Ca. 19). There ship, freight, and cargo all belonged to the same person. He had insured the cargo but not the ship. The cargo underwriters were held liable to pay a contribution to damage done to the ship by cutting away masts for the general safety. The loss was in theory spread over all the interests at risk, and they had undertaken to bear the cargo's share of such losses. Their liability did not depend upon the accident of whether the interests all belonged to one person or not. This agrees with the view taken in the United States.

As to Particular Average, see under Insukance (Marine).

Authorities. — Lowttdes on General Average, 4th ed., London, 1888. — ABBOTi'i Merchant Ships and Seamen, 13th ed., London,

1892. — Arnould’s Marine Insurance, 7th ed., London, 1901. — Carver’s Carriage by Sea, 3rd ed., London, 1900. (t. G. C.)

Aversa, a garrison town and Episcopal see of the province of Caserta, Campania, Italy, 13 miles N. from Naples by rail. A good wine is made in the neighbour- hood. There are manufactures of hemp, cotton, and furniture, and a technical school. Population (1881), 21,176 ;

(1901), 23,477.

Aveyron, a French department on the rim of the Central Plateau.

Area, 3386 square miles, with 43 cantons and 302 communes. The population, 415,826 in 1886, had fallen to 382,074 in 1901. The births (1899) were 8893, of which 277 were illegitimate ; deaths, 88ll; marriages, 2816. The people of Aveyron emigrate in large numbers to South America. In 1896 there were 1457 primary schools, with 70,000 pupils. One and a half per cent, of the population was illiterate. The chief towns are Rodez (16,000 inhabitants in 1896 ; the capital), Espalion, Millau, St Affrique, Villefranche, and Decazeville. The area under cultivation in 1896 comprised 1,469,650 acres, of which 904,020 acres were plough- land, 46,930 acres vineyard, and 29,640 acres grass. In 1899, wheat yielded a revenue of £598,225, and the production of rye, oats, and potatoes in the same year amounted to 2,220,000 cwt. It takes the seventh rank for the production of hemp. Vfne productions were valued at £111,000, and it grows a great abundance of walnuts and chestnuts. The live stock in 1899 numbered 921,250 head, 722,000 of which were sheep. Mining in 1898 produced 1,020,000 tons of coal, 9000 tons of iron, and 600 tons of other minerals, especially argentiferous lead in the basin of Decazeville. The production in metals in 1898 did not, however, exceed 34,000 tons of iron, cast-iron, and steel, and its value, including that of the other metals, was not more than £380,000. The other indiistries are leather-dressing and glove-making (Millau), the making of cheese, for which Roquefort is especially noted, and the weaving of coarse wool.

Avignon, chief town of department Vaucluse, France, 4:53 miles S.S.E. of Paris, on railway from Lyons to Marseilles. The library contains about 117,000 volumes and 3300 manuscripts. The north and oldest part of the Papal palace, restored in the 19th century, is now the de- pository of the public archives. The 15th-century Bene- dictine church of St Martial, partly in ruins, contains a magnificent tomb of Urban V. The ancient city gates have been in part destroyed, including the Porte d'Imbert (1896). Modern monuments are the Centenaire, erected in 1891, to commemorate the union of the Comtat Venaissin with France, and the statue of the Persian, Jean Althen, who in 1765 introduced the culture of the madder plant, which long formed the staple, and still forms an impor- tant branch, of local trade. John Stuart Mill died here in 1873, and is buried in the cemetery to the east of the town. Population (1881), 26,919 ; (1901), 46,896.'

Avila, a province of central Spain, with an area of 2570 square miles. It is divided into 6 districts and 270 parishes. There are valuable forests of oak, beech, and many varieties of firs. The ducal house of Medina Sido- nia has turned vast extents of old pasture-lands and mountains into productive pine-woods. More than a million and a half of acres are cultivated, only about 2 per cent, of which are well irrigated. The offtcial statistics show 133,200 acres producing wheat, 94,250 acres pro- ducing other cereals, 58,750 pod fruit, 32,377 vines, and 14,582 olive. The live stock includes 9125 horses, 9300 mules, 20,348 donkeys, 60,329 cattle, 479,254 sheep, 94,356 goats, and 37,930 pigs. The means of com- munication are not abundant, especially in the moun- tainous districts. The Great Northern railway places the province in communication with Madrid and France ; there are about 155 miles of fairly good roads. The exports are chiefly cereals and live stock ; imports — manu- factured goods, colonial products, machinery, and cod-fish. In 1887 the population was 132,000 ; in 1897, 197,636. The average of births is 4-08 per cent., of deaths 3'63 per

cent., and the proportion of illegitimates is 013 per cent. The proportion of illiterates is 37 per cent.

Avila, a town of Spain, capital of the modern pro- vince of Avila, on the river Adaja, with a station on the line from Madrid to Valladolid. The climate is temperate in summer and very cold in winter, snow often then

lying more than a foot deep. There is a considerable trade in agricultural products, live stock, leather, pottery, and manufactures of hats, linen, and cotton goods. The in- stitute, the normal schools for teachers of both sexes, and several primary schools are well attended. Here is situ- ated the royal school of cadets for the army commissariat corps. In the convent of the Eucarnacion is the cell of Santa Theresa de Jesus, and there are remains of the old alcazar, now turned into barracks. The bishop of Avila is now a suffragan of the archbishop of Valladolid. Population (1897), 11,712.

Aviles, or San Nicolas db Aviles, a port in the province of Oviedo, Spain. Population, 11,749. The trade, especially along the coast, has much increased of late years, the means of communication having been im- proved in the surrounding districts.

Avintes, a town of Portugal, district of Oporto, on the left bank of the Douro, 4 mUes above Villa Nova de Gaia, one of the handsomest suburbs of Oporto, which it supplies with vegetables, &c. Population, 5100.

Aviona, or Valona (Albanian Vliora), a kaimakam- lik of the vilayet of Janina, Turkey, and the nearest sea- port to Italy on the Albanian coast. Its population is officially stated to be 6000. The surrounding district is agricultural and pastoral, producing oats, maize, cotton, olive oil, valonea, cattle, sheep, skins, hides, and butter. All these articles are exported in considerable quantities, besides bitumen, which is obtained from a mine worked by a French company. The imports are woollen and cot- ton piece-goods, metals, and petroleum.

Avon, the name of several rivers of England, of which the most important are the following : — (1) The Lower Avon. Rising in the south of Gloucestershire, it describes a big eastward curve through Wiltshire, and enters Som- ersetshire a few miles S.E. of Bath ; from this city it flows W.N.W through Bristol to the estuary of the Severn, which it enters about 5 miles S. of the Severn Tunnel. The total length is about 70 miles. The chief importance of the river lies in its lower course, especially in the 7 miles below Bristol, though it is navigable for small vessels as far up as Bath, a distance of 12 miles. One^ of the causes of the decline in the trade of Bristol was the tortuous channel of the Avon between that city and the Severn. Something was done to remedy this in 1809, when a new channel

was cut for the river through the city, the river itself converted into a ” floating harbour ” (3 miles long), and two dock basins dug beside it, covering an area of 85 acres and giving a depth of 22 feet. But owing to the increasing size of ocean-going vessels, this accommodation proved insufiicient, and in 1884 the corf)0- ration of Bristol bought, as an out-port at the mouth of the Avon, the two docks of Avonmouth and Portishead. The former, situated on the Gloucester side of the Avon, has an area of 19 acres, with a depth on sills of 28 to 38 feet, and is equipped with large granaries, cattle quarters, chill rooms, and provision stores. The dock can be entered at any time by vessels of 2000 tons ; and there is anchorage for vessels drawing up to 30 feet at one mile distance from the dock gates. The Portishead dock, which is situated about 3 miles S. W. of the mouth of the Avon, has an area of 12 acres, with a depth on sill of 24 to 34 feet. It is easily entered and cleared in all weathers, being under the shelter

of the Portishead Hills. Both ^ocks are connected with Bristol by rail, and so with the Midland and Great Western railway systems. In February 1901 the Imperial Direct West India Mail Service began running fortnightly vessels between Bristol and Jamaica, carrying passengers, and bringing West Indian fruit (chiefly ~~bananas) to England. This led in March 1902 to the opening of a still larger dock (King Edward VII. Dock) at Avonmouth, designed to accommodate vessels of 20,000 tons, equipped with the newest .American machinery for dealing with heavy freight, with colossal grain elevators on the transatlantic model, and with cold storage accommodation of the most scientific description, the estimated cost being two mill~~ ions sterling. The Avon is noted, like the Severn, for its high tides, the rise generally varying from 24 to nearly 40 feet even at Bristol. (2) The Upper Avon, nearly 100 miles long, rising in the west of Northamptonshire near Naseby, flowing through Warwickshire and across the southern extremity of Worcestershire, and entering the Severn im- mediately below Tewkesbury. It is navigable for small craft up to a point about 5 miles above Evesham. (3) The East Avon, rising in the middle of Wiltshire, flowing soath through Amesbury and Salisbury and along the western border of the New Forest,

and eventually entering the English Channel below Christchurch in Dorsetshire. Its length is about 50 miles, and it is not navigable.

Avranches, chief town of arrondissement, depart- ment of Manche, France, 34 miles S.W. of St Lo by rail. There are a communal college, botanic gardens, and a library, the last containing valuable manuscripts. The principal church, that of Notre Dame des Champs, has been rebuilt. Trade is now carried on in cider, cattle, butter, flowers, and fruit, and there are salmon and other fisheries. Population (1881), 7677 ; (1901), 7384.

Awaji, an island belonging to Japan, situated at the eastern entrance of the Inland Sea, having a circumference of 94 miles, an area of 218 square miles, and a population of 188,^08. It is celebrated for its exquisite scenery, and also for the fact that it is traditionally reputed to have been the first of the Japanese islands created by the deities Izanagi and Izanami. The loftiest peak is Yuruuba-yama (1998 feet), the most picturesque Sen-zan (1619 feet).

Awellimiden. See Sahaka.

Axim. See Gold Coast.

Axminster, a market-town and railway station in the Honiton parliamentary division of Devonshire, Eng- land, 24 miles E. by N. of Exeter. There are tooth- and nail-brush works and an iron foundry. A cottage hospital has been opened. Area of parish, 6833 acres. Popula- tion (1881), 2872 ; (1901), 2906.

Axum. See Abyssinia.

Ayacucho, an interior department of central Peru. It has an area of 18,185 square miles, and its population was ofacially estimated at 302,469 in 1896. It contains six provinces — Huanta, La Mar, Ayacucho, Cangallo, Lucanas, aad Parina-cochas. The capital, Ayacucho, has a population of 20,000.

Ayala y Herrera, Adelardo Lopez de (1828- 1879), Spanish writer and politician, was born at Guadal- canal on 1st May 1828, and at a very early age began writing for the theatre of his native town. The titles of , these

juvenile performances, which were played by ama/- teurs, were ” Saiga por donde saliere,” ” Me voy a Sevilla,” and ” La Corona y el Punal.” As travelling companies never visited Guadalcanal, and as ladies took no part in the representations, these three plays were written for

men only. Ayala persuaded his sister to appear as the heroine of his comedy, “La primera Dama,” and the innovation, if it scandalized some of his townsmen, per- mitted him to develop his talent more freely. In his twentieth year he matriculated at the university of Seville ; but it is not certain whether he joined the faculty of law or that of philosophy, and his career as a student was undistinguished. In Seville he made acquaintance with Garcia Gutierrez, who is reported to have encouraged his dramatic ambitions and to have given him the beiieiit of his own experience as a playwright. Early in 1850 Ayala removed his name from the university books, and settled in Madrid with the purpose of becoming a profes- sional dramatist. Though he had no friends and no influence, he speedily found an opening. A four-act play in verse, ” Un Hombre de Estado,” was accepted by the managers of the Teatro Espafiol, was given on 26th January 1861, and proved a very, remarkable success. Henceforward Ay ala’s position and popularity were secure. Within a twelvemonth he became more widely known by his ” Castigo y Perd6u,” and by a more humorous effort, ” Los dos Guzmanes ” ; and shortly afterwards he was appointed by the Moderado Government to a post in the Home Office, which he lost in 1854 on the accession to power of the Liberal party. In 1854 he produced “Rioja,” perhaps the most admired and the most admirable of all his works,, and from 1854 to 1856 he took an active part in the political campaign carried on in the journal El Padre Cobos. A zarzuela, entitled ” Guerra £ muerte,” for which Erailio Arrieta composed the music, belongs to 1866, and to the same collaboration is due ” El Agente de Matrimbnios.” At about this date Ayala passed over from the Moderate to the Progressive party, and this political manoeuvre had its effect upon the fate of his plays. The performances of ” Los Comuneros ” were attended by members of both political parties ; the utterances of the different characters were taken to represent the author’s personal opinions, and every speech which could be wrenched into connexion with current politics was applauded by one half of the house and derided by the other half. A zarzuela, named ” El Conde de Castralla,” was given amid much uproar on 20th February 1856, and, as the

piece seemed likely to cause serious disorder in the theatre, it was suppressed by the Government after the third performance. Ayala's rupture with the Moderates was now complete, and in 1857, through the interest of O'Donnell, he was elected as Liberal deputy for Badajoz. His political changes are difficult to follow, or to explain, and they have been unsparingly censured. So far as can be judged, Ajala, had no strong political views, and drifted with the current of the moment. He took part in the revolution of 1868, wrote the " Manifesto of Cadiz," took office as colonial minister, favoured the candidature of the due de Mont- pensier, resigned in 1871, returned to his early conserva- tive principles, and was a member of Alfonso XII. 's first Cabinet. Meanwhile, however divided in opinion as to his political conduct, his countrymen were practically unanimous in admiring his dramatic work; and his reputation, if it gained little by " El nuevo Don Juan," was greatly increased by " El Tanto por Ciento " and " El Tejado de Vidrio." His last play, " Consuelo," was given on 30th March 1878. Ayala was nominated to the dignifled post of president of Congress shortly before his death,-which occurred unexpectedly on 30th January 1 879. The best of his lyrical work, excellent foi> finish and intense sincerity, is his "Epistola" to Emilio Arrieta, and, had he chosen to dedicate himself to lyric poetry, he might possibly have ranked with the bestof Spain'sinodern singers ; as it is, he is a very considerable poet who affects the dramatic form. In his later writings he deals with modern society, its vices, ideals, and perils ; yet in many

essentials he is a manifest disciple of Calderon. He has the familiar .Calderonian limitations ; the substitution of types for characters, of eloquence for vital dialogue. Nor can he equal the sublime lyrism of his model ; but he is little inferior in poetic conception, in dignified idealization, and in picturesque imagery. And it may be fairly claimed for him that in " El Tejado de Vidrio " and « El Tanto por Ciento " he displays a very exceptional combination of satiric intention with romantic inspiration. By these plays, and by "Eioja" and " Consuelo," he is entitled to be judged.

They will at least ensure for him an honourable place in the history of the modern Spanish theatre.

(j. F.-K.)

Aylesbury, a market-town in the Aylesbury parlia^ mentary division (since 1885) of Buckinghamshire, Eng- land, 48 miles N.W. of London by rail. Modern erec- tions are a church, a clergy house, two Methodist chapels, a literary institute, a club for working men, and public swimming baths. An improved drainage system has cost £25,000. There are printing works and works for con- densing milk, but the manufacture of pillow-lace is almost extinct. Area of parish (an urban district), 3302 acres. Population (1881), 7795 ; (1901), 9244.

Ayr, a royal and parliamentary burgh (Ayr group) and the county town of Ayrshire, a seaport and maniifactur- ing town, situated at the influx of the Ayr river into the bay of the same name, 40|- miles S.W. by S. of Glasgow by rail. The New Bridge was injured by floods in 1877, and rebuilt in 1879. Another bridge was erected in 1898, and a footbridge in 1900. A town hall and corporation offices, built in 1883, were destroyed by fire in 1897. Eecent structures are two Established, Trinity Episcopal (rebuilt), and United Free churches, new railway station, free library, cattle market, post office, and academy (re- built). A statue of Burns was erected in 1891. The harbour has been improved at a cost of £153,500. An esplanade leading from the harbour has been made, and another was laid out on the north side in 1898. Vessels on the port register numbered 22 of 3689 tons at the end of 1898, and the traffic, mostly coasting, was : 1898, en- .tered 2467 vessels of 399,233 tons, cleared 2451 vessels of 386,634 tons. Exports were valuedat £13,397 in 1888, and £14,536 in 1898 ; imports at £79,668 in 1888, and £207,495 in 1898. The academy is under the School Board. Population (1881), 20,812 ; (1901), 28,624.

Ayrshire, a maritime coimty of S.W. Scotland, bounded on the N. by Renfrewshire, on the N.E. by Ren- frew and Lanark shires, on the E. by Lanark and Dum- fries shires, on the S.E. by Kircudbrightshire, on the S. by Wigtownshire, and on the W. by the Irish Sea and the Eirth of Clyde.

Area and Population. — In 1891 the Renfrewshire portions of the parishes of Beith and Dunlop (543 and 1101 acres respectively) were transferred to the county of Ayr. According to the latest official estimate, the area of the county (foreshore excluded) is 730,947 acres, or 1142 square miles. The population was in 1881, 217,619 ; in 1891, 226,283, or, on the above area, 226,386, of whom 111,037 were males and 115,349 females ; in 1901, 254,436, an in- crease of 28,050. On the old area, taking land only (722,229 acres, or 1128-5 square miles), the number of persons to the square mile in 1891 was 201, and the number of acres to the person 3-2. In the registration county the increase of population between 1881 and 1891 was 4 per cent. Between 1881 and 1891 the excess of births over deaths was 34,250, and the increase of the resident population 8779. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 :—

Year.

Deaths.

Marriages.

Births.

Percentage of

Illegitimate

Births.

1880

1890 1899

4414 4241 4404

1456 1670 1843

7766 7299 7838

7-8

7-03

5-6

The birth-rate and marriage-rate were above and the death-rate was below those of Scotland. The following table gives the birth- rate, death-rate, and marriage-rate per thousand of the population for a series of years : —

1880.

18S1-90.

1890.

1891-98.

1899.

Birth-rate . Death-rate . Marriage-rate

35-90

20-41

6-73

3412

18-70

6-82

32-32

18-78

7-39

33-31

18-05

7-18

33-63

18-94

7-91

In 1891 there were 1827 Gaelic-speaking persons in the county, of whom 14 spoke Gaelic only, and 154 foreigners. Valuation in 1889-90, £1,059,056; 1899-1900, £1,229,844.

Constitution and Government. — The county returns two members to parliament, who represent North and South Ayrahire respec- tively. Ayr, the county town (28,624 inhabitants in 1901), and Irvine (9603) are royal burghs and belong to the Ayr group of parliamentary burghs, and Kilmarnock (34,161) is a parliamentary burgh of the Kilmarnock group. Police burghs are : Ardrossan (5933), Cumnock (3087), Darvel (3070), Galston (4876), Girvan (4019), Kilwinning (4439), Largs (.3243), Maybole (5892), New- milns (4466), Saltcoats (8121), Stewarton (2858), Troon (4696). Other towns are: Beith (7523), Catrine (2340), Dairy (5314), Hurlford (5246), Kilbirnie (7207), Muirkirk (5670), Stevenston (6797). Under the county council 32 special water districts have been formed, 26 drainage districts, and 19 lighting and scavenging districts. There are 44 civil parishes, which are divided among the three combinations of Kyle (in the centre), Cunningham (in the N.), and Carrick (in the S.), with poorhouses at Ayr, Irvine, and Maybole ; the number of paupers and dependants in Septem- ber 1899 was 5408. The county forms a sheriffdom, and there are resident sheriffs-substitute at Ayr and Kilmarnock, who sit also at Irvine, Beith, Cumnock, and Girvan.

Education. — Fifty-one school boards manage 149 schools, which had in 1898-99 an average attendance of 37,956, and there are 28 voluntary schools in the county, of which 17 are Koman Catholic and one Episcopal, with an average attendance of 39,000. There are secondary schools at Ayr, Irvine, Kilmarnock, and Beith, and Kilmarnock Dairy School is now a

constituent part of the West of Scotland Agricultural College established in 1899. Six other board schools earned grants in 1898 for giving higher education. For the year ending March 1899 the county council expended £5176 on secondary and technical education, including £2317 contributed by the county council and some of the burgh councils from the “residue” grant; contributions were made to the Glasgow and West of Scotland Technical College and the Kilmarnock Dairy School, and the technical classes subsjitiized at various local centres embraced instruction in agriculture, mining, engineering, plumbing, gardening, and various science and art subjects.

Agriculture. — The fertility of the soil has been enormously developed by high farming. Potato-growing is an important industry ; the coast lands supply the early markets of Scotland and the north of England, and the potato acreage actually ex- ceeded that under turnips in 1898. There is a very large produc- tion of milk, butter, and cheese. A fair quantity of wheat is grown — about 2000 acres on an average — and the barley acreage is rather less. Oats form the bulk of the corn crop. The follow- ing table gives the principal acreages at intervals of five years from 1880:—

Tear.

Area under Crops.

Corn Crops.

Green Crops.

Clover.

Perma- nent Pasture.

Fallow.

1880 1885 1890 1895 1899

317,387 317,484 319,856 321,902 321,172

59,061 57,645 52,493 49,343 49,232

19,049 16,439 17,114 17,472 16,503

99,055 123,712 138,511

97,986 102,644

138,510 119,532 111,184 156,779 152,503

1712 156 235 172 147

The following table gives particulars of the live stock during the same years : —

Tear.

Total Horses.

Total Cattle.

Cows or

Heifers in

MUk or Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1899

8787

8585 8931 9974 9329

88,932 95,095

100,943 98,842

101,885

43,558 46,126 49,718 50,373 51,031

362,190 335,050 356,385 361,057 386,098

12,164 14,566 16,285 16,768 13,920

The percentage of cultivated area was 43-8 in 1898. The acreage under wood in 1895 was 25,725. Farms are, as a rule.

™°oo^oo u fl^^- ^^ *^^ “^^t^ o^ t^>e last return, 1895, there nno^^-j noWings m the county of an average size of 97 acres; «, L °°’ exceed 5 acres ; 27-12 were between 5 and 60, and 0^-96 were above 50 acres. Farms between 60 and 100 acres numbered 763 ; between 100 and 300, 1240 ; between 300 and 600, 8rf ; and above 500, 13. According to the census of 1891 there were 9201 men and 1672 women engaged in pursuits connected with agriculture.

Industries and Trade.— Ayrshire is the principal mining county in Scotland, and has the second largest coalfield. The following toble gives particulars of the mineral industry :—

Tear.

Coal.

Iron Ore.

Pig Iron.

Fire Clay.

Tons.

Value.

Tons.

Value.

Tons.

Tons.

Value.

1890 1899

8,159,-727 8,809,313

£1,105,904 £1,412,620

446,246 854,833

£245,485 £177,166

240,848 345,488

87,175 113,127

£18,888 £18,622

In 1890 there were 21 blast furnaces ; in 1899, 26 on an average. Of sandstone, 120,268 tons, valued at £31,341, were obtained in 1895, and 151,955, valued at £47,481, in 1899. Of limestone 21,228 tons were raised in 1895, and 14,369 tons in 1899.

Industries have spread throughout the towns generally. There are now large lace curtain factories in Galston, Newmilns, and Darvel ; shoemaking is engaged in on an extensive scale a.t May- bole, and also at Ayr, Kilraaurs, and Kilmarnock ; cabinetmaking at Beith, shipbuilding at Troon, Ayr, Irvine, and Fairlie ; while calico-printing, bleaching, silk-weaving, bonnet-making, tanning, and freestone-quarrying are all carried on.

The seaports are Girvan, Ayr, Troon, Irvine, Saltcoats, Ardros- san, and Largs. Fishing is carried on from 12 harbours or creeks, which are divided between the two fishery districts of Ballantrae and Greenock, and statistics for the two districts conjointly may most conveniently be given here.

Year.

Boats in Districts.

Value of Gear.

Resident Fishermen and Boys.

Total Value of all Fish.

No.

Tons.

Value.

1890 1898 1899

757 787 744

2403 1698 1852

£15,770 £29,768 £15,097

£13,244 £13,862 £12,810

1333

1429

‘ 1304

£44,138 £37,138 £38,493

£13,010 of the total value of fish in 1899 was the value of shell-fish only. The number of persons connected with the various branches of the sea fisheries in 1899 in the two dis- tricts was 5956. To Ayrshire harbours alone there belonged in 1899 822 boats of 877 tons ; there were 474 fishermen and boys resident in the county, and the value of the fish landed was £14,500.

At the census of 1891 the number of persons engaged in In- dustrial pursuits was 47,252 men and 14,011 women, of whom 2269 men were concerned in the production of machines and im- plements, 4136 men and 6056 women of textiles, and 18,992 men of minerals. Commerce occupied 7875 men and 326 women. A large number of short railway lines have been built since 1875 by the Caledonian and Glasgow and South- Western Railway Com- panies, the total new mileage being about 60 miles, and there are about 35 miles under construction by the Glasgow and South-western Railway Company,

Authorities. — James Paterson. “History of the County of Ayr” (Transactions of Ayrshire and G-alloway ArchKologieal Asso- ciation). Edinburgh,” 1879-1900. — John Smith. Prehistoric Man in Ayrshire. London, 1895. — William Robertson. History of Ayrshire. Edinburgh, 1894. — Historical Tales and Legends of Ayrshire. Ayr, 1890.— Robert Bkyden. Etchings of Auld Ayr and some Ayr Characters. 1898.— Roderick Lawson. The Capital of Carrick. Paisley, 1897.— David Caldwell. History of the Parish of Ayr. Ayr, 1896.— John Warrick. The History of Old Cumnock. Paisley, 1897.— William Baird. Sixty Years ‘of Church Life in Ayr. Ayr, 1898.— Archibald Stureook. “On the Agriculture of Ayrshire” {Transactions of Highland and Agricultural Society).— Archibald Maokat. History of Kilmarnock. Kilmarnock. — D. Landsborough. Contribu- tions to Local History. Kilmarnock, 1878. — M’Ilwraith. History of the Glasgow and South- Western Bailway. Glasgow, 1880. ‘ (w. -Wa)

Ayub Khan, Afghan prince, son of Sher Ali, form- erly Amir of Afghanistan, and cousin of the Amir Ab- durrahman, was born about 1865. During his father’s reign little is recorded of him, but after Sher Ali’s expul- sion from Kabul by the English, and his death in Janu- ary 1879, Ayub took possession of Herat, and maintained

himself there until June 1881, vrhen he invaded Afghanistan with the view of asserting his claims to the sovereignty, and in particular of gaining possession of Kandahar, still in the occupation of the British. He encountered the British force commanded by General Burrows at Maiwand, on 27th July, and was able to gain one of the very few pitched battles that have been won by Asiatic leaders over an army under European direction. His triumph, however, was short-lived ; while he hesitated to assault Kandahar he was attacked by Sir Frederick (afterwards Lord) Eoberts, at the close of the latter' s mem- orable march from Kabul, and utterly discomfited, 20th September 1880. He made his way back to Herat, where he remained for some time unmolested. In the summer of 1881 he again invaded Afghanistan, and on the anniver- sary of the battle of Maiwand obtained a signal victory over Abdurrahman's lieutenants, mainly through the de- fection of a Durani regiment. Kandahar fell into his hands, but Abdurrahman now took the field in person, to- tally defeated Ayub, and expelled him from Herat. He took refuge in Persia, and for some time lived quietly in receipt of an allowance from the Persian Government. In 1887 internal troubles in Afghanistan tempted him to make another endeavour to seize the throne. Defeated and driven into exile, he wandered for some time about Persia, and in November gave himself up to the British agent at Meshed. He was sent to India to live as a state prisoner.

Azamgarh or Azimgaeh, a town and district of British India, in the Gorakhpur division of the ISTorth- West Provinces. The town 'is situated on the river Tons, and has a railway station. The population is 19,000 ; the municipal income in 1897-98 was Rs. 13,107; the regis- tered death-rate in 1897 was 39 per thousand. There are two printing-presses. The district of Azamgarh has an area of 2148 square miles. In 1891 its population was 1,728,625, being 805 persons per square mile. In 1901 it was 1,530,655, showing a decrease of 11 per cent. The land revenue and rates were Es. 17,48,488, the inci- dence of assessment per acre being R.l : 0 :7 on the tem- porarily settled land, and Es.0 : 0 : 4 on the permanently settled ; the cultivated area in 1896-97 was 693,067 acres, of which 417,932 were irrigated from wells, &c. ; the number of police was 2845; there are 160 vernacular schools with 6724 pupils ; the registered death-rate in 1897 was 38-7 per thousand. There are 364 indigo facto- ries, with an out-turn valued

at Es.4,66,000. A branch of the Bengal and North-Western railway to Azamgarh town was opened in 1898.

Azerbaijan (Azerbijan, Azerbadegan of mediaeval writers, Athropatakan and Atropatene of the ancients), the north-western and most important province of Per- sia, with an estimated area of 32,000 square miles and a population of about two millions. It is divided into a number of administrative sub-provinces and districts, each with a hdJcim, governor, or zdbit, sub-governor, under the governor-general, who, under the present dynasty — that of the Kajars — has been the heir-apparent to the throne of Persia, assisted by a responsible minister ap- pointed by the Shah. The administrative divisions of the province are as follows : Tabriz and environs, Uskiih, Deh Khareg^n, Mar^gha, Miandoab, Saujbulagh, Suldiiz, Urmia, Selmas, Kho'i, Maku, Gerger, Merend (Mehrand in ninth edition), Karadagh, Arvanek, Talish, Ardebil, Mishkin, Khalkhal, Hashtriid, Garmriid, Afshar, Sain Kaleh, Ujan, Sarab (Siral in ninth edition). The revenue of the province derived from land taxation and other maliat is said to amount to about £200,500 per annum in cash and kind, and nearly all of it is expended in the province for the maintenance of the court of the heir-

apparent, salaries and pay to Government officials and troops, pensions, &c. The revenue from customs, most of it remitted to Tehran, was reported to have been £94,000 in 1887 and £90,333 in 1889, and is now about £80,000. The value of the impotrts and exports exceeded £2,000,000 in 1898. A concession for working some copper ore in the Karad^gh district was granted in 1898 to a Eussian company*.

A-zhe-ho, or Ashekhe (Manch. Alchuku), a town of China, Manchuria, 125 miles N.E. of Kirin, and 30 miles S. of the Sungari. Population, about 30,000.

Azjer. See Sahara.

Azores, an archipelago of islands belonging to Portugal, and lying in the Atlantic W. of that country, with an area of 922 sq. miles, and a population of 255,594. The vineyards cover about 9450 acres, and produce 972,- 850 gallons of wine (the greater part in Pico), valued at £89,360. On St Michael tea is grown, the produce being consumed in Lisbon. The fish caught in 1898 were val- ued at an aggregate of £33,100, the number of fishermen being 5860, and their vessels 1092. In 1897 the ports of the archipelago were entered and cleared by a total of 1062 vessels of 2,052,792 tons ; and the imports and ex- ports together were valued at £210,000. The district of Ponta Delgada, embracing the islands St Mary and St

Michael, has a population of 124,000, and manufactures pottery, cottons, spirits, straw hats, and tea. The capi- tal, and also capital of the islands, is Ponta Delgada, in St Michafel (population, 16,767). The district of Angra de Heroismo, embracing the islands Terceira, St George, and Graciosa, has a population of about 72,000, and manu- factures linen, woollens, cheese, butter, soap, bricks, ajid tiles. Its capital, Angra (population, 11,012), in Terceira, is an episcopal see. The district of Horta, embracing the islands Fayal, Pico, Flores, and Corvo, with a population of about 58,000, makes baskets, mats, &c., of straw and osiers, and articles of the pith of the fig. Some 7250 acres are annually planted with vines, which yield 496,000 gallons of wine, valued at £42,250. Its capital is Horta (population, 6879), in Payal. Meteorological stations are situated at Ponta Delgada and Angra de Heroismo.

Azrek, Bahr el. See Abyssinia.

Azuay, a province of Ecuador, bounded on the N. by the province of Canar, on the S. by that of Loja, on the E. by Oriente, and on the W. by the province of the Oro. Its area covers 3870 sq. miles, and the population num- bers 132,400. The capital, Cuenca, has about 25,000 in- habitants. Amongst the principal towns are Gualacco (3000), Paute, Jiron, Sigsig. The province is divided into 44 parishes.

Baalbek, ancient Heliopolis, altitude 3850 feet, situ- ated on the east side of the fertile valley of the Litani, not far from the water-parting between that river and the Orontes. The remarkable ruins of the temples are de- scribed in the ninth edition of this work. In the centre of the main court of the Great

Temple are the remains of a basilica, possibly built by Theodosius, with its apse at the west end. The ruins suffered severely from an earth- quake in 1759, and in 1870 it became necessary to support the keystone of the portal of the Temple of the Sun with a wall. In the quarries near the town is a stone 68 feet long and 14 feet high, weighing about 1500 tons, which is still attached to its quarry bed, and was evidently in- tended for the temple wall. Important excavations have been made in the temple eijclosure by Germany.

A good description of the ruins will be found in Baedekeh's Palestine and Syria, Leipzig, 1898.

BSbilsm is the religion founded in Persia in a.d. 1844-45 by Mirza 'All Muhammad of Shiraz, a young Sayyid who was at that time not twenty-five years of age. Before his " manifestation " (zuhuf), of which he gives in the Persian Baydn a date corresponding to 23rd May 1844, he was a disciple of Sayyid Kizim of Easht, the leader of the Shaykhis, a sect of extreme Shfites characterized by the doctrine (called by them Ruknr-vrdbi, "the fourth support ") that at all times there must exist an inter- mediary between the twelfth Im^m and his faithful followers. This intermediary they called "the perfect Shfite," and his prototype is to be found in the four suc- cessive Bdhs or " gates " through whom alone the twelfth Imam, during the period of his " minor occultation " {Ghayhat-irSiighrd, a.d. 874-940), held communication with his partisans. It was in this sense, and not, as has been often asserted, in the sense of " Gate of God " or " Gate of Eeligion," that the title Bdh was understood and as- sumed by Mirz^ "AH Muhammad ; but, though still gener- ally thus styled by non-B^bis, he soon assumed the higher title of Nuqta ("Joint"), and the title Bdb, thus left var

cant, was conferred on his ardent disciple Mulla Husayn of Bushrawayh.

The history of the Bd.bi movement down to the execu- tion of the B£ib at Tabriz (8th July 1850) and the great persecution which followed the attempt of three or four Babis to assassinate the late Shah, Nasiru'd-Din, in the summer of 1852, is best told by Gobineau, and is summa- rized in vols, iii., xviii., and xxii. of the ninth edition of the Encyclopcedia Britannica, s.v. " B§,bi or Baby," " Persia : Modern History," and " Sunnites and Shfites." The Bd,b was succeeded on his death by Mirza Yahya of Nur (at that time

only about twenty years of age), who escaped to Bagh- dad, and, under the title of Subh-i-Ezel (" the Morning of Eternity"), became the pontiff of the sect. He lived, how- ever, in great seclusion, leaving the direction of affairs almost entirely in the hands of his elder half-brother (born 12th November 1817), Mirza Husayn 'All, entitled Bahd- 'u'lldh (" the Splendour of God "), who thus gradually be- came the most conspicuous and most influential member of the sect, though in the Iqdn, one of the most important polemical works of the B^bis, composed in 1858-69, he still implicitly recognized the supremacy of Sxibh-irJEzel. In 1863, however, Bah^ declared himself to be " He whom God shall manifest " {Man Yuz-hiruhu'Udh, with prophecies of whose advent the works of the Bab are filled), and called on all the Bdbis to recognize his claim. The majority responded, but Subh-i-Ezel and some of his faithful adherents refused. Since that date the B^bis have been divided into two sects, Ezelis and Bah^'is, of which the former have steadily lost and the latter gained ground, so that at the present day there are probably from half a million to a million of the latter, and at most only a hundred or two of the former. In 1863 the Babis were, at the instance of the Persian Government, removed from Baghdad to Constantinople, whence they were shortly afterwards transferred to Adrianople. In 1868 Baha and his followers were exiled to Acre in Syria, and Subh-i-Ezel with his few adherents to Famagusta in Cyprus, where he

still lived in 1901. Bah^ died at Acre on 16tli May 1892, and was succeeded by his son 'Abbas Efendi, whose claims, however, were contested by another son named Muhammad 'AH. The followers of the latter do not ap- pear to be numerous, but in Acre itself they are said to have succeeded in retaining the custody of Bah^'s tomb. Full particulars of this latest schism are stUl lacking. During the last five or six years the doctrine of Baha has been preached with considerable success by a certain Ibrahim Khayru'lMh in the United States, where there are now some 3000 American converts.

The tenets of the older B^bfe (now represented by the Ezelfs) included, besides a belief in the divine mission of the Bib and the plenary inspiration of all his numerous writings, a denial of the finality of any revelation, and

of the resurrection of the body. Great importance was attached to the mystical values of letters and numbers, especially the numbers 18 and 19 (" the number of the unity ") and 192=361 (" the number of all things "). In general the Bab's doctrines most closely resembled those of the Isma'ihs and HurTifls. In the hands of Bah4 the aims of the sect became much more practical and ethical, and the wilder pantheistic tend- encies and metaphysical hair-splittings of the early Bibls almost disappeared. The intelligence, integrity and morality of the present Bibls (whose numbers appear to be rapidly increasing) are high, but their efforts to improve the social position of woman have been much exaggerated. They were in no way concerned (as was at the time falsely alleged) in the assassination of N4siru'd-Dln Shdh

in May 1896. Since the persecution at Yezd in May 1891 they have been comparatively unmolested.

Literature.— The literature of the sect is very voluminous, but mostly in manuscript. The most valuable public collections in Europe are at St Petersburg, London (British Museum), and Paris (Bibliothfique Nationale), where two or three very rare MSS. col- lected by Gobineau, including the precious history of the Bab's contemporary, Hajl Mlrzfi, Jd,nl of Kishin, are preserved. For the bibliography up to 1889, see vol. ii. pp. 173-211 of the Traveller's Narrative, written to illustrate the Episode of the B&b, a Persian work composed by Babe's son, 'AbbAs EpENnf, edited, translated and annotated by E. 6. Browne (Cambridge, 1891). More recent works are: — Browne. The New History of the B&b. Cambridge, 1893; and "Catalogue and Description of the 27 B4bl Manu- scripts," Journal of B. Asiat. Soc, July and October 1892.— Andreas. Die Babfs in Persien. 1896. — Baron Victor Rosen. Collections Scientifiques de VInstitut des Langues Orientales, vol. i. (1877), pp. 179-212; vol. iii. (1886), pp. 1-51 ; vol. vi. (1891), pp. 141-255. "Manuscrits BSbys" ; and other important articles in Russian by the same scholar, and by Captain A. G. Toumansky, in the Zapiski vostochnava otdyeleniya ImperatorskavaJiusskava Archeologieheskava Obshchestva (St Petersburg, 1890-1900, vols, iv.-xii.). — Also an excellent edition by Toumansky, with Russian translation, notes and introduction, of the Kit&b-i-Aqdas (the most important of Bahd's works), &c. (St Petersburg, 1899).— Of the works composed in English for

the American converts the most important is entitled Sehd^uHldh {The Glory of God), by Ibrd,him Khayru‘114h, assisted by Howard MacNutt (Chicago, 1900).

(e. g. b.)

BABYLOl^IA AISTD ASSYRIA.

SINCE the publication of the article on Babylonia in the ninth edition of the Encyclopaedia Britannica, excavations in that country have been carried on so actively, while so largely increasing a number of Assyrian students has been engaged in deciphering the thousands of inscribed tablets which have been brought to Europe and America, that the account given of its history and culture requires to be considerably supplemented and Recent ex- ^^■‘“ised. Though little has been done towards pioratiotts the excavation of Assyrian sites, Babylonia has and dis- been explored by expedition after expedition, and coveries. gQ^g Qf ^j^g earliest records of civilization have been brought to light. After the death, however, of Mr George Smith at Aleppo in 1876, the first expedition — that sent out by the British Government in 1877-79 under the conduct of Mr Hormuzd Eassam — confined its opera- tions to Assyria. Excavations in the mounds of Balawat (called Img^r-Bel by the Assyrians), 15 miles east of Mosul, resulted in the discovery of a small temple dedi- cated to the god of dreams by Assur-nazir-pal II. (885 B.C.), and containing a stone coffer or ark, in which were two inscribed tables of alabaster of rectangular shape, as well as of a palace which had been destroyed by the Babylonians, but rebuilt by Shalmaneser II. From the latter came the bronze gates with hammered reliefs which are now in the British Museum. The remains of a palace of Assur-nazir-pal II. at Nimroud (Calah) were also ex- cavated by Mr Eassam, and hundreds of enamelled tiles were disinterred. Two years later (1880-81) Mr Eassam was sent to Babylonia, where he discovered the site of the temple of the Sun-god of Sippara at Abu-Habba, and so fixed the position of the two Sipparas or Sepharvaim. Abu-Habba lies south of Baghdad, midway between the Euphrates and Tigris, on the south side of an ancient canal, on the opposite bank of which was Sippara of the goddess Anunit, now D§r.

Meanvirhile (1877-81) the Erench consul, de Sarzec, had been excavating at Tello, the ancient Lagas, in Southern Babylonia, and bringing to light

monuments of the Sumerian or pre-Semitic age, which included the diorite statues of the High-priest Grudea, now in the Louvre, the stone of which, according to the inscriptions upon them, had been fetched from Magan, the Sinaitic penin-

sula. The subsequent excavations of M. de Sarzec in Tello and its neighbourhood have carried the history of the city back to at least 4000 B.C., and a library of more than 30,000 tablets has been found, which were arranged on shelves in the time of Gudea (in 2700 B.C.). In 1886-87 a German expedition under Koldewey ex- plored the cemetery of El-Hibba (immediately to the south of Tello), and for the first time made us accurately acquainted with the burial customs of ancient Babylonia. Another German expedition, on a large scale, has been despatched in 1899 with the object of thoroughly explor- ing the site of Babylon, the palaces and temples of which still remain for the most part unidentified. Its first result has been the identification of the mound called El-Qasr with the palace of Nebuchadrezzar, and that of Amran with the temple of Bel. But thus far the most im- portant and most systematic work done in Babylonia has been that of the American expedition of the University of Pennsylvania, which has been (since 1889) patiently and scientifically excavating the great temple of El-lil or Bel at Niffer, the ancient Nippur, in Northern Babylonia. Here Mr Haynes has been working winter and summer, steadily removing stratum after stratum of debris and cutting sectioris in the ruins down to the virgin soil. Midway in the mound is a platform of huge bricks stamped with the names of Sargon of Akkad and his son Naram-Sin (3800 B.C.), and as the debris above them is eleven metres thick, the topmost layer being not later than the Christian era (Hilprecht, T7ie Baby- lonian Expedition, i. 2. p. 23), it is calculated that the debris underneath the pavement, 9-26 metres thick, must represent a period of about 3000 years, more especially as older constructions had to be levelled be- fore the pavement was laid. In the deepest part of the excavations, however, inscribed clay tablets and fragments of stone vases are still found, though the cuneiform characters upon them are of a very archaic type, and sometimes even retain their primitive pic- torial forms.

The temple of Nippur was one of the oldest sanctuaries in Babylonia, and one of the two centres from which the early culture of the country radiated.

The other centre was Eridu, now represented by Abu-Shahrein (or NowSr

•wis), which, though now 130 miles inland, was once the seaport of primeval Chaldsea. As about 46 miles of land have been formed by the silting up of the shore since the

foundation of Spasinus Charax (Mohammerah) affErida. ™ *^^ *i™6 of Alexander the Great, or about 115

feet a year, the foundation of Eridu must go back to at least 6000 e.g. Babylon seems to have been a colony of Eridu, since its patron-god, Merodach, was a son of Ea of Eridu, while Ur, now Muqayyar, on the western bank of the Euphrates, must have owed its foundation to Nippur, El-lil, the god of Nippur, being accounted the father of the Moon-god of Ur.

The two streams of culture which flowed from Nippur and Eridu afforded a strong contrast. Ea of Eridu was a

god of light and beneficence, who employed his b’”*^’?” / divine wisdom in healing the sick and restoring culture. ^^^ dead to life. Rising each morning from his

palace in the deep, he had given man the arts and sciences, the industries and manners of civilization. El-lil of Nippur, on the contrary, was the lord of the ghost-land, and his gifts to mankind were the spells and, incantations which the spirits of good or evil were com- pelled to obey. But both Ea and El-lil were the gods of the early Sumerian population of Babylonia, who spoke an agglutinative language, and to whom the invention of the cuneiform system of writing, or rather the pictorial hieroglyphs out of which it developed, was due, as well as all the other elements of Babylonian civilization. All the older inscriptions are in the Sumerian language, and the princes of the older epoch all bear Sumerian names. The precise linguistic position of this language is still a matter of dispute. Professor Hommel has advanced strong reasons for believing it to be related to the Turko- Tatar

family ; Professor de la Couperie and Mr Ball have endeavoured to connect it with Chinese. The present writer has long since given up the belief that it was a primitive form of Ural-Einnic. All that can be said positively about it is that it is an early representative of the agglutinative languages. There were two dialects of it, one spoken in Sumer or Southern Babylonia, and called by the native grammarians ” the pure language ” (eme-lakhJeha), the other in Akkad or Northern Babylonia, and termed ” the woman’s language ” (eme-sal). The latter Was much affected by phonetic decay and the in- fluence of a Semitic population, which was more numerous in Akkad than in Sumer, and its native appellation was probably derived from its being spoken imperfectly by the Semitic wives of Sumerian husbands. At an early period the Sumerians came into contact with Semitic tribes on the Arabian side of the Euphrates, ‘ and after their engineering works had regulated the water-supply of Babylonia and rendered it one of the most fertile of agricultural countries Semitic settlers established them- selves in it, and before 3800 b.c. became the predominant population in Akkad or Northern Babylonia. The lan- guages spoken by the two races were naturally affected by the intercourse between them ; Sumerian was influ- enced by Semitic Babylonian, and still more Semitic Babylonian by Simierian. Indeed, the Semitic Babylo- nian of literature may be described as a mixed language, though not to the same extent as modern English. It was many centuries, however, before it succeeded in su- perseding the older language of the country ; in fact, it is questionable whether Sumerian did not survive in some of the country districts of Sumer as late as the Greek period, and even under the dynasty of Khammurabi official texts were still published in the two lahguages, the older language of Sumer taking the first place. Long after the establishment of Semitic supremacy Sumerian continued to be the language of law, and it remained the language of the official religion to the very last.)

The alluvial plain of Babylonia, after its reclamation from swamp and jungle, was called by the Sumerians the Edin or ” Plain,” a word which was borrowed by Semitic Babylonian under the form of Edinnu, ™B^“f the Eden of Gen. ii. 8. A Sumerian hymn describes a magical tree — the tree of life — which ” grew in Eridu,” in ” the centre of the earth,” where the god Ea walks in his garden, forbidden to man, and Tammuz dwells beneath its s^hade, while the Tigris and Euphrates flow on either side. In this

description it is difficult not to see a parallel to that of the Biblical Garden of Eden.’ Hardly any addition has been made to our knowledge of Assyrian chronology, no further copies of the leponym canon having been found since 1889. The first lists of limmi, or eponymous archons who gave wy”””” their names to their years of office, were brought to light by Sir H. Eawlinson {Athenaeum, 1862). They are twofold in character, one version containing merely a list of the eponyms in their chronological order, while in the other their titles are added as well as the chief event which marked each term of office. They furnish a con- tinuous and accurate chronology from 893 b.c. (or 911, if George Smith was right in the position he assigned to a fragment of one of them) down to 666 b.c, fixed dates being given within this period by the capture of Samaria in 722 B.C. and’ the solar eclipse of 15th June 763 b.c, which took place in the ninth year of the reign^of Assur- dan III.

Babylonian chronology, however, which a few years agO’ was almost a blank, has now been to a considerable extent recovered. George Smith had already discovered a frag- ment of what must have been a complete list of the Chaldean dynasties with their respective dates {Trans.. S.B.A. iii. 2, 1874), and portions had been published of a so-called Synchronous History of Assyria and Baby- lonia, consisting of brief notices of the occasions on which the kings of the two countries had entered into relation, hostile or otherwise, with one another (Sayce, Records of the Past, first series, iv. pp. 24-35). In 1880 Mr. Pinches discovered a tablet, which seems to have been a school- boy’s exercise, containing a list of the kings of the first two dynasties of Babylon, and in 1884 a chronological list of the dynasties that reigned in Babylonia from the time that Babylon became the capital of the whole kingdom. In the same year ” The Babylonian Chronicle ” was also’ discovered by the same scholar. This is a compilation from older records made in the time of Darius, from a Baby- lonian point of view, and when perfect must have given a- very complete synopsis of Babylonian history, with dates and synchronisms. The portions of it thus far known relate to the Kassite dynasty and the conquest of Babylon by the Assyrian king Tiglath-Ninip, in the 13th century B.C., and more especially to the period beginning with the third year of Nabonassar in Babylonia and the accession of Tiglath-pileser III. in Assyria (745 b.c), and ending^ with the accession of Samas-sum-yukin (668 b.c). In Babylonia time was registered, not by eponyms, but

by the chief event that distinguished each year of a king's reign, the accession and death of the king being of course- noted. At the end of a reign a list of the dates belonging to it was drawn up, and from time to time these were combined into a longer record. In a commercial com- munity, such as Babylonia was from the first, accurate dating was a matter of vital importance ; the validity of contracts and other legal documents often depended upon

1 Kar-Duniyas, once miswritten Gan-Duniyas, has nothing to do with the Garden of Eden. It means " the Wall " or " Fortification of the god Daniyas," and was the name applied to Northern Babylonia, probably alter the rise of the Kassite dynasty, from a line of fortifica- tions which defended the frontier, and maybe "the Median Wall" mentioned by Xenophon {Anah. ii. 4. 12).

it, and it was necessary that there should be easy access to an ofiBcial chronological record. Among the tablets recently acquired 'by the British Museum is one which was compiled on the 2nd day of the month lyyar in the accession year of Ammi-zadok (2190 b.c), and which con- tains a complete chronological register of the earlier reigns of the first dynasty of Babylon. Similar tablets which give the chronology of the reigns of Dungi and Bur- Sin II. (of the dynasty of Ur) have been found at Niffer {Sayce, Proceedings S.B.A. xxi. 1), while the annals of Sargon of Akkad and of the first three years of his son ITaram-Sin (3800 b.c.) have long been known. The events recorded in these latter have been recently verified by the dates found attached to contemporaneous contracts. To these chronological materials must be added the references to past history which occur in later inscriptions. Naboni- dos especially, who was more of an antiquary than a poli- tician, and who spent a good deal of his time in excavating for the monuments of his predecessors, has left us valuable notices. Thus he states that Naram-Sin, the son of Sargon, lived 3200 years before himself, and that a Kassite king, Burna-buryas, reigned 700 years after Khammurabi.

In the earliest period of which we have any knowledge JBabylonia was divided into several independent states.

Their frontiers were defined by canals and -^J’^^* boundary-stones, and the infringement of these Babylonia, frequently led to war. Many of the states were

ruled by a patesi or high-priest, the god of its ■chief sanctuary being nominally the ruler, and the human patesi his minister. But in course of time many of the high-priests assumed the functions and title of king; while retaining their priestly of&ce they claimed at the ■same time to be supreme in the state in all secular con- cerns. The god remained nominally at its head; but •even this position was lost to him when Babylonia was unified under Semitic princes, and the earthly king be- came an incarnate god. It was only at Babylon that Bel-Merodach continued to hold his own and compel the deified kings to acknpwledge themselves his sons, who derived from him their right to rule.

When the monumental evidence first becomes distinct we find a kingdom of Kengi or Sumer in the south of Babylonia, and a kingdom of Kis in the north. Kis is represented by El-Hymer, a little to the east of Babylon, .and ii? later ages was known chiefly on account of its temple of Zamama. In its wars with the south Kis was ■often assisted by another northern kingdom, the reading •of the name of which, and consequently its precise situar tion, are still uncertain. The name has been read as ” the land of the Bow,” and supposed to represent Harran in Mesopotamia ; this, however, was certainly not the case, .and the ideograph by which the name is expressed is probably to be identified with that which in later Baby- lonian denoted Upg or Opis on the Tigris. Dr Scheil would make it Ukh and identify it with the modern Jokha between the Shatt ^-Hai and the Shatt el-Nil, but Jokha is more probably the ancient Isin. On a seal cylinder two of the rulers of the place are called kings of T§. Perhaps the first king of Up§ (?) was a certain Lugal-zaggisi, as he gives his father U-kus the title merely of patesi or high-priest.1 He founded the earliest empire in Western Asia of which we know. He not only conquered Kengi, but also claims to have made Erech his capital, and to have

1 It must be remembered that the readings of these early non- ;Semitic names are only provisional, as the pronunciation of the ideo- graphs by which they are expressed is uncertain. On palseogra^hical erounds Lugal-zaggisi has been placed after the two kings of ie, Jin- akalli and his son Urinmma, the latter of whom was a contemporary of Entemena of Lagas. Tg may be Tewa, a suburb of Babylon, since a contract tablet speaks of ” Te in Babylon.”

ruled ” from the lower sea of the Tigris and Euphrates ” or Persian Gulf to the ” Upper Sea ” or Mediterranean. The long inscription which he caused to be engraved on the hundreds of stone vases dedicated to El-lil of Nippur has been edited and translated by Professor Hilprecht. The predominance of Kengi in the south was succeeded by that of Lagas, now Tello, on the east side of the Shatt el-Hai. Lagas was at one time dependent ‘ra^as on Kis, and we hear of Me-salim, king of Kis, *‘

overthrowing Us, the high-priest of Upg in the edin or plain of Lagas, which he had invaded.^ Lugal-sug-gur was at the time the high-priest of Lagas. Subsequently Lagas recovered its independence, and its high-priests became kings. One of these, Ur-Nina, was the builder of an edifice attached to the temple of Nina, in the ruins of which terra-cotta bas-reliefs of the king and his sons have been found, as well as lions’ heads of onyx, which remind us of Egyptian work, and fragments of onyx plates. These were ” booty ” dedicated to the goddess Bau. The grand- son of Ur-Nina, E-ana-gin or E-anna-du, made himself master pf the whole of Southern Babylonia, including ” the district of Sumer,” together with the cities of Erech, Ur, and Larsa (?). He also annexed the kingdom of Kis, and drove the king of Up8 from a part of the territory of Lagas which he had occupied. Up§ was made tributary, a certain amount of grain being levied upon each person in it, which had to be paid into the treasury of the goddess Nina and the god Ingurisa. The so-called Stela of the Vultures, now in the Louvre, was erected Jte/a?’”’”’ as a monument of the victory. On this various incidents in the war are represented. In one scene the king stands in his chariot, with a curved weapon in his right hand formed of three bars of metal bound together by rings,^ while his kilted followers with helmets on their heads and lances in their hands march behind him. In another a flock of vultures is feeding on the bodies of the fallen enemy ; in a third a tumulus is being

heaped up over those who had been slain on the side of Lagas. Elsewhere we see the victorious prince beating down a vanquished chief and superintending the execution of other prisoners who are being sacrificed to the gods, while in one curious scene he is striking with his mace a sort of wicker-work cage filled with naked men. In his hand he holds the crest of Lagas and its god, a lion-headed eagle with out- stretched wings and supported by two lions which are set heraldically back to back. The sculptures belong to a primitive period of art.

E-anna-du's campaigns extended beyond the confines of Babylonia. He overran a part of Elam, and took the city of Az, on the Persian Gulf. At home he was a great builder. Temples and palaces were repaired or erected at Lagas and elsewhere, the town of NinS. — which probably gave its name to the later NinS. or Nineveh — was rebuilt, and canals and reservoirs were dug. He was succeeded by his brother, En-anna-dun, under whom Upg once more became the dominant power. The sanctuaries of Lagas were destroyed and part of its territory was annexed to Upg. As En-anna-dun has the title only of high-priest, and not of king, it is probable that he acknowledged Urlumma of Up§ as his suzerain. His son and successor, Entemena, re- stored the prestige of Lagas. Up§ was subdued and a cer- tain lUi appointed to govern it as high-priest. A tripod of hammered silver dedicated by him to his god is now in the Louvre. A frieze of lions devouring ibexes and deer, and incised with great artistic skill, runs round the neck, while

2 According to Dr Scheil, a monument recently discovered by Mr de Morgan at Susa makes Me-salim the son of Manistusu.

8 As M. Henzey has noticed, it resembles a weapon carried by the chief of an Asiatic tribe in a tomb of the twelfth dynasty at Beni Hassan (see Beni-Hassan, I. PL xxviii. ; Egypt Exploration Fund).

the eagle crest of Lagas adorns the globular part. The vase is a proof of the high degree of excellence to which the goldsmith's art had already attained. A vase of calcite, also dedicated by Entemena, has been found at Nippur.

While the Sumerian princes of Lagas were fighting and building, the Semitic element in Northern Babylonia was growing in numbers and strength. Manistusu, " king of Kis," a long inscription of whom has been discovered by de Morgan on a monument in the ruins of Susa, probably belonged to the Semitic race. He was a contemporary of Uru-duggina, the vassal king of Lagas, in whom M. Heuzey sees one of the successors of Entemena, though Hilprecht would refer him to a much earlier period. Another Semitic ruler of Kis of the same period was Alusarsid (or Uru-mus), who "subdued Elam and Ba- rahse." But the fame of these early establishers of Semitic supremacy was eclipsed by that of ^^^°' Sargon of Akkad and his son Naram-Sin, the founders of an empire which extended from Elam to the Mediterranean' and the Sinaitic peninsula. The date of Sargon is placed by Nabonidos at 3800 b.c. He was the son of Itti-Bel, and a legend related how he had been born in concealment and set adrift in an ark of bulrushes on the waters of the Euphrates. Here he had been rescued and brought up by " Akki the husbandman"; but the day arrived at length when his true origin became known, the crown of Babylonia was set upon his head, and he entered upon a career of foreign conquest. Eour times he invaded Syria and Palestine, and spent three years in thoroughly subduing the countries of " the west," and in uniting them with Babylonia " into a single em- pire." Images of himself were erected on the shores of the Mediterranean in token of his victories, and cities and palaces were built |at home out of the spoils of the conquered lands. Elam and the northern part of Meso- potamia were also subjugated, and rebellions were put down both in Kazalla and in Babylonia itself. Contract tablets have been found dated in the years of the cam- paigns against Palestine and Sarlak, king of Gutium or Kurdistan, and copper is mentioned as being brought from Magan or the Sinaitic peninsula.

Sargon's son and successor, Naram-Sin, followed up the successes of his father by marching into Magan, whose king he took captive. He assumed the imperial title of "king of the four zones," and, like his father, was addressed? as a " god." He is even called " the god of Agadg " (Akkad),

reminding us of the divine honours claimed by the Pharaohs of Egypt, whose territory now adjoined that of Babylonia. A finely-executed bas-relief, representing ISTaram-Sin, and bearing a striking resem- blance to early Egyptian art in many of its features, has been found at Diarbekir. Babylonian art, however, had already attained a high degree of excellence ; two seal cylinders of the time of Sargon are among the most beautiful specimens of the gem-cutter's art ever dis- covered. The empire was bound together by roads, along which there was a regular postal service, and clay seals, which took the place of stamps, are now in the Louvre bearing the names of Sargon and his son. A cadastral survey seems also to have been instituted, and one of the documents relating to it states that a certain Uru-Malik, whose name appears to indicate his Canaanitish origin, was governor of the land of the Amorites, as Syria and Palestine were called by the Babylonians. It is probable that the first collection of astronomical observations and terrestrial omens was made for a library established by Sargon.

Bingani-sar-ali was the son of Narafli-Sin, but we do not yet know whether he followed his father on the throne. Another son was high-priest of the city of Tutu, and in the name of his daughter, Lipus-Eaum, a priestess

of Sin, some scholars have seen that of the Hebrew deity Yahveh. The Babylonian god Ea, however, is more likely to be meant. The fall of Sargon's empire seems to have been as sudden as its rise. The seat of supreme power in Babylonia was shifted southwards to Erech, Isin, and Ur. At least three dynasties appear to have reigned "at Ur and claimed suzerainty over the other Babylonian states. One of these, under ™^/'"^* Grungunu, succeeded in transferring the capital of Babylonia from Isin to Ur. It is still uncertain whether Gungunu belonged to the second or third dynasty of Ur ; if to the second, among his successors would have been Ur-Gur, a great builder, whtf built or restored the temples of the Moon-god at Ur, of the Sun-god at Larsa, of Istar at Erech, and of Bel at Nippur. His son and successor was Dungi I., one of whose vassals was Gudea, the patesi or high-priest of Lagas (Tello). Gudea was also a great builder, and the materials for his buildings and statues were brought from all parts of Western Asia, cedar wood from the Amanus mountains, quarried stones from Lebanon, copper from Northern Arabia, gold and precious stones from the desert between Palestine and Egypt, dolerite from Magan (the Sinaitic peninsula), and timber from Dilmun in the Persian Gulf. Some of his statues, now in the Louvre, are carved out of Sinaitic dolerite, and on the lap of one of them (statue E) is the plan of his palace, with the scale of measurement attached. Six of the statues bore special names, and offerings were made to them as to the statues of the gods. Gudea claims to have conquered Ansan in Elam, and was succeeded by his son Ur-Ningirsu. His date may be provisionally fixed at 2700 B.C.

The high-priests of Lagas still owned allegiance to Ur, when the last dynasty of Ur was dominant in Babylonia. The dynasty was Semitic, not Sumerian, though one of its kings was Dungi II. He was followed by Bur-Sin II., Gimil-Sin, and In8-Sin, whose power extended to the Mediterranean, and of whose reigns we possess a large number of contemporaneous monuments in the shape of contracts and similar business documents, as well as chronological tables. After the fall of the dynasty.

Babylonia passed under foreign influence. Sumu- abi (“Shem is my father”), from Southern otaSoutb Arabia (or perhaps Canaan), made himself master Arabian of Northern Babylonia, while Elamite invaders y^^y- occupied the south. After a reign of fourteen years Sumu- abi was succeeded by his son Sumu-larilu, in the fifth year of whose reign the fortress of Babylon was built, and the city became for the first time a capital. Eival kings, Pungun-ila and Immerum, are mentioned in the contract tablets as reigning at the same time as Sumu-la-ilu (or Samu-la-ilu) ; and under Sin-muballidh, the great-grandson of Sumu-la-ilu, the Elamites laid the whole of the country under tribute, and made Eri-Aku or Arioch, called Eim- Sin by his Semitic subjects, king of Larsa. Eri-Aku was the son of Kudar-Mabug, who was prince of Yamudbal, on the eastern border of Babylonia, and also ” governor of Syria.” The Elamite supremacy was at last shaken oif by the son and successor of Sin-muballidh, Khammurabi, whose name is also written Ammurapi and Khammuram, and who was the Amraphel of t^hammu- Gea. xiv. 1. The Elamites, under their king Amraphel. Kudur-Lagamar or Chedor-laomer, seem to have taken Babylon and destroyed the temple of Bel-Merodach ; but Khammurabi retrievedhis fortunes, and in the thirtieth year of his reign (in 2340 b.c) he overthew the . Elamite forces in a decisive battle and drove them out of Baby- lonia. The next two years were occupied in adding Larsa and Yamudbal to his dominion, and in forming Baby- lonia into a single monarchy, the head of which was Babylon. A great literary revival followed the recovery

of Babylonian independence, and the rule of Babylon was obeyed as far as the shores of the Mediterranean. Vast numbers of contract tablets, dated in the reigns of Khammurabi and other kings of the dynasty, have been discovered, as well as autograph letters of the kings themselves, more especially of Khammurabi. Among the latter is one ordering the despatch of 240 soldiers from Assyria and Situllum, a proof that Assyria was at the time a Babylonian dependency. Constant intercourse was kept up between Babylonia and the west, Babylonian officials and troops passing to Syria and Canaan, while ” Amorite ” colonists were established in Babylonia for

the purposes of trade. One of these Amorites, Abi-ramu or Abram by name, is the father of a witness to a deed dated in the reign of Kham- murabi's grandfather. Ammi-ditana, the great-grandson of Khammurabi, still entitles himself "king of the land of the Amorites," and both his father and son bear the Canaanitish (and South Arabian) names of AbSsukh or Abishua, and Ammi-zadok.

Samsu-ditana, the son of Ammi-zadok, was the last king of the first dynasty of Babylon, which was followed by a dynasty of eleven Sumerian kings for 368 years. We know but little of them; their capital has not yet been discovered, and no trading documents dated in their reigns have been found. They were overthrown and

Babyloniavwas conquered by Kassites or Kos- rfraas^*"* sseans from the mountains of Elam, under Kan-

dis or Gaddas (in 1800 b.c), who established a dynasty which lasted for 576 years and nine months. Under this foreign domination, Babylonia lost its empire over Western Asia. Syria and Palestine became inde- pendent, and the high-priests of Assur made themselves kings of Assyria. The divine attributes with which the Semitic kings of Babylonia had been invested disappeared at the same time ; the title of " god " is never given to a Kassite sovereign. Babylon, however, remained the cap- ital of the kingdom and the holy city of Western Asia. Like the sovereigns of the Holy Roman Empire, it was necessary for the prince, who claimed rule in Western Asia, to go to Babylon and there be acknowledged as the adopted son of Bel before Ms claim to legitimacy could be admitted. Babylon became more and more a priestly city, living on its ancient prestige and merging its ruler into a pontiff. From henceforth, down to the Persian era, it was the religious head of the civilized east.

One of the earlier Kassite kings was Agum-kakrime, who recovered the images of Merodach and his consort, which had been carried away to Khani. At a later date Kadasman-Bel and Burna-buryas I. corresponded with the Egyptian Pharaohs Amon-hotep III. and Amon-hotep IV. (1400 B.C.). The Assyrian king Assur-yuballidh still owned allegiance to his Babylonian suzerain, and inter- marriages took place between the royal families of As- syria and Babylonia. Babylonia, moreover, still sought

opportunities of recovering its old supremacy in Palestine, which the conquests of the eighteenth dynasty had made an Egyptian province, and along with Mitanni or Aram- Naharaim and the Hittites intrigued against the Egyptian Government with disaffected conspirators in the west. After the death of Burna-buryas, however, civil war in Babylonia led to Assyrian interference in the affairs of the country, and from this time forward even the nominal obedience of Assyria to its .old suzerain was at an end. Frequent wars broke out between the two nations, and

eventually (about 1280 b.c.) Tiglath-Ninip of Assyrian Assyria, in the fifth year of his reign, captured l^abyilT' Babylon and sent the treasures of fl-Saggil, the

temple of Bel-Merodach, to Assur. For seven years the Assyrian monarch reigned over Babylonia, then a revolt obliged him to retire ; Hadad-nadin-sumi of the

native dynasty was placed on the Babylonian throne ; and Tiglath-Ninip was shortly afterwards murdered by his son, Assur-nazir-pal I. Assyria steadily increased in power, while Babylonia fell more and more into decay. Shalmaneser I., the builder of Calah (now Nimroud) in 1300 B.C., carried his victorious arms in all directions, and Tiglath-pileser I. extended the Assyrian empire as far as the Mediterranean (1100 b.c). The Kassite dyn-asty had fallen about 1230 b.c, in consequence of an attack on the part of the Elamites, and a new dynasty which sprang from Isin took its place, and lasted for 132|- years. Then came a series of short-lived dynasties, end- ing with that of Nebo-nazir, the Nabonassar of classical writers, who ascended the throne of Babylon in 747 b.c Assyria was at the time in the throes of a revolution. Civil war and pestilence were devastating the kingdom, and its northern provinces had been wrested from it by Ararat (or Van). In 746 B.C. Calah rebelled, and on the 13th of lyyar (April), in the following year, Pulu or Pul, who took the name of Tiglath-pileser III., seized the~ throne, and inaugurated a new and vigorous policy.

Under him and his successors arose the second Assyrian empire, which finally included the whole civilized world of the day. In 729 b.c Babylonia was conquered, and the Assyrian king, under his original name The second of Pulu, was invested with the sovereignty of g^p[r° Asia in the holy city

of Babylon. Two years later, in Tebet (or December) 727 b.c, he died, but his successor Ulula, who took the name of Shalmaneser IV., continued the policy he had begun. Shalmaneser died suddenly in Tebet 722 b.c, and the seizure of the throne by Sargon on the 12th of the month gave the Babylonians an opportunity to revolt. In Nisan (or March) the KaldS, prince, Merodach-baladan, entered Babylon, and was there crowned legitimate king. For twelve ^years he successfully resisted the Assyrians ; but the failure of his allies in the West to act in concert with him, and the overthrow of the Elamites, eventually compelled him to fly to his ancestral domains in the marshes of South- ern Babylonia. Even here his enemies pursued him, and along with his followers he sought refuge in Elam. Sargon was accepted as king by the Babylonian priests, and the legitimacy of his rule was acknowledged up to the time of his murder in 705 b.c Sennacherib, who followed him as king of Assyria, was never crowned at Babylon, the result being revolt after revolt on the part of the Babylonians, who found supporters in the Elam- ites. At length (in 691 b.c) a decisive battle was fought at Khalulg. Both sides claimed the victory, but the Elamites retired from the struggle, and the Babylonians were too exhausted to face their invaders again in the open. field. Two years, however, were still required for the complete subjugation of the country, and it was not till 689 B.C. that Babylon was taken, its houses and temples razed to the ground, the images of of^y/””^ its gods broken in pieces, and the ruins of the city thrown into the canal Arakhtu. The catastrophe aroused a feeling of horror and indignation throughout Western Asia, and the murder of its perpetrator nine years afterwards was regarded by the Babylonians as the punishment inflicted on him by heaven. The murder took place on the 20th of Tebet (681 b.c), and for forty- two days the conspirators held the capital; then they were forced to fly to Ararat, against which an Assyrian army, under the command of Esar-haddon, was carrying on hostilities. A battle was fought with the Armenian and rebel Assyrian forces near Malatiyeh on the 12th of lyyar ; the veterans of Assyria won the day, and at the close of it saluted Esar-haddon as king. He thereupon returned to Nineveh, and on the 8th of Sivan (May) for- mally ascended the throne.

Conquest ot Egypt.

One of his first acts was to restore Babylon, to send back the image of Bel-Merodach to its old home, and to repeople the city with such of the priests and the former population as had survived massacre. Then he was solemnly declared king in the temple of Bel-Merodach, which had again risen from its ruins, and Babylon became the second capital of the empire. Esar-haddon's policy was successful, and Babylonia remained contentedly quiet throughout his reign. In February (674 b.c.) the Assyrians entered upon their invasion of Egypt. But two more campaigns were needed before its conquest could be completed. At last in Nisan (or March) 670 B.C., an expedition on an unusually large scale set out from Nineveh. The Egyptian frontier was crossed on the 3rd of Tammuz (June), and Tirhakah, at the head of the Egyptian forces, was driven to Memphis after fif- teen days of continuous fighting, during which the Egyp- tians were thrice defeated with heavy loss and Tirhakah himself was wounded. On the 22nd of the month Mem- phis was entered by the victorious army, and Tirhakah fled to the south. A stele commemorating the victory and representing Tirhakah with the features of a negro was set up at Sinjirli (north of the Gulf of Antioch), and is now in the Berlin Museum. Two years later (668 b.c.) Egypt revolted, and whila on the march to reduce it Esar- haddon fell ill and died (on the 10th of Marchesvan or October). Assur-bani-pal succeeded him as king of As- syria and its empire, while his brother, Samas-sum-yukin, was made viceroy of Babylonia. The arrangement was evidently intended to flatter the Babylonians by giving them once more the semblance of independence. But it failed to work. Samas-sum-yukin became more Baby- lonia6 than his subjects ; the viceroy claimed to be the suc- cessor of the monarchs whose empire had once stretched to the Mediterranean; even the Sumerian language was revived as the ofRcial tongue, and a revolt broke out which shook the Assyrian empire to its foundations. After several years of struggle, during which Egypt re- covered its independence, Babylon was starved into sur- render, and the rebel viceroy and his supporters were put to death. Then followed the contest with Elam, in spite of the efforts of Assur-bani-pal to ward it off. Assyria, however, was aided by civil war in Elam itself; the country was wasted with fire and sword, and its capital Shushan levelled with the ground. But the long strug- gle left Assyria maimed and exhausted. It had been drained of both wealth and fighting population; the

devastated provinces of Elam and Babylonia could yield nothing with which to supply the needs of the imperial exchequer, and it was difiicult to find sufiicient troops even to garrison the conquered populations. Assyria, there- fore, was ill prepared to face the hordes of Scythians — or Manda, as they were called by the Babylonians — who now began to harass the frontiers. A Scythian power had grown up in the old king- dom of Ellip, to the east of Assyria, where Ekbatana was built by a ” Manda” prince ; Asia Minor was infested by the Scythian tribe of Kimmerians, and the death of the Sfiythian leader Dugdammg (the Lygdamis of Strabo, i. 3. 16) was regarded by Assur-bani-pal as a special mark of divine favour. When Assur-bani-pal died, his empire was fast breaking up. Under his successor, Assur-etil-ilani, the Scythians penetrated’into Assyria and made their way as far as the borders of Egypt. Calah was burned, though the strong walls of Nineveh protected the relics of the Assyrian army which had taken refuge behind them ; and when the raiders had passed on to other fields of booty, a new palace was erected among the ruins of the neighbour- ing city. But its architectural poverty and small size show that the resources of Assyria were at a low ebb. A contract has been found at Sippara, dated in the fourth year

Scythian Invasion.

of Assur-etil-ilani, though it is possible that his rule in Babylonia was disputed by his Eab-shakeh or vizier, Assur-sum-lisir, whose accession year as king of Assyria has been found on a contract from Niffer. The last king of Assyria was probably the brother of Assur-etil-ilani, Sin-sar-iskun, who seems to have been the Sarakos of Berossos. He was still reigning in Babylonia in his seventh year, as a contract dated in that year has been discovered at Erech, and an inscription of his, in which he speaks of restoring the ruined temples and their priests, couples Merodach of Babylon with Assur of Nineveh. Babylonia, however, was again restless. After the over- throw of Samas-sum-yukin, Kandalanu, the Chineladanos of Ptolemy’s canon, had been appointed viceroy. His successor was Nabopolassar, between whom and the last king of Assyria war broke out. The Scythian king of Ekbatana, the Kyaxares of the Greeks, came to the help of the Babylonians. Nineveh was captured and destroyed by the Scythian army, along with those cities of North- ern Babylonia which had sided with Babylonia, and the Assyrian empire was at an end.

But little addition has been made to our knowledge of the political events that marked the reign of Nebuchad- rezzar. Only a small fragment of his annals conauest has been discovered relating to his invasion of of Baby Egypt in 567 b.c, and referring to “Phut of loniaby the lonians.” Of the reign of the last Baby- ”•>’”’*■ Ionian king, Nabonidos, however, and the conquest of Babylonia by Cyrus, we now have a fair amount of information. This is chiefly derived from a chronological tablet containing the annals of Nabonidos, which is sup- plemented by an inscription of Nabonidos in which he recounts his restoration of the temple of the Moon-god at Harran, as well as by a proclamation of Cyrus issued shortly after his formal recognition as king of Babylonia. It was in the sixth year of Nabonidos (649 b.c) that Cyrus, ” king of Anzan ” in Elam, revolted against his suzerain Astyages, king of “the Manda ” or Scythians at Ekbatana. The army of Astyages betrayed him to his enemy, and Cyrus established himself at Ekbatana, thus putting an end to the empire of the Scythians, which the Greek writers called that of the Medes, through a confusion of Mada or ” Medes ” with Manda. Three years later we find that Cyrus has become king of Persia and is engaged in a campaign in the north of Mesopotamia. Meanwhile Nabonidos has established a camp at Sippara, near the northern frontier of his kingdom, his son — probably the Belshazzar of other inscriptions — being in command of the army. In 638 b.c Cyrus invaded Babylonia. A bat- tle was fought at Opis in the month of June, in which the Babylonians were defeated, and immediately afterwards Sippara surrendered to the invader. Nabonidos fled to Babylon, whither he was pursued by Gobryas, the governor of Kurdistan, and on the 16th of Tammuz, two days after the capture of Sippara, “the soldiers of Cyrus entered Babylon without fighting.” Nabonidos was dragged out of his hiding-place, and Kurdish guards were placed at the gates of the great temple of Bel, where the services continued without intermission. Cyriis did not arrive till the 3rd of Marchesvan (October), Gobryas having acted for him in his absence. Gobryas was now made governor of the province of Babylon, and a few days afterwards the wife or son of Nabonidos — the reading is unfortunately uncertain — died. A public mourning followed, which lasted six days, and Cambyses accompanied the corpse to the tomb. Cyrus now claimed to be the legitimate suc- cessor of the ancient Babylonian kings and the avenger of Bel-Merodach, who was wrathful at the impiety of Nabonidos in removing the images of the local gods from

their ancestral shrines to his capital Babylon. Nabonidos, in fact, had excited a strong feeling against himself by

attempting to centralize the religion of Babylonia in the temple of Merodacli at Babylon, and while he had thus alienated the local priesthoods the military party despised him on account of his antiquarian tastes. He seems to have left the defence of his kingdom to others, occupying himself with the more congenial work of excavating the foundation records of the temples and determining the dates of their builders. The invasion of Babylonia by Cyrus was doubtless facilitated by the existence of a disaffected party in the state, as well as by the presence of foreign exiles like the Jews, who had been planted in the midst of the country. One of the first acts of Cyrus Restora- accordingly was to allow these exiles to return tioaot to their own homes, carrying with them the Jewish images of their gods and their sacred vessels. The permission to do so was embodied in a pro- clamation, in which the conqueror endeavoured to justify his claim to the Babylonian throne. The feeling was still strong that none had a right to rule over Western Asia until he had been consecrated to the of&ce by Bel and his priests ; and from henceforth, accordingly, Cyrus assumed the imperial title of “king of Babylon.” A year before his death, in 529 b.c, he associated his son Cambyses in the government, making him king of Babylon, while he reserved for himself the fuller title of ” king of the (other) provinces” of the empire. It was only when Darius Hystaspis, the representative of the Aryan race and the Zoroastrian religion, had re-conquered the empire of Cyrus, that the old tradition was broken and the claim of Babylon to confer legitimacy on the rulers of Western Asia ceased to be acknowledged. Darius, in fact, entered Babylon as a conqueror ; after the murder of the Magian it had recovered its independence under Nidinta-Bel, who took the name of Nebuchadrezzar III., and reigned from October 521 b.c. to August 520 B.C., when the Persians took it by storm. A few years later, probably 514 b.c, Babylon again revolted under the Armenian Arakha ; on this occasion, after its capture by the Persians, the walls were partly destroyed. £-Sagila, the great temple of Bel, however, still continued

to be kept in repair, and to be a centre of Babylonian patriotism, until at last the founda- tion of Seleucia diverted the population to the new capital of Babylonia, and the ruins of the old city became a quarry for the builders of the new seat of government.^

1 The following is a list of the dynasties and kings of Babylonia and Assyria so far as they are known at present : —

The Babylonian Dynasties from oir. 2700 b.c.:-

Second Dynasty of Ur : — Ur-Gur, cir. 2700 b.c. Dungi I. (suzerain of Gudea of

Lagas). Kirgal-daramas, 50 years. A-dara-kalama, 28 years. Akurduana, 26 years. Melamma-kurk«rra, 8 years. Ea-ga[mil], 20 years.

Third Dynasty of Ur :— Dungi II., more than 51 years. Bur-Sin II. ,more than 12 years. Gimil-Sin, more than 9 years. Ing-Sin. Mrst Dynasty of Babylon.

2460 B.C. Sumu-abi, 14 years. Sumu-la-ilu, 36 years. Zabium, 14 years. Abil-Sin, 18 years. Sin-muballidh, 20 years. Khammurabi, 43 years. Samsu-iluna, 38 years. Abesiikh, 25 years. Ammi-ditana, 25 years. Ammi-zadoq, 21 years. Samsu-ditana, 31 years.

Dynasty of Sisku(^?)for36Syears. 2174 B.C. Anman, 60 years. Ki-Nigas, 56 years. Damki-ilisu, 26 years. Iskipal, 15 years. Sussi, 24 years. Gul-ki[sar], 55 years.

Kassite Dynasty of 36 kings for 576 years 9 months.

1806 B.C.

Gandis, 16 years. Agum-sipak, 22 years. Bitilyasi I., 22 years. Ussi (?), 9 years. Adu-metas. Tazzi-gurumas. Agum-kakrime.

Kara^indas.

Kadasman – Bel (corresponded

with Anion-hotep III. of

Egypt, 1430 B.C.). Kuri-galzu I. Burna-buryas, his son. Kuri-galzu II., his son (?).

Babylonian religion and culture emanated from two centres — Nippur, with its temple of El-lil or Bel, in the north ; and Eridu, with its cult of Ea, the god sources ot of the water, on the shore of the Persian Gulf. Babyioaian Butthe nature of thereligious influence exercised ““g’o”- by the two cities differed greatly. From Nippur came a belief in the powers of night and darkness, exorcisms

Kara-khardas. b.c.

Kadasman-kharbe, his son. Samas-mudammiq . cir. 920

Nazi-bugas, a usurper. Nebo-sum-iskun . cir. 900

Kuri-galzu III., son of Kadas- Nebo-baladan . . cir. 880

man-kharbe, 35 (?) years. Merodach-nadin-sumi cir. 860

Nazi-Maruttas, his son, 26 Merodach-baladhsu-iqbi cir. 830

years. Bau-akhi-iddin . cir. 810

Kadasman-Turgu, his son, 17 Probably two names missing,

years. Nebo-sum-iskun, son of

Kadasman-buryas, 14 years. Dakuri . . cir. 760

Kudur-Bel, 6 years. Nabonassar, 14 years . 747

Sagarakti-buryas, his son, 13 Nebo-nadin-suma,hisson,

years. 2 years . . . 733

Bitilyasu II., 8 years. Nebo-sum-yukin, his son,

Bel-sum-iddin, IJ years. 1 month 12 days . . 731

Hadad-sum-iddin, 6 years. End of ” the 22nd dynasty.’,’

Hadad-sum-uzur, 30 years (in- ’’ „ .

eluding the 7 years during Dynasty of Sape. ^^

which the Assyrian king Tig- Yukin-zera or Chinziros, 3

lath-Ninip occupied Baby- years 730

Ion). pulu (Pul or Poros), called

Meli-sipak, 15 years. Tiglath-pileser III. in

Merodach-baladan I., his son, Assyria, 2 years . . 727

13 years. Ulula, called Shalmaneser

^amama-sum-iddin, 1 year. ly. in Assyria . 725

Bel-sum-iddin, 3 years. Merodach-baladan II. the

Dynasty of Isin of 11 kings for „ Chaldsean . . . 721

132i years. Sargon of Assyria . . 709

^ Sennacherib, his son . . 705

1229 B.C. Merodaoh – zakir – sumi, 1

Merodach- .... 18 years. month 702

Merodach-baladan III., 6

Nebuchadrezzar I. months 702

Bel-nadin-pal. Bel-ebus of Babylon . . 702

Merodach-nadin-akhi,22years. Assur-nadin-sumi, son of

Merodaoh- . . . IJ years. Sennacherib . . . 700

Hadad-baladan, an usurper. Nergal-yusezib . . . 694

Merodach-sapik-zer-mati, 12 Musezib-Merodach . . 693

years. Sennacherib destroys

Nabu-nadin, 8 years. Babylon 689

7-1 * ^ jt cY /-< »* Esar-haddon, his son . . 681

Dynasty of the Sea-Coast. gamas -sum-yukin, his son 668

109b B.C. Kandalanu (Kineladanos) . 648

Simbar-sipak, 18 years. Nabopolassar . . . 626

Ea-mukin-zeri, 5 months. Nabu – kudur – uzur (Nebu-

Kassu-nadin-akhi, 3 years. chadrezzar II.) . . 605

Dynasty of Bit-Bazi. Amil-Marduk (Evil-Mero-

” *^ dach), his son . . 562

1075 B.C. Nergal-sarra-uzur (Nergal-

B-Ulmas-sakin-sumi, 17 years. sharezer) . . . 560

Ninip-kudur-uzur I., 3 years. Labasi-Marduk, bis son, 3

Silanim-Suqarouna, 3 months. months 556

Dynasty of Elam. Nabu-nahid (Nabonidos) . 556

” ” •’ Cyrus conquers Babylon . 538

1055 B.C. • Cambyses, his son . . 529

An Elamite, 6 years. Gomates, the Magian, 7

Secoi^ Dynasty of Babylon. jfeZchadrezzar' III.', na-

1049 B.C. tiveking . . .521

Nebo-kin-abli, 36 years. Darius, son of Hystaspes . 520

Ninip-kudur-uzur II. (?) 8 Nebuchadrezzar IV., rebel

months 12 days. king 514

Probably four names missing. Darius restored . . . 513

Kings of Assyria.

Bel-kap-kapu, "founder of the b.c

monarchy." Assur-bil-nisi-su . cir. 1450

Buzur-Assur . . . 1440

Assur-sum-esir. Assur-nadin-akhe II. . 1420

Ninip-tuklat-Assur, his son (con- Assur-yuballidh, his son . 1400

temporary with Kharbe-sipak Bel-nirari, his son . . 1380

of Babylonia). Pudilu (Pedael), his son . 1360

Hadad-nirari I., his son . 1340

Erba-Hadad. Shalmaneser I. , his son . Assur-nadin-akhe I., his son. (built Calah) . 1320 Tiglath-Ninip I., his son . 1300

and spells, and a sorcerer-priesthood. From Eridu came, on the contrary, the elements of art and science, and a belief in divine beings who worked for the good of man. Ea was the culture-god of Babylonia, who communicated to his son ” Asari, the benefactor of mankind,” the various charms whereby diseases could be cured and the dead raised again to life. Asari, whose resemblance to the Egyptian Osiris is striking, was identified with the Semitic Mero- dach, the patron-god of Babylon, while El-lil of Nippur became ” the older Bel ” of Semitic faith. In the primitive Sumerian age of Babylonia, however, neither El-lil norEa was as yet a god in the Semitic sense of the term. Accord- ing to Sumerian ideas every object and force in nature had its zi, or ” spirit,” which manifested itself in life and motion. The zi was sometimes beneficent, sometimes malignant, but it could be controlled by the incantations and spells which were known to the sorcerer-priests. Gradually real gods emerged from among the rc^ultitude of zis with which the universe was filled, perhaps as a result of contact with Semitic tribes. Among these gods Ea, the spirit of the water, El-lil, the spirit of the earth and air, and Ana of Erech, the spirit of heaven, occupied a foremost place. Under Semitic influence they finally became a trinity, while other spirits which had also become gods were ranged below them. A state religion grew up in which the Sumerian elements were modified and transformed in accordance with Semitic conceptions, the sorcerer passed into the priest, and an elaborate ritual was compiled. The female divinities fell into the background, with the ex- ception of Istar, originally the evening-star, who managed to preserve her independence ; but the other goddesses became merely the pale reflexions of the god, in many cases owing their existence to the exigencies of Semitic grammar, which attached a feminine form to a masculine noun. Thus Anu, the Semitic equivalent of Ana, was provided with his feminine counterpart, Anatu. The systematizing of the state theology occupied many centu- ries, and included the formation of an astro-theology in which the planets and principal stars were identified with certain deities in the official pantheon. Between this state religion and the religion of the people there was a wide gulf, though a considerable part of the popular superstitions was incorporated by the priests into their tlieology, and there modified or explained away. Up to the last, however, a sort of organized popular faith, or ” black magic,” existed by the side of the official theology, tolerated, though hardly recognized, by it. In this the

witch and wizard took the place of the priesthood, malevolent demons were adored

B.C.

Conquers Babylon . . 1290 Assur-nazir-pal I. , his son,

6 years . . . 1280

Tiglath-Assur-Bel . . 1276

Assur-narara . . . 1260

Nebo-dan, his son . . 1260

Bel-kudur-uzur . . 1230

Ninip-pileser . . . 1215

Assur-dan I., his son . 1185

Mutaggil-Nebo, his son, . 1160

Assur-ris-isi, his son . 1140

Tiglath-pileserl., hisson . 1120

Assur-bil-kala, his son . 1090 Samsi-Hadad I., his

brother . . cir. 1070 Assur-nazir-pal 11., his

son . . . cir. 1060

Assur-irbi ... —

Tiglath-pileser II. . cir. 950

Assur-dan II., hisson ct>. 9-30

Hadad-nirari II., his son 911

Tiglath-Ninip II. , his son 889

Assur-nazir-pal III., his son ....

Shalmaneser II., his son . Assur-danin-pal (Sardana-

pallos) , rebel king . Samsi – Hadad II. , his

brother .... Hadad-nirari III. , his son . Shalmaneser III. Assur-dan III. . Assur-nirari Pulu, usurper, takes the

name of Tiglath-pileser

III

Uluia, usurper, takes the

name of Shalmaneser IV”. Sargou, usurper Sennacherib, his son . Esar-haddon, hisson . Assur-bani-pal, his son Assur-etil-ilani-yukin, his

son Assur-sum-lisir . Sin-sarra-uzur (Sarakos) Destruction of Nineveh

88.3 858

825

823 810 781 771 753

745

727 722 705 681 668

?

?

?

606

instead of the gods of light, and the ritual consisted of spells and incantations addressed to them under the cover of night. The central object of worship was -an Istar who differed essentially from the Istar of the official cult, and was little more than a mistress of witchcraft and evil.

Closely connected with the religious cult were the poems and epics in which the ancient myths and stories of the gods were embodied, or attempts were made to explain the origin of the universe. The most /f" famous of these was the Epic of Gilgames, in twelve books, composed by a certain Sin-liqi-unninni, ajjd arranged upon an astronomical principle. The eleventh book, corresponding to the zodiacal sign Aquarius, con- tains the episode of the Deluge. Gilgames is described as the friend and ally of the satyr Earbani, who had originally been created to destroy him. Together they overthrow the tyrant Khumbaba, who dwelt within the enchanted cedar forest of Elam, as well as the " divine " bull which Anu had made to avenge the slight put by Gilgames on the goddess Istar. But the destruction of the bull led to the death of Ea-bani and the infliction of a mortal sickness on Gilgames himself. To find a means of cure he determined to make his way to Xisu- thros, the hero of the Deluge, who had been translated beyond the river of death. So he travelled through the desert of Mas, or Northern Arabia, to the Twin Moun- tains behind which the sun sets, and which are guarded by " scorpion-men." Then he plunged into the darkness beyond, and finally emerged on the shore of the ocean which encircles the earth, where a tree grew whose fruit was precious stones. With the help of the boatman, Nis-Ea, Gilgames built a boat, and voyaged for forty-five days until at last the waters of death were reached. There on the islands of the blest he beheld Xisuthros "afar off," and heard from him the story 'of the Deluge. His disease, moreover, was cured, and a twig of the tree of life was allowed him to carry back to Babylonia. On the way, however, while he stopped to drink of a spring, a serpent came out of the water and stole the precious plant. Gilgames wept in vain. He had to return to his city of Erech without the divine herb and there make lamentation over the dead Ea^-bani, whose spirit rose from the earth, like that of Samuel, to tell the hero of the fate that awaited him in the world beyond the grave.

Another epic was that of the Creation, the object of which was to glorify Bel-Merodach by describing his contest with Tiamat, the dragon of chaos.

In the first book an account is given of the creation of the world out of the primeval deep and the birth of the gods of light. Then comes the story of the struggle between the gods of light and the powers of darkness, and the final victory of Merodach, who clove Tiamat asunder, forming the heaven ‘out of one half of her body and the earth out of the other. Merodach next arranged the stars in order, along with the sun and moon, and gave them laws which they were never to transgress. After this the plants and animals were created, and finally man. Merodach here takes the place of Ea, who appears as the creator in the older legends, and is said to have fashioned man out of the clay.

The legend of Adapa, the first man, a portion of which was found in the record-office of the Egyptian king, Khu- n-Aten at Tel el-Amarna, explains the origin of death. Adapa while fishing had broken the wings of the south wind, and was accordingly summoned before the tribunal of Anu in heaven. Ea counselled him not to eat or drink there. He followed the advice, and thus refused the food which would have made him and his descendants immortal.

Among the other legends of Babylonia may be mentioned those of Namtar, the plague-demon, of Urra, the pestilence,

of Etanna, and of Zu. Hades, the abode of Nin-erisgal, or Allat, had been entered by Nergal, who, angered by a message sent to her by the gods of the upper world, ordered Namtar to strike off her head. She, however, declared that she would submit to any conditions imposed on her and would give Nergal the sovereignty of the earth. Nergal accordingly relented, and Allat became the queen of the infernal world. Etanna conspired with the eagle to fly to the highest heaven. The first gate, that of Ann, was successfully reached ; but in ascending still farther to the gate of Istar the strength of the eagle gave way, and Etanna was dashed to the ground. As for the storm-god Zu, we are told that he stole the tablets of destiny, and therewith the prerogatives of Bel. God after god was ordered to pursue him and recover

them, but it would seem that it was only by a stratagem that they were finally regained.

The contract-tablet's have thrown a flood of light on the social life and customs of Babylonia, and have shown that Social life. *^® "w^oman was on a footing of equality with ■ the man. She could carry on business on her own account, could inherit and bequeath property, could hold civil ofiELces, and plead in a court of justice. Polygamy seems to have been rare ; and we even hear of a case in which it is stipulated that if the husband marries a second wife the dowry of the first wife shall be returned to her, and she shall be free to go where she chooses. Slaves were protected by law, and they too could acquire property of their own under certain conditions, and appear as witnesses in court. The use of torture for extorting confessions was unknown. The judges, who were appointed by the crown, decided according to the evidence brought before them. There were pleadings and counter-pleadings, and we hear of punishment for perjury. Babylonia was pre-eminently an industrial and commercial state, carrying on commerce with all parts of the known world, and there was therefore a highly elaborate commercial code of law. The decisions of the judges were largely ruled by precedents, which necessitated a careful registration of former verdicts, as well as an accurate system of dating. Education was widespread, and involved a study of the extinct language of Sumer. Women, as well as men, could read and write, and letters passed to and fro between all classes of the community. Mathematics were fairly advanced ; eclipses of the sun and moon could be foretold, and the zodiac was a Babylonian invention. There were various holidays, that of the New Year {Zagmuku, of Akltu) being the most sacred. It was then that Bel entered the Holy of Holies, and seating himself above the mercy-seat {paraJchu) de- termined the destinies of mankind. There were no castes. Each man was free to follow what profession he chose. The priesthood, however, was divided into many different classes. Among these we may name the barhu, asipd, emdzammarH, or " seers," "prophets," and " singers." The ordinary priests were termed kaM (galU) and sanyCitu, the high-priest being sanga-makhkhu. Other classes of priests attended to the sattukku, or daily sacrifice, and received the nindabu or freewill offering from the worshipper. The sacrifices were bloody (2:16^) and unbloody, among the latter being the niqu, or libation, the qutrinnu, or incense- offering, and the sirqu, or

drink-offering. ISTor must we forget the qurbannu, the korban of the Jewish ritual. The temples were supported by the esrd or tithe. By the side of the priests there does not appear to have been any privileged class of nobility. As might have been expected in a commercial community, no stigma attached to trade. All members of the state took part in it, and we find even the crown-prince, Belshazzar, acting through his agent as a wool-merchant. Money-lending, however, appears to have been one of the most profitable professions. The ordinary rate of interest was 20 per cent., paid in mpnthly

instalments ; but at Babylon in thetime of Nebuchadrezzar it tended to be lower, and there are instances of loans in which it is put at 13^ per cent. Payment was either in kind, or, more usually, in specie, the money consisting of stamped rings or bars of gold, silver, and copper. The standard was the maneh, divided into 60 shekels, the standard maneh which was still in use up to the age of Nabonidos being that which had been originally fixed by Dungi, king of Ur. One of these standard-weights, made of stone and from the mint of Nebuchadrezzar, is now in the British Museum.

The Babylonian cemetery adjoined the city of the living, and was built on the same plan as the lettter. It was laid out in streets through which trickled rivulets of ” pure ” water. Many of the tombs, which were made of crude bricks, were provided with gardens, and there were shelves or altars on which were placed the offerings to the dead. After a burial brushwood was usually heaped round the wall of the tomb, and set on fire, so that the corpse within was partially cremated along with the objects that had been buried with it. As the older tombs decayed a new city of tombs arose above them, the city of the dead thus ,growing in height in the course of centuries, like the cities of the living. The city and the cemetery of ancient Babylonia are alike marked by a ” tel.”

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Bacau, a town in Rumania, capital of the dis- trict of the same name, situated near the river Bistritza. The town, which is of modern growth, owes its commercial importance to the fact of its being the point of con- vergence of the two great highways, one from Bacau to Gyergyo-Szent-Miklds in Transylvania, vid Piatra and the pass of Tolgyes, the other from Bacau to Kezdi-ViCsarhely in Transylvania, viA Onesci, Soosmezo and the pass of Ojtoz. The population in 1895 numbered 16,000; in 1900, 16,187, of whom 7850 were Jews.

Baccarat, a towTi of France, in the department of Meurthe-et-Moselle, arrondissementof Luneville, 30 miles S.E. of Nancy ; connected with Paris by rail. Its glass- works continue to grow in importance, and now give employment to about 2300 persons. The products include ornamental articles of great variety and beauty. Popular tion (1881), 4902 ; (1896), 5425 ; (1901), 7014.

Bacchylides, the only lyric poet of G-reece, except Pindar, of whose work we possess large remains, was born at lulls, in the Island of Ceos. His father’s name was probably Meidon ; his mother was a sister of Simonides, himself a native of lulls. Eusebius says that Bacchylides “flourished” (rJKfi.oia’) in 01. 78. 2 (467 b.c). As the term ■^/c/nafev refers to the physical prime, and was commonly placed at about the fortieth year, we may suppose that Bacchylides was born circa 507 B.C., a date

which agrees sufficiently well with the few facts which can be gleaned concerning his life. Among his odes found in 1896 the earliest that, can be approximately dated is xiii. (ed. Kenyon), which may belong to 479 or 477 b.c. ; the latest is vi., of which the date is fixed by the recently- found fragment of the Olympic register to 01. 82. 1 (452 B.C.). He would thus have been some thirty-nine years younger than his uncle Simonides, and some fifteen years younger than Pindar.

Elsewhere Eusebius states that Bacchylides ” was of repute ” (iyvu)pi^€To) in 01. 87. 2 (431 e.g.) ; and Georgius Syncellus, using the same word, gives 01. 88 (428-25 e.g.). The phrase would mean that he was then in the fulness of years and of fame. We have no other evidence ; but there is nothing improbable in the supposition that he survived the beginning of the Peloponnesian war.

Bacchylides, like Simonides and Pindar, visited the court of Hieron, who ruled Syracuse from 478 to his death in 467. In his fifth ode (476 b.c), the word ^ei/os (v. 11) has been taken to mean that he had already been the guest of the prince ; and, as Simonides went to Sicily in or about 477 e.g., that is not unlikely. Ode iii. (468 B.C.) was possibly written at Syracuse, as verses 15 and 16 suggest. He there pays a high compliment to Hieron’s taste in poetry (ver. 3 ff.). A scholium on Pyth. i. 166 avers that Hieron preferred the odes of Bacchylides to those of Pindar. The Alexandrian scholars interpreted a number of passages in Pindar as hostile allusions to Bacchylides or Simonides. If the scholiasts are right, it would appear that Pindar regarded the younger of the two Cean poets as a jealous rival, who disparaged him to their common patron (schol. Pyth. ii. 52 f.), and as one whose poetical skill was due to study rather than to genius {01. 2. 91-110). In Olymp. ii. 96 the dual yapuerov, if it does not refer to the uncle and nephew, remains mysterious ; nor does it admit of probable emendation. One would gladly reject this tradition, to which the scholia so frequently refer ; yet it would be rash to assume that it rested merely on surmise. The Alex- andrians may have possessed evidence on the subject which is now lost. It is tolerably certain that the three poets were visitors at Hieron’s court at about the same time : Pindar and Bacchylides wrote odes of the same

kind in his honour ; and there was a tradition that he preferred the younger poet. There is thus no intrinsic improbability in the hypothesis that Pindar's haughty spirit had suffered, or imagined, some mortification. It is noteworthy that, whereas in 476 and 470 both he and Bacchylides celebrated Hieron's victories, in 468 (the most important occasion of all) Bacchylides alone was commissioned to do so ; although in that year Pindar composed an ode {Olymp. vi.) for another Syracusan victor at the same festival. Nor is it difficult to conceive that a despot such as Hieron, whose constitutional posi- tion was ill-defined, and who was perhaps all the more exigent of deference on that account, may have found the genial Ionian a more agreeable courtier than Pindar, an aristocrat of the Boeoto-Aeolic type, not unmindful of " his fathers the Aegeidae," and rather prone to link the praises of his patron with a lofty intimation of his own claims (see, e.g., Olymp. i. ad fin.). But, whatever may have been the true bearing of Pindar's occasional innuen- does, it is at any rate pleasant to find that in the extant work of Bacchylides there is not the faintest semblance of hostile allusion to any rival. Nay, one might almost imagine a compliment to Pindar, when, in mentioning Hesiod, he calls him BotwTos dv^p.

Plutarch (de Exilio, p. 605 c) names our poet in a list of writers who, after they had been banished from their native cities, were active and successful in literature. It was Peloponnesus that afforded a new home to the exiled

Bacchylides. The passage gives no clue to date or cir- cumstance; but it implies that Peloponnesus was the region where the poet's genius ripened, and where he did the work which established his fame. This points to a residence of considerable length ; and it may be noted that some of the poems illustrate their author's intimate knowledge of Peloponnesus. Thus in Ode ix., for Auto- medes of Phlius, he draws on the legends connected with the Phliasian river Asopus. In Ode x., starting from the Argive legend of Proetus and Aerisius, he tells how the Arcadian cult of Artemis 'Hyuepa was founded. In one of his dithyrambs (xx.) he treated the legend of Idas (a Messenian hero) and Marpessa in the form of a hymenaeus sung by maidens of Sparta.

The Alexandrian scholars, who drew up select lists of the best writers in each kind, included Bacchylides in their " canon " of the nine lyric poets,

along with Alcman, Sappho, Alcaeus, Stesichorus, ^bycus, Anacreon, Simon- ides, and Pindar. The Alexandrian grammarian Didymus (circ. 30 B.C.) wrote a commentary (iwoiivrjim) on the epinikian odes of Bacchylides. Horace, a poet in some respects of kindred genius, was a student of his works, and imitated him (according to Porphyrion) in Ode i. 15, where Proteus predicts the destruction of Troy. Quota- tions from Bacchylides, or references to him, occur in Dionysius of Halicarnassus, Strabo, Plutarch, Stobaeus, Athenaeus, Aulus Gellius, Zenobius, Hephaestion, Clem- ent of Alexandria, and various grammarians or scholiasts. Ammianus Marcellinus (xxv. 4) says that the Emperor Julian enjoyed reading Bacchylides. It is clear, then, that this poet continued to be popular during at leasi the first four centuries of our era. No inference ad- verse to his repute can fairly be drawn from the fact that no mention of him occurs in the extant work of any Attic writer. The only definite estimate of him by an ancient critic occurs in the treatise Ilepi vi/‘ovs, commonly translated “On the Sublim,e,” but meaning rather, ” On the sources of elevation in style ” ; a work ambiguously ascribed to Cassius Longinus {circ. a.d. 260), but more probably due to some writer of the first century. In chapter xxxiii. of that treatise, the author asks whether we ought to prefer “greatness” in liter- ature, with some attendant faults, to flawless merit on a lower level, and of course replies in the affirmative. In tragedy, he asks, who would be Ion of Chios rather than Sophocles ; or in lyric poetry, Bacchylides rather than Pindar ? Yet Bacchylides and Ion are ” faultless, with a style of perfect elegance and finish.” In short, the essay- ist regards Bacchylides as a thoroughly finished poet of the second class, who never commits glaring faults, but never reaches the loftier heights.

The first and most general quality of style in Bacchy- lides is his perfect simplicity and clearness. Where the text is not corrupt, there are few sentences which are not lucid in meaning and simple in structure. This lucidity is partly due, no doubt, to the fact that he seldom attempts imagery of the bolder kind, and never has thoughts of a subtle or complex order. Yet it would be very unjust to regard such clearness as merely a compensatory merit of lyric mediocrity, or to ignore its intimate connexion with the man’s native grace of mind, with the artist’s feel- ing for expression, with the poet’s delicate skill. How many readers, who could enjoy and appreciate Pindar if he were less difficult, are stopped on the threshold by the aspect of

his style, and are fain to save their self-esteem by concluding that he is at once turgid and shallow ! A pellucid style must always have been a source of wide, though modest, popularity for Bacchylides. If it be true that Hieron preferred him to Pindar, and that he was a favourite with Julian, those instances suggest the charm which he must always have had for cultivated readers to

whom affairs did not leave much leisure for study, and who rejoiced in a poet with whom they could live on such easy terms.

Another prominent trait in the style of Bacchylides is his love of picturesque detail. This characteristic marks the fragment by which, before the discovery of the new MS., he was best known, — a passage, from one of his paeans, on the blessings of peace (fr. 13, Bergk) ; and it frequently appears in the odes, especially in the mythical narratives. Greater poets can make an image flash upon the mind, as Pindar sometimes does, by a magic phrase, or by throwing one or two salient points into strong relief. The method of Bacchylides is usually quieter ; he paints cabinet pictures. Observation and elegance do more for him than grasp or piercing insight ; but his work is often of very high excellence in its own kind. His treatment of simile is only a special phase of this general tendency. It is exemplified by the touches with which he elaborates the simile of the eagle in ode v., and that of the storm-tossed mariners in ode xii. This full develop- ment of simile is Homeric in manner, but not Homeric in motive : Homer’s aim is vividness ; Bacchylides is rather intent on the decorative value of the details themselves. There are occasional flashes of brilliancy in his imagery, when it is lit up by his keen sense of beauty or splendour in external nature. A radiance, ” as of fire,” streams from the forms of the Nereids (xvi. 103 ff.). An athlete shines out among his fellows like ” the bright moon of the mid-month night” among the stars (viii. 27 ff.). The sudden gleam of hope which comes to the Trojans by the with- drawal of Achilles is like a ray of sunshine “from beneath the edge of a storm-cloud” (xii. 105 ff.). The shades of the departed, as seen by Heracles on the banks of the Cocytus, are compared to the countless leaver fluttering in the wind on ” the gleaming

headlands of Ida” (vv. 65 ff.), — an image not unworthy of Dante or of MUton.

Among the minor features of this poet’s style the most remarkable is his use of epithets. A god or goddess nearly always receives some ornamental epithet ; some- times, indeed, two, or even three (e.g., Ka\vKO(rTi

The poems contained in the new MS. are of two classes: I. Odes of Victory; II. Dithyrambs. The Ode of Victory, Ittivlklov (jxeXo’s) or lirlvt.Ko

~~first Olympian, alike celebrate the victory of the horse Pherenicus; but, while Pindar’s reference to the race itself is slight and general (vv. 20-22), Bacchylides describes the running of the winner much more vividly and fully (vv. 37-49).~~

~~The MS. contains fourteen epinikia, or thirteen if Blass be right in supposing that odes vi. and vii., as numbered by Kenyon in the editio princeps, are parts of a single ode (for Lachon of Ceos). Four (or on the view just stated, three) of the odes relate to the Olympian festival ; two to the Pythian ; three to the Isthmian ; three to the Nemeau ; and one to a Thessalian festival called the UerpaTa. This comes last. The order in which the MS. arranges the other epinikia seems to be casual ; at least it does not follow (1) the alphabetical sequence of the victors’ names, or of the names of their cities ; nor (2) chronological sequence ; nor (3) classiiioa- tion by contests ; nor (4) classification by festivals — except that the four great festivals precede the Petraea. The first ode, celebrating a victory of the Cean Argeios at the Isthmus, may possibly have been placed there for a biographical reason, viz. , because the poet treated in it the early legends of his native island.~~

~~A mythical narrative,‘connecte^ in some way with the victor or his city, usually occupies the central part of a Pindaric ode. It serves to lift the poem into an ideal region, and to invest it with more than a local or tem- porary significance. The method of Bacchylides in this department of the epinikion is best illustrated by the myth of Croesus in ode iii., that of Heracles and Meleager in ode v., and that of the Proetides in ode x. Pindar’s habit is to select certain moments or scenes of a. legend, which he depicts with great force and vividness. Bacchylides, on the other hand, has a gentle flow of~~

simple epic narrative ; he relies on the interest of the story as a. whole, rather than on his power of presenting situations. Another element, always present in the longer odes of victory, is that which may be called the " gnomic." Here,, again, there is a contrast between the two poets. Pindar packs his yvUfixu, his maxims or moral sentiments, into, terse and sometimes obscure epigrams ; he utters them in a didactic tone, as of one who can speak with the com- manding voice of Delphic wisdom. The moralizing of Bacchylides is rather an utterance of quiet medita- tion, sometimes recalling the strain of Ionian gnomic elegy.

The epinikia of Bacchylides are followed in the MS. by six compositions which the Alexandrians classed under the general name of hi6vpa.ix.poi, and which we, too, must be content to describe collectively as Dithyrambs. Th& derivation of Si-6vpafjiPos is uncertain: 8i may be the root seen in Stos (cp. StiroXia) and Ovpa/j-^oi another form of ^pia^a/Sos, a word by which Cratinus (c. 448 b.c.) denotes some kind of hymn to the wine-god. The " dithyramb," first mentioned by Archilochus (c. 670 e.g.), received a finished and choral form from Arion of Lesbos (c. 600 B.C.). His dithyrambs, produced at Corinth, be- longed to the cult of Dionysus, and the members of his chorus (rpayiKoi x°P°^) personated satyrs. Originally concerned with the birth of the god, the dithyramb came to deal with all his fortunes : then its scope became still larger ; it might celebrate, not Dionysus alone, but any god or hero. This last development had taken place before the close of the 6th century b.c. Simonides wrote a dithyramb on Memnon and Tithonus ; Pindar, on Orion and on Heracles. Hence the Alexandrian scholars used Mvpaix^oi in a wide sense, as denoting simply a lyric poem occupied with a mythical narrative. Thus ode xvii. of Bacchylides (relating the voyage of Theseus to Crete), though it was clearly a Traidv for the Delian Apollo, was classed by the Alexandrians among his "dithyrambs" — as appears not only from its place in our MS., but also from the allusion of Servius (on Aen. vi. 21). The six dithy- rambs of Bacchylides are arranged in (approximately) alphabetical order: 'AvTTjvop^ai, "HpaxX^s, "RtOeoi ^ ©lytrcw,

BACH E — B ACKERGUNJE

®i;(T£us, ‘I(u, *l8as. The principal feature, best exemplified by the first and third, is necessarily epic narrative, — often adorned with touches of picturesque detail, and animated by short speeches in the epic manner.

Several other classes of composition are represented by those fragments of Bacchylides, preserved in ancient literature, vfhich vrere known before the discovery of the new MS. (1) ‘iifivoi. Among these we hear of the iirowe/iTTiKol, hymns of pious farewell, speed- ing some god on his way at the season when he passed from one haunt to another. (2) Troioi-e!, represented by the well-known frag- ment on the blessings of peace. (3) irpotrdSia, choral odes sung during processions to temples. (4) iropx^imTa, lively dance-songs for relig- ious festivals. (5) ipunKd, represented by five fragments of a class akin to arfXio, drinking-songs. Under this head come some lively and humorous verses on the power of wine, imitated by Horace (O. iii. 21. 13-20). It may be conjectured that the facile grace and bright fancy of Bacchylides were seen to especial advantage in light compositions of this kind. (6) The elegiacs of Bacchylides are represented by two iiriypd/jiiiaTa dvaSripjiTiKi, each of four lines, in the Palatine Anthology. The first {Anth. vi. 313) is an inscription for an offering commemorative of a victory gained by a chorus with a poem written by Bacchylides. The second {Anth. vi. 53) is an inscription for a shrine dedicated to Zephyrus. Its authenticity has been questioned, but not disproved.

The papyrus containing the odes of Bacchylides was found in Egypt by natives, and reached the British Museum in the autumn of 1893. It was then in about 200 pieces. By the skill and industry of Mr F. G. Kenyon, the editor of the editio princeps (1897), the MS. was reconstructed from these lacerated members. As now arranged, the MS. consists of three sections. (1) The first section contains 22 columns of writing. It breaks off after the 8 opening verses of ode xii. (2) The second section contains columns 23-29. Of these, column 23 is represented only by the last letters of two words. This section comprises what remains of odes xiii. and xiv. It breaks off before the end of xiv. , which is the last of the epinikia. (3) The third section comprises columns 30-39. It begins with the mutilated opening verses of ode xv. (‘ Avrrimpldai, the first of the dithyrambs), and breaks off after

~~verse 11 of the last dithyramb, “I3m. The number of lines in a column varies from 32 to 33, the usual number being 35, or (though less often) 34.~~

~~It is impossible to say how much has been lost between the end ■of column 29 and the beginning of column 30. Probably, however, ode xiv., if not the last, was nearly the last, of the epinikia. It concerns a festival of a merely local character, the Thessalian nerpata., and was therefore placed after the thirteen other epinikia, which are connected with the four great festivals. The same lacuna leaves it doubtful whether any collective title was prefised to the SMpaii^oL. After the last column (39) of the MS., a good ■deal has probably been lost. Bacchylides seems to have written at least three other poems of this class (on Kassandra, Laocoon, and Philoctetes) ; and these would have come, in alphabetical order, .after the last of the extant six (Idas).~~

~~The writing of the MS. is a fine uncial. It presents some traits •of a distinctly Ptolemaic type, though it lacks some features found in the earlier Ptolemaic MSS. (these of the 3rd or 2nd century e.g.). Among the characteristic forms of letters is the l”, with a shallow curve on the top of the upright ; a form found in MSS. ascribed to the 1st century b.c. , and different from the more fully formed upsilon of the Roman period. , Another very significant letter is the S, written as ZZ, a form which begins to go out after circ. 50 B.C., giving place to one in which the middle stroke is connected with the other two. From these and other indications it is probable that the MS. is not later than the middle of the first century b.c.~~

~~The scribe, though he sometimes corrected his own mistakes, was, on the whole, careless of the sense, as of the metre ; he seems to have been a mechanical copyist, excellent in penmanship, but intent only on the letters. The MS. has received corrections or smiU supplements from at least two different persons. One of them (Kenyon’s A^) was contemporary, or nearly so, with the scribe. The other (A’) was considerably later ; he wrote a Roman cursive which might belong to the end of the first century a.d., or to the early part of the second. The correctors seem to be generally trustworthy ; though, like the scribe, they were inatten- tive to metre, passing over many metrical faults which could easily have been removed. They appear to have compared their MS. with another, or others ; but they sometimes made a~~

~~bad use of such aid, intruding a false reading where their text had the true one.~~

~~Breathings are generally added, especially rough breathings ; the form is usually square, but sometimes partially rounded. Accents are added, not to all words, but only, as a rule, to those which might cause doubt or difficulty to the reader. This was the Alexandrian practice, accents being regarded as aids to correct reading, and more liberally used when the dialect was not Attic.~~

~~In accordance with the older system, the accent is not written on the last syllable of a word ; when the accent falls there, a grave accent is written on the preceding syllable, or on two such syllables (e.Jf., pXiixpas, 7rd>'SA\T;s).~~

~~As Kenyon observes, no MS. of equal antiquity is so well supplied with accents. The MS. which comes nearest to it in this respect is the Alcman fragment in the Louvre, which is of similar or slightly higher age, belonging perhaps to the early part of the first century a.d. ; and in that MS. the comparatively frequent accents were doubtless designed to aid readers unfamiliar with Alcman's Laconian Doric. With regard to other grammatical or metrical signs (Tpoaqidlai) used in the Bacchylides MS., there is not much that calls for special remark. The punctuation, whether by the scribe or by correctors, is very sparse, and certainly cannot always be regarded as authoritative. The signs denoting the end of a strophe or antistrophe (paragraphus), of an epode (coronis), or of an ode (asterisk), are often omitted by the scribe, and, when employed, are sometimes placed incorrectly, or employed in an irregular manner.~~

~~Editions. — F. J. Kenyon. Ed. princeps, 1897. — F. Blass. Leipzig, Teubner. 1st ed. 1898 ; 2nd 1899. — H. Jurenka. Vienna, 1898. — N. Festa. Text, trans, and notes. Florence, 1898.~~

~~(e. C. j.)~~

~~Bache, Francis Edward (1833-1858), English musical composer, vi^as born in Birmingham, 14th Sep- tember 1833. The pupil of Alfred Mellon for violin, and Sterndale Bennett for composition, he afterwards went to~~

~~Leipzig in 1863 and studied with Hauptmann and Plaidy. Considering the early age at which he died, his compositions are fairly numerous, and the best, a trio for piano and strings, is still held in high esteem. Two operettas, a piano concerto, and a number of published pianoforte pieces and songs, do little more than show how great was his promise. He died at Birmingham of con- sumption on the 24th of August 1858. His younger brother, Walter (1842-1888), was born in Birmingham, 19th June 1842, and followed him to the Leipzig Conser- vatorium, where he became an excellent pianist. From 1862 to 1866 he studied with Liszt in Rome, and for many years devoted himself to the task of winning popularity for his master's works in England. At his annual concerts in London, nearly all Liszt's larger works were heard for the first time in England, and on the occasion of Liszt's last visit to England, in 1886, he was entertained by Bache at a memorable reception at the Grosvenor Gallery; Walter Bache was professor of the pianoforte at the Eoyal Academy of Music for some years before his death, and the foundation of the Liszt scholarship at that in- stitution was mainly due to his efforts. He died in Lon- don on the 26th of March 1888. An interesting memoir of the two brothers, by Miss Constance Bache, appeared in 1901 under the title Brother Musicians, (j. a. r. m.)~~

~~Bachian (Dutch, Batjan), an island (belonging to the residency of Teruate) in the Molucca Sea, in 0° 13'- 0° 66′ S. and 127° 22'128° E. It lies west of the south ern peninsula of the island of Halmahera (or Jilolo), and has an area of 2990 square miles. It is the most important island of a group formerly governed by a sultan, but since 1889 by a committee of chiefs Under the control of a Dutch controlenr. Since 1882 the Batjan company has attempted to exploit the island, but unsuc- cessfully, owing to a deficient knowledge of the soil and its capabilities and a lack of labourers.~~

~~Backergunje, or Bakarganj, a district of British India, in the Dacca division of Bengal, forming part of the joint delta of the Ganges and the Brahmaputra. The administrative headquarters are at Barisal, which is the only town in the district. Its area is 3649 square miles. In 1891 the population was 2,153,965, giving an average density of 690 persons per square mile. Classified ac- cording to religion, Hindus numbered 680,381 ; Mahom- raedans, 1,462,712; Buddhists and Jains, 6080; Chris- tians, 4669, including 60 Europeans; "others," 133.~~

~~B A C K N A N G — B ACTERIOLOGY~~

~~In 1901 the population was 2,291,812, showing an increase J J. ¼^LJ^V^''^ revenne and rates (1897-98) ««no t^'^^d^^ ^°y' ^* «''^°°1 (1896-97) numbered 76,602, being 46-2 per cent, of the male population of school-going age; the registered death-rate (1897) was 42-46 per 1000. The number of police was 648. Backer- gunje IS essentially a deltaic tract, traversed by numerous navigable water channels, which afford almost the only means of communication. By far the most important «rop is rice, which is largely exported. Jute, oilseeds, betel-nuts, and coco-nuts are also grown. The only manu- facture IS pottery. The islands on the sea front are exposed to devastation by cyclonic storm-waves On account of an epidemic of murders, disarmament has ■been enforced with good effect.~~

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~~Backnang, a town of Wllrtemberg, Germany, 19 miles by rail N.E. from Stuttgart, with an interesting church (12th century), and notable tanneries and leather factories, also woollen and cloth mills. Population (1885"). 6003; (1895), 7380. ^~~

~~Back's River (Thleweechodyeth, or Great Fish), a river in Mackenzie and Keewatin districts, Canada, rising in Sussex lake, a small body of water in 108° 20′ W, long, and 64° 25′ N. lat., and flowing north-eastward to the Arctic Ocean, passing through several large lake- expansions — Pelly, Garry, and M'Dougal — in its course. It was discovered and explored by Captain (afterwards Sir George) Back in 1834. Its total length is 560 miles.~~

~~BACTERIOLOGY.~~

~~I. General.~~

~~DUEING the last decade of the 19th century enormous strides were made in the study of the ubiquitous and minute organisms known as Schizomycetes (bacteria). schizo '^^^ conviction that Cohn was right in re- mycete's. garding them as plants has gained ground, and is now generally accepted, but evidence has also accumulated to show that the group is a hetero- geneous one, and that many forms usually included are not true~~

~~Schizomycetes at all. That most of the typical l)acteria have been derived from Cyanophyceee, such as Oscillaria, Nostoc, &c., while Micrococcus, Sarcina, &c.. have their prototypes in Chroococcacese, Palmellaceee, may be regarded as fairly well established, and forms like Beggiatoa and Spirochoeta have their Algal analogues in Oscillaria and Spirulina; but difficulties arise in several cases, especially since the flagella have become bettei; known. Thaxter's group of Myxobacteriacese, if these turn out to be autonomous, points to allianpes with the Myxomycetes, and the existence of ciliated Micrococci together with the formation of endospores — structures not known in the Cyanophyceae — reminds us of the flagellate Protozoa, e.g., Monas, ChromuUna. Resemblances also exist between the endospores and the spore4ormations in the Saccharomycetes, and if Bacillus inflatus, B. ventri- <:ulus, &c., really form more than one spore in the cell, these analogies are strengthened. Schizomycetes such as Clostridium, Plectridium, &c., where the sporiferous cells enlarge, bear out the same argument, and we must pot forget that there are extremely minute " yeasts," easily mistaken for Micrococci, and that yeasts occasionally form ■only one spore in the cell. Further, Schizo-sacciaromyces is a genus of " yeasts " which combines the peculiarities of the two groups. Nor must we overlook the possibility that the endospore-formation in non-motile bacteria more than merely resembles the development of azygospores in the conjugatse, and some Ulothricaceae, if reduced in size, would resemble them. Meyer regards them as chlamydo- spores, and Klebs as " carpospores " or possibly chlamydo- spores similar to the endospores of yeast. The former also looks on the ordinary disjointing bacterial cell as an oidium, and it must be admitted that since Brefeld's dis- covery of the frequency of minute oidia and chlamydo- spores among the fungi, the probability that some so-called bacteria — and this applies especially to the branching forms, accepted' by some bacteriologists — are merely reduced fungi is increased. Even the curious one-sided growth of certain species which form sheaths and stalks — e.g., Bacterium vermiforme, B. pediculatum — can be matched by Algae such as Oocardium, Hydrurus, and some Diatoms in this respect; and there are re-**

~~semblances in other directions between Phragmidothrix and Bangia.~~

That bacteria have existed from very early periods is clear from their presence in fossils ; and although we can- not accept all the conclusions drawn from the imperfect records of the rocks, and may dismiss oistribu- as absurd the statements ttiat geologically im- mured forms have been found still living, the researches of

Fig. 1.— Preparations showing the various kinds of cilia and their arrangement. A, Bucillue subtilu Cohn, and Spirillmn undula Ehrenb. ; B, Planoeoeeua citreus (Menge) Migula; C, Paeitdornonas pyocyaiiea (Gessard) Migula; D, P. maeroselmis Migula; E, P. ^ymo.yomeB (Ehrenb.) Migula; F, Bacillua typhi Gaffky ; G, B. 'vulgaris (Haiiser) Migula ; H, Microapira Comma (Koch) Schroeter ; J, K, Spirillum rubrvmi Esmarsch ; L, M, 8. undula (Mailer) Ehronb. {All after Migula.)

Renault and van Tieghem have shown pretty clearly that large numbers of bacteria existed in Carboniferous and Devonian times, and probably earlier. As regards their distribution in space, little is to be added. Several tropi- cal species, especially the pathogenic forms — e.g.. Vibrio cholerm, &c. — have been more thoroughly examined, but no geographical distribution of bacteria, in the sense usedwith

regard to higher plants, can be spoken of. The increas- ing importance to crowded communities of a knowledge of the bacteriology of sewage, of rivers, soil, dairy farms, &c., has stimulated investigation in several directions, and led to extensions and corrections of previous in- formation on these subjects. It has been found that of the numerous species found in rivers some are nitrifying or de-nitrifying harmless forms, and that pathogenic and other species are apt to degenerate quickly, and even die, a process closely connected with the bactericidal action of light referred to below. That typhoid and other bacilli can be transferred by water is well known, but in clear water even the resistant anthrax bacillus gradually

~~succumbs, and no information of value can be obtained from the mere counting of the colonies developed in cul- tures from any given water.~~

~~The principal recent advances in our knowledge of the morphology of bacteria concern the motile organs (cilia), the nature of the cell-contents, the cell-membranes, and the nucleus and spore-formation. The bacterial cell is always clothed by a definite cell-membrane, as Membrane ^*® shown by the plasmolysing experiments of Pischer and other observers ; but whether this is the same structure as the cell-wall of ordinary plants, or more of the nature of an outer pellicle of the protoplasm, is much disputed. On the one hand it rarely gives clear reactions of cellulose or chitine, but appears to contain nitrogen and has been regarded as proteid in character, while the cilia are traced into it ; on the other, it is capable of swelling to relatively enor- mous dimensions under certain conditions, and is probably always more diffluent at the surface ; in some cases dex- tran and similar carbohydrates are found in the swollen mass. In a few cases, however, e.g., Sarcina, Bacterium xylinum, B. tuberculosis, &c., the cellulose reaction is said to be distinct. Certain forms of iron-bacteria have depo- sits of oxide of iron (rust) in the membranes. The dense capsules observed in some species on certain media appear to be characteristic (e.g., Leuconostoc), but in others they are artificial precipitations. The inflated "involu- tion forms " often found in old cultures of given species appear to ^e due to changes induced by osmosis.~~

~~The improvements in technique, and especially in the~~

~~methods of fixing and staining devised by Loffler,~~

~~Fischer, and van Ermengem, have led to im-~~

~~"■ portant additions to our knowledge of the~~

~~motile organs of the bacteria, and completely altered our ideas of their frequency and distribution. The principle of all the methods is to fix the living and actively-moving organisms by simple drying in air, and then to add a medium which acts as a mordant and forms a delicate transparent film in which the bodies of the bacteria, with their extended and uninjured cilia, remain imbedded during the further staining operations. The intense heating~~

~~employed in ordinary fixing operations must be avoided, since it destroys the delicate cilia. After the fixing in the film, which is of tannin and osmic acid, or sulphate of iron, the superfluous fixative is washed off, and the stain — fuchsin, silver nitrate, &c. — is added, and the preparation washed, dried, and mounted, &c., in various ways. Van Ermengem's method, which is very successful in many cases, may be given in detail, in illustration of the care necessary in such preparations.~~

~~The bacteria having been carefully dried on the cover-slip, are plunged for from 5 to 30 minutes according to the temperature in a "fixing bath" of 1 vol. 2 per cent, osmic acid, 2 vol. 10-25 per cent, tannin-solution, to which 4-6 drops of acetic acid per 100 c.c. are added, and then carefully washed in water and alcohol. The washed preparation is immersed in a "sensitizing bath" of 0'25- 0-60 per cent, silver nitrate solution for a few seconds. From this, without further washing, it is plunged also for a few seconds only into a " reducing bath " of 6 grams gallic acid, 3 grams tannin, 10~~

~~grams sodium acetate per 350 grams distilled water, and again without washing brought back into the " sensitizing bath " until it begins to blacken. It is then thoroughly washed, dried, and mounted in the ordinary way. Much care is needed in the details, but the rich brown to nearly black staining in good preparations- shows up the cilia very sharply.~~

~~Such methods have brought out the facts that cilia may be present during a short period only in the life of a Schizomycete, and that their numbers may vary accord- ing to the medium on which the organism is growing. Nevertheless there is more or less constancy in the type of distribution, &c., of the cilia for each species when growing at its best. The chief results may be summed up as follows : some species, e.g., B. anthracis, have no cilia ; others have only one flagellum at one pole (Mono- trichous), e.g., BaciUus pyocyaneus (Fig. i, C, D), or one at each pole ; others again have a tuft of several cilia at one pole (Lophotrichous), e.g., B. syncyaneus (Fig. 1, E), or at each pole {Ampliitrichous) (Fig. 1, J, K, L); and.~~

~~Fig. 2. — The various phases of germiDation of spores of BaciUus rwmosus: (Fraenkel), as actually observed in banging drops under very high powers. A, the spore sown at 11 a.m., as shown at a, had swollen (6) perceptibly by noon, and had germinated by 8.80, as shown at c: in <2 at 6~~

~~p.m., and « at 8.80 p.m. ; the resulting filament is segmenting into bacilli as it elongates, and at midnight (/) consisted of twelve such segments. B, C, show similar series of phases in the order of the small letters in each case, and with the times of observation attached. At /and (7 occurs the breaking up of the iilament into rodlets. B, germinating spores in various stages, more highly magniiied, and showing the- diflferent ways of escape of the filamentfrom the spore-membrane. {.Original.)~~

~~finally, many actively motile forms have the cilia spring- ing all round (Peritrichous), e.g., B. vulgaris (Fig. 1, G). It is found, however, that strict reliance cannot be placed on the distinction between the Monotrichous, Lophotrich- ous, ani Amphitrichous conditions, since one and the same species may have one, two, or more cilia at one or both poles ; nevertheless some stress may usually be laid on the existence of one or two as opposed to several — e.g., five or six or more — at one or each pole.~~

~~In spite of their minuteness several cell-contents have been observed, such as sulphur-granules (Cohn), oil or fat drops (Meyer), and carbohydrates which turn blue (granulose) or red-brown (glycogen or amylo- ^'J^„fg dextrin) with iodine (Meyer). A red pigment appears in Chromatium, Tliiocystis, &c. The meaning of the so-called chromatin granules observed in many forms, and their possible relations to nuclear substance, have given rise to much discussion. Klebs, Biitschli, and others have regarded the whole of the protoplasmic con- tents of a bacterium as equivalent to a nucleus, but Meyer's and Wager's preparations suggest thai here as La~~

~~general]~~

~~other vegetable cells nuclei, or at least nuclear substance in the form of chromatic bodies, exist, thoiigh they are extremely minute ; Fischer doubts their being true nuclei, but Migula accepts the view that they represent them in a rudimentary form.~~

~~With regard to the essential details in the process of «pore-formation and germination, resistance to physical Spores. reagents, &c., little advance in knowledge was made in the decade 1890-1900. De Bary's <;onception of arthrospores, as contrasted with endospores, has been found of little value ; an arthrospore is merely an isolated bacterial cell in a resting state, and such occur in endosporous forms, e.g., B. mbtilis, as well as in species not known to form endospores. In a few cases, ^.g., B. Zopfli, arthrospores appear to be well formed, but even in this typical case it is evident that we must regard these resting vegetative cells as in the same category as the pidia or gemmae of true fungi, and in no way morpho- logically specialized as spores. Similar objections have~~

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~~Tig. 3. — Stages iu the development of spores of Bacillus ramesue (Fraenkel), in the order and at the times given, in a hanging drop culture, under a very- high power. The process begins with the formation of brilliant granules (A, B) ; these increase, and the brilliant substance gradually balls together (C) and forms the spores (D), one in each segment, which soon acquire a membrane and ripen (E). {Original.) ^~~

~~been made to the use of the term arthrospore in the case of Leuconostoc, where true endospores appear to be formed. In short, the "arthrospore" is nothing more than any ordinary vegetative cell which separates and passes into a. condition of rest — just as do the cells of yeast and the encysted cells of many micro-organisms — • and according to the older definition every cell of a Micrococcus would be an " arthrospore." The so-called arthrospores of Cladothrix and other chlamydo-bacte- riacese are ciliated motile cells, comparable with the zoospores of Algse, and germinating forthwith to new filaments.~~

~~The conditions for spore-formation differ. Anaerobic species usually require little oxygen, but aerobic species a free supply. Each species has an optimum temperature, and many are known to require very special food-media. The systematic interference with these conditions has enabled bacteriologists to induce the development of so- called asporogenous races, in which the formation of spores is indefinitely postponed, changes in vigour, viru- lence, and other properties being also involved, in some cases at any rate. The addition of minute traces of acids, poisons, &c., leads to this change in some forms ; high~~

~~temperatures have also been used successfully. Most spores are ellipsoid, but those of B. tetani are spherical, and those of B. leptosporus elongated. The spore may be small and cause no deformation of the mother-cell, in which it lies at one end or in the middle; or it may during formation bring about a swelling of the cell or part of it, so that the mature sporogenous cell is drum- stick-shaped (Plectridium) as in B. tetani, or fusiform (Clostridium) as in C. butyricum, &c. Only in rare cases are two spores formed in the rod, e.g., B. inflatus. Much careful work has been done on the details of the forma^ tion, structure, and germination of spores, but little has been added to what has long been known, viz., that the spore results from aggregation of the protoplasmic con- tents of the rod (Fig. 3), that no definite nucleus can be made clear, that the spore-wall — probably of some altered protoplasmic product — is thin and extremely resistent when ripe, and that germination is preceded by the rup- ture or dissolution of the latter at the ends or equator, where it is apparently thinner, the contents growing out as the first rodlet (Fig. 2).~~

~~Numerous attempts have been made to construct schemes of classification based on the power of growing colonies to liquefy gelatine, to secrete coloured pigments, to ferment certain media with evolu- f/^^^’”’^’ tion of carbon-dioxide or other gases, or to induce pathological conditions in animals. None of these systems, which are chiefly due to the medical bac- teriologists, has maintained its position, owing to the diffi- culty of applying the characters and to the fact that such properties are physiological and liable to great fluctuations in culture, because a given organism may vary greatly in such respects according to its degree of vitality at the time, its age, the mode of nutrition, and the influence of external factors on its~~

growth. Even when used in conjunction with purely morphological characters, these physiological properties are too variable to aid us in the discrimination of species and genera, and are apt to break down at critical periods. Among the more characteristic of these schemes adopted at various times may be men- tioned those of Miquel (1891), Eisenberg (1891), and Lehmann and Neumann (1897). Although much progress was made during the decade 1890 to 1900 in determining the value and constancy of morphological characters, we are still in need of a sufficiently comprehensive and easily applied scheme of classification, partly owing to the existence in the literature of imperfectly described forms, the life-history of which is not yet known, or the microscopic characters of which have not been examined with sufficient accuracy and thoroughness. The principal attempts at morphological classifications recently brought forward are those of de Toni and Trevisan (1889), Fischer (1897), and Migula (1897). Of these systems, which alone are available in any practicable scheme of classifica- tion, the two most important and most modern are those of Fischer and Migula. The extended investigations of the former on the number and distribution of cilia (Fig. 1) led him to propose a scheme of classification based on these and other morphological characters, and differing essentially from any preceding one. This scheme may be tabulated as follows : —

I. Oedek — Haplobacterinae. Vegetative body uni- cellular ; spheroidal, cylindrical, or spirally twisted ; isolated or connected in filamentous or other growth series. 1. Family — CoocacevE. Vegetative cells spheroidal.

(a) Sub-family — Allococcacb.«. Division in all or any planes, colonies indefinite in shape and size, of cells in short chains, irregular clumps, pairs, or isolated: — Micrococcus (Cohn), cells non- motile ; Planococcus (Migula), cells motile.

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~~(6) Sub-family — Homococcace;e. Division planes regular and definite : — Sarcina (Goods.), cells non-motile ; growth and division in three suc- cessive planes at right angles, resulting in packet- like groups ; Plaruisarcina (Migula), as before, but motile ; Pediococous (Lindner), division planes at right angles in two successive planes, and cells in tablets of four or more ; strepto- coccus (Billr.), divisions in one plane only, re- sulting in chains of cells.~~

~~2. Family — Bacillace^. Vegetative cells cylindric~~

~~(rodlets), ellipsoid or ovoid, and straight. Divi- sion planes always perpendicular to the long axis.~~

~~(a) Sub-family — Bacille^. Sporogenous rodlets cylindric, not altered in shape : — Bacillus (Cohn), non-motile; Bactrinium (Fischer), motjje, with one polar flagellum (Monotrichous) ; Bactrillum (Fischer), motile, with a terminal tuft of cil.a (Lophotrichous) ; Bactridium (Fischer), motile, with cilia all over the surface (^Peritrichous).~~

~~(6) Sub-family — Clostridie^. Sporogenous rodlets, spindle-shaped : — Clostridium (Prazm.), mo- tile, peritrichous.~~

~~(c) Sub-family — Pi,ectkidie.e. Sporogenous rodlets, drum-stick-shaped : — Plectridium (Fischer), motile, peritrichous.~~

~~3. Family — Spirillace^. Vegetative cells cylindric,~~

~~but curved more or less spirally. Divisions per- pendicular to the long axis : — Vibrio (Milller- Loffler), comma-shaped, motile, monotrichous ; Spirillum (Ehrenb.), more strongly curved in open spirals, motile, lophotrichous ; Spirochcete (Ehrenb.), spirally coiled in numerous close turns, motile, but apparently owing to flexile movements, as no cilia are found.~~

~~II. Order — Trichobacterinse. Vegetative body of branched or unbranched cell-filaments, the segments of which separate as swarm-cells (Gonidia). 1. Family — Trichobaoteriace^. Characters those of the Order.~~

~~(a) Filaments rigid, non-motile, sheathed : — Crenothrix (Cohn), filaments unbranched and devoid of sulphur particles ; Thiothrix (Winogr.), as before, but with sulphur particles ; Cladothrix (Cohn), filaments branched in a pseudo-dichotomous manner. (fi) Filaments showing slow pendulous and creeping movements, and with no distinct sheath: — Beggiatoa (Trev.), with sulphur particles.~~

~~The principal objections to this system are the following : — (1) The extraordinary difficulty in obtaining satisfactory preparations showing the cilia, and the discovery that these motile organs are not formed on all substrata, or are only developed during short periods of activity while the organism is young and vigorous, render this character almost nugatory. For instance, B. megatherium and B. suhtilis pass in a few hours after commencement of growth from a motile stage with peritrichous cilia, into one of filamentous growth preceded by casting of the cilia. (2) By far the majority of the desci-ibed species (over 1000) fall into the three genera — Micrococcus (about 400), *Bacillus (about 200), and Bactridium (about 150), so that only a quarter or so of the forms are selected out by the other genera. (3) The monotrichous and lophotrichous conditions are by no means constant even in the motile stage ; thus Pseudomonas rosea (Mig.) may have 1, 2, or 3 cilia at either end, and would be distributed by Fischer's classification between Bac- trinium and Bactrillum, according to which state was observed. In Migula's scheme the attempt is made to avoid some of these difficulties, but others are introduced by his otherwise clever devices for dealing with these puzzling little organisms.~~

~~'The question. What is an individual ? has given rise to much difficulty, and around it many of the speculations regarding pleo- morphism have centred without useful result. If a tree fell apart into its constituent cells periodically we should have the same difficulty on a larger and more complex scale. The fact that every bacterial cell in a species in most cases appears equally capable of performing all the physiological functions of the species has led~~

~~most authorities, however, to regard it as the individual — a view which cannot be consistent in those cases where a simple or branched filamentous series exhibits differences between free apex and fixed base and so forth. It may be doubted whether the discussion is profitable, though it appears~~

~~necessary in some cases — e.g., concern- ing pleomorphy — to adopt some definition of individual.~~

~~Myxobacteriacem. — In 1867 Berkeley figured a curious organism then named Chondromyces, and in 1892 this and a number of allied organisms were rediscovered by Thaxter, who showed that they form plasmodium-like aggregations and build themselves up- into sporogenous structures quite similar in general features to the cysts of Myxomycetes, except that the Plasmodium is filled with — or, according to Thaxter, consists of — swarming bacteria. Several genera and species are described, and if the author's appreciation of the facts is correct, we have here a remarkable group of organisms partaking of the nature of both Schizomycetes and Myxomycetes as his name' implies. Until the details of the life-history are better worked out it is, however, impossible to say whether his views are right, or whether we have here — as seems to the present writer to be the case from the only example he has been able to examine — a case of symbiosis, or possibly parasitism, between true Schizomycetes and Myxomycetes.~~

~~The discoveries that some species of nitrifying bacteria and pigmented forms are capable of carbon-assimilation, that others can fix free nitrogen, and that a number of d'ecompositions hitherto unsuspected ^5//""/ are accomplished by Schizomycetes, have put bacteria. the questions of nutrition and fermentation in quite new lights. Apart from numerous fermentation~~

~~Fi&. 4. — A series of phases of germination of the spore of S. ramoeus sown at 8.30 (to the extreme left), showing how the growth can be measured. If we place the base of tho filament in each case on a base line in the order of the suc- cessive times of observation recorded, and at distances apart proportional to the intervals of time (8.30, 10.0, 10.30, 11.40, and so on), and erect the straightened- out filaments, the proportional length of each of which is here given for each period, a line joining the tips of the filaments gives the curve of growth. Of. Fig. 5. (Origiiial.)~~

~~processes such as rotting, the soaking of skins for tanning, the preparation of indigo and of tobacco, hay, ensilage, &c., in all of which bacterial fermentations are concerned, attention may be especially directed to the~~

following evidence of the supreme importance of Schizomycetes in agriculture and daily life. Indeed, nothing marks the attitude of modern bacteriology more clearly than the increasing attention which is being paid to useful fer- mentations. The vast majority of these organisms are not pathogenic, most are harmless, and many are in- dispensable aids in natural operations important to man. Fischer has proposed that the old division into sapro-

general]

phytes and parasites should be replaced by one which takes into account other peculiarities in. the mode of nutrition of bacteria. The nitrifying, nitrogen-fixing, sulphur- and iron-bacteria he regards as monotrophic, i.e., as able to carry on one particular series of fermentations or decompositions only, and since they require no organic food materials, 6r at least are able to work up nitrogen or carbon from inorganic sources, he regards them as primi- tive forms in this respect, and terms them Prototrophic. They may be looked upon as the nearest existing repre- sentatives of the primary forms of life which first obtained the power of working up non-living into living materials, and as playing a correspondingly important r6le in the evolution of life on our globe. The vast majority of bacteria, on the other hand, which are ordinarily termed saprophytes, are saprogenic, i.e., bring organic material to the putrefactive state — or saprophilous, i.e., live best in such putrefying materials — or become zymogenic, i.e., their metabolic products may induce blood-poisoning or other toxic effects (facultative parasites) though they are not true parasites. These forms are termed by Fischer Metatrophic, because they require various kinds of organic materials obtained from the dead remains of other organ- isms or from the surfaces of their bodies, and can utilize and decompose them in various ways (PolytropJiic), or, if monotrophic,are at least unable to work them up. The true parasites — obligate parasites of de Bary — are placed by Fischer in a third biological group, Paratrophic bac teria, to mark the importance of their mode of life in the interior of living organisms where they live and multiply in the blood, juices, or tissues.

The growth of an ordinary bacterium consists in uni- form elongation of the rodlet until its length is doubled, a wtb °-‘°^®^ ^J division by a median septum, then by the simultaneous doubling in length of each daughter cell, again followed hj median division, and so on (Figs. 4, 6). If the cells remain connected the result- ing filament repeats these processes of elongation and sub- sequent division uniformly so long as the conditions are maintained, and very accurate measurements have been obtained on such a form, e.g., B. ramosus. If a rodlet in a hanging drop of nutrient gelatine is fixed under the microscope and kept at constant temperature, a curve of growth can be obtained recording the behaviour during many hours or days. The measured lengths are marked oif on ordinates erected on an abscissa, along which the times are noted. The curve obtained on joining the former points then brings out a number of facts, foremost among which are (1) that as long as the conditions remain constant the doubling periods — i.e., the times taken by any portion of the filament to double its length — are constant, because each cell is equally active along the whole length ; (2) there are optimum, minimum, and maximum temperatures, other conditions remaining con- stant, at which growth begins, runs at its best, and is soon exhausted, respectively; (3) that the most rapid cell-division and maximum growth do not necessarily accord with the best conditions for the life of the organ- ism ; and (4) that any sudden alteration of temperature brings about a check, though a slow rise may accelerate growth (Fig. 6). It was also shown that exposure to light, dilution or exhaustion of the food-media, the pres- ence of traces of poisons or metabolic products check growth, or even bring it to a standstill ; and the death or injury of any single cell in the filamentous series shows its effect on the curve by lengthening the doubling period, because its potential progeny have been put out of play. Hardy has shown that such a destruction of part of the filament may be effected by the attacks of another organism. Among the most important advances in our know-

ledge of the bacteria are those having reference to the circulation of nitrogen on the globe. When we reiiect that some hundreds of thousands of tons ^^f^” of urea are daily deposited, which ordinary plants are unable to assimilate until considerable changes have been undergone, the question is of importance. What happens in the meantime ? In effect the urea first be- comes carbonate of ammonia by a simple hydrolysis brought about by bacteria, more and more definitely known since Pasteur, van Tieghem, and

~~Cohn first de- scribed them. Lea and Miquel further proved that the hydrolysis is due to an enzyme — urase — separable with diflftculty from the bacteria concerned. Many forms in~~

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Fig. 5. — Curve of g:rowth of a filament of Bacillus ram.osuR (Frflenke]\ con- structed from data such as in Fig. 4. The abscissje represent intervals ol time, tlie ordinates the measured lengths of the growing filament. Thus, at 2,33 P.M. the length of the filament was 6 f^i ; at 5.45, 20 fi. ; at 8 p.m., 70 jiA, and so on. Such curves show differences of steepness according to the temperature (see temp, curve), and to alterations of light (lamp) and dark- ness. {Original.)

rivers, soil, manure heaps, &c., are capable of bringing about this change to ammonium carbonate, and much of the loss of volatile ammonia on farms is preventible if the facts are apprehended. The excreta of urea alone thus afford to the soil enormous stores of nitrogen combined in a form which can be rendered available by bacteria, and there are in addition the supplies brought down in rain from the atmosphere, and those due to other living debris. The researches of the decade 1890-1900 demonstrated that a still more inexhaustible supply of nitrogen is made available by the nitrogen-fixing bacteria of the soil. There are in all cultivated soils forms of bacteria which are capable of forcing the inert free nitrogen to combine with other elements into compounds assimilable by plants. This was long asserted as probable before Winogradsky showed that the conclusions of .Berthelot, Laurent, and others are right, and that Clostridium pasteurianum, for

instance, if protected from access of free oxygen by an envelope of aerobic bacteria or fungi, and provided with the carbohydrates and minerals necessary for its growth, ixes nitrogen in proportion to the amount of sugar con- sumed. This interesting case of symbiosis is equalled by j’et. another case. The work of recent observers leaves no room for doubt that the free

~~nitrogen of the atmos- phere is brought into combination in the soil in the nodules filled with " bacteroids " on the roots of Legiuni- noseae, and since these nodules are the morphological ■expression of a symbiosis between the higher plant and the bacteriarlike " bacteroids," there is evidently here .also a case similar to the last, though it is as yet impos- sible to say where and how the nitrogen is fixed.~~

~~As regards the ammonium carbonate accumulating in "the soil from the conversion of urea and other sources, we know from Winogradsky's researches that it under- goes oxidation in two stages owing to the activity of the so-called " nitrifying " bacteria (an unfortunate term in- asmuch as "nitrification" refers merely to a particular phase of the cycle of changes undergone by nitrogen). It had long been known that under certain conditions~~

~~Fm. 6. — St^es in the formation of a colony of a variety of Bacillus (^Proteus) vulgaris (Hauser), observed in a hanging drop. At 11 a.m. a rodlet appeared (A) ; at i P.M. it had grown and divided and broken up into eight rodlets (B) ; C shows further development at 8 p.m., D at 9.30 p.m. — all under a high power. At E, F, and G further stages are drawn, as seen under much lower power. {Original.)~~

~~large quantities of nitrate (saltpetre) are formed on ex- posed heaps of manure, &c., and it was supposed that ■direct oxidation of the ammonia, facilitated by the pres- ence of porous bodies, brought this to pass. But re- search showed that this process of nitrification is dependent on temperature, aeration, and moisture, as is life, and that while nitre-beds can infect one another, the process is stopped by sterilization. Warington, Schloesing, Miintz, and others had proved that nitrifi- cation was promoted by some organism, when Winograd- sky hit on the happy idea of isolating the organism by using gelatinous silica, and so avoiding the difficulties which Warington had shown to exist with the organism in presence of organic nitrogen, owing to its refusal to nitrify on gelatine or other nitrogenous media. Wino- gradsky's investigations resulted in the discovery that two kinds of bacteria are concerned in nitrification : one of these, which he terms the Nitrosobacteria, is only capar ble of bringing about the oxidation of the ammonia to nitrous acid, and the astonishing result was obtained that~~

~~this can be done, in the dark, by bacteria to which only pure mineral salts — e.g., carbonates, sulphates, and chlo- rides of ammonium, sodium, and magnesium — were added. In other words these bacteria can build up or- ganic matter from purejy mineral sources by assimilating carbon from carbon-dioxide in the dark, and by obtaining~~

~~their nitrogen from ammonia. The energy liberated during the oxidation of the nitrogen is regarded as split- ting the carbon-dioxide molecule, — in green plants it is the energy of the solar rays which does this. Since the supply of free oxygen is dependent on the activity of green plants the process is indirectly dependent on energy derived from the sun, but it is none the less an astound- ing one and outside the limits of our previous generaliza- tions. It has been suggested that urea is formed by polymerization of ammonium carbonate, and formic alde- hyde is synthesized from CO2 and OHj. The Nitro-bac- teria are smaller, finer, and quite different from the nitroso-bacteria, and are incapable of attacking and utiliz- ing ammonium carbonate. When the latter have oxidized ammonia to nitrite, however, the former step in and oxi- dize it still further to nitric acid. It is probable that important consequences of these actions result from the presence of nitrifying bacteria in rotten stone, decaying bricks, &c., where all the conditions are realized for pre- paring primitive soil, the breaking up of the mineral constituents being a secondary matter. That " soil" is thus prepared on barren rocks and mountain peaks may be concluded with some certainty.~~

~~In addition to the bacterial actions whicli result in the oxidization of ammonia to nitrous acid, and of the latter to nitric acid, the reversal of such processes is also brought about by numerous bacteria in the soil, rivers, &c. War- ington showed some time ago that many species are able to reduce nitrates to nitrites, and such reduction is now known to occur very widely iii nature. The researches of G-ayon and Dupetit, Giltay and Aberson and others have shown, moreover, that bacteria exist which carry such reduction still further, so that ammonia or even free nitrogen may escape. The importance of these results is evident in explaining an old puzzle in agriculture, viz., that it is a wasteful process to put nitrates and manure to- gether on the land. Fresh manure abounds in denitrify- ing bacteria, and these organisms not only reduce the nitrates to nitrites, even setting free~~

~~nitrogen and am- monia, but their effect extends to the undoing of the work of what nitrifying bacteria may be present also, with great loss. The combined nitrogen of dead organ- isms, broken down to ammonia by putrefactive bacteria, the ammonia of urea, and the results of the fixation of free nitrogen, together with traces of nitrogen salts due to meteoric activity, are thus seen to undergo various vicissitudes in the soil, rivers, and surface of the globe generally. The ammonia may be oxidized to nitrites and nitrates, and- then pass into the higher plants and be worked up into proteids, and so be handed on to animals, eventually to be broken down by bacterial action again to ammonia ; or the nitrates may be degraded to nitrites and even to free nitrogen or ammonia, which escapes.~~

~~Another important advance is in our knowledge of the part played by bacteria in the circulation of carbon in nature. The enormous masses of cellulose de- posited annually on the earth's surface are, as torter/a" we know, principally the result of chlorophyll action on the carbon-dioxide of the atmosphere decomposed by energy derived from the sun ; and although we know little as yet concerning the magnitude of other processes of carbon-assimilation — e.g., by nitrifying bacteria — it is probably comparatively small. Such cellulose is gradu- ally reconverted into water and carbon-dioxide, but until recently nothing positive was known as to the agents which thus break up the paper, rags, straw, leaves, and wood, &c., accumulating in cesspools, forests, marshes, and elsewhere in such abundance. The work of van Tieghem, van Senus, Fribes, Omeliansky, and others has now shown that while certain anaerobic bacteria decompose the sub- stance of the middle lamella — chiefly pectin compounds —~~

~~general]~~

~~and thus bring about the isolation of the cellulose fibres when, for instance, flax is steeped or " retted," they are unable to attack the cellulose itself. There exist in the mud of marshes, rivers, and cloacae, &c., however, other anaerobic bacteria which decompose cellulose, probably hydrolysing it first and then splitting the products into carbon-dioxide and marsh gas. When~~

calcium sulphate IS present, the nascent methane induces the formation of calcium carbonate, sulphuretted hydrogen, and water. We have thus an explanation of the occurrence of marsh gas and sulphuretted hydrogen in bogs, and it is highly prob- able that the existence of these gases in the intestines of herbivorous animals is due to similar putrefactive changes on the undigested cellulose remains.

Cohn long ago showed that certain glistening particles observed in the cells of Beggiatoa consist of sulphur, and Sulphur "iiiogr3,dsky and Beyerinck have shown that a bacteria, ' ^ole series of sulphur bacteria of the genera -Thiothrix, Chromatium, Spirillum, Monas, &c., exist, and play important parts in the circulation of this element in nature, e.g., in marshes, estuaries, sulphur

Fia. 7. — A plate-culture of a bacillus -which had been exposed for four hours, on 80th March, behind a zinc stencil-plate, in which the letters C and B were cut. The lig-ht had to traverse a screen of water before passing through the C, and one of Aesculin (which filters out the blue and violet rays) be- fore passing the B. The plate was then incubated, and, as the figure shows, the bacteria on the C-shaped area were all killed, whereas they developed else- where on the plate (traces of the B are just visible to the right) and covered it with an opaque growth. {Original.)

, springs, &c. When cellulose bacteria set free marsh gas, the nascent gas reduces sulphates — e.g., gypsum — with liberation of SHj, and it is found that the sulphur bacteria thrive under such conditions by oxidizing the SHa and storing the sulphur in their own protoplasm. If the SHj runs short they oxidize the sulphur again to sulphuric acid, which combines with any calcium carbonate present and forms sulphate again. Similarly nascent methane may reduce iron salts, and the black mud in which these bacteria often occur owes its colour to the FeS formed. Beyerinck and Jegunow have shown that some partially anaerobic sulphur bacteria can only exist in strata at a certain depth below the level of quiet waters where SHj is being set free below by the bacterial decompositions of vegetable mud and rises to meet the atmospheric oxygen coming down from above, and that this zone of physiological activity rises and falls with the variations of partial pressure of the gases due to the rate of evolution of the SHj. In the deeper parts of this zone the bacteria absorb the SH2, and, as they rise, oxidize it and store

~~up the sulphur ; then ascending into planes more highly oxygen- ated, oxidize the sulphur to SO3. These bacteria therefore employ SH3 as their respiratory substance, much as higher plants employ carbohydrates — instead of liberating energy~~

~~as heat by the respiratory combustion of sugars, they do it by oxidizing hydrogen-sulphide. Beyerinck has shown that spirillum desulphuricans, a definite anaerobic form, attacks and reduces sulphates, thus undoing the work of the sulphur bacteria, as certain de-nitrifying bacteria re- verse the operations of nitro-bacteria. Here again there- fore we have sulphur, taken into the higher plants as sulphates, built up into proteids, decomposed by putrefac- tive bacteria and yielding SHj which the sulphur bacteria oxidize, the resulting sulphur is then again oxidized to- SO3 and again combined with calcium to gypsum, the- cycle being thus complete.~~

~~Chalybeate waters, pools in marshes near ironstone, &c., abound in bacteria, some of which belong to the remark- able genera Crenothrix, Cladothrix, and Lepto- thrix, and contain ferric oxide, i.e., rust, in ‘°^,g their cell-walls. This iron deposit is not merely mechanical but is due to the physiological activity of the organism which, according to Winogradsky, liberates energy by oxidizing ferrous and ferric oxide in its proto- plasm — a view not accepted by Molisch. The iron must be in certain soluble conditions, however, and the soluble bicarbonate of the protoxide of chalybeate springs seems most favourable ; the hydrocarbonate absorbed by the cells is oxidized, probably thus —~~

~~2 FeCOa + 3 OHj -f 0=Fe2 (OH), + 2 CO^.~~

~~The ferric hydroxide accumulates in the sheath, and gradu- ally passes into the more insoluble ferric oxide. These actions are of extreme importance in nature, as their con- tinuation results in the enormous deposits of bog-iron ore, ochre, and — since Molisch has shown that the iron can be re- placed by manganese in some bacteria — of manganese ores. Considerable advances in our knowledge of the various chromogenic bacteria have been made by the studies of Beyerinck, Lankester, Engelmann, Ewart, and others, and have assumed exceptional importance Racier”* owing to the discovery that Bacterio-purpurin — the red colouring matter contained in certain sulphur bacteria — absorbs certain rays of solar energy, and enables~~

~~the organism to utilize the energy for its own life-purposes. Engelmann showed, for instance, that these red-purple bacteria collect in the ultra^red, and to a less extent in the orange and green, in bands which agree with the absorp- tion spectrum of the extracted colouring matter. Not only so, but the evident parallelism between this absorp- tion of light and that by the chlorophyll of green plants, is completed by the demonstration that oxygen is set free by these bacteria — i.e., by means of radiant energy trapped by their colour-screens the living cells are in both cases enabled to do work, such as the reduction of highly oxidized compounds. In the case of these red-purple bacteria the colouring matter is contained in the proto- plasm of the cell, but in most chromogenic bacteria it occurs as excreted pigment on and between the cells, or is formed by their action in the medium. Ewart has con- firmed the principal conclusions concerning these purple, and also the so-called chlorophyll bacteria (B. viride, B. chlorinum, &c.), the results going to show that these are,, as many authorities have held, merely minute Algae. The pigment itself may be soluble in water, as is the case with the blue-green fluorescent body formed by B. pyocyaneuSf B. fluorescens, and a whole group of fluorescent bacteria. Neelson found that the pigment of B. cyanogenus gives a. band in the yellow and strong lines at E and F in the solar spectrum — an absorption spectrum almost identical with that of triphenyl-rosaniline. In the case of the scarlet and crimson red pigments of B. prodigiosus, B. ruber, &c., the violet of B. violacens, B. janthinus, &c., the red-purple of the sulphur bacteria, and indeed most~~

~~bacterial pigments, solution in water does not occur, though aclohol extracts the colour readily. Finally, there are a few forms which yield their colour to neither alcohol nor water, e.g., the yellow Micrococcus cereus-flavus and the B. berolinensis. Much work is still necessary before we can estimate the importance of these pigments. Their spectra are only imperfectly known in a few cases, and the bearing of the absorption on the life-history is still a~~

mystery. In many cases the colour-production is de- pendent on certain definite conditions — temperature, presence of oxygen, nature of the food-medium, &c. Ewart's important discovery that some of these lipo- chrome pigments occlude oxygen, while others do not, may have bearings on the facultative anaerobism of these organisms.

Abranch of bacteriology which offers numerous problems of importance is that which deals with the organisms so

common in milk, butter, and cheese. Milk is a bac^ria. iii^dium not only admirably suited to the growth

of bacteria, but, as a matter of fact, always con- taminated wit^ these organisms in the ordinary course of supply. Laf ar has stated that 20 per cent, of the cows in Germany suffer from tuberculosis, which also affected 17-7 per cent, of the cattle slaughtered in Copenhagen between 1891 and 1893, and that one in every thirteen samples of milk examined in Paris, and one in every nineteen in

Fig. 8. — A similar preparation to Fig. 7, except that two slit-like openings of equal length allowed the light to pass, and that the light was that of the electric arc passed through a quartz prism and easting a powerful spectrum on the plate. The upper slit was covered with glass, the lower with quartz. The bacteria were killed over the clear areas shown. The left- hand boundary of the clear area corresponds to the line F (green end of the blue), and the beginning of the ultra-violet was at the extreme right of the (upper (short) area. The lower area of bactericidal action extends much farther to the right, because the quartz allows more ultra-rays to pass th.an does glasp. The red-yellow-green to the left of F were without effect, (.Original.)

Washington, contained tubercle bacilli. Hence the de- sirability of sterilizing milk used for domestic purposes becomes imperative. No milkis free from bacteria, because the external orifices of the milk-ducts always contain them, but the forms present in the normal fluid are principally those which induce such changes as the souring or " turning " so frequently observed in standing milk (these were examined by Lord Lister as long ago as 1873-77, though several other species are now known), and those which bring about the various changes and fermentations in butter and cheese

~~made from it. The presence of foreign germs, which may gain the upper hand and totally destroy the flavours of butter and cheese, has led to the search for those particular forms to which the approved properties are due. A definite bacillus to which the peculiarly fine~~

~~flavour of certain butters is due, is said to be largely em- ployed in pure cultures in American dairies, and in Den- mark certain butters are said to keep fresh much longer owing to the use of pure cultures and the treatment em- ployed to suppress the forms which cause rancidity. Quite distinct is the search for the germs which cause un- desirable changes, or " diseases " ; and great strides have been made in discovering the bacteria concerned in render- ing milk " ropy," butter " oily" and ^" rancid," &c. Cheese in its numerous forms contains myriads of bacteria, and some of these are now known to be concerned in the various processes of ripening and other changes affecting the product, and although little is known as to the exact part played by any species, practical applications of the discoveries of the decade 1890-1900 have been made, e.g., Edam cheese. The Japanese have cheeses resulting from the bacterial fermentation of boiled Soja beans.~~

~~That bacterial fermentations are accomjianied by the evolution of heat is an old experience ; but the discovery that the " spontaneous " combustion of sterilized cotton-waste does not occur simply if moist and '"?f/""°" freely exposed to oxygen, but results when the bacteria. washings of ifresh waste are added, has led to clearer proof that the heating of hay-stacks, hops, tobacco, and other vegetable products is due to the vital activity of bacteria and fungi, and is physiologically a consequence of respiratory processes like those in malting. It seems fairly established that when the preliminary heating pro- cess of fermentation is drawing to k close, the cotton, hay, &c., having been converted into a highly porous friable and combustible mass, may then ignite in certain cir- cumstances by the occlusion of oxygen, just as ignition is induced by finely divided metals. A remarkable point in this connexion has always been the necessary conclu- sion that the living bacteria concerned must be exposed to temperatures of at least 70° C. in the hot heaps. Apart from the resolution of doubts as to the power of spores to withstand such temperatui^es for long periods, the discoveries of Miquel, Globig, and others have shown that there are numerous bacteria which will grow and divide at such temperatures, e.g., B. thermophUus, from sewage,~~

which is quite active at 70° C., and B. Ludwigi and B. ilidzensis, &c., from hot springs, &c.

The bodies of sea fish, e.g., mackerel and other animals, have long been known to exhibit phosphorescence. This phenomenon is due to the activity of a whole series of marine bacteria of various genera, the Pt^osphor- examination and cultivation of which have been bacteria. successfully carried out by Cohn, Beyerinck, Fischer, and others. The cause of the phosphorescence is still a mystery. The suggestion that it is due to the oxidation of a body excreted by the bacteria seems an- swered by the failure to filter off or extract any such body. Beyerinck's view that it occurs at the moment peptones are worked up into the protoplasm cannot be regarded as proved, and the same must be said of the suggestion that the phosphorescence is due to the oxidation of phos- phoretted hydrogen. The conditions of phosphorescence are the presence of free oxygen, and, generally, a relatively low temperature, together with a medium containing sodium chloride, and peptones, but little or no carbo- hydrates. Considerable differences occur in these latter respects, however, and interesting results were obtained by Beyerinck with mixtures of species possessing different powers of enzyine action as regards carbohydrates. Thus, a form termed Pliotohactermm plwsplioreacens by Beyerinck will absorb maltose, and will become luminous if that sugar is present, whereas P. Pflugeri, is indifferent to maltose. If then we prepare densely inseminated plates of these two bacteria in gelatine food-medium to which starch is added as the only carbohydrate, the bac-

general]

teria grow but do not phosphoresce. If we now streak these plates with an organism, e.g., a yeast, which sac- charifaes starch, it is possible to tell whether maltose or levulose and fructose are formed; if the former, only those plates containing P. phosphorescens will become luminous ; if the latter, only those containing P. Pflugeri. It has long been known that the production of vinegar depends on the oxidization of the alcohol in wine or

beer OxUiziaz ^^f^'^^i" ^''id, the chemical process being prob- bacteria. ^P^y Carried out in two stages, viz., the oxidar

tion of the alcohol leading to the formation of aldehyde and water, and the further oxidation of the aldehyde to acetic acid. The process may even go farther, and the acetic acid be oxidized to COj and OHj ; the art of the vinegar-maker is directed to preventing the accom- plishment of the last stage. These oxidations are brought about by the vital activity of several bacteria, of which four — Bacterium aceti, B. pasteurianum, B. Mtzingianum, andB. xylinum — have been thoroughly studied by Hansen and A. Brown. It is these bacteria which form the zoo- gloea of the " mother of vinegar," though this film may contain other organisms as well. The idea that this film of bacteria oxidized the alcohol beneath by merely con- densing atmospheric oxygen in its interstices, after the maimer of spongy platinum, has long been given up ; but the explanation of the action as &a. incomplete combus- tion, depending on the peculiar respiration of these organisms — much as in the case of nitrifying and sul- phur bacteria — is not clear, though the discovery that the acetic bacteria will not only oxidize alcohol to acetic acid, but further oxidize the latter to CO2 and OH2 supports, the view that the alcohol is absorbed by the organism and employed as its respirable substance. Proniise of more light on these oxidation fermentations is afforded by the recent discovery that not only bacteria and fungi, but even the living cells of higher plants, contain peculiar enzymes which possess the remarkable property of " carrying " oxygen — much as it is carried in the sul- phuric acid chamber — and which have therefore been termed oxydases. It is apparently the presence of these oxydases which causes certain wines to change colour and alter in taste when 'poured from bottle to glass, and so exposed to air.

Much as the decade from 1880-90 abounded with investigations on the reactions of bacteria to heat, so

the following decade was remarkable for dis- andlight coveries regarding the effects of other forms of

radiant energy. The observations of Downes and Blunt in 1877 left it uncertain whether the bacteri- cidal effects in broth cultures exposed to solar rays were

~~Fig. 9.— Ginger-beer plant, showing yeast (Saccharomi/oex pyriformis) entangled in the meshes of the bacterium {B. vermi/orme). (Original.)~~

~~due to thermal action or not. Further investigations, in which Arloing, Buchner, Chmelewski, and others took part, have led to the proof that rays of light alone are quite capable of killing these organisms. The principal questions were satisfactorily settled by Marshall Ward's experiments in 1892-93, when he showed that even the spores of B. anthracis, which withstand temperatures of~~

~~100° C. and upwards, can be killed by exposure to rays of reflected light at temperatures far below anything injuri- ous, or even favourable to growth. He also showed that the bactericidal action takes place in the absence of food materials, thus proving that it is not merely a poisoning effect of the altered medium. The principal experiments also indicate that it is the rays of highest refrangibility — ^the blue-violet and ultra-violet rays of the spectrum — which bring about the destruction of the organisms (Figs. 7, 8). The practical effect of the bactericidal action of solar-light is the destruction of enormous quantities of germs in rivers, the atmosphere, and other exposed situations, and experiments have shown that it is especially the pathogenic bacteria — anthrax, typhoid, &c. — which thus succumb to light-action; the discovery that the electric arc is very rich in bactericidal rays led to the hope that it could be used for disinfecting purposes in hospitals, but mechanical difficulties inter- vene. The recent application of the action of bacteri- cidal rays to the cure of lupus is, however, an extension of the same discovery. Even when the light is not suf- ficiently intense, or the exposure is too short to kill the spores, the experiments show that attenuation of viru- lence may result, a point of extreme importance in con- nexion with the lighting and ventilation of dwellings, the purification of rivers and streams, and the general dimi- nution of epidemics in nature.~~

~~As we have seen, thermophilous bacteria can grow at high temperatures, and it has long been known that some forms develop on ice. The somewhat different question of the resistance of ripe spores or cells ^^^"l to extremes of heat and cold has received atten- tion. Eavenel, Macfadyen, and Rowland have shown that several bacilli will bear exposure for seven days to the temperature of liquid air (—192° C. to —183° C.) and again grow when put~~

into normal conditions. More recent experiments have shown that even ten hours' exposure to the temperature of liquid hydrogen — 252° C. (21° on the absolute scale) failed to kill them. Farmer has shown the probability that in all these cases of resistance of seeds, spores, &c., the fact that completely dry albumin does not lose its coagulability on heating to 110° C. for some hours may be of importance, since it is well known that completely ripe spores and dry heat are the conditions of extreme experiments.

No sharp line can be drawn between pathogenic and non-pathogenic Schizomycetes, and some of the most marked steps in the progress of our mode'tn knowledge of these organisms depend on the ^^^"f"""" discovery that their pathogenicity or vir'ulence can be modified — diminished or increased — by definite treatment, and, in the natural course of epidemics, by alterations in the environment. Similarly we are unable to divide Schizomycetes sharply into parasites and sapro- phytes, since it is well proved that a number of species — facultative parasites — can become one or the other accord- ing to circumstances. These facts, and the further know- ledge that many bacteria never observed as parasites, or as pathogenic forms, produce toxins or poisons as the result of their decompositions and fermentations of or- ganic substances, have led to important results in the applications of bacteriology to medicine.

Bacterial diseases in the higher plants have been described, but the subject requires careful treatment, since several points suggest doubts as to the organism described being the cause of the f^^/J,°g'^ disease referred to their agency. Until recently it was urged that the acid contents of plants explained their immunity from bacterial diseases, but it is now known that many bacteria can flourish in acid media. Another objection was that even if bacteria obtained

access through the stomata, they could not penetrate the cell-walls bounding the intercellular spaces, for although certain anaerobic forms are knowii to

ferment cellulose, no undoubted bacterium has been shown to possess the power of penetrating the cell-walls of living cells, unless we except the bacteroids of Leguminoseee first described by Marshall Ward in 1887, and confirmed by Miss Dawson in 1898. On the other hand a long list of plant-diseases have been of late years attributed to bacterial action. Some, e.g., wet rot of potatoes, the Sereh disease of the sugar-cane, the slime fluxes of oaks and other trees, are not only very doubtful cases, in which other organisms such as yeasts and fungi play their parts, but it may be regarded as extremely improbable that the bacteria are the primary agents at all ; they are doubtless saprophytic forms which have gained access to rotting tissues injured

Fig. 10.— -The Ginger-beer plant. A, one of the bfain-like gelatinous masses into which the mature "plant" condenses^; B, the bacterium with and without its gelatinous sheaths (cf. Fig. 9) ; C, typical filaments and rodlets in the slimy sheaths ; D, stages of growth of a sheathed filament^ rr at 9 a.m., 6 at 3 p.m., c at 9 p.m., d at 11 a.m. next day, e at S p.m., /at 9 p.m., g at 10.80 a.m. next day, A at 24 hours later. {Original.)

by other agents. Saprophytic bacteria can readily make their way down the dead hypha of an invading fungus, or into the punctures made by* insects, and Aphides have been credited with the bacterial infection of carnations, though more recent researches by Woods go to show the correctness of his conclusion that Aphides alone are re- sponsible for the carnation disease. On the other hand, recent investigation has brought to light cases in which bacteria appear to be the primary agents in certain diseases of plants. The principal features are the stop- page of the vessels and consequent wilting of the shoots ; as a rule the cut vessels on transverse sections of the shoots appear brown and choked with a dark yellowish slime in which bacteria may be detected, e.g., cabbages, cucumbers, potatoes, &c. In the carnation disease and in certain diseases of tobacco and other plants the seat of bacterial action appears to be the parenchyma, and it may

Sym- biosis.

be that Aphides or other piercing insects infect the plants, much as insects convey pollen from plant to plant, or (though in a different way) as mosquitoes infect man with malaria. If the most recent work on the cabbage

~~disease may be accepted, the bacteria make their entry at the water pores at the margins of the leaf, and thence viA the glandular cells to the tracheids. Nothing is known of the mode of action of bacteria on these plants, but it may be assumed with great confidence that they excrete enzymes and poisons (toxins), which diffuse into the cells and kill them, and that the effects are in principle the same as those of parasitic fungi. Support is found for this opinion in Beyerinck's discovery vthat the juices of tobacco plants affected with the disease known as " leaf mosaic," will induce this disease after filtration through porce- lain.~~

~~In addition to such cases as the Kephir and Ginger-beer plants (Figs. 9, 10), where anaerobic bacteria are associated with yeasts, several interesting examples of sym- biosis among bacteria are now known. Bacillus chauvoei ferments cane-sugar solutions in such a way that normal butyric acid, inactive lactic acid, carbon- dioxide, and hydrogen result ; Micrococcus acidi-paralactici, on the other hand, ferments such solutions to optically active paralactic acid. Nencki showed, however, that if both these organisms occur together, the resulting pro- ducts contain large quantities of normal butyl alcohol, a substance neither bacterium can produce alone. Other observers have broiight forward other cases. Thus neither B. coli nor the B. denitrificans of Burri and Stutzer can reduce nitrates, but if acting together they so completely undo the structure of sodium nitrate that the nitrogen passes off in the free state. Van Senus showed that the concurrence of two bacteria is necessary before his B. amylobacter can ferment cellulose, and the case of mud bacteria which evolve sulphuretted hydrogen below which is utilized by sulphur bacteria above has already been quoted, as also that of Winogradsky's Clostridium pasteur- ianum, which is anaerobic, and can fix nitrogen only if protected from oxygen by aerobic species. It is very prob- able that numerous symbiotic fermentations in thfe soil are due to this co-operation of okygen-protecting species with anaerobic ones, e.g.. Tetanus.~~

~~Astonishment has been frequently expressed at the powerful activities of bacteria — their rapid growth and dissemination, the extensive and profound decompositions and fermentations induced by ^^'J°* them, the resistance of their spores to desiccar tion, heat, &c. — but it is worth while to ask how far these properties are really remarkable when all the data for~~

~~comparison with other organisms are considered. In the first place, the extremely small size and isolation of the vegetative cells place the protoplasmic contents in peculiarly favourable circumstances for action, and we may safely conclude that, weight for weight and molecule for molecule, the protoplasm of bacteria is brought into contact with the environment at far more points and over a far larger surface than is that of higher organisms, whether — as in plants — it is distributed in thin layers round the sap-vacuoles, or — as in animals — is bathed in fluids brought by special mechanisms to irrigate it. Not only so, the isolation of the cells facilitates the exchange of liquids and gases, the passage in of food materials and out of enzymes and products of metabolism, and thus each unit of protoplasm obtains opportunities of im- mediate action, the results of which are removed with equal rapidity, not attainable in more complex multi- cellular organisms. To put the matter in another way, if we could imagine all the living cells of a large oak or of a horse, having given up the specializations of function impressed on them during evolution and simply carrying~~

~~general]~~

~~out the fundamental functions of nutrition, growth, and multiplication which mark the generalized activities of the bacterial cell, and at the same time rendered as accessible to the environment by isolation and consequent extension of surface, we should doubtless find them exert- ing changes in the fermentible fluids necessary to their life similar to those exerted by an equal mass of bacteria, and that in proportion to their approximation in size to the latter. Ciliary movements, which undoubtedly con- tribute in bringing the surface into contact with larger supplies of oxygen and other fluids in unity of time, are not so rapid or so extensive when compared with other standards than the apparent dimensions of the microscopic field. The microscope magnifies the distance traversed as well as the organism, and although a bacterium which~~

~~covers 9-10 cm. or -f more in 16 minutes~~

— say 0-1 mm. or 100 ju. per second — appears to be dart- ing across the field with great velocity, because its own small siz e — s a y 5×1 ju, — comes into comparison, it should be borne in mind that if a mouse 2 inches long only, travelled twenty times its own length, i.e., 40 inches in a second, the distance tra- versed in 15 minutes at that rate, viz., 1000 yards, would not appear excessive. In a similar way we must be careful, in our wonder at the marvellous rapidity of cell-division and growth of bacteria, that we do not exaggerate the significance of the pheno- menon. It takes any ordinary rodlet 30-40 minutes to double its length and divide into two equal daughter cells when growth is at its best (see Figs. 4 and 5) ; nearer the

Fig. 11. — A. plate-culture colony of a speciea of Bacillus — Proteus (Hauser) — on the fifth day. The flame-like processes and outliers are com- poaed of writhing filaments, and the con- tours are continually chang^ing while the colony moves as a whole. Slightly magnified. i^Original.)

Fig. 12.— Portions of a colony saoh as that in Fig. 11, highly magnified, showing the kinds of changes brought about in a few minutes, from A to B, and B to C, by the growth and ciliary movements of the filaments. The arrows show the direction of motion. (Original.’)

minimum it may require 3-4 hours or even much longer. It is by no means certain that even the higher rate is greater than that exhibited by a tropical bamboo which will grow over a foot a day, or even common grasses, or asparagus, during the active period of cell-division, though the phenomenon is here complicated by the phase of extension due to intercalation of water. The enormous extension

of surface also facilitates the absorption of energy from the environment, and, to take one case only, it is impos- sible to doubt that some source of radiant energy must be at the disposal of those prototrophic forms which decom- pose carbonates and assimilate carbonic acid in the dark and oxidize nitrogen in dry rocky regions where no organic materials are at their disposal, even could they utilize them. It is usually stated that the carbon-dioxide molecule is here split by means of energy derived from the oxidation of nitrogen, but apart from the fact that none of these processes can proceed until the tempera- ture rises to the minimum cardinal point, Engelmann’s experiment shows that in the purple bacteria rays are used

~~other than those employed by green plants, and especially ultra-red rays not seen in the spectrum, and we may probably conclude that "dark rays" — i.e., rays not appearing in the visible spectrum — are absorbed and employed by these and other colourless bacteria. The purple bacteria have thus two sources of energy, one by the oxidation of sulphur Und another by the absorption of " dark rays." Stoney {Scient. Proc. B. Dub. Soc, 1893, p. 154) has suggested yet another source of energy, in the bombardment of these minute masses by the molecules of the environment, the velocity of which is sufBcient to drive them well into the organism, and carry energy in of which they can avail themselves.~~

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~~II. Pathological.~~

~~The action of bacteria as pathogenic agents is in great part merely an instance of their general action as pro- ducers of chemical change, yet bacteriology as Ba^ro- ^ whole has become so extensive, and has so important a bearing on subjects widely different from one another, that division of it has become essential. The science will accordingly be treated in this section from the pathological standpoint only. It will be considered under the three following heads, viz. (1) the methods em ployed in the study; (2) the modes of action of bacteria and the effects produced by them ; and (3) the facts and theories with regard to immunity against bacterial disease. The demonstration by Pasteur (see Schizomycbtbs, Ency. Brit., ninth ed.) that definite diseases could be pro- duced by bacteria, proved a great stimulus to summon', research in the etiology of infective conditions, and the result was a rapid advance in human knowledge. An all-important factor in this remarkable progress was the introduction by Koch of solid culture media, of the " plate-method," &ci, an account of which' he published in 1881. By means of these the modes of cul- tivation, and especially of separation, of bacteria were greatly simplified. Various modificationg'have since been made, but the routine methods in bacteriological procedure still employed are in great part those given by Koch. By 1876 the anthrax bacillus had been obtained in pure culture by Koch, and some other pathogenic bacteria had been observed in the tissues, but it was in the decade 1880-90 that the most important discoveries were made in this field. Thus the bacteria of suppuration, tubercle, glanders, diphtheria, typhoid fever, cholera, tetanus, and others were identified, and their relationship to the individual diseases established. In the last decade of the 19th cen- tury the chief discoveries were of the bacillus of influenza (1892) and of the bacillus ofplague (1894).i Immunity against diseases produced by bacteria has been the sub- ject of systematic research from 1880 onwards. In pro- ducing active immunity by the attenuated virus,~~

~~Duguid and Burdon-Sanderson, and Greenfield in Great Britain, and Pasteur, Toussaint, and Chauveau in Prance, were pioneers. The work of Metchnikoff, dating from about 1884, has proved of high importance, his theory of phagocytosis having proved a great stimulus to research, and having also contributed to important advances. The modes by which bacteria produce their effects also became a subject of study, and attention was naturally turned to their toxic products. The earlier work, notably that of Brieger, chiefly concerned ptomaines (vide infra), but no great advance resulted. A new field of inquiry was, however, opened up when, by filtration, a bacterium-~~

~~1 A bacillus (B. icteroides) was described as the cause of yellow fever by Sanarelli in 1897, but the etiology of this disease must still C1901) be considered as subjudice.~~

~~free toxic fluid was obtained which produced the important symptoms of the disease — in the case of diphtheria by Eoux and Yersin (1888), and in the case of tetanus a little later by various observers. Research was thus directed towards ascertaining the nature of the toxic bodies in such a fluid, and Brieger and Fraenkel (1890) found that they were proteids, to which they gave the name "toxalbumins." Though subsequent researches have on the whole con- firmed these results, it is still a matter of dispute whether these proteids are the true toxins or merely contain the ' toxic bodies precipitated along with them. In the United Kingdom the work of Sidney Martin, in the separation of toxic substances from the bodies of those who have died from certain diseases, is also worthy of mention. Immunity against toxins also became a subject of investigation, and the result was the discovery of the antitoxic action of ' the serum of animals immunized against tetanus toxin by Behring and Kitasato (1890), and by Tizzoni and Cattani. A similar result was also obtained in the case of diphtheria. The facts with regard to passive immunity were thus, established, and were put to practical application by the introduction of diphtheria antitoxin as a therapeutic agent in 1894. The technique of serum preparation has become since that time greatly elaborated and improved, the work of Ehrlich in this respect being specially noteworthy. The laws of passive immunity were shown to hold also in the case of immunity against living organisms by Pfeiffer (1894), and various anti-bacterial sera have been intro- duced. Of~~

these the anti-streptococcic serum of Marmorek (1895) is probably the most important. The principles of protective inoculation have been developed and prac- tically applied on a large scale, notably by Haffkine in the case of cholera (1893) and plague (1896), and recently by Wright and Semple in the case of typhoid fever. One other discovery of great importance may be mentioned, viz., the agglutinative action of the serum of a patient suffering from a bacterial disease, first discovered in the case of typhoid fever independently by Widal and by Griinbaum in 1896, though led up to by the work of Pfeiffer, Gruber and Durham, and others. Thus a new aid was added to medical science, viz., serum diagnosis of disease. It will thus be seen that the last decade of the 19th century was largely occupied with the investiga- tion of toxins, of questions of immunity, and of the prop- erties of the serum of immunized animals ; it will stand out in the history of medical science as the period in which serum therapeutics and serum diagnosis had their birth.

The methods employed in studying the relation of bacteria to disease are in principle comparatively simple,, but considerable experience and great care are necessary in applying them and in interpreting Ji{ethods results. In any given disease there are three "*"■>'• chief steps, viz. (1) the discovery of a bacterium in the- affected tissues by means of the microscope ; (2) the obtain- ing of the bacterium in pure culture; and (3) the production of the disease by inoculation with a pure culture. By means, of microscopic examination more than one organism may sometimes be observed in the tissues, but one single organ- ism by its constant presence and special relations to the tissue changfes can usually be selected as the probable cause of the disease, and attempts towards its cultivation can then be made. Such microscopic examination requires the use of the finest lenses and the application of various staining methods. In these latter the basic aniline dyes in solution are almost exclusively used, on account of their special affinity for the bacterial protoplasm. The methods vary much in detail, though in each case the endeavour is to- colour the bacteria as deeply, and the tissues as faintly, as possible. Sometimes a simple watery solution of the dye is sufficient, but very often the best result is obtained by

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increasing the staining power, e.g., by addition of weak alkali, application of heat, &c., and by using some sub- stance which acts as a mordant and tends to fix the stain to the bacteria. Excess of stain is afterwards removed from the tissues by the use of decolourizing agents, such as acids of varying strength and concentration, alcohol, &c. Different bacteria behave very differently to stains ; some take them up rapidly, others slowly, some resist decolorization, others are easily decolourized. In some instances the stain can be entirely removed from the tissues, leaving the bacteria alone coloured, and the tissues can then be stained by another colour. This is the case in the methods for staining the tubercle bacillus and also in Gram's method, the essential point in which latter is the treatment with a solution of iodine before decolourizing. In Gram's method, however, only some bacteria retain the stain, while others lose it. The tissues and fluids are treated by various histological methods, but, to speak generally, examination is made either in films smeared on thin cover-glasses and allowed to dry, or in thin sections cut by the microtome after suitable hardening and fixation of the tissue. In the case of any bacterium discovered, observation must be made in a long series of instances in order to determine its invariable presence.

In cultivating bacteria outside the body various media to serve as food material must be prepared and sterilized by heat. The general principle in their prepa- ration is to supply the nutriment in a form as nearly similar as possible to that of the natural habitat of the bacterium — in the case of pathogenic bacteria, the natural fluids of the body. The media are used either in a fluid or solid condition, the latter being obtained by a process of coagulation, or by the addition of a gelatinizing agent, and are placed in glass tubes or flasks plugged with cotton-wool. To mention examples, blood serum solidified at a suitable temperatiire is a highly suitable medium, and various media are made with extract of meat as a basis, with the addition of gelatine or agar as solidifying agents and of non-coagulable proteids (commercial " peptone ") to make up for proteids lost by coagulation in the

~~preparation. The reaction of the media must in every case be carefully attended to, a neutral or slightly alkaline reaction being, as a rule, most suitable. The media from the store-flasks are placed in glass test-tubes or small flasks, protected from contamina- tion by cotton-wool plugs, and are sterilized by heat. As a rule the solid media are to be preferred, since bacterial growth appears as a discrete mass and accidental con- tamination can be readily recognized. Cultures are made by transferring by means of a sterile platinum wire a little of the material containing the bacteria to the medium. The tubes, after being thus inoculated, are kept at suitable temperatures, usually either at 37° C, the temperature of the body, or at about 20° C, a warm summer temperature. Tor maintaining a constant temperature incubators with regulating apparatus are used. The simplest case is that in which only one variety of bacterium is present, and a "pure culture" may then be obtained at once. When, however, several species are present together, means must be adopted for separating them. For this purpose various methods have been devised, the most important being the plate-method of Koch. In this method the bacteria are distributed in a gelatine or agar medium liquefied by heat, and the medium is then poured out on sterile glass plates or in shallow glass dishes, and allowed to solidify. Each bacterium capable of growth gives rise to a colony visible to the naked eye, and, if the colonies are sufiicieutly apart, an inoculation can be made from any one to a tube of culture-medium and a pure culture obtained. Of course, in applying the method means must be adopted**

~~for suitably diluting the bacterial mixture. Another important method consists in inoculating an animal with some fluid containing the various bacteria. A pathogenic bacterium present may invade the body, and may be obtained in pure culture from the internal organs. This method applies especially to pathogenic bacteria whose growth on culture media is slow, e.g., the tubercle bacillus.~~

~~The full description of a particular bacterium implies an account not only of its microscopical characters, but also of its growth characters in various culture media, its biological properties, and the effects produced in animals by inoculation. To demonstrate readily its action on various substances, certain media have been devised. For example, lactose and the other sugars are added to test the action of the bacterium on these substances ; litmus is~~

~~added to show changes in reaction, specially standardized media being used for estimating such changes ; peptone solution is commonly employed for testing whether or not the bacterium forms indol ; ster- ilized milk is used as a culture medium to determine whether or not it is curdled by the growth. Sometimes a bacterium can be readily recognized from one or two characters, but not infrequently a whole series of tests must be made before the species is determined ; this is, for example, the case with members of the bacillus coli group.~~

~~The modes of cultivation described apply only to organisms which grow in presence of oxygen. Some, however — the strictly anaerobic bacteria — grow only in the absence of oxygen, hence means must be adopted for excluding this gas. It is found that if the inoculation be made deep down in a solid medium, growth of an anaerobic organism will take place, especially if the medium contains some reducing agent such as glucose. Such cultures are called " deep cultures." To obtain growth of an anaerobic organism on the surface of armedium, in using the plate method, and also for cultures in fluids, the air is dis- placed by an indifferent gas, usually hydrogen.~~

~~In testing the effects of bacteria by iuoculation the smaller rodents, rabbits, guinea pigs, and mice, are usually employed. One great drawback in certain cases is that such animals are not susceptible to a given bacterium, or that the disease is different in character from that in the human subject. In some cases, e.g., Malta fever and relapsing fever, monkeys have been used with success, but in others, e.g., leprosy, none of the lower animals have been fohnd to be susceptible. Discretion must therefore be- exercised in interpreting negative results in the lower animals. For purposes of inoculation young vigorous cultures must be used. The bacteria are mixed with some indifferent fluid, or a fluid culture is employed. The injections are made by means of a hypodermic syringe into the subcutaneous tissue, into a vein, into one of the serous sacs, or more rarely into some special part of the body. The animal, after injection, must be kept in favourable surroundings, and any resulting symptoms noted. It may die, or may be killed at any time desired, and then a post-mortem examination is made, the con- ditions of the organs, &c., being observed and noted. The various tissues affected are examined microscopically and cultures made from them~~

; in this way the structural changes and the relation of bacteria to them can be- determined.

Though the causal relationship of a bacterium to a. disease may be completely established by the methods given, another very important part of bacteriology is concerned with the poisons or toxins formed by bacteria. These toxins lAay become free in the culture fluid, and the living bacteria may then be got rid of by filtering through a filter of unglazed porcelain, whose pores are

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sufficiently small to retain them. The passage of the

fluid is readily effected by negative pressure ■ottoj^s." prodiiced by an ordinary water exhaust-pump.

The effects of the filtrate are then tested by the methods used in pharmacology. In other instances the toxins are retained to a large extent within the bacteria, •and in this case the dead bacteria are injected as a suspension in fluid. Sometimes, as in the preparation of Koch's new tuberculin, the bacteria are bruised in an .agate mortar, so as to set free the intracellular toxins. The bacteria are usually killed by chloroform vapour or some volatile antiseptic, the agent used being afterwards got rid of by evaporation ; when the toxins are comparar tively resistant to heat, a suitable temperature may be used for the purpose. The study of the nature of toxins requires of course the various methods of organic chemistry. Attempts to obtain them in an absolutely pure condition have, however, failed in important cases. So that when a " toxin " is spoken of, a mixture with other organic substances is usually implied. Or the toxin may be precipitated with other organic substances, purified to a certain extent by re-solution, re-precipitation, &c., and desiccated. A " dry toxin " is thus

obtained, though still in an impure condition. Toxic substances have also been separated by corresponding methods from the bodies of those who have died of certain diseases, and the action of such substances on animals is in some ■cases an important point in the pathology of the disease. Another auxiliary method has been applied in this ■department, viz., the separation of organic substances by filtration under high pressure through a colloid membrane, gelatine supported in the pores of a porcelain filter being usually employed. It has been found, for ■example, that a toxin may pass through such a filter while an antitoxin may not. The methods of pro- ducing immunity will be described in connexion with that subject.

The fact that in anthrax, one of the first diseases to be fully studied, numerous bacilli are present in the blood of

infected animals, gave origin to the idea that Bacteria ■j^jj^g organisms might produce their effect by Tt^swse. using up the oxygen of the blood. Such

action is now known to be quite a subsidiary matter. And although effects may sometimes be pro- duced in a mechanical manner by bacteria plugging ■capillaries of important organs, e.g., brain and kidneys, it may now be stated as an accepted fact that all the important results of bacteria in the tissues are due to poisonous bodies or toxins formed by them. Here, just as in the general subject of fermentation, we must inquire whether the bacteria form the substances in question directly or by means of non-living ferments or enzymes. With regard to toxin formation the following general statements may be made. In certain instances, e.g., in the case of the tetanus and diphtheria bacilli, the pro- duction of soluble toxins can be readily demonstrated by filtering a culture in bouillon germ-free by means of a porcelain filter, and then injecting some of the filtrate into an animal. In this way the characteristic features of the disease can be reproduced. Such toxins being set free in the culture medium are often known as extra- cellular. In many cases, however, the filtrate, when injected, produces comparatively little effect, whilst toxic action is observed when the bacteria in a dead con- dition are used; this is the case with the organisms of tubercle, cholera, typhoid, and many others. The toxins are here manifestly contained within the bodies of the bacteria, i.e., are intracellular, though

they may become free on disintegration of the bacteria. The dis- tinction between the two varieties, though convenient, must not be pushed too far, as we know little regarding

their mode of formation. Although the formation of toxins with characteristic action can be demonstrated by these two methods, it must not be inferred that this can be done in every instance. On the contrary, it is highly probable that some toxins are only produced in the living tissues. We have at least examples of intense local toxic action round living bacteria, which have not yet been repro- duced by means of separated toxins. Not only are the general symptoms of poisoning in bacterial disease due to toxic substances, but also the tissue changes, many of them of inflammatory nature, in the neighbourhood of the bacteria. Thus, to mention examples, diphtheria toxin produces inflammatory oedema which may be followed by necrosis ; dead tubercle bacilli give rise to a tubercle-like nodule, &c. Furthermore a bacillus may give rise to more than one toxic body, either as stages in one process of change or as distinct products. Thus paralysis fol- lowing diphtheria is in all probability due to a particular modification of the ordinary toxin, sometimes formed in specially large amount.

Eegarding the chemical nature of toxins less is known than regarding their physiological action. Though an enormous amount of work has been done on the subject, no important bacterial toxin has ^’bs” as yet been obtained in a pure condition, and, though many of them are probably of proteid- nature, even this cannot be asserted with absolute certainty. Brieger, in his earlier work, found that alkaloids were formed by bacteria in a variety of conditions, and that some of them were poisonous. These alkaloids he called ptomaines. The methods used in the investigations were, however, open to objection, and it is now recognized that although organic bases may sometimes be formed, and may be toxic, the important toxins are not of that nature. A later research by Brieger along with Fraenkel pointed to the extracellular toxins of diphtheria, tetanus, and other diseases being of pi;oteid nature, and various other observers have arrived at a like conclusion. The general result of such research has been to show that the toxic bodies are, like proteids, precipitable by alcohol and various salts ; they are soluble in water, are somewhat easily dialysable, and are relatively unstable both to light and heat. Attempts to get a pure toxin by repeated

precipitation and solution have resulted in the produc- tion of a whitish amorphous powder with highly toxic properties. Such a powder gives a proteid reaction, and is no doubt largely composed of albumoses, hence the name toxalbumoses has been applied. The question has, however, been raised whether the toxin is really itself a proteid, or whether it is not merely carried down with the precipitate. Eecently Brieger and Boer have, by precipitation with certain salts, notably of zinc, obtained a body which is toxic but gives no reaction of any form of proteid. There is of course the possibility that the toxia is a proteid, but is in so small amount that it escapes detection. These facts show the great difficulty of the problem, which is probably insoluble by present methods of analysis; 'the only test, in fact, for the existence of a toxin is its physiological effect. It may also be mentioned that many toxins 'have now been obtained by growing the particular organism in a proteid-free medium, a fact which shows that if the toxin is a proteid it may be formed synthetically by the bacterium as well as by modification of proteid already present. With regard to thfe nature of intracellular toxins, there is even greater difl&culty in the investiga- tion and still less is known. Many of them, probably also of proteid nature, are much more resistant to heat; thus the intracellular toxins of the tubercle bacillus retain certain of their effects even after ex- posure to 100° C.

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We cannot as yet speak definitely with regard to the part played by enzymes in these toxic processes. Certain BBxymes. °,'s resemble enzymes as regards their con- ditions of precipitation and relative instability, and the fact that in most cases a considerable period interyenes between the time of injection and the occur- rence of symptoms has been adduced in support of the Yiew that enzymes are present. In the case of diphtheria Sidney Martin obtained toxic albumoses in the spleen, which he considered were due to the digestive action of an enzyme formed by the bacillus in the membrane and absorbed into the circulation. According to this view, then, a part at least of the directly toxic substance is produced in the living body by enzymes present in the so- called toxin obtained from the bacterial culture. Ee- cent researches go to show that enzymes play a greater part m fermentation by living ferments than was for- merly supposed, and by analogy it is

likely that they are also concerned in the processes of disease. But this has not been proved, and hitherto no enzyme has been sepa- rated frorii a pathogenic bacterium capable of forming, by digestive or other action, the toxic bodies from pro- teids outside the body.

The action of toxins is little understood. It consists in all probability of disturbance, by means of the chemical affinities of the toxin, of the highly complicated molecules of living cells. This disturbance results in disintegration to a varying degree, and may produce changes visible on microscopic examination. In other cases such changes cannot be detected, and the only evidence of their occur- rence may be the associated symptoms. The very impor- tant work of Ehrlich on diphtheria toxin shows that in the molecule of toxin there are at least two chief atom groups — one, the " haptophorous," by which the toxin nJolecule is attached to the cell protoplasm; and the other the "toxophorous," which has a ferment-like action on the living molecule, producing a disturbance which results in the toxic symptoms. On this theory, susceptibility to a toxin will imply hoth a chemical affinity of certain tissues for the toxin molecule and also sensitiveness to its action. A bacterial infection when analysed is seen to be of the nature of an intoxication. There is, however, another all- important factor concerned, viz., the multipliea- ^atKti'oa *^°'^ ^^ *^^ living organisms in the tissues; this is essential to, and regulates, the supply of toxins. It is important that these two essential factors should be kept clearly in view, since the means of defence against any disease may depend either upon the power of neutralizing toxins or of killing the organisms producing them. It is to be noted that there is no fixed relation between toxin production and bacterial multiplication in the body, some of the organisms most active as toxin producers having comparatively little power of invading the tissues.

We shall now consider how bacteria may behave when they have gained entrance to the body, what effects may be produced, and what circumstances may mod- Tbe pro- j^fy ^jj^g disease in any particular case. The ex- d^Mse. ° treme instance of bacterial invasion is found in some of the septicaemias in the lower animals, e.g., anthrax septicaemia in guinea- pigs, pneumococcus septicaemia in rabbits. In such diseases the bacteria, when introduced into the subcutaneous tissue, rapidly gain en- trance to the

blood stream and multiply freely in it, and by means of their toxins cause symptoms of general poi- soning. A widespread toxic action is indicated by the lesions found — cloudy swelling, which may be followed by fatty degeneration, in internal organs, capillary haemor- rhages, &c. In septicaemia in the human subject, often due to streptococci, the process is similar, but the organisms are found especially in the capillaries of the internal

organs and may not be detectable in the peripheral circu- lation during life. In another class of diseases, the organisms first produce some well-marked local lesion, from which secondary extension takes place by the lymph or blood stream to other parts of the body, where corre- sponding lesions are formed. In this way secondary ab- scesses, secondary tubercle glanders and nodules, &c., result ; in typhoid fever there is secondary invasion of the mesenteric glands, and clumps of bacilli are also found in internal organs, especially the spleen, though there may be little tissue change around them. In all such diseases there is seen a selective character in the distribution of the lesions, some organs being in any disease much more liable to infection than others. In still another class of diseases the bacteria flourish in some particular part of the body, and the symptoms are due to toxic absorption from it. Thus in cholera the bacteria are practically confined to the intestine, in diphtheria to the region of the false membrane, in tetanus to some wound. In the last-men- tioned disease even the local multiplication depends upon the presence of other bacteria, as the tetanus bacillus has practically no power of multiplying in the healthy tissues when introduced alone.

The effects produced by bacteria may be considered under the following heads : (1) tissue changes produced in the vicinity of the bacteria, either at the primary or secondary foci ; (2) tissue changes produced at a distance by absorption of their toxins; (3) symptoms. The changes in the vicinity of bacteria are to be regarded partly as the direct result of the action of toxins on living cells, and partly as indicating a reOiC- ‘^^g^ tion on the part of the tissues. (Many such changes are usually grouped together under the heading of “inflammation” of varying degree — acute, subacute, and chronic.) Degeneration and necrosis of cells, haemor- rhages, serous and fibrinous exudations, leucocyte emi- gration, proliferation of connective tissue and other cells, may be mentioned as some of the fundamental

changes. Acute inflammation of various types, suppuration, granu- lation tissue formation, &c., represent some of the com- plex resulting processes. The changes produced at a distance by distribution of toxins may be very manifold — cloudy swelling and fatty degeneration, serous effusions, capillary hfemorrhages, various degenerations of muscle, hyaline degeneration of small blood-vessels, and, in cer- tain chronic diseases, waxy degeneration, all of which may be widespread, are examples of the effects of toxins, rapid or slow in action. Again, in certain cases the toxin has a special afHuity for certain tissues. Thus in diphtheria changes both in nerve cells and nerve fibres have been found, and in tetanus minute alterations in the nucleus and protoplasm of nerve cells.

The lesions mentioned are in many instances neces- sarily accompanied by functional disturbances or clinical symptoms, varying according to site, and to the nature and degree of the affection. In •’”’’’’’’’’*• addition, however, there occur in bacterial diseases symp- toms to which the correlated structural changes have not yet been demonstrated. Amongst these the most im- portant is fever with increased proteid ^ metabolism, attended with disturbances of the circulatory and res- piratory systems. Nervous symptoms, somnolence, coma, spasms, convulsions, and paralysis are of common occur- rence. All such phenomena, however, are likewise due to the disturbance of the molecular constitution of living cells. Alterations in metabolism are found to be asso- ciated with some of these, but with others no correspond- ing physical change can be demonstrated. The action of toxins on various glands, producing diminished or in- creased functional activity, has a close analogy to that of certain drugs.

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~~The result of the entrance of a' given bacterium into the tissues of an animal is not a disease with hard and fast characters, but varies greatly with circumstances. With regard to the subject of infection the chief factor is susceptibility ; with regard to the bacterium virulence is all-important. Susceptibility, as is well recognized, varies much under natural conditions in different species, in different races of the same species, and amongst individuals of the same race. It also varies with the period of life, young subjects being more susceptible to certain diseases, e.g.,' diphtheria, than adults. Further, there is the very important factor of acquired susceptibility. It has been experimentally shown that conditions such as fatigue, starvation, exposure to cold, &c., lower the general resist- ing powers and increase the susceptibility to bacterial infection. So also the local powers of resistance may be lowered locally by injury or depressed vitality. In this way conditions formerly believed to be the causes of disease are now recognized as playing their part in predisposing to the action of the true causal agent, viz., the bacterium. In health the blood and internal tissues are bacterium-free; after death they offer a most suitable pabulum for various bacteria; but between these two extremes lie states of varying liability to infection. The circumstances which alter the virulence of bacteria will be referred to again in connexion with immunity, but it may be stated here that, as a general rule, the virulence of an organism towards an animal is increased by sojourn in the tissues of that animal. The increase of virulence becomes especially marked when the organism is inocu- lated from animal to animal in series, the method of pass- age. This is chiefly to be regarded as an adaptation to sur- roundings, though the fact that the less virulent members of the bacterial species will be liable to be killed off also plays a part. Conversely, the virulence tends to dimin- ish on cultivation on artificial media outside the body, especially in circumstances little favourable to growth.~~

~~By immunity is meant non-susceptibility to a given disease, or to experimental inoculation with a given bacterium or toxin. The term must be used in Immunity. ^ relative sense, and account must always be taken of the conditions present. An animal may be readily susceptible to a disease on experimental inoculation, and yet rarely or never suffer from it naturally, because the necessary conditions of infection are not supplied in nature. That an animal possesses natural immunity can only be shown on exposing it to such conditions, this being usually most satisfactorily done in direct~~

~~experiment. Further, there are various degrees of immunity, and in this connexion conditions of local or general diminished vitality play an important part in increasing the suscep- tibility. Animals naturally susceptible may acquire im- munity, on the one hand by successfully passing through an attack of the disease, or, on the other hand, by various methods of inoculation. Two chief varieties of artificial immunity are now generally recognized, differing chiefly according to the mode of production. In the first — active immunity — a reaction or series of reactions is produced in the body of the animal, usually by injections of bacteria or their products. The second — passive immunity — is pro- duced by the transference of a quantity of the serum of an animal actively immunized to a fresh animal ; the term is applied because there is brought into play no active change in the tissues of the second animal. The methods of active immunity have been practically applied in pre- ventive inoculation against disease ; those of passive im- munity have given us serum therapeutics. The chief facts with regard to each may now be stated.~~

~~I. Active Immunity. — The key to the artificial estab- lishment of active immunity is given by the fact long~~

~~established that recovery from an attack of certain infec- tive disffiises is accompanied by protection for varying periods of time against a subsequent attack. Hence fol- lows the idea of producing a modified attack of the disease as a means of prevention — a principle which had been previously applied in inoculation against smallpox. Immunity, however, probably results from certain sub- stances introduced into the system during the disease rather than from the disease itself ; for by properly ad- justed doses of the poison (in the widest sense), immunity may result without any symptoms of the disease occurring. Of the chief methods used in producing active immunity the first is by inoculation with bacteria whose virulence has been diminished, i.e., with an "attenuated virus." Many of the earlier methods of attenuation were devised in the case of the anthrax bacillus, an organism which is, however, somewhat exceptional as regards the relative stability of its virulence. Many such methods consist, to speak generally, in growing the organism outside the body under somewhat imsuitable conditions, e.g., at higher temperatures than the optimum, in the presence of weak antiseptics, &c. The virulence of many organisms, how- ever,~~

~~becomes diminished when they are grown on artifi- cial media, and the diminution is sometimes accelerated by passing a current of air over the surface of the growth. Sometimes also the virulence of a bacterium for a par- ticular kind of animal becomes lessened on passing it through the body of one of another species. Cultures of varying degree of virulence can be obtained by such methods, and immunity can be gradually increased by inoculation with vaccines of increasing virulence. The immunity may be made to reach a very high degree by ultimately using cultures of intensified virulence, this " supervirulent " character being usually attained by the method of passage already explained. A second method is by inj ection of the bacterium in the dead condition, whereby immunity against the living organism may be produced. Here manifestly the dose may be easily controlled, and may be gradually increased in successive inoculations. This method has a wide application. A third method is by injections of the separated toxins of a bacterium, the resulting immunity being not only against the toxin, but, so far as present knowledge shows, also against the living organism. It appears to be a general law that, when an animal becomes immune to the toxic products of an organ- ism, the latter ceases to be able to flourish in its tissues. In the development of toxin-immunity the doses, small at first, are gradually increased in successive inoculations ; or, as in the case of very active toxins, the initial inj ections are made with tc*xin modified by heat or by the addition of various chemical substances. Immunity of the same nature can be acquired in the same way against snake and scorpion, poisons, and against certain vegetable toxins, e.g., ricin, alorin, &c.~~

~~In order that the immunity may reach a high degree, either the bacterium in a very virulent state or a large dose of toxin must ultimately be used in the injections. In such cases the immunity is, to speak generally, specific, i.e., applies only to the bacterium or toxin used in its production. A certain degree of non-specific immunity or increased tissue resistance may be produced locally, e.g., in the peritoneum, by injections of non-pathogenic organ- isms, peptone, nucleic acid, and various other substances. In these cases the immunity is without specific character, and cannot be transferred to another animal. Lastly, in a few instances one organism has an antagonistic action, to another ; for example, the products of B. pyocyaneus~~

have a certain protective action against B. anthracis. This method has, however, not yielded any important practical application,

II. Passive Immunity: Anti-sera. — The serum of an

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animal actively immunized may have one of two proper- ties— it may be antitoxic or it may be anti-bacterial. Antit xi '^^^ *^^"^ antitoxic signifies that the serum has serum^ " ^^^. po^er of neutralizing the action of the

toxin, as is shown by mixing them together outside the body and then injecting them into an animal. The antitoxic serum when injected previously to the toxin also confers immunity (passive) against it; when injected after the toxin it has within certain limits a curative action, though in this case its dose requires to be large. The antitoxic property is developed in a sus- ceptible animal by successive and gradually increasing doses of the toxin. In the earlier experiments On smaller animals the potency of the toxin was modified for the first injections, but in preparing antitoxin for therapeu- tical purposes the toxin in its unaltered condition is used, the horse being the animal usually employed. The injections are made subcutaneously and afterwards in- travenously. To obtain high antitoxic power the toxin must, at least ultimately, be a powerful one ; and, while the dose must be gradually increased, care must be taken that this is not done too quickly, otherwise the antitoxic power of the serum may fall and the health of the ani- mal suffer. The serum of the animal is tested from time to time against a known amount of toxin, i.e., is standardized. The unit of antitoxin in Ehrlich's new standard is the amount requisite to antagonize the unit of toxin, i.e., 100 times the minimum lethal dose to a guinea- pig of 600 grm. weight, "antagonizing" action signifying that a fatal result does not follow within five days after the injection. In the case of diphtheria the antitoxic power of the serum may reach 800 units per cubic centi- metre, or even more. The laws of antitoxin production and action are not confined to bacterial toxins, but apply also to other vegetable and animal toxins, resembling them in

~~constitution, viz., the vegetable toxalbumoses and the snake- venom group referred to above.~~

~~The production of antitoxin is one of the most striking facts of biological science, and two important questions~~

~~with regard to it must next be considered, viz., how ^uox°tt *^°®^ *'^® antitoxin act ? and how is it formed~~

~~within the body ? Theoretically there are two possible modes of action : antitoxin may act by means of the cells of the body, i.e., indirectly or physiologicq.lly ; or it may act directly on the toxin, i.e., chemically. The second view is now practically established, and, though the question cannot be fully discussed here, the chief grounds in support of a chemical action may be given, (a) The action of antitoxin on toxin, as tested by neutralization effects, takes place more quickly in con- centrated than in weak solutions, and more quickly at a warm (within certain limits) than at a cold temperature. (&) Antitoxin acts more powerfully when injected along with the toxin than when injected at the same time in another part of the body ; if its action were on the tissue- cells one would expect that the site of injection would be immaterial, (c) Antitoxic action is apparently governed by the law of simple multiples ; that is, the amount of antitoxin necessary to neutralize varies directly with the amount of toxin. For example, the amount necessary to neutralize five times the lethal dose being determined, twenty times that amount will neutralize a hundred times the lethal dose. In the case of physiological antagonism of drugs this relationship does not hold, {d) It has been shown by Martin and Cherry, and by Kanthack and Cobbett, that in certain instances the toxin can be made to pass through a gelatine membrane, whereas the anti- toxin cannot, its molecules being of larger size. If, how- ever, toxin be mixed with antitoxin for some time, it can no longer be passed through, presumably because it has become combined with the antitoxin.~~

~~If this view as to the chemical relationship is correct — and none of the objections brought forward appear of a cogent nature — the antitoxin may act on the toxin in one of two ways. It may produce a disintegration of the toxin molecule, or it may combine with it to produce a body whose chemical affinities are satisfied. The latter view, strongly advocated by~~

Ehrlich, is the more prob- able, as it harmonizes with the facts established with re- gard to toxic action and the behaviour of antitoxins. His view as to the dual composition of the toxin molecule has already been mentioned, and it is evident that if the hap- tophorous or combining group has its affinity satisfied by union with antitoxin, the toxin will no longer combine with living cells, and will thus be rendered harmless. One other important fact in support of what has been stated is that a toxin may have its toxic action diminished; and may still require the same amount of antitoxin as previ- ously for neutralization. This is readily intelligible on the supposition that the toxophorous group is more labile than the haptophorous. Against the view that antitoxin combines with toxin there has been brought forward the statement, notably by Calmette, that in a neutral mixture of the two substances the toxic action reappears when exposed to a temperaturfe sufficient to destroy the antitoxin in its free condition. This result has been questioned on the ground that the time necessary for complete combi- nation was not taken into account, but even if the result be as stated, it is quite possible that of two complicated substances in combination the more labile may be de- stroyed by the same temperature as when free.

Eegarding the origin of the antitoxin there has been, and still is, much discussion. There are three chief possibilities : (a) that the antitoxin is a modifi- cation of the toxin ; (6) that it is a substance ^°™f j”””” normally present, but produced in excess under toxin. stimulation of the toxin ; (c) that it is an en- tirely new product. The first of these, which would imply a process of a very remarkable nature, is dis- proved by what is observed after bleeding an animal whose blood contains antitoxin. In such a case it has been shown that, without the introduction of fresh toxin, the antitoxin is partly restored, and therefore must be produced by -the living tissues. The second theory is the more probable d, priori, and if established removes the necessity for the third. It is strongly supported by Ehrlich who, in his so- called ” side-chain ” (Seitenlcette} theory, explains antitoxin production as an instance of regeneration after loss. Living protoplasm, or in other words a biogen molecule, is regarded as consisting of a central atom group {Leistungskern) , related to which are numerous secondary atom groups, or side-chains, with unsatisfied chemical affinities. The side-chains constitute the means by which other molecules are added to the living molecule, e.g., in the process of nutrition. It is by means of such side-chains that toxin

molecules are attached to the protoplasm, so that the living mole- cules are brought under the action of the toxophorous groups of the toxins. In antitoxin production this .combination takes place, though not in suf- ct'f'" ficient amount to produce toxic symptoms. It theory. is further supposed that the combination being of somewhat firm character, the side-chains thus com- bined are lost for the purposes of the cell and are there- fore thrown off. By the introduction of fresh toxin the process is repeated, and the regeneration of side-chains is increased. Ultimately the regeneration becomes an over- regeneration, and free side-chains produced in excess are set free and appear in the blood as antitoxin molecules. In other words the substances, which when forming part of the cells fix the toxin to the cells, constitute anti- toxin molecules when free in the serum. This theory.

though not yet absolutely established, certainly affords the most satisfactory explanation of antitoxin pro- duction. In support of it there is the remarkable fact, discovered by Wassermann and Takaki in the case of tetanus, that there do exist in the nervous system mole- cules with combining affinity for the tetanus toxin. If, for example, the brain and spinal cord removed from an animal be bruised and brought into contact vdth tetanus toxin, a certain amount of the toxicity disappears, as shown by injecting the mixture into another animal. Further, these molecules in the nervous system present the same susceptibility to heat and other physical agen- cies as does tetanus antitoxin. There is therefore strong evidence that antitoxin molecules do exist as part of the living substance of nerve cells. In other diseases the evidence obtained is less definite, but in them the toxic q,ction is less limited to a particular tissue. It has, how- ever, been found that the serum of various animals has a certain amount of antitoxic action, and thus the basis for antitoxin production, according to Ehrlich's theory, is afforded. The theory also supplies the explanation of the power which an animal supplies of producing various antitoxins, since this depends ultimately upon suscepti- bility to toxic action. The explanation is thus

carried back to the complicated constitution of biogen molecules in various living cells of the body.

In preparing anti-bacterial sera the lines of procedure correspond to those followed in the case of antitoxins, but the bacteria themselves in the living or J*””- dead condition are always used in the injec-

semm’ tions. Sometimes dead bacteria, living virulent bacteria, and living supervirulent bacteria, are used in succession, the object being to arrive ultimately at a high dosage, though the details vary in different in- stances. The serum of an animal thus actively immu- nized has powerful protective properties towards another animal, the amount necessary for protection being some- times almost inconceivably small. As a rule it has no action on the corresponding toxin, i.e., is not antitoxic. In addition to the protective action, such a serum may possess properties which evidence themselves by pro- ducing physical change in the bacterium in ^loa!”” I^sstion. The first of these is the lysogenic action, which consists in the production of a change in the corresponding bacterium whereby it becomes granular, swells up, and ultimately may un- dergo dissolution. Pfeiffer was the first to sho^ that this occurred when the bacterium was injected into the peritoneal cavity of the animal immunized against it, and also when a little of the serum of such an animal was injected with the bacterium into the peritoneum of a fresh, i.e., non-immunized animal. Metchnikoff and Bordet subsequently devised means by which a similar change could be produced in vitro, and analysed the con- ditions necessary for its occurrence. It has been com- pletely established that in this phenomenon of lysogenesis there are two substances concerned, one specially devel- oped or developed in excess, and the other present in normal serum. The former (Immunkorper of Ehrlich, substance sensibUisatrice of Bordet) is the more stable, resisting a temperature of 60° C, and though giving the specific character to the reaction cannot act alone. The latter is ferment-like and much more labile than the former, being readily destroyed at 60° C. It may be added that the protective power is not lost by exposure to the temperature mentioned, this apparently depending upon the immune body. Furthermore, lysogenic action is not confined to the case of bacteria,, but obtains also with other organized structures, e.g., red corpuscles (Bor- det, Ehrlich and

~~Morgenroth), leucocytes and sperma- tozoa (Metchnikoff). That is to say, if an animal be~~

~~treated with injections of these bodies, its serum acquires the power of dissolving them. Ehrlich and Morgenroth ^ have shown in the case of red corpuscles that the immune body (specially developed) combines directly with the red corpuscles, and also effects a loose combination with the ferment-like substance, normally present, which he calls " addiment " or " complement." The development of the immune body with specific combining affinity thus presents an analogy to antitoxin production, the differ- ence being that in lysogenesis another substance is neces- sary to complete the process.~~

~~Another property which may be possessed by an anti- bacterial serum is that of agglutination. By this is meant the aggregation into clumps of the bacteria uniformly distributed in an indifferent ^/"J" fluid ; if the bacterium is motile its movement is arrested during the process. The process is of course observed by means of the microscope, but the clumps soon settle in the fluid and ultimately form a sediment, leaving the upper part clear. This change, visible to the naked eye, is called sedimentation. Charrin and Eoger first showed in the case of B. pyocyaneus that when a small quantity of the homologous serum (i.e., the serum of an animal immunized against the bacterium) was added to a fluid culture of this bacillus, growth formed a sediment instead of a uniform turbidity. Gruber and Durham showed that sedimentation occurred when a small quantity of the homologous serum was added to an emulsion of the bacterium in a small test- tube, and found that this obtained in all cases where , Pfeiffer's lysogenic action could be demonstrated. Shortly afterwards Widal, and also Griinbaum, showed that the serum of patients suffering from! typhoid fever, even at an early stage of the disease, agglutinated the typhoid bacillus — a fact which laid the fouijdation of serum diagnosis. A similar phenomenon has been dem- onstrated in the case of Malta fever, cholera, plague, in- fection with B. coli, " meat-poisoning " due to Gartner's bacillus, and some other diseases. As regards the mode of action of agglutinins, Gruber and Durham consider that it consists in a change in the envelopes of the bacteria, by which they swell up and become adhesive. This view has various facts in its support, but Kruse and NicoUe have found that if a bacterial culture be filtered germ-~~

~~free, an agglutinating serum still produces some change in it, so that particles suspended in it become gathered into clumps. Duclaux, for this reason, considers that agglutinins are coagulative ferments. At present it is not possible to speak definitely on this question. Of more importance, however, is the relation of agglutinative to protective power. On the other hand a protective serum has not always agglutinative action, and the early appearance of the latter property in the serum, in a disease such as typhoid fever, has been considered by some to show that the two properties have no relation to one another. This conclusion is not justified, as we must suppose that the process of immunization begins to be developed at an early period in the disease, that it gradually increases, and ultimately results in cure. It is also doubtful whether a serum with high agglutinating power has been obtained without possessing protective properties at the same time. As regards resistance to heat, agglutinins cannot be separated from protective substances. It should also be stated that agglutinins are used up in the process of agglutination, apparently combining with some element of the bacterial structure. In view of all the facts it must be admitted that the agglutinins and protective bodies are the result of corresponding reactive processes, and are probably related to one another. It may be that some protective substances, but not all, are agglutinins, or it may be that the two are distinct. In the latter case they~~

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~~are both to be regarded as the products of a reactive process, and it is probable that the development of all antagonistic substances which confer the special character onantimicrobic sera, as well as antitoxins, will be expressed as the formation of bodies with specific combining afSnity for the organic substance introduced into the system- toxin, bacterium, red corpuscle, &c., as the case may be. The bacterium, being a complex organic substance, may thus give rise to more than one antagonistic or combining substance.~~

~~Passive immunity has thus been shown to depend upon certain substances present in the serum. After, however, these substances have disappeared, as they always do in the course of time, the animal still possesses immunity~~

~~(active) for a varying period. This apparently depends upon some alteration in the cells of the body, but its exact nature is not known.~~

~~The destruction of bacteria by direct cellular agency both in natural and acquired immunity must not be over- looked. The behaviour of certain cells, espe- cytofis. cially leucocytes,^ in infective conditions led Metchnikoff to place great importance on phago- cytosis. In this process there are two factors con- cerned, viz., the ingestion of bacteria by the cells, and the subsequent intracellular digestion. If either of these is wanting or interfered with, phagocytosis will necessarily fail as a means of defence. As regards the former, leucocytes are guided chiefly by chemiotaxis, i.e., by sensitiveness to chemic'al substances in their surroundings — a property which is not peculiar to them but is pos- sessed by various unicellular organisms, including motile bacteria. When the cell moves from a less to a greater degree of concentration, i.e., towards the focus of produc- tion, the chemiotaxis is termed positive ; when the con- verse obtains, negative. This apparently purposive move- ment has been pointed out by Verworn to depend upon stimulation to contraction or the reverse. Metchnikoff showed that in animals immune to a given organism phagocytosis is present, whereas in susceptible animals it is deficient or absent. He also showed that the develop- ment of artificial immunity is attended by the appearance of phagocytosis; also, when an anti-serum is injected into an animal, the phagocytes which formerly were indifferent might move towards and destroy the bacteria. In the light of all the facts, however, especially those with regard to anti-bacterial sera, the presence of phago- cytosis cannot be regarded as the essence of immunity, but rather the evidence of its existence. It is not suf&cient to state that the leucocytes are stimulated to activity; it is necessary to explain how this is brought about. When positive chemiotaxis is brought into play by an anti-serum, it is just as likely that it is indirectly through some change produced in the bacterium by the anti-serum as by a direct stimulation of phagocytes. We think that the importance of phagocytosis as an ex- planation of immunity by Metchnikoff and his school has been considerably over-rated, but on the other hand that it is one valuable means of destroying bacteria. Extra- cellular destruction in the various conditions mentioned is, however, also an established fact. Evidence has been brought forward within recent years that the leucocytes constitute an important source of the antagonistic sub- stances which appear~~

~~in the serum. Much of such evidence possesses considerable weight, and seeing that these cells possess active digestive powers it is by no means improbable that substances with corresponding ^ properties may be set free by them. To ascribe such powers to them exclusively is, however, not justi- fiable.~~

~~We have thus endeavoured to state some of the chief facts with regard to artificial immunity. The subject has~~

~~occupied a large proportion of bacteriological literature within recent years, and our endeavour has been mainly to indicate the general laws which are ^^^u- in process of evolution. When the facts of natural immunity are examined, we find that no single explanation is possible. Natural im munity against toxins must be taken into account, and, if Ehrlich's view with regard to toxic action be correct, this may depend upon either the absence of chemical affinity of the living molecules of the tissues for the toxic molecule, or upon insensitiveness to the action of the toxophorous group. It has been shown with regard to the former, for example, that the nervous system of the fowl, which possesses immunity against tetanus toxin, has little combining affinity for it. The non-sensitiveness of a cell to a toxic body when brought into immediate relationship cannot, however, at present be explained. Then as regards natural powers of destroying bacteria, phagocytosis aided by chemiotaxis plays a part, and it can be understood that an animal whose phagocytes are attracted by a particular bacterium will have an advantage over one in which this action is absent. The natural bactericidal power of the serum, as tested outside the body, also shows variations in different animals. Observations made on this property with respect to the anthrax bacillus at first gave the hope that variations in natural immunity could be thus ex- plained, but further investigation showed that immunity did not vary pari passu with this property. It is, more- over, doubtful whether the bactericidal power of the serum, in the living body is always indicated by the results obtained in vitro. We therefore cannot fully explain in every case the exact property or process on which the destruction of a bacterium in normal tissues depends.~~

~~Authorities. — Bacteriological literature has become so exten- sive that it is impossible to give here references to^original articles, even the more~~

~~important. A number of these, giving an account of classical researches, were translated from French and German, and published by the New Sydenham Society under the title Micro-parasites in Disease : Selected Essays, In 1886. The follow- ing list contains some of the more important books published within recent years : — ^Abbott. Principles of Bacteriology, 5th edit. London, 1899. — Ceookshank. Bacteriology and Infective Diseases (with bibliography), 4th edit. London, 1896. — Ducladx. Traite de microbiologie, vols. i. and li. Paris, 1899. — ^Flijgge. Die MiJcroorganismen, 3rd edit. Leipzig, 1896. — ^Fischer. Vor- lesungen uber Bakterien. Jena, 1897. — GiJNTHEK. Einfuhrung in das Studium der Bakteriologie, 4th edit. Leipzig, 1893. — Heim. Lehrbuch der bacteriologischen JJntersuchung und Diagno- stik. Stuttgart, 1894. — Hewlett. Manual of Bacteriology. Lon- don, 1898. — Hueppe. Principles of Bacteriology (translation). London, 1899. — Kanthack and Detsdale. Practical Bacterio- logy. London, 1895. — Klein. Micro-organisms and Disease, 3rd edit. London, 1896. — Lofplee. Vorlesungen uber die geschichtliohe Entwickelung der Lehre von der Bacterien. Leipzig, 1887. — M'Faeland. Text-book upon the Pathogenic Bacteria. London, 1896. — Muie and Ritchie. Manual of Bacteriology (with bibliography), 2nd edit. Edin. and London, 1899. — Sternberg. — Manual of Bacteriology (with full bibliography), 2nd edit. New York, 1896. — Thoinot et Masschn. Pr&cis de Microbie, 3rd edit. Paris, 1896. — Wuetz. Fricis de bacteriologie cUnique. Paris, 1895. — Woodhead. Bacteria and their Products (with bibliography). London, 1891. The bacteriology of the infective diseases (with bibliography) is fully given in the System of Medicine, edited by Clippoed Allbutt. London, 1896-1900. For references consult Gentralbl. fur Bahter. u. Parasitenk. Jena, a " General Register " of which down to June 1899 (vols, i.-xxv.) has been published ; also Index Medicus. (k. m.)~~

~~Bacup, a municipal borough (1882) in the Eossen- dale parliamentary division of Lancashire, England, on the Irwell, 20 miles N. of Manchester by rail. A borough police force has been organized (1887), and a borough fire brigade constituted out of its members. An Established church has been rebuilt and a theatre erected, whilst in 1893 commodious public baths and a well-arranged recrea^ tion ground were presented to the town by Mr J. H.~~

~~B A D A J 0 Z — B ADAKSHAN~~

~~Madeiij M.P. Cotton 'spinning and power-loom weaving are the chief of the numerous manufacturing industries carried on. The principle of co-operation is strongly developed; a handsome store costing over £22,000 con- tains among other departments a free library for mem- bers, with upwards of 12,000 volumes. Area, 6083 acres ; population (1881), 25,034: (1891), 23,498: (1901),~~

~~22,503.~~

~~Badajoz, a frontier province in the south-west of Spain, the largest of the whole kingdom with, an area of 8688 square miles, only 2,850,000 acres of which are culti- vated. The population grew from 475,183 in 1887 to 490,551 ia 1897. The province is divided into 15 ad- ministrative districts and 162 parishes. In the north- east, south-east, and south, there are some hilly regions, but the greater part is flat or slightly undulating, and in many districts looks like a dreary steppe, with sparse vegetation that affords very meagre pasture for the numer- ous flocks. Comparatively little rain falls in average years, and barely 13,000 acres are properly irrigated, whilst 1,900,000 acres are devoted to pasture or covered with very thin bush and forest. The Guadiana, which flows through the north of the province, and its tribu- taries, have any considerable volume of water in their beds only at certain seasons of the year, and the Guadiana is often fordable in many parts of its course. Badajoz has more live stock than any other province — in all 1,302,754 head. This figure includes 10,705 horses, 33,471 mules, 38,273 asses, 35,057 cattle, 940,444 sheep, 108,354 goats, and 136,450 pigs, which supply famous hams, &c. 336,285 acres are devoted to the culture of wheat, 258,812 to oats, barley, rye; 86,437 to pod fruit; 88,942 to* olive plantations, and 46,012 to vineyards. One copper and 24 lead mines are now at work, while no less than 575 are registered as unproductive. This stagnation of the min- ing interests is chiefly due to the lack of means of com- munication, though some impulse has been given of late years to the mining railways by a company that is work- ing several concessions ; another company has endeavoured to lease several good lead mines, and has bought others near the central Badajoz railway. The mines will cer- tainly attract more notice when several local lines are completed. Among~~

those at present unproductive are 345 lead, 170 iron, 27 copper, and 12 quicksilver, all duly registered. The local industries are not of much importance: manufactures of woollen and cotton stuffs of a coarse description, soaps, oil, cork, and leather. The purely commercial interests are more important than the industrial, because of the transit trade to and from Portugal through no less than seven custom-houses. The climate shows great extremes of heat in summer and of cold in winter, when fierce north and north-west winds blow across the plains. In the hot months intermittent fevers are prevalent in the Guadiana valley. There are 275 miles of railways in the province, the principal being 133 miles of the main line from Madrid to Lisbon, 78 of the Merida-Seville line, and 38 of the Huelva-Zafra. The roads, state and parish, are in bad condition, and totally insufficient. Very few inhabitants emigrate from this province, where the birth-rate considerably exceeds the death-rate. Education, even primary, is in a very back- ward condition, not 33 per cent, of the children between four and fourteen years of age being sent to school. Badajoz, the capital of the province, is situated near the Portuguese frontier, 310 miles south-west of Madrid by rail. Population (1897), 29,006. It is still the centre of an active trade with Portugal, but the local industries have declined considerably. A serious military and repub- lican j'ising took place in August 1883, but the movement found no response among the majority of the inhabitants

of the town or in the rest of Spain, and completely failed. (a. b. h.)

Badakshan. — The Afghan province of Badakshan requires new definition since the boundary agreement of 1893 limited Afghan territory to the left bank of the Oxus. Much of the interior of the province is still unex- plored. On the west, Badakshan is bounded by a line which crosses the Turkestan plains southwards from the junction of the Kunduz and Oxus rivers till it touches the eastern water-divide of the Tashkurghan river (here called the Koh-i-Chungar), and then runs south-east, crossing the Sarkhab af9.uent of the Kunduz, till it strikes the Hindu Kush. The southern boundary is carried along the crest of the Hindu Kush as far as the Khawak pass, leading from Badakshan into the Panjshir valley. Beyond this it is indefinite. It is known that the Kafir occupy the west of the Hindu Kush eastwards of the Khawak, but how far they extend north of the main watershed is not ascertainable. The southern limits of Badakshan become definite again at the Dorah pass.

~~The Dorah connects Zebak and Ishkashim at the elbow, or bend, of the Oxus with the Lutku valley leading to Chitral. From the Dorah eastwards the crest of the Hindu Kush again becomes the boundary till it effects a junction with the Muztagh and Sarikol ranges, which shut off China from Russia and India. Skirting rotmd the head of the Tag- dumbash Pamir, it finally merges into the lately-defined Pamir boundary, and turns westwards, following the course of the Oxus, to the junction of that river and the Kunduz. So far as the northern boundary follows the Oxus stream, under the northern slopes of the Hindu Kush, it is only separated by the length of these slopes (some 8 or 10 miles) from the southern boundary along the crest. Thus Badakshan (in which we include Wakhan) reaches out an arm into the Pamirs eastwards — bottle- shaped — narrow at the neck (represented by the northern slopes of the Hindu Kush), and swelling out eastwards so as to include a part of the great and little Pamirs (see Afghajstistan). Before the boundary settlement of 1893 the small states of Eoshan and Shignan extended to the left bank of the Oxus, and the province of Darwaz, on the other hand, extended to the right bank. Now, however, the Darwaz extension northwards is exchanged for the Russian Pamir extension westwards, and the river through- out is the boundary between Russian and Afghan terri- tory ; the political boundaries of those provinces being no longer coincident with their geographical limits.~~

Subdivisions. — The following are the chief provincial subdivi- sions of Badakshan, omitting Keshan and Shignan : — On the west Kustak, Kataghan, Ghori, Narin, and Anderah ; on the north Darwaz, Ragh, and Shiwa ; on the east Charan, Ishkashim, Zebak, and Wakhan ; and in the centre Faizabad, FarkSar, Minjan, and Kishm. There are others, but nothing certain is known about these minor subdivisions.

Physiography. — The conformation of the mountain districts, which comprise all the southern districts of Badakshan and the northern hills and valleys of Kafiristan, is undoubtedly analogous to that of the rest of the Hindu Kush westwards. The water-divide of the Hindu Kush from the Dorah to the Khawak pass, i.e. through the centre of Kafiristan, has never been accurately traced ; but its topographical conformation is evidently a conttauation of that which has been observed in the districts of Badakshan to the west of the Khawak. The Hindu Kush represents the southern edge of a great central upheaval or plateau. It breaks up into long spurs southwards, deep amongst which are hidden the valleys of Kafiristan, almost isolated from each other by the rugged and snow-capped altitudes which divide them. To the north the plateau gradually slopes away towards the Oxus, falling from an average altitude of 15,000 feet to 4000 feet about Faizabad, in the centre of Badakshan, but tailing off to 1100 at Kunduz, in Kktaghan, where it merges into the flat plains bordering the Oxus.

Bivers and Moads. — The Kokcha river traverses Badakshan from south-east to north-west, and, with the Kunduz, drains all the northern slopes of the Hindu Kush west of the Dorah pass. Some of its sources are near Zebak, close to the great bend of the Oxus

northwards, so that it cuts ofl aU the mountainous area included within that bend from the rest of Badakshan. Its chief affluent is the Minjan, which Robertson found to be a considerable stream where It approaches the Hindu Kush close under the Dorah. Like the JKunduz, it probably drains the northern slopes of the ffindu Kush by deep lateral valleys, more or less

~~parallel to the crest, reach- ing westwards towards the Khawak pass. From the Oxus f 1000 ft) to Faizabad (4000 ft.) and Zebak (8500 ft.) the course of the Kokoha offers a high road across Badakshan ; between Zebak and Ishkashim, at the Oxus bend, there is but an insignificant pass of 9500 ft. ; and from Ishkashim by the Panja, through the Pamirs, is the continuation of what must once have been a much-traversed trade route connecting Afghan Turkestan with Kashgar and China. It is undoubtedly one of the great continental high roads of Asia. North of the Kokha, within the Oxus bend, is the mountainous district of Darwaz, of which the physiography belongs rather to the Pamir type than to that at the Hindu Kush.~~

~~A very remarkable meridional range extends for 100 miles north- wards from the Hindu Kush (it is across this range that the route from Zebak to Ishkashim lies), which determines the great bend of the Oxus river northwards from Ishkashim, and narrows the valley of that river into the formation of a trough as far as the next bend westwards at Kila Wamar. The western slopes of this range drain to the Oxus either north-westwards, by the Kokcha and the Ragh, or else they twist their streams into the Shiva, which runs due north across Darwaz. Here again we find the main routes which traverse the country following the rivers closely. The valleys are narrow, but fertile and populous. The mountains are rugged and difficult; but there is much of the world-famous beauty of scenery, and of the almost phenomenal agricultural wealth of the valleys of Bokhara and Ferghana to be found in the as yet half-explored recesses of Badakshan. The people of the country are Tajak, dominated by Afghans.~~

~~There are no recent works on Badakshan and Darwaz which can be considered authoritative. The foregoing is compiled from un- published notes of the Russo-Afghan and Pamir boundary surveys by the author. /^_^ g_*\~~

~~Badalona, a town and railway station of Spain, in province and diocese of Barcelona, situated in a plain, near the left bank of the river Besos. Woollen, cotton goods, glass, biscuits, sugar, and brandy are manufactured. The country around is fertile, and produces abundantly cereals, wine, oranges, and fruit of all kinds. Population,~~

~~18,165.~~

~~Baden, a grand-duchy of the German empire, with an area of 6821 square miles, and population (1886) 1,601,256, (1896) 1,725,464, of whom 847,281 were males and 878,183 females. The density in 1895 was 296 in- habitants to the square mile ; and of the total population over 46 per cent, were urban (i.e., lived in places above 2000 inhabitants each), and nearly 65 per cent, rural. At the same date 1,067,076 confessed the Roman Catholic faith, 637,946 were Evangelical Protestants, and there were 25,90J Jews. Of the total area, 67-2 per cent, is under cultivation and 37‘6 per cent, under forests. Of the total number of farms 223,631, or 94-7 per cent., were less than 25 acres, 12,411 were between 25 and 250 acres, and only 117 exceeded 250 acres. The crops most exten- sively cultivated are hay, potatoes, barley, oats, spelt, rye, maize, wheat, and beetroot. In 1898 42,400 acres were planted with the vine, and the yield was 6,316,600 gallons of wine, valued at £460,000. Tobacco was planted on 21,700 acres (17,860 acres in 1898), and the yield was 20,000 tons, valued at £822,000. In the same year the live stock consisted of 660,885- cattle, 411,253 pigs, 81,- 821 sheep, and 71,516 horses. In 1897 the breweries produced 60,306,450 gallons of beer, and in 1898 the dis- tilleries 946,560 gallons of pure alcohol. The total length of railways in 1898 was 1080 miles, of which 992 belonged to the state; and from them was derived (1897) a revenue of £1,067,600. In 1897 there were 173,794 hands employed in the various industries. In addition to the two universities (Heidelberg and Freiburg), and the polytechnic at Carlsruhe, there are over 220 technical, agricultural, and other special schools, 60 middle schools (classical and modern), and over 1600 elementary schools.~~

~~In 1900 the revenue and expenditure balanced at £4,125,- 300. The contribution to the imperial exchequer was fixed at £872,930 in 1900. The public debt, which has been incurred entirely for the construction of the rail- ways, amounted in 1900 to £16,668,400.~~

~~Baden, or Baden-Baden, a town and watering-place of the grand-duchy of Baden, Germany, in the Black Forest, 23 miles S. by W. from Carlsruhe by rail. There are two chief bath establishments, the Frederick Baths (Renaissance building, 1869-77) and the Empress Augusta Baths (Renaissance, 1891-92), the former used by men only in summer, and by both sexes in winter, the latter used by women only in summer, and closed~~

~~in winter. Almost every conceivable variety of bath can be had in both. The number of visitors exceeds 60,000 annually. Baden possesses a technical school. Population (1886),~~

~~12,779 ; (1895), 14,862.~~

~~Baden, or Baden bei WiEN,vchief town of a govern- ment-district, and principal thermal springs and summer resort in Lower Austria, situated in the Schwechat valley, about 12 miles from Vienna. Population (1890), 11,263, or with Wiekersdorf, 16,776; (1900), 12,447, Wiekersdorf, 6287, all German and mostly Catholic (esti- mated to have 5 per cent. Jewish and 2 per cent. Protes- tant). It has now numerous educational institutions, new bathing Establishments, fifteen in all, a town museum, new park and kurhaus, a summer theatre. There are about 20,000 visitors annually, including several members of the Austrian imperial family.~~

~~Badenweiler, a small village and watering-place of the grand-duchy of Baden, Germany, 28 miles N. by E. by rail from Basel, at the western edge of the Black Forest. Its new parish (Evangelical) church (1897) is built at the foot of the 11th-century castle (destroyed by the French in 1688) which belonged to the margraves of Baden. The place is visited by 6000 people annually, partly for its warm mineral springs (70°), partly for its whey cure, partly for its equable climate and picturesque surroundings. There are a kurhaus, built in 1853, and a park of 15 acres (1826 and 1865) ; also a grand-ducal castle, refitted in 1887-88. In 1784 well-preserved Roman baths were discovered here. The permanent population is about 600.~~

~~Badulla, the capital of the province of TJva, Ceylon, 54 miles S.E. of Kandy. It is the seat of a government agent and district judge, besides minor courts. It was in Kandyan times the home of a prince who ruled Uva as a principality. Badulla stands 2222 feet above sea- level ; the average annual rainfall is 79|^ inches ; the average temperature 73°. ■ The population of the town in-1901 was about 6600 ; of the Badulla district, 188,964. There is a botanic garden; and the town, being almost encircled by a river — the BaduUaeya — and overshadowed by the Naminacooly Kande range of mountains (highest peak 6680 feet), is very picturesquely situated. The railway terminus at Bandarawella is 18 miles from Badulla, but there is a~~

prospect of a tramway connexion. Tea is cultivated by the planters, and rice, fruit, and vegetables by the natives in the district. —

Baer, Karl Ernst von (1792-1876), German biolo- gist and founder of the science of comparative embryology, was born at Piep in Esthonia on the 29th February 1792. His father, a small landowner, sent him to school at Revel, which he left in his eighteenth year to study medicine at Dorpat University. Burdach's lectures suggested research in the wider field of life-history, and as at that time Ger- many offered quicker facilities for, and greater encourage- ment to, scientific work, von Baer went to Wiirzburg, where

the distinguished physiologist Bollinger, father of the famous Catholic theologian, was professor. In teaching von Baer comparative anatomy, DoUinger gave a direc- tion to his studies which secured his future pre-eminence in the science of organic development. He collaborated with Pander in researches on the evolution of the chick, the results of which were first published in Burdach's treatise on physiology. Continuing his investigations alone, von Baer extended them to the evolution of or- ganisms generally, and after a sojourn at Berlin he was invited by his old teacher Burdach, who had become pro- fessor of Anatomy at Konigsberg, to join him as prosector and chief of the new ZoologicEd Museum. Von Baer's great discovery of the human ovum is the subject of his Epistola de Ovo Mammalium et Hominis Oenesi (Leipzig, 1827), and in the following year he published the first part of his History of the Evolution of Animals (Ueber EntwickelungsgescJiichte der Thiere), which Haeckel says " even now is generally and rightly considered the most important and most valuable contribution to embryo- logical literature." Until von Baer's discovery (for Wolff's cognate theory of epigenesis, promulgated seventy years earlier, had secured no adherents) it was believed that every egg contained, encysted as it were, the complete animal in miniature. On the logical assumption that the " animalculist " theory, as it was nicknamed, involved the existence of the preformed body in all ova, Haller made the ingenious calculation that the germs of two hTindred billions of men were

~~packed in the ovary of Eve ! The " ovist " gave this fantastic speculation its quietus. Von Baer demonstrated, first, that the Graafian follicles (so named after their discoverer) in the ovary are not the actual eggs, but that they contain the spherical vesicle, which is the true ovum, a body about the xirtli of an inch in diameter, wherein, so great is the marvel of heredity, lie the properties transmitting the physical and mental characteristics of the parent or grandparent, or even of more remote ancestors. He next showed that in all vertebrates the primary stage of cleavage of the fertilized egg is followed by modification into leaf-like germ layers- skin, muscular, vascular, and mucous — whence arise by subtle differentiation the several organs of the body. He further discovered the gelatinous, cylindrical cord, known as the chorda dorsalis, which passes along the body of the embryo of vertebrates, in the lower types of which it is limited to the entire inner skeleton, while in the higher the backbone and skull are developed round it. His " law " of corresponding stages in the development of ver- tebrate embryos had example in the fact recorded by him concerning certain specimens preserved in spirit which he had omitted to label. " I am quite unable to say to what class they belong. They may be lizards, or small birds, or very young mammalia, so complete is the simi- larity in the mode of formation of the head and trunk in these animals. The extremities are still absent, but even if they had existed in the earliest stage of the develop- ment we should learn nothing, because all arise from the same fundamental form." And in his History of Evolution he suggests, " Are not all animals in the beginning of their development essentially alike, and is there not a primary form common to all ? " (i. 223). Notwithstanding this, the " telic " idea, with the archetypal theory which it involved, possessed von Baer to the end of his Ufe, and explains his inability to accept the theory of unbroken descent with modification when it was propounded by Darwin and Wallace in 1858. The influence of von Baer's discoveries has been far-reaching and abidiag. Not only is he the pioneer in that branch of biological science to which Francis Balfour, gathering up the labours of many fellow- workers, gave coherence in his Compara- tive Embryology (1881) ; the impetus to Huxley's researches~~

~~in the structure of the medusae came from him (Life, i. 163) ; and Herbert Spencer found in von Baer's " law of development " the " law of all development " (Essays, i. 30). In 1834 von Baer was appointed librarian of~~

~~the Academy of Sciences of St Petersburg. In 1835 he published his Development of Fishes, and as the result of collection of all available information concerning the fauna and flora of the Polar regions of the empire, he was appointed leader of an Arctic expedition in 1837. The remainder of his active lifei was occupied in divers fields of research, geological as well as biological, an outcome of the latter being his fine monograph on the fishes of the Baltic and Caspian Seas. One of the last works from his prolific pen was an interesting autobiography published at the expense of the Esthonian nobles on the celebration of the jubilee of his doctorate in 1864. Three years after- wards he received the Copley medal. He died at Dorpat on 28th November 1876. (e. cl.)~~

~~Baeyer, Johann Friedrich Wilhelm Adolph~~

~~(1835), German chemist, was born at Berlin, 31st~~

~~October 1835. He studied chemistry under Bunsen and Kekule, and ia 1858 took his degree as Ph.D. at Berlin, becoming privat-docent a few years afterwards, and assistant professor in 1866. Five years later he was ap- pointed professor of chemistry at Strasburg, and in 1873 he migrated in the same capacity to Munich. He has devoted himself mainly to investigations in organic chemistry, and in particular to synthetical studies by the aid of "condensation" reactions. The Eoyal Society of London awarded him the Davy medal in 1881 for his researches on indigo, the nature and composition of which he has done more to elucidate than any other single chemist, and which he has also succeeded in preparing artificially, though his methods have not been found commercially practicable. The "centric" view of the constitution of the benzene ring supported by him, and others of his contributions to chemical theory, are dis- cussed in the article Chemistrt.~~

~~Baffin, a barren insular tract in Franklin district, Canada, with an approximate area of 230,000 square miles, situated between 61° and 90° W. long, and 62° and 74° N. lat. The eastern and northern coasts are rocky and mountainous, and are deeply indented by large bays, including Frobisher and Home Bays, Cumberland Sound and Admiralty Inlet. It is separated from Green- land by BafB.n Bay and Davis Strait, from Ungava by Hudson Strait, from Keewatin and Melville Peninsula by Fox Channel and Fury-and-Hecla Strait, from Boothia Peninsula and North Somerset by the Gulf~~

~~of Boothia and Prince Regent Inlet, and from North Devon by Lancaster Sound. The north-western portion is called Cockburn Land; the south-western. Fox Land; and the eastern, Cumberland Land.~~

~~Bagehot, Walter (1826-1877), English publicist and economist, editor of the Economist newspaper from 1868-60 to his death, was born at Langport, Somerset, 3rd February 1826, his father being a banker at that place. Bagehot was altogether a remarkable personality, his writings on different subjects exhibiting the same bent of mind and characteristics, — philosophic reflectiveness, practical common-sense, a bright and buoyant humour, brilliant wit, and always a calm and tolerant judgment of men and things. Though he belonged to the Liberal party in politics he was essentially of conservative dis- position, and often spoke with sarcastic boastfulness to his Liberal friends of the stupidity and tenacity of the English mind in adhering to old ways, as displayed in city and country alike. His life was comparatively~~

~~uneventful, as he early gave up to literature the energies which might have gained him a large fortune in business or a great position in the political world. To write books, he remarked to the present writer not long before he died, a man must give up a good deal ; and, as a man of letters, there is no doubt he made the sacrifice for himself will- ingly and cheerfully, following his true bent without turn- ing to right or left. He took his degree at the London University m 1848; and was called to the bar in 1852, but from an early date he joined his father in the banking business of Stuckey & Co., in the West of England, and during a great part of his life, while he was editor of the Economist, he managed the London agency of the bank, lending its surplus money in "Lombard Street," and otherwise attending to its . London affairs. He became also an underwriter at Lloyd's, taking no part, however, in the active detailed business, which was done for him by proxy.~~

~~Bagehot's connexion with the Economist began in 1858, about which time he married a daughter of the first editor, the Eight Honourable James Wilson, at that time Secretary of the Treasury, and afterwards finance~~

~~minister in India. Partly through this connexion he was brought into the inside of the political life of the time. He was an intimate friend of Sir George Cornewall Lewis, and was afterwards in constant communication with other political chiefs, especially with Mr Gladstone, Mr Lowe, and Mr Grant Duff, and with the permanent heads of the great departments of state. In the City in the same way he was intimate with the governor and directors of the Bank of England, and with leading magnates in the. banking and commercial world, such as Mr Bertram Currie of Glyn's, Mr Wade of the National Provincial Bank, Mr William Eowler of Alexanders', afterwards of the National Discount Company, and Mr Newmarch ; while his con- nexion with the Political Economy Club brought him into contact in another way with both City and politics. His Active life in business and politics, however, was not of so absorbing a kind as to prevent his real devotion to literature, but the literature largely grew out of his activities, and of no one can it be said more truly than of Bagehot that the atmosphere in which he lived gave tone and colour and direction to his studies, one thing of course acting and reacting on another. The special note of his books, apart from his remarkable gift of conversational epigrammatic style, which gives a peculiar zest to the writing, was the quality of scientific dis- passionate description of matters which were hardly thought of previously as subjects of scientific study. This is specially the case with the two books which perhaps brought him the most reputation, The English Constitu- tion (1867) and Lombard Street (1873). They are both books of observation and description. The English Con- stitution is described, not from law books and as a lawyer would describe it, but from the actual working, as Bagehot himself had witnessed it, in his contact with ministers and the heads of Government departments, and with the life of the society in which the politicians moved. The true springs and method of action are consequently de- scribed with a vivid freshness which gives the book a wonderful charm, and makes it really a new departure in the study of politics. It is the same with Lombard Street. The money market is there pictured as it really was in 1850-70, and as Bagehot saw it with philosophic eyes. Beginning with the sentence, "The objects which you see in Lombard Street are the Bank of England, the joint ^-^ stock banks, the private banks, and the discount houses," he describes briefly and clearly the respective functions of these different bodies in the organism of the City, according to his own close~~

~~observation as a banker himself, knowing the ways and thoughts of the men he describes,~~

~~and as a man of business likewise in other ways, knowing at first hand' the relation of banking to the trade and com- merce of the country. Lombard Street is perhaps a riper, work than The English Constitution, as its foundation was really laid in 1858 in a series of articles which Bagehot then wrote in the Ecokomist, though it was not published till the early 'seventies, after it had been twice rewritten and revised with infinite labour and care. Lombard Street, like T%e English Constitution in political studies, is thus a new departure in economic and financial studies, apply- ing the same sort of keen observation which Adam Smith used in the analysis of business generally to the special business of banking and finance in the complex modern world. It is, perhaps, not going too far to say that the whole theory of a one-reserve system of banking and how to work it, and of the practical means of fixing an " apprehension minimum " below which the reserve should not fall, originated in Lombard Street and the articles which were the foundation of it; and the subsequent conduct of banking in England and throughout the world has been infinitely better and safer in consequence. A like note is also struck in Physics and Politics (1869), which is a description of the evolution of communities of men. The materials here are derived mainly from books, the surface to be observed being so extensive, but the attitude is precisely the same, that of a scientific observer. To a certain extent the Physics and Politics had even a more remarkable in- fluence on opinion, at least on foreign opinion, than The English Constitution or Lombard Street. It "caught on " as a development of the theory of evolution in a new direction, and Darwin himself was greatly interested, while one of the pleasures of Bagehot's later years was to receive a translation of the book into the Russian language. In Literary Studies (1879) and Economic Studies (1880), published after his death, there is more scope than in the books already mentioned for other characteristics besides those of the scientific observer, but observation always comes to the front, as in the account of Eicardo, whom Bagehot describes as often, when he is most theoretical, really describing what a first-rate man of business would do and think in actual transactions. The observation, of course, is that of a type of business man in the City to which Eicardo as well as Bagehot belonged,**

~~though Eicardo could hardly look at it from the outside as Bagehot wag able to do.~~

~~Bagehot had great City, political, and literary influence, to which all his activities contributed, and much of his influence was lasting. In politics and economics especially his habit of scientific observation affected the tone of dis- cussion, and both the English Constitution and the Money Market have been better understood generally because he wrote and talked and diffused his ideas in every possible way. He was unsuccessful in two or three attempts to enter Parliament, but he had the infiuence of far more than an ordinary member, as director of the Economist and as the adviser behind the scenes of the Ministers and permanent heads of departments who consulted him. His death, on the 24th of March 1877, occurred at Lang- port very suddenly, when he was in the fullest mental vigour, and might have looked forward to the accomplish- ment of much additional work and the exercise of even wider influence.~~

~~It is impossible to give a full idea of the brightness and life of Bagehot's conversation, although the conversa- tional style of his writing may help those who did not knowhim personally to understand it. With winged words he would transfix a fallacy or stamp a true idea so that it could not be forgotten. He was certainly greater than his books and always full of ideas. The present writer recalls two notions he had, not for writing new books~~

~~himself, but as something that might be done. One was that there might be a history of recent politics with new lights if some one were to do it who knew the family- connexions and history of English politicians. This was apropos of the passage of a certain Bill through Parliament, when the head of the department in the House of Commons failed and the management of the measure was taken by the Chancellor of the Exchequer himself, a relative of the permanent head of the depart- ment concerned, who was thus able to carry his own ideas in legislation notwithstanding the failure of his~~

~~political chief. Another book he wished to see written was an account of the differences in the administrative systems of England and Scotland, by which he had been greatly impressed, the differences not being in detail, but in fundamental idea and in form, so that no judicial or other officers in the one were represented in the other by corresponding fuactionaries. Many other illustrations might be given of his fulness of ideas which helped to make him an ideal editor. Eeference must also be made to the assistance which Bagehot gave as a journalist to the study of statistics. From the manipulation of figures he was most averse, and he rather boasted that he was unable to add up. But he was a most excellent mathematician, and no one could be so careful as he was about the logic of the figures got together for his articles, which he always most carefully scrutinized. He would frequently point out that his figures were illustrative merely, and did not by themselves establish an argument. He was always anxious, again, to impress on those about him that a subject could not be studied with the help of figures and accounts alone. Whether it was insurance, or banking, or underwriting, or shipowning, he insisted that some one who knew the business should see the writ- ing before it was published. Knowing so many depart- ments of business from actual experience, he was a host in himself as referee, but when in doubt he would always con- sult some one who knew the facts ; and he used his great influence so well that in subsequent years it inspired indirectly not a few who were hardly aware of his claims to be a statistician at all. (k. gn.)~~

~~Baghdad, (1) a viMyet of Asiatic Turkey, situated between Persia and the Syrian desert, and including the greater part of ancient Babylonia. The original vilayet extended from Mardin on the north to Basra on the south, but in 1878 it was reduced in size by the creation of , the Mosul vilSiyet out of its northern sanjaks, and again in 1884 by that of the Basra viMyet out of its southern sanjaks. Baghdad is still one of the largest and most important provinces of the empire, and includes some of the most fertile lands in the valleys of the Euphrates and ^ Tigris. The climate is very hot in summer, mean tempera^ ture 97° F., but generally healthy. In November heavy rains commence, and during the winter the thermometer falls to 46° F. There are springs of bitumen, locally called karasakiz, " black mastic," of naphtha, and of white petroleum in the province. Population, 852,000 (Moslems, 790,000, including 481,000 Shias; Christians, 8000; Jews, 54,000). (2) The~~

~~capital of the viMyet, and head- quarters of the army corps which garrisons the Baghdad, Mosul, and Basra viMyets, situated in a fertile but arid plain on both banks of the Tigris. Eastern Baghdad, on the left bank, is the larger and more modern city, and contains the principal buildings, bazars, &c. A bridge of boats connects it with " Old Baghdad," a suburb chiefly occupied by Shias, on the right bank. Here stood the " Eound City " founded by Mansiir in a.d. 762, with its three concentric walls, enclosing as a central point the palace and mosque of the Khalif, and its four equi-distant gates. Of this city no trace remains ; walls and houses~~

~~have been destroyed by civil war and fire, or have been swept away by inundations.~~

~~The exact position of Mansiir' s palace is unknown, but it seems certain that the tomb of Zobeide was near the river at Kazimfn and not where now shown. Eastern Baghdad has no distinctive architectural character. Little remains of the great buildings of the khalifs, and there is nothing imposing in the barracks, bazdrs, khans, and narrow winding streets. The old city walls of brick have been demolished except in a few places ; but the great fosse remains, and a line of mounds marks the position of the glacis. Baghdad is unrivalled for position and fertility of soil, and under better government would regain its former prosperity. Many im- provements were introduced by Midhat Pasha. Barracks and schools were built, a tram-way was laid down to the ShiA. shrines at Kazimfn, trade was encouraged, and the nomads were brought under control. But no effort has been made to restore the old system of canalization which made the country betvreen the Eu- phrates and Tigris a continuous garden. A Turkish and an Eng- lish company run steamers from Baghdad to Basra, but the state of the Tigris has become a source of anxiety. No steps are taken to stop the outflow of water to the desert and the marshes, and the main channel becomes almost unnavigable during August and September. Above Baghdad sailing vessels of about 30 tons are employed. The exports and imports pass chiefly through Basra. Population^ according to Cuinet, 145,000, but this is probably an exaggeration. Baghdad is the seat of a British consul-general.~~

~~G. LE Strange. "Description of Mesopotamia and Baghdad about A.D. 900; and Greek Embassy to Baghdad in a.d. 917," in Journal Boyal Asiatic~~

~~Society, 1895, 1897 ; Baghdad under the Abhasid Caliphate, 1901. (c. w. W.)~~

~~Baghelkhand, or Bhagelkhajjd, a tract of country in Central India, lying between the ISTorth-West and the Central Provinces, east of Bundelkhand. It takes its name from the Baghel clan of Rajputs, now represented by the Maharaja of Rewa. Politically, it con- sists of five native states under the Baghelkhand agency, of which Rewa is by far the most important. The total area is 11,324 square miles. Population (1891), 1,737,095, being an average of 153 persons per square mile ; (1901), 1,654,577, showing a decrease of 11 per cent., due to the effects of famine. The country is for the most part hilly, and the soil is poor.~~

~~Bagheria, or Bagaeia, a decaying town of the province of Palermo, Sicily, 8 miles by rail E. by S. from Palermo. It contains palaces of Sicilian magnates, and has manufactures of macaroni, preserved food, olive oil, and casks. Under the Bourbon kings (first half of 19th century) it was a favourite seaside resort. Population, about 11,600.~~

~~Bagirmi. See Chad, Lake.~~

~~Bagnara, a town of the province of Reggio, Cala^ bria, Italy, 20 miles N. by E. from Reggio by rail. It was founded by Robert Guiscard in the 11th century, but suffered severely from the earthquake of 1783. It has tunny and swordfish fishing. Population, about 10,000.~~

~~Bagnolet, a town in the arrondissement of Saint- Denis, department of Seine, France, ^ mile E. of the outer circle of Paris. Market gardening is extensively carried on, and the manufacture of billiard balls, perfumery, fancy soaps, and glue are the principal industries. Popu- lation, 7100.~~

~~BagO, a town of 16,000 inhabitants on the eastern coast of Cebu, Philippine Islands, near its northern extreniity. The climate is hot, but healthful. The surrounding country is fertile, producing rice, cacao, and hemp in abundance. Sinamay and guinara cloths are woven and exported to a limited extent. The fisheries are of considerable local importance. The language is Cebu-Visayan.~~

Bahamas, or Lucatos, an extensive archipelago of the British West Indies, which recent surveys (1870-90) show to consist of 12 large islands, 661 islets or cays

(keys) as they are called, and 2387 banks, reefs, and rocks above the surface of the water, all but thirty unin- habited. They all rise on the margin of large coral banks, and are themselves exclusively of coralline formation, with a mean elevation of 100 feet, but rising here and there to 300 or even 400 feet above the sea. They are disposed in the direction from north-west to south-east, extending from Florida along the GreoA Bahama Bank for a dis- tance of about 780 miles to Turks islets north of San Domingo. They have a collective area of 5450 square miles, with a population which was returned in 1891 at 47,564 (about 12,000 white, the rest coloured), and was estimated in 1900 at about 60,000. The largest and most important members of the group, following in the normal direction from north-west to south-east, are : — Bahama, which gives its name to the archipelago ; G-reat Abaco, Eleuthera, New Providence, Andros, Cat Island, Watling, Yuma, Aclin, Mariguana, The Caicos (North, Grand, and East), Inagua (G-reat and Little), and Turks. Cat (Gua- nahani), the highest land in the group (400 feet), was long supposed to be the island which was first reached by Columbus (12th October 1492), and was named by him San Salvador. Then the distinction was successively transferred to the neighbouring Watling, Great Turk, and Mariguana ; but in 1880 the American marine surveyor, G. V. Fox, identified San Salvador, on seemingly good grounds, with Samana (Atwood Cay), which lies about midway between Watling and Mariguana. The chief difficulty is its size, for if Samana is the true San Salva- dor, it must have been considerably larger 400 years ago than it now is. The Bahamas are unaffected by the de- pressed state of the sugar market in so many other West Indian groups, the chief produce being fruits (principally oranges), hemp fibre, sponges, salt, and some cotton. The salt and sponge latterly seem to be dying out, while fruit cultivation is on the increase. The imports rose from £195,000 in 1896 to £238,000 in 1898, and the ex- ‘ ports from £139,000 to £175,000 in the same period. The revenue in 1896,

~~£65,000, and 1898, £87,000; expen- diture (1896), £60,000 ; (1898), £64,000 ; debt (1900), £118,400. The total trade with America is nearly four times that with Great Britain. Trade with British Col- onies or with other countries than America and the United Kingdom is quite insignificant. A number of visitors from America and Canada come every year to winter in the Bahamas. The total tonnage of vessels, inwards and outwards, was 741,522 in 1898. There has been rapid increase of late years owing to steamers call- ing on their way to and from the ports of the Gulf of Mexico to engage and to re-land labourers. There is regu- lar fortnightly mail communication with New York and Cuba, and frequent sailing vessels to and from Cuba and Key West. The extent of Crown lands is estimated at 500,000 acres, lying chiefly in the islands of Inagua, Andros, Grand Bahama, and Abaco, but little of this is serviceable for cultivation. There are 44 Government schools, with 5998 pupils on the register, and 4050 in average attendance in 1898. There are 11 schools which receive grants-in-aid, besides others, independent of such aid, belonging chiefly to the Anglican Church body. There are no railways or telegraphs, and but few roads, except in New Providence. Cable communication with the United States was established in 1892. There are no regular forces, militia, or volunteers. The constabu- lary is a semi-military force, originally enlisted in Bar- bados, but recruited at times in the Bahamas.~~

~~(a. h. k.)~~

~~Bahawalpur, a native state of India, within the Punjab, stretches for more than 300 miles along the left bank of the Sutlej, the Punjnud, and the Indus, and is~~

~~bordered on the other side by the desert of Eajputana. The area covers 17,285 square miles ; in 1881 the popu- lation was 573,494; in 1891 it was 650,042 (average density, 38 persons per square mile) ; in 1901, 720,662, showing a further increase of 11 per cent. The estimated gross revenue is Es.16,00,000 ; the military force (includ- ing police) is 1607 men. There is no tribute. The chief, whose title is Nawab, is a Mahommedan of the Daudputra family from Sind. The dynasty established its independ- ence of the Afghans towards the end of the 18th century, and made a treaty with the British in 1838, to which it has always been loyal. The benefits of canal~~

~~irrigation were introduced during the minority of the late Nawab, and the revenue thus doubled. The territory is traversed throughout its length by the North- Western and South- ern Punjab railways. In 1896-97 the total number of schools was 487, with 5828 pupils, of whom 721 were girls ; the proportion of boys at school to the total male population was 1 in every 61. There are an arts college, and 7 Anglo-vernacular schools, with 856 pupils.~~

~~The town of Bahawalptje is situated near the left bank of the Sutlej ; railway station 63 miles from Mool- tan. It has a magnificent palace. Population, 13,635.~~

~~Bahia, an Atlantic state of Brazil between 9° 55′ and 18° 15′ S. lat. and 37° 40′ and 39° 40′ W. long. Its area covers 164,640 square miles. Its population in 1890 was 1,919,800, and in 18”97 was estimated at 1,822,000. The chief towns are Bahia or S. Salvador, the capital, and Alagoinhas (12,000), Bom-Mm (14,000), Feira de Sant Anna (16,000), Marogogipe (13,000), Santo Amaro (11,000), Jacobina (9000), Ilheos (6000), Cachoeira (9200), Barra do Eio Grande. There are over 70 towns in the state. Railways run from Bahia to Joazeiro on the northern border of the state and thence to other localities beyond; from Nazareth to Maragogipe; from Amaro to near the port of Abbadia ; from Caravellas to Serra dos Aymores. Others are in construction. The capital, Bahia or San Salvador, is a seaport with a population estimated at between 180,000 and 200,000. The port was visited in 1896 by 1045 ships of 1,538,881 tons, in 1897 by 1028 ships of 1,533,078 tons, and in 1898 by 881 ships of 1,504,797 tons. The value of the exports in 1897 was £1,519,930. The principal articles of export were coffee, tobacco, cacao, sugar, rosewood, logwood, and hides.~~

~~Bahraich, a town and district of British India, in the Faizabad division of Oudh. The town is on the river Sarju. Since the opening of the railway the place has begun to flourish. It contains the most popular place of pilgrimage in Oudh, the tomb of Masaud, a champion of Islam, slain in battle by the confederate Kajputs in 1033, which is resorted to by Mahommedans and Hindus alike. There is also a Mussulman monastery, and the ruined palace of a nawab of Oudh. The American Methodists have a mission here. Population, about 24,000.~~

~~The district of Baheaich lies between the Tarai of Nepal and the river Gogra. It contains an area of 2680 square miles. The population in 1891 was 1,000,432, being 373 persons per square mile ; classified according to religion, Hindus numbered 830,459, Mahommedans 169,798, Christians 124, including 28 Europeans, " others " 51. In 1901 the population was 1,051,856, showing an increase of 5 per cent. Land revenue and rates are returned as Es.lO, 93, 737, the incidence of assessment per acre being Es.0 : 9 : 4 on the temporarily settled, and Es. 0 : 15 : 7 on the permanently settled area ; the number of police was 2820. In 1896-97, out of a total cultivated area of 919,844 acres, 60,976 were irrigated from tanks, wells, etc. A considerable trade is conducted with Nepal, chiefly~~

~~in timber. A line of railway has been opened through the district to Nepalganj on the frontier.~~

~~Bahrein Islands. — The Bahreins include a group of islands situated about 20 miles east of the coast of Al Hasa, in the Persian Gulf, a little to the south of the port of Al Katif, which, under the ancient name of Gerrha, has been celebrated throughout history as the mart of Indian trade, the starting-point of caravans across Arabia. The largest of the group is called Bahrein. It is about 27 miles long from north to south and about 10 wide — a low flat space of sandy waste with cultivated oases and palm groves of great luxuriance and beauty. The rocky hill of Jebel Dukhan (the " mountain of the mist ") rises in the -midst of it to a height of 400 feet. The rest of the group are of coral formation. The next island in size to Bahrein is Moharek, curved in shape, and about 5 miles long by i mile in breadth. It lies 1 mile to the north of Bahrein. Sitrah (4 miles long), Nebbi, Saleh, Sayeh, Khasifeh, and Arad (f mile long) complete the group. Of these minor islands Arad alone retains its classical name. I The sea around the Bahrein islands is shallow, so shallow as to admit only of the approach of native craft, and the harbour is closely shut in by reefs. There is very little doubt that it was from these islands that the Puni, or Phoenicians, emigrated northwards to the Mediterranean. Bahrein has always been the centre of the pearl-fishing industry of the Persian Gulf. There are about 400 boats now employed in~~

~~the pearl fisheries, each of them paying a tax to the Sheikh. The pearl export from Linja is valued at about £30,000 to £35,000 per annum.~~

~~The capital town of Bahrein is Manameh, a long, straggling, narrow town of about 8000 inhabitants, chiefly of the Wahabi sect. Manameh is adjacent to the most northern point of the island, and looks across the narrow strait to Moharek.~~

~~Pish and sea- weed form the staple food of the islanders. The water-supply of Moharek is probably unique. It is derived from springs which burst through the beds below sea-level with such force as to retain their freshness in the midst of the surrounding salt water. Scattered through the islands are some fifty villages, each possessing its own date groves and cultivation, forming features in the landscape of great fertility and beauty. Most of these villages are walled in for protection.~~

~~The present Sheikh of Bahrein (who lives chiefly at Moharek) is of the family of El Kalifa, which furnishes chiefs to the Uttubi tribe. This ruling race was driven from the mainland (where they held great possessions) by the Turks about 1850. In the year 1867 the Persians threatened Bahrein, and in 1875 the Turks laid their hands on it. British interference in both cases was successful in maintaining the integrity of Arab rule, and the Bahrein Islands are now under British protection.~~

~~To the south-west of the picturesque belts of palm trees which stretch inland from the northern coast of Bahrein, is a wide space of open sandy plain filled with gigantic tumuli, or earth mounds, of which the outer layers of gravel and clay have been hardened by the weather action of centuries to the consistency of conglom- erate. Within these mounds are two-chambered sepulchres, built of huge slabs of limestone, several of which have been opened and examined by Durand, Bent, and others, and found to contain relics of undoubted Phoenician design. Scattered here and there through-out the islands are isolated mounds, or smaller groups, all of which are of the same appearance, and probably of similar origin.~~

~~See Bent, vol. xii. Proceedings M. &. S. (t. h. h.*)~~

~~Bahr-el-Chazal. See Sudan, Nile, and Egypt.~~

~~Baiburt, chief town of a district of the Erzeriim vilayet of Asiatic Turkey, altitude 6114 feet, situated on both banks of the Choruk Su (Acampsis), at the point where the Trebizond-Erzeriim road crosses that river. The town is dominated by an old Armenian fortress on an isolated mass of rock. Population, 10,000 (Moslems, 8500; Christians, 1500).~~

~~Baikal, a lake of Russia, East Siberia, the sixth in size of all the lakes of the world and the largest fresh- water basin of Eurasia. It has the shape of a narrow~~

~~crescent, which spreads from S.W. to N.E. (61° 29′ to 66° 60′ N. lat. and 103° to 110° E. long.), separating the pro- vince of Irkutsk from Transbaikalia, and has a length, of 376 miles and a width of from 20 to 70 miles. Its south- western extremity penetrates into the high plateau of East Asia, and the lake lies entirely in the Alpine zone which fringes the plateau from the north-west. Its area is 13,600 square miles, i.e., nearly as great as Switzerland. The length of its coast-line is 626 miles along the western, and 640 along the eastern shore. Its altitude is now estimated by Russian geographers at 1587 and at 1661 feet — 90 feet above the level of the Angara at Irkutsk — both figures being derived from a levelling accomplished in the 'seven- ties across Siberia (Zapiski, Euss. Geog. Soc, Gen. Geogr. XV. 1886) ; but owing to errors which have crept into that levelling between Krasnoyarsk and Irkutsk, these altitudes seem to be exaggerated and 1500 feet (1433 feet for Irkutsk) would seem a more correct altitude (Izvestia, East Sib. Branch, xxviii. 1, 1897). Its level is subject to slight oscillations, and after the heavy five weeks' rains of 1869, it rose by 7 feet, an immense territory at the mouth of the Selenga being submerged.~~

~~The elongated hilly island of Olkhon and the peninsula Svyatoi Nos which rises as its continuation on the opposite eastern shore, divide the lake into two basins. Careful soundings show that the deepest part of the lake is in the south-west, at the foot of the Khamar-daban border-ridge of the high plateau. An elongated cavity, 66 miles long, reaches there a depth of over 600 fathoms, with a maxi- mum depth of 791 fathoms, i.e., about 3240 feet below the level of the ocean. The bottom of the lake has very steep slopes as a rule, the 100- and even the 250-fathom lines running close to the~~

~~shores. Only at the mouth of the Selenga, which is a mighty stream 800 miles long, enter- ing the lake from the south-east, and pouring into it the waters and the deposits from a drainage area of 173,500 square miles, a wide delta protrudes into the lake, reducing its width to 20 miles and spreading under its waters, so as to leave only a narrow channel, 230 to 247 fathoms deep, along the opposite coast.~~

~~The depths of the middle portion of the lake have not yet been measured but must exceed 500 fathoms. It was expected that an underground ridge would be found con- necting Olkhon with Svyatoi Nos; but depths exceed- ing 622 fathoms were found even along that line. As to the northern basin, the configuration of its bottom is in accordance with the high mountains which surround it, and most of its area has a depth exceeding 400 fathoms, the maximum depths along three lines of soundings taken across it being 491, 485, and 476 fathoms respectively.~~

~~Temperature. — The surface-layers of this immense basin are heated in the summer along the coast so as to reach temperatures of from 55° to 67° Fahr. both close to the shores and at some dis- tance from the mouth of the Selenga ; \ait these warmer layers are not thick and a uniform temperature of nearly 39° F. is gener- ally found at a depth of 20 fathoms, as also on the surface in the middle of the lake. At a depth of 500 fathoms there is a nearly uniform temperature of 38° from top to bottom. The lake freezes usually at the end of December or in the beginning of January, so solidly that a temporary post-horse station is erected on the ice in the midst of the lake, and it remains frozen till the second half of May. The evaporation from this large basin exercises a certain infiuence on the climate of the surrounding country, while the absorption of heat for the thawing of the ice has a notable cooling effect in early summer.~~

~~Mivers. — Lake Baikal receives over 300 streams, mostly short mountain torrents, besides the Tipper Angara, which enters its north-east extremity, the Barguzin on its east shore, and the Selenga from the south-east. Its only outflow is the Lower Angara, which issues through a rocky cleft on the west shore. The Irkut reaches the Baikal no more. After approaching its south-west extremity it abandons the broad valley which leads to the lake~~

~~and makes its way northwards through a narrow cleft pierced in high mountains, to join the Angara at Irkutsk.~~

~~Mountains. — With the exception of the delta of the Selenga, lake Baikal is surrounded with high mountains. The Khamar daban border-ridge (the top of a mountain of the same name is 5300 feet above the lake) falling with steep cliffs towards the lake, fringes it in the south ; a massive, deeply ravined highland occu- pies the space between the Irkut and the Angara ; the Onot and Baikal ridges (also Primorskiy) run along its north-west shore, reaching it in a diagonal direction ; an Alpine complexus of yet unexplored mountains spreads along its north-east shore ; the Bar- guzin range reaches its shores in an oblique direction in the east, and the Ulan Burgasu mountains appear in the delta of the Selenga.~~

~~Geology. — It is certain that in previous geological ages lake Baikal had a much greater extension. It spread westwards into the Tunka valley of the Irkut, and up the lower portions of the valleys of the Upper Angara and the Barguzin. "Volcanic activity took place around its shores at the end of the Tertiary or during the Quaternary age, and mighty streams of lava cover the Sayan and Khamar-daban mountains, as well as the Tunka valley. Earthquakes are still frequent along its shores. The researches of Meglitzky (1851) and Chersky (1875) have proved that the northern portion of Baikal is a diagonally-running transversal rift which was made in the Laurentian schists and slates, whose synclinal and anticlinal plications run from south-west to north- east, crossing in an oblique direction the present axis of the lake ; while its southern portion has the character of a longitudinal vaUey, Immensely modified by erosion and running between the outer ioot of the border-ridge of the high plateau and the Alpine zone which fringes it. The mountains around lake Baikal (granites, syenites, gneisses, and various crystalline schists, con- glomerates and limestones) belong chiefly to the Laurentian, Huronian, Cambrian, and Silurian ages — ^red Devonian sand-stones (Silurian, according to Baron ToU ?) lying in nearly hori- zontal layers at the outer foot of the Onot and Baikal ranges. Jurassic and Tertiary deposits of fresh-water origin occur in the old valleys. Gold is found at its~~

~~northern extremity, and beauti- ful lapis-lazuli, baikalite, and some graphite on the slopes of the Khamar-daban, near Kultuk.~~

~~Fauna. — The fauna of lake Baikal, explored by Dybowski and Godlewski, is much richer than it was supposed to be, and has quite an original character ; but hypotheses as to a direct com- munication having existed between lake Baikal and the Arctic Ocean during the Post Tertiary or Tertiary ages, are not proved. Still, lake Baikal has a seal {Phoca vitulina, Phoca baikalensis of Dybowski) quite akin to the seals of Spitzbergen. The waters of the lake swarm with fishes (sturgeons, salmonidse), and its herring {Salmo omul) yields the chief product of the fisheries, about 11,000 casks every year. Its quantity, however, notably diminished within the last forty or fifty years. The little lake Frolikha, situated close to lake Baikal near its northern extremity and communicating with it by means of a river of the same name, is interesting on account of the species of trout, Salmo erythreas, which is found in it but is not known elsewhere.~~

~~Navigation. — Navigation on lake Baikal is rendered diflBcult both by sudden storms and by the absence of good bays and ports. The main port on the western shore, Listvenichnaya, near the outflow of the Angara, is an open roadstead at the foot of high mountains. Steamers ply from it thrice a week to Posolskoye, on the opposite shore, five times a year to Verkhne-Angarsk, at the northern extremity of the lake, and frequently to the mouth of the Selenga which becomes an important artery of trade. Steamers go up that river to Bilyutai, near the Mongolian frontier, and bring back nearly 6660 tons of tea, out of the 16,500 tons imported Vict Kiakhta, while nearly 5000 tons of grain, cedar nuts, salt, soda, wool, and timber are shipped on rafts down the Khilok, Chikoi, and Uda (tributaries of the Selenga), and about 1000 tons of manufactured goods are taken up the river for export to China. Ten steamers ply on lake Baikal and three on the Selenga. Besides, attempts are being made to render the Angara navigable below Irkutsk down to the Yenisei. In winter, when the lake is covered with a crust of ice three to four feet thick, it is crossed on sledges from Listvenichnaya to Posolskoye. The lake offering, nevertheless, a serious interruption on the main road which leads through Siberia to the Amur, a highway, available all the year round, was made in 1863-64 around its southern shore, partly by piercing the cliffs falling to the lake. It will be followed by the trans-~~

~~Siberian railway, notwithstanding the considerable difficul- ties offered by a great number of streams wildly rushing to the lake from the Khamar-daban. In the meantime, a powerful pro- tected ice-breaker (3750 horse-power, 4200 tons) will carry over the trains (up to twenty-five carriages) from Listvenichnaya to the head of the Transbaikalian railway at Posolskoye.~~

~~Towns. — The shores of the lake are thinly populated. The chief villages are Listvenichnaya, Posolsk monastery and Posol- skoye, Verkhne-Angarsk at the north-eastern extremity, Kmtuk at the south-western extremity, and several villages in the delta of the Selenga.~~

~~Authorities. — Dkizhenko. " Hydrographic Reconnoitring of Lake Baikal," in Izvestia, Buss. Geogr. Soc. 1897, 2, with hydro- graphic map. — Russian Addenda to Hitter's Asia, East Siberia, Baikal, &c., St Petersburg, 1895. — Chersky's Geological Map of Shores of Lake Baikal, 6f miles to the inch, in Zapiski of Buss. Geogr. Soc. xv. 1886. — "Report of Geological Exploration of Shores of Lake Baikal," in Zapiski of Mast Siberian Branch of Buss. Geogr. Soc. xii. Irkutsk, 1886. — Oerucheff. "Geology of Baikal Mountains," Izvestia of same Society, 1890, xxi. 4 and 5. — Dybowski and Godlewski on "Fauna," in same periodical, 1876. — "WiTKOwsKi on "Seals." — Yakovlbv's "Fishes of An- gara," in same periodical, 1890-93. — " Fishing in Lake Baikal and its Tributaries," in same periodical, 1886-90. (p. a. k.)~~

~~Bailey, Philip James (1816 ■), English poet,~~

~~author of Festus, was born at Nottingham, 22nd April 1816. His father, who himself published both prose and verse, ovmed and edited from 1845 to 1852 The Nottingham Mercury, one of the chief journals in his native /town. Philip James Bailey received a local education until his sixteenth year, when he matriculated at Glasgow Univer- sity. He did not, however, take his degree, but moved in 1835 to London, and entered Lincoln's Inn. Without mak- ing serious practice of the law he settled at Basford, and for three years was occupied with the composition of Fes- tus, which appeared anonymously in 1839. Its success, both in England and America, was immediate. It passed through a dozen editions in the country of its birth, and nearly three times as many in the United States ; and when in 1889 its author was able to publish a " Jubilee Edition " he could feel that it was one~~

~~of the few poems of its time which was known to both the older and younger genera- tions. Its author is known almost exclusively by his one Toluminous poem, for though Bailey published other verses he is essentially a man of one book. Festus has undergone many changes and incorporations, but it remains a singu- lar example of a piece of work virtually completed in youth and never supplanted or reinforced by later achieve- ments of its author. It is a vast pageant of theology and philosophy, comprising in some twelve divisions an attempt to represent the relation of God to man and of man to God, to emphasize the benignity of Providence, to preach the im- mortality of the soul, and to postulate " a gospel of faith and reason combined." It contains fine lines and dignified thought, but its extraordinarily ambitious theme, and a certain incoherency in the manner in which it is worked out, prevent it from being easily readable by any but the most conscientious and most sympathetic student.~~

~~Baillieston, a large mining village of Old Monkland parish, Lanarkshire, 6^ mUes E. of Glasgow by rail. There are 13 collieries at present working in the vicinity, with a daily output of 4300 tons, and employing 3000 men. There is a large nursery and market garden. Population (1881), 2927: (1891), 4026; (1901), 5151.~~

~~Bain, Alexander (1818), Scottish logician~~

~~and philosopher, was born in Aberdeen, 11th June 1818, and received his early education there. In 1836 he entered Marischal College, the younger of the two universities that had then a separate existence in Aberdeen ; and, while a student, he came under the influence of Professor John Cruickshank, who held the Chair of Mathematics, and of Dr William Knight, who was Professor of Natural Philo- sophy— from each of whom he received a considerable impetus. His college career was very distinguished, espe- cially in the departments of mental philosophy, mathe- matics, and physics. Towards the end of his arts course he became a contributor to the Westminster Review, and thereby came into contact with John Stuart Mill. This was the beginning of his connexion with Mill, which was to lead to a life-long friendship. In 1841 he became sub- stitute for Dr Glennie, the Professor of Moral Philosophy,~~

~~BAIN, ALEXANDER~~

~~T^ho, through ill-health, was unable to discharge the ac- tive duties of the chair. This post he occupied for three successive sessions, during which time he continued writ- ing for the Westminster, and also in 1842 helped Mill with the revision of the MS. of his System of Logic, giving special aid in the province of Induction, and supplying many of the more impbrtant examples of the experimental methods. In 1844, when the chair of Natural Philosophy was vacant through the death of Dr Knight, he filled the gap until the appointment of a new professor. He was unsuccessful in his application for the chair ; but, in 1845, he was appointed Professor of Mathematics and Natural Philosophy in the Andersonian University of Glasgow. This he did not long retain, but, preferring a wider field, resigned the position and devoted himself to literary work, partly in connexion with the magazines, but still more in the production of scientific manuals and philosophical articles for Messrs Chambers of Edinburgh. In 1848 he removed to London to fill a post in the Board of Health under Edwin Chadwick. While resident in London he was a member of the brilliant coterie that included George Grote and John Stuart Mill, and was associated with them in the leading political, social, and intellectual movements of the time. In 1865 he published his first large work. The Senses and the Intellect, which was fol- lowed in 1869 by !Z%e Emotions and the Will. Through these two treatises his place as an independent thinker was assured. This led in 1860 to his appointment by the Crown, on the recommendation of the then Home Secre- tary, Sir G. Comewall Lewis, to the chair of Logic and English in the University of Aberdeen. That chair had just been created, on the amalgamation of the two uni- versities (King's and Marischal) by the Scottish Universi- ties Commission of 1858 ; and Mr Bain became its first Qccupant. In his new capacity he had a twofold work to perform. Up to this date neither Logic nor English had received adequate attention in Aberdeen, and now was the opportunity for furthering the interests of both. Mr Bain threw himself with great energy into the task. Not content with shaping lectures for his class, he set to work by published writings to instruct the outside world also ; and in this way he succeeded not only in raising the standard of education in the north of Scotland, but also in forming a school of philosophy, and in widely influ- encing the teaching of English gram'mar and of compo- sition. His efforts were first directed to the English part of~~

his charge. This resulted in the publication of the Higher English Grammar in 1863, followed in 1866 by the Manual of Rhetoric, in 1872 by A First English Orammp/r, and in 1874 by the Companion to the Higher Grammar. These works covered a large field, and by their original views and new methods aroused much interest, and met with wide acceptance in the scholastic world. But the other subject of his chair also called for attention. No doubt his own philosophical writings already published, especially TTie Senses and the Intellect (to which was added, in 1861, Tlie Study of Character), were ready to hand for the purposes of prelection; but the volumes were too large for effective use in the class-room. A psychological handbook was needed, for there was hardly anything of that stamp in existence, cer- tainly nothing at all satisfactory. Accordingly, in 1868, he published his Manual of Mental and Moral Science, mainly a condensed form of his own larger philosophical treatises, but with the doctrines re-stated, and in many instances freshly illustrated, and with many important additions, chiefly in the shape of chapters on the history of the intellectual controversies (universal-s, sense-percep- tion, &c.), and of a recasting of the ethical positions, and an elaborate analysis of the leading systems of Ethics, ancient and modern. The year 1870 saw the. publication of the

Logic. This, too, was a work designed specially for the use of students, based on Mill, but differing from him in many particulars, and having as distinctive features the treatment of the doctrine of the conservation of energy in connexion with causation and the detailed applica- tion of the principles of logic to the various sciences. After the publication of the Logic, his eminent services to education in Scotland were recognized by the conferment of the honorary degree of Doctor of Laws by the Univer- sity of Edinburgh in 1871. Next came two publications in " The International Scientific Series," namely, Mijid and Body (1872), and Education as a Science (1879). The first of these is a re-statement of Mr Bain's intellectual system, with an appended chapter on the history of the conception of the Soul ; and the second carries the prin- ciples of psychology with great thoroughness into the province of teaching.

All these works, from the Higher English Grammar , downwards, were written by Mr Bain during his twenty years' occupancy of the chair of Logic in the University of Aberdeen. To the same period belongs his

~~institution of the philosophical journal Mind; the first number of which appeared in January 1876, under the editorship of a former pupil and attached disciple, Professor G. Croom Eobertson of University College, London. To this journal Mr Bain contributed many important articles and discussions ; and he continued sole proprietor of it till Robertson, owing to ill-health, resigned the editorship in 1891, when it passed into other hands. Feeling the burden of the teaching work as years advanced, Dr Bain resigned his professorship in 1880. This did not, how- ever, mean cessation of intellectual activity or of pro- ductive energy. On the contrary, his interest in thought and his desire to complete the scheme of work which he had mapped out for himself in earlier years remained as keen as ever. Accordingly, in 1882 appeared the Biog- raphy of James Mill, and accompanying it John Stuart Mill: A Criticism, with Personal Recollections. Next came (1884) a collection of articles and papers, most of whicji had appeared ia magazines, under the title of Practical Essays. This was succeeded in 1887 by the first volume of the new edition of the Rhetoric, devoted to the handling of the Intellectual qualities of style, and, along with it, a book On Teaching English, being an ex- haustive application of the principles of rhetoric to the criticism of style, for the use of teachers. The following year the second volume of the new Rhetoric appeared, dealing with the Emotional qualities of style. This completed, attention was next directed to a revision of The Senses and the Intellect, which resulted in the fourth edition of the work, published in 1894, in which may be found Dr Bain's last word on psychology ; for, although a new edition of !Z%e Emotions and the Will was brought out in 1899, the author's physical condition did not per- mit of any recasting of the treatise such as had been accorded to the companion volume.~~

~~Dr Bain's life has been mainly that of a thinker and a man of letters. But he is also so far a man of affairs that he has always taken a keen interest, and frequently an active part, in the political and social movements of the day; and so highly did the students of Aberdeen rate his practical ability that, after his retirement from the chair of Logic, they twice in succession elected him Lord Eector of the University, each term of office extending over three years. This was no mere compliment to a former professor, of whom they were naturally proud, but a deliberate selec- tion of the man whom they believed best able to guide the affairs of the university as head of its~~

superior court. Being the acknowledged leader of the Progressive party, he was all on the side of reform, pushing forward the interests of science, and strenuously advocating, in the face of much

opposition, the recognition of the claims of the modern languages to a place in the academic curriculum. In like manner, the vast amount of work that Dr Bain did for the community as a member of the first School Board, and in connexion with the management first of the Mechanics' Institute, and next of the Free Public Library, shows him to be no mere recluse. It was in appreciation of his services of this kind that the people of Aberdeen placed a marble bust of him in the Public Library— just as his former pupils, in gratitude for the inspiration of his teach- ing, have presented a portrait of him in his rectorial robes, painted by Sir George Eeid, to the university, to be hung in the picture gallery of Marischal College.

Wide as Professor Bain's influence has been as a logician, a grammarian, and a writer on rhetoric, his greatest repu- tation rests on his psychology. At one with Johannes Mliller in the conviction psychologus nemo nisi physiologus, he was the first in Great Britain during the 19th century to apply physiology in a thoroughgoing fashion to the elucidation of mental states, and thereby to advance the science of mind at a bound. His happy idea of applying the natural history method of classification to psychical phenomena further gave scientific character to his work, the value of which was still more enhanced by the author's faculty of methodical exposition and his exceptional com- mand of felicitous illustration. In line with this, too, is his rigorous demand that psychology shall be cleared of metaphysics; and to his lead is no doubt due in great measure the position that psychology has now acquired as a distinct positive science. Although his work pre-dated the psycho-physical developments of the present day, these are all in the exact spirit of it ; and although he has from the beginning strongly and consistently advocated the supremacy of the introspective method in psychological investigation, he was among the first to appreciate the help that may be given to it by animal and social and infant psychology as subsidiary adjuncts. He may justly claim the merit of having effectively

~~guided the awakened psychological interest of British thinkers of the second half of the 19th century into fruitful channels. Nor will any just estimate of his work ignore the subtlety and sug- gestiveness of his analyses ; or his masterly handling of the laws of Association, alike penetrating and exhaustive, bold in the application of them to each and every province of mind — intellectual, emotional, and volitional. These mark him off among psychologists, and determine his place in the history of philosophy.~~

~~Bainaluka, or Banjaluka, a town of Bosnia, Austria-Hungary, situated on the Vrbas, on the borders of a plain fronting the entrance to a narrow defile, at the terminus of a railway line from Sunja, from which by rail it is distant 85 miles S.E. Among the mosques the most notable is the FeradijarDjami, dating from the end of the 16th century. On the right bank of the Vrbas are the ruins of the ancient citadel. There are powder mills and cloth factories, and also a Government tobacco factory. Borings have lately been made by the Government in the neighbouring coal-fields. Bainaluka, under the name of Servitium, was a Roman military station. The population is 13,666, of whom the majority are Mahommedans.~~

~~Baindir, a town in Asiatic Turkey, in the Aidin, Smyrna, viMyet, situated in the valley of the Kuchuk Mendere (ancient Caystrus). It is connected with Smyrna by railway, and has a trade in cotton, figs, raisins, and tobacco. Population, 10,000 (Moslems, 7500 ; Christians,~~

~~2500).~~

~~Baird, Spencer Fullerton (1823-1887), American scientist, was born in Eeading, Pennsylvania,~~

~~3rd February 1823. He graduated at Dickinson College, Carlisle, Penn., in 1840. The next year, when eighteen years old, he made an ornithological excursion through the mountains of Pennsylvania, walking, says one of his biographers, " 400 miles in twenty-one days, and the last day sixty miles." In 1838 he met Audubon, and thence- forward his studies were largely ornithological, Audubon giving him a part of his own collection of birds. After studying medicine for a time, Baird became professor of natural history in Dickinson College, assuming likewise the duties of the chair of chemistry, and meanwhile giving instruction in physiology and~~

~~mathematics. This variety of duties, in a small college, tended to give him that breadth of scientific interest which characterized him through life, and made him perhaps the most representative general scientist in America. For the long period between 1850 and 1878 he Was assistant-secretary of the Smith- sonian Institution, Washington, and on the death of Joseph Henry, in the latter year, he became secretary. While an ofllcer of the Smithsonian, Baird's duties consisted, in large part, of the gathering of information from many fields, and the superintendence of the labour of workers in widely different lines. Thus, apart from his assistance to others, his own studies and published writings cover a broad range : iconography, geology, mineralogy, botany, anthropology, general zoology, and, in particular, ornitho- logy; while for a series of years he edited an annual volume summarizing progress in all scientific lines of in- vestigation. He gave general superintendence, between 1850 and 1860, to several Government expeditions for scientific exploration of the western territories of the United States, preparing for them a manual of Instruc- tions to Collectors, and enlisting the collaboration even of such army of&cers as Scott, M'Clellan, and Thomas, as well as of ofH-cers in the navy. Of his own publications,, the bibliography by G. Brown Goode, from 1843 to the close of 1882, includes 1063 entries, of which 775 were short articles in his Annual Record. His most impor- tant volumes, on the whole, were Birds, in the series of reports of explorations and surveys for a railway route from the Mississippi river to the Pacific ocean (1858), of which Dr Elliott Coues says (as quoted in the Pop- ular Science Monthly, xxxiii. 553), that it "exerted an influence perhaps stronger and more widely felt than that of any of its predecessors, Audubon's and Wilson's not excepted, and marked an epoch in the his- tory of American ornithology" ; Mammals of North Amer- ica: Descriptions based on Collections in the Smithsonian Institution (Philadelphia, 1859) ; and the monumental work (with Thomas Mayo Brewer and Robert Ridgway) History of North American Birds (Boston, 1875-84; "Land Birds," 3 vols., " Water Birds," 2 vols.). He died 19th August 1887, at the great marine biological laboratory at Wood's HoU, Massachusetts, an institution largely the result of his own effprts, and one which has exercised a wide effect not only upon scientific but upon economic ichthyology. (c. f. e.)~~

Bajaor, a small district peopled by Pathan races of Afghan origin, about 45 miles long by 20 broad, lying at a high level to the east of the Kunar valley, from which it is separated by a continuous line of rugged frontier hills forming a barrier easily passable at one or two points. Across this barrier the old road from Kabul to India ran, before the Khaibar was adopted as the main route. To the south of Bajaor is the wild mountain district of the Mohmands, an Afghan . race. To the east, beyond the Panjkora river, are the hills of Swat, dominated by another Afghan race. To the north is an intervening watershed between Bajaor and the small state of Dir ; and it is over this watershed and through

the valley of Dir that the new road from Malakand and the Punjab runs to Chitral. The drainage of Bajaor flows eastwards, starting from the eastern slopes of the dividing ridge which overlooks the Kunar and terminat- ing in the Panjkora river, so that the district lies on a slope tilting gradually downwards from the Kunar ridge to the Panjkora. Nawagai is the chief town of Bajaor, and the Khan of Nawagai is under British protection for the safeguarding of the Chitral road. Jandul, one of the northern valleys of Bajaor, has ceased to be of political importance since the failure of its chief, XJmra Khan, to appropriate to himself Bajaor, Dir, and a great part of the Kunar valley. It was the active hostility between the Amir of Kabul (who claimed sovereignty of the same districts) and Umra Khan that led, firstly to the demarcation agreement of 1893 which fixed the boundary of Afghanistan in Kunar ; and secondly to the invasion of Chitral by Umra Khan (who was no party to the boundary settlement) and the siege of the Chitral fort in 1895.

An interesting feature in Bajaor topography is a mountain spur from the Kuna,r range, which curving eastwards culminates in the well-known peak of Koh-i- Mor, which is visible from the Peshawur valley. It was here, at the foot of the mountain, that Alexander found the ancient city of Nysa and the Nyssean colony, traditionally said to have been founded by Dionysos. The Koh-i-Mor has been identified as the Meros of Arrian's history — the three-peaked mountain from which the god issued. It is also interesting to find

~~that a section of the Kafir community of Kamdesh still claim the same Greek origin as did the Nysseans ; still chant hymns to the god who sprang from Gir Nysa (the mountain of Nysa) ; whilst they maintain that they originally migrated from the Swat country to their present habitat in the lower Bashgol. Long after Buddhism had spread to Chitral, Gilgit, Dir, and Swat ; whilst Ningrehar was still full of monasteries and temples, and the Peshawur valley was recognized as the seat of Buddhist learning, the Kafirs or Nysseans held their own in Bajaor and in the lower Kunar valley, where Buddhism apparently never prevailed. It is probable that the invader Babar (who has much to say about Bajaor) fought them there in the early years of the 16th century, when on his way to found the Turk dynasty of India centuries after Buddhism had been crushed in Northern India by the destroyer Mahmud.~~

~~The Gazetteers and Reports of the Indian Government Contain nearly all the modern information available about Bajaor. The Autobiography of Babar (bjr Leyden and Erskine) gives interest- ing details about the country in the 16th century. For the connexion between the Kafirs and the ancient Nysasans of Swat, see S. G.8. Journal, vol. vii. 1896.- (t. h. h.*)~~

~~Baker, a city of Oregon, U.S.A., capital of Baker county, in the eastern part of the State, in the valley of the Powder river, at the east base of the Blue Moun- tains, and on the Oregon Eailroad and Navigation Co. Railway. It is a supply-point for the mines in these mountains and those in the Wallowa range, to the north-east. Population (1880), 1258; (1890), 2604;~~

~~(1900), 6663.~~

~~Baker, Sir Samuel White (1821-1893), Eng- lish traveller and author, was bom in London, 8th June 1821. He was educated partly in England and partly in Germany. His father destined him for a commercial career, but a . short experience of office-work proved him to be entirely unsuited to such a life. On 3rd August 1843 he married Henrietta Biddulph Martin, daughter of the rector of Maisemore, and the two follow-~~

~~ing years were spent, with his wife, in Mauritius, looking after some property held there by his father. The desire for travel took him in 1846 to Ceylon, where, in the following year, he founded an agricultural settlement~~

~~at Newara Eliya, a mountain health-resort. Aided by his brother, he brought emigrants thither from England, together with choice breeds of cattle, and before long the new settlement was a success. His health necessitated his leaving Ceylon in 1855 ; and soon after his return to England his wife died (29th December 1855), leaving him with four children. During his residence in Ceylon he published TJie Rifle and the Hound in Ceylon (1853), and, two years later. Eight Years' Wanderings in Ceylon (1855). After a journey to Constantinople and the Crimea in 1866, he found an outlet for his restless energy by undertaking the supervision of the construction of a railway across the Dobruja, connecting the Danube with the Black Sea. After its completion he spent some months in a tour in south-eastern Europe and Asia Minor. It was during this time that he met, in Hungary, the lady who (in 1860) became his second wife, Florence, daughter of Herr Einnian von Sass. In 1861 he started upon his first tour of exploration in Central Africa. This, in his own words, was undertaken " to discover the sources of the Nile, with the hope of meeting the East African expedition under Captains Speke and Grant somewhere about the Victoria Late." After a year's exploration of Abyssinia, as a result of which he fixed the position of the chief Nile tributaries in that region, he started from Khartum, in December 1862, to follow up the Course of the White Nile. Two months later he met Speke and Grant, who were returning after their discovery of Victoria Nyanza. Their success made him fear that there was nothing left for his own expedition to accomplish ; but the two ex- plorers generously gave him information which enabled him, after separating from them, to achieve the discovery of Albert Nyanza, of whose existence credible assurance had already been given to Speke and Grant. Baker first sighted the lake on 14th March 1864, after which, having spent some time in the exploration of the neighbourhood, he started upon his return journey, and reached Khartum, after many checks, in May 1865. In the following October he returned to England, with his wife, who had accompanied him throughout the whole of the perilous and arduous journey. In recognition of his achievements the Royal Geographical Society awarded him its gold medal, and a similar distinction was bestowed on him by the Paris Geographical Society. In August 1866 he was knighted. In the same year he published The Albert- Nyanza, Cheat Basin of the Nile, and Explorations of the Nile Sources, and, in 1867, The Nile Tributaries of Abys- sinia, both books quickly going through several editions. In 1868 he published a story~~

~~called Cast up by the Sea. In 1869, at the request of the Khedive, Baker undertook the command of a military expedition to Central Africa, with the object of suppressing the slave trade there and open- ing the way to commerce and civilization. Before start- ing from Cairo with a force of 1700 Egyptian troops he was given the rank of Pacha and Major-General in the Ottoman army. Lady Baker, as before, accompanied him. The Khedive appointed him Governor-General of the new territory for four years, at a salary of £10,000 a year ; and it was not until the expiration of that time that Baker returned to Cairo, leaving his work to be car- ried on by the new governor. Colonel Gordon. He had at least succeeded in planting in the new territory the foundations upon which others could build up an administration ; had he remained longer there, or had the Khedivial Government supported him with more vigoiir, the results of his efforts might have been more permanent. He returned to England with his wife in 1874, and in the~~

~~following year purchased the estate of Sandfoyd Orleigh, in South Devon, - where he made his home for the rest of his life. He published his narrative of the Central African expedition, under the title of Ismailia, in 1874. Cyprus as I saw it in 1879 was the result of a visit to that island. With the exception of winters spent in Egypt and India, Baker passed the rest of his life in comparative seclusion at Sandford Orleigh. He kept up an exhaustive and vigorous correspondence with men of all shades of opinion upon Egyptian affairs. Next to these, questions of maritime defence and strategy chiefly attracted him in his later years. He died at Sandford Orleigh on 30th December 1893. (e. f. s.)~~

~~Bakhtiari, one of the great nomad tribes of Persia, whose camping grounds are in the hilly district known as the Bakhtiari province. This province extends from Chahar Mahd^l (west of Isfahan) in the E., to near Shushtar in the W., and separated from Lurist^n in the N. by the Dizful river (Ab i Diz), and in the S. touches BehbahSin and Ram Hormuz. The Bakhtiari are divided into the two great divisions Haft-lang and Chahar-lang, and a number of branches and clans, and were known until the 15th century as the " Great Lurs," the " Little Lurs " being the tribes settled in the district now~~

~~known as Lurist^n, with Khorremdb^d as capital. According to popular tradition the Lurs originally came from Syria in the 10th century, but it is now held that they were in Persia long, perhaps fifteen centuries, before. They speak the. Lur language, a Persian dialect. The Bakhtidiri number about 38,000 or 40,000 families, under 200,000 souls, while the area of the district occupied by them is about 25,000 square miles. About fifty or sixty years ago they could put 20,000 well-equipped horsemen into the field, but in consequence of misrule and long-lasting feuds between the different branches, which the Government often fostered, or even instigated, the district has become poor, and it would now be diflcult to find 4000 horsemen. The province is under the governor-general of Arabistan, and pays a yearly tribute of about £5000. The chiefs of the Bakhtitiri, in 1897, having obtained the Shah's per- mission for improving the road between Shushtar, or Ahvdiz, and Isfahan, an iron suspension bridge with a span of 120 feet was erected over the Karun river at Gud^r i Baliitek ; another, with a span of 70 feet, over the Bazuft river at Pul i Am^rat; and a stone bridge over the Karun at Do-pu-lan. A great part of the traffic from the Persian Gulf to Isfahan will probably now be diverted from the Bushire-Shiras-Isfahan road to the Ahvaz-Bakhtid^ri-Isfahan one.~~

~~For accounts of the Bakhtidri and their country the foUowing works may be consulted with advantage : — Mrs Bishop. Journeys in Persia and Kurdistan. London, 1893.— C. db Bode. Travels in Luristan. London, 1841. — Hon. G. N. Cuezon. Persia and the Persian Question, vol. ii. 283-303. London, 1892.— Sir H. Layakd. Early Adventures in Persia. London, 1894. (A. H.-s.)~~

~~Bakony, a large chain of mountains in south-west Hungary, E. of the Alps, in the counties of, Veszprem, Zala, and Fejer. It extends some 68 miles from south- west to north-east, and 18 to 31 miles from north-west to south-east. The highest peak is Koroshegy (2339 feet). On the shores of Lake Balaton the range has many beautiful basaltic cones, and its other peaks are also mostly coniform or dome-shaped, being richly covered with beech-woods. Formerly the Bakony was a wild forest, full of game, but its wild character has disappeared. Only the stag, deer, and badger are now found in any numbers. Glass-works, porcelain manufactories, forges, and sawmills have~~

~~been built on its wooded slopes. The soil produces grapes yielding excellent wine, and on the tops of the hills are many romantic ruins 'of old castles.~~

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~~Baku, a Russian government of Transcaucasia, bounded by the Caspian Sea from 41° 50′ to 38° 30′ N. lat. in the E., and the Russian provinces of Daghestan and Elisabethpol and Persia in the W. and S. It covers part of the plains on the north-east slope of the Caucasus (Kuba plain) ; the south-east extremity of the main Caucasus range, from Shah-dagh and Bazardyuz to the Caspian, where it ends in the Apsheron peninsula ; the low plains and steppes of the lower Kura ; and finally a narrow belt of-the slopes of the Anti-Caucasus plateaus, steeply falling about Lenkorafi to the Caspian Sea, where the gulf of Kyzyl-agach, protected by a peninsula of the same name, is formed. 'The province is watered by the lower Kura and by a number of small rivers.~~

~~The northern part, on both slopes of the Caucasus, is very fertile and well irrigated, with fine forests and rich fields (partly rice) and gardens. Shemakha is renowned for silkworm culture. The plains on the Kura are also fertile, but require irrigation, especially for the cotton-tree plantations. The Mugafi and Shirvan steppes are richly covered with grass from October to March. The fisheries at the mouth of the Eura (Bozhiy Promysel) are the richest in Russia. The Lenkoran district has a very warm climate (year, 58° Pahr. ; January, 38°; July, 79°), and has a large rainfall (47-6 in.), i.e., five times as much, as Baku. Bice-fields and rich gardens are characteristic of the district. The Apsheron peninsula is dry and nearly devoid of vegetation, but it contains very rich naphtha wells, the richest of which are 8 miles E.N.E. and three miles S.W. of Baku. The extraction of naphtha, which attained only 6600 tons in 1863, has grown rapidly, reaching 7,380,000 tons in 1898. The wells, opened by boring 600 to 680 feet deep, throw out enormous quantities of naphtha mixed with sea-water (up to 10,000 tons a day) ; 765,000 tons of refined paraffin oil were obtained in the same year, and 788,000 exported abroad. It is exported in cistern-ships and railway carriages. The vine tree is widely grown, as also the mulberry tree for silkworm rearing, especially in the district of Shemakha. Spirit is obtained in large quantities. Permanent population (1897), 789,659 ; 814,789 accord-~~

~~ing to the Caucasus census of 1896. Of the 712,703 inhabitants inscribed in 1891, only 42,430 were Russians, 376,520 were Tatars, 118,166 Tates, 55,460 Armenians, 60,610 Talyshins, 41,784 Kyiu-ins, and so on. It is divided into six districts, the chief towns of which are : — Baku, capital of the province (112,253 inhabitants in 1897) ; Geok-chai (2247 in 1896) ; Saliany, chief town of Jevat district (10,168) ; Kuba (16,346) ; Lenkorafi (8768) ; Shemakha (20,008).~~

~~Baku, capital of the above province, on the S. coast of the Apsheron peninsula, 381 miles by rail E.S.E. of Tiflis, 40° 21′ N. and 49° 60′ E., is now connected by a railway with the seaport of Petrovsk, and consequently with the Russian railway system via Vladikavkaz. No other town of Russia has developed as rapidly as Baku, its population having grown from 13,381 in 1860 to 112,263 in 1897.~~

~~Baku has in its southern part a stone quay, IJ mile long, the governor's house, the old garden of the khans, and many rich shops. Numbers of well-paved streets with good European build- ings spread inwards, while the Asiatic town, with narrow winding streets, is built in terraces on the slope of a hill. Here are the ruins of a once beautiful palace of the khans built in the 15th century, the mosque of the shahs built in 1078, and, by the sea, the " tower of the girls," now transformed into a lighthouse. The " black town," with its naphtha yells and works, lies to the north. The climate of Baku is extreme, the average temperature being : year, 58° Fahr. ; January, 38° ; July, 80° ; yearly rainfall, 9-4 inches. A north-north-west wind of exceptional force blows occasionally in winter. Owing to its good harbour and fortunate position, Baku is also the chief depot for all sorts of goods coming from Persia and Transcaucasia — raw cotton, rice, silk, wine, fish, dried friiit, and timber — as also for Russian manufactured goods. The port is visited yearly by 3650 steamers and about 2200 sailing vessels.~~

~~Balaghat (= above the ghats or passes, the high- lands), a district of British India in the Nagpur division of the Central Provinces. The administrative headquarters are at the town of Burha. The district contains an area of 3139 square miles. The population in 1891 was~~

383,331, being 122 persons per square mile; Hindus numbering 282,169, Mahommedans 6901, aborigines 93,917 (chiefly Gonds), Christians 35, of whom 14 were Europeans. In 1901 the population was 326,704, show- ing a decrease of 15 per cent., due to the effects of famine. The total amount of land revenue and rates was returned as E,s. 1,18,835, the incidence , of assessment being Es.O : 3 : 6 per acre of assessed area ; the number of police was 237. In 1897-98, out of a total cultivated area of 332,761 acres, 51,827 were irrigated from tanks, &c. A large part of the area (654,313 acres) is still covered with forest, the most valuable timber-tree being sal. There are no railways, and few good roads. In 1897-98 there were 66 schools, attended by 3791 pupils. The district suffered very severely from the famine of 1896-97. In 1897 the death-rate was returned at 84 per 1000, rising to 307 in the town of Burha. It suffered again in 1900, when in April the number of persons re- lieved rose above 100,000.

Balakovo, a village of south-eastern Eussia, govern- ment of Samara, 10 miles above the mouth of the Irghiz. It is one of the chief river ports on the Volga. Nearly 167,000 tons of grain are exported every year, while manufactured goods are imported for a wide and wealthy praitie region. It also contains iron works. The popu- lation is 15,995.

Balance of Trade. — This term belongs originally to the period of Political Economics when the ” mercantile theory” prevailed, but it is still in use,. though not quite perhaps in the same way as at its origin. The ” balance of trade ” was then identified with the sum of the precious metals which a country received in the course of its trading with other countries or with particular countries. There was no doubt an idea that somehow or other the amount of the precious metals received represented profit on the trading, and each country desired as much profit as possible. Princes and soveteigns, however, with political aims in view, were not close students of mercantile profits, and would probably have urged the acquisition of the precious metals as an object of trade even if they had realized that the country as a whole was exporting “money’s worth” in order to buy the precious metals which were desired for political objects. The ” mercantile theory ” was

~~exploded by Adam Smith's demonstration that gold and silver were only commodities like others with no special virtue in them, and that they would come into a country when there was a demand for them, accord- ing to the amount, in proportion to other demands, which the country could afford to pay ; but the ideas in which the theory itself have originated have not died out, and the idea especially of a " balance of trade " to which the rulers of a country should give attention is to be found in popular discussions of business topics and in politics, the general notion being that a nation is prosperous when its statistics show a '•' trade balance " in its favour and un- prosperous when the reverse is shown. In recent times the excess of imports over exports or of exports over imports, shown in the statistics of foreign trade, has also come to be identified in popular speech with the " balance of trade," and many minds are no doubt imbued with the ideas (1) that an excess of imports over exports is bad, and (2) an excess of exports over imports is the reverse, because the former indicates ah " unfavourable " and the latter a " favourable " trade balance. In the former case it is urged that a nation so circumstanced is living on its capital. Exact remedies are not suggested, although the idea of preventing or hampering foreign imports as a means of developing home trade and of thus altering the supposed disastrous trade balance is obviously the logical inference~~

~~from the arguments. A consideration of these ideas, and of recent discussions about imports and exports, appears accordingly to be needed, although the mercantile theory is itself exploded.~~

~~The phrase " balance of trade," then, appears to be an application of a trader's language in his own business to the larger affairs of nations or rather of the aggregate of individuals in a nation engaged in foreign trade. A trader in his own books sets his sales against his pur- chases, and the amount by which the former exceed the latter is his trade balance or profit. What is true of the individual, it is assumed, must be true of a nation or of the aggregate of individual traders in a nation engaged in the foreign trade. If their collective sales amount to more than their collective purchases the trade balance will be in their favour, and they will have money to re- ceive. Contrariwise, if their purchases amount to more than their sales, they will have to pay money, and they will presumably be living on their capital. The argu- ment fails, however, in many ways. Even as regards the experience of~~

~~the individual trader, it is to be ob- served that he may or may not receive his profit, if any, in money. As a rule he does not do so. As the profit accrues he may invest it either by employing labour to add to his machinery or warehouses, or by increasing his stock-in-trade, or by adding to his book debts, or by a purchase of stocks or shares outside his regular business. At the end of a given period he may or may not have an increased cash balance to show as the result of his profit- able trading. Even if he has an increased cash balance, according to the modern system of business, this might be a balance at his bankers', and they in turn may have invested the amount so that there is no stock of the precious metals, of " hard money," anywhere to represent it. And the argument fails still further when applied to the transactions between nations, or rather, to use the phrase already employed, between the aggregate of indi- viduals in nations engaged in the foreign trade. It is quite clear that if a nation, or the individuals of a nation, do make profit in their foreign trading, the amount may be invested as it accrues — in machinery, or warehouses, or stock-in-trade, or book debts, or stocks and shares pur- chased abroad, so that there may be no corresponding "balance of trade" to bring home. There is no doubt also that what may be is in reality what largely happens. A prosperous foreign trade carried on by any country im- plies a continuous investment by that country either abroad or at home, and there may or may not be a bal- ance receivable in actual gold and silver.~~

~~In another particular the argument also faUs. In the aggregate of individual trading with foreign countries, there may sometimes be purchases and sales as far as the individuals are concerned, but not purchases and sales as be- tween the nations. We see this in the dealings with foreign governments. Goods are exported from the United King- dom, ammunition and stores and ships, which appear in the British returns as exports, and which have really been sold by individual British traders to individuals abroad ; but these sales are not set off by any purchases on the other side which come into the international account, as the set-off is a loan by the people of one country to the people or government of another. The same with the export of railway and other material when goods are exported for the purpose of constructing railways or other works abroad. The sales are made by individuals here to individuals abroad; but there is no set-off of purchases on the other side. Mutatis mutandis the same explanation applies to the remittance of goods~~

~~by one country to another, or by individuals in one coun- try to individuals in another to pay the interest or repay the capital of loans which have been received in~~

~~former times. These are all cases of the movement of goods irrespective of international sales and purchases, though the movements themselves appear in the inter- national records of imports and exports, and therefore it seems to be assumed, though without any warrant, in the international records of the balance of trade. There is yet another failure in the comparison. The individual trader would include in his sales and purchases services such as repairs performed by him for others, and similar services which others do for himself; but no similar accounts are kept of the corresponding portions of inter- national trade such as the earning of freights and com- missions, although in strictness, it is obvious, they belong as much to international trade as the imports and exports themselves, which cannot therefore show a complete "balance of trade."~~

~~The illusions which may result then from the confu- sion of ideas between a balance of trade or profit, and a balance of cash paid or received, and from the identifi- cation of an excess of imports over exports or of exports over imports with the balance of trade itself, though they are not the same things, hardly need description. The believers in such illusions are not entitled to any hearing as economists, however much they may be accepted in the market-place or among politicians.~~

~~The "balance of trade" and "the excess of imports over exports " are thus simply pitfalls for the amateur and the unwary. On the statistical side, moreover, there is a good deal more to be urged in order to impress the student with care and attention. The records of imports and exports themselves may vary from the actual facts of international purchases and sales; The actual values of the goods imported and paid for by the nation may vary from the published returns of imports which are, by the neces- sity of the case, only estimated values. And so with the exports. The actual purchases and sales may be some- thing very different. A so-called sale~~

~~may prove abortive through its not being paid for at all, the debtor fail- ing altogether. In any case the purchases of a year may not be paid for by the sales of the year, and the " squar- ing" of the account may take a long time. Still more the estimates of value may be so taken as not to give even an approximately correct account as far as the records go. Thus in the plan followed in the United Kingdom imports are valued as at the port where they arrive and exports at the port where they are despatched from — a plan which so far places them on an equal footing for the purpose of striking a balance of trade. But in the import and export records of the United States a different plan is followed. The imports are no longer valued as at the port of arrival with the freight and other charges included, but as at the port of shipment. The- results on the balance of trade drawn out must accordingly be quite different in the two cases. With other countries similar differences arise. To deduce then from records of imports and exports any con- clusions as to the excess of imports or exports at different times is a work of enormous statistical difficulty, quite apart from the farther difficulties of substance above described which beset the problem.~~

~~It remains only to notice that the country which presents the most interesting questions in connexion with the study is the United Kingdom, which has by far the largest for- eign trade. Its annual imports and exports, excluding bullion, exceed 800 millions sterling, and the bullion one year with another is 100 millions more. Its excess of im- ports moreover in the last forty years has gradually risen from a small figure to 180 millions sterling annually, and has given rise mainly to the popular discussion referred to respecting an " adverse " balance of trade, and particularly to the belief existing in many quarters that the nation is living on its capital. The result has been a new investigar~~

~~tion of the subject, so as to bring out and present the credits to which the country is entitled in its trade as a shipowner and commission merchant, and to exhibit at the same time the magnitude of British foreign investments, which can- not be less than 2000 millions sterling and must bring in an enormous annual income. Other countries, however, such as France, Germany, Belgium, Holland, Denmark, Nor- way, and Sweden, are in the same condition, though their foreign trade is not on the same scale, and similar rules apply to the reading of their import and export accounts.~~

~~The United States, on the other .hand, is a conspicuous instance of a country which as yet is in the position of a borrower and has a large excess of exports over imports, though there are signs of a change in the opposite direc- tion. New countries generally, such as Canada, Australia, and the South American countries, resemble the United States. Comparisons are made difficult by the want of uniformity in the methods of stating the figures, but that different countries have to be grouped according as they are indebted or creditor countries is undeniable, and no study of the trade statistics is possible without recogni- tion of the underlying economic circumstances.~~

~~In conclusion it maybe useful to repeat the main proposi- tions laid down as to the balance of trade. (1) A " balance of trade" to the individual trader, from whose experience the phrase comes, is not necessarily, as is supposed, a baSt ance received or receivable in the precious metals. It may be invested as it accrues — in machinery, or warehouses, or stock-in-trade, or in book debts, or in stocks and shares or other property outside the trader's business, as well as in cash. (2) What is true of the individual trader is also true of the aggregate of individuals engaged in the foreign trade of a country. Cash is only one of the forms in which they may elect to be paid. (3) The imports and exports recorded in the statistical returns of a country do not correspond with the purchases and sales of individual traders, as the sales especially may be set off by loans, while the so-called imports may include remittances of interest and of capital repaid. (4) When capital is repaid the country receiving it need not be living on it, but may be investing it at home. (5) The foreign trading of countries may also comprise many transactions, such as the earning of freights and commissions, which ought to appear in a proper account showing a balance of trade, as similar transactions appear in an individual trader's account, but which are not treated as imports or exports in the statistical returns of a nation's foreign trade. (6) Import and export returns themselves are not the same as accounts of purchases and sales ; the values are only estimates, and must not be relied on literally without study of the actual facts. (7) Import and export returns in different countries are not in all cases taken at the same point, there being important variations, for instance, in this respect between the returns of two great countries, the United Kingdom and the United States, which are often compared, but are really most difficult to compare. (8) The~~

~~United Kingdom is a conspicuous instance of a country which has a great excess of imports over exports in consequence of its large lending abroad in former times ; while its accounts are specially affected by the magnitude of its services as a trading nation carrying passengers and goods all over the world, which do not result, however, in so-called " exports." The United States, on the other hand, is a conspicuous instance of an indebted nation, which has or had until lately few or no sums to its credit in foreign trade except the visible exports. (9) The various countries of the world naturally fall into groups. The nations of Western Europe, such as France, Germany, Belgium, Holland, with Sweden and Norway, fall into a group with Great Britain as creditor nations, while Canada, Australasia, and the South American countries fall into a group with the United States as~~

~~undeveloped and indebted countries. So also /of other countries. Each belongs naturally to one group or another. (10) Tie excess of imports or exports may vary indefinitely at different times accordin g as a creditor country is receiving or lending at the time, or according as a debtor country is borrowing or paying off its debts at the time, but the permanent characteristics are always to be considered.~~

~~(b. gn.)~~

~~Balanoglossus is the general name given to certain peculiar opaque worm-like animals which live an obscure life under stones, and burrow in the sand from between tide-marks down to the abyssal regions of the sea. Their colour is usually some tone of yellow with dashes of red, brown, and green, and they frequently emit .^ pungent odour. The name has reference to the tongue- shaped muscular proboscis by which the animal works its way through the sand. The proboscis is not the only~~

~~organ of locomotion, being assisted by the succeeding segment of the body, the buccal segment or collar. By the waves of contraction exe- cuted by the proboscis accom- panied by inflation of the collar, progression is effected, sometimes with marvellous rapidity. The third body- region or trunk may~~

~~attain a great length, one or two feet, or even more, and is also muscular, but the truncal muscles are of subordinate importance in locomotion, serving principally to promote the peristaltic contractions of the body by which the food is carried through the gut. The function of alimentation is closely associated with that of locomotion, somewhat as in the burrowing earthworm ; in the excavation of its burrows the sand is passed through the body, aud any nutrient matter that may ad- here to it is extracted during its passage through the intestine, the exhausted sand being finally ejected through the vent at the orifice of the burrow and appearing at low tide as a worm-casting. In accordance with this manner of feeding, the mouth is kept permanently open and prevented from collapsing by a pair of skeletal comua belonging to a sustentacular apparatus (the nuchal skeleton), the body of which lies w;ithin the narrow neck of the proboscis ; the latter is inserted into the collar and surrounded by the anterior free flap of this segment of the body.~~

~~When first discovered by Eschscholtz at the Marshall Islands in 1825, Balanoglossus was described as a worm- like animal belonging to the Echinoderm order of Holothurians or sea-cucumbers. In 1865 Kowalevsky discovered that the organs of respiration consist of numerous pairs of gill-slits leading from the digestive canal through the thickness of the body-wall to the exterior. On this account the animal was, subsequently placed by Gegenbaur in a special class of Vermes, the Enteropneusta. In 1883-86 Bateson showed by his embryological researches that the Enteropneusta exhibit chordate (vertebrate) affinities in respect of the ccelomic, skeletal, and nervous systems as well as in regard to the respiratory system, and, further, that the gill-slits were~~

~~Fig. 1. — Ptychodera fiwea (New Caledonia), from above ; about life size.~~

~~formed upon a plan similar to that of the gill-slits of Amphioxus, being subdivided by tongue-bars which depend from the dorsal borders of the sUts.~~

~~Cfelom and Pore-canals. — In correspondence with the tri- regional differentiation of the body in its external configuration, the ccelom (body-cavity, perivisceral cavity) is divided into three portions completely separated from one another by septa: — (1) proboscis-coslom, or first body-~~

~~cavity ; (2) the coUar-coelom, or second body-cavity ; (3) truncal cdelom, or third body-cavity. Of these divisions of the coelom the first two communicate with the exterior by means of a pair of ciliated pore-canals placed at the posterior end of their respective segments. The proboscis-pores are highly variable, and frequently only one is present, that on the left side ; sometimes the pore-canals of the proboscis unite to open by a common median orifice, and sometimes their communication with the proboscis-coelom appears to be occluded, and finally the pore-canals may be quite vestigial. The collar-pores are remarkable for their constancy ; this is probably owing to the fact that they have become adapted to a special fimction, the inhalation of water to render the collar turgid during progression. There are reasons for supposing that the truncal coelom was at one time provided vrith pore-canals, but supposed vestiges of these structures have only been described for one genus, Spengelia, in which they lie near the anterior end of the truncal coelom.~~

~~Enteron. — ^Not only is the ccelom thus subdivided, but the enteron (gut, alimentary canal, digestive tube) itself shows indications of three main subsections in continuity with one another: — (1) proboscis-gut (" Eicheldarm," stomochord, vide infra); (2) collar- gut (buccal cavity, throat); (3) truncal gut extending from the collar to the vent.~~

~~Stomochord. — The proboscis-gut occurs as an outgrowth from the anterior dorsal wall of the collar-gut, and extends forwards into the basal (posterior) region of the proboscis, through the neck into the proboscis-coelom, ending blindly in front. Although an integral portion of the gut, it has ceased to assist in alimentation, its epithelium undergoes vacuolar differ- entiation and hypertrophy, and its lumen becomes more or less vestigial. It has, in fact, become metamorphosed into a resistant supporting structure resembling in some respects the notochord of the true Chordata, but probably not directly compar- able with the latter structure, being related to it solely by way of substitution. On account of the presence and mode of origin (from the gut-wall) of this organ, Bateson introduced thft term Hemichorda as a phyletic name for the class Enteropneusta. As the proboscis-gut appears to have undoubtedly skeletal properties, and as it also has topographical relations with the mouth, it has been designated in English by the non-committal term stomochord. It is not a simple~~

diverticulum of the collar-gut, but a complex structure possessing paired lateral pouches and a ventral convexity (ventral caecum), which rests in a concavity at the front end of the body of the nuchal skeleton (Fig. 3). In some species (Spengelidse) there is a long capillary vermiform ex- tension of the stomochord in front. The nuchal skeleton is a non-cellular laminated thickening of basement-membrane under- lying that portion of the stomochord which lies between the above-mentioned pouches and the orifice into the throat. At the point where the stomochord opens into the buccal cavity the nuchal skeleton bifurcates, and the two comua thus produced pass obliquely backwards and dovfnwards embedded in the wall of the throat, often giving rise to projecting ridges that bound a dorsal groove of the collar-gut which is in continuity with the wall of the stomochord (Fig. 3).

Nervous System. — At the base of the epidermis (which is in general ciliated) there Is over the entire siu^ace of the body a layer of nerve-fibres, occurring immediately outside the basement- membrane which separates the epidermis from the subjacent musculature. The nervous system is thus essentially epidermal in position and diffuse in distribution ; but an interesting con- centration of nerve-cells and fibres has taken place in the collar- region, where a medullary tube, closed in from the outside, opens in front and behind by anterior and posterior neuropores. This is the collar nerve-tube. Sometimes the central canal is wide and uninterrupted between the two neuropores ; in other cases it becomes broken up into a large number of small closed medullary cavities, and in others again it is obsolete. In one family, the Ptychodeiidse, the medullary tube of the collar is connected at intermediate points with the epidermis by means of a variable number of unpaired outgrovrths from its dorsal wall, generally containing an axial lumen derived from and in continuity with the central canal. These hollow roots terminate blindly in the dorsal epidermis of the collar, and place the nervous layer of the latter in direct connexion with the fibres of the nerve-tube. The exact significance of these roots is a matter for speculation, but it seems possible that they are epiphysial

~~iCr—~~

~~gtructures remotely comparable with the epiphysial (pineal) complex of the craniate vertebrates. In accordance with this view there would be also some probability in favour of regarding the collar nerve-tube of the Enteropneusta as the equivalent of the cerebral vesicle only of Amphioxus and the Ascidian tadpole, and also of the primary fore-brain of vertebrates.~~

~~Special thickenings of the diffuse nervous layer of the epidermis occur in certain regions and alongi certain lines. In the neck of the proboscis the fibrous layer is greatly thickened, and other intensifications of this layer occur in the dorsal and ventral middle lines of the trunk extending to the posterior end of the body. The dorsal epidermal nerve-tract is continued in front into the ventral wall of the collar nerve-tube, and at the point of junction there is a circular commissural thickening following the posterior rim of the collar and affording a special connexion between the dorsal and ventral nerve-tracts. From the ventral surface of the collar nerve-tube numerous motor fibres may be seen passing to the subjacent musculature. These fibres are not aggregated into roots.~~

~~Gill-slits. — The possession of gill-slits is as interesting a feature in the organization of Balanoglossus as is the presence of tracheae in Peripatus. These gill-slits occupy a variable extent of the anterior portion of the trunk, commencing immediately behind the collar-trunk septum. The branchial bars which constitute the borders of the clefts are of two kinds:— (1) Septal bars between two contiguous clefts, corresponding to the primary bars in Amphioxus; (2) Tongue-bars. The chief re- semblances between Ba- .<&i, lanoglossus and Am-~~

~~I ds. phioxus in respect of~~

~~— 3,y. the gill-slits may be stated briefly as fol- lows : — (o) the pres- ence of two kinds of I branchial bars in all~~

~~species and also of small cross-bars (syn- apticulae) in many species ; (/S) numerous gill-slits, from forty to more than a hundred pairs ; (7) the addition of new gill-slits by fresh perforation at the posterior end of the pharynx through- out life. The chief~~

~~Fig. 2. — Structure of branchial region. &c, ccelom ; differences are that «p, gill-pore ;», tongue-bars ; dm, dorsal nerve ; , •. .y^ tnn(riip-har is d«, mesentery ; dv, vessel ; pr, ridge ; 09, oesoph- ^^J "^^ tongue-oar IS agns ; ««, vessel ; v», mesenteiy ; vti, ventral the essential organ of nerve. the giU-slit in Balano-~~

~~- glossus, and exceeds the septal bars in bulk, while in Amphioxus the reverse is the case ; (6) the tongue-bar contains a large coelomio space in Balanoglossus, but is solid in Amphioxus; (c) the skeletal rods in the tongue-bars of Balanoglossus are double; (tZ) the tongue-bar in Balanoglossus does not fuse with the ventral border of the cleft, but ends freely below, thus producing a continuous U-shaped cleft. The meaning of this singular contrast between the two animals may be that we have here an instance of an interesting gradation in evolution. From serving primitively as the essential organ of the cleft the tongue-bar may have undergone reduction and modification, becoming a secondary bar in Amphi- oxus, subordinate to the primary bars in size, vascularity, and development; finally, in the craniate vertebrates it would then have completed its involution,, the suggestion having been made that the tongue-bars are represented by the thymus-primordia. Gill-pouches and Gill-pores. — Only rarely do the gill-slits open freely and directly to the exterior (Fig. 1). In most species of Balanoglossus each gill-slit may be said to open into its own atrial chamber or gill-pouch ; this in its turn opens to the exterior by a minute gill-pore. There are, therefore, as many gill-pouches as there are gill-slits, and as many gill-pores as pouches. The gill- pores occur on each side of the dorsal aspect of the worm in a longi- tudinal series at the base of a shallow groove, the branchial groove. The respiratory current of water is therefore conducted to the ex- terior by different means from that adopted by Amphioxus, and this difierence is so great that the theory which seeks to explain it has to postulate radical changes of structure, function, and topography. Excretory and Vascular Systems. — It seems likely that the ccelomic pore-canals were originally excretory organs, but in the existing Enteropneusta the pore-canals (especially the collar canals) have, as we have seen, acquired new functions or become vestigial, and the function of excretion is now mainly accom- plished by a structure peculiar to the Enteropneusta called the glomerulus, a vascular complex placed on either side of the~~

~~anterior portion of the stomochord, projecting into the proboscis- coelom. The vascular system itself is quite peculiar, consisting of lacunsB and channels destitute of endothelium, situated within the thickness of the basement-membrane of the body-wall, of the gut-wall, and of the mesenteries. The blood, which is a non- corpuscular fluid, is propelled forwards by the contractile dorsal vessel and collected into the central blood-sinus; this lies over the stomochord, and is surrounded on three sides by a closed vesicle, with contractile walls, called the pericardium (" Herz-blase "). By the pulsation of the pericardial vesicle (best observed in the larva) the blood is driven into the glomerulus, from whence it issues by efferent vessels which effect a junction with the ven- tral (sub-intestinal) vessel in the trunk. The vascular system does not readily lend itself to morphological comparison between such widely different animals as Balanoglossus and Amphioxus, and the reader is therefore referred to the memoirs cited at the end of this article for further details.~~

~~Beproductive System. — The sexes are separate, and when mature are sometimes distinguished by small differences of colour in the genital region. Both male and female gonads consist of more or less lobulated hollow sacs connected with the epidermis by short ducts. In their disposition they are either uniserial, biserial, or multiserial. They occur in the branchial region, and also extend to a variable distance behind it. In exceptional cases they are either confined to the branchial region or excluded from it. When they are arranged in uniserial or biserial rows the genital ducts open into or near the branchial grooves in the region of the pharynx, and in a corresponding position in the post-branchial region. An important feature is the occurrence in some species (Ptychoderidae) of paired longitudinal pleural or lateral folds of the body which are mobile, and can be approxi- mated at their free edges so as to close in the dorsal surface, em- bracing both the median dorsal nerve-tract and the branchial grooves with the gill-pores, so as to form a temporary peri- branchial and medullary tube, open behind where the folds cease. On the other hand, they can be spread out horizontally so as to expose their own upper side as well aa the dorsal surface of the body (Fig. 1). These folds are called the genital pleuree because they contain the bulk of the gonads. Correlated with the presence of the genital pleurae there is a pair of vascular folds of the base-ment membrane proceeding from the dorsal wall of the gut in the post-~~

~~branchial portion of the branchio-genital region, and from the dorsal angles made by the pleural folds with the body-wall in the pharyngeal region; they pass, in their most fully developed condition, to the free border of the genital pleurae. These vas- cular membranes are called the lateral septa. Since there are many species which do not possess these genital pleurae, the ques- tion arises as to whether their presence or their absence is the more primitive condition. Without attempting to answer this question categorically, it may be pointed out that within the limits of the family (Ptychoderidae) which is especially charac- terized by their presence there are some species in which the genital pleurae are quite obsolete, and yet lateral septa occur {e.g., Ptychodera ruflcollis), seeining to indicate that the pleural folds have in such cases been secondarily suppressed.~~

~~Development. — The development of Balanoglossus takes place according to two different schemes, known as direct and indirect, correlated with the occurrence in the group of two kinds of ova, large and small. Direct development, in which the adult form is achieved without striking metamorphosis by a gradual succession of stages, seems to be confined to the family Balanoglossidae. The remaining two families of Enteropneusta, Ptychoderidae and Spengelidae, contain species of which probably all pursue an in- . direct course of development, culminating in a metamorphosis by which the adult form is attained. In these cases the larva, called Tornaria, is pelagic and transparent, and possesses a complicated ciliated seam, the longitudinal ciliated band, often drawn out into convoluted bays and lappets. In addition to this ciliated band the form of the Tornaria is quite characteristic and unlike the adult. The Tornaria larva offers a certain similarity to larvae of Eohinoderms (sea-urchins, star-flshes, and sea-cucumbers), and when first discovered was so described. It is within the bounds of possibility that Tornaria actually does indicate a re- mote affinity on the part of the Enteropneusta to the Echino- derms, not only on account of its external form, but also by reason of the possession of a dorsal water-pore communicating with the anterior body-cavity. In the direct development Bateson showed that the three divisions of the coelom arise as pouches constricted off from the archenteron or primitive gut, thus resembling the development of the mesoblastic somites of Amphioxus. It would appear that while the direct development throws light upon the special plan of organization of the Enteropneusta, the indirect development~~

aflords a clue to their possible derivation. How- ever this may be, it is sufficiently remarkable that a small and circumscribed group like the Enteropneusta, which presents such a comparatively uniform plan of composition and of

external form, should follow two such diverse methods of develop- ment.

Distribution. — Some thirty species of Balanoglossus are known, distributed among all the principal marine provinces from Green- land to New Zealand. The species which occurs in the English Channel is Ptychodera sarniensis. The Ptychoderidse and Spen- gelidse are predominantly tropical and subtropical, while the Balanoglossidse are predominantly arctic and temperate in their distribution. One of the most singular facts concerning the geo- graphical distribution of Enteropneusta has recently been brought

Fig. 8. — Btructure of anterior end. a, arrow from proboscis-cavity (jtc) pass- ing to left of pericardium (per) and out througli proboscis pore-canal ; &*, arrow from central canal of neurochord (one) passed out tm'Ougb anterior neuropore; &3, ditto, through posterior neuropore; c, arrow intended to pass from 1st gill pouch through collar pore-canal into collar coelom (cc) ; ciB, posterior limit of collar; dv, dorsal vessel passing into central sinus (68) ; ev, efferent vessel passing into ventral vessel (vv) ; epr, epiphysial tubes ; s^, stomochord ; ws, ventral septum of proboscis ; sk, body of nuchal skeleton ; 7n, mouth ; th, throat ; thy tongue-bars ; tc, trunk coelom.

to light by Benham, who found a species of Balanoglossus s. str. on the coast of New Zealand hardly distinguishable from one oociuring off Japan. Finally, Cflandiceps abyssicola (Spengelidse) was dredged during the Challenger expedition in the Atlantic Ocean off the coast of Africa at a depth of 2500 fathoms.

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~~Besults (Willey), part iii. 1899; see also Q. J. M. S. vol. xlii. p. 223, 1899.— Hill, J. P. ” The Enteropneusta of Funafuti,” Mem. Austral. Mus., iii. 1897-98. — Caullbry, M., et MssmL, F. ” Balanoglossus Kochleri, n. sp. English Channel,” C. jB. Soe. Biol. lu. p. 256, 1900. (a. w.*)~~

~~Balasore, a town and district of British India, in the Orissa province of Bengal, on the right bank of the river Burabalang, about seven miles from the sea. The town still possesses a large maritime trade, despite the silting-up of the river mouth. It is a station on the East Coast railway. It has a high school, two printing-presses, which each issue a vernacular newspaper, and three literary institutions. Population, about 21,000.~~

~~The district of Balasoee, which stretches along the coast between the sea and the hills of Orissa, has an area of 2473 square miles. The population in 1891 was 994,636, giving an average density of 402 persons per square mile ; Hindus numbering 969,211, Mahommedans 24,250, Chris- tians 1075, of whom 96 were Europeans. In 1901 the popu- lation was 1,081,426, showing an increase of 9 per cent. Land revenue and rates (1897-98) were Rs. 4,88,011; the number of police was 396 ; boys at school (1896-97’), 31,277. Almost the only crop grown is rice, which is largely exported by sea. The registered death-rate (1897) was 30-5 per 1000. The former industry of manufactur- ing salt from sea^-brine by boiling in pots is now~~

~~extinct. The country is exposed to destructive floods from the hill- rivers, and also from cyclonic storm-waves. The district is traversed throughout its entire length by the navigable Orissa coast canal, and also by the East Coast railway, from Calcutta to Madras. The seaports of Balasore, Chandbali, and Dhamra conduct a very large coasting trade, valued in 1897-98 at Es.1,38,05,460, or nearly a million sterling. The number of vessels that cleared was 420, with a tonnage of 107,919. The exports are almost confined to rice, which is sent to Ceylon, the Maldives, and Mauritius. The imports consist of cotton twist and piece goods, mineral oils, metals, betel-nuts, and salt.~~

~~Balaton (Plattensbb), the largest lake of Middle Europe, in the south-west of Hungary, situated between the counties of Veszprem, Zala, and Somogy. Its length is 48 miles, average breadth 3^4^ miles, greatest breadth 7^ miles, least breadth a little less than 1 mile. It covers 266 square miles, and has a greatest depth of 149 feet. Its northern shores are bordered by the beautiful basaltic cones of the Bakony Mountains, the volcanic soil of which produces grapes yielding excellent wine; the southern consist partly of a marshy plain, partly of downs. The most beautiful point of the lake is that where the peninsula of Tihany projects in the waters. An ancient church of the Benedictines is here situated on the top of a hill. In a tomb therein is buried Andrew I. (d. 1061), a king of the Hungarian Arpadin dynasty. The temperature of the water varies greatly, in a manner resembling that of the sea, and many connect its origin with a sea- of the Miocene period, the waters of which are said to have covered the Hungarian plain. About fifty streams flow into the lake, which drains into the Danube and is well stocked with fish. It often freezes in winter. Lake Balaton is of growing importance as a bathing resort.~~

~~Balayan, a town of 24,700 inhabitants, at the head of the Gulf of Balayan, in the province of Batangas, Luzon, Philippine Islands. It has an extremely healthful climate, and is in the midst of a very fertile district, which produces rice, cacao, coffee, pepper, and cotton. Horses and cattle are raised for mfirket in considerable number. The fisheries are important. The language is Tagalog.~~

Balearic Islands, a group of islands in the Mediterranean, off the east coast of Spain, of which they

BALFOUR

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form a province 1860 square miles in area, divided into live administrative districts and sixty-one parishes. The population was 289,035 in 1877, and 312,646 in 1887, I!?«?^^?'^. °'''* contained 248,993 inhabitants, Menorca 38,959, Ibica, 22,509, Fromentera 1984, and the smaller islands the remaining 201. In 1897 the total population had decreased to 309,807. This decrease has not been due exclusively to emigration, as barely 650 inhabitants in all depart annually for Algeria or the Spanish main- land. In 1897 the live stock numbered only 176,113 head, this figure including 1737 horses, 17,289 mules, 8928 asses, 7276 cattle, 94,290 sheep, 10,432 goats, and 36,162 pigs. Only 16,000 acres are irrigated, but wheat IS grown on 139,535 acres; oats, rye, barley on 101,187 acres ; pod fruit on 35,877 acres ; vines on '36,460 acres, and the olive on 67,100 acres. The export of oranges has greatly declined, their culture having been abandoned owing to an insect plague. Figs also are now only used to feed live stock and for consumption in the province. Besides the salt mines of Ibica, eight lignite and ten lead mines are actually worked in the islands, and there are seventy-four unproductive mines, mostly lignite. The output of lignite amounted to 18,000 tons in 1898. The means of communication are being im-proved by the local corporations. Forty-eight miles of railways have been .completed in Mallorca, the main line (40 miles running from Palma to Manacor. The standard of primary education is well up to the average for Spain, and there are higher schools in the principal towns. The local industries are thriving. Shoemaking is one of the most prosperous trades in the islands. There is not a very active trade direct wit^ foreign countries, as the principal imports — cotton, leather, petroleum, sugar, coal, and timber — are introduced into the islands through Barcelona. The export trade is chiefly with the peninsula, France, Italy, Algeria, and the Spanish West Indies. Most of the agricultural products are sent to the peninsula ; wine, figs, marble, almonds, lemons, and rice, to Europe and Africa. In 1898 the imports of the Balearic isles were valued at £143,687 and the exports at £442,942.

The best modem work on the Balearics is that of the Archduke Ludwig Salvator, published in several volumes at Leipzig 1869-90, of which an

~~abridged edition in Spanish was published at Palma in 1886. (a. b. h.)~~

~~Balfour, Arthur James (1848), British~~

~~statesman, eldest son of the late James Maitland Balfour of Whittinghame, Haddingtonshire, and of Lady Blanche Gascoyne Cecil, second daughter of the second Marquis of Salisbury, was born 25th July 1848. He was educated at Eton and Trinity College, Cambridge. In 1874 he was elected in the Conservative interest for Hertford, and represented that constituency until 1885. When, in the spring of 1878, Lord Salisbury became Foreign Minister on the resignation of the 15th Lord Derby, Mr Balfour became his private secretary. In that capacity he accompanied Lord Salisbury to the Berlin Congress, and gained his first experience of international politics in connexion with the settlement of the Eusso-Turkish conflict. It was at this time also that he becanie known in the world of letters, the intellectual subtlety and literary capacity of his Defence of Philosophic Doubt (1879) suggesting that he could, if he chose, make a reputation as a speciilative thinker. Belonging, however, to a class to which the responsibilities of government are a tradi- tional duty, Mr Balfour divided his time between the political arena and the study. Being released from his duties as private secretary by the general election of 1880, he began to take a rather more active part in parliamentary affairs. He was for a time politically associated with Lord Eandolph Churchill, Sir Henry~~

~~Arthur Jamks Balfoitb.~~

~~(From a photograph by Elliott and Fry, London.)~~

~~Drummond Wolff, and Sir John (then Mr) Gorst, the quartette becoming known as the " Fourth Party," and gaining notoriety by the freedom of the criticisms directed by its leader. Lord Eandolph Churchill, against Sir Stafford Northcote, Lord Cross, and other prominent members of the "old gang." In these sal- lies, however, Mr Bal- four had no direct share. He was thought to be merely amusing himself with politics. It was regarded as doubtful whether his health could withstand the severity of English winters, and the delicacy of his physique and the languor of his manner helped to create the impression that, however great his intellectual p o we r s might be, he had neither the bodily strength nor the energy of character requisite~~

~~for a political career. He was the “odd man” of the Fourth Party, apparently content to fetch and carry for his colleagues, and was believed to have no definite ambitions of his own. His reputation in the Parliament of 1880-86 was that of a dilettante, who allied himself with the three politicians already named from a feeling of irresponsi- bility rather than of earnest purpose ; he was regarded as one who, on the rare occasions when he spoke, was more desirous to impart an academic quality to his speeches than to make any solid contribution to public questions. The House, indeed, did not take him quite seriously. Members did not suspect the reserve of strength and ability beneath what seemed to them to be the pose of a parliamentary flaneur, looking upon him merely as a young member of the governing classes who remained in the House because it was the proper thing for a man of family to do. As a member of the clique known as the ” Souls ” he was, so to speak, caviare to the general. Indolence was supposed to be the keynote of his character — a refined indolence, not, however, without cleverness of a somewhat cynical and superior order.~~

~~That these views were not shared by Lord Salisbury is suf&ciently shown by the fact that in his first Adminis- tration (June 1885-January 1886) he made Mr Balfour President of the Local Government Board, and in forming his second administration (July 1886) secretary for Scot- land with a seat in the Cabinet. These offices gave few opportunities for distinction, and may be regarded merely as Mr Balfour’s apprenticeship to Departmental responsibilities. The accidents of political life suddenly opened out to him a career which made him, next to Lord Salisbury, the most prominent, the most admired, and the most attacked Conservative politician of the day. Sir Michael Hicks-Beach, who was chief secretary for Ireland, suffered from an affection of the eyes, and found it desirable to resign, and Lord Salisbury ap- pointed his nephew in his stead. The selection took the political world by surprise, and was much criticized. By the Irish Nationalists it was received with con- temptuous ridicule, for none suspected Mr Balfour’s immense strength of will, his debating power, his ability in attack, and his still greater capacity to disregard~~

criticism. The debates on tlie Crimes Bill and tlie Irish Land Bill quickly undeceived them, and the steady and even remorseless vigour with which the government of Ireland was conducted speedily convinced the House of Commons and the country that Mr Balfour was in his right place as Chief Secretary. His policy was that of " coercion " — the fearless administration of the Crimes Act, — coupled with remedial legislation ; and he enforced the one while he proceeded with the other, regardless of the risk of outrage outside the House and of insult within. Mr Balfour's work at this period covered one of the most turbulent and most exciting periods in modern Parliamentary history and Irish administration. With a courage that never faltered he broke down the Plan of Campaign in Ireland, and in Parliament he not only withstood the assaults of the Irish Nationalists, but waged successful warfare with the entire Home Rule party. He combined an iron will with a mastery of facts unsurpassed by any of his predecessors in the Secretaryship. Events, it is true, were in his favour. The disclosures before the Parnell Commission, the O'Shea divorce proceedings, the downfall of Mr Parnell, and the disruption of the Irish party, assisted him in his task ; but the fact remains that by persistent courage and undeviating thoroughness he reduced crime in Ire- land to a vanishing point. His work was also construc- tive, for he broadened the basis of material prosperity and social progress by creating the Congested Districts Board in 1890. During this period, from 1886-92, moreover, he developed gifts of oratory which made him dne of the most effective of public speakers. Impressive in matter rather than in manner of delivery, and seldom rising to the level of eloquence in the sense in which that quality was understood in a House which had listened to Bright and Gladstone, his speeches were logical and convincing, and their attractive literary form delighted a wider audience than that which listens to the mere politician.

In 1888 Mr Balfour served on the Gold and Silver Commission, currency problems from the standpoint of bimetallism being among the more academic subjects which had engaged his attention. On the death of Mr W. H. Smith in 1891 he became First Lord of the Treasury and leader of the House of Commons, and in that capacity introduced in 1892 a Local Government Bill for Ireland. The Conservative Government was then at the end of its tether, and the project fell through. For the next three years Mr Balfour led the Opposition with great skill and address. On the return of the

~~Unionists to power in 1895 he resumed the leadership of the House, but not at first with the success expected of him, his management of the abortive education proposals of '96 being thought, even by his own supporters, to show a disinclination for the continuous drudgery of Parliamentary management under modern conditions. But after the opening session matters pro- ceeded more smoothly, and Mr Balfour regained his old position in the estimation of the House and the country. He had the satisfaction of seeing a Bill pass for providing Ireland with an improved system of local government, and took an active share in the debates on the various foreign and domestic questions that came before Parliament during 1895-1900. His championship of the Voluntary Schools, his adroit Parliamentary hand- ling of the problems opened up by the so-called " crisis in the Church " caused by the Protestant movement against ritualistic practices, and his pronouncement in favour of a Roman Catholic University for Ireland — for which he outlined a scheme that met with much adverse criticism both from his colleagues and his party, — were the most important aspects of Mr Balfour's activity dur-~~

~~ing these years. His speeches and work throughout this period took a wider range than before his accession to the leadership of the Commons. During the illness of Lord Salisbury in 1898, and again in Lord Salisbury's absence abroad, he was in charge of the Foreign Office, and it fell to his lot to conduct the very critical negotia- tions with Russia on the question of railways in North China. To his firmness, and at the same time to the conciliatory readiness with which he accepted and elabo- rated the principles of a modus vivendi, the two Powers owed the avoidance of what threatened to be a dangerous quarrel. As a member of the Cabinet responsible for the Transvaal negotiations in 1899 he bore his full share of controversy, and during the war his high character and personal charm helped the Government over some awk- ward places, though in his attitude on the charges of hospital deficiency made by Mr Burdett Coutts, he per- mitted himself to depart from the suavity which had usually distinguished his conduct in the House. At the general election of 1900 he was returned for East Man- chester (which he had represented since 1885) by a majority of 2463, and continued in office as First Lord of the Treasury. His leadership of the House of Commons in the first session of the new Parliament was marked by considerable firmness in the suppression of~~

~~obstruction, but there was a slight revival of the criticisms which had been current in 1896. ^r Balfour's inability to get the maximum amount of work out of the House must, however, be regarded in relation to the situation in South Africa, which absorbed the intellectual energies of the House and of the country and impeded the progress of legislation. On the subject of the South African war Mr Balfour delivered, in the House and from the platform, various speeches which rank among his best oratorical efforts.~~

~~Besides the Defence of Philosophic Doubt Mr Balfour hks published Essays and Addresses (1893) and 2%e Foundations of Belief, being Notes introductory to the Study of Theology. He was made LL.D. of Edinburgh Uni- versity in 1881 ; of St Andrews University in 1885 ; of Cambridge University in 1888 ; of Dublin and Glasgow Universities in 1891 ; Lord Rector of St Andrews Uni- versity in 1886 ; of Glasgow University in 1890 ; Chan- cellor of Edinburgh University in 1891 ; Member of the Senate London University in 1888; and D.C.L. of Oxford University in 1891. He is a cultured musician and an enthusiastic golf player, having been captain pi the Royal and Ancient Golf Club of St Andrews in 1894-95; his taste for cycling is attested by his presi- dency of the National Cyclists' Union, 1896.~~

~~Bali, an island E. of Java, Dutch East Indies, and separated from it by the Bali Strait. In 1882, for administrative purposes, it was separated from Java and combined with the island of Lombok to form the residency of Lombok and Bali. Politically its divisions are two : (1) the two districts, Buleleng and Jembrana, on Dutch territory ; and (2) the autonomous states of Klung Kung, Bangli, Mengui, Badung, and Tabanan. Exploration of the island has proved its geological formation to include (as does that of Java) three regions, the central volcanic, the southern peninsula of Tertiary limestone, and alluvial plains between the older formations. The highest vol- canoes, Tabanan, Batur, and Gunung Agung, have re- spectively the height of 7645, 7383, and 10,497 feet, the central chain having an average altitude of 3282 feet. The only roadstead safe all the year round is Temukus on the north coast. The rivers are not navigable. Agricul- ture is the chief means of subsistence. Rice is cultivated. Other crops grown for export are coffee, tobacco, cocoa, and indigo. Gold-working, the making of arms and~~

musical instruments, wood-carving, cotton, silk, and gold thread weaving are of importance. The value of the combined exports > and imports of late years has been about £400,000-£500,000. The area of the island is 2240 square miles, the population on Dutch territory being 103,101, and in the autonomous states 1,259,135.

Van Eck. Schetsen van het eiland Bali. Tijdsch. van Nederl. Indie, 1878-79. — Dr Jacobs. JEeenigen tijd onder de Baiters, Batavia, 1883.— Dr Tonkes. Volks Kunde von Bali. Halle, 1888.— LiEFEiNCK. DerijstcultuuropBali. Indische Gids. 1886.

Balikisri, the chief town of the Karasi sanjak, in Asia Minor, altitude 575 feet, situated on tising ground above a broad fertile valley which drains to the sea of Marmora. It is a centre of trade in opium, silk, and cereals. Population, 20,000 (Moslems, 15,000; Christians, 5000). The sanjak lies to the south of the sea of Mar- mora, and is fertile and well-watered. It is also rich in mineral wealth ; silver mines are worked at Balia, and boracite mines at Susurlu.

Balkan Peninsula The Balkan Peninsula, for- merly known as Turkey in Europe, is the most easterly of the three large peninsulas which form the sputhern extremities of the European continent. Its area is slightly greater than that of the Iberian peninsula, and somewhat > less than twice that of Italy. Its northern boundary is generally regarded as marked by the courses of the rivers Danube, Save, and Kulpa; but may, perhaps, be more accurately defined by a line drawn from the Kilia mouth of the Danube to the northern extremity of the Adriatic near Trieste. On the east it is bounded by the Black Sea, the Sea of Marmora, and the-^gean ; on the south by the Mediterranean ; on the west by the Ionian Sea and the Adriatic. With the exception of the Black Sea coast and the Albanian littoral, its shores are con- siderably indented and flanked by groups of islands. The Peninsula in its general contour resembles an in- verted pyramid or triangle, terminating at its apex in a subsidiary peninsula, the Peloponnesus, or Morea. Its surface is almost entirely mountainous, the only exten- sive plains being those

~~formed by the valleys of the Danube and Maritza and the basin of Thessaly, drained by the Salanibria (Peneus). The Danubian plain is en- closed by the Carpathians on the north, and the Balkans (from which the peninsula derives its name) on the south : these ranges form together the great semicircular moun- tain-chain, known as the anti-Dacian system, through which the Danube finds a passage at the Iron Gates. The other mountain-systems display great complexity of formation; beginning with the Dinaric Alps and the parallel ranges of Bosnia, they run, as a rule, from north- west to south-east: the great chain of Ehodope traverses the centre of the Peninsula, throwing out spurs towards the Black Sea and the Mg&ajo. ; farther west are the lofty Shar Dagh and the mountains of Montenegro and Albania, continued by the Pindus range and the heights of Akar- nania and ^tolia. The principal summits are Liubotrn in the Shar Dagh (3050 metres), Olympus, overlooking the Gulf of Salonika (2985 m.), MusalM (2924 m.), and Popova Shapka (2699 m.), both in the Ehodope system ; Elin, in the Perin Planina (2681 m.); and Kiona in .a^tolia (2511 m.). The geological formation has hitherto been imperfectly studied, especially in the districts under Turkish rule. Owing to the distribution of the mountain- chains the principal rivers flow in an easterly or south- easterly direction : the Danube falls into the Black Sea ; the Maritza, Mesta, Struma (Strymon), Vardar, and Salambria into the ^gean. The only considerable rivers flowing into the Adriatic are the Narenta, Drin, and Viossa. The principal lakes are those of Okhrida, Prespa, Scutari, and lannina. The climate is more severe than**

that of the sister peninsulas, and the temperature is liable to sudden changes. The winter, though short, is often intensely cold, especially in the Danubian plain and in Thrace, the rigorous climate of which is frequently al- luded to by the Latin poets. Bitter north-easterly winds prevail in the spring, and snow is not uncommon even in the low-lying districts of Greece.

(For further details with regard to the physical features, &c., see Turkey, ninth edition, vol. xxiii. p. 653, and the articles there quoted ; also Bulgabia in the present supplement.)

The following figures show the area and population of the various political divisions of the Balkan Peninsula. Among these it is customary to include

~~the kingdom of Rumania, of which, however, only a small portion (the D6bruja, pop. about 110,000) lies within the generally accepted limits.~~

~~Area, sq. kilo.~~

~~Population.~~

~~, Pop. per sq. kilo.~~

~~Turkish possessions (excluding~~

~~Crete . . . . ‘ . Rumania .... Bulgaria (including Eastern , Rumelia) ....~~

~~Servia~~

~~Montenegro .... Greece ..... Bosnia and Herzegovina (under~~

~~Austrian administration) . Novi-bazar (with three Austrian~~

~~garrisons) . Dalmatia (Austro-Hungarian~~

~~monarchy) ....~~

~~162,550 131,020~~

~~95,704~~

~~48,303~~

~~9,080~~

~~65,119~~

~~51,028~~

~~7,350~~

~~12,835~~

~~5,812,300 5,417,249~~

~~3,310,713~~

~~2,384,205~~

~~227,841~~

~~2,433,806~~

~~1,568,092~~

~~153,000~~

~~527,426~~

~~34~~

~~41~~

~~34-5 49 25 37~~

~~31~~

~~21 41~~

~~582,989~~

~~21,834,632~~

~~37-4~~

~~The Peninsula is inhabited by “. great variety of races, whose ethnological limits are far from corresponding with the existing political boundaries. The Turkish population, de- „~~

~~scended in part from the Ottoman invaders of the 14th *”*■~~

~~and 15th centuries, in part from colonists introduced at various epochs from Asia by the Turkish Government, has considerably declined during the past century, especially in tiie countries with- drawn from the Sultan’s authority.~~

~~It is diminishing in Thessaly; it has entirely disappeared in the rest of Greece, almost entirely in Servia, and continues to decrease in Bulgaria notwithstanding the efforts of the authorities to check emigration. It is nowhere found in compact masses except in north-eastern Bulgaria and the region between Adrianople, the Black Sea, and the Sea of Marmora. Elsewhere it appears in separate villages and isolated districts, or in the larger towns and their immediate neighbourhood. The total Turkish population of the Peninsula scarcely exceeds 1,800,000. The Slavonic population, including the Serbs and Bulgars, is by far the most numerous ; its total aggregate approaches 9,000,000. The Serbs, whose progenitors entered the Peninsula in the 6th century, inhabit Bosnia, Herzegovina, Montenegro, the kingdom of Servia, and the north-western portion of Macedonia, known as Old Servia. Their numbers, exclusive of the Serbo-Croats of Dalmatia (about 300,000), may be estimated at 4,500,000. The Bulgars, wlio de- scend from a fusion of the Slavonic element with a later TJgro-Finnish immigration, inhabit the principality of Bulgaria (including Eastern Rumelia), the D6hruja, and the greater part of Macedonia, except Old Servia and the JEgean littoral. . Apart from their colonies in Bessarabia and elsewhere, they may be reckoned at 4,100,000. Only a portion of the widely spread Ruman or Vlakh race, which extends over a great part of Transylvania, the Banat, and Bessarabia, as well as the Rumanian kingdom, falls within the limits of the Peninsula, It is found in numerous detached settle ments in Macedonia, Albania, and northern Greece, and in colonies of recent date in Servia and Bulgaria. The nomad Vlakhs or Tzintzars of these countries call themselves Arumani or "Romans"^ they are either a remnant of the native Latinized population or descendants of Daco-Roman refugees, who fled south- wards after the abandonment of Dacia by Aurelian. The entire Ruman population of the Balkan countries may be set down approximately at 5,600,000, of which 5,000,000 belong to the Rumanian kingdom. The Albanians, who call themselves Shkipetar or Arber, are the representatives of the primitive Dlyrian popula- tion ; they inhabit the Adriatic littoral from the southern frontier of Montenegro to the northern boundary of Greece, and are found in considerable numbers in the latter country. They have shown a tendency to advance in a north-easterly direction towards the Servian frontier, and the movement has been encouraged for~~

political reasons by the Turkish Government. The whole Albanian nation possibly numbers from 1,500,000 to 1,600,000. The Greeks, ■whose immigration from Asia Minor took place in pre-historic times, are, next to the Albanians, the oldest race in the Peninsula. Their maritime and commercial instincts have led them from the

earliest times to found settlements on the sea-coast and the islands. They inhabit the Black Sea littoral from Varna to the Bosphorus, the shores of the Sea of Marmora and the JEgean, the archipelago of the latter sea, the mainland of Greece, Epirus, and the western islands as far north as Corfu. In Constantinople they probably

«,....__ ., Existing Fpontizra.

J , Ber/jn Treaty.

««HMMi-i«iM» ^^" Siefaiio Treaty.

..... . Frontiers m 1B56,

1 Occupied by Austria in 187S. \Rest0r9d to Turkey in 1880^ I Ceded to Greece in IdSt. I Restored Co Turkey in 1386

Sketch Map or the Balkan Peninsula.

exceed 300,000. They are seldom found in large numbers at any great distance from the sea except in the principal towns and com- mercial centres, such as Adrianople, Braila, Galatz, and Philip- popolis, and in detached colonies at Melnik, Stanimaka, Kavakli, Negush, and elsewhere. The Greek inhabitants of the Peninsula and adjacent islands probably number 4,500,000. The remainder of the population is for the most part composed of Armenians,

Jews, and gypsies. The Armenians, like the Greeks, congregate in the principal centres of trade, especially at Constantinople ; their numbers were greatly reduced by the massacres of 1896. The Jews are most numerous in the Eumanian towns and at Salonika, where they form half the population : the Rumanian Jews belong to the Ashkenazim, the Macedonian and Bulgarian to the Sephardim. The gypsies are scattered' widely throughout the Peninsula ; they

are found not only in wandering troops, as elsewhere in Europe, but in settlements or cantonments in the neighbourhood of towns and villages.

Owing to the numerous conversions to Islam which followed the Turkish conquest, the Mahommedan population of the Peninsula is Religions. la.rgelyinexcessofthepurelyTurl!;ishelement. Morethan half the Albanian nation and about two-fifths of the Serbs of Bosnia and Herzegovina adopted the creed of the conquering race. Among the Bulgars and Greeks the conversions were less numerous. The Bulgarian Mahommedans, or Pomaks, who inhabit the valleys of Ehodope and certain districts in northern Bulgaria, are numerically insignificant ; the Greek followers of Islam are almost confined to Crete. The whole Moslem population of the Peninsula is about 3,300,000. The great bulk of the Christian population belongs to the Orthodox Church, of which the (Ecumenical Patriarch at Con- stantinople is the nominal head, having precedence over all other ecclesiastical dignitaries. The Rumanian, Bulgarian, Servian, Montenegrin, and Greek churches are, however, in reality auto- cephalous. The Bulgarian church enjoys an exceptional position, inasmuch as its spiritual chief, the Exarch, who resides at Con- stantinople, controls the Bulgarian prelates in European Turkey as well as those in the principality of Bulgaria. On the other hand, the Greek prelates in Bulgaria are subject to the Patriarch. Religious and political questions are intimately connected in Eastern Europe. The heads of the various religious communities are the only representatives of the Christian population recognized by the Turkish Government ; they possess a seat in the local ad- ministrative councils, and supervise the Christian schools. The efforts of the several branches of the

~~Orthodox Church to obtain a separate organization in the Turkish dominions are to be attributed exclusively to political motives, as no difEerenoe of dogma divides them. The Serbo-Croats of Dalmatia, some of the Gheg tribes in Albania, a small proportion of the Bosnian Serbs, a still smaller number of Bulgarians in the Principality and Macedonia, and a few Greeks in the islands belong to the Catholic Church. A certain number of Bulgars at Kukush in Macedonia and elsewhere form a "uniate" church, which accepts the authority and dogma of Rome, but preserves the Orthodox rite and discipline. The Armenians are divided between the Gregorian and Uniate- Armenian churches, each under a patriarch. The other Christian confessions are numerically inconsiderable. The Gagausi in Eastern Bulgaria, a Turanian and Turkish-speaking race, profess Christianity.~~

~~Until comparatively recent times Turkish and Greek were the only languages systematically taught or officially recognized in the j^ Balkan lands subject to Turkish rule. The former.~~

~~Languages. ^ speech of the conquering race,, was the official lan- guage ; the latter, owing to the intellectual and literary superiority of the Greeks, their^educational zeal, and the privileges acquired by their church, became the language of the upper classes among the Christiana. The Slavonic masses, however, both Servian and Bulgarian, preserved their language, which saved these nation- alities from extinction. The Serb dialect, extending into regions which escaped the Turkish yoke, enjoyed certain advantages denied to the Bulgarian : in free Montenegro the first Slavonic printing- press was founded in 1493 ; at Ragusa, a century later, Serb literal ture attained a high degree of excellence. The Bulgarian, for nearly four centuries, ceased to be a written language except in a few monasteries : a literary revival in recent times was the first symptom of returning national consciousness. In Rumania the Roman tongue of Trajan's colonists and the Latinized Daoians gave way in the Middle Ages to Slavonic under the rule of the Bulgarian Tsars; it revived under the Wallachian and Moldavian princes, but was not introduced into the liturgy and state documents till the middle of the seventeenth century. The Rumanian and the two Slavonic languages have borrowed largely from the Turkish in' their vocabularies, but not in their structural forms, and have adopted many words- from the~~

~~Greek. The modern Greek has also a large number of Turkish words which are rejected in the artificial literary language. The revival of the various Balkan nationalities has in every case been accompanied or preceded by a literary movement ; ia Servian literature, under the influence of Obradovitch and Vuk Karajitch, the popular idiom, notwithstanding the opposition of the priest- hood, superseded the ecclesiastical Russian-Slavonic ; in Bulgaria the eastern dialect, that of the Sredna Gora, prevailed ; in Rumania an artificial reconstruction on the Latin model with an elimination of all foreign elements was attempted and abandoned. Among the Greeks, whose literature never suffered a complete eclipse, a similar effort to restore the classical tongue has resulted in a kind of com- promise ; the conventional literary language, which is neither ancient nor modem, differs widely from the vernacular. The Albanian, the only surviving remnant of the ancient Thraco-Illyrian speech, affords an interesting study to philologists. It undoubtedly belongs to the Indo-Germanio family, but its earlier forms cannot, unfortunately, be ascertained owing to the absence of literary monu- ments. Certain remarkable analogies between the Albanian and~~

~~the other languages of the Peninsula, especially the Bulgarian and Rumanian, have been supposed to point to the influence exercised by the primitive speech upon the idioms of the immigrant races.~~

~~At the beginning of the 19th century the whole Peninsula, with the exception of Dalmatia, Montenegro, and the Ionian Islands, formed a portion of the Ottoman Empire. The period of Turkish de-~~ ~~”” ‘ cadence had begun a century before, and the process of disintegration now set in. Owing to the uncom- promising character of the Mahommedan religion and the contemptuous attitude of the dominant race, the subject nationalities underwent no process of assimilation during the four centuries of Turkish rule ; they retained not only their language but their religion, manners, and peculiar characteristics, and when the power of the central author- ity waned they still possessed the germs of a national ex- istence. The independence of Greece was acknowledged in 1829, that of Servia (as a tributary principality) in 1830. No territorial changes followed the Crimean war except the restoration to Moldavia of Southern Bessarabia, which Russia had annexed in 1812 ; but the continuance of the weakened authority~~

of the Porte tended indirectly to the independent development of the various nationalities. The Ionian Islands were ceded by England to Greece in 1864. The great break-up came in 1878. The abortive Treaty of San Stefano, concluded in that year, reduced the Turkish possessions in the Peninsula to Albania, Epirus, Thessaly, and a portion of southern Thrace. A large Bulgarian Principality was created extending from the Danube to the .^gean and from the Black Sea to the river Drin in Albania; it received a considerable coast-line on the Mgean, and abutted on the Gulf of Salonika under the walls of that town. At the same time the frontiers of Servia and Montenegro were enlarged so as to become almost con- tiguous, and the latter State received the ports of Antivari and Dulcigno on the Adriatic. From a strategical point of view the Bulgaria of the San Stefano treaty threatened Salonika, Adrianople, and Constantinople itself ; and the Great Powers, anticipating that the new state would be- come a Russian dependency, refused their sanction to that instrument. The Treaty of Berlin followed, which limited the Principality to the country between the Danube and the Balkans, created the autonomous province of Eastern Eumelia south of the Balkans, and left the remainder of the proposed Bulgarian state under Turkish rule. The Montenegrin frontier laid down at San Stefano was con- siderably curtailed, Dulcigno, the district north-east of the Tara, and other territories being restored to Turkey ; in addition to Msh, Servia received the districts of Pirot and Vranye on the east instead of the Ibar valley on the west ; the D6bruja, somewhat enlarged, was ceded to Rumania, which surrendered southern Bessarabia to Russia. Bosnia and Herzegovina were handed over to Austrian adminis- tration; under a subsequent copvention with Turkey, Austria sent troops -into the sanjak of Novi-bazar. The complete independence of the principalities of Servia, Rumania, and Montenegro was recognized. The claims of Greece, ignored at San Stefano, were admitted at Berlin ; an extension of frontier, including Epirus as well as Thessaly, was finally sanctioned by the Powers in 1880, but owing to the tenacious resistance of Turkey the latter province only, together with the district of Arta, was acquired by Greece in 1881. Rumania was proclaimed a Kingdom in that year, Servia in 1882. In 1880, after a naval demonstration by the Powers, Dulcigno was surrendered to Montenegro in compensation for the districts of Plava and Gusinye restored to Turkey. In 1886 the informal union of Eastern Rumelia with Bulgaria was sanctioned by

~~Europe, the districts of Tumrush (Ehodope) and Krjali being given back to the Sultan. In 1897 Crete was withdrawn from Turkish administration,~~

~~and the Greco-Turkish war'of that year was followed by the cession to Turkey of & few strategical points on the Thessalian frontier.~~

~~The liberation of the Balkan nationalities has in most cases been effected by the aid of one or more of the Great A Balkan Powers, but their growth and independent de- contedera- velopment has, on the other hand, been retarded tioa. \yy (jtig international jealousies arising from the~~

~~Eastern Question. The possibility of the young states entering into a combination which would enable them to offer a united resistance to foreign interference while simultaneously effecting a compromise in regard to Jheir national aims, has at various times occupied the attention of Balkan politicians. , Among the earliest advocates of this idea was Eistitch, the Servian statesman. During the reaction against Russia which followed the war of 1877 informal discussions were conducted with this object, and it was even suggested that a reformed or constitutional Turkey might find a place in the confederation. The movement was favourably regarded by King Charles of Rumania and Prince Alexander of Bulgaria. But the revolt of Eastern Eumelia, followed by the Servo-Bul- garian war and the coercion of Greece by the Powers, embittered the rivalry of the various races, and the project was laid aside. It was revived in a somewhat modified form in 1891 by Tricoupis, who suggested an offensive alliance of the Balkan states, directed against Turkey and aiming at a partition of the Sultan's possessions in Europe. The scheme, which found favour in Servia, was frustrated by the opposition of Stambuloff, who denounced it to the Porte. In 1897 a Bulgarian proposal for joint pacific action with a view to obtaining reforms in Mace- donia was rejected by Greece.~~

~~See AMi-Bouii. La Turquie d"Europe. Paris, 1840. — Lejean, Ethnographie de la Turquie d'Europe. Gotha, 1861. — Mackenzie and Ikbt. Travels in the Slavonic Provinces of Turkey. London, 1866. — RupFEK.~~

~~Die Balkanhalbinsel und ihre Volker. Bautzen, 1869. — Emile de Latelete. La Peninsule des Balkans. Paris, 1888. — Hertzlet. The Map of Europe by Treaty (especially vol. iv.). London, 1891. — Bourchier. " A Balkan Confederation." Fortnightly Eeview. London, September 1891. — Miller. The Balkans. London, 1896. — LAMoncHE. La Feninsule Balkanique. Paris, 1899. (j. d. b.)~~

~~Baikh, a city of Afghanistan, about 100 miles E. of Andkhoi and some 46 miles S. of the Oxus, in 37° N. lat. and 67° E. long. It comprises about 500 houses of Afghan settlers, a colony of Jews, and a small bazaar, set in the midst of a waste of ruins and many acres of debris. Entering by the west (or Akcha) gate, one passes under three arches, which are probably the remnants of a former Jam^ Masjid. The outer walls (mostly in utter disrepair) are about 6^ to 7 miles in perimeter, and on the south-eastern borders are set high on a mound, or rampart, indicating a Mongol origin. The fort and citadel to the north-east are buUt well above the town on a barren mound, and are walled and moated. There is, however, little left but the remains of a few pillars. The Masjid Sabz, with its green-tiled dome, is said to be the tomb of a Khwaja, Abul Narsi Parsar. Nothing but the arched entrance remains of the Madrasa, which is traditionally not very old. The earlier Buddhist constructions have proved more durable than the Mahommedan buildings. The Top-i-Rustam is 50 yards in diameter at the base and 30 yards at the top, circu- lar, and about 50 feet high. Pour circular vaults are sunk in the interior, and four passages have been pierced below from the outside, which probably lead to them. The base of the building is constructed of sun-dried bricks about 2 feet square and 4 or 5 inches thick. The Takht-i-Rustam is wedge-shaped in plan, with uneven sides. It is apparently built of pis^ mud (i.e., mud mixed with straw and~~

~~puddled). It is possible that in these ruins we may recognize the Nan Vihara of the Chinese traveller Hwen Thsung. There are the remains of many other topes (or stupas) in the neighbourhood. The mounds of rinns on the road to Mazar probably represent the site of a city yet older than those on which stands the modern BalkL The town is garrisoned by a few hundred kasidars, the regular troops of Afghan Turkestan being cantoned at Takht-i-Pul, near Mazar. The gardens to the north-east contain a caravanserai, which is fairly~~

~~well kept and com- fortable. It forms one side of a courtyard, which is shaded by a group of magnificent chenar trees. (t. h. h.*)~~

~~Balkhash (Kiighiz, jik-oiAlarDenghiz), a great lake of Russia, in the Kirghiz Steppes, between the provinces of Semipalatinsk and Semiryechensk, in 45° to 47° N. and 74° to 78° E., about 650 miles to the east of Lake Aral, it is fourth in size in Eurasia, and has anarea of 8610 square miles, and an altitude of 900 feet. It has the shape of a broad crescent, about 280 miles long from W. S.W. to E.N.E. , having its concave side turned southwards ; its width is 65 miles in the west, narrowing to 10 miles eastward. Its north-western shore is occupied by a dreary plateau, known as the Famine Steppe (Bekpak-dala) in its southern portion. The south-east shore is, on the contrary, low, and bears traces of a former much greater extension of the lake in that direction. Its desiccation proceeds rapidly, a lower- ing of the level of three feet having been noticed in the course of fourteen or fifteen years. The chief tributary of the lake is the Hi, which rises in the high Khan- tengri group of the Tian Shan. The Karatal, the Aksu, and the Lepsa also enter the lake from the south-east, and the Ayaguz from the north-east. In their lower courses the first three rivers make their way with difficulty through the sands and rushes, which at a quite recent time were covered by the lake ; while it also undoubtedly extended farther east so as to include the group of lakes Sasyk-kul and Ala-kul. The water of the lake is Salter along its north- western than along its south-eastern shores. It freezes for four and a half months every year. Its greatest depth, 135 feet, is also along the north-west shore. The fauna of the lake and of its tributaries — explored by Nikolsky — ^is more akin to the fauna of the rivers of the Tarim basin than to that of the Aral ; it also does not contain the common frog. It seems, therefore, probable that Lake Balkhash stood formerly in communication — through the lakes Ebi-nor, Ayar, &c., with the lake that formerly filled the Lukchun depression, but researches show that a con- nexion with Lake Aral — at least, at a recent time — was improbable.~~

~~Ball, John (1318-1889), Irish politician, naturalist, and Alpine traveller, son of an Irish judge, was born at Dublin, 20th August 1818. He was educated at Oscott and Christ's College, Cambridge. He showed in early years a taste for natural science, particularly' botany ; and after leaving Cambridge he~~

travelled in Switzerland and elsewhere in Europe, studying his favourite pursuits, and contributing papers on botany and the Swiss glaciers to scientific periodicals. In 1846 he was made an assistant poor-law commissioner, but resigned in 1847, and stood unsuccessfully as a parliamentary candidate for Sligo. In 1849 he was appointed second poor-law commissioner, but resigned in 1852 and successfully contested the county of Carlow in the Liberal interest. In the House of Commons he attracted Lord Palmerston's attention by his abilities, and was made under-secretary for the colonies, a post which he held for two years. At the Colonial Office he had great influence in furthering the cause of natural science, particularly in connexion with the equip- ment of the Palliser expedition in Canada, and with Sir W. Hooker's efforts to obtain a systematic knowledge of

the colonial floras. In 1858 he stood for Limerick, but ■was beaten, and he then gave up politics and devoted himself to natural history. He was first president of the Alpine Club (founded 1857), and it is for his work as an Alpinist that he is now remembered, his well-known Alpine Guide (1863-68) being the result of innumerable climbs and journeys and of careful observation recorded in a' clear and often entertaining style; he wrote the article Alps in the ninth edition of the Ency. Brit. He also travelled in Morocco (1871) and South America (1882), and recorded his observations in books which were recognized as having a scientific value. He died 21st October 1889.

Ballance, John (1839-1893), New Zealand states- man, eldest son of Samuel Ballance, farmer, of Glenavy, Antrim, Ulster, was born on 27th March 1839. He was educated at a national school, and, on leaving, was apprenticed to an ironmonger at Belfast. Thereafter he was clerk in a wholesale ironmonger's house in Birming- ham, and migrated to New Zealand, intending to start in business there as a small jeweller. After settling at Wanganui, however, he took an opportunity, soon offered, of founding a newspaper, the Wanganui Herald, of which he became editor, and remained chief owner for the rest of his life. During the fighting with

~~the Maori chief Titokowaru, in 1867, Ballance was concerned in the raising of a troop of volunteer horse, in which he re- ceived a commission. Of this he was deprived owing to the appearance in his newspaper of articles criticizing the management of the campaign. He had, however, behaved well in the field, and, in spite of his dis- missal, was awarded the New Zealand war medal. He entered the colony's parliament in 1875 and, with one interval (1881-84), sat there, till his death. Ballance was a member of three ministries, that of Sir George Grey (1877-79); that of Sir Robert Stout (1884-87); and that of which he himself was premier (1891-93). His alliance with Grey ended with a notorious and very pain- ful quarrel. In the Stout government his portfolios were those of lands and native affairs ; but it was at the Treasury that his prudent and successful finance made the chief mark. As native minister his policy was pacific and humane, and in his last years he contrived to adjust equitably certain long-standing difficulties relating to re- served lands on the west coast of the Nortl;i Island. He was resolutely opposed to the sale of Crown lands for cash, and advocated with effect their disposal by perpetual lease. His system of State-aided " village settlements," by which small farms were allotted to peasants holding by lease from the Crown, and money lent them to make a beginning of building and cultivation, has been on the whole suc- cessful. To Ballance, also, was due the law reducing the life-tenure of legislative councillors to one of seven years. He was actively concerned in the advocacy of woman suffrage. But his best known achievement was the im- position, in 1891, of the progressive land-tax and progres- sive income-tax still levied in the colony. As premier he brought together the strong experimental and progressive party? which in 1901 still held office in New Zealand. In office he showed debating power, constructive skill, and tact in managing men; but in 1893, at the height of his success and popularity, he died at Wellington of an intestinal disease after a severe surgical operation. Quiet and unassuming in manner, Ballance, who was a well- read man, always seemed fonder of his books and his chessboard than of public bustle; yet his loss tb his party was great, and the mark he left on New Zealand politics bids fair to be enduring. A statue has been erected to his memory in front of Parliament House, Wellington. (w. p. b.)~~

~~Ballantine, William (1812-1887), English bar- rister, was born 3rd January 1812, being the son of a London police-magistrate. He was educated at St~~

~~Paul's School, and called to the Bar in 1834. He began in early life a varied acquaintance with dramatic and literary society, and his experience, combined with his own pushing character and acute intellect, helped to obtain for him very soon a large practice, particularly in criminal cases. He became known as a formidable cross- examiner, his great rival being Serjeant Parry. The three great cases of his career were his successful prosecution of the murderer Franz Mtiller in 1864, his skilful defence of the Tichborne claimant in 1871, and his defence of the Gaekwar of Baroda in 1875, his fee in this last case being one of the largest ever known. Ballantine became a serjeant-at-law in 1856. He died on 9th January 1887, having previously published more than one volume of reminiscences. Serjeant Ballantine's private life was decidedly Bohemian; and though he earned large sums, he died very poor.~~

~~Ballantyn^, Robert Michael (1825-1894), Scottish writer of fiction, was born at Edinburgh on 24th April 1825, and came of the same family as the famous printers and publishers. When sixteen years of age' he went to Canada, and was for six years in the service of the Hudson Bay Company. He returned to Scotland in 1847, and next year published his first book, recording his experiences in the " Wilds of North Amer- ica." For some time he was employed by Messrs Con- stable, the publishers, but in 1856 he gave up business for the profession of literature, and began the series of enjoyable stories of adventure for the young with which his name is popularly associated. The Coral Island, The World of Ice, TJie Young Fur-Traders, Ungava, The Dog Crusoe, The Lighthouse, Deep Down, The Pirate City, Erling the Bold, The Settler and the Savage, and other books, to the number of upwards of a hundred, followed in regular succession, his rule being in every case to write as far as possible from personal knowledge of the scenes he described. His stories had the merit of being thor- oughly healthy in tone, with considerable graphic force. Ballantyne was also no mean artist, and exhibited some of his water-colours at the Koyal Scottish Academy. He lived in later years at Harrow, and died on 8th February 1894, at Rome, where he had gone to attempt to shake off the results of overwork.~~

~~Ballarat and Ballaeat East, a city and a town of Victoria, Australia, in the county of Grenville, 74 miles by rail W.N.W. of Melbourne, divided by the Yarrowee creek. The former is the second city and chief goldfield town of~~

~~the state. These municipalities are in the centre of the richest alluvial goldfields ever opened up, biat the yield has greatly declined, and gold is now chiefly obtained by quartz crushing, the deep levels giv- ing a fair return. The total output of gold for the dis- trict in 1899 was 208,920 ozs. It is an important railway centre, from which six lines branch, and has iron foun- dries, woollen milli, and other factories. There are several recreation grounds, including the Botanic Gar- dens. Connected with the latter is a lake of 600 acres, where pisciculture is carried on with great success. Alti- tude, 1438 feet. Mean temperature for the year, 55-2° F. ; for January, 66-7° F. ; July, 43-5° F. ; rainfall (17 years), 27 inches. The population of the city of Ballarat was in 1901, 25,448 ; of the town^of Ballarat East in 1901,~~

~~18,262.~~

~~Ballet. See Spkctagle.~~

~~Ballia, a town and district of British India, in the Benares division of the North- West Provinces. The town~~

~~is situated on the left bank of the Ganges, below the con- fluence of the Lesser Sarju. It is really an aggregate of rural villages. Population about 16,500 : municipal income in 1897-98, Rs.10,482.~~

~~The district of Ballia, constituted in 1879, occupies an angle at the junction of the Gogra with the Ganges, being bordered by two districts of Behar. It contains an area of 1170 square miles. The population in 1891 was 995,325, being 936 persons per square mile; Hindus numbering 926,368, Mahommedans 68,962, Christians 15, of whom 7 were Europeans. In 1901 the population was 949,966, showing a decrease of 6 per cent. Land revenue and rates were returned as Es. 8,75,449, the incidence of assessment (which is permanently settled) being Rs.0 : 14 : 3 per acre ; the number of police was 2740. There are no canals and no railways. Out of a total cultivated area in 1896-97 of 610,828 acres, 157,443 were irrigated from wells, tanks, &c. The principal crops are rice, barley, other food-~~

~~grains, pulse, sugar-cane, and opium. There are no manufactures^, except that of sugar ; and trade is almost entirely carried on by the two bordering rivers.~~

~~Ballina, a maritime town, urban sanitary district of county Mayo, Ireland, on the river Moy and the Midland Great Western Eailway. In population and trade it is the first town in the- county. Salmon fisheries gave employ- ment in 1898 to 547 persons. A light railway now runs from Ballina to Killala. Population, 4846.~~

~~Ballinasloe, an inland town and urban sanitary district in the province of Connaught, county of Galway, Ireland, on the river Suck, 91 miles W.S.W. of Dublin by the Midland Great Western Eailway. In 1898 the portion in Eoscommon was added to Galway. The number of sheep offered for sale at the great October fair in 1900 was 28,360, and of horned cattle, 11,294. Population about 4700.~~

~~Balloons, Military. — When, in 1783, Mont- golfier first caused a balloon to rise in the air, and to lift a man to a considerable height, whence an extensive view of the surrounding country could be obtained, military authorities were not slow to recognize the immense benefits which the employment of such a contrivance might confer in war. Within the next ten years the French Govern- ment made "trials, resulting in the establishment of a company of " ASrostiers," suitably equipped with several balloons, and these proved of great service during the campaigns of that period. In June 1794, Captain Coutelle made an ascent at Maubeuge. At the battle of Pleurus the balloon was up all day and valuable observations were made from it. A second company of "Aerostiers" was then formed, and frequent ascents were made. At the siege of Mayenne in 1799, Coutelle ascended during a very strong wind, but was able to gain important informa- tion. Balloon observations were also made at Ehren- breitstein, Bonn, Frankfort, Wiirzburg, and at the siege of Liege. It may seem curious that after such an apparently successful debut military ballooning should have died out of fashion. With the exception of an ascent at the siege of Antwerp in 1815, and one at Solferino in 1859, balloons were not again used in war until the Federals brought them into requisition in the American civil war of 1861. Much valuable information was thus gained of the enemy about Eichmond~~

~~and in other places. Though during the Franco-German war in 1870 balloons were occasionally used, no regular organization was instituted, nor were important results obtained until the siege of Paris, when the French made great use of them for sending out letters and carrier pigeons. Sixty-four large balloons were sent off, taking nearly a ton of letters. Yet it may be said that ballooning as a recognized military science only dates~~

~~back to about the year 1883 or 1884, when most of the powers organized regular balloon establishments. In 1884-85 ti).e French found balloons very useful during their campaign in Tongking ; and the British Government also despatched balloons with the Bechuanaland expedition and also with that to Suakin in those years. During the latter campaign several ascents were made in the presence of the enemy, on whom it was said that a great moral effect was produced. In the war against the Spaniards in Cuba the United States again used a balloon, but it was carried so close to the enemy's lines that it was soon shot down, after drawing the enemy's fire upon the troops. Balloons were employed in the South African war of 1899-1902 with useful results.~~

~~Aj^aratus. — We may briefly describe the apparatus used in military operations. The Prench in the campaigns of the last century used varnished silk balloons of about 10,000 cubic feet capacity. The Americans in the civil war used much larger ones, those of 26,000 cubic feet being found the most suitable. These were also of varnished silk. In the present day most nations use balloons of about 20,000 cubic feet, made of varnished cambric; but the British war balloons, made of goldbeater skin, are usually of comparatively small size, the normal capacity being 10,000 cubic feet, though others are also used of 7000 and 4500 cubic feet, the latter two sizes having been used at Suakin. The usual shape is spherical ; but since 1896 the Germans, and now other nations, have adopted a long, cylindrical-shaped balloon, so affixed to its cable as to present an inclined surface to the wind and thus act partly on the principle of a kite.~~

~~Though coal-gas and even hot air may occasionally be used for inflation, hydrogen gas is on accoimt of its lightness far preferable. In the early days of ballooning this had to be manufactured in the field, but nowadays it is almost universally carried compressed in steel tubes. About 100 such tubes,~~

~~each weighing 76 R), are required to fill a' 10,000-feet balloon. New tubes of greater capacity have also been tried.~~

~~The transport for a British balloon section consists of 6 four- horsed waggons, 1 carrying the balloon with its steel wire captive rope, 4 for gas tubes, and 1 for equipment. The personnel consists of 3 officers and 25 rank and file. These all belong to the Royal Engineers.~~

~~The balloon is almost always used captive. If alloiWed to go free it will usually be rapidly carried away by the wind, and the results of the observations cannot easUy be transmitted back. Occasions may occur when such ascents will be of value, but the usual method is to send up a captive balloon to a height of somewhere about 1000 feet. With the standard British balloon two officers are sent up, one of whom has now particularly to attend to the manage- ment of the balloon, while the other makes the observations.~~

~~With regard to observations from captive balloons much will depend on circumstances. In a thickly wooded country, such as that in which the balloons were used in the American civil war, no very valuable information is, as a rule, to be obtained ; but in fairly open country all important movements of troops should be discernible by an experienced observer at any point within about four or five miles of the balloon. The circumstances, it may be mentioned, are such as would usually preclude one unaccustomed to ballooning from affording valuable reports. Not only is he liable to be disturbed by the novel and apparently hazardous situation, but troops and features of the ground often have so peculiar an appearance from that point of view, that a novice will often have a difficulty in deciding whether an object be a column of troops or a ploughed field. Then again, much will depend on atmospheric conditions. Thus, in misty weather a balloon is well-nigh useless ; and in strong winds, with a velocity of anything over 20 miles an hour, efficient observation becomes a matter of difficulty. When some special point has to be reported on, such as whether there is any large body of troops behind a certain hill or wood, a rapid ascent may still be made in winds up to .30 miles an hour, but the balloon would then be so unsteady that no careful scouting could be made. It is usually estimated that a successful captive ascent can only be made in England on half the days of the year. As a general rule balloon ascents would be made for one of the~~

~~following objects, viz.: to examine the country for an enemy; to reconnoitre the enemy's position ; to ascertain the strerigth of his force, number of guns, and exact situation of the various arms ; also to note the plan of his earthworks or fortifications. During an action the agrial observer would be on the look-out for any move- ments of the enemy and give warning of flank attacks or surprises. Such an observer could also keep the general informed as to the progress of various detached parties of his own force, as to the advance of reinforcements, or to the conduct of any fighting going~~

~~on at a distance. Balloon observations are also of especial aid to artillery in correcting their aim.~~

~~The vulnerability of a captive balloon to the enemy's fire has been tested by many experiments with variable results. One fact undoubtedly is that the range of a balloon in mid-air is extremely difficult to judge, and, as its altitude can be very rapidly altered, it becomes a very difficult mark for artillery to hit. A few bullet holes in the fabric of a balloon make but little difference, since the size of the perforation is very minute as compared with the great surface of material, but on the other hand, a shrapnel bursting just in front of it may cause a rapid fall. It is therefore considered prudent to keep the balloon well away from an enemy, and two miles are laid down as the nearest approach it should make habitually.~~

~~Besides being of use on land for war purposes, balloons have also been tried in connexion with the naval service. In France especially regular trials' have been made of inflating balloons on board ships, and sending them aloft as a look-out ; but it is now generally contended that the difficulties of storing the gas and of manoeuvring the balloon are so great on board ship as to be hardly worth the results to be gained.~~

~~A very important development of military ballooning — which, however, has not yet passed the experimental stage — is that of the navigable balloon. If only a balloon could be sent up and driven in any required direction, and brought back to its starting-point, it is obvious that it would~~

~~be of the very greatest use in war. The French, here again, were the first to make practical efforts to ac- complish this end. Giffard, a civil engineer, as long ago as 1852, ascended in an elongated balloon with a steam engine to work a screw propeller. The speed attained was, however, not sufficient to be of any practical use, since, of course, the rate of progress must be greater than that of tiie wind in order to make certain of return- ing to the point of departure. Dupuy de Ldme, constructor to the French navy, undertook further experiments in this line for the Government in 1872, but without much more satisfactory results. In 1884, however. Captains Renard and Krebs, of the military balloon establishment at Meudon, succeeded in making and work- ing a balloon, called "La France," with electric engines, which on several occasions attained a speed of about 14 miles an hour ; and this was sufficient, so long as the wind was very light, to enable it to travel some miles and return to its point of departure. Though there have been frequent rumours of this balloon having been improved upon, nothing definite seems to have really resulted. Several further attempts to solve the problem have been made in Germany and other countries without much success. Count Zeppelin's great air-ship, in 1900, promised better results. Having a capacity of over 350,000 cubic feet, it could carry about thirty men, and was estimated to travel at the rate of 22 miles an hour. (See also Aeronautics.) This huge vessel was kept distended by an aluminium framework, and was driven by two benzine motors of 15 horse-power each, rotating four screw propellers placed at the sides of the vessel. (b. f. a. b.-p.)~~

~~Ballot. — The history of the ballot in the United Kingdom, generally, was treated in the ninth edition of this work, but it is desirable here to give further particulars concerning its use in the United States. At the first elections in America voting was vivd voce; but several of the colonies early provided for the use of written or printed ballots. By 1776 ballots were used in the New England states, in Pennsylvania, Del- aware, North Carolina, and South Carolina; they were introduced in New Jersey in 1776 and in New York in 1778, so that, at the time the Constitution of the United States waiS adopted, vivd voce voting prevailed at public elections only in Maryland, Virginia, and Georgia. Of the new states which later entered the Union, only Illinois, Kentucky, Missouri, and Arkansas did not have a ballot system when they became states. During the first half of the 19th century, Maryland, Georgia, Arkansas (1846) and Illinois (1848) adopted~~

~~the ballot. In Missouri ballot voting was introduced to some localities in 1845, but not until 1863 was it generally adopted in that state. Virginia did not pro- vide for voting by ballot until 1869, and in Kentucky vivd voce voting continued until 1891. But while the use of ballots was thus required in voting, and most of the states had laws prescribing the form of ballots and providing for the count of the vote, there was no provi- sion making it the duty of any one to print and distribute~~

~~the ballots at the polling places on election day. In the primitive town meetings ballots had been written by the voters, or, if printed, were furnished by the candidates. With the development of elections, the task of preparing and distributing ballots fell to political committees for the various parties. The ballot tickets were thus prepared for party lists of candidates, and it was not easy for any one to vote a mixed ticket, while, as the voter received the ballot within a few feet of the polls, secrecy was almost impossible, and intimidation and bribery became both easy and frequent.~~

~~Soon after the adoption of the Australian ballot in Great Britain, it was introduced in Canada, but no serious agitation was begun for a similar system in the United States until 1886. In 1887 bills for the Australian ballot were actively urged in the legislatures of New York and Michigan, although neither became law. A Wisconsin law of that year, regulating elections in cities of over 60,000 population, incorporated some features of the Australian system, but the first complete law was enacted by Massachusetts in 1888. This Massachusetts statute provided for the printing and distribution of ballots by the state to contain the names of all candidates arranged alphabetically for each office, the electors to vote by marking the name of each candidate for whom they wished to vote. At the Presidential election of 1888 it was freely alleged that large sums of money had been raised on an unprecedented scale for the purchase of votes, and this situation created a feeling of deep alarm which gave a powerful impetus to the movement for ballot reform. In 1889 new ballot laws were enacted in nine states : two states bordering on Massachusetts, Con- necticut and Ehode Island ; four states in the middle- west, Indiana, Michigan, Wisconsin, and Minnesota ; two southern states, Tennessee and Missouri; and Montana, in the far west. The Connecticut law, however, marked but little improvement over former conditions, since it provided only for~~

~~official envelopes in which the unofficial party ballots should be voted. The Indiana law provided for a single or " blanket " ballot, but with the names of candidates arranged in party groups, and a method of voting for all of the candidates in a party group by a sin- gle mark. Michigan and Missouri also adopted the party group system. The other states followed the Massachu- setts law providing for a blanket ballot with the candi- dates arranged by offices.~~

~~The new ballot system had its first practical demon- stration at the Massachusetts election of 1889, and its success led to its rapid adoption in many other states. In 1890 ballot laws were passed in seven states : Vermont, Mississippi, Wyoming, and Washington provided for the Massachusetts plan, although Vermont afterwards adopted the system of party groups, which Maryland used from the first. The New York and New Jersey laws, of 1890, however, only provided for official ballots for each party,' and allowed ballots obtained outside of the polling booths to be used. In 1891 seventeen additional states and two territories adopted the Australian ballot system. All of these provided for a blanket ballot; but whUe the Massachusetts arrangement was adopted jn Arkansas, Nebraska, New Hampshire, North and South Dakota, Kentucky, Texas, and Oregon, the system of party groups was followed in Colorado, Delaware, Illinois, Maine, Ohio, Pennsylvania, and West Virginia. California had the Massachusetts arrangement of names, but added on the ballot a list of party names, by marking one of which a voter would cast his vote for all of the candidates of that party. Pennsylvania placed all the candidates not in a party group in alphabetical order.~~

~~Iowa adopted the Australian ballot system in 1892; Alabama and Kansas in 1893 ; Virginia in 1894 ; Florida~~

~~in 1895 ; and in 1896 Louisiana and Utah. In 1896, too, New York adopted the blanket ballot in place of separate party ballots, but arranged the names of candi- dates in party columns. The only state to abandon the Australian ballot after once adopting it has been Dela- ware, which in 1898 returned to~~

~~the system of separate b&,llots, with no provision for booths where the ballot might be marked in secret. Up to 1901 four other states had not yet adopted the Australian ballot, viz., North Carolina, South Carolina, Georgia, and Nevada.~~

~~Owing to the large number of officials chosen at one time in American elections, the form and appearance of the ballot used is very different from that in Great Britain. At the quadrennial presidential election in New York state, for example, the officers to be voted for by each elector are thirty-six presidential electors, one congress- man, state governor, lieutenant-governor, and five other state officers, a member for each house of the state legis- lature, several judges, a sheriff, county clerk, and other county officers. The column with the list of the candi- dates of each party for all of these offices is two to three feet in length ; and as there are often eight to ten party tickets in the field, the ballot paper is usually from 18 to 20 inches in width. Each voter receives one of these "blanket" ballots on entering the polling place, and retires to a booth to mark either a party column or the individual candidates in different columns for whom he wishes to vote. Where, as in Massachusetts, the names of candidates are arranged by offices instead of in party lists, every voter must mark the name of each individual candidate for whom he wishes to vote. Connecticut, New Jersey, and Delaware continue to use the system of separate party ballots, the voter selecting the ballot he wishes to vote, on which he can write any changes he may wish to make. (See also the article Voting Machine.)~~

~~(j. A. FA.)~~

~~Ballston Spa, capital of Saratoga county. New York, U.S.A., situated in the eastern part of the State, in 43° 00′ N. lat., and 73° 51′ W. long., on the Delaware and Hudson Eailway, at an altitude of 294 feet. It contains fine chalybeate springs, which attract a large number of visitors every summer. Population (1880),~~

~~3031 ; (1890), 3527 ; (1900), 3923.~~

~~Ballycastle, a seaport and watering-place in the county of Antrim, Ireland, on a bay of the same name opposite Rathlin Island. The town is now connected with Ballymoney by a light railway. In 1899, 134 vessels were~~

~~registered in the fishing district, employing 284 hands. Population (1891), 1481 ; (1901), 1476.~~

~~Ballymena, an inland town and urban sanitary district in the county of Antrim, Ireland, on the river Braid and the Belfast and Northern Counties Eailway, 33 miles N.N.W. of Belfast. The value of brown linens alone produced annually averages £1,000,000. There are frequent markets and fairs. Light railways now run from Ballymena to Lame, 23 miles distant, and to Parkmore, 13 miles distant. Population (1901), 10,880.~~

~~Balmaceda, Jose Manuel (1838-1891), Presi- dent of the republic of Chile, was born in Santiago in 1838. His parents were wealthy, and in his early days he was chiefly concerned in industrial and agricultural enter- prise. In 1865 he was one of the representatives of the Chilian Government at the general South American con- gress at Lima, and after his return took an active part in the proceedings of the National Assembly, obtaining great distinction as an orator. After discharging some diplo- matic missions abroad he became successively minister of foreign affairs and of the interior under the presidency of~~

~~Senor Santa Maria, and in the latter capacity carried com- pulsory civil marriage and several other legislative meas- ures highly obnoxious to the clergy. In 1886 he was elected president. It soon appeared that he was irrecon- cilably at variance with the majority of the Assembly, and refusing to accept the alternative "se soumettre ou se demettre," prescribed by Gambetta to Marshal MacMahon, on 1st January 1891 he sought to terminate an intolerable situation by the desperate remedy of a coup d'itat, refus- ing to convoke the Assembly, and ordering the continued collection of the taxes on his own authority. A week af- terwards the navy revolted almost en masse, and the un- precedented spectacle was seen of the legal representatives of the nation huddled together in a small port at the north- ern extremity of the republic — safe, however, under the protection of the fleet, — while the executive retained the allegiance of the army, and was apparently obeyed through- out the rest of the country. So matters continued until August, when the party of the Assembly, having com- pleted their preparations, disembarked at Coquimbo, and with some assistance from treachery overthrew Balma- , ceda's troops in the tvfo desperate battles of~~

~~Conchon, 21st August, and Placilla, 28th August. The unfortunate president, abandoned by all, committed suicide on 18th September, the anniversary of his elevation. Seldom has there been a more forcible illustration of the maxim that the master of the sea is also master of the land ; and the contest is further memorable as definitively establishing the parliamentary regime in Chile. Balmaceda was acapar ble and probably a well-intentioned man, but his imperious character disqualified him for the first place in a free state. (See also Chile.) (b. g.)~~

~~Balrampur, a town of British India, in the Gonda district of Oudh, which gives its name to one of the largest talukdari estates in the province. The raja was conspicuously loyal during the Mutiny, and was rewarded with accessions of territory and hereditary privileges. His death gave rise to prolonged litigation, and the estate was recently under the court of wards. The income is esti- mated at Es. 18,00,000, paying a revenue of Es.7,00,000. Numerous schools and hospitals are supported. The town of Balrampur is situated in 27° 25′ N. lat. and 82° 13′ E. long., near the river Eapti, 28 miles from Gonda ; railway station. Population about 15,000; municipal income (1897-98), Es.5756. Balrampur contains a large palace, handsome new temple, an Anglo-vernacular school, and a printing-press.~~

~~Baltic Sea. — The Baltic Sea (Ostsee of the Swedes, Danes, and Germans, Baltiiskoye Morye of the Eussians) lies between 54° and 66° N. lat., and 9° and 30° E. long. ; it is surrounded by the territories of Sweden, Eussia, Germany and Denmark. Its greatest length is about 960 miles; greatest breadth, about 400 miles; and length of coast-line, 5000 miles. Its central axis runs approxi- mately from south-west to north-east. The Baltic is connected with the North Sea by the winding channel between, the south of Scandinavia and the Cimbrian pen- insula. This channel is usually included in the Baltic. The part of it west of a line joining the Skaw with Christiania fjord receives the name of Skagerrak ; east of this line the channel is called the Kattegat. At its south- ern end the Kattegat is blocked by the Danish islands, and it communicates with the Baltic proper by narrow channels called the Sound, the Great Belt, and the Little Belt. The real physical boundary between the North Sea and the Baltic is formed by the plateau on which the islands Zealand, Funen, and Laaland are situated, and its~~

~~prolongation from the islands Falster and Moen to the coasts of Mecklenburg and Eilgen.~~

~~East of this line the Baltic proper forms a series of~~

~~BALTIC SEA~~

~~hollows or troughs. The first, or Bornholm deep, lies east~~

~~t^e island of Bornholm, and is separated from the next,~~

~~or "Gothland" deep, by the « Middelbank." Beyond~~

~~THE BALTIC~~

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~~Swedish coast a deep channel runs northward from outside the island of Oland ; this is entirely cut off to the south and east by a bank which sweeps eastward and northward from near Karlskrona, and on which the island of Gothland stands, but it communicates at its northern end with the Gothland deep, and near the junc- tion opposite Landsort is the deepest hole in the Baltic (420 metres =230 fathoms).~~

~~An unbroken ridge, extending from Stockholm to Hango in Fin- land, separates the Baltic basin proper from the depression between Sweden and the Aland Isles, to which the name Aland Sea has been given. North of the Aland Sea a ridge defines the southern edge of another depression, the Both- nian Sea, which in turn is separated from the most northerly division, the Gulf of Bothnia, by a ridge across the narrow Quarken Strait. The Gothland deep may be said to extend directly into the Gulf of Finland, an arm of the Baltic, running eastwards for about 260 miles, and separating Finland from Esthonia. Between Esthonia and Courland is the Gulf of Eiga,~~

~~a shallow inlet of roughly circular form, about 100 miles in diameter, and nowhere more than 27 fathoms deep.~~

~~According to recent computar tions the total area of the Baltic, including the Skagerrak and Kat- tegat, is 430,970 sq. km. (=166,397 sq. m.V and its volume 28,732 cub. km. (^=6907 cub. m.), giving a mean depth of 36 fathoms, ‘ which is markedly less than that of any other arm of the sea of similar a^ea. , In the deeper hollows in the south part of the Baltic the bottom consists almost invariably of either soft brown or gray mud or hard clay, while on the shallow banks and near the low coasts fine sand — of white, yellow, or brown colour — with small pebbles, is usually found.~~

~~Map of Tiui iiALTlo Sea.~~

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the "Middelbank" the "Danziger Tiefe," an isolated depression, lies to the south-east, while to the north-east the Gothland basin, the largest and deepest of all, ex- tends north-eastwards to the Gulf of Finland. Along the

At the time of the last great subsidence, in glacial times, an arm of the sea ex- tended across Sweden, "f??"""" submerging a great P'"'>'<'gy- part of the littoral up to the Gulf of Bothnia, and including the present lakes Wener, Hjel- mar, and Malar. During this period the waters of the north- ern Baltic were sufficiently salt for oysters to flourish. The sub- sequent upheaval restricted di- rect communication with the open sea to the Danish channels, and the Baltic waters became fresher : the oyster disappeared, but a number of cold salt-water fishes and crustaceans, and even seals, became acclimatized. It has been suggested that the presence of the remains of theso animals indicates a communication to the north with the Arctic Ocean; but in view of the severe climatic conditions

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still prevailing at the time, this seems an unnecessary assumption. In the next stage of its history the Baltic is transformed by further elevation into a vast freshwater lake, the Ancylus lake of De Geer j^named from the remains of the mollusc Ancylus fluviatilis), which is supposed to have covered an area of about 570,000 sq. km. (220,000 miles), including the whole of the present Baltic area and a large part of Finland, with Lake

~~Ladoga. Then followed a subsidence, which not only re-established communication through the Danish channels, but allowed the Baltic to become sufficiently salt for such fornis as Cardium edule and Littorina Uttorea. At this time the Gulf of Bothnia must have suffered greater depression than the Baltic proper, for the deposits of that epoch show a thick- ness of 100 metres (328 feet) near Hernbsand, but of only 25 metres (82 feet) in the neighbourhood of Gothland. After this period of subsidence the process of elevation set in which gave the Baltic its present form and physical condition, and appears to be still in progress. Dr Sieger has traced a series of isobasic lines, or lines of equal rate of elevation, for portions of Sweden and Finland ; these indicate that the movement is now almost nil along the axial lines of the Baltic and the Gulf of Finland, but increases in amplitude northwards to the Gulf of Bothnia and in the direction of the main ridge of the massif of southern Sweden. At Stockholm the rate of elevation is approximately 0-47 m. (=1-54 feet) in a century.~~

~~The drainage area of the Baltic is relatively large. According to the measurements of Murray it extends to 461,450 square sea miles (=611,700 square English miles). The largest river basin included in it is that of the Neva in the east, and next in size come the Vistula and the Oder in the south. The narrow parallel troughs, at right angles to the coast, which form the drainage system of Sweden and western Finland, are a remarkable feature.~~

~~The coast of the Baltic is rocky only in the island-studded region at the head of the Baltic basin proper — a submerged lake- district — and the littoral generally is a typical morainic land, the work of the last great Baltic glacier. The southern margin of the Baltic is of peculiar interest. From Schleswig eastwards to Liibeck Bay the coast is pierced by a number of narrow openings or Fohrde, the result of encroachment of the sea caused by subsidence. East of Liibeck as far as the mouth of the Oder, these give place to Bodden, ramified openings studded with islands : the structure here resembles that of Scania in southern Sweden, a region once joined to both Denmark and Pomerania by an isthmus which was severed by tectonic movements. Beyond the Oder the coast-line is unbroken as far aS the Gulf of Danzig. It is then cut into by the estuaries of the Vistula, the Pregel, and the Memel. Here the westerly winds have full play, and the coast is rimmed~~

~~by a con- tinuous line of dunes, which out ofi the two great lagoons of the Frisches Saff and Kurisches Haff by sand-spits or Nehrunge.~~

~~Levellings from Swinemunde show that the mean level of the surface of the Baltic at that point is 0-093 metres (= -305 feet) below the surface of the North Sea at Amsterdam, and 0-066 metres (= -216 feet) below its level at Ostend. A line of levels from SwinemUnde through Eger to the Adriatic showed the mean level of the surface of the Baltic to be 0-499 metres (1 -6 feet) above that of the Adriatic Sea. The mean level of the surface of the Baltic rises about 0-5 metres (1-6 feet) from the coast of Holstein to Memel, probably as a result of the prevailing westerly winds ; this mean difference is exceeded with strong westerly winds, and disappears or is reversed with easterly winds. The waves of the Baltic are usually short and irregular, often dangerous to naviga- tion. Destructive waves, probably caused by distant earthquakes, called Seebdren (fif. English "bores") have been recorded.~~

~~The range of the tides is about one foot at Copenhagen ; within the Baltic proper ordinary tides are scarcely perceptible. There is, however, a distinctly marked annual rise and fall due to meteoro- logical influences having a mean range of about 11-4 cm. (0-37 feet) at Travemiinde, and 13-9 cm. (0-46 feet) at Swinemunde, the maxi- mum occurring at the end of the summer rainy period in August.~~

~~The circulation of water in the Baltic proper must be con- sidered apart from the circulation in the channels connecting it with the North Sea ; and in this relation the ridge connecting the islands Falster and Moen with the coasts of Mecklenburg land Rugen must be taken as the dividing line. In the great basins and hollows from Rugen to the Gulfs of Bothnia and Finland the upper layers of water, from 30 to 70 metres (16 to 38 fathoms) in thickness, have almost the same salinity throughout. In these waters a vertical circulation is kept up by convection currents. Beneath these layers are masses of Salter water, through which a thermal wave of small amplitude is slowly propagated to the bottom by conduction. These strata, are practically stagnant, deficient in oxygen, and surcharged with carbonic acid. Their Salter waters must have been originally derived from outside, and must therefore have passed over the ridge between Falster and~~

~~Mecklenburg, but their horizontal extension is checked by the ridges separating the deep hollows in the Baltic from each other. The inflow to the~~

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~~deep basins is intermittent, probably with, a long period of flux and reflux.~~

~~The circulation in the channels connecting the Baltic proper with the North Sea is of a complex character. It is necessary in the first place to distinguish clearly between outflowing and in- flowing waters, and in practice this is easily done, because the out- flowing water always contains less than 30 pro mille of salt, and the inflowing water more than 32 pro mille. Since the Baltic receives much more water by rainfall, discharge of rivers, etc. , than it loses by evaporation, a surplus might be got rid of by an out- flowing current Vhich may be named the "Baltic Stream." The following general laws may be laid down with regard to this : —~~

~~1. That the Baltic Stream must be a surface current, because it originates from a redundancy of fresh water.~~

~~2. That, on account of the earth's rotation, the main part of the Baltic Stream must keep close to the coast of the Scan- dinavian peninsula.~~

~~3. That it must be a periodic stream because the discharge of the rivers into the Baltic varies with the season of the year. In spring and summer the water from the Baltic is sufficiently abundant to inundate the whole surface of the Kattegat and Skagerrak, but in winter the sources of the Baltic current are for the most part dried up by the freezing of the land water.~~

~~All the waters which enter the Skagerrak or Kattegat as under- currents can be found at the surface of the North Sea (see North Sea). They may be divided according to their origin and salinity as follows : —~~

~~a) Ocean water of 35 pro mille salinity or more. 6) North Sea water, the predominant water in the North Sea area, of 34 to 35 pro mille salinity.~~

~~(c) Sank water, 32 to 34 pro mille, which forms a broad edging covering the coast banks of Holland, Germany, Denmark, and Norway.~~

~~The deepest water stratum in the Skagerrak is certainly of oceanic origin ; it has been found to suffer changes of long period, and it is probably not always composed of water derived from the same part or the same depth of the North Atlantic ; this water is, as a rule, deficient in oxygen. The " North Sea" water, of 34-36 pro mille salinity, does not appear at the surface in the Skagerrak, except as a strip along part of the coast of Jutland, but it is always found as an undercurrent overlying the oceanic water. It enters into all the deep coast channels, and into the Christiania fjord, but it is not always found in the deep channels of the Kattegat. The principal time of inflow of North Sea water is during spring and summer. The bank-water of 32 to 34 pro mille salinity is found all along the continental coast of the North Sea and North Atlantic, and it may therefore enter the Skagerrak either from the North Sea or from the north along the coast of Norway. It is probable indeed that an influx of this water occurs from both directions — in August and September from the south, and in the late winter and early spring from the north. The seasonal changes in the distribution of the bank-waters ini different parts of the coast are too complex to be briefly explained ; their relations to the times of occurrence of various fisheries of the region present many remarkable features, which have been investi-gated in recent years by the Swedish Commission.~~

~~On the west and south coasts of Sweden, and in the Skagerrak south-east of Norway, navigation is interfered with by ice only in severe winters, and then the ice is usually drifting, compact sea-ice being very rare. Between Stockholm and Wisby navigation usually ceases at the end of December and begins again about 10th April. During very severe winters the Aland sea is covered with thick ice available for traffic. The south part of the Gulf of Bothnia is cov- ered with ice every winter along the coasts, but rarely, if ever, in its central part. Navigation is interrupted by drifting ice from about the middle of November to the beginning of May, though the port of Hemosand has been known to remain open during a whole win- ter. The northern Quarken is covered with traversable ice every third or fourth year. The northern part of the Gulf of Bothnia is frozen every winter. In the Gulf of Finland the sea is closed to navi- gation by ice for about 150 days in the year ; but navigation is now rendered possible throughout the winter by the use of ice-breakers.~~

~~See references to different parts of the subject in the standard books of Pence, de Lapparent, Suess, and others. Also Credner. Die Entstehung der Ostsee. Leipzig, 1 895. — Db Geer. Om Skandinaviens nivdf'drdndringar under quartdrperioden. Stock- holm, 1888. — SiBGER. Seenschwankungen und Strandverschiebun- gen in Skandinavien. Berlin, 1893. — Pettersson. " Review of Swedish Hydrographic Research," Scottish Geographical Magazine, 1894. — N. Ekholm. Om klimatets andringar i geologisk och historisk tid. Ymer. Stockholm, 1899. (h. n. d.)~~

~~Baltic and Black Sea Canal. See Canals. Baltimore, in Maryland, one of the chief cities~~

~~BALTIMORE~~

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~~of the United States of America, situated on the north side of the Patapsco river, about 14 miles above its entrance into Chesapeake Bay, 38 miles N.E. of Wash- ington, and 97 miles S.W. of Philadelphia. Its latitude is 39° 17′ N. and longitude 76° 36′ W. The harbour is defended by Fort M'Henry. (It was during the bom- bardment of this fort in 1814 that Francis Scott Key, a prisoner on one of the British ships, wrote "The Star- Spangled Banner.") The area of Baltimore was about doubled by an extension made in 1888. The region annexed extends to a line 2 miles north of the old northern boundary, and about 2 miles west of the old western boundary. The present area is about 32 square miles. Population (1880), 332,313; (1890), 434,439; (1900), 508,957. The death-rate in 1890 was 22-9, and in 1900, 21-0 ; of the whites (1900), 19-0, and of the coloured, 31-1. The coloured population was (1880) 63,716, (1900) 79,739 (79,258 negroes). Of the total population in 1900, 243,280 were. males, 265,677 females, 440,367 native-born, 68,600 foreign-born. Out of 141,271 males 21 years of age and over, 10,152 were illiterate (unable to write), of whom 1261 were native whites, 2921 foreign whites, and 5785 negroes. Baltimore was among the earliest American cities to be provided with a general system of electric car-lines; and since 1890 there has been a rapid suburban growth, Eoland Park to the north and Walbrook to the north-west being 'two of the principal new suburbs. In 1899 the total assessed valuation of real and personal property was $388,242,020, the tax-rate $21.68 per $1000, and the net public debt~~

~~$32,928,106. The water-supply of Baltimore was very greatly increased in 1881 by the introduction of water from the Gunpowder Kiver (in addition to the old supply from Jones Falls), the source of supply being at a point about 11 miles north of the city. The cost of the work, including the building of three new reservoirs, was about $4,000,000. The entire water system of Baltimore is now capable of furnishing about 200,000,000 gallons daily. To the park system was added, in 1895, Clifton Park, acquired through the purchase from the trustees of the Johns Hopkins University of Clifton, the handsome estate of the late Johns Hopkins, comprising 252 acres. The parks are maintained from the proceeds of a tax of 9 per cent, on the gross receipts of the street rail- ways (with certain exemptions as to the annexed dis- trict), which tax now amounts to nearly $300,000 annually. The new court-house, completed in 1899, is a building of great beauty, chaste and dignified. In it all the courts (except the United States courts), the land records, the library of the Bar Association, &c., are accommodated. Opposite the court-house is the post-office, a large granite building, completed in 1890. Congress has also made provision for a handsome cus- tom-house.~~

~~An event of the first importance in education, not only to Baltimore but to the whole United States, was the foundation of Johns Hopkins University, which opened its doors in 1876. Its endowment, under the will of Johns Hopkins, a Baltimore merchant and financier, who died in 1873, was valued at more than $3,000,000. The devotion of the revenue thus placed in the hands of the trustees chiefly to the establishment of advanced university studies, somewhat on the plan of the German universities, constituted a new departure of the first importance in the history of higher education in America. (See Johns Hopkins University.) In 1888 was opened the Woman's College of Baltimore, an institution endowed and controlled by Methodists, but non-sectarian in its spirit. The Bryn Mawr School, founded by Miss Mary E. Garrett in 1885, and the Latin School of the Woman's College are important girls' schools preparatory to col-~~

~~lege. The number of public schools is now 183, with 1802 teachers, an enrolment of about 66,000 pupils, and an annual expenditure of about $1,400,000. In 1900 there were in the city 160,379 persons of school age (5 to 20 years inclusive). Baltimore has a number of medical schools, of which~~

~~the most important are that of the Johns Hopkins University, that of the University of Maryland (founded in 1807), the College of Physicians and Surgeons, and the Baltimore Medical College. The chief law school is that of the University of Maryland. Among the dental schools is the Baltimore College of Dental Surgery, chartered in 1839, the oldest dental col- lege in the world. The Maryland Institute maintains a very meritorious school of design, covering drawing, painting, and sculpture. The Peabody Institute carries on an important conservatory of music.~~

~~The Walters Art Gallery, although a private collection, is thrown open to the public during part of the year. Of the important foundations instituted in Baltimore, out- side the field of education, the most noteworthy is the Johns Hopkins Hospital, for the endowment of which the founder bequeathed half his fortune. The prin- cipal (about $3,000,000) of the fund has not been trenched upon, the buildings having been erected out of the income. The hospital was planned and constructed under the advisory supervision of Dr John S. Billings of the United States Army Medical Corps. It provides clinical facilities for the medical school of the Johns Hopkins University, for the accom- modation of which it also has extensive laboratories. The buildings are situated upon a tract of 12 acres, and are twenty in number ; the beds numbered 320. It main- tains a training school for nurses of the highest order. The Sheppard Asylum for the curative treatment of the insane was opened in 1890, upon the basis of a bequest made by Moses Sheppard in 1857. The endowment was more jthan doubled in 1898, through the bequest of Enoch Pratt, a Baltimore merchant and financier, the bequest being coupled with the condition that the name be changed to Sheppard and Enoch Pratt Hospital. It is now the most richly endowed hospital for mental dis- eases in the United States. Other notable institutions inaugurated within the past two or three decades are the M'Donogh School, the Samuel Ready Asylum for Female Orphans, and the Wilson, Sanitarium for children. Baltimore was without a free circulating library until 1886, when the Enoch Pratt Free Library was opened. This institution has a central building and seven branphes, and possesses about 200,000 volumes. Mr Pratt gave the buildings and the sum of $833,333.33, upon condition that the city expended $50,000 annually upon it.~~

~~The growth of manufactures in Baltimore has been rapid; the capital invested in manufacturing has risen from $38,500,000 in 1880 to $92,700,000 in 1890 ; the number of employees from 56,300 in 1880 to 83,700 in 1890; the annual amount of wages from $15,000,000 in 1880 to $36,000,000 in 1890. It is estimated that the amount of capital invested is now more than $160,000,000. The Abbott Iron Works have been abandoned and the sugar-refining industry has ceased to exist ; on the other hand, the steel works of the Maryland Steel Company have been established at Sparrow's . Point, representing an investment of about $8,000,000. The export trade has steadily increased. The total of exports for the fiscal year ending 30th June 1901 was $106,239,081. During the preceding year the exports of breadstuffs amounted to $37,997,080; sheep and cattle, $5,139,864; copper, $16,656,875 ; cotton and its manufactures, $8,360,193 ; provisions (meat and dairy products), $20,304,582 ; and tobacco, $6,797,534. The imports are much smaller, the~~

~~aggregate for the year ending 30th June 1901 being~~

~~$18,899,473.~~

~~The Baltimore and Ohio railway tunnel was completed in 1896. It is one mile and two-thirds in length, passes under the city from north to south, and is so equipped that trains can be run through it by electricity. Balti- more trust companies have taken a very active part in the financing of southern railway and other enterprises. It is estimated that the city has more than f 100,000,000 invested in the south. Connected with this financial business has been the growth of the bonding companies taking the place of individual bonds. Baltimore is probably the chief centre of this business for the United States. The bondiug and trust companies of the city have an aggregate capital of f 21,650,000 and a surplus of f 17,502,000, or a total of capital and surplus of over $39,000,000. The national banks of the city have an aggregate capital of $11,758,260 and a surplus of $4,479,275. Deposits in the savings banks amount to over $50,000,000.~~

~~The political history of Baltimore in recent years has been peculiarly interesting. Shortly after the Civil War the Democratic party regained control of the city and organized a, "machine" which for twenty-eight years held unshaken control of the govern- ment. The struggle to overthrow the machine began in earnest in 1875, when a coalition was made between the reform element in the Democratic party (under the able leadership of Severn Teackle~~

~~Wallis) and the Bepublican party. The attempt was renewed at frequent intervals, the chief obstacle encountered being the fraud and violence iri elections, until it culminated in the victory of 1895. A new election law of the most thoroughgoing kind was then enacted by the legislature, under which the old evils have been completely removed. The Republican mayor elected in 1895, in his desire to govern the city properly, encountered strong opposition from the city council, which passed an ordinance taking away from the mayor the power of appointment and vesting it in themselves, and carried it by a three-fourths vote over the mayor's veto. Upon a test case, the Maryland Court of Appeals decided that the council had exceeded its powers. The affair led to the passing of a new charter, some of the salient features of which are as follows : — Doubling of the terms of mayor and city councillors ; appointment by the mayor of the heads of executive departments, and of sub- ordinate officials by these heads ; mayor's appointments subject to confirmation by the second branch of the city council only ; this branch made a small body of eight men, each chosen from the whole of a section, including one-fourth of the city ; the president of the second branch elected by the city as a whole ; a board of estimates and a board of public improvements, each made up of heads of the appropriate executive departments (together with the president of the second branch), exercising supervision and control of appropriations, &c., and a school board consisting of nine persons appointed from the city at large by the mayor. The new school board replaced a board of twenty-two members, one from each ward, who were nominally elected by the first branch of the city council, but were practically chosen for political reasons, each by the coun- cillor from his ward, and were, as a rule, obviously unfit for school management. The characteristic features of the events here sketched have been the effectiveness of the reform movement and the recognition of the power of the independent element.~~

~~(f. fb.)~~

~~BALUCHISTAN.~~

~~BALUCHISTAlSr, a country which, like Afghanistan, derives its name from the dominant race of its in- habitants, extends from the Gomul (or Gumal) river to the Arabian Sea, and from the borders of Persia and Afghan- istan to those of the Punjab and Sind. Three hundred miles of its mountain walls facing the Indus are south of the railway from the Indus to Quetta, and about 250 north of it. The railway with the passes and plains about it, and the dominant hills which surround Quetta, divide Baluchistan into two distinct parts. North of the railway line, hedged in between Afghanistan and the plains of the Indus, stretch the long ridges of rough but picturesque highlands, which embrace the central ranges of the Suli- mani system (the prehistoric home of the Pathan high- lander), where vegetation is often Alpine, and the climate clear and bracing and subject to no great extremes of tem- perature. The average breadth of this northern Pathan district is 150 miles, but it narrows to less than 100 miles on the line of the (jomul, and expands to more than 200 miles on the line of the railway. Here all the main drainage runs either northwards to the Gomul, passing through the uplands that lie west of the Sulimani range ; or it gathers locally in narrow lateral valleys at the back of these mountains, and then bursts directly eastwards through the limestone axis of the hills, making for the Indus by the shortest transverse route. South of the railway lies a square block of territory, measuring roughly 300 miles by 300, primarily the home of the Brahui and the Baluch ; but within that block are included almost every conceivable phase of climate and representatives of half the great races of Asia. Here, throughout the elevated highlands of the Kalat plateau which are called Jalawan, the drainage gathers into channels which cut deep gorges in the hills, and passes eastwards into the plains of Sind. Beyond and south of the hydrographical area of the Jala- wan highlands the rivers and streams of the hills either run in long straight lines to the Arabian Sea, north of Karachi, or, curving gradually westwards, they disappear in the in- land swamps which form so prominent afeature in this part of South-West Asia. A narrow width of the coast districts collects its waters for discharge into the Arabian Sea direct.~~

~~This section includes Makr^n. Baluchistan thus becomes naturally divided into two districts, north and south, by an intervenii;ig space which contains the Sind-Pishin railway. This intervening space comprises the wedge-shaped desert of Gandava (Kach Gandava), which is thrust westwards from the Indus as a deep indentation into the mountains, and, above it, the central uplands which figure on the map as "British Baluchistan" — where lies Quetta. All Baluchistan has now been surveyed. From the great Indus series of triangles, bases have been selected at intervals which have supported minor chains of triangulation reaching into the heart of the country. These again have been connected by links of more or less regularity, so that, if the Baluchistan triangulation lacks the rigid accuracy of a " first-class " system, it at least supports good topography on geographical scales.~~

~~From Domandi, at the junction of the Gomul and Kundar rivers, the boundary between Baluchistan and Afghanistan follows the Kundar stream for about 40 miles to the south-west. It then leaves the river and diverges northwards, so as """"«""• to include a section of the plain country stretching away towards Lake Abistada, before returning to the skirts of the hills. After about 100 miles of this divergence it strikes the Kadanai river, turning the northern spurs of the Toba plateau (the base of the Kojak range), and winds through the open plains west of the Kojak. Here, however, the boundary does not follow the river. It deserts it for the western edge of the Toba plateau (8000 feet high at this point), till it nears the little railway station of New Chaman. In then descends to the plains, returns again to the hills 40 miles south of Chamau, and thenceforward is defined by hill ranges southwards to Nushki. The eastern boundary of this northern section of Baluchistan is the " red line " at the foot of the frontier hills, which defines the border of British India. This part of Baluchistan thus presents a buffer system of independent tribes between the British frontier and Afghanistan. But the indepen- dence of the Pathan people south of the Gomul is not as the indepen- dence of the Pathans (Waziris, Afridis, &c.) who live north of it. It is true that the Indian Government interferes as little with the internal jurisdiction of the tribal chiefs amongst the Pathans of the Sulimani range as it does with that of the northern chiefs ; but the occupation of a line of posts on the Zhob river, which flanks that range almost from end to end on the west, places the doors of communication with Afghanistan in British~~

~~hands, and gives command of their hills. It thus tends to the maintenance of peace~~

~~and order on the southern frontier to a degree that does not exist in the north.~~

~~The central range of the Sulimanis is the dominant feature in the geography of Northern Baluchistan. The central line or axis of the range lies a little east of the meridian of 70° E., and it is geologically composed of one or more great folds of the Cretaceous series. Towards the northern extremity of the range occur a group of peaks, which together form an oblong block or "massif" amongst the neighbouring ridges known as "Kaisargarh" amongst the Sherani clansmen who occupy it, and as the "Takht- i-Suliman " (Solomon's throne), generally, on the frontier, from the fact of a celebrated shrine of that name existing near its southern~~

~~abutment. The massif of the Takht is a high tableland (about 8000 feet above sea-level), bounded on its eastern and western edges by high, rugged, and steep parallel ridges. The western ridge culminates on the north in the peak of Kaisargarh (11,300 feet) , and the eastern in a block, or detached headland, on the south, where rests the immortal " ziarat " or shrine (11,070 feet). This tableland is formed by a huge cap of coral limestone, estimated by Griesbach at from 4000 to 5000 feet in thickness. At each end the tableland is rent by gorges which deepen, amidst stupendous precipices, to the channel of the Draband or " Gat " on the north, and of the Dhana on the south. These two channels carry the rush of mountain streams from the western slopes of the massif right~~

~~Walker Sc Cockerell se.~~

~~Map of Bahjchistan.~~

~~across the axis of the mountains and through the intervening barrier of minor ridges to the plains of the Indus. The plateau is covered with a fairly~~

~~thick growth of the chilghosa or " edible " pine, and a sprinkling of juniper, on the higher slopes. It was ascended and surveyed for the first time in 1883.~~

~~From the summit of the Kaisargarh peak a magnificent view is obtained which practically embraces the whole width of Northern Baluchistan. Westwards, looking towards Afghanistan, line upon line of broken jagged ridges and ranges, folds in the Cretaceous series overlaid by coarse sandstones and shales, follow each other in order, preserving their approximate parallelism until they touch the borders of Baluchistan. Immediately on the west of the Kaisargarh there towers the Shingarh mountain, a geological repetition of the Kaisargarh ridge, black with pines towards the summit, and crowned with crags of coral limestone. Beyond it are the gray outlines of the close-packed ridges which enclose the lower reaches of the Zhob and the Kundar. As they pass away southwards this gridiron formation strikes with a gentle curve westwards, the narrow enclosed valleys widening out towards the sources of the rivers, where ages of denudation have worn down the folds and filled up the hollows with fruitful soil, until at last they touch the central water-divide, the key of the whole system, on the Quetta plateau. Thus the upper parts of the Zhob valley are~~

~~comparatively open and fertile, with flourishing villages, and a cultivation which has been greatly developed under British rule, and are bounded by long sweeping gentle spurs clothed with wild olive woods containing trees of immense size. The lower reaches of the Zhob and Kundar are hemmed in by rugged limestone walls, serrated and banded with deep clefts and gorges, a vrilder- ness of stony desolation. Looking eastwards from the Kaisargarh, one can again count the backs of innumerable minor ridges, smaller wrinkles or folds formed during a process of upheaval of the Sulimani mountains, at the close of a great volcanic epoch which has hardly yet ceased to give evidence of its existence. On the outside edge, facing the Indus plains, is a more strictly regular, but higher and more rugged, ridge of hiUs which marks the Siwaliks. The Baluch Siwaliks afford us strange glimpses into a recent geological past, when the same gigantic mammals roamed along the foot of these wild hills as once inhabited the tangled forests below the Himalaya. Between the Takht mountain and the Siwaliks,~~

the intervening belt of ridge and furrow has been greatly denuded by transverse drainage^a system of drainage which we now know to have existed before the formation of the hills, and to have continued to cut through them as they gradually rose above the plain level. Where this intervening band is not covered by recent gravel deposits, it exhibits beds of limestone,.

clays, and sandstone with fossils, ■which, in age, range from the Lower Eocene to the Miocene. Beyond the Siwaliks, still looking eastwards, are the sand waves of the Indus plain ; a yellow sea broken here and there with the shadow of village orchards and the sheen of cultivation, till it rests against the long black sinuous line which denotes the fringe of trees bordering the Indus. Such is the scene which Solomon is said to have invited his Indian bride to gaze upon for the last time, as they rested on the crags of the southern buttress of the Takht — where his shrine exists to this day. To that shrine thousands of pilgrims, Mahommedans and Hindus alike, re- sort on their yearly pilgrimages, in spite of its dangerous approach. All this country, so far, is independent Baluchistan within the jurisdiction of the Baluchistan Agency, with the exception of certain clans of the Sheranis on the eastern slopes of the Takht^i-Suliman, north of the Vihowa, who are under Punjab administration. ^ Wedged in between the railway and the Indus, but still north of the railway, is a curious mass of rough mountain country, which forms the southern abutment of the Sulimani system. The strike of the main ridges forming that system is almost due north and south till it touches 30° N. lat. Here it assumes a westerly curve, till it points north-west, and finally merges into the broad band of mountains which hedge in the Quetta and Pishin uplands on the north and east.

At this point, as might be expected, are some of the grandest peaks and precipices in Baluchistan. Khalifat on the east of Quetta, flanking the Harnai loop of the Sind-Pishin railway ; Takatu to the north ; Chahiltan on the south-west ; and the great square-headed Murdar to the south — all overlook the pretty canton- ment from heights which range from 10,500 to 11,500 feet. Lying in the midst of them, on an open plain formed by the

~~high-level tributaries of the Lora (which have also raised the Pishin valley to the north), 6500 feet above the sea, is Quetta. Quetta was founded in 1873, and has now grown into one of the most popular, as it is one of the most picturesque, of Indian military stations. The mass of twisted flexures, the curved wrinkles that end the Sulimani system, is occupied by true Baluchis, the Mari and Bugti sections of the great Rind confederation of tribes owning an Arabic origin. There are no Pathans here. To the north of them are the Bozdars, another Kind clan ; and these Rind tribes form the exception to the general rule of Pathan occupation of Northern Baluchistan. Amongst the Pathans, the Kakurs and Dumurs of Pishin, with the Mando Khel of Zhob, are the most prominent tribal divisions.~~

~~The curved recession of the Sulimani ranges to the north-west leaves a space of flat alluvial desert to the south, which forms a sort ^, . of inlet or bay striking into the Baluchistan mountain~~

~~" system. The point of this desert inlet receives the~~

~~drainage of two local basins, the Bolan and the Nari. Both drain south-eastwards from the central Quetta-Pishin plateau, and both have served for railway alignment. Being fed by tributaries which for the most part drain narrow valleys where gradual denudation has washed bare the flat-backed slopes of limestone ridges, and which consequently send down torrents of rapidly accumulating rainfall, both these central lines of water-course are liable to terrific fioods. The drainage of the Bolan and Nari finally disappears in the irrigated flats of the alluvial bay (Kach Gandava), which extends 130 miles from the Indus to Sibi at the foot of the hills, and which offers (in spite of periodic Indus floods) an opportunity for railway approach to Baluchistan such as occurs nowhere else on the frontier. Kach Gandava, whilst its agricultural development has in no way receded, is now rivalled by many of the valleys of the highlands. Its climate debars it from European occupation. It is a land of dust-storms and poisonous winds ; a land where the thermometer never sinks below 100° P. in summer, and drops below freezing-point in winter ; where there is a deadly monotony of dust-coloured scenery for the greasier part of the year, with the minimum of rain and the maximum of heat. The Quetta and Pishin plateau to which it~~

leads is the central dominant water- divide of Baluchistan and the base of the Kandahar highway.

An irregularly-shaped block of upland territory, which includes all the upper Lora tributaries, and the Toba plateau beyond them ; . resting on the Kojak range (with an advanced loop to in-

elude the Chaman railway terminus) on the west ; reach- ing south through Shorarud to Nushki ; including the basins of the Bolan and Nari as far as Sibi to the south-east ; stretching out an arm to embrace the Tal Chotiali valley on the east, and following the main water-divide between the Zhob and Lora on the north, is called British Baluchistan. It is leased from Kalat, and forms a distinctive province, being brought under the ordinary forms of civil administration in British India. Beyond it, north and south, lies independent Baluchistan, but this independence is not that of Afghanistan — hardly that of the native states of the Indian penin- sula. Instead of being subject to civil administration, independent Baluchistan is under political control ; and its administrative staff is more distinctly military than that of the assigned districts of

1 Now included within the limits of the lately formed frontier province.

British Baluchistan. The degree of independence enjoyed by the various districts of Baluchistan may be said to vary in direct pro- portion to their distance from Quetta. No part of Baluchistan is beyond the reach of the political officer, but there are many parts where he is not often seen. The governor-general's agent at Quetta is invested with supreme authority. The climate of British Baluchistan is dry and bracing — even exhilarating — but the ex- tremes of temperature lead to the development of fever in very severe forms. On the whole it is favourable to European existence.

South-west of the dividing railway lies the great block of Southern Baluchistan. Within this area the drainage generally trends south and west, either to the Arabian Sea, or to the central swamps of Lora and Mashkel. The Hab river, which ^o"™*™- forms the boundary west of Karachi ; the Purdli (the ancient Arabis), which drains the low-lying flats of Las Bela ; the Hingol (the ancient Tomeros) and the Dasht, which drain Makr^n, are all considerable streams, draining into the Arabian Sea, and forming

~~important arteries in the network of internal communication. An exception to the general rule is found in the MuUa, which carries the floods of the Kalat highlands into the Gandava basin, and which forms one of the most important of the ancient highways from the Indus plains to Kandahar. The fortress of Kalat is situated about midway between the sources of the Bolan and the Mulla, near a small tributary of the Lora (the river of Pishin and Quetta), about 6800 feet above sea^level, on the western edge of a cultivated plain in the very midst of hills. (See Kalat.) To the north are the long sweeping lines of the Sarawd,n ridges, enclosing narrow fertile valleys, and passing away to the south-west to the edge of the Khar^in desert. East and south are the rugged bands of Jalawin, amongst which the Mulla rises, and through which it breaks in a series of magnificent defiles in order to reach the Gandava plain. Routes which converge on Kalat from the south pass for the most part through narrow wooded valleys, enclosed between steep ridges of denuded hills, and, following the general strike of these ridges, they run from valley to valley with easy grades. Kalat is the ‘ ‘ hub ” or centre, from which radiate the Bolan, the Mulla, and the southern Lora affiuents ; but the Lora drains also the Pishin valley on the north ; the two systems uniting in Shorawak, to lose themselves in the desert and swamps to the west of Nushki, on the road to Sist^n. Sixty miles south of Kalat, and beyond the Mulla sources, com- mences another remarkable hydrographic System which includes all Southern and South- Western Baluchistan. To the west lies the Khariin desert, with intermittent river channels enclosed and often lost in sand-waves ere they reach the Mashkel swamps on the far borders of Persia. To the south-west are the long sweeping valleys of Rakshin and Panjgur, which, curving northwards, likewise dis- charge their drainage into the Mashkel. Directly south are the beginnings of the meridional arteries, the Hab, the Purd,li, and the Hingol, which end in the Arabian Sea, leaving a space of moun- tainous seaboard (Makrdn) south of the Panjgur and west of the Hingol, which is watered (so far as it is watered at all) by the long lateral Kej stream and several smaller mountain nullahs. Thus Southern Baluchistan comprises four hydrographical sections. First is the long extension from Kalat, southwards, of that inconceivably wild highland country which faces the desert of Sind, the foot of which forms the Indian frontier. This is the land of the Brahui, and the flat wall of its frontier limestone barrier is one of the most remarkable features in the configuration of the whole line of Indian~~

borderland. For the first 60 miles from the sea near Karachi the Hab river is the boundary of Sind, and here, across the enclosing desolation of outcropping ridges and intervening sand, a road may be found into Makrdn. But from the point where the boundary leaves the Hab to follow the Kirthar range not a break occurs (save one) in 150 miles of solid rock wall, rising many thousands of feet straight from the sandy plain. The one break, or gorge, which allows the Kej waters to pass only forms a local gateway into a mass of impracticable hills. Secondly, to the west of this moun- tain wilderness, stretching upwards from the sea in a wedge form between the Brahui highlands and the group of towering peaks which enclose the Hingol river and abut on the sea at Malan, are the alluvial flats and delta of the Pur^li, forming the little province of Las Bela, the home of the Las Rajput. In this hot and thirsty corner of Baluchistan, ruled by the Jam or Cham, there is a fairly wide stretch of cultivation, nourished, by the alluvial detritus of the Pur^li, and well irrigated. In a little garden to the south of the modern town of Las Bela (the ancient Armahel) is the tomb of Sir Robert Sandeman, who spent the best part of an energetic and active life in the making of Baluchistan.

Westward of the Hingol, and fringing the Arabian Sea, stretch- ing to the Persian frontier (here defined by the Dasht river), is the maritime province of Makrdn, the home of many mixed ,

races, amongst which the Arab Rind predominates. ”’^kr^o. The long lateral valley of Kej is usually associated with Makra,n in early geographical records. The Kej-Maoord,n of Marco Polo is the Makrin of to-day. Behind a stretch of sandy foreshore, which is broken on the coast-line by the magnificent cliffs of Maldn, the

hammer-shaped headlands of Urmara and Gwadur, and the precipitous cliffs of Jebel Zarain, near Pasni, lies the usual frontier band of parallel ridges, alternating with narrow furrows or valleys. Amongst them the ranges called Talina andTalur are conspicuous by their height and regular configuration. The normal conformation of the frontier is somewhat emphasized in

~~Makrdn. Here the volcanic action which preceded the general upheaval of recent strata and the folding of the edges of the interior highlands, is still in evidence in occasional boiling-mud volcanoes on the coast-line. It is repeated in the blazing summit of the Koh-i-taft&n (the burning mountain of the Persian frontier), which is the highest active vol- cano in Asia (13,000 feet), and probably the farthest inland. Evidence of extinct mud volcanoes exists through a very wide area in Baluchistan and Sistan. Probably the Miri, or fort, at Quetta represents one of them. The coast is indented by several consider- able harbours. Urmara, Khor Khalmat, Pasni, and Gwadur are all somewhat difBoult of approach by reason of a sand-bar which seems to extend along the whole coast-line, and which is very possibly the last evidence of a submerged ridge ; and they are all subject to a very lively surf under certain conditions of wind. Of these the port of Gwadar (which belongs to Muscat and is therefore foreign territory) is the most important. They all are (or were) stations of the Indo-Persian telegraph system which unites Karachi with Bushire. With the exception of the Kej valley, and that of the Bolida, which is an affluent of the Kej, there are no considerable spaces of ovHtivation in Makrdn. These two valleys seem to con- centrate the whole agricultural wealth of the country. They are picturesque, with thick groves of date palms at intervals, and are filled with crops and orchards. They are indeed exceedingly beautiful ; and yet the surrounding waste of hills is chiefly a barren repetition of sun-cracked crags and ridges with parched and withered valleys intersecting them, where a trickle of salt water leaves a white and leprous streak amongst the faded tamarisk or the yellow stalks of last season's grass. Makr^n is the home of remnants of an innumerable company of mixed people gathered from the four corners of Asia and Eastern Africa. The ancient Dravidians, of whom the Brahui is typical, still exist in many of the districts which are assigned to them in the works of Herodotus. Amongst them there is always a prominent Arab element, for the Arabs held Makrdn even before they conquered Sind and made the Kej valley their trade highway to India. There are negroes on the coast, bred from imported slaves. The Meds of the Indus valley still form the greater part of the fishing population, representing the Ichthyophagi of Arrian's history. The old Tajak element of Persia Is not so evident in Makrdn as it is farther north ; and the Karak pirates, who gave their name to Karachi, and whose de- predations led to the invasion of India and the conquest of Sind, seem to have disappeared altogether. The fourth~~

~~section includes the valleys formed by the Eakshin and Mashkel, which, sweeping downwards from the Kalat highlands and the Persian border east and west, unite to break through the intervening chain of hills northward to form the Mashkel swamps, and define the northern limits of Makrto. In these valleys are narrow strips of very ad- vanced cultivation, the dates of Panjgur being famous and generally reckoned superior even to those of the Euphrates. The great Mashkel swamp, and the Khardn desert to the east of it, mark the flat phase of Southern Baluchistan topography. It is geologically part of an ancient inland lake or sea which included the present swamp regions of the Helmund, but not the central depression of the Lora. The latter is buttressed against hills at a much higher elevation than the Kharto desert, which is separated from the great expanse of the Helmund desert within the borders of Afghanistan by a transverse band of serrated hills forming a dis- tinct watershed from Nushki to Sistdn. Here and there these jagged peaks appear as if half overwhelmed by an advancing sea of sand. They are treeless and barren, and water is but rarely found under the edges of their foot-hills. The Koh-i-Sultan, at the western extremity of the northern group of these irregular hills, is over 6000 feet above sea-level, but the general level of the surrounding deserts is only about 2000 feet, sinking to 1500 feet in the Mashkel Hamun and the Gaod-i-^irreh.~~

~~The boundary between Baluchistan and Afghanistan, starting from Nushki, cuts across the Lora Hamiin, leaving the frontier _ post of Chagai to Baluchistan, and from this point to~~

~~Races. ^^^ Malik Siah Koh it is based partly on the central mountainous water-divide already referred to, and partly runs in straight lines through the desert south of the salt swamps of the Gaod-i-Zirreh. It thus passc-s oo miles to the south of the Helmund, entirely shutting oft that valley, and the approach to Sistdn between the Helmund and the Gaod-i-Zirreh (the only approach from the east in seasons of flood) from Baluchistan. But it leaves a connected line of desert route between Nushki and Sistan, which is open in all ordinary seasons, to the south, and this route has been largely developed, posts or serais having been established at intervals, and wells having been dug. There is already a promising Khafila traflSc along it. Within the Baluchistan half of the desert are to be found scattered tribes of nomads, called~~

~~Rekis (or desert people), of which the Mohamadani are the most numerous. They are probably of Arab origin. This central desert is the Kir, Kej, Katz, or Kash Kaiin of Arabic mediaeval geography and a part of the ancient Kaiini kingdom ; the prefix Kej or Kach always denoting low-level flats or valleys, in contradistinction to mountains or hills. The Mohamadani nomads occupy the central mountain region, to the south of which lie the Mashkel and Khar^n deserts, inhabited by a people of quite different origin, who possess something approaching to historical records. These are the Naoshirwanis, a purely Persian race, who passed into Baluchistan within historic times, although the exact date is uncertain. The Naoshirwanis appear to be identical with the Tahuki or Tahukini, who are to be found in Perso-Baluchistan. Tahuki is mentioned by Nearkos, by Strabo, and by Ptolemy. They are a fine manly race of people, in many respects superior to their modern compatriots of Iran. If left to themselves it is probable that the Naoshirwanis would displace the Brahuis as the dominant race in Baluchistan. Between the Naoshirwanis of the Khar^n desert and Mashkel, and the fish-eating population of the coast, enclosed in the narrow valleys of the Rakshin and Kej tributaries, or about the sources of the Hingol, are tribes innumerable, rem- nants of races which may be recognized in the works of Herodotus, or may be traced in the records of recent immigration. Equally scattered through the whole country, and almost everywhere recognizable, is the underlying Persian population (Tajak) , which is sometimes represented by a locally dominant tribe, but more frequently by the agricultural slave and bondsman of the general community. Such are the Dehwars or Dehkans, and the Durzadas (Derusix of Herodotus), who extend all through Makrin, and, as slaves, are called Nakibs. The Arabs have naturally left their mark most strongly impressed on the ethnography of Baluchistan. All Rind tribes claim to be of Arab origin and of Khoreish extraction. As the Arabs occupied all Southern Baluchistan and Sistdn from a very early date, and finally spread through the Sind valley, where they remained till the 12th century, their genealogical records have become much obscured, and it is probable that there is not now a pure Arab in the country. It is as builders or engfneers that they have established their most permanent records, Makrto being full of the relics of their irrigation works constructed in times when the climatic conditions of Baluchistan must have been very different from what they are now. Lower Sind also contains a great wealth of architectural remains, which may be found to the west of the~~

~~Indus as well as in the delta. One particular tribe (the Kalmats), who left their name on the Makrin coast and subse- quently dominated Bela and Sind, west of the Indus, for a considerable period, exhibit great power of artistic design in their sepulchral monuments. The Dravidian races (Brahuis) , who are chiefly represented by the Kambaranis and Mingals, or Mongals (the latter are doubtless of Tartar origin), spread through Southern Baluchistan as well as the eastern hills, and are scattered irregularly through the mountain tracts south of KharS,n. The ancient Orietse mentioned by Arrian are probably represented by the tribe of Hot, who, as original masters of the soil, are exempt from taxation. The name Brahui is (according to Bellew) but a corruption of Ba-rohi, (or " hillmen") in a language derived from Sanskrit which would represent the same term by Parva-ka. So that the " Parkanai " of Arrian may be recognized as surviving in the Brahui, and in the name (Parkdn) of a mountain-bred stream which is a tributary of the Hingol. Amongst other aboriginal tribes to whom reference is made by very early writers are the Bolfidi, who give their name to the Bolida valley, a tributary of the Kej. The Boledi were once the ruling race of Southern Baluchistan, which was originally called Boledistan, and it seems possible that this may be the real origin of the much-disputed name of the country generally. Bola was an Assyrian term for Bael or Bel, the god of the Phoenicians and Druids. The Bol6di ruling family are at present represented by but one living member, a lady, who Is a Government pensioner. The fast-diminishing Sajidis (Sajittse) and Saka (Sacse) are others of the more ancient races of Baluchistan easily recognizable in classical geography. Most recent of all are the Gichkis. TheGichkis derive from a Rajput adventurer who flourished in the early part of the 17th century. They are now the dominant race in Panjgur and Kej, from whence they ousted the Boledis. For three genera- tions they remained Hindus ; since then there has arisen amongst them a strange new sect called Zikari, with exceedingly loose notions of morality. The sect, however, appears to be fast merging into orthodox Mahommedanism. A Baluch (or rather Makran) race which deserves attention is that of the Gadaras, who once gave the name Gadrosia to Southern Baluchistan. According to Tate, the Gadaras are now represented by Sidi half-castes — those MakrAni "boys" who are so well known in the mercantile marine as stokers and flremen. It seems unlikely that this modern admixture of Asiatic and African blood represents the " Asiatic Ethiopian " of Herodotus, which was more probably~~

a direct connexion of the Himyaritic Arab builders of " bunds," and revetments who spread eastwards from Arabia (see Arabia). Bellew finds in the Gadara the Garuda (eagles) of Sanskrit, who were ever in opposition to the

Naga (snakes) of Scythic origin. Southern Baluchistan affords a most interesting field for the ethnographer. It has never yet been thoroughly explored in the interests of ethnographical science.

The Baluoh character is influenced by its environment as much as by its origin, so that it is impossible to select any one section of the general community as affording a satisfactory sample of popular Baluch idiosyncrasies. The Rind, or Baluch Arab, is perhaps the dominant type, and as he is least affected by foreign influence he is usually selected as the representative Baluch. The Baluchis of Arab extraction exhibit their Semitic origin strongly in their features, and possess much of the courage and chivalry of the original stock. They are a manly, hardy, and physically well-developed race, following no priestly leading, and not given to fanaticism, but banded together in a sort of feudal confederation under their tribal chiefs, who are their leaders in council as they are in war. Their courage and their loyalty to their chiefs are noble characteristics ; and they are characteristics which render them far more amenable to British control than is the republican Path^n. In war it leads them to attack in the open, and in council it places the conduct of negotiations in the hands of but a recognized few.

The strategical position of Great Britain in Baluchistan is a very important factor in the problem of maintaining order and good administration in the country. The ever-rest- Strategic jggg pathan tribes of the Sulimanis are held in check a eresu ^y ^^^ occupation of the Zhob valley ; whilst the central dominant position at Quetta safeguards the peace and security of Kalat, and of the wildest of the Baluch hills occupied by the Maris and Bugtis, no less than it bars the way to an advance upon India by way of Kandahar. Nominally all the provinces and districts of Baluchistan, with the

~~exception of the cteded territory which we call British Baluchistan, are under the Khan of Kalat, and all chiefs acknowledge him as their suzerain. But it may be doubted if this suzerainty was ever complete, or could be maintained at all but for the assistance of- the British Government. The Baluch is still essentially a robber and a raider (a trait which is common to all tribes), and the history of Baluchistan is nothing but a story of suc- cessful robberies, of lawless rapine and bloodshed for which plunder and devastation were accounted a worthy and honourable return.~~

~~Extensive changes have taken place in the climatic condition of the country — changes which are some of them so recent as to be „., noted by surveyors who have found the remains of~~

~~Climate. forests in districts now entirely desiccated. Possibly the ordinary processes of denudation and erosion, acting on those recent deposits which overlie the harder beds of the older series, may have much to say to these climatic changes, and the wanton destruction of forests may have assisted the efforts of nature ; but it is difficult to understand the widespread desiccation of large areas of the Baluch highlands, where evidences of Arab irrigation works and of cultivation still attest to a once flourishing agricultural condition, without appealing to more rapidly destructive principles for the change. There is ample proof throughout the country of altera- tions of level within recent geologic periods ; and there have even been compressions, resulting in a relative rise of the ground, over the crests of anticlinal folds, within historic record. "Proof that this compression is still going on was given on 20th December 1892, when a severe earthquake resulted from the sudden yielding of the earth's crust along what appears to be an old line of fault, west of the Khojak range, whereby an adjustment took place indicated by a shortening of some 2J feet on the railway line which crossed the fault." ^ Nor should the evidences of active volcanic agency afforded by the mud volcanoes of the coast be overlooked. It is probably to climatic changes (whatever their origin may have been), rather than to the effects of tribal disturbances, that the Arab's dis- appearance from the field of trade and agriculture must be attributed.~~

~~Law and order, and with them prosperity, were revived for a short space by the treaty of 1854 between the Khan of Kalat and the M dera British~~

Government, but with the breaking of that history. treaty came a renewal of the old state of confusion to which it was intended to put an end. The chiefs of Las and Wad, the Maris and Bugtis, Kej and Makrd,n, all threw off their allegiance, and anarchy became so widespread that the British Government again interfered. The treaty of 1854 was renewed in 1876 by Lord Lytton (under Sandeman's advice), and the Khan received substantial aid from the Government in the form of an annual subsidy of a lakh of rupees, instead of the 50,000 previously assigned to him. The treaty of 1854 was a treaty of alliance offensive and defensive. The treaty of 1876 renewed these terms, but utterly changed the policy of non-intervention which was maintained by the former, by the recognition of the sirdars as well as the Khan, and by the appointment of the British Government as referee in cases of dispute between them. British troops were to be located in the Khan's country ; Quetta was founded ; telegraphs and railways were projected ; roads were made ; and the reign of

1 Oldham, Journal S. G. S. vol. iii. p. 184.

law and order established. The nebulous claims of Afghanistan to Sibi and Pishin were disposed of by the treaty of Gandamak in the spring of 1879, and the final consolidation of the existing form of Kalat administration was effected by Sapdeman's expedition to Khard,n in 1883, and the reconciliation of Azad Khan, the great Naoshirwani chief, with the Khan of Kalat. British Baluchistan was incorporated with British India by the resolution of 1st November 1887, and divided into two districts — Quetta-Pishin and Tal Chotiali — to be administered by a deputy-commissioner and a regular staff.

In 1890 and 1891 were carried out that series of politico-military expeditions which resulted in the occupation of the Zhob valley, the foundation of the central cantonment of Fort Sandeman, and the extension of a line of outposts which, commencing at Quetta, may be said to rest on Wana north of the Gomul. The effect of these expeditions, and of this extension of military occupation, has been to reduce the independent Pathan tribes of the Sulimani mountains to effective order, and to put a stop £o border raiding on the Indus plains south of the Gomul. In 1893 serious differences ?,rose between the Khan of Kalat and Sir James Browne, who

~~succeeded Sir Robert Sandeman as agent to the governor-general in Baluchistan, arising out of Mir Khuidad Khan's outrageous conduct in the management of his own court, and the treatment of his officials. Finally, the Khan was deposed, and his son Mir Mahommed Khan succeeded in November 1893. Since then the most important change in Baluch administration has been the perpetual lease and transfer of management to British agency of the Nushki district and Nidbat, with all rights, jurisdiction, and administrative power, in lieu of a perpetual rent of 9000 rupees per annum. This was effected in July 1899. This secures the direct control of the great highway to Sist^n which has been opened to Khafila traffic.~~

~~The revenues of the Khan of Kalat consist partly of subsidies and partly of agricultural revenue, the total value being about 500,000 rupees per annum. Since 1882 he has received 25,000 rupees as government rent for the Quetta district, besides 30,000 in lieu of transit duties in the Bolan ; this has been increased lately by 9000, \ as already stated. In 1899 the total imports of Kalat were valued at 700,000 rupees, and the exports at 605,000.~~

~~Authorities. — Very little has been published of late years about Baluchistan, in spite of the comparative wealth of new information. This is due to the fact that the records of the surveys of India, both topographical and geological, together with the Gazettfeers (all of which are confidential), absorb most of the information collected by Indian Government officials. This article has been compiled chiefly from the unpublished notes of the author.~~

~~The following are amongst the most accessible of recent works on Baluchistan which have been published since the Sist^n Boundary Report of 1873 by Sir F. Goldsmid: — ^Floter. Unexplored Baluchistan, London, 1882. — Thornton, T. Life of Sandeman, London, 1896. — Tate, G. P. Kalat (a memoir), Calcutta, 1896. — HoLDicH, Sir T. " Ethnographic and Historical Notes on MakrAn," Calcutta, 1892 (^Survey Report) ; " Antiquities, Ethnography, &c., of Las Bela and Makrin," Calcutta, 1894 (Survey Beport) ; " Ancient and Mediaeval Makrto," vol. vii. B.G.S. Journal, 1896 ; " Perso- Baluch Boundary," vol. ix. B.G.S. Journal, 1897. — M'Mahon. " The Southern Borderland of Afghanistan," vol. x. Journal~~

~~B. G.S. 1897. Notes on Sir R. Sandeman's tours in Baluchistan will be found in vols, v., xii., xiii., and xix. of the B.G.S. Proceedings.~~

~~(t. h. h.*)~~

~~Bambaraland. See Sei^egal.~~

~~Bamberg, a town and archiepiscopal see of Bavaria, Germany, district of Upper Franconia, on the Eegnitz, 2 miles above its confluence with the Main, and 39 miles by rail N. from Nuremberg. The church of Our Lady, a Gothic structure of 1320-87, but rebuilt in the Rococo style in the 18th century, contains wood carvings by Veit Stoss. The Altenburg (1266 ft.) has been the fortalice of the prince bishops of Bamberg since 1251, but is of older origin. The former Benedictine monastery of St Michael contains the municipal picture gallery. The royal library has 300,000 vols, and more than 3000 MSS. There is a new astronomical observatory. Of the numerous bridges which span the arms of the Eegnitz the principal is the Ludwig bridge, built in 1892. In 1880 the handsome Maximilian fountain, with bronze statues of kings, bishops, and the Emperor Henry II., was set up. Bamberg has developed into an important manufacturing centre, chiefly for cotton spinning and weaving, ropes, and brewing. There is a famous porcelain painting institute. Popular- tion (1885), 31,521 ; (1895), 38,940 ; (1900), 41,626.~~

~~Bamberger, Ludwig (1823-1899), German economist and politician, was born on the 22nd of July 1823 at Mainz of Jewish parents. After studying at Giessen, Heidelberg, and Gottingen, he entered on the practice of the law. When the Revolution of 1848 broke out he took an active part as one of the leaders of the Republican party in his native city, both as popular orator and as editor of one of the local papers. In 1849 he joined the Free Corps, who attempted a Republican rising in the Palatinate and Baden ; on the restoration of order he was condemned to death, but he had escaped to Switzerland. The next years he spent in exile, at first in London, then in Holland ; in 1852 he went to Paris, where, by means of private connexions,~~

~~he received an appointment in the bank of Bischoffheim and Goldschmidt, of which he became managing director, a post which he held till 1866. During these years he saved a competence, and gained a thorough acquaintance with the theory and practice of finance. This he put to account when the amnesty of 1866 enabled him to return to Germany. He was elected a member of the Reichstag, where he joined the National Liberal party, for like many other exiles he was willing to accept the results of Bismarck's work. In 1868 he published a short life of Bismarck in French, with the object of producing a better understanding of German affairs, and in 1870, owing to his intimate ac- quaintance with France and with finance, he was sum- moned by Bismarck to Versailles to help in the discussion of terms of peace. In the German Reichstag he was the leading authority on matters of finance and economics, as well as a clear and persuasive speaker, and it was chiefly owing to him that a gold currency was adopted and that the German Imperial Bank took its present form ; in his later years he wrote and spoke strongly against bi- metallism. He was the leader of the Free Traders, and after 1878 refused to follow Bismarck in his new policy of Protection, State Socialism, and colonial development ; in a celebrated speech he declared that the day on which it was introduced was a dies nefastus for Germany. True to his Free Trade principles he and a number of followers left the National Liberal party and formed the so-called " Secession " in 1880. He was one of the few prominent politicians who consistently maintained the struggle against State Socialism on the one hand and Democratic Socialism on the other. In 1892 he retired from political life, and died in 1899. Bamberger was a clear and at- tractive writer, and was a frequent contributor on politi- cal and economic questions to the Nation and other peri- odicals. His most important works are those on the currency, on the French war indemnity, his criticism of socialism, and his apology for the Secession., An edition of his collected works (including the French life of Bis- marck) was published in 1894 in five volumes. After his death in 1899 appeared a volume of reminiscences, which, though it does not extend beyond 1866, gives an interest- ing picture of his share in the Revolution, and of his life in Paris. (j- ^- h=-)~~

~~Bamian, atownin Afghanistan, some 80 miles north- west of Kabul. It was visited by Major Maitland and Capt. the Hon. M. G. Talbot during the progress of the Russo- Afghan boundary commission in November 1885.~~

~~The height of the valley was fixed at about 8500 feet, and the country around it carefully surveyed. The two colossal standing figures carved from the face of the cliff (see ninth ed. ii. p. 307) were measured, and drawings made by a native artist. They proved to be 173 feet and 120 feet ‘ ‘ high respectively. The Buddhist nature of the figures, and of the caves with which they are surrounded, was veri- fied by the observations of these officers, who discovered other Buddhist caves and excavations in the valleys of the~~

~~Balkhab and Sarikol. Chahilburj, 28 miles from Zari, on the road to Balkh by the Balkhab, at the east end of the Sokhtagi valley ; Shahr-i-Babar, about 45 miles above Chahilburj ; and Gawargin, 6 miles above Shahr-i-babar, are all fortified sites of about the same age as the relics at Bamian. At Haibak there is a very perfect excavation called the Takht-i-Rustam (a general name for all incom- prehensible constructions amongst the modern inhabitants of Afghan Turkestan), which consists of an annular ditch enclosing a platform, with a small house about 21 feet square above it, all cut out of the solid rock. There are hundreds of caves in this neighbourhood, all pointing to a line of Buddhist occupation connecting Balkh with Kabul.~~

~~Talbot, Hon. M. G. “The Rock-cut Caves and Statues of Bami&n,” Journal B. Austral. Soc. vol. xviii. Part 3.~~

~~(t. h. h.*)~~

~~Bamra, a feudatory state of India, in the Chattis- garh division of the Central Provinces. Its area covers 1988 square miles. The population in 1881 was 81,286 ; in 1891, 104,367; and in 1901, 123,289, showing a contin- uous increase. The estimated revenue is Rs.76,000; tribute, Rs.1500. Most of the country is forest, producing only timber and lac, but said to be rich in iron ore. The northern border is touched by the Bengal-Nagpur railway, with a station at Bamra town.~~

~~Banbury, a municipal borough (extended 1889) and market-town in the Banbury parliamentary division (since 1885) of Oxfordshire, England, on the river Cherwell, 77 miles N.W. of London by rail. Recent erections include a temperance hall, an institute, and a municipal secondary and~~

~~technical school; the infirmary has also been enlarged. Population (1881), 12,072 ; (1891), 12,768 ; (1901), 12,967.~~

~~Banca (Dutch Sanka), an island off the east coast of Sumatra, from which it is separated by Banca Strait, and from Billiton (on its east) by Gaspar Strait. Area, 4458 square miles. Geologically it resembles the Malay Pe- ninsula, its formations being mainly granite, Silurian and Devonian slate, frequently covered with sandstone, laterite (red ironstone clay) of small fertility, and alluvium. The granite extends from W.N.W. to S.S.E., forming the mountain chains (chief range the Maras). As these lie near the east coast, it follows that the rivers of the west coast are the longer. Another chain runs from west to east near Muntok, the chief town. There are no volcanoes on the island. The chief rivers (Jering, Kotta, and War ringin) are navigable nineteen miles from their mouths, and are used for the transport of tin. The rainfall, of great importance for the tin exploitation, is 120 inches yearly. It rains, on an average, 168 days. Politically the island is divided into nine mining districts, including 120 mines, under government control, with, in 1898-99, 12,000 workmen, producing 167,369 piculs of tin. The population in 1898 was 93,600, of whom 260 were Europeans, 32,187 Chinese, 209 Arabs, and about 60,937 natives. The natives cultivate rice, pepper, gambler, Liberia coffee, and palms, but they are chiefly occupied in fishing and in gathering in the produce of the forests. Industry (mining excepted) is as unimportant as trade. Muntok, the only town of any size, on Banca Strait, has 4000 inhabitants.~~

~~ZoNDERVAN. Banka en Zijne bewoners. Amsterdam, 1895 (with bibliography). — Posewitz. Die Zinn-inseln im Indischen Ocean. For geology and the tin mines, Jaarboek vor het Mijnwezen in Ned. Ind. Amsterdam, 1877-84.~~

~~Bancroft, George (1800-1891), American historian and statesman, was born in Worcester, Mass., 3rd October 1800, and died in Washington, D.C., 17th January 1891. His family had been in America since~~

~~BANCEOFT, GEORGE~~

~~1632, and his father, Aaron BancToft, was distinguished as a revolutionary soldier, clergyman, and author. The son was educated at Phillips Academy, Exeter, at Harvard University, at Heidelberg, Gottingen, and Berlin. At Gottingen he studied Plato with Heeren, New Testament Greek with Eichhorn, and natural science with Blumen- bach. His heart was in the work of Heeren, easily the greatest of historical critics then living, and the fore-runner of the modern school; it was from this master that Bancroft caught his enthusiasm for minute pains- taking erudition. He concluded his years of preparation by a European tour, in the course of which he received kind attention from almost every distinguished man in the world of letters, science, and art ; among others, from Goethe, Humboldt, Schleier- macher, Hegel, Byron, Nie- buhr, Bunsen, Savigny, Cousin, Constant, and Man-zoni. Bancroft's father was a Unitarian, and he had devoted his son to the work of the ministry; but the young man's first experi- ments at preaching, shortly after his return from Europe in 1822, were unsatisfactory, the theological teaching of the time having substituted criticism and literature for faith. His first position was that of tutor in Harvard. Instinctively a humanist, he had little patience with the narrow curriculum of Harvard in his day and the rather pedantic spirit with which classical studies were there pursued. More- over, he had brought from Europe a new manner, full of the affectations of ardent youth, and this he wore without ease in a society highly satisfied with itself; the young knight-errant was therefore subjected to con- siderable ridicule. A little volume of poetry, trans- lations, and original pieces published in 1823 gave its author no fame. As time passed, and custom created familiarity, his style, personal and literary, was seen to be the outward symbol of a firm resolve to preserve a philosophic calm, and of an enormous underlying energy which spent itself in labour, "ohne Hast, aber auch ohne East." He found the conventional atmosphere of Cambridge uncongenial, and with a friend he established the Eound Hill School at Northampton, Mass. This was the first serious effort made in the United States to elevate secondary education to the plane on which it belonged.~~

~~Although born into a Whig family, yet Bancroft's studies carried him irresistibly into the Democratic party. While a teacher in his own school he was elected to the State legislature as a Democrat, but under pressure from~~

~~the family of his first wife, who were ardent Whigs, he refused to serve. In 1831 he likewise declined the nomination of the Massachusetts Democrats for secretary of state. By this time he was influential in the councils of his party, and President Van Buren appointed him collector of the port of Boston, a position which he filled with success. Two of his appointees were Orestes~~

~~GrEOBQE BANCROFT.~~

~~Photo.by C. M. Bell, Washington, D.O.~~

~~Brownson and Nathaniel Hawthorne, In 1844 he was the Democratic candidate for the governorship, but he was defeated. In 1845 he entered Polk's Cabinet as secretary of the navy, serving until 1846, when for a month he was acting secretary of war. During this short period in the Cabinet he established the naval academy at Annapolis, gave the orders which led to the occupation of California, and sent Zachary Taylor into the debatable land between Texas and Mexico. He also continued his pleadings for the annexation of Texas, as extending " the area of free- dom," and though a Democrat, took high moral ground as to slavery ; he likewise made himself the authority on the North-Western Boundary question. In 1846 he was sent as minister to London, where he lived in constant~~

~~companionship with Macau- lay and Hallam. On his return in 1849 he with- drew from public life, re- siding in New York. In 1866 he was chosen by Congress to deliver the special eulogy on Lincoln ; and in 1867 he was ap- pointed minister to Berlin, where he remained until his. resignation in 1874. Thence- forward he lived in Wash- ington and Newport. His latest official achievements were the greatest. In the San Juan arbitration he displayed great versatility and skill, winning his case before the emperor with brilliant ease. The naturali- zation treaties which he negotiated successively with Prussia and the other North German States were the first international recognition of the right of expatriation, a principle since incorporated in the law of nations.~~

~~In spite of the exacting and severe routine of the Eound Hill School, Bancroft contributed frequently to the North American Review and to Walsh's American Quarterly; he also made a translation of Heeren's work~~

on The Politics of Ancient Greece. In 1834 appeared the first volume of the History of the United States. The second followed in 1837, and others as the exigencies of public life permitted. Supple- mentary to the first volume was an article ;^ublished by him in the North American Review for 1836 on "The Documentary History of the Eevolution." This article not merely brought the new method to the notice of the reading public, but revealed to it the wealth of material available. The nature and extent of his studies, the solidity of his work, and the philosophic spirit which animates both, explain the enthusiasm with which the earlier volumes of Bancroft were received. Their sale at home was very large ; they were reprinted in England, and translated immediately into Danish, Italian, German, and French. The latest volumes were considered by all competent judges quite as important as their predecessors. When the author was preparing to return from Berlin, the Eoyal Academy made him their guest at a public dinner, an unprecedented honour ; and the universities of Berlin, Heidelberg, and Munich united in a testimonial of regard. At Washington he was the confidential adviser of states-

men to the end of his life, and the unofficial dean of the best society.

Bancroft's historical creed is best set forth in the address h6 delivered on the semi-centennial of the New- York Historical Society in 1854. In philosophy he found the basis for positing a collective human will, revealing in its activities the materials for determining ethical lavirs. Since there must be the same conservation of energy in morals as elsewhere, the eternal reason is the divine Logos. History, therefore, is God working in examples. It must be a unit, its forces constant, and its totality an organic whole. Within this the individual moves and acts with liberty and responsibility ; for each, in will, affection, and intellect, is consubstantial with the rest. Truth, morals, and justice are subject to no evolu- tion; but the collective man evolves better forms of knowledge and behaviour. The organization of society, therefore, produces successive states, in each of which the principle of freedom is better established than in the antecedent. Permanency in republican government is, therefore, based upon

~~corresponding experience and cul- ture, and its possibilities grow ever stronger. The rela- tion of American democracy to the systems which have preceded it forms the latest proof of these contentions. As Heeren's pupil, he laid enormous stress on the impor- tance of original authorities. In dealing with document- ary evidence he sought to ajJply very stringent rules : — (1) Carefully distinguish between original authority and historical memorials or aids ; for example, between a fact recorded at first- or second-hand knowledge, and a deci- sion of principle by authority. (2) Represent every man from his own standpoint; judge him from your own. His collections of original material were vast ; beginning with his residence in England, he brought together at enormous pains and expense the authenticated copies of archives, family papers, and personal journals written by historic personages, which now constitute an invaluable treasure in the New York public library. They are from every land and from every people with which American origins are connected. His use of this material was not always according to accepted standards. To avoid dry- ness and prolixity he condensed quotations, and occasion- ally employed the Thucydidean method of abridgment or representation in place of fact catalogues. During his long life enormous strides were made by others in collect- ing the materials of American history, and while in the main he kept pace with them by ruthless revision, yet even the latest edition of his work disregards some minor facts which others knew for the insertion of much which the, author alone knew.~~

~~Bancroft's imagination and enthusiasm were alike ex- uberant. His pages abound in fine and acute insight. His generalizations are vivid and enlightening. He spared no pains to acquire true style, frequently rewriting his chap- ters, and sometimes testing passages of philosophy and de- scription in eight different forms. Yet to a certain extent he lacked the representative power and often failed to con- ceal his art, many pages ringing with artificial tones. But, after making all allowances, it remains true that he had a perfect sense of proportion, sound maxims, and thorough common-sense. He was of that greatest human type : a man of the present, valuing j ustly the past, and no dreamer. In the nature and extent of his studies, in the solidity of his work, and in the philosophic spirit which animated his life he ranks as the foremost historian of the United States, and as an American historian second to none of his European contemporaries in~~

~~the same line. He displayed the heroic, epic value of American history, the unity of its course with the great central stream, and dispelled forever the extrava- gant conceptions of a sentimental world just emerging from the visionary philosophy of the 18th century, (w. m. s.)~~

~~Bancroft, Hubert Howe (1832), American~~

~~historical writer, was born at Granville, Ohio, on the 5th of May 1832. From 1852 to 1868 he was a publisher in San Erancisco. During this period he accumulated a great library of historical material, and at last gave up business in order to devote himself to the collection and publication of an extensive History of the Pacific Coast of North America. This work is comprised in no less than thirty-one octavo volumes, besides some subsidiary treatises, autobiographical data, &c., and includes ethno- , graphy, archaeology, and history. As the compiler neces- sarily relied upon the labours of a corps of assistants, his work is, properly speaking, an encyclopaedia rather than a unified history ; but as a storehouse of material its value is great, and is likely to be enduring.~~

~~Bancroft, Sir Squire. See Drama.~~

~~Banda, a town and district of British India, in the Allahabad division of the North-West Provinces. The town is on the right bank of the river Ken, 96 miles south-west of Allahabad. The population is about 23,000 ; the municipal income in 1897-98 was Rs.26,531. The town possesses 66 mosques and 161 Hindu temples. It has also a church and an English high school. It is no longer a military cantonment.~~

~~The district of Banda is the most barren and most backward portion of the province. It contains an area of 3060 square miles. The population in 1891 was 705,832, being 231 persons ‘ per square mile ; Hindus numbering 664,810, Mahommedans 40,662, Christians 74, including 30 Europeans. In 1901 the population w&,s 631,337, showing a decrease of 11 per cent., due to the effects of famine. Land revenue and rates were returned as Es.7,06,341, the incidence of assessment being 10 annas per acre ; the number of police was 2308. In 1896-97, out of a total cultivated area of 662,865 acres, only 6938 were irrigated. The principal crops are mil- let, other food-grains, pulse, rice, cotton, and oil-seeds. Banda cotton enjoys a high repute in the market. A branch railway from Manikpur to Jhansi traverses the length of the district, which is also crossed by the main line of the East Indian to Jubbulpur.~~

~~Banda Islands, a group of three chief and several lesser islands in the Banda Sea, south of Ceram (East Indian archipelago), forming, with Waru (the eastern portion of Ceram) and the islands of Ceram Laut and Goram, a district of the Dutch residency of Amboyna. The main islands are Great Banda or Lontor, Banda Neira to its north, Gunong Api (west of Banda Neira), Wai or Ai (still farther west), with Run on its south- west. The group (total area under 19 square miles) shows parts of a volcanic formation resembling that of Santorin (in the jEgean). The production of late years has amounted to 9600 piculs (a picul=159 lb) nutmegs and 2400 piculs mace. The capital of the group is Banda (on B. Neira), seat of the Assistant Resident. Jalti or jatti wood is cultivated on the island of Rosingen. The total population of the islands is about 6000, descendants of the Javanese inhabitants of the neighbouring islands. They are Christians and Mahommedans.~~

~~Bander Abbasi, a town of Persia, on the Persian Gulf, and now forming part of the administrative divi- sion of the ” Persian Gulf ports,” whose governor resides at Bushire. It has a population of about 10,000, an in- salubrious climate, and very bad water.~~

~~Bander AbMsi was called Gombrlin (Gombroon, Gamaroon ; Comron and Komoran of Portuguese writers) until 1622, when it received its present name in honour of the reigning shah, Abbds I. About 1740 Nadir Shah~~

~~granted the town and district, with the fort of Shamll and the town of Mlnd,b, together with the islands of~~

~~Kishm, Hormiiz (Ormus), and Mrak to the Arab tribe of the Beni Ma'fni in return for payment of a yearly rent or tribute. About forty years later Sultin bin Ahmad, the ruler of Maskat, having been appealed to for aid by the Arab inhabitants of the place against Persian misrule, occupied the town and obtained a firman from the Persian Government confirming him in his possession, on the condition of his paying a yearly rent of a few thousand tomans. The islands were considered to be the property of Maskat. In 1852 the Persians expelled the Maskat authorities from Bander Abbisi and its district, but retired when Maskat agreed to pay an increased rent. By a treaty concluded between Persia and Maskat in 1856 it was stipulated that Bander Abbfei, town and district and the islands, were to be considered Persian territory, and leased to Maskat at an annual rent of 14,000 tomans. The treaty was to have been in force for twenty years, but in 1866 the Persian Government took advantage of the assassination of Sayyid Thuwaini, the sultan of Maskat, to install as governor of Bander Abbdsi and district a nominee of its own , who agreed to pay a rent of 20,000 tomans per annum. Further difficulties arising between Persia and Maskat, and the ruler of the latter, then in possession of a powerful fleet, threatening to blockade Bander Abbfei, the Persian Government solicited the good offices of the British Government, and the lease was renewed for another eight years upon payment of 30,000 tomans per annum. This was in 1868. In the same year, however, the sultan of Maskat was expelled by a successful revolt, and the Pefrsian Government, in virtue of a clause in the lease allowing them to cancel the contract if a conqueror obtained possession of Maskat, installed their own governor at Bander AbbSlsi, and have retained possession of the place ever since (Curzon, Persia, ii. 424).~~

~~Bander Abbasi has a lively trade, exporting much, of the produce of Yezd and Kerman and Eastern Persia, and supplying imports to those districts and Khorassan. Bander AbbEisi has a British post office, and the mail steamers of the British India Steam Navigation Company call at the port weekly. The~~

~~following table shows the value of the exports and imports from and to Bander-Abbasi in thousands of pounds sterling, and the shipping entered and cleared at the port in thousands of tons, according to British consular reports : —~~

~~Shipping.~~

~~Exports.~~

~~Imports.~~

~~Tear.~~

~~Total.~~

~~British.~~

~~Total.~~

~~British.~~

~~Total.~~

~~British.~~

~~Entered.~~

~~Cleared.~~

~~Entered,~~

~~Cleared.~~

~~1887~~

~~278~~

~~136~~

~~823~~

~~307~~

~~103~~

~~103~~

~~1890~~

~~348~~

~~201~~

~~409~~

~~393~~

~~72~~

~~72~~

~~61~~

~~62~~

~~1895~~

~~325~~

~~237~~

~~478~~

~~435~~

~~No returns availab~~

~~e.~~

~~1896~~

~~180~~

~~125~~

~~364~~

~~341~~

~~107~~

~~104~~

~~88~~

~~87~~

~~1897~~

~~231~~

~~121~~

~~382~~

~~348~~

~~94~~

~~89~~

~~88~~

~~83~~

~~1898~~

~~187~~

~~115~~

~~449~~

~~422~~

~~87~~

~~86~~

~~79~~

~~79~~

~~Bander Lingah, a tovra. of Persia, on the Persian Gulf, and about 300 miles by sea from Bushire, in 26° 33′ N. lat. and 64° 54′ E. long. It forms part of the administrative division of the " Persian Gulf ports," whose governor resides at Bushire, and has a population of about 10,000. The following table shows the value of the exports and imports from and to Bander Lingah, in thousands of pounds sterling, and the shipping, in thou- sands of tons, according to British consular reports. Nearly one-half of the exports and imports is in pearls, which pass Bander Lingah in transit from the fisheries on the Arab coast to Bombay : —~~

~~Shipping.~~

~~Exports.~~

~~Imports.~~

~~Tear.~~

~~Total.~~

~~British.~~

~~Total.~~

~~British.~~

~~Total.~~

~~British.~~

~~Entered.~~

~~Cleared.~~

~~Entered.~~

~~Cleared.~~

~~1887~~

~~523~~

~~308~~

~~526~~

~~273~~

~~99~~

~~92~~

~~1890~~

~~592~~

~~•362~~

~~665~~

~~381~~

~~187~~

~~203~~

~~157~~

~~175~~

~~1895~~

~~511~~

~~263~~

~~587~~

~~226~~

~~No returns availab~~

~~e.~~

~~1896~~

~~498~~

~~?74~~

~~425~~

~~156~~

~~129~~

~~107~~

~~97~~

~~74~~

~~1897~~

~~548~~

~~270~~

~~582~~

~~288~~

~~115~~

~~92~~

~~93~~

~~73~~

~~1898~~

~~571~~

~~287~~

~~641~~

~~347~~

~~125~~

~~76~~

~~102~~

~~58~~

~~1899~~

~~552~~

~~269~~

~~612~~

~~344~~

~~125~~

~~68~~

~~99~~

~~48~~

~~Like many other~~

~~for many generations a hereditary patrimony of the sheikh of an Arab tribe, in this case the Jovasmi tribe, and it was only in 1898 that the Arabs were expelled from the place by a Persian force. Bander Lingah is the chief port for the Persian province of Laristan, and has a thriving trade with Bahrein and the Arab coast. It has a British post office, and the British India Company's steamers call there weekly.~~

~~Banff, a royal and parliamentary burgh (Elgin group) and the county town of Banffshire, on Moray Firth, 50 miles NT.N.W. of Aberdeen by rail. In 1888, 425 vessels of 37,377 tons entered ; in 1898, 449 vessels of 43,772 tons. Coal and timber are the principal imports. (For statistics of the fishery district of which Banff is the centre see the following article.) Population of municipal burgh (1891), 3876 ; (1901), 3730 ; of parliamentary burgh, which includes Macduff (1891), 7578 ; (1901), 7148.~~

~~Banffshire, a maritime county of N.E. Scotland, bounded on the N. by the Moray Firth, on the E. and S. by Aberdeenshire, and on the W. by Elgin and Inverness shires.~~

~~Area and Population. — In 1891 the Aberdeen portion of the parish of Cabrach was placed in Banff ; the Banffshire portions of Cairnie and King Edward were separated from the Aberdeen portions and transferred to other Banfi parishes ; Gartly, Glass, New Machar, Old Deer, and St Fergus were wholly transferred to Aberdeen. Of parishes divided between Banff and Elgin, Boharm, Inveravon, and Keith were placed wholly in the former, and Bellie and Rothes in the latter. According to the latest official estimate the~~

~~area of the county is 405,432 acres, or about 633J square miles. The population was in 1881, 62,736 ; in 1891, 64,190, or, on the above area, 61,684, of whom 29,547 were males and 32,137 females. On the old area, taking laud only (410,112 acres or 640-8 square miles), the number of persons to the square mile in 1891 was 100, and the number of acres to the person 6”4, the county ranking fourteenth in Scotland in respect of density of population. In the registration county the population increased between 1881 and 1891 by 2-8 per cent. In 1901 the population was 61,487. Between 1881 and 1891 the excess of births over deaths was 9593, and the increase of the resident population 1713. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 :—~~

~~Tear.~~

~~Deaths.~~

~~Marriages.~~

~~Births.~~

~~Percentage of niegitimate.~~

~~1880 1890 1899~~

~~1000 1055 1006~~

~~337 318 361~~

~~1873 1837 1797~~

~~16 ‘0 14 ‘86 13-4~~

~~The birthrrate, death-rate, and marriage-rate are all below the rates for Scotland. The following table gives the birth-rate, death- rate, and marriage-rate per thousand of the population for a series of years : —~~

~~1880.~~

~~1881-90.~~

~~1890.~~

~~1891-98.~~

~~1899.~~

~~Birth-rate . Death-rate . Marriage-rate .~~

~~31-37~~

~~16-75~~

~~5-64~~

~~32-16~~

~~16 -.30~~

~~5-73~~

~~30-06~~

~~17-26~~

~~5-20~~

~~29-10~~

~~15-37~~

~~5-73~~

~~28-43~~

~~15-91~~

~~5-71~~

~~The number of Gaelic-speaking persons in the county in 1891 was 638, of whom 3 spoke Gaelic only, and there were 5 foreigners. Valuation in 1889-~~

~~90, £242,149 ; in 1899-1900, £261,677.~~

~~Administration. — The county returns a member to parliament. Royal burghs are Banff (3730) and CuUen (4059), which belong to the Elgin group of parliamentary burghs, the parliamentary burgh of Banff having a population of 7578 in 1891. The chief police burghs are Buckie (6541), Keith (4753), and Macduff (3418). There are 22 civil parishes, most of which belong to the Buchan Combination, and the number of paupers and dependants in September 1899 was 1587. Banffshire forms a sheriffdom with Aberdeen and Kincardine shires, and there is a resident sheriff-substitute at Banff, who sits also at Keith, Buckie, and Dufftown.~~

~~Education. — Twenty-five school boards manage 73 schools, which had an average attendance of 10,378 in 1898-99, and 14 voluntary schools (6 Roman Catholic and 4 Episcopal) with an average attendance of 1157. Twenty-five schools earned grants in 1898 for giving higher education, and the county council out of the "residue" grant subsidizes classes in agriculture, navigation, veterinary science, and cookery and laundry work.~~

~~Agriculture. — ^The percentage of cultivated area was 36-9 in 1898. Barley grows well in most parts of the county, and the demand of~~

~~distillers tends to keep up the acreage, though the predominant crop IS oats; the barley acreage was 11,725 in 1898 and 16,504 in 1899, and the oat acreage was 46,874 in the latter year. Cattle- feeding is, however, the staple agricultural industry. There is also a fair proportion of dairy farming. The following table gives the principal acreage at intervals of five years from 1880 :~~

~~Tear.~~

~~Area under Crops.~~

~~Corn Crops.~~

~~Green Crops.~~

~~Clover.~~

~~Permanent Pasture.~~

~~FaUow.~~

~~1880 1885 1890 1895 1899~~

~~167,317~~

~~168,595 172,563 160,240 160,260~~

~~62,099 62,457 62,238 57,810 57,640~~

~~28,875 27,978 28,368 25,508 25,031~~

~~67,097 . 65,558 69,618 62,801 67,665~~

~~8,946 12,299 11,000 13,959~~

~~9,862~~

~~300 273 312 140~~

~~88~~

~~The following table gives particulars of the live stock in the same years : —~~

~~Tear.~~

~~Total Horses.~~

~~Total Cattle.~~

~~Cows or~~

~~Heifers in~~

~~Milk or Calf.~~

~~Sheep.~~

~~Pigs.~~

~~1880 1885 1890 1895 1899~~

~~8127 8072 8381 8881 8915~~

~~40,259 43,674 45,216 41,764 44,561~~

~~12,548 13,682 13,970 12,470 13,377~~

~~49,128 57,816 68,262 62,703 71,400~~

~~2837 3920 4306 2461 2736~~

~~Of 3737 holdings in 1895, the date of the last return, the average size was 43 acres. The percentage under 5 acres was 20-84, between 5 and 50 acres 51-73, and above 50 acres 27-43. Farms between 60 and 100 acres numbered 556 ; between 100 and 300, 439 ; and over 300 acres, 30 ; only 2 being over 500 acres. There were 30,955 acres under wood in 1895. According to the census of 1891 there were 7139 men and 415 women engaged in agriculture.~~

~~Industries and Trade. — Woollen factories have spread to Duff- town, Eothiemay, and GoUachy, and engineering works in Banff, Portsoy, and Keith are of importance. There are seven harbours at which a miscellaneous and fish trade is done — Banff, Macduff, Buckie, Gardenstown, Portsoy, CuUen, and Port Gordon; and fishing is prosecuted at fourteen creeks or harbours along the Banffshire portion of the Moray Firth. The herring season lasts from June to September ; white fishing is prosecuted all the year round. There are two fishery districts in the county centring respectively in Banff and Buckie, for which, conjointly, the following table gives statistics : —~~

~~Tear.~~

~~Boats.~~

~~Value of Gear.~~

~~Resident Fishermen and Boys.~~

~~Total Value of aU Fish.~~

~~No.~~

~~Tons.~~

~~Value.~~

~~1890 1898 1899~~

~~1221~~

~~1161 1197~~

~~17,101 21,714 23,064~~

~~£135,664 £202,819 £218,874~~

~~£129,872 £152,676 £387,023~~

~~5110 3512 5364~~

~~£125,852 £80,926 £79,692~~

~~The herring catch only was valued at £41,478 in 1899. The number of persons employed in the two districts in 1899 in con- nexion with the various branches of the sea fisheries was 5787. Banff contains large limestone deposits; 24,863 tons valued at £9385 were raised in 1895, and 38,355 tons valued at £5819 in 1899; there is also a little granite-quarrying, the output being 1470 tons in 1895 and 7438 tons in 1899. The total industrial population in 1891 was 5175 men and 1479 women. The Great North of Scotland and the Highland Railway Companies have together added 30 miles to the railway mileage of the county.~~

Adthoeities. — W. Cramond. Annals of Banff. (New Spalding Club) Aberdeen, 1991.— The Guide to Cullen. CuUen, 189(>.— The Guide to Suckie. Buckie, 1898.— Dr. Gordon. Chronicles of Keith, Grange, &o. Glasgow, ISSO.— Banffshire Tear-Book. Banff.— Banff and the Neighbourhood. Banff, 1879.— TVons. of Banffshire Field Club. Ba-niS.. — Proceedings of the Soc. of Antiq. of Scotland. Edinburgh. — Ordnance Gazetteer of Scotland. New edition. Lon- don.— Professor Dickie. Botanists Guide to Aberdeen, Banff, &c. Aberdeen, 1860. — W. Cramond. Church of Boyndie. Banff, 1886 ; and works by the same author on other churches in the county, mostly published at Banff. Inventory of Charters of Cullen, Banff, 1887 ; and Inventory of Charters of Banff, Banff. (yf. wa.)

Banffy- Hunyad, a market-tovm of the county of Kolozs in Hungary. In the neighbourhood rise the romantic castles of the noble families BanfEy and Barcsai. It is the centre of the Hungarian tribe of Kalotaszeg, famous for its picturesque dressing, old songs, and popular pustoms, but especially for its beautiful female handiwork, the so-called "Kalotaszegi varrottas." Population, about

4500.

Bangalore, a city of India, the capital of the native state of Mysore and also a British cantonment. It is 3113 feet above the sea, 216 miles west of Madras by rail. The total area is about 15 square miles. The total population in 1881 was 155,857, in 1891 it was 180,366, and in 1901 it was 159,030, showing a decrease of 12 per cent., due to the effects of plague. When the state of Mysore was restored to its raja in 1881, the civil and military station of Bangalore was permanently reserved under British jurisdiction as an "assigned tract." It has an area of 12-4 square miles, and had in 1881 a population of 93,540; in 1891 of 100,081, of whom 17,902 were Christians ; and in 1901 of 159,030. The municipal income in 1897-98 was Es.3,29,097 ; the number of boys at school was 5227, of girls 2610, giving a total of 7837, or 52 per cent, of the estimated population of school-going age ; the registered death-rate in 1897 was 21-53 per thousand. Bangalore is the headquarters of a military district, with accommodation for a strong force of all arms and an arsenal in the old fort. A considerable number of Euro- pean pensioners reside here. A new palace has been built for the

~~Maharaja. There is an aided Koman Catholic college, besides many schools for Europeans. A permanent water-supply has been introduced, and a complete system of drainage is under consideration. Bangalore is an important railway centre. There are two cotton mills with 248 looms and 30,872 spindles, employing 1600 hands ; four breweries, with an annual out-turn of 470,000 gallons. The city suffered severely from plague in 1899 and 1900.~~

~~The district of Bangalore borders on the Madras dis- trict of Salem. Its area is 2559 square miles ; its popu- lation in 1881 was 669,139, and in 1891 it was 802,994, showing an increase of 20 per cent., or an average density of 314 per square mile, being considerably the highest rate in Mysore; in 1901 the population was 877,927, showing a further increase of 9 per cent. The district is crossed by several lines of railway. Outside Bangalore city there is a woollen mill with 38 looms and 1088 spindles, employing 200 hands, which turns out blankets, cloth for greatcoats, and woollen stuffs to the annual value of Es.2,61,600.~~

~~Banganapalle, a state of Southern India, sur- rounded by the Madras district of Kurnool. Area, 255 square miles; population (1891), 35,496; (1901), 32,279. Estimated revenue, Rs.2,23,000, of which a large portion is alienated in grants to junior branches of the family ; no tribute ; number of schools, 20, with 671 pupils in 1897-98. The town of Banganapalle is situated in 15° 15′ N. lat. and 78° 20′ E. long., not far from the branch of the Southern Maratha Eailway from Guntakal to Bezwara.~~

~~Bangkok, the capital of Siam, situated on the river Me Nam, in 100° 30′ E. long, and 13° 46′ N. lat., under- went great changes, and developments within the last quarter, and especially during the last decade, of the 19th century. The main streets are now for the most part wide, well-made, well-policed, and lighted with electricity. The town is traversed by electric trams, and the river is crowded with steamers. The larger ships are specially built with flat bottoms for crossing the bar, where no im- provement has yet been effected by the Government, and the maximum depth at high water does not exceed 15 feet. The more important European countries and the United States are now represented by a minister plenipo- tentiary and a consular staff, and the European colony has increased to over 600 in number, and~~

includes represen- tatives of many of the best-known firms in the East and of the more important banks. The town is con- nected with Paknam at the mouth of the river by a

steaan tramway, and the railway to Korat, on the lower sections of which the traffic has been steadily increasing, was opened for trafle to that place towards the end of 1900. The affairs of the town were for a long time controlled by a Local Government Department. Latterly a Sanitary Board has been created, and has done ex- cellent work, not before it was needed. In the near future a municipality will probably be formed in which the European residents will be represented in proportion to their interests, in which case it may be expected that the long-talked-of waterworks and drainage scheme will be effectively carried out. There are good dispensaries and hospitals, and French, Eoman Catholic, and American Protestant missions. Steps are being taken to improve primary education by raising the efficiency of the monas- tery schools and bringing them under regular Govern- ment supervision. The population, though composed principally of Siamese and Chinese, includes representa- tives of every race to be found in Indo-China, as well as a large number of natives of India. The total has been variously estimated, and probably exceeds 400,000.

The climate, though enervating from the humidity of the atmosphere, is not one of extreme heat, owing to its 'proximity to the gulf, from which during the hot season (February to April) a strong sea-breeze blows nearly every day. 93° Fahr. is an exceptional maximum in the daytime, and at night the thermometer generally falls below 90°, and renders sleep possible. In the rainy season (May to October) there is a rainfall which seldom exceeds 50 inches. The cold season which follows is dry and pleasant, the temperature at night occasionally falling below 70° Fahr.

In 1888, 472 ships of 352,445 tons (396 of 300,247 tons, steam) cleared the port ; in 1898 the total number was 524 of 453,341 tons (509 of 444,653 tons, steam). These figures do not include junks, of which from 200 to 300 enter the port from the Malay peninsula, Cambodian, and South China ports

~~in the course of the year. For the ten years ending 1898 British shipping averaged 74 per cent, of the whole, and in value of cargoes carried reached an even higher percentage. The transference of both the Holt Singapore and Scottish Oriental Hongkong lines to the German flag in 1899, and the enterprise of the Danish East Asiatic Company, will effect a considerable reduction in these figures in the next few years. In 1889 the total exports were valued at £2,286,280, and in 1899 at £3,123,775 ; the value of the rice output in 1899 was £2,223,953, and of teak £323,867. The imports in 1889 were valued at £1,593,257, and in 1899 at £2,532,137, treasure being the largest item in both years, followed by cotton goods, opium, silk goods, gunny bags, iron, steel, and machinery.~~

~~For recent authorities, see Siam. (h. w. Sm.)~~

~~Bangor, a municipal (1883) and contributory par- liamentary borough (Carnarvon district), seaport, and market town of Carnarvonshire, North Wales, at the north end of Menai Strait, 240 miles W. of London by rail. The Cathedral has been restored ; there are three other churches and twenty-one Nonconformist chapels. The town council possess the gas and water works, electric light works, a fine promenade pier and ferries, fine (en-closed) open-air sesrwater baths, museum and reading- room, infectious diseases hospital, and public cemetery. The University College of North Wales (1883) is located here, and a hall for female students has been provided. There are also the Independent and Baptist Colleges, the Normal College, the North Wales Training College, and two intermediate schools (boys and girls), two public halls, and an infirmary. Area of municipal borough, 1208 acres. Population (1881), 9005 ; (1901), 11,269.~~

~~Bangor, a city and seaport of Maine, U.S.A., capital of Penobscot county, situated in the southern part of the State, on the west bank of Penobscot river. Several branches of the Maine Central Railway have their~~

~~termini here. Power for manufacturing is supplied by the Penobscot, and the city has large and varied manu- factures. The lumber business is, however, still of the greatest importance, 175,000,000 feet of lumber being sawn annually. Population (1880), 16,856; (1900), 21,850.~~

~~Bangweulu, a shallow lake of Eastern Central Africa, roughly oval in shape, formed by the head stream of the Congo. It lies between 10° 48′ and 11° 31′ S. lat. and is cut by 30° E. long. Except on the west, its shores are fringed with marsh, overgrown with reeds and papyrus. The three islands Kirui, Kisi, and Mbawala much diminish the extent of open water, the channel between the two former being 3^ miles wide with a depth of 12^ feet, and that between Kisi and Mbawala nearly 5 miles with 15 feet in the centre. On the west shore a long narrow peninsula almost separates the lakelet Chifunawuli from the main body of water. The Chambezi, the most remote head stream of the Congo, enters the south-east corner through a mass of aquatic vegetation, while some 25 miles farther west the Luapula makes its exit through a vast marsh extending to 12° 20′ S. lat. Though heard of by the Portuguese traveller Lacerda in 1798, Bangweulu was first reached in 1868 by Dr Livingstone, who died six years later among the swamps to the south. It was partially surveyed in 1883 by the French traveller Giraud, and first circumnavigated by Mr Poulett Weath- erley in 1896. Its altitude is about 3700 feet.~~

~~See Geographical Journal, vol. xii. p. 241 ; vol. xiv. p. 561.~~

~~Banjermasin (Dutch, Bandjermasin), a district in the south-east of Borneo, on the Barito, now, after much fighting and insurrection, the chief district in the residency of South and East Borneo. The seat of the Eesident is at the town of Banjermasin, in 3° 18′ S., 114° 36′ E., on the left bank of the Barito, where its tributary, the Martapura, forms with it the small island of Tatas. As both these rivers are navigable for large vessels, the town is a trade-centre for the products of all the districts along their banks (benzoin, rattans, wax, gold, diamonds, iron, and weapons). The population in 1898 was 48,021, including 2230 Chinese, 882 Arabs, and 531 Europeans.~~

~~Bankim Chandra Chatterji (1838-1894), the greatest novelist of India in the 19th century, was born in the district of Twenty-four Parganas in Bengal in 1838. He received an English education, first in the Hugli College, and then in the Presidency College of Cal- cutta, and he was the first B.A. of the Calcutta University. Shortly after leaving college he published his first histori- cal novel, the Durges-Nandini or The Chieftain's Daughter. To Bankim Chandra is due the credit of creating in India a school of fiction~~

~~after the modern European model. His first work, named above, and modelled upon the style of Sir Walter Scott, made a great sensation in Bengal. It was followed by the Kapala-Kundala and the Mrinalini, and established his fame as a writer, with a creative imagination and a power of delineation as yet unsur- passed in India. In 1872 he brought out his first social novel, the Bisha-Brikkha, or The Poison Tree, which was followed by others in rapid succession. For over twenty years the reading public in Bengal recognized and felt the power of the talented novelist, and^Bengali ladies in the zenana read every new work of Bankim Chandra as it issued from the press. During all these years Bankim Chandra was serving the British Government as a deputy- magistrate in various districts of Bengal. His ability as a magistrate and as an official was appreciated, and on his retirement he was decorated and made a Companion of the Indian Empire. In his last years he wrote on Hindu religion, and died in 1894. Some of his novels have been~~

~~translated into English by Mrs Knight; and although numerous works of fiction are now annually produced in every province in India, Bankim Chandra still holds the first place. He gathered round him a number of literary men who have left their impress on the literature of Bengal. In his earlier years he served his apprentice- ship m literature under Iswab Chandka Gupta, the chief poet and satirist of Bengal during the earlier half of the~~

~~19th century. Bankim Chandra's friend and colleague, DiNA Bandhu Mitra, was virtually the founder of the modern Bengali drama. Another friend of his, Hem Chandra Banebjea, was a poet of recognized merit and talent. And among the younger men who venerated Bankim Chandra, and benefited by his example and advice, may be mentioned two distinguished poets, Nalein Chandra Sen and Eabindra Nath Tagore. (r. o. d.)~~

~~BAIN^KII^G.~~

~~I. History and Statistics. British Banks.~~

~~THE f olloyp-ing article is confined generally to the state of affairs at the present time, and with respect to the United Kingdom does not go back farther than to the date when Sir Eobert Peel's Bank Acts of 1844-46 were passed. . These Acts have greatly influenced the present position of banking in Great Britain and Ireland, and it is necessary to begin with them, although to render the history intelligible some references must be made to earlier events. The charter of the Bank of England was dated 27th July 1694. Originally established to advance the government a loan of £1,200,000, the management of the National Debt of the country has been confided to it ever since its foundation, and it has always re- mained the banker of the Government. The interest on the stock in which the debt is inscribed has always been paid by the bank, originally half-yearly, now quarterly, and the registration of all transfers of the stock itself is carried on by its ofiicers. The bank also assumes the responsibility of the correctness of all the transfers. These circumstances and the monopoly granted to it from the date of its foundation till 1826, of being the one joint stock bank in England and Wales and also of issuing notes which, since 1833, have been legal tender in England and Wales everywhere except at the Bank of England itself, combined with the fact that besides being the banker of the Government it is the banker of the other banks of the country, and for many years had the control of far larger deposits than any one of them indi-vidually, gave it early a pre-eminence over all the other banks. This pre-eminence it still maintains, though more than one competitor now holds larger deposits, and though, collectively, the deposits of the other banks of the country which have offices in London many times overpass its own. In one sense the power of the Bank of England is greater now than ever. By the Act of 1844, regulating the note-issue of the country, the Bank of England became the sole source from which legal tender notes can be obtained, a power important at all times, but pre-eminently so in periods of pressure. The authority to supply the notes required, when the issue needs to overpass the limits of the Act of 1844, is given by the Government at the request of the bank. Hence the Bank of England becomes the centre of interest at the times when a " Treasury letter " is required, and holds then a power, the force of which can hardly be estimated. In the early days of the business in England, issuing notes formed, as Bagehot says in his Lombard Street, the introduction to the system of deposit banking— so much so, that a bank which had not the power of issuing notes could scarcely exist out of~~

~~London, where tradi- tional custom associated with the "Goldsmiths," who took deposits from the time of James I. onwards, had established " deposit banking " as early as the 17th century. The Bank of England possessed a practical, though perhaps not an absolutely legal, monopoly of issuing notes~~

~~in London, and was gradually surrounded by a circle of private banks, some of considerable power. The purely city banks associated themselves at the "Clearing House " as early as 1776. The Bank of England has never formed a member of this body, though it " clears on one side," — i.e., its claim on the clearing bankers is made through the clearing house, but the claims of the clearing bankers on the Bank are forwarded direct to Threadneedle Street twice or thrice daily. Nor did the banks in Fleet Street or at Charing Cross ever belong to it. In 1858 the clearing of country cheques was added through the arrangements made by Sir John Lubbock (afterwards Lord Avebury). The " country clearing " is a great assistance to business, as it enables a cheque drawn on the most distant village in England to be dealt with as conveniently as a cheque on London. The Bank of England, as stated before, was incorporated by the Act of 1694. The position ,,. . of the other banks at that time was defined by the Act of 1697, which declared that no bank, that is, no joint stock bank, was "to be established within England during the continuance of the Bank of England," and by the Act of 1708, which provided that " during the con- tinuance of the Bank of England, no company or partner- ship exceeding six persons, in England" should "borrow, owe, or take up any sum or sums of money on their bills or notes, payable on demand, or at any less time than six months from the borrowing thereof." This was con- firmed by the Act of 1800. No change of importance was made till the Act of 1826, which prohibited " bank notes under £5," and the second Banking Act of that year. This act allowed the establishment of co-partner- ships of more than six persons, which necessarily were " Joint Stock Companies," " beyond 66 miles from Lon- don." The Act of 1833 allowed the establishment of joint stock banks within the 65-miles limit, and took away various restrictions of the amounts of notes for less than £50. But the power of issuing notes was not al- lowed to joint stock banks within the 65-miles radius.~~

~~As during the whole of the period from 1694 to 1826 and 1833 no bank could be formed with more than six partners, the majority of the banks~~

~~throughout England and Wales, for more than a century, were necessarily small and usually isolated firms. Those in the country districts had frequently branches in the small market towns close to them, those in London had never more than one office. These banks were sometimes powerful, but absolute secrecy was preserved as to the particulars of their business, the amount of capital employed in it and of deposits held. This secrecy was preserved by many of the private banks as late as the year 1890. Messrs Glyn, of Lombard Street, who assumed the joint stock form with unlimited liability in 1885, took the lead in the movement for publishing accounts. It was some time before the practice became general. The restriction of partners in private banks to six continued till. 1862. By an Act passed in that year they were allowed to be ten. This, however, did not extend to issuing banks, who were restricted to six as before. The power of increasing bank partnerships to ten has been but little made use of.~~

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~~[bkitish~~

~~The difficulties of carrying on business on a large scale were augmented by certain legal technicalities which practically rendered large private banks impossible in ordinary circumstances. Hence banking business did not begin to assume its present form till almost half-way through the 19th century. The gradual change followed the passing of the Acts of 1826-33 and 184445. In- cidentally the latter legislation had an unexpected influence in promoting the formation of large and powerful banks. The main features of the Act of 1844 are as follows :— By it the Bank of England was divided into two departments, one concerned with the issue and the other with the bank- ing business ; no new bank of issue whatever was allowed to be established; restrictions were placed on the English issuing banks. Private issuing banks with not more than six partners were allowed to remain, to amalgamate and retain their issues. The joint stock banks which possessed issues were also allowed to continue these, but when two joint stock banks amalgamated, the continuing bank only retained its issue. Also when a~~

~~private issuing bank was formed into or joined a joint stock bank, the issue lapsed. All the larger provincial banks in England and Wales had practically been banks of issue up to 1844. The enact- ments of that year, besides separating the Issue Depart- ment from the Banking Department of the Bank, were arranged with the intention of concentrating the note issues on the Bank of England in order to secure the~~

~~monopoly of that bank as the one issuer of notes in Eng- land and Wales. The result has been that nearly all the provincial banks in England had by 1901 lost the right of issue. Probably all will do so unless legislation is intro- duced to resuscitate the local issues in a form which will render them secure and enable them to be as useful to bank- ing in England as the local issues have been to Scotland and Ireland. No security was ever provided for the localissues in the United Kingdom. The requirements of the Acts of 1844-45, which compel the Irish and Scottish banks to hold specie against the notes issued beyond the legal limit, do not appear to make the coin held a security for them. The legislation of 1879, which made them a first charge, with unlimited liability, on the total assets of the joint stock banks which accepted the principle of limited liability for the rest of their business, has been the only recognition of the duty to the note-holders of rendering them secure. It has been a real disadvantage to England that this duty has not been sufficiently recognized. A different policy was followed by Sir Eobert Peel in Scotland and Ireland. By the Acts of 1844-45, the Scottish and Irish banks were allowed to exceed their authorized issue on holding specie to the amount of the excess and no restrictions were placed on amalgamations among banks in these countries. In Scotland, and also in Ireland, notes for less than £5 continued to be allowed. The result has been that the ten large banks in Scotland, and six of the nine banks in~~

~~BANK OF ENGLAND (New Form).~~

~~Week ending Satuedat, 7th Septembek 1844.~~

~~Issue Department.~~

~~Notes issued £28,351,295~~

~~£28,351,295~~

~~Government Debt Other Securities Gold Coin and Bullion Silver Bullion~~

~~£11,015,100~~

~~2,984,900~~

~~12,667,208~~

~~1,694,087~~

~~£28,351,295~~

~~Banking Department.~~

~~Proprietors' Capital £14,553,000~~

~~Rest 3,564,729~~

~~Public Deposits (including exchequer, savings banks, commissioners of national debt and dividend~~

~~accounts) 3,630,809~~

~~Other Deposits . 8,644,348~~

~~Seven Day and other Bills . .... 1,030,354~~

~~Dated the 12th day of September 1844.~~

~~£31,423,240~~

~~Government Securities, including dead-weight an- nuity £14,554,834~~

~~Other Securities 7,835,616~~

~~Notes 8,175,025~~

~~Gold and Silver Coin 857,765~~

~~M. ,Maeshall, Chief Cashier.~~

~~£31,423,240~~

~~Weekly Statement or the Liabilities and Assets op the Bank op England, 7th Septembee 1844 (Old Form).~~

~~Circulation — London Country~~

~~£14,802,000~~

~~6,405,000~~

~~Deposits, Public, viz. —~~

~~Exchequer Account~~

~~£2,198,000~~

~~For payment of Dividends~~

~~315,000~~

~~Savings Banks, &c. .~~

~~501,000~~

~~Other Public Accounts, .~~

~~617,000~~

~~Deposits, Private, viz. —~~

~~Railways~~

~~£30,000~~

~~London Bankers ....~~

~~963,000~~

~~East India Company~~

~~636,000~~

~~Bank of Ireland, Royal Bank of~~

~~Scotland, &c~~

~~175,000~~

~~Other Deposits ....~~

~~5,631,000~~

~~Deposits at Branches~~

~~1,209,000~~

~~i£21,207,000~~

~~3,631,000~~

~~8,644,000~~

~~£33,482,000~~

~~1 This includes seven day and other bills.~~

~~Public Securities — Advances on Exchequer Bills- Deficiency~~

~~Other Exchequer Bills Exchequer Bills purchased Stock and Annuities~~

~~£870,000~~

~~311,000~~

~~12,821,000~~

~~Private Securities — Bills discounted —~~

~~London £113,000~~

~~Country 2,003,000~~

~~East India Bonds .... £198,000~~

~~City Bonds 8,357,000~~

~~Mortgage 620,000~~

~~A. Q. V3iTl C G S— ^~~

~~Bills of Exchange .... 883,000~~

~~Exchequer Bills, Stock, &.C. . . 661,000~~

~~£14,002,000~~

~~Bollion~~

~~2,116,000~~

~~5,719,000~~

~~£21,837,000~~

~~15,209,000~~

~~£87,046,000~~

~~banks]~~

~~BANKING~~

Ireland, possess the power of issuing notes. The large proportion of local branches in these countries has been greatly assisted by this power.

The immediate effect of the division of the Bank of England into the two departments — ^the issuing depart- Bank f ^^'^t ^^d the banking department — is best shown Eagiald. ^y comparing the weekly statement of the liabilities and assets of the Bank of England of the 7th September 1844, the date when the first publication of accounts was made, according to the old and the new form. The figures are as given on page 75.

On examining the statement according to the " old form," it will be seen that the main difference between the two sides of the account

Dr. £3.3,482,000 Or. £37,046,000

is the rest 3,564,000 (omitted in tlie " old," incorporated in

£37,046,000 the "new form").

The "Proprietors' Capital," £14,553,000, and the Government securities held against it, £14,554,834, are both omitted in the " old form," but the principal effect of the Act of 1844 is shown by the figures in the issue department shown in the " new form." It will be observed that against £14,000,000 of the notes issued, securities were held, principally Government securities, but the re- mainder of the issue was madeagainst bullion. £8,175,025 of the notes are returned as in the banking department, which had accordingly that amount of specie at its disposal, or rather of notes against which specie was held. Hence, if through any circumstance the Bank of England were called on for a larger sum in notes or specie than the notes in its " banking department," now technically spoken of as the " reserve," amount to, permission has to be obtained from the Government to "suspend the Bank Act," in order to allow the demand to be met, whatever the amount of specie in its " issue department " may be. Three times since the passing of the Bank Act — during the crises of 1847, 1857, and 1866 — authority has been given for its suspension. On one of these dates, in 1857, the powers of the Act had to be exceeded ; on the other two occasions, the

~~fact that the permission had been given stayed the alarm. It should be remembered, whenever the Act of 1844 is criticized, that since it came into force there has been no anxiety as to payment in specie of the note circulation; but the division of the specie held into two parts is an arrangement which is not without disadvantages. It appears to increase the liability to constant fluctuations in the rate of discount which is one main characteristic of the English money market. Between 1822 and 1844 a rise in the Bank rate above 4 per cent, was rare ; 5 per cent, was occasionally charged, and 6 per cent, on 1st August 1839. Of late years the changes in the Bank rate have been constant, and the fluctuations, even in ordinary years, very severe. Thus in 1899 the rate was 4 per cent, on 9th May, and 7 per cent, on 19th December. From the day when the Act came into operation in 1844 to the close of the year 1900 there had been 400 changes in the rate. The other hopes which Sir E. Peel expressed in 1844, such as that after the Act came into force commercial crises would cease, have not been realized. There has been frequent discussion among bankers and occasionally with the Government as to the advantage it might be to grant the Bank of England an automatic power to augment the note issue on securities when required — similar to that possessed by the Bank of Germany (q.v.). One of the hindrances to the success of the plan has been that hitherto the Government, acting on the advice of the Treasury, has required an extremely high rate of interest, of which it would reap the advantage, to be paid on the advances made under these conditions.~~

~~The object of the arrangement of the Bank of Germany is to prevent panic, hence only a rate of 5 per cent, has been generally charged, though in 1899 the rate was 7 per cent, for a short time. The proposal made by Mr Lowe (after- wards Lord Sherbrooke) in 1873 was to charge 12 per cent., a rate which presupposes panic. Hence the negotiations came to nothing. The Act of 1844 remains unaltered. The issue on securities, allowed by it to the Bank of England, was originally £14,000,000. This has since been increased under the provisions of the Act to £17,775,000 (3rd March 1900). Hence the notes issued by the Bank have less gold by £3,775,000 behind them than previously. Clause 3 of the Act of 1844 allowed silver to form part of the specie to be held against the issue to an extent " not exceeding one-fourth part of the gold coin and bullion " held, and it will be observed that £1,694,087 in " silver bullion " was held in the issue department —~~

~~first return, 7th September 1844. This had been increased to £2,727,001 by the 3rd October 1846. After that date the amounts declined tUl 20th August 1863, when the last entry disappeared from the accounts of the bank.~~

~~The Bank of England had no branches before 1826. It has now offices at Birmingham, Bristol, Hull, Leeds, Liverpool, Manchester, Newcastle, Plymouth, Portsmouth, Western London (1 Burlington Gardens), Law Courts Branch (London, W.C). Originally, besides the Bank of England, nearly all the provincial banks in England and Wales possessed the privilege of issue. By the Act of 1844, the maximum circulation of the English issuing banks was fixed at the average circulation of the twelve weeks before 27th April 1844.~~

~~The numbers were fixed at : —~~

~~207 Private banks with an authorized issue of . £5,153,417 72 Joint stock banks with an authorized issue of 3,478,230~~

~~£8,631,647~~

~~and the actual circulation of the country in October 1844 was as follows : —~~

~~Notes in Circulation.— The monthly return of the circulation ending 12th October 1844 (Stamps and Taxes, 25th October).~~

~~England.~~

~~Private banks~~

~~Joint stock banks ....~~

~~Scotland. Chartered, private and joint stock banks~~

~~Ireland.~~

~~Bank of Ireland~~

~~Private and joint stock banks~~

~~Total ....~~

~~£4,674,162~~

~~3,331,516~~

~~2,987,665~~

~~3,597,850~~

~~2,456,261~~

~~£17,047,454~~

~~In January 1901 the number and amounts were re- duced to : —~~

~~Authorized issue. Actual issue. 33 Private banks . . . £1,220,588 £344,760~~

~~27 Joint stock banks . . 1,541,736 825,009~~

~~The issues have gradually diminished under the provi- sions of the Act of 1844, designed, as mentioned before, to concentrate the note issue of England and Wales on the Bank of England.~~

~~The yearly average of notes in circulation of the Bank of England, of the banks of issue in England and Wales, and in Scotland and Ireland, and also bullion at the Bank of England, was as follows : — England and Wales.~~

~~1844~~

~~Bank of~~

~~England. £21,030,000~~

~~Banks in Scotland.~~

~~Bullion in Bank.~~

~~£15,567,000~~

~~Private~~

~~Banks.~~

~~£4,880,000~~

~~Joint Stock Banks.~~

~~£3,483,000~~

~~1844 £3,026,000 £3,523,000~~

~~Scotland and Ireland.~~

~~Total Irish Banks. Great Britain~~

~~and Ireland. £2,205,000 £38,147,000 S. IL — IS~~

~~Bank of Ireland.~~

~~114~~

~~BANKING~~

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~~We may compare this amount with the circulation, January 1901 : —~~

~~Bank of England £29,795,599~~

~~Private banks 344,760~~

~~Joint stock banks .... 825,009~~

~~Total in England Scotland Ireland~~

~~United Kingdom~~

~~£30,965,368~~

~~8,565,743 7,288,360~~

~~£46,819,471~~

~~— an apparent increase of £8,800,000 since 1844. The •decrease of the country-circulation in England and the increase of the Scottish and Irish circulations may be set off against each other. The increase is practically in the notes of the Bank of England; in 1901 about £8,800,000 more than at the earlier date. It is probable that a large part of this amount is held in the reserves of the banks in England and Wales, and that the active note-circulation of the United Kingdom is but little larger now than half-a-century since.~~

~~The Government received from the note-circulation in 1897, the latest statement to hand ; — Bank of England, out of the profits of the issue, £175,065, 10s.; composition for duties on bills and notes, &c., £123,211, 9s. 3d. ; and a small sum for bankers' licenses not exceeding £2500 a year.~~

~~With respect to the other banks in England, the London banks first claim our attention. In 1844 there were 49 banks in London, 26 connected with the Clearing House. At that time only private banks were allowed to be members. Gradually the joint stock banks made their way into that body, and in 1901 the numbers were 3 private banks and 16 joint stock banks who joined in the clearing, — 19 banks in all. The diminution in the num- bers of the banks has been mainly the result of amalga- mations. In London, Child's Bank and Hoare's aaks. ° Fleet street, and among the provincial banks. Smith's of Nottingham, claim an antiquity greater than that of the Bank of England, the last claim- ing to have been founded in 1688. The old Bank of Bristol (Bailey, Cave and Co.) was founded in 1760. The business still exists amalgamated with Prescott and Co. Limited, of London. The Hull Old Bank (Pease and Co.) dated froiti 1764. This business also still continues (amalgamated, 1894, with the York Union Banking Co. Limited). The banks of Gurney and Co., in the eastern counties principally, established more than a century since, have with numerous other banks of similar stand- ing amalgamated with the firm of Barclay and Co. Limited, of Lombard Street. Of recent years amalgama- tion has been active among English banks. The banks in England and Wales are believed to have been 360 in number in 1792. Those registered from 1826 to 1842 were : —~~

~~1826 1827 1833 1842~~

~~The effect of the panic of 1826 is shown by the reduced number in 1827. Since that date the diminution in the number of the banks has gone on regularly. At the present time the banking business of England is carried on practically by 22 private and 103 joint stock banks, some of which are more properly , private firms uiider joint stock forms of organization. Though the number of banks has diminished the offices have increased greatly. In 1858 there were 2008 in the United Kingdom. In 1900 there were 6521, divided as follows : —~~

~~Private.~~

~~Joint Stock~~

~~654~~

~~465~~

~~6~~

~~416~~

~~35~~

~~311~~

~~118~~

~~England and Wales .... 4741~~

~~Isle of Man 21~~

~~Scotland 1081~~

~~Ireland 678~~

~~6521~~

~~In Scotland and Ireland a different form of organiza- tion from that in use in England has long prevailed. The private form of partnership in both countries gradu- ally died out during the 19th century, and all existing banks there are now organized as joint stocks. The earliest was the Bank of Scotland in 1695. There are in Scotland at the present time 10 banks. All these banks possess the right of issuing notes. They are permitted by the Act of 1844 to issue £2,676,350 without any restriction on what was to be held against the notes in circulation and to any extent beyond on the deposit of bullion. The return of 17th March 1900 showed £7,286,709 circulation and £5,834,104 bullion held. In Ireland a very similar state of matters exists. The earliest bank was the Bank of Ireland, founded 1783. The same clause as in the case of the Bank of England, limiting the partners of any other bank to six, was inserted in the Act to the great disadvantage of Irish banking. This restriction was afterwards rescinded. At present six banks are allowed to issue £6,354,494 against securities and anything further that is required on bullion. On 17th March 1900 the return was £6,651,392 circulation and £3,200,385 bullion held.~~

~~Though the note-circulation is the feature in banking which attracts most attention from those unacquainted with the real working of the business, it is virtually a trivial detail in comparison with the deposits. It is, un- fortunately, impossible to give any trustworthy statistics of the position of banking in the United Kingdom ex- tending back for any considerable time. It is only of recent years that any statement of these other than an estimate has been possible owing to the long-continued reluctance of banks to allow any publication of their balance sheets. A paper by the late Mr Newmarch, printed in the journal of the Statistical Society for 1851, supplies a basis for an estimate. According to this the total amount of deposits, including the Bank of England, in England and Wales, Scotland and Ireland, may have been at that date, from £250,000,000 to £360,000,000. The estimate in Palgrave's Notes on Banking, 1872, ex- cluding deposits in discount houses and the capitals of the banks, was from £430,000,000 to £460,000,000. The corresponding amounts at the close of — 1900 were, in round figures, including acceptances, etc., £920,000,000. The total resources, including capitals and reserves (in round figures, £130,000,000) and note circulation, were for 1900 :—~~

~~Banks in England and Wales (including~~

~~Bank of England) : . . .~~

~~Scotland . . . .~~

~~Ireland~~

~~Isle of Man ....~~

~~£844,259,000~~

~~137,182,000~~

~~67,988,000~~

~~1,001,000~~

~~£1,050,430,000~~

~~The progressive growth in bank deposits since it has been possible to keep a record of their amounts, affords some means for checking roughly the correctness of the estimates of 1861 and 1872. Broadly speaking, it may be said that the bank deposits of the United Kingdom have doubled since the latter date.~~

~~Practically at the present time every large transaction in the United Kingdom is settled by cheque, that is,by a series of ledger transfers, notes and specie being but the small change by which fractional amounts are settled. A large proportion of these are arranged through the operation of the London Clearing House. This is facilitated by~~

~~banks]~~

~~the fact that every bank in the United Kingdom has an agent in London. If we add to the returns of the Lon- don Clearing House those of the Clearing Houses in the large towns of England, in Ireland and Scotland, and the numerous exchanges which occur daily, and the large number which the different ofdces of banks with a great many branches settle among themselves and the number drawn by one customer of a bank and paid to another, we may form some notion of the vast amount of the yearly turnover of banks. This may roughly be estimated in all as at least twice as great as that registered by the London Clearing House. The earliest authentic statement as to the clearing is found in the Appendix to Second Report, Committee of House of Commons, Banks of Issue, 1841 : —~~

~~In 1839, the clearings were £954,401,600, 29 banks.~~

~~In 1840, ,, ,, ,, 978,496,800, 28 banks.~~

~~In 1899, ,, ,, ,, 9,150,269,000, 19 banks.~~

~~In 1900, ,, ,, ,, 8,960,170,000, 19 banks.~~

~~Estimates have been made of the amount of business turnover which does not pass through the London Clearing House. This would include the large number of cheques drawn by one customer of a bank in favour of another customer of the same bank ; of elcchanges between banks in the same place ; of the sums passed in the same way through the Clearing Houses in the larger cities, as Man- chester, Birmingham, Liverpool, and other places in Scotland and in Ireland ; and cheques paid in different manners. It is believed that these amounts may fully equal the sums paid through the London bankers' clearings. The increase in the clearings is striking; but it is on the deposits that attention must be fixed. The deposits are the mainstay of the banking of the United Kingdom. On the way they are employed and on their fluidity the prosperity of the country greatly depends. By the assist- ance they give, all the new business of the country has to be established as well as all the old business maintained.~~

~~In the year 1901 the most important requirement of banking in the United Kingdom was still the establish- ment of an efficient specie reserve. The reserve in the bank- ing department of the Bank of England, which~~

~~averaged ^21,465,000 in 1900, £21,000,000 in 1899, £22,000,000 in 1898, provides but a narrow basis for the whole business requirements of the country. Though it is much larger than the reserve kept before 1893, which had for several years been completely inadequate, it cannot yet be con- sidered sufficient. The gold held was actually less towards the close of 1900 than at the corresponding date in 1876. The figures were : —~~

~~1st November 1876 7th November 1900~~

~~£32,190,735~~

~~29,968,945~~

~~Beyond this there is the cash held by the other banks. Part of this is held in the form of balances at the Bank ■of England, and in notes of the Bank of England, and hence is not unlikely to be estimated twice over unless •care is taken to separate these sums from the specie actually in the hands of other banks. The published figures on this point are meagre. Private inquiries, however, lead to the belief that an amount of about 10 per cent, of the deposits may be held in balances at the Bank of England, in specie and Bank of England notes. This would amount, if this belief is correct, to a sum of not less than £80,000,000. The subject is of such im- portance that it is to be hoped that authoritative figures -will before long be published.~~

~~As regards the banks in which British interests are concerned in British colonies and other countries we can only speak briefly. It must not be overlooked that in the Dominion of Canada there are 14 large banks, managed much on the Scottish principle, with capitals~~

~~of over £16,000,000 and deposits of nearly £55,000,000. These banks have 431 offices. In Australia and New Zealand there are 18 banks with ^^^j"' capitals of fully £25,000,000 and deposits of about £114,000,000. The number of offices is more than 1400. There are, including the 3 Presidency Banks, about 7 banks doing business mainly in India — in some cases connecting neighbouring countries and places like Bangkok, Hong Kong and Zanzibar. These banks have capitals of about £6,000,000 and deposits of £30,000,000 and 43 offices. There are at least 4 banks in South Africa with capitals of £4,380,000, deposits of £23,000,000, and 163 offices. There~~

are 7 banks, principally in South America, with £6,410,000 capital, £37,000,000 deposits, and 56 offices. There are 4 large banks doing business principally in the East with more than £11,000,000 capital, £48,000,000 deposits, and 73 offices; and two other large banks, Barings and the Colonial Bank, with nearly £2,000,000 capital, £37,000,000 deposits,— the latter with 21 offices, doing business mainly with North and South America.

In this statement we have only included the larger banks. These collectively wield about £70,000,000 of capital and more than £340,000,000 of deposits — ^in all more than £410,000,000 of resources operating at nearly 2200 different places as widely separated from each other in distance as California and Hong Kong, Constantinople and New Zealand. The resources of these banks, which are principally British in origin, may, though the dis- tricts in which they operate are generally far distant from the United Kingdom, be considered as supplemen- tary to English banking.

F7-ance.

In Prance the first bank of issue was established in 1716 by John Law, the author of the Mississippi Plan and the System. Law's bank came to an end in 1721; an attempt at reconstruction was made in 1767, but the bank thus established was suppressed in 1793. Other banks, some issuing notes, then carried on opera- tions with limited success, but these never attained any real strength. There were many negotiations on the subject of the establishment of a bank in 1796. The financial difficulties of the times prevented any immediate result, but the advice of those engaged in this plan was of great assistance to Napoleon I., who, aided by his minister Mollien, founded in 1800 the Bank of France, by far the most powerful financial institution in the country, to sup- port the trade and industry of France and to supply the use of loanable capital at a moderate charge. These functions it has exercised ever since with great vigour, extending itself through its branches and towns attached to branches over the whole country. At its establishment the operations of the bank did not extend over the whole of France. Departmental banks, with the privilege of issue, had been formed under a law adopted in 1803. At the close of 1847 there were nine of these banks exist- ing in as many of the larger towns. In 1848, however, they

were absorbed into the Bank of France, which has since possessed an exclusive privilege of issue, and in 1863 took over the Bank of Savoy after that province was united to France. The Bank of France has successfully surmounted many political as well as financial troubles both diiring and since the times of Napoleon I. The overthrow of the government of Louis Philippe in 1848, the war with Germany in 1870, the many difficulties that followed when the Commune reigned in Paris in 1871, the payment of the war indemnity — com- pr"acef pleted in 1873 — were all happily surmounted. Great pains, too, have been taken, especially of recent

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years, to render services to large and small businesses and to agricultural industry. In 1877 the offices of the Bank of France were 78 in number ; in 1900 they were 392, including the towns "connected with the branches," — an arrangement which, without causing the bank the expense of opening a branch, gives the place connected many of the advantages which a branch confers. The commercial paper discounted has largely increased, and 'in 1900 amounted to £489,902,000. The advances on securities were in the same year £66,000,000. The rate of discount in Paris is, as a rule, lower than in London, and the number of alterations in it fewer. Bills as low as 4s. 2d. are admitted to discount, and since 27th March 1890, loans of as small an amount as £10 are granted. In most cases three " names " must be furnished for each bill, or suitable guarantees or security given, but these necessary safeguards have not to be furnished in such a manner as to hamper applicants for loans unduly. In this manner the Bank of France is of great service to the industry of the country. It has never succeeded, however, in attracting deposits on anything like the scale of the Bank of England or the banks of the English-speaking peoples, but it holds about £25,000,000 in deposits, and operates through its enormous note circulation (averaging in 1900 £161,400,000) by means of which most business transactions in France are carried on.

~~The limits of the circulation of the Bank of France and the dates when it has been extended are as follows : —~~

~~Dates. 15th March 1848 27th April, 2nd May 1848 2nd December 1849 12th August 1870 . 14th August 1870 . 29th December 1871 15th July 1872 30th January 1884 ‘ 25th January 1893~~

~~The extension of the circulation of the Bank of France, now ten times as large as half-a-century since, is a suffi- cient proof of the assistance afforded by that institution to the business of the country.~~

~~Most business transactions in France are liquidated in notes of the Bank of France. These, owing to their convenience, are preferred to specie. This is accumulated in the vaults of the Bank of France, which in 1900 held £93,372,000 gold, and £44,000,000 silver. The gold held by the Bank of France is generally considerably larger in amount than that held by the Bank of England, which in the autumn of 1890 had to borrow £3,000,000 in gold from the Bank of France at the time of the Baring crisis. The large specie reserve of the bank has given stability to the trade of France, and has enabled the bank to manage its business without the numerous fluctuar tions in the rate of discount which are constantly occurring in England. The mass of the reserve in France is so great that the movements of the precious metals, when they are the result only of natural causes, are allowed to go on without corresponding movements in the discount rate. But it must be remembered that this large reserve is held in part against a gigantic note issue, and also that the trade activity and enterprise of the French people are less intense than in the United Kingdom or Germany, so that it is much easier for the Bank of France to main- tain a steady rate of discount.~~

~~Besides the Bank of France, several great credit institu- tions carry on business, as the Credit Lyonnais, the Gomp- toir National d’Escompte de Paris, the Socidte Generate pour favoriser le developpement du Commerce et de I’ln- dustrie en France, and the Soci^t^ Generale de Credit Industriel et Commercial. Their principal figures are as follows : —~~

~~MiUions of~~

~~Converting the~~

~~Francs.~~

~~Franc as 25 = £1.~~

~~350~~

~~£14,000,000~~

~~48 . 452~~

~~18,000,000~~

~~525~~

~~21,000,000~~

~~1,800~~

~~32,000,000~~

~~2,400~~

~~96,000,000~~

~~2,800~~

~~112,000,000~~

~~3,200~~

~~128,000,000~~

~~3,500~~

~~140,000,000~~

~~4,000~~

~~160,000,000~~

~~Capital~~

~~and Beserve,~~

~~Other Liabilities, Deposits,~~

~~Branches.~~

~~Comptoir National d'Escompte (deTaris f~~

~~OrMit Lyonnais ....~~

~~Soci6t6 G6n6rale pour favoriser le developpement du Commerce > et de 1′ Industrie en France~~

~~Soci6t6 G^nirale de OrMit In- 1 dustrlel et Commercial . . J~~

~~£4,000,000~~

~~10,400,000~~

~~2,960,000 880,000~~

~~£21,000,000~~

~~46,000,000~~

~~22,000,400 4,690,000~~

~~1 122 offices.) 80 in France.~~

~~178~~

~~(282~~

~~55 in France.~~

~~18~~

~~There is also the Credit Foncier de France with a capital of nearly £13,500,000, but the business done is so largely that of mortgages that it can hardly be included among banks, though it carries on in some measure the business of banking.~~

~~Besides the four large joint stock banks mentioned above, there exist in France a very large number of country banks carrying on a very considerable business. Little is known as to their deposits, but their business appears to be conducted with great prudence and dis- cretion. One hundred and eighty-two of these were members of the French Country Bankers' Association in 1898. They carry on business in 66 out of the 86^ Departments. More than one of these banks has several offices — one possessing 18, including the head office. These branches are situated in the small towns in the vicinity. In this the business follows more the English method of small branches. The French Country Bankers' Association holds its meetings in Paris, where matters of interest to bankers are discussed. (See Bankers' Magazine^ July 1898.)~~

~~The business of banking in France is carried on with great regularity and vigour. Little, comparatively, is heard of it in a general way beyond the boundaries of the country, but within those limits it exerts a very useful influence on the development of industrial progress and of agriculture.~~

~~Germany.~~

~~There are, together with the Eeichsbank, to whick reference will be made more particularly later, about 140 banks doing business in the states which form the German empire. These credit and industrial banks with their large resources have had an immense influence in bringing about the astonishing industrial development of the country. Six of these banks possess the right of uncovered note issue ; these are —~~

~~Bank of Frankfort, with right of issue~~

~~£500,000~~

~~Bank of Saxony, ,,~~

~~838,550~~

~~Bank of Bavaria, ,,~~

~~1,600,000~~

~~Bank of Wurtemberg, ,,~~

~~500,000~~

~~Bank of Baden, ,,~~

~~500,000~~

~~Bank of South Germany, ,,~~

~~500,000~~

~~£4,438,550~~

~~Besides these there are (to name only some of the more im- portant of the credit and industrial banks) the following : —~~

~~Deutsche Bank (capital and reserve, deposits and~~

~~acceptances) £32,000,000′~~

~~Disconto-Gesellschaft (capital and reserve, deposits~~

~~and acceptances) ‘ . 20,000,000′~~

~~Dresdner Bank (capital and reserve, deposits and~~

~~acceptances) 23,000,000′~~

~~Bayerische Handelsbank (capital and reserve, deposits~~

~~and acceptances) nearly 9,000,000-~~

~~Bergisch Markisohe Bank (capital and reserve, de- posits and acceptances) . . more than 6,000,000'~~

~~Berliner Handels-Gesellschaft (capital and reserve,~~

~~deposits and acceptances) . . more than 11,000,000-~~

~~National Bank flir Deutschland (capital and reserve,~~

~~deposits and acceptances) . . . about 8,000,000'~~

~~The capital and reserves of all these larger German banks, including those of the Bank of Germany, are fully~~

~~banks]~~

~~£130,000,000. This amount compares very closely witli the amount of the capital of the banks of the United Kingdom, but the deposits do not bear in the least any close proportion to those held by the English banks. The deposits, however, are not the whole of the resources of the German banks. The banks make use, besides, of their acceptances in a manner which is not practised by the banks of other countries, and the average note circu lation of the Keichsbank alone is between £50,000,000 and £60,000,000. The circulation of the other note- issuing banks does not appear to be up to the limit allowed.~~

~~A large proportion of the resources of the German banks is employed in industrial concerns, some of which are beyond the boundaries of the empire. The dangers of this practice have called forth many criticisms in Germany, among which we may quote the remarks of Mr CaBsar Strauss and of Dr R. Koch, the president of the Eeichsbank. Dr Koch especially points out the need of the increase of powerful banks in Germany unconnected with speculative business of this kind. The object of employing their funds thus is the higher rate of interest ~to be obtained~~

~~from these investments than from dis- counting bills or making loans at h6me. But such an employment of the resources of a bank is opposed to all regular rules of business and of banking tradition, which abstains from fixed investments of any large part of the resources of a bank. On the other hand, Dr Koch observes that the risks of the one "reserve system " mentioned by Bagehot are not to be feared in Germany."^~~

~~There are, besides the banks we have referred to, many private banking firms in Germany which do a consider- able amount of business.~~

~~The Imperial Bank (Reichsbank), which is by far the most powerful banking institution in Germany, is man- aged by the Bank Directory appointed by the ^i^s- Chancellor of the empire. The shareholders join in the management through a committee, of which each member must be qualified by holding not less than three shares. The government exercises complete powers of control through the Chancellor of the empire. The influence of the Imperial Bank now permeates by means of its branches all the separate kingdoms of the empire — the uniformity of coinage introduced through the laws of 1871-73 rendering this possible. The Imperial Bank assists business principally in two ways. First through the clearing system (Giro-Verkehr), which it has greatly developed, and secondly through the facilities given to business by its note circulation. The Imperial Bank also receives deposits, and cheques are drawn against these, but in Germany notes are principally used in payments for ordinary business. Before the Reichsbank was established, Hamburg was the first and for a long time the only example of a clearing in Germany. This was taken up by the Reichsbank when it established its office in Hamburg in the time-honoured building which had belonged to the Hamburg Clearing House. Similar business had long been undertaken by the Bank of Prussia. This was absorbed and developed by the Reichsbank in 1876. Through the "clearing system" money can be remitted from any of the 311 places in which there is an office of the Reichsbank, to any other of these places, without charge either to the sender or the receiver. It is sufficient that the person to whom the money is to be remitted should have an account at the bank. Any person owing him money in the remotest parts of the empire may go to the office of the bank which~~

~~1 Vortrage und Aufsdtze hauptsachlich aus dem Hcmdels- und Wechselrecht, von Dr R. Koch, pp. 163-4.~~

~~is most convenient to him and pay in' the amount of his debt, which is immediately remitted, without charge, to the account of his creditor wherever he may reside. The impetus given to business by this arrangement has been very considerable. It practically amounts to a money- order system without charge or risk of loss in transmis- sion. From Hamburg and Bremen to the frontiers of Russia, from the shores of the Baltic to the frontiers of Switzerland, Germany, for monetary purposes, is thus only one country. The note circulation is also a powerful factor of the business of the Reichsbank. It is governed by the law of 1876 and the amending law of 1899, corre- sponding in some degree to Peel's Act of 1844, which regulates the note circulation of the Bank of England. An uncovered limit, originally, £12,500,000, increased to £14,811,450 by the lapse of the issues of other banks allowed to it, has been extended by the Act of 1899 to £22,500,000. Against the notes thus issued which are not represented by specie, treasury notes (Eeichskassen- scheine, the legal tender notes of the empire ^, and notes of the other issuing banks which are allowed to be reck- oned as specie, or discounted bills, must be held — maturing not later than three months after being taken — with, as a rule, three, but never less than two, good endorsements. There is also a provision that at least one-third of the notes in circulation must be covered by current German money, notes of the imperial treasury, and gold in bullion or foreign coin reckoned at £69, 12s. per pound fine. The Reichsbank is bound by law to redeem its notes in current German money. It is stated that this may be gold coin or silver thalers, or in bar gold at the rate of 1392 marks (£69, 12s., reckoning marks as 20 = £1) — the pound fine of gold. In practice, however, facilities are not always given by the Reichsbank for the payment of its obligations in gold, though the importance of this is admitted. In the balance sheet for 1899 the bills held amounted to £54,000,000, and the loans and advances to £8,500,000. The notes issued averaged for the year £57,000,000. The gold held amounted, 31st December 1899, to £23,450,000. If the condition of business requires that the notes in circulation should exceed the limits allowed by the law, the bank is permitted to do this on the payment of 5 per cent, on the surplus. In this respect the German Act differs from the English Act, which allows no such automatic statutory power of overpassing the~~

~~limit of issue. Some good authorities consider that this arrangement is an advantage for the German bank, but recent experience makes it doubtful whether the system may not tend to encourage reckless speculation. Of late years the excess of issue of the Reichsbank has been annual and has become large — more than £6,800,000, on average, in 1899. It remains to be seen whether the increase of the uncovered limit will be sufficient to obviate the need for an excess of issue beyond the limit for the future.~~

~~The amendment to the banking law of Germany, passed in 1899, not only affects the position of the Reichsbank, but that of the six other note-issuing banks. The Bill of 1899 directed an increase of the capital of the Reichsbank, then £6,000,000, up to £9,000,000. Of the £3,000,000 new capital, half is to be emitted prior to 31st December 1901 and the other half before 31st December 1905. The reserve fund, then £1,500,000, is to be raised gradu- ally out of surplus profits to a maximum of £3,000,000. The amending Act further diminishes the dividend receivable by the stock-holders of the Reichsbank~~

~~2 The imperial treasury is bound to pay the State notes in cash at any time when this is required, but an independent fund of cash set apart for this purpose does not exist. HandwOrteriuch der Staats- wissenschaften, vol. v., art. " Papiergeld," p. 97, ed. 1893. Jena: Conrad and Elster, Lexis and Loening.~~

~~[united~~

~~and increases the share which the Government will obtain. The untaxed limit of issue (note reserve, as termed in Germany) is increased, as mentioned above, from M.293,400,000 (£14,670,000) to M.450,000,000 (£22,500,000). The arrangement with the six note- issuing banks is designed to cause them to work in harmony with the Eeichsbank, when the Eeichsbank has to raise its rate in order to protect its gold reserve. The official published rate of discount of the Eeichsbank is to be binding on the private note-issuing banks after it has reached or when it exceeds 4 per cent.~~

~~At other times they are not to discount at more than a quarter per cent, below the official rate of the Eeichsbank, or in case the Eeichsbank itself discounts at a lower rate than the official rate, at more than one-eighth per cent, below that rate. If the Eeichsbank discounts below the official rate, it is to announce that fact in the Gazette.~~

~~The subject being important, we quote from the amending Act the sections governing the discount rate : — Gesetz, betreffeud die Abanderung des bank-gesetzes vom 14 Marz 1875 ; vom 7 Juni 1899, Artikel 7, § 1. The private note-issuing banks are bound by artikel 7, § 2, after the 1st January 1901 — "(1) Not to discount below the rate published in § 15 of the bank law, so long as this rate attains or exceeds 4 per cent. ; and (2) moreover, not to dis- count at more than a quarter per cent, below the Eeichsbank rate, published in § 15 of the bank law, or in case the Reichsbank itself discounts at a lower rate, not to discount at more than one-eighth per cent, below that rate."~~

~~It remains to be seen whether the note-issuing banks will find these conditions too onerous, and will give up their right of issuing notes rather than be bound by them. The object of the enactment is apparently to protect th^ specie reserve of the Eeichsbank, but it may be doubted whether, considering the importance of the other banks of Germany — none of which are bound by similar conditions — relatively to the note-issuing banks, the restrictions put on the note-issxiing banks will have any practical effect.~~

~~Since 1870 banking has made immense progress in Germany, but it will probably be some time before the system of making payments by cheque instead of specie or notes becomes general.~~

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~~United States.~~

~~The " National Bank Act " of 1864, as amended, has been modified by the Act of March 1900. Originally designed to force a market for U. S. bonds during a time of civil strife and to provide for the issue~~ *"'~~' of national currency, the Act of 1864 has created a great commercial institution, whose distinctive features are : implied responsibility of the U.S. Government for the safety of the notes of the banks ; reports made five times each year to the Comptroller of the Currency as to con- dition on days previous to the date of his call therefor ; verification of each bank's assets and liabilities by experi- enced Government examiners; and a compulsory cash reserve for each national bank, in large cities equal to 25 per cent, of the amount of its deposits. In the smaller cities this reserve is 15 per cent, of that liability, three-~~

~~states]~~

~~fifths of which may be deposited with banks in the larger cities as approved by the Comptroller of the Currency. Banks or associations may own their banking houses but no other real estate, unless taken for debt, and then only~~

~~for fiT« years. Interest rates are charged according to state laws. Dividends may not be paid to stockholders unless one-tenth of the profits is set aside as surplus, though such surplus need not exceed 20 per cent, of the capital stock. Notes of a bank, secured by a deposit at Washington of U.S. bonds, are receivable in payment of taxes, excises, public lands, and all other debts except custom duties. The average circulation of each bank or association is subject to a tax, and a fund amounting to 5 per cent, of such circulation is deposited at the Treasury by each bank for the purpose of redeeming mutilated notes. In addition to a possible loss of the money invested in the shares of national banks, stock- holders are personally liable for the debts of such banks to the amounts of their respective holdings at par.~~

~~By 1873 the National Banks' circulation had amounted to $341,320,256. Because of the swollen volume of the country's paper currency, gold had remained out of circulation, the premium working slowly down from the enormous war price of $258 of paper money for f 100 of gold in July 1864, to a rate of only 15 per cent. premium in the same month of 1873. During the panic of 1873 the circulating notes of the banks held good and were redeemed. With the "hard times" clamour for more currency, and with the constant outflow of exported gold, the Government's legal tender obligations could not be met in that coin. In preparation for the resumption of specie payments, 1st January 1879, the Government sold bonds, depositing large sums in the New York banks. Under the Bland Bill of 1877 the Government coined monthly 2,000,000 to 4,000,000 silver doUars— worth, internationally, about 90 cents in gold each. The New York Sub-Treasury was admitted to membership in the Clearing House in 1878, and in the same year the Clearing House rule was adopted, prohibiting payments of balances between members in silver except in small sums. In New York and Boston it was agreed that deposit accounts kept in terms of gold should be abolished. Arrangements wqre made for the maintenance of 40 per cent, of the outstand- ing U.S. notes to be held by the Treasury in gold. By the aid of the banks, which agreed not to demand pay- ment of their legal tender notes in gold from the New York Sub-Treasury, a gold standard of value was estab- lished in 1879.~~

~~The regular increase in the volume of money under the Bland Law, and the inability of the U.S. Treasury to get rid of its accumulating stock of silver~~

through the banks, led Congress, in 1882, to stipulate that no national bank- ing association should be amember of any Clearing House in which silver certificates should not be received in settle- ment of balances ; but the banks were only striving to resist the- conversion of their banking reserve from gold into silver. Meanwhile, under the stimulus of agricultural and business prosperity, speculation had gone beyond bounds, producing in 1884 a panic, mainly confined to New York financial circles. Several important failures occurred in Wall Street, including the Marine and Metro- politan Banks, though the banks in geheral well sustained the burden of credits. On 1st October 1881 the circular tion of all the national banks amounted to |320,t)00,000. In July 1882 the Government funded its outstanding 6 per cent, war bonds by an issue of 3 per cents. As considerably more than half the bank holdings were of the class converted, and as tl^e Government policy of reducing interest also led to the retirement of bonds by the aid of its now steadily-growing revenue surplus, during the next

few years bank-note circulation steadily decreased, until by October 1890 the outstanding notes were ^educed to $122,928,084, the lowest point ever reached. In 1885, because of a diminishing gold reserve, the New York banks on appeal turned over to the U.S. Treasury nearly $6,000,000 gold in return for fractional silver coin. During these years other forms of currency than the bank notes increased in volume. In 1890 the Treasury legal tender notes, and the form of Government obliga- tion known as silver certificates, together aggregated $620,000,000. Until this time the Government's gold reserve had been constantly maintained since 1879 at above $100,000,000, and the arrangement with the banks for them to redeem in gold the notes turned in by the public while exchanging gold at the Sub-Treasury for the same notes had been carried out. In 1890 a law was passed which obliged the U.S. Treasury to purchase 4,500,000 ounces of silver monthly, and to pay for the same in U.S. notes, which should be redeemed in gold or silver coin. In 1891 the gold reserve fell below

$100,000,000.

The years between 1885 and 1893 were years of activity and business prosperity, supported by abundant harvests marketed at high prices. A reaction was the result, and by 1893 a memorable panic had set in.

~~Frightened de- positors withdrew their money from banks in the west, while increased demands for loans came upon the banks east and west alike. The western banks withdrew from the reserve cities the funds which they had left with the reserve banks, in order to secure the 2 per cent, interest allowed on such deposits, with the result of decreasing the cash reserve in New York city alone over $41,000,000 in the space of two months, bringing these reserves, as was usually the case in times of panic, below the 25 per cent, required by law. Large railroad and industrial suspensions resulted, yet, as heretofore, the banks were able to meet all emergencies because of their inherent soundness. In that year the New York banks turned over to the Treasury more than $6,000,000 in gold in exchange for U.S. notes. During this panic a plan was again successfully employed, which had been tried in the panic of 1873 and again in 1884 and 1890, namely, the issue by the New York Clearing House of loan certificates, having as the basis of their value securities and sound commercial paper of the banks deposited with the Clearing House to an amount 25 per cent, above the par of the certificates. These Clearing House certificates passed be- tween the banks in lieu of cash settlement for Clearing House balances. The example of New York was followed by the Clearing Houses of Boston, Philadelphia, Baltimore, and Pittsburgh. No very important National Bank failures resulted, although upwards of, 150 banks out of an aggre- gate of 3800 suspended during the year, all but five being in the west and south; nearly 400 state and savings banks and private bankers, however, came to grief. Finally, the New York banks, by means of increased Clearing House certificates, arranged to import several millions of gold.~~

~~Because of a scarcity of currency, depositors had been compelled to accept certified cheques instead of money for all purposes except the most urgent needs. Both gold and paper money commanded a premium of 4 per cent, over bank cheques, and gold was attracted from abroad and from being hoarded to realize the profit. In February 1894 the banks subscribed for 80 per cent, of a new issue of Government bonds. In August of the same year, on appeal from the U.S. Treasury, they again exchanged $15,000,000 of gold for U.S. notes called legal tenders. In November the banks again subscribed for a further issue of Government bonds. In January 1895 a syndicate~~

~~[united~~

~~of international banks and bankers subscribed for another issue of Government bonds, with the condition that the syndicate would protect the Treasury against the with- drawal of gold for export purposes. These operations, extending through the years 1895 and 1896, together with the check given to the increasing amount of silver by the repeal in 1893 of the Silver Purchase Law of 1890, had the effect of restoring public confidence in the Govern- ment's ability to redeem its obligations in gold at any time. Since 1895 banking has not experienced star- tling changes, bearing up well under the Venezuelan diffi- culties of that year, the outbreak of the Spanish war in 1898, and the flurry in the money market in December~~

~~1899.~~

~~Some tendencies have shown themselves. Following other lines of business, consolidation of banks has increased as bankers have become impressed with the advisability of having larger financial institutions. In the same way many banks have increased their capital, so that larger amounts could be lent at one time, and that larger depositors might be attracted by the added security. In April 1899 the New York banks, acting through the Clearing House, agreed upon a schedule of charges for the collection of out-of-town cheques deposited with them in the course of business, such cheques having been collected gratis. The custom has been growing of requiring state- ments of financial condition from merchants and corporOr tions when asking for loans or offering for sale single- name commercial paper. The formation of the large industrial companies has tended to take from the banks the smaller loans made heretofore to the individual concerns absorbed, and to substitute the lending of large sums to the industrial combinations themselves, the latter plan involving more of the principles of corpora- tion financing.~~

~~In March 1900 certain of the provisions of the National Banking Act were amended as follows: — The ratio of population to capital of new banks in~~

~~places Baflfc”’’ °* l^ss than 3000, to be $25,000 ; in places of not more than 6000, not less than $100,000. Old and new banks to be allowed circulation up to the full par of bond deposited with the Treasury, while such bonds shall remain at or above par in the market. Not more than one-third of each bank’s circulation to be in denomination of five dollars. Each bank to be permitted to obtain circulation on deposit of new 2 per cent, bonds authorized under the same Act. The average circu- lation to be taxed ^ per cent, each half-year. The bonds thus authorized were designed to refund former issues at higher rates, and from the first, large exchanges of the new bonds were effected, the latter being much esteemed as a basis for national bank circulation, particularly as touch- ing newly-organized banks in small towns and cities. On 13th February 1900, the national banks of the U.S. numbered 3604; their total assets were $4,674,910,713, inclusive of about 550 millions of dollars due to and from the banks themselves. Among their assets were the following, in millions of dollars : — Loans and discounts, 2481; U.S. bonds for circulation, 236; stocks, securities, &c., 330; banking houses, 79; other real estate and mortgages owned, 28; specie, 339; legal tender notes, 122. Among the liabilities were, also in millions of dollars: — Capital stock paid in, 613; surplus and un- divided profits, 363 ; circulating notes, 204 ; due to state banks and bankers, 318; individual deposits, 2481; U.S. deposits, 103. Of the above assets New York city banks comprised $1,107,000,000, including loans and discounts of 499 millions; their capital stock was 56 millions; their surplus and undivided profits, 68 millions ; their circulation outstanding, 17 millions ; their individual deposits, 475 millions. The National City Bank of New**

~~York, the largest bank in the U.S., had “a capital of 10 million dollars paid in, and assets of 168 millions ; while the Chemical National Bank, also of New York, had 38 millions of assets, at the same time reporting a capital stock of $300,000, with a surplus of undivided profits of $6,697,000, or over 22 times the amount of the original capital, this surplus making it the richest bank of the U.S. in point of book value of capital stock.~~

~~From the inception of the National Bank plan, the State banks began to withdraw their circulating notes, a national law having been passed making their notes subject to a prohibitive tax of 10 per f*”^ cent, on the average annual circulation. By 1873 the aggregate of notes outstanding on account~~

~~of all the State banks was only about $200,000, some of them having a few scattered notes in circulation at the present time. The laws in all the forty-four States differ to some extent, but the following chief distinctions from the National Bank plan may be observed, the excellent laws of New York State being taken as fairly representative of the regulations in all the States. A State superintendent of banks is appointed by the Governor for a term of three years. This official exercises a control over the banks, in- cluding savings banks and loan and trust companies, similar to that of the National Comptroller of the currency. Reports are rendered to him every half-year ; and in New York State, as in most of the other States (Khode Island being an exception to the general rule), an examination of each bank is made by his department at irregular intervals, but at least once in each year. Loans may not be made to any one person, firm, or corporation in excess of 20 per cent, of a bank's combined capital and surplus. Notes or other evidences of debt shall not be purchased for less than the amount due according to the face of the same. Loans may be made upon mortgages, but except for owning a banking-house, real estate may not be acquired except for debt. A money reserve of 15 per cent, is required in New York city, and of 10 per cent, in other cities in New York State. Stockholders are responsible for the debts of the bank to the extent of the par value of their stock, in addition to the amount invested in such stock. Under the New York law 6 per cent, is the legal rate of interest, but demand loans secured by collaterals may be made at higher rates. Since 1895 it has been lawful in New York State for banks in the same municipality to consolidate, as agreed upon by their respective directors and subject to the approval of the superintendent of banks. This privilege has been utilized in several cases, one large New York city institution, the Corn Exchange bank, having in three years absorbed five smaller State banks. In 1863 the State banks numbered 1466 throughout the United States. Five years later they had decreased to 247 ; but in subsequent years they grew very rapidly in number, aggregating 620 in 1880, 2101 in 1890, and 4191 in 1899. The assets of these latter aggregated in 1899, $1,636,000,000, including the following in millions of dollars : — Loans on real estate, 51 ; other loans, 857 ; stocks and bonds, 172 ; due from banks, 255 ; real estata, 68; cash and cash items, 216. Among their liabilities also in millions of dollars were : — Ca.pital stock, 233 ; surplus and undivided profits, 113; deposits, 1164; due to banks, 108. The greater proportion of failures on their part, as against failures of~~

~~National Banks, should be noted. In the six and a half years beginning with the panic year of 1893 and ending 30th June 1899, 283 State banks failed, having assets, according to their books, amounting to $62,739,332. Of these sums there had been recovered from shareholders $1,517,178, and from the liquidation of assets $32,925,233, or about 56 per cent, of the total assets. The total failures of National Banks during thirty-six years, from 1864-99 inclusive, were~~

~~states]~~

~~only 387. The nominal assets of these National Banks aggregated f 235,636,778. Upon the assets of 376 of these there had been collected on 31st October 1899, either from stockholders or from the liquidation of assets, 73-92 per cent.~~

~~There is a large number of private bankers in the United States, particularly in the central-western States. In 1899, 756 of these had total assets of over $87,000,000, of which about $14,000,000 represented the investment or other holding of individual capital and about $65,000,000 depositors' funds.~~

~~The New York Clearing House Association, instituted in 1853, is the foremost clearing organization in the United States. The largest banks in the city Housed ^'°* representatives each morning to the clear- ■ ing building, where all the cheques received on deposit during the previous day by each bank on other Clearing House banks are exchanged. At precisely ten o'clock, on the stroke of the manager's bell, the clerks of the banks begin to pass from desk to desk, delivering packages of cheques to the settling clerk of each bank. The average length of time required for effecting this exchange of cheques is nine minutes, and the cheques are immediately taken away to the banks on which they are drawn. The aggregates of cheques received, as per the footings made by all the settling clerks, is made to balance against the aggregates, previously prepared, of all the cheques which have been brought to the Clearing House. Forty-live minutes usually suffices to ascertain the amount in which each bank has become a debtor or~~

~~creditor with the Clearing House. Each debtor bank then has until 12.30 o'clock to turn in to the manager of the Clearing House in cash the amount of its debit balance, settlement with creditor banks being made, also in cash, by 1.30 o'clock. Tardiness as well as inaccuracies in listings or footings subjects the banks to fines. During 1900 a single cheque for $17,000,000 was cleared. In the previous year one bank had a credit balance after making its day's exchanges of $13,462,379.78. The ' total clearings of the New York institution during 1899 were $67,368,230,771. The average daily clearings amounted to $189,961,029. The total balances for that year between members were $3,085,971,370, the average each day being $10,218,448, involving the handling of over 260,000 daily cheques. Similar Clearing House ar- rangements obtain in 71 other American cities. The total clearings of all these institutions were $38,626,000,000 in 1879; $66,175,000,000 in 1889; and $88,909,671,776 in 1899. The New York Association was, in 1900, com- posed of 63 banks and the U.S. sub-treasury at New York. Ninety-five banks have been members of the Association since it was organized. The loss in numbers is due to failures, retirements, and consolidations. Of the first 26 members,^ 19 still remained in 1900. The Association is composed only of National and State banks, but these provide clearing accommodations for 78 other banking institutions, trust companies, which do an in- dividual deposit business, and smaller neighbouring banks. No bank can become a member of the New York Clearing House, or is allowed to clear its cheques through the bank of a member, until its Board of Directors by resolution gives permission to the Clearing House Committee to examine into its financial condition at any time without notice. The Clearing House issues every Saturday a statement showing the condition of all the banks by aggregates, averaged for the week, and giving surplus over required reserve. This statement is regarded as important by financial circles throughout the U.S. as indicating by comparison tendencies in the money market. (t- l- g.)~~

~~II. Laws affecting Banks and theik Customers.~~

~~Apart from the question of the issue of bank notes the modern tendency of legislation and legal decision alike appears to favour the expansion and facilitate the operar tions of banking. With regard to note issue, the legis- lation which culminated in the Bank Charter Acts of 1844 and 1845 secured~~

~~to the Bank of England the absolute monopoly of the note issue within the City, of London and a three-miles radius. Outside that radius, and within sixty-five miles of the City, there is a con- current right in banks, consisting of six or less than six persons, established before 1844, and issuing notes at that date ; beyond the sixty-five-miles radius the privilege may be exercised by all banks established before 1844, and then issuing notes, who have not since lost their right to do so by bankruptcy, abandonment of business, or temporary suspension of issue. According to some authorities, the effect of 20 and 21 Vict. cap. 49, sec. 12 was to sanction the increase in the constitution of any bank issuing notes outside the three-miles and within the sixty-five-miles radius from six to ten persons without affecting the power to issue notes. This is the view accepted by Chalmers, Macleod, and Byles; while, on the other hand, Lord Lindley, Grant, Chitty, Douglas Walker, and Cavanagh regard the constitution of such banks as limited to six persons. Consideration of the various statutes appears to support the view of the latter authorities, and the rule as laid down above is believed to be the correct one. the increase in the number of Joint Stock Banks and the gradual absorption of the smaller and older concerns have had the effect of diminishing the output of notes other than those issued by the Bank of England, and, as exemplified by the case of Tlie Attorney- General V. BirkbecJc, 12 Q. B. D. 57, it would seem impos- sible to devise any scheme by which the note-issuing power of an absorbed bank could be continued to the new or amalgamated body.~~

~~The functions of a bank as what is somewhat incor- rectly termed a bank of deposit, as opposed to a bank of issue, are of more everyday importance. The term "bank of deposit" gives a mistaken idea of the real relation between banker and customer. So long ago as 1848 it was decided by the House of Lords in Foley v. Hill, 2 H. of L. 28, that the real relation between banker and customer was that of debtor and creditor, not in any sense that of trustee and cestui que trust, or depositee and depositor, as had been formerly supposed and contended. The ordinary process by which a man pays money in to his account at his banker's is in law simply lending the money to the banker ; it fixes the banker with no fiduciary relation, and he is in no way responsible to the customer for the use he may make of the money ^^"**'' so paid in. And as being a mere debt, a cus- customer. tomer's right to recover money paid in is barred on the expiration of six~~

~~years by the Statute of Limita- tions, if there has been no payment meantime on account of principal or interest, and no acknowledgment sufficient to bar the statute (Pott v. Clegg, 16 M. & W. 321). Such a state of affairs, however, is hardly likely to arise, inas- much as, in the absence of specific appropriation, earlier drawings out are attributed to the earlier payments in, as in the ordinary case of current accounts, and so the items on the credit and debit side cancel each other. An apparent exception to this system of appropriation exists in cases where a man wrongfully pays into his own account monies held by him in a fiduciary capacity. In such circumstances he is presumed to have drawn out his own monies rather than those affected by the trust, and so long as the account is in credit, any balance will be~~

~~attributed to the trust money. As between contending claims to the money, based on different breaches of trust, the ordinary rule of appropriation will apply.~~

~~It has often been suggested that the only method of withdrawing money from a banker is by cheque, that the presentation of a cheque is a condition precedent to the liability of the banker to repay. This is not so; such a view being inconsistent with the cases establishing the effect of the Statute of Limitations on money left in a banker's hands, and with the numerous cases in which a balance at a bank has been attached as a simple and unconditional debt by a garnishee order, as, for instance, in Rogers v. Whiteley, 1892, A. C. 118. The banker's position with regard to cheques is that, super added to the relation of debtor and creditor, there is an obligation to honour the customer's cheques provided the banker has a suf&cient and available balance in his hands for the purpose (Foley v. HilV). If, having such funds in his hands, the banker dishonours a cheque, he is liable to the customer in substantial damages without proof of actual injury having~~

~~accrued (Rolin v. Steward, 14 C. B. 596). It would further seem a legitimate condition that the cheque should be drawn in the ordinary recognized form, not in one raising any question or doubt as to its validity or effect. Cheques drawn to " wages or order," " petty cash or order," or the like, are common, and are usually regarded as payable to bearer. Such payees are not, however, " fictitious or non-existent persons," so as to render the cheques payable to the bearer under sec. 7, subs. 3 of the Bills of Exchange Act, 1882, hereinafter referred to, nor can such payees indorse. Some banks, therefore, refuse to pay such cheques, and it is conceived they are justified in so doing. Money paid in so shortly before the presentation of the cheque that there would not have been time to pass it through the books of the bank would not be treated as available for this purpose. If a person have an account at one branch of a bank, he is not entitled to draw cheques on another branch where he has either np account or is overdrawn, but the bank has, as against the customer, the right to combine accounts at different branches and treat them as one account {Garnet v. M'Ewen, L. E. 8 Ex. 10).~~

~~The very questionable practice of post-dating cheques has been the source of considerable doubt and incon- venience to bankers. The use of such documents enables the drawer to obtain the results of a bill at a fixed future date without the expense of a regular bill-stamp. But the Bills of Exchange Act, 1882, sec. 13, subs. 1, pro- vides that "a bill is not invalid by reason only that it is ante-dated or post-dated, or that it bears date on a Sunday." It seems very possible that the drawer may be liable to penalties under the Stamp Act, 1891, either for issuing a document improperly stamped, or for executing an instrument in which all the facts and circumstances affecting its liability to stamp duty are not truly set forth, inasmuch as a post-dated cheque is not really payable on demand, but only on demand after a future date. These, however, are matters with which the banker is not con- cerned. He cannot refuse to pay a cheque presented after the apparent date of its issue on the ground that he knows it to have been post-dated. On the other hand, he is entitled and indeed bound to refuse payment if such a cheque is presented before the apparent date of its issue.~~

~~The banker is bound to observe secrecy with respect to the customer's account, unless good cause exists for disclosure, and the obligation does not cease if the account becomes overdrawn {Hardy v. Veasey, L. E. 3 Ex. 107).~~

~~In England a cheque is not an assignment of funds in the banker's hands (Bills of Exchange Act, 1882, sec. 53). The holder of the cheque has therefore no~~

~~claim on the banker in the event of payment being refused, his remedy being against the drawer and indorser, if any. On this section is also based the custom of English bankers not to pay part of the amount of a cheque where there are funds, though not sufficient to meet the whole amount. The section does not apply to Scotland, where it would seem that the bank is bound to pay over what funds it has towards satisfaction of the cheque. A banker is entitled to hold paid cheques as vouchers until there has been a settlement of account between him and the cus- tomer. The entries in a pass-book constitute 2>nm,d facie evidence against the banker, and when returned by the ■customer without comment, against him ; but in either case such evidence may be displaced by proof that the entries have been made by mistake and do not represent the true state of the accouht. It has been held, however, that where the customer has altered his position on the faith of entries in the pass-book showing money to have been received, the banker cannot afterwards deny the receipt of such monies or retain others in satisfaction of them {STcyring v. Greenwood, 4 B. & C. 281). Acqui-escence by the customer in a course of business indicated in the pass-book will justify the banker in treating such course of business as established for the future so long as the relation of banker and customer continues. In this manner the banker may acquire the right to charge interest or even compound interest on overdrafts, neither of which he is entitled to do at common law.~~

~~The above-mentioned rule, by which the holder of a cheque has no direct recourse against the banker who dishonours it, holds good even wbfere the banker has marked or certified the cheque as good for the amount, such marking not amounting to an acceptance by the banker. As between banker and banker, however, such marking or certifying probably amounts to a binding representation that the cheque will be paid. In the United States, on the contrary, a certified cheque gives the holder a direct claim against the banker, and if the cheque be so certified at the instance of the holder this operates as a complete discharge to the drawer.~~

~~Where legislation has intervened for the protection of the banker, it has usually been to counterbalance some particular risk which would otherwise have been imposed upon him by enactments primarily intended to safeguard the customer. Thus in 1863 the Stamp Act of that year made a penny stamp sufficient for an order cheque as well as a bearer cheque, the object being the protection of the drawer by making it impossible for a wrongful holder to obtain payment without committing forgery. But it was recognized that this would cast a new burden on the banker, who would obtain no discharge by paying on a forged indorsement. A section was therefore inserted in the Act, relieving the banker from responsibility in case of payment on a forged or unauthorized indorsement, and the provisions of this section are practically re-enacted by sec. 60 of the Bills of Exchange Act, 1882. It appears, however, very doubtful whether this section protects a banker who, according to the usual custom, demands and obtains the signature of an ostensible payee on the back of an order check presented by him for payment in that character. Such signature is not an indorsement within sec. 2 of the Act, and the payment is not made on the forged indorsement, nor to him as indorsee, but as payee.~~

~~So again with crossed cheques. The custom of crossing cheques originated between bankers at the Clearing House, and was adopted by the public for a consider- able period before it received any legislative S^eguel recognition or efficacy. At this stage such crossing only operated as a warning to the banker on~~

~~aspects]~~

~~whom the cheque was drawn to exercise caution in pay- ing the cheque otherwise than to a banker if crossed generally, or to a particular banker if crossed specially. Various statutes, now repealed, were passed between 1856 and 1882 dealing with the subject, the effect of which IS reproduced by the Bills of Exchange Act, 1882. That statute authorizes various forms of crossing, and renders the paying banker liable, not only to the drawer, but also to the true owner, for any loss he may have sus- tained by reason of the~~

~~banker having paid the cheque contrary to the crossing. The system, designed in the interest and for the protection of the public, imposed new burdens on the paying banker and indirectly on the collecting banker. It necessitated the intervention of a banker for the obtaining payment of any, crossed cheque, thus largely increasing the mass of such business and the risk of the collecting banker being held liable in any case where he had collected a cheque for a person who had no title to it, as where it was held under a forged indorsement. Some counterbalancing advantages were therefore conferred on bankers. By sec. 80 it was enacted that where a banker on whom a crossed cheque is drawn, in good faith and without negligence pays it, if crossed generally, to a banker, and, if crossed specially, to the banker to whom it is crossed or his agent for collection, being a banker, he shall be entitled to the same rights and be placed in the same position as if payment of the cheque had been made to the true owner thereof. Ex- emption from liability in respect of payment of a crossed cheque was thus ensured to the paying banker in certain cases in which he might not have been able to debit his customer with payment of an open cheque. The pro- tection to the collecting banker is contained in sec. 82, which enacts that "when a banker in good faith and without negligence receives payment for a customer of a cheque crossed generally, or specially to himself, and the customer has no title or a defective title thereto, the banker shall not incur any liability to the true owner of the cheque by reason only of having received such pay- ment." This section has been the subject of much judicial interpretation, both as to what constitutes a customer and when a bank receives payment for the cus- tomer and when for itself. A single isolated transaction cannot constitute a man a customer (Matthews v. Williams, Brown & Co., 10 Times L. B.. 386; Lacave v. Credit Lyonnais, 1897, 1 Q. B. 148). But where the relation of banker and customer exists, the fact that the account is overdrawn does not preclude the banker who has received the proceeds of a cheque paid in by his customer from pro- tection {Clarke v. The London and County Bank, 1897, 1 Q. B. 652), the transaction being regarded as in substance a collection for the customer, although the banker might be benefited by the reduction of the overdraft. The judgment of the House of Lords (given on 22nd July 1901) iu the case of The Great Western Railway Co. v. The London and County Bank (1901, A. C. 414) contains an authoritative exposition of this section. In that case a rate-collector named Huggins had for many years been in the~~

~~habit of obtaining at one of the branches of the defendant bank cash for cheques drawn in his favour on other banks. He was consequently well known there, but kept no account with the defendant bank, and his only transactions with them were of the above nature. He fraudulently obtained from the plaintiff company a cheque to his own order crossed " not negotiable." This cheque he took to the defendants' branch and endorsed to them, receiving the full face value at once, save for a small balance which by his direction was put to another account, and the defendant bank in due course received the pro- ceeds of the cheque from the bank on which it was drawn. The judge of first instance and the Court of Appeal held~~

~~that the defendants were protected by sec. 82, having received payment of the cheque for a customer in good faith and without negligence, and gave judgment in favour of the bank. This judgment was reversed by the House of Lords, and judgment given for the plaintiffs, the main grounds of the judgment being that the dealings between Huggins and the bank were not properly de- scribable as banking transactions, and could not there- fore, however long continued, constitute him a customer, and secondly that, whether the bank were to be regarded as having purchased the cheque or as having advanced the full amount on the security of it, they had received the proceeds for themselves and not for Huggins. It may now therefore be taken as settled law that to consti- tute a man a customer within this 82nd section he must either have an account with the bank or at the least must be in the habit of resorting to the bank in the course of ordinary banking transactions productive of advantage to both parties, and further, that a bank which has given cash over the counter for a cheque drawn on another bank cannot subsequently set up that it received the proceeds for any one but itself. Lord Brampton in this case enunciated a dictum or suggestion to the effect that, even supposing the case had been one of banker and customer and of genuine collection for the customer, still the fact of the cheque being marked " not negotiable " would or might have made a difference and deprived the bank of the protection of the section, on the ground that it was negligence to collect such a cheque without inquiry, even for the ostensible payee. Obviously such addition to the crossing can have no application what- ever where there has been no transfer of the cheque. And it is equally obvious that the fact of the customer being the transferee of a cheque crossed " not negotiable " in nowise affects the liability of the collecting~~

~~banker. Under sec. 76 of the Bills of Exchange Act the words " not negotiable " are simply made an optional integral part of the crossing, and so when sec. 82 speaks of negli- gence in relation to a crossed cheque, it can only mean negligence altogether independent of the form of the crossing. Again, the bearing and design of the "not negotiable " crossing is, under sec. 81, to affect the title of the transferee, and sec. 82 specially protects the banker in cases where, other conditions being fulfilled, the customer has either no title or a defective title to the cheque. Section 77, subs. 6, of the Bills of Exchange Act provides that " when an uncrossed cheque, or a cheque crossed generally, is sent to a banker for collection he may cross it specially to himself." It would appear somewhat doubtful whether this enables a banker to avail himself of the protection of sec. 82 by crossing an open cheque received by him for collection. In Bissell V. Fox, 51 Law Times Eep. 663, Denman, J., expressed the opinion that sec. 82 only applied where the banker received the cheque already crossed, but this subsection was not brought to his notice, not being applicable to the case, and there are grounds for believing that it was expressly introduced for the purpose of enabling bankers so to protect themselves. The addition to a crossing of the words " not negotiable " was sanctioned and its effect defined by the Crossed Cheques Act, 1876, and re-enacted by sec. 81 of the Bills of Exchange Act, 1882. Curious misapprehensions have existed with regard to this cross- ing, owing probably to the somewhat ambiguous words em- ployed. The presence of such a crossing does not preclude the transfer of the cheque. The word " negotiable " is not used as equivalent to " transferable " as it is elsewhere in the Act (see sec. 8, subs. 1). It denotes that the cheque is not fully negotiable, and the statutory effect annexed by the section to such crossing is to put the cheque on the footing of an overdue bill, with the result~~

~~that a person taking a cheque so crossed takes it subject to all equities affecting it, and can neither acquire nor pass on a better right either to the cheque itself or the money realized by means of it than the person from~~

~~whom he took the cheque. But so long as there is nothing wrong with the cheque or the circumstances attending its issue or transfer, it may pass through any number of hands, and be enforced by the holder for the time being. See the judgment of Vaughan Williams, L. J., in Great West- ern Railivay v. Tlie London and County Bank, 1900, 2 Q. B. 464, and of the House of Lords in the same case. The addition of these words to the crossing in no way pre- judices the protection afforded under the crossed cheques sections of the Bills of Exchange Act, 1882, to the pay- ing banker, on whom the crossing only imposes the duty of seeing that the cheque reaches him through the proper channel.~~

~~A practice has grown up of adding to the crossing of a cheque the words " account payee," or similar words indicating an intention that the cheque shall be placed to some particular account. There is no statutory sanction for such an addition, and its effect is somewhat doubtful. It was decided in National Bank v. Silke, 1891, 1 Q. B. 43.5, that the addition of such words did not prevent the cheque being transferable. Nor can such words have the statutory effect attributed to the words " not negotiable " by sec. 81 of the Bills of Exchange Act, 1882. Probably the only effect of such crossings as " account payee " is one analogous to that of an ordinary crossing before the legislature intervened, or now of an indorsement being per pro., namely, to impose a greater degree of caution upon the banker who receives a cheque so crossed for an account other than" the one indicated ; but the point has still to be definitely decided.~~

~~The protection of the banker against forged indorse- ments under sec. 60 of the Bills of Exchange Act, 1882, _ . extending only to bills or cheques payable to order on demand, the banker is not discharged in other cases by payment on a forged indorsement, unless circumstances exist to take the case out of the general rule. Such circumstances existed in the well-known case of Vagliano v. Tlie Bank of England, 1891, A. C. 107. In that case, by the fraud of the plaintiff's clerk, a genuine acceptance of the plaintiff's was obtained to documents in the form of bills to which the drawer's name was forged, and to which the name of the payees to whose order they were drawn was subsequently forged as indorsers. The names utilized as those of drawer and payee were the names of persons having business trans- actions with the plaintiff Vagliano, and their names were selected as giving colour~~

~~to the fraud. All the bills were accepted payable at the Bank of England where Vagliano had a large account. Their coming forward for payment was notified to the bank by letters of advice, which referred also to genuine bills, Vagliano's signature to the letters being fraudulently obtained. The fabri- cated bills were presented to the bank for payment by or on behalf of the fraudulent clerk, and paid by the bank over the counter. There were forty-three of such bills, and the amount realized by the clerk was £71,500, with which, on discovery of the frauds and conviction of the clerk, Vagliano refused to be debited. The House of Lords, by a majority, ultimately decided in favour of the bank. The main grounds of the judgment were as follows : That whether the documents could properly be termed bills or not, they must be treated as such as against Vagliano who had accredited them as such, and whose case against the bank was based on their possessing that character ; that, inasmuch as the persons whose names appeared as payees and indorsers, though really existing people known to Vagliano, were never intended to have~~

~~and never could have had anything to do with the bills, the bills came within the provisions of sec. 7, subs. 3 of the Bills of Exchange Act, 1882, which enacts that " Where the payee of a bill is a fictitious or non-existent person, the bill may be treated as payable to bearer " ; that whatever may have been the law prior to the Bills of Exchange Act, it was not necessary for the operation of this subsection that the fictitious or non-existent character of the payee should be within the knowledge of the acceptor or other person sought to be made liable ; that it was open to any one whose interest it was to do so to treat the bills as payable to bearer, that the bank was entitled to do so, and was therefore discharged; that apart from these considerations, the bank wdre agents for Vagliano in the payment of bills accepted payable there, that Vagliano's own act in accepting the bills and signing the letters of advice, and his omission to take any steps to verify the supposed transactions when circumstances occurred which might have aroused suspicion, were the direct cause of the bank's making the payments on his behalf, and that he was therefore not entitled to repudiate them. It was incidentally decided in this important case that a banker is not entitled to a reason- able time in which to make inquiries and satisfy him- self as to the genuineness of the indorsements on a bill, but must pay or refuse payment at once. Prior to this date the contrary opinion had prevailed,~~

~~founded on a dictum of Maule, J., in Boharts v. Tucker, 16 Q. B. 660 ; and when once the payment has been made, the banker, on discovery of the forgery, would appear to have no power, as against an innocent party, to retract it or claim repayment of the money. Such a payment-has no doubt been made under a mistake of fact, and so under ordinary rules of law would be recoverable, but it is essential for the free circulation of negotiable instru- ments that their payment or dishonour should be con- clusive as well as immediate, and if in the interval between payment and the claim for the return of the money the payee's position might have been altered, as would almost invariably be the case, the money is not recoverable (London and River I^late Bank v. The Bank of Liverpool, 1896, 1 Q. B. 7). This somewhat rigorous rule has been modified in Canada. By an Act of the Canadian Legislature passed in 1897, if a bill bearing a forged or unauthorized indorsement is paid in good faith and in the ordinary course of business by or on behalf of the drawee or acceptor, the money may be recovered from the person to whom it was paid or from any indorser who has indorsed the bill subsequently to the forged or unauthorized indorsement, provided notice be given in the same manner as notice of dis- honour. It was the more imperative on Canada to take this step because bankers there have no such protection in case of payment of bills payable on demand or cheques on a forged or unauthorized indorsement as is afforded in England by sec. 60 of the Bills of Exchange Act,~~

~~1882.~~

~~Another class of forgery to which bankers are more or less exposed is where the amount of a cheque is fraudu- lently altered, and the banker is thereby induced to pay the larger sum. In such cases the question arises whether he is entitled to debit the customer's account with the increased amount. In Young v. Grote, 4 Bing. 253, a man left signed blank cheques with his wife to be filled up as business required. The wife delivered one to a clerk with instructions to fill it up for a particular sum. He filled it up for that sum, but purposely left spaces to allow of the introduction of other words and figures. He showed it to the wife in this state, who told him to get it cashed ; the clerk then added words and figures, raising the apparent amount by £300, which the~~

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~~clerk obtained from the banker and appropriated. The court held that the bank were entitled to debit the~~ ?°°?2 ~~“^^*^ *’^^ ^^rger sum. The reasons assigned by the different judges were various and somewhat obscure, and probably no case has ever been so much discussed, doubted, and even dissented from as this one, which Lord Esher once described as ” the fount of bad argument.” The most recent criticisms upon it appear in the case of Scholfield V. Lord Londesborough, 1896, A. C. 514. There the House of Lords held that there was no duty on the part of the acceptor of a bill towards the possible holder binding him to take precautions against fraud of this natiire, but there are passages in the judgments which distinctly recognize that such a duty may exist on- the part of a customer towards his banker by virtue of the relation of mandant and mandatory, and the authority of Young v. Grote may be regarded as considerably rehabili- tated by these expressions of opinion.~~

~~The question of a banker's responsibility for the loss of valuables deposited with him by a customer for safe- keeping was raised, but not decided, in an action dtp^sitel brought by Mrs. Langtry against the Union Bank of London in 1896. Certain jewels belonging to her had been delivered up by the bank to an unauthorized person on a forged order. The case was settled; but bankers being desirous to ascertain their real position, many legal opinions were taken on the point, and after consideration of these, the Central Association of Bankers issued a memorandum, in which they stated that the best Ifegal opinion appeared to be that a distinction must be •drawn between cases in which valuables were by mistake delivered to the wrong person and cases in which they were destroyed, lost, stolen, or fraudulently abstracted, whether by an ofiftcer of the bank or some other person. That in the former case the question of negligence did not arise, the case being one of wrongful conversion of the goods by a voluntary act for which the bank was liable apart {tom any question of negligence. That, in the second case, that of loss or theft, the banker being a gratuitous bailee, would only be liable if he had failed to use such care as an ordinary prudent man would take of valuables of his own. The latter rule is practically that laid down in Gihlin v. MacMuUen, L. E. 2 P. C. 318, but in estimating the amount of care to be taken by the banker, the nature of the goods, if known or suspected, and the exceptional means of protection at the disposition •of bankers, such as strong-rooms, must be taken into consideration. Methods of obviating both classes of risk by means of special receiptsi have frequently been sug- gested, but such receipts do not appear to have come into general use.~~

~~This gratuitous assumption of the custody of valuables, like the collection of cheques and the usage by which bills are ordinarily accepted payable at a banker's, and presented and paid there, is an abnormal graft upon the ■original and simple system of banking. Banks are com- pelled to afford such facilities and undertake the resultant liabilities by the pressure of competition increasingly ■enhanced by the concurrence of Post Office and Trustee Savings Banks, state-aided institutions whose returns con- clusively demonstrate that they are utilized by classes for whose benefit they were never intended. And naturally ■this multiplication of the banker's functions complicates his legal position, inasmuch as, according to the branch ■of~~

~~business he is in a particular case pursuing, he may have to be regarded as a debtor, a creditor, an agent, or a bailee.~~

~~Apart, too, from such unusual transactions as the •cashing of crossed cheques over the counter, many banks Timdertake the discounting of bills and the granting of~~

~~advances on various classes of securities. This latter branch of business falls within the region of general rather than banking law, but the question has frequently arisen whether a bank has taken a '**«'' <9'- cheque in its capacity as agent for collection, or whether it has taken it as a transferee in the same way as a dis- counted bill. Banks invariably claim the right of redeb- iting a customer's account with any cheque which has been dishonoured on presentation, whether such cheque was indorsed by the customer or not, and notwithstanding any entry in the books with regard to such cheque. Such course is only justifiable on the supposition that the banker is acting purely as an agent for collection. Where the account is overdrawn at the time the cheque is paid in, when the customer is allowed to draw against the cheque before it is cleared, or where the cheque is at once entered as cash either in the pass-book or the books of the bank, there are authorities, such as ex p. Bichdale, 19 Ch. D. 409 ; M'Lean v. The Clydesdale Bank, 9 A. C. 95 ; and Royal Bank of Scotland v. Tottenham, 1894, 2 Q. B. 715, which go to prove that the bank become holders for value and proprietors of the cheque in their own right, a position inconsistent with that of a mere agent for its collection. It may be difficult logically to justify the conclusion, but from the late cases of Oaden v. The New- foundland Savings Bank, 1899, A. C. 281, and J. Bavins, Jun., and Sims v. The London and South-Western Bank, 1900, 1 Q. B. 270, it would appear that in all such cases the bank has really an option which character it will assume, and can, as suits its interest, either redebit the customer, or proceed against the other parties liable on the instrument in its own right as a holder in due course. The primd facie presumption would seem to be that a bank, not being a discount bank, is not likely to have taken the document as a transferee, leaving it, however, open to the bank to assert that it did so. The existence of the banker's lien enables him in many cases to enforce for his own benefit negotiable instruments strictly belonging to the customer. A banker has a lien over all securities of the customer coming to his hands in~~

his capacity of banker for the amount of the general bal- ance due from the customer. The lien extends to money, but not to goods or securities deposited for a specific purpose, as for safe custody, and it is excluded where another agreement relating to the subject-matter is shown.

The unauthorized pledging by stockbrokers or money- brokers of their clients' securities to secure advances from banks to themselves has given rise to important and apparently conflicting decisions of the House Pledging of Lords. In 1888 that tribunal gave judgment "lel^'^"" in the case of Lord Sheffield v. The London Joint Stock Bank, 13 A. C. 333. That judgment was widely understood as laying down the general proposition, that the nature of the business of the borrower which necessitates his being entrusted with securities belonging to other people was sufficient to put the banker on inquiry as to the extent of his authority to deal with them. In the later case of Simmons v. Tlie London Joint Stock Bank, 1892, A. C. 201, the House of Lords expressly declared that Lord Sheffield's case had been decided simply on the facts, which, in their Lordships' opinion, established actual knowledge on the part of the bank of the limited authority of the agent, and that no such proposition as is above referred to was to be deduced from that case. It must, therefore, be taken that no new legal principle was embodied in the earlier case. Nor was any new doctrine enunciated in the judgments in Simmons's case. They merely applied the ordinary rule of law by which the transferee of a negotiable instrument, whether the transfer

be absolute or by way of pledge, if lie take it in good faith and for value, and before it is overdue, acquires an independent title, unaffected by any equities existing against previous holders. Their Lordships expressly disclaimed the idea that there was anything in the nature of the business of a stockbroker or money-dealer to put a bank on inquiry as to his authority to deal with secur- ities in his hands tendered as cover for a personal ad- vance. The possession by an agent of negotiable instruments is, in the absence of extrinsic suspicious circumstances, suf&cient evidence of his authority to deal with them in any way he pleases. This view, being based

~~on the essential character of negotiable instru- ments, only applies to such as are in their nature fully negotiable, that is, which possess the quality of vesting in a hondrfide holder for value an independent title against all the world.~~

~~Outside bills, notes, and cheques, the category of fully negotiable instruments is a somewhat indeterminate one. It includes all such securities as either by statute Negotiable or by the custom of merchants have acquired rae/ite.' t^is particular quality. It has been claimed that custom of the Stock Exchange to treat a security as fully negotiable is, apart from statute, the only trustworthy test. It would probably be more correct to say, that in order to attain the status of full negotiability a security must be on its face negotiable and recognized as such by the mercantile community of the United Kingdom at large. Negotiability in the country of its origin is no evidence of negotiability in England {Picker v. Tlie London and County Bank, 18 Q. B. D. 615) . It has been contended on the authority of Crouch v. Cridit Fancier, L. E. 8 Q. B. 374, that, with regard to English securities, at any rate, evidence of modern mercantile usage was inadmissible to a.ffiy the character of negotiability to an instrument not re- cognized as negotiable by statute, or by that ancient custom of merchants which has been adopted by the common law. The judgment of Mr Justice Kennedy in the Bechuana-land Exploration Company v. The London Trading Bank, Limited, 1898, 2 Q. B. 668, seems, however, to show con- clusively that this view is not in accordance with the decision of the House of Lords in Goodwin v. Rohaits, 1 Ap. Cases, 476, and that when once a security, whether English or foreign, is universally recognized and treated by the mercantile community of Great Britain as negotiable, the fact of its acceptance as such being recent is no bar to its admission into the category of negotiable securities.~~

~~Bankers are affected or protected in certain cases by special legislation annexing to particular classes of docu- ments incidents usually found in connexion with strictly negotiable instruments. Thus, section 96 of the Bills of Exchange Act, 1882, extends to dividend warrants the provisions of the Act regarding crossed cheques; and sec. 17 of the Revenue Act, 1883, makes the same provisions applicable to " any document issued by a customer of a.ny banker, and intended to enable any person or body corporate to obtain payment from such bankei" of the sum of money~~

~~mentioned in such document." In dealing with such documents the banker must always bear in mind that it is only the crossed cheques sections of the Act which are applied by the above-mentioned legislation. Unless the documents are in themselves negotiable, either as being cheques within the terms of the Bills of Exchange Act, or as having acquired negotiability by statute or custom, they remain non-negotiable and even non-transferable instruments, and must be treated as such. The class of document, now so common, in which payment is made conditional on an annexed receipt being signed, dated, and presented with the order for payment, or in which payment is made dependent on presentation within~~

~~a specified period, are not cheques or negotiable instru- ments, though included in the above legislation. Bankers, therefore, would not be safe in collecting them for persons other than the actual payee, notwithstanding the crossing.~~

~~The rule laid down by the House of Lords in Rogers V. Whiteley, 1892, A. C. 118, as to the course to be adopted by a banker on whom a garnishee order nisi is served in respect of a judgment recovered g^"" against his customer, appears to impose a hard- ship on the latter. The garnishee order binds all debts due or accruing due to the customer to answer the judgment debt. The House of Lords heldr that however much the balance to the customer's credit exceeded the stated amount of the judgment debt, the banker, ^fter service of the order, was entitled and indeed bound to hold the whole balance, and to dishonour all cheques of the customer presented after that date, whether drawn before the order was served or not. It was suggested in some of the judgments that steps might be taken to modify this result of the process, but up to the present no alteration in the practice has been notified.~~

~~Although, as before stated, a banker is entitled to combine several accounts against the customer, he can- not do so in the face of an established course of business by which they are kept separate (Buckingham v. The London and Midland Bank, 12 Times L. E. 70). It is further deducible from this case that a bank is not enti- tled arbitrarily to close a customer's account when in credit by tendering him the balance, or offering to transfer it to another bank. Provision must at least be made for out- standing cheques, and the~~

~~practice of referring them to another bank is not an adequate provision, as it involves technical dishonour of the cheques.~~

~~The Bankers' Books Evidence Act, 1879, was passed to obviate the inconvenience and dislocation of business caused to bankers by their being compellable to produce their books in court, in legal proceedings to which they were not parties. It provides that duly authenticated copies of entries in such books shall be receivable as evidence of such entries, and the matters, accounts, and transactions therein recorded, and that no banker or of&cer of a bank shall in any legal proceedings, to which the bank is not a party, be compellable to pro- duce books or attend as a witness where such evidence could be supplied under the provisions of the Act unless a judge for special cause so orders. Provision is also made for inspection of bankers' books by parties to any legal proceedings who obtain a judge's order for the purpose. Although the exercise of this latter power is not in terms limited to inspection of the account of one of the parties to the litigation, an order will not be made for the inspection of the account of any other person save in exceptional circumstances, such, for instance, as there being ground for believing that the account, though in another name, is substantially the account of the litigant (Pollock v. Oarle, 1898, 1 Ch. 1 ; South Staffordshire Tramways Co. v. Ehbsmith, 1898, 2 Q. B. 669).~~

~~Banks frequently decline to open accounts under headings denoting that the customer holds the money in a fiduciary capacity, such as that of trustee or executor. But even if an account is so headed, or if the bank is otherwise affected with notice of its being a trust account, the bank is not entitled to raise any question whether cheques drawn on it are drawn for or applied to proper purposes. Presumably, however, a banker would be justified in refusing to honour a cheque drawn on the account, the object of which ^^^^^ was to benefit himself, as, for instance, to pay off an ascertained overdraft on the customer's private~~

~~Legal evidence.~~

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~~account; and a banker will not be allowed to retain any benefit from a payment made in circumstances amounting to privity on his part with the breach of trust {Oray v. Johnston, L. E. 3 H. of L. 1), as where, for instance, the banker has pressed for the payment of an ascertained overdraft on private account and received a cheque on the trust account for that purpose. The mere fact that money standing to the credit of a trust account was transferred to an overdrawn private accoimt on which no balancje had been struck, and for the liquidation of which no application had been made, and, being so trans- ferred, wiped out the overdraft, was held^in Oray v. Johnston not to show any privity on the part of the banker with the breach of trust, and he retained the money so transferred against the beneficiaries.~~

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~~Banking Practice, 5th edit. 1898. Blades, East, and Blades, and Effingham WOson.— Legal Decisions affecting Bankers, 1900. Same publishers.— J. Douglas Walker. A Treatise on Banking Law, 2nd edit. 1885. Stevens and Sons. — Chalmers. Bills of Exchange, 5th edit. 1896. Stevens and Sons. — Daniel. Negotiable Instruments, 4th edit. 1891. Baker, Voorhis, and Co., New York.~~

~~(j. B. p.*) Bankruptcy.-^The history of English bankruptcy legislation prior to the year 1869, and the chief features of the Consolidating and Amending Act passed Ba^'fisb"' ™ ^^ ysar, are briefly set forth in the article i^isiation. on "Bankruptcy" in the ninth edition of this work. The main object of the Act of 1869 was to remedy abuses which had grown up under previous bankruptcy Acts, the efEect of which, to adopt the language of Sir Eobert Collier, the then Attorney General, had been to enable a bankrupt to "defraud those to whom he was indebted, and to set them at defiance." Lord Cairns, in introducing the measure in the House of Lords, also ex pressed the opinion that the large increase which had taken place in the annual insolvency of the country during the preceding years could not "be attributed to depres- sion in trade, but must be traced to the enormous facilities which are given to debtors who wish to be released from their debts on easy terms." It is a curious illustra- tion of the difficulties which have attended bankruptcy legislation in England, that the measure which was passed in 1869 to remedy these defects was described twelve years~~

~~later by Mr Chamberlain, the President of the Board of Trade, in introducing an Amending Bill, as "the most unsatisfactory and the most unfortunate of the many attempts which had been made to deal with the subject," and as " the object of the almost unanimous condemnation of all classes." This result cannot be re- garded as due to any new departure or change of principle in the Act of 1869, which, on the contrary, while it introduced some amendments in the methods of procedure which were apparently well calculated to effect a reform of many of the abuses complained of, followed in the main the lines of the immediately preceding legislation. The failure of the measure was rather the failure of a long-continued line of policy ; and the fact that after half a century's experience of legislation, directed by the ablest minds in the legal profession, matters had grown worse , instead of better, was calculated to cast serious doubts on the soundness of the principles on which the various bankruptcy Acts from 1825 to 1869 had been based. During this period no less than six measures of first-class importance had received the assent of the Legislature, viz. the Acts of 1825, 1831, 1842, 1849, 1861, and 1869, each of which was a practical acknowledgment of the failure of its predecessor ; and the last of these, as already stated, was admitted to be the most unsatisfactory in its results. In order to understand the causes of these successive failures, it is necessary to bear in mind the complex character of the con- siderations which enter into the question. Bankruptcy law was~~

~~primarily a branch of the criminal law. Its object being to punish fraudulent bankrupts, and to compel the surrender of their property for the benefit of creditors, but without releasing the debtor from his obligations. Subsequent legislation introduced the principle of granting relief to the bankrupt with or without the consent of the creditors, where he conformed to the provisions of the bankruptcy law. But the whole of the procedure was con- ducted by or under the supervision of the court exercising juris- diction in bankruptcy. On the other hand, the right of creditors to exercise some control over the realization of the debtor's property through an assignee chosen by themselves was recognized at an early date, but this right was also exercised subject to the super- vision of the court, which investigated the claims of creditors and determined who were entitled to take part in the proceedings. Provision was also made for the interim protection of the debtor's property by official assignees attached to the court, who took possession until the~~

creditors could be consulted, and under the supervision of the court audited the accounts of the creditors' assignee. So long as this system continued substantial justice was generally secured ; the claims of creditors were strictly investi- gated, and only those who clearly proved their right before a com- petent court were entitled to take part in the proceedings. The bankrupt was released from his obligations, but only after strict inquiries into his conduct, and under the exercise of judicial dis- cretion. The accounts of assignees were also strictly investigated, and the costs of solicitors and other agents were taxed by officers of the court. But the system was found to be cumbrous, to lead to delay, and too often to the absorption of a large part of the estate in costs, over the incurring of which there was a very ineffective control. Hence arose a demand for larger powers on the part of creditors, and the introduction into the bankruptcy procedure of the system of "arrangements" between the debtor and his creditors, either for the payment of a composition, or for the liquidation of the estate free from the control of the court. At first these . arrangements were carefully guarded. Under the Act . .„-, of 1825, a proposal for payment of a composition might be adopted only after the debtor had passed his examination in court, and with the consent of nine-tenths in number and value of his creditors assembled at a meeting. Upon such adoption the bankruptcy proceedings were superseded. Dissenting creditors, however, were not bound by the resolution, but could still take action against the debtor's subsequently acquired property. These powers were not found to be sufficiently elastic, and the Act failed to give public satisfaction. Attempts were made by the Acts of 1831 and 1842 to remedy the defects com- '^f** ,, plained of, by a reconstitution of the Bankruptcy Court g„j fg^2 and its official system. But these measures also failed, because they were based on the assumption that judicial bodies, could exercise effective control over administrative action, a con- trol for which they are naturally unsuited, and which they could only carry out by cumbrous and expensive methods of procedure. Under the Act of 1849 a totally new principle was in- troduced by the provision that a deed of arrangement executed by six-sevenths of the creditors for £10 and upwards should be binding upon all the creditors without any proceedings in or supervision by the court. But the determina- tion of the question who were or were not creditors was practically left to the debtor himself, without any opportunity for testing by independent investigation the claims of those who signed the deed to

~~control the administration of the estate. It is not difficult to see, in the light of subsequent experience, how well calculated this provision was to encourage fraudulent arrangements, and to intro- duce laxity in the administration of debtors' estates. A modi- fication of the too stringent conditions of the Act of 1825, which would have enabled a bankrupt to pay a composition on his debts, with the consent of a large proportion of his bon&-flde creditors, and subject to the approval of the court, after hearing the objec- tions of dissenting creditors, would doubtless have proved a bene- ficial reform, but the Act of 1849 proceeded on a very different principle. Instead of reforming, it practically abolished judicial control. By avoiding Scylla it fell into Charybdis. To give any majority of creditors the power to release a debtor from all his obligations without full disclosure of his affairs, and without any exercise of judicial discretion or any investigation into the causes of the failure, or the conduct of the debtor, would in any circum- stances have been to introduce a new and mischievous principle into legislation. But to give such a power to creditors whose claims were subject to no independent investigation was to invite inevitable confusion and failure. Yet this was the dominating principle of English bankruptcy legislation for nearly thirty-five years. Under the Act of 1861 the evil was aggravated, by reducing the majority required to make a deed of arrangement binding on all the creditors, to a majority in number and three-fourths in value of those whose claims amounted to £10 and upwards. It was these provisions which, according to the highest judicial authorities, enabled bankrupts~~

~~Act~~

~~ot 1849.~~

~~Ad~~

~~of 1861.~~

~~to defraud their creditors and set them at defiance. Yet, in the legislation which ensued, this fact appears to have been fl869 entirely ignored. Under the Act of 1869, which was * ■ passed for the avowed purpose of remedying the evils which had arisen, the procedure under a bankruptcy petition was certainly rendered more effective. Meetings of creditors were presided over, and creditors' claims were, for voting purposes, adjudicated upon by the registrar of the court ; the banlcrupt had to pass a public examination in court, which although chiefly left to the trustee appointed by the creditors, afforded some opportunity for investigation ; and the banlirupt could not obtain his discharge without the approval of the court, and in certain circumstances the consent of the creditors. An independent official, the Comp- troller in Bankruptcy, was appointed, whose duty it was to examine the accounts of trustees, call them to account for any misfeasance, neglect, or omission, and refer the matter to the court for the exercise of disciplinary powers where necessary. These provisions were well calculated to promote sound adminis- » tration, but they were, unfortunately, rendered nugatory by provisions relating to wliat were practically private arrangements on similar lines to those which had rendered previous legislation ineffective. In some respects tlie evil was aggravated. Deeds of arrangements were nominally abolished, but under sections 125 and 126 of the Act, a debtor was empowered to present a petition to the court for liquidation of his affairs by "arrangement," or for payment of a composition, whereupon a meeting of creditors was summoned from a list furnished by the debtor, and without any judicial investigation of claims, a majority in number and three-fourths in value of those who lodged proofs of debt, and who were present in person or by proxy at the meeting, might by resolution agree to liquidation by arrangement, or to the acceptance of the composition. Such resolution tliereupon became binding upon all the creditors, without any act of approval by the court, any judicial examination of the debtor, or any official supervision over the trustee's account. As a delator was not permitted to present a bankruptcy petition against himself, his only method of procedure was that which thus removed the matter from the supervision and control of the court, and as about nine-tenths of all the proceedings under the Act of 1869 were initiated by debtors, it followed that only about one-tenth was submitted to proper investigation. It is true that the creditors might refuse to assent to the debtor's proposal, and that any creditor for £50 or upwards could present a petition in bankruptcy, but~~

~~even where this course was adopted, the proceedings under the petition were, as a' rule, stayed by the court if the debtor subsequently presented a proposal for liquidation or composition, and the creditor was left to pay the expenses of his petition if the requisite majority voted for "the debtor's proposal. So far, therefore, as the Act was concerned, every inducement was held out to the adoption of a course which took the examination of the debtor, the conditions of his discharge, and the audit of the trustee's accounts, out of the control of the court.~~

~~One of the chief reasons why the Acts of 1849, 1861, and. 1869 thus proved failures, lies in the , obvious fact Causes ^^^^ *'^® Creditors of a particular estate are of aoa- not, as appears to have been assumed, a homo- ^access. geneous or organized body capable of acting together in the administration of a bankrupt estate. In the case of a fevf special and highly organized trades it may be otherwise, but in the great majority of cases the creditors have but little knowledge of each other, or means of organized action, while they have neither the time nor the inclination to investigate the complicated questions which frequently arise, and which are therefore left in the hands of professional trustees or legal agents. But the appointment of trustees under these Acts, instead of being the spontaneous act of the creditors, was frequently due to touting on the part of such agents themselves, or to individual creditors whose interests were not always identical with those of the general body. According to Mr. Eobson, the author of a standard work on the subject, the arbitrary powers conferred by the Act of 1861 " led to great abuses, and in many cases creditors were forced to accept a composition, the approval of which had been obtained by a secret understanding between the debtor and favoured creditors, and not unf requently by the creation of fictitious debts." These evils were greatly aggravated by the decisions of the court relating to proofs on bills of exchange, under which it was held that the~~

~~holder of a current bill could prove on the bankrupt estate of an endorser, although the bill was not yet due, and the acceptor was perfectly solvent and able to meet it at maturity. Thus in large mercantile failures, bankers and other holders of first-class bills could prove and vote on the estates of their customers, for whom the bills had been discounted, and thus control the entire proceedings, although they had no ultimate interest in the estate.~~

~~But probably the greatest source of the abuses which atose under the Act of 1869 was the proxy system estab- lished by the Act, and by the rules which were subse- quently made to carry it out. The introduction of proxies was no doubt intended to give absent creditors an oppor- tunity of expressing their opinions upon any question which might arise. But the system was too often used for the purpose of stifling the views of those who took an independent part in the proceedings. The form of proxy prescribed by the rules contained no limitation of the powers of the proxy-holder, and no expression of the opinion of the creditor. It simply appointed the person named in it as " my proxy," and these magic words gave the holder power to act in the creditor's name on all questions that might be raised at any time during the bankruptcy. Hence arose a practice of canvassing for proxies, which were readily given under the influence of plausible representations, such as the holding out df the prospect of a large composition, but which, when once obtained, could be used for any purpose whatsoever except the receipt of a dividend. Thus it frequently happened that the entire proceedings were controlled by professional proxy-holders, in whose hands these documents acquired a marketable value. They were not only used to vote for liquidation by arrangement instead of bankruptcy proceedings, but not infrequently the matter took the form of a bargain between an accountant and a solicitor, under which the former became trustee, and the latter the solicitor in the liquidation, without any provision for control over expenditure, or for any audit of the accounts. Even where a committee of inspection was appointed to exercise functions of control and audit, they too were often appointed by the proxy-holders, and not infre- quently shared in the benefits. On the other hand, where the amount of debts represented by the proxy- holder was insufi&cient to carry the appointment of a trustee and committee, the votes could be sold to swell the chances of some other candidate. Where the debtor opposed these appointments, or refused to assist in carrying them by using such influence as he might possess, he sometimes became a target for the exercise of revenge. His discharge, which under liquidation by arrangement was entirely a matter for the creditors, might be refused indefinitely : and so largely and harshly was this power exercised under the proxy system, espe- cially where it was supposed that the debtor had friends who could be induced to come to his aid, that a special Act of Parliament was passed in 1887, authorizing the court to deal with cages where, under the Act of 1869,~~

~~a debtor had not been able to obtain a release from his creditors. On the other hand, the complaisant debtor, although he had incurred large obligations in the most reckless manner, often succeeded in stifiing investigation and obtaining his release without difficulty as a return for his aid in carrying out the arrangement.~~

~~The result of such a system could not be other than a failure. After the Act of 1869 had been in operation for ten years, the Comptroller in Bankruptcy reported that out of 13,000 annual failures in England ‘^ o” and Wales, there were only 1000 cases (or about sMistta?^ 8 per cent.) “to which the more important provisions of the Act for preventing abuses by insolvent debtors and professional agents applied ; the other 12,000~~

~~cases (or 92 per cent.) escaping the provisions which refer to the examination and discharge of bankrupts, and to the accounts, charges, and conduct of the agents em- ployed.” It is not to be supposed that all the cases in the latter class were marked by the abuses which have beerj, here described. In a large number the proceedings were conducted by agents of high character and standing, and with a due regard to the interests of the creditors. But the facilities for fraudulent and collusive arrange- ments afforded by the Act, and the want of effective con- trol over administration, inevitably tended to lower the morale of the latter, and to throw it into the hands of the less scrupulous members of the profession. The demand for reform, therefore, came from all classes of the business community. No fewer than thirteen bills dealing with the subject were introduced into the House of Commons during the ten years succeeding 1869. At length in 1879 a memorial, which was authoritatively described as ” one of the most influential memorials ever presented to any Government,” was forwarded to the Prime Minister by a large body of bankers and merchants in the City of London. The matter was then referred to the President of the Board of Trade (Mr Chamberlain), who made ex- haustive inquiries, and in 1881 introduced a measure which, with some amendments, finally became law~~

~~under the title of the « Bankruptcy Act, 1883." Hitherto the question had been dealt with as one of legal procedure ; it was now treated as an act of commercial legislation, the main object of which, while providing by carefully framed regulations for the equitable distribution of a debtor's assets, was to promote and enforce the principles of commercial morality in the general interests of the trading community. One of the chief features of the Act of 1883 is the separation which it has effected between the judicial and the administrar tive functions which had previously been exercised by the court, and the transfer of the latter to the Board of Trade as a public department of the state directly responsible to Parliament. Under the powers conferred by the Act a new department was subsequently created, under the title of the Bankruptcy Department of th.e Board of Trade, with an of&cer at its head called the Inspector-General in Bankruptcy. This department exer- cises, under the direction of the Board of Trade, a general supervision over all the administrative work arising under the Act. It has extensive powers of control over the appointment of trustees, and conducts an audit of their accounts ; and it may, subject to appeal to the court, remove them from office for misconduct, neglect, or unfit- ness. A report, upon the proceedings under the Act is annually presented to Parliament by the Board of Trade, and although the department is practically self-sup- porting, a nominal vote is each year placed upon the public Estimates, thus bringing the administration under direct parliamentary criticism and control. The Act also provides for the appointment and removal by the Board of Trade of a body of officers entitled Official Receivers, with certain prescribed duties having relation both to the conduct of bankrupts and to the administration of their estates, including the interim management of the latter until the creditors can be consulted. These officers act in their respective districts under the general author- ity and directions of the Board of Trade, being also clothed with the status of officers of the courts to which they are attached. While effecting this supervision and control by a public department directly responsible to Parliament, the main objects of the measure were to secure — (1) An independent and public investigation of the debtor's conduct; (2) The punishment of com- mercial misconduct and fraud in the interests of piiblic morality; (3) The summary and inexpensive adminis-~~

~~Act~~

~~at 1890.~~

~~tration of small estates where the assets do not exceed £300 by the Official Receiver, unless a majority in number and three-fourths in value of the creditors voting resolve to appoint a trustee ; (4) Full control in other cases by a majority in value, over the appointment of a trustee and a committee of inspection; (5) Strict investigation of proofs of debt, with regulations as to proxies, and votes of creditors; (6) An independent audit and general supervision of the proceedings, and control of the funds in all cases. Besides amending and consolidating previous bankruptcy legislation, the measure also contains special provisions for the admin- istration under bankruptcy law of the estates of persons dying insolvent (§ 126) ; and for enabling county courts to make administration orders for payment by instal- ments in lieu of committal to prison, in the case of judg- ment debtors whose total indebtedness does not exceed £50 (§ 122). It also provides for the getting in and administration by the Board of Trade of unclaimed divi- dends and undistributed balances on estates wound up under previous Bankruptcy Acts (§ 162). Lastly, it amends the procedure under the Debtors Act of 1869, dealing with criminal offences, by enacting that when the court orders a prosecution of any person for an offence under that Act, it shall be the duty of the director of public prosecutions to institute and carry on the prosecution.~~

~~An Amending Act, under the title of thp " Bankruptcy Act, 1890 " (53 and 54 Vict. c. 71), was passed in that year, mainly with the view of supplementing and strengthening some of the provisions of the Act of 1883, more particularly with regard to the conditions under which a bankrupt should be discharged, and requiring that schemes of arrangement or composition should be approved by the court. It also dealt with a variety of matters of detail which ex- perience had shown to require amendment, with the view of more fully carrying out the intentions of the Legislature as embodied in the principal Act. These two Acts are to be construed as one, and may be cited col- lectively as the Bankruptcy Acts 1883 and 1890. They are further supplemented by a large body of general rules made by the Lord Chancellor with the concurrence of the President of the Board of Trade, which may be added to, revoked, or altered from time to time by the~~

same authority. These rules are laid before Parliament and have the force of law.

Besides these general Acts, various measures dealing with special interests connected with bankruptcy pro- cedure have from time to time been passed since 1883, the chief of which are as follow, viz., the Bankruptcy Appeals (County Courts) Act, 1884; the Preferential Payments in Bankruptcy Act, 1888, regulating the priority of the claims of work- men and clerks, &c., for wages and salaries ; and the Bankruptcy (Discharge and Closure) Act, 1887, dealing with unclosed bankruptcies under previous Acts.

It would be out of place in this article to attempt to answer the question how far this latest legislation has solved the difficult problems which prior to nesuits 1883 were found so intractable. The annual otiegisia- reports of the Board of Trade, which are accom- ”””• panied by elaborate tables of statistics, and by copious illustrations both of the working of the system and of the characteristic features and causes of current in- solvency, are published as parliamentary papers, and may be usefully consulted by those interested in the subject. It appears from these reports that the total number of insolvencies dealt with under the Bankruptcy Acts during the ten years ending 31st December 1900, was 43,895, involving estimated liabilities amounting

to £69,029,795, and estimated assets amounting to £25,667,785. It may also be pointed out that, accord- ing to the official figures, the cost of bankruptcy adminis- tration under the present system has very considerably decreased as compared with that under the Act of 1869. Estates are also closed at much shorter intervals, and, Tvhat is more important from a public

~~point of view, it appears that while the estimated liabilities of bankrupt estates during the ten years ending 1883 amounted on an average to £22,380,000 per annum, the estimated lia- bilities during the ten years ending 1900 only averaged £6,902,979 per annum. But during the latter period there was a further estimated annual liability of £4,986,399 on private arrangements entered into out- side of the Bankruptcy Act by insolvent debtors. There are no means of ascertaining the corresponding amount of liabilities on private arrangements outside of the Bankruptcy Acts prior to 1883, and therefore a complete comparison is impossible ; but it is evident that on any method of computation there has been a very great diminution in the trading insolvency of England and Wales, while it is also clear as a matter of general knowledge in commercial circles, that a great decrease in the proportion of fraudulent trade and reck- less speculation has been a marked feature of private trading during the period in question.~~

~~The cost of bankruptcy administration under the Act is provided for : (1) by fees charged to bankrupt estates, which for the year ended 31st March 1900 Revenue amounted to £111,874; (2) by interest on bal- ances at the credit of such estates with the bankruptcy estates account, a portion of which invested in public securities yielded for the same year an income of £20,400; and (3) by interest on unclaimed funds at the credit of estates under former Bankruptcy Acts, which yielded £37,746 ; the total revenue of the department for the year 1900 being thus £170, 020. Out of this were paid the salaries of all the officers of the de- partment, including the official receivers ; the remunera- tion due in respect of bankruptcy services to the county court registrars ; pensions, &c., payable to retired officers under the present and previous Bankruptcy Acts ; cost of bankruptcy prosecutions ; and rents, stationery, trav- elling, and other incidental expenses ; the total expenditure amounting for the year ended March 1900 to $160,901. The system is thus self-supporting, and involves no charge upon the tax-payers of the country. It has been objected that inasmuch as the Act professes to be based on the principle of enforcing commercial morality in the interests of the general community, the cost of administering it should not be charged entirely to the bankruptcy estates concerned. But when it is considered that the revenue of the department, to the extent of £37,746pis derived from funds to which estates administered under the present Act have contributed nothing, this objection does not appear to be well founded.~~

~~For the convenience of readers who may require more detailed information, the accompanying summary of the leading provisions of the law relating to bank^ Summary ruptcy procedure is submitted. It must be borne in mind, however, that the subject is in some of its branches extremely intricate, and that both the law and the procedure are being constantly affected by a considerable body of judicial interpretation. A referetkce to the latest text-books or competent pro- fessional advice will always be advisable for those who have the misfortune to be practically interested either as debtors or as creditors in bankruptcy proceedings. ‘ The ” Deeds of Arrangement Act, 1887,” although not falling strictly within the scope of the bankruptcy law, may also, in consequence of its important bearing upon~~

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~~the question of insolvency in England and Wales, be here noticed. It has been pointed out that, under the Bank- ruptcy Acts of 1849 and 1861, non-official ar- rangements by deed between a debtor and the ^‘e”’* general body of his creditors were not only ^e^T”***’ officially recognized, but were in certain cir- cumstances made binding on all the creditors, in- cluding those who refused to assent to them. Under the Act of 1869, although such deeds were no longer recognized or made binding on non-assenting creditors, the proceedings under the ” liquidation by arrangement ” and “composition” clauses were practically private arrangements by resolution instead of deed, and were proved by experience to be open to the same abuses. It has also been shown that under the Act of 1883 no arrangements either by deed or by resolution have any force against dissenting creditors, unless confirmed after full investigation and approval by the bankruptcy courts. Private arrangements, therefore, cease to form any part of the bankruptcy system. But they are, nev- ertheless, binding as contracts between the debtor and such creditors as assent to them. Being, however, in the nature of assignments of the debtor’s property, they are either deemed fraudulent if the benefit of the assignment is limited to a portion of the creditors, or, if it is extended to all they become acts of bankruptcy, and, like any other voluntary assignment, are liable to be invalidated if made within three months prior to the petition on which a receiving order is made against the debtor. Treated as voluntary assignments, which are not binding on those who do not assent to them,~~

~~such arrangements, where honestly entered into and car- ried out by capable administration, in many cases form a useful and expeditious method of liquidating a debtor's affairs, and where the debtor's insolvency has been brought about without any gross misconduct they will probably always be largely resorted to. The danger attending them is that even in cases where the debtor has been guilty of misconduct, a private arrangement may be used to screen his ponduct from investigation, while in many cases it may be made the medium for the concealment of fraudulent preferences. The absence of any independent audit of the trustees' accounts may also encourage or con- ceal irregularities ia administration. Previous to 1887, however, much inconvenience arose from the fact that the execution of these private arrangements was frequently kept secret, and fresh credit was obtained by the debtor without any opportunity being afforded for the new creditors becoming acquainted with the fact that they were dealing with an insolvent person, and that in many cases they were simply supplying the means for meeting past obligations in respect of which the debtor had already committed default. The " Deeds of Arrangement Act, 1887," was therefore passed to compel the disclosure of such arra:!igements, by declaring them void unless registered within seven days after the first execution by the debtor or by any creditor. Registration is effected by lodging with the Registrar of Bills of Sale at the central office of the supreme court a true copy of the deed, and of every inventory and schedule attached thereto, together with an affidavit by the debtor, stating the total estimated amount of property and liabilities, the total amount of composition if any, and the names and addresses of the creditors. Where the debtor's residence or place of business is outside the London bankruptcy district, the registrar is required to forward a copy of the deed to the registrar of the county court of the district where the debtor's residence or place of business is situated. Both the central and the local registers are open to public inspection on payment of a small fee, and general publicity is secured by the action of various~~

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~~trade agencies, which make a practice of extracting and publishing the information for the benefit of those in- terested. By section 25 of the Bankruptcy Act, 1890, every trustee under a deed of arrangement is required to transmit to the Board of Trade within thirty days of the 1st of January in each year an account of his receipts and payments, and such, accounts are open to the inspection of any creditor on payment of a small fee. The registrar is also required to make periodical returns of the deeds thus registered to the Board of Trade, in order that a report of proceedings under the Deeds of Arrangement Act may be included in the annual report which the department is required to make on proceedings under the Bankruptcy Acts. Full statistics of such proceedings are accordingly included in these reports, from which it appears that during the ten years ended 31st ' December 1900 the total number of registered deeds of arrange- ment was 33,688, with estimated liabilities amounting to £49,863,989, and estimated assets to £25,673,169.~~

~~SuMMAEx OF Bankruptcy Pkoceduee. Subject to certain special provisions in the case of what are termed "small banliuptcies " (see below), the following summary sets forth the leading provisions of the various acts and rules relating to bankruptcy admin- istration grouped under convenient heads to facilitate reference. In some cases the effect of legal decisions has been embodied in the summary.~~

~~Preliminary Proceedings.~~

~~Petition and Receiving Order. — ^Any court exercising bankruptcy jurisdiction in the district in wliich lie resides or carries on business in England or Wales may make a receiving order against a debtor, whether a trader or not, either on his own petition or on that of a creditor or creditors whose claims aggregate not less than £50. In the case of a creditor's petition proof must be given of the debt, and of the commission of an act of bankruptcy within three months preceding the date of the petition. An act of bank- ruptcy is committed 2 the debtor fails to satisfy the creditor's claim upon a bankruptcy notice ; if he makes an assignment for the benefit of his creditors generally ; if he absconds or keeps house ; if he gives notice of suspension of payments ; if his goods are sold or seized under execution ; if he flies in court a declaration of inability to pay his debts ; or if he grants a~~

~~fraudulent prefer- ence or conveyance. These acts are here, enumerated in the order in which they most frequently occur in practice.~~

~~Object and Effect of Receiving Order. — ^The object of the order is to protect the debtor's property until the first meeting of creditors, and to bring the debtor and his afiairs within the jurisdiction of the court. Its effect is to stay all separate action against the debtor, and to constitute the Official Receiver attached to the court receiver of the debtor's property, although the legal title still remains in the debtor. Where there is an estate or business to be managed the Oiflcial Receiver may appoint a special manager, who receives such remuneration as the creditors, or failing them the Board of Trade, may determine. As a consequence of the order the following obli- gations are imposed upon the debtor : — He must make out and submit to the Ofacial Receiver within a prescribed period a state- ment of his affairs, containing the names and addresses of his creditors, the amount of their claims and the securities held by them, and the nature and value of his assets ; and accounting for his deficiency. Any material omission or false statement of his losses or expenses is a misdemeanour under the Debtors Act, unless he can prove that he had no intention to defraud. The statement is open to the inspection of creditors. He must also in every case submit to a^public examination in court, in which the Ofloial Receiver, the trustee, and any creditor who has proved his debt may take part. His evidence may be used against him. He may further be specially examined by the court at any time with reference to his dealings or property. He must attend the first meeting of creditors, wait upon the Official Receiver, trustee, and special manager, and give all necessary information, and generally do all acts which may reasonably be required of him with the view of securing a full investigation of his affairs. He may be arrested if there is reasonable ground for believing that he is about to ab- scond, destroy papers, or remove goods, or if he fails without good cause to attend any examination ordered by the court. The court may also for a period of three months order his letters to be re- addressed by the Post Office to the Official Receiver or trustee. With regard to persons other than the debtor, any person capable of giving information respecting the debtor, his dealings or prop-**

~~erty, may be examined by the court, and a summary order may be made against such person for delivery of any property belonging to the debtor.~~

~~First Meeting of Creditors.~~

~~This meeting is summoned by the Official Receiver, notice being given in the London Gazette and in a local paper, and sent by post to each creditor. A summary of the statement of affairs fhould accompany the notice, with any observations by the Official Receiver which he may think fit to make. The object of the meeting is to decide whether any proposal for payment of a composition or for a scheme of arrangement submitted by the debtor is to be entertained, or whether an applicaltion should be made to the court to adjudicate the debtor bankrupt. In the latter case the meetipg may by an ordinary resolution appoint a trustee with or without a committee of inspection. It may also give any directions as to the adminis- tration of the estate. The meeting should be held at the place most convenient for the majority of the creditors. It is presided over by the Official Receiver or his deputy, who, subject to appeal to the court, admits or rejects proofs for the purpose of voting. For the transaction of business three creditors qualified to vote, or all the creditors if fewer than three, must be present or represented. Only persons who have proved their debts are entitled to vote, and detailed regulations respecting proofs and the valuation, of securities are laid down in the first and second schedules to the Act of 1883. One of the chief alterations in the law on this point is the condition imposed on creditors on bills of exchange to deduct from their claims l5ie value of the liability of prior obligants before voting, thus cancelling the power of controlling the proceedings, previously possessed by persons who had no real interest in the estate. Votes may be given in person or by proxy, and stringent regulations are laid down with the view of preventing the abuse of proxies. General proxies entitling the holder to exercise all the powers which the creditor could exercise if present, may be given to the Official Receiver, or to any person in the regular employment of the creditor. Special proxies may be given to any person to vote for specified resolutions, or for the appointment of specified persons as trustee and committee. Only official forms can be used, and the blanks must be filled up in the handwriting of the creditor or some person in his regular employment, including the authorized agent of a creditor resident abroad. A proxy must be lodged with the Official Receiver not later than four o'clock on the day before the meeting or adjourned meeting at which it is to be used. Reso- lutions are ordinary, special, or extraordinary. An ordinary~~

~~resolution is carried by a majority in value of the creditors voting ; a special resolution by a majority in number and three-fourths in value of such creditors. The only instance of a resolution other than these is that required for the approval of a composition or scheme, which requires a majority in number and three-fourths in value of all the creditors who have proved. The majority of ques- tions arising at a meeting are decided by an ordinary resolution.~~

~~Adjudication.~~

~~If the creditors so resolve; or if a composition or scheme of arrangement is not proposed by the debtor, or entertained by the creditors, or if entertained, is not approved by the court, or if without reasonable excuse the debtor fails to furnish a proper state- ment of his affairs, or if his public examination is adjourned sine die, the court adjudicates the debtor bankrupt, and thereupon his property vests in a trustee, and, subject to the payment of the costs and fees of administration, is divisible among his creditors, until all his debts are paid in full with interest at the rate of four per cent, per annum.~~

~~Effect on Bankrupt. — The bankrupt is bound to aid the trustee in his administration, and if he wfifuUy fails to deliver up any part of his property he is guilty of contempt of court. He is also liable to criminal prosecution under the Debtors Act, if with intent to defraud he conceals or removes property to the value of £10 or upwards ; or if he fails to deliver to the trustee all his property, books, documents, etc. ; or if he knowingly permits false debts to be proved on his estate without disclosure ; or mutilates, falsifies, destroys, or parts with books or accounts ; or attempts to account for his property by fictitious losses ; or if within four months next before presentation of a bankruptcy petition, he ob- tains property on credit by false representation ; or pledges or dis- poses of, otherwise than in the ordinary way of his trade, any property which has not been paid for ; or by misrepresentation obtains the assent of his creditors to any agreement with reference to his affairs. He is also, under the Act of 1883, guilty of misde- meanour if before his discharge he obtains credit for more than £20 from any person without informing such person that he is an un- discharged bankrupt. It is the duty of the Official Receiver to report any such facts to the court, and If the court is satisfied that there is a reasonable probability of~~

~~conviction, it is required to order a prosecution which is then conducted by the Director of Public Prosecutions.~~

~~Disqualifications. — A bankrupt cannot during his bankruptcy, or until five years after his discharge, unless the bankruptcy is annulled, or he obtains his discharge with a certificate by the court that the bankruptcy was caused by misfortune without mis- conduct, act as a member of the Legislature, or as a justice of the peace, mayor, alderman, councillor, guardian or overseer of the poor, member of a sanitary authority, school, highway, or burial board, or select vestry in any part of the United Kingdom.~~

~~Annulment. — An order of adjudication may be annulled if the court is of opinion that it should not have been made, or that the bankrupt's debts are paid in full, or if a composition or scheme of arrangement is approved by the court after adjudication.~~

~~Discharge. — The court may also at any time after the conclusion of the bankrupt's public examination, and after hearing the Official Receiver, the trustee, and any creditor, to all of whom previous notice of the application must be given, grant the bankrupt a dis- charge either absolutely or under conditions, but subject to the fpUowing qualifications, viz. : (1) If the bankrupt has committed a criminal offence connected with the bankruptcy, the application must be refused unless for special reasons the court determines otherwise. (2) If tlie assets are not equal in value to ten shillings in the pound of the unsecured liabilities (unless the bankrupt can show that he is not responsible) ; or if proper books have not been kept ; or if the bankrupt has traded after knowledge of insolvency ; or has contracted debts without reasonable probability of payment ; or failed to account for his deficiency ; or contributed to the bankruptcy by rash speculation, gambling, culpable neglect, or by unjustifiable expenses ; or has taken or defended legal proceedings on frivolous grounds ; or has within three months preceding the receiving order given an undue preference ; or has increased his liabilities with the view of making his assets equal to ten shillings in the pound ; or has previously been bankrupt, or made an arrangement with~~

~~creditors ; or has been guilty of any fraud or fraudulent breach of trust ; then the court shall, on proof of any of these facts, either (a) refuse the discharge, or (6) suspend it for a period of not less than two years, or until a dividend of not less than ten shillings in the pound has been paid ; or (,c) qualify the order by the condition that judgment is entered up against the bankrupt for payment of any unpaid balance of his debts, or any part of such balance out of his future earnings or property. The bankrupt may, however, after two years apply to the court to modify the conditions if he is unable to comply with them. An order of discharge releases the debtor from all his obligations, ex- cept debts due to the Crown, and other obligations of a public character which can only be discharged with the consent of the Treasury, debts incurred by fraud, and judgment debts in an action for seduction or as a co-respondent in a matrimonial suit or under an affiliation order, which are only released to such extent and subject to such conditions as the court may expressly prder. The release of the bankrupt does not operate as a release of any partner of or oo-obligant with him. Neither does it release the bankrupt from liability to criminal prosecution.~~

~~Composition or Scheme of Arrangement.~~

~~After a receiving order has been made the debtor may submit a proposal for the payment of a composition, or for the liquidation of his affairs, by a trustee or otherwise, without adjudication. The proposal must be lodged with the Official Receiver in sufficient time to allow notice, together with a report by that officer, to be sent to the creditors before the meeting is held at which it is to be con- sidered. If the proposal is entertained at the meeting by a majority in number and three-fourths in value of all the creditors who have proved their debts, and if it Is thereafter approved by the court, it becomes binding upon all creditors who would be bound by an order of discharge had the debtor been adjudicated bankrupt. A similar proposal may be made after adjudication, and if entertained by the creditors and approved by the court, the adjudication may be annulled. The debtor's release will be subject to the terms of the scheme, but his future acquired property will not pass to the creditors unless there is an express stipulation to that effect. If default is made in carrying out the scheme, or if it is found that it cannot proceed without injustice or undue delay, the court may at any time adjudicate the debtor bankrupt, in which case the scheme will fall to the~~

~~ground, except in respect of past transactions under it. The approval of a composition or scheme does not release the debtor from his liabilities under the criminal law, nor from the necessity of undergoing a public ex- amination which must, in fact, be held and concluded before the approval of the court is applied for. Also before such approval is given a report must be filed by the Official Receiver upon its terms and on the conduct of the debtor, and the court must be satisfied after hearing that officer and any creditor, that the proposal is reasonable and calculated to benefit the creditors, and that no criminal offences connected with the bankruptcy have been committed by the debtor. Further, if any fact is proved which would have prevented the debtor from obtaining an absolute or unconditional order of discharge had he been adjudged bank-~~

~~rupt, the composition or scheme cannot be approved unless it provides reasonable security for the payment of not less than seven shillings and sixpence in the pound on all the unsecured debts. Where a trustee is appointed to carry out the composition or scheme, all the provisions of the Act with reference to the remuner- ation of the trustee, the custody of funds, the audit of his accounts, and the control exercised by the Board of Trade, apply in the same manner as they would under an adjudication. Further, the pro- visions relating to the administration of property, proof of debts, dividends, &c., will also apply, so far as the nature of the case and the terms of the arrangement admit.~~

~~Property divisible among the Creditors.~~

~~No part of the law of bankruptcy is more intricate, or has been the subject of more litigation than this, and any detailed view of the effect of legal decisions can only be gathered by a perusal of the cases ; but the following general principles may be stated : — The term "property" includes not only property of which the bankrupt is the true owner, but property in his possession, order, or disposition in his trade or business with the consent of the true owner, in such circumstances that he is the reputed owner thereof. The application of the doctrine of reputed ownership has been considerably restricted in recent years by the growth of alleged trade customs, in accordance with which property is fre- quently lent under a contract of " hire and purchase," or otherwise ; and by the decisions of the courts that~~

~~where such custom is sufficiently proved the doctrine does not apply. Further, the trustee's title not only includes property in the actual possession of the bankrupt, but relates back to the date of the first act of bankruptcy committed by him within the three months pre- ceding the presentation of the bankruptcy petition, and thus invalidates all payments and assignments to creditors made during that period with knowledge on the part of the cred- itor or assignee of the commission of the act of bankruptcy. In such cases the trustee may, therefore, require the money or property to be restored to the estate. And even where no prior act of bankruptcy is proved, any payment made to a creditor with the view of giving such creditor a preference over the other creditors, within the three months preceding the presenta- tion of the petition on which the payer is made bankrupt, is rendered void as against his trustee. Settlements of property within the two years preceding the bankruptcy, unless made be- fore and in consideration of marriage, or made in good faith for valuable consideration, are also void, as are similar settlements within ten years, unless it is proved that the settlor was (in- dependently of tiie settled pi;operty) solvent at the date of the settlement, and that the interest in the property passed to the trustees on the execution of the deed. The same rule applies to covenants to settle in consideration of marriage future ac- quired property in which the debtor had no interest at the date of the marriage (other than property acquired by the bankrupt through his wife), if such property is not actually transferred before the bankruptcy. Executions by a creditor not completed at the date of the receiving order are also void, and the proceeds of an execution in the hands of the sheriff must, with certain exceptions, and subject to deduction of costs, be handed over to the trustee. But all property held by the bankrupt on trust, and tools of trade, wearing apparel and bedding to a total value not exceeding £20, are excluded from the property divisible among the creditors. With respect to property acquired by the bankrupt, whether by gift or legacy, or consisting of accumulations of business or other profits after the commencement of the bankruptcy, and before he obtains his discharge, the trustee's title also prevails ; but bond^fide trans- actions by the debtor for value, other than transactions relating to freehold property, appear to be valid. Where the bank- rupt is a beneficed clergyman the trustee may, subject to cer- tain provisions for the due discharge of the duties of the office, apply for the sequestration of the profits of the benefice ; and where he is in receipt of a sa.lary, income, or pension, etc., the court may 6rder~~

~~any part thereof to be paid to the trustee, but where he is an officer of the army, navy, or. civil service, such order is only to be made with the consent of the chief of the department concerned.~~

~~Claims of Creditors and Dividends.~~

~~In the distribution of the debtor's property certain claims are entitled to priority over others. Thus the landlord, although not entitled to a preference out of the funds in the hands of the trustee, can distrain for unpaid rent on the goods and effects of the debtor remaining on the landlord's premises, but where the distraint is levied after the commencement of thp bankruptcy this right is limited by the Act of 1890 to six months' rent due before adjudica- tion, the remainder of his claim ranking for dividend with the claims of other creditors. Various gas and water companies have also statutory powers of distraint under special Acts, but the policy of recent legislation has been to discourage any extension of such privileges. Where the bankrupt holds an office of trust in any~~

~~savings bank or friendly society, any balance in his hands due to such bank or society has been held under the Acts relating to these bodies to be payable in preference to any other claim against the estate. Other preferential claims are regulated by the Bankruptcy Acts and by the Preferential Payments in Bankruptcy Act of 1888, and include taxes, parochial and other local rates for not more than one year, wages and salaries for four months, but not exceed- ing £60 [limited in the case of ordinary labourers and workmen to two months' wages not exceeding £25], and agricultural labourers' claims not exceeding one year's wages, if hired by special contract for payment of a lump sum at the end of a year. These claims are entitled to preference not only over funds in the hands of the trustee, but also over the proceeds of any distraint levied by the landlord within the three months prior to the receiving order, the latter in that ease becoming a preferred creditor for the amount so paid. Articled clerks and apprentices may also be allowed re- payment of a proportion of the premium on their unexpired agree- ments. On the other hand, usual trade~~

~~discounts (exceeding 6 per cent.) must be deducted from traders' proofs, and the following claims are postponed until the general creditors are paid in full, viz., claims by a married woman for loans to the husband for the purposes of his business, claims for loans advanced to any person in business at a rate of interest varying with the profits, and claims for interest in excess of 5 per cent.- per annum. Subject to these exceptions all debts proved in the bankruptcy must be paid pari passu. Any surplus after payment of 20s. in the pound and interest at the rate of i per cent, per annum, from the date of , the receiving order, is payable to the bankrupt.~~

~~Proofs of Debt. — All claims and liabilities present or future, certain or contingent, arising out of obligations incurred before the date of the receiving order are provable in the bankruptcy, an estimate of the liability in the case of contingent debts being made by the trustee subject to appeal to the court. But demands in the nature of unliquidated damages arising otherwise than by reason of a contract, promise, or breach of trust, are not provable. A secured creditor if he proves must either surrender his security, or value the security and prove for the balance ; and the trustee can thereupon, subject to the creditor's power in certain circum- stances to amend the valuation, take over the security by paying the amount of the valuation, or may require it to be realised. He may be required by the creditor to elect which of these courses he will adopt, failing which the equity of redemption will vest in the creditor. For further regulations as to proofs, the time within which they must be lodged for voting and for dividend, and the manner of dealing with them, reference should be made to the first and second schedules of the Act of 1883 and the rules connected therewith.~~

~~Dividends. — After payment of costs of administration and pre- ferential debts, it is the duty of the trustee to distribute the estate with, all convenient speed, — ^the first dividend within four months after the first meeting of creditors, and subsequent dividends at intervals of not more than six months, but the declaration may be postponed for sufficient reason by the committee of inspection. Notice of the intention to declare a dividend is gazetted and sent to each creditor mentioned in the bankrupt's statement of affairs who has .not proved. The notice should state the last day for proving in order to participate in the distribution, and should be given not more than~~

~~two months before the declaration. When the dividend is declared, notice of the amount due, and where the same is payable, is sent to each creditor who has proved, with a statement showing particulars of the estate. And provision must be made for creditors at a distance, who have not had time to prove, for disputed claims, and for debts the subject of claims not yet determined. Creditors who fail to prove before the declaration of a dividend are entitled to receive their dividends on proving before any subsequent dividend is declared, but cannot disturb the distribution of any dividend already declared. Before dis- tributing a final dividend notice is sent to every creditor whose claim has been notified to the trustee, but not finally established, with an intimation that unless so established within a specified period he will be excluded from participation in the estate. In the case of a bankrupt firm the joint creditors are not entitled to receive a dividend out of the separate property of the bankrupts until all the separate creditors are paid in full.~~

~~Trustee's Administration. While the interim preservation and management of the estate is conducted by or under the direct supervision of officers appointed by and responsible to the Board of Trade, the ultimate realization and distribution of the assets devolve upon the trustee appointed by the creditors. But besides acting as receiver prior to the first meeting of creditors, the Official Receiver also becomes trustee by operation of law on the making of an order of adjudication. He vacates the office when a trustee is appointed by the creditors, and certified by the Board of Trade, but again becomes trustee on the creditors' trustee being released, dying, resigning, or being removed~~

~~from office. As the bankrupt's property vests in the trustee for the time being, and passes from trustee to trustee by operation of law, and without any formal act of conveyance, the continuity of the office is thus secured.~~

~~Appointment of Trustee. — A trustee may be appointed by a majority in value of the creditors voting, at the first or any subse- quent meeting, or the appointment may be left to the committee of inspection. In either case the appointment is subject to confirma- tion by the Board of Trade, who may object on the ground that the creditors have not acted in good faith in the interests of the gei;ieral body, or that the person appointed is not fit to act,~~

~~or occupies such a position in relation to the debtor, to any creditor, or to the estate, as makes it difficult for him to act with impartiality, or that in any previous case he has been removed from office for misconduct or for failure without good cause to render his accounts for audit. An appeal from such objection to the High Court lies at the instance of a majority in value of the creditors, but in the absence of an appeal it is fatal to the appointment. Before being con- firmed, the trustee-elect must also furnish security to the satisfac- tion of the Board of Trade, and such security must be kept up to the amount originally fixed, or to such lesser amount as that depart- ment may require, throughout the tenure of the trusteeship, failing which the trustee is liable to be removed from office. Where the creditors fail to appoint a trustee, the Board of Trade may do so, but such appointment may at any time be superseded by the creditors.~~

~~Bemoval. — The trustee may be removed by the creditors at a meeting summoned for the purpose without reason assigned, or by the Board of Trade for misconduct, or for incapacity or failure to perform his duties, or on either of the other personal grounds of ^ objection to which the appointment is open. But the removal is in like manner subject to appeal at the instance of creditors. .If a receiving order is made against a trustee he thereby vacates office. He may also, with the consent of a general meeting of creditors, resign, but his resignation does not operate as a release from his liability to account for his administration.~~

~~Powers and Duties. — The trustee is required to take immediate possession of the bankrupt's property, including deeds, books, and accounts, and has the powers of a receiver in the High Court for the purpose of enforcing delivery. After payment of the costs of administration it is his duty to distribute the estate in dividends as speedily as possible. He may also, and with the sanction of the committee, or where there is none, with that of the Board of Trade, carry on the business so far as is necessary to a beneficial winding up, institute or defend legal proceedings, employ a solici- tor to do any business previously sanctioned by the same authority, compromise debts and claims, raise money on mortgage, sell prop- erty on credit, or divide the estate where practicable among the creditors in its existing form. He may, without special sanction, but subject to any directions which ma,y be given by the creditors in general jmeeting, or failing them, by the~~

~~committee, sell the property or any part of it for cash, including business goodwill and book debts, and either by public auction or private treaty, and generally exercise all the powers which the bankrupt might before adjudication have exercised in relation to the 'property, or which are by the Bankruptcy Act conferred on the trustee.~~

~~Where any part of the property is held subject to onerous obligar- tions, such as the payment of rent, etc., the trustee may disclaim the same, subject in certain cases to the leave of the court, and the disclaimer operates to determine all interest in or liability in respect of the property on the part of the estate. The trustee is required to keep a Eecord book (which is commenced by the Official Receiver), containing minutes of the proceedings in the bankruptcy, and a Cash book in the prescribed form, in which all receipts and pay- ments by him must be entered. AH monies received must forth- with be paid into an account at the Bank of England, entitled the " Bankruptcy Estates Account," which is under the control of the Board of Trade, unless where in special circumstances the sanction of that department is obtained to the opening of a local banking account, but in no circumstances must estate monies be paid to the trustee's private account. When monies are required for the pur- pose of the estate, special cheques or money orders are issued by the Board of Trade on the application of the trustee.~~

~~Control over Trustee. — In his administration of the estate the trustee is subject to control by the committee of inspection, the creditors, the court, and the Board of Trade. The committee is appointed by the creditors, and must consist of not more than five nor less than three creditors, or authorized representatives of creditors. It acts by a majority present at a meeting, and should be convened once a month unless it otherwise directs. If no committee is appointed, the Board of Trade may give any direction or permission which might have been given by a committee. Directions given by the committee, if not inconsistent with the provisions of the Act, are binding on the trustee, unless contrary to or overruled by those of the creditors or of the court. The Official Receiver or trustee may summon a meeting of the creditors at any~~

~~time to ascertain their wishes, and must do so when so required by one-sixth in value of the creditors, or when directed by the court. The Board of Trade may also direct the OfBcial Receiver to summon a meeting for the purpose of reviewing any act done by the trustee or any resolution of the committee of inspection. Further, the trustee ffiay apply to the court for directions in any particular matter, and the court may also, on the application of any person aggrieved, reverse or modify any act of the trustee, or make such order as it deems just. The directions of the court override those of the creditors. The Board of Trade is required to take general cognizance of the conduct of trustees, to inquire into any com-plaints by creditors, and in the event of any trustee not faithfully performing his duties, to take such action, including the power of removal, as may be expedient. It may also direct a local investi- gation of the trustee's books and accounts, and may require him to answer any inquiries, or may apply to the court to examine him on oath. If any loss has arisen to the estate from any misfeasance, neglect, or omission of the trustee, it may require him to make it good. The orders of the Board of Trade under the powers con-ferred by the Act may be enforced by the court by committal of the trustee .^r otherwise.~~

~~Audit of Accounts. — The trustee's accounts must be audited by the committee of inspection not less than once in everv three months ; and once in every six months, as well as at the close of the administration, the record and cash books must also be sub- mitted with the vouchers, and the committee's certificate of audit to the Board of Trade for final audit. If it appears that the trustee has retained more than £50 in hand for more than ten days without a satisfactory explanation, he may be removed from office, surcharged with interest at the rate of 20 per cent, per annum, and lose all claim to remuneration.~~

~~Bemuneration. — The trustee's remuneration is fixed by the creditors, or by the committee if so authorized by them. It must be in the nature of a percentage on the amount of the realizations and on the dividends. If one-fourth of the creditors in number or value dissent from the resolution, or if the bankrupt satisfies the Board of Trade that the remuneration is excessive,~~

~~the Board may review the same and fix the remuneration. A trustee may not receive any remuneration for services rendered in any other ca- pacity, e.g., as solicitor, auctioneer, etc. beyond that voted to him as trustee ; nor may he share his remuneration with the bankrupt, the solicitor, or other person employed about the bankruptcy ; or receive from any person any gift, or other pecuniary or personal benefit in connection therewith.~~

~~Costs. — A trustee receiving remuneration is not allowed the costs of any other person in respect of duties which ought to be per- formed by himself. All bills of solicitors and other agents em- ployed must be taxed before payment, as being in accordance with the prescribed scales of costs ; and the taxing master must satisfy himself that the employment has been properly authorized before the work was done. AH bills of costs must be delivered to the trustee within seven days of the request for the same, otherwise the estate may be distributed without regard to such costs.~~

~~Belease.' — When the property, so far as it is capable of realization, has been realized and distributed, the trustee must apply to the Board of Trade for his release, forwarding to each creditor a notice of his having done so, together with a copy of his final accounts, and the Board of Trade, after preparing and considering a report on the same, and the objections of any person interested, may, subject to appeal to the High Court, grant or withhold the release. If a release is withheld, the court may, on the application of any person interested, make such order against the trustee as it thinks just. The release when granted operates as a removal from office, and thereupon the Official Receiver again becomes trustee, and is thus in a position, even after the nominal close of the bankruptcy, to deal with any circumstances which may arise, or which have not been foreseen and provided for.~~

~~Small Bankruptcies.~~

~~When the Official Receiver reports, or the court is otherwise satisfied that the debtor's property is not likely to realize more than £300, the court may make an order for the summary admin- istration of the estate, in which case, if the debtor is adjudged bankrupt, the Official Receiver in the ordinary course becomes and remains trustee, and certain other modifications are effected with the view of simplifying and accelerating the procedure. The~~

~~chief of these modifications are as follow, viz., the Board of Trade acts as committee of inspection ; there is no advertisement of the pro- ceedings in a local paper ; in legal proceedings all questions of law and fact are determined by the court without a jury ; adjudication may be made on a report by the Official Receiver before the first meeting of creditors, where no composition or scheme is proposed ; meetings of creditors may be held in the tovm where the court sits or the Official Receiver's office is situated ; notice to creditors of meetings other than the first meeting, or of application by a debtor for his discharge, are dispensed with in the case of creditors for amounts not exceeding £2. Costs, other than a solicitor's charges, may be paid without taxation; and the time for declaring the first dividend is extended to six months, but the whole estate must be realized and distributed within this period if practicable. No modification, however, is permitted in the procedure relating to the public examination and discharge Of the bankrupt. Notwith- standing that an order has been made for summary administration, the creditors may at any time by a resolution passed by a majority in number and three-fourths in value of those voting at the meet- ing, appoint a trustee in place of the Official Receiver, in which case the summary order ceases to be operative.~~

~~Scottish Bankruptcy Legislation.~~

~~Since the publication of the ninth edition of this work some important changes have taken place in the law of bankruptcy in Scotland, although the main features of that law, as embodied in the Act of 1856, remain substantially untouched. . Among the less important alterations may be mentioned those effected by the Bank- ruptcy and Real Securities Act of 1857, which deals with the costs of coijipetition for trusteeships ; the Bankruptcy Amendment (Scotland) Act, 1860, which enables the Court to recall a sequestration where it is more convenient that the estate should be wound up in England or Ireland; and the Bankruptcy Amendment Act (Scotland), 1875, which makes the wages of clerks, shopmen, and servants preferential claims for a period not exceeding four months and an amount not exceeding £50, while the claims of workmen are placed on a similar footing for a period not exceeding two months. One of the principal modifica- tions is that effected by the Debtors (Scotland), Act of 1880,~~

~~which abolished imprisonment for debt, but which, like its English prototype (the Debtors Act of 1869), con- tains a series of important provisions for the punishment of fraudulent bankrupts. Under these provisions the laws of the two countries on that subject are practically assimi- lated, although some minor differences still survive. One of the most important of these differences is, that while the Scottish Act makes the failure, within the three years prior to the sequestration, to keep " such books and ac- counts as, according to the usual course of any trade or business in which he (the debtor) may have been engaged, are necessary to exhibit or explain his transactions " a criminal offence, the English Act contains no provision of an analogous character; the non-keeping of such books being treated as a fact to be taken into account in dealing with the debtor's application for his discharge, but not coming vyithin the scope of the criminal law. On the other hand, there are a few minor trading irregularities dealt with in the English Act which are not specifically included in that of Scotland. Another important distinc tion is that under the Scottish Act the same offences may be treated differently, according as they are brought for trial before the Court of Justiciary or a sheriff and jury, in which case the maximum penalty is two years' im- prisonment ; or before a sheriff without a jury, in which case the penalty is limited to imprisonment for a period not exceeding sixty days. This distinction admits of a useful elasticity in the administration of the law, having regard to the comparative importance of the case, which is hardly possible under the English Act.~~

~~Another most important modification of the law is effected by the Debtors Act of 1880, combined with the Bankruptcy and Cessio Act of 1881, and the Act of Sederunt anent Cessios of 22nd December 1882. Under the law existing prior to these enactments, the process of cessio bonorum operated chiefly as a means for obtaining release from imprisonment for debt on a formal surrender by a debtor of all his goods and estate. I^ut under this process the debtor was not entitled to a discharge, and his future acquired property was still subject to diligence at the instance of unsatisfied creditors. By abolishing imprisonment for debt (except in regard to Crown debts~~

~~BANKEUPTCT~~

~~and public rates and assessments), the Legislature also practically abolished this use of the process of cessio, and the process itself would probably have become obsolete, but for certain changes effected by the Act of 1881, which have given it a different and more extended scope. Among these changes may be noted (1) the extension to "any creditor of a debtor who is notour bankrupt," with- out reference to the amount of his debt, of the right, hitherto limited to the debtor himself, to petition the court for a decree of cessio, the prayer of the petition, whether presented by the debtor or by a creditor, being "to appoint a trustee to take the management and dis- posal of the debtor's estate for behoof of his creditors " ; (2) the discretionary power given to the court upon such petition to award sequestration under the Bankruptcy Act, in any case where the liabilities o^ the debtor exceed £200 ; and (3) the right of the debtor to apply for his discharge under similar conditions to those obtaining in the case of sequestration. An important modification of the law relating to discharge which equally affects a debtor under the Bankruptcy and Cessio Acts, is also ef- fected by the provision of the Act of 1881, which requires, in addition to the concurrence of creditors, the fulfilment of one of the following conditions — viz., " (a) That a divi- dend of five shillings in the pound has been paid out of the estate of the debtor, or that security for payment thereof has been found to the satisfaction of the cred- itors ; or (6) That the failure to pay five shillings in the pound has, in the opinion of the sheriff, arisen from cir- cumstances for which the debtor cannot justly be held responsible." Orders of cessio are only made in the Sheriff Courts, and when made, the court also appoints a trustee, who cpnducts the proceedings without the control exercised by the creditors in a sequestration. Under these conditions it will be seen that the original purpose and con- stitution of the process of cessio has entirely disappeared, and it has now become a modified form of oflS.cial bank- Tuptcy procedure, with a less elaborate routine than in the case of sequestration, and one perhaps more suitable to the smaller class of cases, to which in practice it is limited.~~

~~The Bankruptcy Frauds and Disabilities (Scotland) Act of 1884 applies to sequestrations and decrees of cessio the criminal provisions of § 31 of the English Bankruptcy Act of 1883, relating to the obtaining of credit for £20~~

~~and upwards by an undischarged bankrupt, without dis- closure of his position. It also places the law relating to the disqualifications attaching to such bankrupts on a similar footing to that of the English Act.~~

~~The Judicial Factors Act of 1889 contains a provision calculated to check excessive costs of administration, by requiring that where the remuneration of a trustee under a sequestration is to be fixed by the commissioners, inti- mation of the rate of remuneration is to be given to the creditors and to the Accountant of Court before being acted on, and the latter officer is empowered, subject to appeal, to modify the same if he deems it expedient.~~

~~It may be pointed out that the Deeds of Arrangement Act of 1887, which applies to England and Ireland, does not apply to Scotland, and there is no analogous provision requiring registration of private deeds of assignment for the benefit -of creditors as a condition of their validity iu that country.~~

~~Finally, it is to be noted that the office of Accountant in Bankruptcy, which was established by the Bankruptcy Act of 1856, has under the Judicial Factors Act of 1889 been abolished, the duties being merged in those of the office of Accountant of the Court of Session.~~

~~Irish Bankruptcy Legislation.~~

~~With the exception of an Act passed in 1888 for estab- lishing local Bankruptcy Courts in certain districts in~~

~~Ireland, and an Act passed in 1889, applying the main provisions of the English Act of 1888, relating to prefer- ential payments in bankruptcy, to Ireland, no material change has occurred in the Irish law of bankruptcy, which therefore continues to be regulated by the two leading Irish statutes of 1867 and 1872, together with the Irish Debtors Act, 1872, and corresponds in its main features to some of the older English enactments, with modifications adopted from the English Act of 1869. It may be pointed out, however, that the system of liquidar tion by arrangement and composition without the ap- proval or control of the court, which proved fatal to the success of the latter, has not at any time been imported into the Irish law.~~

~~The Deeds of Arrangement Act of 1887, which has been already discussed above under the head of English bankruptcy legislation, also applies in its main provisions to Ireland, and as supplemented by the Irish Deeds of Arrangement Amendment Act of 1890, places the law relating to this branch of insolvency procedure upon a similar footing in both countries, so far as regards the publicity of such deeds. The last-mentioned Act also requires a similar registration of all petitions for arrange- ment under the Bankruptcy Act of 1867.~~

~~Bankruptcy Legislation in the British Colonies and India.~~

~~Since the passing of the English Bankruptcy Act of 1883, there have been numerous acts of legislation affect- ing the law of bankruptcy in the British Colonies. In some of these the principles of the English Act have been more or less closely followed, the main distinction being that the control and supervision which in England is vested in the Board of Trade and its officers, are in the Colonies vested in the local courts and specially consti- tuted officials acting under their control. For general information on the subject of Colonial and Indian bank- ruptcy legislation down to a recent date, reference may be made to the Si:^teenth Annual Report to Parliament by the Board of Trade, dated 1st August 1899, and to the subsequent annual reports of that department, which con- tain interesting risumis of the principal features of the various acts at present in force in the British Colonies and in India. (j. sm.*)~~

~~Bankeuptot in the United States.~~

~~The United States Bankruptcy Law of 1867 was re- pealed in 1878. For the twenty years following, until 1898, the only insolvency laws in the United States were those of the separate States, in which there has been lit- tle change ; they varied much, especially as to dissolving attachments and preferences and granting discharges. In 1898 these laws were again superseded by another general United States Bankruptcy Act.~~

~~The especial objects of this Act were the securing of discharges from debts to all insolvents not guilty of fraud, ajid promptness and economy in the settlement of estates. The provisions as to discharges from debts are much more liberal than in any former Act. Any bankrupt may have a discharge~~

from his debts unless he has committed some crime punishable by imprisonment under the Act (viz., concealment of property or perjury), or with fraud- ulent intent and in contemplation of baniruptcy destroyed, con- cealed, or failed to keep books from which his true condition might be ascertained. No dividend to or consent of the creditors is required. A preference, or conveyance to defraud creditors, or spending or wasting of property, or loss by gambling before the adjudication, is no ground for refusing a discharge. Discharges do not affect the following : — taxes, judgments for frauds, fsflse pretences, or wilful injuries ; debts not scheduled ; debts created by embezzlement or misappropriation, either as an officer or by one acting in a fiduciary capacity. Compositions approved by a major- ity in number and amount of the creditors, and confirmed by the judge, may be enforced ; and the bankrupt, upon depositing the consideration for the composition, and money to pay the preferred

claims, and the costs of the proceedings, will be discharged. Jurisdiction of proceedings in bankruptcy is committed to the United States district court with the right of appeal in some cases to the circuit court of appeals and the supreme court. A jury may be demanded by the respondent in involuntary cases. The judges appoint referees for the diSerent sections of their districts, and must appoint one for each county in which the services of a referee are needed. The referees have extensive judicial powers, and most of the proceedings are in practice con- ducted before the referees ; but their orders are subject to revision by the judges. Judges only can grant discharges and confirm compositions ; but the petitions are usually sent to the referees to report the facts with their recommendation. Any person, except a corporation, owing debts, may become a voluntary bankrupt. Involuntary petitions may be brought against any natural per- son, except a wage-earner or farmer, and any business corpora^ tion owing 1000 dollars. A wage-earner is defined to be one whose compensation does not exceed 1500 dollars per annum. Acts of bankruptcy are less in number than in former laws. They are, transferring property to delay or defraud creditors ; making or permitting preferences ; making a general assignment ; admit- ting in

~~writing inability to pay debts and willingness to be adjudged bankrupt. An adjudication in bankruptcy dissolves attachments and levies of execution, and avoids preferences, made within four months of the adjudication. A trustee to administer the estate is elected by a majority in number and amount of the unsecured creditors ; the judge or referee may disapprove an appointment, but may appoint only when creditors fail to do so. The trustee takes, as of the time of adjudication, all property which a creditor, under the laws of the State, might appropriate. In partnership cases the creditors of the partnership elect the trustee, who administers the estates of the partnership and of the individual partners. The assets are marshalled, partnership assets being applied first to partnership claims and individual assets to individual claims. The bankrupt is allowed to retain all property exempt by the laws of the State in which he resides. These exemptions vary greatly — e.g., from homesteads worth $500 to those worth f5000, and in about the same proportions as to personal property. Taxes, wages of labourers to the amount of $300, earned within three months of the adjudication, and claims preferred by the laws of the State, are preferred in United States bankruptcy. Fees are very small.~~

~~As may be seen from the above summary, there are many differences between the law of 1867 and that of 1898. One distinction of importance concerns jurisdiction of suits by trustees. A trustee can only sue where the bankrupt could have feued — that is, usually, only in the State courts. A suit to recover property fraudulently conveyed by the bankrupt to one in the same State cannot be brought in the district court unless the defendant con- sents. The law has worked well upon the whole, and an association of referees in bankruptcy has recommended to Congress several amendments calculated to remove its objectionable features. The principal points of the amendments thus recommended are : (1) the adding of the following to the grounds for objecting to the granting of discharges — viz., obtaining credit by false representations, making fraudulent preferences or transfers not restored, causing bankruptcy by gambling, destruction of books, refusing to obey orders made or to answer questions ap- proved by the court ; (2 providing that discharges shall not affect liability for fraud or wilful injury, or for ali- mony, or support of family, or seduction ; (3) increasing the compensation to trustees ; (4) allowing corporations to become voluntary bankrupts ; (6) shortening the time for involuntary proceedings ; (6) giving the United States courts jurisdiction to set aside preferences and fraudulent transfers ; (7) making definite the effect~~

~~upon dividends of bond-fide payments on account within four months of the bankruptcy. These amendments and several others of less importance, when adopted, would make the Act of 1898 the most liberal, as well as the most economical. Bankruptcy Act which has ever existed in the United States. (h. g. n.)~~

~~Banks, Nathaniel Prentiss (1816-1894), Amer- ican politician and soldier, was born in Waltham, Massa- chusetts, on the 30th of January 1816, and died there on~~

~~the 1st of September 1894. He was admitted to the bar, and, in 1849, was elected to the State Assembly, of which he was speaker in 1851 and 1862. In 1853 he was chairman of the state constitutional convention. In that year he was elected to the national House of Representa- tives, as a coalition-Democrat. He was re-elected by the "American" party, and after a long contest became Speaker of the House. In 1856 he was re-elected by the Eepublicans, but resigned, in 1857, to become goVernor of Massachusetts, to which office he was re-elected in 1858 and 1859. After serving for a short time as presi- dent of the Illinois Central railroad, he became, in 1861, a major-general of volunteers in the Civil War. He performed conspicuous services in the army of the Poto- mac, and in the department of the Gulf of Mexico. He resigned his commission in 1864, and was again elected a representative in Congress, where he served almost con- tinuously until 1877. Fdr several years he held the important position of chairman of the Committee on Foreign Affairs. He was once more a member of the House from 1889 to 1891.~~

~~Banldira, a town of British India, in the Burdwan division of Bengal, situated on the left Ijank of the river Dhalkisor. Population, about 19,000. The town stands high, and is reckoned healthy. It has a high school, with 246 pupils in 1896-97, two printing-presses, one of which issues a weekly newspaper in the vernacular, and a Hindu public library.~~

~~The district of Bankuba lies partly in the plain and partly on the hills, its northern boundary being the river Damodar. It contains an area of 2621 square miles. Population (1881), 1,041,752; (1891), 1,069,668, showing an increase of 3 per cent. ; average density, 408 persons per square mile. Hindus numbered 920,373 ; Mahommedans, 45,312; aborigines (chiefly~~

Sonthals), 103,747 ; Christians, 132, of whom 21 were Europeans ; "others," 104. In 1901 the population was 1,114,185, showing a further increase of 4 per cent. Land revenue and rates in 1897-98 were Es.5,21,659; the number of police was 367 ; the boys at school in 1896-97 numbered 37,587, being 47-6 of the male population of school- going age; the registered death-rate (1897) was 26-7 per thousand. There are 14 indigo factories, with an out-turn valued at Es.17,700. Large quantities of lac and tusser silk are gathered in the hilly tract, which is overgrown with jungle. The stone quarries and minerals are little worked. There are two coal mines, employing about 200 people, and producing about 9000 tons a year. Both cotton and silk are woven, and plates, &c., are carved from! soap-stone. The district is exposed to drought, and also to destructive floods. It suffered in the famines of 1866, 1874^75, and again in 1896-97. The old capital of the country was at Bishnupur, which is still the chief centre of local industries. The north of the district is near the East Indian railway, beyond the river Damodar.

Bannu, a town and district of British India, in the Derajat division of the Punjab. The town (also called Edwardesabad and Dhulipnagar) lies in the north-west corner of the district, in the valley of the Kuram river. Population, about 6000. The municipal income in 1897-98 was Es.52,781. The cantonments of Fort Dhulipnagar accommodate artillery, cavalry, and infantry. There are a missionary church, school, and printing-press, a Victoria Jubilee high school (opened in, 1897), and a Mahommedan school.

The district of Bannu, stretching across both banks of the Indus, contains an area of 3847 square miles. The population in 1891 was 372,276, being 97 persons per

square mile. Classified according to religion, Mahomme- dans numbered 337,269; Hindus, 33,832; Sikhs, 1062; Christians, 58, including 39 Europeans ; « others," 56. In 1901 the population was 403,072, showing an increase of 8 per cent. The total amount of land revenue and rates was returned as Es.4,93,138, the incidence of assessment being 3| annas per acre

~~; the number of police was 514. In 1896-97, out of a total cultivated area of 628,734 acres, 166,675 were irrigated, almost entirely from private canals. Salt is quarried on Grovernment account at Kalabagh, and alum is largely obtained in the same neighbourhood. The chief export is wheat. The main line of the North- western rail way, with a branch now in process of extension northwards, runs for 93 miles through the cis-Indus tract ; and a military road, 80 miles in length, leads from Bannu town towards Dera Ismail Khan. The Indus, which is nowhere bridged within the district, is navigable for native boats throughout its course of 76 miles. Education is making fair progress. In 1896-97 there were altogether 297 schools attended by 6029 boys, the proportion of boys at recognized schools to those of school-going age being 12 per cent. The death-rate in 1897 was 43 per 1000 ; the rainfall in 1897 was 20-23 inches.~~

~~Banswara, a native state of India, in the Eaj- putana agency, with an area of 1605 square miles. The population in 1891 was 180,916, showing an average density of 120 persons per square mile. The estimated gross revenue in 1896-97 was Es.2,53,788; the tribute, Es.38,000. The administration is in the hands of a Hamdar or minister. The petty state of Kushalgaeh is feudatory to Banswara ; area, 432 square miles ; popula- tion (1891), 31,353 ; gross revenue, Es.61,977. In 1901 the population of the two states was 166,276, showing a decrease of 22 per cent., due to the effects of famine.~~

~~The town of Banswaka has a population of about 7500.~~

~~Bantam, the most western residency of Java, on Bantam Bay, with its chief town of the same name, 45 miles west by north of Batavia. The soil is fertile only in the central portion of the residency, which, from several causes (cattle plague of 1879, fever epidemics, the erup- tion of Krakatao in 1883, causing the death of 24,000 of the inhabitants, and the insurrection of 1888), is less populous and less cultivated than the rest of Java. The industries are rice, coffee, Tcatjang, and fishing. The capital is in a decayed state. The residency (area, 2989 square miles) had, in 1897, a population of 709,339, in- cluding 302 Europeans, 1959 Chinese, 64 Arabs, and 35 other Asiatic i^oreigners.~~

~~Bantry, a seaport in county Cork, Ireland, on Bantry Bay, which is one of the headquarters stations of the Channel Squadron and an important fishing centre. It is the terminal station of the Cork, Bandon, and South Coast Eailway. The coaches on the famous Prince of Wales route to Glengariff start from here. The manufac- ture of Irish friezes and tweeds is now successfully carried on ; also salmon fishing. Population, about 2900.~~

~~Bantu Languages. — The greater part of Africa south of the equator possesses but one linguistic family so far as its native inhabitants are concerned. This clearly-marked division of human speech has been entitled th^ Bantu, a name invented by the late Dr Bleek, and it is, on the whole, the fittest general term to use to designate the most remarkable group of African languages.^~~

~~1 Bantu (literally Bci^ntu) is the most archaic and most widely spread term for " men," " mankind," " people," in these languages. It also~~

~~It must not be supposed for a moment that all the j)eople who speak Bantu languages belong necessarily to a special and definite type of Negro. On the contrary, though there is a certain physical resemblance among those tribes who speak the purest Bantu dialects (the Ba-yanzi of the Upper Congo, the people of the great lakes, the Ovarherero [Damara], Zulu-Kafirs, Awenba, and some of the east coast peoples), there is nevertheless a great diversity in outward appearance, shape of head, and other physical characteristics, among the negroes who inhabit Bantu Africa. Some tribes speaking Bantu dialects are dwarfs or dwarfish, and obviously akin to the non-Bantu Bushmen or Forest Pygmies. Others betray relationship to the Hottentots; others again cannot be distinguished from the most exaggerated forms of the black West African Negro. Yet others again, especially on the north, show traces of Galla or Nilotic intermixture. But the general deduction to be drawn from a study of the Bantu languages as they exist at the present day is that at some period not much more than two thousand years ago a powerful tribe of negroes speaking the Bantu mother language, and allied physically to the negroes of the Western Nile and Southern Lake Chad basins, pushed themselves forcibly into the southern half of Africa, which at that time was probably very sparsely populated except in the north-west, east, and south. The Congo basin at the time of the Bantu invasion would have been occupied on the Atlantic seaboard by west coast negroes, and in the centre by Eorest Pygmies ; the vicinity of Victoria Nyanza and the East African coast region down to opposite Zanzibar probably had a population partly Nilotic-negro and partly (in the south) Hottentot. From Lakes Tanga- nyika and Nyasa south-~~

westwards to the Cape of Good Hope the population was Hottentot and Bushman. Over nearly all this area the Bantu swept with such a vehemence that they destroyed or absorbed the vast majority of the preceding populations, of which, linguistically speaking, the only survivors are the scattered tribes of pygmies in the forests of the Congo and Gabun, a few patches of quasi-Hottentot and Nilotic peoples between Victoria Nyanza and the Zanzibar coast, and the Bushmen and Hottentots of South-West Africa. The first area of decided concentration on the part of the Bantu was very probably Uganda and the shores of Tanganyika. The main line of advance south-west trended rather to the east coast of Africa than to the west. Finally, when the Bantu had reached the south-west corner of Africa, their further advance was checked by two causes : first, the concentre-tion in a healthy, cattle-bearing part of Africa of the Hottentots (themselves only a superior type of Bushman, but able to offer a much sturdier resistance to the big black Bantu negroes than the crafty but feeble Bushmen), and secondly, the arrival on the scene of the Dutch and British, but for whose final intervention the whole of Southern Africa would have been rapidly Bantuized, as far as the imposition of language was concerned. The theory thus briefly set forth of the origin and progress of the Bantu, and the approximate date at which their great southern exodus commenced, is to some extent attribu- table to the present writer only, and has been traversed at different times by other writers on the same subject. In

indicates aptly the leading feature of this group of tongues, which is the governing of the unchangeable root by prefixes. The syllable -ntu is nowhere found now standing alone, but it originally meant “object,” or possibly ” person.” Combined with different prefixes it has different meanings. Thus (in the purer forms of Bantu languages) muntu means ” a man,” bantu means ” men,” Mntu means ” a thing,” bintu ” things,” kantu means “a little thing,” tuntu “little things,” and so on. This term Bantu has often been criticised by writers, such as Sir H. M. Stanley, but no one has supplied a better, simpler designation for this section of the negro race and of negro languages, and the term has now been definitely consecrated by a use of over forty years.

~~the neaxly total absence of any historical records, the only means of building up Bantu history lies in linguistic research, in the study of existing dialects, of their relative degree of purity, of their connexion one with the other, and of the most widely spread roots common to the majority of the Bantu languages. The present writer, relying on linguistic evidence, fixed the approximate date at which the Bantu negroes left their primal home, some- where in the very heart of Africa (between the northern basin of the Congo, the western basin of the Nile, and the southern basin of Lake Chad), at not much more than two thousand years ago ; and the reason adduced seems unanswerable. It lies in the root common to nearly all the Bantu languages expressing the domestic fowl — Jcuku {nkuku, ngoko, nchuchu, nsusu, nguku, nku). Now the domestic fowl reached Africa first through Egypt, at the time of the Persian occupation — not before 500 to 400 B.C. It would take at that time at least a couple of hundred years before — from people to people and tribe to tribe up the Nile valley — the fowl, as a domestic bird, reached the very heart of Africa. The Muscovy duck, introduced by the Portuguese from Brazil at the beginning of the 17th century, is spreading itself over Negro Africa at just about the same rate. Yet the Bantu people must have had the domestic fowl well established amongst themselves before they left their primeval home, because throughout Baatu Africa (with rare exceptions, and those not among the purest Bantu tribes)- the root expressing the domestic fowl remounts to the one vocable of kuku} Curiously enough this root kuku resembles to a marked degree several of the Persian words for " fowl," and is no doubt remotely derived from the cry of the bird. Among those Negro races which do not speak Bantu languages, though they may be living in the closest proximity to the Bantu, the name for fowl is quite different.^ The fowl was only introduced into Madagascar, as far as researches go, by the Arabs during the historical period, and is not known by any name similar to the root kuku. Moreover, even if the fowl had been (and there is no record of this fact) introduced from Madagascar on to the east coast of Africa, it would be indeed strange if it carried with it to Cameroon, to the White Nile, and to Lake Ngami one and the same name. It may, however, be argued that such a thing is possible, that the introduction of the fowl south of the, equator need not be in any way coincident with the Bantu inva- sion, as its name in North Central Africa may have followed it everywhere among the Bantu peoples. But all *other cases of introduced plants or animals do not~~

~~support this idea in the least. The Muscovy duck, for instance, is pretty well distributed throughout Bantu Africa, but it has no common widely-spread name. Even tobacco (though the root " taba " turns up unexpectedly in remote parts of Africa) assumes totally different designations in different Bantu tribes. The Bantu, moreover, remained faithful to a great number of roots like "fowl," which referred to animals, plants, imple- ments, and abstract concepts known to them in their original home. TJius there are the root-words for ox {-huzi), pig (-gulu), pigeon (jiba), dog (mbwa), hippo potamus {-bugu), elephant (-jobo, -joko), leopard (ngwi),~~

~~1 In Luganda, the language of Buganda, Victoria Nyanza, and also* in Lunyoro on the White Nile, the word for " fowl " is nkoko. In Ki- Swahili of Zanzibar it is kuku. In Zulu it is inkuku. In some of the Cameroon languages it is lokoko, and on the Congo it is nkogo, nsusu. On the Zambezi it is nkuku ; so also throughout the tribes of Lakes Nyasa and Tanganyika.~~

~~2 From this statement are excepted those tongues classified as " semi-Bantu." In some languages of the Lower Niger and of the Gold Coast the word for " fowl " is generally traceable to a root kuha. This form kuba also enters the Cameroon region , where it exists along- side of koko. Kuba may have arisen independently, or have been de rived from the Bantu kuku.~~

~~house (-yumba and -dago), moon {-ezi), sun (-juba\ water {-ndiba, mandiba), lake or river (an«a),' drum (ngoma), name (-ina or .;ma), wizard {-nganga) ; adjectives like -bi (bad), -ei-u, (white) ; verbs like fwa (to die), ta (to strike, kill), la or lia (to eat). The root-words cited are not a hundredth part of the total number of root-words which are practically common to all the spoken dialects of Bantu Africa. Therefore the possession amongst its root-words of a common name for " fowl " seems to the present writer to show conclusively that (1) the original Bantu tribe must have possessed the domestic fowl before their dispersal to the southern half of Africa began, and that (2) as it is historically certain that the fowl as a domestic bird did not reach Egypt before the Persian conquest in 526 b.c, and probably would not have been transmitted to the heart of Africa for another couple of hundred years, the Bantu exodus may safely be placed at a date not much anterior to 2100 years ago. It is also interesting to note that the designs on the Zimbabwe and other neighbouring monuments supposed to be made by~~

~~the Semitic gold workers of Southern Zambezia exhibit natives with distinct Hottentot physical peculiarities, as though at the period when these buildings were erected (about 2000 years ago) black Bantu negroes were not familiar to the pre-Islamite Arabians who mined for gold in what is now Rhodesia. Early Arab geographers, also, while alluding to the Zenj or modern Zanzibar negroes on the east coast of Africa opposite Zanzibar, described the regions farther south as being inhabited by Wakwak, who from the accounts given seem to have been a savage people of Hottentot or Bushman race. Indeed, the very name Wakwak may be only a corruption and duplication of the Hottentot root kwa, which means " men " and is a constant tribal sufHx.* Further, the legends and tradi- tions of the Bantu peoples themselves invariably point to a northern origin, and a period, not wholly removed from their racial remembrance, when they were strangers in the land. It is not to be supposed that this argument about the relatively recent occurrence of the Negro exodus which has spread the Bantu languages over a third of the Dark Continent implies that Africa south of the Equator was uninhabited, or even very sparsely inhabited, prior to the Bantu invasion. On the contrary, it would seem as if the southern half of Africa had been inhabited from a very early period in the history of mankind. It is merely that the invasion of tie Bantu and the expansion of their family of languages are events of very recent occurrence. No doubt before their coming the eastern coast regions, down to about the Ruvuma river, were inhabited by a Nilotic type of Negro akin to the Shiluk, Dinka, and Masai; and the west coast of Africa, down to about the Congo mouth, was inhabited by negroes of the Guinea type, while the Congo forests and Angola were sparsely peopled by dwarf races, which in the south and south-east developed or degenerated into Bushmen and Hottentots. Seemingly the Bantu some- wliat early in their migration down the east coast took to the sea, and not merely occupied the islands of Pemba and Zanzibar, but travelled as far afield as the Comoro archi- pelago, and even the west coast of Madagascar. Their in- vasion of Madagascar must have been fairly considerablein numbers, and they seemingly gave rise to the race of black people known traditionally to the Hovas as the Va-zimba.~~

~~The accompanying map will show pretty accurately the distribu- tion of the Bantu-speaking Negroes at the present day. It will be seen by a glance at~~

~~this map that the areas In which Bantu lan- guages of archaic fdtm and general purity from other elements are~~

~~8 Whence the many nyanza, nyanja, nyasa, mwanza, of African geography. * As in Nama-kioa, Qri-kwa, &c.~~

~~spoken are somewhat widely spread. Perhaps on the whole the most archaic dialects at the present day are those of Uganda, of~~

~~.u ii ^ b~~

~~s~~

~~the north-west coast of Tanganyika^, and of the Awemba, who inhabit the country between the south-westemmost comer of~~

~~Tanganyika, the river Chambezi, and the districts round the north end of Lake Nyasa. Another language of typical Bantu construc- tion is the Ki-yanzi or Ei-bangi tongue, spoken on a section of the Central Congo and on the Lower Ubangi river ; another is the well- known Oci-herero of Damaraland. Ki-makonde, on the east coast of Africa, is archaic ; so in some features is the celebrated Ki-swa- hili of Zanzibar, and the Ci-bodzo of the Zambezi delta ; while the celebrated Zulu-Kair dialects, though they exhibit several marked changes in vocabulary and phonetics (both probably of recent date) , preserve nevertheless so many of the characteristics of the hypothetical mother tongue that, until the languages of the great lakes came to be known, Zulu-Kafir was regarded as the Sanskrit of the Bantu. Perhaps it is so, as Sanskrit is now viewed in rela- tion to the original Aryan tongue. In that case the lake dialects would correspond to Lithuanian (only "more so," that is to say, even nearer to the original Bantu than are the Lithuanian~~

~~dialects to the hypothetical Aryan parent speech), the Oci-herero to Greek, and Ki-yanzi to Gothic.~~

~~With our present inadequate knowledge of the aflSnities of the existing Bantu tongues it is difficult and premature to divide them accurately into groups and subdivisions, the enumeration of which also in an article like the present becomes too much of a wearisome string of names ; but there may be mentioned severally (1) the Uganda group of languages, occupying the area between Albert Nyanza and the White Nile, the north and west coasts of "Victoria Nyanza, the north and north-west coasts of Tanganyika and the Congo forests (a clearly-marked congeries of kindred dialects) ; (2) the Ki-emba or Ci-wemba, between Tanganyika, Bangweulu, and Nyasa ; (3) the Nyamwezi group, south of Victoria Nyanza ; (4) the Swahili; (5) the Nyika, and (6) the Kikamba groups, on the east and north-east ; (7) the Ci-hehe group, south of the Nyamwezi and north of the Euvuma river ; (8) the well-marked Makonde- Yao, to the south of the Ruvuma, and south and east of the Yao ; (9) the remarkable Makua tongue (which though very archaic in the roots of its vocabulary is, like the Secuana, singu- larly corrupt in phonetics). Southern and Eastern Nyasaland and Central Zambezia are filled (10) with various Ci-nyanja or Mana- nja dialects. ■ Immediately south of the Central and Lower Zam- bezi (putting aside the intrusive Zulu) is (11) the Makarakagroxip. South and west of that again is (12) the Secuana,^ spoken over a wide area in closely-allied dialects. (The Secuana, like the Makua, though truly Bantu in its roots, is extremely corrupt in its phonet- ics.) It has not, however, except in one or two dialects, borrowed any "clicks" from the Hottentots.~~

~~To the south and east of the Secuana group lies (13) the import- ant Zulu-Kafir section, which with cognate dialects stretches along the coast regions from Port Elizabeth in the south to Inhambane ^ in the north. The dialects in the coast region between Inhambane and the Zambezi share their alliance between the Zulu, Makaraka, and Nyanja groups. The word "Kafir" has been so long mis- applied to the most southerly of the Bantu peoples that it is diffi- cult to ignore it. It is simply the cant term of "infidel" applied by the Arabs of Sofala to the heathen Bantu round them, and communicated by the Arabs to the earliest Portuguese navigators who visited these shores. The Portuguese applied the term Cafres to all the east coast negroes from~~

Natal to Quillimane. North- west of the Secuana is (14) the Oci-herero group of Damaraland, Ovamboland, and Portuguese West Africa as far north as Benguela and«the highlands of Bihe. Herero is by far the most archaic of this section of the Bantu languages, the dialects related to it in the north and north-east being much more corrupt. The Central Zambezi region, west of the great Nyanja congeries of dialects, is mainly occupied by (15) the Tonga or Toka family, and west of this again is (16) the Kiloi language-group of Barotseland, which is related to (17) the Kiboko section of the Upper Zambezi and Lower Kasai. Then to the west comes (18) the great Bunda group, including most of the dialects of Angola and of the Lower Kwango. These shade by insensible gradations into (19) the Kongo family, on the Lower Congo from Stanley Pool to the sea, and ex- tending north along the coast to Loango. The southern basin of the Congo is mainly occupied by one great family (20), the Bua or Lunda dialects, which stretch eastwards to the vicinity of Tanga- nyika, and even seem to include the Ki-lungu and Ki-mambwe of the Nyasa-Tanganyika Plateau. It is not known yet whether the language of the Tu-shilange and Batetela is related to the Bua. On the Upper Congo, from the vicinity of West Tanganyika and Nyangwe, down past Stanley Pool to the confluence of the Aru- wimi, there seems to be one dominating form of the Bantu lan- guage which may be classified as (21) the Manyema group, and which exhibits very great corruption. The Balolo group (22) to the west, which occupies the regions immediately south of the

1 In accordance with the phonetic system adapted from Lepsius, in which Bantu languages are transcribed, c stands for the English eft. Secuana is the language spoken by the Bechuana.

2 This is the Portuguese town and district, which should really he pronounced Inyambane — ^Portuguese nh=ny.

Upper Congo, is seemingly related to the IVfanyema, but is less corrupted. The Lower Kasai would appear to be occupied by (23) a group which may be called, from one of its dialects, the Kibuma. These languages march with the Kongo dialects to the west. The greater part of the Central Congo, on both banks, and the Lower Ubangi are occupied by peoples speaking (24) the Ki-bangi (or Ki-yanzi') language. West of that, and about Stanley Pool

~~and the interior of French Congo, is (25) the Kiteke group, which, with its allied languages, marches on the west with the Kongo dialects, and on the north-west with (26) the Qabun or Mpongwe family. North of the Mpongwe group (which ends about the Gabun river) is (27) the Cameroon group, which includes all the coast dialects up to the Rio del Key (where the Bantu territory ends), and also the dialects of the island of Fernando Po. In the interior of Cameroon and of the Gabun there is a wide tract of country in-habited by tribes such as the Fan, which are evidently recent intruders, and can only be regarded as semi-Bantu. The general structure of these languages (Mbudikum, Mfut, Bayoh, Bamom, Panhwe (Fan), Papiax, Param, Penin, Balu, Nki, Melon, Mo- menya, Bagba, Juka, Kamuku, BascC Juku, even the Mid south of the Benue) is essentially Bantu, but of a very corrupt kind. But although the shattered prefixes are of obviously Bantu origin, only a very small part of the vocabulary can be called Bantu, and in many important root-words the Bantu connexion is not at all obvious. These languages seem to be of a degraded type, and possibly are very remotely descended from cognate dialects of the original mother language. Eastward of this intrusive wedge of semi- Bantu we again come to Bantu languages to the north of the Congo, within the limits of the Congo basin, the Sanga group (28) of dia- lects spoken by the Bonjo, the Baya, the Ndere, and the Yangere, in the basin of the river Sanga and its affluents. Immediately east of this Sanga group, although the people would appear to be Bantu, we know too little about their dialects to be able to classify them in groups. Farther east still, in the region between the Welle and Albert Nyanza, we come to (29) the Bavira, the Wazamboni, and other tribes encountered by Stanley in his march to the relief of Emin Pasha. These inhabitants of the north-easternmost corner of the Congo forests and the adjoining grass country up to the southern half of the western shore of Albert Nyanza bring us back to the Uganda group of languages from which we started, and to this group the dialects last referred to would seem to be related.~~

~~This summary of the geographical grouping of the Bantu lan- guages may be concluded by again directing attention to the striking contrast which exists, from a linguistic point of view, north and south of the Bantu border line — a border Une which, commencing on the west coast of Africa close to the Niger delta, and following more or less closely the limits of the Northern Congo watershed to Albert Nyanza, the White Nile, and Victoria~~

~~Nyanza, thence con- tinues in an irregular line to the vicinity of Zanzibar. North of this line there is great linguistic confusion, and an almost uncounted number of separate linguistic families exists, each differing from the other as they differ in turn from Bantu. This is the condition of affairs throughout all Negro Africa between Abyssinia and the Atlantic. Once the Bantu border line is crossed, however, there is but one family of languages — the Bantu — prevailing, with the pos- sible exception of relics of a Pygmy language in the Congo forests, of Hottentot or Nilotic fragments in the Zanzibar Hinterland, and, of course, the Hottentot and Bushman dialects in South-West Africa. The general homogeneity of the Bantu languages is greater than that of the existing condition of Aryan tongues, though it is a great exaggeration to say that the various Bantu dialects differ from one another no more than do the existing Eomance languages.~~

~~The following propositions may be laid down to define the pecul- iar features of the Bantu languages : — '~~

~~1. They are agglutinative in their construction, their syntax being formed by adding prefixes and suffixes to the root, but no infixes (that is to say, no syllable incorporated into the root-word).~~

~~2. The root {excepting its terminal vowel) is unchanging to all intents and purposes, though its first or penultimate vowel or con- sonant may be modified in pronunciation by the preceding prefix or succeeding suffix. With one exception there is no inflexion; that exception (scarcely in origin a true one) is in the preterite tense of the verb in certain languages where the root changes in its terminal tion, probably by the absorption of a suffix.~~

~~3. No two consonants come together viithout an intervening vowel {except where one of them is a nasal, a labial, or a semi-vowel) ; no consonant is doubled (except by the accidental juxtaposition of two m's or Ti's, one of which represents an abbreviated particle) ; no word ever ends in a consonant, except in rare instances where the termination through contraction and the dropping of a vowel becomes a nasal sound.~~

~~4. Substantives are divided into many classes or genders indicated by the pronominal particle prefixed to the root. Some of these pre- fixes are used in a plural sense, others in the singular. No singular prefix can be used as a~~

~~plural, nor can a plural pi-efix be employed in the singular number. There is a certain degree of correspondence~~

~~Singular. Class 1. Mu- (Ngu-) „ 3. Mu- (Ngu-) „ 5. Di- (Ndi-) „ 7. Kl- (Nki-?) „ 9. N or Ni~~

~~between the singular and plural prefixes (thus, No. 2 prefix (see below) invariably serves as plural to No. 1 ; No. 8 (plural) corre- sponds to No. 7 (singular), but this cannot be depended on as a rule). The full number of the prefixes is sixteen?- The pronomi- nal particle or prefix of the noun is attached to the adjectives, pro- nouns, and verbs in the sentence which are connected with that noun, and though in course of time these particles may differ in form from the noun-prefix, they were formerly identical in origin. (This system is the "Concord" of Dr BJeek.) The pronominal particles, whether in nominative or accusative case, must always precede the verbal root, though they often follow the auxiliary pre- fixed particles used in conjugating the verbs. (An apparent but not a real exception to this rule is in the second person plural of the imperative mood, where an abbreviated form of the pronoun is affixed to the verb,^ and other phases of the verb are occasionally emphasized by the repetition of the governing pronoun at the end.)~~

~~5. The verbal root may modify its termination by a change of the last vowel or by suffixing certain particles, or it may even change its radical vowel either to form a tense or to alter the original meaning of the simple stem.~~

~~6. The root of the verb is the second person singular of the "■ imperative.~~

~~7. No sexual gender is recognized.~~

~~The sixteen original prefixes of the Bantu languages are given below. They are stated in the most archaic forms to be found in living languages ; but their oldest types, and these' latter obtained by deduction from the other forms of the particle used in the syntax, are given in brackets.~~

~~Bantu Fbefixes.~~

~~Plural. Class 2. Ba- „ 4. Mi- (Ngi-) „ 6. Ma- (Nga.) „ 8. Bi-~~

~~„ 10. TI-, Ti-n-, or 0-,^ bi-n-, or Zi-, Zi-D- „ 11. Lu- (Ndu- ?) „ 12. Tu (often diminutive in~~

~~„ 13. Ka (usually a diminu- sense)~~

~~tive) „ 14. Bu- (sometimes used in a plural sense; generally em- ployed to indicate abstract nouns) „ 15. Ku- (identical with the preposition "to," used as an infinitive with verbs, but also with certain nouns indicating functions of the body primarily) „ 16. Pa- (locative: applied to nouns and other forms of speech to indicate place or position ; identical with adverb " here," as ku- is with " there ") To these sixteen prefixes should perhaps be added the preposition j»it- " in, " " into," which in some languages is used as a prefix or pro-~~

~~. , . , ■ j.r. c vv I, < M"nyumbai-nimw-ace\ nommal particle, as m the Swahilijihrase | j^ y^^^^ ^^ j^, j^ j^jg |~~

~~= In his house — where the preposition M'' (abbreviation for Mu-) has the particle mw (jmu) agreeing with it and placed before the pronoun -ace.~~

~~Also the prefix in the singular number having a diminutive sense, which is found in some of the north-western ^ Bantu tongues —fl- or m-. This is possibly an additional prefix which has come into independent being in that rather divergent group. It cannot be traced to derivation from any of the other prefixes among the sixteen. It is always used in the singular, and its corresponding plural prefix is the twelfth (tu-).~~

~~The concord may be explained thus : —~~

~~Let us for a moment reconstruct the original Bantu mother tongue (as attempts are sometimes made to deduce the ancient Aryan from the most archaic of its daughters), and propound sen- tences to illustrate the repetition of pronominal particles known as the " concord."~~

~~Old Bantu.~~

~~Abao ba-ntu borbi ba-ba-ota tu-boroga.~~

~~They they person they bad they they- who kill we them fear. Rendered into modern dialect of Luganda, of Buganda :~~

~~Bo ba-ntu babi babota tu-ba-Ua.~~

~~They they person they bad they they- who kill we them fear. Or, again.~~

~~Old Bantu.~~

~~Ngu-ti ngu-nguo ngu-gwa ; kur-ngurmbona 9~~

~~This tree this-one this falls ; thou this seest ?~~

~~(" The tree falls ; dost thou see it ? ")~~

~~1 Possibly seventeen.~~

~~2 jr(a=call ! J~~

~~■• As mu-ntu, a man ; bu^tu, humanity. t t -t :~~

~~6 Perhaps in the Eastern Congo basin. In the form ot i- it is seemingly present in Manyema.~~

~~Rendered into Kiguha of Tanganyika, this would be : —~~

~~Muti guno gugwa ; ugumona f It tree t\as (one) it falls ; thou it seest 7~~

~~The prefixes and their once identical particles have varied greatly in form from the aboriginal syllables as the various Bantu dialects became more and more corrupt. The eighth prefix, W-, becomes ui-, pi-, fin, fy-, si^ ; i-, by-, bz-, py-, ps-, zi-. Further confusion is caused by the retention and fusion in the prefix of the preceding vowel which marked the full definite form when the prefix was usedi as a definite article or demonstrative pronoun. The definite forms of the prefixes were these : 1. Umu {ungu, unu) ; 2. Aba ; 3.~~

~~Umu (ungu unu) ; 4. Imi (ingi, ifd) ; 5. Idi (indi) ; 6. Ama (janga, ana) ; 7. Iki; 8. Ibi; 9. In-; 10. lein or izin; 11. Ulu; 12. Utu; 13. Aka; 14. Ubu; 15. Uku; 16. Apa.~~

~~Not many of the existing Bantu languages possess all the pre- fixes of the mother tongue ; that is to say, all the sixteen. Amongst those that do may be cited the Kirega, some of the Kavirondo dialects, and the Kiguha of the Uganda group ; the Kiwemba of South Tanganyika ; the Makonde of the Zanzibar coast, possibly the Nkonde dialects of the north end of Lake Nyasa ; Oci-herero of Damaraland, and the Kongo language of the Lower Congo. The second prefix Ba, retains its original form in the Uganda group, in the languages of North Tanganyika, on the Central Congo, in South-West Congoland, in Cameroon, Fernando Po, and the Gabun (with the exception of the Mpongwe) ; also in the upper part of the Central Zambezi, and perhaps in one or more dialects of West Nyasa and Kiwemba ; in the Secuana dialects and in the Zulu-Kafir tongues. In the Herero group of languages it becomes Va, as also in parts of the Lower Zambezi and in South-East Africa. In the greater part of Eastern Africa and Nyasaland it becomes Wa, and dwindles finally into A in the Makua countries, in Southern Nyasaland, on the Nyasa-Tanganyika Plateau, among the Bua dialects of the South Congo basin, among the Manyema in Angola, on the Lower Congo, among the Mpongwe, and in some of the dialects of the Nyika and the Kamba groups in the north-eastern part of the Bantu language- field. North of the 10th parallel of south latitude the tenth prefix (6i or Zi) is rarely met with, though traces of its former existence may be deduced from its presence in the concordant particles. Thus, though it is absent as a plural prefix for nouns in the Swahili of Zanzibar, it reappears in the Concord. For instance: nombe hizi zangu — cows these mine (These cows are mine). Although nombe has ceased to be zihombe, in the plural the zi particle reap- pears in hizi and zangu. Nevertheless, the tenth prefix is still met with in its full form in Kongo, perhaps in Mpongwe, and in the Kavirondo dialects of the Uganda group.~~

~~The pronouns in the Bantu are in most cases traceable to some such general forms as these : —~~

~~I, me~~

~~Thou, thee~~

~~He or she, him, her~~

~~Ye, you They, them~~

~~ngi, mi.'~~

~~ku.~~

~~a ; also ngu, mu (which becomes yu, ye) ;~~

~~there is also another form perhaps, ndi, but~~

~~the pronouns for the third person, as in so~~

~~many other languages, partake largely of~~

~~the nature of demonstrative pronouns,~~

~~and are often identical with the latter.~~

~~nu, mu.~~

~~bao, ba.~~

~~In addition to this it must be remembered that the Bantu languages do not distinguish sex, but divide all objects in the third person into two main divisions — (1) human beings and such other living creatures as may be distinguished by the first and second prefixes ; (2) all other substances not actively " alive," which are distributed amongst the other " classes " of nouns. The pronominal particles of these are determined by the class to which they belong, the par- ticles in question being more or less identical with the prefixes.~~

~~The Bantu verb consists of a practically unchangeable root which is employed as the second person singular of the imperative. To this root are prefixed and suffixed various particles. These are worn-down verbs which have become auxiliaries, or reduced adverbs or prepositions." It is probable~~

~~(with one exception) that the building up of the verbal root into moods and tenses has taken place independently in the principal groups of Bantu languages, the arrangement followed being probably founded on a fundamental system common to the original Bantu tongue. The exception alluded to may be a method of forming the preterite tense, which seems to be shared by a great number of widely-spread Bantu languages. This may be illustrated by the Zulu tanda, love, which changes to tandile, have loved, did love. This -He or -Hi~~

~~6 Sfti-, the F palatized.~~

~~‘ Mi is probably a softening of %i, ni ; ngi becomes in some dialects nji, ndi, ni ; there is in some of the coast Cameroon languages a word mba for ” I,” ” me,” the origin of which is not very clear.~~

~~8 Once, in their turn, nouns.~~

~~may become in other forms -idi, -ire, -ini, but is always referable back to some form like -Hi or -He, which is probably connected with the root li or di (ndi or ni), which means ” to be ” or “exist.” The initial i in the particle -He often affects the last or penultimate syllable of the verbal root, thereby causing one of the very rare changes which take place in this vocable. £i many Bantu dialects the root pa (which means to give) becomes pele in the preterite (no doubt from an original pa-He). Likewise the Zulu tandile is a contraction of tanda-ile.~~

~~Two other frequent changes of the terminal vowel of the common root are those from the vowel a (which is almost invariably the ter- minal vowel of Bantu verbs), (1) into e to form the subjunctive tense, (2) into i to give a negative sense in certain tenses. It has been stated that the vowel a almost invariably terminates verbal roots. The exceptions to this rule are so rare that it might almost ‘be included among the elementary propositions determining the Bantu languages. And these exceptions when they occur are gen- erally due (as in Swahili) to borrowed foreign words (Arabic, Portuguese, or English). i This point of the terminal a is the more interesting, because by changing the terminal vowel of the verbal root and~~

~~possibly adding a personal prefix one can make nouns from verbs. Thus in Luganda senyua is the verbal root for " to pardon." " A pardon " or " forgiveness " is ki-senyuo. " A pardoner" might be mv^senyul. In Swahili poJajiisa would be the verbal root for "conciliate"; mpatanasi is a "conciliator," and upataniio is "conciliation." Another marked feature of Bantu verbs is their pover of modifying the sense of the original verbal root by suffixes, the afBxion of which modifies the terminal vowel, and sometimes the preceding consonant of the root. The fullest number of these variations and their usual meanings are as follows : —~~

~~Supposing an original Bantu root, tanda, to love ; this may become~~

~~tandioa to be loved.~~

~~tandeka or tandika . . . to be lovable.~~

~~tandila or tandela "... to love for, with, or by~~

~~some other person.~~

~~tandiza (or -e«o) 1 . . , '~~

~~tandisalot-esay] ■ ■ ■ to cause to love~~

~~tandana to love reciprocally.~~

~~The suffix -aka or -aga sometimes appears and gives a sense of continuance to the verbal root. Thus tanda may become tandaka in the sense of "to continue loving." *~~

~~The negative verbal particle in the Bantu languages may be traced back to an original ka or sa in the Bantu mottier tongue. Apparently in the parent language this particle had already two forms — ka and sa. In the vast majority of the languages at the present day the negative particle in the verb (which nearly always coalesces with the pronominal particle) is descended from this ka or sa, assuming the forms of ka, ga, nga, sa, ta, ha, a. It has coalesced to such an extent in some cases with the pronominal particle that the two are no longer soluble, and it is only by the existence of some~~

~~intermediate forms (as in the Kongo language) that we are able to guess at the original separation between the two. Originally the negative particle ka or sa was joined to the pronominal particles, thus : —~~

~~Ka-ngi not I.~~

~~(therefore Ka-ngi tanda=l not love)~~

~~Ka-ku or kor-wu .... not thou.~~

~~Ka-a not he, she.~~

~~Ka^tu ..... not we.~~

~~Ka-nu ..... not ye.~~

~~Ka-ba ..... not they.~~

~~In like manner sa would become sa-ngi, sa-vm, &c. But very early in the history of Bantu languages ka-ngi, or sa-ngi, became contracted into kai, sai, and ki, si; ka-ku or ka-wu into ku ; and~~

~~1 Exceptions to this rule are of course foreign interjections which in course of time have been verbalized, and the verbal particle li or di, which means " to be."~~

~~2 Or -ira, -era.~~

~~8 This form may also appear as sa, as for instance aka— to be on fire, becomes asa, to set on fire.~~

- ~~In choosing this common root tanda, and applying it to the above various terminations, the writer is not prepared to say that it is associated with aU of them in any one Bantu language. One has to be so very careful what one writes on the subject of the Bantu lan- guages in general, because at the present time very few people are living who have studied several of th«se languages. There are students of Zulu and Chinyanja, of Kongo, of Swahili, of Luganda, who are apt to attack a theory wliich does not exactly accord with the state of things~~

~~of which they have made an exclusive study. Thus, although tanda is a common verb in Zulu, it has not in Zulu all these variations, and in some other language where it may by chance exhibit all the variations its own form is changed to londa or randa.~~

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~~kaa or saa have always been ka or sa. Sometimes in the modem languages the negative particle is used without any vestige of a pronoun being attached to it, and is applied indifferently to all the persons. Sometimes this particle has fallen out of use, and the nega- tive is expressed (1) by stress or accent ; (2) by a suffix answenng to the French " pas," and having the same sense ; and (3) by the separate employment of an adverb, like the "not " in English.~~

~~Authorities. — A Comparative Cframmar of South African Languages (in two parts, left unfinished) by Dr W. H. I. Bleek, 1869. — Cenni di Qlottologia Bantu Sud-Africana, by Dr Giacomo DI Gregokio. (Turin, 1882.) This last not much more than a paraphrase of the work of Bleek and others. — A Sketch of the Modern Languages of Africa, by R. N. Gust, 1882. — Comparative Grammar of the South African Santu Languages, by Father J. ToRREND. (Mainly based on a study of the languages of the Central Zambezi, and therefore erroneous in some deductions, and incomplete.) — The Kilimanjaro Expedition, by H. H. Johnston, 1884. (Slight sketch of the history and structure of the Bantu languages given at the end of the book.) — British Central Africa, by Sir H. H. Johnston (1898, second edition) ; a further description of the Bantu languages in general is given in this book, together with vocabularies and illustrations of the Bantu languages of South Central Africa. — Man : Past and Present, by Professor A. H. Keane, 1899. — An Encyclopcedic Dictionary of the Mahanja {Mang''anja) Language of British Central Africa, by the Eev. D. C. Scott, 1891. — The Folklore of Angola, by Dr Eli Chatelain. — A, Dictionary of the Kongo Language, by the Rev. Holman Bentlet. ^ — Polyglotta Africana Orientalis, by J. T. Last. — The late Bishop Steere's Manuals of the Swahili, Shambala, and Makonde Lan- guages.— Introductory Handbook of the Tao Language, by the Eev. Alexander Hetherwick. — Vocabularies of~~

~~Various Kongo Languages, compiled by Dr A. Sims ; (published by Gilbert and Remington).~~

~~The present writer has, however, relied considerably for his in- formation on vocabularies and other studies of Bantu languages independently compiled by himself, which are not yet accessible in print, but which he hopes to publish shortly. Some of these vocabularies (especially those to the north-west of the Bantu border line) have been printed in Foreign Office reports dealing with the Niger. Vocabularies of more or less value may also be found in Sir H. M. Stanley's Through the Dark Continent, and In Darkest Africa ; also, in Serpa Pinto's Sow I Crossed Africa, and in Commander V. L. Cameron's Across Africa. An interest- ing study of a little-known language is the Methodo Pratico para Fallar a Lingua da Lunda, by Henrique de Carvalho. This work, the outcome of a Portuguese expedition to the Lunda country, was published in 1889 at Lisbon by the Imprensa Nacional. Another work which should certainly be consulted, especially in regard to the Western Bantu borderland, is Koelle's Polyglotta Africana. (h. h. j.)~~

~~Banville, Theodore Faullain de (1823-1891), French poet and miscellaneous writer, born at Moulins' in the Bourbonnais on 14th March 1823, was the son of a captain in the French navy. His boyhood, by his own account, was cheerlessly passed at a lycee in Paris ; he was not harshly treated, but took no part in the amusements of his companions. On leaving school with but slender means of support, he devoted himself to letters, and in 1842 published his first volume of verse {Les Cariatides), which was followed by Les Stalactites in 1846. The poems encountered some adverse criticism, but secured for their author the approbation and friend- ship of Alfred de Vigny and Jules Janin. Henceforward Banville's life was steadily devoted to literary production and criticism. He printed other volumes of verse, among which the Odes Funambulesques received unstinted praise from Victor Hugo, to whom they were dedicated. Later, several of his comedies in verse were produced at the TheS,tre Fran9ais and on other stages; and from 1853 onwards a stream of prose flowed from his industrious pen, including studies of Parisian manners, sketches of well-known persons {Gamies Parisiennes, &c.), and a series of tales (Contes bourgeois, Contes Mrdiques, &c.), most of which were republished in his~~

~~collected works (1875-78). He also wrote freely for reviews, and acted as dramatic critic for more than one newspaper. Throughout a life spent mainly in Paris, Banville's genial character and cultivated mind won him the friendship of the chief men of letters of his time. He was also intimate with Fr^d^ric~~

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~~Lemaitre and other famous actors. In 1858 he was decorated with the Legion of Honour, and was promoted to be an offtcer of the order in 1886. He died in Paris on 16th March 1891, having just completed his sixty-eighth year. Banville's claims to remembrance rest mainly on his poetry. His plays are written with distinction and refine- ment, but are deficient in dramatic power; his stories, though marked by fertility of invention, are as a rule conventional and unreal. Most of his prose, indeed, in substance if not in manner, is that of a journalist. His lyrics, however, rank high. A careful and loving student of the finest models, he did even more than his greater and somewhat older comrades, Hugo, de Musset, and Gautier, to free French poetry from the fetters of metre and mannerism in which it had limped from the days of Malherbe. In the Odes Funambulesques and elsewhere he revived with perfect grace and understanding many old poetic forms, such as the rondeau, the vilanelle, and the pantoum. He was a master of delicate satire, and used with much effect the diflacult humour of sheer bathos, happily adapted by him from some of the early folk-songs. He has somewhat rashly been compared to Heine, whom he profoundly admired; but if he lacked the supreme touch of genius, he remains a delightful writer, who exercised a wise and sound influence upon the art of his generation. (c.)~~

~~Baptists. — (1) United Kingdom. — The condition of the Baptists in the United Kingdom during recent yqars appears to have been one of steady prosperity, their members and adherents having increased at a rate probably more than proportionate to the increase of the population at large. In the Baptist Tear-Book for 1901, the follow- ing statistics were given for their churches in 1900, ex- cluding chapels which are " non-associated " and have no relations with the Baptist Union : churches 2739 (2812), places of~~

~~worship 3918 (3798), members 365,678 (304,163), Sunday scholars 528,131 (448,921), local preachers 6562 (4155), pastors 1992 (1841). The figures in brackets are those for 1891; and in comparing them it should be borne in mind that whereas in 1891 estimated statistics were included for those churches which failed to send in returns, these are omitted in 1900, and " the figures given represent the statistics actually received in the returns from the churches " ; and " the editor, as in former years, ■does not vouch for more than approximate correctness in the statistics." The Baptist Missionary Society, the ear- liest to be founded in the United Kingdom (i.e., outside the Church of England), had a home income of £77,642, 2s. 9d. for the year ending 31st March 1900; and the expenditure during the same period was £81,912, 4s. lid. : the list of missionaries on active service contains 146 names. Perhaps the most important event of recent years was the inauguration of a "Twentieth Century Tund " on the same general lines as those of the Wesleyans and Congregationalists. The proposal was to raise at least £260,000 before 21st April 1902, one half to be allotted to a " forward movement," and the rest to assist- ing weaker churches in the maintenance of their pastors, providing an annuity fund, buildiug a Baptist church house, &c. Of this sum about £180,000 had been prom- ised by August 1901 ; and the president of the Baptist Union declared, in the Autumn assembly of the previous year, that the movement had " risen far above money " and been productive of much spiritual good. V,~~

~~The Baptist Year-Book, published annually, gives full particulars of Baptist societies, colleges, publications, &o. (w. B. Co.)~~

~~(2) United States. — Bnvmg the period 1875-1900 the Baptists of the United States increased more rapidly than the population as a whole, until in 1900 they~~

~~reported 29,473 churches with 4,181,686 members. If to these we add numerous smaller bodies, such as the Free- Will Baptists and the Primitive Baptists, the total Baptist Church membership in the United States is about 4,600,000. But the chief growth in recent years has been in the direction of internal organization and educa- tion. Without any central ecclesiastical authority, or any one form of worship, or any one binding creed, the Baptists have developed a number of large and powerful volun- tary~~

~~organizations, which in turn have reacted strongly on the denominational life. Some of these were formed early in the 19th century, but many of them are of recent growth. The most important are the American Baptist Foreign Missionary Union (formed in 1814), the American Baptist Publication Society (1824), the American Baptist Home Mission Society (1832), the Southern Baptist Con- vention (1845), the American Baptist Historical Society (1853), the Baptist Congress (1882), the American Baptist Education Society (1888), and the Baptist Young People's Union of America (1891). Since 1870 five different Women's Societies have been formed for prosecuting missionary work at home and abroad. The Educational Society has had a notable career. Through its agency the University of Chicago was founded, and from the treasury of the Education Society sixty-six other institu- tions have been aided, the total assistance thus offered amounting to f 1,273,100. Almost all of this was given on condition that far larger sums should be raised by others, and the resulting increase in the endowment of educational institutions has been very great. A scarcely less important work has been done by refusing aid to institutions whose further existence was needless. The Baptist Congress is an organization meeting annually in various cities for the discussion of questions of current interest, furnishing a platform on which all varieties of denominational opinion may find a hearing. It has done much to promote mutual understanding and tolerance of divergent views. The Baptist Young People's Union now includes several thousand young people's societies, and by its " Christian Culture Courses " (in which 15,000 persons were enrolled and examined in 1899) has performed a valuable work. The result of these various movements has been increased concentration of effort and centraliza- tion of administrative power, a decline of interest in sectarian controversy, and increased hospitality to new truth on the part of tb ' entire denomination. No longer content with the attitude of protest and separation, the churches have devoted themselves to the development of their resources, and the training of leaders for the future.~~

~~The most striking change has been seen in the new attitude of the denomination towards education. In their earlier history in the United States, the Baptists were inclined to depreciate formal intellectual discipline, as tending to interfere with the spontaneity and power of true religion. But within twenty years the interest in education has advanced~~

with unprecedented rapidity, and the gifts to education have been very generous. Brown University, founded in 1764, is the mother of all the Baptist institutions of the country. Vassar College, founded in 1861 under Baptist auspices, was the pioneer in the collegiate instruction of women in America, and marked a new epoch in American education. The University of Chicago, founded in 1890, seemed to grow up out of the prairie as if by magic, and within ten years reported 3500 students, and fi property in buildings and endowment amounting to $13,000,000. This one in- stitution has visibly changed the intellectual and religious development of the western states. Large sums have also been expended in academies and secondary schools, while the " freedmen's schools," planted by northern generosity

among the coloured people of tlie south, have done much to lift the level of the negro race in America. The Baptist Tear-Book for 1900 reported as under Baptist control, seven theological seminaries with 1100 students; 104 colleges and universities with 26,000 students; and 84 academies with 11,000 students. The theological seminaries have buildings and endowment amounting to $4,850,000; the colleges and universities have about '$30,000,000 in endowment and buildings; while the academies represent a valuation of f 6,000,000. The result of these great endowments for Christian education is already seen in wider sympathies, a wiser evangelism, more important contributions to research and to literature, and a much higher standard of admission into the ranks of the ministry. A change of emphasis on doctrine has been a feature of great importance in recent denominational his- tory. While retaining the essential tenets of their fathers, the new generation have acquired a new view of the Bible, a fresh interest in humanitarian effort, a new zeal in mis- sionary enterprise, and a deeper interest in the application of truth to the present life of the world. (w. h. p. f.)

Baraba, or Barabinskaya Steppe, vast prai- ries of South-Western Siberia, between the Ob and the Irtysh, 52° to 56° N. lat., 75° to 85° E. long., com- prising the Kainsk district of Tomsk and those of Omsk and Tara of

~~Tobolsk. They are divided naturally into three parts : the Baraba proper, the Kulunda Steppe, and the Berezovaya Steppe, to which the marshy lowlands of the Vas'yugan are sometimes improperly added. The resemblance of these prairies to those of Canada about Winnipeg is striking. But nowhere in the world are vast areas of so low an altitude, i.e., from 200 to 300 feet above the sea, found at such a great distance (over 1000 miles) from the ocean. They offer quite flat lowlands covered with a fertile soil, similar to the black earth of South Eussia, in which even shingle had to be brought from enormous distances for the building of the railway. The slope of the surface is so gentle that immense marshes are formed farther north on the Vas'yugan, an^ the rivers flow lazily over the prairies, forming lakes which are rapidly drying up, while others, which formerly were freshwater lakes, have now become salt. The drying up of the lakes of the Chany basin has been so rapid that villages occupy ground that eighty years ago was covered with lakes. TSie Baraba Steppe has now a con- j siderable and wealthy . Russian population, distributed in large villages.~~

~~See Middendoepf's Die Baraba. — Yadeintseff in Zapiski of West Siber. Branch of Russ. Geogr. Soc, ii. (p. a. k.)~~

~~Bara Banki, a town and district of British India, in the Fyzabad division of Oudh. The town, which forms one municipality with IsTawabganj, the administrar tive headquarters of the district, is 17 miles east of Lucknow by railway. The population is about 14,500 ; the municipal income in 1897-98 was Es.18,940. There is some trade in sugar and cotton.~~

~~The district of Baea Banki has an area of 1740 square miles. The population in 1891 was 1,130,906, being 649 persons per square mile. Classified according to religion, Hindus numbered 943,778; Mahommedans, 186,938; Christians, 147, of whom 21 were Europeans ; " others," 1043. In 1901 the population was 1,179,632, showing an increase of 4 per cent. Land revenue and rates were returned as Es.18,67,851, the incidence of assessment being E.l : 10 : 2 per acre ; the number of police was 4129. In 1896-97, out of a^ total cultivated area of 670,813 acres, 219,096 were irrigated from wells, tanks, &c. The principal crops are rice, wheat, pulse, and other food- grains, sugar-cane, and opium. Both the bordering rivers~~

~~are navigable ; and the district is traversed by two lines of the Oudh and Eohilkhand railway, with eleven stations. Trade in agricultural produce is active.~~

~~Baraboo, capital of Sauk county, Wisconsin, U.S.A., situated in the southern part of the state, on Baraboo river, and on the Chicago and North-Western railway, at an altitude of 861 feet. Population (1880), 3266;~~

~~(1890), 4605; (1900), 5761.~~

~~Baracaldo, a town of Spain, province of Biscay, on the Nervion or Bilbao river. It has important iron- works and a dynamite factory, and is connected by rail with all the mining districts of Somorrostro and the coast to Santander. The low flat country is covered with maize, pod fruit, and chacoli vine. Few towns in Spain have sprung up so rapidly. By 1887 its population was 8870, and by 1897, 12,709.~~

~~Baracoa, a seaport city of the north coast of eastern Cuba, the chief centre of the banana export trade. It is the oldest town in Cuba, having been settled as the first capital by Lieut.-Governor Diego Velasquez in 1511. It is also ,the oldest city in the territory now under the American flag. Population, 4937.~~

~~Barbados, an island of the British West Indies, lying 100 miles to the east of St Vincent ; area 166 square miles, with a dense population, which rose from 182,000 in 1891 to about 192,000 in 1900, mostly coloured. From the results of recent marine surveys Barbados would appear to belong geologically, not to the West Indian system proper, but to the Venezuelan coast range (Sierra Cumana), of which it at one time formed a , seaward extension, the north-easterly direction of which is still indicated by the intervening islands of Trinidad and Tobago. It is one of the most thickly peopled lands in the world, and- of the whole surface (106,500 acres) about 100,000 acres are under cultivation. The temperature is equable, ranging from 60° F. to 80° F. in the cool season, which is also the dry season (extending from Christmas to the end of May) ; and from 73° to 86° in the hot season. The rainfall of 1898 was 65 inches ; September being the wettest month, and May the driest. The death-rate in 1898 was 39 per 1000. The density of the population compels to constant labour. The Barbadian~~

negroes are, as a rule, more intelligent than those of the other West Indian islands. The whole island is almost entirely given up to sugar growing and manufacture : in 1898 there were 441 sugar-works in operation, with antiquated methods of machinery. Barbados is the headquarters of the Imperial Agricultural Department for the West Indies, instituted in 1898, on the recommendation of the West India Eoyal Commission of 1897. The value of the imports of 1896 was £1,049,000; that of 1899 was £998,006. In 1896 the exports were valued at £768,000, and in 1899 at / £845,590. Of the exports, £610,405 represented produce of the colony. Of the island produce, the value of £473,750 was due to sugar, and £109,262 to molasses. The exports are distributed as follows : — ^to the United Kingdom, £13,834 ; British Colonies, £131,580 ; foreign countries (chiefly United States), £464,991. The imports were derived as follows: — from the United Kingdom, £429,148 ; British Colonies, £135,417 ; foreign countries (mainly United States), £433,441. The revenue for 1899 was £216,022, the expenditure for the same year being £207,883. In 1899 the revenue was swelled by a grant from the Imperial Government of £40,000 to repair damage done by the hurricane of 1898 ; and the expendi- ture by £31,443 spent on this account. In 1899 the public debt was £414,000. The revenue is derived mainly from customs and excise. The only mineral product is

"manjak," or glance pitch, a form of asphalt, which occurs in the older rocks of the Scotland district, which yielded in 1899 £2297 at £4, 10s. per ton. The manu- factures of Barbados are few and comparatively insignifi- cant— rum distilleries, a sulphuric acid factory, chemical mixing factories, one cigar and tobacco factory, and one ice factory. There is a fortnightly mail service between Bridgetown, the capital of the island, and Southampton ; and also a fortnightly service between Canada and the Windward Islands and British Guiana, calling at Bar- bados, and frequent communication with the other West Indian Islands. A total tonnage of 632,553 entered and 632,864 cleared during 1899 ; but this is exclusive of a ■large number of vessels merely touching at the port. There is no inland telegraph, but a telephone service supplies its place, and a railway (24 miles

~~in extent) runs partly round the island. In 1899 the island had three colleges, six secondary schools, and 171 elementary schools. In the last-named there were 25,334 children on the rolls, with an average attendance of 14,978. Codrington College was in 1899 in danger of being closed for lack of funds due to the decline of the value of the estates forming its endowment, but a special subscription was raised in England and the island, and this misfortune was averted. The police force consists of 355 officers and men. There are (1900) stationed in the island the headquarters and four companies of a British regiment and two companies of the West Indian regiment — the functions of the commanding officer extending throughout the British West Indies (except Jamaica) and British Guiana. The colony possesses representative institutions, but not responsible government. The Crown has a veto on " legislation, and the Home Government controls the appointment of public officers. The Government consists of the governor, an executive council, a legislative coun- cil of nine members appointed by the Crown, and a House of Assembly having twenty-four members elected annually on the basis of a moderate franchise. The governor was for many years governor-in-chief of the Windward Islands, but in 1885 Barbados was made a separate government. (a. h. k.)~~

~~Barberino, two towns of Italy (Tuscany, province of Florence) : (1) B. di Mugello, 16 miles N. of Florence. Population, about 10,500. (2) B. di Val d' Elsa, 16 miles S. by W. of Florence. It produces many chip and straw hats. Population, about 10,500.~~

~~Barberton. See Tban^svaal.~~

~~Barbizon School, The. — This designation is ap- plied to an illustrious group of French artists more or less associated with the village of Barbizon, near the forest of Fontainebleau, whose lives cover, roughly speak- ing, the first three-quarters of the 19th century. Its leaders were Corot, Eousseau, Millet, and Daubigny ; and with them were associated Diaz, Dupre, Jacque, Franqais, Harpignies, and others less known. They founded a school of painters of the country — of its landscape and its peasant life — whose influence is so widespread that it may be traced in the art of every western nation at the present day. Each of the leaders of this group possessed a strong and ir^dividual genius, yet with all the wide differences of~~

~~temperament, there exists in their work, taken as a whole, a common impulse sufficiently evident to justify the rough classification as a “school.” It is, however, impossible to draw a hard and fast line ; other artists, such as Decamps, Troyon, and Courbet, worked on similar lines ; but, broadly speaking, the distinction of the Barbizon group is that they were the greatest of those who put aside the conven- tional idea of subject in their works, and in going direct~~

~~to the fields and the woods for their inspiration, struck out a new path. In considering individual members of this group, it is enough to say here that the art of Corot was not allied to that of any contemporary painter, and, strictly speaking, owed nothing to Barbizon or its influ- ences ; nor perhaps did the art of Daubigny. The dis- tinctive note of the school is seen in the work of Eousseau and of Millet, each of whom, after spending his early years in Paris, made his home in Barbizon. Unappreci- ated, poor, and neglected, it was not until after years of struggle that they attained recognition and success. They both died there : Eousseau in 1867, and Millet in 1876. It is difficult now to realize that their work, so unaffected and beautiful, should have been so hardly received. To understand this, it is necessary to remember the conflicts that existed between the classic and romantic schools in the first half of the 19th century, when the classicists, followers of the tradition of David, were the predominant accepted school. The romantic movement, with Gericault, Boning- ton, and Delacroix, was gaifiing favour. In 1824 Constable’s pictures were shown in the Salon, and fixed the resolve of the younger men to abandon the lifeless pedantry of the schools and to seek inspiration, as he did, from nature. As may be imagined, every new departure was contested by the men in authority, who, qidte honestly unable to’ see merit in works which ignored their cherished ideals, rejected them from the salons again and again. Eousseau was so often and persistently rejected that he was known as le Grand Befus&. In those troubled times Eousseau and Millet unburdened their souls to their friends, and their published lives contain many letters, some extracts from which will ekpress the ideals which these artists held in common, and show clearly the true and firmly-based foun- dation on which their art stands. Eousseau wrote, ” It is good composition when the objects represented are not there solely as they are, but when they contain under a natural appearance the sentiments which they have stirred in our souls. . . . For God’s sake, and in~~

~~recompense for the life He has given us, let us try in our works that the manifestation of life be our first thought : let us make a man breathe, a tree really vegetate.'' And Millet — " I try not to have things look as if chance had brought them together, but as if they had a necessary bond between themselves. I want the people I represent to look as if they really belonged to their station, and that imagination cannot conceive of their ever being anything else. People and things should always be there with an object. I "want to put strongly and completely all that is necessary, for I think things weakly said might as well not bel said at all, for they are, as it were, defiowered and spoiled — but I profess the greatest horror for uselessness (however brilliant) and filling up. These things can only weaken a picture by distrficting the attention toward secondary things." In another letter he says — " Art began to decline from the moment that 4iie artist did not lean directly and naively upon impressions made by nature. Cleverness naturally and rapidly took the place of nature, and de- cadence then began. ... At bottom' it always comes to thisx;^ a man must be moved himself in order to move others, and all that is done from theory, however clever, can never attain this end, for it is impossible that it should have the breath of life." It does not seem to-day that there is anything to contest in these words ; nor is it easy now, on seeing how naturally the works of the Barbizon painters take their place in true line of succession with the masterpieces of the older schools, to imagine the storms that raged round them in their early days. Time has justified them ; and those who led this little band now rank with the greatest of the many artists whom France proudly counts among her sons. See D. Cboal Thomson. The Barbizon School. Chapman and~~

~~Hall, 1891. (Mr Thomson gives a full list of the French authorities to be consulted.) — Jules Bketon. Nos Peintres du Siecle. Paris, 1900. Also the articles on Cokot, Millet, Rodsseau, Daubigny, Diaz, Troyon, and Schools of Painting. (q_ cl.)~~

~~Barbuda. See Antigua.~~

~~Barceliona, a town of the province of Messina, Sicily, Italy, 27 miles W. by S. from Messina by rail. It prepares lemon juice and olive oil, manufactures macaroni and pottery, burns lime, and makes bricks. It is formed by the union of tvro communes — Barceliona and Pozzo di Gotto. Population about 18,000.~~

~~Barcelona, a maritime province in the N.E. of Spain, with an area of 2985 square miles. It is flat near the sea, but rises inland. The highest peak is Coll de Fou, 8317 feet. For many years Barcelona has been the most populous province in the kingdom, having in 1877, 835,306 inhabitants ; in 1887, 899,264 ; and in 1897, 1,034,538, in fact a little over the eighteenth part of the whole population of Spain. Emigration, chiefly to South America, has in no year taken more than 2000 inhabit- ants. The province is divided into 13 administrative districts, 3 of which constitute the city of Barcelona, and 320 parishes. None of the rivers are navigable, and the roads are in general indifferent and insufficient. The province is better oif in regard to railways, of which there are 349 miles. Besides the main and more im- portant lines, like those which communicate with Sara- gona (65 miles within the province), France, and Valencia, there are several useful and local lines connecting with important centres of industry. Indeed, to the Spaniards this province is, in a measure, a Manchester, Leeds, Sheffield, and Birmingham all in one. In every direction the country looks like a veritable hive of human activity and enterprise, every town and village full of " fabricas," with their tall chimneys, and alive with the din of machinery. Next to Barcelona rank as prosperous man- ufacturing centres, Badalona, with 18,075 inhabitants; Igualada, 10,419 ; Manresa, 25,121 ; Mataro, 19,918 ; Sabadell, 23,044; Tarrasa, 15,440; Vich, 11,724; Villa- nueva^-y-Geltru, 12,046; and nine other towns, ranging from 5000 to 8000 inhabitants. There were, in 1898, 12,812 acres of irrigated soil and 91,857 acres of dry soil devoted to the culture of wheat, 51,562 acres to barley, oats, rye, and maize, 22,812 to pod fruit, 13,500 to olive plantations, and 89,187 to the vine. The live stock included 11,389 horses, 9909 mules, 8293 asses, 10,499 cattle, 93,649 sheep, 20,173 goats, 18,886 pigs. The mineral productions are lead, zinc, lignite, salt, subterra- neous waters; 8 salt and 13 lignite mines are in full production, but 197 mines, though duly registered, are unproductive. The province is very rich in mineral waters, containing 12 sulphurous springs, 22 chloruretted, 5 of bicarbonate, and 18 ferruginous. In point of~~

~~climate the province can be divided into three distinct zones : a temperate one near the sea, where even palm and orange trees grow, a colder one in the valleys and plains, more inland, and a colder still among the mountains, where not a few peaks are snowclad for a great part of the year. In point of education this province is quite among the first in Spain, and as far back as 1880 there were 97,077 children enrolled on the school registers ; the figures have since steadily increased.~~

~~Barcelona, the capital of the above province, on the shore of the Mediterranean, 310 miles N.E. of Madrid by rail. No town in Spain has increased so rapidly in importance, extent, and population. The population was, in 1887, 272,480; with the suburbs of Gracia, San Andres de Palamor, and San Martin de Provenqals, 421,265 ; in 1897, including the same suburbs, 604,396. This increase is not due to any unusual excess of birth-~~

~~rate, but chiefly to immigration from the rest of Spain. The influx has been occasioned by the extraordinary development of the industries and commerce of Barcelona since 1870. At the close of 1899 Barcelona paid about £550,000 in the shape of industrial and commercial taxes, being more than 11 per cent, of the whole amount of the said tax collected in the kingdom. Trades and industries give occupation to more than 150,000 hands of both sexes. There are powerful and numerous guilds and labour societies, and the principal trades union has en- rolled' more than 26,000 members. The spinning and weaving of wool, cotton, and silk are still its principal industries, but the enterprising spirit of the Catalans has impelled theln to try almost every industry in which native capital could attempt to compete with foreign im- ports, especially since the institution of the protection- ist tariffs of 1892. The prosperity has been in part due to the great development of means of communication around the city and in the four Catalan provinces. The city is the seat of the head offices of the Hispano-Colonial Bank, of the state-subsidized trans-Atlantic mail company, which has a splendid fleet of 50 steamers, and of several other great shipping companies. Its industrial companies are quite able to compete in peninsular markets with for- eign rivals. The new part of the town has been adorned with splendid public promenades, parks, and public buildings. The older parts have been improved, and Barcelona has more numerous and better means of com- munication with its distant suburbs and~~

~~environs than Madridj in the shape of electric and steam tramways. Improvements have also been made in its ports and quays, so much so, that during the Barcelona Exhibition of 1888 the fleets of ten European nations anchored inside the harbour or in the outer roadstead. During 25 years harbour duties have been levied to carry on the yet incom- plete extension of the quays and harbour works.~~

~~The port of Barcelona is the most import3,nt in Spain. In 1898 3546 vessels of 2,796,367 tons (metric) entered, and 3385 of 2,743,725 tons (only 249 of 236,891 tons British) cleared : 2007 of the entrances and 1986 of the clearances were Spanish vessels, these high figures being largely due to the extent of the coasting trade. The imports from Great Britain were £1,670,568 in value in 1898, against £1,791,923 in 1897, the falling off being due to the coal strike in England and the high rates of exchanges during the war with the United States. The exports to England from Barcelona amounted in value to £126,320 in 1898, compared with £96,848 in 1897. The imports from British colonies in Asia and Africa were valued at £497,260 in 1898 ; exports to, at only £2947. Imports from France were valued at £476,171 in 1898 ; exports to, at £844,407, being an increase of £380,000 on the figures of 1897. Germany ranks next, exporting to Barcelona in 1898 goods valued at £502,413, and taking back to the value of £81,203. The war with the United States caused the imports from that country to drop from £2,512,915 in 1897 to £624,239 in 1898 ; but Barcelona obtained through other European markets the cotton that used to come direct from the States, as the value of cotton imported only dropped from £2,785,892 in 1897 to £2,349,384 in 1898. Comestibles, raw materials, and combustibles form the greater part of the imports, but this great manufactory singularly enough imports a considerable quantity of foreign manu- factured goods, the most important items in this respect in 1898 being linen and jute goods, £268,784 ; woollen goods, £218,150 ; machinery, £230,219 ; and electric cables and dockyard materials, about £200,000. The principal exports are wines, cereals, olive oil, cotton goods, soap, cigarette-paper, furniture and barrels, boots, shoes and leather goods, machinery ; but in almost every class there was a marked decline in 1898 compared with 1897, mainly attribut- able to the loss of the colonies, which falls especially heavy on Barcelona. The export of cotton goods declined~~

~~£921,000 in value ; soap and woollen goods each £20,000 ; shoes and leather goods, £850,000. (a. e. H.)~~

~~Barcelona, a town of Venezuela, capital of the old state of Bermudez (now capital of the state of Barcelona), close to the mouth of the river Neveri, and 12 miles from Guanta port by rail. At the beginning of the 19th century its population numbered 16,000~~

~~inhabit^ts, but is now only 9000. Among public buildings are Government house, the theatre, market, two hospitals, the Masonic temple, and several churches and educational institutions. It is an important com- mercial market.~~

~~Bareilly, or Baeeli, a city and district of British India, in the Rohilkhand division of the North-West / Provinces. The city is situated on the Eamganga river, 788 miles north-west from Calcutta. The population in 1891 was 107,785, of whom more than half were Hindus ; in 1901, 117,433. The municipality consists of thirty- seven members, of whom twenty-seven are elected, but no interest is taken in the elections. The municipal income in 1897-98 was Rs.1,19,226. The principal build- ings are two mosques built in the 17th century; a modern fort overlooking the cantonments; the railway station, which is an important junction on the Oudh and Eohilkhand line ; the palace of the Nawab of Eampur, and the Government college. Bareilly is the head- quarters of a military division under a brigadier. The chief manufactures are furniture and upholstery. In 1896-97 the college had 123 students. There is also an efficient high school. There are ten printing-presses, and an Anjuman, or literary institute, with a libraiy and read- ing-room. The death-rate in 1897 was 34-13 per 1000.~~

~~The district of Baebillt has an area of 1595 square miles ; it had a population in 1891 of 1,040,950, being 652 persons per square mile, and in 1901 of 1,089,550, showing an increase of 5 per cent. Classified according to religion, Hindus in 1891 numbered 790,479 ; Mahom- medans, 245,073 ; Christians, 5271, of whom 2437 were Europeans (mostly soldiers) ; ”~~

~~others," 127. The land revenue and rates were Es.15,56,303, the incidence of assessment being E..1 : 5 : 9 per acre ; the number of police was 3055. In 1896-97, out of a total cultivated area of 718,604 acres, 74,292 were irrigated from the Eohilkhand system of Government canals, and 94,045 from wells, tanks, &c. There are no manufactures except for domestic use, and little external trade. Several lines of the Oudh and Eohilkhand railway pass through the district.~~

~~Barentin, a town in the arrondissement of Eouen, department of Seine Infdrieure, France, 11 miles N.W.' of Eouen, with station on the railway from Paris to Havre. The town is situated in the valley of the Aus treberte, a small affluent of the Seine, here crossed at a height of 100 feet by a fine railway viaduct, 540 yards long. The manufacture of cotton fabrics is the principal industry. Poptilation (1896), 4413, comm., 6082.~~

~~Barguzin, a district town of East Siberia, province of Transbaikalia, on the Barguzin river, 27 miles from its entrance into Lake Baikal. It is situated in a large longi- tudinal valley which runs at the foot of the border range of the Vitim plateau, and ends in a wide prairie. Important gold mines are worked in its district ; hot mineral waters are near to the town, at Turk^. Population (1897), 1380.~~

~~Bar Harbor, a well-known summer resort in Hancock county, Maine, U.S.A., situated on the west shore of ^Frenchinan Bay, on the east side of Mount Desert Island.~~

~~Bari, a seaport town, archiepiscopal see, and capital of the province of Bari, Apulia, Italy, on the Adriatic, 69 miles E".W. from Brindisi by rail. The citadel is now used as a prison. The Athenaeum contains a technical school and the provincial museum. University classes axe held here ; and there is a nautical school. Bari is the seat of active industries — engineering works and foundries, olive-oil mills, and cooperages being the most important. The men make excellent sailors. The har- bour on the west of the town has been improved since I~~

~~1893; its depth varies from 11^ to 28 ft. The old har- bour, on the E., is only used by fishing-boats. The exports av.erage £2,279,700 annually (£2,621,700 in 1899) ; the imports £1,185,800 (£1,418,200 in 1899). The~~

~~former consist principally of olive oil, wine, almonds, and cream of tartar. The shipping entering the port increased from 946 vessels of 430,242 tons in 1888 to 1789 vessels of 945,400 tons in 1899 (77 vessels of 98,780 tons being British). Population, of town (1881), 60,675; (1901), 79,693 ; of province (1881),^679,497 ; (1901), 823,998.~~

~~Barili, a town of 21,000 inhabitants, on the west coast of Cebu, Philippine Islands, in latitude 10° 16′ N. It has a relatively cool and healthful climate. Its people are agriculturists and raise Indian corn, sibucao, hemp, cacao and coffee. The language is Cebu-Visayan.~~

~~Baring Land. See Noeth-Wbst Teecitories.~~

~~Barisal, a town of British India, headquarters of Backergunje district in Bengal, is situated on a river of the same name. Population, about 15,500. It is an important centre of river trade, on the steamer route through the Sundarbans from Calcutta to the Brahmar putra. It contains two colleges, opened without aid from government, and an English high school. There are four printing-presses, which issue two vernacular news- papers ; a public library, established by subscription in 1858; and a students' union, for helping the sick and poor and promoting the intellectual and physical improve- ment of boys. Barisal has given its name to a curious physical phenomenon, known as the " Barisal guns," the cause of which has not yet been satisfactorily explained. These are noises, like the report of cannon, frequently heard in the channels of the delta of the Brahmaputra.~~

~~Barka. See Tripoli.~~

~~Barking, a market town and railway station in the Eomford parliamentary division of Essex, England, on the Roding, near the Thames, 7 miles E. of Whitechapel church. Ilf ord, which was once a ward of Barking parish, was separated from the town in 1888, and now forms a civil parish under the metropolitan police. Victoria Gardens and a recreation groimd have been opened, public baths erected, and the electric light installed. The Gas- light and Coke Company's works at BeCton are in the parish, and also Warne and Company's rubber works, formerly of Tottenham, and both works employ a large number of hands, who reside in the town. Area, 3814 acres; population (1881), 9203 ; (1891), 14,301 ; (1901),~~

~~21,511.~~

~~Barkly, two towns in Cape Colony : — 1. Barkly East lies in an upland valley near the river Kraal, which joins the left bank of the Orange a short distance above Aliwal North, and has an estimated population of over 2000; 2. Barkly West, formerly Klip-drift, stands on the right bank of the Vaal opposite Pniel in Griqualand West, about 24 miles to the north-west of Kimberley, and was th,e site of the first diamonds from river-diggings, which between 1870 and 1886 yielded stones to the total value of over £2,000,000, but are now nearly exhausted. The diamonds of this district are noted for their purity and lustre, and are generally associated with other crystals, — garnets, agates, quartz, and chalcedonies. After the discovery of the Kimberley diamond fields most of the Vaal diggings were abandoned, and the population of Barkly has fallen from about 4000 to less than 2000.~~

~~Barietta, a fortified seaport town and archiepiscopal see of the province of Bari, Apulia, Italy, on the S. shore of the Gulf of Manfredonia, 42 miles E. S. E. from Foggia. In 1887 it had an export trade in wine (90 per cent.), brandy, and tartaric acid of the aggregate value of £1,666,000.~~

~~By 1895 this had declined to a total of only £137,000, but since then it has increased again (£276,600 in 1899). The port is cleared by an average of 440 vessels of 294,500 tons annually. The chief industry is the manufacture of tartaric acid. Population (1881), 31,994; (1900), 44,891.~~

~~Barmen, a town in the Ehine province, Prussia, immediately E. of Elberfeld, 35 miles E. from Diisseldorf by rail. Its industries are identical with those of El- berfeld, with which it virtually makes one town. A pantheon or hall of glory (1^00) is destined to contain statues of the Emperors William I. and Frederick III., the municipal library, the collebtions of the Berg Histori- cal Society, and those of the Barmen Art Association. There are also a new concert hall and a monument of the 1870-71 war. Population (1890), 116,144; (1900),~~

~~141,947.~~

~~Barnard Castle, a market town and railway sta^ tion, in the Barnard Castle parliamentary division of Durham, England, on the Tees, 15 miles W. of Darling- ton. Eecent erections are a large county school, two Methodist chapels, and a fever hospital. The Bowes Museum has been extended and endowed. Area of town- ship, 7790 acres; population (1881), 4269; (1891), 4725. Area of urban district, 533 acres; population (1881),~~

~~4096; (1901), 4421.~~

~~Barnby, Sir Joseph (1838-1896), English musical composer and conductor, was born at York on 12th August 1838. He was a chorister at York Minster from the age of seven, was educated at the Royal Academy of Music under Cipriani Potter and Charles Lucas, and was appointed in 1862 organist of St Andrew's, Wells Street, London, where he raised the services to a high degree of excellence. He was conductor of "Bamby's Choir" from 1864, and in 1871 was appointed, in succession to Gounod, conductor of the Albert Hall Choral Society, a post he held till his death. In 1875 he was precentor and director of music at Eton, and in 1892 became prin- cipal of the Guildhall School of Music, receiving the honour of knighthood in July of that year. His works include an oratorio, Rehekdh, Ps. xcvii., many services and anthems and hymn-tunes, as well as some part-songs (among them the popular " Sweet and Low"), and some pieces for the organ. As a conductor he possessed the qualities as well as the defects of the typical north- countryman ; if he was wanting in the higher kind of imagination or ideality, he infused into those who sang under him something of his own straightforward recti- tude and uncompromising precision. He was largely instrumental in stimulating the love for Gounod's sacred music among the less educated part of the London pub- lic, although he displayed little practical sympathy with opera, the branch of art in which Gounod's best powers were manifested. On the other hand, he organized a remarkable concert performance of Parsifal at the Albert Hall in London in 1884. He conducted the Cardiff Fes- tivals of 1892 and 1895. He died in London on the 28th of January 1896. (j. a. f. m.)~~

~~Barnes, William (1800-1886), the Dorsetshire poet, was born 22nd February 1800, at Eushay, near Pentridge in Dorset, the son of John Barnes and Grace Scott, of the farmer class. He was a delicate child, in direct con- trast to a strong race of forebears, and inherited from his mother a refined, retiring disposition and a love for bookfe. He went to school at Sturminster Newton, where he was considered the clever boy of the school; and, when a solicitor named Dashwood applied to the master for a quick-witted boy to join him as pupil, Barnes was selected for the post. He was therefore apprenticed to the law.~~

~~and worked with the village parson in his spare hours at classics, and studied mUsic under the organist. In 1818 he left Sturminster for the office of one Coombs at Dorchester, where he continued his evening education with another kindly clergyman. He also made great progress in the art of wood-engraving, and with the money he received for a series of blocks for a work called Walks about Dorchester, he printed and published his first book, Orra, a Lapland Tale, in 1822. In the same year he became engaged to Julia Miles, the daughter of an excise officer. In 1823 he took a school at Mere in Wiltshire, and four years later married and settled in Chantry House, a fine old Tudor man- sion in that town. The school grew in numbers, and Barnes occupied all his spare time in assiduous study, reading during these years authors so diverse in char- acter as Herodotus, Sallust, Ovid, Petrarch, Buffon, and Burns. He also began to write poetry, and printed many of his verses in the Dorset County Chronicle. His chief studies, however, were philological ; and in 1829 he published An Etymological Glossary of Eng- lish, Words of Foreign Derivation. In 1832 a strolling company of actors visited Mere, and Barnes was so pleased by their performance that he wrote a farce, The Honest Thief, which they produced, and also a comedy which was played at Wincanton. Barnes also wrote a number of educational books, such as Elements of Perspective, Outlines of Chography, An Essay on the Advantages of the Study of Mathematics, and in 1833 first began his poems in the Dorsetshire dialect in the pages of the local paper. In 1835 he left Mere and returned to Dorchester, where he started another school, which, after its removal in 1837 into more commodious quarters, flourished satisfactorily. The year 1844 is a landmark in Barnes's life, for it was then that he published his first series of Dorsetshire poems. They made consider- able literary success, the Hon. Mrs Norton busying her- self with the advocacy of their claims. Three years later Barnes took holy orders, and was appointed to the care of Whitcombe, three miles from Dorchester. He had been for some years upon the books of St John's College, Cambridge, and took the degree of B.D. in 1860. He resigned Whitcombe in 1852, finding the work too hard in connexion with his mastership ; and in June of that year he lost his wife, whom he never ceased to mourn with an intensity of devotion. Continuing his studies in the science of language, he published his Philological Grammar in 1854, a remarkable compilation, drawing examples from more than seventy languages. For the copyright of this erudite work he received~~

~~£5. The second series of dialect poems, Hwomely Rhymes, appeared in 1857, and the third in 1863. Hwomely Rhymes contained some of his best-known pieces, and in the year of its publication he first began to give readings from his works, which were extremely successful. As their reputation grew he travelled all over the country, delighting large audiences with his quaint humour and natural pathos. In 1861 he was awarded a civil list pension of £70 a year, and at the close of the same year published Tiw, the most striking of his philological studies, in which an attempt is made to trace the English language to a Teutonic origin. In the next year he broke up his school, and removed to the rectory of Winterborne Came, to which he was presented by his old friend, Captain Darner. Here he worked continuously at verse and prose, contributing largely to the magazines. He was persuaded in 1868 to publish a series of Poems of Rural Life in ordinary English, but he was less successful in verse which abandoned dialect. His poems were collected into a single volume in 1879, and on 11th October 1886 he died at Winterborne Came. Barnes's poetry is~~

~~essentially English in chaxacter; no other writer has given quite so simple and sincere a picture of the homely life and labour of niral England. His work is full of humour and the clean, manly jOy of life ; and its rustic- ity is singularly allied to a literary sense and to high technical finish. He is indeed the Victorian Theocritus ; and, as English country life is slowly swept away before the advance of the railway and the telegraph, he will be more and more read for his warm-hearted and fragrant record of rustic love and piety. (a. wa.)~~

~~Bar net.— Three English towns in the St Albans parliamentary division of Hertfordshire bear this name : (1) Chipping or High Baknet, a market town 11 miles north of London by rail; population of parish (1881), 4283; (1891), 4563. (2) East Baknet, a village 2 miles south of the above ; populktioii of East Barnet Valley urban district (1891), 7716; (1901), 10,094. (3) New Barnet, a town formed by -portions of the two preceding parishes, with a station 9 miles north of London. The urban district of Barnet has an area of about 690 square miles, and had a population of 6437 in 1891 and 7876 in~~

~~1901.~~

~~Barnfield, Richard (1574-1627), an English poet, whose obscure though close relationship with Shake- speare has long made him interesting to students, has attracted of late years further attention from the circum- stance that important discoveries regarding his life have been made. Until recently nothing whatever was known about the facts of Barnfield's career, whose very existence had been doubted. It was, however, discovered by the late Dr Grosart that the poet was the ^son of Eichard Barnfield (or Barnefield) and Maria Skrymsher, his wife, who were married in April 1572. They resided in the parish of Norbury, in Staffordshire, on the borders of Salop, where the poet was baptized on the 13th of June 1574. The mother died in giving birth to a daughter early in 1581, and her unmarried sister, Elizabeth Skrymsher, seems to have devoted herself to the care of the children. In November 1589 Barnfield matriculated at Brasenose College, Oxford, and"1!ook his degree in February 1592. He " performpd the exercise for his master's gown," but seems to have left the university abruptly, without pro- ceeding to the M.A. It is conjectured that he came up to London in 1593, and became acquainted with Watson, Drayton, and perhaps with Spenser. The death of Sir Philip Sidney had occurred while Barnfield was still a school-boy, but it seems to have strongly affected his imagination, and to have inspired some of his earliest verses. In November 1694, in his twenty- first year, Barn- field published anonymously his first work. The Affection- ate Shepherd, dedicated with familiar devotion to Lady Penelope Eich. This was a sort of florid romance, in two books of six-line stanza, in the manner of Lodge and Shakespeare, dealing at large with "the complaint of Daphnis for the love of Ganymede." As the author ex- pressly admitted later, it was an expansion or paraphrase of Virgil's second eclogue —~~

~~"rormosum pastor Corydon ardebat Alexin."~~

~~This poem of Barnfield's was the most extraordinary specimen hitherto produced in England of the license introduced from Italy at the Eenaissance. Although the poem was successful, it did not pass without censure from the moral point of view. Into the conventional outlines of The Affectionate Shepherd the young poet has poured all his fancy, all his epithets, and all his coloured touches of nature. If we are not repelled by the~~

~~absurd subject, we have to admit that none of the immediate imitators of Venus amd Adonis has equalled the juvenile Barnfield in the picturesqueness of his " fine ruff-footed doves," his~~

~~" speckled flower call'd sops-in-wine," or his desire " by the bright glimmering of the starry light, to catch the long-bill'd woodcock." Two months later, in January 1595, Barnfield published his second volume, Cynthia, with certain Sonnets, and this time signed the preface, which was dedicated, in terms which imply close personal relations, to William Stanley, the new Earl of Derby. This is a book of extreme interest ; it exemplifies the ear- liest study both of Spenser and Shakespeare. "Cynthia" itself, a panegyric on Queen Elizabeth, is written in the Spenserian stanza, of which it is probably the earliest example extant outside The Faerie Queene. This is fol- lowed by a sequence of twenty sonnets, which have the extraordinary interest that, while preceding the publica- tion of Shakespeare's sonnets by fourteen years, they are closer to them in manner than are any others of the Eliz- abethan age. They celebrate, with extravagant ardour, the charms of a young man whose initials seem to have been J. U. or J. V., and of whom nothing else seems known. These sonnets, which preceded even the Amoretti of Spenser, are of unusual merit as poetry, and would rank as high in quality as in date of publication if their subject-matter were not so preposterous. They show the influence of Drayton's Idea, which had appeared a few months before; in that collection also, it is to be obseryed, there had appeared amatory sonnets addressed to a young man. If editors would courageously alter the sex of the pronouns, several of Barnfield's glowing sonnets might take their place at once in our anthologies. Before the publication of his volume, however, he had repented of his heresies, and had become enamoured of a "lass" named Eliza (or Elizabeth), whom he celebrates with effusion in an " Ode." This is probably the lady whom he presently married, and as we find him a grandfather in 1626, it is unlikely that the wedding was long delayed. In 1598 Barnfield published his third volume. The Enco- mion of Lady Pecunia, a poem in praise of money, fol- lowed by a sort of continuation, in the same six-line stanza, called "The Complaint of Poetry for the Death of Liberality." In this volume there is already a decline in poetic quality. But an appendix *of " Poems in diverse Humours " to this volume of 1698 presents some very in- teresting features. Here appears what seems to be the absolutely earliest~~

~~praise of Shakespeare in a piece en- titled " A Eemembrance of some English Poets," in which the still unrecognized author of Venus and Adonis is cele- brated by the side of Spenser, Daniel, and Drayton. Here also are the sonnet, "If Music and sweet Poetry agree," and the beautiful ode beginning, " As it fell upon a day," which were until recently attributed to Shakespeare him- self. In the next year, 1599, Tlie Passionate Pilgrim was published, with the words " By W. Shakespeare " on the title-page. It was long supposed that this attribution was correct, but Barnfield claimed one of the two pieces just mentioned, not only in 1698, but again in 1605. It is cer- tain that both are his, and possibly other things in The Passionate Pilgrim also ; Shakespeare's share in the twenty poems of that miscellany being doubtless confined to the five short pieces which have been definitely identified as his. In the opinion of the present writer, the sonnet be- ginning " Sweet Cytherea" has unmistakably the stamp of Barnfield, and is probably a gloss on the first rapturous perusal of Venus and Adonis; the same is to be said of " Scarce had the sun," which is aut Barnfield, aut diabolus. One or two other contributions to The Passionate Pilgrim may be conjectured, with less confidence, to be Barnfield's. It has been stated that the poet was now studying the law at Gray's Inn, but for this the writer is unable to discover the authority, except that several members of that society are mentioned in the course of the volume of 1698. In all probability Barnfield now married and with-~~

~~drew to his estate of Dorlestone (or Darlaston), in the county of Stafford, a house romantically situated on the river Trent, where he henceforth resided as a country gentleman. In 1605 he reprinted his Lady Pecunia, and this was his latest appearance as a man of letters. His son Robert Barnfield and his cousin Elinor Skrymsher were his executors when his will was proved at Lichfield ; his wife, therefore, doubtless predeceased him. Barnfield died at Dorlestone Hall, and was buried in the neighbour- ing parish church of St Michael's, Stone, on the 6th of March 1627. The labours of Dr Grosart and of Professor Arber have thrown much light on the circumstances of Barnfield's career. He has taken of late j-ears a far more prominent place~~

~~than ever before in the history of English literature. This is due partly to the remarkable merit of his graceful, melodious, and highly-coloured verse, which was practically unknown until it was privately printed in 1876 (Grosart), and at length given to the public in 1882 (Arber). It is also due to the mysterious persoual relation of Barnfield to Shakespeare, a relation not easy to prove in detail, as it is built up on a great variety of small in- dications. It is, however, obvious that Barnfield warmly admired Shakespeare, whose earliest imitator he may be said to have been, and that between 1595 and 1600 the younger poet was so close to the elder that the composi- tions of the former could be confused with those of the latter. Barnfield died, as a poet, in his twenty-fifth year. Up to that time he had displayed a talent which, if he haxi pursued it, might have placed him very high among the English poets. As it is, he will always interest a certain number of readers as being, in his languid " Ital- ianate" way, a sort of ineffectual Meleager in the rich Elizabethan anthology. (e. g.)~~

~~Barnsley, or Black (more properly Bleak) Barnsley, a municipal borough in the Barnsley parliamentary divi- sion of Yorkshire, England, 15 miles N. of Sheffield, The borough received a separate commission of the peace in 1895. Modern erections are a church, a new court-house, a public hall, an institute, and a free library (cost about £27,000). ■The hospital has beea enlarged. Area, 2386 acres ; popu- lation (1881), 29,790; (1891), 35,427; (1901), 41,083.~~

~~Barnstaple, a municipal borough, port, and market town, in the Barnstaple parliamentary division (since 1885) of Devonshire, England, on the Taw, 6 miles from its mouth, and 40 miles N.W. of Exeter by rail. The ancient church of St Peter and St Paul has been restored, that of St John the Baptist enlarged, and the infirmary twice extended. Eegistered shipping in 1900, 43 vessels of 1915 tons ; in 1899, 3202 vessels of 212,873 tons en- tered, and 3167 of 210,822 tons cleared. Area of mu- nicipal borough, 1837 acres. Population (1881), 12,282;~~

~~(1891), 13,058; (1900), 14,137.~~

~~Baro River. See Nile.~~

~~Baroda, a native state of India, within the Gujarat province of Bombay, but in direct relations with the governor-general. It consists of four isolated divisions, each of which is surrounded by British territory or by other native states. Three of these — Kari, Baroda, and Nausari — are in Gujarat proper ; the fourth, Amreli with Okha- mandal, is in the peninsula of Kathiawar. The total area covers 8226 square miles. In 1881 the population was 2,185,005; in 1891 it was 2,415,346, giving an average density of 294 persons per square mile, compared with 301 for the Gujarat division of Bombay. Classified according to religion, Hindus numbered 2,137,668; Mahommedans, 188,740; Jains, 50,332; Parsis, 8206; Christians, 646 ; aborigines, 29,854. In 1901 the popu- lation was 1,960,927, showing a decrease of 19 per cent..~~

~~compared with an increase of 11 per cent, in the preced- ing decade.~~

~~The last Gaekwar, Mulhar Eao, was deposed in 1875 for gross misgovernment ; but the widow of his brother and predecessor, Khande Eao, was permitted to adopt an heir from among the descendants of the founder of the family. This heir, by name Sayaji Eao, then a boy of twelve years, was educated by an English tutor, the administration being meanwhile placed for eight years under the charge of the late Sir Madhava Eao, formerly Diwan of Travancore, one of the ablest and most enlightened of Indian statesmen. The result was a conspicuous success. The Gaekwar has been a model prince, and his territories are as well gov- erned and prosperous as a British district. He has re- peatedly visited Europe in company with his wife. In 1887 the Queen-Empress conferred upon him at Windsor the insignia of G.C.S.I., and in 1892 upon his wife the Imperial order of the Crown of India.~~

~~In 1894-95 the gross revenue amounted to Es.1,68,14,- 810, or more than a million sterling. The total expendi- ture was Es.1,62,36,227. The amount of silver coined in 1894-95 was Es.31,80,000 ; but in 1901 the state currency of Babashai rupees was withdrawn, and the British rupee was introduced. The regular military force consists of 1 field battery, 4 regiments of cavalry, and 6 battalions of infantry : total strength, 6000 men, of whom 13 are Europeans. In addition, there is an irregular force of 2000 horse and 1800 foot. The police numbers 4304 men, being 1 for every 547 of the popula-~~

~~tion. In 1897-98 the total number of vernacular schools was 1356, attended by 78,101 boys and 14,892 girls. The proportion of boys at school to those of school-going age is 42 per cent., compared with 27 per cent, for the Bombay presidency ; and the proportion of girls 7-2 per cent., com- pared with 4-2 per cent. For a few years compulsory education has been enforced in 30 villages of the Amreli division with apparent success, the compulsory age being 7 to 12 for boys and 7 to 10 for girls. Special measures are also adopted for the education of low castes and aboriginal tribes. There is a female training college under a Christian lady superintendent. In 1894-95 the Baroda college was attended by 164 students. There were 2 high schools, 13 Anglo-vernacular schools, and 6 aided schools, with a total of 5334 pupils, of whom 51 passed the matriculation. The Kala Bhavan, or technical school, with departments for drawing, carpentry, dyeing, weaving, and agriculture, was attended by 139 students. There is also a state museum under a European director, and a state library of about 6000 volumes. The number of hospitals and dispensaries is 61, which were attended in 1894-95 by 6837 indoor and 339,844 outdoor patients. Portions of the state are crossed by the Bombay and Baroda and the Eajputana railways. In addition, the state has constructed three railways of its own, on three different gauges : total length, 177 miles. Other railways are in contemplation. The state supports a cotton mill, with 260 looms and 12,734 spindles, employing 600 hands. Baroda has suffered considerably from the plague, the total number of deaths down to July 1897 having been 2950 ; and also from the famine of 1899- 1900, the persons in receipt of relief averaging about 60,000 a month.~~

~~The city of Baroda is situated in 22° 17′ N. lat. and 73° 16′ E. long., on the river Viswamitri, a station on the Bombay and Baroda railway, 247 miles north of Bombay. The population in 1881 was 106,512; in 1891 it was 116,420 ; and in 1901 it was 103,782. The municipal area is about 8 square miles, giving a density of 14,059 persons per square mile. The municipal expenditure in 1894-95 was Es.2,69,273, almost entirely contributed by the state. The whole aspect of the city has been~~

~~changed by the construction of handsome public buildings, the laying-out of parks, and the widening of the streets. An excellent water-supp^ly is provided from the Ajwa lake. The cantonments, garrisoned by a native infantry regi- njient, are under British jurisdiction, and have a popula- tion of 4000. They contain an Anglo-Indian school, and 2 vernacular schools for boys and girls. In 1894-95 the Baroda high school was attended by 660 boys, of whom 38 passed the Bombay matriculation; and the Anglo-vernacular school by 351 boys. There are also 31 ver- nacular schools, with 4984 pupils. The chief hospitals are called after the countess of Dufferin, Jamnabai, and Sayaji Eao, with a total of 2856 indoor patients.~~

~~(j. s. Co.)~~

~~Barotse. — This is the name given to a country and a people in South-Central Africa. The name is sometimes spelt Barutse, and is said to be derived from a corruption of Bahurutse, the name of a Bechuana tribe. The word is also given with a different plural prefix as Marotse. It will probably survive for general use in the form which heads this article. Barotseland lies along both banks of the upper Zambezi, from the junction of the Kabompo and the Liambai to the junction of the Kwando and the main Zambezi at Kasungula. Politically, it may be also held to include the adjoining countries inhabited by the Batoka and the Bashukulumbwe — in short, the basins of the upper Zambezi and of the Kafue rivers. On the north it is bounded by Portuguese West Africa and the Congo Free State, on the east by British Central Africa (of which it is sometimes considered to form a geographical part), on the south by Ehodesia, and on the west by the German and Portuguese possessions. Barotseland proper is the very marshy and unhealthy country along the banks of the upper Zambezi, which at certain seasons of the year spreads its floods far and wide. The extreme north of Barotseland is densely forested ; elsewhere trees are few and far between. The Batoka and the Bashukulumbwe countries chiefly consist of plateaux with an average elevation of about 2500 feet, here and there rising into hills and mountain ranges of no great altitude. The river Kafue, which is also known as the Kaf ukwe and the Luenge, is the second most important river of Barotseland, and is by some geographers considered to have been the original head-waters of the Zambezi, in the days before the present upper~~

~~Zambezi by means of the crack known as the Victoria Fallsi was deflected towards the Indian Ocean.~~

~~The indigenous Negro race of Barotseland proper is known as the Baloi or Balui. They are Bantu Negroes, speaking dialects more nearly related to those of the southern Congo basin than to the Zambezi tongues. Their country was invaded in the early part of the 19th cen- tury by ravagers from Bechuanaland across the Zambezi, a people who generally went by the name of Mokololo, but who eventually adopted the term Barotse. These Bechuana conquered Barotseland, and ruled it for about forty years, when an uprising among the indigenous Baloi drove them from power and replaced them by a native dynasty. Nevertheless, Bechuana influence in the country is very marked, and for some time the Bechuana language was the Court tongue. The present king of Barotseland is named Lewanika, and his capital city on the upper Zambezi is Lialui. Lewanika is a very enlightened mon- arch as African princes go, and rules his country with wisdom, and much under the advice of a Resident of the British South Africa Company and of French Protestant missionaries, who have long been settled in the country. Lewanika's hold upon the Batoka and the Bashukulumbwe 'is very dubious, but it is probable that for political pur- poses it may be strengthened, as the best means of bringing~~

~~these wild tribes under reasonable subjection. There is a good deal of the' West African strain in the manners and customs, trade and religion, of the Barotse, or more properly speaking, of the Baloi. Having, however, for many years past (from the Bechuana invasion and the settlement of the French Protestant missionaries) been brought into connexion with British South Africa commercially, and finally politically,, there is a certain am,ount of " Cape " influence in the new civilization which is springing up. On the other hand, the Batoka, and still more the Bashukulumbwe, are in a completely savage state. The men go absolutely naked (as was formerly the case with allied tribes in West Nyasaland) and wear their hair with artificial additions in a tremendously long peak which is drawn to a fine whip-like point. Physically, they are a fine, handsome race, though the Barotse are not so, resembling rather the West African Negroes in appear- ' ance. It is probable that the Bashukulumbwe are in remote origin nearly allied to the Zulu Kaifirs. The Batoka and Bashukulumbwe country is fairly healthy, and~~

~~adapted for European settlement as much as the Rhodesian territory to the south. On the other hand, Barotseland proper is exceedingly unhealthy, and quite unfitted for European occupation. In flora and fauna Barotseland is closely con- nected with British Central Africa, though in the north- west there is a marked infusion of West African forms. Politically, the country lies within the limits of the British Empire. It remains under the government of its king, but the British South Africa Chartered Company has by treaty a certain interest in its government, and maintains a Resident at the court of King Lewanika. For geographi- cal reasons it is probable that Barotseland will one day form part of the South African congeries of states, and will be administered quite independently of its eastern neigh- bour, British Central Africa, which in peoples, languages, history, and methods of administration tends much more towards Eastern Africa and Zanzibar.~~

~~See Livingston. Missionary Travels and Eesearches in South Africa. London, 1857. — Major Serpa Pinto. JSow I Crossed Africa. London, 1881. — Coillard. On the Threshold of Central Africa. London, 1897. — Major St H. Gibbons. Exploration and Bunting in Central Africa. London, 1898. — "Journeys in Barotseland," GeographicalJournal, 1901. — Beetrand. Aux Pays des Barotse, Haut Zambeze. Paris, 1898. — D^cle. Three Years in Savage Africa. London, 1898. (h. h. j.)~~

~~Barquisimeto, capital of the state of Lara, in Venezuela, in a valley, 1711 feet above the level of the sea. Its population numbers 40,000. It is an important commercial centre, having great facilities for communica- tion with the states of Carabobo, Zamora, and Falc6n, and is connected by rail with the port of Tucacas. It is the seat of an episcopal chair, has many colleges and schools, both public and private, hospitals, &c. The main buildings are the Government palace, the barracks, the market, the cathedral, and several other churches.~~

~~Barrackpore, or Nokth Baeeackpore, a town of British India, in the Twenty- four Parganas district of Bengal, lies on the left bank of the Hooghly, 15 miles above Calcutta. Population, about 21,000. It is the largest cantonment in Lower Bengal, having accommoda^ tion for two batteries of artillery, the wing of a European regiment, and two native battalions. It is a station on the Eastern Bengal railway. A fine park along the river contains the country~~

~~residence of the Viceroy. The English high school was attended in 1896-97 by 201 pupils.~~

~~Barracks. — Barracks are necessary accompaniments of a standing arlny. As long as operations in the field were carried on by means of troops levied especially for the war in hand, no barracks apart from fortifications~~

~~nentat systems,~~

~~were required except those for the royal body-guard; and even after the standing army exceeded those limits, the necessity for additional barracks was often avoided by having recourse to the device of billeting, i.e., quartering the soldiers on the populations of the towns where they were posted. This, however, was a device burdensome to the people, subversive of discipline, and prejudicial to military efficiency in many ways, while it exposed the scattered soldiers to many temptations to disloyalty. Hence, instead of billeting soldiers, there were gradually provided for them barracks, which, in the case of the British empire, were first erected at stations where such an arrangement was most necessary owing to the paucity of the population, or where concentration of troops was most important owing to the disaffection of some of the inhabitants. These barracks sometimes formed part of fortifications and their character was subordi- nate to considerations of defence. Generally, however, they were separate, and it is such only that are dealt with in this article.~~

~~It was in France, where, in the reign of Louis XIV., provision had to be made for the housing of a huge standing army, that barracks were first built upon an organized plan. In 1680 Vauban devised and introduced a system of barrack construction which became universally adopted in France, and maintained its position there for nearly two centuries. Its leading features may be briefly described as follows : — The barrack was a square building of masonry of two or more storeys, with a court- Cooti' yard in the centre. Staircases connected from the ground with each floor. On either side of the staircase-landings two parallel barrack rooms opened — the one lying to the~~

~~front and the, other to the back (the courtyard side), separated from each other by a stout partition wall. These wards were the barrack rooms of the men for all purposes — ^living, sleeping, eating, and the furbishing of accoutrements. In process of time the partition wall was removed, and both rooms being thus thrown into one, better ventilation was gained. > After an unbroken existence of nearly two centuries the " Vauban " system was modified by that known as the "Belmas," which introdilced a corridor in place of the discarded partition wall. The evils attendant upon this change in internal construction were, from the hygienic point of view, soon apparent. Not only was the corridor dark and incapable of ventilation, but there was a constant inter- change of effluvia from one ward to the other through the doors opening into the passage, and the result was soon seen in increased sickness and mortality. Germany and Austria followed in the main the Spanish system, the characteristics of which were an open gallery running round the courtyard quadrangle on every floor, upon which the barrack rooms opened.~~

~~The year 1874 inaugurated a new era in barrack con- struction for the two leading military nations of Europe. With the lessons of the field hospitals in the Franco-German war fresh upon them, and in view of the beneficial results attained in them, each country set itself to work to devise a better sanitary system of housing troops than had hitherto obtained. A new departure was made from the quadrangular systems above described. The " Front " system was now introduced, and became almost universally adopted in the case of new erections. Barracks were now built upon the following plan : — The main building was an oblong front block of at most three storeys, with wings running back at each end, but not exceeding in depth one-third of the frontage. The ad- vantages of this system were increased light and air, and the greater facility afforded for keeping outhouses, such as latrines, wash-houses, kitchens, and harness rooms, away from the living and sleeping accommodation for~~

~~the men. The floor- and air-space allotted to each man in the German barracks under the new system is about 550 cubic feet air-space and 49 square feet floor-space. Barracks on this plan have been built in France to accommodate as many as 5000 men under one roof. But perhaps the most perfect arrangement of the kind is to be found in Dresden. The so-called "~~

~~Albertstadt," situated about two miles from the centre of that city, consists of seven or more of such barracks, erected on a spacious and even sumptuous scale, with a total frontage of close upon two miles. Indeed, it is only in Germany and in the United States of America where as yet provision has been made for separate living and sleeping accommodation for the soldiers. But in spite of all that the best architects and builders could devise, it has been found, even in the model " Albertstadt " of Dresden, that the sanitary conditions of any system of complete centralization leave much to be desired, as compared with the decentralization exempli- fied in the pavilion system, which was first established in England after the Crimean war. A somewhat similar system to this, known as the Toilet, was introduced in France in 1875, going further in the direction of de-centralization even than the English. Its main charac- teristics are the following: — 1. Every pavilion to be of one storey, to have a pitched roof, and to contain at most seventy men. 2. The blocks to be built on stone foundations, and the structure of iron skeleton framework filled in with non-porous bricks. The materials used to be non-inflammable, and capable of being thoroughly cleansed. 3. The blocks to be built outside towns;' and 55 square yards space to be allowed per head within the area assigned to the whole of the barrack erections, whilst in the barrack rooms 33 square feet floor-space and 760 cubic feet air-space are allowed for each foot soldier, and 41 square feet floor-space and 860 cubic feet air-space for each trooper. 4. Each block to have separate wash-houses and latrines.; whilst the furniture of all rooms must be such as permits of thorough and rapid cleansing and dis- infecting. 5. Every block has in the centre an ante- room fitted with all appliances for washing, whilst to the right and left lie the barrack rooms, each 63 feet long and 21 feet broad, lighted by eight large windows, and with ventilators in the roof. At the end of each ward are two rooms occupied by the under-officers responsible for the discipline and general supervision of the rooms. The hygienic results of this change of barrack system in France have been considered very satisfactory.~~

~~British Army. — The earliest barracks of which there is record, as regards England, were those for the royal body- guard, i.e., those for the foot-guards, erected in 1660. Among the earliest of those still existing were the Eoyal Barracks at Dublin, dating from the beginning of the 18th century, about which time barracks were built in several parts of Ireland, but the~~

~~great barrack-building era in England was the end of the 18th and the beginning of the 19th century, i.e., during the great wars with France. That period saw the erection of a very large number of barracks in towns in Great Britain and Ireland and in the colonies. Communication being slow and difficult, while there was much distress owing to the war, and consequently frequent riots, the barracks were generally placed in large or market towns, where the troops could be most easily supplied, where they would be at hand for putting down disturbances, and where recruits could be most readily obtained. Few barracks were built on a large scale during the next forty years, but the same policy held the field, in spite of the intro- duction of railroads and steamships, the invention of the electric telegraph, and the establishment of organized and efficient police forces. On the other hand, those forty years~~

~~were a critical period. Apart from the violence of strikes and anti-machinery riots, and the excitement of parlia^ mentary elections, there was the tension caused by the Koman Catholic Emancipation Bill, the great Eeform Bill, and the abolition of the Corn Laws, besides the catastrophe of the Irish famine, and the Chartist upheaval of 1848, while the effect of the fundamental alteration in the mat- ter of communication had not as yet been fully realized. The Crimean war and the adoption of rifled guns and small arms brought about a great change. It was recog- nized that, after the necessary garrisons of fortresses had been provided for, the leading principle of barrack policy must in the future be to facilitate in peace time the train- ing of the army for war ; and that this could only be done by barracking troops in large bodies, including all branches of the service, in positions where they would have space for training, gun and rifle practice, and man- oeuvring. The camps at Aldershot, Colchester, Shorn- cliffe, and Curragh were accordingly started between 1866 and 1860, and the same policy has been since pursued by the acquisition of Strensall Common, near York, feil- worth domain, near Fermoy, the lease of a portion of Dartmoor and a large area at Glen Imaal, county Wick- low, for the Horse and Pield Artillery, and finally the purchase of a great part of Salisbury Plain. It is not~~

~~at all these places that there are or will be regular barracks. In some cases the troops are encamped while training; but the principle rema,ins that, when permanent barracks are built, they should as a rule be for a force of all arms in a locality where they can be trained. With the pres- ent means of communication support to the civil power in case of disturbances can always be afforded in time, without permanently stationing troops in the actual locality where their assistance may be needed.~~

~~Unfortunately, however, the old barracks, such as those of the beginning of the 19th century, exist in many towns, and for economy's sake must for the present be utilized. These OU-tyim barracks were built before the true principles of sanitary barracks, ggience were known, and the health of the troops stationed in them was very bad, while the accommodation they afforded was insufficient in many respects. Hardly any provision was made for married men, who were generally placed with their wives • and families in ordinary barrack rooms, the space allowed for four single soldiers being allotted to each family, with no pri- vacy beyond that aHorded by screens of blankets erected by the occupants. Even for single men the accommodation was inadequate, the space allowed per man being seldom over 450 cubic feet, and sometimes as low as 258 f ^et, while most of the rooms had windows only on one side, and there were no special means of ventilation. The latrines were often mere privies ; the ablution arrangements were very rough, and baths there were none, while the only means of cooking provided for the soldiers was by boiling. There was no sergeants' mess or recreation establishment, while the accessories that were provided were far short of the modern standard. The buildings were often arranged so as to interfere with the proper circulation of air, and the drainage was almost invariably bad.~~

~~The result of this state of affairs was disastrovis. As late as 1857 the annual rate of mortality in the army at home per 1000 men was 17 '5, vfhile the rate among the civil male population of corre- sponding ages was only 9-2. Contrast with this the rate of mortal- ity in the army at home forty years later, in 1897, which was only 3-42 per 1000. It is not contended that improvement in barracks was the only factor in thus reducing mortality. There have been other causes at work, such as better clothing, better food and cook- ing, greater temperance, education, amusements, careful~~

supervision of health, and the introduction of short service ; but still, the most effectual cause has probably been the improvement in barrack accommodation. The disasters of the Crimean war directed public attention to the health of the army, and resulted in the appointment of the " Official Committee on Barrack Accommodation Reforms. ^^^ ^.j^g ^^my," presided over by Viscount Monk, M.P., which reported in 1855. This was followed by a Eoyal Commission in 1857, resulting, in October 1857, in the appointment of' the Bar- rack and Hospital Improvement Commission to go into the matter in detail as regards the United Kingdom and the Mediterranean stations. The reports of this commission, presented in 1863, besides containing valuable recommendations for the improvement of almost every barrack inspected by them, laid down the general

sanitary principles applicable to the arrangement and construction of military barracks and hospitals, and in spite of the lapse of time they may be still regarded as text-books of sanitary science as applied to the construction and improvement of such buildings. The labours of many contributed to that result, but beyond all others should be remembered the names of Sidney Herbert (after- wards Lord Herbert of Lea), Captain (afterwards Sir Douglas) Galton, E.E., F.E.S., and John Sutherland, M.D. The Barrack and Hospital Improvement Committee was constituted as a stand- ing body in 1862 to continue the work of the commission, changed its name to that of the Army Sanitary Committee in 1865, was re- constituted in 1890, and remains to this day the principal adviser of the Secretary of State for War on sanitary matters. In accord- ance with the recommendations of these bodies great changes have been made from time to time in those old barracks which were required for constant occupation, while under the same inspiration a high standard for new work was established by the erection of numerous regimental depots and other barracks under the Military Forces Localization Act of 1872. Later a further advance was made when the Barracks Act (1890) was passed, in order to deal writh barracks generally, and especially to replace with permanent buildings the worn-out wooden huts at Aldershot, Colchester, Shomcliffe, and Curragh ; and under the Military Works Acts of 1897, 1899, and 1901 still further improvements have been intro- duced. This raising of the standard of barrack accommodation is doubtless bound to continue ; for in a country where a short-service army is kept up by a large annual number of voluntary

enlistments, in order to encourage recruiting it is necessary to provide for the soldier such advantages as will compare favourably with what he might expect in civil life, and thus make up for the smaller pay and restricted liberty to which he will have to reconcile himself. Hence in dealing with this question there are three great objects to keep in view, viz., the training, the health, and the comfort of the soldier, while in addition financial considerations ordain due regard to economy.

A description of a modem barrack for a battalion of infantry will show how at present these objects are sought to be attained. The general locality for the barrack having been deter- mined by military considerations, especially with regard y^""'^ **to proper facilities for rifle practice, training and man- '"'■™'*'** ceuvring, the selection of a suitable site becomes a matter of the first importance.

In the United Kingdom an ideal site should be airy, open, and dry in itself, should slope gently towards the south, and be pro- tected from cold winds by trees or rising ground. It should be free from local mists, and from smells from gas or chemical works, brickfields, sewage farms, etc. The levels and situation should be such as to afford ample falls for sewers and subsoil drains, and to prevent flooding or waterlogging by surface or subsoil water from adjacent areas. The surface soil should be light but fairly fertile, uncontaminated by sewage, heavy manuring, or previous occupa- tion. The subsoil, if not rock, should be porous, such as gravel, or absorbent, such as chalk, and it is desirable that the level of the subsoil water should be low and fairly constant throughout the year. Clay, whether as surface or subsoil, should be avoided if possible, especially in the case bf barracks for mounted troops, for which sand or gravel are the best soils, as being the least muddy. Finally, there should be a good and ample water supply, facilities for obtaining gas and electricity, means of disposing of sewage in a satisfactory manner, preferably into public sewera, and easy access by road and rail. It cannot be expected that any site would possess all these characteristics, which are not all of equal import- ance, while the absence of some of them can be remedied. For instance, trees can be planted to give shelter ; insufficient drainage- fall can be made up for by pumping ; flooding can be prevented by intercepting drains ; contaminated surface soil can be purified by burning ; and if there are no public sewers or

natural sewage- outfalls available, no companies for the supply of water, gas or electricity, insufficient roads or railways, in that case sewage works can be established, wells can be sunk and pumping machinery erected, gas or electricity can be manufactured, roads and railways can be constructed ; but the general airiness and salubrity of position, satisfactory subsoil, freedom from noxious and insanitaiy surroundings, and purity and sufficiency of water sources, are essentials, defects in which cannot be remedied by mere expendi- ture. These essentials generally indicate a country site, although the proximity of a small town is advantageous for supply, and for residences and lodgings for married officers and soldiers, and also for the sake of the sewers, water and lighting companies, and railway communication that would probably become available. The barrack, however, should not be too near the town, but should be isolated from it if necessary by the purchase of inter- vening land. The area required for the regimental buildings and parade of an infantry battalion is about 22 acres. A cavalry regi- ment, or a brigade division of horse or field artillery, requires about 30 acres, and a company of garrison artillery, engineers, army

service corps, or army ordnance corps, 3 acres and upwards, accord- ing to the number of horses and waggons to be provided for. In addition to these areas, space is required for recreation ground and soldiers' gardens, and for garrison accessories, such as offices for the staff, garrison church, hospital and school establishments, engineer ■workshops and yard, stores of the army service corps and army ord- nance corps, provost or military prisons, with the necessary quarters ineach case, apart from any land required for rifle or gun practice, military training and manceuvring. The whole site, perhaps omit- ting the recreation ground and soldiers' gardens, may be enclosed by a wall or iron railings, although such enclosure is often omitted in the open country, or where there are a number of barracks together, as at Aldershot. Taking the case of an infantry barrack for a single battalion, on a site of about 22 acres, a suitable portion, about 450 feet by 300 feet, is set

~~apart for a parade for forming-up purposes, it being assumed that, as is generally the case, ground is avaOable near at hand for battalion or brigade drill. Round the parade are arranged the several buildings, the men's barracks with their imme- diate accessories and the canteen being probably on the upper side, the officers' quarters on the opposite side or at one end of the parade, the guard-room, regimental offices, stores and shops, ser- geants' mess and recreation establishment, at the other end, the drill shed facing the parade, where convenient, and the married soldiers' quarters either behind the single men's barracks, or in one corner of the site near but not overlooked by them . If garrison accessories are to be provided for, the site would be larger, and they would prob- ably be disposed sympathetically, as it were, i.e., with staff officers' quarters near the officers' quarters, garrison offices, stores and shops near the regimental ones, schools convenient for access both for men and children, church and gymnasium facing the parade, mar- ried men's quarters with those for the battalion, the hospital estab- lishment, with quarters, in as isolated and airy a position as the site afiords, and any prison buildings in au inconspicuous comer.~~

~~Such would be a fairly typical arrangement of the buildings of an infantry barrack ; and it would be somewhat similar in other cases, except that with mounted troops the foot parade might be smaller, in which case there might be a stable square or mounted parade, probably behind or flanking the men's barracks, the stables being on the side nearest the men, with forage stores, forges, shops, riding school, waggon or gun sheds round or abutting on the square, infirmary stables isolated but not far from a forge, and exercising ground and manages farther in rear, the latter, however, near the riding school. In all oases the general of the district obtains the opinions of an engineer officer, of a medical officer, of the officer in charge of the barracks, and of an officer of the branch of the service for which the building is intended, and he forwards these opinions with his own to the War Office for approval. In the more important cases additional opinions and local information as to climatology are obtained, the site is explored by excavation and boring, and the water sources are tested. Frequently the site is also inspected by officers of the headquarters staff, in order that they may have personal local knowledge to assist them in dealing with the pro- posals put before them, which are then submitted to the Army Sanitary Committee,~~

who in all important cases inspect and con- sider them on the spot. Finally, on the buildings, when completed, the general calls for reports as in the case of sites, and they are only taken into occupation if they satisfy the officers consulted.

Scales of floor-space and air-space have been laid down for men in their barrack rooms, in hospital, in school and lecture rooms, in chapel and in confinement, the more important of these scales embracing all climates. The provision of proper arrangements for ventilation is assumed, and the initial point, so to speak, is an allowance of 57 feet of floor-space and 600 cubic feet of air-space per man in a permanent barrack room in England, the allowance for ordinary hospital patients being one and a half that amount of floor-space and twice that amount of air-space. With these scales as a guide it is easy to ensure sufficient spaciousness in all other rooms. To secure dryness of site siibsoil drainage is resorted to when necessary, and is always provided for unmetalled surfaces used by horses, such as exercising grounds and manages. Parades, roads, and paths are paved, metalled, or gravelled, according to use, and are provided with surface channels and storm-water drains. Surfaces not exposed to much traffic are laid down in grass, as being generally less costly than gravel, less dusty, and more easily kept in order by the troops. To secure dryness of buildings asphalt damp-courses are provided, and the area of each building is covered with an impervious coating of cement-concrete or paving, to prevent ground-air and damp from rising and to keep out vermin. Hollow external walls were generally adopted for the sake of warmth and dryness during the last 30 years of the 19th century, and are still used in exposed positions. When well built these are quite satisfactory for buildings not exceeding two storeys in height, but their erection requires much care and supervision. The present tendency, therefore, is to have solid walls, which are unobjection- able for most buildings and situations, if of sufficient thickness to keep out damp. With a view to cleanliness, hollows which might

harbour dirt or vermin are avoided as far as possible. With this object, during the last decade of the 19th century, different kinds of water-proof- and dirt-proof floors were used, so as to keep the space under them dry and clean. None of them were free from objections of one kind or another, and their use is abandoned for the present ; but the sanitary importance of

~~providing such floors is so great that it is to be hoped that renewed efforts will be made to devise a form suitable for barracks.~~

~~As for sanitation, the recognized principles of good drainage are adhered to, viz., that well-ventilated air-tight and water-tight pipe drains should be laid in straight lines and with even inclinations from point to point, where there should be ^on manholes for inspection and cleansing, in which changes of direction and inclination and junctions with other drains should take place. No drains are allowed to run mader buildings, and the sanitary apparatus therein is doubly cut off from the drains by water-trap and air-disconnexion, the drains themselves being dis- connected from the sewers in the same way. The water-supply is to cisterns containing sufficient for two days at the rate of 20 gal- lons per head and per horse. Water is laid on for all necessary services, that for sanitary purposes being always drawn from sepa- rate cisterns. Only cast or wrought iron is, as a rule, used for supply or service pipes. The purity of the water, both as received and as delivered, is guarded by periodical testing and analysis. When pure water is scarce, there is sometimes a separate supply- system of inferior water for sanitary and fire purposes. With regard to the supply of pure air, the principle that holds the field is that of through-ventilation, partly by means of windows on opposite sides of every building and of almost every room, and partly by a system of inlet and outlet ventilation that cannot be completely closed. HIalf of the air admitted by inlets is brought directly to ventilating grates, which in cold weather warm it before passing it into the rooms. The clear sectional area of fresh air inlets is approximately equal to that of the outlet shafts, and is at the rate of 10 square inches per man in barrack rooms and 20 square inches per patient in hospital wards. With this as a guide it is easy to judge what special ventilation should be provided in other rooms, according to their use and occupation, bearing in mind that no room that is slept in should be without a fresh air inlet and a chimney flue or extracting shaft. As for light, the allow- ance in open positions is 1 square foot of glass to 100 cubic feet of air-space, but this proportion is exceeded in dark situations, in rooms that are thronged at times, such as recreation- and tap- rooms, and also in lavatories and bath-rooms, kitchens and scul- leries, which cannot be made too light. For the sake of both light and air, buildings facing each other are placed at least as far apart as twice the height from ground floor to eaves, and the ends of the spaces or lanes between them are kept open. With regard~~

~~to sunshine, officers' quarters are planned so that no rooms intended for habitation should face north, while all other blocks of inhabited buildings, especially the ward-blocks of hospitals, are arranged to run approximately north and south, so that the majority of win- dows may face east and west and receive sunshine at some time during the day. As also bearing on the question of health it should be mentioned that, except a few attic bedrooms in one type of married quarters, no rooms are less than 9 feet high, the great majority being from 9 feet 6 inches to 11 feet 6 inches high.~~

~~The amenity of a barrack is secured partly by planting trees, especially round the parade and recreation ground, and by pro- viding a certain amount of shrubbery and grass-plot in connexion with such buildings as the officers' quarters and mess, sergeants' mess, recreation establishment, hospitals, &c. ; and partly by such attention to architecture as is fairly consistent with economy, the result aimed at being to avoid a sordid or repellent appearance, and to emphasize the different buildings according to their occu- pation and importance. In some conspicuous situations, such as facing Southsea Common, and on some historic sites, such as the Tower of London and Edinburgh Castle, the attention paid to architecture has rightly far exceeded this limit. Soundness of construction is a matter of course, for barracks are built to last and not to sell. The only points worth mentioning, besides those already noticed, are that stairs are almost'always of stone or iron, and that, in order to keep down repairs, few buildings have plas- tered walls except those used by officers and warrant officers, school-rooms, and hospitals. Barracks are generally lighted by gas, both internally and externally, or by mineral oil when gas is not available. At some stations, however, electric light is being introduced, especially for hospitals, and it is doubtless the light of the future. For habitation, buildings of two storeys are pre- ferred to those of one storey, as being warmer and more convenient, while they occupy somewhat less space, and are a little less costly, taking all things into consideration. It is only on restricted sites that buildings of more than two storeys are adopted.~~

~~For the lieutenant-colonel commanding there is provided a house, generally detached, of ten rooms of moderate size, besides offices. Majors get two good-sized rooms and a servant's room ;~~

~~Officers' quarters.~~

~~Obtains and subalterns get half that amount, a portion of the officer's room, with a window in it, being often partitioned off for sleepmg m. The quartermaster gets a seven-roomed house with small rooms, and the riding-master gets similar accommodation. Special quarters for married officers are also m future to be occasionally provided. The officers' mess contains a mess-room, ante-room, and billiard-room, with the necessary offices, and the block of officers' quarters and mess is so designed that the officers can reach the mess under cover For general, staff, and departmental officers, quarters are provided as may be required, generally in detached houses, and varying in size according to the probable rank of the occupant, from the house for the general, with twenty rooms besides offices, to the six- or seven- roomed cottage of the married aide-de-camp or staff captain. War-rant officers get quarters consisting of a living-room, kitchen, scul- lery, and three bedrooms. Married sergeants and rank and file numbering about fifty in the case of an infantry battalion, get quarters consisting of a living-room, small kitchen or scullery, and in I H °'^®' *^°' "' three bedrooms, according to the number sfldlfrs °^ chUdren. There have been several types of married soldiers' quarters, each an improvement on the last. In the latest type each quarter is self-contained and opens ofE a verandah, each family having its own water-closet, reached by a ventilated lobby from the quarter itself. Near the quarters is a good laundry with washing-room, heated drying-closet, ironing- room, and drying-ground. The proportion of quarters of each size is arrived at from statistics as to 10,000 soldiers' families, and, though based solely on the number of children, it varies according to rank, and even according to the character of the barrack. For sergeants are, on the whole, men of 'longer service than the rank and file, and therefore have larger families, and the married ser- geants and rank and file at depots have, as a rule, more years' ser- vice than those at headquarters. The proportion of quarters with one bedroom ranges from 52 to 68 per cent. ; with two bedrooms, from 35 to 27 per cent. ; with three bedrooms, from 5 to 13 per cent. Out of the 10,000 families referred to, no less than about 24 per cent,~~

~~had no children, about 20 per cent, had only one child, about 19 per cent, had two children, about 14 per cent, had three children, under 10 per cent, had four children, and only about 13 or 14 per cent, had more than four children living with the parents, i.e., under fourteen years of age if boys, and under 16 years if girls. For the single non-commissioned officers and men of each half- battalion, according to the latest designs, two parallel two-storeyed blocks are built facing each other, and ftbout 200 feet Barrack apart, with verandahs on both floors, and each contain- “”’”’”’■ ing two companies. Midway between these blocks is~~

~~the cook-house for the half battalion, and alttached to it is a bath house and four company drying-rooms for wet clothes. Close to the cook-house, and between it and each barrack block, are com- pany dining-rooms, with wash-up sculleries. These five blocks of buildings are connected by verandahs, so that from any barrack- room a man can go under cover to any room in that block, to his dining-room and drying-room, to the bath-house and kitchen. The barracks for a half-battalion occupy a square plot, and can therefore be turned to face in the direction that may best suit the site. •’ The barrack blocks contain for each company two sergeants’ rooms, two store-rooms, eight men’s rooms 30 feet by 23 feet 6 inches, each for twelve men, and four ablution-rooms. Thus not only each com- pany, but each section or quarter-company, has its own separate accommodation. The barrack-rooms, 10 feet 6 inches in height, afford 57 square feet of floor-space and 600 cubic feet of air-space per man. They have windows on opposite sides of the rooms, so as to give through- ventilation, and the beds are arranged with their heads to an external wall, seldom less than 18 inches apart, and generally in pairs, with a window and an inlet ventilator to each pair. An arm-rack and shelves for each man’s arms, kit, and belongings are fixed at the head of each bedstead, which can be shortened to half its length in the day-time, when it serves as a seat. Each man has a box with a lock beside his bed, and tables and forms are provided as required. In the ablution-rooms water is laid on and basins provided at the rate of one to six men. In the cook-house is apparatus for all ordinary modes of cooking, except roasting before an open fire. The bath-house, with one bath for the sergeants and four for the men of the half -battalion, has hot and cold water laid on, as also have the wash-up sculleries, and the drying- and dining-rooms are heated with hot water. Water-latrines and urinals are provided, with all due~~

~~regard to decency, in con- venient positions not far from the barrack blocks, at the rate of 5 per cent, on the accommodation for single sergeants and men, those for sergeants being kept separate. When water-drainage is not available, the earth-closet system is adopted.~~

~~Such is the approved design at the commencement of the 20th century. Up to that time each company had a separate block, and there were no dining-rooms vrith sculleries, no drying-rooms, and no covered communication with the kitchen, while hot water laid on to baths was only allowed at stations where many recruits were~~

~~received. Such barracks were good in essentials, but the new type gives much greater comfort. Any further advance in barrack- room construction is likely to be in the direction of providing sepa- rate cubicles for each man, a system which, some hope, will improve recruiting in consequence of the greater privacy afforded ; against which advantage, however, must be set disadvantages of a hygienic, disciplinary, and social character.~~

~~The guard-house, situated at the main entrance to the barrack, contains a guard-room, with a prisoners' room opening off it, and four cells. A small-arm ammunition store, fire- engine house and ladder-shed, form part of the same ^'s"*'" block, or are near it. Close to the guard-room are the ^^/S^. regimental offices, embracing the commanding officer's " * ' office, or orderly-room, the clerk's office, and an officers' waiting- room. Here also is the telegraph- or telephone-room, when such is required. A medical-inspection-room, with waiting-room, is also provided if the hospital is too far off for the sick to be marched thither for examination. The drill-shed, facing the parade-ground, and 150 feet long by 30 feet wide, is usually open on one side and floored with gravel. When there is no gymnasium it is closed on the fourth side, has a wood-block floor and a little gymnastic apparatus, and is lighted with gas. The shooting-gallery is sometimes combined with the drill-shed. The sergeants', mess, in a pleasant situation not too close to the canteen or men's barracks, but convenient for access both for single and married sergeants, contains a mess-room, about 40 feet by 24 feet, and the necessary adjuncts and offices, in- cluding a jug-department with separate entrance for sergeants' families.~~

~~The regimental institute consists of two parts, the canteen and the recreation establishment. The former contains a bar, a tap- room, about 48 feet by 25 feet, with a stage at one end for music and entertainments, and a room for corporals, with a separate en- trance. There is also a separate jug-department for soldiers' wives, the necessary cellars and accessories, and a quarter for the manager. The recreation establishment, jn a cheerful position and quite separate from the canteen, though often near it, contains a recreation- or games-room, a reading-room with library, a coffee- room aiid coffee-bar, kitchen and offices, a grocery shop and store, with separate entrance, and quarters for the manager. The public- rooms have an area of about 2500 square feet, and are about 15 feet high. Attached to the building, and capable of being used for recreation when required, is a lecture-room for the instruction of companies by their officers. Additional means of recreation are provided in the shape of a fives-court, a shooting-gallery, and, when land is available, a cricket-ground and soldiers' gardens.~~

~~The regimental stores and shops include an office for the quarter- master, stores for bread and meat, clothing, general purposes, coal, musketry, and pioneers, and for oil, if the barrack is not lighted by gas or electricity. 'The shops are for tailors, shoemakers, armour- ers, carpenters, plumbers, painters, and glaziers. Transport stables for six horses, with harness-room and forage store, and sheds with gates for the waggons and carts used in peace time, for mobilization vehicles and for two machine guns, complete the purely^ regimental buildings. In addition, there are the garrison accessories, arranged to serve all the barracks at an ordi- nary station, or groups of barracks at such a station as Aldershot.~~

~~The army service corps buildings may comprise only the ordi- dinary stores for bedding, utensils, unserviceable stores, &c., and for forage for any mounted troops, or they may include a bakery with flour and bread stores, an abattoir with cattle byres and meat stores, and reserve provision stores, according to the circumstances of the station. A chapel is seldom built for a single barrack if arrangements can be made for divine services for the troops at neighbouring places of worship. Gymnasia vary in size from 80 feet by 40 feet to 150 feet^by 50 feet, according to the force they have to serve. Military prisons for the longer sentences are few in number, and provost prisons for the shorter sentences are less necessary than used to be~~

the case. They are both constructed in accordance with the regulations of the Prison Department of the Home Office, modified as necessary to meet military requirements, and are certified as fit for occupation by the inspector-general of military prisons.

For the engineers there are ordinarily stores for tools, &c., for field-works, and a building yard, with ,shops, stores, and offices, while sometimes pumping establishments and sewage, gas, electric, and railway works have also to be provided.

Schools are of two kinds, one for men and for children over seven years of age, under masters, and the other for the younger children, under mistresses. They are built in accordance with the principles and regulations of the Committee of Council for Educa- tion, modified slightly to suit military requirements. School seats in the adult and elder children's school are provided according to a sliding scale which works out at lOJ per cent, for a battalion, but gives a somewhat higher percentage for smaller bodies of troops and a lower percentage for larger bodies. In infant schools

the provision of seats is at the rate of about one per family on the married establishment, with a similar variation in the case of large and small numbers.

Hospitals are fenced ofi from the rest of the barrack buildings, and are constructed in accordance with the approved principles of Hosoltal modern hospital construction, avoiding, Uowever, the ' *■ extravagance with which they are often applied. As there are no facilities for treating in their quarters men who are slightly ill, many patients are admitted to military hospitals who, in civil lite, would be out-patients, or would be treated in their own homes. The number of beds provided is at the rate of 5f per cent, on the strength of the garrison, exclusive of officers. In civil life the provision of hospital beds, at the rate of one per 1000 of popu- lation, is considered by some authorities to be fairly sufficient ; and even if this proportion is multiplied fivefold, nothing more emphasizes the difference of character

between civil and military hospitals than the contrast of such a number with the 58 beds per 1000 provided for the army. In the United Kingdom the allowance of floor-space and air-space for patients is as follows : —

For light cases For ordinary cases For infectious cases

Floor-Bpace.

65 square feet

85 110

Air-space.

900 cubic feet

1200 ,, 1500

The construction adopted is the pavilion system. In a large hospital the lighl^case wards are for about 28 beds each, and the ordinary large wards are for 22 beds, one of them specially fitted up and warmed for pneumonia cases. There are smaller wards for cases under observation, for prisoners, lunatics, ophthalmia, itch, and serious cases requiring quiet and special nursing. General reading-rooms and dining-rooms are provided for patients able to avail themselves of them. There are the usual accessories of a hospital, namely, the administrative department, the stores, kitchens, quarters for medical staff and hospital orderlies, and for nursing sisters in the larger hospitals, in which also are provided an operating-room, lift for recumbent patients, and apparatus for disinfection and destruction, unless these processes can be carried out in existing local establishments. The isolation wards for in- fectious cases form a separate hospital as far as nursing goes, cut off from the rest by double fences with neutral space between, and there is no covered communication between the different wards or ward blocks, which are at least two, and often three, in number, so that the three prevalent diseases, scarlet . fever, diphtheria, and typhoid, can be kept separate. At some large stations a separate isolation hospital is provided, with its own staff and administration, and divided into two portions, one for men and one for women and young children, if the latter

~~cannot be provided for in local hospitals. Occasionalljr a hospital for women and children is also provided, with a general wing and a maternity wing.~~

~~The barracks for other branches of the army are very similar to those for infantry as far as officers and men are concerned, with the addition of stables and their accessories, sheds for waggons and guns, stores and shops, to meet their several requirements. In stables each horse is allowed at least 1500 cubic feet of air-space and from 85 to 110 feet of floor-space. The stalls, 11 feet long by 6 feet 6 inches to 6 feet wide, are arranged against the outer walls, with windows over them. In addition to inlet ventilation at the eaves, fresh air is brought to each horse when lying down by ducts at a height of 15 inches above the floor. Windows and skylights are provided to give 9 square feet of glass- space per stall, and the windows are arranged on each side of the stable, and are all made to open, so as to give cross ventilation. Stables generally have open roofs with roof ventilation, but if there are rooms over them they have concrete ceilings and large extracts ing shafts to carry off vitiated air. Paving is generally of cement concrete, as being unabsorbent and free from joints. It is grooved to prevent slipping as far as possible, the grooves being arranged to run to surface channels and to be easily swept out. Infirmary stables are similar but larger, giving 1800 cubic feet per horse ; but half the infirmary accommodation of 6 per cent, on the total number of horses is in the shape of loose boxes, some of them fitted with slings, and giving at least 2000 cubic feet per horse. Two of these boxes are in a separate building for isolation purposes.~~

~~For a cavalry regiment a riding-school 150 feet by 53 feet 6 inches, 8 open manfeges each 180 feet by 60 feet, and courses for jumping and "heads and posts " exercise, about 1100 or 1200 feet long by 150 feet wide, are also provided, as well as shops for saddlers and saddle-tree makers, and a four-fire forge with a couple of enclosed shoeing sheds. Each horse and field artillery battery, besides its barrack and stable accommodation, has its own battery office, store, shops for collar-makers and wheelers, forge, harness rooms, gun-shed and manfege ; while all other accessories are for joint use, on a scale proportionate to the number of batteries stationed together ; and a system similar in principle prevails in barracks for garrison artillery,~~

~~engineers, army service corps, army ordnance corps, and army medical corps, in all which branches of~~

~~the service the troop or company is the administrative unit, instead of the battalion or regiment.~~

~~At foreign stations similar accommodation is provided for white troops, and the same general principles hold both for European and native troops, but the air-space and floor-space allowed, and the details of construction, vary greatly ^i according to climate and locality. The main difference * ”’‘ is that in tropical and sub-tropical countries provision is made for the freest possible circulation of air below the ground floors of inhabited buildings, which are raised at least 4 feet above cement concrete paving covering the site. All such buildings are provided with verandahs, generally on all four sides within the tropics, and on the sunny side, at any rate, at sub-tropical stations. These verandahs are commonly used for dining in, and as they take the place of passages, the internal arrangement of the buildings is, as a rule, simpler than at home. The space for Europeans allowed in barrack rooms varies from 60 square feet of floor-space and 630 cubic feet of air-space in Nova Scotia and a hill-station in Mauritius to 80 feet of floor-space and 1000 feet of air-space at the hottest or unhealthiest stations, such as Port Louis in Mauritius, Sierra Leone, Ceylon, Singapore, &c. ; while in hospitals the allowance varies between 85 feet of floor-space with 1200 feet of air-space and 110 feet of floor-space with 1600 feet of air-space, or 150 feet of floor-space with 2100 feet of air-space for infectious cases. For native troops in all climates the normal 57 feet of floor-space and 600 feet of air-space in barracks is generally adhered to.~~

~~The aspect of buildings in hot climates is in most cases either north and south instead of east and west, or else such as to catch the prevailing winds. In some places it is necessary, especially in the case of hospitals, to fill the openings of the verandahs with movable louvres; and in some stations, such as Sierra Leone, where tornadoes are common, it is found advisable to enclose the verandahs to a considerable extent to prevent the rooms from being flooded by driven rain, or to provide hurricane shutters. The mode of construction varies greatly, according to the custom and resources of the country, both as regards labour and materials, the local construction being~~

~~generally adopted, provided it gives suffi- ciently sound sanitary and vermin-proof buildings. For several sta- tions, however, it has been found cheaper as well as better to send many of the materials from England, even including bricks. In hurricane countries, if wooden buildings are used, they should not be more than one storey in height. In earthquake countries one-sto- reyed wooden buildings with iron frames are the best, and they should have wooden ceilings instead of plaster. In white-ant countries as little wood should be used as possible, and that should be ant-proof.~~

~~Outside India British barracks have to satisfy the manifold needs of all the branches and establishments of an army of up- wards of 200,000 men ; or, in other words, they form a landed and house estate of the value of somewhere about 40 million pounds, scattered in many hundreds of localities all over the world, with all kinds of varieties of climate, position, and altitude, subject to many different systems of law and government, and adapted to meet the customs, prejudices, and religious requirements of many different races. (h. lo.)~~

~~India. — The changes which have led up to the present status of barracks and military sanitation in India are directly traceable to the recommendations of the Royal Commission of 1859, and are primarily accountable for a net decrease in the annual army death-rate in India, since that date, of about 54 per mille, i.e., from 69 to 15 per mille. In the upkeep of the necessary standard plans and regulations, whether for British or native troops, in hills or plains, the Government of India is guided by the Royal Engineers and medical services. Further assist- ance in these matters is given by special sanitary com- missioners, who report annually on the health of the troops, and incidentally on the military works carried out in eatfh Presidency, and by the Army Sanitary Com- mittee at home ; Parliament being kept informed of all Indian sanitary measures in a consolidated report framed every year by the India Office. Present practice, so far as it differs materially from that of the United Kingdom, is briefly described below.~~

~~The common difficulty of obtaining sufficient gradients or suitable outfall for ordinary pipe drainage has resulted, except in rare cases, in the adoption of the primitive methods of conservancy known as the " removal " and~~

~~“trench ” systems. In the former, which is common to private quarters and dwelling-houses as well as to public latrines, the foul matter is removed by a native “sweeper” in constant attendance, and transported nightly to~~

~~barrac:k:s~~

~~isolated plots of ground, where it is lightly burled in a series of shallow trenches. In the “trench” system, which is commonly used by natives and in camp, the latrines themselves are on the disposal ground, and consist of light screens which are daily shifted over the trenches, the ground in either system being subsequently cultivated. Incineration is also soihetimes used. Waste water from cook-houses and baths is carried in channels to, or poured from receptacles over, patches of grass or neighbouring gardens. Although readily open to inspection, and well suited to a country where space is often unlimited, these operations require the most rigid regimental supervision; and the necessary precautions to this end, together with the proper sanitary policing of all native lines and bazars, are among the most important safeguards of the health of the army in India.~~

~~While pipe systems for water supply are now being generally introduced, the older method of direct carriage from wells or reservoirs by hand, bullock, or cart is still practised. Special care is taken to ensure a pure as well as a plentiful supply in the im- mediate neighbourhood of every barrack.~~

~~Sites for barrack and hospital buildings, being more extensive, allow greater dispersion and consequently freer circulation of air among buildings than is either necessary or possible at home ; parade and cricket grounds and soldiers’ gardens are easily pro- vided, and tree planting is general. Por British troops double- storeyed barrack blocks, with sleeping rooms above and day-rooms and other regimental accessories below, were very generally intro- duced after 1859. Single-storeyed barracks, while more convenient, are, however, found to be equally sanitary if sufficiently raised from the ground, and are now the ruling type. Each standard block (for half-company, “half-troop, etc.) consists of two dormitories 20 feet high, giving 90 square feet and 1800 cubic feet per man (this allowance was frequently~~

~~given before 1859), with central mess-room affording 30 square feet per man, and a sergeants' quarter of two rooms and bath-room at either end. A store for each barrack room is provided in the verandahs, which are 12 feet in width. Detached lavatories, which are provided at the rate of one to each two barrack blocks, contain fixed basins at 20 per cent, and private ablution-rooms at 8 per cent., water being laid on from outside cisterns. A large plunge-bath is also generally supplied to every half -battalion. Cook-houses are arranged in blocks for 2 companies, and have each 2 kitchens, 2 cooking places, and 2 cooks' rooms. Native cooks are still generally employed, and the apparatus is of the simplest.~~

~~Married quarters are of six classes, three for sergeants, varying with rank, and three for men, varying with size of families, as follows: — Sergeants' quarters. — Class A, 1 sitting- and 2 bed- rooms ; class B, 1 sitting- and 1 bed-room ; class C, do. (smaller), itfejis' gworters.-T-Class 3, 1 sitting- and 1 bed-room ; class 2, do. (smaller) ; class 1, 1 bed-sitting-room. There is a bath-room in the verandah in all cases. Although the married establishments in India are liberal — viz., 100 per cent, for sergeants and 4 per cent, for rank and file — it is found in practice that these figures are never worked up to; and the percentage of married quarters actually provided is as follows for the different arms : —~~

~~Infantry.~~

~~Cavalry.~~

~~Artillery~~

~~Per cent.~~

~~Per cent.~~

~~Pe^ cent~~

~~Sergeants .~~

~~. 36~~

~~40~~

~~66~~

~~Rank and file .~~

~~. 1-25~~

~~3~~

~~4~~

~~Warrant officers' quarters consist of 1 large sitting-, 2 bed-, and 2 bath-rooms, besides cook-house and outside latrine.~~

~~The institute contains a liquor bar (now invariably in a separate building), a library, and a recreation and refreshment portion, corresponding to the English canteen and recreation establish- ments, but on a slightly more lavish scale. The remaining accessories are also more liberal, notably in the case of the voluntary shops, which inolude tinsmith's, printing, painting, bookbinding, and watchmaking shops. Furniture stores in charge of the royal engineers, who make the furniture, are an extra ; whilst laundries are never found except in hospitals, owing to the general adoption of the native outdoor system of washing.~~

~~Stables for mounted branches consist of long double rows of stalls 14 feet by 7 feet, in which the horses are picketed, facing inwards to a central passage; the construction is light, and mangers are dispensed with. The floors are normally of earth, periodically renewed, or Of more permanent material if readily available. Open terraces for use of horses in temperate weather are often built regimentally. Separate harness-rooms, stores, and night picquet guard-rooms are invariably provided. Inflrm'ary stables generally include a casting shed. Closed riding-schools are unusual, and the open manages are fewer than in the United Kingdom. All mounted corps are allowed dummy waggons and trucks for practice in entraining horses and guns.~~

~~Besides the usual station buildings, a reading-room for religious literature is invariably provided. School accommodation is at the rate of 120 adults and 64 children per battalion, as compared with 84 and 60 at home. Lines or huts for native followers are a necessary~~

~~adjunct of every barrack. Transport lines or standings for pack animals are also necessary where the latter are kept regimentally.~~

~~In hill stations or convalescent depots the scale of accommoda- tion is somewhat reduced, the individual allowance being 60 square feet and 600 cubic feet. The type buildings are light permanent huts designed in bays, capable of being combined in any numbers, vrith or without verandahs, closed or open.~~

~~Native barracks are, except in special cases, built by the sepoys with materials provided by themselves, as in the cavalry, or as in the infantry, out of a hutting allowance granted by Government, the buildings, when completed, becoming in the former case the property of the men, and in the latter that of Government. The forms of construction are, owing to the native mode of life, essen- tially simple, and vary slightly in different parts of the country. Quarters for married non-commissioned officers and men consist of lines of huts 12 feet to 14 feet high, slightly raised off the ground, , and divided into separate single rooms, about 12 feet by 10 feet, with verandahs, bath-rooms, and court-yards, whereby privacy and individual responsibility for cleanliness and protection of property are ensured. Eor unmarried men, continuous huts or "pendals," with non-commissioned officers' rooms, are provided, giving a minimum of 60 square feet and 810 cubic feet per man in the plains, and 45 square feet and 400 cubic feet in the hills. In some cases two single men are allotted to a married man's quarter. Native officers have separate establishments similar to the married men's quarters, but with a varying number of rooms and proportion of servants' huts and outhouses, according to rank. The remaining accessories of a native barrack, which are provided and built by Government, are on the same simple scale, no permanent latrines, cook-houses for married men, ablution-rooms, mess- or recreation- rooms being required, and no furniture, &c., being provided.~~

~~Native cavalry have open standings for their horses (which are their own property) adjoining their quarters, and sheds for camels and saddle-rooms are provided. In the native mountain artillery stables are generally built for the mules.~~

~~Quarters and messes for European officers are occasionally pro- vided by Government at reasonable rents, according to rank ; but more often officers make their own arrangements for hiring, their pay being intended, except in special cases, to cover either con- tingency. Where neither of these courses is possible Government occasionally advances the necessary money for building at a mod- erate rate of interest.~~

~~Hospitals for British troops are allotted on the station system. The typical ward block consists of a single-storeyed building in the style of a half-company barrack, and containing, besides the neces- sary wards, one attendants'- and one day-room, with bath-rooms, &c., at the ends. The beds, reckoned at 10 to 12 per cent, of garrison, are allowed 120 square feet and 2400 cubic feet in ordinary wards, and 150 square feet and 3000 cubic feet in separate isolation blocks. These latter, in common with officers' wards, are provided at special stations only. A women's and children's ward, with a matron's quarter to every ten beds, is usually an adjunct of every hospital, the beds being calculated at -8 per cent, of the men in garrison. Wards for followers, for severe cases or accidents, at fixed proportions for different units, are built and kept up by the departments concerned. The remaining hospital buildings comprise quarters for lady nurses and medical subordinates, with outhouses and stables; lines for hospital servants, an administration block, with stores, cow-shed, ambulance-shed, lamp-room, guard-room, mortuary, disinfector and latrines, ablu- tion-rooms and laundry. In the hills provisions are similar, but somewhat curtailed, the allowance per bed being 102 square feet.~~

~~In the case of native troops, although the station hospital system is approved for new barracks, the existing hospitals are chiefly regimental. The main building, which follows generally the lines of the ward block for British troops, includes the wards, giving 60 square feet and 810 cubic feet per bed, as well as the administration offices, stores, and bath-rooms. The cook-houses, latrines, washing-well, mortuary, and quarters are provided~~

~~separately. Hut wards for contagious diseases, giving 110 square feet and 1800 cubic feet per man, are also provided when required.~~

~~Although the standard types for barracks and hospitals are essentially adhered to, climatic conditions and local resources govern the materials used to a certain extent. Periodical repairs are more frequent than in the United Kingdom. Walls are usually of burnt brick, built hollow, or of solid sun-dried bricks or stone. Raised plinths are commonly filled in, but are some- times arched. Roofs are either flat, or single- or double-tiled, or occasionally of corrugated or\plain sheet iron at hill stations — thatched roofs nowadays being forbidden, except in the case of unimportant outhouses, on account of the danger from fire. Verandahs, which are a necessary accompaniment of every inhabited building, may be double or single, clerestory windows being usually provided above them. Fireplaces are provided where required, designed without projections, so that they can be filled in and tlie wall space utilized if necessary. Fuel, when required, is issued according to a fixed scale. Cooling devices in the plains~~

~~consist of punkahs pulled in series, or of tatties or fibre hurdles in the doorways kept continually wet, or of therm-antidotes by which air is artifloially forced through wet fibre into the rooms. Where electric or other mechanical power is not available for working these appliances, a special staff is hired for this purpose. Except at very large stations where gas is specially made, the lighting of barracks is almost universally by oil lamps, the standard pattern lamp being considered sufficient to light 200 square feet of floor, and each British soldier in barracks being allowed 46 square feet of such illuminated area. For other military buildings lighted by Government the number of lamps is regulated by a fixed scale. Barracks for native troops are not lighted by Government. (b. h. h.)~~

~~AcTHORiTiES. — The Army Book for the British Empire. London, 1893. — F. Richtee. " Geblinde f iir MUitSr. Zwecke" (in Handbuch der Architektur). Darmst., 1887. — Brockhaus. KonversatiorC s Lexicon, 14th ed. 1895. — Meyer's Konversation's Lexicon, 6th ed. 1898.~~

~~Barrafranca, a town of Sicily, in the Italian province of Caltanissetta, 11 miles S.E. from Caltanissetta. It has sulphur mines, olive-oil mills, and sulphur springs. Population (1881), 9052; (1891), about 10,000.~~

~~Barranquiila, the capital of a province of the same name in the department of Bolivar, Colombia, South America, and the great commercial centre of the republic, situated on a slightly sloping plain on the left bank of the Magdalena river, about 7 miles from its mouth, and about 85 miles N.E. of Cartagena. The river below the town being dangerous for large steamers, it is connected with the ocean by a railway running to Puerto Colombo (Sabanilla), where there is a steel pier 4000 feet in length, permitting the approach of vessels drawing 26 feet of water, and affording accommodation for five large ocean steamers. Situated at the initial point of the navigation of the Magdalena river, on which there is an excellent service of steamboats to Honda 592^ miles distant, Barranquiila now more than, rivals Cartagena as a com- mercial centre. Originally founded in 1629, it is only within recent years that it has risen into importance. It is regularly laid out, and the better-class houses are surrounded by beautiful gardens, while the business por- tion contains many fine warehouses. A few of the houses are constructed of wood, those of the better classes being built of brick with tile roofs, and those of the poorer classes of clay supported by a framework of split guadua cane, the roofs being thatched with rushes. There are three Roman Catholic churches and a Protestant mission, the other principal public buildings being the market, the hospital, and the theatre. The city is supplied with water from the Magdalena river, and possesses a telephone system, and a street railway with cars drawn by mules. There are large tanneries, shoe factories, hat factories, tin shops, soap and candle works, brick and tile works, match works, furniture works and rum distilleries. The population now approaches 50,000. (t. p. h.)~~

~~Barre, a city of Washington county, Vermont, U.S.A., north of the centre of the state, a few miles south of Montpelier, the state capital, on branches of the Central Vermont and of the Montpelier and Wells Eiver Railways. Formerly a village in Barre town, it has been separated from the latter and given a city charter. Population~~

~~(1890), 4146; (1900), 8448.~~

~~Barrett, Lawrence (1831-1891), American actor, was born of Irish parents in Paterson, N.J., 4th April 1838. Beginning as a call-boy, he advanced steadily in his profession, gradually coming into prominence in leading parts. At 'the age of twenty he was acting with Charlotte Cushman and Edwin Booth. He served with distinction in the civil war as captain in a Massachusetts regiment. From 1867 to 1870 he managed the California theatre, San Francisco, together with John M'Cullough.i~~

~~He rendered the drama of his country a special service by successfully producing new plays at a time when the Am erican playwright was almost without recognition. He frequently supported Edwin Booth, who was a close per- sonal friend, playing always with admirable intelligence and distinction. Among his many and varied parts may be mentioned Hamlet, Lear, Macbeth, Shylock, Richard III.,Wolsey, Benedick, Richelieu, David Garrick, Hernani, Alfred Evelyn, Lanciotto ; and his performance of Richelieu was one which attracted considerable attention when he appeared in London. He wrote a life of Edwin For- rest in the American Actors Series (Boston, 1881), and an admirable sketch of Edwin Booth in Edwin Booth and His Contemporaries (Boston, 1886). He died 20th March~~

~~1891. *~~

~~Barrhead, a police burgh of Renfrewshire, Scot- land, 8f miles S.W. of Glasgow by raU. Iron and brass works, calico-printing, cotton-spinning, and the manufac- ture of sanitary appliances are all now important. A drainage scheme has been inaugurated. Population~~

~~(1891), 8215; (1901), 9855.~~

~~Barrie, the capital of Simcoe county, Ontario, Canada, 53 miles N. of Toronto, on Lake Simcoe. It is an important railway centre on the Grand Trunk Railway, and has steamboat communication with various points on Lakes Simcoe and Conchiching. It contains railway shops, agricultural implement works, and saw and grist mills. Population (1881), 4804 ; (1899), 5980.~~

~~Barrow-in-Furness, a civil parish, municipal, county (1888), and parliamentary borough (1885), seaport and market town of Lancashire,~~

~~England, including the isle of Walney ; 87 miles N.N.W. of Manchester by rail. The corporation consists of a mayor, 8 aldermen, and 24 councillors. The cemetery, with three mortuary chapels, covers 55 acres. The educational institutions include a school of science and art, a girls' high school, a higher- grade board school, and a technical school (1901). The principal building is the new town hall, which is fronted by a statue of Lord Frederick Cavendish (assassinated in Dublin, 1882). The main reservoirs of the water supply, 90 acres in area, will hold 578,000,000 gallons. The Bessemer steel works now have only 9 blast furnaces in use, but the works of one firm of shipbuilders cover 82 acres, and the slipways allow of the building of 14 vessels at a time. There have come into importance a petroleum establishment holding over 22,500 tons of oil, and a paper- pulp factory employing about 450 hands. Sailing vessels at port in 1888 were 88 of 10,599 tons ; steam vessels, 51 of 63,487 tons: in 1899— sailing vessels, 227 of 31,255 tons net reg. ; steam vessels, 1162 of 444,957 tons net reg. Vessels entering port in 1888 were 2283 of 460,679 tons; clearances, 2296 of 452,202 tons; in 1899— en- trances, 1389 of 476,212 tons net reg. ; clearances, 1377 of 455,408 tons net reg. The imports of foreign and colonial produce for 1899 amounted to the value of £721,519 against £396)240 in 1888. Population of the civil parish, the municipal and county borough, and the parliamentary borough, which are all three co-extensive, covering an area of 21,009 acres (including 11,000 acres of sand and water) (1881), 47,259; (1891), 61,712; (1901),~~

~~57,589.~~

~~Barry, a town and seaport of England, on the Bristol Channel, opposite Barry Island, 8 miles S.W. of Cardiff, in the southern parliamentary division of Glamorganshire. In 1894 the parishes of Barry, Cadoxton, Merthyr Dovan, and part of St Andrews and of Sully, were constituted the urban sanitary district of Barry and Cadoxton. A village of no significance till 1888, Barry is now, in con- junction with Cadoxtoii, owing mainly to the docks, a~~

~~populous and important town. Besides the churches of St Nicholas (1876) and St Paul (1893) there are numer- ous dissenting places of worship. There are also three board schools, a county school, a seamen's institute, a free library, and a market, and two weekly newspapers.~~

~~Area of urban district, 3323 acres. Population (1891), 13,278 ; (1901), 27,028. Barry docks, the first of which was opened in 1889, lie about 8 miles S.W. of Cardiff, and 4 miles S.W. of Penarth. The following are the dimensions of the docks : —~~

~~Docks, See.~~

~~Area.~~

~~Length.~~

~~Width.~~

~~Quayage.~~

~~Width of~~

~~Entrance~~

~~Gates.~~

~~Depth of Water~~

~~onsm.~~

~~Dock No. 1 .~~

~~Dock No. 2 (in construction) .~~

~~Basin~~

~~Deep Lock Entrance~~

~~Barry Railway Co.'s Commer- cial Graving Dock~~

~~Barry Graving Dock Co.‘s Graving Dock~~

~~Timber-Float (in construction)~~

~~Entrance Channel from the~~

~~Breakwater Heads to Deep~~

~~Lock Gates ....~~

~~Acres.~~

~~73 40~~

~~7~~

~~7~~

~~Feet.~~

~~3100~~

~~3300~~

~~600~~

~~647~~

~~743~~

~~732~~

~~800 1500~~

~~Feet.~~

~~1100 400 500 65~~

~~f at bottom ‘~~

~~1 100′ 0″~~

~~1 at top I 113′ 6″ . f at bottom ‘ J 100′ 0″ 1 at top I 113′ 6″ .~~

~~400~~

~~Feet.~~

~~10,500 7000 2040~~

~~2000~~

~~Feet.~~

~~80 80 80 65~~

~~60 60~~

~~H.W.O.S.T.~~

~~37′ 8″ ‘37′ 8″ 37′ 8″~~

~~26′ 8″ 24′ ‘8″~~

~~H.W.O.N.T.~~

~~29′ 4″ 29′ 4″ 29′ 4″~~

~~18′ 4″ 16′ 4″~~

~~Barry Eailway Company’s graving dock can be divided into outer and inner docks of 384 and 359 feet respect- ively: depthonouter sill H.W.O.S.T., 26′ 8”; H.W.O.N.T., 18′ 4”. Barry Graving Dock Company’s graving dock can be divided into outer and inner docks of 354 feet each : average depth on sill, spring tides, 24′ 8”; neap tides, 16′ 4”. No. 1 Dock and Basin are provided with 11 high- and 10 low-level fixed, 2 high- and 3 low-level movable, coal staiths ; and 31 cranes, including 20 mov- able and 4 fixed hydraulic ballast cranes and one 60-ton crane. The total tonnage increased from 567,968 for half- year ending 1889, to 1,290,665 for half-year eliding~~

~~1895. When the dock was opened in 1889 all the railway service was between Barry and Cogan. Now there is a through- service between Barry, Cardiff, and the Bute docks, between Barry and Perth in the Ehondda valley ; and between Cardiff, Barry, and Bridgend. There are alto- gether about 29^ miles of railways of the Barry Eailway Company connecting the dock with the various collieries and with the Taff Vale Company's lines at Penarth Dock. When completed, the Bute, Penarth, and Barry docks, all comprised within the Port of Cardiff, will have 14 miles of quayage, and about 200 miles of sidings.~~

~~Barry, Sir Redmond (1813-1880), British colonial judge, son of Maj.Gen. H. G. Barry, of BaUyclough, pounty Cork, was born in 1813. He was educated at a military school in Kent, and at Trinity College, Dublin, where he graduated B.A. in 1833, and was called to the Irish bar in 1838. He emigrated to Australia, and after a short stay at Sydney went to Melbourne, with which city he was ever afterwards closely identified. After prac tising his profession for some years, he became commis- sioner of the court of requests, and after the creation in 1851 of the colony of Victoria, out of the Port Phillip district of New South Wales, was the first solicitor-general with a seat in the legislative and executive councils. Subsequently he held the offices of judge of the supreme court, acting chief-justice, and administrator of the Gov- ernment. He represented Victoria at the London Inter- national Exhibition of 1862, and at the Philadelphia Exhibition of 1876. He was knighted in 1860 and was created K.C.M.G. in 1877. Sir Eedmond Barry was the first person in Victoria to take an interest in higher edu- cation, and induced the local government to ejxpend large sums of money upon that objiect. He was the founder of the University of Melbourne, of which he was the first~~

~~chancellor, was president of the Melbourne public library, national gallery and museum, and was one of the first to foster the volunteer movement in Australia. To his exer- tions is due the prosperity of the two institutions with which his memory is identified. The university was founded in 1864, and was thrown open to women in 1880. It has three affiliated colleges, Trinity (Anglican), Ormond (Presbyterian), Queen's (Wesleyan), and a conservatorium of music. The total number of graduates is 2066, about half being in arts, and the remainder in medicine, law, and science. The total~~

~~number of persons attending lectures in 1898 was 668, and 147 took degrees. The teaching staff numbers 35, and about 1100 persons present themselves for matricidation every year, of whom about 500 pass, but a large proportion do not pursue their studies any farther. The total income of the university in 1898 was £30,110, of which £9000 was contributed by the Government. The Melbourne public library was opened 3rd July 1853, is free to every one, contains 480,000 volumes including^ pamphlets and periodicals, ranks as the tenth library in the British dominions, and is visited by about half a million of people every year. The national gallery of Victoria contained, in 1898, 434 oil paintings, 3461 statues and works of art. The total sum expended by the trustees has been £600,000. (g. c. l.)~~

~~Barsi, a town of British India, iu the Sholapur dis- trict of Bombay, lying within a tract entirely surrounded by the Nizam's dominions. It is situated in 18° 13′ N. lat. and 76° 44′ E. long. Population about 20,000. Barsi is a fiourishing centre of trade, exporting to Bombay large quantities of cotton and oilseeds. It has eight factories for ginning and pressing cotton — some on a large scale. It is connected with the main line of the Great Indian Peninsula Eailway by a light railway of 22 miles, the property of a company, which will be extended 32 miles in another direction to Pandharpur.~~

~~Barth, a seaport town of Prussia, province Pomerania, on a coast lagoon, 19 miles by rail W. by N. from Stral- sund. It has a mercantile fleet and a school of navigation, and carries on shipbuilding, sugar manufacture, the export of herrings, &o. Population (1895), 6223.~~

~~Barthelemy Saint-Hilaire, Jules (1805-1895), French scholar and statesman, was born at Paris 19tn August 1805. In his early days he was connected with the National newspaper, and in its office he formed~~

~~the intimate friendship with Thiers and Mignet which continued all his life. In 1833 he quitted politics for a time to devote himself to literature, and especially the study of ancient philosophy. Victor Cousin had won fame as~~

~~the translator of Plato, Barthelemy Saint- Hilaire in like manner attached himself to Aristotle, and undertook a translation of his works. The first of thirty- five volumes appeared in 1837 and the last in 1892. This great work gained him the patronage of Cousin, a seat in the Academy, and the professorship of ancient philosophy at the College of France. During its progress he published a treatise on The Logic of Aristotle, 1839, a,nd another on The School of Alexandria, 1845. The revolu- tion of 1848 brought him back for a while to public life ; he entered the Assembly, and was president of the commis- sion on public instruction, but upon Louis Napoleon's coup d'itat he again gave up concern in public affairs. Absorb- ing himself in Sanskrit studies he produced important works on the Vedas, 1854, and on Buddhism, 1868. In 1855 he travelled in Egypt, and in the following year published a book on the country, warmly vindicating his friend Lesseps's project, at that time much contested, for the construction of the Suez Canal. After the disasters of 1870 M. Barthelemy Saint-Hilaire reappeared in politics, exerted his utmost efforts to secure , the election of Thiers as provisional President of the Eepublic, and upon this taking place became his secretary, and con- tinued his most intimate confidant and counsellor until the statesman's death. In 1875 he was made perpetual senator, and he was Minister of Foreign Affairs in Jules Ferry's cabinet, from September 1880 to November 1881. The most important event of his administration was the annexation of Tunis under the form of a French pro- tectorate, which he actively promoted. His latter years were chiefly employed in writing the life and publishing the correspondence of his former patron, Victor Cousin, who had beqneathed him a handsome fortune ; he also commenced a new edition of Cousin's translation of Plato, which he did not live to complete. H^e died, labouring to the last, on 24th November 1895. Among his other works may be named Mahomet et le Coran, 1865, a translation of Marcus Aurelius, and a metrical version of the Iliad. (b. g.)~~

~~Bartlett, John (1820), American publisher~~

~~and compiler, was born in Plymouth, Massachusetts, on the 14th of June 1820. He became the university book- seller (aud also a publisher) in Cambridge, Massachusetts, and from 1865 to 1889, when he retired, was a member of the bookselling and publishing firm of Little, Brown, and Co., in~~

~~Boston. In 1855 he published the first edition of his dictionary of Familiar Quotations, long the best-known collection of the sort, and in 1894 (although it had been copyrighted five years before), after many years' labour, he published his New and Complete Con- cordance or Verbal Index to Words, Phrases, and Passages in the Dramatic Works of Shakespeare ; with a Supple- mentary Concordance to^ the Poems — surpassing any of its predecessors in the number and fulness of its citations from the poet's writings.~~

~~Bartlett, John Russell (1805-1886), American historical and linguistic student, was born in Provi- dence, Ehode Island, 23rd October 1805, and died there 28th May 1886. Several of his minor writings were devoted to matters connected with the earlier or later history of Rhode Island, of which he was secretary of state between 1855 and 1872; but his place in Ameri- can scholarship is chiefly due to his Dictionary of Americanisms, of which the first edition appeared in 1850 ; a pioneer work which, although later dialect-changes have of course deprived it of completeness or final author-~~

~~itativeness, was long of value to students of language, and remains the chief contribution to the subject.~~

~~Barwani, a native state of India, in the Bhopawar agency. It lies in the Satpura Mountains, south of the Narbada. Area, 1362 square miles; population, about 80,000; average density, 59 persons per square mile. Many of the inhabitants are Bhils. Revenue (1897-98), Rs.3,14,246 ; subsidy to Bhil corps, Rs.4000. The chief, whose title is Rana, is a Rajput of the Sesodia clan, connected with the Udaipur family. The forests are under an English official. The town of Bhawani is situated near the left bank of the Narbada. Population, about 5500.~~

~~Barye, Antoine Louis (1795-1859), one of the greatest sculptors of the French school, was born in Paris in 1795. Like many of the sculptors of the Renaissance he began life as a goldsmith. After studying under Bosio, the sculptor, and Gros, the painter, he was admitted to the jScole des Beaux Arts. But it was not till 1823, when he was working for Fauconnier, the goldsmith, that he discovered his real bent from watching the wild beasts in the Jardin des Plantes, making vigorous studies of them in pencil drawings worthy of Delacroix, and then modelling them in sculp- ture on a large or~~

~~small scale. In 1830 he exhibited a " Tiger," and in 1832 had mastered a style of his own in the "Lion and Snake" (see Plate). Thence- forward Barye, though engaged in a perpetual struggle with want, exhibited year after year these studies of animals — admirable groups which reveal him as inspired by a spirit of true romance and a feeling for the beauty of the antique, as in" Theseus and the Minotaur," "Lapithia and Centaur," and numerous minor works now very highly valued. Barye was no less successful in sculpture on a small scale, and excelled in representing animals in their most familiar attitudes. As examples of his larger work we may mention the Lion of the Column of July, various Lions and Tigers of the Gardens of the Tuileries, and the four groups — War, Peace, Strength, and Order. The fame he deserved came too late to the sculptor. He was made professor at the museum in 1854, and was elected to the Academy of Fine Arts in 1868, only five years before his death. The mass of admirable work left to us by Barye entitles him to be regarded as the great- est artist of animal life of the French school, and as the creator of a new class of art which has attracted such men as Fremiet, Peter, Cain, and Gardet, who are re- garded with justice as his worthiest followers.~~

~~See Emile Lam:6. Les Sculpteurs d'Animaux : M. Barye, Paris, 1856. — Gustave Planche. " M. Barye," Bevue des Deux Mondes, July 1851. — Theophilb Silvestre. Histoires des Artistes Vivants, Paris, 1856. — ArsJine Alexandbe. Les Artistes Oelebres : A. L. Barye, Paris, 1889. (h. fr.)~~

~~Base- ball. — Base-ball, especially in the United States, has two distinct phases — one professional, and the other amateur. The sport itself has been traced back through various forms of trap ball, "one old cat," and rounders, to a comparatively early period. While Eng- land was developing cricket, America developed base- ball. The principal feature in the American pastime, as distinguished from cricket, is the limited time in which a game can be finished. One other vital point in which the two sports differ is that in base-ball if the ball is knocked in a certain direction it is called a foul, and the player who knocked it has not the privilege of making a run, but he may be caught out. This rule seems to a cricket lover a blunder in legislation, because if a player is not privileged to take advantage of the hit by maiing a run he ought not to be put to the risk of being caught out.~~

Professional base-ball in the United States began soon after 1850 ; but the sport itself was not regarded then as a pro-

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fession. A man who played for a financial consideration always had some other means of a livelihood, as the in- come to be derived from playing ball in the summer time was not nearly enough to support him through- out the year. While the game grew for a time in popularity, it soon acquired certain adjuncts which were by no means desirable. The betting evil be- came prominent, as did also pool selling, and before long the game had little standing in respectable com- munitities. It was not only generally supposed that the matches were not played on their merits, but it was known that players themselves were not above selling contests. At that time many of the journals of the day foretold the speedy downfall of the sport. A convention of those interested in the game, both financially and otherwise, was accordingly held in 1867 in Philadelphia, and an effort was made to

Catehei^s

Batter^ Position l€ft Hand

effect a reformation. That the sport even then was by no means insignificant can be seen from the fact that in that conven- tion some 600 organ- izations were repre- sented. While the work done at the convention did not accomplish all that . was expected, it did produce certain re- forms, and the sport grew rapidly there- after both in the eastern and in the middle western paTt of the United States. In the’ next five years the interest in the game became so great that it was decided to send a representa- tion of American base-ball players to England ; and two ■clubs, the Bostons, who were the cham- pions that year, and the Athletics, former ■champions, went ■over and played several exhibition games with each other. While successful in

exciting some interest, the trip did not succeed in populariz- ing base-ball in Great Britain. Fifteen years later two ■other Nines, representing American base-ball players, made a general tour of Australia and various other •countries, completing their trip by a contest in Eng- land. This too, however, had little effect, and later attempts to establish base-ball in England have like- wise been unsuccessful. But in America the game continued to prosper. In 1876 was formed the Ka- tional League of eight clubs, which contained the «xpert ball-players of the country. There were so many people in the United States who wanted to see professional base-ball that this organization proved too small to furnish the desired number of games, and hence in 1881 the American Association was formed. For a time it seemed? that there would be room for both organizations ;. but there was considerable rivalry, and it was not until an agreement was made between the two

organizations that they were able to work together in harmony. They practically controlled professional base- ball for many years, although there were occasional attempts to overthrow their authority, the most notable being the formation of a Brotherhood of players, organ- ized for the purpose of securing some of the financial benefits accruing to the managers, as well as for the purpose of abolishing black-listing and other supposed abuses. The Brotherhood proved not sufilciently strong for the task, and fell to pieces. For the last few years professional base-ball has been somewhat under a cloud, owing to questionable practices and rowdyism on the field, as well as quarrels among the managers. Whether it will ever again be as popular as it once was is a question which time alone can determine. Careful legislation only can effect the dtsired end.

Amateur base-ball

Θ

Home Base

Batters Position Right Hand

•^v First

~~1 1~~

~~Third j^\ Base \ /.~~

~~/\?Base~~

~~Position oF First Baseman~~

~~>. Second / \Base/~~

~~/~~

~~/ o~~

~~^ f^aition of~~

~~Third Safe man~~

~~Posit/en of y^~~

~~θ~~

~~Position of Short Sta/t~~

~~Q~~

~~Position of Bight Fimlder~~

~~O~~

~~Position of Centre Fielder~~

~~Diagram op Babe-ball Field.~~

~~in America dates back to the time of the formation of the pro- fessional clubs, and the two have pro- gressed along similar lines so far as rules and style of play are concerned. Fre-~~

~~quently, however, the amateur rules, and especially the college rules, have differed from those of the professional in minor points. The history of col- lege base-ball has been marked by the formation and dis- solution of leagues and by individual championships be- tween universities or colleges, and by some quarrels and disagree- ments, but never by anything like the lui- pleasant practices which have at times crept into the pro- fessional games. For this reason the sport has maintained its hold more strongly during the last few years, and while the attendance at games by no means equals that at the younger sport of football, it has fully as constant a following and appar- ently an equally long lease of life.~~

~~Any comparatively level field over 100 yards square will serve for a base- ball ground. Upon this field is marked out a square, commonly called the "diamond," whose sides measure 30 yards each, and whose nearest corner is distant about 90 feet from one end of the field (see diagram). This corner is marked by a white plate a foot square, sunk level with the ground, and called the home base. At the other three corners are canvas bags 15 inches square, and called, beginning at the right as one looks into the field from the home plate, the first, second, and third bases respec- tively. The lines from home base to first, and from home base to third, indefinitely prolonged, are called the foul lines. The game is played by two sides of nine men each, one of these taking its turn at the bat while the other side is in the field endeavouring, as provided by certain rules, to~~

~~retire or put out the side at bat. Each side has nine turns at the bat. The arrangement of the men in the field, with the exception of pitcher and catcher, is in the form of two arcs, facing the home plate, whose radii are, roughly speak- ing, 30 and 60 yards. The arc with the lesser radius consists~~

~~of four men called the in-fielders, and named the first, second, and third basemen and the short-stop. The last-named player stands midway between the second and third basemen. The other arc is composed of the out-fielders, and they are named, right, centre, and left fielders. Inside the diamond, and distant in a straight line in front of the home plate some 55 feet, is the pitcher's position, upon which he is obliged to stand when deliver- ing the ball to the batsman. The catcher's position is not thus defined, but according as necessity requires he stands either close behind the batsman, or; when no runner is on the bases, and the batsman has not reached his last strike, some 70 feet behind the plate. When standing thus he simply performs the duty of returning the ball to the pitcher, as it is then unnecessary for him to catch it. The players of the side at the bat take their turn in regular rotation, and continue until three of them have been put out by the opponents. This retires that side to the field, and the other comes in to the bat. The batsman has a certain space marked off in which he must stand when striking at the ball. The batsman becomes a base- runner immediately he has made a " fair hit " (that is, knocked the ball so that it will fall' in front of the foul lines), or when he has had "three strikes" (that is, three fair opportunities of hitting the ball), or, finally, when the pitcher has delivered " four balls," none of which have passed over the plate at the proper height, or have been struck at by the batsman. In this latter case he is entitled to occupy first base without being put out. In the other cases, i.e., when he has made a fair hit or has had three strikes, he must start to make the round of the bases, which are to be taken in regular order (first, second, third, and home), and the first of which at least he must reach before he is temporarily safe from being put out/ When he completes this circuit and crosses the plate without being put out, he scores a run ; and the number of runs thus scored in nine innings decides the match. A batsman is put out if he hits the ball and the ball is caught by an opponent before touching, the ground, or if he make three foul bunts (that is, attempts to block the ball with the bat). (By recent legislation a foul counts as a strike until a batsman has had two strikes.) A base-runner may be put out in any of the following ways — if, having made a fair hit, the ball Jae caught by an opponent before touching the ground, or, having touched the ground, be held by a fielder any part of whose person is touching the first base, before the runner reaches the base ; if, after three strikes, the ball be caught before it touches the ground, or, having touched the ground, be held at first base as above~~

~~described ; and, finally, if he be touched by the ball in the hands of a fielder at any time during his circuit of the bases when he is not touching the base which he is legally entitled to occupy. To pro- vide for the satisfactory conduct of the game an umpire is agreed upon by the contesting Nines, and it is his duty to see that all the provisions of the rules are observed. He is also the judge of good and bad balls, put-outs, and runs. Any other point liable to become a point of dispute comes under his jurisdiction. Sometimes two umpires act at the same time, one at the plate and the other at the bases. (w. ca.)~~

~~Basel, or Bale (Basle is a wholly erroneous form), one of the Swiss cantons, which since 1833 has been divided into two half cantons — Basel-Stadt (urban Basel)~~

~~— which besides the town includes three country districts — and Basel Landschaft (rural Basel). The total area of Basel Stadt is 13-8 square miles, of which 11-7 square miles are reckoned as " productive." Of this 1^ square miles are covered by woods, and 049 square miles by vineyards. The statistics of this half canton are as iollows: — Population. — (1880) 64,207, (1900) 112,246. In 1900 there were 8133 inhabitants to each square mile, the highest rate of density in Switzerland. Seli- c^iOMS. — -Protestants, (1880) 44,236, (1888) 50,081, (1900) 73,126 ; Eomanists, (1880) 19,288, (1888) 22,132, (1900) 36,987; Jews, (1880) 830, (1888) 1086, (1900) 1903. img'wisfic — German-speaking, (1880) 62,644, (1888) 71,113, (1900) 107,205; Trench-speaking, (1880) 1901, (1888) 2040, (1900) 2741 ; Italiau-speaking,. (1880) 338, (1888) 346, (1900) 2361. The capital of this half canton is Basel. The cantonal constitution dates from 1889. The executive of seven m^embers and the legislature of 130 members are elected by a popular vote, each for three years. Since 18,75 the " obligatory referendum " obtains for all laws, while 1000 citizens can exercise the right of " initiative " in legislative matters, or demand the revision of the cantonal constitution. In 1897 the state revenue was 9,359,412 frcs. (a rise of lOi per cent, since 1885), and the state expenditure 9,352,414 frcs. (a rise of 99 per cent, since 1885), while in 1898 the surplus was 461,519 frcs. ; but in 1900 there was a deficit of 1,190,631 frcs. In 1897 the public debt was 30,050,800 frcs.~~

~~The total area of Basel Landschaft is 163-8 square miles, of which 158-8 square miles are classed as “productive.” Of this 55-9 square miles are covered by forests and 1-7 square miles by vineyards. The statistics of this half canton are as follows : — Population. — (1880) 59,171, (1900) 68,451. In 1900 there were 411 inhabitants to each square mUe. Religious. — Protestants, (1880) ^ 46,670, (1888) 48,698, (1900) 52,617 ; Eomanists, (1880) 12,109, (1888) 12,921, (1900) 15,775 ; Jews, (1880) 223, (1888) 165, (1900) 135. Linguistic. — German-speaking, (1880) 58,961, (1888) 61,507, (1900) 66,581; French- speaking, (1880) 217, (1888) 303, (1900) 598; Italian- speaking, (1880) 72, (1888) 115, (1900) 1470. (Earlier figures are untrustworthy.) The capital of Basel Land- schaft is Liestal. The cantonal constitution dates from 1892. The executive of five members and the legislature (one member per 800 inhabitants or fraction over 400) ai-e elected by a popular vote. The ” obligatory referen- dum ” obtains in the case of all laws, while 1500 citizens have the right of ” initiative ” whether in legislative matters or in demanding the revision of the cantonal constitution. In 1897 the state revenue was 1,496,726 frcs. (a rise of 133 per cent, since 1885) and the state expenditure 1,480,684 frcs. (a rise of 126i|- per cent, since 1885), while the surplus in 1898 was 49,382 frcs. ; the public debt in 1897 was 56,000 frcs. (w. a. b. c.)~~

~~Basel , or Bale, the capital of the Swiss half canton, of Basel Stadt or urban Basel. It is now the largest city in the Swiss confederation except Zurich. It is also the richest city in Switzerland, having vastly increased in wealth and importance since the- opening of the St Gotthard railway in 1882. Its statistics are as follows : — Populatim.— {1880) 60,550, (1900) 107,287. Religious. —Protestants, (1880) 41,308, (1888) 47,007, (1900) 70,520 ; Eomanists, (1880) 18,556, (1888) 21,312, (1900) 36,524; Jews, (1880) 801, (1888) 1047, (1900) 1898. ijTisfMistiC.— German-speaking, (1880) 69,002, (1888) 67,266, (1900) 104,155; French-speaking, (1880) 1867, (1888) 1997, (1900) 2720; Italian-speaking, (1880) 324, (1888) 305, (1900) 2348. The university library now contains 220,000 volumes and 4000 MSS., while in the~~

~~‘The JlEETixii.” By M.vkie Basiikiktseff.~~

~~B A S H A H K — B A S I M~~

~~winter of 1898-99 the matriculated students of the university numbered 332, and in that of 1899-1900, W6 (including "hearers"). A number of new buildings {e.g., the Bernouillianum and the Vasalianum) for the purposes of natural science have of late years been erected m Basel. In modern days it has become known as a centre of missionary enterprise.~~

~~laTK-RATVRti.—Basler Chroniken (original chronicles), 5 vols. if7?f ^' 1872-90.— Boos. Oeschichte d. Stadt Basel. Basel (from i»/0.— (xEERiNG. Handel u. Industrie d. Stadt Basel, 1885.— Mechtsquellen von Basel Stadt u. Land, 2 vols. Basel and Biel, 1866-65.— Sturbt. Die Weidewirthschaft im Kant. Baselland. hoieure, lS9i.— Urkundenbuch d. Landschaft Basel (from 1881) and ditto for the city of Basel (from 1890). (w. A. B. c.)~~

~~Bashahr, or Bisahik, a native state of India, within the Punjab, amid the Himalayan mountains, with an area of 3300 square miles, and a population of about 75,000. The estimated gross revenue is Rs.70,000 ; the tribute is Es.39,450. The administration is temporarily in charge of a British official. ,~~

~~Bashan, a country on the E. side of the Jordan valley, often mentioned in the Bible. It included the Eoman districts Itureea, Gaulanitis, Trachonitis, Auranitis, ajid Batansea, the present Jeidtir, JauMn, Lej^, Haur^n, and Ard el-Batanieh. The region is now remarkable for, the fertility of its friable volcanic soil, and for the character of its archaeological remains. It is for the most part a plateau, 1500-2000 feet above the sea, with small isolated volcanic hills rising above its surface, and near its eastern extremity the Jebel Haur^n, or Jabel ed-Druz mountains. The climate is healthy and the summer heat is mitigated by the prevailing westerly winds. The soil is peculiarly suitable for the growth of wheat and barley, especially the highly-prized hard wheat. The area under cultivation has increased greatly since the railway was opened in 1894, from Damascus to Mezeirib ; but much of the produce is still sent by camel to Acre and Haifa. Fruit trees and eucalyptus have been introduced on the Haurdn property of Baron Edmond de Eothschild, and thrive well. At Adra^h (Edrei) there are subterranean dwellings which are evidently of very early date. Great interest attaches to the stone houses, built without using wood, and to the numerous temples,~~

~~mausolea, reservoirs, and conduits, all constructed with basalt. Most of the buildings are the yroA of the Ghassanide Arabs, who came under Greco-Koman influence, and at an early period embraced Christianity. The decorative details of the temples show strong local influence, and they and the dwelling-houses have many points in common with the temples and houses, built about the same time, in the treeless districts of Moab and Edom, where, however, the material is usually limestone or sandstone. The usual identification of the Leja with the Argob of the Bible is now rejected by some scholars.~~

~~Schumacher, Across th^ Jordan, 1886 ; 2^e Jauldn, 1888 ; Northern 'Ajl4n, 1890. (c. w. W.)~~

~~BashkirtsefTjIVIariaConstantinova (Marie),~~

~~(1850-1884), Russian artist and writer, was born at Gavrontsi in the government of Pultowa in Russia, on the 23rd November 1860. When Marie was seven years old, as her father (marshal of the nobility at Pultowa) and her mother were unable through incompatibility to live together, Madame Bashkirtseff , with her little daughter, left Russia, to spend the winters at Nice or in Italy, and the summers at German watering-places. Marie acquired an education superior to, that given to most girls of her rank. She could read Plato and Virgil in the original, and write four languages with almost equal facility. A gifted musician, she at first hoped to be a singer, and studied seriously in Italy to that end ; her voice,~~

~~however, was not strong enough to stand hard work and failed her. Meanwhile she was also learning to draw. When she lost her voice she devoted herself to painting, and in 1877 settled in Paris, where she worked steadily in Tony Eobert-Fleury's studio. In 1880 she exhibited in the salon a portrait of a woman ; in 1881 she exhibited the "Atelier Julian"; in 1882 " Jean' et Jacques " ; in 1884 the " Meeting " (see Plate), and a portrait in pastel of a lady — her cousin — now in the Luxembourg gallery, for which she was awarded a mention honorable. Her health, always delicate, could not endure the labour she imposed on herself in addition to the life of fashion in which she became involved as a result of her success as an artist, and she died of consumption on the 31st of October 1884, leaving a small series of works of remarkable promise. Prom her childhood Mary~~

~~Bashkirtseff kept an autobio- graphical journal ; but the editors of these brilliant con- fessions (Journal de Marie Bashkirtseff, 1890), aiming apparently at captivating the reader's interest by the girl's precocious gifts and by the names of the various distin- guished persons with whom she came in contact, so treated certain portions as to draw down vehement protest. This, to some extent, has brought into question the stamp of truthfulness which constitutes the chief merit of this extra^ ordinarily interesting book. More recently a further instal- ment of Marie Bashkirtseff literature has been published in the shape of letters between her and Guy de Mau- passant, with whom she started a correspondence under a feigned name and without revealing her identity.~~

~~See Mathilde Blind, A Study of Marie Bashkirtseff. T. Fisher Unwin, 1892. — The Journal of Marie Bashkirtseff: an Exposure and a Defence. By " S." (Showing that there is through- out a mistake of four years in the date of the Diary.) Black and White, 6th Feb. and 11th April 1891, pp. 17, SOi.—The Journal of Marie Bashkirtseff. Translated, — with an Introduction. By Mathilde Blind (2 vols.), London, 1890. — The Letters of Marie Bashkirtseff, 1 vol. (b. k.)~~

~~Basilicata, a territorial division of S. Italy, lying be- tween Apulia, Calabria, Campania, and the sea, contains the one province of Potenza, with an area of 3846 sq. miles, and a population of (1900) 490,000. Marble, lignite, and chalk are the most important minerals worked. Mineral springs, especially sulphur springs, are abundant. Industrial activity is but little developed. Its towns are mostly small, the more important being Potenza, Avigliano, Eionero, Melfi, Matera, and Lauria.~~

~~Basim, a town and district of India, in Berar or the Haidarabad assigned districts, under British administra- tion. The town is 62 miles south from Akola railway station. Population, about 12,000 ; municipal income in 1897-98, Rs.14,868.~~

~~The district of Basim has an area of 2966 square miles. The population in 1881 was 398,179, being 135 persons per square mile. Classified according to religion, Hindus numbered 371,537; Mahommedans, 23,020; Christians, 88, of whom 17 were Europeans ; " othersj^' 3534, chiefly Jains. In 1891 the population -tvas 353,522, showing a decrease of 11 per cent., compared~~

with an increase of the same amount in the preceding decade. The land revenue and rates in 1897-98 were Rs.6,76,026, the incidence of assessment being nearly 9 annas per acre ; the number of police was 426. The principal crops are millet, wheat, other food grains, pulse, oilseeds, and cotton. There is some manufacture of cotton-cloth and blankets. There is no railway, but the district is traversed from north to south by an old military road. In 1896-97 the number of schools was 118, attended by 4127 pupils, the propor- tion of boys at school being 13 per cent, of the male population of school-going age. The death-rate in 1897 was 42-7 per 1000.

Basingstoke, a municipal borough (extended 1891) and market town, in the Basingstoke parlia- mentary division of Hampshire, England, 19 miles N.E. by N. of Winchester by rail. A cottage hos- pital and a " home " for women have been built. Area, 4194 acres; population on this area (1891), 8213;

(1901), 9793.

Basque Provinces, an old division of Spain, now subdivided intothe provinces of Viscaya or Biscay, Alava, and Guipuzcoa, for particulars of each of which see under the separate headings. The total area is 2958 square miles ; population about 570,000. The second Carlist insurrection (1870 to 1876) led to some curtailment of the almost com- plete local self-government previously enjoyed by these provinces, and especially to their forfeiting exemption from conscription. When the three provinces sent|in their first contingent of 2046 conscripts in 1877 it was found that all but about 60 knew how to read and write, and succeeding contingents have kept up to this average of primary educar tion. After the close of the civil war in 1876, the repre- sentatives of the three provincial councils, assisted by-the senators and deputies of the Basque provinces in the Cortes, negotiated several successive pacts, each lasting some years, and the last still in force, securing for the three provinces their municipal and provincial self-government, the ad- ministration of their local affairs, and the assessment, distribution, and collection of their principal taxes and octroi duties, on the understanding that a lump sum, agreed upon beforehand, but subject to

~~increase whenever the national taxation of other provinces was augmented, should be paid annually. These pacts have been scrupu- lously observed, and as the local authorities levy the contribution after their own ancient customs, landed property and the industrial and commercial classes are less heavily taxed in these territories than in the rest of Spain. Enough is raised, however, besides the amount handed over to the Government, to enable the schools, roads, har- bours, and public works of every kind to be maintained at a standard which compares very favourably with that maintained elsewhere in Spain. The present provincial deputations of the three provinces have less power than the ancient " foral diputaciones " ; they are now elected like the rest of the Spanish provincial councils, and are subject to the ordinary interference of the civil governors in their deliberations. (a. e. h.)~~

~~Basra, or Bussoeah. (1) A viMyet of Asiatic Turkey formed in 1884 by detaching the southern districts of the Baghdad vilayet. It includes the great marshy districts of the Lpwer Euphrates and Tigris, and of their joint stream the Shatt el-Arab, and a sanjak, Nejd, on the western shore of the Persian Gulf. The climate is humid and unhealthy. There are large numbers of sheep, camels, and cattle. The exports are dates, wool, cereals, and indigo. Population, 950,000 (Moslems, 940,000, of whom 664,000 are Shias ; Christians, 6000 ; Jews, 4000).~~

~~(2) The capital of the vilayet, situated two miles from the right bank of the Shatt el-Arab, was founded by Midhat Pasha. It is reached from the river by a narrow ■winding creek, but the British Consulate and the merchants' houses are at Margil on the bank of the river. The water supply is bad, the climate trying and at times unhealthy, and there is much malarial fever. The country on both banks is liable to floods, which some- times, as in 1896, when 2,000,000 date trees were destroyed, do much damage. The ruins of the Basra of the Khalifs and of the Arabian Nights are to the south- west of the present town. Basra is the port of tranship- ment from river boats to ocean steamers which run to Engla!nd and India, and is the seat of a British Consul. The principal exports are wool, dates, cereals, gum.~~

~~liquorice root, &c. Most of the exports and imports are from and to Baghdad. The average exports of the five years 1894-98 were valued at~~

~~£996,224, and the imports at £1,103,356.~~

~~Bassam, Grand. See Ivoky Coast.~~

~~Bassano, a town of the province of Vicenza, Venetia, Italy, picturesquely gituated at the foot of the Venetian Alps and on the torrential Brenta, 24 mile? N.E. from Vicenza by rail. Its most important building is the museum, which contains a picture gallery and a library. Bassano also possesses a bronze statue of Garibaldi, a monument to Victor Emmanuel, and a school of industrial design. Population, about 8000; of commune, about~~

~~15,000.~~

~~Bassein, a district in the Irrawaddy division of Lower Burma, in the delta of the Irrawaddy. It has been reduced to 4090 square miles, from 8954 square miles in 1871, having given up a large tract to the district of Myaungmya formed in 1896. In 1871-72 the population of the larger area amounted to 316,883 in 1554 villages. In 1891 the smaller district had 1439 villages, with a total population of 311,262, paying in 1898-99, Rs.14,98,772 revenue. Of the population 284,349 were Buddhists and Jains, 6315 Hindus, 4741 Mahom- medans, and 16,867 Christians, of whom 15,610 were natives, chiefly Karens. Of a total area of 2,617,600 acres, 472,357 were cultivated in 1898-99, and 1,125,935 acres were not available for cultivation, the cultivable area apart from fallow being 927,833 acres. The rain- fall in 1898-99 was 124-56 inches. Apart from Bassein the chief town is Ngathainggyaung, which had a popidar tion in 1891 of 5608. It is a municipal town. Bassein, the chief town and port, which had 19,577 inhabitants in 1871, had 30,177 in 1891. It has a municipal committee of 16 members, of whom 12 are elective, and there is a central jail capable of holding 1242 prisoners. There is a large rice export from Bassein, with several steam rice mills. In 1898-99 forty sea-going vessels with a burden of 78,123 tons entered Bassein port, and 42 with a tonnage of 78,058 cleared. The vessels of the Irrawaddy Flotilla Company ply between Eangoon and Bassein by inland waters.~~

~~Bastar, a feudatory state of British India, in the Chhattisgarh division of the Central Provinces, with an area of 13,062 square miles. In 1881 the population was 196,284, and in 1891 it was 310,884, being 24 persons per~~

~~square mile. In 1901 the population was 306,544, showing a decrease of 1 per cent., compared with an apparent increase of 58 per cent, in the preceding decade. The estimated revenue was E.s.2,60,162 ; the tribute Es.17,200. The chief town and residence of the Eaja is Jagdalpur, on the river Indravati. The principal products are rice, oilseeds, lac, tusser silk, horns, hides, wax, and a little iron. Teak timber is floated down the rivers to the Madras coast. The state is (1901) under British administration, while the young Eaja is being educated at the Eajkumar college at Eaipur. A good road will shortly bring Jagdalpur into connexion with the railway at Eaipur.~~

~~Basti, a town and district of British India, in the Gorakhpur division of the North- West Provinces. The town, a collection of villages, is on the river Kuana, 40 miles from Gorakhpur by railway. The population in 1891 was 13,630. It has no municipality. The district has an area of 2767 square miles ; the population in 1891 was 1,785,944, being 645 persons per square mile. Classi- fied according to religion, Hindus numbered 1,510,149; Mahommeda:ns, 275,729; Christians, 66, including 23 Europeans. In 1901 the population was 1,846,768,~~

~~showing an increase of 3 per cent. The land revenue and rates were Ks.24,26,828, the incidence of assessment being K.l : 8 : 10 per acre ; the number of police was 2476. There are no canals, but the country is watered by rivers from the hills. In 1896-97, out of a total cultivated area of 1,169,887 acres, 494,814 were irrigated from wells, tanks, &c. A railway from Gorakhpur to Gonda runs through the district; and the river Gogra is navigable. A large trade is conducted with Nepal.~~

~~Bastia, chief town of arrondissement in the island of Corsica, 94 miles N.E. of Ajaccio, by rail. The new port has 1100 feet of quayage, served by a railway, and with a depth alongside of 25 feet. The total number of vessels entered and cleared in 1899 was 620, with a ton- nage of 279,823. Population (1896), 28,357.~~

~~Bastian, Adolf (1826), German ethnologist,~~

was born at Bremen 26th June 1826. From his early years he devoted himself to travel. Proceeding to Aus- tralia in 1861 as surgeon on a vessel, he had visited almost every part of the world before his return in 1859. In 1861 he departed on an expedition to the Far East, which lasted five years. Upon his return he commenced the publica- tion of his great work on The Peoples of Eastern Asia, an immense store-house of facts owing little to arrange-

A Sketcu-modei. foe Joan of Ako. (From the Statuette by Baetien-Lepage.)

ment or style. He settled in Berlin, where he was made keeper of the Ethnographical Museum; but at various

times undertook further scientific travels in Africa, South America, and India. The results of these explorations were made public in a long series of separate publications, comprising several on Buddhism, and on the psychologi- cal problems presented by native superstitions. Bastian also edited the Zeitschrift filr Ethnologie from 1869, in con- junction with Virchow and Robert von Hartmann. On his seventieth birthday, 1896, he was presented with a volume of essays composed by the most distinguished ethnologists in celebration of the event, and dedicated to him.

Bastien- Lepage, Jules (1848-1884), French painter, was horn in the village of Damvillers, Meuse, France, on the 1st of November 1848, and spent his childhood there. He first studied at Verdun, and prompted by a love of art went in 1867 to Paris, where he was admitted to the !cole des Beaux Arts, working under Cabanel. After exhibiting in the Salons of 1870 and 1872 works which attracted no attention, in 1874 he made his mark with his " Song of Spring," a study of rural life, representing a peasant girl sitting on a knoll looking down on a village. His " Portrait of my Grand- father," exhibited in the same year, was not less remark- able for its artless simplicity, and received a third-class medal. This success was confirmed in 1875 by the "First Communion," a picture of a little girl minutely worked up as to colour, and a "Portrait of M. Hayem." In 1875 he took the second Prix de Rome with his "Angels appearing to the Shepherds," exhibited again in 1878. His next endeavour to win the Grand Prix de Rome in 1876 with "Priam at the Feet of Achilles" was again unsuc cessful (it is in the Lille gallery), and the painter determined to return to country life. To the Salon of 1877 he sent a full-length "Portrait of Lady L." and "My Parents"; and in 1878 a "Portrait of M. Theuriet" and "The Hayfield." The last picture, now in the Luxembourg gallery, is regarded as a typical work from its

stamp of realistic truth. Thenceforth Bastien-Lepage was re- cognized in France as the leader of a school, and his “Portrait of Mme. Sarah Bernhardt,” 1879, painted in a light key, won him the Cross of the Legion of Honour. In 1880 he exhibited a small portrait of M. Andrieux and “Joan of Arc listening to the Voices ” ; and in the same year, at the Royal Academy, the little por- trait of the “Prince of Wales.” In 1881 he painted “The Beggar” and the “Por- trait of Albert Wolf”; in 1882 “Le Pere Jacques”; in 1883 “Love in a Village,” in which we find some trace of Courbet’s in- fluence. His last dated work is “The Forge,” 1884. The artist, long ailing, had tried in vain to re-establish his health in Algiers. He died in Paris, 10th December 1884, when planning a new series of rural subjects. Among his more important works may also be mentioned the portrait of “Mme .J. Drouet,” 1883; “Gambetta on his Death-bed,” and some landscapes ; ” The Vin- y tage,” 1880, and “The Thames at London,”

1882. ” The Little Chimney-Sweep ” was never finished. An exhibition of his collected works was opened in March and April 1885. A. Theuriet. Bastien – Lepaffe. 1885. (English Edition. 1892.) L. DE FouRCAUD. Bastien-Lepage. 1885. (h. fr.)

BASUTOLAND

Basutoland, a British protectorate in South Africa occupying the upland region enclosed by the Draken- berg range on the south, and northwards by the Caledon affluent of the Orange river. It is thus coterminous to- wards the south with Cape Colony, north-eastwards with Natal, and on the north and south-west with Orange Eiver Colony, and has an area of about 10,300 square miles, with a population which increased from over 218,000 in 1891 to 250,000 in 1896, and in 1900 was estimated at nearly 300,000. The ” Switzerland o!f South Africa,” as it has been called, forms a continuous rugged and broken plateau at a mean altitude of about 6000 feet, and is tra- versed in its entire length by the Maluti (” Blue “) range, running north of and parallel with the Drakenberg. Towards Natal the two systems converge in the huge table-shaped Potong (Antelope), to which the French missionaries have given the name of Mont aux Sources, because on its slopes have their rise the head-streams of the Tugela flowing to the Indian Ocean, and of the Orange flowing to the Atlantic. Above Potong, itself over 10,000 feet high, tower other mountains, such as Cathkin or Champagne

~~Castle (10,520), and Hamilton (10,700 ?), cul- minating point of Africa south of the Zambezi. Besides the Caledon, Basutoland is watered by the Senku ("Black Water") and the Kornet-spruit, which descend from Potong, and after traversing the plateau between the Drakenberg and Maluti ranges, converge in a single channel to form the Orange above Herschel. Owing to the abundance of running waters and a sufficiently copi- ous rainfall, the uplands form excellent grazing grounds for vast numbers of cattle and horses (the hardy and sure- footed " Basuto ponies "), while the finest crops of cereals in South Africa are raised on the fertile banks of the Cal- edon. The country takes its name from its Basuto inhabit- ants, a brave and highly intelligent branch of the Bechuana nation, who have been evangelized by French Protestant missionaries, and noyr form perhaps the most orderly and most flourishing Christian community in Africa. . The Basutos were not originally confined to their present highland territory, but ranged over both banks of the Caledon, and beyond them in the direction of the Vaal. In fact, the whole region corresponding to the present Orange River Colony formed part of the Basuto domain until they were dispossessed and driven to the uplands by the early Boer settlers. For fiscal and judicial purposes the country is divided into the seven districts of Maseru, Leribe, Mohale's Hock, Berea, Mafeking, Quthing, and Qacha's Nek, and each district is subdivided into wards ruled by hereditary chiefs, all members of the Moshesh family. Maseru, the capita^ and largest town, lies on the left bank of the Caledon, a little below Ladybrand on the opposite side, and has an estimated popula- tion of about 1000 (Europeans, 120). There are indica^ tions of iron and copper, while coal of a fair quality occurs in several parts, and is worked for the local supply. But agriculture is the chief resource of the peo- ple, the yield of grain, cattle, and wool being sufficient to support a brisk export trade, valued in 1898 at £138,600. In the same year the imports (saddlery, clothes, groceries, iron and tin ware) exceeded £100,000, and in 18i99 the revenue (£46,847) more than balanced the expenditure (£46,417). The hut tax yielded £23,678, although, owing to the scarcity of food during 1899, only ten shillings a hut was levied instead of the one pound that is chargeable. There is no public debt. The 144 schools (chiefly missionary) are regularly attended by about 9000 pupUs, and supported by a grant in aid of £4440. Many of the Basutos speak and write English fluently, and dress in the European manner.~~

~~WiDDicoMBB, J. Fourteen Years in Basutoland. London, 1892.~~

~~— Bakklet, Mrs. Among Boers and Basutos. London, 1894~~

~~Reclds, E. Universal Geography, new issue, "Africa," vol. iii. London, 1901. (a. h. k.)~~

~~Recent History. — The Basutos belong to the mountain tribes of the great Bantu race. They appear to combine in a remarkable manner the fighting qualities of the coast tribes, such as the Zulus, with the higher intel- ligence and cunning of the interior tribes, such as the Bechuanas. They are hardy and industrious ; Moshesh, the founder of the Basuto tribe, and for a long lifetime the leader of his people, was a striking example of the strong- est qualities to be found in a Bantu chief. The Basuto tribe formed itself under the leadership of Moshesh, out of remnants of various other Bantu tribes, which had been broken up by the Zulu chief Chaka. There is no people among whom personal kudos counts for more than it does amongst the Bantu, and the rising reputation of Moshesh as a hunter and warrior brought him, while quite young, many followers from the surrounding tribes. The Basutos at the outset acquired an unenviable notoriety as a race of bold cattle lifters and raiders, and in their early settle- ments the emigrant Boers found them extremely trouble- some neighbours. At the same time, if the Basutos were eager for cattle, it is equally certain that the Boers were eager for land ; and their encroachments on the territories of the Basutos led to a proclamation in 1842 from Sir George Napier, the then Governor of Cape Colony, for- bidding further encroachments on Basutoland. In 1843 a treaty was signed with Moshesh on the lines of that already arranged with Waterboer, the Griqua chief, creating Basutoland a native state under British protection. Not- withstanding this treaty, the cattle-stealing propensities of the Basutos continued to manifest themselves ; and a commando, consisting of British troops, farmers, and natives, was sent against Moshesh in 1849. This com- mando did not prove strong enough to accomplish its end, and was repulsed by Moshesh.~~

~~The ambition of Moshesh led him to endeavour to regain if possible the territories south of the Vaal and west of the Drakensberg, which had been at one time occupied by those very Bantu tribes from whom many of his retainers were drawn. In 1852 General Cathcart, who succeeded Sir Harry~~

Smith as governor of Cape Colony, decided to take strong measures with the tribe, and proceeded with three small divisions of troops against Moshesh. The expedition was by no means a success, but Moshesh, with that peculiar statecraft for which he was so famous, saw that he could not hope permanently to hold out against the British troops, and followed up his successful skir- mishes with General Cathcart by writing him a letter, in which he said : "As the object for which you have come is to have a compensation for Boers, I beg you will be satisfied with what you have taken. You have shown your power, you have chastised ; I will try all I can to keep my people in order in the future." In this instance Moshesh displayed similar cunning strategy to that which he had used so successfully against the Matabele warrior, Moselekatze, twenty years before, when he followed up his victory by sending a letter after the retreating enemy couched in the following terms : " Moshesh salutes you. He sends you these cattle as a recognition of your bravery. . . . He desires to live at peace with you." This diplomatic letter was so successful in its object that Moselekatze never attacked him again. In reference to this letter and to the other diplomatic correspondence of this astute chief, it is only fair to state that he owed a good deal to the assist- ance of two missionaries attached to the French Pro- testant Mission in Basutoland, Mr Dyke, an Englishman, and M. Cassalis, a Frenchman. At the same time revela^ tions of recent date show that while these gentlemen believed themselves to be guiding Moshesh, they were

frequently used by this wily chief when occasion served him.

In 1865 afresh feud occurred between the Ofange Tree State Boers and the Basutos. The latter applied to Sir Philip Wodehouse at the Qape for protection, but he de- clined to interfere. The Boers proved more successful than they had been in the past, and occupied several of the Basuto strongholds. They also annexed a certain fertile portion of Basuto territory, and finally terminated the strife by a treaty at Thabo Bosigo, by which Moshesh gave up the tract of territory taken by the Boers and pro- fessed himself a subject of the Free State. Seeing that the struggle against the

~~Boers was hopeless, no fewer than 2000 Basuto warriors having been killed, Moshesh again appealed for protection to the British authorities, saying : " Let me and my people rest and live under the large folds of the flag of England'bpfore I am no more." In response to this request, the British authorities decided to take over Basutoland, and a proclamation of annexation was issued. At the same time the Boer commandoes were requested to leave the country. The Free States strongly resented the British annexation of Basutoland, and in 1869 the treaty of Aliwal North was concluded between the Free State and the High Commissioner. This treaty defined the boundary between the Free State and Basutoland, whereby the fertile strip of country west of the Caledon Eiver was finally transferred to the Free State, and the remainder of Basutoland was recognized as a portion of the British dominions. It further dealt with cattle thefts, and made special provisions enabling the Free State Boers to trace and recover at any time stock which the Basutos might steal.~~

~~Moshesh, who for nearly fifty years had led his people so skilfully and well, died in 1870. In 1871 Basutoland was annexed to Cape Colony, the area at that time being given as 10,300 square miles. The turbulent Bantu warriors did not remain quiet for any length of time, and in 1879 Moirosi, a chief residing in the southern portion of Basuto- land, openly repudiated colonial rule. An expedition was despatched from Cape Colony and severe fighting followed. Moirosi's stronghold was captured and the chief himself was killed. Immediately after the war, strife occurred among the Basutos themselves over the question of the partition of Moirosi's territory, which had been decided on as one of the results of the war. In 1880 the Cape Government felt sufficiently strong to extend to Basuto- land the Cape Peace Preservation Act of 1878. This Act provided for the disarmament of natives, and had already been put in force successfully among some of the Kafl&r tribes on the Cape eastern frontier. Its execution in Basutoland, however, proved an extremely difficult task, and was never entirely accomplished. Desultory warfare was carried on between the colonial troops and the Basutos until 1881, when the intervention of the High Com- missioner, Sir Hercules Robinson, was asked for. Peace in Basutoland was not announced until the end of 1882. In the following year a form of self-government was estab- lished, but was once more followed by internal strife among the petty chieftains.~~

~~The subjection of Basutoland to the control of the Cape Government had by this time proved unsatisfactory, both to the Basutos and to Cape Colony. The Basutos on their part found that self-government involved not only strife amongst themselves, but also serious danger from their Free State neighbours, and they appeared desirous that Basuto- land should be taken under the direct administration of the Imperial Government. The Cape Government found, that owing to their endeavour to disarm the Basutos, including the " gun war " of 1880, they had incurred an expenditure of three millions, and they were by no means pleased at the prospect of a continued governing of the country. They~~

~~thei;ef ore offered no opposition to the appeal made by the Basutos themselves to the l^mperial Government to take them over, and, moreover, Cape Colony undertook to pay towards the cost of administration an annual contribution of £18,000. Consequently, in 1884, Basutoland ceased to be a portion of the Cape Colony and became a British Crown Colony. A period of comparative quiet followed, and in 1891 Basutoland was admitted to the Customs Union, which already existed between Orange Free State, Cape Colony, and British Bechuanaland. The country has since been administered by a Resident Commissioner and a small staff of o£B.cials, and when Lord (then Sir Alfred) Milner.yisited Basutoland in 1898, on his way to Bloem-fontein, ne was received by fifteen thousand mounted Basutos. The chiefs also attended a large meernig at Maseru, and gave expression to their gratitude for the beneficent character of Queen Victoria's rule and protection. On the outbreak of the Boer war in 1899, these same chiefs, at a great meeting held in the presence Of the Resident Commissioner, gave a further protestation of their loyalty to Her Majesty. There can be no question that the con- version of Basutoland into a Crown Colony, administered by a British Resident Commissioner responsible to the^ Colonial Office, has contributed alike to the prosperity of the Basutos, the security of the property of neighboiiring colonists, and a peaceful condition among the natives of South Africa generally. The annual report of the residMit commissioner. Sir Godfrey Lagden, for the year 1899, is adequate testimony ^o this success. During the year no less than 37,371 passes were given to natives who visited the neighbouring states and colonies in search of work. With regard to the influence of education amongst the Basutos, Sir Godfrey Lagden reported as follows : — " The ability to imbibe technical~~

~~knowledge and earn good wages, the desire to possess money, to wear decent clothes, to have respectable houses and furniture, to educate the children and have their own churches and schools, are automatically working social changes which no laws can so well effect."~~

~~Authorities. — ^Livingston. South Africa. — Thejvl. History of South Africa ; South African History and Geography ; Basuto- land Records. — By Special Commissioner of the Cape Argus. History of the Basutos of South Africa. — E. Cassalis. The Basutos. — HiLLiEB. South African Studies. — Pkatt. Leading Points in South African History. (a. p. h.)~~

~~Batabano, a small village on the south coast of Cuba opposite Havana and the terminus of the south coast steamer trade of Havana. The original settlement of Havana made under Diego Velasquez about 1517 was near this place. Population, 1025.~~

~~Bataisk, a wealthy village of South Russia, 5 miles south of Rostov-on-Don. It has a population of more than 10,000, and is a centre for trad# in grain and cattle.~~

~~Batala, a town of British India, in the Gurdaspur district of the Punjab, with a station on a branch of the • North-Western Railway, 24 miles from Amritsar. The population is about 27,000 ; the municipal income in 1897-98 was Rs.33,664. It is an important centre of trade, with manufactures of cotton and silk goods, shawls, brass-ware, and leather. There are two mission schools.~~

~~Batalpashinsk, a district town of Russia, North Caucasia, province of Kubaii, on the left bank of Kuban fiver, 27 miles S. of Nevinnomysskaya station on the North Caucasian railway. Timber is exported, and there is an important sawmill. Salt is obtained from lakes of the same name, situated 10 miles from the town. Population~~

~~(1897), 8100.~~

~~Batangas, a well-built town of some 40,000 inhabitants, in the island of Luzon, Philippine Islands, and capital of the province of Batangas. It is well~~

~~situated on tKe eastern coast of the Gulf of Batangas, and is the most important port of a province noted for the fertility of its soil and the industry of its inhabitants. Its exports, which are large, include rice, coffee of excellent quality, cacao, sugar, Indian corn, horses, and cattle. The horses of Batangas are unusually strong and active. Good cotton is also produced, and is vi^oven into fabrics by the women. The language is Tagalog.,~~

~~Batavia, a residency on the north coast of West Java, consisting of the districts of Batavia (town and suburbs), Meester Cornelis, Tangerang, and Buitenzorg. It is bounded on the S. by the mountains and volcanoes of the residency of Preanger, in which the rivers (which, with the sea, have formed the broad band of alluvium in the north of the residency^ Jidani, Jilivong, Jitarum, take their rise. In this fertile region are situated the private estates of Europeans and Chinese, and the orchards and fruit gardens near the capital. On the higher lands of the residency coffee, tea, cloves, and cinnamon are cultivated. Area, 2595 square miles. Population in 1898, 1,313,383, including 12,434 Europeans, 82,510 Chinese, 3279 Arabs, 147 other Asiatic foreigners.~~

~~The capital, of the same name, is the chief town of all the Dutch East Indian Colonies, and lies in 106° 60′ E., 6° 8′ S. Since 1874 the progress of the commerce and shipping of the town must be mainly attributed to the~~

~~improvement in its communication with other resi- dencies and its harbour improvements. Since 1873 the old and new towns have been connected by steam tram- ways. The Batavia-Buitenzorg railway passes the new town, thus connecting it with the main railway which crosses the island from west to east. But the construction of the new harbour at Tanjong Priok, to the east of the old one, is of the first importance. The works, com- menced in 1877 and completed in 1886, connect the town with Tanjong ("cape") Priok by a canal and include an outer port formed by two breakwaters 6072 feet long, with a width at entrance of 408 feet and a depth of 27 feet throughout. The inner port has 3282 feet of quayage ; its length is 3609 feet, breadth 573 feet, and depth 24 feet. There is also a coal dock, and the port has railway and roadway connexion with Batavia. The total cost of these works has been £2,250,000. The tonnage of vessels clearing from Batavia to countries beyond the archipelago has increased from 879,000 tons in 1887 to 1,224,000 tons in 1898. The population of the town in 1880 was 96,957; in 1898, 116,667; including 9423 Europeans, 26,433 Chinese, 2828 Arabs, and 132 other Asiatic foreigners.~~

~~Literature. — Van Ebes. Batavia. Leiden, 1881. — Boys. Batavia, Buitemorgen de Preanger. Batavia, 1892.~~

~~Batavia, capital of Genesee county, New York, U.S.A., situated in 43° 00′ N. lat. and 78° 11′ W. long., in the western part of the state, 36 miles east of Buffalo, on Tonawanda Creek, at an altitude of 890 feet. It is on three railways, the New York Central, the Lehigh Valley, and the New York, Lake Erie, and Western. Its manu- factures consist largely of agricultural tools and machines. Population (1880), 4845 ; (1890), 7221 ; (1900), 9180.~~

~~Bates, Harry (1850-1899), English sculptor, was born at Stevenage, Herts, on 26th April 1850. Before beginning the regular study of plastic art he passed through along apprenticeship in architectural decoration. In 1879 he came to London and entered the Lambeth School of Art, studying under Jules Dalou, and winning a silver medal ia the national competition at South Ken- sington. In 1881 he was admitted to the Royal Academy schools, where in 1883 he won the gold medal and the~~

~~travelling scholarship of £200 with his relief of " Socrates teaching," which showed the qualities of grace of line and harmony of composition which~~

always distinguished his work. He then went to Paris and studied under Eodin. A head and three small bronze panels (the ” Odyssey ”’ executed by Bates in Paris were exhibited at the Eoya! Academy, and selected for purchase by the Chantrey Trustees ; but the selection had to be cancelled because they had not been modelled in England. His “.ffineas ” (1886), “Homer” (1886), three “Psyche” panels, and ” Rhodope ” (1887), all snowed marked advance in form and dignity ; and in 1892, after the exhibition of his vig- orously designed “Hounds in Leash,” Bates was elected A.E.A. His ” Pandora” in the same year was bought for the Chantrey Bequest, and is now in the Tate Gallery. Among his later work was the colossal equestrian statue of Lord Eoberts (1896), cast in bronze and set up in Calcutta ; and a statue of Queen Victoria for Dundee. But perhaps his masterpiece, showing the sculptor’s delicate f aney-and skill in composition, was an allegorical presentment of ” Love and Life ” — a winged male figure in bronze, with a female figure in ivory being crowned by the male. Bates died in London 30th January 1899, his premature death robbing English plastic art of its most promising representative at the time.

Bates, Henry Walter (1826-1892), English naturalist and explorer, was born at Leicester on 8th February 1825. His father, a manufacturing hosier, in- tended him for business, and for a time the son yielded to his wishes, escaping as often as he could into the neigh- bouring country to gratify his love of botany and ento- mology. This determined his future, and in 1844, meeting a congenial spirit in Alfred Eussel.Wallace, the result was discussion and execution of a plan to explore some then little known region of the globe. The banks of the Amazons was the district chosen, and in April 1848 the two friends sailed in a trader for Para, which was reached in a month. They had little or no money, and, as the expenses were to be met by the sale of duplicates of specimens, work was begun on arrival. After two years Bates and Wallace agreed to collect independently, Wal- lace taking the Eio Negro and the upper waters of the Ori- noco, while Bates continued his route up the great river for 1400 miles. He remained in the country eleven years, during which time he collected no fewer than 8000 species of insects new to science. His long residence in the tropics, with the privations which it entailed, undermined his health, and he returned to England the victim of chronic dyspepsia. Nor had the exile from home the compensation of freeing him from financial cares, which hung iieavy on

~~him till he had the good fortune to be appointed in 1864 assistant secretary of the Eoyal Geo- graphical Society, a post which, to the inestimable gain of the Society, and the advantage of a succession of explorers, to whom he was alike Nestor and Mentor, he retained till his death on 16th February 1892. So far as an authorita- tive position in the scientific world was concerned. Bates had secured this by two publications the importance and interest of which are abiding. He is best known as the author of one of the most delightful books of travel in the English language, Tlie Naturalist on the River Amazons (1863) , the writing of which, as the correspondence between the two has shown, was due to Darwin's persistent urgency. " Bates," wrote Darwin to Lyell, " is second only to Humboldt in describing a tropical forest." But his most memorable.,contribution to biological science, and more especially to that branch of it which deals with the agencies of modification of organisms, was his paper on the " Insect Fauna of the Amazon Valley," published in vol. xxiii. of the Linnean Society's Transactions. He therein, as Darwin~~

~~testified, clearly stated and solved the wonderful problem of " mimicry ,"^as it is conveniently called, or the super- ficial resemblances between totally different species; and the likeness between an animal and its surroundings, whereby it evades its foes or conceals itself from its prey. The species which has varied most from the normal type of its group is far rarer than the form which it resembles, while the mimicked is abundant and well defended by such devices as unpleasant taste or smell, or the power of stinging or wounding. The basis of mimetic analogies lies in the origination of some slight variation in the mimicker, which tends in the direction of likeness to the mimicked, upon which variation natural selection operates. Bates's other contributions to the literature of science and travel were sparse and fugitive, but he edited for several years a periodical of Illustrated Travels. A man of varied tastes, he devoted the larger part of his leisure to ento- mology, notably to the classification of coleoptera. Of these he left an extensive and unique collection, which, fortunately for science, was purchased intact by M. Een6 Oberthur of Eennes. (b. cl.)~~

~~Bath, a city, municipal, county, and parliamentary borough, market town, and fashionable watering-place, in the county of Somerset, England, on the Avon, 107 miles W. of London by rail. The borough is divided into seven wards under a mayor, 14 aldermen, and 42 councillors. The corporate property yields a gross income of £8500. The new municipal buildings, costing £38,000, were erected in 1894. Other recent buildings include a Eoman Catholic church, new Queen's Baths, Jubilee Hall, Bath Church Institute, Lyric Theatre, and a handsome art gallery (1900) erected as a memorial of the Diamond Jubilee. A new public park, was opened in 1897. To the list of charitable institutions have been added four dispens- aries, including the Hahnemann Free Dispensary (1888). Bath publishes two daily and five weekly newspapers. Since 1875 excavation has been carried on with the result of exposing the baths erected during the Eoman occupation, in wonderful preservation, portions of a church erected in the 9th century, and other antiquities. Area of city and municipal borough, 3382 acres ; population (1881), 51,814 ; (1901), 49,817. Area of parliamentary borough, 3455 > acres ; population (1881), 53,785 ; (1901), 52,751.~~

~~See King's Municipal Beeords (1885) ; Britton's History of Bath Abbey OHurch (1887) ; Peach's Bath, Old and New (1888) ; and Collections of Books belonging to the City (1893) ; Handbook to Bath, edited by J. W. Mokkis (1888) ; Davis's Guide to the Soman Baths (1883) ; Excavations of Roman Baths (1895); and The Saxon Cross (1898).~~

~~Bath, a city and port of entry of Maine, U.S.A., and capital of Sagadahoc county, situated in the southern part , of the state, on the west bank of Kennebec river, 12 miles above its mouth, where it is broad and navigable for all classes of vessels. It was formerly one of the most prominent centres of wooden shipbuilding, and its ships are still found in all parts of the world. In recent years ' the building of iron ships has become of importance, the Bath Iron Works having constructed a number, among them several smaller ships of the U.S. navy. Population~~

~~(1880), 7874; (1890), 8723; (1900), 10,477.~~

~~Bathgate, a burgh of barony and police burgh of Linlithgowshire, Scotland, 19f miles westby south of Edin- burgh by rail. The academy had in 1898-99~~

~~an average attendance of 831, while a Board school had 352, and a Eoman Catholic school 205. Population (1901), 6786.~~

~~Bathurst, a city in Australia, New South Wales, 144 miles west of Sydney on the Great Western Eailway, in the centre of the chief wheat-growing district of the colony, on the south bank of the Macquarie river. It has |~~

~~been a municipality since 1862. Altitude, 2200 feet. Mean temperature, year, 57-6° F. ; January, 72-6° ; July, 43-3°. Population, about 10,000.~~

~~Batley, a municipal borough of Yorkshire, England, distant 8 miles from Leeds by rail, and about the same distance from Wakefield and Bradford. With the adjacent municipal borough of Dewsbury it forms part of the parliamentary borough of Dewsbury. All Saints' Church contains ancient memorials, and there, are an ancient grammar school, a technical school (established by public subscription), a town hall, a hospital, a mark-et house, and public baths. The town is the centre of the heavy woollen trade, and has extensive manufactures of army cloths, pilot cloths, druggets, flushings, &c. ; also iron foundries, manufactures of machinery, and stone quarries. The borough lies in the south-west Yorkshire coalfield, and there are a number of collieries in the district. Area, 2039 acres. Population (1881), 27,505 ; (1901), 30,321.~~

~~Baton Rouge, a city of Louisiana, U.S.A., capital of East Baton Eouge Parish. It was made the state capital in 1849. In 1862 the seat of government was transferred to New Orleans, and in 1880 it was restored to Baton Eouge. It is the seat of the Louisiana State University. Population (1880), 7197; (1890), 10,478; (1900), 11,269, of whom 4660 were white and 6596 negro.~~

~~BattagI ia, a town of the province of Padua, Venetia, Italy, 11 miles S.S.W. from Padua by the railway to Bologna. It lies on the Euganean Hills, and has much- frequented hydropathic and hot sulphur springs, which supply inter alia mud baths and a natural vapour bath. The springs gush out at the foot of Mount Sant' Elena, and have a temperature of 136-4° to 159-8° F. In the immediate vicinity are the castle of Cattajo, built in 1550, and the church of Arqua Petrarca, in which is the tomb of Petrarch; there also is the~~

~~house in which he lived, now containing relics of the poet. Building stone is quarried. Population, about 3700.~~

~~Battambang (locally known as Pbattabawng), situated in 103° 13′ E. long, and 13° 6′ N. lat., lies in the great Cambodian plain upon the river Sangk, which drains from the Patat range into the great lake to the eastward. Itisthechief town of the Cambodian province of the same name, and was conquered by the Siamese at the end of the 18th century, atthesame timeastheneighbouring province of Siemrap. If the Pailin district (for which see Chan- tabun) is excepted, the chief products of the province are rice and dried fish. The total value of the export and import trade of the two provinces of Battambang and Siemrap does not at present exceed £100,000 a year. The population of the town is about 5000, and that of the province scarcely 50,000. A hereditary chief of Cam- bodian descent resides within the brick walls of the old citadel, and since 1893 a commissioner appointed from Bangkok has resided at Sis.~~

~~By the terms of the treaty of October of that year between France and Siaih, the Siamese Go.verument bound itself not to maintain or navigate ships or armed vessels on the Great Lake, nor to construct any fortified port or military establishment, nor to maintain any armed force in the provinces of Battambang and Siemrap. A clause was introduced to encourage trade between French Cambodia on the south and these lake provinces, but owing to the high tarifi imposed in the French colonies the bulk of the trade still goes overland to Bangkok in preference to the easier water route to Saigon.~~

~~Battas (Dutch Battdks), the inhabitants of the formerly independent Batta country, in the central high- lands of Sumatra, now for the most part subjugated to the Dutch government (1832-90). The still independent area extends from 98°-99° 35′ E., and 2°-3° 25′ S. North-east of Toba lake dwell the Timor Battas, and west of it the Pakpak, but on its north (in the mountains which~~

~~border on the east coast residency) the Karo Battas form a special group which, by its dialects and ethnological character, appears to be allied to the Gajus and Alias occupying the interior of Achin. The Battas are engaged in agriculture (rice, kapas, indigo), in horse and pig breeding, and in gathering the products of the forests.~~

~~Literature. — Beisen nach dem Toba See. Petermann' s Mitteil. 1883. — MoDiGLiANi. Fra i Batacchi indipendenti. Rome, 1892. — Neumann. Het Pane-en Bilastroomgebied, Tydschr. Aardr. Gen. 1885-87. — Van Dijk in the same periodical, 1890-95. — Wing Easton in the Jaarboek voor het Mynwezen, 1894. — Niemann in the Encyclopaedie van Nederlandsch-Indie, under the heading Bataks, with very detailed bibliography.~~

~~Batticaloa, the provincial capital of the eastern province of Ceylon, on the E. coast, 69 miles S.S.E. of Trincomalee. The population of the town in 1901 was about 8000 ; of the district (2872 square miles), 145,155. The old Dutch " Fort " is a mere name. Batticaloa is the seat of k government agent and district judge; criminal sessions of the supreme court are also held. Rice and cocoanuts are the two staples of the district, and a steamer trading round the island calls once a week at the port. The lagoon is famous for its " singing fish " ; the district has a remnant of Veddahs or wildmen of the wood. The average annual rainfall is 56^ inches; the average temperature 80-4°.~~

~~Battle Creek, a city of Calhoun county, Michigan, U.S.A., situated on Kalamazoo river, at the mouth of Battle Creek, in the southern part of the lower peninsula, at an altitude of 820 feet. It has three railways, which give communication in all directions. It is the seat of Battle Creek College, contains a sanatorium, and has extensive manufactures, largely of agricultural imple- ments. Population (1880), 7063; (1900), 18,563.~~

~~BatU (Dutch Batoe), a group of three greater and forty-eight lesser islands between 0° 10′ N. to 0° 46′ S. and 97° 60'-98° 35′ E., belonging to the Ayerbangi district of the lowlands of Padang (Sumatra). They are separated by the strait of Sibirut from the Mentavei group. Only twenty of the smaller islands are inhabited. The natives are of Malay-Buginese origin.~~

~~Batum, a seaport of Russia, Transcaucasia, province and 85 miles by rail S.E. of Kutais, on the south-east shore of the Black Sea, in 41° 39′ N. and 41° 38′ E., near the mouth of the Chorokh ; annexed from Turkey in 1878. The bay of Batum is being continually filled up by the sand that is carried into it by several small rivers. It is protected by strong forts, and the anchorage has been greatly improved by artificial works. The town is built on the steep slopes of the hills on its western shore. The climate is very warm, lemon and orange trees, magnolias and palms growing in the open air, but it is extremely wet and changeable. The yearly amount of rain (90 inches) is higher than anywhere in Caucasia,,' but is very unequally distributed (23 inches in August and September, sometimes 16 inches in a couple of days), and the town is still most unhealthy. Only bridle-paths connect Batum with the interior.~~

~~Batum has grown rapidly in recent years. It is now connected by rail with the main line of Transcaucasia, and is the chief port of the whole country for the export of naphtha, parafBn oil, liquorice, wheat, Indian corn, and timber (about £4,000,000 a year). Some 800 vessels are engaged in foreign trade, and 500 coasting vessels visit it every year. Population (1875), 2000; (1897), 28,500, very mixed. The district of Batum (85,576 inhabitants, with Batum town, in 1897), with the districts of Artvin and Ajar (56,456), formerly made a separate province of Batum. They are now two military districts of the province of Kutais.~~

~~Bauan, a town of 30,000 inhabitants, in Luzon, Philippine Islands, situated near the head of the Gulf of~~

~~Batangas. It is noted for having an unusually fine church. The surrounding country is very fertile, and cacao, pepper, cotton, hemp, coffee, and rice are pro- duced in abundance. Cattle and horses are raised for the Manila market. The women weave and dye cotton and hempen fabrics. The language is Tagalog.~~

~~Bauchi. See I^igeria.~~

~~Baudry, Paul Jacques Aime (1828-1886\ French painter, was born at La Roche-sur-Yonne (Vendue). He studied under Drolling, a sound but second-rate artist, and carried off the Prix de Rome in 1850 by his picture of "~~

~~Zenobia found on the banks of the Araxes." His talent from the first revealed itself as strictly academical, full of elegance and grace, but somewhat lacking originality. In the course of his residence in Italy Baudry derived Strong inspiration from Italian art with the mannerism of Correggio, as was very evident in the two works he exhibited in the Salon of 1857, which were purchased for the Luxembourg : " The Martyrdom of a Vestal Virgin " and " The Child." His " Leda," « St John the Baptist," and a " Portrait of Beul^," exhibited at the same time, took a first prize that year. Throughout this early period Baudry commonly selected mythological or fanciful subjects, one of the most note- worthy being "The Pearl and the Wave." Once only did he attempt a historical picture, " Charlotte Corday after the murder of Marat " (1861), and returned by preference to the former class of subjects or to painting portraits of illustrious men of his day — Goiizot, Charles Gamier,. Edmond About. The works that crowned Baudry's reputation were his mural decorations, which show much imagination and a high artistic gift for colour, as may be seen in the frescoes in the Paris Cour de Cassation, at the Chi,teau of Chantilly, and some private residences — the Hotel Fould and HStel Paiva — but, above all, in the decorations of the foyer of the Paris Opera House. These, more than thirty paintings in all, and among them com- positions figurative of dancing and music, occupied the painter for ten years. Baudry died in Paris in 1886. He was a member of the Institut de France, succeeding Schnetz. Two of his colleagues, Dubois and Merci^, co- operating with his brother, Baudry the architect, erected a monument to him in Paris (1890). The statue of Baudry at La Roche-sur-Yonne (1897) is by G^rSme.~~

~~See H. Delaborde. Notice sur la vie et les ouvrages de Baudry. 1886. — Ch. Ephbussi. Baudry, sa vie et son ceuvre. 1887.~~

~~(H. Fr.)~~

~~Bauer, Bruno (1809-1882), German theological and historical critic, was born 6th September 1809, the son of a painter in a porcelain factory at Eisenberg in Saxe-Alten- burg. He was educated at Berlin, where he fell under the then all-powerful influence of Hegel, attaching himself to the " right " of the Hegelian school under Marheineke. In 1834 he began to teach in Berlin as a licentiate of theology, and in 1839 was transferred to Bonn.~~

Meanwhile his opinions had been changing, and in two works, Kritik der evangelischen Geschichte des Johannes (1840) and Kritik der evangelischen Geschichte der Synoptiker (1841), he announced his complete rejection of his earlier orthodoxy. In 1842 the Government, having taken the opinions of the various Prussian faculties of theology, revoked his license to teach, and he retired for the rest of his life to Rixdorf, near Berlin. Henceforward he took a deep interest in modern history and politics, as well as in theology. Among the fruits of his new studies were Geschichte der Politik, Kvltur und Aufklarung des 18. Jahrhunderts, in 4 vols. (1843-45), and Geschichte der Franzosischen Bevolution, in 3 vols. (1847). He kept up this line of interest till the end, and Disraelis romantischer und Bismarcks socialist-

iscJier Imperialismus was published in the year of his death. Other critical works are Kritik der Evangelien und Geschichte Hires Ursprungs, 4 vols. (1850-52), Apostel geschichte (1850), Kritik der Paulinischen Briefe, 3 parts (1850-52). He died at Eixdorf, 13th April 1882. Bruno Bauer's criticism of the New Testament was of a highly destructive type, going far beyond the most sceptical conclusions of the Tubingen school. Strauss in his Life of Jesus had accounted for the Gospel narratives as half- conscious products of the mythic instinct working in the early Christian communities. Bauer ridiculed Strauss's notion that a community could produce a connected narra- tive. " A community has no hands for writing, no judg- ment for composing." His own doctrine, embodying a theory of Wilke's, was that the original narrative was the Gospel of St Mark ; that this was composed in the reign of Hadi-ian ; and that after this, as a type, the other narra- tives were modelled by other writers. On the same princi- ple the four principal Pauline epistles were regarded as forgeries of the second century. The other main point in Bauer's criticism was his argument for the preponderance of the Greco-Roman element, as opposed to the Jewish, in the Christian writings. The writer of St Mark's Gospel was " an Italian, at home both in Eome and Alexandria " ; that of St Matthew's Gospel " a Roman, nourished by the spirit of Seneca " ; the Pauline epistles were

~~written in the West in antagonism to the Paul of the Acts, and so on. Christianity is essentially " Stoicism ' triumphant in a Jewish garb." Needless to say, this line of criticism has not been generally accepted, though it has found occasional supporters, especially in the Netherlands. It certainly had its value in emphasizing the importance of studying the influence of environment in the formation of theXJhristian Scriptures. Bauer was a man of restless, impetuous activity and independent, though ill-balanced, judgment, one who, as he himself perceived, was more in place as a free-lance of criticism than as an official teacher. He came in the end to be kindly regarded even by opponents, and he was not afraid of taking a line displeasing to his Liberal friends on the Jewish question. (h. st.)~~

~~Bautzen, a town of Germany, on the Spree, 32 miles E.N.E. of Dresden, capital of the circle of Bautzen, kingdom of Saxony, on the Dresden-Gorlitz, and the Bautzen-Neustadt railways. The town has a, clerical college, 2 normal schools (one for Protestant, the other for Catholic teachers), 2 higher, a Wendish, an agricul- tural, an industrial, a commercial, and other schools. A centre of industry, it has iron foundries, dyeworks, potteries, distilleries, and cigar factories. Population~~

~~(1890), 21,515; (1895), 23,678 ; (1900), 26,025.~~

~~Bavaria, a kingdom of Germany, ranking next after Prussia in bofli area (29,284 square miles) and population^5,420,199 (1885) ; 5,818,544 (1895), of whom 2,846,687 were males and 2,971,857 females, the density being 198-7 inhabitants to the square mile. Of the popu- lation 64-5 per cent, were rural and 35-5 per cent, urban. The preliminary results of the 1900 census placed the total population at 6,175,153. During the years 1880 to 1893 the number of emigrants from Bavaria ranged from 8068 to 17,986 per annum; since 1893 it has averaged not more than 3256. Classified according to religion, the population in 1895 was thus distributed: — 4,112,623 Roman Catholics (70-7 per cent.), 1,640,133 Evangelical Protestants (28-2 per cent.), 53,750 Jews, and 10,964 of other Christian sects (of whom 3249 were Mennonites). Illegitimacy ranks high, being annually 13 to 14 per cent. of the total births.~~

~~Agriculture.— Of the total area of Bavaria close upon 67 per cent, is arable and garden land, and of this again one-fourth is meadow land. Since about the middle of the 19th century con- siderable attention has been given to the drainage of the bogs and~~

~~moors of the upper districts of Bavaria. Since 1895 three experi- mental stations have been established for continuing the work of reclamation, but there still remain over 366,000 acres of unre- claimed bog. The farms in Bavaria, of which there were in all 663,785 in 1895, are mostly small :— 23-6 per cent., or 156,971, were each less than 2J acres ; 561 per cent., or 372,683, were each between 2J and 25 acres ; 20 per cent., or 133,510, between 26 and 250 acres ; and 621 over 250 acres. The total number of persons employed in agricultural operations exceeded 1,437,000, or approxi- mately 25 per cent, of the population. Hay is a long way the most important crop in respect of area and bulk of produce. Next come potatoes ; then follow oats, rye, barley, and wheat. But in respect of value, and economic and social importance, the wine, hops, and tobacco crops count amongst the most valuable in the kingdom. In 1899 some 51,000 acres were planted with vines, and the yield was 17,552,000 gallons of wine, valued at £1,360,000. Between 60,000 and 70,000 acres are planted with hops annually ; in 1899 the yield was about 11,000 tons, equivalent to nearly one- half of the entire yield of hops in all Gei-many. Of this amount 35 to 40 per cent, is used in the Bavarian breweries, the rest being exported. The chief hop markets of Southern Germany are Nuremberg and Bamberg. The barley grown is very largely used for malting. Tobacco cultivation is decreasing : from 9500 acres planted in 1890 the area decreased to 4800 acres in 1899. Brewing, although carried on by several gigantic firms in Munich, Erlangen, and other large towns, is also to a very considerable extent a purely agricultural business. For instance, out of over 12,500 breweries in the country in 1898, some 5300 were in the hands of farmers. In 1897, 373,421,400 gallons of beer were brewed, and of these 56,823,300 gallons were exported, leaving a consumption per head of the population (estimated at 5,932,077 in 1897) of 53J gallons annually. In 1898-99 the 6405 distilleries produced 3,502,620 gallons of pure alcohol. The live stock consisted in 1897 of 3,419,421 cattle, 1,412,579 pigs, 905,916 sheep, and ^76,557 horses. Considerable attention is paid to the breeding of cattle, and their numbers have increased by upwards of 233,400 since 1863. On the~~

~~other hand, the number of sheep decreased by more than 50 per cent, between 1863 and 1897, having in the former year numbered 2,058,638. Pigs, again, have increased from 926,522 in 1863 to the figure quoted above, an uicrease of 65J per cent. The State encourages the breeding of horses by the maintenance of stud-stock farms at Augsburg, Landshut, Zweibrtioken, and Erding.~~ ~~Mining and Industry. — In 1897 the mines yielded 1,007,403 tons of coal, valued at £481,850 ; 41,098 tons of lignite, valued at £5200 ; and 175,305 tons of iron ore, valued at £36,350, or, m all, 1,223,806 tons of minerals of the value of £523,400. One of the chief sources of graphite in Germany are mines near Passau in Bavaria. This kingdom also exports over 6000 tons of litho- graphic stones (from Solnhofen, &c.) annually. The salt works and furnaces produced 41,633 tons of salt, valued at £77,600 ; 83,656 tons of iron, valued at £194,750 ; and 7041 tons of sul- phuric acid, valued at £12,750. The foundries, forges, &c., turned out steel, iron wire, bars, &c., to the weight of 251,989 tons and value of £1,695,600. About 20,000 men are employed in the forests and sawmills, of which last there are about 1400 in the kingdom. Nearly 6~~ ~~million acres are covered with forests, of which 36-3 per cent, belong to the State. The total quantity of timber used at home and exported amounts to over £4,006,000 in value per annum. In 1895 some 520,000 persons over 16 years of age were employed in industry and handicraft, and of these 90,000 were females. The chief branches of industry are cotton-spinning (especially in Swabia), linen, hemp, worsted yarn, and other textiles (Augsburg, Bayreuth, &c.), thread and twist, chemicals and aniline dyes (Palatinate), plate glass, porcelain, matches, machinery (Palatinate, Nuremberg), lead pencils (Nuremberg), steel shot, toys (Nuremberg and Furth), wine and beer, litho- gifephic and other printing (Munich), iron foundries, &c., bells, straw hats and baskets, leather, paper,.gingerbread, &c. In 1897 the sugar factories and refineries produced 46,630 tons of sugar.~~

~~Communications. — The railways extended over a length of 4150 miles in 1899, and of these 3522 miles belonged to the State. The total cost of the State lines up to the end of the year 1897 amounted to £57,915,760. The profits from the railways formed the largest item in the public revenue in 1899, namely, £7,184,7.34, as also the heaviest item in the public expenditure, namely, £4,956,093, the net profit being thus £2,228,641.~~

~~Finances. — For each of the years 1900 and 1901 the public revenue and expenditure were balanced at £21,646,000, the prin- cipal sources of~~

~~revenue being the railways, custoins, and indirect taxes. In 1900 the public debt amounted to £72,931,800, of which over 75 per cent, was incurred 'for railways. The contribution to the imperial exchequer was fixed at £2,959,650 for each of the years 1900 and 1901.~~

~~Army.-r-The peace footing of the Bavarian army in 1899-1900 numbered 66,356 officers and men. A third army corps was raised in 190a (j. T. BE.)~~

~~Bay City, capital of Bay county, Michigan, U.S.A., situated in 43° 36′ N. lat. and 83° 53′ W. long., in the eastern part of the state, on the east bank of Saginaw river, 4 miles from its mouth and at the head of navigar tion, at an altitude of 592 feet. It has four railways, the Detroit and Mackinaw, the Flint and Pere Marquette, the Grand Trunk, and the Michigan Central. Besides these facilities, it has large commerce on the lakes. It is a manufacturing city of prominence, its leading industries being lumber and salt. It contains many lumber, shingle, and planing mills. Salt is made by evaporating the water of salt springs, the waste from lumber mills being used as fuel. Population (1880), 20,693; (1900), 27,628. The death-rate in 1900 was only 12-7.~~

~~Bayamo, an old interior city on the north slope of the Sierra Maestro in Santiago province, Cuba. It was the second of the seven cities of Cuba established by Diego Velasquez, and has been conspicuous in all the w^s. It was in 1512 the site of the first Spanish battle in the war in which the Indians were reduced. During the ten years' insurrection it was the scene of a desperate conflict between the Spaniards and Cubans. In the insurrection which resulted in independence, Bayamo was nearly destroyed by the opposing parties. Population, 3022.~~

~~Bayard, Thomas Francis (1828-1898), American diplomatist, was born in Wilmington, Dela- ware, on 29th October 1828, and died on 28th September 1898, in Dedham, Massachusetts. His great-grandfather, Governor Bassett; his grandfather, James Asheton Bayard ; his uncle, Richard H. Bayard ; and his father, James A. Bayard, all represented~~

~~Delaware in the United States Senate. Intending to go into business, he did not receive a college education; but in 1848 he decided to study law, and was admitted to the bar in 1851. Except from 1855-57, when he was a partner of William Shippen in Philadelphia, he practised chiefly in Wilmington. He was a senator from Delaware from 1869 to 1885. His abilities made him leader of the Democrats in the Senate, and his views on financial and legal questions gave him a permanent reputation for statesmanship. He was member of the Electoral Commission appointed to decide the dispute as to whether Hayes or Tilden had been elected President of the United States. In the Democratic national conventions of 1872, 1876, 1880, and 1884 he received votes for nomination as the party candidate for the Presidency. He was secretary of state, 1885-89, and pursued a conservative policy in foreign affairs. When ambassador to England, 1893-97, he became exceedingly popular, his tall dignified person, unfailing courtesy, and polished, if somewhat deliberate, eloquence making him a man of mark in all the best circles. He was considered by many Americans to have become too partial to English ways ; and, for the expression of some criticisms regarded as unfavourable to his own countrymen, the House of Representatives went so far as to pass a vote of censure on him. The value of Mr Bayard's diplomacy was, however, fully recognized in the United Kingdom, where he worthily upheld the traditions of a famous line of American ministers.~~

~~Baybay, a town of 11^,000 inhabitants, in the Philippine Islands,, near the centre of the western coast of Leyte, of which it is one of the important ports. It exports hemp in large quantities. Other products are sulphur, wax, brea, sugar, coffee, cacao, cattle, and horses. The language is Visayan.~~

~~Bayezid, a border fortress of Asiatic Turkey, chief town of a sanjak of the Erzeriim vilayet, situated on a tributary of the Aras, on the site of the old Armenian~~

~~town Pakovan. In the Russo-Turkish war of 1877-78, it was taken by the Russians, but was restored to Turkey by the Treaty of Berlin. During the war the Christians were massacred, and the town has since lost any commercial importance it once possessed.~~

~~Baynes, Thomas Spencer (1823-1887), English editor and man of letters, was born at Wel- lington, Somerset, 24th March 1823, and was the son of the minister of the Baptist congregation there. He graduated at the University of London, but received his most important instruction at Edinburgh University under ^ir William Hamilton, whom he assisted in the conduct of his class, and of whose views on logic he became the authorized exponent. He was assistant editor of the Daily News from 1858 to 1864, when he was appointed professor of logic, metaphysics, and English literature at the University of St Andrews. In 1873 he undertook the editorship of the ninth edition of the Encydopcedia Britannica, and conducted it singly until 1880, when the decline of his health rendered it neces- sary to provide him with a coadjutor in the person of Professor W. Robertson Smith. Baynes, however, con- tinued to be engaged upon the work until his death on 31st May 1887, shortly before its completion. His remarkable article on Shakespeare was republished in 1894, along with other essays on Shakespearean topics and a memoir by Professor Lewis Campbell. He was a man of great and versatile ability, and made valuable contributions to the subjects of logic, grammar, politics, and general literature, which occupied his attention by turns. (e. g.)~~

~~Bayonet. — The first known mention of the bayonet occurs irf the Memoirs of the elder Puysegur, published posthumously in Paris, 1747. He says that when com- manding the troops at Ypres in 1647 his musketeers used bayonets consisting of a steel dagger fixed in a wooden haft, which fitted into the muzzle of the musket — in fact, plug-bayonets. Courts-martial were held on some English soldiers at Tangier in 1663-64 for using their daggers on their comrades. As bayonets were at first called daggers, and as there were few or no pikemen in Tangier until 1675, the probable conclusion is that the troops in Tangier used plug-bayonets. In 1671 plug-bayonets were issued to the French regiment of fusiliers then raised. They were issued to part of an English dragoon regiment raised in 1672 and disbanded in 1674, and to the Royal Fusiliers when raised in 1685. The danger incurred by the use of this bayonet (which put a stop to all fire) was felt so early that the younger Puysegur saw a ring-bayonet in 1678 which could be fixed without stopping the fire. The English defeat at Killiecrankie in 1689 was due (among other things) to the plug-bayonet; and shortly afterwards the defeated leader. General Mackay, introduced a ring-bayonet~~

of his own invention. A trial with badly-fitting socket or zigzag-bayonets was made after the battle of Fleurus,. 1690, in the presence of Louis XIV., who refused to adopt them. Shortly after the peace of Ryswick was signed, 20th September 1697, the English and Germans abolished the pike and introduced these bayonets, and plates of them are given in Surirey de St Remy's Mimoires d'Artillerie, published in Paris in that year ; but owing to a military cabal they were not issued to the French infantry until 1703. This bayonet remained in the British service until 1805, when the present spring-bayonet was introduced by Sir John Moore.

Bayonne, chief town of arrondissement in the department of Basses-Pyrenees, France, 66 miles W.N.W. of Pau, on the railway to Bordeaux and Toulouse. Great improvements have been effected,and the port now extends

inwaiids to the confluence of the Nive with the Adour, forming an outer and an inner harbour, with areas respectively of 143 and 274 acres, having a total length of quayage of 8758 feet, 5,nd a depth at entrance (spring tides) of 19 feet. Including coasting trade, in 1899, 845 vessels of 307,937 tons entered, and 853 of 310,354 tons cleared ; of which British vessels numbered 108 entered of 82,387 tons, and 106 cleared of 81,919 tons. Imports were valued at £600,000 and exports at £580,000 in 1899. The port is an entrepot for colonial produce and Spanish wool. The foreign trade is chiefly with Spain and England. The cathedral, begun in the 13th century, was completed in 1875. The AlMes Marines, a series of fine promenades bordering the Adour for 1^ miles, form a special feature of the town. The legend which derives the word bayonet from the name of this town is supported by no suf&cient evidence. Population (1881), 18,468: (1896), 22,278;

(1901), 27,601.

Bayonne, a city of Hudson county, Kew Jersey, U.S.A., occupying the peninsula between New York harbour and Newark Bay, immediately south of Jersey city. It is traversed by the Central Railway of New Jersey, and has

~~large petroleum refineries and chemical works. Population (1885), 13,080 ; (1890), 19,033 ; (1900), 32,722. The death-rate in 1900 was 16-7.~~

~~Bayreuth, or Baibbuth, a town of Bavaria, Ger- many, district Upper Pranconia, 58 miles by rail N.N.E. from Nuremberg. The town is best known in recent years for the performances of Wagner's operas, which are performed in a theatre (1876) exclusively constructed for the purpose, and situated outside the town on 'the north. In the town is Wagner's house, with his grave in the garden. Pranz Liszt (1811-86) is buried here, as well as Richter. Amongst the institutions of the town should also be mentioned the palace of Duke Alexander of Wiirtemberg, the administrative oiiices, the statue of King Maximilian II. (1860), a lunatic asylum, an agricultural school, an art society^ the collec- tions of the historical society, a convict prison, and a mUitary hospital. Population (1885), 23,559; (1895),~~

~~27,693.~~

~~The Wagner Theatre. — As the centre of the Wagnerian mdtus, Bayreuth has assumed an importance altogether new. Among the many advantages which Wagner gained from his intimacy with Ludwig II., king of Bavaria, not the least was the practical support given to his plan of erecting a theatre for the ideal performance of his own music-dramas. The first plan, of building a new theatre for the purpose in Munich itself, was rejected, because Wagner rightly felt that the appeal of his advanced works, like the Nibelungen trilogy, would be far stronger if the comparatively small number of people who wished to hear them were removed from the distractions of a large capital; Bayreuth possessed the desired seclusion, being on a line of railway that could not be approached from any quarter without changing. The municipality furthered Wagner's scheme in every way, and in May 1872 the foundation stone of the Pest- spielhaus was laid, the event being commemorated by a notable performance of Beethoven's Choral Symphony in the old opera house. The funds for the erection of the theatre were raised in part by the issue of 1000 certificates of patronage (" Patronatsscheine "), but the bulk of the sum was raised by founding " Wagner Societies " from St Petersburg to Cairo, from London to New York ; these societies sprang up with such success that the theatre was opened in the summer of 1876 with the first complete performance of " Der Ring des~~

~~Nibelungen." The theatre, which stands on a height a little under a mile from the town, is built from the plans of Gustav Semper, the idea of the design being Wagner's own, an experiment indeed,~~

~~but one which succeeded beyond all expectation. Though external ornamentation was cut down to almost nothing, space was more generously granted, and the number of entrances would be ample for an audience of twice the size that can be accommodated; for 1750 seats are all that are available for the public. These are arranged on a kind of sloping wedge, in such a manner that every one has an almost equally good view of the stage, for there are no boxes, and the only galleries are quite at the back, one, the " Ptlrstenloge," being reserved for distinguished guests, the other, above it, for the townspeople. Imme- diately in front of the foremost row of seats a hood, or sloping screen of wood, covers a part of the orchestra, and another hood of similar shape starts from the front of the stage at a slightly lower level. Thus there is left a space between the two hoods through which the sound of the orchestra ascends with wonderfully blended effect ; the conductor, sitting at the highest point of the orchestra,, though under the screen, has a complete view of the stage as well as of his instrumentalists, and the sound of the orchestra is sent most forcibly in the direction of the- stage, so that the voices are always well supported. The stage itself has every modern appliance in the way of scenic device and machinery, the illusion presented in each picture being perfect. The pictorial effect, and th& wonderful system of lighting, are greatly enhanced by th& distance between the front of the stage and the foremost- spectator, as well as by the disposition of all the spectators- on the same plane, so that the scene has the same effect of perspective, &c. to every one in the audience. After the first set of performances, which were conducted by Hans Richter, and resulted in a loss of £7500, Wagner was compelled to allow performances of the trilogy to be given in the ordinary theatres of Germany; it was brought to England in 1882, the year which saw the pro- duction of the crowning work of Bayreuth, and Wagner's masterpiece, "Parsifal," on 28th July. In this great work the master's practical knowledge of the splendid acoustic properties of his theatre, and of its scenic possibilities, enabled him to create effects which could never be realized in the ordinary theatre, even if the character of the subject rendered it suitable for performance in the usual rotation with other operas. Por Bayreuth and all that it means, this~~

performance was of the greatest possible value ; the impossibility of the work being given elsewhere, unless other theatres on a similar principle should be built for its reception in the future, gradually attracted a larger and larger number of spectators, and though from time to time at subsequent festivals the other works of Wagner have been produced, yet " Parsifal " has very seldom been out of the scheme.

As an important addition to the work of the theatre, a per- manent school has been established at Bayreuth for the sake of training young musicians to take part in the festival performances, which were at first exclusively, and then partially, undertaken by artists from other Gei-man and foreign theatres. The special feature upon which most stress has been laid, ever since Wagner's death in 1883, has been not so much the musical as the dramatic significance of the works ; it is contended by the inmost circle of Wagnerian adherents that none but they can fully realize the master's intentions or band down his traditions. What is called the "Bayreuth Idea" is set forth in much detail from this point of view by Mr Houston Stewart Chamberlain, in his Mchard Wagner (1897 and 1900). (j. ¯j,·j\

Bazaine, Francois Achille (1811-1888), mar- shal of France and senator of the Empire, was born at Versailles, on 13th February 1811. He entered the army as, a private soldier in 1831, and received a com- mission as sub-lieutenant in 1832. By his gallantry in Algeria he won the Cross of the Legion of Honour and was promoted lieutenant. He served two campaigns with the Foreign Legion against the Carlists in Spain in 1837-38,

returning to Africa as captain in 1839. During the succeeding decade he saw much active service in Africa, and rose to be a brigadier-general with the charge of the district of Tlemcen. In the Crimean war he commanded a brigade and maintained his reputation in the trenches before Sebastopol. On the capture of the south side he was appointed governor of the place, and was promoted general of division. He commanded the French forces in the expedition to Kinburn (commander, Legion of Honour). In Lombardy in 1869 he was wounded when in command of the third division of the first

~~corps in the attack lipon Melegnano, and took a conspicuous part in the battle of Solferino (grand cross, Legion of Honour). He com- manded the first division under Marshal Forey in the Mexican expedition in 1862, succeeded him in suprteme command in 1863, and became a marshal and senator of France in the following year. He at first pursued the war with great vigour and success, entering Mexico in 1863, and driving President Juarez to the frontier. He organized a system of guerilla warfare which was carried out with barbarity. He nlarried a rich Mexican lady, whose family were supporters of Juarez, and it was alleged that he was not true to the Emperor Maximilian. At any rate there were grave differences, and finally the French forces were withdrawn. The retreat and em- barkation at Vera Cruz were skilfully conducted by Bazaine in 1867. On his return to Paris he was ap- pointed to the command of the third army corps at Nancy, and in 1869 commander-in-chief of the imperial guard at Paris. In the Franco-German war he commanded the army of the Rhine, and, after the sanguinary battles round Metz, was shut up in that fortress with an army of 170,000 men, which surrendered in October 1870. On his return to France he was tried by court-martial, found guilty of negotiating with and capitulating to the enemy before doing all that was prescribed by duty and honour, and sentenced to degradation and death, but recommended to mercy. His sentence was commuted to twenty years' seclusion, and the humiliating ceremonies attending deg- radation were dispensed with. He was incarcerated in the tie Sainte Marguerite, whence he escaped in 1874 to Italy. He finally took up his abode in Madrid, where he died on the 23rd of September 1888. He published an account Qf his share in the war and a justification of his conduct. He also wrote L'Armie du Rhin, describing its operations to the date of the surrender of Metz.~~

~~(k. h. v.)~~

~~Bazalgette, Sir Joseph William (1819-1891), English engineer, was born at Enfield on 28th March 1819. At the age of seventeen he was articled as pupil to an engineer, and a few years later he began to practise suc- cessfully on his own account. His name is best known for the engineering works he carried out in London, espe- cially for the construction of the main drainage system and the Thames embankment. In 1848 the control of London drainage, which had hitherto been divided among eight distinct~~

~~municipal bodies, was consolidated under twelve commissioners, who were in 1849 superseded by a second commission. Under the latter Bazalgette accepted an appointment which he continued to hold under the three successive commissions which in the course of a year or two followed the second one, and when finally in 1866 these fleeting and ineffective bodies were replaced by the Metropolitan Board of Works, he was at once appointed its chief engineer. His plans were ready, but the work was delayed by official obstruction and formality until 1858. Once begun, however, it was vigorously pushed on, and in 1865 the Prince of Wales was able formally to open the system, which consisted of 83 miles of large intercepting sewers, draining more than 100~~

~~square miles of buildings, and calculated to deal with 420 million gallons a day. The cost was £4,600,000. Al- most simultaneously Bazalgette Avas engaged on the plans for the Thames embankment. The section between Westminster and Vauxhall on the Surrey side was built between 1860 and 1869, and the length between West- minster and Blackfriars was declared open by the Prince of Wales in 1870. The Chelsea embankment followed in 1871-74, and in 1876 Northumberland Avenue was formed. The total outlay on the scheme exceeded two millions sterling. Bazalgette was also responsible for various other engineering works in the metropolitan area, designing, for example, new bridges at Putney and Batter- sea and the steam ferry between North and South Wool- wich. He also prepared plans for a bridge over the river near the Tower and for a tunnel under it at Blackwall, but did not live to see either of these projects carried out. He died on 15th March 1891 at Wimbledon.~~

~~bazeilles, a town in the arrondissement of Sedan, department of Ardennes, France, 2^ miles S.E. of Sedan. The town was the scene of one of the earliest conflicts in the war of 1870. After a most sanguinary struggle during two days, Aug. 31-Sept. 1, it was taken by the Prus- sians and given up to the flames ; it was subsequently rebuilt by national subscription. Population (1896),~~

~~1276; (1901), 1406.~~

~~Beaconsficid, Benjamin Disraeli, Earl of (1804-1881), British statesman, second child and eldest son of Isaac Disraeli and Maria Basevi, who were~~

~~married in 1802, was bom at No. 6 John Street, Bedford Row, on the 21st of December 1804. Of Isaac Disraeli's other children, Sarah was born in 1802, Naphtali in 1807, Ralph (Raphael) in 1809, and James (Jacob) in 1813. None of the family was akin to Benjamin for genius and character, except Sarah, to whom he was deeply indebted for a wise, unswerving, and sympathetic devotion, when, in his earlier days, he needed it most. All Isaac Dis- raeli's children were born into the Jewish communion, in which, however, they were not to grow up. It' is a reasonable inference from Isaac's temperament, character, and history, that he was never at ease in the ritual of Judaism. He was in troubled relations with his synar gogue for some years before the death of his father, whom he was naturally unwilling to hurt or offend by declared secession. His father died in the winter of 1816. Soon afterwards Isaac formally withdrew with all his household from the Jewish church. His son Benjamin, who had been admitted to it with the usual rites eight days after his birth, was baptized at St Andrew's Church in Holborn on 31st of July 1817. One of Isaac Disraeli's reasons for quitting the tents of his people was that rabbinical Judar ism, with its unyielding laws and fettering ceremonies, "cuts off the Jews from the great family of mankind." Little did he know, when therefore he cut off the Disraeli family from Judaism, what great things he was doing for one small ipember of it. The future prime minister was then short of thirteen years old, and there was yet time to provide the utmost freedom which his birth allowed for the faculties and ambitions he was born with. Taking the worldly view alone, of course, most fortunate for his aspira- tions in youth was his withdrawal from Judaism in child- hood. That it was fully sanctioned by his intellect at maturity is evident; but the vindication of unbiassed choice would not have been readily accepted had Disraeli abandoned Judaism of his own will at the pushing Vivian Ch-ey period or after. And though a mind like Disraeli's might work to satisfaction with Christianity as "com- pleted Judaism," it could but dwell on a breach of continu- ity which means so much to Jews and which he was never~~

~~allowed to forget amongst Christians. With all, lie was proud of his race as truly, if not as vehemently, as his paternal grandmother detested it. Family pride con- tributed to the feeling in his case; for in his more speculative moods he could look back upon an ancestry which was of those, perhaps, who colonized the shores of the Mediterranean from before the time of the Captivity. More definite is the history of descent from an ennobled Spanish family which escaped from the Torquemada per- secutions to Venice, there found a new home, took a new name, and prospered for six generations. The Benjamin Disraeli, Lord Beaconsfield's grandfather, who came to England in 1748, was a younger son sent at eighteen to try his fortune in London. "A man of ardent ■character, sanguine, courageous, speculative, fortunate, ■with a temper which no disappointment could disturb "~~

~~LOED Beaconsfielp. (From a photograph ty Hughes and MulUns, Ryde, J, IT.)~~

~~'(so Lord Beaconsfield described him), he soon made the beginnings of a handsome fortune and turned country gentleman. That his grandson exaggerated his prosperity is highly probable ; but that he became a man of wealth and consideration is certain. He married twice. His ; second wife was Siarah Siprout de Gabay, "a beautiful woman of strong intellect" and importunate ambitions, who hated the race she belonged to because it was despised by others. She felt so keenly the social disabilities it brought upon her, and her husband's indifference to them, that "she never pardoned him his name." Her literary son Isaac suffered equally or even more ; for though he had ambitions he had none that she could recognize as such. She could ridicule him for the aspirations which he had not and for those which he had; on the other hand, he never heard from her a tender word "though she lived to be eighty." Nor did any other member of her family, -according to her grandson. _~~

~~Isaac Disraeli was devoted to the reading and writing~~

~~of books in domestic quiet ; and his son Benjamin suffered appreciably from his father's gentle preoccupations. As a child — unruly and disturbing no doubt — he was sent to a school of small account at Blackheath, and was there " for years " before he was recalled at the age of twelve on the death of his grandfather. Isaac Disraeli was his father's sole heritor, but~~

~~change of fortune seems to have awakened in him no ambitions for the most hopeful of his sons. At fifteen, not before, Benjamin was sent to a Unitarian school at Walthamstow — a well-known school, populous enough to be a little world of emulation and conflict, but otherwise unfit. Not there, nor in any similar institution at that illiberal time, perhaps, was a Jewish boy likely to make a fortunate entry into "the great family of mankind." His name, the foreign look of him, and some pronounced incompatibilities not all chargeable to young Disraeli, soon raised a crop of troubles. His stay at Walthamstow was brief, his depar- ture abrupt, and he went to school no more. With the run of his father's library, and the benefits of that born bookman's guidance, he now set out to educate himself. This he did with an industry stiffened by matchless self- confidence and by ambitions fully mature before he was eighteen. Yet he yielded to an attempt to make a man of business of him. He was barely seventeen when (in November 1821) he was taken into the office of Messrs Swain, Stevens and Co., solicitors, in Frederick's Place, Old Jewry. Here he remained for three years — " most assidu- ous in his attention to business," said one of the partners, "and showing great ability in the transaction of it." It was then determined that he should go to the bar; and accordingly he was entered at Lincoln's Inn in 1824. But Disraeli had found other studies and an alien use for his pen. Though " assiduous in his attention to business " in Frederick's Place, he found time to write for the printer. Dr Smiles, in his Memoirs of John Murray, tells of certain pamphlets on the brightening prospects of the Spanish South American colonies, then in the first enjoyment of emancipation — pamphlets seemingly written for a Mr Powles, head of a great financial firm, whose acquaintance Disraeli had made. In the same year, apparently, he wrote a novel — his first, and never published. Aylmer Papillon was the title of it, Dr Smiles informs us'; and he prints a letter from Disraeli to the John Murray of that ■day, which indicates its character pretty clearly. The last chapter, its author says, is taken up with " Mr Papillon's banishment under the Alien Act, 'from a ministerial mis conception of a metaphysical sonnet." About the same time he edited a History ofPaulJones, originally published in America, the preface to the English edition being Disraeli's first appearance as an author. Murray could not publish Aylmer Papillon, but he had great hopes of its boyish writer (Isaac Disraeli was an old friend of his), "took him into his confidence, and related to him his experiences of men and affairs." Disraeli had not com-~~

pleted his twenty-first year when (in 1826) Murray was possessed by the idea of bringing out a great daily news- paper ; and if his young friend did not inspire that idea he keenly urged its execution, and was " The entrusted by Murray with the negotiation of all gg^^iye." manner of preliminaries, including the attempt to bring Lockhart in as editor. The title of the paper, Tlie Rejyresentative. was Disraeli's suggestion. He chose re- porters, looked to the setting-up of a printing-office, busied himself in all ways to Murray's great satisfaction, and, as fully appears from Dr Smiles's account of the matter, with extraordinary address. But when these arrangements were brought to the point of completion, Disraeli dropped out of the scheme and had nothing more to do with it. He was to have had a fourth share of the proprietorship, bringing in a corresponding amount of capital. His friend

Mr Powles, whom he had enlisted for the enterprise, was to have had a similar share on the same conditions. Neither seems to have paid up, and that, perhaps, had to do with the quarrel which parted Benjamin Disraeli and John Murray before a sheet of the luckless Representative was printed. Many years afterwards (1853) Disraeli took an active interest in Tlie Press, a weekly journal of con- siderable merit but meagre fortunes.

At the death of the elder Benjamin (1817), his son Isaac had moved from the King's Road, Gray's Inn (now Theobald's Road), to No. 6 Bloomsbury Square. Here he entertained the many distinguished friends, literary and political, who had been drawn to him by his " Curiosities " and other ingenious works, and here his son Benjamin also had their acquaintance and conversa- tion. In Bloomsbury Square lived the Austens, and to their house, a great resort of similar persons, Mrs Austen cordially welcomed him. Murray's friendship and asso- ciations helped him in like manner, no doubt ; and thus was opened to Disraeli the younger a world in which he was to make a considerable stir. The very much smaller society of that day was, of course, more comprehensible to sight and hearing, when once you were within its borders, than the society of this. Reverberations of the gossip of

~~St James's and Mayf air extended to Bloomsbury in those days. Yet Disraeli's range of observation must have been not only brief but limited when he sat down at twenty or twenty-one to write Vivian Orey. It is therefore a probable conjecture that Mrs Austen, a clever woman of the world, helped him from her knowledge. His own strongly perceptive imagination (the gift in which he was to excel every other politician of his time) and the bent of political reading and aspiration from boyhood completed his equip- ment ; and so the wonder that so young a man in Disraeli's social position should write a book like Vivian Orey is accounted for. It was published in 1826. The success of this insolently clever novel, the immediate introduction of its author to the great world, and the daring eccentricities of dress, demeanour, and opinion by which he fixed attention on himself there, have always been among the most favourite morsels of Disraeli's history. With them it began, and successive generations of inquirers into a strange career and a character still shrouded and baffling refer to them as settled starting- points of investigation. What was the man who, in such a society and with political aspirations to serve, could thrive by such vagaries as these, or in spite of them ? If unaffected, what is to be thought of them as keys to character ? If affected, what then ? Inquiry still takes this shape, and when any part of Disraeli's career is studied, the laces and essences, the rings over gloves, the jewelled satin shirt-fronts, the guitareries and chibou- queries of his early days are never remote from memory. The report of them can hardly be doubted ; and as the last relation was made (to the writer of this article) not with intent to ridicule Mr Disraeli's taste but to illustrate his conquering abilities, the story is repeated here. One of Disraeli's first friends in the world of fashion and genius was Sir Edward Lytton Bulwer. " And," said Sir Henry Bulwer (" Pelham's " brother), " we heard so much at that time of Edward's amazingly brilliant new friend that we were the less inclined to make his acquaintance." At length, however. Sir Edward got up a little dinner- party to convince the doubters. It was to meet at the early hour of those days at one of the Piccadilly hotels. " There was my brother, Alexander Cpckburn, myself, and (I think) MUnes ; but for a considerable time no Mr Disraeli. Waiting for Mr Disraeli did not enhance the pleasure of meeting him, nor when he did arrive did his appearance predispose us in his favour. He wore green~~

~~velvet trousers, a canary-coloured waistcoat, low shoes, silver buckles, lace at his wrists, and his hair in ringlets." The description of the coat is forgotten. " We sat down. Not one of us was more than five-and-twenty years old. We were all — if you will allow me to include myself — on the road to distinction, all clever, all ambitious, and all with a perfect conceit of ourselves. Yet if on leaving the table we had been severally taken aside and asked which was the cleverest of the party, we should have been obliged to say ' the man in the green velvet trousers.' " This story is a little lamp that throws much light. Here we see at their sharpest the social prejudices that Disraeli had to fight against, provocation of them carried to its utmost in every way open to him, and com- plete conquest in a company of young men less likely to admit superiority in a wit of their own years, probably, than any other that could have been brought together at that time.~~

~~Soon after the publication of Vivian Orey, Disraeli, who is said by Froude to have been "overtaken by a singular disorder," marked by fits of giddiness ("once he fell into a trance, and did not recover for a week "), went with the Austens on a long summer tour in France, Switz- erland, and Italy. Returning to a quiet life at Bradenham — an old manor-house near High Wycombe, which his father had taken — Disraeli put law in abeyance and resumed novel-writing. His weakest book, and two or three other productions, brief, but in every literary sense the finest of his works, were written in the next two or three years. But for Ixion in Heaven, The Infernal Marriage, and Popanilla, Disraeli could not be placed among the greater writers of his kind ; yet none of his imaginative books have been so little read as these. The mysterious malady continued, and Disraeli set out with William Meredith, who was to have married Sarah Disraeli, for a tour in southern Europe "*■~~

~~and the nearer East. He saw Cadiz, Seville, Granada,. Athens, Constantinople, Jerusalem, Cairo, Thebes ; played the corsair with James Clay on a yacht voyage from Malta- to Corfu ; visited the terrible Reschid, then with a Turkish army in the Albanian capital ; landed in Cyprus, and left it with an expectation in his singularly prescient mind that the island would one day be English. These travels- must have profited him greatly, and we have our share of the advantage ; not so much, however, in The Wondrous- Tale of Alroy or Tancred, or the " Revolutionary Epic " which~~

~~he was inspired to write on " the windy plains of Troy," but in the letters he sent home to his sister. These letters, written with the utmost freedom and fulness to the one whose affection and intellect he trusted more than any, are of the greatest value for interpreting the writer. Together with other letters also published some time after Disraeli's death, they tell more of him than anything that can be found in print elsewhere. They show, for example, that his extraordinary exuberances were unforced, leaping- by natural impulse from an overcharged source. They also show that his Oriental fopperies were not so much " purposed affectation " as Froude apd others have sur- mised. That they were so in great part is confessed again and again in these letters, but confessed in such a way as to reveal that they were permitted for his own enjoyment of them as much as planned. The " purposed affectation " sprang from an unaffected delight in gauds of attire, gauds of fancy and expression. It was not only to startle and impress the world that he paraded his eccen- tricities of splendour. His family also had to be impressed by them. It was to his sober father that he wrote, at the age of twenty-six : " I like a sailor's life much, though it. spoils the toilette." It is in a letter from Gibraltar to the same hand that we read of his two canes — " a morning- and an evening cane "—changed as the gun fires. And-~~

~~the same correspondent must be told that "Ealph's hand- kerchief which he brought me from Paris is the most successful thing I ever wore."~~

~~When Disraeli returned to England in 1831, all thought of the law was abandoned. The pen of romance was~~

~~again taken up— the poet's also and the poli- p'rodSS^ tician's. In the next five years he wrote tioa. Contarini Fleming, the Revolutionary Epick,~~

~~Alroy, Henrietta Temple, What is He? (a pam- phlet expository of his opinions), the Bunnymede Letters, a Vindication of the British Constitution, and other matter of less note. The epic, begun in great hope and con- fidence, was ended in less, though its author was to the last unwilling that it should be forgotten. The novels revived the success he had with Vivian~~

~~G'^ey, and restored him to his place among the brilliancies and powers of the time. The political writing, too, much of it in a garish, extravagant style, exercised his deeper ambitions, and stands as witness to the working of original thought and foresight. Both qualities are conspicuous in Wliat is He? and the Vindication, of which it has been truly said that in these pages he " struck the keynote to the explanations he afterwards consistently offered of all his apparent inconsistencies." Here an interpretation of Tory principles as capable of running with the democratic idea, and as called upon to do so, is ingeniously attempted. The aristocratic principle of government having been destroyed by the Reform Bill, and the House of Lords being practically " abrogated " by that measure, it became necessary that Toryism should start from the democratic basis, from which it had never been alien. The filched liberties of the Crown and the people should be restored, and the nation red.eemed from the oligarchies which had v^stolen from both. When at the beginning of all this writing Disraeli entered the political arena as candidate for, High Wycombe (1832), he was nominated by a Tory and seconded by a Radical — in vain ; and vain were two subsequent attempts in the autumn of 1832 and in 1834. In the first he was recommended to the electors by Daniel O'Connell and the Radical Hume. In his last candidature at Wycombe he stood on more independent ground, commending himself by a series of speeches which fully displayed his quality, though the prescience which gemmed them with more than one prophetic passage was veiled from his contemporaries. Among Disraeli's great acquaintances were many — Lyndhurst at their head — whose expectations of his future were confirmed by the Wycombe speeches. He was " thought of " for various boroughs, Marylebone among the number, but his demo- cratic Toryism seems to have stood in his way in some places and his inborn dislike of Radicalism in others. It was an impracticable situation — no getting on from it ; and so, at Lyndhurst's persuasion, as he afterwards ac- knowledged, he determined to side with the Tories. Accordingly, when in the spring of 1835 a vacancy oc- curred at Taunton, Disraeli contested the seat in the Tory interest with Carlton Club support. Here again he failed, but with enhanced reputation as a fighting politician and with other consequences good for notoriety. It was at Taunton that Disraeli fell upon O'Connell, rather ungrate- fully ; whereupon the Liberator was roused to retort on his assailant vehemently as " a liar," and humorously as a probable descendant of the imj)enitent thief. And then~~

followed the challenge which, when O'Connell declined it, was fastened on his son Morgan, and the interruption of the duel by seizure of Mr Disraeli in his bed, and his famous appearance in the Marylebone police court. He declared himself very well satisfied with this episode, but nothing in it can really have pleased him, not even the noise it made.

Here the first period of Disraeli's public life came to an

end, a period of preliminaries and flourishes, and of what he himself called sowing his political wild oats. It was a. more mature Disraeli who in the general elec- tion of 1837 was returned for Maidstone as the Baters colleague of his providential friend Mr Wy ndham ^enl' Lewis. Though the fortunes of the Tory party were fast reviving under Peel's guidance, the victory was denied him on this occasion ; but, for once, the return of the Whigs to power was no great disappointinent for the junior member for Maidstone. To gain a footing in the House of Commons was all that his confident spirit ever asked, and Froude vouches for it that he succeeded only just in time to avert financial ruin. His electioneering ventures, the friendly backing of bills, and his own ex- pense in keeping up appearances, had loaded him with debt. Yet (mark his worldly wisdom) " he had never entangled his friends in his financial dealings. He had gone frankly to the professional money-lenders, who made advances to him in a speculation on his success": they were to get their money back with large interest or lose it altogether. Such conditions were themselves, ■incitement enough to a prompt redemption of the- promise of parliamentary distinction, even without the- restless spurring of ambition. ' And t)israeli had another- promise to redeem : that which he uttered when he told O'Connell that they would meet again at Philippi. Therefore when, three weeks after the session began, a debate on Irish election petitions gave him oppor- tunity, Disraeli attempted that first House of Commons speech which imagination still dwells upon as something wondrous strange. That he should not have known better, even by hearsay, than to address the House of Commons in fantastic phrase from the mouth of a fantastic figure is indeed remarkable, but not that he retained self-confidence enough to tell the unwitting crew who laughed him down that a time would come when they would hear him. It was one of the least memorable of his prophecies. The speech was a humiliating but not an oppressive failure. In about a week afterwards 'he

~~spoke again, which shows how little damage he felt, while the good sense, brevity,, and blameless manuer of the speech (on a Copyright Bill) announced that he could learn. And for some time there- after he affected no importance in the House, though not. as withdrawing from attention.~~

~~Meanwhile, consciously and unconsciously, as is the^ way with men of genius, his mind was working upon problems of government, the magnitude, the relations,, and the natural developments of which he was more- sensible of than any known politician of his time. " Sensible of," we say, to mark the difference between one sort of understanding and another which comes of labour and pains alone. Disraeli studied too, no doubt, reading and inquiring and applying set thought, but "such means were insufficient to put into his mind all that he found there. It seems that opinions may be formed of inquiry and study alone, which are then constructive ; but where intuitive perception or the perceptive imaginar tion is a robust possession, the fruits of research become assimilative — the food of a divining faculty which needs, more or less of it according to the power of divination. The better judgment in all affairs derives from this quality, which has some very covetable advantages for- its possessor. His judgments may be held with greater confidence, which is an intellectual advantage; and, standing in his mind not so much an edifice as a natural growth, they cannot be so readily *"' abandoned at the call of ease or self-interest, isttcs. They may be denied assertion or even outraged for a purpose, but they cannot be got rid of, — which is a. moral advantage. Disraeli's mind and its judgments were of this character. Its greatest gift was not the romantic~~

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~~imagination which he possessed abundantly and employed overmuch, but the perceptive, interpretive, judicial or divining imagination, without which there can be no great man of affairs. Breadth of view, insight, foresight, ^are more familiar but less adequate descriptions of a faculty which Disraeli had in such force that it took command of him from first to last. Although he~~

~~knew and acted on the principle that " a statesman is a practical character," whose business is to " serve the country according to its present necessities," he was unable to confine his vision to the nearer consequences of whatever policy, or course of action, or group of conditions it rested on. Without effort, and even without intention probably, it looked beyond first consequences to the farther or the final out- come ; and to complete the operation, the faculty which detected the remoter consequences did not allow them to remain in obscurity, but brought them out as actualities no less than the first and perhaps far more important than the first. Moreover, it did not allow him to keep silence where the remoter consequences were of that character, and ought to be provided for betimes. Of course silence was always possible. These renderings to foresight might be denied assertion either for the sake of present ease (and Disraeli's prescience of much of his country's later troubles only made him laughed at) or in deference to hopes of personal advancement. But the same divining imagination which showed him these things also showed him the near time when it would be too late to speak of them, and when not to have spoken would leave him irredeemably in the ■ common herd of hand-to-mouth politicians. Therefore he spoke.~~

~~Remembrance of these characteristics — remembrance, too, that his mind, which was neither English nor Eu- ropean, worked in absolute detachment — should accom- pany the traveller through all the turns and incidents . of Disraeli's long career. They are sometimes puzzling, . often speculative) yet nearly all that is obscure in them becomes clear, much apparent contradiction disappears, when read by these persistent unvajrying lights. The command which his idiosyncrasies had upon him is shown, for example, by reproachful speeches on the treat- ment of Ireland, and by a startling harangue on behalf of the Chartists, at a time when such irregularities could but damage him, a new man, where he hoped for influence and ofiB-ce. At about the same time his political genius directed him to open a resolute critical campaign against the Conservatism of the party he proposed to thrive in, and he could but obey. This he did in writing '/^"b'" Goningsby, a novel of the day and for the "%rbii." day, but commended to us of a later generation not only by the undimmed truth of its character- portraits, but by qualities of insight and foresight which we who have seen the proof of them can measure as his~~

~~• contemporaries could not. Sybil, which was written in the following year (1845), is still more remarkable for the faculties celebrated in the preceding paragraph. When Sybil was written a long historic day was ending in England, a new era beginning ; and no eyes saw so~~

~~• clearly as Disraeli's the death of the old day, the birth of the new, or what and how great their differences would be. In Coningsby the political conditions of the country were illustrated and discussed from the constitutional point of view, and by light of the theory that for generar tions before the passing of the Eeform Bill the authority of the Crown and the liberties of the people had been absorbed and extinguished in an oligarchic system of government, itself become fossilized and soulless. In Sybil were exhibited the social relations of rich and poor (the " two nations ") under this regime, and under changes in which, while the peasantry were neglected by a shoddy~~

~~aristocracy ignorant of its duties, factory life and a purblind gospel of political economy embruted the rest of the population. These views were enforced by a startling yet strictly accurate representation of the state of things in the factory districts at that time. Taken from the life by Disraeli himself, accompanied by one or two members of the Young England party of which he was the head, it was the first of its kind ; and the facts as there dis- played, and Disraeli's interpretation of them — a marvel of perceptive and prophetic criticism — opened eyes, roused consciences, and led direct to many reforms.~~

~~These . two books, the Vindication, published in 1835, and his speeches up to this time and a little beyond, are quite enough to show what Disraeli's Tory-democracy meant, how truly national was its aim, and how exclusive of partisanship for the "landed interest " ; though he did believe the stability and prosperity of the agricultural class a national interest of the first order, not on economic grounds alone or even chiefly. And if Disraeli, possessed by these views, became aggressively insubordinate some time before Peel's proclaimed conversion to Pree-Trade, we can account for it on reasonable and even Creditable grounds. Spite, resentment at being passed over when Peel formed the 1841 Government, is one explanation of these outbreaks, and a letter to Peel, lately published, is proof to many minds that Disraeli's~~

~~denial to Peel's face in 1846 that he had ever solicited office was daringly mendacious. The letter certainly reads like solicitation in the customary half-veiled form. All that can be said in doubt is that since the '41 Government came into existence on the 6th of September, and the letter was written on the 5th, its interpretation as complaint of being publicly neglected, as a cravipg for some mark of recognition, is possible. More than possible it is if Disraeli knew on the 5th (as he very well might from his friend Lyndhurst, Peel's lord chancellor) that the appointments were then completfe. The pecuniary need of office, if that comes into the question, had been light- ened, if not extinguished, two years before by his marriage with Mrs Wyndham Lewis. Mrs Lewis — a lady fifteen years his senior — brought him a considerable fortune, which, however, was but for' her life. She lived to a great age, and would gladly have lived longer, in any of the afflictions that times brings on, to continue her mere money-worth to her " Dizzy." Her devotion to him, and his devotion to her, is the whole known story of their private life; and we may believe that nothing ever gratified him more than offering her a coronet from Mr Disraeli.~~

~~Disraeli made Peel's acquaintance early in his career and showed that he was proud of it. In his Life of Lord George Bentinck he writes of Peel fairly and even gener- ously. But they were essentially antipathetic persons ; and it is clear that the great minister and complete Briton took no pains to understand the dazzling young Jew of whom Lyndhurst thought so much, and wished to have little to do with him. Such men make such feelings evident ; and there is no reason for thinking that when, after 1841, Disraeli charged at Peel in obedience to his principles he gave himself pain. It was not long after it had settled in office that Peel's Government, the creature of an anxious Conservative reaction, began to be suspected of drifting toward Manchester. Sf/f^' That it was forced in that direction we should say rather, looking back, for it was a time of dire distress, especially in the manufacturing districts of the north ; so that in his second session Peel had to provide some relief by revising the corn laws and reducing import dues generally. His measures were supported by Dis- raeli, who undej.'stood that Protection must bend to the menacing poverty of the time, though unprepared for~~

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~~total abolition of the com tax and strongly of opinion that it was not for Peel to abolish it. In the next session (1843) he and his Young England party took up a [definitely independent r61e, which became more sharply critical to the end. Disraeli's first strong vote of hostility was on a Coercion Bill for perishing and rebellious Ire- land. It was repeated with greater emphasis in the session of 1844, also in a Condition-of-Ireland debate ; and from that time forth, as if foreseeing Peel's course and its effect on the' country party, Disraeli kept up the attack. Meanwhile bad harvests deepened the coun- try's distress, Ireland was approached by famine, the Anti-Corn-Law League became menacingly powerful, and Peel showed signs of yielding to Free Trade^ Disraeli's opportunity was soon to come now; and in 1845, seeing it on the way, he launched the brilliantly destructive series of speeches which, though they could not prevent the abolition of the corn- laws, abolished the minister who ended them. These speeches appeal more to admiration than to sympathy, even where the limitations of Disraeli's protectionist beliefs are under- stood, and where his perception of the later conse- quences of free trade is most cordially acknowledged. That he remained satisfied with them himself is doubt-' ful, unless for their foresight, their tremendous effect as instruments of punishment, and as they swept him to so much distinction. Within three years, on the death of Lord George Bentinck, there was none to dispute with him the leadership of the Conservative party in the House of Commons.~~

~~In the parliament of 1841 he was member for Shrews- bury. In 1847 he was returned for Buckinghamshire, and never again had occasion to change his constituency. Up to this time his old debts still embarrassed him, but now his private and political fortunes changed together. Froude reports that he "received a large sum from a private hand for his Life of Lord George Bentinck" (published in 1852), "while a Conservative millionaire took upon himself the debts to the usurers ; the 3 per cent, with which he was content being exchanged for the 10 per cent, under which Disraeli had been staggering." In 1848 his father Isaac Disraeli died, leaving to his son Benjamin nearly the whole of his estate. This went to the purchase of Hughenden Manor — not, of course, a great property, but with so much of the pleasant and picturesque, of the dignified also, as quite to explain what~~

~~it was to thB affectionate fancy of its lord. About this time, too (1851), his acquaintance was sought by an old Mts Brydges Willyams — born a Spanish Jewess and then the widow of a long-deceased Cornish squire — who in her dis- tant home at Torquay had conceived a restless admiration for Benjamin Disraeli. She wrote to him again and again, pressing for an appointment to consult on an important matter of business : would meet him at the fountaia of the Crystal Palace in Hyde Park. Her importunity succeeded,- and the very small, oddly'dressed, strange mannered old lady whom Disraeli met at the fountain became his adoring friend to the end of her life. Grati- tude for her devotion brought him and his wife in constant intimacy with her. There were many visits to Torquay ; he gratified her with gossiping letters about the great people with whom and the great affairs with which the man who did so much honour to her race was connected, that being the inspiration of her regard for him. She died in 1863, leaving him all her fortune, which was considerable ; and, as she wished, was buried at Hughen- den, close to the grave where Disraeli was to lie.~~

~~It is agreed that the first three years of Disraeli's leadership in Opposition were skilfully employed in reconstructing the shattered Tory party. In doing this he made it sufficiently clear that there could be no sudden~~

~~return to Protectionist principles. At the same time, however, he insisted (as he did from first to last) on the enormous importance to the country, to the . , , character of its people no less than to its mate- y,, ^^e rial welfare, of agricultural contentment and House ot prosperity ; and he also obtained a more general Commons. recc^nition of the fact that " the land " had borne fiscal burdens under the old regime which were unfair and unendurable under the new. So far he did well ; and when in 1852 he took ofiice as chancellor of the ex- chequer ifi Lord Derby's first Administration, the prospect was a smiling one for a man who, striving against difii- culties and prejudices almost too formidable for imagina- tion in these days, had attained to a place where he could fancy them all giving way. That, however, they were not. New difBculties were to arise and old prejudices to revive in full force. His first budget was a quaint failure, and was thrown out by a coalition of Liberals and Peelites which he believed was formed against Mr Disraeli more than against the chancellor of the exchequer. It was on this occasion that he exclaimed, "England does not love coalitions."~~

~~After a reign of ten months he was again in Opposition, and remained so for seven years. Of the Crimean war he had a better judgment than those whose weakness led them into it, and iie could tell them the whole truth of the affair in twenty words : " You are going t6 war with an opponent who does not want to fight, and whom you are unwilling to encounter." Neither were they prepared; and the scandals and polit- ical disturbances that ensued revealed him as a party leader who could act on such occasions with a dignity, moderation, and sagacity that served his country well, maintained the honour of party government, and cost his friends nothing. The mismanagement of the war broke down the Aberdeen Government in 1855, and then Disraeli had the mortification of seeing a fortunate chance of return to ofiice lost by the timidity and distrust of his chief. Lord Derby — the distrust too clearly includ- ing the undervaluation of Disraeli himself. Lord Derby wanted LordPalmerston's help, Mr Gladstone's, Mr Sidney Herbert's. This arrangement could not be made ; Lord Derby therefore gave up the attempt to form a ministry, and Lord Palmerston came in. The next chance was taken in less favouring.times. The Government in which Disraeli was again financial minister lasted for less than eighteen months (1858-59), and then ensued another seven years in the cold and yet colder shade of Opposition. Both of these seven-year outings were bad, but the second by far the worse. Parliamentary r'eform had become a burning question and an embarrassing one for the Tory- party. An enormous increase of business, consequent upon the use of steam machinery and free-trade openings to commerce, filled the land with prosperity, and dis-credited all statesmanship but that which steered by the star over Manchester. Mr Gladstone's budgets, made possible by this prosperity, were so many triumphs for Liberalism. Foreign questions arose which 'strongly excited English feeling — ^the arrangements of peace with Russia, Italian struggles for freedom, an American quarrel, the Arrow affair and the Chinese war, the affair of the French colonels, and the Conspiracy Bill ; and as they arose Palmerston gathered into his own sails (except on the last occasion) every wind of popular favour. Amid all this the Tory fortunes sank rapidly, becoming nearly hopeless when Lord Palmerston, without appreciable loss of confidence on his own side, persuaded many Tories in and out of Parliament that Conservatism would suffer little while he was in power. Yet there was great despondency, of course, in the Conservative~~

ranks; with despondency discontent ; with discontent rancour. The prejudice against Disraeli as Jew, the revolt at his theatri-

calisms, the distrust of him as ” mystery man,” whicli up to this time had never died out even among men who were his nearest colleagues, were now more openly in- dulged. Out of doors he had a ” bad press,” in Parlia- ment he had some steady, enthusiastic friends, but more that were cold. Sometimes he was seen on the front Opposition bench for hours quite alone. Little con- spiracies were got up to displace him, and might have succeeded but for an unconquerable dread of the weapon that destroyed Peel. In this state of things he patiently held his ground, working for his party more carefully than it knew, and never seizing upon false or discrediting advantages. But it was an extremely bad time for Ben- jamin Disraeli.

Though Lord Palmerston stumbled over his Foreign Conspiracy Bill in 1858, his popularity was little damaged, and it was in no hopeful spirit that the Tories took office again in that year. They were perilously weak in the House of Commons, and affairs abroad, in which they had small practice and no prestige, were alarming. Yet the new Administration did very well till, after resettling the government of India, and recovering from a blunder committed by their Indian secretary. Lord EUenborough, they must needs launch a Reform Bill to put that dan- gerous question out of controversial politics. The well- intended but fantastic measure brought in for the purpose was rejected. The country was appealed to, with good but insufficient results ; and at- the first meeting of the new parliament the Tories were turned out on a nb-con- fidence vote moved by Lord Hartington. Foreign affairs supplied the motive: failure to preserve the peace of Europe at the time of the Italian war of independence. It is said that the Foreign Office had then in print a series of despatches which would have answered its accusers had they been presented when the debate began, as for some unexplained reason they were not. Lord Palmerston now returned to Downing Street, and while he lived Disraeli and his colleagues had to satisfy them- selves with what was meant for useful criticism, though with small hope that it was so for their own service. A Polish insurrection, the

~~Schleswig-Holstein question, a commercial treaty with France, the civil war in America, gave Disraeli occasions for speech that was always forcible and often wiser than all could see at the time. He never doubted that England should be strictly neutral in the American quarrel when there was a strong feeling in favour of the South. All the while he would have gladly wel- comed any just means of taking an animated course, for these were dull, dark days for the Conservatives as a parliamentary party. Yet, unperceived. Conservatism was advancing. It was much more than a joke that Palmerston sheltered Conservative principles under the Liberal flag. The warmth' of his popularity, to which Radical applause contributed nothing in his later days, created an atmosphere entirely favourable to the quiet growth of Conservatism. He died in 1865. Earl Russell succeeded him as prime minister, Mr Gladstone as leader of the House of Commons. The party most pleased with the change was the Radical ; the party best served was Disraeli's. Another Reform Bill, memorable for driv ing certain good Liberals into a cave of Adullam, broke up the new Government in a few months ; Disraeli con- tributing to the result by the delivery of opinions not new to him and of lasting worth, though presently to be subordinated to arguments of an inferior order and much less characteristic. " At this rate," he said in 1866, " you will have a parliament that will entirely lose its command over the executive, and it will meet with less consideration and possess less influence." Look for declining states- manship, inferior aptitude, genius dying off. " Instead of these you will have a horde of selfish and obscure~~

~~mediocrities, incapable of anything but mischief, and that mischief devised and regulated by the raging dem- agogue of the hour." The Reform legislation which promised these results in 1866 was thrown out. Lord Derby's third Administration was then formed in the summer of the same year, and for the third time there- was a Tory Government on sufferance. Its followers^ were still a minority in the House of Commons ; an angry Reform agitation was going on ; an ingenious resolution founded on the demand for an enlarged franchise service- able to Liberals might extinguish the new Government almost immediately ; and it is pretty evident that the Tory leaders took office meaning to seek a cure for this desperate weakness by wholesale extension of the suffrage. Their excuses and calculations Reform are well known, but when all is said, Lord /se/." Derby's statement~~

~~of its character, " a leap in the dark," and of its intention, "dishing the Whigs," cannot be bettered. Whether Lord Derby or Mr Disraeli originated this resolve has been much discussed, and it remains an unsettled question. It is known that Disraeli's private secretary, Mr Ralph Earle, quarrelled with him violently at about this time ; and Sir William Eraser re- lates that, meeting Mr Earle, that gentleman said: "Iknow what your feelings must be about this Reform Bill, and I think it right to tell you that it was not Disraeli's Bill, but Lord Derby's. I know everything that occurred."' Mr Earle gave the same assurances to the writer of these lines, and did so with hints and half-confidences (quite intelligible, however) as to the persuasions that wrought upon his chief. Mr Earle's listener on these occasions confesses that he heard with a doubting mind, and that belief in what he heard still keeps company with Maho- met's coffin. One thing, however, is clear. To suppose Disraeli satisfied with the excuses made for his adoption of the " dishing " process is forbidden by the whole tenor of his teaching and conduct. He could not have become suddenly blind to the fallacy of the expectations derived from such a course ; and all his life it had been his dis- tinction to look above the transient and trafficking ex- pedients of the professional politician. However, the thing was done. After various remodellings, and amid much perturbation, secession, violent reproach, the House- hold Suffrage Bill passed in August 1867. Another mem- orable piece of work, the Confederation of Canada, had already been accomplished. A few days after Parliament met in the next year Lord Derby's failing health compelled him to resign, and Mr Disraeli be- came prime minister. Irish disaffection had long been astir ; the Fenian menace lool^d formidable not only in Ireland but in England also. The reconstructed Government announced its intention of dealing with Irish grievances. Mr Gladstone approved, proposing the abolition of the Irish Church to begin with. A resolution to that effect was immediately carried against the strong opposition of the Government. Disraeli insisted that the question should be settled in the new parliament which the Franchise Act called for, and he seems to have had little doubt that the country would declare against Mr Gladstone's proposal. He was mistaken. It was the great question at the polls ; and the first elections by the new constituencies went violently against the authors of their being.~~

~~The history of the next five years is Mr Gladstone's. The Irish Church abolished, he ^et to work with passion- ate good intention on the Irish land laws. The while he did so sedition took courage and flourished exceedingly, so that to pacify Ireland the constable went hand in hand with the legislator. The abolition of the Irish Church was followed by a Coercion Act, and the Land Act by suspension of Habeas Corpus. Disraeli, who at~~

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~~first preferred retirement and the writing of Lotlmir, came forward from time to time to p'oint the moral and predict the end of Mr Gladstone's impulsive courses, which soon began to fret the confidence of his friends. Some un pleasant errors of conduct — the Collier case, the Ewelme rectory case, the grave and significant Odo Russell scandal (to help the Government out of a scrape the ambassador was wrongfully accused of exceeding his instructions) — told yet more. Above all, many humiliating proofs that England was losing her place among the nations came out in these days, the discovery being then new and unendur- able. To be brief, in less than four years the Government had well-nigh worn out its own patience with its own «rrors, failures, and distractions, and would gladly have gone to pieces when it was defeated on an Irish University Bill. But Disraeli, having good constitutional reasons for declining office at the moment, could not allow this. Still gathering unpopularity, still offending, alarming, alienating, the Government went on till 1874, suddenly dissolvedParliament, and was signally beaten, the Liberal party breaking up. Like most of his political friends, Disraeli had no expectation of such a victory — little hope, indeed, of any distinct success. Yet when he went to Manchester on a brief political outing two years before, he was received with such acclaim as he had never known in his life. He was then sixty-eight years old, and this was his first full banquet of popularity. The elation and con- fidence drawn from the Manchester meetings were con- firmed by every circumstance of the 1874 elections. But he was well aware of how~~

~~much he owed to his opponents' errors, seeing at the same time how safely he could lay his future course by them. He had always rejected the political economy of his time, and it was breaking down. He had always refused to accept the economist's dictum without reference to other considerations than the turn- over of trade ; and even Manchester could pardon the refusal now. The national spirit, vaporized into a cosmopolitan mist, was fast condensing again under mortification and insult from abroad uncompensated by any appreciable percentage of cash profit. This was a changing England, and one that Disraeli could govern on terms of mutual satisfaction; but not if the reviving ■" spirit of the country " ran to extremes of self assertion. At one of the great Manchester meetings he said, "Do not suppose, because I counsel firmness q,nd decision at the right moment, that I am of that school of statesmen who are favourable to a turbulent and ag gressive diplomacy. I have resisted it during a large part of my life."~~

~~But for the hubbub occasioned by the Public Worship Kefeulation Act, the first two years of the 1874 adminis- tration had no remarkable excitements till near the end of them. The Public Worship Act, introduced by the Archbishop of Canterbury, was meant to restrain ritualism. Disraeli, who from first ^to last held to the Eeformed Church as capable of dispensing social good as no other organization might, supported the Bill as "putting down ritualism " ; spoke very vehemently ; gave so much offence that at one time neither the Bill nor the Government seemed quite safe. Eor some time afterwards there was so little legislation of the kind called " enterprising " that even some friends of the Government began to think it too tame ; but at the end of the second year an announce- ment was made which put that fear to rest. The news that the Khedive's Suez Canal shares had beeil bought by the Government was received with boundless Suez Canal applause. It was a courageous thing to do; shares. ^^^ .^ ^^^ ^^^ ^ Disraelian conception, nor did it originate in any Government department. It was suggested from without at a moment when the possibility of ever acquiring the shares was passing away. On the~~

~~morning of the 15th of November 1875, the then editor of the Pall Mall Gazette went to Lord Derby at the Foreign Office, informed him that the Khedive's shares were passing into the hands of a French syndicate, and urged arrest of the transaction by purchase for England. (The shares being~~

~~private property their sale could not, of course, be forbidden.) Lord Derby thought there must be a mistake. He could not believe that bargaining of that kind could go on in Cairo without coming to the knowledge of the British Consul there. He was answered that nevertheless it was going on. The difficulties of purchase by England were then arrayed by Lord Derby. They were more than one or two, and of course they had a formidable look ; but so also had the alternative and the lost opportunity. One difficulty had already come into existence, and had to be met at once. Lord Derby had either to make direct inquiry of the Khedive or to let the matter go. If he inquired, and there was no such negotiation, his question might be inter- preted in a very troublesome way; moreover, we should put the idea of selling the shares into the Khedive's head, which would be unfortunate. " There's my position, and now what do you say ? " The answer given. Lord Derby drafted a telegram to the British Consul- General at Cairo, and read it out. It instructed Colonel Stanton to go iminediately to the Khedive and put the question point blank. Meanwhile the prime minister would be seen, and Lord Derby's visitor might call next day to hear the reply from Cairo. It is enough to add here that on receipt of the answer the pur- chase for England was taken up and went to a speedy conclusion.~~

~~As if upon the impidse of this transaction, Disraeli opened the next session of Parliament with a Bill' to confer upon the Queen the title of Empress of India — a measure which offended the instincts of many Englishmen, and, for the time, revived the prejudices against its author. More important was the revival of disturbances in European Turkey, which, in their outcome, were to fill the last chapter of Disraeli's career. But for this inter- ruption it is likely that he would have given much of his attention to Ireland, not because it was an attractive employment for his few remaining years, but because he saw with alarm the gathering troubles in that country. And his mind was strongly drawn in, another direction. In a remarkable speech delivered in 1872, he spoke with great warmth of the slighting of the colonies, saying that " np minister in this country will do his duty who neglects any opportunity of reconstructing as much as possible our colonial empire, and of responding to those distant sym- pathies which may become the source of incalculable strength and happiness to this island." However, nothing was done in fulfilment of this duty in the first two years from lS74, and early in the third the famous Andrassy note, the Berlin memorandum,~~

the ^^^oa Bashi-Bazouk atrocities, and the accumulative ex- citement thereby created in England, reopened the Eastern question with a vengeance. The policy which Disraeli's Government now took up may be truly called the national policy. Springing from the natural suggestions of self- defence against the march of a dangerous rivalry, it had the sanction of all British statesmanship for generations, backed by the consenting instinct of the people. It was quite unsentimental, being pro-Turkish or anti-Russian only as it became so in being pro-British. The statesmen by whom it was established and continued saw in Russia a Power which, unless firmly kept within bounds, would dominate Europe ; more particularly, that it would undermine and supersede British authority in the East. And without ijicely considering the desire of Russia to expand to the Mediterranean, the Pacific, or in any other

direction, they thought it one of their first duties to maintain their own Eastern empire ; or, to put it another way, to contrive that Great Britain should be subject to Russian ascendancy (if ever), at the remotest period allowed by destiny. Such were the ideas on which England's Kussian policy was founded. In 1876 this policy revived as a matter of course in the Cabinet, and as spontaneously, though not upon a first provocation, became popular almost to fury. And furiously popular it remained. But a strong opposing current of feeling, equally passionate, set in against the Turks ; war began and lasted long; and as the agitation at home and the conflict abroad went on, certain of Disraeli's col- leagues, who were staunch enough at the beginning, gradually weakened. It is certainly true that Disraeli was prepared, in all senses of the word, to take strong measures against such an end to the war as the San Stefano treaty threatened. Eather than suffer that, he would have fought the Russians in alliance with the Turks, and had gone much farther in maturing a scheme of attack and/ defence than was known at the time or is commonly known now. That there was a master motive for this resolution may be taken for granted ; and it is to he found in a belief that not to throw back the Russian advance then was to lose England's last chance of post- poning to a far future the predominance of a great rival

~~power in the East. How much or how little judgment shows in that calculation, when viewed in the light of later days, we do not discuss. What countenance it had from his colleagues dropped away. At the end their voices were strong enough to insist upon the diplomatic action which at no point falls back on the sword ; Lord Derby (foreign minister) being among the first to make a stand on that resolution, though he was not the first seceder from the Government. Such diplomacy in such condi- tions is pa»alytic. It cannot speak thrice, with whatever affectation of boldness, without discovering its true char- acter to trained ears ; which should be remembered when Disraeli's successes at Berlin are measured. It should be remembered that what with the known timidity of his colleagues, and what with the strength and violence of the Russian party in England, his achievement at Berlin was like the reclamation of butter from a dog's mouth; as Prince Bismarck understood in acknowledging Disraeli's gifts of statesmanship. It should also be remembered, when his Eastern policy in 1876-78 is denounced as malign and a failure, that it was never carried out. Good or bad, ill or well calculated, effective existence was denied to it ; and a man cannot be said to have failed in what he was never permitted to attempt. The non- descript course of action which began at the Constan- tinople Conference and ended at Berlin was not of his direction until its few last days. It only marked at various stages the thwarting and suppression of his policy by colleagues who were haunted night and day by memories of the Crimean war, and not least, prob- ably, by the fate of the statesmen who suffered for its blunders and their own. Disraeli also looked back to those blunders, and he was by no means insensible to the fate of fallen ministers. But just as he main- tained at the time of the conflict, and after, that there would have been no Crimean war had not the British Government convinced the Tsar that it was in the hands of the peace party, so now he believed that a bold policy would prevent or limit war; and at the worst put off grave consequences which otherwise would make a rapid advance.~~

~~As if aware of much of this, the country was well content with Disraeli's successes at Berlin, though sore on some points, he himself sharing the soreness. Yet there were great days for him after his return. At the~~

~~Berlin Conference he had established a formidable reputa^ tion; the popularity he enjoyed at home was affection- ately enthusiastic ; no~~

~~minister had ever stood in more cordial relations with his sovereign; and his honours in every kind were his own achievement against un- ending disadvantage. But he was soon to suffer irre- trievable defeat. A confused and unsatisfactory war in Afghanistan, troubles yet more unsatisfactory in South Africa, conspired with two or three years of commercial distress to invigorate "the swing of the pendulum" when he dissolved parliament in 1880. Dissolution the year before would have been wiser, but a certain pride forbade. The elections went heavily against him. He took the blow with composure, and sank easily into a comparative retirement. Yet he still watched affairs as a great party leader should, and from time to time figured vigorously in debate. Mean- while he had another novel to sit down to — the poor though highly characteristic Endymion ; which, to his great surprise and equal pleasure, was replaced on his table by a cheque for ten thousand pounds. Yet even this satisfaction had its tang of disappointment ; for though Endymion was not wholly written in his last days, it was in no respect the success that Lothair was. This also he could bear. His description of his grandfather recurs to US : " A man of ardent character, sanguine, courageous, and fortunate, with a temper which no disappointment could disturb."~~

~~As Earl of Beaconsfield (failing health had compelled him to take refuge in the House of Lords in 1876) Benjamin Disraeli died in his house in Curzon Street on the 19th of April 1881. The likelihood of his death was publicly known for some days before the event, and then the greatness of his popularity and its warmth were declared for the first time. No such demonstration of grief was expected even by those who grieved the most. He lies in Hughenden churchyard, in a rail-enclosed grave, witii liberty for the turf to grow between him and the sky. Within the church is a marble tablet, placed there by his Queen, with a generous inscription to his memory. The anniversary of his death has since been honoured in an unprecedented manner, the 19th of April being celebrated as " Primrose Day " — ^the primjrose, for reasons impossible accurately to define, being popularly supposed to have been Disraeli's favourite flower. Even among his friends in youth (Sir Edward Lytton Bulwer, for example), and not improbably among the City ifloleflw men who wagered their money in irrecoverable loans to him on the chance of his success, there may have been some who compassed the thought of Benjamin Disraeli as prime~~

minister and peer ; but at no time could any fancy have imagined him remembered so enduringly as Lord Beaconsfield has been. It is possible that Sarah Disraeli (the Myra of Endymion), or that "the most severe of critics but a perfect wife," may have had such dreams — hardly that they could have occurred to any mind but a devoted woman's. Disraeli's life was a succession of surprises, but none was so great as that he should be remembered after death more widely, lastingly, respectfully, affectionately, than any other statesman in the long reign of Queen Victoria. While he lived he did not seem at all cut out for that distinction even as an Imperialist. Significant as was the common grief when he died, no such consequence could be inferred from it, and certainly not from the elections of 1880. It stands, however, this high distinction, and with it the thought that it would have been denied to him altogether had the " adventurer " and " mystery man " of the 'sixties died at the age of threescore years and ten. We have said that never till 1872 did he look upon the full cup of popularity. It might have been said that even at that

time intrigue to get rid of him had yet to cease in his own party ; and but a few years before, a man growing old, he was still in the lowest deeps of his disappointments and humiliations. How, then, could it be imagined that with six years of power from his seventieth year, the Jew "adventurer," mysterious and theatrical to the last, should fill a greater space in the mind of England twenty years after death than Peel or Palmerston after five ? Of course it can be explained ; and when explained, we see that Disraeli's good fortune in this respect is not due entirely to his own merits. His last years of power might have been followed by as long a period of more acceptable government than his own, to the effacement of his own from memory; but that did not happen. What did follow was a time of universal turbulence and sus- picion, in which the pride of the nation was wounded again and again. To say "Majuba" and "Gordon "re- calls its deepest hurts, but not all of them ; and it may be that a pained and angry people, looking back, saw in the man whom they lately displaced more than they had ever seen before. From that time, at any rate, Disraeli has been acknowledged as the

~~regenerator and represen- tative of the Imperial idea in England. He has alsobeed accused on the same grounds ; and if the giver of good wine may be blamed for the guest who gets drunk on it, there is justice in the accusation. It is but a statement of fact, however, that Disraeli retains his hold upon the popular mind on this account mainly. The rekindling of the Imperial idea is understood as a timely act of revolt and redemption: of revolt against continuous humiliations deeply felt, redemption from the fate of nations obviously weak and suspected of timidity. It has been called rescue-work — deliverance from the dan- gers of invited aggression and a philosophical neglect of the means of defence. And its first achievement for the country (this is again a mere statement of fact) was the restoration of a much -damaged self-respect and the creation of a great defensive fleet not a day too soon for safety. So much for " the great heart of the people." Meanwhile political students find to their satisfaction that he never courted popularity, and never practised the art of working for " quick returns " of sympathy or applause. As "adventurer" he should have done so; yet he neglected the cultivation of that paying art fbr the wisdom that looks to the long future, and bears its fruit, perchance, when no one cares to remember who sowed the seed. So it is that to read some of his books and many of his speeches is to draw more respect and admiration from their pages than could have been found there originally. The student of his life under- stands that Disraeli's claim to remembrance rests not only on the breadth of his views, his deep insight, his lor^g foresight, but even more on the courage which allowed him to declare opinions supplied from those qualities when there was no visible likelihood of their justification by experience, and therefore when their natural fate was to be slighted. His judgments had to await the event before they were absolved from ridicule or delivered from neglect. The event arrives ; he is in his grave; but his reputation loses nothing by that. It gains by regret that Death was beforehand with him.**

~~" Adventurer," as applied to Disraeli, was a mere term of abuse. "Mystery-man " had much of the same inten- tion, but in a blameless though not in a happy sense it was true of him to the end of his days. Even to his friends, and to many near him, he remained mysterious to the last. It is impossible to doubt that some two or three, four or five perchance, were at home in his mind, being freely admitted there; but of partial admissions to its inner places there seem to have been few or none. Men~~

~~who were long associated with him in affairs, and had much of his stinted companionship, have confessed that with every wish to understand his character they never succeeded. Sometimes they fancied they had got within the topping walls of the maze, and might hope to gain the point whence survey could be made of the whole; but as often they found themselves, in a moment, where they stood at last and at first — outside. His speeches carry us but a little way beyond the mental range ; his novels rather bafle than instruct. It is commonly believed that Disraeli looked in the glass while describing Sidonia in Coningshy. We group the following sentences from this description for a purpose that will be presently seen : — (1) "He was admired by women, idolized by artists, re- ceived in all circles with great distinction, and _. appreciated for his intellect by the very few to whom he at all opened himself." (2) "For, though affable and generous, it was impossible to penetra|;e him : though unreserved in his manners his ftankness was limited to the surface. He observed everything, thought ever, but avoided serious discussi'on. If you pressed him for an opinion he took refuge in raillery, and threw out some paradox with which it was not easy to cope. The secret history of the world was Sidonia's pastime. His great pleasure was to contrast the hidden motive with the public pretext of transactions." (3) "He might have discovered a spring of happiness in susceptibilities of the heart ; but this was a sealed fountain for Sidonia. In his organization there was a peculiar, perhaps a great deficiency ; he was a man without affection. It would be hard to say that he had no heart, for he was suscep- tible of deep emotions ; but not for individuals. Woman was to him a toy, man a machine." These sentences are separately grouped here for the sake of suggesting that they will more truly illustrate Disraeli's character if taken as follows : — The first as representing his most cherished social ambitions — in whatever degree achieved. The second group as faithfully and closely descriptive of himself : descriptive too of a character purposely cloaked. The third as much less simple ; in part a mixture of truth with Byronic affectation, and for the rest (and more significantly), as intimating the resolute exercise of extraordinary powers of control over the promptings and passions by which so many capable ambitions have come to grief. So read, Sidonia and Benjamin Disraeli are brought into close resemblance by Disraeli himself ; for what in this description is untrue to the suspected fundamentals of his character is true to his known foibles. But for a general interpretation of Lord Beaconsfield~~

~~andl his career none serves so well as that which Froude insists on most. He was thoroughly and unchangeably a Jew. At but one remove, by birth, from southern Europe and the East, he was an Englishman in nothing but his devotion to England and his solicitude .for her honour and prosperity. It was not wholly by volition and (iesign that his mind was strange to others arid worked in absolute detachment. He had " none of the hereditary prepossessions of the native Englishman." No such pre- possessions disturbed his vision when it was bent upon the rising problems of the time, or rested on the machinery of government and the kind of men who worked it audi their ways of working. The advantages of Sidonia's. intellect and temperament were largely his, in affairs, but- not without their drawbacks. His pride in his knowledge- of the English character was the pride of a student ; ani we may doubt if it ever occurred to him that there would have been less pride but more knowledge had he been an English'man. It is certain that in shrouding his own character he checked the communication of others to- himself, and so could continue to the end of his career the costly mistake of being theatrical in England. There~~

~~•was a great deal too (though little to his blame) in Lord Malmesbury's observation that he was not only disliked in the House of Commons for his mysterious manner, but prejudiced by a pronounced foreign air and aspect. Lord Malmesbury does not put it quite as strongly as that, but he might have done so with truth. No Englishman could approach Disraeli without some immediate consciousness that he was in the presence of a foreigner.~~

~~Lord Beaconsfield has been praised for his integrity in money-matters : the praise could have been spared — it does not rise high enough. It is also said to his honour that he " never struck at a little man," and that was well ; but it is explained as readily by pride and calculation as by magnanimity. A man of extraordinary coolness and self-control, his faults in every kind were faults of excess : it is the mark of them all. But whatever offence they gave, whatever mischief they did, was soon exhausted, and has long since been pardoned.~~

~~Lord Beaconsfield's Preface to 1849 edition of Isaac Disraeli's works. — Correspondence with his Sister, and Home Letters, edited by Ealph Disraeli. — Samuel Smiles. Memoirs and Correspond- ence of John Murray. — Life of the Earl of Beaconsfield, by F. HiTCHMAN. — JfemoiV by T. E. Kebbel. — Memoirhy J. A. Frodde. — Memoir by Harold Gorst. — Sir William Fraser's Disraeli and his Day. — The Speeches of Lord Beaconsfield, edited by T. E. Kebbel. — T. P. O'Connor's Life. — National Dictionary of Bio-~~ graphy. Personal knowledge. (f. g.)

~~Beaconsfield, a town of Cape Colony in Griquar land West, nearly 2 miles S.W. of Kimberley, after which it ranks as the most important place in the diamond fields. Although dating only from 1870, when it was founded neai- the famous Dutoit's Pan mine, and still figured on but few maps, it had a population in 1891 of 10,500, and in 1898 of over 13,000. In the same district are also the rich De Beer's and Bultfontein mines, for the collective •output of which, see Kimbbelet.~~

~~Beardsley, Aubrey Vincent (1872-1898), Eng- lish artist in black and white, was born at Brighton, 24th August 1872. In 1883 his family settled in London, and in th^ following year he appeared in public as an " infant musical phenomenon," playing at several concerts with his sister. In 1888 he obtained a post in an archi- tect's ofB.ce, and afterwards one in the Guardian Life and Fire Insurance Company (1889). In 1891, under the advice of Sir Edward Burne-Jones and M. Puvis de ■Chavannes, he took up art as a profession. In 1892 he attended the classes at the Westminster School of Art, then under Professor Brown; and from 1893 until his •death, at Mentone, 16th March 1898, his work came con- tinually before the public, arousing a storm of criticism and much hostile feeling. Beardsley had an unswerving tendency -towards the fantastic of the gloomier and "unwholesome" sort. His treatment of most subjects was revolutionary; he deliberately ignored proportion and perspective, and the "freedom from convention" which he displayed caused his work to be judged with harshness. In certain phases of technique he especially excelled; and his earlier methods of dealing with the single line in conjunction with masses of black are in their way unsurpassed, except in the art of Japan, the country which probably gave his ideas some assistance. He was always an ornamentist, rather than an illustrator ; and his work must be judged from~~

~~that point of view. His frontispiece to Volpone is held by some to be, from this purely technical standpoint, one of the best pen-draw- ings of the age. His posters for the Avenue Theatre and for Mr Eisher XJnwin were among the first of the modern cult of that art. *~~

~~The following are the chief works which are illustrated with draw- ings by Beardsley: the Bon Mot Library, The Pall Mall Budget, and The Studio (1893), Sir Thomas Malory's Morte d'AIHhur (1893-94),~~

~~Salome (1894), The Yellow Book (1894-95), The Savoy Magazine (1896), The Bape of the Lock (1896).~~

~~See also J. Pennbll. The Studio. 1893.— Stmons. Aubrey Beardsley. 1898. — R. Ross. Volpone. 1898. — H, C. Marillier. The Early Work of Aubrey Beardsley. 1899. — Smitheks. Bepro- ductions of drawings by Aubrey Beardsley. — John Lane. The Later Works of Aubrey Beardsley. 1901. (e. f. s.)~~

~~Beardstown, a city of Cass county, Illinois, U.S.A., situated in the western part of the stated on the east bank of Illinois river, at an altitude of 448 feet. It is entered by two railways, the Baltimore and Ohio South- western, and the Chicago, Burlington, and Quincy. Popu- lation (1880), 3135; (1890), 4226; (1900), 4827.~~

~~Bearings, Ball and Roller. — There are two methods usually adopted for the transport of loads along roads, namely, by wheels or by rollers. The former consists of a disc or wheel, turning on a spindle or axle ; in this case frictional resistance due to the load is exerted at the bearing surface of the wheel on the axle, and has to be met and overcome. The latter arrangement, in its primitive form, is usually adopted for the transport of heavy loads only. It possesses the advantage that, as there is no rubbing contact between the surface of the rollers and the load, purely frictional resistances do not exist. This argument is strictly only true when the rollers are hard and work on true hard surfaces. The ball bearing, which has done much to make the cycle carriage efBcient, com- bines the adoption of the principle involved in the latter method de- scribed above, with its application to the former, so that the frictional resist- ances which would otherwise 6xist between wheel and axle are practically eliminated. In place of rollers, however, balls are~~

~~generally used, espe- cially for light loads, as they possess the obvious ad- vantage that, being symmetrical about a centre, there is no need to constrain them, as in the case of rollers whose axes must be kept in correct relation to each other. It will be seen that in the case of a sphere placed between two plane surfaces actual contact is made at two points only, and the stresses at these points under a load are correspondingly severe. Eor this reason it is necessary to employ in a bearing a large number of balls in order to increase the points of support, and to make the balls themselves and the paths on which they run of the finest hardened steel, and perfectly true in form. Perfect rolling contact is only obtained when the balls and contact surfaces touch at points, and then only when the parts in contact are not constrained to move at different speeds in relation to each other. It is frequently the case that, in order to obtain more contact surface so as better to support a load, the paths on which the balls run are curved to fit the balls, but in such cases friction, due to rubbing contact in place of true rolling contact, must necessarily result. In light machines, such as bicycles, it is customary to have one circle of balls to each bearing, but for heavier bearings these are increased in number; and as the examination and separation of a bearing with a large number of balls would be exceedingly inconvenient, it is customary to carry the balls in cages or some similar device. Where heavy loads have to be carried it is customary to use rollers in a bearing in place of balls, with very satisfactory results. It is absolutely necessary, however, that the axes of the rollers should retain a symmetrical relation to each other, and that their peripheries should not touch, or friction will result.~~

~~Ball Beabino.~~

~~The circle of rollers is therefore carried either in a cage or some other contrivance. A well-designed bearing is shown in the figure. The balls and paths are capable of ready removal from the outer bracket support, and when removed the balls are prevented from falling by the ring paths. Very heavy loads, such as bridges, guns, and their mountings, &c., are commonly carried on a cir- cle of rollers, forming in effect roller bearings, with such~~

~~excellent results that the resistance to rotation is very small compared with the total load. (g. h. ba.)~~

~~Beatrice, capital of Gage county, Nebraska, U.S.A., situated in the south-eastern part of the state, in the valley of Big Blue river, at an altitude of 1265 feet, in an agricultural regi,on. It has three railways : the Burlington and Missouri Eiver ; the Chicago, Eock Island, and Pacific ; and the Union Pacific. Population (1900), 7875.~~

~~Beau lieu, a French village in the arrondissement of Nice, department of Alpes Maritimes, 5 miles E. by N. of Nice and 1 mile S.E. of Villefranche, of which it may be regarded as an extension. Formerly a mere hamlet, it has become in recent years a frequented and fashionable winter resort, and has numerous handsome villas. In the vicinity are interesting grottoes. Population (1891"), 184 :~~

~~(1896), 1031.~~

~~Beaumont, capital of Jefferson county, Texas, U.S.A., situated on Neches river, in the eastern part of the state, in a rich agricultural region, where cotton is the principal product. It is surrounded by dense forests of pine and cypress, and has extensive lumber manufactures. In 1901 wells were sunk at Beaumont, and petroleum was found in large quantities. It is at the intersection of four railways, affording communication in all directions. Pop- ulation (1900), 9427.~~

~~Beaumont, Sir John (1583-1627), English poet, second son of the judge. Sir Francis Beaumont, was born at Grace-Dieu, in Leicestershire, in 1583. The deaths of his father (in 1598) and of his elder brother, Sir Henry Beaumont (in 1605), made the poet early the head of this brilliant family ; the dramatist, Francis Beaumont, being a younger brother. John went to Oxford in 1596, and entered as a gentleman commoner in Broadgate's Hall, the present Pembroke College. It is said that he was intended for the law, but on the death of Henry he no doubt went down to Grace-Dieu to manage the family estates. He began to write verse early, and in 160§, at the age of nineteen, he published anonymously his Metamorphosis of Tobacco, written in very smooth couplets, in which he addressed Drayton as his "loving friend." He lived in Leicestershire for many years as a bachelor, being one~~

~~"who never felt Love's dreadful arrow." But in process of time he became a tardy victim, and married a lady of the -Fortescue family, who bore him four stout sous, the eldest of whom, another John, was accounted one of the most athletic men of his time. " He could leap 16 feet at one leap, and would commonly, at a stand-leap, jump over a high long table in the hall, light on a settle beyond the table, and raise himself straight up." This magnificent young man was not without literary taste ; he edited his father's posthumous poem s, and wrote an enthusiastic elegy on him ; he was killed in 1644 at the siege of Gloucester. Another of Sir John Beaumont's sons, Gervaise, died in childhood, and the incidents of his death are recorded in one of his father's most touching poems. Sir John Beau- mont concentrated his powers on a poem in eight books, entitled The Crown of Thorns, which was greatly admired in MS. by the earl of Southampton and others, but which is lost. After long retirement, Beaumont was persuaded by the duke of Buckingham to move in larger circles ; he~~

~~attended court, and in 1626 was made a baronet. This honour he did not long survive, for he died on the 19th of April 1627, and was buried in Westminster Abbey ten days later. The new Sir John, the strong man, published in 1629 a volume entitled Bosworth Field; with a taste of th/e variety of other Poems left by Sir John Beaumont. No- more " tastes " were ever vouchsafed, so that it is by this volume and by the juvenile Metamorphosis of Tobacco that Beaumont's reputation has to stand. Of late years, the peculiarities of John Beaumont's prosody have drawn attention to his work. He wrote the heroic couplet,, which was his favourite measure, with almost unprece- dented evenness. Bosworth Field, the scene of the battle of which Beaumont's principal poem gives a vaguely epical narrative, lay close to the poet's house of Grace- Dieu. He writes on all occasions with a smoothness which was very remarkable in the first quarter of the 17th century, and which marks him, with Waller and Sandys, as one of the pioneers of the classic reformation of English verse. (b. g.)~~

~~Beauregard, Pierre Custave Toutant (1818- 1893), American soldier, was born near New Orleans), Louisiana, on 28th May 1818. At the United States military academy he graduated second in his class in July 1838, and was detailed as a lieutenant of engineers. In the Mexican war he distinguished himself in siege operations at Vera Cruz, and upon the advance to the~~

~~Mexican capital was wounded and twice brevetted. As captain of engineers, in March 1853, he took charge of constructive defences in and about Louisiana and the Gulf coast (1863-60), and was superintendent at West Point in January 1861 for a few days. Resigning his United States commission on 20th February 1861, he became a brigadier-gpneral of the new Soutliern Confed- eracy, and was sent to direct the operations at Charles- ton, South Carolina, which resulted in the capture of Fort Sumter and the outbreak of civil war. Ordered next to- Virginia, he won, with General Joseph E. Johnston, the first battle of Bull Run (21st July), was promoted to general, and in the spring of 1862 went to Tennessee as second in command to General Albert S. Johnston. When that officer was killed during the battle of Shiloh on 6th April, Beauregard assumed command. Nearly routing his adversary the first day, he was compelled on the second to fall back to Corinth, Mississippi, which he evacuated in good order on 30th May, i^pon General Halleck's approach. His health now failing, he performed less conspicuous service ; defending Charleston (September 1862- April 1864) ; reinforcing Lee near Petersburg (May 1864) ; and later in . 1864 attempting with inadequate troops to resist General Sherman's march through Georgia, and the Carolinas. With General Joseph E. Johnston he surrendered to Sherman in April 1865. After the war he engaged in railway management, became adjutant-general of his native state, and served the Louisiana lottery. He died in New Orleans, 20th February 1893.~~

~~Beauvais, chief town of department of Oise, France, 44 miles N.N.W. of Paris, with stations on the railway from Paris to Trefort and other lines. Besides its other industries, Beauvais is a great centre of toy manu- factures. Population (1881), 14,934; (1896), 16,371.~~

~~Beaverdam, a city of Dodge county, Wisconsin, U.S.A., situated in the south-eastern part of the state, in 45° 28′ N. lat. and 88° 52′ W. long., at an altitude of 873 feet. The Chicago, Milwaukee, and St Paul Railwaypasses through it. Its position on the shore of Beaverdam Lake makes it an attractive summer resort. It is the seat of Wayland University. Population (1900), 6128.~~

~~Beaver Falls, a borough of Beaver countyj,~~

Pennsylvania, U.S.A., situated in the western part of the state, on Beaver river, 30 miles north-west of Pittsburg, at an altitude of 784 feet, on the Pennsylvania and the Pittsburgh and Lake Erie railways. It is in the coal and natural gas region and has extensive manufactures. It is the seat of Geneva College. Population (1900), 10,054.

Beawar, a town of British India, the administrative headquarters of Merwara district in Eajputana, situated in 26° 9′ N. lat. , and 74° 23′ E. long., 33 miles from Ajmer. Population, about 20,000. It is an important centre of trade, especially in raw cotton, and has four factories for ginning and pressing cottoq, two of which are worked by hydraulic pressure. ”

Bebel, Ferdinand August (1840), German

socialist, was born at Cologne on the 22nd of February 1840 ; he became a^urner and worked at Leipzig. Here he took a prominent part in the workmen’s movement and in the association of working men which had been founded under the influence of Schultz-Delitzsch ; at first an opponent of socialism, he came under the influence of Liebknecht, and since 1865 he has been a confirmed ad- vocate of socialism. With Liebknecht he belonged to the branch of the socialists which was in close corre- spondence with Karl Marx and the International, and refused to accept the leadership of Schweitzer, who had attempted to carry on the work after Lassalle’s death. He was one of those who supported a vote of want of con- fidence in Schweitzer at the Eisenach conference in 1867, from which his party was generally known as ” the Eisen- acher.” In this year he was elected a member of the North German Keichstag for a Saxon constituency, and, with the exception of the years 1881 to 1883, has been a member of the German Parliament ever since. His great organizing talent and oratorical power quickly made him one of the leaders of the socialists and their chief spokesman in parliament. In 1870 he and Liebknecht were the only members who did not vote the extraordinary subsidy required for the war

with Prance ; the followers of Lassalle, on the other hand, voted for the Government proposals. He was the only Socialist who was dected to the Eeichstag in 1871, but he used his position to protest against the ■annexation of Alsace-Lorraine and to express his full sympathy with the Paris Commune. Bismarck after- wards said that this speech of Bebel's was a "ray of light," showing him that Socialism was an enemy to be fought against and crushed ; and ' in 1872 Bebel was accused in Brunswick of preparation for high treason, and condemned to two years' imprisonment in a fortress, and, for insulting the German emperor, to nine months' ordinary imprisonment. After his release he helped to organize, at the Congress of Gotha, the united party of Social Demo- crats, which had been formed during his imprisonment. After the passing of the Socialist Law he continued to show great activity in the debates of the Eeichstag, and was also elected a member of the Saxon Parliament; when the state of siege was proclaimed in Leipzig he was expelled from the city, and in 1886 condemned to nine months' imprisonment for taking part in a secret society. Although the rules of the Social Democratic party do not recognize a leader or president, Bebel has since been by far the most influential member of the party. In)the party meetings of 1890 and 1891 his policy was severely attacked, first by the extremists, the " young " Socialists from Berlin, who wished to abandon parliamentary action; against these Bebel won a complete victory. On the other side he was involved in a quarrel with Volmar and his school, who desired to piit aside from immediate consideration the complete attainment of the Socialist ideal, and proposed that the party should aim at bringing about, not a com-

plete overthrow of society, but a gradual amelioration. The conflict of tendencies then begun has continued, and Bebel has come to be regarded as the chief exponent of the traditional views of the orthodox Marxist party. He has been exposed to some natural ridicule on the ground that the " Kladderadatsch," which he often spoke of as imminent, has not yet taken place. On the other hand, though a strong opponent of militarism, he has publicly stated that foreign nations attacking Germany must not expect the help or the neutrality of the Social Democrats. His book, Die Frau und der Socialismus, which has gone through many editions, and contains an attack on the institution of marriage, has identified him with the most extreme forms of Socialism.

~~Mehring. Oeschichte der deutschen Social-Demokratie. Stutt- gart, 1898. — Reports of the Annual Meetings of the Social Demo- cratic Party. Berlin Vorwarts Publishing Company, 1890-1900. — B. RcssBLL. German Social Democracy. London, 1897.~~

~~(j. W. HE.)~~

~~Beccles, a municipal borough, market town, and railway station, in the Lowestoft parliamentary division of Suffolk, England, on the Waveney, 10 miles W. by S. of Lowestoft. The corporation is lord of the manor and principal landowner. There are now extensive printing works and a hospital. Area of borough (a parish), 2017 acres; population (1881), 5721; (1891), 6669; (1901),~~

~~6898.~~

~~Bechuanaland, acoimtryof British South Africa, which occupies all the central part of the great inland plateau, stretching from the Orange Eiver uninterrupt- edly northwards to the Zambezi, and merging gradually westwards in the Kalahari desert. It is thus coterminous on the east with Orange Eiver Colony, Transvaal, alnd Eho- desia, and on the west with German South-West Africa,~~

~~Tribal Groups.~~

~~Territory.~~

~~Area in Square MUes.~~

~~Popula- tion.~~

~~Chief Kraals.~~

~~Batlaro and Basao-~~

~~maka (totem, Klu,~~

~~the Elephant) ;~~

~~chief, Mankoroane Batlapin (totem,~~

~~Tlapi, the Fish);~~

~~chief, Mankoroane Barolong (totem,~~

~~Jfan, the Buffalo);~~

~~chief, Montsioa~~

~~Total, South Be~~

~~Bawanketsi (totem, Kwena, the Croco- dUe); chief, Bath- oen~~

~~Bakwena (totem, Kwena) ; chief, Se- bele~~

~~Bamangwato and Batwana (totem, Puti, the duiker Antelope) ; chiefs, Khama and Sec- home~~

~~Total, Noeth Be~~

~~From Griqua- land West to Kuruman and Taungs~~

~~Between Taungs and Vryburg~~

~~Between Vry- burg and Molopo river~~

~~JHUANALAND .~~

~~From the Mo- lopo to the Kanya dis- trict~~

~~From Kanya to .Tropic of Capricorn~~

~~From Scheie's to the Zam- bezi and westwards to and be- yond Lake Ngami~~

~~CHOANALAND .~~

~~30,000 20,000~~

~~60,000 30,000~~

~~Kuruman~~

~~Taungs Mafeking~~

~~50,000~~

~~90,000~~

~~50,000 160,000~~

~~100,000 400,000~~

~~Kanya~~

~~Formerly Kolobeng, now Mo- lepolole~~

~~Formerly Shoshong, now Palapye~~

~~200,000~~

~~500,000~~

~~where the conventional boundaries, as laid down by the Anglo-German agreements of 1884 and 1890, coincide partly with 20° and partly with 21° E. Gr. This region, which enjoys almost complete ethnical unity, being mainly inhabited by various branches of the great Bechuana na- tion, is divided politically into two sections — SouthBechua- naland, from the Orange to the Molopo river, forming since~~

~~1895 an integral part of Cfape Colony ; and North Bechvr Kxnaland, from the Molopo to the Zambezi, since 1885 a British protectorate. In both sections the natives retain their primitiye tribal organization, with their hereditary chiefs, totems (tutelar deities), recognized territories, and head kraals (stations), as tabulated above.~~

~~Here the areas include extensive hunting grounds claimed by the several tribe's in the Kalahari desert, and in the populations are comprised some thousands of the so- called BarKalahari, i.e., Bushman, half-breeds, formerly slaves, now servants and farm assistants of their Bechuana masters. The emancipation of these debased Bushman groups was one of the most beneficent results of the extension of British rule over Bechuanaland. Khama, the central figure if not the recognized paramount chief of the Bechuana nation, has long administered his extensive territory and controlled his formerly lawless Bamangwato subjects with a vigour combined with kindness which would reflect credit on any European potentate. In this ■Christian prince are embodied all the higher qualities of which the Bantu race is capable, and he, with Moshesh, Chaka, and a few others, has been appealed to in proof of the mental superiority of the Negroid Bantus over the full- blood Sudanese negro. In the protectorate the three chiefs, ' Khama, Sebele, and Bathoen, continue to govern their own people under the protection of Great Britain, which is rep- resented by a Resident Commissioner stationed at the ad- ministrative capital, Mafeking, and acting under the High Commissioner of South Africa. The natives pay a hut- tax, which is collected by the chiefs, and order is main- tained by a force of mounted police. The people are occupied chiefly with stock-breeding, and in recent years have suffered greatly from drought and rinderpest. In con- sequence of these losses the expenditure has in some years greatly exceeded the revenue (in 1897, £88,450 and £47,- 510 respectively) ; but in normal times accounts are bal- anced, and the population appears to be increasing. Khama had always forbidden the importation of spirits in his territory, and at present no licenses are granted for their sale in any part of the protectorate. For the physical features, climate, and other geographical de- tails, see South Africa.~~

~~J. D. Hepburn. Twenty Tears in Khama's Country. London, 1895.— Sib Harry Johnston. The Colonization of Africa. Cam- bridge, 1899.— A. H. Keane. Africa, vol. ii. London, 1895.~~

~~(a. h. k.)~~

~~Becent History.—Withthe settlement of Dr Livingstone in the country in the easrly 'forties, the political history of Bechuanaland may be said to begin. In 1852 a trader named M'Cabe was~~

stopped by the Boers whilst crossing the Kalahari. This satisfied Livingstone that the Boers were endeavouring to close the country to British coloniza- tion. " The Boers," he wrote, " resolved to shut up the interior, and I determined to open the country." At this time the Boers attacked Setylli, a tribal chief, and tried to induce Montsioa, chief of the Barolong, to assist them, but he refused to be drawn into the strife. At a later date they tried to raise taxes from the Barolong, but without success. This led to a protest from Montsioa, which he lodged with a landdrost at Potchefstroom in the Transvaal, threatening to submit the matter to the British High Commissioner if any further attempt at taxation were made on the part of the Boers. The Boers then resorted to cajolery, and invited the Barolong to join their territories with the Transvaal, in order to save them from becoming British. Montsioa's reply was short : " No one ever spanned in an ass with an ox in one yoke." These overtures of the f reebooting parties of Boers having failed, the president of the Transvaal in 1872 endeav- oured to replace Monsioa as chief of the Barolong by

Moshette, whom he declared to be the rightful ruler and paramount chief of that people. The attacks of the Boers at length became so unbearable that Montsioa made a request to the British authorities to be taken under their protection. In formulating this appeal he declared that when the Boers were at war with Moselekatze, chief of the Matabele, he had aided them on the solemn under- taking that they were to respect his boundaries. This promise they had broken. Khama, chief of the Bamang- wato in Northern Bechuanaland, wrote about the same time to Sir Hdnry Barkly making an appeal similar to that sent by the Barolong. The letter, which is a remarkable one, contained the following significant passages : " I write to you. Sir Henry, in order that your queen may preserve for me my country, it being in her hands. The Boers are coming into it, and I do not like them." " Their actions are cruel among us black people. We are like money, they sell us and our children." " I ask Her Majesty to defend me, as she defends all her people. There are three things which distress me very much — war, selling people, and drink. All these things I shall find in the Boers, and it is these things which destroy people to make an end of them in the country. The custom of the Boers has always been to cause people to be sold, and to- day they are still selling people." The statements of Khama in this letter do not appear to have been exaggerated. The testimony of Livingstone confirms them, and even a Dutch clergyman, writing in 1869, described the

~~system of apprenticeship of natives which obtained among the Boers " as slavery in the fullest sense of the word." These representations on the part of the Barolong, and the Bamangwato under Khama, supported by the representations of Cape poli- ticians, led in 1878 to the military occupation of Southern Bechuanaland by a British force under Colonel Warren. The imperial troops at Warren's disposal, with the Kimberley volunteers, were able to check the Boers in the district aj; that time. With regard, however, to the indignant protests that were made by missionaries and travellers on the subject of Boer cruelty towards the natives, it is only fair to say that at the outset, in a large number of instances, the Boers' aid was called in by one or other native chief, a party to the tribal strife continu- ally raging among the Bantu. In fact what occurred in Bechuanaland occurred more or less throughout South Africa. A continual struggle for power was going on, amongst petty Bantu chieftains, who did not hesitate to call in any allies they could obtain. Thus in 1881 Massow invited the aid of the Boers against Mankoroane, who claimed to be paramount chief of Bechuanaland. The Transvaal war of that date offered opportunities to the freebooting Boers of the west which were not to be lost. Once having entered upon the scene of internal native warfare, the Boers continued their interference until Montsioa himself became involved, the Boers professing to support the claims of Moshette.~~

~~At this time the British forces were too much occupied with the Boers themselves to be able to respond to native appeals for help. Consequently the Boers pro- ceeded without let or hindrance with their f^^'''"'f conquest and annexation of territory. In oosbea. 1882 they set up the republic of Stellaland, with Vryburg as its capital, and forthwith proceeded to set up the republic of Goshen, farther north, in spite of the protests of Montsioa, and established a small town called Eooi Grond as capital. They then summoned Montsioa to quit the territory. The efforts of the British. authorities E^t this period (1882-83) to bring about a satis- factory settlement were feeble and futile, and fighting continued until peace was made entirely on Boer lines. The Transvaal Government was to have supreme power, and to be the final arbiter in case of future quarrels arising among~~

~~the native chiefs. This agreement, arrived at witkout any reference to the British Government, was a breach of the Pretoria Convention, and led to an intimation on the part of Great Britain that she could not recognize the~~

~~• new republics. In South Africa, as well as in England, strong feeling was aroused by this act of aggression. Unless steps were taken at once, the whole of Bechuana- land might be permanently lost, while German territory on the west might readily be extended to join with that of the Boers. In the London Convention of 1884, con- ceded by Lord Derby in response to the overtures of Boer delegates, the Transvaal boundaries were defined, but in spite of this convention the Boers remained in Bechuana- land, and at length the Eev. John Mackenzie, who had succeeded Livingstone, was sent to the country to arrange matters. He found very little difficulty in negotiating with the various Bechuana chiefs, but with the Boers he was not so successful. In Goshen the Boers defied his authority, while in Stellaland only a half-hearted acceptance of it was given. He was then recalled by Sir Hercules Eobinson, and Mr Rhodes succeeded him as deputy commissioner of Bechuanaland.~~

~~\ Mr Rhodes's mission was attended with great difficulty. British prestige after the disastrous Boer war of 1881 was at a very low ebb, and he realized that he could not count on any active help from the imperial or colonial authorities. He adopted a tone of conciliation, and decided that the Stellaland republic should remain under a sort of British suzerainty. But in Goshen the Boers would let him do nothing. Joubert, after meeting him at Rooi Grond, entered the country and attacked Montsioa. Mr Rhodes then left under protest, declaring that the Boers were making war against Great Britain. The Boers now proclaimed the country Transvaal territory. This was a breach of the London Convention, and Mr Kruger explained that the steps had been taken in the "interests of humanity." Indignant protest in Cape Town and throughout South Africa, as well as England, led to the despatch in October 1884 of the Warren Expedition, which was sent out by the British Govern- ment to remove the filibusters, to bring about peace in the country, and to hold it until further measures were decided upon. Mr Kruger met Sir Charles Warren's force at the Modder river, and~~

~~endeavoured to stop him from proceeding farther, saying that he would be respon- sible for keeping order in the country. Warren, however, proceeded with his mission, and broke up the republics of Stellaland and Goshen. Bechuanaland was formally taken under British protection, and the sphere of British influence was declared to extend to the 22nd parallel of latitude.~~

~~The natives cheerfully accepted this new departure in British policy, and from this time forward Khama's country was known as the British Protectorate of Bechuanaland. That, portion lying to the south of the Molopo river was described as British Bechuanaland, and was constituted a crown colony. In 1890 the northern portion also passed under the control of the governor of British Bechuanaland, Sir Sidney Shippard, a protest being made at the time by the British South Africa Com- pany, on the ground that it was included in the sphere of their charter. Under the able administration of Sir Sidney Shippard peace was maintained among the na- tives, who have shown great loyalty to British rule.~~

~~A review of the history of the country down to this date shows how much has been due to the efforts of men like Livingstone, Mackenzie, and Rhodes. It is quite clear that had they not represented the true state of affairs to the authorities the whole of this territory would have gradually been absorbed by the Boers, until they had effected a union with the Germans on the west. The~~

~~great trade route to the north-^the " Suez Canal of South Africa," as Mr Rhodes called it — would thus have been effectually shut against trade and British colonization. With regard to the precise effect of missionary influence upon the natives, opinion will always remain divided. But Livingstone, who was not only a missionary but also an enlightened traveller, stated that a considerable amount of benefit had been conferred upon the native races by missionary teaching. Livingstone was a great advo- cate of the prohibition of alcohol among the natives, and that policy has always been adhered ta^y Khama.~~

~~In 1891 the Customs Union was extraded to British Bechuanaland, and in 1895 the country was annexed to Cape Colony. At the same time it was provisionally arranged that the Bechuanaland protectorate should pass under the administration of the British South Africa Company. On learning~~

~~what was going on, Khama and two other Bechuana chiefs came to England and protested against this arrangement. The result was that their territories and those of other petty chiefs lying to the north of the Molopo were made native reserves, into which the importation of liquor was forbidden. A British resident officer was to be appointed to each of the reserves. A stipulation, however, was made with these chiefs that a strip of country sufficient for the purposes of the Matabeleland railway should be conceded to the Chartered Company. In December 1895, the occurrence of the Jameson Raid, an expedition which started from theseterritories, prevented the completion of negotiations, and the whole of Nort];iern Bechuanaland still remains a British protectorate. The two chief towns in British Bechuanaland are Mafeking and Vryburg, Palapye being the chief town in the protectorate. The railway is now extended throughout the entire length of the country, and up to Bulawayo in Rhodesia. Material progress during the last few years in Bechuanaland has not been great, owing to disturbed political conditions, but there is little question that as a grazing country, and also possibly for agricultural and mineral purposes, the country has a promising future.~~

~~Authorities. — Theal. History of South Africa; South African History and Geography. — Livingstone. South Africa. — Private correspondence; Sir David Tennantand Sir Henry Bulwer. John Mackenzie. Austral Africa, Losing it or Muling it. — Statistical Begister, Cape of Good Hope, 1899. — Pkatt. Leading Points in South African History. — Vindex. Cecil Rhodes, His Political Life and Speeches. (j^_ p. H.)~~

~~Beckenham, a parish and urban district in the Sevenoaks parliamentary divisioii of Kent, England, 10 miles S. of London by rail. Although one of the more remote outlying districts around London, it has found great favour as a place of residence among City business men, andTias changed from a village to a rapidly-growing modern town. It still retains many of its rural characteristics, and has wide thoroughfares and many handsome residences standing in extensive grounds. It has adopted electric lighting andpublicbaths. Population of urban district(area, 3881 acres) (1881), 13,045; (1891), 20,707; (1901), 26,330.~~

~~Beckx, Petrus Johannes (1795-1887), twenty- second General of the Jesuits, was born at Sichem, near Louvain in Belgium, on 5th February 1795, and was ad- mitted to the Society of Jesus at Hildesheim in 1819. In 1826 the conversion of Duke Ferdinand and Duchess Julia of Anhalt-Kothen (daughter of Frederick William II. of Prussia) to the Roman Catholic faith produced a great sensation in Germany ; and it was a proof of Father Beckx's reputation that he was recommended by the General of the Order as their confessor. On the death of the duke he accompanied the duchess to Vienna, where he acquired great influence over the highest persons of the state, and in particular over Metternich.~~

~~On the expulakm of the Jesuits in 1848 he became rector of the college of Louvaiu; but in 1852 was recalled to Austria, and became Superior for Hungary, to which of&ce was soon added that of Provincial of Austria. It was greatly owing to his exertions that the Primate of Hungary, Cardinal Szcitowski, obtained the revocation of the edict of 1848, expelling the Jesuits from Hungary. In 1853 Father Beckx attended the General Assembly of the Jesuits at Eome, where on 2nd July he was elected Oeneral of the Order in succession to Father Eoothaan, by twenty-seven votes against sixteen given for Father Pierling. In 1883, owing to his great age, he received the assistance of Father Anderledy, vicar-general, and in the following year resigned to him the ofEice of General. During his long tenure of the post (only exceeded by one of his predecessors, Claudio Acquaviva), he had seen the Jesuits emerge triumphant from the disasters of 1848 ; and thejr had proved too strong even for so formidable a foe as Bismarck. This success was largely the work of Father Beckx, whose combination of energy and tact, as well as his personal piety^ gave him a preponderant influence in the Church. Pius IX. in particular placed unbounded confidence in him. He died at Eome on 4th March 1887. His Month of Mary, published anonymously in 1838, ran through many editions, and was translated into most of the European languages (English edition, 1883). He was also joint-author of the Kothen Prayer- Book, another work that obtained the widest circulation. But his literary activity~~

~~was chiefly confined to the Jesuit organ, Civiltd, CattoUca, of which he was the founder and director. (h. sy.)~~

~~Bedford, a municipal and parliamentary borough (co-extensive and returning one member), market town, and county town of Bedfordshire, England, on the Ouse, 50 miles N.N. W. of London by rail.]$ew buildings at the Grammar School were erected in 1891 at a cost of £25,000. In 1900 a further separate building for younger boys was opened, and there have also been recently erected admi- rably-equipped carpentering, engineering, and other work- shops. The chemical and physical laboratories, gym- nasium, &c., have been fitted out with every modern convenience and appliance. The number of scholars at the end of 1900 was 876. The Harpur Trust also governs a modern school with (1900) 508 boys, a high school with 538 girls, a modern school 'with 213 girls, and elementary schools with 1975 children. This last figure was formerly much larger, but three board schools, providing accommodation for 2670 children (1901), have been opened in order to relieve the Trust. Technical classes under the control of the county council are also conducted in the town. The old grammar school buildings have been turned intd a town hall, &c. Mod- ern structures include the barracks (£50,000), the corn exchange, the shire hall (rebuilt at a cost of £20,000), a suspension bridge, a theatre, and the county hospital (£34,000). The Bedford rooms are now used as a library. There are statues of John Bunyan (1874) and of John Howard, the philanthropist (1894). "Bunyan Meeting, a chapel on the site of that in which the former preached, has interesting memorials of its founder. The corporation owns the markets and the water supply, and provides electric light. The water supply from the present sources being insufficient to meet the growing demands of the town, a scheme was proposed in 1901 for bringing water from Henlow, 12 miles distant. A provisional order to construct and work tramways has been granted to the corporation. A public park of 61 acres was opened in 1888, and another of 23 acres in 1894. Large engineer- ing works have also been erected. Pillow-lace making in the neighbourhood is almost extindt. Area, 2200**

~~acres; population (1881), 19,532; (1891), 28,023;~~

~~(1901), 35,144.~~

~~Bedford, a city of Indiana, U.S.A., capital of Lawrence county, in the southern part of the state, at the intersection of three railways. It has extensive stone quarries. Population (1900), 6115.~~

~~Bedfordshire, a south midland county of England, is bounded on the N. by Huntingdon, on the N.W. by Northampton, on the W. by Buckingham, on the S. by Hertford, and on the E. by Hertford and Cambridge.~~

~~Area and Population. — According to the census returns of 1891 the area of the ancient and administrative county was 298,494 acres, or 466 square miles, with a population in 1881 of 149,473, and in 1891 of 160,704, of whom 75,477 were males, and 85,227 females, the number of persons to a square mile being 345, and of acres to a person 1-80. Since 1891 the area of the adminis- trative county has undergone various alterations. In 1896 the parish of Swineshead was transferred from Huntingdon to Bedford, and the parish of Tilbrook from Bedford to Huntingdon ; and in 1897 a part of the parish of Caddington, and the parishes of Kens- worth and Studham, were transferred from Hertford to Bedford, and the hamlet of Humbershoe, part of the parish of Houghton Regis, the parish of Holywell, and parts of the parish of Shilling- ton, from Bedford to Hertford. The area of the registration county is 309,989 acres, with a population in 1891 of 165,999, of which 74, 189 were urban, and 91,810 rural. Within this area the increase of population between 1881 and 1891 was 7-59 per cent. Between 1881 and 1891 the excess of births over deaths was 21,383, but the increase in the resident population was only 11,713. In 1901 the population was 171,699. The following table gives particulars as to births, deaths, and marriages in 1880, 1890, and 1898 : — '~~

~~Year.~~

~~Marriages.~~

~~Births.~~

~~Deaths.~~

~~Illegitimate births.~~

~~Males.~~

~~Females.~~

~~1880 1890 1898~~

~~975 1052 1298~~

~~5008 4597 4423~~

~~3064 2667 2697~~

~~191 139 113~~

~~189 125 107~~

~~In 1899 the number of marriages was 1213, of births 4328, and of deaths 2858.~~

~~The following table gives the marriage-, birth-, and death-rates per thousand of the population, with the percentage of illegitimate births, for a series of years : —~~

~~1870-79.~~

~~1880.~~

~~1880-89.~~

~~1890.~~

~~1888-97.~~

~~1898.~~

~~Marriage-rate .~~

~~14-1~~

~~12-6~~

~~13-5~~

~~12-1~~

~~13-5~~

~~14-9~~

~~Birth-rate .~~

~~33-7~~

~~32-4~~

~~31-2~~

~~27-8~~

~~27-3~~

~~25-4~~

~~Death-rate~~

~~19-6~~

~~19-8~~

~~17-7~~

~~16-2~~

~~16-0~~

~~15-5~~

~~Percentage of~~

~~illegitimacy .~~

~~7-2~~

~~7-6~~

~~6-6~~

~~6-7~~

~~5-5~~

~~5-0~~

~~Both the birth-rate and the death-rate were below those of Eng- land. In 1891 there were in the county 658 natives of Scotland, 663 natives of Ireland, and 316 foreigners.~~

~~Constitution and Government. — The county is divided Into two parliamentary divisions, and also includes the parliamentary borough of Bedford returning one memiber. There are three municipal boroughs : Bedford, Dunstable, and Luton. The urban districts are Ampthill, Biggleswade, Kempston, and Leighton- buzzard. The county is in the Midland circuit, and assizes are held at Bedford. The boroughs of Bedford, Dunstable, and Luton have separate commissions of the peace, and Bedford has in addition a separate court of quarter sessions. The ancient county, which forms an archdeanery in the diocese of Ely, con- tains 125 ecclesiastical parishes and districts, and parts of 6 others.~~

~~Education. — The number of elementary schools on 31st August 1899 was 156, of which 69 were board schools and 87 voluntary, the latter including 80 National Church of England schools, 3 Wesleyan, 1 Roman Catholic, and 3 "British and other." The average attendance at board schools was 13,315, and at voluntary schools 14,019. The total school board receipts for the year ending 29th September 1899 were over £47,247. The income under the Technical Instruction Act was over £8, and that under the Agricultural Rates Act was over £1550.~~

~~Agriculture. — About nine-tbnths of the total area of the county is under cultivation. Of the corn crops, which still occupy an exceptionally large area, wheat is still the chief, although its area within the last 25 years has diminished more than a third. Potatoes and turnips occupy an almost eq<2al area, but the area of~~

the former is gradually increasing. The following table gives the principal acreages at intervals of five years from 1880 : —

Year.

Area under crops.

Corn crops.

Green crops.

Clover.

Perma- nent pasture.

Fallow.

1880 1885 1890 1895 1900

260,376 260,298 259,396 254,997 257,346

109,878

101,026

99,350

89,571

88,043

31,810 35,283 29,932 29,813 31,752

20,696 22,795 21,028 22,317 26,471

81,090 87,944 96,703 99,773 102,794

~~16,901 13,250 12,203 13,235- 7,954~~

~~The following table gives particulars regarding the live stock for the same years : —~~

~~Tear.~~

~~Total horses.~~

~~Total cattle.~~

~~Cows or heifers~~

~~in miUc or~~

~~in calf.~~

~~Sheep.~~

~~Pigs.~~

~~1880 1885 1890 1895 1900~~

~~12,082 11,882 11,665 12,103 11,991~~

~~31,552 37,525 33,467 30,023 34,833~~

~~10,751 12,187 12,233 11,092 11,876~~

~~152,084 151,813 121,994 96,278 104,759~~

~~28,526 32,545 33,958 32,826 25,280~~

~~Industries and Trade. — According to the report of the inspector of factories for 1898 (1900), there were no persons employed in textile factories, while 6383 were employed in non-textile factories, and 6788 in workshops. Between 1895 and 1896 there was an increase of 7-4 per cent, in the number of persons employed in non-textile factories, and between 1896 and 1897 an increase of 15-8. Of those employed in workships no~~

~~fewer than 5901 are in the "returns" stated to be employed in "clqthing." This in- cludes chiefly those employed in the point pillow lace manufacture, which is an extensive female industry, and in the straw plait manufacture carried on mainly at Luton and Dunstable. In the manufacture of machines^ conveyances, tools, etc., nearly 2300 persons are employed, there being at Bedford extensive agp-icultural implement and engineering works. In 1899, 611,745 tons of chalk were raised, 166,829 tons of clay, and 78,420 tons of gravel and sand.~~

~~AoTHORiTiES. — The more important works are : Abbot. Flora Bedfordiensis, 1898. — Fishe. Collections, Historical, Genealogical, and Topographical, for Bedfordshire. London, 1812-16, and also 1812-36. — Parey. Select Illustrations of Bedfordshire, London, 1827 ; Bedfordshire Domesday Book, Bedford, 1881 ; Visitation of Bedford, 1566, 1582, and 1634, in Harleian Society's Publica- tions, vol. xiv., London, 1884 ; and Qenealogica Bedfordiensis, 1538, 1800, London, 1890 ; and Illustrated Bedfordshire, Nottingham, 1895. See also Bedfordshire Notes and Queries, ed. F. A. Blades, and Transactions of the Bedfordshire Natural History and Field Club.~~

~~Beecher, Henry Ward (1813-1887), American preacher and reformer, was born in Litchfield, Connecti- cut, 24th June 1813. He was the ninth child of Lyman and Koxana Foote Beecher, and brother of Harriet Beecher Stowe. Entering Amherst College in 1830, he gave more attention to his own courses of reading than to college studies, and was more popular with his fellows than with the faculty. With a patience foreign to his impulsive nature, he submitted to minute drill in elocu- tion, and becam e a fluent extemporaneous speaker. Beared in a Puritan atmosphere, he has graphically described the mystical experience which, coming to him in his early youth, changed his whole conception of theology and determined his choice of the ministry. "I think," he says, " that when I stand in Zion and before God, the highest thing that I shall look back upon will be that blessed morning of May, when it pleased God to reveal to my wondering soul the idea that it was His nature to love a man in his sins for the sake of helping him out of them." In 1837 he graduated from Lane Theological Seminary in Ohio, of which his father was president, and entered upon his work as pastor of a missionary Presbyterian church at Lawrenceburg, a village on~~

~~the Ohio, a few miles below Cincinnati. The member- ship numbered nineteen women and one man. Mr Beecher was sexton as well as preacher. Two years later he accepted a call to Indianapolis. His unconventional preaching shocked the more staid members of the flock.~~

~~but filled the church to overflowing with people unaccusi- tomed to churchgoing. He studied men rather than books ;; became acquainted with the vices in what was a pionecF town ; and in his Sermons to Young Men treated these with genuine power of realistic description and with youth- ful and exuberant rhetoric. Eight years l^ter (1847) he accepted a call to the pastorate of Plymouth church (Con- gregational), then newly organized in Brooklyn, New York. The situation of the church, within five minutes' walk of the chief ferry to New York, the stalwart character of the- men who had organized it, and the peculiar eloquence of Mr Beecher, combined to make the pulpit a national plat- form. The audience-room of the church, capable of seating 2000 or 2500 people, frequently contained 500 or lOOO more.~~

~~Mr Beecher at once became a recognized leader. On the all-absorbing question of slavery he took a middle ground' between the pro-slavery or peace party, and abolitionists like William Lloyd Garrison and Wendell Phillips, believing, with such statesmen as W. H. Seward,. S. P. Chase, and Abraham Lincoln, that slavery was to be- overthrown under the constitution and in the Union, by forbidding its growth and trusting to an awakened con- science, enforced by an enlightened self-interest. He was always an anti-slavery man, but never technically Aa abolitionist. In the earlier days of the agitation, he chal- lenged the hostility which often mobbed the anti-slavery gatherings; in the later days he consulted with the political leaders, inspiring the patriotism of the North,, and sedulously setting himself to create a public opinion which should confirm and ratify the emancipation pro- clamation whenever the President should issue it. When danger of foreign intervention cast its threatening shadow across the national path, he went to England, and by his famous addresses did what probably no other American could have done to strengthen the spirit in England favour- able to the United States, and to convert the doubtful and the hostile. For a little while he acted as one of the editors of the Independent, then a Congregational news- paper; and his editorials, copied far and wide, produced a profound impression on the public mind by clarifying and defining the issue. Later,~~

he founded and became editor- in-chief of the Christian tfnion, afterwards the Outlook, a weekly religious undenominational newspaper. His lect- ures and addresses had the spirit if not the form of his. sermons, just as his sermons were singularly free from the homiletical tone. Yet his work as a reformer was subsidi- ary to his work as a preacher. He was not indeed a parish pastor ; he inspired church activities which grew to large proportions, but trusted the organization of them to laymen of organizing abilities in the church ; and for acquaintance with his people he depended on such social occasions as were furnished in the free atmosphere of this essentially New England church at the close of every service, but during his pastorate the church grew to be probably the largest in membership in the United States.

It was in the pulpit that Mr Beecher was seen at his best. His mastery of the English tongue, his dramatic power, his instinctive art of impersonation, which had become a second nature, his vivid imagination, his breadth of intellectual view, the catholicity of his sympathies, his. passionate enthusiasm, which 'made for the moment his theme seem to him the one theme of transcendent import- ance, his quaint humour alternating with genuine pathos, and above all his simple and singularly unaffected devotional nature, made him as a preacher without a peer in his ovm time and country. His favourite theme was love ; love to man was to him the fulfilment of all law ; love of God was the essence of all Christian- ity. Eetaining to the day of his death the forms and phrases of the New England theology in which he

had been reared, he poured into them a new meaning, and gave to them a new significance. He probably did more than any other one man in America to lead the Puritan churches from a faith which regarded God as a moral governor, the Bible as a book of laws, and religion as obedience to a conscience, to a faith which regards God as a Father, the Bible as a book of counsels, and religion as a life of liberty in love. The later years of his life were darkened by a scandal which Mr Beecher's personal, political, and theological enemies used for a time effectively to shadow a reputation previously above reproach. But in the midst of these accusations the largest

~~and most representative Congregational council ever held in the United States, gave expression to a vote of confidence in him, which time has absolutely justified. It is safe to say that the verdict of history will class this scandal with the somewhat similar, but more excusable one, respecting John Wesley. Not a student of books nor a technical scholar in any department, Mr Beecher's knowledge was as wide as his interests were varied. He was early familiar with the works of Matthew Arnold, Charles Darwin, and Herbert Spencer ; he preached his Bible Studies sermons in 1878, when the higher criticism was wholly unknown to most evangelical ministers or known only to be dreaded ; and his sermons on Evolution and Beligion in 1886, when many of the ministry were denouncing evolution as atbeistic. He was stricken with apoplexy while still active in the ministry, and died at Brooklyn on Tuesday, 8th March 1887, in the seventy-fourth year of his age.~~

~~The principal books by Mr Beecher, besides his published sermons, are: Seven Lectures to Young Men, 1844. Plymouth Collection of Hymns and Tunes, 1855. Star Papers, Experiences of Art artd Nature, 1855. Life Thoughts, 1858. Views and Ex- periences of Religious Sulyects, 1858. Plain and Pleasant Talks about Fruits, Flowers, and Farming, 1859. Speeches on the American Mehellion — Manchester, G-lasgow, Edinburgh, Liverpool, and London; London, 1864. Prayers from Plymouth Pulpit, 1867. Norwood: A Tale of Village Life in New England, 1867. TTie Life of Jesusthe Christ, 2 vols., 1871. Yale Lectures on Preaching, 3 vols., 1872-74.~~

~~The principal lives of Mr Beecher are : Henry Ward Beecher : A Sketch of His Career. By Ltman Abbott and S. B. Halliday, 1883. — Beecher : Christian Philosopher, Pulpit Orator, Patriot and Philanthropist. By T. W. Handford, 1887. — Life of Henry Ward Beecher. By Joseph Howard, Jr., 1887. — A Biography of Henry Ward Beecher. By William C. Beecher, Rev. Samuel Scoville, and Mrs H. W. Beecher. — Henry Ward Beecher. By John Henry Barrows, 1893. — Henry Ward Beecher: a Study. By John R. Howard, 1891. — The Boyhood of Henry Ward Beecher. By Frank S. Child (Pamphlet), 1897. — The History of Plymouth Church. By Noyes L. Thompson, 1847-72.— TAe Life and Work of Henry Ward Beecher. By Thomas W. Knox. (l. A.)~~

~~Beechworth, a beautifully situated town in the county of Bogong, Victoria, Australia, with a station 172 miles by rail N.E. of Melbourne. It is the chief town of the Ovens goldfields, on which over 6000 miners are em- ployed. The town has several churches and various public buildings,! including a good library and museum. Mean temperature for the year, 65-2° F.; for January, 69-7° F. ; for July, 41-0° F. Mean rainfall (4 years), 29-29 inches. Population (1891), 2528; (1901), 7359.~~

~~Beer. See Brewing.~~

~~Beets, Nikolaas (1814.), Dutch poet, was~~

~~born at Haarlem on the 13th of September 1814 ; con- stant references in his poems and sketches show how deeply the beauty of that town and its neighbourhood impressed his imagination. He studied theology in Leyden, but gave himself early to the cultivation of poetry. In his youth Beets was entirely carried away on the tide of Byronism which was then sweeping over Europe, and his early works — Jose, 1834; Kuser, 1836 ; and Guy de Vlam- ing, 1837 — are gloomy romances of the most impassioned type. But at the very same time he was beginning in prose~~

~~the composite work of humour and observation which has; made him famous, and which certainly had nothing that was in the least Byronic about it. This was the celebrated Camera Obscura (1839), the most successful imaginative work which any Dutchman of this century has produced. This work, published under the pseudonym of " Hilde-. brand," goes back in its earliest inception to the year 1835, when Beets was only twenty-one. It consists of complete short stories, descriptive sketches, studies of peasant life — all instinct with humour and pathos, and written in a style of great charm ; it has been reprinted in countless editions. Beets became a professor at the University of Leyden, and the pastor of a congregation in that city. In middle life he published further collections of verse — Cornflowers, 1863, and Hew Poems, 1857 — in which the romantic melancholy was found to have disappeared, and to have left in its place a gentle sentiment and a depth of religious feeling. In 1873-75 Beets collected his works in three volumes. In April 1883 he visited Scotland, when the honorary degree of LL.D. was conferred upon him by the University of Edinburgh. (b. q.)~~

~~Begas, Reinhold (1831), German sculptor,~~

~~the son of Karl Begas, a distinguished painter, was born at Berlin on 15th July 1831. He received his early education (1846-51) in the ateliers of Eauch and Wiehmann. During a period of study in Italy, from 1856-1858, he was- influenced by Bocklin and Lenbach in the direction of a naturalistic style in sculpture. This tendency was marked in the group " Borussia," executed for the faqade of the Exchange in Berlin, which first, brought him into general notice. In 1861 he was appointed professor at the Art School in Weimar, but retained the appointment only a few months. That he was chosen, after competition, to execute the statue of Schiller for the Gendarmen Markt in Berlin, was a high tribute to the fame he had already acquired ; and the result, one of the finest statues in the German metropolis, tirely justified his selection. Since the year 1870, Begas has entirely domi- nated the plastic art in Prussia, but especially in Berlin. Among his chief works during this period are the colossal statue of Borussia for the Hall of Glory; the Neptune fountain in bronze on the Schlossplatz ; the statue of Alexander von Humboldt, all in Berlin ; the sarcophagus of the Emperor Frederick III. in the mausoleum of the Friedenskirche at Potsdam ; and, lastly, the national monu- ment to the Emperor William (see Beklin), the statue of Bismarck before the Reichstag Gebailde, and several of the statues in the Siegesalle. He was also entrusted with the execution of the sarcophagus of the Empress Frederick.~~

~~Begles, a suburban town in the department of Gironde, France, 3 miles S.S.E. of Bordeaux, on the rail- way from Bordeaux to Cette. The principal manufactured products are chemicals, artificial manure, soap, and candles ; and fish-curing is an important industry. Pop- ulation (1881), 7238 ; (1896), 10,372.~~

~~Behar, or Bihak, a town of British India, in the Patna district of Bengal, which gives its name to an old province, situated on the right bank of the river Paur- chana. Population (1881), 48,968; (1891), 47,723; (1901), 44,894. There are still some manufactures of silk and muslin, but trade has deserted Behar in favour of Patna, and other places more favourably situated, on the river Ganges and the railway. The old province, stretch- ing widely across the valley of the Ganges from the fron- J;ier of Nepal to the~~

hills of Chota Nagpur, corresponds to the two administrative divisioiis of Patna and Bhagalpur, with a total area of 44,197 square miles, population of 23,127,104, and a land revenue of Rx.1,426,876, or nearly one million sterling. It is the most densely populated

"tract in India, and, therefore, always liable to famine; but it is now well protected almost everywhere by railways. It is a country of large landholders, and also of indigo planters. The vernacular language is not Bengali, but a dialect of Hindi ; and the people likewise resemble those of Upper India.

Beira, a region of Portugal, formerly divided between the provinces of Beira Alta and Beir Baixa, but now comprised within the districts of Vizeu (answering to the former), and Guarda and Castello Branco (corre- sponding to the latter).

Beira, (town). See East Afkica, Portuguese.

Beirut, or Betrout. (1) A viMyet of Syria which stretches along the sea^coast from Jebel el-Akra, south of the Orontes, to the Nahr Zerka> south of Mount Carmel, and towards the south extends from the Mediterranean to the Jordan. (2) The chief town of the viMyet', ancient Berytus, the most important sea-port town in Syria, situated on the south side of St George's Bay, on rising ground at the foot of Lebanon. Since the pacification of the Lebanon after the massacre of the Christians in 1860, Beirut has greatly increased in extent, and has become the centre of the transit trade for all Syria. In 1894 a small harbour, constructed by a French company, was opened, but the dues are so high that trade is being driven away to Haifa and Tripoli. In 1896 a French company com- pleted a railway across the Lebanon to Damascus, and connected it with a line from Damascus to Mezeirib in the Haur^n. In 1898 a portion of a railway from Beirut to Tripoli was opened. The town has been supplied with water, since 1875, by an English company, and with gas, since 1888, by a French conipany. There are many American and European institutions in the city :

~~the American Presbyterian mission, with a girls' school and a printing ofBce, which published the Arabic translation of the Bible, and now issues a weekly paper and standard works in Arabic; the Syrian Protestant college with its theological seminary, medical faculty, training college, and astronomical observatory ; the Scottish mission, and .St George's institute for Moslem and Druse girls ; the British Syrian mission schools ; the German Hospital, orphanage, and boarding school ; the French hospital and schools, and the Jesuit " Universite de St Joseph " with a printing ofB.ce. The average value of the exports for the five years 1894-98 was £726,981, and of the imports £1,656,672. In 1898 the exports were £2600, and the imports £253,400 less than the average, the latter being £650,000 less than in 1894. Population, 120,000 (Moslems, 36,000; Christians, 77,000; Jews, 2500; Druses, 400 ; foreigners, 4100). (c. w: w.)~~

~~Beith , a market and manufacturing town of Ayrshire, : Scotland, 18^ miles W.S.W. of Glasgow, with which it has two railway connexions. Modern erections are a Free Church, court house, and a post office. Beith is the • centre of the West of Scotland cabinet-making industry. 'There is a good secondary school. Population (1891), 7126; (1901), 7523. The parish contains coal andiron- stone mines, and trap, sandstone, and limestone quarries.~~

~~Beja, a town and episcopal see of Portugal, capital of district of the same name, 87 miles south-east from Lisbon. Population, 8394. The district of Beja has an area of 4196 square miles, and population 157,751, giving thirty- seven inhabitants to the square mile. Pig-breeding is the chief industry. Copper, iron, and manganese are mined.~~

~~Bela, or Las Bela, situated in 26° 27′ 30″ N. lat.~~

~~.and 66° 45′ 0″ E. long., 350 feet above sea level, capital~~

~~of a small independent state to the south of Kalat~~

~~(Baluchistan), ruled by the Jam (or Cham), who occupies~~

~~,tiie position of a protected chief under the British Eaj.~~

~~To the east lies Sind, and to the west Makr^n, and from time immemorial the great trading route between Sind and Persia has passed through Las Bela. The low-lying, alluvial, hot and malarial plains of Las Bela, occupying about 2000 square miles on the north-east corner of the Arabian Sea, are highly irrigated and fertile — two rivers from the north, the PorEili and the Kud, uniting to pro- vide a plentiful water supply. The bay of Sonmiani once extended over most of these plains, where the Porali delt^a is now growing with measurable strides. The hill ranges to theeast parting the plains from Sind, generally known as Hala but, locally, as the Mor and the Kirthar, between which lies the long narrow line of the Hab valley, strike nearly north and south, diminishing in height as they approach the sea and allowing of a route skirting the coast between Karachi and Bela. To the west they are broken into an infinity of minor ridges massing themselves in parallel formation with a strike which curves from south to west till they form the coast barrier of Makran. The Persian route, curving some- what to the north, traverses this waste of barren ridges almost at right angles, but on dropping into the Kolwah valley its difficulty ceases. It then becomes an open road to Kej and Persia, with an easy gradient. This was un- doubtedly one of the greatest trade routes of the mediaeval days of Arab ascendancy in Sind, and it is to this route that Bela owes a place in history which its modern ap- pearance and dimensions hardly seem to justify. Bela is itself rather prettily situated on a rocky site above the banks of the Porali. About four miles to the south are the well-kept gardens which surround the tomb of Sir Robert Sandeman ; which is probably destined to become a "ziarat," or place of pilgrimage, of even greater sanctity than that of General Jacob at Jacobabad. The population of the town numbers about 5000. The Jam's retinue consists of about 300 infantry, 50 cavalry, and 4 guns. Liability to assist on active service is the only acknowledgment of suzerainty which is paid by the Jam to the Khan of Kalat.~~

~~From very early times this remote comer of Baluchistan has held a distinct place in history. There are traces of ancient Arab (possibly Himyaritic) occupation to be found in certain stone ruins at Gondakeha on the Kud river, 10 miles to the north-west of Bela, whilst the Greek name " Arabis " for the Porili is Itself indicative of an early pre-historic connexion with races of Asiatic Ethiopians referred to by Herodotus. On the coast, near the village of Sonmiani (a station of the Indo-Persian telegraph line) may be~~

~~traced the indentation which once formed the bay of Morontobara, noted in the voyage of Nearkos ; and it was on the borders of Makrdn that the Turanian town of Rhambakia was situated, which was once the centre of the trade in " bdellium." In the 7th century a.d. Las Bela was governed by a Buddhist priest, at which time all the province of Gandaya was Buddhist, and Sind was ruled by the Brahman, Chach. Buddhist caves are to be found excavated in the conglomerate clifis near Gondakeha, at a place called Gondrtoi, or Shahr-i-Eogan. With the influx of Arabs into Mak- rin, Bela, under the name of Armel (or Armabel), rose to im- portance as a link in the great chain of trading towns between Persia and Sind ; and then there existed in the delta such places as Yusli (near the modern Uthal) and Kambali (which may possibly be recognized in the ruins at Khairokot), and many smaller towns, each of which possessed its citadel, its caravanserai and bazaar, which are not only recorded but actually mapped by one of the mediseval Arab geographers, Ibn Haukel. It is probable that Kari^ Pir, IJ miles to the east of the modem city, represents the site of the Armabel which was destroyed by Mahommed Kasim in his victorious march to Sind in 710. There is another old site 5 miles to the west of the modem town. The ruins at Kari^ Pir, like those of Tijarra Pir and Khairokot, contain Arab pottery, seals, and other mediaeval relics. The Lumris, or Lassis, who originate the name Las as a prefix to that of Bela, are the dominant tribe in the province. They are comparatively recent arrivals who displaced the earlier Tajik and Brahui occupants. It is probable that this influx of Rajput population was coincident with the displacement of the Arab dynasties in Sind by the Mahommedan Rajputs in the 11th century a.d. Some authorities connect the Lumris with the Sumras.~~

~~BEL A — B E L F A S T~~

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~~There are no published accounts of Bela, excepting those of the liidian Government reports and gazetteers. This article is com- piled from unpublished notes by the author and by Mr Wainwright,~~

~~of tte Indian Survey Department.~~

~~(t. H. h.*)~~

~~Bela, a town of Britisli india, administrative head- quarters of the Partabgarh district of Oudh ; a railway- station 80 miles from Benares. Population about 9000 ; municipal income (1897-98), Es.9610. It adjoins the village of Partabgarh proper, and the civil station some- times known as Andrewganj. It has a high school and three printing presses, one of which issues a newspaper in English and the vernacular.~~

~~Be I da. See Nigeeia.~~

~~Belfast, a maritime city, county and parliamentary borough, capital of the province of Ulster, Ireland, on the river Lagan, 101 miles N. of Dublin. It is the centre of an extensive railway systerii, which includes the Great Northern, the Belfast and Northern Counties, and the Belfast and County Down railways. Population (1881), 208,122 ; (1891), 255,960, of whom 118,759 were males, and 137,191 females, divided as follows among the different religions — ^Presbyterians, 87,234; Protestant Episcopa- lians, 75,522; Eoman Catholics, 67,378; Methodists, 13,747 ; and other denominations, 12,069. The following table shows the degree of education in 1891 : —~~

~~Males.~~

~~Females.~~

~~Total.~~

~~Percentage,~~

~~Eoman Oath.~~

~~Presby- terians.~~

~~Protes. Epls.~~

~~Metlio- aists.~~

~~Eead and write . Bead only . . IMtorate . . .~~

~~8T,673~~

~~8,019 7,968~~

~~95,40T~~

~~16,111 11,680~~

~~188,080 28,130 19,598~~

~~72-8 12-8 14-4~~

~~86‘8 8-3 4-9~~

~~79-5 11-2 9-8~~

~~87-8 7-8 4-9~~

~~In 1881 the percentage of illiterates among Eoman Catholics was 20-8, among Presbyterians 6-3, among Protestant Episcopalians 11-8, and among Methodists 5-2. In 1891 there were 30 superior schools with 2327 pupils (Protestants 1769 and Eoman Catholics 658), and 233 primary schools, with 36,123 pupils (Protestants 27,070 and Eoman Catholics 9053). Under the powers of an Extension Act the area of the city was considerably enlarged in 1897, and the population in 1901 was~~

~~348,876.~~

~~Recent History. — On the 27th of April 1613 Belfast, then a small town, was constituted a corporation by charter of James I., to consist of a chief magistrate and twelve burgesses and commonalty, with the right of sending two members to Parliament. This charter was annulled by James II., and a new one issued in 1688, but the original one was restored in 1690 by William III. In conformity with the passing of the Municipal Corporations Act of 1840 the constitution of the corporation was changed and made to consist of ten aldermen and thirty councillors, under the style and title of ” The Mayor, Aldermen, and Burgesses of the Borough of Belfast.” In 1888 the rank of a city was by Eoyal Charter conferred upon Belfast, with the incidental rank, liberties, privileges, and im- munities. In 1892 Queen Victoria conferred upon the mayor of the city for the time being the title of~~

~~” Lord Mayor,” and upon the corporation the name and descrip- tion of ” The Lord Mayor, Aldermen, and Citizens of the city of Belfast.” By the passing of the Belfast Corpora^ tion Act of 1896, the boundary of the city was extended, and the corporation made to consist of fifteen aldermen and forty-five councillors, and the number of wards was increased from fiye to fifteen. By virtue of the Local Government (Ireland) Act, 1898, Belfast became a county borough 1st April 1899. Letters patent issued 26th November 1866, granting a separate court of quarter sessions, comprising a court of record for the trial of civil |~~

~~actions ; and by the Local Government (Ireland) Act, 1898, Belfast became for assize purposes ” the county of the city of Belfast,” with a high sheriff.~~

~~Public Buildings and Improvements. — Pew cities in the United Kingdom have been more extensively improved. Squalid districts have been removed and new thoroughfares opened up. The finest of these — Eoyal Avenue — contains the new post oflBce and the Free Public Library (opened in~~

~~1888, and comprising a collection of over 30,000 volumes, as well as an art gallery and museum of antiquities). The Albert Bridge over the Lagan having collapsed, a new bridge was opened for traffic in 1890. The Campbell College, in the suburb of Belmont, was founded in 1892, in accordance with the will of Mr H. J. Campbell, who left £200,000 for the building and endowment of a public school. In 1897 the citizens subscribed £100,000 to found a new hospital to commemorate the Diamond Jubilee. A new city hall, now being erected at a cost of £200,000, will occupy the site of the old Linen Hall. In September 1899 the foundation stone of a Protestant cathedral to accommodate 3000 people was laid in Donegall Street, towards the erection of which the late countess of Shaftsbury bequeathed £7000. Several churches, belonging to different denominations have also been built during the last few years, and the city now contains 121 places of worship. Six public parks and two theatres have been opened since 1878. The corporation has under its control the gas and electric undertakings, four public bath establishments, free library and art gallery, a well-equipped fire organization, a model lodging- house for men, and a modern refuse destructor. The tramway system, about 30 miles, is horse traction, but on theexpiry of thecompany’sleasethe corporation will install~~

~~electric traction. A technical institution, estimated to cost £100,000, is in process of erection. An infectious diseases hospital to accommodate 160 patients, also in progress, is to cost £45,000. The water-supply is under the control of the City and District Water Commissioners, who' were incorporated in 1840. Under the Main Drainage Act of 1887 a comprehensive system was carried out, at a cost of £300,000, for intercepting the sewage which formerly flowed into the Lagan, and at present bacterial purification beds are being formed. Under recently-obtained powers water is brought a distance of 40 miles from the Mourne Mountains to a service reservoir at Knockbreckan. The estimated cost of this undertaking is over £1,000,000. There are two other sources of supply.~~

~~Administration. — Belfast is divided into four parlia- mentary divisions, north, south, east, and west, the number of registered electors in 1901 being respectively 10,108, 8813, 14,903, 8230. The harbour and docks are managed by a board of Harbour Commissioners, elected by the ratepayers and the shipowners. The rateable value of the city in 1901 was £1,196,051, and the total revenue in 1900 was £429,000.~~

~~Commerce and Shipping. — By the Belfast Harbour Acts the commissioners were empowered to borrow more than £2,500,000, in order to carry out several new works and improvements in the port. Under the powers of these Acts a new channel, called the Victoria Channel, several miles in length, was cut, leading in a direct line from the quays to the sea. This channel now affords 20 feet of water at low tide, and 28 feet at full tide, the width of the channel being 300 feet. The Alexandra Dock, which is 852 feet long and 31 feet deep, was opened in~~

~~1889, and the extensive improvements (including the York Dock, where vessels carrying 10,000 tons can discharge in from four to six days) have been effected from time to time, making the harbour one of the most commodious in the United Kingdom. Since 1891 the foreign trade of~~

~~the port has increased by 72 per cent., which, seems to prove that Belfast is fast becoming, like Liverpool, a great distributing port. The following table shows the number of vessels cleared from and registered at the port in various years : —~~

~~Tear.~~

~~Cleared.~~

~~Registered.~~

~~Vessels.~~

~~Tonnage.~~

~~Vessels.~~

~~Tonnage.~~

~~1880 1890 1896 1897 1898 1899 1900~~

~~7965 8050 8737 8763 9049 8454 8318~~

~~1,616,908 1,840,666 2,207,965 2,298,868 , 2,369,908 2,358,705 2,325,936~~

~~399 293 250 235 229 219 210~~

~~76,386 125,632 146,710 137,386 128,283 139,074 147,575~~

~~In 1880 the harbour receipts were £101,637, and in 1899 the receipts were £158,772 and the expenditure £128,505. In 1880 the customs dues collected amounted to £1,492,875, in 1890 to £2,128,446, and in 1899 to £2,832,563, an increase of over 90 per cent, in twenty years. The following were the amounts of the chief ex- ports in 1900— linen, 38,142 tons ; whiskey, 30,782 tons ; aerated waters, 10,552 tons ; iron ore, 50,155 tons ; linen yam, 9087 tons; and 125,239 head of cattle. The Harbour Commissioners have obtained parliamentary powers to construct a graving dock capable of accommo- dating the largest class of warships. The growth and development of the shipbuilding industry during recent years has been~~

~~immense, the firm of Harland and Wolff being amongst the first in the trade. In 1895, 18 vessels were launched in Belfast of 101,816 tonnage ; in 1896, 25 vessels of 119,756 tonnage; in 1897, 21 vessels of 108,863 tonnage ; in 1898, 16 vessels of 121,380 tonnage; in 1899, 17 vessels of 127,652 tonnage ; and in 1900, 16 vessels of 136,226 tonnage. Amongst the most notable of the recent vessels built by Messrs Harland and Wolff are the Oceanic (1899) and Celtic (1901), for the White Star Line, the two largest vessels constructed up to those dates.~~

~~Trade and Manufactures. — Belfast is the centre of the Irish linen industry; it contains within its boundaries about 480,000 spindles for spinning flax and 15,000 power-looms. It is also the headquarters and business place for the entire flax-spinning and weaving industry of the country. The machinery gives constant employ- ment directly to about 40,000 workers, and for subsequent processes to prepare the cloth for the market it employs about 10,000 more. The linen yarns exported average 20,750,000 ft per annum, the value of which exceeds £1,000,000. The imported yarns average 8,800,000 ft a year, and cost upwards of £300,000. Distilling is exten- sively carried on, the largest firm paying over £1,500,000 annually in duty. Several firms are engaged in the manu- facture of mineral waters, for which the water of the Cromac Springs is peculiarly adapted, and the volume of trade may be estimated from the fact that in 1899, 11,084 tons of aerated waters were exported. The city also contains two of the largest establishments of their kind in the world — ropeworks employing 3000 hands, and a tobacco factory. Belfast boasts the largest tobacco factory in the world, that of Messrs Gallaher, Limited, and the largest rope manufactory in the world, that of the Belfast Eopework Company, Limited. (w. h. po.)~~

~~Belfast, capital of Waldo county, Maine, U.S.A., situated in the southern part of the state, at the head of West Penobscot Bay, nearly 30 miles south of Bangor. It has an excellent harbour, with some commerce and varied manufactures, and is on a branch of the Maine Central railway. It was settled in 1770, and chartered as a city in 1863. Population (1880), 5308 ; (1900), 4615.~~

~~Belfort. — The territory of Belfort is, by the Franco- German Treaty of 1871, all that is left to France of its former Department of Haut-Ehin, created in 1790 out of territories belonging to Alsace, then one of the provinces of France. A mere fragment of its former self, the terri- tory has been decreed resumption of the title " Departe- ment du Haut-Ehin." It comprises 4 cantons and parts of 2 others out of the 30 cantons composing in 1870 the De- partment of Haut-Ehin, and contains 106 communes. It is bounded on the N.E. and E. by German Alsace, on the S.E. and S. by Switzerland, on the S.W. by the Department of DoubSj.on the W. by that of Haute-Saone, on the N. by that of Vosges. Its greatest length from N. to S. is 28 miles, greatest breadth from W. to E., 13J miles.~~

~~With an area of only 235 square miles, it is, next to that of the Seine, the smallest Department of France. The northern part is occupied by the southern offshoots of the Vosges, the southern part by the northern outposts of the Jura. Between these two highlands stretches the Depression of Belfort, 18J miles broad, joining the basins of the Rhine and the EhOne, traversed by the Ehdne canal and several railways. A part of the natural highway open from Frankfort to the Mediterranean, the Depression has from earliest times provided the route for the migration from N. to S., and is still of great commercial and strategical value. The northern part, occupied by the Vosges, rises to 4124 feet in Ballon d' Alsace, the northern termination and the culminating point of the Department ; to 3773 feet in the Planche des Belles-Filles ; to 3345 feet in Baerenkopf ; and to numerous other lesser heights. South of the Troupe de Belfort, there rise near Delle limestone hills, in part wooded, on the frontiers of France, Alsace, and Switzerland, attaining 1680 feet in the For6t de Florimont. The territory between Lachapelle-sous-Rougemont (in the N.E.), Belfort, and Delle does not rise above 1300 feet. The line of lowest altitude follows the river St Nicolas and the Eh6ne canal. The chief rivers are the Savoureuse, 24 miles long, running straight S. from the Ballon d' Alsace, and emptying into the AUaine ; the AUaine, from Switzer- land, entering the territory a little to the south of Delle, and leaving it a little to the west of Morvillars ; the St Nicolas, 24 miles- long, from Baerenkopf, running southwards into the EhSne canal and then S.W. into the AUaine. The climate is divided between the " Vosges climate " to the north of the town of Belfort, marked by long and rigorous winters, sudden changes of temperature, and an annual rainfall~~

~~of 80 centimetres to 1 metre (31 inches to 39′ inches), intensified by an impervious subsoil, against an average of 177 centimetres (30 inches) for the whole of France ; and the- ” Bhdne climate,” milder and more equable, with a rainfall of 60- to 80 centimetres (23 inches to 31 inches), quickly absorbed by the soil or evaporated by the sun. The higher levels of the moun- tains are clothed with forests of pine, oak, beech, and chestnut. At lower levels grow the elm, ash, poplar, linden, maple, and. acacia. Of wild animals there are found the wolf, fox, wild cat, otter, and badger. The population, 74,244 in 1881, 79,758 in 1886, had increased to 91,763 in 1901. Births in 1899, 2188, of which 259 were illegitimate ; deaths, 1650 ; marriages, 638. There were in 1896, 188 schools, with 14,000 pupils, less than 1 per cent, of the population being illiterate. The only town in the territory is. Belfort, whose population, 22,181 in 1886, had increased to 32,112 in 1901. The area under cultivation in 1896 amounted to 140,790 acres, of which 46,930 acres were plough-land. The wheat crop of 1898 was valued at £54,510 ; rye, £17,090 ; oats, £16,100 ; potatoes, £131,760 ; mangold- wurzel, £15,890 ; natural pastures, £155,600. The live stock of 1899 included 3550 horses, 19,940 cattle, 3800 sheep, 9440 pigs, and 1750 goats. Though minerals are not abundant, mining has made some progress in the territory. Its. real industry, however, is in calicoes and spinning, an industry which, owing to the large immigration of spinners from the terri tory annexed by Germany, has made rapid progress since the war.~~

~~Belfort, or Bbfort, chief town of the Territory of Belfort, France, 275 miles E.S.E. of Paris, on the railways from Paris to BUe and Lyons to Strasburg. Its fortifica- tions have been greatly extended since the war of 1871. In front of the citadel is a colossal figure. The Lion of Belfort, by Bartholdi, 36 feet high and 72 feet long, erected to commemorate the brave defence of the town during the war, and opposite the H5tel de Ville, a bronze group in memory of Thiers and Denf ert-Eochereau. A new railway station was erected in 1890, and a civQ hospital in 1895. The town has important trade, especially in wine. Imports in 1899, £3,468,000; exports, £4,864,000. Poptdation~~

~~(1901), 32,112.~~

~~BELGIUM~~

~~Be I gaum, a town and district of British India, in the Carnatic or Caranese-speaking division of Bombay. The town is situated in 15″ 51′ N. lat. and 74° 34′ E. long., nearly 2500 feet ahove sea-level ; it is a station on the Southern Mahratta railway, 245 miles south of Poona. The population in 1881 was 32,697; in 1891 it was 40,737; and in 1901 it was 26,237. Belgaum contains a cantonment which is the headquarters of a military dis- trict, with a garrison of all arms. It is also a considerable centre of trade and of cotton weaving. There are two cotton mills, with a capital of Es.3,20,000, working 52,000 spin- dles, and employing 2186 hands, of whom 909 are children.~~

~~The district of Belgaum has an area of 4657 square miles. The population in 1891 was 1,013,261, being 217 persons per square mile. Classified according to religion, Hindus numbered 873,051; Mahommedans, 80,484 ; Jains, 62,048 ; Christians, 7617, of whom 1454 were Europeans ; Parsees, 61. In 1901 the population was 994,209, showing a decrease of 2 per cent, compared with an increase of 17 per cent, in the preceding decade. The land revenue and~~

~~rates were Es.22,51,550, the incidence of assessment being about 16 annas per acre ; the number of police was 877. Out of a total cultivated area in 1897-98 of 1,714,200 acres, 51,069 were irrigated, including 5479 from government canals. The principal crops are millet, rice, wheat, other food-grains, pulse, oil-seeds, cotton, sugar-cane, spices, and tobacco. There are considerable manufactures of cotton- cloth. The town of Gokak is known for its dyes, its paper, and its wooden and earthenware toys. The West Deccan line of the Southern Mahratta railway runs through the district from north to south. In 1897-98 there were 311 schools, with 18,168 pupils, showing one village with a school to every 17 square miles, and 1-9 pupils to every 100 of the population. Two high schools at Belgaum town are maintained by Government and by the London Mission ; total pupils about 830. There are nine printing- presses, most of which issue a vernacular newspaper. In 1897-98 the municipalities had a total income of E.s.1,09,-980, the incidence of taxation being 13 annas per head. The death-rate in 1897 was 42 per 1000.~~

~~BELaiUM.~~

~~Geography and Statistics.~~

~~BELGIUM (French Belgique, Flemish Belgie, German Belgien), a kingdom of Europe, lying between 49° 31′ and 61° 30′ N. latitude and between 2° 36′ and 6° 3′ E. longitude. Its frontier touches the North Sea, Holland, Ehenish Prussia, the Grand Duchy of Luxembourg, and France. Gradually rising towards the S.E., Belgium lies very low in the provinces of Antwerp and Flanders; reaches over 300 feet in height a little to the S.E. of Brussels ; 650 feet near the Sambre and the Meuse ; 1640 feet on th'e plateaux of the province of Luxembourg; over 2000 feet on the E. frontier of the province of Lifege. The land is traversed from S. to K. by the Scheldt and its afB.uent the Lys, and by the Meuse and its affluent the Sambre. To the S. of the Sambre and the Meuse the country is, in general, undulating. The valleys of the Meuse, the Ourthe, the Ambleve, the Lesse, the Semois, &c., are highly picturesque ; the natural grottos of Han on the Lesse being celebrated, and the grotto of Eemou- champs and the prehistoric caverns of Furfooz being no less remarkable. The mean annual temperature is 49-1° F. in the central part, but sinks to 44-6° P. on the highest plateaux. The most frequent winds are S.W. and W., bringing with them the humidity of the Atlantic. The average annual precipitation in rain and in snow amounts at Brussels to 28-8 inches.~~

~~Area and Population. — The area comprises 2,945,589 hectares, or 29,456 kilometres, or 11,373 English square miles, and the total population at the- end of 1899 numbered 6,744,000, an average of 693- 11 per square mile. The nine provinces, and their respective areas, populations, and densities at the end of 1899, were : —~~

~~Provinces.~~

~~Area in English square miles.~~

~~Populatioa~~

~~at end of~~

~~1899.~~

~~Popula- tion per BO. mile,~~

~~1899.~~

~~Antwerp~~

~~1093~~

~~825,000 /~~

~~‘ 754-8~~

~~Brabant~~

~~1268~~

~~1,281,000~~

~~1010-2~~

~~Plandersj^^^/,*~~

~~1249~~

~~811,000~~

~~649-3~~

~~1158~~

~~1,035,000~~

~~893-7~~

~~Hainault~~

~~1437~~

~~1,134,000~~

~~789-1~~

~~Lifege .~~

~~1117~~

~~843,000~~

~~754-7~~

~~Limbourg .~~

~~931~~

~~242,000~~

~~259-9~~

~~Luxembourg~~

~~1706~~

~~221,000~~

~~129-5~~

~~Namur .~~

~~1414~~

~~352,000~~

~~^248-9~~

~~Total ....~~

~~11,373~~

~~6,744,000~~

Average Yearly Births per 1000 Inhabitants.

Year.

1877-1886 .

. 31-21

1887-1896 .

. 29-25

1898

. 28-62

From 1876 to 1880 the average annual increase of population

■was 46,000 ; from 1880 to 1890, 55,000 ; from 1890 to 1899, over 75,000. At the census of 1898, out of a total population of 6,669,732, 3,326,190 were males and 3,343,542 females. The births and deaths per 1000 inhabitants have since 1876 undergone a gradual diminution, the births however continuing in marked excess over the deaths, as shown in the following table : —

Average Yearly Deaths

per 1000 Inhabitants.

21-31

20-92

17-61

For every 100 births the percentage of illegitimacy has since 1871 varied from 7-2 to 8-76. The annual immigration since 1871 has varied from

~~15,000 to 27,000, and, since that date, has been continuously greater than the emigration, which in 1898 reached its maximum of 22,860. Among the population of foreign birth in 1890, 64,800 were born in France ; 47,459 in Holland ; 38,367 in Germany ; 9266 in the Grand Duchy of Luxembourg ; and 4102 in England. Linguistically, Belgium is distributed into three parts : Flemish, to the N. of a line stretching from near Wameton on the Lys eastwards to Vis6 on the Meuse ; French in the country of the Walloons, to the S. of that line ; German, in the arrondissement of Arlon. At the census of 1890 there were 2,744,271 inhabitants, or 45-21 per cent, of the total population, speaking only Flemish; 2;485,072, or 40-94 per cent., speaking only French ; 700,997 speaking both French and Flemish ; and 32,206 speaking only German.~~

~~Constitution and Government. — The constitution, adopted in 1831, was revised in 1893 with a view to extension of the rights of suffrage. The form of government is a constitutional, repre- sentative, and hereditary monarchy. The constitution declares that all power emanates from the people, and establishes three authorities — legislative, executive, and judicial. The legislative power is the conjoint function of the chamber of representatives, the senate, and the king. The members of the chamber of repre- sentatives are elected for four years, the half of them retiring every two years. Their number must not exceed the pro- portion of one to every 40,000 inhabitants. To be elected a representative one must be a Belgian by birth or by naturalization, must have attained the age of twenty-flve years, and be domiciled in Belgium. No other condition is required. Every member receives a yearly indemnity of 4000 francs (£160) for discharging his functions as representative. Before 1893 the electoral law was based solely on the census. The members of the chamber of representatives were elected by citizens paying in taxes a fixed amount (namely 42 francs, 32 centimes). After the revision of 1893 the constitution granted the right of suffrage to every citizen who had attained the age of twenty-five years and been domiciled for not less than one year in the same commune. A supple- mentary vote is allowed to every citizen fulfilling certain con- ditions in respect of age, family, and personal or property tax. Two supplementary vote are accorded to every citizen whose profession, or the possession of a diploma or a certificate, attests an average level of higher instruction. No person, however, can dispose of more than three votes. In 1892, before the revision, the number of electors was 36,775. In 1900, after the revision, it had risen to 1,432,232. Further, the law of 29th December~~

~~[statistics~~

~~1899 introduced into the election of members of the legislative chambers the principle of proportional representation, a principle which in the case of an election divides the vfrits among the parties according to the number of votes they represent. The members of the senate are elected for eight years, one half being renewed every four years. Senators must be at least forty years of age, and must fulfil prescribed conditions of fortune, excepting in the case of a certain number elected by the provincial councils. They are chosen by so many of the electors who vote for the chamber of representatives as have attained the age of thirty years, amounting in 1900 to 1,227,720 ; and by the provincial councils, two, three, or four for each province, according to popula- tion. Sons of the king, or, failing these, Belgian princes of the reigning branch of the royal family, are, by right of law, senators at the age of eighteen, but till the age of twenty-five have no voice in the deliberations. The king takes part in the legislative power by his right of initiative to present projects of law, and by the assent he gives to the projects of law voted by the chambers. He is charged with the sole executive power, which he exercises through the intermediation of the ministers whom he appoints and removes, and who are held responsible for the acts of the government. There are eight ministries : — ^justice ; foreign affairs ; interior and public instruction ; finance and public works ; war ; railways, posts, and telegraphs ; agriculture ; industry and labour. The country is divided into 26 judicial arrondissements and into 222 cantons of justices of peace.~~

~~Provinces and Communes. — For purposes of civil administration, the country is divided into the nine provinces already specified, and the provinces, again, are divided into communes, at present numbering 2610. Each province is self-governed. In each there is a commissioner of the government, bearing the title of governor, and appointed by the king ; and a council chosen for fovir years by the electors of the province. Since the revision of the consti- tution the electors to the provincial council are the same body as elect the senators. In 1893 the number of provincial electors~~

~~was 425,451; in 1900, 1,227,720. The council must assemble each year in the month of July. The provinces are divided into administrative arrondissements, in each of which a commissaire d^arrondissement is appointed to watch over the administration of communes having less than 5000 inhabitants. Each commune is self governed. In each there is a burgomaster nominated by the king and, saving in exceptional cases, chosen by the members of the communal council ; also a number of aldermen chosen by the members of the councU from among themselves ; further, a communal council elected for eight years by the electors of the commune. To be an elector to the communal council, it is necessary, since the law of the 11th April 1895, (1) to be a Belgian by birth or by naturalization ; (2) to fulfil the same con ditions as are required for the right to elect senators ; (3) to have been actually domiciled in the commune for at least three years. If the elector fulfil certain other conditions he may dispose of as many as four votes. In 1893 the number of communal voters was 547,550; in 1900, 1,136,010. The principle of proportional representation applies also to communal elections.~~

~~Seligion. — The recognized religions are the Roman Catholic, the Protestant, the Anglican, and the Hebrew. The population is almost wholly Catholic. The Protestants number only about 16,000 and the Jews 3000. In the budget of 1898, 5,268,000 francs figures under the head of expenditure for the support of the Catholic religion, and 118,000 francs for the other creeds.~~

~~Education. — ^Free education has been recognized. There are accordingly schools of various grades established by private persons, by corporations and associations, and by the public authorities, national, provincial, and communal. There are three grades of general public education — elementary, middle-class, and higher. Elementary education comprised in 1898 more than 2000 infant schools with 195,000 pupils; 6700 elementary schools subject to government inspection, numbering altogether 775,000 pupils; 2300 adult schools with an attendance of 12,000 ; 19 normal schools for male teachers and 34 for female teachers, comprising altogether 3700 students. The expenditure on elementary education amounted in 1897 to 35,761,000 francs, in 1875 to 24,800,000 francs. The number of young men unable to read and write when called on to draw lots for the conscription~~

~~was in 1870, 29-2 per cent. ; in 1899, 12-8 per cent. Middle-class instruction, lower grade, was imparted in 1898 by 78 government schools for boys and 10 communal schools, having altogether 16,000 pupils; by 34 government schools for girls and 6 communal schools, with an attendance altogether of 7000 pupils ; and by 2 male normal schools numbering, in 1899, 60 students, and 2 female normal schools numbering 100 students. Middle- class instruction, higher grade, was given in 1899 by 20 royal athenaeum and 15 communal colleges, counting altogether 7500 scholars. The expenditure of the State, the provinces, and the communes on middle-class instruction, inclusive of the two grades, increases year by year, and amounted in 1897 to 4,600,000 francs.~~

~~The higher learning is communicated in the two State univer- sities of Li6ge and Ghent, in the two free universities of Louvain and Brussels, and in the "new" university founded at Brussels. To these universities are annexed schools of civil engineering, of mines, and of arts and manufactures. The students attending the universities numbered in 1899, in all, more than 5000. There is also a very large number of schools for special instruc- tion. (1) For purposes of military instruction, there are at Brussels a military school, with an attendance of 300, designed for the training of oflicers of all arms, and a school of war (ecole de guerre) attended by officers desiring to obtain the brevet of adjoint d^etat major; a riding school; regimental schools with an attendance of 3300 ; classes for illiterate soldiers. (2) To provide artistic education, there are the Royal Academy of Fine Arts at Antwerp, with 1300 students, and 84 other academies and schools of design, having altogether an attendance of 15,000 ; the Royal Conservatoire of Music at Brussels with 1600 students ; another at Ghent with 1200 students ; another at Lifege with 1200 students ; and 71 other schools of music having an attend- ance altogether of 12,000. (3) For industrial and com- mercial education there are special schools, with 1400 students, attached to the universities ; the Hainault provincial school of mines (250 students) ; industrial or professional schools, com- munal or free, having an attendance altogether of 17,000 ; the Institut Supfirieur of Commerce at Antwerp ; schools to teach weaving, brewing, &c. (4) There are also schools of navigation at Antwerp and Ostend ; a government agricultural institute at Gembloux ; reform agricultural schools and prison schools ; schools for the deaf and dumb ; schools of domestic economy, &c. Public~~

~~education is supported and encouraged by numerous scientific and literary institutions or associations, the principal of which are the Royal Academy of Sciences, Letters, and Fine Arts, at Brussels, founded in 1769 ; the Royal Flemish Academy, founded at Ghent in 1886 ; the Royal Academy of Medicine, established at Brussels in 1884 ; the observatory set up at Brussels in 1826 and now transferred to Uccle ; the Royal Museum of Natural History and the government botanic gardens at Brussels ; the zoological gardens at Antwerp, formed by a private society ; and other bodies. The Government has instituted prizes, granted every three years, in French and Flemish dramatic litera- ture ; every five years in the history of Belgium, in social' science, French and Flemish literature, mathematics, and natural and medi- cal physics ; and every ten years in philosophy and philology.~~

~~Crime and Pauperism. — In 1897 the number of criminals sen- tenced at the Assize courts was 105 ; and at the correctional tribu- nals 43,364. The average number of inmates of the various classes of prisons in 1897 was : — central prisons, 735 ; secondary prisons, 3833 ; reformatories, 222. The charitable institutions received in donations and legacies in 1898, 4,407,000 francs. In 1898 the total entries in the depots of mendicit^ for the reception of beggars and adult vagabonds were 3623, and the expenditure 1,224,213 francs.~~

~~Mnance. — Every year the chambers settle the accounts and vote the budget. The total receipts and total expenditure of the State have to be entered in the budget and in the accounts. A special court called the Cour des Comptes is charged with the duty of examining and liquidating the accounts of the general administration and of presenting its observations thereon. The revenue and expenditure for the years specified were as follows : —~~

~~Expenditure~~

~~(Francs).~~

~~382,908,429 351,251,439 417,893,629 410,383,402 511,398,214~~

~~From 1880 to 1897 the revenue has increased 26 per cent., and the increase on the expenditure has been in that period 33 per cent. The taxation, amounting to 28 francs per head of population in 1880, had risen to 31 francs per head in 1897. The total amount of taxation shows an increase of 39 per cent, on the total sum of 1880. Among the items of expenditure for 1898, the most for- midable one is that on account of the service of railways, posts, and telegraphs, figuring at 127,679,000 francs. The next in im- portance is on account of the interest on public debt, 123,303,850 francs. The public debt, consolidated and floating, was in 1880, 1,422,814,049 francs; in 1890, 2,018,043,774 francs; in 1899, 2,693,787,176 francs. In the budget for 1900 the revenue was estimated at 452,246,618 francs, and expenditure 450,929,726 francs. In each province the council settles every year the account of the revenue and expenditure of the preceding financial year, and votes the budget for the current year. In 1897 the provincial receipts amounted altogether to the sum of 17,501,567 francs. The sum total of the provincial debts- amounted to 32,679,614 francs. In each commune the council prepares every year the budget of revenue and expenditure. In 1892 the sum total of the~~

~~Tear.~~

~~Bevenue (Francs).~~

~~1880 .~~

~~. 394,215,932~~

~~1885 .~~

~~. 338,085,424~~

~~1890 .~~

~~378,404,319~~

~~1895 .~~

~~. 395,730,445~~

~~1897 .~~

~~. 499,612,888~~

~~statistics]~~

~~communal receipts amounted to 178,020,761 francs, and that of Its expenditure to 179,816,792 francs.~~

~~Defence.— The constitution establishes a permanent army, a gendarmerie, and a civil guard (garde civique). The army is recruited by voluntary engagement and by annual calls on the country, regulated by a drawing for conscription among the citizens who have reached twenty years of age. The contin- gent is fixed each year by enactment. Ordinarily it is about 13,000 men out of an average inscription of 63,000 men. The effective strength in pay on a peace footing is about 50,000 men; the complete war strength, including officers, 165,000. The strength of the gendarmerie, ofBcers included, is 2865 men. In time of war the gendarmerie accompanies the army. The expenditure of the ministry of war for 1898 was 65,670,000 francs, five millions of which were on account of the gendarmerie. The expenditure on the war service in 1875 was 46,066,000 francs. The civic guard (garde civique) is composed of Belgians and foreigners who have been resident at least one year in Belgium, subject, however, in respect of the latter, to any provisions in international conventions. It is organized per commune or group of communes. It can only be mobilized by enactment. It is divided into the active and the inactive guard. The strength of the active guaiji is about 44,000 men. The yearly expenditure of the ministry of the interior for the civic guard is 139,000 francs. There are five fortified places in Belgium: Antwerp, capable of serving the army as a base of operations and as a refuge ; it con- sists of a fortified enceinte and fourteen detached forts sur- rounding it at a distance of 3 to 7 kilometres (1-86 to 4-35 miles). The others are Dendermonde on the Scheldt, and Diest on the Demer, these two and Antwerp forming a triangle of defence ; Lifege, surrounded at a distance of 6 to 7 kilometres (3-73 to 4-35 miles), by fourteen detached~~

~~forts; and Namur, surrounded by nine detached forts, which, with those of Lifege, defend the valley of the Meuse. There is an exercise-camp at Beverloo in Limbourg, and a shooting artillery school at Brasschaet in the province of Antwerp. Production and Industry. — The principal mineral production is coal, at present extracted from 115 mines actually in work, against 175 in 1875. These mines employ 120,000 workers; their annual production is about 22 million tons, of the value of "243 million francs. Notwithstanding the reduction in the number of working mines, the output has increased by 5 million tons since 1880. Black and red marble, building and paving stone, limestone and slate are extracted from 1500 quarries employing more than 35,000 workers, and yielding material to the value yearly of about 50 million francs. Iron, zinc, lead, and manganese are extracted by about 1600 miners, and the annual yield is valued at 2 million francs ; since 1875, however, the pro- duction of these minerals has much declined, and it has been necessary to import them to the value, in 1898, of 90 million francs. The most important branches of industry are: agriculture, metallurgy, glass-works, and textiles. Agriculture employs the greatest number of labourers — 19 per cent, of the general popula- tion. Cereals occupy 2,000,700 acres ; fodder and orchards, 1,575,860 acres; potatoes, 456,950 acres; beetroot (sugar), 133,380 acres ; and cattle number 1,420,000 head. The annual value of the agricultural products is estimated at about IJ milliards of francs. Nevertheless, great quantities of food products are annu- ally imported, amounting in 1898 to 480 million francs. The industry in metals, employing 32,000 workers and yielding a yearly value of 340 million francs, is represented by the manu- facture of pig-iron, the construction of machinery and railway material ; by the manufacture of arms, Lifege producing annually one million of assayed pieces ; by glass and crystal works employ- ing altogether about '23,000 workers, and yielding in 1898 a value of 66 million francs. The manufacturing industry is represented more particularly by the fabrication of woollen yarn and woollen tissues, cloths, flannels, covers, &c., employing 30,000 workers. Wools are imported to the amount of 110,250,000 R) from La Plata, Australia, and the Cape. The manufacture, again, of cotton thread and tissues employs 18,000 operatives; and cotton is imported yearly to the amount of 99,225,000 lb, principally from the United States of ji.merica, East Indies, and England. The manufacture of linen thread and linen cloth employs 36,000 workers, the flax being in part grown, the rest imported to~~

~~the amount of 143,325,000 R) from Russia, Holland, and France. Lace is also manufactured. The sea flsheries occupy about 400 vessels, and crews to the number of 2000 men.~~

~~Commerce.— The annual value of the commerce with foreign countries amounted in 1899 to 7 milliards of francs' in the way of general commerce, and to over 4 milliards in the way of special commerce. The value of the commerce has since 1870 experienced a continuous increase, as shown, in millions of francs, in the table given below.~~

~~The average share of each inhabitant in the special imports, i.e., imports for home consumption, amounted in 1870 to 183 francs, rising to 310 francs in 1898; in the special exports (i.e., exports~~

~~of Belgian produce), 136 francs in 1870 rising to 270 francs in 1889 ; in the transit trade, 165 francs in 1870, 187 francs in 1898. The countries with which Belgium did the greatest business in~~

~~Imports, General Commerce~~

~~Special Exports, General ,,~~

~~Special~~

~~18T0.~~

~~1830.~~

~~1890.~~

~~1898.~~

~~1760-2 920-8~~

~~1521-8 690-1~~

~~2710-4 1680-9 2225-2 1216-7~~

~~.3189-2 1672-1 2948-1 1437-0~~

~~3654-3 2260-2 3351-6 1949-3~~

~~1898 were : Germany, from which she received imports valued at 25-4 million francs, and t6 which she sent exports valued at 485-5 million francs ; France, from which the imports were 385-7 million francs, and the exports to which 345-8; Great Britain ex- porting 312-0, and importing 360-7 ; Holland exporting 169-0 and importing 211-8; the United States exporting 280-1 and import- ing 69-4; Russia exporting 131-9 and importing 43-16. In the relative magnitude of the annual value of its special commerce, Belgium takes the sixth place among the nations of the world, following Great Britain, Germany, the United States, France, and Holland. The articles of greatest value imported were: cereals and their derivatives, 19 per cent, of the total import; raw textiles such as cotton, wool, silk, flax, hemp, and jute, 13 per cent. ; mineral substances such as iron-ore, diamond, sulphur, copper, tin, lead; and timber. The exports, of greatest value were textiles, wool, linen, oakum, hemp, 9 per cent. ; cereals and their derivatives, 5 per cent. ; coal, coke, briquette, glass, machinery and railway carriages, arms.~~

~~Shipping and Navigation. — Belgium has no navy for purposes of war. There is a daily service of steamers between Ostend and Dover, and between Antwerp and Harwich. The national merchant marine is not considerable ; the number of vessels has little varied since 1870, amounting in 1898 to but 73, six of which were sailing vessels ; the total tonnage being 108,537. The total number of vessels entering the ports of* Belgium in 1899 was 8672, of 8,632,862 tons, and clearing 8581, of 8,521,331 tons. The ports are Antwerp, one of the most important in Europe, the ships entering which number annually more than 5200 (480 of them sailing vessels), with a united tonnage of 6,423,000; Ostend on the North Sea,.with a yearly entrance of 1923 ships of 1,202,000 tons ; Ghent, communicating with the sea by the Ghent canal to Terneuzen ; Brussels, communicating with the Scheldt, by the canal of Willebroeck ; Bruges, communicating by canal with Ostend ; Nieuport on the North Sea ; Selzaete on the Ghent-Temeuzen canal. Among the vessels arriving in 1898, the largest number came from Great Britain (4010); from Germany (986); Norway and Sweden (599). Antwerp has regular inter- course with all parts of the vrorld.~~

~~Internal Communications. — Inland communication is highly developed, especially when compared with its extent of territory. The State and provincial roads, paved or macadamized, and the concrete roads have a total length of 5737 miles, against 5002 in 1875. The communal roads have likewise experienced a very large development. The total length of railway line open in Belgium in 1899 was 2867 miles (2069 belonging to the State, and 798 to companies), against 2175 in 1875. This gives an average of on^ mile of railway for every 4J square miles of territory, and for every 2420 inhabitants. The gross receipts in 1898 amounted for the State to 183,950,458 francs, of which 60,185,764 francs were for passengers ; and for the companies, 24,836,703 francs, of which 7,519,768 francs were for passengers. The number of passengers conveyed in 1898 was 126 millions. Since 1886 "vicinal" rail- ways have been opened to the number of 96 lines, their total length of line in actual operation being, in 1898, 1094 miles. Horse and electric tramways have been laid down in the principal towns. The vicinal railways and tramways are constructed and worked by societies. Navigable waterways are formed of numerous canals, and canalized rivers such as the Upper Scheldt and its tributaries, the Lys, the Durme, the Bender, the Gnat and the Little N6the ; the Meuse and its tributaries ; the Sambre; and the Lower Ourthe. The total length of navi- gable waterways is 1360 miles.~~

~~Posts, Telegraphs, and Telephones are exclusively in the manage- ment of the State. The gross revenue of the post office in 1898 exceeded 22 million francs, and the expenditure was more than 12 millions. The total number of letters and post cards conveyed in 1898 was over 200 millions, of newspapers and printed matter, over 130 millions. In 1898 there were 1022 post offices in Belgium. The» total receipts of the telegraph service in 1898 amounted to more than 7J million francs, and to an Ordinary expenditure of over 5,700,000 francs. The telegraph lines had in 1898 a combined length of 3964 miles; there were 1058 telegraph offices. The use of the telephone dates from 1884. All the lines construQted from the beginning, were taken up by the State in 1896, There were in 1898 local telephones of a total length of~~

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~~19,620 miles. The same year there were over 100,000 inter- national telephonic communications made.~~

~~Banks. — There are three very important financial institutions, established at the intervention of the state : the National Bank, the General Savings Bank under state guarantee, and the Societe du Credit Communal. The National Bank discounts bills, has its headquarters at Brussels, and branches in the provinces. It serves gratuitously as cashier of the state and of the Savings Bank. The following figures shovr the situation of the National Bank on the 31st December 1899 : —~~

~~Active.~~

~~1000~~

~~Francs.~~

~~Passive.~~

~~1000~~

~~Francs.~~

~~Cash~~

~~Portfolio, Belgium .~~

~~,, rorelgn Advances in public purse . Property, Mutuals~~

~~112,668~~

~~387,304~~

~~112,861~~

~~49,918~~

~~89,477~~

~~Capital and revenue Notes in circulation Treasury accounts, current . Private „ „ Various~~

~~77,464 543,357 84,161 38,232 11,894~~

~~There are 54 joint-stock and private banks, also agricultural banks, credit unions, and popular banks. The sums discounted by the Bank in 1898 amounted to 3,026,959,163 francs. The Savings Bank under state guarantee receives deposits bearing interest, keeps cheque-books, and an insurance fund. There were in 1898, 899 offices, 1,377,643 depositors, and the amount of deposits at end of year was 532,081,819 francs.~~

~~The Societe du Credit Communal is designed to secure to the communes the means of contracting loans on favourable terms. A Credit Agricole was officially organized in 1884 by a law authorizing the Savings Bank to devote part of its funds in loans to agriculturists. Among the great number of other financial institutions are savings banks under the patronage of communes, the society for the encouragement of national industry, &c.~~

~~Money. — The mintage of Belgian money is committed to a contractor, entitled Directeur de la fabrication, who works under the superintendence of the Government at a rate of charges fixed by royal decree. The value of all the coins minted since 1832 down to 1898 amounts to 1,172,516,348 francs. Since 1861 no coins have been minted, except the gold piece of 20 francs ; silver pieces of 5, 2, and 1 francs, and of 50 centimes ; nickel pieces of 10 and 5 centimes; and copper pieces of 2 and 1 centime.~~

~~For Belgium's relation with the Congo Fkeb State, see that article, and also below (p. 203).~~

~~Authorities. — J. C. Houzeon. Essai Wune Geographie physique de la Belgique, 1854. — Annuaire statistique de la Belgique, published annually ; Annuaire de Vobservatoire royal, Brussels, 67th year, 1900; Bulletin Mensuel et Tableau Annual du Com- merce de la Belgique aveo les pays~~

~~Strangers, published by the Ministry of Finance ; Becensement general des industries et des metiers, published by the Ministry of Industry and Labour, Brussels, 1900, 3rd vol. — Bug. van Bemmel, "Patria Belgica." Encyclopidie Nationale, Brussels, vol. iii., 1873-75. — Edg. van Bemmel. La Belgique illustree, Brussels, two vols., 1878-82. Cartes de la Belgique, published by the Military Cartographical Institute. — Do Fibp, Atlas du Belgique, 27 maps. (j. du f.)~~

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~~When Belgium was definitely established, in 1839, as an independent state, the political parties which had formed a coalition for thepurpose of safeguardiag and reorganizing the country again split up. In 1846 the first Catholic admiuistration was formed under Mai ou, and was succeeded in the following year by the first Liberal administration of Eogier and Fr6re-0rban. This government preserved Belgium from the contagion of the revolutionary ideas of 1848, extended the electoral franchise, diminished the intensity of the industrial crisis in Flanders, restored the financial equilibrium, instituted the municipal guard and the National Bank, and introduced public middle-class education. After a short interval of the Catholic Ministry of de Decker (1865-67), the Liberals again returned to power, under Eogier (1857-68), and under Fr^re-Orban (1868-70). In 1860 the octroi of the towns was abolished, and next year Protection was introduced, savings banks, were established, co-operative and friendly societies promoted, and trade unions declared legal. In 1865 the devolution of the crown from Leopold I. upon his son was satisfactorily effected. Between 1870 and 1878 two Catholic Cabinets were in power, d'Anethan's (1870-71)~~

~~and Malou's (1871-78). The latter, composed of moderate Catholics, permitted the extreme Eight, "the Ultramon- tanes," to take the lead. In this period came the struggle between the Pope and the Italian Government, and the German Kulturkampf. The Belgian Clericals declared in favour of the re-establishment of the temporal power, and congratulated the German priests whom Bismarck had dispossessed. M. Malou held the Government aloof from these manifestations, and in consequence of the representa- tions of the German Chancellor was obliged even publicly to condemn them, but,~~

~~notwithstanding the attitude of the Government, the Ultramontane agitation compassed its fall. The Liberals, who in Eogier's second Ministry had divided themselves into Doctrinaires (Moderates) and Progressists, again joined hands as a protest against Clerical intervention in politics and especially against the attitude of the Church in the elections. The Govern- ment was obliged to pass a law ensuring the secrecy of the ballot (1877), the provisions of which were framed on the English system, and this soon gave the Liberals a majority in the Chambers, which lasted from 1878 to 1884.~~

~~The new Cabinet devoted itself, under M. Frfere-Orban, solely to the settlement of the educational question. The office of Minister of Public Education was created, and a new system of primary education uberai introduced. In 1842 the popular schools were party sectarian in character, and instruction by the ^'"*« clergy in the Catholic faith was obligatory ; question. children belonging to other persuasions being dispensed from attendance. After 1846 the Liberal Congress, in framing the programme of the party, de- manded the abolition of this system. The law of 1879 provided for the secularization of primary education ; but by Article 4 the ministers of all confessions received per- mission to impart religious instruction in the schools to children whose parents desired it, at hours other than those set apart for regular education. Instruction in morals, until then entrusted to the clergy, was secularized and placed in the hands of the regular teachers. On the , other side, the State extended its direction and control to the communal schools, subjecting them to a rigorous inspection. After the passing of this law, a stfpggle ensued between the Government and the Liberalyparty on the one side, and the Episcopate and the GathoUc party on the other, the latter not being satisfied(with the concessions made by Article 4. The bishops condemned the school law, and ordained that absolution should be refused to teachers in the Government schools, and to all parents who left their children in them ; moreover, they implored their clergy to found schools everywhere in opposi- tion to the schools " sans Dieu." This movement succeeded to a great extent. In 1884 the state primary schools numbered only 346,000 scholars, as against 600,000 in the Catholic schools. The Government was unable to prevail upon the Episcopate to end this " school campaign," the clergy being entirely~~

~~independent of the State, although it vainly negotiated with the Pope for the is sue of an ordinance to the bishops to abandon their opposition to the law. M. Fr^re-Orban was obliged to recall the Belgian Minister to the Vatican on the eve of the fgtes of the national jubilee, 1880, with which the clergy refused to associate themselves. The struggle was embittered by the report of a parlia- mentary committee appointed to inquire into the educar tional system, which not only showed conclusively the insufficiency of education as imparted in Catholic schools, but exposed the measures taken by the clergy to boycott the Government schools.~~

~~In order to meet the Catholics with any hope of success, Liberalism had need of all its strength ; but at this very juncture it became so completely disintegrated that its~~

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~~unity has never since been restored. The cause of this disintegration was the extension of the franchise.~~

~~The Constitution of 1831 (Article 47) granted the Parliamentary franchise to citizens paying 100 florins~~

~~Dutch currency (211 f . 60 c.) direct taxes in the refo^Lf* l^rg^ communes, gradually descending to 20~~

~~florins in the vUlages. The Liberal Congress of 1846 demanded the reduction of the electoral qualification to the last-named figure, and this reform was carried out in 1848. It was impossible to go farther without modifying the text of the Constitution, which required the consent of two-thirds of the Chambers, specially elected for the purpose. Nevertheless, the Liberal Progressists in Novem ber 1870 proposed in the Chamber the revision of Article 47. This motion was rejected by 73 Liberal and Catholic votes to 23 Progressist. But, in order to some extent to compensate the minority, the Ministry of M. d'Anethan lowered the qualification for the~~

provincial and communal electorate, so far as it was possible to do so without viotating the Constitution. There were from that date 350,000 communal electors (paying 10 f. in taxes), 200,000 provincial electors (paying 20 f.), and 100,000 general electors (paying 42 f . 32 c). This reform enhanced the strength of the revisionist movement, for the communal and provincial electors evinced a natural desire to acquire full rights of sulirage. Relying on these tendencies, M. Janson, head of the Progressists, moved a second time, in 1883, the revision of Article 47. This motion was defeated by 116 Catholic and Ministerial votes to 11 (8 Progressist and 3 Catholic). But, as in 1870, the Pro- gressists again obtained some compensation. The electoral body, communal and provincial, was enlarged by the grant of the franchise to qualified electors, i.e., such as could show, either by certificates or by examination, that they had received a full primary education. One hundred and thirty thousand new voters were thus created. But the hostility of the Progressists to the Ministry was not assuaged by this concession, nor by the lodging of Bills making education obligatory upon all, and founding industrial schools for infants. Moreover, to political difficulties financial ones were added. Eeceipts iato the Treasury had fallen off, as a consequence of the European economic crisis; expenses had increased owing to the extension of primary education ; and the deficit had reached a total of 25,000,000 f. in 1883. The Government, in spite of the Catholics and Progressists, imposed a fresh tax upon tobacco, alcohol, &c. In the month of June 1884, the elections not only deprived the Liberal party of its majority, but also consigned it for an indefibaite period to the cold shade of opposition. Its defeat was due to the Catholic agitation against the School Law, and to dif- ferences in regard to the franchise question. The Con- servative electors, swaying from right to left, and alarmed by the demands of the Progressists and the anti-Cleri- cal policy of the Government, gave their votes to the Catholics.

The period since 1884 may be divided into two parts, that of the bourgeois regime, or the limited franchise

(1884-94), and the beginning of the Democratic Catholic regime — universal suffrage (1894-1900). Six “r^ioJs! . Ministries were in office, under Malou, Beernaert,

de Burlet, de Smet de Naeyer, van den Peere- boom, and de Smet de Naeyer (for the second time). In the Malou Ministry, which lasted from June' to October 1884, the Premier's chief colleagues were MM. Woeste, Beernaert, and van den Peereboom. The portfolio of Public Education was abolished, and a new enactment replaced the School Law of 1859. The communes obtained the right to suppress their secular schools, and to adopt at their pleasure the Catholic schools established since 1879. They might retain at least one secular

school, or adopt at least one Catholic school, where 25 fathers of families demanded it. The State subsidized all the communal schools, whether secular or sectarian. Secular instruction in morals disappeared from the programme, but religious instruction was not made obligatory. The passing of this Bill in October called forth violent protests. The Liberal mayors of the large cities went in a body to the king to entreat him to withhold his sanction; the measure none the less became law. In the same month the communal elections turned out unfavour- ably for the Catholics, and the king, grasping the situar tion, demanded the resignation of the Ministers who had been most vehemently attacked on account of their Clericalism, namely, MM.- Woeste and Jacobs. M. Malou followed his colleagues, and M. Beernaert, who had been Minister of Public Works from 1873-78, and agaip. from June 1884, became President of the Cabinet.

M. Beernaert's Ministry, which held office during the period from October 1884 to March 1894, controlled affairs during the most troublous period through which purther Belgium had passed since 1839. The political demaads agitation of 1884, confined to the bourgeoisie, for gave place in 1886 to an agitation which was «”’’«’<«'• at once both political and social, and of which the main- spring lay in the. working class. On the 18th of March 1886 a Socialist rising suddenly burst out at Lifege, on the occasion of the anniversary of the Paris Commune. The movement rapidly spread in the industrial centres of Li^ge, Charleroi, and Mons. Thousands of working men went on strike, demanding better wages and the suffrage. On the 28th March a body of strikers set fire to a glass manufactory at Jumet, near Charleroi. The coalfields were put into a state of siege, and the military came on several occasions into armed conflict with the strikers. The vigour with which this outbreak was suppressed soon re-established public order,

~~but these sad occurrences drew public attention sharply to the condition of the working classes. It was felt that political and social reforms were imperative. The Government opened a comprehen- sive inquiry, which served as the basis of numerous social laws. Simultaneously, the Liberal Progressists began a campaign for the extension of the franchise, and in this were supported by the Socialist labour party, formed in~~

~~1885.~~

~~The movement of 1886 must be regarded as one of the epoch-making events in modern Belgian history. By giving a fresh impulse to the demands of the revision- ists, by calling forth the framing of laws for the protection of workers, and bringing the Socialist party upon the scene, it caused Belgium to pass rapidly from a middle- class to a democratic regime. In 1887 the third motion for revision was rejected in the Chamber by 83 votes (Eight) to 35 (Left). The moderate Liberals, acting on the advice of M. Prere-Orban, voted on this occasion for the motion. Harmony did not reign among the partisans of revision : the Socialists demanded universal suffrage, while the Progressists, faithful to Liberal tradition, insisted upon granting the franchise only to such Belgian subjects as could read and write. But the unanimity of the parties composing the Left as to the necessity for revision, ren- dered the measure inevitable. The revisionist propaganda became intense. M. Janson was returned to the Chamber by the solid vote of the Liberals of the capital, and forth- with moved revision for the fourth time. The Socialist party threatened the Government that, in the event of M. Janson's motion being defeated, it would proclaim a general strike. The motion was eventually taken into consideration (November 1890) by the unanimous vote of the House, M. Beernaert having persuaded the Catholic majority to support the principle of revision. Between this vote and~~

~~the end of the Constitutional crisis three years elapsed, marked by long Parliamentary discussions, by demon- strations on the part of the~~

~~revisionists, and by strikes of a political tendency. The length of the debates was due to the divergent views of the parties. The Govern- ment and almost all the Catholics declared in favour of the adoption of the " occupation and residence " quali- fications (as in England). The moderate Liberals proposed to refuse the franchise to the illiterate, and to- such as were in receipt of charitable relief, public or private. The Progressists rallied round the Socialist watchword, " universal suffrage." On the other side, the problem had become considerably enlarged. M. Janson had only de- manded the modification of Articles 47 (right of suffrage) and 63 and 56 (organization of the Senate). M. Beernaert thought that the revision should extend farther, in order that the new Constitution shoidd have the same equilib- rium as that of 1830, urging that it was necessary to have a counterpoise to democracy. He declared himself in favour of a complete reconstruction of the Senate, the qualification for election to it being fixed at 2116 f . a year, the election being partly direct and partly indirect, th& establishment of the obligatory vote, and proportional representation. Finally, he demanded that it should be recognized as the prerogative of the Crown to take the opinion of the electors on the laws passed in Parliament or on Bills submitted for its deliberation. In order to carry these reforms, the revision of Articles 54, 57, 58, 26, and 48 was imperatively required. The Senate and the Chamber declared, in May 1892, that the time was come to modify the articles indicated by M. Janson and M. Beer- naert. As prescribed by the Constitution, the Chambers were immediately dissolved, and two new Chambers elected. The Catholics had a majority in both, but not sufficiently large to enable them to dispense with the assistance of the Liberals, the Constitution requiring for every revision a majority of two-thirds. At the be- ginning of the iinal debate, which lasted from February until April 1893, M. Beernaert appealed to the " patriotic consensus " of the parties, a consensus which was not, however, conspicuous until the last moment, when, after the close of the general discussion, votes were taken successively upon the various Bills for extending the franchise. These were all thrown out (11th and 12th April).~~

~~In view of this rebuff to popular aspirations, the Council of the Labour party proclaimed a general strike.~~

~~Fifty thousand workmen struck work ; in The Labour Brussels, violent demonstrations took place ‘eat r°i in the streets, and collisions followed between revision, the working-meu and the constabulary. The~~

~~like happened at Antwerp and Mons, where several strikers were killed by the gardes civiques. The agitation assumed a dangerous aspect, and the Govern- ment and the Liberal Progressist Opposition perceived that it was necessary to terminate it. Harmony was restored as the result of a compromise proposed by M. Nyssens, Catholic Deputy and professor at the University of Louvain, who had already mooted the idea in a pamphlet published in 1890, and on 18th April the Chamber adopted the new Article 47 by 119 votes to 14. The new article introduced an electoral system until then unknown — le suffrage universel plural. Every Belgian citizen became an elector on attaining the age of 25 years, and one or two supplementary votes were conferred upon him under certain conditions. Hereupon the General Council of working men, while keeping universal suffrage, pure and simple, still nailed to the mast, ordered a resumption of work. The revision of the other articles presented fewer difficulties. M. Beernaert withdrew his amendment giving the Crown the right to take the opinion of the constitu-~~

~~Elecioral laws.~~

~~encies, an innovation that seemed in the main contrary to the essence of a Parliamentary system, as well as dangerous to the Crown itself. But he obtained the obligatory vote, the possibility of introducing proportional representation, thanks to a redrafting of Article 48, and lastly some modifications in the organization of the Senate. The electoral age was to be 30 years, with a qualification of 1000 f., and twenty-six senators were to be elected by the provincial councils. The new articles were promulgated on 7th September.~~

~~The electoral laws had yet to be framed. M. Beernaert introduced the Bill for proportional representation, but, before it was set down for, debate, it roused such violent opposition on the part of the Catholic majority that he resigned. The labours of the Ministry of M. de Burlet, which lasted from March 1894 to February 1896, were mainly directed towards the passing of electoral laws for the additions to the Senate and the Chamber (1894), to the~~

~~Provincial Councils (1894), and the Communal Councils (1895). TThe general tendency of this legislation was to restrain the application of Article 4 as much as possible. The following conditions resulted from these laws. The citizen, in order to possess a vote for the election of representatives to the Chamber, was to be of a minimum age of 25 years, and of 30 years for the election of senators and provincial and communal councillors. A minimum of three years' domi- cile was required for the communal electorate, and of one only for each of the others. For the four categories of elec- tions a supplementary vote was given to (a) citizens who, having attained the age of 35 years and being married or widowers with children, paid at least 5 f. income-tax, and (6) to citizens of the age of 25 years possessing real estate to the value of 2000 f ., or Belgian State securities yielding an income of at least 100 f. Two supplementary votes were bestowed upon citizens having certificates of middle- class education or upon such as were fulfilling functions and professions requiring the possession of such educa- tional certificates. Moreover, for the communal elections a third supplementary vote was given to those who were in possession of real estate yielding an annual income of at least 100 f. It was thus possible to have at most four votes for the communal elections and three for the rest. The composition of the three electoral bodies for the year 1894-95 was as follows : — For the Chamber of Represen- tatives there were 1,354,891 electors with 2,085,605 votes, and 21 electors for each 100 inhabitants, giving 1-54 vote per elector. For the Senate and Provincial Councils there were 1,148,433 electors with 1,856,838 votes. Every 100 inhabitants had 18 electors, equal to 1-62 vote per elector. For the Communal Councils there were 1,124,276 electors with 1,926,681 votes, and 17-6 electors per 100 inhabitants, equal to 1-71 vote per elector. The communal law of 1895 introduced a system of partial proportional representation. Where none of the lists of candidates obtains half the votes, the seats are distributed among the lists that have obtained a certain number of votes (quorum). On the other hand, the laws of 1894 retained, in the case of the other assemblies, both the system of majorities and the scrutin de liste by arron- dissement or by canton.~~

~~These legislative labours having been completed, all the elected assemblies were dissolved and reconstructed by universal suffrage. The Parliamentary elections of October 1894 sent to the Senate 71 Catholics, 29 Liberals, and~~

~~2 Socialists (in February 1900 the numbers were respec- tively 72, 29, and 1), and to the Chamber 104 Catholics, 28 Socialists, and 20 Liberal Progressists (in February 1900 the figures were respectively 112, 28, and 12). The main features of this election were the great strengthen- ing of the Catholic majority, the advent of a compact body~~

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~~of Socialists, and the dSfeat of tlie Liberals. But the strength of the parties was not proportionate to the num- ber of seats gained ; the strength of the Catholic vote being 900,000 as against 350,000 Socialists and 450,000 Liberals. The provincial elections in the same year gave the Liberals the administration of two provinces — namely Brabant and Hainault; the Radical Socialists secured Lifege, and the Catholics the remaining six provinces. The communal elections held in October 1895 resulted, in many of the cities; in councils without a stable majority, a state of things due to the existence of the three parties and to proportional representation. In February 1896 M. de Burlet, being in bad health, transferred the direction of public affairs to the Minister of Finance, M. de Smet de Naeyep. The Liberal defeat and the Socialist successes had substituted a revolu- tionary for a constitutional Opposition in Parliament. The new Cabinet recognized all the dangers of the situation from the point of view of monarchical and Conservative interests. On the other hand, the Liberals demanded a reform calculated to make their numbers in the Chamber proportionate to their electoral strength. The faults of the existing system were so apparent that opinion among all parties soon veered round in favour of its abolition. Yet parties and Ministry alike were divided as to the nature of the reform required. Some, like M. Woeste, were for the system of the scrutin uninominal, others demanded with M. Beernaert complete proportional representation. The more the Opposition on the left in- sisted on these demands, the less harmony reigned in the majority and in the Government. Hence, in 1899, a Min- isterial crisis occurred. MM. de Smet de Naeyer and Nys- sens, being unable to persuade their colleagues to declare in favour of proportional representation, resigned oflB.ce.~~

~~The new chief of the Cabinet was M. van den Peere- boom, who had been Minister of Eailways since 1884. . He conceived that he could solve the diflB- Propor- culty by applying proportional representation Matationr'~~ ~~the large arrondissements, returning at least three senators and six representatives, the scrutins of the small arrondissements continuing to be held on the majority system. This proposal met with formidable opposition. It satisiied neither M. Woeste nor his friends, and was virulently attacked in Parliar meut, in the press, and on platforms, by Liberals and Socialists alike. As a matter of fact it tended to keep the Catholic party in power. It actually confirmed them in possession of the majority of the small arron- dissements they already held, and brought them seats in the large arrondissements, where they had hitherto not held any, or where the possession of the seats they had previously held was precarious. In spite of all protests to the contrary, M. van den Peereboom insisted on pressing his Bill ; the Socialist Deputies began a course of organized obstruction in the Chamber, and from Parliament the agitation passed to the street. On several evenings in succession during June bloody encounters took place between the demonstrators and the gendarmes guarding the Houses of Parliament, the palace of the king, and the houses of Ministers. As in 1893 the movement degenerated into riots. It extended to all the large cities of the province, and found support among the Liberal middle classes ; even the garde civique declared its dissatisfaction. The Government, weakly supported by the Right, gave way, as in 1893, and with- drew the Bill. A month later, in August 1899, M. van den Peereboom, despairing of finding another solution of the problem, resigned, making way for the second min- istry of M. de Smet de Naeyer. The new Cabinet^ at once introduced a BiU giving proportional representation (for Parliamentary elections) to all the arrondissements.**

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~~After a long debate, the Bill was adopted by the Chamber, in November, by 67 votes to 60, and by the Senate, in December, by 62 , votes to 26, in spite of the double opposition of the Catholics, who held to M. Woeste, and of the Socialists, who considered the passing of the Bill of less importance than the suppression of plural voting. In both Chambers motions for the revision of Article 47 with a view to the introduction of the principle of "~~

one man one vote ” were defended, but rejected by an overwhelming majority. The features of the law are proportional distribution of seats among all the lists en presence, irrespective ,of the number of votes polled; grouping of the smaller districts in larger arron- dissements ; determination by the clerks of the lists of the order of election of candidates; prohibition of electors from giving votes to candidates of two lists; and the appointment of deputy Senators and representatives. The first elections which took place under the operation of the new law in May 1900 resulted as follows : there were elected to the Senate 58 Catholics, 39 Liberals and Radicals, and 5 Socialists ; to the Chamber of Repre- sentatives 85 Catholics, 1 Christian Democrat, 33 Lib- erals and Radicals, 33 Socialists. The Catholic majority in the two Chambers sensibly diiainished, the Socialists and especially the Liberals gaining seats. Experience has shown that the Belgian electoral system is very com- plicated, and its simplification is urgently demanded. The Socialists and a majority of the Liberals advocate universal suffrage pure and simple, i.e., the suppression of plural voting. They also demand the system of pro- portional representation, and an active agitation has begun in favour of these reforms. We may conjecture that, despite the opposition of the Catholics and certain Liberals, complete political equality will be finally attained if the union of the Liberal bourgeoisie and the Socialists, which brought about the electoral reforms of 1893 and 1899, becomes consolidated.

There are three political parties in Belgium — the Catholics, the Liberals, and the Socialists. The Catholic party was formed after the publication of the Encyclical in 1832. In 1846 it came into ^^j power for the first time, and up till 1901 had held it for twenty-seven years. It published its pro- gramme for the first time at the Congress of Malines in 1863. True to the instructions of the Papacy, it has, since then, posed more and more as the defender of constitutional liberties, by means of an ingenious dis- tinction drawn between thesis and hypothesis. Its fight with the Liberal party centres essentially in two points — ^the question of education (lay or sectarian), and the maintenance of the privileged position of the .clergy, which is paid by, but is yet independent of, the State. Since 1894, in spite of Conservative tendencies, the Catholic party, adapting itself to new political exigen- cies, has added to its old programme social reforms which have partly become law. Its unity, however, was in 1901 jeopardized by the rivalry of MM.

~~Beernaert and Woeste, its two chiefs since the death of Malou, — the first before all a " Conservative," and the latter before all a "Clerical." Certain Catholic elements have become organized in working men's associations grouped in a democratic federation distinct from the Catholic federation. In Flanders a Democratic Christian party has been formed under the lead of the Abbe Daens, an inhibited priest. Its demands are obligatory education and military service, a progressive tax levied upon income, and measures of agrarian socialism. On the whole, the Catholic party finds its support in the aristoc- racy, in one section of the bourgeoisie, but chiefly in the Flemish peasants.~~

~~The Liberal party, as constituted by a congress in 1846,~~

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~~had up to 1901 been in power for twenty-seven years. Towards 1860 theve was formed within it a Progressist fraction demanding extension of the franchise and secular schools. How the party became divided in 1883 has been already shown. The Progressists have now formed them- selves into a distinct party. The moderate Liberals favour personal military service, proportionate taxation of income, and liberty of labour in the case of adults. The demands of the Progressists are : a nation in arms, a progressive income tax, universal suffrage pure and simple, and all measures called " Socialisme d'etat." Both fractions of Liberalism insist upon obligatory education and war upon Clericalism. Since 1894, a Liberal working men's party has been formed, to em- brace all working men not belonging to the Socialist or Catholic groups. Its programme is that of the Pro- gressists. But the Liberal party finds its recruits mainly among the middle class, and the financial and industrial world.~~

~~The Socialist party was formed on 6th April 1885, by certain co-operative groups. Its political action began after the troubles' of 1886. It extended its~~

~~influence to the workers in great industrial undertakings. We have seen what rdle it played in the revisionist crisis, and how it became an influential Parliamentary party. Its organization, a mixture of centralization and autonomy, is based upon the powerful trade unions of Ghent, Brus- sels, and other places, and upon numerous professional syndicates. Upon this substratum are built up (1) the district federations, uniting the socialist groups of each district; and (2) professional federations, uniting the workmen of the same branch of industry, wherever their domicile. Above these again comes the Congress, com- posed of delegates of each society, and at the pinnacle, the General Council, or the executive power, elected an- nually by the Congress. The political programme of the party may be summed up in a single word — "collectivism." The more immediate programme resembles that of the Progressists, who have often made electoral alliances with the Socialists, i.e., universal suffrage, a nation in arms, regulation of labour, sliding-scale taxation, the monopoly of alcohol, and nationalization of mines and railways. The Socialist party naturally finds support among the industrial workers, and its considerable success is due to the numerical importance of this class in relation to the total population of the kingdom.~~

~~Of late years Parliamentary tradition has been greatly modified. Since 1884 power had remained in the ha.nds of the same party, with frequent ministerial Jhlmeat' changes, due to divisions in the majority. The constitutional opposition of the Liberals has given place to the revolutionary opposition of the Social- ists. There has been a material decline both in the quality of the debates and in the amount of useful work done in the Chamber. The Senate plays a part which is every day becoming more and more subordinate. It con- fines its labours to voting, without modification. Bills sub- mitted to it by the Chamber. The supporters of propor- tional representation hope, perchance wrongly, that this institution is destined to rectify the defective working of the Parliamentary system.~~

~~There remain to be noted the principal enactments since 1885. In social legislation the following are the more important: — Prohibition of the "truck system " ; the institution in 1887 of industrial and labour councils, composed of employers and employis, and of a superior council, formed of of&cials, workmen, and employers; laws assisting the erection of~~

workmen's dwellings and supervising the labour of women and children (1889) ; laws for ameliorating the system of Friendly Societies (1890) ; laws regulating

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workshops (1896) ; for the insrttution of miners' repre- sentatives (1897) ; conferring corporate rights upon trade unions (1898) ; guaranteeing the security and health of working men during the hours of labour (1899). In 1900 laws were passed regulating the contract of labour, placing the workman on a footing of complete equality with his employer, assuring the married woman free control of her savings, and organizing a system of old-age pensions. The fourth law of primary education (1895) made religious instruction obligatory, and extended State subsidies to all schools, communal, adopted, or free, that satisfied certain conditions. As a matter of fact, the Liberals, the Social- ists, and the Christian Democrats placed in their pro- gramme " obligatory primary education." In 1899 there were in Belgium 6674 subsidized schools, having 775,000 scholars, out of a total of 950,000 children of school age. Only 68,000 did not receive religious instruction. A law affecting higher education, passed in 18^0, enriched the University curriculum by giving it a more scientific character; and confirmed the privilege acquired in 1876 by the four Universities of Li^ge, Ghent, Brussels, and Louvain, of conferring upon their students diplomas giving access to the liberal professions.

The neutrality of Belgium, guaranteed by the Great Powers, is guarded by an army raised by conscription, substitutes being allowed. The annual contin- gent is 13,300 men ; the term of service being '^ys^m two or three years with the colours and ten years in the reserve (130,000 men in time of war). Pop a considerable time past, the General Staff has demanded obligatory military service, 180,000 men in time of war, and the abolition of the principle of substitution. Of the political parties, the Catholics object to obligatory ser- vice and to increase of the army, while cordially advo- cating an army of volunteers and a reduction of the numbers with the colours. The Liberals uphold obligar tory service with a reduction of the years with the colours. The Radicals and Socialists demand an army on the model of the Swiss. In 1887 the entrenched camps of Li^ge and Namur

~~were formed. Until that date Belgium only possessed one entrenched camp, that of Antwerp (1859), which has since then been frequently enlarged. In 1897, the garde civique, a kind of garde nationale, was reorganized, and the Government endeav- oured to give it the character of a reserve force to assist the army in defending the fortresses. The Government, in July 1901, laid before the Chamber a military Bill, which had for its object a reduction of the time of active military service, a large extension of voluntary service, and an increase of the annual contingent of 13,300 men in case only the volunteers do not join in sufficient numbers. This Bill did not abolish the principle of substitution, a reform demanded by the Liberals and the Socialists, nor did it seriously increase the effective strength of the army in time of war, a measure which was consid- ered indispensable by the Military Commission of 1900-1901. (See Armies.)~~

~~The system of commercial liberty and treaties of com- merce, established by M. Pr^re-Orban in 1861, is still of practical value in its main features. It is of vital importance to Belgium, a country of great ”””“■*• industrial production and of dense population. To this system, in fact, Belgium owes her material prosperity. Nevertheless, protectionist tendencies, which took their rise among the agriculturists, have recently gained ground. Since 1887 duties have been imposed upon imported live animals and dead meat; and since 1895 duties upon barley, oats, &c., have either been imposed or the old ones increased.~~

~~Of six mUlions of inhabitants, according to the census of 1890, two and a half millions spoke French, or one of~~

~~its dialects — namely, Walloon ; and two and three-quarter millions, Flemish. The linguistic frontier runs from west Language ° ^^^ (from Comines, lying to the north of Lille, to Vis^, to the north of Li^ge). The sole oflcial language of the country from the 15th century to within the last few years was Trench (with the excep- tion of the Dutch period, 1814-30). But~~

~~the Flemish have by degrees succeeded in obtaining for their language an equal footing with French for official business. The introduction of universal suffrage has enhanced the strength of the Flemish movement, because the Deputies of Northern Belgium are now elected by citizens, of whom four-fifths are ignorant of- French; indeed, in 1900 there was one Deputy who did not even understand that language. Some of the principal laws on the subject are these — use of Flemish in the law courts (1873) ; in the documents of public administrations (1878) ; and in middle-class schools (1883) ; promulgation of laws in both languages (1898).~~

~~Belgium of the present day affords a picture of a rapid and general transformation. Politically, it is becoming a democracy ; economically, thanks to the development of its industries within, and of its commerce and colonial enterprise without, it is one of the wealthiest and most energetic nations of Europe. Its economic progress has determined its political transformation. Situated at the meeting-point of three great civilizations, whose influences it at once feels and assimilates, Belgium is becoming more and more a microcosm of Europe, an active laboratory of political, economic, and social experiences.~~

~~The political relations subsisting between Belgium and the Congo State date from 1885, when Leopold II., presi- dent of the African International Association, silt^’”’^” received at the Berlin Congress the sovereignty of the African State. The Chambers at once and almost unanimously authorized the King to accept this mandate. In 1890 King Leopold communicated to Parliament a clause in his will by which, on his death, he devised his African possessions to Belgium. In 1896 the Government deposited a Bill ia the Chamber making the Congo State a Belgian Colony. The introduction of this Bill had been preceded by the eonclusioa of two conven- tions ; one between Belgium and the Independent State, and the other between Belgium and France by which the latter declared that she did not oppose the cession of the State to Belgium, reserving, however, to herself the right to pre-emption should, in the future, Belgium dispose of either the whole or part of her African colony. In view of the violent opposition of the Socialists and of certain Catholics, the Ministry withdrew the Bill. Various laws have associated Belgium in the task of governing the Congo. A law of 1887 authorized the Congo State to issue in Belgium a~~

~~loan to the amount of 150,000,000 f. Subscriptions were in 1889-95 invited for shares in the railway from Matadi to Stanley Pool, which was opened in 1898. A loan of 25,000,000 f. to the Independent State (1891) was in 1896 increased by a second loan of 6,850,000 f. In return, Belgium obtained the right to elect, in 1900, whether these advances should be repaid or whether the Congo State should be annexed. The Belgian Government was not, however, obliged to come to a decision on the date fixed. In accordance with the Government of the Congo State, the Belgian Government, in July 1901, passed a convention through Parliament, by virtue of which the. Congo State is dispensed from payment of its debt to Belgium until an indeterminate date. Belgium reserves its right to annex the Congo at a date equally indeterminate. The Government, more- over, promised to bring in a Bill regulating the relar tions between Belgium and the Congo, in the event of the annexation of the latter.~~

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~~Belgian literature, as distinguished from French, has come about through a fusion of two elements, the Flemish and the Walloon, which make up what we call the Belgian race ; and it is only somewhat recently that any attempt has been made in literature to fuse these two elements. The Walloon, which is related to the French, brings a nervous sensibility, a delicate mental energy, while the Flemish, which is related to the Dutch, brings a slow, profound faculty of meditation, an almost primitive simplicity, together with a gross animal fervour, deeply rooted in the earth. Belgium is the country of Euysbroeck and Eubens, of the most spiritually abstract of mystics, and of the most carnal of the painters of life. In Belgian literature, coming into existence under that twofold influence, one becomes conscious at once of the body and of the soul, each interpenetrating the other in a constantly realized communion with nature. Beginning unconsciously, and under definitely French influences, Baudelaire, Zola, for example, a group of Belgian writers began tp detach themselves from the various schools of France ; their first public proclamation of a new literature may be dated from the banquet given in 1883 to Camille Lemonnier. Lemonnier had already f oimd out a way for himself, on definitely Flemish soil ; Maeterlinck began to concern himself with the soul ; Eekhoud with the strange passions of the body ; Verhaeren with whatever was most coloured and violent in body and soul and the external world ; Eodenbach with the aged quietude of the little dead cities of his country. It was as if a sluggish body had become possessed^ of an unexpectedly powerful life; as if restless nerves had come to awaken a stolid nature. It was thus a new quality of imagina- tion which seemed to reveal itself, as the soul became conscious of the mystery of the universe, and the body shivered at new fears, apprehensions, the haunting of a forgotten spiritual sense. It was the soiil coming into a literature of mind, and at once the literature of Belgium was distinguished from the litera- ture ^of France.~~

~~Camille Lemonnier (born 24th March 1855), though he may have learned something of his method from Zola, is himself a personal force, and perhaps the first personal force to show itself in Belgium. Beginning as an art- critic, his first characteristic books are the Contes Flamands et Wallons and Un Coin de Village of 1879. Then came Les Chamiers, 1881; Un M&le, 1881; Le Mart, 1883; Happe-Chair, 1886; La Faute de Madame Charvejt, 1895; L'lle Vierge, 1896; Adam et Eve, 1896; La petite femme de~~

la Mer, 1897, &c. His best novels, such as Un M&le, are full of a great, healthy, animal life ; the life of the earth, rudely yet subtly apprehended, as if by an instinct very close to nature. He knows the peasant, in all his simplicity, brutality, uncouth vigour.

He gives us the peasant as a human being, the most elemental of human beings. His descriptions are so admirable because they are so human. His men and "women are admirable because they are seen as a part of the same substance as the ■woods and fields they move in, not as social items. They live, love, act, as they do, because a mysterious force, of which they are for the most part unconscious, is in them ; the same mysterious force ■which germinates in the furro^ws -which they turn. And so he has surprising naivetes, can be gross, accepts no compromises, and yet is full of restraint, of a kind of dignity, the strong man's mastery over his own strength. His style is large, coloured, vividly sober, always firm and decisive, always the faithful interpreter of his thought or sensation.

Maurice Maeterlinck was born 29th August 1862. His first book was a collection of verses. Serves Chaudes, 1889 ; this was followed by La Princesse Maleine, 1889 ; Les Aveugles, 1890 ; Les Sept Princesses, 1891 ; PelUas et MMisande, 1892 ; Alladine et Palomides, 1894 ; Le TrSsor des Humbles, 1896 ; Aglavaine et SMysette, 1896 ; Lq. Sagesse et la Destinie, 1898 ; La Vie des Abeilles, 1901. Maeterlinck, though he began with plays, and has only latterly written essays, is rather a philosopher who has turned dramatist than a dramatist who has turned philosopher. A brooding poet, a mystic, a conteniplative spectator of the comedy of death : that is how he presents himself to us in his work, and the introduction which he has prefixed to his transla- tion of L' Omement des Noces Spirituelles of Euysbroeck 1' Admirable shows how deeply he has studied the mystical writers of all ages, and how much akin to theirs is his own temper. In his plays he is always concerned with spiritual issues, with action as it might be seen in dreams, with a world reflected in a chamber of mirrors, with dis-

~~embodied passions and the tragedies of childish and ghostly souls. He has invented a whole theatre of marionettes, who are more mysteriously simple than human beings; he has made the stage at once more subjective and more pictorial than it ever was before. In his essays he is content to speak with his own voice, and his own voice is more beautiful, and has more beautiful and profound things to say, than the feigned voices of his characters. Speaking wi^thout intermediary, he speaks with a more absolute abandonment of every convention of human reserve, except the reserve of an extreme fastidious- ness in the choice of words simple enough and sincere enough to convey exactly his meaning, more spontaneously, it would seem, than any ■writer since Emerson. His essays might well be the favourite reading of those to whom beauty must come ■with a certain dogmatism, if it is to be accepted for what it is.~~

~~The poetry of Emile Verhaeren (born 21st May 1855), more than that of any other modern poet, is mad.e directly out of the complaining voices of the nerves. In his early books, Les Flamandes, 1883 ; Les Moines, 1886, he began by solid, heavily-coloured genre pictures in the Flemish style. But it is not until Les Soirs, 1887, that we find what was to be his really individual style developing itself. In Les D&bdcles, a year later, this art of writing in coloured and audible metaphor, and on in- creasingly abstract and psychological subjects, the sensa- tions externalized, has become more master of itself, and at the same time more immediately the servant of a more and more feverishly nervous organization. In Les Flarrv- beaux Noirs, 1890, there is a self analysis, a kind of self torture, which conveys to one the sense of all that is most solitary, picturesque, and poignant in the transformation of an intensely active and keen-sighted reason into a thing of conflicting ■visionary moods. Gradually, in Les Apparus dans mes Ohemins, 1891 ; in Les Campagnes Hal- Incinies, 1893 ; in Les Villages Illusoires, 1895 ; in Les~~

~~Villes Tentaculaires, 1895, the hallucinations become entirely external ; it is now the country, the village, the town, that is to say, the whole organized world, which agonizes among cloudy phantoms, and no longer a mere individual, abnormal brain. With Les Heures Claires,~~

~~1899, we see him, in these poems of fiery reverie, sending his soul into the universe, and becoming a vehement voice for all that he finds most passionate in it. It is, in its way, a dramatizing of emotion, but, if one may say so, an abstract dramatizing. In his two plays, Les Aubes, 1898, and Le Cloitre, 1900, he tries to give a more lyrical form to the new subjective kind of drama which Maeterlinck has made possible, gi^ving us, in his brief and fiery scenes, little broken bits of the savage forces of the world, working out their passionate issues in a con- flict of cities, or under the quiet roofs of the cloister. His latest collection of poems is Petites Ligendes, 1900. What he has so far achieved is a melodrama of the spirit ; there is poetry in it, as there is in everything written by the only contemporary writer of French verse who has a really vivid energy, but there is rhetoric as well as poetry.~~

~~Georges Eekhoud (born in 1854) is in some ways the most passionately Flemish of the Belgian group, partial and imperfect as he is. In his Kermesses, 1883 ; NouveUes Kermesses, 1887 ; Le Cycle Patibulaire, 1892 ; Mes Com- munions, 1895 ; Escal-Vigor, 1899; La Faneuse d' Amour,~~

~~1900, he has evoked, in a prose more feverish than the verse of Verhaeren, the image of all that is most excessive, outcast, extravagant, in the life of his country. He writes the tragedies of those whom their own natures, or the misery of circumstance, have brought into conflict with society. He writes with a kind of fury of sympathy, a sort of perverse ecstasy, as if he delighted in the sorrows for which he has so revolutionary a pity. Every story is a little violent episode, full of cruelty and compassion. The life of the people comes into his pages with all its exuberance, colour, disorder, its pell-mell of noble and abominable sentiments, its gross joys and sor- did disasters ; life so vehemently realized that it seems, in these pages, to overflow all bounds. He is impatient with words, as with acts ; his words seem to reel under some airy intoxication ; he -writes always at full speed. All his work is a kind of confession, in which he seems to unburden himself of a heart-load of hates and sympa- thies, dramatizing his own emotions into incidents of an only too vigorous externality.~~

~~In Georges Eodenbach (born 16th July 1855, died 25th December 1898) we find the sleepy spirit of Bruges, that other side of what is typically Flemish, and the titles of his books are themselves significant of the aspect under~~

which he saw his corner of the world : Le Bigne du Silence, 1891; Bruges-la-Morte, 1892; Les Vies Encloses, 1896 ; Le Carillonneur, 1897 ; Le Miroir du Ciel Natal, 1898. His best known book, Bruges-la-Morte, is an attempt to study the soul of a town, which he evokes ■with an almost feminine delicacy of perception. His prose and verse are pallid, elegant, monotonous with a kind of ^eet monotony ; 'they are sincere to a certain aspect of' Belgian life, and to a personal way of receiving sensation, but they have none of the energy of a tempera ment able to dream strongly. They have charm, but it is a drowsy charm, a little conscious of the effectiveness of its languor ; they are like faint pictures, not faded by time, but painted with timid colours.

By the side of these writers, or preceding them, as with Charles de Coster, Octave Pirmez, Theodore Hannon, are many writers whom space forbids to do more than men tion; but an account of Belgian literature would not be complete without at least mention of the names of Edmond Picard, Eugtoe Demolder, Charles van Lerberghe,

Max Elskamp, Albert Giraud, Pernand Severin, and Albert Mockel. (a. sy.)

Belgrade (Servian, Beograd, i.e., White Castle), the capital of Servia, situated in 44° 47′ N., and 20° 28′ E. Belgrade in 1895 contained 59,790 inhabitants, of whom 11,471 were foreigners, mostly Austro-Hungarian and Turkish subjects. The number of houses in 1895 was 5317, of which 156 were governmental and 67 municipal buildings. It is the most important commercial town in Servia, and one of the more important of the whole Balkan peninsula. It is situated at the confluence of two great rivers, the Save and the Danube, on a triangular ridge of which the southern base, having in its centre the pyramid of the Avala hill, leans on the northern slopes of the mountains of Central Servia (called Shumadiya). The north-western side of the triangle slopes towards the Save, while the north-eastern side descends slowly to the right bank of the Danube. The northern end of the ridge is formed by a cliff of Tertiary chalk, about 200 feet high, on which the citadel (grad) is built. The western side of the cliff is washed by

~~the Save, which, coming from the west, there falls into the Danube. This latter, coming from the north, turns at the foot of the citadel in an easterly direction. Just opposite the citadel, in a north-westerly direction, half-an-hour by steamer across the Danube, lies the Hungarian town Zimony (Serv. Zemun; G-erm. Semlin), which in many respects may be considered as a suburb of Belgrade. The position of Belgrade_ has been always considered as of great strategical, political, and commercial importance. The city was considered to be the key of Hungary, and its possession was believed to secure possession of Servia, besides giving command of the trafiBio between the Upper and the Lower Danube. It has, in consequence, seen more battles under its walls than most fortresses in Europe. The Turks used to call it " Darol-i-Djehad," " the home of wars for faith." As the royal residence, the seat of the government, and the centre of the import ■ trade, , Belgrade is being rapidly transformed into a modern European town, with wide streets, electric tram- ways, and electric lighting. The glacis of the citadel has been converted into a beautiful park, from which there are lovely views. Another popidar resort is the park of Topchider, with an old Turkish kiosk of Prince Milosh situated in beautifuUy-laid-out grounds. In the adjoining forest of lime-trees, called Koshutnyak (Parc-aux-Cerfs), Prince Michael was assassinated in 1868. The highest educational establishments are to be found in Belgrade : the "Velika Shkola" (a small university with three faculties), the military academy, the theological seminary, the high school for girls, a commercial academy, and several schools for secondary education on German mod- els. A commercial tribunal, a court of appeal, and the Court of Cassation are also in Belgrade. There is a fine monument to Prince Michael, who succeeded in remov- ing the Turkish garrison from the Belgrade citadel and obtaining other Turkish fortresses in Servia by skilful diplomacy. There are no monumental buildings in the town; still there are several fine architectural structures, the New Palace, the High School, the National Bank, and the National Theatre. There is also an interesting national museum, with Eoman antiquities and numis- matic collections, a national library with some 40,000 volumes, with a wealth of old Servian MSS., and a botanical garden, rich in specimens of the Balkan flora. To promote commerce there is a stock and produce exchange {Berza), a national bank, privileged to issue notes, and several banking establishments. The insurance work is done by foreign companies, amongst which the Gresham and the North British occupy foremost places.~~

~~Eor a town of nearly 60,000 inhabitants and of such political and commercial importance, which is also the seat of the Metropolitan of Servia, Belgrade has very few churches, and these are of a somewhat modest type. There are four Servian Orthodox churches, one Eoman Catholic chapel, one evangelical chapel (German), one synagogue, and one mosque. This last is kept up entirely at the expense of the Servian Government.~~

~~The first fortification of the rock, at the confluence of the Save and the Danube, was made by the Celts in the 3rd century e.g. They gave it the name of Singidunum, by which Belgrade was known until the 7th century a.d. The Komans took it from the Celts, and replaced their fort by a regular Roman castrum, placing in it a strong garrison. Eoman bricks, dug up in the fortress, bear the inscription, Legio JV. Flavia Felix. From the 4th to the beginning of the 6th century a.d. it often changed its masters (Huns, Sarmatians, Goths, Gepids); then the emperor Justinian brought it once more under Roman, or rather Byzantine, rule, and fortified and embellished it. Towards the end of tte 8th century it was taken by the Pranks of Charlemagne. In the 9th century it was captured by the Bulgarians, and held by them until the beginning of the 11th century, when the Byzantine emperor Basilius II. reconquered it for the Greek empire. The Hungarians, under king Stephen, took it from the Greeks in 1124. From that time it was constantly changing hands — Greeks, Bulgarians, Hungarians, replacing each other in turn. During the 14th century it was in the hands of the Servian kings. The Servian prince George Brankovich ceded it to the Hungarians in 1427. The Turkish forces unsuccessfully besieged the city in 1444 and 1456, on which last occasion a glorious victory was obtained by the Christian garrison, led by the famous John Hunyady and the enthusiastic monk John Capistran. In 1621 Sultan Suleyman took it from the Hungarians, and from that year it remained in Turkish possession until the year 1687, when the Austrians captured it, only to lose it again in 1690. In 1717 Prince Eugene of Savoy conquered it for Austria, which kept it until 1739, im- proving the fortifications and giving great impulse to the commercial development of the town. From 1739 to 1789 the Turks were again its masters, when, in that last year, the Austrians under General Laudon carried it by assault, only to lose it again in 1792. In 1807 the Servians, having risen for their independence, forced the Turkish garrison to~~

~~capitulate, and became masters of Belgrade, which they kept until the end of September 1813, when they abandoned it to the Turks. Up to the year 1862 not only was the fortress of Belgrade garrisoned by Turkish troops, but the Danubian slope of the town was inhabited by Turks, living under a special Turkish administration, while the modem part of the town (the plateau of the ridge and the western slope) was inhabited by Servians living under their ovm authorities. This dual govern- ment was a constant cause of friction between the Servians and the Turks, and on the occasion of one conflict between the two parties the Turkish commander of the fortress bombarded the Servian part of the town (14th June 1862). The indirect consequence of this incident was that in 1866, on the categoric demand of Prince Michael of Servia, and under the diplomatic pressure of the Great Powers, the Sultan withdrew the Turkish garrison from the citadel and delivered it to the Servians. (o. mi.)~~

~~Belize. See Honduras, British.~~

~~Bell, Alexander Graham (1847), inventor~~

~~and physicist, son of Alexander Melville Bell {q.v.), was born in Edinburgh on 3rd March 1847. He was educated at the University of Edinburgh and the University of London, and removed with his father to Canada in 1870. In 1872 he removed to Boston, and became professor of vocal physiology in Boston University. In 1876 he exhibited an apparatus embodying the results of his studies in the transmission of sound by electricity, and his invention, with improvements and modifications, con- stitutes the modern commercial telephone (see Ency. Brit. vol. xxiii. p. 128). He is the inventor also of the photophone (see vol. xxiii. p. 130), an instrument for transmitting sound by variations in a beam of light.~~

~~Bell, Alexander Melville (1819), teacher~~

~~and phonetist, was born at Edinburgh on 1st March 1819. Between 1843 and 1865 he was a lecturer at the University and New College of his native city. He was subsequently a lecturer at University College, London, and professor of philology and linguistics in Queen's University, Kingston.~~

~~B E L L A G I 0 — B ELLINZONA~~

~~In 1881 he removed to Washington, D.C. He is best known as the inventor of "visible speech" (see Ency. Brit. vol. xxii. p. 385), a system of indicating by alphabetical characters the utterances and modes of action of the human organs of speech. Among his writings are Visible Speech, Principles of Plumetics, and several books on elocution.~~

~~Bellagio, a town in the province of Como, Lombardy, Italy. It is beautifully situated at the tip of the peninsula which separates the two southern arms of Lake Como, and on this account is a favourite tourist resort. Its pic- turesque surroundings are studded with handsome villas {e.g., Serbelloni, Melzi, &c.), and parks and gardens. The people are employed in turnery, and in the manufacture of silk, wooUens, and cement. Population, about 3500.~~

~~Bellaire, a city of Belmont county, Ohio, U.S.A., situated in the eastern part of the state, on Ohio river, 5 miles south of Wheeling, at an altitude of 654 feet. It is entered by the Baltimore and Ohio, the Bellaire, Zanes- ville and Chicago, the Cleveland, Lorain, and Wheeling, and the Pennsylvania railways. Population (1900), 9912.~~

~~Bellamy, Edward (1850-1898), American author and social reformer, was born at Chicopee Palls, Massar chusetts, 25th March 1850. He studied for a time at Union College and in Germany ; was admitted to the bar in 1871 ; but soon afterwards entered upon journalistic work in Springfield, Massachusetts, and New York. After publishing three novelettes, pleasantly written, and show- ing some inventiveness in situation, but attracting no special notice, in 1888 he caught the public attention with Looking Backward, 2000-1887, in which he set forth ideas of co-operative or semi-socialistic life in village or city communities. The book was at first judged merely as a romance, but was soon accepted as a statement of the deliberate wishes and n^ethods of its author, who devoted the remainder of his life, as editor, author, lecturer, and politician, to the spread of what he called " nationalism," his ideal being, in the opinion of M. Emile de Laveleye, " pure communism." Bellamy died at Chicopee Palls on the 22nd of May 1898. Looking Backward was widely circulated in America and Europe, and translated into several foreign languages.~~

~~Bellary (Ballaki), a city and district of British India, in the Madras Presidency. T^e city is 305 miles by rail from Madras. Population (1881), 53,460 ; (1891), 69,467 ; (1901), 57,700. The municipal income in 1897- 98 was Es.1,00,050. Bellary is an important cantonment, and the headquarters of a military division. There is con- siderable trade in cotton, with two large steam presses, and some manufacture of cotton cloth. There is also a cotton mill, with 110 looms and 17,800 spindles, employ- ing 456 hands. There are a missionary college, three high schools for boys, with 725 pupils; nine printing-presses, which issue three vernacular periodicals, and several reading-rooms and literary institutions. In 1901 Bellary was chosen as one of the places of detention iw India for Boer prisoners of war.~~

~~The district of BBLiiAKV has an area of 5975 square miles. The population in 1891 was 900,126, being 151 persons per square mile. Classified according to religion, Hindus numbered 807,597 ; Mahommedans, 85,770 ; Chris- tians, 5283, of whom 1124 were Europeans ; Jains, 1463 ; « others," 13. In 1901 the population was 947,329, show- ing an increase of 8 per cent. The total amount of the land revenue and rates was Iis.19,64,992, the incidence of assessment being nearly 14 annas per acre ; the number of police was 701. In 1897-98, out of a total cultivated area of 2,146,624 acres, 68,595 were irrigated, including~~

~~23,280 from Government canals. The principal crops are millet, other food-grains, pulse, oil-seeds, and cotton. There are considerable manufactures of cotton and woollen goods, and cotton is largely exported. The district is traversed by the Madras and Southern Mahratta railways, meeting on the eastern border at Guntakal junction, where another line branches off to Bezwada. In 1896-97 the number of schools was 1035, attended by 24,186 pupils, being one pupil to every 37 of the population. In spread of education Bellary ranks third among the rural districts of the province. The death-rate in 1897 was 31 -2 per 1000.~~

~~Bellefontaine, a city of Ohio, U.S.A., capital of Lo- gan county, north-west of the centre of the state, at the intersection of three railways. Population (1900), 6649.~~

~~Belleville, capital of St Clair county, Illinois, U.S.A., situated in the south-western part of the state, in 38° 29′ N. lat., and 89° 58′ W. long., at an~~

~~altitude of 527 feet. It has four railways — ^the Illinois Central ; the Louisville and Nashville ; the LouisvUle, Evansville, and St Louis ; and the St Louis, Belleville, and Southern ; affording con- nexions in all directions. It is in the Southern Illinois coal-field, and has a large commerce in coal. It also has copper-refining works. Population (1880), 10,683 ; (1890),~~

~~16,361 ; (1900), 17,484.~~

~~Belleville, a city and port of entry of Ontario, Canada, and capital of Hastings county, 106 miles E.N.E. of Toronto, on Bay of Quints and the Grand Trunk rail- way. Communication is maintained with Lake Ontario and St Lawrence ports by several lines of steamers. It is the commercial centre of a fine agricultural district, and has a large export-trade in cheese and farm produce. There are several educational institutions, including Al- bert College, Ontario Business College, a convent, and an institute for the deaf and dumb, supported by the Government. The principal industries are cabinet and sewing-machine factories, grist and saw-mills, and dis- tilleries. The exports for 1899-1900 were $1,691,935, and the imports were $460,326. Incorporated as a city in 1878, the population in 1881 was 9516, and in 1901 was 9117.~~

~~Belleville boilers. See Boilebs.~~

~~Bellevue, a city of Campbell county, Kentucky, U.S.A., on the south bank of the Ohio river, in the northern part of the state, near Cincinnati, Ohio, and adjoining Newport, Kentucky. Population (1900), 6332.~~

~~Bel ley, chief town of arrondissement in department of Ain, Prance, 47 miles S.E. of Bourg, on railway from St Andrd-le-Gay to Virren-le-Grand, pleasantly situated between vine-covered hills about 3 miles from the right bank of the Ehone. Indian cottons and muslin are manu- factured, and there is trade in cattle, fowls, and tru£B.es. The best lithographic stone is found in the vicinity. The town is of Roman origin, and in the 6th century became an episcopal see, and the capital of the province of Bugey. In 1385 it was almost entirely destroyed by an act of in- cendiarism, but was subsequently rebuilt by Duke Ama- deus VIII. of Savoy. A stone with a curious inscription commemorating its destruction was buried in the founda- tion of~~

the bishop's palace. Population (1876), 3499; (1896), 3763, comm., 4687; (1901), 6467.

Bellinzona, now the sole political capital of the Swiss canton of Tessin or Ticino. It is on the St Gothard railway, 96^ miles from Lucerne, while a branch line of 13f miles leads from Bellinzona to Locarno. Bellinzona is a picturesque and thoroughly Italian little town. Popu- lation (1888), 3290 ; (1901), 5047.

Bel I u no, a town and episcopal see and capital of the province of Belluno, Venetia, Italy, on the river Piave, 72 miles by rail N. from Venice. It has a museum with numismatical, mineralogical, and other collections, and a technical school (1879). There are also mineral springs and a hydropathic (1483 ft.). Population (1881) 15,660, (1901) 18,649; of province (1891) 174,140, (1901) 191,400. ^ ^ > > K J

Beloit, a city of Eock county, Wisconsin, U.S.A., situated in 42° 30′ N. lat., and 89° 11′ W. long., in the southern part of the state, on Eock river, at an altitude of 744 feet. It has two railways, the Chicago and North-Western, and the Chicago, Milwaukee, and St Paul. Beloit College, a Presbyterian institution, was founded in 1846. It has a faculty of 20 professors and about 400 students. Beloit was settled in 1835, and received a city charter in 1856. Population (1880), 4790 :

(1890), 6315 ; (1900), 10,436.

Bel per, a market town and railway station, in the Mid parliamentary division of Derbyslure, England, on the Derwent, 7 miles K. of Derby. The church of St Peter has been restored, and an Anglican convent, a mission church, and a public hall erected. The nail trade has declined, but there are now large cotton mills, hosiery works, foundries, and engineering works. Area of town ship (an urban district), 3183 acres ; population (1881),

9875; (1901), 10,934.

~~Belvidere, a city of Illinois, U.S.A., capital of Boone county, on the Kishwaukee river and at the inter- section of two lines of the Chicago and North- Western railway, in the northern part of the state. Population~~

~~(1890), 3867 ; (1900), 6937.~~

~~Benares, or Vaeas-asi, a famous city of British India, in the North-West Provinces, which gives its name to an administrative district and a division. The city is situated in 25° 18′ N. lat., and 83° 3′ E. long., 421 miles N.W. from Calcutta, on the left bank of the Ganges. The area (exclusive of cantonments) is 3448 acres. The population in 1881 was 214,758 ; in 1891 it was 219,467 ; and in 1901 it was 203,095. The municipality consists of 26 members, of whom 18 are elected, with the district magistrate as ex officio chairman. The municipal income in 1897-98 was Es.4,93,238, of which just half was derived from octroi ; the incidence of taxation was E.l : 12 : 1 per head. A considerable debt has been incurred for water- works and drainage. In 1897-98 the total quantity of water pumped into the mains was 695,000,000 gallons ; and the average daily consumption was 9 gallons per head. The death-rate in 1897 was 58-63 per 1000, comparing with a mean of 46-64 for the previous five years. In the early months of 1901 the city was visited by an outbreak of plague. The modern temples number 1464. The most conspicuous buildings are the mosque of Aurangzeb and the observatory of Eaja Jai Singh. The European quarter of Benares lies to the west of the native town, on both sides of the river Barna. Here is the cantonment of Sikraul, no longer of much military importance ; and the suburb of Sigra, the seat of the chief missionary institutions. Among recent buildings are the town hall, of red stone, erected at the Sole cost of the Maharaja of Vizianagram, to commemorate the visit of Prince Alfred in 1870; the Carmichael Library, built mainly by the same nobleman in 1874 ; and the Prince of Wales Hospital, erected by public subscription to com- memorate the visit of the prince in 1876. Benares conducts a flourishing trade by rail and river with the surrounding country. It is the junction between the Oudh and Eohilkhand and East Indian railways, the**

~~Ganges being crossed by a steel girder bridge of seven spans each 350 feet long. The chief manufactures are silk brocades, gold and silver thread, gold filigree work, jewellery, embossed brass vessels, and lacquered toys. The~~

~~Queen's College was attended in 1896-97 by 157 students. In addition, the Sanskrit College, founded by Warren Hastings, had 370 students. This institution is active in the publication of Sanskrit texts. There are also many efficient schools, some of which are supported by missionary and native bodies. The number of printing presses is about 50, publishing 5 newspapers. There are about 16 literary societies, of which the Carmichael Library receives a grant of Es.300 from the municipality.~~

~~The district of Benaees, which extends over both sides of the Ganges, has an area of 1099 square miles. The population in 1891 was 921,943, being 912 persons per square mile. Classified according to religion, Hindus numbered 831,782; Mahommedans, 88,401; Christians, 1364, of whom 727 were Europeans ; " others," 396. In 1901 the population was 882,972, showing a decrease of 4 per cent. The land revenue and rates were Es.10,05,822, the incidence of assessment being E.l : 6 : 1 per acre ; the number of police was 2450. The district is under permanent settlement. In 1896-97, out of a total cultivated area of 396,466 acres, 136,647 were irrigated from wells, &c. There are no Government canals. The principal crops are barley, rice, wheat, other food-grains, pulse, sugar-cane, and opium. The main line of the East Indian railway runs through the southern portion of the district, with two stations and a branch to Benares city ; the Oudh and Eohilkhand railway through the northern portion, starting from the city, with three stations.~~

~~The division of Benaees has an area of 10,414 square miles. The total population in 1891 was 6,368,774, being an average of 515 persons per square mile. In 1901 the population was 6,032,699, showing a decrease of 6 per cent. The aggregate land revenue, which is per- manently assessed, amounts to Es.44,38,308, the average incidence being E.0:14:4 per head of population, and E.0 : 14 : 10 per acre of total area.~~

~~Bencoolen (Dutch Benkoelen), a Dutch residency on the south-west coast of Sumatra extending from 2° 30′ S. lat. to 5° 8′ S., and separated by the Barisan mountains from Palembang and Lampong. Its area is 9426 square miles. The bays of the coast are but slight indentations and the rivers small. The chief products are rice, pepper, tobacco, cotton, and gambier. There is considerable fishing. Since the abolition of forced labour (1878) and the~~

substitution of taxation, the residency has made progress. Bencoolen, the capital, is on the coast near the island of Pulu Tiku (or Eat Island). The population of the town is about 6000, of the residency 168,767, including 146 Europeans, 659 Chinese, and 43 Arabs and other Asiatic foreigners.

Bendigo, the official name of Sandhuest, a city of Victoria, Australia, in the county of Bendigo, on the main line of railway between Melbourne and Echuca, 101 miles by rail N.N.W. from Melbourne. It is the centre of a large gold-mining district, which is also noted for its wines and agricultural produce. The deepest shaft in the colony is the Lazarus, which is 3424 feet in depth, and is still being sunk. There are several handsome public buildings, including the government offices, law courts, and town hall, and various industries, the manufacture of Epsom pottery being specially noteworthy. The output of gold in the district, in 1899, was 235,596 ozs. Bendigo was proclaimed a municipality in 1855, a borough in

1863, and a city in 1871. Its water supply is. excellent, and the street mains have a total length of 100 miles. Altitude, 758 feet. Mean temperature for the year, 68-7° F.; for January, 72-3°; for July, 461°; rainfall (16 years), 23-85 inches. Population (1881), 28,153;

(1891), 26,774; (1901), 31,020.

Benedek, Ludwig (1804-1881), Austrian general, was born at Odenburg in Hungary on 14th July 1804, his father being a medical man. He received his commission in the army as ensign in 1822. In 1846 he was engaged in suppressing the rising of Polish peasants in Galicia; he fought with great distinction during the Italian campaigns of 1848-49 ; was advanced to the rank of major-general, and took a leading part in the campaign of 1849 in Hungary, during which he was wounded. In the war of 1859 he commanded the eighth army corps, and in the battle of Solferino, where he held the right of the Austrian position, he succeeded in repulsing the attack of the Piedmontese. This success had little effect on the general course of the battle, but it confirmed his reputation as a fighting general and won him

~~great popularity, which, owing to the prevailing discontent with the reactionary and clerical government of previous years, was increased by the fact that he was a Protestant and not of noble birth. He was made Feldzeugmeister and commander-in-chief of the Austrian army in Venetia. When war with Prussia was imminent he was with general approbation appointed to command the northern army w'hich was to be concen- trated in Bohemia. It was a post he did not himself desire, as he had no intimate knowledge of the country, and did not feel confidence in his capacity to direct operations on so large a scale. Though an admirable leader in battle, he had no scientific military education. It was, however, impossible for him to refuse the personal commands of the emperor and the requests of the Arch- duke Albrecht. The Austrian concentration was, how- ever, not completed when war broke out, and during the first few days, instead of using the advantage which other- . wise they might have secured by the possession of the inner lines, the Austrian armies were defeated in detail in a number of engagements fought between 24th June and 1st July ; at Miinchengratz, Gitschin, Nachod, Trautenau, and Kalitz. Benedek, therefore, telegraphed to the emperor advising him to make peace ; the emperor refused on the ground that no decisive battle had been fought ; Benedek, thereupon, instead of retreating across the Elbe, determined to bring on a decisive engagement, and took up a position with the whole of his forces (210,000 men) near Koniggratz with the Elbe in his rear. Here he was completely de- feated by the Prussians on 3rd July, but he succeeded in effecting his retreat on the evening of the battle across the river. He was at once suspended from his command and a court-martial ordered; the emperor, however, in December determined that the inquiry should be suspended. Bene- dek from this time lived in absolute retirement, and in obedience to the emperor's orders made no attempt to defend himself. While the indecision which he showed during the first few days of the war to a great extent caused him to lose the confidence of the army and pre- pared the way for the catastrophe of 3rd July, he was undoubtedly much impeded by the defects of the Austrian organization, as well as by the reluctance with which the, representatives of the greatest Austrian families saw them- selves placed under the command of a man who belonged to the middle class. The official account of the campaign, Oesterreich's Kampfe 1867 (French translation Les luttes d'Autriche), probably for this reason~~

~~leaves much to be explained as to the conduct of the war. The fullest account of Benedek's life and of the campaign of 1866~~

~~will be found in Fkiedjung, Der Kampf um die Vorherr- schafi in Deutschland, Stuttgart, 1897. (j. w. he.)~~

~~Benedetti Vincent, Count (1817-1900), French diplomatist, was born at Bastia, in the island of Corsica, on 29th April 1817. In the year 1840 he entered the service of the French Foreign Office, and was appointed to a post under the marquis de la Valette, who was consul-general at Cairo, lie spent eight years in Egypt, being appointed consul in 1846; in 1848 he was made consul at Palermo, and in 1851 he accompanied the marquis, who had been appointed ambassador at Con- stantinople, as first secretary. For fifteen months during the progress of the Crin^ean war he acted as charg^ d'affaires. In the second volume of his essays he gives some recollections of his experiences in the East, including an account of Mehemet Ali, and a (not very friendly) sketch of Lord Stratford de Eedcliffe. In 1855, after refusing the post of minister at Teheran, he was employed in the Foreign Office at Paris, and acted as secretary to the Congress at Paris (1855-56). During the next few years he was chiefly occupied with Italian affairs, in which he was much interested, and Cavour said of him he was an Italian at heart. He was chosen in 1861 to be the first envoy of France to the king of Italy, but he resigned his post next year on the retirement of Thouvenel, who had been his patron, when the anti-Italian party began to gain the ascendancy at Paris. In 1864 he was appointed ambassador at the court of Prussia.~~

~~Benedetti remained in Berlin till the outbreak of war in 1870, and during these years he played an important part in the diplomatic history of Europe. His position was a difficult one, for Napoleon did not keep him fully informed as to the course of French policy. In 1866, during the critical weeks which followed the attempt of Napoleon to intervene between Prussia and Austria, he accompanied the Prussian headquarters in the advance on Vienna, and during a visit to Vienna he helped to arrange the preliminaries of the armistice signed at Nikolsburg. It was after this that he was instructed to present to Bismarck French demands for " compensation," and in August, after his return to Berlin, as a result of his discussions with~~

Bismarck a draft treaty was drawn up, in which Prussia promised France her support in the annex- ation of Belgium. This treaty was never concluded, but the draft, which was in Benedetti's handwriting, was kept by Bismarck and published in 1870. During 1867 he was much occupied with the affair of Luxemburg. In July 1870, when the candidature of the prince of HohenzoUern for the throne of Spain became known, Benedetti was instructed by the due de Gramont to present to the king of Prussia, who was then at Ems, the French demands, that the king should' order the prince to withdraw, and afterwards that the king should promise that the candidature would never be renewed. This last demand Benedetti submitted to the king in an informal meeting on the promenade at Ems, and the misleading reports of the conversation which were circulated were the immediate cause of the war which followed, for the Germans were led to believe that Benedetti had insulted the king, and the French that the king had insulted the ambassador. Benedetti was severely attacked in his own country for his conduct as ambassador, and the diic de Gramont attempted to throw upon him the blame for the failures of French diplomacy. He answered the charges brought against him in a book. Ma Mission en Prusse, Paris, 1871, which still remains one of the most valuable authorities for the study of Bismarck's diplomacy. In thisBenedetti successfully defends himself, and shows that he had kept his Government well informed ; he had even

■warned them a year before as to the proposed Hohen- zoUern candidature. Even if he had been outwitted by- Bismarck in the matter of the treaty of 1866, the policy of the treaty was not his, but was that of Drouyn de Lluys. The idea of the annexation of part of Belgium to France had been suggested to him first by Bismarck ; and the use to which Bismarck put the draft was not one which he could be expected to anticipate, for he had carried on the negotiations in good faith. After the fall of the empire he retired to Corsica. He lived to see his defence confirmed by later publications, which threw more light on the secret history of the times. He published in 1895 a volume of Essais Diplomatiques, containing a full account of his mission to Ems, written in 1873; and in 1897 a second series dealing with the Eastern

~~Question. He died 28th March 1900, while on a visit to Paris. He received the title of Count from Napoleon.~~

~~EoTHAN. La politique franqaise en 1866, Paris, 1879 ; and Vaffaire de Luxemburg, Paris, 1881. — Sorel. Historie diplo- matique. Paris, 1875. — Steel. Die Begrundung des deutschen Beiches, Munich, 1889, &o. (j. -^^ hk.)~~

~~Benedict, Sir Juiius (1804-1885), musical com- poser, was born in Stuttgart on 27th November 1804. He was the son of a Jewish banker, and learnt composi- tion from Hummel at Weimar and Weber at Dresden; with the latter he enjoyed for three years an intimacy like that of a son. He was appointed Capellmeister of the Karnthnerthor Theatre at Vienna in 1823, and of the San Carlo Theatre at Naples in 1825. Here his first opera, Giacinta ed Ernesto, was brought out in 1829, and another, written for his native city, I Portoghesi in Goa, was given there in 1830 ; neither of these was a great success, and in 1835 he went to Paris, leaving it, at the suggestion of Malibran, in the same year, for London, where he spent the remainder of his life. In 1836 he was given the conductorship of an operatic enterprise at the Lyceum Theatre, and brought out a short opera, Uii anno ed un giorno, previously given in Naples. In 1838 he became conductor of the English Opera at Drury Lane, under the famous Bunn management, during the period of Balfe's great popularity; his own operas, produced there, were The Gipsy's Warning (1838), The Bride of Venice (1843), and The Crusaders (1846). In 1848 he conducted Mendelssohn's Elijah at Exeter Hall, for the first appearance of Jenny Lind in oratorio, and in 1850 he went to America as the accompanist on that singer's ; tour. On his return in 1852 he became conductor under Mapleson's management, and wrote recitatives for Weber's Oberon, producing his best known opera. The Lily of Killamey, at Covent Garden, under the Pyne and Harrison Company, in 1862. At the same theatre his last work, originally intended for the stage. The Bride of Song, was brought out in 1864. From the beginning of the Monday I*bpular Concerts he acted as regular accompanist, and he conducted the Norwich Festivals from 1845 to 1878 inclusive. His cantatas Undine (1860) and Bichard Ooeur de Lion (1863), and his oratorio St Cecilia (1866) were brought out at these festivals, and his St Peter at the Birmingham Festival of 1870. The cantata Graziella was brought out at the~~

~~Birmingham Festival of 1882, and in the following year was produced at the Crystal Palace as an opera. A symphony from Benedict's pen was given at the Crystal Palace in 1873, and he contributed an interesting life of Weber to the series of biographies of " Great Musicians." For many years he ofB.ciated as " conductor " at the most fashionable concerts in London, whether public or private, and was knighted in 1871. He died in London on the 5th of June 1885. Benedict was one of the last, but at the same time one of the most capable, of those numerous~~

~~German musicians who from the time of Handel onwards have found fortune by yielding to the less highly devel- oped tastes of the English public, without making any very serious attempt to elevate the standard of their appreciation. (j. a. f. m.)~~

~~Benefice. — Under the modem statute law the term benefice means an ecclesiastical preferment with cure of souls, the right to confer which is called an advowson. An advowson is either presentative, in which case the patron presents a clerk to the bishop with a petition that he may be instituted to the vacant benefice, and if the clerk be canonically qualified the bishop admits and institutes him; or collative, where the bishop is the patron in right of his see. Durative benefices no jlonger exist, the Benefices Act 1898 making all donations with cure of souls presentative in accordance with the recom- mendation of a committee of the House of Commons in 1884.~~

~~The spiritual side of the right of advowson was also emphasized by the same Act. Under the previously existing law simony or " the corrupt presentation of any ' person to an ecclesiastical benefice for gift, moneys or reward" renders the presentation void, and subjects the persons privy or party to it to penalties ; a presentation to a vacant benefice cannot be sold, and no clerk in holy orders can purchase for himself a next presentation. An advowson may, however, be sold during a vacancy, though that will not give the right to present to that vacancy ; and a clerk may buy an advowson even though it be only an estate for life, and present himself on the next vacancy. Under the Benefices Act, advowsons may not be sold by public auction except in conjunction with landed property adjacent to the benefice ; transfers of patronage must be re- gistered in the registry of the diocese,'~~

~~and no such transfers can be made within twelve months after the last admission or institution to the benefice. Restrictions had also been imposed on the transfer of patronage of churches built under the Church Building Acts and New Parishes Acts, and on that of benefices in the gift of the Lord Chancellor, and sold by him in order to augment others ; but agree- ments may be made as to the patronage of such churches in favour of persons who have contributed to their build- ing or enlargement without being void for simony.~~

~~The right of presentation may be exercised by its owner whether he be an infant, executors, trustees, coparceners (who, if they cannot agree, present in turn in order of age), or mortgagee (who must present the nominee of the mortgagor), or a bankrupt (who, although the advowson belongs to his creditors, yet has the right to present to a vacancy). Certain owners of advowsons are temporarily or permanently disabled from exercising the right which- devolves upon other persons; and the Crown as patron paramount of all benefices can fill all churches not regularly filled by other patrons. It thus presents to all vacancies caused by simoniacal presentations, or by the incumbent having been presented to a bishopric or in benefices belong- ing to bishopric when the see is vacant by the bishop's death, translation, or deprivation. Where a presentation belongs to a lunatic, the Lord Chancellor presents for him. Where it belongs to a Roman Catholic the right is exercised in his behalf by the University of Oxford if the benefice be situate south of the river Trent, and by that of Cam- bridg& if it be north of that river.~~

~~Besides the qualifications required of a presentee by canon law, such as being of the canonical age, and in priest's orders before admission, sufficient learning- and proper orthodoxy or morals, the Benefices Act now requires that a year shall have elapsed since a transfer of the right of patronage, unless it can be shown that such transfer was not made in view of a probable vacancy ; that the~~

~~presentee has been a deacon for three years ; and that he is not unfit for the discharge of his duties by reason of physical or mental infirmity or incapacity, grave pecuniary embarrassment, grave misconduct or neglect of duty in an ecclesiastical office, evil life, or conduct causing grave scandal concerning his moral character since his ordination, or being party to an illegal agreement with regard to the presentation ; that notice of the presentation has been given to the parish of the benefice. Except by leave of the bjshop or sequestrator, the incumbent of a sequestered benefice cannot be presented. The Act also gives to both patron and presentee an alternative mode of appeal against a bishop's refusal to institute or admit, except on a ground of doctrine or ritual, to a court composed of an archbishop of the province and a judge of the High Court nominated for that purpose by the Lord Chancellor, a course which, however, bars resort being had to the ordinary suits of duplex querela or action of quare impedit. In case of refusal of one presentee, a lay patron may present another, and a clerical patron may do so after an unsuccessful appeal against the refusal.~~

~~Upon institution the church is full against everybody except the Crown, and after six months' peaceable pos- session the clerk is secured in possession of the benefice, even though he may have been presented by a person who is not the proper patron. The true patron can, however, exercise his right to present at the next vacancy, and can reserve the advowson from an usurper at any time within three successive incumbencies so created adversely to his right, or within sixty years. Collation which otherwise corresponds to institution does not make the church full, and the true patron can dispossess the clerk at any time, unless he is a patron who collates. Possession of the benefice is completed by induction, which makes the church full against anyone, including the Crown. If the proper patron fails to exercise his right within six calendar months from the vacancy, the right devolves or lapses to the next superior patron, e.g., from an ordinary patron to the bishop, and if he makes similar default to the archbishop, and from him on similar default to the Crown. If a bishopric becomes vacant after a lapse has accrued to it, it goes to the metropolitan ; but in case of a vacancy of a benefice during the vacancy of the see the Crown presents. Until the right of presentation so accruing to a bishop or archbishop is exercised, the patron can still effectually present, but not if lapse has gone to the Crown. All benefices except those under the clear annual value of £50 pay their first fruits (one~~

~~year's profits) and tenths (of yearly profits) to Queen Anne's Bounty for the augmenta- tion for the maintenance of the poorer clergy. Their profits during vacation belong to the next incumbent. Tithe rent charge attached to a benefice is relieved from payment of one-half of the agricultural rates assessed thereon. Benefices may be exchanged by agreement between incumbents with the consent of the ordinary, and they may, with the consent of the patron and ordinary, be united or dissolved after being united. They may also be charged with the repayment of money laid out for their permanent advantage, and be augmented wholly by the medium of Queen Anne's Bounty.~~

~~Eecent legislation has also affected the vacation of benefices by plurality, resignation, and deprivation. As regards plurality, by dispensation from the archbishop of Canterbury, two benefices may be held together, the churches of which are within four miles of each other, and the annual value of one of which does not exceed £200 (1885). As regards resignation, incumbents of seven years' standing, incapacitated by permanent mental or bodily infirmity from due performance of their duties, can resign their benefices and receive a pension not exceeding one-~~

~~third of the net income (1871-81). As regards depriva- tion under the Clergy Discipline Act 1892, an incumbent who has been convicted of offences against the law of bastardy, or against whom judgment has been given in a divorce or matrimonial cause, is deprived, and on being found guilty in the consistory court of immorality or ecclesiastical offences (not in respect of doctrine or ritual), he may be deprived or suspended or declared incapable of preferment.~~

~~AtTTHORlTlBS. — Phillimore. Eccles. Lww, inA. edit. London, 1895. — Cripps. Law of Church and Clergy, 6th edit. London, 1886. For statistics of Benefices see England, Church of.~~

~~(g. G. p.)~~

~~BeneventOi a town and archiepiscopal see and capital of the province of Benevento, Campania, Italy, situated amid the South Apennines, 78 miles by rail N.E. from Naples. There is a new suite of provincial offices. Brick-making, lime-burning, and rope-making are also carried on. Population of~~

~~town (1881) 21,631, (1901) 24,650; of province (1881) 238,425, (1901) 257,101.~~

~~Benfey, Theodor (1809-1881), German philologist, son of a Jewish trader at Norten, near Gottingen, was born on the 28th January 1809. His taste for philology was awakened in his youth by the careful instruction in Hebrew which he received from his father, and although originally designed for the medical profession, he resolved upon a literary career. After brilliant studies at Gottingen he spent a year a,t Munich, where he was greatly impressed by the lectures of Schelling and Thiersch, and afterwards settled as a teacher in Frankfort. His pursuits were at first chiefly classical, and his attention was diverted to Sanskrit by an accidental wager that he would learn enough of the language in a few weeks to be able to review a new book upon it. This feat he accomplished, and rivalled in later years when he learned Kussian in order to translate Wasiheff's work on Buddhism. For the time, however, his labours were chiefly in classical and Semitic philology. At Gottingen, whither he had returned as privat-docent, he wrote a little work on the names of the Hebrew months, proving that they were derived from the Persian, prepared the great article on India in Ersch and Griiber's Encyclopcedia, and published from 1839 to 1842 the Lexicon of Greek Roots which gained him the Volney prize of the Institute of France. From this time his attention was principally given to Sanskrit. He published in 1848 his edition of the iSama Veda; in 1852-54 his Manual of Sanskrit, comprising a grammar and chrestomathy ; in 1858 his practical Sanskrit Grammar, afterwards translated into English; and in 1859 his edition of the Pantscha Tantra, with an extensive dissertation on the fables an(J mythologies of primitive nations. All these works had been produced under the pressure of poverty, the Govern- ment, whether from parsimony or from prejudice against his Jewish extraction, refusing to make any substantial addition to his miserable salary as extra-professor at the University. At length, in 1862, the growing apprecia- tion of foreign scholars shamed it into making Viitti an ordinary professor, and in 1866 Benfey published the laborious work by which he is, on the whole, best known, his great Sanskrit-English Dictionary. In 1869 he wrote a history of German philological research, especially Oriental, during the 19tli century. In 1878 his jubilee as doctor was celebrated by the publication of a volume of philological essays dedicated to him, and written by the first scholars in~~

~~Germany. He had designed to close his literary labours by a grammar of Vedic Sanskrit, and was actively preparing it when he was interrupted by a fatal illness, which terminated in his death at~~

~~BENGAL~~

~~211~~

~~Gottingen on 26th June 1881. A collection of Ms various -writings was published in 1890, prefaced by a memoir by his son. (k. g.)~~

~~Beng^al, a province of British India, under the administration of a lieutenant-governor, situated in the north-east of the peninsula, occupying the lower valley of the Ganges. The total area (including native states) comprises 187,377 square nules. In 1891 the population~~

~~was 74,643,366, and in 1901 it was 78,448,735. The capital is Calcutta, which is also the capital of the Indian empire. The word " Bengal " is sometimes used in a narrower sense for the geographical area of Bengal proper, excluding Behar and Orissa. This use has its justification in the fact that here alone is the Bengali language spoken.~~

~~Population. — The following table gives the area and population of the several districts and native states of Bengal, according to the census of 1891 :—~~

~~Area and Population of Bengal (1891).~~

~~Divisions,~~

~~Districts.~~

~~Area~~

~~in Square~~

~~Miles.~~

~~Number~~

~~of Towns and~~

~~Villages.~~

~~PopulatioA, Census of 1S91.~~

~~Density of~~

~~Population~~

~~to Square~~

~~Mile.~~

~~Males.~~

~~Females.~~

~~Total.~~

~~Presidency .~~

~~Dacca . Chittagong . Bajshahi~~

~~Bhagalpur Patna .~~

~~Burdwan Chota Nagpur~~

~~24 FarganAs~~

~~Calcutta and Suburbs .~~

~~ITadiya Jessore Khulna Murshidabad~~

~~Dacca ....~~

~~Faridpur~~

~~Backergunje~~

~~Maimansingh~~

~~Chittagong . . Noakhali . ‘ . Tippera Hill Tracts .~~

~~Dinajpur .~~

~~Rajshahi~~

~~Rangpur . .~~

~~Bogra ....~~

~~Pabna.~~

~~Darjiling .~~

~~Jalpaiguri .~~

~~Monghyr .~~

~~Bhagalpur .~~

~~Purnea~~

~~Malda.~~

~~Sonthal Fargands~~

~~Patna ....~~

~~Gaya ....~~

~~Shahabad .~~

~~Muzaffarpur~~

~~Darbbanga .~~

~~Saran ....~~

~~Champaran ,~~

~~Burdwan . Bankura Birbhum . Midnapur . Hooghly Howrah~~

~~Hazaribagh. Lohardaga ■ Singbhum . • Manbhum . ‘. Falamau~~

~~2,i08~~

~~20~~

~~5,765~~

~~1~~

~~989,278 446,746~~

~~902,755 234,814~~

~~1,892,033 681,560~~

~~898 37,067~~

~~2,128 2,794 2,925 2,077 2,144~~

~~5,766 2,982 4,851 3,209 3,627~~

~~1,436,024 802,147 941,334 617,981 605,665~~

~~1,137,569 841,961 947,493 559,671 645,281~~

~~2,573,593 1,644,108 1,888,827 1,177,652 1,250,946~~

~~1,209 588 646 567 583~~

~~12,068~~

~~20,435~~

~~4,403,151~~

~~4,131,975~~

~~8,585,126~~

~~707~~

~~2,797 2,267 8,649 6,332~~

~~6,813 4,403 4,708 7,959~~

~~1,200,583~~

~~893,091~~

~~1,104,443~~

~~1,788,616~~

~~1,220,073~~

~~904,229~~

~~1,049,522~~

~~1,683,570~~

~~2,420,656 1,797,320 2,153,965 3,472,186~~

~~865 792 590 548~~

~~15,045~~

~~23,883~~

~~4,986,733~~

~~4,857,394~~

~~9,844,127~~

~~654~~

~~2,563 1,645 2,491 5,419~~

~~1,234 2,625 6,318 1,029~~

~~615,868~~

~~508,727~~

~~911,799~~

~~59,566~~

~~674,299~~

~~500,966~~

~~871,136~~

~~47,720~~

~~1,290,167~~

~~1,009,693~~

~~1,782,935~~

~~107,286~~

~~508 614~~

~~716 20~~

~~12,118~~

~~11,206~~

~~2,095,960~~

~~2,094,121~~

~~4,190,081~~

~~345~~

~~4,118 2,330 3,486 1,452 1,839 1,164 2,962~~

~~7,676 5,219 3,537 4,223 3,892 1,319 3,331~~

~~812,047 654,338 1,061,812 418,916 677,911 123,046 364,659~~

~~743,788 658,998 1,003,652 398,578 684,481 100,268 316,693~~

~~1,555,835~~

~~1,318,336~~

~~2,065,464~~

~~817,494~~

~~1,362,392~~

~~223,314~~

~~681,352~~

~~378 564 592 563 741 192 230~~

~~17,351~~

~~29,197~~

~~4,112,729~~

~~3,906,458~~

~~8,019,187~~

~~456~~

~~3,921 4,226 4,993 1,902 5,469~~

~~3,867 5,067 5,994 3,248 11,266~~

~~987,072 1,004,865 993,496 399,917 870,567~~

~~1,048,949~~

~~1,027,831~~

~~951,162~~

~~415,002~~

~~883,629~~

~~2,036,021 2,032,696 1,944,658 814,919 1,754,196~~

~~519 481 389 428 321~~

~~20,511~~

~~29,442~~

~~4,255,917~~

~~4,326,573~~

~~8,582,490~~

~~418~~

~~2,076 ,4,712 4,365 3,003 3,835 2,653 3,531~~

~~4,663 10,095 4,883 4,104 3,890 4,296 ‘ 5,117~~

~~865,732 1,045,011~~

~~990,799 1,305,374 1,370,985 1,133,926~~

~~936,135~~

~~903,272 1,093,320 1,072,538 1,406,071 1,430,970 1,333,551~~

~~923,330~~

~~1,769,004 2,138,331 2,063,337 2,711,445 2,801,955 2,467,477 1,859,465~~

~~852 454 473 903 .840 980 527~~

~~23,675~~

~~37,048~~

~~7,647,962~~

~~8,163,052~~

~~15,811,014~~

~~667~~

~~2,697 2,621 1,753 5,186 1,223 476~~

~~3,660 5,497 3,193 14,934 2,582 1,335~~

~~682,872 525,941 389,639 1,308,100 529,139 364,890~~

~~709,008 543,727 408,194 1,323,416 547,571 356,321~~

~~1,391,880 1,069,668~~

~~797,833 2,631,516 1,076,710~~

~~721,211~~

~~516 408 455 507 880 1,515~~

~~‘ 13,956~~

~~31,101~~

~~3,800,581~~

~~3,888,237~~

~~7,688,818~~

~~550~~

~~7,021 7,140 3,753 4,147 4,905~~

~~8,0g7~~

~~3,578 2,877 8,317 3,901~~

~~566,964 551,873 271,417 593,199 294,320~~

~~597,357 577,012 274,071 600,129 302,450~~

~~1,164,321 1,128,885~~

~~545,488 1,193,328~~

~~596,770~~

~~166 156 145 288 122~~

~~26,966~~

~~26,760~~

~~2,277,773~~

~~2,351,019~~

~~4,628,792~~

~~172~~

~~212~~

~~BENGAL~~

~~Area and Population of Bengal (1891) — corUimied.~~

~~Di-risions.~~

~~Districts.~~

~~Area~~

~~in Square~~

~~Hiles.~~

~~Number~~

~~of Towns and~~

~~Villages.~~

~~Population, Census of 1891.~~

~~Density of~~

~~Population~~

~~to Square~~

~~Mile.~~

~~Males.~~

~~Females.~~

~~Total.~~

~~Orissa .~~

~~Total Bn~~

~~Cuttack~~

~~Puri ....~~

~~Balasore~~

~~Angul and Kondmals .~~

~~tish Territory~~

~~3,633 2,473 2,066 1,681~~

~~5,429 6,000 6,311 1,443~~

~~940,657~~

~~474,530~~

~~481,638~~

~~85,768~~

~~997,114~~

~~470,468~~

~~612,987~~

~~84,290~~

~~1,937,671 944,998 994,625 170,058~~

~~533 382 481 101~~

~~9,863~~

~~18,183~~

~~1,982,493~~

~~2,064,869~~

~~4,047,352~~

~~411~~

~~151,643′~~

~~227,255~~

~~35,563,299~~

~~35,783,688~~

~~71,346,987~~

~~471~~

~~‘ Exclusive of the Sundarbans, about 6500 square mUes. Area and Population of Native States of Bengal (1891).~~

~~Divisions.~~

~~Area~~

~~in Square~~

~~Miles.~~

~~Number~~

~~of Towns and~~

~~VillaBes.~~

~~Population, Census of 1891.~~

~~Density of~~

~~Population~~

~~to Square~~

~~MQe.~~

~~Males.~~

~~Females.~~

~~Total.~~

~~Coocbi Behar~~

~~HillTippera~~

~~Tributary States : Orissa .~~

~~„ „ Chota Nagpur~~

~~Total Native States .~~

~~Grand Total .~~

~~1,307~~

~~4,086~~

~~14,387~~

~~16,054~~

~~1,164~~

~~11,385 4,678~~

~~302,467~~

~~71,596~~

~~849,460~~

~~449,683~~

~~276,411~~

~~65,846~~

~~847,260~~

~~433,676~~

~~578,868~~

~~137,442~~

~~1,696,710~~

~~883,359~~

~~443 34~~

~~118 55~~

~~35,834~~

~~17,217~~

~~1,673,186~~

~~1,623,193~~

~~3,296,379~~

~~93~~

~~187,377~~

~~244,472~~

~~37,236,485~~

~~37,406,881~~

~~74,643,366~~

~~898~~

~~Since 1881 the population increased by nearly 7 per cent. , vfhich ■was below the rate of increase for India generally. But this in- crease of population was unequally distributed. In some of the central and northern districts there was an actual decrease, attributed to the prevalence of malarial fever. In eastern Bengal, where the population is already very dense, the rate of increase was as high as 11 per cent. In the hilly country of Chota Nagpur, where some emigration prevails, the increase was 10 per cent. The extremely mgh rate of increase for native states (19 per cent., despite an actual decrease in Cooch Behar) may be ascribed to more accurate enumeration. Excluding the metropolitan districts of the Twenty-four Parganis and Hooghly, the greatest density of population is to be found in the Patna division, or Behar proper. Here two purely agricultural districts (Saran and Muzatfarpur) each support more than 900 persons on every square mile, being the highest density for all India. In Chota Nagpur the average density falls to 172 persona per square mile. Classified according to religion, and excluding native states, Hindus numbered 45,220,124, or 63 '4 per cent, of the total population, as compared with 64 '8 per cent, in 1881, showing that they iucreased leas rapidly than other religions. Mahom-medans numbered 23,437,591, or 32 '85 per cent., being specially numerous in eastern Bengal, where in some districts they form more than two-thirds of the inhabitants. The fact that they have increased more than the Hindus is explained partly by conversion and partly by their healthier mode of life. They eat more meat, and marry later. The Christians numbered 190,829, or '27 per cent. Of these, 23,301 were Europeans, and 15,006~~

~~Eurasians, leaving 162,522 for native converts, who are most numerous in the Lohardaga district of Chota Nagpur. Buddhista and Jains t6gether numbered 196,164, or '27 per cent. The Buddhists proper are almost confined to the half-Tibetan district of DarjiHng and the half-Burmese district of Chittagong. The few Jains are traders residing chiefly in Calcutta and Murshidabad. Aboriginal tribes numbered 2,294,606, or 2 "4 per cent. They are found chiefly in Chota Nagpur, the Sonthal Parganda, and the border districts of the Burdwan division. In the native states of Bengal the proportion of aboriginal tribes rises as high as 14 per cent. Jews numbered 1447 ; Sikhs, 412 ; and Parsia, 179 ; leaving 5735 for " others."~~

~~According to the preliminary returns of the census of 1901, the total population of Bengal amounted to 74,713,020 for British ter- ritory alone, showing an increase of nearly 5 per cent. In eastern Bengal the rate of increase was maintained ; but there is an actual decrease in the thickly populated tracts of Behar. In the native states, which for the first time include Sikkim, the total popula- tion amounted to 3,735,715, showing an apparent increase of 13 per cent.~~

~~Crops. — Excluding Orissa, almost the entire area of Bengal was brought under the permanent settlement of Lord Cornwallis in 1793. Consequently, no agricultural statistics are available, as for the rest of India. The following figures are little better than conjectural. The total cultivated area is estimated at 55 million acres, of which 10 millions are cropped more than once. The staple crop almost everywhere is rice, grown on 40 million acres, while other food grains cover 16 milUon acres ; oil-seeds, 4 million~~

~~acres; jute, 2 milUon; sugar-cane, 1 million; tobacco, 648,000; indigo, 555,000; opium, 235,000; cotton, 167,000; tea, 128,000. The two crops grown under E^uropean supervision are indigo and tea. Indigo-planting has decreased in Bengalproper, but is still an important industry in northern Behar. The crop is a very fluctuating one, the total out-turn having been 58,000 maunds in 1896-97, compared with 94,000 maunds in the next year. The following table gives the chief statistics of the tea industry for 1897, according to districts : —~~

~~District.~~

~~Darjiling . Jalpaiguri . Chittagong Chittagong Hill Tracts Hazaribagh Lohardaga~~

~~Total -.~~

~~Number~~

~~of Gardens.~~

~~186~~

~~285~~

~~23~~

~~4 21~~

~~520~~

~~Area of Gardens.~~

~~Acres.~~

~~55,822~~

~~65,072~~

~~4,024~~

~~100~~

~~611 2,438~~

~~128,067 102,204~~

~~Area under Mature Plant.~~

~~Acres.~~

~~48,588~~

~~46,905~~

~~3,696~~

~~100~~

~~586 2,429~~

~~Area~~

~~under~~

~~Immature~~

~~Plant.~~

~~Acres.~~

~~7,234~~

~~18,167 428~~

~~25~~

~~25,863~~

~~Out-turn of~~

~~Manufactured~~

~~Leaf.~~

~~lb.~~

~~11,697,256 24,232,316 2,126,028~~

~~27,120~~

~~36,200 931,695~~

~~38,950,615~~

~~The tea industry is almost confined to the hills of Darjiling, and the submontane tract of the Dwars (or Dooars) in JalpaigurL It is in the latter tract that most of the later extensions have taken place. The larger out-turn is apparently due to the leaf being sent here from Darjiling to be manufactured. The returns show 75,143 persons permanently employed, and a daily average of 52,444 persons temporarily employed. Cinchona is grown on Government plantations in the neighbourhood of Darjuing, and there manufactured into quinine. The total number of cinchona trees is about 24 millions. In 1897-98 the crop amounted to 318,715 lb of dry bark. The output of the factory was 10,149 lb of sulphate of quinine and 4075 lb of cinchona febrifuge. The gross receipts amounted to Es.1,76,798, a net profit of E3.n,632. Industries. — The chief coalfields of Bengal are near Raniganj in the Burdwan district, and at Karharbari and Giridih in Hazari-bagh. The industry has progressed rapidly, not only supplying fuel to the local railways and factories, but also exporting it by sea. In 1898 the aggregate output of all the Bengal collieries was 3,622,090 tons, valued at Ils.96,87,250. The total number of persons employed was 48,604, of whom 14,709 were women and 2090 children. The following table gives the output for 1893-99 and also for earlier quinquennial periods : —~~

~~Output of Coal~~

~~in BengaL~~

~~Tons.~~

~~2,716,155~~

~~3,037,920~~

~~3,142,497~~

~~3,622,090~~

~~3,883,000~~

~~The only important ironworks are those of the Barrakur Company~~

~~Output of Coal~~

~~Year.~~

~~in Bengal.~~

~~Year.~~

~~Tons.~~

~~1878~~

~~957,243~~

~~1895 .~~

~~1883~~

~~. 1,200,957~~

~~1896 .~~

~~1888~~

~~. 1,380,594~~

~~1897 .~~

~~1893~~

~~. 1,902,866~~

~~1898 .~~

~~1894~~

~~. 2,035,944~~

~~1899 .~~

~~BENGAL~~

~~213~~

~~near Raniganj, where iron ore and coal are fonnd together. In 1898, the total output of pig-iron was 19,719 tons, of which 15,779 tons were sold and 8515 tons were consumed in the foundries.~~

~~Jute is grown throughout the marshes of Eastern Bengal. Apart from the quantity exported and the quantity made up by hand, it supports a prosperous mill industry, chiefly In the neigh- hourhood of Calcutta and Howrah. Jute presses, mostly worked by steam or hydraulic power, employ nearly 30,000 persons. The following table gives the chief statistics of iute mills in Bengal for 1895-98 :—^~~

~~No. of Mills.~~

~~No. Of Looms.~~

~~No. Of Spindles.~~

~~Persons Employed.~~

~~Men.~~

~~Women.~~

~~Young Persons.~~

~~Children.~~

~~Total.~~

~~1895-96 1896-97 1897-98~~

~~27 30 33~~

~~10,406 12,611 13,444~~

~~4,000,875 4,366,225 4,567,500~~

~~50,973 59,389 61,343~~

~~15,640 17,092 16,995~~

~~4082 5649 6023~~

~~6,923~~

~~9,174~~

~~10,405~~

~~77,618 91,254 94,766~~

~~Imports — Foreign Coasting~~

~~1893-94.~~

~~Bs.~~

~~. 31,03,61,126 . 6,23,26,924~~

~~1897-98.~~

~~Rs.~~

~~31,30,17,449~~

~~8,66,26,161~~

~~Total~~

~~. 37,26,88,050~~

~~39,96,43,610~~

~~Ejcports — Foreign Coasting~~

~~. 42,26,18,585 . 6,42,39,959~~

~~46,31,20,317 9,31,17,535~~

~~Total~~

~~. 48,68,58,544~~

~~65,62,37,852~~

~~In 1898, the number of cotton mills, all in the same neighbour, hood, was ten, with 200 looms and 379,082 spindles, employing 11,739 hands. The total out-turn was nearly 45 million lb of yarn, chiefly of counts between 10 and 20, and 63,266 lb of woven goods, chiefly dhutis, chadars, and shirtings. There were also four paper mills, employing 3222 hands, with an out-turn of 33 miUion re of paper, valued at Rs. 49, 72, 850. The materials used are rags, jute, grasses, old gunny bags, &c., and paper of good quality is produced. The number of flour niills, large and small, was 25 ; of oil mills, 83 ; and of rice mills, 1.~~

~~Hallways. — Bengal is well supplied with railways, which natu- rally have the seaport of Calcutta as the centre of the system. South of the Ganges, the East Indian follows the river from the North-Vestem Provinces, with its terminus at Howrah on the Hooghly, opposite Calcutta. A chord line passes by the coalfield of Kaniganj, wnioh enables this great railway to be worked more economically than any other in India. The Bengal-Nagpur, from the Central Provinces, also has its terminus at Howrah, and the section of this railway through Midnapur carries the East Coast line from Madras. North of the Ganges the Eastern Bengal runs north to Darjiling, and maintains a service of river steamers on the Brahmaputra. The Bengal Central serves the lower Gangetic delta. Both of these have their termini at Sealdah, an eastern suburb of Calcutta. Northern Behar is traversed by the Bengal and North-Western, with an extension eastwards through Tirhut to join the Eastern Bengal. The Assam-Bengal railway will connect the Brahmaputra valley with the Bengal port of Chittagong. In addition there are a few light lines and steam tramways.~~

~~Canals and Rivers. — Rivers and other waterways still carry a large part of the traffic of Bengal, especially in the delta and along the Brahmaputra. The Government maintains two channels through the Sundarbans, known as the Calcutta and Eastern canals, and likewise does its best to keep open the Nadiya rivers, which form the communication between the main stream of the Ganges' and the Hooghly. There is further a route by water between Calcutta and Midnapur. The most important canals, those in Orissa and on the Sone river in Southern Behar, have been constructed primarily for irrigation, though they are also used for navigation. The following table gives the financial results of the four chief irrigation schemes, classified as "major works," for 1897-98 :—~~

~~Capital Outlay.~~

~~Revenue Receipts.~~

~~Working Expenses.~~

~~Simple Interest.~~

~~Excess Expendi- ture.~~

~~Loss per cent.~~

~~Orissa Pro- ject~~

~~Midnapur Canal~~

~~Htjili Tidal Canal~~

~~Sone Pro- ject~~

~~Total~~

~~Rs.~~

~~2,63,02,141~~

~~84,65,427~~

~~26,15,242~~

~~2,67,91,549~~

~~” Rs.~~

~~5,54,757~~

~~2,75,636~~

~~92,210~~

~~12,66,974~~

~~Rs.~~

~~6,42,752~~

~~2,41,831~~

~~40,167~~

~~6,30,326~~

~~Es.~~

~~10,27,516~~

~~3,31,130 1,02,063 10,37,108~~

~~Rs.~~

~~10,15,511~~

~~2,97,326~~

~~60,020~~

~~4,00,460~~

~~3-33 3-51 1-93 1-49~~

~~6;41,74;359~~

~~21,89,577~~

~~14,65,076~~

~~24,97,817~~

~~17,63,316~~

~~2-11~~

~~Various other ” minor works,’’ against which no interest is charged, show an excess revenue of Rs. 2, 20, 720, being 178 per cent, on a capital outlay of Rs.1,23,81,671. Except as a protection against famine, expenditure on irrigation cannot be considered remunera- tive in Bengal.~~

~~Commerce. — The seaborne trade of Bengal is almost entirely concentrated at Calcutta, which serves also as the port of Assam and the North-Western Provinces. A small share is conducted at Chittagong and the Orissa ports. The following table gives the value of the total seaborne trade of the province, foreign and coasting, but exclusive of Government transactions, for the two years 1893-94 and 1897-98 :—~~

~~Grand total 85,95,46,594 95,58,81,462~~

~~It will be observed .that the foreign imports show hardly any change, while the foreign exports have improved by 9*5 per cent. The considerable increase in both branches of coasting trade is due mainly to the importation of rice from Burma on account of famine, and to the growing exportation of coal and jute manu- factures. In foreign trade the rate of increase during a period of twenty years is 52 per cent, for imports, and 45 per cent, for exports. The principal imports are cotton piece goods, railway maiterials, metals and machinery, oils, sugar, cotton twist, salt. _ The prin- cipal exports are jute, tea, hides, opium, rice, oil-seeds, indigo, lac.~~

~~Internal trade. — The interprovincial trade of Bengal is carried on mostly with the North-Western and Central Provinces and with Assam. In 1897-98, the total imports by rail were valued at Rs.l4, 08,97,894, of which 66 per cent, came from the North- Western and 14 per cent, from the Central Provinces. The principal articles were opium, hides, raw cotton, wheat, shell-lac, and oil-seeds. The exports by rail were valued at Rs.12,26,27,407, of which 71 per cent, went to the North-Western and 13 per cent, to the Central Provinces. The principal articles were cotton piece goods (more than one-fourth of the total), rice, coal, gunny bags, iron and steel, unrefined sugar, kerosene oil, cotton twist, gram and pulse, tobacco, manufactra'ed silk, raw silk, and salt. In 1897-98, the imports from Assam by river steamer were valued at Rs.5,05, 74,823, almost entirely tea, with some oil-seeds and jute. The exports to Assam by river steamer were valued at Rs. 2, 95, 84, 768, chiefly cotton piece goods (nearly one-third of the total), rice, gram and pulse, salt, cotton twist, su^ar, tobacco, and gunny bags. The imports from Assam by country boat were valued at Rs. 1,27,10,294, chiefly rice (one-third of the total), oil-seeds, timber, limestone, hides, jute, mats, oranges, raw cotton, and dried fish. The exports into Assam by Country boat were valued at Rs.88,50,073, chiefly sugar,* spices, kerosene oil, tobacco, salt, gram and puke, rice, provisions, dried fruit and nuts, and Indian piece-goods. The frontier trade of Bengal is registered with Nepal, Sikkim and Tibet, and Bhutan, but, except with Nepal, the amount is insig- nificant. In 1897-98 the imports from Nepal were valued at Rs.1,45,97,183, chiefly rice (more than one-third), other food grains, oil-seeds, cattle, hides, tobacco, ghee, and timber. The exports into Nepal were valued at Rs. 1,46, 54, 634, chiefly silver (more than one-fifth), cotton piece-goods, salt, tobacco, spices, brass and copper, provisions, sugar, betel-nuts, and iron.~~

~~Administration. — The administration of Bengal is conducted by a lieutenant-governor, with a chief secretary, two secretaries, and three under-secretaries. There is no executive council, as in Madras and Bombay ; but there is a board of revenue, consisting of two members. For legislative purposes the lieutenant-governor has a council of twenty members, of whom not more than ten may be officials. Of the remaining members seven are nominated on the recommendation of the Calcutta corporation, groups of municipalities, groups of district boards, selected public associa- tions,~~

~~and the senate of Calcutta university. The number of divisions or commissionerships is 9, of which Chota Nagpur ranks as "non-regulation." The number of districts is 44, excluding the cities of Calcutta and Howrah. The total number of civil and revenue judges is 380, and of magistrates of all kinds, 2739. In 1898 the sanctioned strength of the district police was 23,788 of all ranks. In addition, the railway police numbered 654, and the military police 300. These numbers give a proportion of one policeman to every 2880 of the population, a much lower proportion than for India generally. The village police, or chaukidars, number about 160,000.~~

~~Army. — Since the reorganization of the Indian army in 1895, the Bengal command, under a lieutenant-general, comprises all Northern India, except the Punjab. It consists of two first-class and six second-class districts, of which only one — the Presidency district — lies wholly within the province of Bengal. Apart from Fort William and Barrackpur, near. Calcutta, the only other important military station is Dinapur, near Patna, which is included in the Allahabad district. In 1898 the strength of the Bengal command was 23,252 European and 31,822 native troops — total 55,074. In addition there were 13,085 enrolled volunteers.~~

~~Local Government. — Excluding Calcutta the number of munici- palities in Bengal is 151, The number of persons within municipal~~

~~limits is 2,722,000, or less than 4 per cent, of the total population. The number of electors is 469,000, or about one in six of the inhabitants. The municipalities vary in size, from Patna with 168,000 persons to Nalohiti with only 1675 ; the majority, how- ever, have between 5000 and 15,000. The rule is that two-thirds of the municipal commissioners shall be elected by the ratepayers. But in a few oases (27 in all) the Government exercises the right of nomination. Out of a total of 2183 commissioners, 1172 are elected and 1011 nominated; 349 are officials and 1834 non- officials ; 1949 are Indians and 234 Europeans. The classes most numerously represented are lawyers, landholders, merchants, doctors, and schoolmasters. In 1897-98, the aggregate municipal income was Es. 33, 00, 000, of which~~

~~Es.26,79,000 was derived from taxation, the average incidence of taxation being nearly R. 1 per head. The aggregate expenditure was Ks. 36, 00, 000, of which Es. 10,68,000 was devoted to conservancy, Es. 5, 04, 000 to buildings and roads, Es. 3,76, 000 to water-supply and drainage, Es.3,62,000 to hospitals and vaccination, Es.2,82,000 to police, lighting, and fire preven- tion, and Rs.1,32,000 to education.~~

~~The number of district boards is 38, and of local boards 104. These bodies possess no power of taxation, but administer certain funds made over to them for expenditure on roads and bridges, education, hospitals, &c. On the district boards the number of members is 794, of whom 328 are elected by the local boards.' On the local boards the number of members is 1253, of whom 413 are elected. Of the total number of both (2047), 1635 are non-officials, and 1761 are Indians. In 1897-98, the total income of the boards was Es.65,80,000, of which Es.39,20,000 was derived from road cess, Es.12,20,000 from tolls at ferries, &c., Es.4,70,000 from fees at cattle pounds, &o., and Es. 5,40, 000 from a Govern- ment grant. The total expenditure was Es.69,10,000, of which Es. 37, 90, 000 was devoted to roads, bridges, &c., Es. 12, 00, 000 to education, Es.3, 00,000 to hospitals, and E3.2,60,000 to sanitation and water-supply.~~

~~Mevenue and Expenditure. — The net revenue of Bengal for 1897-98 (in tens of rupees), was Ex. 14,340,376, classified thus : Imperial, Ex.10,051,972 ; provincial, Rx.3,783,460; local, Ex.504,944. The net expenditure for the same period was Ex.4,375,988 : Imperial, Ex.87,584 ; provincial, Ex.3,670,721 ; local, Ex.617,683. Of the total revenue, Rx.3,945,951 was derived from land, Ex.2,443,364 from salt, Ei.l, 759,285 from stamps, Rx.1,444,919 from customs, and Ex.1,273,766 from excise.~~

~~Eduoation. — The following table gives the chief statistics of education in Bengal for the three quinquennial years, 1886-87, 1891-92, and 1896-97 : —~~

~~1886-87.~~

~~1891-92.~~

~~1896-97.~~

~~Schools.~~

~~Pupils.~~

~~Schools.~~

~~Pupils.~~

~~Schools.~~

~~Pupils.~~

~~Colleges . . Secondaiy~~

~~Schools Primary~~

~~Schools Special~~

~~Schools Private~~

~~Institutions~~

~~Total . .~~

~~39 2,235~~

~~50,667~~

~~180~~

~~4,221~~

~~4,611 184,319~~

~~1,1^2,286~~

~~5,378~~

~~45,508~~

~~48 2,369~~

~~51,269~~

~~270~~

~~13,868~~

~~6,287 202,684~~

~~1,175,962~~

~~7,438~~

~~139,594~~

~~56 2,532~~

~~62,854~~

~~198~~

~~12,207~~

~~8,273 224,094~~

~~1,307,867~~

~~8,359~~

~~126,182~~

~~57,342~~

~~1,362,102~~

~~67,824~~

~~1,531,965~~

~~67,847~~

~~1,674,775~~

~~These figures show fair progress, particularly in colleges, secondary, and primary schools. The general rate of increase in pupils was 12 per cent, during the first quinquennium, and 9 per cent, during the second, which is in both cases somewhat below the rate of increase for India generally. If we compare the number of pupils with the estimated population of school-going age (15 per cent, of the total population), the increase in ten years has been from 13 '3 to 15-2 per cent. Taking girls alone, the number at school increased from 88,731 in 1891-92 to 105,919 in 1896-97, or by 19 per cent., while the proportion to the female population of school- going age rose from 1'61 to 1-93 per cent. Expenditure on educa- tion increased from Es.78,87,383 in 1886-87 to Es.1,09,68,635 in 1896-97. The total expenditure has increased faster than the total number of pupils, the rate of increase being 19 per cent, in the first quinquennium, and 17 per cent, in the second. But by far the larger share of this increase has come from fees and " other sources, ".chiefly missionary contributions and subscriptions. Alto-gether, the proportion of the total expenditure borne by public funds fell in ten years from 40'8 to 36-1 per cent. In secondary schools alone public funds contribute less than one-fifth.~~

~~Public Calamities. — Bengal has been fortunate in escaping to a great extent the two calamities of famine and plague which recently afflicted Central and Western India. The drought of 1896-97 did indeed extend to Bengal, but not to such an extent as to cause actual famine. The distress was most acute in the densely populated dis- tricts of Northern Behar, and in the remote hills of Chota Nagpnr. Keduoing the persons relieved to terms of one day, the net result of the operations from first to last shows that in the fifteen affected~~

~~districts 61,018,611 individuals were employed on works for one day, and 70,783,120 were fed gratuitously. The total expenditure on famine relief amounted to Es. 1,08,03,758, of which Es. 63, 00, 000 were spent on wages and Es.32,00,000 on food. Plague first appeared at Calcutta in a sporadic form in April 1898, but down to April of the following year the total number of deaths ascribed to plague throughout the province was less than~~

~~1000, compared with 191,000 for Bombay. At the beginning of 1900, however, there was a serious recrudescence of plague at Calcutta, and a very malignant outbreak in the district of Patna, which caused 1000 deaths a week. In the early months of 1901, plague again appeared in the same regions. During 1900 the total number of deaths from plague in Bengal was 37,265, and dunng the first three months of 1901 as many as 52,402 deaths had occurred. The earthquake of 12th June 1897, which had its centre of disturbance in Assam, was felt throughout eastern and northern Bengal. In all the large towns the masonry buildings were severely damaged or totally wrecked. The per- manent way of the railways also suffered. The total cost of repairs to Government buildings alone was estimated at Es.13,00,000, while the losses to private individuals may have amounted to a crore of rupees (say, ^666, 000). The total number of deaths returned was only 135. Far more destructive to life was the cyclone and storm-wave that broke over Chittagong district on the night of 24th October 1897. Apart from damage to shipping and buildings, the low-lying lands along the coast were completely submerged, and in many villages half the inhabitants were drowned. The loss of human lives was reported to be about 14,000, and the number of cattle drowned about 15,000. As usual in such cases, a severe outbreak of cholera followed in the track of the storm-wave. Another natural calamity on a large scale occurred at Darjiling in October 1899. Torrential rains caused a series of landslips, carrying away houses and breaking up the hill railway. The loss of life was returned at 300, including several English school children, and the value of property de- stroyed at Es.25, 00, 000. (j. s. C.)~~

~~Beng^hazi. See Tbifoll~~

~~Bengfuella, or SIo Fujfe de Bengitella, a town of Portuguese West Africa, capital of district Benguella, stands on a bay of the same name, and is connected with. its emporium, Catumbella, by a railway. Population, 2500. The district of Benguella exports spirits, cotton, india-rubber, wax, cocoanuts, hides, gums, ivory, salt, he. — the principal being india-rubber (£358,200 in 1896). The total trade increased froih £186,900 in 1886 to £669,100 in 1896, and £534,666 in 1899.~~

~~Beni| a department of Bolivia. Occupying the N.E. part of the republic and extending to the Rio Beni which is its west boundary, it borders on the department of La Paz and the territory of Madre de Dios. The river Guapore forms its boundary to the east where it touches Brazil. To the south its limits are the departments of Cochabamba and Santa Cruz. Its area is 1 00, 5 80 square miles. The popula- tion in 1893 numbered 25,760, and in 1898, 18,640, mostly Indians. The capital, Trinidad (5000), is situated on the Mamore. The department is divided into three provinces. In 1898 there were 24 schools with 700 pupils.~~

~~Benin. — ^The old kingdom of Benin has been in- corporated in Southern Nigeria. Few Europeans visited Benin city in the period 1875 to 1891. Consul Annesley saw the king in 1890 with the hopes of making a treaty, but failed in his object. In March 1892 Captain Vice- Consul Gallwey (now Lieut. -Colonel H. L. Gallwey, C.M.G., D.S.O.) succeeded in concluding a treaty with the king Overami. The treaty, however, proved of no avail, and the king kept as aloof as of old from any outside interference. In January 1897, the Acting Consul-General J. R. Phillips and eight Europeans were brutally massacred on the road from Gwato to Benin city whilst on a mission to the king. A punitive expedition (see below) was organ- ized under the command of Admiral Sir Harry Rawson, K.C.B., and the city was assaulted and captured on 18tli February 1897. The king and chiefs responsible for the massacre having been placed on their trial by Sir Balph. Moor, K.C.M.G., the king was deposed, and deported to~~

~~Old Calabar, and the cMefs, six in all, were executed. The chief offender was not brought to justice until a second punitive expedition in 1899 completed the pacifica- tion of the country. After the removal of the king in September 1897, a council of chiefs was appointed. This council carries on the government of the whole Beni country, and is presided over by the Kesident. Up to 1897 the only trade product allowed by the king was palm oU. Now an extensive trade is done in oil, kernels, timber, ivory, rubber,~~

~~The British Expedition of 1897. — This expedition was a remarkable example of good organization hastily impro- vised. The news of the massacre of Mr Phillips's party reached Kear-Admiral Kawson, the commander-in-chief on the Cape station, on 4th January 1897. The flagship St. George was at Simons Town. The small craft were dispersed. The Theseus and Fcn-te at Malta had been ordered to join the Cape command. The Malacca trans- port was chartered in the Thames for the purposes of the expedition. In twenty-nine days a force of 1200 men, coming from three places between 3000 and 4500 miles from the Benin river, was landed, organized, equipped, and provided with transport. Five days later the city of Benin was taken, and in twelve days more the men were re- embarked, and the ships coaled and ready for any further service. This feat is probably unique. The plan of operations was to move upon Benin in a single column from Warrigi, making demonstrations at Gwato and Sapo- bar in order to distract the attention of the Beni from the main advance. Four companies of Hausas from the force of the Niger Company Protectorate preceded the naval expedition, and were employed in making a road 7 miles long between Warrigi and Ceri on Ologbo Creek. Fifty native scouts were raised at Lagos and rendered useful service. About 800 carriers were obtained from the tribes in the neighbourhood of New Benin. On 11th February the admiral with the bluejackets and marines landed at Warrigi, and marchted to Ceri. On the following day an advanced party of bluejackets and Hausas with two Maxim guns proceeded up the creek, and landing at Ologbo were soon afterwards fired on from the thick bush. On the 14th the advance guard under Lieutenant- Colonel Hamilton moved 5 miles in the direction of Benin, being constantly under fire. Agagi, 4 miles farther, was reached on the 15th after further fighting. _ Here the ex- pected water supply was not found, and as it was necessary to carry at least three days' supply, together with five days' rations, the expedition had to be reorganized, and to leave behind every man not absd'lutely necessary. On the 1 6th a fresh start was made, the Beni constantly firing from the bush and being dislodged by volleys and the Maxims. On the 17th Benin was occupied after further fighting. Some rockets fired at randomMn the supposed direction of the**

town fell in the Juju compound and created a panic, which caused the place to be abandoned. On the following day the much-needed water was obtained. The town, which was found to be reeking of human sacrifices,

~~was partly burned, and on the 22nd the expedition started on its^ return, leaving the Hausas in possession. Meanwhile the Philomel, Barrosa, and Widgeon anchored off the entrance to Gwato Creek on the 8th, and on the 9th an advance in boats was made under Captain O'Callaghan, E.N. Gwato was found deserted on the 10th, and was burned alter an hour's engagement with the Beni. The Phcehe, Alecto, and Magpie supplied a force under Captain M'Gill, E,.N., which occupied Sapobar on the 9th, and was attacked on the 20th. The total losses of the expedition were 10 killed, including 2 officers (Lieut.-Commander Pritchard and Surgeon Fyffe), and 32 wounded, including 5 officers. Staff-Surgeon Way died of sunstroke at Warrigi. The operations, though brief, threw a heavy and continuous strain upon the forces. Their marked success was due to the excellent organization devised by the naval officers and to the great care bestowed upon details. King Duboar of Benin was subsequently captured, and the country has quietly passed under British administration. The reign of wholesale murder has ended, and trade is de- veloping in what was once the worst human shambles of Africa. (g. s. c.)~~

~~Benjamin, Judah Philip (1811-1884),~~

~~Anglo-American lawyer, of Jewish descent, was born a British subject at St Croix in the West Indies on the 11th of August 1811, and was successively an American lawyer, a leading Confederate politician, and a distin- guished English barrister. He eventually died in Paris a domiciled Frenchman. After 1815 his parents lived in Wilmington, North Carolina, and he went to Yale in 1825 for his education, but left without taking a degree, and entered an attorney's office in New Orleans. He was admitted to the New Orleans bar in 1832, He compiled with his friend Slidell a valuable digest of decisions of the Supreme Courts of New Orleans and Louisiana ; and as a partner in the firm of Slidell, Benjamin, and Conrad, he enjoyed a good practice. In 1848 he v^'as admitted a councillor of the Supreme Court, and in 1852 he was elected a senator for Louisiana, from which date he took an active part in politics, declining to accept a judge- ship of the Supreme Court. In 1861 he withdrew from the Senate, left Washington, and actively espoused the Confederate cause. He joined Jefferson Davis's provisional government as attorney-general, becoming afterwards his secretary for war (1861-62), and chief secretary of state (1862-65). Although at times subject to fierce~~

criticism with regard to matters of administration and finance, he was recognized as one of the ablest men on the Confederate side, and he remained with Jefferson Davis to the last, sharing his fiight after the surrender at Appomattox, and only leaving him shortly before his capture, because Benjamin found himself unable to go farther on horse- back. He escaped from the coast of Florida in an open boat, and after many vicissitudes reached Liverpool, Eng- land, an exile. Shortly afterwards his remaining property was lost in the failure of Overend and Gurney.

In London Benjamin was able to earn a little money by journalism, and on the 13th of January 1866 he entered Lincoln's Inn. He received a hospitable welcome from the English legal profession. The infiuence of English judges who knew his abilities and his circumstances enabled him to be called to the bar on the 6th of June 1866, dispensing with the usual three years of studentship, and he acquired his first knowledge of the practice and methods of English courts as the pupil of Mr C. E. Pollock (after-

wards Baron Pollock). Mr Pollock fully recognized his abilities and they became firm friends during their joint lives. Benjamin was naturally an apt and useful pupil ; for instance, an opinion of Mr Pollock, which for long guided the London police in the exercise of their right to search prisoners, is mentioned by him as having been really composed by Benjamin during his pupillage. Benjamin joined the Northern Circuit, and |a large pro- portion of his early practice came from solicitors at Liverpool who had correspondents in New Orleans. His business gradually increased, and having in 1872 re- ceived a patent of precedence, he was on the 2nd of November in that year called within the bar as a Queen's Counsel. In addition to his knowledge of law and of commercial matters he had considerable eloquence, and a power of marshalling his facts and his arguments that rendered him extremely effective, particularly before judges. He was less successful in addressing juries, and for some time towards the close of his career did not take Nisi prius work, but in the Court of Appeal and House of Lords and before the Judicial Committee of the Privy Council he enjoyed a very large practice, making for some time fully £15,000 a year. The question of rais- ing him to

~~the bench was seriously considered by Lord Cairns, who, however, seems to have thought that the ungrudging hospitality and good-will with which Benjamin had been received by the English legal profession had gone far enough. For some time towards the close of his career symptoms of diabetes and cardiac weakness manifested themselves in Benjamin, much as they did in Sir George Jessel, another great Jewish lawyer who died a year before him, and he suffered from the results of a fall from a tramcar in Paris, where he had built him- self a house, and where he used to spend his vacations with his wife, who was a Frenchwoman. He retired to Paris at Christmas in 1882 and never returned to his practice, his medical advisers having ordered him. absolute rest. He only came back to, London in order to be entertained by the bench and bar of England at a banquet in the Inner Temple Hall on the 30th of June 1883 ; and he died at Paris on the 6th of May~~

~~1884.~~

~~In person J. P. Benjamin was thick-set, stout, and Jewish-looking, with a close-cut beard and an expression of great shrewdness. An early portrait of him is to be found facing page 242 in Jefferson Davis's Bise and Fall of the Confederate Government. His political history may be traced in that work, and in American histories and articles dealing with the period in which he was promi- nent, such as Draper's American Civil War, von Hoist's Constitutional History of the United States, and Stephens's History of the United States. Many allusions to his English career will be found in works describing English lawyers of his period, and there are some interesting reminiscences of him by Baron Pollock in the Fortnightly Review for March 1898. A portrait of him in his later life was painted by Piercy and engraved by Eoffe. His Treatise on the Law of Sale of Personal Property with References to the American Decisions and to the French Code and Civil Law — a bulky volume known to practi- tioners as Benjamin on Sales — is the principal text-book on its subject, and a fitting monument of the author's career at the English bar, of his industry and learning. Many of the speeches made by him during his American career have been published. (e. a. ar.)~~

~~Bennigsen, Rudolph von (1824^-~~

), Ger man politician, was born at Ltlneburg on the 10th of July 1824, He was descended from an old Hanoverian family, his father being an officer in the Hanoverian army, who rose to the rank of general, and also held

diplomatic appointments. Bennigsen, having studied at the University of Gottingen, entered the Hanoverian civil service. In 1855 he was elected a member of the second chamber; and as the Government refused to allow him leave of absence from his official duties he resigned his post in the public service. He at once became the recognized leader of the Liberal opposition to the reactionary Government, but must be distin- guished from Count Bennigsen, a member of the same family, and son of the distinguished Russian general, who was also one of the parliamentary leaders at the time. What gave Bennigsen his importance not only in Hanover, but throughout the whole of Germany, was the foundation of the National Verein, which was due to him, and of which he was president. This society, which arose out of the public excitement created by the war between France and Austria, had for its object the formation of a national party which should strive for the unity and the constitutional liberty of the whole Fatherland. It united the moderate Liberals through- out Germany, and at once became a great political power, notwithstanding all the efforts of the govern- ments, and especially of the king of Hanover, to suppress it. In 1866 Bennigsen used all his influence to keep Hanover neutral in the conflict between Prussia and Austria, but in vain. He took no part in the war, but his brother, who was an officer in the Prussian army, was killed in Bohemia. In May of this year he had an important interview with Bismarck, who wished to secure his support for the reform of the Confederation and after the war was over at once accepted the posi- tion of a Prussian subject, and took his seat in the Diet of the North German Confederation and in the Prus- sian parliament. He used his influence to procure as much autonomy as possible for the province of Hanover, but was a strong opponent of the Guelph party. He was one of the three Hanoverians, Windthorst and Miquel being the other two, who at once won for the representatives of the conquered province the lead in both the Prussian and German parliaments. The National Verein, its work being done, was now dissolved ; but Bennigsen was chiefly in- strumental inf ounding a new political party — the National Liberals — who, while they supported Bismarck's national policy, hoped to secure the constitutional development of the country. For

~~the next thirty years he was president of the party, and was the most influential of the parlia- mentary leaders. It was chiefly owing to him that the buUding up of the internal institutions of the empire was carried on without the open breach between Bismarck and the parliament, which was often imminent. Many amendments suggested by him were introduced in the debates on the constitution; in 1870 he undertook a mission to South Germany to strengthen the national party there, and was consulted by Bismarck while at Versailles. It was he who brought about the compromise on the Military Bill in 1874. In 1877 he was offered the post of vice-chancellor with a seat in the Prussian ministry, but refused it because Bismarck or the king would not agree to his conditions. From this time his relations with the Government were less friendly, and in 1878 he brought about the rejection of the first Socialist Bill. In 1883 he resigned his seat in parliament owing to the reactionary measures of the Government, which made it impossible for him to continue his former co- operation with Bismarck, but returned in 1887 to support the coalition of national parties. One of the first acts of the Emperor William II. was to appoint him president of the province of Hanover. In 1897 he resigned this post and retired from public life.~~

~~Bennington, capital of Bennington county,~~

~~Vermont, U.S.A., situated in the south-western part of the state, on Hoosic river, and traversed by the Benning- ton and Eutland railway. It contains three villages : Bennington, North Bennington, and Bennington Centre. It was here that General Stark, at the head of a body of Green Mountain Boys, gained a notable victory over a detachment of General Burgoyne's army in 1777. Popu- lation of the town (1890) 6391, (1900) 8033 ; of the village (1890) 3971, (1900) 5656.~~

~~Benoit, Peter Leonard Leopold (1834-1901), composer and leader of the Flemish musical movement, was born 17th August 1834, at Harlebecke in Flanders. His father and a local village organist were his first teachers. In 1851 Benoit entered the Brussels Conser- vatoire, where he remained till~~

~~1855, studying chiefly under F^tis. During this period he composed music to many melodramas, and to an opera Le Village dans les Montagnes for the Park Theatre, of which in 1856 he became conductor. He won a Government prize and a money grant in 1857 by his cantata^ Le Meurtre d'Abel, and this enabled him to travel through Germany. In course of his journeyings he found time to write a con- siderable amount of music, as well as an essay L'Ecole de Musique Flamande et son Avenir. F^tis loudly praised his Messe ■ Solennelle, which Benoit produced at Brussels on his return from Germany. In 1861 he visited Paris for the production of his opera Le Roi des Aulnes ("Erlkonig") which, though accepted by the Thd§,tre Lyrique, was never mounted ; while there he conducted at the Bouffes-Parisiens. Again returning home, he astonished a section of the musical world by the produc- tion at Antwerp of a sacred tetralogy, consisting of his Cantate de No'M, the above-mentioned m(iss, a Te Deum, and a Requiem, in which were embodied to a large extent his theories of Flemish music. By prodigious efforts he succeeded in gathering round him a small band of enthusiasts, who affected to see with him possibilities in the foundation of a school whose music should differ completely from that of the French and German schools. ' In its main features this school failed, for its faith was pinned to Benoit's music, which is hardly more Flemish than French or German. Benoit's more important com- positions include the Flemish oratorios De Schelde and Lucifer, the latter of which met with complete failure on its production in London in 1888 ; the operas Set Dorp int Oebirgte and Isa, the Drama Ohristi; an enormous mass of songs, choruses, small , cantatas, and motets. Benoit also wrote a great number of essays on musical matters, notably on his favourite theme of Flemish music. He died at Antwerp on the 8th of March 1901. (e. h. l.)~~

~~Bensberg, a village of Prussia, in the Rhine pro- vince, 12 miles by rail E. from Cologne. Here is a castle (now cadet college), built by the Elector John William of the Palatinate in 1705. It has iron, lead, zinc, and silver mines. Population (1885), 10,269;~~

~~(1900), 10,400.~~

~~Benson, Edward White (1829-1896), Arch- bishop of Canterbury, was born on 14th July 1829 at Birmingham. He came of a family of Yorkshire dales-~~

~~men, his father, whose name was also Edward White, being a manufacturing chemist of some note ; his mother's maiden name was Harriet Baker. He was educated at King Edward VI.'s School, Birmingham, under James Prince Lee, afterwards Bishop of Manchester, and amongst his school-fellows were B. F. Westcott and J. B. Lightf oot, both of whom preceded him to Trinity College, Cambridge, where he was elected a sub-sizar in 1848, becoming subsequently sizar and scholar. The death of a favourite sister in 1850, of typhus, was followed two days afterwards by that of his widowed mother ; and as~~

~~her income consisted almost entirely of an annuity, the youth found himself almost without resources, with a family of younger brothers and sisters dependent upon him. Relations came to his aid (though he refused' the offer made by his mother's brother, a devout Unitarian, to adopt one of the children and bring him up as his heir), and presently his anxieties were ^relieved by Francis Martin, bursar of Trinity, who gave him liberal aid, and treated him ever afterwards as a son. Benson took his degree in 1852 as a senior optime, eighth classic, and senior chancellor's medallist, and was elected Fellow of Trinity in the following year. He became a master at Rugby, first under Dr Goulburn, and then (1857) under Dr Temple, who became his lifelong friend ; he was also ordained deacon in 1854 and priest in 1856. From Rugby he went, on Dr Temple's recommendation, to be the first headmaster of Wellington College, which was opened in January in 1859 ; and ip the course of the same year he married his cousin, Mary Sidgwick (sister of Professor Henry Sidgwick), to whom he had long been devotedly attached. Wellington College made him widely known, provided a scope for his enthusiastic love of teaching, and developed his administrative abilities; it grew rapidly under his headship, and to him it was due that, instead of becoming merely " a kind of military academy for army preparation," it took its place as a great English public school. By degrees his thoughts began to turn towards other work. His appointment to the prebendal stall of Heydour in Lincoln Minster (1868) gave him an office in a great cathedral chapter, towards which he had always felt greatly drawn ; and as examining chaplain to Bishop Christopher Wordsworth he came into close contact with candidates for holy orders. For a short time also, in 1870, he held the same ofi&ce for Dr Temple, just appointed to the see of Exeter. In 1872 came an offer of the chancellorship of Lincoln ; his~~

acceptance of it brought his school work to an end, and opened-a new period of his life. As chancellor, the statutes directed him to study theology, to train others in that study, and to over- see the educational work of the diocese. To such work Benson at once devoted himself ; and it is not too much to say that through his personal efforts and his studies he did more perhaps than any other man to reiuvigorate cathedral life in England. He started a theological col- lege (the Scholce Gancellarii), which has had a prosperous career ; he founded night schools, he delivered courses of lectures on church history, and held bible-classes ; he was instrumental in founding a society of mission preachers for the diocese, the " Novate Novale " ; and owing to his influence a general mission was held in the city of Lincoln in the spring of 1876.

In the winter of the same year he was offered and accepted the newly-constituted see of Truro ; he was con- secrated on St Mark's Day 1877, and enthroned in St Mary's Church at Truro on 1st May. The " brand-new bishop," as he was called by John Bright, threw himself into his work with characteristic vigour. Cornwall was to him "aland of wonderment, historical, physical, spiritual" ; he soon came to know it well, and showed a remarkable power of grappling with its peculiar religious conditions. His knowledge, his sympathy, his enthusiasm, made them- selves felt everywhere, and by degrees he won the warm affection of the Cornish people. The new diocese was organized rapidly, the ruridecanal conferences of clergy became a real force, and the church life of Cornwall came to have a strength and solidity that had never been possible when it was merely a part of the huge unwieldy diocese of Exeter. A chapter was constituted, the bishop being dean ; amongst its members was a canon missioner (the first to be appointed in England), and the Scholce CanceUarii were founded after the Lincoln pattern. Moreover, the

bishop at once set to work to build a cathedral, and the efforts which were made to raise the necessary funds did perhaps more than anything else to

~~draw the whole diocese together. The foundation-stone was laid on 20th May 1880, and the work went steadily for-ss^ard. The south or Benson transept commemorates his episcopate ; and on 3rd November 1887 the cathedral, so far as then completed, was consecrated. The nave wUl commemorate his primacy.~~

~~Archbishop Tait died on 3rd December 1882, and, to the joy of most church-people, Dr Benson was nominated as his successor : his election by the chapter of Canterbury was confirmed on 3rd March 1883, and he was enthroned on 29th March. It may be said without hesitation that his primacy was one of almost unprecedented activity, and that he bore the lion's share of all that was done. 'So Archbishop of Canterbury since the Eeformation exer- cised such an influence outside the British Isles as he did. Erequent communications passed between him and the heads of the Eastern Churches. With their cordial approval a bishop was again consecrated, aftpr six years' interval (1881-87), to have charge over the Anglican con- gregations in Jerusalem and the East ; and the features which had formerly made the plan objectionable to many English churchmen were now abolished. In 1886, after much careful investigation, he founded the " Archbishop's Mission to the Assyrian Christians," having for its object the instruction and the strengthening from within of the "Nestorian " churches of the East [Nestoeiakt Chukch]. An interchange of courtesies with the Metropolitan of Kieff, on the occasion of the 900th anniversary of the con- version of Eussia (1888), led to further intercourse, which has already done much to briag about a better under- standing between the English and Eussian churches. With regard to the Eoman Communion his action was perhaps less happy. In 1894 the Abb^ Portal (who, in common with many other French clergy, had been led by his studies to accept the validity of English orders) was in England, and an interview was sought on his behalf with Dr Benson, in which the question was discussed of a possible rapprochement with the Papacy. The Archbishop refused to take any part in such a plan, and subsequent events only showed the wisdom of this course. But there were many who felt that, then as at other times, some act of courtesy on the part of the English primate might have smoothed the way for possible action in the future. With the other churches of the Anglican Communion (q.v.) the Archbishop's relations were cordial in the extreme, and grew ever closer as time went on. Particular questions of importance,~~

~~the Jerusalem bishopric, the healing of the Colenso schism in the diocese of Natal, the organization of native ministries, and the like, occupied no small part of his time ; and although he held unflinchingly to all the accustomed rights and prerogatives of his see, he did all in his power to foster the growth of local churches. But it was the work at home which occupied most of his energies. That he in no way slighted diocesan work had been shown at Truro. He complained now that the bishops were " bishops of their dioceses but not bishops of England," and did all he could to make the Church a greater religious force in English life. He sat on the Ecclesiastical Courts Commission (1881-83) and the Sweating Commission (1888-90). He brought Bills into Parliament to reform Church Patronage and Church Discipline, and worked unremittingly for years in their behalf. The latter became law in 1892, and the former was merged in the Benefices Bill, which passed in 1898, after his death. He wrote and spoke vigorously against Welsh Disestablishment (1893) ; and in the following year, under his guidance, the existing agencies for Church Defence were consolidated, and greater stress was laid~~

~~upon proper instruction than had previously been the case. He was largely instrumental in the inauguration of the House of Laymen in the province of Canterbury (1886) ; he made diligent inquiries as to the internal order of the Sisterhoods of which he was visitor ; from 1884 onwards he gave regular Bible readings for ladies in Lambeth Palace Chapel. But the most important ecclesiastical event of his primacy was undoubtedly the judgment in the case of the Bishop of Lincoln [Lincoln Judgment], in which the law of the prayer-book is investigated, as it had never been before, from the standpoint of the whole history of the English Church. In 1896 the Archbishop paid a long-promised visit to Ireland, to see the working of the sister Church. He was received with enthusiasm, but the work which his tour entailed over-fatigued him. On Sunday morning, 11th October, just after his return, whilst on a visit to Mr Gladstone, he expired in Hawarden Parish Church of heart failure, just as the Absolution was said at Matins.~~

~~Archbishop Benson left niunerous writings, including a valuable essay on Tlie Cathedral (London, 1878), and various charges and volumes of sermons and addresses. But his two chief works, posthumously published, are his Cyprian (London, 1897), a work of great learning, which had~~

~~occupied him at intervals since early manhood ; and The Apocalypse, an Introductory Study (London, 1900), interesting and beautiful, but limited by the fact that the method of study is that of a Greek play, not of a Hebrew apocalypse. The Archbishop's knowledge of the past was both wide and minute, but it was that of an antiquary rather than of an historian. " I think," writes his son, " he was more interested in modern movements for their resemblance to ancient than vice versd." - His sermons are very noble, written in a style which is over-compressed and often obscure, but full of love, of faith, of large-hearted- ness. He was a hymn-writer of a high order, as may be seen, for example, in " 0 Throned, 0 Crowned " and " The Splendours of Thy Glory, Lord," which he wrote for the Wellington College Hymn-book, which he edited, and in his beautiful version of Vrbs Beata. His " grandeur in social function" was unequalled, and his interests were very wide. But above all else he was a great ecclesiastic. He paid less attention to secular politics than Archbishop Tait ; but if a man is to be judged by the effect of his work, it is Benson, and not Tait, who should be described as a great statesman. His biography, by his son, reveals him as a man of devout and holy life, impulsive indeed and masterful, but one who learned self-restraint by strenuous endeavour.~~

~~A. C. Benson. Life of Archbishop Benson, 2 vols. London, 1899. — J. H. Beknaed. Archbishop Benson in Ireland, 1897. — Quarterly Beview, Oct. 1897, art. "Archbishop Benson" (by L. T. Dibdin). (w. E. Co.)~~

~~Bentham, George (1800-1884), British botanist, was born at Stoke, near Portsmouth, England, 22nd Septem- ber 1800. His father. Sir Samuel Bentham, was the only brother of Jeremy Bentham, the publicist, and of scarcely inferior ability though in a different direction. Devoting himself in early life to the study of naval architecture. Sir Samuel went to Eussia to visit the naval establishments in the Baltic and Black Seas. He was induced to enter the service of the Empress Catherine II., built a flotilla of gunboats and defeated the Turkish fleet. Por this he was made, in addition to other honours, a colonel of a cavalry regiment. On the death of the Empress he re- turned to England to be employed by the Admiralty, and was sent (1805-07) again to Eussia to superintend the buUdiugof some ships forthe British navy. He attained the rank, under the Adiniralty, of inspector-general of Naval Works. He introduced a multitude of improvements in~~

~~naval organization, one of the most remarkable being the invention with Marc Isambard Brunei, whom he brought to England, of the machinery for making pulley-blocks. His son, George Bentham, had neither a school nor college education, but early acquired the power of giving sustained and concentrated attention to any subject that occupied him^an essential condition of the success he attained as perhaps the greatest systematic botanist of the 19th century. Another was his remarkable linguistic aptitude. At the age of six to seven he could converse in French, German, and Russian, and he learnt Swedish during a short residence in Sweden, when little older. At the close of the war with France, the Benthams made a long tour through that country, staying two years at Montauban, where Bentham studied Hebrew and mathematics in the Protestant Theological School. They eventually settled in the neighbourhood of Montpellier, where Sir Samuel purchased a large estate.~~

~~The mode in which George Bentham was attracted to the botanical studies, ;which became the occupation of his life, is noteworthy. For it was through the applicability to them of logical methods which he had imbibed from his uncle's writings, and not from any special attraction to natural history pursuits. While studying at Angoulgme, a copy of de Candolle's Flore Frangaise fell into his hands and he was struck with the analytical tables for identifying plants. He immediately proceeded to test their use on the first that presented itself. The result was successful and he continued to apply it to every plant he came across. A visit to London in 1823 brought him into contact with the brilliant circle of English botanists. In 1826, at the pressing invitation of his uncle, he agreed to act as his secretary, at the same time entering at Lincoln's Inn and reading for the Bar. He was called in due time, and in 1832 held his first and last brief. The same year Jeremy Bentham died, leaving his property to his nephew. His father's inheritance had fallen to him the previous year. He was now in a position of modest independence, and able to pursue undistractedly his favourite studies. For a time these were divided between botany, juris- prudence, and logic, in addition to editing his father's professional papers. Bentham's first publication was his~~

~~Catalogue des Plantes Indigenes des Pyrin&es et du Bas Languedoc (Paris, 1826), the result of a careful exploration of , the Pyrenees in company with Dr Walker Arnott (after- wards professor of Botany in the University of Glasgow). It is interesting to notice that in it Bentham adopted the principle from which he never deviated, of citing nothing at second-hand, or any fact or reference which he had not himself independently verified. This was followed by articles on various legal subjects : on codification, in which he disagreed with his uncle, on the laws affecting larceny, and on the law of real property. But the most remarkable production of this period was the Outline of a New System of Logic, with a Critical Sxaw,ination of Dr Whately's Elements of Logic (1827). In this the principle of the quantification of the predicate was first explicitly stated. This Stanley Jevons declared to be " undoubtedly the most fruitful discovery made in abstract logical science since the time of Aristotle." Before sixty copies had been sold the publisher became bankrupt and the stock went for waste-paper. The book passed into oblivion, and it was not till 1873 that Bentham's claims to priority were finally vindi- cated against those of Sir William Hamilton by Herbert Spencer. In 1836 he published his Labiatarum genera et species. In preparing this work he visited, between 1830-34, every European herbarium, several more than once. The following winter was passed in Vienna, where he produced his CommentationesdeLeguminosarumgeneri- bus, published in the annals of the Vienna Museum. In 1842 he removed to PontrUas in Herefordshire. His**

~~chief occupation for some succeeding years was his con- tributions to the Prodromus Systemaiis Naturalis Begni Vegetabilis, which was being carried on by his friend, Alphonse de Candolle. In all these dealt with some 4730 species.~~

~~In 1864 he found the maintenance of a herbarium and library too great a tax on his means. He therefore offered them to the Government on the understanding that they should form the foundation of such necessary aids to research in the Royal Botanic Gardens at Kew. At the same time he contemplated the abandonment of botanical work. Fortunately, he yielded to the persua- sion of Sir William Hooker, Lindley, and other scientific friends. In 1855 he took up his residence in London, and worked at Kew for five days a week, with a brief summer holiday, from this time onwards till the~~

~~end of his life. As his friend Asa Gray wrote : “With such methodical habits, with freedom from professional or administrative functions, which consume the time of most botanists, with steady devotion to his chosen work, and with nearly all authentic material and needful appliances at hand, or within reach, it is not so surprisingthat he should have undertaken and have so well accomplished such a vast amount of work, and he has the crowning merit and happy fortune of having completed all that he undertook.” The Government, in 1857, sanctioned a scheme for the preparation of a series of Floras, or descriptions in the English language of the indigenous plants of British colonies and possessions. Bentham began with the Flora HongJcongensis in 1861, which was the first comprehensive work on any part of the little-known flora of China. This was followed by the Flora AustraKensis, in seven volumes (1863-78), the first flora of any large continental area that had ever been finished. His greatest work was the Genera Plantarum, commenced in 1862, and concluded in 1883, in collabora- tion with Sir Joseph Hooker, ” the greater portion being,” as Sir Joseph Hooker tells us, ” the product of Bentham’s indefatigable industry.” As age gradually impaired his bodily powers, he seemed at last only to live for the com- pletion of this monumental work. When the last revise of the last sheet was returned to the printer, the stimulus was withdrawn : his powers seemed suddenly to fail him. He commenced a brief autobiography. The pen with which he had written his two greatest works broke in his hand in the middle of a page. He accepted the omen, laid aside the unfinished manuscript, and patiently awaited the not distant end. He died on the 10th September 1884, within a fortnight of his 84th birthday.~~

~~The scientific world has received the Genera Plantarum with as unanimous an assent as was accorded to the Species Plantarum of Linnaeus. Bentham possessed, as Professor Oliver has renjarked, ” an insight of so special a character as to ‘deserve the name of genius, into the relative value of characters for practical systematic work, and as a conse- quence of this, a sure sifting of essentials f romnpn-essentials in eachrespective grade.” Hispreparationforhiscrowning- work had been practically life-long. There are few parts of the world upon the botany of which he had not touched. In the sequence and arrangement of the great families of flowering plants, different views from those of Bentham may be adopted. But Bentham paved the way by an inti- mate and exact statement of the structural facts and their~~

~~accurate relationship, which is not likely to be improved. In method and style, in descriptive work, Bentham was a supreme master. This, to quote Professor Oliver again, is "manifest not only in its terseness, aptness, and precision, but especially in the judicious selection of diagnostic marks, and in the instinctive estimate of proba- ble range in variation, which long experience and innate genius for such work could alone inspire."~~

~~(W. T> T.-D.)~~

~~BENTON HARBO E — B E R C H E M~~

~~Benton Harbor, a city of Berrien county, Michigan, [J.S.A., situated in the southern part of the lower peninsula, on St Joseph river and on Lake Michi- gan, at an altitude of 696 feet. The city has three rail- ways and a large lake commence. Population (1900),~~

~~6562.~~

~~Benue, R. See]^i&eb.~~

~~Berar, or the Beeaks, the familiar name of a pro- vince in Central India, officially styled the Haidarabad Assigned Districts. It is administered on the lines of a British province by a commissioner, who is subordinate to the resident at Haidarabad. The ancient capital was Ellichpur ; the administrative headquarters are now at Amraoti, while Akola is the residence of the judicial commissioner. The six districts of Berar are — Amraoti, Akola, Ellichpur, Buldana, Wun, Basim. Its area covers 17,718 square miles. The population in 1891 was 2,897,486; the average density being 164 persons per square mile, ranging from 238 in the fertile plain of Amraoti to 120 in Wun, and only 29 in the hilly tract of Ellichpur. Classified according to religion, Hindus num- bered 2,531,791, or 87 per cent, of the total population ; Mahommedans, 207,681, or 7 per cent. ; aboriginal tribes, 137,108, or 5 per cent., chiefly in the two hilly districts of Wun and Ellichpur; Christians, 1359, of whom 330 were Europeans and 318 Eurasians, leaving 711 for native converts, chiefly in Amraoti and Akola ; Jains, 18,9i52 ; Parsees, 412 ; Sikhs, 177 ; and " others," 6. In 1901~~

the population was 2,752,418, showing a decrease of 6 per cent., compared with an increase of 8 per cent, in the pre- ceding decade. Excluding the hilly tract in Ellichpur known as the Melghat, which has never been surveyed for revenue, it is estimated that only 2 per cent, of the total area available for cultivation remains unoccupied. The incidence of land revenue is nearly E.l per acre. In 1897-98, out of a total cultivated area of 6,625,806 acres, only 18,078 were twice cropped. The irrigated area was 80,981 acres, almost entirely from wells, and mainly in the district of Buldana. The two staple crops of Berar are millet and cotton, each of which is ordinarily grown on about one-third of the cultivated area. Next in im- portance come wheat, oil-seeds, and pulse. In 1897-98, the area under cotton was 2,150,709 acres. The exports of cotton to Bombay average about 326,000 bales of 392 flb, valued at Es.3,00,00,000 (£2,000,000 sterling). In 1897 there were altogether 79 cotton factories under inspec- tion. The daily number of operatives employed was 7547. The cotton mill at Badnera has 219 looms and 15,976 spindles, and employs 1186 hands, of whom 677 are adult males. In 1898 the output was 5796 bales, of twist and yarn, equal to 2,298,767 lb, and 2339 bales of cloth. There are also three oil-mills worked by steam, of which two at Amraoti in 1898 produced 236,150 gallons of oil and 2181 tons of oil-cake. Coal exists, but no mines are worked. Berar is traversed by the Nagpur line of the Great Indian Peninsula railway. The average im- ports and exports by rail, for the quinquennial period ending 1897, were valued at — imports, Rs.1,87,08,000, and exports (mainly raw cotton) Ks.3,97,56,000. The results of the famine were shown in 1897-98 by a reduc- tion of one-half I in the export of grain and oil-seeds, while the export of hides and the import of grain doubled. The export of raw cotton was little affected ; but this almost entirely ceased in the still more disastrous year 1899- 1900. In 1897-98 the total provincial revenue of Berar amounted to Es.99,23,458, of which Es. 68,55,550 was derived from land, Ks.10,63,058 from excise, Es.8,27,641 from stamps, and Es.4,00,350 from forests. The total provincial expenditure amounted to Es.1,00,47,081, of which Es.43,91,423 was devoted to defraying the cost of

the Haidarabad Contingent, Es.43,65,180 to the civil de- partments, Es.7,16,137 to public works, and Es.3,66,816 to famine relief. There was consequently a deficit ; and for the first time for more than twenty years nothing could be paid over to the Nizam. . In 1897-98 the local revenue

~~amounted to Es.8,55,967, and the local expendi- ture amounted to Es.9,64,676. The municipalities in Berar number 12, with an aggregate population of 170,912. There are 6 district boards, with 21 subordinate taluk boards. In 1897-98 the aggregate income of the district boards was Es.7,14,030, the aggregate expenditure was Es.6,66,006. The following table gives the chief statistics of education in Berar for the years 1 886-87, and 1896-97 : —~~

~~1886-87.~~

~~1896-97.~~

~~Secondary Schools Primary Schools Special Schools Private Institutions~~

~~Schools.~~

~~26~~

~~S35~~

~~, 1~~

~~26~~

~~Pupils.~~

~~4,695~~

~~38,530~~

~~96~~

~~340~~

~~Schools.~~

~~28~~

~~1324~~

~~4~~

~~5~~

~~Pupils.!~~

~~3,992~~

~~50,085~~

~~109~~

~~157~~

~~Total~~

~~988~~

~~43,661~~

~~1361~~

~~54,343~~

~~Compared with the estimated population of school-going age, the proportion of boys at school rose in ten years from 20-4 to 22-6 per cent. ; while the proportion of girls at school has risen from -7 to 1-8 per cent. The expendi- ture on education in 1886-87 was Es.4,20,674, and in 1896-97 Es.4,54,962. Berar suffered from famine in 1896-97, and again in 1899-1900. In June 1900 the maximum number of persons in receipt of relief, was 516,000, or 18 per cent, of the total population, (j. s. co.)~~

~~Berat, chief town of the sanjak to which it gives its name, forming part of the vilayet of Janina, South Albania, Turkey in Europe. The population numbers 12,000, consisting wholly of Albanians, of whom about half are Orthodox Christians, and the remainder Mahom- medans.~~

~~Beraun (Czech, Beroun), an old manufacturing town in the government-district of Horowitz in Bohemia, Austria, south-west of Prague, at the~~

~~confluence of the Beraun with the Litawa river. It is the seat of important textile industry, sugar-refining, corn-milling, and brewing. Lime-kilns and the manufacture of cement and smelting and iron works are carried on in the environs. In 1890 it had 7265 Czech inhabitants ; in 1900, 9693.~~

~~Berbers. — The mingled aboriginal white races of the North African coast — hence known as Barbary — are now chiefly confined to the highlands, where they still maintain their own unwritten language, split up into many dialects, although for nearly a thousand' years they have professed IsMm. "Ethnologists are not agreed as to the division in which to class either their stock or their language, which latter approximates to the Hamitic group in its vocabulary, but to the Semitic in its construction ; and until, in recent years, French students made known the peculiarities of the Algerian section, very little had been ascertained regarding them, except that under the Carthaginian generals they were the valiant foes of Eome, and under Arab generals the conqu^rors of Spain. In Morocco they still maintain a semi-independence. Among themselves they are known as Imazighan, "Free-men" (s. Amazigh), and by various local names, but by the MoQrs as Bri,ber (s. Berber). Whether the Greeks, and through them the Eomans, borrowed this name from the natives and applied it to other tribes of uncouth tongue, or whether the natives learned it from the foreigners, is a disputed point. (b. m.*)~~

~~Berchem, a town of Belgium, in the province and 2 miles south of the town of Antwerp, of which it is a~~

~~B E E C K-S TJ E-M E E — B E E G E N-0 P-Z 0 0 M~~

~~suburb. Its raUway station is on the line between 1 fJ^coc ^^ Brussels. Population (1880), 9384 ; (1897),~~

~~Berck-sur-Mer, a seaside resort in the arron- dissement of Montreuil, department of Pas-de-Calais, Prance, 53 miles m direct line W. by N. of Arras, with stations on branch line of railway from Abbeville to Boulogne. It comprises two parts, Berck-ville and Berck- plage. The latter has a fine sandy beach. There are large children's hospitals, the climate proving peculiarly bene- ficial in the treatment of scrful6us affections. About 100~~

~~boats are employed in the fisheries, and herrings form the staple of an active trade. Pishing boats are built Population (1881), 3999; (1896), 6787.~~

~~Beregszasz, a corporate town of Hungary, capital of the county of Bereg, 57 miles E. by N. of Tokay. Sax- ons were the original settlers in the 13th century ; now almost the entire population (9629) is Magyar. There are administrative and other of&ces ; also a state gymnasium.~~

~~Berezovskiy Zavod, a wealthy village of east Eussia, on the eastern slope of the Urals, on Pyshma river, 8 miles north-east of Ekaterinburg. It is one of the largest settlements of the government of Perm and the centre of an important mining region of the same name, where gold is extracted from quartz veins. The crushing of the quartz used to be made at Berezovskiy Zavod, but is now done at other works as "well. The population, which was 10,189 in 1885, has decreased since, and has chiefly taken to the manufacture of boots, stone-cutting, and cabinet-making.~~

~~Berga, a town of Spain, in the province of Barce- lona, on a spur of the Pyrenees, on the right bank of the river Llobregat. It is partly built on rising ground, and partly on the level plain. It has a theatre, casinps, and a fine parish church with three naves. Here was estab- lished the first cotton industry of Catalonia, and the house of Targneil invented the "bergadanas" weaving machinery long used in the province. In the neighbourhood there are lignite beds of importance, and barley, oats, corn, and maize are grown in the hills around Berga. It is supposed to be the Oastrum Bergium of Livy. It was taken and retaken often in the 17th and 18th centuries by the French and Spaniards, and by Liberals and Carlists in the 19th. Population, 5239.~~

~~Bergamo, chief town of the province of Bergamo, Lombardy, Italy. A large public slaughter-house, a cattle market, and a provincial asylum for 700 inmates (cost- ing £60,000), have been built, electric tramways and lighting have been introduced, and a funicular railway has been constructed between the modern town and the ancient city on the hill. Several new streets have been opened and works erected to protect the town against torrents from the surrounding heights. The municipal library has, since 1875, been enriched by bequests from Donizetti, Meyer, Spaventa, and Eavelli, and now possesses 160,000 volumes. The Fine-Arts Academy, founded in 1797 by Count Giacomo Carrara, has likewise been enriched by legacies. The~~

cathedral has been restored and completed, the ancient baptistery reconstructed by the side of the Colleoni chapel, and the house of the famous Condottiero Colleoni restored. Monuments have been erected to Victor Emmanuel II., Garibaldi, and the musicians Doni- zetti and Meyer, natives of Bergamo. The elementary schools give instruction to nearly 3000 children. Direct railway communication now exists with Milan, Cremona, Lecco, Monza, Brescia, Venice, Novara, and Turin. Steam tram lines also connect it with Treviglio, Lodi, and Monza. The mining industry (iron, copper, and marble) has been greatly developed since 1875. The commune of Gandino in

the province of Bergamo is a centre of woollen industry, while at Fara d' Adda are the largest linen and woollen mills in Italy. Twelve cotton-spinning works have recently been established. The silk industry has maintained its im- portance in the province, while in the city printing and lithography have especially advanced. Various artificial manure factories supply the demands of agriculture. The cattle markets dispose annually of 50,000 cattle, 12,000 horses, 10,000 sheep, and 60,000 swine, for a total value of £640,000. The city octroi in 1899 amounted to £30,000. Population of town (1881) 39,704, (1901) 45,785 ; of pro- vince (1881) 390,775, (1901) 457,983. (l. bi)

Bergedorf, a town of Germany, in the territory of Hamburg, 10 miles by rail E. by S. from the city. It pro- duces vegetables and fruit for the Hamburg markets, and carries on tanning, glass manufacture, brewing, and brick-making. It received town rights in 1275, belonged to Liibeek and Hamburg conjointly from 1420 to 1867, and in the latter year was bought by Hamburg. Population

(1885), 5209; (1895), 8297; (1900), 10,250.

Bergen, a seaport, fortress, and bisTiop's see of Nor- way, forming a separate county {amt) by itself, on the W. coast, in 60° 23′ IS", lat., and 5° 18′ E. long. The new buildings include St John's church (1893), the Exhibition Building (containing fisheries museum, &c.), an observa- tory, a fine exchange, a biological station, and an aquarium. Both Ibsen and

~~Bjornson were connected with the theatre. Bergen is the birthplace of the poets Holberg (1684-1764) and Welhaven (1807-1873), of Dahl, the painter (1788- 1857), of Ole Bull, the violinist (1810-1880), and of Grieg, the composer. There are statues to Holberg (1884) and Christie, president of the Storthing in 1816-16 and 1818. The mercantile fleet in 1899 numbered some 370 vessels, with an aggregate of 541,200 tons, as compared with 350 vessels of 370,600 tons owned by Christiania in the same year, Bergen's preponderance being due to her larger number of iron steamships. In 1879 Bergen ranked after Christiania, Arendal, Stavanger, and Drammen; in 1900 she ranked first. The trade of the town grew from a total of £2,346,700 (imports£l,475,700, exports £871,000) in 1879 to £3,596,600 (imports £2,223,000, exports £1,372,600) in 1897. The staple of the trade is fish — codfish, herrings, cod-liver oil, and other fish pro- ducts, anchovies, lobsters, &c. The other exports of chief importance are butter, copper ore, and hides. The imports consist principally of coal (125,000 to 190,000 tons annu- ally), steamships, salt, cereals and flour, groceries, wines and spirits. The port was entered and cleared by a total of 690,200 tons in 1898. Bergen is not a great manu- facturing city. Its chief industries are connected with the preparation offish products and with shipbuilding; but there are also cotton and woollen weaving, with manu- facture of paper, glass, earthenware, tobacco, cordage, and distilleries. Bergen is connected by rail with Vosse- vangen in the interior, a distance of 67 miles. In 1896 a beginning was made with the continuance of this line through the f jelds (fells) to connect with Christiania. In the first 50 miles from Vossevangen the line ascends 4080 feet, passing through a tunnel 6796 yards long at an altitude of 2822 feet ; the tunnel is to be completed in July 1902. Population (1876), 38,573; (1891), 63,684; (1899), 68,393. (j. T. BE.)~~

~~Bergeri'Op-Zoom, a town in the province of North Brabant, Holland, about 16 miles north of Antwerp, on the Eoosendaal-Flushing railway. Beetroot is cultivated, and a trade is carried on in- oysters as well as anchovies. A steam tramway to Antwerp, of recent construction, has given a great impetus to the export trade in fish. The population in 1899 was 13,668.~~

~~Bergerac, chief town of arrondissement, department of Dordogne, France, 19 miles S.S.W. of P^rigueux, at the intersection of the railways from Libourne to Buisson, and AngoulSme to Marmands. Extensive trade is main- tained in truffles, grain, and chestnuts, considerable quan- tities of the last being sent to England. There are fine nurseries, and an important salmon fishery at the Sal- vette reservoir. Population (1881), 10,022 ; (1896), 10,697 ; comm. 13,594 ; (1900), 15,982.~~

~~Berhampore, the name of two towns in British India, in Bengal and Madras. (1) The headquarters of Murshidabad district, in Bengal, is situated on the left bank of the river Bhagirathi, 5 miles below Murshidabad city. Population, about 25,500. Berhampore was fixed upon after the battle of Plassey as the site of the chief military station for Bengal ; and a huge square of brick barracks was erected in 1767, at a cost of £300,000. Here was committed the first overt act of the mutiny, on 25th February 1857. No troops are now stationed here, and the barracks have been utilized for a jail, a lunatic asylum, and other civil buildings. The old cemetery con- tains many interesting tombs, including those of Warren Hastings' first wife, the Irish adventurer George Thomas, and the hero of Mrs Sherwood's tale. Little Henry and his Bearer. A college, founded by Government in 1853, was made over in 1888 to a local committee, being mainly sup- ported by the munificence of the late Rani Svarnamayi. (2) The headquarters of Ganjam district, in Madras, is situated in 19° 18′ N. lat. and 84° 48′ E. long., about 9 miles from the sea-coast. It is^a station on the East Coast railway, which connects Calcutta with Madras. Population, about 25,500. Berhampore has a military cantonment, containing a wing of a native regiment, sometimes distinguished as Baupur. There is some weav- ing of silk cloth, and export trade in sugar. There are two churches and four printing-presses. The college, originally founded by Government, is now maintained by the £,aja of Kallikota.~~

~~Beri-beri. — Beri-beri is described as a specific form of multiple peripheral neuritis, endemic in certain lati- tudes, and liable to epidemic diffusion. (For peripheral neuritis, see Pathology, Neuropathology.) According to Dr Manson, it is a disease of the greatest antiquity, and known to the Chinese from an extremely remote period. At one time its importance as a tropical disease was gen- erally recognized, but it gradually dropped out of sight and~~

~~was forgotten, until an epidemic in Brazil in 1863, and the opening up of Japan, where it prevails exten- sively under another name, brought it again into notice. The recognition of its character as essentially a form of" peripheral neuritis is quite recent, and due to the re- searches of Scheube and Baly in Japan, and of Pekel- haring and Winkler in the Dutch In dies. The geographical distribution of beri-beri is between 46° N. and 35° S. It occurs in Japan, Korea, and on the Chinese coast south of Shanghai; in Manila, Tongking, Cochin China, Burma, Singapore, Malacca, Java, and the neighbouring islands ; also in Ceylon, Mauritius, Madagascar, and the east coast of Africa. In the Western hemisphere it is found in Cuba, Panama, Venezuela, and South America. This distribution is . curious and unintelligible as it stands. Probably further investigation will show that the disease is much more widely distributed. It has been carried in ships to Australia and to England. Dr Manson has " known it originate in the port of London in the crews of ships which had been in harbour for several months," and he suggests that when peripheral neuritis occurs in epidemic form it is probably beri-beric.~~

~~The cause is believed by many authorities to be an in- fective agent of a parasitic nature, but attempts to identify~~

~~it have not hitherto been successful. It is "not obviously communicable from person to person" (Manson), but may be carried from place to place. It clings to particular localities, buildings, and ships, in which it has a great tendency to occur ; for instance, it is apt to break out again and again on certain vessels trading to the East. It haunts low-lying districts along the coast, and the banks of rivers. Moisture and high temperature are required to develop its activity, which is further favoured by bad ventilation, overcrowding, and underfeeding. Some writers have suggested that it is allied to malaria, but it has not the same geographical distribution, and the symptoms are entirely different. The absence of fever seems to exclude the theory of a micro-parasite. Another hypothesis is that it is caused by unwholesome diet. The experience of the Japanese navy points strongly in this direction. Beri-beri was constantly preva- lent among the sailors until 1884, when the dietary was changed. A striking and progressive diminution at once set in, and continued until the disease wholly disap- peared. Major Konald Ross has suggested that beri-beri is really arsenical poisoning.~~

~~Many facts about it sup- port the idea that it is some form of chronic poisoning, but at present there is nothing pointing to arsenic. One would rather expect it to be some fungoid growth affect- ing grain, such as rice or maize, or some other food- stuff commonly used in the localities where beri-beri is prevalent, and among sailors. The conditions under which their food is kept on board certain ships might explain the tendency of the disease to haunt particular vessels.~~

~~The most susceptible age is from 15 to 40. Children under 15 and persons over 50 or 60 are rarely attacked. Men are more liable than women. Eace has no influence. Previous attacks powerfully predispose.~~

~~The symptoms are mainly those of peripheral neuritis with special implication of the phrenic and pneumo-gastric nerves. There is usually a premonitory stage, in which the patient is languid, easily tired, depressed, and com- plains of numbness, stiffness, and cramps in the legs ; the ankles are cedematous and the face is puffy. After this, pronounced symptoms set in rapidly, the patient suddenly loses power in the legs and is hardly able to walk or stand ; this paresis is accompanied by partial anaesthesia; and by burning or tingling sensations in the feet, legs, and arms ; the finger-tips are numb, the calf muscles tender. These symptoms increase; the oedema becomes general, the paralysis more marked; breathlessness and palpitation come on in paroxysms ; the urine is greatly diminished. There is no fever, unless it is of an incidental character, and no brain symptoms arise. The patient may remain in this condition for several days or weeks, when the symptoms begin to subside. On the disappearance of the oedema the muscles of the leg are found to be atrophied. Recovery is very slow, but appears to be certain when once begun. When death occurs it is usually from syncope through over-distension of the heart. The mortality varies greatly, from 2 to 50 per cent, of the cases. The disease is said to be extremely fatal among the Malays. After death there is found to be serous infiltration into all the tissues, and often haemorrhages into the muscles and nerves, but the most important lesion is degeneration of the peripheral nerves. 'The cerebro-spinal centres are not affected, and the degeneration of the nerve-fibres is more marked the farther they are from the point of origin. The implication of the phrenic and pneumo-gastric nerves, and of the cardiac plexus, accounts for the breathlessness, pal- pitation, and heart~~

~~failure ; that of the vaso-motor system for the oedema and diminution of urine, and that of the spinal nerves for the loss of power, the impairment and perversion of sensation. According as* these nerves are~~

~~variously affected, the symptoms will be modified, some being more prominent in one case and some in another.~~

~~There is no specific treatment for beri-beri. The most important measure is the removal of patients from the locality. If this is done they generally recover spon- taneously, which again is in keeping with the theory of chronic poisoning. Symptoms may be treated as they arise. For prevention it is advisable to move other peo- ple from the same locality, or withdraw them from the operation of the same influence whatever it may be.~~

~~SiK Patkick Manson. Tropical Diseases, new ed., 1900. A full bibliography is given by Dr Manson in AUbutt's System of Medicine. /^ g^ \~~

~~Berislav, or Boeislav, a town of south-west Eussia, government and 46 miles N.E. of Kherson, situated on the left bank of the Dnieper. It is supposed to. have been founded in 1450 by the Turks. It contains steam flour-mills. The population is 12,081.~~

~~Berja, a town of Spain, province of Almeria, in a valley to the east of the Rio Grande. The country around Berja is mostly mountainous, and produces in a few valleys cereals, wine, oil, oranges, esparto grass, and fruits. Lead mines are in the district, and paper, cotton goods, and linen are manufactured in the town. Popular tion (1897), 12,116.~~

~~Berkeley, a city of Alameda county, California, U.S.A., situated in 37° 52′ N. lat., and 122° 16′ W. long., on the east shore of San Francisco Bay, adjoining Oakland on the north and opposite San Francisco. It is traversed by two branches of the Southern Pacific Rail- way. It is the site of the University of California, founded in 1868, one of the largest and most prosperous educational institutions in the state. It is richly endowed, having~~

~~property valued at $8,000,000 and an income exceediilg $500,000. Besides the literary, scientific, and engineering departments, which are at Berkeley, it has law, medical, and other departments in San Francisco, and an astronomical observatory (Lick) on Mount Hamilton near San Jose. Its professors and instructors in all departments in 1900 numbered 483, and its students 3024, about 40 per cent, of whom were women. Population (1890), 5101 ; (1900), 13,214.~~

~~Berkeley Fort. See Nile.~~

~~Berkeley, Miles Joseph (1803-1889), British botanist, was born in 1803 at Biggin, Derbyshire, and educated at Rugby and Christ Church, Oxford. He took holy orders, and was curate at Margate and Market Harborough, afterwards being vicar of Sibbertoft. An English country clergyman of good family, he had acquired so enthusiastic a love of cryptogamic botany in his early years that he soon became well known as the leading British authority on Fungi and plant pathology, a position he maintained till very late in life. Berkeley was especially famous as a systematist in mycology, some 6000 species of Fungi being credited to him, but it would be an error to regard him as merely a specialist in this direction. His Introduction to Cryptogamic Botany, pub- lished in 1857, and his papers on " Vegetable Pathology " in the Gardner's Chronicle in 1854 and onwards, show that he had a very broad grasp of the whole domain of physiology and morphology as understood in those days. Moreover, it should be pointed out that Berkeley com- menced his work as a field naturalist and collector, his earliest objects of study having been the Mollusca and other branches of zoology, as testified by his papers in the Zoological Journal and the Magazine of Natural His- tory, between 1828 and 1836. As a microscopist he was an assiduous and , accurate worker, as is shown by his numerous drawings of the smaller Algae and Fungi, and by the admirable dissections of Mosses and Hepatics~~

~~which he contributed ; his investigations into the potato murrain, caused by Phytophthora infestans, and the grape mildew, to which he gave the name Oidium Tuckeri, and the pathogenic Fungi of wheat rust, hop mildew, and various diseases of cabbage, pears, coffee, onions, tomatoes, &c., were important in results on the life- history of these pests, at a time when very~~

~~little was known of such matters, and must always be considered in any historical account of the remarkable advances in the biology of these organisms which were made between 1850 and 1880; and when it is remembered that this work was done without any of the modern appliances or training of a properly equipped laboratory, the signifi- cance of Berkeley's genius as a pioneer gains consid- erably in importance. It is as the founder of British mycology, however, that Berkeley's name will live in the history of botany, and his most important work is con- tained in the account of native British Fungi in Sir W. Hooker's British Flora (1836), the Introduction to Crypto- gamic Botany (1867), and in his Outlines of British Fun- gology (1860), together with his magnificent herbarium of over 9000 species now at Kew. This collection is enriched by numerous notes and sketches, and forms one of the most important type series in the world. Berkeley's writings abound in evidence of his apprecia- tion of the labours of others, whether as collaborators with himself as a collector, as were Broome in England and Curtis in America, or as workers in foreign countries with whom he had corresponded or whose works he had studied, as in the case of the Tulasnes, de Bary, Prings- heim, Fries, and other Continental workers engaged, like himself, in laying, the foundations of modern cryp- togamic botany. Berkeley died in July 1889. He was a man of refined and courteous bearing, an accomplished classical student, with the simple and modest habits that befit a man of true learning. A list of his publications will be found in the Catalogue of Scientific Papers of the Royal Society, and sketches of ' his life in Proc. B. S. vol. xlvii., 1890, p. 9, by Sir Joseph Hooker, and Annals of Botany, vol. xi., 1897, by Sir W. T. Thiselton-Dyer.~~

~~^ (h. M. w.)~~

~~Berkhampstead, Creat, a market town and railway station, in the Watford parliamentary division of Hertfordshire, England, 26 miles N.W. of London. The grammar school has been extended, and a high school for girls, on the same foundation, established. The sewerage is improved. A large chemical factory has been estab- lished. Area of ancient parish, of which the present parish and urban district is only part (since 1898), 4364 acres ; population (1881), 4485; (1891), 6034; (1901), 6219.~~

~~Berkshire, a south-eastern county of England, bounded N. and N.E. by the Thames, S.E. by Surrey, S. by Hampshire, and W. by Wilts.~~

~~Area and Population. — The area of the ancient county is 462,224 acres, or 722 square miles, with a population in 1881 of 218,363, and in 1891 of 238,709, of whom 117,208 were males and 121,501 females, the number of persons per square mile being 831 and of acres to a person 1-91. In 1901 the preliminary census report gave the population as 254,931. The area of the administrative county, as given in the census returns of 1891, was 461,742 acres, with a population of 236,163 ; in 1901 (including the county borough of Beading), a population of 252,580. But a slight alteration iu the area was made in 1895, by the transference to Berks of the part of the parish of Hungerford in Wilts, and of the parish of Combe in Hampshire, and by the transference to Wilts of part of the parish of Shalboum in Berks. The registration county comprises 574,298 acres, with a population in 1891 of 268,357, of whom 111,543 were urban and 156,814 rural. Within the registration area the increase of population between 1881 and 1891 was 9-60 per cent. The excess of births over deaths between 1881 and 1891 was 34,690, but the-inosease in the resident population was only 20,727. The following table gives the numbers of marriages, births, and deaths, with the number of illegitimate births for 1880, 1890, and 1898 :—~~

~~Tear.~~

~~Marriages.~~

~~Births.~~

~~Deaths.~~

~~Illegitimate Births.~~

~~Males.~~

~~Females.~~

~~1880 1890 1898~~

~~1697 1729 1935~~

~~7771 7174 7031~~

~~4464 4218 4210~~

~~191 180 181~~

~~189 152 170~~

~~The number of marriages in 1899 was 2026, of births 6913, and of deaths 4288.~~

~~The marriage-, birth-, and death-rates were all below the average for England, as is also the percentage of illegitimate births. The following table gives the rates to 1000 persons living for a series of years, with the percentage of illegitimate births : —~~

~~1870-79.~~

~~1880.~~

~~18S0-89.~~

~~1890.~~

~~1883-97.~~

~~1893.~~

~~Marriage-rate~~

~~13-8~~

~~12 ‘9~~

~~12-6~~

~~13 0~~

~~13-2~~

~~13 ‘7~~

~~Birth-rate~~

~~31-9~~

~~31-5~~

~~30-2~~

~~26-9~~

~~26-8~~

~~24-8~~

~~Death-rate .~~

~~18-5~~

~~18-1~~

~~16-4~~

~~15-8~~

~~15-2~~

~~14-9~~

~~Percentage of~~

~~5-2~~

~~4‘8~~

~~4-8~~

~~4-6~~

~~4-6~~

~~5-0~~

~~illegitimacy~~

~~In 1891 there were in the county 1430 natives of Scotland, 1422 natives of Ireland, and 596 foreigners.~~

~~Constitution and Government. — Berks is divided into three parliamentary divisions, and it also contains th^ parliamentary borough of Reading and parts of the boroughs of New Windsor and Oxford. There are seven municipal boroughs, Abingdon (6480), Maidenhead (12,980), Newbury (11,061), New Windsor (13,958), Reading (72,214), Wallingford (2803), and Wokingham (3254). Reading is now a county borough. The only urban district is Wantage (3766). The county is in the Oxford circuit, and assizes are held at Reading. The boroughs of Abingdon, Maiden- head, Newbury, New Windsor, Reading, and Wallingford have separate commissions of the peace, and Abingdon, Newbury, New Windsor, and Reading have, in addition, separate courts of quarter sessions. The ancient county is in the diocese of Oxford, and con- tains 190 ecclesiastical parishes or districts and parts of ten others.~~

~~Education. — The number of elementary schools on 31st August 1899 was 249, of which only 23 were board and 226 were voluntary schools, the latter including 201 Church of England schools, 7 Wesleyans, 4 Roman Catholic, and 14 “British and other.” The average attendance at voluntary schools was 30,740, and at board schools 7969. The total school board receipts for the year ending 29th September 1899 were £47,431. The income under the Agricultural Rates Act was over £286.~~

~~Agriculture. — Much attention is paid to dairy farming, butter and cheese being largely made, and also condensed milk. Sheep are also largely reared, and an excellent breed of pigs is peculiar to the county. About seven-ninths of the total area is under cultivation, and of this about five-ninths is in permanent pasture. Only about 2000 acres are in hill pasture, while over 35,000 acres are under woods, and about 2700 acres under orchards, apples and cherries being largely grown. Although diminishing, the' acreage under wheat still amounts to about two-fifths of that under corn crops, the other principal com crops being oats and barley. Of the green crops turnips occupy much the larger acreage — about one half of the whole, the acreage under potatoes being inconsiderable. The-foUowing table gives the acreages of the larger main divisions of the cultivated area at intervals of five years from 1880 : —~~

~~Tear.~~

~~Total Area under Culti- vation.~~

~~Corn Crops.~~

~~Green Crops.~~

~~Clover.~~

~~Permanent Pasture.~~

~~Fallow.~~

~~1880 1885 1890 1895 1900~~

~~375,890 377,321 376,358 367,983 364,431~~

~~138,462 131,100 123,746 105,101 104,612~~

~~54,910 56,079 49,631 48,865 41,265~~

~~41,993 43,839 42,114 41,837 41,953~~

~~123,918 136,004 151,984 163,520 169,304~~

~~16,591 10,283~~

~~8,681 13,086~~

~~6,981~~

~~The following table gives particulars regarding the principal live stock at the same date : —~~

~~Tear.~~

~~Total Horses.~~

~~Total Cattle.~~

~~Cows or Heifers in MUk or in Calf.~~

~~Sheep.~~

~~Pigs.~~

~~1880 1885 1890 1896 1900~~

~~15,292~~

~~16,055 15,397 15,517 14,717~~

~~35,274 45,713 43,461 39,154 46,161~~

~~16,414 19,971 20,292 19,052 21,348~~

~~259,572 266,546 231,322 184,668 184,797~~

~~28,931 36,489 36,371 33,197 22,130~~

~~Industries and Trade. — According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in non-textile factories and workshops in 1897 was~~

~~16,006, as compared with 14,794 in 1896. There were no textile factories. The number employed in non-textile factories was 12,110, the increase between 1895 and 1896 being 7 -S per cent., while between 1896 and 1897 it was 6-1 per cent. No fewer than 5364 were employed in the food industry, a large number in the biscuit works at Reading. Over 2000 persons are employed in factories and workshops in the manufacture of machines, appliances, &c., chiefly in iron foundries and engineering works. Boat-building also gives employment to a good many persons. The clothing trade has been revived at Abingdon, the total number of persons em- ployed in workshops in this industry being 1735. There are exten- sive seed warehouses at Reading, and the Kennet and Windsor ales retain their repute. Whiting is manufactured from chalk at Kintbury. Of clay 110,953 tons were raised in 1899.~~

~~Authorities. — Chief of the older works is: Elias Abhmole. Antiquities of Berkshire, 3 vols., 1719 ; 2nd ed. London, 1723 ; 3rd ed. Reading, 1736. Other works are : Marshall. Topographical and Statistical Details of the County of Berkshire, London, 1830. — Earl or Carnarvon. Archasology of Berkshire, London, 1859. — Kennedy. Birds of Berkshire arid Buckinghamshire, Eton, 1868. — King. History of Berkshire (popular County History series), London, 1887. — Lowsley. Glossary of BerJcshire Words, London, 1888, and Index to Wills in the Court of the Archdeacon of Berk- shire, 1508-1652, Oxford, 1893. See also The Berks Archceological Society'' s Quarterly Journal, and Berkshire Notes and Queries.~~

~~Berlad, a town in Eumania, chief town of the dis- trict of Tutova. There is a fine hospital under the ad- ministration of the St Spiridion hospital of Jassy. Bgrlad possesses several soap factories, and its horse fairs are well known throughout Eumania. In the vicinity are some traces of a Roman encampment. Population (1895), 23,000; (1900), 24,484— about one-fourth Jews.~~

~~Berlin, the capital of Prussia, and since 1871 the metropolis of the Germ'an empire, is situated on the river Spree in 52° 30′ 17″ N. lat. and 13° 23′ 17″ E. long., at a height of about 100 feet above the level of the Baltic. The mean temperature for the ten years 1889-98 was 48-2° Fahj., and the rainfall 22-4 inches. In a general way it may be said that the climate is~~

~~exhilarating and healthful. The boundaries of the city have not been extended since 1861, and though large and important suburbs have crept up and have practically coalesced with it, the administrative area remains unchanged. It occupies 28 English square miles, with a length from E. to W. of 6, and a breadth from N. to S. of 5\ English miles, contains about 940 streets, 90 open places, and 90 bridges, and has a population (1900) of 1,857,000 inhabitants. If the immediate suburbs be reckoned. Greater Berlin has a" population of no less than 2,430,000. Politically, the city is divided into six Reichstag and four Landtag parliar mentary constituencies, returning six and nine members re- spectively, and it must be noted that, despite the enormous increase in population, there has not been in Prussia, in the case of the Landtag, any redistribution of seats since 1860, so that the city is, in proportion to its population, much under-represented. It should have twenty-three members instead of nine.~~

~~The oldest part of Berlin, the city and AltkoUn, built along the different arms of the Spree, still remains the centre of business activity. The social and ofl&cial life of the capital centres round Unter den Linden, which runs from the royal palace to the Brandenburger Thor. This street, nearly one English mile in length, and forming a double avenue, is the favourite promenade, and presents Berlin life in all its varying aspects. Many historical scenes have taken place in this famous boulevard, such as the entry of the troops in 1871, and the funeral pageant of the Emperor William I., and no other city in Euro.pe possesses so stately a thoroughfare. Although it has been embellished by the addition of new buildings, not- ably hotels, restaurants, and caf^s, its appearance has undergone no important change. South of Unter den Linden lies the Friedrichstadt, with its parallel lines of straight streets, comprising the Behrenstrasse, the seat of the haute-finance, the Wilhelmstrasse (with the palace of~~

~~the Eeichskanzler) the " official " quarter of the capital, and the long Friedrich and Leipziger Strassen, both of which are flanked by handsome and attractive shops and restaurants, among the latter being the " bier palaces " of the great breweries. It is beyond this quarter that great additions have been made. In 1870 Berlin was practi- cally bounded on the south by the Landwehr canal, but it has since extended far beyond, and on this side is now only limited by the Tempelhofer Feld, the "champ de Mars " of the capital, where the famous military reviews are held. The Landwehr canal, leaving the Spree at the Schlesisches Thor and rejoining it at Charlottenburg, after a course of six miles, adds no little to the charm of the southern and western districts (the residential quarter of the city), being flanked by fijie boulevards and crossed by many handsome bridges, notably the Potsdamer and Victoria Briicke, which carries the traffic from two con- verging streets into the outer Potsdamer Strasse and the Hercules Briicke, connecting the spacious Liitzow Platz with the Thiergarten. To the north of the Unter den Linden lies the university quarter, with numerous hos- pitals and scientific institutions, which, interspersed with barracks and other military buildings, practically occupies the whole district lying between the Spree and the Oranien and Karl Strassen, the so-called Luisenstadt.~~

~~Berlin is the principal residence of the emperor, the seat of the Eeichstag and the Prussian diets, and of the various State offices of the empire, the sole exception being the Supreme Court of Justice (Beichsgericht) which, despite the exertions of Prussia, remains fixed at Leipzig. Since 1871 the growth of the city and its economic pro- gress have been phenomenal; indeed, it is only in Budar pest that any parallel can be found among cities of the eastern hemisphere for such rapid expansion and develop- ment. Its population has more than doubled in the last three decades. While in 1871 it amounted to 826,341, in 1890 to 1,578,794, it had in 1900 reached a total (in- cluding a garrison of some 20,000 strong) of 1,857,000.~~

~~The marriage-rate (1898) was 22'09 per thousand, as against 21-92 for the preceding ten years; the birth-rate, for the same year, 28-93 per thousand, of which 4-58 were illegitimate, as against an average of 31-20 for the 10 years ; the death-rate 18-25, a rate which has rapidly diminished, the~~

~~average for the ten years ending 1898 being 21-00, the average for the whole century from 1798 being no less than 30 per thousand.~~

~~The situation of Berlin, so far from being prejudicial to its growth and prosperity, has been the greatest deter- mining factor in its rapid rise to the position of the greatest industrial and commercial city on the Continent. The Spree with its deep-water channel, and rarely frost- bound, connects it on the east through canals with the Oder, and thus with Stettin and other Baltic ports, and with river navigation in upper Silesia, Poland, and upper Austria, while linking it on the west through the Havel lakes with Hamburg, and with the cities of the upper Elbe. In addition to its waterways, it is also the centre of an extensive railway system bringing it into close con- nexion with all the leading cities of the Continent.~~

~~For administrative purposes the city is divided into 48 wards, with 369 municipal and 102 police districts. After 1870 doubts were often expressed whether the capital would be able to bear the burden of empire, so enormous was the influx of citizens. It is due to the magnificent services of the municipal council that the city was enabled to assimilate the hosts of newcomers, and it is to its indefatigable exertions that Berlin has in point of organization become the model city of Europe. In none other has public money been expended with such enlightened discretion, and in none other has the munici- pal system kept pace with such rapid growth and dis-~~

~~played greater resource in emergencies. In 1870 the sanitary conditions of Berlin were the worst of any city in Europe. It needed a Virchow to open the eyes of the municipality to the terrible waste of life such a state of things entailed. But open sewers, public pumps, cobble- paved roads, open market-places, and overcrowded sub- terranean dwellings are now things of the past. The city is excellently drained, well paved, well lighted, and fur- nished with an abundant supply of carefully filtered water) whilst the cellar dwellings have given place to light and airy tenements, and it justly claims to rank with the cleanest and healthiest capitals in Europe.~~

~~The immediate effect upon Berlin of the successful issue of the war of 1870 was electrical. The old Prussian capital girded itself at once to fulfil its new rdle. The concentration upon the city of a large garrison flushed with victory, and eager to emulate the vanquished foe in works of peace, and vie~~

~~with them in luxury, was an incen- tive to Berliners to put f^th all their energy. Besides the military, an enormous immigration of civilian officials took place as the result of the new conditions, and as accom- modation was not readily available rents rose to an enor- mous figure. Building proceeded in hot haste, and in the years immediately following the war whole streets of tenement houses, for the most part badly arranged, ill built, and of no architectural pretensions, were hurriedly erected. The year 1878 marks a fresh starting-point in the develop- ment of the city. In that year Berlin was the meeting- place of the famous congress which bears its name. The recognition of Germany as a leading factor in the world's councils had been given, and the people of Berlin could indulge in the task of embellishing the capital city of the empire in a manner befitting its position. From this time forward, State, municipal, and private enterprise have worked hand in hand to make the capital cosmo- politan. Since the last edition of this work was published Berlin has been enriched by many public buildings, and is able in this respect to vie in magnificence with any other capital in the world. Especially in the matter of churches a striking increase is noticeable. The city now contains 115 Christian places of worship : viz., 99 Evan- gelical, 15 Eoman Catholic, and 1 Greek ; and 9 Jewish synagogues, and of these no fewer than 30 have been dedi- cated during the reign of the Emperor William II. First g^nd foremost among them is the new cathedral (Dom) which replaces the old building pulled down in 1893. It- is an imposing edifice of sandstone in the style of the Italian Eenaissance, and has a dome rising with the lan- tern to a height of 380 feet (see article Aechitbcturb). The Kaiser Wilhelm Gedachtniss Kirche (in the suburb- Charlottenburg) with a lofty spire, the Dankes Kirche (in commemoration of the Emperor William I.'s escape- from the hand of the assassin Nobiling in 1878) in Wedding, and the Kaiser Friedrich Gedachtniss Kirche- on a grassy knoll in the north of the Thiergarten, are- worthy of especial notice. In the Montbijou Park, on the north bank of the Spree, and just behind the Eoyal Museum, has been built the very pretty little English church of St George. The establishment of the imperial Government in Berlin naturally brought with it the- erection of a large number of public buildings, and the great prosperity of the country, as well as the enhanced- national feeling, has enabled them to be built on a scale of splendour befitting the capital of an empire. First- in importance is the Eeichstagsgebaude, in which tha- Eeichsrath (imperial council) and the Eeichstag (imperial diet) hold their~~

~~sittings. The building is described in the article on Aechitectuee ; a special feature is the library, which is exceedingly rich in works on constitu- tional law. A new house has also been built for the Prussian parliament (Landtag) and the Prussian House~~

~~of Lo^s (Hermhaus) in the Albrecht Strasse. Other new official buildings are the Patent Office on the site of the old Ministry of the Interior ; the new Ministry of Posts (with Post Museum) at the corner of the Mauer and Leipziger Strassen ; the Central Criminal Court in Moabit; the courts of first instance on the Alexander Platz ; the Ministry of Police, and the Reichsversiche- rungs-amt, which is the centre for the great system of old-age pensions. In addition to these, many buildings have been restored and enlarged, 6hiei among them being the Zeughaus (Armoury), the War Office, and the ministry of public works, while ‘ the Marstall (Royal Mews) has been entirely rebuilt and boasts an imposing facade.~~

~~Among the public monuments comes first and foremost~~

~~the bronze equestrian statue of the Emperor William I. (by R. Begas), erected opposite the west portal of the Schloss. The space for the site was gained by pulling down the old houses composing the so-called Schloss-freiheit and damming back the Spree. The monument, which cost £200,000, represents the emperor in a martial cloak, his right hand resting on a field-marshal’s baton, reining in his charger, which is led by a female genius of peace. The work is mounted on a high pedestal and is surrounded by a colonnade of Ionic columns. On the square on the south side of the castle is a bronze foun- tain (also by R. Begas) representing ” Neptune on rocks,” the gift of the city to the Emperor William II. On the Konigsplatz, in the north-east corner of the Thier- garten, between the column of Victory and the Reich-~~

~~Bbklin (^Environs).~~

~~stagsgebaude, and immediately facing the western f aqade of the latter, is the bronze statue of Prince Bismarck, unveiled in April 1901, a figure 20 feet in height standing on a granite socket. From the south side of the Konigs- platz runs the broad Sieges Alice, lately adorned by thirty-two groups of marble statuary representing famous rulers of the house of HohenzoUern, the gift of the Umperor William II. to the city. The Thiergarten itself, the beautiful park with its thickets of dense undergrowth and winding lanes and lakes, has lost somewhat of its sylvan character owing to building encroachments on the north side and the laying out of new rides and drives. It has in addition to those above enumerated been en-riched by statues of Queen Louisa, of Goethe, and Lessing. The smaller parks around the city, as , the Friedrichshain, Humboldtshain, and the Victoria park on the Kreuzberg, have not, except in the case of the last, which has received a waterfall, been materially altered.~~

~~Berlin is the centre of the North German network of railways. No fewer than twelve main lines concentrate upon it. Internal communication is provided for by~~

~~the Ringbahn, or outer circle, which was opened in 1871, and by a well-devised system connects the termini of the various main lines. The through traffic coming from east and west is carried by the so-called Stadtbahn, or city railway, which also connects with and forms an integral part of the outer circle. This line runs through the heart of the city, and was originally a private enterprise. Owing, however, to the failure of the company, the great work was taken in hand by the State, and the line opened in 1878. It has four tracks — two for the main-line through traffic, and two for local and suburban service, and is carried at a height of about 20 feet above the streets. Its length is twelve miles, the total cost 3f millions sterling. The chief stations are Zoologischer Gar- ten, Friedrich Strasse, Alexander Platz, and Schlesischer Bahnhof. Lying apart from the system are the Lehr- ter Bahnhof for Hamburg and Bremen, the Stettiner for Baltic ports, and the Gorlitzer, Anhalter, and Potsdamer termini for traffic to the south, of which the last two are fine specimens of railway architecture. Internal com-munication is also provided for by an excellent system of tramlines worked both by horses and by electricity, while~~

an overhead electric railway runs from the Zoologischer Garten to the Schlesisches Thor, with a branch from the Potsdamer Bahnhof terminating near the Friedrichstrasse Bahnhof.

Industry, Trade, and Commerce. — It is in respect of its manufacture and trade that Berlin has attained its pre- sent high pitch of economic prosperity. More than 50 per cent, of its working population are engaged in in- dustry, which embraces almost all branches, of which new ones have lately sprung into existence, whilst most of the older ones have taken a new lease of life. The old wool industry, for example, has become much ex- tended, and now embraces products such as shawls, car- pets, hosiery, &c. Its silk manufactures, formerly so important, have, however, gradually gone back. It is particularly in the working of iron, steel, and cloth, and in the by-products of these, that Berlin excels. The manufacture of machinery and steam-engines shows an enormous development. No fewer than 100 large firms, many of them of world-wide reputation, are engaged in this branch alone. Among the chief articles of manu- facture and production are railway plant, sewing machines, bicycles, steel pens, chronometers, electric and electric- telegraph plant, bronze, chemicals, soap, lamps, linoleum, china, pianofortes, furniture, gloves, battens, artificial flowers, and ladies' mantles, the last of an annual value exceeding £5,000,000. The output of its 100 breweries, including those in the suburbs, reached in the year 1898-1899 the enormous total of about 80,000,000 gallons. Berlin is also the great centre and the chief market for speculation in corn and other cereals which reach it by water from Poland, Austria, and South Eussia, while in commerce in spirits it rivals Hamburg.

The Borse, where 4000 persons daily do business, is the chief market in Germany for stocks and shares, and its dealings are of great influence upon the gold market of the world. Numerous banks of world-wide reputation, doing an extensive international business, have their seats in Berlin, chief among them, in addition to the Keichs- bank, being the Berliner Kassen Verein, the Disconto Comihandit, the Deutsche Bank, and the Boden-Credit Bank.

~~Learning and Art. — Berlin is rapidly becoming not only the centre of the imperial Government, but also of the intellectual life of the nation. The famous Friedrich Wilhelm University, although young in point of foundar tion (a.d. 1810), has long since outstripped its great rival Leipzig in point of numbers, and can point with pride to the fact that its teaching staff has yielded to none in the number of illustrious names. To its roll must now be added those of Helmholtz, van't Hoff, Koch, E. Fischer, Waldeyer, and von Bergmann among scientists and surgeons ; Mommsen, Treitschke, and Sybel among historians, Hamack among theologians, Brunner among jurists. Taking ordinary, honorary, extraordinary professors, and licensed lecturers (privat- docenten) together, its professorial strength consists of 21 teachers in the faculty of theology, 29 in that of law, 134 in that of medicine, and 207 in that of philosophy, altogether 391. The number of matriculated students in the winter term 1898-99 was 5873, as against 4648 in the preceding summer term ; the reason of the disproportion being that in the summer term university towns having pleasant surroundings, such as Bonn, Heidelberg, Kiel, and Jena are more largely frequented, the larger towns showing an increased strength in the winter. Berlin is essentially a Prussian university, 4319 of the number above given hailing from the kingdom. Of .students from non-German states, the United States of America, with 108 students, come next after Eussia, while Great Britain is credited with but 21. It is, however, in the**

ugly palace of Prince Henry of Prussia, which was given for the purpose in the days of Prussian poverty and dis- tress, that the university is stUl housed, and although some internal rearrangement has been effected, no sub- stantial alterations have been made to meet the ever-in- creasing demand for lecture-room accommodation. The garden towards Unter den Linden has been adorned by a bronze statue of Helmholtz, and by marble statues in sit- ting posture of Wilhelm and Alexander von Humboldt, the last a masterpiece by E. Begas, Technical education is provided in the magnificent buildings erected at a cost of £100,000 in Charlottenburg, which are equipped with all the apparatus for the teaching of science. This college was attended in the winter term 1898-99 by 2425 students. In view of the fact that Charlottenburg is rapidly re- placing the Luisenstadt as a students' quarter, the pro- ject has been seriously entertained of removing thither the Eoyal Library, which is in intimate touch with the university and

~~largely used by students. Among other institutions of university rank and affiliated to it are the School of Mines, the Agricultural College, the Veterinary College, the new Seminary for Oriental Languages, and the High School for Music. The Geodetic Institute has been removed to Potsdam. The university is, moreover, rich in institutions for the promotion of medical and chemical science, for the most part housed in buildings belonging to the governing body.~~

~~Schools. — Berlin possesses 19 " gymnasia " (schools for the highest branches of a learned profession), of which 6 are under the direct supervision of the provincial authorities and have the prefix Koniglich (royal), while 11 are municipal and under the control of the civic authorities. These schools were attended in the winter term 1898-99 by 8387 scholars, of whom no less than 1989 were of the Jewish persuasion. There are also numerous Eealschulen (schools in which special attention is given to instruction for the higher branches of com- mercial life), and these were attended by 5138 scholars. The 8 public high schools for girls showed for the same period an attendance of 5320, while the elementary parochial schools show 105,709 boys and 101,642" girls.~~

~~Museums. — Many new ipuseums have been erected. The National Gallery, a fine building surrounded by a Corinthian colonnade, and lying between the Eoyal Museum and the Spree, contains many inl cresting modern German paintings. The Kunstgewerbe Museum, at the corner of the Koniggratzer and Albrecht Strassen, con- tains valuable specimens of applied art and the famous Schliemann treasures. The Eoyal Museum's picture gallery has become, if not one of the largest, at least one of the best collections of pictures in existence, and there are few great painters of whom it does not contain one or two masterpieces, while the sculpture gallery has been enriched by an unique collection, the result of the ex- cavations at Pergamon.~~

~~Theatres. — In nothing has the importance of Berlin become more conspicuous than in theatrical affairs. In addition to the old-established Opernhaus and Schauspiel- haus, which are supported by the State, numerous pri- vate playhouses have been erected, notably the " Lessing " theatre and the " Deutsches Theater," and it is in these that the modern~~

~~works by Wildenbruch, Sudermann, and Hauptmann have been produced, and it may be said that it is in Berlin that the modern school of German drama has its home. In art Mimich still holds the first place, and though in music Berlin is not able to cope with Leipzig, Dresden, or Munich, yet it is well represented by the Consefvatorium, with which the name of Joachim is connected, whilst the more modern school is repre- sented by Xaver Scharwenka.~~

~~Politics. — Ever since the revolution of 1848 and the~~

~~beginning of parliamentary life in Prussia, Berlin has been the chief support of the Radical party. In the old days of the conflict between Bismarck and the parliament Berlin always supported the opposition, and it continued to do so even after it had become the capital of the empire. It has been represented by men such as Virchow, Lasker, and Richter; and the Radicals, who have lost their influence in other parts of the country, still held in 1901 all the seats in Berlin for the Prussian Landtag. In the town council of Berlin no Conservative is able to find a seat, and they have always elected as chief burgomaster a man of strong Radical sympathies. Hence it has come about that there have been serious collision^ between the town council and the court (William II. and the empress having frequently expressed their dissatisfaction with the attitude of the city of Berlin in political and religious matters), which have been intensified on more than one occasion by the fact that the emperor has refused to ratify the appointment of a Radical burgomaster. During recent years the forces of Social Democracy have succeeded in winning most of the seats from the Radicals in the elections to the Reichstag. In 1873 Berlin returned five Social Democrats and one Radical. In 1898 the proportion was four to two. In the town council also the Jews have won a large number of seats, and, of course, support the Liberal majority in the general opposition to the Government, which by such measures as the law controlling the Exchange, increased duties on food, and the support given to the more orthodox parties, has offended both the busi- ness interests and the intellectual prejudices of the city. Environs. — Marvellous as has been the~~

~~transformation in the city itself, no less surprising results have been effected since 1875 in the surroundings of Berlin. On the east, north, and west the city is surrounded at a distance of some 5 miles from its centre by a thick belt of pine woods, the Jungfernheide, the Spandauer Forst, and the Grunewald, the last named stretching away in a south- westerly direction as far as Potsdam, and fringing the beautiful chain of Havel lakes. These forests enjoyed until quite recent times an unenviable notoriety as the camping-ground and lurking-place of footpads and other disorderly characters. After the opening of the circular railway (Ringbahn) in 1871, private enterprise set to work to develop these districts, and a " villa colony " was built at the edge of the Grunewald between the station West End and the Spandauer Bock. Erom these begin- nings, owing mainly to the expansion of the important suburb of Charlottenburg, has resulted a complete trans- formation of the eastern part of the Grunewald into a picturesque and delightful villa suburb, which is con- nected by railway, steam-tramway, and a magnificent new boulevard — the Kurfuerstendamm — with the city. Nowadays the little fishing villages on the shores of the lakes, notably the Wannsee, cater for the recreation of the Berliners, while palatial summer residences of wealthy merchants occupy the most prominent sites. Suburban Berlin may be said now to extend practically to Potsdam.~~

~~Government and Administration. — ^The government is partly semi-military (police) and partly municipal. The police ministry (a branch of the home office) consists of six departments: (1) general; (2) trade; (.3) building; (4) criminal; (5) passport; (6) market. It. controls the &e brigade and has the general inspection over all strangers, and is responsible for public order. The magistracy (the civil authority) consists (1) of a chief mayor (oberbtirgermeister) and (2) of a mayor, both of whom are elected by the council (Stadtverordnete) of 144 members, of whom three are elected for each ward by manhood suffrage. Ratification by the Crown is necessary in the case of the two mayors, and no reason need be given for the withholding of such sanction. (3) Of a council (Stadtrathe) of 30 members, of whom 14 are jurists and paid, and who devote themselves exclusively to the service of~~

~~the city, whilst the services of the remaining 16 are given gratuitously and their office honorary. For general work both magistrates and Stadtverordnete coalesce, and committees are ap- pointed from their body for various purposes, which, however, are usually presided over by magistrates. Their jurisdiction extends to water-supply, the drainage, lighting and cleaning of the streets, the care of the poor, hospitals, and schools. The combined rate for all purposes amounted in 1901 to about 2s. Id. in the £ of rental assessment.~~

~~Public Conveyances. — At the end of 1898 there were in Berlin, according to police returns, 6097 first-class cabs (victorias and broughams), mostly with fare indicators, 1842 second-class (closed cabs), 157 luggage cabs, 551 omnibuses, and 1842 tramcars. In 1898 the omnibus companies carried 53,817,422 passengers, the tramways (now mainly worked by electricity) 212,940,112, and the various local railways 362,594,886, as against 184,935,602 carried in 1888. In the summer of the same year the steamboats plying above and below the city conveyed 765,000 passengers.~~

~~Streets. — The public streets have a total length of about 290 English miles. The staff employed in maintaining and cleaning the public roads consists of 36 superior officials, inspectors, and overseers, and 1036 scavengers. The force is well controlled, and the work of cleaning and removing snow after a heavy fall is thoroughly and efficiently carried out. The less important thoroughfares are mostly paved with the so-called Vienna paving, granite bricks of medium size, while the principal streets, and especially those upon which the traffic is heavy, have either asphalt or wood paving.~~

~~Water-Supply and Drainage. — The water-supply is mainly derived from works on the Miiggel and Tegeler lakes, the river water being carefully filtered through sand. The drainage system is elaborate, and has stood the test of time. The city is divided into twelve radial systems, each with a pumping station, and the drainage is forced through five mains to eighteen sewage farms, each of which is under careful sanitary supervision, in respect both of the persons employed thereon, and the products, mainly milk, passing thence to the city for human consumption. Only in a few isolated cases has any contamination been traced to fever or other zymotic germs. In this connexion it is worth noting that the infectious diseases~~

~~hospital has a separate system of drainage which is carefully disinfected, and not allowed to be employed for the purposes of manure.~~

~~Hospitals. — In no other city of the world is the hospital organiza- tion so well appointed as in Berlin, or are the sick poor tended with greater soflcitude. State, municipal, and private charity here again join hands in the prompt relief of sickness and cases of urgency. The municipal hospitals are 5 in number, the largest of which is that of Friedrichshain, which is built on the pavilion system, while the State controls 6, of which the world-renowned Charit^ in the Luisenstrasse is the principal. The hospitals of the nursing sisters (Diaconissen Anstalten) number 8, while there are no less than 51 registered private hospitals under the superintend- ence of responsible doctors and under the inspection of Govern- ment. In all there are 70 hospital establishments with a grand total (1898) of 7677 beds.~~

~~Charities. — ^Berlin js also very richly endowed with charitable institutions for the relief of pauperism and distress. In addition to the municipal support of the poor-houses there are large funds derived from bequests for the relief of the necessitous and deserv- ing poor ; while night shelters and people's kitchens have been organized on an extensive scale for the temporary relief of the indigent unemployed. For the former several of the arches of the city railway have been utilized, and correspond in internal arrangement to the like shelters instituted by the Salvation Army in London and various other cities.~~

~~Markets. — Open market-places in Berlin are things of the past, and their place has been taken by airy and commodious market halls. Of these, 15 in number, the central market, close to the Alexander Platz station of the city railway with which it is con- nected by an admirable service of lifts for the rapid unloading of goods, is the finest. It has a ground area of about 17,000 square yards, and is fitted with more than 2000 stalls. The other markets are conveniently situated at various accessible places within the city, and the careful police supervision to which they are subjected, both in the matter of general cleanliness, and in the careful examination of all articles of food exposed for sale, has tended to the general health and comfort of the population.~~

Mattoir. — The central cattle market and slaughter-houses for the inspection and supply of the fresh meat consumed in the metropolis occupies an extensive area in the north-east of the city on the Kingbahn, upon which a station has been erected for the accommodation of meat trains and passengers attending the market. It is under the superintendence of 72 inspeotors-in-chief, and employs altogether 3317 persons. In 1898-99 there were slaughtered 153,675 cattle, 150,202 calves, 409,302 sheep, and 659,553 pigs, altogether 1,372,732 animals. The inspection is

rigorously carried out, and only carcases which have been stamped as having been certified good are permitted to be taken avfay for human consumption.

li^nance. — For the year 1898-99 the receipts into the municipal exchequer amounted to 130-8 millions of marks and the expenditure to 123 millions, showing a surplus of 7-8 millions of marks. The chief items of the receipts were : taxes, 59,864,508; capital and debt administration, 12,791,719; municipal works, 7,006,660; build- ing, 5,927,260 ; education, 2,868,482 ; sanitary department, 2,034,895 ; and poor, 1,190,849 marks. The chief items of expen- diture were as follows : building, 26,261,735 ; education, 20,457,479 ; capital and debt administration, 16,467,028 ; poor, 11,810,676 ; administration, 10,418,715; police, 5,988,267; lighting and street cleaning, 3,698,464 marks.

Authorities. — Streokfuss. 1000 Jahre Berliner Geschichte. — Statistisches Jahrbuch der Stadt Berlin, 1899. — Brockhaus. Conversations Lexikon, 1895, and Supplement, 1897. — Meyer. Konversations Lexikon, Supplement, 1899-1900. — Baedeker's Fuhrer durch Berlin, 1901. — Pollakd. A Study in Municipal Government. Edinburgh, 1893. (p. a. A.)

Berlin, a town and port of entry, Ontario, Canada, and capital of Waterloo county, 58 miles W. of Toronto, on the Grand river and the Grand Trunk railway. It is a flourishing manufacturing town, and contains leather, furniture, shirt and collar, felt, glove, button, and rubber factories. The

~~exports for 1898-99 were $695,773, and imports, $876,784. Population (1881), 4054 ; (1899), 9359.~~

~~Berlin, a city of Coos county, New Hampshire, U.S.A., on the Androscoggin river in the White Moun- tains, in the northern part of the state, on the Grand Trunk and the Boston and Maine railways. It is in a heavily forested region, and contains lumber camps, saw- mills, and pulp-mills. The development of these indus- tries has caused a large influx of population, which increased from 3729 in 1890 to 8886 in 1900'.~~

~~Bermudas, a group of about 360 coralline islets in the North Atlantic, 580 miles E. of North Carolina, and 677 from New York, 64° 50′ W., and 31° 65′ to 32° 20′ N., this latitude marking the extreme northern range of the coral-buildtng polyps. The total area is 20 square miles, and the population in 1898 was 16,300 (6000 whites, and over 10,000 blacks and coloured), chiefly centred in the horseshoe-shaped St George, which is much the largest of the 18 or 20 inhabited islands, the next in size being St David, Bermuda, Gates, Cooper, Somerset, Bird, and Ireland. The group became an important naval and coaling station in 1869, when a large iron dry dock was towed across the Atlantic and placed in a secure position in St George. The islands are encircled, especially on the north and west, by fringing reefs which are still growing, but leave a few deep passages wide enough to admit the largest vessels. They are now con- nected by submarine cables with Nova Scotia, Turks Islands, and . Jamaica, and, owing to their important strategic position in mid-Atlantic, the British Govern- ment maintains a strong garrison of over 3000 men. The imports rose from £286,000 in 1894 to £361,000 in 1898, and the exports from £98,000 to £113,000 in the same period ; revenue (1898), £39,000 ; expenditure, £39,100 ; debt, £45,600. Most of the food supplies come from the United States and Canada, which countries take in exchange nearly all the exported farm produce, such as onions, potatoes, and lily bulbs. The Bermudas are a British crown colony, with a governor resident at the capital, Hamilton, on Bermuda or Main Island, who is assisted by an executive council of six members appointed by the Crown, a legislative council of nine similarly appointed, and a representative assembly of thirty-six members returned by about 112 voters. (a. h. k.)~~

~~Bermudez, a former state of Venezuela, now di- vided into the states of Barcelona and Sucre, was formed by the districts of Barcelona, Cumana, and Maturin. It is bounded on the N. by the Caribbean Sea, on the S. by~~

~~the state of Bolivar ; on the E. by the Gulf of Paria and the delta of the Orinoco, and on the W. by the former state of Miranda. Its area is over 31,000 square miles, and its population exceeds 300,000. The state is divided into 22 districts. The capital of the state of Barcelona is the town of the same name (population, 9000) ; that of Sucre is Cumana.~~

~~Bern, one of the Swiss cantons. Politically it comes after Ziirich, even though Bern is the Federal capital. Its total area is 2657 square miles. Of this 2172 square miles are classed as " productive," 686 square miles being covered by forests, and 2^ square mUes by vineyards. Of the 485 " unproductive " square miles, 111 -3 square miles are covered by glaciers, while a large space is occupied by different lakes. Population. — (1880) 530,411, (1900) 687,983. In 1900 there were 221 inhabitants to each square mile. Religions. — Protestants, (1880) 463,163, (1900) 506,837; Romanists, (1880) 65,828, (1900) 81,162; Jews, (1880) 1316, (1900) 1572. Language.— German-speaking, (1880) 462,039, (1900) 484,544; French-speaking, (1880) 78,640, (1900) 98,132; Italian- speaking, (1900) 4374.~~

~~The capital is Bern. The cantonal constitution dates from 1893. The legislature is elected by popular vote in the proportion of one member per 2500 (or fraction over 1250) inhabitants, and is renewed every four years. It elects the nine members of the executive who also hold office for four years. The " obligatory referendum " obtains in the case of all laws, while 12,000 citizens have the right of "initiative "'in the case of legislative projects, and 15,000 may demand the revision of the cantonal con- stitution. In 1897 the state revenue was 27,715,498 frcs. (a rise of 34J per cent, since 1885), and the state expen- diture 27,712,526 frcs. (also a rise of 34^ per cent, since 1886), but in 1898 there was a deficit of 71,640 frcs., while in 1900 there was one of 1,118,685 frcs. In 1897 the public debt was 98,697,000 frcs. There are now many railways in the canton, particularly mountain rail- ways, e.g., to Grindelwald, Lauterbrunuen, Miirren, over the Wengern Alp (or Little Scheidegg), to the Schynige Platten, up the Gurten, &c. ; there is even a railway up the Jungfrau in course of construction.~~

~~The canton (admitted in 1353) grew out of the conquests and acquisitions of the town of Bern (founded in 1191). The dates of some of these are as follows : — Muri, 1295 ; Hasli, 1334 ; Burgdorf and Thun, 1384 ; Frutigen, 1400 ; Upper Simmenthal and Unter- seen, 1386 ; Emmenthal, 1420 ; Lower Simmenthal, 1448-49 ; Grindelwald and Lauterbrunnen, 1528 ; and part of the Gruytoe, 1555. At the time of the French Revolution (1798), Bern lost many of its former subject lands, e.g., Aargau (1415), Aigle and Grandson (1475), and Vaud (1536). But in 1815 the Congress of Vienna gave the Canton (besides the town of Biel) what is now called the "Bernese Jura," formerly belonging to the prince-bishop of Basel. This last acquisition, being Romanist and French-speak- ing, has been a great source of trouble to the canton, as it intro- duced two discordant elements.~~

~~Bern, the capital of the canton of that name, and since 1848 the political capital of the Swiss confederation, Ziirich being the seat of the federal Polytechnic School, and Museum, and Lausanne the home of the federal tribunal. The Aar is crossed by five lofty bridges, the most recent of which (Kirchfeld and Kornhaus) have done much to create new quarters on the north and south of the old town respectively. The most considerable building in the town is the double Bundesrathhaus, the new portion of which was completed in 1901. Bern never was the see of a bishop, so that it is wrong to give the name of cathedral to the collegiate church or Mtinster, built in the 16th century, and recently restored. The university (founded in 1834) was attended during the summer of 1901 by 1055 matriculated students (besides 111 " hearers "), the faculty of philosophy being~~

~~the most numerous. The town library contains about 85,000 volumes, but the historical relics have now been transferred to the new historical museum on the Kirch- feld, which also houses archaeological and ethnological collections. On the Kirchfeld the federal library is now being built. The strict aristocratic government of the town dates from 1295 and lasted till 1798. Population, 63,994. Literature.— ^rcAit) d. hist. Vereins d. Kant. Bern, from 'ii.i?,.— Festschrift zur Iten Sdcularfeier d. Grundung Berns, 1191. Bern, 1891.— Pontes Berum Bernensium (to 1353), 8 vols. Bern,~~

1883-93.— Geisek. 6-escMehte d. Bernischen Verfassung, 1191-1491. Bern, 1888. —Von Mulinen. Bern's Geschichte, 1191-1891. Bern, 1891.— Von RoDT. Bernische Stadtgeschichte. Bern, 1888.— Von Wattenwyl. Gesohichted. Stadtu.LandschaftBern (to 1400), 2 vols. Schaffliausen and Bern, 1867-72. (-w. a. b. 0.)

Bernard, Claude (1813-1878), French physiologist, was born oil 12th July 1813, in the village of Saint- Julien, near Villefranche. He received his early educa- tion in the Jesuit school of that town, and then proceeded to the college at Lyons, which, however, he soon left to become assistant in a druggist's shop. His leisure hours were devoted to the- composition of a vaudeville comedy, La Rose du Bhdne, and the success it achieved moved him to attempt a prose drama in five acts, Arthur de Bretagne. At the age of twenty-one he went to Paris, armed with this play and an introduction to Saint-Marc Girardin, but the critic dissuaded him from adopting literature as a profession, and urged him rather to take up the study of medicine. This advice he followed, and in due course became "interne" at the H5tel Dieu. In this way he was brought into contact with the great physiologist Magendie, who was physician to the hos- pital, and whose of&cial " pr^parateur " at the College de France he became in 1841. Six years afterwards he was appointed his deputy-professor at the College, and in 1855 he succeeded him as full professor. Some time pre- viously he had been chosen the first occupant of the newly- instituted chair of physiology at the Sorbonne. There no laboratory was provided for his use, but Louis Napoleon, after an interview with him in 1864, supplied the defi- ciency, at the same time building a laboratory at the Natural History Museum in the Jardin des Plantes, and establishing a professorship, which Bernard left the Sor- bonne to accept in 1868 — the year in which he was ad- mitted a member of the Institute. He died in Paris on 10th February 1878, and was accorded a public funeral — an honour which had never before been bestowed by France on a man of science.

Claude Bernard's first important work was on the functions of the pancreas gland, the juice of which he proved to be of great significance in the process of diges- tion; this achievement won him the prize for experi- mental physiology from the Academy of Sciences. A second investigation — perhaps his most famous — was on the glycogenic function of the liver ; in

~~the course of this he was led to the conclusion, which throws light on the causation of diabetes, that the liver, in addition to secreting bile, is the seat of an " internal secretion," by which it prepares sugar at the expense of the elements of the blood passing through it. A third research resulted in the discovery of the vaso-motor system. "While en- gaged, about 1851, in examining the effects produced in the temperature! of various parts of the body by section of the nerve or nerves belonging to them, he noticed that division of the cervical sympathetic gave rise to more active circulation and more forcible pulsation of the ar- teries in certain parts of the head, and a few months af- terwards he observed that electrical excitation of the upper portion of the divided nerve had the contrary effect. In this way he established the existence of vaso- motor nerves — both vaso-dilatator and vaso-constrictor. The study of the physiological action of poisons was also~~

~~a favourite one with him, his attention being devoted in particular to curare and carbon monoxide gas. The earli- est announcements of his results, the most striking of which were obtained in the ten years from about 1850 to 1860, were generally made in the recognized scientific publications; but the full exposition of his views, and even the statement of some of the original facts, can only be found in his published lectures. The various series of these Legons fill seventeen octavo volumes. . In addition he published an Introduction to the Study of Experimental Medicine in 1865, and a few years later a volume on General Physiology.~~

~~An English Life of Bernard, by Sir Michael Foster, was pub- lished in London in 1899. (h. m. e.)~~

~~Bernburg, a town of Germany, duchy of Anhalt, on the Saale, 29 miles N. by W. from Halle by rail. A bronze statue of Bismarck was unveiled in 1896. It is the seat of considerable industry, manufacturing machin- ery and boilers, sugar, pottery, and stoneware, briquettes, chemicals, and lead and zinc smelting. Gardening is extensively carried on. Population (1885), 21,644 ; (1895),~~

~~32,374; (1900), 34,427.~~

~~Bernhardt, Sarah [Eosinb Bbknaed] 1845- -), French actress, was born in Paris, 22nd October~~

1845, of mixed French and Dutch parentage, and of Jewish descent ; she was, however, baptized at the age of twelve and educated in a convent. Her earliest years were spent in Holland. When she was thirteen she entered the Paris Conservatoire, where she gained the second prize for tragedy in 1861 and the same for comedy in 1862. Her first appearance at the Comedie Franqaise was made in a minor part in Racine's Iphiginie without any marked success, and her career there was speedily in- terrupted by her having the temerity to slap the face of one of the " leading ladies," whom she considered to have insulted her sister. After a year spent La playing bur- lesque parts at the Porte-St Martin and Gymnase theatres, she took a sudden trip to Spain; but having spent all her moAej, she returned, and became a member of the company at the Odeon in 1867. There she made her first definite success as the Queen in Buy Bias. Dur- ing the siege of Paris she organized an ambulance service in the theatre. When peace was restored she left the Odeon for the Comedie Fran^aise, thereby incurring a considerable monetary forfeit. Her dSbut at the Comedie Frangaise was made in November 1872 as Gabrielle in Mademoiselle de Belle Isle. From that time she steadily increased her reputation, in spite of an uphill fight against adverse criticism, two of the most definite steps in her progress being her performances as Phedre (in December 1874), and Dona Sol in Hernani (in November 1877). In 1879 she came to London with the company of the Comedie Franqaise for their famous season at the Gaiety Theatre. By this time her position was securely estab- lished. Her amazing power of emotional acting, the extraordinary realism and pathos of her death scenes, the magnetism of her personality, and the beauty of her " voix d'or," — which could now rage like a tiger, now coo like a dove, — made the public tolerant of her occasional caprices. She had developed some skill as a sculptor, and exhibited at the Salon at various times between 1876 and 1881, gaining honourable mention in 1876. She also exhibited a painting there in 1880. In 1878′ she published a prose sketch Dans les Nuages. Her rela- tions with the other societaires of the Comedie Fran- Qaise having become somewhat strained, a crisis arrived in 1880, when, enraged by an unfavourable criti- cism of her acting, she threw up her position on the day following the first performance of Augier's L'Aventuri&re. This obliged her to pay a forfeit of

~~£4000 for breach of contract. Immediately after the rapture she gave a series of performances in London, relying chiefly upon Adrienne Lecouvreur and Frou Frou. These were followed by tours in Denmark, America, and Russia, during 1880 and 1881, with La Dame aux Camillas as the principal attraction. In April 1882 she married M. Jacques Dainala, a Greek, in London, but separated from him at the end of the fol- lowing year. After a fresh triumph in Paris with Fidora at the Vaudeville, she became proprietress of the Porte St Martin theatre. Nana Sahib (1883), Thiodora (1884), La Tosca (1887), Jeanne d'Arc (1890), and GMopatre (1890), were among her most conspicuous successes at the Porte St Martin, where she remained till she became proprietress of the Eenaissance Theatre in 1893. During those ten years she made several extended tours, includ- ing visits to America in 1886-87 and 1888-89. Between 1891 and 1893 she again visited America (North and South), Australia, and the chief European capitals. In November 1893 she opened the Eenaissance Theatre with Les Bois, which was followed by Izeyl (1894), Oismonda (1894), La Princesse Lointaine (1896). Por the next few years she visited London almost annually, and America in 1896. In the autumn of 1896 she made a success with Lorenzacdo; and in Easter week of 1897 furnished her audiences with a new sensation by giving performances of a religious drama, La Samaritaine, by M. Rostand. In December 1896 an elaborate fSte was organized in Paris in her honour ; and the value of this public recognition of her position at the head of her profession was enhanced by cordially appreciative greetings from all parts of the world. Early in 1899 she removed from the Eenaissance to the Theatre des Nations, a larger house, which she opened in January with a revival of La Tosca. In May of the same year she made the bold experiment of a pro- duction of Hamlet, in which she played the part of the prince of Denmark. She repeated the impersonation in London not long afterwards, where she also appeared (in 1901) in M. Eostand's L'Aiglon, which had been produced in Paris the year before.~~

~~Bertani, Agostino (1812-1886), Italian revolu- tionist, was born at Milan, 19th October 1812. He took part in the insurrection of 1848, though opposed to the fusion of Lombardy with Piedmont. During the Roman republic of 1849, he, as medical officer, organized the ambulance service,~~

~~and, after the fall of Eome, withdrew to Genoa, where he worked with Sir James Hudson for the liberation of the political prisoners of Naples, but held aloof from the Mazzinian conspiracies. In 1859 he founded a revolutionary journal at Genoa, but, shortly afterwards, joined as surgeon the Garibaldian corps in the war' of 1859. After Villafranca he became the organizer- in-chief of the expeditions to Sicily, remaining at Genoa after Garibaldi's departure for Marsala, and organizing four separate volunteer corps, two of which were intended for SicUy and two for the Papal States. Cavour, however, obliged all to sail for Sicily. Upon the arrival of Gari- baldi at Naples, Bertani was appointed secretary-general of the Dictator, in which capacity he re-organized the police, abolished the secret service fund, founded twelve infant asylums, suppressed the duties upon Sicilian prod- ucts, prepared for the suppression of the religious orders, and planned the sanitary reconstruction of the city. Enter- ing Parliament in 1861, he opposed the Garibaldian expedi- tion, which ended at Aspromonte, but nevertheless tended Garibaldi's wound with affectionate devotion. In 1866 he organized the medical service for the 40,000 Garibaldians, and, in 1867, fought at Mentana. His parliamentary career, though marked by zeal, was less brilliant than his revolutionary activity. Up to 1870 he remained an~~

~~agitator, but, after the liberation of Eome, seceded from the historic Left, and became leader of the extreme Left, a position held until his death on 30th April 1886. His chief work as deputy was an inquiry into the sanitary conditions of the peasantry, and the preparation of the sanitary code, adopted by the Crispi Administration.~~

~~(h. w. s.)~~

~~Berthelot Pierre, Eugene Marcellin (1827-~~

~~-), French chemist and politician, was born at Paris~~

~~on the 29th of October 1827, being the son of a doctor. After distinguishing himself at school in history and philosophy, he turned to the study of science. In 1851 he became a member of the staff of the College de Prance as assistant to Balatd, his former master, and in 1854 he made his reputation by his doctoral thesis, Sur les combinaisons de la glycirine avec les acides, which described a series of beautiful researches in continuation and ampli-~~

~~fication of Chevreul's classical work. In 1859 he was appointed professor of organic chemistry at the ificole Superieure de Pharmacie, and in 1865 he accepted the new chair of organic chemistry, which was specially erected for his benefit at the College de France. He became a member of the Academy of Medicine in 1863, and ten years afterwards entered the Academy of Sciences, of which he became perpetual secretary in 1889 in succes- sion to Pasteur. During the siege of Paris he was presi- dent of the scientific defence committee, and the experience he gained in that capacity in the manufacture of gun- powder and othei; munitions of war especially turned his attention to the study of therm o-chemistry as applied to explosives. The results of his researches were published in his book Sur la force de la poudre et des matures explosives (1872), which was subsequently followed by the more general treatises, each in two volumes, on M4ca7iique cJiimique fondie sur la thermochimie (1879), and Thermo-chimie (1897). In the domain of organic chemistry his name is associated with many important discoveries, and in particular he is remarkable for the wide application of synthetic methods in his investigations. Among the books he published on this branch of chemistry may be mentioned Chimie organique fondle sur la syntMse (1860), Lemons sur les principes sucris (1862), Legons sur les m6- thodes ginirales de synthase (1864), and Legons sur I'isomirie (1865). Students of chemical history are' also greatly in-debted to M. Berthelot for his book on Les engines de VakMmie (1886), and his Introduction d, I'itude de la chimie des anciens et du moyen-dge, as well as for editing various old treatises on alchemy and chemistry. His scientific jubilee was celebrated in Paris in 1901. As to his official life, he was appointed inspector-general of higher educa- tion in 1876, and after his election as life senator in 1881 he continued to take an active interest in educational ques- tions, especially as affected by compulsory military ser-vice. In M. Goblet's short-lived ministry of 1886-87 he was minister of public instruction, and in the Bourgeois cabinet of 1896-96 he held the portfolio for foreign affairs.~~

~~Bertillon, Alphonse (1853), French crimi nologist, was born in Paris in 1853. He was the son of Louis Adolphb Bertillon, a distinguished anthropolo- gist (1821-83), and brother to Jacques Bertillon, a statis- tician (born 1851), and is sometimes confounded with one or other of these. He published in 1882 a work on Les races sauvages, but his chief claim to~~

distinction lies in the system invented by him for the identification of criminals, which is described in an appendix to his Photographie judiciaire (Paris, 1890), and has been in use since 1883. Whenever a person passes through the hands of the police, exact measurements are taken — comprising (1) length of head, (2) breadth of head, (3) length of left middle

finger, (4) length of left foot, (6) length of left forearm to the tip of the middle finger — and recorded on a card, The whole of the cards are arranged in three classes according as the first measurement is long, medium, or short ; each of these again into three, according to the character of the .second measurement, and so on. The number of cards in each subdivision at the end of this process is generally about a dozen, and identification is rendered complete by certain other measurements and observations, and by photographs of the full face and of the profile (right side). On the recommendation of a committee appointed in 1893 by Mr Asquith, the Bertil- lon system has been introduced into England, and is used in conjunction with the system of identification by Mr Francis Galton. (See Antheopometby.) M. Bertillon was oflcially appointed in 1894 to report on the hand- writing of the bordereau in the Dreyfus case, and was a witness for the prosecution before the Cour de Cassation on 18th January 1899.

Berwick-upon-Tweed, a seaport and municipal borough in the Berwick parliamentary division of Northumberland, England, on the northern bank of the Tweed, 47 miles E.S.E. of Edinburgh by rail. In 1899 307 vessels entered with 28,949 tons, and 305 cleared with 28,949 tons. Population of municipal borough (area, 6507 acres) (1881), 13,998; (1901), 13,437 (Berwick, 8277; Tweedmouth, 3086 ; Spittal, 2074).

Berwickshire, a maritime county of Scotland, forming its S.E. extremity, is bounded on the N.E. by the German Ocean, on the N. by Haddingtonshire, on the W. by Mid-Lothian, on the S.W. by Eoxburgh, on the S. by the Tweed, which separates it from Northumberland, and on the S.E. by Berwick-on-Tweed.

~~Area and Population. — In 1891 the parish of Oldhamstocks was placed wholly in Haddingtonshire, and the Berwick portion of the parishes of Lauder, Earlston, and Mertoun were transferred to parishes in Eoxburgh. According to the last of&cial estimate the area of the county (foreshore excluded) is 293,946 acres, or about 459 square miles. The population was in 1881, 35,883 ; in 1891, 32,406; in 1891, on the above area, 32,290, of whom 15,383 were males and 16,907 females. On the old area, taking land only (294,806 acres or 460-6 square miles), the number of persons to the square mile in 1891 was 70, and the number of acres to the person 9-1. In the registration county the decrease of population between 1881 and 1891 was 8-1 per cent. In 1901 the population was 30,816. Between 1881 and 1891 the excess of births over deaths was 3711, and the decrease of the resident population 2970. The following table gives particulars of births, deaths, and marriages in 1880, 1890, 1899 :—~~

~~Tear.~~

~~Deaths.~~

~~Marriages.~~

~~Births.~~

~~Percentage of Illegitimate.~~

~~1880 1890 1899~~

~~557 475 440~~

~~182 178 178~~

~~1020~~

~~787 686~~

~~10-0 9-40 9-6~~

~~The following table gives the birth-rate, death-rate, and marriage- rate per thousand of the population for a series of years : —~~

~~1880.~~

~~1881-90.~~

~~1890.~~

~~1891-98.~~

~~1899.~~

~~Birth-rate . . . Death-rate . . . Marriage-rate . .~~

~~28-85~~

~~15-75~~

~~5-15~~

~~26-60~~

~~15-62~~

~~4-80~~

~~24-19~~

~~14-60~~

~~5-47~~

~~23-14~~

~~13-98~~

~~5-49~~

~~22-89~~

~~14-70~~

~~5-94~~

~~In 1891 the number of Gaelic-speaking persons in the county was 89, and of foreigners 54. Valuation in 1889-90, £828,457; 1899-1900, £310,720.~~

~~Administration.— The county returns a member to parliament. Lauder (808) is the only royal burgh, and it has now no separate representation. Greenlaw is the county town, but steps are being taken to transfer the administrative machinery to Duns (2206), which is a police burgh. The civil parishes number 82. The number of paupers and dependents in September 1899 was 646. Berwickshire forms a sheriffdom with Roxburgh and Selkirk shires, and there is a resident sheriff-substitute at Duns, who sits also at Greenlaw, Coldstream, Ayton, and Lauder.~~

~~Education.— Thirty-two school boards manage 64 schools, which~~

~~had an average attendance of 3882 in 1898-99, and 2 voluntary schools had 72. There is a high school, which is also a technical school, at Duns, and Coldstream and Lauder public schools have secondary departments. Dvins school is subsidized by the county council, which pays the expenses of students attending it from a distance.~~

~~Agriculture. — The cultivated area was 64·7 of the whole in 1898. Farming is high, and is mixed in the Merse, or borderland, and generally pastoral in the uplands. The following table gives the principal acreages at intervals of five years from 1880 : —~~

~~Year.~~

~~Area under Crops.~~

~~Corn Crops.~~

~~Green Crops.~~

~~Clover.~~

~~Permanent Pasture.~~

~~Fallow.~~

~~1880 1885 1890 1896 1899~~

~~194,562 197,290 197,963 191,983 190,701~~

~~64,044 63,321 59,722 56,928 57,626~~

~~36,074 32,830 32,400 32,175 31,826~~

~~58,646 60,488 61,338 58,394 58,182~~

~~36,517 40,373 44,321 44,418 42,978~~

~~262~~

~~278~~

~~162~~

~~47~~

The following table gives particulars of the live stock during the same years :—

Year.

Total Horses.

Total OatUe.

Cows or

Heifers in

Milk or Calf.

Sheep.

Pigs.

1880 1885 1890 1896 1899

5412 5482 5521 5836 5449

16,571 19,415 17,649 15,936 16,832

3417 3782 8266 3100 3119

267,901 287,554 311,440 307,365 315,958

3873 4663 4974 4530 3796

Large farms predominate ; indeed, the average size of holding — 221- acres for 867 farms — is the highest in the kingdom. In 1895, 16-80 per cent, were under five acres, 23-41 between 5 and 50 acres, and 60-79 over 50. Sixty-nine holdings were between 50 and 100 acres, 218 between 100 and 300, 120 between 300 and 500, 100 between 500 and 1000, and 20 over 1000 acres. The acreage under wood in 1895 was 15,378. According to the

~~census of 1891, there were 4620 men and 1498 women in the county engaged in agriculture.~~

~~Industries and Trade. — The industrial population in 1891 num- bered 3279 men and 1076 women. The season for herring is from May to the middle of September, and for white fish from October to the end of May. Eyemouth, Bummouth, and St Abb's Head form the Scottish division of the Eyemouth fishery district, which includes a number of Northumberland ports, and for which statis- tics are given below : —~~

~~Tear.~~

~~Boats.~~

~~Value of Gear.~~

~~Resident Fishermen and Boys.~~

~~Total Value of aU Fish.~~

~~No.~~

~~Tons.~~

~~Value.~~

~~1880 1898 1899~~

~~486 166 159~~

~~4850 2269 2369~~

~~£23,236 £13,839 £14,977~~

~~£30,678 £19,289 £22,602~~

~~1214 545 535~~

~~£49,766 £29,076 £51,133~~

~~The value of the herring catch only in 1899 was £33,459. During 1899, 1252 persons were employed in the district in connexion with the various branches of the sea fisheries. The salmon fisheries of the Tweed are very valuable. A light railway (10 J miles) from the Waverley line to Lauder was built in 1900.~~

~~Proceedings of Berwickshire Naturalists^ Club. — G. Henderson. The Popular Bhymes, Sayings, and Proverbs of the County of Ber- wick. Newcastle, 1856.— J. W. Bkown. The Covenanters of the Merse. Edinburgh, 1893. — W. S. Crockett. Minstrelsy of the Merse. Paisley, 1898. — ire Praise of Tweed. Serkirk, 1899.— J. EoEsoN. The Churches and Churchyards of Berwickshire. Kelso, 1893.— E. H. Groome. A SHort Border History. Kelso, 1887.— J. Tait. Two Centuries of Border Church Life. Kelso, 1889. — Sir T. Dick Lauder. Scottish Bivers. Glasgow, 1890. — Margaret Warrendek. Marohmont and the Humes of Polwarth. Edinburgh, 1894. — W. K. Hunter. History of the Priory of Coldingham. Edinburgh, 1858. — G. Muirhead. The Birds of Berwickshire. Edinburgh, 1892 and 1897. (w. wa.)~~

~~Besancon, chief town of the department Doubs, France, 241 miles S.E. of Paris, on the railway from Dijon to Belfort. It is the headquarters of the 7th army corps. The ancient library contains nearly 140,000 volumes and 1850 manuscripts, besides 10,000 medals, and there is a popular library with 10,000 volumes. A statue of Cardinal Granvelle (16th cent.) was erected in 1897. The watch-makiQg industry employs about one-fifth of the population, and is said to supply four-fifths of the watches sold in France. The actual number made in 1896 was~~

~~113,418 in gold and 345,706 in sUver. In recent years considerable advance has been made in enamelling and other decorative processes in connexion with this industry. There is a national school of watch- and clock-making. Population (1881), 89,800 ; (1896), 36,942, (comm.) 49,178.~~

~~Besant, Sir Walter (1836-1901), English author, was born at Portsmouth, 14th August 1836, third son of William Besant of that town. He was educated at King's College, London, and Christ's College, Cambridge, of which he was a scholar. He graduated in 1859 as 18th wrangler, and from 1861 to 1867 was senior pro- fessor of the Royal College, Mauritius. From 1868 to 1885 he acted as secretary to the Palestine Exploration Eund. In 1884 he was mainly instrumental in establish ing the Society of Authors, a trade-union of writers de- signed for the protection of literary property, which has rendered great assistance to inexperienced authors by ex- plaining the principles of literary profit. Of this society he was chairman from its foundation in 1884 till 1892. He married Mary, daughter of Mr Eustace Eoster-Barham of Bridgwater, and was knighted in 1896. He died at his house, Erognal End, Hampstead, on the 9th of June 1901. Sir Walter Besant practised many branches of literary art with success, but he is most widely known for his long succession of novels, many of which have enjoyed remarkable popularity. His first stories were written in collaboration with Mr James Eice, and two at least of these, The Golden Butterfly and Beady-Money Mortiboy, are among the most vigorous and most char- acteristic of his works. Though not without exaggeration and eccentricity, attributable to the influence of Dickens, they are full of rich humour, shrewd observation, and sound common-sense, and contain characters which have taken their place in the long gallery of British fiction. After Eice's death, Sir Walter Besant continued to write alone, and in All Sorts and Conditions of Men (1882) pro- duced a stirring story of East End life in London, which set on foot the movement that culminated in the estab- lishment of the People's Palace in the Mile End Eoad. Other popular novels from his pen were Dorothy Forster, Armorel of Lyonesse, and Beyond the Dreams of Avarice. He also wrote critical and biographical works, including The French Humorists, Rabelais, and lives of Coligny, Whittington, Captain Cook, and Eichard Jefferies, and undertook a series of important historical and archae- ological volumes, dealing with the associations and development of the various districts of London — a " survey " of the metropolis of the present day. His books on London, Westminster, and South London showed that his mind was full of an attractive subject. No man of his time evinced a keener interest in the professional side of literary work, and the improved conditions of the literary career in England were largely due to his energetic and capable~~

~~exposition of the commercial value of authorship and to the unselfish efforts which Sir Walter constantly made on beh'alf of his fellow-workers in the field of letters. (a. wa.)~~

~~Bessarabia, a province of south-west Eussia, on the Black Sea, bounded by Bukovina (Austria) in the N.W., Eumania in the W. and S., the Black Sea in the S.E., and the Eussian provinces of Kherson and Podolia in the N.E. and N. It occupies the space between the Dniester and the Pruth, and, since the Berlin treaty, is separated by the Kilia mouth of the Danube from the Dobruja belonging to Eumania. Area, 17,619 square miles. ^~~

~~Owing to its fertile black earth soil, its level prairies, and its warm climate (year, 50° at Kishineff ; January, 26° ; July, 72″ ; 25-2 inches of rain and snow), wheat growing and the culture of the vine and tobacco, as also the raising of fine breeds of sheep, are prosperous. Nearly one half of the total surface (4,468,000~~

~~acres) is under com crops, 1,229,000 acres under meadows, 689,500 under forests, 241,950 under vineyards (17,000,000 gallons of wine), and 4180 under tobacco. Wheat, barley, and linseed, as also wine and wool, are exported. Industry is developing, and there are now several woollen-cloth mills, three foundries, soap-works and tan- neries.~~

~~The Dniester, down which considerable amounts of timber and wooden ware are shipped from Galicia, as also, corn and wool within Bessarabia itself, is an important artery of navigation. Steamers ply up to Moghilev, and on the Pruth up to Leovo. Bessarabia is also well provided with railways, three branches of the Woloczisk to Odessa railway starting westwards and ramifying towards the Rumanian frontier. Population, 988,431 in 1860 ; 1,93.3,436 4n 1897, of whom 942,179 women, and 302,852 living in towns. Divided into eight districts, the chief towns of which are : — Kishineff, capital of the government (108,796 inhabitants in 1897), Akkerman (28,303), Bendeiy (31,861), Byeltsy (18,526),, Izmail (31,293), Khotin (18,126), Orghy^efE (13,356), and Soroki (15,800). Kagul (7094), on the Pruth, and Reni (6946), on the Danube, a railway terminus opposite Galatz in Rumania, are also worth mentioning.~~

~~After the Mongol invasion the Genoese founded their colonies at the mouth of the Dniester. Later the territory became tributary to, and subsequently was annexed by Turkey. Russian troops, in their wars against Turkey, took possession of it five times from 1711 to 1812, when it was finally annexed to Russia. In 1829 the delta of the Danube was added to Bessarabia, but was returned to Turkey by the Paris treaty. Out of it was made the Dobruja, the northern part of which became Russian again in 1878. Bessarabia was peopled in the 19th century by a very motley crowd of Russian immigrants, runaway serfs and Nonconformists, Germans, Greeks, and Bulgarians, in addition to its indigenous inhabitants, Molda^ vians, and LittHe Russians (Galicians), with an addition of Jews (181,000) and gipsies, part of whom were serfs. (p. a. k.)~~

~~Bessemer, a town of Jefferson county, Alabama, U.S.A.,' a few miles south-west of Birmingham, a little north of the centre of the state, and on the Southern, the Queen and Crescent, the Louisville and Nashville, and the Kansas City, Memphis and Birmingham railways. It is in the Alabama coal and iron region, and its industries consist chiefly in the smelting and manufacture of iron. Population (1890), 4544; (1900), 6358.~~

~~Bessemer, Sir Henry (1813-1898), English en- gineer, was born on ♦19th January 1813, at Charlton, in Hertfordshire. Throughout his life he was a prolific in- ventor, but his name is chiefly known in connexion with the Bessemer process for the manufacture of steel, by which it has been rendered famous throughout the civilized world. Though this process is now largely supplemented, and even displaced, by various rivals, at the time it was brought out it was of enormous industrial importance, since it effected a great cheapening in the price of steel, and led to that material being widely substituted for others which were inferior in almost every respect but that of cost. Bessemer's attention was drawn to the problem of steel manufacture in the course of an attempt to im- prove the construction of guns. Coming to the conclusion that if any advance was to be made in artillery better metal must be available, he established a small ironworks in St Pancras, and began a series of experiments. These he carried on for two years before he evolved the essential idea of his process, which is to effect the decarbonization necessary to convert cast iron into steel by forcing a blast of air tkrough the mass of metal when in the molten con- dition. , The~~

first public announcement of the process was made at the Cheltenham meeting of the British Association in 1856, and immediately attracted considerable notice. Many metallurgists were sceptical on theoretical grounds about his results, and only became convinced when they saw that his process was really able to convert melted cast iron into malleable iron in a perfectly fluid state. But though five firms applied without delay for licenses to work under his patents, success did not at once attend his efforts ; indeed, after several ironmasters had put the process to practical trial and failed to get good results, it was in danger of being thrust aside and entirely

forgotten. Its author, however, instead of being dis- couraged by this lack of success, continued his experi- ments, and in two years was able to turn out a product, the quality of which was not inferior to that yielded by the older methods. But when he now tried to induce makers to take up his improved system, he met with general rebuffs, and finally was driven to undertake the exploitation of the process himself. To this end he erected steelworks in Sheffield, on ground purchased with the help of friends, and began to manufacture steel. At first the output was insignificant, but gradually the magnitude of the operations was enlarged until the com- petition became effective, and steel traders generally became aware that the firm of Henry Bessemer and Co. was underselling them to the extent of £20 a ton. This argument to the pocket quickly had its effect, and licenses were applied for in such numbers that, in royalties for the use of his process, Bessemer received a sum in all considerably exceeding a million sterling.

Of course, patents of such obvious value did not escape criticism, and invalidity was freely urged against them on various grounds. But Bessemer was fortunate enough to maintain them intact without litigation, though he found it advisable to buy up the rights of one patentee, while in another case he was freed from anxiety by the patent being allowed to lapse in 1859 through non-pay- ment of fees. There is good reason to think that in this latter instance there was real danger. Bessemer, in fact, practically admitted this to be his own opinion by grant- ing the inventor, Eobert Mushet, an annuity for life. At the outset he had found great difficulty in making steel

~~by his process — ^in his first licenses to the trade iron alone was mentioned. Experiments he made with South Wales iron were failures because the product was devoid of malleability; Mr Goransson, a Swedish ironmaster, using the purer charcoal pig-iron of that country, was the first to make good steel by the process, and even he was successful only after many attempts. His results prompted Bessemer to try the purer iron obtained from Cumberland haematite, but even with this he did not meet with much success, until Mushet showed that the addition of a certain quantity of spiegeleisen (a pig-iron containing manganese) had the effect, for whatever reason, of removing the difficulties. Whether or not Mushet's patents could have been sustained, the value of his pro- cedure was shown by its general adoption in conjunction with the Bessemer method of conversion. At the same time it is only fair to say that whatever may have been the conveniences of Mushet's plan, it was not absolutely essential ; this Bessemer proved in 1865, by exhibiting a series of samples of steel made by his own process alone. The pecuniary rewards of Bessemer's great invention came to him with comparative quickness ; but it was not till 1879 that the Royal Society admitted him as a fellow and the Government honoured him with a knighthood.~~

~~Among Bessemer's numerous other inventions, not one of which attained a tithe of the success or importance of the steel process, were movable dies for embossed stamps, a gold paint, sugar machinery, and a ship which was to save her passengers from the miseries of mcd de mer. This last had her saloon mounted in such a way as to be free to swing relatively to the boat herself, and the idea was that this saloon should be always maintained steady and level, no matter how rough the sea. For this purpose hydraulic mechanism of Bessemer's design was arranged under the control of an attendant, whose duty it was to keep watch on a spirit-level, and counteract by proper manipulation of the apparatus any deviation from the horizontal that might manifest itself on the floor of the saloon owing to the rolling of the vessel. A boat, called the Bessemer, was built on this plan in 1875 and put on~~

~~the cross-Channel service to Calais, but the mechanism of the swinging saloon was not found effective in practice and was ultimately removed. Bessemer's ideas were indeed of very unequal merit, and he must be~~

~~numbered with those inventors who at more or less frequent^inter- vals have happy thoughts which occasionally prove of real value, rather than with those who set themselves by a patient process of scientific deduction, based on a firm grasp of scientific principle, to discover a means by which an exactly predetermiued object may be practically ac- complished. He died at Denmark HiU, in the south of London, on 15th March 1898. (h. m. e.)~~

~~Best, William Tliomas (1826-1897), English organist, was born at Carlisle 13th August 1826. The son of a solicitor, he received his first instruction from Young, the cathedral organist ; but when he decided to adopt the profession of music, he set to work to teach himself, as the organs of his youth were mostly very incpmplete from a modem standpoint, and the admirers of the greatest master of the organ, Sebastian Bach, were very few. He applied himself especially to Bach's music, and became a player of great skill. His successive appointments were to Pembroke chapel, Liverpool, 1840; to a church for the blind, 1847, and the Liverpool Phil- harmonic Society, 1848. For a short time (1854-55) he was in London, at the Panopticon in Leicester Square, the church of St Martin's-in-the-Fields, and Lincoln's Inn chapel. In 1855 he returned to Liverpool as organist of St George's Hall, where his frequent performances rapidly became famous throughout England. He held other appointments in or near LiverpooVbut the post at St George's Hall was the most important. He held this until 1894, when ill-health obliged him to retire. He had been in the receipt of a civil list pension since 1880, and in 1890 went to Sydney to open the organ there. Best died at Liverpool on the 10th of May 1897. He played concertos at many of the Handel ^Festivals at the Crystal Palace. His playing was always effective and often artistic; though his style in interpreting Bach was not always of the purest, the service he rendered in popular- izing the works of that master must be acknowledged. He published a good deal of church music of a more or less popular kind, and issued many arrangements of organ music, editions of Bach, &c. (j. a. f. m.)~~

~~Betliel, eleven miles north of Jerusalem, altitude 2880 feet, now Beitin, a small village of about 360 houses. Population, about 2000.~~

~~Betlilehem, i.e., "house of bread," probably so called from the fertility of the vicinity, situated on a projecting spur five miles from Jerusalem, altitude~~

~~2650 feet. Eor a description of the church erected by Constan- tine in 330, see de Vogii^, Les J&glises de la Terre Sainte. There are several monasteries and convents, and British, French, and German schools. The population, 8000, has contained few Moslems since the Moslem quarter was destroyed by Ibrahim Pasha, after an insurrection in~~

~~1834.~~

~~Betlleliem, a borough of Northumberland county, Pennsylvania, U.S.A., situated in the eastern part of the state, on the north bank of Lehigh river, opposite South Bethlehem, in 40° 37′ N. lat., and 76° 23′ W. long. It is a centre for four railways, and has extensive ironworks, the chief industry. A Moravian college and seminary for young women are situated here. Population (1880),~~

~~6193; (1900), 7293.~~

~~Betliulie. See Orange Rivek Colont.~~

~~Beth line, chief town of arrondissement and railway station, department of Pas-de-Calais, France, 18 miles in~~

~~236~~

~~BETTERMEN T— B E T T I N G~~

~~direct line N.N.W. of Arras. It is situated in a very- productive coal-field. The fortifications of the town are no longer maintained. Port traffic on the Aire Canal in 1898 amounted to 987,157 tons. Population (1881),~~

~~9076; (1896), 10,529; (1901), 11,370.~~

~~Betterment. See Compensation.~~

~~Bettia, a town of British India, in the Champaran district of Bengal ; situated in 26° 48′ N. lat., and 84° 32′ E. long., on the Harha river; station on the Tirhut section of the Bengal and North-Western railway. Population, about 22,000. Bettia is the residence of one of the lead- ing noblemen of Northern Behar, who enjoys a rent-roll of £66,000, and who raised a~~

~~mortgage loan of £475,000 at 5 per cent, on the London Stock Exchange in 1888. In 1901, owing to a disputed succession, tha estate was under the management of the Court- of Wards. It com- prises land in no less than ten districts, much of which is let on permanent leases to indigo-planters. Besides the palace of the raja, the town contains a middle English school and a female dispensary, entirely supported out of the estate. There is a Eoman Catholic mission, with about 1000 converts, which was founded by an Italian priest in 1746.~~

~~Betting. — In the early days of horse-racing persons who wished to bet often failed to gratify their inclination because of the difficulty of finding any one ready to wager. To obviate this difficulty the professional bookmaker arose. It was perceived that if a man laid money against a number of horses, conducting his business on discreet principles, he would in all probability receive enough to pay the bettor who was successful and to leave a surplus for himself ; for the " bookmaker," as the professional betting man came to be called, had enormous advantages in his favour. He was presumably shrewd and wary, whereas many of those with whom he dealt were precisely the opposite, and benefit arose to him from the mistakes and miscalculations of owners and trainers of horses, and from the innumerable accidents which occur to prevent anticipated success ; moreover, if he carried out the theory of his calling he would so arrange his book, by what is called "betting to figures," that the money he received would be more than he could possibly be called upon to pay. In practice, of course, this often does not happen, because " backers " will sometimes support two or three horses in a race only,, and the success of one may result in loss to the bookmaker ; but in the long run it has been almost invariably found that the bookmaker grows rich and that the backer of horses loses money. It is the bookmaker who regulates the odds, and this he does, some- times b'y anticipating, sometimes by noting, the desire of backers to support certain animals. Such things as stable secrets can scarcely be said to exist at the present time ; the bookmaker is usually as well able as any one else to estimate the chances of the various horses engaged in races. Notwithstanding that the reports of a trial gallop are of comparatively little value to any except the few persons who know what weights the animals carried when tried, the bookmaker is extraordinarily~~

~~keen, and frequently successful, in his search for information ; and on this the odds depend.~~

~~Betting is of two kinds : " post," when wagering does not begin until the numbers of the runners are hoisted on the board; and "ante-post," when wagering opens weeks or months before the event ; though of this latter there is far less than was formerly the case, doubtless for the reason that before the introduction of so many new and valuable stakes attention was generally concentrated on a comparatively small number of races. Bets on the Derby, the Oaks, and the St Leger were formerly common nearly~~

~~a year before the running of the races, and a few handi- caps, such as the Chester Cup, used to occupy attention months beforehand ; the weights, of course, being pub- lished at a much longer interval prior to the contest than is at present the rule. As regards ante-post betting, bookmakers have their own ideas as to the relative pros- pects \of the horses entered. A person who wishes to back a horse asks the price, and accepts or declines, as the case may be. If the bet is laid it will probably be quoted in the newspapers, and other persons who propose to wager on the race are so likely to follow suit that it is shrewdly suspected that in not a few cases bets are quoted which never have been laid, in order to induce the back- ers to speculate. According to the public demand for a horse the price shortens. If there is little or no demand the odds increase, the market being almost entirely .regu- lated by the money ; so that if a great many people bet on a certain animal the odds become shorter and shorter, till in many cases instead of laying odds against a horse, the bookmaker comes to take odds, that is, to agree to pay a smaller sum than he would receive from the backer if the animal lost. Post betting is conducted on very much the same principles. When the numbers are hoisted bookmakers proclaim their readiness to lay or take cer- tain odds, which vary according to the demand for the different animals. Backers are influenced by many con- siderations: by gossip, by the opinions of writers on racing, and in many cases, unfprtunately, by the advice of "tipsters," who by advertisements and circulars pro- fess their ability to indicate winners, a pretence which is obviously absurd, as, if these men possessed the knowledge they claim, they would assuredly keep it to themselves and utilize it for their own private purposes. , The specious promises of such men do infinite mischief, as they so often appeal with~~

~~success to the folly and gullibility of the ignorant, and it is for this reason that a certain amount of sympathy is felt for the endeavours of ‘ persons who have entered upon the forlorn hope of endeavouring to prevent betting. A society was formed called the Anti-Gambling League. A bookmaker was summoned for betting in Tattersall’s enclosure, which it was contended contravened the Betting House Act of 1853. This Act had been aimed against what were known as “list houses,” establishments then kept by bookmakers for betting purposes, and associated with many disgracefid scandals. In the preamble to his Bill Lord Cockburn began by remarking that “Whereas a , new form of betting has of late sprung up,” and the Anti-Gambling League sought to argue that this included a form of betting which had not sprung up of late but had on the contrary been carried on without interference for many generations. The Divisional Court held that such betting was an infringement of the Act, but ultimately the question came before the House of Lords, and the decision was reversed. The arguments turned almost entirely upon whether such an enclosure was a ” place” within the mean- ing of the Act, and it was finally held that a place did not mean an enclosure in a racecourse, to which many persons, no doubt, did go for the purpose of betting, whilst others -went merely with the object of seeing the races. The law -with regard to betting is in fact not a little curious. A few years agp two men were imprisoned for introducing a machine similar to the Pari-Mutuels which are recognized and supported by the French Government and by authorities elsewhere, and from which French municipalities derive handsome sums in relief of rates.~~

~~Many attempts have been made in France to interfere •with the practice of bookmaking and to induce all who desire to wager on horse-races to support the Pari-Mutuels. On all French racecourses, as on others nearly everywhere else on the Continent, and likewise in the Colonies, where~~

~~the Pari-Mutuel is called the Totalizator, this system of betting is carried on. Rows of offices are established behind or near the stands, on each of which lists are ex- hibited containing the numbers of the horses that are to run in the coming race. At some of these the minimum wager is five francs, at~~

~~others ten, twenty, fifty, one hundred, five hundred, and in some cases 'a thousand. The person who proposes to bet goes to the clerk at one of these offices, mentions the number, as indicated on the card, of the horse he wishes to back, and states whether he desires to bet on it to win or for a place only. He receives a voucher for his money. After the race the whole amount collected at the various offices is put together and divided, after a percentage has been deducted for the administration and for the poor. As soon as this has been done, the money is divided and the prices to be paid to winners are exhibited on boards. These prices are calculated on a unit of ten francs. Thus, for instance, if the winner is notified as bringing in twenty-five francs, the meaning is that the backer receives his original stake of ten and fifteen in addition, the money being paid im- mediately by another clerk attached to the office at which the bet was made. (a. b. t. w.)~~

~~BetuI, a town and district of British India, in the Narbuda division of the Central Provinces. In 1891 the population of the town was 6260. The administrative headquarters of the district have been transferred to the town of Badnur, 5 miles north, which had in 1891 a popu- lation of 6014.~~

~~The district of Betul has an area of 3824 square miles. The population in 1891 was 323,116. Classified according to religion, Hindus numbered 197,774; Mahom- medans, 5122; aborigines, "119,008, chiefly Gonds; Christians, 66, of whom 21 were Europeans ; " others," 1146. In 1901 the population was 285,324, showing a decrease of 12 per cent., due to the results of famine. The total amount of land revenue and rates is returned at Rs.2,02,866, the incidence of assessment being only two annas per acre of assessed area; the number of police was 321. In 1897-98, out of a total cultivated area of 662,069 acres, only 8309 were irrigated from wells. The principal crops are wheat, millet, other food- grains, pulse, oil-seeds, and a little sugar-cane and cotton. A large part of the area (778,976 acres) is still covered with forests, which yield teak and other timber. The only manufacture is cotton cloth. There is no railway, and good roads are few; nor is any of the rivers navigable. In 1897-98 there were 69 schools attended by 3223 pupUs. This district suffered very severely from the famine of 1896-97 ; in 1897 the death-rate being as high as 73 per 1000. It suffered again in 1900, when in May the number of persons relieved rose to one-third of the total population.~~

~~Beust, Friederich Ferdinand von (1809-1886), Austrian statesman, was descended from a noble family which had originally sprung from the Mark of Branden- burg, and of which one branch had been for over 300 years settled in Saxony. He was born on 13th January 1809 in Dresden, where his father held office at the Saxon court. After studying at Leipzig and Gottingen he entered the Saxon public service ; in 1836 he was made secretary of legation at Berlin, and afterwards held appointments at Paris, Munich, and London. In March 1848 he was summoned to Dresden to take the office of foreign minister, but in consequence of the outbreak of the revolution was not appointed. In May he was appointed Saxon envoy at Berlin, and in February 1849 was again summoned to Dresden, and this time appointed minister of foreign affairs, an office which he continued to hold~~

~~till 1866. In addition to this he held the ministry of education and public worship from 1849 to 1853; that of internal affairs in 1853, and in the same year was appointed minister-president. Prom the time that he entered the ministry he was, however, the leading member of it, and he was chiefly responsible for the events of 1849. By his advice the king refused to accept the constitution proclaimed by the Prankfurt assembly, a policy which led to the outbreak of revolution in Dres- den, which was suppressed after four days' fighting by Prussian troops, for whose assistance Beust had asked. On Beust fell also the chief responsibility for governing the country after order was restored, and he was the author of the so-called coup d'itat of June 1850 by which the new constitution was overthrown. The vigour he showed in repressing all resistance to the Government, especially that of the university, and in reorganizing the police, made him one of the most unpopular men among the Liberals, and his name became synonymous with the worst form of reaction, but it is not clear that the attacks on him were justified. After this he was chiefiy occupied with foreign affairs, and he soon became one of the most conspicuous figures in German politics. He was the leader of that party which hoped to maintain the independence of the smaller states, and was the op- ponent of all attempts on the part of Prussia to attract them into a separate union; in 1849-50 he had been obliged to join the "three kings' union" of Prussia, Hanover, and Saxony, but he was careful to keep open a loophole for withdrawalj of which he speedily availed himself. In the crisis of 1861 Saxony was on the side of~~

Austria, and he supported the restoration of the Diet. In 1864 he took part in the Bamberg conferences, in which the smaller German states claimed the right to direct their own policy independent of that of Austria or of Prussia, and he was the leading supporter of the idea of the Trias, i.e., that the smaller states should form a closer union among themselves against the preponderance of the great monarchies. In 1863 he came forward aS a warm supporter of the claims of the prince of Aug^sten- burg to Schleswig-Holstein ; he was the leader of the party in the German Diet which refused to recognize the Treaty of London, and in 1864 he was appointed repre-sentative of the Diet at the Congress of London. He was thus thrown into opposition to the policy of Bismarck, and he was exposed to violent attacks in the Prussian press as a " Particularist," i.e., a supporter of the in-dependenceof the smaller states. The expulsion of the Saxon troops from Kendsburg nearly led to a conflict with Prussia. Beust was accused of having brought about the war of 1866, but the responsibility for this must rest with Bismarck. On the outbreak of war Beust accompanied the king to Prague, and thence to Vienna, where they were received by the emperor with the news of Koniggratz. Beust undertook a mission to Paris to procure the help of Napoleon. When the terms of peace were discussed he resigned, for Bismarck refused to negotiate with him.

After the victory of Prussia there ,was no place for Beust in Germany, and his public career seemed to be closed, but he quite unexpectedly received an invitation from the emperor of Austria to become his foreign minister. It was a bold decision, for Beust was not only a stranger to Austria, but also a Protestant, but the choice of the emperor justified itself. Beust threw himself into his new position with great energy ; it was owing to him that the negotiations with Hungary were brought to a successful issue. When difficulties came he went himself to Pesth, and acted directly with the Hungarian leaders. In 1867 he also held the position of Austrian minister-president, and he carried through the measiires by which

parliamentary government was restored. He also carried on the negotiations with the pope concerning the repeal of the concordat, and in this matter also

~~did much by a liberal policy to relieve Austria from the pressure of institutions which had checked the development of the country. In 1868, after giving up his post as minister-president, he was appointed chancellor of the empire, and received the title of count. His conduct of foreign affairs, especially in the matter of the Balkan states and Crete, successfully maintained the position of the empire. In 1869 he accompanied the emperor on his expedition to the East. He was still to some extent influenced by the anti-Prussian feeling he had brought from Saxony. He maintained a close understanding with France, and there can be little doubt that he would have welcomed an opportunity in his new position of another struggle with his old rival Bismarck. In 1867, however, he helped to bring the affair of Luxemburg to a peaceful termination. In 1870 he did not disguise his sympathy for France, and the failure of all attempts to bring about an intervention of the Powers, joined to the action of Russia in denouncing the Treaty of Paris, was the occasion of his celebrated saying that he was nowhere able to find Europe. After the war was over he completely accepted the new organization of Germany, and in a meeting with Bismarck at Gastein laid the foundation for the good understanding between Austria and Germany. In 1871 he interfered at the last moment, together with Andrassy, to prevent the emperor accepting the federalist plans of Hohenwart. He was successful, but at the same time he was dismissed from office. The precise cause for this is not known, and no reason was given him.~~

~~At B^ust's own request he was appointed Austrian ambassador at London; in 1878 he was transferred to Paris; in 1882 'he retired from public life. He died at his villa at Altenberg, near Vienna, on the 24th of October 1886, leaving two sons, who hold positions in the Austrian diplomatic service. His wife, a Ba- varian lady, survived him only a few weeks. His elder brother Friederich Constantino, who was at the head of the Saxon department for mines, was the author of several works on mining and geology, a subject in which other members of the family had distinguished themselves.~~

~~Beust was in many ways a diplomatist of the old school. He had great social gifts and personal graces ; he was proud of his proficiency in the lighter arts of composing waltzes and vers de sociitL His chief fault was vanity, but it was an amiable weakness. It was more vanity than rancour which made him~~

~~glad to appear even in later years as the great opponent of Bismarck ; and if he cared too much for popularity, and was very sensitive to neglect, the saying attributed to Bismarck, that if his vanity was taken away there would be nothing left, is very unjust. He Was apt to look more to the form than the substance, and attached too much importance to the verbal victory of a well-written despatch ; but when the opportunity was given him he showed higher qualities. In the crisis of 1849 he displayed considerable courage, and never lost his judgment even in personal danger. If he was defeated in his German policy, it must be remem- bered that Bismarck held all the good cards, and in 1866 Saxony was the only one of the smaller states which entered on the war with an army properly equipped and ready at the moment. That he was no mere reactionary the whole course of his government in Saxony, and still more in Austria, shows. His Austrian policy has been much criticized, on the ground that in establishing the system of dualism he gave too much to Hungary, and did not really understand Austrian affairs. This is prob- ably true, but it remains the fact that in a crisis of~~

~~extraordinary difficulty he carried to a successful con- clusion a policy which, even if it was not the best imaginable, was probably the best attainable in the circumstances, and it is difficult to name any statesman of the century to whom Austria has more real ground for gratitude.~~

~~Beust was the author of reminiscences : Aus drei Viertel-Jahr- hunderten, 2 vols. Stuttgart, 1887. — An English translation was edited by Baron H. de Worms ; and he also wrote a shorter work, Erinnerungen zu Erinnerungen, Leipzig, 1881, in answer to attacks made on him by his former colleague, Herr v. Frieseri, in his remin- iscences. See also Ebeling. F. F. Graf v. Beust. Leipzig, 1876. A full and careful account of his political career, especially up to 1866. — Diplomatic Sketches: No. 1, Count Beust. By Outsidee (Baron Carl -v. Malortie). — Flathe. Oeschichte von Sachsen, vol. iii. Gotha, 1877. — FEiBsiiN. Erinnerungen aus meinem Leben. Dresden, 1880. fj_ ■^_ he.)~~

~~Beuthen, a mining town of Prussia, province of Silesia, 121 miles by rail S.E. from Breslau. It is the centre of coal and zinc mines, iron and zinc smelting, steam planing and saw milling. Population (1885),~~

~~30,602 ; (1900), 51,600.~~

~~Beveren, a town of Belgium, in the province of East Flanders, 29 miles N.E. of Ghent by rail. It has numerous breweries and manufactures of lace and cigars. Population (1880), 7838 ; (1897), 9^04.~~

~~Beverley, an ancient municipal borough and a market town in the Holderness parliamentary division of York- shire, England, 8 miles N.N.W. of Hull by rail. Since 1889 it has been the seat of a suffragan bishopric. Amongst its public buildings are the minster and the parish church of St Mary's, two of the finest examples of Early English architecture, various Nonconformist chapels, a cottage hospital, waterworks, and (under one buUding) a corn exchange, butter market, and swimming baths. Its staple trades are tanning, the manufacture of agricultural implements, wood-carving, and matting. It possesses communication with the port of Hull by water, and thence to all parts. The corporation own the gasworks and the electric lighting works. The borough comprises three parishes, with a total area of 2411 acres of common pasture land. Population (1881), 11,426; (1901), 13,183.~~

~~Beverly, a seaboard city of Essex county, in Eastern Massachusetts, U.S.A., situated on the north shore of Massachusetts Bay, opposite Salem, and 17 miles N.E. of Boston. The principal village, of the same name, is on the Boston and Maine railway. Beverly received a city charter in 1893. Population (1880), 8456; (1900),~~

~~13,884.~~

~~Bexley, a large parish, urban district, and village, in the Dartford parliamentary division of Kent, England, 12 miles from London by rail. The urban district includes Bexley Heath, with Welling, and Lamorbey or Halfway Street, and has an area of 6328 acres. Population (1891), 10,605 ; (1901), over 12,000.~~

~~Bezae Codex. See Cobex Bezab.~~

~~Beziers, chief town of arrondissement, department of Hdrault, France, 46 miles W.S.W. of Montpellier, on railway to Narbonne. The AUees Paul~~

~~Eiquet is a hand- some promenade adorned with a statue of Riquet. The Canal du Midi here crosses the Orbe by a fine bridge- aqueduct, and about half-armile from the town are the large locks of *Fonserannes, in which the water is raised 80 feet in 330 yards to the level of the Orb. The distilling of brandy has far outdistanced all other industries, and most of the manufactures of the town are more or less connected with the trade. Population (1881), 37,824 ; (1896), 41,706, (comm.) 46,260 ; (1901), 52,310.~~

~~Bezwada, a town of British India, in the Kistna district of Madras, on the left bank of the river Kistna, at the head of its delta ; population, about 20,000. The~~

~~municipal income in 1897-98 was Ks.46,280. Here are the headquarters of the Kistna canal system, which irri- gates more than 500,000 acres, and also provides naviga- tion throughout the delta. The anicut or dam at Bezwada, begun in 1852, consists of a mass of rubble, fronted with masonry, 1240 yards long. Here also is the central junction of the East Coast railway from Madras to Cal- cutta, 267 miles from Madras, where one branch line comes down from the Warangal coalfield in the Nizam's dominions, and another from Bellary on the Southern Mahratta line. It is proposed to construct a third branch to Masulipatam on the coast. There are a Church Mission and high schools.~~

~~Bhagalpur, a city of British India, in the Behar province of Bengal, which gives its name to a district and to a division ; situated on the right bank of the Ganges, 265 miles from Calcutta. It is a station on the East Indian railway. Population (1881), 68,238; (1891), €9,106; (1901), 75,273, showing an increase of 9 per cent. The chief educational institution is the Tejnarayan Jubilee College, supported almost entirely by fees. The English high school had 335 pupils in 1897, and there are four printing-presses.~~

~~The district of Bhagalpuk strfetches across both banks of the Granges. It has an area of 4226 square miles. Population (1881), 1,967,635; (1891),~~

~~2,032,694, show- ing an increase of 3 per cent.; average density, 481 persons per square mile. Classified according to religion, Hindus 3iumbered 1,811,359 ; Mahommedans, 195,591 ; aborigines, 24,740 ; Christians, 534, of whom 140 were Europeans ; •"others," 470. In 1901 the population was 2,088,565, .showing a further increase of 3 per cent. The land revenue and rates in 1897-98 were Es.7,60,266, and •number of police was 473. There were 23,437 boys at school in 1896-97. The registered death-rate (1897) was ■30 per 1000. There are 17 indigo factories, employing .about 7000 persons, with an out-turn Valued at Es.2,82,000. 'Other industries include the weaving of tusser silk and the making of coarse glass. A large trade is carried on by rail and river with Lower Bengal. The tract south of the Ganges is traversed by the loop-line of the East Indian railway, and a railway across the northern tract was, in 1901, under construction.~~

~~The divisioriof Bhagalpur stretches across the Ganges from the Nepal frontier to the hills of Chota Nagpur. It -comprises the five districts of Monghyr, Bhagalpur, Turneha, Maldha, and the Sonthal Parganas. The total :area covers 20,511 square miles ; and in 1891 the population was 8,582,490, being an average of 418 persons per square mile; the land revenue and rates in 1897-98 were Es.38,76,645 ; the number of police was 2196. In 1896-97 the total number of schools was 5432, attended by 113,240 pupils, of whom 7418 were girls.~~

~~Bhamo, in ancient times the capital of the Shan istate of Manmaw, later the seat of a Burmese governor, now the headquarters of a district in the northern division of Upper Burma (Chinese frontier). It lies wholly in the basin of the Irrawaddy, which, as well as its tributaries, runs through the heart of it. On the east is the river ■of the Shan plateau, running almost due north and south. West of the Irrawaddy there is a regular series of ranges, •enclosing the basins of the Kaukkwfe, Mosit, Indaw, and oj;her streams, down which much timber is floated. Beyond the Kaukkwfe there is a ridge of hills, which starts ■at Leka, near Mogaung, and diverges to the south, the eastern ridge dividing the Kaukkwe from the Mosit, and the western forming the eastern watershed of the Nam Yin and running south into Katha. It is an offshoot from the latter of these ridges that forms the third defile~~

~~of the Irrawaddy between Bhamo and Sinbo. The district covers an area of 9800 square miles, and the population in 1891 was 54,200, but this must now be much below the real number. It is mainly composed of Shan-Burmese and Kachins. The Shan-Burmese inhabit the valleys and alluvial plains on each side of the river. The Kachins, who probably came from the sub-regions of the Himalayas, occupy the hills throughout the district. There are also settlements of Shans, Shan-Chinese, Chinese and Assamese. There are extensive fisheries in the Shwegu and Mo-hnyin circles, and in the Indaw, a chain of lakes just behind the Mosit, opposite Shwegu. These yield Rs.13,000 rental a year. The district abounds in rich teak forests, and there are reserves representing 60,000 acres of teak plantation. Contracts and licenses were issued in 1897 for nearly 26,000 logs. The whole of the countr/ along the baiJis of the Irrawaddy, the Mol^, Taping Sinkan, and Kaukkw^, is generally in a water- logged condition during the rains. The climate in the district is therefore decidedly malarious, especially at the beginning and end of the rains. Prom November to March there is very bracing cold weather. The highest temperatures range a few degrees over 100° F. up to 106°, and the lowest a few degrees under 40°. The average maximum for the year is about 87°, the average minimum about 62°. The rainfall averages 72 inches a year.~~

~~Bhamo, the headquarters of the district, is situated in 24° 16′ N. lat. In 1891 it contained 5798 inhabitants, of whom a con- siderable number were Chinamen, natives of India, and Shan- Chinese. It stretches for a distance of nearly four miles along the Irrawaddy bank in a series of small villages, transformed into quarters of the town, but the towa proper is confined mainly to the one high ridge of land running at right angles to the river. The surface of the ground is much out up by ravines which fill and dry up according to the rise and fall of the river. When the Irrawaddy is at its height the lower portion of the town is flooded, and the country all round is a sheet of water, but usually for no very long time. Here or hereabouts has long been the terminus of a great deal of the land commerce from China. Until some years after the annexation, however, the trade routes were very unsafe owing to attacks from th^ Kachins. These have now quite ceased, and the roads, which were mere bridle-tracks, have been greatly improved. The two chief are the so-called Santa and Ponlaing route, through Manyun (Manwaing) and Nantien to T'§ngyueh, and the southern or Sawadi route~~

by way of Namhkam. Cart roads are now being constructed on both routes, and that south of the Taping river could easily be continued through Manyun to T'engyueh if the Chinese should be induced to co-operate. A railway to T'gngyiieh is quite feasible and would doubtless be profitable, but it would never serve a large area of country, could not be prolonged beyond T'gngyiieh, and would be greatly inferior to the route by the Kun-16ng ferry. There is a fairly large military garrison in Bhamo distributed between two forts to the north and east of the town. There are in general stationed here a native regiment, two sections of a battery, and the wing of a European regiment. Besides the barracks there are a circuit house, dSk bungalow, courthouse, and post and telegraph offices. There is daily steamer communication, either direct to Mandalay or to the terminus of the railway at Katha, by the vessels of the Irrawaddy Flotilla Company.

(j. G. sc.)

Bhandara, a tovm and district of British India, in the Nagpur division of the Central Provinces. The town (population about 13,000) is situated on the left bank of the river Wainganga, six miles from a station on the Bengal-Nagpur railway. It has considerable manufactures of cotton cloth and brass-ware, and a first-grade middle school, -with a library. The average death-rate for five years is 28 per thousand.

The district of Bhandara has an area of 3968 square miles. The population in 1891 was 742,850, be- ing 187 persons per square mile. Classified according to religion, Hindus numbered 639,994; Mahommedans, 13,100; aborigines, 89,179, chiefly Gonds; Christians, 121, of whom 13 were Europeans; "others," 456. In 1901 the population was 663,578, showing a decrease of 11 per cent., compared with an increase of 8 per cent, in the

preceding decade. The total amount of land revenue and rates is returned as Es.4,74,385, the incidence of assess- ment being Es.0 : 5 : 3 per acre of assessed area ; number of police, 237. In 1897-98, out of a total cultivated area of 796,618 acres, 195,416 were irrigated from tanks, &e. The principal

~~crops are rice, wheat, millet, other food-grains, pulse, linseed, and a little sugar-cane. The district is traversed by the main road from Nagpur to the east, and also by the Bengal-Nagpur railway. The number of schools is 152, attended by 7802 pupils. The average death-rate for five years is 32 per thousand. Bhandara suffered in the famine of 1896-97, and yet more severely in 1900.~~

~~Bharatpur, or Bhubtpoee, a native state of India, in the Rajputana Agency. Its area covers 1961 square miles. In 1881 it had a population of 645,640, and in 1891 of 640,303, giving an average density of 327 persons per square mile. In 1901 the population was 626,120, a decrease of 2 per cent. The estimated gross revenue was Es.27,00,000 ; the expenditure on public works in 1897-98 was Es.5,52,420, of which Es.1,88,780 was devoted to irrigation; the number of schools was 89, with 6248 pupils; the number of hospitals and dispensaries was 77, attended by 116,228 patients. The present Maharaja, Eaghunath Sing, was placed on the throne in 1895, in supersession of his elder brother, who was found unfit. During his minority the administration has been con- ducted by a native minister, together with a state council, under the general superintendence of the political agent. Imperial service cavalry are maintained. The state is traversed for about 40 miles by the Eajputana railway.~~

~~The city of Bhakatpub is 34 miles west of Agra by rail. The population in 1881 was 66,163 ; in 1891 it was 68,033. The immense mud ramparts still stand. It has a handsome palace, a new hospital, acd- a high school, with 144 pupils learning English. There are special manufactures of chauris, or flappers, with handles of sandalwood, ivory, or silver, and tails also made of strips of ivory or sandalwood as fine as horse-hair.~~

~~Bhau Daji (Eamkrishna Vithal) (1822-1874), Hindu physician of Bombay, Sanskrit scholar and anti- quary, born in 1822 at the village of Manjare, in the native state of Savantwudi, of humble parents, dealing in clay dolls. Dr Bhau's career is a striking instance of great results arising from small accidents. An Englishman noticing his cleverness at chess induced his father to give the boy an English education. Accordingly Bhau was brought to Bombay and was educated at the Elphinstone Institution, under Harkness, Bell, and Henderson. He relieved his father of the cost of his~~

~~education by winning many prizes and scholarships, and on his father's death two years later he cheerfully undertook the burden of supporting his mother and a brother (Nabaten), who also in after-life became a distinguished physician and surgeon. About this time l^e gained a prize for an essay on Infan- ticide, and was appointed a teacher in the Elphinstone Institution. . He began to devote his time to the study of Indian antiquities, deciphering inscriptions and ascertain- ing the dates and history of ancient Sanskrit authors. He then studied at the Grant Medical College, under Morehead, Ballingall, and Giraud, and was one of the first batch who graduated there in 1845. In 1861 he set up as a medical practitioner in Bombay, where his success was so great that he soon made a fortune. He studied the Sanskrit literature of medicine, and also tested the value of drugs to which the ancient Hindus ascribed marvellous powers, among other pathological subjects of historical interest investigating that of leprosy. He was an ardent promoter of education. He was appointed a member of the Board of Education, and was one of the~~

~~original fellows of the University of Bombay. As the first native president of the Students' Literary and r Scientific Society, and the champion of the cause of female education, a girls' school was founded in his name, for which an endowment was provided by his friends and admirers. In the political progress of India he took a great and active interest, and the Bombay Association; and the Bombay Branch of the East Indian Association owe their existence to his ability and exertions. He was twice chosen Sheriff of Bombay, in 1869 and 1871. Various scientific societies in England, France, Germany, and America conferred on him their membership. He con- tributed numerous papers to the journal of the Bombay branch of the Eoyal Asiatic Society. He found time to make a large collection of rare ancient Sanskrit manu- scripts at great cost and trouble. But his career was cut short by a sudden stroke of paralysis, to which he succumbed in May 1874. His brother, Dr Narayen Daji (who helped him to set up the charitable dispensary in Bombay), did not long survive him. Dr Bhau was a man of the most simple and amiable character and manners ; his kindness and sympathy towards the poor and dis- tressed were unbounded, and will ever embalm and endear his membry among the Hindus of Bombay, (n. b. w.)~~

~~Bhaunagar, or Bhavnagae, a native state of India, in Kathiawar, within the Gujarat division of Bombay. Its area covers 2860 square miles; in 1881 the population was 400,323, and in 1891 it was 464,671. The estimated gro'ss revenue in 1897'98 was Es.38,27,740, of which Es.9,22,810 was expended on public works, and Es.2,82,000 on famine relief; the tribute was Es.1,54,490. The chief, whose title is Thakor Saheb, is a Gohel Eajput. He was educated at the Eajkumar College at Eajkot, and has visited England. The system of administration, formed during his minority, has been continued with admirable results under his personal supervision, and forms a model for other native states. Bhaunagar suffered terribly from the famine of 1899-1900. About 60 miles of the Bhaunagar-Gondal railway run through the state, with its terminus at the town of Bhaunagar, which is the principal port. The town of Bha'unagab is situated in 21° 45′ N. lat. and 72° 12′ E. long., on the west coast of the Gulf of Cambay. The population in 1881 was 47,792; in 1891 it was 57,663. It is now the chief port in Kathiawar, though only admitting vessels of . small burden. There is a cotton mill, with 208 looms and 12,000 spindles ; several steam presses and ginning factories ; an arts college, with 102 students in 1896-97; a high school, with 384 pupils; a school for girls, entirely supported by the state ; and a state printing-press.~~

~~Bhera, a town of British India, in the Shahpur district of the Punjab, situated in 32° 29′ N. lat. and 72° 57′ E. long., on the river Jhelum. It is the terminus of a branch of the North- Western railway. In 1881 it had a population of 15,166; and in 1891 of 17,428; the municipal income in 1897-98 was Es.19,419. It is an important centre of trade, with manufactiires of cotton goods, metal-work, carving, &c. It has two high schools, municipal and Anglo-Sanskrit, and a printing-press, issuing a newspaper.~~

~~Bhiwani, a town of British India, in the Hissar district of the Punjab, 38 miles south-east of Hissar town by rail. The population in 1881 was 33,762 ; in 1891 it was 36,487; the municipal income in 1897-98 was Es.50,042. It is an important centre of trade with Eaj- putana, and has three factories for ginning and pressing cotton. It has a Baptist mission and a municipal school.~~

~~B H 0 P A L — B I B E E A C H~~

~~Bhopal, a native state of India, in the Central India agency, Jias an area of 6874 square miles. In 1881 it had a population of 954,901 ; and in 1891 of 962,486, giving an average density of 138 persons per square mile. The estimated revenue is Es.40,00,000, and it pays a subsidy of Es.2,00,000 for the Bhopal battalion. For three gen- erations the ruler has been a woman. Sultan Shah Begum succeeded on the death of her mother in June 1901. Besides the Bhopal battalion, a regiment of imperial service cavalry is maintained, under the name of the Victoria Lancers. There is a branch railway from Itarsi to Bhopal city, continued to Jhansi. The British currency has been introduced, and in 1897-98, Es.71,00,000 of Bhopali coins were converted. The residence of the political agent and the headquarters of the Bhopal battalion are at Sehore, 20 miles west of Bhopal city. The city of Bhopal, a railway station, had a population in 1881 of 55,402 ; and in 1891, of 70,338. The palace, with its rock fortress, is called Fatehgarh. An excellent water-supply has been provided from two large artificial lakes. There are two hospitals. In 1897-98 the exports of opium were 678 chests, paying a duty of Es.3,67,500. The state suffered very severely from famine in 1899- 1900. The preliminary returns of the census of 1901 showed a decrease of no less than 40 per cent.* in the population of the Bhopal agency, which is not co-extensive with the state of Bhopal.~~

~~Bhor, a native state of India, in the Deccan division of Bombay, forming one of the Satara Jagirs ; situated among the higher peaks of the Western Ghats. Its area covers 1491 square miles. The population in 1881 was 145,876 ; in 1891 it was 155,659, giving an average density of 104 persons per square mile; and in 1901 it was 137,269, showing a decrease of 12 per cent. ; the estimated gross revenue is Es.4,30,528; the tribute, Es.4643; the military force numbers 117 men ; the number of schools is 35, with 1328 pupils. The chief, whose title is Pant Sachiv, is a Brahman by caste. The town of Bhor is situated in 18° 9′ N. lat. and 73° 53′ E. long., 25 miles south of Poona. In 1891 the population was 6250. There is a state printing-press. The Bhor Ghat, on the northern border of the state, has always been the main pass over the Western Ghats, or means of communication between the sea-coast and the Deccan. Since 1861 it has been traversed by the main line of the Great Indian Peninsula railway.~~

~~Bhuj, a town of India, the capital of the native state of Cutch, in the Gujarat division of Bombay, is situated in 23° 15′ N. lat. and 69° 48′ E. long., at the base of a fortified hill. In 1881 it had a population of 22,-308, and in 1891 of 25,421. It contains some interesting examples of architecture ; a high school, with 131 pupils in 1896-97; a school of art; a library; and a state printing-press.~~

~~Bhutan, a country of the eastern Himalaya, be- tween the Brahmaputra and the southern face of the mountains. Information respecting it accumulates but slowly. In 1873, Captain Godwin Austen accompanied Sir Ashley Eden's mission to the court of the Deb Eaja, and made a survey of the route to Punaka. There has also been a certain amount of geographical sketching com- bined with trigonometrical observations; and there are the route surveys of native explorers. In 1887-88 two native Indian explorers "E. N." and "P. A." traversed a part of Western Bhutan, but were forced to retire owing to the disturbed state of the districts. They re-entered the country on the east from Dewangiri. Here they explored the Kuru, or Lhobrak Chu, which proves to be the largest river in Bhutan. It drains the tract between the Yamdok Tso and Tigu lakes, and is fed by the~~

~~glaciers of the Kulha Kangri and other great ranges. The Lhobrak was finally identified with the Mon^s river, a geographical discovery of some importance. A previously unknown tribe, the Chingmis, were discovered in Eastern Bhutan, who are socially on a higher level than the Bhutias, and differ from them chiefly in the matter of wearing pigtails. The Monla Kachung pass (17,500 feet), by which "E. N." crossed into Tibet, is nearly on the meridian of Gualpara, and is one of the most important passes between Bhutan and Tibet. East of Bhutan, amongst the semi-independent hill states which sometimes own allegiance to Tibet and sometimes assert complete freedom from all authority, the geo- graphical puzzle of the course of the Sangpo, the great river of Tibet, has been solved by the researches of Captain Harman, and the explorations of the native surveyor "K. P." The, Sangpo has been defiiiUjply ascertained to be frhe same river as the BrahmaputiX The tracts inhabited by the aboriginal tribes entitled Lo Nakpo, Lo Karpo, and Lo Tawa ("Lo" signifies "barbarous" in TibetanV are described as a pleasant country; the lands on either side of the Sangpo being well cultivated and planted with mangoes, plantains, and oranges.~~

~~Nothing is known with certainty about the area and population of Bhutan, the former being estimated at 16,800 square miles. The government is nominally vested in a temporal and a spiritual sovereign known as the Deb Eaja and the Dharm Eaja. Eecently official corre- spondence has been written in the name of the latter instead of the former, but it is not known whether this change possesses any special significance. The people are Buddhists in religion. Trade between Bhutan and Bengal is registered at stations in Jalpaiguri district. In 1897-98 the exports were valued at Es. 1,08,000, chiefly wax, musk, wool, ponies, cattle, fruit, and vege- tables; the imports were valued at Es.1,37,000, chiefly cotton piece-goods, betel nuts, tobacco, rice, and metals. Some trade is also conducted at fairs on the Assam frontier.~~

~~Beport on Explorations in Sikkim, Bhutan, and Tibet. Deva Dun, 1889. — Tannee. " Our present Knowledge of the Hima- layas," JS.Cf.S. Proceedings, vol. xiii. (t. h. h.*)~~

~~Biala, the chief town of a government-district in Galicia, Austria, opposite Bielitz, on the river Biala, which at this point forms the boundary between Galicia and Austrian Silesia. It is the chief seat of the Galician textile industry, and an important market for pigs. Popu- lation (1890), 7622 (of whom 5493 were Germans);~~

~~(1900), 8266.~~

~~Biancavilla, a town of the province of Catania, Sicily, Italy, situated at the S.W. foot of Mount Etna, 19 miles N.W. from Catania by rail. It is famous for its oranges, and has flour mills. An Albanian colony was settled here in 1480. Population, about 13,500.~~

~~Biarritz, a seaside resort of France, department of Basses-Pyrenees, in the arrondissement of Bayonne, 61 miles in direct line W. by Nj of Pan, on the railway from Paris vid Bordeaux and Bayonne. Its present popularity is chiefly due to its having been a favourite place of sojourn of the Emperor Napoleon III. and the Empress Eugenie. The town extends in irregular form for nearly two miles along the rugged coast. It is entirely modem, and the chief feature is the casino, finished in 1901. There is an English season early in the year, a Spanish season in the summer, and a Eussian season in~~

~~the autumn. It is connected with Bayonne by a local rail- way and a tramway. Population (1881), 6488; (1896), 10,544, (comm.) 11,869 ; (1901), 12,812.~~

~~Biberach, a town of Wilrtemberg, Germany, 23~~

~~miles S.S.W. from Ulm. A monument to the poet Wie- land, born near here in 1733 (died 1813), was put up in 1881. Biberach has various textile industries, and manu- factures of toys and zinc wares ; bell-easting ; and its fruit markets are famous. Population (1900), 8390.~~

~~Bicycle. See Cycling.~~

~~Biddeford, a city of York county, Maine, U.S.A., situated in the south-western part of the state, in 43° 30′]Sr. lat. and 70° 27′ W. long., on the west bank of the Saco river, which is here not navigable. It is supplied with water from the Saco, and a fall in the river at this point affords excellent water-power, which has been utilized to a great extent, principally in the manufacture — of cotton goods, in which Biddeford holds high rank. It is on two branches of the Boston and Maine railway. Population (1880), 12,651 ; (1890), 14,443 ; (1900), 16,145.~~

~~Bidder, George Parlcer (1806-1878), English engineer, was born at Moreton Hampstead, in Devonshire, on 14th June 1806. From a very early age he manifested an extraordinary natural aptitude for calculation, which induced his father, who was a stone-mason, to exhibit him as a ” calculating boy.” In this way his talent was turned to profitable account, but his general education was in danger of being completely neglected. Interest, however, was taken in him by some of those who hap- pened to witness his performances, among them being Sir John Herschel, and it was arranged that he should be sent to a school in Camber Well. There he did not remain long, being removed by his father, who wished to exhibit him again, but he~~

~~was saved from this misfortune and enabled to attend classes at Edinburgh University, largely through the kindness of Sir Henry Jardine, to whom he subsequently showed his gratitude by founding a " Jar- dine Bursary" at the university. On leaving college in 1§24 he received a post in the Ordnance Survey, but gradually drifted into engineering work. In 1834 Kobert Stephenson, whose acquaintance he had. made at Edin- burgh, offered him an appointment on the London and Birmingham railway, and in the succeeding year or two he began to assist George Stephenson in his parliar mentary work, which at that time included schemes for railways between London and Brighton and between Manchester and Rugby vid the Potteries. In this way he was introduced to engineering and parliamentary practice at a period of great activity which saw the establishment of the main features and principles that have since governed English railway construction. He is said to have been the best witness that ever entered a committee-room. He was quick to discover and take advantage of the weak points in an opponent's case, and his powers of mental calculation frequently stood him in good stead, as when, for example, an apparently casual glance at the plans of a railway enabled him to point out errors iu the engineering data that were sufficient to secure rejection of the scheme to which he was opposed. In consequence there was scarcely an engineering proposal of any importance brought before Parliament in connexion with which his services were not secured by one party or the other. On the constructive side of his profession he . was also busily occupied. In 1837 he was engaged with E.- Stephenson in building the Blackwall railway, and it was he who designed the peculiar method of disconnect- ing a carriage at each station while the rest of the train went on without stopping, which was employed in the early days of that line when it was worked by means of a cable. Another series of railways with which he had much to do were those in the eastern counties which afterwards became the Great Eastern system. Nor was his practice confined to England. He advised on the construction of the Belgian railways ; with K. Stephenson~~

~~he made the first railway in Norway, from Christiania to Eidsvold ; he was engineer-in-chief of the Eoyal Danish railway ; and he was largely concerned with railways in India, where he strongly and successfully opposed break of gauge on through-routes. But though he sometimes spoke of himself as a mere " railway engineer," he was LQ reality very much~~

~~more ; there was indeed no branch of engineering in which he did not take an interest, as was shown by the assiduity with which for half a cen- tury he attended the weekly meetings of the Institution of Civil Erifgineers and joined in the discussions. He was one of the first to recognize the value of the electric telegraph. That invention was in its infancy when, in 1837, jointly with R. Stephenson he recommended its introduction on a portion of the London and Birmingham and on the Blackwall lines, while three years later he advised that it should be adopted to facilitate the work- ing of the single line between Norwich and Yarmouth. It was he, too, who persuaded Cooke, Stephenson, and others to join him in founding the Electric Telegraph Company, which enabled the public generally to enjoy the benefits of telegraphic communication. In hydraulic engineering, he was the designer of the Victoria Docks (London), being responsible not only for their construction, but also for what was regarded by some people at the time as the foolish idea of utilizing the Essex marshes for dock ac- commodation on a large scale. It may be mentioned, too, that he was one of the engineers consulted lq regard to the London main drainage scheme, and the Government of the day frequently sought his advice outpoints both of naval and military engineering. He died at Dart- mouth, 28th September 1878, retaining his remarkable powers of calculation down to the very end of his life.~~

~~(h. m. b.)~~

~~Bideford, a municipal borough and market town in the Barnstaple parliamentary division of Devonshire, England, on the Torridge, 9 miles S.W. of Barnstaple by rail. The customs port of Bideford was in 1882 included in the port of Barnstaple. Eecent structures are an Anglican, a Wesleyan Methodist, and a Roman Catholic church, a public hall, the post office, market buildings, an iufirmary, and new buildings for the municipal, science, art, and technical schools. The water-works have been extended^ Shipbuilding has ceased, but there are now extensive cuff and collar manufactures, a foundry, and a pottery. Area, 3398 acres; population (1881), 6512;~~

~~(1901), 8732.~~

~~Biebrich, a town of Prussia, province of Hesse- Nassau, on the right bank of the Rhine, 3 miles S. from Wiesbaden, of which it serves as the river port. It has a non-commissioned officers' school, and a castle of the grand-duke of Luxemburg (1704-6). There are ironworks, and also cement, artificial wool, and other manufactures. JPopulation, inclusive of the adjacent Mosbach, (1885)~~

~~9669, (1895) 12,292, (1900) 15,048.~~

~~Biel, or BiBNNE, a town in the Swiss Canton of Bern, near the north end of the lake of the same name, and 21 miles by rail from Bern. The parish church of St Benedict was founded in 1451, and contains some good painted glass, dated 1457. In the town is the important Scliwab Museum, containing many prehistoric and Roman antiquities. At Biel is the technical school for West Switzerland, as well as schools for watchmaking and rail-way science, the town being an important railway centre. There is a funicular railway from the town north-west up to the hUl of Magglingen or Macolin. Population (1880), 11,613 ; (1888), 15,289 ; (1900), 21,958. In 1888 it num- bered 12,782 Protestants and 2176 Romanists, while 10,505 were German-speaking, and 4697 French-speaking.~~

~~Bielefeld, a town of Prussia, province of Westphalia~~

~~68 miles by rail S.W. from Hanover. It is the chief centre of the linen industry of Westphalia, and an im- portant seat for the manufacture of plush, sUk, and hosiery, and for bleaching. The old fort of Sparenberg ■was burnt down in 1877, but rebuilt. Population (1885),~~

~~34,931 ; (1900), 62,464.~~

~~Bielitz (Bohemian or Czech, Bilsko; Polish, Bielsko), chief town of district of the same name in Austrian Sile sia. In 1890 the population of the district, a German enclave, was 71,333, of whom 43,350 were Catholic, 26,663 Protestant, and 1320 Jews; in 1900, 75,425. Population of town (1890),~~

~~14,573; (1900), 16,885. It has important woollen and linen industry, and manufac- tures of jute, paper, machinery, &c.~~

~~Biella, a town and episcopal see of the province of Novara, Piedmont, Italy, on the N.W. edge of the valley of the Po, 30 miles by rail N.W. from Vercelli. It has statues to General Lamarmora, Garibaldi, and Sella (mineralogist, died 1884). Biella is the seat of very considerable woollen, cotton, and clothing manufactures, also ironworks and foundries, tanneries, sawmills, turnery shops, and hat factories. It has a technical school. Pop- ulation about 15,000. In the neighbourhood are several hydropathic establishments, e.g., Oropa, Cossilla, &c.~~

~~Bigelow, John (1817-~~

~~—), American journalist Men, New York, 26th~~

~~and diplomat, was born at Mali~~

~~November 1817. He graduated at Union College, 1835 ; was a practising lawyer in New York several years after 1839; took up journalistic work, becoming joint-owner (with William CuUen Bryant) and managing editor of the New York Evening Post (1849-61); was United States consul at Paris, 1861-64, and minister to Prance, 1864-67,' and was secretary of state for the state of New York, 1876-77. He wrote books of travel, of popular biography, or of historical or political discussion, &c., from time to time; but his principal literary achieve- ments were editions, between 1868 and 1888, of Franklin's autobiography and autobiographical writings, copiously annotated; and of the complete works of Pranklin, in ten octavo volumes (New York, 1887-89). These edi- tions were based, in part, upon the editor's personal investi- gations of manuscript sources in France and elsewhere, and supplanted the well-known, long serviceable, but less accurate edition by Jared Sparks (Boston, 1836-40). Mr Bigelow was a close friend of Samuel J. Tilden, and became his literary executor, editing a two-volume collection of his speeches and other political writings, issued in 1885. As re- gards its unity of plan and symmetry of literary execution, Mr Bigelow's most noteworthy book is a brief biography of his editorial associate Wi^iam Cullen Bryant (1890).~~

~~Big RapidSi capital of Mecosta county, Michigan, U.S.A., situated on Muskegon river, in the central part of the lower peninsula. Population (1900), 4686.~~

~~Bijapur, an ancient city and modern district of British India, in the Carnatic or Canarese-speaking divi- sion of Bombay. The city was made the administrative headquarters of the district in 1885 ; it is a station on the Southern Mahratta railway, 60 miles south of Shola- pur. The population in 1881 was 11,424 ; in 1891 it was 16,759. The water-supply is derived from an elaborate system of reservoirs and aqueducts, which was restored in part as a famine relief work. Bijapur is probably the most picturesque collection of ruins in all India.~~

~~The district of Bijapuk, formerly called Kaladgi, occu- pies a barren plain, sloping eastward from a string of feudatory Mahratta states to the Nizam's dominions. It contains an area of 5668 square miles. The population~~

~~in 1891 was 796,339, being 140 persons per square mile. Classified according to religion, Hindus numbered 703,604 ; Mahommedans, 88,522 ; Jains, 3353 ; Christians, 827, of whom 42 were Europeans; "others," 33. In 1901 the popiilatiok was 735,041, showing a decrease of 8 per cent., compared with an increase of 27 per cent, in the preceding decade, and a decrease of 21 per cent, in the period between 1872 and 1881. These changes in population reveal the effects of famine, which was very severely felt in 1876-78, and again in 1899-1900. The total amount of land reve- nue and rates was returned as Es.18,52,507, the iacidence of assessment being about eight annas per acre ; the num- ber of police was 684. In 1897-98, out of a total culti- vated area of 2,608,290 acres, only 16,972 were irrigated from tanks, &c. The principal crops are millet, wheat, pulse, oil-seeds, and cotton. There are considerable man- ufactures of cotton and silk goods and blankets, and eight factories for ginning and pressing cotton. The East Dec- can line of the Southern Mahratta railway traverses the district from north to south. In 1897-98 there were 313 schools with 15,081 pupUs, showing one viUage with a school to 23 square miles of area, and 1-9 pupils to every hundred of the population. There were four printing presses, each issuing a weekly newspaper in the vernacu- lar. The municipalities had a total income~~

~~of Es.72,956, the incidence of taxation being 14 annas per head. The death-rate in 1897 was 46 per thousand for the district, rising to 60 for the city.~~

~~Bijawar, a native state of India, in the Bundelkhand agency. Area, 974 square miles ; population (1891), 123,414 ; average density, 127 persons per square mile ; revenue (1897-98), Es.1,63,767. The chief, whose title is Maharaja, is a Eajput of the Bundela clan, descended from Chhatar Sal, the champion of the independence of Bundelkhand in the 18th century. In 1901 the state was under British administration. The town of Bijawar is situated in 24° 37′ N. lat. and 79° 31′ E. long.~~

~~Bijnor, or Bijnaub, a town and district of British India, in the Rohilkhand division of the North- West Pro- vinces. The town is about three miles from the left bank of the Ganges. The population in 1891 was 16,236 ; the municipal income in 1897-98 was Rs.10,320. It conducts a large trade in sugar. The American Methodists have a mission, which maintains some aided schools, and there is an English high school for boys. The district of Bijnor has an area of 1898 square miles, and had a pop- ulation in 1891 of 794,070, being 417 persons per square mile. Classified according to religion, Hindus numbered 525,002; Mahommedans, 267,162; Christians, 980, of whom 30 were Europeans ; " others," 998. In 1901 the population was 779,361, showing a decrease of 2 per cent. The land revenue and rates were Es.13,99,964, the inci- dence of assessment being E.l : 2 : 4 per acre ; the number of police was 2459. The country is watered in most parts by streams from the hills. A series of small canals has been constructed. Out of a total cultivated area in 1896- 97 of 601,601 acres, 18,958 were irrigated from canals, and 26,969 from wells. Sugar is largely exported. A line of the Oudh and Eohilkhand railway from Morada- bad to Saharanpur has been opened thi-ough the district.~~

~~Bikanir, a native state of India, in the Eajputana agency, with an area of 2309 square miles. The popu- lation in 1881 was 509,021, and in 1891 was 831,955, giving an average density of 36 persons per square mile. In 1901 the population was 584,712, showing a decrease of 30 per cent, due to the results of famine. The present Maharaja, Ganga Singh, was born in 1879, succeeded in 1887, and was intrusted with full powers in 1898. In 1897-98, the gross revenue was Es.21,46,064. The~~

expenditure included Es.1,41,191 on railways, and E.s.1,54,462 on irrigation. The military force consists of 500 men, besides the imperial service corps of the same strength, maintained at a cost of Es.1,56,000. This corps took part in the China expedition of 1900-1. There are 17 schools with 1606 pupils, including a high school affiliated to the university of Allahabad, a school for the sons of nobles, and a girls' school called after Lady Elgin. The railway from Jodhpur is being extended towards Bhatinda in the Punjab ; on the northern border, the Ghaggar canal in the Punjab irrigates about 6000 acres. Coal has been found in the state. Drought is of common occurrence. The famine of 1899-1900 was severely felt. The chief agricultural stock consists of camels, and an annual show has been started to improve the breed. The principal industries are the weaving of woollen fabrics, carving, and the making of ivory bracelets ornamented with gold.

The city of Bikanik has a raUway station. The popu- lation in 1881 was 43,283; in 1891 it was 56,252. It has special manufactures of fine blankets and sugar-candy.

Bilaspur, a town and district of British India in the Chhattisgarh division of the Central Provinces. The town is situated on the right bank of the river Arpa. The popu- lation in 1891 was 11,122. It is now an important junc- tion on the Bengal-Nagpur railway, where the two lines from the west meet on their way to Calcutta, 255 miles from Nagpur.

The district of Bilaspur has an area of 8341 square miles. The population in 1891 was 1,163,897, being 140 persons per square mile. Classified according to religion, Hindus numbered 1,069,457 ; Mahommedans, 11,101 ; aborigines, 93,126, chiefly Gonds; Christians, 128, of whom 70 were Europeans; "others," 85. In 1901 the population was 1,011,612, showing a decrease of 13 per cent., compared with an increase of 14 per cent, in the preceding decade. The total amount of land revenue and rates is returned as Es.5,98,395, the incidence of assessment being 4 annas per acre of assessed area ; number of police, 611. In 1897-98, out of a total cultivated area of 1,496,166 acres, only 3169 were irrigated from tanks, &c. The principal

~~crops are rice, wheat, other food-grains, oil-seeds, and a little cotton. There are considerable manufactures of cotton cloth. In 1897-98 the number of schools was 168, attended by 9606 pupils. Bilaspur, which was formerly a very isolated tract, is now traversed in three directions by lines of the BengAl-Nagpur railway. It suffered severely from the famine of 1896-97. In 1897 the general death-rate was as high as 90 per thousand, rising to 297 in Bilaspur town. It suffered no less severely in 1900, when in May the number of persons relieved rose to one-fourth of the total population.~~

~~Bilbao, a town of Spain, capital of the Basque pro- vince of Biscay, on the river Ansa orNervion, about 6 miles from the sea. Few cities in Spain have grown so rapidly in size, importance, and wealth as Bilbao in the last thirty years. The population, 17,649 in 1870, rose to 60,734 in 1887, 74,076 in 1897, and 83,213 in 1900. Since 1876 a completely new town has been mapped out, and " new " Bilbao is no longer confined to the right bank of the river. Eine broad streets, splendid squares and public gardens, hotels, villas, palatial new public buildings, a new post office, and numerous schools have come into existence, which vie with those of Madrid and Barcelona. The part of the town on the right bank is, however, still the great centre of business, the narrow streets containing the best of shops. There, too, are the banks, the town hall, the principal clubs, and the four principal churches. In~~

~~and around Bilbao there are more than thirty convents and monasteries, and at Olaviaga, about a mile off, the Jesuits have built a university, attended by 860 students. Public education is not, however, entirely in the hands of the priesthood and nuns : there are an institute, a normal school to train teachers, a school of arts and han dicrafts, a nautical school, and sixteen public primary schools for both sexes. A fine modern theatre has been erected. '~~

~~A meteorological institute publishes very complete statistics, The mean temperature in 1898 was 58-3° F., the maximum 106°, and the minimum 28-4°. Only eighty- five days were classed as clear, and the total rainfall for the year was 36-22 inches, that being 10-1 inches less than in 1897. During the year 1898 the marriages were 6-96 per 1000, the deaths 32-19, the living births 40-62, the legitimate children 54-26, the illegitimate 11-78.~~

~~The foundling hospital had 1026 inmates at the close of 1898, with a death-rate of 102-29 per 1000. The pro- sperity of Bilbao since 1874 has been chiefly due to the development of the mining and metallurgic industries. By reason of this the town has become the centre of a network of railway lines unrivalled in any province in Spain, and the Harbour Works Board, constituted in 1877, has improved the river channel and the bar, made wharves and embankments, lighted the lower third of the river by electricity, so as to allow vessels to enter by night, and constructed a breakwater and counter-mole outside the bar of the river Nervion, between Santurce, Portugalete, and the opposite headland at Algorta, so as to secure deep anchorage and easy access to the river. Dry-docks were constructed in 1896. The sums collected as customs duties in Biscay, 96 per cent, of which were drawn from the port of Bilbao, amounted in 1898 to £471,275 (at the old fixed rate of 25 pesetas to each pound sterling). The general movement of shipping in the same year showed 4006 vessels of 2,352,157 tons entered and cleared. Spanish vessels numbered 1764 of 494,877 tons, chiefly engaged in the coasting trade. Great Britain has been at the head of the shipping movement since 1880. In 1898, 157 British vessels entered, with cargoes of 133,701 tons, valued at £313,492, whilst 291 entered in ballast, with a tonnage of 269,876; 6 vessels cleared in ballast with a tonnage of 3430, and 1317 vessels with cargoes of 1,105,696 tons, valued at £1,522,823. The exports are chiefly iron ores, of which Great Britain took from all sources 3,043,000 tons in 1898, France 263,000, Holland and Belgium 968,000, in reality in transit for Germany. The new ironworks become more important every year. Five large firms in 1898 employed over 4000 persons, and produced 191,220 tons of pig iron, 83,423 tons of steel, and 80,910 tons of coke. The export of pig iron rose from 21,962 tons in 1896 to 51,942 tons in 1898. In the coasting trade the exports are mostly pig iron, codfish, and some products of local industries and agriculture. The exports of wines, in great part brought by rail from Navarre and the Ebro valley, has increased from 283,000 gallons in 1894 to 873,000 in 1898. The imports in 1898 included 407,837 tons of coal and 386,792 tons of coke from Great Britain. This total was seriously affected by the Welsh coal strike ; in the previous year 431,273 tons of coal alone were imported, chiefly from England. Of great importance also were woods of all kinds from Sweden and Finland, and coast- wise from Asturias (141,000 tons). Besides the mining and metallurgic industries, Bilbao has breweries,~~

~~tanneries, flour mills, glass works, brandy distilleries, and paper, soap, cotton, and mosaic factories. In 1874 Bilbao was for months besieged unavailingly by the second Carlist pretender. Its relief enabled it to retain its title of "Invicta Villa." (a. e. h.)~~

~~Bilejik, chief town of the Ertoghrul sanjak of the Brusa vilayet ia Asia Minor (Byzantine JSeZocome), altitude 1900 feet, situated on a hill 2\ miles from its station on the Ismid-Angora railway. It is an important centre of the silk industry, and has several silk-spinning factories. Population, 10,500 (Moslems, 7200 ; Christians, 3300).~~

~~Bilin (Czech, Bilina), a town in the government- district, of Dux, in Bohemia, Austria, situated on the Biela, about 5 miles south-west of Teplitz. It is chiefly known for its alkaline mineral waters (from the " Biliner Sauerbrunnen ") of which some two million bottles are annually exported. Another export article is a salt re- covered from the waters by evaporation. Large quantities of lignite are mined in the vicinity, where there is also a number of limestone quarries. The town, which is very old and possesses the ruias of a castle dating from the 11th century, is further . distinguished by the largest mass of phonolite or clinkstone in Bohemia — ^the " Biliner Stein " — about 1760 feet high. Indeed, the town is sur- rounded by basaltic rooks. Population (1890), 6661, chiefly German; (1900), 7871.~~

~~Billiards. — Since 1875 the game of billiards has developed in a somewhat curious manner. Tables, balls, cues, and other implements have not been radically altered, though in some respects their manufacture has improved, but the best class of professional play was, if length of breaks be the measure, undoubtedly better in 1900 than it was twenty-five years before. On the other hand, public matches played now are for the most part less genuine struggles than of old. The reasons for these changes are not difficult to explain. Formerly the stakes were more generally real, and were the chief inducement for exertion and the reward of success ; games were short and slow, great caution being exhibited, and players had to be con-~~

~~tent with slender pay. More recently gate-money has far exceeded the value of any stake, so that the problem before players has been less how to win than how to get the most entrance-money from the public. Much atten- tion has been given to this question, and many clever persons have assisted in its solution ; but unquestionably the chief credit for developing the game must be given to John Eoberts, sen., and to his son of the same name who has long held the position of champion. Indeed, their careers form the. history of modern billiards from 1849, when the elder Eoberts challenged Kentfield (who declined to play) for the championship. No useful comparison can be made between the last-named men, and the change of cushions from list to india-rubber further complicates the question. Kentfield represented the best of the old style of play, and was a most skilful performer; but Roberts had a genius for the game, combined with great nerve and physical power. This capacity for endurance enabled him to practise single strokes tUl they became certainties, when weaker men would have failed from sheer fatigue ; and that process applied to the acquisition of the spot-stroke was what placed him decisively in front of the players of his day until a younger generation taught by him came forward. . His all-round play, especially in strokes which required great strength or power of cue, was better for at any rate twenty years than that of any conteniporary ; yet his main influence in developing the game during that period lay in his mastery of the spot-stroke, which became practically the measure of proficiency. " Tell me how many spots you can make, and I will handicap you" was then a common remark. In 1869 the younger generation had caught him up, and soon afterwards surpassed him at this stroke ; both W. Cook and J. Eoberts, jun., carried it to greater perfection, but they were in turn put entirely in the shade by W. MitcheU and W. J. Peall. The latter's remarkable break (3304), made at the Aquarium in 1890,~~

~~has never been, approached. But this very perfection killed the stroke, for the public wearied of its monotony. Adroit use of this objection was made by professional players who could not play the stroke so well, and " spot-barred " matches were generally introduced. It is curious to realize that John Eoberts, sen., developed the game chiefly by means of spot-play, whereas his son continued the process by abandoning it. The public, however, liked quick scoring and long breaks, and therefore a substitute had to be devised. This was provided chiefly by the younger Eoberts, whose fertility of~~

~~resource and manual dexterity eventually placed him by a very long way at the head of his profession. In exhibition matches he barred the spot-stroke and gave his attention chiefly to play which kept the three balls near the spot and xmder control not far from each other. Thus instead of a long succession of winning hazards he developed a series of two winning hazards (one from where the red ball hap- pened to lie, the next from the spot) followed by a cannon. This style of play was soon brought to great perfection. Stroke followed stroke with rapidity and certainty nearly equalling spot-play, the main difference being that three strokes scored 8 instead of 9. This method is known as top-of-the-table play, and may perhaps be best defined as an endeavour, after every cannon, to leave the opponent's ball near the spot and the red ball near a pocket, so that the next stroke may be an easy winning hazard, to be so played that either a spot-stroke or cannon may be left. Like spot-play, but even to a greater degree, it is a dan- gerous game for a bad hazard-striker, because in case of a break-down the balls are likely to be left near each other, close to a pocket, and consequently the opening is favourable to the adversa:^y. On the other hand, it presents a rapid means of scoring to a good hazard- striker; few of the strokes are very difficult, judgment rather than execl^tion being required, while strength or force is seldom needed after the necessary position has been gained.~~

~~The next development was borrowed from the French game, which consists entirely of cannons ; and in America it has practically superseded other forms of the game. Both French and American professors, giving undivided attention to cannons and not being permitted to use the push-stroke, arrived at a perfection in controlling or " nursing " the balls to which English players could not pretend ; yettheprinciplesinvolved inmaking along series of cannons were applied, and leading professionals soon acquired the necessary delicacy of touch. The plan is to get the three balls close to each other, say within a space which a hand can cover, and not more than from four to eight inches from a cushion. The striker's ball should be behind the other two, one of which is nearer the cushion, the other a little farther off and farther forward. The striker's ball is tapped quietly on the one next the cushion, and hits the third ball so as to drive it an inch or two in a line parallel to the cushion. The ball first struck rebounds from the cushion, and at the close of the stroke all three balls are at rest in a position exactly~~

similar to that at starting, which is called by the ‘EierLch.position mdre. Thus each stroke is a repetition of the previous one, the positions of the balls being relatively the same, but actually forming a series of short advances along the cushion. With the push-stroke a great number of these cannons could be quickly made, say 50 in 3^ minutes ; and, as that means 100 points, scoring was rapid. Most of the great spot- barred breaks contained long series of these cannons, and their value as records is correspondingly diminished, for in such hair’s-breadth distances very often no one but the player, and sometimes not even he, could tell whether a stroke was made or missed or was foul. Push-barred, the cannons are played nearly as fast ; bu;t with most njen the

series is shorter, inass4 strokes being used when the cannon cannot be directly played. To this in professional hands there is no great objection, but with ordinary amateurs the danger of damaging the cloth is so great, and the chance of bringing off the stroke so small, that it would be more sensible to bar the masse than to bar the push. It is of course understood that from human and other imperfection the position m&re is soon lost, and play has to be modified with the view of regaining it as quickly as possible. The most recent alteration in play is that the push-stroke is generally abandoned, perhaps with advantage ; the game, therefore, as usually practised is push- and spot-barred.

A few words about the championship are here appro- priate. When Kentfield declined to play in 1849, John Roberts assumed the title, and held the position till 1870, when he was defeated by his pupil W. Cook. The follow- ing table gives particulars of every match played for the championship, from which it will be seen that four men only have held that position, Roberts, sen.. Cook, Roberts, jun., and Bennett; and that since 1885 no competitor has contested the younger Roberts’s claim.

Points.

Date.

~~Players.~~

~~Won by~~

~~1200~~

~~Feb. 11, 1870~~

~~Cook 6. Roberts, sen. .~~

~~117~~

~~1000~~

~~April 14, 1870 .~~

~~Roberts, jun., 6. Cook .~~

~~478~~

~~1000~~

~~May 30, 1870~~

~~Roberts, jun., 6. Bowles~~

~~246~~

~~1000~~

~~Nov. 28, 1870~~

~~Jos. Bennett 6. Roberts, jun.~~

~~95~~

~~1000~~

~~Jan. 30, 1871~~

~~Roberts, jun., &. Bennett~~

~~363~~

~~1000~~

~~May 25, 1871~~

~~Cook 6. Roberts, jun. .~~

~~16~~

~~1000~~

~~Nov. 21, 1871~~

~~Cook 6. Jos. Bennett .~~

~~58~~

~~1000~~

~~Mar. 4, 1872~~

~~Cook 6. Roberts, jun. .~~

~~201~~

~~1000~~

~~Feb. 4, 1874~~

~~Cook 6. Roberts, jun. .~~

~~216~~

~~1000~~

~~May 24, 1875~~

~~Roberts, jun., 6. Cook .~~

~~163~~

~~1000~~

~~Dec. 20, 1875~~

~~Roberts, jun., 6. Cook .~~

~~135~~

~~1000~~

~~May 28, 1877~~

~~Roberts, jun., 5. Cook .~~

~~223~~

~~1000~~

~~Nov. 8, 1880~~

~~Jos. Bennett 6. Cook .~~

~~51~~

~~1000~~

~~Jan. 12, 13, 1881 .~~

~~Jos. Bennett 6. Taylor .~~

~~90~~

~~3000~~

~~March 30, 31, and~~

~~April 1, 1885~~

~~Roberts, jun., 6. Cook .~~

~~92~~

~~3000~~

~~June 1,2, 3,4, 1885~~

~~Roberts, jun. , 6. Jos. Bennett~~

~~1640~~

~~These games were all played on three-inch-pocket tables, and Roberts has fairly contended that he remained cham- pion till beaten on such a table under the rules in force when he won the title or under a new code to which he was a con- senting party. The nearest approach to a match for the championship since 1885 was that between Roberts and Dawson (M:arch20 to Aprils, 1899) of 18,000 up, level, half the game at the Argyll Hall, Argyll Street, London, and half at the Egyptian Hall, Piccadilly. The main departure from a championship game lay in the table, which had ordinary, though not easy pockets, instead of three-inch pockets. Thematchexcited much interest, because Dawson, who had already beaten North for the Billiard Association championship, was the first man for many years to play Roberts even. The performances of the players were often disappointing, particularly those by the champion, and the scores at the close of the first week's play (Roberts, 9001 ; Dawson, 8721) proved how closely the game was contested. Next week's play in the room to which Roberts was ac- customed resulted in his favour, and he secured the game by 1814 points. Nevertheless, the result showed clearly that Dawson had greatly lessened the gap which for many years had separated Roberts from the next best player, and that he was entitled to challenge the champion on even terms. After this Dawson improved materially', and in 1899, for the second time, he won the Billiard Association championship. His position was challenged by Diggle and Stevenson, who contested a game of 9000 points. Steven- son won by 2900, but lost to Dawson by 2225 points ; he beat him in~~

~~January 1901, but Dawson reasserted his superiority before the close of the spring.~~

~~A matter closely connected with the development of the game is the absence of a satisfactory and aTithoritative code~~

~~of laws or rules. Several codes more or less faulty exist, of which perhaps those of the Billiard Association are the best, but they do not command universal respect or accept- ance. The want of a club or committee of sufficiently representative persons who shall be to billiards as the M.C.C. is to cricket has made itself apparent.~~

~~Record scores at billiards have greatly altered since W. Cook's break of 936, which included 292 spots, and was made in 1873. It may be useful to mention a few of the great breaks, since they are in some degree a measure of development; but too much weight must not be given to them, for tables vary considerably between easy and diffi- cult ones, and comparisons are apt to mislead. Peall, in addition to the break of 3304 (1890) already mentioned, has made 2031 (1888), and has scored 1000 points in 44 minutes. Mitchell has made several breaks over 1000 ; while Memmott, from Australia, a very sound and steady player, is credited with 423 consecutive screw-back spot- strokes, which total 1269 points. Roberts, the champion, has made 1392 and 1017 spot-barred, and innumerable breaks between 1000 and 100, of which 155 (made in a game for the championship) is far from being the least remarkable. All the leading players have made Tery long spot-barred breaks, but as some were made push-in and others push-barred, whUst tables varied, no useful purpose is' served in recording them.~~

~~Respecting the various games of Pool, it may be said that the old-fashioned Following Pool has been to a great extent superseded by Black Fool, in which hazard-striking has more influence than safety play, and players can join and leave the game on giving due notice. Single Pool, a very good game, is now seldom seen, but Pyramids is still played, though nowadays knocking a ball off the table is a foul stroke, and is scored against the player. Snooker, a game combining pool and pyramids, is becoming popular, probably because of its additional element of chance. No~~

~~universally accepted rules of this game exist, so players must agree before commencing how they will play, or follow the custom of the room.~~

~~Snooker is described In the volume on Billiards of the " Bad- minton Library," from which the following Is extracted: — "Th? pyramid balls are set up in the usual way, and the striker always uses the white ball. The black ball is set on the billiard spot, the pink on the centre spot. Blue is placed just below the apex- ball of the pyramid, brown on the centre spot of the D, with yellow an'd green on the right and left corner spots. ... A red ball counts one, yellow two, green three, brown four, blue five, pink six, and black seven. The score, if two persons are playing or sides are formed, may be marked on the board as at billiards. A red ball must be taken before a coloured ball can be played at ; if the striker, playing on a red, holes it, and takes a coloured ball also, the latter does not count, and is spotted. If, playing on the red, he fails to hole it, but holes a coloured ball, the value of the latter is- scored to the other side. . . . After taking a red, the striker must play on one of the coloured balls. If he holes one of them, any other balls that go down by the same stroke count to him. All coloured balls which are holed must be spotted immediately ; it the striker plays before all are spotted, the stroke is foul. No red ball is ever put up. ... If the striker gives a miss, the ball is left where it finally stops. If the striker is by law obliged to play on a red ball or on a coloured ball, but from the position of his own ball is unable to do so directly, he is said to be snookered ; he must then make a hondrfide shot at the proper ball off the cushion, the penalty if he misses being the minimum penalty. . . . When all the red balls have been holed the others must be taken In proper pool order." For greater detail, reference to the "Bad- minton" volume must be made.~~

~~To the bibliography of Billiards given in the article in the ninth edition of the Encyclopedia Britannica the following should be added : — W. Cook. Billiards. Burroughes and Watts. — J. P. Buchanan. Hints on Billiards. Bell and Sons. — Modern Bill- iards. The Brunswlck-Balke-CoUender Co. , New York. — Vignacx. Manukl du Billard. Paris, Delarue. — Bboadpoot. Billiards. Badminton Library (Longmans). — Locock. Side and Screi/r (Longmans). For those interested in the purely mathematical as- pect of the game — Hemming. Billiards Mathematically Treated. MacmlUan. (\f_ b^.)~~

Billiton (Dutch, Blitoeng), an island E. of Banca and W. of Borneo. Its area is 1847 square miles. The coasts are sandy or marshy ; the geological formation Devonian and granitic, with laterites ; the surface rises to an altitude of from 325 to 1670 feet. The rainfall is heavy, 102 to 126 inches. The products resemble those of Banca. In 1898-99, 82 mines (7553 workmen) pro duced 93,603 piculs (a picul = 159 flb). The imports and exports, exclusive of tin, have heen valued together for recent years at £85,000. The population of 41,558 includes 96 Europeans and ahout 12,000 Chinese. The natives belong to two classes, the Orang Darat, the aborigines (probably Malayan colonists), and the Orang Sekah, who live in boats. The capital; Tanjong Padang, on the west coast, has a population of 12,000.

Billroth, Albert Christian Theodor (1829- 1894), Viennese surgeon, was born on 26th April 1829, at Bergen, on the island of Eiigen, his family being of Swedish origin. He studied at the Universities of Greifswald, Gottingen, and Berlin, and after taking his doctor's degree at the last in 1852, started on an educar tional tour, in the course of which he visited the medical schools of Vienna, Prague, Paris, Edinburgh, and London. On his return to Berlin he acted for a time as assistant to Professer Langenbeck, and then in 1859 accepted the professorship of surgery at Zurich. Eight years later he was invited to fQl the same posiijion at Vienna, and in that city the remainder of his professional life was spent. In 1887 he received the distinction, rarely bestowed, on members of his profession, of a seat in the Austrian Herrnhaus. He died at Abbazia, a winter resort on the Adriatic, where he had a beautiful vUla, oil 6th February 1894. Billroth was one of the most distinguished sur- geons of his day. His boldness as an operator was only equalled by his skill and resourcefulness ; no accident or emergency could disturb his coolness and presence of mind, and his ability to invent or carry out any new pro- cedure that might be demanded in the particular case with which he was dealing, gained for him the appellation of " surgeon of great initiatives." At the same time he was full of consideration for the comfort and well-being of his patient, and never forgot that he had before him a human being to be relieved, not a mere " case ". for the

~~display of technical dexterity. He was especially inter- ested in military surgery, and during the Franco-G-erman war volunteered to serve in the hospitals of Mannheim and Weissenburg. His efforts did much to improve the arrangements for the transport and treatment of the wounded in war, and in a famous speech on the War Budget in 1891, he eloquently urged the necessity for an improved ambulance system, pointing out that the use of smokeless powder and the greater precision of the arms of modern warfare must tend to increase the number of men wounded, and that therefore more efficient means must be provided for removing them from the battlefield. Possessing a clear and graceful style, he was the author of numerous papers and books on medical subjects ; his Lectures on General Surgical Pathology and Therapeutics ran through many editions, and were translated into many languages, and the same is true of his Handbook of Sick Nursing at Home and in Hospitals. He was of an exceedingly artistic disposition, and in particular was devoted to music. A good performer on the pianoforte and violin, he was an intimate friend and admirer of Brahms, many of whose compositions were privately performed at his house before they were published. At the time of his death he was engaged on a book on the Physiology of Music. (h. m. e.)~~

~~Bills of Exchange.— The Bills of Exchange Act,~~

~~1882, codifies for the United Kingdom the law relating to bills of exchange, promissory notes, and cheques. One peculiar Scottish rule is preserved, but in other respects uniform rules are laid down for England, Scotland, and Ireland. After glancing briefly at the history of these instruments, it will probably be convenient to dis- cuss the subject in the order followed by the Act, namely, first, to treat of a bill of exchange, which is the original and typical negotiable instrument, and then to refer to the special provisions which apply to promissory notes and cheques. Two salient characteristics distinguish negotiable instruments from other engagements to pay money. In the first place, the assignee of a negotiable instrument, to whom it is transferred by indorsement or delivery according to its tenor, can sue thereon in his own name ; and, secondly, he holds it by an independent title. If he takes it in good faith and for value, he takes it free from "all equities," that is to say, all defects of title or grounds of defence which may have attached to it in the hands of any previous party. These character- istic~~

~~privileges were conferred by the Law Merchant, which is part of the Common Law, and are now confirmed by statute.~~

~~Prom a legal point of view the history of bills of exchange is short, though somewhat obscure. It is ably summed up by Lord Chief Justice Cockburn in his judg- ment in Goodwin v. Roharts, L.E. 10 Ex. pp. 346-358. Bills of exchange were probably invented by Florentine Jews. They were well known in England in the Middle Ages, though there is no reported decision on a bill of exchange before the year 1603. At first their use seems to have been confined to foreign bills between English and foreign merchants. It was afterwards extended to domestic bills between traders, and finally to bills of all persons, whether traders or not. But for some time after they had come into general employment, bills were always alleged in legal proceedings to be drawn secundum usum et consuetudinem mercatorum. The foundations of our modem law were laid by Lord Mansfield with the aid of juries of London merchants. No better tribunal of com- merce could have been devised. Subsequent judicial decisions have developed and systematized the principles thus laid down. Promissory notes are of more modern origin than bills of exchange, and their validity as nego- tiable instruments was doubtful until it was confirmed by 3 and 4 Anne, e. 8. Cheques are the creation of the modern system of banking. The codifying Act of 1882 amends the law in a few minor details, and fills up a few gaps which were uncovered by authority, but in the main it is an exact reproduction of the then existing law. The change effected is a change of form, not of substance. Before the Act, the law was to be found in 17 statutes dealing with isolated points, and about 2600 cases scattered over some 300 volumes of reports.~~

~~Definition. — By § 3 of the Act a bill of exchange is defined to be " an unconditional order in writing, ad- dressed by one person to another, signed by the person giving it, requiring the person to whom it is addressed to pay on demand or at a fixed or determinable future time a sum certain in money to or to the order of a speci- fied person, or to bearer."^ The person who gives the order is called the drawer. The person thereby required to pay is called the drawee. If he assents to the order, he is then called the acceptor. An acceptance must be in writing and must be signed by the drawee. The~~

mere signature of the drawee is sufficient (§ 17). The person to whom the money is payable is called the payee. The

1 This is also the definition given in the United States, hy § 126 of the general Act relating to negotiable instruments, prepared by the Conference of State Commissioners on uniform legislation, and it has been adopted in the leading States.

person to whom a bill is transferred by indorsement is called the indorsee. The generic term " holder " includes any person in possession of a bill who holds it either as payee, indorsee, or bearer. A bill which in its origin is payable to order becomes payable to bearer if it is indorsed in blank. If the payee is a fictitious person the bill may be treated as payable to bearer (§ 7).

-The following is a specimen of an ordinary form of a bill of exchange : —

£100 London, 1st January 1901.

Three months after date pay to the order of iSx J. Jones the sum of one hundred pounds for value received."

Beown and Co. To Messrs Smith and Sons, Liverpool.

The scope of the definition given above may be realized by comparing it with the definition given by Comyn's Digest in the early part of the 18th century : — " A bill of exchange is when a man takes money in one country or city upon exchange, and draws a bill whereby he directs another person in another country or city to pay so much to A, or order, for value received of B, and sub- scribes it." Comyn's definition illustrates the original theory of a bill of exchange., A bill in its origin was a device to avoid the transmission of cash from place to place to settle trade debts. Now a bill of exchange is a substitute for money. It is immaterial whether it is payable in the place where it is drawn or not. It is immaterial whether it is stated to be given for value received or not, for the law itself raises a presumption that it

~~was given for value. But though bUls are a substitute for cash payment, and though they constitute the commercial currency of the country, they must not be confounded with money. No man is bound to take a bill in payment of debt unless he has agreed to do so. If he does take a bill, the instru- ment ordinarily operates as conditional, and not as absolute payment. If the bill is dishonoured the debt revives. Under the laws of some Continental countries, a creditor, as such, is entitled to draw on his debtor for the amount of his debt, but in England the obligation to accept or pay a bill rests solely on actual agreement. A bill of exchange must be an unconditional order to pay. If an instrument is made payable on a contingency, or out of a particular fund, so that its payment is dependent on the continued existence of that fund, it is invalid as a bill, though it may, of course, avail as an agreement or equitable assignment. In Scotland it has long been the law that a bill may operate as an assignment of funds in the hands of the drawee, and § 53 of the Act preserves this rule.~~

~~Stamp. — Bills of exchange must be stamped, but the Act of 1882 does not regulate the stamp. It merely saves the operation of the stamp laws, which necessarily vary from time to time according to the fluctuating needs and policy of the Exchequer. Under the Stamp Act, 1891, bills pay- able on demand are subject to a fixed stamp duty of one penny, and by the Finance Act, 1899, a similar privilege is extended to bills expressed to be payable not more than three days after sight or date. The stamp may be im- pressed or adhesive. All other bills are liable to an ad valorem duty. Inland bills must be drawn on stamped paper, but foreign bills, of course, can be stamped with adhesive stamps. As a matter of policy, English law does not concern itself with foreign revenue laws. Eor English purposes, therefore, it is immaterial whether a bill drawn abroad is stamped in accordance with the law of its place of origin or not. On arrival in England it has to cbnform to the English stamp laws.~~

~~Maturity. — A bill of exchange is payable on demand when it is expressed to be payable on demand, or at sight, or on presentation, or when notice for payment is ex- pressed. In calculating the maturity of bills payable at~~

~~a future time, three days, called days of grace, must be added to the nominal due date of the bill. For instance, if a bill payable one month after sight is~~

~~accepted on the 1st January, it is really payable on 4th February, and not on 1st February as its tenor indicates. On the Continent generally days of grace have been abolished as anomalous and misleading. Their abolition has been pro- posed in England, but it has been opposed on the ground that it would curtail the credit of small traders who are accustomed to bills drawn at certain fixed periods of cur- rency. When the last day of grace is a non-business day some complicated rules come into play (§ 14). Speaking generally, when the last day of grace falls on Sunday or a common law holiday the bill is payable on the preceding day, but when it falls on a bank holiday the bill is payable on the succeeding day. Complications arise when Sunday is preceded by a bank holiday; and, to add to the confusion, Christmas Day is a bank holiday in Scotland, but a common law holiday in England. When the code was in committee an attempt was made to remove these anomalies, but it was successfully resisted by the bankers on alleged grounds of practical convenience.~~

~~Acceptan.ce. — By the acceptance of a bill the drawee becomes the principal debtor on the instrument and the party primarily liable to pay it. The acceptor of a bill " by accepting it engages that he will pay it according to the tenor of his acceptance," and is precluded from deny ing the drawer's right to draw or the genuineness of his signature (§ 54). The acceptance may be either general or qualified. As a qualified acceptance is so far a dis-regard of the drawer's order, the holder is not obliged to take it ; and if he chooses to take it he must give notice to antecedent parties, acting at his own risk if they dissent (§§ 19 and 44). The drawer and indorsers of a bill are in the nature of sureties. They engage that the biU shall be duly accepted and paid according to its tenor, and that if it is dishonoured by non-acceptance or non-payment, as the case may be, they will compensate the holder provided that the requisite proceedings on dishonour are duly taken. Any indorser who is compelled to pay the bill has the like remedy as the holder against any antecedent party (§ 55). A person who is not the holder of a biU, but who backs it with his signature, thereby incurs the liability of an indorser to a holder in due course (§ 66). An indorser may by express term either restrict or charge his ordinary liability as stated above. Primd facie every signature to a bill is presumed to have been given for valuable consideration. But sometimes this is not the case. For friendship, or other reasons, a man may be willing to lend his name and credit to~~

another in a bill transaction. Hence arise what are called accommodation bills. Ordinarily the acceptor gives his acceptance to accommodate the drawer. But occasionally both drawer and acceptor sign to accommodate the payee, or even a person who is not a party to the bill at all. The criterion of an accommodation bill is the fact that the principal debtor according to the instrument has lent his name, and is in substance a surety for some one else. The holder for value of an accommodation bill TD.s£y enforce it exactly as if it was an ordinary bill, for that is the presumable inten- tion of the parties. But if the bill is dishonoured the law takes cognizance of the true relations of the parties, and many of the rules relating to principal and surety come into play. Suppose a bill is accepted for the accom modation of the drawer. It is the drawer's duty to provide the acceptor with funds to meet the bill at maturity. If he fails to do so, he cannot rely on the defence that the bill was not duly presented for payment or that he did not receive due notice of dishonour. If the holder, with notice of the real state of the facts, agrees to give time

to the drawer to pay, he may thereby discharge the acceptor.

Holder in due Course. — The holder of a bill has special rights and special duties. He is the mercantile owner of the bill, but in order to establish his ownership he must show a mercantile title. The bill must be negotiated to him, that is to say, it must be transferred to him according to the forms prescribed by mercantile law. If the bill is payable to order, he must not only get possession of the bill, but he must also obtain the indorse- ment of the previous holder. If the bill is payable to bearer it is transferable by mere delivery. A bill is pay- able to bearer which is expressed to be so payable, or on which the only or last indorsement is an indorsement in blank. If a man lawfully obtains possession of a bill payable to order without the necessary indorsement, he may obtain some common law rights in respect of it, but he is not the mercantile owner, and he is not technically the holder or bearer. But to get the full advantages of mercantile ownership the holder must be a " holder in due course," — that is to say, he must satisfy three business conditions. First, he must have given value, or claim through some holder

~~who has given value. Secondly, when he takes the bill, it must be regular on the face of it. In particular, the bill must not be overdue or known to be dishonoured. An overdue bill, or a bill which has been dishonoured, is still negotiable, but in a restricted sense. The transferee cannot acquire a better title than the party from whom he took it had (§ 36). Thirdly, he must take the bill honestly and without notice of any defect in the title of the transferor, — as, for instance, that the bill or acceptance had been obtained by, fraud, or threats, or for an illegal consideration. If he satisfies these conditions he obtains an indefeasible title, and can enforce the bill against all parties thereto. The Act substitutes the expression " holder in due course " for the somewhat cumbrous older expression " bon§.fide holder for value without notice." The statutory term has the advantage of being positive instead of negative. The French equivalent " tiers porteur de bonne f oi " is ex pressive. Forgery, of course, stands on a different foot- ing from a mere defect of title. A forged signature, as a general rule, is a nullity. A person who claims through a forged signature has no title himself, and cannot give a title to anyone else (§ 24). Two exceptions to this general rule require to be noted. First, a banker who in the ordinary course of business pays a demand draft held under a forged indorsement is protected (§ 60). Secondly, if a bill be issued with material blanks in it, any person in possession of it has primd facie authority to fill them up, and if the instrument when complete gets into the hands of a holder in due course the presumption becomes absolute. As between the immediate parties the trans- action may amount to forgery, but the holder in due course is protected (§ 20).~~

~~Dishonour. — The holder of a bill has special duties which he must fulfil in order to preserve his rights against the drawers and indorsers. They are not absolute duties ; they are duties to use reasonable diligence. When a bill is payable after sight, presentment for acceptance is neces- sary in order to fix the maturity of the bill. Accordingly the bill must be presented for acceptance within a reason- able time. When a bill is payable on demand it must be presented for payment within a reasonable time. When it is payable at a future time it must be presented on the day that it is due. If the bill is dishonoured the holder must notify promptly the fact of dishonour to any drawer and indorser he wishes to charge. If, for example, the holder only gives notice of dishonour to the last indorser, he could not sue the drawer unless the last indorser or some other party liable has duly sent notice to the drawer.~~

~~When a foreign bill is dishonoured the holder must cause it to be protested by a notary public. The bill must be noted for protest on the day of its dishonour. If this be duly done, the protest, i.e., the formal notarial certificate attesting the dishonour can be drawn up at any time as of the date of the noting. A dishonoured inland bill may be noted, and the holder can recover the expenses of noting, but no legal consequences attach thereto. In practice, however, noting is usually accepted as showing that a bill has been duly presented and has been dis- honoured. Sometimes the drawer or indorser has reason to expect that the bill may be dishonoured by the drawee. In that case he may insert the name of a " referee in case of need." But whether he does so or not, when a bill has been duly noted for protest, any person may, with the consent of the holder, intervene for the honour of any party liable on the bill. If the bill has been dishonoured by non-acceptance it may be " accepted for honour supra protest." If it has been dishonoured by non-payment it may be paid supra protest. When a bill is thus paid and the proper formalities are complied with, the person who pays becomes invested with the rights and duties of the holder so far as regards the party for whose honour he has paid the bill, and all parties antecedent to him (§§ 65 to 68).~~

~~Discharge. — Normally a bill is discharged by payment in due course, that is to say, by payment by the drawee or acceptor to the holder at or after~~

~~maturity. But it may also be discharged in other ways, as for example by coin- cidence of right and liability (§ 61), voluntary renimcia- tion (§ 62), cancellation (§ 63), or material alteration (§ 64).~~

~~Conflict of Laws. — A bill of exchange is the most cosmo- politan of all contracts. It may be drawn in one country, payable in another, and indorsed on its journey to its desti- nation in two or three more. The laws of all these countries may differ. Provision for this conflict of laws is made by § 72, which lays down rules for determining by what law the rights and duties of the various parties are to be measured and regulated. Speaking broadly, these rules follow the maxim Locus regit actum. A man must be expected to know and follow the law of the place where he conducts his business, but no man can be expected to know the laws of every country through which a bill may travel. For safety of transmission from country to country bills are often made out in sets. The set usually consists of three counterparts, each part being numbered and con- taining a reference to the other parts. The whole set then constitutes one bill, and the drawee must be careful only to accept one part, otherwise if different accepted parts get into the hands of different holders, he may be liable to pay the bill twice (§ 71). Foreign bills circulat- ing through different countries have given rise to many intricate questions of law. But the subject is perhaps one of diminishing importance, as in many trades the system of " cable transfers " is superseding the use of bills of exchange. -,~~

~~A cheque " is a bill of exchange drawn on a banker payable on demand " (§ 73). For the most part the rules of law applicable to bills payable on demand „ apply in their entirety to cheques. But there are certain peculiar rules relating to the latter which arise from the fact that the relationship of banker and customer subsists between the drawer and drawee of a cheque. For example, when a person has an account at a bank he is, as an inference of law, entitled to draw on it by means of cheques. A right to overdraw can, of course, only arise from agreement. The drawer of a cheque is not absolutely discharged by the holder's omission to present it for pay- ment within a reasonable time. He is only discharged to the extent of any actual damage he may have suffered~~

~~through the delay (§ 74). Apart from any question of delay, a banker's authority to pay his customer's cheques is determined by countermand of payment or by notice of the customer's death (§ 76). Of recent years the use of cheques has enormously increased, and they have now become the normal machinery by which all but the smallest debts are discharged. To guard against fraud, and to facilitate the safe transmission of cheques by post, a system of crossing has been devised which makes crossed cheques payable only through certain channels. The first Act which gave legislative recognition to the practice of crossing was the 19 and 20 Vict. c. 95. That Act was amended in 1858, and a consolidating and amend ing Act was passed in 1876. The Act of 1876 is now repealed, and its provisions are re-enacted with slight modifications by §§ 76 to 82 of the Bills of Exchange Act, 1883. A cheque maybe crossed either "generally" or " specially." A cheque is crossed generally by drawing across it two parallel lines and writing between them the words " & Co." When a cheque is crossed generally it cannot be paid over the counter. It must be presented for payment by a banker. A cheque is crossed specially by adding the name of the banker, and then it can only be presented through that particular banker. A cheque, whether crossed generally or specially, may further be crossed with the words " not negotiable." A cheque crossed " not negotiable " . is still transferable, but its negotiable quality is restricted. It is put on pretty much the same footing as an overdue bill. The person who takes it does not get, and cannot give a better title to it, than that which the person from whom he took it had. These provisions are supplemented by provisions for the protection of paying and collecting bankers who act in good faith and without negligence. . Suppose that a cheque payable to bearer, which is crossed generally and with the words " not negotiable," is stolen. The thief then gets a tradesman to cash it for him, and the trades- man gets the cheque paid on presentment through his banker. The banker who pays 3,nd the banker who receives the money for the tradesman are protected, but the tradesman would be liable to refund the money to the true owner. Again, assuming payment of the cheque to have been stopped, the tradesman could not maintain an action against the drawer. (See also under Banking.) A~~

promissory note is defined by section 83 of the Act to be an ” unconditional promise in writing made by one person to another, signed by the maker, en- nl^’^^’”^ gaging to pay on demand, or at a fixed or determinable future time, a sum certain in money to or to the order of a specified person or to bearer.” A promissory note may be made by two or more makers, and they may be liable either jointly, or jointly and severally, according to its tenor (§ 85). For the most part, rules of law applicable to a bill of exchange apply also to a promissory note, but they require adaptation. A note differs from a bill in this : it is a direct /promise to pay, and not an order to pay. When it issues it bears on it the engagement of the principal debtor who is primarily liable thereon. The formula for applying to notes the rules as to bills is that ” the maker of a note shall be deemed to correspond with the acceptor of a bill, and the first indorser of a note shall be deemed to correspond with the drawer of a bill payable to drawer’s order” (§ 89). Eulesrelatingtopresentment for accept- ance, acceptance, acceptance supra protest, and bills in a set, have no application to a note. Moreover, when a foreign note is dishonoured it is not necessary, for English purposes, to protest it. All promissory notes are, under the Stamp Act, 1891, subject to an ad valorem stamp duty. Inland notes must be on impressed stamp paper. Foreign notes are stamped with adhesive stamps.

Foreign laws.

For ordinary legal purposes a bank note may be regarded as a promissory note made by a banker payable to bearer on demand. It is, however, subject to special stamp regulations. It is not discharged by payment, but may be re- issued again and again. In the interests “•of the currency the issue of. bank notes is subject to various statutory restrictions. A bank, other than the Bank of England, may not issue notes in England unless it had a lawful note issue in 1844. On the other hand. Bank of England notes are legal tender except by the bank itself. In fundamental principles there is general agreement between the laws of all commercial nations regarding negotiable instruments. As Mr Justice Story, the great American lawyer, says : ” The law re- specting negotiable instruments may be truly declared, in the language of Cicero, to be in a great measure not the law of a single country only, but of the whole com- mercial world. Non erit lex alia Momce, alia Athenis, alia nunc alia posthac, sed et apud omnes gentes et omni tempore,

~~una eademgue lex obtinebit" (Swift v. Tyson, 16 Peters 1). But in matters of detail each nation has impressed its in- dividuality on its own system. The English law has been summarized above. Perhaps its special characteristics may be best brought out by comparing it with the French code and noting some salient divergences. English law has been developed gradually by judicial decision founded on trade custom. French law was codified in the 17th cen- tury by the " Ordonnance de 1673." The existing " Code de Commerce " amplifies but substantially adopts the pro- visions of the " Ordonnance." The growth of French law was thus arrested at an early period of i^s development. The result is instructive. A reference to Marius' treatise on Bills of Exchange, published about 1670, or Beawes' Lex Mercatoria, published about 1740, shows that the law, or rather the practice, as to bills of exchange was even then fairly well defined. Comparing the practice of that time with the law as it now stands, it will be seen that it has been modified in some important respects. For the most part, where English law differs from French law, the latter is in strict accordance with the rules laid down by Beawes. The fact is that, when Beawes wrote, the law or practice of both nations on this subject was nearly uniform. But English law has gone on growing while French law has stood still. A bill of exchange in its origin was an instrument by which a trade debt due in one place was transferred iil another place. This theory French law rigidly keeps in view. In En gland bills have developed into a paper currency of perfect flexibility. In France a bill represents a trade transaction ; in England it is merely an instrument of credit. English law affords full play to the system of accommodation paper ; French law endeavours to stamp it out. A comparison of some of the main points of difference between English and French law will show how the two theories work. In England it is no longer necessary to express on a bill that value has been given for it, for the law raises a presump- tion to that effect. In France the nature of the considerar tion must be stated, and a false statement of value avoids the bill in the hands of all parties with notice. In Eng- land a bill may be drawn and payable in the same place. In France the place where a bill is drawn shoiild be so far distant from the place where it is payable that there may be a possible rate of exchange between the two. This so- called rule of distantia loci is said to be disregarded now in practice, but the code is unaltered. As French lawyers put it, a bill of exchange necessarily presupposes a contract of exchange. In England since 1765 a bill may be drawn payable to bearer,~~

~~though formerly it was otherwise. In France it must be payable to order ; if it were not so it is clear that the rule requiring the consideration to be truly stated would be a nullity. In England a bill originally~~

~~payable to order becomes payable to bearer when indorsed in blank. In France an indorsement in blank merely operates as a procuration. An indofsement, to operate as a negotiation, must be to order, and must state the con- sideration ; in short, it must conform to the conditions of an original draft. In England, if a bill is dishonoured by non-acceptance, a right of action at once accrues to the liolder. In France no cause of action arises unless the bill is again dishonoured at maturity; the holder in the meantime is only entitled to demand security from the drawer and indorsers. In England a sharp distinc- tion is drawn between current and overdue bills. In France no such distinction is drawn. In England no pro- test is required in the case of the dishonour of an inland bill, notice of dishonour being sufficient. In France every ■dishonoured bill must be' protested. Opinions may differ whether the English or the French sysiem is better calcu- lated to serve sound commerce and promote a healthy commercial morality. But an argument in favour of the English system may be derived from the fact that as the various Continental codes are from time to time revised and re-enacted, they tend to depart from the French model and to approximate to the English rule. The effect upon English law of its recent codification has yet to be proved. A common objection to codification in England is that it deprives the law of its elastic character. But when principles are once settled common law has very little elasticity. On the other hand no code is final. Modern parliamentslegislate very freely, and it is a much simpler task to alter statute law than to alter common law. More- over, legislation is cheaper than litigation. One conse- quence of the codification of the English law relating to bills is clear gain. Nearly all the colonies have adopted the Act, and where countries are so closely connected as England and her colonies, it is an obvious advantage that their mercantile transactions should be governed by one and the same law expressed in the same words.~~

~~The ordinary text-books on the law of bills of exchange are con- stantly re-edited and brought up to date. The following among •others may be consulted : — Btles, Bills of Exchange; Chalmers, Bills of Exchange; Daniel, Law of Negotiable Instruments (United States) ; NonGuiER, Des lettres de change et des effets de commerce (France) ; Thorbcen, Bills of Exchange Act, 1883 (Scotland) ; Story, Bills of Exchange (United States) ; Hodgins, Bills of Exchange Act, 1890 (Canada). (m. d. ch.)~~

~~Bills of Lading. See Affbeightment.~~

~~Bills of Sale. See Sale.~~

~~Bilma, or Hawak. See Sahara.~~

~~Biloxi, a city of Harrison county, Mississippi, U.S.A., on the coast of Mississippi Sound, in the southern part of the state, on a line of the Louisville and Nashville rail- way. It is a place of resort, both in summer and winter, for the people of New Orleans and Mobile, and has numerous hotels, and an excellent water-supply. Popu- lation (1880), 1540; (1900), 6467.~~

~~Biiston, a market town (under an urban district •council), and railway station, of Staffordshire, England, 2\ miles S.E. of Wolverhampton (of which parliamentary borough it forms part). Recent erections are the post-office, the market hall (rebuilt), and baths and wash-houses (rebuilt). Area, 1867 acres ; population (1901), 24,034.~~

~~Bimetallism. — ^From mediaeval times until the be- ginning of the 19th century coins of both gold and silver were current in the leading commercial countries of Eu- rope, ordinances being issued from time to time by the governments concerned with the object of fixing their relative value, or more correctly, their equivalency as legal tender. Both metals were, moreover, as a rule coined at the mints without restrictions as to quantity. England~~

~~was the first to abandon this system and to adopt gold as the sole standard of value; at a later date the United States followed this example; and, in 1873, the Latin Union, of which France was the leading nation, took the~~

~~first steps in the same direction. From this date mono- metallism prevailed all over Europe, silver coins in gold- using countries becoming mere tokens. The object of bimetallists is to revert to a monetary system somewhat similar to that which prevailed in the Latin Union before 1873, though it is generally admitted that the proposed Bimetallic Union must cover a wider area. Bimetallism is, in fact, a currency system which would establish a right on the part of the debtor to discharge his liabilities at his option in either of the two metals at a ratio fixed by law. For this system to be successful it is obvious that a fixed ratio or value between the metals must be maintained. From 1820 to 1870 the ratio of the value of silver to-g:old (taking annual averages) appears to have varied between the limits of 16-19 to 1 and 15-9l5 to 1 — a variation of about 5 per cent, during a period of 60 years, and a variation which bimetallists accounted for by the inefficiency of the currency ordinances. Between 1872 and 1900 the ratio varied between the limits of 15-66 to 1 and 36-03 to 1 — a variation of about 124 per cent, in a period of twenty-eight years — a period during which there were no currency ordinances with regard to the relative value at which metals could be freely coined. This increase of instability is the true basis of the bime- tallic controversy, a controversy which may be divided under three heads : (1) Was the change in the stability of the relative value of the metals due to the changes in the monetary systems of the world, or was it due to the increased production of silver or to other similar causes ?~~

~~(2) Would it be possible to establish a fixed ratio of value between the metals by the enactment of bimetallic laws ?~~

~~(3) Would such a change in the English monetary system, if practicable, be on the whole advantageous ? With re- gard to the last question the aim of bimetallists is, by linking the metals together, both to create a more stable standard of value, and to limit the variations in the rate of exchange between gold- and silver-using and bimetallic countries, and also, by increasing the volume of metal in the currency, to produce a rise in prices, or, at all events, to prevent a further fall.~~

~~In the article on Money {Ency. Brit. xvi. 731) the history of this controversy is brought up to the year 1883. Since that date there have been no great changes in the mone- tary systems of Europe or America, though the~~

discussion on this problem has never ceased. The report issued by the Royal Commission of 1888 to inquire into the recent changes in the relative values of the precious metals prob- ably constitutes the most important contribution to this debate. The evidence given before the Commission is also of great value, that of Professor Alfred Marshall, from a theoretical point of view, being specially worthy of study. On that occasion Professor Marshall advocated a monetary system under which certificates would be issued, each standing for a certain amount of gold and a certain amount of silver, the ratio between the two being fixed by international agreement — a system which would have undoubted theoretical advantages. The bimetallic ques- tion was also dealt with by the Royal Commission on Agricultural Depression of 1897. In September 1889 a Bimetallic Congress sat in Paris ; and, in November 1892, a conference was heM at Brussels, on the initiative of the United States, to consider what measures could be taken "to increase the use of silver." Most of the important States were represented, but no resolution was arrived at.

At this time the fall in the gold price of silver had seriously interfered with the finances of India, where silver was the standard. In May 1893 a committee appointed

by the Government reported in favour of closing the Indian mints to the free coinage of silver, with a view to the establishment of a gold standard. This' policy was adopted, but the effects hoped for were not produced as quickly as was anticipated, and a second committee was appointed in 1899. They reported in favour of keeping the mints closed to the free coinage of silver, of main- taining the rupee at a value equivalent to 16 pence, and of taking other steps in the direction of establishing a gold standard in India. The bimetaUists were much dissatisfied with these decisions.

Bimetallism has in recent years attracted more atten- tion in the United States than anywhere else. Although gold had been adopted for some time as the standard of value, nevertheless in 1878 the Government of that country commenced a systematic coinage of silver with- out regard to the

~~quantity of silver coin required by the nation. This plan was adopted partly because it was re- garded as a step in the right direction by convinced bimetaUists; partly as a result of pressure applied by the silver-producing States, and partly through the unreasoning advocacy of " cheap and abundant money." The agitators were not satisfied, and in 1889 and 1890 the agitation in favour of the free-coinage of silver became formidable. In the latter year, as a further pal- liative measure, the Sherman Act was passed, by which the Treasury was bound to purchase a large quantity of silver every month. This Act was repealed in 1893. The agitation, however, continued in fidl force, and the presidential election of 1896 turned largely on the bi- metallic question. Mr McKinley, the Republican candi- date, upheld the maintenance of the gold standard, but only until an international agreement should sanction the free-coinage of silver. Mr Bryan, the Democratic candidate, was in favour of the free-coinage of silver at a ratio of 16 to 1, without waiting for the co-operation of other nations, and used the famous phrase, "You shall not crucify mankind on a cross of gold." McKinley was elected by a large majority, and in his inaugural address again expressed his adherence to international bimetallism. In 1897 the Wolcott Commission visited Europe, and advocated the reopening of the Indian mints ; but their mission produced no results. In 1898 the Spanish war drove the currency question, for the time being at all events, out of the field of American politics. In 1900 its revival by Mr Bryan produced no effect on the Presidential contest, except perhaps in rendering the re-election of Mr McKinley the more over- whelming.~~

~~The above are the principal events connected with the bimetallic controversy in recent years. It is far more difficult to indicate with any certainty the changes of opinion which have taken place during this period. Per- haps a majority of economists now admit the validity of the theoretical arguments brought forward by bimetal- lists to prove that the relative value of gold and silver might, within limits, be fixed by legislation. Many keen opponents of bimetallism, who believe that legisla- tive arrangements would break down in practice, agree with those monometallic members of the Gold and Silver Commission of 1888, who admitted that "in any conditions fairly to be contemplated in future, a stable ratio might be obtained if " the United Kingdom, Germany, the United States, and the Latin Union " were to accept and strictly adhere " to bimetallism at a ratio~~

~~approximating to that obtaining in the market. On the other hand, though bimetallism thus defined would probably tend to increase the stability of the standard of value, yet Prof. Edgeworth has given reasons for believ- ing that no great change would be produced in this respect. The benefits thus obtained would be much the~~

~~same in the long run whatever ratio of value were adopted. But it is evident from the writings of bimetal- lists that, with few exceptions, they would only be satis- fied with such a ratio as would cause a great inflow of silver into the currency of the world ; and, as this would certainly tend to make prices rise, it is fair to con- clude that the hope of producing this result is the true stimulus which keeps the bimetallic controversy alive. The benefits and evils likely to arise from rising and falling prices have been much discussed. Eising prices would, so it is argued, increase the volume of trade, But in reply it is urged that the main reason for antici- pating such a result from an inflation of prices due to currency legislation is that the real wages of labour would thus be reduced, a result in itself always most objectionable. BimetaUists, however, contend that, even if the labourer should suffer at first, he would gain in the long run because he would eventually share in benefits arising from the increase of trade. At present the value of gold appears to be diminishing, and if the desire for a rise in prices is the true underlying force of the bimetal- lic movement, this agitation is likely to be less vigorous as long as this fall in the value of gold continues ; for the desired effect will thus be produced without the aid of exceptional legislation.~~

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~~Bimlipatam, a town of British India, in the Vizaga- patam district of Madras ; situated in 17° 53′ N. lat. and 83° 30′ E. long., on the sea^coast 18 miles N. of Vizaga- patam. Population, about 10,000 ; municipal revenue, (1897-98), Es.13,840. It was formerly a Dutch factory, and is now the principal port of the district. The anchor- age is an open roadstead, with a lighthouse at Santapalli. In 1897-98, the total seaborne trade of this and the sub-ordinate ports amounted to Es.94,17,240, of which nearly half was conducted with foreign countries. The princi- pal exports are oil-seeds and sugar.~~

~~Binang, a town in Luzon, Philippine Islands, on a small river flowing into the Laguna' de Bay, and distant about a mile from its western shore. It is one of the most important towns of the province of Laguna, and is surrounded by an extensive and extremely fertile plain, which produces very large quantities of rice, as well as a great variety of tropical fruits. A ready market for these products is found in Manila, which is reached by way of the Laguna de Bay and the Pasig. The language is Tagalog. Population, 20,000.~~

~~Binche, a town of Belgium, in the province of Hainaut, 11 miles S.E. of Mons by rail. It has iron- and glass-works, tanneries, and an important industry in boot- and shoe-making, and the making of Brussels lace (appliqui) employs many women and girls. Population~~

~~(1880), 8252; (1897), 11,121.~~

~~Bingen, a town of Germany, grand-duchy of Hesse- Darmstadt, on the left bank of the Ehine, 19 miles W. from Mainz. The Eochus chapel, where thousands of persons gather on the first Sunday after 16th August, was rebuilt in 1889-94 after a fire. Of late Bingen has grown in importance as a trading-place, and new quays and a harbour have been buUt. Coal and iron enter largely into the trade. Population (1885), 7178; (1900), 9670.~~

~~Binghamton, capital to-mi of Broome county, New York, U.S.A., situated in 42° 07′ N. lat. and 76° 56′ W. long., in the southern part of the state, on the north branch of Susquehanna river, at the mouth of the Chenango river, at an altitude of 863 feet. It has three railways : the Delaware and Hudson ; the Delaware, Lackawanna, and Western; and the New York, Lake Erie, and Western. The city is built on both sides of both the Susquehanna and the Chenango. It is a manu- facturing city of importance. In 1890 the manufactur- ing capital was $9,058,651. There were 10,191 persons employed, and the product was valued at $15,040,152, consisting principally of boots and shoes, flour and tobacco. The last comprised nearly one-fifth of the whole. The assessed valuation of real and personal prop- erty was in 1900, $21,130,730, and the tax rate was $23.80 per $1000. The debt was only $710,555. Since 1880 the city has had a very rapid growth, due probably to increase in railroad communications and in manufac- tures. Binghamton was named after William Bingham, who purchased the site of the city. The first settle- ment was made in 1799, under the name of Chenango. In 1834 it was incorporated as the village of Binghamton, and in 1867 received a city charter. Population (1880), 17,317; (1900), 39,647, of whom 4272 were foreign- born. The death-rate in 1900 was 17‘6.~~

~~Bingley, a market town and railway station in the Otley parliamentary division of Yorkshire, England, on the Aire, 5i miles N.W. of Bradford. The grammar school has been enlarged, a technical school and free library have been provided, and a cottage hospital has been built. Bradford water-works supply water. Area of urban district, 11,831 acres ; population (1891), 17,381 ;~~

~~(1901), 18,461.~~

~~Bintang, the chief island of the Ehiouw archipelago, on the south side of the Strait of Singapore, in 1° 13’-0° 50′ N., 104° 13’104° 37′ E. The Chinese cultivate gambler and pepper successfully, and there is a considerable trade in wood. The seat of the Dutch government is at Tan jong Pinang on the south-west coast, a small port of 4000 inhabitants (160 Europeans and about 2000 Chinese).~~

~~Bio- bio, a province of Southern Chile, situated between 37° 15′ and 38° 40′ S. lat., and 71° 05′ and 73° 02′ W. long. Its area is 4158 square miles. The~~

~~population in 1895 numbered 88,749. The capital, Los Angeles, had a population of 7868 in 1895. The province is divided into three departments.~~

~~Birbhum, a district of British India, in the Burd- wan division of Bengal, situated in the Gangetic plain and partly on the hills, being bounded on the south by the river Ajai. The administrative headquarters are at Suri, which is the only town in the district. The area com- prises 1752 square miles. The population in 1881 was 792,031 ; in 1891, 798,274, giving an average density of 455 persons per, square mile. Classified according to religion, Hindus numbered 593,602; Mahommedans, 169,752 ; aborigines, 34,289 ; Christians, 542, of whom 68 were Europeans ; " others," 89. In 1901 the population was 901,223, showing an increase of 13 per cent. The total amount of land revenue and rates is retuirod at Es.10,84,185 ; the number of police at 272; ch'. boys at school (1896-97) were 24,165, being 41-3 pei cent, of the male population of school-going age;^ the registered death-rate in 1897 was 29-7 per thousand. The principal industry is the spinning and weaving of silk, chiefly from tusser or jungle silkworms. In 1897 the total out-turn of silk was valued at Rs.22,85,100. There are also seven h.c factories, whose produce is valued at Es.26,700. Th? loop-line of the East Indian~~

~~railway runs through the district for 68 miles, with a junction at Nalhati for Murshidabad.~~

~~Birch, Samuel (1813-1885), English Egypto- logist and antiquary, was born 3rd November, 1813, and was the son of the rector of St Mary Woolnoth, London. Prom an early age he manifested a tendency to the study of out-of-the-way subjects, and after a brief appointment in the Record Office obtained in 1836 an appointment in the Antiquities Department of the British Museum on account of his knowledge of Chinese. He soon extended his researches to Egyptian, and when the cumbrous department came to be divided he was appointed to the charge of the Egyptian and Assyrian branch. In the latter language he had assistance, but for many years there was only one other person in the institution — in a different department — who knew anything of ancient Egyptian, and the entire arranjgement of the depart- ment devolved upon Birch. He found time never- theless for Egyptological work of the highest value, including a hieroglyphical~~

~~grammar and dictionary, translations of The Book of the Dead and the Harris papyrus, and numerous catalogues and guides. He further wrote what was long a standard history of pot- tery, investigated the Cypriote syllabary, and proved by various publications that he had not lost his old interest in Chinese. Paradoxical in many of his views on things in general, he was sound and cautious as a philologist; while learned and laborious, he possessed much of the instinctive divination of genius. He died on 27th Decem- ber 1885. (b. g.)~~

~~Birds. — The first attempt at a classification of birds based upon the theory of descent — in fact the first phylo- genetic tree of the Class of birds — is due to E. Haeckel (Generelle Morphologie der Orgarv-~~ ~~"'J' ismen, vol. ii. p. 139, Berlin, 1866), who divided thp whole Class into two Sub-classes : Saururce and Orni- thurce, the latter into the two legions of Autophagce s. Nidi- fugce and Paedotrophae s. Insessores. His further Sub-divi- sions or Orders are significant, since they are accompanied by short hints as to probable lines of development and mutual relationship of the various Orders. With Huxley, " On the Classification of Birds . . ." Proc. Zool. Sac, 1867, pp. 415-472, began the earnest search for anatomical characters as affording the only trustworthy clue to the natural system. His concise diagnoses of the Orders and Sub-orders are based upon various other characters besides those yielded by the palatal bones. He took pains to show that the lineal sequence of his groups does not, and cannot, indicate their relationship, and he published a separate phylogenetic outline (Ibis, 1868, pp. 357-362). A. H. Garrod expected much from the combination of a few anatomical characters which were taken from the various organic systems, and which presumably could not stand in direct correlation with each other — ^notably the carotid arteries, the configuration of the nasal bones, the oil-gland, caeca, and, above all, certain muscles of the thigh. Laying, however, more stress upon the me];p presence or absence than upon the quality of these characters, and using their combinations in a father mechanical way, his ultimate system (published in Proc. Zool. Soc, 1873, pp. 624-644, and 1874, pp. 111-113) resulted in a failure. He was, however, the first to show clearly the relationship of the heron-like birds with the Steganopodes, of the stork-like birds with the American vultures, the great difference between the latter and the o'".her birds of prey, the connexion of the Gulls and Auks with the Plovers, and that of the Sandgrouse with the~~

~~Pigeons — discoveries expressed in the newly-established terms of the Orders Ciconiiformes and Charadriiformes. Garrod, his equally short-lived successor W. A. Forbes,~~

~~and F. E. Beddard, have amassed a vast amount of anatomical facts, giving a new impetus to ornithotomy at home and abroad. New light was in the meantime thrown upon the whole study of scientific ornithology by the discovery of the remains of toothed birds in the Cretaceous deposits of Kansas. The results of the indefatigable labours of the late 0. Marsh were published by him in his grand volume, Odontomithes (Washington, 1880). In 1884 Prof. A. Newton (see Ency. Brit. vol. xviii. pp. 43-49) made an attempt to indicate those points in recent classifications which then seemed to have been established on a pretty sure footing, though therein he had no intention of inventing (as has sometimes been supposed) a new system of birds. He broke up the unnatural assembly of the Odontomithes, separated the Striges entirely from the Accipitres, and showed by many suggestions, and by critical discernment in the acceptance of the results of other workers, that the old-fashioned traditions have been given up, and that no classification can hope for recognition unless it be based upon the con- sideration of as many anatomical characters as possible. This principle was also recognized by L. Stejneger, who in the fourth volume of The Standard Natural jaege s. jj^gf^^^y (Boston, 1885) brought out an elabo- rate, and to a great extent new, classification. It is eclectic, the author having welde'd together what seemed to him well established by other taxonomists, in addition to a careful compilation from the available literature of whatever characters he considered taxonomically service- able. Anatomy, eggs, nesting habits, food, geographical distribution, have all been laid under contribution, and on the purely anatomical characters he laid in some cases more stress than would have been done by comparati'^e anatomists. His classification stands as follows : —~~

~~Sub-class I. Saururs. Order Oknithopappi ; Archseopteryx. Laopteryx.~~

~~Sub-class II. Odontotonnae. Order Pteropappi: Ichthyomls. Apatornis.~~

~~Sub-class III. Odontoholcae. Order Deom^opappi : Hesperornis. Enaliomls.~~

~~Sub-class IV. EurhipidursB. Super-order I. DKOHliEOGNATHa:, with the Orders Struthiones, ^pyornithes, Apteryges, Crypturi, Gastornithes.~~

~~Super-order II. Impennes. Order Ftilopteri : Sphenisoidse.~~

~~Super-order III. Euoknithes, divided into 13 Orders with 31 Super-families.~~

~~(1) CecomorphcB ! Colymboideae, HeliornithoideEe, Alcoidese, LaroideEB, Procellaroidese ; (2) Oralloe : Chionoideae, Scolopacoideae, Eurypygoidese, Cariamoidese, Gruioidese ; (3) OhenomorphcB : An- himoidesB [PalamedesB], Anatoideae, Phoenicopteroideae ; (4) Herodii: Ibidoideae, Ardeoideae ; (5) Steganopodes : Phaethon- toideae, Pregatoideae, Pelecanoideae ; (6) Opisthocomi ; (7) Gal- linoe; (8) Pterocletes ; (9) ColumbcB; (10) Accipitres; (11) Psittaci; (12) Picarice: Cuculoideae ; Coracloldeae with Steator- nithidae, Podargidse, Caprimulgidse, Coraclidae, Leptosomatidse; Colioldeae ; Alcedinoideae with Meropidse, Todidae, Momotidae, Al- cedinidas, Bucerotidse ; Upupoideae with Upupidae and Irrisoridse ; Picoidese with six families, including Bucconidae and Galbulidse ; Trogonoidea ; Micropoideae with Cypselidss and Trochilidse ; (13) Passeres : Menuroideae ; Eurylaemoideae ; Tyrannoideae ; Formioa- roidese ; Passeroidese.~~

~~The establishment of Eurhipiduroe as a Sub-class, the isolation of the Impennes, and their elevation to the rank of a Sub-order are anatomically unjustifiable. The Pro- cellarice are put into one Super-family with the Auks and Gulls, while the latter are separated from their close allies the Scolopacoidece. The Owls stUI remain with the Accipitres, and the great difference between the Cathartce and the other birds of prey is not indicated. Opis- thocomus is relegated to a position lower than the GaUinai. The Ibises form a Super-family, whUe Storks and Herons are each reduced to family rank. On the other hand, the arrangement of the Orders Gralloe, Picarioe, and Passeres marks a decided progress.~~

~~The year 1888 heralded a new epoch in scientific ornithology. Prof. M. Fuerbringer's Untersuchungen zur Morphologie und SystematikderVoegel, published as a jubilee work by the " Natura Artis Magis- briaiger. tra "~~

~~Society of Amsterdam, is a monumental production. The first of the two gigantic volumes is devoted chiefly to a minute description of the bones, muscles, and nerves of the region of the shoulder-girdle. The second volume contains the results, not only from the standpoint of the pTire morphologist,but also with a view to their applicability to a systematic arrangement of birds. The author, fully aware of the impossibility of deducing a sound classification from the study, be it ever so minute, of one organic system, or of part of the body only (in the present case of the region of thfe shoulder- girdle), reviewed also the enormous literature relating to most other organs, sifting and tabulating whatever characters could possibly be of taxonomic value. Being a highly accomplished morphologist, he distinguished especially in the muscular, nervous, and skeletal systems, between primary and secondarily acquired features, and he produced an entirely new, strictly genealogical system, logically worked out. He grouped the recent and extinct birds into about 46 Gentes, groups which, with few exceptions, will stand the test of time. These 46 Gentes are combined into 24 Sub-orders, including no less than 9 intermediary Sub-orders. The latter are the weak spot in his system. Since it is left undecided to which of the principal 8 Orders they belong, the 8 Orders lose much in practical value; and this is all the more to be regretted as Puerbringer has given us entirely new views by his establishment of these greater and great- est Groups. Moreover, he gives no diagnoses of either Orders, or Sub-orders, or Gentes, or Families, but leaves the reader in the embarrassing position of drawing his own conclusions, after the perusal of pages and pages of detail, in which every imaginable view has been dis- cussed, or at least hinted at. Consequently only those who are well trained in anatomy will, by attentive study, derive the full benefit from this monumental and most suggestive work. It has already become, and will remain, an inexhaustible fount of information, not always ac- knowledged. There is, lastly, another difficulty, not very patent. The work took several years to get through the press, and during this time the author found it n"ecessary to modify, and even to change completely, some of his views on the systematic position of several groups, notably the relationship of Hesperornis, Palamedem, and Ratitce. Hence there are discrepancies in the second vol- ume, not easily understood and reconciled with his final very determined views, unless the reader does not shirk the laborious task of following up the argumentations which are often separated by hundreds of pages. Fuer- bringer was the first to show~~

~~clearly that the Batitae are the retrograde descendants of volant ancestors, that the various Groups of existing Batitce represent cases of con- vergence, that the Batitce are as such a polyphyletic Group, and he has gone fully into the interesting question of the development and subsequent loss of the power of flight. The loss took place not only in different Groups, but also at various geological periods. Of course the author does not assign any taxonomic valu3 to such cases of isomorphism. Only a few of the Qore prominent advances in classification can here be mentioned— the complete separation of Hesperornis from the Ratitce and its near relationship with the Colymbo Podicipedidoe ; final proof that the Odontomithes are not a natural Group ; affinity of Apteryx with the Crypturi and Balliformes; Sphenisci recognized as allied to the Tubinares and Steganopodes; establishment of the Group Coraciijormes.~~

~~BIRDS~~

~~255~~

~~Fuerbringer's classification stands as follows. The 90 families have here been omitted for want of space, save~~

~~Sub-olass I. Saururae. Order Aechoenithes. Gens. Arohseopteryges. Sub-class 11. Omithura.~~

~~those, the assigned position of which is of particular interest : —~~

~~Order.~~

~~STEDTHiOKNITHES .~~

~~Bheobnithes hippaleotbyoenithes .~~

~~Sub-order. StruthioniforTnes . Bheiformes . Casuariiformes . Intermediary Sub-orders.~~

~~^pyornithiformes 'ormes~~

~~Pblargobnithes~~

~~CaABADBIORiriTHES~~

~~Alectobobnithes~~

~~Podiclpitiformes~~

~~Ciconiiformes~~

~~Intermediary Sub-orders.~~

~~Procellariiformes . Aptenodytiformes . Ichthy or nithif ormes .~~

~~. Charadriiformes .~~

~~Intermediary Sub-orders. Cfruiformes .~~

~~HaUiformes .~~

~~f Apterygiformes . . i Crypturtfome^ . (. Qalliformes –~~

~~Intermediary Sub-orders.~~

~~Columbiformes~~

~~Psittaciformes~~

~~Coccygiformes~~

~~Pico- Passerif ormes~~

~~COEACOENITHES~~

~~Salcyoniformes~~

~~Coraciiformes~~

~~Another comprehensive work on the anatomy and classi- fication of birds, which has appeared since the publication of Professor Newton's article Ornithology (Encydopcedia Britannica, vol. xviii.), is the volume Aves of~~

~~Bronn's Classen und Ordnungen des Thier- reichs. Begun originally by E. Selenka, the anatomical part was taken up in 1884 by H. Gadow, by whom it was completed in 1891, and in 1893 it was followed by the systematic part. Harmonious intercourse with Fuerbringer and the benefit of the latter's work enabled the present writer not only to continue the same lines of morphological research, but alsofurther to investigate those questions which were still left in abeyance or seemed to require renewed study. The resulting "classification is based on the examination, mostly autoptic, of a far greater ' number of characters than any that had preceded it; more- over, they were chosen in a different way, discernment being exercised in sifting and weighing them, so as to determine, so far as possible, the relative value of each, according as that value may vary in different groups, and not to produce a mere mechanical 'key' after the fashion become of late years so common" (Newton's Dictionary~~

~~Gens. Struthioues. Rheae. Casuarii.~~

~~Mpyondthea.~~

~~Palamedese. f Gastomithes. \ Anseres. f Enaliomithes. i Hesperomithes. (Colymbo-Podicipites. fPhoenicopteri. J Pelargo-Herodii. j Accipitres. [.Steganopodes.~~

~~Tubinares. Impennes. lohthyomithes.~~

~~{Laro-Limicolee. Parrae. Otides.~~

~~/ EuiypygSB, including Rhinochetus, Aptomis. \ Grues. '~~

~~/ Pulicariae (HeliomithidEe + Rallidse) . \ Hemipodii (MesitidEB-l-Hemipodidse).~~

~~Apteryges (including Dinornithidse).~~

~~Crypturi.~~

~~Galli (including Opisthocomidse).~~

~~f Pterocletes. \ ColumbsB. Psittaci.~~

~~f Coccyges. \ Galbulss.~~

~~Pico-Passeres .~~

~~Macrochires~~

~~jPici.~~

~~\ Passeres ,~~

~~f CypselidsB. \ TrochilidsB.~~

~~f Pseudoscines. \ Passeiidse.~~

~~Colli. ? Trogones. f Halcyones. . -j Bucerotes (Bucerotidae+tTpupidse). (Meropes.~~

~~? Todi (Todid»+Momotid»). f Coracise. . -j Caprimulgi. (. Striges. ^~~

~~of Birds, Introduction, p. 103). It is not the quantity but the quality of the anatomical and bionomic characters which determines their taxonomic value, and a few funda- mental characters are better indications of the affinities of given groups of birds than a great number of agreements if these can be shown to be cases of isomorphism or heterophyletic, convergent analogy. Nature possesses three great educational or developmental schools — ^ter- restrial, aquatic, and aerial life. Each of these affords animal, vegetable, or mixed diet. Animal diet implies the greatest variety with regard to locality and the modes of procuring the food. Each of these schools impresses its pupils, in the case of the birds, with its own stamp, but there are many combinations, since in the course of phyletic development many a group of birds has exchanged one school for another. Originally terrestrial groups have taken to an entirely aquatic life, and vice versd; others, originally endowed with the power of flight, have become, or are transforming themselves into, absolutely cursorial forms ; some members of one group live entirely on seeds, while others have become fierce fishers, and so forth. Only by the most careful inquiry into their history can~~

~~Pale- ontology,~~

~~their relationship or pedigree be unraVelled. Gadow's system is given below.~~

~~Newton's Dictionary of Birds, 1893-96, is the latest standard work on ornithology. Under its various headings, anatomical, bionomio, geographical, historical, and systematic, and in the 120 pages of the introduction, it contains condensed accounts of, or at least references to, wellnigh everything which pertains to ornitho- logy.—H. Seeeohm. Classification of Birds. London, 1890. Based upon Fuerbringer and not a genetic system, with ' ' diagnoses ' ' based upon mechanical combinations of striking, but often arbi- trarily selected characters. — K. B. Shaepe. A Beview of Attempts to Classify Birds. Budapest, 1891. Likewise based upon Fuer- bringer and not genetic. Simply a linear arrangement of well-selected groups, with enumeration of anatomical and bionomio characters selected from Stejneger and Seebohm. Dr Sharpe is also the author of by far the greater number of volumes of the Cat. Birds, Brit. Mus., a gigantic descriptive work which was finished in 1898. — St G. Mivakt. Tke Elements of Ornithology. London, 1892. — F. E. Beddard. Structure and Classification of Birds. London, 1898. — H. H. Evans. Birds, Cambridge Natural History, vol. ix. London, 1899.~~

~~Much had naturally been expected from the study of fossil birds, but, so far as the making of classifications is concerned, they have proved rather a source of perplexities. So long as the characters of new fossils are only of specific and generic value, it is mostly possible to assign the birds to their proper place, but when these characters indicate new Families or Sub-orders, for instance Hesperornithes, Ichthyomithes, Palaelodi, their owners are put outside the more tersely constructed classifications applicable to modern birds. It is no exaggeration to say that the genus, often even the species, can be determined from almost any recent bone, but in the case of Miocene, and still more, of Eocene fossils, we have often to deal with strange Families, which either represent an extinct side branch, or which~~

~~connect several recent Groups with each other. Our artificially-established classifications collapse whilst we gain further insight into the mutual aflS.mties of the ex- isting Groups. Of course this must be so if evolution is true. But it also follows that, if every extinct and recent bird were known, neither Species, nor Genera, nor Fami- lies, nor Orders could be defined. We should be able to construct the pedigree of every Group, in other words, the gigantic natural system, but there would be no clas- sification. Much light has also been thrown by fossil birds upon the study of geographical distribution. The key to the distribution of recent groups lies in that of the extinct forms. Not only have many absolutely new Families been discovered, but many kinds of modern birds are now known to have existed also in countries where they are now extinct. There were, for instance, trogons, secretary-birds, parrots, and other now Ethiopiap forms in Miocene France. Ostriches, undistinguishable from Struthio, have been found in Samos and in the Sivalik Hills.~~

~~The proper study of fossil birds may be said to have begun with the late A. Milne-Edwards, whose magnifi- cent Oiseaux fossiles de la France was published from 1867-71. This work deals chiefly with mid-Tertiary forms. A new impetus was given by the late O. Marsh, who, as we have seen, since 1870 discovered a great number of bird remains in the cretaceous strata of North America. The most important result is the proof that until the end of the Cretaceous epoch most, if not all, birds were still possessed of teeth. In 1877 a second specimen of Archceopteryx was discovered. This Berlin specimen supplements our knowledge of that in the British Museum. It has been fully described by W. Dames in Faloeontolog. Abhandl. bd. ii. pt. 3, Berlin, 1884. Archceopteryx is already a typical bird, possessed of the power of flight, owing to the transformation of its anterior extremities into typically avine wings with remiges. It still retains various very archaic characters.~~

~~e.g., teeth, amphiccelous vertebrae, those of the tail num- bering about twenty, and although they carry about twelve pairs of well-developed rectrices, they are not yet condensed into a pygostyle. The latter character is, however, of no absolutely distinctive value, it being only peculiar to the majority of the Carinatce. Hence the inad- visability of retaining the term Saururce in opposition to OmithuroB. Archceopteryx has only slightly~~

~~narrowed the enormous gap between birds and reptiles. The at- tempt to look for the ancestors of birds among the Pterosauria is as futile as the various attempts to seek them amongst any of the known groups of Dinosauria. A great number of other fossil birds has been described from various parts of the world, notably by Cope, Fraas, Lund, Lydekker, Seeley, &c., but the most recent and bewildering mass of new forms was discovered by Ameghino chiefly in mid-Tertiary strata of Argentina (see Bevista Argentina de Historia Natural, i. 1891; Boleiin. del Inst. Oeograf. Argentin. xv. 1895; and the sumptuous publication in the Anales del Museo de la Plata, 1891, by F. P. Moreno and A. Mercerat). Many of the bones indicate birds of gigantic size, and they were col- lectively called Stereornithes by Moreno, who not unnatu- rally considered them as allied to the JSatitce. Some of these birds were undoubtedly flightless. The most re- markable genus is Phororhacos, with an enormous skull of more than two feet in length. Renewed investigation by Mr Andrews of some of the material now in the British Museum has shown that Stereornithes has to be abolished as a taxonomic group. Phororhacos belongs to the early Oruiformes, perhaps with Pelecyomis and Liornis. Dryornis seems to belong to the Cathartm, anyhow to the Falconiformes, while Mesembriornis is a direct forerunner of the present Bhem.~~

~~In conclusion, the present writer gives his classification of birds in which the extinct forms have been inter- calated so far as possible. The few characters assigned to the various groups are suflB.ciently diagnostic when taken together, although they are not always those upon which the classification has been established : —~~

~~Class AVES.~~

~~I. Sub-class Archaeornitlies. — The three fingers and their metacarpals remain separate, each with a claw. Well-developed remiges. Both jaws with alveolar teeth. Amphiccelous. Caudal vertebrae more than thirteen, without a pygostyle, but with about twelve pairs of rectrices. Archceopteryx, A. lithographica, s. macroura, and A. siemensi, two specimens from the upper Oolite of Solenhofen, Bavaria.~~

~~II. Sub-class Neornithes. — Metacarpals fused. Second finger the longest. Not more than thirteen caudal ver- tebrae.~~

~~I. Division Eatix^;. — Terrestrial, flightless. Without sternal keel. Quadrate bone with single proximal knob. Without pygostyle. Coracoid and scapula fused. Compound Rhamphotheca. Adult without apteria. With copulatory organ. A collective polyphyletic or heterogeneous group, originally cosmopolitan ; with certainty existing since the Miocene.~~

~~1. Order Struthiones. — With pubic symphysis. Two toes only,~~

~~third and fourth. Struthio, ostrich, Miocene of Samos, Plio- cene of north-west India, now Africa and Arabia.~~

~~2. Order Rhese. — With long ischiadic symphysis. Three toes.~~

~~Mesembriornis, miocene or pliocene of Argentina. Shea, South America.~~

~~3. Order Casuarii. — ^Three toes. Aftershaft as long as the other~~

~~halt. Casuarius and Dromeeus, Australian region. Sypse- lornis. Pliocene of Sivalik Hills.~~

~~4. Order Apteryges. — Four toes. Bill long and slender. New~~

~~Zealand.~~

~~5. Order Dinornithes. — Three or four toes. Bill short. Anterior~~

~~extremities extremely reduced. Dinornis, numerous species, recently extinct, New Zealand. 6. Order Mpyoiaithes. — ^pyornis, recently extinct, Madagascar. To the RatitEB belong possibly also the imperfectly known Diatryma, Eocene of New Mexico, Gastornis and Dasornis, Eocene of Europe, Genyornis of Pleistocene, Australia.~~

~~II. Division ODONTOLCffii. — Marine, flightless, without~~

~~sternal keel. Upper and lower Jaws with teeth in furrows. Cretaceous epoch. Enaliomis, England, vertebrae chiefly biconcave; Hesperomis, North America, vertebrae heteroeoelous.~~

~~III. , Division Carinat^. — With keeled sternum.~~

~~1. Order Ichthyornithes. — Power of flight well developed. Verte-~~

~~brae still amphicoelous. With small pygostyle. Incisura Ischiadica. With alveolar teeth. Cretaceous. Ichthyornis, Apatornis.~~

~~2. Order Colymbiformes. — Plantigrade, nidifugous, aquatic. All~~

~~‘ toes webbed, fourth largest, hallux short ; metatarsus later- ally compressed ; tibia with high, pyramidal crest. Bill straight, pointed, with simple sheath.~~

~~Sub-order 1. Coltmbi, Divers. Front toes completely~~

~~webbed. Periarctic. Colymbus. Sub-order 2. Podioipedes, Grebes. Toes lobated. Cos- mopolitan.~~

~~3. Order Sphenisciformes. — ^Nidicolous, marine. Plightless, wings~~

~~transformed into rowing paddles. Sphenisoi, penguins. Antarctic and southern temperate coasts. Since the Eocene.~~

~~4. Order Procellarilformes. — Well flying, pelagic, nidicolous.~~

~~Hallux absent or vestigial. Ehamphotheca compound. Cos- mopolitan. TuBiNAKEs, petrels and albatrosses. 6. Order Ciconiiformes. — Swimmers or waders. Desmognathous, without basipterygoid processes ; with one pair of sterno- tracheal muscles. Sub-order 1. Steganopodes. — Well flying, aquatic, nidicolous; with all the four toes webbed together. Ehamphotheca compound; cosmopolitan. Phaethon, tropic-bird ; Sula, gannet ; Phalacrocorax, cormorant, and Plotus, snalie-bird ; Fregata, frigate-bird ; Pelecch nus. Here also Pelagornis, Miocene of France ; Argil- lornis and probably Odontoptei-yxiTom theLondon Clay. Sub-order 2. Aede^. — Piscivorous, nidicolous, waders; with complicated hypotarsus and with long~~

~~cervical apteria. Ard^d,m, cosmopolitan ; including Cancroma, BalcBniceps, Scopidce, Ethiopian. Proherodias, Eocene of England. Sub-order 3. Ciconi2e. — Carnivorous, nidicolous, waders ; with simple hypotarsus and without cervical apteria. Cosmopolitan. Ciconiidce, storlis. IbidcB, ibises and spoonbills. Propelargus, Oligocene. Sub-order 4. Ph~~

~~6. Order Anseriformes. — Desmognathous, nidifugous ; with two~~

~~pairs of sterno-tracheal muscles, with complete basipterygoid processes and with a penis.~~

~~Sub-order 1. Palamede^. — Screamers. Ribs without uncinate processes. Hypotarsus simple. Neotropical. Chauna, Palamedea. Sub-order 2. Ansebbs. — ^Family Anatidse. Hypotarsus complex. Anser, Anas, Cygnus, since Miocene. Cnemiornis, Pleistocene, New Zealand, flightless.~~

~~7. Order Falconifonnes. — Birds of prey. Carnivorous, desmogna-~~

~~thous, nidicolous, without functional caeca. Terrestrial, aerial. Sub-order 1. Cathakt^. — American vultures. With~~

~~nares pervisB. Catharistes, condor ; Cathartes. Sub-order 2. Acoipitbes. — With nares pervise. Cfypo-~~

~~geranidm, secretary-bird, Ethiopian ; Miocene, France.~~

~~Vultwridm, Old World vultures, excluding Australia.~~

~~PaloonidaB, cosmopolitan, since the Eocene. Harpa-~~

~~gornis, Pleistocene, New Zealand ; Lithornis, Eocene,~~

~~England. Pandionidoe, pandion.~~

~~8. Order Tinamiformes. — Nidifugous, with incisura ischiadica,~~

~~without pygostyle. Herbivorous, terrestrial, neotropi- cal. Crypturi, tinamous.~~

~~9. Order Galliformes. — Schlzognathous, herbivorous, terrestrial.~~

~~With ten functional remiges. With strong spinse stemi.~~

~~Sub-order 1. Mesites. — Without basipterygoid processes, and with large spina interna. Mesites, Madagascar.~~

~~Sub-order 2. Tuknices. — Hemipodes. Nidifugous ; vomer large; sternum without processus obliqui. Hallux absent or vestigial. Old World. Turnix, Pedionomus.~~

~~Sub-order 3. Galli. — With large spina communis, and with large processus obliqui. Hallux functional. Megapodiidx, Australian region. Cracidm, curassows and guans, Neotropical. GallidcB, cosmopolitan.~~

~~Sub-order 4. Opisthooomi. — Arboreal, with long spina externa ; without basipterygoid processes. Opistho- comus, hoatzin, Guiana and Venezuela.~~

~~10. Order GruifOrmes. — ^Legs of the wading type. Without basi-~~

~~pterygoid processes. Without spina interna. Nidifugous. Essentially sohizognathous. Rallidm, cosmopolitan, since Oligocene. Ballus, Fulica, Ocydromus, &c., GalUnula nesiotis, Tristan d'Acunha, flightless. Notornis, New Zealand, flightless, nearly extinct. Aptornis, New Zealand, flightless, , extinct. Aphanapteryx (Mauritius) =Erythromachus (Rodri- guez) =i)japftorap*en/a; (Chatham Island), flightless and re- cently extinct. Gypsornis, upper Eocene, France. Gruidm, cranes, cosmopolitan, allied Phororhacos, Tertiary of Argen- tina. Dicliolophidm, cariamas, neotropical. Olididx, bus- tards. Shinochetidae, kagas, New Caledonia. Eurypygidm, sun-bittern, neotropical. Heliornithidm, finfoots, tropical.~~

~~11. Order Charadriiformes. — Schlzognathous. With eleven remiges,~~

~~of which the terminal very short. Aquinto-cubital. Spinse stemi short, separate.~~

~~Sub-order 1. Limicol^. — Nidifugous, without spina interna stemi. Hypotarsus complicated. CharadriidcB, plovers. OhionididcB, sheath-bill.~~

~~Glareolidce, wading swallows and coursers. Thinocorytidx, seed-snipes. (Edicnemididce, thiclmees. Parridm.~~

~~Sub-order 2. Laki. — Aquatic, vomer complete. Without basipterygoid processes. Front toes webbed ; hallux small or absent. Large supraorbital glands. Since Miocene. Laridoe, gulls, cosmopolitan. Alcidce, auks, northern half of periarctic region.~~

~~Sub-order 3. Ptekocles. — Sand-grouse. Nidifugous. Vomer vestigial. With large crop and caeca. Hallux vestigial or absent. Africa to India. Pterocles and Syrrhaptes.~~

~~Sub-order 4. CoLUMBiE. — Pigeons. Nidicolous. Vomer ves- tigial. With large crop, vestigial caeca. Qolumbidce, cosmopolitan, since miocene. Dididm, flightless, re- cently extinct. Didus, dodo, Mauritius. Pezophaps, solitaire, Rodriguez.~~

~~12. Order Cuculifonnes. — Desmognathous, nidicolous; zygodac-~~

~~tylous, or with the outer toe reversible.~~

~~Sub-order 1. Cuculi. — Cuckoos. Quinto-cubital. Guculidoe, cosmopolitan. MusophagidcB, plantain-eaters and touracos, Ethiopian.~~

~~Sub-order 2. Psittaci. — Parrots. Zygodactylous ; aquinto- cubital. Cosmopolitan, chiefly tropical. Trichoglos- sidce, lories, Austro-Malayan. Nestor, New Zealand. Cyclopsittacus, Eos, Lorius, &c. Psittacidce, tongue smooth, incl. Stringops.~~

~~13. Order Coraciiformes. — Nidicolous. Nares impervlse, holo-~~

~~rhinal. Down restricted to the apteria or absent. Thirteen to fifteen cervical vertebrae. Mostly desmognathous. Deep plantar tendons connected with each other.~~

~~Sub-order 1. CoBAciiE. — Either (1) with long spina ex- terna stemi, and Ooraciidce, rollers. Old World. Momo- tidce, neotropical, motmots and todies. Alcedinidce, kin^shers, cosmopolitan or (2) with long spina com-~~

~~munis. Meropidm, bee-eaters. Old World. Upupidce, hoopoes and hombills, palaearctic and palaeotropical.~~

~~Sub-order 2. Stbiges. — Owls. Outer toe reversible. Schlzognathous. Long caeca. Flexor tendons normal. Hypotarsus simple. Cosmopolitan.~~

~~Sub-order 3. Capeimulgi. — Nightjars. Nocturnal. With gaping mouth. Ten remiges and ten rectrices. Spinse stemi vestigial. Caeca functional. Steatornithidce, Steatornis, oil-bird or Guaoharo, South America. Podargidce, Australasian, Oaprimulgidce, cosmopolitan.~~

~~Sub-order 4. Ctpseli. — ^Tenth terminal remex the longest. With short spinse stemi. Without cseca. Gypselidce, swifts, cosmopolitan. TrochilidcB, humming-birds, American.~~

~~Sub-order 5. Colii. — Mouse-birds. First and fourth toes reversible. Ethiopian.~~

~~Sub-order 6. Teogones. — ^Trogons. Heterodactyle, first and second toes directed forwards, third and fourth back- wards. Tropical. Trogon gallieus, Miocene of France.~~

~~Sub-order 7. Pici. — Zygodactylous. Tendon of the middle flexor hallucis longus sending a strong vinculum to that of the middle flexor profundus, the tendon of which goes to the third toe only. , Galbulidm, puff-birds and jacamars, neotropical. Capitonidce, barbets, tropical. Bhamphastidoe, toucans, neotropical. Picidoe, wood- peckers, cosmopolitan, excepting Madaigascar and Australian region.~~

~~14. Order Passerifonnes. — Nidicolous. JEgithognathous, -without basipterygoid processes. Spina externa sterni large, spina interna absent. Quinto-cubital, toes normal. Apparently since the upper Eocene.~~

~~Sub-order 1. Passeres AuisoMTODiE. — Syrinx muscles entirely lateral or attached to the dorsal or ventral corners of the bronchial semi-rings. (1) Subclamatores. Deep plantar tendons connected by a vinculum. JSury-IcBmidoB, broad-bills, Indian and Indo-Malayan. (2) Clamatores. Deep flexor tendons not connected. Pittidce, palseotropical. Xenicidcs, New Zealand. Tyrannidm, Formicariidx, Pteroptochidoe, American. Sub-order 2. Passeres DiACROMTODiE.— Syrinx muscles of either side attached to the dorsal and ventral corners of the rings. Hallux strong, with a large claw. (1) Suboseines with Menura, lyre-bird, and Atrichia, scrub- bird, in Australia. (2) Oscines, the true singing-birds, with more than 4500 recent species, are mostly divided into some thirty "families," few of which can be defined. The fourteen orders of the Carinatse are further congregated into four " Legions " : — I. COLYMBOMORPHIjE = Ichthyomithes I Colymbifonnes I~~

~~Sphenisciformes I Procellariformes. II. PELARGOMORPH^ = Ciconiifonnes + Anseriformes I~~

~~Falconiformes. m. ALECTOROMORPH^ = Tinamiformes + Galliformes +~~

~~Gruif ormes + Charadriif onnes. IV. CORACIOMORPHIiE = Cuculiformes + Coraciifonnes + Passeriformes. These four legions are again combined into two " Brigades," the first of which comprises the first and second legions, while the second brigade contains the third and fourth legions. Thus the whole classification becomes a rounded-off phylogenetic system, which, at least in its broad outlines, seems to approach the natmral system, the ideal goal of the scientific ornithologist. The main branches of the resultant "tree" may be rendered as follows : —~~

~~CORACIOMORPH.S;~~

~~+~~

~~ODONTOLCiE. . . COLTMBO-) PELARGO- ALECTOROMORPHIiE.. . RATIT^~~

~~MORPHiE MORPHa!~~

~~NEORNITHES~~

~~The OdontolcsB seem to be an early specialized ofishoot of the Colymbo-Pelargomorphous brigade, while the Ratitse represent a number of side branches of early Alectoromorphse. The Ratitse branched off, probably during the Eocene period, from that still indifferent stock which gave rise to the Tinami-|-Galli-|-Gruiformes, when the members of this stock were still in possession of those archaic characters which distinguish Ratitse from Carinatse. It follows that new groups of Ratitse can no longer be developed since there are no Carinatse living which still retain so many low characters, e.g., configuration of the palate, precoracoid, pelvis, intes- tinal convolutions, copulatory organ, &c. Loss of the keel is coordinated with the power of using the forelimbs for locomotion ; although a ‘ ‘ Ratite ‘ ‘ character, it is not sufficient to turn a Notornis, Cnemiornis, or Stringops, not even a Fhororhacos into a member of the Ratitse.~~

~~Another branch of the Alectoromorphse, in particular of the Galliformes, when these were still scarcely separated from the Gruiformes, especially rail-like birds, leads through Opisthocomi to the Cuculiformes. These are, again in an ascending direction, connected with the Coraciif ormes, out of which have arisen the Passeriformes, and these have blossomed Into the Oscines, which, as the apotheosis of bird life, have conquered the whole inhabitable world. (h. f. G.)~~

~~B i rej i k , or Bie (Assyrian Til Bar sip, classical Apamea- Zeugma), altitude 1170 feet, built on a limestone cliff 400 feet high, on the left bank of the Euphrates, in the Aleppo viMyet. It is situated at one of the most important crossings of the Euphrates, where there was, in ancient times, a bridge of boats, and where there is now a ferry on the caravan route from Aleppo to Diarbekr and Mosul. In the massacres of 1895 most of the Armenians •were killed or forced to embrace IsMm. Population before 1895, 9500 (Moslems, 8000 ; Christians, 1500).~~

~~Birkenhead, an English seaport, market town, township, rural deanery, and municipal and parliamentary borough, in the hundred of Wirral and county and diocese of Chester, situated on the western bank of the~~

~~river Mersey, directly opposite Liverpool. The boun- daries were extended in 1877, and the population nearly doubled between 1871 and 1881, when there were 84,006 inhabitants; in 1901 the population was 111,000. The~~

~~rateable value increased from £404,678 in 1881 to £547,449 in 1899. On incorporation in 1877, the town- ships of Tranmere (1071 acres), Oxton (814 acres), and part of Higher Bebington (246 acres) were included in Birkenhead, the total area of which thus became 3850 acres. The extension coincided with the grant to the town of its municipal charter, and the govern- ment is now conducted by a mayor, 14 aldermen, and 42 councillors. Birkenhead has 21 churches belonging to the Established Church, and 41 belonging to various nonconforming bodies. A town-hall and sessions court, built at a total cost of £109,000, were opened in 1887. The water-supply of the town is derived from four pumping stations, all but one inside the borough boundary. The pumping power of the engines is 358,000 gallons per hour, and the total yield per week 27,000,000 gallons. The consumption for 1899 was over 700 million gallons, at an average rate of about 17 gallons per head per day. In 1893 a school board of 15 mem- bers was created. It had in 1901 four large schools under its control, with accommodation for 3095 children. Mercy Park, in the south end of the borough, was opened in 1886; a track of moorland, measuring 45 acres, in the township of Thurstaston, at a distance of six miles from Birkenhead, was allotted to the borough as an open space in 1883. In 1900 a portion of a piece of land known as Meols Common, comprising upwards of 64 acres of pasture land, lying on the shore of Liverpool Bay, about three miles from the borough,, was vested in the corporation. The Birkenhead ferry service is now carried on by five steamers with a total carrying capacity of 7356 persons, while the g©ods traffic is conveyed by three large steamboats. In 1897 the- corporation further acquired the rights over the Eock Perry and the New Perry, at the south end of the borough. The total number of passengers carried by the ferries in 1899 was 8^ millions. In connexion - with the free library, two branch reading-rooms and libraries- were opened in 1894. In 1879 lairages to deal with, the imported cattle trade were opened by the dock board at Woodside and on the south side of Wallasey Dock, with accommodation for 3164 oxen and 10,000 sheep. During the year ending 31st December 1899,. 162,661 oxen and 276,424 sheep passed through these lairages, quite apart from the cattle landed at the North Wallesey Lairage, just outside the borough boun- dary. Large new abattoirs were opened in 1887. The hospital accommodation of the borough has been increased by the opening in 1883 of an enlarged children's hos- pital, and in 1895 of a specially commodious infectious diseases hospital at Playbrick.~~

~~The supply of electric light is undertaken by the municipal authorities, and the generating works were opened in 1896. The tram- way system has been reorganized, in order to be worked by electric traction under the control of the corpora^- tion. In 1878 the old Monks Perry station on the Great Western system was superseded by the opening of the Woodside passenger station, and a few years later the Birkenhead town station was also opened. In 1886 the Mersey tunnel, connecting Birkenhead with Liverpool, was opened by the Prince of Wales. This system extends from Eock Perry and Park stations on the Cheshire side to the low level at central station in Liverpool, and has connexions on the Cheshire side with the Great Western, London and North-Western, Wirral, and other local systems. In 1896 the Wrexham, Mold and Connah's Quay railway was opened, thus bringing the~~

~~mineral and coal districts of Flintshire and North Wales into touch with the Birkenhead docks; a considerable traffic has resulted. A handsome Young Men's Christian Association building and a commodious theatre have been erected. In 1897 the ruins of the ancient Benedictine Priory were purchased by private subscription and pre- sented to the town. They have been carefully restored at the expense of the corporation. The general trade of the borough has increased, and latterly shipbuilding and ship repairing have developed to a considerable extent.~~

~~Birmingham, one of the chief manufacturing towns (a county borough) of England, in Warwickshire, 112|- miles (by rail) from London, with an area of about 30 square miles. The greatest length from N.E. to S.W. is about 7 miles, and the greatest breadth a little over 4 miles, the form being roughly oblong. The London and North-Western, the Midland, and the Great Western rail- ways run through Birmingham, the two former having a joint station in Kew Street, and the latter a separate~~

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~~Coulicy Boundoriei EKtentofCeatralPlui — .-, Engl. Mile~~

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Map of Sitbuebs op Bibmingham.

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station in Snow Hill. The population grew from 360,000 in 1876 to 408,000 in 1881, to 430,000 in 1891, and, cer- tain extensions having been made in the boundaries dur- ing the interval, in 1901 was found to be 522,182. The death-rate was 24-8 per 1000 in 1876, 19-1 in 1886, and 20 in 1899. The following table shows the number of births, deaths, and marriages in recent years : —

Births.

Deaths.

Marriages.

1870 1880 1890 1898

8678 9466 7966 8351

5784 5414 6263 5603

2230 2074 2544 2753

The boundaries and parliamentary representation of the city have undergone considerable changes since 1875. At that date the town (which became a city in 1889) still returned the three representatives assigned in 1867. By the Eepresentation of the People Act of 1885 this number was increased to seven, and a corresponding number of parliamentary divisions created. By the Provincial Local Government Board Act of 1891 four Local Board districts were added to the city of Birmingham for local govern- ment— Harborne (Staffordshire), Balsall Heath (Worces- tershire), Saltley, and the rural hamlet of Little Brom- wich (Warwickshire). These districts were by the Act declared to be in the county of Warwick, though still

~~remaining in their respective counties for the exercise of freehold votes. By this Act the boundaries of the city were made coterminous for parliamentary, municipal, and school board purposes. No change was made in poor-law areas or in existing ecclesiastical rights. SiQce 1876 con- siderable changes have been made in the laying out of principal streets. In the year named a great Improve- ment Scheme was initiated, with the twofold object of clearing away a mass of insanitary property from the centre of the town (in some parts of which an alarmingly high death-rate prevailed) and of constructing a main thoroughfare from the centre to the IsT.E. outlet, com- mencing from New Street, near the principal railway station, to Bull Street, and thence continuing to the Aston Eoad. The scheme received parliamentary sanc- tion in 1876, and was finished in 1882, the total cost being £1,520,667. This led to an almost total extinction of the residential quarter in the centre of the town. The great thoroughfare thus created is called Corporation Street. It was rapidly lined with buildings of considerable beauty, these being erected on leases of seventy-five years' dura- tion, at the expiration of which they become the property of the Corporation.~~

~~The most marked extension of building has heen eastwards and southwards in Saltley, Balsall Heath, and Small Heath, and to the N.W. in the direction of the Handsworth boundary, but building sites are being rapidly filled up in all quarters. Edgbaston, the fashionable suburb, owing to the strict rules enforced by the ground landlord, still remains remarkably open, and is an almost unique example of a semi-rural district, where almost every house has a garden, extending to within less than a mile of the centre of a city of more than half, a million inhabitants. This feature has had a most important effect in preserving the local life of Birming- ham intact, inasmuch as the richer and more influential inhabitants, instead of residing at a distance from the centre, as in so many large towns, remain in close contact with the general community and take a full share in municipal government and the administra- tion of charities. Edgbaston is however becoming partly surrounded by manufacturing district^, specially to the S.W., where the grow- ing districts of Selly Oak and Bourneville, with their ever-increasing factories, interpose between it and the country proper. On the E. side of the city the transition from town to country is well defined, but to the N.W. the exit from Birmingham conducts from one populous district to another. On~~

~~that side Birmingham has joined hands with the Black Country, nearly the whole of the road to Dudley, 10 miles distant, having the character of a street.~~

~~Drainage. — The sewage of the city is dealt with by a body known as " The Birmingham, Tame, and Eea District Drainage Board," constituted in 1877. It consists of nineteen members, of whom twelve are elected from the City Council, the others repre; senting districts outside the municipal area. The total area drained is over 45,000 acres, and is likely to be increased, the whole of the sewers falling to a common outlet at Saltley, adjacent to a sewage farm of 2000 acres in the valley of the Tame. After being purified in tanks by precipitation with lime, the fluid matter is passed through the land and issues as clear water into the Tame. The solid residuum is dug into the land. The board has power to serve precepts on the various local bodies included within the area. In 1899 the precept on the Birmingham corporation amounted to £•32,726, representing three-fourths the total expenditure of the board.~~

~~Lighting and Water. — Both the gas and water supplies are In the hands of the corporation. The two local gas companies were bought out in 1875. In that year 290,000 tons of coal were car- bonized ; in 1899 the quantity was 515,000, in addition to which 1,400,000 gallons of oil were also used for gas manufacture. Since 1875 the annual sale of gas has increased from 2327 to 5201 million cubic feet. The capital expenditure has increased from £2,000,000 to £2,283,000, i.e., a reduction of capital per 1000 cubic feet of gas sold from 17s. 8d. to 9s. 2d. £680,000 has been appropriated from the profits of the undertaking, and from the interest on the invested reserve fund, in aid of the rates. The rates in the lighting area have been indirectly relieved by £200,000 by means of reduced charges for public lighting ; the Art Gallery building has been provided, and a reserve of £658,000 accumulated. The corporation has taken over the electric supply from 1st January 1900, the purchase money being £420,000. The water was acquired in 1876. In contrast to the gas undertaking, the water has never been looked upon as a profit-making con- cern, this beipg expressly disavowed, and the motive of public~~

policy declared by the promoters of municipalization. The present sources of supply are the rivers Bourne and Blythe, the Plant Brook, and the Perry Stream, and eight deep wells. The works can provide 20 million gallons daily in dry weather. The area supplied covers 129| square miles, with an estimated population of 800,000. Owing to the rapid increase of demand, a new reser- voir has been constructed at Shustoke on the Bourne, with a capacity of 400 million gallons. This brought the total capital authorized up to date to £2,097,860, the whole of which has been raised and expended. In 1891 the demand having risen to nearly 17 millions a day, new sources of supply had to be considered, and it was determined to seek an entirely new supply in Wales. By an Act of 1892 power was given to acquire the watershed of the rivers Elan and Claerwen, tributaries of the Wye in Radnor and Brecon shires, and to construct the necessary works, the capital authorized being £6,000,000. The works for the first instal- ment of the Welsh scheme are now in hand. These comprise a large storage and compensation reservoir, and two storage reservoirs on Qie river Elan. The estimate formed in 1891 for the present works was £3,621,950, but the actual cost will be greater. It may be mentioned that the capitalized value of the gas and water undertakings, as re- gards wor^ now in operation (excluding the Welsh scheme), is about £4,500,000, against which is to be set an accumu- lated sinking fund amounting to nearly £800,000.

Administration. — In 1883 the various Acts of past years were com- bined into the Bir- mingham Corporation Consolidation Act, which gave further powers to erect assize courts, increase the area of gas supply, impose Free Library rate, and conduct a municipal School of Art. The poor — law administration has, since 1876, been put on a more popular basis. In 1882 a super- intendent relieving of&cer was appointed, and a system of cross visitation started for the purpose of checking abuses of outdoor re- lief. In the same year the Guardians built an infirmary with 1300 beds. In 1878 they de- cided to build cottage homes in a rural district for the purpose of bringing up per- manent pauper children. Each home has 30 inmates under the care of a “foster parent.” There are 400 inmates altogether. Workhouses have been thoroughly modernized, the principle of separating children adopted, and infirmaries built. Women first sat on the Board of Guardians in

~~1880. In 1889 Birmingham was created a city, and a grant made of an official coat-of-arms carrying supporters. The title of lord mayor was conferred on the chief magistrate in 1897. The police force has increased from 500 in 1875 to 700 in 1899. In 1876 the amount of assessment to the borough rate was £1,254,911, the rate being 3s. 10|d. in the £ (of which 3d. was for the School Board), and the income about £300,000. In 1898-99 the income from rates was £535,659 at 5s. IJd. in the £ on a gross assessment of £2,297,542, and the total debt to be provided for £9,380,000, of which about seven millions is represented by gas and water liabilities and by the dwelling-house improvement fund. The School Board rate for the same year was Is. 0-64d. in the £ (included in the aforementioned 6s. IJd.). The City Council consists of eighteen aldermen and fifty-four councillors, selected from eighteen wards ; it is divided into seventeen committees, most of which consist of eight members. The corporation is the largest employer of labour in the borough ; it employs over 5000 persons, and is also a large landov\mer. The administration of justice was performed from 1838 td 1884 by a Court of Quarter Sessions, with a recorder, and a Court of Petty Sessions. In 1884 Birmingham was made an~~

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~~assize district of Warwickshire. In connexion with this event new law courts had to be created.~~

~~'Religion, — The total sittings provided by the various churches of all denominations in Birmingham amount to about one quarter of the total population. In 1892 the Establishment had 108 churches and mission rooms, and other denominations 159 places of worship. This number has not materially changed. Three new churches belonging to the Establishment were consecrated in the period 1875-1897. Since 1897 two more have been consecrated and one commenced ; three have been closed, and arrangements made for rebuilding in other districts.~~

~~Charities. — The old General Hospital had, in 1875, 2000 in- and 25,000 out-patients. This has now been replaced by a splendid new erection on St Mary's Square, which both for external and internal merit ranks amongst the foremost hos- pitals of the kingdom! The building was commenced in 1894 and finished in 1897 at a total cost of £206,000. In that year the number of in-patients was 4119 ; out-patients, 54,217. The work of the Queen's Hospital has risen from 1300 ,and 17,000 in- and out-patients in 1876 to 2020 and 28,569 in 1898. The various medical and other charities mentioned as existing in~~

~~1875 are, with few ex- ceptions, still in opera- tion, and on an increased scale. Most of the hospitals and dispensaries, of which there are now fourteen, have been made free since that date.~~

~~Tramways. — The tramways belong to private companies, which hold leases from the corporation. Steam, electric, horse, and cable traction are employed. The total length is over 33 miles. The rent paid to the corporation during the period 1893 – 1900 was £8762.~~

~~Education. — The foundation of the schools of King Edward VI. derive an income, from endowments, of £37,000, as against £16,000 in 1876, and there is prospect of further increase. The principal school — the Boys' High School- is held in the building erected in New Street in 1840. It has a classical and a modern side, and educates about 500 boys. Adjoining it, in a new building opened in 1896, is a large high school for girls, with 300 pupils. There are also on the foundation seven middle schools, called gram- mar schools, four for girls and three for boys, situate in different parts of the city, and containing about 1900 pupils altogether. The schools have numerous scholarships tenable at the schools as well as exhibitions to the universities and other places of higher education. Queen''s College, with its medical and theological departments, was in 1875 flourishing on the former, languishing on the latter side. In 1882 a large part of the scientific teaching, hitherto done by special professors in Queen's College, was taken over by Mason College, and in 1892 the whole medical depart- ment was removed to the same institution under an order from the Court of Chancery. This change helped to advance the Birmingham Medical School to a position of high repute. The theological students of Queen's College are~~

~~extremely few. The idea of developing Queen's College into a university had long existed. The idea was destined to be realized in connexion with Mason College. The foundation deed (dated 1870) of this college, the first stone of which was laid in 1876, declares the founder's intention to be that of promoting " thorough systematic education and instruction specially adapted to the practical, mechanical, and artistic requirements of the manufactures and industrial pur- suits of the Midland district … to the exclusion of mere literary education and instruction." Subsequent deeds (1874 and 1881) added Greek and Latin, and provided that instruction may be given in all such other subjects as the trustees may from time to~~

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~~time judge necessary, while once in every fifteen years the pro- visions of the deed may be varied to meet changing needs — theology only being definitely excluded. In 1897 a ,new Act was passed at the instance of the trustees, creating a court of 180 members, and removing the theological restriction. A measure of popular control is given through the appointment by the City Council of five out of the eleven trustees. The college opened in 1880 with 63 students ; in 1884-86 the number was 626 ; in 1898-99 there were 666. In 1898 a public meeting carried a resolution in favour of creating a university. It was estimated that a quarter of a million was needed to endow and equip a university on the scale proposed. Including £60,000 offered by Mr Carnegie, the Pennsylvania iron- master, and an equal amount from an anonymous donor, the rest from local subscribers, in the autumn of 1899, £325,000 had been subscribed, and the Privy Council was at once petitioned for a charter, which was granted. The draft provides for the incorpora^ tion of " the University of Birmingham " with faculties of science, arts, medicine, and commerce, with power to grant degrees, and for its government by a court of governors (of which women may be members), a council, and a senate. Mason College is merged in the university. It will be seen that one of the faculties is that of commerce, constituting a distinctive feature in the scheme of the university, the object being to bring its teaching into close touch with the industrial life of the city, the district,~~

~~and the kingdom. Elementary education has passed chiefly into the hands of the School Board. In 1870 the existing voluntary schools provided accommodation for 30,000 children, about half of what wasnecessary. The School Board was elected for the first time in 1870. In 1898, 88,944 places had been provided, of which 56,868 were in board, and 31,751 in denominational, and 325 in private schools. The per- centage of average attendance to the number on the books is about 82 in the denominational and 84 in the board schools. There were fifty-seven schools under the board, exclusive of two special schools for deaf and three for feeble-minded children. There are also under the board sixteen evening continuation schools, nine for boys and men, seven for girls and women ; six commercial evening schools, three for each sex. There are two higher-grade schools, with a combined attendance of 585. The cost of the School Board to the rates has now amounted to about £120,000 per annum, and the total expenditure of the board, exclusive of capital, to £200,000 per annum. The Municipal School of Art was formed by the transference to the Corporation in 1885 of the then existing School of Art and the Society of Arts, and by the erection of a noble building in Margaret Street, the site having already been given and a portion of the cost provided by private donors. There are one central school and two branch schools. Evening classes are also held in six of the board schools. In 1899 there were 1300 students in the central school, and 3828 in the branches and classes. The Midland Institute still continues an important work of higher education. A marked development took place in 1885, when, fresh room havmg been provided by the removal of the School of Art hitherto held in the building, the industrial department was greatly enlarged, resulting in the creation of one of the best metallurgical schools in the kingdom. The present number of students in the industrial department is 2499. On the erection of the Municipal Technical School the whole of the scientific teaching of the Midland Institute was transferred to the former. The Municipal Technical School was established in 1893 in the building of the Midland Institute, and in 1895 was housed in a noble building of its own, in Suffolk Street, at a cost of £93,000. It contains metallurgical and engineering workshops and laboratories, lecture theatres for the teaching of chemistry and physics, a women's department, and rooms for the teaching of machine drawing and building construc- tion. There are 2595 students in the evening classes and 195 boys in the day school. The books in the Birmingham Library increased from 40,000 in~~

~~1875 to about 65,000 in 1899. The old building, its home for 100 years, has been demolished and a new one erected. The free libraries of the city are supported by a rate of about IJd. in the £. There is one central library, having 140,000 volumes in the reference and 30,000 in the lending departments respectively, and nine free libraries in other parts of the city, each with a lending department and a reading room. The net borough expenditure on this item amounted in 1898-99 to about £14,000.~~

~~Miscellanea.— There are ten principal banks, five theatres, and six clubs ; two morning and two evening papers, and four weekly papers. The great musical festival is still held trienni- ally for the benefit of the General Hospital. Seven new parks or recreation grounds have been added since 1875, making the total twelve.~~

~~Public Buildings.— The noble block of buildings comprismg the Council House and Art Gallery was commenced in 1874, the front portion completed in 1879, the rear in 1881. It completes the fine group of buildings, of which the Town Hall and Mason College are the other conspicuous members. The style is Eenaissance, and the material is Barley Dale, Spinkwell, and Wrexham stone.~~

~~The entrance is surmounted with a pediment filled with groups of excellent sculpture. The erection of that part which forms the Art Gallery was the work of the Gas Committee, to whom the council granted the site on condition that they would build such a gallery over their own office, the council having no powers at the time to raise the required funds. The cost of the Council House, exclusive of the art gallery, was £163,805. The Art Gallery contains a fine collection of modern paintings, including master-pieces of David Cox, Millais, Hunt, Henry Moore, Albert Moore, Briton-Rivifere, Burne-Jones. In the industrial hall are rich stores of Oriental metal-work, Ljmoges enamel, EngUsh and foreign glass, Japanese ceramics. In~~

~~Manufactures.— Birmingham manufactures retain their charac- ter of multitudinous variety. Among changes since 1875 may be noted the rapid growth in the jewellery and the gun trades, and in the making of metal tubes of all kinds. The following figures issued by the Assay Office, showing the~~

~~amount of gold and silver marked in successive years, will give some idea of the growth of the jewellery trade : —~~

~~Gold. Silver.~~

~~1870~~

~~OZB.~~

~~48,123~~

~~OZB.~~

~~84,323~~

~~1880~~

~~81,606~~

~~239,835~~

~~1890 , .~~

~~193,426~~

~~1,,098,250~~

~~1895~~

~~239,472~~

~~1,796,056~~

~~1899~~

~~362,481~~

~~2,823,525~~

The year 1897 was famous for a sudden development of cycle manufacturing, followed in 1899 by an almost equaUy sudden col- lapse. But the variety of manufactures is such that a misfortune occurring to one is not likely to destroy the general prosperity of the city.

Social Life. — One of the most marked features of social life in Birmingham is the fact that contrasts in the distribution of wealth are less strongly mai-ked than in most other great cities. The distance between the poorest and the richest is bridged over by a larger number of intermediate gradations. Colossal fortunes are few ; on the other hand there is a numerous class of rich men. These, however, for the greater part are actually engaged in trade or manufactures, and hold their place in local life rather on account of industry pursued than of wealth possessed. The number of the leisured class, enjoying large incomes vrithout participating in any local industry, is relatively small, but is said to be on the increase. There are many manufacturing companies, but great private firms are also numerous. In regard to labour conditions, the system of small masters, so rarely found at the present day, still holds its own in the manufactures of Bir- mingham, and shows no present signs of extinction. These facts give to the social relationships of the community a remarkable closeness, integrity, and permanence. (l. p. j\

Birmingham, capital of Jefferson county, Alabama, U.S.A., situated in the central part of tfie state, in 33° 30′ N. lat. and 86° 47′ W. long., at an altitude of 600 feet. It is an important railway centre, being entered by five lines : the Central of Georgia, the Kansas City, Memphis and Birmingham, the Louisville

and Nashville, the Queen and Crescent, and the Southern. It is the most important point south of Pennsylvania for iron smelting and manufacturing. For this it has un- equalled facilities, since in its immediate neighbourhood, at Ked Mountain, are great deposits of iron ore, with limestone and coal for smelting. The city contains many hlast furnaces, foundries, and other ironworks. Birming- ham has had a very rapid growth owing to this

~~develop- ment of the iron industry. In 1880 the population was only 3086, but in 1890 it had jumped to 26,178, and in 1900 to 38,415, of whom 1776 were foreign-born and 16,575 were negroes. The assessed valuation of real and personal property in 1900, on a basis of about 60 per cent, of the full value, was $16,387,226, the tax rate |22 per $1000, and the net debt $2,127,262.~~

~~Birsk, a district town of S.E. Russia, government of and 69 miles N.W. of Ufa, on Byelaya river. It is an important centre for trade with the Bashkirs. Popula- tion, 8603.~~

~~Biscay, a maritime province — one of the Basque Provinces — in the north of Spain, with 52 miles of coast, and an area of 849 square miles, divided into 6 adminis- trative districts and 120 parishes. Its population was 235,659 in 1887, and 290,222 in 1897. The increase of population has been chiefly in Bilbao, Abando, Baracaldo, Portugalete, Santurce, and Sestao, owing to the growth of the mining and metallurgic industries. The birth-rate per 1000 was 38-5, the death-rate 30-9, and the marriage- rate 7-3. Only a few hundred emigrate annually. The climate is rather inclement and variable. The ther- mometer seldom drops below freezing-point, however, nor does snow fall frequently in winter except on the highest heights. The rainfall is on an average greater than in any province except those of the extreme north-west. The mountainous slopes of the province are studded with the traditional Basque " Caserio," or farmhouse, in which the hardy peasantry live on the mitayer system, dividing the profits of the soil with absentee landlords. The soil is not very fertile except in some valleys and sheltered hillsides. Only 10,567 acres are devoted to the culture of 'wheat, 13,437 to maize, 6005 to pod fruit, 1742 to vines. There are, in aU, 143,214 head of live stock, in- cluding 5259 horses, 825 mules, 2003 asses, 49,587 cattle, 61,642 sheep, 6848 goats, and 17,060 pigs. Except iron and zinc mining and calcination of ores, the industries of Biscay are declining, through peninsular and foreign competition, especially those connected with wool, petroleiun, tanneries, and the export of fish, in particular " sardinas." The fishing fleet, however, still consists of several hundred boats, manned by nearly 5000 men and boys. Another very important industry is the manufac- ture of dynamite and other explosives at Galdacano, closely connected with the mining interests. There are also potteries, paper, soap,~~

~~and shoe factories, flour mills and breweries, and the many sprihgs and spas are frequented by people from aU parts of Spain. The chief source of the province's prosperity lies in its mines ; there were, in 1898, 2 sulphur, 12 zinc, 2 lead, and 204 iron ore productive mines, and 1037 unproductive. In some concessions the veins produce less and less every year. 11,105 persons were engaged in the iron ore mines, all but 76 in outside employment, and the total production of iron ore in 1898—5,073,338 tons — was 181,111 tons less than in 1897. The principal classes of ore are the limonite, or rubio, of all kinds of which from 4,000,000 to 4,250,000 tons, on an average, were extracted in 1896, 1897, and 1898 ; the red haematite or campanil, the out- put of which dwindled from 440,000 tons in 1896 to 275,800 tons in 1898, and will soon become nil ; and the spathic or siderite, calcined carbonate, of which 300,000~~

~~tons were extracted in 1896, 454,300 in 1897, and 477,700 in 1898. It is estimated that there are only from 40,000,000 to 50,000,000 tons of iron ore still to be mined, so that at the present rate of extraction the output would cease in about ten years. Nearly all the iron ores are sent abroad. Bilbao is the only port of any importance. The mining and industrial interests of Biscay have been very materially assisted by the quick and important development of means of communication of every kind. The provincial and parish roads, kept up by the local government, are excellent. No province in Spain had at the close of the 19th century such a complete network of railways, and they have all been built since 1870.~~

~~(a. e. h.) Bisceglie, a fortified seaport town and episcopal see of the province of Bari, Apulia, Italy, 21 miles by rail N.W. from Bari. In 1897 the port was cleared by 499 yessels of 151,568 tons. The population (1901) was~~

~~30,885.~~

~~Bischofswerda, a town of Germany, on the Wesenitz, which empties into the Elbe 12 miles W.S.W. of the town, and in the circle of Bautzen, kingdom of Saxony. It has a branch railway line to Zittau. There are a commercial and a technical school, cloth and artificial flower factories, glass-works, potteries, and in the neigh- bourhood large granite quarries. It is famous as the scene of a battle in 1813 between the French and the Allies on Napoleon's retreat from Moscow. It was the residence of Bishop Benno~~

~~in the 11th century, and the " Bishop's Eoad" still runs from here to Meissen. Population~~

~~(1890), 5612 ; (1900), 6610.~~

~~Bischweiler, a town of Germany, in the imperial territory of Alsace-Lorraine, district of Lower Alsace, 23 miles by rail N. by E. from Strasburg. It has manufaio- tures of jute and machinery, brewing, and iron founding. Hops are extensively grown. Popidation (1885), 6815 ;~~

~~(1900), 7875.~~

~~Bishop Aucldandj' a market town and railway station in the Bishop Auckland parliamentary division of Durham, England, on the Wear and Gaunless, 11 miles S.S.W. of Durham city. Recent buildings are a temper-ance hall, church institute, memorial -hall, fever hospital, accident hospital, and theatre (rebuilt). Area of urban district, 950 acres ; population (1881), 10,097 ; (1901),~~

~~11,966.~~

~~Bishop Stortford, a market town and railway station in the Hertford parliamentary division of Hert- fordshire, England, on the Stort, 14 mUes E.N.E. of Hertford. The old church of St Michael's has been restored and a hospital opened. There are also grammar schools and other first-class educational establishments, including the Roman Catholic convent of St Mary. The church of St Joseph has also been established. There are important cattle and horse markets. Area of civil parish (an urban district), 3285 acres ; population (1881),~~

~~6704 ; (1891), 6595 ; (1901), 7143.~~

~~Bishop Wearmouth. See Sunderland.~~

~~Bislcra, a town in Algeria, capital of a canton in the department of Constantino, 150 miles by rail S. by W. of Constantine. It is in communication with Philippeville by a railway which is to be extended as far as Tuggurt and Wargla. Since 1894-95 Biskra has grown into great~~

repute as a winter residence, laying itself out rapidly in hotels, villas, and casinos. The climate is uncommonly healthy, the sky serene, and there is very seldom any rain. In spite of its proximity to the Sahara desert, the French enjoy excellent sanitary conditions. Only 700 in 1890, the French population in 1900 numbered 1500, and the

mimber of visitors every winter reaches an average of 20,000. The local population in 1880 was 6955 ; in 1891, 7165 ; in 1900, 8417.

Bismarck, capital of Burleigh county, North Dakota, U.S.A., and capital of the state. It is situated a little south of the centre of the state, on the east bank of the Missouri river, at an altitude of 1670 feet, and is on the main line of the Northern Pacific railway. The river is navigable at high water for 1200 miles above this point, and much freight is shipped from here by this route. The state'Capitol, which cost $600,000, is a fine building. Population (1880), 1758 ; (1900), 3319.

Bismarck, Otto Eduard Leopold von, Pbikce, Duke of Laubnbukg (1815-1898), the great German statesman, was born on 1st April 1815, at the Manor House of Schonhausen, his father's seat in the Mark of Brandenburg. The family has, since the 14th century, belonged to the landed gentry, and many members had held high o£B.ce in the kingdom of Prussia. His father (d. 1845), of whom he always spoke with much affection, was a quiet, unassiltning man, who retired from the army in early life with the rank of E/ittmeister. His mother, a daughter of Mencken, cabinet secretary to the king, was a woman of strong character and ability, who had been brought up at Berlin under the " Auf klarung." Her ambition was centred in her sons, but Bismarck in his recollections of his childhood missed the influences of maternal tenderness. There were several children of the marriage, which took place in 1806, but all died in childhood except Bernhard (b. 1810, d. 1893), Otto, and one sister, Malvina (b. 1827), who married in 1845 Oscar von Arnim. Young Bismarck was educated in Berlin, first at a private school, then at the gymnasium of the Graue Kloster (Grey Friars). At the age of seventeen he went to the University of Gottingen,

~~where he spent a little over a year; he joined the corps of the Hannoverana and took a leading part in the social life of the students. He completed his studies at Berlin, and in 1835 passed the examinations which admitted him to the public service. He was intended for the diplomatic service, but spent some months at Aix-la-Chapelle in administrative work, and then was transferred to Potsdam and the judicial side. He soon retired from the public service ; he conceived a great distaste for it, and bad shown himself defective in discipline and regularity. In 1839, after his mother's death, he undertook, with his brother, the management of the family estates in Pomerania ; at this time most of the estate attached to Schonhausen had to be sold. In 1844, after the marriage of his sister, he went to live with his fatherat Schonhausen. He and his brother took an active part in local affairs, and in 1846 he was appointed Deichhauptmann, an office in which he was responsible for the care of the dykes by which the country, in the neighbourhood of the Elbe, was preserved from inundation. During these years he travelled in England, France, and Switzerland. The influence of his mother, and his own wide reading and critical character, made him at one time inclined to hold liberal opinions on government and religion, but he was strongly affected by the religious revival of the early years of the reign of Frederick William IV.; his opinions underwent a great change, and under the influence of the neighbouring country gentlemen he acquired those strong principles in favour of monarchical government as the expression of the Christian state of which he was to become the most celebrated exponent. His religious convictions were strengthened by his mar- riage to Johanna von Puttkamer, which took place in 1847.~~

~~In the same year he entered public life, being chosen as substitute for the representative of the lower nobility~~

~~of his district in the Estates-General, which were in that year summoned to Berlin. He took his seat pariia- with the Extreme Eight, and distinguished meatary himself by the vigour and originality with career. which he defended the rights of the king and the Christian monarchy against the Liberals. When the revolution broke out in the following year he offered to bring the peasants of Schonhausen to Berlin in order to defend the king against the revolutionary party, and in the last meeting of the Estates voted in a minority of two against the address thanking the king for granting a~~

~~constitution. He did not sit in any of the assemblies summoned during the revolutionary year, but took a very active part in the formation of a union of the Conserva- tive party, and was one of the founders of the New Prussian Gazette, better known as the Kreuzzeitung, which has since then been the organ of the Monarchical party in Prussia. In the new parliament which was elected at the beginning of 1849, he sat for Brandenburg, and was one of the most frequent and most incisive speakers of what was called the Junker party. He took a prominent part in the discussions on the new Prussian constitution, always defending the power of the king. His speeches of this period show great debating skill, combined with strong originality and imagination. His constant theme was, that the party disputes were a struggle for power between the forces of revolution, which derived their strength from the fighters on the barricades, and the Christian monarchy, and that between these opposed principles no compromise was possible. He took also a considerable part in the debates on the foreign policy of the Prussian Government ; he defended the Government for not accepting the Frankfort con- stitution, and opposed the policy of Eadowitz, on the ground that the Prussian king would be subjected to the control of a non-Prussian parliament. The only thing, he said, that had come out of the revolutionary year unharmed, and had saved Prussia from dissolution and Germany from anarchy, was the Prussian army and the Prussian civil service ; and in the debates on foreign policy he opposed the numerous plans for bringing about the union of Germany, by subjecting the Crown and Prussia to a common German parliament. He had a seat in the parliament of Erfurt, but ouly went there in order to oppose the constitution which the Parliament had framed. He foresaw that the policy of the Govern- ment would lead it into a position when it would have to fight against Austria on behalf of a constitution by which Prussia itself would be dissolved, and he was, therefore, one of the few prominent politicians who defended the complete change of front which followed the surrender of Olmiitz.~~

~~It was probably his speeches on German policy which induced the king to appoint him Prussian representative at the restored Diet of Frankfort in 1851. The appointment was a bold one, as he was entirely “‘j^”™””*’ without diplomatic experience, but he justified the confidence placed in him. During the eight years he spent at Frankfort he acquired an unrivalled knowledge of German politics. He was often used for important mis- sions,~~

as in 1852, when he was sent to Vienna. He was en- trusted with the negotiations by which the duke of Augusten- burg was persuaded to assent to the arrangements by which he resigned his claims to Schleswig and Holstein. The period he spent at Frankfort, however, was of most impor- tance because of the change it brought about in his own po- litical opinions. When he went to Frankfort he was still under the influence of the extreme Prussian Conservatives, men like the Gerlachs, who regarded the maintenance of the principle of the Christian monarchy against the revolution as the chief duty “)^f the Prussian Government. He was

prepared on this ground for a close alliance with Austria. He found, however, a deliberate intention on the part of Austria to humble Prussia, and to degrade her from the position of an equal Power, and also great jealousy of Prussia among the smaller German princes, many of whom owed their thrones to the Prussian soldiers, who, as in Saxony and Baden, had crushed the insurgents. He therefore came to the conclusion that if Prussia was to regain the position she had lost she must be prepared for the opposition of Austria, and must strengthen herself by alliances with other Powers. The solidarity of Conserva tive interests appeared to him now a dangerous fiction. At the time of the Crimean war he advocated alliance with Russia, and it was to a great extent owing to his advice that Prussia did not join the western Powers. Afterwards he urged a good understanding with Napoleon, but his aidvice was met by the insuperable objection of the king to any alliance with a ruler of revolutionary origin.

The change of ministry which followed the establish- ment of a regency in 1857 made it desirable to appoint a new envoy at Frankfort, and in 1858 Bismarck was ap- pointed ambassador at St Petersburg, where he remained for four years. During this period he acquired some knowledge of Russian and gained the warm regard of the Tsar, as well as of the Dowager-Empress, herself a Prus- sian princess. During the first two years he had little influence on the Prussian Government ; the Liberal minis- ters distrusted his known opinions on parliamentary government, and the monarchical feeling of the prince regent was offended by Bismarck’s avowed readiness for

~~alliance with the Italians and his disregard of the rights of other princes. The failure of the ministry, and the estrangement between the king and the Liberal party, opened to him the way to power. Eoon, who was ap- pointed Minister of War in 1861, was an old friend of his, and through him Bismarck was thenceforward kept closely informed of the condition of affairs in Berlin. On several occasions the ptospect of entering the ministry was open to him, but nothing came of it, apparently because he required a free hand in foreign affairs, and this the king was not prepared to given him. When an acute crisis arose out of the refusal of parliament, in 1862, to vote the money required for the reorganization of the army, which the king and Eoon had carried through, he was summoned to Berlin ; but the king was still unable to make up his mind to appoint him, although he felt that Bismarck was the only man who had the courage and capacity for con- ducting the struggle with parliament. He was, therefore, in June, made ambassador at Paris as a temporary ex- pedient. There he had the opportunity for renewing the good understanding with Napoleon which had been begun in 1857. He also paid a short visit to England, but it does not appear that this had any political results. In September the parliament, by a large majority, threw out the budget, and the king, having nowhere else to turn for help, at Boon's advice summoned Bismarck to Berlin and appointed him minister-president and foreign minister.~~

~~Bismarck's duty as minister was to carry on the gov- ernment against the wishes of the Lower House, so as to Ministry ^^^^^^ *^® ^^^S *o complete and maintain the reorganized army. The opposition of the House was supported by the country and by a large party at court, including the queen and crown prince. The in- dignation which his appointment caused was intense ; he was known only by the reputation which in his early years he had won as a violent ultra-Conservative, and the apprehensions were increased by his first speech, in which he said that the problems of the time could only be settled by blood and iron. His early fall was predicted, and it~~

~~was feared that he might bring down the monarchy with him. Standing almost alone he succeeded in the task he had undertaken. For four years he ruled without a budget, taking advantage of an omission iu the constitu- tion which did not specify what was to happen in case the Crown and the two Houses could not agree on a budget The conflict of the ministers and the~~

~~House assumed at times the form of bitter personal hostility ; in 1863 the ministers refused any longer to attend the sittings, and Bismarck challenged Virchow, one of his strongest op- ponents, to a duel, which, however, did not take place. In 1852 he had fought a duel with pistols' against George von Vindre, a political opponent. In June 1863, as soon as parliament had risen, Bismarck published ordinances controlling the liberty of the press, which, though in ac- cordance with the letter, seemed opposed to the intentions of the constitution, and it was on this occasion that the crown prince, hitherto a silent opponent, publicly dis- sociated himself from the policy of his. father's ministers. Bismarck depended for his position solely on the con- fidence of the king, and the necessity for defending himself against the attempts to destroy this confidence added greatly to the suspiciousness of his nature. He was, however, really indispensable, for his resignation must be followed by a Liberal ministry, parliamentary control over the army, and probably the abdication of the king. Not only, therefore, was he secure in the continuance of the king's support, but he had also the complete control of foreign affairs. Thus he could afford to ignore the criticism of the House, and the king was obliged to acquiesce in the policy of a minister to whom he owed so much.~~

~~He soon gave to the policy of the monarchy a resolu- tion which had long been wanting. When the emperor of Austria summoned a meeting of the German princes at Frankfort to discuss a reform of the "H" confederation, Bismarck insisted that the king of Prussia must not attend. He remained away, and his absence in itself made the congress unavailing. There can be no doubt that from the time he entered on office Bismarck was determined to bring to an issue the long struggle for supremacy in Germany between the house of Hapsbuig and the house of HohenzoUern. Before he was able to complete his preparations for this, two unforeseen occurrences completely altered the European situation, and caused the conflict to be postponed for three years. The first was the outbreak of rebellion in Poland. Bismarck, an inheritor of the older Prussian traditions, and recollect- ing how much of the greatness of Prussia had been gained at the expense of the Poles, offered his help to the Tsar. By this he placed himself in opposition to the universal feeling of Western Europe; no act of his life added so much to the repulsion with which at this time he was regarded as an enemy of liberty and right. He won, however, the gratitude of the Tsar and the support of~~

Russia, which in the next years was to be of vital service to him. Even more serious were the difficulties arising in Denmark. On the death of the king in 1863 Prince Frederic of Augustenburg came forward as claimant to the duchies of Schleswig-Holstein which had hitherto been joined to the crown of Denmark. He was strongly supported by the whole German nation and by many of its princes. Bismarck, however, once more was obliged to oppose the current of national feeling, which imperiously demanded that the German duchies should be rescued from a foreign yoke. Prussia was bound by the treaty of London, which guaranteed the integrity of the Danish monarchy ; to have disregarded this would have been to bring about a coalition against Germany similar to that of 1851. Moreover, he held that it would be of no advant- age to Prussia to create a new German state ; if Denmark

Otto von Bis:\iAKrK.

(From till- I'anilni'i In/ Fniiiz rcn Lt-nhach.)

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War with Austria.

were to lose the ducHes, he desired that Prussia should acquire them, and to recognize the Augustenburg claims ■would make this impossible. His resistance to the national desire made him appear a traitor to his country. To check the agitation he turned for help to Austria; and an alliance of the two joint Powers, so lately at variance, was formed. He then falsified all the predictions of the opposition by going to war with Denmark, not, as they had required, in support of Augustenburg, but on the ground that the king of Denmark had violated his promise not to oppress his German subjects. Austria continued to act with Prussia, and, after the defeat of the Danes, at the Peace of Vienna the sovereignty of the duchies was surrendered to the two allies — ^the first step towards annexation by Prussia. There is no part of Bismarck's diplomatic work which deserves such careful study as these events. Watched as he was by countless enemies at home and abroad, a single false step would have brought ruin and disgrace on himself ; the

~~growing national excitement would have burst through all re- straint, and again, as fifteen years before, Germany divided and unorganized would have had to capitulate to the orders of foreign Powers.~~

~~The Peace of Vienna left him once more free to return to his older policy. For the next eighteen months he was occupied in preparing for war with Austria. For this war he was alone responsible; he undertook it deliberately as the only means of securing Prussian ascendancy in Germany. The actual cause of dispute was the disposition of the conquered duchies, for Austria now wished to put Augustenburg in as duke, a plan to which Bismarck would not assent. In 1865 a provisional arrangement was made by the treaty of Gastein, for Bismarck was not yet ready. He would not risk a war unless he was certain of success, and for this he required the alliance of Italy and French support ; both he secured during the next year. In October 1865 he visited Napoleon at Biarritz and Paris". No formal treaty was made, but Napoleon promised to regard favour- ably an extension of Prussian power in Germany ; while Bismarck led the emperor to believe that Prussia would help him in extending the frontier of France. A treaty of alliance with Italy was arranged in the spring of 1866"; and Bismarck then with much difiiculty overcame the reluctance of the king to embark in a war with his old ally. The results of the war entirely justified his calcu- lations. Prussia, though opposed by all the German states except a few principalities in the north, completely defeated all her enemies, and at the end of a few weeks the whole of Germany lay at her feet.~~

~~The war of 1866 is more than that of 1870 the crisis of modern German history. It finally settled the contro- versy which had begun more than a hundred o/ /itf™*"' years before, and left Prussia the dominant power in Germany. It determined that the unity of Germany should be brought about not by revo- lutionary means as in 1848, not as in 1849 had been attempted by voluntary agreement of the princes, not by Austria, but by the sword of Prussia. This was the great work of Bismarck's life ; he had completed the programme foreshadowed in his early speeches, and finished the work of Frederick the Great. It is also the turning-point in Bismarck's own life. Having secured the dominance of the crown in Prussia and of Prussia in Germany, he could afford to make a reconciliation with the parties which had been his chief opponents, and turn to them for help in building up a~~

~~new Germany. The settlement of 1866 was peculiarly his work. We must notice, first, how in arranging the terms of peace he opposed the king and the military party who wished to advance on Vienna and annex part of Austrian Silesia; with greater foresight he~~

~~looked to renewing the old friendship with Austria, and insisted (even with the threat of resignation) that no territory should be demanded. The southern states he treated with equal moderation, and thereby was able to arrange an offensive and defensive alliance with them. On the other hand, in order to secure the complete con- trol of North Germany, which was his immediate object, he required that the whole of Hanover, Hesse Cassel, Hesse Nassau, and the city of Frankfort, as well as the Elbe duchies, should be absorbed in Prussia. He then formed a separate confederation of the North German states, but did not attempt to unite the whole of Germany, partly because of the internal difficulties which this would have produced, partly because it would have brought about a war with France. In the new confedera- tion he became sole responsible minister, with the title Bundes-Kanzler ; this position he held till 1890, in addition to his former post of premier minister. In 1871 the title was altered to Beichs-Kanzler.~~

~~The reconciliation with the Prussian parliament he effected by bringing in a bill of indemnity for the money which had been spent without leave of parliament. The Eadicals still continued their opposition, but he thereby made possible the formation of a large party of moderate Liberals, who thenceforward supported him in his new Nationalist policy. He also, in the constitution for the new confederation, introduced a general Diet elected by universal suffrage. This was the chief demand of the revolutionists in 1848 ; it was one to which in his early life he had been strongly opposed. His experience at Frankfort had diminished his dislike of popular represen- tation, and it was probably to the advice of Lassalle that his adoption of universal suffrage was due. He first publicly proposed it just before the war ; by carrying it out, notwithstanding the apprehensions of many Liberal politicians, he placed the new constitution on a firmer base than would otherwise have been possible.~~

~~Up to 1866 he had always appeared to be an opponent of the National party in Germany, now he became their leader. His next task was to complete the~~

~~work which was haK-finished, and it was this which brought about the second of the great wars which he undertook.~~

~~The relations with Napoleon form one of the most inter- esting but obscurest episodes in Bismarck's career. We have seen that he did not share the common prejudice against co-operation with France. He Bismarck found Napoleon willing to aid Prussia as he had ^apoieon. aided Piedmont, and was ready to accept his assistance. There was this difference, that he asked only for neutrality, not armed assistance, and it is improbable that he ever intended to alienate any German territory ; he showed himself, however, on more than one occasion ready to discuss plans for extending French territory on the side of Belgium and Switzerland. Napoleon, who had not anticipated the rapid success of Prussia, after the battle of Koniggratz at the request of Austria came for- ward as mediator, and there were a few days during vyhich it was probable that Prussia would have to meet a French attempt to dictate terms of peace. Bismarck in this crisis by deferring to the emperor in appearance avoided the danger, but he knew that he had been deceived, and the cordial understanding was never renewed. Immediately after an armistice had been arranged, Benedetti, at the orders of the French Government, demanded as recom pense a large tract of German territory on the left bank of the Ehine. This Bismarck peremptorily refused, declaring that he would rather have war. Benedetti then made another proposal, submitting a. draft treaty by which France was to support Prussia in adding the South German states to the new confederation, and Germany was to sup- port France in the annexation of Luxemburg and Belgium.~~

~~s. n.-34~~

~~Bismarck discussed, but did not conclude the treaty ; he kept, however, a copy of the draft in Benedetti's hand- writing, and published it in the Times in the summer of 1870 so as to injure the credit of Napoleon in England. The failure of the scheme made a contest with France inevitable, at least unless the Germans were willing to forego the purpose of completing the work of German unity, and during the next four years the two nations were~~

~~each preparing for the struggle, and each watching to take the other at a disadvantage.~~

~~It is necessary, then, to keep in mind the general situa^ tion in considering Bismarck's conduct in the months immediately preceding the war of 1870. In 1867 there was a dispute regarding the right to garrison Luxemburg. Bismarck then produced the secret treaties with the southern states, an act which was, as it were, a challenge to France by the whole of Germany. During the next three years the Ultramontane party hoped to bring about an anti-Prussian revolution, and Napoleon was working for an alliance with Austria, where Beust, an old oppo- nent of Bismarck's, was chancellor. Bismarck was doubtless well informed as to the progress of the nego- tiations, for he had established intimate relations with the Hungarians. The pressure at home for completing the work of German unity was so strong that he could with difficulty resist it, and in 1870 he was much embarrassed by a request from Baden to be admitted to the confederation, which he had to refuse. It is therefore not surprising that he eagerly welcomed the opportunity of gaining the goodwill of Spain, and supported by all the means in his power the offer made by Marshal Prim that Prince Leopold of Hohenzollern should be chosen king of that country. It was only by his urgent and repeated representations that the prince was persuaded against his wiU to accept. The negotiations were carried out with the greatest secrecy, but as soon as the acceptance was made known the French Government intervened and declared that the project was inadmissible. Bismarck was away at Varzin, but on his instructions the Prussian Foreign Office in answer to inquiries denied all knowledge or responsibility. This was necessary, because it would have caused a bad impression in Germany had he gone to war with France in support of the prince's candidature. The king, by receiving Benedetti at Ems, departed from the policy of reserve Bismarck himself adopted, and Bismarck (who had now gone to Berlin) found himself in a position of such difficulty that he contemplated resignation. The French, however, by ' changing and extending their demands enabled him to find a cause of war of such a nature that the whole of Germany would be united against French aggression. France asked for a letter of apology, and Benedetti personally requested from the king a promise that he would never allow the candidature to be resumed. Bismarck published the telegram in which this information and the refusal of the king~~

~~were conveyed, but by omitting part of the telegram made it appear that the request and refusal had both been conveyed in a more abrupt form than had really been the case. But even apart from this, the publication of the French demand, which could not be complied with, must have brought about a war.~~

~~It was not till many years later that our knowledge of these events (which is still incomplete) was established ; in 1894 the publication of the memoirs of the king of Rumania showed, what had hitherto been denied, that Bismarck had taken a leading part in urging the election of the prince of Hohenzollern. It was in 1892 that the language used by Bismarck himself made it necessary for the German Government to publish the original form of the Ems telegram.~~

~~In the campaign of 1870-71 Bismarck accompanied the headquarters of the army, as he had done in 1866. He was present at the battle of Gravelotte and at the surrender of~~

~~Sedan, and it was on the morning of 2nd September that he had his famous meeting with Napoleon after the sur- render of the emperor. He accompanied the king to Paris, and spent many months at Versailles. Here he was occupied chiefly with the arrangements for admitting the southern states to the confederation, and the estab- lishment of the empire. He also underwent much anxiety lest the efforts of Thiers to bring about an interference by the neutral powers might be successful. He had to carry on the negotiations with the French preliminary to the surrender of Paris, and to enforce upon them the German terms of peace.~~

~~For Bismarck's political career after 1870 we must refer to the article on Gbemaky, for he was thenceforward entirely absorbed in the affairs of his country. The foreign policy he controlled absolutely. '"'■ '*^"- As chancellor he was responsible for the whole internal policy of the empire, and his influence is to be seen in every department of state, especially, however, in the great change of policy after 1878. During the earlier period the estrangement from the Conservatives, which had begun in 1866, became very marked, and brought about a violent quarrel with many of his old friends, which culminated in the celebrated Arnim trial. He incurred much criticism during the struggle with the Eoman Catholic Church, and in 1873 he was shot at and slightly wounded by a youth called Kullmann, who~~

~~professed to be an adherent of the Clericjtl party. Once before, in 1866, just before the outbreak of war, his life had been attempted by a young man called Cohen, a native of Wurtemburg, who wished to save Germany from a fratricidal war. In 1872 he retired from the presidency of the Prussian ministry, but returned after a few months. On several occasions he offered to retire, but the emperor always refused his consent, on the last time with the word " Never." In 1877 he took a long leave of absence for ten months. His health at this time was very bad. In 1878 he presided over the Congress of Berlin. The following years were chiefly occupied, be- sides foreign affairs, which were always his first care, with important commercial reforms, and he held at this time also the office of Prussian Minister of Trade in addition to his other posts. During this period his rela- tions with the Keichstag were often very unsatisfactory, and at no time did he resort so freely to prosecutions in the law-courts in order to injure his opponents, so that the expression Bismarck-Beleidigung was invented. He was engaged at this time in a great struggle with the Social- Democrats, whom he tried to crush by exceptional penal laws. The death of the Emperor William in 1889 made a serious difference in his position. He had been bound to him by a long term of loyal service, which had been rewarded with equal loyalty. For his relations to the Emperor Frederick and William II., and for the events connected with his dismissal from office in March 1890, we must refer to the articles under those names.~~

~~After his retirement he resided at Friedrichsruh, near Hamburg, a house on his Lauenburg estates. His criti- cisms of the Governlnent, given sometimes in conversation, sometimes in the columns of the Hamburger Nachrichten, caused an open breach between him and the emperor; and Capri vi, in a circular despatch which was afterwards published, warned all German envoys that no real import- ance must be attached to what he said. When he visited Vienna for his son's wedding the German ambassador, Prince Reuss, was forbidden to take any notice of him. A reconciliation was effected in 1893. In 1895 his eightieth birthday was celebrated with great enthusiasm : the Reichstag alone, owing to the opposition of the Clericals and the Socialists, refused to vote an address. In 1891 he had been elected a member of the Reichstag,~~

but lie never took his seat. He died at Friedrichsruh, 31st July 1898.

Bismarck was made a count in 1865 ; in 1871 he received the rank of Ftirst (prince). On his retirement the emperor created him duke of Lauenburg, but he never used tlie title, which is not inherited by his son. In 1866 he received £60,000 as his share of the donation voted by the Reichstag for the victorious generals. With this he purchased the estate of Varzin in Pomerania, which henceforth he used as a country residence in preference to Schon- hausen. In 1871 the emperor presented him with a large part of the domains of the duchy of Lauenburg. On his seventieth birthday a large sum of money (£270,000) was raised by public subscription, of which half was devoted to repurchasing the estate of Schonhausen for him, and the rest was used by him to establish a fund for the assistance of schoolmasters. As a young man he was an officer in the landwehr and militia, and in addition to his civil honours he was eventually raised to the ra.nk of general. Among the numerous orders he received we may men- tion that he was the first Protestant on whom the Pope bestowed the order of Christ; this was done after the cessation of the Kulturkampf and the reference of the dispute with Spain concern- ing the Caroline Islands to the arbitration of the Pope.

Bismarck's wife died in 1894. He left one daughter and two sons. Herbert, the elder, was wounded at Mars-le-Tour, after- wards entered the Foreign office, acted as private secretary to his father, and then became secretary of state for Foreign affairs and Prussian minister. He conducted many of the negotiations with Great Britain on colonial affairs. He retired at the same time as his father. The second son, William, who was president of the province of Prussia, died in 1901.

'Authorities. — The literature on Bismarck's life is very exten- sive, and it is only possible to enumerate a few of the most important books. The first place belongs to his own works. These include his own memoirs, published after his death, under the title Qedanken und Erinnerungen ; there is an English translation, Bismarck : his Reflections and Beminiscences, Smith, Elder, and Co., 1898. They are incomplete, but contain very valuable discussions on particular points. The speeches are of the greatest importance both for his character and for political history ; of the numerous

~~editions that by HoRST Kohl, in twelve volumes (Stuttgart, 1893-94), is the best; there is a cheap edition in Reclam's Universal Bibliothek. Bismarck was an admirable letter-writer, and numbers of his pri- vate letters have been published ; a collected edition has been brought out by Horst Kohl. His letters to his wife were published by Prince Herbert Bismarck in 1900. A translation of a small selection of the private letters was published in 1876 by F. Maxse. Of great value for 'the years 1851-1858 is the correspondence with General L. v. Gerlach, which has been edited by Horst Kohl. A selection of the political letters, in four volumes, has been published under the title Politische Brief e (Berlin, 1889-93), but it is badly arranged. Of far greater importance are the collections of de- spatches and state papers edited by Herr v. Poschinger. These include four volumes entitled Preussen im Bundestag, 1851-59 (1882-84), which contain his despatches during the time he was at Frankfort. Next in importance are two works, Bismarck als Volkswirth and AktenstUcke zur Wirthschaftspolitik des Fursten Bismarck, which are part of the collection of state papers, Akten- stUcke zur Geschichte der Wirthschaftspolitik in Preussen. They contain full information on Bismarck's commercial policy, includ- ing a number of important state papers. A useful general collec- tion is that by Ludwig Hahk, in five volumes, which includes a selection from letters, speeches, and newspaper articles.. These collections have only been possible owing to the extreme generosity which Bismarck showed in permitting the publication of docu- ments ; he always professed to have no secrets. A full account of the diplomatic history from 1863 to 1866 is given by Steel in Die Begrundung des deutschen Beichs (Munich, 1889-94), written vfith the help of the Prussian archives. The two last volumes, covering 1866-70, are of less value, as he was not able to use the archives for this period. Poschinger has also edited a series of works in which anecdotes, records of interviews and conversations are re- corded; they are, however, of very unequal value. They are Bismarck und die Parliamentarier, Furst Bismarck und der Bundesrath, Die Ansprache des Fursten Bismarck, Neue Tisckge- sprdche, and Bismarck und die Diplomaten. Selections from these have been published in English by Charles Lowe, The Tabletalk of Prince Bismarck, and by Sidney Whitman, Conversations with Bismarck. There is no satisfactory biography in German ; the most ambitious is that by Hans Bltjm, Bismarck und seine Zeit (Munich, 1894). By far the fullest guide to his life is by Horst Kohl,~~

~~Bismarck-Begesten (Leipzig, 1891-92), which conUins a record of Bismarck's actions on each day, with references to and extracts from his letters and speeches. Hesbkiel's Das Buch des Grafen Bismarck is pleasantly written, but is now quite out of date. There is a ^ood translation by K. B. H. Mackenzie (Lon-~~

~~don, 1870). For the works of Mokitz Busch, which contain graphic pictures of his daily life, see the article Busch. There are several periodical publications devoted to the collection of documents bearing on Bismarck's life ; of these much the most valuable is the Bismarck-Jahrbuch, edited by Horst Kohl. Herr v. Poschinger also brought out a Bismarck Portfeuille. There are English biog- raphies by Charles Lowe, Bismarck, a Political Biography (2 vols. Lond.) ; revised edition in 1 vol. 1895 ; and by James Head- lam (Putnam's, 1899). (j. w. he.)~~

~~Bismarck Archipelago. See New Guinea~~

~~and Melanesia.~~

~~Bistritz (Hungarian, Beszterce), an ancient town (now corporate) of Eastern Hungary, 48 miles N.E. by E. of Kolosvdr ; capital of the county of Beszterce-Naszdd, with 12,081 inhabitants. It is surrounded with the ruins of ancient bastions and towers ; but in 1857 a great portion of the old town was burnt down. There are a Lutheran church, a gymnasium, religious houses of the Minorite and Piarist orders, an agricultural school, and hospitals. Its markets are much frequented, and an active trade is carried on with Rumania.~~

~~Bitlis, or Bbtlis. (1) A vilayet of Asiatic Turkey, on the Armenian plateau, situated to the W. and S.W. of Lake Van. It is a high-lying pastoral and agri- cultural country, with fertile, well-watered plains, rich pastures, and high rugged mountains, completely dis- forested. The climate is healthy, but the winter, which lasts six to seven months, is severe. There are many mineral springs, and much unworked mineral wealth. Carpets and cotton cloths are made, and gum, yellow- berries, furs, &c., are exported. Population, 400,000 ^Moslems, 254,000; Christians, 142,000; Yezidis, 4000). (2) The capital of the viMyet, Armenian Paghesh, altitude 4700 feet, picturesquely situated in the deep valley of the Bitlis Chai, on the principal road from the~~

~~plateau to Mesopotamia. It has chalybeate and sulphur springs, which are much used, and is the seat of an American mission with schools ^for boys and girls. Bitlis has always been a turbulent city, peopled chiefly by Kurds and Armenians, and until 1836 it was ruled by a semi- independent Kurd Bey. On the 26th October 1895 there was a massacre of Armenians which commenced and ended by bugle-call. Population, 38,000 (Moslems, 20,500; Christians, 17,500).~~

~~Bitterfeld, a town of Prussia, province of Saxony, 26 miles K. from Leipzig by raU, on the river Mulde. It manufactures drain-pipes, paper-roofing, and machinery, and has saw-mills. Several coal-mines are in the vicinity. The town, which dates from at least the 12th century, was built by Dutch immigrants. Population (1885), 7596;~~

~~(1895), 10,636; (1900), 11,839.~~

~~Biwa, a lake in the fprovinee of Omi, Japan. It measures 36 miles in length by 12 in breadth, has an area of 180 square miles, is about 330 feet above sear level, and has an extreme depth of some 300 feet. There are only a few small islands in the lake, the principal of them being Chikubu-shima at the northern end.~~

~~Tradition alleges that Lake Biwa and the mountain of Fuji were produced simultaneously by an earthquake, in 286 e.c. On the west of the lake the mountains Hiei-zan and Hira-yama slope down almost to its margin, and on the east a wide plain extends towards the boundaries of the province of Mino. It is drained by a river flowing out of its southern end, and taking its course into the sea at Osaka. This river bears in succession the names of Seta-gawa, Uji-gawa, and Yodo-gawa. The lake abounds with fish, and the beauty of its scenery is remarkable. Small steam- boats ply constantly to the points of chief interest, and around its shores are to be viewed the Omi-no-hakkei, or "eight land- scapes of Omi " ; namely, the lake silvering under an autumn moon as one looks down from Ishi-yama ; the snow at eve on Hira-yama ; the glow of sunset at Seta ; the groves and classic temple of Mii-dera as the evening bell sounds ; boats sailing~~

home from Yabase ; cloudless peaks at Awazu ; laln at nightfall over Karasaki ; and wild geese sweeping down to Katata. The lake is connected with Kyoto by a canal constructed in 1890, and is thus brought into water communication with Osaka.

Bixio, Nino (1821-1873), Italian soldier, was born on 2nd October 1821. While still a boy he was com- pelled by his parents to embrace a maritime career. After numerous adventures he returned to Italy in 1846, joined the Giovine Italia, and, on 4th November 1847, made himself conspicuous at Genoa by seizing the bridle of Charles Albert's horse and crying, " Pass the Ticino, Sire, and we ai-e all with you." He fought through the campaign of 1848, became captain under Garibaldi at Eome in 1849, taking prisoners an entire French battalion, and gaining the gold medal for military valour. In 1859 he commanded a Garibaldian battalion, and gained the military cross of Savoy. Joining the Marsala expedition in 1860, he turned the day in favour of Garibaldi at Calatafimi, was wounded at Palermo, but recovered in time to besiege Eeggio in Calabria (21st August 1860), and, though again wounded, took part in the battle of Volturno, where his leg was broken. Elected deputy in 1861, he endeavoured to reconcile Cavour and Garibaldi. In 1866, at the head of the seventh division, he covered the Italian retreat from Custozza, refusing the Austrian invitation to surrender. Created senator in February 1870, he was in the following September given command of a division during the movement against Kome, took Civit4 Vecchia, and participated in the general attack upon !^ome (20th September 1870). He died of cholera at Achin Bay in Sumatra en route for Batavia, whither he had gone in command of a commercial expedition (16th December 1873). (h. w. s.)

Bizet, Georges (properly Alexandre Chables Leopold) (1838-1875), French musical composer, was bom at Bougival, near Paris, on the 25th October 1838. He displayed musical ability at an early age, and was sent to the Paris Conservatoire, where he studied under Halevy and speedily distinguished himself, carrying off prizes for organ and fugue, and finally in 1857, after an ineffectual attempt in the previous year, the Grand Prix de Rome. A success of a different kind also befell him at this time. Offenbach, then

~~manager of the Theatre des Bouffes- Parisiens, had organized a competition for an operetta, in which young Bizet was awarded the first prize in con- junction with Charles Lecocq, the future composer of La Fille de Mme Angot. After the three years spent in Home, an obligation imposed by the French Government on the winners of the first prize at the Conservatoire, Bizet returned to Paris, where he achieved a reputation as a pianist and accompanist. On the 23rd of Septem- ber 1863, his first opera, Les Picheurs de Perles, was brought out at the Theatre Lyrique, but owing possibly to the somewhat uninteresting nature of the story, the opera did not enjoy a very long rvm. The qualities dis- played by the composer, however, were amply recognized, although the music was stated, by some critics, to exhibit traces of Wagnerian influence. Wagnerism at that period was a sort of spectre that haunted the imagination of many leading members of the musical press. It sufficed for a work to be at all out of the common for the epithet " Wagnerian " to be applied to it. The term, it may be said, was intended to be condemnatory, and it was applied with little understanding as to its real meaning. The score of the PScheurs de Perles contains several charm- ing numbers ; its dreamy melodies are well adapted to fit a story laid in Eastern climes, and the music reveals a decided dramatic temperament. Bizet's second opera. La Jolie Fille de Perth, produced at the Theatre Lyrique on 26th December 1867, was scarcely a step in advance.~~

~~Founded on Sir Walter Scott's novel, this opera lacks unity of style, and its pages are marred by concessions to the vocalist. One number has survived, the charac- teristic Bohemian dance which has been interpolated into the fourth act of Carmen. In his third opera Bizet returned to an Oriental subject. Djamileh, a one- act opera given at the Opera Comique on 22nd May 1872, is certainly one of his most individual efforts. The music is impregnated with a fascinating Eastern flavour, and the entire work is a veritable artistic gem. Again were accusations of Wagnerism hurled at the composer's head, and Djamileh did not achieve the success it un- doubtedly deserved. The composer was more fortunate with the incidental music he wrote to Alphonse Daudet's drama L'ArMsienne, produced in October 1872. Different numbers from this arranged in the form of suites have often been heard in the concert-room. Rarely have poetry and imagination been so well allied as in these exquisite pages, which seem to reflect the sunny skies of Provence. Bizet's masterpiece. Carmen, was brought out at the~~

~~Op^ra Comique on 3rd March 1875. Three months later the genial composer expired after a few hours' illness from a heart affection (3rd June). Before dying he had the satis- faction of knowing that Carmen had been accepted for production at Vienna. After the Austrian capital came Brussels, Berlin, and in 1878 London, when Carmen was brought out at Her Majesty's Theatre with immense success, Mme Minnie Hauk impersonating the heroine. The influence exercised by Bizet on dramatic music has been very great, and may be discerned in the realistic works of the young Italian school, as well as in those of his own countrymen. Carman may be said, in a measure, to constitute a fresh point of departure in French operatic music. Although conceived according to the ideas then in vogue at the Opera Comique theatre, and in its original form containing spoken dialogue, it is essentially modern in spirit, new and bold in its harmonic and instru- mental treatment. It clearly foreshadows the present evolution of the French " lyrical drama." (a. he.)~~

~~Bjdrneborg (Finnish, Pori), a district town of Finland, government of Abo-Bjorneborg, on the B. coast of the Gulf of Bothnia, at the mouth of the Kumo. Lat. 51° 8′ N., long. 46° 0′ E. Population, 11,669 in 1897, mostly Swedes. Large vessels cannot enter its roadstead, and stop at Rafso. The town has shipbuilding wharfs, one large saw-mill, mechanical works, and several tanneries and brickworks, the aggregate returns of which are about 2,000,000 marks. Its foreign trade is considerable, the chief exports being timber, and the main imports flour and metals.~~

~~Bjornson, Bjornstjerne (1832), Norwegian~~

~~poet, novelist, and dramatist, was born on the 8th December 1832, at the farmstead of Bjorgen, in Kvikne, in Osterdalen, a very remote district of Norway. In 1837 his father, who had been priest of Kvikne, was transferred to the parish of Ncesset, in Romsdalen ; in this romantic place the childhood of Bjornson was spent. In 1841 he was sent to school at the neighbouring town of Molde. At the age of 17 he was sent to Christiania to study for the University ; his instinct for poetry was already awakened, and indeed he had written verses from his eleventh year. He took his degree at the University of Christiania in 1852, and began to work as a journalist, especially as a dramatic critic. His progress was, however, slow. It was not~~

~~until 1856 that in Thrond, the earliest of his short stories, he began to develop his real talent. In 1857 ap- peared Synnove Solbakken, the first of Bjornson's peasant- novels ; in 1858 this was followed by Arne, in 1860 by A Happy Boy, and in 1868 by The Fisher Maiden. These~~

~~are the most important specimens of his " bonde-fortsel- linger " or peasant-tales — a section of his literary work •which has made a profound impression in his own country, and has made him popular throughout the world. These novels were full of freshness and beauty combined with remarkable realism. Two of these tales, Aime and Synnove Solbakken, are nearly perfect, and offer perhaps finer examples of the pure peasant-story, than are 'to be found elsewhere in literature. Bjornson was anxious "to create a new saga in the light of the peasant," as he put it,~~

~~and he thought this should be done, not merely in prose fic- tion, but in national dramas or " folke- stykker." The ear- liest of these was Between the Battles, written in 1865, but not produced until ; 1857. It was fol- lowed by Lame Hulda in 1859, and King Sverre in 1861. All these efforts, however, were far excelled by the splen- did trilogy of Sigurd the Bastard, which -^.... — Bjornson issued in~~

~~bjornbtjebnb bjobhsoh. , 1862. This raised~~

~~iFrom apAotograpA by Otto, Paris.) j^.^ ^^ j^ ^^^^^ ^^^^~~

~~among the younger poets of Europe. His Sigurd the Crusader should be added to the category of these heroic plays, although it was not printed until 1872. At the close of 1867 Bjornson had been ap- pointed director of the theatre at Bergen, a post which he held, with much journalistic work, for two years, when he returned to the capital. From 1860 to 1863 he travelled widely throughout Europe. Early in 1866 he undertook the management of the Christiania theatre, and brought out his popular comedy of The Newly Married and his romantic tragedy of Mary Stuart in Scotland. Although Bjornson has introduced, into his novels and plays, songs of extraordinary~~

~~beauty, he has never been a very copious writer of verse ; both his principal contributions to this art were collected in the year 1870, when he published his Poems and Songs and the spirited romance called Amljot Gelline; the latter volume contains the magnificent ode called ” Bergliot,” Bjornson’s finest contribution to lyrical poetry. It has been remarked that between 1864 and 1874, in the very prime of life, Bjornson displayed a slackening of the intellectual forces very remarkable in a man of his energy ; he was indeed during these years mainly occupied with politics and with his business as a theatrical manager. This was the period of Bjornson’s most fiery propaganda as a Radical agitator. In 1871 he began to supplement his journalistic work in this direction by delivering lectures over the length and breadth of the northern countries. He possesses to a surprising degree the arts of the orator, combined with a magnificent physical prestige. From 1873 to 1876 Bjornson was absent from Norway, and in the peace of voluntary exile he recovered his imaginative powers. His new departure as a dramatic author began with The Editor in 1874 and A Bankruptcy in 1875, social dramas of an extremely modern and realistic cast, the second of which has continued to be, in many countries, the piece of Bjornson’s which has longest kept the stage. The poet was now settled at the estate of~~

~~Aulestad, in Gausdal ; this house, a fine example of old Norwegian domestic architecture, has been his home since 1874 to the present day. In 1877 he published another novel, Magnhild, — an imperfect production, in which Bjornson’s ideas on social questions were seen to be in a state of fermentation, — and the polemical play called TTie King. Another story, Captain Mansana, an episode of the war of Italian independence, belongs to 1878. Extremely anxious to obtain a full success on the stage, Bjornson concentrated his powers on the drama called Leonarda, which appeared in 1879. This was an appeal for religious toleration, and it raised a violent controversy. This was not allayed by a satirical play, The New System, which was brought’ out a few weeks later. Although these plays of Bjornson’s second period were greatly dis- cussed, none of them (except A Bankruptcy^ pleased on the boards. He was greatly disappointed and for some years again preserved silence as a dramatist. When once more he produced a social drama, A Gauntlet, in 1883, he was unable to persuade any manager to stage it at all. This was, nevertheless, one of the most skilfully composed “problem-plays” of modern times. In the autumn of the~~

~~same year, Bjornson published a mystical or symbolic drama (Over u^vne. Beyond our Powers), which was a new departure in his work and deals with the abnormal features of religious excitement with extraordinary power ; this was not acted until 1899, when it achieved a great success. Bjornson, convinced that the theatre was practically cloged to him, turned back to the novel, and published in 1884 Flags are Flying in Town and Port, the first really long book he had written. In 1889 he printed another novel as lengthy, and still more remarkable. In God's Way, which is one of the works by which he is most widely known outside his native country. The same year saw the publication of a comedy. Geo- graphy and Love, which was acted, and continues to be played, with success. A number of short stories of a more or less didactic character, dealing with startling points of emotional experience, were collected in 1894 ; among them those which produced the greatest sensation were Bust, Mother's Hands, and Ahsalom's Hair. Bjorn- son's latest writings have been a political tragedy called Paul Lange and Tora Parsberg, a second part of Beyond our Powers, and a drama, Laboremus. In 1899, at the open- ing of the National Theatre, Bjornson, whose popularity in Norway is unbounded, received an ovation, and his saga- drama of Sigurd the Crusader was put on the boards with great magnificence. A subject which interested him greatly, and on which he has^ occupied his indefatigable pen, is the question of the " bonde- maal," the adopting of a national language for Norway distinct from the " dansk- norsk" (Dano-Norwegian), in which her literature has hitherto been written. Bjornson's strong and sometimes rather narrow patriotism has not blinded him to the fatal folly of such a proposal, and his lectures and pamphlets against the " maalstreev " in its extreme form have done more than anything else to save the language in this dangerous moment.~~

~~Black, William (1841-1898), British novelist, was bom at Glasgow in 1841. His early ambition was to be a painter, but he made no way, and soon had recourse to journalism for a living. He was at first employed in newspaper offices in Glasgow, but obtained a post on the Morning Star in London, and at once proved himself a descriptive writer of exceptional vivacity. During the war between Prussia and Austria in 1866 he repre- sented the Morning Star at the front, and was taken prisoner. This paper shortly afterwards failed, and Black joined the editorial staff of the Daily News. He also~~

edited the Examiner, at a time when that periodical was already moribund. After his first success in fiction, he gave up journalism, and devoted himself entirely to the production of novels. For nearly tjiirty years he was industriously successful in retaining the popular favour. He died at Brighton, 10th December 1898, without having experienced any of that reaction of the public taste which so often follows upon conspicuous successes in fiction. Black's first novel, James Merle, published in 1864, was a complete failure ; his second, Love and Marriage (1868), attracted but very slight attention. But in 1871 A Daughter of Heth suddenly raised him to the height of popularity, and he followed up this success by a string of favourites. Among the best of his books are The Strange Adventures of a Phaeton, 1872; A Princess of Thule, 1873; Madcap Violet, 1876; Macleod of Dare, 1878 WTiite Wings, 1880; Sunrise, 1880 ; Shandon Bells, 1883 White Heather, 1885; Donald Ross of Heimra, 1891 Highland Cousins, 1894; and Wild Eelin, 1898. Black was a thoroughgoing sportsman, particularly fond of fish- ing and yachting, and his best stories are those which are laid amid the bree2ry mountains of his native land, or upon the deck of a yacht at sea off its wild coast. His descriptions of such scenery are simple and pic- turesque. He was a word-painter rather than a student of human nature. His women are stronger than his men, and among them are many wayward and lovable creatures ; but subtlety of intuition plays no part in his characterization. Black also contributed a life of Oliver Goldsmith to the English Men of Letters series. (a. wa.)

Blackburn, a municipal (extended 1879), county (1888), and parliamentary borough of Lancashire, Eng- land, on the Brook, 24 miles N.K.W. of Manchester, 210 miles by rail N.N.W. of London. In 1877 the municipal and parliamentary boroughs became co-extensive, and in 1892 their area was constituted the township of Black- bum, and distributed into 14 wards, under a mayor, 14 aldermen, and 42 councillors. Besides the parish church, there are 70 churches and chapels. Of recent institution are a fish market (1874) ; municipal of&ces (1880) ; a cham- ber of commerce (1887) ; a free library (1873, extended 1893) ; additions to the infirmary in 1884, 1896,

~~and 1897 ; a municipal technical school, opened in 1891 and extended in 1894, attended (1901) by 18,000 students; new and enlarged buildings for the grammar school (1884) ; a theatre rebuilt in 1886; and the Queen's Park (1887). The cotton industry employs thousands of operatives, the iron trade is also very considerable, and many are engaged in the making of machines; but the woollen manufacture has become practically extinct. There are two daily newspapers. Its area covers 6974 acres. Population (1881), 104,014; (1891), 120,064 ;' (1901),~~

~~127,527.~~

~~Blackburn, Colin, Bacon (1831-1896), British judge, was born in Selkirkshire in 1813, and educated at Eton and at Trinity College, Cambridge, where he took very high mathematical honours in 1835. He was called to the bar in 1838, and went the northern circuit. His progress was at first slow, and he employed himself in reporting and editing along with Mr Ellis eight volumes of the highly- esteemed Ellis and Blackburn reports. His deficiency in all the more brilliant qualities of the advocate almost confined his practice to commercial cases, in which he obtained considerable employment in his circuit ; but he continued to belong to the outside bar, and was so little known to the legal world that his promotion to a puisne judgeship in the Court of Queen's Bench in 1859 was at first ascribed to Lord Campbell's partiality for his countrymen, but Lord Lyndhurst, Lord Wensleydale, and~~

~~Lord Cranworth came forward to defend the appointment. Blackburn himself is said to have thought that a county court judgeship was about to be offered him, which he had resolved to decline. He soon proved himself one of the soundest lawyers on the bench, and when he was promoted to the Court of Appeal was considered the highest authority on common law. In 1876 he was made a Lord of Appeal and a life peer. Both in this capacity and as judge of the Queen's Bench he de- livered many judgments of the highest importance, and no decisions have been received with greater respect. In 1886 he was appointed a member of the commission charged to prepare a digest of the criminal law, but re- tired on account of indisposition in the following year. He died on 8th January 1896. He was the author of a valuable work on the Law of Sales.~~

~~Black Hills, an isolated group of mountains in the western part of South Dakota and Eastern Wyoming, U.S.A., rising three to four thousand feet above their base, the highest peak, Hamey, having an altitude above the sea of 7216 feet. The mass has an elliptical shape, its longer axis trending nearly north-west and south-east. The hills are structural in their origin, being formed by a short, broad, anticlinal fold, which is flat or nearly so on its summit. Erom this fold the stratified beds have in large part been removed, the more recent having been entirely eroded from the elevated mass. The edges of these are now found encircling the mountains, and form- ing a series of fairly continuous rims of hogbacks. The Carboniferous and older stratified beds still cover the west half of the hUls, while from the eastern half they have been removed, exposing the granite. The hills were formerly within the range of the Sioux Indians, but rich gold placers were discovered, and in 1875 the Indians were removed. Subsequently low-grade quartz mines were found and developed, and at present furnish a notable part of the gold supply of the country.~~

~~Blackle, John Stuart (1809-1895), Scottish scholar and man of letters, was born in Glasgow, 28th July 1809. He was educated at the New Academy, and afterwards at the Marischal College, in Aberdeen, where his father had established himself as banking agent. After attending classes at Edinburgh University, Blackie spent two years at Aberdeen University as a student of theology ; but the two succeeding years, which he spent abroad, extinguished his wish to enter the Church, and he somewhat unwillingly gave himself up, at his father's desire, to the study of law. By the time he was admitted a member of the Faculty of Advocates he had acquired a strong love of the classics and a taste for letters in general. A translation of Faust, which he published in 1834, met with considerable success. After a year or two of desultory literary work he was (in May 1839) appointed to the newly-instituted Latin chair in the Marischal College, Aberdeen. Difftculties arose in the way of his installation, owing to the action of the Presbytery on his refusing to sign unreservedly the Confession of Paith ; but these were eventually overcome, and he took up his dutjies as professor in November 1841. In the following year he married. From the first his professorial lectures were conspicuous for the unconventional enthusiasm with which he en- deavoured to revivify the study of the classics ; and his growing reputation, added to the attention excited by a translation of~~

.SJschylus which he published in 1850, led to his appointment in 1852 to the professorship of Greek at Edinburgh University, a post which he continued to hold for thirty years. He was somewhat too erratic in his methods to be a great teacher, but his lectures were a triumph of personality. ” Greek as a living language ”

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was a favourite theme of Ms, especially in his later years; and before his death he endowed a travelling scholarship to enable students to learn Greek at Athens. Scottish nationality was another source of enthusiasm with him ; and in this connexion he displayed real sympathy with Highland home life and the grievances of the crofters. The foundation of the Celtic chair at Edinburgh University was mainly due to his efEorts. In spite of the many calls upon his time he produced a considerable amount of literary work, usually on classical or Scottish subjects, tacluding some poems and songs of no mean order. His life to its close was full of activity, and iuvariably gave the impression of being resolutely happy. He died in Edinburgh on 2nd March 1895. His published works include (besides several volumes of verse) Horce Hellenicce (1874), The Language and Litera- ture of the Scottish Highlands (1876), Lay Sermons ^1881), Altavona (1882), Life of Burns (1888), Scottish Song (1889), Essays on Subjects of Moral and Social Interest (1890), Christianity and the Ideal of Humanity (1893).

(b. v. s.) /

Blackmore, Richard Doddridge (1825-1900), English novelist, was born 9th June 1825 at Longwortn, Berks, of which village his father was rector. He was educated at Blundell’s School, Tiverton, and Exeter College, Oxford, where he obtained a scholarship. In 1847 he was placed in the second class in Idterce Hum- aniores, and took his degree. Two years later he entered as a student at the Middle Temple, and was called to the Bar in 1852. His first publication was a volume of Poems by Melanter, 1854, which showed no particular promise, nor did the succeeding volume Epullia, 1855, suggest that Blackmore had the makings of a poet. He was nevertheless enthusiastically sincere in his desire to follow literature as a profession ;

~~and when, a few years later, the complete breakdown of his health rendered it clear that he must remove from London, he determined to combine a literary life in the country with a business career as a market-gardener. He acquired land at Tedd- ington, and set earnestly to work, the literary fruits of his new surroundings beiug a translation of the Qeorgics pub- lished in 1862. Verse, however, was clearly not his strong point, and when in 1864 he published his first novel, CHara Vaughan, several critics were prompt in recognizing its merit. Cradock Nowell, which followed it iu 1865, -was also praised ; but neither story made much way with the general public. In 1869, however, he suddenly sprang into fame. Lorna Doone, which was published in that year, was a pioneer in the romantic revival ; and appear ing at a jaded hour, it was presently recognized as a work of singular charm, vigour, and imagination. Its success could scarcely be repeated, and though Blackmore wrote many other capital stories, of which the best known are. The Maid of Sker (1872), Christowell (1880), and Perly- cross (1894), he will always be remembered almost ex- clusively as the author of Lorna Doone. He continued his quiet country life to the last, and died at Teddington, 20th January 1900, in his seventy-fifth year. Lorna Doone has faults of construction and exaggeration, but it is from every point of view a fine and picturesque romance. It has the true out-of-door atmosphere, is shot through and through with adventurous spirit, and in its dramatic moments shows both vigour and intensity. The heroine, though she is invested with qualities of faery which are scarcely human, is an idyllic and haunting figure ; and the bluff hero is, both in purpose and achievement, a veritable giant of romance. The story is almost a classic of the West country, and the many pilgrimages that are made annually to the Doone Valley (the actual characteristics of which differ materially from the descriptions given in**

the novel) are entirely inspired by the buoyant imaghiation of Eichard Blackmore. (a. wa.)

Blacl(pooi, a municipal borough (1876) and sea- side resort in the Blackpool parliamentary division of Lancashire, England, 46 miles K. of Liverpool by rail. The town, which is quite modern, contains many churches and chapels of all denominations, a new town hall, public libraries, the Victoria hospital, three piers, theatres, ball- rooms, and other places of public amusement, including a tower 250 feet high and a " big

~~wheel." New promenades, consisting of higher and lower walks, have recently been completed at a cost of upwards of £100,000, and the old promenade is in course of being widened and extended at an authorized cost of £350,000, When completed it will be 3 miles long. Area of borough, exclusive of foreshore, 3496 acres ; including foreshore, 4244 acres. Population (1881), 14,229; (1891), 23,846; (1901), 47,346, or practically double. The return of inhabited houses shows a similar result, the number for 1891 being 4921, and for •~~

~~1901, 9945.~~

~~Blacic Sea, Tlie. — The conditions that prevail in the Black Sea are very different from those of the Mediterranean or any other sea. The existence of sul- phuretted hydrogen in great quantities below 100 fathoms, the extensive chemical precipitation of calcium carbonate, the stagnant nature of its deep waters, and the absence of deep-sea life are conditions which make it impossible to discuss it along with the physical and biological conditions of the Mediterranean proper. In outline the Black Sea is kidney-shaped and lies almost entirely between the latitudes 41° and 45° N., extending to about 47° N. near Odessa. It is bounded on the N. by the southern coast of Eussia ; on the W. by Eumania, Turkey, and Bulgaria ; on the S. and E. by Asia Minor. The northern boundary is broken at Kertch by a strait entering into the Sea of Azof, and at the junction of the western and southern boundary is the Bosporus, which unites the Black Sea with the Mediterranean through the Sea of Marmora and the Dardanelles. The 100-fathom line is about 10 to 20 miles' from the shore except in the north- west comer between Varna and Sebastopol, where it extends 140 miles seawards. The greatest depth is 1030 fathoms ■^ near the centre, there being only one basin. The steepest incline outside 100 fathoms is to the south- east of the Crimea and at Amastra ; the incline to the greater depths is also steep off the Caucasus and between Trebizond and Batum.~~

~~The depths of the Black Sea are lifeless, higher organic life not being known to exist below 100 fathoms. Fossiliferous remains of Dreissena, Cardium, and other moUuses have,, however, been dredged up, which help to show that conditions formerly existed in the Black Sea similar to those that exist at the present day in the Caspian Sea. According to Andrusof,~~

when the union of the Black Sea with the Mediterranean through the Bosporus took place, salt water rushed into it along the bottom of the Bosporus and killed the fauna of the less saline waters. This gave rise to a production of sulphuretted hydrogen which is found in the deposits, as well as in the deeper waters.

Observations in temperature and salinity have only been taken during summer. During summer the surface salinity of the Black Sea is from 1-70 to 2-00 per cent, down to 50 fathoms, whereas in the greater depths it attains a salinity of 2-25 per cent. The temperature is rather remarkable, there being an intermediate cold layer between 25 and 50 fathoms. This is due to the sinking of the cold surface water (which in winter reaches freezing-point) on to the top of the denser more saline water of the greater depths. There is thus a minimum circulation in the greater depths causing there uniformity of temperature, an absence of the circulation of oxygen by other means than diffusion, and a protection of the sulphuretted hydrogen from the oxidation which takes place in homologous situations in the open ocean. The temperature down to 25 fathoms is frop 78-3° to 46-2° P., and in the cold layer,

1 1227 Bossian fathoms.

between 25 and 50 fathoms, is from 46-2° to 43-5° F., rising again in greater depths to 48-2° F.

The Sea of Marmora may be looked upon as an arm of the JEgean Sea and thus part of the Mediterranean proper. Its salinity is comparable to that of the eastern basin of the Mediterranean, which is greater than that of the Black Sea, viz. 4 per cent. Similar currents exist in the Bosporous to those of the Strait of Gibraltar. Water of less salinity flows outwards from the Black Sea as an upper current, and water of greater salinity from the Sea of Marmora flows into the Black Sea as an under-current. This under-current flows towards Cape Tarhangut, where it divides into a left and right branch. The left branch is appreciably noticed near Odessa and the north-west

~~comer ; the right branch sweeps past the Crimea, strikes the Caucasian shore (where it comes to the surface running across, but not into, the south-east corner of the Black Sea), and finally disperses flowing westwards along the northern coast of Asia Minor between Cape Jason and Sinope. This current causes a warmer climate where it strikes. So marked is this current that it has to be taken into account in the navigation of the Black Sea.~~

~~The Sea of Azof is exceedingly shallow, being only about 6 fathoms in its deepest part, and it is largely influenced by the river Don. Its water is considerably fresher than the Black Sea, vary- ing from 1-55 to 0-68 per cent. It freezes more readily and is not affected by the Mediterranean current.~~

~~Little is known of the fauna and flora of the Black Sea, although plankton, nekton, and benthos exist down to 100 fathoms. It appears to be related to that of the Mediterranean. The debris of these animals and plants, falling to the greater depths, helps to keep up the supply of sulphuretted hydrogen, probably with the aid of anaerobic bacteria. The deposits contain remains of pelagic and shore diatoms, f oraminif era, and other protozoa, sponge spicules, fish bones, &c. The formation of sulphuretted hydrogen in the depths is accompanied by two processes ; a continual sinking of fine deposit of calcium carbonate and the formation of ferrous sulphide, which depends on the accumulation of deposits capable of changing it to pyrites. Probably also free sulphur will be found to exist in thCjdeposits. Laminated ooze has been taken ; when dried it appears in white and yellow layers, the white being mostly caloiiim carbonate. The lamination of the ooze may be due to the seasonal fluctuations of deposits brought down by great rivers, such as the Danube, which brings down 228 times as much sediment in full as in low water. Part of the sulphuretted hydrogen forms ferrous sulphide' at the bottom, which occurs in all deposits, especially in gray ooze, and flUs the cells of cosoinodiscus and the pipe-like shells of rhizosolenia, and the inside of diatoms. The conditions both in the Dardanelles and the Bosporus were examined very carefully in the year 1872 by Captain (afterwards Admiral Sir) William Wharton of H.M.S. Shearwater, and his results were published in an interesting report to the Admiralty of that date.~~

~~It is remarkable that the comparatively fresh water of the Black Sea persists without sensible mixture through the Sea of Marmora and into the Dardanelles. The depth in the two channels is only from 30 to 50 fathoms, and the dimensions of the strait are too small to make the phenoihenon of any importance for the supply of the Mediterranean. Were the exit of the Black Sea a channel with sufficient fall to bring the surface of the Sea of Marmora below the level of the highest part of its bottom, so that no return current could take place, the waters of the Black Sea would be fresh. (j. t. b.)~~

~~Blackstone, a town of Worcester county, Massa- chusetts, U.S.A., situated in the southern part of the state, has an area of 17 square miles, bordering on the Connecticut line. The principal village bears the same name, and is on the Blackstone river, and the New York, New Haven, and Hartford railway. It is at an altitude of 200 feet, and is regularly laid out. Popula- tion of the town (1880), 4907 ; (1900), 5721.~~

~~Blaenavon, a town, urban district, railway station, and parish in the northern parliamentary division of Mon- mouthshire, England, on the river Avon Lwyd or Torvaen. There are very extensive iron, steel, and coal works, with blast furnaces and rolling mills in the district. Popular tion of urban district (area, 4105 acres) (1901), 10,869.~~

~~Blagodat, a mountain of Russia, government of Perm, on the eastern slope of the Ural Mountains, 13 miles from the main range, and near to Kushvinsk iron- works. Altitude about 1270 feet. It contains the largest deposits of magnetic iron hitherto known in the world, and, with the Vysokaya, Magnitnaya and Kachkanar~~

~~mountains of the Urals, belongs to the same type as the "Iron Mountain" in Missouri and Taberg in Sweden. Its western slope consists of various augitic rocks, while on its top and southern slope large deposits of magnetic iron (occasionally crystalline) are found. The ore is extracted to the amount of from 400,000 to 540,000 metric quintals, and is worked at the Goro-Blagodat ironworks.~~

~~Blagovyeschensk, a town of East Siberia, chief town of the Amur province, on the left bank of the Amur, near its confluence with the Zeya, 60° 15′ N.,~~

~~127° 38′ E. ; altitude about 500 feet. The Chinese village Sakhalin is opposite it, and the town of Aihun is 20 miles below on the left bank of the Amur. Founded in 1858, the town has progressed since, and had in 1897, 32,606 inhabitants. There are several steam flour-mills and one ironworks. It is now a centre for tea exported to Eussia, and cattle brought from Transbaikalia and Mongolia, vid Merghen, for the Amur, as well as for all sorts of provisions, &c., shipped to the lower Amur. It has gymnasia for boys and girls, a seminarium, and 7 other schools, and is the seat of the bishop of Amur and Kamchatka.~~

~~Blaine, James Gillespie (1830-1893), American statesman, was born in West Brownsville, Pa., 31ft Jan- uary 1830, of sturdy Scottish-Irish stock on his father's side. With many early evidences of literary capacity and political aptitude, he graduated at Washington College, Pennsylvania, in 1847, and spent a few years in teaching. Settling in Augusta, Maine, in 1854, he became editor of the Kennebec Journal, and subsequently of the Portland Advertiser. But his editorial work was speedily aban- doned for a more active public career. He was elected to the Legislature in 1858, serving four years, the last two as Speaker. At the same time he became chairman of the Eepublican State Committee, and for twenty years per- sonally directed every campaign of his party. In 1862 he was elected to Congress, continuing in the House fourteen years, followed by four years in the Senate. He was chosen Speaker in 1869 and served three terms. The House was the fit arena for his political and parlia- mentary ability. He was a ready and powerful debater, full of resource, and dexterous in controversy. The tempestuous politics of the war and reconstruction period suited his aggressive nature and constructive talent. The measures for the rehabilitation of the States that had engaged in rebellion occupied the chief attention of Congress for several years, and Mr Blaine bore a leading part in framing and discussing them. The primary ques- tion related to the basis of representation upon which they should be restored to their full rank in the political system. A powerful section contended that the basis should be the body of legal voters, on the ground that the South could not then secure an increment of political power on account of the emancipated blacks unless they were admitted to political rights. Mr Blaine, on the other hand, contended that representation should be based on population instead of voters, as being fairer to the North, where the ratio of voters varied widely,~~

~~and he insisted that it should be safeguarded by security for impartial suffrage. This view prevailed, and the fourteenth amendment to the constitution was substantially Mr Blaine's proposition. In the same spirit he opposed a scheme of military governments for the Southern States, unless associated with a plan by which, upon the acceptance of prescribed conditions, they could release themselves from military rule and resume civil government. He was the first in Congress to oppose the claim, which gained momentary and widespread favour in 1867, that the pub- lic debt, pledged in coin, should be paid in greenbacks. The protection of naturalized citizens who, on return to~~

~~their native land, were subject to prosecution on charges of disloyalty, enlisted his active interest and support, and the agitation in which he was conspicuous led to the treaty of 1870 between the United States and Great Britain, which placed adopted and native citizens on the same footing.~~

~~As the presidential election of 1876 approached, Mr Blaine was clearly the popular favourite of his party. In the Republican National Convention he missed by only twenty-eight votes nomination for President, being finally beaten by a combination of all the other candidates. Thereupon, through a vacancy, he entered the Senate, where his activity was unabated. Currency legislation was specially prominent. Blaine, who had previously opposed greenback inflation, now resisted depreciated silver coinage. He was the earnest champion of the advancement of American shipping, and advocating liberal subsidies, insisted that the policy of protection should be applied on the sea as well as on land. The National Convention of 1880, divided between the two nearly equal forces of Blaine and Grant, struggled through thirty-six ballots, when the friends of Blaine succeeded in nominating General Garfield. In the new Administration Blaine became Secretary of State, but, through the assassi- nation of the President, held the ofB.ce only a few months. His brief service was distinguished by several notable steps. In order to promote the friendly understanding and co-operation of the nations on the American continent he projected a Pan-American Congress, which, after being arranged for, was frustrated by his~~

~~retirement. He also sought to secure a modification of the Clayton- Bulwer treaty, and in an extended correspondence with the British Government strongly asserted the policy of an exclusive American control of any isthmian canal.~~

~~With undiminished hold on the imagination and devo- tion of his followers he was nominated for President in 1884. After a heated canvass, in which he made a series of brilliant speeches, he was beaten by a narrow margin in New York. Refusing to be a candidate in 1888, he became Secretary of State under President Harrison, and resumed his work which had been interrupted nearly eight years before. The Pan-American Congress, then projected, now met in Washington, and Blaine, as its master spirit, presided over and guided its deliberations through its session of five months. Its most important conclusions were for reciprocity in trade, a continental railway, and compulsory arbitration in international com- plications. Shaping the tariff legislation for this policy, Blaine negotiated a large number of reciprocity treaties which augmented the commerce of his country. He upheld American rights in Samoa, pursued vigorous diplomacy with Italy over the New Orleans lynchings, held a firm attitude through the Chilean complications and the Barrundia affair, and carried on with Great Britain a resolute controversy over the seal fisheries of Bering Sea, — a difference afterwards settled by arbitra- tion. He resigned on the eve of the National Convention of 1892, wherein his name was ineffectually used, and died at Washington, D.C., on 27th January 1893. During his later years of leisure he wrote Twenty Years in Congress, a brilliant historical work in two volumes. Of singularly alert faculties, with remarkable knowledge of the men and history of his country, and an extraordinary memory, his masterful talent for politics and statecraft, together with his captivating manner and engaging per- sonality, gave him, for nearly two decades, an unrivalled hold upon the fealty and affection of his party.~~

~~(c. B. s.)~~

~~Blair, Francis Preston (1821-1875), American soldier and politician, was born in Lexington, Kentucky,~~

~~and died in St Louis, Missouri, 8th July 1875. He was educated at Princeton College, and, in 1843, began the practice of law in St Louis. In succession~~

~~he served in the Mexican war, was a Democratic editor, and a member of the Missouri legislature. He was elected as a Republican to the national House of Representatives in 1856, 1860, 1862. Vigorous measures on his part were instrumental in preventing Missouri from joining the Confederacy. He became colonel of volunteers in 1861, rose to the rank of major-general, and performed im- portant military services. He strenuously opposed the congressional plan of reconstruction, and in 1868 was the Democratic candidate for the vice-presidency. To fill an unexpired term, he was United States Senator from Missouri, 1871-73.~~

~~Blairgowrie, a police burgh of Perthshire, Scot- land, finely situated on the Ericht, at the terminus of a branch of the Caledonian railway, 20 miles N.E. of Perth. The town is entirely modem, and owes its progress to the water-power supplied by the Ericht for linen and jute factories. There are also sawmills and a large factory for bee appliances. Strawberries, rasp- berries, and other fruit are largely grown in the neigh- bourhood. Among the public buildings are the town hall and the mechanics' institute. A public park was presented to the town in 1892. Population (1881), 4537 ;~~

~~(1891), 3714; (1901), 3377.~~

~~Blanc, Jean Joseph Charles Louis, gener- ally known as Louis Blanc (1811-1882), Prench politician and historian, was born on 29th October 1811 at Madrid, where his father held the post of inspector-general of finance under Joseph Bonaparte. Eailing to receive aid from Pozzo di Borgo, his mother's imcle, Louis Blanc studied law in Paris and became a contributor to various journals. In 1839 appeared his L' Organisation du travail. The principles laid down in this famous essay form the key to Louis Blanc's whole political career. He attributes all the evils that afilict society to the pressure of competi- tion, whereby the weaker are driven to the wall. He demanded the equalization of wages, and the merging of personal interests in the common good — " a chacun selon ses besoins, de chacun selon ses facultes." This was to be effected by the establishment of " social workshops," a sort of combined co-operative society and trade-union, where the workmen in each trade were to unite their efforts for their common benefit. On the outbreak of the Revolu- tion of 1848 Louis Blanc became Minister of Labour, and presided over the " Commission du~~

~~gouverneiiient pour les travailleurs," which served only to air a great variety of theories. He was generally held responsible for the establishment of national workshops, which were really due to the Minister of Public Works, Marie, and were, on the confession both of Lamartine and of the director of the workshops, ^fimile Thomas, intended to counteract Blanc's influence. Nevertheless, the failure of this at- tempt to provide for thousands of idle or incompetent workmen, for whom no real work could be found, undermined Blanc's position; and after the abortive Socialist movement of 15th May, the triumph of the Moderates obliged him, after suffering personal violence, to flee, first to Belgium, and thence to London. Ten years later he published (in English) a defence of his share in the Revolution under the title of 1848: Historical Revelations. As far back as 1839 Louis Blanc had vehemently opposed the idea of a Napoleonic resto- ration, predicting that it would be "despotism without glory," "the Empire without the Emperor." He there- fore remained in exile till the fall of the Second Empire in 1870. In the following Eebruary he was elected a~~

~~member of the National Assembly, and protested passion- ately against the peace-proposals. Though a member of the extreme Left, he was too clear-minded to sympathize with the Commune, but exerted his influence in vain on the side of moderation. In 1878 he advocated the aboli- tion of the Presidency and the Senate, with unlimited right of association and freedom of the press. His last important act was to obtain an amnesty for the Com- munists. He died at Cannes on 6th December 1882, and on 12th December received a public funeral in P^re- Lachaise. As a historian Louis Blanc obtained most success with his Histoire de dix ans, 18S0-18Jfi (1841-44). During his stay in England he utilized the collection of French revolutionary tracts at the British Museum, as the basis of the greater part of his Histoire de la Bivolution Franqaise (1847-62). He possessed a picturesque and vivid style, and considerable power of research ; but the fervour with which he expressed his convictions, while placing him in the first rank of orators, too often degraded his historical writings into political~~

~~pamphlets. His most important works, besides those already men- tioned, are Lettres sur PAngleterre (1866-67), Dix annies de Vhistoire de V Angleterre (1879-81), and Questions d'aujourd 'hui et de demain (1873-84). (h. sy.)~~

~~Blanc, Le, chief town of arrondissement, depart- ment of Indre, France, 27 miles W.S.W. of Chateauroux, on the railway from Paris to Agen, and on the Creuse, which divides it into two parts, an upper and a lower town. It has manufactures of cloth, agricultural imple- ments, and tools, wool- and hemp-spinning and tanning, and trade in horses. The town (anciently Fines, later Oblincum, and in the 15th century Naillac, from the baronial family who then held possession of it) was a frontier fortress of the province of Berry. It is well built, and has the remains of three ancient castles and the church of St Genitour, parts of which date from the 12th century. Population (1881), 4614; (1896), 4971, comm., 6253.~~

~~Blandford, or Blandfoed Foeum, a municipal borough, market town, and railway station, in the North- ern parliamentary division of Dorsetshire, England, on the Stour, 16 miles N.E. of Dorchester. The town is an ancient one, and has a town hall, cottage hospital, a grammar school (founded 1521 at Milton Abbas, transferred to Blandford 1775), and Blue Coat school (1729). There are other educational charities. Antiquarian remains are found in the district, and the chalk abounds in fossils. Lord Portman has recently built a fine new mansion on the high ground in place of the old " Bryanston " near the river. Area, 145 acres ; population (1881), 3753 ; (1901), 3649.~~

~~Blankenberghe, a seaport town of Belgium, in the province of West Flanders, on the North Sea, 9^ miles N.N.W. of Bruges, with which it is connected by rail. A canal from this town unites, a little to the west of Bruges, with the Bruges-Ostend canal. The popularity of the place as a bathing resort is growing, and it now receives about 30,000 visitors annually. A dyke, forming a handsome promenade, a mile long, has been constructed along the dunes, and there are a casino, large hotels, and viUas. Population (comm.) (1890), 4116.~~

~~Blan ken burg, a town and health resort of Ger- many, duchy of Brunswick, at the N. foot of the Harz Mountains, 12 miles by rail S.W. from Halberstadt. It has been in large part rebuilt since a fire in 1836, and~~

~~possesses a castle, with various collections, a museum of antiquities, an old town hall, and churches. There are pine-needle baths and a hospital for nervous diseases. Gardening is a specialty. Population (1885), 6010 ;~~

~~(1895), 9289; (1901), 10,173.~~

~~Blanqui, Louis Auguste (1805-1881), French publicist, was born on 8th February 1805 at Puget- Theniers, where his father, Jean Dominique Blanqui, was at that time sub-prefect. He studied both law and medicine, but found his real vocation in politics, and at once constituted himself a champion of the most advanced opinions. He took an active part in the Revolution of July 1830, and continuing to maintain the doctrine of republicanism during the reign of Louis Philippe, was condemned to repeated terms of imprisonment. Impli- cated in the armed outbreak of the Sociiti des Saisons, of which he was a leading spirit, he was in the following year, 1840, condemned to death, a sentence that was after- wards commuted to imprisonment for life. He was released by the Eevolution of 1848, only to resume his attacks on existing institutions. The Revolution, he declared, was a mere change of name. The violence of the Societ6 ripvMicaine centrale, which was founded by Blanqui to demand a modification of the government, brought him into conflict with the more moderate Republicans, and in 1849 he was condemned to ten years' imprisonment. In 1865, while serving a further term of imprisonment under the Empire, he contrived to escape, and henceforth continued his propaganda against the Government from abroad, until the general amnesty of 1869 enabled him to return to France. Blanqui's leaning towards violent measures was illustrated in 1870 by two unsuccessful armed demonstrations ; one at the funeral of Victor Noir on 12th January ; the other on 14th August, when he. led an attempt to seize some guns at a barrack. Upon the fall of the Empire, through the Revolution of 4th September, Blanqui established the club and jour- na,l La Patrie en danger. He was one of the band that for a moment seized the reins of power on 31st October, and for his share in that outbreak he was again con- demned to death on 10th March of the following year. A few days'afterwards the insurrection which established the Commune broke out, and Blanqui was elected a member of the insurgent government, but his detention in prison prevented him from taking an active part. Nevertheless he was in 1872 condemned along with~~

~~the other members of the Commune to transportation ; but on account of his broken health this sentence was com- muted to one of imprisonment. In 1879 he was elected a deputy for Bordeaux ; although the election was pronounced invalid, Blanqui was set at liberty, and at once resumed his work of agitation. At the end of 1880, after a speech at a revolutionary meeting in Paris, he was struck down by apoplexy, and expired on 1st January 1881. Blanqui's uncompromising communism, and his determination to enforce it by violence, necessarily brought him into conflict with every French Government, and half his life was spent in prison. Besides his in- numerable contributions to J9urnalism, he published an astronomical work entitled L'Eternit4 par les astres (1872), and after his death his writings on economic and social questions were collected under the title of Critique sociale (1885). (h. sy.)~~

~~Blantyre, a parish in Lanarkshire, Scotland, S.E. of Glasgow, containing High Blantyre, Low Blantyre, Stone- field, and several villages, besides stations. High Blantyre had a population of 7836 in 1891. Low Blantyre (1505) has a weaving factory, successor to one in which David Livingstone, born in Blantyre Works village, worked as a boy. Stonefield (5581) has a purely mining population. Coal and limestone are worked in the parish. The popu- lation of Blantyre parish in 1901 was 14,151.~~

~~Blantyre (Africa). See Beitish Centeal Africa.~~

~~Blasting. See Mining.~~

~~Biavatsky, Helena Paulovna (1831-1891), Eussian theosophist, was bom at Bkaterinoslav, Russia, 31st July (O.S.) 1831. She is stated to have been the daughter of Peter Hahn, a Eussian officer. An unruly girl, she sought emancipation from family ties by marrying in her 17th year (7th July 1848) Nicephore Biavatsky, a Eussian official in Caucasia, from whom she was separated after a few months of stormy conjugal life. In later days, when seeking to invest herself with a halo of virginity, she described the marriage as a nominal one, and her bridegroom as "a plumeless raven nearer seventy~~

~~than sixty." If this statement were true, M. Biavatsky, who was reported as still living in 1895, would then have been considerably over 110 years of age. During the twenty years that followed the separa- tion from her husband, Mme Biavatsky travelled and probably gained experience as a spiritualistic medium in large cities, among which it is believed that she visited Paris, Cairo, New Orleans, Tokio, and Calcutta. The period 1848-58 was alluded to subsequently as the veiled period of her life, and she spoke vaguely of a seven years' sojourn in " Little and Great Tibet " or preferably of a "Himalayan retreat." In 1858 she revisited Eussia, where she created a considerable sensa- tion as a spiritualistic medium. Early in the 'seventies she acquired prominence among the spiritualists of the United States, and was mixed up in the Eddy Brothers and Katie King frauds. Her leisure was occupied with the study of occult and cabalistic Uterature, to which was soon to be added that of the sacred writings of India, though these had to be approached through the medium of translations. In 1875 she conceived the plan of com- bining the spiritualistic "control" with the Buddhistic legends about Tibetan sages or wonder-working adepts. Henceforth she determined to exclude all control save that of two Tibetan adepts or " mahatmas," called respectively Koot Hoomi and Morya. The mahatmas exhibited their " astral bodies " to her, " precipitated " messages which reached her from the confines of Tibet in an instant of time, supplied her with sound doctrine, and incited her to perform tricks for the conversion of sceptics. At New York, in October 1875, with the aid of Colonel Olcott, she definitely launched the " Theosophical Society,'' which was formed out of a group of disillusioned spiritualists, and had for its avowed objects to put down spiritualism, to convert the materialists, and to prove the existence of the Tibetan brothers. The Brahmanic and Buddhistic literar tures supplied the society with a technical vocabulary, and its doctrines were a curious amalgam of Egyptian, cabalistic, occultist, Indian, and modern spiritualistic ideas and formulas. The two leading text-books, Jsis Unveiled (1877) and The Se(?ret Doctrine (1888), both compiled by Madame Biavatsky, are a mosaic of unac- knowledged quotations from well-known works, as Mac- kenzie's Masonic Cyclopaedia, King's Gfnostics, Zeller's Plato, the works on magic byDunlop, Salverte, Ennemoser, and Des Mousseaux, but above all from the mystical writ- ings of Eliphas Levi. She took great pains with A Glossary of Theosophical Terms (1890-92), compiled for the benefit of the " flap-doodles," as in moments of candour she called her disciples. But the~~

~~appearance of Home's Lights and Shadows of Spiritualism (1877) had a pre- judicial effect upon the propaganda, and Heliona P. Biavatsky (as she began to style herself) sought temporary obscurity ia India. Thence she contributed some clever papers, " From the Caves and Jungles of Hindostan," to the Bussky Vyestnik. Defeated in her object of obtaining employment in the Eussian secret service, she resumed her efforts to gain converts to theosophy. For this purpose the exhibition of "physical phenomena" was found necessary. The jugglery which she practised was~~

~~cleverly conceived, but carelessly executed, and on three distinct occasions the elaborate system of trickery to which she resorted was exposed in the most conclusive manner. Nevertheless, Madame Blavatsky's extraordinary clever- ness, volubility, energy, and will power enabled her to maintain her ground, and when she died on 8th May 1891 (White Lotus Day), at the Theosophical headquarters in Avenue Eoad, Eegent's Park, London, she was the acknowledged head of a community numbering not far short of 100,000, with journals in London, Paris, New York, and Madras. Much information respecting her will be found in Solovyoff's Modem Priestess oflsis, trans- lated by Walter Leaf (1895), in Arthur Lillie's Madame Biavatsky and her Theosophy (1895), and in the report made to the Society for Psychical Eesearch by the Cam- bridge graduate despatched to investigate her doings in India. In personal appearance the " old one," as Madame was familiarly called by her following, has been described as globvilar in shape, with a dull gray complexion, a far from attractive physiognomy, and eyes like discoloured turquoises. Yet she certainly fascinated those who came in contact with her, even those of her colleagues whom her " fibs " and indiscretions kept in a continual state of uneasiness. (t. sk.)~~

~~Blavet, a river of France in the departments of Cotes du Nord and Morbihan. It rises in the W. of the former department, at an altitude of 1000 feet, some 3 miles S.W. of Bourbriac. Flowing generally S. by E. to Goarec, it forms, about midway in its course to that place, the "perte of the Blavet," the " Toul-Goulic " of the Bretons. This is a deep defile, whose bed is a chaotic mass of gigantic rocks, amongst which the stream first dashes wildly and then disappears underneath for a dis- tance of 300 to 400 yards. Its first important affluent, the Sulon, joins it a little above Goarec on the~~

~~left, and at this town the Nantes and Brest Canal, carried along the valley of its affluent the Dor^, in whose basin are several reservoirs, joins it on the right. From Goarec to Pontivy the Blavet is incorporated with the canal, but at the latter town the canal leaves it, and the Blavet, itself canalized, fiows S. by W. and then S.W. for 37 miles to Hennebont, where maritime navigation begins. Here it widens into an estuary, and at its outfall, 9 miles lower, opposite Port Louis, has a width of over a mile. At Lorient, 2 miles above Port Louis, it is joined on the right bank by its chief tributary, the Scorff, forming the port of Lorient. The Scorff rises in the C6tes du Nord, on the borders of Morbihan, flows generally S., and at Pont Scorff, 6 miles N.N.W. of Lorient, becomes navigable. Its total length is about 47 miles. The Blavet has a length of about 87 miles, and a drainage basin of 646,000 acres. The traffic on the Blavet between Pontivy and Hennebont employed in 1899, 3233 boats, carrying 148,706 tons of merchandise, chiefly combustible minerals, metallurgical products, building materials, wood, and manure.~~

~~B I ay d O n , a town in the Chester-le-Street parliam entary division of Durham, England, on the Tyne, 5 miles W. of Gateshead by rail. There are parish churches and Methodist chapels. The chief industries are coal-mining, iron-founding, pipe, fire-brick, chemical manure, and bottle manufactures. Area of urban district, 9339 acres ; population (1881), 10,687; (1901), 19,617.~~

~~Bleiberg ("Lead Mountain"), a commune composed of five villages at the foot of the Dobratsch, 9 miles W. of Villach, in Carinthia, Austria, one of the richest lead- mining centres in Europe. The ores comprise silver-free galena, sulphate of zinc, and calamine. In 1891 the total yield was 33,922 metric centals of lead ore, and 25,636 m.c. of zinc ore. In addition to the mining and smelting works~~

~~there are factories for the production of mre cable. Population (1900), 3436.~~

~~Blida, a town of Algeria, 32 miles by rail S.W. of the city of Algiers, capital of a canton in the depart- ment of Algiers, situated at the foot of the first slopes of the Atlas mountains. It carries on an important flour trade, but its principal commerce is in oranges, surrounded as it is with orangeries numbering from 50,000 to 60,000 trees. Its population, 15,255 in 1872, increased to 23,685 in 1890, and in 1900 numbered 27,772, of whom 6991 were French.~~

~~Blind, Mathlide (1841-1896), author, was bom at Mannheim on 21st March 1841. Her father was a banker named Cohen, but she took the name of Blind in conse- quence of her mother's marriage to Karl Blind, one of the leaders of the Baden insurrection in 1848-49. The family was compelled to take refuge in England, and in course of time Mathilde Blind devoted herself to literature and to endeavours for the elevation of her sex. As a writer of verse she produced some remarkable work, such as " The Prophecy of St Oran," « The Heather on Fire," " The Ascent of Man," and other minor poems. She wrote biographies of George Eliot and Madame Eoland, and translated Strauss's The Old Faith and the New, and the Memoirs of Marie BashJdrtseff. She died in 1896, be- queathing her property to Newnham College, Cambridge. Her collected poetical works have been republished.~~

~~Bloemfontein, a town of British South Africa, capital of the Orange Eiver Colony, and formerly of the Orange Free State. It- was founded by the early Boer trekkers about 1836 on a southern affluent of the Vaal, on the open veldt amid a few low detached kopjes at an alti- tude of 4518 feet above the sea, about 120 miles from the Cape frontier, 760 from Cape Town, and 450 from Port Elizabeth. Of its normal population of 10,000 (1901), fully 7000 are whites (Dutch and English), and 3000 blacks (Basutos and Bechuanas, commonly called "Kaf- firs "). The town is regularly laid out with streets running at right angles and flanked by several fine buildings, mostly of stone quarried in the vicinity. Amongst them are the government ofB.ces and the former Eaadzaal (Parliament Hou se), now used for general municipal purposes. It is well supplied with electric light and good water, and is a great railway centre with lines converging from Cape Town, Port Elizabeth, and Pretoria. Owing to its dry, salubrious climate it has become a sort of South African sanatorium, recommended especially for pulmonary~~

~~affections. During the Boer war Bloemfontein was occupied without resist- ance by Lord Roberts, soon after the surrender of Kronje at Paardeberg (27th-28th February 1900).~~

~~Bloomfield, a township of Essex county, New Jersey, U.S.A., situated in the north-eastern part of the state, on the Brie and the Delaware, Lackawanna, and Western railways, at an altitude of 130 feet; founded toward the close of the 17th century, under the name of Watsesson. Population (1880), 6748 ; (1900), 9668.~~

~~Bloomlngton, capital of M'Lean county, Illinois, U.S.A., situated in 40° 30′ N. lat. and 89° 00′ W. long., in the central part of the state, at an altitude of 785 feet. It is a railway centre, being on the Chicago and Alton, the Cleveland, Chicago, Cincinnati and St Louis, the Illi- nois Central, and the Lake Erie and Western railways. It is the seat of Illinois Wesleyan University, with a faculty numbering 34, and with 300 students, one-third of whom are women. Population (1880), 17,180 ; (1900), 23,286.~~

~~Bloomlngton, a city of Indiana, U.S.A., capital of Munroe county, S.W. of the centre of the state, on the Chicago, Indiana, and LouisvUle railway. It is~~

~~the seat of the state university, which in 1900 had a faculty numbering 77, and students numbering 1137. Population (1890), 4018 ; (1900), 6460.~~

~~Bloomsburg, a chartered town of Pennsylvania, U.S.A., capital of Columbia county, on the north branch of the Susquehanna river, and on the Delaware, Lackar wanna, and Western and the Philadelphia and Bead- ing railways. Its industries are connected chiefly with iron manufacture. Population (1890), 4635; (1900),~~

~~6170.~~

~~Blue Island, a village of Cook county, Illinois, U.S.A., in the north-eastern part of the state, adjoining Chicago, of which it is a suburb. Population (1890),~~

~~3329 ; (1900), 6114.~~

~~Bluff Harbour. See Invebgabgill.~~

~~Blumenthal, Leonhard von (1810-1900), Prus- sian field-marshal, son of Captain Louis von Blumenthal (d. 1813), was born at Schwedt, on the Oder, on 30th July 1810. Educated at the military schools of Culm and Berlin, he entered the Guards landwehr regiment as 2nd lieutenant in 1827. After serving in the Rhine provinces he joined the topographical division of the general staff in 1846. As lieutenant of the 31st foot he took part, in 1848, in the suppression of the Berlin riots, and in 1849 was promoted captain on the General Staff. The same year he served on the staff of General von Bonin in the Schleswig-Holstein campaign, and so distinguished himself, particularly at Fredericia, that he was appointed chief of the staff of the Schleswig-Holstein army. In 1850 he was general staff officer of the mobile division under von Tietzen in Hesse Cassel. He was sent on a mission to England in that year (4th class of Red Eagle) and on several subsequent occasions. He became a major in 1853, was appointed personal adjutant to Prince Frederick Charles in 1869, and promoted in 1860 to be colonel of the 31st regiment, and later of the 71st regiment. He was chief of the staff of the 3rd army corps when, on the outbreak of the Danish war of 1864, he was nominated chief of the general staff of the army against Denmark, and displayed so much ability, particularly at Missunde, Diippel, and the passage to Alsen island, that he was promoted to be major- general and given the Order of Merit. In the Austrian war of 1866 Blumenthal was chief of the General Staff of the second army under the Prussian crown prince, and led it with a swiftness of decision and directness of aim. which enabled it to strike home on the heights of Culm, and to decide the fortunes of the day at Koniggratz (lieut.- general, the oak-leaf of the Order of Merit, and knight commander of Hohenzollern). In the years of peace which followed he commanded the 14th army division at Diisseldorf, and his conduct of the manoeuvres arranged with the 13th division under General von Groeben earned the highest praise from military critics. In the Franco-German war of 1870-71, as chief of the staff of the third army, Blumenthal's knowledge and skill were in- valuable. His co-operation with Moltke was masterly. Before orders had been given for the decisive flank march which ended at Sedan, he had grasped the position of Bazaine at Metz and had made all his preparations. No general order was ever given for the battle of Sedan, but Moltke knew that the third and fourth armies would close the iron ring in~~

the nick of time. In 1871 Blumenthal represented Germany at the Chobham manoeuvres, and was given the command of the 4th army corps at Magdeburg. He was made a field-marshal in 1888, and died at Quillendorf, 21st December 1900. He married in 1852 Delicia Anna von Vyner {nie Calthorpe), and left two sons and three daughters. Field-Marshal Blumenthal had the

reputation of being one of the first strategists of the time. If in 1866 it was Moltke's mind that calculated the issue of the campaign, it was Blumenthal's vigour which defeated all obstacles before the goal. Like Moltke he was a man of sterling simplicity of character. Short and thick-set in figure, with large head and kindly features, his appearance was rather that of a professor than of a soldier ; but his eyes were full of fire and energy. He was affectionately known for many years as "der alte Blumenthal."

Bluntschli, Johann Kaspar (1808-1881), Swiss jurist, was born at Zurich, 7th March 1808. Having studied law at Berlin and Rome, he was appointed pro- fessor of jurisprudence in the newly-founded University of Zurich in 1833. In the troubles which agitated the state, he mainly sided with the Conservative party, which he led in the Great Council from 1837, and after the revolution of September 1839 he became a member of the Government. An important modification in his ideas was effected by his becoming acquainted with the philosophy of that remarkable, but little-known man, Frederick Eohmer, of whom he said, shortly before his death, " I have gained renown as a jurist, but my greatest desert is to have comprehended Kohmer." This more liberal direction of mind made Bluntschli's participation in the Government uneasy to him, and he resigned ; but so high was the estimation of his eminence as a jurist that\the task of compiling a civil code was unanimously entrusted to him. After the counter-revolution and overthrow of the Sonderbund (1847), Bluntschli removed to Munich, where he was professor both of private and of state law from 1848 to 1861. He produced there the Allgemeines Staatsrecht, and the Lehre vom modemen Staat, which gave him a European reputation, as well as numerous minor works, and conducted a legal review from 1855 to 1858.

His removal to Heidelberg in 1861 was mainly occasioned by the unpopularity of his advocacy of German unity in opposition to the "particularism" then prevailing at Munich. " I felt," he says, " that I was merely tolerated." In his new state, Baden, he soon had to encounter active antagonism from his endeavours to keep it neutral during the Austro-Prussian war of 1866 ; the course of events, however, speedily decided the question in Bluntschli's favour, and, though frequently annoyed by intestine troubles in the University, upon which his memoirs throw a curious light, he held his position unchallenged until his sudden death, at Carlsruhe, on 21st October 1881. While at Heidelberg he produced several books which have taken rank as classics of jurisprudence, especially GescMchte des aUgemeinen Staatsrechts (1864) ; Das modeme Kriegsrecht (1866) ; Das modeme Volkerreoht (1868) ; Das Beuterecht in Krieg (1878). The Staatsrecht has been translated into Japanese. The most remarkable external incidents of his life during this period were his active participation in the Protestantenverein, a societjr formed to combat reactionary and Ultramontane ideas in theology ; and his important contribution towards the settlement of the Alabama difficulty by a seasonable pamphlet. His highly interesting autobiography was published in 1884. His library was acquired by the Johns Hopkins University at Baltimore. (e- g.)

Bobbin, a town of British India, in the Vizagapatam district of Madras, situated in 18° 34′ K lat. and 83° 25′ E. long., 70 miles N. of Vizagapatam town. Population (1891), 14,468. It is the residence of a raja of old family, whose estate covers an area of 227 square miles; estimated income, £40,000; permanent land revenue, £9000. The present raja is a highly-educated man who has visited England. He is a K.C.I.E. and member of the Madras legislative council. He main-

tains a high school (270 pupils in 1896-97), and also a printing-press.

Bober, a river of Germany, rising at an altitude of 2438 feet in the Riesengebirge, S.W. of Landeshut. It threads the valley of Hirschberg, reaches the lowlands at Lowenberg, flows past Bunzlau and Sagan, and enters the Oder from the left at Krossen (118 feet altitude), after a N.N.W. course of 158 miles. In summer it is often a mere shallow stream, but after the melting of the snows becomes a devastating torrent.

~~Bobrinets, a town of South Russia, in the govern- ment and 120 miles' N.N.W. of Kherson, near the railway from Mkolaiev to Kieff. It has tobacco factories and several steam flour-mills. Population, 14,352.~~

~~Bobruisk, a first-class fortress and district town of Russia, government and 108 miles by rail S.E. of Minsk, oil the right bank of the Berezina river, and on the railway from Libau and Wilno to Ekaterinoslav. It has important ironworks and steam flOur-mills, and carries on an important trade in corn and timber shipped to Libau. Population (1897), 35,177 (58,256 with military).~~

~~Bochnia, the chief town of a district of the same name in the Austrian crown-land of Galicia. Population of district (1890), 100,653, mostly Polish and Catholic; (1900), 105,375. Population of town (1890), 8849, of whom 2133 were Jews ; (1900), 10,049. In addition to the salt-mines (with an annual yield of about 15,000 tons) and deposits of gypsum, there are a number of steam-mills and factories for the manufacture of tin wares ; while a considerable trade is done in corn, salt, and eggs.~~

~~Bochoit, a town of Prussia, province of Westphalia, 12 miles by rail N. from Wesel, and near the frontier of Holland. It is a seat of the cotton industry. Population~~

~~(1885), 10,567; (1895), 16,273; (1900), 21,241.~~

~~Bochum, a town of Prussia, province of Westphalia, 11 mUes by rail W. from Dortmund. It is a centre of the iron and steel industries, producing principally cast steel, cast iron, iron pipes, wire and wire ropes, and lamps, with tin and zinc works, coal-mining, factories for carpets, calcium carbide, and paper-roofing, brickworks, and breweries. There are a mihing and a metallurgical school. Population (1885), 40,767 ; (1895), 53,842 ; (1900),~~

~~65,554.~~

~~Boclcenheim. See Feankfort-on-Main.~~

~~Boclclin, Arnold (1827-1901), Swiss painter, was born at B§le, 16th October 1827. HIs father. Christian Frederick Bocklin, was born at B§,le,~~

16th July 1802, was descended from an old family of Schaffhausen, and engaged in the silk trade. His mother, Ursula Lippe, was a native of the same city. In 1846 he began his studies at the Dilsseldorf Academy under Schirmer, who recognized in him a student of exceptional promise, and sent him to Antwerp and Brussels, where he copied the works of Flemish and Dutch masters. Bocklin then went to Paris, worked at the Louvre, and painted several landscapes ; his ” Land- scape and Ruin ” reveals at the same time a strong feeling for nature and a dramatic conception of scenery. After serving his time in the army he set out for Rome in March 1850, and the sight of the Eternal City was a fresh stimulus to his mind. So, too, was the influence of Italian nature and that of the dead pagan world. At Rome he married (20th June 1863) Angela Rosa LorenzaPascucci. In 1856 he returned to Munich, and remained there four years. He then exhibited the ” Great Park,” one of his earliest works, in which he treated ancient mythology with the stamp of individuality, which was the basis of his reputation. Of this period, too, are his “Nymph and Satyr,” “Heroic

Landscape” (Diana Hunting), both of 1858, and ” Sappho,” 1859. These works, which were much dis- cussed, together with Lenbach’s recommendation, gained him his appointment as professor at the Weimar Acadftijiy. He held the oflB.ce for two years, painting the “Venus and Love,” a ” Portrait of Lenbach,” and a ” Saint Catherine.” He was again at Rome from 1862 to 1866, and there gave his fancy and his taste for violent colour free play in his ” Portrait of Mme Bocklin,” now in the B§,le Gallery, in ” An Anchorite in the Wilderness,” 1863 ; a ” Roman Tavern ” and ” Villa on the Sea^shore,” 1864 ; this last, one of his best pictures. He returned to Bale in 1866 to finish his frescoes in the gallery, and to paint, besides several portraits, ” The Magdalene with Christ,” 1868 ; ” Anacrseon’s Muse,” 1869 ; and ” A Castle and Warriors,” 1871. His “Portrait of Himself,” with Death playing a violin, 1873, was painted after his return again to Munich, where he exhibited his famous ” Battle of the Centaurs” (in the Bale gallery) ;” Landscape with Moorish Horsemen ” (in the Lucerne gallery) ; and ” AParm,” 1875. Prom 1876 to 1885 Bocklin was

~~working at Plorence, and painted a “Pieta,” “Ulysses and Calypso,” “Prometheus,” and the « Sacred Grove.” From 1886 to 1892 he settled at Zurich. Of this period are the “Naiads at Play,” “A Sea Idyll,” and “War.” After 1892 Bocklin resided at San Domenico, near Plorence. An exhibition of his collected works was opened at Bale from 20th September to 24th October 1897. He died on the 16th of January 1901. His life has been written by Henri Mendelssohn.~~

~~F. Heemann. Gazette des Beaux Arts. Paris, 1893. — Max Lbhrs. Arnold Bocklin, Ein Leitfaden zum Verstandniss seiner Kunst. Munich, 1897. — W. Rittek. Arnold Bocklin. Gand, 1895. — Katalog, der. Bocklin, Jubildiims Ausstellung. Basel, 1897. (h. Vr.)~~

~~Bodenbach (Czech, PodmoTdy), a town in the government-district of Tetschen in Bohemia, Austria, near the Saxon frontier, situated on the left bank of the Elbe, opposite Tetschen, with which town it is connected by a chain bridge and two railway bridges. There is an Austrian and a Saxon custom-house ; and the town has an im- portant transit trade in addition to considerable manu- factures (cotton and woollen goods, earthenware and crockery, chemicals, chicory, chocolate, sweetmeats and preserves, and beer). Population (1890), 7574, almost exclusively German ; (1900), 10,782.~~

~~Bodenstedt, Friedrich Martin von~~

~~(1819-1892), German author, was born at Peine, in the kingdom of Hanover, 22nd AprU 1819. Although a prolific and meritorious writer, Bodenstedt is more than most authors, as regards his European celebrity, “the man of one book.” His career, as it proved, was determined by his engagement in 1841 as tutor in the famUy of Prince Galitzin at Moscow, where he gained a thorough acquaint- ance with Russian. This led to his appointment in 1844 as the head of a public educational establishment at Tiflis, Transcaucasia. Thus residing in close proximity to Persia, he became acquainted with a modern Persian poet, Mirza SchafEy, and this intercourse inspired him with the volume of little poems in the Oriental taste published after his return to Europe (1851) as a translation from the Divan of his friend, but really original. The success of this work can only be compared with that of FitzGerald’s Omar Khayydm, produced in somewhat similar~~

~~circumstances, but (fiffered from it in being immediate. The Divan has gone through innumerable editions in Germany, and has been translated into almost all literary languages. Nor is this celebrity undeserved, for although Bodenstedt does not attain the poetical elevation of FitzGerald, his view of life is wider, more cheerful, and more sane, while the~~

~~execution is a model of grace and elegance. The rich stores of knowledge which Bodenstedt brought back from the East were turned to account in two important books, The Peoples of the Caucasus and their Struggles against the Russians (1848) and A TJiousand and One Days in the East (1850). For some time after his return Bodenstedt continued to work up Slavonic subjects, producing trans- ‘ lations of Pushkin, Lermontoff, Turgenieff, and of the poets of the Ukraines, and writing a tragedy on the false Demetrius, and an epic, Ada, the Lesghian Maid, on a Circassian theme. Finding, probably, this vein exhausted, he exchanged, in 1858, the Slavonic professorship he had obtained at Munich for one of Early English literature, and published (1858-60) a valuable work on the English dramatists contemporary with Shakespeare, with copious translations. In 1862 he produced a standard translation of Shakespeare’s sonnets, and between 1866 and 1872 published a complete version of the plays, with the help of many coadjutors. In 1867 he undertook the direction of the Meiningen Dramatic Company of Actors, and was ennobled by the duke. After 1873 he lived successively at Altona, Berlin, and Wiesbaden, where he died on the 19th of April 1892. His later works consist of an auto- biography (1888), successful translations from Hafiz and Omar Khayyd^m, and lyrics and dramas which added little to his reputation. (e, g.)~~

~~Bodmin, a market town, municipal borough, and county town in the Bodmin parliamentary division (since 1885) of Cornwall, England, 30 miles by rail W. by N. of Plymouth. The ancient church of St Petrock has been restored and the county lunatic asylum extended, public rooms and a public library have been erected. Bodmin also contains H.M. civil and naval prisons, the head- quarters of the county constabulary, the depot of the Duke of Cornwall’s Light Infantry, and the District Probate Registry. Area, 2797 acres ; population (1881), 5061 ; (1901), 53S3.~~

~~Boehm, Sir Joseph Edgar, Babt. (1834- 1890), British sculptor, was bom of Hungarian parentage on 4th July 1834, at Vienna, where his father was director of the Imperial Mint. After studying the plastic art in Italy and at Paris, he worked for a few years as a medallist in his native city. After a further period of study in England, he was so successful as an exhibitor at the Exhibition of 1862, that he determined to abandon the execution of coins and medals, and to give his mind to portrait busts and statuettes, chiefly equestrian. The colossal statue of Queen Victoria, executed in marble (1869) for Windsor Castle, and the monument of the duke of Kent in St George's Chapel, were his earliest great works, and so entirely to the taste of his royal patrons, that he rose rapidly in favour with the court. He was made A.R.A. iu 1878, and produced soon after- wards the fine statue of Carlyle on the Thames Embank- ment at Chelsea. In 1881 he was appointed sculptor in ordinary to the Queen, and in the ensuing year became full Academician. On the death of Dean Stanley, Boehm was commissioned to execute his sarcophagus in West- minster Abbey, and his achievement, a recumbent statue, has been pronounced to be one of the finest pieces of portrait sculpture of modern times. He executed the equestrian statue of the duke of Wellington at Hyde Park Corner, and designed the jubilee (1887) coinage. He died suddenly in his studio at South Kensington on 12th December 1890.~~

~~Boghaz Keui, a small village in Asia Minor, N.W. of Yuzgat in the Angora viMyet, remarkable for the ruins and rock-sculptures in its vicinity. The ruins are those of " a ruling city of the Oriental type,~~

~~unaffected by, and earlier than, Greek influence " ; and they have generally been identified with Pteria, a place taken by Croesus after he had crossed the Halys (Herodotus, i. 76).~~

~~The city walls, the acropolis, and the palace are of great archseo- logical interest. Excavations made on the site by M. Chantre led to the discovery of a number of tablets with cuneiform inscriptions, some in a primitive CJappadooian dialect which has not yet been read, and of small oDjects of~~

~~interest. The rock- sculptures, Yasili Kaya, IJ miles east of the city, belong to a dis- tinct style of art which has been called " Hittite," but many traces of Assyrian influence survive. It seems probable " that the cult of the great earth-mother (Cybele) and her son (Attis) supplies the motive of these reliefs, and that it was dominant in the city below them." Another view is that the sculptures commemorate an historical event. At Euyuk, about 12 miles north of Boghaz Keui, is a gateway flanked by sphinxes and a series of remarkable sculptures which, like those at Yasili Kaya, represent, according to Professor Ramsay, "scenes and figures in the ritual of a reli^on which can be traced over the greater part of Asia Minor, modified by local circumstances." Here also M. Chantre made interesting discoveries.~~

~~HuMANN and Puchstein. Beisen in Kleinasien und Nordsyrien. — Chantke. Mission en Cappadocie, 1893-94 ; Becherches archeo- logiques. — Pbbrot and Chipiez. Histoire de VArt en Phrygie. — HoQARTH in Murray's Handbook to Asia Minor. (p. w. w.)~~

~~Bognor, a seaside resort in the Chichester parliar mentary division of Sussex, England, 7 miles S.E. of Chichester, and 28 W. of Brighton by rail. Besides the parish church, there are a Roman Catholic priory and church, and Congregational, Wesleyan, and Methodist chapels ; also a ^theatre, assembly rooms, and numerous convalescent homes, including establishments belonging to the Merchant Taylors' Company, the Ragged School Union, East London Hospital for Children, and the Surrey Women's Jubilee Memorial Committee. A pier pavilion and a promenade are other features. Area of urban district, 885 acres ; population (1881), 3290 ;~~

~~(1901), 6180.~~

~~Bogorodsk, a district town of Central Russia, in the government and 27 miles by rail E.IST.E. of Moscow, near the railway to Nijni, with which it is connected by a branch line. It is built on the bank of the Klyazma river, and has several woollen and silk mills. Population,~~

~~11,210.~~

~~Bogota, or Santa Ei: db Bogota, the chief town of the department of Cundinamarca, Colombia, South America, and the capital of the republic,~~

~~situated on a high tableland 8985 feet above searlevel, on the San Francisco river at its junction with the Rio de Bogota. Erom Barranquilla it is distant, by the nearest trafftc route, 683|- miles, communication being by rail to Eacatativa 24 miles, from Eacatativa to La Dorada by mules 45 miles, from La Dorada to Honda by rail 22 miles, and from Honda to Barranquilla, by steamers on the Magdalena river, 592^ miles. There is also communication with the Magdalena by an American express service of waggons drawn by horses. A railway is projected to Zupaquira. Within recent years the city has greatly extended, and occupies an area of about 2^ miles in length by 1^ in breadth. The streets, though narrow, are well laid out and well kept, and lighted by electricity. There is an excellent water-supply, besides a telephone service and other modern conveniences. A special feature are the fine squares in the Erench fashion adorned with fountains. In the Plaza Bolivar is a statue of Liberty by Tenerain, a pupil of Canova, and in the Plaza Santander a statue of G-eneral Santander by Costa of Elorence. Among the public buildings are the palace of San Carlos occupied by the president of the republic, and the palaces of Santo Domtugo and San Erancisco occupied by Govern- ment offices. The university has a high reputation, and the city, on account of its appreciation of art and letters.~~

~~has acquired the surname of the "Athens of South America." The population is about 125,000.~~

~~Bogra, or Bagtjea, a town and district of British India, in the Rajshahi division of Bengal. The town is situated on the right bank of the river Karatoya. Popu- lation (1881), 6179 ; (1891), 6584. It possesses a high school, two printing-presses, and a public library.~~

~~The district of Bogra lies west of the main channel of the Brahmaputra. It contains an area of 1452 square miles. Population (1881), 734,751; (1891), 817,494, showing an increase of 11 per cent. ; average density, 563 persons per square mile. Classified according to religion, Hindus numbered 154,296 ; Mahommedans, 661,100 ; Christians, 16, of whom 7 were Europeans; "others," 2083. In 1901 the population (on a reduced area) was 849,955, showing a further increase of 11 per cent. Land revenue and rates (1897-98) were Rs.5,35,327 ; the number of police was 230; the number of boys at school (1896-97) was 15,484, being 26-6 per cent, of the male population of~~

~~school-going age ; the registered dea,th- rate (1897) was 30 per thousand. The former production of indigo is extinct, and the industry of silk-spinning is decaying. There is no town with as many as 10,000 inhabitants, trade being conducted at riverside marts. Nor are there any metalled roads. The Northern Bengal railway runs through a corner of the district for 39 miles, on its way north to Darjiling.~~

~~Bogusiav, a town of Western Russia, government and 69 miles S.E. of Kieff. It dates from the 12th century, and has a population of 13,000. Machinery works, woollen cloth mills, and distilleries are its leading industries.~~

~~Bohain, a town in the arrondissement of Saint Quentin, department of Aisne, Erance, 30 miles in direct line N. by W. of Laon, on the railway from St Quentin to Lille. The Torrents. Canal affords communication with the Scheldt. Local industry is mainly associated with the production of woollen fabrics, including French cashmeres, gauzes, and various fancy stuffs. Population (1881), 6380 ;~~

~~(1901), 6899.~~

~~„ Bohemia (German Bohmen ; Bohemian or Czech, Cechy), a kingdom and crown-land of the Austro-Hun- garian monarchy, of which it constitutes the most northern part. Population (1869), 6,106,069 (of which it was esti- mated that there were 20 Germans to every 32 Slavs) ; (1880), 5,560,819 ; (1890), 6,843,094, which is equivalent to 293 inhabitants per square mile; (1900), 6,318,280. The density of population is greatest in the northern or industrial districts. The proportion of females to males in 1891 was 1071 to 1000: 62-38 per cent, were Czech and 36-94 German, 96 per cent. Roman Catholic, 2-17 per cent. Protestant, and 1-6 per cent. Jews. Next to Galicia, Bohemia has the largest population of any Austrian crown-land, and about 24-46 per cent, of the entire popu- lation of Austria. In 1896 the marriage-rate was 8-31 ; the birth-rate 37-29, or, excluding still-births, 36-04 ; and the death-rate 24-31 per 1000. Of the births 14-41 per cent, were illegitimate, an increasing ratio. Bohemia sends 110 members to the Reichsrath, or central parlia^ ment in Vienna, 18 of whom are returned by the new universal suffrage curia ; 66 are Czech and 45 German, including the large landed proprietors of bothnationalities. Education is provided for~~

~~by two universities, one German and the other Czech (4178 students in 1897), two poly- technics (1227 students), an academy of fine art, a mining academy, 4 theological seminaries, 56 gymnasia, 22 real- gymnasia, 311 intermediate and 5149 elementary schools (the proportion of Czech and German being as 3 to 2), with an average attendance of 98-5 per cent, of all children.~~

~~together with about 860 other state, municipal, and pri- vate educational establishments, mostly technical. The proportion of illiterates, the lowest in Austria, sank from 815 per cent, in 1880 to 6-8 per cent, in 1890. In 1898 there was a total of 618 periodicals (384 Czech, 220 Ger- man, 2 English, and 12 polyglot).~~

~~Despite its great industrial development, about 45-25 per cent, of the population is still engaged in agriculture and forestry, 39-65 being occupied in mining and other industries and in trade. Bohemia produces 64-20 per cent, of the whole Austrian beetroot crop (Moravia coming next with 30 per cent.), in addition to the largest crops of wheat, rye, barley, oats, and potatoes, and considerable quantities of other agricultural produce. Nearly 49 per cent, in value of the entire yield of the Austrian mines falls to Bohemia, whose principal products are lignite, coal, iron ore, together with smaller quantities of gold, silver, and other metals, several of which are only mined in this crown-land. Its wealth of coal (40 million metric centals coal and 169 million m.c. lignite in 1897), to- gether with the improvements in the refining process have made it the chief centre of the iron industry, in which it has now begun to compete with Germany. Sugar-refining is of growing importance, as is also the manufacture of railway rolling-stock, while the old staple industries show a marked advance. In 1890 it possessed 35 per cent, of all the factories in Austria, 38 per cent, of the entire motive power, and 41 per cent, of the fac- tory hands — figures which show that it holds the first place for industrial enterprise on the largest scale. Be- tween 1870 and 1890 there has been an increase in the number of homed cattle, 2,022,305 (4-420,290); pigs, 514,367 (-1-286,187); horses, 215,729 (f 25,392) ; and goats, 334,417 (-1-140,144) ; and a reduction in the num- ber~~

~~of sheep, 423,602 (682,688). Bohemia is the most favoured portion of the monarchy in the matter of com munications, possessing (in 1897) 5228 kilometres of railway, 30 per cent, of the total length in Austria; 28,156 kilometres of roads, and 1160 kilometres of navi- gable rivers and canals, which (vid the Elbe) afford it cheap access to the sea. In 1896 2,535,000 tons of goods were forwarded in both directions on the Elbe by 21,200 vessels, of which nearly 3000 were steamers. There are 1347 post and 718 telegraph offices, with 7361 kilometres of line and 20,227 kilometres of wire.~~

~~Political Importance. — As the situation in Bohemia is the pivot upon which Austrian domestic politics turns, and has turned for a generation past, it may be well to recall some of the principal factors in the problem. The national movement among the Czech people, revived in 1848, has made immense progress since the Czech representatives abandoned their policy of parliamentary abstention in 1879. During the term of ofl3.ce of Count Taaffe (1879-93) they secured in detail a series of im- portant concessions — the language ordinances of 1880 and 1886, which ultimately established Czech predomi- nance in the public service, the founding of a Czech university (1882) and of numerous Czech gymnasia, together with the state support for the Czech Acad- emy of Science at Prague, &c. They at the same time so consolidated their position in the Czech pro- vinces and the Eeichsrath that the Government found itself constantly obliged to purchase their support by fresh concessions. After the failure of Count Taaffe's effort to overcome the nationality deadlock by a heroic electoral reform nearly equivalent to universal suffrage, and the breakdown of the German-Polish-Clerical coali- tion that followed his fall, the Czechs won the greatest triumph in the issue by the Badeni ministry of the noto- rious language ordinances of April 1896. These ordi- nances, which rendered a thorough knowledge of the~~

~~Czech and German languages obligatory upon all officials in Bohemia and Moravia, did not merely gratify Czech national sentiment, but were of considerable material advantage to that nationality, inasmuch as they almost created a monopoly for the bilingual Czech claimants. The grant of the German demand for administrative separation of the German and Czech districts of Bohemia and Moravia, with the afftcial use of German in the~~

~~former and of Czech in the latter, would not only have constituted a hindrance to ultimate autonomy, but would have increased the competition and diminished the number of appointments open to Czech official aspirants. This last concession to their opponents was regarded by the Germans as evidence that the centralistic constitution was in serious danger, and that the Czechs and their allies were within measurable distance of realizing their aims. These were, first, the restoration to the provincial diets of the right of electing the Eeichsrath or, central parliament (a privilege abolished in 1873), and, ultimately, a purely federal constitution. A compromise between the nationalities has hitherto proved impossible. The struggle, accompanied at times by violence involving destruction of life and property and repeated suspensions of constitutional rights, had at one time nearly de- stroyed the Austrian parliamentary system and even threat- ened the integrity of the dual monarchy. The withdrawal of the last of the series of language ordinances (Septem- ber 1899) only replaced German obstruction by that of the Czechs, which upset the ministry and again rendered parliamentary government impossible. The truce brought about by the Korber ministry in 1901 per- mitted the passage through the Eeichsrath of an im- portant economic scheme, comprising a large extension of railways and canals, and seemed to furnish the basis of an eventual political compromise.~~

~~The remarkable growth of Czech influence has been promoted by the rapid increase of the Czech popular tion in the towns, whither they are attracted by higher wages. This increase is coincident with and one of the consequences of the development of industry on a large scale in Austria, which is the work of the past quarter of a century. The establishment of factories created a demand for hands, which the German popu- lation alone was unable to supply. Indeed, where a German proletariat existed, it was at a disadvantage in the competition with the Czechs and Poles owing to its higher standard of living. Moreover, the cheaper and more docile Slav labourers are less attached to their native place than are the Germans, and they marry at an earlier age — two circumstances that still con- tinue to promote their relative increase in the industrial centres. This tendency has been welcomed by the State and the Church for different reasons. Apparently in view of the rooted discontent of the German population with the position of a minority in a country where they had been accustomed to~~

rule, the State has consistently and successfully strengthened the Slav element as a precaution against a possible Oermania irredenta agitation, so that now the Czechs are all-powerful in the administration of Bohemia and Moravia, including the German di^stricts on the frontier. The Germans occupy a broad belt of the western and northern border adjoining Bavaria and Saxony, while the Czechs are settled in the centre and the southern districts of Bohemia. There are several grounds for the action of the Eoman Catholic Church in the same direction. The clergy, as well as the reactionary nobles, regard the nationality struggle as a useful means of divert- ing attention from their own privileges. Like the large manufacturers, the priests find the Slavs more docile to their teachings and more tolerant of their pretensions. More- over, the bulk of the priests are themselves of the Slav

race. While the Austrian episcopacy is in an exception- ally favourable pecuniary position, the minor clergy are badly paid. The profession has therefore little attraction for the well-to-do middle classes. The consequence is that it is largely recruited among the Slav peasantry, so that the priests even of the German districts of Bohemia and Moravia are predominantly Czech. Such a priest, filled ■with a sense of his own dignity and authority, enters his sacred office not merely with an unenlightened racial Chauvinism, but with an almost personal grudge against the better educated leaders of the German element, and indeed against the less deferential German part of his flock altogether. The irritation produced by this attitude of the Catholic clergy accounts for a good deal in the move- ment in favour of wholesale conversion to Protestantism, which has made most progress in Bohemia. The motive of the promoters of the " Emancipation from Eome " move- ment, however, is to make German Austria more palatable to Protestant Germany in view of future eventualities. The Pan-Germanic movement finds encouragement and support among an important section of the German manu- facturers of Bohemia on other than national grounds. These argue that Austrian industry has now reached a stage at which it can compete successfully with that of Germany. The latter, it is true, has had the start, but Austrian industry has the advantage in the matter of good taste, a

~~point in which Germany is deficient. Moreover, Austria has numerous undeveloped resources, which, if properly utilized, would place it on a level with its rival. The most pressing requiremeat of the Austrian manufac- turers is fresh markets and liberty for their expanding energies, and this, it is urged, would be at once provided by some form of amalgamation with the German empire. Other sections of the industrial community hold, how- ever, that Austrian industry is not yet strong enough to dispense with the high protectionist tariff that now excludes German products. The recent aggravation of the nationality conflict has done less damage to trade in the Czech provinces than might have been expected, the pre- vailing system of credit having opposed practically insur- mountable difficulties in the way of the threatened boycott of political opponents.~~

~~Authorities. — R. Andrbe. Nationalitats-verJialtnisse und Sprachgreme in Bohmen, Leipzig, 1872 ; and Tschechische Cfdnge, 1872 ; Bbndel. Die Deutschen in Bohmen, Mdhren, und Schlesien, Teschen, 1884; Die Oesterreichisch-UngarischeMonarchiein.Wort und Bild; the histories and historical sketches of Tomek, ScHLBSiNGER, Frind ; ToMAN. Das Bohmische Staatsrecht; Mbnger. Bohmische Ausgleich, Stuttgart, 1891 ; Tuknwald. Administrative Teilung Bohmens; the article "BShmen" in MiscHLER and Ulbrich's Oesterreichisches Staatsworterbuch, Vienna, 1895-97. Dr H. Eauchbekg. Die Bevolkerung Oster- reichs, Vienna, 1895, &c. (jE. o'n.)~~

~~Bohmisch-Leipa (Czech, CesM Idpa), the chief town of a district in North Bohemia, on the Polzen, a tributary of the Elbe. It has a considerable industry, in- cluding the works of the Bohemian Northern railway, textile and calico-printing factories, and the manufacture of pianos, glass, dextrine and starch, sweetmeats and pre- serves, sugar, stores, the preparation of furs and skins, brewing and corn-milling. Population (1890), 10,406; (1900), 10,674 ; chiefly German and Catholic.~~

~~Bohmish — Trubau (Czech, Trebovd Ceskd), an old town in the government — district of Landskron, in North-Bast Bohemia, Austria, near the Moravian frontier. It has considerable textile industry (linen spinning and weaving), brewing and the preparation of malt, and trade in flax, which is extensively~~

~~cultivated in the district. The inhabitants (4982 in 1890, 6040 in 1900) are Czech.~~

~~Boilers. — In the article Stbam-Engine (Encyclo-\~~

~~"Lanca- shire."~~

~~K3 X1J.\I±1. J-LX UJ-L^-JH^V/X~~

~~JL~~

~~pcedia Britannica, vol. xxii.) the general principles underlying the design and use of all steam boilers are stated, and several kinds of boilers are illustrated. The examples giVen still fairly agree with the present practice of the types described, but during the last few years some changes have taken place in matters of detail, and several new designs have come into use. It is with these that this article is intended to deal.~~

~~Land-Boilers. — The boilers most generally used in large mills and manufactories at the present time are the "Lancashire" and its modification the "Gallo- way." Cross-sections of these are illustrated in the Encyclopedia Britannica, vol. xxii. p. 497. They are usually from 26 to 30 feet long, with diameters from 6 feet 6 inches to 8 feet. The working pressure is in som^ cases as high as 200 lb per square inch, but is usually about 60 To per square inch in the elder boilers, 100 to 120 ft in those supply- ing steam to compound engines, 160 ft to 170 ft where the engines are triple expansion, and 200 ft where they are quadruple. The furnace flues are now generally made in sec- , ,. . , „ , ,~~

~~,. o o^j.j.oj?i./»' i_ Fig. 1. — " Adamson " Joint.~~

~~tions from 3 feet to 3 feet 6 inches long, each from one plate, the seam being sometimes riveted but more usually welded. The rings are flanged outwards at the ends, and are connected together by "Adamson" joints (Fig. 1). It will be seen that these joints do not expose any rivets or double thickness of plate to the action of the fire, and they serve also as strengthening rings to prevent collapse of the fur- nace. In such boilers the long flues beyond the fire- bridge form combustion-chambers in which the~~

~~furnace gases may be completely burned. The amount of heat- absorbing surface provided in proportion to the grate surface is not so large as in some types of tubular boilers ; and, although they are regarded as fairly economical, they do not give such good results as are obtained with some more complicated forms. The space occupied by them, and their weight in proportion to the power developed, are both large ; but their design is one which affords great facilities for easy inspection and cleaning of all the vital parts. The great amount of water they contain, and the large area of the water-level, provide a considerable reservoir of energy for fluctuations of power or of firing, and a reserve of water for variations of the feed supply. These reasons lead to their employment in situations where the feed- water is impure or very skilled attention is not available, and where in addition space and weight are not very im- portant considerations.~~

~~In some large works water-tube boilers axe used. Two types of these boilers will be described.~~

~~The " Bahcook and Wilcox " boiler, illustrated in Fig. 2 , consists of a horizontal cylinder forming a steam-chest, having dished ends and two specially constructed cross-boxes riveted to the bottom. Under the cylinder is placed a sloping nest of " Babcock tubes, under the upper end of which is the Are. The f^^™ ,, sides and back of the boiler are enclosed in brickwork ^'~~

~~up to the height of the centre of the horizontal cylinder. Suitable brickwork baffles are arranged between the tubes themselves, and between the nest of tubes and the cylinder, to ensure a proper circulation of the products of combustion. The nest of tubes consists of several separate elements, each of which is formed by a front and back header made of wrought steel of sinuous form connected by a number of tubes. The upper ends of the front headers are connected by short tubes to the front cross-box of the horizontal cylinder, the lower ends being closed. The upper ends of the back headers are connected by longer pipes to the back cross- box, and their lower ends by short pipes to a horizontal mud drum to which a blow-ofE cock and pipe are attached. The headers are furnished with holes on two opposite sides ; those on one side form the means of connexion between the headers and~~

tubes, and the others allow access for fixing the tubes in position and clean-ing. The outer holes are oval, and closed by special fittings shown

in Fig. 3, the watertiglitness of the joints heing secured by the outer cover-plates. The holes being oval, the inside fitting can be placed in position from outside, and it is so made as to cover the opening and prevent any great outrush of steam or water should the bolt break. Any desired working pressure can be pro- vided for in these boilers ; in some special cases it rises as high as

Fig. 2. — Babcock and Wilcox Water-tube Boiler fitted with Superheaters,

500 R) per square inch. Like all water-tube boilers, they require to be frequently cleaned if impure feed-water is used ; but the straightness of their tubes enables their condition to be ascertained at any time when the boiler is out of use, and any accumulation of scale to be removed. The superheaters which are sometimes fitted consist of two cross-boxes or headers placed transversely under the cylindrical drum and connected by numerous c-shaped tubes. The steam is taken by an internal pipe passing through the bottom of the drum into the upper cross-box, then through the c= tubes into the lower box, and thence to the steam-pipe. When steam is being raised the superheater is flooded with water, which is drained out through a blow-ofE pipe before communication is opened with the steam-pipe.

Another type of water-tube boiler in use for stationary purposes is the "Stirling," illustrated in Fig. 4. This boiler usually con- sists of five horizontal drums, of which the three upper H^^JlT ones form the steam space and the two lower contain ^' the water. In some cases only one lower chamber is

~~used. The lower drums are connected to each other at about the middle of their height by horizontal tubes, and to the upper drums~~

~~by numerous nearly vertical tubes which form the major por- tion of the heating-surfaces. The central upper drum is at a slightly higher level than the others, and communicates with that nearest the back of the boiler by a set of curved tubes entirely above the water-level, and with the front drum by two sets — the upper one being above, and the lower entirely below, the water-level. The whole boiler is enclosed in brickwork, into which the supporting columns and girders are built. Brickwork baffles compel the furnace-gases to take specified courses among the tubes. It will be seen that the space between the boiler front and the tubes forms a large combustion-chamber, into which pass before they enter the spaces~~

~~Fio. 8.— Handhole Fittings.~~

~~all the furnace-gases must~~

~~between the tubes ; another chamber is formed between the first and second sets of tubes. The feed-water enters the back upper drum, and must all pass dovra the third set of tubes into the lower drum before it reaches the other parts of the boiler. Thus the coldest water is always where the temperature of the furnace-gases is lowest ; and as the current through the lower drum is slight, the solid matters separated from the feed-water while its temperature is being raised have an opportunity of settling to~~

~~the bottom of this drum, where the heating is not great, and where therefore their presence will not be injurious.~~

~~Locomotive Boilers. — At the present time locomotive boilers do not differ very much, from the type illustrated in the Encyclopaedia Britannica, vol. xxii. p. 498, ex- cept that they are considerably larger and aiTanged for a higher working pressure than formerly. A pressure of 200 lb per square inch is common on the North-Eastern and London and North-Western railways, while 230 ft) per square inch is being used in some instances on the Continent and in America. One of the largest of recent engines, made for the Lancashire and Yorkshire Railway Company (illustrated in the Engineer for ITljh March 1899), has a working pressure of 175 lb per square inch, a~~

grate surface of 26 square i feet, and a total heating surface of 2052 square feet. There are 239 tubes, 2 inches in outside diameter and 16 feet long. The shell of the boiler is 4 feet 9 inches in diameter. The fire-box is of copper, and the stays of bronze set at the usual pitch of 4″ x 4”. The rest of the boiler, including the tubes, is of steel. In some of the large boilers, especially on the London and South-Westem railway, water- tubes have been fitted. These are usually about 2f inches in diameter, and are in- clined across the fire-box to facilitate the circulation of the water. They axe expanded into and beaded over the side plates of the fire-box, and the outer plates of the shell are provided with stays passing through the tubes. They considerably increase the heating surface, and are regarded as very efBcient. Experience shows that they

stand well.

^vsrsLa BUS. [^HsBak

Flu. 4. — Stirling Boiler.

Marine Boilers. — For marine work the varied conditions to be fulfilled in different classes of vessels have led to the employment of several different types of boilers. In mer- chant vessels, except in a few passenger steamers making short runs, ordinary cylindrical return-tube boilers are always used, while in war vessels and in a few passenger vessels of high speed engaged in cross-Channel services various forms of water-tube boilers are found. The great difference in the weights of these types forms the principal

reason for the adoption of the •water-tube system in war vessels. Acccording to the particulars given by Sir A. J. Durston and Mr H. J. Oram, E.N., in a paper read before the Institution of Civil Engineers in 1899, ordinary cylindrical boilers and boiler-room fittings -weigh 130 lb per indicated h.p. The similar weights of the Belleville water-tube boilers fitted in similar vessels only amount

Fig. 5. Morison Ti/pe

Fig. 8 Purres Type

fig. 6 Fox Type

Fig. 3. Bronn's Arched & Ribbed Tijpe

Fig. 7. Deighhn Type

S-

Fig. 10. Browns Cambered Secfion

to 100 lb, while the weights of various types of small tube water-tube boilers and their fittings as supplied to cruisers amount to 66 lb, and as adopted in torpedo-boat destroyers are less than 40 lb per indicated h.p.

The sketches of the ordinary cylia- drical marine boiler, both single and double ended, given in the Ency. Brit. ^ .. J . . vol. xxii. p. 499, still Cylindrical. ^^^.^^.^ represent existing

practice; but, mainly owing to the im- provements in the manufacture of steel plates, some modifications in detail have become common. Circular steel boiler- plates can now be procured up to llj feet in diameter, of thicknesses ranging from I inch to If inches ; and rect- angular plates of the same thicknesses are made of all widths up to 11 feet and of such length as will keep their weight from exceeding 7 tons. As a result, many single-ended boilers have only one plate in their length, and double-ended boilers only two; in this way some of the circular seams of rivets in the shell are avoided. Boilers are also made of larger size and for higher steam-pressures than formerly. Pres- sures up to 260 R) per square inch have been used at sea with ordinary cylin- drical boilers in some few instances, and several boilers with a diameter of 17 feet are now . successfully working at a pressure of 210 R). The furnaces used in the smaller sizes are often of the plain cylindrical type, of thicknesses up to I inch ; but for large furnaces

~~some of the corrugated or ribbed types are generally adopted. Sketches of the sec- tions of these are given in Figs. 5-10. The first three are made from plates originally rolled of a uniform thickness, the differences being only in regard to the shapes of the corrugations ; while~~

~~in the second three the plates are rolled with ribs or thickened portions at distances of 9 inches. In the more recent boilers steam-chesfB or domes are not used, sufficient steam space being provided in the cylindrical shell.~~

~~This type of boiler contains a considerable quantity of water in proportion to the heating surfaces. The thickness of the plates, and the numerous stays required to support the flat portions.~~

~~render it heavy in proportion to the evaporative power ; but ex- perience shows it to be durable, and not very expensive in upkeep. The provision of combustion-chambers, which the furnace gases must traverse, and the change of direction which they must take before entering the tubes, give an opportunity for the gases to be burned before they are cooled below the ignition-point ; and this form of boiler is therefore fairly economical under ordinary con- ditions. To these qualities of economy and durability is due its almost universal adoption in merchant steamers, where questions of weight and compactness are not so important as in war vessels. The boilers are generally worked with chimney or "natural" draught ; but forced draught is not uncommon, the Howden system being that usually adopted. In this the ashpits are closed, and the air for combustion is supplied to the fire partly through the grate- bars and partly through openings in the furnace front above the fire, having previously passed through a regenerative apparatus where it absorbs heat from the smoke, &c., leaving the ordinary boiler-tubes.~~

~~In all recent war vessels, both of the British and foreign navies, the boilers fitted are exclusively of the water-tube type. These may be divided into two distinct classes : — (1) those in which large tubes ranging from 4^ inches to 1| inches in diameter are used ; and (2) the " Express " boilers, in which the tubes are from 1 inch to 1\ inch di- ameter. The former are adopted in the larger ships, the latter in the smaller vessels which do not keep the sea for long periods, and in which the conditions of durability are not so important~~

as to outweigh the requirement of extremely high power with a minimum of weight.

The large-tube type hitherto generally used is the “Belleville ” boiler (which, however, has been adversely criticized, and was reported against by the Admiralty BoUer Committee ,,,, .. ,,, ,, in 1901). Two views of this boiler are shown in Fig. “““‘e””*- 11. It is composed of two parts, the boiler proper and the ” economizer.” Each of these consists of several sets of elements placed side by side ; those of the boiler proper are situated immediately over the flre, and those of the economizer in the uptake

Fio. 11.— Belleville Boiler.

above the boiler, the intervening space being designed to act as a combustion-chamber. Each element is constructed of a number of straight tubes connected at their ends by means of screwed joints to junction-boxes which are made of malleable cast iron. These are arranged vertically over one another, and, except in the case of the upper and lower ones at the front of the boiler, each connects the upper end of one tube with the lower

end of the next tube of the element. The boxes at the back of the boiler are all close-ended, but those at the front are provided ■with a small oval hole, opposite to each tube end, closed by an internal door with bolt and cross-bar ; the purpose of these openings is to permit the inside of the tubes to be examined and cleaned. The lower front box of each element of the boiler proper is con- nected to a horizontal cross-tube of square section, called a “feed- collector,” which extends the whole width of the boiler. When the boiler is not in use, any element can be readily disconnected and a spare one inserted. The lower part of the steam-chest is connected to the feed-collector by vertical pipes at each end of the boiler, and prolongations of these pipes below the level of the feed- collector form closed pockets for the collection of sediment. The tubes are usually made of seamless steel, although lap-welded tubes have sometimes been used. They are generally about 4^ inches in ex- ternal diameter ; the two lower rows are f inch thick,

~~the next two rows ^5 inch, and the remainder about J inch. The construction of the economizer is similar to that of the boiler proper, but the tubes are shorter and smaller, being generally about 2| inches in diameter.- The lower boxes of the economizer elements are connected to a horizontal feed-pipe which is kept supplied with water by a feed-pumping engine, and the upper boxes are connected to another horizontal pipe from which the heated feed-water is taken into the steam- chest. Both the boiler proper and the economizer are enclosed in a casing which is formed of two thicknesses of thin iron separated by non-conducting material and lined with fire-brick at the part between the fire-bar level and the lower rows of tubes. Along the front of the boiler, above the level of the firing-doors, there is a small tube having several nozzles directed across the fire- grate, and supplied with compressed air at a pressure of about 10 lb per square inch. In this way not only is additional air supplied, but the gases issuing from the fire are stirred up and mixed, their combustion being thereby facilitated be- fore they pass into the spaces between the tubes. A similar air-tube is pro- vided for the space between the boiler proper and the economizer, and further combustion of the furnace gases is found to take place in this chamber. Any water suspended in the steam is separated in a special separator fitted in the main steam-pipe, and the steam is further dried by passing through a reducing-valve which ensures a steady pressure on the engine side of the valve, notwithstanding fluctuations in the boiler. The boiler pressure is usu- ally maintained at about 50 lb per square inch in excess of that at which the engines are working, the excess forming a reservoir of energy to pro- vide for irregular firing or feeding.~~

~~Another type of large-tube boiler which has been used in the British and in other navies is the " Niclausse,"~~

~~shown in Pig. 12. It is also in use on land in several electric- light installations. It consists of a horizontal steam- chest under which is placed a number of elements arranged side by side over the fire, the whole being enclosed in an iron casing lined with fire-brick where it is exposed to the direct action of the fire. Each element consists of a header of rectangular cross-section, fitted with two rows of inclined close- ended tubes, which slope downwards towards the back of the boiler with an inclination of 6° to the horizontal. The headers are usually of malleable cast iron with~~

~~diaphragms cast in them, but sometimes steel has been employed, the bottoms being closed by a riveted steel plate, and the diaphragms also made of the same material. The headers are bolted to socket-pieces which are riveted to the bottom of the steam-chest, so that any element may be easily removed. The tube-holes are accurately bored, at an angle to suit the inclination of the tube, through the front and back of the headers and through the diaphragm, those in the header walls being slightly conical. The tubes themselves, which are formed of seamless steel, are of~~

~~peculiar construction. The lower or back ends are reduced in diameter and screwed and fitted with cap-nuts which entirely close them. The front ends are thickened by being upset, and the parts where they are to fit into the header walls and in the diaphragm are carefully turned to gauge. The upper and lower pai-ts of the tubes between these fitting portions are then cut away, the side portions only being retained, and the end is termed a " lanterne." A small water-circulating tube of thin sheet steel, fitted inside each gener- ating tube, is open at the lower end, and at the other is secured to a smaller "lanterne," which, however, only extends from the front of the header to the diaphragm. This smaller " lanterne ' ' closes the front end of the generating tube, and the whole arrangement is such that when the tubes are in place only the small inner circulating tubes communicate with the front space between the front of the~~

~~"Ni- clausse.~~

~~Fig. 12. — KiclauBse Boiler — transverse section.~~

~~header and the diaphragm, while the annular space in the generat- ing tubes around the water- circulating tubes communicates only with the space between the diaphragm and the back of the header. The steam, therefore, formed in the tubes escapes from them into this back spaee, through which it rises into the steam-chest, whilst the space in the front of the header always contains a down- current of water supplying the inner circulating tubes. The tubes are maintained in position by cross-bars, each secured by one stud- bolt screwed into the header wall, and each serving to fix two tubes. The products of combustion ascend directly from the fire amongst the tubes, and the combustion is rendered more complete by the~~

~~introduction of jets of high-pressure air immediately over the fire, as in the “Belleville ” boiler.~~

~~The “Diirr” boiler, in use in several vessels in the German navy, and in 1901 fitted for trial in two vessels of the British navy, in some respects resembles the ‘ ‘ Niclausse. ‘ ‘ The , _ „ separate headers of the latter, however, are replaced by “”’””’• one large water-chamber, and instead of the tubes being secured~~

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~~by a ” lanterne ” to two plates, they are fitted by conical joints to the inner plate only, the holes in the outer plate being closed by small round doors. The tubes are closed at the lower end, and circulation is provided for by a diaphragm in the water-chamber, and inner water-tubes as in the ” Niclausse” boiler.~~

~~The “Lagrafel-D’AUest” boilers also have large tubes. They are necessarily arranged in pairs having one combustion-chamber “Lagrafel- °°™™°o *o both. Each of a pair consists of a nearly D’AUest” liorizontal cylindrical steam-chest, connected at the ends with large flat water-chambers, between which the numerous water-tubes are fitted above the fire-level. The nests of tubes, except at the upper portion, do not extend the whole width of each of the pairs of boilers, but a space is left on the inner side of each to form a combustion-chamber. The grate-bars are placed below the tubes, and a fire-bridge is formed at the inner side of each fire, separating the grate from the combustion-chamber. On the outer side of the fires the iron casing of the boiler is pro- tected by fire-brick lining. The spaces between the tubes of the lower row, and also of the upper horizontal row, are closed by suitably-shaped tiles, and iron plates are fitted to cover the upper portion of the spaces between the outside vertical rows of tubes. The products of combustion are therefore compelled to pass over the fire, under the lower horizontal row of tubes, over the fire-bridge into the combustion-chamber, thence returning in an opposite direc- tion across all the tubes, and finally leaving the nest of tubes at its lowest part. The course of the gases thus~~

bears a marked resem- blance to that obtaining in the ordinary return-tube type of boiler.

FiQ. 18.— Baboook and Wilcox Marine Boiler— longitudinal section.

The “Babcock and Wilcox” marine boiler is in use in the American and British navies and also in several yachts and mer- ” n fc t “J^^”^* steamers. A recent example is shown in Fig. 13.

Babcock jj. consists of a horizontal cylindrical steam-chest placed Wilcox ” transversely over a group of elements beneath which is the fire. Each element consists of a front and back header connected by numerous water-tubes which have a consider- able inclination to facilitate the circulation in the boiler. The upper ends of the back headers are situated immediately under the steam-chest, and are connected to it by short nipples ; by a similar means they are connected at the bottom to a pipe of square section which extends across the width of the boiler. Additional con- nexions, are made by nearly vertical tubes between this cross-pipe and the bottom of the steam-chest, and also between the pipe and the feed-purifler. The front headers are connected at their upper ends, by means of long horizontal tubes, with the steam-chest, the bottom ends being closed. The headers are made of wrought steel, and except the outer pairs, which are flat on the outer portions, they are sinuous on both sides, the sinuosities fitting into one another. The tubes are If inch outside diameter, and are arranged in groups

of two, three, or four to nearly all of the sinuosities of the header, the purpose of this arrangement being to give opportunities for the furnace gases to become well mixed together, and to ensure their contact with the heating surfaces. Access for securing the tubes in the headers is provided by a hole formed on the other side of the header opposite each of the tubes, where they are grouped in threes or fours, and by one larger hole opposite each group of two tubes. The larger holes are oval, and are closed by fittings similar to those used in the land boiler (Fig. 3). The smaller holes are conical, with the larger diameter on the inside, and are closed by special conical fittings ; the conical portion and bolt are one forging, and the nut is close-ended. In case of the breakage of the bolt, the fitting would be retained in place by the steam-pressure. The feed-purifler is a small horizontal cylinder placed above and in front of the steam-chest, and

~~connected to it by a pipe which provides an uninterrupted communication between the upper parts of the two chests, so that when in use the upper part of the purifier is always fully charged with steam. The lower half of the small chest is divided into several compartments by means of diaphragm plates. The feed-water is led into the chest in the upper part at the middle of the length, and falls over a dished plate through the steam in the form of a cascade. Its temperature is thus raised nearly to the boiling-point, and most of the impurities are separated out in a solid form and deposited in the various chambers through which the water flows. The purified feed-water passes from the end divisions down the vertical pipes into the square-sectioned cross-pipe, whence it is carried into the general circulation of the boiler.~~

~~The other boilers to be described are the types, some- times called " Express " boilers, which are largely used in torpedo-boats, torpedo-boat destroyers, and in small cruisers, where the most important requirement is very high power with a very small weight of boiler. They all consist of a horizontal steam-chest in the upper part, connected by numerous small tubes of from 1 inch to 11 inch outside diameter to two or three smaller horizontal chambers placed near the fire-level. The tubes are always made of seamless steel, and are usually galvanized on the outside by an electrical process.~~

~~In the "Normand" boiler (Fig. 14) both the upper and lower chambers are considerably longer than the fire-grate, and are con- nected by large pipes at each end of the boiler, out- „„ „ side the action of the fire, which serve as downcasts "O""" and facilitate the circulation of water. The heating-tubes are all bent to the forms shown in the cross-section ; the outer rows usu- ally enter the steam-chest at about the water-line, and the others lower down. The two inner rows on each side, for a part of the length of the fire-grate, touch one another along nearly all their length, and are separated only at their ends, where they have to enter the horizontal chambers through separate holes. Arranged thus they form "water- walls." The two outer rows on each side are similarly arranged along the whole length of the boiler, and protect its outer casing from the action of the fire. These water- walls direct the flow of the products of combustion amongst all the heating-tubes. The~~

ends of the casing, between the tubes and the fire-grate, are protected by fire-brick linings.

In the " Yarrow " boiler, which is shown in cross-section in Fig. 15, the tubes are all straight, and there are no water-walls. The products of combustion pass across all the tubes the „ „

whole length of the boiler. The outer casings are '"'"'"'o^- made of double thickness, with an air-space between them. Out- side circulating pipes, similar to those in the "Normand" boiler, are occasionally fitted, but it is often found that there is suflloient circulation without them. In the larger boilers the inner rows of tiibes are slightly larger than the others, and are arranged with wider spaces between them, and the lower chambers are made with riveted plates, access to examine the tube ends being ob- tained through manholes in the ends. In smaller boilers the lower parts of the chambers are portable, being bolted to the tube-plates. The " Blechynden" boiler bears considerable resemblance to the " Yarrow " boiler, but the heating-tubes, instead of being straight, are all slightly curved. The object is to enable any of , them to be drawn out or replaced without disturbing ^ Blecbya- the remainder, the curvature permitting them to be led ' through several small holes in the upper part of the steam-chest which are closed by ordinary doors. In the earlier type the outer rows of tubes form water- walls at their lower part to protect the outer casings ; but their upper portions, not being in contact, permit the furnace gases to pass between them. In the more recent form there are no water-walls, but a baffle is fitted between the tubes to ensure that the products of combustion take a definite course amongst them. Each lower chamber is connected to the upper

chamber by four down-pipes placed outside the casing. These are of comparatively small diameter, and are designed principally as part of the framework. There are also two larger outside circu- lating pipes at one end of the boiler.

The "Keed" boiler resembles the "Normand" in some respects,

but the tubes are longer and more curved, and there are no water- walls, the products of combustion passing between all „„ the tubes as in the “Yarrow” boiler. The tubes, in- stead of being expanded into the plates of the chambers, are fitted at each end with specially designed screw and nut connexions,

SECTION ON C C. i SECTION ON B B A

Fig. 14. — ^Normand Boiler.

- Thoray’ croft”

which enable them to be quickly taken out and replaced in case of need. The tubes are somewhat reduced in diameter at their lower ends, enabling the lower connexions to be smaller than the upper, and thus permitting smaller lower chambers to be used. Access to the lower tube connexions is obtained by means of numerous doors

arranged along the lower chambers. Outside circu- lating pipes are provided at each end as in the “Nor- mand” boiler.

Mr J. I. Thomycroft has introduced two types of water-tube boiler, both of which have been largely used. One, generally known as the ” Speedy ” boil- er, has only one fire-grate ; the other, known as the “Daring” boiler, has two. In both types there is one large steam and water upper cylinder ; while the “Speedy ” boiler has two, and the ‘ ‘ Daring’ ‘ boiler three, lower cham- bers, which in each case are connected to the upper chamber by outside circu- lating tubes as well as by the numerous small heat- ing-tubes. The rows of tubes nearest the fire form water-walls, except near their lower ends, while the other rows form water- walls except near their upper ends ; the intervening spaces act as flues through which the furnace gases must pass on their way from the fire to the chimney. The peculiar feature of these boilers is that all the heating-tubes discharge into the steam-space above the water-line, whereas in all the other boUers they enter below the water-level.

All the small-tube boilers described are’ -worked with strong forced draught when full power is desired, the air-pressure employed sometimes exceeding 4 inches of water-column. Owing to the rapidity with which the

~~products of combustion are hurried amongst the tubes, where no further combustion can take place, if some of the gases are not completely burned, only part of their heat can be given up; for instance, in a "Yarrow" boiler working at full power, the time taken for the products of combustioii to pass across all the tubes is~~

~~Fia. 15. — yarrow Boiler.~~

~~less than one quarter of a second, very high rates of working these~~

~~It follows that at boilers cannot be economical in coal consumption, and it is only their extreme lightness in proportion to the power they yield that determines their suitability for the special purposes for which they are employed. (j. t. mi.)~~

~~Boise, capital of Ada county and of the state, Idaho, U.S.A., in the valley of Boise river, in 43° 37′ N. lat. and 116° 12′ W. long. Its houses are in great part heated by water brought in pipes from hot springs situated about 2 miles from the town. Here terminates a branch of the Oregon short line railway from Nampa. Boise is a supply-poiat for miners in the neighbouring mountains. Population (1880), 1899; (1900), 6967.~~

~~Bois-le-Duc, 'S Hektogenbosch or 'S Bosch, the capital of the province of North Brabant, Holland, , 28 miles S.S.E. of Utrecht, at the confluence of the Uommel and Aa. It is the market of the fertile Meiery district, and does considerable trade with Dordrecht and Eotterdam, Nimeguen and Arnheim, Maestricht and Lifege. The industrial features include cigar factories. A new station was built in 1894. In the same year the seminary for teacher^ ceased to exist. In the provincial museum are interesting Eoman and German antiquities. Population, 30,517,~~

~~Boissier, Marie Louis Gaston (1823),~~

~~French classical critic, and secretary of the French Acad- emy, was born at Nimes on the 16th August 1823. The Roman monuments of the place of his birth very early attracted his attention, and drew him insensibly to the study of ancient history. He made epigraphy his par- ticular theme, and, whUe stiU a youth, became a teacher of rhetoric in his native town. In 1846 M.~~

~~Gaston Boissier was appointed professor of that science at Angoulgme, where he lived and worked for ten years without further ambition. A travelling inspector of the university, how- ever, passing through Angoulgme, happened to hear him lecture, and M. Boissier was called to Paris to be professor at the Lyc€e Charlemagne. It was only in mature years that he began to be an author. The Academic des Inscriptions offered, in 1859, a prize for an essay on Terentius Varro. M. Gaston Boissier was induced~~

~~to compete, and lie composed a monograpt which was in- stantly recognized as a masterpiece, not only of learning, but of grace. In 1861 lie received the responsible appoint- ment of prof essor of Latin oratory at the College de France, and he became a pillar of the Revue des Deux Mondes. In 1866 he published what remains the most popular of his works, Ciciron et ses Amis, which has enjoyed a success such as rarely falls to the lot of a work of erudition and research. In studying the manners of ancient Rome M. Gaston Boissier had learned to recreate its society, and to reproduce its characteristics with the most exquisite vivacity. His next work of importance was L' Opposition sous les C6sars, in which he drew a remarkable picture of the political decadence of Rome under the early successors of Augustus, and showed by an examination of the state of feeling in the successive strata of Roman society how low the sentiment of republican liberty had sunk. In 1875 M. Boissier published La Religion Romaine d'Auguste aux Antonins, in which he analysed the elements which produced the great religious movement of antiquity that preceded the acceptance of Christianity. Through so many solid contributions to literature, M. Boissier had by this time drawn to himself the universal respect of scholars and men of letters, nor did he lack admirers in the polite world. He was manifestly destined for the French Academy, and on the death of Patin, in 1876, he was appropriately elected to fill the vacant place. He was received on the 21st of December 1876 by M. Ernest Legouv^ and his reply — ^his discours de riception — is a finished essay on the study of ancient society in the literatures of Greece and Rome. In 1880 M. Gaston~~

~~Boissier published Promenades archSologiques : Rome et Pompei, of which a second series appeared in 1886. In 1895, on the death of Camille Doucet, he was elected to succeed him as perpetual secretary to the French Academy. M. Boissier is a representative example of thft French talent for lucidity and elegance applied with entire seriousness to weighty matters of literature. He is a scholar of the highest attainments, but his learning seems cast about his shoulders with the elegance and decorum of a toga about those of a Roman senator. M. Boissier has not written very much, and he has never strayed from his single theme, the reconstruction of the elements of Roman society.~~

~~Boito, Arrigo (1842), Italian poet and~~

~~musical composer, was born at Padua on the 24th February 1842. He studied music at the Milan Con- servatoire, but even in those early days he devoted as much of his time to literature as to music, forecasting the divided allegiance which was to be the chief characteristic of his life's history. While at the Conservatoire he wrote and composed, in collaboration with Franco Faccio, a cantata, Le Sorelle d'Italia, which was performed with success but has never been published. On completing his studies Boito travelled for some years, and after his return to Italy settled down in Milan, dividing his time between journalism and music. In 1866 he fought under Garibaldi, and in 1868 conducted the first performance of his opera Meflstofele at the Scala Theatre, Milan. The work failed completely, and was withdrawn after a second performance. It was revived in 1876 at Bologna in a much altered and abbreviated form, when its success was beyond question. It was performed in London in 1880 with success, but in spite of frequent revivals has never succeeded in firmly establishing itself in popular favour. Boito treats the Faust legend in a wider spirit than Gounod, but, in spite of many isolated beauties, his opera lacks cohesion and dramatic interest. Since writing Mefistofele Boito has produced no musical •work of any importance, although he was said to be at work~~

~~in 1901 upon an opera on the subject of Nero, the libretto of which has already been published. His energies have been chiefly devoted to the composition of libretti, of which the principal are Otello and Falstaff, set to music by Verdi; La Gioconda, setbyPonchielli ; Jlwi^eto, set by Faccio; and~~

~~Ero e Leandre, set by Bottesini and Mancinelli. These works display a rare knowledge of the requirements of dramatic poetry, together with uncommon literary value. Boito has also published a book of poems and a novel, L'Alfier Meno. The degree of Doctor of Music was conferred upon him in 1893 by the University of Cam- bridge.~~

~~Bokhara, or Bukhara, a khanate of Central Asia, now in a state of vassalage to Russia. It occupies a broad strip of land on the right bank of the middle Amu-daria, between 37° and 41° N., 62° and 72° E., and is limited by the Russian Turkestan provinces of Amu-daria, Samarkand, and Fergana in the N.E., the Russian Pamir in the E., Afghanistan in the S., and the Russian Transcaspian territory and Khiva in the W. Its south-eastern frontier on the Pamirs is quite undetermined except where it touches the Russian dominions, there being a mountainous unpopulated territory which is visited alternatively by nearly quite independent Kir- ghiz and by Afghan patrols. With the khanates of Karateghin and Darvaz, as also those of Roshan and Shugnan, the area would be about 95,650 square miles ; without the two latter, which have fallen xmder Afghan influence, about 76,600 square miles.~~

~~Bokhara may be divided into three parts. The ■western part, crossed now by the railway, is a plain, watered by the Zerafshan and by countless irrigation canals drawn from it. It has in the east the Karnak-chul prairie, covered with grass in early summer only, and in the north an intrusion of the Kara-kum sand desert. Land suitable for culture is only found in oases, where it is covered with irrigation canals, but these oases are very fertile. The cotton and mulberry trees are cultivated, as also all sorts of com, including rice and the vine. The middle portion is occupied by high plains, about 4000 feet in altitude, slQping from the Tian Shan, and inter- sected by numerous rivers (Surkhan, Kafimagan, Waksh, and many smaller ones) flowing towards the Amu. This region, very fertile in the valleys and enjoying a cooler and damper climate than the lower plains', is densely populated, and agriculture and cattle-breeding are carried on extensively. Here are the towns of Karshi, Kitab, Shaar, Chirakchi, and Guzar. As to the eastern portion , it is covered with high mountains and plateaus.~~

~~The Hissar range, which separates the Zerafshan from the large tributaries of the Amu — the Surkhan, Kafimagan, and Vaksh (Surkhab) — is generally represented as running west to east, and ending in the west by the group Hazret^sultan ; but it may perhaps be continued in reality to the south-west, ending in the Haja Mahmud mountains. In the east it is continued by the Alai mountains. Its length is about 200 miles, and its passes, lying from 1000 to 3000 feet below the surrounding peaks, are at altitudes of from 12,000 to 14,000 feet. The highest peaks are at the head-waters of the Yagnob (Great and Small Barzenghi, RostovtseH's pass), where large glaciers are found. Numerous spurs run from it to the south and south-west, and there seems to exist a parallel range, Zigdi. Granites, gneisses, diabases, various porphyries, as also mica, clay, and silica, slates, limestones, conglomerates, and sandstones, enter into its composition. Numbers of rivers pierce or flow in wild gorges between its spurs. Its southern foot-hills, covered with loess, make the fertile valleys of Hissar and the Vaksh. The climate is so dry, and the rains are so scarce, that an absence of forests and Alpine meadows is characteristic of the ridge ; but when great rain comes during the melting of the snow in the mountains, the devastations of the torrents are terrible. The main glaciers (12) are on the north slope, at the sources of the Yagnob and the Namrut ; but none of them creeps below the 10,000 to 12,000 feet level. The passes across this ridge are extremely difficult.~~

~~The Peter the Great range, or Periokh-tau, in Karateghin, south of the valley of the Vaksh, runs west-sputh-west to east-north- east for about 130 miles, and is still higher; It is pierced in its south-west part by the Obi-khingou. From the meridian of Garm it rises above the snow-line, attaining at least 18,000 feet in the Sary-kaudal peakj and 20,000 feet farther east where it joins the snow-clad Darvaz range, and where the group Sandal, adornefl~~

~~with several glaciers, rises to 24,000 or 25,000 feet. Only three passes, very difficult, are known through it.~~

~~The bekdom of Darvaz, vassal to Bokhara, is situated on both sides of the Panj, near its sharp bend westwards, and is limited in the south by the Badakshan (Pamir), and on the west by Baljeran and Kulab, both belonging to Bokhara. It is covered with high mountains, and only in the lower parts of the valleys is agriculture possible. The population, about 35,000, consists chiefly of Moslem Tajiks (Galcha), and its chief tovra is at Kala-i-khum on the Panj, at an altitude of 4370 feet. Finally, the Roshan, another bekdom vassal to Bokhara, is on the Pamir. Its population (also Tajiks) is estimated at 5000 families, and its chief town is Kala-i-Vamar, at the junction of the Murghab with the Panj.~~

~~The chief river of the khanate is the Amu, which waters its eastern portion, and flows along its south-west border, attaining at the spot where it is spanned by the railway bridge the width of IJ mile ; it is navigated from the mouth of the Surkham, and steamboats ply on it up to Kerki. Of its tributaries, the Zerafshan, the water of which is largely utilized for irrigation (43 main canals, having an aggregate length of 660 miles, are drawn from it), is lost in the sands 20 miles before reaching the Amu. Of the other right- bank tributaries of the Amu — the Surkhan, Kafirnagan, Vaksh, Alisu, &c. — only the flrst-named is navigated to some extent. Finally, the Kashka-daria, which flows westwards out of the glaciers of Hazret-sultan, supplies the Shahri-sabs (properly Shaar-sabiz) oasis with water, but is lost in the desert to the west of Karshi.~~

~~The climate of Bokhara is extreme. In the lowlands a very hot summer is followed by a short but cold winter, during which a frost of —20° Fahr. may set in, and the Amu may freeze for a couple of weeks. In the highlands this hot and dry summer is followed by four months of winter ; and, finally, in the regions above the 8000-feet level, one sees a great development of snow- fields and glaciers ; the passes are buried under snow, and the short summer is rainy. The lowlands are sometimes visited by terrible sandstorms from the west, which exhaust men and kill the cotton trees. Malaria is widely spread, and in some years, after a wet spring, takes a malignant character.~~

~~The population is estimated at from 2,000,000 to perhaps 2,500,000. About 300,000 live on the lower Zerafshan, 500,000 in the Shaar-sabiz and its~~

~~neighbourhood ; 200,000 in the Hissar region, and about 500,000 on the Amu. Another 500,000 may be scattered in the highlands. The population is of both Turkish and Iranian origin. The dominant nationality are the Uzbegs, who are fanatic Moslem Sunnites, despise work and their Iranian subjects, and maintain their old division into tribes or kins. The Turkomans (chiefly Ersaris) and the Kirghiz are also of Turkish origin ; while the Sarts, who constitute the bulk of the population in towns, are a mixture of Turks with Iranians. The great bulk of the population in the country is composed of Iranian Tajiks, who are Sunnites by name and Shiites in reality. Afghans, Persians, Jews, Arabs, Armenians, &o., must be added to the above. Nearly 20 per cent, of the population are nomads and about 15 per cent, half-nomads.~~

~~On the irrigated lowlands rice, wheat, and other corn are grown, sufficient to be exported to the highlands, and only a small quantity is imported from Russian Turkestan. Cotton is widely grown and exported (500,000 cvrts.). The silkworm culture is, however, of late years in decay. Cattle-breeding is widely spread in Hissar and the highlands generally. Cotton, silks, woollen cloth, and felt are largely fabricated, also boots, saddles, hardware, pottery, and various oils. Salt, as also some iron and copper, and small quantities of gold are extracted. The internal and the ex- ternal trade are both very animated. The exports to Russia (raw cotton, raw silk, lamb-skins, carpets, &c.) attain the value of £1,200,000, and the imports of manufactured goods, sugar, &c., attain jei,000,000. The imports from India (cottons, tea, shawls, indigo) reach £560,000 and from Persia about £50,000, while the exports are £50,000 and £200,000 respectively. There are very few roads in Bokhara, the goods being transported on camels, or on horses and donkeys in the hilly tracts. The main caravan roads radiate from Bokhara to Baljeran, vi9. Karshi, Guzar, and Hissar ; to Balkh ; to Meimene, vici Kerki ; and to Samarkand, viS Jam. The Transcaspian railway crosses the khanate on a length of 268 miles.~~

~~The emir of Bokhara is an autocratic ruler who governs according to the laws of the Shariat (common law). His troops consist of a regular army and a militia, to which the general militia (hazawat) must be added in time of war. There are 14,000 infantry, 14,000 cavalry, and 20 guns. The chief~~

~~towns of the khanate are : — Bokhara, Karshi (about 35,000 inhabitants), and Charjui.~~

~~(p. A. K.)~~

~~Bokhara (Bokhara-i-sherif), capital of the above khanate, is situated on the left bank of the Zerafshan, on the irrigation canal Shahri-rud, in a fertile plain dotted with villages. It is 8 miles from the Bokhara station of~~

~~the Transcaspian railway, 165 miles by rail W. of Samar- kand, 39° 47′ N. lat. and 64° 27′ E. long. ; alt. 640 feet. The city is surrounded by a stone wall 28 feet high and 8 miles long, having 131 half-circular towers and 11 gates of little value as a defence. It was begun in 830, de- stroyed by Chenghiz-khan, and rebuilt subsequently. The water-supply is very unhealthy. The city has no less than 360 mosques and as many streets, nearly 40 caravan- serais, and 60 market-places. Nearly 10,000 pupils receive education in its 103 medresses ; primary schools (mehtebs) are kept at most mosques. Of its numerous squares the Eaghistan is the principal. It has on one side the citadel erected on an artificially made eminence about 40 feet high, surrounded by a wall one mile long, and containing the palace of the emir, the houses of the chief functionaries, the prison, and the water-cisterns. The houses are mostly one-storeyed and built in un- burned bricks. Some of the medresses and mosques are of a very fine architecture. Of the former the most notable is the Mir-arab-i-Zariryan, with its beautiful lecture-halls ; the chief mosque of the emir is the M^jidi- kalyan, or Kok-humbez, close by which stands the brick minaret, 203 feet high, from the top of which the state criminals used to be thrown up to 1871.~~

~~From a remote antiquity Bokhara was a centre of pagan learning and worship. It retained the same position when it become Mussulman, only having a rival in Samarkand, under Timur. And while other cities, like Balkh, Merv, and Samarl^and, lost their educational and religious importance with the fall of their political power, Bokhara has fully retained it up till now. The Bokhara learned Mussulmans took a lively part in the collection of the holy traditions about the prophet, iind later in the compilation of the books which systematized his teachings. The mysticism which took hold on Persia in the Middle Ages, also spread at Bokhara, and later, when the Mongol invasions laid waste Samarkand and other Moslem~~

~~cities, Bokhara, remaining independent, con- tinued to be the seat of learning. It is still the main stronghold of Islam and a centre of Mussulman learning for all the Russian dominions. Its book-market is small, and contains nothing but the current text-books, written, lithographed, or printed in India, Persia, or Kazan ; the medresse libraries, too, some of which were very rich, have been scattered and lost, or confiscated by emirs, or have perished in conflagrations. But there are still treasures of literature concealed in private libraries, and Afghan, Persian, Armenian, and Turkish bibliophiles come continually to Bokhara to buy rare historical, geographical, medical and other books. Besides, owing to the custom existing among learned men to bequeath their libraries to the emir, his library is said to be very rich. As a whole, Bokhara is thus the chief book-market of Central Asia. The population is estimated variously, but is supposed by Russian travellers not to exceed 50,000 or 60,000. For its trade, interior and exterior, Bokhara is the chief city of all Central Asia.~~

~~New Bokhara, or Itussian Bokhara, a Russian town near the railway station, is rapidly growing on a territory conceded by the emir. Population, 2000. (p. a. K.)~~

~~Bolgrad, a town of South Eussia, government of Bessarabia district, and 30 miles E. of IzmaLl. It was founded at the beginning of the 19th century as a colony of Bulgarians. It has now a population of 12,390, gymnasia for boys and for girls, and is a depot for trade in corn.~~

~~Boli, the chief town of a sanjak of the Kastamuni viMyet in Asia Minor, altitude 2500 feet, situated in a rich plain watered by the Boli Su, a tributary of the Piliyas Chai (Billaeus). Three miles east of Boli, at Eskihissar, are the ruins of Bithynium, the birthplace of Antinous, also called Antinoopolis, and Claudiopolis. At Ilija, south of the town, are warm springs much prized for their medicinal properties. Population, 10,800 (Moslems, 9600 ; Christians, 1200).~~

~~Bolivar, a department of the republic of Colombia, bounded on the N. by the Caribbean Sea, on the S. by the department of Antioquia, on the E. by Magdalena and Santander, and on the W. by Cauca and the Caribbean Sea. Area, 27,000 square miles. Population, 325,000,~~

mostly white. The capital, Cartagena, has 11,000 inhabit- ants, and the principal towns include Mom pox, Chinu, Sabanalarga, Barranquilla, at the mouth of the Magdalena, Soledad, Magangue, Corozal.

Bolivia, a country of South America extending from 10° to 23° S. lat., and from 58° to 70° W. long., bounded on the N. by Brazil, on the E. by Brazil and Paraguay, on the S. by the Argentine Eepublic, and on the W. by Chile and Peru. In the course of the war of 1879-83 with Chile, Bolivia lost her maritime provinces, and by the treaty of 4th April 1884 agreed provisionally to a new boundary. According to this

Bound- aries.

B. VMarbisUri Gt Q.J.K.Hmitrlk

Jh%flUK Milt*

Sesiou Map of Bolitia.

treaty, the western frontier of Bolivia, starting from Sapalegui, the point where the Chilian, Argentine, and Bolivian boundaries meet, runs in a straight line to the Licancaur volcano, and thence straight to the southern source of the waters of Lake Ascotan, whence in another straight line it passes lengthwise over the lake and is continued to Ollagua volcano, from which it goes direct to Tua volcano, and joins the recognized eastern boundary of the department of Tarapaca. A prelimi- nary treaty of 10th April 1886 provides rules for the demarcation of the frontier towards Peru. The de facto boundary runs from Tacora mountain across the sources of the Maure to Lake Titicaca ; crosses the lake from the point of outflow of the Desaguadero to Huaicho on the northern side, runs to the sources of the valley of the San Juan Del Oro, passes down the valley and down the

Inambary to its confluence with the Madre de Dios, whence it runs in a straight line to the sources of the Yavary in 7° 1′ 17″ S. lat, there uniting

~~with the Brazilian frontier, decided by treaty of 1867. The frontier towards Paraguay is still under dispute. An unratified treaty of 23rd November 1894 places the boundary in a straight line drawn due west across the Gran Chaco from a point on the Paraguay river, three leagues north of Puerto Olimpo, to a point where the principal channel of the Pilcomayo is intersected by the meridian of 61° 28″ W. long.~~

~~Mountains. — The mountains of Bolivia may be boldly grouped~~

~~into two main divisions, the western and the eastern Cor- dilleras. The western Cor- dillera consists of two or more parallel and associated ranges, whereof the lowest or Coast Cordillera does not exceed 5000 feet in altitude. Farther inland the mountains are higher till the main western Cordillera, to which some would confine the name Andes, is reached. This is a volcanic range, averaging about 15,000 feet in height, and contains some volcanoes not yet extinct. Mount Sajama is its highest measured peak (21,044 feet, Pissis ; 21,559 feet, Reck). The eastern Cordillera or Cor- dillera Real branches from the western or Cordillera de los Andes about 24° S. lat. and making a bend to the east reunites with that range in 14° 40′ S. lat. Its three chief peaks are Mount Sorata, cul- minating iu two peaks, Anco- huma or Hankuma (21,286 feet, Pentland; 21,710 feet, Conway), and lUampu (200 feet lower than Anoohuma) ; Caca-aca, wrongly called Huaina Potosi, (20,170′ feet, Minchin ; 20,560 feet, Conway) ; and Ulimani (21,355 feet, Pissis ; 21,015 feet, Conway). Between Mount Sorata in the north and Ulimani in the south, a distance of about 64 miles, this range is almost continuously snow-clad and bears a number of large glaciers, though south of Caca-aca are several broad de- pressions below the snow-level. The mean summer snow-line lies at about 17,000 feet. The range is cut through south of Ulimani by the valley of the La Paz, and north of Mount Sorata by the Mapiri, both rivers drain- ing portions of the west slope of the range. Across the high part of the range between these valleys are several passes traversed by mule-paths or over which mule-paths could be easily made. Between the two main ranges lies the high plateau, a plain at an average altitude of about 12,500 feet. Various minor hills, called Serrania, rise out of this plain. It also includes Lakes Titicaca and Poop6, and the Rio Desaguadero which connects them. Eastwards the Cordillera Real falls rapidly to a mean level of about 3000 feet, which slopes away to the great~~

~~central continental plain. The rapidly falling eastern slope is cut up into deep valleys or quebradas, called las Yungas, wnich are richly forested and include areas of great fertility. In the south the extension of the Argentine railway system to Jujuy has opened up the country, but the Beni district is still shut out from easy eastward communication by the rapids of the Madeira. But an almost level road might easily be cut through the forest from the navigable upper part of the Madre de Dios to the Rio Aquiry, in about 69° W. long., whereby the cataracts would be avoided. The rivers could also be united by a canal.~~

~~Climate. — The high plateau is subject to a rainy season which~~

~~begins in November or December and continues till April or May. During this time immense quantities of snow fall on the high mountains and violent thunderstorms rage over the Puna. In the winter months, May, June, and July, the weather is of almost unbroken clearness with strong cold winds. In August, September, and October the weather begins to break and showers fall occasion- ally. The eastern valleys near the mountains share in this succes- sion of seasons to a less marked degree.~~

~~Geology. — The best account of the geology of Bolivia is that of Mr David Forbes (Quarterly Journal of the Geological Society, February 1861). The mass of the Cordillera Real consists of granite, diorite, and crystalline schists, with Silurian and Devonian rocks farther west. Small basin-shaped Carboniferous deposits appear at intervals farther west from Titicaca to Oruro and in the department of Santa Cruz. The Permian formation comes next to the west, and is largely developed and very rich in mineral deposits. The coast region is formed of deposits belonging to the Upper Oolitic system. The chief region of volcanic activity is the line of the western Cordillera, though a bed of trachytic tuff is found near La Paz, and some andesite has been observed on the flank of Illimani. The high plateau is covered by recent alluvial deposits, 1500 feet thick near La Paz, which mark the site of a great inland sea, whereof Titicaca and Poopd are the disappearing remnants. It is probable that the whole of the high region of Bolivia has risen in recent geological times, and it is perhaps still rising.~~

~~Area and Population. — The area of Bolivia (exclusive of the maritime provinces and Atacama) extends to 734,340 square miles. No complete census of the republic has ever been carried out, but the population is officially estimated at 2,313,750. The area and population of the eight departments and of the two territories of the republic are given as follows : —~~

~~Departments and Territories.~~

~~Area. Square Miles.~~

~~Population.~~

~~Population per square mile.~~

~~Chuquisaca .~~

~~La Paz~~

~~Cochabamba~~

~~Potosi. . ...~~

~~Oruro ....~~

~~Tarija ....~~

~~Santa Cruz .~~

~~Beni ....~~

~~Madre de Dios, Ter. .~~

~~Purus, Ter. .~~

~~Total .~~

~~39,870~~

~~171,080~~

~~21,420~~

~~52,090~~

~~21,330~~

~~34,600~~

~~87,700~~

~~100,550~~

~~13,600~~

~~192,200~~

~~260,000~~

~~673,750~~

~~485,900~~

~~365,600~~

~~230,600~~

~~94,900~~

~~210,800~~

~~38,700~~

~~18,600~~

~~45,000~~

~~6 3~~

~~23 7~~

~~11 3 2~~

~~ɨ~~

~~734,340~~

~~2,313,750~~

~~3~~

~~Oorera- ment~~

~~Of the population 79,000 are whites and 299,600 of mixed Euro- pean and Indian blood. The rest of the inhabitants are Indians, most of whom are semi-civilized, the number of ■uncivilized being estimated at over 240,000. The principal towns of Bolivia are La Paz, the capital, with 62,000 inhabitants ; Cochabamba, 29,500 ; Sucre, 27,000 ; Potosi, 16,000 ; ftruro, 16,000 ; Santa Cruz, 12,000 ; Tarija, 12,000. Formerly the seat of government passed in rotation to each of four towns ; in 1898 a law was passed making Sucre perpetual capital ; La Paz protested, claiming the dignity for itself, and, after a brief war and a change of government, prevailed.~~

~~According to the constitution established by a National Convention in 1880, Bolivia is a republic, with a repre- sentative and democratic form of government. The legislative power resides in a National Congress of two chambers, one of senators, the other of deputies. The Senate consists of sixteen mem- bers (two for each department) chosen for six years, of whom one-third retire every two years. Senators must be at least thirty-five years of age, and have an annual income of not less than 800 bolivianos. The Chamber of Deputies contains sixty-nine members chosen for four years, of whom one-half are removable every two years. Deputies must be at least twenty-five years of age, and have an annual income of not less than 400 bolivianos. Both senators and deputies are elected by direct suffrage, but electors must possess real property, or an annual income of not less than 200 bolivianos. Congress meets annually on 6th August for a session of at least sixty days. The executive power is vested in a president chosen for four years by direct and secret popular vote. He is not eligible for the succeeding presidential term. He has power to make treaties, subject to ratification by Congress ; he is at the head of the military forces ; may convoke Congress for extraordinary sessions ; and has~~

~~rights of patronage both in Church and State. He is. assisted by two vice-presidents elected in the same man- ner and for the same period, and by a cabinet of five ministers appointed by himself as heads of departments, of government. These ministries are — foreign affairs and worship, government and fomento, finance and industry, justice and public instruction, war and colonization.~~

~~Local Government. — At the head of each of the eight depart- ments into which Bolivia is divided is a prefect appointed by the president and removable at his pleasure. The provinces are governed by sub-prefects, the cantons by justices (^corregidores), and the country districts by alcaldes. The capital of each department has a municipal council ; there are administrative boards in the pro- vincial capitals, and cantonal agents in the villages. The duties of the municipal authorities relate to public works, municipal taxation, instruction, police, charity, and other matters. The two territories formed in 1890 are controlled by officials called national delegates.~~

~~Justice. — Justice is administered by a supreme court in the capital, by district courts in the departmental capitals, and by inferior tribunals of several grades.~~

~~Education. — Primary instruction is gratuitous and obligatory, and is under the care of the municipal authorities. In 1899 there were 692 primary schools, with 1020 teachers and 36,418 pupils. Among these are included about seventy schools for rural Indians taught by parish priests, and about 140 mission schools. The sum spent annually by the municipalities on primary education amounts- to 140,000 bolivianos (£12,720). Secondary education is given in eight colleges, four seminaries, one religious college, and four pri- vate lycees. In 1899 there were 115 secondary teachers and 2321 pupils. At Sucre and La Paz there are schools of arts and trades conducted by the Salesian friars ; at Sucre there is, besides, a com- mercial school, and at La Paz a military college. Higher education is given in six universities, at four of which medical science is taught. In 1898 the number of students was 2221. The theological faculty, including the seminaries, had 110 students in 1899.~~

~~Defence. — ^By laws of 1875 and 1880, every Bolivian citizen fit for service is a soldier, and is required to serve under the colours for two years, but the clergy are exempt, as are also certain others for special reasons. The military force consists of (a) troops of the line, numbering, in 1899, 2560, organized in two battalions of infantry, two regiments of cavalry, two regiments of artillery, and garrison troops distributed among the departments ; (6) the reserves, composed of depot corps, with 30,000 men~~

~~from twenty to twenty- five years of age ; the ordinary and extraordinary reserve, with 40,000 men from twenty-five to forty years of age ; and the terri- torial guard, with 10,000 men from forty to fifty years of age. The total combatant force thus amounts to 82,560.~~

~~Finance. — The public revenues collected within the republic are divided into national, departmental, and municipal. The first and second are applied to the ordinary expenses of government ; the third, to those of the municipalities. The national revenue is derived mainly from customs, monopolies, and taxes on the pro- duction and export of minerals and of rubber, while the depart- mental revenues are mainly the proceeds of taxes on land, paid by natives, on inheritances and" legacies, on deeds, and on cattle im- ports and exports. The expenditure passes through the various government ministries. The national and departmental revenues for 1895-99, officially stated in silver bolivianos, are given in the sub- joined table converted into sterling at the rate of eleven bolivianos to the £. No corresponding statement of expenditure is accessible.~~

~~Eevenue, |~~

~~Tears~~

~~National.~~

~~Departmental.~~

~~1896~~

~~£374,120~~

~~£136,140~~

~~1896~~

~~430,870~~

~~142,320~~

~~1897~~

~~606,800~~

~~164,220~~

~~1898~~

~~472,180~~

~~164,220~~

~~1899~~

~~539,910~~

~~169,610~~

~~For 1900 the national revenue and expenditure (at the same rate of exchange) were estimated as follows : —~~

~~Sources of Eevenue.~~

~~Eevenue.~~

~~Branches of Expenditure.~~

~~Expenditure.~~

~~Customs~~

~~Spirit monopolies . Silver . Rubber~~

~~Tin, copper, bis- muth . Various~~

~~Total~~

~~£335,420~~

~~138,170~~

~~64,540~~

~~45,460~~

~~23,630~~

~~69,210~~

~~Legislative . Foreign affairs, &c. Government, &c. . Finance, &o. . Justice, instruc- tion War, colonization~~

~~Total~~

~~£16,000~~

~~67,680~~

~~127,300~~

~~242,990~~

~~36,640~~

~~241,360~~

~~£666,420~~

~~£720,860~~

~~BOLIVIA~~

~~291~~

~~For 1900 the total departmental revenue was estimated at £179,540, and the total municipal at £140,960. The internal debt recognized by the State amounted in 1899 to 3,934,250 bolivianos (£356,620). This amount included accumulated deficits, 1,564,226 bolivianos (£142,190), and war loans, 763,390 bolivianos (£69,390). The external debt, which originally amounted to 6,550,830 boli- vianos, was due to Chilians as indemnity for their losses in the war of 1879-83. At the end of 1899 the outstanding amount was 881,910 bolivianos (£80,170).~~

~~Agriculture. — The most important vegetable product of Bolivia is rubber, which grows abundantly in the region of the upper Tahuamanu river, in the territories of Madre de Dios and Purus, in the department of La Paz, and in the region bordering on the Brazilian state of Matto Grosso. The trees are the property of the State, and any person, citizen or foreigner, may collect the gum without license, but the discoverer of trees may, by applying for a concession, obtain exclusive right to the advantages of his dis- covery. The total quantity of rubber which passed through the ports of Puerto Perez, Villa Bella, and Puerto Suarez in 1890 was 646,800 R) ; in 1895, 1,804,900 lb ; and in 1898, 6,943,100 fb. The rubber exported through MoUendo is known as " MoUendo rubber," while that sent eastwards to Brazil becomes "Para rubber." Another product which has risen into importance is coca, from which cocaine is obtained. The annual production of coca is stated to reach 10,120,000 ft, three-fourths of which grows in the province of Yungas, in the department of La Paz. In coca extraction duties the government collects about 250,000 bolivianos (£22,725) annually. Cinchona is exported in small quantities. Coffee, cocoa, and tobacco are cultivated, but are not commercially important. Besides the vicufia, llama, and alpaca, the country contains many cattle, and the cattle imports and exports are con- siderable. The use of llamas as beasts of burden is much less common than formerly, though flocks of them are still frequently met with on the roads. Donkeys and mules have taken their place. Some of the finest chinchilla skins come from Bolivia.~~

~~Minerals. — The country is rich in mineral wealth, much of which is still undeveloped. Gold is found in the gravels of most of the eastern valleys descending from the high part of the Cordillera Real, as well as in the La Paz valley and its upper eastern branches. Auriferous quartz is worked in the Araoa valley and elsewhere. The most important gold-mining enterprises are those of two com- panies in the neighbourhood of La Paz, and one in the province of Cercado in the same department. For the working of the hydraulic mines of Tipuani there are five English and four French companies. Silver-mining in the Oruro district has been greatly developed, and a great quantity of the metal has been extracted from the impor- tant mines of Pulacayo (now full of water) and Oruro. Copper is now extensively min^d at Corocpro. Tin is worked near Oruro, where large quantities of very rich ore exist, and on the west flank of Caca-aca in the~~

~~hill called Huaina Potosi. In the tin districts bismuth is produced in increasing quantities. Coal exists on an island in Lake Titicaca, and an attempt is being made to work it. Most of the nitrate fields and guano beds once Bolivian are in areas now held by Chile. The following table presents a view of the metal output during 1895-99. The quantities of gold and silver are stated in troy ounces ; thos& of copper, tin, and bismuth are given in tons, Spanish quintals being taken as equivalent to 101-6 ft av. The quantities of copper are only those obtained at Corocoro.~~

~~TeBTS.~~

~~Gold.~~

~~Silver.~~

~~Copper.~~

~~Tin.~~

~~Bismuth.~~

~~Oz.~~

~~Oz.~~

~~Tons.~~

~~Tons.~~

~~Tons.~~

~~1895~~

~~14,467~~

~~21,508,350~~

~~2487~~

~~1407~~

~~142~~

~~1896~~

~~16,075~~

~~21,058,250~~

~~3370~~

~~1360~~

~~131~~

~~1897~~

~~22,023~~

~~21,935,560~~

~~2748~~

~~2705~~

~~181~~

~~1898~~

~~17,682~~

~~10,999,800~~

~~3370~~

~~8692~~

~~272~~

~~1899~~

~~17,554~~

~~10,042,575~~

~~5192~~

~~453~~

~~Antimony, borate of lime, lead, and other minerals are produced and exported in small quantities. Apart from the working of mines and the exploitation of rubber, the industries' of Bolivia are of little account. The more important of them are distilling, brewing, and the preparation of wines ; the weaving of vicuna and alpaca cover- lets ; the manufacture of sugar, sweets, chocolate, and cigarettes. Commerce. — The value of the imports and exports in 1895-99 was as follows (conversions being made at the uniform rate of 11 bolivianos to the £): —~~

~~Tears.~~

~~Imports.~~

~~Exporte.~~

~~1895 1896 1897 1898 1899~~

~~£~~

~~1,263,270 1,177,380 1,132,360 1,081,460 1,167,150~~

~~£~~

~~1,901,100 2,004,100 1,998,930 2,495,810 2,487,550~~

~~In 1899 the imports consisted almost entirely of articles for personal or domestic use or consumption, such as cotton and woollen goods, food-stuffs and beverages, furniture and hardware, while mineral and agricultural products were exported. The mineral exports reached the value of~~

~~£1,616,400, the most important having been silver, £909,000 (10,000,000 bolivianos) ; tin, £454,500 ; bismuth, £85,450 ; and copper, £72,720. The agiicultural exports amounted to the value of £792,540, the rubber exports alone being valued at £727,200. Of the imports 16 per cent, in value came from Ger- many, 12 per cent, from Chile, 9 per cent, from Great Britain, from France, and from the United States, and 8 per cent, from Peru. Of the exports, 44 per cent, in value went to Great Britain, 34 per cent, to Germany, 7 per cent, to France, 3 per cent, to Chile, to Peru, and to the United States. Bolivia having no sea- port, its trade on the side towards the Pacific passes through the ports of MoUendo, Arica, and Antofagasta, at all of which there are Bolivian customs agencies. On the eastern side large quanti- ties of rubber are exported from Villa Bella and Puerto Suarez, and towards the Argentine Republic there is a growing export trade through Tupiza. Of the imports in 1899, 57 per cent, in value passed through Antofagasta, 19 per cent, through MoUendo, 16 per cent, through Arica, 6 per cent, through Puerto Suarez and Villa Bella together. Of the exports, 61 per cent, passed through Anto- fagasta, 5 per cent, through MoUendo, 1 per cent, through Arica, 21 per cent, through Puerto Suarez and Villa BeUa together, and 3 per cent, through Tupiza.~~

~~Boutes — Boad, Biver, Bail. — ^Bolivia is provided with a vast system of natural highways in its lakes and rivers — Lake Titicaca, with an area of 3880 square miles, being connected by the Desaguadero river with Lake Poop6, covering 2800 square miles, while throughout the country the length of rivers navigable for steam launches is estimated at 5600 miles. The national roads which traverse the republic are made and maintained by the government. Those in the upper Andes were, at great expense, constructed by Indian labour, and serve for transport by means of pack animals. The roads which connect the principal cities with neighbouring towns are in general constructed by the munici- palities. The nature of the country makes road-making difficult and costly. A reasonably good carriage-road connects the port of Chililaya, on Lake Titicaca, with La Paz, Corocoro, Sicasica, and Oruro. Braiich roads run eastward to Cochabamba and Potosi, whilst the last-mentioned towns are connected with Sucre and one another by carriage-roads. The Tacna road has ceased to be an important commercial route. The only railway that actually enters Bolivia is a narrow-gauge line from the Chilian port of Antofagasta to Oruro. It is 574 mUes in length, and~~

~~attains an altitude of 13,580 feet. The northern part of the country is most easily reached from MoUendo by the railway to Puno on Lake Titicaca (325 miles ; highest point, 14,666 feet), whence three steamboats ply to the Bolivian port of Chililaya, about 40 miles from La Paz. Other railways have been projected.~~

~~Post and Telegraph. — Bolivia joined the Postal Union in 1885. In the country there are 328 postr-ofSces, and, in 1898, 899,080 pieces of mail matter were received, while 747,633 were despatched. The telegraph lines within the republic have a length of 2250 miles, and are served by 35 telegraph and 2 telephone offices. The tele- gi'aph lines belonging to the State have a length of 1240 miles.~~

~~Banks. — In 1900 there were in Bolivia 4 banks of issue : the National Bank, founded at Sucre in 1871, with a paid-up capital of 3,000,000 bolivianos (or, at the rate of exchange adopted for this article, £272,700) ; Argandoiia's Bank, founded at Sucre in 1893, with a paid-up capital of 2,000,000 bolivianos (£181,800) ; the industrial Bank at La Paz (1899), and the Commercial Bank at Oruro (1900), the two last named having each a paid-up capital of 500,000 bolivianos (£45,450). There are also 3 mortgage banks with paid-up capital amounting in all to 285,587 bolivianos (£25,960), and a savings bank, founded in 1900. The bank notes in circulation amount to 6,482,000 jDolivianos (aU of the National and Argandofia Banks), and, notwithstanding the large production of sUver, there is great scarcity of sUver coin. The metal not at once exported as bullion is minted and leaves the country as coin. The money coined and put in circulation during 1895-99 amounted to 7,931,760 bolivianos,. showing an annual average of 1,586,352 bolivianos.~~

~~The boUviano, the unit of account, is of silver, and weighs 25 grams,- or 385-8 grains, -900 fine. The value at par is 5 francs, but in July 1900 its actual Value was Is. 9-9d. (or 43-8 United States cents). The metric system of weights and measures is prescribed by law, but the old Spanish system is stiU in use.~~

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Becent History. — In January 1871 President Melgarejo was de- posed and driven from the country by a revolution headed by Colonel Augustin Morales. The latter, becoming president, was himself murdered in November 1872 and was succeeded by Colonel Adolfo Ballivian, who died in 1874. Under this president, Bolivia entered upon a secret agreement with Peru which was destined to have grave consequences for both countries. To

~~understand the reasons that urged Bolivia to take this step it is necessary to go back to the year 1866, when Chile and Bolivia were allied against Spain. A treaty was then concluded between fhose'two republics, by which Bolivia conceded the 24th parallel as the boundary of Chilian territory and agreed that Chile should have a half share of the customs and full facilities for trading on the coast that lay between the 23rd and 24th parallels, Chile at thaf time being largely interested in the trade of that region. It was also agreed that Chile should be allowed to mine and export the products of this district without tax or hindrance on the part of Bolivia. In 1870, in further consideration of the sum of |10,000, Bolivia granted to an Anglo-Chilian company the right of working certain nitrate deposits north of the 24th parallel. The great wealth which was passing into Chilian hands owing to these com- pacts created no little discontent in Bolivia, nor was Peru any better pleased with the hold that Chilian capital was establishing in the rich district of Tarapaca. On 6th February 1873 Bolivia entered upon a secret agreement with Peru, the ostensible object of which was the preservation of their territorial integrity and their mutual defence against exterior aggression. There can be no doubt that the aggression contemplated as possible by both countries was a further encroachment on the part of Chile.~~

~~Upon the death of Adolfo Ballivian, immediately after the con- clusion of this treaty with Peru, Dr Tomas Frias succeeded to the presidency. He signed yet another treaty with Chile, by which the latter agreed to withdraw her claim to half the duties levied in Bolivian ports on condition that all Chilian industries established in Bolivian territory should be free from duty for twenty-five years. This treaty was never ratified, and four years later General Hilarion Daza, who had succeeded Dr Frias as president in 1876, demanded as the price of Bolivia's consent that a tax of 10 cents per quintal should be paid on all nitrates exported from the country, further declaring that, unless this levy was paid, nitrates in the hands of the exporters would be seized by the Bolivian Government. As an answer to these demands, and in order to protect the property of Chilian subjects, the Chilian fieet was sent to blockade the ports of Antofagasta, Cobija, and Tocapilla. On 14th February 1879 the Chilian Colonel Sotoraayor occupied Antofagasta, and on 1st March, a fortnight later, the Bolivian Government declared war.~~

~~An offer on the part of Peru to act as mediator met with no favour from Chile. The existence of the secret treaty, well known to the Chilian Govemmentj rendered the intervention of Peru more than questionable, and the law passed by the latter in 1875, which practically created a monopoly of the Tarapaci nitrate beds to the serious prejudice of Chilian enterprise, offered no guarantee of her good faith. Chile replied by curtly demanding the annulment of the secret treaty and an assurance of Peruvian neutrality. Bofh demands being refused, she declared war upon Peru.~~

~~The superiority of the Chilians at sea, though checked for some time by the heroic gallantry of the Peruvians, soon enabled them to land a sufficient number of troops to meet the allied forces which had concentrated at Arica and other points in the south. The Bolivian ports were already in Chilian hands, and a sea attack~~

~~upon Pisagua surprised and routed the troops under the Peruvian General Buendia and opened the way into the southern territory of Peru. General Daza, who should have co-operated with Buendia, turned back, on receiving news of the Peruvian defeat, and led the Bolivian troops to Tacna in a hasty and somewhat disorderly \retreat. The fall of San Francisco followed, and Iquique, which was evacuated by the allies without a struggle, was occupied. Severe fighting took place before Tarapacd surrendered, but the end of 1879 saw the Chilians in complete possession of the province.~~

~~Meanwhile a double revolution took place in Pei-u and Bolivia. In the former country General Prado was deposed and Colonel Pierola proclaimed dictator. The Bolivians followed the example of their allies. The troops at Tacna, indignant at the inglorious part they had been condemned to play by the incompetence or cowardice of their president, deprived him of their command and elected Colonel Camacho to lead them. At the same time a revolu- tion in La Paz proclaimed General Narciso Campero president, and he was elected to that post in the following June by the ordinary procedure of the constitution. During 1880 the war was chiefly maintained at sea between Chile and Peru, Bolivia taking little or no part in the struggle. In January of 1881 were fought the battles of Chorillos and Miraflores, attended by heavy slaughter and savage excesses on the part of the Chilian~~

~~troops. They were followed almost immediately by the surrender of Lima and Callao, which left the Chilians practically masters of Peru. In the interior, however, where the Peruvian Admiral Montero had formed a provisional government, the war still lingered, and in September 1882 a conference took place between the latter and President Campero, at which it was decided that they should hold out for better terms. But the Peruvians wearied of the useless struggle. On 20th October 1883 they concluded a treaty of peace with Chile ; the troops at Arequipa, under Admiral Montero, surrendered that town, and Montero himself, coldly received in Bolivia, whither he had fled for refuge, withdrew from the country to Europe. On the 9th of November the Chilian army of occupation was concentrated at Arequipa, while what remained of the Bolivian army lay at Oruro. Negotiations were opened, and on 11th December a peace was signed between Chile and Bolivia. By this treaty Bolivia ceded to Chile the whole of its sea-coast, including the port of Cobija.~~

~~On 18th May 1895 a treaty was signed at Santiago between Chile and Bolivia, "with a view to strengthening the bonds of friendship which unite the two countries," and, "in accord with the higher necessity that the future development and commercial prosperity of Bolivia require her free access to the sea." By this treaty Chile declared that if, in consequence of the plebiscite (to take place under the treaty of Ancon with Peru), or by virtue of direct arrangement, she should " acquire dominion and permanent sovereignty over the territories of Tacna and Arica, she undertakes to transfer them to Bolivia in the same form and to the same extent as she may acquire them " ; the republic of Bolivia paying as an indemnity for that transfer $5,000,000 silver. If this cession should be effected, Chile should advance her own frontier north of Camerones to Vitor, from the sea up to the frontier which actually separates that district from Bolivia. Chile also pledged herself to use her utmost endeavour, either separately or jointly with Bolivia, to obtain possession of Tacna and Arica. If she failed, she bound herself to cede to Bolivia the roadstead (caleta) of Vitor or another analogous one, and $5,000,000 silver. Supplementary protocols to this treaty stipulated that the port to be ceded must "fully satisfy the present and future requirements " of the commerce of Bolivia.~~

~~On 23rd May 1895 further treaties of peace and commerce were signed with Chile, but the provisions with regard to the cesaon of a seaport to Bolivia still remained unfulfilled. During those ten years of recovery on the part of Bolivia from the effects of the war, the presidency was held by Dr Pacheco, who succeeded Campero, and held office for the full term ; by Dr Aniceto Aroe, who held it until 1892, and by Dr Mariano Baptista, his successor. In 1896 Dr Severe Alonso became president, and during his tenure of office diplomatic relations were resumed with Great Britain, Seiior Aramayo being sent to Xondon as minister plenipotentiary in July 1897. As an outcome of his mission an extradition treaty was concluded with Great Britain in March 1898.~~

~~In December an attempt was made to pass a law creating Sucre the perpetual capital of the republic. Until this Sucre had taken its turn with La Paz, Cochabamba, and Oruro. La Paz rose in open revolt. On 17th January of the following year a battle was fought some forty miles from La Paz between the insurgents and the Government forces, in which the latter were defeated with the loss of a colonel and forty-three men. Colonel Pando, the insurgent leader, having gained a strong following, marched upon Oruro, and entered that town on 11th April 1899, after completely defeating the Government troops. Dr Severe Alonso took refuge in Chilian territory ; and on 26th October Colonel Pando was elected consti- tutional president and formed a government.~~

~~Peace and prosperity for Bolivia, as well as for the two republics with whose fortunes her own are so closely allied, depend mainly~~

~~on the question of her seaboard, In which Chile and Peru are also concerned, being definitely settled and, with it, the question of boundary. In October 1901 Tacna and Arica had not yet been invited to declare by plebiscite their willingness to become Chilian territory. Chile still waited the final settlement of her frontier with Peru, and Bolivia was still without her seaport. The feeling of suspense, engendered by the uncertainty of the situation, had led to some show of impatience on the part of Chile, who~~

seemed disposed to press for the legitimization of her position on what was formerly Bolivian territory before the way had been cleared towards providing Bolivia with a compensating access to the sea. Her impatience was said to be due to the discovery of a secret treaty, made between Bolivia and the Argentine Republic in 1891, con- stituting an offensive and defensive alliance between these two countries. At the close of 1901 there was no apparent obstacle to a final and peaceful settlement of the claims of Bolivia on the terms originally proposed. /-^^ Hi, ■)

Bolkhov, a district town of Russia, government and 35 miles N. of Orel, on the Oka river. It has important trade with Moscow, St Petersburg, and Little Eussia, in hemp ropes, hemp-seed oil, hemp goods, and cattle, and there are several hemp mills and important tan- neries. The much-venerated monastery, Optina Pustyn, is close by. Bolkhov probably existed at the begin- , ning of the 13th century. Population, including sub- urbs, 26,570.

BollandistS. — The publication of the BoUandist Acta Sanctorum was suspended in 1794 during the in- vasion of the Netherlands by the French (see Ency. Brit. ninth ed. vol. iv. p. 18). The continuation of the work was undertaken in 1837, on behalf of the Society of Jesus, by Jo. Bapt. Boone, Joseph, van der Moere, Prosper Coppens, and Joseph, van Hecke, of the Jesuit College of St Michael at Brussels. The programme " De prosecutione operis Bollandiani, quod Acta Sanctorum inscribitur " was published on 26th March 1838 ; and the first volume of the new series (vol. Iv. of the whole work) appeared in 1845. It contained the lives of the saints for two days only, 15th and 16th October, and even these only in part. Since then additional volumes, which on the whole fully maintain the standard of scholarship of the earlier series, have appeared at intervals, the latest being vol. Ixiv. This was published in 1894 ; and a considerable part of its bulk is taken up by a critical edition of the Martyro- logium Hieronymianum by Jo. Bapt. de Rossi and the Abb^ L. Duchesne. The scale has increased steadily with the progress of the work : the month of October occupies thirteen volumes, followed by a supplementary volume edited by L. M. Eigollot, a secular priest of the diocese of Langres; and November bids fair to attain to an even greater bulk. In addition to the writers above mentioned, many others have taken part in the work from time to time, including Benj. Bossue, Victor and Remigius de Buck, Ant. Tinnebrock, Edu. Carpentier,

~~Henr. Matagne, Carol, de Smedt, Gulielm. van Hooff, Joseph, de Backer, Franc, van Ortroy, Joseph, van den Gheyn, Hippolytus Delehaye, and Alb. Poncelet. In 1882 de Smedt, the present director, with van Hooff and Backer, began the publication of the Analecta Bollandiana, in which were to appear newly discovered lives, documents, and frag- ments, or such as were unknown when the volumes were issued to which they properly belonged : by this means, not only is there provided a means of communication between the editors and the world at large, but a supple- mentary collection is being formed which can be incor- porated in any future revised and enlarged edition of the Acta Sanctorum.~~

~~A series of lives of the saints in French, known as Les Petits Bollandistes, was edited by Mgr Paul Gufirin ; it is based upon the BoUandist Acta Sanctorum, Surius, and other collections of the same kind (7th edition in 17 volumes, 1882). In 1899 the Abb6 C. Narbey of Cliohy published the first volume of his~~

~~Supplement aux Acta Sanctorum pour les Vies des Saints de Vepoque Merovingienne. A very full Table Alphabetique General^ des Saints, giving references to the volumes of the BoUandist Acta Sanctorum so far as then published, is given in de Mas Latrie's Tresor de Chronologie, d'Histoire et de Oeographie, cols. 665-862, Paris, 1889. (-^^ e. Co.)~~

~~Bologna, capital of the province of Bologna, in the compartment of Emilia, Italy, situated between the rivers Reno and Savena, 23 miles S.E. by E. of Modena by rail. It is the headquarters of the fifth Italian army corps. Since 1880 the city has undergone considerable trans- formation. New streets have been opened, new public and private buildings constructed, and new public gardens laid out both in the interior and the suburbs. In 1885 the municipal council sanctioned a scheme for the regular- ization and enlargement of the city, of which the cost to the commune alone was estimated at thirty million lire. This reform was necessitated when Bologna became in 1880 the centre of the railway communications of mid- Italy. The new streets with their colonnades retain the characteristic type of Bolognese buildings. The Giardino Marco Minghetti, near the palatial savings bank, and the monumental stairway in the Piazza Venti Settembre have been completed. In the Piazza Vittorio Emanuele the Palazzo del Podesta and~~

~~other ancient buildings have been restored. Near Porta Lame a large public slaughterhouse and cattle-market have been constructed at a cost of more than 1,000,000 lire, while the Commercial Exchange, the public baths, and the customs warehouses have been added to the number of public edifices. Monuments to Victor Emmanuel II., Garibaldi, Minghetti, Cavour, Galvani, and Ugo Bassi have been erected in the various public squares. Side by side with the work of reconstruc- tion has "proceeded the development of industry, both private and official. Electric engineering works, beet^ sugar factories, breweries, ice-works, machine-works, and flax-mills have been established by private enterprise, while the railway companies have installed railway work- shops and a pyrotechnical laboratory, and the State a tobacco factory. The gasworks have been municipalized, and the octrois upon necessaries of life abolished. Charitable institutions have been extended by the estab- lishment of a foundling hospital, an infant asylum, evening schools, and female educational institutes. The secondary education of the middle classes has been stimulated by the new Philological Club and the Circolo Cavour. In addition to educatorii (designed to amuse and feed the children of poor parents after school hours), summer school colonies have been created, which provide the poorer children with holidays on the mountains or at the seaside. Further, soup kitchens, free hospitals, sanatoria for children, an anti-rabies institute, an institute for the blind, deaf, and dumb, and above all, the Eizzoli Ortho- paedic Institute, are maintained for the aflicted and the deformed. The famous university has been increased by the addition of a faculty of Agriculture, and Bologna has succeeded in retaining its engineering school, while the academic renown of the occupants of the various chairs has prevented decadence. The number of students is at present 1900. Provision has been made for the erection of new educational buildings of experimental science and for the enlargement of public museums and libraries. Great attention has also been paid to the elementary schools, which were attended in 1880-81 by only 7000 children, but now are frequented by 12,500, or 85 per cent, of the children who came within the scope of the compulsory educational law of 1877. Another 10 per cent, attend private schools and colleges. Small museums and circulating libraries have been attached to nearly all the schools. Similar progress has been made in regard to the school of decorative art and the female~~

technical school. The school buildings have been enlarged and in some cases renewed on hygienic principles. Educa- tional expenses have increased in proportion. In 1873 they amounted to 170,000 lire per annum, in 1886 to 290,000 lire, and are to-day more tian 500,000 lire (£20,000). In respect of aesthetic, industrial, and educar tional requirements, Bologna still holds a high place among the progressive cities of modern Italy. Popu- lation of town (1881) 123,274, (1901) 162,009 ; of province (1881) 457,474, (1901) 527,642. (e. vi.)

Bologoye, a village of North Eussia, half-way on the St Petersburg to Moscow railway. It is an important junction, with lines to Rybinsk and Yaroslavl, and to Pskov and Riga. It is a great depot for the upper Volga region.

Bolton-le- Moors, a municipal (extended 1898), county (1888), and parliamentary borough of Lancashire, England, on the Croal, 11 miles IST.W. of Manchester, 200 miles by rail N.W. by N. of London. It has stations on the London and North- Western and the Lancashire and Yorkshire railways, with running powers for the Midland railway. It is governed by a mayor, 24 aldermen, and 72 councillors. Of recent institution are a natural history museum, an art and industrial museum, two hospitals, an orphanage, a new public park (1890), a new theatre, and 5 free lending libraries. There are about 130 cotton mills employing over 15,000 workers. In 1891 there werp engaged in the manufacture of cotton and cotton goods 8130 males and 7070 females ; in printing, dyeing, and bleaching of cotton and calico, 915 males and 494 females ;

and 945 males and 148 females as spinning and weaving machine makers. Bolton publishes two daily and two weekly newspapers. Area of municipal and county borough in 1891, 2361 acres ; population (1881), (1891), 115,002. On the recently extended population in 1891 was 146,487; in 1901,

105,414 ;

area the

~~168,746.~~

~~Boma.~~

~~See Congo ,Eebe State.~~

~~Bombay Presidency, a province or presidency of British India, under the administration of a governor. Politically it includes the settlement of Aden ; geographic- ally it also includes the native state of Baroda, which is in direct political relations with the governor-general. Ex- cluding Aden, it lies roughly between 13° 63′ and 28° 45′ N. lat. and between 66° 40′ and 76° 30′ E. long. Its total area (including native states) is 194,189 square miles; the population in 1891 was 26,960,421. The capital is Bombay city, from which the province takes ‘ its name. Eor the hot weather, the Government moves to the hill station of Mahabaleshwar, and for the rainy season to Poona. Native states occupy more than one-third of the total area of the presidency, with nearly one-third of the population. In some parts, as in the peninsula of Kathiawar, they continuously cover the whole area ; in other parts, as in the Southern Maratha country, they are awkwardly interlaced amid British territory.~~

~~Population.— The population in 1901, according to the pre- liminary census returns, was 25,457,563. The following table gives the area and population of the several districts and native states of Bombay according to the census of 1891 : —~~

~~Area and Population of Bombay Presidency (1891).~~

~~DiTislons.~~

~~Districts.~~

~~Area in Square Miles.~~

~~Number of~~

~~Towns and~~

~~Villages.~~

~~Population, Census of 1891.~~

~~Density of~~

~~Population~~

~~to Square~~

~~Mile.~~

~~Population,~~

~~Censns of~~

~~1831.~~

~~Males.~~

~~Females.~~

~~Total.~~

~~Northern Division Central Division Southern Division Sind .~~

~~Ahmedabad~~

~~Kaira~~

~~Panch Mahals .~~

~~Broach~~

~~Sural~~

~~Thana~~

~~Khandesh Nasik~~

~~Ahmednagar . Poona Sholapur . Satara~~

~~Belgaum . Dharwar Bijapur Kolaba Katnagiri . Kanara .~~

~~Karachi . Hyderabad Shikarpur Thar and Parkar Upper Sind Frontier~~

~~3,949 1,609 1,613 1,463 1,662 3,935~~

~~867 583 656 405 797 1,891~~

~~473,563 460,610 162,101 174,964 321,625 471,-669~~

~~448,149 410,979 ‘ 151,316 166,526 328,364 433,199~~

~~921,712 871,589 313,417 341,490 649,989 904,868~~

~~233 542 194 233 391 230~~

~~856,324 804,800 256,479 326,930 614,198 807,367~~

~~14,231~~

~~5,189~~

~~2,064,532~~

~~1,938,533~~

~~4,003,065~~

~~281~~

~~3,665,098~~

~~10,907 6,940 6,645 5,369 4,642 4,987~~

~~2,828 1,647 1,348 1,191 716 1,346~~

~~745,847 432,338 451,825 545,494 381,400 613,852~~

~~715,004 411,244 436,930 522,306 369,289 612,137~~

~~1,460,851 843,682 888,755~~

~~1,067,800 750,689~~

~~1,225,989~~

~~134 142 184 199 165 246~~

~~1,252,016 781,206 760,021 901,828 683,411~~

~~1,062,350~~

~~38,.390~~

~~9,076~~

~~3,170,756~~

~~3,066,910~~

~~6,237,666~~

~~162~~

~~5,330,832~~

~~4,657 4,603 5,668 1,872 3,922 3,910~~

~~1,076 1,.303 1,112 1,201 1,310 1,185~~

~~511,885 628,071 398,104 255,064 513,616 234,356~~

~~501,376 523,243 398,236 254,520 592,310 211,995~~

~~1,013,261~~

~~1,061,314~~

~~796,339~~

~~509,684~~

~~1,105,926~~

~~446,351~~

~~217 228 140 272 282 114~~

~~865,922 893,587 626,889 482,830 997,090 421,840~~

~~24,632~~

~~7,187~~

~~2,441,096~~

~~2,481,679~~

~~4,922,775~~

~~200~~

~~4,288,168~~

~~14,182 9,033 9,296~~

~~12,729 2,549~~

~~783~~

~~1,348~~

~~1,111~~

~~212~~

~~296~~

~~318,152 500,068 493,872 165,225 96,273~~

~~261,728 418,578 421,626 132,978~~

~~78,275~~

~~564,880 918,646 915,497 298,203 174,648~~

~~40 102 98 23 68~~

~~489,496 754,624 820,549 146,810 203,344~~

~~47,789~~

~~3,750~~

~~1,568,590~~

~~1,803,184~~

~~2,871,774~~

~~60~~

~~2,413,823~~

~~Bombay City and Island~~

~~Aden~~

~~22~~

~~1~~

~~518,093~~

~~303,671~~

~~821,764~~

~~37,352~~

~~773,199~~

~~80~~

~~1~~

~~30,914~~

~~13,165~~

~~44,079~~

~~551~~

~~34,860~~

~~Total Bri~~

~~tish Territory .~~

~~125J44~~

~~25,204~~

~~9,793,981~~

~~9,107,142~~

~~18,901,123~~

~~151~~

~~16,505,967~~

~~BOMBAY~~

~~295~~

~~Native States~~

~~Divisions.~~

~~Districts.~~

~~Area in Square Miles.~~

~~Number of Towns and Vil- lages.~~

~~Population, Census of 1891.~~

~~Density of~~

~~Population~~

~~to Square~~

~~Mile.~~

~~Population, Census of~~

~~1881.~~

~~Males.~~

~~Females.,~~

~~Total.~~

~~Northern Division .~~

~~Cutch ....~~

~~6,500~~

~~936~~

~~278,441~~

~~279,974~~

~~558,415~~

~~86~~

~~512,084~~

~~Kathiawar~~

~~20,559~~

~~4,199~~

~~1,416,633~~

~~1,335,771~~

~~2,752,404~~

~~134~~

~~2,343.899~~

~~Palanpur~~

~~7,775~~

~~1,177~~

~~335,587~~

~~309,939~~

~~645,526~~

~~83~~

~~576,478~~

~~Mahi Kantha~~

~~9,300~~

~~1,867~~

~~296,646~~

~~284,922~~

~~581,568~~

~~63~~

~~517,485~~

~~Rewa Kantha~~

~~4,980~~

~~3,156~~

~~376,146~~

~~357,360~~

~~733,506~~

~~147~~

~~549,892~~

~~Cambay~~

~~350~~

~~88~~

~~46,231~~

~~43,491~~

~~89,722~~

~~256~~

~~86,074~~

~~Surat Agency~~

~~1,051~~

~~380~~

~~92,457~~

~~88,751~~

~~181,208~~

~~172~~

~~151,132~~

~~Jawhar~~

~~534~~

~~107~~

~~27,825~~

~~25,006~~

~~52,831~~

~~99~~

~~48,556~~

~~Janjira ....~~

~~324~~

~~229~~

~~39,629~~

~~42,151~~

~~81,780~~

~~252~~

~~76,361~~

~~Savantvadi .~~

~~926~~

~~227~~

~~98,520~~

~~99,428~~

~~192,948~~

~~208~~

~~174,433~~

~~Central Division . .~~

~~TheDangs .~~

~~660~~

~~343~~

~~17,237~~

~~15,683~~

~~32,920~~

~~50~~

~~31,280~~

~~Satara Agency~~

~~844~~

~~148~~

~~66,269~~

~~65,260~~

~~131,529~~

~~156~~

~~117,318~~

~~Akalkot.~~

~~498~~

~~106~~

~~38,615~~

~~37,159~~

~~75,774~~

~~152~~

~~58,040~~

~~Surgana~~

~~360~~

~~57~~

~~6,545~~

~~5,853~~

~~12,398~~

~~34~~

~~14,205~~

~~Bhor ....~~

~~1,491~~

~~473~~

~~78,602~~

~~77,067~~

~~155,669~~

~~104~~

~~145,876~~

~~Southern Division .~~

~~Kolhapur~~

~~Southern Mahratta~~

~~2,816~~

~~1,066~~

~~467,572~~

~~445,559~~

~~913,131~~

~~324~~

~~800,189~~

~~Jaghirs~~

~~2,919~~

~~608~~

~~320,531~~

~~318,789~~

~~639,270~~

~~219~~

~~528,753~~

~~Savanur~~

~~70~~

~~24~~

~~8,330~~

~~8,646~~

~~16,976~~

~~243~~

~~14,763~~

~~Jath ....~~

~~979~~

~~119~~

~~40,576~~

~~39,210~~

~~79,786 .~~

~~81~~

~~55,498~~

~~Sind~~

~~Total Native S Grand Total~~

~~Khairpur tates ....~~

~~.6,109~~

~~149~~

~~■72,733~~

~~59,204~~

~~131,937~~

~~22~~

~~129,153~~

~~69,045~~

~~15,453~~

~~4,120,125~~

~~3,939,173~~

~~8,059,298~~

~~117~~

~~6,926,464~~

~~194,189~~

~~40,657~~

~~13,914,106~~

~~, 18,046,315~~

~~26,960,421~~

~~138~~

~~23,432,431~~

~~Since 1881 the population increased by 14 per cent, in British territory, and by 16 per cent, in native states. Both these rates are considerably above the rate of increase for India generally. The average density of population ranged from 542 persons per square mile in the Gujarat district of Kaira to 60 in Sind generally, and only 23 in the desert district of Thar and Parkar. Classified according to religion, and excluding native states, Hindus num- bered 14,657,179, or 78 per cent, of the total population. Mahom- medans~~

~~numbered 3,501,910, of whom nearly two-thirds were found in Sind, where they formed 77 per cent, of the population as opposed to 8 per cent, for the rest of the province. Jains (with whom Buddhists were included) numbered 241,061, chiefly in Belgaum, Ahmedabad, and Bombay city. Parsis numbered 73,945, of whom nearly two-thirds were in Bombay city and its immediate neighbourhood, and most of the remainder in Surat. Christians numbered 158,765, of whom 28,110 were Europeans and 9464 Eurasians, leaving 121,191 for native converts, chiefly in the Konkan districts of Thana and Kanara. Jews numbered 9689, mostly in the city of Bombay and its neighbourhood. "Others" numbered 214,545, chiefly Bhils in Khandesh and aboriginal tribes in Thar and l?arkar. In the native states the proportions were much the same, except that Jains were more numerous than in British territory, forming 4 per cent, of the total population. Native Christians were chiefly found in the two states of Sawantwari and Kolhapur, bordering on Goa. According to the, preliminary returns of the census of 1901, the decrease in population was 5-57 per cent. In the British districts of Gujarat, where the famine of 1899-1900 was most severely felt, the rate of decrease was from 12 to 18 per cent., and in some of the native states it was as high as from 30 to 40 per cent.~~

~~Agriculture.— 'Excladmg Sind, the total cultivated area in the rest of Bombay in 1897-98 amounted to 23,557,557 acres, of which only 963,454 acres were irrigated, mostly from wells. In Sind, on the other hand, out of a total cultivated area of 3,802,482 acres, no less than 2,917,624 acres were irrigated, almost entirely from government canals. Cotton was grown on 2,288,609 acres in 1897-98, chiefly in the districts of Khandesh, Dharwar, Ahmedabad, and Broach. No crops are grown under European supervision, such as the indigo of Bengal or the tea of Assam.~~

~~Industries. — The most important industry of the province is that of cotton, which, besides employing about 270 factories for cleaning and pressing the raw material, supports also about 114 mills for spinning and weaving. In 1897-98 the number of cotton mills was 70 in Bombay city, 40 in the rest of the province, and 4 in native states, total 114, employing about 100,000 persons, of whom 20,000 were women, 12,000 young persons, and 6000 children. The total number of looms was 28,808, and of spindles 2,933,736 ; and the capital invested was nearly ten crores of rupees (say six millions~~

~~sterling). The total production was estimated at 324,649,184 R) of yarn, chiefly of counts 20, 10, and 16 ; and 73,481,564 lb of woven goods, chiefly shirtings, tea-cloths, dhutis, and chadars. The industry is passing through a period of severe depression, caused partly by the general efCects of plague and famine, partly by the loss of almost the entire crop of cotton in~~

~~the drought of 1899, and partly by the overstocking of the China market. Other large industries include a woollen mill at Bombay, employing 363 hands; three paper-mills at Bombay, Poona, and Surat, employing 415 hands; a brewery at Dapuri, near Poona; two dyeing-works at Bombay, employing 1037 hands; 11 flour- mills at Bombay, employing 648 hands ; 15 ironworks in Bombay, one of which employs 1200 hands ; and a tannery at Bombay, employing 614 hands.~~

~~Bailways. — The province is well supplied with railways, all of which, with one exception, concentrate at Bombay city. The exception is the North-Western line, which enters Sind from the Punjab, and finds its natural terminus at Karachi. In 1898 the total length of railway under the Bombay Government opeii for traffic was 6261 miles, while 246 additional miles were under con- struction, and 1040 miles had been surveyed. These figures do not include the railway system in Sind.~~

~~Irrigation. — With the exception of Sind, the water-supply of the Bombay presidency does not lend itself to the construction of large irrigation works. These are classified as protective, productive, and minor. In 1897-98 the total receipts from three "protective" works in the Deccan and Gujarat amounted to Ils.1,51,108, while the working expenses were Es.95,785, and the charge for interest was Es.3,09,149, showing a deficit of Es.2,63,831 on a capital outlay of Es.81, 56,083. The total receipts from seven "productive" works amounted to Es.'3,52,901, while the working expenses were Es.2,13,370, and the charge for interest was Es.4,16,238 ; showing a deficit of Es.2,76,707 on a capital outlay of Es.1,09,10,421. In the case of 26 "minor" works, on which no interest is charged, the total receipts were Es.1,01,056, and the expenses Es.88,540, showing a profit of Rs.12,516, or -2 per cent, on a capital outlay of Es.61,71,896. The figures for Sind are given under that heading.~~

~~Imports and Exports. — The sea-borne trade of the presidency is almost entirely concentrated at Bombay and Karachi, though there is considerable coasting traffic from the ports of Cutch, Kathiawar, and the Konkan. The following table gives the value (in tens of rupees) of the foreign imports and exports of merchandise only for the whole presidency (including Sind) for the six quinquennial years, 1877-78 to 1897-98: —~~

~~Imports. Ex.~~

~~1877-78 15,699,638~~

~~1882-83 21,330,294~~

~~1887-88 29,122,076~~

~~1892-93 30,185,600~~

~~1897-98 30,754,383~~

~~The value (in tens of rupees) of each of the principal articles of import and export in 1897-98 was as follows: —~~

~~Imports. — Cotton piece goods, Ex.7,852,255; sugar, Rx.3,278,565; wrought metals, Ex.2,344,775; railway materials, Ex.1,807,897; mineral oils, Bx.1,089,785; machinery, Rx.1,563,477; cotton twist, Ex.978,861; provisions, Ex.866,426; silk goods, Ex.758,896; liquors, Ex.645,571; hardware and cutlery, Ex.639,923 ; dyeing and tanning materials, Ex.611,025. Exports. — Eaw cotton, Rx.7,277,118; cotton~~

~~Exports.~~

~~23,755,287 84,055,919 37,034,206 44,620,635 32,074,314~~

~~twist, Rx.6,043,332 ; oil-seeds, Ilx.5,273,794 ; opium, Rx.2,203,607; cotton piece goods, Rx.l, 899,858; raw wool, Rx.1,902,718 ; wheat, Rx. 1,303,693;~~

hides, Rx.919,360 ; other food grains, Rx.697,220.

A significant fact was the decline in trade with the United Kingdom during the ten years ending 1897-98. The imports from the United Kingdom fell by 3 orores of rupees, and their propor- tion of the total from 73 to 59 per cent. The exports to the United Kingdom fell by 3f crores of rupees, and their proportion of tlie total from 24 to 16 per cent. Under imports, Germany, Russia, Belgium, and Austria each showed a very large increase ; while under exports the largest increases were to Germany and Japan. Bombay is still the depot for trade with the Persian Gulf and Zanzibar, but this trade is not increasing. The interprovincial trade of Bombay by railway in 1897-98 was valued at Rs.16,71,27,000 for imports, and Rs. 14,85,48,000 for exports.

Administration. — Including Sind, there are 4 divisions or com-missiouerships, distributed among 24 districts, each under the charge of a collector, with assistants and deputies. Many of the collectors have political duties in connexion with, the numerous native states. The total number of civil and revenue judges is 266, and of magistrates of all sorts 648. In 1898, the total strength of the police (excluding Bombay city, Sind, and Aden) was 15,455 officers and men, being one policeman to every 10 square miles of area and to every 1948 of the population. In addition, there were 2121 railway police.

Army. — Since the reorganization of the Indian army in 1894 the Bombay command, under a lieutenant-general, comprises Baluchistan, and parts of. Rajputana, Central India, and the Central Provinces, in addition to the Bombay presidency, with headquarters at Poona. It consists of three first-class and five second-class military districts, of which Poona and Bombay alone lie entirely within the presidency. In 1898 the strength of the Bombay command was 14,6.36 European and 30,103 native troops ; total, 44,739. In addition theie were 6710 volunteers.

Local Government. — Excluding Bombay city, the number of municipalities in the presidency is 167, with an aggregate popula- tion of 2,245,000. The total number of municipal commissioners is 2343, of whom 908 are elected. In 1897-98 the aggregate municipal income (excluding loans) was Rs.47,00,000, of which Rs.34,68,000 was derived from taxation,

~~the incidence of taxation being nearly Rs.2 per head of population. The aggregate ex- penditure was Rs.67,00,000, of which Rs.27,36,000 was devoted to public health and convenience, Rs.6,35,000 to education, Es.5,34,000 to plague, and Rs.2,48,000 to public safety. The number of district boards is 23, and of taluk or subdivisional boards 205. Almost all of these boards are partly elective. The total number of members is 3538, of whom 1593 are elected. In 1897 — 98 the aggregate income of all the local boards was Es.44,94,000, of which Rs.27,34,000 was derived from rates. The aggregate expenditure was Rs.47,65,000, of which Rs.22, 55,000 was devoted to public works, Rs.15,59,000 to education, and Es.3,19,000 to medical.~~

~~The following is the net revenue and expenditure of Bombay for 1897-98 (in tens of rupees) , distributed under the three heads of im- perial, provincial, and local : — Net revenue, imperial, Rx.8,414,539 ; provincial, Rx.2,931,442 ; local, Rx.332,748 ; total, Rx.11,678,729. Net expenditure, imperial, Rx.4, 966,446 ; provincial, Rx.2,876,452 ; local, Rx.387,738; total, Rx.8,230,636. Of the total revemie, Rx.3,678,082 was derived from land, Rx.2,287,245 from salt, Bx.1,904,348 from customs, and Rx.1,033,637 from excise.~~

~~Education. — The following table gives the chief statistics of education in Bombay for the years 1886-87 and 1896-97 : —~~

~~1886-8T.~~

~~1896-97.~~

~~Schools.~~

~~PupUs.~~

~~Schools.~~

~~Pupils.~~

~~Colleges~~

~~Secondary Schools Primary Schools . Special Schools Private Institutions~~

~~13~~

~~388~~

~~7,520~~

~~75 2,927~~

~~1,633~~

~~38,064~~

~~434,377~~

~~2,225 65,737~~

~~14~~

~~466~~

~~9,572~~

~~50 2,832~~

~~1,824~~

~~36,164~~

~~561,160~~

~~2,778 70,779~~

~~Total~~

~~10,923~~

~~542,036~~

~~12,934~~

~~672,705~~

~~If we compare the number of pupils with the estimated population of school-going age (16 per cent, of the total population), the increase in ten years has been from 15 ‘6 to 16-6 per cent. Taking girls alone, the number at school increased from 52,941 in 1886-87 to 82,163 in 1896-97, or by 56 percent.; while the proportion to the female population of school-going age rose from 3-1 to 4-2 per cent. A feature in the Bombay system of public instruction is the success with which it has been extended to native states. In* 1896-97, the total number of pupils in native states (not includ- ing Baroda) was 153,798, of whom 14,182 were girls. In 1886-87 the total expenditure on education was Rs.49,95,970, in 1896-97 it was Rs.73,72,931.~~

~~PuUic Calamities. — During the last few years the entire history of Bombay has been sadly affected by plague and famine. Bubonic plague, of a very fatal and contagious nature, first broke out in Bom- bay city in September 1896, and, despite all the efforts of the Govern- ment, quickly spread to the surrounding country. Since that date there have been fluctuations in the mortality, but the diseas^e has never disappeared entirely. From September 1896 to March 1901, a period of four and a half years, the total number of deaths recorded from plague was no less than 335,555. The great cities of Bombay, Karachi, and Poona suffered most severely. A few districts in Gujarat almost entirely escaped ; but the mortality was vei-y heavy in Satara, Thana, Surat, Poona, Kolaba, and in the native states of Cutch, Baroda, Kolhapur, and Palanpur. The only sanitary measure that can be said to have been successful was complete migration, which could only be adopted in villages and smaller towns. Inoculation was extensively tried in some oases. Segregation was the one general method of fighting the disease ; but, unfortu- nately, it v?as misunderstood by the people and led to some deplorable outbreaks. In Poona, during 1897, two European officials were assassinated ; the editor of a prominent native paper was sentenced to imprisonment for sedition ; and two leaders of the Brahman community were placed in confinement. At Bombay, in March 1898, a‘‘riot begun by Mahommedan weavers was not suppressed until several Europeans had~~

~~been fatally injured. In Nasik district, in January 1898, the native chairman of the plague committee was brutally murdered by a mob. But on the whole the people sub- mitted with characteristic docility to the sanitary regulations of the Government. Bombay, like the Central Provinces, suffered from famine twice within three years. The failure of the monsoon of 1896 caused widespread distress throughout the Deccan, over an area of 46,000 square miles, with a population of 7 millions. The largest number of persons on relief was 301,056 in September 1897; and the total expenditure on famine relief was Rs.l, 28,00,000. The measures adopted were signally successful, both in saving life and in mitigating distress. In 1899 the monsoon again failed in Gujarat, where famine hitherto had been almost unknown ; and the winter rains failed in the Deccan, so that distress gradually spread over almost the entire presidency. The worst feature was a virulent outbreak of cholera in Gujarat, especially in the native states. In April 1900 the total number of persons in receipt of relief was 1,281,159 in British districts, 566,671 in native states, and 71,734 in Baroda (Sir W. W. Hunter, Bombay, 1885-1890; London, 1892). For 1900-1 the total expenditure on famine relief was nearly 3 crores (say, £2,000,000 sterling); and a continuance of drought necessitated an estimate of 1 crore in the budget of the following year. (j. s. Co.)~~

~~Bombay city, the capital of Bombay presidency and chief seaport of Western India ; situated in 18° 55′ N. lat. and 72° 54′ E. long. The city stands on an island of the same name, which forms one of a group now con- nected by causeways with the mainland. It occupies an area of 22 square miles; the population in 1881 was 773,196; in 1891 it was 821,764, showing an increase of 6 per cent. ; and in 1901 it was 770,843, showing a decrease of 6 per cent., due to the effects of continued plague. Bombay thus falls to the second place, below Calcutta; but it is still the third most populous city in the British empire.~~

~~Classified according to religion, Hindus in 1891 numbered 543,276 ; Mahommedans, 155,247 ; Christians, 45,310, of whom 11,294 were Europeans and 4326 Eurasians, leaving 29,690 native converts, mostly Goanese ; Parsis numbered 47,458, more than half the total ■ in all India; Jains (including Buddhists), 25,415; Jews, 5021, nearly half the total in the presidency ; " others," 37.~~

~~Bombay city is the centre of the cotton industry. In 1898 the number of cotton-mills was 70, with 19,303 looms and 2,040,409 spindles, employing about 65,000 hands, and consuming about 2,377,000 cwts. of cotton. The total number of factories of all kinds under inspection was 180, employing about 88,000 operatives.~~

~~Bombay contests with Calcutta the first place in the maritime trade of India. As the terminus of three railway systems, it serves Western and Central India ; but this region cannot vie in pro- ductiveness with the valley of the Ganges. Bombay's commerce, like her cotton industry, lias suffered severely in recent years from drought and plague. The following table gives the value (in tens of rupees) of the foreign imports and exports for the five years, 1893-94 to 1897-98 :—~~

~~Imports.~~

~~Exports.~~

~~1893-94~~

~~29,262,413~~

~~38,736,680~~

~~1894-96~~

~~28,786,724~~

~~34,871,984~~

~~1896-96~~

~~27,866,711~~

~~37,933,016~~

~~1896-97~~

~~26,855,083~~

~~33,162,284~~

~~1897-98~~

~~24,606,163~~

~~27,457,899~~

~~BON A — B ONAPARTE~~

~~297~~

~~In 1897-98 the coasting trade was valued at Rs. 10,42,58,674 for imports, and Rs.9,76,27,197 for exports.~~

~~In 1897-98, 40,051 vessels of 2,665,727 tons entered; and 31,264 vessels of 2,596,515 tons cleared the port.~~

~~The port of Bombay (including docks and warehouses) is man- a,ged by a port trust, the members of which are nominated by the Government from among the commercial community. In 1897-98 the revenue of the port trust was Rs.46,48,409, and the expenditure Rs.48,47,049, showing a deficit of Rs.1,98,640. The expenditure included Rs.24,67,927 for interest and sinking fund on a capital debt amounting to Rs.5,20,88,058. The municipal government of the city was framed by an Act of the Bombay legislative council passed in 1888. The governing body consists of a municipal cor- poration and a town council. The corporation is composed of 72 members, of whom 16 are nominated by the Govern- ment. Of the remainder, 36 are elected by the ratepayers, 16 by the justices of the peace, 2 by the senate of the univer- sity, and 2 by the chamber of commerce. The council, which forms the standing committee of the corporation, consists of 12 members, of whom 4 are nominated by the Government and the rest elected by the corporation. Of the members of the corporation in 1898, 18 were Europeans, 16 Hindus, 12 Mahommedans, and 24 Parsis. In 1897-98 the total revenue was Rs.67,08,505, and the total expenditure Rs.74,96,970 ; on 31st March 1898 the total amount of loans outstanding was Rs.4, 11, 20,498, bearing interest at rates varying from 5 to 3J per cent. A large proportion of these loans had been raised for waterworks and similai-~~

~~permanent out- lay ; but during 1897-98 it was found necessary to borrow no less than Rs.27,00,000 for temporary purposes. In this embarrassed condition of the corporation a new body was constituted in 1898 for the improvement and future expansion of the city, under the title of " Trustees for the Improvement of the City of Bombay." The board of trustees consists of fourteen members, of whom seven are elected. Their duties are to form new and alter existing streets, to remove and alter insanitary buildings, to provide open spaces for better ventilation and for recreation, to construct new sanitary dwellings for certain classes of the inhabitants, to lay out vacant lands, and to reclaim parts of the foreshore of the island. In April 1900 the Bombay Improvement Trust raised a loan of Rs.50,00,000 (say £333,333), in 4 per cent, debentures, on the London market.~~

~~The Bombay University was constituted in 1857 as an examining . body, on the model of the University of London. During the five years ending 1897 the total number of persons who matricu- lated was 4813, while 815 graduated B. A., 869 passed examinations in law, 416 in medicine, and 314 in engineering. The chief educa- tional institutions in Bombay city are the Government Elphin- stone College, two missionary colleges (Wilson and St Xavier), the Grant Medical College, the Government law school, the Sir Jamsetji Jijibhai School of Art, and the Victoria Jubilee Technical Institute. There are altogether twenty-four high schools for boys, and ten for girls. In 1897-98, a year of plague, the total number of pupils under instruction was 22,204, being 3-4 per cent, of the population.~~

~~The effects of the plague in Bombay city may be briefly shown by a few figures. From September 1896 to July 1898 the number of cases recorded was 31,083, of whom 27,533 died. In three years the number of deaths from plague was 1811 in 1898, 15,692 in 1899, and 13,247 in 1900. During 1897 the total number of deaths from all causes was 47,896, equal to a death-rate of 58-3 per thousand, compared with an average death-rate of 35 per thousand for the preceding five years. Among Europeans alone the death-rate was only 19 per thousand. In 1899 the death-rate rose to 69-6 per thousand. (j. s. Co.)~~

~~Bona (French, Bdne), a seaport town of Algeria, on a bay of the Mediterranean, in the department of Con- stantino, 220 miles by rail W. of~~

~~Tunis, with railway connexion with Guelma and Constantine. It is the seat of a sub-prefecture and an Important commercial centre for the export of cereals, oils, corks, wools, and minerals. It owes its prosperity to the rich plain surrounding it. The port is now one of the best and safest on the Mediterranean coast, having been considerably enlarged in 1896-98. Its tonnage, 298,223 in 1890, amounted in 1898 (entered and cleared) to 583,144. There are forty- six merchant ships registered at the port. From 18,866 in 1872, the population increased to 26,475 in 1891, and 32,498 in 1900. Of this 12,011 were French, 7800 were Arabs, and about 12,500 were foreigners, chiefly Italians and Maltese.~~

~~Bonaparte, Napoleon Joseph~~

~~Charles Paul (commonly known as Prince Napo-~~

~~leon, or by the sobriquet of « Plon-Plon ” ‘), (1822-1891), the second son of Jerome Bonaparte, king of Westphalia, by his wife Catherine, princess of Wiirtemberg, was born at Trieste, 9th September 1822. After the French revolu- tion of 1848 he was elected to the National Assembly as a representative of Corsica, and (his elder brother, Jerome Napoleon Charles, dying in 1847) assumed the name of Jerome. Notwithstanding his ostensible opposition to the coup d’&tat of 1851, he was, upon the establishment of the empire, placed in the direct line of succession, and received a liberal dotation, but was allowed no share in public affairs. Privately he professed himself the representative of the Napoleonic tradition in its demo- cratic aspect, and associated mainly with men of advanced political opinions. In 1854 he took part in the Crimean campaign as general of division. His conduct at the battle of the Alma occasioned imputations upon his per- sonal courage, but they seem to have been entirely ground- less. Eeturning to France, he undertook the chief direction of the National Exhibition of 1855, in which he manifested great capacity. In 1858 he was appointed minister for the Colonies and Algeria, and his administration aroused great hopes, but his activity was diverted into a different channel by his sudden marriage in January 1859 with the Princess Clotilde, daughter of Victor Emmanuel, a prelude to the war for the liberation of Italy. In this war Prince Napoleon commanded the French corps that occupied Tuscany, and it was expected that he would become ruler of the principality, but he refused to~~

exert any pressure upon the inhabitants, who preferred union with the Italian kingdom. The next few years were chiefly distinguished by remarkable speeches which dis- played the prince in the unexpected character of a great orator. Unfortunately his indiscretion equalled his elo- quence : one speech (1861) sent him to America to avoid a duel with the duke d'Aumale ; another (1865), in which he justly but intemperately protested against the Mexican expedition, cost him all his official dignities. He was, nevertheless, soon restored to the position of dubious favour which he generally occupied under his cousin's reign, and was influential in effecting the reform by which, in 1869, it was sought to reconcile the empire with Liberal principles. The fatal war of 1870 was resolved upon dur- ing his absence in Norway, and was strongly condemned by him. After the first disasters he undertook an in- effectual mission to Italy to implore the aid of his father- in-law ; and after the fall of the empire lived in compara^ tive retirement until the death of the Prince Imperial (1879) made him direct heir to the Napoleonic succession. His part as Imperial pretender was unfortunate and in- glorious : his democratic opinions were unacceptable to the Imperial party, and ere his death he was virtually deposed in favour of his son Prince Napoleon Victor. He died at Rome, 17th March 1891. His eldest son. Prince Napo- leon Victor (born 1862), has since then been the head of the French Bonapartist party ; but the second son. Prince Louis Napoleon, an officer in the Eussian army, has given more reason to suppose that he has inherited some of the finer characteristics of his family. Prince Napoleon's sister. Princess Mathilde Letitia Wilhelmine Bona- parte, born at Trieste, 27th May 1820, married in October 1841 Prince Anatole Demidoff. The prince's conduct led to a separation within four years, and he wa,s compelled by the Tsar Nicholas to make the princess a handsome allowance. After the election of her cousin Louis Napoleon, as pres- ident of the Republic, the princess took up her residence in Paris, and did the honours of the l^lysee until his

1 Derived, it is supposed, from the nickname "Plomb-plomb," or " Craint-plomb " (fear-lead), given him by his soldiers in the Crimea.

marriage. She has since continued to reside in Paris, dis- tinguished as the friend and patron of men of letters and artists, and herself displaying no mean skill as a painter. Able man though he was. Prince Napoleon was dis- qualified by character and temperament from success in public life. His democratic convictions, however sin- cere, coexisted with a despotic temper; his indepen- dence, in itself highly honourable to him, became in its excess disdain for public opinion and offensive brusque- ness ; while despising princely affectations, he failed to manifest princely dignity or princely munificence ; and his private life was by no means exemplary. It would, moreover, have been difficult for any one to have resisted the constant stream of calumny directed against him by the absolutist and clerical sections of the Imperialist party; he was constantly taxed with disloyalty to the emperor, and yet, when his proceedings are impartially reviewed, he appears to have opposed all the mistakes that proved fatal to the dynasty, and to have invariably given the soundest advice. In the character of his in- tellect, as in personal appearance, be bore an extraordi- nary resemblance to the first Napoleon, possessing the same marvellous lucidity of insight, and the same g^t of infallibly distinguishing the essential from the non- essential. He was a warm friend of literature and art, and in a private station would have achieved high dis- tinction as a man of letters. (e. g.)

Bonaparte, Napoleon Eugene Louis Jean Joseph, Pkince Imperial (1856-1879), son of the Emperor Napoleon III. and the Empress Eugenie, was born at Paris 16th March 1856. He received a careful education, and was considered a youth of promise. In the Franco-German war of 1870 he went to the front, though aged only fourteen, and much dynastic capital was made of his ” baptism of fire ” and his having dis- charged a mitrailleuse at the battle near Saarbrilcken. So soon, however, as the campaign threatened to become disastrous he was sent to Brussels, and speedily joined his mother in England, residing at Chislehurst. Upon his father’s death in 1873 he was proclaimed by the Imperialist party as Napoleon IV., passing under the title of coimt de Pierrefonds. He had already, in 1872, entered the military academy at Woolwich, where he made fair progress in his studies, and gained the esteem of his teachers and companions by his amiable

~~disposi- tion. Desirous of acquiring military experience, and of recommending himself to the French nation by exploits in the field, he volunteered for service in the Zulu war, and departed for South Africa on 27th F|ebruary 1879. His period of military service was short indeed, for he was killed in a reconnaissance on 1st June. His remains were brought home, and interred with those of his father at Chislehurst. His death was an event of considerable political importance, virtually destroying the Bonapartist party in France by transferring its leadership to the unpopular Prince Napoleon Jerome. The Prince Impe- rial's amiable character, and the romantic interest attach- ing to him, would have made him a formidable pretender in the ^ event of any internal trouble menacing the sta- bility of the Eepublic. (e. g.)~~

~~Bonghi, Ruggero (1828-1895), Italian politician, was born at Naples, 20th March 1828. Exiled from Naples in consequence of the movement of 1848, he took refuge in Tuscany, whence he was compelled to flee to Turin on account of a pungent article against the Bour- bons. At Turin he resumed his philosophic studies and his translation of Plato, but in 1858 refused a professor- ship of Greek at Pavia, under the Austrian Government, only to accept it in 1859 from the Italian Government. In 1860, with the Cavour party, he opposed the work of~~

~~Garibaldi, Crispi, and Bertani at Naples, and became secretary of Luigi Carlo Farini during the latter's lieu- tenancy, but, in 1865, assumed contemporaneously the editorship of the Perseveranza of Milan and the chair of Latin literature at Florence. Elected deputy in 1860 he became celebrated by the biting wit of his speeches, while, as journalist, the acrimony of .his polemical writings made him a redoubtable adversary. Though an ardent supporter of the historic Eight, and, as such, entrusted by the Lanza Cabinet with the defence of the law of guarantees in 1870, he was no respecter of per- sons, his caustic tongue sparing neither friend nor foe. Appointed minister for public instruction in 1873, he, with feverish activity, reformed the Italian educational system, suppressed the privileges of the university of Naples, founded the Vittorio Emanuele library in Eome, and prevented the establishment of a Catholic university in the capital. Upon the fall of the Eight from power in 1876 he joined the Opposition, and, with characteristic vivacity, protracted during two months the debate on~~

~~Baceelli's University Eeform Bill, securing, single- handed, its rejection. A bitter critic of King Humbert, both in the Perseveranza and in the Nuova Antologia, he was, in 1893, excluded from court, only securing re-ad-mission shortly before his death, on 22nd October 1895. In foreign policy a Francophil, he combated the Triple Alliance, and took considerable part in the organization of the inter- Parliamentary peace conference, (h. w. s.)~~

~~Bonham, a city of Texas, U.S.A., capital of Fannin county, in the N.E. part of the state, on a line of the Texas Pacific railway, and an important point in the ship- ment of cotton. Population (1890), 3361 ; (1900), 5042.~~

~~Bonheur, Marie Rosaiie, known as Eosa BoNHEUE (1822-1899), . one of the most famous women artists of the 19th century, was born at Bordeaux, in France, on the 22nd March 1822. She was of Jewish origin. Jacques Wiener, the Belgian medallist, a native of Venloo, says that he and Eaymond Bonheur, Eosa's father, used to attend synagogue in that town ; while another authority asserts that Eosa used to be known in common parlance by the name of Eosa Mazeltov (a Hebrew term for " good luck," Gallici Bonheur). She was the eldest of four children, all of whom were artists : Auguste (1824-1884), painted aninlals and landscape; Juliette (1830-1891), " honourabljr mentioned " at the exhibition of 1855 ; Isidore, born in 1827, a sculptor of animals. Eosa at an early age was taught to draw by her father (who died in 1849), and he, perceiving her very remarkable talent, permitted her to abandon the business of dressmaking, to which, much against her will, she had been put, in order to devote herself wholly to art. From 1840 to 1845 she exhibited at the salon, and five times received a prize ; in 1848 a medal was awarded to her. Her fame dates more especially from the exhibi- tion of 1855 ; from that time Eosa Bonheur's works were much sought after in England, where collectors and public galleries competed eagerly for them. What is chiefly remarkable and admirable in her work is that, like her contemporary, Brascassat, she represents animals as they really are, as she saw them in the country. She gives us a picture of real life, instead of the often artificial presentment of rural scenes and incidents of animal life. Her gift of accurate observation was, however, allied to a certain dryness of style in painting ; she often failed to give a perfect sense of atmosphere. On the other hand, the anatomy of her animals is always faultlessly true. There is nothing feminine in her handling ; her~~

~~treatment is always manly and firm. Of her many works, we may note the following — " Ploughing in the Nivernais " (1848), in the Luxembourg gallery (see Plate); "The~~

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~~Horse Fair " (1853), one of the two replicas of which is in the National Gallery, London, the original being in the United States (see Plate) ; and " Hay Harvest in Auvergne" (1855). She was "decorated" with the Legion of Honour by the Empress Eugenie, and was sub- sequently promoted to the rank of " officer " of the order. After 1867, Eosa Bonheur exhibited but once in the salon, in 1899, a few weeks before her death. She lived quietly at her country house at By, near Fontainebleau, where for some years she had held gratuitous classes for drawing. She left at her death a considerable number of pictures, studies, drawings, and etchings, which were sold by auction in Paris in the spring of 1900. (h. fb.)~~

~~Bonhill. See Alexandria.~~

~~Boni (Bone), a vassal state belonging to the government of Celebes and its dependencies (Dutch East Indies), on the south-west peninsula of Celebes (q.v.), on the Gulf of Boni. Its area is 2548 square miles. The chief products are rice, tobacco, coffee, cotton, and sugar-cane, none of them important exports. The buffaloes and horses of this state are highly-esteemed breeds. The trade, shipping, and fishery are in a state of decline. The chief town, Boni, lies 80 miles north-east of Macassar.~~

~~For the wars in Boni, see Pbrblaek, De Bonische ezpediti'en, 1859-60, Leiden, 1872 ; and Meyebs, in the Militaire Spectator~~

~~(1880).~~

~~Bonifacio, a coast town in the arrondissement of Sartine, Corsica, 42 miles in direct line S.E. of Ajaccio, on the railway from Bastia. Cork-cutting, an industry of recent growth, employs in a single factory 200 persons, producing annually 50 millions of corks. Population (1881), 2790 ; (1896), 3191, (comm.) 3587.~~

~~Bonin Isiands, called by the Japanese Ogasar warajima, a chain of small islands stretching nearly due north and south, a little to the east of 142° E. long., and from 26° 35′ to 27° 45′ N. lat. They number twenty, according to Japanese investigations, and have a coast-line of 174-65 miles long and a superficies of 28-82 square miles. Only ten of them have any appreciable size, and these are named — commencing from the north — Muko- shima (Bridegroom Island), Nakadachi-shima (Go-between Island'), Yome-shima (Bride Island), Ototo-jima (Younger- brother Island), Ani-shima (Elder-brother Island), Chichi- jima (Father Island), Haha-jima (Mother Island), Mei-jima (Niece Island), Ani-jima (Elder-sister Island), and Imoto- jima (Younger-sister Island). European geographers have been accustomed to divide the islands into three groups for purposes of nomenclature, calling the northern group the Parry Islands, the central the Beechey Islands, and the southern the Coffin, or Bailey Islands. The second largest of all, that is to say Chichi-jima (Father Island), in Japanese cartography, was called " Peel Island " in 1827 by Captain Beechey, and the same officer gave the name of " Stapieton Island " to the Ototo-jima of the Japanese, and that of " Buckland Island" to their Ani-jima. To complete this account of Captain Beechey's nomenclature, it may be added that he called a large bay on the south of Peel Island " Fitton Bay," and a bay on the south-west of Buckland Island " Walker Bay."^ Port Lloyd, the chief anchorage (situated on Peel Island), is considered by Commodore Perry — who visited the islands in 1853 and strongly urged the establishment of a United States coaling station there — to have been formerly the crater of a volcano from which the surrounding hills were thrown~~

~~1 Referring to the Japanese custom of employing a go-between to arrange a marriage. „, „ . r , j ^ -d h~~

~~2 These details are taken from The Bomn Islands by Kussell Robertson, formerly H.B.M. Consul in Yokohama, who visited the islands in 1875.~~

~~up, the entrance' to the harbour being a fissure through which lava used to pour into the sea. The islands are, indeed, plainly volcanic in their nature.~~

~~History. — The diversity of nomenclature indicated above suggests that the ownership of the islands was for some time doubtful. According to Japanese annals they were discovered towards the close of the 16th century, and added to the fief of a Daimyo, Ogasawa Sadayori, whence the name "Ogasawarar-jima." They were also calleiBunin-jima (corrupted by foreigners into " Bonin ") because of their being without (6m) inhabitants (jiin). Effective occupation did not take place, however, and communications with the islands ceased altogether in 1635, as was a natural consequence of the Japanese Government's veto against the construction of sea-going vessels.' In 1728 fitful communication was restored by the then representative of the Ogasawara family, only to be again interrupted until 1861, when an unsuccessful attempt was made to establish a Japanese colony at Port Lloyd. Meanwhile, Captain Beechey having visited the islands in the Blossom, having assigned names to some of them, and having published a description of their features, a small party consisting of two British subjects, two American citizens, and a Dane, sailed from the Sandwich Islands for Port Lloyd in 1830, taking with them some Hawaiian natives. These colonists hoisted the British flag on Peel Island (Chichi-jima), and settled there. When Commodore Perry arrived in 1853, there were on Peel Island thirty-one in- habitants, four being English, four American, one Portuguese, and the rest natives of the Sandwich Islands, the Ladrones, &c. ; and when Mr Eussell Robertson visited the place in 1875, the colony had grown to sixty-nine, of whom only five were pure whites. Mr Robertson found them without education, without religion, with- out laws, and without any system of government, but living comfortably on clearings of cultivated land. English was the language of the settlers, and they regarded themselves as a British colony. But (in 1861) the British Government renounced all claim to the islands in recognition of Japan's right of possession. There is now regular steam communication ; the affairs of the islands are duly administered, and the population has grown to 4519. There are no mountains of any considerable height in the Ogasawara Islands, but the scenei-y is hilly with occasional bold crags. The vegetation is almost tropically luxuriant, palms, wild pineapples, and ferns growing profusely, and the valleys being filled with wild beans and patches of taro.~~

~~Mr R. Robertson catalogues a number of valuable timbers that are obtained there, among them being Tremana, cedar, rose-wood, iron- wood (red and white), box-wood, sandal, and white oak. The kekop tree, the orange, the laurel, the juniper, the wild cactus, the curry plant, wild sage, and celery flourish. No minerals have yet been dis- covered. The shores are covered with coral ; earthquakes and tidal waves are frequent, the latter not taking the form of bores, but of a sudden steady rise and equally sudden fall in the level of the sea ; the climate is rather tropical than temperate, but^ sickness is almost unknown among the residents. (f. by.)~~

~~Bonn, a town of Prussia, in the Ehine province, 21 miles by rail S. by E. from Cologne, on the left bank of the Ehine. The river is here crossed by a fine bridge (1896-98), 1417 feet in length, flanked by an embankment two miles long, above and parallel with which is the Coblenzer Strasse, with beautiful villas and pretty gar- dens reaching down to the Ehine. There is a new railway station, which is not only commodious, but also a handsome structure. The minster was restored in 1875 and following years, and in 1890-94 was adorned with paintings by Martin. The " Stiftskirche " has been rebuilt, 1879-84. "Der alte ZoU," commanding a magnificent view of the Seven Mountains, is the only remaining bulwark of the old fortifications, the Sternthor having been lately removed in order to open up better communication with the rapidly increasing western suburbs and the terminus of the light railway to Cologne. The Eoman Catholic archiepiscopal theological college, beautifully situated on an eminence overlooking the river, dates from 1892, and the provincial museum of antiquities from 1889-93. In 1889 a museum of Beethoven relics, &c., was opened in the house in which the musician was born. There are further a municipal museum, arranged in a private house since 1882, the academic art museum (1884), with some classic originals, a creation of F. G.~~

~~s The Bonins are 500 miles from the main island of Japan.~~

~~Weleker, and the provincial museum, lying near the railway station, which contains a collection of mediaeval stone monuments and works of art,~~

~~besides a small picture gallery. Amongst the university institutions may be mentioned the physical institute, eye hospital, ear hospital, palseontological museum, on the south of the old town ; the pathological institute and medical schools on the north ; and the chemical laboratory, anatomical school, and physio- logical institute at Poppelsdorf. The university librarj^ now numbers some 250,000 vols, and about 1350 MSS. The university itself was in 1900 attended by 2162 students, and had 152 professors. One of the most con- spicuous features of Bonn, viewed from the river, is the pilgrimage (monastic) church of Kreuzberg (1627), behind and above Poppelsdorf ; it has a flight of 28 steps, which are so venerated that they used to be ascended on the knees. Here, too, are a large provincial lunatic asylum (1883) and an agricultural college. In the chief cemetery are the tombs of (amongst others) Niebuhr, A. W. Schlegel, Schumann, Bunsen, and Simrock; also, Schiller's wife. The town is adorned with a marble monument of the 1870-71 war (1877), and with a fine fountain (1879). There are but few industries, chiefly jute spinning and weaving, the manufacture 6t porcelain, flags, machinery, and beer, and saw-milling. There are considerable numbers of foreign residents, notably English, attracted by the natural beauty of the place and by the educational facilities it affords. Population (1885), 35,989 ; (1900), 50,741.~~

~~Bonny. See Nigebia.~~

~~Book-binding. — Eecent years have witnessed a marked revival of interest in the art of book-binding, which, since the death of Eoger Payne in 1797, had, in England, been wanting in vigour and originality. Con- currently with^ the revival of the easily appreciated artistic side of the subject, there has also arisen a remark- able development in the technical processes, owing to the invention of ingenious and delicate machinery which is capable of executing the work which has hitherto been always laboriously done by hand. The processes of fold- ing the printed sheets, and sewing them together on bands, rounding the backs when sewn, and of making the outer cases, covering them with cloth or leather, and stamping designs upon them, can now all be efficiently executed by means of machines. The saving in time and labour thus effected is very great, although it must be said that the old methods of carrying out the process of sewing and rounding the backs of books by hand labour were safer and stronger, as well as being~~

~~much less liable to bruise and injure the paper (Figs. 1, 2). These processes unfor- tunately are not only slow but also necessitate highly skilled labour. Already the larger trade binders utilize machines extensively and advantageously, but exclusively high-class trade- binders do not as yet materially depart from the older methods. Private binders have naturally no reason to use machines at all. Fine and delicate examples of large electrotype blocks have been very successfully used for the decoration of covers measuring about 11^ by 8 inches. For the decoration of book-covers in gold alone it is probable that in the near future more use will be made of such blocks produced by the aid of photography from drawings, or from ordinary working designs made out in lamp black on white paper.~~

~~Besides the large trade binders working mainly by the help of machinery, and producing a great quantity of bound work which is not expected to last long, there also exists in London a small class of art binders who work throughout upon the principles which have been con- tinuously in use for first-class work ever since about the 6th century, when vellum first began to be folded in quires. These binders are inaugurating what will in~~

~~due time be recognized as the 19th-century style of decoration for book-bindings. The initial impetus to this school can be traced to William Morris, who actually made some beautiful designs himself for book-bindings, to be executed both in gold and in blind. Although he pro- bably did not fully appreciate either the peculiar limitar tions or the possibilities of the art of gold-tooling on leather, nevertheless his genius guided him truly as to the spirit in which the designs should be conceived. The revived art soon reached its first stage of development under the guidance of Mr T. J. Cobden-Sanderson, who may fairly be considered as the founder of the modern school of design for gold-tooling on' book-covers, the pre-eminence and individuality of his work in this direction being proved by the number of his imitators. Among the most successful of his pupils is Mr Douglas Cockerel 1, whose work is distinguished by a marked originality of treatment, while it shows a scholarly appreciation of ancient methods. A number of women artists, both in England and in America, have already discovered in book- binding a fitting and lucrative field for their energies. One, Miss Sarah Brideaux, is not only skilled and original in her own work, but she has also given us much valuable literature on her subject. Miss E.~~

M. MacColl may claim to be the inventor of the small curved gold line produced by means of a tiny wheel, for though the

Fig. 1. — Section of back of book sewn on bands.

Fia. 2. — Section of same book after it has passed through the machine for rounding and backing.

possibility of producing such a line in blind was known for a long time, it was rarely used. The graceful curves and lines found on Miss NMacColl's work are designed for her by her brother, Mr D. S. MacColl. Miss Birkenruth recalls the highly decorative mediaeval binding by her use of jewels cut en cabochon, but set in morocco instead of gold or silver, and there are many others who are working well and earnestly at art binding with delicate skill and taste. Outside the inner circle of professional book-binders, there is now growing up a new profession indirectly, but nearly, affecting their productions. It is that of the designer for pictorial book-covers, especially those intended to be shown in colour on cloth or paper. It is probably true that first-rate book-bindings should be begun, carried forward, and finished entirely by the same artist from his own designs ; still, the decoration of a cheap binding with a colour picture or design stamped upon it in colour from blocks, may be considered purely an artist's province.

As a designer for gold-tooling in book-bindings Mr Lewis F. Day has already brought his unrivalled know- ledge into use. Mr A. A. Turbayne, himself a skilled finisher, is thoroughly conversant with the technical peculiarities of the art, and his designs consequently are pre-eminently workable. Mr Walter Crane and Mr Charles Ricketts have studied more especially pictorial art as applicable to book-covers.

Modem book-binding machines of all kinds are usually driven by steam-power, and in consequence of the necessary setting of most of them accurately to some particular size of book, they are

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not suitable for binding books of different sizes ; but the full advantage of them can only be taken in the case of a large edition of one book.

Seiciny ilachineCFig.Pj). — American patent book-sewing machines appear to be largely of German manufacture. They are of two kinds ; one sews the books on bands, either flat or round, and the

Fig. 3. — Stitchin'? Machine.

other supplies the place of bands by a kind of chain stitch. The band-working machines bring the return thread back by pulling it through the upper and lower edges of the back of each section, thereby to some extent weakening each section, but at the same

time this weakening can be to some extent neutralized by careful headbanding. The other system, wliere the band is replaced by a chain stitch, brings back the return thread inside each section ; the objection to this is that there is a flattening out of the back of the

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Fig. 4. —Case-making Machine.

book, which becomes a diflSculty when the subsequent operation of covering the book begins. The sections are sewn continuously in a long line, and are afterwards cut apart. The threads catch into hooked needles and are drawn through holes made by piercers set

to a certain distance ; a shuttle like that used in an ordinary sewing machine sews the inner thread backwards and forwards. Each section is placed upon a sort of metal saddle by the hand of the operator, one after the other, the machine working continuously

~~unless the action is cut off or controlled by a toot-lever or pedal. This machine is probably the type of the book-sewing machine of the future, as it is much quieter to work than tlie otlier, and although the inner threads are too bulky to be quite satisfactory, this is not a serious matter like the cutting of the upper and lower edges of the back already described, and, moreover, is probably capable of being either improved away or so minimized that it will become of small importance.~~

~~Bounding and Backvi(i Machine. — An American machine for rounding and backing sewn books has been placed on the market. It requires a rather elaborate and very careful setting of several parts to the exact requirement of each size to be worked. The sewn book with the back glued is caught in a clip and forced between two tight rollers, the result being that the hitherto fiat back is automatically turned into a rounded shape (Figs. 1 and 2). The book is then drawn forward, by a continuance of the onward movement, until it reaches the rounding plate, which is a block of steel with a — polished groove a little larger than the size required. This round- ing plate moves within a small arc by means of heavy counter- weights, and on the back of the book being strongly pressed against it, it receives the permanent form of the grodve cut in it, at the same time a strong grip on each side of the book causes the~~

~~Fig. 6. — Blocking Machine.~~

~~ledge to rise up along each outer edge of the back. This ledge it is which enables the boards to be subsequently fixed in such a way as to hinge on a line outside the actual and natural boundary of the book. Before the discovery of the possibility of producing this ledge, the boards of books hinged upon a line coincident with the inner edges of the back, the result of which was that when the book was opened there was an invariable tendency to open and pull away the few outer sections of the paper or vellum itself — a destructive and disagreeable jteculiarity. These machines are capable, after they are properly set, of rounding and backing about 760 volumes, of the same size, within an hour.~~

~~Casing Machine. — A German patent machine for making cases, or "case" covers (Fig. 4), for books, is produced by an American firm. It is a large and complicated machine, but beautifully effective. It contains altogether over fifty springs, some of which are very small, like watch fittings, while others are large and powerful. The machine is fed with pieces of cardboard cut exactly to the sizes of the required boards, other pieces cut to the size of the back, and a long roll of the cloth with which the cases are to be covered, and when set working the roll of chjth is gradually unwound and glued by contact with a roller, which is drawn along until it reaches a point where the two boards are ingeniou.sly dropped upon it one by one, then on again to where a long arm swings backwards and forwards, at each movement picking up a piece of cardboard for the back and placing it gently exactly upon the glued bed left for it between the two boards already fixed. Next, as the cloth passes along, it comes under the sharp influence of two rectangular gouges which cut out the corners, the remaining side pieces being gradually but irresi.stibly turned up by hollow raisers and flattened down by small rollers, a very delicate piece of machinery finishing the corners in a ma.sterly way. Then, lastly, an arrangement of raisers and rollers acting at right angles to the last mentioned turn~~

~~over and press out the remaining pieces of cloth. Of course each piece of cloth is cut across at the propier point before the turning up begins. This machine is capable of producing 1200 cases in an hour of any size that the machine will take.~~

~~Wiring Machine. — This executes a cheap form of sewing for keeping together thin parts of periodicals or tracts, and is simple in construction and use. It drives a short wire pin, bent at right angles at each end, through the folds of the sections of a book or through the entire thickness, sideways, after the manner of stabbing. The projecting ends, when through the substance of the paper, are bent over and flattened so as to grip firmly. The metal used for these pins was at first very liable to rust, and consequently did n)uch damage to the paper, near it, but this defect has novf been largely remedied. At the same time the principle of using hard metal wire instead of flexible hempen thread is essentially vicious, and should only be used as a temporary expedient for publications of little value.~~

~~Blocking 3Iachine (Fig. 5). — The machines now used for blocking designs upon book-covers are practically the same as have been employed for many years. Several small improvements have been introduced as to better inking of the rollers for colour work, and better heating of the blocks used for gold work. A blocking press is now, in consecjuence of the size of many of the blocks, a large and cumbersome machine, The block itself is flxed firmly in a strong metal bed, and a movable table in front of it is fitted with gauges which keep the cover exactly in its right place. F"or gold work the block is kept at the proper temperature by means of gas jets, and the cover being properly overlaid with gold leaf is passed, on its table, directly under the block and then pressed steadily upwards against it, lowered, drawn out, and the superfluous gold rubbed off. The same process is followed in the case of colour blocks, only now the block need not be heated, but is inked by means of a roller for each impression. A separate printing is necessary for each colour. These printings always require great care on the part of the operator, who has to watch the working of each pull very carefully, and if any readjustment is wanted, to make it at once, so that it is difficult to estimate at what rate they can be made. In the matter of gold blocking there must be great care exercised in the matter of the heat of the block, for if it is too hot the gold will adhere where it is not wanted, and if too cool it wfll not adhere where it is required. Great nicety is also necessary as to the exact pressure reciuired as well as the precise number of moments during which the block should be in contact with the gold, which is fastened to the cloth or leather by means of the solidiflcation by heat of egg albumen. Blocking presses are mainly of German make, but Scottish and English presses are also largely used.~~

~~Authorities. — Gruel (L.). Mannel de V amateur de Belieures. Paris, 1887. — Zaehnshorf (J. W.). The Art of Book-binding, 2nd ed. London, 1890, — Pkideaux (S. T.). Historical Sketch of Book- binding. London, 180.3. — Thoinan (K.). Les Belieiirs Fran<;ais. Paris, 189.J. — Horne (H. P.). The Binding of Books. London, 1894. — Fletcher (W. Y.). English Book-bindings in the British Museum. London, 1895. — Foreign Book-bindings in the British Museum. London, 1896. — Davenport (C. J.). Boyal English Book-bindings. London, 1890. — Cantor Lectures on Book-binditig. London, 1898. (c. D.)~~

~~Book Illustration. See Illustration.~~

~~Book-plates. — The value attached to book-plates, otherwise than as an object of purely personal interest, is comparatively modern. The stitdy of, and the taste for collecting, these private tokens of book-ownership hardly date farther back than a quarter of a century. Since then the book-plate, or ex-libris (to use a jargon term that is now finding its way into dictionaries), has become fully recognized as a small but attractive ofi'shoot of the general subject of bibliography. As a matter of fact, the book-plate, or printed label intended to indicate owiiershii^ in individual volumes, is nearly as old as the printed book itself. It bears very nuich the same relation to the hand- painted armorial or otherwise symbolical personal device found in medieeval manuscripts that the printed p)age does to the scribe's work. The earliest known examples of book-plates are German. AccordiugtoFriedrichWarnecke, of Berlin (one of the best authorities on the subject), the oldest movable ex-libris yet brought to light are certain woodcuts representing a shield of arms supported by an angel (Fig. 1), which were pasted in books presented to the Carthusian monastery of Buxheim by Brother Hildebrand Brandenburg of Biberach, about the year 1480 — the date~~

~~being fixed by that of the recorded gift. The woodcut, in imitation of similar devices in old MSS., is hand~~

~~Fia. 1, — Gift-plate of Hildebrand Brandenburg of Biberach to the Monastery of Buxheiin. Circa 1480.~~

~~painted. In France the most ancient ex-libris as yet discovered is that of one Jean Bertaud de la Tour- Blanche, the date of which is 1529 ; and in England~~

~~J^TfBacon eqties auratas (T rnagni jigtlli (lAngUae Cujios librum hunc bu bliothecae CantahrigJtcauit,~~

~~Fig. 2.— Book-plate of Sir Nicholas Bacon.~~

~~that of Sir Nicholas Bacon, a gift-plate for the books he presented to the University of Cambridge (Fig. 2). Holland comes next with the plate of a certain Anna van~~

~~der Aa, in 1597 ; then Italy with one attributed to the year 1622. The earliest known American example is the plain printed label of one John Williams, 1(579.~~

~~A sketch of the history of the book-plate, either as a minor work of symbolical and decorative art, or as an accessory to the binding of books, must obviously begin in Germany, not only because the earliest examples kno^\^l are German, but also because they are found in great numbers long before the fashion spread to other countries, and are often of the highest artistic interest. Albert Durer is known to have actually engraved at least six plates (some of very important size) between 1.50.3 and 1516 (Fig. .3), and to have supplied designs for many others. Several notable plates are ascribed to Lucas (.'ranach and to Hans Holbein, and to that bevy of so-called " Little Masters," the Behams, Virgil Soils, Matthias Zundt, Jost Amman, Saldorfer, Georg Hlipschmann, and others. The~~

~~Fig. 3.— Boolt-plate of Lazarus Spengler, by Albert Diirer (1D15).~~

~~influence of these draughtsmen over the decorative styles of Germany has been felt through subsequent centuries down to the present day, notwithstanding the invasion of successive Italian and French fashions during the 17tli and 18th centuries, and the marked effort at originality of composition observable among modern designers. The heavy, over-elaborated German " style " never seems to have invaded neighbouring countries ; but since it was undoubtedly from Germany that was spread the fashion of using ornamental book-plates as marks of possession, the history of German ex-libris remains on that account one of high interest to all those that are curious in the matter.~~

It was not before the 17th century that the movable ex-libris became tolerably common in France. Up to that time the more luxurious habit of stamping the cover with a personal device had been in such general favour with book-owners as to render the use of labels super-

fluous. From tlie middle of the centuiy, however, the e.c-libris proper became quite naturalized; examples of that period are very numerous, and, as a rule, are very handsome. It may here be pointed out that the expres- sion ex^Ubris, used as a substantive, which is now the recognized term for book-plate everywhere on the Conti- nent, found its origin in France. The words only occur

Convirs LauJomnsLi TV-

Fio. 4.— Book-plate of P. A. Convers, 1762.

in the personal tokens of other nationalities long after they had become a recognized inscription on French labels. In man}^ ways the consideration of the English book- plate, in its numerous " styles," from the late Elizabethan to the late Victorian period, is peculiarly interesting. In all its varieties it reflects with great fidelity the jjre- vailing taste in decorative art at different epochs. Of English examples, none thus far seems to have been dis- covered of older date than the gift-plate of Sir Nicholas Bacon ; for the celebrated, gorgeous, hand-painted, ar- morial device attached to a folio that once belonged to Henry VIII., and now reposes in the King's Library, lU'itish Museum, does not come under the head of book- plate in its modern sense. The next is that of Sir Thomas Tresham, dated 1585. Until the last quarter of the 17tli century the number of authentic English plates is very limited. Their composition is always remarkably simple, and displays nothing of the German elaborateness. They are as a rule very plainly armorial, and the decoration is usually limited to a symmetrical arrangement of mantling, with an occasional display of palms or wreaths. Soon after the Restoration, however, a book-plate seems to have suddenly become an established accessory to most well- ordered libraries. Book-

~~plates of that period offer very distinctive characteristics. In the simplicity of their heraldic arrangements they recall those of the previous age; but their physiognomy is totally different. In the first place, they invariably display the " tincture " lines and dots, after the method originally devised in the middle of the century by Petra Sancta, the author of Tesserce OentUitice, which by this time had become adopted throughout Europe. In the second, the mantling assumes a much more elaborate appearance — one that irresistibly recalls that of the periwig of the period — surrounding the face of the shield. This style was undoubtedly imported from France, but it assumed a~~

~~character of its own in England. As a matter of fact, thenceforth until the dawn of the French Revolution, English modes of decoration in book-plates, as in most other chattels, follow at some years' distance the ruling French taste. The main characteristics of the style which prevailed during the Queen Anne and early Georgian periods are : — ornamental frames suggestive of carved oak, a frequent use of fish-scales, trellis, or diapered patterns, for the decoration of plain surfaces ; and, in the armorial display, a marked reduction in the importance of the mantling. The introduction of the scalloi:>-shell as an almost constant element of ornamentation gives already a foretaste of the RoraiUe-CoqniUe, the so-called " Chip- pendale " fashions of the next reign. As a matter of fact, during the middle third of the century this " Rococo " style (of which the Convers plate (Fig. 4) gives a toleralDly typical sample) affects the book-plate as universally as all other decorative objects. Its chief element is a fanciful arrangement of scroll and shell work with curveting acanthus-like sprays — an arrangement which in the exam- ples of the best period is generally made asymmetrical in order to give freer scope for a variety of countercurves. Straight or concentric lines and all ajopearances of flat surface are studiously avoided ; the helmet and its sym- metrical mantling tends to disappear and is replaced by the plain crest on a " fillet." The earlier examples of this " Chippendale " manner are tolerably ponderous and simple. Later, however, the composition becomes exceedingly light and complicated ; every conceivable and often incongruous element of decoration is introduced, from cupids to dragons, from flowerets to Chinese pagodas. During the early part of George III.'s reign there is a return to greater sobriety of ornamentation, and a style more~~

truly national, which may be called the " Urn " style, makes its appearance. Book-plates of this

Fig. 5.— Book-plate of Francis Gwyn of Lansanoi-, lOUS.

period have invariably a physiognomy which at once recalls the decorative manner made popular by archi- tects and designers such as Chambers, the Adams, Josiah Wedgwood, Hepplewhite, and Sheraton. The shield shows a plain spade-like outline, manifestly based upon that of the pseudo-classic urn then so much to the fore. The ornamental accessories are symmetrical palms and sprays, wreaths and ribbands. The archi- tectural " boss " is also an important factor. In many plates, indeed, the shield of arms takes quite a subsidiary

Book-plate of Koijert Pinknev. By Thomas Bewkk.

(TARLRiCKELJiSSf

FREIHERRLy.LIPPERHEIDE'scHE BfeJCHERSAMMLUNG

Nr.

BoOK-TLATE (IF ClIAKl.KS UtXTKIl Al.LliN. By E. D. FkENCH.

{Rt'liroductd btj Process/rvtn onrjinal Emjr'avin'j.)

BcM)K-PLATE OF Fheiiierr V. Li pi'iiKHEiiJE. By Karl Rickelt.

BiiOK-PLATE iiK Sir Arthur A'h ars. By C. W. Siierborx.

yRi-jji-o'liiri^d III/ Pr:'c>^ssjr'>ui "nijuu.'l Euiiraiiinj.)

BOOKPLATES

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position by the side of the predominantly architectural urn. From the beginning of the 19th century, until com- paratively recent days, no special style of decoration seems to have established itself. The immense majority

~~of examples display a plain shield of arms with motto on a scroll below, and crest on a fillet above. Of late years, however, a rapid impetus appears to have been given to the designing of ex-libris ; a new era, in fact, has begun for the book-plate, one of great interest.~~

~~The main styles of decoration (and these, other data being absent, must always in the case of old examples remain the criteria of date) have already been noticed. It is, however, necessary to point out that certain styles of composition were also prevalent at certain periods. Many of the older plates (like the majority of the most modern ones) were essentially pictorial. Of this kind the best defined English genus may be recalled : the " Library~~

~~Fia. 6.— Book-plate of William Hewer, 1699.~~

~~Interior "—& term which explains itself — and " Book- piles," exemplified by the ex-libris (Fig. 6) of W. Hewer (Samuel Pepys's secretary). Wehave also many "Portrait- plates," of which, perhaps, the most notable are those of Samuel Pepys himself and of John Gibbs, the architect ; "Allegories," such as were engraved by Hogarth, Bartolozzi, Pine, and George Vertue ; " Landscape-plates," by wood engravers of the Bewick school (see Plate), &c. In most of these the armorial element plays but a secondary part.~~

~~Concerning the taste for collecting book-plates, it may be said that it originated in England. The first impetus was given to it by the appearance of the Guide by the late Lord de Tabley (then the Hon. Leicester "Warren) in 1880. This work, highly interesting from many points of view, established what is now accepted as the general classification of " styles " : " Early Armorial " (i.e., previous to Restoration, exemplified by the Nicholas Bacon plate) ; " Jacobean," a somewhat misleading term, but distinctly understood to include the heavy decorative manner of the Restoration, Queen Anne, and early Georgian days (the Lansanor plate, Fig. 5, is typically « Jacobean ") ; " Chippendale " (the style above described as Rococo, tolerably well represented by the French plate of Convers) ; " Wreath and Ribbon," belonging to the period described as that of the " Urn," &c. Since then the literature on the subject has grown considerably.~~

~~Societies of collectors have been founded, first in England, then in Germany and France, and in the United States, most of them issuing a "~~

~~Journal ” or ’’ Archives ” : Tlie Journal of the Ex-libris Society (A. and C. Black, London), the Archives de la sociiti frangaise de collectionneurs d’ex- lihris (Paris), both of these monthlies ; the Ex-libris Zeitschrift, Berlin, a quarterly.~~

~~Much has been written for and against book-plate collecting. If, on the one hand, the more enthusiastic ” ex-librists ” (for such a word has actually been coined) have made the somewhat ridiculous claim of ” science ” for ” ex-librisme,” the bitter animadversion, on the other, of a certain class of intolerant bibliophiles upon the ” vandalism ” of removing book-plates from old books has at times been rather extravagant. Book-plates are un-doubtedly very often of high interest (and of a value often far greater than the odd volume in which they are found affixed), either as specimens of bygone decorative fashion or as personal relics of well-known personages. There- can be no question, for instance, that engravings or- designs by artists such as Holbein and Dtirer and the ” Little Masters ” of Germany, by Eisen, Gravelot, Chodo- wiecki, or Gribelin ; by W. Marshall, Faithorne, David Loggan, Sir Robert Strange, Piranesi; by Hogarth, Cipriani, Bartolozzi, Sherwin, Henshaw, Hewitt, or Bewick and his imitators ; or, to come to modern times, that the occasional examples traced to the handicraft of Thomas Stothard, Thackeray, Millais, Maclise, Bell Scott, T. G. Jackson, Walter Crane, Caldecott, Stacy Marks, Edwin Abbey, Kate Greenaway, Gordon Browne, Herbert, Railton, Aubrey Beardsley, Alfred Parsons, D. Y. Cameron, Paul Avril — there can indeed be no doubt that- these things are worth collecting.~~

~~Until the advent of the new taste the devising of book-^ plates was almost invariably left to the routine skill of the heraldic stationer. Of late years the composition of personal book-tokens has become recognized as a minor branch of a higher art, and there has come into fashion an entirely new class of designs which, for all their wonderful variety, bear as unmistakable a character as that of the most definite ” styles ” of bygone days. Broadly speaking, it may be said that the purely heraldic element tends to , become subsidiary and the allegorical or symbolic to assert itself more strongly. Among modern English artists who- have more specially paid attention to the devising of book-plates and have produced admirable designs, may be mentioned C. W. Sherborn, G. W. Eve, Robert Anning Bell, J. D. Batten,~~

~~Erat Harrison, J. Forbes Nixon,. Charles Ricketts, John Vinycomb, John Leighton, and the late Warrington Hogg. The development in various directions of " process " work, by facilitating and cheapen- ing the reproduction of beautiful and elaborate designs, has no doubt helped much to popularize the book-plate — a thing which in older days was almost invariably restricted to ancestral libraries or to collections otherwise important. Thus the great majority of modern plates are reproduced by " process." There are, however, a few artists left who devote to book-plates their skill with the graver. Some of the work they produce challenges comparison with the finest productions of bygone engravers. Of these the best known are C. W. Sherborn (see Plate) and G. W. Eve in England, and in America E. D. French of New York City (see Plate). The process work which it has been necessary here to employ in reproducing book-plates of this kind cannot render justice to the exquisiteness of their treatment.~~

~~The curious in the matter of book-plate composition will find it treated in the various volumes of the Ex- libris Series (London : George Bell and Sons) ; and almost every other item of information in the following works : —~~

~~Poulkt-Malassis. Les Ex-Libris Frani;ais. Paris, 1875. —~~

~~s.n.-39~~

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~~BOO K-P E I N T I N G — B 0 0 T H~~

~~Hon. J. Leicester "Warben [Lord de Tabley]. A Guide to .the Study of Book-plates. London, 1880.— Sir A. W. Franks. Notes on Book-plates, 1574-1800 [Private]. London, 1887.— Friedrich Waenecke. Die Deutschen Bilcherzeichen. Berlin, 1890.— Henri Boochot. Les Sx-Libris et les Marques de Posses- sion du Liiire. Paris, 1891. — Egerton Castle. English Book- plates. G. Bell and Sons, London, 1892. — Walter Hamilton. French Book-plates. G.Bell and Sons, London, X?,^.— Dated Book- plates. G. Bell and Sons, London, 1895. — H. W. Fincham. Artists and Engravers of British and American Book-plates, 1897. — German Book-plates, by Count~~

~~K. E. zu Leiningen-Westerburg, translated by G. R. Dennis. G. Bell and Sons, 1901. (e. ca.)~~

~~Book-Printing. — The latest development in print- ing, in which each component of a book is controlled by a sense of harmony and beauty, owes its conception .and realization to William Morris, and takes definite form in the founts and books of the Kelmscott Press. Previous efforts by Morris himself, Mr Daniel of Oxford, and others, count only as experiments towards a tasteful use of material to hand. The great originality of the Kelm scott books lies, not merely in the order and design shown in their " build " and decoration, but in the vivifying of each part from type to paper by a high order of design and excellence. Herein they differed in 1891 in all essentials, and in many new particulars, from all other modern books both in aim and aspect.~~

~~The Kelmscott Press is distinguished by the use of three founts designed by William Morris. The Troye and Chaucer founts, both of them Gothic, named after books in which they first appeared, are best fitted for ornamented mediseval works. These books owe their chief interest to the bold and handsome decoration by Mr Morris, and to woodcuts after designs by Sir Edward Burne-Jones ; one of the most noteworthy examples is the " Chaucer," of :a page of which we are, by the special permission of William Morris's trustees, enabled to give a reduced facsimile (p. 271). In Swinburne's Atalanta in Calydon we note the partial failure of this order of type to fit the character of a modem book. In the Golden or Roman fount lie the strength and future of the Kelmscott Press as an influence on type. The Golden type is without the -exaggerated contraction of form laterally, the exaggerated use of thick and thin strokes, or the vicious stroke-terminations common -to modern founts. It is a type of full body, designed in careful relation to the up-and-down strokes, and resting upon solid serifs, as with Jenson, for instance, but in detail more allied to fine pen- manship or even black letter. The character of the decoration in the Kelmscott pages is stamped with the vigour which one expects from a designer of Morris's importance. Usually on a black ground, the forms combine a northern character in thistle leaf and com- posite flower, with a fluency of curve comparable to the famous borders of Ratdolt of Venice.~~

~~The Vale books, often classed by writers and collectors with the Kelmscott, may be counted with them so far as they also are singular in being controlled by one designer, from the important matter of type, decoration, and illustration, to that of "build" and press-work. The first Vale book in which each of these conditions was achieved is Milton's Minor Poems (1896). In this the Roman type, known as the Vale fount, designed by Charles Rioketts, differs from the Venetian and Kelmscott founts by a greater round- ness or fulness of body, and in a modification of details by the •conditions of type-making. The second fount used in the Vale issues, first employed in The Plays of Shakespeare (1896), is less round in body, more traditional in detail, and lighter in effect. ' To be mentioned with the foregoing are some half-dozen books, printied by L. Pissarro in the Vale fount at his press, "The Eragny Press," with woodcut decorations. They are unique iij the revival ■of printing by the occasional use of colours and gold.~~

~~No other books have hitherto combined the conditions specified •of new type, woodcut decoration, original woodcuts, and personal control. Two American founts, adapted from Morris, are tenta- tively used by publishers. Mons. Grasset, in France, has designed an eclectic fount, but none of these can be associated with a special press or series of notable books. Recently, however, Messrs Sanderson and Walker have recut Jenson's fount and established the Doves Press, conspicuous for its taste and technical excellence.~~

~~A certain number of technical conditions had to be faced in the revival of printing for the first time in late years, i.e., the print- ing of woodcuts on hand-made paper, and the printing of borders and initials in the body of the text ; both in pitch and in sustained evenness of tone the Kelmscott Press (notably in the Chaucer) remains unsurpassed. The inking-up process employed to achieve the above conditions is a very gradual one. The paper ■chosen for its regular thickness is, moreover, slightly damped.~~

~~to avoid a gritty aspect in the blacks ; hence the delicate embossed appearance of the pages, and the absence of all overloading with ink. In the manipulation of English or " Roman " vellum the consistency of the inks used is even greater, the vellum, of course, not being damped. The so-called~~

~~“Roman” vellum is made at Brentford. The vellum used for the Kelmscott Chaucer was damped.~~

~~Authorities. — Articles on the revival have appeared in the Athenoium, the Saturday Review, Magazine of Art, The Studio, and the Contemporary Review. More detailed and more accurate information will be found in A N.ote by William Morris on his Aims in founding the Kelmscott Press. Kelmscott Press, 1898. — Flodry. De la typographie et de Vharmonie de lapage imprimee. Paris.— Hacon and Ricketts. A Defence of the Revival of Printing. — See also article, Morris, William. (c. Ki.)~~

~~Boom, a town of Belgium, in the province, and 10 miles S. by rail, of Antwerp. , Its numerous manufactures include boat-building, sail-making, and extensive brewing. Population (communal) (1880), 12,657 ; (1897), 14,971.~~

~~Boone, capital of Boone county, Iowa, U.S.A., situated on Des Moines river, near the centre of the state, at an altitude of 1134 feet. Two railways cross here, the Chicago and North- Western, and the Des Moines, Northern and Western. Population (1880), 3330 ; (1900), 8880.~~

~~Booth, Charles (1840), English sociologist,~~

~~was born at Liverpool on 30th March 1840, and has been since 1862 a partner in Alfred Booth and Company, a Liverpool firm engaged in the Brazil trade. He has for many years past devoted his time, and no inconsiderable sums of money, to inquiries into the statistical aspects of social questions. The results of these are chiefly embodied in a work entitled Life and Labour of the People in London, of which the earlier portion appeared under the title of Life and Labour in 1889. The nine volumes that have appeared deal only with East, Central, and Southern London. The book is designed to show ” the numerical relation which poverty, misery, and depravity bear to regular earnings and comparative comfort, and to describe the general conditions under which each class lives.” It contains a most striking series of maps, in which the varying degrees of poverty are represented, street by street, by shades of colour. The data for the work were derived in part from the detailed records kept by school-board ” visitors,” partly from systematic ijiquiries directed by Mr~~

~~Booth himself, supplemented by information derived from relieving officers and the Charity Organization Society. Mr Booth has also paid much attention to a kindred subject — the lot of the aged poor. In 1894 he published a volume of statistics on the subject, and, in 1891 and 1899, works on " Old Age pensions," his scheme for the latter depending on a general provision of pensions of five shillings a week to all aged persons, irrespective of the cost to the State.~~

~~Booth, Edwin (Thomas) (1833-1891),- the most famous of American tragic actors, was born in Harford county,Maryland, 13th November 1833. His father, Junius Brutus Booth (1796-1852), was an elevated and powerful, if erratic, English tragedian who had emigrated to the United States. Edwin's first regular appearance was in 1849 as Tressel in " Richard III.," and he early played Wilford in " The Iron Chest." He was a youthful Apollo, lithe and graceful in figure, buoyant in spirits. His dark hair fell in waving curls across his brow, and his glowing eyes were soft and luminous, and most expressive. His father watched him with great interest, but with evident disappointment, and the members of the theatrical pro- fession, who held the acting of the elder Booth in great reverence, seemed to agree that the genixis of the father had not descended to the son. It was not until after his parent's death that the son showed any histrionic talent. Between 1852 and 1856 he played in California, Australia,~~

~~iVlfl~~

~~X have no wommcn euffisaunt ccrtayn ■Che cbambres for tarraye in ordinaunce Hf ter my lust, and tberfore wolde 1 fsyn "Chat tbyn were al swicb mancre govemaunce: Cbou hnowcst ech of old al my plesaunce; ■Cbogb tbyn array be badde and yvcl biseye. Do tbou tby devoir at the leeste wcy e.~~

~~j^^HC oonly, lord, thatlam glad, quodsbe,' oMifl Co doon youre luet, but I desire also afflsp' \o-n for to serve and plese in my degree Slitbouten fCyntyng, and sbal everemo; J>f e nevere, for no wcle ne no wo, fJe sbal the goost -witbinne myn bertc stente Co love yow best witb al my trewe entente.~~

~~J^En d with that word she gran the hous to digbte,~~

~~Hnd taj^les for to sette and beddes mahe ; Hnd peyned hire to doon al tbat abe mygbte, preyynge tbe cbambercres ftor (3oddes sahe Co hasten hem, and faate swepe and abahe; Hnd she, the mooste servysable of alle, Rath every cbambrc arrayed and bis balle. i~~

~~^^BOClce]^ undren gan this ert aligbte, ^^1 Chat with him brogbte tbiee noble~~

~~i children tweye, for which the peple ran to seen the sighte~~

~~Of birearray.soricbely biseye; Hnd thanne at erst amonges hem they seye, IChatdalterwas no fool, tbogh thathym leate •Co cbaunge bis wyf, ftor it was fox the. teste.~~

~~for she is fairer, as they deemen alle, ^ than ia Griailde,and moorc tendre of age, Hnd fairer fruy t bitwene hem abolde falle, Hnd moore plesant, for hire heigh lynage ; Bir brother eeh so faire was of visage, ■Chat hem to seen the peple hath caught plesaunce, ^~~

~~Commendyngenow themarhysa9y£m4unce.~~

~~Huctor _~~

~~SCORMYpcptel uneadanct~~

~~evereuntrewel~~

~~Hy undiscreetand cbaungynge~~

~~as a vane,~~

~~Delitynge evere Cn rumbul tbat~~

~~ia newe,~~

~~for ly h the moone ay wexe ye and wane; Hy f ul of clappyng, deere ynogh ajane; ■~~

~~H ful greet foot is he tbat on yow leevetbt~~

i^Chua acyden sadde fblh in tbat citee glban that the peple gazed up an d doun.

Heduckd Facsimile of a Page of the Kelmscott Chadcbb. (5y permis&ion of Witliavi Morrises Trustees.')

and the Sandwich Islands, and those who had known him in the East were surprised when the news came that he had captivated his audiences with his brilliant acting. From this time forward his dramatic triumphs were warmly acknowledged. There was no dissenting voice. His Hamlet, Richard, and Richelieu were pronounced to be superior to the performances of Edwin Forrest. In 1862 he became manager of the Winter Garden Theatre, New York, where he made a series, of Shakespearean pro- ductions of then unexampled magnificence (1864-67), in- cluding "Hamlet," "Othello," and "The Merchant of Venice." In 1868-69 he built a splendid theatre of his own — Booth's Theatre — and organized a stock company. The company was headed by such actors as Edwin Adams, Lawrence Barrett, Edwin L. Davenport, and J. W. Wallack, Jr., and was of extreme excellence. It gave splendid pro- ductions of "Romeo and Juliet," "The Winter's Tale," " Julius Caesar," " Macbeth," " Much Ado about Nothing," "The Merchant of Venice," and others. In all cases Booth used the original text of Shakespeare, thxis ante- dating by many years a similar reform in England. Besides this. Booth's theatre presented a series of attrac- tions by the leading actors and companies of the United States. Almost invariably his ventures were successful ; but he was of a generous and confiding nature, and his management was not economical. In 1874 the grand dramatic structure he had raised was taken from him, and with it went his entire fortune. By arduous toil, how- ever, he again accumulated wealth, in the use of which his generous nature was shown. He converted his spacious - residence in Gramercy Park, New York, into a club — The Players' — for the elect of his profession, and for such members of other professions as they might choose. The house, with all his books and works of art, and many invaluable mementos of the stage, became the property of the club. A single apartment he kept for himself. In this he died on 7th June 1891.

~~Among his parts were Macbeth, Lear, Othello, lago, Shylock, Wolsey, Richard II., Richard III., Benedick, Petruccio, Richelieu, Sir Giles Overreach, Brutus (Payne's), Bertuccio (in Tom Taylor's " The Fool's Revenge "), Ruy Bias, Don Cesar de Bazan, and many more. His most famous paA was Hamlet, for which his extraordinary grace and beauty and his eloquent sensibility peculiarly fitted him. He probably played the part oftener than any other actor before or since. He visited London in 1851, and again in 1880 and in 1882, playing at the Haymarket Theatre with brilliant success. In the last year he also visited Germany, where his acting was received with the highest enthusiasm. His last appearance was in Brooklyn as Hamlet in 1891.~~

~~Edwin Booth's prompt books were edited by William Winter, 1878. In a series of volumes, Actors and Actresses of Great Britain and America, edited by Lawrence Button and Brander Matthews, Edwin Booth contributed recollections of his father, which con- tain, much valuable autobiographic material. For the same series I/awrence Barrett contributed an eloquent article on Edwin Booth. Life and Art of Edwin Booth, by William Wintek, 1893. Edwin Booth, by Lawbence Hutton, 1893. (j. j.*)~~

~~Booth, William (1829-), founder of the Sal- vation Army, was born at Nottingham on 10th April 1829. At the age of 15 his mind took a strongly reli- gious turn, under the influence of the Wesleyan Methodists, in which body he became a local preacher in the year following. In 1849 he came to London, where, according to his own account, his passion for open-air preaching caused his severance from the Wesleyans. Joining the New Connexion, he was ordained a minister, but not being employed as he wished in active " travelling evan- gelization," left that body also. During this period he had married, and had now a family of four children. Both he and his wife occupied themselves with preaching,~~

~~first in Cornwall and then in Cardiff and Walsall. At the last-named place was first organized a "Hallelujah band'" of converted criminals and others, who testified in public of their conversion. In 1864 William Booth went to London and continued his services in tents and in the open air, and founded a body which was successively known as the East London Revival Society, the East London Christian Mission, the Christian Mission, and (in 1878) the~~

~~Salvation Army. The Army operates (1) by holding meetings out of doors, and marching singing through the streets, in harmony with law and order; (2) by visiting public-houses, gin-palaces, prisons, private houses, and speaking to and praying with all who can be got at ; (3) by holding meetings in theatres and the other common resorts of those who prefer pleasure to God, and turning factories and other strange buildings into meet- ing-rooms ; (4) by using the most popular song-tunes and the language of everyday-life, &c. ; (5) by making every convert a daily witness for Christ, both in public and private. The Army is divided into a quasi-military or- ganization, and Booth modelled its " Orders and Regula- tions " on those of the British army. The " campaigns " of the Army excited violent opposition, a " Skeleton Army" being organized to break up the meetings, and for many years Booth's followers were subjected to fine and imprisonment as breakers of the peace. Since 1889, however, these disorders have been little heard of. The operations of the Army were extended in 1880 to the United States, in 1881 to Australia, and have since spread to the Continent, to India, Ceylon, and elsewhere. The wife of Mr Booth (n^e Kate Mumford), whom he married in 1855, was actively associated with him in his work, more especially in preaching. In 1869 she published a pamphlet, entitled Female Teaching, in defence of women as preachers. Mrs Booth died in 1890. In 1890 Mr Booth attracted public attention by the publication of a work entitled In Darkest England, and the Way out, in which he proposed to remed^ pauperism and vice by a series of ten expedients : (1) the city colony ; (2) the farm colony ; (3) the over-sea colony ; (4) the household salvage brigade; (5) the rescue homes for fallen women; (6) deliverance for the drunkard; (7) the prison gate brigade; (8) the poor man's bank; (9) the poor man's lawyer; (10) Whitechapel-by-the-sea. The scheme was much criticized, and has not been fully carried out, though a very large amount of money, for which Mr Booth appealed to the public, was subscribed to start it. In the year ending 30th September 1899 the Salvation Army possessed 68,000 " ofi&cers " ; and £52,000 was sub- scribed in Great Britain alone for its operations (apart from the " Darkest England " scheme).~~

~~Boothia, or Boothia Felix, a peninsula of Franklin district, British North America, is situated between 69° 30′ and 72° N. lat. and 91° 30′ and 97° W. long. It includes an area of 13,100 square miles.~~

~~Boothia Gulf, in the Arctic ocean, situated between 85° and 94° W. long, and 67° and 72° N. lat., separates the north-western portion of Baffin Land and Melville Peninsula from Boothia Peninsula. It is connected with Lancaster Sound by Prince Regent Inlet, with Franklin Strait by Bellot Strait, and with Fox Channel by Fury and Hecla Strait. The principal bays are Committee and Pelly in the southern portion, and Lord Mayor in the western.~~

~~Boppard, a town of Prussia, in the Rhine province, on the left bank of the Rhine, 12 miles S. of Coblenz, is an old town in part surrounded by mediaeval fortifica^ tions. Noteworthy buildings are the parish church (12th and 13th centuries) ; the Carmelite church (1318) ; the~~

~~former castle, noTV administrative ofl&ces ; the Evangelical church (1851, enlarged 1887) ; the hydropathic Marien- berg (1839), occupying a former Benedictine abbey, which crowned a hill 100 feet above the Ehine. Population~~

~~(1900), 5806.~~

~~Boras, a town of Sweden, province Elfsborg, 36 miles E. of Gothenburg by rail, on the river Wiske, with numerous cotton spinning And weaving mills. It was founded by Gustavus Adolphus in 1632, and has a mineral spring. Population (1880), 4723 ; (1898), 13,772.~~

~~Bordeaux, capital of the department of Gironde, and metropolis of south-western France, 359 miles from Paris by rail. It is one of the' finest cities of France, owing to its position on the left bank of the Garonne, its spacious quays, promenades, broad roads bordered with handsome buildings, and the animation of its streets and places of business. It is also rich in scientific institutions, which have recently taken new developments and ac- quired fine premises. The faculty of medicine and phar- macy, built between 1880 and 1888, is attended by 1200 students. The faculty of literature and science, built between 1881 and 1886, possesses the grave of Montaigne,~~

~~one of the most celebrated inhabitants of the district, whose body was transported here. It also contains numer- ous laboratories, and an astronomical observatory adjoins it. Attached to the natural history museum is a prehis- toric, anthropological and ethnographical museum, which has been furnished with valuable types by the grottos and caves of the Dordogne and Gironde. The Theatre Louis, burnt in 1888, was replaced in 1890 by the Theatre des Arts ; and in 1893 the Olympia replaced the former The- atre FranQais, burnt in 1855. A magnificent monument to commemorate, the Girondists and in honour of the re- public has been erected on the Place des Quinconces. The town of Bordeaux, formerly supplied by local wells and springs, acquired (1883-87) the spring of the Fontbannes, on the bank of the Ciron, thus securing a daily allowance of 40 gallons of water per head to 260,000 persons.~~

~~The works for the improvement of the port commenced during the Second Empire have been proceeded with. A vast wet dock with one mile of quayage, and capable of accommodating ships of 5000 tons, has been excavated. The bed of the river has been dredged to admit vessels of 2000-2500 tons each. On the borders of the new quays and the wet dock powerful cranes are set in motion by compressed water. A long timber boom has been constructed opposite the city on the right bank, where are also the chief ship-building yards, from which have issued a large number of ships of the national fleet. In 1899, 10,041 vessels (coasting included) entered the port, and 10,169 cleared, with a total of 3,776,548 tons. The value of exports reached £14,564,000, that of imports £12,788,000. 'Vf ine forms the staple article of Bordeaux trade. Twenty-two millions of gallons iii casks and a miUion bottles are exported annually, to which must be added the quantity despatched by rail. The total amount of this export is 66,000,000 gallons. The chief lines of steamers connect Bordeaux with the West Coast of Africa and with South America. The Basques who emigrated to Brazil and especially to La Plata, have established between France and those countries important relations. There is no part of the world which is not in regular communication with this important commercial port. Pine-wood is exported to England for the working of mines. The population of the town in 1886 was 225,281 ; in 1896, 239,806 ; in 1901, 257,471.~~

~~Bordentown, a borough of Burlington county. New Jersey, U.S.A., situated in 40° 08′ N. lat., and 74° 43′ W. long., on the east bank of Delaware river, 6 miles below Trenton, and on the Pennsylvania railway. It is the terminus of the Delaware and Earitan canal. Population (1880), 4258; (1900), 4110.~~

~~Bordighera, a winter resort of the province of Porto Maurizio, Liguria, Italy. It stands about midway between San Eemo and Ventimiglia, 91 miles W. by S. of Genoa by rail. Bordighera consists of the. New T(iwn, close down by the shore, the " Visitors' " Town,~~

~~on a gently rising plain behind it, backed by the Old Town and hills (600 to 1000 ft. in alt.). It is famous for its palms and other exotic plants, and grows large quanti- ties of flowers and lemons for export. Amongst its "lions" are the Villa Bischoffsheim and the Villa Garnier, the latter with wall-paintings by French artists. The parish church dates from 1648, and was restored in 1886. There are two museums, one containing Roman antiquities found on the Ligurian coast, paintings by Italian artists of the 17th century, and natural history collections, the other containing botanical and ethnographical collections. Pop- ulation, about 3600.~~

~~Borgerhout, a town of Belgium, in the province and 1 mile E. of the town of Antwerp, with a station on the railway between Antwerp and Brussels. Candles, cigars, and tobacco are among its mani^ifactures. Its Maison Gommunale, completed in 1890, is one of the finest in the district of Antwerp. Population (communal)~~

~~(1880), 20,268 ; (1897), 33,419.~~

~~Borgo, a town of Finland, 33 miles by rail N.E. of Helsingfors, situated on a river of the same name, at its entrance into a bay of the Gulf of Finland. It was here that the Chamber of Deputies framed, in 1802, the constitution of Finland. Trade, which is chiefly in furs, leather, &c., is hindered by the shallowness of the bay. Population, 4420.~~

~~Borgo San Sepoichro, a town and episcopal see of the province of Arezzo, Tuscany, Italy, 29 miles N.E. of Arezzo on the railway to Ancona, and on the river Tiber. It stands at the foot of Monte Maggiore, and is still surrounded by mediaeval town walls. Its chief claim to notice is as the~~

~~birthplace of Piero della Francesca, Kaffaello dal Colle, and Gherardi, whose paintings adorn the cathedral and other churches, the town picture-gallery, a large hospital (dating from 1466), and the Collacchioni house. A monument to the first named was erected in the public gardens in 1892. There is a technical school, and woollens are manufactured. Population of commune, about 8300 ; of town, about 3700.~~

~~Borgu. See Nigeria.~~

~~Borisov, a district town of Russia, government and 50 miles N.E. of Minsk. It is a very old town, mentioned in the 12th century. It was annexed to Russia after the first partition of Poland, and is famous for a battle fought in 1812, which compelled Napoleon I. to make the dis- astrous passage of the Berezina. Population, 14,900.~~

~~Borisovka, a village of Middle Russia, govern- ment of Kursk, near the Kursk to Kharkov railway, 32 miles from Byelgorod railway station. It has developed rapidly with the extension of the railway, and has a steam fiour-mill, and many tanneries, and carries on a lively business in corn, hides, leather, and holy pictures. Popu- lation, 16,420.~~

~~Borku. See Sahara.~~

~~Borkum, an island and summer resort of Prussia, the westernmost of the (German) East Frisian chain, lying between the E. and W. arms of the estuary of the Ems, and opposite to the DoUart. It belongs to the province of Hanover, and is visited by some 14,000 persons annually. The island affords pasture for cattle, and is a breeding- place for sea-birds. In the village of Borkum there are a couple of lighthouses, a Reformed church (1897), and a Roman Catholic chapel. Population, about 1350.~~

~~Bormio, an Alpine resort of the province of Sondrio, Lombardy, Italy, 35 miles N.E. of Sondrio. It stands 'at an altitude of 4380 ft. on the Adda and at the~~

mouth of the Turva valley, but enjoys a July mean temperature of 59°. Its mineral springs and baths were known to the Romans, and were frequented all through the Middle Ages. Their water is saline, with a temperar ture of 98-6° to 107-6°, and is used for drinking, as well as in mud baths, spray baths, steam baths, etc. In the Turva valley are the ferruginous springs and baths of Santa Caterina, 5801 ft. above sear-level. The village of Bormio is two miles below the baths. Population of commune, about 2000. ■

Borna, a town of Germany, on the Wirha emptying into the Pleisse, 17 miles S. by E. by rail of the town and in the circle of Leipzig, kingdom of Saxony. The indus- tries include peat-cutting, iron-foundries, organ, piano-forte, felt, and shoe factories. Population (1890), 7485 ;

(1900), 8422.

Borneo, next to New Guinea the largest island in the world, is situated about the middle of the East Indian archipelago, and extends from 7° N. to 4° 20′ S. lat., and from 108° 53′ to 119° 22′ E. long. It is some 760 miles long by 600 miles' maximum breadth ; its area, according to the more correct calculations of the Topographical Bureau at Batavia (1894), comprises 293,496 square miles. The highest mountain chains and plateaus in the centre are formed of granite and crystalline schists — ^the oldest formations of the island — varying with sandstone and grau- wacke. The surrounding coasts of the Borneo of that age, broken in all probability into a number of islands occupy- ing a much smaller area than does the present island, were a Tertiary deposition, buttressed with the ddbris of the older formations borne down by rivers and with the chalk of foraminifera and corals. Bordering the mountain chains and plateaus, the hills of Borneo are formed of Tertiary strata with their eruptive rocks (andesite and basalt). More recent formations, the diluvium, still em- bedding in it abundant platinum, diamonds, and metals of the primary formation, and the alluvium of sea and rivers, next filled up gulfs, bays, and basins of the earlier Borneo, spread out its coasts, built up its higher and lower plains, and thus pieced out the island to its modern dimensions. The explorations of Professor MolengraafE have proved that there is no proper nucleus of mountains whence chains ramify in different directions. The centre, however, of the island is occupied by three mountain chains and a plateau, namely — 1st.

~~The folded chain of the Upper Kapuas, dividing the western division of Dutch Borneo from Sarawak, extending W.S.W. to E.N.E., end- ing probably in Bern, and attaining near the sources of the Kapuas a height of 5500 to 6000 feet. To this chain belongs the plateau of the Baram river. 2nd. TheSchwaner plateau, south of the Kapuas, with summits ranging from 3000 up to 7500 feet in the Bukit Eaja, a plateau dividing the waters of the Kapuas from the rivers of South Borneo. 3rd. The high plateau of Madi (3000 to 4000 feet), clothed with tropical high fens. 4th. The Miiller chain of moun- tains, between the Madi plateau and the Kapuas chain, a volcanic region presenting heights that were once active volcanoes, such as Bukit Terata (4700 feet), long extinct. The chains and plateaus extend all in a W. to E. direction. They are homologous in structure with the mountains, not of Celebes or Halmaheira, but of Malacca, Banka, and Billiton. Eimmed round with low alluvial lands, and resting on a submarine plateau of no great depth, the coasts of Borneo are marshy, sandy, sometimes of the character of sawahs, presenting cliffs or mudbanks to the sea, which round the shore has a maximum depth of but 1 to 3 fathoms. The coast offers, therefore, few access- ible ports. The towns and seaports are to be found at such river mouths as are not barricaded by sandbanks or~~

~~mudbanks. All round the island there are but seven places at which the steamers of the Dutch Packet Company call — Pontianak, Banjermasin, Kota Baru, Pasir, Samarinda, Bern, and Balungan. The rivers play a very important part in the economy of Borneo, as high- ways and as the lines along which run the main arteries of population. Within recent years the exploration of nearly all the larger rivers has been advanced. The most im- portant are those having their outlet at the west coast : the Sambas, navigable in its lower course for vessels of 25′ feet draught, and the Kapuas, of volume varying with the tide and the amount of rainfall, normally navigable by small steamers and praus of 4 to 5 feet draught for 300 1» 400 miles, from Pontianak up to Sin tang, and thence as far as Benut. The mid- part of this river, shallower and broader than in its lower course, gives rise tq a region of inundations and lakes extending as far as the northern mountain-chain. Among its considerable tributaries may be mentioned the southern Melawi with its afB.uent the Pinuh. Of less importance in the way of commerce and navigation, but noticeable in the way of the political division of the country, are the Simpang, Pawan, and Kandawangan, with~~

~~the chief native villages at theii- mouths or on the seaboard near by. The Eejang, a. river of Sarawak, is navigable for over 100 miles. The southern rivers — Katingan, Kahayan or Great Dayak, the Kapuas Murung or Little Dayak, and the Barito — are- waters of capacious drainage, the Kahayan basin having an area of 16,000 square miles, and the Barito of 38,000′ sqiiare miles. These rivers are navigable for two-thirds of their course by larger steamers ; but in many cases their mouths are barred by banks of sand or mud which cannot be cleared by ships of more than 8 or 9 feet draught. Most of the larger affluents of the Barito are, in the greater part of their course, also navigable. The largest river dis- charging at the east coast is the Kutei, which at a great distance from its mouth has still a depth of three fathoms,, and in all its physical features is comparable with the Kapuas and the Barito.~~

~~Climate. — Throughout Borneo the temperature averages 78-8° to 80° Fahr., with very slight variations. The rainy W. (S.W. and N.W.) wind prevails at all the meteorological stations, not the comparatively dry S.E. wind. Even at Banjermasin the N.W. wind brings an annual rainfall of 60 inches, against 33 inches of rain carried by the S.E. wind.~~

~~Minerals. — Since 1875, Dr Posewitz and mining engineers have more exactly defined the distribution of diamonds, gold, platinum, quicksilver, iron, tin, &c., and have discovered new mineral regions. The exploitation of the mines suffers, however, from inadequate means of export, the high duties payable to the native princes, the competition among the rival companies, and the often too limited quantities of minerals found in-the mines. In WestBornea the production of gold during 1895-99 amounted to from one to two million florins annually. The Asahan mines of Orange Nassau and of Kutei yield some thousands of tons annually. In Sarawak a coal mine at Sadong yields nominally 130 tons daily, though now actually much less. Another coal mine at Brooketon yields 50 tons daily, an output which cannot but Increase indefinitely. It is only now that a serious attempt is being made to work the mineral oil known to exist in Sarawak. The Borneo Com- pany are working gold mines in Upper Sarawak under a large staff of Europeans, and the mines are known to offer good prospects. ‘~~

~~Fauna and Flora. — Animals of economic value are the sea- swallows, whose edible nests are prized as the best in the archi- pelago ; bees yielding wild wax ; the elephant ; the civet ; the ciawan, a species of fish found in the rivers and valued for its spawn, which is salted ; the turtle ; and the trepang, &c. Pearl- shell is also of commercial importance. Besides the ordinary products of the forests, rice is cultivated near the rivers and lakes and on ladangs in the forests ; sugar-cane of superior quality in Sambas and Montrado ; cotton on the banks of the Negara (a tributary of the Barito), sometimes exported in small quantities. Indigo, coffee, and pepper have been cultivated since 1855 in the western division of Dutch Borneo, and tobacco in both the eastern and western divisions, but rarely by Europeans, and of small commercial value.~~

~~Population. — The political division of Borneo is as follows : —~~

~~Dutch Borneo British N. Borneo Sarawak Brunei .~~

~~Population.~~

~~1,180,580~~

~~176,000~~

~~500,000~~

~~25,000~~

~~Total . . 1,880,680~~

~~Dutch Borneo. — Dutch Borneo is divided into two parts — the western, and the south and eastern division. The (estimated) population in each of the two divisions and their distribution according to races in 1896 were : —~~

~~Division.~~

~~European.~~

~~Chinese.~~

~~Arabs.~~

~~Other~~

~~Oriental~~

~~Foreigners.~~

~~Natives.~~

~~Total.~~

~~Western~~

~~S. and Eastern~~

~~302 598~~

~~37,735 4,542~~

~~1542 1534~~

~~437 116~~

~~330,759 803,015~~

~~370,775 809,805~~

~~In both divisions there is an average density of about 1 to every 2 square miles. The sparseness of population throughout the whole of the Dutch territory is due in part to the physical character of the country, but in part also to historic causes : the prejudicial influence in earlier times of Malayan, Arabian, Chinese, and Buginese colonists ; to wars, piracy, and head-hunting, now suppressed by the Dutch Government. Among the natives, nomadic life in the wide forests, poverty, insufficient nourishment,~~

~~feasts and other injurious habits,. have contributed to the mortality. In Sambas, Montrado, and some parts of Pontianak, the greater density of population is due to the greater fertility of the soil, the opening of mines, the navigation and trade plied on the larger rivers, and the concentration of population at the junctions of rivers, the mouths of rivers, and the seats of government. Pontianak has about 9000 inhabitants ; Sambas, 8000 to 9000 ; Montrado, Mampawa, Landak, between 2000 and 4000. In the south and eastern division, in Amui;itai and Martapura, Hindu colonization, the fertile soil, navigable rivers, and trade and industry have co-operated towards the growth of a population, in marked contrast with that in the interior parts of the Upper Barito and of the more westerly rivers.~~

~~Only a very small part of the Europeans in Dutch Borneo live by agriculture and industry ; the great majority of them belong to the Civil Service. The Arabs and Chinese are engaged in trading, shipping, mining, fishing, and agriculture. Of the natives 90 per cent, live by agriculture. Their industries are confined to the ordinary native crafts of spinning, weaving, and dyeing, the manufacture of iron agricultural implements, shipbuilding, &c. More particularly in the south-eastern division (in the districts of Negara, Banjermasin, Amuntai,. Martapura), shipbuilding, iron- forging, gold- and silver-smith's work, and the polishing of diamonds, are industries of high development in the larger centres of population : Banjermasin, with 40,000 inhabitants ; Marabahan, Amuntai, Negara, Samarinda, Tengarung, each with 5000 to 10,000 inhabitants.~~

~~British North Boeneo or Sabah.^~~

~~The State of North Borneo is the official term applied to the whole of that portion of the island of Borneo formally recognized by the Charter of Incorporation granted in November 1881 as the territory of the British North Borneo Company (see Chakteked Companies). It may roughly be said to form a pentagon, of which three sides, the north-west, north-east, and east sides are washed by the sea, while the remaining two sides, the west and the south, are bordered respectively by the independent Malayan Sultanate of Brunei, and by the territory of Dutch Borneo. The western boundary, with Brunei, is farmed by a purely conventional line drawn from Gura Peak (3° 50′ N. lat., 115° 10′ E. long.), to the mouth of the river~~

~~Sipitong on the west coast. The boundary between the Company's territory and that of Dutch Borneo is defined by a treaty concluded on 20th June 1891. It runs due east from Gura Peak to 115° 22′ E. long., and thence in a north-easterly direction until the 116th meridian is reached on parallel 4° 20′ N. lat.~~

~~1 Sabah is the name applied by the natives to certain portions of the territory in the west coast of Borneo, now under the control of the Chartered Company of British North Borneo, but it is doubtful how far this term can with propriety be applied to the whole of the territory.~~

~~Thence the boundary follows parallel 4° 10′ N. lat. until the 117th meridian is intersected, whence it dips to the' south-east until the coast is reached at Broers Hoek,. 117° 37′ E., and 4° 10′ N. The total area of the Company's territory is estimated at about 31,000 square miles, with a coast-line of over 900 miles. The greater portion is exceedingly mountainous, and the interior consists almost entirely of highlands, with here and there open valleys and plateaus of fifty or sixty square miles in extent. On the west coast the mountain range runs parallel with the seashore, at a distance of from fifteen to twenty-five miles. Of this range the great central feature is the mountain of Kinabalu (the Chinese Widow), built up of porphyritic granite and igneous, rocks to a height of 13,698 feet. Some fifteen or twenty miles to the north rises Mount Madalon (6000 feet). Inland, across the valley of the Pagalan river, which is. itself a double row of hills from 1000 to 2000 feet in height, with a few plateaus marking the scenes of former lakes, the great peak of Trus Madi rises to a height estimated at 11,000 feet above sea-level, and between its base and the east coast the country is again covered with mountains and hills of varying height and magnitude. The principal plateaus are those of the Tambunan and Kaningau valleys, in the basin of the Pagalan, and the Eanau plain to the eastward of the base of Kinabalu. Other similar plateaus of minor importance are alsa found dotted about the interior. The close proximity of the mountain range to the seashore causes the rivers on the west coast to be rapid boulder-obstructed streams, which, with the single exception of the Padas, are of little value as means of communication for a distance of more than half-a-dozen miles from their mouths. The Padas is navigable for light-draught steam-launches for a distance of about fifty miles, and boats can be punted up stream as far as~~

~~Eayoh, a distance of some seventeen miles farther. Here further passage is stopped finally by rapids, down which nothing can be brought, and even below Eayoh navigation is rendered difficult and sometimes dangerous by obstructions of a similar nature. The other principal rivers on the west coast are the Kalias, Kimanis, Benoneh, Papar, Kinarut, Putatan, Inanam, Mengkabong, Tampassuk, and Pandasan rivers, none of which, however, are of any great importance as means of communication. The Tampassuk is noted for a stout breed of pony, and also for Kalupis waterfall (1500 feet), one of the highest in the world. At the northern extremity of the island Marudu Bay receives the waters of the Marudu,. which rises on the west side of Mount Madalon. On the- east coast the principal rivers are the Sugut, which rises, in the hills to the east of Kinabalu, and forms its delta, near Torongohok or Pura-Pura island ; the Labuk, debouching in Labuk Bay, and having its sources seventy miles inland ; the Kinabatangan, the largest and most- important river in the territory, wh^eh has its rise, it is believed, to the eastward of the range of mountains of which Trus Madi is the principal feature, and is navigable by steamer for a considerable distance, and by boats for over a hundred miles from its mouth; the Segamah, which rises to the west of Darvel Bay ; the Kumpong, and the Kalabakang, which debouches in Cowie Harbour. Taking it as a whole, the Company's territory is less generously watered than are other parts of Borneo, which again com- pare unfavourably in this respect with the Malayan States of the peninsula. Many of the rivers, and especially those on the west coast, are further obstructed by bars at their mouths, which render access to them difficult. Several of the natural harbours of North Borneo, on the other hand,, are at once accessible, safe, and commodious. Sandakan Harbour, on the north-east coast (5° 40′ N. lat. and 118° 10′ E. long.), runs inland for some seventeen miles~~

~~with a very irregular outline broken by the mouths of numerous creeks and streams. The mouth, only two miles across, is split into two channels by the little island of Balhala. The depth in the main entrance varies from~~

~~17 to 10 fathoms, and vessels drawing 20 feet can advance half-way up the bay. The seat of government is the town of Sandakan, situated just inside the mouth of the Sarwaka inlet. At Silam, on Darvel Bay, there is good~~

~~Walker & Cockerell sc.~~

~~Map op Borneo.~~

~~anchorage ; and Kudat, in Marudu Bay, discovered by Commander Johnstone of H.M.S. Egeria in 1881, is a small but valuable harhour. On Gaya Bay stands Jasselton, the principal coast terminus of the railway (110 miles in length), in course of construction along the coast from Weston, in Padas Bay, whence the~~

~~line is already open to Beaufort on the Padas river, a distance of twenty miles. From Beaufort the line runs along the right bank of the Padas river through the gorge from Eayoh to Tenom, a distance of aboiit twelve miles. A road to Tenom down the whole length of the Pagalan valley, which will connect a large tract of country~~

~~with the rail-way, is in contemplation. The population of the Company's territory is about 200,000 (including 20,000 Chinese). Of this total three-fourths are found in the west coast districts. Sandakan, the capital, has a population of nearly 7000.~~

~~The seashore and the country for a few miles inland on the west coast are inhabited for the most part by Malay settlers originally from Brunei, by Bajaus, the descendants of the lawless pirate hordes once the terror of these seas, by Kadayans, who are also Mahommedans, and by Dusuns. The last are the most numerous. The east coast is less thickly peopled, but its inhabitants are almost entirely Bajaus and settlers from the neighbouring Sulu archi- pelago. The interior of the territory is inhabited almost entirely by Muruts, a debased race filled with savage instincts, whose habits are both unclean and debauched, men, women, and children alike being~~

~~addicted to the excessive use of intoxicating liquors of native manu- facture. Tribes of Dusuns are also found in villages scattered over the interior, but there can be little doabt but that the Muruts are the representatives of the abori- ginal race of this portion of the island. The Dusuns have attained to a far higher stage of civilization than have the Muruts. They cultivate rice with considerable skill, and show great ingenuity in the management and con- struction of their irrigation work. Very few anthro- pological data are yet available concerning either the Dusuns or the Muruts, and- it is impossible to pronounce with any certainty as to the stock to which they belong. Probably the theory that they do not properly belong to the Malayan family will prove to be well founded. On the other hand, the Bajaus and the Kadayans as well as the Bruneis undoubtedly are Malayan.~~

~~The climate of North Borneo is tropical, with a very equable temperature, and a steady, suflScient, but not excessive rainfall. The lowest reading of the thermometer recorded in 1899 at Sanda- kan was 72° Fahr. in January, June, July, and August. The maximum in the shade recorded at Sandakan during 1899 was 94° in August. The highest rainfall recorded on the coast during 1899 was 136‘76 inches. The records made in the interior are unfor- tunately not trustworthy, hut they certainly largely exceed those made on the coast.~~

~~The capabilities of the Company’s territory are only dimly known. Coal has been found in the neighbourhood of Cowie Harbour, the quality of which is stated to be superior to any hitherto discovered east of Suez. Gold in alluvial deposits has been found in the beds of several rivers on the east coast, but as yet no reefs or lodes and no large alluvial beds have been discovered. No trace of tin in payable quantities has yet been found, but the country has hitherto been little exploited by trained geologists or prospectors, and it would be premature to express an opinion as to the mineral wealth or poverty of the territory. The oil-springs of British North Borneo have as yet proved less satisfactory than those of other parts of the island. Iron ores have been found, and there are indications of the existence of copper, antimony, and zinc ores. The wealth of the country still lies chiefly in its jungle pro- duce— gutta, rubber, rattans, mangrove-bark, edible nuts, guano, &o. ; in its timber, which is of excellent quality,~~

~~supporting a large export trade to Hong-Kong and the Philippines ; and in its planting produce, of which tobacco, sago, sugar-cane, cocoanuts, coffee, pepper, and gambier are the principal items. There are twelve large tobacco estates now open, which have produced satis- factory results, the leaf grown being peculiarly well suited for the wrapping of cigars, and possessing, it is said, some of the special qualities of the Havana leaf. In 1886 the crop yielded 27 bales, valued at £471, but in 1897 the bales had grown to 10,469, and the value to £168,600, the value in 1898 being £200,000. There are forty-three estates planted with coffee and cocoanuts, three with Manila hemp, three with pepper and gambier. Rice is grown in large quantities in many parts, and it is probable that, when means of communication have been further improved, this will form an important item of export. The birds'- nests exported from the caves of the interior and on the coast bring in a steady annual revenue ; and as the country is becoming daily more peace- ful, new caves in the interior are annually being exploited by those who know how to avail themselves of their wealth.~~

~~The trade is largely in the hands of Chinese shopkeepers, who send their agents to the interior to attend the Tamus~~

~~(Malay, Temu, to meet) or fairs which are the recognized scenes of barter between the natives of the hills and those of the coast. At Sandakan there is a Chinese population of over 2000 souls. The Sabah Steamship Company, subsidized by the Chartered Company, possesses a number of boats which ply along the coast of the Com- pany's territory, calling at all important points, and facilitating communication between the various stations. A German firm in Singapore runs vessels at short intervals between that port and Labuan and Sandakan, calling also at some of the other principal ports of the Company's territory. There is also frequent steam- ship communication between Sandakan and Hong-Kong, which is. distant four days' steaming from the former port.~~

~~Por administrative purposes the territory has been divided intO' nine provinces : Alcock and Dewhurst in the north ; Keppel on the- west ; Martin in the centre ; Myburgh, Mayne, and Elphinstone on the east coast ; and Dent and Cunliffe in the south. The bound- aries of these provinces, however, are purely arbitrary, and are not accurately defined. The territory~~

~~is governed by a governor, who is appointed by the Court of Directors with the approval of the Secretary of State for the Colonies. The governor is assisted by a council which is composed of several of the senior officials and one non-official member. The administration is carried on by means of a civil service which is recruited by a system of selection. The .gfficers in charge of Labuan, Kudat, and Darvel Bay possess the rank and title of resident. The officers administering the other districts are called district magistrates. The judicial work of the territory is performed by the residents, who hear appeals from the district courts, and by the governor, who is the final court of ap- peal. The company's police force, which is officered by Europeans, is composed of Sikhs, Pathans, Punjabi Mahommedans, Dyaks,. and Malays. The force numbers six hundred men of all ranks. Until recently expeditions were necessary almost annually to quell disturbances in the interior, the more serious of which were those fomented by the noted rebel, Muhaminad Saleh, who was killed fighting against the Government on 31st January 1900. The coun- try is now rapidly becoming pacified, and the natives of the interior are found to be very amenable to European rule. The laws are based on the Indian penal, criminal, and civil procedure codes and local proclamations and ordinances. There is an Imaum's court for Mahommedan law.~~

~~In 1888, by a convention dated between the British North Borneo- Company and the British Government, the Company made over the control of its foreign relations to the British Government in consid- eration of being placed under the protection of Great Britain. On 1st January 1889 the Crown colony of Labuan was handed over to- the British North Borneo Company by the Colonial Office for admin- istrative purposes, the Secretary of State arranging for the issue of the necessary commission as governor of Labuan to the officer wha for the time being might be approved by him as governor of British North Borneo. In 1899 it was decided to occupy the Tambunan country in the interior of British North Borneo, with an area of 500 square miles and a population of 25,000.~~

~~As regards religion and education, there is a Protestant mission which supports a church and school at Sandakan, with branches at. Kudat, Labuan, and Kaningow. The Roman Catholic mission maintains several priests and~~

~~chapels throughout the territory, with headquarters at Sandakan. The Chinese have their joss- houses, and the Mahommedans their mosques.~~

~~The following are statistics of revenue, expenditure, and trade : —~~

~~1896.~~

~~1897.~~

~~1898.~~

~~1899.~~

~~1900.~~

~~Dollars.~~

~~Dollars.~~

~~Dollars.~~

~~Dollars.~~

~~Dollars.~~

~~Revenue \ proper /~~

~~407,207~~

~~436,062~~

~~503,307~~

~~542,919~~

~~587,226~~

~~Land sale~~

~~4,492~~

964

2,061

3,210

799

Expen- \ diture /

313,807

341,124

881,807

369,351

402,858

Exports Imports

2,473,753 1,882,188

2,942,293 1,887,498

2,839,844 2,419,087

3,439,560 2,456,988

About a million acres have been alienated by the Government on leases for 999 years. Shipping entered, in 1900, 110,908 tons – cleared, 111,385 tons, of which German ships were 47,126 tons entered, and 47,126 tons cleared, and British were 34,616 tons, entered, and 84,522 tons cleared.

The Company has a copper coinage of J and 1 cent pieces, and issues notes expressed in dollars and cents. Mexican, Straits Settlements, Hong-Kong, and British dollars are treated as currency. There are bank agencies in Sandakan, and the Company does banking business when required. The

~~State, which has adopted the imperial penny postage, is in the Postal Union, and money orders on North Borneo are issued in the United Kingdom, India, the Straits Settlements, Ceylon, Hong-Kong, and elsewhere, ■ and vice vers^. The main telegraph runs from Menumbok on the west to Sandakan on the east, and a line is also being made from~~

~~Menumbok to Kudat, with connexion at Jesselton and other inter mediate stations.~~

~~See also Brunei and Sarawak.~~

~~AuTHORiTiE.s. — PosEWiTz. Bomco : Its Geology and Mineral Mesources. — Martin in Tijdschr. Aardr. Gen. vii. Jaarboek van het Mijnwezen, 187.5-1900. — Molengraaff. " Die Niederlandisciie Expedition nach Central Borneo" in Petermann'' s 3Iitteil., lS9o ; and Borneo Expedition (Geological explorations in Central Borneo), with Atlas. Leyden, 1900. — Tromp. " Mededeelingenuit Borneo" in Tijdschr. Aardr. Gen. vii. (N. S.) 1890.— Bock. Eeis in 0. en Z. Borneo van Kaetei naar Banjermasin, 1881-87. — Nieuwenhuis. " Die Durchquerung Borneos " in Pet. Mitt., 1898 ; and In Gentraal Borneo. Leyden, 1900. — Van der Stok. Atlas of Wind and Weather (Batavia), 1897. — Kan. "Borneo," and Pleyte, " Dajaks," in tlie Encyclopcedie van Ned. Indie. — Frank Hutton. North Borneo. — .Joseph Hutton. The New Ceylon. — Mrs W. B. Bryor. a Decade in Borneo. (c. M. K.; H. cl.)~~

~~Bornholm, an island of Denmark, in the Baltic, 90 miles E. of Copenhagen and 23 S.E. of the coast of Sweden. Population, about 38,000. Excavations were carried on in the castle of Hammershuus in 1893. At Nekso a bust commemorates J. N. Madvig, who was born there in 1804 (died 1886). Coal-mining is now continued. A railway from Ronne (the capital ; population, 9000) to Nekso, 22 miles, was opened in 1899.~~

~~Bornu, formerly a negro kingdom of some import- ance in the Central Sudan. Since 1880 it has steadily declined, owing to the political disturbances of which it has been the scene. The greater part of the area, which extends W. of Lake Chad in the valley of the Yobe, and S. between that river and the Shari, has been placed by international agreements within the British and German spheres of Nigeria and Cameroon, but no practical steps had been taken up to 1901 to establish the authority of these Powers in the country. After the visits of Eohlfs (1866) and Nachtigal (1871-73) the country was visited by no European traveller until 1892, when Colonel Monteil resided for a time at Kuka during his great journey from the Senegal to Tripoli. The French traveller noticed many signs of decadence, the energy of the people being sapped by luxury, while a virtual anarchy prevailed owing to rivalries and intrigues among members of the royal family. The king of Zinder had ceased to pay tribute, and the sultan was not strong enough to exact it by force. At the same time a danger was threatening from the south, where the negro adventurer Rabe or Rabah, once a slave of Zobeir Pasha, was menacing the kingdom of Baghirmi. After making himself master of the fortified town of Manifa, Rabe proceeded against Bornu, soon defeating the army of the sultan Ahsem in two pitched battles. In December 1893 Ahsem fled from Kuka, which was entered by Rabe and soon afterwards destroyed, the capital being transferred to Dikoa in the south of the kingdom. These events ruined the trade between Tripoli and Kuka by the long-established route vid Bilma, which has not since recovered its importance. Rabe had by this time raised a large, well-drilled army, and proved a formidable opponent to the French in their advance on Lake Chad from the south. The expedition under Lieu- tenant Bretonnet was cut to pieces by his troops in 1899, l3ut later in the same year he met with a severe defeat at the hands of Captain Robillot, and early in 1900 was again defeated, and killed, at Kussuri, near the lower . Shari, by the combined forces of three French expeditions which had been converging from the Congo, the Sahara, and the Niger. By the Anglo-French agreement of 1898 the tributary state of Zinder in the north fell to the French sphere, and French influence has been established there by the expeditions under Foureau, Joalland, and Peroz.~~

~~See Monteil. De St Loms a Tripoli par le Lac Tchad. Paris, 1895. — FouKEAU, in La Geographic, December 1900. — .Joalland, ibid.. May~~

~~1901. (E. He.)~~

~~Borrow, George Henry (1803-1881), English traveller, linguist, and author, was born at East Dere- ham, Norfolk, .5th July 1803, of a middle-class Cornish family. His father was a recruiting officer. His mother was a Norfolk lady of French extraction. From 1816 to 1818 Borrow attended, with no very great profit, the grammar school at Norwich. After leaving school he was articled to a firm of Norwich solicitors, where he neglected the law, but gave a great deal of desultory and unscholarly attention to languages. On the death of his father in 1824 he went to London to seek his fortune as a literary adventurer. Engaged by Sir Richard Phillips, the publisher, as a hack-writer at starvation wages, his experiences in London were bitter indeed. His struggles at last became so dire that if he would escape Chatterton's doom, he must leave London and either return to Norwich~~

~~Ocoi'.ge Borrow. (From the painting Ijy Phillips in the posne^Hion of Mr John Murray.)~~

~~and share his mother's narrow income, or turn to account in some way the magnificent physical strength with which Nature had endowed him. Determining on the latter of these courses, he left London on tramp. As he stood con- siderably more than 6 feet in height, was a fairly trained athlete, and had a countenance of extraordinary impressive- ness, if not of commanding beauty — Greek in type with a dash of the Hebrew — we may assume that there had never before appeared on the English high-roads so majestic- looking a tramp as he who, on an afternoon in May, left his squalid lodging with bundle and stick to begin life on the roads. Shaping his course to the south-west, he soon found himself on Salisbury Plain. And then his extraordinary adventures began. After a while he became a travelling hedge-smith, and it was while pursuing this avocation that he made the acquaintance of the splendid road-girl, born at Long Melford Workhouse, whom he has immortalized under the name of Isopel Berners. He was now brought much into contact with the gypsies, and this fact gave him the most important subject-matter for his writings. For picturesque as is Borrow's style, it is this subject-~~

~~BOREOWSTOUNNES S — B 0 S B 0 0 M~~

~~matter of his, the Eomany world of Great Britain, which — if his pictures of that world are true — will keep his writings alive. Now that the better class of gypsies have migrated so rapidly to America that scarcely any are left in England, Borrow's pictures of them are challenged as being too idealistic. It is unfortunate that no one who was brought into contact with Borrow, and with the gryengroes or horse-dealers with whom he associated, and whom he depicted, has ever written about him and them. Full of " documents " as is Dr Knapp's painstaking biography, it 'cannot be said to give a vital picture of Borrow and his surroundings during this most interesting period of his life. It is this same peculiar class of gypsies (the gryengroes) with whom the present writer was brought into contact, and he can only refer, in justification of Bor- row's pictures of them, to certain publications of his own, where the whole question is discussed at length, and where he has set out to prove that Borrow's pictures of the section of the English gypsies he knew are true to the life. As to the deep impression that Borrow made upon his gypsy friends, that is partly explained by the singular nobility of his appearance, for the gypsies are extreniely sensitive upon matters of this kind. The silvery whiteness of the ^ thick crop of hair which Borrow retained to the last seemed to add in a remarkable way to the nobility of his hairless face, but also it gave to the face a kind of strange look " not a bit like a Gorgio's," to use the words of one of his gypsy friends. Moreover, the shy, defiant, stand-off way which Borrow assumed in the company of his social equals left him entirely when he was with the gypsies. The result of this was that these wanderers knew him better than did his own countrymen. Seven years after the events recorded in Lavengro and TJie Romany Bye Borrow obtained the post of agent to the Bible Society, in which capacity he visited St Petersburg (1833-35) (where he published Targum, a collection of translations), and Spain, Portugal, and Morocco (1835-39). The result of these travels and adventures was the pub- lication, in 1841, of Zincali, or the Gh/psies in Spain. In 1843 appeared The Bible in Spain, when suddenly Borrow became, famous. Every page of the book glowed with fresh- nessj picturesqueness, and vivacity. In 1840 he married a well-to-do widow, and permanently settled at Oulton, near Lowestoft, with her and her daughter. Here he began to write again. Very likely Borrow would never have told the world about his vagabond wanderings in England~~

~~as a hedge-smith had not Tlie Bible in Spain made him famous as a wanderer. Lavengro appeared in 1851 with a success which, compared with that of The Bible in Spain, was only partial. He was much chagrined at this, and although Lavengro broke off in the midst of a scene in the Dingle, and only broke off there because the volumes would hold no more, it was not until 1857 that he pub- lished the sequel. The Romany Rye. In 1844 he travelled in South-Eastern Europe, and in 1854 he made a tour with his stepdaughter in Wales. This tour he described in Wild Wales, published in 1862. In 1874 he brought out a volume of ill-digested material upon the Eomany tongue, Romano Lavo-lil, or Word-book of the Gypsy Language. In the summer of 1874 he left London, bade adieu to Mr Murray and a few friends, and returned to Oulton. On the 26th July 1881 he was found dead in his house at Oulton, in his seventy-ninth year. (t- w.-d.)~~

~~Borrowstounness, or Bo'ness, a seaport, burgh of Barony, and police burgh (1880), on the Firth of Forth, Linlithgowshire, Scotland. The harbour has been largely extended in recent times. At the end of 1888 the port register contained 10 vessels of 2385 tons ; in 1898, entered 1097 vessels of 326,167 tons, cleared 1127~~

~~vessels, of 324,194 tons. Coal and pig-iron are the prin- cipal commodities shipped, and Bo'ness is the principal port of discharge in Scotland for pitwood from the Baltic. Imports were valued at £219,778 in 1888, and at £223,612 in 1898; exports at £161,081 in 1888, and £219,582 in 1898. Iron foundries (7) and engineering works are now of great importance. Shipbuilding and whale-fishing are extinct. One of the schools has a well-equipped secondary department. Populatioh (1881),~~

~~5284; (1901), 9100.~~

~~Borsz6k, a health resort of Eastern Hungary, situated among the Carpathians, 95 miles E. by N. of Kolosvar. It is noted for its mineral springs, six of which are rich in carbonic acid and one in iron oxide. From three to four million bottles of mineral water are prepared annually.~~

~~.Bdrystaw, a village in Galicia, Austria, at the foot of the lower northern slopes of the Carpathians, about 6 miles S. of Drohobycz. It is the chief centre of the Galician petroleum wells and ozocerite deposits. The oil beds~~

~~occur immediately at the foot of the range of hills along a terrace but lightly raised above the level of the plain, where the sandstone is so saturated with petroleum as to form a soft white mass. The quality of the oil is inferior to that of Western Galicia and the yield has de- clined, while that of ozocerite has increased. Both pro- ducts are refined at B6ryslaw and the neighbouring village of Wolauka. The village is connected with the Austrian state railway by a branch line. Population (1890), 10,424 (double that of 1869) ; (1900), 10,671.~~

~~Borzhom, a small watering-place of Russia, Trans- caucasia, government and 93 miles S.W. of Tiflis, 18 miles from the Transcaucasian railway. It is situated at an altitude of about 3000 feet, in the Borzhom gorge, a narrow rift in the Little Caucasus mountains. Its warm climate, its two hot springs, and the good state in which its beautiful parks are kept (the estate belonging to a member of the Russian imperial family), make it a favourite summer resort in Transcaucasia, and give it its popular name of " the pearl of Caucasus." The export of the bottled' mineral waters, which was only 5350 bottles in 1890, reached 653,250 in 1897.~~

~~Borzna, a district town of S.W. Russia, government of Chernigov, 15 miles S. of the junction of the Desna with the Seim, and 9 miles from the Pliski station of the railway Kursk to Kieff. It is situated on sandy ground and surrounded on the north with marshes. It was annexed to Russia in 1654. Population, 12,500.~~

~~Bosboom, Anna Louisa Ceertruida, nie~~

~~ToussAiNT (who assumed the name of Bosboom-Tous- SAiNT, after marrying at the Hague, in 1851, the well- known Dutch painter, Bosboom), (1812-1886), a dis- tinguished Dutch novelist, was born at Alkmaar in North Holland, on 16th September 1812. Her father, a local chemist of Huguenot descent, gave her a fair education, and at an early period of her career Miss Toussaint developed a taste for historical research, fostered, perhaps, by a forced indoor life, the result of weak health. Her first romance, Almagro, appeared in 1837, followed by the Oraaf van Devonshire (The Earl of Devonshire) in 1838 ; the Engel- schen te Rome (TTie English at Rome) in 1840, and Het Huis Lauernesse (The House of Lauemesse) in 1841, an episode of the Reformation, translated into many~~

~~European languages. These stories, mainly founded upon some of the most interesting epochs of Dutch history, betrayed a remarkable grasp of facts and situations, combined with an undoubted mastery over her mother tongue, though her style is sometimes involved, and not always faultless. Ten years (1840-50) were mainly devoted to further~~

~~studies, the result of which was revealed in 1851-54, when her Leycester in Nederland (3 vols:), Vrouwen van het Leycestersche Tydperk {Women of Leicester's Epoch, 3 vols.), and Gideon Florensz (3 vols.), appeared, a series dealing with Robert Dudley's adventures in the Low Countries. After 1870 Mrs Bosboom-Toussaint abandoned historical romance for the modern society novel, but her Delftsche Wonderdokter (TJie Necromancer of Delft, 1871, 3 vols.) and Ma,joor Frans (1876, 3 vols.) did not command the success of her earlier works. Major Frank has been translated into English (1886). Mrs Bosboom died at the Hague, 13th April 1886. Her novels have been published there in a collected edition (1885-88, 25 vols.). (h. ti.)~~

~~Boshof. See Orange Eiver Colony.~~

~~Bosnia and Herzegovina. — By the Berlin Treaty of 1878 the Turkish provinces of Bosnia and Herzegovina were handed over for civil administration and military occupation to the monarchy of Austria^ Hungary. To Austria-Hungary was also committed the military occupation of the Turkish sanjak of Novi-Bazar, its civil administration being left to Turkey. Approxi- mately of the shape of an equilateral triangle, the compact territory of Bosnia and Herzegovina forms the north- western part of the Balkan peninsula. It is bounded on the W. by Dalmatia, on the N. by Croatia and Slavonia, on the E. by Servia, and on the S. by Turkey and Monte-negro. Leaving out 6 kilometres of maritime boundary, the frontier line for about two-fifths of its length is formed by continuous watercourses, and for the remaining three-fifths runs over solid land, yet always following distinctive geographical features. According to the cadastral survey, the area of Bosnia and Herzegovina amounts to 19,700 square miles. The land is in general mountainous, yet ranges from low-lying plain up to the region of~~

~~high mountains. In the north of Bosnia, along the Save, low-lying land, forming a continuation of the Hungaro-Slavonian depression, cuts here and there pretty deeply into the country, but in its progress to the south and south-west the land gradually rises, first to a hilly and then to a highland formation till, in the centre of the country and in Herzegovina, it attains the unequivocal character of high mountain. The hilly land reaches a mean elevation of about 1500 feet; the zone of highlands comprises heights of 3000 to 4600 feet ; in the mountain districts of Travnik, Sarajevo, and Mostar, the principal peaks mount to over 6000 feet. In the depression, occupy- ing about 5 per cent, of the land, the prevalent soil con- sists of exceedingly fertile alluvial deposits. The hilly land, about 24 per cent, of the whole area, and comprising fruitful valleys at the lower courses of its rivers, approxi- mates in natural fertility of soil to the depression. The mountains and woodland, about 42 per cent, of the whole area, display not only natural forest and meadow, but also, though to, a less extent, productive pasture. The Karst region, 29 per cent, of the whole area, from its scarcity of water and general poverty of soil, is suitable for cultivation only in the valleys and adjacent slopes, the rest being for the most part available only as pasture land. Geologically, the highlands of Bosnia and Herze- govina are to be regarded, both in their orographic and tectonic character, as a continuation of the South Alpine calcareous belt. Along the west frontier there appear broad and strongly-marked zones of Cretaceous limestone, alternating with Jurassic and Triassic, joined by a strip of Palaeozoic formations running from the north-west corner of Bosnia. Next, proceeding from this region in an easterly direction, are the Neogene freshwater forma- tions, filling up the greatest part of the north-east of Bosnia, as also a zone of flyseh intermingled with several**

~~strips of eruptive rock. In the south-east of Bosnia the predominant formations are Triassic and Palaeozoic strata with red sandstone and quartzite. Along the whole northern rim of Bosnia, as also in the fluvial and Karst valleys (Poljes), are found diluvial and alluvial forma- tions, interrupted at one place by an isolated granite layer.~~

~~Climatically, considerable variations are observable in different parts of Bosnia and Herzegovina. The winter rains of the Karst region show how it belongs to the fringe of the sub-tropical climatic zone. The greater part of~~

~~Bosnia falls within a zone in which the atmospheric precipitations are, with approximate equableness, dis- tributed all over the year, having affinity on one side to the Alpine climate of the southern highlands of Austria, and on the other side to the continental climate of the regions of the Danube and Theiss. The yearly precipitation amounts in the Herzegovina to 1610 mm. ; in Bosnia to 1030 mm. The mean yearly temperature in the Herzegovina is in the lower lands 11-7° to 14-7° Celsius; in high regions, 7-7° Celsius ; in Bosnia, 8-7° to 10° Celsius.~~

~~3. V Darbishirt 6r O.J.Jt Hmiarth S>v2-V*t*#~~

~~'Oxford i9at.~~

~~Sketch Map of Bosnia and Herzegovina.~~

~~In correspondence with the natural configuration of the land and the variation of climate, the productions of the soil in the four natural regions are different. Fifty-five per cent, of the lowland is laid out in plough-land, garden, and meadow ; 40 per cent, of it is pasture and woodland. In the hilly region 41 per cent, consists of plough-land, garden, and meadow ; 56 per cent, of pasture and woodland. In the highlands plough-land occupies about 26 per cent. ; pasture and woodland, 72 per cent. In the Karst region 16 per cent, is under the plough, and 81 per cent, is pasture and wood. The forest of the Karst region is mainly brushwood ; that of the other regions tall timber and copse.~~

~~Por purposes of administration, Bosnia and Herzegovina are divided into six districts (Kreise), the names, areas, and popula- tions of which, according to the census of 1895, are as follows : —~~

~~District.~~

~~Area iD~~

~~KUo- metres.~~

~~CiTil Population.~~

~~Number of Per- sons to a Kilo- metre.~~

~~Natural Increase of Popu- lation since~~

~~1886,~~

~~p.c.~~

~~Males.~~

~~Females.~~

~~Persons.~~

~~Sarajevo . Banjaluka . Bihal~~

~~DolnjaTuzla Travnik Mostar (Her- zegovina) .~~

~~8,411 9,044 5,526 8,904 10,023~~

~~9,119~~

~~121,131 176,322 102,896 189,222 128,515~~

~~111,104~~

~~106,976 154,177 89,001 169,678 111,573~~

~~108,407~~

~~228,107 329,499 191,897 358,900 240,088~~

~~219,511~~

~~27-12 36-43 34-90 40-32 23-85~~

~~24-07~~

~~1-86 2-02 2-06 1-45 1-52~~

~~1-70~~

~~Total .~~

~~51,027~~

~~828,190~~

~~739,812~~

~~1,568,002~~

~~30-73~~

~~1-74~~

~~BOSNIA AND HERZEGOVINA~~

~~317~~

~~Mades accordingly constitute 52-86 per cent, of the total civil popu- lation. In respect of creeds, 36 per cent, of the inhabitants are Mahommedans ; 43 per cent. Oriental Orthodox ; 21-3 per cent. Roman Catholics ; 0-5 per cent. Israelites. The Mahommedans are most strongly represented in the district of Sarajevo, making 49 per cent, of the population ; the Oriental Orthodox in Banjaluka, 59-2 per cent. ; the Koman Catholics in Travnik, 37-7 per cent. ; and in Mostar, 40-2 per cent. ; the Jews in Sarajevo, 2-1 per cent. Since 1885 the Mahommedans have increased by 11 per cent. ; the Oriental Orthodox, 18 per cent. ; the Roman Catholics, 26 per cent. ; and the Jews, 41-5 per cent. The occupation of the land shows a preponderance of small settlements. In 73 per cent, of all the inhabited places the maximum population is 300 ; 23 per cent. of inhabited places have from 300 to 1000 inhabitants ; only forty places have a population of more than 2000 ; eleven places have over 6000 inhabitants each. 32-4 of the population live in little settle- ments of a maximum population of 300; 39 -8 per cent, in places of between 300 and 1000 ; 12-6 per cent, in places of between 1000 and. 2000; 15-2 per cent, in places of larger population. The capital town, Sarajevo, has 38,083 inhabitants. The agricultural population of the whole land numbers~~

~~1,385,291 persons, or 88-4 per cent, of the total population. There are 221,581 heads of families. Of these 2-63 per cent, are landed proprietors ; 39-2] per cent, are free peasants; 40 '15 per cent, are Kmeten (not free) ; 10-23 per cent, are free peasants and at the same time Kmeten; and 7-78 are of other ranks engaged in agriculture.~~

~~There is a Roman Catholic archbishopric in Sarajevo, one bishopric in Mostar, and one Apostolic administrator in Banjaluka. There is further an Oriental Orthodox metropolitan in eacli of the towns of Sarajevo, Dolnja Tuzla, and Banjaluka. The Eeis-el-Ulema is the highest Mahommedan ecclesiastical authority.~~

~~In the way of education, there are 3 higher gymnasia, a higher real, 1 technical, and 3 higher-grade girls' schools, a training college for teachers, a scheviot (rough wool) weaving school, a Roman Catholic archiepiscopal gymnasium and priest seminary, an Oriental Orthodox theological institute, 10 commercial schools, several handi- craft schools, 108 general elementary schools, 1 national museum — all under State administration. There are, further, 1 private insti- tute for female teachers, 1 Mahommedan training school for teach- ers, 1030 Mahommedan religious schools (among them 25 reformed) , 41 medresse or Mahommedan high schools, 79 Oriental Orthodox and 29 Roman Catholic schools, 2 Jewish normal primary schools, 4 German private primary schools, and 6 Roman Catholic congre- gational female schools.~~

~~The budget for the administration of Bosnia and Herzegovina for the year 1900 showed the expenditure and revenue as follows : —~~

~~Expenditure. Central Government Ministry of the Interior . ,, ,, Finance ,, ,, Justice.~~

~~„ Buildings .~~

~~Total .~~

~~M^venue. Central Government Ministry of the Interior . „ ,, Finance ,, ,, Justice~~

~~„ Buildings .~~

~~Total .~~

~~Ordinary.~~

~~Extra- ordinary,~~

~~Total.~~

~~£~~

~~143,606 675,242 519,187 66,921 203,605~~

~~£~~

~~8,868 33,956 11,653~~

~~4,484 61,803~~

~~£~~

~~151,974 709,198 530,840 71,405 265,408~~

~~1,608,561~~

~~120,264~~

~~1,728,825~~

~~1,249~~

~~102,358~~

~~1,398,236~~

~~4,896~~

~~226,728~~

~~666·42~~

~~1,249~~

~~102,358~~

~~1,398,902~~

~~4,938~~

~~226,728~~

~~1,733,467~~

~~708~~

~~1,734,175~~

~~The entire area is laid out as follows : —~~

~~Square Kilometres.~~

~~Percentage of Total Area.~~

~~21·63~~

~~0·95~~

~~6·79~~

~~Oil~~

~~16-50 52-10~~

~~1-93~~

~~Plough-land . . . 11,032~~

~~Garden ground . . 483~~

~~Meadow. . . . 3,465~~

~~Vineyard ... 59~~

~~Pasture .... 8,418~~

~~Wood .... 26,581~~

~~Unproductive. . . 989 The yearly average total produce in wheat, rye, barley, oats, spelt, buckwheat, millet, corn and wheat mixed, maize, and marsh-millet, for the period 1892-96, amounted to over 5 million centners against a yearly average for the period 1882-86 of 2-24 millions, showing an increase for 1892-96 of more than double. The largest produpe was yielded by maize, with 25,483 wagons (each 100 quintals) ; next, bar- ley, 7879 ; wheat, 7854 ; oats, 4501 ; millet, 1590 ; spelt, 1318 ; rye, 1249 • mixed corn and wheat, 1229 ; marsh-millet, 481 ; buckwheat.~~

~~88 wagons. In the north of the land and on the Dalmatian frontier the principal product is maize ; in the south, barley. The yearly produce of pulse averaged, for the period 1892-96, 142,669 centners — an increase of 126-82 per cent, on the yield for 1882-86. The yearly yield of potatoes for 1892-96 averaged 519,667 centners, 190 per cent, more than in the corresponding years of the previous decade. Other products of the soil are tobacco, chiefly in Herze- govina, 37,160 centners ; other commercial plants (rape-seed, hemp, linen, pyrethrum, madder), 32,225 centners. The yearly hay crop averaged, for the period 1892-96, 6,621,734 centners, 105 per cent, more than in the corresponding years of the previous decade ; clover, principally in the district of Banjaluka, 19,761 centners.~~

~~Of great importance in the husbandry of Bosnia is the fruit culture, the yearly yield of which for the period 1892-96 was—~~

~~Centners.~~

~~1,149,429~~

~~140,926~~

~~209,457~~

~~18,476~~

~~Increase per cent, on 1882-86.~~

~~94-80~~

~~240-40~~

~~20-66~~

~~91-18~~

~~Black damsons~~

~~Other stone fruit .~~

~~Kernel fruit ....~~

~~Nuts~~

~~Tropical fruits (only in Herze- govina) .... 7,402 280-57~~

~~Grapes (principally in Herze- govina) .... 64,549 73-40 The following table shows the supply and distribution of cattle, &c., according to the census of 1895 :—~~

~~For every~~

~~Number~~

~~100 Agri-~~

~~Per cent.~~

~~Number.~~

~~to a Kilo-~~

~~cultural~~

~~Increase~~

~~metre.~~

~~Inhabi-~~

~~since 1879.~~

~~Horses, Asses, and Mules~~

~~tants.~~

~~239,626~~

~~4-69~~

~~17-30~~

~~48-68~~

~~Horned cattle .~~

~~1,417,341~~

~~27-77~~

~~102-31~~

~~85-98~~

~~Sheep ....~~

~~3,230,720~~

~~63.32~~

~~233-22~~

~~284-62~~

~~Goats ....~~

~~1,447,049~~

~~28-36~~

~~104-46~~

~~177-15~~

~~Swine ....~~

~~662,242~~

~~12.-98~~

~~47-80~~

~~58-88~~

~~Beehives~~

~~140,061~~

~~2-75~~

~~10-83~~

~~26-20~~

~~Mining forms an important branch of the industry of Bosnia. The metalliferous beds known from olden times have since the Austro-Hungarian occupation been taken in hand, and further openings have been made, first in 1881 by the Mining Company of Bosnia, an undertaking taken over by the State in 1886.~~

~~The mining output in 1898 was —~~

~~Quantity,~~

~~Fallow copper ore Copper ore Iron ore Chrome ore Manganese ore Zinc ore Pyrites Brown coal~~

~~Salt spring .~~

~~Quintals.~~

~~5,380~~

~~37,850~~

~~585,327~~

~~4,580~~

~~53,196~~

~~100~~

~~2,404~~

~~2,711,835~~

~~Hectol.~~

~~1,177,708~~

~~The smelting works yielded in 1898 : —~~

~~Mercury~~

~~Pure copper~~

~~Copper wares~~

~~Raw iron .~~

~~Castings~~

~~Martiningots~~

~~Rolled iron~~

~~Salt from evaporation~~

~~Quantity, Quintals.~~

~~40-5~~

~~1,489~~

~~499~~

~~135,365~~

~~9,419~~

~~86,694~~

~~85,109~~

~~144,962~~

~~Value in Florins.~~

~~13,950 23,546 128,357 16,370 93,154 260~~

566,‘324

47,112

Talue in Florins.

9,815 109,340

505,025 106,675

737,‘470 1,120,264

The total value of the products of the smelting works was accord- ingly 2,588,080 florins, or, after deduction of waste stuffs from smelting, 2,138,943 florins. The mining output amounted to the value of 889,073 florins, an increase of 11 per cent, on the value of the preceding year’s output.

The chief industries are weaving, leather, and metal work car- ried on by the workmen in their own houses. The Government has set up some workshops of its own with a view to a higher technical and artistic development of the house industry. More particularly, chased and inlaid metallic wares, bez (thin cotton), and carpet- weaving receive Government support. The four tobacco factories of the land, the national printing-press, an annular fur- nace for brick-burning, an iron-foundry, and several blast-furnaces are also under the management’ of the State. Among the larger private establishments are seven breweries, one brandy distillery, one sugar, two jam, two soap and candle factories, two building and furniture works, a factory for twisting thread, one

iron and steel works, one paper and one ammonia and soda factory, and one mineral-oil refinery. ‘

In respect of foreign trade Bosnia and Herzegovina have since 1882 been included in the customs and commercial system of Austria-Hungary, to the

~~extinction of all intermediate imposts. Since 1898 special statistics have been drawn up respecting its trade also with Austria and Hungary. According to these statistics the most important articles of export are wood, 722,000 centners ; coal and turf, 373,000 centners ; fruit, 417,000 centners ; minerals, 217,000 centners ; soda, 124,000 centners ; iron and steel, 82,000 centners ; cattle, 324,000 head. Other articles of export are chemicals, dyeing and tanning stuffs, tobacco, sugar-beet, and kitchen — salt. The import consists principally of food stuffs, 546,000 centners ; building materials, 228,000 centners ; drinks, 95,000 centners ; sugar, 45,000 centners ; besides machinery, glass, fats, clothes, wooden and stone wares, and other products of industry. The total export in 1898 amounted to 3,861,759 centners ; the total import to 1,937,291 centners. Of this, trade nearly 19 per cent, was absorbed in the intercourse with Austria-Hungary by highways and transport ; 46 per cent, by the State railways of Bosnia and Herzegovina.~~

~~In 1898 the total length of the railways was 877 kilometres, or 176 kilometres of railway to every 10,000 kilometres of the land. In 1898 the total length of the telegraph lines was 2840 kilometres, or 7182 kilometres' length of wire-line. Both are under State administration.~~

~~There is a national bank in Sarajevo with a joint stock of 10,000,000 florins, also carrying on a hypothecary credit business and managing the wholesale trade of the tobacco factories. There are savings banks in Banjaluka, Bjelina, and Brgka — all in stocks (340,000 florins joint stock), with a deposit, at the end of 1897, of 741,000 florins.~~

~~Authorities. — Hauptergebnisseder Volkssdhlungen, 1879, 1885, and 1895. — Srgebnisse der Viehzdhlungen, 1879, 1895. — Strauss. " Die osterreiohisch. und ungarischen StaatsangehBrigen in Bos- nien und der Herzegovina," Statistische Monatsschrift, "Vienna, 1897. — Das Bauwesen in B. u. S. Official, 1887. — Beitrag zur Kenntniss der Erzlagerstdtten Bosniens. Official, 1887. — Die Land- wirthschaft in B. u. H. Official, 1899. — Das Veterinarwesen in B. u. H., since 1879. Official, 1899. — Jahresberichte iiber das Berg- und Huttenwesen in B. u. H. (in the Austrian Periodical ftir Berg- und Huttenwesen). Annual. — Ludwig. Die Mineral-~~

~~quellen in B. u. H. — Bosnia und Herzegovina auf der Milleniums-ausstellung in Budapest, 1896. (k. t. i.-s.)~~

~~Bosnia Seraj. See Sebajevo.~~

~~Boston, a municipal and parliamentary borough, and seaport of Lincolnsliire, England, 4 miles from the mouth of the river Witham, and 107 miles N. of London by rail. Since about 1884 it has been growing in importance as a commercial and fishing port, a result due principally to the construction (1882-84) of a new dock some 7 acres in extent with an entrance lock giving vessels of 3000 tons access to the quay sides. In 1880-87 the bed of the river (for 3 miles) below the town was deepened to 27 feet, and a new cut of 3 miles in length made at its mouth into deep water. Further, an iron swing rail- way bridge, 126 feet long, was thrown across the river between the Great Northern railway and the dock. Above Boston the river was improved and the Grand Sluice deepened in 1881-83. A repairing slipway capable of taking vessels of 800 tons has been constructed. The parish church was further restored in 1874 – 91. A wing was added to the hospital in 1887. Eecent buildings include a church (1885), two grain warehouses, and fishmarkets at the dock, a memorial hall (1893), a seamen's and fishermen's institute (1892), and an endowed middle-class girls' school. There are engineering works, and oil-cake and tobacco factories. The imports, prin- cipally timber, grain, cotton, and linseed, increased from £116,179 in 1881 to £449,499 in 1887, to £804,958 in 1893, and to £816,697 in 1899. The exports, embracing coal, machinery, and manufactured goods, increased from £83,000 in 1883 to £175,725 in 1887, and to £349,712 in 1891, but declined to £261,873 in 1899. In 1885 22 vessels of 4621 tons cleared ; in 1899, 213 vessels of 67,356 tons. There is also a coasting trade of about 70,000 tons annually. In 1899, 61 vessels of 4285 tons**

~~were registered at the port, and there were 76 fishing- boats, employing over 2200 hands. There are also a deep-sea fishing and steam trawling fleet (40 vessels in 1899). In 1898 fish valued at £87,672 was landed here. Population (1891), 14,570 ; (1901), 15,667.~~

~~See PiSHEY Thompson. History and Antiquities of Boston. Boston, 1856. — Wheeler. The History of the Fens of South Lincolnshire (chap. xii.).~~

~~Boston, 1897. •~~

~~Boston, capital of the commonwealth of Massa- chusetts, U.S.A., is situated in lat. 42° 21′ N. and long. 71° 3′ W. It is fifth in population among the cities of the United States, second in commerce and perhaps in wealth also, arid richest in historic associations. In 1890 the population was 448,477, and in 1900 it was 560,892. The death-rate in 1890 was 23-4, and in 1900 it was 20-1. Of the total population in 1900, 274,922 were males, 285,970 females; 363,763 native-born, 197,129 foreign- born ; 12,809 were coloured (of whom 11,591 were negroes). Out of 176,068 males, twenty-one years of age and over, 8111 were illiterate (unable to write), of whom 7701 were foreign-born. Out of 82,580 foreign-born males, twenty- one years of age and over, 43,331 were naturalized, 3637 had filed their first naturalization papers, 24,119 were~~

~~A y.£>ariKiin &.O.y.R.H~~

~~Sketch Map of Entironb of Bobtox.~~

~~aliens, and the citizenship of 11,493 was returned as un- known. The so-called Boston metropolitan district, popu- larly termed " Greater Boston," comprises thirty cities and towns within a radius of ten miles (generally speaking) from the State House, having a population in 1900 of 1,128^04, or 40-23 per cent, of the population of the state. Projects have been mooted for giving this district some form of political unity, and already the metropolitan prin- ciple has been recognized in the establishment of the metro- politan sewerage district, comprising parts of Boston,ele ven other cities, and eleven towns; the metropolitan parks district, embracing twelve cities and twenty-five towns ; and the metropolitan water district, composed of the cities and towns within a 10-miles' circuit of the State House. The government of Boston has been reconstructed in important particulars by amendment^ to the charter in Acts of the legislature of 1885, separating the executive and legislative~~

~~branches, and in subsequent Acts. It now compreliends a mayor, elected for a term of two years (annual salary, $10,000), and a city council, composed of a board of aldermen, thirteen members, elected annually (salary, $1500 each), and a common council of seventy-five members, three from each, ward, also elected ‘ annually (salary, f 300 each). In the mayor are vested the execu- tive powers of the city, and the legislative powers are vested in the city council, to be exercised by concurrent vote. The mayor appoints, subject in most cases to con- firmation by the board of aldermen, all heads of depart- ments, boards, and commissions with the exception of the police commissioners, who are appointed by the governor of the commonwealth. The mayor has the veto power over acts of the board of aldermen and of the common council, and, in matters involving the expenditure of money, of the school committee. A two-thirds vote of all the members of both branches of the city council or of the school committee will override the mayor’s veto. The school committee is an independent body, having both executive and legislative functions, subject in its expenditure of money only to the mayor’s veto. It is composed of twenty-four members, elected for terms of three years, eight members annually, including such women as may qualify for that purpose. There is a superintendent of schools (salary, $4200), and a board of supervisors, six members (salary, $3780 each), to which women are eligible, elected by the school committee annually, the duties of the latter being to examine the schools in detail at stated intervals, and to conduct the annual examinations of pupils. The total expenditure for schools and schoolhouses in 1900-1901 was $3,714,446.26 net running expenses for the same period, $2,676,098.70 number of pupils, 88,852 ; net rate per scholar, $32.96 number of school buildings in 1901, 224 ; value of school buildings (nominal), $12,637,300. According to the census of 1900, there were in the city 143,858 persons of school age (5 to 20 years inclusive). The total current expenses of the city for 1900 were estimated at $30,000,000. The net city debt in 1901 was $51,383,765.44. The valuation of the city, real and personal, taxable property, in 1900 (1st May) was $1,129,175,832, an increase of $330,400,000 in twenty-five years. The valuation of pro- perty held by religious, charitable, literary, and scientific corporations, exempt from taxation, was : real, $21,508,300, and personal, $24,665,020.~~

~~The Boston public library, founded 1852, is one of the oldest free libraries in the country, and the largest, with the possible exception of the Library of Congress at Washington. The building (1888-95) is of stone, in the Italian Kenaissance style, and of dignified fagades, quad- rangular in shape, surrounding a court, with richly de- signed and embellished marble entrance hall. The walls at the head of the main staircase were decorated by M. Puvis de Chavannes, and there are mural paintings in other rooms and corridors by Edwin A. Abbey, E.A., illustrating " The Quest of the Holy Grail," and by John S. Sargent, R.A., depicting the struggle of Judaism with polytheism. The cost of the building, with subsequent interior alterations, was $2,500,000. The annual cost of maintenance of the library is $255,000, appropriated by the city government. Other valuable and important libra^ ri6s, private institutions, but hospitable to scholars, are the collections of the Boston Athenaeum, founded in 1807 ; the Massachusetts historical society (founded 1791) ; the American academy of arts and sciences (founded 1780) ; the Kew England historic-genealogical society (1845) ; the Boston society of natural history (1830) ; and the Massachusetts horticultural society (1829). The Massa- chusetts state library, in the State House annex, has a notable collection. The State House annex is practically~~

~~a new State House, built (1889-97) in the rear of, and connected with, the " Bulfinch Front," the State House designed by Charles Bulfinch, the pioneer American architect, built, in 1795. Boston is the seat of various collegiate institutions — the Boston university (chartered 1869), embracing a college of liberal art^, schools of law,, theology, and medicine, and a graduate school of arts and sciences ; the Massachusetts institute of technology (founded 1865), comprising eight laboratories, and includ- ing six large buildings, workshops, and a gymnasium ; the medical school, the dental school, the school of veterinary medicine, and the Bussey institution, or school of agri- culture and horticulture, all of Harvard University, the remaining departments of which are in the college build- ings at Cambridge ; the Massachusetts college of phar-~~

~~Btyj>trHiUn »• .OJ-X Hmmlt~~

~~Oxjori igoi~~

~~Plan op Boston.~~

macy (1852) ; the Massachusetts normal art school (1873) ;, Boston college (1860), Roman Catholic; and St John'a theological seminary (1880), Roman Catholic. Boston also sustains numerous art schools, while the museum of fine arts (founded 1870), with its school of drawing and painting (1876),, is one of the most important institutions of its kind, well endowed, richly stored with collections of paintings, statuary, and objects of ve,rtu, and maintained at a high standard. As a musical centre Boston has long been recognized. Chief among its. musical training schools is the New England conservatory of music (incorporated 1870), the largest in the country. The Boston symphony orchestra, composed of picked musicians, organized in 1887, and sustained by the muni-, ficence of a single citizen, is a permanent feature, giving each season twenty-four public concerts and as many public rehearsals, of the highest order, at low prices. The Lowell institute, established in 1839 under the will of John Lowell, junior, who bequeathed $237,000, one-half of his property, for this purpose, provides anni^ally regular

courses of free public lectures upon branches of natural and moral science by the foremost authorities of the day •on these subjects. The theatres number seventeen. There are twenty clubhouses, one of which, that of the May- flower club, is for women. Of churches there are 296 — 228 Protestant, 49 Eoman Catholic, and 19 Jewish synar gogues. The Eoman Catholic churches outnumber those •of any single Protestant denomination, the largest among the latter — thirty-eight — being credited to the Baptists; the Congregational Trinitarians and the Methodist Episco- palians come next with thirty-six each ; the ProtestantEpis- copalians, thirty-four ; and the Congregational Unitarians, twenty-five. In private charities, philanthropic and bene- ficent work, Boston annually expends large sums through •organizations of various classes. There are about 300 of these bodies, or one society for every 1800 persons in the •city. The charitable capital has been estimated at upwards of $17,000,000, and the annual contribution of citizens for charitable and benevolelit purposes at more than $600,000. The Associated Charities of Boston is an in- corporated organization (1881),

with a central office, and district offices in various sections, employing numerous paid agents and volunteer assistants, the objects of which are to secure the concurrent and harmonious action of the different charities of the city. Among the larger and more important of the beneficent institutions are thirty- three thoroughly equipped special hospitals, and three general hospitals, the latter including the Massachusetts General Hospital, aijd the Massachusetts HomcBopathic Hospital.

The foreign commerce of Boston is second only to that -of New York. The exports for the year ending 30th June 1901, valued at $143,708,268, were the largest in the history of the port ; the imports were $61,452,370. The aggregate foreign commerce for 1900, $192,608,636, shows an increase in a quarter of a century, or since 1875, of $109,760,279. Nearly one-fouith of the entire American exports of the various meat and dairy products classed^ as provisions, in the year ending 30th June 1899, passed through this port. It holds the first place among American ports in the export of live cattle. It is the largest wool market and the largest fish market in the country, in each second only in the world to London. The ocean tonnage entered and cleared in the foreign trade in the year ending 30th June 1900 aggregated 4,145,187 tons ; the steamship sailings to foreign ports were 973. In connexion with the freight service there has been built up between Boston and Liverpool a passenger service of increasing proportions. The arrivals in the coastwise trade in 1900 were 10,436, an aggregate tonnage of 8,244,860 tons. In various in dustries the census of 1895 showed $77,064,107 of capital invested. The great railway systems having their terminals in Boston — ^the Boston and Maine (with which are con- solidated the former Eastern; the Boston and Lowell systems, extending into New Hampshire and Canada ; and the Eitchburg and Hoosac tunnel system), entering on the north side of the city ; the New York, New Haven, and Hartford (controlling by lease the Boston and Providence, the Old Colony, and the New England railways), and the Boston and Albany (New York Central) systems, entering on the south side — ^now enter two immense stations — the Union, or North station, and the South Terminal — in place of eight separate stations, four on each side. The Union station, first completed (1893), a structure of brick, granite, and brown stone, covers an area of 9 acres. The train-shed is 539 feet long, 537 feet wide, and 51 feet high, and contains 23 tracks. The length of tracks under cover is 2 miles, and nearly 600 passenger trains

~~arrive and depart from this station each week-day. The South Terminal station (built 1897-98) is called the largest and most costly of modern railway stations. It covers an area~~

~~of 13 acres. The train-shed is with curved roof of one sweep 602 feet long, 570 feet wide, and 112 feet extreme height. There are 32 tracks — 28 on the main floor, and 4 in the shape of 2 loop tracks on the lower or subway, for suburban traffic. The length of tracks under the roof is 4 miles, and the number of trains using the station daily is 750 ; on Sundays 195. It was estimated in 1900 that 50,000,000 passengers were carried to and from Boston yearly upon the railway routes within a radius of 60 miles of the city. The street electric car system is the most extensive in the world, the total length of track being 337 miles, and the number of passengers annually carried upwards of 190,000,000. Many of its lines pass through the heart of the city by the subway, an underground work built in 1895-98 to relieve the congestion caused by the pressure of cars and traffic in some of the most crowded thoroughfares. The subway is about a mile and two-thirds in length, partly with four tracks and partly with two. Grade crossings are avoided by means of interior loops, with sub-subways at junction points. The width of the foxu—track portion is 48 feet. The average height is 14 feet. The platforms at the stations are island platforms. The interior is lighted throughout by electricity, and thoroughly ventilated by fans. The subway was built under the supervision of the Boston Transit Commission at a cost of $4,250,000 within the appropriation. Over 50,000,000 passengers are carried through it annually. The compensation paid by the rail- way company for its use is a sum per annum equal to 4^ per cent, of its net cost. An elevated railway through portions of the city, completed in 1901, is worked in con- nexion with the surface system.~~

~~Boston has a magnificent system of public parks, in addition to the historic Common in the heart of the city, which has been a Common almost since the founding of the town, and the unique public garden separated from the Common by a single street. This system, a chain of parks, embraces 2308 acres of picturesque lands, 126-9 acres of ponds and rivers, 38-45 miles of drives, 70-01 miles of walks, and 8-7 miles of rides. There are, besides, numerous playgrounds and separate parks. The cost of the system, including lands and construction, to January 1900 was $16,627,033. In the~~

~~outlying districts, mostly within the boundaries of " Greater Boston," is the larger metropolitan park system, established by the state, which embraces 9279 acres of forest or woods, seashore, and river-bank reservations, and 17 miles of parkways and boulevards, valued at $10,000,000. Notable additions to the public statues and monuments of the city are the monument by Augustus St' Gaudens to Colonel Robert G. Shaw (1896), commander of the first enlisted coloured regiment in the Civil War, killed at its head while leading the assault on Fort Wagner in 1863 ; statues of General, afterwards Judge, Charles Devens (1898), of Sir Henry Vane, in the vestibule of the public library, and of Admiral Farragut (1896) ; and a monument to John Boyle O'Reilly (1892). A regular department of the city government is an art department, in charge of five com- missioners, serving without pay, appointed by the mayor from candidates namM by certain local art and literary institutions, without whose approval no work of art can become the property of the city. (e. m. b.)~~

~~Botany. See Anatomy of Plants, Cytology, Paleobotany, Pathology op Plants, Physiology of Plants, &c.~~

~~Bothnia, Gulf of. See Baltic Sea.~~

~~Bothwell, a village of Lanarkshire, Scotland, stands near the Clyde, 8 miles S.E. of Glasgow by rail. A gravitation water-supply has been introduced, the old~~

~~parish churcli restored, and a statue of the poetess, Joaima Baillie, a native, erected (1899). Population (1881), 1635 ; (1901), 3097. The parish of Bothwell, which contains coal-mines, quarries, and ironworks, embraces also the towns of Uddingston (5099), Bellshill (3330), and Holy- town (2811), and parts of two others, besides several large villages. Population (1881), 25,540; (1901), 45,901.~~

~~Botosani, a town in Eumania, in the north of Moldavia, situated in the midst of a rich agricultural and pastoral country. It has a commercial importance,~~

~~being the town through which goods from Poland and Galicia pass in transit for the south. There are extensive flour-mills equipped with modern appliances. The town of Boto§ani owes its name to a Tartar chief, Batus or Batu Khan, grandson of Genghis Khan, who occupied the country in the 13th century. There is a large colony of Armenians. Population (1895), 33,000 ; (1900), 32,193.~~

~~Bottesini, Giovanni (1823-1889), Italian con- trabassist and musical composer, was born at Crema in Lombardy on 24th December 1823. He studied music at the Milan Conservatoire, devoting himself especially to the double-bass, an instrument with which his name is principally associated. On leaving Milan he spent some time in America and also occupied the position of prin- cipal double-bass in the theatre at Havana. Here his first opera, Cristoforo Colombo, was produced in 1847. In 1849 he made his first appearance in England, playing double-bass solos at one of the Musical Union concerts. After this he made frequent visits to England, and his extraordinary command of his unwieldy instrument gained him great popularity in London and the provinces. Apart from his triumphs as an executant, Bottesini was a conductor of European reputation, and earned some suc- cess as a composer, though his work had not sufficient individuality to survive the changes of taste and fashion. He was conductor at the Theatre des Italiens in Paris from 1855 to 1857, where his second opera, L'Assedio di Firenze, was produced in 1856. In 1861 and 1862 he conducted at Palermo, supervising the production of his opera Marion Delorme in 1862, and in 1863 at Barcelona. During these years he diversified the toils of conducting by repeated concert tours through the principal countries of Europe. In 1871 he conducted a season of Italian opera at the Lyceum Theatre in London, during which his opera AM Baba was produced, and at the close of the year he was chosen by Verdi to conduct the first performance of Aida, which took place at Cairo on 27th December 1871. Bottesini wrote three operas besides those already mentioned : H Diavolo della Notte (Milan, 1859) ; Vinci- guerra (Paris, 1870); and Ero e Leandro (Turin, 1880), the last named to a libretto by Arrigo Boito, which was subsequently set by Mancinelli. He also wrote TJie Garden of Olivet, a devotional oratorio (libretto by Joseph Ben- nett), which was produced at the Norwich Festival in 1887, a concerto for the~~

~~double-bass, and numerous songs and minor instrumental pieces. Bottesini died at Parma on 7th July 1889. (e. a. s.)~~

~~Botzen (German, Bozen; Italian, Bolzano), the chief town of the government-district of the same name in Tirol, Austria. Population (1890), 11,744; (1900), 13,632; Catholic and German, with the exception of about 12 per cent. Italians. There is a garrison of 1032 men. Botzen, which is the busiest commercial town in the German Tirol, owes a portion of its prosperity to its popularity, and that of the adjoining village of Gries, as a winter resort. This accounts for the handsome new district, with hotels and villas, which has grown up in the south-western outskirts of the town. Viticulture and the growth of fruit and vegetables, in which there~~

~~is an important export trade not only to the neighbour- ing countries but to North Germany, Russia, and America, is the principal resource of the district, in addition to the important transit trade.~~

~~Boucher de Crdvecoeur de Perthes, Jacques (1788-1868), French geologist and antiquary, was born on 10th September 1788, at Kethel, Ardennes, France. He was the eldest son of Jules Armand Guil- laume Boucher de Cr^vecceur, botanist and customs officer, and of !^tienne-Jeanne-Marie de Perthes (whose surname he assumed in addition to his father's). A fancy for a seafaring life was quenched in him by a short experience at the age of thirteen, and in 1802 he entered Government employ as an officer of customs. His duties kept him for six years in Italy, whence returning (in 1811) he found rapid promotion at home, and finally was appointed (March 1825) to succeed his father' at Abbeville, where he remained for the rest of his life, being superannuated in January 1853, and dying at Amiens on 5th August 1868. His leisure was chiefly devoted to the study of what was afterwards called the Stone Age, "ante- diluvian man," as he expressed it. By his collections of flints gathered in Europe, Asia, and Africa, and by his monumental work AntiquMs celtiques et antSdiluviennes ; Mimoire sur I'industrie primptive et les arts d, lew origin (Paris, 1847, 1857, 1864, 3 vols.), he was the first to establish the existence of man in the Quaternary period. His views met with little approval, till the English geologists, following Falconer and Prestwick, pronounced in their favour. In 1863 and 1864 the discovery of human jawbones together with worked flints in the~~

~~quarry of Moulin-Quignon near Abbeville seemed to vindicate Boucher de Perthes entirely, but doubt was thrown on the genuineness of the find, though not on the good faith of the discoverer, who was the same year made an officer of the Legion of Honour together with Quatrefages his champion. Boucher de Perthes displayed activity in many other directions. He was the author of several tragedies, two books of fiction, several works of travel, and a number of books on economic and philanthropic questions, e.g.. Opinion de M. Christophe Vigneron sur les prohibitions et la liberti de commerce (1831-84), De la Misire (1840), De la Femme dans I'itat social, &c. (1860). To his scientific books must be added a rather fantastic treatise : De la creation : essai sur I'origine et la progres- sion des ^res (1839-41).~~

~~See Alcius Ledibn. Boucher de Perthes ; sa vie, ses ceuvres, sa correipondance. Abbeville, 1885. (j. m'f.)~~

~~Bouches du Rhone, a French department on the Mediterranean, washed by the Eh6ne (which, discharging its waters into the sea, there forms a large delta), by the Durance, a tributary of the Ehone, forming the N.E. frontier of the department, and by the Arc.~~

~~Area, 2026 square miles, divided among 29 cantons and 109 communes. The population, 604,857 in 1886, had increased to 734,347 in 1901. This increase is due in part to foreign immi- gration, mostly Italian, the contingent of which mounted from 42,955 in 1872 to 97,500 in 1896. Births in 1899, 16,683, of which 2079 were illegitimate ; deaths, 17,831 ; marriages, 5031. In 1896 the primary schools numbered 872, with 790,000 pupils ; 4 per cent, of the population was illiterate. The chief towns are Mar- seilles (the capital, and the third city of France), with 442,889 inhabitants in 1896, Aix and Aries the sub-prefectures. The sur- face under cultivation in 1896 amounted to only 741,000 acres, of which 390,260 acres were plough- land and 61,750 acres in vines. The wheat crop in 1899 was of Uie value of £400,010, and the other cereals also yielded but mediocre returns. The vine brought the department a revenue of over £1,043,000. Among the other cultures may be mentioned olive, yielding (1898) £245,779 ; and mulberry, £19,737. The sericultural product amounted to 2999 cwts. The live stock has largely increased since 1872, especially sheep. Out of 626,670 head in~~

all in 1899, 628,490 were sheep. The mineral production registered, in 1896, 364,000 tons of lignite

of the value of £132,000, and 63,500 tons of salt got from the salt-pans of the coast. Mining in 1898 yielded 16,000 tons of iron and cast-iron. Altogether, its gross returns exceeded the value of £250,000 ; its principal centres are the forges and ship-engineering works of Marseilles and Ciotat. Other industries are manufactures of oil, soap, glass, and chemicals. Including its transit trade, the commerceof Marseilles amounted in 1898 to the value of £78,200,000, more than a sixth of the general commerce of France, which totalled the value of £440,000,000.

Boucicault, Dionysius Lardner (commonly known as Dion) (1822-1890), actor and playwright, was born in Dublin, 26th. December 1822. His education was partly gained in Dublin and partly in London. Before he was twenty he was fortunate enough to make an im- mediate success as a dramatist with his play, London Assurance, which was produced at Covent Garden on 4th March 1841 with a cast that included Charles Mathews, Farren, Mrs Nesbitt, and Madame Vestris. It was given out to be from the pen of "Mr Lee Morton," but all Boucicault's succeeding plays appeared under his own name. Amongst his most conspicuous early successes were: Alma Mater (Haymarket, September 1842), Old Heads and Young Hearts (Haymarket, November 1844), A School for Scheming (Haymarket, February 1847), and The Broken Vow (Olympic, February 1851). In June 1852 he made his first appearance as an actor, in a melo- drama of his own entitled The Vampire, at the Princess's Theatre. Soon after this he went to the United States, where he remained (principally in New York) till 1855. A play of his called The Fox Hunt was successfully produced at Burton's Theatre, New York, in November 1853. In September 1860 he reached the climax of his career in the production of The Colleen Bawn at the Adelphi, a play that was hailed as one of the best domestic dramas of the day. This was followed at the same theatre by The Octoroon in November 1861.

~~Boucicault's next marked success was with Arrahna-Pogue, at the Princess's Theatre in March 1865. In this play he gave a masterly delineation of Irish character in the part of a Wicklow carman, a performance which won him the reputation of the best' stage Irishman of his time. Plays, original and adapted, flowed in numbers from his pen during the next ten years ; until, after the pro- duction of The Shaughraun at Drury Lane in September 1875, he returned to New York, and finally made his home there. Previous to this he had undertaken the partial or entire management of various London theatres, usually with disastrous financialresults. During the latter years of his life he exercised a powerful influence in the theatrical world of New York, and was still proliflc in his output of original plays and adaptations. He paid occa- sional visits to London, where his last appearance as an actor was made in his play, The Jilt, at the Prince of Wales's Theatre in 1886. He was twice married, his second wife being Agnes Eobertson, the adopted daughter of Charles Kean. He died in New York on 18th Septem- ber 1890. (b- i— s.)~~

~~Bougie, a seaport of Algeria, on the Bay of Bougie, 120 miles E. of Algiers, at the foot of Mount Guraya. It is the seat of a sub-prefecture in the department of Constantino. It serves Central Kabylia, and is a centre for the commerce in oils, wools, hides, and minerals. The traffic of the port amounted in 1898 to 70,000 tons. The population in 1872 was only 7200, but, owing to the impulse given to colonization, it had increased in 1890 to 12,380, and in 1900 to 14,290 (2510 French).~~

~~Bouguereau, Adolphe William (1825),~~

~~French painter, was born at La EocheUe, 30th November 1825. From 1843 till 1850 he went through the course of training at the ificole des Beaux Arts, and in 1850~~

~~divided the Grand Prix de Rome scholarship with Baudry, the subject set being " Zenobia on the banks of the Araxes." On his return from Eome in 1855 he was employed in decdrating several aristocratic residences, deriving inspiration from the frescoes which he had seen at Pompeii and Herculaneum, and which had already suggested his "Idyll" (1853). He also began in 1847 to exhibit regularly at the Salon. " The Martyr's Triumph," the body of St Cecilia borne to the catacombs, was placed in the~~

~~Luxembourg after being exhibited at the Great Exhibition of 1855 ; and in the same year he exhibited “Fraternal Love,” a “Portrait,” and a “Study.” The State subsequently commissioned him- to paint the emperor’s visit to the sufferers by the inundations at Tarascon. In 1857 Bouguereau received ‘a first prize medal. Nine of his panels executed in wax-painting for the m^yusion of M. Bartholomy were much discussed — “Love,” “Friendship,” “Fortune,” “Spring,” “Sum- mer,” ” Dancing,” ” Arion on a Sea-horse,” a ” Bacchante,” and the “Four Divisions of the Day.” He also exhibited at the Salon “The Eeturn of Tobit” (now in the Dijon Gallery). While in antique subjects he showed much grace of design, in his “Napoleon,” a work of evident labour, he betrayed a lack of ease in the treatment of modern costume. M. Bouguereau subsequently exhibited “Love Wounded” (1859), “The Day of the Dead” (at Bordeaux), ” The First Discord ” (1861, in the Club at Limoges), ” The Eeturn from the Fields ” (a picture in which Th^ophile Gautier recognized ” a pure feeling for the antique”), “A Fawn and Bacchante,” and “Peace”; in 1863 a “Holy Family,” “Eemorse,” “A Bacchante teasing a Goat ” (in the Bordeaux Gallery) ; in 1864 « A Bather ” (at Ghent), and « Sleep ” ; in 1866 « An Indigent Family,” and a portrait of Mme. Bartholomy ; in 1866 ” A First Cause,” and ” Covetousness,” with “Philo- mela and Procne ” ; and some decorative work for M. Montlun at La EocheUe, for M. Emile Pereire in Paris, and forthe churches of St ClotildeandStAugustin; andinl866 the large painting of ” Apollo and the Muses on Olympus,” in the Great Theatre at Bordeaux. Among other works by this artist may be mentioned ” Between Love and Eiches ” (1869), “A Girl Bathing” (1870), “In Harvest Time” (1872), “Nymphs and Satyrs” (1873), “Charity” and “Homer and his Guide” (1874^, “Virgin and Child,” “Jesus and John the Baptist,” “Eeturn of Spring” (which was purchased by an American collector, and was destroyed by a fanatic who objected to the nudity), a “Pieta” (1876), “A Girl defending herself from Love” (1880)^ “Night” (1883), “The Youth of Bacchus” (1884), “Biblis” (1885), “Love Disarmed” (1886), “Love Victorious ” (1887), « The Holy Women at the Sepulchre’^ and “The Little Beggar Girls” (1890), “Love in a Shower ” and ” First Jewels ” (1891). To the Exhibition of 1900 were contributed some of Bouguereau’s best known pictures. Most of his works, especially ” The Triumph of Venus” (1856) and “Charity,” are popularly known through engravings. “Prayer,” “The Invocation,” and “Sappho” have been engraved by M. Thirion, “The Golden Age ” by M. Annetombe. Bouguereau’s~~

pictures, highly appreciated by the general public, have been severely criticized by the partisans of a freer and fresher style of art, who have reproached him with being toa content to revive the formulas and subjects of the antique. At the Great Exhibition of 1867 M. Bouguereau took a third-class medal, in 1878 a medal of honour, and the same again in the Salon of 1885. He was chosen by th& Society of French Artists to be their vice-president, a post he filled with much energy. He was made a member of the Legion of Honour in 1856, an officer of the Order 26th July 1876, and Commander 12th July 1885. He- succeeded Pils as member of the Institute, 8th Januaiy

BOULANGE E — B 0 U L 0 G N ES U E-M E E

1876. Bouguereau has also been highly distinguished as a teacher.

Ch. Vbndhyes. Catalogue Illustre des (Euvres de Bouguereau. Paris, 1885. — Jules Clabbtie. Peintres et Sculpteurs Contempo- rains. Paris, 1874. — P. G. Hamekton. French FairUeji-s. — Artistes Modernes : Dictionnaire Illustre des Beaux Arts, 1885. — " W. Bouguereau," Fortfolio, 1875.— iljuiLE Bayard. " William Bouguereau," Monde Moderne, 1897.

Boulanger, George Ernest Jean Marie

(1837-1891), French general, was born at Eennes, 29th April 1837. 1 He entered the army in 1856, and served in Algeria, Italy, Cochin-China, and the rranco-German war, earning the reputation of being a smart soldier. He was made a brigadier-general in 1880, on the recommen- dation of the due d'Aumale, then commanding the 7th army corps, and Boulanger's expressions of gratitude and devotion on this occasion were remembered against him afterwards when, as War Minister in M. Ereycinet's Cabinet, he erased the name of the due d'Aumale from the Army List, as part of the Republican campaign against the Orleanist and Bonapartist princes. In 1882 his ap- pointment as director of infantry at the War Office enabled him to make himself conspicuous as a military reformer ; and in 1884 he was appointed to command the army occupying Tunis, but was recalled owing to his-differences of opinion with M. Cambon, the political resident. He

~~returned to Paris, and began to take part in politics under the aegis of M. Cl^menceau and the Radical party ; and in January 1886, when M. Freycinet was brought into power by the support of the Radical leader, Boulanger was given the post of War Minister. By introducing genuine reforms for the benefit of officers and common soldiers alike, and by laying himself out for popularity in the most pronounced fashion — notably by his fire-eating attitude towards Germany in April 1887 in connexion with the Schneebel^ frontier incident — ^he came to be accepted by the mob as the man destined to give France her revenge for the disasters of 1870, and to be used simultaneously as a tool by all the anti-Republican intriguers. His action with regard to the royal princes has already been referred to, but it should be added that Boulanger was taunted in the senate with his ingratitude to the due d'Aumale, and denied that he had ever used the words alleged. His letters containing them were, however, pub- lished, and the charge was proved. Boulanger fought a bloodless duel with the baron de Lareinty over this affair, but it had no effect at the moment in dimming his popu- larity, and on M. Freycinet's defeat in December 1886 he was retained by M. Goblet at the War Office. M. Clemen- ceau, however, had by this time abandoned his patronage of Boulanger, who was becoming so inconveniently prominent that, in May 1887, M. Goblet was not sorry to get rid of him by resigning. The mob clamoured for their "brav' general," but M. Rouvier, who next formed a Cabinet, ■ declined to take him as a colleague, and Boulanger was sent to Clermont-Ferrand to command an army corps. A Boulangist " movement " was now in full swing. The Bonapartists had attached themselves to the general, and even the comte de Paris encouraged his followers to sup- port him, to the dismay of those old-fashioned Royalists who resented Boulanger's treatment of the due d'Aumale. His name was the theme of the popular song of the moment — " C'est Boulanger qu'il nous faut " ; the general and his black horse became the idol of the Parisian populace ; and he was urged to play the part of a plebiscitary candidate for the Presidency. The general's vanity lent itself to what was asked of it ; after various symptoms of insubordination had shown themselves, he was deprived of his command in 1888 for twice coming to Paris without leave, and finally, on the recommendation**

of a council of inquiry composed of five generals, his name was removed from the Army List. He was, however, almost at once elected to the

~~Chamber for the Nord, his political programme being a demand for a revision of the constitution. In the Chamber he was in a minority, since genuine Republicans of all varieties began to see what his success would mean, and his actions were accordingly directed to keeping the public gaze upon himself. A popular hero survives many deficiencies, and neither his failure as an orator nor the humiliation of a discomfiture in a duel with M. Floquet, an elderly civilian, sufficed to check the enthusiasm of his following. During 1888 his personality was the dominating feature of French politics, and, when he resigned his seat as a protest against the reception given by the Chamber to his revisionist pro- posals, constituencies vied with one another in selecting him as their representative. At last, in January 1889, he was returned for Paris by an overwhelming majority. He had now become an open menace to the parliamentary Republic. '"* Had Boulanger immediately placed himself at the head of a revolt, he might at this moment have effected the coup d'&tat which the intriguers had worked for, and might not improbably have made himself master of France ; but the favourable opportvmity passed. The Government, with M. Constans as Minister of the Interior, had been quietly taking its measures for bringing a prose- cution against him, and within two months a warrant was signed for his arrest. To the astonishment of his friends, on 1st April he fled from Paris before it could be executed, going first to Brussels and then to London. It was the end of the political danger, though Boulangist echoes continued for a little while to reverberate at the polls during 1889 and 1890. Boulanger himself, having been tried and condemned in absentid for treason, in October 1889 went to live in Jersey, but nobody now paid much attention to his doings. The world was startled, however, on 30th September 1891 by hearing that he had committed suicide in a cemetery at Brussels by blowing out his brains on the grave of his mistress, Madame de Bonnemains (n4e Marguerite Crouzet), who had died in the preceding July.~~

~~See also the article France, History; and Veklt, Le General Boulanger et la conspiration monarchique, Paris, 1893. (h. ch.)~~

~~Boulder, capital of Boulder county, Colorado, U.S.A., situated at the base of the Front Range, on Boulder Creek, in 40° 01′ ISr. lat. and 105° 17′ W. long., at an altitude of 5047 feet. It is a point of distribution for an important mining region, and is entered by the Union Pacific, the Colorado and North-~~

Western, and the Colorado and South- ern railways. Population (1880), 3669 ; (1900), 6150.

Boulogne — sur — Mer, a fortified seaport of France, chief town of arrondissement, department of Pas- de-Calais, 25 miles from Calais by rail. It is 28 miles from Folkestone, with which there is a fixed steamboat service, the average passage occupying one hour and a half. A new deep-sea harbour is in course of construction, affording accommodation for the largest seargoing vessels. The southern pier, the so-called "Mole de Carnot," has a length of 1^ miles. A new railway station has been opened at the Tintilleries in the upper town on the through main line from Calais to Paris, the old town station being now mostly used for local traffic. Boulogne is rapidly extending northwards up the coast, and is connected by an electric tram-line with the pretty little watering-place, Vimille-Wimereux, 3 miles distant, which thus practically forms a suburb of the larger town. Public institutions include the communal college, schools of practical com- merce and industry. The number of volumes in the library has more than doubled, and there are now three other libraries, two museums, and three hospitals. Several

learned societies meet here. Fish-curing occupies several large establishments. The commercial activity of the town is of great and growing importance, and extends to all parts of the world. The numbers of vessels entered and cleared in 1899 (including French coasting vessels) were, respectively, 2946 of 1,295,360 tons, and 2961 of 1,293,270 tons. Of these there entered British vessels 1976 of 548,083 tons, and cleared 1983 of 549,203 tons. Of exports in 1899 wines formed the bulk ; next came cement, then potatoes, fresh fruit, and vegetables. The principal imports during the same year were coal and wood coke. The total value of the imports in. 1899 was £6,584,000, and of the exports £12,360,000. The total number of passengers arriving at Boulogne in 1899 was 115,967, and of departures 1 30,029. In 1899 the fisheries of Boulogne, including the sub-ports of iStaples, Andres- selles, Le Partel, and lEquihen, employed 400 boats and 6350 men, the value of the fish taken being estimated at

~~£506,680. Steamboats are gradually replacing the smaller sailing boats. Population (1881), 43,9^4 ; (1891),~~

~~44,340 ; (1901), 49,083.~~

~~Boulogne-sur-Seine. See Pabis.~~

~~Bourbaki, Charles Denis Sauter (1816- 1897), French general, was born at Pau, 22nd April 1816, being the son of a Greek colonel who died in the War of Independence in 1827. He entered St Cyr, and in 1836 joined the Zouaves, becoming lieutenant of the Foreign Legion in 1838, and aide-de-camp to King Louis Philippe. It was in the African expedition that he first came to the front. In 1842 he was captain in the Zouaves ; 1847, colonel of the Turkos ; 1850, lieutenant-colonel of the 1st Zouaves ; 1851, colonel ; 1854, brigadier-general. In the Crimean war he commanded a portion of the Alge- rian troops ; and at the Alma, Inkerman, and Sebastopol Bourbaki's name became famous. In 1857 he was made general of division, commanding in 1869 at Lyons. His success in the war with Italy was only second to that of MacMahon, and in 1862 he was proposed as a candidate for the vacant Greek throne, but declined the proffered honour. In 1870 the emperor entrusted him with the command of the Imperial Guard, and he played an impor- tant part in the fighting round Metz. On 25th Septem- ber Bourbaki escaped from Metz in disguise, though whether his departure was the result of an intrigue on the part of Bazaine or of connivance on the part of the German authorities (who, it is said, were anxious that communications should be opened up with the Empress Eugenie), has not been sufficiently cleared up. At all events it was given out that he had a mission to Chisel- hurst, and he went to England with a safe-conduct, but soon returned to France having effected nothing. He offered his services to Gambetta and received the com- mand of the Northern army, but was recalled on 19th November and transferred to the army of the Loire. Towards the end of the siege of Paris he unsuccessfully attempted to create a diversion by cutting the Prussian line at Belfort, but was outmanoeuvred by Manteuffel, and driven across the Swiss frontier. His troops were in the most desperate condition, owing to lack of food ; and out of 150,000 men under him when he started, only 84,000 escaped from the Germans into Swiss territory. Bourbaki himself, rather than submit to the humiliation of a~~

~~probable surrender, on 26th January 1871 delegated his functions to General Clinchant, and in the night fired a pistol at his own head, but the bullet, owing to a deviar tion of the weapon, was flattened against his skull and his life was saved. General Clinchant carried Bourbaki into Switzerland, and he recovered sufficiently to return to France. In July 1871 he again took the command at Lyons, and subsequently became military governor. In~~

~~1881, owing to his political opinions, he was placed on the retired list, together with Generals de Barail, Bataille, and Ducrot. In 1886 he was an unsuccessful candidate for the Senate. He died 27th September 1897. A patriot and a brilliant soldier and leader, Bourbaki was yet not equal to the tasks that fell to his lot ; and in this he resembled some other French generals of the Second Empire whose training had been obtained in Africa.~~

~~(h. oh.)~~

~~Bourgeois, L6on Victor Auguste (1851- -), French statesman, was born at Paris, 21st May"~~

~~1861, and educated for the law. After holding a sub- ordinate office (1876) in the department of public works, he became successively prefect of the Tarn (1882) and the Haute-Garonne (1885), and then returned to Paris to enter the Ministry of the Interior. He became prefect of police in November 1887, at the rather critical moment of President Gravy's resignation. In the follow- ing year he entered the Chamber, being elected deputy for the Mame, in opposition to General Boulanger, and joined the Eadical Left. He was Under-Secretary for Home Affairs in the Floquet Ministry of 1888, and resigned with it in 1889, being then returned to the Chamber for Reims. In the Tirard Ministry, which succeeded, he was Minister of the Interior, and subse- quently Minister of Public Instruction in the Cabinet of M. Freycinet, a post for which he had qualified himself by the attention he had given to educational matters. In this capacity he was responsible in 1890 for some im- portant reforms in secondary education. He retained his office in M. Loubet's Cabinet in 1892, and was Minister of Justice under M. Eibot at the end of that year, when the Panama scandals were making the office one of peculiar difficulty. He energetically pressed the Panama prosecu- tion, so much so that he was accused of having put wrongful pressure on the wife of one of the defendants in order to procure evidence. To meet the charge he~~

resigned in March 1893, but again took office, and only retired with the rest of the Freycinet Ministry. In November 1895 he himself formed a Cabinet of a pronouncedly Radical type, the main interest of which was attached to its fall, as the result of a constitutional crisis arising from the persistent refusal of the Senate to vote Supply. The Bourgeois Ministry appeared to consider that popular opinion would enable them to over- ride what they claimed to be an unconstitutional action on the part of the Upper House ; but the public was indifferent and the Senate triumphed. The blow was undoubtedly damaging to M. Bourgeois's career as an homme de gouvernement. After officiating as Minister of Public Instruction in the short-lived Brisson Cabinet of 1898, he represented his country with dignity and effect at the Hague Peace Congress.

Bourges, chief town of department Cher, France, 137 miles S. of Paris, on the railway from Paris to Nevers, is the headquarters of the 8th army corps, and its military establishments have become of the very highest importance ; they include, amongst other depart- ments, schools of artillery and pyrotechnics, engineering works, and a national cannon foundry. At Maziferes also, about 1^ miles S. of Bourges, are very important metallurgical works. Population (1881), 29,001 ; (1901),

39,822.

Bourget, Paul (1852), French novelist and

critic, was bom at Amiens, 2nd September 1852. His father, a professor of mathematics, was afterwards appointed to a post in the college at Clermont-Ferrand. Here Bourget received his early education. He then pro- ceeded to the college of Sainte-Barbe at Paris, and

followed a course at the Lycde Louis-le-Grand, where he studied with distinction, and passed his first examination with honours. In 1872-73 he produced a volume of verse, Au hord ^e la mer, which was followed by others, the last, Les Aveux, appearing in 1882. Meanwhile he was making a

~~name in literary journalism, and in 1883 he published Essais de Psychologie Contemporaine, studies of eminent writers first printed in the Nouvelle Bevue, and now brought together. In 1884 Bourget paid a long visit to England, and there wrote his first published story (L'lrriparable). Oruelle Enigme followed in 1885 ; and in 1887 Andre Oomelis and Mensonges were received with much favour. Le Disciple (1889) showed the novelist in a graver attitude ; while in 1891 Sensations d'ltalie, notes of a tour in that country, revealed a fresh phase of his powers. In the same year appeared the novel Coeur de Femme, and Nbuveaux Pastels, types of the characters of men, the sequel to a similar gallery of female types (Pastels, 1890). His later novels include La Terre Promise (1892) ; CosmopoUs (1892), a psychological novel, with Home as a background ; Une Idylle Tragique (1894) ; La Duchesse Bleue (1897) ; and some volumes of shorter atoTies^Gomplications Sentimentales (1896), the powerful Drames de FamiUe (1898), and Un Homme Fort (1900). Etudes et Portraits, first published in 1888, contains im- pressions of Bourget's stay in England and Ireland, especially reminiscences of the months which he spent at Oxford ; and Outre-Mer, a book in two volumes, is his critical journal of a visit to the United States in 1893. He was admitted to a chair at the Academy in 1894, and in 1895 was promoted to be an officer of the Legion of Honour, having received the decoration of the order ten years before.~~

~~As a writer of verse Bourget was merely trying his wings, and his poems are chiefly interesting for the light which they throw upon his mature method and the later products of his ayt. It was in criticism that his genius first found its true bent. The habit of close scientific analysis which he derived from his father, the sense of style produced by a fine ear and moulded by a classical education, the innate appreciation of art in all its forms, the taste for seeing men and cities, the keen interest in the oldest not less than the newest civilizations, and the large tolerance not to be learned on the boulevard — all these combined to provide him with a most uncommon equip- ment for the critic's task. It is not surprising that the Sensations d'ltalie, and the various psychological studies, are to. their different ways scarcely surpassed throughout the whole range of literature. Bourget's reputation as a novelist has long been assured. Deeply impressed by the singular art of Henry Beyle (Stendhal), he struck out on a new course at a moment when the realist school reigned without challenge in French~~

~~fiction. His idealism, moreover, had a character of its own. It was constructed on a scientific basis, and aimed at an exactness, different from, yet comparable to, that of the writers who were depicting with an astonishing faithfulness the environ- ment and the actions of a person or a society. With Bourget observation was mainly directed to the secret springs of human character. At first his purpose seemed to be purely artistic, but when Le Disciple appeared, the preface to that remarkable story revealed in him an un- suspected fund of moral enthusiasm. Since then he has varied between his earlier and his later manner, but his work in general has been more seriously conceived. From first to last he has figured with a most delicate brush the intricate emotions of women, whether wronged, erring, or actually vicious; and he has described not less happily the ideas, the passions, and the failures of those young men of France to whom he makes special appeal.~~

~~Bourget has been charged with pessimism, and with undue delineation of one social class. The first charge can hardly be sustained. The lights in his books are usually low ; there is a certain lack of gaiety, and the characters move in a world of disenchantment. But there is no despair in his own outlook upon human destiny as a whole. As regards the other indictment, the early stories sometimes dwell to excess on the mere framework of opulence; but the pathology of moral irresolution, of complicated affairs of the heart, of the ironies of friend- ship, in which the writer revels, can be more appropriately studied in a cultured and leisured society than amid the simpler surroundings of humbler men and women. The style of all Bourget's writings is singularly graceful. His knowledge of the literature of other lands gives it a greater flexibility and a finer allusiveness than most of his contemporaries can achieve. The precision by which it is not less distinguished, though responsible for a certain over-refinement, and for some dull pages of the novels, is an almost unmixed merit in the critical essays. As a critic, indeed, either of art or letters, Bourget leaves little to be desired. If he is not in the very flrst rank of novelists, if his books display more ease of flnished craftsmanship than joy in spontaneous creation, it must be remembered that the supreme writers of flction have rarely succeeded as he has in a different field.~~

~~Bourke, a town in New South “Wales, Australia, 503 miles by rail N.W. from Sydney, on th4 south bank, and at the head of the ordinary winter navigation, of the Darling river, in the county of Cowper. Remarkably rich copper ore exists in the district (which is also pastoral and agricultural) in great abundance. Population, about~~

~~3000.~~

~~Bournemouth, a municipal (1890) and county (1900) borough and watering-place in the parliamentary borough of Christchurch, England, 107^ miles S.W. by W. of London by rail. The town has been greatly extended in recent years, and many new streets and villas have been erected, as well as hotels, for the increasing number of visitors that frequent the town. Modern erections include twelve Established churches and several chapels, a science and art school, a public library, two drill halls, the Eoyal Victoria Hospital, and the Eoyal Boscombe and West Hants Hospital. The iron pier has been extended to 1000 feet in length. Golf links of 60 acres have been provided in Meyrick Park. The beautiful chines at Boscombe, Alum, and Branksome have attracted a large number of wealthy residents, and Talbot Woods is a favourite resort. Area, 2592 acres ; population (1881), 18,607; <1891), 37,781; (1901), 47,003. The urban districts of Pokesdown and Winton, which adjoin Bourne- mouth on the west and north, were included in the borough in Kovember 1901, and their population is respectively 4930 and 6719. Parts of the rural parishes of Holdenhurst and Southbourne have also been in- corporated.~~

~~Bouscat, Le, a suburban and residential town, de- partment of Girpnde, France, in^the arrondissement and 3 miles K. by W. of Bordeaux, on electric tramway to Eysines. It has a hydropathic establishment, and the Bourdeaux racecourse is here. Population (1881), 3644 ;~~

~~(1896), 9234 ; (1901), 10,462.~~

~~Boussu, a town of Belgium, in the province of Hainaut, 7 miles W. of Mons by rail. In its neighbour- hood copper-, bronze-, and iron-founding, and sugar manu- facture are carried on, also the building of steam- machinery and boats. Mines and quarries are also worked in the vicinity. Population (communal) (1880),~~

~~8722 ; (1897), 10,564.~~

~~Bowen, Charles Synge Christopher, Bakon (1835-1894), English judge, was bom on 1st January 1835, at Woolaston in Gloucestershire, his father, the Eev. Christopher Bowen of Hollymount, Co. Mayo, being then curate of the parish. At ten years of age Charles Bowen was sent to school at Lille, whence he was trans- ferred to Blackheath proprietary school. In 1850 he went to Rugby, entering the school-house. The master of his first form (the upper fifth) was Bradley, afterwards dean of Westminster, and his tutor was Cotton, afterwards headmaster of Marlborough, and subsequently bishop of Calcutta. At Eugby Bowen had a brilliant career, which he closed by winning a Balliol scholarship in 1863, while he was noted (as he was afterwards at Balliol) as a crick- eter and football player. At Oxford he made good the promise of his earlier youth, his principal achievements being the Hertford scholarship 1855, First Class Classi- cal Moderations 1856, Ireland scholarship 1857, Chancel- lor's prize for Latin verse 1857, First Class in Lit. Hum. 1858, Balliol Fellowship 1858, Arnold prize for English essay 1859. He also won the friendship of, among many others, Benjamin Jowett, then tutor, afterwards master of Balliol, a friendship which only ended when Jowett died in 1893, a year before his pupil, who had in 1885 become visitor of the college. From Oxford Bowen went to Lon- don, where he was called to the bar at Lincoln's Inn in 1861, and while studying law he wrote regularly for the Saturday Review, and also later for the Spectator. For a time he had little success at the bar considering his talents, and came near to exchanging it for the career of a college tutor. He had friends, however, who believed in him, and the persuasion of Mr Coleridge, afterwards Lord Chief Justice, the leader of the Western Circuit, which he had joined, and of Mr G. Baugh Allen, a well- known special pleader with whom he had read, and others, induced him to persevere. Soon after he had begun to make his mark he was briefed against the Claimant in the civil and criminal trials connected with the famous "Tichborne Case." Bowen's services to his leader. Sir John Coleridge, during the former helped to procure for him the appointment of junior counsel to the Treasury~~

~~(known in the legal vernacular as Attorney-General's devil), when Sir John had passed, as he did while the trial proceeded, from the office of Solicitor-General to that of Attorney General ; and from this time his practice became a very large one. The strain, how ever, of the Tichborne trials had been great, and possibly the combination of severe intellectual effort with the struggle for athletic distinction at school and at college had told upon his constitution, for his physical health became unecLual to the tasks which his zeal for work imposed upon it, and in 1879 his accept- ance of a judgeship m the Queen's Bencb Division, on the retirement of Mr Justice Mellor, gave him the opportunity of comparative rest, while it closed to him. the prospect of distinction in politics before he had had time to seek it. The character of Charles Bowen's intellect hardly qualified him for some of the duties of a puisne judge ; but it was otherwise when, in 1882, in succession to Lord Justice Holker, he was raised to the Court of Appeal. As a Lord Justice of Appeal he was conspicuous for his learning, his industry, and his courtesy to all who appeared before him ; and in spite of failing health he was able to sit more or less regularly until August 1893, when on the retirement of Lord Hannen he was made a Lord of Appeal in ordinary, and a baron for life, with the title of Baron Bowen of Colwood. By this time, however, his health had finally broken down ; he never sat as a law lord to hear appeals, and he gave but one vote as a peer, while his last public service con- sisted in presiding over the Commission which sat in**

October 1893 to inquire into the Featherstone riots. He was barely able to attend the meeting held on 2nd December in order to raise a memorial to Dr Jowett, at which both his old friend Lord Chief Justice Coleridge and he, respectively mover and seconder of a resolution as to the disposal of the fund to be raised, made their last speeches in public. Lord Coleridge lived till 14th June, but Lord Bowen became rapidly worse during the early months of 1894, and died on 10th April. He was buried in the churchyard of Slaugham, near Colwood, his country house in Sussex ; and a marble tablet has been erected to his memory in the vestibule of Lincoln's Inn chapel, bearing a Latin inscription from the pen of the Hon. George Denman, formerly a judge' of the Queen's Bench Division, and a senior classic, who also died soon afterwards.

~~Lord Bowen was regarded with great affection by all who knew him either professionally or privately. In the more intellectual circles of English society he had many friends, including Mr Gladstone. He had a polished and graceful wit, of which many instances might be given, although such anecdotes lose force in print. For example, when it was suggested on the occasion of an address to Queen Victoria, to be presented by her judges, that a passage in it, " conscious as we are of our shortcomings," suggested too great humility, he proposed the emendation " conscious as we are of one another's shortcomings " ; and on another occasion he defined a jurist as " a person who knows a little about the laws of every country except his own." Of Lord Bowen in the Court of Appeal Lord Davey wrote (Law Quarterly, July 1894), " It is upon his work there that his judicial reputation will rest. Law to Bowen was not a mere collection of rules, but was the embodiment of the conscience of the nation. . . . Lord Bowen will be remembered amongst the great judges who steered the ship in the transition from the old system' to the new. . . . There will be found in the series of judg- ments delivered by him a luminous interpretation of legal principles as applied to the facts and business of life, ex- pressed in language worthy even of his literarj/ reputa- tion." Among good examples of his judgment. Lord Davey proceeded to cite that given in advising the House of Lords in Angus v. DaUon (6 App. Cas. 740), and those delivered in Abrath v. North-Eastem Railway (11 Q.B.D. 440) ; Thomas v. Quartermaine (18 Q.B.D. 685) ; Vagliano V. Bank of England (23 Q.B.D. 243) (in which he pre- pared the majority judgment of the Court, which was held to be wrong in its conclusion by the majority of the House of Lords) ; and the Mogul Steamship Company v. M'Gregor (23 Q.B.D. 698). Of Lord Bowen's literary works besides those already indicated may be mentioned his translation of VirgU's Edogv^s, and-dBmeid, books i.vi., his article on the "Administration of the Law," con tributed to The Reign of Queen Victoria, edited by Mr Humphry Ward, and his pamphlet The Alabama Claim and Arbitration considered from a Legal Point of View. Lord Bowen married in 1862 Emily Frances, eldest daughter of Mr James Meadows Rendel, F.R.S. (and niece of Mr Stuart Eendel, afterwards raised to the peer- age as Baron Eendel), by whom he had issue, William Edward, a clergyman, born 1862, who succeeded to Hol- lymount ; Maxwell Steele, born 1865 ; and Ethel Kate, born November 1870.~~

~~See also Lord Bowen, by Sir Henry Stbwakt Cuitoiiigham.~~

~~(e. a. AB.)~~

~~Bowles, Samuel (1826-1878'), American journalist, was bom in Springfield, Massachusetts, 9th February 1826. He was the son of Samuel Bowles, an editor of the same city, wJio had established the weekly Springfield Republican in 1824. The daUy Repiiblican was begun in~~

~~1844, as an evening newspaper, afterwards becoming a morning journal. To its service Samuel Bowles, junior, devoted Ms life (with the exception of a brief period during which he was in charge of a daily in Boston), and gave it a national reputation by the vigour, incisiveness, and independence of its editorial utterances, and the con- cise and convenient arrangement of its local and general news-matter. During the controversies affecting slavery and resulting in the Civil war, Bowles supported, in gen- eral, the Whig and B.epublican parties, but in the period of reconstruction under President Grant his paper repre- sented anti-administration or "Liberal Eepublican" opinions, while in the disputed election of 1876 it fa^ voured the claims of Tilden, and has since been indepen- dent of all party control. He died at Springfield on 16th January 1878. During his lifetime, and subsequently, the Republican ofB.ce became a sort of school for young journalists, especially in the matter of pungency and conciseness of style, one of his maxims being "put it all in the first paragraph." Bowles wrote several epheme- ral books of travel in the western part of the United States, but his best work was in the columns of his news- paper. A eulogistic Life and Times of Samuel Bowles (2 vols., 1885), by George S. Merriam, is virtually a history of American political movements after the com- promise of 1850.~~

~~Bowling Green, capital of Warren county, Ken- tucky, U.S.A., situated on Barren river, at the head of navigation, in the southern part of the state, at an alti- tude of 468 feet, and on the Louisville and Nashville railway. Population (1880), 5114 ; (1900), 8226.~~

~~Bowling Green, a town of Ohio, U.S.A., capital of Wood county, in the north-western part of the state, 20 miles S. of Toledo, at the intersection of lines of the Cincinnati, Hamilton, and Dayton and the Toledo and Ohio Central railways. It is in an oil and natural gas region. Population (1890), 3467 ; (1900), 5067.~~

~~Bowls. — Since 1880 there has been a remarkable re- vival of interest in the game of Bowls in every part of the globe where English-speaking communities are found. In Scotland, so far from passing out of fashion. Bowls, along with its winter analogue of curling, may still be considered the national game, and it is estimated that there are no fewer than 700 Bowling clubs in the country. In Glasgow and the immediate neighbourhood there are some thirty clubs, most of which possess two greens. The Queen's Park and Titwood clubs, however, have each three greens, and as tliey can quite comfortably play six rinks on each, it is common to see 144 players making their game simul- taneously. In Edinburgh and Leith there are at least thirty clubs, and every town jof any consequence boasts one green at all events. But it is in London, where it is dif6.cult to obtain suitable pitches, that the revival in Bowls has been most conspicuous. The day when the pastime was looked npon as a mere " pothouse recreation " has gone for ever, for even in those cases where the greens are still in connexion with the public-houses whose names the clubs bear, they are now rented by the clubs for their own use exclusively. Within the metropolitan area the number of clubs exceeds forty, the majority of them hav- ing been founded since 1885. Following the lead of Edinburgh, Glasgow, and other Scottish corporations, the London County Council have laid down greens (as the annexed table shows) in several of the publia parks under their control,, and have it in contemplation to construct others at Sydenham Wells Park, Brockwell Park, and elsewhere.~~

~~With regard to the British colonies a similar tale of progress and popularity has to be recorded. In Australia and New Zealand nearly every little town or village has~~

~~its Bowling-green, and in Melbourne and Sydney — in- cluding in both instances the surrounding districts — there are almost as many greens as there are in Glasgow. In Canada the game is being taken up rapidly,~~

~~although the Dominion is yet a long way behind the Australian Commonwealth in this respect. There is a green in Cape Town, in Port Elizabeth, in Kimberley, and in a few~~

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~~1900~~

~~36×36~~

~~from £50 to £90~~

~~. 35~~

~~46~~

~~Ravens-~~

~~court~~

~~Park~~

~~1901~~

~~40×30~~

~~£98 (est.)~~

~~The Island~~

~~Gardens,~~

~~/~~

~~Poplar .~~

~~1901~~

~~40×30~~

~~£105 (est.)~~

~~Victoria~~

~~Park~~

~~1901~~

~~86×36~~

~~£91 (est.)~~

~~other towns in South Africa. Calcutta and Hong Kong each possesses a green, and there is one in Kumamoto in Japan. The universality of the game in Greater Britain affords interesting evidence of the fact that the pastime is (within the modem period at any rate) distinctly Scot- tish, for Caledonian colonists, wherever they settle, give early attention to the constructing of a Bowling-green. This circumstance makes it strange that in the United States the number of clubs is still somewhat limited.~~

~~There are two kinds of green — one the crown, and the other the level. The former is confined almost entirely to Lancashire and Yorkshire and one or two more of the North of England counties. This is the type of green on which most of the gate-money contests take place, the prizes having encouraged a good many players to take up the game professionally. The fall from the " crown " of the green to the ditch may be as much as 18 inches, and the ordinary biassed bowls are practically useless on such a pitch. The game upon such a green is of a very sport- ing character, but its associations must preclude it from ever becoming general. It is the game on the perfectly flat or level green that constitutes the historical game of Bowls, as may be amply proved not only by the hundreds of admirably-kept club greens in Scotland, but also by the fine private greens in connexion with so many of the famous mansions of England, and the beautiful sheets of turf belonging to several of the colleges of Oxford and Cambridge. Subject to the rule as to a minimum jack (25 yards, according to the Laws of the Scottish Bowling Association, adopted on 24th April 1893), there is~~

~~no prescribed size for the green ; but 42 yards square would form an ideal green. The Queen's Park Club of Glas- gow have one green of about 47 yards square, big enough, that is, to accommodate seven rinks. A really under- sized green is a poor pitch, because it commonly involves playing diagonally instead of up and down — the orthodox direction. The construction of a green scientifically is a heavy undertaking, which only wealthier clubs can iace. The ground for the whole of its extent must be ex- cavated to a depth of two feet or so, well drained, and layers of different materials (gravel, cinders, mould, silver sand) laid down before the final covering of turf. Seaside~~

~~turf is the best of all. It wears longest, and keeps its " spring " to the last. At one time the clubs in Glasgow and Ayrshire obtained turf from the coast near Ayr or Irvine, but after the shore had been stripped of the most suitable grass, clubs of later date went as far as Islay and the Solway to procure good sea-turf. Much of the latter is under water every tide. It answers its purpose excel- lently in Glasgow, but possibly does best in some such " soft " climate as the West of Scotland too consistently offers. Turf like this is not generally obtainable, and becomes so costly an item in the contractor's tender that poorer clubs have to be satisfied with much commoner and more ordinary turf. The mere difference in turf, however, measures the difference between a Glasgow green and a London one, or, in other words, between a game of skill and a game largely of luck.~~

~~It is the rougher green in many parts of London and the South of England that has necessitated a modification of the Scottish practice of play, which otherwise would un- questionably govern every club in the world. In Scot- land the custom is to play rinks of four arside — the players being called leader, second player, third player, and driver or skip — which gives rise on a fine green to a beautiful display of keen and accurate Bowling. On the inferior greens of the majority of London clubs, though such a system would be quite possible — and is often adopted in friendly games — it cannot be said that the play would be either scientific or satisfactory. In these cases, accordingly, the rule is to play rinks of only two Srside in~~

~~matches. On the other hand, in the Colonies, where the greens closely approximate the quality of the Scottish greens, the Scottish practice is almost invariably followed.~~

~~In theory the game of Bowls is simplicity itself, the aim of the player being to deliver his ball from the " footer " or mat with sufficient strength and bias to cause it to rest nearer to the jack than his opponent's bowl. But in practice there is plenty of scope for skill. The leader's business is to " be up." There is no excuse for short play on the part of the first players ; their bowls would be far better in the ditch. It is their plain duty to be on the jack, the ideal position being a bowl at rest immediately behLud the tee. It is customary for the skip, or driver, to direct his men from the end that is being played t6, and they must do precisely as they are bidden. The player who disobeys orders, whatever his individual merits, will be of little use in a team. The skip, having carefully noted the lie of the different bowls, then takes his place at the footer, and acts according to the posi- tion of the "wood" around the jack. It may be that he has to throw away his bowl, or to draw a shot with the utmost nicety, or even to " fire." Judgment and nerve are all-in-all in a skip. When the foe are lying massed around the jack, and the draws are all blocked, it is some- times the wisest plan for the skip to " fire " — that is, to deliver his bowl almost dead straight, and with enough force to kill the bias for the moment — and scatter his enemies. Ignorant onlookers or irritated players may describe this as "skittles," but there are situations in which it is absolutely the correct thing to do ; and the skip who has the pluck to do it deserves to be com- mended for his indifference to sneers and his desire to win the end.~~

~~In a general way the Sowling season runs from May- day till the end of September or the middle of October. When the season is closed the green should be carefully examined. Weeds must be uprooted, worn patches re-turfed, and if the whole can then be laid under a winter blanket of silver sand, by the following spring this will all have been absorded and the elasticity of the pitch restored. During the season the ground-man will of course be on duty constantly, and in most clubs it is the~~

~~rule to appoint a " green rota " of members, who under- take a superintendence of the green week by week, and who have, amongst other~~

~~matters, occasionally to decide whether or not, having regard to the state of the weather, play should be allowed.~~

~~Bowls has now been provided with a code of laws as full and as far-reaching as the laws which govern cricket. The rules and regulations of the Scottish Bowling Associa- tion, so far at any rate as principles are concerned, have been cordially accepted. In certain details, as has already been indicated, modifications have been introduced which do not, however, imperil the cardinal features of the game. The dimensions of a rink are laid down, the maximum circumference of the bowl is fixed at 16^ inches, and un- biassed bowls are forbidden. A game consists of any number of ends or points agreed upon, or for a specified length of time. In clubs following the Scottish code, 25 ends, or heads, a rink is the ordinary practice ; but most of the London and many English provincial clubs prefer 21 points a rink for match play, championships, and handi- caps. There are obvious objections to playing matches by time, and this is consequently seldom adopted. In Scot- land a full rink consists of four men a-side, each playing two bowls, but in a " pairs " game (two against two) each player uses four bowls. Thus the same aggregate num- ber of bowls (8) is employed in both games. But, as we have said, many London clubs, for good and sufficient reasons in their case, play only two men a-side in matches, and in " friendlies " it is rare indeed to see players use four bowls each on English greens. Probably most difference of opinion has arisen over what con- stitutes a minimum and maximum jack. In the Scottish rules the former is fixed at 25 yards, but several English clubs prefer a shorter distance. The latter is usually fixed at six feet from the ditch, but the Scottish rules seem to be singularly lax on the subject, for they declare that "when thrown less than two yards from the ditch it should be moved out to that distance," and if it run to the side " it shall be moved out and placed in a straight line between the pins numbering the rinks." This handling of the jack by any person but the thrower is, in the view of the South London Association of Bowling Clubs, itself an illegal act, and neither logical nor sportsmanlike, and it is difficult to reject this con- tention. It is of interest, in this connexion, to note that the Australian Bowlers who visited the United Kingdom in 1901 considered that the practice of bowling to jacks of uniform length was far too common on British greens and did not make for the best possible game. Another question upon which doctors differ is as to the condition of the jack after it~~

~~has been driven into the ditch. Unless it has been forced clean out of bounds, such a jack is still alive, according to Scottish rules. On nearly all English greens it is a dead- jack, and the end "no end." English practice here seems preferable. Nor has the Scottish doctrine of "touchers" proved generally acceptable south of the Cheviots. A bowl which, dur- ing its original course, touches the jack, is called a toucher, and counts in the game even should it run into the ditch, or be driven in by another bowl. For the purpose of this and other laws, the Scottish Associa- tion holds that the ditch within the limits of the rink is part of the green so far as the jack and touches are concerned. It is a comparatively easy feat for early players in a rink to touch the jack, and no special re- ward seems called for by this exhibition of common- place dexterity. Moreover, the ditch seems to be the ditch and not the green. The last law in the Scottish code might be universally adopted and rigidly enforced. " Persons not engaged in the game," it runs, " must confine themselves to the banks and preserve an attitude of strict~~

~~neutrality/' On most London greens this rule is more honoured in the breach than in the observance.~~

~~All clubs look to the Scottish Bowling Association, the headquarters of which are in Glasgow, as the leading legislative authority. Other important bodies are the London and Southern Counties Bowling Association, the South London Association of Bowling Clubs, and the Imperial Bowling Association, besides numerous county associations, which are nearly all affiliated to one or other of the main bodies. The first-named body was founded in October 1895 at the instigation of Mr Ernest C. Price, the then president of the Brownswood Bowling Club of Mnsbury, an enthusiast who thought the time had come for codifying and fixing the laws which should govern the game, at least in the South of England, and already most of the strongest and most representative Southern clubs have joined the Association. Another body which aimed at drawing up common rules for match play was the South London Association of Bowling Clubs, started in~~

~~1898 on the suggestion of Mr Joseph Hay, captain of the Temple Bowling Club of Camberwell. The~~

~~chief question with which this association was confronted was the important point whether or not the Scottish rules should be adopted en bloc. It was felt that, in view of the comparatively rough condition of many of the South London greens and the small dimensions of some of them, it was not possible to accept several of the Scottish details of play, and accordingly a separate body was needed to legislate for these special circumstances. Under the rules of this Association, therefore, matches with affiliated clubs are played in rinks of two a-side, 21 points up. The Imperial Association was founded in 1899 with the twofold obj ect, first, of promoting intercolonial matches and tournaments, home and away, and secondly, of codi- fying the laws of the game, which should be binding on the players in all such matches and tournaments, and which, the hope was cherished, might also become recog- nized by every club in the British empire and elsewhere as the final laws of Bowls. The earl of Jersey, who had been governor-general of New South Wales from 1890 to 1893, and was himself an expert player, accepted the post of president, and lent the Association efficient support.~~

~~Sfeet ^~~

~~J~~

~~O~~

~~o J~~

~~Fig. 1.— Drawing.~~

~~Fig. 2.— Guarding. Fig. 8.— Trailing.~~

~~(In every case F is the Footer, B, the Bowl, J, the Jack.)~~

~~Laws, mainly based upon the Scottish code, were drawn up and submitted to the leading colonial clubs. But the principal difficulty was a practical one, namely, the means of defraying the expenses of visiting teams.~~

~~Fortunately for the game, gate-money contests have never come into vogue, and consequently funds from this source were not available. Though the question had to be left unsettled, and'mainly to be dealt with by the respective clubs, there appeared to be no substantial reason against holding periodically matches of an exceptionally interesting character, in which the best talent of the Colonies and the Mother Country should be pitted against each other. The visit of Bowlers from the States of Australia and New Zealand in 1901, already alluded to, was one out- come of the energies of the Imperial Bowling Association. On broader grounds, the visit was nothing short of a landmark in the history of the game.~~

~~On Scottish greens the game of Points is occasionally played, but it is rarely seen on English greens. Its main object seems to be to perfect the proficiency of players in certain departments of Bowls proper. There are four sections in the game, namely, drawing, guarding, trailing, and driving. In drawing (Fig. 1), the object is to draw as near as possible to the jack, the player's bowl passing outside of two other bowls placed five feet apart in a horizontal line fifteen feet from the tee, without touching either of them. Three points are scored if the bowl come to rest within one foot of the jack, two points if within two feet, and one point if within three feet. Circles of these radii are usually marked around the~~

~~Fia. 4.— Driving.~~

~~jack for convenience' sake. In guarding (Fig. 2), two jacks are laid at the far end of the green twelve feet apart in a vertical line. A thread is then pinned down between them, and on each side of this thread three others are pinned down parallel with it and six inches apart from each other. A bowl that comes to rest on the central line, or within six inches of it, counts three points, a bowl twelve inches away two points, and a bowl eighteen inches off one point. In trailing (Fig. 3), two bowls are laid on the turf three feet apart, and straight lines are chalked from bowl to bowl across their back aAd front faces, and a jack is then deposited equidistant from each bowl and immediately before the front line. A semi- circle is then drawn behind the bowls with a radius of nine feet from the jack. Three points are given to the bowl that trails the jack over both lines into the semicircle and goes over them itself. If a bowl trail the jack over both lines, but only itself cross the~~

~~first ; or if it pass both lines, but the jack cross only the first, two points are awarded. A bowl passing between the jack and either of the stationary bowls, and passing over the back line ; or touch- ing the jack, yet not trailing it past the first line, but itself crossing the back line ; or trailing the jack over the front line without crossing it itself, receives one point. In no case must the sta- tionary bowls be touched, or the semicircle crossed by the trailed jack or played bowls. In driving (Fig. 4), two bowls are laid down two feet apart, and then a jack is placed In front of them, fifteen inches apart from each, and occupying the position of the apex of an inverted pyramid. The player who drives the jack into the ditch between the two bowls scores three. If he moves the jack, but does not carry it through to the ditch, he scores two. If he pass between the jack and either bowl he scores one, although it is not easy to see what driving he has done. The played bowl must itself run into the ditch without touching either of the stationary bowls. It is obvious that the Points game demands an ideally perfect green.~~

~~See W. M. Mitcheli,. Manual of Bowl-playing. Glasgow, 1880. — H. J. DiNGLET. Touchers and Rubs. Glasgow, Thomas Taylor, 1893.— 37ie Field. 31st March, 28th July, 15th December 1900 ; 23rd March, 22nd June 1901 (vols, xcv., xcvi., and xcvii.); and the Laws of the Game as adopted by the Scottish Bowling Associa- tion 1893, and also the Code drafted by the Imperial Bowling Association, and published in 1901. (j. a. m.)~~

~~Boyaca, a department of the Eepublic of Colombia, bounded on the N. by the department of Santander and Venezuela, on the S. by Cundinamarca, and on the W. by Cundinamarca, Santander, and Antioquia. Area, 33,300 square miles ; population, 608,000. The capital, Tunja, has 6000 inhabitants, and amongst other towns are Chi- quinquira, Santa Eosa, Sogamoso, Moreno.~~

~~Bozrah, (1) in Edom, now el-Buseireh, south-east of the Dead Sea, in the broken country on the west side of the Edomite plateau. (2) In the Mishor, or "plain country " of Moab, perhaps Kestir el-Besheir. Whether Bostra, the Bosora of 1 Mace. t. 26, now Busr^, in the HaurSin south of Damascus, was originally called Bozrah is uncertain. From its position it may be inferred that it was a place of importance at a very early period.~~

~~Brabant, North, the northern half of the former duchy of that name (the southern portion of which belongs to Belgium), and the largest province of the Netherlands. The south-eastern part of the province differs in every respect from the north-western, being higher (on the frontier, 85-1000 feet), on diluvial sand (with occasional clay and loam in the sub-soil and on the banks of the smaller rivers), covered with heath and fens (the peel) and waste grounds (25 per cent, of the province), growing only potatoes, rye, and buck-wheat, and inhab- ited by a scanty, poor population of Roman Catholics. The north-western portion, on the other hand, consists of flat alluvial land (3-16 feet in altitude), has more and larger rivers (the Maas, Dieze, Mark, and Donge) and towns ('S Bosch, Breda, &c.), more fertile land, growing wheat and beetroot, a denser and Protestant population, and holds commercial communication by river and railway with the provinces of Holland, Zeeland, and Gelderland. Area, 1980 square miles ; population (1899), 653,845.~~

~~Brabant, South, a central province of Belgium, bordering on the provinces of Antwerp, Limbourg, Lifege, Namur, Hainaut, and E. Elanders. It is formed of the southern part of the ancient duchy, which extended to the Lower Meuse north of Bois-le-Duc. In the time of the first kingdom of the Netherlands (1815-30), Northern Brabant was distinguished from Southern Brabant, and separated from it by the province of Antwerp. The surface presents plateaux of more than 300 ft high (as much as 443 ft at Waterloo) and ramifications of hills. The soil is gen- erally fertile. The province has important paving- and building-stone quarries, numerous breweries and distil- leries, beetroot-sugar refineries, and paper-mills. It is divided into the three administrative arrondissements of Brussels, Louvain, and Nivelles, and covers 1268 square miles; population (1899), 1,281,000 (or 1010-2 per square mile), against 959,800 in 1875. The arron- dissement of Brussels alone has a population of 871,000, or 2035-7 to the square mile.~~

~~Brachiopoda. — Since the publication of the ninth edition of this Encyclopaedia, though much has been written on Brachiopoda, little real advance has been made in our knowledge of the afB.nities and embry- ology of the group. On the other hand, our knowledge of the histology and structure of the adult has been materially increased by the researches of van Bemmelen (Jena Zeitschr. xvi. 1883), followed by Shipley (M. Stat^ Neapel. iv. 1883), Schulgin (Zeitschr. wiss. Zool. xli. 1885),~~

~~Joubin (Arch. Zool. exp. (2) iv. 1886), culminating in the exhaustive papers of Blochmann (Untersuchungen iiber den Bau der Brachiopoden, Th. i., 1892 ; Th. ii., 1900), which unfortunately at present deal only with Crania, Discinisca, and Lingula. Numerous dredging opera- tions have added to what is known of the distribution and, to some extent, of the habits of the Brachiopoda. In particular Francois (Arch. Zool. exp. (2) ix. 1891) has given a good description of the niode of life of Lingula. The works on fossil Brachiopods which have appeared within the period named amount to hun- dreds, and are far too numerous to mention. Ameri- can naturalists have been particularly active, and their labours have resulted in the system of classification given below. Beecher (Amer. Jour. Scr. Ser. 3, xli. and xliv.) suggested the four orders amongst which in 1893 Schuchert (Amer. Geol. xi. and xiii. ; BuU. U. S. Geol. Survey, No. 87, 1897) arranged all the known genera of Brachiopods. The latest views on the classification are expressed in the latter author's work published in 1897. An excellent summary of this side of the question is pre- sented in Wood's PaloBontology, and on a more extensive scale in the article " Brachiopoda " by Schuchert in the English edition of von Zittel's Palceon- tology.~~

~~Caelomic Spaces. — With regard to morphology, the chief points in which Davidson's account of the group (see Ency. Brit. vol. iv.) has received amplifica- tion are the nature of the several cavi- ties in the body and in the arms, the structure of the vas- cular system and of the nervous system, and the histology of the various tissues. The spaces in the body of a Brachio- pod are coelomic in nature. The coelom, the walls of which give rise to the reproductive cells and the cavity of which opens to the~~

~~exterior through fia.l.—AdS6ermaot(bBletthiil.tot&MeffathyH» j-Vn ⁄^'K^i/^^o id a (•^»-ffiop«), which has been bisected in the median LUe~~

~~nepnriuid, ib~~

~~spacious chamber surrounding the ali- mentary canal, and is continued d©rs- “* “*■ iici/uimmui , xx, cawhuu upmiui^ oi tue~~

~~^^^ on/^ ■traTi+i.t.nTr same; 12, ventral adjuster; 18, divaricator any ana veutldliy mnscle ; 14, sub-oesophageal nerve gai ”’ into the sinuses of ^^^ ‘’*’-* ! ^^’ dorsal adjustor muscle.~~

~~the mantle (Fig. 1). Some of the endothelial cells lining the ccelom are ciliated, the cilia keeping the fluid contents in movement. Others of the endothelial cells show a great tendency to form muscle fibres. Besides this main coelomic cavity there are certain other spaces which Blochmann regards as coelomic, but it must be remembered that his interpretation rests largely on histological grounds, and at present embryological confirmation is wanting. These~~

~~valve ; 8, the pedicle ; 4, the mouth ; 6, lip which overhangs the month and runs all round the lophophor ; 6, tentacles ; 7, ovary in dorsal valve ; 8, liver diverticula ; 9, occlusor muscle — its double origin is shown ; 10, internal opening- of left nephridium ; 11, external opening of the same ; 12 , ventral adjuster ; 18, divaricator muscle ; 14, sub-oesopbageal nerve ganglion ; 15,~~

~~spaces are as follo-ws: — (i.) the great arm-sinus; (ii.) the small arm-sinus together with the central-sinus and the peri-cesophageal sinus, and in Discinisca and lAngvla, and, to a less extent, in Crania, the lip-sinus ; (iii.) certain portions of the general body-cavity -which in Crania are separated off and contain muscles, &c. ; (iv.) the cavity of the stalk when such exists. The great arm-sinus of each side of the lophophor lies beneath the fold or lip which together with the tentacles forms the ciliated groove in which the mouth opens. These sinuses are completely shut off from all other cavities, they do not open into the main ccelomic space nor into the small arm-sinus, nor does the right sinus communicate with the left. The small~~

~~arm-sinus runs along the arms of the lophophor at the base of the tentacles, and gives off a blind diverticulum into~~

~~each of these. This diverticulum con-~~

~~tains the blood-vessel and muscle-fibres (Fig. 2). In the region of the mouth where the two halves of the small arm- sinus approach one another they open into a central sinus lying beneath the OBSophagus and partly walled in by the two halves of the ventral mesentery. This sinus is con- tinued round the oes- ophagus as the peri- cesophageal sinus, and thus the whole com-~~

~~Fro. 2. — Diagrammatic sectioathrouerh an arm of r^1a-v rtf fho email the lophophor of Crania. Magnified ; after P^”-^ . “^ J’”” SUid,il Blochmaon. 1, the lip; 2, the base of a tentacle arm-SinuS has the rela- biseotedin the middle line; 3, great arm-sinus; i- f ii^ orufalloH~~

~~4, small arm-sinns, containing muscle-fibres; wons OX me bO-Cdiieu~~

~~5, tentacular canal; 6, external tentacular vaSCUlar SVStem of a muscle ; 7, tentacular blood-vessel arising from «. tj t n the cut arm-vessel in the small arm-sinus ; 8, bipunCUllCl. In OrO- chief arm-nerve ; 9, secondary arm-nerve ; 10, „„■„ itf. £g comuletelv under arm-nerve. „ _ ” .•’~~

~~shut off from the mam coelom, but ‘in lAngvla it communicates freely with this cavity. In Discinisca and lAngula there is further a lip-sinus or hollow system of channels which traverses the supporting tissue of the edge of the mantle and contains muscle-fibres. It opens into the peri-cesophageal sinus. It is better developed and more spacious in. lAngula than in Discinisca. In Crania, where only indications of the lip- sinus occur, there are two other closed spaces. The pos- terior occlusor muscles lie in a special closed space which Blochmann also regards as ccelomic. The posterior end of the intestine is similarly surrounded by a closed ccelomic space known as the peri-anal sinus, in which the rectum lies freely, unsupported by mesenteries. AH these spaces contain a similar coagulable fluid with sparse corpuscles, and all are lined by ciliated cells. There is further a great tendency for the endothelial cells to form muscles, and this is especially pronounced in the small arm-sinus, where a conspicuous muscle is built up. The mantle-~~

~~sinuses which form the chief spaces in the mantle are diverticula of the main ccelomic cavity. In Discinisca they are provided with a muscular valve placed at their point of origin. They contain the same fluid as the general ccelom. The stalk is an extension of the ventral~~

~~body-wall, and contains a portion of the coelom, which, in Discinisca and lAngula, remains in communication with the general body-cavity.~~

~~Circulatory System. — The structures mentioned in the article Bbachiopoda of the ninth edition as pseudo-hearts have been shown by Huxley to be nephridia ; the true heart was described and figured by Hancock, but has in many cases escaped the observatio^i of later zoologists. Blochmann in 1884, however, observed this organ in the living animal in species of the following genera: — Terebratulina, Magellania (Waldheimia) , Rhynchonella, Megathyris (Argiope), Lingula, and Crania (Fig. 1). It consists of a definite contractile sac or sacs lying on the dorsal side of the alimentary cajial near the oesophagus, and in preparations of Terebratulina made by quickly removing the viscera and examining them in sea-water under a microscope, he was able to count the pulsations, which followed one another at intervals of 30-40 seconds.~~

~~A vessel — ^the dorsal vessel — runs forward from the Seart along the dorsal surface of the oesophagus. This vessel is nothing but a split between the right and left folds of the mesentery, and its cavity is thus a remnant of the blastocoel. A similar primitive arrangement is thought by Blochmann to obtain in the genital arteries. Anteriorly the dorsal vessel splits into a right and a left half, which enter the small arm-sinus and, running along it, give off a blind branch to each tentacle (Fig. 1). The right and left halves are connected ventrally to the oesophagus by a short vessel which supplies these tentacles in the immediate neighbourhood of the mouth. There is thus a vascular ring around the oesophagus. The heart gives off posteriorly a second median vessel which divides almost at once into a right and a left half, each of which again divides into two vessels which run to the dorsal and ventral mantles respectively. The dorsal branch sends a blind twig into each of the diverticula of the dorsal mantle-sinus, the ventral branch supplies the nephridia and neighbouring parts before reaching the ventral~~

~~lobe of the mantle. Both dorsal and ventral branches supply the generative organs.~~

~~The blood is a coagulable fluid. Whether it contains corpuscles is not yet determined, but if so they must be few in number. It is a remarkable fact that in Discinisca, although the vessels to the lophophor are arranged as in other Brachiopods, no trace of a heart or of the posterior vessels has as yet been discovered.~~

~~The nervous system of Brachiopods has, as a rule, maintained its primitive connexion with the external epithelium. In a few places it has sunk into the con- nective-tissue supporting-layer beneath the ectoderm, but the chief centres still remain in the ectoderm, and the fibrils forming the nerves are for the most part at the base of the ectodermal cells. Above the oesophagus is a thin commissure which passes laterally into the chief arm-nerve. This latter includes in its course numerous ganglion cells, and forms, according to Blochmann, the immensely long-drawn-out supra-oesophageal ganglion. The chief arm-nerve traverses the lophophor, being situated between the great arm-sinus and the base of the lip (Figs. 2 and 3) ; it gives off a branch to each tentacle, and these all anastomose at the base of the tentacles with the second nerve of the arm, the so-called secondary arm- nerve. Like the chief arm-nerve, this strand runs through the lophophor, parallel indeed with the former except near the middle line, where it passes ventrally to the oesophagus. The lophophor is supplied by yet a third nerve, the^under arm-nerve, which is less clearly defined than the others, and resembles a moderate aggregation of the nerve fibrils, which seem everywhere to underlie the ectoderm, and which in a few cases are gathered up into~~

~~nerves. The under arm-nerve, which lies between the small arm-sinus and the surface, supplies nerves to the muscles of both arm-sinuses (Figs. 2 and 3). Medianly, it has its origin in the sub-oesophageal ganglion, which,~~

~~like the supra-oeso- phageal, is drawn out laterally, though not to the same extent. In the middle line the sub-cesophageal nerve mass is small; the~~

ganglion is in fact drawn out into two halves placed on either side of the body. From each of these sub-cesophageal ganglia numerous nerves arise. Passing from the middle line outwards they are — (i.) the median pallial nerve to the middle

Fio. 8.— Diagram of nervous sjitem of Crania; of the dorsal mantle : from the dorsal side. The nerves running to /•■ \ 11

the dorsal parts are white, with black edges; iP-) numerous Small those running to the ventral parts are solid nerves — the circum- Dlack, Magnined ; after Blochmann. 1, oeso- ., .

phagus ; 2, supra-cesophageal commissure ; 3, CBS Ophageal COm- ciroum-(BSophagealcommissures;4,nnderarm- _;;„„„_„„ TtrTiinTi naoo

nerve ; 5, great arm-sinus ; 6, smaU arm-sinus ; mibSUreS ^wnicn paSS

7, tentacle ; 8, Up of lophophor ; 9, Infta- rOUnd the OBSOphagUS

(esophageal commissure ; 10, cuief arm-nerve ;. .1 nh ‘ af

11, secondary arm-nerve ; 12, nerves to ten- I’O DUe Cniei arm-

tacles; 18, 8ub-

dorsal lateral nerve ; 15, 8ab-

or suprarceso-

portion of the secondarv arm-nerve ; 16, median pnageai ganglion; pallial nerve of dorsal lobe of mantle ; 17, /:^: \

anterior occlusor muscle ; 18, posterior occlusor ‘ muscle ; 19, obliquus superior muscle ; 20, leva- nerve tor brachii muscle.

dermal pits, at the base of which is one large cell which is thought to secrete the chseta, as in Chaetopods. These pits are not isolated, but are connected b^ an ectodermal ridge, which grows in at the margin of the mantle and

~~forms a continuous band somewhat resembling the ecto- dermal primordium of vertebrate teeth.~~

~~In spite of some assertions to the contrary, all the Brachiopods which have been carefully investigated have been found to be male or female. Hermaphrodite forms are unknown.~~

~~Emhryology. — Little real advance has been made in our knowledge of the embryology of the Brachiopoda within recent years. Kovalevsky's researches (Izv. Obshch. Moskov. xiv. 1874) on Argiope (Megathyris) are still the most complete as regards the earlier stages. Segmenta- tion is complete, a gastrula is formed, the blastopore closes, the archenteron gives off two ccelomic sacs which, as far as is known, are unaffected by the superficial segmentation of the body that divides the larva into three segments. The walls of these sacs give rise at an early stage to muscles which enable the parts of the larva to move actively on one another (Fig. 4, B). About this stage the larvae leave the brood-pouch, which is a lateral or median cavity in the body of the female, and lead a free swimming life in the ocean. The anterior segment broadens and becomes umbrella- shaped; it has a powerful row of cilia round the rim and smaller cilia on the general surface. By the aid of these cilia the larv^, swims actively, but owing to its minute size it covers very little distance, and this probably accounts for the fact that where Brachiopods occur there are, as a rule, a good many in one spot. The head bears four eye-spots, and it is continually testing the ground (Fig. 4, A, C). The second segment grows downwards like a skirt surrounding the third segment, which is destined to form the stalk. It bears at its rim four bundles of very pronounced cheetae. After a certain time the larva fixes itself by its stalk to some stone or rock, and the skirt-like second segment turns forward over the head and forms the mantle. What goes ori within the mantle is unknown, but presumably the head is absorbed. The chsetse drop off, and the lopho- phor is believed to arise from thickenings which appear in the dorsal mantle lobe. Recently the Plankton Expe- dition has brought back, and Simroth (Ergeh. Plankton Expedition, ii. 1897) has described, a few larval Brachio- pods of undetermined genera, two of which at least were pelagic, or at any rate 'taken far from the coast. These~~

~~the under arm- to the lopho- phor and its muscles; (iv.) the lateral pallial nerve to the sides of the dorsal mantle. Laterally, the sub-cesophageal ganglia give off (v.) nerves to the ventral mantle, and finally they supply (vi.) branches to the various muscles. There is a special marginal nerve running round the edge of the mantle, but the connexion of this with the rest of the nervous system is not clear ; probably it is merely another concentration of the diffused sub-ectodermal nervous fibrils.~~

~~The above account applies more particularly to Crania, but in the maiu it is applicable to the other Inarticulata which have been investigated. In Discinisca and Idngula, however, the sub-oesophageal ganglion is not drawn out, but lies medianly ; it gives off two posteriorly-directed nerves to the ,,~~

~~stalk, which in Lingula unite and form a substantial nerve. Sense organs are unknown in the adult.~~

~~The histology of Brachiopods presents some peculiar and many primitive features. As a rule the cells are minute, and this has especially stood in the way of embryological research. The plexus of nerve-fibrils which underlie the ectoderm and are in places gathered up into nerves, and the great development of~~

~~nriTmofitiirp tioonp nro wni-fTiir «f Fig. 4.— Three larvte stages of il/«(70«%ri« (.irjiiope). A, larva which has just left brood-pouch ; B, longitudinal~~

~~connective Tissue, are wormy ox section through a somewhat later stage ; C, the fully-formed embryo just before fixing— the neo-embryo of~~

~~notice. Much of the latter takes Beecher. Highly magnified. 1, anterior segment ; 2, second or mantle-forming segment ; 8, third or stalk-~~

~~the form of hvaline supporting '■"™'"e segment ; 4, eye-spots ; 5. setffl ; 6, nerve mass (f); 7, alimentary canal ; 8, muscles.~~

~~tissue, embedded in which are scattered cells and fibres. The lophophor and stalk are largely composed of this tissue. The ectodermal cells are large,~~

ciliated, and amongst the ciliated cells glandular cells are scattered. The chitinous chaetse have their origin in special ecto-

larvse, which resemble those described by Fritz Milller {Arch. Naturg. 1861-62), have their mantle turned over their head and the larval shell well developed. No stalk has been seen by Simroth or Fritz Mtiller, but in other respects the larva resembles the stages in the development

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, 0, D, stages Bhowlng the turniDg forward of Brachiopod the second or mantle segment; El completion -^jnoa TViolo

of this ; F, young Brachiopod. second, and third segments.

1, 2, 3, the first,

of Megathyris and Terebratulina wMch immediately pre- cede fixation. The cirri or tentacles, of -wMch three or four pairs are present, are capable of being protruded, and

the minute larva .—' /^"N /-N-x- swims by means of

fL^^y) (\j)- *^® ciliary action

they produce. It can retract the ten- tacles, shut its shell, and sink to the bottom.

Beecher (Amer. Jour. Sci., loc. cit.) has classified with appropriate names

Fia. 5.— stages in the fixing and metamorphosis the VarioUS StageS of TerebratuUna. Highly magnified ; fl-om tTirnncr}! w>iirWHICH

' " ' ' larvae

The last stage, that in which the folds of the second segment are already reflected over the first, he calls the Typembryo. Either before or

~~justafterturning, themantle develops a larval shell termed the protegulum, and when this is completed the larva is termed the Phylembryo. By this time the eyes have disappeared, the four bundles of chaetae have dropped off, and the lophophor has begun to appear as an outgrowth of the dorsal mantle-lobe. The protegulum has been found in members of almost all the families of Brachiopod, and it is thought to occur through- out the group. It resembles the shell of the Cambrian genus Paterina, and the Phylembryo is frequently referred to as the Paterina stage. In some orders the Phyl- embryo is succeeded by an Obolella stage with a nearly circular outline, but this is not universal. The larva now assumes specific characters and is practically adult.~~

~~Classification. — Beecher's division of the Brachiopoda into four orders is based largely on the character of the aperture through which the stalk or pedicle leaves the shell. To appreciate his diagnoses it is necessary to understand certain terms, which unfortunately are not used in the same sense by all authors. The triangular pedicle-opening seen in Orthis, &c., has been named by Hall and Clarke the delthyrium. In some less primitive genera, e.g., Tere- bratula, that type of opening is found in the young stages only ; later it becomes partly closed by two plates which grow out from the sides of the del- thyrium. These plates are secreted by the ventral lobe of the mantle, and were named by von Buch in 1834 the "delti- dium." The form of the deltidium varies in different genera. The two plates may meet in the middle line, and leave only a small oval opening near the centre for the pedicle, as in Bhynclwnella ; or they may meet only near the base of the delthyrium forming the lower boundary of the circular pedicle-opening, as in Terebratula ; or the right plate may remain quite distinct from the left plate, as in Tere- bratella. The pro-deltidium, a term introduced by Hall and Clarke, signifies a small embryonic plate originating~~

~~Fig. 6. — Shell of larval Brachiopod. Phylembryo stage. X 90 ; from Simroth. 1, Protegulum ; 2, permanent shell.~~

~~FiQ. 7. — Diagram of the pedicle-opening oi Bhynchonella. JViagnmea. i, umbo of ventral valve; 2, deltidium ; 8, margin of delthvrium ; 4, pedicle-opening ;. 5, dorsal valve.~~

~~on the dorsal side of the body. It subsequently becomes attached to the ventral valve, and develops into the pseudo-deltidium, in the Neotremata and the Protremata. The pseudo-deltidium (so named by Brown in 1862) is a single plate which grows from the apex of the delthyrium downwards, and may completely close the aperture. The pseudo-deltidium is sometimes reabsorbed in the adult. In the Telotremata neither pro- deltidium nor pseudo-del- tidium is known. In the Atremata the pro-deltidium does not become fixed to the ventral valve, and does not develop into a pseudo-deltidium. The American use of the term deltidium for the structure which Europeans call the pseudo- deltidium makes for con- fusion. The development of the brachial supports has been studied by Friele, Eischer, and Oehlert. A summary of the results is given by Beecher (Trans. Connect. Acad. ix., 1893).~~

~~The orders Atremata and Neotremata are frequently grouped together, as the sub-class Inarticulata or Ecar- dines — the Tretenterata of Davidson — and the orders Protremata and Telotremata, as the Articulata or Testi- cardines — ^the Clistenterata of Davidson. The following scheme of classification is based on Beecher's and Schu- chert's. Most of the families mentioned are described by Davidson. Eecent families are printed in italic type.~~

~~ORDER I. Atremata (Beecher). — Inarticulate Brachiopoda, with the pedicle passing out between the umbones, the opening being shared by both valves. Pro-deltidium attached to dorsal valve. FAMILIES. — Paterinidje, OsoLiDiE, TEiMEKBLLiD.a;, LinOulblhd^, LinqtjlidM, Ligulabmatidje.~~

~~ORDER II. Neotremata (Beecher). — More or less circular, cone- shaped inarticulate Brachiopoda. The pedicle passes out at right angles to the plane of junction of the valves of the shell ; the opening is confined to the ventral valve, and may take the form of a slit, or may be closed by the development of a special plate called the listrium, or by a pseudo-deltidium. Pro-deltidium attached to ventral valve. FAMILIES. — AoEOTEETiD.a:, Sifhono-~~

~~TKETID^, TKEMATIDiE, DISCINIDjS, CBANIID^.~~

~~ORDER III. Protremata (Beecher). — Articulate Brachiopoda, with pedicle-opening restricted to ventral valve, and either open at the hinge Une~~

or more or less completely closed by a pseudo-del- tidium, which may disappear in adult. Tbe pro-deltidium originat- ing in the dorsal surface later becomes anchylosed with the ventral valve. FAMILIES. — KnTOEGiNiD.a;, Eichwaldiid^, Billing- SELLiD^, Steophombnid^, TheCIDIIDJE, Peoductid^, Kichtho- FENiDiE, Orthid2E, Cutambonitid.*;, Stntkophiid^, Poeam-

BONITID^, PeNTAMEEIDJE.

ORDER IV. Telotremata (Beecher). — ^Articulate Brachiopoda, with the pedicle-opening, confined in later life to the ventral valve, and placed at the umbo or beneath it. Deltidium present, but no pro-deltidium. Lophophor supported by calcareous loops, &c.

FAMILIES.— PKOTOEHTNCHII)2E,£SrjrC»0ira'£iH)^,CENTEONBI.-I,ID.a;, TSBEBBATXTLIDjS, STRINGOCEPHAUDiE, MeGALANTEEID^, TEBEBBATELLIDjE, AlETPIliiE, SpiEirBEID^, ATHTRID.aE.

Affinities. — Little light has been thrown on the affinities of the Brachiopoda by recent research, though speculation has not been wanting. Brachiopods have been at various times placed with the MoUusca, the Chsetopoda, the Chsetognatha, the Phoronidea, the Polyzoa, the Hemi-chordata, and the Urochordata. None of these alliances have borne close scrutiny. The suggestion to place Brachiopods with the Polyzoa, Phoronis, Rliabdopleura, and Cephdlodiscus in the Phylum Podaxonia made in volume xix. of the ninth edition (pp. 440-41) has not met with acceptance, and until we have a fuller account of the embryology of some one form, preferably an Inarticulate, it is wiser to regard the group as a very isolated one.

It may, however, be pointed out that Bracliiopods seem to belong to that class of animal which commences life as a larva with three segments, and

~~that tri-segmented larvae have been found now in several of the larger groups.~~

~~Distribution. — Brachiopods first appear in the Lower Cambrian, and reached their highest development in the Silurian, from which upwards of 2000 species are known, and were nearly as numerous in the Devonian period ; at present they are represented by some 140 recent species. The following have been found in the British area, as defined by Norman, Terebratulina captU-serpentis L., Tere- bratula (Owynia) capsula Jeff., MageUania {Macandrevia) cranium Miill., M. septigera Loven, Terebratella ^itz- bergenensis Dav., Megathyris decollata Chemn., Cistella cistellula S. Wood, Gryptopora gnomon Jeff., Ehyn- chonella (Hemithyris) psittacea Gmel., Crania anomala Mull., and Discinisca atlantica King.~~

~~Undue stress is often laid on the fact that Lingida has come down to us apparently unchanged since Cambrian times, whilst Crania, and forms very closely resembling Discina and Rhynchonella, are found from the Ordovician strata onwards. The former statement is, however, true of animals from other classes at least as highly organized as Brachiopods, e.g., the Gasteropod CqpitZtts, whilst most of the invertebrate classes were represented in the Ordo- vician by forms which do not differ from their existing representatives in any important respect.~~

~~A full bibliography of Brachiopoda (recent and fossil) is to be found in Davidson's Monograph of British Fossil Brachiopods, Pal. Soc. Jfon. vi. 1886. The Monograph on Recent Brachiopoda, by the same author, Tr. Linn. Soc. London, Zool. Ser. ii.-iv. 1886-1888, must on no account be omitted. (a. e. s.)~~

~~Braddock, a borough of Allegheny county, Penn- sylvania, U.S.A., situated in south-western Pennsylvania, on the Monongahela river, 10 miles S.E. of Pittsburg, at an altitude of 828 feet. It is entered by the Baltimore and Ohio, the Pennsylvania, and the Pittsburg and Lake Erie railways. It is the site of extensive ironworks. Population (1880), 3310 ; (1890), 8561 ; (1900), 15,664.~~

~~Braddon, Mary Elizabeth (1837-), English~~

~~novelist, daughter of Henry Braddon, solicitor, of Skirdon Lodge, Cornwall, and sister of Sir Edward Braddon, prime minister of Tasmania, was born in Soho, in 1837. She began at an early age to contribute to periodicals, and in 1861 produced her first novel. The Trail of the Serpent. In the same year appeared Garibaldi, accompanied by Olivia, and other poems, chiefly narrative, a volume of extremely spirited verse, deserving more notice than it has received. In 1862 her reputation as a novelist was made by a favourable review in the Tim^s of Lady Audley's Secret. Aurora Floyd, a novel with a strong affinity to Madame Bovary, followed, and achieved equal success. Its immediate successors, Eleanor's Victory, John March-monfs Legacy, Henry Dunbar, remain with her former works the best known of her novels, but all her numerous works have found a large and appreciative public. They give, indeed, the great body of readers of fiction exactly what they require ; melodramatic in plot and character, conventional in their views of life, they are yet dis- tinguished by constructive skill and opulence of invention. Her popularity in the British colonies is especially extensive. For a considerable time Miss Braddon con- ducted Belgravia, in which several of her novels appeared. In 1874 she married the late Mr John Maxwell, publisher.~~

~~Bradford, a municipal, county, and parliamentary borough and city of the West Riding of Yorkshire, Eng- land, on an affluent of the Aire, 9 miles W. by S. of Leeds, 192 miles by rail K.N.W. of London. It has a station on~~

~~seven railways, and communicates by water with the Mersey and the Humber. It has adopted almost every public act conducive to its improvement. The old town has been re-modelled. A new central electric light station, just finished, is the completest of its kind. Additional water-works, tapping the river Nidd 40 miles distant, are in process of construction. There are seven public parks. Eecreation grounds, besides, cover 30 acres ; and 670 acres of moorland, near the city, have been acquired as an additional recreation ground. Educa- tional establishments include a girls' grammar school (1875), a technical college (1881), acquired by the municipality in 1899, and the United Independent College (1888). Amongst recent institutions are a conditioning- house (1891), for which a new building has been con- structed (1900) ; the post office (1886) ; the children's hospital (1890); a home for incurables (1893); and a boys'~~

~~orphanage. The trade of Bradford, accord.ing to an official estimate, advanced between 1836 and 1884 from a total of five to at least thirty-five millions sterling, and from not more than five or six to at least fifty leading staple articles. The exports to the United States alone in 1895 amounted to the value of £5,549,000 ; owing to the McKinley tariffs, the exports in 1899 figure at £1,810,770. This decline is, however, much more than compensated by enhanced trade in the home market. The largest foreign customer for the worsted yarns is Germany, which imports ten times as much as Eussia, the next greatest importer. The annual turnover in the staple trade of Bradford, according to a recent estimate, is not less than £100,000,000. The Saitaire works for alpaca and mohair goods employ about 2500 hands, while silk works at Manningham cover 20 acres and employ 4500 to 5000 people. Furniture- makiug is a business in rapid growth. In 1891, 13,837 males and 21,670 females were engaged in the worsted; 5040 males and 2954 females in the woollen ; 1491 males and 2187 females in the silk; 1135 males and 1096 females in the cotton; and 2380 persons in the iron manufactures. There are three daily newspapers. In 1885 the parliamentary borough was made co-extensive with the municipal and divided into three districts, each of them to return one member to parliament ; in 1888 the municipal borough- was constituted a county borough, and in 1897 it was created a city ; in 1899, whilst the parliamentary boroughremained as before, the municipal, county, and city boundaries were extended so as to include the township of Idle. Area of municipal and county borough and city before extension, and of present parliamentary borough, 10,791 acres; popiilation (1881), 194,495; (1891), 216,361. Extended area of municipal and county borough and city, 22,720 acres. Population (1891),~~

~~265,728; (1901), 279,809.~~

~~Bradford, a city of M'Kean county, Pennsylvania, U.S.A., situated in the northern part of the state, at an altitude of 1427 feet. It is in the petroleum region, and its industries consist mainly in the production and refining of mineral oil. It is entered by four railways. Poprdation~~

~~(1880), 9197; (1890), 10,514 ; (1900), 15,029.~~

~~Bradford-on-Avon, a market town in the West- bury parliamentary division of Wiltshire, England, on the rivers Avon and Kennet, the Avon canal, 6 miles S.E. of Bath, and the Great Western railway.^ There is still standing a small church, built about 705, and de- scribed by Freeman as " the only perfect surviving church of its kind in England, if not in Europe." At the summit of the hill on which the town stands is an ancient chapel, and on one of the central piers of the bridge a small chapel, much modernized, used in ancient times for mass. The parish church — Norman, Early English, and Perpen- dicular— ^has been restored, and contains interesting monu-~~

~~ments and brasses. There is another Anglican church, and Baptist, Congregational, and Wesleyan chapels. Kingston House, buUt in the beginning of the 17th century, was long a seat of the dukes of Kingston. There are a town hall, free school (founded 1712), tem- perance hall, technical institute (containing the county day school), and public baths. Water-works have been constructed.. Woollen manufactures, for which Bradford was long famous, have declined, and the principal indus- tries now are the manufacture of indiarrubber goods, iron-founding, brewing, and quarrying. Area of urban district, 1962 acres; population (1881), 4922; (1901),~~

~~4514.~~

~~Brad laugh, Charles (1833-1891), English poli- tician and freethinker, was born at Hoxton, London, on 26th September 1833. After enlisting as a soldier, he found employment as a lawyer's clerk, and by and by became widely known as a freethought lecturer, under the title of " Iconoclast." He also conducted the National Reformer for several years. His Radicalism in religion and politics commended him to the electors of North- ampton, by whom he was returned to parliament in 1880. He claimed to be allowed to afl5rm under the Par- liamentary Oaths Act, and the rejection of this pretension, and the refusal to allow Mr Bradlaugh to take the oath on his professing his willingness to do so, involved the House in a series of most unedifying conflicts, terminating in the victory of Mr Bradlaugh, who was~~

~~permitted to take the oath in 1886. The law was altered two years subse-quently. Bradlaugh did not, like so many successful agitators, sink into obscurity upon being deprived of the immediate cause of his notoriety, but gained a very gen- eral respect by his transparent honesty and courageous contempt for mere popularity. Experience of public life in the House of Commons seemed to give him a more balanced view of things ; and before he died, on 30th January 1891, it was beginning to be said of him that he was in a fair way to grow into something almost akin to a Conservative. Hard, arrogant, and dogmatic, he yet possessed many sterling qualities ; his great defect was a lack of imagination.~~

~~Bradley, George Granville (1821), dean~~

~~of Westminster, was born 11th December 1821, being the son of the Eev. Charles Bradley, vicar of Glasbury, Brecon. He was educated at Eugby under Dr Arnold, and at University College, Oxford, of which he became a fellow in 1844. He was an assistant master at Eugby from 1846 to 1858, when he succeeded Dr Cotton as headmaster at Marlborough. He occupied this post with great success until December 1870, when he was elected master of his old college at Oxford. In August 1881 he was nlade dean of Westminster in succession to Dean Stanley, whose pupil and intimate friend he had been. He published his recollections of Dean Stanley, originally delivered in the form of lectures, in 1883 ; and afterwards took up the biography of Stanley left unfinished by the death of Mr Theodore Walrond, which was ultimately completed by Mr E. E. Prothero. His other publicar tions include Aids to Latin Prose, and Lectures on Job and Ecdesiastes. One of his daughters, Mrs Margaret Louisa Woods, wife of the ex-president of Trinity College, Oxford, has achieved distinction as a poetess and novelist.~~

~~Bradshaw, Henry (1831-1886), librarian of the University of Cambridge, was born on 2nd February 1831, and educated at Eton. He became a fellow of King's College, Cambridge, then a close foundation for Etonians, and was largely instrumental in throwing it open to others. After a short scholastic career in Ireland, and some preliminary work in the Cambridge University Library, he was appointed to this institution as an extra~~

~~assistant, and soon showed an unexampled faculty for investigations respecting rare books and curious MSS. In addition to his achievements in~~

~~black-letter bibli- ography he threw great light on the life and works of Chaucer, and on ancient Celtic language and literature. Unfortunately he allowed his attention to be too much distracted among a multiplicity of subjects, and the strain upon him was increased by his election in 1867 to the post of university librarian, to which indeed no one else had equal pretensions, but which overwhelmed him with routine duties. He thus left little behind him except a number of brilliant isolated discoveries in bibliography and early literature, besides the fame of having given a marvellous impulse to the former pursuit and impressed it with a more scientific character than had previously belonged to it. As a man he was much respected and beloved. He died very suddenly on 10th February 1886. (b. g.)~~

~~Braga, a city and archiepiscopal see of Portugal, in respect of population the third city of the king- dom, capital of the district of Braga, 3 miles S. of the river C^vado. Mount Sameiro is crowned by a colossal monument of the Virgin of the Conception. Population, 28,089. The district of Beaga, with an area of 1057 sq. miles and population 338,308, giving 320 inhabitants to the sq. mile, is" one of the best cultivated regions of Portugal. The principal production is wine, the yield for 1898 having been 7,589,063 gallons, valued at £351,333. Cattle-breeding is an important industry, as also is 'dairy -farming. The other chief industries are the manufacture of hats, cutlery, linen, and woollens.~~

~~Braganca, a city and episcopal see of Portugal, formerly capital of the province of Traz-os-Montes, and now capital of the district of the same name, is situated near the north-east corner of the kingdom. Population, 5840. The district of BsAGANgA has an area of 2574 sq. miles, and a population of 179,678, giving 70 inhabitants to the sq. mile. Large tracts are uncultivated, and the roads are defective. Silkworms are bred, the annual produce of cocoons amounting to 48,400 lb.~~

~~Bragg, Braxton (1817-1876), American soldier, was born in Warren county, North Carolina, on 22nd March 1817. He graduated with high rank at the United States military academy in 1837, and as an artillery officer gained renown during the Mexican war at Fort Brown, Monterey, and Buena Vista. H!e resigned from the regular army on 3rd January 1856, with the rank of~~

~~brevet lieutenant-colonel, and retired to his plantation in Louisiana. When in 1861 the Civil War began, he joined the Southern side as brigadier-generail, and was sent to command at Pensacola, Florida. In February 1862 he went, as major-general, to the Mississippi army, took part at Shiloh, and was promoted to general on the death of General Albert S. Johnston. In August of that year he led a formidable force into Kentucky, but was checked by Buell, and forced to retreat after the battle of Perryviile on 8tli October. He was worsted by General Eosecrans in the stubborn contest of Murfreesboro (31st December 1862- 2nd January 1863) ; he defeated Eose-crans at Chickamauga on 19th and 20th September 1863, but was routed by Grant at Chattanooga on 23rd-25tli November. Eelieved from western command and called to Eichmond, he acted there for a time as military adviser to President Davis. In the autumn of 1864 he unsuccessfully led an inferior force from North Carolina to Georgia to oppose Sherman's march. After the war he became chief engineer to the state of Alabama, and supervised improvements in Mobile harbour. He died in Galveston, Texas, on 27th September 1876.~~

~~Brahmaputra River, The, rises in 30° 30′~~

~~K lat. and 82° E. long, under the watershed of the Mariam La (15,500 feet), which separates its sources from the eastern affluents of the Mansarowar lake (the sources of the Sutlej), at least 100 miles south-east of those of the Indus. It flows in a south-easterly direction for 170 miles, and then adheres closely to a nearly easterly course for 500 miles more, being at the end of that distance in 29° 10′ N. lat. It then bends north- east for 150 miles before finally shaping itself south- wards towards the plains of Assam. Roughly speak- ing, the river may be said so far to run parallel to the main chain of the Himalaya at a distance of 100 miles therefrom. Its early beginnings are cradled amidst a mighty mass of glaciers which entomb the northern slopes of the watershed, separating them from the sources of the Gogra on the south ; and there is evidence that two of its great southern tributaries, the Shorta Tsanpo (which joins about 150 miles from its source), and the ifyang Chu (the river of Shigatsi and Gyantsi), are both of them also of glacial~~

~~origin. From the north it re- ceives five great tributaries, namely, the Chu Nago, the Chachu Tsanpo, and the Charta Tsanpo (all within the first 200 miles of its course), and the Eaka Tsanpo and Ky-i-chu (or river of Lhasa) below. The Chachu and the Charta are large clear streams, evidently draining from the great central lake district. Both of them measure more than 100 yards in width at the point of junction, and they are clearly non-glacial. The Eaka Tsanpo is a lateral affluent, flowing for 200 miles parallel to the main river course and some 20 to 30 miles north of it, draining the southern slopes of a high snowy range. It is an im- portant feature as affording foothold for the " Janglam " (the great high road of Southern Tibet connecting Ladak with China), which is denied by the actual valley of the Brahmaputra. The great river itself is known in Tibet by many names, being generally called the Nari Chu, Maghang Tsanpo, or Taro Tsanpo, above Lhasa; the word "tsanpo" meaning (according to Waddell) the "pure one," and applying to all great rivers. At 60 miles from its source the river and the Janglam route touch each other, and from that point past Tadum (the first important place on its banks) for another 130 miles, the road follows more or less closely the left bank of the river. Thep it diverges northwards into the lateral val- ley of the Eaka, until the Eaka joins the Brahmaputra below Janglache. The upper reaches are nowhere ford- able between Tadum and Lhasa, but there is a ferry at Likche (opposite I'adum on the southern bank), where wooden boats covered with hide effect the necessary con-nexion between the two banks and ensure the passage of the Nipal trade. From Janglache (13,800 feet) to Shigatsi the river is navigable, the channel being open and wide and the course straight. This is probably the most elevated system of navigation in the world. From Shigatsi, which stand^ near the mouth of the Nyang Chu, to the Ky-i-chu, or Lhasa river, there is no direct route, the river being unnavigable below Shigatsi. The "Janglam" takes a circuitous course southwards to Gyantsi and the Tamdok Cho before dropping again over the Khambala pass to the ferry at Khamba barje near Chushul. Thence the valley of the Ky-i-chu (itself navi- gable for small boats for about 30 miles) leads to Lhasa northwards. At Chushid there is an iron chain-and-rope suspension bridge over the deepest part of the river, but it does not completely span the river, and it is too insecure for use. The remains of a similar bridge exist at Jang- lache ; but there are no wooden or twig suspension bridges over the Tsanpo. At Tadum the river is about one half as wide again as the Ganges at Hardwar in December, i.e., about 250 to~~

~~300 yards. At Shigatsi it flows in a wide (extended bed with many channels, but contracts~~

~~again at Chushul, where it is no wider than it is at Jang- lache, i.e., from 600 to 700 yards. At Chushul (below the Ky-i-chu) the discharge of the river is computed to be about 35,000 cubic feet per second, or seven times that of the Ganges at Hardwar.~~

~~For about 250 miles below Ky-i-chu to a point about 20 miles below the great southerly bend (in 94° E. long.) the course of the Brahmaputra has been traced by native surveyors. Then it is lost amidst the jungle-cot ered hills of the wild Mishmi and Abor tribes to the east of Bhutan for another 100 miles, until it is again found as the Dihong emerging into the plains of Assam. About the intervening reaches of the river very little is known except that it drops through 7000 feet of altitude, and that in one place, at least, there exist some very remark- able falls. These are placed in 29° 40′ N. lat., between Kongbu and PemarKoi. Here the river runs in a narrow precipitous deflle along which no path is practicable. The falls can only be approached from below, where a monastery has been erected, the resort of countless pilgrims. Their height is estimated at 70 feet, and by Tibetan report the hills around are enveloped in per- petual mist, and the Sangdong (the " lion's face "), over which the waters rush, is demon-haunted and full of mystic import. From the north-eastern extremity of Assam where, near Sadya, the Lohit, the Dibong, and the Dihong unite to form the wide placid Brahmaputra of the plains — one of the grandest rivers of the world — its south-westerly course to the Bay of Bengal is suffi- ciently well known. It stUl retains the proud distinction of being unbridged, and still the Eiver Flotilla Com- pany appoints its steamers at regular intervals to visit all the chief ports on its banks as far as Dibrugarh. Here, however, a new feature has been introduced in the local railway, which extends for some 80 miles to Sadya, with a branch to the Buri Dihing river at the foot of the Patkoi range. The Patkoi border the plains of Upper Assam to the south-east, and across these hills lies the most reasonable probability of railway extension to Burma.~~

~~The following are the " lowest level " discharges of the principal affluents of the Brahmaputra in Upper Assam, estimated in cubic feet per second : —~~

~~LoMt river, 9 miles above Sadya . Dibong, 1 mile above junction with Dihong Dihong „ „ Dibong Subansiri~~

~~38,800 27,200 56,400 16,900~~

~~The basis of the Dibong and Subansiri are as yet very imperfectly known. That of the Lohit has been fairly well explored. Near Goalpara the discharge of the river in January 1828 was computed to be 140,000 cubic feet, or nearly double that of the Ganges. The length of the river is 700 miles to the Dihong junction, and about 1000 in Tibet and Eastern Bhutan, above the Dihong. The Brahmaputra, therefore, exceeds the Ganges in length by about 400 miles. The bed of the great river maintains a fairly constant position between its extreme banks, but the channels within that bed are so constantly shifting as to require close supervision on the part of the naviga^ tion authorities ; so much detritus is carried down as to form a perpetually changing series of obstructions to steamer traffic.~~

~~An enormous development of agricultural resources has taken place within the Brahmaputra basin of late years, chiefly in the direction of tea cultivation, as well as in the production of jute and sUk. Gold is found in the sands of all its upper tributaries, and coal and petroleum are amongst the chief mineral products which have been brought into economic prominence.~~

~~See Reports of the native explorers of the Indian Survey, edited by MoNTGOMBKT and Habman. (t, h, h.*)~~

~~BKAHMS, JOHANNES~~

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~~Brahms, Johannes (1833-1897), German com- poser, was born in Hamburg on 7th May 1833. He was the son of a double-bass player in the Hamburg city theatre, and received his first musical instruction from his father. After some lessons from a certain 0. Cossel, he betook himself to Cossel's master, Eduard Marxsen of Altoua, whose experience and artistic taste directed the young man's genius into the highest paths. A couple of public appearances as a pianist were hardly an interrup- tion to the course of his musical studies, and these were continued nearly up to the time when Brahms ac-~~

~~cepted an engagement as accomp9,nist to a once-famous Hungarian violinist, Remenyi, for a concert-tour in 1853. At Gottingen there occurred a famous contretemps which had a most important though indirect influence on the whole after-life of the young player. A piano on which he was to play the " Kreut- zer" sonata of Beethoven with Remenyi turned out to be a semitone below the re- quired pitch; and Brahms played the part by heart, transposing it from A to B flat, in such a way that the great violinist, Joachim, who was present and discerned what the feat implied, intro- duced himself to Brahms, and laid the foundation of a life- long friendship. Joachim gave him introductions to Liszt at Weimar and to Schumann at Diisseldorf; the former hailed him for a time as a member of the advanced party in music, on the strength of his E flat minor scherzo, but the mis- apprehension was not of long continuance. The in- troduction to Schumann im- pelled that master, now drawing near the tragic close of his career, to write the famous article "Neue Bahnen," in which the young Brahms was pro- claimed to be the great (From a photograph~~

~~composer of the future, "he who was to come." The critical insight in Schumann's article is all the more surprising when it is remembered how small was the list of Brahms's works at the time. A string quartet, the first pianoforte sonata, the scherzo already men- tioned, and the earliest group of songs, containing the dramatic " Liebestreu," are the works which drew forth the warm commendations of Schumann. In December 1853 Brahms gave a concert at Leipzig, as a result of which the firms of Breitkopf and Haertel and of Senff undertook to publish his com- positions. In 1854 he was given the post of choir- director and music-master to the prince of Lippe- Detmold, but resigned it after a few years, going first to Hamburg, and then to Zurich, where he enjoyed the friendship and artistic counsel of Theodor Kirch- ner. The unfavourable verdict of the Leipzig Ge- wandhaus audience upon his pianoforte concerto in D minor op. 15, and several remarkably successful ap- pearances in Vienna, where he was appointed director of the Singakademie in 1863, were the most impor- tant external events of Brahms's life, but again he gave~~

~~up the conductorship after a few months of valuable work, and for about three years had no fixed place of abode. Concert tours with Joachim or Stockhausen were undertaken, and it was not until 1867 that he returned to~~

~~Vienna, or till 1872 that he chose it defi- nitely as his home, his longest departure from the Austrian capital being between 1874 and 1878, when he lived near Heidelberg. Erom 1871 to 1874 he con- ducted the concerts of the " Gesellschaft der Musik- freunde," but after the latter date he occupied no official position of any kind. With the exception of journeys to Italy in the spring, or to Switzerland in the summer, he rarely left Vienna. He refused to come to England to take the honorary degree of Mus.D. offered by the University of Cambridge; the~~

~~University of Breslau made him Ph.D. in 1881 ; in 1886 he was created a knight of the Prussian order Pour le mirite, and in 1889 was pre- sented with the freedom of his native city. He died in Vienna on the 3rd of April 1897.~~

~~The works of Brahms may be summarized as follows : — Various sacred compositions for chorus, op. 12, 13, 22, 27, 29, 30, 37, leading up to op. 45, the " German Eequiem " first performed at Bremen in 1868, and subse- quently completed by a soprano solo with chorus ; the " Triumphlied " in com- memoration of the German victories of 1870-71; and some choral songs and motets, op. 74, 109, and 110. Secular choral works, op. 17, 41, 42, 44, 60 ("Rinaldo" for tenor solo and male choir), 53 ("Rhapsodic," alto solo and male choir), 54 (" Schicksalslied "), 62, 82 (Schiller's Nanie), 89, (" Ge- sangder Parzen") 93,104,113. Concerted vocal works, op. 20, BKAHMS. 28, 31, 62 ("Liebeslieder-~~

~~/ a Broach, Berlin.-) Walzer "), 61, 64, 65 (" Neue~~

~~Liebeslieder "), 75, 92, 103, 112. Solo Songs, nearly 300. Orchestral works: four symphonies, op. 68, 73, 90, and 98 ; two serenades, op. 11 and 16 ; two pianoforte con- certos, op. 15 and 83, one violin concerto, op. 77 ; concerto for violin and violoncello, op. 102 ; variations on a theme by Haydn, op. 66 ; two overtures, " Academische Eestou- verture," op. 80, and "Tragic Overture," op. 81. Chamber music: two sextets, op. 18 and 36; quintet, piano and strings, op'. 34, strings, op. 88 and 111, clarinet and strings, op. 115; three string quartets, op. 51 and 67, three quartets for piano and strings, op. 25, 26, and 60. Three trios for piano and strings, op. 8, 87, and 101; trio for piano, violin, and horn, op. 40; piano, clarinet, and violoncello, op. 114. Duet sonatas, three for piano and violin, op. 78, 100, and 108; two~~

~~for piano and violoncello, op. 38 and 99 ; two for piano and clarinet, op. 120. Pianoforte solos: three sonatas, op. 1, 2, and 5 ; scherzo, op. 4 ; variations, op. 9, 21, 23, 24, 35 ; 4 ballads, op. 10 ; waltzes, op. 39 ; two rhapsodies, op. 79; caprices and intermezzi, op. 76, 116, 117, 118, and 119. 5 studies and 51 Uebungen without opus-number, and a chorale^relude and fugue for organ, besides~~

~~s.n.-43~~

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~~BKAHMS, JOHANNES~~

~~four books of Hungarian Dances arranged for pianoforte duet.~~

~~Bralims has been often called the last of the great classical masters, in a sense wider than that of his place in the long line of the great composers^of Germany. Though only the most superficial observers could deny him the possession of the qualities which distinguish the masters of the romantic school, such as warm imagination, originality of thought and expression, deep emotional tenderness, and the like, it is as a classicist that he must be ranked among modern musicians. From the beginning of his career until its close, his ideas were clothed by preference in the forms which had sufficed for Beethoven, and the instances in which he departed from structural precedent are so rare that they might be disregarded, were they not of such high value that they must be considered as the signs of a logical development of musical form, not as indicating a spirit of rebellion against existing modes of structure. His practice, more frequent in later than in earlier life, of welding together the ” working-out ” and the ” recapitulation ” sections of his movements in a closer union than any of his predecessors had attempted, is an innovation which cannot fail to have important results in the future ; and if the skill of younger writers is not adequate to such a display of ingenuity as occurs in the fiiiale of the fourth symphony, where the ” passacaglia ” form has been used with an effect that is almost bewilder- ing to the ordinary listener, that at least stands as a monu- ment of inventiveness finely subordinated to the emotional and intellectual purport of the thoughts expressed. If Brahms’s music is not appreciated by every one on a first hearing, this, if it be a defect, is one in which it has been~~

~~anticipated by the work of every great master since music was a conscious and definite art. His themes are always noble, and even from the point of view of emotional appeal their deep intensity of expression is of a kind which grows upon all who have once been awakened to their beauty, or have been at the pains to grasp the composer's characteristics of utterance. His vocal music, whether for one voice or many, is remarkable for its fidelity to natural inflexion and accentuation of the words, and for its perfect reflexion of the poet's mood. His songs, vocal quartets, and choral works abound in passages that prove him a master of effects of sound; and throughout his chamber music, in his treatment of the piano, of the strings, or of the solo wind instruments he employs, there are numberless examples which sufficiently show the irrele- vance of a charge sometimes brought against his music, that it is deficient in a sense of what is called " tone-colour." It is perfectly true that the mere acoustic effect of a passage was of far less importance to him than its inherent beauty, poetic import, or logical fitness in a definite scheme of development; and that often in his orchestral music the casual hearer receives an impression of complexity rather than of clearness, and is apt to imagine that the " thickness " of instrumentation is the result of clumsiness or carelessness. Such instances as the introduction to the finale of the first symphony, the close of the first movement of the second, what may be called the epilogue of the third, or the whole of the variations on a theme of Haydn, are not only mar- vels of delicate workmanship in regard to structure, but are instinct with the sense of the peculiar beauty and characteristics of each instrument. The "Acar demic Festival " overture proves Brahms a master of musical humour, in his treatment of the student songs which serve as its themes ; and the companion piece, the "Tragic" overture, reaches a height of sublimity which is in no way lessened because no particular tragedy has ever been named in conjunction with the work.~~

~~As with all creative artists of supreme rank, the work of Brahms took a considerable time before it was very generally appreciated, but the number of his admifers has been constantly increasing, and nowhere has his music found a warmer welcome than in England. The change in public opinion is strikingly illustrated in regard to the songs, which, once voted ineffective and un vocal, have now taken a place in every eminent singer's repertory. In the other branches of music in which he worked, the structure of the~~

~~composition is of such enormous im- portance that its appreciation by the general mass of musical amateurs is qf necessity slow. The outline in his greater works must be grasped with some definiteness before the separate ideas can be properly understood in their true relation to each other ; and while it is his wonderful power of handling the recognized classical forms, so as to make them seem absolutely new, which stamps him as the greatest musical architect since Beethoven, the necessity for realizing in some degree what musical form signifies has undoubtedly been a bar to the rapid acceptance of his greater works by the unedu- cated lovers of music. These are of course far more easily moved by effects of colour than by the subtler beauties of organic structure, and Brahms's attitude to- wards tone-colour was scarcely such as would endear him to the large number of musicians in whose view tone-colour is pre-eminent. His mastery of form, again, has been attacked as formalism by certain superficial critics, blind to the real inspiration and distinction of his ideas, and to their perfection in regard to style and the appropriate- ness of every theme to the exact emotional state to be expressed. In his larger vocal works there are some which treat of emotional conditions far removed from the usual stock of subjects taken by the average com- poser ; to compare the ideas in the " German Requiem " with those of the " Schicksalslied " or " Nanie " is to learn a lesson in artistic style which can never be for- gotten. In the songs, too, it is scarcely too much to say that the whole range of human emotion finds expression in noble lyrics that yield to none in actual musical beauty. The four " Ernste Gesange," Brahms's last composition, must be considered as his supreme achievement in dignified utterance of noble thoughts in a style that perfectly fits them. The choice of words for these as well as for the "Bequiem" and others of his serious works reveals a strong sense of the vanity and emptiness of human life, but at least as strong a confidence in the divine consola- tions.~~

~~It is the misfortune of the musical world in Germany that every prominent musician is ranged by critics and amateurs in one of two hostile camps, and it is probably due in the main to the misrepresentations of the followers of Wagner that the idea is so generally held that Brahms was a man of narrow sympathies and hard, not to say brutal manners. The latter impression was fostered, no doubt, by the master's natural detestation of the methods by which the average lionizer seeks to gain his object, and both alike are~~

disproved in the Recollections of J. V. Widmann, an intimate friend for many years, which throw a new light on the master, revealing him as a man of the widest artistic sympathies, neither intolerant of excellence in a line opposed to his own, nor weakly enthusiastic over mediocre productions by composers whose views were in complete sympathy with him. His admiration for Verdi and Wagner is enough to show that the absence of any operatic work from his list of compositions was simply due to the difficulty of finding a libretto which appealed to him, not to any antagonism to the lyric stage in its modern developments. How far he stood from the prejudices of the typical pedant may be seen in the passionate love he showed throughout his life for national

music, especially that of Hungary. Not only were his arrangements of Hungarian dances the first work by which his name was known outside his native land, but his first pianoforte quartet, op. 26 in G minor, incurred the wrath of the critics of the time by its introduction of some characteristics of Hungarian music into the finale. His arrangement of a number of children's traditional songs was published without his name, and dedicated to the children of Robert and Clara Schumann in the earli- est years of his creative life ; and among the last of his publications was a collection of forty-nine German Volks- lieder, arranged with the utmost skill, taste, and sim- plicity. His well-known admiration for the waltzes of Strauss is referred to in all the biographies, and in many passages of his works the entrain that is characteristic of the Viennese dance-writers is present in a striking degree. Within so short a time of the completion of his work, it is impossible to determine the exact place in the hierarchy of music which Brahms will ultimately fill ; but the more closely his music is studied, the more strongly will the conviction grow that the last in the illustrious line of German composers is to be ranked with the greatest of all. (j. A. F. M.)

Bra id wood, a city of Will county, Illinois, U.S.A., situated in the eastern part of the state, 58 miles S. of Chicago, on the Chicago and Alton railway. Its principal industry is the mining of coal. Population (1880), 5524;

~~(1890), 4641 ; (1900), 3279.~~

~~Braila, a town in Rumania, on the left bank of the Danube, about 10 miles S. of Galatz, 100 miles from Sulina on the Black Sea, and 145 miles from Bucarest. As the grain trade of the Danube has been gradually usurped by Braila, so has the town grown and been im- proved. The main streets are paved, and there is a regular supply of filtered water. Large docks and dependencies identical to those at Galatz have been con- structed, and extensive quays face the river bank. Braila is essentially commercial, and has an exchange and chamber x)f commerce; the Bank of Rumania is repre- sented by a branch oflce. An electric tramway has been laid down, and, besides the lines running in the town, conveys passengers to Lacul Sarat (Salt Lake), whose iodine waters are held in much repute. Population (1900), 58,392, of whom 10,811 are Jews.~~

~~The total imports in 1898 were 137,169 tons, value £1,812,490 ; total exports, 621,906 tons, value £2,624,258. Of these the prin- cipal articles of import were : — Cotton yam, £178,932 ; machinery, £161,440 ; jute cloth, £103,719 ; coal, £76,084 ; textiles, £115,000 ; heavy ironmongery, £71,422 ; sheet-iron, £70,344. The principal articles of export were .•—Maize, £769,646 ; barley and malt, £445,936; wheat, £397,745; dried vegetables, £273,295; flour, £178,144; oleaginous seeds, £160,230; oats, £153,483; rye, £123,144 ; millet, £41,028. Braila was visited in 1880 by 172 vessels of 194,919 tons ; in 1890 by 474 vessels of 516,065 tons ; and in 1899 by 121 vessels of 165,842 tons.~~

~~Many events connected with the history of Wallachia took place in the neighbourhood of this city. In 1475 Stephen the Great, having dethroned the Voivode Radu, burned the town. In 1573 another Moldavian prince took the city by storm, and massacred the Turkish garrison. In the year 1659 it was again burned by the Wallachian prince Mircea, and for the time the Turks were expelled, but afterwards returned and possessed it almost without interruption from 1544 to 1828. In the latter year the Russians captured it after a long and sanguinary siege, when the Turks dis- played courage and military virtue almost as extraordinary as they showed half a century later at the siege of Plevna. By the treaty of Adrian ople, however, it was stipulated that the Wallachian fortresses on the Danube should be restored to the~~

~~principality. Before carrying out this stipulation, the Grand Duke Michael razed the citadel of Braila, and in this ruinous condition it was handed over to the Wallachians. On the banks of Danube, a little above the city, are observable some remains of the piles of a bridge said to have been built by Darius.~~

~~Braine I'Alleud (Flemish, EigenrBrakel), a town of~~

~~Belgium, in the province of Brabant, 12 miles S. of Brus- sels by rail. Its industries are numerous, and include the manufacture of woollen and cotton fabrics, dye-works, tan-yards, and breweries. In the district are the Water-loo Lion and Hougomont. Population (communal) (1880),~~

~~6370; (1897), 7885.~~

~~Brainerd, capital of Crow Wing county, Minnesota, U.S.A., situated in the central part of the state, on Mis- sissippi river, at the junction of two branches of the Northern Pacific railway, at an altitude of 1209 feet. Population (1880), 1865; (1890), 5703; (1900), 7524.~~

~~Brakes. — (I)HHydeaulic Military. — The hydraulic principle is almost universally adopted in brakes for con- trolling the recoil of guns. As the recoil energy may be very high, while for the purpose of facilitating the work- ing of the gun and keeping a high rate of fire the length of recoil is kept short, the strains on the structures carrying the gun are severe, and it is necessary to equal- ize the strain through the recoil stroke to keep the stresses to a minimum.~~

~~The hydraulic brake, or pump brake, used for this purpose con- sists of a cylinder with piston and piston rod, the liquid being forced at high velocity through an orifice formed in the piston head. This arrangement is illustrated in the figure. The piston rod, a, of the hydraulic brake is firmly attached to the gun, 6, by the lug, c, and on recoil of the gun in the direction of the arrow, the liquid in the space, d, is forced at constant velocity~~

~~Se&iaiianAA.~~

~~through the orifice, /. The area of this orifice is regulated by the valve key, g, which is so shaped longitudinally that the orifice contracts as the recoil velocity falls ofi, and the resistance is in consequence approximately uniform throughout the stroke. When recoil ceases the gun is returned to firing position by the spring, Jc. The velocity of movement of the gun during recoil is not uniform, but varies from a maximum, shortly after recoil commences, to rest at the end of the stroke. As it is necessary, to obtain uniform resistance, that the velocity of flow should be preserved constant, a valve key to the cylinder is generally employed to produce the desired result by automatically closing the orifice as the speed falls off during recoil.~~

~~(2) Eleotkic. — The adoption of electricity for the pur- pose of operating cranes or lifts has led to the introduc- tion of electrically-controlled frictional brakes. In the case of cranes for lifting weights, the object sought is to prevent the load from taking charge and lowering itself when the current is cut off from the motor; and the arrangement adopted usually consists of a frictional brake, normally applied by spring pressure, but held off by an electro-magnet actuated by the electric current for the motor, or by a shunt current, when the motor is in action.~~

~~On electric elevators or lifts a somewhat similar arrangement is adopted. The brake is usually a strap passing round a drum carried on the motor shaft; the strap is fixed at one end and applied by a spring at the other, which is connected also to the armature of a compound wound electro-magnet, which working against the spring releases the brake when the current passes. One winding of the magnet is in series with the motor, releasing the brake when the current is actuating the motor in hoisting, and the other is a shunt winding used for descending, and controlled by a centrifugal governor on the motor, which automatically cuts out the shunt circuit if the speed of descent becomes too great. An electric brake to control the speed of the cage when lowering is obtained also by use of the driving motor as a dy- namo generating electricity, which is passed through an elec- trical resistance. In this case the weight of the cage is utilized to back-drive and rotate the motor connected up as a dynamo, the power absorbed by the motor in generating its~~

current fumisMng the brake resistance. The current generated varies in potential from zero to a maximum, and the speed of fall of the cage is regulated by varying the electrical resistance. Electric lifts similarly operated are used also on warships for supply of ammunition to the guns. (g. h. ba.)

(3) Railway. — From the very beginning of steam railways, hand-brakes- of various forms have been em- ployed, and they are still largely used on goods trucks. Each hand-brake is independent of all others, and the time required to bring a number of them into operation depends upon the activity of the brakemen. The neces- sity for prompt and effective application of brakes in an emergency led to the invention of means to operate them with power superior to muscular force. Such brakes are known as power brakes. These may be divided into four classes : — (1) Mechanical brakes, worked by springs, by friction wheels on the axle, by chains wound on drums, and other mechanical devices, or by the force produced when, by reason of a sudden checking of the speed of the locomotive, the momentum of the cars causes pressure on the draw-bars or buffing devices. All such momentum or buffer brakes were proved radi- cally defective by tests made by a committee of the Master Car Builders' Association of the United States at Burlington, Iowa, in 1886. (2) Hydraulic brakes, worked by means of water forced through pipes into proper mechanism for transmitting its force to the brake- shoes. (3) Electric brakes, worked by magnets acting on discs or similar appliances fastened to the wheels or axles ; or, more recently, by magnets using the rail as a keeper and utilizing the drag thus produced to force ordinary brake-shoes against the wheels. (4) Air- and vacuum-brakes, worked by compressed air, or by air at atmospheric pressure operating on a vacuum. To these might be added brakes worked by steam or water from the boiler of the engine, operating by means of a cylinder, the use of which is generally limited to the locomotive. Prominent among these is the Le Chatelier or water-brake so called, in which a pipe is led from the boiler below the water line to the locomotive cylinder exhaust ports, the cylinders

~~acting as compressors. The arrangement also prevents hot gases and cinders from being drawn into the cylinders from the smoke-box.~~

~~Power brakes may be either continuous or independent — continuous if connected throughout the train and with the locomotive by pipes, wires, &c., as the compressed air, vacuum and electric brakes ; independent if not so con- .nected, as the buffer-brakes and hand-brakes. Continuous brakes may be divided into two other- great classes — automatic and non-automatic. The former are so arranged that they are applied automatically on all the coaches of the train if any important part of the apparatus is broken, or the couplings between cars are ruptured ; in an emer- gency they can be put on by the guard, or (in some cases) by a passenger. Non-automatic brakes can be applied only by the person (usually the engine-driver) to whom the management of them is given. They may become inoperar tive on all the coaches, and always on those which have become detached, if a coupling or other important and generally essential part is broken. Many mechanical and several hydraulic and electrical continuous brakes have been invented and tried. Experience has shown them so inadequate in practice that they have all practically dis- appeared, leaving the field to the air- and the vacuiim- brakes. At first these were non-automatic, but in 1872 the automatic air-brake was invented by Mr George West- iaghouse, the many advantages of which over the non- automatic brake quickly led to its wide adoption. An automatic vacuum-brake, invented a few years later, is used largely in the United Kingdom and the British colonies.~~

~~The Westinghouse non-automatic air-brake consists in its simplest form of a direct-acting, steam-driven air-pump, carried on the locomotive, which forces com- pressed air into a reservoir, usually placed under ^^^Srake. the foot-plate of the locomotive. From the reservoir a pipe is led through the engine cab, where it is fitted with a three-way cock, to the rear of the locomotive tender, where it terminates in a flexible hose, on the end of which is a coupling. The coaches are furnished with a similar pipe, having hose and coupling at each end, which is connected to one end of a cylinder containing a piston, to the rod of which the brake-rods and levers are connected. The application of the brakes is effected by the engine- driver turning the three-way cock, so that compressed air flows through the pipe~~

~~and acting against one side of the brake-cylinder piston, applies the brake-shoes to the wheels by the movement of this piston and the rods and levers connected to it. To release the brakes the three-way cock is turned to cut off communication between the main reservoir and the train-pipe, and to open a port permitting the escape of the compressed air in the train-pipe and brake-cylinders. This brake was soon found defective and inadequate in many ways. An appreciable time was re- quired for the air to flow through the pipes from the locomotive to the car-cylinders, and this time increased quickly with the length of the trains. Still more serious, however, was the fact that on detached coaches the air- brakes could not be applied, the result being sometimes serious collisions between the front and rear portions of the train. Those respects in which the non-automatic brake is inadequate will be understood from the following summary of the requirements most important in a train- braking apparatus. (1) It must be capable of applica-tion to every wheel throughout the train. (2) It must be so prompt in action that the shortest possible time shall elapse between its first application and the moment when the full power can be exerted throughout the train. (3) It must be capable of being applied by the engine-driver or by any of the offlcials in charge of the train, either in concert or independently. (4) The motion of the train must be arrested in the shortest possible distance. (5) The failure of a vital part must declare itself by causing the brake to be applied and to remain applied until the cause of failure is removed. (6) The breaking of the train in two or more parts must cause immediate automatic application of the brakes on all the coaches. (7) When used in ordi- nary service stops it must be capable of gradual and uniform application (followed, if necessary, by a full emergency application at any part of the service appli- cation) and of prompt release under all conditions of application. (8) It must be simple in operation and construction, not liable to derangement, and inexpensive in maintenance.~~

~~In the automatic vacuum-brake, the exhausting apparar tus generally consists of a combined large and small ejector, worked by steam and under the control of the driver, though in some forms of the vacuum- Automatic brake, such as are used on the Great Western brake!”’ and London and North- Western railways, an air- pump, driven from the main axle of the locomotive, is substituted for the small ejector. These ejectors, of which the small one is at work continuously while the large one is only employed~~

when it is necessary to create vacuum quickly, e.g., to take off the brakes after a short stop, pro- duce a vacuum of 18 or 20 inches in the train-pipe, which extends the whole length of the train and communicates under each vehicle with a cylinder, to the piston of which, by suitable rods and levers, the brake-shoes are connected. The communication between the train-pipe and the cylinder is controlled by a ball-valve, which consists merely of a

half-inch brass ball, having a rolling action in a horizontal direction (see Figs. 1 and 2) . The spindle with the release

.st{:-«^im

TKAIH Pin

Fig. 1. — Automatic Yacuum-Brake. CThe dots Indicate atmoBpheric pressure.)

valve is added for the purpose of withdrawing the ball from its seat when it is necessary to take off the brakes by hand; it is made air-tight by a small diaphragm, the

pressure on which, when there is vacuum in the pipe, pulls in the spindle and allows the ball to fall freely into its seat. When air is exhausted through the train-pipe it travels out from the top of the cylinder direct, and from the bottom past the ball, which is thus forced up the in- cline of the spindle, to roll back again to its seatiug when the exhaustion is complete. In this state of affairs the piston is held in equilibrium and the brake-blocks are free of the wheels. To apply them, air is admitted to the train-pipe, either purposely by the guard or driver, or accidentally by the rupture of the train-pipe or coupling hose between the vehicles. The air passes to the lower side of the piston, but is prevented from gaining access to the upper side by the ball valve which blocks the passage ; hence the pressure becomes different on the two sides of the piston, which in consequence is forced upwards and thus applies the brakes (see Fig. 1). They are released by the re-

~~establishment of equilibrium (by the use of the large ejector if necessary); when this is done the piston falls and the brakes drop off. The general arrangement of the apparatus is shown in Fig. 2. To render the application of the brakes nearly simultaneous throughout a long train, the valve in the guard's van is arranged to open automatically when the driver suddenly lets in air to the train-pipe. This valve has a small hole through its stem and is secured at the top by a diaphragm to a small dome-like chamber, which is exhausted when a vacuum is created in the train-pipe. A gradual application destroys the vacuum in the chamber as quickly as in J;he pipe, but~~

~~Steam CombinationCjector I~~

~~Drlvei^ VacuiimGsuge~~

~~Guardi Vacuum OatigS'~~

~~Universal Coupling ,~~

~~Drip Trap~~

~~Pio. 2.— Automatic Vacuum-Brake, showing its general arrangement.~~

~~with a sudden one the vacuum below the valve is de- stroyed more quickly, and so the pressure of the atmos- phere on the diaphragm lifts the valve and admits air.~~

~~In the Westinghouse automatic quick-action air-brake a main air reservoir on the engine is kept charged with compressed air at 90 lb per square inch by means of~~

~~the pump, controlled by an automatic governor. Con- veniently placed on the locomotive is a valve called the driver's valve, which is connected by a pipe with the main reservoir ; by means of this the ^^^^^ driver controls the flow of air from the main reservoir to the train-pipe, or from the train-pipe to the~~

~~atmosphere. Attached to it is a reducing valve, which, in the normal or running position of the former, re-duces the pressure of the air flowing from the main reservoir to the train-pipe to 70 lb per square inch, or 20 ft per square inch less than the pressure in the main reservoir. A train-pipe runs the whole length of the train. In addition to the brake-cylinder each vehicle is supplied with an air-reservoir, called the auxiliary reser- voir, and an automatic valve called a triple valve. The auxiliary reservoir receives air from the train-pipe and stores it for use in the brake-cylinder of its own vehicle, and both the auxiliary reservoir and triple valve are con- nected directly or indirectly with the train-pipe. The~~

~~Fis. 8. — Diagram of the principal parts of an Air-Brake on one car.~~

~~general arrangement of the brake apparatus on a pas- senger coach is shown in Tig. 3. The brake-cylinder is in section disclosing the piston and release spring.~~

~~The automatic action of the brake is due to the con- struction of the triple valve, the principal parts of which are a piston and slide valve so arranged that the air in the auxiliary reservoir acts at all times on the side of the piston to which the slide valve is attached, while the air in the train-pipe exerts its pressure on the opposite side. A moderate reduction of air pressure in the train-pipe causes the greater pressure remaining stored in the auxiliary reservoir to force the piston of the triple valve with its slide valve to a position which will allow the air in the auxiliary reservoir to pass directly into the brake- cylinder and apply the brake. A sudden or violent re- duction of the air in the train-pipe produces the same effect, and in addition causes supplemental valves in the triple valve to be opened, permitting the pressure in the train-pipe also to enter the brake-cylinder, augmenting the pressure derived from the auxiliary~~

~~reservoir about 20 per cent. This causes practically- instantaneous action of the brakes to their highest effici- ency throughout the entire train. The same effect is pro- duced should the train break in two or a hose or any part of the train-pipe burst. Sometimes the passengers are provided wit!h the means of thus arresting the train on an emergency, a cord running along the inside or outside of the coaches, which on being pulled opens a valve connected to the train-pipe; this arrangement is applicable both to the vacuum and~~

~~compressed-air brakes. When the pressure in the brake-pipe is again restored to an amount in excess of that remaining in the auxiliary reser-roir, the piston and slide valve are forced in the opposite direction~~

~~to their normal position, com- munication is opened from the train-pipe to the aux- iliary reservoir, and the air in the brake-cylinder escapes to the atmosphere, thus re-‘ leasing the brakes.~~

~~buabd’s valve The quiok-action triple valve~~

~~is shown in section in Fig. 4. It consists essentially of two mechanisms : first, a piston and slide valve, 5 and 3, which, properly arranged, constitute the automatic feature ; and second, the piston, 8, puppet valve, 10, and check valve, 15, by means~~

~~>U of which quick action is ob- tained. The latter feature is only essential when stops are to be made in the shortest distance possible, and therefore this part of the mechanism does not come into action during ordinary or “service” stops. The train-pipe is connected at 18, admitting compressed air to chamber 13, thence to cham- ber 19, imderneath piston 5, which is forced to the position shown in the diagram, there admitting air through feed ports I and K, above the slide valve 3 to the auxiliary reservoir at B, in which pressure soon equals that in the train-pipe and the flow stops. In this position port g, which com- municates with a conduit lead- ing to the brake-cylinder, is in communication with the at- mosphere through ports n and p and the brakes are released. If a slight or gradual reduction of pressure is made in the train-pipe, piston 6 moves to the left until it is arrested by graduating stem 21. Its first move- ment opens graduating valve 7 to port z. When in the posi- tion against graduating stem 21 communication between ports G and p is cut off, and port z is open to g, causing a fiow of air from the auxiliary reservoir to the brake-cylinder, which continues until the pressure on the reservoir side of piston 5 is slightly less than that on the train-pipe side, when the piston 5 is moved far enough to the right to close port z, by graduating valve 7. The resistance of the slide valve 3 is too great to be overcome by this slight difference in pressure, so its position is unchanged and the brakes are held applied. A further reduction in the train-pipe pressure will admit more air through port z, by moving the piston again to the left, increasing the force of the application, which, if allowed to~~

~~continue, will cause an equalization of pressure between the auxiliary reservoir and the brake-cylinder when the brakes are fully applied. To release, the full pressure in the train-pipe and consequently underneath piston 5 is restored, which restores all parts to position shown in the diagram, permitting the air in the brake-cylinder to escape to the atmosphere through ports r, s, and p. When the shortest stop is desired, a quick and consider able reduction in pressure is made in the train-pipe. The result is that the piston 5 moves its full traverse, compresses spring 22, bringing port s in register with port r, and allo-ning the auxiliary~~

~~Teservoir air to flow into the brake-cylinder. At the same time air admitted through port t moves piston 8, which unseats valve 10, and allows train-pipe air to lift check valve 15 and charge the brake-cylinder with air from the train-pipe, in addition to that from the auxiliary reservoir. In this way not only is a very sudden application of the brakes brought about, but also an in- creased force of application of about 20 per cent, over the greatest force of an ordinary application. This sudden venting of the train- pipe into each brake-cylinder gives an extremely rapid serial action of the brakes on a train of vehicles by means of which the various brakes throughout the train are successively applied almost with the rapidity of sound.~~

~~It is well known that brake-shoes can be applied,~~

~~Fia. 4.—Alr-Brake Triple TslTe.~~

~~without skidding the wheels, with greater pressure at high speeds than at low. Advantage is aif-b'r^f taken of this fact in the design of the high- speed brake, invented in 1894, which con- sists of attachments, by means of which the pressure in the train-pipe and reservoirs can be increased at the will of the driver. The increased pressure acting in the brake-cylinder increases in the same proportion the pressure of the brake-shoes against the wheels. Attached to the brake-cylinder is a valve for automati- cally reducing the pressure therein proportionately to the reduction in speed, until the maximum pressure under which the brakes are operated in. making~~

~~ordinary stops is reached, when this valve closes, and the maxi- mum safe pressure for operating the brakes at ordinary speeds is retained until a stop is made.~~

~~Famous tests of railway brakes were those made by the~~

~~late Sir Douglas Galton, K.C.B. (then Capt. Galton, R.E.),~~

~~and Mr Westinghouse on the London, Brighton,~~

“ ~~and South Coast railway, in England, in 1878,~~

- ~~■ and by a committee of the Master Car Builders’~~

~~Association, near Burlington, Iowa, in 1886 and 1887.~~

~~The object of the former series was to determine the co-efficient of friction between the brake-shoe and the wheel, and between the wheel and rail at different veloci- ties when the wheels were revolving and when skidded, i.e., stopped in their rotation and caused to slide. These experiments were the first of their kind ever undertaken, and for many years their results furnished most of the trustworthy data obtainable on the friction of motion. It was found that the co-efficient of friction between cast- iron shoes and steel-tired wheels increased as the speed of the train decreased, varying from 0411 at 55 miles an hour to 0”33 just moving. It also decreased with the time during which the brakes were applied; thus at 20 miles an hour the co-efficient was at the beginning 0-182, after ten seconds 0-133, after tweuty seconds 0-099. Generally speaking, especially at moderate speeds, the decrease in the co- efficient of friction due to time is less than the increase due to decrease of speed, although when the time is long the re- verse may be true. When the wheels are skidded the retardation of the train is always reduced; therefore, for the greatest braking effect, the pressures on the brake- shoes should never be sufficient to cause the wheels to slide on the rails. The Bur- lington brake tests were undertaken to determine the practicability of using power brakes on long and heavy freight trains. In the 1886 tests there were five com- petitors — three buffer-brakes, one compressed- air-brake, and one vacuum-brake. The tests comprised stops with trains of twenty-five and fifty vehicles, at 20 and 40 miles an hour, on~~

~~the level and on gradients of 1 in 100. They demonstrated that the buffer-brakes were inadequate for long trains, and that considerable improvements in the con- tinuous brakes, both compressed-air and vacuum, would be needed to make them act quickly enough to avoid excessive shocks in the rear vehicles. In 1887 the trials of the year before were repeated by the same committee, and at the same place. Trains of fifty vehicles fitted with each brake were again provided, and there were again five competitors, but they all entered continuous brakes — three compressed-air-brakes, one vacuum, and one electric. The results of the first day's test of the train equipped with Westinghouse brakes are shown in Table I., the distances in which are the feet run by the train after the brakes were set, and the times the seconds that elapsed from the application of the brakes to full stop.~~

~~Table I. — Stops of a Train of Fifty Empty Cars, 1887 — Automatic Air-Brakes.~~

~~Speed In~~

~~Miles per~~

~~Hour.~~

~~Distance in Feet.~~

~~Time in Seconds.~~

~~Equivalent~~

~~Distance at~~

~~20 Miles and~~

~~40 Miles.~~

~~19i 19| 36|~~

~~186 215~~

~~588~~

17

196 233

693

The remarkable shortness of these stops is the more evident when they are compared with the best results obtained in 1886, as shown in Table II.

344

BRAMBANA N — B E AM P T 0 N

Table U.— Stops of a Train of Fifty Empty Oars, 1886- Automatic Air-Brakes.

Equivalent

Speed in MUee.

Distance

Time in

Distance at

in Feet.

Seconds.

20 Miles and

40 Miles.

23-5

424

in

~~307~~

~~20-3~~

~~354~~

~~16~~

~~340~~

~~...~~

~~40~~

~~922~~

~~22i~~

~~922~~

~~40~~

~~927~~

~~22J~~

~~...~~

~~927~~

~~The time tliat elapsed between, the application of the brakes on the engine and on the fiftieth vehicle was almost twice as great in 1886 as in 1887, being in the latter tests only five to six seconds, and in 1887 the stops were made in less than two-thirds the distance required in 1886. Still, violent shocks were caused by the rear vehicles running against those in front, before the brakes on the former were applied with sufficient force to hold them, and these shocks were so severe as to make the use of the brakes in practice impossible on long trains. When the triple valves were actuated~~

~~electrically, however, the stops were still further improved, as shown in Table III.~~

~~Table III. — Stops of a Train of Fifty Empty Cars — Electric Application of Air-Brakes.~~

~~Speed in Miles.~~

~~Distance in Feet.~~

~~Time in Seconds.~~

~~Equivalent~~

~~Distance at~~

~~20 Miles and~~

~~40 MUes.~~

~~21i~~

~~23 38~~

~~36i~~

~~160 183~~

~~476 460~~

~~7 8~~

~~14i~~

~~14~~

~~139 138~~

~~519 545~~

~~Although the same levers, shoes, rods and other con- nexions were used, there were no shocks in the fiftieth car of the train on any stop, whether on the level or on a gradient. The committee in charge reported that the best type of brake for long freight trains was one operated by air, in which the valves were actuated by electricity, but they expressed doubt of the practicability of using electricity on freight trains. The Westinghouse Company then proceeded to quicken the action of the triple valve, operated by air only, so that stops with fifty-car trains could be made without shock, and without electrically operated valves; and they were so successful in this respect that, towards the end of the same year, 1887, with a train of fifty vehicles, stops were made without shock, fully equalling in quickness and shortness of distance run anjr that had been made at the trials by the electri- cally operated brakes.~~

~~In 1889 some further tests were made by Sir Douglas Galtonwith the automatic vacuum-brake, on a practically level portion of the Manchester, Sheffield, and Lincoln- shire railway (now the Great Central). The train was composed of an engine, tender, and forty carriages, the total length over bufEers being 1464 feet, and the total weight 574 tons, of which 423 tons were braked. At a speed of about 32 miles an hour this train was brought to a standstill in twelve seconds after the application of the brakes, in a distance of 342 feet.~~

~~(b. m. He. ; H. M. E.)~~

~~Brambanan (better Pkambanan), a village in Java, south of the Merapi (Mir-Api), in the territory of the sultan of Surakarta, near the frontier of Jokjokarta (Djogjakarta). Among the most remarkable of the Hindu temples (Tjandis or Chandis) are Kalasa or Kali-bening, a twelve-sided pyramid, 70 feet high, and near it Sari, a quadrilateral building, Chandi China, and L&,r3, Jorgran, the last the temple, par excellence, of Prambanan, com- prising a group of eleven, of which two are of large size.~~

~~For recent descriptions (since 1875) of the monuments, tlie inscriptions, and the history of Hinduism, as connected with these ruins, see Tijdschbift toor Ind. Taal-Land en VolkenJcunde, xxxi. and xxxii. Batavia, 1886 and 1887. — Yzekman. Beschry- ving der ondheden ndby de greus der residenties Soerakarta a Djogjakarta. Batavia, 1891. With photos and atlas. —~~

~~Groneman. Tjandi Parambanan op Midden-Java. La Haye, 1893. — ^Verbeek. Lijst der Ondheden van Java. Verhand v/h Bat. Genootschap, xlvi., and Onheidkundige Kaart van Java. — Guide a travers Vexposi- tion coloniale des Pays Bas (La Haye, 1900). No. 174 seqq. (Kfr productions des Temples civaitiques k Parambanan.)~~

~~Brampton, a market town and railway station in the Eskdale parliamentary division of Cumberland, England, 9 miles E.N.E. of Carlisle. Of the ancient parish church only the interesting chancel is left, but there are a modern parish church, a Presbyterian church (1662), and Methodist chapel ; also a moot hall, and two other halls. Roman remains are frequently found in the neighbourhood. There are cattle and sheep markets. Area of civil parish, 6466 acres; population (1881),~~

~~3438; (1901), 2494.~~

~~Brampton, a township in the Chesterfield parlia- mentary division of Derbyshire, England, 3 miles W. by N. of Chesterfield. A parish church contains ancient memorials, and has been restored. The industries of the parish are agriculture and quarrying. Area, 8166 acres ; population (1881), 6383; (1901), 2185. In 1892 the borough of Chesterfield was enlarged so as to include a portion of this parish. The urban district of Brampton and Walton has an area of 10,102 acres ; population~~

~~(1891), 2532 ; (1901), 2698.~~

~~Brampton, Henry Hawkins, 1st Bakoit~~

~~(1817), English judge, was born at Hitchin, on~~

~~14th September 1817. He received his education at Bed- ford school. The son of a solicitor, he was early familiar- ized with legal principles, a training which stood him iu good stead throughout his long forensic career. Called to the bar by the Middle Temple in 1843, he at once joined the old home circuit, and after enjoying a lucrative prac- tice as a junior, took silk in 1858. His name is identified with many of the famous trials of the reign of Queen Victoria. He was successfully engaged as junior to Mr Edwin James in the Simon Bernard case (of the Orsini plot celebrity), as junior to Mr~~

~~(afterwards Lord Chief Justice) Bovill in that of Roupell v. Waite, and appeared together with Sir John Karslake (Solicitor-General), Mr Hardinge GifEard (afterwards Earl Halsbury), and Ser- jeants Ballantyne and Parry on behalf of the several defendants in the Overend-Gurney prosecutions, which resulted in the acquittal of the accused. The two causes dUhres, however, in which Lord Brampton attained his highest legal distinction, were the Tichborne trials and the great will case of Sugden v. Lord St Leonards. In both of these he was victorious. In the first his masterly cross-examiaation of the witness Baigent was one of the great features of the trial. He did a lucrative business in references and arbitrations, and acted for the royal com- missioners in the purchase of the site for the new law courts. Election petitions also formed another branch of his extensive practice. Mr Hawkins was raised to the bench in 1876, and was assigned to the then Exchequer division of the High Court, not as baron (an appellation which was being abolished by the Judicature Act), but with the title of Sir Henry Hawkins. He was a great advocate rather than a great lawyer. His searching voice, his manner, and the variety of his facial expression, gave him an enor- mous influence with juries, and as a cross-examiner he was seldom, if ever, surpassed. He was an excellent judge in chambers, where he displayed a clear arid vigorous grasp of details and questions of fact. His knowledge of the criminal law was extensive and intimate, the reputation~~

~~he gained as a "hanging" judge making him a terror to evil-doers ; and the Court for Crown Cases Reserved was never considered complete without his assistance. In 1898 he retired from the bench, and was raised to the peerage under the title of Baron Brampton. He has fre- quently taken part in determining House of Lords appeals, and his judgments have been distinguished by their lucidity and grasp. He held for many years the office of counsel to the Jockey Club, and as an active member of that body found relaxation from his legal and judicial duties at the leading race meetings, and has been con- sidered a capable judge of horses. In 1898 he was received into the Eoman Catholic Church.~~

~~Bramwell, George William Wilshere,~~

~~Bakon (1808-1892), English judge, was born in London on 12th June 1808, being the eldest son of George Bram- well, of the banking firm of Dorrien, Magens, Dorrien and Mello, 22 Finch Lane, E. C. (died 1851) . He was educated privately, first at Dr Eeddy's school at Camberwell, where W. E. Channell (afterwards, like himself, a baron of the Exchequer) was one of his school-fellows, and later he went to Palace school, Enfield, kept by Dr May. At the age of sixteen he entered Dorriens' bank, where he gained a practical knowledge of commercial and par- ticularly of banking matters of great use to him in his legal career. In 1830 he gave up business for the law, becoming a pupil in the chambers of Eitzroy Kelly, then a barrister of six years' standing, and afterwards succes- sively Solicitor-General, Attorney-General, and, ten years after Bramwell himself had been raised to the bench, chief baron of the Exchequer. At first Bramwell was content to take out the certificate of a special pleader, and practised as such for some years at 3 Serjeants' Inn. The work of special pleaders (now obsolete) was confined to drawing the pleadings (preliminary documents which precede a trial), which in those days had to be drawn subject to rigid rules, so as to state with the strictest accuracy the issues to be raised at the hearing of the cause. Bramwell had been admitted as a student at Lincoln's Inn in 1830, and at the Inner Temple in 1836, and he was eventually called to the bar at both Inns in 1838. He soon worked his way into a good practice both in London and the home circuit, his knowledge of law and procedure being so well recognized that in 1850 he was appointed a member of the Common Law Procedure Commission, which resulted in the Common Law Pro- cedure Act of 1852. This Act he drafted jointly with his friend Mr (afterwards Mr Justice) Willes, and thus began the abolition of the system of special pleading. In 1851 Lord Cranworth made Bramwell a Queen's counsel, and the Inner Temple elected him a bencher, — he had ceased to be a member of Lincoln's Inn in 1841. In 1853 he served on the Eoyal Commission to inquire into the assimilation of the mercantile laws of Scotland and England and the law of partnership, which had as its result the Companies Act of 1862. It was he who, during the sitting of this Commission, suggested the addition of the word "limited" to the title of companies that sought to limit their liability, in order to prevent the obvious~~

~~danger to persons trading with them in ignorance of their limitation of liability. This danger had appajently seemed insuperable to some members of the Commission, and its removal by a single wordaffords a typical instance of Bramwell's hard-headed business-like common sense. As a Queen's counsel Bramwell enjoyed a large and steadily increasing practice. Of his methods at the bar and his attitude towards the law, it has been said that where other distinguished lawyers of his day would read a client's story in a brief, and then turn at once to find a case " on all fours " with it, Bramwell's way was, after~~

~~mastering the facts, to make up his mind as to what principles were involved, and what the law must be in order that justice might be done, and then seek for author- ity in support of his view. It is interesting to note the steady progress of Bramwell in his profession as shown by his fee-book, and also to compare the income of an English barrister with a good commercial practice in the 'forties and 'fifties, with those of men in srotilar circum- stances in other generations. Mr Bramwell made, in the sixth year after his call £850, in the seventh year £1187, in the eighth £1633 — a friend betting him in the last- named year that in three years he would confess to having passed all the other juniors on his circuit. In the first year after he " took silk " he made £3414, in the three following years £4549, £5846, and £7107 respectively. In his last year at the bar he nearly reached £8000, a large sum in those days for his class of practice ; but he had no opportunity of raising his income higher, as in 1866 Baron Parke (afterwards Lord Wensleydale) resigned his seat in the Court of the Exchequer after occupying it for twenty-two years, and Lord Cranworth invited Mr Bramwell, Q.C., to fill his place.~~

~~As a baron of the Exchequer he sat for twenty years, earning a high reputation in the trial both of civil causes and of criminal charges, although his previous personal experience of crime was said to be limited to a single brief in a criminal case. In 1867, with Mr Justice Blackburn and Sir John Coleridge, he was made a member of the Judicature Commission. In 1871 he was one of the three judges who refused the seat on the Judicial Committee of the Privy Council to which Sir Eobert Collier, in evasion of the spirit of the Act creating the appointment, was appointed ; and in 1876 he was raised to the Court of Appeal, where he sat till the autumn of 1881.~~

As a puisne judge he had been conspicuoiis as a sound lawyer, with a strong logical mind unfettered by technicalities, but endowed with considerable respect for the common law. His rulings were always clear and decisive, while the same clearness and decision marked his dealings with fact, and, coupled with a straightforward, unpretentious manner, gave him great influence with juries. In the Court of Appeal he was perhaps not so entirely in his element as at Nisi Prius, but the same combination of sound law, strong common sense, and clear expression, characterized his judgments, marked as they are by a tendency to recall and refute the arguments of counsel, rather than to be expositions of the law applicable to the matter in hand, delivered irrespective of such argu- ments. His decisions during the three stages of his practical career are too numerous to be referred to particularly, although Byder v. Womhwell (L.E. 3 Ex. 96) ; B. V. Bradshaw (14 Cox C. C. 84) ; Household Fire Insur- ance Company v. Grant (4 Ex. Div. 216) ; Stonor v. Fowle (13 App. Cas. 20), have been cited as examples. A quaint instance is recorded of his candour. Having sat all day with two Chancery Lords Justices hearing an appeal involving points of equity only, he^ave his judgment in these terms : — " Having listened all day to things which I don't think I ever heard of before, I can safely say I am of the same opinion, and for the same reasons." In the course 'of another judgment (9 Chy. Div. 28) he said, "If juries had to give reasons for their verdict trial by jury would not last five years." He was a staunch upholder on the bench, and as a controversial writer, of the common law both in civil and criminal matters, believing that the less it was interfered with by legislation the better. "Please govern me as little as possible," he was wont to say. In particular he strenuously defended, wherever possible, the principle involved in the words " freedom of contract," diminished (whether rightly or wrongly, is a matter of opinion) by modern legislation,

such as that limiting the relations of landlord and tenant, or master and servant. He earned the reputation of re- garding rich corporations with undue favour through his resentment at seeing them unjustly " bled " by

~~juries that sympathized with plaintiffs ; and in the case of railway companies he further refused to recognize the effect on their position of the extraordinary powers and privileges given them by Parliament. Reference in this connexion may be made to Vawglian v. The Taff Railway Company (3 & 5 Hurlston and Norman's Reports) ; and the Ham- mersmith Railway Company y. Brand (Law Reports 4H.L.), in which the decisions were adverse to the companies, and in which the tendencies last referred to may be traced.~~

~~Throughout his legal career Bramwell was constantly in friendly communication with American lawyers, the common law being the bond between them. An expres- sion of his feeling towards American lawyers is to be found in the case of The Attorney-General v. Sillem (2 H. & C. 540). In addition to his other qualities as a judge, and particularly his honesty and love of justice. Lord Bramwell's courtesy and consideration towards those practising before him (although he could be peremptory at times when rendered impatient) had won him their personal affection and esteem, so that upon his retirement, which was announced in the long vacation of 1881, excep- tional honour was accorded to him, twenty-six judges and a huge gathering of the bar entertaining him at a memo- rable banquet in the Inner Temple hall. Shortly after- wards, on 8th December, Mr Gladstone wrote to him offering him a peerage, which he accepted, taking the title Baron Bramwell of Hever, from his home in Kent. Thus he had not wholly said good-bye to judicial life, and many of his decisions are to be found in the reports of the House of Lords, notably that in Vagliano v. The Bank of England (App. Ca. 1891), in which he and Lord Field differed from the majority. In private life Bramwell had simple tastes and enjoyed simple pleasures. He lived, when not in London, at Eour Elms, near Eden- bridge. He was extremely fond of music, and himself played the piano. He was fond also of his garden and of animals, particularly dogs. He rode a little at one time, but never shot. He was fond of walking and of swim- ming, and he played billiards. He was twice married : (1) 1830, to Jane, daughter of Bruno Silva, who died in 1836, and by whom he had one daughter ; (2) 1861, to Miss Martha Sinden. He died at Four Elms on 9th May 1892.~~

~~At all times Lord Bramwell had been fond of controversy and controversial writing. He had written from time to time upon many topics principally of~~

~~legal interest in the Times, the Economist, and elsewhere, but as a peer he had more leisure and also greater freedom than he had had as a judge to deal with the wide variety of questions which interested him, particularly those involving politics (although personally he acknowledged allegiance to no party), and he did so with characteristic vigour, with shrewd insight into the weak parts of his adversary's case, and a still keener appreciation of the strong points of his own. Without being ever intentionally' unfair in controversy, he lost nothing by ignoring at times the full meaning of his adversary unless it was expressed in terms that prevented him from doing so. Still the great majority of his letters to the Times over his well-known signature B. (he also signed himself at different times Bramwell, G. B. and L.L.), will always afford good reading, and it is interest- ing to trace the fulfilment or non-fulfilment of his predictions in the light of subsequent events. He joined in J.882 the Liberty and Property Defence League, and some of his writings after that date took the form of pamphlets published by that society. As examples of Lord Bramwell's controversial style may be cited his letters to the Times, 24th April 1878 (Employers' Liability and Freedom of Contract) ; 3rd June 1880 (Hares and Rabbits Bill and Freedom of Contract); 16th and 24th May 1883 (Unearned Increment); (for replies see 22nd and 28th May) ; 12th November 1885 (Mr Joseph Chamberlain and the Enclosure of Commons). Pamphlets, Laissez Faire ; " Nationalization of Land," a reply to Henry George's Fro- fjress and Foverty; "Drink" (for "Drink" see also the Tim^s,~~

~~10th April 1886), published by the Liberty and Property Defence League ; " Drink, a Rejoinder," Nineteenth Century Magazine, June 1885 ; letters to the Economist (Railways) , 2nd August 1884, 13th and 20th March 1886 ; letter on Employers' Liability to Sir Henry Jackson, published as a pamphlet. "The letter of Mr Baylis exhibits a crass ignorance of the subject on which he writes and a proportionate confidence" (Times, 11th November 1886), written by him in reply to a young barrister who had differed from him with regard to the precise status of Serjeants' Inn, may be quoted as an instance of the hard hitting and somewhat intolerant style that he frequently adopted.~~

~~Authorities. — Some Account of George William Wilshere, Baron Bramwell, by Charles Fairfield.— Times, 10th May 1892.— Law Journal,~~

~~14th May 1892.— Master Macdonell, in Temple Bar, 1896. — Manson's BramwelUana and Builders of our Law ; and private information. (b. A. Ab.)~~

~~Brand, Sir John Henry (1823-1888), President of the Orange Free State, was the son of Sir Christoffel Brand, Speaker of the House of Assembly of the Cape Colony. He was born at Cape Town, 6th December 1823, and was educated at the South African College. Con- tinuing his studies at Leyden, he took the degree of D.C.L. in 1845. He was called to the English bar from the Inner Temple in 1849, and practised as an advocate in the Supreme Court of the Cape of Good Hope from that year until 1863. In 1858 he was appointed professor of Law in the South African College. He was elected president of the Orange Free State in 1863, and subse- quently re-elected for five years in 1869, 1874, and 1879. In 1864 he resisted the pressure of the Basutos on the Free State boundary, and after vainly endeavouring to induce Moshesh, the Basuto chief, to keep his people within bounds, he took up arms against them in 1865. This first war ended in the treaty of Thaba Bosigo, 3rd April 1866 ; and a second war, caused by the treachery of the Basutos, ended in the treaty of Aliwal North, 12th February 1869. In 1871 Brand was solicited by a large party to become president of the South African Republic, and thus unite the two republics ; but as the project was hostile to Great Britain he declined to do so, and main- tained his constant policy of friendship towards the latter country, where his merits were recognized in 1882 by the well-deserved honour of the G.C.M.G. His watchfulness for the interests of the Orange Free State was sufficiently shown in his despatches on the question of the Diamond Fields in 1872. A fluent speaker, a far-sighted politician, and endowed with great firmness and independence of character, President Brand was respected throughout South Africa. He died on 14th July 1888. (See Okauge RivEK Colony.)~~

~~Brandenburg, a central province of Prussia, with an area of 15,381 sq. miles, and population of 2,821,695 (1895), the second in point of area and the third in point of population of the provinces of the kingdom. The crops chiefly grown are potatoes, hay, rye, beetroot, oats, barley, wheat, and some tobacco (£138,750 in 1897). In 1897 the live stock embraced 898,298 sheep, 885,487 pigs, 806,066 cattle, and 280,512 horses. In the same year the mines yielded 7,941,632 tons of lignite, valued at £730,900, and the~~

~~foundries and furnaces produced 27,698 tons of materials, valued at £228,600. In 1898-99 the sugar factories produced 56,693 tons of sugar; the breweries, 146,300,000 gallons of beer; and the dis- tilleries, 6,724,718 gallons of pure alcohol For further particulars, see under Pbussia.~~

~~Brandenburg, a town of Prussia, on the Havel, 38 miles W.S.W. of Berlin, capital of the circle of Brandenburg, government-district of Potsdam, province of Brandenburg ; station on the Berlin-Magdeburg railway. The town has 8 churches and a synagogue, a high school (Ritterakademie), a gymnasium, 13 reaZ-gymnasia, and 2 higher-grade girls' schools. On Marienberg, to the north-~~

~~yest of the town, is a tower (1880) to the memory of about 4000 Brandenbvirgers who fell in the wars of 1864, 1866, and 1870-71. There is considerable shipping and fishing on the river. Population (1880), 28,685 ; (1890), 37,817 ;~~

~~(1900), 49,263. '~~

~~Brandes, Ceorg Morris Cohen (1842-~~

~~•);~~

~~Danish critic and literary historian, generally known as Geoeg Brandes, was born in Copenhagen on 4th Feb- ruary 1842. He became a student in the university in 1859, and first studied jurisprudence. From this, how- ever, his maturer taste soon turned to philosophy and aesthetics. In 1862 he Tvon the gold medal of the university for an essay on The Nemesis Idea among the Ancients. Before this, indeed since 1858, he had shown a remarkable gift for verse-writing, the results of which, however, w^re not abundant enough to justify separate publication. Brandes, indeed, did not collect his poems until so late as 1898. At the university, which he left in 1864, Brandes was much under the influence of the writings of Heiberg in criticism and Soren Kierkegaard in philosophy, influences which have continued to leave traces~~

~~on his work. From 1865 to 1871 Brandes travelled much in Europe, acquainting himself with the condition of literature in the principal centres of learning. His first important contribution to letters was his Esthetic Studies of 1868, in which, in several brief monographs on Danish poets, his maturer method is already fore- shadowed. In 1870 he published several important volumes, The French Esthetics of Our Days, Criticisms and Portraits, and a translation of The Subjection of Women of John Stuart Mill, whom he had met that year during a visit to England. Brandes now took his place as the leading critic of the north of Europe, applying to local conditions and habits of thought the methods of Taine. He became docent or reader in Belles Lettres at the university of Copenhagen, where his lectures were the sensation of the hour. The professor of .Esthetics was the poet Carsten Hauch, a very aged man ; when he died in 1872, it was taken as a matter of course that Brandes would succeed him. But the young critic had offended many susceptibilities by his ardent advocacy of modern ideas ; he was known to be a Jew, he was con- victed of being a Eadical, he was suspected of being an atheist. The authorities refused to elect him, but his fitness for the post was so obvious that the chair of .(Esthetics remained vacant in the university of Copen- hagen, no one else daring to take a post from which Brandes had been rejected. In the midst of these po- lemics the critic began to issue the most ambitious of his works, the Main Streams in the Liter ature of the Nine- teenth Century, of which four volumes appeared between 1872 and 1875. The brilliant novelty of this criticism, as well as the tumult which gathered round the person of the critic, combined to give it unbounded success, and the reputation of Brandes grew apace, not only in his own country, but in Germany and Russia. His sub- sequent writings have been too numerous to be chronicled here in detail. But among them must be mentioned the monographs on Soren Kierkegaard (1877), on Esias Tegner (1878), on Lord Beaconsfield (1878), and on fien- rik Ibsen (1899). Brandes has written with great fulness on the main contemporary poets and novelists of his own country and of Norway, and he and his disciples have long been the arbiters of literary fame in the north. His Danish Poets (1877), his Men of the Modem Transi- tion (1883), and his Essays (1889), are volumes essential to the proper study of modern Scandinavian literature. In 1877 Brandes left Copenhagen and settled in Berlin, taking a considerable part in the aesthetic life of that city ; he speaks and writes German like a native. His political~~

~~views, however, made Prussia uncomfortable for him, and he returned in time to Copenhagen, where he found a whole new school of writers and thinkers eager to receive him as their leader. The most important of his recent works has been his study of Shakespeare, 1897-98, which was translated into English by Mr Archer, and at once took a high position. It is, perhaps, the most authoritative work on Shakespeare, not principally intended for an English- speaking audience, which has hitherto been published in any country. Dr Brandes has recently been engaged on a history of modern Scandinavian literature. In his critical work, which is extended over a wider field than that of any other living writer, Brandes has been aided by a sin- gularly charming style, lucid and reasonable, enthusiastic without extravagance, brUliant and coloured without affectation. In 1900 he collected his works for the first time in a complete and popular edition.~~

~~Brandon, a city and port of entry of Manitoba, Canada, on the Assiniboine river, and the Canadian Pacific and Canadian Northern railways, situated in 99° 57′ W. and 49° 50′ IST., 1184 ^eet above the sea. It is in one of the finest agricultural sections of Manitoba, and contains grain elevators, saw-mills, and grist-mills. It was first settled in 1881, and incorporated as a city in 1882. Population (1891), 3778; (1901), 5380.~~

~~Brandywine Creek, a small stream rising in Chester county, in South-east Pennsylvania, and flowing into Christiana Creek in Northerii Delaware. Its banks in Pennsylvania were the scene of an engagement in 1777, during the American revolution, between the American forces under "Washington and a British army under Gen- eral Howe, in which the former were defeated.~~

~~Brantford, a city and port of entry of Ontario, Can- ada, situated 22 miles S.S.W. of Hamilton, on the Grand river, and on the Grand Trunk and Toronto, Hamilton, and Buffalo railways. Agricultural implement, plough, engine, bicycle, and stove works and potteries, constitute the most important industrial establishments. It contains an institute for the education of the blind, maintained by the provincial Government, and a ladies' college. The total value of the exports for 1899-1900 was $993,346, and imports $1,413,950. Incorporated as a city in 1877, the population in 1881 was 9616 ; in 1891, 12,753 ; and in 1901 it was 16,621.~~

~~Brasseur de Bourbourg, Charles Etienne~~

~~(1814-1874), Belgian ethnographer, was born at Bourbourg, near Dunkirk, 8th September 1814. He entered the Eoman Catholic priesthood, was professor of ecclesias- tical history in the Quebec seminary in 1845, vicar-gen- eral at Boston in 1846, and from 1848 to 1863 travelled as a missionary, chiefly in Mexico and Central America. He gave great attention to Mexican antiquities, published in 1857-59 a history of Aztec civilization, and edited a collection of documents in the indigenous languages from 1861 to 1864. In 1863 he announced the discovery of a key to Mexican hieroglyphic writing, but its value is very questionable. In 1864 lie was archaeologist to the French military expedition in Mexico, and his Monumens andens du Mexique was published by the French Government in 1866. Perhaps his greatest service was the publication of the Popot Vuh, a sacred book of the Indians in the Quichel language, in 1861, along with a Quichel Grammar, and an essay on Central American mythology. In 1871 he brought out his BibliotMque Mexico-Gfuatemdlienne, and in 1869-70 gave the principles of his decipherment of Indian picture-writing in his Manuscrit Troano, Etudes sur le systhme graphique et le langue des Mayas. He died at Nice on 8th January 1874.~~

~~His chief merit is his diligent collection of materials ; his interpretations are generally fanciful.~~

~~Braunau (Czech, Broumov), the chief town of a government-district in Bohemia, Austria, near the frontier of Prussian Silesia. It has an imposing Benedictine abbey (1321), and a church (1683) which played an im- portant part in the events leading to the Thirty Years' War still stands. In 1618 the attempt to build a Protestant church was forcibly prevented, an act which was regarded as the immediate occasion of the Protestant insurrection in Bohemia. After the battle of the White Hill, near Prague, the town was deprived of all its privi- leges, which were, however, in great part restored nine years later. It is now a manufacturing centre (cloth, woollen and cotton~~

~~stuffs, &c.), and has a considerable trade. Population (1890), 7052; 1900, 7622, • chiefly German.~~

~~Braunsberg, a town of Prussia, province of East Prussia, 38 miles by rail S.W. of Kbnigsberg, and 5 miles from the shore of the Frisches Haff. Braunsberg~~

~~has manufactures of soap, yeast, carriages, bricks, and an active trade in flax, corn, flour, timber, &c. Population~~

~~(1885), 10,759; (1895), 11,856; (1900), 12,497.~~

~~Bray, a maritime town, urban sanitary district, and watering-place in the county of Wicklow, Ireland, on the Dublin, Wicklow, and Wexford railway, 12 miles S.S.E. of Dublin. Formerly the town was situated partly in Wicklow and partly in Dublin, but under the Local Government (Ireland) Act, 1898, the portion in Dublin was added to Wicklow. It is known as the "Irish Brighton," and is the chief watering-place in Ireland. A sea wall and promenade, erected at a cost of £25,000, was opened in 1885, and has since been enlarged. A commo- dious harbour has been constructed by the Urban District Council, who are also the harbour authority, at a cost of £45,000, which is capable of accommodating steamers and ships of 400 tons burden. The town is lighted by electricity, and is rapidly increasing in size. Population (1881), 6635 ; (1901), 7284, a number which doubles in the season.~~

~~BRAZIL.~~

~~Bound- aries.~~

~~1. Geography and Statistics.~~

~~BRAZIL, a country of South America, extends from about 4° N. lat. to 35° 41′ S. lat., and from 35° to about 73° W. long. On the north the greater part of the frontier is undefined, but by agreement of 1883 the watershed between the Amazon and Orinoco rivers was accepted as portion of the Venezuelan boundary. The dispute concerning the boundary towards French Guiana was, under a convention of April 1897, referred to a Swiss court of~~

~~arbitration, which gave its award on 1st December 1900. The boundary follows the Oyapoc river from its mouth to its source, and thence the watershed of the Tumuc Humac mountains to the frontier of Dutch Guiana. Towards Peru the Javary river is regarded' as the boundary. The frontier line towards Bolivia is still a matter of dispute. The Acre region, claimed by Bolivia, contains rich rubber forests and has attracted many Brazilians, who refuse to acknowledge the Bolivian claim. On 30th October 1899 a protocol was signed on behalf of the two republics providing for the demarcation of the frontier. Farther south the boundary of Brazil is not disputed, the frontier towards the Argen- tine Republic having been settled in 1895 by arbitration. Climate and Topography. — ^Within the vast area of Brazil are comprised very varied conditions of climate and widely-diversified topographical features. In the south is Rio Grande do Sul, a state consistiug, for the most part, of fertile prairie land, suitable for pastoral and agricultural industries, with a temperate, healthy climate, admirably adapted for European settlement. The ad- joining state of Santa Catharina has similar character- istics, but is intersected by broken country and low moun- tain ranges. Farther north lies the state of Parang with a climate, at the sea-level, humid and almost tropical in summer, but on the grassy, well-watered plateau, some 50 miles from the coast, at a height of 3000 feet, tem- perate and healthy. In the states of Sao Paulo, Rio de Janeiro, and Espiritu Santo, the coast-level is tropical and unhealthy, while the highlands of the interior are tem- perate and pleasant. Inland to the west and north of Rio de Janeiro is the state of Minas, possessing fertile valleys and bold mountain ranges, interspersed with grass- clad tablelands and great areas of forest. Northwards as far as the delta of the Amazon the country, having a**

fertile soil and a heavy rainfall, is clothed with dense vegetation and forest growth ; but towards the interior the land rises to a height of some 4000 feet, and spreads out into a fairly open plateau with a temperate climate. From the delta of the Amazon inland, for many hundreds of miles, there are low, heavily-wooded lands, intersected by innumerable swamps and streams. To the west and north of the Amazon the territories are practically unex- plored, but many of these forest districts are rich in india- rubber trees.

~~The only important waterways in Brazil are the Para and the Amazon, with its tributaries in the north, the San Francisco in the east, the Uruguay in the south-west, and the Paraguay in the west, the last giving access to the state of Matto Grosso. The Amazon is navigable as far as Iquitos in Peru, about 350 miles from the Pacific. All the inhabited districts of Brazil are well watered, and rain falls abundantly.~~

~~Area and Population. — ^Brazil, with an area of 3,218,100 square miles, had in 1890 a population of 14,333,915, the average deDsity being thus 4‘5 inhabitants per square mile. Of the population, 7,237,932 were males and 7,095,983 were females. The area and population of the twenty states and of the Federal, District are given in the subjoined table : —~~

~~states.~~

~~Area in~~

~~Population,~~

~~Pop. per Square Mile.~~

~~Square Miles.~~

~~1890.~~

~~AlagSas~~

~~22,580~~

~~611,440~~

~~22~~

~~Amazonas~~

~~732,250~~

~~147,916~~

~~Bahia ....~~

~~164,600~~

~~1,919,802~~

~~12~~

~~Ceard ....~~

~~40,240~~

~~805,687~~

~~20~~

~~Espiritu Santo~~

~~17,310~~

~~135,997~~

~~8~~

~~Goyaz ....~~

~~288,460~~

~~227,672~~

~~...~~

~~MaranhSo .~~

~~177,510~~

~~430,854~~

~~2~~

~~Matto Grosso~~

~~532,550~~

~~92,827~~

~~Minas Geraes~~

~~221,890~~

~~3,184,099~~

~~...~~

~~Pari ....~~

~~443,790~~

~~328,455~~

~~...~~

~~Parahyba .~~

~~28,840~~

~~457,232~~

~~16~~

~~ParanA~~

~~85,430~~

~~249,491~~

~~3~~

~~Pemambuoo~~

~~49,560~~

~~1,030,224~~

~~21~~

~~Piauhy~~

~~116,490~~

~~267,609~~

~~2~~

~~Rio de Janeiro .~~

~~26,6.30~~

~~876,884~~

~~33~~

~~Kio Grande do Norte~~

~~22,190~~

~~268,273~~

~~12~~

~~Rio Grande do Sul~~

~~91,310~~

~~897,455~~

~~10~~

~~Santa Catharina .~~

~~28,620~~

~~283,769~~

~~10~~

~~Sao Paulo .~~

~~112,280~~

~~1,384,753~~

~~12~~

~~Sergipe~~

~~15,090~~

~~310,926~~

~~20~~

~~Federal District . Total .~~

~~540~~

~~622,651~~

~~970~~

~~3,218,160~~

~~14,333,915~~

~~4~~

~~statistics]~~

~~BRAZIL~~

In these numbers, however, the population is probably much understated, for the great extent of territory and difficulty of com- munication render a complete enumeration impracticable. An official estimate, supplementing the census returns, puts the total number of inhabitants at 16,330,216. About 26 per cent, of the population are whites, mostly undersized and puny, living in the coast regions ; tne remainder are mulattoes, negroes, and Indians. There is, however, a large immigration, which is eagerly encouraged by the Government, free passes from Europe, assistance on arrival, and grants of land being provided for settlers. During the twenty eight years, 1871-98, 1,497,064 immigrants entered Brazil. In the last five years of this period the numbers were : — 1894, 63,294 ;

1895, 164,371; 1896, 157,948; 1897, 112,495; 1898, 53,822.

The new-comers in 1898 comprised 33,272 Italians, 11,662 Portu- guese, 5943 Spaniards, 669 Austrians and Hungarians, 477 Germans,

Towns. Population.

MontesClaros(Min.Grer.) 61,555 Ouro Preto (Min. Ger.) 59,249 Barbacena ,, . 67,850

Mariana ,, . 56,404

Porto Alegre (E. G. do

Sul) .... 52,421 Purifioacao (Bahia) . 51,602

Towns, Popnlation.

Muriah6(Min. Ger.) . 50,189

Belem (Para) . . 60,064 S. JoSo d'El Key (Min.

Ger.) . . . 48,722

Cachoeira (Bahia) . 48,352

~~Bom Jardim (Pernamb.) 46,742~~

~~Paracatu (Min. Ger.) . 46,621~~

~~B. yj)arbishire & O.J.R.Hcwarlh~~

~~Sketoh Map of Brazil.~~

~~247 French, 137 Russians (Jewish), and 129 Swiss. The Italian immigrants betake themselves in great numbers to the coffee plantations in Sao Paulo, Espiritu Santo, and Minas GeiSes. In Sao Paulo alone, in 1899, the Italian population was returned at 1,020,000. Spaniards and Portuguese usually settle in the northern states, where sugar, cotton, and tobacco are grown, or in cities, where they engage in minor trades and industries. The German settlements are mainly in the southern states, Eio Grande do Sul and Santa Catharina, where the German colonists are estimated to number more than 300,000.~~

~~The principal towns, with their population as given in the census of 1890, are :—~~

~~Constitution. — On 15th. November 1889 the Emperor Dom Pedro II. was dethroned and a Federal Eepublic proclaimed, under the title of the United States of Brazil. A Congress, convoked by a Provisional Government and elected by popular vote, met on 15th November 1890,~~

~~and adopted, on 24th February 1891, the con- stitution now in force. Each of the old pro- vinces forms a state, administered at its own expense without inter- ference from the Federal Government, except for defence, the mainten- ance of order (with the consent of the state), and the execution of the federal laws; but fiscal arrangements, in such matters as import duties, stamps, postage, and bank — note circulation, belong to the union. The legislative power is vested in a National Congress of two cham- bers. The Senate con- sists of sixty — three members (three for each state and the Federal District), elected for nine years, one-third of the number retiring every three years. Mem- bers must be over thirty- five years of age. The Chamber of Deputies contains 212 representa- tives, chosen for three years; the number sent by any one state must not be less than four, and must not~~

~~exceed the proportion of one for every 70,000 in- by a decennial census, elected by direct popular~~

~~a vaaoi , (labia)~~

~~Ox/ard igoi~~

~~Towns. Population.~~

~~Rio de Janeiro . . 522,651 San Salvador (Bahia) . 174,412 Recife (Pemambuco) . 111,556 San Amaro (Bahia) . 79,220 Campos (R. Janeiro) . 78,036 Sabard (Minas GerSes) 77,754 Serro „ • 75,270~~

~~Towns. Population.~~

~~JuizdeF(5ro(Min.Ger.) 74,136~~

~~Queluz „ 68,270~~

~~Sao Paulo (S. Paulo) . 64,934~~

~~Nazareth (Pernambuoo) 63,746~~

~~S. Barbara (Min. Ger.) 62,423~~

~~GraoMogol „ . 62,136~~

~~FelradeS.Anna(Bahia) 61,758~~

~~habitants, as determined Senators and deputies are~~

~~vote, every registered Brazilian over twenty-one years of age, not disqualified for special reasons, being an elector. Members of both chambers are paid. The president and vice-president of the republic are likewise elected by direct vote of the people. The term of office is four years, and the retiring president is not eligible for the succeeding term. The election is held on 1st March in the last year of each presidential period, and the new president assumes office on 15th November following. The president is the head of the executive ; he sanctions and promulgates laws,~~

~~issues decrees, and makes treaties (subject to ratification by Congress). He has supreme command of the army and navy, and (with the consent of Congress) appoints federal judges and diplomatic ministers. He is assisted by a cabinet of ministers, who~~

~~[statistics~~

~~are nominated and may be dismissed by himself. The ministers are heads of the various departments of Gov- ernment, but have not seats in either chamber and are not responsible to Congress for advice given to the presi- dent of the republic.~~

~~Local Government. — Each state has its own constitution, which must be republican, and each has its own legislative and adminis- trative authorities, with whom the central Government cannot interfere, except through the supreme federal tribunal. The Federal District is administered by a council elected by the citizens of the district, the municipal executive authority being exercised by a prefect appointed for a term of four years by the president of the republic. The number of municipal districts in Brazil is stated to be 892, and of parishes with administrative machinery 1886.~~

~~Justice. — The administration of justice is entrusted to a federal supreme court of fifteen judges holding office for life, and to inferior federal courts distributed through the country. The states have also their own tribunals, with which the federal courts may not interfere. Justice, however, both civil and criminal, as adminis- tered in Brazil, has fallen into reproach. Judicial appointments in the early years of the republic were made vrith little regard to fitness for office, and so little confidence is placed in thp tribunals that many rather submit to flagrant wrong than seek the redress to which they are entitled.~~

~~Education. — Education is in a backward condition, and probably 80 per cent, of the population can neither read nor write. Accord- ing to the constitution, instruction at all its stages is under lay management.~~

~~Elementary education is free, but not compulsory. Primary schools are under the care of the states and municipalities. In 1891 the number of such schools was returned at 8793 and of pupils .376,399, but the states do not supply complete information concerning their educational work. Secondary and higher educa- tion are under both federal and state control. In the capital the former is given in the National Gymnasium and the Benjamin Constant Institute, which confer degrees, and in the states there are institutions of similar purpose. Higher education is mostly of a professional nature. There are law schools at Pemambuco and Sao Paulo ; medical schools at Rio de Janeiro and Bahia ; a poly- technic at Rio de Janeiro ; a school of mining at Ouro Preto, and a school of fine arts" at Rio de Janeiro, all maintained by the Federal Government. There are also free schools of law, engineer- ing, &o., granting diplomas and degrees ; but such institutions must obtain Government recognition, must have a fixed endowment, and must have a Government official present when examinations are held. Private schools of all grades are numerous.~~

~~Finance. — The national revenue is derived largely from duties on imports ; but an inland revenue stamp duty has been imposed on tobaccos, wines, boots and shoes, candles, and several other classes of merchandise. Formerly customs duties were payable entirely in currency ; but a decree of 1899 required that 10 per cent, should be paid in gold, practically increasing the duty on many articles. The greater portion of the expenditure passes through the Depart- ment of Finance. The annual revenue and expenditure over a series of years, when stated in currency, show a large increase from year to year, but when stated in sterling they exhibit a remarkable decrease. This discrepancy is explained by the rapid depreciation of the inconvertible paper currency. The revenue and expenditure for 1889 and for each of the years 1894-98, stated in sterling, and the value of the paper milreis in pence, were as follows: —~~

~~Exchange.~~

~~Revenne.~~

~~Expenditure.~~

~~Pence.~~

~~£~~

~~£~~

~~1889~~

~~27~~

~~18,094,535~~

~~20,943,616~~

~~1894~~

~~10~~

~~11,014,384~~

~~15,189,594~~

~~1895~~

~~10~~

~~12,820,378~~

~~14,370,098~~

~~1896~~

~~9~~

~~12,523,841~~

~~14,021,025~~

~~1897~~

~~8~~

~~9,033,253~~

~~10,417,460~~

~~1898~~

~~7~~

~~9,429,720~~

~~10,911,560~~

~~For 1899 the revenue was estimated at 351,114,000 milreis (or, at 7d., £10,182,300), and the expenditure at 328,623,257 mil- reis (or £9,530,100) ; for 1900, revenue, 53,975,543 mikeis gold and 312,958,000 paper, and expenditure,' 36,974,000 milreis gold and 263,162,000 paper ; for 1901, revenue, 68,869,000 milreis gold and 278,565,000 paper ; expenditure, 35,799,000 milreis gold and 241,- 125,000 paper.~~

~~In 1888, a year before the establishment of the republican regime, the internal and external national debts amounted to £74,000,000 sterling, with the currency at par. At the end of 1898 the national debt was stated to consist of: external loans, £38,359.200 ; internal gold loans, 179,268,500 milreis ; internal currency loans, 426,813,100 milreis. There were, in addition, a floating debt of 300,000,000 milreis ; Treasury bonds to the amount~~

~~of £1,000,000, and paper money amounting to 780,000,000 milreis. In 1898 the Government, unable to meet the cost of service of the debt and the payment for railway guarantees, had entered into an arrangement for the issue of a 5 per cent, funding loan to the amount of £10,000,000 ; the suspension of all amortization for thirteen years ; and the withdrawal and incineration of the paper currency pari passu with the issue of the loan, the milreis being counted at 18d. The scheme was put in operation in June 1898 ; by the end of May 1900 the loan emissions amounted to £5,519,982, and paper cur- rency had been destroyed to the amount of 84,672,610 milreis (or 11,091,260 milreis more than the arrangement required). Within the same period the £1,000,000 of Treasury bonds had been paid off, and of the~~

~~internal gold debt (the service of which, in gold, had disturbed the market) 22,807,000 milreis (£2,534,000) was redeemed and the remainder converted into currency debt. Inter- est is paid on the external debt at 4, 4J, and 5 per cent. ; on the currency debt af 4, 5, and 6 per cent.~~

~~Besides the national debt there are Brazilian state debts of con- siderable importance. ‘ In 1899, sixteen states had internal debts amounting, in all, to 81,708,627 milreis ; four had floating debts reaching, on the aggregate, 10,311,182 milreis ; and five had ex- ternal debts amounting to £9,168,000 sterling ; but of this amount £1,930,750 was due to the Federal Government. The external debts of states were those of Sao Paulo, £3,224,600 ; Bahia, £2,013,- 200, of which £1,300,000 was due to the Federal Government; Minas Geraes, £2,600,000 ; Espiritu Santo, £700,000 ; Pemambuco, £630,750, due to the Federal Government.~~

~~Z>e/cnce.— The army consisted in 1899 of 2300 officers and 28,160 non-commissioned officers and men, organized in 40 battalions of infantry, 14 regiments and 1 corps of cavalry, 6 regiments of field, and 6 regiments of garrison artillery, and 2 battalions of engineers. Military service is nominally but not actually compulsory. The organization of an effective National Guard has been proposed. The rifle used is the Mannlicher for all the land forces. In addi- tion to the regular troops there are the armed police, numbering 20,000 men. These are used as soldiers when occasion demands, and for all practical purposes form part of the miUtaxy organiza- tion. Brazil is divided into seven military districts. In the mili- tary schools there are 1400 students.~~

~~The navy has been largely reinforced in recent years by the pur- chase of modem vessels, and the rearming and partial reconstruction of several of the older ships. The list of ships available for service now includes 2 armoured and 2 partly armoured turret ships ; 6 first- class and 2 second-class cruisers ; 1 guard ship ; 3 monitors for river work, besides 2 building; 37 torpedo craft of various kinds.~~

~~For service afloat there are 4000 seamen, 1000 firemen, 400 marines, and 3000 cadets and boys in the naval schools and train- ing ships. The school at Rio de Janeiro, from which the cadets graduate to the rank of midshipmen, is one of the best of the Brazilian educational establishments ;~~

~~it is selected by many of the prominent Brazilians for their sons, and, its a consequence, many representa- tives of the leading families of Brazil are found in the naval service. There are four naval arsenals, the principal one at Rio de Janeiro, the others at Bahia, Pemambuco, and Pard. At Rio de Janeiro there is a dry-dock in the naval yard on Cobras Island capa- ble of receiving any of the vessels now on the navy list. There is also a slip for the use of torpedo boats and other craft of smaller dimensions. In the navy the small-arm in use is the Mauser rifle. ‘ FrodUiCts. — Brazil has exceptional natural resources ; and with settled government, and necessary protection for life and property, this wealth must sooner or later be developed. The most im- portant agricultural product is coHee, the cultivation of which has largely extended. When slavery was abolished in 1888 the ovraers of coffee plantations were brought face to face with two serious dif- ficulties. The freeing of the slaves without compensation inflicted on the owners an enormous monetary loss, for the money laid out in the purchase of negroes had formed a large portion of their working capital, and, moreover, it was doubtful whether the former slaves would work at all after having obtained their freedom. Fortunately for Brazil, the prices for coffee in Europe at this crisis were high, and became abnormally so in 1889 and 1890. Money to work the plantations was easily obtained by mortgage of prop- erties, although the rates of interest charged were very high. At first the negroes were not inclined to work ; but after the novelty of the change had passed, large numbers of them returned to the plantations as labourers. To make up the deficiencies, immigration from Italy and Portugal was encouraged and supplied labour more satisfactory than that of the former slaves.~~

~~Of late years the wealthier oofiee-growers, instead of investing their profits in Government bonds as formerly, have made use of them to extend their plantations. A considerable amount of foreign capital, especially British, has been invested in the indus- try, and improved methods of cultivation and preparation have come into use. The total coffee production of Brazil in the year 1879-80 and in the eleven years ending 1898 is estimated to have been as follows (in bags of 132 R) : —~~

~~statistics]~~

~~B E A Z I L~~

~~351~~

~~Tear.~~

~~Bags.~~

~~Tear.~~

~~Bags.~~

~~1879-80 .~~

~~. 3,172,000~~

~~1892-93 .~~

~~6,193,000~~

~~1887-88 .~~

~~. 3,006,000~~

~~1893-94 .~~

~~4,307,000~~

~~1888-89 .~~

~~. 6,735,000~~

~~1894-95 .~~

~~6,689,000~~

~~1889-90 .~~

~~. 4,220,000~~

~~1895-96 .~~

~~6,250,000~~

~~1890-91 .~~

~~. 5,308,000~~

~~1896-97 .~~

~~8,680,000~~

~~1891-92 .~~

~~. 7,376,000~~

~~1897-98 .~~

~~11,110,000~~

~~For 1898-99 the yield was estimated at 9,280,000, and for 1899- 1900 at about 11,500,000 bags.~~

~~Kext in importance to cofiee culture is the production of rubber. The trees from the milky juice of which rubber is manu- factured are of several kinds. The Manihot Qlaziovii, or manicoba, is worked iri the state of Cear&, and its propagation is being tried also in the state of Rio de Janeiro. The Hancornia speciosa, or mangabeira, is the rubber plant of Maranhao, and it is also being planted in Bahia. The tree which is most productive, however, is the Hevea brasiliensis, or seringueira, growing in the valley of the Amazon. It is found sparsely scattered over the forests on the Amazon and its tributaries, the region of the Purus in Bolivia being regarded as the richest. During five months of the year, August – December, the juice of this tree is gathered by labourers who, for the whole extent of the valley, are esti- mated to number about 120,000, the number of trees annually tapped being put at about 24,000,000. From the whole valley, including its upper portions in Peru and Bolivia, the rubber is sent down the river to ParS,, whence it is shipped under the name of " Parfi, rubber " to Europe and the United States. The quantity shipped to foreign countries in 1897 amounted to 22,180 tons ; in 1898, to 21,880 tons ; in 1899, to 25,030 tons. Of the~~

shipments in 1899, 13,660 tons went to the TJnite^States of America, and the remainder to Europe.

Apart from coffee and rubber, there has not been remarkable development in the agricultural and forest industries of Brazil. Tobacco, cocoa, and cotton cultivation have slightly 'extended, but sugar-growing has decreased. The centres of the sugar industry are Bahia and Pemambuco. Food-stuffs, which might be grown abun- dantly in the country, are imported, the local production of maize, beans, and many other articles of common use being insufficient for local demands. >

Cattle-breeding is carried on to a large extent in the states of Hinas GeiSes, Faran&, Santa Catharina, and Eio Grande do Sul. The southern states have been so greatly disturbed by revolutionary outbreaks that the number of cattle has decreased, in spite of the natural advantages of the country. In Eio Grande do Sul the saladero establishments prepare the meat into tasajo, or jerked beef.

Minerals. — Mining enterprise may possibly offer attractions for the investment of capital on a large scale. The diamond fields, far from being exhausted, have hardly been prospected. Difficulties of transport have proved a great obstacle ; but a French syndicate has undertaken a thorough investigation of the Diamantina dis- trict, where the bulk of the stones hitherto exported from Brazil have been found. Gold-mining is also becoming an important industry, especially in the state of Minas. The output is annually increasing, and the required capital is slowly coming forward. Low grade ores are to be found in many districts ; but the machinery necessary to work the mines is expensive, and investors are cautious. Iron ore exists in large quantities in several of the states, but no attempt has hitherto been made to work it. Coal has been found in different parts of Southern Brazil, and is regularly mined in Rio Grande do Sul. The output in 1895 was 11,012 tons, and in 1896 18,300 tons. Difficulties of transport have stood in the way of any rapid expansion in the coal-mining industry.

Commerce. — The commerce during recent years has suffered from the effects of the inflation of prices and over-trading which took place in 1890 and 1891 ; from fiuotuation in the value of the cur- rency; from the fall in the price of coffee, the main article of export, and from the additional

~~taxation imposed by the Govern- ment in the beginning of 1899. There are no complete or trust- worthy statistics of the trade of the republic, such general statements as are published being merely estimates. In 1899 a Commercial Statistical Department was established, a journalist statistician having offered gratuitous service ; and hereafter more exact information, at least as regards imports, will probably be supplied. The estimated value in sterling of the imports and exports from 1893 onwards are given as follows :—~~

~~Tear. Imports. Exports.~~

~~1893 . . , £17,789,570 £32,827,826~~

~~1894 . . . 15,653,886 27,547,944~~

~~1895 . . . 15,420,292 29,015,000~~

~~1896 . . . 17,023,012 26,027,137~~

~~1897 . . . 21,567,660 26,752,224~~

~~1898 . . . 24,486,000 27,442,450~~

~~1899 . . . 20,000,000 24,500,000~~

~~The imports are mainly textiles, food-stuffs, coal, iron, machinery, and hardware ; while the exports consist of coffee, rubber, hides and skins, cocoa, the precious metals, manganese ore, sugar, and~~

~~tobacco. The coffee shipments in 1898 were valued at £15,500,000, and the rubber at £4,600,000. The export of hides in the same year amounted to £450,000, and of cocoa, to £400,000. As to the distribution of the trade of the republic, there are no sufficient data. At the port of Rio de Janeiro in 1899 the imports were stated to amount to the value of 229,207,000 milreis, which at 8d. per milreis would be equivalent to £7,640,230. Of this amount 41 per cent, came from Great Britain, 11 from Germany, 10 from France, 9 from the Argentine Republic, 8 from the United States, 6 from Uruguay, and 5 from Portugal. According to British statistics, the imports from Brazil~~

~~into the United Kingdom in 1899 amounted to the value of £3,959,854, of which £3,089,499 was for rubber. The exports from the United Kingdom to Brazil in the same year attiounted to £5,389,540. According to American statistics, the value of the imports from Brazil into the United States in 1899 amounted to 157,875,747 (£12,038,150), of which $35,253,010 (£7,332,600) was for coffee, and 116,999,345 (£3,535,860) for rubber. The exports from the Unite^ States to Brazil in the same year amounted to $12,239,036 (£2,545,720).~~

~~The import customs receipts of the repulalic in 1898 amounted to 245,909,405 milreis; in 1899 to 271,203,228 milreis (or about £8,196,900 in 1898, and £9,040,100 in 1899). Export duties are not levied by the Federal Government, but by the governments of the separate states. In some states taxes on exports are the chief source of revenue. The state of Par4 in 1897-98 had a revenue of £568,000, of which £476,000 was derived from export duties, £437,000 being from rubber exports aJone.~~

~~Foreigners take a large share in the commerce of Brazil, both in high finance and regular trading. The British and German banks practically control the exchange market ; and the Banco da Repub- lica, the Brazilian state bank, in spite of many attempts, has not yet proved strong enough to change the existing condition of affairs. As merchants and importers the British element is well represented in most branches of trade, but numerically the Portuguese are stronger. In Sao Paulo the trade is mostly in the hands of Italians ; in Bahia, Santa Catharina, and Rio Grande do Sul, the German influence is very strong.~~

~~Manufactures. — Of the manufacturing industries the most im- portant is the production of cotton goods, such as sheetings, ging- hams, and prints from cotton grown in the northern states, chiefly Pemambuco. There were, in 1899, altogether 134 cotton factories within the republic. In or near Eio de Janeiro were 19, with a total of 288,066 spindles and 10,100 looms, turning out 132,228,000 yards annually. There are several woollen factories in South Brazil. At Rio de Janeiro (Petropolis) there are two silk-mills and two large flour-nulls. Other industries more or less prosperous are distilling, brewing, the manufacture of boots and shoes, hats, cord and twine, saddlery, and coarse hempen cloth for coffee sacks.~~

~~Shipping. — In 1898 the merchant marine consisted of 229 steamers, with an aggregate net tonnage of 94,262 tons ; and 844 sailing vessels, with a total tonnage of 88,000 tons. In recent years the number of vessels engaged in the foreign trade entering and clearing at the port of Rio de Janeiro has considerably declined. In 1896, 1535 vessels of 2,469,628 aggregate tonnage entered, and 1404 of 2,282,999 tons cleared. In 1899, 1077 vessels of 1,916,949 tons entered, and 1019 of 1,859,707 tons cleared. Of the vessels entered in 1899, 482 of 956,362 aggregate tonnage were British ; 153 of 330,784 tons were French, 136 of 242,774 were German ; and 79 of 166,887 were Italian. The number of vessels engaged in the coasting trade that entered the port in 1899 was 1085, with a total tonnage of 395,498 ; and the number that cleared was 1085, with a tonnage of 370,447. Since December 1896 the coasting and river trade has been ex- clusively under the Brazilian flag. The principal steamship com- pany engaged in the coastwise trade was, for ten years, the Lloyd Brazillero with 22 steamers ; but the company was not financially successful, and in April 1900 its property was sold for the benefit of creditors. The Government pays an annual subsidy, amounting to 1,476,240 milreis, to the Maranhao and the Pemambuco com- panies which run between Pemambuco, Cearft, and Sergipe and the island of Fernando de Noronha. For river navigation, including the Amazon, its tributaries. Lakes Norte and Man^aba (state of AlagSas), the Rio das Velhas, and the San Francisco, the Govern- ment pays an annual subsidy of 13,334,000 milreis.~~

~~Bailways. — Railway enterprise has made some progress, but the disordered financial condition of the country has acted as a bar to the free investment of foreign capital. In 1899 the number of miles open to traffic and in construction was —~~

~~Miles.~~

~~Open.~~

~~Property of the Federal Government . 2004~~

~~Subsidized 2445~~

~~Without subsidy 995~~

~~Worked or conceded by State Govern- ments 3279~~

~~Total~~

~~8723~~

~~In Construction.~~

~~3720 387~~

~~885~~

~~4992~~

~~352~~

~~BRAZIL~~

~~[histoet~~

~~The railway system connects Rio de Janeiro with Santos and SSo Paulo to the south, and with the states of Minas and Espiritu Santo to the north. The remaining railways are in isolated sections at Pernambuco, Bahia, Paranagua, Santa Catharina, and the eastern and western districts of Rio Grande do Sul. The inten- tion originally was to link these various sections together, and form a trunk line from Pernambuco to Rio Grande, thence making con- nexion with the Uruguayan railway system. Various definite schemes are in hand for connecting and extending railways and tram- ways (electric and other) ; but, between judicial embargo and Gov- ernment imposts, success in such enterprises is difficult to attain.~~

~~Posts and Telegraphs. — The postal service of Brazil shows a large annual deficit, on account of the vastness of the country, the diffi- culties of communication, and the great abuse of the franking privilege. In 1893 there were 2826 post offices, and the mails carried 33,441,000 letters and post-cards, and 37,674,000 samples and printed packets. The telegraph system of Brazil extends over nearly* all the country, and is under Government control (some cable lines only excepted). At the close of 1896 the trunk lines were 4250 miles long, with 14,520 miles of wire ; the branch lines,~~

~~8300 miles, with 10,620 miles of wire ; or a total of 12,550 miles, with 25,140 miles of wire. There were also 1770 miles of line along the railways. At the same date there were 376 telegraph stations (46 of which had telephone service) and 17 cable sta- tions. The service, notwithstanding the transmission of more than 1,300,000 telegrams, showed a deficit of 5,000,000 milreis, due to too low rates and privileges to officials and the press.~~

~~Money and Credit. — The standard of value is gold, the monetary unit being the gold milreis, worth 2s. 2Jd. at par. The 10-milreis gold piece weighs 8-9648 grammes, -QIQ fine, and thus contains 8-2178 grammes of pure gold. The 2-milreis silver piece weighs 25-25 grammes, -916 fine. The existing currency, however, is almost entirely paper, which, owing to the large emissions made in the earlier years of the republic, is of depreciated value. The lowest point was reached in April 1898, when the paper milreis was worth only 5-81 pence. In June 1898 the scheme for the withdrawal of the paper money was put in force, and by the end of May 1900 the amount had been reduced from 785,941,758 milreis to 701,269,148 milreis. In addition to this arrangement two funds have been established — one for the redemption of the paper currency, the other for guaranteeing the notes continuing to circulate. Into the latter fund will be paid 5 per cent, of the import duties payable in gold, and moneys from other sources, including the amount received or to be received from the Bank of the Republic. When this bank was reorganized in 1897 it was agreed that its debt due to the Treasury should be extinguished within twenty years. But early in 1900 an arrangement was made whereby the whole amount of 186,000,000 milreis, comprising 66,000,000 milreis due from the bank itself, 80,000,000 from the industrial bonuses account, and 40,000,000 from the mortgage bank account, should be extinguished by a present payment of 25,000,000 milreis (at 8d.), and further payments in four instalments amounting to another 25,000,000 milreis within two years.~~

~~The metric system of weights and measures was made compulsory in 1874, but the old system has lingered on.~~

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~~(w. w. B. ; I. P. A. E.)~~

~~2. Recent Histoet.~~

~~Under the long reign of Dom Pedro II. progress and~~

~~material prosperity made steady advancement in Brazil.~~

~~Occasional political outbreaks occurred, but none of very~~

~~serious nature except in Rio Grande do Sul, where a~~

~~long guerilla warfare was carried on against the imperial authority. The emperor occupied himself to a far greater extent with the economic development of his people and country than with active political life. Unostentatious in his habits, Dom Pedro always had at heart the true interests of the Brazilians. Himself a highly-educated man, he sincerely desired to further the cause of education, and devoted a large portion of his time to the study of this question. His extreme Liberal- ism prevented his~~

~~opposing the spread of Socialist doc- trines preached far and wide by Benjamin Constant. Begun about 1880, this propaganda took deep root in the educated classes, creating a desire for change and cul- minating in the military conspiracy of November 1889, by which monarchy was replaced by a Republican form of government.~~

~~At first the revolutionary propaganda produced no personal animosity against the emperor, who continued to be treated by his people with every mark of respect and affection, but this state of things gradually changed. In 1864 the Princess Isabella, the eldest daughter of the emperor and empress, had married the Conde d'Eu, a member of the Orleans family. The marriage was never popular in the country, owing partly to the fact that the Conde d'lju was a reserved man who made few intimate friends and never attempted to become a favourite. Princess Isabella was charitable in many ways, always ready to take her full share of the duties falling upon her as the future empress, and thoroughly realizing the responsibilities of her position ; but she was greatly influenced by the clerical party and the priesthood, and she thereby incurred the hostility of the Progressives. When Dom Pedro left Brazil for the purpose of making a tour through Europe and the United States he appointed Princess Isabella to act as regent, and she showed herself so swayed in political questions by Church influence that Liberal feeling became more and more anti-dynastic. Another incident which gave strength to the opposition was the sudden abolition of slavery without any com- pensation to slave-owners. The planters, the principal possessors of wealth, regarded the measure as unnecessary in view of the Act which had been passed in 1885 provid- ing for the gradual freeing of all slaves. The arguments used were, however, of no avail with the regent, and the decree was promulgated on 13th May 1888. No active opposition was offered to this measure, but the feelings of unrest and discontent spread rapidly.~~

~~Towards the close of 1888 the emperor returned and was received by the populace with every demonstration of affection and esteem. Even among the advocates of Republicanism there was no intention of dethroning Dom Pedro, excepting a few extreme members of the party, who now gained the upper hand. They argued that it would be much more difficult to carry out a successful coup d'&tat when the good-natured, confiding emperor had been~~

~~succeeded by his more suspicious and energetic daughter. Discontented officers in the army and navy rallied to this idea, and a conspiracy was organized to depose the emperor and declare a republic. On 14th November 1889 the palace was quietly surrounded, and on the following morning the emperor and his family were placed on board ship and sent off to Portugal. A Provisional Government was then formed and a proclamation issued to the effect that the country would henceforth be known as the United States of Brazil, and that in due time a republican constitution would be framed. The only voice raised in protest was that of the minister of war, and he was shot at and severely wounded as a consequence. Dom Pedro, com- pletely broken down by the ingratitude of the people whom he had loved so much and laboured for so strenuously, made no attempt at resistance. The Repub-~~

~~history]~~

~~lican Government offered to compensate him for the property he had held in Brazil as emperor, but this proposal was declined. His private possessions - were respected, and were afterwards still held by Princess Isabella.~~

~~The citizen named as president of the Provisional Government was General Deodoro da Fonseca, who owed his advancement to the personal friendship and assistance of 'Dom Pedro. Second in authority was placed General Floriano Peixoto, an oficer also under hcSavy obligations to the deposed monarch, as indeed were nearly all of those who took active part in the conspiracy.~~

~~Though the overthrow of the imperial dynasty was totally unexpected throughout, the new rigime was ac- cepted without any disturbances. Under the leadership of General Deodoro da Fonseca a praetorian system of government, in which the military element was all-power- ful, came into existence, and continued till February 1891, when a National Congress assembled and formulated the constitution for the United States of Brazil. The former provinces were converted into states, the only right of the Federal Government to interfere in their administration being for the~~

~~purposes of national defence, the maintenance of public order, or the enforcement of the federal laws. Under the terms of the constitution the legislative au- thority is exercised by the National Congress, with the assent of the president of the republic. Congress consists of the senate and the chamber of deputies, and meets annually on 3rd May unless specially convoked for another day. The ordinary sessions last for four months, but may be prorogued beyond that period. No member of congress, after his election, can make any contract with the execu- tive power, or accept any commission or paid ofB.ce, except such as are diplomatic, military, or imposed by law, nor can any member be a director of any company receiving a subsidy from the Federal Government. Deputies and senators are paid; they cannot be ministers of state and retain their seats in congress. The president of the republic, in whom is vested the executive authority, is elected by the direct vote of the people, as is also the vice-president. The election is held on 1st March, and the term of office is four years. The outgoing president is not eligible for election for the succeeding term. All citizens over 21 years of age, properly inscribed and not being beggars, " illiterates," sojdiers serving in the army or members of monastic orders under vows of obedience, have the franchise. The fiscal arrangements of the constitution provide that import duties, stamps, post office revenue, and bank-note circulation are the pro- perty of the Federal Government; but export duties, formerly an imperial source of revenue, belong to the states. The Constitution of the United States of Amer- ica was taken as a model for drawing up that of Brazil, and the general terms were as far as possible adhered to.~~

~~General da Fonseca and General Floriano Peixoto were elected to fill the offices of president and vice-president until the 15th November 1894. This implied the continu ance of praetorian methods of administration. The older class of more conservative Brazilians, who had formerly taken part in the administration under the emperor, with- drew altogether from public life. Many left Brazil and went into voluntary exile, while others retired to their estates. In the absence of these more respectable elements, the government fell into the hands of a gang of military adventurers and unscrupulous politicians, whose only object was to exploit the national resources for their own "benefit. As a consequence, deep-rooted discontent rapidly arose. A conspiracy, of which Admiral Wandenkolk was the prime instigator, was~~

~~discovered, and those who had taken part in it were banished to the distant state~~

~~of Amazonas. Disturbances then broke out in Eio Grande do Sul, in consequence of disputes between the official party and the people living in the country districts. Under the leadership of Gumercindo Saraiva the country people broke into open revolt in September 1891. This outbreak was partially suppressed, but afterwards it again burst into flame with great vigour. In view of the discontent, conspiracies, and revolutionary movements, President da Fonseca declared himself dictator. This act, however, met with such strong opposition that he resigned office on 23rd November 1891, and Vice-President Floriano Peixoto assumed the presidency.~~

~~Floriano Peixoto had been accustomed all his life to use harsh measures. For the first year of his term of office he kept seditious attempts in check, but discontent grew apace. Nor was this surprising to those who knew the corruption in the administration. Concessions and subsidies were given broadcast for worthless undertakings in order to benefit the friends of the president. Brazilian credit gave way under the strain, and evidences were not wanting at the beginning of 1893 that an outburst of public opinion was not far distant. Nevertheless President Peixoto made no effort to reform the methods of adminis- tration. Meanwhile, the revolution in Eio Grande do Sul had revived ; and in July 1893 the Federal Government was forced to send most of the available regular troops to that state to hold the insurgents in check.~~

~~On 6th September prevailing discontent took definite shape in the form of a naval revolt in the Bay of Eio de Janeiro. Admiral Custodio de Mello took command of the naval forces, and demanded the resignation of the president. General Peixoto replied by organizing a defence against any attack from the squadron. Admiral Mello, finding that his demands were not complied with, began a bombardment of the city, but did not effect his purpose of compelling Peixoto to resign. The foreign ministers then arranged a compromise between the con- tending parties, to the effect that President Peixoto should place no artillery in the city, on condition that Admiral Mello should refrain from bombarding the town, provided the~~

president did not place in it heavy artillery. Shortly afterwards the cruiser Republica and a transport ran the gauntlet of the Government forts at the entrance of the bay, and proceeded south to the province of Santa Catharina, taking possession of Desterro, its capital! A Provisional Government was proclaimed by the insurgents, with headquarters at Desterro, and communication was opened with Gumercindo Saraiva, the leader of the insurrection in Eio Grande do Sul. It was proposed that the army of some 10,000 men under his command should advance northwards towards Eio de Janeiro, whUe the insurgent squadron threatened the city of Eio. In November Admiral Mello left Eio de Janeiro in the armoured cruiser Aquidaban and went to Desterro, the naval forces in Eio Bay being left in charge of Admiral Saldanha da Gama, an ardent Monarchist, who had thrown in his lot with the insurgent cause. All was, apparently, going well with the revolt, Saraiva having invaded the states of Santa Catharina and Parang, and defeated the Government' troops in several encounters. Meanwhile, President Peixoto had fortified the approaches to the city of Eio de Janeiro, bought vessels of war in Europe and the United States, and organized the Na^ tional Guard.

Early in 1894 dissensions occurred between Saraiva and Mello, which prevented any advance of the insurgent forces, and allowed Peixoto to perfect his plans. Admiral da Gama, unable to leave the Bay of Eio de Janeiro on account of lack of transport for the sick and woimded and the civilians claiming his protection, could do no more than wait for Admiral Mello to return from Desterro.

S. II.

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In the meahtime the ships bought by President Peixoto arrived off Eio de Janeiro and prevented da Gama from escaping. On 15th March 1894 the

~~rebel forces evacuated their positions on the islands of Villegaignon, Cobras, and Enxadas, abandoned their vessels, and were received on board two Portuguese -warships then in the harbour, whence they were conveyed to Montevideo. The action of the Portuguese commander was prompted by a desire to save life, for, had the rebels fallen into the hands of Peixoto, they would assuredly have been executed.~~

~~When the news of the surrender of Saldanha da Gama reached Gumercindo Saraiva, then at Curitiba in Parana, he proceeded to retire to Rio Grande do Sul. Govern- ment troops were despatched to intercept his retreat, and in one of the skirmishes which followed Saraiva was killed. The rebel army then dispersed. Admiral Mello made an unsuccessful attack on the town of Eio Grande, and then sailed to Buenos Ayres, there surrendering the rebel squadron to the Argentine authorities, by whom it was immediately delivered to the Brazilian Government. After six months of civil war peace was once more estab- lished, but there still remaiaed some small rebel groups in Rio Grande do Sul. These were joined by Admiral da Gama and a number of the naval officers, who had escaped from Rio de Janeiro ; but in June 1895 the admiral was killed in a fight with the Government troops. After the cessation of hostilities, the greatest barbarities were prac- tised upon those who, although they had taken no part in the insurrection, were known to have desired the over- throw of President Peixoto. The Baron Cerro Azul was shot down without trial ; Marshal de Gama Eza, an old imperial soldier of eighty years of age, was murdered in cold blood, and numerous executions of men of lesser note took place, among these being two Frenchmen for whose death the Brazilian Government was subsequently called upon to pay heavy compensation.~~

~~General Peixoto was succeeded as president on 15th November 1894 by Dr Prudente de Moraes Barros. It was a moot question whether Peixoto, after the- revolt was crushed, would not declare himself dictator; cer- tainly many of his friends were anxious that he should follow this course, but he was broken down by the strain which had been imposed upon him, and was glad to sur- render his duties. He did not recover his health, and died shortly afterwards.~~

~~From the first day that he assumed office, President Moraes showed that he intended to suppress praetorian system s and reduce militarism to a minimum. This policy received the approval and sympathy of the majority of Brazilians, but naturally met with bitter opposition from the military element. The president gradually drew to him some members of the better Conservative class to assist in his administration, and felt confident that he had the support of public opinion. Early in 1895 murmurings and disorderly conduct against the authorities began to take place in the military school at Rio de Janeiro, which had always been a hotbed of intrigue. Some of the officers and students were promptly expelled, and the president closed the school for several months. This salutary lesson had due effect, and no more discontent was fomented from that quarter. Two great difficulties stood in the way of steering the country to prosperity. The first was the chaotic confusion of the finances resulting from the maladministration of the national resources since the deposition of Dom Pedro II., and the corruption that had crept into every branch of the public service. Much was done by President Moraes to correct abuses, but the task was of too herculean a nature to allow of accomplish- ment within the four years during which he was at the head of affairs. The second difficulty was the war waged by religious fanatics under the leadership of Antonio~~

~~Maciel, known as " Conselheiro," against the constituted authorities of Brazil.~~

~~The story of Conselheiro is a remarkable one. A native of Pernambuco, when a young man he married against the wishes of his mother, who took a violent dislike to the bride. Shortly after the marriage the mother assured her son that his wife held clandestine meetings with a lover, and stated that if he would go to a certain spot not far from the house that evening he would himself see that her assertion 'Was true. The mother invented some plea to send the wife to the trysting-place, and then, dressing herself in male clothing, prepared to come suddenly on the scene as the lover, trusting to be able to make her escape before she was recognized. The three met almost simultaneously. Conselheiro, deeming his worst suspicions confirmed, shot and killed his wife and his mother before explanations could be offered. He was tried and allowed to go at liberty after some deten- tion in prison. From that time Conselheiro was a victim of remorse, and to expiate his sin~~

~~became a missionary in the sertao or interior of Brazil among the wild Ja-gunqo people. He built places of worship in many different districts, and at length became the recognized chief of the people among whom he had thus strangely cast his lot. Some few years ago Conselheiro formed a settlement near Canudos, situated about 400 miles inland from Bahia. Difficulty arose between the governor of Bahia and this fanatical missionary, with the result that Conselheiro was ordered to leave the settlement and take away his people. This order was met with a sturdy refusal to move. Early in 1897 a police force was sent to eject the settlers, but encountered strong resistance, and suffered heavy loss without being able to effect the purpose intended. In March 1897 a body of 1500 troops, with four guns, was despatched to bring the JagunQoes to reason, but was totally defeated. An army comprising some 5000 officers and men was then sent to crush Conselheiro and his people at all costs. Little progress was made, the cotintry being difficult of access and the JagunQoes laying ambuscades at every available place. Finally strong reinforcements were sent forward, the minister of war himself proceeding to take command of the army, now numbering nearly 13,000 men. Canudos was besieged and captured in September 1897, Conselheiro being killed in the final assault. The expense of these expeditions was very heavy, and prevented President Moraes from carrying out many of the retrenchments he had planned.~~

~~Soon after the Canudos affair a conspiracy was hatched to assassinate the presidtent. He was watching the dis- embarkation of some troops when a shot was fired which narrowly missed him, and killed General Bitencourt, tho minister of war. The actual perpetrator of the deed, a soldier, was tried and executed, but he was apparently ignorant of the persons who procured his services. Three- other men implicated in the conspiracy were subsequently sentenced to imprisonment for a term of thirty years. The- remainder of the presidency of Dr Moraes was uneventful ; and on 15th November 1898 he was succeeded by Dr Campos Salles, who had previously been governor of the state of Sao Paulo. President Salles publicly promised political reform, economy in the administration, and absolute respect for civil rights, and speedily made efforts- to fulfil these pledges.~~

Brazil lacks to-day the first principles of Republican government. The people have no real voice in the elec- tion of congress or president. Political representation is governed by groups forming miniatiire oligarchies in th& different states, and these autocratically determine how the elections shall result. Only a small proportion of the- population entitled to vote can be induced to attend the

ballot, those who do so only coining forward because of influence brought to bear upon them, and not of their own free will, the great mass of the population is not at present capable of understanding the meaning of political freedom, and of the responsibility which such a state of affairs entails upon the inhabitants of any country where universal suffrage is granted. (c. e. a.)

Brazil, capital of Clay county, Indiana, U.S.A., situated in the western part of the state, 16 miles E. of Terre Haute, at an altitude of 648 feet. It is a coal- mining town of some importance, and the point of inter- section of four railways. Population (1880), 3441;

(1890), 5905; (1900), 7786.

Brazza, an island in the Adriatic, off the coast of Dalmatia. Population (1900), 24,465. It is the largest of the Dalmatian islands as well as the most thickly popu- lated and fertile. The port of MilnEi is now a station of the Austrian Lloyd, and is provided with shipwrights' wharves. There are some twenty-five hamlets in the island. The cultivation of the silkworm is now included among the resources of the inhabitants.

Brazza, Pierre Paul Francois Camille de, Count de Savobgnan (1852—^—), Prench ex- plorer and administrator, of Italian extraction, was born on 26th January 1852, on board a vessel in the harbour of Rio de Janeiro. He was educated at the Jesuits' College at Paris, and, although a foreigner, served in the Prench navy. In 1874 he was naturalized as a Frenchman, and in 1875 was sent on a mission to explore the basin of the river Ogowe, in

the neigh- bourhood of the French colony of the Gaboon river in Western Africa. The exploration occupied him three years, in which, notwithstanding his success in con- ciliating the natives, he underwent great hardships. He nevertheless proved the practicability of penetrating into Central Africa by way of the Ogowe, and in 1879 was despatched on another expedition by the African Associar tion of France. In the course of this exploration M. de Brazza and his companions established twenty-seven posts, including the towns of Prancheville and Brazza- ville, and greatly extended the sphere of French influence by treaties with the native chiefs. He returned in 1882, and in 1883 was despatched by the French Government with a commission to consolidate French authority in the country. Having organized the administration as well as circumstances permitted, he returned to France and was made commissary-general of the new settlements in 1886. In 1887 he departed to assume the government, found the colony suffering from discord, and was obliged by sickness to return for a time. Upon his recovery he went out again, and organized another important expedition in 1891. He finally re- turned to France in 1897.

Brazzaville. See French Congo. Brechin, a royal and Parliamentary burgh (Mon- trose gtoup) of Forfarshire, Scotland, 8^ miles W.N.W. of Montrose by road ; now the terminus of two branches of the Caledonian railway. Recent erections are Episcopal, United Free, and Established churches, a public library, new municipal buildings, new post office, and new railway station. The ancient cathedral is to be restored. Popu- lation (1881), 9031 ; (1901), 8941.

Breclcinridge, John Cabell (1821-1875), American soldier and statesman, was born near Lex- ington, Kentucky, on 21st January 1821. He gradu- ated at Centre College, and for many years was a successful lawyer in Lexington. He was major of a regiment of Kentucky Tolunteers in the Mexican war. Subsequently he became a member of the Kentucky House of Representatives, and then for two terms was a repre-

sentative in Congress. From 1857 to 1861 he was vice- president of the United States. He belonged to the pro-slavery branch of the Democratic party, and was its candidate for the presidency in 1860, in opposition to

~~Stephen A. Douglas. In the electoral college 72 votes were cast for him, 180 for Lincoln, 39 for Bell, and 12 for Douglas. He became United States senator from Kentucky in March 1861, but soon joined the Confederate army, and was expelled from the United States Senate. As major-general in the Confederate service he achieved much distinction. He was secretary of war of the Con- federacy from January to April 1865, when that govern- ment collapsed. He escaped to Cuba and went to Europe, but in 1868 he returned to his practice as a lawyer. He died at Lexington, 17th May 1875.~~

~~Brecon, Brecknock, or Brecknockshire,~~

~~a county of South Wales, bounded on the N.W. by Cardigan, on the N. and N.E. by Radnor, on the E. by Hereford and Monmouth, on the S. by Monmouth and Glamorgan, and on the W. by Carmarthen.~~

~~Area and Population. — The area of the ancient county is 475,224 acres, or 743 square miles ; population (1881), 57,746 ; (1891), 57,031 (of whom 28,509 were males, and 28,522 females, the number of persons per square mile being 77, and of acres to a person 8-33); (1901), 59,906. The area of the administrative county is 469,894 acres, with a population in 1891 of 51,393. The area of the registration county is 458,652 acres, with a population in 1891 of 52,872. Within the registration area there was between 1881 and 1891 a decrease in the population of 2-34 per cent. The excess of births over deaths between 1881 and 1891 was 5691, but the resident population decreased by 1268. The following table gives the numbers of births, deaths, and marriages, with the number and percentage of illegitimate births for 1880, 1890, and 1898 :—~~

~~Tear.~~

~~Marriages.~~

~~Births.~~

~~Deaths.~~

~~lUegitimate Births.~~

~~Number.~~

~~Per Cent.~~

~~1880 ,~~

~~1890~~

~~1898~~

~~370 422 345~~

~~1627 1534 1574~~

~~.1126~~

~~1018~~

~~919~~

~~116~~

~~89 84~~

~~71 5-8 5-3~~

~~There were in the county (in 1891) 203 natives of Scotland, 308 natives of Ireland, and 122 foreigners, while 31,086 of the popu-. lation could speak English, 5228 Welsh, and 13,699 English and Welsh.~~

~~Constitution and Government. — The county returns one member to parliament, and also contains part of the parliamentary borough of Merthyr Tydfil. There is one municipal borough, Brecon. The urban districts are Brynmawr, Builth, and Hay. Brecknock is in the South Wales circuit, and assizes are held at Brecon, which has also a separate commission of the peace. The ancient county, which is partly in the diocese of LlandafE and partly in that of St Davids, contains sixty-six entire parishes and districts, and parts of three others.~~

~~Education. — The number of elementary schools on 31st August 1899 was 87, of which 42 were board and 45 voluntary schools, 37 of the latter being National Church of England schools, and 8 "British and other." The average attendance at voluntary schools was 3268, and at board schools 5134. The total school board receipts for the year ending 29th September 1899 were nearly £19,863. The income under the Agricultural Eates Act was £980.~~

~~Agriculture. — Only a little more than five-twelfths of the county is under cultivation, and of this about three-fourths is in per- manent pasture. There are also nearly 205,000 acres in hUl pasture, and about 14,000 acres under woods. Oats occupy more than half the acreage under corn crops, barley more than one- fifth, and wheat about one-sixth. About four-fifths of the green crop area is under turnips, and less than one-seventh under potatoes. The following table gives the larger main divisions of the cultivated area at intervals of five years from 1880 : —~~

~~Tear.~~

~~Total Area~~

~~under Cultivation.~~

~~Corn Crops.~~

~~Green Crops.~~

~~Clover.~~

~~Permanent Pasture.~~

~~Fallow.~~

~~1880 1885 1890 1895 1900~~

~~200,205 204,483 206,464 202,345 203,406~~

~~30,292 27,455 25,709 22,866 21,422~~

~~6817 7138 7517 7129 6903~~

~~22,428 23,498 19,555 19,714 20,893~~

~~136,442 143,170 151,203 151,456 153,208~~

~~4226 3072 2467 1149 969~~

~~356~~

~~BRED A — B R E M E N~~

~~The following table gives particulars regarding the live stock for the same years : —~~

~~Tear.~~

~~Total Horses.~~

~~Total Cattle.~~

~~Cows or Heifers~~

~~In Milk or in~~

~~Calf.~~

~~Sheep.~~

~~Pigs.~~

~~1880 1885 1890 1895 1900~~

~~11,182 12,235 12,418 12,785 12,065~~

~~35,668 39,736 38,812 40,014 41,920~~

~~13,576 15,554 15,473 15,117 15,782~~

~~381,611 386,717 448,877 456,069 489,417~~

~~7421 9423 9723 9813 8232~~

~~Industries and Trade. — According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in textile and non-textile factories and workshops in 1897 was 1073 as compared with 995 in 1896. Non-textile factories claim the large majority, and workshops nearly all the remainder. The number of persons employed in the mining industry in 1899 was 1968. The most valuable, mineral is coal (chiefly anthracite). The following table gives particulars of the output in 1890 and 1899:—~~

~~1890 1899~~

~~Tonnage . . . 259,260 383,465~~

~~Value . . . £109,568 £142,930~~

~~Much valuable limestone is also obtained; 300,151 tons, valued at £41,892, being raised in 1899. In the same year 25,919 tons of gravel and sand were raised, and 75,413 tons of sandstone.~~

~~Authorities. — Jones. History of the County of Brecknock, 2 vols. Brecknock, 1805-1809. — Poole. Illustrated History of Brecknockshire, 1886. — Kilner. Four Welsh Counties. London, 1891. See also the Guides to South Wales. (t. p. h.)~~

~~Breda, a town and railway station (1886) in the province of North Brabant, Netherlands, 30 miles N.N.E. of Antwerp, situated on the Mark, at its junction with the Aa, where the river becomes navigable. There is connexion by steam tram with Antwerp. The mauso- leums (ascribed to Michael Angelo) of Engelbert and Henry of Nassau in the Protestant church are highly interesting. The fortress has been dismantled. Popu- lation, 26,097.~~

~~Bredow, a village of Prussia, in the province of Pomerania, immediately N. of Stettin, of which it virtually forms a suburb. Here are the famous Vulcan iron-works and shipbuilding yards (where the Deutschland and the Kaiser Wilhelm der Grosse, which broke the Atlantic record, were built), and also sugar, cement, and other factories. Population (1885), 12,715 ; (1900), 19,992.~~

~~Bregentz, or Bkegenz, chief town of the district of the same name in Vorarlberg, Austria, as also of that crown-land. It is a port on Lake Constance and a station on the Austrian state railway. In 1890 the population of the district was 41,824, all German and (with the excep- tion of 420 Protestants) Catholic; in 1900, 46,216. Population of town (1869), 3686 ; (1890), 6739 ; (1900), 7595. It has a garrison of 519 men. Numerous Koman antiquities have been placed in the provincial museum. The town has acquired considerable importance through the railway and a steamship service on the lake, which has promoted the trade in corn, cattle, timber, animal products, &c. The principal industries are cotton spin- ning and weaving, the manufacture of silk, articles of jewellery, woodwork, and hardware.~~

~~Bremen, a city of Germany, capital of the free state of Bremen, on both banks of the Weser, 46 miles from the North Sea and 71 miles by rail S.W. of Hamburg. By the completion of engineering works on the Weser in 1887-99, at a total cost of £1,700,000, whereby the river has, amongst other improvements, been straightened and deepened to 18 feet, large ocean-going vessels are now able to steam right up to the city itself. It has excellent railway connexions with the chief industrial districts of Germany. Its trade, however, like that of Hamburg, is predominantly~~

~~a transit trade ; especially is it important as the importer of the raw products of the United States. The growth of the commerce of the port of Bremen-Bremerhaven is illus- trated by the following statistics : — The value of the total imports (both sea-borne and by river and rail) increased from £22,721,700 in 1883 to £44,667,100 in 1899; the imports from the United States, from £9,755,000 in 1883 to £15,099,800 in 1899; but from Great Britain they decreased from £3,040,000 in 1883 to £1,357,000 in 1894, though they rose again to £3,053,400 in 1899. The countries, in addition to those already named, from which imports principally come are Germany, Eussia, the republics of South America, the Far East, and Aus- tralia. The exports amounted in value to a total of £26,096,500 in 1883, a sum which reached £43,043,700 in 1899. The exports .to the United States increased from £3,985,000 in 1883 to £6,639,200 in 1897, but in 1899 dropped to £3,849,200. The exports to Great Britain amounted to £1,020,000 in 1883, and to £2,621,- 000 in 1899. As regards the shipping, the number of vessels~~

~~which entered the ports of the free state (i.e., Bremen city, Bremerhaven, and Vegesack) increased from 2869 of 1,258,529 aggregate tonnage, in 1883, to 4642 of 2,464,800 tons in 1898; at Bremen-Bremerhaven there arrived 4128 vessels of 2,406,748 tons in 1899. In addi- tion, 1557 vessels of 375,300 tons arrived, belonging to the inland (river) navigation, in 1898. The arrivals under the British flag at the free state ports increased from 389 of 514,310 tons in 1892, to 407 of 661,149 tons in 1899. At the end of 1883 the mercantile fleet of Bremen (state) consisted of 356 seargoing vessels, aggre- gating 307,559 tons, 99 of these, measuring 89,046 tons, being steamships. By 1899 this fleet had increased to 536 vessels of 566,688 tons. Out of this total 380 vessels of 475,763 tons, or 83-9 per cent, of the total tonnage, be- longed to the city of Bremen, which is indeed the seat of some of the more important of the German shipping com- panies, especially of the North German Lloyd (founded in 1856), which at the end of 1898 possessed a fleet of 73 steamboats of 266,138 tons, besides over 100 lighters and similar craft. Bremen shares with Hamburg the position of being one of the two chief emigration ports of Ger- many. There are three docks, all to the north-west of the city — namely, the free harbour (which was opened in 1888), the winter harbour, and the timber and industrial harbour ; but it has been decided to make a new basin, 7200 feet long, below the present docks, with a separate basin for ships to turn in ; also, the area of the timber dock is to be enlarged. Shipbuilding yards, jute-mills, flour-mills, and oil-mills exist on a large scale. A thor- ough restoration of the cathedral was begun in 1888, and a new tower was added in 1898-99. The church of Our Lady, dating from the 12th and 13th centuries, was restored in 1893, and the '12th-century Eomanesque church of St Stephen in 1891. The most important and most imposing amongst the new architectural additions to the city are the post office (1878) ; the law courts (1891- 95), a German Kenaissance building ; the German National Bank (1896) ; the Municipal Museum for Natural Science, Ethnology, and Commerce (1896), with several collec- tions; and the city library, of about 115,000 vols., erected in the Dutch Eenaissance style in 1895-96. The principal ornamental memorials and useful institu- tions embrace a gigantic "Eoland" statue, symbolical of the city's authority; the Willehad fountain (1883); the monument of the 1870-71 war (1875) ; the Centaur fountain (1891) ; an equesitrian statue of the Emperor William I. (1893) ; the Art Exhibition ; and an industrial art museum. It is a peculiarity of the domestic~~

~~accom- modation of Bremen that the majority of the houses unlike the custom in other German towns, are inhabited~~

~~/^^oLv^.T® family only. Population (1890), 125,684; (1895), 141,894; (1900), 163,418. ^ ^ ‘ ‘~~

~~The Free State of Bremen has an area of 99 square miles, and a population of 156,723 (1880); 180,443 (1890) ; 224,697 (1900). The constitution was revised in 1875, 1878, and agam in 1894. The executive consists of a senate of 16 members, elected for life hy the House of Burgesses. The House of Burgesses numbers 150 members, of whom 14 are elected by university graduates, 42 by the merchants, 22 by the mechanics and manu- facturers, 44 by the other taxpayers of the city, 12 by the towns of Vegesack and Bremerhaven, and 16 by the country districts. In 1895, 93-8 per cent, of the popula- tion, namely 184,360, out of 196,404, professed the creed of the evangelical Lutheran church, 8686 were Koman Catholics, and less than 1000 were Jews. In 1897 there were in the state 6482 horses, 16,119 head of cattle, 14,875 pigs, and only 522 sheep. The state revenue was estimated for 1899-1900 at £1,266,100, and the expendi- ture at £1,595,400. The state contribution to the imperial exchequer amounted to £98,910 in 1900. In 1900 the state public debt amounted to £9,043,770. (j. t. bk.)~~

~~Bremerhaven, a seaport town of Germany, in the free state of Bremen, at the mouth of the Weser (E. bank), 38 miles by rail K of the city of Bremen, of which it is the outer port. Commercial and shipping statistics are included in the returns for the city of Bremen (q.v.). The Emperor dock (1876) was very considerably enlarged at a cost of £900,000 in 1897-99. This, together with the north portion of the “new” dock (1861), con- stitutes the free harbour, which is being enlarged by the excavation of a new basin. Here are the workshops and dry docks of the North German Lloyd. The town possesses a technical institute, a natural history collection, a library, theatre, and a monument (1888) to Smidt, the burgomaster of Bremen, to whose enterprise the harbour of Bremerhaven is due. Shipbuilding and kindred in- dustries are carried on. A terrible explosion, caused by an infernal machine,~~

~~took place on 11th December 1875. Though the miscreant, Thomas, who devised the outrage in order to recover the insurance for goods shipped on the liner Mosel, which was thus prematurely wrecked, himself escaped destruction, he committed suicide in his cabin. Population (1885), 14,900; (1895), 18,366;~~

~~(1900), 20,322.~~

~~Brenham, capital of Washington county, Texas, U.S.A., situated in the south-eastern part of the state, at an altitude of 332 feet, on the Houston and Texas Central and the Gulf, Colorado, and Santa Ee railways. The neighbouring region is fertile and produces much cotton, for which Brenham is the compressing- and shipping-point. Population (1880), 4101 ; (1890), 5209; (1900), 5968.~~

~~Brentano, Ludwig Joseph [called Lujo]~~

~~(1844), German economist, a member of the family~~

~~of the celebrated Clemens and Bettina Brentano, was born at Aschaffenburg, 18th December 1844. He received a por- tion of his academical education in Dublin, a circumstance almost unexampled in the history of a German author. In 1868 he visited England, and madea thorough study of trade-unionism, which resulted in his principal work. Die Arbeitergilden der Gegenwart, Leipzig, 1871-72. The book was assailed by Bamberger and other economists, but has proved epoch-making, not only as an authority on modern associations of workmen, but for having given an impetus to the study of the gilds of the Middle Ages, and the examination of the great stores of neglected informa- tion bearing upon the condition of the people in olden days. Brentano's other works are of a more theoretical character, and chiefly relate to political economy, of which~~

~~he has been professor at Breslau froni 1872 to 1882, and at Strasburg since 1882. His work on gilds was trans- lated into English by Miss Lucy Tomlinson Smith.~~

~~Brentford , a market town in the Brentford parliamen- tary division of Middlesex, England, 8 miles W. of St Paul's, London, on the Brent, and the~~

~~London and South- Western railway. Brentford has been the county town for elections since 1701. Population of town (an urban district) (1881), 11,810; (1901), 15,171.~~

~~Brescia, chief town of the province of the same name, in Northern Italy. Since 1875 considerable im- provements have been effected. In the province alone 153 kilometres of new railways and 105 km. of steam tramways have been opened. The chief industries are woollen, cotton, and silk weaving ; iron casting and gun making; hat and rope making. The stone quarries of Mazzano now yield between three and four thousand cubic metres per annum. The stone has been used for the monument to Victor Emmanuel II. at Eome, and for various buildings in Austria, England, Egypt, India, and America. The cement industry has also increased. Agriculture has been improved by draining marshy dis- tricts ; cattle-raising and cheese-making have extended. In the city the communal palace (known as the Loggia), the old cathedral, and the old municipal palace have been restored. The cathedral was reopened for public worship in 1897. Monuments have been erected since 1880 to Arnold of Brescia (by Tabacchi), to Garibaldi (by Eugenio Maccagnani), and to Bonvicino, called Moretto, by Ghidoni. The Museo Patrio having proved too small, the collections of Christian art have been transferred to the church of Santa Giulia, while the Museo itself has been reserved for Eoman remains. By a legacy of Count Leopold Mar- tinengo the municipal gallery has been installed in the Martinengo palace. The collection consists chiefly of 16th and 17th century Italian pictures, including important works by Moretto and Eomanino. In 1899-1900 the water- supply was reorganized and a large reservoir is being constructed. The castle hill has been laid out as a public garden. The population of the town in 1900 was 70,618 ; of the province, 537,690. (l. bi.)~~

~~Breslau (Slav. Vratislavia),a, town oi Prussia, capital of Silesia, and an episcopal see, on the Oder, 204 miles S.E. of Berlin on the railway to Vienna. It is the fifth city in point of population in the empire, and the seat of im- portant and growing industries, the chief branches of which are the manufacture of machinery, railway car- riages, printing, leather and leather goods, distilleries, breweries, and furniture, cigars, ready-made clothing, and musical instrument factories. It is also the centre of a large trade in the~~

~~products of the province, partly by rail, partly by river — wool, cereals, minerals, leather, machinery, horses, cattle, sugar, butter, and honey. In 1898 an aggre- gate of 7552 vessels of 2,305,300 tons entered and cleared by river. The growth and modern spirit of the city are ex- emplified in the large number of new buildings and monu- ments erected since 1876. Of these the most important are the provincial house of assembly ; the provincial administrative offices (1883-86) ; the Breslau Bank of Exchange (1890); the savings bank (1891), in which are preserved the municipal library of 130,000 vols, and more than 3000 MSS., as well as the very valuable city archives ; the post office (1888), in the Eenaissance style ; the Silesian Museum of the Industrial Arts and Antiquities, stored in the former assembly hall of the provincial estates, which has been rebuilt (1897-99) for the purpose ; the Fine Arts Museum (1875-79), with col- lections of pictures, &c. ; the chemical and anatomical institutes of the university; several new churches (St~~

~~Salvator, Luther, St Boniface, &c.), and a gaol; The chief Protestant chvtrch' of St Elizabeth, which contains portraits of Luther and Melanchthon by Lukao Cranach, was restored in 1891-93 ; the church of St Mary Magdalene (Protest- ant), of the same date as the church of St Elizabeth, was restored in 1887-90, after the destruction by fire of one of its twin towers in 1887 ; the town hall was restored in 1885-88. The city is especially rich in fine monuments, the more recent being the Emperor William I. (1896) by Behrens ; a monumeiit of the war of 1870-71 ; a marble statue of General Tauentzien by Langhans and Schadow ; a bronze statue of Svarez, the Prussian jurist (1896) ; a monument of Schleiermacher (1869), who was born here in 1768 ; and monuments to the Emperor Frederick III. and Bismarck. Here, too, should be mentioned the handsome outlook tower on the Liebichshohe (1867). Breslau is also the seat of numerous important educational insti- tutions. First amongst these comes the university (1662 students and 169 professors in 1900). Its library con- tains 400,000 vols., and 4000 vols, of MSS. ; also, an archaeological collection. Further, there are a Roman Catholic normal school, a Jewish~~

~~theological seminary, eight classical and four modern schools, one of the last with technical divisions. This city is the headquarters of the 6th German Army Corps, and of the SUesian Society for Native (vcUerldndische) Civilization, and nearly fifty other learned literary and artistic societies. There are four theatres and three music halls. The course of the Old Oder, which circles round the town to the north- east, was regulated by canal works in 1897. Population~~

~~(1886), 299,640; (1890), 336,186; (1900), 422,738.~~

~~(j. T. BE.)~~

~~Brest, chief town of arrondissement, department of Finistfere, France, with terminal station on the railway from Paris. Orphan boys are trained as sailors, first in a marine school, and afterwards in one or other of the naval training- ships stationed here. Five lighthouses mark the entrance to the harbour. The industrial activities of the town depend mainly on the government dockyard and arsenal, which employ between 8000 and 9000 workmen. Chemicals and briquettes are manufactured, and there are ironworks. The total imports in 1899 were valued at £283,400, of which coal from Englandsupplied one-fourth, other imports being wine, timber, coffee, and phosphates. The exports (of which strawberries form the bulk) are of small value, but go almost entirely to England. In 1898 a new direct submarine cable, was laid between Brest and Cape Cod to the United States, and it has been pro- posed to organize a fast line of passenger ships be- tween Brest and New York. Population (1881), 57,277 ;~~

~~(1901), 84,284.~~

~~Breton, Cape, an island belonging to the pro- vince of Nova Scotia, on the N.E. of the mainland, from which it is separated by the Strait of Canso. The highest land in Nova Scotia is situated in the northern part of the island, where the surface rises to a height of 1600 feet. This area is occupied by pre-Cambrian rooks, which in places are overlaid by Carboniferous strata. In the south- west portion and around Bras d'Or lake there are similar pre-Cambrian areas with others in which Cambrian fossils are abundant. On the west coast between Margaree harbour and Port Hood, and on the south side of the island at Seacoal Bay and Little Eiver, Richmond county, the Coal~~

~~Measures occur with valuable seams of coal, while the Sydney coalfield occupies the east coast from Mira Bay to St Anns, some of the seams having been mined beneath the sea. The highest temperature at Sydney is 82° F. and the lowest —9°. Population (1881), 84,600; (1891), 86,854. In the latter year there were 4035 adherents of the Church of England, 47,913 of the~~

~~Church of Rome, 29,413 Presbyterians, 2546 Methodists, and 2435 Baptists. In 1900 there were 463 schools attended by 18,800 pupils. In the same year 2,200,000 tons of coal were produced. There were 102 vessels, 3522 boats, and 7422 men engaged in the fisheries in 1899. The total value of the fish and their products was $1,300,410 — the value of fishing vessels, boats, nets, lobster-canneries, &c., being $524,755. In 1891 there were 1,184,426 acres of land occupied, 372,848 improved, 185,562 under crop, and 185,472 in pasture. Of wheat 8283 bushels were raised, 30,093 of barley, 313,666 of oats, 8129 of buckwheat, 1,041,292 of potatoes and other roots, and 112,271 tons of hay. There were 13,885 horses, 1286 oxen, 37,454 mUch cows, 33,906 other horned cattle, 96,006 sheep, and 10,036 swine, and 1,888,248 R) of home-made butter were produced, 271,646 lb of cheese, and 286,021 ft of wool.~~

~~See EoBB and Fletcher. Reports of Geological Survey, 1872 to 1882, and 1898 to 1899. — Fletcher. The Sydney Coal Fields, Cape Breton, N. 8., 1900. — Charles Dudley Warner. Baddeck and that Sort of Thing. — Sii John Bocrinot. Historical and Descriptive Account of Cape Breton.~~

~~Breton, Jules Adolphe Aime Louis~~

~~(1827), French painter, was born 1st May 1827, at~~

~~Courriferes, Pas de Calais, France. His artistic gifts being manifest at an early age, he was sent in 1843 to Ghent, to study under the historical painter de Vigne, and in 1846 to Baron Wappers at Antwerp. Finally he worked in Paris under Drolling. His first efforts were in historical sub j ects : " Saint Piat preaching in Gaid " ; then, under the influence of the revolution of 1848, he represented "Misery and Despair." But Breton soon discovered that he was not born to be a historical painter, and he returned to the memories of nature and of the country which were im- pressed on him in~~

~~early youth. In 1853 he exhibited the “Return of the Harvesters” at the Paris Salon, and the “Little Gleaner” at Brussels. Thenceforward he was essentially a painter of rustic life, especially in the province of Artois, which he quitted only three times for short ex- cursions : in 1864 to Provence, and in 1865 and 1873 to Brittany, whence he derived some of his happiest studies of religious scenes. His numerous subjects may be divided generally into four classes : labour, rest, rural festivals, and religious festivals. Among his more important works may be named “Women Gleaning,” and “The Day after St Sebastian’s Day” (1855), which gained him a third-class medal; “Blessing the Fields” (1857), a second-class medal; “Erecting a Calvary” (1869), now in the Lille Gallery ; ” The Return of the Gleaners ” (see Plate) (1859), now in the Luxembourg; “Evening,” and “Women Weeding” (1861), a first-class medal; “Grandfather’s Birthday ” (1862) ; « The Close of Day ” (1866) ; ” Harvest ” (1867) ; “Potato Gatherers ” (1868) ; « A Pardon, Brittany » (1869) ; ” The Fountain ” (1872), medal of honour ; « The Bonfires of St John” (1876) ; ” Woman mending Nets” (1876), in the Douai Museum; “A Gleaner” (1877), Luxembourg ; ” Evening, Finist^re ” (1881) ; ” The Song of the Lark ” (1884) ; ” The Last Sunbeam ” (1886) ; ” The Shepherd’s Star” (1888); “The Call Home” (1889); “The Last Gleanings” (1895); “Gathering Poppies” ri897J; “The Alarm Cry” (1899); “Twilight Glory” (1900). Breton was elected to the Institut in 1886 on the death of Baudry. In 1889 he was made Com- mander of the Legion of Honour, and 1899 Forei^ Member of the Royal Academy of London. He has also written several books, among them Les Champs et la Mer (1876), Nos Peintres du SiMe (1900), and “Jeanne,” a poem.~~

~~See Jules Bebton, Vie tl’un Artiste, Art et Nature (auto- biographical), Paris, 1890.— Mabius Vachon, Jules Breton.~~

~~1899. ‘~~

~~a~~

~~359~~

~~BEEWIl^G.~~

~~THE evolution of the brewing industry since 1875 has been accompanied by many interesting devel- opments, important not only from an economical or trade point of view, but also in their technological and scientific aspects. The period covers the repeal of the malt tax and the introduction of the "free" mash-tun, and, as a consequence of the new law, the greatly increased use of malt substitutes and the rise of the " pure beer " agitation. It is a period which has seen the gradual modification of the character of British beers, the strongly alcoholic, heavily-hopped Uquids consumed by the previous generation slowly giving place to the lighter beverage in vogue at the present time. It includes the classical researches of O'SuUivan, Brown, Heron, and Morris, on starch degradation, and those of Hansen, with their brilliant practical application, on the methods of obtaining and cultivating pure yeasts ; and many import- ant and innumerable minor improvements in the malting, mashing, refrigerating, and fermenting processes.~~

~~Repeal of the Malt Acts, and the Free Mash-tun. — By the act of 1880 the duty was taken off the malt and placed on the beer, or, more properly speaking, on the wort, and the restrictions as to the use of materials in brewing were removed. The chief feature of Mr Glad- stone's Bill was that on and after the 1st October 1880 a beer duty was imposed in lieu of the old malt tax, at the rate of 6s. 3d. per barrel of 36 gallons, at a specific gravity of 1-057 ; and the regulations for charging the duty were so framed as to leave the brewer practically unrestricted as to the description of malt or corn and sugar, or other description of saccharine substitutes (other than deleterious articles or drugs), which he might use in the manufacture or colouring of beer. This freedom in the choice of materials has continued down to the present time, except that the use of "saccharin" (a product of coal-tar) was prohibited in 1888, the reason being that this substance gives an apparent palate-fulness to beer equal to roughly 4° in excess of its real gravity, the revenue suffering thereby. In 1889 the duty on beer was increased by a reduction in the standard of gravity from 1-057 to 1-055, and in 1894 a further 6d. per barrel was added. The duty thus became 6s. 9d. per barrel, at a gravity of 1;055, which was further increased by Is. a barrel by the war budget of 1900.~~

~~Prior to 1896 rice, flaked maize (see below), and other similar preparations had been classed as malt or corn in reference to their wort-producing powers, but after that date they were deemed sugar i in that regard. By the new Act (1880) 42 R) weight of corn, or 28 R) weight of sugar, was to be deemed the equivalent of a bushel of malt, and a brewer was expected by one of the modes of charge to have brewed at least a barrel (36 gallons) of worts (less 4 per cent, allowed for wastage) at the standard gravity for every two bushels of malt (or its equivalents) used by him in brewing ; but where, owing to lack of skill or inferior machinery, a brewer cannot obtain the standard quantity of wort from the standard equivalent of material, the charge is made not on the wort, but directly on the material. By the new Act licences at the annual duty of £1 on brewers for sale, and of 6s. (subsequently modified by 44 Vict. c. 12, and 48 & 49 Vict. c. 5, &c., to 4s.) or 9s., as the case might be, on any other brewers, were required. The regulations dealing with the mashing operations are very stringent. Twenty-four hours at least before mashing, the brewer must enter in his brewing-book (provided by the Inland Revenue) the day and hour of commencing to mash malt, com, &c., or to dissolve sugar ; and the date of making such entry ; and also, two hours at least before the notice hour for mashing, the quantity of malt, corn, &c., and sugar to be used, and the day and hour when all the worts~~

~~1 They were classified at 28 ft in 1896, but since 1897 the standard has been at the rate of 32 ib to the bushel.~~

~~will be drawn off the grains in the mash-tun. The worts of each brewing must be collected within twelve hours of the com- mencement of the collection, and the brewer must within a given time enter in his book the quantity and gravity of the worts before fermentation, the number and name of the vessel, and the date of entry. The worts must remain in the same vessel undisturbed for twelve hours after being collected, unless previously taken account of by the officer. There are various other regulations, such as those prohibiting the mixing of worts of different brewings unless account has been taken of each separately, the alternation of the size or shape of any gauged vessel without notice, and so on.~~

~~1 000 QOO Barrels~~

~~‘ 5 Years~~

~~YearlSU~~

~~mo~~

~~leas~~

~~1890~~

~~1995~~

~~ma~~

~~Fio. 1. — Diagram showing the total production of Beer (barrels) in the TTnited Kingdom, 1875-1900.~~

~~OommerdoZ Developmevi. — ^When the article in the niath edition was written it was believed by competent experts that the brewing trade had attained its maximum extent, and for a series of years it appeared as though this belief was well founded. In the decade 1880-90 both the number of barrels brewed and the quantity of ‘materials annually used were considerably below the figures for 1875 ; the barrelage remaining almost stationary at 27 to 28 millions, as against 31, millions at the latter date. Since 1891, however, there has been a steady increase, and with the exception of 1895 each year has marked an advance on the preceding one (Fig. 1). The following figures with regard to the barrelage, materials, duty, &c., need no explanation : —~~

~~United Kingdom.~~

~~Tear.~~

~~Number of~~

~~Barrels Produced.~~

~~Malt and Com~~

~~(Bushels).~~

~~Sugar and Kqnivalents~~

~~(OwtB.).~~

~~Duty Paid (£).~~

~~Exports (Barrels).~~

~~Imports (Barrels).~~

~~1875~~

~~1885~~

~~1891~~

~~1899~~

~~1899)~~

~~1900 i~~

~~31,014,381 27,986,493 31,927,803 36,498,204~~

~~37,090,986~~

~~58,228,499 51,889,4891 55,698,6231 58,681,112~~

~~67,354,904~~

~~890,686 1,274,589 2~~

~~2,025,658 »~~

~~4,031,290~~

~~4,181,889~~

~~8,218,377~~

~~8,544,749~~

~~9,781,898~~

~~12,085,322~~

~~12,845,150~~

~~503,881 436,529 569,702 485,032~~

~~622,880~~

~~23,884 49,188 50,666~~

~~^ Includes rice, &c.~~

~~2 Exclusive of rice, &c.~~

~~Germany is now the greatest beer-producing nation, the~~

~~United Kingdom coming next, but the consumption per head is considerably greater in the United Kingdom (Fig. 2). The latest comparable figures with regard to the total production and consumption of the three great beer-producing countries, together with those for 1885, are as under :—~~

~~Coantry.~~

~~Total Production (GaUons).~~

~~Consumption per~~

~~Head of Population~~

~~(OallonB).~~

~~1899.~~

~~1885.~~

~~1899.~~

~~1895.~~

~~United Kingdom German Empire United States~~

~~1,346,558,000 1,529,000,000 1,014,696,000~~

~~993,759,000 932,228,000 494,854,000~~

~~32-7 27-5 13-3~~

~~27-1~~

~~19-8~~

~~8-8~~

~~Large as the^er capita (Mg.3) consumption in the United Kingdom may seem, it is considerably less than is the case in Bavaria, which stands at the head of the list with 64-6 gallons, and in Belgium, which comes second with 46-9 gallons. In the city of Munich the consumption is~~

~~actually over 100 gallons, that is to say, more than 2 pints a day for every man, woman, and child. It is curious to note that in Germany, which is usually regarded as the beer-drink- ing country par excellence, the consumption per head of this article is less than in England, and that in- versely the average German consumes more alcohol in the shape of spirits than does the inhabitant of the British islands {consuirvp- tion of spirits per head: Germany, 1-85 gallons ; United Kingdom, 1-03 gal- lons). In the British colo- nies beer is generally, as in the United Kingdom, the staple drink, but whereas in I the United Kingdom 31 Pio. 2.— Diagram showing graphicaUy gallons are consumed annu-~~

~~the total production of Beer (gallons) nllir npr hf>nfl nf -nnnnlatinTi in the United Kingdom and chief f'"?" P^'^ ^f ^*f "\ population,~~

~~countries. in Australasia the per capita~~

~~consumption amounts to only 10-6, in Canada to 3-6, and in Cape Colony to 1-6 gallons. In the latter colony, however, the staple drink appears to be spirits, which are consumed to the extent of 1-1 gallon per head of population.~~

~~As in many other trades, a characteristic feature during recent years has been the absorption or disappearance of small firms and the corresponding growth of the larger breweries. In 1874 there were 34,000 brewers, in 1899 only 6739. At that time the largest brewer (Bass) pro- duced 1,000,000 barrels, now Messrs Guinness (the largest brewers in the world) pay duty on considerably over 2,000,000 barrels. Two other breweries (Bass and All-sopp) produce between 1,000,000 and 2,000,000, and three others between 600,000 and 800,000 barrels. The present capital of Messrs Guinness amounts to £5,200,000, of Messrs AUsopp to £4,900,000, and of Messrs Bass to £3,280,000. In 1874 it was calculated that the capital invested in the liquor trade amounted to £117,000,000; in 1899 (according to Montgomery and Morgan) this had risen to £240,000,000. The number of persons employed is computed at not less than 2,000,000. According to Dr Burns, £162,000,000 were spent by the people of the~~

~~United Kingdom on alcoholic liquors in 1899, or rather more than £4 per head. The largest Continental breweries are : in Germany,the Schultheiss brewery (Berlin),478,000 barrels ; the Lowenbrau (Munich), 320,000 barrels ; in Austria, Anton Dreher, 480,000 barrels.~~

~~Barley. — In common with other branches of agriculture, the cultivation of barley in the United Kingdom is appar- ently declining. The area under cultivation, which was 2,762,263 acres in 1876, had shrunk to 2,068,760 acres in 1898; in 1899 the acreage was 2,151,550. The total estimated quantity also shows a tendency to de- crease, but this, apart from the acreage, is naturally de- pendent on the seasons. It was at a maximum in 1885, Pl when 85,721,672 bushels ^| were collected ; the latest . figures are 74,730,785: bushels. There are no of-"' ficial returns as to the quan- tity of~~

~~home-grown barley used for malting purposes, but there is good reason for believing that, although not actually less than in 1875, it is relatively so. The best English malting barleys are~~

~~quite on a level with, and ^a. 8. — Diagram snowing graphically -nnnVin-nn «««»_;»- 4.,, il, — Boer oonsumptiou (galloDS) per head of perhaps superior to, the population in the UHitedKligdom and~~

~~foreign grain of a similar ouef countries, class, and the average-good foreign malting barley of the Chevalier type possesses no considerable advantage over the English varieties, except that, as a rule, it contains less moisture than the latter. Of late years, however, considerable quantities of six-rowed barley (Hordeum hexastichum) have been imported, principally from the Levant, and this type of barley possesses certain pro- perties which commend it to the brewer, especially for the brewing of rapidly clarifying light ales. It possesses roughly 10 per cent, more husk than the ordinary run of English barley, and this permits of closer crushing simultaneously with better drainage of the " goods " in the mash-tun. Moreover, the Levantine and other bar- leys of this class are usually very well matured and " kindly," as they get plenty of sun, besides which beers brewed with their aid will clarify rapidly. Notwith- standing this, however, the importation of these barleys into the United Kingdom for malting purposes does not make such strides as at one time seemed probable, the chief reason being that the average quality of English malting barleys has tended to improve within the last few years. This is not solely due to the prevalence of favourable climatic conditions, but also to the fact that British farmers are beginning to take advantage of the great mass of practical and scientific research work relat- ing to the cultivation of barley for malting purposes, which has been carried out within the last twenty years.~~

~~It is gratifying to see that the labours of, among others, Lawes and Gilbert, Hellriegel, Maercker, Munro and Beavan, &c., are at last bearing fruit, and that the British farmer is beginning to appreciate them, and to apply their results. Nevertheless, there is still considerable room for improvement, and it is an undoubted fact that an appreci- able proportion of the barley grown in theUnitedKingdom, which, owing to the "unkindly " condition of the starch and the unfavourable character of the nitrogenous matter~~

&c., cannot be employed for malting, could be used for that purpose if it were cultivated and malted on the lines indicated by modern experiments in the field, laboratory, and malt-house. Before the malt tax was repealed it was in the brewer's interest to use as heavy a malt as possible, but this is by no means the case nowadays. A heavily mamired, highly nitrogenous barley is not siiited for brewing light-gravity beers, but many barley-growers have not yet adapted themselves to the new conditions, and continue to produce an article which was suited to the requirements of the past generation of brewers, but is of little use at the present time. The following is a short summary of the views generally held nowadays with re- gard to the cultivation of malting barley : —

The Soil. — It was formerly held that only a rich, friable loam, or a loose sandy soil with a calcareous subsoil, was suitable for barley, but good crops can be grown on heavier soils provided the ground is well worked to provide a fine tilth, and that the drainage is satisfactory. The clearage of all weeds is a most important matter; it has been found that the crop may be reduced by as much as one- third by neglecting to pay proper attention to this point. With regard to rotation, it is considered that the most satisfactory malt- ing barley is obtained by taking barley after wheat or other com crop. The old Norfolk four-course rotation — roots, barley, clover (or beans), and wheat — is probably still adopted by nine farmers out of ten, but it is open to little doubt (Lawes and Gilbert, Munro and Beavan, &c.) that it is better not to grow barley after roots fed off by sheep, as this rotation leaves the land, even if it be of a light description, in too "high" a condition, and a steely, hypernitro- genous barley is likely to be produced. By taking barley as a second corn crop^ the latter following roots fed off, or a "high" crop, not only is a better malting barley produced, but this arrange- ment will be found suitable for the farmer in many other respects. With regard to manure, it has been abundantly proved that an excess of nitrogenous manure is particularly undesirable, and that of all nitrogenous manures the ordinary farmyard variety is the least suitable for malting barley. Nitrogenous manure, preferably in the shape of nitrate of soda, should only

~~be used very slightly (part as top dressing), and in conjunction with a sufficiency of phosphates and potash salts. The latter are not indicated to any extent except where the soil is relatively poor in potash, but phos- phatic manure appears to be an essential. Excess of nitrogen tends to produce steely, unkindly barleys, which not only cause trouble in the mash- tun, but also retard the clarification of the beer. Ex- cessive potash also tends to increase the nitrogen of the grain unduly. The seed should be carefully chosen, kiln-dried if neces- sary, and sown by mechanical means to ensure evenness, both as regards depth and spacing. Two to three inches is considered the most suitable depth for drilling. The barley should be allowed to become dead ripe before cutting, but directly the latter operation is conipleted, and the undergrowth dry and withered, the grain should be stacked at once. Before stacking, the grain and straw should be quite dry, as damp stacking leads to heating, discolouring, mould, and other evils. As soon as the stack has ceased sweating, the barley will be ready for threshing. Kiln-drying after threshing is strongly recommended, as it not only prevents the defects alluded to above, but also to a great extent supplies the want of sun in an unkindly barley. Threshing machines are apt to damage barley if unskilfully used, and damaged barley will give rise to mould on the floors, but if the machine is of the right type, is evenly fed, and provided with properly adjusted screens, the results should be ex- cellent in every respect.~~

~~The following figures with regard to the importation of barley will be of interest in view of what has been said above [N.B. — The fig- ures apply to barley generally, and not only to malting barley.] : — I. Average Annual Quantities of Barley imported into the United Kingdom in Triennial Periods since 1875.~~

~~Period.~~

~~Quantity (Cwts.).~~

~~Value (£).~~

~~1875-77~~

~~11,261,000~~

~~4,593,000~~

~~1881-83~~

~~13,936,000~~

~~5,113,000~~

~~1887-89~~

~~17,649,000~~

~~4,932,000~~

~~1893-95~~

~~25,902,000~~

~~6,135,000~~

~~1897-99~~

~~20,201,694~~

~~5,474,226~~

~~II. Approximate Percentage of Net Imports to Total Supply.~~

~~Period.~~

~~Per Cent.~~

~~Period.~~

~~Per Cent.~~

~~1886-88~~

~~1889-91 1892-94~~

~~32-3 33-2 40-8~~

~~1893-95 1897-99~~

~~44-0 44-0~~

~~III. Percentage of Total Imports contributed by various Countries.~~

~~Country.~~

~~187B-77.~~

~~1881-88.~~

~~1887-89.~~

~~1898-96.~~

~~1897-99.~~

~~Russia, per cent.~~

~~Turkey and Balkan States,~~

~~per cent. Other countries, per cent. .~~

~~16-6~~

~~33-1 50-3~~

~~25-7~~

~~34-3 40-0~~

~~50-7~~

~~21-9 27-4~~

~~59-6~~

~~22-5 17-9~~

~~42-1~~

~~32-4 25-5~~

~~Malt and Malting. — The repeal of the Malt Acts not only gave a free hand to the brewer with regard to materials, but also removed the many irksome restrictions to which the maltster was subjected prior to 1880. The liberty thus accorded to the maltster, the tendency to apply scientific methods to industrial operations, and the riper knowledge of the true inwardness of the malting processes are the chief factors to which the modern mechanical improvements in malting may be ascribed. The machinery for cleaning and grading the grain, for instance, has been brought to a high state of perfection, and (more especially on the Continent of Europe) the old process of turning the malt on the kiln by hand has been, in many malt-houses, replaced by automatic stationary or travelling turning appliances actuated by clockwork or otherwise. The automatic regulation of heats and of the air-supply on the kUn by thermo-regulators, fans, and other contrivances is also a feature in modern malting.~~

~~Up to 1881 malt kilns in England were invariably con- structed with a single drying floor, but in that year the first kiln with two floors (Stopes's system) was tried, and this modification of the older methods of working has given satisfactory results. The advantages of the double- kiln system are that it admits of great regularity of temperature on both floors, and effects considerable econ- omy with regard to fuel and labour. Another novelty, which in a sense may be regarded as a corollary to the pneu- matic (see below) system of malting, is Free's patent kiln, which is practically an air-tight chamber from which the moisture of the green malt can be rapidly removed by means of an air propeller fitted in the apex of the kiln. This arrangement considerably reduces the kilning time, and permits of materially greater depths of malt on the kiln without a corresponding increase of temperature. It is also possible to work at higher temperatures without affecting the colour of the malt as would be the case on an ordinary kiln.~~

~~The pneumatic system of malting, which has been de- veloped since the article in the ninth edition was written, is worthy of notice. The principle of this is that the malt is grown, not on an open " floor " to which the air has free access, but in an enclosed space which is con- tinuously provided with a fresh supply of air, the gases exhaled being simultaneously removed. Pneumatic malt- ing may be briefly described as a system which permits of absolute control of temperature and the condition of the air-supply. The system devised by Mr Galland consists of a series of closed drums from which the air and evolved gases are exhausted by a suction pump or fan, which also draws in a continuous fresh supply of air, the latter being cooled and moistened by passing over a bed of coke which is sprayed with cold water. The drums revolve periodically or continuously, thus preventing the grain from growing together in a tangled mess. Apart from the advantages already mentioned, it is held by many authorities that the pneumatic system effects considerable economy as regards primary cost, space, labour, and other working expenses. Pneumatic malting, although exten- sively employed on the Continent and in America, has not, so far, attained the results that were anticipated of it in England, but the improvements which have been effected (more especially by Hemming) in this system are very marked, and it seems probable that in time it will find a wide application in Great Britain also.~~

~~The repeal of the Malt Acts has been responsible for at least one considerable modification in the process of malt- ing, namely, the abandoning of the ccmch. It is true that some maltsters still make use of it, but there can be little doubt that the piling up of the freshly-steeped grain in heaps for any length of time is not only unnecessary but undesirable, as it leads to unevenness of growth on the floors. The conditions necessary for the treatment and modification of unkindly barleys, both as regards the starch and the nitrogenous matters, have formed the sub- ject of many investigations, the results of which have largely added to the maltster's resources. These investi gations can only be indicated here, but it may be~~

~~sufficient to say that our knowledge of the influence of temperature (on the floors as well as on the kiln) of the merits of pro- longed slow flooring as opposed to a more rapid (so-called ” forced “) growth, and of other kindred considerations, has been very considerably increased. It has been shown that the ” forcing ” process, which consists essentially in the employment of relatively high floor temperatures in order to accelerate rootlet growth, is liable to lead to unsatisfactory clarification — at any rate, when brewing on infusion lines — and that better results are obtained by prolonged flooring at lower temperatures. It also appears fairly certain that the total quantity of nitrogen in a barley or a malt is no criterion of its value, but that it is the condition of the nitrogenous matter which is of impor- tance, and more particularly the pro’portion of coagulable to non-coagulable albuminoids (Morris, Kukla, &c.). The methods for controlling the value of a barley or malt in the laboratory have also been much elaborated, and it is now possible, within certain limits, to determine by a laboratory examination whether a barley or a malt is satisfactory or not, what the methods of treatment should be in the malt-house or the brewery, and so on. If the technical operations have made considerable advances it is to a great extent due to the fact that the objects to be attained and the processes taking place during malting are now much better understood.~~

~~The results of some of the more important modem investigations — in this connexion the work of Messrs O’SuUlvan, and Brown and Morris must be specially mentioned — may be briefly summed up as follows. During the periods of steeping and germination there is in the first place formed a substance called cytase, the principal function of which is to break up or liquefy the envelope of cellulose with which each grain of the starch proper — the granulose — in the barley corn is surrounded, and so to prepare the way for the action of the diastase. The latter is unable to act until this transforma^ tion of the cellulose sheath has taken place. Cytase is one of a class of bodies which were formerly called “ferments,” but are now termed “enzymes” in order to distinguish them from living micro-organisms such as the yeasts and bacteria. The ” enzymes ” are unorganized (i.e., without biological structure or life) products formed in the course of the metabolic processes exhibited by the living cell, and they possess a certain specific action or actions which they are able to exercise outside or independently of the organism by which they are produced. It is characteristic of these~~

~~substances — and in this they are sharply differentiated from the ordinary chemical reagents — that the amount of work they can do (transforming, liquefying, saccharifying, &c.) stands in no definite relation to the quantity of the enzyme.~~

~~Messrs Brown and Morris have shown that immediately the germinating process in the barley com begins, the embryo com- mences to secrete diastase, which diffuses into the endosperm and there quickly starts its attack on the cellulose (modified by the previous action of the cytase) and the starch immediately below the scutellum. This formation of diastase takes place principally, if not indeed entirely, in the epithelium, and is favourbd by the presence of small quantities of acid, but restricted almost com- pletely by readily assimilable carbohydrates (sugars). Thus, if barley be germinated in such a way that a sufBcient quantity of cane sugar for the nourishment of the embryo is always present, no diastase is formed, and it is therefore probable that the diastatic secretion of the epithelium is an example of the starvation processes well known to botanists.~~

~~The action of diastase is twofold, liquefying and saccharifying ; that is to say, it both makes the starch soluble in water and also |~~

~~converts it into sugar. It is probable that there are at least three distinct enzymes contained in malt diastase ; one liquefies starch, a second saccharifies the same, and a third (a peptonizing enzyme) is responsible for the modification of the nitrogenous matters. There is a certain quantity of saccharifying diastase in unger- minated barley, but it possesses no liquefying action. During the process of germination the proportion of this saccharifying diastase is enormously increased, and at the same time the liquefying enzyme is formed and stored for future use. Green malt ordinarily contains a large excess of diastase, especially of the saccharifying variety, and this in itself — apart from other reasons — makes ite direct employment in the mash-tub impracticable, but it is neces- sary that it should contain a very large excess, as the kilning pro- cess destroys the diastatic activity of the green malt to a greater or lesser extent.~~

~~It is now known that the partial conversion of the insoluble albuminous substances into the soluble forms is one of the most important results of the malting process. An excess of insoluble albuminoids not only causes~~

difficulties in clarification, but tends to promote the growth of undesirable micro-organisms in the finished beer. Hilger and van der Becker give the following figures as an example of the increase of the soluble albuminoids during malting : —

Percentage of Total Nitrogen. Barley . . . 6-74 per cent, of soluble nitrogen. Steeped barley . . 3‘75 ,, ,,

Green malt . . 21-96 ,, ,,

Cured ,, . . 24-44 ,, ,,

There is considerable divergence of opinion as to the nature of the soluble bodies formed, but they certainly appear to include coagul- able proteids, albumoses, amides, amido-acids, and substances which, if they are not peptones proper, are at any rate very similar to the latter.

Considerable changes also take place during germination in regard to the disappear- ance of starch and the formation of sugar. The disappearance of starch varies from 4 to 20 per cent. Part of this is lost altogether in the shape of carbonic acid and water, a part is used for the formation of tissue, and the remainder is transformed into cane and other sugars (Brown and Morris, T. C. Day, Kjeldahl, O’SuUivan, &c.). At the same time there is a decrease in the percentage of fat and in- organic salts, but a con- siderable increase of acid — principally lactic acid.

Malt Substitutes. — Prior to the repeal of the Malt Acts the only substitute for malt \^ g^

allowed in the United Kingdom was sugar

(Eig. 4). The quantity re^nSB ‘isss mi /ess

of the latter employed ,,,,, , T.i«™.™ i, • v- ,, .v \ . ,

nrvf o/.f J. • Fig*.— Diagram showing graphically the total

was zy5,ODO CWt. m quantities (bushels) of (a) malt and corn and 1 87A 8fiS QA^ OW+ in iJ) ■”*” substitutes used in brewing in the i»/U, »b»,y4d

~~CWt. in United Kingdom in the years 1875, 1885 1891 1875, and 1,136,434 ^99. (Malt substitutes at 28 h) to the~~

~~CWt. in 1880— the last ”~~

~~year prior to the passing of the new Act. Since then the figures have shown a steady advance, reaching 2,025,658 ewt. in 1890, and 2,980,039 cwt. in 1900 ; that is to say, they have practically trebled within twenty years. At the same time other substitutes, such as unmalted corn and preparations of rice and maize, have come into favour, the quantity of these substances used being in 1899, 218,889 bushels of unmalted corn, and 1,087,538 cwt. of rice, maize, &c. These figures appear all the more strik- ing when it is stated that the quantity of malt converted into beer has not increased since 1878. The following statistics with regard to the use of malt substitutes in the United Kingdom are not without interest : —~~

~~6~~

~~Si S6~~

~~BREWING~~

~~363~~

~~Tear.~~

~~Quantities otMalt~~

~~and Corn uBed in~~

~~Brewing. (Bushels.)~~

~~Quantities of Sugar,~~

~~Bice, Maize, ifcc.,~~

~~used in Brewing.~~

~~(Bushels.)~~

~~Percentage of~~

~~Substitutes~~

~~used to Total~~

~~Material.~~

~~1878 1883 1890 1895 1900~~

~~59,388,905~~

~~51,331,4511~~

~~55,359,9641~~

~~53,731,177~~

~~57,354,904~~

~~3,825,148 4,503,6802 7,904,7082 10,754,510 16,727,536~~

~~6-05~~

~~8 06~~

~~12-48~~

~~16-66~~

~~22-56~~

~~1 Inclusive of rice and maize.~~

~~2 Exclusive of rice and maize.~~

~~If we take into account the fact that roughly 8,000,000 bushels of malt are used by brewers who do not employ substitutes, the net amount of sugar and its equivalents used in beer brewed with malt adjuncts was in 1900~~

~~somewhat over 25 per cent, on the total material. Some brewers have used as much as 60 to 70 per cent, of sugar, but these cases may be regarded as exceptional. With regard to the nature of the substitutes for barley malt more generally employed, raw grain (unmalted barley, wheat, rice, maize, &c.) is not used extensively in Great Britain, but in America brewers employ as much as 50 per cent., and even more, of maize, rice, or similar materials. The use of such a high proportion of these materials makes it necessary to work with malts made from coarse-skinned, highly diastatic barleys, in order to ensure efGLcient drainage and conversion of the goods in the mash-tun. The maize, rice, or other grain is usually gelatinized in a vessel entirely separated from the mash- tun — termed a " converter " — by means of steam at about 200° F., mostly with, but occasionally without, the addition of a little malt meal. After about half an hour the gela- tinized mass is mixed with the main mash, and this takes place shortly before taps are set. This is possible inas- much as the starch, being already in a highly disintegrated condition, is very rapidly converted. By working on the limited decoction system (see below) it is possible to make use of a fair percentage of raw grain in the mash-tun proper, thus doing away with the "converter" entirely. The maize and rice preparations mostly used here are practically starch pure and simple, substantially the whole of the oO, water, and other subsidiary constituents of the grain being removed. The germ of maize contains a con- siderable proportion of a very objectionable oil, which has to be eliminated before this material is fit for use in the mash-tun. After de-germing, the maize is unhusked, wetted, submitted to a temperature sufficient to rupture the starch cells, dried, and finally rolled out in a flaky condition. Rice is similarly treated.~~

~~The sugars used are chiefly cane sugar, glucose, and " invert " sugar — ^the latter commonly known to brewers as "saccharum" — in approximately equal quantities. Cane sugar is mostly used for the preparation of heavy mild ales and stout, as it gives a peculiarly sweet and full flavour to the beer, to which, no doubt, the popularity of this class of beverage is largely due. Invert sugar (the ordinary method of preparation) is still substantially the same as that described in the ninth edition. Of late years it has become the practice among many brewers to prepare their own invert sugar, either by the ordinary acid process, or by the method introduced by Tompson, which makes use of the inverting power of one of the enzymes (invertase)~~

~~contained in ordinary yeast. The cane-sugar solution is pitched with yeast at about 66° C, and at this comparatively high temperature the inversion proceeds very rapidly, and fermentation is practically impossible. When this operation is completed, the whole liquid (including the yeast) is run into the boilLag con- tents of the copper. The chemical equation representing the conversion (or inversion) of cane sugar is : —~~

~~C^HjaOu | H2O = CijHjjOe | CfiHuOg~~

~~Cane sugar. Glucose. Fructose.~~

~~Invert sugar.~~

~~Invert sugar is so called because the dextro-rotation (of the plane of a ray of polarized light) of the original cane sugar is changed or inverted by the action of acid or invertase, the resultant mixture being laevo-rotatory. Invert sugar is laevo-rotatory because the rotation due to the Isevo-rotatory fructose is greater than that caused by the dextro-rotatory glucose.~~

~~Glucose, which is one of the constituents of invert sugar, is largely used by itself in brewing. It is, how- ever, never prepared from invert sugar for this purpose, but directly from starch by means of acid. By the action of dilute boUing acid on starch the latter is rapidly converted first into a mixture of dextrin and maltose and then into glucose. The proportions of glucose, dextrin, and maltose present in a commercial glucose depend very much on the duration of the boiling, the strength of the acid, and the extent of the pressure at which the starch is converted. In England the materials from which glucose is manufactured are generally purified maize, sago, and rice. In Germany potatoes (potato starch) form the most common raw material, and in America purified Indian corn (maize) is ordinarily employed.~~

~~The causes which have led to the largely increased use of substitutes in the United Kingdom are of a somewhat complex nature. The brewer has found, to begin, with, that the brewing operations are simplified and accelerated by the use of a certain proportion of sugar, and that he is thereby enabled appreciably to increase his turnover — i.e., he can make more beer in a given time from the same plant. Moreover, with the exception, perhaps, of the very finest class of brewing sugar, substitutes are cheaper than malt. In~~

~~view of the ever-growing compe- tition in the brewing trade, due largely to the develop- ment of the " tied house " system and the steady increase of taxation, this is a matter of considerable economical importance. Having regard to the enormous consump- tion of beer in the United Kingdom, it is obvious that the extensive use of malt substitutes in brewing is a question of interest not only to the brewer and agricul- turist, but also to the general public. Beer is not, per- haps, a food in the ordinary sense of the word, but it possesses a certain food value, and the consumption is so great that its albuminous and carbohydrate constituents form an appreciable percentage of the total proteid and carbohydrate food of the nation. Shortly after the repeal of the Malt Acts a serious agitation against the unre- stricted and undeclared use of malt substitutes was started by an influential section of the community. This move- ment attained such dimensions that the Chancellor of the Exchequer appointed a Departmental Committee to consider thp whole question. The Beer Materials Com- mittee, as it was called, sat during 1896-98, and the arguments on the main points of controversy are shortly set forth in the following summary : —~~

~~The advocates of "pure beer" (the anti-substitute party) pleaded : —~~

~~(1) That by the use of substitutes, more especially of sugar, an article is produced which is materially different from the product obtained from barley malt alone ; that the consumer desires to have an " all-malt " beer, and that it is deceiving the latter to seU. him an article which is not of the ' ' nature, substance, and quality " desired. The consumer has (owing to the "tied house" system) in many cases no choice but to drink the beer offered him, and is therefore practically not a free agent.~~

~~(2) That coBteris paribus a beer brewed with a proportion of sugar contains proportionally less nutritive matter — ^less extract and less of the valuable by-products which are the chief characteristics of beer — as compared with other spirituous liquors.~~

~~(3) That foreign substances are introduced into beer by means of substitutes, as these are in many cases not pure. Some of these~~

foreign matters (for instance the unfermentable residue of potato glucose) have been held by authorities to be deleterious to health ; but in any case, by giving an unlimited choice of materials to the brewer, the latter may — no doubt unintentionally — introduce into beer substances which are harmful (see Adultebation).

(4) That long experience both in the United Kingdom and abroad has shown that beer brewed from malt alone has important dietetic properties, and that this experience is lacking in the case of sub- stitute beers. That even if it be correct to estimate food value by direct analysis, "substitute" beers contain less food and more alcohol than "all-malt" beers.

(5) That the use of substitutes is not necessary, as many of the most important brewers (including the largest firms in the United Kingdom) use practically none, and that, if it be a fact that, in order to meet the modern demand for light sparkling beers, it is necessary to use a corrective for the excess of nitrogenous matter in much of the English barley, there is no reason why foreign barley should not be used.

(6) That although it is (with certain exceptions) admitted to be an impossibility to detect the use of substitutes by analysis, there is no doubt that science would find the means to overcome this difficulty.

In answer to these arguments it was urged by those defending the use of substitutes : —

(1) That it is possible by modifying the curing, mashing, and fermenting processes to bring about greater changes in the char- acter and composition of a beer than by the moderate and rational use of substitutes. It is denied that the consumer expects to obtain an " all-malt " article when he asks for "beer, "nor does he care provided that his palate is suited. That since the repeal of the Malt Acts it has been legal for the brewer to use whatever material he desires, but sugar was used, and in considerable quan- tities, for

~~many years prior to 1880. That the consumer is not forced to drink any particular brew. That if two beers be brewed from the same malt, and on identical lines, but replacing, say, 25 per cent, of the latter by sugar in the one instance, the difference in food value will be infinitesimal — roughly a quarter of an ounce to the pint — and that even if this system of estimating food value be incorrect, there is nothing to prove that the beer brewed with a well-prepared substitute is not, from a dietetic point of view, of equal value to the " all-malt " article.~~

~~(2) That the small quantities of so-called foreign substances or impurities contained in properly prepared substitutes are in no way harmful, and, with regard to the questionable nature of potato glucose, there is much experimental evidence tending to prove that it is harmless. That practically none of this glucose is used for brewing in England, and that the use of any harmful ingredient is punishable by the existing laws, and the fact of its being employed could not fail to come to the notice of the Revenue officials.~~

~~(3) That the great and increasing demand of modern times for a light and sparkling beer renders the use either of substitutes or of foreign barley a necessity.~~

~~(4) That it would be impracticable to enforce a declaration of the use of substitutes, as it is impossible to discover by analysis whether a beer is " all-malt " or not.~~

~~(5) That it is not the fact that substitutes are used because they are cheaper than malt ; the better class of substitutes are relatively expensive.~~

~~The majority of the Committee reported in favour of the existing laws, substantially declaring that there is no reason either for prohibiting the use or for enforcing the declaration of substitutes. A minority report, signed by one of the six members, advocated declaration and closer control of materials, and held that the majority of the points advanced by the " pure beer " party had been proved.~~

~~Germany. — In Bavaria the use of all substitutes is absolutely prohibited, the only substances which may be used in brewing being malt, hops, yeast,~~

~~and water. In the German Brewing Tariff Union (comprising the whole of the German Empire with the exception of Bavaria, Baden, and Wiirtemberg) brewers are not restricted with regard to materials, except by the general laws relating to the composition of food stuffs injurious to health. It is a curious fact, however, that the North German Brewers' Union has frequently petitioned Government for restrictive legislation directed against the use of all substitutes, on the ground that the general consumer has more faith in Bavarian beer, knowing it to be made from malt and hops alone, and that such legis- lation would tend to improve the position of the brewers in the Brewing Tariff Union with regard to Bavarian competition. The quantity of substitutes used within the Tariff Union is small, both actually and in relation to the malt employed, when compared with the figures for the United Kingdom (see above, p. 326). The following table gives the statistics concerning the materials used in the Tariff Union for the financial year 1898-99.~~

~~Materials.~~

~~Quantities (100 Kilos.).~~

~~PerceDtage on Total Material,~~

~~iiT„uo„^ f Barley malt . Malt and whe/t malt . . S^^™ 1 Other grain . .~~

~~Total grain .~~

~~7,444,983~~

~~194,719~~

~~4,664~~

~~95-4 2-4 0-1~~

~~7,644,366~~

~~97-9~~

~~(•Rice Substitutes! Sugar . proper 1 Syrup .~~

~~l Other substances .~~

~~Total substitutes .~~

~~102,254~~

~~36,709~~

~~1,584~~

~~17,009~~

~~1-3 0-8~~

~~157,556~~

~~2-1~~

~~The gross percentage of substitutes (including grain other than barley malt) is therefore less than 5 per cent., and of substitutes proper — rice, sugar, &c. — barely 2 per cent.~~

~~Taking the whole of Germany the gross quantity of all barley malt substitutes used amounts roughly to IJ per cent.~~

~~United States. — TSo restriction is placed by law upon the kind, quantity, or quality of the materials employed. The materials commonly used are malt and hops, but a variety of substitutes for malt is in use to a greater or less extent, and usually in combina- tion with malt. The substitutes chiefly employed are rice, com (maize), cerealine, glucose, and maltose. The American official returns do not lend themselves to an exact calculation of the per- centage of malt substitutes employed at an English equivalent, but the figures show that the ratio of barley malt to substitutes is approximately as two to one. Of the substance chiefly used, rice and other grain constitute about one-half, sugar one-seventh, the remainder consisting of materials which are not separately specified.~~

~~In Aiistria there is no restriction as to materials, but substitutes are very little employed, probably because they are more expensive in that country~~

~~than the natural products which they are designed to replace.~~

~~In Belgium the grain substitutes form roughly 9 per cent, of the total material ; sugar may be used, but the nature and weight, &c. , must be specified.~~

~~In Holland there are no restrictions, but substitutes are little used, probably four-fifths of the beer being brewed from grain alone.~~

~~Preservatives. — These are very generally, in fact almost universally, employed nowadays for light draught ales ; to a lesser extent for stock ales. The light beers in vogue to-day are less alcoholic, more lightly hopped, and more quickly brewed than the beers of the last generation, and in this respect are somewhat less stable and more likely to deteriorate than the latter were. The preservative in part replaces the alcohol and the hop extract, and shortens the brewing time. The preservatives mostly used are the bisulphites of lime and potash, and these, when employed in small quantities, are generally held to be harmless.~~

~~Hops. — The acreage under hops in the United Kingdom has varied considerably since 1875, but on the whole is decreasing. At the date mentioned hops were grown on 69,171 acres; in 1885 this area had risen to the maximum figure noted during the last fifty years — 71,327 acres — but since then the average has been considerably lower, amounting between 1896 and 1900 roughly to 60,000 acres a year. Very considerable quantities of foreign hops are now used in the United Kingdom, and according to Messrs Briant and Meacham, the explanation of the preference for American and Continental hops by many brewers is that they improve the keeping properties of the beer. This is due to the fact that foreign hops contain rather more of the soft hop resins — to which the main preservative effect of the hop is due — than many of the English samples. The authorities mentioned above (Jour- nal of the Boyal Agricultural Society, 1897) point out that English methods of growing, drying, and packing are in many cases faulty, and that by improving these methods the quantity and quality of the soft hop resin can be appreciably improved.~~

~~Hop substitutes are very little used. They mostly con- sist of quassia, gentian, and camomile, and these substances~~

are quite harmless per se, but impart an unpleasantly rough and bitter taste to the beer.

Mashing. — The writer has already alluded to and attempted to give reasons for the fact that in recent times the trend of brewing has been in the direction of light, bright beers, and there is no doubt that in many respects the modern product is preferable to the ^ighly alcoholic, heavily-hopped beers of the bygone generation. When this class of beer is well and cleanly brewed from good material and the fermentation has proceeded on satisfactory lines, it is not only more palatable and sightly, but also less intoxicating and more easily digest- ible than the beer consumed by our predecessors. Al- though the imports of foreign beer into the United King- dom are still infinitesimal compared with the total quan- tity consumed, it seems that the British taste for beer brewed on the German principle or some modification thereof is steadily growing. Within the most recent times the laying down of a lager beer plant by Messrs AUsopp, capable of turning out 50,000 barrels yearly — i.e., a liquid quantity practically equal to the total imports of foreign beer — has created a very widespread interest. The ordinary German beer — commonly called "Lager" in Great Britain (the German name for it is Export Bier, the the term Lager being reserved for a somewhat different class of brew) — is produced on totally different lines from English beer. The latter is brewed by a process of infusion, the former according to the decoction system, so called because portions of the mash are treated separately from the whole.

The method pursued in the decoction system is as fol- lows : — After the grist has been mashed with cold water until a homogeneous mixture ensues, sufficient hot water is introduced into the mash-tun to raise the temperature to 85°-100° F. according to circumstances. Thereupon roughly one-third of the mash (including the " goods ") is transferred to the maisch Kessel (mash copper) in which it is gradually brought to a temperature of (about) 166° P., and this heat is maintained until the mash, which at first presents a milky appearance, becomes transparent — a sign that the starch is completely converted. The DicJemaische, as this portion is called, is then raised to the

~~boiling-point and the ebullition sustainedbetween a quarter and three-quarters of an hour. Just sufficient of the DicJe- maische is returned to the mash-tun proper to raise the temperature of the whole to 110°-126° P., and after a few minutes a third is again withdrawn and treated as before, to form the second Dickmaische. When the latter has been returned to the mash-tun the whole is thoroughly worked up, allowed to stand in order that the solids may deposit, and then another third, which is now, however, practically a clear wort (called the Lautermaische), is with- drawn, boiled by itself until the coagulable albuminoids are thoroughly precipitated, and finally reconveyed to the mash-tun, where the mashing is continued for some time, the final heat beiug rather over 160° F. (See under " Fer- mentation.") As to the relative character and stability of decoction and infusion beers, the latter are, as a rule, more alcoholic; but the former contain more unfermented malt extract, and are therefore, broadly speaking, more nutritive.~~

~~Beers of the German type are also less heavily hopped and more peptonized than English beers, and more highly charged with carbonic acid, which, owing to the low fermentation and storing temperatures, is retained for a comparatively long time, and keeps the beer in condition. On the other hand infusion beers are of a more stable and stimulating character. It is impossible to keep "lager" beer on draught in the ordinary sense of the term in England. It will not keep unless placed on ice, and, as a matter of fact, the "condition" of lager is dependent to a far greater extent on the methods of distribution and~~

~~storing than is the casewith infusion beers. If a cask is opened it must be rapidly consumed ; indeed, it becomes undrinkable within a very few hours. The gas escapes rapidly when the pressure is released, the temperature rises, and the beer becomes flat and mawkish. In Ger- many every publican is bound to have an efficient supply of ice, the latter frequently delivered by the brewery together with the beer. The following comparative analysis may give the reader some idea of the difference in composition of various Continental and English beers : —~~

~~Beer.~~

~~Total Solids (Extract) per Cent.~~

~~Alcohol per Cent.~~

~~Original~~

~~Gravity of~~

~~Wort.~~

~~English Beers~~

~~German &c. — Beers~~

~~‘Stout . Pale Ale . Light Bitter Mild Ale . ‘ Munich Lager Munich Export ^ Pilsener~~

~~5-27 4-32 3-96 5-81 6-95 7-48 4-48~~

~~6-11 5-58 3-34 4-54 3-43 4-15 3-39~~

~~1-0648 10579 10394 1-0554 1-0523 1-0595 1-0416~~

~~It was formerly believed that by the mashing process the starch of the malt is first converted Into dextrin, and that a part of the latter is then transformed into glucose ; but modern inyestigations have shown that the diastatic degradation of starch is by no means so simple a matter. In the first place we now know that the final product obtained from starch under brewing conditions is not glucose, but maltose. It is held by some authorities that the latter is split up into glucose prior to fermentation ; but this Is certainly not the case in the mash-tun. Although not yet universally accepted, the theory of starch degradation propounded by Messrs Brown and Morris, usually known as the amyloin or malto-dextrin theory, and which is based on a great mass of experimental evi- dence, is of considerable interest, and not only offers a rational and consistent explanation of the phenomena known to accompany the transformation of starch by diastase, but has proved itself to be a practical working hypothesis by which the mashing and fermenting operations may be regulated and controlled. According to Messrs Brown and Morris, the starch molecule consists of five amylin groups, each of which corresponds to the molecular~~

formula (Ci2H2oOio)2o. Four of these amylin radicles are grouped centrally round the fifth thus : —

[Cl2H2oOlo]20

[Cl2H2oOlo]20

[Cl2H2oOlo]20

[Ci2H2oOio]20

[Cl2H2oOlo]20

By the action of diastase this complex molecule is split up, undergoing hydrolysis into four groups of amyloins, the fifth or central amylin group remaining unchanged (and under brewing conditions unchangeable), forming the substance known as stable dextrin. The following equation explains the primary transfor- mation : —

Starch. Water, Stable Dexl/HIn. Atnylovus of variouB types, •inr vr n 1 ij.« TT n— ff tt n ^ j.iJ (CuHajOiOin-^ — Maltose radicle. 5([C,2Hj„Oio]jo)+«.HjO-(OuH2„0,„)j„+4-j (C^HzoOioJo-t-Dextrin radicle.

The amyloins are substances containing varying numbers of amylin (original starch or dextrin) groups in conjunction with a proportional number of maltose radicles. They are not separable into maltose and dextrin by any of the ordinary means, but exhibit the properties of both these substances.

As the process of hydrolysis and degradation proceeds the amyloins become gradually poorer in amylin and relatively richer in maltose groups, the final product of transformation being maltose. The progress of the transformation of the four con- vertible amylin groups into malto-dextrins, first of a high and then of a lower type, and finally into maltose, is accompanied by char- acteristic changes in the physical and chemical properties of the products of hydrolysis. The "opticity" — that is, the power of rotating a ray of polarized light — ^gradually diminishes, and, inversely, the cupric reduction, by which is denoted the capacity for reducing an

alkaline solution of tartrate of copper (Fehling's solution), increases. Messrs Brown and Morris have shown that there is a direct relationship between the opticity and the cupric re- duction exercised by the mixed products of starch conversion, and also of any fraction of those mixed products. This relationship is so exact that if either the opticity or the cupric reduction of a solution of starch conversion products of a known density is ob- served, the other factor can be obtained by calculation. In the

light of our modem knowledge of starch conversion, determina- tions of the optical properties and the cupric reduction of a wort or of a beer, and of the behaviour of the same towards malt extract and yeast, &c., constitute valuable subsidiary methods for control- ling and regulating the brewing operations. Several amyloins of definite composition have been isolated, one being amylo-dextrin (CijH2oOio)6 (CijHaaOii), and another malto-dextrin (CuHaoOio)! (C12H22O11). The first is an amyloin of a "high," the second an amy loin of a " low " type. The amyloins are not split up in the primary fermentation, but are converted into maltose more or less rapidly, according to their type, during the secondary fermenta- tion. If it is desired to obtain a beer of a stable character — that is to say, one containing a considerable proportion of high-type amyloins — it is necessary to restrict the action of the diastase in the mash-tub accordingly. On the other hand, for mild running ales, which are to "condition" rapidly, it is necessary to provide for the presence of sufficient malto-dextrin of a low type. Investiga- tion has shown that the type of malto-dextrin can be regulated not only in the mash-tub, but also on the malt-kiln. A higher type is obtained by low kiln and high mashing temperatures than by high kiln and low mashing heats, and it is therefore possible to regulate on scientific lines, not only the quantity, but also the type of amyloins which are suitable for a particular beer.

Cooling. — The introduction of refrigerators led many brewers to believe that it would be possible to do without the cooler altogether, but experience has shown that this was a fallacious conclusion. It is true that the exposure of hot wort on the cooler is attended with many dangers ; but it is now

~~known — ^thanks chiefly to Pasteur — that the oxygen necessary for the conversion of the hop-resins and other substances into insoluble modifications — that is to say, the chemically hound oxygen — can only be absorbed at a relatively high temperature. Beers which have not undergone a thorough hot aeration are liable to be of an unsatisfactory character, owing to the incomplete or tardy precipitation of the hop-resin, &c., in cask. In order, on the other hand, to overcome the dangers attendant on hot aeration, the greatest care must be taken with regard to the purity of the air-supply in the cooling-rooms. With regard to the refrigerator, the wort flows over it in a thin stream, and is, if anything, more exposed to infection during this process than on the cooler. Enclosed refrig- erators with a purified air-supply are now being intro- duced into some breweries, and there is little doubt that this principle will in time be applied to the cooler also.~~

~~Fermerttation. — The study of the phenomena connected with the process of fermentation, and more particularly of those associated with brewing, has led to discoveries of epoch-making importance, both from a theoretical and practical point of view. Up till 1897 Pasteur's theory of fermentation, according to which this process is indisso- lubly connected with the living cell, and the products of the fermentation of a saccharine liquid are actual products of yeast metabolism, was almost universally accepted as correct, the evidence in its favour being apparently over- whelming. The discovery in 1897 by Buchner that it is possible to obtain from brewing yeast an unorganized substance, which rapidly converts sugar into alcohol, carbonic acid, &c., outside of and quite apart from the living cell, has necessarily led to some modification of our views. According to Buchner, the substance in question is an enzyme to which he gave the name zymase. It may be obtained by grinding up yeast with quartz sand, then subjecting the mass of disintegrated yeast cells so obtained to great pressure, and finally passing the result- ant liquid through a filter of the porous porcelain type. By evaporating this liquid at a low temperature the zymase can be obtained in the solid state, and may be kept for a considerable time without losiHg its property of causing fermentation.~~

~~The cause of the activity of the yeast-cell juice has given rise to considerable controversy, and it is contended by some (Ahrens, Macfadyen and Morris, &c.) that it is not due to an enzjTne but to particles of living~~

~~protoplasm. So far, however, the balance of evidence appears to be in favour of Buchner' s enzyme theory, and~~

~~the fact remains that fermentation can be produced without the presence of yeast cells.~~

~~The brilliant researches of the Danish chemist and botanist Hansen, which we wiU next consider, not only mark a new era in our knowledge of the yeasts, but have probably had a greater influence on fiie fermentation — and especially the brewing — indus- tries than the work of any other man, excepting, no doubt, that of Pasteur. Hansen recognized the fact that it was impossible to study tje life action and functions of micro-organisms, more par- ticularly of the yeasts, without first obtaining these in a pure — that is, an unmixed or uncontaminated — state. The "pure culture" yeast of Pasteur (see under "Fermentation," vol. ix. ninth edition) was not a pure culture in the true sense, as no certainty existed that the yeast obtained by Pasteui-'s method did not contain more than one type of organism. Hansen perceived that in order to obtain a reaJly pure culture — that is to say, a culture containing only one particular variety — it was necessary to start from a single cell. He successfully attained this object by two methods — first, by the dilution method .so called because a drop of liquid, the approximate number of organisms in which is known, is diluted to such an extent that the average drop of the dilute liquid contains less than one cell ; and secondly, by a modification of Koch's plate method, by which each cell, after the distribution of a small num- ber amongst a suitable medium, is kept under microscopic obser- vation during the whole of its development into a colony. By examining ordinary brewing yeast by these methods Hansen dis- covered that it consists of a number of different species and varie- ties, some of which are not favourable to the formation of a good beer, and it was found that not only bacteria and the so-called "disease-ferments" (Pasteur, &c.), but also certain types of yeast proper possess various undesirable properties from the brewer's point of view. Hansen showed that although different species and varieties of the same species may appear identical under the micro- scope, they may possess properties of a widely divergent nature, and that by virtue of those properties they may be differentiated. The chief types occurring in ordinary brewing yeast are — (1) The various varieties of Saccharomyces cerevisice; (2) Sacch. Pastor I., II., and ni. ; and (3) Sacch. ellipsoideus I., II., and III.~~

~~Of these the 8. cerevisice varieties are the true brewing yeasts. iS. Pastor I. gives a bitter taste to the beer ; 8. Pastor HI. and 8. ellips. I. pro- duce no particular ill effects, but are not characteristic beer yeasts ; the latter being in fact the most common species among the grape yeasts.~~

~~Application of Hansen's Discoveries to Brewing. — In 1883 Hansen described a method by which he overcame a persistent tendency of the beers brewed at the Tuborg brewery near Copenhagen to become turbid. This he effected by introducing a pure yeast grown from a single cell. At the same time the Old Carlsberg brewery was afflicted in that its beer displayed a disagreeably bitter taste. Hansen examined the yeast in use there and dis- covered that it consisted of four varieties, and by experi- ment he found that only one of these gave a satisfactory beer; a pure culture of this was then tried in the brewery with excellent results, and has been in use there ever since. This is the yeast which is now known as Carlsberg bottom-yeast I. The advantages attendant on the use of pure yeast consist in the fact that it is possible to select the yeast which is best suited to the character of the beer which it is desired to brew, and that by always working with the same yeast it is possible to be absolutely certain of the results— that is to say, flavour, attenuation, stabil- ity, and so on, will remain constant.~~

~~In Denmark, Norway, and Sweden the practice of brew- ing with pure yeast is wellnigh universal; it has also been adopted in most of the chief breweries in Germany and Holland, and in many cases in America. Hansen's method has not yet made much headway in England but it seems probable that in the course of time it will find favour there, but no doubt in a somewhat modified form. The chief difficulty so far is that the conditions under which English beer is fermented are quite unlike those obtaining for beer brewed on decoction lines, and also the radically different characters of the two classes of beer. In the English top-fermentation system the wort is pitched and fermented at a relatively high temperature — 55°-65° F., sometimes higher. The fermenting vessels are of enormous size, and therefore present a large surface~~

~~to the air. The system is called top-fermentation, be- cause the type of yeast employed develops on the surface of the liquid, forming the "head." The primary fer- mentation proceeds rapidly, and is usually complete in two to three days, and in the case of running ales the secondary fermentation is over within a fortnight, or even less. In the Continental bottoin-fermentation system, the pitching and fermentation take place at a very low temperature (and in relatively small vessels), the cellars being maintained at a temperature of approximately 37°-38° P. The yeast formed in the fermenting wort, the temperature of which rarely rises above 50° P., reposes at the bottom of the fermenting tun, and hence is derived the name of bottom-fermentation. After eleven or twelve days the primary fermentation is complete, and the beer is then run into store (lager) casks where it remains at a temperature approaching the freezing-point of water for six weeks to six months, or even more, according to the time of the year and the class of beer that is being brewed. To put the matter briefly, these are conditions eminently suitable for the employment of pure yeast and the maintenance of it in an uncontami- nated state, whereas the high temperatures, the surface exposure of the yeast and so on, which are essential factors of the English system, tend to cause a rapid deterioration of the pure yeast originally used. It is also more or less generally held that there is no single type of yeast which will produce English beer with all its characteristics, but that the latter are due to the joint action of at least two or three varieties or species. It has been stated that satisfactory results have been ob- tained in English breweries by the use of mixed pure cultures, which fact is not without interest, inasmuch as it is a general rule that one type of yeast (and this applies to micro-organisms generally) tends to predominate in a given liquid at a certain temperature. Cases are known, it is true, where several micro-organisms are essential to the production of a certain substance. This form of multifold existence is termed " symbiosis." Thus for the process of fermentation which results in ginger beer, two organisms are necessary — the one a yeast, the other a mould.~~

~~The process of lager beer brewing introduced by Messrs AIlsopp into the United Kingdom exhibits many features of interest, as it combines infusion mashing with fermentation on decoction lines, and also embodies a new principle, that of vacuum fermentation, and many of the latest improvements in brewing technology. This process, which is used fairly~~

~~widely in America, and tas even taken a footing in Germany, is the Pfaudler vacuum fermentation process, of which the following is a brief description: — The wort is prepared on the ordinary infusion lines, and is then rapidly cooled by means of refrigerated brine before passing to a temporary store tank, which serves as a gauging vessel. From the latter the wort passes directly to the fermenting tuns, huge closed cylindrical vessels made of sheet-steel and coated with glass-enamel. Here the wort ferments "^under reduced pressure, the carbonic acid generated being removed by means of a vacuum pump, and the gas thus withdrawn is replaced by the introduction of eool sterilized air. The fermenting cellars are kept at a temperature of 40° E. all the year round, but the fermenting liquid, which shows 45° Fahr. at the com- mencement, gradually rises to a final temperature of ;about 53° F. The yeast employed is a pure culture bottom-yeast, but the vnthdrawal of the products of yeast metabolism and the constant supply of pure fresh air cause the fermentation to proceed far more rapidly than is the case with lager beer brewed on ordinary lines ; it is, in fact, finished in about six days. Thereupon the air~~

~~supply is cut off, the green beer cooled by means of refrigerated brine to 40° F. and then conveyed by means of filtered air pressure to the store tanks. Here the secondary fermentation which takes three weeks proceeds at a low temperature (about 33° F.), but the gases of fermentation are now not removed, but, on the contrary, allowed to collect under pressure, so that the beer may be thoroughly charged with the carbonic acid necessary to give it condition, and in order to replace the gas with- drawn during the primary fermentation. When the secondary fermentation is completed (the attenuation being 68-70 per cent.) the beer is quite bright, but in order to make sure of its being perfectly free of yeast cells, &c., it is passed through a refrigerator and then through a filter, before going to the racking or bottling rooms, as the case may be. The beer is racked and bottled under counter pressure, so that none of the gas of the secondary fermentation can escape ; indeed, from the time the wort leaves the copper to the moment when it is bottled in the shape of beer it does not come into contact with the outer air. (p. s.)~~

~~Brialmont, Henri Alexis (1821), Belgian~~

~~general and military engineer, son of General Laurent Mathieu Brialmont (d. 1885), was born at Venloo in Limburg on 25th May 1821. Educated at the Brussels military school, he entered the army as sub-lieutenant of engineers in 1843, and was employed on the defences of Diest. From 1847 to 1860 he was private secretary to the war minister, General Chazal. In 1855 he entered the staff corps and rose to the rank of lieutenant-general in 1877, having been appointed, in 1875, inspector-general of fortifi- cations and of the corps of engineers. The preparation and execution of the defence works of the country, and particularly of Antwerp, and of the new works of the Meuse, were carried out under his direction. In 1883 he went to Rumania to advise as to the fortification works required for the defence of the country, and presided over the elaboration of the scheme by which Bucarest was pro- posed to be made a first-class fortress. On his return to Belgium in 1884 he resumed his command of the Antwerp military district. He retired in 1886, but continued to supervise the Eumanian defences. He is a member of the Belgian Eoyal Academy of Science, and is widely known as an expert in fortification and as a writer of many military works. He originated in 1850 Le journal de VArmie Beige. Some of his principal publications are : Considerations politiques et mUitaires sur la Belgique, 1851-52; Histoire du due de Wellington, 1856-57; Agrandissement giniral d'Anvers, 1858; Etudes sur la defense des Mats et sur la fortification, 1863; Traiti de fortification^polygonale, 1869; La fortification h fossis sees, 1872; La difense des 6tats et les camps retrancMs, 1876; La fortification du champ de bataille, 1878; Tactique de combat des trois armes, 1881 ; Situation mUitaire de la Belgique : Travaux de difense de la Meuse, 1882; Le Oindral Comte Todleben, sa vie et ses travaux, 1884 ; La fortification du temps present, 1885.~~

~~Brianza, a district of Italy, called the " Garden of Lombardy." It lies between the two southern arms of Lake Como, and stretches south as far as Mariano. It is a hilly and beautiful country, which, although possessing no large town, is densely populated, and, owing to the mildness of its climate and the softness of its air, is a favourite summer resort of the Milanese. Area, about 170 sq. miles.~~

~~Briare, a town in the arrondissement of Gien, depart- ment of Loiret, France, on the right bank of the Loire, 43 miles in direct line S.E. of~~

Orleans. A bust of Bapterosses (introducer of the button manufacture) was erected in 1897, and there is a handsome modern church. It has

manufactures of fine pottery, and the so-called porcelain buttons, made of specially prepared feldspar ; with com- merce in wine, wood, and coal. The Canal of Briare (about 37 miles long) unites the Loire with the Loiag. A new port has been established on a branch of the lateral canal, opened in 1896, on which the traffic in 1898 was 36,217 tons ; the traffic on the canal de Briare being 67,512 tons. Population (1881), 4577; (1901),

6619.

Bribery and Corrupt Practices. — Adminis- trative corruption was dealt with by the British Parlia- ment in the Public Bodies' Corrupt Practices otntxrs '> 1889 T^ public bodies concerned are county councils, town or borough councils, boards, commissioners, select vestries, and other bodies having local government, public health, or poor law powers, and having for those purposes to administer rates raised under public general Acts. The giving or receiving, promising, offering, soliciting or agreeing to receive any gift, fee, loan, or advantage by any person as an inducement for any act or forbearance by a member, officer, or servant of a public body in regard to the affairs of that body is made a misdemeanour in England and Ireland and a crime and offence in Scotland. Prosecution under the Act requires the consent of the Attorney- or Solicitor-General in England or Ireland and of the Lord Advocate in Scotland. Conviction renders liable to im- prisonment with or without hard labour for a term not exceeding two years, and to a fine not exceeding £500, in addition to or in lieu of imprisonment. The offender may also be ordered to pay to the public body concerned any bribe received by him ; he may be adjudged incapable for seven years of holding public office, i.e., the position of member, officer, or servant of a public body ; and if already an officer or servant, besides forfeiting his place, he is liable at the discretion of the court to forfeit his right to compensation or pension. On a second conviction he may be adjudged forever incapable of holding public office, and for seven years incapable of being registered or

~~of voting as a parliamentary elector, or as an elector of members of a public body. An offence under the Act may be prosecuted and punished under any other Act applicable thereto, or at common law ; but no person is to be punished twice for the same offence.~~

~~For a list of the principal statutes dealing with corrupt and illegal practices at elections, and for the effect of such practices in avoiding returns, see Elections. Corrupt practices include bribery as defined by the Corrupt Practices Prevention Act, 1854, treating, un- due influence, personation, and aiding, abetting, counsel- ling, and procuring personation. The definition of treating has been extended to include the case where the treater is not a candidate, and the voter treated is guilty of the offence as well as the treater ; the definition of undue in- fluence now expressly includes the inflicting or threaten- ing to inflict spiritual injury, damage, harm, or loss. Illegal practices are certain acts and omissions in regard to an election which are now prohibited, whether done or omitted, honestly or dishonestly. They may be classified imder the following heads : — (1) Acts which are illegal practices by whomsoever committed. These are as follows : Pajrment or receipt or contracts to pay or receive money for conveyance of voters to or from the poll, on account of any committee room beyond the number allowed by the Act, or to an elector for use of house or land to exhibit addresses, &c., or for exhibition by him (otherwise ■than in the ordinary course of his business of advertising agent) of such addresses, &c. ; payment of election ex- penses otherwise than by or through the election agent, and payment otherwise than to a candidate or election agent of money provided by any other person for election expenses; voting or procuring to vote of any person prohibited from voting, if the person offending knows of the prohibition ; knowingly publishing a false state- ment that a candidate has withdrawn, or publishing with a view to affect the return of a candidate a false statement as to his character or conduct. (2) Acts and omissions which are illegal practices in the case of candidates and agents only, being breaches of duties specially imposed on them. These are the payment or incurring expenses in excess of the maximum authorized by the Legislature, the omitting without lawful excuse to make a return and declaration of expenses in due time, and the payment by an election agent of any election expense amounting to 40s. not vouched by bill of particulars~~

~~and receipt, of any claim for expenses not sent in in due time, or of any such claim after the time allowed for payment thereof. (3) Acts which are illegal practices when done by a candidate or agent, and are a minor offence when done by any one else. These are illegal payments, employment, and hiring, and printing, publishing, or posting a bill, placard, or poster not bearing on its face the name of the printer or publisher. Illegal payments are knowingly providing money for prohibited payments or expenses in excess of the maximum, corruptly inducing a candidate to withdraw by payment or promise of payment (the candidate so induced being guilty of the like offence), paying or agree- ing to pay for torches, flags, banners, cockades, ribbons, and other marks of distinction (the receiver being guilty of the like offence if he is aware of the illegality). Illegal employment is the employment for payment or promise of payment of persons beyond the number allowed by the Legislature or for purposes not authorized. The employ^ is guilty of the like offence if he knows of the illegality. Illegal hiring is the letting or lending, or the employing, hiring, borrowing, or using to carry voters to the poll of stage, or hackney carriages, or horses, or of carriages or horses ordinarily let for hire, and the hiring of committee rooms in premises licensed for the sale of intoxicants, in a club (not being a permanent political club) where intoxicants are sold, in premises where refreshments are ordinarily sold, or in a public elementary school in receipt of a parliamentary grant Personation and aiding, abetting, &c., of personation are felonies punishable with two years' imprisonment with hard labour. All other corrupt practices are indictable misdemeanours (in Scotland, crimes and offences) punishable with one year's imprisonment, with or without hard labour, or a fine not exceeding £200. Conviction of any corrupt practice also renders the offender incapable for seven years of being registered as an elector, or voting at any election, parliamentary or other, in the United Kingdom, or of holding any public or judicial office, or of being elected to or sitting in the House of Commons; and any such office or seat held by him at the time is vacated. In the case of a parliamentary candidate, if an election court finds that there has been treating or undue influence by him, or any other corrupt practice with his knowledge or consent, he becomes incapable of ever being elected for the same constituency, and incurs the like incapacities as if he had been convicted on indictment ; if it is found by the election court that he has been guilty by his agents of a corrupt practice, he becomes incapable for seven years of being~~

elected for the same constituency. Illegal prac- tices are offences punishable on summary conviction with a fine not exceeding £100, and with five years' incapacity for being registered or voting as a parliamentary elector, or an elector to public office within the county or borough where the offence was committed. Illegal payments, employment, and hiring, and printing and publishing of

bills, &c., not bearing the printer's or publisher's name, are, when committed by any one who is not a candidate or agent, offences punishable on summary conviction with a fine not exceeding £100, but carry with them no incapacities. Where an election court finds that any Ulegal practice has been committed with the knowledge or consent of a parliamentary candidate, he becomes in- capable for seven years of being elected to or sitting in the House of Commons for the same constituency. He incurs the like incapacity, limited to the duration of the parliament for which the election was held, if the election court finds that he was guilty by his agents of an illegal practice. A prosecution for any of the above offences cannot be instituted more than a year after the offence was committed, unless an inquiry by Election Commis- sioners takes place, in which case it may be instituted at any time withia two years from the commission of the offence, not being more than three months after the date of the Commissioners' report.

The law as to corrupt and illegal practices, as above stated, applies to parliamentary, municipal, county, parochial, and school board elections. Incapacities cor- responding to those incurred by parliamentary candidates found guilty by an election court are incurred ,by muni- cipal and other candidates in the like case, e.g., a municipal candidate found personally guUty of a corrupt practice is incapacitated forever, and a candidate found guilty by his agents is incapacitated for three years from holding corporate ofB.ce in the borough. No maximum of ex- penses is prescribed for school board candidates, nor is any return and declaration of expenses required from them.

~~Bribery at elections of fellows, scholars, ofia.cers, and other persons in colleges, cathedral and collegiate churches, hospitals, and other societies is prohibited by the Act 31 Eliz. c. 6. If a member receives any money, fee, reward, or other profit for giving his vote in favour of any candidate, he forfeits his own place ; if for any such consideration he resigns to make room for a candi- date, he forfeits double the amount of the bribe, and the candidate by or on whose behalf a bribe is given or promised is incapable of being elected on that occasion. The Act is to be read at every election of fellows, &c., under a penalty of £40 in case of default. By the same Act any person for corrupt consideration presenting, in- stituting, or inducting to an ecclesiastical benefice or dignity forfeits two years' value of the benefice or dignity; the corrupt presentation is void, and the right to present lapses for that turn to the Crown, and the corrupt pres- entee is disabled from thereafter holding the same bene- fice or dignity ; a corrupt institution or induction is void, and the patron may present. For a corrupt resignation or exchange of a benefice the giver and taker of a bribe forfeit each double the amount of the bribe. Any person corruptly procuring the ordaining of ministers or grant- ing of licenses to preach forfeits £40, and the person so ordained forfeits £10, and for seven years is incapaci- tated from holding any ecclesiastical benefice or promo- tion, (l- l- s.)~~

~~Bridge. — Bridge is a game of cards for four players developed out of the game of whist. It is probably of Eussian origin. It appeared to have been first played in England about 1880 under the name of Biritch or Eussian whist. It found its way to the London clubs about 1894, from which date its popularity rapidly increased. Bridge differs from whist in the following respects :— Although there are four players, yet in each hand the partner of the dealer takes no part in the play of that particular hand. After the first lead his cards are placed on the table exposed, and are played by the dealer as at dummy~~

~~whist ; nevertheless the dealer's partner is interested in the result of the hand equally with the dealer. The trump suit is not determined by the last card dealt, but is selected by the dealer or his partner without consulta- tion, the former having the first option. It is further open to them to play without a trump suit. The value of tricks and honours varies with the suit declared as trumps. Honours are reckoned differently from whist, and on a scale which~~

~~is somewhat involved and illogical. There are five honours, the ten being accepted as one of them. The score for honours does not count towards winning or losing the rubber, but is added afterwards to the trick score in order to determine the value of the rubber. There is also a score for holding no trumps in one of the hands, and for winning a " slam."~~

~~The score has to be kept on paper. It is usual for the scoring block to have two vertical columns divided half- way by a horizontal line. The left column is for the scorers' side and the right for the opponents'. Honours are scored above the horizontal line and tricks below. The drawback to this arrangement is that, since the scores for each hand are not kept separately, it is generally impossible to trace an error in the score without going through the whole series of hands. A better plan, it seems, is to have four columns ruled, the inner two being assigned to tricks, the outer ones to honours. By this method a line can be reserved for each hand, and any discrepancy in the scores at once rectified.~~

~~The Portland Club drew up a code of laws in 1895, and this code, with a few amendments, was in July 1895 adopted by a joint committee of the Turf and Portland Clubs. The provisions of the code are here summarized. Each trick above 6 counts 2 points in a spade declara- tion, 4 in a club, 6 in a diamond, 8 in a heart, 12 in a no-trump declaration. The game consists of 30 points made by tricks alone. When one side has won two games the rubber is ended. The winners are entitled to add 100 points to their score. Honours consist of ace, king, queen, knave, ten, in a suit declaration. If a player and his partner conjointly hold 3 honours they score twice the value of a trick ; if 4 honours, 4 times ; if 5 honours, 5 times. If a player in his own hand hold 4 honours he is entitled to score 4 honours in addition to the score for conjoint honours ; thus, if one player hold 4 honours and his partner the other their total score is 9 by honours. Similarly if a player hold 5 honours in his own hand he is entitled to score 10 by honours. If in a no-trump hand the partners conjointly hold 3 aces, they score 30 for honours ; if 4 aces, 40 for honours. 4 aces in 1 hand count 100. On the same footing as the score for honours are the following : chicane, if a player hold no trump, in amount equal to 2 by honours ; grand slam, if one side win all the tricks, 40 points ; little slam, if they win 12 tricks, 20 points. At the end of the rubber the total scores, whether made by tricks, honours, chicane, slam,~~

~~or rubber points, are added together, and the difference between the two totals is the number of points won.~~

~~The Flay. — The cards are shuffled, cut, and dealt (the last card not being turned) as at whist ; but the dealer cannot lose the deal by misdealing. After the deal is completed, the dealer makes the trump declaration, or passes the choice to his partner without remark. If the dealer's partner make the declaration out of his turn, either adversary may, without consultation, claim a fresh deal. If an adversary make a declaration, the dealer may claim a fresh deal or disregard the declaration. Then, after the declaration, either adversary may double, the leader having first option. The effect of doubling is that each trick is worth twice as many points as before ; but the scores for honours, chicane, and slam are unaltered. If a declaration is doubled, the dealer and his partner~~

~~have the right of redoubling, thus making each trick ■worth four times as much as at first. The declarer has the first option. The other side can again redouble, and so on. It is well to limit the value to which a trick can reach to 100 points. In the play of the hand the laws are nearly the same as the laws of whist, except that the dealer may expose his cards and lead out of turn without penalty. Dummy cannot revoke. The dealer's partner may take no part in the play of the hand beyond remind- ing the dealer when it is his lead or dummy's, and guard- ing him against revoking.~~

~~Advice to Players.~~

~~In the choice of a suit two objects are to be aimed at : first, to select the suit in which the combined forces have the best chance of making tricks ; secondly, to select the trump so that the value of the suit agrees with the character of the hand, i.e., a suit of high value when the hands are strong and of low value when very weak. As the deal is a great advantage, it generally happens that a high value is to be aimed at, but occasionally a low~~

~~value is desirable. The task of selection should fall to the hand which has the most distinctive features, that is, either the longest suit or unusual strength or weakness. No consultation being allowed, the dealer must assume only an average amount of variation from the normal in his partner's hand. If his own hand has distinctive features beyond the average, he should name the trump suit himself, otherwise pass it to his partner. It may here be stated what is the average in these respects. As regards the length of suit, a player's long suit is rather more likely to be fewer than five than over five. If the dealer has in hand a suit of five cards including two honours, it is probable that he has a better suit to make trumps than dummy ; if the suit is in hearts or diamonds, and the dealer has a good hand, he ought to name the trump. As regards strength, the average hand would contain ace, king, queen, and knave or equivalent strength. Hands stronger or weaker than this by the value of a king or less may be described as featureless. If the dealer's hand is a king over the average, it is more likely than not that his partner will either hold a stronger hand, or will hold such a weak hand as vHl counteract the player's strength. The dealer would not, therefore, with such a hand declare no trump, especially as by making a no-trump declaration the dealer forfeits the advantage of holding the long trumps.~~

~~The following is a rough method of calculating the value of the player's chances : — Count each ace (above or below the player's share, 1 ace) as worth 1^ tricks ; each king, f trick ; each queen, ^ trick ; each knave, ^ trick ; each trump beyond 3^, 1 trick. The result, multiplied by the suit value, gives the player's net expectation after deduct- ing the value of the adversaries' chance. As regards the score for honours, compared with an average declaration with 2 honours, 3 honours are equivalent to half an extra trick, 4 honours to 2 extra tricks, and each honour short means a loss of half a trick. In no-trump declarations the value of high cards is nearly double that given above for suit declarations. When the decision has been left to dummy, he knows that he can expect less than average assistance from the dealer's hand. On this account he should deduct 1 trick for a no-trump, heart, or diamond declaration. When considering the strength of a hand, account must be taken whether the high cards are guarded or not; a king single is of less value than a queen guarded.~~

~~Declarations by Dealer. — A hand, to be strong enough for a no-trump declaration, should be a king and knave, or two queens above the average, or a king above the average, if all the honours are well guarded; and per-~~

~~haps even a queen above the average if all the suits are protected. But in doubtful cases a suit of 6 red cards with 2 honours, or even 4, all honours, is to be preferred. With an average hand declare 5 hearts with 2 honours, or 4 with 3 honours; 5 diamonds with 3 honours, or~~

~~4 all honours; 6 clubs with 3 honours, or 6 with 4 honours; 8 spades. With a weak hand, containing a king only, or a queen and knave, declare any suit con- taining 5 cards with 2 honours. With a very weak hand, containing no card higher than a 10, declare 6 hearts or~~

~~5 diamonds, or 4 clubs or 1 spade. Hands containing a suit headed by a strong sequence of high cards lend them- selves especially to no-trump declarations. With an estab- lished black suit of 5 or 6 cards the dealer should declare no-trump if he has another suit protected. When very weak in red suits the dealer should propose rather more often, especially when blank in a suit. Thus with no hearts he should be content with 1 trump fewer in clubs and 2. trumps fewer in spades than when he has a fair suit of hearts.~~

~~Declarations by Dummy. — ^When the dealer has passed the declaration to his partner, the latter knows that the dealer's hand is not strong, either as regards high cards or in the two red suits, wlulst there is a slightly increased possibility of the dealer being strong in the black suits. This is about accurately represented by subtracting 1 trick in the case of a no-trump or red suit declaration. With the advantage of the long trumps, the dealer's side generally have still the better chance of winning the odd trick, and the cautious policy often adopted is a mistake. The value of dummy's chance, with different declarations, can be calculated by the method given above, and the best chosen. With a hand an ace above the average, or with 3 aces, no trumps should be declared, unless dummy has a suit of 6 hearts or diamonds. With a hand two queens above the average no trump should also be declared, unless there is a good red suit; and there are hands in which all suit declarations are so weak that a no-trump declaration can be made with a king above the average. With an average hand the best suit should be declared, if it consists of 5 cards. If there be no suit of 6 cards, it is~~

~~sometimes better to declare 3 clubs or spades than 4 of a red suit. With a hand an ace below the average, a red suit should not often be selected unless it contains 6 cards ; 4 clubs or 3 spades should be chosen in preference to a suit of 5 hearts or diamonds.~~

~~Doubling. — ^When either the dealer or his partner has declared no trumps, hearts, or diamonds, he is nearly certain to have a hand apparently worth two tricks above the normal ; the average value of hands will probably be three tricks. It would appear to be to the adversaries' advantage to double whenever one of them holds a hand with a better face-value than the average strength that the declarer may be presumed to hold. But it has to be considered, first, that doubling gives the declarer a chance of redoubling should he hold an exceptionally strong hand ; secondly, that doubling gives information to the dealer — not of much value when the doubler is on the declarer's left, but of great value when he is on the declarer's right. The player on the declarer's left is justified in doubling if the face-value of his hand is 4 tricks above the normal, by the method explained above. In order that the player on the declarer's right may be justified in doubling, his hand must be considerably stronger, or else his hand must be so free from tenaces that it is immaterial on which side the strength lies. A spade declaration can be much more freely doubled by either player. The presumption is that when the dealer declares spades his weakness f uUy counter- balances the advantage of the deal. When the dealer has declared spades, either adversary possessing a hand worth~~

~~two tricks above the normal can doubla When dummy has declared spades, either adversary may double if his hand is -worth thi'ee tricks above the normal With a club declaration the strength that would justify doubling is intermediate between that in the case of spades and of a high declaration.~~

~~Sometimes the player who has the lead may be justi- fied in doubling in a no-trump declaration on account of a suit established, having weakness in other suits. With such a hand he should not rely on any assist- ance from his partner. There is, however, one case in which the player on the right of the~~

~~dealer should double a no-trump declaration. When he has an established suit of six or seven cards, it is of great importance that he should inform his partner of his strength in the suit. This he does by doubling ; his partner then knows that there is great strength ia one suit, and abandons his own game to lead the suit in which he is most likely to find his partner strong. This has become a recognized signal, but with a double interpretation. In England the player wiU lead the suit in which he himself is weakest. In America he will lead hearts, the suit in which the dealer is least likely to be strong. Regarded purely as a sig- nal, reserving the device for the heart suit makes it of greater value, since the command given is of a definite character ; often, even with moderate strength, it will save enough tricks to compensate for the doubled value. It must be admitted, however, that it approaches an arbi- trary convention.~~

~~Redoubling. — When a declaration has been doubled, the declarer knows the minimum that he will find against him; he must be prepared to find occasionally strength against him considerably exceeding this minimum. Except in the case of a spade declaration, cases in which redoub- ling is justifiable are very rare.~~

~~The play of the hand. — In a no-trump declaration the main object is to bring in a long suit. In selecting the suit to establish, the dealer should be guided by the following considerations : — One hand should hold at least five cards of the suit. The two hands, unless with a sequence of high cards, should hold between them eight cards of the suit, so as to render it probable that the suit will be established in three rounds. The hand which contains the strong suit should be sufficiently strong in cards of re-entry. The suit should not be so full of possible tenaces as to make it disr advantageous to open it. The tricks lost should, if possible, be inevitable ones; for instance, of two suits of equal length, one headed by a king, queen, knave, the other by ace, king (there being no chance of catch- ing the queen), the former should be chosen, since the ace of that suit will win a trick anyhow, but the queen of the latter suit will not unless the suit is opened early. As regards the play of the cards in a suit, it is not the object to make tricks early, but to make all possible tricks. Deep finesses should be made when there is no other way of stealing a trick. Tricks may be given away, if by so doing a favourable open- ing can be made for a finesse. When, however, it is~~

~~doubtful with which hand the finesse should be made, it is better to leave it as late as possible, since the card to be finessed against may fall, or an adversary may fail, thus disclosing the suit. It is in general unsound to finesse against a card that must be unguarded. Erom a hand short in cards of re-entry, winning cards should not be led out so as to exhaust the suit from the partner's hand. Even a trick should sometimes be given away. Eor instance, if one hand holds seven cards headed by ace, king, and the other hand holds only two of the suit, although there is a fair chance of mak- ing seven tricks in the suit, it would often be right to~~

~~give the first trick to the adversaries. When one of the adversaries has shown a long suit, it is frequently possible to prevent its being brought in by a device, such as holding up a winning card, until the suit is exhausted from his partner's hand, or playing in other suits so as to give the player the lead whilst his part- ner has a card of his suit to return, and to give the latter the lead when he has no card to return. The dealer should give as little information as possible as to what he holds in his own hand, playing frequent false cards. Usually he should play the higher or highest of a sequence ; stiU there are positions in which playing the higher gives more information than the lower ; a strict adherence to a rule in itself assists the adversaries. In a suit declaration the positions are so numerous that no general remarks can be offered on the dealer's conduct of the hand.~~

~~In a no-trump declaration the opponents of the dealer should endeavour to find the longest suit in the two hands, or the one most easily established. With this object the leader should open his best suit. If his partner next obtains the lead he ought to return the suit, unless he himself has a suit which he considers better, having due regard to the fact that the first suit is already partially established. The opponents should employ the same tactics as the dealer to prevent the latter from bringing in a long suit; they can use them with special effect when the long suit is in the exposed hand.~~

~~To lead up to dummy's weak suits is a valuable rule. The converse, to lead through strength, must be used with caution, and does not apply to no-trump declarations. It is not advisable to adopt any of the recent whist methods of giving information. It is clear that, if the dealer's is the only hand kept secret, he, in addition to his natural advantage, has the further~~

~~advantage of better informar tion than either of the adversaries. In no-trump declarar tions, however, it is of great importance that a player should be able to show his strong suit. The original leader does this by his lead ; his partner can often only show his by his discard. This he does by discarding from his weak suit. It is open to objection that he must some- times unguard the dealer's or dummy's suit. When he considers it advisable to discard from his long suit, it is a recognized signal that he should discard a higher card before a low one. A similar method is used to show strength in the suit opened by his partner. In a suit declaration this signal sometimes has a different sig- nification, and is taken to mean that the player has no more of the suit.~~

~~The highest of a sequence led through dummy will frequently tell the third player that he has a good finesse. The lowest of a sequence led through the dealer will some- times explain the position to the third player, at the same time keeping the dealer in the dark.~~

~~When on dummy's left it is futile to finesse against a card not in dummy's hand. But with ace and knave, if dummy has either king or queen, the knave should usually be played, partly because the other high card may be in the leader's hand, partly because, if the finesse fails, the player may still hold a tenace over dummy. In a suit declaration it is frequently the best play for the original leader not to lead from his longest suit, as at whist, (1) because with so many cards exposed his partner is not likely to be deceived by the lead, and will probably lead the suit to him to greater advantage ; (2) because there is not much chance of his bringing in a suit. He may often, with success, lead a singleton in hearts or diamonds, knowing from the declarations that he is not leading up to great strength, and that the suit is probably his partner's.~~

~~Playing to the score. — At the beginning of the hand~~

~~the chances are so great against any particular result, that at the score of love-all the advantage of getting to any particular score has no appreciable~~

~~effect in determin- ing the choice of suit. In the play of the hand, the advantage of getting to certain points should be borne in mind. The principal points to be aimed at are 6, 18, and, in a less degree, 22. The 2 points that take the score from 4 to 6 are worth 4, or perhaps 5, average points ; and the 2 points that take the score from 6 to 8 are worth 1 point. When approaching game it is an advantage to make a declaration that may just take the player out, and, in a smaller degree, one that will not exactly take the adversaries out. When the score is 24 to 22 against the dealer, hearts and clubs are half a trick better relatively to diamonds than at the score of love-all. In the first and second games of the rubber the value of each point scored for honours is probably about a third of a point scored for tricks — in a close game rather less, in a one-sided game rather more. In the deciding game of the rubber, on account of the importance of winning the game, the value of each point scored for honours sinks to one-fifth of a point scored for tricks. (w. h. w.*)~~

~~Bridgfe of Allan, a police burgh (1870) and health resort of Stirlingshire, Scotland, on the Allan water, 3 miles N. of Stirling by rail and tramway. There are two public halls and two reading-rooms, a hydropathic estab- lishment, a mineral spring and well-room, and a fine art and natural history museum. The industries are bleaching, dyeing, and paper-making. The private schools are noted. Population (1881), 3004; (1901), 3240.~~

~~Bridgencl, a market town of South Wales on the Ogmore, 20 miles W. by N. of Cardiff by rail, in the southern parliamentary division of the countyof Glamorgan. There are a town hall, and two lunatic asylums, for the county of Glamorgan and the county borough of Swansea, erected at a cost of nearly £200,000. Bridgend has a foundry, joinery works, a tannery, and brickworks. Area of urban district (created in 1894), 2448 acres ; population~~

~~(1881), 4153 ; (1901), 6399.~~

~~Bridgenorth, a municipal borough and market town in the Ludlow parliamentary division (since 1885) of Salop, England, on the Severn, 20 miles S.E. of Shrews- bury by rail. A steep line of rail between the Low and the High Town has been opened, and the town hall (1652) restored. Area, 1168 acres; population (1881), 5317;~~

~~(1901), 6049.~~

~~Bridgreportj a town and city of Connecticut, U.S.A., and capital of Fairfield county, the town and city occupying the same area, situated on Long Island Sound, at the mouth of Pequanoc river. The New York, New Haven, and Hartford railway furnishes communication. There are extensive manufactures, which in 1890 em- ployed over $13,000,000 of capital, and produced more than $22,000,000 of manufactured goods. The principal among these were corsets, steam -fitting and heating apparatus, and foundry and machine-shop products. In 1900 the assessed valuation of real and personal property was $62,905,862, the tax rate $13 per $1000, and the net debt $1,270,098. Population (1880), 27,643 ; (1890), 48,866; (1900), 70,996, of whom 22,281 were foreign- born, and 1149 were negroes. The death-rate in 1900 was 17 "3.~~

~~BridgfeS. — The article in the ninth edition of this Encyclopsedia ends with a description of the Tay Bridge, then in course of construction (1876).i That bridge was overturned in a storm on 28th December 1879, when an~~

- ~~Later information will be found, however, in the ninth edition under other headings, e.g., the Forth Bridge under Railways, xi. 234.~~

~~aggregate length of 3000 feet of girders fell, this being one of the greatest disasters which ever occurred to an engineering structure. Since that time greater attention has been given to the loading forces acting on bridges, to the determination of the severest straining actions, and to the best and most economical arrangememt of material. The general use of mild steel in place of wrought iron in bridge-work involves much greater care in the selection and testing of the material. The analysis of the secondary straining actions, bending and twisting due to the local conditions in which loads are applied to individual members, has been worked out. With more complete knowledge of the straining actions engineers have greater confidence in design, and bridges have been built with spans approaching the theoretical limit possible for the material used. Lastly, with increase of size, more study of methods of erection has been necessary, and it is re- cognized that in large bridges facility of erection becomes a governing consideration in design. In materials other than iron or steel the greatest change has been the extension of the use of cement concrete for foundations and substructures,~~

~~and in some cases for the arches of large arched bridges. Concrete strengthened by iron bars or a network of steel has also been used, and seems Kkely to be of considerable value. In metal bridges wrought iron has been replaced by mild steel — a stronger, tougher, and better material. Ingot metal or mild steel was sometimes treacherous when first introduced, and accidents occurred, the causes of which were obscure. In fact, small differences of composition or variations in thermal treatment during manufacture involve relatively large differences of quality. Now it is understood that care must be taken in specifying the exact quality and in testing the material supplied. Structural wrought iron has a tenacity of 20 to 22|- tons per sq. in. in the direction of rolling, and an ultimate elongation of 8 or 10 per cent, in 8 inches. Across the direction of rolling the tenacity is about 18 tons per square inch, and the elongation 3 per cent, in 8 inches. Steel has only a small difference of quality in different directions. There is still controversy as to what degree of hardness, or (which is nearly the same thing) what percentage of carbon, can be permitted with safety in steel for structures.~~

~~The qualities of steel used may be classified as follows : — (a) Soft steel, having a tenacity of 22J to 26 tons per sq. in., and an elongation of 32 to 24 per cent, in 8 in. (6) Medium steel, having a tenacity of 26 to 30 tons per sq. in., and 28 to 25 per cent, elonga- tion, (c) Moderately hard steel, having a tenacity of 30 to 34 tons per sq. in., and 20 per cent, elongation, {d) Hard steel, having a tenacity of 34 to 40 tons per sq. in., and 10 per cent, elongation. Soft steel is used for rivets always, and sometimes for the whole superstructure of a bridge, but medium steel more generally for the plates, angle bars, &c., the weight of the bridge being then reduced by about 7 per cent, for a given factor of safety. Moderately hard -steel has been used for the larger members of long span bridges. Hard steel, if used at all, is used only for compression members, in which there is less risk of flaws extending than in tension members. With medium or moderately hard steel all rivet holes should be drilled, or punched 4 inch less in diameter than the rivet and reamed out, so as to remove the ring of material strained by the punch.~~

~~The external forces acting on a bridge may be classified as follows : — I. The live or temporary load, for road bridges, is taken to be the weight of a dense crowd (about 120 ft per sq. ft.), or the weight of a heavily loaded~~

waggon (say 10 to 25 tons on four wheels), while for railway bridges it is the weight of the heaviest train likely to come on the bridge. II. An allowance is sometimes made for impact, that is, the dynamical action of the live load due to irregularities of the permanent way or yielding of the structure. III. The dead load comprises the weight of the main girders, fiooring and wind bracing, or total weight of the superstructure exclusive of any part

directly carried by the piers. IV. The horizcmtal pressure is due to a wind blowiag transversely to the span. V. The longitudinal drag is due to the friction of a train when braked (about |th of the weight of the train). VI. On a curved bridge the centrifugal load is due to the radial acceleration of the train. VII. In some cases changes of temperature set up stresses equivalent to those produced by an external load.

In the earlier girder railway bridges the live load was taken to be equivalent to a uniform load of one ton per foot run for each Live load ^^^^ °^ '^^7- At that time locomotives on railways of 4 ft. 8J in. gauge weighed at most 35 to 45 tons, and their length between buffers was such that the average load did not exceed one ton per foot run. Trains of waggons did not weigh more than three-quarters of a ton per foot run when most heavily loaded. The weights of engines and waggons are now greater, and in addition it is recognized that the concentration of the loading under the axles gives rise to straining actions greater than those due to the same load uniformly distributed. A modern heavy English tank loco- motive may weigh 47 tons with a length over buffers of SOJ feet, and a, wheel base of 16 feet. This corresponds to 1'53 tons per foot run of engine length. American locomotives are heavier. Thus, a consolidation engine and tender may weigh 126 tons, with a length over buffers of 57 feet, corresponding to an average load of 2-55 tons per foot run. In America long ore-waggons are some- times used which weigh loaded two tons per foot rim. It is clear, with such variation in weight and in its distribution, that some typical arrangement of loads must be assumed representing in given oases the worst to be expected. Mr Waddell (De Pontibus, New York, 1898) proposes

~~to arrange railways in seven classes, according to the live loads which may be expected from the character of their traffic, and to construct the bridges in accord- ance with this classification : — For the lightest class, he takes a locomotive and tender of 93 “5 tons, 52 feet between buffers (average load = 1 ‘8 tons per foot run), and for the heaviest, a locomotive and tender weighing 144 “5 tons, 52 feet between buffers (average load =2 ‘77 tons per foot run). Waggons he assumes to weigh for the lightest class 1”3 tons per foot run, and for the heaviest 1 ‘9 tons. Then he takes the live load for a bridge to consist of two such engines, followed by a train of waggons covering the span.~~

~~If a vertical load is imposed suddenly, but without velocity, work is done during deflection, and the deformation and stress are momentarily double those due to the same load at rest Impact, gjj ^jjg structure. No load of exactly this kind is ever applied to a bridge. But if a load is so applied that the deflection increases with speed, the stress is greater than that due to a very gradually applied load, and vibrations about a mean position are set up. The rails not being absolutely straight and smooth, centrifugal and lurching actions occur which alter the distribution of the loading. Again, rapidly-changing forces, due to the moving parts of the engine which are unbalanced vertically, act on the bridge ; and, lastly, inequalities of level at the rail ends ^ve rise to shocks. For all these reasons the stresses due to the live load are greater than those due to the same load resting quietly on the bridge. This increment is larger on the flooring girders than on the main ones, and on short main girders than on long ones. The impact stresses depend so much on local conditions that it is difficult to fix what allowance should be made. Mr E. H. Stone {Trans. Am. Soc. of Civil Engineers, xli. p. 467) collated some measurements of deflection taken during official trials of Indian bridges, and found the increment of deflection due to impact to depend on the ratio of dead to live load. By plotting and averaging he obtained the following results :— Excess of DefUdion and straining Action of a moving Load over that due to a resting Load.~~

~~Dead load in per cent, of total load i~~

~~10~~

~~20~~

~~30~~

~~40~~

~~50~~

~~70~~

~~90~~

~~Live load in per cent, of total load~~

~~90~~

~~80~~

~~70~~

~~60~~

~~50~~

~~30~~

~~10~~

~~Ratio "of live to dead load~~

~~9~~

~~4~~

~~2-3~~

~~1-5~~

~~1-0~~

~~0-43~~

~~0-10~~

~~Excess of deflection and stress due to moving load per cent.~~

~~23~~

~~13~~

~~8~~

~~5-5~~

~~4-0~~

~~1-6~~

~~0-3~~

~~These results are for the centre deflections of main girders, but Mr Stone infers that the augmentation of stress for any member, due to causes included in impact allowance, will be the same per- centage for the same ratios of live to dead load stresses. Valuable measurements of the deformations of girders and tension members • due to moving trains have been made by Mr Eobinson (Proc. Am.~~

~~Soc. C. E., xvi.) and by Mr Tumeaure {Proc. Am. Soc. 0. E. xli.). The latter used a recording deflectometer and two recording extensometers. The observations are difficult, and the inertia of the instrument is liable to cause error, but much care was taken. The most striking conclusions from the results are that the locomotive balance weights have a large effect in causing vibration, and next, that in certain cases the vibrations are cumulative, reaching a value greater than that due to any single impact action. Generally : (1) At speeds less than 25 miles an hour there is not much vibration. (2) The increase of deflection due to impact at 40 or 50 miles an hour is likely to reach 40 to 50 per cent, for girder spans of less than 50 ft. (3) This percentage decreases rapidly for longer spans, becoming about 25 per cent, for 75-feet spans. (4) The increase per cent, of boom stresses due to impact is about the same as that of deflection ; that in web~~

~~bracing bars is rather greater. (5) Speed of train produces no effect on the mean deflection, but only on the magnitude of the vibrations.~~

~~A purely empirical allowance for impact stresses has been proposed, amounting to 20 per cent, of the live load stresses for floor stringers ; 15 per cent, for floor cross girders ; and for main girders, 10 per cent, for 40-feet spans, and 5 per cent, for 100-feet spans. These percentages are added to the live load stresses.~~

~~The dead load consists of the weight of main girders, flooring, and wind-bracing. It is almost always reckoned as uniform per foot run, though sometimes allowance should be made n a I d for the increase of weight towards the centre of the *' "' span. The weight of the bridge flooring depends on the type adopted. Roughly, the weight of sleepers, rails, &c., is 0'25 ton per foot run for each line of way, while the rail girders, cross girders, or troughing weigh 0'15 to 0'25 ton. The weight of main girders increases rapidly with the span, and there is for any type of bridge a limiting span beyond which the dead load stresses exceed the assigned limit of working stress.~~

~~Let Wi be the total live load, "W/ the total flooring load on a bridge of span I, both being considered for the present purpose to be uniform per foot run. Let fc(W^-^'W/) be the weight of main girders designed to carry Wj-hW/, but not their own weight in addition. Then~~

~~w,=(W^^-■w»(;fc■^s=-|-p. . .)~~

~~will be the weight of main girders to carry Wj 1 W/ and their own weight (Buck, Proc. Inst. C. E. Ixvii. p. 331). Hence,~~

~~W,=(W(-h-W,)A/(l-A).~~

~~Since in designing a bridge W;-fW/is known, iCWj-fW/) can be found from a provisional design in which the weight W^ is neglected. The actual bridge must have the section of all members greater than those in the provisional design in the ratio A/(l — k).~~

~~Mr Waddell {Be Pontilms) gives the following convenient em- pirical relations. Let w^ w^, be the weights of main girders per foot iim for a live load p per foot run and spans Ij, Zj. Then~~

~~Wi 2Li!i VzJJ'~~

~~Now let Wi', tOj' be the girder weights per foot run for spans Zj, l^ and live loads p' per foot run. Then~~

~~■i-iOAmi~~

~~l-H4^~~

~~A partially rational approximate formula for the weight of main girders is the following (Unwin, Wrought-Iron Bridges and Hoofs, 1869, p. 40) : — Let W be the total distributed load on a girder exclusive of its own weight, in tons ; Wj, the weight of the girder ; I, the span, in ft. ; s, average stress, in tons, per sq. in. on gross section of members ;~~

~~^~Cds-P~Cs-lr~~

~~where 0 is a constant for any type of bridge. It is not easy to fix the average stress s per sq. in. of gross section. Hence the formula is more useful in the form~~

~~„ _ WP _WZr~~

~~^~kd-P~k-lr'~~

~~where Jc=(Wi + 'W)lrfWi is to be deduced from the data of some bridge previously designed for the same live load per foot ran and the same working stresses. From some known examples, C varies from 1500 to 1800 for iron, and from 1200 to 1500 for steel bridges. ^=6000 to 7200 for iron, and =4800 to 6000 for steel bridges.~~

~~Much attention has been given to wind action since the disaster to the Tay Bridge in 1879. As to the maximum wind pressure on small plates normal to the wind, there is not much j^. doubt. Anemometer observations show~~

that pressures “^’”’ of 30 lb per sq. ft. occur in storms annually in many “**””• localities, and that occasionally higher pressures are recorded in

exposed positions. Thus at Bidstone, LiTerpool, where the gauge has an exceptional exposure, a pressure of 80 lb per sq. ft. has been observed. In tornadoes, such as that at St Louis in 1896, it has been calculated, from the stability of structures overturned, that pressures of 45 to 90 & per sq. ft. must have been reached. As to anemometer pressures, it should be observed that the re- corded pressure is made up of a positive front and negative (vacuum) back pressure, but in structures the latter must be absent or only partially developed. Great difference of opinion exists as to whether on large surfaces the average pressure per sq. ft. is as great as on small surfaces, such as anemometer plates. The experiments of Sir B. Baker at the Forth Bridge showed that on a surface 30 ft. x 15 ft. the intensity of pressure was less than on a similarly exposed anemometer plate. In the case of bridges there is the further difficulty that some surfaces partially shield other surfaces ; one girder, for instance, shields the girder behind it (see Brit. Assoc. Report, 1884). In 1881 a committee of the Board of Trade decided that the maximum wind pressure on a vertical surface in Great Britain should be assumed in designing structures to be 66 lb per sq. ft. For a plate-girder bridge of less height than the train, the wind is to be taken to act on a surface equal to the projected area of one girder and the exposed

fart of a train covering the bridge. In the case of braced girder ridges, the wind pressure is taken as acting on a continuous surface extending from the laUs to the top of the carriages, plus the vertical projected area of so much of one girder as is exposed above the train or below the rails. In addition, an allowance is made for pressure on the leeward girder according to a scale. The committee recommended that a, factor of safety of 4 should be taken for wind stresses. For safety against overturning they considered a factor of 2 sufficient. In the case of bridges not subject to Board of Trade inspection, the allowance for wind pressure varies in different oases. Mr Shaler Smith allows 300 lb per foot run- for the pressure on the side of » train, and in addition 30 Bb per sq. ft. on twice the vertical projected area of one girder,

~~treating the pressure on the train as a travelling load. In the case of bridges of less than 50 feet span he also provides strength to resist a pressure of 50 lb per sq. ft. on twice the vertical projection of one truss, no train being supposed to be on the bridge.~~

~~For a long time engineers held the convenient opinion that, if the total dead and live load stress on any section of a structure (of iron) did not exceed 5 tons per stresses gq_ jjj_^ ample safety was secured. It is no longer ‘ possible to design by so simple a, rule. In an interesting address to the Eritish Association in 1885, Sir B. Baker described the condition of opinion as to the safe limits of stress as chaotic. “The old foundations,” he said, “are shaken, and engineers have not come to an agreement respecting the rebuilding of the structure. The variance in the strength of existing bridges is such as to be apparent to the educated eye without any calculation. In the present day engineers are in accord as to the principles of estimating the magnitude of the stresses on the members of a structure, but not so in proportioning the members to resist those stresses. The practical result is that a bridge which would be passed by the English Board of Trade would require to be strengthened 5 per cent, in some parts and 60 per cent, in others, before it would be accepted by the German Government, or by any of the leading railway companies in America.” Sir B. Baker then described the results of experiments on re- petition of stress, and added that “hundreds of existing bridges which carry twenty trains a day with perfect safety would break down quickly under twenty trains an hour. This fact was forced on my attention nearly twenty- five years ago by the fracture of a number of girders of ordinary strength under a five-minutes’ train service.”~~

~~Practical experience taught engineers that though 5 tons per sq. in. for iron, or 6J tons per sq. in. for steel, was safe or more than safe for long bridges with lajge ratio of dead to live load, it was not safe for short ones in which the stresses are mainly due to live load, the weight of the bridge being small. The experiments of Wohler, repeated by Bauschinger, Sir B. Baker, and others, show that the breaking stress of a bar is not a fixed quantity, but depends on the range of variation of stress to which it is subjected, if that variation is repeated a very large number of times. Let K be the breaking strength of a bar per unit of section, when it is loaded once gradually to breaking. This may be termed the statical breaking strength. Let Icma- be~~

~~the breaking strength of the same bar when subjected to stresses varying from k^ax- to £„«„.~~

~~alternately and repeated an indefinitely great number of times ; ifcnrin. is to be reckoned + if of the same kind as kmax-, and — if of the opposite kind (tension or thrust). The range of stress is therefore Ic-miuc — ifcmin. , if the stresses are both of the same kind, and k„^. + k,„i„., if they are of opposite kinds. Let A=*™««.+ *,„„.= the range of stress, where A is always positive. Then Wohler'a results agree closely with the rule,~~

~~*m».=|+v'(K''-»AK),~~

~~where » is a constant which varies from 1"3 to 2 in various qualities of iron and steel. For duotUe iron or mild steel it may be taken as 1*5. For a statical load, range of stress nil, A=0, kmaic- = K, the statical breaking stress. For a bar so placed that it is alternately loaded and the load removed, A=k,nax- and k,aax. = 0-6 K. For a bar subjected to alternate tension and compression of equal amount, i^ = 'Zfmca- and kmax- = ^ K- The safe working stress in these different cases is kmaz- divided by the factor of safety. It is sometimes said that a bar is "fatigued" by repeated straining. The real nature of the action is not well understood, but the word fatigue may be used, if it is not considered to imply more than that the breaking stress under repetition of loading diminishes as the range of variation increases.~~

~~It was pointed out as early as 1869 (Unwin, WrmigM-Iron Bridges wnd Roofs) that a rational method of fixing the working stress, so far as knowledge went at that time, would be to make it depend on the ratio of live to dead load, and in such a way that the factor of safety for the live load stresses was double that for the dead load stresses. Let A be the dead load and B the live load, producing stress in a bar ; p=B/A the ratio of live to dead load ; fj the safe working limit of stress for a bar subjected to a dead load only and / the safe working stress in any other case. Then~~

~~f=A~~

~~A+B~~

~~/i~~

~~1 + P~~

~~A+2B n + 2/)~~

~~The following table gives values of / so computed on the assump- tion that/j=7i tons per sq. in. for iron and 9 tons per sq. in. for steeL~~

~~Working Stress for combined Dead and Live Load.~~

~~Fador of~~

~~Safety twice as great for Live Load~~

~~as for Dead Load.~~

~~Talaes of/, tons per sq. in.~~

~~Hatio. P~~

~~1+p~~

~~H-2p~~

~~Iron.~~

~~Mild Steel.~~

~~All dead load .~~

~~θ~~

~~1^00~~

~~7-5~~

~~9-0~~

~~-25~~

~~0^83~~

~~6^2~~

~~7-5~~

~~■33~~

~~0^78~~

~~5^8~~

~~7^0~~

~~■50~~

~~0^75~~

~~5-6~~

~~6^S~~

~~•66~~

~~0^71~~

~~5^3~~

~~6^4~~

~~live load = Dead load~~

~~1-00~~

~~0^66~~

~~4-9~~

~~59~~

~~2-00~~

~~0^60~~

~~4^5~~

~~5-4~~

~~4-00~~

~~0^56~~

~~4-2~~

~~5^0~~

~~All Uve load .~~

~~oc~~

~~0^50~~

~~3^7~~

~~4^5~~

~~Bridge sections designed by this rule differ little from those designed by formulae based directly on Wbhler's experiments. This rule has been revived in America, and appears to be increas- ingly relied on in bridge-designing. (See Trans. Am. Soc. C. E. xli. p. 156.)~~

~~Wejrrauch and Launhardt's method, based on an empirical expression for Wbhler's law, has been much used in bridge designing (see Proc. Inst. C. E. IxiiL p. 275). Let t be the statical breaking strength of a bar, loaded once gradually up to fracture (<= breaking load divided by original area of section) ; it the breaking strength of a bar loaded and unloaded an indefinitely great number of times, the stress varying from m to 0 alternately (this is termed the primitive strength) ; and, lastly, let s be the breaking strength of a bar subjected to an indefinitely great number of~~

repetitions of stresses equal and opposite in sign (tension and thrust), so that the stress ranges alternately from s to — s. This is termed the mhraiion strength. 'Wohler's and Bauschinger's experiments give values of t, u, and s, for some materials. If a bar is subjected to alternations of stress having the range A= fmax- -faia; thcu, by "Wohlcr's law, the bar will ultimately break, if

/»»x.=FA, ... (1) where F is some unknown function. Launhardt found that for stresses always of the same kind, F= (< - u)l(t -/„„,) approximately agreed with experiment. For stresses of different kinds Weyrauch found F = (m - s)/{2m - s /™,x) to be similarly approximate. Now let /„„.//„„. =0, where 0 is -f or — according as the stresses are of the same or opposite signs. Putting the values of F in (1) and solving for /„„!., we get for the breaking stress of a bar subjected to repetition of varying stress,

/) [Stresses of same sign.]

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frnax- = « (1 + — ^ ^ J [Stresses of opposite sign.]

The working stress in any case is fmax- divided by a factor of safety. Let that factor be 3. Then Wbhler's results for iron and Bauschinger's for steel give the following equations for tension or thrust : —

Iron, working stress, /= 4'4|1 + ^^) Steel, „ „ =5-87[l + -0y

In these equations (^ is to have its + or — value according to the case considered. For shearing stresses the working stress may have 0'8 of its value for tension. The following table gives values of the working stress calculated by these equations : —

Working Stress for Tension or Thrust i Weyrauch Formula.

I Lawrihardt and

Working Stress/, ,

•

~~1 + t-~~

~~tons per aq. in.~~

~~Iron.~~

~~Steel.~~

~~All dead load.~~

~~1-0~~

~~1-5~~

~~6-60~~

~~8-80~~

~~0-75~~

~~1-375~~

~~6-05~~

~~8-07~~

~~0-50~~

~~1-25~~

~~5-50~~

~~7-34~~

~~0-25~~

~~1-125~~

~~4-95~~

~~6-60~~

~~All live load .~~

~~0-00~~

~~1-00~~

~~4-40~~

~~5-87~~

~~-0-25~~

~~0-875~~

~~3-85~~

~~5-14~~

~~-0-50~~

~~0-75~~

~~3-30~~

~~4-40~~

~~-0-75~~

~~0-625~~

~~2-75~~

~~3-67~~

~~Equal stresses + and –~~

~~-1-00~~

~~0-500~~

~~2-20~~

~~2-93~~

~~To compare this with the previous table, (^=(A + B)/A=l + p. Except when the limiting stresses are of opposite sign, the two tables agree very well. In bridge work this occurs only in some of the bracing bars.~~

~~It is a matter of discussion whether, if fatigue is allowed for by the Weyrauch method, an additional allowance should be made for impact. There was no impact in Wohler's experiments, and there- fore it would seem rational to add the impact allowance to that for fatigue ; but in that case the bridge sections become larger than experience shows to be necessary. Some engineers escape this difficulty by asserting that Wohler's results are not applicable to bridge work. They reject the allowance for fatigue (that is, the effect of repetition) and design bridge members for the total dead and live load, plus a large allowance for impact varied according to some purely empirical rule. (See Waddell, De Pontibus, p. 7.) Now in applying Wohler's law, /„„«. for any bridge member is found for the maximum possible live load, a live load which though it may sometimes come on the bridge and must therefore be provided for, is not the usual live load to which the bridge is subjected. Hence the range of stress, /„„». -/»;„., from which the working stress is deduced, is not the ordinary range of stress which is repeated a practically infinite number of times, but is a range of stress to which the bridge is subjected only at comparatively long intervals.~~

~~Hence practically it appears pro- bable that the allowance for fatigue made in either of the tables above is sufficient to cover the ordinary effects of impact also;~~

~~English bridge — builders are somewhat hampered in adopting rational limits of working stress 3fl2 ^y ^^^ rules of the Board of Trade. Nor do they all accept the guidance of Wohler's law. The following are some examples of limits adopted. For the Duf- ferin Bridge (steel), the work- ing stress was~~

~~taken at 6 -5 tons per sq. in. in bottom booms and diagonals, 6 -0 tons in top booms, 5-0 tons in verticals and long compression members. For the Stanley Bridge at Brisbane, the limits were 6-5 tons per sq. in. in compression boom, 7-0 tons in tension boom, 5-0 tons in vertical struts, 6-5 tons in diagonal ties, 8-0 tons in wind bracing, and 6-5 tons in cross and rail girders. In the new Tay Bridge the limit of stress is generally 5 tons per sq. in., but in members in which the stress changes sign 4 tons per sq. in.~~

~~Let a girder, supported at the ends, carry a fixed load W at to from the right abutment. The reactions at the abutments are Ej = Wot/? and K2=W(Z-to)/Z. The shears on vertical sections to the left and right of the load are Rj and — Ej, and the dis-~~

~~tribution of shearing force is given by two rectangles (Fig. 1). Bending moment increases uniformly from either abutment to the load, at which the bending moment is 'M. = 'R^m='Ry{l — m). The distribution of bending moment is given by the ordi- nates of a triangle. Next let the girder carry a Straining uniform load w per foot run (Fig. 2). The total load action. is wl; the reactions at abutments, Ki=E2=it«/. The distribution of shear on vertical sections is given by the ordlnates of a sloping line. The greatest bending moment is at the centre and =M.c=\wP. At any point X from the abutment, the bend- ing moment is M. = ^wx[l-x), an equation to a parabola.~~

~~Let a uniform train weighing w per foot run advance over a girder of span 2c, from the left abutment. When it covers the girder to a distance x from the centre (Fig. 3) the total load is w[c+x) ; the reaction at B is~~

~~R,=~~

~~=w{e+x)x.''J^=1!L{e + xf, ic 4e~~

~~Fig. 2.~~

~~A s-~~

~~QooaQcjoa~~

~~B~~

-iwl

which is also the shearing force at 0 for that position of the load. As the load travels, the shear at the head of the train will be given by the ordinates of » parabola having its vertex at A,

and a maximum F^^t- = — i'wl at B. If the load travels the reverse way, the shearing force at the head of the train is given by the ordinates of the dotted parabola. The greatest shear at C for any position of the load occurs when the head of the train is at C. For any loady between C and B will increase the reaction at B and therefore the shear at C by part of p, but at the same time will diminish the shear at C by the whole of p. The web of a girder must resist the maximum shear, and, with '• travelling load like a railway train, this is greater for partial than for complete loading. Generally a girder supports both a dead and a, live load. The distribution of total shear, due to a dead load wa per foot run and a travelling load Wl per foot run, is shown in Fig. 4, arranged so that the dead load shear is added to the maximum travelling load shear of the same sign.

In the case of girders with braced webs, the tension bars of which are not adapted to resist a thrust, another circumstance due to the position of the live load must be considered. For a train advancing from the left, the travel- ling load shear in the left half of the span is of a different sign from that due to the dead load. Fig. 5 shows the maximum shear '

at vertical sections due to a dead ^'S- *•

and travelling load, the latter ad- vancing (Fig. 5, a) from the left and (Fig. 5, b) from the right abutment. Comparing the figures it wUl be seen that over a dis- tance X near the middle of the girder the shear changes sign,

according as the load advances from the left or the right. The bracing bars therefore for this part of the girder must be adapted to resist either tension or thrust. Further, the range of stress to which they are sub- jected is the sum of the strpsses due to the load advancing from the left or the right. To find the greatest shea^ with a, set of concentrated loads at fixed dis- tances, let the loads advance from the left abutment, and let C be the section at

which the shear is required (Fig. 6). The greatest shear at C may occur with W, at C. If Wl passes Fig. 5. beyond C, the shear at C will

probably be greatest when Wo is at C. Let R be the resultant of the loads on the bridge when

;

Wi

! i

1 W2 W3

B

“1

÷

,-....11—

<- m

1 k---a —■>

-J * ;

-‘r— -l-m-

r

Fig. 6.

~~“Wi is at C. Then the reaction at B and shear at C is Hn/l. Next let the loads advance a distance a so that Wj comes to C. Then~~

~~the shear at C is~~

~~^ R C ^{n + a)/l-Wi, plus~~

~~~ ^ any reaction d at B,~~

~~due to any additional load which has come !5# on the girder during the movement. The shear will therefore be increased by bringing “Wa to C, if~~

~~Ea/Z + rf>‘Wj and d is generally small and negligible. TTiis result is modified if the action of the load near the section is distributed to the bracing intersections by rail and cross girders. In Fig. 7 the action of W is dis- tributed to A and B by the floor-*” ing. Then the loads at A and B are Wiji-xyp and “Wai/p. Now let C (Fig. 8) be the section at which the greatest shear is required, and let the loads ad- vance from the left tiU Wj is at C. If E is the resultant of the loads then on the girder, the re- action at B and shear at C is Em/Z. But the shear may be greater when Ws is at C. In that dsse the shear at C becomes B.{n + a)/l+d-‘Wi, if a>p, and E(m-fa)/i + d-‘Wialp, ii a<:p. If we neglect d, then the shear increases by moving Wj to C, if E«//>Wi in the first case, and i[‘Ba/l>Wja/p in the second case.~~

~~For the greatest bending moment due to a travelling live load, let a load of w per foot run advance from the left abutment (Fig. 9), and let its centre be at x from the left abutment. The reaction at B is 2w3?ll and the bending moment at any section C, at m from the left abutment, is 2w3i?{l — m)ll, which increases as x in- creases tiE the span is covered. Hence, for uniform travelling~~

~~/\Ax~~

~~a/ \/ q|.~~

~~/ . \A/i~~

~~/ 9 w~~
~~~

~~/\ /~~

~~\~~

~~k a-»!«!—~~

~~-p… -,~~

~~f~~

~~Fig. 8.~~

~~loads, the bending moments are greatest when the loading is com- plete. In that case the loads on either side of C are proportional to m and l-m. In the case of a series of travelling loads at fixed distances apart passing over the girder from the left, let Wi, "W2 (Fig. 10), at distances x and x+a from the left abutment, be their resultants on either side of C. Then the reaction at B is W^x/l + Wiix+ayi. The bending moment at C is~~

~~If the loads are moved a distance Ax to the right, the bending moment becomes~~

~~nr , Aur tir X+Ax,. , . tit (i X + a + Ax \~~

~~Ax Am=Wi-j-(?OT)~~

~~and this is positive or the~~

~~A3QQOQiQQQQ~~

~~—X ———>»• 1-:~~

~~bending moment increases, if~~

~~'Wi(Z-m)>W2m, or~~

~~ifW-i/m>WJ(,l-m).~~

~~But these are the~~

B average loads per

rrr foot run to the left and right of C. Hence, if the aver- I age load to the left of a section is greater than that to the right, the bending moment at the sec- tion will be increased by moving the loads to the right, and vice versd. Hence the maximum bending moment at 0 for a series of travelling loads will occur when the average load is the same on either side of C. If one of the loads is at C, spread over a very

U.—

....J._-l.in….

-1-2C-

Fig. 9.

small distance in the neighbourhood of C, then a very small dis- placement of the loads will permit the fulfilment of the condi- tion. Hence the criterion for the position of the loads which makes the moment at C greatest is this : one load must be at C, and the other loads

must be distributed, so = —— >■ vVi VV2

that the average loads ^Q Q Q CQ JQ B

per foot on either side 7 ^ v ^ —— – —— —— =« —— =^—

of C (the load at C being neglected) are nearly equal. If the loads are very unequal in magnitude or dis- tance this condition may be satisfied for more than one position of the loads, but it is not difficult to ascertain which position gives the maximum moment. Generally one of the largest of the loads must be at C with as many others to right and left as is consistent with that condition. Fig. 11 shows the curve of bending moment under one of a series of travelling loads at fixed distances. Let Wj, Wj, W3 traverse the girder from the left at fixed distances a, b. For the position shown the distribution of bending moment due to Wj is given by ordinates of the triangle A'CB' ; that due to Wj by ordinates of A'DB' ; and that due to Wj

~~by ordinates of A'EB'. The total moment at Wj, due to three loads, is the sum mC + mn+mo of the intercepts which the triangle sides out off from the vertical under~~

~~Wj. As the loads move over the girder, the points C, D, E describe the parabolas Mj, M^ M3, the middle ordinates of which are iWJ, JWjZ, and JWjZ. If these are first drawn it is easy, for any jposi- tion of the loads, to draw the lines B'C, B'D, B'E, and to find the sum of the intercepts which is the total bending moment under a load. The lo^er portion of the figure is the curve of bending moments under the leading load. Till Wi has advanced a distance a only one load is on the girder, and the curve A"F gives bending moments due to Wi only ; as Wj advances to a distance a + b, two loads are on the girder, and the curve FG gives moments due to Wj and Wj. GB" is the curve of moments for all three loads Wj t W^ + "W,.~~

~~Fig. 12 shows maximum bending moment curves for an extreme case of a short bridge with very unequal loads. The three lightly dotted parabolas are the curves of maximum moment for each of the loads taken separately. The three heavily dotted curves are curves of maximum moment under each of the loads, for the three loads passing over the bridge, at the given distances, from left to right. As might be expected, the moments are greatest in this case at the sections under the 15-ton load. The heavy continuous line gives the last-mentioned curve for the reverse direction of passage of the loads.~~

~~With short bridges it is best to draw the curve of maximum bending moments for some assumed typical set of loads in the way just described, and to design the girder accordingly. For longer bridges the funicular polygon affords a method of determining maximum bending moments which is perhaps more convenient. But very great accuracy in drawing this curve is unnecessary, because the rolling stock of railways varies so much that the precise magnitude and distribution of the loads which will pass over a bridge cannot be kno?m. All that can be done is to assume a set of loads likely to produce somewhat severer straining than any probable actual rolling loads. Now, except for very short bridges~~

~~and very unequal loads, a parabola can be found which includes the curve of maximum moments. This parabola is the curve of maximum moments for a travelling load uniform per foot run. Let w,, be the load per foot run which would produce the maxi- mum moments represented by this parabola. Then w, may be termed the uniform load per foot equivalent to any assumed set of concentrated loads. Mr Waddell has calculated tables of such equivalent uniform loads. But it is not difficult to find Wg, ap- proximately enough for practical purposes, very simply. Experience~~

~~fi^ons~~

~~10 ton3~~

~~Fig. 12.~~

~~shows that (a) a parabola having the same ordinate at the centre of the span, or (i) a parabola having the same ordinate at one-quarter span as the curve of maximum moments, agrees with it closely enough for practical designing. A criterion already given shows the position of any set of loads which will produce the greatest bending moment at the centre of the bridge, or at one-quarter span. Let Mc and Ma be those moments. At a section distant x irom the centre of a girder of span 2c, the bend- ing moment due to a uniform load We per foot run is~~

~~U=’^(,c-z)(c+x). Putting iB=0, for the centre section ‘~~

~~and putting a;=ic, for section at quarter span~~

~~” 8~~

~~From these equations a value of w, can be obtained. Then the bridge is designed, so far as the direct stresses are concerned, for bendiug moments due to a, uniform dead load and the imiform equivalent load We.~~

~~In dealing with the action of travelling loads much assistance may be obtained by using a line termed an influence line. Such a line has for abscissa the distance of a load from one end of a girder, and for ordinate the bending moment or sjiear at any given section, or on any member, due to~~

~~that load. Generally the influence line is drawn for unit load. In Fig. 13 let A'B' be a~~

~~F.-^-iKc Am~~

~~Fig. 13.~~

~~rirder supported at the ends and let it be required to investigate flie bending moment at C due to unit load in any position on the girder. When the load is at F', the reaction at B' is m/l and the moment at C is m{l-x)/l, which will be reckoned positive, when it resists a tendency of the right-hand part of the girder to turn~~

~~counter-clockwise. Projecting A'F'C'B' on to the horizontal AB, take ¥/=m{l-x)ll, the moment at C of unit load at F. If this process is repeated for all positions of the load, we get the influence line AGB for the bending moment at C. The area AGB is termed the influence area. The greatest moment CG at C is a;(Z — is)ll. To use this line to investigate the maximum moment at C due to a series of travelling loads at fixed distances, let PuPjjPg, ... be the loads which at the moment considered are at distances mi, m^, . ■ • from the left abutment. Set off these distances along AB and let yi, y^, . . ■ be the correspond- ing ordinates of the influence curve {y=¥/) on the verticals under the loads. Then the moment at C due to all the loads is~~

~~M=Piyi-)-P22/2-t- . . .~~

~~p The position of the loads which gives the greatest moment~~

~~f at 0 may be settled by the criterion given above. For a~~

~~f/I.^ i uniform travelling load w ~peT foot of span, consider a small~~

~~' interval Ffc=Am on which the load is viAm, The moment due to this, at C, is vmi{l — x)Am/l. But m(l-x)Am/l is the area of the strip Ffhk, that is yAm. Hence the moment of the load on Am at C is wyAm, and the moment of a uni- form load over any portion of the girder is w x the area of the influence curve under that portion. If the scales are so chosen that a inch represents~~

~~one inch ton of moment, > and b inch represents one foot of span, and w is in tons per foot run, then ab is the unit of area in measuring the influence curve.~~

~~If the load is carried by a rail girder (stringer) with cross girders at the intersections of bracing and boom, its effect is distributed to the bracing intersections D'E' (Fig. 14), and the part of the influence line for that bay (panel) is altered. With imit load in the position shown, the load at D' is (.p-n)lp, and that at E' is n/p. The moment of the~~

~~load at C is m(l-x)jl-n{p-n)lp. This is the equation to the~~

~~dotted line RS (Fig. 13). If the unit load is at F', the reaction at B' and the shear at C~~

~~is mjl, positive if~~

~~the shearing stress~~

~~resists a tendency~~

~~of the part of the~~

~~girder on the right~~

~~to move upwards ;~~

~~se"tupF/=m/i(Fig.~~

~~15) on the vertical~~

~~under the losid. Re- peating the process~~

~~for other positions,~~

~~we get the influence~~

~~line A6HB, for the~~

~~shear at C due to~~

~~unit load anywhere~~

~~on the girder.~~

~~GO = xll and~~

~~CH = — (Z — x)ll.~~

~~The lines AG, HB are parallel. If the load is in the bay D'E'~~

~~and is carried by a rail girder which distributes it to cross girders~~

~~at D' E', the part of the influence line under this bay is altered.~~

~~Let n (Fig. 16) be the distance of the load from D', Xi the~~

~~distance of D' from the left abutment, and p the length of a bay. The loads at D', E, due to unit weight on the raU girder are (p-n)/p and n/p. The reaction at B' is {{p-n)xi + n{Xi+p)}lpl. The shear at C is the reaction at B' less the load at E', that is {p(.Xi+n)-nl}/pl, which is the equation to the line DH (Fig. 15).~~

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~~I~~

~~Clearly, tlie distribution of the load by the rail girder considerably alters the distribution of shear due to a load in the bay in which the section considered lies. The total shear due to a series of~~

~~loads Pi, P2, ... at distances m^, m^, . . . from the left abut- ment, 2^1, 2/2, .. . being the ordinates of the influence curve under the loads, is~~

~~“C’ ■£’ S = Pi3/i + P22/2+ . . .~~

~~‘ I 1 I Generally, the~~

~~X, «=— n- » I I greatest shear S at C~~

~~! will occur when the~~

~~3J longer of the seg-~~

~~; ‘ ments into which C~~

~~X 1 1 >i divides the girder is~~

~~fully loaded and the other is unloaded, Fig. 16. the leading load be-~~

~~ing at C. If the loads are very unequal or unequally spaced, a trial or two will determine which position gives the greatest value of S. The greatest shear at C of the opposite sign to that due to the loading of the longer segment occurs with the shorter segment loaded. For a uni- formly-distributed load w per foot run the shear at C is «» x the area of the influence-curve under the segment covered by the load, attention being paid to the sign of the area of the curve. If the load rests directly on the main girder, the greatest + and — shears at 0 will be w X AGO and wx CHB. But if the load is distri buted to the bracing intersections by rail and cross girders, then the shear at C will be greatest when the load extends to N, and will have the values w x ADN and -wx NEB.~~

~~Influence lines were described by Frankel, Ser CiviUngenieur, i 876. See also Eandbuch der Ingenieur-wissenschaften, vol. ii. ch. X. , 1882, and Levy, La statique graphiqite, 1886. There is a useful paper by Prof. G. F. Swain {Tram. Am. Soc. C. E. ivii., 1887), and another by L. M. Hoskins {Proc. Am. Soc. G. E. xxv., 1899). Another method of investigating the maximum shear at a section due to any distribution of a travelling load has been given by Prof. H. T. Eddy (Trans. Am. Soc. C. E. xxii., 1890). Let hk (Fig. 17) represent in magnitude and position a load W, at x from the left abutment, on a girder AB of span I. Lay off kf, hg, horizontal and equal to I. Join / and g to h and k. Draw verticals at A, B, and join no. Obviously no is~~

~~horizontal and equal to I. Also mnlinf=Kklkf ox mn=‘W{l-x)/l, which is the reaction at A due to the load at C, and is the shear at any point of AC. Similarly, po is the reaction at B and shear at any point of CB. The shaded rectangles represent the distribution of shear due to the load at C, while «.o may be termed the datum line of~~

~~i !~~

~~j i~~

~~i i~~

~~f i~~

~~i~~

~~• • !~~

~~Cjllc iD~~

~~i~~

~~i i~~

~~L—X...J. a -^~~

~~1. 1—~~

~~i——.J~~

~~Fig. 17.~~

~~shear. Let the load move to D, so that its distance from the left abutment is x+a. Draw a vertical at D, intersecting /A, kg, in s and q. Then gr/ro=hkjhg or ro=‘W{l-x-a)ll, which is the reaction at A and shear at any point of AD, for the newposition of the load. Similarly, rs=‘W{x+a)/l is the shear on DB. The distribution of shear is given by the partially-shaded rectangles. For the application of this method to a series of loads Prof. Eddy’s paper must be referred to.~~

~~In the case of a bridge of many spans, there is a length of span which makes the cost of the bridge least. The cost of abutments and bridge flooring is practically indejwndent of the length of span adopted. Let P be the cost of one pier ; G the cost of the main girders for one span, erected ; n the number of spans ; I the length~~

~~Arched bridges.~~

~~of one span, and L the length of the bridge between abutments. Then, n=‘L/l nearly. Cost of piers (n.-l)P. Cost of main girders ■nG. The cost of a pier will not vary materially with the span adopted. It depends mainly on the character of the foundations and height at which the bridge is carried. The cost of the main girders for one span wiU vary nearly as the square of the span for anygiven type of girder and intensify of live load. Thatis, G=oP, where a is a constant. Hence the total cost of that part of the bridge which varies with the span adopted is — C={n-l)?+naP = LFIl-P + Lal. Differentiating and equating to zero, the cost is least when~~

~~dC LP ^ „ /del>- + L«=0,~~

~~P=aP=G;~~

~~that is, when the cost of one pier is equal to the cost erected of the main girders of one span. Sir Guildford Molesworth puts this in a convenient but less exact form. Let G be the cost of superstructure of a 100-feet span erected, and P the cost of one pier with its pro- tection. Then the economic span is 1=100 ^T/ i^G.~~

~~All the earlier arclied bridges were of masonry or brick- work, so built that they could be treated as blockwork structures composed of rigid voussoirs. The stability of such structures depends on the position of the line of pressure in relation to the extrados and intrados of the arch ring. Generally the line of pressure lies within the middle half of the depth of the arch ring. In finding the line of pressures some jsrinciple such as the principle of least action must be used iu de- terminiag the reactions at the crown and spring- ings. For an elastic arch of metal there is a complete theory, but it is difficult, and there is always some doubt as to the validity of some of the assumptions which must be made. If hinges are introduced at crown ajid~~

~~springings, the calculation of the stresses in the arch ring becomes simple, as the line of pressures must pass through the hinges. Such hinges have been used not only for metal arches, but in a modified form for masonry and concrete arches. Three cases therefore arise : (a) The arch is rigid at crown" and springings j (6) the arch is two- hinged (hinges at springings) ; (c) the arch is three-hinged (hinges at crown and springings). For an elementary account of the theory of arches, hinged or not, reference may be made to a paper by Mr H. M. Martin {Proc. Inst. C. E. vol. xciii. p. 462) ; and for that of the elastic arch, to a paper by Mr A. E. Young {Proc. Inst. C. E. voL cxxxL p. 323).~~

~~In Germany three hinged arches of masonry and concrete have been built, up to 150 feet span, with much economy, and the calculations being simple, an engineer can venture to work closely to the dimensions required by theory. For hinges, Mr Liebbrand, of Stuttgart, uses sheets of lead about one inch thick extending over the middle third of the depth,of the voussoir joints, the rest of the joints being left open. As the lead is plastic this construction is virtually an articulation. If the pressure on the lead is uniformly varying, the centre of pressure must be within the middle third of the width of the lead ; that is, it cannot deviate from the centre of the voussoir joint by more than one-eighteenth of its depth. In anjr case the position of the line of pressures is confined at the lead articulations within very narrow limits, and ambiguity as to the stresses is greatly diminished. The restricted area on which the pressure acts at the lead joints involves greater intensity of stress than has been usual in arched bridges. In the Wiirtemberg hinged arches a limit of stress of 110 tons per square foot was allowed, while in the unhinged arches at Cologne and Coblentz the limit was 50 to 60 tons per square foot (Annates des Fonts et Chaussies, 1891). At Reohtenstein a bridge of two concrete arches has been constructed, span 75i feet, with lead articulations- width of arch 11 feet ; depth of arch at crown and springing 2 'l' and 2-96 feet respectively. The stresses were calculated to be 15 17, and 12 tons per square foot at crown, joint of rupture and springing respectively. At Cincinnati, a concrete arch of 70 feet span has been built, with a rise of 10 feet. The concrete is re inforced by eleven 9-inch steel-rolled joists, spaced 3 feet apart and supported by a cross channel joist at each springing. The arch is 15 inches thick at the crown and 4 feet at the abutments. The concrete consisted of 1 cement, 2 sand, and 3 to~~

~~4 broken “stone. An important series of experiments on the strength of masonry~~

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~~Steel SPA>f Bridge over the North Sea axd Baltic Caxal.~~

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~~The Xew East Rivek Bridge, Keav Yohk.~~

~~The Tdwer Bridc;e, London.~~

~~(From a Phvturjraph by L\ Talbot, London.)~~

~~brick, and concrete strncturea will be found in the Zeitschr. des Oesterreichen Ing. und Arch. Vereines, 1895.~~

~~Recently steel arcbes of great span have been constructed, partly because they have a better appearance than girder bridges, but mainly because they can be erected without false works. The first very important bridges of this kind were the St. Louis Bridge (for description, see article Bridges in Sncy. Brit. vol. iv. p. 339), and the Douro Bridge (Fig. 18). Amongst other examples the Washington Bridge over the Harlem river, New York, may be men- tioned (see Plate). It has a length of 2375 feet, with a roadway 80 feet in width, 133 feet above the river. Two principal arches are 510 feet span, springing from granite piers. Each steel arch has six ribsresting on steel pins 34 inches long and 18 inches in diameter, carried on steel bearings. The ribs, of a nearly uniform depth of 13 feet, are formed of a web plate and flanges of steel plate. The Niagara arched Railway Bridge, replacing a suspension bridge, was erected without stopping the traffic. The span is 650 feet and the rise 114 feet. The hinges are formed of two steel castings. Between~~

~~Fig. 18.~~

~~the convex face of the upper and concave face of the lower casting are 45 segmental rollers set radially to the centre of movement. The pressure on the rollers is one ton per lineal inch. The Garabit Viaduct carries the railway near St Flour, in the Cantal Department, France, at 420 feet above low water. The deepest part of the valley is crossed by an arch of 541 feet span, and 213 feet rise. The bridge is similar to that at Oporto, also designed by Mr Seyrig. It is formed by a crescent-shaped arch, continued on one side by four, on the other side by two lattice girder spans, on iron piers. The arch is formed by two lattice ribs hinged at the abutments. Its depth at the crown is 33 feet, and its centre line follows nearly the parabolic line of pressures. The two arch ribs are 65^ feet apart at the springings and 20 J feet at the crown. The roadway girders are lattice, 17 feet deep, supported from the arch ribs at four points. The total length of the viaduct is 1715 feet. The lattice girders of the side spans were first rolled into place, so as to project some distance beyond the piers, and then the arch ribs were built out, being partly supported by wire-rope cables from the lattice girders above. The~~

~~total weight of ironwork was 3200 tons and the cost £124,000 (Annales des travaux publiques, 1884).~~

~~In suspension bridges the principal member is in tension, and can be made of material of great tenacity, such as ■wire. The compression memberrequired in girder bridges is absent. Hence, suspension bridges should be economical in cost. But, on the other hand, expensive piers and anchorages are necessary, together with stiffening members to counteract the flexibility of the chain. The Ordish Bridge, built at Prague in 1868, had obKque chains supporting Suspensloa ^.j^g stiffening girders at intermediate points of "* the span. A curved chain supports the oblique chains and keeps them straight. Cables are now made of wire either in twisted strands or laid paraUeL In the East Eiver Bridge, New York (see Plate), the individual wires forming the cable were led over the piers one by one, thus avoiding the severe straining to which heavy cables are subjected from flexure over the saddles and elsewhere during erection.~~

~~The Brooklyn Bridge, New York, including approaches, is 5989 feet long. The centre span is 1596 j feet, and the clear height over the water 135 feet. The tower piers are built on caissons. The roadway is suspended from four steel- wire cables. Number of wires in strands of cable, 278; strands in each cable, 19; wires(7B."W.G.) in each cable, 5296 ; strength of cable per square inch, 71 tons ; total weight of bridge, 14,680 tons ; approximate cost, £3,067,000.~~

~~The Tower Bridge, London, is a suspension bridge with a second- ary bascule bridge in the centre span to permit the passage of ships (see Plate). Two main towers in the river and two towers on the shore abutments cany the suspension chains. The openin" bridge between the river towers consists of two leaves or bascules, pivoted near the faces of the piers and rotating in a vertical plane. When raised, the width of 200 feet between the main river piers is unobstructed up to the high-level foot-bridge,~~

~~which is 141 feet above Trinity H. W. The clear width of the two shore spans is 270 feet The total length of the bridge is 940 feet, and that of the approaches 1260 feet on the north and 780 feet on the south. The width of the bridge between parapets is 60 feet, except across the centre span, where it is 49 feet. The main towers consist Of a skeleton of steel, enclosed in a~~

~~facing of granite and Portland stone, backed with brickwork. There are two high-level footways for use when the bascules are raised, the main girders of which are of the cantilever and suspended girder type. The cantilevers are fixed to the shore side of the towers. The middle girders are 120 feet in length and attached to the cantilevers by links. The main suspension chains are carried across the centre span in the form of horizontal ties resting on the high-level footway girders. These ties are jointed to the hanging chains by pins 20 inches in diameterwith a ring in halves surrounding it 5 inches thick. One half ring is rigidly attached to the tie and one to the hanging chain, so that the wear due to any movement is distributed over the length of the pin. A rocker bearing under these pins transmits the load at the joint to the steel columns of the towers. The abutment towers are similar to the river towers. On the abutment towers the chains are connected by horizontal links, carried on rockers, to anchor ties. The suspension chains are constructed in the form of braced girders, so that they are stiff against un-symmetrical loading. Each chain over a shore span consists of two segments, the longer attached to the tie at the top of the river tower, the shorter to the link at the top of the abutment tower, and the two jointed together at the lowest point. Transverse girders are hung from the chains at distances of 18 feet. There are fifteen main transverse girders to each shore span, with nine longitudinal girders between each pair. The trough flooring, f inches thick and 6 inches deep, is riveted to the longitudinals. The anchor ties are connected to girders embedded in large concrete blocks in the foundations of the approach viaducts.~~

~~The two bascules are each constructed with four main girders. Over the river these are lattice girders, with transverse girders 12 feet apart, and longitudinal and subsidiary transverse girders dividing the floor into rectangles 3 feet by 3i feet covered with buckled plates. The roadway is of pine blocks dowelled. The bascules rotate through an angle of 82°, and their rear ends in the bascule chambers of the piers carry 365 tons of counterweight, the total weight of each being 1070 tons. They rotate on steel shafts 21 inches in diameter and 48 feet long, and the bascules can be lifted or lowered in one minute, but usually the time taken is one and a half minutes. They are worked by hydraulic machinery.~~

~~The main girders of girder bridges consist of three principal members, a tension and compression boom or chord, and a web. When the booms are parallel the web resists the shear. If one or both ?‘f?*’’ booms are curved the straining action on the web is diminished. At first the girders had plate webs even for large spans, but now plate webs are not used for spans over 50 to 75 feet. The web in modern girders is an arrangement of struts and ties termed bracing. In some girder bridges the members are jointed or connected by pins, in others they are more rigidly connected by riveting. The pin connexion system first used in England in the Cnmilin and Newark Dyke Bridges is now much more commonly adopted in America, so that it has come to be regarded as a distinctively American feature. With pin connexions some weight is saved in the girders, and erection is easier, but the girders are less rigid than riveted girders and suffer more from oxidation. Commonly now the pin connexion is restricted to tension members. A fundamental difference in girder bridges arises from the method of support. In the simplest case the main girders are supported at the ends, and if there are several spans, are discontinuous. Next, the main girder may be supported at more than two points so as to be continuous over two or more spans. This economizes weight, but the objection is that very smaU, alterations of level of the supports involve comparatively large differences in the straining action. Settlement of one of the piers might perhaps render the girder unsafe. A girder may be supported at the centre and then forms a pair of canti- levers. Lastly, some bridges are composed of cantilevers and suspended girders. The main girder is then virtually a continuous girder hinged at the points of contrary flexure so that no ambiguity can arise as to the stresses.~~

~~Figs. 19, 20, and 21 show an independent girder, a cantilever, and a cantilever and suspended girder bridge.~~

~~In a three-span bridge continuous girders are lighter than discontinuous ones by about 45 per cent, for the dead load and 15~~

~~per cent, for the live load, if no allowance is made for ambi- guity due to uncer- tainty as to the level of the supports. The cantilever and suspended girder types are as eco- nomical and free from uncertainty as to the stresses. In long- span bridges the cantilever system permits erection by building out, -which is economical and sometimes necessary. It is, however, unstable unless rigidly fixed at the piers. In the Forth Bridge stability is obtained partly by the great excess of dead over live load, partly by the gi'eat width of the river piers. The majority of bridges not of great span have girders with parallel booms. This~~

~~Fig. 19.~~

~~Fig. 20.~~

~~involves the fewest difficulties of workmanship and perhaps permits the closest approximation of actual to theoretical dimensions of the parts. In spans over 200 feet it is economical to have one horizontal boom and one polygonal (approximately parabolic) boom. The hog- backed girder is a compromise between the two types, avoiding some difficulties of construction near the ends of the girder.~~

~~Fig. 21.~~

~~Most braced girders may be considered as built up of two simple forms of truss, the king-post truss (Fig. 22, a), or the jjueen-post truss (Fig. 22, i). These may be used either in the upright or the inverted position. A multiple truss consists of a number of simple~~

~~Fig. 22.~~

~~trusses, e.g., Bollman truss (see Bkidobs, ninth edition). Some timber bridges consist of queen-post trusses in the upright position, as shown diagrammatically in Fig. 23, where the circles indicate points at which the flooring girders transmit load to the main~~

~~Fig. 23.~~

girders. Compound trusses consist of simple trusses used as primary, secondary, and tertiary trusses, the secondary supported on the primary, and the tertiary on the secondary. Thus, the Fink tniss consists of king-post trusses ; the Pratt truss (Fig.

24) and “Whipple truss (Fig. 25) of queen-post trusses ; the Varren truss of queen-post trusses alternately upright and inverted.

A combination bridge is built partly of timber, partly of steel, the compression mpmbers being generally of timber and the tension

Fig. 24.

members of steel. On the Pacific coast, where excellent timber is obtainable and steel works are distant, combination bridges are still largely used (Ottewell, Trans. Am. Soc. Civil Eng. xxvii. p. 467). The combination bridge at Eoseburgh, Oregon, is a cantilever bridge. The shore arms are 147 ft. span, the river arms 105 ft, and the suspended girder 80 ft., the total distance between anchor piers being 584 ft. The floor beams, floor, and railing are of timber. The compression members are of timber

Fig. 25.

except the struts and bottom chord panels next the river piers, which are of steeL The tension members are of iron and the pins of steeL The chord blocks and post shoes are of oast iron.

The exceptional local conditions at the site of the Forth Bridge led to the adoption there of the cantilever system, till then little considered. Now it is well understood that in many Q^g^/jgygf positions that system is the simplest, most convenient, j,yj„s_ and most economical method of bridging. The spans are virtually reduced to smaller spans so far as the girders are con- cerned ; and what is much more important, the cantilevers can be built out from the piers, member by member, and no river staging is required. Mr. Waddell has shown that, in some cases, it is convenient to erect simple independent spans, by building them out as cantilevers and converting them into independent girders after erection. Fig. 26 shows girders erected in this

~~way, the dotted lines being temporary members during erection, which are removed~~

~~Fig. 26.~~

~~afterwards. The side spans are erected first on staging and anchored to the piers. From these, by the aid of the temporary members, the centre span is built out from both sides. The principal cantilever bridges are(l) the Forth Bridge, with two central spans of 1710 ft., and two anchor spans of 680 ft. ; (2) the railway bridge at Memphis over the Mississippi, span 790 ft. ; (3) the Red Rock Bridge over the Colorado river, with a span of 660 ft. and anchor spans of 165 ft., suspended girder 330 ft. in length ; (4) the Poughkeepsie Bridge over the Hudson ; (5) the Lansdowne Bridge over the Indus at Sukkur, which, though designed later, was erected earlier than the Forth Bridge ; (6) the Niagara Bridge for a railway — towers 495 ft. high, cantilever arms each 175 ft., suspended girder 120 ft., total length of bridge 910 ft.~~

~~The Forth Bridge was described in Eney. Brit. vol. xx. p. 234. Further details may be found in The Forth Bridge, by W. West- hofen, reprinted from Engineering ; "The Forth Bridge," by Sir B. Baker, Beports of British Association, 1884 and 1885 ; Die Forth BrUcke, von G. Barkhausen, Berlin, 1889 ; The Forth Bridge, by Philip Philips, Edinburgh. In the Sukkur Bridge (Fig. 27), the~~

~~Fig. 27.~~

~~clear span is 790 ft., and the suspended girder 200 ft. in length. The span to the centres of the end uprights is 820 ft. ■ width between centres of main uprights at bed-plate 100 ft., and between centres of main members at end of cantilevers 20 ft. The bridge is for a single line of railway of 5 ft. 6 in. gauge. The back guys are the most heavily strained part of the structure, the stress provided for being 1200 tons. This is due to the half weight of~~

~~centre girder, the weight of the cantilever itself, the rolling load on half the bridge, and the wind pressure. The anchors are built up of steel plates and angle bars, and are buried in a large mass of concrete. The area of each anchor plate, normal to the line of ^reas, is 32 ft. by 12 ft. The bridge was designed by Sir A. Kendel, the consulting engineer to the Indian Government.~~

~~In the United States, few railway companies design or build their own bridges. General specifications as to span, loading, &c., are furnished to bridge-buUding companies, which make the design under the direction of engineers who are experts in this kind of work. The design, with strain sheets and detail drawings, is sub- mitted to the railway engineer with estimates. The result is that American bridges are generally of well -settled types and their members of uniform design, carefully considered with reference to convenient and accurate manufacture. Standard patterns of details are largely adopted, and more system is introcfiiced in the workshop than is possible where designs are more varied. Riveted plate girders are used up to 50 ft. span, riveted braced girders for spans of 50 ft. to 75 ft., and pin-connected girders for longer spans. Since the erection of the Forth Bridge, cantilever bridges have been extensively used, and some remarkable steel arch and suspension bridges have also been constructed. Overhead railways are virtually continuous bridge constructions, and much attention has been given to a study of the special conditions appertaining to that case.~~

~~Consideration of the local conditions aflfecting the erection of bridges is always important, and sometimes becomes a controlling factor in the determiner tion of the design. The methods of erection may be classed as — (1) erection on staging or falsework ; (2) floating to the site and raising ; (3) rolling out from one abutment ; (4) building out member by member, the completed part forming the stage from which additions are handled.~~

~~(1) In erection on staging, the materials available determine the character of the staging ; stacks of timber, earth banks, or built- up staging of piles and trestles have all been employed, also iron staging, which can be rapidly erected and moved from site to site. The most ordinary type of staging consists of timber piles at nearly equal distances of 20 ft. to 30 ft., carrying~~

~~a timber plat- form, on which the bridge is erected. Sometimes a wide space is left for navigation, and the platform at this part is carried by a timber and iron truss. When the headway is great or the river deep, timber-braced piers or clusters of piles at distances of 50 ft. to 100 ft. may be used. These carry temporary trusses of timber or steel. The Kuilenburg Bridge in Holland, which has a span of 492 ft., was erected on a timber staging of this kind, containing 81,000 cubic feet of timber and 5 tons of bolts. The bridge superstructure weighed 2150 tons, so that 38 cubic feet of timber were used per ton of superstructure. ,~~

~~(2) The Britannia and Conway Bridges were built on staging on shore, lifted by pontoons, floated out to their position between the piers, and lastly lifted into place by hydraulic presses. The Moerdyk Bridge in Holland, with 14 spans of 328 ft., was erected in a similar way. The convenience of erecting girders on shore is very great, but there is some risk in the floating operations and a good deal of hauling plant is required.~~

~~(3) If a bridge consists of girders continuous over two or more spans, it may be put together on the embankment at one end and rolled over the piers. In some cases hauling tackle is used, in others power is applied by levers and ratchets to the rollers on which the girders travel. In such rolling operations the girder is subjected to straining actions different from those which it is intended to resist, and parts intended for tension may be in compression ; hence it may need to be stiffened b^ timber during rolling. The bending action on the bottom boom in passing over the rollers is also severe. Modifications of the system have been adopted for bridges with discontinuous spans. In narrow ravines a bridge of one span may be rolled out, if the projecting end is supported on a temporary suspension cable anchored on each side. The free end is slung to a block running on the cable. If the bridge is erected when the river is nearly dry a travelling stage may be constructed to carry the projecting end of the girder while it is hauled across, the other end resting on one abutment. Sometimes a girder is rolled out about one-third of its length, and then supported on a floating pontoon.~~

~~(4) Some types of bridge can be built out from the abutments, the completed part forming an erecting stage on which lifting appliances are~~

~~fixed. Generally, in addition, wire cables are stretched across the span, from which lifting tackle is suspended. In bridges so erected the straining action during erection must be studied, and material must be added to resist erecting stresses. In the case of the St Louis Bridge, half arches were built out on either side of each pier, so that the load balanced. Skeleton~~

~~towers on the piers supported chains attached to the arched ribs at suitable points. In spite of careful provision, much difficulty was experienced in making the connexion at the crown, from the expansion due to temperature changes. The Douro Bridge was similarly erected. The girders of the side spans were rolled out so as to overhang the great span by 105 ft. , and formed a platform from which parts of the arch could be suspended. Dwarf towers, buUt on the arch ring at the fifth panel from either side, helped to support the girder above, in erecting the centre part of the arch (Seyrig, Proc. Imt. C. E. Ixiii. p. 177). The great cantilever bridges have been erected in the same way, and they are specially adapted for erection by building out. (yr. c. U.)~~

~~Bridgeton, capital of Cumberland county, New Jersey, U.S.A., situated in 39° 26′ N. lat. and 74° 14′ W. long., in the southern part of the state, on Cohansey Creek, which is tidal and navigable at this point. It is entered by two railways, the Central of New Jersey and the West Jersey and Southern. Population (1880),~~

~~8722; (1890), 11,424; (1900), 13,913.~~

~~BridgfWater, a municipal borough (extended in 1896), seaport, and market town in the Bridgwater parlia- mentary division of Somersetshire, England, 12 miles N.E. of Taunton by rail, on the Parret. Recent erections are a corn exchange and waterworks ; the infirmary has been enlarged. The value of foreign and colonial imports in~~

~~1900 was £104,827 ; of exports of produce and manufac- tures of the United Kingdom, £5682. The tonnage entered in 1900 was 162,626 (of which 148,870 tons was coajSting) ; the tonnage cleared was 159,889 (of which 157,640 tons was coasting). The registered shipping in~~

~~1901 was 90 sailing vessels of 5724 tons, and 10 steamers of 499 tons. Population on the enlarged area (1891),~~

~~13,264 ; (1901), 15,209.~~

~~Bridport, a municipal borough, seaport, and market town in the Western parliamentary division (since 1885) of Dorsetshire, England, 18 miles W. of Dorchester, on the Brit, and a branch of the Great Western railway. Area, 571 acres. Population (1881), 6795 ; (1891), 6611 ;~~

~~(1901), 5710.~~

~~Brieg', a town of Prussia, province of Silesia, on the Oder, 26 miles S.E. from Breslau, by the railway to Beuthen. It is an industrial place, manufacturing cigars, millstones, ribbons, leather, machinery, paper, and sugar. The castle (begun 1544) is now used as a military store. Population (1885), 18,899; (1895), 21,164.~~

~~Brig^house, a municipal borough (1893) in the EUand parliamentary division of the West Biding of Yorkshire, England, 4 miles N.E. of Huddersfield by rail, on the river Calder. It is governed by a mayor, 8 alder-men, and 24 councillors. There are a technical school, a theatre and operarhouse, and a public library, opened in 1898 in commemoration of Queen Victoria's Diamond Jubilee. The corporation owns gas, water, and electric- lighting works, but a new scheme of electric lighting has been adopted. Extensive sewage works were commenced in 1896. Population of municipal borough area (1891),~~

~~20,666; (1901), 21,735.~~

~~Bright, Sir Charles Tiiston (1832-1888),~~

~~telegraph engineer, the youngest son of Mr Brailsford Bright, was bom on 8th June 1832, at Wanstead. iHe was employed from very early youth in telegraph work. At the age of twenty he became engineer to the Magnetic Telegraph Company, and in that capacity — ^the telegraphs had not at that time been taken over by the State — superintended the laying of lines in various parts of Great Britain. He was also working out in conjunction with~~

his brother many valuable telegraphic inventions. In 1 853 he laid the first submarine cable between England and Ireland. His experiments soon convinced him of the practicability of signalling electrically between the British Isles and

America, and though the very idea was regarded as absurd by some of the leading authorities of the day, with the aid of friends he raised the money with which to make the attempt. The result was the first Atlantic cable — that of 1858. As is well known, this, regarded as a means of practical communication, had only a very limited success, and largely on account of the ill-treatment to which it was subjected by the ignorance of the operators its useful life was a very brief one. It was, however, quite sufficient to prove the general principle that electrical signals can be sent for thousands of miles under the sea. Subsequently, Sir Charles Bright himself supervised the laying of sub- marine cables in almost every region of the world. He died on 3rd May 1888, at Abbey Wood, near London.

Bright, John (1811-1889), British manufacturer, political economist, and statesman, was born at Rochdale on 16th November 1811. His father, Jacob Bright, was a much respected member of the Society of Friends, who had started a cotton-mill at Rochdale in 1809. The family had reached Lancashire by two migrations. Abraham Bright was a Wiltshire yeoman, who, early in the 18th century, removed to Coventry, where his descendants remained, and where, in 1776, Jacob Bright was born. Jacob Bright was educated at the Ackworth School of the Society of Triends, and was apprenticed to a fustian manufacturer at New Mills. He married his employer's daughter, and settled with his two brothers-in-law at Eochdale in 1802, going into business for himself seven years later. His first wife died without children, and in 1809 he married Martha Wood, daughter of a trades- man of Bolton-le-Moors. She had been educated at Ackworth school, and was a woman of great strength of character and refined taste. There were eleven children of this marriage, of whom John Bright was the second, but the death of his elder brother in childhood made him the eldest son. He was a delicate child, and was sent as a day-scholar to a boarding-

~~school near his home, kept by Mr William Littlewood. A year at the Ackworth school, two years at a school at York, and a year and a half at Newton, near Clitheroe, completed his education. He learned, he himself said, but little Latin and Greek, but acquired a great love of English literature, which his mother fostered, and a love of outdoor pursuits — especially fishing, which became his chief relaxation in later years. In his sixteenth year he entered his father's mill, and in due time became a partner in the business. Two agitations were then going on in. Eochdale — the first (in which Jacob Bright was a leader) in opposition to a local church-rate, and the second for parliamentary reform, by which Eochdale successfully claimed to have a member allotted to it under the Eeform Bill. In both these move- ments John Bright took part. He was an ardent Non- conformist, proud to number among his ancestors John Gratton, a friend of George Fox, and one of the persecuted and imprisoned preachers of the Society of Friends. His political interest was probably first kindled by the Preston election in 1830, ta which Lord Stanley, after a long struggle, was defeated by "Orator" Hunt. But it was as a member of the Eochdale Juvenile Temperance Band that he firfet learned public speaking. These young men went out into the villages, borrowed a chair of a cottager, and spoke from it at open-air meetings. In Mrs John Mills's life of her husband is an account of John Bright's first extempore speech. It was at a temperance meeting. Bright got his notes muddled, and broke down. The chairman gave out a temperance song, and during the singing told Bright to put his notes aside and say what came into his mind. Bright obeyed, began with much hesitancy, but found his tongue and made an excellent address. On some early occasions, however, he com-**

~~mitted his speech to memory. In 1832 he called on the Rev. John Aldis, an eminent Baptist minister, to accom- pany him to a local Bible meeting. Mr Aldis described him as a slender, modest young gentleman, who surprised him by his intelligence and thoughtfulness, but who seemed nervous as they walked to the meeting together. At the meeting he made a stimulating speech, and on the way home asked for advice. Mr Aldis counselled him not to learn his speeches, but to write out and commit to memory certain passages and the peroration. Bright took the advice, and acted on it all his life.~~

~~This " first lesson in public speaking," as Bright called it, was given in his twenty-first year, but he had not then contemplated entering on a public career. He was a fairly prosperous man of business, very happy in his home, and always ready to take part in the social, educational, and political life of his native town. He was one of the founders of the Eochdale Literary and Philosophical Society, took a leading part in its debates, and on return- ing from a holiday journey in the East, gave the society~~

~~JOHIlf Bbight. (,J¥om. a photograph T>y MlUott and Wry.')~~

~~a lecture on his travels. He first met Richard Cobden in 1836 or 1837. Cobden was an alderman of the newly- formed Manchester corporation, and Bright went to ask him to speak at an education meeting in Eochdale. " I found him," said Bright, " in his office in Mosley Street, introduced myself to him, and told him what I wanted." Cobden consented, and at the meeting was much struck by Bright's short speech, and urged him to speak against the Corn Laws. His first speech on the Corn Laws was made at Eochdale in 1838, and in the same year he joined the Manchester Provisional Committee which in 1839 foimded the Anti-Corn Law League. He was still only the local public man, takingpart in all public movements, especially in opposition to Mr Feilden's proposed factory legislation, and to the Eochdale church-rate. In 1839 he built the house which he called " One Ash," and married Elizabeth, daughter of Jonathan Priestman of Newcastle- on-Tyne. In November of the same year there was a din- ner at Bolton to Mr Paulton, who had just returned from a successful Anti-Corn Law tour in Scotland. Among the speakers were Cobden and Bright, and the dinner is memorable as the first occasion on which the two future leaders appeared together on a Free Trade platform. Bright is described by the historian of the League as " a young man then appearing for the first time in any meeting out of his own town, and giving evidence, by his energy and by his grasp of the subject, of his capacity~~

~~soon to take a leading part in the great agitation." But his call had not yet come. In 1840 he led a movement against the Eochdale church-rate,~~

~~speaking from a tomb- stone in the churchyard, where it looks down on the town in the valley below. A very happy married Ufe at home contented him, and at the opening of the Free Trade Hall in January 1840 he sat with the Eochdale deputation, undistinguished in the body of the meeting. A daughter, Helen, was bom to him ; but his young wife, after a long illness, died of consumption in September 1841. Three days after her death at Leamington, Cobden called to see him. " I was ia the depths of grief," said Bright, when unveiling the statue of his friend at Brad- ford in 1877, " I might almost say of despair, for the life and sunshine of my house had been extinguished." Cobden spoke some words of condolence, but "after a time he looked up and said, 'There are thousands of homes in England at this moment where wives, mothers, and children are dying of hunger. Now, when the first paroxysm of your grief is past, I would advise you to come with me, and we will never rest till the Corn Laws are repealed.' I accepted his invitation," added Bright, " and from that time we never ceased to labour hard on behalf of the resolution which we had made." At the general election in 1841 Cobden was returned for Stockport, and iu 1843 Bright was the Free Trade candidate at a by-election at Durham. He was defeated, but his successful competitor was unseated on petition, • and at the second contest Bright was returned. He was already known in the country as Cobden's chief ally, and was received in the House of Commons with a suspicion and hostility even greater than had met Cobden himself. In the Anti-Corn Law movement the two speakers were the complements and correlatives of each other. Cobden had the calmness and confidence of the political philosopher, Bright had the passion and the fervour of the popular orator. Cobden did the reasoning. Bright supplied the declamation, but like Demosthenes he mingled argument with appeal. No orator of modern times rose more rapidly to a foremost place. He was not known beyond his own borough when Cobden called him to his side in 1841, and he entered Parliament towards the end of the session of 1843 with a formidable reputation as an agitator. He had been all over England and Scotland addressing vast meetings and, as a rule, carrying them with him ; he had taken a leading part in a conference held by the Anti-Corn Law League in London, had led deputations to the duke of Sussex, to Sir James Graham, then Home Secretary, and to Lord Eipon and Mr Glad- stone, the Secretary and Under Secretary of the Board of Trade; and he was universally recognized as the chief orator of the Free Trade movement. Wherever "John~~

~~Bright of Eochdale" was announced to speak, vast crowds assembled. He had been so announced, for the last time, at the first great meeting in Drury Lane Theatre on 15th March 1843 ; henceforth his name was enough. He took his seat in the House of Commons as one of the members for Durham on 28th July 1843, and on 7th August delivered his maiden speech in support of a motion by Mr Ewart for reduction of import duties. He was there, he said, " not only as one of the representatives of the city of Durham, but also as one of the representatives of that benevolent organization, the Anti-Corn Law League." A member who heard the speech described Bright as " about the middle size, rather firmly and squarely built, with a fair, clear complexion, and an intelligent and pleasing expression of coiintenance. His voice is good, his enunciation distinct, and his delivery free from any unpleasant peculiarity or mannerism." He ■wore the usual Friend's coat, and was regarded with much interest and hostile curiosity on both sides of the House.~~

~~Mr Ewart's motion was defeated, but the movement of which Cobden and Bright were the leaders continued to spread. In the autumn the League resolved to raise £100,000 ; an appeal was made to the agricultural inter- est by great meetings in the farming counties, and in November the Times startled the world by declaring, in a leading article, " The League is a great fact. It would be foolish, nay, rash, to deny its importance." In London great meetings were held in Covent Garden Theatre, at which William Johnson Fox was the chief orator, but Bright and Cobden were the leaders of the movement. Bright publicly deprecated the popular tendency to regard Cobden andhimself as the chief movers in the agitation, and Cobden told a Eochdale audience that he always stipulated that he should speak first, and Bright should follow. His " more stately genius," as Mr John. Morley calls it, was already making him the undisputed master of the feelings of his audiences. In the House of Commons his progress was slower. Cobden's argumentative speeches were re- garded more sympathetically than Bright' s more rhetorical appeals, and in a debate on Villiers's annual motion against the Corn Laws Bright was heard with so much impatience that he was obliged to sit down. In the next session (1845) he moved for an inquiry into the operation of the Game Laws. At a meeting of county members earlier in the day Peel had advised them not to be led into discussion by a violent speech from the member for Durham, but to let the committee be~~

~~granted without debate. Bright was not violent, and Cobden said that he did his work admirably, and won golden opinions from all men. The speech established his position in the House of Commons. In this session Bright and Cobden came into opposition, Cobden voting for the Maynooth Grant and Bright against it. On only one other occasion — a vote for South Kensing- ton — did they go into opposite lobbies, during twenty-five years of parliamentary life. In the autumn of 1845 Bright retained Cobden in the public career to which Cobden had invited him four years before. Bright was in Scotland when a letter came from Cobden announcing his determination, forced on him by business difQculties, to retire from public work. Bright replied that if Cobden retired the mainspring of the League was gone. "1 can in no degree take your place," he wrote. "As a second I can fight, but there are incapacities about me, of which I am fully conscious, which prevent my being more than second in such a work as we have laboured in." A few days later he set off for Manchester, posting in that wettest of autumns through "the rain that rained away the Corn Laws," and on his arrival got his friends together, and raised the money which tided Cobden over the emergency. The crisis of the struggle had come. Peel's budget in 1845 was a first step towards Free Trade. The bad harvest and the potato disease drove him to the repeal of the Corn Laws, and, at a meeting in Manchester on 2nd July 1846, Cobden moved and Bright seconded a motion dissolving the League. A library of twelve hundred volumes was presented to Bright as a memorial of the struggle.~~

~~Bright married, in June 1847, Miss Margaret Elizabeth Leatham, of Wakefield, by whom he had seven children, Mr John Albert Bright being the eldest. In the succeed- ing July he was elected for Manchester, with Mr MUner Gibson, without a contest. In the new Parliament, as in the previous session, he opposed legislation restricting the hours of labour, and, as a Nonconformist, spoke against clerical control of national education. In 1848 he voted for Hume's household suffrage motion, and introduced a Bill for the repeal of the Game Laws. When Lord John Eussell brought forward his Ecclesiastical Titles BUI, Bright opposed it as " a little, paltry, miserable measure,"~~

~~and foretold its failure. In this Parliament he spoke much on Irish questions. In a speech in favour of the Government Bill for a rate in aid in 1849, he won loud cheers from both sides, and was complimented by Disraeli for having sustained the reputation of that assembly. Prom this time forward he had the ear of the House, and took effective part in the debates. He spoke against capital punishment, against church rates, against flogging in the army, and against the Irish Established Church. He supported Cobden's motion for the reduction of public expenditure, and in and out of Parliament pleaded for peace. In the election of 1852 he was again returned for Manchester on the principles of free trade, electoral reform, and religious freedom. But war was in the air, and the most impassioned speeches he ever delivered were addressed to this Parliament in fruitless opposition to the Crimean War. Neither the House nor the country would listen. " I went to the House on Monday," wrote Macaulay in March 1854, " and heard Bright say every- thing I thought." His most memorable speech, the greatest he ever made, was delivered on 23rd February 1855. " The angel of death has been abroad throughout the land. You may almost hear the beating of his wings," he said, and concluded with an appeal to the Prime Minister that moved the House as it had never been moved within living memory. There was a tremor in Bright's voice in the touching parts of his great speeches which stirred the feelings even of hostile listeners. It was noted for the first time in this February speech, but the most striking instance was in a speech on Mr Osborne Morgan's Burials Bill in April 1876, in which he described a Quaker funeral, and protested against the "miserable superstition of the phrase, ' buried like a dog.' " " In that sense," he said, " I shall be buried like a dog, and all those with whom I am best acquainted, whom I best love and esteem, will be ' buried like a dog.' Nay more, my own ancestors, who in past time suffered persecution for what is now held to be a righteous cause, have all been buried like dogs, if that phrase is true." The tender, half-broken tones in which these words were said, the inexpressible pathos of his voice and manner, were never forgotten by those who heard that Wednesday morning speech.~~

~~Bright was disqualified by illness during the whole of 1856 and 1867. In Palmerston's penal dissolution in the latter year. Bright was rejected by~~

~~Manchester, but in August, while ill and absent, Birmingham elected him without a contest. He returned to Parliament in 1858, and in February seconded the motion which threw out Lord Palmerston's government. Lord Derby thereupon came into office for the second time, and Bright had the satisfaction of assisting in the passing of two measures which he had long advocated, the admission of Jews to Parliament and the transfer of the government of India from the East India Company to the Crown. He was now restored to full political activity, and in October addressed his new constituents, and started a movement for parlia- mentary reform. He spoke at great gatherings at Edin- burgh, Glasgow, Bradford, and Manchester, and his speeches filled the papers. For the next nine years he was the protagonist of Eeform. Towards the close of the struggle he told the House of Commons that a thousand meetings had been held, that at every one the doors were open for any man to enter, yet that an almost unanimous vote for reform had been taken. In the debates on the Reform Bills submitted to the House of Commons from 1859 to 1867, Bright's was the most influential voice. He rebuked Lowe's "Botany Bay view," and described Horsman as retiring to his "cave of AduUam," and hooking in Lowe. " The party of two," he said, " reminds me of the Scotch terrier, which was so covered with hair~~

~~that you could not tell which was the head and which was the tail." These and similar phrases, such as the excuse for withdrawing the Eeform Bill in the year of the great budget of 1860 — "you cannot get twenty waggons at once through Temple Bar" — were in all men's mouths. It was one of the triumphs of Bright's oratory that it constantly produced these popular cries. The phrase " a free breakfast table " was his ; and on the rejection of Forster's Compensation for Disturbance Bill he used the phrase as to Irish discontent, " Force is not a remedy."~~

~~During his great reform agitation Bright had vigorously supported Cobden in the negotiations for the treaty of commerce with France, and had taken, with his usual vehemence, the side of the North in the discussions in England on the American civil war. In March 1865 Cobden died, and Bright told the House of Commons he dared not even attempt to express the feelings which oppressed him, and sat down overwhelmed with grief. Their friendship was one of the most characteristic features of the public life of~~

~~their time. “After twenty years of intimate and almost brotherly friendship with him,” said Bright, ” I little knew how much I loved him till I had lost him.” In June 1865 Parliament was dis- solved, and Bright was returned for Birmingham without opposition. Palmerston’s death in the early autumn brought Lord John Eussell into power, and for the first time Bright gave his support to the Government. Eussell’s fourth Reform Bill was introduced, was defeated by the Adullamites, and the Derby-Disraeli ministry was in- stalled. Bright declared Lord Derby’s accession to be a declaration of war against the working classes, and roused the great towns in the demand for reform. Bright was the popular hero of the time. As a political leader the winter of 1866-67 was the culminating point in his career. The Reform Bill was carried with a clause for minority representation, and in the autumn of 1868 Bright, with two Liberal colleagues, was again returned for Birmingham. Mr Gladstone came into power with a programme of Irish reform in church and land such as Bright had long urged, and he accepted the post of President of the Board of Trade. He thus became a member of the Privy Council, with the title of Eight Honourable, and from this time forth was a recognized leader of the Liberal party in Parliament and in the country. He made a great speech on the second reading of the Irish Church Bill, and wrote a letter on the House of Lords, in which he said, ” In harmony with the nation they may go on for a long time, but throwing themselves athwart its course they may meet with accidents not pleasant for thein to think of.” He also spoke strongly in the same session in favour of the bill permitting marriage with a deceased wife’s sister. The next session found him disquali- fied by a severe illness, which caused his retirement from office at the end of the year, and kept him out of public life for four years. In August 1873 Mr Gladstone reconstructed his Cabinet, and Bright returned to it as Chancellor of the Duchy of Lancaster. But his hair had become white, and though he spoke again with much of his former vigour, he was now an old man. In the election in January 1874 Bright and his colleagues were returned for Birmingham (without opposition. When Mr Gladstone resigned the leadership of his party in 1876, Bright was chairman of the party meeting which chose Lord Hartington as his successor. He took a less prominent part in political discussion, till the Eastern Question brought Great Britain to the verge of war with Russia, and his old energy flamed up afresh. In the debate on the Vote of Credit in February 1878, he made one of his impressive speeches, urging the Govern- ment not to~~

increase the difficulties manufacturers had in finding employment for their workpeople by any single

word or act whicli could shake confidence in business. The debate lasted five days. On the fifth day a telegram from Mr Layard was published announcing that the Russians were nearing Constantinople. The day, said the Times, " was crowded with rumours, alarms, contradictions, fears, hopes, resolves, uncertainties." In both Houses Mr Layard's despatch was read, and in the excited Commons Mr Forster's resolution opposing the Vote of Credit was withdrawn. Bright, however, distrusted the ambassador at the Porte, and gave reasons for doubting the alarming telegram. While he was speaking a note was put into the hands of Sir Stafford Northcote, and when Bright sat down he read it to the House. It was a confirmation from the Russian prime minister of Bright's doubts : " There is not a word of truth in the rumours which have reached you." At the general election in 1880 he was re-elected at Birmingham, and joined Mr Gladstone's new government as Chancellor of the Duchy of Lancaster. For two sessions he spoke and voted with his colleagues, but after the bom- bardment of the Alexandria forts he left the ministry and never held oflce again. He felt most painfully the sever- ance from his old and trusted leader, but it was forced on him by his ^ conviction of the danger and impolicy of foreign entanglements. He, however, gave a general support to Mr Gladstone's government. In 1883 he took the chair at a meeting of the Liberation Society in Mr Spurgeon's chapel; and in June of that year was the object of an unparalleled demonstration at Birmingham to celebrate his twenty-five years of service as its representative. At this celebration he spoke strongly of " the Irish rebel party," and accused the Con- servatives of "alliance" with them, but withdrew the imputation when Sir Stafford Northcote moved that such language was a breach of the privileges of the House of Commons. At a banquet to Lord Spencer he accused the Irish members of having " exhibited a boundless sympathy for criminals and murderers." He refused in the House of Commons to apologize for these words, and was supported in his refusal by both sides in the House. At the Birming- ham

~~election in 1885 he stood for the Central Division of the redistributed constituency ; he was opposed by Lord Randolph Churchill, but was elected by a large majority. In the new Parliament he voted against the Home Rule Bill, and it was generally felt that in the election of 1886 which followed its defeat, when he was re-elected with- out opposition, his letters told with fatal effect against the Home , Rule Liberals. His contribution to the dis- cussion was a suggestion that the Irish members should form a Grand Committee to which every Irish bill should go after first reading. The break-up of the Liberal party filled him with gloom. His last speech at Bir- mingham was on 29thr March 1888 at a banquet to cele- brate Mr Chamberlain's return from his Peace Mission to the United States. He spoke of Imperial Federar tion as "a dream and an absurdity." In May his ill- ness returned, he took to his bed in October and died on 27th March 1889. He was buried in the grave- yard of the meeting — house of the Society of Friends in Rochdale.~~

~~Bright had much literary and social recognition in his latef years. In 1882 he was elected Lord Rector of the University of Glasgow, and Dr Dale wrote of his Rectorial address, " It was not the old Bright." " I am weary of public speaking," he had told Dr Dale; "my mind is almost a blank." He was given an honorary degree of the University of Oxford in 1886, and in 1888 a statue of him was erected at Birmingham. Lord Salisbury said of him, and it sums up his character as a public man, " He was the greatest master of English oratory that this generation — I may say several generations — has seen. ... At a time when much speaking has depressed, has almost~~

~~exterminated, eloquence, he maintained that robust, powerful, and vigorous style in which he gave fitting expression to the burning and noble thoughts he desired to utter."~~

~~No full biography of Bright has been published since his death. The fullest is The Life and Speeches of the Bight Hon. John Bright, M.P., by George Baknett Smith, 2 vols. 8vo., 1881. See also The Life of John Bright, M.P., by John M'Gilchrist, in Cassell's Representative Biographies, 1868. — John Bright, by C. A. ViNCE, 1898. — Speeches on Parliamentary Beform by John Bright, M.P., revised by himself, 1866. — Speeches on Questions~~

~~of Public Policy, by John Bright, M.P., edited by J. E. Thorold Rogers, 2 vols. Svo., 1868. — Public Addresses, edited by J. E. Thorold Rogers, 8vo., 1879. — Public Letters of the Bight Son. John Bright, M.P., collected by H. J. Leech, 1885. (p. w. c.)~~

~~Brighton, a municipal, county (1880), and par- liamentary borough of England, on the English Channel, 50^ miles by rail S. of London, 44 miles E. of Ports- mouth, 34 miles W. of Hastings, in the county of Sussex, on the London, Brighton, and South Coast rail- way. The municipal borough of Hove, with which in 1893 was incorporated the parish of Aldrington, adjoins the county borough of Brighton. The parish of Hove forms part of the parliamentary borough of Brighton, but the parish of Aldrington is a part of the Mid or Lewes parliamentary division of Sussex. Preston to the north, formerly a distinct suburb, is now absorbed in the giunicipal and parliamentary borough of Brighton. Practically one town, Brighton and Hove extend 4 miles, east to west, along the coast, fronted, for a length of 3 miles, by a massive sea-wall, 60 feet high, 23 feet thick at the base, and 3 feet at the summit, and a fashionable pro- menade. Till 1894, when its boundaries were altered, Brighton was distributed into 7, but since then into 14 wards, under the government of a mayor, 14 aldermen, and 42 councillors. Incorporated by Royal Charter 1898, Hove is under a mayor, 10 aldermen, and 30 councillors. In continuous fast growth, Brighton now comprises more than 700 streets and squares. Recent improvements in- clude the widening of King's Road (1888) ; improvements effected on the Marine Parade (1890) ; an electric railway along the beach ; a railway (opened 1887) from Brighton to Devil's Dyke, 5^ miles distant; electric tramways (1901); "railway in the sea," from Kemp Town to Rottingdean, &c. The Corporation are erecting at Port- slade, at a total cost of about £270,000, a large power station to 'enable them to meet the increasing demand for electricity in the borough. Extension works for augment- ing the existing supply of water are being carried out at an estimated cost of over £100,000. There are 35 churches, and over 50 dissenting chapels. The more recent churches include St Paul's, with elaborate decora- tions, completed 1885 ; Trinity church, restored and partly rebuilt 1887 ; St Andrew's, St Nicholas' (the old parish church, dating from the 12th century), restored 1884; All Saints', the new parish church of Hove (1891), costing £19,400; St Augustine's (1896); the church of St Philip in~~

Aldrington parish, erected since 1893, but still incomplete. The Brighton municipal school of science and technology, costing about £33,000, was opened in 1898. The same year the municipal school of science and art, erected in 1876 at a cost of £11,000, was enlarged and re-adapted, and St Mary's Hall (1836), for the educa- tion of daughters of poor clergymen, was also enlarged. Brighton grammar school now includes chemical and physical laboratories and a workshop, attended by between 300 and 400 boys. The Victoria lending library (1889) was rebuilt in 1901 at a cost of about £38,000, and the Hove free library was opened in 1892. Among the more recent erections are the terminus of the London, Brighton, and South Coast railway, covering 20 acres, entirely reconstructed in 1887; the west pier (1886),

lately enlarged and extended ; a new pier, completed in 1900, 1700 feet long, -with a three-deck landing-stage at its head, near the site of the chain pier, which was washed away in 1896 ; the town hall, entirely rebuilt in 1899 at a cost of nearly £48,000 ; the town hall of Hove (1882), costing £40,000 ; the new parochial offices (1894) ; the Booth collection of (1400) British birds (1893); the Victoria (1888), Cobden Bead (1894), and Hove (1894) public baths. The wholesale and retail fruit and flower market was rebuilt in 1901 at a cost of over £10,000. Places of entertainment are a theatre, rebuilt 1894 ; another theatre (1891), rebuUt 1895; a variety theatre, reconstructed 1892 at a cost of £30,000 ; a concert hall (1892) ; an alhanibra (1888). In 1876 the aquarium was enlarged, and in 1878 its roof was laid out as a terrace garden. Under the powers of their Act of 1901 the Corporation have purchased the aquarium, and are re- modelling and rearranging the building, in order to carry it on as a high-class concert hall and winter garden. The hospitals comprise a fever hospital and sanatorium (1898) ; a children's hospital (1881) ; throat and ear hos- pital (1878), re-erected 1898. There are several public parks and recreation grounds. The Corporation acquired in 1900, for the purposes of a park, 180 acres of land on the east side of Ditchling Road. The mackerel and herring fishery is

~~extensive. There are 4 daily, 1 tri- weekly, and 9 weekly newspapers. Area of municipal borough of Brighton in 1901, 2620 acres. Population (1881), 107,546; (1891), 115,873 ; (1901), 123,478. Area of municipal borough of Hove in 1901, 1694|- acres ; population (1881), 20,804; (1891), 26,097; (1901), 36,642. Area of parliamentary borough in 1891, 3715 acres; population (1881), 128,440; (1891), 142,129; (1901),~~

~~153,691.~~

~~Brighton, a watering-place in Victoria, Australia, in the county of Bourke, on the east shore of Port Phillip Bay, 7-^ miles S.E. from Melbourne, of which it is prac- tically a suburb connected by raU. Population (1881),~~

~~4755 ; (1901), 10,029.~~

~~Brin, Benedetto (1833-1898), Italian naval administrator, was born at Turin, 17th May 1833, and, until the age of 40, worked with distinction as a naval engineer. In 1873, Admiral Saint-Bon, Minister of Marine, appointed him under-secretary of state. The two men completed each other ; Saint-Bon conceived a type of ship, Brin made the plans and directed its construction. On the advent of the Left to power in 1876, Brin was appointed Minister of Marine by Depretis, a capacity in which he continued the programme of Saint-Bon, while enlarging and completing it in such way as to form the first organic scheme for the development of the Italian fleet. The huge warships Italia and Dandolo, were his work, though he afterwards abandoned their type in favour of smaller and faster vessels of the Varese a.n.d. the OarihaXdi class. By his initiative Italian naval industry, almost non-existent in 1873, made rapid progress. During his eleven years' ministry (1876-78 with Depretis, 1884-91 with Depretis and Crispi, 1896-98 with Eudini), he succeeded in creating large private shipyards, engine works, and metallurgical works for the production of armour, steel plates, and guns. In 1892 he entered the Giolitti cabinet as Minister for Foreign Affairs, accom- panying, in that capacity, the king and queen of Italy to Potsdam, but showed weakness towards France on the occasion of the massacre of Italian workmen at Aigues- Mortes. He died on 24th May 1898, while Minister of Marine in the Eudini Cabinet. He, more than any other man, must be regarded as the practical creator of the Italian navy. (h. w. s.)~~

~~Brindaban, a town of British India, in the Muttra district of the North-West Provinces, on the right bank of the Jumna, 6 miles N. of Muttra. Population, about 26,000. The municipal income in 1897-98 was Es.20,931. BrLndaban is one of the most popular places of pil- grimage in India, being associated with the cult of Krishna as a shepherd. It contains handsome temples, bathing stairs, tanks, and wells.~~

~~Brindisi, a seaport town and archiepiscopal see of the province of Lecce, Apulia, Italy, on the shore of the Adriatic, near the S.E. extremity of the kingdom, 346 miles by rail from Ancona. The port has been gradu- ally, but slowly, improved and dredged year by year, the intention being to go on with the work until there is a depth of 30 ft. all over the inner harbour ; the eastern arm was dredged to 13 ft. in 1898.~~

~~In July 1898 the Peninsular and Oriental Company (who first used Brindisi as a port of embarkation in December 1870) began to start their main line boats from Marseilles instead of from Brindisi, chiefly with the view of decreasing the cost of the overland railway journey from Calais. But at Brindisi they substituted an express service of small boats for Port Said, principally to carry the mails. The Peninsular and Oriental Company's service from "Venice viS, Brindisi to Port Said was discontinued in March 1900. But there are mail services to Greek ports and to Constantinople. During the five years 1893-97 an average of 14,728 passengers sailed annu- ally from this port ; in 1898 the number fell to 2369. Adding to the mail boats the tonnage and number of the trading ships, we find that the port was cleared by an average of 1335 vessels of 1,385,000 tons annually during the years 1888-99. In 1898 the British entries numbered 155 vessels of 362,700 tons, but in 1899 only 128 vessels of 153,000 tons. The exports average £326,100 (£253,000 in 1899) annually, and the imports £300,100 (£298,400 in 1899). There is not much industrial activity. As regards the public buildings, the cathedral has been recently restored, the castle of Frederick II. is now a convict prison, and the baptisteiy of San. Giovanni has been converted into a museum. There is also a new theatre (1899). Population, about 20,000.~~

~~Brionian Islands, The, in the Oulf of Venice, off the Istrian coast, from which they are separated by the narrow Canale di Jasana. They belong to~~

~~Austria and are twelve in number. Up to a recent period they were chiefly noted for their quarries (on S. Girolamo and Brion minore), which have been worked for centuries and have supplied material not only for the palaces and bridges of Venice and the whole Adriatic coast, but latterly for Vienna and Berlin also. As they command the entrance to the naval harbour of Pola, a strong fortress, " Port. Tegethoff," has been erected on the largest of them, together with minor fortifications on some of the others. The islands are inhabited by about 100 Italian quarrymen.~~

~~Brisbane, the capital city of Queensland, Australia,, about 25 miles from the mouth of the river Brisbane, in 27° 28′ 3″ S. lat., 153° 1′ 65″ E. long. The population has increased greatly since 1875, largely on account of the rapid growth of outlying suburbs ; in 1901 the population of Brisbane metropolitan area was 119,907. The population of the city proper in 1901 was estimated, at 28,830 persons, and of South Brisbane at 25,485. The most important suburbs are Kangaroo Point,, Fortitude Valley, New Farm, Eed Hill, Paddington, Milton, Toowong, Breakfast Creek, Bulimba, Woollon- yabba, Highgate, and Indogroopilly. The city is mostly built on a series of hills rising from the river, but. some portions of it, such as WooUonyabba and South Brisbane, are built on low-lying flats, and have from time to time been much damaged by floods. The plan of Brisbane is not in accordance with modern principles, and the streets are comparatively narrow, but they are well paved and fairly well lighted with gas. The publi& buildings are of an unusually fine order of architecture, such structures as the Parliament Houses, the new block of public offices, the Custom House, the General Post~~

~~Office, Government House (the residence of the Sov- ereign's representative), the General Museum, and the Supreme Court being conspicuous. Besides these there are many fine civic, commercial, religious, and private buildings. Both Brisbane proper and South Brisbane have town hallsj'knd there are an Anglican pro-cathedral, a !Roman Catholic cathedral, two grammar schools (one for boys and one for girls), a hospital, an opera house and two theatres, two^useums (one attached to the mines~~

~~department and the other to the agricultural department), and a national art gallery, with an annual government grant of £500, situated in the' town-hall buildings. The old Victoria iron bridge connecting North and South Brisbane was swept away in the great floods of 1893. A new bridge was commenced in 1894, and completed in 1897, at a cost of £110,000. At this point the river is a quarter of a mile wide. The city is well provided with parks and open spaces. The largest is the Victoria Park, and there are five others besides the Botanical Gardens, and the gardens of the Acclimatization Society, wherein tropical vegetation is cultivated. The mean temperature of Brisbane during December, January, and February is about 76° ; during June, July, and August, about 60°. The average rainfall over a period of 35 years was 60-01 inches. '~~

~~The municipal government of Brisbane, and also of South Brisbane, is in the hands of a corporation consisting of a mayor and ten aldermen, representing five wards ; the suburbs are under the control of shire councils and divisional boards. The sanitary arrangements of Brisbane are not worthy of so fine a city, but there is a splendid gravitation system of water-supply. The united storage capacity of the various reservoirs, one of which holds 1,000,000,000 gallons and another 400,000,000 gallons, is 225,700,000 cubic feet. Electric light has been installed by private enterprise, and is largely used. By the same means the city has been provided with a most convenient tramway service worked by electric power, which runs in all directions from the centre of the city to the suburbs. There is railway communication with Sydney to the south and Eockhampton to the north, while westwards a line runs almost as far as Cunnamulla, 660 miles distant. Telegraphic communication exists between Brisbane and, among other places, the French settlement of New Caledonia, a cable to which islands is in the hands of a French company. In 1899 nearly 1800 telephones were in use. Three daily newspapers are published. Brisbane is an important trading port, and the broad river, by careful dredging, has been rendered navigable for vessels of the largest size, ships of 6000 tons being easily able to come up to the town from the mouth. It is the terminal port of the line which carries the Queensland royal mail to Europe, and a calling port for lines of steamers to China, Japan, and Canada. The various intercolonial lines also call at Brisbane on their way to northern and southern Australian ports. As regards merchant shipping, 713~~

~~vessels with cargoes of 835,355 tons entered in 1900 ; 716 of 819,662 tons cleared. The value of the imports in 1900 was £7,184,112 ; of the exports, £9,581,562. As a manufacturing centre Brisbane has not yet attained any great importance. In the metropolitan district there are a number of boot factories, employing 1500 hands ; soap factories, 130 hands ; preserve and pickle factories, 300 hands ; breweries, 270 hands ; and tanneries, 250 hands. There are also several tobacco factories and various minor industries. North Brisbane is the principal business part, but South Brisbane is rapidly growing in population and importance. (j. d. f.)~~

~~-), French~~

~~Brisson, Eugene Henri (1835- statesman, was born at Bourges 31st July 1835. He fol-~~

~~lowed his father's profession of advocate, and, having made himself conspicuous in opposition during the last days of the empire, was appointed deputy-mayor of Paris after its overthrow. He was elected to the Assembly in 1871 as a member of the Extreme Left, and after following a steady and consistent political course for nine years was chosen its president in 1881. He showed remarkable firmness and dignity in the discharge of his duties, and in March 1885 became prime minister upon the resignation of M, Jules Ferry; but he resigned when, after the general elections of that year, he only just obtained a majority for the vote of credit for the Tongking expedition. He remained conspicuous as a public man, took a prominent part in exposing the Panama scandals, was a powerful candidate for the presidency after the murder of President Carnot in 1894, and was again president of the chamber from 1894 to 1898. In June of the latter year he formed a Cabinet when the country was violently excited over the Dreyfus affair ; his firmness and impartiality increased the respect in which he was already held by good citizens, but a chance vote on an occasion of especial excite- ment overthrew his ministry in October. No politi- cian in France enjoys a higher public reputation than M. Brisson, owing to his known uprightness and auster- ity of character.~~

~~Bristol, a city and county in itself, municipal county (1888) and parliamentary borough, and seaport of Eng- land, on the tidal river Avon at its confluence with the Frome, 8 miles S.E. of its mouth in the Bristol~~

~~Channel, 12 miles W.N.W. of Bath, 163 miles S. of Manchester, 118 miles, by the Great Western railway, W. of London,^ chiefly in the county of Gloucester but partly in that of Somerset. An important junction on the Great Western and Midland railways. In 1885 the parliamentary limits were extended, and the enlarged borough now returns 4 members, one for each of the four divisions. The govern- ment of the city consists of a mayor, 21 aldermen, 62 town councillors, and about 70 magistrates, together with a sheriff and other officers.~~

~~The see of Bristol was founded by Henry VIII. in 1542. In 1836 the sees of Gloucester and Bristol were united. In 1896 the sees were separated and a disjiinet diocese of Bristol was established. The Cathedral has been doubled in size since 1875. The Norman nave and aisles were restored in 1877 ; the Elder Lady Chapel and^the Central Tower in 1894. About £80,000 has been spent on the Cathedral since 1861. The restoration of the parish church of St Mary Eedcliff was completed in 1879 at a cost of upwards of £50,000. In the suburb of Clifton, included in the municipality of Bristol, are the churches of St Peter's (1882), All Saints' (1891), and St Anselm's (1897). There are in Bristol 18 churches of the original parishes, 24 ecclesiastical parish churches — in all 69 churches and Episcopal chapels, 6 Eoman Catholic churches, besides 5 convents connected with the Cathedral at Clifton, 23 Congregational, 19 Wes- leyan, 17 Baptist chapels, and numerous other dissent- ing places of worship. The Technical College, founded in 1885, of the Company of Merchant Venturers, supplies scientific, technical, and commercial education. Univer- sity College, to which is attached the older Medical School, dates from 1876. Clifton College, opened in 1862 and incorporated in 1877, includes a physical science school with laboratories, a museum and observatory. Colston's Girls' Day School (1891) includes domestic economy and calisthenics. There are 5 grammar and collegiate schools, a Baptist College (1679), 9 endowed charity, 4 orphan, and 4 reformatory, besides numerous board and national schools. The harbour, formed in 1809 by the conversion of the Avon and a branch of the Frome into "the Float," by the cutting~~

~~of a new channel for the Avon and the formation of two basins, comprises about 63 acres of water. Altogether, the dammed-up water area, at fixed level, measures about 85 acres. In 1884 the Avonmouth and Portishead docks at the river entrance were bought up by the city. The dock gates have also been enlarged so as to admit first-class steamships and trading vessels of 2000 tons burden. The quay accommodation withiu the harbour is over a mile in length. Clifton Eocks railway, cut in a tunnel from the gorge of the Avon to the summit of the Clifton Rocks, was opened in 1893. The council house, fine arts academy and school of science and art, post office, and commercial rooms, have all been greatly enlarged, and recent new erections are the assize courts, a theatre seating 3500 persons, St Philip's Free Public Library, Cheltenham Road Library (1901), Colston Hall, and statues of Queen Victoria (1888), Samuel Morley (1888), Edmund Burke (1894), and Edward Colston (1895), in whosefmemory are held annual Colston banquets. The museum and reference library were transferred to the Corporation in 1893, in addition to which eight other libraries have been provided for the public use. Mr Vincent Stuckey Lean, who died in 1899, bequeathed to the Corporation of Bristol the sum of £50,000 for the further development of the free libraries of the city, and with especial regard to the formation and sustenance of a general reference library of a standard and scientific character. With a view to reviving interest in the once famous hot springs there, a new spa and pump-room has been opened in Clifton, where also two Established churches and a memo- rial tower (1897) to John Cabot, the explorer, have been erected. Among the many charitable institutions are the General Hospital, opened in 1858, and since repbatedly enlarged ; Royal Hospital for sick children and women. Royal Victoria Home, and the Queen Victoria Jubilee Convalescent Home, opened by H.M. the Queen on 15th November 1899. The entire assessable value for poor rate in the union of Bristol, with a population of 65,549, was in the year 1897-98, £421,495 against £377,982 in the year 1887-88, with a population of 57,479. The amount of poor rate expended for the year 1897-98 was £34,029 against £29,300 in 1887-88. The local taxation expended by the town council of the county borough for the year 1897-98 was £183,026 against £111,190 for the year 1887-88. There are 5 daily and 5 weekly newspapers.~~

~~The principal industries are shipbuilding, ropewalks, chocolate factories, sugar refineries, tobacco mills and pipe-making, glass works, potteries, soaperies, shoe factories, leather works and tanneries, chemical works, saw mills, breweries, copper, lead, and shot works, iron works, machine works, stained paper works, anchors, chain cables, sail-cloth, buttons. A coal-field extending 16 miles south-east to Radstock avails much for Bristol manufactures.~~

~~Registered shipping in 1888 — sailing vessels, 135 of 21,901 tons ; steam vessels, 62 of 20,516 tons. In 1898 — sailing vessels, 74 of 8925 tons ; steam vessels, 87 of 31,488 tons. Ships entering port in 1888—8601 of 1,249,344 tons ; clearances, 8223 of 1,246,981 tons. In 1898 — entrances, 5136 of 1,264,023 tons; clearances, 5131 of 1,260,677 tons.~~

~~The following table will indicate the magnitude of the trade of Bristol :— Imports of foreign and colonial produce for 1898 —~~

~~Grain of all sorts .... £4,723,641~~

~~Sugar 886,623~~

~~Leather 341,828~~

~~"Wine 142,917~~

~~Total value of imports of foreign and colonial produce for 1898 . . . 11,057,715 Against this may be set — Total value of imports of foreign and colonial produce for 1888 . . . 7,863,478 Exports of the produce and manufactures of the United Kingdom for 1898—~~

~~Chemical products .... £32,972~~

~~Corn, grain, meal, and flour . 22,738~~

~~Metals of all sorts .... 873,806~~

~~Total value of exports of produce and manufactures of the United Kingdom for 1898 £1,372,815~~

~~Against this may be set —~~

~~Total value of exports of produce and manufactures of the United Kingdom for 1888 763,210~~

~~G&oss customs revenue for 1898 . . 1,617,220 „ „ 1888 . 914,108~~

~~Area of city and municipal b(irough, 11,407 acres ; population (1891), 289,280 ; (1901), 328,842. Area of parliamentary borough, 9675 acres ; population (1891), 286,231 ; (1901), 321,908.~~

~~NiCHOLL and Tatlok. Bristol, Past and Present (1881). — Hunt. Bristol; Historic Towns Series (lifil). — Latimer. Annals of Bristol in Nineteenth Century (1887) ; ditto in the eighteenth century (1893). — Prout. Picturesque Antiquities of Bristol (1893). — Weare. Collectanea relating to the Bristol Friars (1893) ; Burke's Connection with Bristol, 1774-80 (1894).~~

~~Bristol, a town of Hartford county, Connecticut, U.S.A., situated in the central part of the state, includes an area of 27 square miles of hiU country. It contains two villages, Bristol borough and Forestville, both on Pequanoc river, and on the New England railway. They have varied manufactures, chiefly of highly manufactured articles. Population of the town (1880), 5347; (1890), 7382; (1900), 9643; of the borough (1900), 6268.~~

~~Bristol, a borough of Bucks county, Pennsylvania, U.S.A., situated in the south-eastern part of the state, on Delaware river, and on a branch of the Pennsylvania rail- way, 19 miles N. of Philadelphia. Population (1880),~~

~~5273 ; (1890), 6553 ; (1900), 7104.~~

~~Bristol, capital of Bristol county, Rhode Island, U.S.A., situated on the east shore of Narragansett Bay, traversed by the New York, New Haven, and Hartford railway. The principal village, also known as Bristol, is a port of entry, with a capacious and deep harbour. It has manufactures of cotton, woollen, and rubber goods, and yards for the building of yachts, for the construction of which it is famous. Population of the town (1880),~~

~~6028 ; (1890), 5478 ; (1900), 6901.~~

~~Bristol, a city in Virginia and Tennessee, U.S.A. The state boundary follows the middle of the main street, dividing the city into two corporations, each bearing the same name. The Tennessee city is in Sullivan county ; the Virginia city, formerly known as Goodson, lies within Washington county, but is independent of county juris- diction. Bristol is situated in 36° 36′ N. lat. and 82° 11′ W. long., at an altitude of 1689 feet. It has some manu- factures, especially of iron and tobacco. It is the site of several educational institutions, among them King's and Sullin's Colleges. Branches of the Norfolk and Western and the Southern railways join here, besides which the~~

city is the terminus of two smaller railways. Population (1880), 3209; (1890), 6226; Virginia city (1900), 4579; Tennessee city (1900), 5271.

Bristow, Benjamin Helm (1832-1896), American lawyer and Secretary of the Treasury, was born in Elkton, Kentucky, in 1832. He received a college education, and was admitted to the bar in 1853. At the beginning of the Civil War he became lieutenant-colonel in the Union army, and afterwards was colonel of cavalry. He served throughout the war. He was state senator from 1863 to 1865 ; United States district attorney for the Louis- ville district, 1865-70; and Solicitor-General of the United States, 1870-72. President Grant nominated him Attorney-General of the United States in 1873, but the nomination was not confirmed. He was Secretary of the Treasury for two years after June 1874, when he vigor- ously prosecuted the whisky ring. He was an unsuccess- ful candidate for the Presidential nomination in 1876

and removed in the same year to New York to practise his profession. He died iii New York city on 22nd June 1896.

British Columbia, the western province of the Dominion of Canada. It is bounded to the eastward by the continental watershed in the Eocky Mountains, until this, in its north-westerly course, intersects the 120th meridian of west longitude, which is followed north to the 60th parallel, thus including within the province a part of the Peace river country to the east of the mountains. The southern boundary is formed by the 49th parallel and the strait separating Vancouver Island from the state of Washington. The northern boundary is the 60th parallel, the western, the Pacific Ocean, upon which the province fronts for about 600 miles, and the coast strip of Alaska for a farther distance of 400 miles. British Columbia is essentially a mountainous country, comprising practically the entire width of what has been designated the Cordillera or Cordilleran belt of North America between the parallels of latitude above indicated, its area has as yet been very imperfectly mapped, and many different mountain ranges are recognized under local names; but there are two ruling mountain systems,

~~the Eocky Mountains proper on the north-east side and the coast ranges on the south- west or Pacific side. The general direction of all these ranges is fundamentally dependent upon successive fold- ings of the earth's crust that have occurred parallel to the corresponding portion of the border of the Pacific Ocean, and their trend is therefore from south-east to northrwest. Along the south-western side of the Eocky Mountains is a very remarkable valley of considerable geological antiquity, in which several of the great rivers of the Pacific slope flow for parts of their upper courses, including the Kootenay, Columbia, Fraser, and Pinlay. This valley can be traced continuously for a length of at least 800 miles. (For further details as to the geology and physical geography of British Columbia, see the article on Canada.) One of the most important rivers of the province is the Fraser, which, rising in the Eocky Mountains, flows for a long distance to the north-west, and then turning south eventually crosses the coast ranges by a deep, canon-like valley and empties into the Strait of Georgia, a few miles south of the city of Vancouver. The Columbia, which rises farther south in the same range, flows north for about 160 miles, and then taking a short bend to the west flows south through the Kootenay country into the United States, emptying into the Pacific neaT Portland in the state of Oregon. In the north-western part of the province the Skeena flows south-west into the Pacific, and still farther to the north the Stikine rises in British Columbia, but before entering the Pacific crosses the coaist-strip of Alaska, of which the width has not yet been defined. The Liard, rising in the same district, flows east and falls into the Mackenzie, which empties into the Arctic Ocean. The head-waters of the Yukon are also situated in the northern part of the province. All these rivers are swift and are interrupted by rapids at frequent intervals, so that, as means of communication for commercial purposes, they are of indifferent value. Wherever lines of railway are constructed they lose whatever importance they may have held in this respect previously.~~

~~At an early stage in the Glacial period British Columbia was covered by the Cordilleran glacier, which moved south- eastwards and north-westwards, in correspondence with the ruling features of the country, from a gathering-ground situated in the vicinity of the 57th parallel. Ice from this glacier poured through passes in the coast ranges and to a lesser extent debouched~~

~~upon the edge of the great plains, beyond the Eocky Mountain range. The great~~

~~valley between the coast ranges and Vancouver Island was also occupied by a glacier that moved in both directions from a central point in the vicinity of Valdez Island. The effects of this glacial action and of the long periods of erosion preceding it and of other physiographic changes connected with its passing away, have most important bearings on the distribution and character of the gold- bearing alluviums of the province.~~

~~History. — The discovery of British Columbia was made by the Spaniard Perez in 1774. With Cook's visit the geographical exploration' of the coast began in 1778. Vancouver, in 1792-94, surveyed almost the entire coast of British Columbia with much of that to the north and south, for the British Government. The interior, about the same time, was entered by Mackenzie and traders of the N.W. Company, which at a later date became amal gamated with the Hudson Bay Company. In 1859, con- sequent on the discovery of gold and the large influx of miners, the mainland ^territory was erected into a separate colony under the name of British Columbia, and in 1866 this was united with Vancouver Island, under the same name. In 1869 some extension of responsible go*ernment was given to the colonies, and in 1871 British Columbia entered confederation and became part of the Dominion of Canada, sending three senators and six members of the House of Commons to the federal parliar ment. One of the conditions under which the colony entered the Dominion was the speedy construction of the Canadian Pacific railway, and in 1876 the non-fulfilment of this promise and the apparent indifference of the Government at Ottawa to the representations of British Columbia created strained relations, which were only ameliorated when the construction of a transcontinental road was begun. In subsequent years the founding of the city of Vancouver by the C.P.E., the establishment of the first Canadian steamship line to China and Japan, and that to Australia, together with the disputes with the United States on the subject of pelagic sealing, and the I discovery of the Kootenay mining districts, have been the chief events in the history of the province.~~

~~Area and Population. — The area of British Columbia is 382,300 square miles, and its population by the census of 1891 was 98,178. Since that date~~

~~this has been largely increased by the influx of piiners and others, consequent upon the discovery of precious metals in the Kootenay, Columbia, and Atlin districts. Much of this is a floating population, but the opening up of the valleys by railway and new lines of steamboats, together with the settlements made in the vicinity of the Canadian Pacific railway, has resulted in a con- siderable increase of the permanent population. The white popu- lation comprises men of many nationalities. There is a large Chinese population, the census of 1891 giving 9000, but since that date the number has greatly increased despite the tax of $50 per head on all Chinamen entering the seaports, and of late years many Japanese have also come in. The Japanese are as yet mainly in the towns, but the Chinese are found everywhere in the province. Great objection is taken by the white population to the increasing number of. " Mongolians," and legislative efforts have been made to hinder their competition with whites in the labour markets. The Japanese do not appear to be so much disliked, as they adapt themselves to the ways of white men, but they are equally objec- ticpable on the score of cheap labour.~~

~~The Indian population is returned at 24,973, that of the coast numbering 13,392 and of the interior 11,581. Of the total, 19,586 are professing Christians and 5387 pagans. The Indians are divided into very many tribes, under local names, but fall naturally on linguistic grounds into a few large groups. Thus the southern part of the interior is occupied by the Salish and Kootenay, and the northern interior by the Tinneh or Athapackan people. On the coast are the Haida, Tsimshian, Kwakiatl, Nootka, and about the Gulf of Georgia various tribes related to the Salish proper.~~

~~There is no treaty with the Indians of British Columbia, as with those of the plains, for the relinquishment of their title to the land, but the Government otherwise assists them. There is an Indian superintendent at Victoria, and under him are nine agencies throughout the province to attend to the Indians — ^relieving their sick and destitute, supplying them with seed and implements, settling their disputes, and administering justice. The Indian~~

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~~fishing stations and burial grounds are reserved, and other land has been set apart for them for agricultural and pastoral purposes. A number of schools have been established for their education ; but it is questionable whether great benefit is derived from these. Though at one time a dangerous element they are novr quiet and peaceable.~~

~~In 1891 there was a large disparity between the sexes in British Columbia, the figures showing 63,003 males to 35,170 females; the average size of a famUy being four to seven. The chief cities are Victoria, the capital, on Vancouver Island, and Vancouver on the mainland, New Westminster on the Fraser, Nanaimo on~~

~~VancouTfer Island. Eossland and Nelson in "West Kootenay are also places of importance.~~

~~Climate. — ^The subjoined figures relating to temperature and precipitation are from a table prepared by Mr R. F. Stupart, director of the meteorological service. The station at Victoria may be taken as representing the cOnditioni of the southern part of the coast of British Columbia, although the rainfall is much greater on exposed partsof the outer coast. Agassiz represents the Fraser delta, and Kamloops the southern interior district. The mean temperature naturally decreases to the northward of these selected stations, both along the coast and in the interior, while the precipitation increases.~~

~~Mean Temperature, Highest and Lowest Temperature, Mean Daily Jtange, and Precipitation at three stations in British GolumUa.~~

~~Jan.~~

~~Feb.~~

~~March.~~

~~April.~~

~~May.~~

~~June.~~

~~July.~~

~~Aug.~~

~~Sept.~~

~~Oct.~~

~~Nov.~~

~~Dec.~~

~~Tear.~~

~~Victoria.~~

~~Mean temperature~~

~~37-2~~

~~38-7~~

~~43-3~~

~~47-0~~

~~52-8~~

~~56-5~~

~~59-6~~

~~59-3~~

~~54-6~~

~~49·5~~

~~43·2~~

~~41·3~~

~~48·6~~

~~Mean daily range~~

~~9·0~~

~~10·2~~

~~13·5~~

~~15·4~~

~~17·5~~

~~17·7~~

~~20·1~~

~~19·6~~

~~17·4~~

~~13·1~~

~~9·9~~

~~8·9~~

~~14·4~~

~~Absolute highest~~

~~56~~

~~60~~

~~68~~

~~74~~

~~82~~

~~86~~

~~89~~

~~86~~

~~80~~

~~70~~

~~60~~

~~59~~

~~89~~

~~Absolute lowest~~

~~-1~~

~~6~~

~~20~~

~~24~~

~~30~~

~~36~~

~~37~~

~~37~~

~~31~~

~~22~~

~~18~~

~~8~~

~~-1~~

~~Precipitation~~

~~5-13~~

~~3‘53~~

~~2-57~~

~~2-11~~

~~1-21~~

~~1-16~~

~~0-46~~

~~0-59~~

~~1-98~~

~~3-11~~

~~6-13~~

~~7-53~~

~~35 ol~~

~~Agassiz.~~

~~Mean temperature~~

~~*33 0~~

~~37-6~~

~~44-0~~

~~46-7~~

~~53-9~~

~~58-9~~

~~63-9~~

~~64-7~~

~~57-0~~

~~51-7~~

~~39-3~~

~~36-3~~

~~48-9~~

~~Mean daily range~~

~~9-7~~

~~11-8~~

~~16-1~~

~~16-9~~

~~18-1~~

~~21-2~~

~~25-7~~

~~28-5~~

~~20-7~~

~~19-2~~

~~10-3~~

~~8-9~~

~~17-3~~

~~Absolute highest~~

~~57~~

~~64~~

~~74~~

~~82~~

~~90~~

~~95~~

~~95~~

~~97~~

~~90~~

~~82~~

~~73~~

~~58~~

~~97~~

~~Absolute lowest .~~

~~-13~~

~~-12~~

~~16~~

~~28~~

~~30~~

~~36~~

~~38~~

~~38~~

~~32~~

~~29~~

~~9~~

~~8~~

~~-13~~

~~Precipitation~~

~~7-29~~

~~6-68~~

~~5-47~~

~~5-49~~

~~4-85~~

~~3-97~~

~~1-55~~

~~1-62~~

~~5-25~~

~~6-56~~

~~8-69~~

~~9-43~~

~~66-85~~

~~Kamloops.~~

~~Mean temperature~~

~~22-3~~

~~24-3~~

~~38-1~~

~~48-2~~

~~56-8~~

~~63-6~~

~~68-8~~

~~68·3~~

~~57·1~~

~~47·7~~

~~33·3~~

~~29·0~~

~~46·5~~

~~Mean daily range~~

~~14·6~~

~~17·4~~

~~22·0~~

~~23·1~~

~~22·9~~

~~27·4~~

~~28·3~~

~~29·4~~

~~25·0~~

~~18·2~~

~~12·3~~

~~11·3~~

~~21·0~~

~~Absolute highest~~

~~56~~

~~64~~

~~69~~

~~75~~

~~86~~

~~101~~

~~101~~

~~97~~

~~87~~

~~82~~

~~65~~

~~56~~

~~101~~

~~Absolute lowest .~~

~~-27~~

~~-27~~

~~-5~~

~~24~~

~~26~~

~~39~~

~~44~~

~~39~~

~~31-~~

~~16~~

~~-22~~

~~-17~~

~~-27~~

~~Precipitation.~~

~~0-75~~

~~1-26~~

~~0-63~~

~~0-50~~

~~1-45~~

~~1-49~~

~~P42~~

~~0-53~~

~~1-00~~

~~0-72~~

~~1-00~~

~~0-80~~

~~11-55~~

~~Government. — The province is governed by a lieutenant-governor, appointed by the governor-general in council for five years, but subject to removal for cause, an executive council of five ministers, and a single legislative chamber. The executive council is appointed by the lieutenant-governor on the advice of the first minister, and retains office so long as it enjoys the support of a majority of the legislature. The powers of the lieutenant-governor in regard to the provincial Government are analogous to those of the governor- general in respect of the Dominion Government.~~

~~The British North America Act (1867) confederating the colonies, defines the jurisdiction of the provincial legislature as distinguished from that of the federal parliament, but within its own jurisdiction the province makes the laws for its own governance. The Act of the legislature may be disallowed, within one year of its passage, by the governor-general in council, and is also subject to challenge as to its legality in the Supreme Court of Canada, or on appeal by the judicial committee ot the Privy Council of the United Kingdom.~~

~~Justice. — ^There is a supreme court of British Columbia presided over by a chief justice and five puisne judges, and there are small- debt courts for amounts up to $100. II. British Columbia the Supreme Court has jurisdiction in divorce cases, this right having been invested in the colony before confederation.~~

~~Religion. — In 1891 the population was divided by creeds into — Church of England, 23,619; Methodist, 14,298; Presbyterian, 15,284 ; Roman Catiolic, 20,843 ; other denominations, 21,031 ; not stated, 3098 ; total, 98,173. These figures are now much larger, but there is no reason to suppose that the proportions have materially changed. Except in the cities a large proportion of the religious work of the province is performed by the aid of the missionary societies of England.~~

~~Education. — The educational system of British Columbia differs slightly from that of other provinces of Canada. There are three classes of schools~~

— common, graded, and high — all maintained by the Government, and all free and undenominational. There is no university, and only one collegiate establishment — ^the Methodist college at Vancouver — and that is affiliated with the M'Gill University in Montreal. The schools are controlled by trustees selected by the ratepayers of each school district, and there is a superintendent of education acting under the provincial secretary. In 1899 there were 280 schools in operation, the expenditure for educational purposes proper being $268,653, in addition to $67,362 spent by the public works department on school buildings.

Finance. — Under the terms of union with Canada, British Colum- bia receives an annual subsidy of $242,689. This with provincial taxes on real property, personal property, income tax, sales of public land, timber dues, &c., amounted in the year 1899 to $1,531,638. The expenditure for the year was $2,156,473. The deficit, how- ever, was due to special expenditure. The gross debt of the province in 1899 was $8,243,083, with assets $5,480,248, or a net debt of $2,762,835. These assets do not include new legislative

buildings or other public works. The income tax is on a sliding scale, and all taxes are subject to a discount of about J of 1 per cent, on payment being made before a specified date. In 1899 a fairly close estimate was made of the capital invested in the province, which amounted to $307,385,000, including timber, $100,000,000 ; railways and telegraphs, $47,500,000 ; mining plant and smelters, $10,500,000; municipal assessments, $45,000,000; provincial assessments, $51,500,000 ; in addition to private wealth,

$280,000,000.

Postal. — The number of letters mailed in British Columbia for 1898 was 6,700,000; of post cards, 525,000; registered letters, 165,000 ; free letters, 166,000 ; transient nevvspapers, parcels, pe- riodicals, &c., 836,000.

Mining is the principal industry of British Columbia. The country is rich in gold, silver, copper, and coal, and has some large iron deposits. From 1888 to 1898 the mining output increased from $2,608,803 to $10,906,861. By 1900 it had reached $16,344,751. For 1897-98 the figures are :—

~~1897.~~

~~189S.~~

~~Gold placer~~

~~$513,520~~

~~$643,346~~

~~Gold lode .~~

~~2,122,820~~

~~2,201,217~~

~~Silver .~~

~~3,272,836~~

~~2,375,841~~

~~Copper~~

~~266,258~~

~~874,781~~

~~Lead~~

~~1,390,517~~

~~1,077,581~~

~~Coal .~~

~~2,648,562~~

~~3,407,595~~

~~Coke .~~

~~89,155~~

~~175,000~~

~~Other materials i~~

~~151,600~~

~~151,500~~

~~Total .~~

~~$10,455,268~~

~~$10,906,861~~

~~Between 1858 — the year of the placer discoveries on the Frasei river and in the Cariboo district — and 1882 the placer yields were much heavier than in subsequent years, running from one to nearly four mUUon dollars annually, but there was no quartz mining. At the present time the greater part of the return is from lode mining, though the use of hydraulic plant has produced a fair proportion and promises to be still more productive, gravel beds of apparent richness having been recently discovered in many districts. The Kootenay districts are at present the chief centres of vein-mining, yielding free- milling gold quartz, auriferous and cupriferous pyrrhotites, as at Rossland, and large quantities of silver-bearing lead ores. Ores of copper and the precidus metals are being prospected and worked in the boundary district, and also in several places along the coast and on Vancouver Island. The mining laws are liberal, and being based on the experience gained in the adjacent mining centres of the~~

~~1 Accurate returns of these materials being unobtainable, the figures given are estimated.~~

■Western States, are convenient and effective. There are several snielting and reducing plants in operation at Trail and Nelson in the Kootenay country, and on Texada Island. In the Stocan division of the Kootenay there are five concentrating plants, and another and a cyanide plant at Phillip's Arm on the mainland. Others are being built. Mining machinery of the most modem types is being introduced wherever required.

Coal. — In 1888 the output of coal was 489,301 tons of $1,467,903 value; in 1898 it had increased to 1,135,865 tons of f 3,407,595 value. Nearly all this was the output of the coal-mines at Nanaimo and Comox on Vancouver Island ; 765,811 tons of the 1898 output were exported, 752,686 tons goiug to the United States.

Fisheries. — A large percentage of the commerce is derived from the sea, the chief product being salmon. Halibut, cod (several varieties), oolachan, sturgeon, herring, and many other fishes are also plentiful, but with the exception of the halibut these have not yet become the objects of extensive industries. There are several kinds of salmon, and they run in British Columbia waters at differ- ent seasons of the year. The quinnat or spring salmon is the largest and best table fish, and is followed in the latter part of the summer by the sockeye, which runs in enormous numbers up the Eraser river. This is the fish preferred for canning. It is of brighter colour, more uniform in size, and comes in such quantities that a constant supply can be reckoned upon by the canneries. About the mouth of the Fra- ser river from 1500 to 2000 boats are occupied during the run. The silver salmon or cohoe arrives a little later than the sockeye, but is not much used for packing except when required to make up deficien- cies. The dog-salmon and-^the humpbacked have no commercial value, and are only used by Indians. Great Britain is the chief but riot the only market for British Columbia salmon. The years vary in productiveness, 1897 having been unusually large and 1898 the small- est in five years, but the average pack is about 500,000 cases of 48 one- R) tins. The value of the salmon export for 1899 was $2,740,124, the greater part of all returns being from the Fraser river canneries, the rivers of the Inlets and Skeena river coming next in order. There are between fifty and sixty canneries, of which about fifty are on the banks of the Fraser river. The total value of the fisheries product from 1876 to 1896 inclusive was £45,912,686, of which salmon is rep- resented at

~~$28,873,083, all other kinds, including fur-seals and fish oils, making up the balance. The fish oils are extracted chiefly from several species of dog-fish, and sometimes from the basking shark, as well as from the oolachan, which is also an edible fish.~~

~~The fur-seal fishery is an important industry, though apparently a declining one, the average value of late years having been about $700,000. Owing to the low price of seal-skins and international difficulties concerning pelagic sealing in Bering Sea, where the greatest number have been taken, the business of seal-hunting is losing favour. The amount of capital invested in vessels, plant, &c. , in 1897 for fishing and sealing was $2,514,660.~~

~~The Dominion Government has established a fish-hatchery, and another is to be added, and oysters and lobsters from the Atlantic coast have been planted in British Columbia waters.~~

~~Timber. — The province is rich in forest growth, and there Is now a steady demand for its lumber in South America, Africa, Australia, and China. The following is a list of some of the more important trees of a commercial kind — large-leaved maple (Acer macrophyl- lum), red alder (Alnus rubra), western larch (Larix occidentalis), white spruce (Picea alba), Engelmann's spruce (Picea Engel- manii), Menzie's spruce (Picea sitchensis), white mountain pine (Pinus monticola), black pine (Finns murrayana), yellow pine (Firms pbnderosa), Douglas fir (Pseudotsuga Douglasii), western white oak (Quercus garjryana), giant cedar (Thuya gigantea), yellow cypress or cedar (Thuya excelsa), western hemlock (Tsuga mertensiana). The principal timber of commerce is the Douglas fir, which grows to a very great size in the neighbourhood of the coast, and has great weight-bearing power. Eed or giant cedar is plentiful, and is used for shingles. The western white spruce is also much employed for various purposes. There are about eighty saw-mills — large and small — in the province. In 1898 the export of timber amounted to 52,531,458 feet ; Australia taking 25,928,877 feet. South America 7,342,818, South Africa 5,316,587, China 7,116,350, Japan 1,152,894, Great Britain or Europe 4,401,767, and Vladivostok 1,272,165. The whole cut for the year, excluding railway and Dominion lands, was 124,546,658 feet.~~

~~Agriculture. — British Columbia is not in the main a farming coun- try, but there are many localities admirably suited for the cultivation of cereals, hay, and fruit. The lower Eraser is the principal part where farming is carried on without irrigation, but in all parts of the southern interior below a certain level farming can be carried on where water for irrigating is convenient. In the northern interior and Spallumsheen valley, irrigation is not necessary. Cattle, horse, and sheep " ranches " are numerous and important in the southern in- terior, where the climate and conditions are especially favourable. A great deal of the farm produce and fruit at present used is imported, but in 1899 the exports show $61,239 of agricultural produce and $.355,323 of animals, the greater part of the latter being beef cattle.~~

~~Imports and Exports. — The value of the imports of 1899 was $8,714,733, of which $7,101,735 was dutiable and $1,612,998 free. The duties collected for the year amounted to $2,350,738. Exports, being the produce of Canada, from the province amounted in 1899 to $14,748,025, the largest amount yet reached with the exception of 1898, when 16,919,717 was exported. The exports of 1899 com- prised products of the mine, $10,467,502 ; of the fisheries, $2,740,- 124 ; of the forest, $527,820 ; animals and their produce, $355,323 ; agricultural products, $61,239 ; miscellaneous, $420,689. The ex- ports of 1899 show an increase of $10,413,7i9 over those of 1889.~~

~~Bailways. — The Pacific division of the Canadian Pacific railway enters British Columbia through the Eocky Mountains on the east, and runs for about 500 miles before reaching the terminus at Van- couver. From that port steamers convey the mails and passengers for Vancouver Island to Victoria. The same company have built a southern branch line from Lethbridge in Alberta through the Crow's Nest Pass, near the international boundary line, into the Kootenay country, opening up extensive coal-fields from which the mines in Southern British Columbia will in the future be supplied with coal and coke for smelting, a development of the country's resources which must add greatly to the value of its mines, from which most of the ore has heretofore been exported in a crude state. This road has several branches to mining towns on the south of its main line, and there are several other short lines not connected with the Canadian Pacific system. On Vancouver Island there are two railways, the Esquimalt and Nanaimo railway (78 miles), connect- ing the coal-fields with the southern ports, and the Victoria and~~

~~Sydney of about 16 miles in length. Apart from the Canadian Pacific railway, the bonded debt of the lines in British Columbia is about five and a half million dollars, and the total cost of them, including rolling stock, about $49,000,000.~~

~~Shipping. — The Canadian Pacific railway company has two lines of mail steamers running from Vancouver and Victoria — (1) the Em- press line, which runs to Japan and China once in three weeks, and (2) the Australian line to Honolulu, Fiji, and Sydney once a month. 1272 sea-going ships with 1,239,470 tons of cargo cleared from the four ports — Victoria, Vancouver, Nanaimo, and New "Westminster ; and 1108 vessels, carrying 931,416 tons of cargo, entered at the same ports during the year 1899. In ballast 754 of 498,557 tonnage cleared outwards, and 890 of 818,919 entered. In the coasting trade 5758 vessels of 1,408,973 tonnage cleared outwards, and 5702 with 1,375,914 entered. During the year 51 vessels, aggregating 4954 tons, were built in the province, and 49, aggregating 4641 tons, were registered.~~

~~Fauna. — Among the larger mammals are the big-horn or mountain sheep (Ovis canadensis), the Kocky Mountain goat (Mazama montana), the grizzly bear, moose, woodland caribou, black-tailed or male deer, white-tailed deer, and coyote. All these are to be found only on the mainland. The black bear, wolf, puma, lynx, wapiti, and Columbian or coast deer are common to parts of both mainland and islands. Of marine mammals the most charac- teristic are the sear-lion, fur-seal, sea-otter, and harbour-seal. About 340 species of birds are known to occur in the province, among which, as of special interest, may be mentioned the burrowing owl of the dry, interior region, the American magpie, Steller's jay, and a true nut-cracker, Clark's crow (Picicorvus columbianus). True jays and orioles are also well represented. The gallinaceous birds include the large blue grouse of the coast, replaced in the Rocky Mountains by the dusky grouse. The western form of the "spruce partridge" of Eastern Canada is also abundant, together with several forms referred to the genus Bonasa, generally known as " partridges " or ruffed grouse. Ptarmigans also abound in many of the higher mountain regions. Of the AnatideB only passing mention need be made. During the spring and autumn migrations manysspecies are found in great abundance, but in the summer a smaller number remain to breed, chief~~

among which are the teal, mallard, wood-duck, spoon-bill, pin-tail, buffle-head, red-head, canvas-back, scaup-duck, &o.

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BRITISH EMPIRE, THE.

THE land surface of the earth is estimated to extend over about 52,500,000 square miles. Of this area the British empire occupies nearly one-quarter, extending over an area of about 12,000,000 square miles. By far ,, the greater portion lies within the temperate

zones, and is suitable for white settlement. The notable exceptions are the southern half of India and Burma ; East, West, and Central Africa ; the West Indian Colonies ; the northern portion of Australia ; New Guinea, British Borneo, and that portion of North America which extends into Arctic regions. The area of the territory of the empire is divided almost equally between the southern and the northern hemispheres, the great divisions of Australasia and South Africa covering between them in the southern hemisphere 5,308,606 square miles, while the United Kingdom, Canada, and India, including the native states, cover between them in the northern hemisphere 6,271,375 square miles. The alternation of the seasons is thus

~~complete, one-half of the empire enjoying summer, while one-half is in winter. The division of territory between the eastern and western hemispheres is less ecjual, Canada occupying alone in the western hemisphere 3,653,946 square miles, while Australasia, South Africa, India, and the United Kingdom occupy together in the eastern hemisphere 6,925,976 square miles. As a matter of fact, however, the eastern portions of Australasia border so nearly upon the western hemisphere that the dis- tribution of day and night throughout the empire is, like the alternations of the seasons, almost complete, one-half enjoying daylight, whUe the other half is in darkness. These alternations of time and of seasons, combined with the variety of soils and climates, are calcu- lated to have an increasingly important effect upon the ma- terial and industrial, as well as upon the social and political developments of the empire. This will become evident in considering the industrial productions of the different divisions, and the harvest seasons which permit the sum- mer produce of one portion of the empire to supply the winter requirements of its other markets, and conversely. The empire contains or is bonn'ded by some of the highest mountains, the greatest lakes, and the most im- portant rivers of the world. Its climates may be said to include all the known climates of the world ; its soils are no less various. In the prairies of Central Canada it possesses some of the most Valuable wheat-producing land; in the grass lands of the interior of Australia the best pasture country ; and in the uplands of South Africa the most valuable gold- and diamond-bearing beds which exist. The United Kingdom at present produces more coal than any other single country except the United States (which exceeded the British output in 1900). The effect of climate throughout the empire in modifying the type of the Anglo-Saxon race has as yet received only partial attention, and conclusions regarding it are of a somewhat empiric nature. The general tendency in Canada is held to be towards somewhat smaller size, and a hardy active habit; in Australia to a tall, slight, pale development locally known as "cornstalkers," characterized by considerable nervous and intellectual activity. In New Zealand the type preserves almost exactly the characteristics of the British isles. The South African, both Dutch and British, is readily recognized by an apparently sun-dried, lank, and hard habit of body. In the tropical possessions of the empire where white settlement does not take place to any considerable extent the individual~~

alone is affected. The type undergoes no modification. It is to be observed in reference to this interesting aspect of imperial develop-

ment, that the multiplication and cheapening of channels of communication and means of travel throughout the empire will tend to modify the future accentuation of race differ- ence, while the variety of elements in the vast area occupied should have an important, though as yet not scientifically traced, effect upon the British imperial type.

The white population of the empire reaches a total of upwards of 52,000,000, or about one-eighth of its entire population, which, including native races, is es- „„„„„„„„„„„ timated at something over 430,000,000. The “”’”’”’”’”’°- white population includes some French, Dutch, and Spanish peoples, but is mainly of Anglo-Saxon race. It is distributed roughly as follows : —

United Kingdom and Ireland . . . 41,454,578

Australia 4,600,000

Canada — French . . . 1,400,000

English . . . 3,800,000

5,200,000

Africa^Dutch -I 1,000,000

British J ‘

India 100,000

West Indies and Bermuda 100,000

52,454,578

These figures must be taken only as approximate. In some cases census details are out of date, and ofileial estimates have been accepted.

~~The native population of the empire includes types of the principal black, yellow, and brown races, classing with these the high-type races of the East, which may almost be called white. It is distributed as follows : —~~

~~India. British Provinces 1 ii/r^f-i^ i,i™v, *„„„ (• Native States \ ^^^l}”^^ ‘’^’ \.~~

~~British Tracts I~~

~~brown~~

~~231,085,132~~

~~63,181,569~~

~~607,710~~

~~. 294,874,411~~

~~The population of India is divided into 118 groups, on the basis of language. These may, however, be collected into twelve principal groups as follows : —~~

~~Aryo-Indic~~

~~Ehasi~~

~~Sinitic~~

~~Dravidian~~

~~Tibeto-Burman~~

~~Aryo-Iranlc~~

~~Kolarian~~

~~Mon Annam~~

~~Semitic~~

~~Gypsy~~

~~Shan~~

~~Aryo-European~~

~~Eastern Colonies.~~

~~Ceylon {^^f^^rxer^”} • ■~~

~~3,391,000~~

~~Straits Settlements — Brown and mixed~~

~~267,073~~

~~Chinese yellow .~~

~~228,000~~

~~Hong- Kong-~~

~~—Chinese yellow~~

~~211,000~~

~~Brown~~

~~1,901~~

~~North Borneo — M~~

~~ixed brown~~

~~200,000~~

~~4,298,974~~

Of the various races which inhabit these Eastern dependencies the most important are the 2,000,000 Sin- halese and the 750,000 Tamil that make up the popular tion of Ceylon. The rest is made up of Malays, Chinese (in the Straits Settlements and Hong-Kong), Dyaks, Eu- rasians, and others.

West Indies. The West Indies, including the continental colonies of British Guiana and Honduras, and seventeen islands or groups of islands, have a total coloured population of about 1,600,000. The colonies of this group which have the largest coloured populations are : — Jamaica — Chiefly black, some brown and yellow . 625,000

Trinidad — Black and brown 244,000

British Guiana — Black and brown 270,000

1,139,000

The populations of tlie West Indies are very various, being made up largely of imported African negroes. In Jamaica these contribute four-fifths of the population. There are also in the islands a considerable number of imported East Indian coolies and some Chinese. The aboriginal races include American Indians of the mainland and Caribs. With these there has been intermixture of Spanish and Portuguese blood, and many mixed types have appeared. The total European population of this group of colonies amounts to upwards of 80,000, to which 16,000 on account of Bermuda may be added.

Africa. Central} Chiefly black { ;

5,000,000

3,000j000

The aboriginal races of South Africa were the Hottentots and Bushmen. The Hottentots are a yellow-skinned race with crisp light hair. The Bashmen,

~~who appear to have been a lower order of the same race, are believed to be the aboriginal type of the Abatwa or pigmy race of Central Africa. Both these races are rapidly diminishing in numbers, and in British South Africa it is expected that they will in the course of the twentieth century become extinct. Besides these primitive races there are the dark- skinned negroids of Bantu stock, commonly known in their tribal groups as Kaffirs, Zulus, Makalakas, Bechu- anas, and. Damaras, which are again subdivided into many lesser groups. The Bantu compose the greater part of the native population. There are also in South Africa Malays and Indians and others, who during the last two hundred years have been introduced from Java, Ceylon, Madagascar, Mozambique, and British India, and by intermarriage with each other and with the natives have produced a hybrid population generally classed togetjier under the heading of the Mixed Baces. These are of all colours, varying from yellow to dark brown* The tribes of Central Africa are as yet less known. Many of them exhibit racial character- istics allied to those of the tribes of South Africa, but with in some cases an admixture of Arab blood.~~

~~East Africa.~~

~~Asiatics Zanzibar — Black and brown . Uganda — Estimated in 1899 .~~

~~2,485,000~~

~~15,000~~

~~250,000~~

~~3,800,000~~

~~6,550,000~~

~~West Africa. Nigeria I ‘^^”” I Estimated In 1900 . 35,000,000~~

~~. 3,000,000~~

~~. 1,500,000~~

~~260,000~~

~~14,000~~

~~Lagos 1 C~~

~~Gold Coast I Chiefly J~~

~~Sierra Leone j black 1~~

~~Gambia j I~~

~~4,774,000~~

~~From east to west across Africa the aboriginal nations are mostly of the black negroid type, their varieties being only imperfectly known. The tendency of some of the lower negroid types has been to drift towards the west coast, where they still practise cannibalistic and fetish rites. On the east coast are found much higher types approaching to the Christian races of Abyssinia, and from east to west there has been a wide admixture of Arab blood producing a light brown type. In Uganda and Nigeria a large proportion of the population is Arab and relatively light-skinned.~~

~~Australasia.~~

~~Australia — ^Black, very low type~~

~~Chinese and half castes, yellow New Zealand — Maoris, brown . Fiji — Polynesian, black and brown . New Guinea — ^Polynesian, black and brown~~

~~200,000~~

~~50,000~~

~~40,000~~

~~121,700~~

~~250,000~~

~~661,700~~

~~The native races of Australia and the Polynesian groups of islands are divided into two main types known as the dark and light Polynesian. The dark type, which is black, is of a very low order, and in some of the islands still retains its cannibal habits. The aboriginal tribes of Australia are of a low-class black tribe, but generally peaceful and inoffensive in their habits. The white Poly- nesian races are of a very superior type, and exhibit, as in the Maoris of New Zealand, characteristics of a high order. The natives of New Guinea are in a very low state of civilization. The estimate given of their numbers is approximate, as no census has been taken.~~

~~Canada. Indians— Brown 100,000~~

~~The only coloured native races of Canada are the Eed Indians, many in tribal variety, but few in numbers.~~

~~Summary.~~

~~Nattve Populations of Principal Divisions of the~~

~~Empire.~~

~~India ..... 294,874,411~~

~~Ceylon and Eastern Colonies ... 4,298,974~~

~~West Indies 1,650,000~~

~~South Africa 5,000,000~~

~~British Central Africa 3,000,000~~

~~East Africa 6,550,000~~

~~West Africa 40,000,000~~

~~Australasia and Islands .... 661,000~~

~~Canada 100,000~~

~~White populations~~

~~Giving a total of~~

~~356,134,385 52,454,578~~

~~408,588,963~~

~~This is without taking into account the population of the lesser Crown colonies or allowing for the increase likely to be shown by a later census. Throughout the empire, and notably in the United Kingdom, there is among the white races a considerable sprinkling of Jewish blood.~~

~~The latest calculation of the entire population of the world, including a liberal estimate of 660,000,000 for peoples not brought under any census, gives a total of something over 1,600,000,000. The population of the empire may therefore be calculated as amounting to some- thing more than one-fourth of the population of the world.~~

~~It is a matter of first importance iu the geographical dis- tribution of the empire that the five principal divisions, the United Kingdom, South Africa, India, Australia, and Canada are separated from each other by the "s™"*- three great ocep,ns of the world. The distance as usually calculated in nautical 'miles : from an English port to the Cape of Good Hope is 5840 miles ; from the Cape of Good Hope to Bombay is 4610 ; from Bombay to Melbourne is 6630 f from Melbourne to Auckland is 1830 ; from Auck- land to Vancouver 6210 ; from Halifax to Liverpool is 2744. From a British port direct to Bombay by way of the Mediterranean it is 6272 ; from a British port by the same route to Sydney 11,548 miles. These great distances have necessitated the acquisition of intermediate ports suitable for coaling stations on the trade routes, and have determined the position of many of the lesser Crown colonies which are held simply for military and commer- cial purposes. Such are the Bermudas, Gibraltar, Malta, Aden, Ceylon, the Straits Settlements, Labuan, Hong- Kong, which complete the~~

~~chain of connexion on the eastern route, and such on other routes are the lesser West African stations, — Ascension, St Helena, the Mauritius, and Seychelles, the Falklands, Tristan d'Acunha, and the groups of the Western Pacific. Some of the latest annexa- tions of the British empire have been rocky islets of the Northern Pacific required for the purpose of telegraph stations in connexion with an all-British cable.~~

~~For purposes of political administration the empire falls into the three sections of the United Kingdom of Great Britain and Ireland, with the dependencies of the Channel Islands and the Isle of Man; the Indian empire, con- sisting of British India and the feudatory native states ; and the Colonial empire, comprising all other colonies and dependencies.~~

~~In thp modern sense of extension beyond the limits of the United Kingdom the growth of the empire is of com- paTatively recent date. The Channel Islands ''™ ■ became British as a part of the Norman inherit- ance of William the Conqueror. The Isle of Man, which was for a short time held in conquest by Edward I. and restored, was sold by its titular sovereign to Sir William Scroop, earl of Wiltshire, in the year 1393, and by hia sub- sequent attainder for high treason and the confiscation of his estates, became a fief of the English Crown. It was granted by Henry IV. to the earls of Stanley, and held by them and their collateral descendants until the sov- ereignty and revenues of the island were finally surren- dered to the Crown in 1765. With these exceptions and the nominal possession taken of Newfoundland by Sir Humphrey Gilbert in 1583, all the territorial acquisitions of the empire have been made in the 17th, 18th, and 19th centuries.~~

~~The following list of British colonies and dependencies shows the date and manner of their acquisition : —~~

~~Name.~~

~~Date.~~

~~Method of Acquisition.~~

~~Newfoundland~~

~~1583~~

~~Possession taken by Sir H. Gil- bert for the Crown.~~

~~17th Century.~~

~~St Helena .~~

~~1600~~

~~Captured. Settled by East India Coy. 1651. Govern- ment vested in British Crown, 1833.~~

~~Barbados~~

~~1605~~

~~Settlement.~~

~~Bermudas .~~

~~1609~~

~~Prince Edward Is.~~

~~1626~~

~~,,] Ceded to France~~

~~Nova Scotia .~~

~~1626~~

~~,, >■ 1632; recovered~~

~~New Brunswick .~~

~~1626~~

~~J 1713.~~

~~St Christopher .~~

~~1623~~

~~,, 1 Ceded to France; ,, J recovered 1713.~~

~~Nevis~~

~~1628~~

~~Bahamas~~

~~1629~~

~~Gambia~~

~~1631~~

~~,, A second time in~~

~~1817.~~

~~Antigua~~

~~1632~~

~~Leeward Is. .~~

~~1632~~

~~Jamaica~~

~~1655~~

~~Conquered.~~

~~Gold Coast .~~

~~1661~~

~~Settlement.~~

~~N.-W. Territories ol~~

~~t 1670~~

~~Settlement under Royal Charter~~

~~Canada~~

~~of Hudson Bay Coy. Pur- chased from Imp. Govt. 1869, and transferred to Canada~~

~~1870.~~

~~18th Century.~~

~~Name.~~

~~Date.~~

~~Method of Acquisition,~~

~~Gibraltar .~~

~~1704~~

~~Capitulation.~~

~~Ontario~~

~~1759-90~~

~~”~~

~~Quebec~~

~~1769-90~~

~~Dominica .~~

~~1763~~

~~St Vincent .~~

~~1763~~

~~Grenada~~

~~1763~~

~~Windward Is.~~

~~1763~~

~~Tobago~~

~~1763~~

~~Falkland Is.~~

~~1765~~

~~Settlement.~~

~~Honduras~~

~~1783-86~~

~~Treaty.~~

~~Sierra Leone~~

~~1787~~

~~Settlement.~~

~~N. S. Wales.~~

~~1788~~

~~))~~

~~Ceylon .~~

~~. 1795~~

~~Capitulation.~~

~~Trinidad~~

~~1797~~

~~ij~~

~~19th Century.~~

~~Malta .~~

~~. 1800~~

~~Capitulation.~~

~~B. Guiana .~~

~~. 1803~~

~~11~~

~~St Lucia~~

~~. 1803~~

~~»)~~

~~Tasmania .~~

~~. 1803~~

~~Settlement.~~

~~Cape of Good Hope~~

~~. 1806~~

~~Capitulation.~~

~~Seychelles .~~

~~. 1806~~

~~ij~~

~~19th Century — continued. Name. Date. Method of Acquisition.~~

~~1810 Capitulation. 1815 Military occupation.~~

~~Mauritius . Ascension and Tristan~~

~~d'Acunha West Australia . South Australia . New Zealand Hong-Kong .~~

~~Natal .~~

~~Labuan~~

~~Turks and Caicos Is.~~

~~Victoria~~

~~B. Columbia~~

~~Straits Settlements~~

~~1829~~

~~1836~~

~~1840~~

~~1843-61~~

~~1844 1846 1848 1851 1858~~

~~1858~~

~~Queensland Lagos . Manitoba~~

~~.~~

~~1859 1861 1870~~

~~Fiji .... W. Pacific Islands, in-~~

~~1874 1877~~

~~cluding Union, EUice, Gilbert, Southern~~

~~Solomon,~~

~~and~~

~~other~~

~~groups~~

~~Cyprus North Borneo~~

~~Niger Coast or S. Nigeria B. New Guinea . Bechuanaland Nigeria~~

~~Somaliland . Sarawak Brunei . British East Africa~~

~~Rhodesia~~

~~British Central Africa .~~

~~Federated Malay States~~

~~Uganda~~

~~Pacific Islands — Christmas, Fanning, Penrhyn, Suwarrow~~

~~Wei-hai-Wei~~

~~Orange River Colony .~~

~~Transvaal .~~

~~1878 1881~~

~~1884 1884 1885 1886~~

~~1887 1888~~

~~1888~~

~~1889~~

~~1891 1874-95 1894-96~~

~~1898~~

~~Settlement.~~

~~Settlement and treaty.~~

~~Treaties. Kowloon on the main- land added in 1861.~~

~~By separation from Cape.~~

~~Cession. ‘~~

~~Separation from Bahamas.~~

~~Separation from N. S. Wales.~~

~~Settlement under Hudson Bay Coy. Transferred to Crown 1869. Entered Canadian Con- federation 1871.~~

~~Vested in Crown by E. I. Coy. Transferred from Indian to Colonial possessions, 1867.~~

~~By separation from N. S. Wales.~~

~~Cession.~~

~~By separation from N.-W. Territory.~~

~~Cession.~~

~~By international agreement. High commission created by Order in Council, giving juris- diction over islands not in- cluded in other Colonial Governments, nor VTithin jurisdiction of other civil- ized powers. Tonga and Cook Islands annexed to New Zea- land 1900.~~

~~Occupied by treaty.~~

~~Treaty and settlement under~~

~~Royal Charter. Protectorate declared.~~

~~Treaty ^conquest, and settlement under Royal Charter. Trans- ferred to Crown, incorporated with Niger Coast Protectorate and divided into N. and S. Nigeria, 1900.~~

~~Protectorate declared.~~

~~Treaty, conquest, and settle- ment under Royal Charter. Transferred to Crown 1895.~~

~~Treaty, conquest, and settle- ment under Royal Charter.~~

~~Protectorate declared.~~

~~Treaty.~~

~~Protectorate declared.~~

~~Annexed for purposes of pro- jected Pacific cable.~~

~~1898 Lease from China. 1900 Annexation. 1900 Annexation, i~~

~~In the Pacific there are, in addition to the possessions already mentioned, Bauman Islands, Bakir Island, Bell Cay, Bird Island, Bramble Cay, Caroline Island, Cato Island, Coral Island and Dudosa, Danger Island, Ducie Island, Flint Island, Rowland Island, Humphrey Island, Jarvis Island, Lihow Island, Little Scrub Island, Maiden Island, Manihiki Islands, Nassau Island, Palmerston Island, Palmyra Island, Phoenix Group of Islands, Pit- cairn Island, Pnrdy Group, Eaine Island, Rierson Island, Eoggewein Island, Sophia Island, Starbuck Island, Sur- prise Island, Teinhoven Island, Vestoc, Washington or New York Island, Willis Group, Wreck Reef, Macquarie Island, Rotuma Island, and islands adjacent to British New Guinea. Among thp dependencies of New Zealand should be mentioned the Kermadec Islands.~~

~~In the Indian Ocean there are, besides the colonies already mentioned, Seychelles, Rodrigues, the Chagos~~

~~Islands, St Brandon Islands, Amirante Islands, Aldabra and some other small groups. There are also the Kuria- Muria Islands, the Maldive Islands, and the Ashmore Islands.~~

~~In America there is all land which lies to the north of the Canadian provinces, with the exception of the United States territory of Alaska and its dependencies.~~

~~The Indian section of the empire was acquired during the same three centuries under a royal charter granted to the East India Company by Queen Elizabeth in 1600. It was transferred to the Imperial Government in 1858, and Queen Victoria was proclaimed empress under the Eoyal Titles Act in~~

~~1877. The following list gives the dates and method of acquisition of the centres of the main divisions of the Indian empire. They have, in most instances, grown by general process of extension to their present dimensions.~~

~~The nine provinces are : — i~~

~~Name. Date, Method of Acquisition.~~

~~Madras . 1639 By treaty and subsequent conquest. Tort to St George, the foundation of Madras, was~~

~~1748 the first territorial possession of the E. I. Coy. in India. It was acquired by treaty with its Indian ruler. Madras was raised into a presidency in 1683 ; ceded to France 1746 ; recovered 1748. Bombay . 1608 Treaty and cession. Trade first established to 1608. Ceded to British Crown by Portugal~~

~~1685 1661. Transferred to E. I. Coy. 1668. Presidency removed from Surat 1685. Bengal . 1633 Treaty and subsequent conquests. First to trade settlement established by treaty at~~

~~1765 Pipli in Orissa 1633. Erected into presi- dency by separation from Madras 1681. Virtual sovereignty announced by E. I. Coy., as result of conquests of Clive, 1766. N.W. Pro 1764 By conque.sts and treaty through successive vincesand to stages, of which the principal dates were~~

~~Oudh 1856 1801-3-14-15. In 1832 the nominal sover-~~

~~eignty of Delhi, till then retained by the Great Mogul, was resigned into the hands of the E. L Coy. Oudh, of which the con- quest may be said to have begun with the battle of Baxar in 1768, was finally annexed in 1856. It was attached as a commissionership to the N.-W. Provinces in 1879. Central 1802-17 By conquest and treaty.~~

~~Provinces Assam . 1825-26 Conquest and cession. Burma . 1824-52 Conquest and cession.~~

~~Punjaub . 1849 Conquest and annexation. Made into dis- tinct province 1869. N.W. Pron 1901 Subdivision, tier Province~~

~~The senior commissionerships are : —~~

~~Ajmere and , 1818 By conquest and cession.~~

~~Merwara Coorg . 1834 Conquest and annexation. British Bal- 1841-76 Conquest and treaty.~~

~~uchlstan Andaman 1858 Annexation.~~

~~Islands~~

~~The following is a list of the principal Indian states or agencies which are more or less under the control of the British Government: —~~

~~Haidarabad. Kashmir.~~

~~Baroda. Sikkim.~~

~~Mysore. Shan States.~~

~~Rajputana States, including Udaipur. Dholpur.~~

~~Jodhpur. Alwar.~~

~~Bikaner. Jhalawar.~~

~~Jaipur (and Tonk.~~

~~feudatories). Kotah.~~

~~Bhurtpur.~~

~~Central Indian States, including Indore. Bhopal.~~

~~/ Kewa. Gwalior.~~

~~Bombay States, including Cutch. Khairpur (Sind.)~~

~~Kolhapur (and dependencies).~~

~~Madras States, including~~

~~Travancore. Cochin.~~

~~Central Provinces States~~

~~Bastar.~~

~~Bengal States~~

~~Cooch Behar. Hill Tipperah.~~

~~N.-W. Provinces States, including Eampur. — Garhwal.~~

~~Punjaub States, including Patiala. Sirmur (Nahan),~~

~~Bahawulpur. Maler Kotla.~~

~~Jind. Paridkot.~~

~~Nabha. Chamba.~~

~~Kapurthala. Suket.~~

~~Mandi. Kalsia. r~~

~~In addition to these there are British tracts known as the Upper Burma frontier and the Burm a frontier. There is also a sphere of British influence in the border of Afghanistan. The state of Nepal, though independent, has been since the campaign of 1814-15 in close relations with Great Britain. All these native states have come into relative dependency upon Great Britain as a result of con- quest or of treaty consequent upon the annexation of the neighbouring provinces. The settlement of Aden, with its dependencies of Perim and Socotra Island, forms part of the government of Bombay.~~

~~This vast congeries of states, widely different in charac- ter, and acquired by many different methods, holds together under the supreme headship of the Crown on a generally acknowledged triple principle of self- ^™oa'' government, self-support, and self-defence. The principle is more fully applied in some parts of the empire than in others ; there are some parts which have not yet reached their full political evolution ; some others in which the principle is temporarily or for special reasons in abey- ance ; others, again — chiefly those of very small extent, which are held for purposes of the defence or advantage of the whole — to which it is not applicable ; but the principle is generally acknowledged as the structural basis upon which the constitution of the empire exists.~~

~~In its relation to the empire the home section of the British Isles is distinguished from the others as the place of origin of the British race and the residence of the Crown. The history and constitutional development of this portion of the empire will be found fully treated under separate headings. (See Englabtd and Wales; English Histokt; Ireland, Scotland, United Kingdom, &c.)~~

~~The total revenue, expenditure, and trade of the home section of the empire in 1900 were as follows : —~~

Revenue . Expenditure Imports . Exports .

£119,839,905

133,976,920 563,146,659 387,522,633

Eor full information with regard to the constitution and history of India and the Colonies reference must also be made to the respective headings. (See India, Africa, Australia, Canada, &c.)

It is enough to say that for purposes of administration the Indian empire is divided into nine great provinces (of which the ninth, the N.-W. Frontier, was proclaimed in 1901) and four minor commissionerships. The nine great provinces are presided over by two governors (Bombay and Madras), four lieut.-governors (Bengal, North-West Pro- vinces, the Punjaub, and Burma), and three chief commis- sioners (Assam, the Central Provinces, and the N.-W. Frontier Province). The four minor commissionerships are presided over each by a chief commissioner. Above

these the supreme executive authority in India is vested in the Viceroy in Council. The Council consists of five ordinary members besides the existing Commander-in- Chief. For legislative purposes the Governor-General's Council is increased by the addition of sixteen members nominated by the Crown, and has power under certain restrictions to make laws for British India, for British subjects in the Native States, and for native Indian subjects of the Crown in any part of the world. The administrar tion of the Indian empire in England is carried on by a Sec^retary of State for India assisted by a council of not less than ten members. The expenditure of the revenues is under the control of the Secretary in Council.

The total revenue, expenditure, and trade, of India for 1900 were as follows :—

~~Eevenue Expenditure Imports Exports .~~

~~£67,617,800~~

~~64,976,920 64,188,440 78,646,690~~

~~The Colonial empire — exclusive of the Transvaal and Orange River Colonies — comprises forty-three district governments. It is divided into colonies of three classes and dependencies; these, again, are in some instances associated for administrative purposes in federated groups. The three classes of colonies are Crown Colonies, Colonies possessing representative institutions but not responsible government, and Colonies possessing representative institutions and responsible government. In Crown Colonies the Crown has entire control of legislation, and the public ofB.cers are under the control of the Home Government. In representative Colonies the Crown has only a veto on legislation, but the Home Government retains control of the public ofiicers. In responsible Colonies the Crown retains a veto upon legislation, but the Home Government has no control of any public ofRcer except the Governor.~~

~~In Crown Colonies — with the exception of Gibraltar and St Helena, where laws may be made by the Governor alone — laws are made by the Governor with the con- currence of a councU nominated by the Crown. In some Crown Colonies, chiefly those acquired by conquest or cession, the authority of this council rests wholly on the Crown ; in others, chiefly those acquired by settlement, the council is created by the Crown under the authority of local or Imperial laws. The Crown council of Ceylon may be cited as an example of the first kind, and the Crown council of Jamaica of the second.~~

~~In colonies possessing representative institutions with- out responsible government, the Crown cannot (generally) legislate by Order in Council, and laws are made by the Governor with the concurrence of the legislative body or bodies, one at least of these bodies in cases where a second chamber exists possessing a preponderance of elected representatives. The Bahamas, Barbados, and Bermuda have two legislative bodies — one elected and one nominated by the Crown; Malta and the Leeward Islands have but one, which is partly elected and partly nominated.~~

~~Under responsible government legislation is carried on by parliamentary means exactly as at home, with a cabinet responsible to parliament, the Crown reserving only a right of veto which is exercised at the discretion of the Governor in the case of certain Bills. The executive councils in those colonies designated as at home by parliamentary choice are appointed by the Governor alone, and the other public ofiicers only nominally by the Governor on the advice of his executive council.~~

~~Colonial governors are classed as governors-general ; governors; lieut.governors ; administrators; high com missioners ; and commissioners, according to the status~~

~~of the colony and dependency, or group of colonies and dependencies over which they preside. Their powers vary according to the position which they occupy. In all cases they represent the authority of the Crown.~~

~~As a consequence of this organization the finance of Crown Colonies is under the direct control of the Imperial Government ; the finance of representative Colonies, though not directly controlled, is usually influenced in important departures by the opinion of the Imperial Government. In responsible Colonies the finance is entirely under local control, and the Imperial Government is dissociated from either moral or material responsibility for colonial debts.~~

~~The total revenue, expenditure, and trade of the Colonial empire for 1900 were as follows : —~~

~~Revenue Expenditure Imports Exports~~

~~£58,815,700~~

~~56,563,660~~

~~181,846,110~~

~~192,330,040~~

~~In federated groups of colonies and dependencies matters which are of common interest to a given number of separate governments are by mutual consent of the federating communities adjudged to the authority of a common government, which, in the case of self-governing colonies, is voluntarily created for the purpose. The associated states form under the federal government one federal body, but the parts retain control of local matters, and exercise all their original rights of government in regard to these. The advantages of united action are thus secured for larger questions without impairing the vigour of independent initiative in matters of individual concern. The two great self-governing groups of federated colonies within the empire are the Dominion of Canada and the Commonwealth of Australia. India, of which the associated provinces are under the control of the central Government, may be given as an example of the practical federation of dependencies. Examples of federated Crown Colonies and lesser dependencies are to be found in the Leeward Island group of the West Indies and the federated Malay States.~~

~~This rough system of self-government for the empire has been evolved not without some strain and friction, by the recognition through the vicissitudes of three hundred years of the value of independent initiative in the development of young countries. Queen Elizabeth's first patent to Sir Walter Ealeigh permitted British subjects to accompany him to America, "with guarantee of a con- tinuance of the enjoyment of all the rights which her subjects enjoyed at home."~~

~~This guarantee may presumably have been intended at the time only to assure the intending settlers that they should lose no rights of British citizenship at home by taking up their residence in America. Its mutual inter- pretation in a wider sense, serving at once to establish in the colony rights of citizenship equivalent to those enjoyed in England, and to preserve for the colonist the status of British subject at home and abroad, has formed in applicar tion to all succeeding systems of British colonization the unconscious charter of union of the empire.~~

~~The first American colonies were all settled under royal grants. Each had its own constitution, and looked to no other head but the king. Their governments were free — the executive being responsible to the elective~~

element in the legislature, as now in the colonies which enjoy responsible self-government. The immense distance which in those days separated America from Great Britain secured them from interference on the part of the home authorities. They paid their own most moderate govern- ing expenses, and they contributed largely to their own defence. From the middle of the 17th century their trade was not free, but this was the only restriction from which

they sufEered. The great war with France in the middle of the 18th century temporarily destroyed this system. That war, which resulted in the conquest of Canada and the delivery of the North American colonies from French antagonism, cost the Imperial exchequer £90,000,000. The attempt to avert the repetition of such expenditure by the assertion of a right to tax the colonies through the British Parliament led to the one great rupture which has marked the history of the empire. It has to be noted , that at home during the latter half of the 17th century and the earlier part of the 18th century Parliamentary power had to a great extent taken the place of the Divine ‘ Eight of kings. But Parliamentary power meant the power of the English people and taxpayers. The strug- gle which developed itself between the American colonies and the British Parliament, was in fact a struggle on the part of the people and taxpayers of one portion of the empire to resist the domination of the people and tax- payers of another portion. In this light it may be ac- cepted as having historically established the fundamental axiom of the constitution of the empire, that the Crown is the supreme head from which the parts take equal dependence.

The Crown requiring advice in the ordinary and con- stitutional manner receives it in matters of colonial administration from the Secretaries of State for the Colonies and.for India. After the great rupture separate provision in the Home Government for the administration of colonial affairs was at first judged to be unnecessary, and the ” Council of Trade and Plantations,” which up to that date had supplied the place now taken by the two offices of the Colonies and India, was suppressed in 1782. There was a reaction from the liberal system of colonial self-government, and an attempt was made to

~~govern the colonies which remained, simply as dependencies, the Home Treasury being responsible for their expenditure as now in the Crown Colonies.~~

~~In 1791, not long after the extension of the- range of Parliamentary authority in another portion of the empire, by the creation in 1784 of the Board of Control for India, Pitt made the step forward of granting to Canada representative institutions, of which the Home Govern- ment kept the responsible control. Similar institutions were also given at a later period to Australia and South Africa. But the long peace of the early part of the 19th century was marked by great colonial developments; Australia, Canada, and South Africa became important communities. Eepresentative institutions controlled by the Home Government were insufficient for their needs, and they reasserted the old British colonial claim for liberty to manage their own affairs.~~

~~Fully responsible government was granted to Canada in 1840, and gradually extended to the other colonies. In 1854 a separate Secretary of State for the Colonies was appointed at home, and the Colonial Office was es- tablished on its present footing. In India, as in the Colonies, there came with the growing needs of empire a recognition of the true relations of the parts to each other and of the whole to the Crown. In 1858, on the complete transference of the territories of the East India Company to the Crown, the Board of Control was abol- ished, and the India Council, under the presidency of a Secretary of State for India, was created. It was espe- cially provided that the members of the council ipay not sit in Parliament.~~

~~Thus, although it has not been found practicable in the working of the British constitution to carry out the full theory of the direct and exclusive dependence of colonial possessions on the Crown, the theory is recognized as far as possible. It is understood that the principal sections of the empire enjoy equal rights under the Crown,~~

~~and that none are subordinate to each other. The inter- vention of the Imperial Parliament in Colonial affairs is only admitted theoretically in so far as the support of Parliament is required by the constitutional advisers of the Crown. To bring the practice of the empire into complete harmony with the theory it would be necessary to constitute, for the purpose of advising~~

~~the Crown upon Imperial affairs, a.parliament or council in which all im- portant parts of the empire should be represented.~~

~~The gradual recognition of the constitutional theory of the British empire, and the assumption by the principal colonies of full self-governing responsibilities, has cleared the way for a movement in favour of a further develop- ment which should bring the supreme headship of the empire more into accord with modern ideas.~~

~~It was during the period of domination of the " Man- chester school," of which the most effective influence in public affairs was exerted for about thirty years, extending from 1845 to 1876, that the fullest develop- ment of colonial self-government was attained, the view being generally accepted at that time that self-governing institutions were to be regarded as the preliminary to inevitable separation. A general inclination to with- draw from the acceptance of Imperial responsibilities throughout the world gave to foreign nations at the same time an opportunity by which they were not slow to profit, and contributed to the force of a reaction of which the part played by Great Britain in the scramble for Africa marked the culmination. Under the increas- ing pressure of foreign enterprise, the value of a federa- tion of the empire for purposes of common interest began to be discussed. Imperial federation was openly spoken of in New Zealand as early as 1852. A similar sugges- tion was officially put forward by the general association of the Australian colonies in London in 1857. The Eoyal Colonial Institution, of which the motto " United Empire " illustrates its aims, was founded in 1868. First among leading British statesmen to repudiate the old in- terpretation of colonial self-government as a preliminary to separation. Lord Beaconsfield, in 1872, spoke of the constitutions accorded to the colonies as " part of a great policy of Imperial consolidation." In 1875 Mr W. E. Forster, afterwards a member of the Liberal Govern- ment, made a speech in which he advocated Imperial federation as a means by which it might become practica- ble to "replace dependence by association." The founda- tion of the Imperial Federation League — in 1884, with Mr Forster for its first president, shortly to be succeeded by Lord Eosebery — marked a distinct step forward. The Colonial Conferences of 1887 and 1894, in which colonial opinion was sought and accepted in respect of important questions of Imperial organization and defence, and the enthusiastic loyalty~~

displayed by the Colonies towards the Crown on the occasion of the jubilee manifestations of Queen Victoria's reign, were further indications of progress in the same direction. Coincidently with this de- velopment, the achievements of Sir George Goldie and Mr Cecil Ehodes, who, the one in West Africa, and the other in South Africa, added between them to the empire in a space of less than twenty years a dominion of greater extent than the whole of British India, followed by the action of a host of distinguished disciples in other parts of the world, effectually stemmed the movement initiated by Cobden and Bright. A tendency which had seemed temporarily to point towards a complacent disso- lution of the empire was arrested, and the closing years of the 19th century were marked by a growing disposition to appreciate the value and importance of the unique position which the British empire has created for it- self in the world. No stronger demonstration of the reality of Imperial union can be needed than that which

was afforded by the support given to the Imperial forces by the Colonies and India in the South African war. It remains only to be seen by what process of evolution the further consolidation of the empire will find expression in the machinery of government.

The question of self-government is closely associated ■with the question of self-support. Plenty of good land and the liberty to manage their own affairs were the causes assigned by Adam Smith for the marked prosperity of the British Colonies towards the end of the 18th century. The same causes are still to be observed to produce the same effects, and it may be pointed out that since the date of the latest of Adam Smith's writings, upwards of 6,000,000 square miles of virgin soU, rich with possibilities of agricultural, pastoral, and mineral wealth, have been added to the empire. In the same period the white population has grown from about 12,000,000 to 52,000,000, and the developments of agricultural and in- dustrial machinery

~~have multiplied, almost beyond com- putation, the powers of productive labour.~~

~~It is scarcely possible within this article to deal with so widely varied a subject as that of the productions and industry of the empire. Tor the purposes of a general statement, it is interesting to observe that concurrently with the acquisition of the vast continental areas during the 19th century, the pro- gress of industrial science in application to means of trans- port and communicatiop. brought about a revolution of the most radical character in the accepted laws of eco- nomic development. Railways did away with the old law that the spread of civilization is necessarily governed by facilities for water carriage and is consequently con- fined to river valleys and sea-shores. Steam and elec- tricity opened to industry the interior of continents previously regarded as unapproachable. The resources of these vast inland spaces which have lain untouched since history began became available to individual enter- prise, and over a great portion of the earth's surface were brought within the possessions of the British empire. The production of raw material within the empire in- creased at a rate which can only be appreciated by a care- ful study of figures, some of which will be found under the headings of the United Kingdom and the principal British colonies and dependencies, and by a comparison of the total of these figures with the total figures of the world. The tropical and temperate possessions of the empire include every field of production which can be required for the use of mao. There is no main staple of human food which is not grown ; there is no material of textile industry which is not produced. The British em- pire gives occupation to more than one-third of the persons employed in mining and quarrying in the world. It may be interesting, as an indication of the relative position in this respect of the British empire to the world, to state that at present it produces one-third of the coal supply of the world, one-sixth of the wheat supply, and very nearly two-thirds of the gold supply. But while these figures may be taken as in themselves satisfactory, it is far more important to remember that as yet the potential resources of the new lands opened to enterprise have been barely conceived, and their wealth has been little more than scratched. Population as yet has been only very sparsely sprinkled over the surface of many of the areas most suitable for white settlement. In the wheat lands of Canada, the pastoral country of Australasia, and the mineral fields of South Africa and Western Canada~~

~~alone, the undeveloped resources are such as to insure employ- ment to the labour and satisfaction to the needs of at least as many millions as they now contain thousands of the British race. In respect of this promise of the future the position of the British empire is unique.~~

~~In regard to the distribution of existing industry, although the more important Colonies have established manufactures of their own, of which the prosperity is assured, the general conditions have hitherto been main- tained under which Great Britain has remained the manufacturing centre for the raw material of the whole. The primary production of the Colonies and the indus- trial development of Great Britain are still, therefore, the important divisions of the subject. These subjects are dealt with elsewhere in detail.~~

~~It is not too much to say that trade has been at once the most active cause of expansion and the most potent bond of union in the development of the empire. Trade with the tropical and settl,ement in the temperate regions of the world formed the basis upon which the foundations of the empire were laid. Trading companies founded most of the American and West Indian colonies ; a trad- ing company won India; a trading company colonized the north-western districts of Canada ; commercial wars during the greater part of the 18th century established the British command of the sea, which rendered the settlement of Australasia possible. The same wars gave Great Britain South Africa, and chartered companies in the 19th century carried the British flag into the inte- rior of the African continent from south and east and west. Trading companies produced Borneo and Fiji. The bonds of prosperous trade have kept the Austral- asian colonies within the empire. The protection of colonial commerce by the Imperial navy is one of the strongest of material links which connect the Crown with the outlying possessions of the empire.~~

~~The trade of the empire, like the other developments of Imperial public life, has been profoundly influenced by the variety of local conditions under which it has flourished. In the early settlement of the North American colonies their trade was left practically free ; but by the famous Navigation Act of 1660 the importation and exportation of goods from British colonies were restricted to British ships, of which the master and three-fourths of the~~

mariners were English. This Act, of which the intention was to encourage British shipping and to keep the monopoly of British colonial trade for the benefit of British merchants, was followed by many others of a similar nature up to the time of the repeal of the Corn Laws in 1846 and the introduction of free trade into Great Britain. And the Navigation Acts were repealed in 1849. Thus for very nearly two hundred years Brit- ish trade was subject to restrictions, of which the avowed intention was to curtail the commercial inter- course of the empire with the world. During this period the commercial or mercantile system, of which the falla- cies were exposed by the economists of the latter half of the 18th century, continued to govern the principles of British trade. Under this system monopolies were common, and among them few were more important than that of the East India Company. In 1813 the trade of India was, however, thrown open to competition, and in 1846, after the introduction of free trade at home, the principal British colonies which had not yet at that date received the grant of responsible government were specially empowered to abolish differential duties upon foreign trade. A first result of the commercial emanci- pation of the Colonies was the not altogether unnatural rise in the manufacturing centres of a school known as the Manchester school, which was disposed to question the value to Great Britain of the retention of colonies which were no longer bound to give her the monopoly of their com- mercial markets. An equally natural desire on the part of the larger colonies to profit by the opportunity which was opened to them of establishing local manufactures, of their own, combined with the convenience in new countries

of using the customs as an instrument of taxation, led to something like a reciprocal feeling of resentment, and there followed a period during which the policy of Great Britain was to show no consideration for colonial trade, and the policy of the principal colonies was to impose heavy duties upon British trade. By a gradual process of better understanding, largely helped by the develop- ment of means of communication, the antagonistic extreme was abandoned, and a tendency towards a system of pre- ferential duties within the empire displayed itself. At the Colonial Conference held in

~~London in 1887, a pro- posal was formally submitted by the South African dele- gate for the establishment within the empire of a preferential system, imposing a duty of 2 per cent, upon all foreign goods,"the proceeds to be directed to the main- tenance of the Imperial navy. To this end it was requested that certain treaties with foreign nations which imposed restrictions on the trade of various parts of the empire with each other should be denounced. Some years later the treaties in question were denounced, but simultane- ously with the movement in favour of reciprocal fiscal advantages to b^ granted within the empire by the many local governments to each other, there was a growth of the perception that an increase of the foreign trade of Great Britain, which is carried on chiefly in manufactured goods, was accompanied by a corresponding enlargement of the home markets for colonial raw material, and conse- quently that injury to the foreign trade of Great Britain must necessarily react upon the Colonies. This view was definitely expressed at the Colonial Conference at Ottawa in 1894, and made itself felt in the relinquishment of the demand that in return for colonial concessions there should be an imposition on the part of Great Britain of a differential duty upon foreign goods. Canada was the first important British colony to give substantial expression to the new Imperial sentiment in commercial matters by the introduction in 1897 of an Imperial tariff, granting without any reciprojal advantage a deduction of 25 per cent, upon customs duties imposed upon British goods. The same advantage is offered to all British colonies trading with her upon equal terms. Although in Great Britain trade is free, and customs duties are only im- posed for purposes of revenue on a few selected articles, about half the national income is derived from customs and excise. In most of the Colonies customs form of necessity one of the important sources of revenue. It is, however, worthy of remark that in the self-governing colonies, even those which are avowedly Protectionist, a smaller proportion of the public revenue is derived from customs and excise than is derived from these sources at home. . The proportion in Australasia before federation was about one-quarter. In Canada it is more difB.cult to estimate it, as customs and excise form the principal pro- vision made for federal finance, and note must therefore be taken of the separate sources of revenue in the pro-~~

~~vinces. With these reservations it will still be seen that customs, or, in other words, a tax upon the movements of trade, forms one of the chief sources of Imperial revenue. The development of steam shipping and elec- tricity gave to the movements of trade a stimulus no less remarkable than that given by the introduction of rail- roads and industrial machinery to production and manu- factures. Whereas at the beginning of the 19th century the journey to Australia occupied eight months, and business communications between Sydney and London could not receive answers within the year, the journey can now be accomplished in thirty-one days, and tele- graphic despatches enable the most important business to be transacted within twenty-four hours. For one cargo carried in the year at the beginning of the 19th century at least six may now be carried by the same ship, and- from the point of view of trade the difference of a venture which realizes its profits in two months, as compared with one which occupied a whole year, does not need to be insisted on. The increased rapidity of the voyage and the power of daily communication by telegraph with the most distant markets have introduced a wholly new elcp ment into the national trade of the empire, and commercial intercourse between the southern and the northern hemi- spheres has received a development from the natural alternation of the seasons, of which until quite recent years the value was not even conceived. Fruit, eggs, butter, meat, poultry, and other perishable commodities pass in daily increasing quantities between the northern and the southern hemispheres with an alternate flow which contributes to raise in no inconsiderable degree the volume of profitable trade. Thus the butter season of Australasia is from October to March, while the butter season of Ireland and Northern Europe is from March to October. In three years after the introduction 'of ice-chambers into the steamers of the great shipping lines, Victoria and New South Wales built up a yearly butter trade of £1,000,000 with Great Britain without seriously affecting the Irish and Danish markets whence the summer supply is dra^sn. These facilities, combined with the enormous additions made to the public stock of land and labour, contributed to raise the volume of trade of the empire from a total of less than £100,000,000 in the year 1800 to a total of nearly £1,500,000,000 in 1900. The declared volume of British exports to all parts of the world in 1800 was £38,120,120, and the value of British imports from all parts of the world was £30,570,606; total, £68,690,725. As in those days the Colonies were not allowed to trade with any other country this must be taken as~~

~~representing Imperial trade. The exact figures of the trade of India, the Colonies, and the United Kingdom for 1900 were : imports, £809,178,209 ; exports, £657,899,363 ; total, £1,467,077,572.~~

~~The foregoing statements are summarized in statistical form in the following table : —~~

~~The World.~~

~~The British Empu-e.~~

~~Proportton.~~

~~Area Population .~~

~~Trade . . |~~

~~Kevenue . |~~

~~Production of — Gold . Wheat Coal .~~

~~62,000,000 sq. m.~~

~~1,500,000,000~~

~~2,862,143,000~~

~~(excluding Brit, empire)~~

~~£950,203,000 (excluding Brit, empire)~~

~~15,911,280 oz.~~

~~1,533,393,000 bush.~~

~~, 723,617,836 net tons~~

~~12,000,000~~

403,000,000

X 1,467,077,572

1 246,273,405

9,034,226 242,624,500 239,995,148

Something less than one-fourth Something more than one-fourth

About one-third ,, one-flfth

,, two-thirds ,, one-sixth ,, one-third

A question of sovereign importance to the continued

existence of the empire is the question of defence.

Defence. j^ country of which the main thoroughfares are

the oceans of the world demands in the first instance a

strong navy. It has of late years been accepted as a funda- mental axiom of defence that the British navy should exceed in strength any reasonable combination of foreign navies which could be brought against it. The expense of maintain-

ing such a floating armament is colossal, and until within the decade 1890-1900 it was borne exclusively by the tax- payers of the United Kingdom. As the benefits of united empire have become more consciously appreciated in the Colonies, and the value of the fleet as an insurance for British commerce has been recognized, a desire manifested itself on the part of the self-governing colonies to contri- bute towards the formation of a truly Imperial navy. As yet the movement remains in its infancy. In 1895 the Australasian colonies voted a small subsidy of £126,000 per annum for the

~~maintenance of an Australasian squad- ron, and in 1897 the Cape Colony also offered a contri- bution of £30,000 a year to be used at the discretion of~~

~~the Imperial Government for naval purposes. The Colonies have also contributed in some degree to their own naval defence by the erection of fortifications at selected points upon their shores. The net cost of the navy to the Imperial exchequer, as estimated for the year 1900-1901, was £27,522,600. Though available for service throughout the empire, and forming the principal bulwark' of colonial defence, the cost, with the trivial exceptions named, is still borne exclusively by the Home Govern- ment, and recruiting for the navy is carried on wholly in the British isles.~~

~~The following comparative list of the navies of the world is taken from the Statesman's Tear-Book for 1901 : —~~

~~/Strength of the Principal Navies of the World in April 1901.~~

~~United Kingdom.~~

~~France.~~

~~BnsBia.~~

~~Germany.~~

~~U.S.A.~~

~~Japan.~~

~~Italy.~~

~~Afloat.~~

~~Bldg.~~

~~Afloat.~~

~~Bldg.~~

~~Afloat.~~

~~Bldg.~~

~~Afloat.~~

~~Bldg.~~

~~Afloat.~~

~~Bldg.~~

~~Afloat. Bldg.~~

~~Afloat.~~

~~Bldg.~~

~~Battleships, 1st class .~~

~~21~~

~~8~~

~~6~~

~~2~~

~~2~~

~~6~~

~~7~~

~~5~~

~~8~~

~~4 ,~~

~~4~~

~~„ 2nd „ . . .~~

~~12~~

~~9~~

~~,,~~

~~15~~

~~9~~

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~~4~~

~~,,~~

~~2~~

~~‘3~~

~~3rd „ .~~

~~11~~

~~7~~

~~2~~

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~~1~~

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~~1~~

~~4~~

~~Seagoing, 4tli class~~

~~9~~

~~4~~

~~:~~

~~8~~

~~,,~~

~~,,~~

~~Coast defence (modern) .~~

~~8~~

~~3~~

~~1~~

~~8~~

~~1~~

~~4~~

~~^,~~

~~,,~~

~~„ (old) . . .~~

~~13~~

~~13~~

~~,,~~

~~5~~

~~11~~

~~7~~

~~2~~

~~5~~

~~V~~

~~Armoured cruisers~~

~~4~~

~~12~~

~~8~~

~~1~~

~~1~~

~~2~~

~~2~~

~~9~~

~~6~~

~~7~~

~~1st class cruisers~~

~~21~~

~~1~~

~~2~~

~~I~~

~~2~~

~~Other cruisers,protected or belted~~

~~100~~

~~2~~

~~38~~

~~12~~

~~)4~~

~~ie~~

~~2~~

~~28~~

~~6~~

~~ii~~

~~2~~

~~15~~

~~Torpedo gunboats, &c.~~

~~15~~

~~2~~

~~15~~

~~9~~

~~:~~

~~8~~

~~1~~

~~3~~

~~1~~

~~16~~

~~Destroyers~~

~~100~~

~~10~~

~~18~~

~~14~~

~~20~~

~~10~~

~~27~~

~~16~~

~~21~~

~~, ,~~

~~11~~

~~8~~

~~14~~

~~1st class torpedo boats~~

~~15~~

~~2~~

~~37~~

~~4~~

~~40~~

~~(?)10~~

~~47~~

~~25~~

~~17 26~~

~~7~~

~~2nd and 3rd class torpedo boats .~~

~~175~~

~~143~~

~~36~~

~~151~~

~~98~~

¯,

~~6~~

~~25 14~~

~~138~~

~~Submarines . . . .~~

~~1~~

~~4~~

~~11~~

~~28~~

~~Unknown~~

~~2~~

~~6~~

~~1~~

~~Rams (special) . . . .~~

~~1~~

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~~1~~

~~1.~~

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~~Torpedo depot ships (special) .~~

~~1~~

~~•■~~

~~1~~

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~~Under the head of " afloat " all ships ready or nearly ready for sea are included. " Building " covers those still on the stocks or~~

~~only just launched, which will not be completed for a year.~~

~~Land defence has hitherto been regarded as forming a secondary branch of the great question of Imperial defence. But though secondary it has been intimately connected with the development and internal growth of the empire. In the case of the first settlement of the American colonies they~~

~~were expected to provide for their own land defence. To some extent in -the early part of their career they carried out this expectation, and even on occasion, as in the taking of Louisburg, which was subsequently given back at the peace of Aix-la-Chapelle as the price of the French evacuation of Madras, rendered public service to the empire at large. In India the principle of local self-defence was from the beginning carried into practice by the East India Company. But in America the claim of the Trench wars proved too heavy for local resources. In 1755 Great Britain intervened with troops sent from home under General Braddock, and up to the outbreak of the American war the cost of the defence of the North American colonies was borne by the Imperial exchequer. To meet this expense the Imperial parliament took upon itself the right to tax the American colonies. In 1765 a Quartering Act was passed by which 10,000 Imperial troops were quartered in the colonies. As a result of the American war which followed and led to the loss of the colonies affected, the Imperial authorities accepted the charge of the land defences of the empire, and with the exception of India and the Hudson Bay territo- ries, where the trading companies de):ermined to pay their own expenses, the whole^cost of Imperial defence was borne, as the cost of the navy still is, by the taxpayers of the United Kingdom. This condition of affairs lasted till the end of the Napoleonic wars. During the thirty years' peace which followed there came time for reconsideration.~~

~~The fiscal changes which towards the middle of the 19th century gave to the self-governing colonies the command of their owfu resources very naturally carried with them the consequence that a call should be made on colonial exchequers to provide for their own governing expenses. Of these defence is obviously one of the most ^essential. Coincidently, therefore, with the movements of free trade at home, the renunciation of what was knowh as the mercantile system and the accompanying grants of con- stitutional freedom to the colonies, a movement for the reorganization of Imperial defence was set on foot. In the decade which elapsed between 1846 and 1856 the movement as regards the colonies was confined chiefly to calls made upon them to contribute to their own defence by providing barracks, fortifications, &c., for the accommo- dation of Imperial troops, and in some cases paying for the use of troops not strictly required for Imperial purposes. In 1857 the Australian colonies agreed to pay the expenses of the Imperial garrison quartered in Australia. This was a very wide step from the~~

Imperial attempt to tax the American colonies f 6r a similar purpose in the preceding century. Nevertheless, in evidence given before a depart- mental committee in 1859, it was shown that at that time the Colonies of Great Britain were free from almost every obligation of contributing either by personal service or money payment towards their own defence, and that the cost of military expenditure in the Colonies in the preced- ing year had amounted in round figures to £4,000,000. A committee of the House of Commons sat in 1861 to consider the question, and in 1862 it was resolved without a division, that "colonies exercising the right of self- government ought to undertake the main responsibility of providing for their own internal order and security, and

ought to assist in their own external defence." The decision was accepted as the basis of Imperial policy. The first effect was the gradual withdrawing of Imperial troops from, the self-governing colonies, together with the encouragement of the development of local military sys- tems by the loan, when desired, of Imperial piilitary experts. A call was also made for larger military contri- butions from some of the Crown colonies. The committee of 1859 had emphasized in its report the fact that the principal dependence of the Colonies for defence is neces- sarily upon the, British navy, and in 1865, exactly 100 years after the Quartering Act, which had been the cause of the troubles that led to the independence of the United States, a " Colonial Naval Defence " Act was passed which gave power to the Colonies to provide ships of war, steamers, and volunteers for their own defence, and in case of necessity to' place them at the disposal of the Crown. In 1868 the Canadian Militia Act gave the fully organized nucleus of a local army to Canada. In the same year the Imperial troops were withdrawn from New Zealand, leaving the colonial militia to deal with the native war still in progress. In 1870 the last Imperial troops were withdrawn from Australia, and in 1873 it was officially announced that military expenditure in the Colonies was almost "wholly for Imperial purposes." In 1875 an Imperial officer went to Australia to report for the Australian Grovernment upon Australian defence. The appointment in 1879 of a royal

~~commission to con- sider the question of Imperial defence, which presented its report in 1882, led to a considerable development and reorganization of the system of Imperial fortifications. Coaling stations were also selected with reference to the trade routes. In 1885 rumours of war roused a very strong feeling in connexion with the still unfinished and in many cases unarmed condition of the fortifications recom- mfeded by the commission of 1879. Military activity was stimulated throughout the empire, and the Colonial Defence Committee was created to supply a much-felt need for organized direction and advice to colonial admin- istrations acting necessarily in independence of each other. The question of colonial defence was among the most important of the subjects discussed at the Colonial Conference held in London in 1887, and it was at this Conference that the Australasian colonies first agreed to contribute to the expense of their own naval defence. Prom this date the principle of local responsibility for self-defence has been fuUy accepted. With the exception of Natal all the self-governing colonies have provided practically for their own military requirements. India has its own native army, and pays for the maintenance within its frontiers of an Imperial garrison. Early in the summer of 1899, when hostilities in South Africa appeared to be imminent, the governments of the prin- cipal Colonies took occasion to express their approval of the policy pursued by the Imperial Government, and offers were made by the governments of India, the Australasian colonies, Canada, Hong-Kong, the Federal Malay states, some of the West African and other colonies, to send con- tingents for active service in the event of war. On the outbreak of hostilities these offers, on the part of the self-goveriiing Colonies, were accepted, and colonial contingents up wards, of 30,000 strong were among the most efficient sections of the British fighting force. The manner in which these colonial contingents were raised, their admirable! fighting qualities, and the service rendered by them in the field, have disclosed altogether new military possibilities within the empire, and the reorganization of the army on an Imperial footing is among the more probable developments of the near future. As at present organized the army is divided into two~~

~~main sections, namely, the British and the Indian armies, of which the strength is roughly as follows, though for fuller details reference should be made to the article Akmibs : —~~

~~British.~~

~~Regular forces, home and colonial . . 203,852~~

~~Army reserve, 1st class .... 90,000~~

~~Militia 139,237~~

~~Yeomanry 11,907~~

~~Volunteers 265,061~~

~~Total, home and colonial . Begular forces on Indian establishment~~

~~710,057 73,484~~

~~783,541~~

~~Indian Army. Eegular forces on Indian establishment already noted.~~

~~Native Army.~~

~~European Officers.~~

~~Native Officers.~~

~~Non-com- missioned Officers and Privates.~~

~~Total.~~

~~Artillery~~

~~Cavalry ....~~

~~Sappers and miners~~

~~Infantry~~

~~Total native army .~~

~~33~~

~~358~~

~~65~~

~~1122~~

~~54~~

~~619~~

~~488~~

~~2048~~

~~2,001~~

~~21,955~~

~~3,142~~

~~108,755~~

~~2,088~~

~~22,932~~

~~3,695~~

~~111,926~~

~~1578~~

~~3209~~

~~135,853~~

~~140,640~~

~~The feudatory and dependent native states have native armies of their own which, according to the latest available estimates, number about 3^0,000 men, with upwards of 4000 guns. Offers of military service in South Africa in 1900 were received from some of the principal feudatory states.~~

~~Special expenditure has been made by the Indian Government upon coast defences armed with modern breechloading guns. Large sums have also been spent upon external and border defences, and an establishment of two coast-defence ironclads, a despatch vessel, two first- class torpedo gunboats, seven first-class torpedo boats, as well as armed gunboats, &c., is maintained.~~

~~With the exceptions of Natal and the garrisons of the naval stations of Cape Town and Halifax, no imperial gar- risons are under normal conditions maintained in the self- governing Colonies. In the Crown Colonies garrisons are maintained in Gibraltar, Malta, Mauritius, Sierre Leone, St Helena, Ceylon, Straits Settlements, Hong-Kong, and the West Indies. There are Imperial naval stations at Simon's Bay, Trincomalee, Bermuda,~~

Esquimalt, Halifax, Malta, Gibraltar, St Lucia, Ascension, Hong-Kong, and Wei-hai-Wei.

The important questions of justice, religion, and in- struction will be found dealt with in detail under the headings of separate sections of the empire. Systems of justice throughout the empire have a close resemblance to each other, and the Privy Council of the House of Lords, on which the self-governing colonies and India are repre- sented, constitutes a Supreme Court of Appeal for the entire empire; but common law varies according to its origin in some important divisions. Eeligion, Of which the forms are infinitely varied, is everywhere free, except in cases where the exercise of religious rites leads to practices foreign to accepted laws of humanity. Systems of instruction of which the aim is generally similar in the white portions of the empire, and is directed towards giving to every individual the basis of a liberal educa- tion, are governed wholly by local requirements. Native schools are established in all settled communities under British Eule. (f. l. s.)

S.IL-si

B E I T 0 N-F ERE Y — B E 0 G L I E

Briton- Ferry, a seaport and railway station in the Mid parliamentary division of Glamorganshire, Wales, at the mouth of the Neath river, 2^ miles S. of Neath. There are four Episcopalian churches, and Baptist, Con- gregational, Methodist, and Bible Christian chapels. There are coal mines and iron, steel, and tin-plate works. The dock belongs to the Great Western Eailway Company, and is 13 acres in extent. Area of parish (an urban district), 1693 acres. Population (1881), 6061 ; (1901),

7000.

Brive, or Brive-la-Caillarde, chief town of arrondissement, department Corrfeze, France, 18 miles S. W. of Tulle ; an important railway centre on the main liae from Paris to Toulouse. A statue has been erected to Marshal

~~Brune, a native of the town. Manufactures include straw work in great variety. Population (1881), 9598 ; (1891),~~

~~11,142; (1901), 19,496.~~

~~Brixen (Italian, Bressanone), chief town of a district of the same name in Tirol. Population of district (1890), 27,050; (1900), 27,691; and of commune (1890), 5625; (1900), 5767. Corn, fruit and viticulture, and the breed- ing of the silk-worm, are the leading industries. It is a favourite health resort in spring and autumn, on account of its mild climate.~~

~~Brixham, a market town in the Torquay parlia- mentary division of Devonshire, England, on the south side of Tor Bay, 30 miles S. of Exeter. The Western Counties Home for the orphan boys of seamen (1869) has been enlarged and a market buildiug erected. Area of parish (an urban district), 5612 acres.' Population (1881),~~

~~7033 ; (1901), 8622.~~

~~Broach, or Bhaeuch, an ancient city and modern district of British India, in the Gujarat division of Bombay. The city is on the right bank of the Narbada, about 30 miles from the sea, and 203 miles N. of Bombay. The area, including suburbs, occupies 3 square miles. Population (1881), 37,281; (1891), 40,168 ; (1901), 42,298. The searborne trade is now confined to a few coasting vessels. Handloom weaving is almost extinct, but four cotton mills have been opened, with 800 looms and 70,000 spindles, employing 1450 hands. There are also fi-ve large flour mills. The English high school, called after a munificent Parsee, was attended in 1896-97 by 290 pupils.~~

~~The district of Bboach contains an area of 1463 square miles. The population in 1891 was 341,490, being 233 persons per square mile. According to religion, Hindus numbered 245,422; Mahommedans, 71,263; Parsees, 3273; Jains, 3576; Christians, 128, including 31 Euro- peans; "others," 17,828. In 1901 the population was 291,428, showing a decrease of 16 per cent., compared with an increase of 6 per cent, in the preceding decade. The total amount of land revenue and rates was re- turned as E.s.28,31,477, the incidence of assessment being B.s.4 : 2 : 5 per acre ; the~~

~~number of police was 508. In 1897-98, out of a total cultivated area of 567,228 acres, only 879 were irrigated from wells, &c. The principal crops are cotton, millet, wheat, and pulse. Dealing in cotton is the chief industry, the dealers being organized in a guild. Besides the cotton mills in Broach city there are about 20 factories for ginning and pressing cotton, some of them on a very large scale. The district is traversed throughout its length by the Bombay and Baroda railway, which crosses the Narbada opposite Broach city on an iron girder bridge of 67 spans. In 1897-98 there were 263 schools, with 19,773 pupils, showing one village with a school to every 7 square miles of area, and 6-12 pupils to every hundred of the population. There were four printing-presses, issuing three newspapers in~~

~~the vernacular. The municipalities had a total income of Es.1,69,959, the incidence of taxation being Es.l : 8: 8 per head. Eor 1897 the death-rate was 34 per thousand, rising to 41 in Broach city. The district suffered severely from the famine of 1899-1900.~~

~~Broad Stairs, a town and watering-place in the Isle of Thanet parliamentary division of Kent, 3 mUes S.W. of Margate, on the South-Eastern and Chatham railway. Erom 1837 to 1851 Broadstairs was a favourite summer resort of the novelist Dickens, who, in a sketch called "bur English Watering-Place," described it as a place " left high and dry by the tide of years." This sea-side village, with its " semi-circular sweep of houses," has grown into a considerable town owing to the influx of summer visitors, for whose entertainment, there are, besides the "Albion" mentioned by Dickens, a Grand Hotel, numerous inns and boarding-houses, libraries, a bathing establishment, and a fine promenade. Area of urban district, 1442 acres. Population (1881), 4322;~~

~~(1891), 6234; (1901), 6460.~~

~~Brockton, a city of Plymouth county, Massa^ chusetts, U.S.A., 20 miles S. of Boston, and containing an area of 21 square mUes of rolling surface. One of the many lines of the New York, New Haven, and Hartford railway passes through it. It is an important manufac- turing place, the making of boots and shoes being the most important branch of industry. Brockton was settled about 1700, and was incorporated as a town under the name of North Bridgewater. This was changed to Brockton in 1874. In 1881 it received a~~

~~city charter. The assessed valuation of real and personal property in 1900 was 127,868,799, the tax-rate f 20.10 per $1000, and the net debt $1,946,872. Population (1880), 13,608; (1890), 27,294; (1900), 40,063, of whom 9484 were foreign-born. The death-rate in 1900 was 13-2.~~

~~Brockville, a town and port of entry of Ontario, Canada, and capital of Leeds county, situated 119 miles S.W. of Montreal, on the left bank of the St Lawrence, and on the Grand Trunk, Canadian Pacific, and Brock- ville and Westport railways. It has steamer communica- tion with the St Lawrence and Lake Ontari^ ports. The principal manufactures are hardware, furnaces, agri- cultural implements, carriages, sulphuric acid, &c. The value of imports for 1899-1900 was $1,111,461 ; exports $460,948. Population (1881), 7609 ; (1891), 8791 ; (1901),~~

~~8940.~~

~~Brod, a town of Croatia Slavonia, Hungary, near the river Save. As chief town for the transit trade in cereals, prunes, wood, and wine between Hungary and Bosnia, it is rapidly rising in importance. The railway crosses the river at this point. Population, 7310.~~

~~Brody, chief town of district of same name in the Austrian crown-land of Galicia, near the Russian frontier. Population of district (1890), 130,707; (1900),' 133,865 ; of town (1890), 17,534; (1900), 17,360. The latter is for the most part German-speaking, about two-thirds being Jews. There is a garrison of 888 men. It is one of the most important commercial centres in Galicia, particularly for the trade with Eussia, which furnishes com, furs, and wool, receiving in return Austrian cottons, silks,agricultural implements, leather goods, j ewellery, &c. Thpre has, how- ever, been a marked decline both in imports and exports since 1879, when its charter as a free commercial city was withdrawn, its position being further damaged by the construction of the railway vid Tarnopol.~~

~~Broglie, Jacques Victor Albert, Dire de (1821-1901), French statesman and historian, the eldest son of Achille Charles L^once Victor, due de Broglie, was born in Paris on 13th June 1821. After a brief~~

diplomatic career at Madrid and Rome^ the revolution of 1848 caused him to withdraw from public life and devote himself to literature. He had already published a transla- tion of the religious system of Leibnitz (1846). He now at once made his mark by his contributions to the Bevue des Deux Mondes, and the Orleanist and clerical organ Le Correspondant, which were afterwards collected .under the titles of Etudes morales et littiraires (1853), and Questions de religion et d'histoire (1860). These were supplemented in 1869 by a volume of JSfouvelles itudes de littirature et de morale. His L'jSglise et VEmpire romain au IV' sihcle (1856-66) brought him the succession to Lacordaire's seat in the Academy in 1862. In 1870 he succeeded his father in the dukedom, having previously been known as the prince de Broglie. In the following year he was elected to the National Assembly for the departm ent of the Eur e, and a few days later (19th February) was appointed ambassador to the Court of St James's; but in March 1872, in consequence of criticisms upon his negotiations concerning the commercial treaties between England and France, he resigned his post and took his seat in the National Assembly, where he became the leading spirit of the monarchical campaign against Thiers. On the replacement of the latter by Marshal MacMahon, the due de Broglie became president of the Council and minister for Foreign Affairs (May 1873), but in the recon- struction of the ministry on 26th November, after the pass- ing of the septennate, transferred himself to the ministry of the Interior. His tenure of office was marked by an extreme Clericalism and Conservatism, which roused the bitter hatred of the Kepublicans, while he alienated the Legitimist party by his friendly relations with the Bona- partists, and the Bonapartists by au attempt to effect a com- promise between the rival claimants to the monarchy. The result was a coalition, which overthrew the Cabinet on 16th May 1874. Three years later (16th May 1877) he was entrusted with the formation of a new Cabinet, with the object of appealing to the country and securing a new Chamber more favourable to the reactionaries than its predecessor had been. The result, however, was a de- cisive Republican majority. The due de Broglie was defeated in his own district, and resigned office on 20th November. From this time he gradually dropped out of politics and reverted to his former historical studies. Besides editing the Souvenirs of his father (1886, &c.), the M&moires of Talleyrand

~~(1891, &c.), and the^ letters of the Duchess Albertine de Broglie (1896), he pub- lished Le secret du Roi. Correspondance secrUe de Louis X.V. avec ses agents diplomatiques, 1753-74 (1878) ; Fridiric IL et Marie Thir&se (1883); FrMiric II. et Louis XV. (1886) ; Marie Thirise Impiratrice (1888) ; Histoire et diplomatie (1889) ; Lep^re Lacordaire (1889); Maurice de Saxe et le marquis d'Argenson (1891); La Paix d'Aix-lorChapelle (1892); Le Concordat (1893); L' Alliance Autrichienne (1895); La Mission de M. de Gontaut-Biron d, Berlin (1896); Histoire et politique (1897) ; La Journie de Fontenoy (printed for private circulation, 1897) ; Malherbe, in the series of " Les grands icrivains Franqais" (1897); Voltaire avant et pendant la Guerre de Sept Ans (1898) ; Saint Ambroise, translated by Margaret Maitland in the series of " The Saints" (1899). He died in Paris on 19th January 1901.~~

~~(h. Sy.)~~

~~Broken Hill, a silver-mining town in New South Wales, Australia, about 925 miles W. of Sydney. One of the neighl^uring mines is the most prolific in the world. Gold is associated with the silver, and fairly good copper lodes are found. The problem of the profitable treatment of the sulphide ores has been practically solved here. The Barrier mines employ over 7000 men, and~~

~~claim 27 per cent, of the lead production of the world. Population (1901), 27,518.~~

~~Brokers. — In the primary sense of the word a broker is a mercantile agent, of the class known as general agents, whose office is to bring together intending buyers and sellers and make a contract between them, for a remunerar tion called brokerage or commission ; e.g'.,, cotton brokers, wool brokers, or produce brokers. Originally the only contracts negotiated by brokers were for the sale or pur- chase of commodities ; but the word in its present use includes other classes of mercantile agents, such as stock-brokers, insurance-brokers, ship-brokers, or bill-brokers. Pawnbrokers are not brokers in any proper sense of the word ; they deal as principals and do not act as agenfs. In discussing the chief questions of modern legal interest in connexion with brokers we shall deal with them, firstly, in the original sense.~~

~~1. Relations between Broker and Principal. — A broker has not, like a factor, possession of his principal's goods, and cannot buy or sell in his own name ; his business is to bring into privity of contract his principal and the third party. When the contract is made ordinarily he drops out altogether. Brokers very frequently act as factors also, but, when they do so, their rights and duties as factors must be distinguished from their rights and duties as brokers. It is a broker's duty to carry out his principal's instructions with diligence, skill, and perfect good faith. He must see that the terms of the bargain accord with his principal's orders from a commercial point of view, e.g., as to quality, quantity, and price ; he must ensure that the contract of sale effected by him be legally • enforceable by his principal against the third party; and he must not accept any commission from the ttiird party, or put himself in any position, in .which his own interest may become opposed to his principal's. As soon as he has made the contract which he was employed to make, ordinarily his duty to, and his authority from, his principal alike cease ; and consequently the law of brokers relates principally to the formation of contracts by them.~~

~~The most important formality in making contracts for the sale of goods with which a broker must comply, is contained in section 4 of the Sale of Goods Act, 1893, which (in substance re-enacting section 17 of the Statute of Frauds) provides as follows : — "A con- tract for the sale of any goods of the value of ten pounds or upwards shall not be enforceable by action unless the buyer shall accept part of the goods as sold, and actually receive the same, or give some- thing in earnest to bind the contract, or in part payment, or unless some note or memorandum in writing of the contract be made and signed by the party to be charged or his agent in that behalf.""~~

~~From the reign of James I. till 1884 brokers in London were admitted and licensed by the Corporation, and regulated by statute ; and it was common to employ one broker only, who acted as inter- mediary between, and was the agent of both buyer and seller. When the Statute of Frauds was passed in the reign of Charles II., it became the practice for the broker, acting for both parties, to insert in a formal book kept for the purpose a memorandum of each contract effected by him, and to sign such memorandum on behalf 6f both parties, in order that there might be a written memorandum of the contract of sale, signed by the agent of the parties as required by the statute.~~

He would then send to the buyer a copy of this memorandum, called the " bought note," and to the seller a " sold note," which would run as follows : —

"I have this day bought for you from A B [or "my princi- pal"] " [signed] " M, Broker.'"

" I have this day sold for you to A B [or "my principal"] "

[signed] "M, Broker.'"

There was in the earlier part of the 19th century considerable dis- cussion in the courts as to whether the entry in a broker's book, or the bought and sold notes (singly or together), constituted the statutory memorandum ; and judicial opinion was not unanimous on the 'point. But at the present day brokers are no longer regulated by statute, either in London or elsewhere, and keep no formal book ; and as an entry made in a private book kept by the brokers for another purpose, even if signed, would probably not be regarded as a memorandum signed by the agent of the parties in that behalf, the old discussion is now of little practical interest.

Under modern conditions of business the written memorandum of the contract of sale efieeted by the broker is usually to be found in a " contract note " ; but the question whether, in the particular circumstances of each case, the contract note affords a suflBcient memorandum in writing, depends upon a variety of con- siderations— e.g., whether the transaction is effected through one or through two brokers ; whether the contract notes are rendered by one broker only, or by both ; and, if the latter, whether ex- changed between the brokers, or rendered by each broker to his own client ; for under present practice any one of these methods may obtain, according to the trade in which the transaction is effected, and the nature of the particular transaction.

~~Where one and the same broker is employed by both seller and buyer, bought and sold notes rendered in the old form provide the necessary memorandum of the contract. Where two brokers are employed, one by the seller and one by the buyer, sometimes one drops out as soon as the terms are negotiated, and the other makes out, signs, and sends to the parties the bought and sold notes. The latter thus becomes the agent of both parties for the purpose of signing the statutory memorandum, and the position is the same as if one broker only had been employed. On the other hand, if one broker does not drop out of the transaction, each broker remains to the end the agent of his own principal only, and neither becomes the agent of the other party for the purpose of signing the memo- randum. In such a case it is the usual practice for the buyer's broker to send to the seller's broker a note of the contract, — "I, acting on account of A. B. [or, " of my principal,"], have this day bought/rom you, acting on account of C.D.[or "of yourprincipal"] , ' ' — and to receive a corresponding note from the sejler's broker. Thus each of the parties receives through his own agent a memorandum signed by the other party's agent. These contract notes, as they are called, p,re not "bought" and "sold" notes, as originally understood ; for the " bought note " proper was sent to the buyer, and ran : — "I have this day bought for you" and the sold note was sent to the seller, and ran^" I have this day sold /or you." But they are usually known as, and serve the purpose of, " bought" and "sold" notes.~~

~~In all the above three cases the broker's duty of compliance with all formalities necessary to make the contract of sale legally enforceable is performed, and both parties obtain a written memo- randum of the contract upon which they can sue. But in cer- tain Exchanges governed by a close association which excludes strangers from its market, all members of the association, whether brokers or merchants, are by the custom or rules of the Exchange treated as principals amongst themselves ; and the bargains they make are enforced on the market by the governing body of the Exchange, whether legal formalities such as the signed memoran- dum are complied with or not; and it thus becomes, from the broker's point of view, unnecessary to comply with legal require- ments which are not insisted upon on the market. If he complies with the rules of the association he knows his contracts will be enforced. The domestic takes the place of the public forum. So the practice has arisen on certain Exchangesj at least in~~

~~reference to certain classes of transactions, for the brokers making contracts on the market, instead of rendering to each other duly signed con- tract notes, merely to enter the bargain each in his own private market book. Such entries are usually checked by subsequent com- parison, and bargains so made are enforced by the governing body. So long as the two brokers remain solvent, the contract is, as between them, performed on the market.~~

~~In contracts for future delivery, at each periodical "settlement" up to the date of delivery, " differences " are paid, by one broker to Differences *^® Other, through the clearing house of the Exchange, ■ i.e., the difference between the contract price and the market price at the settlement, or between the last and the present settlement prices. When the date of delivery arrives, if the selling principal be a stranger to the market and fail to deliver, his broker is compelled by the rules of the Exchange to make good to the buying broker any loss due to a rise of the market. Similarly it the buying principal refuses to take de- livery, and the market has fallen, the buying broker must make good to the selling broker the consequent loss. But when an agent receives money on his principal's behalf, it is his duty to account for it, and the statutory requirement of a memorandum in writing does not apply to prevent a principal from suing his agent for money received to his use. Thus, so long as the two brokers remain solvent, the contract of sale, though by reason of the absence of any statutory memorandum, legally unenforceable by one principal against the other, is, in fact, indirectly enforced. But if the selling broker becomes insolvent, the seller must suffer loss ; for ex hypothesi the seller cannot enforce the contract directly against the buyer, and his remedy against his broker becomes a mere right of proof against an insolvent estate. Again, should the buying broker become insolvent, then, if the seller has employed his broker on the terms that all rules and customs, of the market are to be read into the contract of employment (which question is~~

~~dealt with below), the seller cannot complain that his broker has, in conformity to those rules and customs, omitted to make for him a contract which he can enforce at law directly against the buyer ; and his only right will be to recover from his broker the money which the latter receives on his account, viz., the dividends paid by the insolvent estate of the buying broker. On the principal markets it also very often happens in dealings in "~~

~~futures " that one purchase may be made through several intermediate brokers, who sell first, and then buy against their contract of sale from another broker. In such a case, the first buying broker and the last selling broker are alone in direct relations with the two principals. The intermediate brokers act as principals towards each other according to the rules of the Exchange, and when their bargain is made, drop out of the transaction, usually at the next periodical settlement. Ultimately the position is precisely the same as if only two brokers had been employed from the start, and the remarks made above as to that position apply.~~

~~When two brokers are employed, it is commonly the practice (except when one broker drops out, and the other signs bought and sold notes on behalf of both parties) for each broker to send to his principal a contract note, either in the form of the old bought~~

~~and sold notes — " I have rq]^ for you," — or in a form which purports to make himself a principal instead of agent in relation to his client, — " I have this day i,o„giJf from °" '^^^ contract notes, though often so spoken of, are not really bought and sold notes ; for the buying broker is not the agent of the seller, and the selling broker is not the agent of the buyer, for the purpose of signing such notes. They are memoranda not of the contract of sale, but of the contract of employment, and contain the terms upon which the broker is employed. by his principal. Sometimes they are accompanied by a detachable form, known as the "client's return contract note," to be filled in, signed, and returned by the client ; but even the " client's return contract note " is retained by the client's own broker, and is only a memorandum of the terms of employment. The following is a form of contract note rendered by a broker to his client for American cotton, bought on the Liverpool Cotton Exchange for future delivery. The client's contract note is attached to it, and is in precisely corresponding form.~~

~~American Cotton, Delivery Contract Note.~~

~~M.~~

~~Liverpool, .~~

~~Dear Sirs, ^^ ^^^^ ^^^^^ ^ to^ ^^^~~

~~ft) American Cotton, net weight, to be contained~~

~~in American Bales, more or less, to be delivered in~~

~~Liverpool, during on the basis of per Jb~~

~~for on the terms of the rules, bye-laws, and Clearing~~

~~House regulations of the Liverpool Cotton Association, Limited, whether endorsed hereon or not.~~

~~The contract, of which this is a note, is made between ourselves and yourselves, and not by or with any person, whether disclosed or not, on whose instructions or for whose benefit the same may have been entered into. Yours faithfully.~~

~~The contract, of which the above is a note, was made on the date specified, within the business hours fixed by the 'Liverpool Cotton Association, Limited. per cent, to us. '~~

~~Please confirm by signing, and returning the contract attached.~~

~~Primd, facie, as already stated, it is the duty of a broker, employed to buy, to make with an actual seller, either direct or through another broker, a contract of sale which is legally enforceable at the instance of the buyer. And Custom- it the buyer did not consent to employ his broker on ”’’ “”*• the terms that he should act according to the rules and customs of the market, the broker would be guilty of a breach of duty, if, in obedience to such rules or customs, he omitted to procure a statutory memorandum. Such consent may be given ex- pressly by the client, before he instructs his broker to execute any order. He may say, ” I consent to your following all the rules and customs of your Exchange and am willing to be bound by them!” In such a case the client could not complain if his broker did follow those rules and customs, and he would be bound by them, whether the rules and customs were expressed in extenso in the contract of employment, or incorp6rated by reference as in the above form of contract note for ” delivery cotton.” But it is also a rule of law, that trade contracts are to be construed subject to trade usages, and the contract of employment of the~~

broker is therefore impliedly made subject to the usages of the broker's trade, whether the client is already aware of these usages or not. This legal implication is, however, subject to the limitation,

that the contract shall not be construed as incorporating any custom or usage which, in the opinion of the court, is unreasonable, unless the party to be bound by it actually knew of it beforehand, or by his conduct is precluded from saying that he did not know of it. A custom which is inconsistent with the fundamental nature of the contract is considered by the courts as unreasonable ; e.g., a custom that a broker employed to buy as broker may convert him- self into a principal contracting party and sell to his client on his own account. The " principal " clause in the above form of contract note would not be binding unless assented to. So also the practice above mentioned by which the broker omits to obtain a properly signed memorandum of the contract upon which his principal can sue, would be held unreasonable. The important question therefore which arises in considering the duty of a broker to his client, is, in practice usually, whether the client has actually consented (or must be taken to have consented) to be bound by some usage which is unreasonable, and would not bind him without that consent. This is a question of fact in each case, and depends on what notice the client has had of the particular usage. It is chiefly as evidence of consent, or at any rate of notice, that the printed forms' of contract notes sent by brokers to their clients incorporating the rules and customs of the Exchange or market, are important. K in any case it appears that the printed forms have been brought to the previous notice of the client, there will be evidence (of which the force will no doubt differ according to the circumstances of every case) from which to infer the client's consent to the customs and rules referred to in the form. If the client receives and signs a "return note," the evidence of his consent becomes practically conclusive. In this context, however, the rule of evidence should not be forgotten, that a contract in writing cannot be varied by extrinsic evidence ; and therefore if the terms upon which the broker is employed have previously been reduced to writing, evidence whether oral or written of usages or rules inconsistent

~~with those terms will be inadmissible ; and even if a client signed such a " return note " as above mentioned, the reference therein to the rules and usages of the particular market would not serve to alter the contract already made ; nor would it constitute a new contract, for there would be no fresh consideration.~~

~~The broker, on performing his duty in accordance with the terms upon - which he is employed, is entitled to be , paid his brokerage. This usually takes the form~~

~~n erage. ^^ ^ percentage, varying according to the nature of business, upon the total price of the goods bought or sold through him. When he guarantees the solvency of the other party, he is said to be employed upon del credere terms, and is entitled to a higher rate of remuneration. If he fails to perform his duty, he loses his right to re- muneration, reimbursement, and indemnity, and further becomes liable to an action for damages for breach of his contract of employment, at the suit of his principal. The measure of damages will, in the absence of any special arrangement, be the difEerence between the contract price and the market price at the time of the breach. In some trades it is the custom for ihe selling broker to receive payment from the buyer or his broker ; and in such case it is his duty to account to his principal for the purchase money. A broker who properly expends money or incurs liability on his principal's behalf in the course of his em- ployment, is entitled to be reimbursed the money, and indemnified against the liability. Not havin g, like a factor, possession of the goods, a broker has no lien by which to enforce his rights against his principal.~~

~~2. Relations between Broker and Third Party. — A broker who signs a contract note as broker on behalf of a principal, whether named or not, is not personally liable on the contract to the third party. But if he makes the contract in such a way as to make himself a party to it, the third party may sue either the broker or his principal, subject to the limitation that the third party, by his election to sue one, precludes himself from suing the other. In this respect the ordinary rules of the law of agency apply to a broker. Brokers who are members of Exchanges are personally liable to any member with whom they contract, whether he be a merchant or a broker; because by joining the association each member contracts to be bound by~~

~~the rules, one of which is that all members are between themselves principals. Generally, a broker~~

~~has not authority to receive payment, but in certain trades it is customary for him to do so, and in such trades if the buyer pays the seller's broker, and is then sued by the seller for the price by reason of the broker having become insolvent or having absconded, he may set up the payment to the broker as a defence to the action by the broker's principal. A payment by the buyer to his own broker is no defence to an action by the seller unless the seller has led the buyer to believe that he has already settled with the buyer's broker. Brokers may render themselves liable for damages in tort for the conversion of the goods at the suit of the true owner if they negotiate a sale of the goods for a selling principal who has no title to the goods.~~

~~A stockbroker is a broker who contracts for the sale of stocks and shares. Stockbrokers differ from brokers proper chiefly in that stocks and shares are not " goods," and the requirement of a memorandum in writing, enacted by the Sale of Goods Act, 1893, does not apply. Hence actions may be brought by the principals to a contract for the sale of stocks and shares although no memo- randum in Writing exists. Tor instance, the jobber, on failing to recover from the buyer's broker the price of shares sold, by reason of the broker having failed and been declared a defaulter, may sue the buyer whose " name was passed " by the broker. The employ- ment of a stockbroker is subject to the rules and customs of the Stock Exchange, in accordance with the principles discussed above, which apply to the employment of brokers proper. A custom which is illegal, such as the Stock Exchange practice of disregarding Leeman's Act, which enacts that contracts for the sale of joint- stock bank shares shall be void unless the registered numbers of the shares are stated therein, is not binding on the client to the extent of making the contract of sale valid. But if a client choose to instruct his broker to buy bank shares in accordance with that practice, the broker is entitled to be indemnified by his client for money which he pays on his behalf, even though the contract of sale so made is unenforceable. For further information the reader is referred to the article and to the treatises on the law of the Stock Exchange.~~

~~An insurance broker is an agent whose business is to effect policies of marine insurance. He is employed by the person who has an interest to insure, pays the premiums to the underwriter, takes up the policy, and receives from the underwriter payment in the event of a loss under the policy. By the custom of the trade the underwriter looks solely to the broker for payment of premiums, and has no right of action against the assured ; and, on the other hand, the broker is paid his commission by the underwriter, although he is employed by the assured. Usually the broker keeps a current account with the underwriter, and premiums and losses are dealt with in account. It is only in the event of the underwriter refusing to pay on a loss, that the broker drops out and the assured sues the underwriter direct.~~

~~Ship-brokers are, firstly, "commission agents," and, secondly, very often also ships' managers. Their office is to act as agents for owners of ships to procure purchasers for ships, or ships for intending purchasers, in precisely the same manner as house-agents act in respect of houses. They also act as agents for ship-owners in finding charterers for their ships, or for charterers in finding ships available for charter, and in either case they effect the charter- party (see ApFREIGHTMtlNT).~~

~~Chartering brokers are customarily paid by the ship-owner, when the charter-party is effected, whether originally employed by him or by the charterer. ' Charter-parties effected through brokers often contain a provision — "2^ per cent, on estimated amount of freight to be paid to AB, broker, on the signing of this charter-party, and the ship to be consigned to him for ship^s business at the port of X [inserting the name of the port where A B carries on business]." The broker cannot sue on the charter-party contract because he is not a party to it, but the insertion of the clause practically prevents his right from being disputed by the ship-owner. When the broker does the ship's business in port, it is his duty to clear her at the customs and generally to act as " ship's husband."~~

~~A bill-broker was originally an agent who, for a commission, procured for country bankers the discounting of their bills in London. But the practice arose of the broker guaranteeing the London banker or financier ; and finally the brokers ceased to deposit with the London bankers the bills they~~

~~received, and at the present day a bill-broker, as a rule, buys bills on his own account at a discount, borrows money on his own account and upon his own security at interest, and makes his profit out of the difference between the discount and the interest. When acting thus the bill-broker is not a broker at all, as he deals as principal and does not act as agent.~~

~~See Stokt. Commentaries on the Law of Agency. Boston, 1882. — Brodhubbt. Law and Practice of the Stock Exchange.~~

~~London, 1897. — Grow. HanAhoolc of Marine Insurance. London, 1900. — Arnould. On Marine Insurance. Edited by Messrs Hart and Simey, 1901. (l. t. S.)~~

~~Bromberg, a town of Prussia, province of Posen, 32 miles by rail W.N.W. from Thorn, 7 miles W. from the bank of the Vistula. The new buildings include a the- atre (1896) and a synagogue (1884). The town possesses a bronze statue of Frederick the Great (1862), a bronze equestrian statue of the Emperor William I. (1893), a monument of the war of 1870-71 (1880), and a statue of BenkenhofE (1894), the constructor of the Bromberg Canal (1773-74), connecting the Vistula and the Netze, with a length of 17 miles. There is also an archaeo- logical collection belonging to the Historical Society of the Netze District. The principal industrial works are iron foundries and machine shops, paper factories, and flour mills ; the town has an active trade in agricultural and other products. Population (1885), 36,294: (1900),~~

~~52,082.~~

~~Bromley, a suburban market town in the Sevenoaks parliamentary division of Kent, England, 10 miles S.S.E. of London by rail. Recent erections are a science and art school, a drill-hall, a public. library, and four new churches, besides a Roman Catholic church and several chapels. The cottage hospital has been enlarged and a recreation ground purchased. Population of parish (an urban district)~~

~~(1881), 15,154; (1891), 21,684; (1901), 27,358.~~

~~Bromsgrove, ancient market town in the Broms- grove parliamentary division of Worcestershire, England, 13 miles S.W. by S. of Birmingham by rail and 13 miles N. by W. of Worcester. Amongst recent erections are a cot- tage hospital and a school of art. Birmingham Sanato- rium stands in the parish. Near the town are carriage works belonging to the Midland railway. Area of urban district, 1122 acres. Population (1901), 8416.~~

~~Brongniart, Adolphe Theodore (1801-1876), French botanist, was born in Paris on 14th January 1801. His father, Alexander Brongniart, at that time director of the imperial pottery at Sevres, being a well- known scientific man, young Adolphe grew up in a scien- tific atmosphere. He soon showed an inclination toward the study of the natural sciences, devoting himself at first more particularly to geology, and later, to botany, thus equipping himself for what was to be the main occupa- tion of his life — the investigation of fossil plants. In 1826 he graduated as Doctor of Medicine with a disser- tation on the Rhamnacese; but the career which he adopted was botanical, not medical. In 1831 he became assistant to Desfontaines at the Museum d'Histoire Naturelle, and two years later succeeded him as professor, a position which he continued to hold until his death on 18th February 1876. Brongniart was an indefatigable investigator and a prolific writer, so that he left behind him, as the fruit of his labours, a large number of books and memoirs. Of these, the great majority refer to palaeo- botany, a study with which his name will ever be associated. As early as 1822 he published a paper on the classification and distribution of fossil plants (M6m. Mus. Hist. Nat. viii.). This was followed by several papers chiefly bearing upon the relation between extinct and existing forms ; a line of research which culminated in the publication of the Histoire des Vigitaux Fossiles, which has earned for him the title of " father of palseobotany." This great work was heralded by a small but most im- portant " Prodrome " (contributed to the Grand Diction- naire d'Hist. Nat., 1828, t. Ivii.) which brought order into chaos by a classification in which the fossil plants were arranged, with remarkably correct insight, along with their nearest living allies, and which forms the basis of all subsequent progress in this direction. It is of~~

~~especial botanical interest, because, in accordance with Robert Brown's discoveries, the Cycadeae and Coniferae are here placed in the new group Phanirogames gym- nospermes. In this book attention is also directed to the succession of forms in the various geological periods, with the important result (stated in modern terms) that in the Palaeozoic period the Pteridophyta are found to predominate ; in the Mesozoic, the Gymnosperms ; in the Cainozoic, the Angiosperms, a result subsequently more fully stated in his "Tableau des Genres de V^g^taux Fossiles" (D'Orbigny, Diet. Univ. d'Hist. Nat., ;1849). But the great Histoire itself was not destined to be more than a colossal fragment ; the publication of successive parts proceeded regularly from 1828 to 1837, when the first volume was completed; but after that only three parts of the second volume appeared. Brongniart no doubt was overwhelmed with the continually increasing magnitude of the task that he had undertaken. Apart from his more comprehensive works, his most important palaeontological contributions are perhaps his observa- tions on the structure of Sigillaria {Arch. Mus. Hist. Nat. i., 1839) and his researches (almost the last he undertook) on fossil seeds of which a full account was published posthumously in 1880. His activity was by no means confined to palseobotany, but extended into all branches of botany, more particularly anatomy and phanerogamic taxonomy. Among his achievements in these directions, the most notable is the memoir " Sur la generation et le d^veloppement de I'embryon des Phanirogames " {Ann. Sci. Nat. xii., 1827). This is remarkable in that it con- tains the first account of any value of the development of the pollen; as also a description of the structure of the pollen-grain, the confirmation of Amici's (1823) dis- covery of the pollen-tube, the confirmation of R. Brown's views as to the structure of the unimpregnated ovule (with the introduction of the term " sac embryon- naire") ; and in that it shows how nearly Brongniart anticipated Amici's subsequent (1846) discovery of the entrance of the poUen^tube into the micropyle, fertilizing the female cell which then develops into the embryo. Of his anatomical works, those of the greatest value are probably the " Recherches sur la structure et les f onetions des f euilles " {Ann. Sci. Nat. xxi., 1830), and the "Nouvelles Recherches sur I'^^pi- derme" {Ann. Sci. Nat. L, 1834), in which, among other important observations, the discovery of the cuticle is re- corded ; and, further, the " Recherches sur I'organisation des tiges des Cycadees " {Ann. Sci. Nat. xvi., 1829), giving the results of the fijrst investigation of~~

~~the anatomy of those plants. His systematic work is represented by a large number of papers and monographs, many of which relate to the flora of New Caledonia ; and by his JEnumira- tion des genres de plantes cultivies au Musium d'Histoire Naturelle de Paris, 1843, which is an interesting land- mark in the history of classification in that it forms the starting-point of the system, modified successively by A. Braun, Eichler, and Engler, which is now adopted in Germany. In addition to his scientific and professorial labours, Brongniart was actively engaged in other direc- tions. He held various important of&cial posts in con- nexion with the Department of Education, and interested himself greatly in agricultural and horticultural matters. With Audouin the geologist and Dumas the chemist, his future brothers-in-law, he established the Annates des Sciences Naturelles in 1824 ; he also founded the Societd Botanique de France in 1864, and was its first president~~

~~Accounts of his life and work have been given by M. de Saporta {Bull, de la Soc. Oiol. de France, 1876) , and by M. Poisson (ia Nature, 1876') ; the Bulletin de la Soc. Bot. de France for 1876 (vol. xxiii.) contains a list of his works and the orations pronounced at his funeral. Cg_ g_ y #\~~

~~BRONX, THE — BROOKLYN~~

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~~Bronx, The, the northernmost of the five boroughs of New York city {q.v.).~~

~~Bronze. — Bronze alloys have in recent years come to be largely used in mechanical engineering. The prin- cipal bronzes are phosphor bronze, aluminium bronze, delta metal, and manganese bronze.~~

~~Phosphor hrome, in the ingot, has the composition — copper, 87-8 parts; tin, 11-17; phosphorus, 1-03, although this pro- portion may vary somewhat. After casting from the ingot, the phosphorus may be reduced to the merest trace, hut its presence while melting is useful. If overheated in casting, phosphor bronze loses many of its valuable properties. Phosphor bronze is used for pump plungers, valves, bushes of bearings, &c., and generally for purposes where a hard, strong metal is needed. It is less well suited than other bronzes for bearing heavy vibratory loads. The tensile~~

~~strength of phosphor bronze in the ingot ranges from 22 to 25 tons per square inch, with an elongation of from 4 to 8 per cent, in 2 inches' length. This strength is usually reduced in the casting to about 16 tons, and may be increased by the process of rolling to from 25 to 40 tons, with from 8 to 20 per cent, elongation in 2 inches.~~

~~Aluminium bronze has a considerable tendency in casting to draw in the mould. It possesses a tensile strength of about 25 tons per square inch, with 17 per cent, elongation in 2 inches in the casting, and this may be further increased by rolling to 40 tons with 15 per cent, elongation. This alloy will take a very high polish, and it is claimed for it that it does not readily corrode. It is difficult, if not impossible, to solder satisfactorily together articles made of aluminium bronze.~~

~~Bronzes termed Delta metal are variously composed to suit the particular purpose for which the alloy will be used, and give generally excellent results. Some of these bronzes possess high tensile strength and ductility. They resist corrosion from sea- water to a remarkable extent, and are well suited for manufacture of pump plungers, pistons, glands, and for screw propellers. Propellers of this material have in actual use withstood a remarkable amount of deformation without fracture, while, on account of its malleability, a limited amount of bending of the propeller blade,' resulting from accident, may be corrected by heating and setting. Delta metal heated to a dull red becomes malleable, and can be worked under the hammer, press, or stamps, the strength being very much increased by the process. When so treated an ultimate tensile strength of 30 tons per square inch has been obtained, with the remarkable elongation of 32 per cent, in 2 inches and a contraction of area of 30 per cent. Mr Alex. Dick, of the Delta Metal Company, has made the discovery that copper and its alloys can be separated while in a heated and plastic condition, and, provided no air is allowed to come into contact with the surfaces to produce oxidation, they will reunite under pressure, becoming perfectly welded together. This has led to the laying down of plant for the manufacture of bronze tubes and pipes, and other sections, by the process of extension, the resulting products being of high quality and strength, and perfectly sound. The process of manufacture is carried on by means of a hydraulic press ; the metal, which is at a high temperature, that of plasticity, about 1000 deg. rah. , is placed in~~

~~a compressing cylinder or container, into which the hydraulic ram enters. The ram is provided with a dished steel check-disc at the forward end, which expands under the pressure and fits the bore of the cylinder. , The die-plates are formed with opening^ representing the section required for the article to be produced, and in the case of tubes there is a mandril in the central opening in the die-plate, which is attached by ribs to the die. The plastic metal when flowing is divided by the ribs of the die, but becomes reunited and firmly welded together after passing the ribs. This action is dependent on the exclusion of the air. The process improves the quality of the metal, and some tests of delta metal bars made by extension show a tensile strength of 48 tons per square inch, with 32 per cent, elongation in 2 inches.~~

~~The limit of elasticity of the alloys of copper and zinc increases with the proportion of zinc. The amount of elongation before fracture also increases with the proportion of zinc, reaching a maximum at 30 per cent, of zinc, and then decreasing rapidly. The tenacity in- creases with the proportion of zinc, attains a maximum at 45 per cent, of zinc, and fien decreases rapidly. The alloys become fragile when tjiey contain 50 per cent, of zinc. By varying the proportion of zinc between 30 and 43 per cent, a series of alloys may be prepared presenting very varied properties. The most malleable of the series elongates about 60 per cent., with a tensile strength of 17 •& tons per square inch. Higher tensile strength may be obtained by increasing the proportion of zinc, but the percentage of elonga- tion is reduced thereby and the tendency to produce unsound castings materially increased. The addition of a small quantity of iron improves the quality of copper zinc alloys.~~

~~Manganese hrome is a copper zinc alloy of high value, on~~

~~account of the possibility of obtaining a material in which the elastic limit more nearly approaches the ultimate strength than is usually the case with bronzes. The composition of manganese ■bronze in the ingot maybe taken as: — Copper, 56-52 per cwt. ; tin, -85; lead, -35 ; iron, 1-5 ; zinc, 40-78, with a trace of man- ganese. The fracture when broken by tension has a fine silky appearance. In the ingot the material may possess a tensile strength of 32 tons per square inch, with 35 per cent, elongation in 2 inches, which is usually reduced by casting to about 29-5 tons per square inch, with 20 per~~

~~cent, elongation. By rolling, the tensile strength is increased to 35 to 40 tons per square inch, with from 10 to 35 per cent, elongation in 2 inches. In casting there is considerable tendency to volatilize the zinc from overheating, rendering it somewhat difficult to secure sound castings with high tensional strength ; there is also a large amount of shrinkage in the mould when cooling, which is objectionable. Speaking gener- ally, there is risk of unsoundness with high-tension bronze, render- ing it somewhat untrustworthy for the purpose of retaining water or air under pressure ; but a low-tension bronze, with a tenacity of about 12 tons per square inch, will give sound castings. Thus, a bronze composed of copper, 85-5 per cent. ; tin, 12-0 per cent. ; zinc, 2-5 per cent., gives satisfactory results. (a. h. ba.)~~

~~Brookfield, a city of Linn county, Mo., U.S.A., situated in the northern part of the state, on the Chicago, Burlington, and Quincy railway, at an altitude of 767 feet. Population (1880), 2264; (1890), 4547; (1900),~~

~~5484.~~

~~Brookings, capital of Brookings county, South Dakota, U.S.A., situated in the eastern part of the state, on the Chicago and North-Western railway, and on Big Sioux river, at an altitude of 1636 feet. It is the seat of the State Agricultural College. This institution, main- tained at the joint expense of the state and the United States, had, in 1900, 29 instructors and 608 students. Population (1890), 1618 ; (1900), 2346.~~

~~Brookline, a town of Norfolk county, Massachusetts, U.S.A., adjoining Boston on the south-west. It is a residential suburb of Boston, containing several small villages, and is traversed by the Boston and Albany railway. Population (1880), 8057 ; (1890), 12,103 ; (1900), 19,935.~~

~~Brooklyn, formerly a city of New York State, U.S.A., but since 1st January 1898 a borough of the city of New York. It is situated at the west end of Long Island, in the south-eastern part of the state, and is separated from Manhattan borough, formerly New York city, by the East river. The borough of Brooklyn includes all of King's county, ttte township of New Lots having been annexed to the then city of Brooklyn in 1886, and Platbush, Gravesend, New Utrecht, and Platlands in 1894. ' These additions gave the city an area of 65-77 ' square miles, extending from the East river~~

across 6ie island to the south coast, and including the summer resorts of Coney Island. It retains under its present organization as fa borough, practicailly the same area as it had before as a city. The borough contains thirty-two wards. It is connected (1901) with Manhattan borough by numerous ferries and by the Brooklyn suspension bridge, opened in 1883, and will in the near future be connected by additional bridges. Means of transportation are ample ; there are five lines of elevated railway, and there are trolley lines on many of the streets. The summer resorts on CSney Island on the south coast are connected with the city by trolley and steam railway lines. The borough contains thirty -two parks, ranging in size from a part of an acre to 516 acres, and with a total area of 1027 acres ; the principal and best known of these is Prospect Park, a little west of the centre of the borough, containing 516 acres, and having the soldiers' and sailors' memorial arch at its entrance. There is also Brooklyn Forest Park situated in Queen's borough, containing 635 acres, and Port Green Park in the heart of the city, besides which may be mentioned in this connexion the beautiful Greenwood Cemetery, of 474 acres, and a number

of broad, park-lined streets of differing length, the best known of which is the drive from Prospect Park to Coney Island. Brooklyn has long been known as the city of churches, probably from the famous clergymen who formerly lived there. In 1900 there were in the borough 466 churches, of which the Protestant numbered 364 with 129,413 members, and property valued at $16,925,781. The Roman Catholic churches numbered 84, with 307,976 parishioners, and property valued at $10,086,000. The borough contains a large number of hospitals and other eleemosynary institutions, and numerous libraries and educational institutions. Among its libraries are the Brooklyn Library, with -(1901) 153,000 volumes ; the Brooklyn Public Library, with 40,000 ; and the Long Island Historical Society Library with 66,000. Among its educational institutions is the Pratt Institute, largely for technical and industrial education, with 3000 students. This school has a fine library of 70,543 volumes. The Brooklyn Institute, founded in 1824, and reorganized in 1890 as the Brooklyn Institute of Arts and Sciences, has

~~a fine building erected by the city, a membership (1900) of 6250, and gives lectures and laboratory practice in twenty-six departments of art and science. The public school system of Brooklyn consisted in 1901 of 1 training, 6 high, 121 elementary, and 1 truant schools ; employed 3961 teachers and supervisors, and gave elementary and high school education to 154,542 scholars. In 1900 there were in the borough 354,612 persons of school age (5 to 20 years inclusive). Of a total street mileage of 722 miles, all but 162 miles were paved as follows : — granite blocks, 117 miles ; Belgian blocks; 47 miles ; asphalt, 82 mUes ; cobble stone, 227 miles ; macadam, 82 miles ; brick, 5 miles. Order is maintained by a force of 1838 police, including officers and privates. The provision against fire consists of 62 engines and 17 hook and ladder companies. The water-supply is in public hands ; it is derived from streamsflowing southwards in the sparsely settled area east of the borough, and also from driven wells in the same region ; it is pumped at Eidgewood to a reservoir having a capacity of 375,000,000 gallons, while a small part is re-pumped to a high-service reservoir for the service of the most elevated part of the borough. Besides this system the towns recently annexed have their own water-supply. Within the limits of the borough are 597 miles of public distributing mains. The borough has seven markets, including the immense Wall- about market, which is situated on the water front and has a large wholesale trade. **

~~Although in great part a residential suburb of her greater neighboiSr on the other side of the East river, Brooklyn has large manufacturing and commercial interests of her own. By the census of 1890 she had 10,583 industrial establishments employing capital to the amount of $161j730,500. The number of employees was 109,292, and to them was paid 165,247,119 in wages. Raw material to the value of $151,060,710 was used, and the value of the products was 1269,244,147. These products were varied, no class greatly preponderating; the following list contains the principal items, with the value of the product : — bread and other bakery products, $9,331,523 ; chemicals, $9,091,609 ; clothing, $13,941,636 ; cordage, $6,535,792 ; foundry and machine- shop products, $15,627,536; malt liquors, $12,004,529; lumber, $5,930,829; slaughtering and meat packing, $13,087,354; sugar refining, $16,629,982. Besides the above, oil refining and ship- building are important industries, and at the present time probably half the sugar supply of the country is refined here. As a commercial port~~

~~Brooklyn is surpassed only by the borough of Manhattan and by Jersey City. It has 33 miles of water front, that portion bordering on the East river and New York harbour being lined with wharves, docks, warehouses, and elevators, con- structed at a cost of hundreds of millions of dollars. Among its docks are the Atlantic Basin, containing 40 acres, and having seven elevators, and the Erie Basin, enclosing about 100 acres, and containing two dry docks, respectively 510 and 610 feet long, besides three floating dry docks. Brooklyn is the v principal port in the U.S. for the export of grain, four-fifths of that exported~~

~~from the port of New York being shipped here. Its elevators have a capacity of 20,000,000 bushels. Steamships of more than twenty regular lines land here, besides many "tramps" and sailing vessels. The U.S. Navy Yard, located here, is the largest in the country, and contains three dry docks, respectively 338, 440, and 627 feet in length on the floor. The borough contains also a U.S. Naval Hospital. Most of the financial operations are carried on upon the opposite sid6 of the East river, yet the borough contains 5 national banks, 16 state banks, 16 savings banks, and 10 trust companies. The assessed valuation of real estate in 1901 was $658,962,119, and of personal property, $89,241,624, a total of $748,203,743. The tax rate for municipal purposes (i.e., expenses of New York city as a. whole) was 2-03869 per cent.; for local county purposes (expenses of Kings county), 0-14908 per cent, additional. The number of marriages in 1900 was 8087, of births 23,073, and of deaths 23,473, showing a death-rate of 20 per thousand. The population of what is now Brooklyn, then Kings county-, was ln'"1880, 599,495 ; in 1890, 838,547 ; and in 1900, 1,166,582. The towns added to it in 1894 had in 1890 a popula- tion as follows : — Elatbush, 12,338 ; Hatlands, 4075 ; Gravesend, 6937 ; New Utrecht, 8854. Of the total population in 1900, 355,697 were foreign-bom and 19,673 were cc^oiyed, of whom 18,367 were' negroes. Of the white population, 1,146,9,09, com- prising 98-3 per cent, of the total population, 353,750 were foreign- bom, 482,658 were native-bom but of foreign parents, leaving only 310,501, or 27 per cent., native-born of native parents. Out of 332,715 males of voting age (21 years and over), 15,415 were illiterate (unable to write), of whom 14,159 were foreign-bom. The death-rate, which in 1890 was 24, had fallen to 19-9 in 1900. (See also New Yokk City.)~~

~~Brooks, Phillips (1835-1893), American clergy- man and author, was born in Boston, Mass., 13th December 1835. He was son of William Gray and Mary Ann (Phillips) Brooks. Through his father he was descended from the Eev. John Cotton ; through his mother, a woman of rare force of character and religious faith, he was a great-grandson of the founder of Phillips Academy, An- dover, Mass. Of the six sons, four — Phillips, Frederic, Arthur, and John Cotton — entered the ministry of the Protestant Episcopal Church. He was educated in the Boston Latin School and Harvard College, graduating in 1855. After a short and unsuccessful experience as a teacher in the Boston Latin School, he began in 1856 to study for the ministry of the Protestant Episcopal Church in the Seminary at Alexandria, Virginia. In 1859 he was ordained deacon by Bishop Meade of Virginia, and be- came rector of the Church of the Advent, Philadelphia. In 1860 he was ordained priest, and in 1862 became rector of the Church of the Holy Trinity, Philadelphia, where he remained seven years, gaining an increasing name as preacher and patriot. Endowea by inheritance with a rich religious character, evangelical traditions, ethical temper, and strong intellect, he developed, by wide reading in ancient and modern literature, a personality and an attitude of mind which appealed to the characteristic thought and life of the period. With Tennyson, Coleridge, Maurice, and F. D. Eobertson he was in strong sympathy. During the Civil War he upheld with power the cause of the North and the negro, and his sermon on the death of President Lincoln was an eloquent expression of the char- acter of both men. In 1869 he became rector of Trinity Church, Boston. In 1877 the present church was built, the architect being his friend H. H. Eichardson. Here Phillips Brooks preached Sunday after Sunday to great congregations, until he was consecrated bishop of Massa.- chusetts in 1891. In 1886 he declined an election as assistant bishop of Pennsylvania. He was for many years an overseer and preacher of Harvard University. In 1881 he declined an invitation to be the sole preacher to the University and professor of Christian Ethics. His influ- ence upon the religious life of the University was deep and wide. In the hearts of the people of his own city and commonwealth, and as years passed, of the whole country, he held a position of unique influence. His character was pure, simple, and great. Just, endowed~~

~~BROUGHTY F E R R Y — B R 0 W N~~

~~with excellent judgment and a keen sense of humour, he was at the same time quick to respond to any call for sympathy. In physique he was tall and well propor- tioned, his height being six feet four inches, his weight over 21 stones. When kindled by his subject it seemed to take possession of him and pour itself out with over- whelming speed of utterance, with heat and power. His sympathy with men of other ways of thought and with the truth in other ecclesiastical systems gained for him the confidence and affection of men of varied habits of mind and religious traditions, and was thus a great factor in gaining for the Episcopal Church the devotion of many people and in extending its influence throughout the nation. On 20th April 1891 he was elected sixth bishop of Massachusetts, and on 14th October was conse- crated to that ofB.ce in Trinity Church, Boston. After a brief but great episcopate of fifteen months, he died, un- married, on 23rd January 1893. The degree of Doctor of Divinity had been conferred upon him by the univer- sities of Harvard, U.S.A., and of Cambridge, England. In 1877 he published a course of lectures upon preaching, which he delivered at the Theological School of Yale University, and which are an, expression of his own ex- perience. In 1879 appeared the Bohlen Lectures on "The Infiuence of Jesus." In 1878 he published his first volume of sermons, and from time to time issued other volumes, including Sermons Preached in English Churches in the summer of 1882.~~

~~In 1901 was published, in two Tolumes, Phillips Brooks, Life and Letters, by the Rev. A. V. G. Allen, D.D., Professor of Ecclesiastical History, Episcopal Theological School, Cambridge, Mass. (w. L.)~~

~~Broughty Ferry, a police burgh and watering- place of Forfarshire, Scotland, on the north shore of the Firth of Tay, 3^ miles E. of Dundee by rail. The Castle of Broughty (Burgh Tay, 1498) is mounted with some heavy guns and garrisoned by a few artillerymen. There is a small fishing industry. There are a Dundee Con- valescent Home, three public parks, and also several high- class private schools. Population (1881), 7407 ; (1901),~~

~~10,482.~~

~~Brown, Ford Madox (1821-1893), English painter, was bori^ at Calais on 16th 'April 1821. His father was Ford Brown, a retired purser in the navy ; his mother, Caroline Madox, of an old Kentish family. His pater- nal grandfather had been Dr John Brown, a Scotsman of humble origin, who established the So-called Brunonian Theory of Medicine, introducing principles and practice which are now allowed to be in great measure reforms. Ford Madox Brown was the only child of his parents, save for a daughter who died young. In childhood he was shifted about a good deal between France and Eng- land ; and having shown from the age of six or seven a turn for drawing, he was taken, when aged fourteen and with meagre acquirements in the way of general tuition, to Bruges, and placed under the instruction of Gregorius, a pupil of the celebrated David. His principal instructor however, from about 1837, was Baron Wappers, of Antwerp, then regarded as a great light of ^the Belgian school. From him the youth learned the technique not only of oil painting but of various other branches of art. At a very early age Brown attained a remarkable degree of force in drawing and painting, as attested by an extant oil-portrait of his father, done at an age not exceeding fifteen. His first composition, towards 1836, represented a blind beggar' and his child; his first exhibited work, 1837, was "Job on the Ash-heap"; the first exhibited work in London (at the Eoyal Academy, 1840), " The Giaour's Confession," from Byron's poem.~~

~~Both his parents died before 1840, leaving to the young painter a moderate competence, which soon was materially reduced. In 1840 Brown completed a Iferge picture, "The Execution of Mary Queen of Scots," strong in dramatic effect and in handling, with rather sombre colour J from this time forth he must be regarded as a proficient artist, independent in his point of view, and strenuous in execution. He contributed to the cartoon competitions, 1844 and 1845, for the Houses of Parlia- ment—"Adam and Eve after the Fall," "The Body of Harold brought to William the Conqueror," and " The Spirit of Justice." These highly remarkable cartoons passed not wholly unobserved, but not one of them obtained a prize. .The years 1840 to 1845 were passed in Paris, London, and Eome : towards the middle of 1846 Brown settled permanently in London. In 1841 he married his cousin Elizabeth Bromley, who died of consumption in 1846, leaving a daughter, Lucy, who in 1874 became the wife of William M. Rossetti. Not long after being left a widower, Brown took a second wife, Emma Hill, who~~

~~figures in many of his pictures. She had two children who grew up: Catherine, who married Dr Franz Hueffer, the musical scholar and critic, and Oliver, who died in 1874 in his twentieth year. All the three children showed considerable ability in painting, and Oliver in romance as well. The second Mrs Brown died in 1890.~~

~~The most marked distinction of Brown as an artist may be defined as vigorous invention of historic or dramatic scenes, carried out with a great regard to individuality in the personages, expressions, and accessories of incident and detail, not excluding the familiar, the peculiar, and the semi-grotesque, when these seem to subserve the general intent. Owing, however, to Hs association with artists of the so-called " pre-Kaphaelite " movement (which began late in 1848), and especially with Dante Gabriel Eossetti, who received some training in his studio in the spring of that year, he has been regarded sometimes as the precursor or initiator of this movement, and sometimes as a direct co-operator in it. His claim to be regarded as a pre-cursor or initiator is not strong ; though it is true that even before 1841 he had pondered the theory (not then much in vogue) that a picture ought to present the veritable light and shade proper to some one moment in the day, and his " Manfred on the Jungfrau " (1841) exem plifies this principle to some extent ; it re-appears in his very large picture of "Chaucer atthe Court of Edward III." (now in the public gallery of Sydney, Australia), which, although projected in 1845, was not brought to completion until 1851. As to becoming a direct co-operator in the pre-Eaphaelite movement, he did not join the " Brother- hood," though it would have been open to him to do so ; but for some years his works exhibited a marked infiuence derived from the movement, not on the whole to their clear advantage. The principal pictures of this class are : " The Pretty Baa-lambs" ; "Work" (a street scene at Ham p- stead, see Plate); and " The Last of England" (an emigra- tion subject, one of his most excellent achievements) : dating between 1851 and 1863. " Christ Washing Peter's Feet " (now in the National Gallery of British Art) comes within the same range of dates, and is a masterly work ; here the pre-Eaphaelite influence is less manifest. Alto- gether it may be averred that the conception and intro- duction of the pre-Eaphaelite scheme, such as it appeared to the public eye in 1849 and 1850, belong to Millais, ^olman Hunt, and Eossetti, rather than to Brown.~~

~~l)ther leading pictures by Brown are the following : — " Cordelia attheBedside of Lear " ; " Shakespeare " ; "Jacob and Joseph's Coat " ; " Elijahand the Widow's Son" ; " Cor- delia's Portion " ; " The Entombment " ; " Eomeo and Ju- liet " (the parting on the balcony) ;" Don Juan and Haidee " ;~~

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~~B E 0 W N — B K 0 W N E~~

~~" Cromwell on his Farm " ; " Cromwell, Protector of the Vaudois " ; — covering the period from 1849 to 1877. " Sar- danapalus and Myrrha," begun within the same period, was finished later. He produced, moreover, a great number of excellent cartoons for stained glass, being up to 1874 a member of the firm of decorative art, Morris, Marshall, Faulkner, and Co. He also executed, in colours or in crayons, various portraits, including his own. From 1878 he was almost engrossed by work which he undertook for the town hall of Manchester, and which entailed his living for some few years in that city — twelve large wall paint- ings, some of them done in a modified form of the Gambier- Parry process, and others ii^ oils on canvas applied to the wall surface. They present a compendium of the history of Manchester and its district, from thfe building of the Roman camp at Mancunium to the experimental work of Dalton in elaborating the Atomic Theory. This is an extremely fine series, though with some diversity of individual merit in the paintings, and is certainly the chief representative, in the United Kingdom, of any such form of artistic effort — if we leave out of count the works (by various painters) in the Houses of Parliament.~~

~~MadoxBrownwas never apopular or highly-remunerated artist. Up to near middle age he went through trying straits in money matters ; afterwards his circumstances improved, but he was not really well off at any time. In youth he followed the usual course as an exhibiting painter, but after some mortifications and heart-burnings he did little in this way after 1852. He held, how- ever, in 1866, an exhibition of his own then numerous paintings and designs. He also delivered a few lectures on fine art from time to time. From 1868 he suffered from gout ; and this led to an attack of apoplexy,~~

~~from which he died (in St Edmund's Terrace, London) on 6th October 1893. He was a man of upright, independent, and honourable character, of warm affections, a steady and self-Sacrificing friend ; but he took offence rather readily, and viewed various persons and institutions with a degree of suspicion which may be pronounced excessive. He felt interest in many questions outside the range of his art, and, being a good and varied talker, had often some- thing apposite and suggestive to say about them. On more than one occasion he exerted himself very zealously for the benefit of the working classes. In politics he was a consistent Democrat, and on religious questions an Agnostic.~~

~~The life of this artist has been well written by his grandson, Ford M. Hueffer, in a handsomely-illustrated volume named Ford Madox Brown, London, 1896. This volume contains some extracts from Brown's diary, extending in the whole from 1847 to 1866 ; and other lengthier extracts appear in two books edited by William M. Rossetti — Buskin, Bossetti, Pre-Baphaelitism, 1899, and Pre- BaphaelUe Diaries and Letters, 1899. See also the Preferences in Art, <6c., by Harry Quilter, 1892. f-^, jl. jj.)~~

~~Brown, Thomas Edward (1830-1897), English poet, scholar, and divine, was born on 5th May 1830, at Douglas, Isle of Man, where his father, the Rev. Robert Brown, held the living of St Matthew's — a homely church in a poor district. His mother came of Scottish parentage, though born in the island. Thomas, the sixth of ten children, was but two years old when the family removed to Kirk Braddan Vicarage, a short distance from Douglas, where his father (a scholar of no university, but so fastidious about composition that he would have some sentences of an English classic read to him before answer- ing an invitation) took share with the parish schoolmaster in tutoring the clever boy until, at the age of fifteen, he was entered at King William's College. Here his abilities soon declared themselves, and hence he proceeded to Christ Church, Oxford, where his position (as a servitor) cost him~~

~~much humiliation, which he remembered to the end of his life. He won a double first, however, and was elected a fellow of Oriel in April 1864, Dean Gaisford having refused to promote him to a senior studentship of his own college, on the ground that no servitor had ever before attained to that~~

~~honour. Although at that time an Oriel fellowship conferred a deserved distinction, Brown never took kindly to the life, but, after/ a few 'terms of private pupils, returned to the Isle of Man as vice-principal of his old school. He had been ordained deacon, but did not pro- ceed to priest's orders for many years. In 1857 he mar- ried his cousin. Miss Stowell, daughter of Dr Stowell of Ramsey, and soon afterwards left the island once more to become headmaster of the Crypt School, Gloucester — a position which in no long time he found intolerable. From Gloucester he was summoned by the Rev. John Percival (afterwards Bishop of Hereford), who had recently been appointed to the struggling young foundation of Clifton College, which he soon raised to be one of the great public schools. Percival wanted a master for the modern side, and made an appointment to meet Brown at Oxford ; "and there," he writes, "as chance would have it, I met him standing at the corner of St Mary's Entry, in a somewhat Johnsonian attitude, four-square, his hands deep in his pockets to keephimselfstiU.,andlookingdecidedly volcanic. We very soon came to terms, and I left him there under promise to come to Clifton as my colleague at the begin- ning of the following term." At Clifton Brown remained from September 1863 to July 1892, when he retired — to the great regret of boys and masters alike, whp had long since come to regard "T. E. B.'s" genius, and even his eccentricities, with a peculiar pride — to spend the rest of his days upon the island he had worshipped from child- hood and often celebrated in song. His poem, "Betsy Lee," appeared in Macmillan's Magazine (April and May 1873), and was published separately in the same year. It was included in Fo'c's'le Yams (1881), which reached a second edition in 1889. This volume included at least three other notable poems — " Tommy Big-eyes," " Christ- mas Rose," and " Captain Tom and Captain Hugh." It was followed by The Doctor and other Poems (1887), TJie Manx Witch and other Poems (1889), and Old John and other Poems (a volume mainly lyrical) (1893). Since his death all these and a few additional lyrics and fragments have been published in one volume by Messrs Macmillan under the title of TJie Collected Poems of T. E. Brown (1900). His familiar letters (edited in two volumes by an old friend, Mr S. T. Irwin, in 1900) bear witness to the zest he carried back to his native country, although his thoughts often reverted to Clifton. In October 1897 he returned to the school on a visit. He was the guest of one of the house- masters, and on Friday evening, 29th October, he gave an address to the~~

~~boys of the house. He had spoken for some minutes with his usual vivacity, when his voice grew thick and he was seen to stagger. He died in less than two hours. Brown's more important poems are narrative, and written in the Manx dialect, with a free use of pauses, and sometimes with daring irregularity of rhythm. A rugged tenderness is their most characteristic note ; but the emotion, while almost equally explosive in mirth and in tears, remains an educated emotion, disci- plined by a scholar's sense of language. They breathe the fervour of an island patriotism (humorously aware of its limits) and of a simple natural piety. In his lyrics he is happiest when yoking one or the other of these emotions to serve a philosophy of life, often audacious, but always genial. (a. t. Q.-c.)~~

~~Browne, Hablot Knight (1815-1882), English artist, famous chiefly as "Phiz,." the illustrator of the best-known books by Charles Dickens, Charles~~

~~Lever, and Harrison Ainsworth in their original editions. His talents in other directions of art were of a very ordinary kind. As an interpreter and illustrator of Dickens's char- acters, " Phiz," as he nearly always signed his drawings, was in some respects the equal of his rivals Cruikshank and Leech, while, in his own way, he excelled them both. Browne was of Huguenot extraction and was born in Lambeth on 11th June 1815. His father dying early, left the family badly off. From the first, Browne showed a disposition towards art, and, after a moderate education, was apprenticed to Pinden, the eminent engraver on steel, in vfhose studio Browne obtained his only artistic educa tion. To engraving, however, he was entirely unsuited, and having in 1833 secured an important prize from the Society of Arts for a drawing of " John Gilpin," he abandoned engraving in the following year and took to other artistic work, with the ultimate object of becoming a painter. In the spring of 1836 the great event in the life of the artist took place, when he met Charles Dickens. It was at the moment when the serial publication of Pickwick was in danger from the want of a capable interpreter for the illus- trations. Dickens knew Browne slightly as the illustrator of his little pamphlet Sunday under Three Heads, and prob- ably this slight knowledge of his work stood the draughts- man in good stead. In~~

~~the original edition of Pickwick, issued in shilling monthly parts from early in 1836 until the end of 1837, the first seven plates were drawn by Robert Seymour, a clever illustrator who committed suicide in April 1836. The next two plates were by E. W. Buss, an otherwise successful portrait-painter and lecturer, but they were so poor that a change was imperative.. So thought the publishers, and so also did both H. K. Browne and W. M. Thackeray, who called independently at the pub- lishers' ofB.ce with specimens of their powers for Dickens's inspection. The novelist preferred Browne. Browne's first two etched plates for Pickwick were signed " Nemo," but the third was signed " Phiz," a pseudonym which was retained in future. When asked to explain why he chose this name he answered that the change from " Nemo " to " Phiz " was made " to harmonize better with Dickens's Boz." Possibly Browne adopted it to conceal his identity, hoping one day to become famous as a painter. It is to be noted, however, that " Phiz " is usually attached to his better work and H. K. B. to his less successful drawings. " Phiz " undoubtedly created Sam Weller, so far as his well-known figure is concerned, as Seymour had created Pickwick. Dickens and "Phiz" were personally good friends in early days, and in 1838 travelled together to Yorkshire to see the schools of which Nicholas Nickleby became the hero ; afterwards they made several journeys of this nature in company to facilitate the illustrator's work. The other Dickens characters which "Phiz" realized most successfully are perhaps Squeers, Micawber, Guppy, Major Bagstock, Mrs Gamp, Tom Pinch, and, above all, David Copperfield. Of the books by Dickens which " Phiz " illustrated the best are David Copperfidd, Pickwick, Dombey and Son, Martin Chuzzlewit, and Bleale House. Browne! made several drawings for Punch in early days and also towards the end of his life ; his chief work in this direction being the clever design for the wrapper which was used for eigWeen months from January 1842. He also contributed to Punch's Pocket Books. In addition to his work for Dickens, " Phiz " illustrated over twenty of Lever's novels (the most successful being Harry Lorrequer, Cliarles O'Malley, Jack Hinton, and the Knight ofOwynne). He also illustrated Harrison Ains worth's andFrankSmedley's novels. Mervyn CHtheroe by Ainsworth is one of the most admirable of the artist's works. Browne was in continual employment by publishers until 1867, when a shock of paralysis ruined his artistic career. Although he recovered slightly~~

~~and made many illustrations on wood, they were by com- parison inferior productions, which the draughtsman's admirers would willingly ignore. In 1878 his affairs became so straitened that he was awarded an annuity by the Royal Academy. He gradually became worse in health until he died, 8th July 1882, at the age of sixty- seven. He was buried at Brighton. Browne was a facile draughtsman who readily grasped the intention of the writer he was illustrating. Occasionally he made an error, but it was usually because his pencil went on to delineate what the author may have intended but had not described. His illustrations are full of rollicking good-humour, and having a tendency to caricature they suit Dickens's and Lever's works admirably.~~

~~Most of Browne's work was etched on steel plates because these yielded a far larger edition than copper. Browne was annoyed at some of his etchings being transferred to stone by the publishers and printed as lithographic reproductions. Partly with the view to prevent this treatment of his work he employed a machine to rule a series of lines over the plate in order to obtain what appeared to be a tint ; when manipulated with acid this tint gave an effect somewhat resembling mezzotint, which at that time it was found practically impossible to transfer to stone. The illijstrations executed by Browne are particularly noteworthy because they realized exactly what the reader most desired to see represented. So skilful was he in drawing and composition that no part of the story was avoided by reason of the elaborateness of the subject. Whatever was the best incident for illustration was always the one selected.~~

~~D. Cecal Thomson. SablSt Knight Browne, "Phiz " ; Life and Letters. London, 1884. — John Forstee. Life of Charles Dickens. London, 1871-74. — F. G. Kitton. " JPhiz " ; ^ Memoir. London, 1882. — Charles Dickens and his Ulustratqrs. London, 1899. — M. H. Spielmann. The History of Punch. London, 1895.~~

~~(d. c. t.)~~

~~Brownhills, a village of Staffordshire, England, in the Lichfield division of the county, 6 miles W. of the town of Lichfield, with stations on the North-western and Midland railways, and near the Essington canal. Since 1894 it has been governed by an urban district council. There are extensive coal-~~

mines in the district. The popu- lation of the urban district in 1891 was 11,820 ; in 1901,

15,252.

Browning, Robert (1812-1889), the great English poet, born at Camberwell, London, on 7th May 1812, was the son of Robert Browning, who for fifty years was employed in the Bank of England. Earlier Brownings had been settled in Wiltshire and Dorsetshire, and there is no ground for the statement that the family was partly of Jewish origin. The poet's mother was a daughter of William Weidemann, a German who had settled in Dundee and married a Scottish wife. His parents had one other child, a daughter, Sarianna, born ia 1814. They lived quietly in Camberwell. The elder Browning had a sufBcient income and was indifferent to money- making. He had strong literary and artistic tastes. He was, an ardent book collector, and so good a draughts- man that paternal authority alone prevented him from adopting an artistic career. He had, like his son, a singular faculty for versifying, and helped the boy's early lessons by twisting the Latin grammar into grotesque rhymes. He lived, as his father had done, to be 84, with unbroken health. The younger Robert inherited, along with other characteristics, much of his father's vigour of constitution. From the mother, who had delicate health, he probably derived his excessive nervous irritability ; and from her, too, came his passion for music. The family was united by the strongest mutual affection, and the parents erred, if anything, on the side of indulgence. Browning was sent to a school in the neighbourhood, but left it when fourteen, and had little other teaching. He had a French Ijutor for the next two years, and in his eighteenth year he attended some Greek lectures at the London University. At school he never won a prize,

though it was more difficult to avoid than to win prizes. He was more conspicuous for the love of birds and beasts, which he always retained, than for any interest in his lessons. He rather despised his companions and made few friends. A precocious poetical capacity, however, showed itself in

~~extra-scholastic ways. He made his schoolfellows act plays, partly written by himself. He had composed verses before he could write, and when twelve years old completed a volume of poems called Incondita. His parents tried unsuccessfully to find a publisher ; but his verses were admired by Sarah Flower Adams, a well-known hymn-writer of the day, and by W. J. Fox, both of whom became valuable friends. A copy made by Miss Flower was in existence in 1871, but after- wards destroyed by the author. Browning had the run of his father's library, and acquired a very unusual amount of miscellaneous reading. Quarles' Emblems was an especial favourite ; and besides the Elizabethan dramatists and standard English books, he had read all the works of Voltaire. Byron was his first master in poetry, but about the age of fourteen he fell in acci- dentally with Shelley and Keats. For Shelley in par- ticular he conceived an enthusiastic admiration which lasted for many years, though it was qualified in his later life.~~

~~The more aggressive side of Browning's character was as yet the most prominent; and a self-willed lad, con- scious of a growing ability, found himself cramped in Camberwell circles. He re- jected the ordinary careers. He declined the offer of a clerkship in the Bank of England ; and his father, who~~

~~had found the occupation uncongenial, not only approved the refusal but cordially accepted the son's decision to take poetry for his profession. For good or evil, Browning had been left very much to his own guidance, and if his intellectual training suffered in some directions, the liberty permitted the development of his niarkecl originality. The parental yoke, however, was too light to provoke rebellion. Browning's mental growth led to no violent breach with the creeds of his childhood. His parents became Dissenters in middle life, but often attended Anglican services; and Browning, though he abandoned the dogmas, continued to sympathize with the spirit of their creed. He never took a keen interest in the politics of the day, but cordially accepted the general position of contemporary Liberalism. His worship of Shelley did not mean an acceptance of his master's hostile attitude towards Christianity, still less did he revolt against the moral discipline under which he had been educated. He frequented literary and artistic circles, and was passionately fond of the theatre ; but he was entirely free from a coarse~~

~~Bohemianism, and never went to bed, we are told, without kissing his mother. He lived with his parents until his marriage. His mother lived till 1849, and his father till 1866, and his affection- ate relations to both remained unaltered. Browning's~~

~~(From a photograph by Elliott and Fry, Lonchnt.)~~

~~reflect~~

~~first published poem, Pauline, appeared anonymously in 1833. He always regarded it as crude, and only consented with reluctance to republishing it in the collected works of 1868. The indication of genius was recognized by W. J. Fox, who hailed it in the Monthly Repository as mark- ing the advent of a true poet. Pauline contains an enthusiastic invocation of Shelley, whose influence upon its style and conception is strongly marked. It is the only one of his works which can be regarded as imitative ; and Browning's personality was fully revealed in his next considerable poems, Paracelsus (1835) and Sordello (1840). The three, however, form a group. In an essay (prefixed to the spurious Shelley letters of 18.51), Browning de- scribes Shelley's poetry " as a sublime fragmentary essay~~

~~towards a presentment of the correspondency of the uni- verse to Deity." The phrase describes his own view of the true functions of a poet, and Browning, having ac- cepted the vocation, was meditating the qualifications which should fit him for his task. The hero of Pauline is in a morbid state of mind which endangers his fidelity to his duty. Paracelsus and Sordello are studies in the psychology of genius, illus- trating its besetting tempta- tions. Paracelsus fails from intellectual pride, not bal- anced by love of his kind, and from excessive ambition, which leads him to seek success by unworthy means. Sordello is a poet distracted between the demands of a dreamy imagination and the desire to utter the thoughts of mankind. He finally gives up poetry for practical politics, and gets into per- plexities only to be solved by his death. PavMne might in some indefinite degree Browning's own feelings, but in the later poems he adopts his characteristic method of speak- ing in a quasi-dramatic mood. They are, as he gave notice, " poems, not dramas." The interest is not in the external events, but in the " development of a soul " ; but they are observations of other men's souls, not direct revelations of his own. Paracelsus was based u.pon a study of the~~

~~original narrative, and Sordello was a historical, though a very indefinite person. The back- ground of history is intentionally vague in both cases. There is one remarkable difference between them. The Paracelsus, though full of noble passages, is certainly diffuse. Browning heard that John Sterling had complained of its " verbosity," and tried to remedy this failing by the surgical expedient of cutting out the usual connecting words. Relative pronouns hence- forth become scarce in his poetry, and the gram- matical construction often a matter of conjecture. Words are forcibly jammed together instead of being articulately combined. To the ordinary reader many passages in his later work are both crabbed and obscure, but the " obscurity " never afterwards reached the pitch of Sordello. It is due to the vagueness with which the story is rather hinted than told, as well as to the sublety and intricacy of the psychological~~

~~expositions. The subtlety and vigour of the thought are indeed surprising, and may justify the frequent com- parisons to Shakespeare; and it abounds in descriptive passages of genuine poetry.~~

~~Still, Browning seems to have been misled by a fal- lacy. It was quite legitimate to subordinate the external incidents to the psychological develqpment ip which he was really interested, but to secure the subordination by making the incidents barely intelligible was not a log- ical consequence. We should not understand Hamlet's psychological peculiarities the better if we had to infer his family troubles from indirect hints. Browning gave more time to Sordello than to any other work, and perhaps had become so familiar with the story which he professed to tell that he failed to make allowance for his readers' difficulties. In any case it wq,s not surprising that the ordinary reader should be puzzled and repelled, and the general recognition of his genius long delayed, by his reputation for obscurity. It might, however, be expected that he would make a more successful appeal to the public by purely dramatic work, in which he would have to limit his psychological speculation and to place his characters in plain situations. Paracelsus and Sordello show so great a power of reading~~

~~character and appreciating subtler springs of conduct that its author clearly had one, at least, of the most essential qualifications of a dramatist.~~

~~Before Sordello appeared Browning had tried his hand in this direction. He was encouraged by outward circum- stances as well as by his natural bent. He was making friends and gaining some real appreciative admirers. John Forster had been greatly impressed by Paracelsus. Browning's love of the theatre had led to an intro- duction to Macready in the winter of 1835-36; and Macready, who had been also impressed by Paracelsus, asked him for a play. Browning consented and wrote Strafford, which was produced at Covent Garden on 11th May 1837, Macready taking the principal part. Later dramas were King Victor and King Charles, published in 1842, The Return of the Druses and A Blot on the 'Scutcheon (both in 1843), Colombe's Birthday (1844), Luria and A Soul's Tragedy (both in 1846), and the fragmentary In a Balcony (1853). Strafford succeeded fairly, though the defection of one of the actors stopped its run after the fifth performance. The Blot on the 'Scutcheon, produced by Macready as manager of Drury Lane on 11th February 1843, led to an unfortunate quarrel. Browning thought that Macready had felt unworthy jealousy of another actor, and had gratified his spite by an inadequate presentation of the play. He remonstrated indignantly and the friendship was broken off for years. Browning was disgusted by his experience of the annoyances of practical play-writing, though he was not altogether discouraged. The play had apparently such a moderate success as was possible under the conditions, and a similar modest result was attained by Colombe's Birthday, produced at Covent Garden on 25th April 1853. Browning, like other eminent writers of the day, failed to achieve the feat of attracting the British public by dramas of high literary aims, and soon gave, up the attempt. It has been said by competent critics that some of the plays could be fitted for the stage by judicious adaptation. The Blot on th^ 'Scutcheon has a very clear and forcibly treated situation; and all the plays abound in passages of high poetic power. Like the poems, they deal with situations involving a moral probation of the characters and often suggesting the ethical problems which always interested him. The speeches tend to become elaborate analyses of motive by the persons concerned, and would try the patience of an average audience, though interest- ing to an intelligent reader in the closet. For whatever~~

~~reason. Browning, though he had given sufficient proofs of genius, had not found in these works the most appropriate mode of utterance.~~

~~The dramas, after Strafford, formed the greatest part of a series of pamphlets called Bells and Pomegranates, eight of which were issued from 1841 to 1846. The name, he explained, was intended to indicate an "alterna^ tion of poetry and thought." The first number con- tained the fanciful and characteristic Pippa Passes. The seventh, significantly named Dramatic Romances and Lyrics, containpd some of his most striking shorter poems. In 1844 he contributed some similar poems to Hood's Magazine in order to help Hood, then in his last illness. These poems take the special form in which Browning is unrivalled. He wrote very few lyrical poems of the ordinary kind purporting to give a direct expression of his own personal emotions. But, in the lyric which gives the essential sentiment of some im- pressive dramatic situation, he has rarely been ap- proached. There is scarcely one of the poems published at this time which can be read without fixing itself at once in the memory as a forcible and pungent presenta- tion of a characteristic mood. Their vigoux and originality failed to overcome at once the presumption against the author of Sordello. Yet Browning was already known to and appreciiated by such literary celebrities of the day as Talfourd, Leigh Hunt, Procter, Monckton lililnes, Carlyle, and Landor. His fame began to spread among sympathetic readers. The Bells and Pomegranates at- tracted the rising school of " pre-Raphaelites," especially D. G. Rossetti, who guessed the authorship of the anony- mous Pauline and made a transcript from the copy in the British Museum. But his audience was still select.~~

~~Another recognition of his genius was of incomparably more personal importance and vitally affected his his- tory. In 1844, Miss Barrett published a volume of poems containing "Lady Geraldine's Courtship," with a striking phrase about Browning's poems.. He was naturally gratified, and her special friend and cousin, John Kenyon,- encouraged him to write to her. She admitted him to a personal interview after a little diffidence, and a hearty appreciation of literary genius on both sides was speedily ripened into genuine and most devoted love. Miss Barrett was three years older than Browning and a confirmed invalid with shaken nerves. She was tenderly attached to an autocratic father who objected on principle to the marriage of~~

his children. The correspondence of the lovers (published in 1899) shows not only their mutual devotion, but the chivalrous delicacy with which Browning behaved in a most trying situation. Miss Barrett was gradually en- couraged to disobey the utterly unreasonable despotism. They made a clandestine marriage on 12th September 1846. The state of Miss Barrett's health suggested mis- givings which made Browning's parents as well as his bride's disapprove of the match. She, however, appears to have become stronger for some time, though always fragile and incapable of much active exertion. She had already been recommended to pass a winter in Italy. Browning had made two previous tours there, and his impressions had been turned to account in Sordello and Pippa Passes. For the next fifteen years the' Brownings lived mainly in Italy, making their headquarters at Florence. A couple of winters were passed in Eome. In the summer of 1849 they were at Siena, where Browning was helpful to Landor, then in his last domestic troubles. They also visited England and twice spent some months in Paris. Their only child, Robert Weidemann Browning, was born at Florence in 1849. Browning's literary activity during his marriage seems to have been comparatively small ; though the two volumes called Men and Women (1855) contained

some of Ms best work and showed that his power was still growing. His position involved some sacrifice and imposed limitations upon his energies. Mrs Browning's health required a secluded life ; and Browning, it is said, never dined out during his marriage, though he enjoyed society and made many and very warm friendships. The only breach of complete sympathy with his wife was due to his contempt for " spiritualists " and " mediums," in whom she fully believed. His portrait of the notorious Home as " Sludge " only appeared after her death. This domestic happiness, however, remained essentially un- broken until she died on 29th June 1861. The whole love-story had revealed the singular nobility of his char- acter, and, though crushed for a time by the blow, he bore it manfully. Browning determined to return to England and superintend his boy's education at home. He took a house in Warwick Crescent, Bayswater, and became

~~gradually acclimatized in London. He resumed his work and published the Dramatis Personal in 1864. The publication was well enough received to mark the growing recognition of his genius, which was confirmed by The Ring and the Book, published in four volumes in the winter of 1868-69. In 1867 the University of Ox- ford gave him the degree of M.A. "by diploma," and Balliol College elected him as an honorary fellow. In 1868 he declined a virtual offer of the rectorship of St Andrews. He repeated the refusal on a later occasion (1884) from a dislike to the delivery of a public address. The rising generation was now beginning to buy his books ; and he shared the homage of thoughtful readers with Tennyson, though in general popularity he could not approach his friendly rival. The Ring and the Booh has been generally accepted as Browning's masterpiece. It is certainly most characteristic. The audacity of the scheme is surprising. To tell the story of a hideous murder twelve times over, to versify the arguments of counsel and the gossip of quidnuncs, and to insist upon every de- tail with the minuteness of a law report, could have oc- curred to no one else. The poem is so far at the opposite pole from SordellQ. Vagueness of environment is replaced by a photographic distinctness, though the psychological interest is dominant in both. Particular phrases may be crabbed, but nothing can be more distinct and vivid in thoughx and conception. If some of those "dramatic monologues" of which the book is formed fail to be poetry at all, some of them — that of Pompilia the victim, her champion Caponsacchi, and the Pope who gives judg- ment — are in Browning's highest mood, and are as im- pressive from the ethical as from the poetical point of view. Pompilia was no doubt in some respects an ideal- ized portrait of Mrs Browning. Other pieces may be ac- cepted as a background of commonplace to throw the heroic into the stronger relief. The Ring and the Book is as powerful as its method is unique.~~

~~Browning became gentler and more urbane as he grew older. His growing fame made him welcome in all cul- tivated circles, and he accepted the homage of his ad- mirers with dignity and simplicity. He exerted himself to be agreeable in private society, though his nervous- ness made him invariably decline ever to make public speeches. He was an admirable talker, and took pains to talk his best. A strong memory supplied him with abundant anecdotes ; and though occasionally pugnar cious, he allowed a fair share of the conversation to his companions. Superficial observers~~

~~sometimes fancied that the poet was too much sunk in the man of the world ; but the appearance was due to his characteristic reluctance to lay bare his deeper feelings. When due occasion offered, the underlying tenderness of his affections was abundantly nianifest. No one could show more del- icate sympathy. He made many warm personal friend-~~

~~ships in his later years, especially with women, to whom he could most easily confide his feelings. In the early years of this period he paid visits to country houses, but afterwards preferred to retire farther from the London atmosphere into secluded regions. He passed some holidays in remote French villages, Pornic, Croisic, and St Aubyn, which have left traces in his poetry. At St Aubyn he had the society of J. Milsand, a French writer who had shown his warm appreciation of Browning's poetry by an article in the Revue des Deux Mondes, which in 1852 had led to a personal friendship lasting till Milsand's death in 1886. Browning sent to him the proof-sheets of all his later works for revision. In 1877 Browning was at La Saisiaz on the Sal^ve, near Geneva, where an old friend. Miss Egerton Smith, was staying. She died suddenly almost in his presence. She had constantly accompanied him to -concerts during his London life. After her^death he almost ceased to care for music. The shock of her loss produced the singular poem called Let Saisiaz, in which he argues the problem of personal immortality with a rather indefinite conclusion. In later years Browning returned to Italy and passed several autumns at Venice. He never visited Florence after his wife's death there.~~

~~Browning's literary activity continued till almost the end of his life. He wrote constantly, though he composed more slowly. He considered twenty-five or thirty liaes to be a good day's work. His later writings covered a very great variety of subjects, and were cast in many different forms. They show the old characteristics and often the old genius. Browning's marked peculiarity, the union of great speculative acuteness with intense poetical insight, involved difficulties which he did not always surmount. He does not seem to know whether he is writing poetry or when he is versifying logic ; and when the speculative impulse gets the upper hand, his work suggests the doubt whether an imaginary dialogue in prose would not have been a more effective medium. He is analysing at length when he ought to "be presenting a concrete type, while the necessities of verse complicate~~

~~and obscure the reasoning. A curious example is the Prince Hohenstiel-Schwangau (1871), an alias for Louis Napoleon. This attempt to show how a questionable hero apologizes to himself recalls the very powerful " Bishop Blougram," and " Sludge, the medium," of earlier works, but becomes prolix and obscure. Mfine at the Fair (1872) is another curious speculation containing a defence of versatility in love-making by an imaginary Don Juan. Its occasionally cynical tone rather scandal- ized admirers, who scarcely made due allowance for its dramatic character. Browning's profound appreciation of high moral qualities is, however, always one main source of his power. In later years he became especially interested in stories of real life, which show character passing through some sharp ordeal. The Red Cotton Nightcap Country (1873), describing a strange tragedy which had recently taken place in France, and especially The Inn Album (1875), founded on an event in modern English society, are powerful applications of the meth- ods already exemplified in The Ring and the Book. The Dramatic Idyls (1879 and 1880) are a collection of direct narratives, with less analytical disquisition, which surprised his readers by their sustained vigour. In the last volumes, Jocoseria (1883), Ferishtah's Fancies (1884), Parleyings with Certain People (1887), and Asolando (1889), the old power is still apparent, but the hand is beginning to fail. They contain discussions of metaphysical problems, such as the origin of evil, which are interesting as indications of his creed, but can scarcely be regarded as successful either poetically or philosophically.~~

~~Another group of poems showed Browning's interest in Greek literature. Balaustion's Adventure (1871) includes a " transcript fjom Euripides," a translation, that is, of part of the Alcestis. Aristophanes' Apology (1876) in- cluded another translation from the HeraUes, and in 1877 he published a very literal translation of the Agamemnon. This, it seems, was meant to disprove the doctrine that schylus was a model of literary style. Browning shared his wife's admiration for Euripides, and takes a phrase from one of her poems as a motto for Balaustion's Adventure. In the Aristophanes' Apology this leads characteristically toia long exposition by Aristo- phanes of his unsatisfactory reasons for ridiculing Euri- pides. It recalls the apologies of " Blougram~~

~~" and Louis Napoleon, and contains some interesting indications of his poetical theory. Browning was to many readers as much prophet as poet. His religious position is most explicitly, though still not very clearly, set forth in the Christmas Eve and Easter Day (1850). Like many eminent contemporaries, he combined a disbelief in orthodox dogma with a profound conviction of the im- portance to the religious instincts of the symbols incor- porated in accepted creeds. Savl QSA5), A Death in the Desert (1864), and similar poems show his strong sym- pathy with the spirit of the old belief, though his argumentative works have a more or less sceptical turn. It was scarcely possible, if desirable, to be original on such topics. His admirers hold that he shows an af&nity to German metaphysicians, though he had never read their works nor made any express study of metaphysical questions. His distinctive tendency is to be found rather in the doctrine of life and conduct which both suggests and is illustrated by his psychological analyses. A very characttieristic thought emphatically set forth in the Babbi Ben Ezra (1864) and the Gh-ammarian's Funeral (1855) is that a man's value is to be measured, not by the work done, but by the character which has been moulded. He delights in exhibiting the high moral instinct which dares to override ordinary convictions, or which is content with discharge of obscure duties, or superior to vulgar ambition and capable of self-sacrifice, because founded upon pure love and sympathy for human suffering. Browning's limitations- are character- istic of the poetry of strong ethical preoccupations. His strong idiosyncrasy, his sympathy with the heroic and hatred of the base, was hardly to, be combined with the Shakespearian capacity for sympathizing with the most varied types of character. Though he deals with a great variety of motive with singularly keen analysis, he takes almost exclusively the moral point of view. That point of view, however, has its' importance, and his morality is often embodied in poetry of surpassing force. Brown- ing's love of the grotesque, sometimes even of the hor- rible, creates many most graphic and indelible por- traits. The absence of an exquisite sense for the right word is compensated by the singular power of striking the most |Drilliant flashes out of obviously wrong words, and forcing' comic rhymes to express the deepest and most serious thoughts. Though he pro- fessed to care little for motive as .apart from human interest, his incidental touches of description are un- surpassably vivid.~~

~~The appreciation of Browning's genius became general in his later years, and zeal was perhaps a little heightened by the complacency of disciples able to penetrate a sup- posed mist of obscurity. The Browning Society, founded in 1881 by Mr Furnivall and Miss Hickey, was a pro- duct of this appreciation, and helped to extend the study of the poems. Browning~~

~~accepted the homage in a simple and friendly way, though he avoided any action which would make him responsible for the publications. He~~

~~received various, honours; the LL.D. degree from Cam- bridge in 1879, the D.C.L. from Oxford in 1882, and LL.D. from Edinburgh in 1884. He became foreign correspondent to the Royal Academy in 1886. His son, ‘ who had settled at Venice, married in 1887, and Browning moved to De Vere Gardens. In the autumn of 1889 he went with his sister to visit his son, and stayed on the way at Asolo, which he had first seen in 1838, when it supplied the scenery of Pippa Passes. He was charmed with the place, and proposed to buy a piece of ground and to build upon it a house to be called “Pippa’s Tower ” — in memory of his early heroine. While his proposal was under consideration he went to his son at Venice. His health had been breaking for some time, and a cold, aggravated by weakness of the heart, brought on a fatal attack. He died on 12th. December 1889. He was buried in Westminster Abbey on 31st December. It was suggested that his wife’s body should be removed from Florence to be placed beside him ; but their son rightly decided that her grave should not be disturbed.~~

~~Browning’s personal characteristics are so strongly stamped upon all his works that it is difficult to assign his place in contemporary thought. He is unique and outside of all schools. His style is so peculiar that he is the easiest of all poets to parody and the most danger- ous to imitate. In spite of his early Shelley worship he is in certain respects more closely related to Words- worth. Both of them started by accepting the poet’s mission as quasi-prophetical or ethical. In other respects they are diametrically contrasted. Wordsworth expounded his philosophy by writing a poetical autobiography. Browning adheres to the dramatic met)iod, of which Wordsworth was utterly incapable. He often protested against the supposition that he put himself into his books. Yet there is no writer whose books seem to readers to be clearer revelations of himself. Nothing, in fact, is more characteristic of a ma.n than his judgments of other men, and Browning’s are keen and unequivocal. The revolu- tionary impulse had died out, and Browning has little to say either of the political questions which had moved Shelley and Byron or of the social problems which have lately become more prominent. He represents the thought of a quieter epoch. He was little interested, too, in the historical or ” romantic ” aspect of life. He~~

takes his subjects from a great variety of scenes and places — from ancient Greece, mediaeval Italy, and modern France and England; but the interest for him is not in the picturesque surroundings, but in the human being who is to be found in aU periods. Like Balzac, whom he always greatly admired, he is interested in the eternal tragedy and comedy of life. His problem is always to show what are the really noble elements which are eternally valuable in spite of failure to achieve tangible results. He gives, so far, another version of Wordsworth's doctrine of the cultivation of the, " moral being." The psychological acuteness and the subtle analysis of character are, indeed, peculiar to himself. Like Carlyle, with whom he had certain points of affinity, he protests, though rather by implication than direct denunciation, against the utilitarian or materialistic view of life, and finds the divine element in the instincts which guide and animate every noble character. When he is really inspired by sympathy for such emotions he can make his most grotesque fancies and his most far- fetched analyses subservient to poetry of the highest order. It can hardly be denied that his intellectual ingenuity often tempts him to deviate from his true function, and that his observations are not to be excused because they resultfroman excess, instead of adeficiency, of intellectual acuteness. But the variety of his interests — aesthetic, philosophical, and ethical — is astonishing, and his successes

are poems which stand out as unique and unsurpassable in the literature of his time.

Browning's Life, Toy Mrs. Orr (1891), one of his most Intimate friends in later years, and tlie correspondence with his wife before their marriage, published by his son in 1899, are the main authorities. A collection of Browning's poems in 2 vols, appeared in 1849, another in 3 vols, in 1863, another in 6 vols, in 1868, and a definite edition in 16 vols, in 1888-89. (l. s.)

Brown — Sequard, Charles Edward (1817- 1894), the eminent physiologist, was born at Port Louis, Mauritius, on 8th April 1817. His father was an

~~Ameri- can and his mother a Frenchwoman, but he himself always desired to be looked upon as a British subject, though in the restlessness of his life and the enthusiasm of his disposition characteristics of his mother's nation were plainly visible. After graduating in medicine at Paris in 1840, he returned to Mauritius with the inten- tion of practising there, but he soon went to America, subsequently returning to Paris. In 1869 he migrated to London, and became physician to the National Hospital for the Paralysed and Epileptic. There he stayed for about five years, expounding his views on the pathology of the nervous system in numerous lectures which attracted considerable attention. In 1864 he again crossed the Atlantic, and was appointed professor of Physiology and Nervous Diseases at Harvard. This position he relinquished five years later, to become pro- fessor at the ;ficole de Medeeine in Paris, but in 1873 he again returned to America, 'and began to practise in New York. Finally, he came back to Paris to succeed Claude Bernard in 1878 as professor of Experimental Medicine in the College de France, and he remained there till his death, which occurred on 2nd April 1894. Brown- S^quard was a bold investigator who did not shrink from trying daring experiments even on his own person, and in drawing inferences from his results he seemed to be gifted with a sort of prophetic instinct which enabled him to reach correct conclusions before they were war- ranted by actually ascertained facts. His researches, which are contained in about 500 essays and papers, some written in French and some in English, cover a wide range, but are especially concerned with the physiology and pathology of the nervous system. Towards the end of his life he gained a certain notoriety among people who would otherwise have taken no interest in his work, by his advocacy of the subcutaneous injection of orchitic substance for the treatment of nervous dis- orders. In this particular case the beneficial effects of the method are open to question, but in other applications, e.g., the administration of thyroid in myxce- dema, good results have been obtained by the system of organotherapy, which is founded on the doctrines he held respecting the importance of the internal secre- tions of certain organs and their reabsorption into the circulation.~~

~~Brownson, Orestes Augustus (1802-1876), American theological, philosophical, and sociological writer, was born in Stockbridge, Vermont, 16th September 1803. Having spent some time in active religious, refor- matory, and political (Democratic) work in the interior of New York State,~~

~~Brownson removed to Chelsea, near Boston, Massachusetts, and at once made himself felt in the movements then agitating New England, which, between 1830 and 1850, was stirred by discussions per- taining to unitarianism, transcendentalism, spiritualism, abolitionism, and various schemes for communistic living. In several of these movements Brownson took an active but independent part, establishing the Boston Quarterly Review, mainly written by himself, in 1838. In his religious views he was successively a Presbyterian, a Universalist, and a Unitarian, finally becoming a Roman~~

~~Catholic in 1844, and so remaining, though the question of the orthodoxy of his writings was at one time sub- mitted to a cardinal by the Pope. la his philosophy Brownson was a more or less independent follower of Comte for a time, and of Cousin, who praised him ; he may be said to have taught a modified intuitionalism. In his schemes for social reform he was at first a student of Robert Owen, until his later views led him to accept Roman Catholicism. His first quarterly was followed, in 1844, by Brownson's Quarterly Review, in which he expressed his opinions on many themes until its suspen- sion in 1864, and after its revival for a brief period in 1873. Of his numerous publications in book form, the chief during his lifetime were Charles Elwood, or The Infidel Converted (1840, autobiographical), and The American Republic: its Constitution, Tendencies, and Destiny (1865), in which he based government on ethics, declaring the national existence to be a moral and even a theocratic entity, not depending for validity upon the sovereignty of the people. After his death his son, Henry F. Brownson, collected and published his various political, religious, philosophical, scientific and literary writings, in no less than twenty octavo volumes (Detroit, 1883-87), of which a condensed summary appeared in a single volume, also prepared by his son, entitled Literary and Political Views (New York, 1893). Brownson died in Detroit, Michigan, 17th April 1876.~~

~~Brownsville, capital of Cameron county, Texas, U.S.A., situated near the southern point of the state, on the Rio Grande, a few miles above its mouth, and opposite Matamoras in Mexico. It is on the Rio Grande railway, by which it is connected with Isabel on the coast. It has some river traffic, and a large trade with Mexico. Population (1880), 4938; (1890), 6134; (1900),~~

~~6305.~~

~~Broxburn, a mining and manufacturing town and railway station of Linlithgowshire, Scotland, on the Union Canal, llf miles W. of Edinburgh by road. It is the centre of the Scottish shale oil trade. There is a public hall, with reading-room. Population (1881), 3066 ; (1901),~~

~~6270.~~

~~Bruay, a town in the arrondissement of Bdthune, department of Pas-de-Calais, France, on the Lawe, an affluent of the Lys, 16 miles in direct line N.W. of Arras, with station on the railway from Lens to St Pol. It is situated in a rich coal-mining district. Population (1886),~~

~~6052 ; (1901), 7096.~~

~~Bruch, Max (1838), German musical com- poser, son of a city official and grandson of the famous Evangelical cleric, Dr Christian Bruch, was born at Cologne, 6th January 1838. From his mother (nie Almenrader), a well-known musician of her time, he learnt the elements of music, hut under Breidenstein he made his first serious effort at composition at the age of fourteen by the production of a symphony. In 1853 Bruch gained the Mozart Stipendium of 400 gulden per annum for four years at Frankf ort-on-Main, and for the following few years studied under Hiller, Reinecke, and Breunung. Subse- quently he lived from 1868 to 1861 as pianoforte teacher at Cologne, in which city his first opera (in one act), Scherz, List und Roche, was produced in 1858. On his father's death, in 1861, Bruch began a tour of study at Berlin, Leipzig, Vienna, Munich, Dresden, and Mannheim, where his opera Lorelei was brought out in 1863. At Mannheim he lived till 1864, and there he wrote some of his best-known works, including the beautiful Frithjof. After a further period of travel he became musical-director at Coblenz (1866-67), Hof-kapell- meister at Sondershausen (1867-70), and lived in Berlin (1871-73), where he wrote his Odysseus; his first violin~~

~~concerto and two symphonies being composed at Sonders- hausen. After five years at Bonn (1873-78), during which he made two visits to England, Bruch, in 1878, succeeded Stockhausen as conductor of the Stern Choral Union ; in 1880 Benedict at the Liverpool Philharmonic ; in 1892 von Herzogenberg at the Berlin Hochschule. In 1893 he was given the honorary degree of Mus. Doc. by Cambridge University. Max Bruch has'written in almost every conceivable musical form, invariably with straight- forward honest simplicity of design. He has a gift of refined melody beyond the common, his melodies being broad and su*ve and often exceptionally beautiful.~~

~~Bruchsal, a town of Germany, grand-duchy of Baden, 20 miles by rail S. of Heidelberg. It has a tech- nical school, a prison constructed on the single-cell system, a gaol for female prisoners, and manufactures of machin- ery, paper, soap, beer, &c. Population (1885), 11,662;~~

~~(1895), 12,614 ; (1900), 13,567.~~

~~Bruges (Flemish, Brugge), capital of the Belgian province of W. Flanders, 14 miles by r^il E. of Ostend, at the junction of the Ghent, Ostend, and Sluys canals. This delightful town is largely visited for the sake of its old buildings and its art treasures. Its ancient rampart is levelled and turned into a promenade, and its moat is in large part filled up. The manufacture of lace of various kinds employs about 12,000 women, from 4000 to 5000 of whom live in the city. There are also works for the construction of railway material and steam trawlers, brush factories, establishments for smoking herring and other fish, and many nurseries. The canal to Cfstend offers an indifferent sea-road, because of its shallowness, sluices, and bridges. The new maritime way, intended to be completed in 1902, includes a port of call on the North Sea at Heyst, and a canal, 26 ft. deep, running in a straight line, 7 miles long, to Bruges, which will then be an inland port (see Canals). The population, 47,961 in 1875, had fallen to 44,501 in 1880, but since then it has gradually increased to 55,641 in 1900.~~

~~See Weale, Bniges et ses environs, 1865 ; Stad Brugge, Verslag ever het bestuur en den toestand van stads zaken, 1897 ; Gompagnie des installations maritimes de Bruges: le port d'escale et le port interieur de~~

~~Bruges, 1898 ; Bulletin de la societe royale beige de geographie, 1898.— J. du Fief. Bruges et le nouveau canal maritime. (j. du f.)~~

~~Brugsch, Heinrich Karl (1827-1894), German Egyptologist, was the son of a Prussian cavalry ofBcer, and was born in the barracks at Berlin, 18th February 1827. He early manifested a great inclination to Egypt- ian studies, in which, though encouraged by Humboldt, he was almost entirely self-taught. After completing his university course and visiting foreign museums he was sent to Egypt by the Prussian Government in 1853, and contracted an intimate friendship with Mariette. On his return he received an appointment in the Berlin Museum. In 1860 he was sent to Persia on a special mission under Baron Minutoli, travelled over the country, and after Minutoli's death discharged the functions of ambassador. In 1864 he was consul at Cairo, in 1868 professor at Got- tingen, and in 1870 director of the school of Egyptology, founded at Cairo by the Khedive. From this post he was unceremoniously dismissed in 1879 by the European •controllers of the public revenues, determined to economize at all hazards ; and French jealousy prevented his succeed ing his friend Mariette at the Boulak Museum in 1883. He afterwards resided principally in Germany until his ■death on 9th September 1894, but frequently visited Egypt, took part in another official mission to Persia, and organized an Egyptian expedition in the United States. He had been made a pasha by the Khedive in 1881. H-e published his autobiography in 1894, concluding with a~~

~~warm panegyric upon British rule in Egypt. Brugsch's services to Egyptology are most important, including the standard ancient Egyptian History (1877), a geographical Dictionary of Ancient Egypt (1877-80) ; a hieroglyphic- demotic Dictionary (1877-82), and numerous works on the monuments. He also published accounts of his travels in Persia and northern Africa. (k. g.)~~

~~Brunei, a state situated in the north-west of Borneo. It has been so diminished in area since the beginning of the 19th century as to have become in comparison with the other states of Borneo territorially insignificant. It formerly included the whole of Northern Borneo, Southern Palawan, and stretched down the west coast as far as Sambas. What remains of this once powerful sultanate is a triangular-shaped territory, the base of~~

~~the triangle being represented by eighty miles of coast-line, and the two sides by the frontiers of Sarawak. The area, as calculated by one method, is 1686 square miles ; ‘ by another, 1701 square miles. In 1888 the state was placed under British protection. The country is ruled by a sultan, with absolute powers, whose usually good intentions are thwarted by ministers. The interior people have for centuries been subject to petty oppression, and there is too much of the old spirit left among the Malays to avoid acrimonious dispute and rebellion.~~

~~The bulk of its inhabitants, who consist of Malays, Kadayans, Orang Bukits, and a few Muruts, are to be found in and about the capital — also called Brunei — the population of the city being estimated at about 15,000, and the population of the whole territory being about 26,000. The city is prettily situated on the river, with cleared hills in the distance, and a background of heights clothed with magnificent forest. The dwelling-houses are built over the river, on slender piles obtained from the Nibong palm which resists the action of the water for several years. Though there are practically no exports and imports, there is a certain amount of inland commerce, the Brunei Malay usually earning a living as a trader with the interior tribes of Sarawak and British North Borneo. Some of them are skilled workers of brass, and the Brunei women make very beautiful cloth, interwoven and embroidered with gold thread. Sago is worked in Tutong and Balait, the two most important rivers in Brunei territory, but only a small quantity of rice is cultivated.~~

~~The history of this ancient and decaying sultanate is of great interest. Brunei, or, as it is called by the natives, Bruni or Dar- ul-Salam (city of peace) , possesses a historic tablet of stone upon which, in X.h. 1221 (1804), was engraved in Malay characters the genealogy of the sovereigns who have ruled over the country. The engraving was the work of Datu Imaum Yakub, the high priest at the time, who received the genealogy from the lips of Merhoum Bongsu, otherwise the Sultan Muadin, and Sultan Kemal-Udin, who ordered this record of their forefathers to be written. This stone tablet now stands on the tomb of Sultan Mahommed Jemal- ul-Alam at the foot of Panggal hill, in the city of Brunei. The Selesilah, or Book of Descent, is kept in the palace by the present sultan. The other heirlooms which are also kept in the sultan’s palace, and which descend to each sultan~~

in turn, are the " Nobab Nagara " (two royal drums) from Johore and Menang-Kabau, and the " Gunta Alamat" (bells), the gift of Sultan Bahkei of Johore or Malacca. The first sultan of Brunei was Alakber-Tata, who was probably of Bisaya stock, and who governed the country be- fore the introduction of Islam, in the 15th century. He assumed the name of Mahommed on his conversion to Islam, which was brought about during a visit to the Malay peninsula. Brunei, at this time, was a dependency of Menjapahit (Java), and paid a yearly tribute of a jar of areca juice obtained from the young green nuts of the areca palm, and of no monetary value. The Hindu kingdom of Menjapahit was destroyed by the Mahommedans in 1478, and Brunei is mentioned in the history of Java as one of the countries conquered by Adaya Mingrat, the general of Angka Wijaya. Sultan Mahommed's only child was a daughter. His brother Akhmed married the daughter of Ong Chum Ping, a Chinese officer said to have been sent by his emperor to obtain a

jewel from mount Kina Balu in North Borneo, and was the successor of Sultan Mahommed in the sovereignty of Brunei. He was succeeded by Sultan Berkat, an Arab Serif of high rank, from the country of Taif in Arabia,* who had married Sultan Akhmed's only child. Sultan Berkat built a mosque and enforced Mahommedan law, and with the assistance of the Chinese built the stone wall, by sinking forty junks filled with rock across the mouth of the Brunei river, between the islands of Kaya Orang and Chermin, which is still in existence. This work was completed before the arrival of Pigafetta in 1521. In the reign of Sultan Bulkeiah Magellan's squadron anchored off the mouth of Brunei river in August 1521, and Pigafetta makes mention of the splendid court and tlie imperial magnificence of the Borneo capital. Sultan Bulkeiah was otherwise known as Nakoda Ragam, and was the great warrior of Brunei who voyaged to Java, Malacca, Luzon, and all round the coast of Borneo. His tomb, which is handsomely built of stone, is still to be seen in Brunei, and is constantly visited by Malays, who leave ' money and various articles on the tomb as

~~offerings to his memory. Others, again, come and take away anything they can find, which they keep as charms and mementos. The Spaniards captured Brunei in 1580, the reigning sultan and his court retiring to Suai in the Baram district. The invaders were compelled to evacuate the place, however, in conse- quence of the heavy losses they sustained in the numerous attemjits made for its recovery. The golden age of Brunei was nevertheless at an end, and there is little more of striking importance to record. Disputed successions and civil war, maladministration and the untrustworthiness of the Malay character, caused a steady decline in prosperity. ' The East India Company started a factory in the town in the 18th century, but commerce had already decayed and the establishment was abandoned.i In the early part of the 19th century Brunei was but a resort for pirates and a market for the slave trade. During the 'forties Admiral (then Captain) Keppel and other officers of the British navy suppressed piracy in the neighbourhood. Sarawak was handed over to Raja Brooke, and, after the capture and temporary occupation of Brunei by Sir Thomas Cochrane, Labuan was ceded to the British empire. From this island it has always been possible to check the designs of the townspeople, and of late years a consul has been stationed there to watch affairs. Nowadays the political consequence of Brunei largely arises from the existence there of valuable seams of coal, leased to the Sarawak Government, which may in the future prove of great commercial importance.~~

~~Brunetiere, Ferdinand (1849), French critic~~

~~and man of letters, was born at Toulon, 19th July 1849. After attending a school at Marseilles, he proceeded to Paris, and studied at the Lycee Louis-le-Grand. Desiring to follow the profession of teaching, he entered for examination at the Ecole Normale superieure, but failed, and the outbreak of war in 1870 debarred him from a second attempt. Having but small means, he turned his attention to private tuition, and at the same time tried his hand at literary criticism. After the pub- lication of successful articles in the Bemie Bleue, he became connected with the Revue des Deux Mondes, first as contributor, then as secretary and sub-editor, and finally as principal editor. In 1886 he was appointed professor of French language and literature at the ificole Normale, a singular honour for one who had not passed through the academic mill; and later he presided with distinction~~

~~over various conferences at the Sorbonne and elsewhere. He was decorated with the Legion of Honour in 1887, and became a member of the Academy in 1893. The published works of M. Brunetiere consist entirely of reprinted papers and lectures. They include five series of essays on French history and literature (1880-87), Le Roman Naturaliste (1883), Histoire et Litterature, three series (1884-86), Questions de Critique (1888), and a second series (1890). The first volume of ^Evolution de Genres dans V Histoire de la Litterature, lectures in which a formal classification, founded on the Darwinian theory, is applied to the phenomena of literature, appeared in 1890; and his latest works include a series of studies on the evolution of French lyrical poetry during the 19th century, and various pamphlets of a polemical nature dealing with questions of education, science, and religion. M. Brunetifere is strictly orthodox, and his political sympathies are in the main reactionary. He~~

~~possesses two prime qualifications of a great critic, vast erudition and unfiinching courage. His mind is closely logical and intensely accurate, and he rarely makes a trip in the wide field of study over which it ranges. The most honest, if not the most impartial, of magisterial writers, he has a hatred of the unreal, and a contempt for the trivial : nobody is more merciless towards those who affect effete and decadent literary forms, or maintain a vicious standard of art. On the other hand, his intoler- ance, his sledge-hammer methods of attack, and a certain dry pedantry, have alienated the sympathies of many who recognize the remarkable qualities of hi^ mind. The application of universal principles to every question of letters is a check to dilettante habits of thought, but it is apt to detain the critic in a somewhat narrow and dusty path. M. Briineti^re's influence, however, cannot be dis- puted, and it is in the main thoroughly sound and wholesome.~~

~~Brunn (Czech, Brno), the capital of the Austrian margraviate and crown-land of Moravia. It has a special charter and is the seat of the district of the same name (consisting of the environs, with a population in 1900 6f 132,480, chiefly Czech), as well as of the Diet and pro- vincial authorities and of the provincial high court of jus- tice for Moravia and Austrian Silesia. Population in 1880, 82,660 ; in 1890, 94,462—69 per cent, of whom are German and 31 per cent. Czech, a reversal of the proportions pre- vailing throughout the crown-land. Population in 1900, 109,346, chiefly~~

~~Eoman Catholic, with exception of about 7-5 per cent. Jews and 2 per cent. Protestants. There is a garrison of 4548. Its educational ihstitutions include, in addition to the theological seminary and the polytechnic, 11 upper and lower gymnasia and high schools (6 German and 5 Czech), 13 continuation and technical schools, 6 inter- mediate, 34 elementary, and 17 municipal kindergarten schools. Briinn, which is sometimes styled " the Austrian Manchester," is the most purely industrial town of the monarchy. It has latterly maintained its position, with- out any marked alteration in the character of its produc- tion. Its main industries are woollen manufacture's and more particularly cloth, leather, the machinery required in the textile factories, brewing, distilling and milling, and the production of sugar, oil, gloves, and hardware. The workers enjoy a comparatively high degree of pro- sperity. Five railway lines touch at Briinn, which has a very good connexion with Vienna. Suburban traffic is promoted by steam tramways and omnibuses. The fortifications of the old town have now been entirely re- moved, giving place to handsome gardens and well-built streets. The numerous new buildings in Briinn include the hall of the provincial Diet, a theatre, an industrial museum, the polytechnic, the German gymnasium, the Slav assembly rooms, and the German club. The racial antipathies are much less violent in Briinn than they are in Prague, although the same political and national differ- ences prevail. There is a movement in favour of the re-establishment of a Moravian university in the town, but the Germans and Czechs cannot agree as to the language of instruction.~~

~~See Hanak, Die Konigliche Landes-Hauptstadt Brunn und die Umgebung (Briinn, 1880), and works in German by d'Elvert, Neu-Briinn, wie es entstanden ist (Briinn, 1889), Deutsch, and~~

~~TkAUTENBEEGER. ^ /jg o'N.)~~

~~Briinnow, Franz Fried(^ich Ernst (1821- 1891), German astronomer, was born in Berlin on 18th November 1821. Between the ages of eight and eighteen he attended the Friedrich-Wilhelm Gymnasium. In 1839 he entered Berlin University, where he attended lec- tures in mathematics, astronomy, and physics ; chemistry, philosophy, and philology also occupying his attention.~~

~~BEUNSBtJTTE L — B RUNSWICK~~

~~After graduating as Ph.D. in 1843 he took au active part in astronomical work at the Berlin Observatory, under the direction of the celebrated Encke, contributing numer- ous important papers on the orbits of comets and minor planets to the Astronomische Nachrichten. In 1847 he was appointed director of the Diisseldorf Observatory. Dur- ing his tenure of this post he published his well-known Memoire sur la com&te elliptique de De Vico, for which he received the gold medal of the Amsterdam Academy. In 1851 he succeeded Galle as first assistant at the Berlin Observatory. While occupying this position he computed his tables of the minor planet Flora, which were followed in 1859 and 1869 by tables of two other minor planets, Victoria and Iris. In 1854 he accepted the post of di- rector of the new observatory of Ann Arbor, Michigan, U.S.A. Here he published for several years a journal entitled Astronomical Notices. In 1860 he went, as asso- ciate director of the observatory, to Albany, N.Y., whence he continued to issue his Astronomical Notices; but in 1861 he returned to Michigan, and threw himself with vigour into the work of studying the astronomical and physical constants of the observatory and the instru- ments it possessed. In 1863 he resigned the directorship of the Ann Arbor Observatory and returned to Germany, but three years later, on the death of Sir W. R. Hamilton, he accepted the post of Andrews professor of astronomy in the University of Dublin and Astronomer Royal of Ireland. The first task he undertook at the Dublin Ob- servatory was the erection of an equatorial telescope to carry the fine object-glass which had been presented to the university by Sir James South. On the completion of this instrument he commenced his important researches on stellar parallax. The first, second, and third parts of the^ Astronomical Obseruations and Researches made at Dunsink contain the results of these labours, and include discussions of the distances of the stars a Lyrae, o- Dra- conis, G- roombridge 1830, 85 Pegasi, and Bradley 3077, and of the planetary nebula H. iv. 37. In 1873 the ob- servatory, on Dr Briinnow's recommendation, was pro- vided with a first-class transit-circle which, with his usual thoroughness, he proceeded to test as a preliminary to commencing an extended programme of work with it, but in the following year, in consequence of failing health and eyesight, he resigned the post and retired to Basel. In 1880 he removed to Vevey, and in 1889 to Heidel- berg, where~~

~~he died on 20th August 1891. It was during his residence at Diisseldorf that he composed his Lehr- buch der Sphdrischen Astronomie, on which, more perhaps than on any of his other works, his reputation will rest. Its importance was immediately recognized in Germany and other countries. In 1860 Part I. was translated into English by Main, the Radcliffe Observer at Oxford ; in 1865 an English translation of the whole work by Briin- now himself appeared ; while the fact that it reached a fourth edition, and has also been translated into French, Russian, Italian, and Spanish, proves how widely its value has been appreciated. " (a. a. e.*)~~

~~Brunsbiittel, a seaport town of Prussia, province of Schleswig-Holstein, on the N. bank of the Elbe, 60 miles N. W. from Hamburg. It is the W, extremity of the North-Sea-Baltic Canal, which is closed at that end by double locks, estimated to have cost £771,750. Here also are an inner harbour, 1640 feet long and 656 feet wide, a coaling station, and a small harbour for the tugs and other vessels belonging to the canal company. Popu- lation (1900), 2151.~~

~~Brunswick (German, Braunschweig), a duchy of Ger- many; area, 1424 sq. miles; population (1885) 372,452, (1895) 434,213, of whom 215,772 were males and 218,441 females; density, 304-9 to the sq. mile. Except for~~

~~19,508 Roman Catholics, the people belong almost en- tirely to the Lutheran church. The emigrants decreased from 333 in 1892 to 112 in 1899. Of the births annually 10 to 11 per cent, are illegitimate. The total number of farms in 1895 was 58,091, of which 38,901, or 67 per cent., were each less than 2^ acres, 13,929 were between 2^ and 25 acres, 6080 between 25 and 260 acres, and 181 exceeded 260 acres. In 1897 the live stock embraced 167,931 pigs, 149,149 sheep, 120,798 cattle, and 33,170 horses. The mines produced in the same year 1,067,192 tons of lignite, valued at £168,660 ; 108,502 tons of iron, valued at £10,800 ; 21,580 tons of potassium salts, valued at £148,850 ; or, in all, 1,187,274 tons of the value of £318,200′ (£442,550 in 1898). — There were also mined 44,262 tons of asphalt, valued at £12,650. The produce of the furnaces consisted of 26,285 tons of iron, valiied at £71,200, and 16,499 tons of sulphuric acid. In 1898-99 the sugar factories and refineries produced 91,942 tons of sugar; the breweries, 13,530,000 gallons of beer; and the distilleries (1897) 375,850 gallons of~~

~~pure alcohol. The duchy had 303 miles of railway in 1898. As re- formed by laws of 1888 and 1899, the legislative assembly now consists of 48 members, thus elected by indirect voting — 15 by the large towns, 15 by the country communes, and 18 by the learned professions, the clergy, landowners, manufacturers, and those who are assessed highest for income-tax. The assembly meets every two years, and the representatives sit for four years. The public revenue for the year 1900-01 was estimated at £787,600, and the public expenditure at £808,150. In addition to this the duke had a civil list of £180,630, derivable from domains, forests, &c. ; and there was a special budget of £70,460, devoted to religion and education. The public debt, of which 80 per cent, was incurred for the construction of railways, amounted in 1899 to £913,317. The contribution to the imperial ex- chequer was fixed at £218,675 in 1900.~~

~~Brunswick, a town of Germany, capital of the duchy, 53 miles W. by N. from Magdeburg by the rail- way to Hanover. Most of the principal churches have been^ restored since 1895 — the cathedral in 1891-92, St Peter's in 1888-92, St Martin's in 1897-99, St Catherine's in 1887-90, St Magnus in 1877, and St Andreas in 1899 onwards. Amongst the new secular buildings the first place is claimed by the ducal museum, built in 1883-87, in which are preserved the pictures col- lected by Duke Anthony Ulrich of Brunswick- Wolfen- biittel, a collection especially valuable for its Dutch canvases; it also contains collections of jewellery and Italian majolica. Other edifices are the post of&ce (1878-81); synagogue (1875); the new town house, an Early Gothic sandstone structure (1896-99) ; and the technical high school, an Italian Renaissance building of 1877, furnishing quarters for the Caroline College, and for various scientific collections. Brunswick also pos- sesses the Dankwarderode, a two-storeyed Romanesque building put up in 1884 on the site of part of the ancient citadel of the same name, which was destroyed by fire in 1873 ; two town halls, one containing a picture gallery, the other the municipal archives and municipal library ; the municipal museum, in the old town house since 1899 ; the national museum ; an anatomical museum ; botanical gardens; and several parks; teachers' seminaries, deaf and dumb and blind asylums; and a national school of arboriculture. Nor should the many fine old houses be overlooked. There are also several monuments, the principal being those erected to Henry the Lion, a bronze fountain (1874) ; to the mathematician~~

~~Gauss (1880), who was born here in 1777 (died 1865) ; to Les- sing, by Rietschel (1853), Lessing having died here in~~

~~1781 ; two bronze equestrian statues (1894) of Dukes ^Charles William and Frederick William ; a bronze monu- raent to Franz Abt (1891); and a monument of the war of 1870-71. Brunswick is the seat of varied in- dustries, the most noteworthy of which are sugar-re- fining, jute-spinning, manufacture of sewing and other machines, hardware, tobacco, beer, musical instruments, colours, lacquered wares, gloves, &c., printing and publish- ing, distilling, and gardening. Brunswick is famous for its sausages, honey-cakes, asparagus, and Mumme beer. Owing to its central situation, at the intersection of the great route between the Middle Rhine (Frankfort) and the middle Elbe (Magdeburg), and that between Hamburg and Leipzig, it is also the seat of a very active trade. The musician Spohr was born here in 1784 (died 1859). Popu- lation (1886), 85,174; (1890), 101,047; (1895), 115,138;~~

~~(1900), 128,177.~~

~~See Brmtnschweig, einst und jetzt (Btvusw., ISQT) . (j. t. be.)~~

~~Brunswick, capital of Glynn county, Georgia, U.S.A., situated on St Simon Sound, 8 miles from the sea. It is a seaport of some importance, particularly in the export of cotton, has two railways, the Southern and the Plant System, and has considerable manufactures of yellow-pine lumber. Population (1880), 2891; (1890),~~

~~8459; (1900), 9081.~~

~~Brunswick, a city of Cumberland county, Maine, U.S.A., on the south bank of Androscoggin river, near its mouth. It is the terminus of several branches of the Maine Central railway. Bowdoin College, situated here, had in 1900 (including the Medical School of Maine), 34 professors and instructors and 356 students. Population~~

~~(1880), 6384; (1890), 6012; (1900), 6210.~~

~~Brusa, or Broussa, the capital of the Khudavendikiar vildyet of Asia Minor, which includes parts of ancient Mysia, Bithynia, and Phrygia, and extends in a south- easterly direction from Mud^nia, on the Sea of Marmora, to Afiun Kara-hissar on the SmyrnarKonia railway. The vilayet is one of the most important in Asiatic Turkey, has great mineral and agricultural wealth, many mineral springs, large forests, and valuable industries. It exports cereals, silk, cotton, opium, tobacco, olive oil, meerschaum, boracite, &c. The Ismid-Angora and Eskishehr-Konia railways pass through the province. Population of the province, 1,600,000 (Moslems, 1,280,000; Christians, 317,000 ; Jews, 3000).~~

~~The city stretches along the lower slopes of the Mysian Olympus or Keshish Dagh, occupying a position above the valley of the NiWfer {Odrysses) not unlike that of Great Malvern above the vale of the Severn. It is divided by ravines into three quarters, and in the centre, on a bold terrace of rock, stood Prusa, built by Prusias and long the capital of the Bithynian kings. The prosperity of Prusa, under Rome, is clear from the letters of Pliny the younger. The modem town has clean streets and good roads made by Ahmed Vefyk Pasha when Vali, and it contains mosques and tombs of great historic and architectural interest; the more important are those of Sultans Murad I., Bayezid 4., Muhammad I., and Murad II., 1360-1451, and the Ulu Jami'. The mosques show traces of Byzantine, Persian, and Arab influence in their plan, architecture, and decorative details. The circular church of St Ellas, in which the first two sultans, Osman and Orkhan, were buried, was destroyed by fire and earthquake, and rebuilt by Ahmed Vefyk Pasha. There are in the town an American mission and school, and a British orphanage. Silk stufis, towels, burniis, carpets, felt prayer-carpets embroidered in silk and gold, are manufactured, and there are several factories in which silk is spun for export and home consumption. The hot iron and sulphur springs near Brds^, varying in temperature from 112° to 178° F., are still much used. The town is connected with its port, Mudinia, by a railway and a road. There is a British Vice-Consul. Population, 75,000 (Moslems, 40,000 ; Christians, 33,000 ; Jews, 2000). (c. w. W.)~~

~~Brushes. — (1) Wire. — Brushes with tufts formed of steel wire are used for cleaning tubes and flues of steam boilers, for the purpose of removing the scale formed~~

~~by the products of combustion. Steel wire brushes are also used for cleaning scale from the interior surface of a boiler, or for removing the sand from the surface of a casting. Occasionally such brushes are revolved in a machine, for more convenient use on the article to be cleaned or polished.~~

~~A novel and effective use is made of a steel wire Brush in utilizing it to form the active principle of what is known as Snyer's patent elastic clutch or coupling. The apparatus is for the purpose of coupling up or disconnecting a steam engine from a line of shafting used for transmitting power to machinery ; or it may be used for coupling an engine and dynamo together, or other similar purpose. The clutch consists essentially of two discs, the adjacent faces of which are provided, one with a ring of brushes made of flat steel wire, the other with a number of finely serrated teeth. One of the discs is movable longitudinally on its shaft, and with the brushes clear of the serrations, the clutch is free. On closing together, which may be done with the engine running at speed, the elasticity of the brush permits the motion to be imparted gradually and without shock to the standing part, until both rotate and are locked together. These clutches are very powerful, and are capable of transmitting as much as 3000 horse-power.~~

~~(2) Electric. — An apparatus for conducting the electric current from the stationary portion, the field magnets, to the revolving part, the armature, of an electric dynamo or motor, is termed a "brush." There are usually two brushes to each dynamo or motor, and they are placed diametri- cally opposite, lightly touching the commutator, of the armature.~~

~~It is important that there should be good metallic contact between the brushes and the commutator in order to avoid sparking, and at the same time the frictional resistance resulting from the contact must be at a minimum. To effect this result brushes are variously made. The kind of brush frequently used consists of a number of copper wires laid side by side and soldered together at one end, where the brush is held. Brushes are also made of strips of spongy copper cut like a comb, which give a number of bearing points on the commutator. Very good results are obtained from~~

~~brushes made of copper gauze wound closely until it takes the exterior form of a rectangular blo(5k, which is held radially in a spring holder, and bears at the end on the commutator. In place of the gauze block, hard carbon blocks are frequently used and form the " brushes." ((j. h. ba.)~~

~~Brussels (French, Bruxelles; Flemish, Bi-usseT), capital of Belgium and of the province of Brabant, in 50° 51′ N. lat., 4° 22′ E. long., partly in the low-lying plain traversed from S. to N. by the Senne, partly on hills rising to the E. The ancient contour of the city is in- dicated by a line of fine boulevards occupying the place of its old fortifications. Beyond that circuit it has absorbed the neighbouring communes, by the laying out on the E. of the Avenue Louise, leading to the Bois de la Cambre ; and also of the Park, with the Palace du Cinquantenaire, in which were held the Exhibitions of 1880, 1888, and 1897. In 1900 the city was extended on the N.W., where the lahds near by the canal of Willebroeck were annexed for the accommodation of shipping establishments. The eight communes that immediately surround the city are those of St Josse-ten-Noode, Schaerbeek, and Laeken on the N. ; Etterbeek and Ixelles on the E.; St Gilles on the S. ; Anderlecht and Molenbeek-St-Jean on the W. These communes form, with Brussels, practically one vast town, without visible sign of their several boundaries. Since 1875 they have experienced a considerable development from the overflow of the population of Brussels, and enjoy, in fact, all the advantages of the capital without sharing its burdens. Thus Brussels is a spacious and handsome city, clean, healthy, and attractive to visitors, more especially since several of the old quarters, insanitary and crowded, have given way to well-aired streets and squares. This process of transformation dates from 1868, when, to remedy the constant exhalations and frequent inundations of the Senne, the course of that river in its passage through the city was enclosed by a great~~

~~arch, on each, side of which were laid two large main sewers, into which the whole sewage system empties itself. Upon these subterranean buildings has been constructed a series of magnificent boulevards, which connect the Gare du Midi with the Gare du Nord, and along which a con- stant stream~~

~~of tram and passenger traf&c flows all day long and far into the night. Beginning in front of the Place de la Constitution, where is situated the Station du Midi, this broadway bears the names successively of the Boulevard du Hainaut, Boulevard Anspach, Place de Brouckere, where the way divides int6 the Boulevard de la Senne (at the end of which the river issues out again into the open), and the Boulevard du Nord ending in front of the Place Eogier, where stands the Station du Kord. These thoroughfares are all distinguished by their elegant and varied architecture. Running parallel to this central way, there has been opened the Avenue du Midi, which, continued by the Eue du Midi, the Rue des Fripiers, the Place de la Monnaie, and the Rue Neuve, forms a second grand thoroughfare, leading also from the Gare du Midi to the Gare du Nord. Other grand thoroughfares and new quarters have been opened up in different parts of the city. Among the more remarkable squares and parks are the Public Park with its fine trees, situated between the Palais du Eoi and the Palais de la Nation ; the Square Frfere-Orban (the old Place de la Societe Civile), on which has been erected a statue of M. Frere-Orban ; the Square du Petit Sablon, remarkable for the group in bronze of Counts Egmont and Hoorn, surrounded by eight statues of personages of the 16th century, and by the artistic iron railing; the Park Leopold, formerly the Zoological Gardens, whither has been transferred the Museum of Natural History, and in which, by private subscription, have been erected the Biological Institutes ; the Pare V du Cinquantenaire, a very beautiful avenue, leads to the Pare de Tervueren, in which is a museura of the Congo ; the Bois de la Cambre, two miles from the Place Royale, at the extremity of the Avenue Louise; the squares Marie-Louise and Ambiorix ; the Park of St Gilles, and the Pare -de Laeken, adjoining the royal residence. .The cathedral has been restored, and the famous Hotel de Ville (15th century) has also been completely repaired, both outside and inside. On the Grande Place, the Maison du Roi (16th century), its old foundations showing signs of giving way, was rebuilt in 1877 on its original plan. The old Guild-houses have likewise experienced a restora- tion of their faqades according to their original aspect, and now form a curious and magnificent ensemble. Since the opening of the Central Boulevard numerous buildings of diverse styles have been eiectel on both sides. In the lower town the New Exchange (1874) has been erected in rich ornamental Renaissance, at a cost of four million francs. Other buildings are the Central Post Office (1892), a fine edifice in Renaissance, erected on the~~

~~site of the ancient Hotel des Monnaies, opposite the Theatre de la Monnaie ; the Communal Theatre, intended specially for the representation of Belgian pieces ; the Fish Halls (1883) ; the Halles Centrales (1874) ; the Marche Convert for fruit, &c., in the Place St Gery ; the Palais du Midi, a vast structure, comprising shops, markets, and an industrial school. On the slope and in the upper part of the city are the Hotel Central des Telephones (1900), on the site of the former Palais de Justice ; the new Palais de Justice, constructed in 1868-83, from designs by Polaert, and costing about fifty million francs, quadrangular in form, covering 270,000 square feet, surmounted by a dome, the cupola of which is about 330 feet above the pavement of the Salle des Pas Perdus. Opening into Place Polaert is the broad Rue de la Regence, in which are a synagogue (1878) in the Romanesque, the Royal Con- servatorium of Music (1876) in Renaissance, the Palace~~

~~of the Count of Flanders, the Palace of the Fine Arts (1880), in which are placed the gallery of old pictures and tne gallery of sculptures, while the modern pictures, as also the general archives of the kingdom, are alongside of the royal library in the old building of the picture gallery (Mus^e de Peinture), and the Museum of Natural History. In the Quartier-Leopold is the Mus^e Wiertz, where the paintings attract innumerable visitors. Be- yond the Park, behind the Palais de la Nation and the Ministries, there are groups of fine buildings of recent construction, in which are the offices of the administra- tion of railways and of that of the marine. In the commune of St Gilles a vast mint (Hotel des Monnaies) has been erected, and a prison of solitary confinement (1884) in Anglo-Gothic, able to accommodate 600 pris- oners. The observatory, formerly placed at the north- east angle of the line of boulevards, was transferred in 1891 to Uccle. In the way of military quarters, all that is now left are a barrack for the grenadiers, and a barrack for the infantry of the line. At Etterbeek, about 1| miles from Brussels, handsome barracks have been built for the cavalry and artillery, with a large field for manoeuvres ; and close by, on the Ixelles ground, is a military hospital. There are new buildings, to serve as a military school, near the Pare du Cinquantenaire. In the Schaerbeek quarter is the barrack of Baudoiu, occupied by the cara- biniers, and, a little farther off, the national shooting- grouni (1888), where, with the latest improvements, are about forty targets.~~

~~Among the industries of Brussels are its noted lace manufactures, cabinetmaking, the making of furniture, coachbuilding, jewellery, goldsmith's work, leather-glove and boot manufactures, the making of organs and pianos, wall-paper, soaps, &c. ; important breweries, &c. Railway lines radiate in all directions : to Ostend, and thence by packet-boats to Dover and London; to Antwerp, and thence by steamer to Harwich and London ; to Amster- dam ; to Berlin and §t Petersburg ; to Vienna and Con- stantinople ; to Basel, Rome, and Brindisi ; to Paris and Marseilles ; to Lille and Calais. Two canals, one from Charleroi,the other from Willebroeck, meet in Brussels on their way to the Rupel and the Escaut (see Canals). The population of the commune of Brussels alone was 183,000 in 1875^ and 183,686 in 1900. But the total population of the combined communes increased from 385,000 in 1875 and 465,317 in 1890 to 571,000 in 1899.~~

~~Hbnne and Wautees. Sist. politique, civile, et monumentale de la ville de Bruxelles, 1843-45. — L. Hymans. Bruxelles a travers les S,ges, 1881. (j. du f.)~~

~~Briix, chief town of district of the same name in Bohemia, on the railway from Prague to Pilsen. Popula- tion (1890), 14,894; (1900), 21,625, mostly Catholic. There are important sugar, iron and hardware, distilling, brewing, and milling industries. Valuable lignite deposits are found in the neighbourhood, and the bitter waters at Piillna, Seidlitz, and Seidschiitz are celebrated.~~

~~Bryan, William Jennings (1860), Ameri- can politician and presidential candidate, was born in Salem, Illinois, 19th March 1860. His parents, well-to-do but not wealthy, were highly respected, his father serving twelve years as a circuit judge. After graduating from the classical course in Illinois College at Jacksonville in 1881, young Bryan took a full course in the Union College of Law, Chicago, supplementing his studies with work in the office of ex-Senator Trumbull. From 1883 to 1887 Mr Bryan practised law in Jacksonville. In 1887 he removed to Lincoln, Nebraska, which has ' since been his home. His success at the bar was much greater than usually comes to so young an attorney, but public~~

questions and his bent of mind turned his attention to politics. In 1890 the first Clongressional district of Nebraska, a Eepublican stronghold, elected Mr Bryan as its representative in the fiftj'-seL'ond Congress, and in 1892 re-elected him to the fifty-tliird. He was placed on the Ways and Means Committee, an unusual honour to a new member, and was known as a worker. He also won high reputation as a debater. Two of his speeches in particular attracted wide attention, those against protec- tion on the 16th March 1892, and against the repeal of the silver purchase clause of the Sherman Act, 16th August 1893. His zeal for bimetallism in the fifty third Congress was the main cause of his failure to be re-elected to the next. As editor of the Omaha Woiid- Ilerald, Mr Bryan championed bimetallism in the press as vigorously as he had advocated it in Congress, his articles being widely quoted and discussed. The Demo- cratic party was radically divided on the monetary policy. To secure the repeal of the silver purchase clause of the Sherman Act, President Cleveland had used all the power he possessed. In spite of this, however, the senti- ment in favour of opening the mints to the free coinage of silver rapidly gained in party favour, so that in the Democratic Convention of July 1896 at Chicago, nearly two-thirds of the delegates were against the administra^ tion and its gold regime. Mr Bryan was a delegate-at- large from Nebraska in this Convention. It was here, in the course of a heated debate on the proper Democratic attitude to the currency question, that he made his memorable declaration, " You shall not crucify mankind on a cross of gold." With the silver majority of the Convention he at once became an idol, and next day he was nominated as candidate for the Presidency. Mr Bryan spent the entire autumn of 1896 upon the hustings. He opened the campaign in the centre of the " gold " country, at Madison Square Garden, New York, with an address of remarkable ability. He visited more than half the States of the Union and delivered more than six hundred speeches. But the opposition both without and within the Democratic party was too strong to be over- come. At the election in November the popular vote was 7,107,822 for McKinley and 6,511,073 for Bryan. Of the electoral votes McKinley received 271 and Bryan 176. Though defeated Mr Bryan not only remained the undisputed leader of the Democrats, but his power and the respect accorded to him rapidly increased. Between 1896 and 1900, except the six months of the

~~Spanish war, in which he served as colonel of the Third Nebraska Volunteers, Mr liryan devoted his entire time to study, speaking and writing in the interest of his party. His ability, his sincerity of character, his wide information, and his qu.ick and accurate grasp of the new issues arising from the Spanish war, of which " imperialism " was the most momentous, drew to him the support of many who had opposed him in 1896. As the time for the Demo- cratic Convention of 1900 drew on, it was seen that he was the only possible candidate. He was again nominated for the Presidency, and again he spent his whole time through the campaign upon the hustings. He was, how- ever, once more defeated by the Eepublican candidate, the popular vote standing 7,206,677 for Mr McKinley, and 6,374,397 for Mr Bryan, and the electoral vote 292 to 155. This result appears to have been mainly due to the fact that the platform again demanded the free coinage of silver.~~

~~Bryansk, a district town of middle Kussia, in the government and 90 miles by rail W.N.W. of Orel, pictur- esquely situated at the confluence of the Desna with the Bolva, which brings it in connexion with Kieff, vid the navigable Desna. Since it has been connected by rail~~

~~with Eiga, vid Vitebsk, and the south-western railways vid Gomel, it has rapidly grown in importance, both as a depot for the export of grain, and chiefly hemp, and as an industrial centre. The exports vid the Desna alone (grain, timber, oils, tar and pitch, metallic goods) are valued at £110,000 per annum, while nearly 50,000 cwts. of hemp and £10,000 worth of hempseed oil are sent to St Petersburg every year. It contains large gun works of the Crown, several hemp-spinning mills, rope works, &c. The Bryansk Byezhitsk works close by, at the junction of the Desna with the Dnieper, have grown to be one of the most considerable centres in Eussia for the manufacture of railway rails and bridges, employing 5000 workers. Population, 23,520.~~

~~Bryant, William Cullen (1794-1878), American poet and journalist, was born at Cummington, a farming village in the Hampshire hills of Western Massachusetts, 3rd November 1794. He was the second son of Peter Bryant, a physician and surgeon of no mean scholarship, refined in all his tastes, and a public-spirited citizen. Peter Bryant was the great-grandson of~~

Stephen Bryant, an English Puritan emigrant to Massa- chusetts Bay about the year 1632. The poet's mother, Sarah Snell, was a descendant of " Mayflower " pil- grims. He was born in the log farmhouse built by his father two years before, at the edge of the pioneer settle- ment ahiong those boundless forests, the deep stamp of whose beauty and majesty he carried on his own mind and reprinted upon the emotions of others throughout a long life spent mainly amid the activities of his country's growing metropolis. By parentage, by religious and political faith, and by hard- ness of fortune, the earliest of American poets was ap- pointed to a life severely typical of the first century of American national existence, and of the strongest single racial element by which that nation's social order has been moulded and promoted. Bated by the amount of time given to school books and college classes, ISryant's early education was limited. After the village school he received a year of exceptionally good training in Latin under his mother's brother, the Eev. Dr Thomas Snell, of Brookfield, followed by a year of Greek under the Eev. Moses Hallock, of Plainfield, and at sixteen entered the sophomore class of Williams College. Here he was an apt and diligent student through two sessions, and then, owing to the straitness of his father's means, he withdrew without graduating, and studied classics and mathematics for a year, in the vain hope that his father might yet be able to send him to Yale Col- lege. But the length of his school and college days would be a very misleading measure of his training. He was endowed by nature with many of those traits which it is often only the final triumph of books and institutional regimen to establish in character, and a

W1LLIA.M Cullen Eeyant. {From a photo. hy Saj-ony, New York,^

double impulse toward scholarship and citizenship showed its ruling influence with a precocity and an ardour which gave every day of systematic schooling many times its ordinary value. It is his own word that, two months after beginning with the Greek alphabet, he had read the New Testament through. On abandoning his hope to enter Yale, the poet turned to and pursued, under private guidance at Worthington and at Bridgewater, the study of law. At twenty-one he was admitted to the bar, opened an office

~~in Plainfield, presently withdrew from there, and at Great Barrington settled for nine years in the attorney's calling, with an aversion for it which he never lost. His first book of verse, Thanatopsis, appeared in 1817.~~

~~At the age of twenty-six Bryant married, at Great Barrington, Miss Trances Fairchild, with whom he enjoyed a happy union until her death nearly half a century later. In the year of his marriage he suffered the bereavement of his father's death. In 1825 he ventured to lay aside the practice of law, and removed to New York city to assume a literary editorship. Here for some months his fortunes were precarious, until in the next year he became one of the editors of the Evening Post. In the third year following, 1829, he came into undivided editorial control, and became also chief owner. He enjoyed ^is occupation, fulfilling its duties with an unflagging devotion to every worthy public interest till the end of his life, which came in 1878, in the month of his choice, as indicated in his beautiful poem entitled "June."~~

~~Though Bryant's retiring and contemplative nature could not overpower his warm human sympathies, it yet dominated them to an extent that made him always, even in his journalistic capacity and in the strenuous prose of daily debate, a councillor rathei* than a leader. It was after the manner of the poet, the seer, that he was a patriot, standing for principles much more than for measures, and, with an exquisite correctness which belonged to every phase of his being, never prevailing by the accommodation of himself to inferiors in foresight, insight, or rectitude. ^ His vigorous and stately mind' found voice in one of the most admirable models of journalistic style known in America. He was foun(Jer of a distinct school of American journalism, characterized by an equal fidelity and temperance, energy and dignity. Though it is as a poet that he most emphatically belongs to history, his verse was the expression of only the gentler motions of his mind ; and it gathers influence, if not lustre, when behind it is seen a life intrepid, upright, glad, and ever potent for the nobler choice in all the largest affairs of his time. His renown as a poet antedated the appearance of his first volume by some four or five years. " American poetry," says Richard Henry Stoddard, " may be said to have commenced in 1817 with . . . (Bryant's) ' Thana- topsis ' and ' Inscription for the entrance of a wood.' " The solemn chords of "Thanatopsis," revealing a voice at once as new and as old as the wilderness out of which they reverberated, had been written at Cummington~~

~~in the poet's eighteenth ' year, the " Inscription " in his nineteenth, and in his twenty-first, while a student of law at Bridgewater, he had composed his lines "To a Water- fowl," whose exquisite beauty and exalted faith his own pen rarely, if ever surpassed. The poet's gift for language made him a frequent translator, and among his works of this sort his rendering of Homer is the most noted and most valuable. But the muse of Bryant, at her very best, is always brief-spoken and an interpreter initially of his own spirit. Much of the charm of his poems lies in the equal purity of their artistic and their moral beauty. On the ethical side they are more than pure, they are — it may be said without derogation — Puritan. He never~~

~~commerces with unloveliness for any loveliness that may be plucked out of it, and rarely or never discovers moral beauty under any sort of mask. As free from effeminacy as from indelicacy, his highest and his deepest emotions are so dominated by a perfect self-restraint that they never rise (or stoop) to transports. There is scarcely a distempered utterance in the whole body of his poetical works, scarcely one passionate exaggeration. He faces life with an invincible courage, an inextinguishable hope and heavenward trust, and the dignity of a benevolent will which no compulsion can break or bend. The bil- lows of his soul are not waves, bu,t hills which tempests ruffle but can never heave. Even when he essays to speak for spirits unlike his own — characters of history or conceptions of his own imagination — he never with signal success portrays them in the bonds, however transient, of any overmastering passion. For merriment he has a generous smile, for sorrow a royal one ; but the nearest he ever comes to mirth is in his dainty rhyme, " Robert of Lincoln," and the nearest to a wail in those exquisite notes of grief for the loss of his young sister, " The Death of the Flowers," which only draw the tear to fill it with the light of a perfect resignation. As a seer of large and noble contemplation, in whose pictures of earth and sky the presence and care of the Divine mind, and every tender and beautiful relation of man to his Creator and to his fellow, are melodiously celebrated, his rank is among the master poets of America, of whom he is his- torically the first. (g. w. ca.)~~

~~Brynmawr, a market town of South Wales, in the county of Brecknock, 14|^ miles S.E. of Brecknock, with a station on the London and North-Western~~

railway. Since 1894 it has been governed by an urban district council. Population of the urban district (1891), 6413 ;

(1901), 6833.

Bryophyta. — This great subdivision of the vege- table kingdom was treated so fully in the article MusciNE^ (see Ency. Brit. vol. xvii.), that only a brief supplementary note is necessary to indicate the nature of the extension of our knowledge of the Mosses and Liver- worts since the date of its publication. The more recent work has shown that in the Bryophyta we have a group of plants, the evolution of which has proceeded on somewhat similar lines to that of the higher plants, as regards the adaptation of the organism to the conditions under which it lives. The important distinction for morphological pur- poses, that in the Bryophyta the leafy plant is the sexual generation, while the corresponding modifications are found in the sporophyte of the higher plants, only gives a special value to the comparison of the two groups, since the adaptations can be seen to have arisen independently. It * will be sufficient here to point out some of the characters of Liverworts and Mosses which receive their explanation in this way, and to refer for details to the work s cited at the end of this article. Starting from the structure found in the simpler thalloid forms, the development of more or less specialized leaves to meet the requirements of assimi- lation can be seen. A series illustrating the passage from the frondose to the foliose condition is afforded by the anacrogynous Jungermanniacece, several interesting new forms of which have been discovered. In some of the acrogynous JungermanniacecB also the main assimilating surface is a flat thallus, only the branches which bear the reproductive organs being leafy. On the other hand, a specialization of the upper surface of a thallus for this purpose can be traced in a series of forms, from the BicciacecB to the Marchantiacew,, culminating in the struc- ture found in such a liverwort as Marchantia. The leafy shoot of the sexual generation of the Mosses may be cited

~~lastly. In one moss (Buxbaumia aphylla) this is so simple that the well-developed protonema bears either solitary scale leaves, or a simple stem with several leaves around the sexual organs. This has been regarded by Goebel as the simplest form of moss, but the complexity of the capsule, combined with the fact that the plant is probably a saprophyte, makes the validity of this infer- ence questionable. The view that in Buxbaumia we have a reduced rather than a primitive form, is supported by the presence of a well-developed leafy shoot in the bosses which appear to be most closely allied to it. In connexion with the partial saprophytism of many of the Bryophyta, the occurrence of fungal hyphse in their rhizoids, forming a mycorhiza, may be noted. The Splachnacece, a group of mosses growing on dung and decomposing animal substances, exhibit in their con-spicuousness, and in their coherent and sticky spores, , characters which may be regarded as adaptive; the spores of these mosses are probably carried to the localized droppings, on which the plants are foimd, by the agency of flies. Another group of adaptive characters is related to the protection of the organism against drought. Many Bryophyta are capable of withstanding prolonged desiccation, recovering on being moistened, and show no special arrangements for their preservation through a dry period. Others, however, do show special adaptations to this end, such as the rolling up of the thallus in certain Marchantiacece, the presence of the auricles on the leaves of some Jungermanniacece (which serve for water-storage, and are most common in epiphytic or epiphyllous forms), and the rolling up of the leaf in the Polytrichacece. In connexion with this the not in- frequent occurrence of underground tubers may be mentioned ; these start the growth of the plant after the dry season is over, and thus serve as a means of vegeta- tive multiplication. Special arrangements have also been shown to exist in the structures adjoining the sexual organs, the function of which is to increase the chance of the spermatozoids being brought withiu the range of the attractive power of the archegonium ; the attraction ap- pears to be due to the irritability of the spermatozoids to certain chemical substances. With regard to the sporophyte, evidence has accumulated, from a study of its structure and from experimental work, that the larger sporogonia of some Mosses and the Anthocerotece are to a considerable extent independent of the gametophyte. Their assimilating tissue may be well developed, especially in the apophysis, which bears true stomata, and in the arrangement of its cells recalls the mesophyll of some foliage leaves.~~

~~Various types of spore-dispersal have also been recognized in the moss sporogonium. It will be ^ evident that, until a considerable insight into the origin of such characters is obtained, the value of their appli- cation to the determination of relationship cannot be estimated ; but it may be pointed out that their bearing on the classification of the Bryophyta, which is to some extent founded on differences in leaf -form, &c., along with more trustworthy characters, is an important onei~~

~~As to the relationship of the Bryophyta, on the one hand, to the Algoe, ajiS. on the other to- the Vascular Cryptogams, little can be added to what is said in the original article. In connexion with the hypothesis ad- vanced by Bower to explain the origin of the latter group, in which the strobilus of a Vascular Cryptogam, such as Equisetum, is regarded as the equivalent of the sporogonial head, the article on Pteridophyta may be referred to. The significance of the Bryophyta as affording an insight into the possible mode of origin of the independent, leafy sporophyte of the Pteridophyta is obvious, whether we regard the two groups as nearly related or not. The alter- nation found in the two is a strictly similar one ; investi-~~

~~gations into the nuclear changes have shown that in Bryophytes the reduction in number of the chromosomes takes place in the spore-mother-cells, and that thus the same cytological difference exists between gametophyte and sporophyte. While apogamy is not known, some mosses have been shown to be aposporous; in Funaria the protonemal filaments may arise from a sporogonium while still attached to the moss plant. Thus the one generation may arise vegetatively from the other in Mosses as in Ferns. This brief account will serve to show that, while our knowledge of the details of morphology and natural history has increased, the general point of view in the original article needs no amendment, while the systematic works cited below will show to what extent the classification of the Bryophyta has been modified by the additional facts brought to light.~~

~~For further information tlie reader may consult : — Campbell. Mosses and Ferns. London, 1895. — Engler and Prantl. Die nalurlichen Fflanzenfamilien, Theil i. Abth. 3. Leipzig, 1893 1900. — GoEEEL. Organographie der Pflanzen. Jena, 1898. Full references to the recent literature of the subject will be found in all these works. (w. H. n.)~~

~~Brzezany, a town in Galicia (Austria). Population of town and commune (1890), 11,221; (1900), 11,244; besides a garrison of 832 men. It has leather manufac- tures, and trade in corn, spirits, and agricultural produce.~~

~~Bucaramanga, capital of the department of Santander, Colombia, South America, 186 miles N.N.E. of Bogota. It is a town of considerable commercial activity, connected with the Magdalena river by a rail- way, and is well built and prosperous, the streets being lighted by electricity. There are gold, copper, and iron mines in the neighbourhood. Population, 18,000.~~

~~Buchanan, Robert Williams (1841-1901), British poet, novelist, and dramatist, son of Robert Buchanan (1813-1866), Owenite lecturer and journalist, was born at Caverswall, Staffordshire, on 18th August 1841. His father, a native of Ayr, after living for some years in Manchester, removed to Glasgow, where BucSianan was educated, at the High School and the University, one of his fellow-students being the poet David Gray. His essay on Gray, originally contributed to the Cornhill Magazine, tells the story of their close friendship, and of their journey to London in 1860 in search of fame. After a period of struggle and disappointment Buchanan published Under- tones in 1863. This " tentative " volume' was followed by Idyls and Legends of Inverburn (1865), London Poems (1866), and 2iforth Coast and other Poems (1868), wherein he displayed a faculty for poetic narrative and a sympa- thetic insight into the humbler conditions of life. On the whole, Buchanan is at his best in these narrative poems, though he essayed a more ambitious flight in The Book of Orm : A Prelude to the Epic, a study in mysticism, which appeared in 1870. He also became a frequent contributor to periodical literature, and obtained notoriety by an article which, under the nom de plume of Thomas Maitland, he contributed to the Contemporary Review for October 1871, entitled " The Fleshly School of Poetry." This article was expanded into a pamphlet (1872), but he subsequently withdrew from the criticisms it contained, and it is chiefly remembered by the replies it evoked from D. G. Eossettiin alettertothe^~~

~~(1894). In 1896 he became, so far as some of his work was concerned, his own publisher. In the autumn of 1900 he had a paralytic seizure, from which he never re- covered. He died at Streatham on 10th June 1901.~~

~~Buchanan's poems were collected into three volumes in 1874, and again, more completely, into one volume in 1884. This volume contains, besides the poems mentioned above and many others, "The Drama of Kings" (1871) ; "St Abe and his Seven Wives," a lively tale of Salt Lake City, published anonymously m 1872; and "Balder the Beautiful" (1877). He afterwards published (among others) "The City of Dream" (1888); "The Outcast: a Rhyme for the Time " (1891); and " The Wandering Jew " (1893). His earlier novels. The Shadow of the Sword and God and the Man (1881), a striking tale of a family feud, are dis- tinguished by a certain breadth and simplicity of treatment which is not so noticeable in their successors, among which may be men- tioned The Martyrdom of Madeline (1882); Foxglove Manor (1885) ; Effie Setherington (1896) ; and Father Anthony (1898). David Gray and other Essays, chiefly on Poetry (1868) ; Master Spirits (1873); A PoeVs Sketch Book (1883), in which the interesting essay on Gray is reprinted ; and A Look round Literature (1887), contain Buchanan's chief contributions to periodical literature. More valu- able is The Land of Lome (two vols. 1871), a vivid record of yachting experiences on the west coast of Scotland. (k. g.)~~

~~Bucharest, or Bucabest (Eumanian, Bucuresci), the capital of Rumania, in the province of Ilfov, on the Dimbovitza, 30 miles from the Danube. It is the resi- dence of ^ the king and court, the seat of government and of the metropolitan primate, and has increased in an extraordinary degree in general importance, more espe- cially since the foundation of the kingdom and of the pres- ent dynasty. It now occupies an area of more than 20 square miles, and is surrounded by a girdle of fortifica^ tions, planned by the celebrated Belgian engineer General Brialmont, extending over a circuit of 45 miles, and com- prising 18 forts mounted with the latest inventions in movable cupolas and siege cannon. Many imposing public buildings and private mansions have been erected during recent years, and new streets and boulevards con- structed. The paving throughout with granite blocks, and even in parts of the central street, the Galea Victoriei, with wood, and the use of the electric light in its main arteries have given to this so-called Paris~~

~~of^the East an entirely novel aspect, and completely removed all trace of the Oriental character it once possessed. The river Dimbovitza has been provided with handsome quays, and the broad boulevard Elizabeth, which meets it at right angles, extends from the palace of the crown prince and princess at Cotroceni to the barrier of the cattle market, west to east, a distance of some 4^ miles. Another new boulevard meets the Chauss^e Kisseleff. This latter, the Bois de Boulogne of Rumania's capital, terminates in the prettily situated racecourse of B§,neasa, where spring and autumn meetings are held. The new public buildings are to be found chiefly on the quays of the Dimbovitza, the Galea Victoriei, and the main boulevards. They comprise the remodelled royal palace, the ministries of state (with the exception of the ministry of the interior, all of recent construction), the national bank, the deposit bank, the post office, the law courts, the prefecture, the athenaeum (used for literary conferences and for concerts), the court of public accounts, the state printing-ofiice, &c. To these must be added the arsenal, on the outskirts of the town, the cavalry barracks on the plateau of Gotroceni, the infantry barracks at Dealu Spirei, and those for the regi- ments of the Chasseurs (VSnatorl) of the Galarasi and Dorobanti at Malmaison, affording in all accommodation for about 30,000 troops.~~

~~As to population Bucharest has increased consider- ably. It amounted in 1890 to about 260,000, and though more or less stationary until 1896, it has since that date, according to the census of 1900, increased to 282,071, of whom 53,056 are foreigners (mostly Austro-Hungarian subjects) and 43,274 are Jews. The great bulk of the~~

~~population are Rumanians of the Greek orthodox religion. There are at least 350 churches of this__ creed in the capital, the most noticeable being the Metropol or Gathedral, the church of Doamna Bala§a, and that of St Spiridion. The Roman Catholic community is a large one,- numbering as many as \30,000, but there are only three Roman Catholic places of worship, including the cathedral of St Joseph. Educational institutions have also made great progress, for besides the university there ai'e now no less than lifty public schools, not to mention numerous Catholic and Lutheran foundations.~~

~~The general sanitary and other improvements are certainly note- worthy, and include, besides the gas and electric lighting and well- paved streets, an almost universally applied system of canalization and water-supply, and electric and horse tramways in all the princi- pal thoroughfares. Manufactories have also sprung up in the neigh- bourhood of the town, and of these the chief are the gun-powder factory at Dudesci, some 7 miles distant ; the sugar factory at Chitila ; brick, tile, pipe, and terra-cotta works at Cotroceni ; three large breweries, linseed-oil mills, and a rope and waterproof cloth factory. With this increase in importance and general wel- fare, the railway system of Rumania has been so far extended that her capital is now in communication with the rest of the continent by six lines.~~

~~1. By that of Bucharest,' Verciorova with Austriar Hungary.~~

~~2. By that vi& Predeal with Transylvania.~~

~~3. By that vid Burdujeni with Austria and Germany.~~

~~4. By that vid. Jassy-Ungheni with Russia.~~

~~5. By the Giurgevo line with Bulgaria ; and~~

~~6. By the Constantza line over the New Danube Bridge with the Black Sea, and so by the Rumanian Maritime Service (Servicird Maritim) with Constantinople and the east.~~

~~Besides a complete external and internal telegraphic service, Bucharest is also in telephonic communication with Sinaia, the summer residence of the court in the Carpathians, and with the ports of Galatz and Braila, and with Jassy.~~

~~Among the most important philanthropic institutions may be mentioned the Coltei Hospital, the Asile Elena Doamna, and the Brancovan, Matemitate, Philantropia, Pantelimon hospitals, and the Marcutza lunatic asylum. Good hotels and restaurants are also plentiful. There are, however, only two theatres properly so called, the National Theatre, restored in 1895-96, and the Ljuric Theatre, chiefly patronized by foreign artistes. There are besides two large concert halls. There is also a large increase in the num- ber of~~

~~clubs, political, social, and sporting. Socially, indeed, the progress of Bucharest is remarkable, its political, literary, and scientific coteries being of a character to place it on a level with most European capitals. The local colouring of the town is rapidly disappearing with the speedy march of Western civilization ; and with the increasing number of houses of several storeys, the room available for the small gardens which once formed so marked a feature is yearly becoming less, although the few public squares and gardens, such as the Cismegiu, Place St Georges, the gardens of the Episcopei and Icoanei, remain for the present intact. The excellent cabs, however, driven by Russian coachmen of the pe- culiar Lipovan sect, the itinerant retail vendors, with their doleful street-cries and often picturesque country dresses, and the native gypsies, whether musicians or employed in building houses, still strike the eye of the foreigner as a last vestige of the (Oriental~~

~~Bucher, Lothar (1817-1892), German publicist, was born on 26th October 1817, at Neu Stettin, in Pome- rania, his father being master at a gymnasium. After studying at the University of Berlin he adopted the legal profession. Elected a member of the National Assembly in Berlin in 1848, he was an active leader of the extreme democratic party. With others of his col- leagues he was in 1860 brought to trial for having taken part in organizing a movement for refusal to pay taxes ; he was condemned to fifteen months' imprisonment in a fortress, but left the country before the sentence was ex- ecuted. For ten years he lived in exile, chiefly in London ; he acted as special correspondent of the National Zeitung, and gained a great knowledge of English life; and he published a work, Der Parliamentarismus wie er ist, a criticism of parliamentary government, which shows a marked change in his political opinions. In 1860 he returned to Germany, and became intimate with Lassalle,~~

~~who made him his literary executor. In 1864 he was offered by Bismarck, and accepted, a high position in the Prussian Foreign Office. The reasons~~

~~that led him to a step which involved so complete a break with his earlier friends and associations are not clearly known. From this time till his death he acted" as Bismarck's secretary, and was the man who probably enjoyed the greatest amount of his confidence. It was he who drew up the text of the constitution of the North German Confederation; in 1870 he was sent on a very confidential mission to Spain in connexion with the HohenzoUern candidature for the Spanish crown ; he assisted Bismarck at the final negotiations for the treaty of Frankfort, and was one of the secretaries to the Berlin Congress ; he also assisted Bismarck in the composition of his memoirs. Bucher, who was a man of great ability, had considerable influence, which was especially directed against the economic doctrines of the Liberals ; in 1881 he published a pamphlet criticizing the influence and prin- ciples of the Cobden Club. He identified himself com- pletely with Bismarck's later commercial and colonial policy, and probably had much to do with introducing it, and he did much to encourage anti-British feeling in Ger- many. He died at Glion, in Switzerland, on 12th October~~

~~1892.~~

~~Heinrich t. Poschingek. Ein 48er : Lothar Suckers Leben und Werke, 3 vols. Berlin, 1890. — Busch. Bismarck: some Secret Pages of his History. London,,1898. (j. -w. He.)~~

~~Buchholz, a town of Germany, on the Sehma, 18 miles S. by E. of Chemnitz by rail, in the circle of Zwickau, kingdom of Saxony. There is a school for instruction in lace-making, an industry dating from 1589, and now counting over 80 factories. Population (1890),~~

~~7808 ; (1900), 8402.~~

~~Buckie, a fishing town and police burgh and rail- way station of Banffshire, Scotland, on the Moray Firth, at the mouth of the Buckie burn, about 21 miles W. of Banff. It attracts one of the largest Scottish fleets in the herring season, and is also the chief seat of line fishing in Scotland. The value of the fish landed in 1899 was £34,247, and the port had 232 boats of 6106 tons. There are two harbours, one of nine acres, with half a mile of quayage. There are engineering works and distilleries. A literary institute contains~~

~~library and recreation rooms. Population (1891), 5849 ; (1901), 6541. (See Banffshire for statistics of fishing district.)~~

~~Buckingham, a municipal borough and market town of Buckinghamshire, England, 61 miles IST.W. of London by rail, on the Ouse, in (since 1885) the Northern parliamentary division of the county. Milk-condensing and the preparation of artificial manure are recently intro- duced industries. Area, 5007 acres ; population (1881),~~

~~3585; (1891), 3364; (1901), 3151.~~

~~Buckingliamshire, a south midland county of England, bounded on the N. by Northampton, on the W. by Oxford, on the S. by the Thames, and on the E. by Middlesex, Hertford, and Bedford.~~

~~Area and Population. — The area of the ancient and administra- tive county, as given in the census returns, is 475,694 acres, or 743 square miles. Population (1881), 176,155; (1891), 185,284 (of whom 91,195 were males, and 94,089 females, the number of persons per square mile being 249, and of acres to a person 2 '57) ; (1901), 195,534. In 1895 the area of the administrative county was slightly altered, part of the parish of Ibstone, and the parish of Stokeuchurch in Oxford being transferred to Bucking- ham, while part of the parish of Kingsey in Buckingham was transferred to Oxford. The area of the registration county is 410,242 acres, with a population in 1891 of 164,442, of whom 43,190 were urban, and 121,252 rural; and in 1901 of 173,060. Within this area the increase of population between 1881 and 1891 was 5-57 per cent. The excess of births over deaths between 1881 and 1891 was 21,762, but the increase of the resident population was only 8669. The following table gives the numbers~~

~~of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 :—~~

~~Tear.~~

~~Marriages.~~

~~Births.~~

~~Deaths.~~

~~Illegitimate Bii-ths.~~

~~Male.~~

~~Female.~~

~~1880 1890 1898~~

~~906 1038 1174~~

~~4875 4529 4348~~

~~2801 2645 2464~~

~~142 108 104~~

~~106~~

~~112~~

~~75~~

~~The number of marriages in 1899 was 1203, of births 4385, and of deaths 2649.~~

~~The following table gives the marriage-, birth-, and death-rates wifh the percentage of illegitimate births for a series of years : —~~

~~1870-79.~~

~~1880.~~

~~1880-89.~~

~~1890.~~

~~1888-97.~~

~~1898.~~

~~Marriage-rate Birth-rate . Death-rate . Percentage of ille- gitimacy~~

~~12-8~~

~~33-2~~

~~19-0~~

~~5-4~~

~~11-6~~

~~31·2~~

~~17·9~~

~~5·1~~

~~12·3~~

~~30·8~~

~~17·0~~

~~6·0~~

~~12·7~~

~~27·7~~

~~16·2~~

~~4·9~~

~~12·7~~

~~28·1~~

~~15·4~~

~~4·5~~

~~13·8~~

~~25·5~~

~~14·5~~

~~4·1~~

~~Both the birth-rate and the death-rate were below the average for England. In 1891 there were in the county 626 natives of Scotland, 496 natives of~~

~~Ireland, and 273 foreigners.~~

~~Constitution and Oovernment.— The ancient county is divided into tliree parliamentary divisions, and it also includes part of the parliamentaiy borough of "Windsor. The administrative county contains two municipal boroughs, Buckingham and Chip- ping Wycombe. The following are urban districts : Aylesbury, Beaoonsfield, Chesham, Eton, Fenny Stratford, Linslade, Marlow, Newport Pagnell, and Slough. The county is in the midland circuit, and spring and summer sessions a5-e held at Aylesbury. The boroughs of Buckingham and Chipping Wycombe have separate commissions of the peace. The ancient county, which is in the diocese of Oxford, contains 207 entire ecclesiastical parishes or districts with parts of others.~~

~~Education.— Eton college is within the county, and there is a board school for deaf children at Chipping Wycombe. The number of elementary schools on 31st August 1899 was 257, of which 67 were board schools, and 190 voluntary, the latter including 173 Church of England schools, 2 Wesleyan, 3 'Roman Catholic, and 12 " British and other." The average attendance at board schools was 11,727, and at voluntary schools 20,006. The total school board receipts for the year ending 29th September 1899 were £38,315. The income under the Agricultural Rates Act was over £1468.~~

~~Agriculture.— There are considerable varieties of soil. On the lower grounds, especially in the vale of Aylesbury, it is remark- ably fertile, but on the hills it is usually poor and thin. The district round Aylesbury is still famous for its ducks, large numbers being fattened for the London market. About eleven- twelfths of the total area of the county is under cultivation, and of this more than three-fifths is in permanent pasture, which is gradu- ally increasing. Over 3500 acres are under orchards, and about 32,000 acres under woods. The acreage under corn crops, and especially that Mnder wheat, has within recent years greatly decreased. While wheat in 1880 occupied 50,391 acres, its aver- age acreage is now only about 36,000. Turnips and swedes are the principal green crops, cattle being chiefly kept both for feed- ing and for dairy purposes. The following table gives the larger main divisions of the cultivated area at interva,ls of five years from 1880 :—~~

~~Tear.~~

~~Total Acre- age under Cultiva- tion.~~

~~Corn Crops.~~

~~Green Crops.~~

~~Clover.~~

~~Permanent Pasture.~~

~~Fallow.~~

~~1880 1885 1890 1895 1900~~

~~405,899 408,361 405,364 401,232 400,276~~

~~125,035~~

~~115,953~~

~~107,476~~

~~95,437~~

~~92,855~~

~~32,536 34,740 29,661 26,819 25,598~~

~~31,040 32,070 30,491 31,901 31,470~~

~~200,774 216,461 228,456 235,850 243,887~~

~~16,514 9,137 9,012~~

~~10,486 5,872~~

~~The following table gives particulars regarding the principal live stock for the same years : —~~

~~Tear.~~

~~Total Horses.~~

~~Total Cattle.~~

~~Cows or Heifers~~

~~in Milk or in~~

~~Calf.~~

~~Sheep.~~

~~Pigs.~~

~~1880~~

~~1885 1890 1895 1900~~

~~17,794 17,753 17,503 18,483 18,182~~

~~68,180 76,912 69,913 66,153 75,183~~

~~28,208 31,734 30,500 28,646 31,308~~

~~195,764 230,152 213,533 192,609 195,567~~

~~31,170 37,429 38,952 40,047 28,098~~

~~Industries and Trnde.— According to the annual report of the inspector of factories for 1898 (1900), the total number of persons employed in textile and non-textile factories and workshops in 1897 was 13,286, as compared with 12,568 in 1896. The number of persons employed in non-textile factories in 1897 was 10,313, between 1895 and 1896 there was an increase~~

~~of 10-6 per cent., and between 1896 and 1897 an increase of 6-2 per cent.; as many as 3795 were employed in the manufacture of machines, convey- ances, tools, &o., and 2095 in the manufacture of paper. In work- shops 2962 persons were employed, of whom 1537 were employed in the furniture industry. The clothing, lace, and straw-plait manufactures continue to prosper, and there is a thriving trade, especially at High Wycombe, in various articles of turnery, such as chairs, spades, and bowls, from beech and other hard woods. Of clay 8680 tons were raised in 1899.~~

~~Authorities. — The original standard history is the laborious and sumptuous work of Lipscomb, 4 vols. , London, 1847. A later work is GiBB, Buckingham, Aylesbury, 1878-82. Mention may also be made of the same author's Worthies of Buckingham, Ayles- bury, 1886 ; and his Buckingham Miscellany, Aylesbury, 1891. Other works are Sheahan, History and Topography of Bucking- hamshire, London, 1862 ; Kennedy, Birds of Berkshire and Buckinghamshire, Eton, 1868 ; and G. S. Eoscoe, Buckingham Sketches, London, 1891.~~

~~Buckner, Samuel Bolivar (1823), Ameri- can soldier, was born in Hart county, Kentucky, on 1st April 1823, and graduated at West Point in 1844. He resigned from the army in March 1865 to practise law and politics. He was adjutant-general and commander of the state guard of Kentucky, in the Southern interest, May- July 1861. Presently, under a commission, he invaded his native state. As brigadier in command he surrendered Fort Donelson to General Grant on 16th February 1862, vrith 16,000 troops and vast stores, his superiors Floyd and Pillow escaping. After his exchange as a prisoner of war, he fought under General Bragg at Murfreesboro' and Chickamauga. After the war he served as governor of Kentucky (1887-91), and in 1896 was candidate of the gold Democrats for vice-president of the United States.~~

~~Bucyrus, capital of Crawford county, Ohio, U.S.A. It is situated in the northern part of the state, 62 miles north of Columbus, on Sandusky river and on the Penn- sylvania and the Ohio Central railways, at an altitude of 991 feet. Its manufactures consist largely of agricultural tools and machines. Population (1880), 3835; (1890),~~

~~5974; (1900), 6560.~~

~~Buczacz, a district-town in Eastern Galicia, Aus- tria, on the Strypa, a tributary of the Dniester. It is memorable in the Turkish wars of the latt6r half of the 17th century and for the Treaty of Buczacz in 1672 {Ency. Brit. xix. 295). It possesses the ruins of an old castle and a chateau belonging to the Potoeki family. Population (1890), 11,096; (1900), 11,504 (Polish).~~

~~Bud a (German, Of en), formerly a royal free town of Hungary, on the right bank of the Danube, opposite Pest (on the left bank). It was incorporated with Pest in 1873. Since then the two towns, together with 0-Buda (Alt-Ofen, the Aquincum of the Eomans) and Steinbruch, form one municipality under the official name of Budapest.~~

~~Budapest, the capital of Hungary and residence of the king, situated on both banks of the Danube, 140 miles S.E. of Vienna. It is the seat of the government, parliament, and the supreme courts, and the headquarters of the commander of the Hungarian Landwehr or Houveds. The area, which is now 77^ square miles, has been but slightly increased since the incorporation of the two towns in 1873. Population (1880), including the garrison, 370,767; (1890), 506,384; (1900), 733,358, an increase in the decade of 44-82 per cent, as compared with 36-57 in the preceding ten years. Of this total, 427,112 were Roman Catholics and 5386 Catholics of the Greek rite ; 166,198 Jews (in 1869, 42,000); 62,837 Protestants of the Helvetic and 37,170 of the Augsburg Confessions, and 3201 of the Greek orthodox faith. Between 1870 and~~

~~1900 the proportion of Roman Catholics declined from 72-3 to 60-7 per cent., of Jews rose from 16-6 to 23-6 per cent., and of Protestants from 10-1 per cent, to 14-2. Hungarian was given as the mother tongue of 559,965; 98,515 being returned as German and 24,091 as Slovaks, a branch of the same race as the Czechs of Austria. The remainder (20,877) was composed of Croatians, Ser- vians, Rumanians, Russians, Greeks, Armenians, Gypsies, &c. The great increase of the Magyar element must not be regarded as of purely ethnographic significance. The adoption of a Hungarian name or of the Hungarian language as the mother-tongue is often 'a political con- fession of faith, sometimes due to the persuasive influ- ence of official superiors. The Jewish contribution amounted to 35-4 per cent., which was still higher in previous years. Of the 733,358 inhabitants~~

~~of Budapest in 1900, including the garrison of 16,000 men, 79-6 per cent, were Magyars, 14 per cent. Germans, and 3-4 per cent. Slovaks, the balance being ma,de up of other nationalities. The proportion of Roman Catholics was 60-7 per cent, (in 1890, 64-7 per cent.), of Protestants of the Helvetic and Augsburg Confessions, 14-8 per cent, (in 1890, 13 per cent.), of Jews, 23-6 per cent, (in 1890, 21 per cent.), and of other creeds 1-5 per cent. Of the nationalities the Magyars have the largest in- crease, and of the creeds the Helvetic Confession. The Roman Catholics show the smallest proportional increase. The Germans and Slovaks have actually declined in number, the former by 17,058 and the latter by 3035 souls.~~

~~The marriage-rate, which averaged 7-2 per thousand in the 'seventies, rose to 8-6 in the 'eighties, and to 9-5 in the period 1891-96. In 1897 and 1898 it was 9-6 per thousand. Between 1874 and 1898 the mixed marriages increased from 15-8 per cent, to 24-7 per cent, of the total number. During the same period the birth-rate diminished from 44-5 to 32-6 per thousand. Of these 29 to 30 per cent, were illegitimate. The decline in the death-rate is one of the most striking features in /the pro- gress of Budapest, sinking from 43-4 per thousand in 1874 to 20-6 per thousand in .1900. In addition to the increased influx of per- sons in the prime of life, this is due largely to the improved water- supply and better sanitary conditions generally, including increased hospital accommodation.~~

~~The progress of education, the direction and development of which have been governed by the desire to promote Magyar national sentiment, has kept pace with that made in other departments of public life. An important achievement in this respect is the retention in Hungarian military academies of the young officers who were previously educated in Austria. In 1898 the Buda- pest University was attended by 5382 students (about 2000 in the 'eighties), and the Polytechnic by 1569 (about 1000 in the 'eighties). A further large increase of the attendance is to be anti- cipated from special measures latterly adopted with the object of keeping Hungarian students at home. The number who attend the Austrian universities, and especially that of Vienna, is already 'diminishing. A new addition to the educational institutions is the Oriental Academy, organized in 1899. Between 1870 and 1891 the proportion of children attending school more than doubled. The number of elementary schools has increased from 35 in 1861 to 157 in~~

~~1899, and that of intermediate schools from one in 1^70 to 16 in 1899. The illiterates over six years of age, who formed 27-8 per cent, of the population in 1870, fell to 23-1 in 1881 and to 16-6 per cent, in 1891. This percentage is lowest. among the Magyar and highest among the Slav inhabitants ; lowest among the Jews and Protestants and highest among the Roman Catholics.~~

~~There are 18 political daily papers, of which 5 are in the German language. Out of a total (in 1898) of 413 periodicals, 327 were in Hungarian, 36 in German, the remainder consisting of polyglot and Slav publications, &c.~~

~~Of the eight theatres, two are subsidized by the State and one by the municipality. The performances are almost exclusively in Hungarian, the exceptions being the occasional appearance of French, Italian, and other foreign artists. Performances in German are under a popular taboo, which effectually excludes them from the theatres, although sometimes given in a music-hall, where they have more than once led to hostile demonstrations. Among the other institutions should be mentioned fourteen lodges of Freemasons. These are forbidden to associate or hold meetings in Austria.~~

~~The municipal administration, although on the whole fairly satisfactory, appears to be somewhat expensive. The communal debt is increasing. The total revenue, ordinary and extraordinary, rose from £686,699 in 1877 to £1,220,787 in 1896, and £1,447,460 in 1900. The estimated value of the estate and efiects of the corporation, which includes a large and increasing amount of house and real property, rose from £6,183,000 in 1887 to £11,582,000 in 1898. The municipality owns a great deal of the vacant land in and about the town.~~

~~The trade of Budapest, is mainly in corn, wool, wine, spirits, cattle, pigs, horses, hidesi wood, coal, &o. The principal in- dustries are steam flour-milling, distilling, and the manufacture of machinery, waggons, bricks, jute, &c. Comprehensive statistics of the trade and industry of Budapest alone are not available ; but, as the leading industrial centre and chief market of~~

~~Hun- gary, there is a constant ratio between its progress and that of the whole country. As an indication of that progress in both respects may be mentioned the in- crease in the period 1887- 98 of the amount paid in direct and indirect tax- ation from, in round numbers, £1,200,000 to £2,187,666, with a corre- sponding increase in the communal surtax. The increase in the number of joint-stock companies and of the capital thus invested (an increase which greatly exceeds that of Vienna) is also a vaUiable indication. In 1873 there were 28 such companies, with a total capital of £2,224,900 ; in 1890, 75 (capital, £9,352,000) ; and in 1899 no less than 242, with a total capital of £31,378,655. In the latter 'year the average net profits of these com- panies was 8-5 per cent. One of the earliest material causes of the progress of Budapest — at first chiefly com- mercial^was the intro- duction of steam navi- gation on the Danube, which gave an immense impetus to its corn trade. This still con- tinues to operate, hav- ing been promoted by the growth of the flour- milling industry, which was revolutionized by certain Budapest inven- tions. According to Mr A. Shaw, Minneapolis~~

~~and Budapest are now the two great milling centres of the world. The latter possesses a number of magnificent establish- ments, fitted with automatic machinery invented and manufac- tured in the city ; fifteen large steam-mills employ 3200 hands. A significant example of the progress of Budapest in another direc- tion, the manufacture of electrical plant, is the fact that a Buda- pest firm was entrusted by the Russian Government (November 1899) with the erection of a great central station for the transmis- sion of electric power at Port Arthur, and also contracted to furnish large and important plant for the Paris electrical underground railway, and an electric-lighting company in the French capital on the eve of the great exhibition of 1900.~~

~~Of the later improvements in Budapest perhaps the most im- portant is the regulation of the older part of the town in connexion with the construction of the two new bridges across the Danube (there are now six in all), and the rapid development of Buda, where entirely new quarters have sprung up. The following figures will give an idea of the building activity : in 1881 the number of houses was 10,748 ; in 1891, 13,066 ; in 1896, 14,628 ; in 1901, 16,254. This growth, which was accompanied by a progres- sive increase in the proportion of the larger houses, is insufficient for the requirements of~~

~~the population, of whom 13 per cent. Still occupy overcrowded dwellings. The rapid development of a~~

~~I. V.Darbi!hirt & O.J.H.lfacSfUt~~

~~quarter, consisting largely of palatial buildings, which has grown up in the vicinity of the new central railway station has won for it the popular appellation of "Chicago." In the period 1885-95 there were erected 221 new public buildings, including the Palace of Justice and the Royal Opera House, 11 other places of public amusement, 12 barracks, 10 bathing establishments, 9 larger educational institutions, 9 hospitals, 7 charitable institutions, 6 churches, 3 museums, 3 permanent exhibition buildings, 2 orphan asylums, and a central railway station. Within the same period there was a considerable addition to the number of public monu- ments by native artists. Rents bear nearly the same burden of taxation in Budapest as in Vienna, and in both towns the remission of taxes for a period of years is the chief means of promoting build- ing and reconstruction by private persons. There has been a great extension of the tramway service (formerly horse traction, now electrical), and the new electric underground railway is one of the~~

~~best-constructed lines of the kind in existence.~~

~~The extraordi- narily rapid growth of Budapest during the 19th century, and more particularly since 1867, together with its remarkable progress in every department of muni- cipal and public life, renders it one of the most interesting of modern cities. In the matter of the in- crease of its popula- tion alone it has only been slightly sur- passed by one Euro- pean town, namely, Berlin. Both capitals multiplied their population by nine in the first nine decades of the century. Ac- cording to an in- teresting and instruc- tive comparison of the growth of twenty- eight European cities made by Dr Joseph de Korosy, director of the Budapest Com- munal Bureau of Statistics, Berlin in 1890 showed an in- crease, as compared with the beginning of the century, of 818 per cent., and Budapest of 809 per cent. Within the same period the increase of Paris was 343 per cent., and of London 340 per cent. This pheno- menon, which has excited the admiration of an exception- ally competent American observer, Mr Albert Shaw (see ■ " Budapest : the Rise of a New Metropolis," in his Muni- cipal Government~~

in Continental Europe), is worthy of special attention. In Mr Shaw's opinion no other im- portant European city falls so far short of the appreciation it merits. There can be no doubt that its progress is ■ mainly due to the revival of Hungarian national^ spirit in the first half of the century, and to the energetic and systematicefforts of the Government and people of Hungary since the restoration of the Constitution. So far as Hungary was concerned, Pesth in 1867 at once became the favoured rival of Vienna, with the important additional advantage that it had no such competitors within its own sphere as Vienna had in the Austrian provincial capitals. The political, intellectual, and social life of Hungary was centred

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in Pesth, and had largely been so since 1848^ when it became the seat of the legislature, as it was that of the Austrian central administration which followed the Eevo- lution. The ideal of a prosperous, brilliant, and attrac- tive Magyar capital, which would keep the nobles and the intellectual flower of the country at home, uniting them in the service of the Fatherland, had received a powerful impetus from Count Stephen Sz^chenyi, the great Hun- garian reformer of the pre-Eevolutionary period. His work, continued by patriotic and able successors, was now taken up as the common task of the Government and the nation, under the guidance of a Liberal aristocracy and gentry distinguished by exceptional political insight. The eminent Hungarian statesman, Count Julius Andrassy, bore a prominent part in this work.

From that time to the present day the record of the Hungarian capital has been one of uninterrupted advance, not merely in externals, such as the removal of slums, the reconstruction of the town, the development of com- munications, industry, and trade, and the erection of important public buildings, but also in the mental, moral, and physical elevation of the inhabitants ; besides an- other important gain from the point of view of the Hun- garian statesman, namely, the progressive increase and improvement of status of the Magyar element of the population. The promotion of the

~~interests of the capital and the centralization of the public and commercial life of the country have — apart from the special acts devoted to that end — formed an integral part of the policy of the State since the restoration of the constitution. Budapest has profited largely by the encouragement of agriculture, trade, and industry, by the nationalization of the rail- ways, which all radiate from Pesth, by the special rates and the zone system, by the development of inland navi- gation, and also by the neglect of similar measures in favour of Vienna in consequence of the discord prevailing in Austria. It would be difB.cult to over-estimate the beneficial effect of such direct Government action as the founding of the large State establishment at Budapest for the manufacture of locomotives and agricultural and other machinery, and of the encouragement given to native and foreign enterprise, to undertake the production of all articles consumed in the country. When it is remembered that the ideal both of the authorities and the people is the ultimate monopoly of the home market by Hungarian industry and trade, and the strengthening of the Magyar infiuence by centrali- zation, it is easy to understand the progress of Budapest.~~

~~Politically, this ambitious and progressive capital is the creation of the Magyar upper classes. Commercially and industrially, it may be said to be the work of the Jews. The sound judgment of the former led them to welcome and appreciate the co-operation of the latter, who furnish an ingredient necessary in the composition of a modern State in which they themselves were lacking. Indeed, a readiness to assimilate foreign elements is characteristic of Magyar patriotism, which has, particularly within the last generation, made numerous and ardent converts among the other nationalities of Hungary, and — for national purposes — may be considered to have quite absorbed the Hungarian Jews. It has thus come to pass that there is no anti-Semitism in Budapest, although the Hebrew element is proportionately much larger (21 per cent, as compared with 9 per cent.) than it is in Vienna, the Mecca of the Jew-baiter.~~

~~A far larger number of Jews and Protestants are en- gaged in industry, commerce, and intellectual pursuits than the more numerous Catholics. Out of every 10,000 Jews, 3274 come under those three categories. The remainder are divided as follows : of no occupation, including women and children, 5498 (a far higher pro-~~

~~portion than the Catholics and Protestants) ; engaged in unskilled physical labour, 993 (about a third of the pro- portion of Catholics and Protestants) ; in transports and communications, 164 (between a third and half the pro- portion of Catholics and Protestants) ; soldiers, policemen, barbers, &c., 55 (about a fourth of the Catholic and an eighth of the Protestant proportion) ; and, finally, 16 Jews per 10,000 are engaged in some form of agri- cultural, horticultural, and vineyard labour, which is less than a third of the Catholic and about a ninth of the Protestant proportion. The money-lending insti- tutions, as well as commerce of the town, particularly in corn, manufactures, jewellery, furniture, and clothing, are mainly in the hands of the Jews. The Protestants are to a great extent agriculturists, while they are also largely represented among the teachers, officials, and artisans.~~

~~A comparison of the statistics of 1870 with those of 1891 shows a steady increase in the proportion of Hun- garians in all occupations, and a corresponding diminution in the proportion of Austrians and other foreigners. In 1891 the percentage of natives engaged in industry was 85-7 per cent. (-|-9‘7 per cent.); in communications, 91-5 per cent. (-)-24-6 per cent.); in trade, 91-1 per cent. (-I-7-2 per cent.) ‘, in the professions and intellectual occupations, 91-3 per cent. (-I-8-5 per cent.). Even in unskilled physical labour the same change is visible, there being within the same period an increase of 16 per cent, in the number of natives employed (in 1891, 86-4 per cent.).~~

~~Among the most important events in the recent history of the city are the National Hungarian Exhibition, held there in 1885 ; its elevation to an equality with Vienna as a royal residence and capital on the occasion of the 25th anniversary of the sovereign’s coronation as king of Hungary in June 1892, followed by the royal ordi- nance of November 1893, superseding Austrian court functionaries by Hungarians during the king’s stay in Hungary ; the imposing national demonstration of respect and the public funeral’ accorded to the Eevolutionary hero Louis Kossuth in March and April 1894 ; and the Millennial Exhibition in 1896 in celebration of the thousandth anniversary of the foundation of the kingdom of Hungary.~~

~~The official publications of the Budapest Cummunal Bureau of Statistics have acquired a European repute for their completeness, and their fearless~~

~~exposure of shortcomings has been an element in the progress of the town. Reference should also be made to separate works of the director of that institution, Dr Joseph de KoROST, known In England for his discovery of the law of marital fertility, published by the Royal Society, and by his labours in the development of comparative international statistics. His Statis- tique Internationale des grandes villes, and Bulletin annuel des finances des grandes villes, give valuable comparative data. See also Budapest hygiene publiqde et culture, by Dr Gustave Thirking, assistant director of the Communal Bureau of Statistics, and the Statistisches Jahrbuch von Budapest, by the same author ; Kahn's niustr'a.ted Guide to Budapest; KRiJcKEN's Budapest in Wort und Bild; the Technischer Fuhrervon Budapest, published by the Hungarian Association of Engineers and Architects ; and Mr A. Shaw's work, cited above. /j^. o'n.)~~

~~Budaun, a town and district of British India, in the Eohilkhand division of the North-West Provinces. The town is near the left bank of the river Sot. The population in 1891 was 35,372; the municipal income in 1897-98 was Es.32,871. There are ruins of an immense fort and a very handsome mosque, formerly a Hindu temple. The American Methodist mission main- tains several girls' schools, and there is a high school for boys.~~

~~The district of Budaun has an area of 2017 square miles. The population in 1891 was 925,598, being 418~~

~~persons per square mile. Classified according to religion, Hindus numbered 774,779; Mahommedans, 148,393; Christians, 2681, of whom 19 were European ; " others," 229. In 1901 the population was 1,024,888, showing an increase of 11 per, cent. The land revenue and rates were Es. 13,03,767, the incidence of assessment being Es.0:13:13 per acre; the number of police was 2680. Out of a total cultivated area in 1896-97 of 840,827 acres, 104,800 were irrigated, mainly from wells. There are 51 ipdigo factories, employing 3000 persons, with an out-turn valued at Es.1,20,400. The dis- trict is crossed by two lines of the Oudh and Eohilk- hand railway, with five stations. The chief centre of trade is Bilsi.~~

~~Buddhism. — Since the article on Buddhism in the ninth edition of this work was written (vol. iv. pp. 424-438) nearly the whole of the works composed in the earliest period of Buddhism have been edited in the original Pali, chiefly through the Pali Text Society. A few works of the second period have been edited in the original Pali or Sanskrit, and a number of books of later Buddhism have appeared in the various languages of Eastern Asia. To appreciate the additions thus made to our knowledge it is necessary to remember that the Buddha, like other Indian teachers of his period, taught by conversation only. A highly-educated man (according to the education current at the time), speaking constantly to men of similar education, he followed the literary habit of his day by embodying his doctrines in set pjirases (s-dtras), on which he enlarged, on different occasions, in different ways. Writing was then widely known. But the lack of suitable writing materials made any lengthy books impossible. Such sutras were therefore the recog- nized form of preserving and communicating opinion. They were catch-words, ^.s it were, memoria technica, which could be easily remembered, and would recall the fuller expositions that had been based upon them. In the Buddha's time the Brahmins had their sutras in Sanskrit, already a dead language. He purposely put his into the ordinary conversational idiom of the day, that is to say, into Pali. When the Buddha died these sayings were collected together by his disciples into what they call the Pour IsTiktyas, or "collections." These cannot have reached their final form till about fifty or sixty years afterwards. Other sayings and verses, most of them ascribed, not to the Buddha, but to the disciples them- selves, were put into a supplementary NikSya. We know of slight additions made to this NikSya as late as the time of Asoka, 3rd century b.o. And the devel- oped doctrine, found in certain portions of it, shows that these are later than the four old Nik^yas. Por a genera^ tion or two the books so put together were handed down by memory, though probably written memoranda were also used. And they were doubtless accompanied from the first, as they were being taught, by a running com- mentary. About one hundred years, after the Buddha's death there was a schism in the community. Each of the two schools kept an arrangement of the canon — still in Pali, or some allied dialect. Sanskrit was not used for any Buddhist works till long afterwards, and never used at all, so far as is known, for the canonical books. Each of these two schools brbke up, in the following cen- turies, into others. Several of them had their~~

~~different arrangements of the canonical books, differing also in minor details. These books remained the only authori- ties for about five centuries, but they all, except only our extant Pali NikS,yas, have been lost in India. These then are our authorities for the earliest period of Buddhism. Now what are these books ?~~

~~We talk necessarily of Pali books. They are not books~~

~~in the modern sense. They are memorial sentences or verses intended to be learnt by heart. And the whole style and method of arrangement is entirely subordinated to this primary necessity. Each sutra (Pali, sutta) is very short; usually occupying only a page, or perhaps two, and containing a single proposition. When several of these, almost always those that contain propositions of a similar kind, are collected together in the framework of one dialogue, it is called a suttanta. The usual length of such a suttanta is about a dozen pages ; only a few of them are longer. And a collection of such suttantas might be called a book. But it is as yet neither narrative nor essay. It is at most a string of passages, drawn up in similar form to assist the memory, and intended, not to be read, but to be learnt by heart. The first of the four Nik§,yas is a collection of the longest of these suttantas, and it is called accordingly the Dlgha Nikdya, that is " the Collection of Long Ones " (soil. Suttantas). The next is the Majjhima Nikdya, the " Collection of the suttantas of Medium Length " — medium, that is, as being shorter than the suttantas in the Digha, and longer than the ordinary suttas preserved in the two folio wing collections. Between them these first two collections contain 186 dialogues, in which the Buddha, or in a few cases one of his leading disciples, is represented as engaged in conversation on some one of the religious, or philosophic, or ethical points in that system which we now call Buddhism. In depth of philosophic insight, in the method of Socratic questioning often adopted, in the earnest and elevated tone of the whole, in the evidence they afford of the most cultured thought of the day, these dialogues constantly remind the reader of the dialogues of Plato. But not in style. They have indeed a style of their own ; always dignified, and occasionally rising into eloquence. But for the reasons already given, it is entirely different from the style of Western writings which are always intended to be read. Historical scholars will, however, revere this collection of dialogues as one of the most priceless of the treasures of antiquity still~~

~~preserved to us. It is to it, above all, that we shall always have to go for our knowledge of the most ancient Buddhism. Of the 186, 144 have now been edited for the Pali Text Society, and the remainder are either in the press or in preparation. The present writer has commenced a translation of them into English, entitled " The Dialogues of the Buddha," of which one volume has appeared. And Dr K. E. Neumann has pub- lished the first volume of a translation of the shorter collection into German, under the title "Eeden des Gotamo." A disadvantage of the arrangement in dia- logues, more especially as they follow one another accord- ing to length and not according to subject, is that it is not easy to find the statement of doctrine on any particular point which is interesting one at the moment. It is very likely just this consideration which led to the compilation of the two following Nikayas. In the first of these, called the Anguttara Nikdya, all those points of Buddhist doctrine capable of expression in classes are set out in order. This practically includes most of the psychology and ethics of Buddhism. Por it is a distinguishing mark of the dialogues themselves that the results arrived at are arranged in carefully systematized groups. We are familiar enough in the West with similar classifications, summed up in such expressions as the Seven Deadly Sins, the Ten Commandments, the Thirty-nine Articles, the Four Cardinal Virtues, the Seven Sacraments, and a host of others. These numbered lists (it is true) are going out of fashion. The aid which they afford to memory is no longer required in an age in which books of reference abound. It was precisely as a help to memory that they were found so useful in the early Buddhist times, when the books were all learnt by heart, and had never' as yet~~

~~been written. / And in the Anguttara we find set out in order first of all the ones, then all the pairs, then all the trios, and so on up to the thirty-four constituent parts of the human organism, or the thirty-seven constituent elements of Arahatship. It is the longest book in the Buddhist Bible, and fills 1840 pages 8vo. The whole of the Pali text has been published by the Pali Text Society, but only a few fragments of it have as yet been trans- lated into English. The next, and last, of these four collections contains~~

~~again the whole, or nearly the whole, of the Buddhist doctrine; but arranged this time in order of subjects. It consists of 55 Samyuttas or groups. In each of these the suttas on the same subject, or in one or two cases the suttas addressed to the same sort of people, are grouped together. The whole of it has been published in , five volumes by the Pali Text Society. Only a few fragments have been translated.~~

~~Many hundreds of the short suttas and verses in these two collections are found, word for word, in the dialogues. And there are numerous instances of the introductory story stating how, and when, and to whom the sutta was enunciated — a sort of narrative framework in which the sutta is set — recurring also. This is very suggestive as to the way in which the earliest Buddhist records were gradually built up. The suttas came first embodying, in set phrases, the doctrine that had to be handed down. Those episodes, found in two or three different places, and always embodying several suttas, came next. Then several of these were woven together to form a suttanta. And finally the suttantas were grouped together into the two NikSyas, and the suttas and episodes separately into the two others. Parallel with this evolution, so to say, of the suttas, the short statements of doctrine, in prose, ran the treatment of the verses. There was a great love of poetry in the communities in which Buddhism arose. Verses were helpful to the memory. And they were adopted not only for this reason. The adherents of the new view of life found pleasure in putting into appro- priate verse the feelings of enthusiasm and of ecstasy which the reforming doctrines inspired. When particu- larly happy in literary finish, or peculiarly rich in reli- gious feeling, such verses were not lost. These were handed on, from mouth to mouth, in the small companies of the brethren or sisters. The oldest verses are all lyrics, expressions either of emotion, or of some deep saying, some pregnant thought. Very few of them have been preserved alone. And even then they are so difficult to understand, so much like puzzles, that they were probably accompanied from the first by a sort of comment in prose, stating when, and why, and by whom they were supposed to have been uttered. As a general rule such a framework in prose is actually preserved in the old Buddhist literature. It is only in the very latest books included in the canon that the narrative part is also reg- ularly in verse, so that a whole work consists of a collec- tion of ballads. The last step, that of combining such ballads into one long epic poem, was not taken till after the canon was~~

closed. The whole process, from the sim ple anecdote in mixed prose and verse, the so-called ■dkhydna, to the complete epic, comes out with striking •clearness in the history of the Buddhist canon. It is typical, one may notice in passing, of the evolution of -the epic elsewhere ; in Iceland, for instance, in Persia, and in Greece. And we may safely draw the conclusion that if the great Indian epics, the MahSrbharata and the Eamayana, had been in existence when the formation of rthe Buddhist canon began, the course of its development would have been very different from what it was.

As -svill easily be understood, the same reasons which led to literary activity of this kind, in the earliest period, continued to hold good afterwards. A number of such

efforts, after the Nik§,yas had been closed, were included in a supplementary Nikaya called the Khuddaka Nikdya. It will throw very useful light upon the intellectual level in the Buddhist community just after the earliest period, and upon literary life in the valley of the Ganges in the 4th or 5th century B.C., if we briefly explain what the tractates in this collection contain. The first, the Khuddaka Pdtha, is a little tract of only a few pages. After a profession of faith in the Buddha, the doctrine and the order, there follows a paragraph setting out the thirty-four constituents of the human body — bones, blood, nerves, and so on — strangely incongruous with what follows. Por that is simply a few of the most beautiful poems to be found in the Buddhist scriptures. There is no apparent reason, except their exquisite versification, why these particular pieces should have been here brought together. It is most probable that this tiny volume was simply a sort of first lesson book for yoving neophytes when they joined the order. In any case that is one of the uses to which it is put at present. The next book is the Dhammapada. Here are brought together from ten to twenty stanzas on each of twenty-six selected points of Buddhist self training or ethics. There are here altogether 423 verses, gathered from various older sources, and strung together without any other internal connexion than that they relate more or less to the same subject. And the collector has not thought it necessary to choose stanzas written in the same metre, or in the same num ber of lines. We know that the early Christians were ‘ accustomed to sing hymns, both in their homes and on the occasions of their meeting together. These hymns are now irretrievably lost. Had some

one made a col- lection of about twenty isolated stanzas, chosen from these hymns, on each of about twenty subjects^ — such as Paith, Hope, Love, the Converted Man, Times of Trouble, Quiet Days, the Saviour, the Tree of Life, the Sweet Name, the Dove, the King, the Land of Peace, the Joy Unspeakable — we should have a Christian Dhammapada ; and very .precious such a collection would be. The Buddhist Dhammapada has been edited by Professor Fausboll (2nd edition, 1900), and has been frequently translated. Where the verses deal with those ideas that are common to Christians and Buddhists, the versions are easily intelligible, and some of the stanzas appeal very strongly to the Western sense of religious beauty. Where the stanzas are full of the technical terms of the Buddhist system of self-culture and self-control, it is often impossible, without expansions that spoil the poetry, or learned notes that distract the attention, to convey the full sense of the original. In all these distinctively Buddhist verses the existing translations (of which Professor Max Miiller's is the best known, and Dr Karl Neumann's the best) are inadequate and sometimes quite erroneous. The connexion in which they were spoken is often apparent in the more an- cient books irom which these verses have been taken, and has been preserved in the commentary on the work itself.

In the next little work the framework, the whole paia^ phernalia of the ancient akhy§,na, is included in the work itself, which is called Uddna, or " ecstatic utterances." The Buddha is represented, on various occasions during his long career, to have been so much moved by some event, or speech, or action, that he gave vent, as it were, to his pent-up feelings in a short, ecstatic utterance, couched, for the most part, in one or two lines of poetry. These outbursts, very terse and enigmatic, are charged with religious emotion, and turn often on some subtle point of Arahatship, that is, of the Buddhist ideal of life. The original text has been published by the Pali Text Society. But the little book, a garland of fifty of these

gems, has not yet been translated. The next work is called the Iti Vuttaka. This contains 120 short passages, each of them leading up to a terse deep saying of the Buddha's, and introduced, in each case, with the words Iti

~~vuttam Bhagavatd — " thus was it spoken by the Exalted One." These anecdotes may or may not be his- torically accurate. It is quite possible that the memory of the early disciples, highly trained as it was, enabled them to preserve a substantially true record of some of these speeches, and of the circumstances in which they were uttered. Some or all of them may also have been invented. In either case they are excellent evidence of the sort of questions on which discussions among the earliest Buddhists must have turned. These ecstatic utterances and deep sayings are attributed to the Buddha, himself, and accompanied by the prose framework. There has also been preserved a collection of stanzas ascribed to his leading followers. Of these 107 are brethren, and 73 sisters, in the order. The prose framework is in this case preserved only in the commentary, which also gives biographies of the authors. This work is called the Thera- then-gdthd.~~

~~Another interesting collection is the JdtaJca book, a set of verses supposed to have been uttered by the Buddha in some of his previous births. These are really 650 of the folk-tales current in India when the canon was being formed, the only thing Buddhist about them being that the Buddha, in a previous birth, is identified in each case with the hero in the little story. Here again the prose is preserved only in the comjnentary. And it is a most fortunate chance that this — the oldest, the most complete, and the most authentic collection of folk-lore extant — has thus been preserved intact to the present day. Many of these stories and fables have wandered to Europe, and are found in mediaeval homilies, poems, and story-books. A full account of this curious migration will be found in the introduction to the present writer's Buddhist Birth (Stories, -the. first volume of a contemplated translation of the whole book, now being, completed under the editorship of Professor Cowell at the Cambridge University Press. The last of these poetical works which it is necessary to mention is the Sutta Nipdta, containing fifty-five poems, all except the last merely short lyrics, many of great beauty. A very ancient commentary on the bulk of these poems has been included in the canon as a separate work. The poems themselves have been translated by Professor Fausboll in the Sacred Books of the East. The above works are our authority for the philosophy and ethics of the earliest Buddhists. We have also a complete state- ment of the rules of the order in the Vinaya, edited, in five volumes, by Professor Oldenberg.~~

~~Three volumes of translations of these rules, by him and by the present writer, have also appeared in the Sacred Books of the East.~~

~~There have also been added to the canonical books seven works on Abhidhamma, a more elaborate and more classified exposition of the Dhamma or doctrine as set out in the Nikdyas. All these works are later. Only one of them has been translated as yet, the so-called Dhamma Sangani. The introduction to this translation, published under the title of Buddhist Psychology, contains the fullest account that has yet appeared of the psychological conceptions on which Buddhist ethics are throughout based. The trans- lator, Mrs Caroline Khys Davids, estimates the date of this ancient manual for Buddhist students as the 4th century b.c.~~

~~So far the canon, almost all of which is now accessible to readers of Pali. But only seven volumes have so far been translated, and a good deal of work is still required before the harvest of historical data contained in these texts shall have been made acceptable to students of philosophy and~~

~~sociology. These works of the oldest period, the two centuries and a half, between the Buddha's time and that of Asoka, were followed by a voluminous literature in the following periods — from Asoka to Kanishka, and from Kanishka to Buddhaghosa, — each of about three centuries. Many of these works are extant in MS. ; but only fjve or six of the more important have so far been published. Of these the most interesting is the Milinda, one of the earliest historical novels preserved to us. It is mainly religious and philosophical, and purports to give the discussion, extending over several days, in which a Buddhist elder named NSgasena succeeds in convert- ing Milinda, that is Menander, the famous Greek king of Bactria, to Buddhism. The Pali text has been edited and the work translated into English. More important historically, though greatly inferior in style and ability, is the Maliavastu or Sublime Story, in Sanskrit. The story is the one of chief importance to the Buddhists — the story, namely, of how the Buddha won, under the Bo Tree, the victory over ignorance, and attained to the Sambodhi, " the higher wisdom," of Nirvana. The story begins with his previous births, in which also he was accumulating the Buddha qualities. And as the MahSr- vastu was a standard work of a particular sect, or rather school, called the MahSrsanghikas, it has thus preserved for us the theory of~~

the Buddha as held outside the followers of the canon, by those whose views developed, in after centiiries, into the MahSyina or modern form of Buddhism in India. But this book, like all the ancient books, was composed, not in the north, in Nepal, but in the valley of the Ganges, and it is partly in prose, partly in verse. Two other works, the Lalita Vistara and the Buddha Carita, give us — but this, of course, is later — Sanskrit poems, epics, on the same subject. Of these, the former may be as old as the century before Christ ; the latter belongs to the century after Christ. Both of them have been edited and translated. The older one con- tains still a good deal of prose, the gist of it being often repeated in the verses. The later one is entirely in verse, and shows off the author's mastery of the artificial rules of prosody and poetics, according to which a poem, a mahS/- k§,vya, ought, according to the later writers on the Ars poetica, to be composed.

These three works deal only quite briefly and incident- ally with any point of Buddhism outside of the Buddha legend. Of greater importance for the history of Buddhism are two later works, the Netti Pakarana and the Sad-dharma Pundartka. The former, in Pali, discusses a number of questions then of importance in the Bhuddist community; and it relies throughout, as does the Milinda, on the canonical works, which it quotes largely. The latter, in Sanskrit, is the earliest exposition we have of the later MahSySna doctrine. Both these books may be dated in the 2nd or 3rd century of our era. The latter has been translated into English. We have now also the text of the Prajnd Pdramitd, a later treatise on the Mah§,yg,na system, which in time entirely replaced in India the original doctrines. To about the same age- belongs also the Divydvaddna, a collection of legends about the leading disciples of the Buddha, and important members of the order, through the subsequent three cen- turies. These legends are, however, of different dates, and in spite of the comparatively late period at which it was-put into its present form, it contains some very ancient, fragments.

The whole of the above works were composed in the- north of India ; that is to say, either north or a few miles south of the Ganges. The record is at present full of gaps. But we can even now obtain a full and accurate idea of the earliest Buddhism, and are able to trace the maiit

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lin.es of its development through the first eight or nine centuries of its career. The Pali Text Society is still publishing two volumes a year ; and the Eussian Academy has inaugurated a series to contain the most important of the Sanskrit works still buried in MS. We have also now accessible in Pali fourteen volumes of the commenta- ries of the great 5th-century scholars in south India and Ceylon, most of them the works either of Buddhaghosa of Budh Gaya, or of Dhammapg,la of KSncipura (the ancient name of Conjevaram). These are full of important historical data on the social, as well as the religious, life of India during the periods of which they treat.

The striking archaeological discoveries of the last few years have both confirmed and added to our knowledge of the earliest period. 'Pre-eminent among these is the discovery, by Mr William Pepp^, on the Birdpur estate, adjoining the boundary between English and Nepalese territory, of the stupa, or cairn, erected by the Sakya clan over their share of the ashes from the cremation pyre of the Buddha. About twelve miles to the north- east of this spot has been found an inscribed pillar,~-put up by Asoka as a record of his visit to the Lumbini Garden, as the place where the future Buddha had been born. Although more than two centuries later than the event to which it refers, this inscription is good evidence of the site of the garden. There had been no interruption of the tradition; and it is probable that the place was then still occupied by the descendants of the possessors in the Buddha's time. North-west of this another Asoka pillar has been discovered, recording his visit to the cairn erected by the Sakyas over the remains of KonSgamana, one of the previous Buddhas or teachers, whose follower Gotama the Buddha had claimed to be. These discoveries definitely determine the district occupied by the Sakya republic in the 6th and 7th centuries b.c. The boundaries, of course, are not known ; but the clan must have spread thirty miles or more along the lower slopes of the Hima- layas, and thirty miles or more southwards over the plains. It has been abandoned jungle since the 3rd century a.d., or perhaps earlier, so that the ruined sites, numerous through the whole district, have remained undisturbed, and further discoveries may be confidently expected.

~~The principal points on which this large number of older and better authorities has modified our knowledge are as follows : — 1. We have learnt that the division of Buddhism, originating with Burnouf, into northern and southern, is misleading. He found that the Buddhism in his Pali MSS., which came from Ceylon, differed from that in his Sanskrit MSS. which came from Nepal. Now that the works he used have been made accessible in printed editions, we find that, wherever the existing MSS. came from, the original works themselves were all com posed in the same stretch of country, that is, in the valley of the Ganges. The difference of the opinions expressed in the MSS. is due, not to the place where they are now found, but to the difference of time at which they were originally composed. Not one of the books mentioned above is either northern or southern. They all claim, and rightly claim, to belong, so far as their place of origin is concerned, to the Majjhima Desa, the middle country. It is undesirable to base the main division of our subject on an adventitious circumstance, and especially so when the nomenclature thus introduced (it is not found in the books themselves) cuts right across the true line of division. The use of the terms northern and southern as applied, not to the existing MSS., but to the original books, or to the Buddhism they teach, not only does not help, us, it is the source of serious misunderstanding. It inevitably leads careless writers to take for granted that we have, historically, two Buddhisms — one manufactured in Cey- lon, the other in Nepal. Now this is admittedly wrong.~~

~~What we have to consider is Buddhism varying through slight degrees, as the centuries pass by, in almost every book. We may call it one, or we may call it many. What is quite certain is that it is not two. And the most useful distinction to emphasize is, not the ambigu- ous and misleading geographical one — derived from the places where the modern copies of the MSS. are found ; nor even, though that would be better, the linguistic one — but the chronological one. The use, therefore, of the inaccurate and misleading terms northern and southern ought no longer to be followed in scholarly works on Buddhism.~~

~~2. Our ideas as to the social conditions that prevailed,, during the Buddha's lifetime, in the eastern valley of the- Ganges have been modified. The people were divided into clans, many of them governed as republics, more~~

~~or less aristocratic. In a few cases several of such republics had formed confederations, and in four cases such con- federations had already become hereditary monarchies. The right historical analogy is not the state of Germany in the Middle Ages, but the state of Greece in the time- of Socrates. The Sakyas were still a republic. They had republics for the^r neighbours on the east and south, but. on the western boundary was the kingdom of Kosala, the modern Oudh, which they acknowledged as a suzerain power. Gotama, the Buddha's father, was not a king. There were r§,jas in the clan, but the word meant at most, something like consul or archon. All the four real kings \ were called Mah§,-r§,ja. And Suddhodana, the teacher's, father, was not even r3,ja. One of his cousins, named Bhaddiya, is styled a rSja ; but Suddhodana is spoken of, like other citizens, as Suddhodana the Sakyan. As the ancient books are very particular on this question of titles, this is decisive.~~

~~3. There was no caste — no caste, that is, in the modern sense of the term. We have long known that the connu- bium was the cause of a long and determined struggle between the patricians and the plebeians in Rome. Evi- dence has been yearly accumulating on the existence of restrictions as to intermarriage, and as to the right, of eating together (commensality) among other Aryan tribes, Greeks, Germans, Russians, and so on. Even without the fact of the existence now of such restrictions among the modern successors of the ancient Aryans in India, it would have been probable that they also were addicted to similar customs. It is certain that the notion of such usages was familiar enough to some at least of the tribes that preceded the Aryans in India. Rules of en- dogamy and exogamy ; privileges, restricted to certain classes, of eating together, are not only Indian or Aryan, but world-wide phenomena. Both the spirit, and to a large degree the actual details, of modern Indian caste-usages are identical with these ancient, and no doubt universal^ customs. It is in them that we have the key to the origin of caste.~~

~~At any moment in the history of a nation such customs seem, to a superficial observer, to be fixed and immutable. As a matter of fact they are never quite the same in suc- cessive centuries, or even generations. The numerous and complicated details which we sum up under the convenient, but often misleading, single naipe of caste are solely de- pendent for their sanction on public opinion. That opinion seems stable. But it is always~~

~~tending to vary as to the degree of importance attached to some particular one of the details, as to the size and complexity of the particular groups in which each detail ought to be observed.~~

~~Owing to the fact that the particular group that in India worked its way to the top, based its claims on re- ligious grounds, not on political power, nor on wealth, the system has, no doubt, lasted longer in India than in Europe. But public opinion still insists, in considerable~~

~~circles, even in Europe, on restrictions of a more or less defined kind, both as to marriage and as to eating to- gether. And in India the problem still remains to trace, in the literature, the gradual growth of the system — the gradual formation of new sections among the people, the gradual extension of the institution to the families of people engaged in certain trades, belonging to the same group, or s^ct, or tribe, tracing their ancestry, whether rightly or wrongly, to the same source. All these fac- tors, and others besides, are real factors. But they are phases of the extension and growth, not explanations of the origin of the system.~~

~~There is no evidence to show that at the time of the rise of Buddhism there was any substantial difference, as regards the barriers in question, between the peoples dwelling in the valley of the Ganges and their contem- poraries, Greek or Roman, dwelling on the shores of the Mediterranean Sea. The point of greatest weight in the establishment of the subsequent development, the supremacy in India of the priests, was still being hotly debated. All the new evidence tends to show that the struggle was being decided rather against than for the Brahmins. What we find in the Buddha's time is caste in the making. The great mass of the people were dis- tinguished'quite roughly into four classes, social strata, of which the boundary lines were vague and uncertain. At •one end of the scale were certain outlying tribes and cer- tain hereditary crafts of a dirty or despised kind. At the other end the nobles claimed the superiority. But Brah- mins by~~

~~birth (not necessarily sacrificial priests, for they followed all sorts of occupations) were trying to oust the nobles from the highest grade. They only succeeded, long .afterwards, when the power of Buddhism had declined.~~

~~4. It had been supposed on the authority of late priestly texts, where boasts of persecution are put forth, that the cause of the decline of Buddhism in India had been Brahmin persecution. The now accessible older authorities, with one doubtful exception,' make no men- tion of persecution. On the other hand, the comparison we are now able to make between the canonical books of the older Buddhism and the later texts of the following •centuries, shows a continual decline from the old stand- point, a continual approximation of the Buddhist views to those of the other philosophies and religions of India. We can see now that the very event which seemed, in the eyes of the world, to be the most striking proof of the success of the new movement, the conversion and strenuous support, in the 3rd century b. c, of Asoka, the most powerful ruler India had had, only hastened the •decline. The adhesion of large numbers of nominal converts, more especially from the newly incorporated .and less advanced provinces, produced weakness rather than strength in the movement for reform. The day of •compromise had come. Every relaxation of the old thoroughgoing position was welcomed and supported by •converts only half converted. And so the margin of difference between the Buddhists and their opponents gradually faded almost entirely away. The soul theory, step by step, gained again the upper hand. The popular gods and the popular superstitions are once more fa- voured by Buddhists themselves. The philosophical basis of the old ethics is overshadowed by new specu- lations. And even the old ideal of life, the salvation of the Arahat to be won in this world and in this world •only,_ by self-culture and self-mastery, is forgotten, or mentioned only to be condemned. The end was inev- itable. The need of a separate organization became less and less apparent. The whole pantheon of the Vedic gods, with the ceremonies and the sacrifices associated~~

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~~1 See Journal of the Pali Text Society, 1896, pp. 87-92.~~

~~with them, passed indeed away. But the ancient Bud- dhism, the party of reform, was overwhelmed also in its fall ; and modern Hinduism arose on the ruins of both.~~

~~The attention of the few scholars at work on the subject being directed to the necessary first step of publishing the ancient authorities, the work of exploring them, of analysing and classify- ing the data they contain, has as yet been very imperfectly done. But the following works have appeared, and are to be preferred to those given at the end of the article in the ninth edition. Only the most important are here mentioned.~~

~~Texts. — Pali Text Society, SO vols. — JUtaha, 7 vols., ed. Faus- BOLL, 1877-97. — Fi'raayn, 5 vols., ed. Oldenbekg, 1879-83. — Dham- mapada, ed. Fadsboll, 2nd ed. 1900. — Divyd,vadS,na, ed. Cowell and Neil, 1882. — Mah&vastu, ed. Senakt, 3 vols. 1882-97. — Buddha Carita, ed. Cowell, 1892. — Milinda-pahho, ed. Trencknek, 1880.~~

~~Translations. — Vinaya Texts, by Rhys Davids and Olden- berg, 3 vols., 1881-85. — Dhammapada, by Max MCller, and Sutta Nipata, by Fadsboll, 1881. — Questions of King Milinda, by Rhys Davids, 2 vols., 1890-94. — Buddhist Suttas, by Rhys Davids, 1881. — Saddharma Pundarika, by Keen, 1884. — Buddhist MahQ,yd.na Texts, by Cowell and Max Mijller, 1894 — all the above in the "Sacred Books of the East." — Jataka, vol. i., by Rhys Davids, under the title Buddhist Birth Stories, 1880;"" vols, i.-iv., by Chalmers, Neil, Francis, and Rouse, 1895-97. Buddhism in Translations, by Warren, 1896. — Buddhistische Anthologie, by Neumann, 1892. Lieder der Monche und Nonnen, 1899, by the same. — Dialogues of the Buddha, by Rhys Davids, 1899. — Die Reden Gotamo Buddha's, by Neumann, 2 vols., 1899- 1900. — Buddhist Psychology, by Mrs Rhys Davids, 1900.~~

~~Manuals, Monographs, &c. — Buddhism, by Rhys Davids, 12mo, 18th thousand, 1899. — Buddha, seine Leben seine Lehre und seine Gemeinde, by Oldenberg, 3rd ed., 1898. — Der Buddhis- mus und seine Oeschichte in Indien, by Kern, 1882. — Der Buddhismus, by Edmund Hardy, XBQO. — American Lectures, Buddhism, by Rhys Davids, 1896. — Inscriptions de Piyadasi, by Senart, 2 vols., 1881-86. — Mara und Buddha, by Windisch, 1895. (t. w. K. D.)~~

Budweis (Czech, Budejovice), the chief town of a government-district in Bohemia, Austria. Population (1890), 28,491 ; (1900), 39,328 (estimated to have 59 per cent. Czech, 41 per cent. German, 95-5 percent. Catholic, 4 per cent. Jewish, and ^ per cent. Protestant). It has a garrison of 2155 men. It is the principal commercial centre of South Bohemia, and has a large, varied, and growing industry, which now comprises the manufacture of chemicals, matches, paper, machinery, bricks and tiles, boat-building, bell-founding, corn and sawmills, &c. The trade is chiefly in corn, timber, coal, lignite, and salt, as well as in industrial products, including beer exported to America. Budweis is the centre of a German enclave in Czech Bohemia, the rural population for a considerable distance round the town being German-speaking.

Buell, Don Carlos (1818-1898), American soldier, was born near Marietta, Ohio, on 23rd March 1818. He graduated at West Point in 1841, and during the Mexican war won brevet promotion, being severely wounded at Cherubusco. Erom 1848 to 1861 he performed various staff duties, chiefly as assistant-adjutant-general. Ap- pointed lieutenant-colonel of staff on 11th May 1861, and brigadier-general of volunteers on 17th May 1861, he aided efficiently in organizing the army of the Potomac, and, at the instance of General McClellan, was sent in November to Kentucky to succeed General William T. Sherman in the reorganized department of the Ohio. Aided by Grant's famous river operations, he occupied Bowling Green in February 1862, and thence marched to Nashville. He was promoted major-general of volunteers on 21st March 1862, and placed at once under the orders of General Halleck, then at the zenith of his fame. Near the critical close of Grant's first day's battle at Shiloh he arrived with reinforcements, and co-operated in driving back the foe on the following day. Detached with his army by Halleck after the capture of Corinth, he met the rapid advance of the Confederate General Bragg into Kentucky, rescued Louisville, and, on 8th October, fought at Perryville, compelling Bragg to retreat. Complaints

against him having been made at Washington, which were later investigated but not published, Buell was now superseded by General Eosecrans. He was

~~mustered out of the volunteer service in May 1864, and on 1st June resigned from the regular army. He was president of Kentucky ironworks (1865-70), and subsequently engaged in various mining enterprises; he served (1886-90) as pension agent .at Louisville. He died near Roekport, Kentucky, on 19th November 1898. Buell was a good organizer of troops and disciplinarian, but somewhat tardy of movement and indisposed to take risks, and his haughty bearing often caused offence. As McClellan's friend, holding similar views, adverse politically to the adminis- tration, he suffered by Jt^cClellan's displacement.~~

~~Buenos Aires, a maritime province of the Argentine Republic. The official area at the census of~~

~~1895 was 117,777 square miles ; the population in 1869 (exclusive of that of the Federal District) was 307,761 ; in~~

~~1896 it was 921,168. The capital is La Plata. In 1895 there were 36,777 farms, 2,774,875 acres planted in cereals, 7,745,896 head of cattle, 1,685,668 horses, and~~

~~. 11,545,018 sheep in the province.~~

~~Buenos Aires, capital of the Argentine Republic, situated in 34° 36′ 29″ S. lat. and 58° 22′ 14″ W. long.; its mean altitude above sea-level, 10 feet. It now forms part of the Federal District (area, 72 square miles ; greatest breadth from IST. to S., 11 miles ; greatest lengthfrom E. to W., 16 miles), which was separated from the rest of the province in 1880, and constituted an administrative entity, when the city was made the federal capital and its ■duties as provincial capital were transferred to La Plata. All the most characteristic features of the old city have ■changed completely. The ancient one-storeyed buildings have been replaced by handsome structures of modern ■design; the streets have been paved with asphalt and wood; electric light has been introduced; water and ■drainage works have been constructed. In short, Euro- pean civilization is now firmly implanted. The once ■outlying parts of the capital either have already become real suburbs or will shortly do so. Amongst later import- ant public buildings and institutions are the Congress House, the Archbishop's Palace, the National Library (60,000 volumes), the National Museum of Fine Arts (1895), the~~

Natural History Museum, the National Historical Museum, the Zoological Gardens, and the Municipal Botanical Gardens. The population in 1880 was estimated to be under 400,000; in 1895 it was ■^663,854, and in 1899, 795,323. The number of foreigners in 1895 was 345,493, as against 63,115 in 1869. The proportion of males to females per thousand :at the same date was 537 males to 463 females. The number of marriages in 1895 was 5492, or 8-1 per thousand; of births in 1898, 40-9 per thousand; of ■deaths, 17-67 per thousand. At the same date the number of property owners was 45,848. As regards public in- rstruction, the census of 1896 showed that of children from six to fourteen years of age 93,560 were attending school •or knew how to read and write, out of a total of 117,388, ■or 719 to each 1000. Most of the immigration to the republic enters through Buenos Aires. In 1896, 102,000 •entered; in 1898, 95,190; in 1899, 88,000, of whom 13,000 were agricultural families with 40,000 members. Buenos Aires is the head of six railway lines^the Southern, Pacific, Eosario, La Ensenada, Argentine Central, and Western. In 1898 these lines took, at the various sta^ -fcions within the municipality, 10,962,240 passengers and ;2,346,946 tons of merchandise. The tramways at the end •of 1898 extended over 246 miles, and carried 106,964,631 j)assengers. The post office received in 1887, 10,752,284

pieces of mail matter; in 1898, 53,175,679. In 1887, 11,243,017 pieces were despatched; in 1898, 61,374,446 pieces. The telegraphic bureau in 1898 received 707,812 telegrams and despatched 479,793. The commercial com- munity is for the most part comprised of foreigners : — British and Germans in the higher branches of banking and finance; British, Spaniards, Germans, and Italians in the import and export trade ; Italians, French, and Spaniards -in the retail business. The value of the imports and exports of Buenos Aires from 1880 to 1898 is shown in the following table, the value being given iji gold pesos: — , I

Tear.

Imports.

Exports.

1880 1885 1890 1895 1898

~~$37,095,243 69,787,044~~

~~103,175,961 82,048,177 92,206,491~~

~~$39,887,302 61,996,527 57,742,342 62,531,492 70,956,559~~

~~The movement of shipping in 1887 and 1898 is shown in the subjoined tabla: —■”~~

~~188T.~~

~~1898. 1~~

~~Sailing.~~

~~Steam.~~

~~Sailing.~~

~~Steam. {~~

~~No.~~

~~Tonnage.~~

~~No.~~

~~Tonnage.~~

~~No.~~

~~Tonnage.~~

~~No.~~

~~Tonnage.~~

~~Entered . Cleared .~~

~~3858 1825~~

~~704,036 898,744~~

~~1642 1769~~

~~1,278,668~~

~~1,S26,67I~~

~~2204 1987~~

~~4.‘J7,836~~

~~352,401~~

~~2307 2311~~

~~2,564,298 2,883,675~~

~~Buffalo, the second city in size in the state of New York and the eighth in the United States of America, situated at the foot of Lake Erie where the Niagara River begins its connecting course to Lake Ontario, and the Erie Canal, by its artificial channel, continues the water route to the searboard. It is practically the midway point between Chicago and New York or Boston ; the journey by rail from New York being somewhat over 400 miles, from Boston a little less than 600, and from. Chicago a little more than 500 miles. Its position, practically in the centre of the thickly populated portion of the United States, and at the transfer point between the east and the west, accounts for the development of this city during the last twenty years of the 19th century. Shortly after 1880 the rapid growth began. In that year the population was 155,134 ; in 1890 it had attained to 266,664, and in 1900 it reached 362,387. The assessed valuation of real and personal property grew from 138,000,000 in 1873 to nearly $246,000,000 in 1900. The net debt in 1900 was $15,753,582, and the tax rate |23.48 per f 1000. It was in the decade from 1880 to 1890 that most of the great railway building vvas done which has made Buffalo a transportation centre of almost unrivalled facilities. There are thirty different railway divisions meeting in the city, and the railways own 6 of the city’s total areaof 42 square miles, and have over SOOmiles of track within the city’s limits. The trunk lines. entering~~

~~the city from the east are the New York Central, West Shore, Erie, Lackawanna, Lehigh, and Pennsylvania; from the west and south, the Lake Shore, Michigan Central, Nickel Plate, Grand Trunk, Wabash, and Ca nadian Pacific. In short, all the trunk lines of what may be called the northern route between the east and the west have made Buffalo a central distributing point. The commerce of the lakes has increased as rapidly as that of the railways. The vessels which arrived at the port of Buffalo in 1899 numbered over 5000, with a tonnage of over 6,000,000. The average annual receipts of grain and flour by the lakes in 1875 was 50,000,000 bushels; now it is over 200,000,000 bushels. The elevators, which even then were a famous and picturesque feature of Buffalo, now~~

~~have a storage capacity of over 21,000,000 bushels as against the 7,000,000 bushels of that time. The coal trade of Buifalo, which in 1875 was in its infancy, has now become a great feature of the lake commerce ; for of the 5,000,000 tons of anthracite coal received in 1899, 2,700,000 tons were shipped to the west by vessel. 3,000,000 tons of bituminous coal were also received by rail in 1899, though only a small amount was shipped. The lumber imports by lake were 230,000,000 feet in 1899, and in the same year over 1,500,000 tons of iron ore were brought from Lake Superior to the port of Buffalo. Fof the protection of this lake commerce and the increase of the harbour facilities the United States has built an outer breakwater of stone and cement almost four miles in length, and costing over $2,000,000. This breakwater and the new post-office, a huge granite pile with a tower over 200 feet in height, are the most notice- able of the newer public improvements. The two public libraries are also among the newer public buildings which decorate the city. The Grosvenor library, for reference only, has over 55,000 volumes, while the Buffalo library has 160,000 volumes. The public school system has grown with the growth of the city. In 1900 there were two high schools with an average attendance of 2228 scholars. The district or grammar schools numbered sixty, with an average attendance of 38,462. There were 114,396 persons of school age (5 to 20 years inclusive). Out of 97,938 males of voting age (21 years and over), 5168~~

~~were illiterate (unable to write), of whom 4813 were foreign- born. Buffalo has always been greatly admired for its broad and spacious streets, almost all of which are handsomely shaded. The streets in the residential portion are mainly occupied by detached houses, largely built of wood and surrounded by lawns and gardens. This system of building and a remarkably cool summer climate have given Buffalo its reputation as a delightful place of residence, and have attracted visitors from all parts of the world. In 1901 the Pan-American Exposition was held from May to November in the park and adjoining lands to the north of the city. It was on a scale eclipsed only by the Expositions at Chicago and Paris. Two of the build- ings were permanent additions to the attractions of the park, namely, the Albright Art Gallery and the New York State building, which is to house the collections of the Buffalo Historical Society. It was during a visit to the Exposition on 6th September that President McKinley was assassinated by Czolgosz. At the south end of the city, on the lake shore protected by the new breakwater, stands the great steel plant of the Lackawanna Steel Com- pany. The property owned by this company, which is capitalized at $20,000,000, extends more than a mile along the shore, and its new works are intended to employ over 6000 men. Much of the power used in Buffalo is from electricity generated at Niagara Falls, some 20 miles away, and most of the residences are heated by natural gas brought from the Canadian and Penn- sylvania gas fields. The park system in Buffalo com- prises 1000 acres and contains 20 miles of boulevards. Of the total population in 1900, 248,135 were native-born and 104,252 foreign-born, 350,586 white and only 1801 coloured, of whom 1698 were negroes. The healthfulness- of the city is attested by its low death-rate of 14-8 per thousand in 1900. ‘ (g. e. m.)~~

~~Building. — The most important development in building since the article on that subject in the ninth edition of this work was published has been in the direc- tion of steel construction, and it is with this that the following article will deal. The very tall buildings which are such prominent objects in the principal cities of the United States are the natural and logical result of the~~

~~introduction of new materials and devices, and of the application of modern science to the solution of the problem of economical construction (see~~

~~Plate). Apart from the aesthetic considerations to which have been due the construction of spires, towers, domes, high roofs, &c., the form and height of buildings have always been largely controlled by a practical consideration of their value for personal use or rental. The cost of buildings of the same class and finish is in direct proportion to their cubic con tents, and each cubic foot constructed is commercially unprofitable which does not do its part in paying interest on the capital invested. Until the latter half of the 19th century, these considerations practically limited the height of buildings on city streets to five or six storeys. The manufacture of the wrought-iron " I " beam in 1855 made cheaper fireproof construction possible, and together with the introduction of passenger lifts (see Elevators) about ten years later led to the erection of buildings to be used as hotels, flats, offices, factories, and for other commercial purposes, containing many more storeys than had formerly been found profitable. The practical limit of height was reached when the sectional area of the masonry of the piers of the exterior walls in the lower storey became sufficientlj'^ great, in order to support safely the weight of the dead load of the walls and floors and the accidental load imposed upon the latter in use, to affect seriously the value of the lower storeys on account of the loss of light and floor space. This limit was found to be about ten storeys. Various devices were successively made to reduce the size of the exterior piers. In 1881 the walls of a very large courtyard were constructed by building a braced cage of iron and/^fiUing the panels with masonry, a system of construction which had been used in the early part of the century for a tall shot-tower erected in the city of New York. Subsequently several buildings were erected in which the entire weight of the floors and roofs was carried by a system of metal columns placed against the inner surface of the exterior walls. The walls thus supported no load but their own weight, and were tied to the inner cage formed by the wall columns, interior columns, girders, and floors, by anchors arranged to provide for the shrinkage of masonry in drying out which always occurs to a greater or less extent. By the use of this form of construc- tion buildings were carried to the height of eighteen or nineteen storeys.~~

~~The first building used for tenants, in which the entire construction including the exterior walls was carried by a metal frame, T^as erected in Chicago in 1883. With the introduction of cheap structural steel, *'•»** this~~

system (known as the steel cage construe- ^*’™’” tion) came rapidly into use. The dimensions of the exterior piers ceased to control the height of the building, which was limited alone by the possibility of securing adequate foundations, and by a consideration of the amount of floor space which could be devoted without too great loss to a system of passenger lifts of sufficient capacity to afford rapid access to all parts of the building. The advantages that led to the very rapid introduction of this system were not only the power of greatly reducing the size of the piers, but the enormous facility afforded for rapid construction, the small amount of materials relatively used, and the proportionately small load upon the foundations, and the fact that as the walls are sup- ported at each storey directly from the cage, the masonry can be commenced at any storey independently of the masonry below it. It is a disadvantage of the system that defects of proportion, material, or workmanship, which would be of less moment in an old-fashioned con- struction, may become an element of danger in building with the steel cage, while the possibility of securing a

permanent protection of all parts of the cage from corrosion is a most serious consideration. The safety of the structure depends upon the preservation of the absolute integrity of the cage. It must not only be strong enough to sustain all possible vertical loads, but it must be suflciently rigid to resist without deformation or weakening all lateral disturbing forces, the principal of which are the pressure of wind, the possible sway of moving crowds or moving machinery, and the vibration of the earth from the passage of loaded vans and trolleys and slight earthquakes which at times visit almost all localities. In buildings wide in proportion to their height it is the ordinary practice to make the floors sufficiently rigid to transfer ■the lateral strains to the walls, and to brace the wall framings to resist them. In buildings of small width in proportion to their height this method of securing rigidity is generally found to be inadequate, and the frame is also braced at right angles to the outer walls to take up the strains directly. In each case all strains are carefully computed. The bracing is accomplished

~~*by the introduc- tion at the angles of the columns and girders or beams of gusset plates or knee braces, or by diagonal straps or rods properly attached by rivet or pin connexions. All portions of the frame are united by hot rivets of mild steel or wrought iron, care being taken that the sum of the sectional areas of rivets affords in each case a sufficient amount of metal for the safe transfer of the stresses. The greatest care should be taken to see that all rivet holes are accurately punched, and if necessary that they are reamed so that each rivet will have its full value.*~~

~~*It is evident that with this system of construction all serious inequality of settlement must be avoided, and*~~

~~*unusual care, therefore, must be employed to a'af*' secure perfect foundations. As a preliminary to*~~

~~*the design of the foundations a knowledge of the character of the site for a considerable distance below the footings should be gained by borings, and in cases where a certain settlement must be expected the footings must be so proportioned that the pressure at their bottom on each square foot of surface of the soil shall be uniform, so that inequality of settlement may be prevented. Ex- perience has shown that a very close approximation to this result may be secured by assuming in the case of residences, hotels, offices, and other buildings in which the principal variable load is that of men and women, that the load on each lower column base is the sum of the dead load of the weight of materials borne by it, and 20 per cent, of the variable loads which may be imposed upon the floor and roof surface it sustains. In the case of shops, factories, &e., increased percentages of the vari- able loads must be assumed to be borne by the lower column bases in proportion to the relative amounts of the variable loads which will be imposed upon the floors for any considerable length of time. The foundations must be spread below the column bases until such areas are reached that the pressure on the soil is not greater than its safe sustaining power. This is accomplished by rackings of stone or brickwork, or stoppings of concrete, or systems of inverted arches, or systems of steel girders and cantUevers bearing on grillages of parallel steel " I " beams kept a uniform distance apart by separators, and bolted together by steel rods. The grillage beams rest upon and are embedded in concrete, and in many cases the girders and*~~

~~cantilevers are also embedded in concrete. The tables of grillage must be so arranged and propor- tioned that there is no serious eccentricity of loading from the columns. Shear and bending moment, as well as the absolute strength of all girders, cantilevers, and " I " beam s, must be carefully computed. Before building on an elastic or yielding bottom the sustaining strength of the soil must be~~

~~ascertained. On the bottom is placed a table with a single leg of a recorded dimension arranged so-that it can only move vertically. This is loaded upon the top with pig- iron or other material of known weight, and the pressure is noted under which initial compression of the soil takes place, and the load under which the settlement becomes marked. At this point the increase of load is stopped and the soil is allowed to remain under pressure for several days, careful observations being taken at regular intervals of the rate of settlement until no further settle- ment occurs. A foundation which will not settle may be secured : —~~

~~(a) By spreading the footings until the pressure on the bottom is less than the load at which the initial settle- ment occurred, which wiU be found to vary from 1^ short tons per foot for ordinary wet clay or eajth, to 3 or 5 tons per foot for retained sand or hard pan ; (6) by building on piles driven to refusal (that is, until they will not move under the repeated blows of a heavy pile-driving hammer), in which case they must not be loaded beyond their safe computed strength as columns with free ends; pile foundations should never be used imless the circum- stances are such as to ensure that they with their cap- pings will be constantly covered with water ; (c) by ex- cavating to bed-rock and laying foundations upon it. Where the rock is covered by dry earth or gravel this can be accomplished without particular difficulty by care- ful sheath-piling to retain the sides of the excavation, but where the covering is quicksand or swamp-mud pneu- matic caissons must be sunk. A pneumatic caisson is a round or polygonal shell of wood or metal open at the bottom, which is called the " cutting edge," about 6 feet above which is built a removable roof, which forms an air-tight chamber. This chamber is entered through the roof by a metal cylinder about 3 feet in diameter, which extends to the top of the caisson, and is called the " air-shaft." On the top of this air-shaft is bolted a cylinder of greater diameter, provided with doors at its top and bottom, which is called the " air-lock."~~

~~*Air is supplied through pipes to the air-chamber, and constantly main- tained at a sufficient pressure to keep water from enter- ing the air-chamber, and to expel it from the ground im- mediately below it. The exterior of the caisson is made very smooth, and is thoroughly lubricated. The caisson is sufficiently loaded to cause it to sink as the material within it is excavated and removed. Access to or from the caisson for both men and materials is gained without altering the air-pressure in the caisson, by opening and closing the doors of the air-lock successively. When the sound bottom is reached it is faced off to secure a good bearing, and concrete is introduced through the air-locks and bedded in the bottom of the caisson to a sufficient depth to form a water seal. The air-locks, air-shaft, and roof are then removed from the top of the caisson, and an open well remains in which the building may be ex- tended with appropriate materials to the concrete founda- tions at the bottom. No reliance is placed upon the strength of the caissons as a direct support to the build- ing. A well-constructed and carefully-handled caisson, in which a proper air-pressure is maintained without interruption, may be sunk through flowing quicksand or mud in close proxiitiity to the foundations of an adjoining building standing on the crust above the soft bottom, without injury to it. Until very lately it has been assumed that a depth of 110 feet below the water- level was the practical limit to which caissons could be sunk, for men cannot safely work in an air-pressure of more than about 50 pounds to the square inch, but it is now found that they can be safely sunk to a considerably greater depth, for recent experience has shown that the exterior water-pressure at the base of a caisson is in*~~

~~*inverse proportion to the resistance to the flow of water through the material in which the caisson is sunk, and that the air-pressure which it is necessary to maintain in the air-chamber, to expel the water and dry the bottom, is always much less than, and frequently not more than 33 per cent, of, the pressure due to the column of water equal in height to the depth of immersion of the cutting edge.*~~

~~*In transferring the loads from the column bases to the*~~

~~bottom of the footings the greatest care must be taken~~

~~in all systems of construction that the stresses~~

~~umns. tiiroughout at no point exceed the safe limits of stress for the various materials used. Steel is generally used for columns in preference to cast iron, because it' atf ords greater facility for securing satisfactory connexions, because its defects of quality or workmanship are more surely detected by careful test and inspection, and because, on account of its superior elasticity and ductility, its fibre is less liable to fracture from slight deformations. It is used in preference to wrought iron on account of its lesser cost. Columns are generally built of riveted work of zeebars, channels, angles, plates, or lattice, of such form as will make the simplest and most easily constructed framing in the particular position in which the column is placed. The columns are sometimes run through two or more storeys and arranged to break joints at the different floors. In buildings to be used as offices, hotels, apartments, &c., it is usual in establishing the loads for the purpose' of computation to assume that the columns carrying the roof and the upper storey will be called upon to sustain the full dead load due to material and the maximum computed variable load, but it is customary to reduce the variable loads at the rate of about 5 per cent, storey by storey towards the base, until a minimum of about 20 per cent. of the entire variable load is reached, for it is evidently impossible that the building can be loaded by a densely packed moving crowd in all of its storeys simultaneously. In the . case of factories and buildings used for storage purposes the maximum variable load which can be imposed for any serious length of time on each floor must be used without reduction in computing the loads of the lower column, and proper allowances must be made for vibrating loads. In the case of very tall exposed buildings of small depth, the vertical load on the columns due to wind-pressure on the opposite side of the building must 'be computed and allowed for, and in case the lower columns are with- out lateral support their bending moment must be sufficient to resist the lateral pressure due to wind and eccentricity of loading. In computing the column sections a proper allowance must be made for any eccentricity of loading. It is usual to limit the height of sections of columns with- out lateral support to 30 diameters, and to limit~~

~~the maximum fibre stress to 12,000 ft per square inch. The sectional areas are computed by the use of the ordinary formulae for columns and struts.~~

~~For girders of small spans " I " beams or channels are~~

~~generally used, but for greater spans girders are built~~

~~of riveted work in the form of boxes with top~~

~~" "■ and bottom plates, side plates, and angles with proper stiffening bars on the side plates, or " I's," or lattice, or other forms of truss work. In girders and beams the maximum fibre stress is usually limited to 16,000 ft. In very short girders the shear must be computed, and in long girders the deflexion, particularly the flexure from the variable load, Since a flexure of more than /del> of the length is liable to crack the plastering of the ceilings carried by the girders. The same necessity for computing shear and flexure applies to the floor beams. The floors between the girders are constructed of " I " beams, spaced generally about 5 feet between centres ; their ends are usually framed to fit the form of the girders, and rest~~

~~either upon their lower flanges, or upon seats formed of angles riveted to their webs, being secured to them by a pair of angles at each end of the beam riveted to its web and to the web of the girder. Sometimes the beams rest upon the girders, and are riveted through the flanges to it ; in this case the abutting ends of beams are spliced by scarf plates placed on each side of the webs and secured by rivets. A similar construction is followed for flat roofs, the grades being generally formed in the girder and beam construction, and a flat ceiling secured by hang- ing from them, with steel straps, a light tier of ceiling beams. The floor beams are tied laterally by rods in continuous lines placed at or above their neutral axis. It is usual in both girders and beams to provide not only for the safe support of the greatest possible distributed load, but for the greatest weight, such as that of a safe or other heavy piece of furniture which may be moved over the floor at its weakest points, the centres of the girders and beams. It must always be borne in mind that the formulae for the ultimate strength of the " I " beams only hold good when the upper chord or flange is supported laterally.~~

Steel cages may be divided into two classes. In the first and more frequent type the exterior columns and girders are embedded in and hidden by the masonry of the walls, in some cases being ™‘^e_ covered on their exterior surface by as little as 4 and generally by only 8 inches of masonry. In the second system the columns are placed inside of. the wall, and beams or channels in couples are run in each side of and past the wall columns, or a floor beam is run through the column and allowed to project beyond it, or the floor beams are allowed to run over a wall girder between the columns and project beyond it, the projections in each case serving as cantilevers to carry the girders which are incor- porated in the masonry of the wall for its direct support. The wall girders in both forms of construction are formed of ” Z's,” ” T's,” or channels, sometimes carrying plates of proper forms which are riveted to them. The wall girders are always incorporated in the masonry. When the exterior columns and girders arfe embedded in the wall, the cement masonry and painted surfaces of the steel are expected to guard it from corrosion. Time only can prove whether this protection will be permanently efficient ; for masonry, particularly when of brick, unless absolutely free from defects or cracks, and unless kept perfectly painted, will not only fail as a waterproof covering, but will maintain a damp surface in contact with the frame for a considerable time after each beating storm. It is claimed that a coating of cement mortar will prevent the oxidation of steel, but it is certain that it is very efficient in preventing the oxidation of paint. For the cantilever system it is claimed that all eccentricity of column loads is avoided, that the columns standing free within the wall are as readily protected from corrosion as any interior columns, that they can be at any time uncovered, examined, and if necessary replaced, and that while the failure of a column may result in the collapse of the building, the failure of a wall girder would be a local injury of relatively small importance, since in almost all cases there is a sufficient margin of strength in the wall to transfer the load to the wall girder next below.

The steel used throughout the entire structure should be subjected to the most thorough chemical and mechanical tests and inspection, first at the mill and sub- sequently at the fabricating shops and the ^^•”””’^ building, to insure that it shall not contain more than -08 per cent, of phosphorus or -06 per cent, of sulphur, that it shall have an ultimate strength of between

~~60,000 and 70,000 ft per square inch, with an elastic limit of not less than 36,000 ft per square inch, and an elongation.~~

~~before fracture of not less than 25 per cent, in 8 inches of length, and that a piece of tlie material may be bent cold 180 degrees over a mandril equal to the thickness of the piece tested without fracture of the fibre on the outside of the bend. At least two pieces are taken from each melt or blow at the mill, and are stamped or marked, and all the various sections rolled from the melt or blow are required to bear a similar stamp or mark for identification. All finished material is carefully examined to see that it possesses a smooth surface, and that it is free'from cracks, seams, and other defects, and that it is true to section throughout. Rivets are either of wrought iron or of extra soft steel, with an ultimate tensile strength of 65,000 ft per square inch. The material must be sufficiently tough to bend cold 180 degrees flat on itself without sign of fracture. The greatest care is taken that no steel is left in a brittle condition by heating and cooling without proper annealing. All abutting joints in riveted work are faced-to exact lengths, and absolutely at right angles to the axis of the piece, and are spliced by scarf plates of proper dimensions adequately secured by rivets. The work should be so accurate that no packing pieces are necessary. If the conditions are such that a packing or filling piece must be used, the end of one piece is cut to a new and true surface, and the filling piece is planed to fill the space accurately. Where cast iron is used it must be of tough gray iron free from defects. In testing it pieces 1 inch ' square, 14 inches long, are cast from each heat and supported on blunt knife edges spaced 12 inches apart; under a load in the centre of the piece of 2500 ft the deflexion must not exceed ¯ of an inch.~~

~~All metal should receive one coat of paint at the works before shipment. All faced and turned surfaces should receive a coat of white lead or tallow before leaving the shop, and the entire structure should receive two coats of paint after erection. As the protection from corrosion will largely depend upon the paint, the most careful in- spection is employed to insure that the metal is perfectly clean from scale and thoroughly dry when painted, and~~

~~that no painting is done in damp or frosty weather. The paint must be applied with an ordinary painter's brush, and well worked in over the entire surface by hand to secure an even and perfect covering. It is valuable as a protection from corrosion in proportion to the amount of oil with which the metal can be coated by its ap- plication. The pigment itself is of small value except as a vehicle to assist in the spread of oil, and as facil- itating the inspection of the work to insure that the oil has been thoroughly and evenly spread. The pig- ment which allows the spread of the largest percent- age of oil is therefore the most valuable as a preventive of corrosion.~~

~~The filling between the girders and fioor beams consists of segmental arches of brick, segmental or fiat arches of porous (sawdust) terra cotta, or hard-burned hollow terra^ cotta voussoirs, or various patented forms of concrete fioors containing ties or supports of steel or iron. In all cases it is customary to fill on top of the arches with a strong Portland cement concrete to a uniform level, generally the top of the deepest beam; the "irtfthos" °°" filling is constructed and carried to this pa oos. jg^gj immediately upon the completion of each tier of beams, for the purpose not only of stiffening the frame laterally, arid of adding to its . stability by the imposition of a static load, but also to afford constantly safe and strong working platforms at regular and con- venient intervals for use throughout the entire period of the construction. In cases in which the lateral rigidity of thd floors is depended upon to transfer the horizontal strains to the exterior walls which are framed to resist~~

~~them, no form of fioor construction should be iised which is not laterally strong and rigid. With very rapid build- ing, no method of construction of floors, furrings, or partitions should be adopted which will not dry out with great speed. In flat fprms of masonry floor construction the level of its bottom is placed somewhat below the bottom of the " I " beams and girders, so that when it is plastered a continuous surface of at least an inch of mortar will form a fireproof protection for the lower flanges of the beams and girders. Where the width of the flange is considerable it is first covered with metal lath secured to the under side of the floor masonry. Girders projecting below the floor are usually encased in from 1 to 2 inches of fireproof material, 2 or 4 inches of which is also put on all columns. Such fireproof coverings, and also interior partitions, are composed of hollow,~~

~~hard-burned terrarcotta blocks, of porosis (sawdust) terra cotta, or various plastic compositions applied to metallic lath, many of which are patented both as to material and method of application. The most simple test for the value of a system of fireproof coverings, and of partitions and furrings, is to erect a large sample of the work and to subject it alternately tO' the continued action of an intensely hot fiame which is allowed to impinge upon it, and to a stream of cold water directed upon it from the ordinary service nozzle of a steam fire-engine. It is important in all fireproof- ing of columns and girders, and in all fioor construction, furring, and partitions, that there shall be no continuous voids, either vertical or horizontal, which may possibly serve as flues for the spread of heat or flame in case of fire. All furrings and partitions must be started on the solid masonry of the floors to prevent the possible passage of fire from the room in which it may occur. The failure to make this provision has been the cause of very serious losses in buildings which were supposed tO' be fireproof.~~

~~It is customary to lay all necessary horizontal gas pipes and electric wire conduits on the flat Portland cement- concrete surface of the floors, and, where wooden floors are to be used, to lay wooden sleepers on the same surface of a uniform depth as great as the diameter of the hubs at the joints of the largest pipes. The sides of the sleepers are bevelled inwards toward their tops. The entire surface is filled to the level of the sleepers, which is the underside of the wooden floor, or to the same level if marble or tile-floors are to be laid, with a very light concrete formed of screened anthracite coal cinders, or preferably locomotive screenings mixed with enough cement only to produce a hard mass. A wooden floor laid in contact with masonry needs no fireproofing ; it will smoulder, but it will not burn rapidly.~~

~~In some buildings the wood used for door sashes and trimming is subjected to one of the patented fireproofing- processes. If such are used it is important that they should be tested to prove both that the fireproofing is permanent, and that it will not cause in the presence of water the corrosion of the steel with which it may be in contact. In some buildings doors, sashes, and window frames are covered with light metals, or are made of patented fireproof composition. If covered with metal, in order to be thoroughly efficient, the parts must be united with lock joints, not solder. In~~

~~some buildings the sashes of interior partitions are glazed with wire-glass (a glass in which a mesh of fine wire is bedded in the centre of the sheet), and in some cases squares of plate-glass not more than 4 inches in diameter, united by a heavy joint of copper electrically deposited, are used for the sam e purpose. Both methods have proved singularly efficient in arresting- the spread of fire.~~

~~It is impossible to design a building which cannot be- injured by fire, but the construction should be such that.~~

~~uo~~

~~BUILDING SOCIETIES~~

~~in case of an interior fire the damage may be confined to the place in which.it originates, and that the efficiency of the weight-carrying supports shall not be de- Fireproot stroyed. Experience has proved that unpro- tion. ‘ tected steel and iron are not fireproof — when heated to a dull red heat they lose their effi- ciency— but that it is difficult, if not impossible, to heat metal, which is embedded in masonry or protected by a substantial and proper fireproof covering, to the point at which its strength is seriously impaired. Unless the building is surrounded by fireproof structures, the danger from exterior confiagration is infinitely greater than from interior fires, and is usually greater on the rear and sides than on the public streets. When there is a possibility that a mass of flame from the conflagration of adjacent property may be driven by wind against the exterior walls, the windows should be protected by fire- proof shutters (wood covered by metal has proved the most efficient), or the sash should be covered with metal and glazed with wire-glass, or with very small panes of thick plate-glaas in metal sash. In warehouses and shops and structures erected to contain large quantities of inflammable material, there should be used the least possible amount of material which is at all affected by fire, and every precaution should be observed to isolate the different floors and sections in case of conflagration. The lifts should be enclosed in masonry shafts, and should have self-closing fireproof doors, and the staircases should be built in masonry enclosures shut off from the lifts by similar doors. In hotels, apartments, and office buildings the mass of inflammable material which they contain is so small that unless there has been careless or improper~~

~~*con- .struction a fire is readily confined to the place in which it •originates until it can be extinguished ; but the staircases should be built as far as possible from the lifts, and if they are constructed with stone treads laid on metal .strings, the treads and platforms should be supported throughout their entire surface by metal, that they may afford safe footing for the tenants and for firemen in case they are shattered by the action of heat, water, or falling material.*~~

~~*Very tall buildings should be supplied with special arrangements to facilitate the extinction of fire, since the longitudinal strength of a fire hose is not great enough to permit ft to support its own weight when filled if hoisted to a sufficient height to reach the upper storeys, and passing the hose in and out of windows or up staircases to give it the necessary support is both difficult and untrustworthy. It has hecome the practice to erect at convenient points within the building steel stand-pipes, generally 6 inches in diameter, extending from the pavement to the roof, pro- vided at each storey with double branches and plugs of the dimension and pitch of screw to receive the regulation fire-hose connexion. Sufficient lengths of hose are con- stantly connected to these stand-pipes to reach all parts of the building. At the bottom is a check-valve. A branch is connected with the house tank so that the stand-pipes are constantly kept full of water, and as far as the supply of the tank is concerned are immediately efficient in case of fire. At the pavement proper screw plugs are provided to make connexions with the town steam fire-engines, and at the tank a check-valve is provided to act against, the fire-engine pressure. The whole system is tested to a pressure of 300 lb to the inch. With careful construction, the best materials, and good workmanship throughout, there is no reason why a very tall building which depends upon a steel cage for its stability should not be as sub- stantial, durable, and fireproof as a structure of ordinary height, with interior columns and girders of iron, and the •ordinary fireproof fioor construction. (g. b. p.)*~~

~~*Fire extinction.*~~

~~*Building Societies. — United Kingdom (for de- scription, see Ency. Brit. iv. 513). By an Act passed in 1894 all the Benefit Building Societies established under the Act of 1836 after the year 1856 were required to*~~

*~~become incorporated under the Act of 1874. There are, therefore, three categories of building societies: — 1. Those established before 1856, which have not been incorporated under the Act of 1874 and remain under the Act of 1836. 2. Those established before 1874 under the Act of 1836, which have been incorporated under the Act of 1874. 3. Those which have been established since the Act of 1874 was passed. The first class still act by means of trustees. Of these societies about 70 are still in existence, the principal one being the Birk- beck. As most of them are of fifty years' standing or more, they are well established, and are still increasing their business. The second and third classes exceed 2000 in number, and have passed through some vicissi- tudes since the article in the ninth edition of the Ency- clopaedia Britannica was written. For several years their progress was steady, but there were not wanting signs that their prosperity was unsubstantial. A prac- tice of receiving deposits repayable at call had sprung up, which must lead to embarrassment where the funds are invested in loans repayable during a long term of years. It was surmised, if not actually known, that many societies had large amounts of property on their hands, which had been reduced into possession in consequence of the default of borrowers in paying their instalments. A practice had also grown up of establishing mushroom societies, which did little more than pay fees to the promoters. The vicious system of trafficking in advances that had been awarded by ballot, near akin to gambling, prevailed in many societies. These signs of weakness had been ob- served by the well-informed, and the disastrous failure of a large society incorporated under the Act of 1874, the Liberator, which had in fact long ceased **V'**" to do any genuine building society business, hastened the crisis. This society had drawn funds to the amount of more than a million sterling from provident people in all classes of the population and all parts of the country by specious representations, and had applied those funds not to the legitimate purpose of a building society, but to the support of other undertakings in which the same persons were concerned who were the active managers of the society. The consequence was that the whole group of concerns became insolvent, and the Liberator depositors and shareholders were defrauded of every penny of their investments. Many of them suiiered great distress from the loss of their savings, and some were absolutely ruined. The result was to weaken confidence in building societies generally, though this was not quite logical, inasmuch as the Liberator Society had long ceased to do any legitimate~~*

building society business ; but it was very marked in the rapiddeclineofthe amount of the capital of the incorporated building societies. From its highest point (nearly 54 millions) reached in 1887, it feU to below 43 millions in 1895. On some societies, which had adopted the deposit system, a run was made, and several were unable to stand it. The Birkbeck Society was for two days besieged by an anxious crowd of depositors clamouring to withdraw their money ; but luckily for that society, and for the building societies generally, a very large portion of its funds was invested in easily convertible securities, and it was enabled by that means to get sufficient assistance from the Bank of England to pay every depositorwho asked for his money without a moment's hesitation. Its credit was so firmly established by this means that many persons sought to pay money in. Had this very large society succumbed the results would have been disastrous to the whole body of building societies. As the case stood, the energetic

means it adopted to save its own credit reacted in favour of the societies generally.

The Liberator disaster convinced everybody that some- thing must be done towards avoiding such calamities in future. The Government of the day brought in a bill for that purpose, and several private members also prepared measures — most of them more stringent than the Govern- ment bill. All the bills were referred to a select com- mittee, of which Mr Herbert Gladstone was the chair- man. As the result of the deliberations of the committee, the Building Societies Act of 1894 was passed. Mean- while the Rt Hon. W. L. Jackson, a member of the committee, moved for an address to Her Majesty for a return of the property held in possession by building societies. This was the first time such a return had been called for, and the managers of the societies much resented it ; there were no means of enforcing the return, and the consequence was that many large societies failed to make it, notwithstanding frequent applications by the Eegistrar. The Act provided that henceforth all incorporated societies should furnish returns in a prescribed form, including schedules showing respectively the mortgages for amounts exceeding £5000 ; the properties of which the

societies .had taken possession for more than twelve months through default of the mortgagors ; and the mortgages which were more than twelve months in arrear of repayment subscription. The Act did not come into operation till 1st January 1895, and the first complete return under it was not due till 1896, when it appeared that the proper- ties in possession at the time of Mr Jackson's return must have been, counted for at least seven and a half millions in the assets of the societies. This has since been reduced to four and a quarter millions. In the two years 1897, 1898, the societies reduced their properties in possession from 14 per cent, of the whole of their mort- gages to 10 per cent. Though this operation must have been attended with some sacrifice in many societies, upon the whole the balance of profit has increased rather than diminished ; and if a loss is to be sustained, it is always best to face it at once and write it off. Thus this provi- sion of the Act, though it greatly alarmed the managers of societies, has really been a blessing in disguise. The Act also gave power to the Registrar, upon the application of ten members, to order an inspection of the books of a society, but it did not confer upon individual members the right to inspect the books, which would have been more effective. It empowered the Eegistrar, upon the application of one-fifth of the members, to order an inspec- tion upon oath into the affairs of a society, or to investi- gate its affairs with a view to dissolution, and even in certain cases to proceed without an application from members. It gave him ample powers to deal with a society which upon such investigation proved to be insol- vent, and these have been exercised so as to procure the cheap and speedy dissolution of such societies. It also prohibited the future establishment of societies making advances by ballot, or dependent on any chance or lot, and provided an easy method by which existing socie- ties could discontinue the practice of balloting. This method has been adopted in a few instances only. The Act, or the circumstances which led to it, has greatly diminished the number of new societies apply- ing for registry.

The statistics of building societies belonging to all the three classes mentioned show that there were on 31st December 1898, 2586 societies in existence in the United Kingdom. Of these, 2495, having 612,874 members, made returns. Their gross receipts for the financial year were £38,221,443. The capital belonging to their members was £34,606,447, and the undivided balance of profit £3,334,129. Their liabilities to depositors and other

~~creditors were £21,533,550. To meet this they had mort- gages on which £44,449,008 was due, but of this £4,226,325. was on properties which had been in possession more than a year, and £271,992 on mortgages which had fallen into arrear more than a year. Their other assets "were £14,563,966, and certain societies showed a deficit bal- ance which in the aggregate was £461,162. The total assets and income are more than three times the amount of the conjectural estimate made for 1870 by the Eoyal Commission, but though the increase of both in the twenty-eight yeai;s has undoubtedly been great, that estimate was probably under the mark. It is not too much to say that a quarter of a million persons have been enabled by means of building socie- ties to become the proprietors of their own homes.~~

~~(e. w. b.) United States. — "Building and loan association" is a general term applied in the United States to such institu- tions as mutual loan associations, homestead aid associa^ tions, savings fund and loan associations, co-operative banks, co-operative savings and loan associations, &c. They are private corporations, for the accumulation of savings, and for the loaning of money to build homes. The first association of this kind in the United States of which there is any record was organized at Erankford, a suburb of Philadelphia, 3rd Januatry 1831, under the title of the Oxford Provident Building Association. Their permanent inception took place between 1840 and 1850. The receipts or capital of the building and loan association consists of periodical payments by the mem- bers, interest and premiums paid by borrowing members, or others, fixed periodical instalments by borrowing members, fines for failures to pay such fixed instalments, forfeitures, fees for transferring stock, entrance fees, and any other revenues or payments, — all of which go into the common treasury. When the instalment payments and profits of all kinds equal the face value of all the shares issued, the assets, over and above expenses and losses, are apportioned among members, and this apportion- ment cancels the borrower's debt^ while the non-borrower is given the amount of his stock. A man who wishes to borrow, let us say, f 1000 for the erection of a house ordinarily takes five shares in an association, each of which, when he has paid all the successive instalments on it, will be worth $200, and he must offer suitable security for his loan, usually the lot ofi which he is to- build. The money is not lent to him at regular rates of interest, as in the case~~

~~of a savings bank or other financial institution, but is put up at auction usually in open meet- ing at the time of the payment of dues, and is awarded to the member bidding the highest premium. To secure the $1000 borrowed, the member gives the association a mortgage on his property and pledges his five shares of stock. Some associations, when the demand for money from the shareholders does not exhaust the surplus, lend their funds to persons not shareholders, upon such terms and conditions as may be approved by their directors. Herein lies a danger, for such loans are sometimes made in a speculative way, or on insufficient land value. Some associations make stock loans, or loans on the shares held by a stockholder without real estate security ; these vary in different associations, some applying the same rules as to real estate loans. To cancel his debt the stockholder is constantly paying his monthly or semi-monthly dues, until such time as these payments, plus the accumulation of profits through compound interest, mature the shares at $200 each, when he surrenders his shares, and the debt upon his property is cancelled.~~

~~Every member of a building and loan association must be a stockholder, and the amount of interest which a member has in a building and loan association is indicated by the number of shares.~~

~~Shares.~~

~~he holds, the age of the shares, and their maturing value. The difference between a stockholder in such an association and one in an ordinary coi- poration for usual business purposes lies in the fact that in the latter the member or stockholder buys his stock and pays for it at once, and as a rule is not called upon for further pay- ment ; all profits on such stocks are received through dividends, the value of shares depending upon the successful operation of the business. In the former the stockholder or member pays a stipu- lated minimum sum, say |1, when he takes his member- ship and buys a share of stock. He continues to pay a like sum~~

~~each month until the aggregate of sums paid, increased by the profits and all other sources of income, amounts to the maturing value of the stock, usually i^SOO, vfhen the stockholder is entitled to the full maturing value of the share and surrenders the same. Shares are usually issued in series. When a second series is issued the issue of the stock of the first series ceases. Profits are distributed and losses apportioned before a new series can be issued. The term during which a series is open for sub- scription differs, but it usually extends over three or six months, and sometimes a year. Some associations, usually known as per- petual associations, issue a new series of stock without regard to the' time of maturity of previous issues. It is the practice in such associations to issue a new series of stock every year. Instead of shares that are paid in instalments, some associations issue prepaid shares and paid-up shares. Prepaid shares, known also as partly paid-up shares, are issued at a fixed price per share in advance. They usually pai^^ioipate as fully in the profits as the regular in- stalment shares, and when the amount originally paid for such shares, together with the dividends accrued thereon, reaches the maturing or par value, they are disposed of in the same manner as regular instalment shares. Some associations, instead of crediting all the profits made on this class of shares, allow a fixed rate of interest on the amount paid therefor at each dividend period, which is paid in cash to the holder thereof. This interest is then deducted from the profits to which the shares are entitled, and the remainder is credited to the shares until such unpaid portion of the profits, added to the amount originally paid, equals the matur- ing or par value. Paid-up shares are issued upon the payment of the full maturity or par value, when a certificate of paid-up stock is issued, the owners being entitled to receive in cash the amount of all dividends declared thereon, subject to such conditions or limitations as may be agreed upon. These shares sometimes par- ticipate as fully in the profits as the regular instalment shares, but in most cases a fixed rate of interest only is allowed, the holders of the shares usually assigning to the association all right to profits above that amount. Certificates of matured shares are also issued to holders of regular instalment shares, who prefer to leave their money with the association as an investment.~~

~~Prior to the maturing of a share it has two values, the holding or book value and the withdrawal value. The book value is ascertained by adding all the~~

dues that have been paid to the profits that have accrued ; that is to say, it is the actual value of ^ share at any particular time. The withdrawal value is that amount of the book value which the association is willing to pay to a shareholder who desires to sever his connexion with the association before his share is matured. Some associations do not permit their members to withdraw prior to the maturing of their shares. Then the only way a shareholder can realize upon his shares is by selling them to some other person at whatever price he can obtain. There are twelve or more plans for the withdrawal of funds. Every association has full regulations on all such matters.

The purchase of a share binds the shareholder to the necessity of keeping up his dues, and thus secures to him not only the benefits of a savings bank but the benefit of constantly accruing compound interest. This accomplishes the first feature of the motive of a building and loan association. The second is accomplished by en- abling a man to borrow money for building purposes. It is a moot question whether this method of obtaining money for the building of homes is more or less economical than that of obtaining it from the ordinary savings banks or from other sources. Sometimes the premium which must be paid to secure a loan increases the regular interest to such an amount as to make the building and loan method more expensive than the ordinary method of borrowing money, but a building and loan association has a moral influence upon its members, in that it encourages a regular payment of in- stalments. Some associations have a fixed or established premium rate, and under such circumstances loans are awarded to the members in the order of their apphcations or by lot. Ikms'ln "^^^ premium may consist of the amount which the methods, orro' ^er pays in excess of the legal interest, or it may consist of a certain number of payments of dues or of Interest to be made in advance. There are very many plans for the payment of premiums, nearly seventy relating to real estate loans being in vogue in different associations in different parts of the United States ; but in nearly all cases the borrower makes his regular payments of dues and interest until the shares pledged

have reached maturing value. There\ is also a great variety of plans for the distribution of profits, something like twenty-five such plans being in existence. The methods of calculating in- terest and profits are somewhat

~~*complicated, but they are all found in the books to which reference will be made. The various plans for the payment of premiums, distribution of profits, and with- drawals, and the calculations under each, are given in full in the Ninth Annual Report of U.S.A. Commissioner of Labour.*~~

~~*Most building and loan associations confine their operations to a small community, usually to the county in which they are situated ; but some of them operate on a large scale, extending their business enterprises even beyond the borders of their own State. These — national associations are ready to make loans on property any- where, and sell their shares to any person without reference to his residence. In local associations the total amount of dues paid in by the shareholders forms the basis for the distribution of profits, while in most national associations only a portion of the dues paid in by the shareholders is considered in the distribution. For instance, in a national association the dues are generally 60 cents a share per month, out of which either 8 or 10 cents are carried to an expense fund, the remainder being credited on the loan fund. The expense fund thus created is lost to the shareholders, except in the case of a few, associations which carry the unexpended ' balances to the profit and loss account, and whatever profits are made are apportioned on the amount of dues credited to the loan fund only. The creation of an expense fund in the nationals has sometimes been the source of disaster. Safety or security in both local and national associations depends principally upon the integrity with which their affairs are conducted, and not so much upon the form of organization or the method of distribution. Some of the States — New York, Massachusetts, New Jersey, Ohio, Illinois, California, and others — bring building and loan associa- tidhs under the same general supervision of law thrown around savings banks. In some States nothing is officially known of them beyond the formalities of their incorporation. Though the busi- ness of the associations is conducted by men not trained as bankers, it yet meets with rare success. Associations disband when not successful, but when they disband great loss does not oc- cur because the whole business of the association consists of its loans, and these loans are to its own shareholders, as a rule, who hold the securities in their associated forms. The amount of money on hand is always small, because it is sold or lent as fast as paid in. A disbanded association, therefore, simply returns to its own mem- bers their own property, and but few real losses occur. Invest- ment in*~~

~~*a building and loan association is as nearly absolutely safe as it can be, for the monthly dues and the accumulated profits, which give the actual capital of the association, are lent or sold, as it is termed, by the association as fast as they accumulate, and upon real estate or upon the stock of the association itself. The opportunities for embezzlement, therefore, or for shrinkage of securities, are reduced to the minimum, and an almost absolute safety of the investment is secured.*~~

~~*The growth of these associations has been very rapid since 1840. In 1900 they numbered 6838, and occur in forty-eight States and territories. Pennsylvania has the greatest number, 1079. The next in order are— Ohio, 721 ; Illinois, 669 ; Indiana, 445 ; New York, 418 ; Missouri, 366 ; New Jersey, 288 ; Maryland, 240 ; Kentucky, 148 ; California, 133 ; Massachusetts, 115; Minnesota, 97. Their accumulated assets have increased to an enormous amount. The Federal Govern- ment, through the Department of Labour, made an investigation of building and loan associations, and pub- lished its report in 1893, with the results given in the table on the next page.*~~

~~*The total dues paid in on instalment shares, according to the following statement, amounted to $460,667,594. The business represented by this great sum, conducted quietly, with little or no advertising, and without the experienced banker in charge, shows that the common people, in their own ways, are quite competent to take care of their savings, especially when it was shown by the report cited that but thirty-five of the associations then in existence met with a net loss at the end of their latest fiscal year, and that this loss amounted to only a little over $23,000. In addition to the statistics of a general character quoted in the table, Bulletin No. 10 (May 1897) of the United States Department of Labour contains a calculation of the business at that date, based upon such States' reports as were available. That calcula-*~~

~~*Statlstlcs.*~~

~~*Statistics of Building and Loan Associations, 1893.— General Results fob the United States.*~~

~~*JU*~~

~~*iN'umber of asBociations ....*~~

~~*Male shareholders in associations re- porting*~~

~~*Female shareholders in associations re- porting .....,,*~~

~~*Total shareholders in associations report-*~~

~~*Average shareholders per association reporting ....*~~

~~*Shareholders who' are borrowers in asso- ciations reporting*~~

~~*Per cent, of borrowers in associations reporting*~~

~~*Number of shares in associations report- ing -.. . ...*~~

~~*Total dues and profits ....*~~

~~*Average shares per shareholder in asso- ciations reporting*~~

~~*Average dues and profits per shareholder in associations reporting*~~

~~*Average value of shares in associations reporting*~~

~~*Total profits .....*~~

~~*Average size of loans in associations reporting . . . ■ .*~~

~~*Homes acquired in associations report- ing*~~

~~*Local.*~~

~~*National.*~~

~~*Total.*~~

~~6,598~~

~~240~~

~~5,838~~

~~«no,i56~~

~~“209,458~~

~~•919,614~~

~~•263,888~~

~~•44,440~~

~~•307,828~~

~~11,859,366~~

~~6386,369~~

~~11,745,725~~

~~1244-5~~

~~11,687-1~~

~~1801-2~~

~~c402,212~~

~~»58,199~~

~~c455,411~~

~~C29-83~~

~~•18.77~~

~~C26-25~~

~~$413,647,228~~

~~$37,020,866~~

~~^13,255,872~~

~~$450,667,594~~

~~•7-6~~

~~e7-2~~

~~«7-5~~

~~e$803.11~~

~~«$86.73~~

~~«$257.26~~

~~6*39.75 $74,402,969~~

~~C$12.12~~

~~$6,261,147~~

~~«$34,18~~

~~$80,664,116~~

~~/$i,ia3~~

~~/$920~~

~~/$1,120~~

~~»290,808~~

~~ff23,952~~

~~»3I4,765~~

~~• Associations not reporting, local, 1503 ; national, 66 ; total, 1569.~~

~~1 Associations not reporting, local, 88 ;' national, 4 ; total, 42.~~

~~« Associations not reporting, local, 69 ; national, 4; total, 73.~~

~~d Associations not reporting, local, 18 ; national, 4 ; total, 22.~~

~~. Based on 5585 local associations, 226 national associations ; total, 5761.~~

~~/ Based on 2128 local associations, 45 national associations ; total, 2173.~~

~~s Associations not reporting, local, 1826 ; national, 68 ; total, 1394.~~

~~tion showed a growth in almost every item. It is safe to say that the total dues and profits of building and loan associations in 1901, constituting their assets, reached about 1600,000,000, with probably 6000 associations con- stantly contributilig to its growth. During the years of depression ending with 1899 the growth of building and loan associations was naturaily slower than in prosperous periods.~~

~~*See Ninth Annual Meport of U. 8. A. Commissioner of Labour, 1893. Bulletin No. 10 (May 1897), of tlie Department of Labour. How to Manage Building Associations, by Edmund Eigley, pub- lished in 1873. A Treatise on Co-operation Savings and Loan Associations, by Seymoue Dexter, New York ; D. Appleton and Co. 1891. A Treatise on Building Associations, adapted to the use of Lawyers and Officers, by Charles N. Thompson, Chicago ; Callaghan and Co. , 1892. (c. D. w.)*~~

~~*Buitenzorg, a district in the island of Java (till 1866, an assistant residency), forming the southern part of the residency of Batavia, with an area of 1447 square miles. It occupies the northern slopes of a range of hills separating it from Preanger, and has a fertile soil. Tea, coffee, cinchona, sugar-cane, and rice are cultivated, as are also nutmegs, cloves, and pepper. Buitenzorg, the capital, in direct line about 32 miles S. of Batavia, is the usual residence of the Governor-Greneral of the Dutch East Indies. Since 1875 the offices of the General Secretary and the bureaux of mines and of the state rail- way have been transferred to this place, which has a well- equipped hospital and sanatorium. A Chinese colony numbering about 5000 has been established in the vicinity.*~~

~~*Bukovina, a duchy and crown-land in the Cisleithan half of the Austro-Hungarian monarchy. Population in 1869, 511,964; in 1880, 571,671 ; in 1890, 646,591, which is equivalent to 160-2 inhabitants per square mile. Proportion of females to males, 993 to 1000 ; 4:j,-77 per cent, are Euthenians, 32-41 per cent. Eumanians, 20-79 per cent. Germans, 3-67 per cent. Poles, the remainder being made up of Czechs, Russians, &c. ; 69-71 belong to the Greek Oriental Church, 12-79 per cent, are Jews, 11-19 per cent. Roman Catholics, 3-25 per cent. Greek United Church, and 2-5 per cent, are Protestant. Popu- lation in 1900, 729,921. In 1^96 the marriage-rate was 7-85 ; the birth-rate, 44-99, or, excluding still-births, 43-86 ; and the death-rate 29-90 — with the exception of*~~

~~*Istria and Carniola the highest in Austria. The illegiti- mate births were 12-24 per cent, of the whole. The marriage-, birth-, and death-rates, as well as the proportion of illegitimacy, are diminishing. Bukovina sends 11 members to the Reichsrath (5 Rumanians, 2 Euthenians, 3 Germans, and 1 Pole). The Diet is composed of 14 Rumanians, 8 Germans, 5 Euthenians, and 4 Poles.*~~

~~*German enjoys special privileges in this crown-land, being the official language of the administration, of law, and of instruction in the university. Education is provided for by a university at Czernowitz (three faculties : theology, law, and philosophy — 371 students), 5 gymnasia, 346 elementary schools (attended by about 63 per cent, of the children), together with 54 technical and continuation schools. The latter show a marked increase, and progress is also visible in elementary education. In 1890 the illiterates- formed 77-2 per cent, of the population, a reduction of 6-3 per cent, on the preceding decade. With the exception of Dalmatia, Bukovina has the largest pro- portion of illiterates in Austria. Of the 31 periodicals and newspapers published in 1898, 19 are German, 6 Ruthenian, 3 Rumanian, 1 Polish, and 2 polyglot. Three- fourths of the population are engaged in agriculture and forestry, 13-76 per cent, in mining and industry, and 6-31 per cent, in trade. Agriculture has made considerable progress. Distilleries, milling, and brewing represent the most important industries. Commerce is chiefly in the hands of the Jews and Armenians, and is mainly confined to raw products, such as corn, cattle, wood, wool, and other animal products. Horse- breeding is encouraged by a government stud at Radautz. In 1897 there were 351 kilometres of railway, 4088 kilometres of roads, and 351 kilometres of waterways, serviceable only for floating timber. There were 93 post and 46 telegraph offices, with 761 kilometres of line and 1772 kilometres of wire.*~~

~~*See BiDEKMANN. Die Bukowina unter der oesterreich. Verwal- tung, 1775-1875. Lemberg, 1876. — Wickenhauser. Molda, Oder Beitrdge zur Oeschichte der Moldau und Bukowina. Czernowitz, 1882. — Dan. Die Volkerschaften der Bukowina. Czernowitz, 1890.*~~

~~*(m,. o'n.)*~~

~~*Bulandshahr, a town and district of British India, in the Meerut division of the North-West Provinces. The town is on the right bank of the Kali Nadi. The population in 1891 was 16,931 ; the municipal income in 1897-98 was Rs. 17,347. Its present handsome appearance is due to a recent collector, the late Mr F. S. Growse, who was active in erecting public buildings, and in encouraging the local gentry to beautify their own houses. In particular,*~~

~~it boasts a fine bathing-ghat, a town hall, a market-place, a tank to supply water, and a public garden.~~

~~The district of Bulandshahb has an area of 1911 square miles. The population in 1891 was 949,914, being 497 persons per square mile. Classified according to religion, Hindus numbered 769,401 ; Mahommedans, 179,019 ; Christians, 210, of whom 79 were Europeans ; " others," 1284. In 1901 the population was 1,138,296, showing an increase of 20 per cent. The land revenue and rates w*re Rs.2z,73,390, the incidence of assessment being R.l:10:7 per acre; the number of police was 2801. Out of a total cultivated area in 1896-97 of 845,668 acres, 199,272 were irrigated from the Ganges canal and 193,522 from wells. There are 190 indigo factories, employing 16,000 persons, with an out-turn valued at Rs. 10,52,190 ; and five mills for pressing and cleaning cotton. The main line of the East Indian railway and the Oudh and Rohilkhand railway cross the district. The chief centre of trade is Khurja.~~

~~Bulawayo,a town of British South Africa, the largest place in Southern Rhodesia, and formerly chief military~~

~~kraal of the Matabele state. It occupies a central position, about 5000 feet above searlevel, on the Matoppo hills, and is 1360 miles from Cape Town, with which it is connected by rail. It is the present terminus of the southern section of the Cape to Cairo trunk line, which was in 1901 advancing in the direction of the rich coalfields discovered in the Wanki district below the Victoria Falls of the Zambezi. The " Place o/ Slaughter," as its name is interpreted, was originally founded about 1838 by Lobengula's father, Moselekatse, some distance to the south of its present position, and continued to be the royal residence till its occupation by the British South Africa Chartered Com- pany's forces in 1893. Since then it has been completely transformed, and is now one of the most flourishing European towns in South Africa, with a population esti- mated in 1900 at 6000, of whom over 3000 were whites. There have been erected substantial government offices, a municipal building, banks, churches, hotels, schools,~~

~~*hos- pitals, a public library, newspaper and telegraph offices. An extensive telephone system has been for some time in operation. Lying in the midst of rich goldfields, and also possessing considerable agricultural resources, it has every prospect of becoming the centre of European culture and civilizing influences in the region between the Lim- popo and the Zambezi.*~~

~~*Buldana, a town and district of India, in Berar or the Hyderabad assigned districts, under British adminis- tration. The town had a population in 1891 of 3243.*~~

~~*The district has an area of 2809 square miles ; and had a population in 1891 of 477,138, being 171 persons per square mile. Classified according to religion, Hindus numbered 442,688; Mahommedans, 34,405; Christians, 103, of whom 18 were Europeans ; " others," 42. In 1901 the population was 423,685, showing a decrease of 12 per cent., due to the effects of famine. The land revenue and rates in 1897-98 were Es.12,55,977, the incidence of assessment being 13 annas per acre; the number of police was 455. In 1897-98, out of a total cultivated area of 1,208,008 acres, 55,471 were irrigated from wells, &c. The only manufacture is cotton cloth. Cotton, wheat, and oil-seeds are largely exported. The Nagpur line of the Great Indian Peninsula railway runs through the north of the district. The most important place of trade is Malkapur — population (1891), 9222 — with three factories for ginning and pressing cotton. In 1896-97 there were 214 schools, with 7500 pupils, the proportion of boys at school being 20 per cent, of the estimated male population of school-going age. The death-rate in 1897 was 53-6 per 1000.*~~

~~*Buldur, or BuRDUR, chief town of a sanjak in the Konia vilayet in Asia Minor, called by the Christians Polydorion, altitude 3150 feet, situated, in the midst of gardens, about two miles from the brackish lake iBul- dur Geul, ancient Ascania Limne. Linen-weaving and leather-tanning are the principal industries. Population,*~~

~~*12,000.*~~

~~*BULGARIA.*~~

~~*1. GeOGRAPHY AND STATISTICS.*~~

~~*BULGARIA, the youngest of European states, obtained its independence under the first article of the Treaty of Berlin (13th July 1878), being declared an autonomous and tributary principality under the suzerainty of the Sultan of Turkey. The newly-created state comprised only the territory between the Balkans and the Danube, to- gether with the mountainous districts of Sofia, Samakov, Kustendil, and Trn. By Article XIII. of the same instru- ment, a province designated "Eastern Eumelia" was formed south of the Balkans, endowed with administrative autonomy under a Christian governor-general, but left subject to the direct political and military authority of the Sultan. The de facto union of the two political divisions was accomplished by the revolution of Philippopolis in 1885. In the following year Prince Alexander of Bulgaria was nominated to the governor-generalship of Eastern Rumelia by the Sultan, and in 1896 his successor, Prince Ferdinand, was confirmed in that office. A legal union of the two Bulgarias was thus effected in the person of their ruler; and as their administrations have been amalgamated without protest on the part of Turkey, we are justified in treating of them as a single state.*~~

~~*Bulgaria is bounded on the north by the Danube, from its con- fluence with the Timok to the eastern suburbs of Silistra (Silistria), whence a line, forming the Rumanian frontier, is drawn to a point on the Blacli Sea coast a little south of Mangalja. On the east it is washed by the Blacli Sea ; on the south the Turliish frontier, starting from a point on the coast about 15 kilometres south of Sozopolis, runs in a south-westerly direction, crossing the river Maritza at Mustafa Pasha, and reaching the Arda at Adakali. The line laid down by the Berlin Treaty ascended the Arda to Ishiklar, thence following the crest of Rhodope to the westwards, but the cantons of Krjali and Rupchus included in this boundary were restored to Turkey in 1886. The present frontier, passing to the north of these districts, reaches the watershed of Rhodope a little north of the Dospat valley, and then follows the crest of the Rilska Planina to the summit of Tchmi Vrkh, where the Servian, Turkish, and Bulgarian territories meet. From this point the western or Servian frontier passes*~~

~~*northwards, leaving Tm to the east and Pirot to the west, reaching the Timok near Kula, and following the course of that river to its junction wjth the Danube. The area thus enclosed extends from lat. 44° 12' 30" to 41° 37'*~~

~~30" N., and from long. 26° 16' 31" to 19° 52' 31" E. (meridian of Paris). The Berlin Treaty boundary is far from corresponding with the ethnological limits of the Bulgarian race, which were more accurately defined by the abrogated treaty of San Stefano (see Balkan Peninsula). A considerable portion of Macedonia, the districts of Pirot and Vrania, now belonging to Servia, the northern half of the vilayet of Adrianople, and large tracts of the Dbbruja are, according to the best and most impartial authorities, mainly inhabited by a Bulgarian population.~~

~~The most striking physical features are the two mountain- chains of the Balkans and Rhodope, the former running^ east and west through the heart of the country, the latter au i i forming for a considerable distance its southern f^^^g boundary. The Balkans constitute the southern half of the great semicircular range knovsTi as the anti-Dacian system, of which the Carpathians form the northern portion. The great chain is sundered at the Iron Gates by the passage of the Danube ; its two component parts present many points of resemblance in their aspect and outline, geological formation, and flora. The Balkans (ancient Haerrms) run almost parallel to the Danube, the mean interval being 60 miles ; the summits are, as a rule, rounded, and the slopes gentle. The culminating points are in the centre of the range: Yumrukchil (2385 metres), Maragudtik (2380 m.), and Kadimlla (2275 m.). The Balkans are known to the people of the country as the Stara Planina or " Old Mountain," the adjective denoting their greater size as compared with that of the adjacent ranges: "Balkan" is not a distinctive term, being applied by the Bulgarians, as well as the Turks, to all mountains. Closely parallel to the south are the minor ranges of the Sredna Gora or "Middle Mountains" (highest summit 1575m.) and the Karaja Dagh, enclosing respectively the sheltered valleys of Karlovo and Kazanlyk. At its eastern extremity the Balkan chain divides into three ridges, the central terminating in the Black Sea at Cape Emin^ (" Hsemus "), the northern forming the watershed between the tributaries of the Danube and the rivers falling directly into the Black Sea. The Rhodope, or southern group, is altogether distinct from the Balkans, with which, how- ever, it is connected by the Malka Planina and the Ikhtiman hills, respectively west and east of Sofia ; it may be regarded as a continuation of the great Alpine system which traverses the Peninsula from the Dinaric Alps and the Shar Planina~~

~~on the west to the Shabkhana Dagh near the JEgean coast ; its sharper outlines and pine-clad steeps reproduce the scenery of the Alps~~

~~geography]~~

~~BULGARIA~~

~~445~~

~~rather than that of the Balkans. The imposing summit of MusalU (2930 m.), next to Liubotrn and Olympus, the highest in the Peninsula, foi-ms the centre-point of the group ; it stands Within the Bulgarian frontier at the head of the Mesta valley, on either side of which the Perin Dagh and the Despoto Dagh descend south and south-east respectively towards the JEgean. The chain of Ehodope proper radiates to the east ; owing to the retrocession of territory already mentioned, its central ridge no longer completely coincides with the Bulgarian boundary, but two of its principal summits, Sytk6 (2188 m.) and Karlyk (2081 m.), are within the frontier. From MusalU in a westerly direction extends the majestic range of the Rilska Planina, enclosing in a picturesque valley the celebrated monastery of Bila; many summits of this chain attain 2200 m. Farther west, beyond the Struma valley, is the Osogovska Planina,~~

~~culminating in Ruyen (2253 m.). To the north of the Bilska Planina the almost isolated mass of Vitosha (2291 m.) overhangs Sofia, gnow and ice remain in the sheltered crevices of Rhodope and the Balkans throughout the summer. The fertile slope trending northwards from the Balkans to the Danube is for the most part gradual and broken by hills ; the eastern portion known as the Deli Orman, or " Wild Wood," is almost waterless, cov- ered by forest, and thinly inhabited. The abrupt and sometimes precipitous character of the Bulgarian bank of the Danube con- trasts with the swampy lowlands and lagoons of the Rumanian side. Northern Bulgaria is watered by the Lom, Ogust, Iskr, Vid, Osem, Yantra, and Eastern Lom, all, except the Iskr, rising in the Balkans, and all flowing into the Danube. The channels of these rivers are deeply furrowed and the fall is rapid ; irrigation is consequently difficult and navigation impossible. The course of~~

~~20 tCrcenmch)~~

¯..^.^Serifian and Moncenegrin frontiers

“^^___ ‘Boundaries of Bul^ria and B Pumelia according to the Berlin Treaty. ”*‘^’ Boundary of Bulgaria according to the Treaty of San Stefano. ////////////////Alfestored to Turkey in 1866

Sketch Map op Bulgaria. .

the Iskr is remarkable : rising in the Rilska Planina, the river de- scends into the basin of Samakov, passing thence through a ser- pentine defile into the plateau of Sofia, where in ancient times it formed a lake ; it now forces its way through the Balkans by the picturesque gorge of Iskretz. Somewhat similarly the Deli, or ” Wild,” Kamchik breaks the central chain of the Balkans near their eastern extremity and, uniting with the Great Kamchik, falls into the Black Sea. The Maritza, the ancient Hebrus, springs from the slopes of Musalld, and, with its tributaries, the Tunja and Arda, waters the wide plain of Eastern Ruraelia. The Struma (anc. and mod. Greek Strymon) drains the valley of Kustendil, and, like the Maritza, flows into the JEge&n. The «levated basins of Samakov (lowest altitude, 930 m.), Trn (770 m.), Breznik (750 m.), Radomir (630 m.), Sofia (500 m.), and Kustendil (470 m.), are a peculiar feature of the western highlands.

The stratified formation presents a remarkable variety, almost all the systems being exemplified. The Archaean, composed of gneiss and crystalline schists, and traversed by erup- Oeology. ^jyg veins, extends over the greater part of the Eastern Rumelian plain, the Rilska Planina, Rhodope, and the adjacent ranges. North of the Balkans it appears only in *he neighbourhood of Berkovitza. The other earlier Palaeozoic

systems are wanting, but the Carboniferous appears in the western Balkans with a continental fades (Kulm). Here anthracitiferous coal is found in beds of argillite and sandstone. Red Sandstone and Conglomerate, representing the Permian system, appear especially around the basin of Sofia. Above these, in the western Balkans, are Mesozoic deposits, from the Trias to the upper Jurassic, also occurring in the central part of the range, j The Cretaceous system, from the infra-Cretaceous Hauterivien to the Senonian,

appears throughout the whole extent of Northern Bulgaria, from the summits of the Balkans to the Danube. Gosau beds are found on the southern declivity of the chain. Flysch, representing both the Cretaceous and Eocene systems, is widely distributed. The Eocene, or older Tertiary, further appears with nummulitic formations on both sides of the eastern Balkans ; the Oligocene only near the Black Sea coast at Burgas. Of the Neogene, or younger Tertiary, the Mediterranean, or earlier, stage appears near Pleven (Plevna) in the Leithakalk and Tegel forms, and between Varna and Burgas with beds of spaniodons, as in the Crimea ; the Sarmatian stage in the plain of the Danube and in the districts of Silistra and Varna. A rich mammaliferous deposit (^Hipparion, Bhinocefos, Dinotherium, Mastodon, &c.) of this period has been found near Mesemvria. Other Neogene strata occupy a more limited space. The Quaternary era is represented

by the typical loess, which covers most of the Banuhian plain ; to Its later epochs belong the alluvial deposits of the riparian districts with remains of the nrsus, equns, &c., found in bone-caverns. Eruptive masses intrude in the Balkans and Sredna Gora, as well as in the Archaean formation of the southern ranges, presenting granite, syenite, diorite, diabase, quartz-porphyry, melaphyre, liparite, trachyte, andesite, basalt, &o.

The severity of the climate of Bulgaria in comparison with that of other European regions of the same latitude is attributable „.. , in part to the number and extent of its mountain ranges, in part to the general configuration of the Balkan Peninsula. Extreme heat in summer and cold in winter, great local contrasts, and rapid transitions of temperature occur here as in the adjoining countries. The local contrasts are remarkable. In the districts extending from the Balkans to the Danube, which are exposed to the bitter north wind, the winter cold is intense, and the river, notwithstanding the volume and rapidity of its current, is frequently frozen over ; the tem- perature has been known to fall to -31° (Celsius). Owing to the shelter afforded by the Balkans against hot southerly winds, the summer

~~heat in this region is not unbearable ; its maximum is 37°. The high table-land of Sofia is generally covered with snow in the winter months ; it enjoys, however, a somewhat more equable climate than the northern district, the maximum tempera- ture being 30°, the minimum -19°; the air is bracing, and the summer nights are cool and fresh. In the eastern districts the proximity of the sea ntoderates the extremes of heat and cold, which attain 32,° and – 13° respectively ; the sea is occasionally frozen at Varna. The coast-line is exposed to violent north-east winds, and the Black Sea, the irin-os Si^avoi, maintains its evil reputation for storms. The sheltered plain of Eastern Rumelia possesses a comparatively warm climate ; spring begins six weeks earlier than elsewhere in Bulgaria, and the vegetation is that of Southern Europe. In general the Bulgarian winter is short and severe ; the spring short, changeable, and rainy ; the summer hot, but tempered by thunderstorms ; the autumn (yasen, "the clear time ") magnificently fine and sometimes prolonged into the month of December. The mean temperature is 11°. . The climate is healthy, especially in the mountainous districts. Malarial fever prevails in the valley of the Maritza, in the low-lying regions of the Black Sea coast, and even in the upland plain of Sofia, owing to neglect of drainage. The mean annual rain- fall is 650 millimetres (Gabrovo, 1060; Sofia, 703; Varna, 470 millimetres).~~

~~The mineral wealth of Bulgaria is not inconsiderable.- Among the minerals which are important, from an industrial point of „. . view, are gold (found in small quantities), silver, aera s. gj^phite, galenite, pyrite, marcasite, chalcosine, spha- lerite, chalcopyrite, bornite, cuprite, haematite, limonite, ochre, chromite, magnetite, azurite, manganese, malachite, gyps, &c. The combustibles are anthraoitiferous coal, coal, "brown coal," and lignite. With the exception of coal, the minerals have hitherto been scarcely worked. The coal mines opened at Pemik in 1891 yielded in 1898 an output of 100,000 tons. Coal beds have recently been discovered at Trevna. Thermal springs, mostly sulphureous, exist in forty-three localities along the southern slope of the Balkans, in Rhodope, and in the districts of Sofia and Kiistendil ; maximum temperature at Zaparevo, near Dupnitza, 82°-5 (Celsius), at Sofia 48°. Many of these are frequented now, as in Roman times, owing to their valuable therapeutic qualities. The mineral springs on the north of thle Balkans are, with one exception (Vrshetz, near Berkovitza), cold.~~

~~Few special features are noticeable , in the Bulgarian fauna. Bears are still abundant in the higher mountain districts, especially in the Rilska Plauina and Rhodope ; the Bulgarian bear Fauna, j^ g^^jj a,nd of brown colour, like that of the Carpathians. Wolves are very numerous, and in winter commit great depreda- tions even in the larger country towns and villages; in hard weather they have been known to approach the outskirts of Sofia. The Government offers a reward for the destruction of both these animals. The roe deer is found in aU the forests, the red deer is less common ; the chamois haunts the higher regions of the Rilska Planina, Rhodope, and the Balkans. The jackal (Canis aureus) appears in the district of Burgas ; the lynx is said to exist in the Sredna Gora ; the wild boar, otter, fox, badger, hare, wild cat, marten, polecat {Foetorius putorlus : the rare tiger polecat, Foetorius sarmaticus, is also found), weasel and shrewmouse {Spermophilus citillus) are common. The beaver (Bulg. behr) appears to have been abundant in certain localities, e.g., Bebrovo, Bebresh, &c., but it is now apparently extinct. Snakes {Coluber p.atrix and other species), vipers {Vipera berus and V. ammodytes), and land and water tortoises are numerous. The domestic animals are the same as in the other countries of south-eastern Europe ; the fierce shaggy gray sheep-dog leaves a lasting impression on most travellers in the interior. Fowls, especially turkeys, are everywhere abundant, and great numbers of geese may be seen in**

~~the Moslem villages. The ornithology of Bulgaria is especially interesting. Eagles (Aquila imperialis and the rarer Aquila fulva), vultures {Vultur monachus, Gyps fulvus, Neophron percnopterus), owls, kites, and the smaller birds of prey are extraoi-dinarily abundant ; singing birds, are consequently rare. The lammergeier {Gypaetus barbatus) is not uncommon. Immense flocks of wild fewans, geese, pelicans, herons, and other waterfowl haunt the Danube and the lagoons of the Black Sea coast. The cock of the woods (Tetrao urogallus) is found in the Balkan and Rhodope forests, the wild pheasant in the Tunja valley, the bustard (Otis tarda) in the Eastern Rumelian plain. Among the migratory birds are the crane, which hibernates in the Maritza valley, woodcock, snipe, and quail : the great spotted cuckoo (Coccystes glandarius) is an occasional visitant. The red starling {Pastor roseiis) some- times appears in large flights. The stork, which is never molested, adds a picturesque feature to the Bulgarian village. Of fresli-water fish, the sturgeon (Acipenser sturio and A. huso), sterlet, salmon~~

(Salmo hucho), and carp are found in the Danube; the mouiS tain streams abound in trout. The Black Sea supplies turbot, mackerel, &c. ; dolphins and flying fish may sometimes be seen. The vegetation of Bulgaria has only recently received the scientific attention it deserves. In regard to its flora the country maybe divided into (1) the northern pla4n sloping from the Balkans to the Danube, (2) the southern plain be- '^™™- tween the Balkans and Rhodope, (3) the districts adjoining the Black Sea, (4) the elevated basins of Sofia, Samakov, and Kiis- tendil, (5) the Alpine and sub-Alpine regions of the Balkans and the southern mountain group. In the first-mentioned region the vegetation resembles that of the Russian and Rumanian steppes ; in the spring the country is adorned with the flowers of the crocus, orchis, iris, tulip, and other bulbous plants, which in summer give way to tall grasses, umbelliferous growths, dianthi, astragali, &c. In the more sheltered district south of the Balkans the richer vegetation recalls that of the neighbourhood of Con- stantinople and the adjacent parts of Asia Minor. On the Black Sea coast many types of the Crimean, Transcaucasian, and even the Mediterranean flora present tliemselves. The plateaux of Sofia and Samakov furnish specimens of sub-Alpine plants, while the vine disappears ; the hollow of Kiistendil, owing to its southerly aspect, affords the vegetation of the Macedonian valleys. The flora of the Balkans corresponds with that of the Carpathians ; the Eila' and Rhodope group is rich in purely indigenous types combined with those of the Central European Alps and the mountains of Asia Minor. The Alpine types are often repre- sented by variants : eig., the Cdmpanula alpina by the Campanula orbelica, the Primula farinosa by the Primula frondosa and P. exigua, the Gentiana germanica by the Gentiaua bulgarica, &c. The southern mountain group, in common, perhaps, with the un- explored highlands of Macedonia, presents many isolated types, unknown elsewhere in Europe, and in some cases corresponding with those of the Caucasus. Among the more characteristic genera of the Bulgarian flora are the following: — Centaurea, Cirsium, Linaria, Scrophularia, Verbascum, Dianthus, Silene, Trifolium, Euphorbia, Cytisus, Astragalus, Ornithogalum, Allium, Crocus, Iris, Thymus, Umbellifera, Sedum, Hypericum, Scabiosa, Ranun- culus, Orchis, Ophris.

The principal forest trees are the oak, beech, ash, elm, walnut, cornel, poplar, pine, and juniper. The oak is universal in the thickets, but large

~~specimens are now rarely found. Magnificent forests of beech clothe the valleys of the ””**’*• higher Balkans and the Rilska Planina ; the northern declivity of the Balkans is, in general, well wooded, but the southern slope is bare. The walnut and chestnut are mainly confined to Eastern Rumelia. Conifers (Pinus silvestris, Picea excelsa^ Pinus laricis) are rare in the Balkans, but abundant in the higher regions of the southern mountain group, where the Pinus peuce, otherwise pe- culiar to the Himalayas, also flourishes. The wild lilac forms a beautiful feature in the spring landscape. Wild fruit-trees, such as the apple, pear, and plum, are common. The vast forests of the Middle Ages disappeared under the supine Turkish administration, which took no measures for their protection, and even destroyed the woods in the neighbourhood of towns and highways in order to deprive brigands of shelter. A law passed in 1889 prohibits dis- foresting, limits the right of cutting timber, and places the State forests under the control of inspectors. According to official statistics, 46,000 square kilometres, or nearly half the superficies of the principality, are under forest, but the greater portion of this area is covered only by brushwood and scrub.~~

~~The Bulgarians, who constitute 75-67 per cent, of the inhabitants of the principality, are found in their purest type in the mountain districts, the Ottoman conquest and subsequent colonization having ”” ”^’ introduced a mixed population into the plains. The northern slopes of the Balkans from Belogradchik to Elena~~

~~statistics]~~

~~are inhabited almost exclusively by Bulgarians; in Eastern Rumelia the national element is strongest in the Sredna Gora and Ehodope. Possibly the most genuine representatives of the race are the Pomaks or Mahom- medan Bulgarians, whose conversion to Islam preserved their women from the license of the Turkish conqueror ; they inhabit the highlands of Ehodope and certain dis- tricts in the neighbourhood of Lovetch (Lovtcha) and Pleven (Plevna). Eetaining their Bulgarian speech and many ancient~~

~~*national usages, they may be compared with the indigenous Cretan, Bosnian, and Albanian Mos- lems. The Pomaks in the Principality are estimated at 26,000, but their numbers are declining. In the north- eastern district between the Yantra and the Black Sea the Bulgarian race is as yet thinly represented ; most of the inhabitants are Turks, a quiet, submissive, agri- cultural population, which unfortunately shows a ten- dency to emigrate. The Black Sea coast is inhabited by a variety of races. The Greek element is strong in the maritime towns, and displays its natural aptitude for navigation and commerce. The Gagauzi, a peculiar race of Turkish-speaking Christians, inhabit the littoral from Cape Emin^ to Cape Kaliakra: they are of Turanian origin and descend from the ancient Kumani. The valleys of the Maritza and Arda are occupied by a mixed population consisting of Bulgarians, Greeks, and Turks : the principal Greek colonies are in Stanimaka, Kavakli, and Philippopolis. The origin of the peculiar Shop tribp which inhabits the mountain tracts of Sofia, Breznik, and Kadomir is a mystery. The Shops are conceivably a remnant of the aboriginal race which remained undis- turbed in its mountain home during the Slavonic and Bulgarian incursions : they cling with much tenacity to their distinctive customs, apparel, and dialect. The con- siderable Vlakh or Euman colony in the Danubian districts dates from the last century, when large numbers of Wal- lachian peasants sought a refuge on Turkish soil from the tyranny of the boyars or nobles : the department of Vidin alone contains thirty-six Ruman villages with a population of 30,550. Especially interesting is the race of nomad shepherds from the Macedonian. and the^gean coast who come in thdusands every summer to pasture their flocks on the Bulgarian mountains ; they are divided into two tribes — the Kutzovlakhs, or " lame Vlakhs," who speak Rumanian, and the Hellenized Karakatchans or " black shepherds" (comp. the Mavro-vlakhs, fxavpoi /SXaxes, of the Dalmatian coast) who speak Greek. The Tatars, a peaceable industrious race, are chiefly found in the neigh- bourhood of Varna and Silistra ; they were introduced as colonists by the Turkish Government in 1861. They may be reckoned at 12,000. The gypsies, who are scattered inconsiderable numbers throughout the country, came into Bulgaria in the 14th century. They are for the most part Moslems, and retain their ancient Indian speech. They live in the utmost poverty, occupy separate cantonments in the villages, and are treated as outcasts by the rest of the population. The Bulgarians, being of mixed origin, possess few salient*~~

~~*physical charac- teristics. The Slavonic type is far less pronounced than among the kindred races; the Ugrian or Finnish cast of features occasionally asserts itself in the central Bal- kans. The face is generally oval, the nose straight, the jaw somewhat heavy. The nien, as a rule, are rather below middle height, compactly built, and, among^^the peasantry, very muscular; the women are generally deflcient in beauty and rapidly grow old. The upper class, the so-called " intelligenzia," is physically very inferior to the rural population.*~~

~~*The character of the Bulgarians presents a singular contrast to that of the neighbouring nations. Less quick- witted than the Greeks, less prone to idealism than the*~~

~~*Servians, less apt to assimilate the externals of civiliza- tion than the Rumanians, they possess in a remarkable degree the qualities of patience, perseverance, and endurance, with the capacity for laborious effort peculiar to an agricultural race. The tenacity ^^^"^ and determination with which they pursue their national aims seem likely in the end to give them the advantage over their more brilliant competitors in the struggle for hegemony in the Peninsula. Unlike most southern races, the Bulgarians are reserved, taciturn, phlegmatic, unresponsive, and extremely suspicious of foreigners. The peasants are industrious, peaceable, and orderly ; the vendetta, as it exists in Albania, Montenegro,, and Macedonia, and the use of the knife in quarrels, so common in southern Europe, are alike unknown. The tranquillity of rural life has, unfortunately, been invaded in recent years by the intrigues of political agitators, and bloodshed is not uncommon at elections. All classes, practise thrift bordering on parsimony, and any display of wealth is generally resented. The standard of sexual morality is high, especially in the rural districts ; the^ unfaithful wife is an object of public contempt, and in former times was punished with death. Marriage cere- monies are elaborate and protracted, as is the case in most primitive communities ; elopements are frequent, but. usually take place with the consent of the parents on both sides, in order to avoid the expense of a regular wedding. The principal amusement on Sundays and holidays is the chord (xo/oos); which is danced on the village green to the strains of the gdida, or bagpipe, and the giXsla, a rudi- mentary fiddle. The Bulgari,ans are religious in a simple way, but not fanatical, and the influence of the*~~

~~*priesthood is limited. Many ancient superstitions linger among the- peasantry, such as the belief in the vampire and the evil, eye; witches and necromancers are numerous and are much consulted.*~~

~~*The area of northern Bulgaria is 62,789-10 square- kilometres, of eastern Rumelia 32,916-40 sq. kil., of united Bulgaria, 95,704-50 sq. kil. According to the census of 1st January 1893, the population of northern Bulgaria was 2,312,282, or 36-8 per sq. kil. ; of eastern Rumelia, 998,431, or 30-33 per sq. kil. ;. of united Bulgaria, 3,310,713, or 34-59 per sq. kil. Bulgaria thus ranks between Rumania and Portugal in regard to area ; between the Netherlands and Switzerland in regard to population : in density of population it may be compared with Spain and Greece. The only previous census of united Bulgaria was taken in 1888 : it gave the total population as 3,154,375, or 32-96 per sq. kil. The increase in five years was consequently 156,338, or 1 per cent, per annum. The area and population of the principal subdivisions are shown in the following table : —*~~

~~*Northern Bulgaria, 16 Departments.*~~

~~*Popula- tion.*~~

~~*Population.*~~

~~*Per square Kilometre.*~~

~~*Varna . ...*~~

~~*215,213*~~

~~*25-68*~~

~~*Vidin .*~~

~~*121,131*~~

~~*38-08*~~

~~*Vratza .*~~

~~151,196~~

~~27-04~~

~~Ktistendil~~

~~167,175~~

~~31-43~~

~~Lovetcli~~

~~125,829~~

~~30-02.~~

~~Lom~~

~~115,893~~

~~32-78~~

~~Pleven .~~

~~99,290~~

~~36-85~~

~~Razgrad~~

~~129,631~~

~~45-64~~

~~Russg .~~

~~162,589~~

~~41-62~~

~~*Svishtov*~~

~~*94,119*~~

~~*34-48*~~

~~*Sevlievo*~~

~~*93,275*~~

~~*49-14*~~

~~*Silistra .*~~

~~*111,830*~~

~~*40-18*~~

~~*Sofia .*~~

~~*244,824*~~

~~*43-82*~~

~~*Tm*~~

~~*79,248*~~

~~*36-30*~~

~~*Tmovo .*~~

~~*224,163*~~

~~*45-09*~~

~~*Shumen*~~

~~*177,476*~~

~~36-41~~

~~•-/~~

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~~EcKtern Bumelia, 6 Departments.~~

~~Population.~~

~~Per square Kilometre.~~

~~Philippopolis Sliven~~

~~Stara Zagora Tatar-pazarjik . Haskovo . Burgas~~

~~232,507 170,514 215,483 138,778 124,985 116,164~~

~~33-45 27-36 33-43 24-10 38-38 19-74~~

~~The population of the principal towns in 1893 was as follows : — Sofia, the capital (the Bulgarian name Sredetz is now little used), 46,593; Philippopolis or Plovdiv (capital of eastern Rumelia), 41,068; Russe (Turkish BAstchuk), 37,174; Varna, 28,174; Trnovo (the ancient Bulgarian capital), 25,295 ; Gornia Orgkhovitza, 26,013 ; Sliven (Russian Slivno), 23,210 ; Pleven (Russian Plevna), 23,178; Tatar-pazarjik, 22,066; Razgrad, 21,551. The increase of the population of Sofia in the period 1888- 93 was 10-62 per cent, yearly ; the capital now probably possesses 65,000 inhabitants.~~

~~The population according to sex is given as 1,690,626 males and 1,620,087 females, or 51 males to 49 females. A somewhat similar disparity may be observed in the other countries of the Peninsula. Classified according to occupation, 2,447,198 persons, or 73-9 per cent, of the population, are engaged in agriculture ; 421,121 in various productive industries ; 145,988~~

~~*in the service of the government or the exercise of liberal professions, and 122,104 in commerce. The population according to race cannot be stated with absolute accuracy, but it is approximately shown by the census of 1893, which gives the various nationalities according to language as follows: — Bulgars, 2,505,326; Turks, 569,728 ;' Rumans, 62,628 ; Greeks, 58,518 ; Gypsies (Tziganes), *2,132 ; Jews (Spanish-speaking), 27,531 ; Tatars, 16,290 ; Armenians, 6445 ; other nationalities, 12,115. The Bulgarian inhabitants of the Peninsula beyond the limits of the Principality may, perhaps, be estimated at 1,500,000 or 1,600,000, and the grand total of the race possibly reaches 4,500,000.*~~

~~*The movemeht of the population at intervals of five years has toeen as follows : —*~~

~~*Tear.*~~

~~*Marriages.*~~

~~*Births (living).*~~

~~*Still- born.*~~

~~*Deaths.*~~

~~*Natural Increase.**~~

~~*1882 1887 1892 1897*~~

~~*19,795 20,089 27,.553 29,227*~~

~~*74,642*~~

~~*83,179*~~

~~*117,883*~~

~~*149,631*~~

~~*300 144 321*~~

~~858~~

~~38,884~~

~~39,396~~

~~103,550~~

~~90,134~~

~~35,758 43,783 14,333 59,497~~

~~The death-rate shows a tendency to rise. In the five years 1882-86 the, mean death-rate was 18-0 per 1000 ; in 1887-91, 20-4 ; in 1892-96, 27-0. Infant mortality is high, owing to various causes, especially among the peasants. As the less healthy infants rarely survive, the adult population is in general robust, hardy, and long-lived. The census of 1893 gives 3372 persons of 100 years and upwards. Young men, as a rule, marry before the age of twenty-five, girls before eighteen. The number of illegitimate births is inconsider- able, averaging only 0-12 of the total.~~

~~The devastation of the country which followed the Turkish con- quest resulted in the extirpation or flight of a large proportion of the Bulgarian inhabitants of the plains, who were replaced by Turkish colonists. The mountainous districts, however, retained their original population and sheltered large numbers of the fugitives. The passage of the Turkish armies during the wars with Austria, Poland, and Russia led to further Bulgarian emi- grations. The flight to the Banat, where 22,000 Bulgarians still remain, took place in 1730. At the beginning of the 19th century the majority of the population of the Eastern Rumelian plain was Turkish. The Turkish colony, however, declined, partly in consequence of the drain caused by military service, while the Bulgarian remnant increased, notwithstanding a con- siderable emigration to Bessarabia before and after the Russo- Turkish campaign of 1828. Efforts were made by the Porte to strengthen the Moslem element by planting colonies of Tatars in 1861 and Circassians in 1864. The advance of the Russian army in 1877-78 caused an enormous exodus of the Turkish population, of which only a small proportion returned to settle permanently. The emigration continued after the conclusion of peace, and is~~

~~still in progress, notwithstanding the efforts of the Bulgarian Government to arrest it. In twenty years (1879-99), at least 150,000 Turkish peasants left Bulgaria. Much of the land~~

~~1 Excess of births over deaths.~~

~~Oovern- meat~~

~~thus abandoned still remains unoccupied. On the other hand, a considerable influx of Bulgarians from Macedonia, the vilayet of Adrianople, Bessarabia, and the D(5bruja took place within the same period, and the inhabitants of the mountain villages show a tendency to migrate into the richer districts of the plains.~~

~~The principality is a constitutional monarchy, hereditary in the family of a prince " freely elected by the popula- tion and confirmed by the Sublime Porte with the assent of the Powers " (Berlin Treaty, Ai-t. III.). According to the constitution of Trnovo, voted by the Assembly of Notables, 29th April 1879, and revised by the Grrand Sobranye, 27th May 1893, the princely dignity descends in the direct male line. The prince must profess the Orthodox faith, only the first elected sovereign and his immediate heir being released from this obligation. The legislative power is vested in the prince in conjunction with the national assembly ; he is supreme head of the army, supervises the executive power, and represents the country in its foreign relations. In case of a minority or an interregnum, a regency of three persons is appointed. The national representation is embodied in the Sobranye, or ordinary assembly (Bul- garian, Subranie, the Russian form Sobranye being usually employed by foreign writers), and the Grand Sobranye, which is convoked in extraordinary circumstances. The former is elected by manhood suffrage, in the proportion of 1 to 20,000 of the population, for a term of five years. Every Bulgarian citizen who can read and write and has completed his thirtieth year is eligible as a deputy. Annual sessions are held from the 27th October to the 27th December. All legislative and financial measures must first be discussed and voted by the Sobranye, and then sanctioned and promulgated by the prince. The Govemmentis respon- sible to the Sobranye and the ministers, whether deputies or not, attend its sittings. The Grand S&branye, which is elected in the proportion 6f 2 to every 20,000 inhabitants, is convoked to elect a new~~

~~*prince, to appoint a regency, to sanction a change in the constitution, or to ratify an alteration in the boundaries of the principality. The executive is entrusted to a cabinet of eight members — the ministers of foreign affairs and religion, finance, justice, public works, the interior, commerce and agriculture, education, and war. Local administration, which is organized on the Belgian model, is under the control of the minister of the interior. The country is divided into twenty-two departments (okrug, pi. okruzi), each admin- istered by a prefect (uprdvitel), assisted by a depart- mental council, and eighty-four sub-prefectures (okoUa), each under a sub-prefect (okoUiski natchdlnik). The number of these functionaries is excessive and will prob- ably be reduced. The four principal towns have each in addition a prefect of p<51ice (gradonatchalnik) and one or more commissaries (jpristav). The gendarmery numbers about 4000 men, or 1 to 825 of the inhabitants. The prefects and sub-prefects have replaced the Turkish mutessarifs and kaimaJcams; but the system of municipal government, left untouched by the Turks, descends from primitive times. Every commune (obsJitina), urban or rural, has its kmet, or mayor, and council ; the commune is bound to maintain its primary schools, a public library or reading-room, &c. ; the kmet possesses certain magisterial powers, and in the rural districts he collects the taxes. Each village, as a rule, forms a separate commune, but occasionally two or more villages are grouped together.*~~

~~*The civil and penal codes are, for the most part, based on the Ottoman law. As the principality forms a portion of the Turkish empire, the privileges of the capitulations are guar- anteed to foreign subjects (Berlin Treaty, Art. VIII.). Justice. The lowest civil and criminal court is that of the village kmet, whose jurisdiction is confined to the limits of the commune ; no corresponding tribunal exists in the towns. Each sub-prefecture and town has a justice of the peace — in some oases two or more •*~~

~~*statistics]*~~

~~the number of these officials is 130. Next follows the depart- mental tribunal, or court of first instance, which is competent to pronounce sentences of death, penal servitude, and deprivation of civil rights ; in specified criminal cases the judges are aided by- three assessors chosen by lot from an annually prepared panel of forty-eight persons. Three courts of appeal sit respectively at Sofia, Russ6, and Philippopolis. The highest tribunal is the Court of Cassation, sitting at Sofia, and composed of a president, two vice-presidents, and nine judges. There is also a HIgh Court of Audit (vrkhovna smetna palata) , similar to the French Cour des Comptes. The judges are insufficiently paid and are removable by the Government.~~

~~.The Orthodox Bulgarian National Church claims to be an in- divisible member of the eastern Orthodox communion, and asserts RetleloB. ^'s^O"^'" continuity with the autooephalous Bulgarian church of the Middle Ages. It was, however, declared schismatic by the Greek Patriarch of Constantinople in 1872, although differing in no point of doctrine from the Greek church. The Exarch, or supreme head of the Bulgarian church, resides at Constantinople; he enjoys the title of "beatitude" {negovo Blaz- henstvo), receives an annual subvention of about £6000 from the principality, and exercises jurisdiction over the Bulgarian hierarchy in all parts of the Ottoman Empire. The Exarch is elected by the Bulgarian episcopate, the HIoly Synod, and a general assembly (jabshti sbof), in which the laity is represented ; their choice is subject to the Sultan's approval. The occupant of the dignity is titular Metropolitan of a Bulgarian diocese. The organization of the church within the principality was regu- lated by statute in 1883. There are eleven eparchies or dioceses in the country, each administered by a Metropolitan with a diocesan council ; one diocese has also a suffragan bisliop. Church government is vested in the HIoly Synod, consisting of four Metropolitans, which assembles once a year. The laity take part in the election of Metropolitans and parish priests, only the "black clergy," or monks, being eligible for the episcopate. All ecclesias- tical appointments are subject to the approval of the Government. There are 2106 parishes {eporii) in the principality with 9 archimandrites, 1936 pai'ish priests, and 21 deaqons, 78 monasteries with 184 monks, and 12 convents with 346 nuns. The celebrated monastery of Rila possesses a vast estate in the Rilska Planina ; its abbot or hegumen owns no spiritual~~

~~*superior but the Ex- arch. Ecclesiastical affairs are under the control of the minister of public worship ; the clergy of all denominations are paid by the State, being free, however, to accept fees for bap- tisms, marriages, burials, the administering of oaths, &c. The census of 1893 gives 2,606,786 persons of the Orthodox faith, 643,258 Mahommedans, 28,307 Jews, 22,617 Catholics, 6643 Gre- gorian Armenians, 2384 Protestants, and 718 whose religion is not stated. The Greek Orthodox community has four Metropolitans dependent on the Patriarchate. Tlie Mahommedan community is rapidly diminishing. The Catholics, who have two bishops, are for the most part the descendants of the mediseval Paulicians ; they are especially numerous In the neighbourhood of Philippopolis and Svishtov. The Armenians have one bishop. The Protestants are mostly Methodists ; since 1857 Bulgaria has been a special field of activity for American Methodist missionaries, who have established an important school at Samakov. The Berlin Treaty (Art. V.), forbids religious disabilities in regard to the enjoyment of civil and political rights, and guarantees the free exercise of all religions.*~~

~~*Education has made astonishing progress since the liberation of the country from Turkish rule. No educational system existed in the rural districts before 1878 ; the peasantry was Education, g^^j^ jjj ignorance, and the older generation is now totally illiterate. In the towns the schools were under the super- intendence of thp Greek clergy, and Greek was the language of in- struction. The first Bulgarian school was founded at Gabrovo in 1835 by the patriot Neophyt. After the Crimean war, Bulgarian schools began to appear in the villages of the Balkans and the south-eastern districts. The children of the wealthier class were generally educated abroad. The American institution of Robert College on the Bosporos rendered an invaluable service to the newly-created State by providing it with a number of well-educated young men fitted for positions of responsibility. Primary education was declared obligatory from the first, but the scarcity of properly qualified teachers and the lack of all requisites proved serious im- pediments to educational organization. The Government has made great efforts and incurred heavy expenditure for the spread of education ; the satisfactory results obtained are largely due to the keen desire for learning which exists among the people. All the villages now possess "national" (narodni) primary schools, maintained by the*~~

communes with the aid of a State subvention and supervised by departmental and district inspectors. The State also assists a large number of Turkish primary schools. The pen- alties for non-attendance are not enforced, and it has been found necessary to close the schools in the rural districts during the sum-

mer, the children being required for labour in the fields. The age for primary instruction is six to twelve years; in 1890, 47-01 per cent, of the boys and 16-11 per cent, of the girls attended the primary schools ; in 1898, 85 per cent, of the boys and 40 per cent, of the girls. In the latter year there were 4686 primary schools, of which 3111 were "national" or communal, and 1575 denomi- national (including 1842 Turkish, 43 Tatar, 42 Greek, 16 Ar- menian, and 38 Jewish), attended by 348,716 pupils, representing a proportion of 10-57 per hundred inhabitants. In 1888 only 327,766 persons, or H per cent, of the population, were literate ; in 1893 the proportion rose to 19-88 per cent. ; in 1897 of 25,620 young men presenting themselves for military service, 12,119, or 47 27 per cent. , were literate. In the system of secondary educa tion the distinction between the classical and ' ' real " or special courses of study is maintained as in most European countries ; there are 121 secondary schools (43 for boys, 38 for girls, and 40 mixed), for the most part with three classes, and 16 gymnasia (9 for boys and 7 for girls) with 7 classes. In addition to these there are 6 technical and 3 agricultural schools ; 5 of pedagogy, 1 theo- logical, 1 commercial, 1 of forestry, 1 of design, 1 for surgeons' assistants, and a large military school at Sofia. Government aid is given to students of limited means, both for secondary education and the completion of their studies abroad. The university of Sofia, of which the organization is incomplete, is still known as the high school (vishe utchilishte) ; it possesses a staff of 17 professors and 25 lecturers. The number of students is 288. The progress of learning has, unfortunately, tended to create a distaste for agri- cultural and industrial pursuits ; the daily increasing number of candidates for State employment swells the ranks of the various political parties, and the country is threatened with the growth of an educated proletariat.

At the outset of its career the principality was practically unen- cumbered with any debt, external or internal. The stipulations of the Berlin Treaty

~~(Art. IX.), with regard to the pay- ment of a tribute to the Sultan and the assumption of "aace.~~

~~an "equitable proportion " of the Ottoman debt, were never car- ried into effect. In 1883 the claim of Russia (under Art. XX. of the Treaty) for the expenses of the occupation, was fixed at 26,545,625 fr., payable in annual instalments of 2,100,000 fr. The union with Eastern Rumelia in 1885 entailed liability for the obli- gations of that province, consisting of an annual tribute to Turkey of 2,951, 000 fr., and a loan of 3,375,000 fr., contracted with the Imperial Ottoman Bank. In 1888 the purchase of the Varna- Russ6 railway for 46,777,500 fr., was effected by the issue to the vendors of treasury bonds at 6 per cent. In 1889 a loan of 30,000,000 fr., bearing 6 per cent, interest, was contracted with the Vienna Landerbank and Bankverein at 85J. In 1892 a further 6 per cent, loan of 142,780,000 fr. in six options was contracted with the Landerbank at 83, 86, and 89, of which 126,480,000 fr. had been issued up to 31st Octolaer 1899, together with an advance of 7,000,000 fr. In August 1899 the national debt stood as follows : Outstanding amount of the above-mentioned loans, 184,898,000 fr. ; advanced by the Landerbank (June 1889), 7,000,000 fr. ; due to Russia, 9,718,296 fr. ; arrears of the Eastern Rumelian tribute, 5,451,900 fr. : total external debt 207,068,196 fr. The total in- ternal debt at the same date was about 33,100,000. The entire national liabilities were, therefore, approximately 240,168,196 fr. The Eastern llumelian tribute and the rent of the Vakarel-Belovo railway, if capitalized at 6 per cent., would represent a further sum of 50,919,100 fr. On the 1st Jan. 1900 a 6 per cent, guaran- teed loan of 25,000,000 fr. at 89, repayable in 5 years, was con- tracted with a group of foreign banks in order to meet immediate liabilities. The national debt is not disproportionately great in com- parison with annual revenue. After the union with Eastern Rumelia the budget receipts increased from 40,893,262 leva (=franos) in 1886 to 101,872,280 leva in 1894 ; the estimated revenue for 1900 was 83,827,863 leva, of which 35,294,900 were de- rived from direct, 29,901,000 from indirect taxation ; the estimated expenditure was 83,270,370 leva, the principal items being ; public debt, 24,646,849; army, 20,773,432; education, 8,114,526; in- terior, 7,238,880 ; public works, 5,863,176 leva. In 1895 direct taxation, which pressed heavily on the agricultural class, was diminished, and indirect taxation (import duties and excise) con- siderably increased. The former is now 10-22 leva~~

per head of the population, the latter 9-65 leva. The financial difficulties into which the country has recently fallen are to be attributed, not to excessive indebtedness, but to heavy outlay on public works, the army, and education, and to the maintenance of an unnecessary number of officials ; the economic situation has been aggra- vated by a succession of bad harvests. The expenditure on public works, however, will ultimately prove remunerative. The war budget during ten years (1888-97) absorbed the large sum of 275,832,017 leva, or 35-77 per cent, of the whole national in- come within that period. Expenditure on education, which was 2,648,154 leva In 1888, reached 9,313,137 leva in 1897. The excess of expenditure over actual receipts (the

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latter including the proceeds of the various loans), from the creation of the principality to the beginning of the financial year 1896, was 65,823,574 leva. Arrears of taxation are considerable : the outstanding amount at the beginning of 1897 was 16,259,340 leva.

The organization of th.e military forces of the princi- pality was undertaken by Russian ofScers, who for a period

of six years (1879-85) occupied all the higher ^my and p^g^g jj^ ^j^g ^rmy. In Eastern Eumelia during

the same period the " militia " was instructed by foreign officers ; after the union it was merged in the Bulgarian army. The present organization is based on the law of 27th December 1891. The army consists of :

(1) the active or field army (deistvuyusMa armia) divided into (i.) the active army ; (ii.) the active army reserve ;

~~(2) the reserve army (reservna armia) ; (3) the opUcheiiie or militia : the two former may operate outside the princi- pality, the latter only within the frontier for purposes of defence. In time of peace the active army (i.) alone is on a permanent footing. The peace strength in 1899 was 2164 officers, 38,987 men, and 6764 horses, the active army being composed of 6 divisions of infantry, 5 regi- ments of cavalry, 7 regiments of artillery, and 1 regiment of engineers, together with artillery garrisons, &c. The total effective in time of war is 162,938 officers and men, with 84,000 officers and men of the reserve army ; grand total 236,938, exclusive of the opltchenie, which as yet is without equipment. Military service is obligatory, but Moslems may claim exemption on payment of £20; the age of recruitment in time of peace is nineteen, in time of war eighteen. Each conscript serves two years in the infantry and subsequently eight years in the active reserve or three years in the other corps and six years in the active reserve; he is then liable to seven years' service in the reserve army and finally passes into the opltchenie. The Bulgarian peasant makes an admirable soldier — courageous, obedient, persevering, and inured to hardship ; the officers are painstaking and devoted to their duties. The hours of drill, &c., are perhaps excessive, but the results are satisfactory. The cavalry is the least efficient branch of the service. Under the new arrangements for mobilization the reserve army will be organized in twelve regiments corresponding with those of the active army. The active army is furnished with the 315" Mannlicher magazine rifle, the reserve with the Mannlicher and Ber dan; the artillery mainly consists of 8-7- and 7-5-cm. Krupp guns and 12-cm. Krupp howitzers. The army is locally distributed in six divisions, with headquarters at Sofia, Philippopolis, Sliven, Shumen, Eusse, and Vidin. The last-named is the only fortified town, but defensive works are in progress at Sofia and Sliv^nitza, and an en- trenched camp has been formed at Belogradchik. The naval force of the principality consists of a flotilla star tioned at Russ^ and Varna. It is composed of 1 prince's yacht (800 tons), 3 gunboats, 3 torpedo boats, and 10 other small vessels, with a complement of 69 officers and 488 men.~~

~~Agriculture, the main source of wealth to the country, is still in an extremely primitive condition. The ignorance and conservatism of the peasantry, the habits engendered by wide-spread insecurity and the fear of official rapacity under Turkish rule, in- sufficiency of communications, want of~~

~~capital, and in some districts sparsity of population, have all tended to retard the development of this most important industry. The peasants cling to traditional usage, and look with suspicion on modern implements and new-fangled modes of production. The plough is of a primeval type, rotation of crops is only partially practised, and the use of manure is almost unknown. The Government has sedulously endeavoured to introduce more enlightened methods and~~

~~ideas by the establishment of agricultural schools, the appointment of itinerant professors and inspectors, the distribution of better kinds of seeds, improved implements, &c. Efforts have latterly been made to improve the breeds of native cattle and horses, and stallions have been in- troduced from Hungary and distributed throughout the country. Oxen and buffaloes are the principal animals of draught; the buffalo, which was apparently introduced from Asia in remote times, is much prized by the peasants for its patience and strength; it is, however, somewhat delicate and requires much care. In the eastern districts camels are also employed. The Bulgarian horses are small, but remarkably hardy, wiry, and intelligent; they are as a rule unfitted for draught and cavalry purposes. The best sheep are found in the district of Karnobat in Eastern Eumelia. The number of goats in the country has considerably declined in recent years, the Government having imposed a relatively high tax on these animals owing to the injury they inflict on young trees. The average price of oxen is £5 each, draught oxen £12 the pair, buffaloes £14 the pair, cows £2, horses £6, sheep 7s., goats 5s. each. The principal cereals are wheat, maize, rye, barley, oats, and millet. The cultivation of maize is increasing in the Danubian and eastern districts. Eice-fields are found in the neighbourhood of Philippopolis. Cereals represent about 80 per cent, of the total exports. Besides grain, Bulgaria produces wine, tobacco, attar of roses, silk, and cotton. The quality of the grape is ex- cellent, and could the peasants be induced to abandon their highly primitive mode of wine-making the Bulgarian vintages would rank among the best European growths. The tobacco, which is not of the highest quality, is grovni in considerable quantities for home consumption, and only an insignificant amount is exported. The best tobacco- fields in Bulgaria are on the northern slopes of Ehodope, but the southern declivity, which~~

~~*produces the famous Kavala growth, is more adapted to the cultivation of the plant. The rose-fields of Kazanlyk and Karlovo lie in a sheltered valley between the Balkans and the parallel chains of the Sredna Gora and Karaja Dagh. About 6000 pounds of the rose-essence are annually exported, valuing from £12 to £14 per pound. Sericulture, for- merly an important industry, has declined owing to disease among the silkworms, but efforts are being made to revive it with promise of success. Cotton is grown in the southern districts of Eastern Eumelia.*~~

~~*Peasant proprietorship is universal, the small freeholds averag- ing about 18 acres each. There are scarcely any large estates owned by individuals, but some of the monasteries possess considerable domains. The large tchifliks, or farms, formerly belonging to Turkish landowners, have been divided among the peasants. The rural proprietors enjoy the right of pasturing their cattle on the common lands belonging to each village, and of cutting wood in the State forests. They live in a condition of rude comfort, and poverty is practically unknown, except in the towns. A peculiarly interesting feature in Bulgarian agricultural life is the zadruga, or house-community, a patriarchal institution apparently dating from prehistoric times. Family groups, sometimes numbering several dozen persons, dwell together on a farm in the observance of strictly communistic principles. The association is ruled by a house-father (domakin, stareishina) and a house-mother (doma- kinid), who assign to the members their respective tasks. In addition to the farm work the members often practise various trades, the proceeds of which are paid into the general treasury. The community sometimes includes a priest, whose fees for baptisms, &c., augment the common fund. The national aptitude for combination is also displayed in the associations of market gardeners (gradinarski druzhini, tdifi), who in the spring leave their native districts for the purpose of cultivating gardens in the neighbourhood of some town, either in Bulgaria or abroad, returning in the autumn, when they divide the profits of the enterprise ; the number of persons annually thus engaged probably exceeds 10,000.*~~

~~*The development of manufacturing enterprise on a large scale has been retarded by want of capital. The principal*~~

~~*statistics]*~~

~~establishments for the native manufactures of aba and shayak (rough and fine homespuns), and of gaitan (braided ^^^ _ embroidery) are at Sliven and Gabrovo re- tares! ^' spectively. The Bulgarian homespuns, which are made of pure wool, are of admirable quality. The exportation of textiles is almost exclusively to Turkey : value in 1896, £104,046; in 1897, £116,250; in 1898, £144,726. Unfortunately the home demand for native fabrics is diminishing, owing to foreign competition ; the smaller textile industries are declining, and the pictur- esque, durable, and comfortable costume of the country is giving way to cheap, ready-made clothing imported from Austria. The Government has endeavoured to stim- ulate the home industry by ordering all persons in its employment to wear the native cloth, and the army is sup- plied almost exclusively by the factories at Sliven. A great number of small distilleries exist throughout the country ; there are breweries in all the principal towns, tanneries at Sevlievo, Varna, &c., numerous corn-mills worked by water and steam, and saw-mills, turned by the mountain torrents, in the Balkans and Rhodope. A cer- tain amount of foreign capital has recently been invested in industrial enterprises ; the most notable are a sugar- refinery in the neighbourhood of Sofia, and a cotton- spinning mill at Varna, on which an English company has expended about £60,000.~~

~~The usages of internal commerce have been considerably modified by the development of communications. The _ primitive system of barter in kind still exists~~

~~in the rural districts, but is gradually disappear- ing. The great fairs (panairi, TrauTjyvpas) held at Eski- Jumaia, Hajioloupazarjik, and other towns, which formerly attracted multitudes of foreigners as well as natives, have lost much of their importance ; a considerable amount of business, however, is still transacted at these gatherings, of which ninety-seven were held in 1898. The principal seats of the export trade are Varna, Burgas, and Baltchik on the Black Sea, and Svishtov, Eusse, Nikopolis, Silistra, Kakhovo, and Vidin on the Danube. The chief centres of distribution for imports are Varna, Sofia, Eusse, Philip- popolis, and Burgas. About 10 per~~

~~*cent, of the exports passes over the Turkish frontier, but the Government is making great efforts to divert the trade to Varna and Burgas, and important harbour works have been under- taken at both these ports. Iti 1887 the total value of Bulgarian foreign commerce was £4,419,589. The follow- ing table gives the values for the six years ending 1899. The great fluctuations in the exports are due to the varia- tions of the harvest, on which the prosperity of the country practically depends : —*~~

~~*Tear.*~~

~~*Exports.*~~

~~*Imports.*~~

~~*Total.*~~

~~*£*~~

~~*£*~~

~~*£*~~

~~*1894*~~

~~*2,914,027*~~

~~*3,969,168*~~

~~*6,883,195*~~

~~*1895*~~

~~*3,107,422*~~

~~*2,760,812*~~

~~*5,868,235*~~

~~*1896*~~

~~*4,349,599*~~

~~*3,061,211*~~

~~*7,410,810*~~

~~*1897*~~

~~*2,391,620*~~

~~*3,359,770*~~

~~*5,751,390*~~

~~*1898*~~

~~*2,661,480*~~

~~*2,909,210*~~

~~*5,570,690*~~

~~*1899*~~

~~*2,138,684*~~

~~*2,407,123*~~

~~*4,545,807*~~

~~*The principal exports are cereals, live stock, homespuns, hides, cheese, eggs, attar of roses. Exports to the United Kingdom in 1898 were valued at £413,668, in 1899 at £394,954. The principal imports are textiles, metal goods, colonial goods, implements, furniture, leather, petroleum. Imports from the United Kingdom in 1898, £695,345 ; in 1899, £493,736. The following is the average percentage of imports from various countries in ten years (1888-97) — from Austria-Hungary, 33-32; United Kingdom, 24-09 ; Turkey, 12-70; Germany, 9-53; Russia, 5-18; France, 4-56; Italy, 2-36; Belgium, 2-26 ; other countries, 6-0.*~~

~~*The National Bank, a State institution with a capital of 10 000,000 leva, has its central establishment at Sofia and*~~

~~*Comaittai' cations.*~~

~~*branches at Philippopolis, Eussfi, Varna, and Tmovo. Besides conducting the ordinary banking operations, it issues loans on mort- gage. There are several private banks in the country. The Imperial Ottoman Bank and the Industrial Bank of Kiev have branches at Philippopolis and Sofia respectively. The agricultural chests, founded by Midhat Pasha in 1863, and reorganized in 1894, have done much to rescue the peasantry from the hands of usurers. They serve as treasuries for the local administration, accept deposits at interest, and make loans to the peasants on mortgage or the security of two solvent landowners at 8 per cent. Their capital in 1887 was 14,231,440 leva ; in 1898, 30,657,360 leva. The post-office savings banks, established 1896, have a capital of 3,403,318 leva. There are over 200 registered provident societies in the country. The legal rate of interest is 10 per cent., but much higher rates are not uncommon.*~~

~~*Bulgaria, like the neighbouring states of the Peninsula, has adopted the metric system. Turkish weights and measures, however, are still largely employed in local commerce. The monetary unit is the lev, or " lion " (pi. leva\ nominally equal to the franc, with its submultiple the stotinka (pi. ki), or centime. The coinage consists of nickel and bronze coins (2|, 5, 10, and 20 stotinki) and silver coins (50 stotinhi; 1, 2, and 5 leva). A gold coinage was struck in 1893 with pieces corresponding to those of the Latin Union. The Turkish pound and foreign gold coins are also in general circulation. The National Bank issues notes for 5, 10, 20, 50, and 100 leva, formerly payable in gold, but since November 1899 payable in silver with the agio. Notes payable in silver are also issued. The gold premium has con siderably increased in recent years.*~~

~~*In 1878 the only railway in Bulgaria was the Eusse- Varna line (221 kilometres) constructed by an English company in 1867. In Eastern Rumelia the line from Sarambey to Philippopolis and the Turkish frontier (196 kilometres), with a branch to Yamboli (106 kilometres) had been built by Baron HIrsch in 1873 ; it is now worked by the Oriental Rail- ways Company. The construction of a railway from the Servian frontier at*~~

~~Tzaribrod to the Eastern Eumelian frontier at Vakarel was imposed on the principality by the Berlin Treaty, but political difficulties intervened, and the line, which touches Sofia, was not completed tiU 1888. In that year the Bulgarian Government seized the short connecting line Vakarel-Belovo belonging to Turkey, and railway communication between Constantinople and the western capitals was established. Since that time great progress has been made in railway construction. In 1888, 384 kilometres of State railways were open to traffic ; in 1893, 493 kilometres ; in 1898, 681 kilometres ; and in December 1899, 1250 kilometres. All these lines are worked by the State, and, with the exception of the Vakarel-Belovo line (46 kilometres), are its property. The completion of the important line Eadomir-SofiarShumen (November 1899) opened up the rich agricultural dis- trict between the Balkans and the Danube. Branches to Samovit and Eusse establish connexion with the Eumanian railway system on the opposite side of the river. It is hoped, with the consent of the Turkish Government, to extend the line Sofia-Eadomir to Uskub, and thus to secure a direct route to Salonika and the .lEgean.~~

~~The total receipts of the State railways in 1898 were 5,103,554 leva ; working expenses, 6,598,053 leva. The expenditure on construction and purchase of railways and rolling stock up to the year 1897 is given as 114,433,522 leva. Road communication is still in an unsatisfactory condition. Roads are divided into three classes: "State roads" or main highways maintained by the Government; "district roads" maintained by the district councils ; and "inter-village roads" (mezhduselskishosseta), main- tained by the communes. Of the first there are 4200 kilometres, of the second, 3515 kilometres. Repairs are effected by the corvee system with requisitions of material ; 1086 kilometres of new roads are now in construction. There are no canals, and inland navigation is confined to the Danube. The Austrian Donau- dampschiffartsgesellschaft and the Russian "Gagarine" steam- ship company compete for the river traffic ; the grain trade is largely served by steamers belonging to Greek merchants. The coasting trade on the Black Sea is carried on by a Bulgarian steamship company ; the steamers of the Austrian Lloyd, and other foreign companies call at Yama, and occasionally at Burgas.~~

~~*BULGARIA*~~

~~*[history*~~

~~*The great development of postal and telegraphic communication attests the advance of civilization. The number of letters posted in 1886 was 1,468,494 ; in 1896, 4,370,216 ; in 1898, 5,869,034. The number of telegrams in 1886 was 527,556 ; in 1896, 1,082,326 ; in 1898, 1,099,163. Receipts of posts and telegraphs were in 1886, 1,024,386 leva ; in 1896, 2,327,660 leva ; in 1898, 2,900,732 leva. In 1898 there were 5244 kilometres of telegraph lines and 87 kilo- metres of telephones.*~~

~~*2. Political History.*~~

~~*The ancient Thraco-Illyrian race which inhabited the ■district between the Danube and the Mgea.n was expelled, or more probably absorbed, by the great Slavonic immi gration which took place at various intervals between the «nd of the 3rd century after Christ and the beginning of the 6th. The numerous tumuli which are found in all parts of the country (see Herodotus, v. 8) and some stone tablets with bas-reliefs remain as monuments of the aboriginal population; and certain structural peculiari- ties, which are common to the Bulgarian and Eumanian languages, may conceivably be traced to the influence of the primitive Illyrian speech, now represented by the Albanian. The Slavs, an agricultural people, were gov- erned, even in those remote times, by the democratic local institutions to which they are still attached; they possessed no national leaders or central organization, and their only political unit was the pleine, or tribe. They were considerably influenced by contact with Eoman civilization. It was reserved for a foreign race, altogether distinct in origin, religion, and customs, to give unity and coherence to the scattered Slavonic groups, and to weld them into a compact and powerful State which for some centuries played an important part in the history of eastern Europe and threatened the existence of the Byzantine empire.*~~

~~*The Bulgars, a Turanian race akin to the Tatars, Huns, Avars, Petohenegs, and "Finns, made tlieir appearance on the banks of the Pruth in the latter part of the 7th century. They ^*® were a horde of wild horsemen, fierce and barbarous,*~~

~~*Bulgars. practising polygamy, and governed despotically by their khans and boyars (or bolyars). Their original abode was the tract between the Ural mountains and the Volga, where the kingdom of Great (or Black) Bolgary existed down to the 13th century. In 679, under their khan Asparukh (or Isperikh), they crossed the Danube, and, after subjugating the Slavonic population of Moesia, advanced to the gates of Constantinople and Salonika. The By- zantine emperors were compelled to cede to them the province of Moesia and to pay them an annual tribute. The invading horde was not numerous, and during the next two centuries it became gradually merged in the Slavonic population. Like the Franks in Gaul the Bulgars gave their name and a political organization to the more civilized race which they conquered, but adopted its language, customs, and local institutions. Not a trace of the Ugrian or Finnish element is to be found in the Bulgarian speech. This complete assimilation of a conquering race may be illustrated by many parallels.*~~

~~*The history of the early Bulgarian dynasties is little else than a record of continuous conflicts with the Byzantine emperors. The tribute first imposed on the Greeks by Asparukh was ^'"y again exacted by Kardam (791-797) and Krum (802-815) ,*~~

~~*dyaastles. ^ sovereign noted alike for his cruelty and his military and political capacity. Under his rule the Bulgarian realm ex- tended from the Carpathians to the neighbourhood of Adrianople ; Serdica (the present Sofia) was taken, and the valley of the Struma conquered. Preslav, the Bulgarian capital, was attacked and burnt by the 'emperor Nikeph6ros, but the Greek army on its return was annihilated in one of the Balkan passes ; the emperor was slain, and his skull was converted by Krum into a goblet. The reign of Boris (852-884) is memorable for the introduction of Christianity into Bulgaria. Two monks of Salonika, SS. Cyril and Methodius, are generally reverenced as the national apostles ; the scene of their labours, however, was among the Slavs of Moravia, and the Bulgars were evangelized by their disciples. Boris, finding himseU surrounded by Christian states, decided from political motives to abandon paganism. He was baptized in 864, the em- peror Michael III. acting as his sponsor. It was at this time that the controversies broke out which ended in the schism between the Latin and Orthodox communities. Boris long wavered between*~~

~~Constantinople and Rome, but the refusal of the Pope to recognize an autocephalous Bulgarian church determined him to offer his allegiance to the Greek Patriarch. The decision was fraught with~~

~~momentous consequences for the future of the race. The nation altered its religion in obedience to its sovereign, and some of the boyars who resisted the change paid with their lives for their fidelity to the ancient belief. The independence of the Bulgarian church was recognized by the Patriarchate, a fact much dwelt upon in recent controversies. The Bulgarian primates subsequently re- ceived the title of patriarch ; their see was transferred from Prgslav to Sofia, Voden, and Prespa successively, and finally to Okhrida.~~

~~The national power reached its zenith under Simeon (893-927), a monarch distinguished in the arts of war and peace. In his reign, says Gibbon, "Bulgaria assumed a rank among the civilized powers of the earth." His dominions ex- g^*) tended from the Black Sea to the Adriatic, and from " "•~~

~~the borders of Thessaly to the Save and the Carpathians. Having become the most powerful monarch in Eastern Europe, Simeon assumed the style of "Emperor and Autocrat of all the Bulgars and Greeks" {tsar i samodrzhetz vsem Blgarom i Grkom), a. title which was recognized by Pope Formosus. During the latter years of his reign, which were spent in peace, his people made great progress in civilization, literature flourished, and Prgslav, accord- ing to contemporary chroniclers, rivalled Constantinople in mag- nificence. After the death of Simeon the Bulgarian power declined owing to internal dissensions ; the land was distracted by the Bogomile heresy, and a separate or western empire, including Albania and Macedonia, was founded at Okhrida by Shishman, a boyar from Tmovo. A notable event took place in 967, when the Russians, under Sviatoslav, made their first appearance in Bulgaria. The Bulgarian tsar, Boris II., with the aid of the emperor John Zimisces, expelled the invaders, but the Greeks took advantage of their victory to dethrone Boris, and the first Bulgarian empire thus came to an end after an existence of three centuries. The empire at Okhrida, however, rose to considerable importance under Samuel, the son of Shishman (976-1014), who conquered the gi-eater part of the Peninsula, and ruled from the Danube to the Morea. After a series of campaigns this redoubtable warrior was defeated at B§lasitza by the emperor Basil II.,~~

~~*surnamed Bulgaroktdnos, who put out the eyes of 15,000 prisoners taken in the fight, and sent them into the camp of his adversary. The Bulgarian tsar was so overpowered by the spectacle that he died of grief. A few years later his dynasty finally disappeared, and for more than a century and a half (1018-1186) the Bulgarian race remained subject to the Byzantine emperors.*~~

~~*In 1186, after a general insurrection under the brothers Ivan and Peter As§n of Tmovo, who claimed descent from the dynasty of the Shishmanovtzi, the nation recovered its inde- pendence, and Ivan AsSn assumed the title of " Tsar of the Bulgars and Greeks." The seat of the second empire was at Tmovo, which the Bulgarians regard as the historic capital of their race. Kaloyan, the third of the As§n monarchs, extended his dominions to Belgrade, Nish, and Skopie (Uskub); he acknowledged the spiritual supremacy of the Pope, and received the royal crown from a papal legate. The greatest of all Bulgarian rulers was Ivan AsSn II. (1218-1241), a man of humane and en- lightened character. After a series of victorious campaigns he established his sway over Albania, Epirus, Macedonia, and Thrace, and governed his wide dominions with justice, wisdom, and moderation. In his time the nation attained a prosperity hitherto unknown : commerce, the arts, and literature flourished ; Tmovo, the capital, was enlarged and embellished, and great numbers of churches and monasteries were founded or endowed. The dynasty of the As§ns became extinct in 1267, and a period of decadence began. Two other dynasties, both of Kuman origin, followed — the Terterovtzi, who ruled at Trnovo, and the Shishmanovtzi, who founded an independent State at Vidin, but afterwards reigned in the national capital. Eventually, on the 28th June 1330, a day commemorated with sorrow in Bulgaria, Tsar Michael Shishman was defeated and slain by the Servians, under Stephen Urosh III., at the battle of Velbfizhd (Kiistendil). Bulgaria, though still re- taining its native rulers, now became subject to Servia, and formed part of the short-lived empire of Stephen Dushan (1331-1355) . The Servian hegemony vanished after the death of Dushan, and the Christian races of the Peninsula, distracted by the quarrels of their petty princes, fell an easy prey to the advancing might of the Moslem invader.*~~

~~*In 1340 the Turks had begun to ravage the valley of the Maritza ; in 1362 they captured Philippopolis, and in 1382 Sofia. In 1366 Ivan Shishman III., the last Bulgarian tsar, ^/., t, was compelled to declare himself the vassal of the Ig**~~

~~*Sultan Murad I., and to send his sister to the harem of ”’”” the conqueror. In 1389 the rout of the Servians, Bosnians, and Croats on the famous field of Kossovo decided the fate of the Peninsula. Shortly afterwards Ivan Shishman was attacked by the Turks ; and Tmovo, after a siege of three months, was cap- tured, sacked, and burnt in 1393. The fate of the last Bulgarian sovereign is unknown ; the national legend represents him aa perishing in a battle near Samakov. Vidin, where Ivan’s brother,*~~

~~*Second empire.*~~

~~*histoey]*~~

~~*B U L G A E I A*~~

~~*453*~~

~~*Strazhimir, had established himself, was taken in 1396, and with Its fall the last remnant of Bulgarian independence disappeared.*~~

~~*The five centuries of Turkish rule (1396-1878) form a dark epoch in Bulgarian history. The invaders carried fire and sword through the land ; towns, villages, and monasteries were sacked and de- stroyed, and whole districts were converted into desolate wastes. The inhabitants of the plains fled to the mountains, where they founded new settlements. Many of the nobles embraced the creed of Islam, and were liberally rewarded for their apostasy ; others, together with numbers of the priests and people, took refuge across the Danube. All the regions formerly ruled by the Bulgarian tsars, including Macedonia and Thrace, were placed under the administration of a governor-general, styled the beyler- bey of Rum-ili, residing at Sofia; Bulgaria proper was divided into the sanjaks of Sofia, Nikopolis, Vidin, Silistra, and Kiistendil. Only a small proportion of the people followed the example of the boyars in abandoning Christianity ; the conversion of the isolated communities now represented by the Pomaks took*~~

~~*place at various intervals during the next three centuries. A new kind of feudal system replaced that of the boyars, and fiefs or spahiliks were conferred on the Ottoman chiefs and the renegade Bulgarian nobles. The Christian population was subjected to heavy imposts, the principal being the haratch, or capitation-tax, paid to the imperial treasury, and the tithe on agricultural produce, which was collected by the feudal lord. Among the most cruel forms of oppression was the requisitioning of young boys between the ages of ten and twelve, who were sent to Con- stantinople as recruits for the corps of janissaries. Notwith- standing the horrors which attended the Ottoman conquest, the condition of the peasantry during the first three centuries of Turkish government was scarcely worse than it had been under the tyran- nical rale of the boyars. The contemptuous indifference with which the Turks regarded the Christian rayas was not altogether to the dis- advantage of the subject race. Military service was not exacted from the Christians, no systematic effort was made to extinguish either their religion or their language, and within certain limits they were allowed to retain their ancient local administration and the jurisdiction of their clergy in regard to inheritances and family affairs. At the time of the conquest certain towns and villages, known as the vo'initchki sela, obtained important privileges which were not infringed till the 18th century ; on condition of furnishing contingents to the Turkish army or grooms for the Sultan's horses they obtained exemption from most of the taxes and complete self-government under their voivodi or chiefs. Some of them, such as Koprivshtitza in the Sredna Gora, attained great prosperity, which has somewhat declined since the establish- ment of the principality. While the Ottoman power was at its height the lot of the subject-races was far less intolerable than during the period of decadence, which began with the unsuccessful siege of Vienna in 1683. Their rights and privileges were respected, the law was enforced, commerce prospered, good roads were constructed, and the great caravans of the Ragusan merchants traversed the country. Down to the end of the 18th century there appears to have been only one serious attempt at revolt — that occasioned by the advance of Prince Sigismund Bd,thory into Wallachia in 1595. A kind of guerilla warfare was, however, maintained in the mountains by the haiduti, or outlaws, whose exploits, like those of the Greek klephts, have been highly idealized in the popular folk-lore. As the power of the Sultans declined anarchy spread through the Peninsula. In the earlier decades of the 18th*~~

~~*century the Bul- garians suffered terribly from the ravages of the Turkish armies passing through the land during the wars with Austria. Towards its close their condition became even worse owing to the horrors perpetrated by the Krjalis, or troops of disbanded soldiers and desperadoes, who, in defiance of the Turkish authorities, roamed through the country, supporting themselves by plunder and committing every conceivable atrocity. After the peace of Bel- grade (1737), by which Austria lost her conquests in the Peninsula, the Servians and Bulgarians began to look to Russia for deliver- ance, and their hopes were encouraged by the treaty of Kainarji, under which the Empress Catherine obtained the protectorate of the orthodox Christians in the Turkish empire. In 1794 Pasvan- oglu, one of the chiefs of the Krjalis, established himself as an independent sovereign at Vidin, putting to flight three large Turkish armies which were despatched against him. This adven- turer possessed many remarkable qualities. He adorned Vidin with handsome buildings, maintained order, levied taxes, and issued a separate coinage. He died in 1807. The memoirs of Sofronii, bishop of Vratza, present a vivid picture of the condition of Bulgaria at this time. "My diocese," he writes, "was laid desolate ; the villages disappeared— they had been burnt by the Krjalis and Pasvan's brigands ; the inhabitants were scattered far and w|de over Wallachia and other lands."*~~

~~*At the beginning of the 19th century the exist-*~~

~~*ence of the Bulgarian race was almost unknown in Europe even to students of Slavonic literature. Dis- heartened by ages of oppression, isolated from Christendom by their geographical position, and revival' cowed by the proximity of Constantinople, the Bulgarians took no collective part in the insurrectionary movement which resulted in the liberation of Servia and Greece. The Eussian invasions of 1810 and 1828 only added to their sufferings, and great numbers of fugitives took refuge in Bessarabia, annexed by Eussia under the treaty of Bucarest. But the long-dormant national spirit now began to awake under the influence of a literary revival. The precursors of the movement were Paisii, a monk of Mount Athos, who wrote a history of the Bul- garian tsars and saints (1762), and Bishop Sofronii, whose memoirs have been already mentioned. After 1824 several works written in modern Bulgarian began to appear, but the most important step was the foundation, in 1836, of the first Bulgarian school at Gabrovo.*~~

~~*Within ten years at least 53 Bulgarian schools came into existence, and five Bulgarian printing-presses were at work. The literary movement led the way to a reaction against the influence and authority of the Greek clergy. The spiritual domination of the Greek Patriarchate had tended more effectually than the temporal power of the Turks to the effacement of Bulgarian nationality. After the conquest of the Peninsula the Greek Patriarch became the repre- sentative at the Sublime Porte of the RHwrmilleti, the Eoman nation, in which all the Christian nationalities were comprised. The independent patriarchate of Trnovo was suppressed; that of Okhrida was subsequently Hellen- ized. The Phanariot clergy — unscrupulous, rapacious, and corrupt — succeeded in monopolizing the higher ecclesi- astical appointments and filled the parishes with Greek priests, whose schools, in which Greek was exclusively taught, were the only means of instruction open to the population. By degrees Greek became the language of the upper classes in all the Bulgarian towns, the Bulgarian language was written in Greek characters, and the illiterate peasants, though speaking the vernacular, called them- selves Greeks. The Slavonic liturgy was suppressed in favour of the Greek, and in many places the old Bulgarian manuscripts, images, testaments, and missals were com- mitted to the flames. The patriots of the literary move- ment, recognizing in the Patriarchate the most determined foe to a national revival, directed all their efforts to the abolition of Greek ecclesiastical ascendancy and the re- storation of the Bulgarian autonomous church. Some of the leaders went so far as to open negotiations with Eome, and an archbishop of the Uniate Bulgarian church was nominated by the Pope. The struggle was prose- cuted with the utmost tenacity for forty years. Incessant protests and memorials were addressed to the Porte, and every effort was made to undermine the position of the Greek bishops, some of whom were compelled to abandon their sees. At the same time no pains were spared to diffuse education and to stimulate the national sentiment. Various insurrectionary movements were attempted by the patriots Eakovski, Panayot Khitoff, Haji Dimitr, Stephen Karaja, and others, but received little support from the mass of the people. The recognition of Bulgarian nation- ality was won by the pen, not the sword. The Patriarchate at length found it necessary to offer some concessions, but thfese appeared illusory to the Bulgarians, and long and acrimonious discussions followed. Eventually the Turkish Government intervened, and on the 28th February 1870 a firman was*~~

issued establishing the Bulgarian Exarchate, with jurisdiction over fifteen dioceses, including Nish, Pirot, and Veles ; the other dioceses in dispute were to be added to these in case two-thirds of the Christian popu- lation so desired. The election of the first exarch was

delayed till February 1872, owing to the opposition of the Patriarch, who immediately afterwards excommuni- cated the new head of the Bulgarian church and all his followers. The official recognition now acquired tended to consolidate the Bulgarian nation and to prepare it for the political developments which were soon to follow. A great educational activity at once displayed itself in all the districts subjected to the new ecclesiastical power.

Under the enlightened administration of Midhat Pasha (1864r68) Bulgaria enjoyed comparative prosperity, but

that remarkable man is not remembered with AeraA ot gja^^jjtude by the people owing to the severity

with which he repressed insurrectionary move- ments. In 1861, 12,000 Crimean Tatars, and in 1864 a still larger number of Circassians from the Caucasus, were settled by the Turkish Government on lands taken without compensation from the Bulgarian peasants. The Circassians, a lawless race of mountaineers, proved a veritable scourge to the population in their neighbourhood. In 1875 the insurrection in Bosnia and Herzegovina produced immense excitement throughout the Peninsula. The fanaticism of the Moslems was aroused, and the Bulgarians, fearing a general massacre of Christians, endeavoured to anticipate the blow by organizing a general revolt. The rising, which broke out prematurely at Koprivshtitza and Panagurishte in May 1876, was mainly confined to the sanjak of Philippopolis. Bands of bashi- bazouks were let loose throughout the district by the Turkish authorities, the Pomaks, or Moslem Bulgarians, and

~~*the Circassian colonists were called to arms, and a succession of horrors followed to which a parallel can scarcely be found in the history of the Middle Ages. The principal scenes of massacre were Panagurishte, Perushtitza, Bratzigovo, and Batak ; at the last-named town, according to an official British report, 5000 men, women, and children were put to the sword by the Pomaks under Achmet Aga, who was decorated by the Sultan for this exploit. Altogether some 15,000 persons were massacred in the district of Philippopolis, and fifty-eight villages and five monasteries were destroyed. Isolated risings which took place on the northern side of the Balkans were crushed with similar barbarity. These atrocities, which were first made known by an English journalist and an American consular official, were de- nounced by Gladstone in a celebrated pamphlet which aroused the indignation of Europe. The Great Powers remained inactive, but Servia declared war in the follow- ing month, and her army was joined by 2000 Bulgarian volunteers. A conference of the representatives of the Powers, held at Constantinople towards the end of the year, proposed, among other reforms, the organization of the Bulgarian provinces, including the greater part of Macedonia, in two vilayets under Christian governors, with popular representation. These recommendations were practically set aside by the Porte, and in April 1877 Eussia declared war. In the campaign which fol- lowed the Bulgarian volunteer contingent in the Russian army played an honourable part ; it accompanied Gourko's advance over the Balkans, behaved with great bravery at Stara Zagora, where it lost heavily, and rendered valuable services in the defence of Shipka.*~~

~~*The victorious advance of the Eussian army to Con- stantinople was followed by the treaty of San Stefano*~~

~~*(3rd March 1878), which realized almost to the BerUn." ^^^ *^^ national aspirations of the Bulgarian*~~

~~*race. All the provinces of European Turkey in which the Bulgarian element predominated were now included in an autonomous principality, which extended from the Black Sea to the Albanian mountains, and from the Danube to the .iEgean, enclosing Okhrida, the*~~

ancient capital of the Shishmans, Dibra, and Kastoria, as well as the districts of Vranya and Pirot, and pos- sessing a Mediterranean port at Kavala. The Ddbruja, notwithstanding its Bulgarian population, was not in- cluded in the new state, being reserved as compensation to Eumania for the Eussian annexation of Bessarabia; Adrianople, Salonika, and the Chalcidian peninsula were left to Turkey. The area thus delimited constituted three-fifths of the Balkan Peninsula, with a population of 4,000,000 inhabitants. The Great Powers, however, anticipating that this extensive territory would become a Eussian dependency, intervened ; and on the 13th July of the same year was signed the treaty of Berlin, which in effect divided the " Big Bulgaria " of the San Stefano treaty into three portions. The limits of the princi- pality of Bulgaria, as now defined, and the autonomous province of Eastern Eumelia, have been already de- scribed ; the remaining portion, including almost the whole of Macedonia and part of the viMyet of Adrianople, was left under Turkish administration. No special organization was provided for the districts thus aban- doned ; it was stipulated that laws similar to the organic law of Crete should be introduced into the various parts of Turkey in Europe, but this engagement was never carried out by the Porte. Vranya, Pirot, and Nish were given to Servia, and the transference of the Ddbruja to Eumania was sanctioned. This artificial division of the Bulgarian nation could scarcely be regarded as possess- ing elements of permanence. It was provided that the prince of Bulgaria should be freely elected by the popu- lation, and confirmed by the Sublime Porte with the assent of the Powers, and that, before his election, an assembly of Bulgarian notables, convoked at Trnovo, should draw up the organic law of the principality. The drafting of a constitution . for Eastern Eumelia -was assigned to a European commission.

Pending the completion of their political organization, Bulgaria and Eastern Eumelia were occupied by Eussian troops and administered by Eussian officials. The assembly of notables, which met at Trnovo in 1879, was mainly composed of half-educated peasants, who from the first displayed an extremely democratic spirit, in which they proceeded to manipulate the very liberal constitu- tion submitted to them by Prince Dondukoff- Korsakoff, the Eussian governor-general. The ™ "^^ long period of Turkish domination had effectu- ^„. ally obliterated all social distinctions, and the radical element, which now formed into a party under*

~~Tzankoff and Karaveloff, soon gave evidence of its pre- dominance. Manhood suffrage, a single chamber, pay- ment of deputies, the absence of a property qualification for candidates, and the prohibition of all titles and dis- tinctions, formed salient features in the constitution now elaborated. The organic statute of Eastern Eumelia was largely modelled on the Belgian constitution. The gov- ernor-general, nominated for five years by the Sultan with the approbation of the Powers, was assisted by an Assembly, partly representative, partly composed of ex- officio members ; a permanent committee was entrusted with the preparation of legislative measures and the general supervision of the administration, while a coun- cil of six " directors " fulfilled, the duties of a ministry.~~

~~On the 29th April 1879 the Assembly at Trnovo, on the proposal of Eussia, elected as first sovereign^ ot. Bulgaria Prince Alexander of Battenberg, a member of the grand ducal house of Hesse ^|""*j and a nephew of the Tsar Alexander II. Ar- riving in Bulgaria on the 7th July, Prince Alexander, then in his twenty-third year, found all the authority, military and civil, in Eussian hands. The history of the earlier portion of his reign is marked by two principal~~

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~~features — a strong Bulgarian reaction against Eussian tutelage and a vehement struggle against the autocratic institutions which the young ruler, under Eussian guid- ance, endeavoured to inaugurate. Both movements were symptomatic of the determination of a strong-willed and egoistic race, suddenly liberated from secular oppression, to enjoy to the full the moral and material privileges of liberty. In the Assembly at Trnovo the popular party had adopted the watchword "Bulgaria for the Bulgarians," and a considerable anti-Russian contingent was included in its ranks. Young and inexperienced. Prince Alexander, at the suggestion of the Russian consul-general, selected his first ministry from a small group of "Conservative" politicians whose views were in conflict with those of the parliamentary majority, but he was soon compelled to form a " Liberal " administration~~

~~*under Tzankoff and Karaveloff. The Liberals, once in power, initiated a violent campaign against foreigners in general and the Russians in particular; they passed an alien law, and ejected foreigners from every lucrative position. The Russians made a vigorous resistance, and a state of chaos ensued. Eventually the prince, finding good govern- ment impossible, obtained the consent of the Tsar to a change of the constitution, and assumed absolute au- thority on the 9th May 1881. The Eussian general Ernroth was appointed sole minister, and charged with the duty of holding elections for the Grand Sobranye, to which the right of revising the constitution appertained. So successfully did he discharge his mission that the national representatives, almost without debate, sus- pended the constitution and invested the prince with absolute powers for a term of seven years (July 1881). A period of Eussian government followed under Generals Skobeleff and Kaulbars, who were specially despatched from St Petersburg to enhance the authority of the prince. Their administration, however, tended to a con- trary result, and the prince, finding himself reduced to impotence, opened negotiations with the Bulgarian leaders and effected a coalition of all parties on the basis of a restoration of the constitution. The generals, who had made an unsuccessful attempt to remove the prince, withdrew ; the constitution of Trnovo was restored by proclamation (19th September 1883), and a coalition min- istry was formed under Tzankoff. Prince Alexander, whose relations with the court of St Petersburg had be- come less cordial since the death of his uncle, the Tsar Alexander II., in 1881, now incurred the serious dis- pleasure of Eussia, and the breach was soon widened by the part which he played in encouraging the national aspirations of the Bulgarians.*~~

~~*In Eastern Eumelia, where the Bulgarian population never ceased to protest against the division of the race, political life had developed on the same lines as Union in the principality. Among the politicians two Rumeiia. parties had come into existence — the Conserva- tives or self-styled " Unionists," and the Eadicals, derisively called by their opponents "Kazioni" or treasury- seekers ; both were equally desirous of bringing about the union with the principality. Neither party, how- ever, while in power would risk the sweets of office by embarking in a hazardous adventure. It was reserved for the Kazioni, under their famous leader Zakharia Stoy^noff, who in early life had been a shepherd, to realize the*~~

~~*national programme. In 1885 the Unionists were in office, and their opponents lost no time in organiz- ing a conspiracy for the overthrow of the governor- general, Krstovitch Pasha. Their designs were facilitated by the circumstance that Turkey had abstained from sending troops into the province. Having previously assured themselves of Prince Alexander's acquiescence, they seized the governor-general and proclaimed the*~~

~~*Servian war.*~~

~~*union with Bulgaria (18th September). The revolution took place without bloodshed, and a few days later Prince Alexander entered Philippopolis amid immense enthu- siasm. His position now became precarious. The Powers were scandalized at the infraction of the Berlin Treaty ; England alone showed sympathy, while Eussia denounced the union and urged the Porte to reconquer the revolted province — both Powers thus reversing their respective attitudes at the Berlin congress.*~~

~~*The Turkish troops were massed at the frontier, and Servia, hoping to profit by the difficulties of her neigh- bour, suddenly declared war (14th November). At the moment of danger the Russian officers, who filled all the higher posts in the Bulgarian army, were withdrawn by order of the Tsar. In these critical circumstances Prince Alexander displayed con- siderable ability and resource, and the nation gave evi- dence of hitherto unsuspected qualities. Contrary to general expectation, the Bulgarian army, imperfectly equipped and led by subaltern ofSeers, successfully resisted the Servian invasion. After brilliant victories at Slivnitza (19th November) and Tsaribrod, Prince Alexander crossed the frontier and captured Pirot (27th November), but his further progress was arrested by the intervention of Austria. The Treaty of Bucarest followed (3rd March 1886), restoring the status quo ante; Servia, notwithstanding her aggression, escaped a war indemnity, but the union with Eastern Eumelia was practically secured. By the convention of Top-Khand (5th April) Prince Alexander was recognized by the Sultan as gov- ernor-general of Eastern Rumeiia ; a personal union only was sanctioned, but in effect the organic statute disap- peared and the countries were administratively united. These military and diplomatic successes, which invested the prince with the attributes of a national hero, quick- ened the decision, of Russia to effect his removal. An instrument was*~~

~~*found in the discontent of several of his officers, who considered themselves slighted in the distri- bution of rewards, and a conspiracy was formed in which Tzankoff, Karaveloff (the prime minister), Archbishop Clement, and other prominent persons were implicated. On the night of the 21st August the prince was seized in his palace by several officers and compelled, under menace of death, to sign his abdication ; he was then hurried to the Danube at Rakhovo and transported to Russian soil at Reni. This violent act met with instant disapproval on the part of the great majority of the nation. Stambu- loff, the president of the Assembly, and Colonel Mutku- roff, commandant of the troops at Philippopolis, initiated a counter-revolution ; the provisional government set up by the conspirators immediately fell, and a few days later the prince, who had been liberated by the Russian author- ities, returned to the country amid every demonstration of popular sympathy and affection. HIs arrival fore- stalled that of a Eussian imperial commissioner, who had been appointed to proceed to Bulgaria. He now com- mitted the error of addressing a telegram to the Tsar in which he offered to resign his crown into the hands of Eussia. This unfortunate step, by which he ignored the suzerainty of Turkey, and represented Bulgaria as a Eus- sian dependency, exposed him to a stern rebuff, and fatally compromised his position. The national leaders, after obtaining a promise from the Eussian representa- tive at Sofia that Eussia would abstain from inter- ference in the internal affairs of the country, consented to his departure; on the 8th September he announced his abdication, and on the following day he left Bul- garia.*~~

~~*A regency was now formed, in which the prominent figure was Stambuloff, the most remarkable man whom modern Bulgaria has produced. A series of attempts to*~~

~~*[language*~~

~~*The regency.*~~

~~*throw the country into anarchy were firmly dealt with, and the Grand Sobranye was summoned to elect a new prince. The candidature of the prince of Mingrelia was now set up by Eussia, and General Kaulbars was despatched to Bulgaria to make known to the people the wishes of the Tsar. He vainly endeavoured to postpone the convocation of the Grand Sobranye in order to gain time for the restoration of Eussian influence, and proceeded on an electoral tour through the country. The failure of his mission was followed by the withdrawal of the Eussian representatives from Bulgaria. The Grand Sobranye, which assembled at Trnovo, offered the crown to Prince Valdemar of Den- mark, brother-in-law of the Tsar, but the honour was declined, and an anxious period ensued, during which a deputation visited the principal capitals of Europe with the twofold object of winning sympathy for the cause of Bulgarian independence and discovering a suitable candi- date for the throne.*~~

~~*On the 7th July 1887, the Grand Sobranye unanimously elected Prince Ferdinand of Saxe-Coburg-Gotha, a grand- son, maternally, of King Louis Philippe. The 'perdtnand ^^^ prince, who was twenty-six years of age, was at this time a lieutenant in the Austrian army. Undeterred by the difficulties of the international situation and the distracted condition of the country, he accepted the crojvn, and took over the government on the 14th August at Trnovo. His arrival, which was wel- comed with enthusiasm, put an end to a long and critical interregnum, but the dangers which menaced Bulgarian independence were far from disappearing. Eussia declared the newly-elected sovereign a usurper ; the other Powers, in deference to her susceptibilities, declined to recognize him, and the grand vizier informed him that his presence in Bulgaria was illegal. Numerous efforts were made to disturb internal tranquillity, and Stambuloff, who became prime minister on the 1st September, found it necessary to govern with a strong hand. A raid led by the Eussian captain Nabokoff was repulsed ; brigandage, maintained for political purposes, was exterminated ; the bishops of the Holy Synod, who, at the instigation of Clement, refused to pay homage to the prince, were forcibly removed from Sofia ; a military conspiracy organized by Major Panitza was crushed, and its leader executed. An attempt to murder the energetic prime minister resulted in the death of his colleague, Beltchev, and shortly afterwards Dr Vlkovitch, the Bulgarian represen- tative at Constantinople, was assassinated. While con- tending*~~

~~*with unscrupulous enemies at home, Stambuloff pursued a successful policy abroad. Excellent relations were established with Turkey and Eumania, valuable concessions were twice extracted from the Porte in regard to the Bulgarian episcopate in Macedonia, and loans were concluded with foreign financiers on comparatively favourable terms. His over- bearing character, however, increased the number of his opponents, and alienated the goodwill of the prince. In 1894 he resigned office ; a ministry was formed under Dr Stoiloff, and Prince Ferdinand inaugurated a policy of conciliation towards Eussia with a view to obtaining his recognition by the Powers. A Eussophil reaction followed, large numbers of political refugees returned to Bulgaria, and Stambuloff, exposed to the vengeance of his enemies, was assassinated in the streets of Sofia (15th Jidy 1895) . The prince's plans were favoured by the death of the Tsar Alexander III. in November 1894, and the reconciliation was practically effected by the conversion of his eldest son. Prince Boris, to the orthodox faith (14th February 1896). The Powers having signi- fied their assent, he was nominated by the Sultan prince of Bulgaria and governor-general of Eastern Eumelia*~~

~~*Siam- baloff.*~~

~~*(14th March). Eussian influence now became predomi- nant in Bulgaria, but the cabinet of St. Petersburg wisely abstained from interfering in the internal affairs of the principality. In February 1896 Eussia proposed the reconciliation of the Greek and Bulgarian churches and the removal of the exarch to Sofia. The project, which involved a renunciation of the exarch's jurisdiction in Macedonia, excited strong opposition in Bulgaria, and was eventually dropped. The death of Princess Marie- Louise of Bourbon Parma (30th January 1899), whom Prince Ferdinand had married in 1893, caused universal regret in the country.*~~

~~*Prince Ferdinand's reign has been marked by a great improve- ment in the material condition of Bulgaria. The completion of a network of railways has considerably benefited the agricultural population, on whose welfare the prosperity of the country depends. Education has progressed, perhaps too rapidly ; the principal danger for the future lies in the growth of a class of educated office-seekers, whose intrigues distract the industrious rural popu- lation. Notwithstanding the dangers and difficulties which dark- ened*~~

~~its earlier years, the principality, in the short period of its existence, has made a rapid and striking advance, to which the sister states of the Peninsula cannot offer a parallel. The Bulga- rians, a virile, laborious, thrifty, orderly, and persevering people, possess many qualities which will fit them to occupy an important position in the future political system of the Balkan Peninsula. The task which lies before them is to develop the resources of their country, to resist foreign interference, to await the future with confidence and patience, and eventually to include within their boundaries the unenfranchised portion of their race.~~

~~3. Language and Litbkaturb.~~

~~The Bulgarian is at once the most ancient and the most modern of the languages which constitute the Slavonic group. In its groundwork it presents £^„^ the' nearest approach to the old ecclesiastical Slavonic, the liturgical language common to all the ortho- dox Slavs, but it has undergone more important modifi- cations than any of the sister dialects in the simplification of its grammatical forms ; and the analytical character of its development may be compared with that of the neo- Latin and Germanic languages. The introduction of the definite article, which appears in the form of a suf&x, and the almost total disappearance of the ancient de- clensions, for which the use of prepositions has been substituted, distinguish the Bulgarian from all the other members of the Slavonic family. Notwithstanding- these changes, which give the language an essentially modern aspect, its close affinity with the ecclesiastical Slavonic, the oldest written dialect, is regarded as estab- lished by several eminent scholars, such as Schafarik, Schleicher, Leskien, and Brugman, and by many Eussian philologists. These authorities agree in describing the liturgical language as " Old Bulgarian." A different view, however, is maintained by Miklositch, Kopitar, and some others, who regard it as " Old Slovene." Ac- cording to the more generally accepted theory, the dialect spoken by the Bulgarian population in the neigh- bourhood of Salonika, the birthplace of SS. Cyril and Methodius, was employed by the Slavonic apostles in their translations from the Greek, which formed the model for subsequent ecclesiastical literature. This view receives support from the fact that the two nasal vowels of the Church-Slavonic (the greater and lesser As), which have been modified in all the cognate lan- guages except Polish, retain~~

~~their original pronunciation locally in the neighbourhood of Salonika and Kastoria; in modern literary Bulgarian the rJiinesmus has disap- peared, but the old nasal vowels preserve a peculiar pro- nunciation, the greater Us changing to u, as in English " but," the lesser to e, as in " bet," while in Servian, Eus- sian, and Slovene the former becomes u or o, the latter e or ya. The remnants of the declensions still existing in~~

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~~Bulgarian (mainly in pronominal and adverbial forms) show a close analogy to those of the old ecclesiastical language.~~

~~The Slavonic apostles wrote in the 9th century (St Cyril died in 869, St Methodius in 885), but the original manuscripts have not been preserved. The oldest existing copies, which date from the 10th century, already betray the influence of the contempor ary vernacular speech, but as the alterations introduced by the copyists are neither constant nor regular, it is possible to recon- struct the original language with tolerable certainty. The " Old Bulgarian," or archaic Slavonic, was an inflexional language of the synthetic type, containing few foreign elements in its vocabulary. The Christian terminology was, of course, mainly Greek; the Latin or German words which occasionally occur were derived from Moravia and Pannonia, where the two saints pursued their missionary labours. In course of time it underwent consider- able modifications, both phonetic and structural, in the various Slavonic countries in which it became the liturgical language, and the various MSS. are consequently classified as " Servian-Slavonic," "Croatian-Slavonic," "Russian-Slavonic," &c., according to the different recensions. The "Russian-Slavonic" is the liturgical language now in general use among the orthodox Slavs of the Balkan Peninsula owing to the great number of ecclesiastical books introduced from Russia in the 17th and 18th centuries ; until comparatively recent times it was believed to be the genuine language of the Slavonic apostles. Among the Bulgarians the spoken language of the 9th century underwent important changes during the next three hundred years. The influence of these changes gradually~~

~~asserts itself in the written language ; in the period extending from the 12th to the 15th century the writers still endeavoured to follow the archaic model, but it is evident that the vernacular had already become widely different from the speech of SS. Cyril and Methodius. The language of the MSS. of this period is known as the "Middle Bulgarian" ; it stands midway between the old ecclesiastical Slavonic and the modern speech.~~

~~In the first half of the 16th century the characteristic features of the modern language became apparent in the literary monuments. These features undoubtedly displayed themselves at a much earlier period in the oral speech ; but the progress of their development has not yet been completely investigated. Much light may be thrown on this subject by the examination of many hitherto little-known manuscripts and by the scientific study of the folk-songs. In addition to the employment of the article, the loss of the noun-declensions, and the modification of the nasal vowels above alluded to, the disappearance in pronunciation of the final vowels yer-golem and yer-mal^k, the loss of the infinitive, and the increased variety of the conjugations, distinguish the modern from the ancient language. The suffix-article, which is derived from the demonstrative pronoun, is a feature peculiar to the Bulgarian among Slavonic and to the Rumanian among Latin languages. This and other points of resemblance between these remotely related members of the Indo-European group are shared by the Albanian, the representative of the old Illyrian language, and have consequently been attributed to the Influence of the aboriginal speech of the Peninsula. A demonstrative suffix, how- ever, is sometimes found in Russian and Polish, and traces of the article in an embryonic state occur in the " Old Bulgarian " MSS. of the 10th and 11th centuries. In some Bulgarian dialects it assumes different forms according to the proximity or remoteness of the object mentioned. Thus zftena-to is " the woman " ; zhena-va or zhena-sa, "the woman close by"; zhena-na, "the woman yonder." In the borderland between the Servian and Bulgarian nationalities the local use of the article supplies the means of dt-awing an ethnological frontier ; it is nowhere more marked than in the immediate neighbourhood of the Servian population, as, for instance, at Dibra and Prilep. The modern Bulgarian has admitted many foreign elements. It contains about 2000 Turkish and 1000 Greek words dispersed In the various dialects ; some Persian and Arabic words have entered through the Turkish medium, and a few~~

~~*Rumanian and Albanian words are found. Most of these are rejected by the purism of the literary language, which, however, has been compelled to borrow the phraseology of modem civiliza- tion from the Russian, French, and other European languages. The dialects spoken in the principality may be classed in two groups — the eastern and the western. The main point of differ- ence is the pronunciation of the letter yedvo'ino, which in the eastern has frequently the sound of ya, in the western invariably that of a in "ate." The literary language began in the western dialect under the twofold influence of Servian literature and the church Slavonic. In a short time, however, the eastern dialect prevailed, and the influence of Russian literature became pre- dominant. An anti-Russian reaction was initiated by Bogoroff (1818-92), and has been maintained by numerous writers educated in the German and Austrian universities. Since the foundation of the University of Sofia the literary language has taken a middle*~~

~~*course between the ultra-Russian models of the past generation and the dialectic Bulgarian. Little uniformity, however, has yet been attained in regard to diction, orthography, or pronunciation.*~~

~~*The Bulgarians of pagan times are stated by the monk Khrabr, a contemporary of Tsar Simeon, to have employed a peculiar writing, of which inscriptions recently found near Kaspitchan may possibly be specimens. The earliest manuscripts of the " Old Bulgarian " are written in one or other of the two alphabets known as the glagolitic and Cyrillic. The former, which is supposed to have been derived from the cursive Greek of the 9th century, was probably the original alphabet devised by SS. Cyril and Methodius. It was used by Bulgarian writers concurrently with the Cyrillic down to the 12th century, and was maintained till recent times in the church literature of the Catholic Slavs in parts of Dalmatia and the Adriatic archipelago. The Cyrillic, which adopted the uncial Greek characters, is now believed to be of later date than the Slavonic apostles ; it is, perhaps, to be attributed to St Clement or one of their other disciples who evangelized Bulgaria. While the glagolitic altered the Greek letters almost beyond recognition, the Cyrillic retained them with little change ; both alphabets supplied several new characters to denote Slavonic sounds unknown to the Greek. Many of the oldest glagolitic and Cyrillic manuscripts have been edited by various scholars in recent times ; they*~~

~~*have been found, for the most part, in Russian libraries, but valuable specimens are preserved in the Vatican, in the monasteries of Rila and Mount Athos, and in Vienna, Agram, Lubliane, Prague, Berlin, and London. The sacred book of Reims, on which the French kings took the coronation oath, is written partly in the Cyrillic, partly in the glagolitic character. Among the orthodox Slavs the Cyrillic ficnally superseded the glagolitic; as modified by Peter the Great it became the Russian alphabet, which, with the revival of literature, was introduced into Servia and Bulgaria. Some Russian letters which are superfluous in Bulgarian have been abandoned by the native writers, and a few characters have been restored from the ancient alphabet.*~~

~~*The ancient Bulgarian literature, originating in the "works of SS. Cyril and Methodius and their disciples, con- sisted for the most part of theological works translated from the Greek. From the conversion of Boris down to the Turkish conquest the religious '»"'"'"'• character predominates, and the influence of Byzantine literature is supreme. Translations of the gospels and epistles, lives of the saints, collections of sermons, exegetic religious works, translations of Greek chronicles, and mis- cellanies such as the Sbornik of St Sviatoslav, formed the staple of the national literature. In the time of Tsar Simeon, himself an author, considerable literary activity prevailed ; among the more remarkable works of this period was the Shestodnev, or Hexameron, of John the exarch, an account of the creation. A little later the heresy of the Bogomiles gave an impulse to controversial writing. The principal champions of orthodoxy were St KosmSs and the monk Athanas of Jerusalem ; among the Bogomiles the Questions of St Ivan Bogosloff, a work con- taining a description of the beginning and the end of the world, was held in high esteem. Contemporaneously with the spread of this sect a number of apocryphal works, based on the Scripture narrative, but embellished with Oriental legends of ahighly imaginative character, obtained great popularity. Together with these religious writings works of fiction, also of Oriental origin, made their ap- pearance, such as the life of Alexander the Great, the story of Troy, the tales of Stephanit and Ichnilat and Barlaam and Josaphat, the latter founded on the bio- graphy of Buddha. These were for the most part repro- ductions or variations of the fantastical romances which circulated through Europe in the Middle Ages, and many of them have left traces in the national legends and folk- songs.*~~

~~*In the 13th century, under the As§n dynasty, numerous historical works or chronicles (Utopisi) were composed. State records appear to have existed, but none of them have been preserved. With the Ottoman conquest literature disappeared ; the manuscripts became the food of moths and worms, or fell a prey to the fanaticism of the Phanariot clergy. The library of the patriarchs of Trnovo was committed to the flames by the Greek Metro-politan Hilarion in 1825.*~~

~~The monk Paisii (bom about 1720) and Bishop Sofronii (1739- 1815) have already been mentioned as the precursors of the literary revival. The Istoria Slaveno-Bolgarskq (1762) of Paisii, written in the solitude of Mount Athos, was a work of little historical value, but its influence upon the Bulgarian race was immense. An ardent patriot, Paisii recalls the glories of the Bulgarian tsars and saints, rebukes his fellow-countrymen for allowing themselves to be called Greeks, and denounces the arbitrary proceedings of the Phanariot prelates. The Life and Sufferings of sinful Sofronii (1804) de-scribes in simple and toaohing language the condition of Bulgaria at the beginning of the 19th century. Both works were written in a modified form of the church Slavonic. The first printed work in the vernacular appears to have been a translation of sermons, also by Sofronii, published in 1806. The Servian and Greek insurrections quickened the patriotic sentiments of the Bulgarian refugees and merchants in Rumania, Bessarabia, and southern Russia, and Buoarest became the centre of their political and literary activity. A modest bukvar, or primer, published at Kronstadt by Berovitch in 1824, was the first product of the new movement. Translations of the Gospels, school reading-books, short histories, and various elementary treatises now appear, written with the object of conveying the simple rudiments of knowledge to the ignorant population. With the multiplication of books came the movement for establishing Bulgarian schools, in which the monk Neophyt Rilski (1793-1881) played a leading part. Hc was the author of a Bulgarian grammar and other educational works, and translated the New Testament into the modern language. Among the writers of the literary renaissance were George Rakovski (1818-67), a fantastic writer of tlie patriotic type, whose works did much to stimulate the national zeal, Liuben Karaveloff (1837- 1879), journalist and novelist, Christo BotefE (1847-76), lyric poet, whose ode on the death of his friend Haji Dimitr, an insurgent leader, is one of the best in the language, and Petko Slaveikoff (died 1895) whose poems, patriotic, satirical, and erotic, moulded the modern poetical language and exercised a great influence over~~

~~*the people. Gavril Krstovitch, formerly governor-general of Eastern Rumelia, and Marin Drinoff, a Slavist of high repute, have written historical works. Stambuloff, the statesman, was the author of revolutionary and satirical ballads ; his friend Zacharia Stoyanoff (d. 1889) who began life as a shepherd, has left some interesting memoirs. The most distinguished Bulgarian man of letters is Ivan Vazoff (born 1850) , whose epic and lyric poems and prose works form the best specimens of the modern literary language. HIs well-known novel Under the Take has been translated into several European languages. The best dramatic work is Ivanko, a historical play, by Archbishop Clement, who has also written some novels. With the exception of Zlatarski's geological treatises no original works on natural science have as yet been produced ; a like dearth is apparent in the fields of philosophy, criticism, and fine art, but it must be remembered that the literature is still in its infancy. The ancient folk-songs have been preserved in several valuable collections ; though inferior to the Servian in poetic merit, they deserve more gpientifixs attention than they have yet received. Several periodicals and reviews have been founded in recent times. Of these the most important are the Perioditchesko Spisanie, issued since 1869 by the Bulgarian Literary Society, and the Sbornik, a literary and scientific miscellany, carefully edited by Dr Shishmanoff, and published by the Government at irregular intervals. Bulgarian journalism is still in the crude stage of development ; the numerous newspapers published in the capital and the provinces contain little more than polemical diatribes written in the interests of the various political leaders.*~~

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~~(j. D. B.)~~

~~Bulgaria, Eastern, on the Volga, a powerful kingdom which existed from the 6th to the 15th century on the middle Volga, in the present territory of the provinces of Samara, Simbirsk, Saratov, and N.Astrakhan, perhaps extending also into Perm. The village Bolgary, near Kazan, surrounded by numerous graves in which most interesting archaeological finds have been made, occupies the site of one of the cities — perhaps the^apital — of that extinct kingdom.~~

~~The history, Tarikh Bulgar, said to have been written in the 12th century by an Arabian cadi of the city Bolgary, has not yet been discovered ; but the Arabian historians, Ibn Foslan, Ibn Hautal, Abul Hamid Andalusi, Abu Abdallah Harnati, and several others, who had visited the kingdom,~~

~~beginning with the 10th century, have left descriptions of it. The Bulgars of the Volga were of Turkish origin, but may have assimilated Finnish and, later, Slavonian elements. In the 5th century they attacked the Russians in the Black Sea prairies, and afterwards made raids upon the Greeks. Ibn Foslan found them in 922 not quite nomadic, and already having some permanent settlements and houses in wood. Stone houses were built soon after that by Arabian architects. Ibn Dasta found amongst them agriculture besides cattle breeding. Trade with Persia and India, as also with the Khozars and the Russians, and undoubtedly with Biarmia (Urals), was, however, their chief occupation, their main riches being furs, leather, wool, nuts, wax, and so on. They accepted Islam in the 10th century, and after that time they began building forts, several of which are mentioned in Russian annals. Their chief town, Bolgary, or Velikij Gorod (Great Town) of the Russian annals, was often raided by the Russians. In the 13th century it was conquered by the Mongols, and became for a time the seat of the Khans of the Golden Horde. In the second half of the 15th century Bolgary became part of the Kazaii kingdom, lost its commercial and political importance, and was annexed to Russia after the fall of Kazail. ^p. ^. k.)~~

~~Bull, Ole Bornemann (1810-1880), Norwegian violinist, was born in Bergen, Norway, on 5th Feb- ruary 1810. At first a pupil of the violinist Paulsen, and subsequently self-taught, he was intended for the church, but failed in his examinations, and became a musician, directing the Philharmonic and Dramatic societies at Ber- gen. In 1829 he visited Spohr at Cassel, and afterwards proceeded to Paris, where he came under the influence of Paganini, and definitely adopted the career of a violin virtuoso, making his first appearance in company with Ernst and Chopin at a concert of his own in Paris, in 1832. Successful tours in Italy and England followed soon afterwards, and he was not long in obtaining Euro- pean celebrity by his brilliant playing of his own pieces and arrangements. HIs first visit to the United States lasted from 1843 to 1845, and on his return to Norway he formed a scheme for the establishment of a Norse theatre in Bergen; this became an accomplished fact in 1850; but the harassing business complications which soon had to be faced were too much for him, and he went again to America in 1852. During this visit he bought 125,000 acres of land in Pennsylvania to found a Norwegian colony ; but his title turned out to be fraudulent, and the troubles he went through in connexion with the~~

under- taking were enough to affect his health very seriously, though not to hinder him for long from the exercise of his profession. Another attempt to found an academy of

music in Christiania had no permanent result, and, after his second marriage, with an American lady, in 1870, he confined himself to the career of a violinist. He died at Lyso, near Bergen, on 17th August 1880. Ole Bull's "polacca guerriera" and a host of other violin pieces, among them two concertos, are a good deal more interesting to the virtuoso than to the musician, and his fame rests upon his prodigious technique rather than upon any very remarkable attainments in the higher regions of art. The memoir published by his widow in 1886 contains many proofs of the interesting inter- course he enjoyed with a great number of the most eminent men of his time, not merely musicians ; it gives a picture of a strong individuality, which often found expression in a somewhat boisterous form of practical humour. (j. a. f. m.)

Buller, Sir Redvers Henry (1839-

);

British General, son of Mr J. W. Buller, M.P., of Crediton, Devonshire, was born in 1839, and educated at Harrow. He entered the army in 1858, and served with his regiment, the 60th Rifles, in the China campaign of 1860. In 1870 he became captain, and went on the Red River expedition, where he was first associated with Lord (then Sir Garnet) Wolseley, and in 1873-74 he accompanied the latter on the Ashantee campaign as head of the Intelligence Department, being slightly wounded at the battle of Ordabai. He was mentioned in despatches and made a C.B., besides being raised to the rank of major. In the Kaffir war of 1878-79 and the Zulu war of 1879 he was conspicuous as an intrepid and popular leader of cavalry, and built up a reputation for courage and dogged determination. In particular his conduct of the retreat at Inhlobana (28th March 1879) drew attention to these qualities, and he earned the V.C. for his assistance in rescuing

~~*Captain D'Arcy and Lieutenant Everitt on that occa- sion; he was given the C.M.G. and made lieutenant- colonel and A.D.C. to the Queen. In the Boer war of 1881 he was Sir Evelyn Wood's chief of the staff, thus adding to his experience of South African conditions of warfare. In 1882 he was head of the Field Intelligence Department in the Egyptian campaign, being present at Kassassin and Tel-el-Kebir, and was knighted for his ser- vices. Two years later he commanded an infantry brigade in the Sudan under Sir Gerald Graham, and was at the battles of El Teb and Tamai, being promoted major- general for distinguished service on the field. In the Sudan campaign of 1884-85 he was Lord Wolseley's chief of the staff, and was given the command of the desert column when Sir Herbert Stewart was wounded. He once more distinguished himself on this occasion by his conduct of the retreat from Gubat to Gakdul, and by his victory at Abu Klea Wells (16th, 17th February), and he was created K.C.B. In 1887 he was made quartermaster- general at the War Office, and in the same year was Under- Secretary for Ireland for a short period. From 1890 to 1897 he held the office of adjutant-general, attaining the rank of lieutenant-general in 1891. At the War Office his power of work, his quick mastery of detail, and trench- ant criticism inspired those that came in contact with him with the belief that he was fitted for the highest command, and in 1895, when the duke of Cambridge was about to retire from the post of Commander-in-Chief, it was an open secret that the Rosebery Cabinet intended Sir Redvers Buller to be his successor, though it was reported that the conditions of the position were to be modified and the title changed to that of Chief of the Staff, as recommended by the Hartington Com- mission. On the eve, however, of this change being effected, the Government was defeated on Mr Brodrick's*~~

~~*motion with reference to the alleged shortage of small- arm ammunition, and Lord Salisbury's Cabinet, on re- considering the question of War Office reform as left to them by their predecessors, selected Lord Wolseley as the new Commander-in-Chief for a period of five years. Sir Redvers Buller remaining adjutant-general. In 1898 he took command of the troops at Aldershot, a five years' appointment, and when the Boer war broke out in 1899 he was selected with universal ap- proval to take command of the South African Field Force (see Transvaal, War), and landed at Cape Town on 31st October. Owing to the Boer investment of Ladysmith and the*~~

~~apparent helplessness of the generals sent to relieve the situation in Natal, he unexpectedly hurried off to Natal in order to supervise personally the rescue of Sir George White ; but on 15th De- cember his attempt to cross the Tugela at Colenso was repulsed with 1100 casualties and the loss of ten guns. The Government, alarmed at the situation and the. tone of Sir Redvers Buller's messages, sent out Lord Roberts to supersede him in the chief command. Sir Redvers being left in subordinate command of the Natal force only. His second attempt to relieve Ladysmith (10th to 27th January) proved another failure, the result of the operations at Spion Kop (24th January) causing consternation in England. A third attempt (5th to 7th February) was again unsuccessful, and it was not till 28th February that, the important position of Hlangwane Hill having been occupied on 19th February and Pieter's Hill having been carried by General Hildyard on 27th February, the relief of Ladysmith was accomplished. Sir Redvers Buller remained in command of the Natal army till 24th October 1900, when he returned to England, having in the meanwhile slowly done a great deal of hard work in driving the Boers from the Biggarsberg (15th May), forcing Lang's Nek (12th June), and occupying Lydenburg (6th September) ; but though he still retainedhis reputation for dogged determination and was devotedly followed by his own rank and file, the verdict of military critics on his capacity for an important commandin delicate and difficult operations had now become decidedly adverse. The con- tinuance in 1901 of his appointment to the Aldershot command, which was the most important in the new army scheme, met with a storm of public criticism, in which the detailed objections taken to his conduct of the operations before Ladysmith (and particiilarly his heliogram hinting at the contingency of surrender) were given new promi- nence. On 10th October 1901, at a luncheon in London, Sir Redvers Buller made a speech in answer to .these criticisms in terms which were held to be a breach of discipline and contrary to the king's regulations, and on 23rd October it was announced by the War Office that he had been relieved of his command and retired on half-pay.~~

~~BuM-fighting. — Bull-fighting is a survival of bar- barism, the existence of which is fervently deplored by all but its devotees, whose delight in it is at the present time as keen as at any former period. The British idea of sport is that the creature pursued should have a chance of saving its life by its~~

strength, speed, or natural cunning; the claim of bull-fighting to be regarded as sport is negatived by the fact that the bull is doomed from the moment of its entrance into the arena. But the main objection to the business in the eyes of persons of the most ordinary humanity lies in the atrocious slaughter of horses, which is a leading feature of the entertainment in Spanish eyes. The poor creatures are blindfolded and forced again and again in the bull's way, until, bleeding from many gores, and usually disembowelled, they drop in agony. That a brief description of bull-fighting should be

here given must not be accepted in any way as a token of approval or admiration. Bulls for the purposes of the ring are bred in various parts of Spain, chiefly in the plains of Las Cabezas, Lebrija, and Utrera. Sometimes during the first two years of their lives they are tormented with red cloths in order to teach them to charge, though many persons consider this is not only unnecessary but a mistake. At the age of four they are considered ready for the ring, and are purchased by agents, at prices of from £30 to more than double that amount. The arena is some 70 yards in diameter, and the bulls destined for the day's work, usually some half-dozen in number, are confined in an enclosure from which they are driven one by one along a divided passage which leads to the ring. Two matadors or espardos are engaged in each day's fight, each of them having his own troop of six assistants, which make up what is described as a cuadrilla. Two of these subordinates are known as picadores, their business being to ride the wretched horses to slaughter ; the others are called banderiUeros, and conduct their operations on foot. The bull-ring at Madrid affords accommodation for over 12,000 people; elsewhere the rings are usually smaller. The spectacle is opened with a procession, and certain formalities also take place, the president at length throwing into the ring the key of the enclosure where the bulls are confined. When the victim is let into the arena his first instinct is usually to charge one of the picadores, who is armed with a lance which rarely proves of much service, the result being that the horse is cruelly wounded, and the man not seldom thrown to the ground. If he is

~~unhurt and the horse has sufficient strength to stand, the man remounts to await another charge. It should here be said that in Portugal and also in South America this cruelty is not practised ; expert riders, provided with good horses, do duty as picadores, and it is considered a disgrace if they do not save their horses from injury. In this latter species of fight the bull's horns are topped with wooden knobs, so that bloodshed is avoided. In Spain usually a dozen horses are killed during a day's fight; sometimes twice as many suffer. The banderiUeros, known also as chulos, then proceed to make play, darting barbs, to which sometimes fireworks are attached, into the bull's body ; and when the animal has reached a certain stage of exhaustion the matador makes ready to give the coup de grdce, after having delivered a brief speech, prefaced by trumpet calls, to the president, who is provided with a white and a red handkerchief, the exhibition of the former signifying approval and of the latter disapproval. The matador holds in his left hand a small red cloak known as a muleta, and in his right a sword. After inducing the bull to charge several times he endeavours to kill the animal with one thrust aimed at a vital spot in front of the withers. He may, of course, succeed or fail; some thrusts are recognized as good, some as passable, and others as bad. If the matador remains without moving, or rather moving only his body to avoid the stroke of the horns, the thrust is known as recibiendo ; when bull and matador are approaching each other the thi'ust is called a un tiempo ; if the matador advances and kills the bull when it is motionless the lunge is distinguished as volapiS or vuelapies. These are all considered good strokes. The matador is very highly paid, as much as £50 being given to the most prominent men for killing a bull. (a. e. t. w.)**

Bull R U n , a small stream in North-Eastern Virginia, U.S.A., a branch of Occoquan Creek, which flows into Potomac river, 23 miles S. of Washington. The sur- rounding country is undulating, and dissected by sharp stream gorges. The first battle of Bull Run, in the early part of the Civil War, occurred on 21st July 1861, on the

south-west bank near Manassas Junction, between the newly organized army of the Potomac under General M'Dowell and the hardly more experienced forces of the Confederate General Beauregard. It resulted in the total defeat and hasty retreat to Washington of the Federals, and brought the North to a realization of the magnitude of the struggle upon

~~*which it was entering. A second battle took place in almost the same position about a year later, on 29th August 1862. General Lee, with a portion of the combined armies of himself and Jackson, moved on Pope, who was established west of Manassas Junction, for the purpose of holding back Lee until M'Clellan's army could be withdrawn from the peninsula. One of the severest battles of the war ensued, in which the Federals were driven back. The main purpose, how- ever, that of delaying Lee's advance on Washington, was achieved.*~~

~~*Billow, Bernhard Heinrich Karl Martin*~~

~~*von, Count (1849), German statesman, was bom*~~

~~*3rd May 1849, at Kleinflottbech, in Holstein. His family is one very widely extended in North Germany, and many members have attained distinction in the civil and military service of Prussia, Denmark, and Mecklenburg. His great-uncle, Heinrich v. Biilow, was Prussian am- bassador in England from 1827-40, and married a daughter of Wilhelm v. Humboldt. (See the letters of Gabrielle v. Bulow.) His father, Bernhard Ernst v. Biilow (1815-73), during his early years, held office under the Danish Government for Holstein ; in 1862 he entered the service of Mecklenburg-Strelitz, and was representar tive of Mecklenburg in the Federal Council at Berlin ; in 1873 he was invited by Bismarck, who had formed a high opinion of his abilities, to enter the imperial service as secretary of state for Foreign Affairs, and he was one of the German representatives at the Congress of Berlin. Bern- hard, the son, after serving in the Franco-Prussian war, entered the Prussian civil service, and was then transferred to the diplomatic service. From 1884 he was first secretary to the embassy at St Petersburg, and acted as charge d'affaires, in 1888 was appointed envoy at Bucharest, and in 1893 to the post of German ambassador at Home. In 1897, on the retirement of Baron Marshall v. Bieberstein, he was appointed secretary of state for Foreign Affairs (the same office which his father had held) under Prince V. Hohenlohe, with a seat in the Prussian ministry. He was chiefly responsible for carrying out the policy of colonial expansion with which the emperor had identified himself, and in 1899, on bringing to a successful conclu- sion the negotiations by which Samoa was acquired by Germany, he was raised to the rank of Count. On the resignation of Hohenlohe in 1900,*~~

~~he was chosen to succeed him as chancellor of the empire and president of the Prussian ministry; and in the autumn of the year after the meeting of the Reichstag distinguished himself by the skill and ability with which he de- fended the policy of the Government and the em- peror in China.~~

~~From him must be distinguished Otto v. Biilow (b. 1827), an official in the Prussian Foreign OiBce, who in 1882 was appointed German envoy at Bern, and from 1892 to 1898 was Prussian envoy to the Vatican.~~

~~Billow, Hans Cuido von (1830-1894), German pianist and conductor, was born of noble parents at Dresden, 8th January 1830. At the age of nine he be- gan to study music under Friedrich Wieck and Eberwein, as part of a genteel education. It was only after an illness while studying law at Leipzig University in 1848 that he determined upon music as a career. At this time he was~~

~~a pupil of Hauptmann. In 1849 more or less revolu- tionary politics took possession of him. In the Berlin Ahendpost, a democratic journal, the young aristocrat poured forth his opinions, which were strongly coloured by Wagner's AH and Revolution. Wagner's influence was musical no less than political, for a performance of Lohengrin under Liszt at Weimar in 1860 completed Yon Billow's determination to abandon a legal career. From Weimar he went to Zurich, where the exile Wagner instructed him in the elements of conducting. But he soon returned to Weimar and Liszt ; and in 1863 he made his first concert tour, which extended from Vienna to Berlin. Next he became principal professor of the piano at the Stern Academy, and married in his twenty-eighth year Liszt's daughter Cosima. For the following nine years von Billow laboured incessantly in Berlin as pianist, conductor, and writer of musical and political articles. Thence he removed to Munich, where, thanks to Wagner, he had been appointed Hof- kapellmeister to Ludwig II., and chief of the Conservatorium. There, too, he organized model performances of Tristan and Die Meistersinger. In 1869 his marriage was dissolved, his wife subsequently marrying Wagner, an incident which, while preventing Billow from revisiting Bayreuth, never~~

~~dimmed his enthusiasm for Wagner's dramas. After a temporary stay in Florence, Billow set out on tour again as a pianist, visiting most European countries as well as the United States of America, before taking up the post of conductor at Hanover, and, later, at Meiningen, where he raised the orchestra to a pitch of excellence till then unparalleled. In 1886 he resigned the Meiningen office, and conducted a number of concerts in Eussia and Germany. At Frankfort he held classes on Liszt's lines for the higher development of piano-playing. He con- stantly visited England, for the last time in 1888, in which year he went to live in Hamburg. Nevertheless he continued to conduct the Berlin Philharmonic Con- certs. He died at Cairo, on 13th February 1894. Billow will long be remembered as a pianist of the highest order of intellectual attainment, an artist of remarkably catholic tastes, a passionate hater of humbug and affectar tion, and one of the greatest orchestral conductors the world has seen. He had a ready pen, and a biting, incisive, sometimes almost rude wit, yet of his kindness of heart and generosity countless tales were told. His compositions are few and unimportant ; his arrangement of some of Wagner's dramas for the pianoforte are ex- ceedingly difficult. ■ (k. h. l.)~~

~~Bunbury, a seaport and municipality in Western Australia, in the county of Wellington, 112 miles by road S. by W. of Perth, with which it is connected by rail. The harbour, known as Koombanah Bay, is sheltered by a coral reef, on which a breakwater was begun by the Government in 1897. In 1900 it had a length of over 3200 feet. Tin, timber, sandal-wood, horses, and produce are shipped. Its population in 1891 was 572 ; in 1900 about 3000.~~

~~Bundaberg, a river port and municipality in Queensland, Australia, in the county of Cook, on the river Burnett, 10 miles from its mouth, 70 miles by rail N. of Maryborough on the line from Brisbane. A mile below the town, at Millaquin, is the largest sugar factory in the colony. There are numerous other sugar factories and 'mills in the district. The staple exports are sugar (about 36,000 tons annually), golden syrup, and timber. The climate is remarkably healthy. Population (1891), 3982; of 'town and district (1900),~~

~~14,000.~~

~~Bundelkhand, a tract of country in Central~~

~~India, lying between the North- West and the Central Provinces. Historically it includes the five British districts of Hamirpur, Jalaun, Jhansi, Lalitpur, and Banda, which now form part of the Allahabad division of the North- West Provinces, but politically it is restricted to a collection of native states, under the Bundelkhand agency. These number about thirty in all, with a total area of 10,241 square miles; total population (1891), 1,608,063, being an average of 145 persons per square mile; (1901), 1,309,323, showing a decrease of 13 per cent., due to the effects of famine. The most important of the states are Orchha, Panna, Chatarpur, Datia, Charkhari, Bijawar, and Ajaigarh. Up to the present no railway traverses the country. A garrison of all arms is stationed at Nowgong, where also there is a Eajkumar college for training the sons of the chiefs according to the methods- of an English public school, with 17 pupils in 1897-98.~~

~~Bundi, or Boondee, a native state of India, in the- Eajputana agency, lying on the north-east of the river Chambal, in a hilly tract historically known as Haraoti. It has an area of 2246 square miles. In 1881 the popular tion was 264,701; in 1891 it was 295,676, giving an average density of 133 persons per square mile ; in 1901, 171,227, showing a decrease of 42 per cent., due to the effects of famine. The estimated gross revenue in 1897-98^ was Es.7,00,000; the tribute, Es.1,20,000. There is no railway, but the metalled road from Kotah to the Brit- ish cantonment of Deoli passes through the state. In 1897-98 the mint coined no less than Es.3,17,686. Th& town of Bundi had a population in 1891 of 22,544.. A school for the education of boys of high rank was opened in 1897.~~

~~Bunsen, Robert Wilhelm von (1811-1898), German chemist, was born in Gottingen on 31st March 1811. He studied at the university in that town, becom- ing privat docent in 1833. Three years later he was appointed to succeed Wohler in the chair of Chemistry at the Polytechnic School of Cassel, and in 1838 moved to Marburg, where he remained some thirteen years. Then, for a short time, he was professor of Chemistry at Breslau, and in 1852 accepted a similar position at Heidelberg, where he spent the rest of his days, in spite of an urgent invitation to migrate to Berlin as successor to Mitscherlich. He retired from active work in 1889, and died at Gottingen on 16th August 1898. The first research, by which attention was drawn to Bunsen's abilities, was concerned with the cacodyl compounds of arsenic. It~~

~~was begun in 1837 at Cassel, and during the six years he spent upon it he not only lost the sight of one eye through an explosion, but nearly Tiilled himself by arsenical poisoning. It represents almost his only excursion into organic chemistry, and apart from its accuracy and completeness it is of historical interest in the development of that branch of science as being the forerunner of the fruitful investigations on the organo-metallic compounds subsequently carried out by his English pupil, Edward Frankland. Simultaneously with his work on cacodyl, he was studying the composi- tion of the gases given oif from blast furnaces. He showed that in German furnaces nearly half the heat yielded by the fuel was being allowed to escape vdth the waste gases, and when he came to England, and in conjunction with Lyon Playfair investigated the con- ditions obtaining in English furnaces, he found the waste to amount to over 80 per cent. These researches marked a stage in the application of scientific principles to the manufacture of iron, and they led also to the elab- oration of Bunsen's famous methods of measuring gaseous volumes, &c., which form the subject of the only book he ever published. In 1841 he iuTented the carbon-~~

~~zinc battery wliicli is known by his name, and wbich con- ducted him to several important achievements. He first employed it to produce the electric arc, and showed that from 44 cells a light equal to 1170 candles could be obtained with the consumption of one pound of zinc per hour. To measure this light he designed another instru- ment, which in various modifications has come into exten- sive use — the grease-spot photometer. In 1852 he began to carry out eleotrolytical decompositions by the aid of the battery, thus foreshadowing what has become an important branch of chemical industry. By means of a very ingenious arrangement he obtained magnesium for the first time in the metallic state, and studied its chemi- cal and physical properties, among other things demon- strating the brilliance and high actinic qualities of the flame it gives when burnt in air, in the way now familiar to every photographer. Another, and perhaps the best known, of the contrivances which thg world owes to him is the Bunsen burner. When the new laboratory was built at Heidelberg in 1855, it became~~

~~*necessary to install apparatus to supply heat for the conduct of chemical ■operations. Bunsen was dissatisfied with all the con- trivances that were brought to his notice, and finally set himself to devise a simple means of burning ordinary coal gas with a hot smokeless flame. The result of his labours was the well-known burner which is now employed by thousands for all sorts of purposes. Mention must also be made of another piece of work of a rather differ- ent character. Travelling was one of his favourite relaxations, and in 1846 he paid a visit to Iceland. There he investigated the phenomena of the geysers, the com- position of the gases coming off from the fumaroles, their action on the rocks with which they came into contact, &c., and on his observations was founded a noteworthy contribution to geological theory. But the most far- reaching of his achievements was the elaboration, about 1859, jointly with Kirchhoff, of spectrum analysis, which has put a new weapon of extraordinary power into the hands both of chemists and astronomers. It led Bunsen himself almost immediately to the isolation of two new elements of the alkali group, csesium and rubidium. Having noticed some unknown lines in the spectra of certain salts he was examining, he set to work to obtain the substance or substances to which these were due. To this end he evaporated large quantities of the Durkheim mineral water, and it says much both for his perseverance and powers of manipulation that he dealt with 40 tons of the water to get about 17 grammes of the mixed chlorides of the two substances, and that with about one-third of that quantity of csesium chloride was able to prepare the most important compounds of the element and determine their characteristics, even making goniometrical meas- urements of their crystals.*~~

~~*Bunsen founded no school of chemistry ; that is to say, no body of chemical doctrine is associated with his name. Indeed, he took little or no part in discussions of points of theory, and, although he was conversant with the trend of the chemical thought of his day, he preferred to spend his energies in the collection of experimental data. One fact he used to say, properly proved is worth all the theories that can be invented. But as a teacher of chemistry he was almost without rival, and his success is sufficiently attested by the scores of pupils who flocked from every part of the globe to study under him, and by the number of those pupils who afterwards made their mark in the chemical world. The secret of this success lay largely in the fact that he never delegated his work to assistants, but was constantly*~~

~~present with his pupils in the laboratory, assisting each with personal direction and advice ; he was also one of the first to appreciate the value of practical vork to the student, and he instituted a regular practical~~

~~course at Marburg so far back as 1840. Though alive to the importance of applied science, he considered truth alone to be the end of scientific research, and the example he set his pupils was one of single-hearted devotion to the advancement of knowledge. (h. m. e.)~~

~~Buoy, a floating body employed to mark the navig- able limits of channels, their fairways, sunken dangers or isolated rocks, mined or torpedo grounds, telegraph cables, or the position of a ship's anchor after letting go ; they are also used for securing a ship to in lieu of anchoring. They vary in size and construc- tion from a log of wood to mooring steel buoys for battleships or a steel gas buoy. In 1882 a conference was held upon a pro- posal to establish a uniform system of buoyage. It was under the presidency of H.E.H. the duke of Edinburgh, and con- sisted of representar tives from the various bodies interested. The questions of colour, visibility, shape, and size were considered, and any modifications necessary owing to locality. The com- mittee proposed the following uniform system of buoy- age, and it is now adopted by the general lighthouse authorities of the United Kingdom : — (1) The mariner when approaching the coast must determine his position~~

~~on the chart, and note the direction of the main stream of flood tide. (2) The term "star- board-hand" shall denote that side which would be on the right hand of the mariner either going with the main stream of flood, or entering a har- bour, river, or estuary from seaward; the term " port-hand " shall de- note the left hand of the mariner in the same cir- cumstances. (3) ' Buoys showing the pointed top of a cone above water shall be called conical (Fig. l)and shall always be starboard-hand buoys, as above defined. (iy Buoys showing a flat top above water shall be called can (Fig. 2), and shall always be port-hand buoys as above defined. (5) Buoys showing a domed top above water shall be called spherical (Fig. 3), and shall mark the ends of middle grounds. (6) Buoys having a tall central~~

~~1 In carrying out the above system the Northern Lights Commis- sioners have adopted a red colour for conical or starboard-hand buoys, and black~~

~~colour for can or port-hand buoys, and this system is aDDlio- able to the whole of Scotland.~~ ‘

~~BUOY~~

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~~structure on abroad face shall be called pillar buoys (Fig. 4), and like all other special buoys, such as bell buoys, gas buoys, and automatic sounding buoys, shall be placed~~

~~to mark special posi-~~

~~the~~

~~Mg. 3.~~

~~tions eitner on. coast or in the ap- proaches to harbours. (7) Buoys showing only a mast above water shall be called spar buoys’ (Fig. 5). (8) Starboard -hand buoys shall always be painted in one colour only. (9) Port-hand buoys shall be painted of another characteristic colour either single or parti- colour. (10) Spherical buoys (Fig. 3) at the~~ ~~7 ends of middle grounds ■== shall always be distin- ■ — guished by horizontal stripes of white colour. (11) Surmounting bea-~~

~~cons, such as staff and globe and others,^ shall always be painted of one dark colour. (12) Staff and globe (Fig. 1) shall only be used on starboard- hand buoys; staff and cage (Fig. 2) on port-hands; diamonds (Fig. 7) at the outer ends of middle grounds ; and triangles (Fig. 3) at the inner ends. (13) Buoys on the same side of a chan- nel, estuary, or tideway, may be distinguished from each other by names, numbers, or letters, and where necessary~~

~~Fig. 4.~~

~~Kg. 5.~~

~~Fig. 6.~~

~~*by a staff surmounted with the appropriate beacon. (14) Buoys intended for moorings (Fig. 6) may be of shape or colour according to the discretion of the authority within whose jurisdiction they are laid, but for marking sub-marine telegraph cables the colour shall be green, with the word "Telegraph" painted thereon in white letters.*~~

~~*Buoying and Marking of Wrecks. — (15) Wreck buoys in the open sea, or in the approaches to a harbour or estuary, shall be coloured green, with the word " Wreck " painted in white letters on them. (16) When possible, the buoy should be laid near to the side of the wreck next to mid-channel. (17) When a wreck-marking Vessel is used, it shall, if possible, have its top sides coloured green, with the word " Wreck " in white letters thereon, and shall exhibit by day, three balls on a yard 20 feet above the sea, two placed vertically at one end and one at the other, the single ball being on the side nearest to the wreck ; in fog, bell and gong in quick succession at intervals not exceeding one minute (wherever practicable) ; by night, three white fixed lights similarly arranged, but not the ordinary riding lights. (18) In narrow waters or in*~~

~~*Fig. 7.*~~

~~*1 Useful where floating ice is encountered.*~~

~~*2 St George and St Andrew crosses are principally employed to surmount shore beacons.*~~

~~*Fig. 8.*~~

~~*Verhcfil Sfn'pes*~~

~~*Kg. 9.*~~

~~*Chequered Fig. 10.*~~

~~*Horizontal Strlpea Fig. 11.*~~

~~*rivers and harbours under the jurisdiction of local authori- ties, the same rules may be adopted, or, at discretion, varied as follows : — When a*~~

~~wreck-marking vessel is used she shall carry a cross-yard on a mast with two balls by day, placed horizontally not less than 6 nor more than 12 feet apart, and two lights by night similarly~~

~~placed. When a barge or~~

~~open boat only is used, a single Co'o"' flag or ball may be shown in the daytime. (19) The position in which the mark- ing vessel is placed with reference to the wreck shall be at the discretion of the local authority having ju- risdiction. A uniform sys- tem by shape has been adopted by the Mersey Dock and HarboTir Board, to assist~~

~~a mariner by night, and, in addition, where practicable, a uniform colour ; the fairway buoys are specially marked by letter, shape, and colour. British India has practically adopted the British system. United States and Canada have the same uniform system ; in the majority of Euro- pean maritime countries and China various uniform sys- tems have been adopted. In Norway and Russia the compass system is used, the shape, colour, and surmount- ings of the buoys indicating the compass bearing of the danger from the buoy; this method is followed in the open sea by Sweden. An international uniform system of buoyage, although desirable, appears impracticable. Germany employs yellow buoys to mark boundaries of quarantine stations. The question of shape versus colour, irrespective of size, is a disputed one ; the shape is a better guide at night and colour in the daytime. All markings (Figs. 8, 9, 10, and 11) should be subordinate to the main colour of the buoy ; the varying backgrounds and atmospheric conditions render the question a com- plex one. Trinity HIouse buoys are divided into five classes, their use depending on whether the spot to be marked is in the open sea, or in an otherwise exposed position, or is in a sheltered harbour, or according to the depth of water and weight of moorings, or the importance of the danger. Buoys are moored with specially tested cables (see Cable) ; the eye at the~~

~~base of the buoy is of wroiight iron to prevent it becoming " reedy," and the cable is secured to blocks (see Anchor) or mushroom anchors accord- ing to the nature of the ground. Trinity HIouse buoys are built of steel, with bulkheads to lessen the risk of their sinking by collision, and with the exception of bell buoys, do not contain water bal- last. In 1878 gas buoys,~~

with fixed and occulting lights of 10 candle power, were introduced. In 1896 Mr T. Matthews, engineer-in-chief to the Trinity corpora- tion, developed the present design (1901) (Fig. 12). It is of steel, the lower plates being ^ in. and the upper .j^ in. in thickness, thus adding to the buoy's stability. The buoy holds 380 cubic feet of gas, and exhibits an occulting light for 2533 hours, 10 feet above the sea, and is visible 8

Fig. 12.

Fig. 13.

miles, witli an intensity of 50 candles. The light oc- cults every ten seconds, seven seconds' visibility and three seconds' obscuration, the occupations being actuated by a double valve arrangement. In the body of the apparatus there is a gas chamber having sufficient capac- ity, in the case of an occulting light, for maintaining the flame in action for seven seconds, and by means of a by-pass a jet remains alight in the centre of the burner. During the period of three seconds' darkness the gas chamber is re-charged, and at the end of that period is again opened to the main burner by a trip- ping arrangement of the valve, and remains in action seven seconds. The gas chamber of the buoy, charged to five atmospheres, is replenished from a steamer fitted with a pump and trans- port receivers carrying indicating valves, the receivers being charged to ten atmo- spheres. Practically no inconvenience has resulted from saline or other deposit, the glazing (glass) of the lantern being thoroughly cleaned when re-charging the buoy. Electric light is exhibited from some buoys in the United States. In England an automatic electric buoy has been suggested, worked by the motion of the waves, which cause a stream of water to act on a turbine connected with a dynamo generating electricity, but at present gas is preferred by British authorities as an illuminant. Boat-shaped buoys are occasionally used for carrying a light or bell. The Courtenay whistling buwy (Fig. 13) is actuated by the undulating movement of the waves. A hollow cylinder extends from the lower part of the buoy to below the movement of the waves, ensuring the water inside keeping at mean level,

~~*whilst the buoy follows the movements of the waves. By a special apparatus the compressed air is forced through the whistle at the top of the buoy, and is replenished by two tubes at the upper part of the buoy. It is fitted with a rudder and secured in the usual manner. Automatic buoys cannot be relied on in calm days with a smooth sea. The nun buoy (Fig. 14) for indicating the position of an anchor after letting go, is secured to the crown of the anchor by a buoy rope. It is usually made of galvanized iron, and consists of two cones joined together at the base and is painted red for the port anchor and green for the star- board. A mooring buoy (Fig. 6) for a battleship is built of steel in four watertight compartments, and has sufficient buoyancy to keep afloat should a compartment be pierced; they are 13 ft. long with a diameter of 6J ft. The mooring cable (bridle) passes through a watertight 16 in. trunk pipe, built vertically in the centre of the buoy, and is secured to a " rocking shackle " on the upper surface of the buoy. Large mooring buoys are usually protected by horizontal wooden battens and are fitted with life chains. (j. w. d.)*~~

~~*Burano, a town of the province of Venice, Venetia, Italy, on an island in the lagoon, 7 miles ;N".E. from Venice. The men are engaged in fishing, extracting salt, and making gondolas, whilst the women devote their time to lace-making. Population of island (1899), 4600.*~~

~~*Burauen, one of the four interior towns of Leyte, Philippine Islands, in latitude 10° 9' N. Its most im- portant export is hemp. Woven fabrics are produced by the women in some quantity. The language is Visayan. Population, 21,000.*~~

~~*Fig. 14.*~~

~~*Burckhardt, Jakob (1818-1897), Swiss writer, was born at Basel, 25th May 1818. He devoted himself to the study of history and of art, and was successively professor at Basel, at Zurich, and at Basel again. His first work of importance was published in 1842, and treated of the works of art in Flemish cities. In 1853 he produced The Age of Constantine the Great, a valuable study of the decay of ancient civilization. In 1855 ap- peared his Cicerone, a guide to objects of art and archi- tecture in Italy which, by revision in numerous successive editions, has become indispensable to the aesthetic traveller. This labour naturally directed Burckhardt's attention to*~~

~~*the renaissance, and he wrote TJie Culture of the Renais- sance, 1860 ; and TJie History of the Renaissance, 1867. His latter years were principally devoted to the elaborar tion of his writings. He died at Basel, 8th August 1897.*~~

~~*Burdett-Coutts, Angela Georgina, Baeon-*~~

~~*Ess (1814), British philanthropist, was born 25th*~~

~~*April 1814, being the youngest daughter of Sir Francis Burdett, Bart., so famous in the early part of the 19th century as Liberal member for Westminster, and grand- daughter of Mr Thomas Coutts, the no less celebrated banker. Inheriting in 1837 a vast fortune from her grandfather. Lady Burdett-Coutts (who was raised to the peerage as a baroness in 1871), has devoted her life to works of public and private charity and beneficence. It has been her especial aim to benefit the working classes in ways involving no loss of independence or self-respect in the recipients of her bounty. She has sent destitute boys into the navy and mercantile service ; provided means for the struggling to emigrate, and insured them a fair start in the colonies ; created or restored fisheries on the Irish coast ; founded and maintained schools, indus- trial and otherwise ; erected and administered model dwellings, and established markets for the , poor. She has been no less active in the promotion of moral reform by the foundation of refuges and reformatories for the criminal and abandoned of both sexes. She has endowed three colonial bishoprics, built and endowed several churches ; her bounty has relieved the distresses of Bul- garian refugees ; her helping hand has been stretched out to the Dyaks of Borneo and the aborigines of South Australia ; and she has been indefatigable in lending her aid to support home and foreign church missions, and schemes for extending British civilization in tropical countries, and for developing the colonial estates of the British Empire. In 1881 she married Mr William Lehman Ashmead Bartlett, M.P. for Westminster since 1885, who assumed his wife's name by royal license.*~~

~~*Burdon-Sanderson, Sir John Scott, Babt.*~~

~~*(1828), English physiologist, was born at Jesmond,*~~

near Newcastle, on 21st December 1828, and received his medical education at the university of Edinburgh. In 1856 he became medical officer of health for Padding- ton, and four years later physician to the Middlesex and theBrompton Consumption Hospitals. When diph- theria appeared in England in 1868 he was sent to in- vestigate the disease at the different points of outbreak, and in subsequent years he carried out a number of similar inquiries, e.g., on the cattle plague and on cholera in 1866. He became first principal of the Brown Institution at Lambeth in 1871, and three years afterwards succeeded Sharpey in the Jodrell professorship of physiology at University College, London. When the Waynflete chair of physiology was established at Oxford in 1883, be was chosen to be its first occupant, and immediately found himself the object of a furious anti-vivisectionist agitation. The proposal that the university should spend £10,000 in providing him with a suitable laboratory, lecture-rooms,

&c., in which to carry on his work, was strongly opposed, by some on grounds of economy, but largely because he was an upholder of the usefulness and necessity of experiments upon animals. It was, however, carried by a small majority (88 to 85), and in the same year the Eoyal Society awarded him a Royal medal in recognition, not only of his researches on the electrical phenomena exhibited by plants, and on the relations of minute organisms to disease, but also of the services he had rendered to physiology and pathology, and of his efforts to promote the study of those sciences in Great Britain. But his opponents at Oxford were not silenced by this adverse vote, and in 1885, after an unavailing effort in the preceding year, they had a third chance. Convocation being asked to vote £500 a year for three years for the purposes of the laboratory, which was then approaching completion. This proposal was fought with the utmost bitterness, and long circulars were issued by both sides, the signatories to that of the anti-vivisectionists including Preeman, Euskin, and Bishop Mackarness of Oxford. Ultimately, in one of the most disorderly meetings of Convocation ever known, the money was granted by 412 to 244 votes, and the Oxford Medical School, for which Burdon-Sanderson has done so much,

was saved from uselessness. In 1885 he was appointed regius professor of medicine at Oxford, and in 1899 he was created a baronet. His attainments, both in biology and medicine, have brought him many honours. He has delivered the Croonian lectures of the Royal Society, has been Harveian orator of the Royal College of Physicians (1878), has acted as president of the British Association (1893), and has served on three royal commissions — Hospitals (1883), Tuberculosis (1890), and University for London

(1892-94).

Burdwan, or Baedwan, a town of British India, in Bengal, which gives its name to a district and to a divi- sion. It is situated in 23° 14' N. lat. and 87° 54' E. long., and has a station on the East Indian railway, 67 miles N.W. from Calcutta. It had a population in 1891 of 34,777. The town owes its importance to the residence of the Maharaja of Burdwan, the premier nobleman of Lower Bengal, with a rent-roll of Rs.46,68,233. The palace is built and furnished after European fashion, and the grounds include a fine menagerie. A college, entirely supported by the estate, at an annual cost of Rs.8546, was attended in 1896-97 by 274 students. A good water- supply is derived froin the river Banka. There are four printing-presses, one of which issues a vernacular news- paper. The town also contains a public library.

The district of Bukdwan lies along the right bank of the river Bhagirathi or Hooghly. It has an area of 2697 square miles. Population (1881), 1,394,220; (1891), 1,391,834, showing a slight decrease due to the pre- valence of endemic fever ; average density, 516 persons per square mile. Classified according to religion, Hindus numbered 1,117,743; Mahommedans, 267,224; aborigines, 5459; Christians, 1408, of whom 657 were Europeans. In 1901 the population was 1,634,113, showing an in- crease of 10 per cent. The land revenue and rates in 1897-98 were Es.32,92,843 ; the number of police was 624 ; in 1896-97 the number of boys at school was 44,549, being 43-4 per cent, of the male population of school- going age ; the registered death-rate in 1897 was 30 per thousand. There are 11 indigo factories. The district suffered from drought in 1896-97. The Eden canal, 20 miles long, has been constructed for irrigation. The weaving of silk is the chief native industry. As regards European industries,

~~*Burdwan takes the first place in Bengal. It contains the great coal-field of Raniganj, with 87 mines great and small, employing more than*~~

~~*30,000 men, women, and' children, with an output of more than three million tons. The Barrakur ironworks produce pig-iron, which is reported to be as good as that of Middlesborough. During 1897-98 the total output was 19,719 tons. The value of the iron sold was Es.12,34,080, being nearly threefold that of two years previously. Apart from Burdwan town and Raniganj, the chief places are the river-marts of Katwa and Kalna. The East Indian railway has two lines running through the district,, with sixteen stations.*~~

~~*The division of Burdwan comprises the six districts of Burdwan, Birbhum, Bankura, Midnapore, Hooghly, and Howrah, with a total area of 13,966 square miles, and a. population in 1891 of 7,688,818, being an average density of 550 persons per square mile ; the land revenue and rates were Rs. 90,30,964 ; the number of police was 3628, being one policeman to every 3-8 square miles of area and to every 2126 of population. In 1896-97 the number of schools was 11,380, attended by 316,699 pupils, of whom 18,484 were girls.*~~

~~*Burgas, capital of a department in Bulgaria, and an important seaport, situated on a promontory on the Gulf of Burgas, 76 miles N.E. of Adrianople. For some time it threatened to rival Varna as the chief port of Bulgaria, but notwithstanding the completion by the SocUti des Batignolles of a splendid harbour in 1900, with a capacious quay, affording access to vessels of deep draught, the port may even yet decline in importance ; the sudden change in its prospects being due partly to the recent cession of the Yamboh-Saramberg line to the Orient company, whose aim is to draw the trade to Dedeagatch and Constanti- nople, and partly to the opening of the Sofia^Varna line, which tends to attract a portion of the import trade to Sofia. The number of vessels that entered the port in 1897 was 619 of 569,432 tons, the number in 1899 being 599 of 356,192 tons. The value of the imports in 1899 was £248,600 and of the exports £200,600. The popular tion is about 12,000.*~~

~~*Burgers, Thomas Francois (1834-1881), Presi-^dent of the Transvaal Republic, was born 15th April 1834, and was sent to be educated at*~~

~~*Utrecht, where h& took the degree of Doctor of Theology. On his return to South Africa he was ordained minister of the Dutch Reformed Church, and stationed at Hanover in Capa Colony, where he exercised his ministrations for eight, years. In 1862 his preaching attracted attention, and two years later an ecclesiastical tribunal suspended him for heretical opinions. He appealed, however, to the Colonial Government which had appointed him, and obtained judgment in his favour, which was supported by the Privy Council of England on counter-appeal in 1865. On the resignation of Pretorius, on 1st July 1872, he was elected President by the Transvaal Boers, and in 1873 he endeavoured to persuade Montsioa to agree to an alteration in the boundary of the Barolong territory as fixed by the Keate award, but failed. In 1876 Burgers, leaving the Transvaal in charge of Acting-President Joubert, went to Europe mainly to promote the Delagoa Bay railway scheme. After meeting with refusals in London he managed to raise £90,000 in Holland, and bought a quantity of railway plant, which on its arrival at Delagoa Bay was mortgaged to pay freight, and this, so far as Burgers was concerned, was the end of the matter. In June 1876 he induced the Raad to declare war against Secocoeni. The campaign was unsuccessful, and with its failure the republic collapsed, and the Transvaal was annexed to Great Britain, 12th April 1877. Mr Burgers accepted a pension from the British Government, and settled down to farming in Hanover. He died at Rich-*~~

~~*mond, South Africa, on 9th December 1881, and in the following year a volume of short stories, Tooneelen uit cms dorp, originally written by him for the Cape Volksblad, was published at the Hague for the benefit of his family. A patriot, a fluent speaker both in Dutch and in English, and possessed of unbounded energy, the failure of Burgers was due to his fondness for large visionary plans, which he attempted to carry out with insufficieut means.*~~

~~*Burgon, John William (1813-1888), British divine, was born at Smyrna, 21st August 1813, and was the son of a Turkey merchant, who was also a skilled numismatist, and afterwards became an assistant in the Antiquities Department of the British Museum. His mother was a Greek. In deference to his father's wish he resigned his preference for a life of study and entered his father's counting-house. In 1841, however, the elder Burgon was compelled to relinquish business, and his son was then enabled to give free course to his inclinations. In that same year he entered at Oxford. He afterwards ■gained the Newdigate Prize Poem, and took his degree in 1845. Among those who had influenced his life up to this time were his brother-in-law, Henry John Eose, the well-known scholar and theologian, not, however, to be confounded with his brother, Hugh James Rose, who was conspicuous in the movement which had culminated in the Tracts for the Times. Burgon made Oxford his head- quarters, while holding a living at some distance. In 1863 he was made vicar at St Mary's. H e had previously visited Eome and the East, and commenced his characteristic literary career. In 1860 appeared the famous Assays and Reviews, which Burgon vehemently attacked in a series of sermons afterwards published. In 1869 he protested against the elevation of Dr Temple to the see of Exeter, on the ground of his having contributed to Essays and Reviews. In 1871 he published an able and learned defence of the genuineness of the twelve last verses of St Mark's Gospel. In 1871 he commenced his attacks on the proposal for a new lectionary for the Church of England, based to a great extent upon his objections to the principles for determining the authority of MS. readings adopted by Westcott and Hort, which he assailed in a memorable article in the Quarterly Review for 1881. This, with his ■other articles, was reprinted in 1884 under the title of The Revision Revised. His biographical essays on Dean Mansel and others were also collected, and published Tinder the title of Twelve Good Men, a highly entertaining book. Protests against the inclusion of Dr Vance Smith among the Revisers, against the nomination of Dean Stanley to be select preacher in the University of Oxford, and against the address in favour of toleration in the matter of ritual, followed in succession. In 1876 Burgon was made Dean of Chichester. He died on the 4th August 1888. H is life was written by Dean Goulburn. Vehement and almost passionate in his convictions, Burgon never- theless possessed a warm and kindly heart. While the strength of his language not unfrequently caused irrita- tion, it did not make him a single*~~

~~enemy, and his decided religious opinions, his profound erudition, his energy and courage, secured for him many friends. He may be described as a High Churchman of the type prevalent before the rise of the Tractarian School. His extensive •collection of transcripts from the Greek Fathers, illustrat ing the text of the 'Sew, Testament, was bequeathed to the British Museum. (j. j. i,.*)~~

~~Burgos, a province in the north of Spain, including the distant county of Trevino, lying between Alava and Navarra. The population was 332,461 in 1877, 338,551 in 1887, and 340,001 in 1897, on an area of 6651 square miles. The province is divided into 12 administrative~~

~~districts and 612 parishes. There has been for many years an excess of births over deaths, and the relatively small increase of population is attributed to emigration of the inhabitants to other parts of Spain. The northern and north-eastern districts are mountainous, and the central and southern form part of the vast and elevated plateau of old Castile. Eastwards are the highest peaks of the province, with the Cerro de San Millan, 6995 feet high. Two ranges of mountains, running east and west of Pancorbo, leave a gap through which run the railway and roads connecting Castile with the valley of the Ebro, at a place that has oft been called the "Iron Gates of Castile," as a handful of men could hold the Pancorbo pass against an army. South of this spot begins the plateau, generally covered with snow in winter, swept by such cold winds that Burgos is considered, with Soria and Segovia, one of the coldest regions of the peninsula. As but little rain falls in summer in this province, the soil is poor, and most of it is devoted to the rearing of flocks ; agriculture thrives only in some valleys, especially that of the Ebro. This river runs eastwards through the province for 62 miles, but is not navigable. The river Douro, too, enters the province, running W.N.W. for 37 miles, with less water than the Ebro ; it also is unnavigable in its upper valley. The province has other important streams, the Pisuerga flow- ing south towards Palencia and Valladolid, and the Arlanzon, which flows in Burgos territory for over 75 miles. The variations of temperature are great, as from 9° to 20° of frost have frequently been recorded in winter, while the mean summer temperature is 64° (Fahrenheit). There are few industries worth mentioning; the chief features in this connexion are potteries, stone quarries, tanneries, and factories for the~~

manufacture of linen and cotton of the coarsest description. The ancient cloth and woollen industries, for which Burgos was famous in days gone by, have almost disappeared. But the province is one of the richest in live stock, containing 736,730 head in all. This total includes 14,808 horses, 17,657 mules, 25,838 asses, 69,323 cattle, 514,747 sheep, 61,493 goats, and 32,964 pigs. 480,860 acres are devoted to the culture of wheat ; 72,177 to barley, rye, and oats ; 11,375 to pod fruits ; 96,000 acres to vineyards. Only 10 mines are at work : 152 are registered as unproductive. Among the former are 2 coal mines, 1 kaolin, and 7 salt. Lack of proper railways, and even of good roads, is the principal drawback to the development of the mining interests. Some extensions have been made of late years in the rail-way system, but there are in all only 126 miles of lines in the province ; 82 of these belong to the main northern line going from Madrid to the French frontier, and 26 to the direct line between Ariza and Valladolid.

Burgos, capital of the above province, 226 miles north of Madrid by rail. Population in 1897, 31,741. The town has not been much altered. A few streets in the new part have been embellished, and some ofBcial buildings, the residences of the governor, the town hall, clubs, and theatre have been improved. It is still a great mart for agriculture, but its local industries have decayed, especially the manufacture of linen and woollen stuffs ; paper and leather goods, on the contrary, are exported in considerable quantities.

Burial and Burial Acts.— The main lines of the law of burial in England may be stated very shortly. Every person has the right to be buried in the churchyard or burial ground of the parish where he dies, with the exception of executed felons, who are buried in the pre- cincts of the prison or in a place appointed by the HIome Ofiice. At common law the person under whose roof a death takes place has a duty to provide for the body being

carried to the grave decently covered ; and the executors or legal representatives of the deceased are bound to bury or dispose of the body in a manner becoming the estate of the deceased, according to their discretion, and they are not bound to fulfil the wishes he may have

~~*expressed in this respect. The disposal must be such as will not expose the body to violation, or offend the feelings or endanger the health of the living ; and cremation under proper restrictions is allowable. In the case of paupers dying in a parish house, or shipwrecked persons whose bodies are cast ashore, the overseers or guardians are responsible for their burial ; and in the case of suicides the coroner has a similar duty. The expenses of burial are payable out of the deceased's estate in priority to all other debts. A husband liable for the maintenance of his wife is liable for her funeral expenses ; the par- ents for those of their children, if they have the means of paying. Eecent legislation has principally affected (!) places of burial, (2) mode of burial, (3) fees for burial, and (4) disinterment.*~~

~~*1. The overcrowded state of churchyards and burial grounds gradually led to the passing of a group of statutes known as the Burial Acts, extending from 1852- up to 1900. By these Acts a general system was set up, the aim of which was to remedy the existing deficiencies of accommodation by providing new burial grounds and ■closing old ones which should be dangerous to health, and to establish a central authority, the HIome Office (now for most purposes the Local G-overnment Board) to superin- tend all burial grounds with a view to the protection of •the public health and the maintenance of public decency in burials. The Local Government Board thus has the power to obtain by Order in Council the closing of any burial ground it thinks fit, while its consent is necessary to the opening of any new burial ground ; and it also has power to direct inspection of any burial ground or ceme- tery, and to regulate burials in common graves in statu- tory cemeteries, and to compel persons in charge of vaults or places of burial to take steps necessary for preventing their becoming dangerous or injurious to health. The vestry of any parish, whether a common law or ecclesi- astical one, was thus authorized to provide itself with a new burial ground, if its existing one was no longer avail- able; such ground might be wholly or partly consecrated, and chapels might be provided for the performance of burial service. The ground was put under the manage- ment of a burial board, consisting of ratepayers elected by the vestry, and the consecrated portion of it took the place of the churchyard in all respects. Disused church- yards and burial grounds in the metropolis may be used as open spaces for recreation, and only buildings for reli- gious purposes can be built on them (1881, 1884, 1887). The Local Government Act, 1894,*~~

introduced a change into the government of burial grounds (consequent on the general change made in parochial government) by tra,ns- f erring, or allowing to be transferred, the powers, duties, property, and liabilities of the burial boards in urban dis- tricts to the district councils, and in rural parishes to the parish councils and parish meetings ; and by allowing rural parishes to adopt the Burial Acts, and provide and manage new burial grounds by the parish council, or a burial board elected by the parish meeting.

2. The mode of burial is a matter of ecclesiastical ■cognizance ; in the case of churchyards and elsewhere it is in the discretion of the owners of the burial ground. The Local Government Board now makes regulations for burials in burial grounds provided under the Burial Acts ; for cemeteries provided under the Public Health Act, 1879. Private cemeteries and burial grounds make their own regulations. Burial may now take place either with or -without a religious service in consecrated ground. Before

1880 no body could be buried in consecrated ground ex- cept with the service of the Church, which the incumbent of the parish or a person authorized by him was bound to perform ; but the canons and prayer-book refused the use of the office for excommunicated persons, majori exconv- municatione, for some grievous and notorious crime, and no person able to testify of his repentance, unbaptized persons, and persons against whom a verdict of felo de se had been found. But by the Burial Laws Amendment Act, 1880, the bodies of persons entitled to be buried in parochial burial grounds, whether churchyards or grave- yards, may be buried there, on proper notice being given to the minister, without the performance of the service of the Church of England, and either without any reli- gious service or with a Christian and orderly religious service at the grave, which may be conducted by any person invited to do so by the person in charge of the funeral. Clergymen of the Church of England are also by the Act allowed, but are not obliged, to use the burial service in any unconsecrated burial ground or cemetery, or building therein, in any case in which it could be used in consecrated ground. In cases where it may not be so used, and where such is the wish of those in charge of the service, the clergy may use a form of service approved by the bishop without being liable to any ecclesiastical or temporal penalty. Except as altered by this Act, it is still

~~*the law that " the Church knows no such indecency as putting a body into consecrated ground without the service being at the same time performed" ; and nothing in the Act authorizes the use of the service on the burial of a, felo de se, which, however, may now (1882) take place in any way allowed by the Act of 1880. The proper per- formance of the burial office is provided for by the Public Worship Eegulation Act, 1874. Statutory provision is made by the criminal law in this Act for the preserva- tion of order in burial grounds and protection of funeral services.*~~

~~*3. Fees are now payable by custom or under statutory powers on all burials. In a churchyard the parson must perform the office of burial for parishioners, even if the customary fee is denied, and it is doubtful who is liable to pay it. The custom must be immemorial and invariable. If not disputed, its payment can be enforced in the ecclesiastical court; if disputed, its validity must be tried by a temporal court. A special contract for the payment of an annual fee in the case of a non-parishioner can be enforced in the latter court. In the case of paupers and shipwrecked persons the fees are payable by the parish. In other parochial burial grounds and ceme- teries the duties and rights to fees of the incumbents, clerks, and sextons of the parishes for which the ground has been provided are the same as in burials in the churchyard. Burial authorities may fix the fees payable in such grounds, subject to the approval of the HIome Secretary ; but the fees for services reiidered by ministers of religion and sextons must be the same in the conse- crated as in the unconsecrated part of the burial ground, and no incumbent of a parish or clerk may receive any fee upon burials except for services rendered by them (1900). On burials under the Act of 1880 the same fees are payable as if the burial had taken place with the service of the Church.*~~

~~*4. A corpse is not the subject of property, nor capable of holding property. If interred in consecrated ground, it is under the protection of the ecclesiastical court ; if in unconsecrated, it is under that of the temporal court. In the former case it is an ecclesiastical offence, and in either case it is a misdemeanour, to disinter or remove it without proper authority whatever the motive for such an act may be. Such proper authority is (1) a penalty from the ordi- nary, where it is to be removed from one consecrated place*~~

of burial to another, and this is often done on sanitary grounds or to meet the wishes of relatives, and has been done for secular purposes, e.g., widening a thoroughfare, by- allowing part of the burial ground (disused) to be thrown into it; but it has been refused where the object was to cremate the remains, or to transfer them from a church- yard to a Roman Catholic burial ground; (2) a license from the HOme Secretary, where it is desired to transfer remains from one unconsecrated place of burial to another ; (3) by order of the coroner, in cases of suspected crime. There has lately been considerable discussion as to the boundary-line of jurisdiction between (1) and (2), and whether the disinterment of a body from consecrated ground for purposes of identification falls within (1) only, or within both (1) and (2) ; and an attempt by the ecclesi- astical court to enforce a penalty for that purpose without a license has been prohibited by the temporal court. See also Ckbmation.

Authorities.— Bakek. Law of Burials, 6th ed., by Thomas. London, 1898. — Phillimore. Ecclesiastical Law, 2nd ed. London, 1895.— Criffes. Law of Church and Clergy, 6th ed. London, 1886. (g. g. p.*)

Burlington, capital of Des Moines county, Iowa, U.S.A., situated in 40° 49' N. lat. and 91° 07' W. long., at an altitude of 533 feet. It has a beautiful situation on the Mississippi river bluffs, which afford fine building sites. It is a railway centre of importance, being entered by the Chicago, Burlington, and Quincy, the Burlington, Cedar Rapids, and Northern, and the Toledo, Peoria, and Western railways. Its river traffic is considerable. The value of its manufactures was, in 1890, $6,413,000. They consisted principally of lumber, iron and steel, furniture, waggons and carriages. Population (1880), 19,450; (1890), 22,566;

(1900), 23,201.

Burlington, a city of Burlington county, New Jersey, U.S.A., situated in 40° 05' N. lat. and 74° 51' W. long., on the east bank of Delaware river and on

~~the Pennsylvania railway, about midway between Philadelphia and Trenton. Population (1880), 6090; (1890), 7264;~~

~~(1900), 7392.~~

~~Burlington, capital of Chittenden county, Ver- mont, U.S.A., and the largest city in the state, situated on Lake Champlain, where an island and a breakwater make an excellent harbour. It has two railways, the Connecticut Valley and the Rutland. Here is situated the University of Vermont, which (including the State Agricultural College) had in 1900 a staff of 53 professors and instructors and 476 students. Its property is valued at about $1,000,000, and its income is not far from |76,000. Besides a] arge lake trade, principally in lumber, Burlington has extensive and varied manufactures, chiefly of cotton, wool, and wood, and there are fine marble quarries in the immediate neighbourhood. Population (1880), 11,365;~~

~~(1890), 14,590 ; (1900), 18,640.~~

~~Burma, a lieutenant-governorship of British India, including the former kingdom of independent Burma, as well as British Burma, acquired by the British Indian Government in the two wars of 1826 and 1852. It is divided into Upper and Lower Burma, the former being the territory annexed on 1st January 1886. The pro- vince lies to the east of the Bay of Bengal, and covers a range of country extending from the Pakchan river in 9° 55' north latitude to the Naga and Chingpaw, or Kachin hills, lying roughly between the 27th and 28th degrees of north latitude ; and from the Bay of Bengal on the west to the Mekong river, the boundary of the dependent Shan States on the east, that is to say, roughly, between the 92nd and 100th degrees of east longitude. The ex- treme length from north to south is almost 1200 miles,~~

~~and the broadest part, which is in about latitude 21° north, is nearly 480 miles from east to west. On the N. it is- bounded by the dependent state of Manipur,^by the Mishmi hills, and by portions of Chinese territory ; on the E. by the Chinese Shan States, portions of the province of Yunnan, the French province of Indo-China, and the Siamese Shan, or Lao, States and Siam ; on- the S. by the Siamese Malay States and the Bay of Bengal ; and on the W. by the Bay of Bengal and Chittagong. The coast-line from Taknaf, the mouth of the Naaf, in the Akyab district on the north, to the estuary of~~

~~*the Pakchan at Maliwun on the south, is about 1200 miles. The area of Upper Burma is estimated at 83,473 square miles. This does not include the townships of Minhla, Taingda, and Sinbaungwe, which have been incorporated for administrative purposes with the Lower Burma district of Thayetmyo, and cover about 737 square miles. The area of Lower Burma before the annexation was returned at 87,220 square miles. Thus the total area now is about 87,957 square miles in Lower Burma and 83,473 square miles in Upper Burma, or 171,430 square miles for the whole province. The area of the northern and southern Shan States is computed to be a little over 40,000 square miles.*~~

~~*Since the removal of the artificial political boundary of Upper and Lower Burma the province is divided by its chief physical features. These are the mountain ranges which run north and south and divide featoraf the country longitudinally. They are the Arakan Yoma, the Pegu Yoma, the Paung Laung range, and the Shan hills. The last two ranges in reality form one series. The Arakan Yoma is a continuation of the mountain chain known as the Naga hills, which forms the eastern boundary of Assam, runs nearly due south, and divides the Arakan division from the basin of the Irra- waddy. The Pegu Yoma rises in the highland of Meiktila, south of Mandalay, and keeping parallel to the Arakan Yoma, divides the Basin of the Irrawaddy from that of the Sittang. The Paung Laung range is an offshoot from the plateau of the Shan States, and divides the basin of the Sittang from that of the Salween. The Pegu Yoma is only of moderate height, but the Paung Laung range has many high peaks, one rising to about 8000 feet. It sinks away to the plain of Thaton. The ranges which run fanwise from the high steppes of Tibet are at first almost as sharply defined as the deep gorges in which the rivers run. But as the ribs of a leaf fade away into the texture, so a. space is gained, the ridges spread out and fall away. The Irrawaddy and the Mekong gain space for their basins at the expense of the Salween, so that not only is the river itself crushed up in its bed, but its watershed on each side is so compressed, that though it sinks steadily, there is no room to form a plain. This is what causes what is called the Shan plateau, which is properly only the country between the Salween and the Irrawaddy, marked on the west by the abrupt line of hills which begin about BhamO' and run southwards until they sink into the plains of Lower Burma. On the east the plateau is no less sharply defined by the deep narrow rift of the Salween.*~~

‘The average height of the plateau is between 2000 and 3000 feet, but it is seamed and ribbed by mountain ranges which split up and run into one another, leaving space here and there for broad rolling downs or flat-bottomed valleys. The highest peaks are in the north and the south. Loi Ling rises to 8842 feet, and in North Theinni there are many peaks of over 7000 feet, and the same heights are nearly reached in the hills of the Karen country on the south. The majority of the intermediate parallel ranges have an average of between 4000 and 500O feet, with peaks rising to over 6000. The country east of the Salween is much less open and more hilly ; insteadi

Walk£i & Cockerell del et :>c

Map of Bubma.

of a rolling plateau there is a mass of broken hills. Except in the north, as is the case also west of the Salween, the hills are clad with dense forest. Burma may, there- fore, be divided conveniently, but with no great precision, into (a) Northern Burma, including the Chin and Kachm hills, with a thin and miscellaneous alien population; (6) Burma proper, which is practically the valley of the Irrawaddy after it ceases to be a gorge ; and (c) the Shan tributary states. Burma proper is practically one great plain ; the hills are comparatively mere undulations, and the one considerable peak. Poppa, is volcanic. Still it is very different from the vast levels that stretch from the base of the Himalayas. It is rather a rolling upland interspersed with alluvial basins and sudden ridges of hills. The delta of the Irrawaddy begins near the village of Yegin Mingy, a few miles south of Myapaung. The sides of the delta measure 179 miles on the west and 126 miles on the east, and the base, measured from Elephant Point to Cape Negrais, is 137 miles in length, with an area of about 12,000 square miles. With the exception of the laterite hills near Myaungmya and the Eocene sandstone range near

~~*Thamandewa, in the same township, but more to the south, the whole of this area is a vast plain, gradually sloping down to the sea-shore. It is estimated that at least 2000 square miles, or one-sixth of this area, is below the level of the highest spring tides. This delta, together with the low-lying land to the east of the estuary of the Sittang, in the Pegu and Shwegyin districts, comprises what should from a physical point of view be considered as the lower province. The general aspect of these areas is the same. Till recent times they were covered with dense forest and bamboo jungle, and with water-logged swamps, clothed with elephant grass. The extension of cultivation and the draining of these swamps had changed the aspect of the country within the memory of persons living in 1901.*~~

~~*Climate. — The climate of the delta is cooler and more temperate than in Upper Burma, and this is shown in the fairer complexion and stouter physique of the people of the lower province as compared with the inhabitants of the drier and hotter upper districts as far as Bhamo, where there is a great infusion of other types of the Tibeto-Burman family. North of the apex of the delta and the boundary between the deltaic and inland tracts, the rainfall gradually lessens as far as Nimbu, where what was formerly called the rainless zone commences and extends as far as Katha. North- ward of this the annual rainfall increases till at Bhamo the average is about 70 inches, which is almost identical with that of Yegin Mingy. The physical conditions of the country are so varied that to give the mean annual rainfall of Burma would be simply misleading. The table in the next column shows (amongst other things) the mean annual rainfall for ten years in Lower Burma and for five years in Upper Burma. The scanty rainfall in the central zone between the 20th and 22nd parallels is caused chiefly by the Arakan range which drains the clouds, but also in no small degree by the want of forests, which is noticeable in all except the southern districts of this zone.*~~

~~*The temperature varies almost as much as the rainfall. It is high- est in the central zone, the mean of the maximum readings in such districts as Magwe, Myingyan, Kyauksfe, Mandalay, and Shwebo in the month of May being close on 100° F., while in the littoral and sub-montane districts it is nearly ten degrees less. The mean of the minimum readings in December in the central zone districts is a few degrees under 60° F. and in the littoral*~~

~~*districts a few degrees over that figure. In the hilly district of Mogdk (Ruby Mines) the December mean minimum is 36-8° and the mean maximum 79°. The climate of the Chin and Kaohin hills and also of the Shan States is temperate. In the shade and off the ground the thermometer rarely rises above 80° P. or falls below 25° P. In the hot season and in the sun as much as 150° P. is registered, and on the grass in the cold weather ten degrees of frost are not uncommon. Snow is seldom seen either in the Chin or Shan hills, but there are snow-clad ranges in the extreme north of the Kachin country. In the narrow valleys of the Shan hills, and especially in the Salween valley, the shade maximum reaches 100° F. regularly for several weeks in April. The rainfall in the hills varies very considerably, but seems to range from about 60 inches in the broader valleys to about 100 inches on the higher forest-clad ranges.*~~

~~*Table showing Mean Annual Mainfall and the character of different districts.*~~

~~*DiTision.*~~

~~*District,*~~

~~*Mean Annual Eainfall.*~~

~~*Chai-aotor of Country.*~~

~~*Arakan . Pegu . . -< Irrawaddy –*~~

~~*Tenasserim •*~~

~~*Mandalat – Sagaing . –*~~

~~*MiNBU . . –*~~

~~*Meiktila . –*~~

~~*Akyab . . . Northern Arakan Kyaukpyu . . Sandoway . . Rangoon Town Hanthawaddy Pegu. . . . Tharrawaddy . Prome . . . Th6ngwa . . Bassein . . . Henzada . . Thayetmyo . Amherst Tavoy . . . Mergui . Toungoo . . Shwegyin . . Salween Mandalay . . Bhamo . . Katha . . . Ruby Mines Shwebo . . .*~~

~~*Sagaing . . . Lower Chindwin Upper Chindwin PakOkku . . Minbu . . . Magwe . . . Kyauksfe . . Meiktila . . Myingyan . . Yamfethin . .*~~

~~*Inches.*~~

~~*184-6 127-49 196-8 1 209-7 /*~~

~~*1 94-4 1*~~

~~*116-66 f 87-5 J*~~

~~*43-9 86-7)*~~

~~*110-3 [84-9 J*~~

~~*36-9*~~

~~*182-2)*~~

~~*200-3' [*~~

~~*183-7 J*~~

~~*83-6*~~

~~*1.37-5*~~

~~*100-31 27-616 70-106 46-97 83-88 30-289”)*~~

~~*26-97 y 28-347 J*~~

~~*73-587 23-18)*~~

~~*24-134 y 34-956 j*~~

~~*22-70 — 29-968 23-90 ” 42-213*~~

~~*Littoral. Sub-montane.*~~

~~*Littoral.*~~

~~*Deltaic.*~~

~~*Central.*~~

~~*Deltaic.*~~

~~*Central.*~~

~~*Littoral.*~~

~~*Central.*~~

~~*Deltaic.*~~

~~*Sub-montane.*~~

~~*Central.*~~

~~*Sub-montane.*~~

~~*Central.*~~

~~*Sub-montane.*~~

~~*Central.*~~

~~*Sub-montane.*~~

~~*Central.*~~

~~*Central.*~~

~~*Geology. — ^The general parallelism of all the streams and hill- ranges gives an appearance of simplicity to the physical geology of the country, but owing to the prevalence of forest it has been found extremely difficult to determine the stratigraphy, and very little can be said to be actually known about the formations occurring. The Pegu Yoma consists entirely of the Miocene group, with beds of later Tertiary age, chiefly sandstone and shale, and the Arakon Yoma and the spurs to eastward and westward of the main*~~

range are chiefly of earlier Tertiary age, resting on Creta- ceous and Triassic beds, which rise to the surface on the western face of the range. The Carboniferous limestone and its associated beds, together with the Mergui group, appear to run up the line of the Salween, and the main area of metamorphic rock lies to the east of all the other formations. The Burmese gneiss series consists of more or less granitoid gneiss, hornblendic gneiss, crystalline lime- stone, quartz and schists of various kinds. In many places the gneiss becomes a true granite. So far as is known there are two groups, the gneissose formation and limestone, which has been supposed to be of Lower Carboniferous age, but according to recent investigations more probably belongs to the Lower Silurian forma- tions. Metamorphic rocks occupy a large but unexplored area in Upper Burma. They form all the higher ranges in the neighbour- hood of Mandalay, and extend throughout a great portion of the country towards the Salween. Farther to the northward they extend from Bhamo to the neighbourhood of T'gng-Yueh (Momien) in Yunnan. The hills that skirt the Irrawaddy north of Mandalay are Silurian limestone, locally charged with crystalline limestone, which is the matrix of rubies, and metamorphic rocks composed of gneiss and hornblendic schist, and opposite Kyaukmyaung green- stone and basalt are found. The Irrawaddy below Ava turns to the west and flows through recent rock formations, while the crystallines continue to the southward, forming a great part of the Shan States and the Karen-ni country, and extending southwards into Tenasserim. The limestone, which is so conspicuous near Moulmein, extends northwards in large hills and ranges into Karen-ni and the Shan States. The abrupt cliffs, full of caves, characteristic of the formation, are very noticeable near Mong Nai (Mynfe) and northwards in the same latitude. The same formation is found eastwards of the Salween in Kgngma, Kokang, ChSnkang, and probably far northwards. It seems to belong to the Carboni- ferous series and to be identical, in part at least, with the lime- stone found in the Mergui archipelago. Until the fossils are better known it is impossible to say whether the Burma series exactly corresponds to the Carboniferous beds of the Himalayas and the

~~*Punjab. They are certainly of the same approximate age. The occurrence of marine fossiliferous rocks of the Carboniferous period at the two extremities of the extra-peninsular area of British India, and the complete absence of any marine Palseozoic fossils withm the peninsular region, afford the most striking illustration of the great divergence between the geological history of peninsular India and that of the surrounding countries. The main outcrop of nummulitic rocks extends from the north to the south-east of the Arakan and Chin hills and west of the Irrawaddy. The beds have a general dip to the eastward. There are occasional out- crops of serpentine. The surface rocks are generally shales and sandstone. Coal has been found, but hitherto has not paid for its working. The Irrawaddy valley from the old frontier to the neighbourhood of Ava, where the metamorphic area is entered, consists of the same Tertiary rocks as are traversed by the river in Pegu. About fifty miles N.N.E. of Yenangyaung the extinct volcano of PSppa rises to a height of 3000 feet above the rolling country composed of Pliocene sands and gravels. The' peak consists of ash breccia, but lava flows, mostly trachytic, form the lower slopes and the surface round the base of the volcano. Amongst these floors are some of a beautiful porphyry with crystals of pyroxene. The volcano is supposed by Mr Blanford to have been in action during the Pliocene period. There is no important expanse of alluvial deposits in the valleys of the Burmese rivers. The beds of all immediately above the deltas are formed in places by older rocks, and there is no such continuous alluvial plain as is found along the courses of the Ganges and Indus. The delta of the Irrawaddy has been formed by elevation by subterranean forces, and not by the accumulation of fluviatile beds of recent origin. Some tracts of alluvium occur here and there, but the wide aud undulating plains iu the neighbourhood of the rivers in Upper Burma are composed, not of river alluvium, but of Pliocene fossil wood deposits, and the hills which bound the river on both sides are chiefly composed of sandstones and shales containing fossil wood and Bones. The mud volcanoes, or salsettes, of Minbu appear never to be subject to the violent eruptions of those- at Ramree, where stones have been ejected and flames are sometimes emitted.*~~

~~*Population. — In Lower Burma in 1881 there were only three divisions. There are now four, and the number of districts has also increased. The kingdom of Burma was annexed on the 1st January 1886, and the territory*~~

~~*so acquired was divided into four commissionerships or divisions. This number has been retained, but the names have been changed, and the number of districts has been increased. The names are given in the tables below. The figures are those of the census of 1891. This was the third census taken in Lower Burma, but the first ever attempted in the Upper Province. The census of 1891 showed the total popula- tion of Upper and Lower Burma to be 7,770,914. The population of the Shan States was estimated at 375,961, which, however, is- probably very much under the proper total. The figures for the whole province, however, amount under this estimate to 8,098,014 persons. The following statement shows how rapidly the popula- tion of Lower Burma has increased since the first census of 1872.*~~

~~*Table shoviing Increase*~~

~~*of Fopulat*~~

~~*ion.*~~

~~*1872.*~~

~~*1881.*~~

~~*Increase.*~~

~~*Per cent.*~~

~~*1891.*~~

~~*Increase.*~~

~~*Per cent.*~~

~~*2,747,148*~~

~~*3,736,771*~~

~~*989,623*~~

~~*36-02*~~

~~*4,658,627*~~

~~*921,856*~~

~~*24-67*~~

~~*The annual rate of increase is 2-23 per cent., which corresponds to 24-67 per cent, for the decade. This means that if this rate of increase be maintained the 'population of Lower Burma will be doubled in 31-428 years. The area of the province, including the Upper Burma districts, but excluding the Shan States, is returned at 171,630 square miles. There thus are on an average 45-04 persons on each square mile throughout the province. In Lower Burma in 1872 there were only 31-5 persons to the square mile, while in 1881 the returns showed 42-8. In 1891 the density had risen to 52-96 persons to the square mile. The subjoined table gives more fully the return of density for each district in Upper and Lower Burma. It gives the administrative divisions as they have been rearranged in 1899, and not as they were in 1891. Survey meanwhile has reduced the estimated total area to 164,990 square miles.*~~

~~*Lower Burma.*~~

~~*Division.*~~

~~*Executive District.*~~

~~*Pi*~~

~~*1-5 «"*~~

~~*Area, sq. miles.*~~

~~*Population.*~~

~~*Chief Town with Population.*~~

~~*No. of Villages.*~~

~~*Land Revenue*~~

~~*and Kates,*~~

~~*1898-99.*~~

~~*Arakan Pegu . . –*~~

~~*Irrawaddy – Tenasserim –*~~

~~*Akyab*~~

~~*Northern Arakan Kyaukpyu .... Sandoway ....*~~

~~*Total Arakan . .*~~

~~*3*~~

~~*i*~~

~~*5,136 5,233 4,387 3,784*~~

~~*416,305*~~

~~*14,628*~~

~~*163,832*~~

~~*78,425*~~

~~*Akgab .... 37,938*~~

~~*2,040*~~

~~*317*~~

~~*1,105*~~

~~*652*~~

~~*Es.*~~

~~17,40,409~~

~~4,73,036 1,69,962~~

~~4~~

~~18,540~~

~~673,190~~

~~...~~

~~4,014~~

~~23,83,406~~

~~Rangoon Town . . Hanthawaddy . .~~

~~Pegu~~

~~Tharrawaddy . . .~~

~~Prome .... Total Pegu . . .~~

~~2 3 2 2~~

~~3~~

~~19 3,023 4,276 2,851~~

~~2,914~~

~~180,324 396,887 237,594 339,240~~

~~368,466~~

~~Rangoon . . 180,324~~

~~Pegu . . . ’”. . 10,762~~

~~*f Prome .... 30,022-)*~~

~~*■ Shwedaung . . 12,424 *~~

~~*.Paungd6 . . . 10,233)*~~

~~*ij'sis*~~

~~*782 1,458*~~

~~*1,848*~~

~~*3,82,730 31,99,729 17,61,123 13,15,648*~~

~~*7,55,672*~~

~~*12*~~

~~*13,083*~~

~~*1,622,511*~~

~~*5,401*~~

~~*74,14,902*~~

~~*Thfingwa .... Bassein*~~

~~*Henzada ....*~~

~~*Myaungmya . . . Total Irrawaddy .*~~

~~*3*~~

~~*2*~~

~~*2 2*~~

~~*3,470 4,090*~~

~~2,886 3,005~~

~~333,443 311,262~~

~~438,131~~

~~217,878~~

~~fYandoon . . . 20,236’)~~

~~IMa-ubin . . 5,327 j’ ■Bassein .... 30,177 \~~

~~\ Ngathainggyaung 5,608/~~

~~‘Zalun .... 6,006"~~

~~Henzada . . . 19,762~~

~~-i Lemyethna . . 5,614 – Myanaung . . . 6,489 Kyangin ... 8,116 Pantanaw . . . 6,030~~

~~971 1,439~~

~~1,329 844~~

~~30,64,920 14,98,772~~

~~15,06,834 15,41,719~~

~~9~~

~~13,451~~

~~1,300,714~~

~~4,583~~

~~76,12,245~~

~~Toungoo Salween ThatSn . Amherst Tavoy . Mergui .~~

~~*m .*~~

~~*3*~~

~~*“3 3*~~

~~*“2*~~

~~*6,172 2,666 5,089 7,062 5,308 9,789*~~

~~*211,784*~~

~~*31,439*~~

~~*266,620*~~

~~*233,539*~~

~~*94,921*~~

~~*73,748*~~

~~*Toungoo . . . 19,232*~~

~~*That6n .... 9,683 Moulmein . . 55,785*~~

~~*Tavoy 15,099*~~

~~*Mergui .... 10,137*~~

~~*1,129 229 922 660 303 360*~~

~~*4,69,142*~~

~~*16,36^381*~~

~~*8,76,819 3,06,673 2,98,671*~~

~~*Total Ter*~~

~~*las!*~~

~~*sen*~~

~~*11*~~

~~*36,086*~~

~~*912,051*~~

~~*3,603*~~

~~*34,87,686*~~

~~*472*~~

~~*BURMA*~~

~~*Upper Burma.*~~

~~*Division.*~~

~~*ExecntlTe District.*~~

~~*3 a> »*~~

~~*Pi*~~

~~*Area gq. miles.*~~

~~*Population.*~~

~~*Chief Town wltli Population.*~~

~~*No. of Villages.*~~

~~*Land Revenue*~~

~~*and Rates,*~~

~~*1898-99.*~~

~~*Minbu . <*~~

~~*Mandalay –*~~

~~*Sagaing ■> Meiktila –*~~

~~*Thayetmyo*~~

~~*Pakdkku . . Minbu . . .*~~

~~*3*~~

~~*3 2*~~

~~*2*~~

~~*4,750*~~

~~*6,210 3,297 2,913*~~

~~*250,161*~~

~~*311,959 215,563 219,190*~~

~~*(Thayetmyo .] AUanmyo .*~~

~~*Pakdkku .*~~

~~*Minbu . .*~~

~~*Magwe . .*~~

~~*. 17,1011 . 9,012 / . 19,972 . 7,270 . 6,673*~~

~~*939*~~

~~*1,354*~~

~~*1,043*~~

~~*759*~~

~~*Es.*~~

~~*4,03,504*~~

~~*8,22,535 5,99,866 5,02,694*~~

~~*Magwe . . .*~~

~~*Total Minbu .*~~

~~*10*~~

~~*17,170*~~

~~*996,873*~~

~~...~~

~~*4,095*~~

~~*23,28,599*~~

~~*Mandalay . . Bhamo .*~~

~~*5 2*~~

~~*2*~~

~~*3 2*~~

~~*2,071 4,146*~~

~~*10,640*~~

~~*6,995 1,915*~~

~~375,055 . 41,939~~

~~51,021~~

~~139,389 34,062~~

~~Mandalay . .~~

~~Bhamo . . f Myitkyina t Mogaung . .~~

~~Katha . .~~

~~Mog6k . . .~~

~~188,815 8,048~~

~~1,465 \~~

~~2,937 / 2,596 5,630~~

~~786 254~~

~~139~~

~~1,578 193~~

~~7,91,413 1,26,055 65,767 5,59,152 1,09,649~~

~~Myitkyina . . Katha , .~~

~~Ruby Mines~~

~~Total Mandalay~~

~~14~~

~~25,767~~

~~641,466~~

~~2,950~~

~~16,52,036~~

~~3~~

~~3 2 4~~

~~5,634~~

~~1,862~~

~~3,481~~

~~19,062~~

~~230,799~~

~~246,141 233,316 111,533~~

~~f Shwebo . . lYe-u . . .~~

~~Sagaing . .~~

~~MOnywa .~~

~~Kiudat . .~~

~~9,3681~~

~~3,173/~~

~~9,934~~

~~6,316~~

~~2,423~~

~~1,200~~

~~593 893 980~~

~~5,29,292~~

~~6,80,827 5,53,982 3,22,057~~

~~Lower Chindwin Upper Chindwin~~

~~Total Sagaing~~

~~.~~

~~12~~

~~30,039~~

~~821,789~~

~~...~~

~~3,666~~

~~20,86,158~~

~~Kyauksfe . .~~

~~2 2~~

~~2~~

~~2~~

~~1,274 2,183~~

~~4,258~~

~~3,139~~

~~126,622 217,280~~

~~206,557~~

~~351,861~~

~~Kyauks6 . .~~

~~MeiktUa . . /Yamfethin . \ Pyinmana . .~~

~~Myingyan . .~~

~~7,201~~

~~4,685~~

~~6,584 1~~

~~12,936/~~

~~19,790~~

~~541 1,066~~

~~1,098~~

~~868~~

~~7,66,120 4,67,190~~

~~4,37,826~~

~~6,52,057~~

~~Yamfethin . . Myingyan . . . Total Meiktila~~

~~8~~

~~10,854~~

~~902,320~~

~~3,573~~

~~23,23,193~~

~~Grand total Burma~~

~~80~~

~~164,990~~

~~7,770,914~~

-

~~31,885~~

~~2,92,88,225~~

~~Gross~~

~~Revenue~~

~~3,99,75,596~~

~~The density varies almost inversely with the size of the district. Tipper Chindwin, with area of 19,000 square miles, a principality two and a ha}f times as large as Wales, has only 5-14 inhabitants to the square mile. Henzada is the most densely populated district, with 195-54 to the square mile. Mandalay district is the most thickly populated in Upper Burma, with 178 to the square mile, but this includes Mandalay city. The rural tracts have only 91-6 to the square mile, whereas Sagaing has 136. Upper and Lower Burma, «ven if we exclude the Shan States, form the largest province of the Indian Empire, but, with the exception of Assam, they contain the fewest inhabitants, and are the least densely populated. Burma itself is as large as Great Britain together with two islands of the size of Ireland. The average size of a district in Burma, including the Rangoon district, the area of which is only 19 square miles, is 4761-94 square miles, that is to say, larger than the three counties of Kent, Sussex, and Hampshire. In the whole province, as well as in Lower Burma, by far the greater part of the~~

~~population lives in villages containing less than 500 inhabitants ; 57-9 per cent, lived in villages containing less than 20 inhabitants. Villages between~~

~~200 and 500 inhabitants number 38-4 per cent, of the total popula- tion. Of villages containing 1000 and less than 2000 inhabitants there were only 376 in 1891, and 202 of these were in Lower Burma. Of villages containing between two and three thousand inhabitants were only 41 in all Burma, and 21 of these were in Lower Burma. Of towns and villages whose inhabitants number 3000 and more, and less than 5000, there were 21 with a total population of 76,565, or 1 -006 per cent, of the total population. In 1891 the population of all towns containing upwards of 5000 inhabitants amounted to 540,672, or 11-6 per cent, of the total population ; there were 25 of these in Lower Burma.~~

~~In 1891 there were 3,887,156 males and 3,740,412 females, or 962 females for every 1000 males. In Lower Burma the disparity be- tween males and females is even more strongly marked, since there were only 891 females for every 1000 of the opposite sex. In Upper Burma the females outnumber the males, and we find 1084 women for every 1000 men. The average numberof male births to 1000 female births was 1067. Lower Burma thus falls into the category of immigration countries.~~

~~Table Showing Distribtition of Population~~

~~per 10,000 of Total Population.~~

~~Division.~~

~~1~~

~~H~~

~~§■3~~

~~a~~

~~6~~

~~6~~

~~*H*~~

~~*55*~~

~~*a*~~

~~*u*~~

~~*1*~~

~~*||| 6 M*~~

~~*Arakan .*~~

~~*Pegu*~~

~~*Irrawaddy . . . Tenasserim . .*~~

~~*Total Lower Burma*~~

~~*614-6 1408-5 1516.8*~~

~~*461-3*~~

~~*-03 112.5 39-9 460-6*~~

~~*-7*~~

~~*84-1*~~

~~*6-8*~~

~~*49-6*~~

~~*-1*~~

~~*33-3*~~

~~*235-6*~~

~~136-4~~

~~•06~~

~~62-3 159-1 72-05~~

~~•4~~

~~-8 -9~~

~~81-05 8-3 31-2 -5~~

~~2-1 21-1~~

~~8-7 13-2~~

~~13-9 109-8 20-6 43-02~~

~~166-9 53-1 14-7 35-4~~

~~•001 •6 •02~~

~~-07~~

~~•064~~

~~•146~~

~~4001-2~~

~~613 03~~

~~141-2~~

~~405-4~~

~~293-51~~

~~2-1~~

~~121-05~~

~~45-1~~

~~187-32~~

~~269-1~~

~~■691~~

~~•15~~

~~Mandalay . . . Sagaing . . Minbu .... Meiktila . . .~~

~~Total Upper Burma~~

~~Total Province .~~

~~688-2~~

~~812-1~~

~~1397-6~~

~~689-5~~

~~-9~~

~~■7 •3~~

~~-03~~

~~54-9~~

~~27-5~~

~~2-1~~

~~10-5~~

~~•2 •02~~

~~-1 2-4~~

~~•1~~

~~•001~~

~~-009 -6~~

~~-06~~

~~•001~~

~~•003~~

~~1-7 1-1 25-6 -08~~

~~4-4 -3~~

~~3-9~~

~~•8~~

~~22-4 4-2 6-4 5-1~~

~~30-5 3-6 4-8~~

~~11-8~~

~~1-4~~

~~■8~~

~~-3~~

~~-8~~

~~2-7~~

~~3587-4~~

~~1-93~~

~~95-0~~

~~2-72~~

~~•610~~

~~•064~~

~~28-48~~

~~9-4~~

~~38-1~~

~~50-7~~

~~3-3~~

~~2^7~~

~~7688-6~~

~~614-96~~

~~236.2~~

~~408-12~~

~~294-120~~

~~2-164~~

~~149-53~~

~~54-5~~

226-42

319-8

3-99

2^85

BURMA

473

in^nn P^®°'^^ ^^^ agricultural classes comprise 6 '415 out of every 10,000 persons of both sexes, and only a very small proportion of these are employed in stock-breeding. The next most important class IS that of persons engaged in the preparation and supply of tood. Of these, the fishermen, grain-dealers, fruit and vegetable sellers, are for the most part Burmese, the stock-breeders and butchers are chiefly Choliars or Chittagonians. Handicraftsmen, ■wood-carvers, lacquerers, makers of textile fabrics, boat-builders, workers m metal, potters, carpenters, form only a very small per- centage of the total population. Of monks or pdngyiis there were)?. "'^^■^■^" Lower Burma 13,613, and in Upper Burma 11,894. Of upazins, or probationers, there were 6668 in Lower Burma, and 14,109 in Upper Burma. A Burman is a jack-of-all trades, and a very large number of them work at different times at all sorts of employments. There is no leisured class to speak of. There were no more than 652 males who could be taken to correspond with the leisured class of European countries.*

The Malthusian maxim that population tends to outgrow the means of support does not yet apply to Burma. The soil is too rich, and there is too great a superabundance of culturable land. War and epidemic disease did not influence the country even in Upper Burma to any appreciable extent during the period 1880- 1900. Famine has never been known in Lower Burma, and failure of crops and deficient rainfall in Upper Burma only tend to swell the tide of emigration to the more favoured districts of the lower province.

~~*Turning now to consider the births and deaths, these in Lower Burma were as follows : —*~~

~~*Births.*~~

~~*Deaths.*~~

~~*Net Increase.*~~

~~*Total Increase.*~~

~~*Male.*~~

~~*Female.*~~

~~*Total.*~~

~~*Male.*~~

~~*Female.*~~

~~*Total.*~~

~~*Male.*~~

~~*Female.*~~

~~*1881 1885 1890*~~

~~*38,012 48,059 43,918*~~

~~*35,742 45,163 40,851*~~

~~*73,754 93,222 84,769*~~

~~*31,966 40,539 36,091*~~

~~*26,170 32,1.33 27,500*~~

~~*58,136 72,672 63,591*~~

~~6046 7520 7827~~

~~9,572 13,030 13,351~~

~~15,618 20,550 21,178~~

~~Por the period of ten years the natural growth by excess of births over deaths was only 57,346, or an increase at the rate of 5-06 per cent. The registration of births and deaths is still only very partial in Upper Burma. In 1898-99 the average birth-rate throughout Lower Burma amounted to 34-11, and the death-rate to 26-13 in every thousand of the population. The proportion of deaths was practically the same as in the previous year, 26-26, while the number of births was grfeater than in any previous year, the 1897 figure being 31 -82. The natural increment of the population only accounts for 21-9 of the total growth. The surplus of 101,433 shown (an increase of 2-77 per cent.) is caused by the excess of immigrants over emigrants. Between the years 1887 and 1891 the total number of immigrants was 558,123, and of emigrants 312,211, so that there was an average gain of 29,182 persons every year. The following table shows that this rate remains fairly constant in the number of immigrants and emigrants who pass through the principal ports of the province : —~~

~~Akyab Rangoon Moulmein .~~

~~1897-98.~~

~~1898-99.~~

~~A~~

~~Emigrrants.~~

~~Immigrants.~~

~~Emi|2^rants.~~

~~Immigrants.~~

~~14,-359~~

~~75,998~~

~~847~~

~~15,925~~

~~106,374~~

~~644~~

~~14,972~~

~~91,033~~

~~743~~

~~16,407~~

~~132,177~~

~~596~~

~~Of the 4,658,627 people in Lower Burma, 3,391,590 are Burmese and Talaings, 680,700 are Karens, and 356,087 are races from India. Europeans and Eurasians number 15,333, Shans, 94,302 ; Chinese, 31,941. The increase in the number of Burmese and Talaings in ten years was 22-58 per cent., of Karens 21-7 per cent., of Europeans 20-2 per cent., and of Chinese 146 per cent. If we add the population of Upper Burma, there are in the whole province 6,129,182 Burmese and Talaings; 633,657 Karens; 95,571 Chins; 206,794 Shans ; 432,639 natives of India ; 37,407 Chinese ; and 20,177 Europeans and Eurasians.~~

~~The province as a division of the Indian Empire is ad- ministered by a Lieutenant-Governor, first appointed 1st~~

~~May 1897, with a legislative council of nine Govern- members, five of whom are oflBcials. There are,~~

besides, a chief secretary, revenue secretai-y, sec- retary and two under-secretaries, a public works department secretary with two assistants. The revenue administration of the province is superintended by a financial commis- sioner, assisted by two secretaries, and a director of land records and agriculture, with a land records departmental staff. There is a chief court for the province with a chief

justice and three justices, established in May 1900. Other purely judicial officers are the judicial commissioner for Upper Burma, and the civil judges of Mandalay and Moulmein. There are four commissioners of revenue and circuit, and nineteen deputy commissioners in Lower Burma, and four commissioners and seventeen deputy com- missioners in Upper Burma. There are two superintend- ents of the Shan States, one for the northern and one for the southern Shan States, and an assistant superintendent in the latter ; a superintendent of the Arakan Hill tracks and of the Chin Hills, and a Chinese political adviser taken from the Chinese consular-service. The police are under the control of an inspector-general, with deputy inspector- general for civil and military police, and for supply and clothing. TheEducation Department is under a director of public instruction, and there are three circles— eastern, west- ern, and Upper Burma, each under an inspector of schools. The Burma forests are divided into three circles each under a conservator, with twenty-one deputy conservators. There are also a deputy postmaster-general, chief superin- tendent and four superintendents of telegraphs, a chief collector of customs, three collectors and four port officers,, and an inspector-general of jails. At the principal towns benches of honorary magistrates,, exercising powers of various degrees, have been constituted. There are forty-one municipal towns, fourteen of which are in Upper Burma. The com- missioners of division are ear officio sessions judges in their several divisions, and also have civil powers, and powers as revenue ofB^cers. They are responsible to the lieutenant- governor, each in his own division, for the working of every department of the public service, except the military depart- ment, and the branches of the administration directly under the control of the supreme Government. The deputy com- missioners perform ihe functions of district magistrates, district judges, collectors and registrars, besides the mis- cellaneous duties which fall to the principal district officer as representative of Government. Subordinate to the dep- uty commissioners are assistant

~~*commissioners, extra- assistant commissioners andmyooks, who are invested with various magisterial, civil, and revenue powers, and hold charge of the townships, as the units of regular civil and revenue jurisdiction are called, and the sub-divisions of districts, into which most of these townships are grouped. Among the salaried staff of officials, the township officers are the ultimate representatives of Government who come into most direct contact with the people. Finally, there are the village headmen, assisted in Upper Burma by elders, variously designated according to old custom. Similarly in the towns, there are headmen of wards and elders of blocks. In- Upper Burma these headmen have always been revenue collectors. The system under which in towns headmen of wards and elders of blocks are ap- pointed is of comparatively recent origin, and is modelled on the village system.*~~

*The Shan States were declared to be a part of British India by notification in 1886. The Shan States Act of 1888 vests the civil,, criminal, and revenue administration in the chief of the state, subject to the restrictions specified in the TheShan sanad or patent granted to him. The law to be ad- s™'** ministered in each state is the customary law of the state, so far as it is in accordance with justice, equity, and good con- science, and not opposed to the spirit of the law in the rest of British India. The superintendents exercise general control over the administration of criminal justice, and have power to call for cases, and to exercise wide revisionary powers. Criminal jurisdic- tion in cases in which either the complainant or the defendant is a European, or American, or a Government servant, or a British subject not a native of a Shan State, is withdrawn from the chiefs, and vested in the superintendents and assistant -superintendents.*

Neither the superintendents nor the assistant superintendents have power to try civil suits, whether the parties are Shans or not. In the Myelat division of the southern Shan States, however, the criminal law is practically the same as the law in force in Upper Burma, and the Ngwekunhmus, or petty chiefs, have been appointed magistrates of the second class. The chiefs of the Shan States are of three classes :— 1. Sawhwas ; 2. Myosas ; 3. Ngwek unhmus. The last are found only in the Myelat, or border country between the southern Shan States and Burma. There are fifteen Sawbwas, sixteen Myosas, and thirteen Ngwekunhmus in the Shan States proper. Two Sawbwas are under the supervision of the commissioner Mandalay division, and two under the commissioner of the Sagaing division. The states vary enormously in size, from the 12,000 square miles of the Trans-Salween State of Kgng Tung, to the 3-95 square miles of Nam IIk6m in the Myelat. The latter contained only 41 houses with 210 inhabitants in 1897. There are five states, all Sawbwaships, under the super- vision of the superintendent northern Shan States, besides an indeterminate number of "Wa States, and communities of other races beyond the Salween river. The superintendent,

~~southern Shan States, supervises thirty-nine, of which ten are Sawbwa-ships. The headquarters of the northern Shan States are at Lashio, of the southern Shan States at Taung-gyi.~~

~~The states included in eastern and western Karen-ni are not part of British India, and are not subject to any of the laws in force in the Shan States, but they are under the supervision of the superintendent southern Shan States.~~

~~The northern portion of the Karen Hills is at present dealt with on the principle of political as distinguished from administrative ■control. The tribes are not interfered with as long as they keep the peace. What is specifically known as the Kachin Hills, the country taken under administration in the Bhamo and Myit-Kyina districts, is divided into forty tracts. Beyond these tracts there are many Kachins in Katha, Mong Mit, and the northern Shan States, but though they are often the preponderating, they are not the exclusive population. The country within the forty tracts may be considered the Kachin Hills proper, and it lies between 23° 30' and ;26° 30' N. lat., and 96° and 98° E. long. Within this area the petty chiefs have appointment orders, the people are disarmed, and the rate of tribute per household is fixed in each case. Govern- ment is regulated by the Kachin Hills regulation. Since 1894 the country has been practically undisturbed, and large numbers of Kachins are enlisted, and ready to enlist in the military police, and seem likely to form as good troops as the Gurkhas of Nepal.~~

~~The Chin Hills were not declared an integral part of Burma until 1895, but they now form a scheduled district. The chiefs, however, are allowed to administer their own affairs, as far as may be, in accordance with their own customs, subject to the super- vision of the superintendent of the Chin Hills.~~

~~Religion. — Buddhists make up more than 90 per cent. ; Mussulmans, 3‘125 ; spirit-worshippers and Hindus, about 2-25 ; and Christians, about 1-25 per cent, of the total population of Upper and Lower Burma. The large nominal proportion of Buddhists is deceptive. The Burmese are really as devoted to demonolatry as the hill-tribes who are labelled plain spirit-worshippers. The actual figures of the various religions, according to the census of 1891, are as follows : —~~

~~*Buddhists*~~

~~*6,888,075*~~

~~*Sikhs*~~

~~*3164*~~

~~*Spirit-worshippers*~~

~~*168,449*~~

~~*Jews*~~

~~*361*~~

~~*Hindus*~~

~~*171,577*~~

~~*Parsees*~~

~~*96*~~

~~*Mussulmans*~~

~~*253,031*~~

~~*Not returned*~~

~~*49*~~

~~*Christians .*~~

~~*120,768*~~

~~*An analysis shows that not quite two in every thousand Burmese profess Christianity, and there are about the same number of Mahommedans among them. It is admitted by the missionaries themselves that Christianity has*~~

~~*progressed very slowly among the Burmese in comparison with the rapid progress made amongst the Karens. It is amongst the Sgaw Karens that the greatest progress in Christianity has been made, and the number of spirit-worshippers among them is very much smaller. The number of Bur- mese Christians is considerably increased by the inclusion among them of the Christian descendants of the Portuguese settlers of Syriam deported to the old Burmese Tabayin, a village now included in the Ye-u subdivision of Shwebo. These Christians returned themselves as Burmese. The forms-of Christianity which make most converts in Burma are the Baptist and Roman Catholic faiths.*~~

~~*Education. — Compared with other Indian provinces, and even with some of the countries of Europe, Burma takes a very high place in the returns of those able both to read and write. Taking the sexes apart, though women fall far behind men in the matter of education, still women are better educated in Burma than in the rest of India. The average number of each sex in Burma per thousand is : literates, male, 450 ; female, 29 ; illiterates, male, 550 ; female, 971. The number of literates in Bengal is : male, -47 ; female, 1. The proportion is reduced by the number of*~~

~~*immigrants from India, who are mostly illiterate. The degree of education prevailing amongst every thousand persons of each sex who profess one of the five chief religions of the province shows Burma still more favourably.*~~

~~*Beligion.*~~

~~*Illiterate.*~~

~~*!LearQing.*~~

~~*Literate.*~~

~~*Male.*~~

~~*Fem.*~~

~~*Male.*~~

~~*Fern.*~~

~~*Male.*~~

~~*Fern.*~~

~~*Buddhist . . . ■ Spirit-worshippers . HIndus .... Mussulmans Christians.*~~

~~*443 922*~~

~~*757 746 471*~~

~~*970 997 960 961 723*~~

~~*74*~~

~~*6*~~

~~*13*~~

~~*25*~~

~~*79*~~

~~*5 1 8 9 51*~~

~~*483 72 230 229 450*~~

~~*25 2*~~

~~*32*~~

~~*30*~~

~~*226*~~

~~*The fact that in Upper Burma the proportion of literates is nearly as high as, and the proportion of those under instruction even higher than, that of the corresponding classes in Lower Burma, is a clear proof that in primary*~~

~~*education, at least, the credit for the superiority of the Burman over the native of India is due to indigenous schools. If we take the numbers of those of 25 years and over, the proportion per thousand is more clear and just. The numbers for Lower Burma were : literates, male, 602 ; female, 34 ; illiterates, male, 398 ; female, 966. For Upper Burma : literates, male, 627 ; female, 16 ; illiterates, male, 373 ; female, 984. It was not till 1890 that the Education department took action in Upper Burma. It was then ascertained that there were 684 public schools with 14,133 pupils, and 1664 private schools with 8685 pupils. It is worthy of remark that of these schools 29 were Mahommedan, and that there were 176 schools for girls, in which upwards of 2000 pupils were taught. There are three circles- Eastern, Central, and Upper Burma. For the special supervision and encouragement of indigenous primary education in monastic and in lay schools, each circle of inspection is divided into sub- circles corresponding with one or more of the civil districts, and each sub-circle is placed under a deputy-inspector or a sub-inspector of schools. There are nine standards of instruction, and the classes in schools correspond with these standards. In Upper Burma all educational grants are paid from Imperial funds ; there is no cess as in Lower Burma. Grants-in-aid are given according to results. There is only one college, which is affiliated to the Calcutta University. The number of students at this Rangoon college was 25 in 1890-91. There were 70 imdergraduates in 1897-98, and 95 in 1898-99. In the latter year the college pro- duced seven B.A.'s (one with honours in English) out of eight candidates. There are three normal schools and two survey schools, one in Upper and one in Lower Burma. There are 44 Government scholarships divided between the various school and university standards, besides special scholarships for students of medi- cine, open to both men and women, tenable in Madras or Calcutta. There are missionary schools amongst the Chins, Kachins, and Shans, and a school for the sons of Shan chiefs at Taung-gyi in the southern Shan States. A Patamabyan examination for marks in the Pali language was first instituted in 1896 and is held annually. The number of candidates has not hitherto been large.*~~

~~*Finance. — The gross revenue of Lower Burma from all sources in 1871-72 was Rs. 1,36,34,520, of which Es.1,21, 70,530 was from Imperial taxation, Es.3, 73,200 from provincial services, and Rs. 10,90,790 from local funds. The land revenue of the province was Rs.34,45,230. In Burma the*~~

cultivators themselves continue to hold the land from Government, and the extent of their holdings averages about five acres. The land tax is supplemented by a poll- tax on the male population from 18 to 60 years of age, with the exception of immigrants during the first five years of their residence, religious teachers, schoolmasters. Government servants, and those unable to obtain their own livelihood. In 1890-91 the revenue of Lower Burma had risen to Rs.2,08,38,872 from Imperial taxation, Rs. 1,55,51,897 from provincial services, and Rs. 12,14,596 from in-corporated local funds. The expenditure on the administration of Lower Burma in 1870-71 was Rs.49, 70,020. In 1890-91 it was Rs.l, 58,48,041. In 1897-98 the gress revenue had risen to Rs.3,87,05,972, and in 1898-99 to Es.4,26,05,080. In Upper Burma the chief source of revenue is the Thathameda, a tithe or income tax which was instituted by King Minddn, and was adopted by the British very much as they found it. For the purpose of the assessment every district and town is classified according to its general wealth and prosperity. As a rule the basis of calculation was 100 rupees from every ten houses, with a 10 per cent, deduction for those exempted by custom. When the total amount payable by the village was thus determined, the village itself settled the amount to be paid by each individual householder. This was done by Thamadis, assessors, usually appointed by the villagers themselves. Other important sources of revenue are the rents from State lands, forests, and miscellaneous items such as fishery, revenue, and irrigation taxes. In 1886-87, the year after the annexation, the amount collected in Upper Burma from all

.sources was twenty-two lakhs of rupees. In the following year it had risen to fifty lakhs. Much of Upper Burma, however, remained •disturbed until 1890. The figures for 1890-91, therefore, show the first really regular collection. The amount then collected was Ks.87,47,020. In 1898-94 the total collections were Rs. 1,05,01,914. In 1896-97 the gross receipts were Rs.1,31,26,451, and in 1898-99 Rs.l, 39, 43,991. The following statement exhibits the gross re- ceipts and expenditure of the province during the years 1897-98 and 1898-99, distributed between imperial, provincial,

~~*incorporated local, excluded local, and municipal funds. These include the transactions of the Rangoon municipality and the Rangoon Port 'Trust, although these funds do not bank with Government.*~~

~~*189T-98.*~~

~~*1898-99.*~~

~~*Receipts.*~~

~~*Expenditure.*~~

~~*Eeceipts.*~~

~~*Expenditure.*~~

~~*Imperial . Provincial . Incorporated*~~

~~*Local Excluded*~~

~~*Local Municipal .*~~

~~*Es.*~~

~~*3,02,02,197 3,16,02,179*~~

~~*20,28,696*~~

~~*23,59,059 22,67,945*~~

~~*E.s.*~~

~~*84,51,802 2,99,07,823*~~

~~*19,47,947*~~

~~*20,54,133 22,70,066*~~

~~*Ks.*~~

~~3,38,45,001 3,41,28,971~~

~~21,45,511~~

~~26,31,022~~

~~24,34,175~~

~~Es.~~

~~86,64,995 3,00,14,084~~

~~21,07,037~~

~~27,16,160 24,73,718~~

~~6,84,60,076~~

~~4,46,31,771~~

~~7,51,84,680~~

~~4,59,75,994~~

~~Defence,. — In 1871, 5016 fighting men, Europeans and natives, wefe maintained at a total cost of Rs.27,62,000, and the strength of the police in the same year was 5319. In 1898-99 the strength of the troops in Burma was : Europeans 4234, and natives 6493 — a total of 10,727 men. These were nearly equally divided between the Rangoon and the Mandalay district commands, with 1262 natives in the southern Shan States command. Besides these there were 14,941 military police, whose cost was Rs.48,46,448. The civil police amounted to 15,5-58 civil constables. There were besides 2530 volunteers, .366 of whom were cadets. They consisted of the Rangoon Port Defence volunteers, comprising artillery, naval, and engineer corps, the Moulmein artillery, the Moulmein, Rangoon, Railway, and Upper Burma rifles. Four Indian marine vessels ply on the Irrawaddy and the Chindwin rivers, and the provincial marine consists of 28 launches in Lower Burma and 30 ia Upper Burma. These carry troops, specie, cattle, ammunition, and stores. Their cost was Rs.1,48,485 in Lower Burma, and~~

~~*Rs.2,45,163 in Upper Burma. There is a battery for the defence of the harbour at Monkey Point at the junction of the Sittang with the Rangoon river.*~~

~~*Minerals and Mining. — The tin mines in Lower Burma remain in much the same condition as they were in 1880. They are still worked by natives, but a company is being formed to work the mines in the Maliwun township of Mergui by European methods. The chief mines and minerals are in Upper Burma. The jade mines of Upper Burma are now practically the only source of supply of that mineral, which is in great demand over all China. The mines are situated beyond Kamaing, north of Mogaung in the Myitkyina district. The miners are all Kachins, and the right to collect the jade duty of 33} is farmed out by' Government to a lessee, who has hitherto always been a Chinaman. The amount obtained has varied considerably. In 1887-88 the rent was Rs.50,000. This dwindled to Rs.36,000 in 1892-93, but the system was then adopted of letting for a term of three years, and in 1898 Es.41,100 was obtained. The amount extracted varies from 2000 to 3000 cwts. The value varies enormously according to colour, which should be a particular shade of dark green. Semi-trans- parency, brilliancy, and hardness are, however, also essentials. The old river mines produced the best quality. The quarry mines on the top of the hill near Tawmaw produce enormous quantities, but the quality is not so good.*~~

~~*The most important ruby-bearing area is the Mog6k stone tract, in the hills about 60 miles east of the Irrawaddy and 90 miles N.N.W. of Mandalay. The right to mine for rubies by European methods and to levy royalties from persons working by native methods was leased to the Burma Ruby Mines Company, Limited, in 1889, and the lease was renewed in 1896 for 14 years at a rent of Rs.3,15,000 a year plus a share of the profits. The rent was reduced permanently in 1898 to Rs.2,00,000 a year, but the share of the profits taken by Government was increased from 20 to 30 per cent. The value of the rubies found in 1898 was Rs.8,69,252, and a dividend of 5 per cent was then paid for the first time. There are other ruby mines at Nanyaseik in the Myitkyina district and at Sagyin in the Mandalay district, where the mining is by native methods under license-fees of Es.5 and Rs.lO a month. They are, however, only moderately successful. Gold is found in most of the rivers in Upper Burma, but the gold-washing industry is for the*~~

~~most part spasmodic in the intervals of agriculture. There is a gold mine at Kyaukpazat in the Mawnaing circle of the Kaltra district, where the quartz is crushed by machinery and~~

~~treated by chemical processes. Work was begun in 1895, and the yield of gold in that year was 274 oz., which increased to 893 oz. in 1896-97, and to 1120 oz. in 1898-99. Coal is found in several fields in the Shan States, on the Upper Chindwin, and at Mergui,but it is of no very high quality. The principal seats of the petroleum industry are Yenangyaung in the Magwe, and Yenangyat in the Pak6kku districts. The yield of the former wells in 1898 was 15,484,301 gallons, and of the Yenangyat field 6,036,088 gallons. The latter field is extending rapidly. In the Akyab district 58,025 gallons were produced, and in Kyaukpyu 106,549 gallons. The wells have been worked for a little over a century by the natives of the country. The Burma Oil Company since 1889 has worked by drilled wells on the American or cable system. The output con- tinues steadily to increase, and there are no signs of exhaustion, but, on the other hand, there seems no prospect of the discovery of flowing wells.~~

~~Amber is extracted by Kachins in the Hukawng valley beyond the administrative border, but the quality of the fossil resin is not very good. The amount exported varies considerably. In 1897 it was valued kt Es.2,830, in 1898 at Rs.4,990, and in 1899 at Rs.15,915. Tourmaline, or rubellite, is found on the borders of the Ruby Mines district and in the Shan State of Mong Long. Steatite to the amount of 19 tons, valued at Rs. 7,995, was extracted in 1899 from the Arakan hill quarries. Salt is manu- factured at various places in Upper Burma, notably in the lower Chindwin, Sagaing, Shwebo, Myingyan, and Yamfethin districts, as well as at Mawhkio in the Shan State of Thibaw. Iron is found in many parts of the hills, but is so far only worked by inhabitants of the country. A good deal is extracted and manufactured into, native implements at Pang L6ng in the Legya (Laihka) Shan State. Lead is extracted by a Chinese lessee from the mines at Bawzaing (Maw-son) in the Myelat, southern Shan States. The ore is rich in silver as well as in lead.~~

~~Agriculture. — Rice continues to be the staple product of the province both in Upper and Lower Burma. In 1871-72 there were 1,836,021 acres devoted~~

~~to its cultivation in Lower Burma. In 1898-99 the area cropped in Lower Burma was 6,478,339 acres, of which 6,098,956 acres were under paddy. Maize covered 11,707 acres, and other food-grains, including pulse, 34,781 acres. Til- seed covered 24,822 acres ; sugar-cane, 10,020 acres ; cotton, 12,078 acres ; tobacco, 29,328 acres ; orchard and garden produce covered 356,777. In all of these, except cotton, there was an increase. In Upper Burma rice is also the chief crop, but the proportion to other crops is not nearly so overwhelming. The total area cropped was 3,419,703 acres in 1899, and of this 1,502,7.36 acres were under rice; wheat, 12,638 acres; millet (cholum or jowar), 713,531 acres ; millet (cumbu or bajra), 30,843 acres ; maize, 75,926 acres ; grain (pulse), 56,129; other food-grains, including pulse, 169,627 ; tilseed, 404,884 acres ; condiments and spices, 19,007 acres ; sugar, 4847 acres ; cotton, 134,243 acres ; tea, 1221 acres ; tobacco, 34,988 acres ; fodder crops, 22,445 acres ; orchards and garden produce, 44,943 acres ; other crops were barley, sago or mandua, linseed and other oil-seeds, various fibres, indigo and other dye crops, and miscellaneous food and non-food crops, the last covering 167,410 acres. The total area cultivated in Lower Burma by irrigation from canals, tanks, wells, and other sources in 1899 was 5005 acres. In Upper Burma in the same year it amounted to 684,189 acres, of which 126,773 acres were in the Kyauksfe district, and 112,701 acres in the Magwe district. Other districts largely dependent on irrigation were Meiktila, Yamfethin, Minbu, Mandalay, and Sagaing. The old national irrigation system has been largely repaired and extended since the annexation. Of the total area of Lower Burma, 53,476,480 acres, the area cropped in 1899 was 6,478,339 acres, the area not available for cultivation was 25,828,221 acres ; 4,813,995 acres were covered with forests, and the cultivable area, other than fallow, amounted to 15,765,976 acres. The total area of Upper Burma is 54,395,395 acres. Of this 3,901,140 acres are in feudatory and tributary states, and for 2,644,713 acres no returns exist. Of the remaining 47,849,642 acres the net area cropped in 1899 was 3,419,702 acres ; forests covered 4,836,138 acres ; 28,945,014 acres were not available for cultivation ; the cultivable waste, other than fallow, amounted to 9,197,905 acres. The current fallow was 1,703,452 acres. Of agricultural stock there were in 1898-99 in Lower Burma 566,312 bulls and bullocks, 302,119 cows, 272,588 bull buffa^ loes, 228,383 cow buffaloes, 560,017 young stock, 2310 sheep, 35,672 goats, 12,144 horses and ponies, 463,122 ploughs, and~~

~~195,207 carts. In Upper Burma there were 639,175 bulls and bullocks, 611,203 cows, 78,404 bull buffaloes, 96,206 cow buffaloes, 599,871 young stock, 4044 sheep, 27,817 goats, 21,076 horses and ponies, 2104 mules and donkeys, 53 camels, 365,518 ploughs, and 222,580 carts.~~

~~Forests. — In 1870-71 the State reserved forests covered only 133 square miles, all in the Rangoon division. The total receipts from the forests then amounted to Rs. 7,72,400. In 1889-90 the total area of reserved forests in Lower Burma was 5574 square miles, and the gross revenue was Rs.31,34,720 and the expenditure was Rs.13,31,930. The work of the forest department did not begin in~~

~~Upper Burma till 1891. At the end of 1892 the reserved forests in Upper Burma amounted to 1059 square miles. On 30tli June 1896 the reserved area amounted to 5438 square miles. At the close of 1899 the area of the reserved forests in the whole province amounted to 15,669 square miles, 962 square miles being the addi- tion made during 1898-99. The revenue in 1898-99 amounted to Ks.83,50,888, and the charges to Rs.23,62,055, showing a surplus of Ks.69, 88,833. The receipts for the previous year had beeu Ks.72,- 16,257, and the average receipts for the preceding five years had been Rs.61,02,382. The proportion of the surplus to the gross revenue for that period showed a percentage of 67 -48.~~

~~Fisheries.— The gross demand of fishery revenue in Lower Burma in 1898-99 was Rs.18,77,933, an increase of Rs.1,37,875 over the figures of the preceding year. To this total fishery leases contri- buted Rs.16,52,227, an advance of Rs.1,43,713, and licenses for fishing implements Rs.2,25,706, or Rs.5,888 less than in 1897-98. In the Irrawaddy division, where most fishing is done, the revenue rose by over a lakh of rupees, and in the Pegu division by Rs.37,405. In Upper Burma the gross revenue derived from fisheries increased from Rs.3,02,216 to Rs.3,05,372.~~

~~Manufactures.— There were in 1871-72 twenty-six steam rice- mills in the province. Five years earlier there were only three. The total number of~~

~~factories in 1889-90 was 125. In 1898-99 there were 136. The mechanical power in every case is steam, and the factories are mostly either rice or timber mills, and in some cases both combined. In 1898-99 two new rice-mills were opened in the Toungoo district, and one each in Hanthawaddy, Henzada, and Rangoon town. Saw-mills were established in Toungoo, Bassein, Rangoon, and Hanthawaddy, an iron and brass factory at Moulmein, and a cotton factory in the Thayetmyo district. The average daily number of operatives in 1899 was 16,181, of whom only 110 were females. The manufacture locally of silk and cotton stuffs is steadily dying out, and aniline is superseding the old natural dyes. Silver work of peculiar and delicate workmanship is perhaps extend- ing, and the pottery, brass, and copper work and lacquer work remain stationary.~~

~~Commerce. — The following table shows the progressive value of the trade of Burma since 1871-72 : —~~

~~Tear.~~

~~Imports.~~

~~Exports.~~

~~Total.~~

~~Kb.~~

~~Es.~~

~~Es.~~

~~1871-72~~

~~3,15,79,860~~

~~3,78,02,170~~

~~6,93,82,030~~

~~1881-82~~

~~*6,38,49,840*~~

~~*8,05,71,410*~~

~~*14,44,21,250*~~

~~*1891-92*~~

~~*10,50,06,247*~~

~~*12,67,21,878*~~

~~*23,17,28,125*~~

~~*1898-99*~~

~~*11,68,08,404*~~

~~*16,46,67,442*~~

~~*28,14,76,846*~~

~~*Of the total sea-borne trade of the province 76-5 per cent, passed through Rangoon in 1898-99, as compared with 78-5 in 1897-98. Rice and timber are by far the most important articles of sea-borne exports. The contributions made by the various kinds of country produce were in 1898-99 in the following proportions : —*~~

~~*Rice .*~~

~~*82-04*~~

~~*Raw cotton .*~~

~~*. 1-20*~~

~~*Teak .*~~

~~*7-79*~~

~~*Jade-stone .*~~

~~*. -54*~~

~~*Cutch .*~~

~~*1-09*~~

~~*Rice-bran*~~

~~*. 2-09*~~

~~*Raw hides .*~~

~~*1-17*~~

~~*Other articles*~~

~~*. 3-28*~~

~~*Raw caoutchouc*~~

~~■*80*~~

~~*The chief articles of import are cotton twist and yarn, cotton, silk and woollen piece goods, crockery, hardware, gunny bags, sugar, tobacco, and liquors.*~~

~~*The system of inland trade registration was in a more or less experimental and progressive state until 1892, when it was thoroughly revised. In the year 1898-99 there were twenty regis- tration stations in Upper Burma, and nine in Lower Burma. The total trade registered at these stations had an aggregate value of Rs.2, 89,23,907, which showed the slight increase on the previous year of Rs. 46,304. A review of the trade returns of the previous six years, however, shows that the trade was expanding. The value of the total trade during the three years ending with March 1899 was 35‘07 per cent, in excess of that registered in the three years ending with March 1896. Of this increase exports advanced more rapidly than imports, and the expansion under both heads was greater in Upper Burma than in Lower Burma — that*~~

~~*is, more with the Shan States and Western China than with Siam and Karen-ni. The value of the trade with Western China in 1898-99 was Rs.36,68,610, showing an increase of 2-8 per cent, over 1897-98, but considerably less than in 1896-97, when Rs.39,57,936 was registered. Trade with the northern Shan States showed a growth during the year from Rs.64,29,744 to Es.72,96,789. In the southern Shan States the figures were Rs.94,60,636 for 1898-9" against Rs.93,59,613 for the preceding year.*~~

~~*Shipping and Navigation. — The number of vessels engaged in the sea-borne trade in 1889-90 was 6435, with a tonnage of 3,360,045. Vessels entered, 2619 ; tonnage, 1,016,373 ; vessels cleared, 2469 ; tonnage, 1,011,880. The traffic to and from Burma through the Suez Canal was : Vessels entered, 40 ; tonnage, 62,618 ; vessels*~~

~~*cleared, 169 ; tonnage, 245,017. In 1898-99 the number of vessels and the aggregate tonnage engaged in the sea-borne trade was: Vessels, 6344 ; tonnage, 4,133,436. These were distributed in the following proportions : —*~~

~~*Port.*~~

~~*Entered.*~~

~~*Cleared, |*~~

~~*Vessels.*~~

~~*Tonnage.*~~

~~*Vessels.*~~

~~*Tonnage.*~~

~~*Rangoon . Akyab Bassein . Moulmein Smaller ports .*~~

~~*1225*~~

~~*290*~~

~~*40*~~

~~674~~

~~922~~

~~1,417,373~~

~~167,158~~

~~78,123~~

~~263,089~~

~~130,477~~

~~1235~~

~~282~~

~~42~~

~~712~~

~~922~~

~~1,431,773~~

~~166,752~~

~~78,058~~

~~270,413~~

~~130,220~~

~~376 steamers with tonnage aggregating 625,030 tons, and 130' sailing vessels with a total tonnage of 98,918, entered ; and 428 steamers with a tonnage of 739,246, and 139 sailing vessels with a tonnage of 110,702, cleared.~~

~~*Internal Communications.— In 1871-72 there were 814 miles of road in Lower Burma, but the chief means of internal communica- tion was by water. Steamers plied on the Irrawaddy as far as Thayetmyo. The vessels of the Irrawaddy Flotilla Company now ply to Bassein and to all points on the Irrawaddy as far north as Bhamo, and in the dry weather to Myilkyina, and also on the Chindwin as far north as Kinpat, and to Homalin during the rains. The length of roads has not greatly increased in Lower Burma, where there are now about 70 miles of navigable canals, but there has been a great deal of road construction in Upper Burma. At the end of the year 1898-99 there were in the whole province 6032 miles of road, 1322 of which were metalled and 1179 unmetalled, but bridged and drained, and the remainder partially bridged and drained. But the chief advance in communications has been in railway construction. The first railway from Rangoon to Prome, 161 miles, was opened in 1877, and that from Rangoon to Toungoo, 166 miles, was opened in 1884. Since the annexation of Upper Burma this has been extended to Mandalay, and the Mu Valley railway has been constructed from Sagaing to Myitkyina, a distance of 762 miles from Rangoon. The Mandalay-KunlSng railway is under construction, and trains run from Mandalay to Nawnghkio, a distance of 72 miles. The Sagaing-Mdnya^Alfi branch and the Meiktila-Myingyan branch were opened to traffic during 1900, so that the length of line now approaches 1200 miles. The Mandalay- KunlOng railway will be carried at least as far as Lashio, 180 miles, and branches between Bassein and Henzada and Tharrawaddy and Henzada are being surveyed, as is also the bridge over the Irra- waddy at Sagaing, where there is now a steam ferry.*~~

~~*Posts and Telegraphs. — There were, in 1899, 34 head post offices, 88 sub-offices, and 64 branch offices, a total of 186 imperial post offices for the province, besides 1 district sub-office and 89 branch offices, making 276 in all. There were 176 post offices doing savings bank business, with 47,652 accounts. In all 17,417,670 postal articles, including parcels, were delivered in the year. Of the articles received for delivery"18 per cent, were addressed in Burmese and Chinese. There were 238 telegraph offices open for paid tele- grams in 1898-99. The length of telegraph lines in the province was 5296 miles, and the total length of wire 12,148 miles.*~~

~~*History. — In 1862 the province of British Burma, the present Lower Burma, was formed with Sir Arthur Phayre as chief com- missioner. In 1867 a treaty was concluded at Mandalay providing for the free intercourse of trade and the establishment of regular diplomatic relations. King Mindon died in 1878, and was succeeded by his son King Thibaw. Early in 1879 he excited much horror by executing a number of the members of the Burmese royal family, and relations became much strained. The British resident was withdrawn in October 1879. The government of the country rap- idly became bad. Control over many of the outlying districts was lost, and the elements of disorder on the British frontier were a standing menace to the peace of the country. The Burmese court, in contravention of the express terms of the treaty of 1869, created monopolies to the detriment of the trade both of England and Burma; and while the Indian Government was unrepresented at Mandalay, representatives of Italy and France were welcomed, and two separ rate embassies were sent to Europe for the purpose of contracting new and, if possible, close alliances with sundry European powers. Matters were brought to a crisis towards the close of 1885, when the Burmese Government imposed a fine of £230,000 on the Bombay- Burma Trading Corporation, and refused to comply with a suggestion of the Indian Government that the cause of complaint should be investigated by an impartial arbitrator. An ultimatum was there- fore despatched on 22nd October 1886. On 9th November a reply was received in Rangoon amounting to an unconditional refusal. The king on 7th Novemlper issued a proclamation calling upon his subjects to drive the British into the sea. On 14th November 1885 the British field force crossed the frontier, and advanced to Mandalay without incurring any serious resistance (see Bckmesb Wa.il). It reached Ava on 26ti»*~~

~~*November, and an envoy from the king signified his submission. On 28th November the British occupied Mandalay, and next day King Thibaw was sent down the river to Rangoon, whence he was afterwards transferred to Eatnagiri on the Bombay coast. Upper Burma was formally annexed on 1st January 1886, and the work of Testoring the country to order and*~~

~~*introducing settled government commenced. This was a more serious task than the overthrow of the Burmese Government, and occupied four years. This was in part due to the character of the country, which was characterized •as one vast military obstacle, and in part to the disorganization which had been steadily growing during the six years of King Thibaw's reign. By the close of 1889 all the larger bands of marauders were broken up, and since 1890 the country has •enjoyed greater freedom from violent crime than the province formerly known as British Burma. The boundary with Siam was demarcated in 1893, and that with China was completed in 1900.*~~

~~*Authorities. — Official: Spearman, Col. Horace. British Burma Grazetteer, 2 vols. Rangoon, 1879. — Scott, ■J. George. Tipper Burma Gazetteer, 5 vols. Rangoon, 1900-1. Non- 'OfB.cial : Bigandet, Right Rev. Bishop. Life or Legend of Gautama, ■3rd ed. London, 1881. — Bird, G. W. Wander- ings in Burma. London, 1897. — Cuming, B. D. In the Shadow of the Pagoda. London, 1893. With the Jungle Folk. Xondon, 1897. — F e r- RARS, Max and Bertha. JBurma. London, 1900. — F I E L D I N G, H. The Soul of a People (_Bud- ■dhism in Burma). Lon- don, 1898. Thibaw's Queen. London, 1899. — Forbes, Capt. C. J. F. S. JBurma. London, 1878. Comparative Grammar ■of the Languages of Farther India. London, 1881. Legendary History •of Burma and Arakan. Rangoon, 1882. — Gor- don, J. Burma and its Inhabitants. London, 1876. — Hakt, Mrs E. Picturesque Burma. London, 1897. — Mac- MAHON, Gen. R. Far 'Cathay and Farther • India. London, 1892. — Mason, Rev. F., D.D., 3urma. Rangoon, 186(i. — P A R K E R, B. H. JBurma. Rangoon, 1892. — Phatre, Sir Arthur. JSistory of Burma. Lon- ■don, 1883. — RiGBY, G. C. History of the Operations in Northern Arakan and the Taw- ■dtoin Chin Hills, Rangoon, 1897.— Scott, J. George. Burma, As it is, As it was, and As it loillbe. London, 1886.— Shwat Yoe. The Burman, His Life and Notions, 2nd ed. London, 1896.— Smea- •TON, D. M. The Karens of Burma. London, 1887. (j. g. so.)*~~

~~*Burmese War of 1885. — The causes wliich led to this war, and the consequent annexation of Upper Burma, may be briefly narrated. Relations between the British and Burmese Governments had for some years ■'been considerably strained, but it was not till the acces sion of Thibaw to the throne in 1878 that matters became really serious. This potentate opened*~~

his reign by a .series of more than usually cold-blooded massacres of his nearest male relatives, and it soon became evident that the position of a British envoy at the Court of Ava was no longer either a desirable or dignified one. In 1879, therefore, Great Britain ceased to be represented in

JRa]i ilutoins Bit piieiliim

UPPER 'bURMA,

WTTB EBOABO TO HEUSaBOORniQ COUNTRIES IJl 18S5.

Seals'! iDoli — 1» aila.

Mandalay, and matters went from bad to worse. Thibaw lent himself more and more to foreign intrigues ; and finally, in the summer of 1885, matters came to a crisis over a dispute that had arisen between the king and a large British mercantile firm, called the Bombay -Burma Trading Company, which for years had been engaged in the export of timber from the great teak forests of the king's dominions. The imposition of an impossible fine on this company, coupled with the threat of confiscation of all their rights and property in case of non-payment, led to the British ultimatum of 22nd October 1885 ; and by 9th November a practical refusal of the terms having been received at Rangoon, the occupation of

Mandalay and the dethronement of the king were determined upon.

At this time, beyond the fact that the country was one of dense jungle, and therefore most un- favourable for military operations, little was known of the interior of Upper Burma ; but British steamers had for years been running on the great river highway of the Irrawaddy, from Rangoon to Mandalay, and it was obvious that the quickest and most satisfactory method of carrying out the British campaign was an advance by water direct on the capital. Fortunately a large number of light- draught river steamers and barges (or " ilats "), belonging to the Irra- waddy Flotilla Com- pany, were available at Rangoon, and the local knowledge of the com- pany's officers of the difficult river navigation was at the disposal of the Government. Major- General, afterwards Sir H. N. D. Prendergast, V.C, K.C.B., R.E., was placed in command of the expedition. As was only to be

expected in an enterprise of this description, the navy as well as the army was called in requisition ; and as usual the services rendered by the seamen and guns were most important. It may be noticed here that strong opposition to the advance of the flotilla was expected from the forts and guns known to exist on the river banks, and some at least of the redoubts had been constructed on scientific principles under European supervision. The following is an abstract of the force detailed : — 3 brigades of infantry each of 1 British and 2 native battalions ; 6 batteries of artillery (1 field, 2 garrison, 3 mountain) ; 1 pioneer regiment (native) ; 6 companies of sappers and miners (native) ; 1 naval brigade with 26 guns from H.M. ships on the station. The bulk of the native troops were from Madras, and it will be noticed that no mounted troops were in the first instance necessary. It was, nevertheless, foreseen that mounted infantry would be valuable as soon as the river-work was completed, and General Prendergast applied for permission to form a company to go with the expedition. The total effective of the force was 9034 fighting men, 2810 native followers, and 67 guns ; and, for river service, 24 machine guns. The river fleet which conveyed the troops and stores was composed of a total of no less than 55 steamers, barges, launches, &c. Thayetmyo was theBritishpost on the river nearest to the frontier,

and here, by 14th November," five days after Thibaw's answer had been received, practically the whole expedition was assembled. On the same day General Prendergast received instructions to commence operations. There is not the slightest doubt that the Burmese king and his country were taken completely by surprise by the unexampled rapidity of the advance. There had been no time for them to collect and organize for the stubborn resistance of which the river and its defences were undoubtedly capable. They had not even been able to block the river by sinking steamers, &c., across it, for, on the very day of the receipt of orders to advance, the armed steamers, the Irrawaddy and Kathleen, engaged the nearest Burmese batteries, and brought out from under their guns the king's steamer and some barges which were lying in read- iness for this very purpose. On the

~~16th the batteries themselves on both banks were taken by a land attack, the enemy being evidently unprepared and making no resistance. On 17th Novem- ber, however, at Minhla, on the right bank of the river, the Burmans in considerable force held successively a barricade, a pagoda, and the palace and redoubt of Minhla. The attack was pressed home by a brigade of native infantry on shore, covered by a bombard- ment from the river, and the enemy were defeated with a loss of 170 killed and 276 prisoners, besides many more drowned in the attempt to escape by the river. The advance was continued next day and the following days, the naval brigade and heavy artillery leading and silencing in succession the enemy's river defences at Nyoungu, Pokoko, and Myingyan. On 26th November, when the flotilla was approaching the ancient capital of Ava, envoys from King Thibaw met General Prendergast with offers of sur- render ; and on the 27th, when the ships were lying off that city and ready to commence hostilities, the order of the king to his troops to lay down their arms was received. There were three strong forts here, full at that moment of thousands of armed Burmans, and though a large number of these filed past and laid down their arms by the king's command, still many more were allowed to disperse with their weapons ; and these, in the time that followed, broke up into "dacoit" or guerilla bands, which became the scourge of the country and prolonged the war for years. Mean- while, however, the surrender of the king of Burma was complete ; and on 28th November, in less than a fortnight from the declara- tion of war, Mandalay had fallen, and the king himself was a prisoner, while every strong fort and town on the river, and all the king's ordnance (1861 pieces), and thousands of rifles, muskets, and arms had been taken. Much valuable and curious "loot" and property was found in the palace and city of Mandalay, which, when sold, realized about 9 lakhs of rupees (£60,000). A grant of money was divided among the troops as " prize money."~~

~~From Mandalay, General Prendergast made a bold stroke and seized Bhamo on 28th December. This was a very important move, as it forestalled the Chinese, who were preparing to claim the place. But unfortunately, although the king was dethroned and deported, and the capital and the whole of the river in the hands of the British, the bands of armed soldiery, unaccustomed to condi- tions other than those of anarchy, rapine, and murder, took advan- tage of the impenetrable cover of their jungles to~~

~~*continue a desultory armed resistance. Keinforcements had to be pressed into the coun- try, and it was in this phase of the campaign, lasting several years, that the most difficult and most arduous work fell to the lot of the troops. It was in this jungle warfare that the losses from battle, sickness, and privation steadily mounted up; and the troops, both British and native, proved once again their fortitude and courage.*~~

~~*Various expeditions followed one another in rapid succession, penetrating to the remotest corners of the land, and bringing peace and protection to the inhabitants, who, it must be mentioned, suffered at least as much from the "dacoits" as did the troops. The final, and now completely successful, pacification of the country was only brought about by an extensive system of small protective posts scattered all over the country, and small lightly-equipped columns moving out to disperse the enemy whenever a gathering came to a head, or a pretended prince or king appeared.*~~

~~*No account of the third Burmese war would be complete without a reference to the first, and perhaps for this reason most notable, land advance into the enemy's country. This was carried out in November 1886 from Toungoo, the British frontier post in the east of the country, by a small column of all arms under Colonel W. P. Dicken, 3rd Madras Light Infantry, the first objective being Ningyan. The operations were completely successful, in spite of a good deal of scattered resistance, and the force afterwards moved forward to Yamfethin and HIaindet. As inland operations developed, the want of mounted troops was badly felt, and several regiments of cavalry were brought over from India, while mounted infantry was raised locally. It was found that without these most useful arms it was generally impossible to follow up and punish the active enemy. (^_ P *~~

~~*Burnaby, Frederick Custavus (1842-1885), English traveller and soldier, was born on 3rd March*~~

~~*1842, at Bedford, and was the son of a clergyman. HIaving been educated at Harrow and in Germany, he entered the Horse Guards (Blue) in 1859. During a period of peace that followed, his spirit of adventure found outlets in balloon-ascents and in travels through Spain and Russia. In the summer of 1874 he accom- panied the Carlist forces as correspondent of the Times, but before the end of the war he was transferred to Africa to report on*~~

~~*General (then Colonel) Gordon's ex- pedition to the Sudan. This took Burnaby as far as Khartum. Returning to England in March 1875, he matured his plans for a journey on horseback to Khiva through Russian Asia, which had just been closed to travellers by the Government. His accomplishment of this task, in the winter of 1875-76, described in his book A Ride to Khiva, brought him immediate fame. His next leave of absence was spent in another adventurous journey on horseback, through Asia Minor, from Scutari to Erzerum, with the object of observing the Russian border, an account of which he afterwards published. In the Russo-Turkish war of 1877, Captain (or, as he soon became, Lieutenant-Colonel) Burnaby acted as travelling agent to the Stafford House (Red Cross) Committee, but had to return to England before the campaign was over. At this point began his active interest in politics, and in 1880 he made a vain attempt to win a seat at Birmingham in the Tory-Democrat interest. In 1882 he distinguished himself by crossing the Channel in a balloon. Having been disappointed of active service in the Egyptian cam- paign of 1882, he participated in the Sudan campaign of 1884 without of&cial leave, and was wounded at El Teb. This did not deter him from a similar course when a fresh expedition started in 1885. He was given a post by Lord Wolseley, and met his death in the battle of Abu Klea (17th January).*~~

~~*Burne-Jones, Sir Edward Burne, Bakt.*~~

~~*(1833-1898), English painter and. designer, was born 28th August 1833 at Birmingham. His father was of Welsh descent, and the idealism of his nature and art has been attributed to this Celtic strain. An only son, he was educated at King Edward's School, Birmingham, and destined for the Church. .He retained through life an interest in classical studies, but it was the mythology of the classics which fascinated him. He went into residence as a scholar at Exeter College, Oxford, in January 1853. On the same day William Morris entered the same college, having also the intention of taking orders. The two were thrown together, and grew close friends. Their similar tastes and enthusiasms were mutually stimulated. Burne- Jones resumed his early love of drawing and designing. With Morris he read Modern Painters and the Morte d' Arthur. He studied the Italian pictures in the Univer- sity galleries, and Diirer's engravings; but his keenest enthusiasm was kindled by the sight of two works by a, living man, Rossetti. One of these was a*~~

woodcut in Allingham's poems, " The Maids of Elfinmere" ; the other was the water-colour, " Dante drawing an Angel," then belonging to Mr Coombe, of the Clarendon Press, and now in the University collection. Having found his true vocation, Burne-Jones, like his friend Morris, determined to relinquish his thoughts of the Church and to become an artist. Rossetti, although not yet seen by him, was his chosen master ; and early in 1856 he had the happiness, in London, of meeting him. At Easter he left college without taking a degree. This was his own decision, not due (as often stated) to Rossetti's persuasion; but on settling in London, where Morris soon joined him at 17 Red Lion Square, he began to work under Rossetti's friendly instruction and encouraging guidance.

As Burne-Jones once said, he "found himself at

"The MiRr.OR of Venus." By Sir E. Burne-Jones.

'Love among the Ruins." By Sir E. Buune-Jones.

(From Fhutnijraphs hi/ F. HoJhjrr, Lomloi:.)

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five-and-twenty what he ought to have been at fifteen." He hacl had no regular training as a draughtsman, and lacked the contidence of science. But his extraordinary faculty ot invention as a designer was already ripening ; his mind,rich m knowledge of classical story andmediaival romance, teemed with pictorial subjects; and he set himself to complete his equipment by resolute labour, witnessed by innumerable drawings. The works of this first period are all more or less tinged by the influence of Kossetti ; but they are already differentiated from the elder master's style by their more facile though less intensely ielt elaboration of imaginative detail. Many are pen- and-ink drawings on vellum, exquisitely finished, of which the "Waxen Image" is one of the earliest and best examples ; it is dated 1856. Although subject, medium,

Sir Edward Burnk-Jones. {From aphotograpli hy Elliott and Fry, London!)

~~*and manner derive from Rossetti's inspiration, it is not the hand of a pupil merely, but of a potential master. This was recognized by Eossetti himself, who before long avowed that he had nothing more to teach him. Burne-Jones's first sketch in oils dates from this same year, 1856 ; and during 1857 he made for Bradfield College the first of what was to be an immense series of cartoons for stained glass. In 1858 he decorated a cabinet with the "Prioress's Tale " from Chaucer, his first direct illustration of the work of a poet whom he especially loved and who inspired him with endless subjects. Thus early, there- fore, we see the artist busy in all the various fields in which he was to labour.*~~

~~*In the autumn of 1857 Burne-Jones joined in Eossetti's . ill-fated scheme to decorate the walls of the Oxford Union. None of the painters had mastered the technique of fresco, and their pictures had begun to peel from the walls before they were completed. In 1859 Burne-Jones made his first journey to Italy. He visited Florence, Pisa, Siena, and other places, and appears to have found the gentle and romantic Sienese more attractive than any other school. Eossetti's influence still persisted ; and its impress is visible, more strongly perhaps than ever before, in the two water-colours " Sidonia von Bork " and " Clara*~~

~~*von Bork," painted in 1860. These little masterpieces have a directness of execution rare with the artist. In powerful characterization, combined with a decorative motive, they rival Eossetti at his best. In June of this year Burne-Jones was married to Miss Georgiana Macdoiiald, and settled in Bloomsbury. Five years later he moved to Kensington Square, and shortly afterwards to the Grange, Fulham, an old house with a garden, where he resided till his death. In 1862 the artist and his wife accompanied Euskin to Italy, visiting Milan and Venice.*~~

~~*In 1864 he was elected an associate of the Society of Painters in Water-colours, and exhibited, among other works, " The Merciful Knight," the first picture which fully revealed his ripened pjersonality as an artist. The next six years saw a series of fine water-colours at the same gallery ; but in 1870, owing to a misunderstanding, Burne-Jones resigned his membership of the society. He was re-elected in 1886. During the next seven years, 1870-77, only two works of the painter's were exhibited. These were two*~~

~~*water-colours, shown at the iJudley Gallery in 1873, one of them being the beautiful "Love among the Euins," destroyed twenty years later by a cleaner who supposed it to be an oil painting, but afterwards reproduced in oils by the painter (see Plate). This silent period was,, however, one of unremitting production. Hitherto Burne- Jones had worked almost entirely in water-colours. He now began a number of large pictures in oils, working at. them in turn, and having always several on hand. The " Briar Eose " series, " Laus Veneris," the " Golden Stairs," the " Pygmalion " series, and " The Mirror of Venus " (see Plate), are among the works planned and completed, or carried far towards completion, during these years. At last, in May 1877, the day of recognition came, with the opening of the first exhibition of the Grosvenor Gallery, when the " Days of Creation," the " Beguiling of Merlin," and the " Mirror of Venus " were all shown. Burne-Jones followed up the signal success of these pictures with " Laus Veneris," the " Chant d' Amour," " Pan and Psyche," and other works, exhibited in 1878. Most of these pictures are fiainted in gay and brilliant colours. A change is noticeable next year, 1879, in the " Annuncia- tion " and in the four pictures called " Pygmalion and the Image " ; the former of these, one of the simplest and most perfect of the artist's works, is subdued and sober ; in the latter a scheme of soft and delicate tints was attempted, not with entire success. A similar temperance of colour marks the " Golden Stairs," first exhibited in 1880. In 1884, following the almost sombre " Wheel of Fortune " of the preceding year, appeared "King Cophetua and the Beggar Maid," in which Burne-Jones once more indulged his love of gorgeous colour, refined by the period of self-restraint. This masterpiece is now in the National collection. He next turned to two important sets of pictures, " The Briar Eose " and " The Story of Perseus," though these were not completed for some years to come. In 1886, having been elected A.E.A. the previous year, he exhibited for the only time at the Eoyal Academy " The Depths of the Sea," a mermaid carrying down with her a youth whom she has unconsciously drowned in the impetuosity of her love. This picture adds to the habitual haunting charm a tragic irony of conception, and a felicity of execution which give it a place apart among Burne- Jones's works. He resigned his Associateship in 1893. One of the "Perseus" series was exhibited in 1887, two more in 1888, with " The Brazen Tower," inspired by the same legend. In 1890 the four pictures of " The Briar Eose " were exhibited by themselves, and won the widest admiration. The huge tempera*~~

picture, " The Star of Bethlehem," painted for the corporation of Birmingham, was exhibited in 1891. A long illness for

some time checked the painter's activity, which, when resumed, was much occupied with decorative schemes. An exhibition of his work was held at the New Gallery in the winter of 1892-93. To this period belong several of his comparatively few portraits. In 1894 Burne- Jones was made a baronet. Ill-health again interrupted the progress of his works, chief among which was the vast " Arthur in Avalon." In 1898 he had an attack of influenza, and had apparently recovered, when he was again taken suddenly ill, and died on the 17th June. In the following winter a second exhibition of his works was held at the New Gallery, and an exhibition of his ■drawings (including some of the charmingly humorous sketches made for children) at the Burlington Fine Arts Club.

Burne-Jones's influence has been exercised far less in painting than in the wide field of decorative design. Here it has been ■enormous. His first designs for stained glass, 1857-61, were made for Messrs Powell, but after 1861 he worked exclusively for Morris and Co. Windows executed from his cartoons are to be found all over England ; others exist in churches abroad. For the American Church in Rome he designed a number of mosaics. Reliefs in metal, tiles, gesso-work, decorations for pianos and organs, and cartoons for tapestry represent his manifold activity. In all works, however, which were only designed and not carried out by him, a decided loss of delicacy is to be noted. The colouring of the tapestries (of which the " Adoration of the Magi " at Exeter College is the best known) is more brilliant than successful. The range and fertility of Burne-Jones as a decorative inventor can be perhaps most conveniently studied in the sketch-book, 1885-95, which he bequeathed to the British Museum. The artist's influence on book-illustration must also be recorded. In early years he made a few drawings on wood for Dalziel's Bible and for Good Words; but his later work for the Kelmscott Press, founded by Morris in 1891, is that by which he is best remembered. Besides several illustrations to other Kelmscott books, he made eighty- seven designs for the Chaucer of 1897.

~~*Burne-Jones's aim in art is best given in some of his own words, ■written to a friend: "I mean by a picture a beautiful, romantic ■dream of something that never was, never will be — in a light better than any light that ever shone — in a land no one can define ■or remember, only desire — and the forms divinely beautiful — and then I wake up, with the waking of Brynhild." No artist was ■ever more true to his aim. Ideals resolutely pursued are apt to provoke the resentment of the world, and Burne-Jones encountered, •endured, and conquered an extraordinary amount of angry criticism. In so far as this was directed against the lack of realism in his pictures, it was beside the point. The earth, the sky, the rooks, the trees, the men and women of Burne-Jones are not those of this world ; but they are themselves a world, consistent with itself, and having therefore its own reality. Charged with the beauty and with the strangeness of dreams, it has nothing of a dream's incoherence. Tet it is a ■dreamer always whose nature penetrates these works, a nature out of sympathy with struggle and strenuous action. Burne-Jones's men and women are dreamers, too. It was this which, more than any- thing else, estranged him from the age into which he was born. But he had an inbred "revolt from fact" which would have estranged him from the actualities of any age. That criticism seems to be more justifled which has found in him a lack of such victorious energy and mastery over his materials as would have enabled him to carry out his conceptions in their original intensity. Repre- senting the same kind of tendency as distinguished his French con- temporary, Puvis de Chavannes, he was far less in the main current of art, and his position suffers accordingly. Often compared with Botticelli, he had nothing of the fire and vehemence of the Florentine. Yet, if aloof from strenuous action, Burne-Jones was singularly strenuous in production. HIs industry was inex- haustible, and needed to be, if it was to keep pace with the constant pressure of his ideas. Invention, a very rare excellence, was his pre-eminent gift. Whatever faults his paintings may have, they have always the fundamental virtue of design ; they are always pictures. HIs fame might rest on his purely decorative work. But his designs were informed with a mind of romantic temper, apt in the discovery of beautiful subjects, and impassioned with a delight in pure and variegated colour. These splendid gifts were directed in a critical and fortunate moment by the genius of Rossetti. HIence a career which shows little waste or misdirection of power, and, granted the aim proposed, a rare level of real success.*~~

~~*Authorities. — Catalogue to BurlingtonClub Exhibition of Draw- ings by Burne-Jones, with Introduction by Cosmo Monkhouse.] 899. — Sir E. Burne-Jones : a Record and a Review. By Malcolm Bell. 1898.— Sir E. Burne-Jones, his Life and Work. By Julia*~~

~~*Cartwright (Mrs. Ady). 1894.— TAe Life of William MoMs. By J. W. Mackail. 1899. (l. b.)*~~

~~*Burnley, a poor-law township, municipal, county (1888), and parliamentary borough, and market town of Lancashire, England, on the Brun, where it is joined by the Calder, 213 miles N. W. of London by rail. In 1889 the boundaries of the borough were extended, and the borough was then distributed into 12 wards, all which in 1894 were united into one civil parish. The corporation consists of a mayor, 12 aldermen, and 36 councillors. By Act of Parlia- ment 1890, the future rector of Burnley will be suffragan bishop of the diocese of Manchester, with the title of Bishop of Burnley. The Mechanics' Institution and School of Science (1852) was enlarged in 1888. Modern erections are 10 Established, 2 Eoman Catholic, and numerous Nonconformist churches, a handsome town hall, a muni- cipal technical school, a Victoria Hospital and infirmary (£28,000), a sanatorium for infectious diseases, a market hall, public abattoirs and cold stores, and baths. The Queen's Park (1893) measures 28, and the Scott Park (1895) 18 acres. There are, besides, 11 recreation grounds. The neighbourhood abounds in coal, and coal- mining constitutes one of the industries of Burnley. The principal industries are cotton-weaving, iron-founding, coal-mining, brick-burning, and the making of sanitary wares. The census of 1891 gives 12,240 males and 15,211 females engaged in the manufacture of cotton goods ; 2087 persons engaged in coal-mining. Area of municipal and county borough, 4015 acres; population (1881), 63,339;*~~

~~*(1891), 87,016; (1901), 97,044.*~~

~~*Burnside, Ambrose Everett (1824-1881), American soldier, was born at Liberty, Indiana, on 23rd May 1824, of Scottish pedigree, his American ancestors settling first in South Carolina, and next in the north- west wilderness, where his parents, who were very poor, lived in a rude log cabin. HIe was appointed to the United State's military academy through casual favour, and graduated in 1847, when the war with Mexico was*~~

nearly over. In 1852 he resigned his commission, and took up in Rhode Island the manufacture of a breech- loading rifle of his own invention. Afterwards he was engaged in railway duties. When the Civil War broke out he took command of a Rhode Island regiment of three months' militia, on the summons of Governor Sprague, hastened to the relief of the national capital, and commanded a brigade in the battle of Bull Run. On 6th August 1861 he was commissioned a brigadier- general of volunteers, and placed in charge of the expe- ditionary force which sailed on 12th January 1862 under sealed orders for the North Carolina coast. The victories of Hatteras Inlet, Roanoke Island, Newbern, and the neighbouring forts (February-March) furnished one of the earliest substantial achievements of the Union arms during the war. Promoted major-general on 18th May 1862, he was transferred with his corps to the army of the Potomac, and fought at South Mountain and Antie- tam in September. His patriotic spirit, with modest and amiable manners, made him highly popular, and upon McClellan's final displacement from the array of the Potomac, President Lincoln chose him as successor. Burnside reluctantly accepted the trust, and, after being disastrously defeated in the assault of Fredericks- burg on 13th December 1862, was led to resign the command in January 1863. Transferred to Cincinnati in April 1863, he caused the arrest and court-martial of Mr Vallandigham, lately an Opposition member of Congress, for an alleged disloyal speech; then starting southwards in August with a column for the relief of loyalists in East Tennessee, he entered Knoxville,to which the Confederate general Longstreet unsuccessfully laid

siege. In April 1864 Burnside returned to the east, and was attached once more to the army of the Potomac in a subordinate command ; but, after long and bloody cam- paigns, he -was blamed for the failure of a mine assault before Petersburg, July 1864, and relieved. Eesigning from the army, April 1865, he was chosen governor of Rhode Island in 1866, and twice annually re-elected. In January 1875 he was chosen to the United States Senate, and re-elected in 1880. He died at Bristol, Ehode Island, on 13th September 1881.

~~*Burntisland, a royal, parliamentary (Kirkcaldy group), and police burgh of Fifeshire, Scotland, on the northern shore of the Firth of Forth, 5^ miles S. W. of Kirkcaldy by rail. Since the opening of the Forth Bridge, Burntisland has ceased to be the terminus of the railway ferry traffic with the south, but hav- ing good wet docks it has still a considerable shipping trade. Population of parliamentary and police burgh (1881), 4099; of the royal burgh, 3197; of the royal, parliamentary, and police burgh (1891), 4962; (1900),*~~

~~*6000.*~~

~~*Burriana, a town of Spain, province of Castellon, on the river Beohi, near the sea, in a broad fertile plain. Population, 12,154. The river Mijares is used to irrigate the country, where wine, cereals, fruit, and especially oranges, are abundant. The port is annually visited by about 300 vessels, engaged in the coasting trade. The trade, however, declined in 1898 and 1897, owing to the damage done to the orange crop by a new insect pest. Burriana was the scene of hard fighting in the earliest wars of the 19th century.*~~

~~*Burrillville, a town of Providence county, Ehode Island, U.S. A. It is one of the largest towns of New England, having an area of 53 square miles. Its surface is rolling, with many small hills and ponds, and, while most of its population is rural, it contains several small villages. Population (1890), 5492; (1900),*~~

~~*6317.*~~

~~*Burroughs, John (1837-*~~

~~*-), American writer on*~~

~~*nature and natural history, was born in Eoxbury, Delaware county, New York, 3rd April 1837. In his earlier years he engaged in various pursuits — teaching, journalism, banking, farming, and fruit-raising, and for nine years was a clerk in the Treasury department at Washington. After publishing a monograph on the poetry and person- ality of Walt Whitman, he began in 1871, with WaTce- Bohin, that series of books on birds, flowers,*~~

~~and rural scenes which has made him the successor of Thoreau as a popular essayist on the plants and animals environing human life. HIs later writings have shown a more philosophic mood and a greater disposition towards literary or meditative allusion than their predecessors, but the general theme and method have been the same. HIs chief books, in addition to Wake-Bobin, are Birds and Poets (1877), and Signs and Seasons (1886) . Win- ter Sunshine (1S75), mi Fresh Fields (ISM) a,Te sketches of travel in England, Ireland, and France. A complete uniform edition of his works was issued in 1895 in ten volumes.~~

~~Burslem, a municipal borough (1878) and market town of Staffordshire, England, 20 miles N. by W. of Stafford, by rail, on the Grand Trunk Canal. Before 1886 part of the parliamentary borough of Stoke-upon- Trent, it now forms part of that of HIanley. Modern structures are two church mission rooms, two Methodist chapels, a market building, a charity hospital, a miners' hall, and public baths. The Wedgwood Memorial Insti- tute has been extended and a public park of 22 acres opened~~

~~(1894). Population (1881), 27,561; (1891), 31,999;~~

~~(1901), 38,766.~~

~~Burton, Sir Frederiolc William (1816-1900), British painter and art connoisseur, the third son of Mr Samuel Burton of Mungret, county Limerick, was born in Ireland in 1816. HIe was educated in Dublin, where his artistic studies were carried on with marked success under the direction of Mr Brocas, an able teacher, who fore- told for the lad a distin guished career. That this estimate was not exaggerated was proved by Burton's immediate success in his profession. HIe was elected an associate of the Eoyal HIibernian Academy at the age of twenty- one and an academician two years later ; and in 1842 he began to exhibit at the Eoyal Academy. A visit to Ger- many and Bavaria in 1861 was the first of a long series of wanderings in various parts of Europe, which gave him a profound and intimate knowledge of the works of the Old Masters, and prepared him admirably for the duties that he undertook in 1874 when he was appointed director of the British National Gallery in succession to Sir W. Boxall, E.A. During the twenty years that he held this post he was responsible for many important pur- chases, among them Leonardo da Vinci's " Virgin of the~~

~~Eocks," Eaphael's " Ansidei Madonna," Holbein's " Am- bassadors," Van Dyck's equestrian portrait of Charles I., and the " Admiral Pulido Pareja," by Velasquez ; and he added largely to the noted series of Early Italian pic- tures in the gallery. The number of acquisitions made to the collection during his period of office amounts to not fewer than 600. His own work, most of which was in water-colour, may be said to have had more attraction for experts than for the' general public. It was always seri- ous and deeply considered, and in style was akin to that of the Pre-Eaphaelites. He was elected an associate of the Eoyal Society of Painters in Water-Colours in 1866, and a full member in the following year. He resigned in 1870, and was re-elected as an honorary member in 1886. A knighthood was conferred on him in 1884, and the de- gree of LL.D. of Dublin in 1889. In his youth he had strong sympathy with the "Young Ireland Party," and was a close associate with some of its members. He died at his house in Kensington on 16th March 1900. (a. l. b.)~~

~~Burton, John Hill (1809-1881), Scottish histori- cal writer and man of letters, was the son of an officer in the army, and was born at Aberdeen on 22nd August 1809. After studying at the university of his native city, he re- moved to Edinburgh to practice as an advocate ; but his progress was slow, and he eked out his harrow means by miscellaneous literary work, much of which cannot now be identified. His Manuai of the Law of Scotland (1839) brought him into notice ; he joined Bowring iu editing the works of Jeremy Bentham, and for a short time was editor of the Scotsman, which he committed to the cause of free trade. In 1846 he achieved high reputation by his lAfe of David Hume, based upon extensive and un- used MS. material. In 1847 he wrote his biographies of Lord Lovat and Duncan Forbes, and in 1849 prepared for Chambers's Series manuals of political and of social econ- omy, and of emigration. In the same year he lost his wife, and never again mixed freely with society, though after some years he married again. He devoted himself mainly to literature, contributing largely to the Scotsman and BlacMiood, writing Narratives from Criminal Trials in Scotland (1852), Treatise on the Law of Bankruptcy in Scotland (1853), and publishing in the latter year the first volume of his History of Scotland., which was completed in 1870. Some of the more important of his contributions to Blackwood were embodied in two delightful volumes. The~~

~~Book Hunter (1860) and The Scot Abroad (1862). He had in 1854 been appointed secretary to the Prison Board,~~

~~an office whieli gave him entire pecuniary independence, and the duties of which he discharged most assiduously, notwithstanding his literary pursuits and the pressui-e of another important task assigned to him after the comple- tion of his history, the editorship of the National Scottish Registers. Two volumes were published under his super- vision. His last work, The History of the Reign of Queen Anne (1880), is very inferior to his History of Scotland. He died on 10th August 1881. Burton was pre-eminently a jurist and economist, and may be said to have been guided by accident into the path which led him to celebrity. It was his great good fortune to find abundant unused material for his Life of Hume, and to be the first to introduce the principles of historical research into the history of Scotland. AU previous attempts had been far below the modem standard in these particulars, and Burton's history will always be memorable as marking an epoch, even if it should one day be superseded by a more picturesque and more animated narrative. His chief defects as a historian are want of imagination, involv- ing feebleness of historical portraiture, and an undig- nified familiarity of style, which, however, at least preserves his history from the dulness by which lack of imagination is usually accompanied. His dryness is associated with a fund of dry humour exceedingly effec- tive in its proper place, as in The Book Hunter. As a man he was loyal, affectionate, philanthropic, and entirely estimable. (b. g.)~~

~~Burton, Sir Richard Francis (1821-1890), British consul, explorer, and orientalist, was born at Barham House, Herts, England, on 19th March 1821. He came of the Westmoreland Burtons of Shap, but his grandfather, the Eev. Edward Burton, settled in Ireland as rector of Tuam, and his father, Lieutenant- Colonel Joseph Netterville Burton, of the 36th Regiment, was an Irishman by birth and character. His mother was descended from the MacGregors, and he was proud of a remote drop of Bourbon blood piously~~

~~*believed to be derived from a morganatic union of the Grand Monarque. There were even those, including some of the Romany themselves, who saw gipsy written in his peculiar eyes as in his character, wild and resentful, essentially vagabond, intolerant of convention and restraint. His irregular education strengthened the inherited bias. A childhood spent in France and Italy, under scarcely any control, fostered the love of untrammelled wandering and a marvellous fluency in Continental vernaculars. Such an education so little prepared him for academic proprieties, that when he entered Trinity College, Oxford, in October 1840, a criticism of his military moustache by a fellow- undergraduate was resented by a challenge to a duel, and Burton in various ways distinguishedhimself by such eccen- tric behavioiTr that rustication inevitably ensued. Nor was he much more m his element as a subaltern in the 18th Regiment of Bombay Native Infantry, which he joined at Baroda in October 1842. Discipline of any sort he abhorred, and the one recommendation of the East India Company's service in his eyes was that it offered opportunities for studying Oriental life and languages. He had begun Arabic without a master at Oxford, and worked in London at Hindustani under Forbes before he went out ; in India he laboured indefatigably at the vernaculars, and his reward was an astonishingly rapid proficiency in Gujarati, Marathi, Hindustani, as well as Persian and Arabic. His appoint- ment as an assistant in the Sind survey enabled him to mix with the people, and he frequently passed as a native in the bazaars and deceived his own munshi, to say nothing of his colonel and messmates. His wanderings in Sind were the apprenticeship for the pilgrimage to Mecca, and his seven years in India laid the foundation of his un-*~~

~~*paralleled familiarity with Eastern life and customs, espe- cially among the lower classes. Besides Government reports and contributions to the Asiatic Society, his Indian period produced four books, published after his return home: Scinde, or the Unhappy Valley (1851), Sindh and the Races that Inhabit the Valley of the Indus (1851), Goa and the Blue Mountains (1861), and Falconry in the Valley of the Indus (1852). None of these achieved popularity, but the account of Sind is remarkably vivid and faithful.*~~

~~*The pilgrimage to Mecca in 1853 made Burton famous. He had planned it whilst mixing disguised among the Muslims and Sind, and had laboriously*~~

~~prepared for the ordeal by study and practice. No doubt the primary motive was the love of adventure, which was his strongest passion; but along with the wanderer's restlessness marched the zest of exploration, and whilst wandering was in any case a necessity of his existence, he preferred to roam in untrodden ways where mere adventure might be dignified by geographical service. There was a " huge white blot" on the maps of Central Arabia where no European had ever been, and Burton's scheme, approved by the Eoyal Geographical Society, was to extend his pilgrimage to this "empty abode," and remove a dis- creditable blank from the map. War among the tribes curtailed the design, and his journey went no farther than Medina and Mecca. The exploit of accompanying the Muslim Hajj to the holy cities was not unique, nor so dangerous as has been imagined. Several Europeans have accomplished it before and since Burton's visit without serious mishap. Passing himself off as an Indian Pathan covered any peculiarities or defects of speech. The pilgrimage, however, demands an intimate proficiency in a complicated ritual, and a familiarity with the minutiae of Eastern manners and etiquette; and in the case of a stumble, presence of mind and cool courage may be called into request. There are legends that Burton had to defend his life by taking others'; but he carried no arms, and confessed, rather shame- facedly, that he had never killed anybody at any time. The actual journey was less remarkable than the book in which it was recorded, Tlie Pilgrimage to M-Medinah and Meccah (1865). Its vivid descriptions, pungent style, and intensely personal " note " distinguish it from books of its class ; its insight into Semitic modes of thought and its picture of Arab manners give it the value of an historical document ; its grim humour, keen observa- tion, and reckless insobriety of opinion, expressed in peculiar, uncouth, but vigorous language, make it. a curi- osity of literature.~~

~~Burton's next journey was more hazardous than the pilgrimage, but created no parallel sensation.' In 1854 the Indian Government accepted his proposal to explore the interior of the Somali country, which formed a subject of official anxiety in its relation to the Red Sea trade. He was assisted by Lieutenant Speke and two other young officers, but accomplished the most difficult part of the enterprise alone. This was the journey to Harar, the Somali capital, which no white man had entered. Burton vanished into the desert, and was not heard of for four months.~~

~~When he reappeared he had not only been to Harar, but had talked with the king, stayed ten days there in deadly peril, and ridden back across the desert, almost without food and water, running the gauntlet of the Somali spears all the way. Undeterred by this ex- perience he set out again, but was checked by a skirmish with the tribes, in which one of his young officers was killed. Captain Speke was wounded in eleven places, and Burton himself had a javelin thrust through his jaws. His First Footsteps in East Africa (1856), describing these adventures, is one of his most exciting and most~~

~~characteristic books, full of learning, observation, and humour.~~

~~After serving on the staff of Beatson's Bashibazouks at the Dardanelles, but never getting to the front in the Crimea, Burton returned to Africa in 1866. The Foreign Office, moved by the Eoyal Geographical Society, com- missioned him to search for the sources of the Nile, and, again accompanied by Speke, he explored the lake regions of equatorial Africa. They discovered Lake Tanganyika in February 1858, and Speke, pushing on during Burton's illness and acting on indications supplied by him, lighted upon Victoria Nyanza. The separate discovery led to a bitter dispute, but Burton's expedition, with its discovery of the two lakes, was the incentive to the later explora- tions of Speke and Grant, Baker, Livingstone, and Stan- ley ; and his report in volume xxxiii. of the Proceedings of the Royal Geographical Society, and his Lake Regions of Equatorial Africa (1860), are the true parents of the multitudinous literature of " darkest Africa." Burton was the first Englishman to enter Mecca, the first to ex- plore Somaliland, the first to discover the great lakes that feed the Nile. His East African pioneering coincides with areas which have since become peculiarly interest- ing to the British Empire ; and three years later he was exploring on the opposite side of Africa, at Dahomey, Benin, and the Gold Coast, regions which have also en- tered among the imperial "questions " of the day. Before middle age Burton had compressed into his life, as Lord Derby said, " more of study, more of hardship, and more of successful~~

~~enterprise and adventure, than would have sufficed to fill up the existence of half a dozen ordinary men."~~

~~Since 1849 his connexion with the Indian army had been practically severed; in 1861 he definitely entered the service of the Foreign Office as consul at Fernando Po, whence he was shifted successively to Santos in Brazil (1865), Damascus. (1869), and Trieste (1871), holding the last post till his death on 20th October 1890. Each of these posts produced its corresponding books : Fernando Po led to the publishing of Wanderings in West Africa (1863), Abeohuta and the Oameroons (1863), A Mission to Gelele, king of Bahomi (1864), and Wit and Wisdom from West Africa (1864). The Highlands of the Brazil (1869) was the resiilt of four years' residence and travel- ling ; and Letters from the Battlefields of Paraguay (1870) relate to a journey across South America to Peru. Damas- cus suggested Unexplored Syria (1872), and might have led to much better work^ since no consulate in either hemisphere was more congenial to Burton's taste and linguistic studies ; but he mismanaged his opportunities, got into trouble with the Foreign Office, and was removed to Trieste, where his Oriental prepossessions and prejudices could do no harm, but where, unfortunately, his Oriental learning was thrown away. He did not, however, abandon his Eastern studies or his Eastern travels. Various fresh journeys or revisitings of familiar scenes are recorded in his later books, such as Zanzibar (1872), Ultima Tliule (1875), Etruscan Bologna (1876), Sind Revisited (1877), The Land of Midian (1879), and To the Gold Coast for Gold (1883). None of these had more than a passing interest. Burton had not the charm of style or imagina- tion which gives immortality to a book of travel. He wrote too fast, and took too little pains about the form. His blunt, disconnected sentences and ill-constructed chap- ters were full of information and learning, and contained not a few thrusts for the benefit of Government or other people, but they were not "readable." There was some- thing ponderous about his very humour, and his criticism was personal and savage. By far the most celebrated of all his books is the translation of the "Arabian Nights" {The Thousand Nights and a Night, 16 vols..~~

~~privately printed, 1885-88), which occupied the greater part of his leisure at Trieste. As a monument of his Arabic learning and his encyclopaedic~~

~~*knowledge of Eastern life this translation was his greatest achievement. It is open to criticism in many ways ; it is not so exact in scholarship, nor so faithful to its avowed text, as might be expected from his reputation ; but it reveals a profound acquaintance with the vocabulary aYid customs of the Muslims, with their classical idiom as well as their vul- garest " Billingsgate," with their philosophy and nlodes of thought as well as their most secret and most disgust- ing habits. Burton's "anthropological notes," embracing a wide field of pornography, apart from questions of taste, abound in valuable observations based upon long study of the manners and the writings of the Arabs. The translation itself is often marked by extraordinary resource and felicity in the exact reproduction of the sense of the original ; Burton's vocabulary was marvellously extensive, and he had a genius for hitting upon the right word ; but his fancy for archaic words and phrases, his habit of coining words, and the harsh and rugged style he affected, detract from the literary quality of the work without in any degree enhancing its fidelity. With grave defects, but sometimes brilliant merits, the translation holds a mirror to its author. He was, as has been well said, an Elizabethan born out of time ; in the days of Drake his very faults might have counted to his credit. Of his other works, Vikram and the Vampire, Hindu Tales (1870), a translation of The Lusiads of Camoens (1880), and a history of his favourite arm. The Book of the Sword (vol. i. 1884, unfinished), may be mentioned. A manu- script translation of the "Scented Garden," from the Arabic, was burnt by his widow, acting in what she believed to be the interests of her husband's reputation. Burton married Isabel Arundell in 1861, and owed much to her courage, sympathy, and passionate devotion. Her romantic and exaggerated biography of her husband, with all its faults, is one of the most pathetic monuments which the unselfish love of a woman has ever raised to the memory of her hero. Another monument is the Arab tent of stone and marble which she built for his tomb at Mortlake.*~~

~~*Besides Lady Bueton's Life of Sir Bichard F. Burton, 2 vols., 1893, 2nd edition, condensed, edited, with a preface, by W. H. Wilkins, 1898, there are A Sketch of the Career of B. F. Burton, by A. B. Richards, Andrew Wilson, and St Clair Baddelet (1886) ; The True Life of Captain Sir Bichard F. Burton, by his niece, G.M.Stisted (1896); and a brief sketch by the present writer prefixed to Bohn's edition of the Pilgrimage to Al-Medinah and*~~

~~*Meccah (1898), from which some sentences have here been by permission reproduced. (s. l.-p.)*~~

~~*Burton-upon-Trent, a municipal (1878) and county borough (1901) in the Burton parliamentary division of Staffordshire, and the Southern parliamentary division of Derbyshire, England, on the Midland, London and North-Western, North Staffordshire, and Great Northern railways. Eecent structures are two Established churches, new buildings for the Eoman Catholic church, Wesleyan and Baptist chapels, a bridge over the Trent, constructed at Lord Burton's expense, and a market hall. The municipal buildings have been presented by Lord Burton to the corporation, which has purchased the ferry rights over the Trent. There are eight recreation grounds. At Burton there are about twenty firms of brewers, representing nearly one-tenth of the brewing trade of the United Kingdom. The premises of Bass's brewery extend over 500 acres, and contain 17 miles of railway directly connected with outer railway systems. The brewery at Burton employs about 3500 men and boys. The total annual barrelage for 1901 exceeded a million and a half, of which the largest part was pale*~~

~~*ale. Allsopp's breweries, cooperages, maltings, &c., at Burton, cover an area of 43 acres, exclusive of land for water-beds, and they employ about 1300 hands. Area, 4025 acres. Population (1881), 39,288 ; (1891), 46,047 ; (1901), 50,386; of parliamentary division (1891), 58,640;*~~

~~*(1901), 61,787.*~~

~~*Burtscheid, a town of Prussia, in the Ehine pro- vince. See Aix-la-Chapbllb.*~~

~~*Buru (Dutch, Boeroe or Boeloe), an island of the East Indian archipelago, belonging to the residency of Amboyna, between 3° 4' and 3° 50' S. lat., and 125° 58' and 127° 15' E. long. Area, 3396 square miles. The chief geological formations are crystalline slate near the north coast, and more to the south Mesozoic sandstone and chalk, deposits of rare occurrence in the archipelago. Lake Wakolo, altitude 2200 feet, is not a crater lake, but is*~~

~~*situated at the junction of the sandstone and slate, where the water, having worn away the former, was accumulated by the latter. The lake has no afluents and only one outlet, the Wai Nibe to the north. The island is divided into two districts. Timber is the only export in addition to cajeput oil. The total population is estimated at 10,000.*~~

~~*Burujird, a province of Persia, bounded on the W. by Lurist^n, on the N. by Nehdlvend and MaMyir, on the E. by Ir^k, and on the S. by Isfah^. It is divided into the following administrative divisions, town of Burujird with villages in immediate neighbourhood ; SiMkhor (upper and lower) ; Japalak (with Sar-lek and Burbariid) ; nomad Bakhti^ri. It has a population of about 250,000 or 300,000, and pays a yearly revenue of about £16,000. It is very fertile and produces much wheat, barley, and rice, also some opium. With improved means of transport, which would allow the growers to export, the produce of cereals could easily be trebled. BuKUJiKD, the capital, is situated in the fertile SiMkhor plain on the river Tahij, a tributary of the Dizf ul or Ab i Diz (which flows to the Persian Gulf), in 33° 65' N. lat. and 48° 55' E. long., at an elevation of 6315 feet. It is 70 miles by road from Hamadan, and 212 miles from Isfahdin. It has a population of about 25,000, and manu- factures various cotton stuffs (coarse prints, carpet covers) and felts (principally saucepan-shaped hats for Lurs and Bakhtiiiri), of which considerable quantities are exported. It has telegraph and post ofB.ees.*~~

~~*Bury, a civil parish, municipal (1876), county (1888), and parliamentary borough, and market town of Lancar shire, England, on the Irwell, about 2 miles from its confluence with the Eoach, 188 miles by rail 'N'.N.W. of London. It is situated on the Manchester, Bury, and Bolton Canal. The corporation consists of a mayor, 10 aldermen, and 30 councillors. Modern erections include an Established church, a Eoman Catholic church, the town hall, an art gallery and public library, a hospital, a tech- nical school (£22,000), the Textile Operatives' Hall, a theatre, new markets and abattoirs. There are 5 recrear tion grounds, formed since 1886. Electric lighting has been introduced. In 1891 there were 3466 males and 7240 females engage^ in the manufacture of cotton goods ; 698 males and 131 females in calico printing, dyeing, and bleaching ; 1377 males and 3*~~

~~females in the iron and steel manufacture. Area of municipal and county borough, 5836 acres; population (1881), 54,717; (1891), 57,212;~~

~~(1901), 58,028.~~

~~Bury St Edmunds, a municipal and parliamentary borough — coextensive and now returning one member — of Suffolk, England, 26 miles N.W. of Ipswich by raU, on the river Lark and the Great Eastern railway. New~~

~~grammar-school buildings have been erected and the Lathbury Institute has been established. The Church Schools Company has a good school here. The corporar tion owns the waterworks, which have recently been ex- tended. The town is well lighted by electricity. Area, 2394 acres; population (1881), 16,111; (1901), 16,255.~~

~~Busch, Julian Hermann Moritz (1821-1900), German writer, was born in Dresden. He studied theol- ogy in Leipzig, being destined for the ministry, but from 1847 devoted himself entirely to journalism and literature. After the revolution he went to America, but soon re- turned to Germany, and published an account of his travels. During the next years he travelled extensively in the East, writing numerous books on Egypt, Palestine, &c. From 1856 he was employed on the Gfrenzboten, one of the most influential German periodicals, which, under the editorship of Gustav Freytag, had become the organ of the Nationalist party. In 1864 he became closely connected with the Augustenburg party in Schleswig- Holstein, but after 1866 he transferred his services to the Prussian Government, and was employed in a semi-official capacity in the newly-conquered province of Hanover. From 1870 onwards he was one of Bismarck's press agents, and was at the chancellor's side in this capacity during the whole of the campaign of 1870-71. In 1878 he published the first of his works on Bismarck — a book called Bismarck und seine Leute, in which, under the form of extracts from his diary, he gave an account of the chancellor's life during the war. The vividness of the descriptions and the cleverness with which the conversa- tions were reported insured a success, and the work was translated into several languages. This was followed in 1885 by another book, Unser Beichskanzler, chiefly dealing with the work in the Foreign Office in Berlin. After Bismarck's death there appeared, this time in England, a work entitled, Bismarck : some Secret Pages of his Histoiy, in~~

~~which was reprinted the whole of the earlier works, but which contains in addition a considerable amount of new matter, passages from the earlier works which had been omitted because of the attacks they contained on people in high position, records of later conversations, and some important letters and documents which had been entrusted to him by Bismarck. Many passages were of such a nature that it could not be safely published in Germany, but in 1899 a German edition appeared differ- ing considerably from the English editions.~~

~~Buschtiehrad, a market town in Bohemia, Austria, about 10 miles N.W. of Prague, the centre of extensive coal-fields, formerly the private property of the emperor of Austria. There is also an imperial brewery, which produces about 20,000 hectolitres of beer annually, and an imperial chateau. Population (Czech) (1890), 3267;~~

~~(1900), 3610.~~

~~Bush. — This term is Anglicized from the French word bouche, and is used in mechanics for designating the internal pipe or lining frequently used in connexion with a wheel or pulley ; or it may be used with reference to a pipe inserted in a plate frame or cast bracket, id order to form a bearing for a shaft to rotate in.~~

~~Bushes are employed because it is found that frictional surfaces, if made of dissimilar metals, work together with less loss in friction and with much less risk of abrasion. Mild steel plate is now in very general use for structural purposes, and spindles and shafting used in connexion therewith are similarly made of mild steel. This material, however, abrades very readily ; and it is the invariable custom with good work to bush or line the holes forming bearings with bronze or other metal than mild steel. In the case of wheels and axles, the wheels are bushed with a metal liner dissimilar to that of which the axle is made ; and hard cast steel, cast iron, hard or soft bronzes, or white metal are variously used in cases where the~~

~~axle IS of mild steel or wrought iron. White metal or Babbitt's metal (an alloy of tin, copper, and antimony, with a large per- centage of tin) is used for bushing ; it has a low melting-point,' and may be cast about the shaft of which it is to form a bearing.~~

~~Bush ire, or Bandek Bushiee, a town of Persia, on the coast of Fars, situated in 28° 59' N. lat. and 60° 49' E. long. The name should be pronounced Boosheer and not Bew-shire ; modern Persians write it Biishehr, and, yet more incorrectly, Abushehr, and translate it as " father of the city," but it is most probably a contraction of Bokht- ardashir, the name given to the place by the first Sassanian monarch in the 3rd century (vide Noeldeke's translation of Aidashir Papak^n's Karnamek). In a similar way Eiv- ardashir has become Eishire (Reesheer). In the first half of the 18th century, when Bushire was an unimportant fishing village, it was selected by Nadir Shah as the southern port and dockyard of the navy which he aspired to create in the Persian Gulf, and soon afterwards the British commercial factory of the East India Company, established at Gombrun, the modern Bander Abbasi, was transferred to it. At the beginning of the 19th century it had a population of 6000 to 8000, and it is now the most important port in the Persian Gulf, with a popular tion of about 25,000. It used to be a port of Pars, but it is now the seat of the governor of the Persiaa Gulf ports, who is responsible to the central Government, and has under his jurisdiction all the ports of the Gulf and the districts along the coast. The following table shows the value of the exports and imports from and to Bushire in thousands of pounds, and the shipping entered and cleared at the port in thousands of tons, as given in British consular reports :—~~

~~Year.~~

~~Exports.~~

~~Imports.~~

~~Total Tonnage.~~

~~British Tonnage.~~

~~*Total.*~~

~~*British.*~~

~~*Total.*~~

~~*British.*~~

~~*Entered.*~~

~~*Cleared.*~~

~~*Entered.*~~

~~*Cleared.*~~

~~*1885*~~

~~*1890 1895 1896 1897 1898 1899*~~

~~*586 720 529 440 393 427 529*~~

~~*204 298 226 183 173 188 174*~~

~~*791*~~

~~*1268*~~

~~*1017*~~

~~*788*~~

~~*1145*~~

~~*843*~~

~~*917*~~

~~*728 1183 928 624 982 632 667*~~

~~113 114 189 166 114 112 149~~

~~Ill~~

~~114 182 144 113~~

~~97 131~~

~~102 109 173 135 100 99 124~~

~~100~~

~~108 164 126 98 85 108~~

~~Bushmen, or Bosjesmajts. — Some of the state- ments made in the earlier article on these aborigines of South Africa (Ency. Brit. vol. iv. pp. 575-6) require to be supplemented in the light of recent research. Ethnologists no longer speak of any resemblance to the Mongolians, except perhaps in the prominence of the cheek-bones, and the yellowish or yellowish-brown colour of the skin. In all other respects the difference between the two races is fundamental, while the complexity of the physical and mental characters seems rather to point to an original con- nexion between the under-sized Bushmen and the distinctly dwarfish Negritoes scattered in small groups over the forest tracts of the Congo and Ogowe basins. Dr Lud wig Wolf (Zm innem Afrikas, pp. 258-61), one of the latest and most careful observers, has little doubt that both groups are sur- viving fragments of a primeval pigmy Negroid stock, which is to be regarded as the true autochthonous element in equatorial and South Africa. Whatever differences are now observable may readily be explained by the different environments — hot, moist woodlands in the north ; hot, dry steppe lands in the south. This generalization is supported by the now established former widespread diffusion of the Bushman race, which has been traced as far north as the Nyasa and Tanganyika basins, where the Bushman and Negrito domains must have been contiguous in prehistoric times. " It would seem," writes Sir H. H. Johnston (British Central Africa, p. 52), " as if the earliest known race of man inhabiting what is now British Central Africa was akin to the Bushman-Hottentot type of negro.~~

~~*Rounded stones with a hole through the centre, similar to those which are used by the Bushmen in the south for weighing their digging-sticks (the graaf stock of the Boers), have been found at the south end of Lake Tanganyika." Nor is any difficulty presented by the character of the tufted woolly hair of the Bushmen, which has no inter- mediate, bald spaces, as was formerly supposed, but is evenly distributed overthe scalp, likethat of the Negritoes, and is also invariably of the same intensely black colour. The assumed "peppercorn" type of hair growing in isolated tufts is based on a misconception ; and although it has been made a racial character by Fr. Miiller and some other distinguished anthropologists, more careful observation has shown that it is not found amongst any known races.*~~

~~*A transition between the Bushmen and the Congo Negritoes seems to be presented by the hitherto little known Vaalpens, who still survive in small groups about the middle Limpopo river, the Zoutpansberg, and perhaps some other districts of North Transvaal. More degraded even than the lowest of the Bushmen, the Vaalpens are so called by the Boeis from the dusty look of their bodies, due to their habit of crawling like burrowing animals into their under- ground dwellings. But the true colour is a pitch black, apparently of a deeper shade than that of the Wolofs or any other negro race. In height the men average about 4 feet, i.e., somewhat less than the shortest Bushmen, and a little more than the shortest Negritoes described by WoU and Emin Pasha. Socially the Vaal- pens, who are the " dogs," or " carrion-birds," of the surrounding Bantu peoples, occupy a lower position perhaps even than the Fuegians, or the extinct Tasmanians. A feeble, harmless folk, they are described as the very dregs of humanity, living in holes, caves, or rock-shelters, without clothes except the kaross, or implements of any kind beyond those procured from others in exchange for skins, ivory, or ostrich feathers. In return for menial services rendered to the Boers, they are thankful for the ofial of the game or other animals they may have helped to skin. They form small family groups of thirty or forty under a chief or patriarch, whose functions are purely domestic, as must be the case where there are no arts, industries, or religion of any kind, nothing but a knowledge of fire with which to cook their meals, often consisting of the aged or infirm members of the family circle. Intercourse with the surrounding populations is carried on by signs, nobody having any knowledge of their speech, which would appear to be scarcely articulate, or*~~

~~at least so full of clicks as to be incapable of expression by any clear phonetic system. Hence it is impossible to say whether the Vaalpens possess any folklore or other oral literature analogous to that of their more advanced Bushman neighbours. Some idea of the astonishing wealth of this Bushman literature may be formed from the fact that the materials collected by Bleek, and now preserved in Sir George Grey's library at Cape Town, form eighty-four stout MS. volumes of 3600 pages. They comprise myths, fables, legends, and even poetry, with tales about the sun and moon, the stars, the crocodile, and other animals ; legends of peoples who dwelt in the land before the Bushmen arrived from the north ; songs, charms, and even prayers, or at least incantations ; histories, adventures of men and animals ; tribal customs, traditions, superstitions, and genealogies. It is largely owing to this copious folklore literature, taken in connexion with their astonishing power of pictorial delineation, that the Bushmen are often regarded as a race which, owing to adverse circumstances, has fallen from a higher cultural plane, whereas the Vaalpens represent, on the contrary, a state of arrested development analogous to that of the Samangs and other Negritoes of the Malay Peninsula.~~

~~See Makk Hutchinson. "Bushman Drawings," in Jbwr. .dn- throp. Instit. 1882, p. 464.— Rev. J. Mackenzie. Blue Book, 1885, p. 63. — Sir H. H. Johnston. Jour. Anthrop. Inst. 1883, p. 463. — Dr H. Welcker. Archiv. f. Anthrop. xvi. — G. Beetin. " The Bushmen and their Language," Jour. S. Asiat. Soc. xviii. Part I. — GusTAv Fritsch. Die Eingeborenen Siicl- afrikas. Breslau, 1872. — W. H. J. Bleek. Bushman Folklore, 1875. — J. L. P. Erasmus. The Wild Bushman, MS. note, 1899.~~

~~(a. h. k.)~~

~~Busk, George (1808-1886), British surgeon and biologist, was born at St Petersburg in 1808. He studied surgery in London, both at St Thomas's and St Bartholomew's hospitals, and was an excellent operator. He was appointed assistant-surgeon to the Greenwich Hospital in 1832, and served as naval surgeon first in the Ghrampus, and afterwards for many years in the Dread-~~

~~nought; but subsequently, on retiring from active work in this capacity with the highest reputation, he devoted himself to the study of biology. Sir William MacCormac, in his volume on the Centenary of the College of Surgeons (1900), declared that the progress of biology and anthro pology in the 19th century must ever be connected to a large extent with the name of Busk. From 1856 to 1859 he was Hunterian professor of Comparative Anatomy and Physiology, and after occupying other important posts in the Eoyal College of Surgeons he became president in 1871. He was a fellow of all the principal scientific societies, and president of several ; and he received the Eoyal Society's Eoyal medal and the Geological Society's WoUaston and Lyall medals. Among his literary con- tributions the most notable were his valuable papers on Extinct Elephants in Malta and Teeth of Ungulates; and he was joint translator of Kolliker's Manual of Histology, and Wall's Rudiments of Pathological Histology. He was also first G- overnment inspector under the Vivi- section Act, and held the post till 1885, performing its duties with conspicuous tact and impartiality. He was a patient and cautious investigator, full of knowledge, and unaffectedly simple in character. He died on 12tli August 1886.~~

~~Busken-Huet, Conrad (1826-1886), Dutch liter- ary critic, was born at the Hague on the 28th December 1826. He was trained for the Church, and, after study- ing at Geneva and Lausanne, was appointed pastor of the Walloon Chapel in Haarlem in 1851. In 1863 consci- entious scruples obliged him to resign his charge, and Busken-Huet, after attempting journalism, went out to Java in 1868 as the editor of a newspaper. Before this time, however, he had begun his, career as a polemical man of letters, although it was not until 1872 that he was made famous by the first series of his Literary Fan- tasies, a title under which he gradually gathered in suc- cessive volumes all that was most durable in his work as a critic. His one novel, lAdewijde, was written under strong French influences. Eeturning from the East Indies, Busken-Huet settled for the remainder of his life in Paris where he died in April 1886. For the last quarter of a century he had been the acknowledged dic tator in all questions of Dutch literary taste. Perfectly honest, desirous to be sympathetic, widely read, and devoid of all sectarian obstiaacy, Busken-Huet intro- duced into Holland the light and~~

~~*air of Europe. He made it his business to break down the narrow prejudices and the still narrower self-satisfaction of his country- men, without endangering his influence by a mere effusion of paradox. He was a brilliant writer, who would have been admired in any language, but whose appearance in a literature so stiff and dead as that of Holland in the 'fifties was dazzling enough to produce a sort of awe and stupefaction. The posthumous correspondence of Busken- Huet has been published, and adds to our impression of the vitality and versatility of his miad. (e. g.)*~~

~~*Bussa. See E'igeria.*~~

~~*Bute, an insular county of S.W. Scotland, situated in the Firth of Clyde, between Ayrshire on the E. and Argyllshire on the N. and W. There are seven islands — Bute, Arran, the two Cumbraes, Holy Isle, Pladda, and Inchmarnock.*~~

~~*Area and Population. — According to the last ofScial estimate, the area of the county is 140,307 acres, or about 220 square miles (of the island of Arran alone, 163 square miles). The population was in 1881,17,666; in 1891, 18,404, of whom 8211 were males and 10,193 females ; in 1901 it was 18,786. Taking the land area only (139,432 acres, or 217-9 square miles), the number of persons per square mile in 1891 was 84, and the number of acres to the person 7-6. In the registration county the increase of population between 1881 and 1891 was 4-3 per cent. Between 1881 and 1891 the*~~

~~*excess of births over deaths was 688, and the increase of the resi- dent population 747. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 :—*~~

~~*Tear.*~~

~~*Deaths.*~~

~~*Marriages.*~~

~~*Births.*~~

~~*Percentage of Illegitimate.*~~

~~*1880 1890 1899*~~

~~*353 370 341*~~

~~*93*~~

~~*85 105*~~

~~*471*~~

~~*387 388*~~

~~*7-0 6-20*~~

~~*6-7*~~

~~*The birth-rate and marriage-rate are below, and the death-rate is above, the rates for Scotland. The following table gives the birth- rate, death-rate, and marriage-rate per thousand of the population for a series of years : —*~~

~~*1880.*~~

~~*1881-90.*~~

~~*1890.*~~

~~*1891-98.*~~

~~*1899.*~~

~~*Birth-rate . Death-rate . Marriage-rate*~~

~~*26-79*~~

~~*20-08*~~

~~*5-29*~~

~~*24-25*~~

~~*20-43*~~

~~*4-73*~~

~~*21-10*~~

~~*20-17*~~

~~*4-63*~~

~~*20-39*~~

~~*18-57*~~

~~*4-44*~~

~~*20-43*~~

~~*17-95*~~

~~*5-53*~~

~~*The number of Gaelic-speaking persons in the county in 1891 was 3482, of whom 29 spoke Gaelic only, and there were 7 foreigners. Valuation in 1889-90, £67,821 ; 1899-1900, £74,489.*~~

~~*Administration. — The county returns a member to parliament. Rothesay (9323) is the only royal burgh, but its constituency is merged in that of the county. There are 6 civil parishes forming the Bute Combination, and the number of paupers and depend- ants in September 1899 was 323. Bute forms a sheriffdom with Renfrewshire, and there is a resident sheriff-substitute at Rothesay, who sits also at Millport and Brodick periodically.*~~

~~*Education. — Six school boards manage 20 schools, with an average attendance of 2277 in 1898-99, and there is one Roman Catholic school with an average attendance of 172. The only secondary school is Rothesay Academy. The county council sub- sidizes technical education in agriculture*~~

~~both at Glasgow and at Kilmarnock, and supports itinerant lecturers on the subject.~~

~~Agriculture. — In 1898, 183 per cent, of the land was under cul- tivation ; 3806 acres were under wood in 1895. Oats are the staple com crop, and potatoes are grown on a considerable scale. The following table gives the principal acreage at intervals of five years from 1880 : —~~

~~Tear.~~

~~Area under Crops.~~

~~Corn Crops.~~

~~Green Crops.~~

~~Clover.~~

~~Permanent Pasture.~~

~~FaUow.~~

~~1880 1885 1890 1895 1899~~

~~25,214 25,115 25,513 25,605 25,728~~

~~5794 5402 5406 5395 5223~~

~~2904 2666 2484 2606 2614~~

~~6284 6651 9460 8662 8305~~

~~10,206~~

~~10,357~~

~~5,991~~

~~8,763~~

~~*9,407*~~

~~*26*~~

~~*49*~~

~~*134*~~

~~*116*~~

~~*96*~~

~~*The following table gives particulars of the live stock during the same years :—*~~

~~*Tear.*~~

~~*Total Horses.*~~

~~*Total Cattle.*~~

~~*Cows or*~~

~~*Heifers in*~~

~~*Milk or Calf.*~~

~~*Sheep.*~~

~~*Pigs.*~~

~~*1880 1885 1890 1895 1899*~~

~~*1177 1073 1251 1443 1277*~~

~~*7652 8454 9347 9539 9751*~~

~~*3230 3.343 3683 3838 3867*~~

~~*42,426 40,343 50,449 49,219 47,897*~~

~~620 859 906 887 621~~

~~At the date of the last return t^iere were 604 holdings in the county, of an average size of 42 acres; 17-05 per cent, did not exceed 5 acres, 61-76 per cent, were between 5 and 50 acres, and 21-19 above 50. There were 51 farms between 50 and 100 acres, 68 between 100 and 300, only 7 between 300 and 500, and 2 above 500. According to the census of 1891 there were 1395 men and 141 women in the county engaged in agriculture.~~

~~Industries and Trade. — Seed-growing is an extensive and grow- ing industry, and the only other industry is fishing. The Rothe- say fishery district includes all the creeks of Bute and a few in Argyll and Dumbarton, while the Cumbraes are included in the Greenock district. The following table gives particulars of the Rothesay district : —~~

~~Tear.~~

~~Bofts.~~

~~Valne of Gear.~~

~~Resident Fishermen and Boys.~~

~~Total Valne of all Fish.~~

~~No.~~

~~Tons.~~

~~Valne.~~

~~1890 1898 1899~~

~~232 228 226~~

~~912 532 529~~

~~£4213~~

3262 3241

£6353

3169 3102

430 268 298

£17,288

6,113 8,605

The herring fishing begins in June, and white fishing is prose-

cuted at one or other of the creeks all the year round. Many of the fishermen find employment during the season on the Clyde yachts, Rothesay heing one of the chief centres of this sport. An export and import trade in agricultural produce and fish and miscellaneous goods respectively is carried on between the Bute ports of Rothesay, Millport, Brodick and Lamlash, and Greenock, Gourock, Wemyss Bay and Ardrossan on the mainland, and there IS regular steamer communication between these ports all the year round, the traffic reaching enormous dimensions in summer.

See J. Wilson. Account of Bothesay and Bute. Rothesay, 1848. —John E. Reid. History of the County of Bute. Glasgow, 1864. —J. K. Hewison. History of Bute. 1894-95.— iute in the Olden Time.— 3. Rogek. Ancient Monuments in the Church of St Mary, Mothesay. Soc. of Antiq. Edinb., 1848.— J. Thoms. Bothesay Castle. Rothesay, 1870. /—^_ wa..

Butler, a borough of Pennsylvania, U.S.A., capital of Butler county, situated 31 miles N. of Pittsburg, at an altitude of 1008 feet. It is entered by three railways — the Pennsylvania; the Pittsburg and Western; and the Pittsburg, Butler, and Lake Erie. It is prominent in the manufacture of glass, using natural gas for fuel. Popu- lation (1880), 3163 ; (1900), 10,853.

~~*Butler, Benjamin Franklin (1818-1893), Amer- ican lawyer and politician, was born in Deerfield, N.H., on 5th I^ovember 1818, and died in Washington, D.C., on 11th January 1893. He early attained distinction as a lawyer in criminal cases. At different times he was a member of each branch of the Massachusetts legislature, and in 1860 he was an unsuccessful candidate for the governorship of the state. Shortly after the beginning of the Civil War he became major-general, and was in command at Fort Monroe. When the return of some slaves that had come within his lines was demanded, he declined to comply on the ground that they were contra- band of war. This was a new and important, as well as amusing, application of the term. He captured forts on the coast of North Carolina in August 1861, and, after Farragut's successful movements at New Orleans, Butler took possession of that city on 1st May 1862. In the administration of its affairs he showed much vigour and some severity. His famous order stating that women in- sulting Federal soldiers should be treated as women of the town, was misrepresented at the South and misunderstood abroad, and Jefferson Davis declared him an outlaw. Butler's seizure of $800,000, which had been deposited in the office of the Dutch consul, led to his displacem.ent. Afterwards he was in command of the department of Virginia and North Carolina, but in 1864 he was removed * by General Grant. He was Representative in Congress from 1867 until 1879, except the years 1875-77. He was one of the members appointed by the House of Eepre- sentatives to conduct the impeachment trial of President Johnson. In 1882 the Democrats elected him as Gov- ernor of Massachusetts. In 1884 he was an unsuccessful •candidate of the Greenback and Antimonopoly parties for the Presidency.*~~

~~*Butt, Isaac (1813-1879), Irish lawyer and Nation- alist leader, was born at Stranorlar, Donegal, in 1813, his father being the local Episcopalian rector. Having won ligh honours at Trinity, Dublin, he was appointed pro- fessor of political economy in 1836. In 1838 he was •called to the bar, and not only soon obtained a good practice, but became known as a politician on the Protes- tant Conservative side, and an opponent of O'Connell. In 18'44 he was made a Q.C. He figured in nearly all the important Irish law cases for many years, and was •engaged in the defence of Smith O'Brien in 1848, and of the Fenians between 1865 and 1869. In 1862 he was returned to Parliament by Youghal as a Liberal-Con- servative, and retained this seat*~~

~~*till 1865 ; but his views gradually became more liberal, and he drifted away from*~~

~~*his earlier opinions. HIs career in Parliament was marred by his irregular habits, which resulted in pecuniary embarrassment, and between 1865 and 1870 he returned again to his work at the law courts. The result, however, of the disestablishment of the Irish Church was to drive Butt and other Irish Protestants into union with the Nationalists, who had always repudiated the English connexion ; and on 19th May 1870, at a large meeting in Dublin, Butt inaugurated the HIome Eule movement in a speech demanding an Irish parliament for local affairs. On this platform he was elected in 1871 for Limerick, and found himself at the head of an Irish HIome Rule party of fifty-seven members. But it was an ill-assorted union, and Butt soon found that he had little or no control over his more aggressive followers. HIe had no liking for violent methods or for " obstruction " in Parliament ; and his leadership gradually became a nullity. HIs false position undoubtedly assisted in breaking down his health, and he died in Dublin on 5th May 1879.*~~

~~*Butte, the largest city of Montana, U.S.A., and capital of Silver Bow county. It is situated in 46° CO' N. lat. and 112° 32' W. long., in the valley of Deer Lodge river, near its head, at an altitude of 5544 feet. It is entered by four railways — the Northern Pacific ; the Great Northern ; the Montana Central ; and the Butte, Anaconda, and Pacific. It is the centre of the greatest copper-mining region on the globe ; the surrounding hills are honeycombed with mines, and the city contains large smelting works. The annual output of copper from this district is usually almost one-half that of the whole United States. The assessed valuation' of real and per- sonal property, in 1900, on a basis of assessment of about 60 per cent, of full value, was $18,989,200, the tax rate $26 per $1000, and the net debt $686,487. Popidation (1880), 3363; (1890), 10,723; (1900), 30,470, of whom 20,260 were native-born and 10,210 foreign-born.*~~

~~*Butterflies. See Insects.*~~

~~*Buturlinovka, or Pbteovskote, a village of Russia, government of Voronezh, district and 28 miles S.E. of Bobrov, on the great highway to Saratov. Its inhabitants are engaged in the leather industry, have twenty tan- neries,*~~

~~*and prepare a considerable amount of sheep-skins and boots exported to the Don and the Black Sea provinces. Population, 23,400.*~~

~~*Buxton, a market town and fashionable watering- place in the HIgh Peak parliamentary division of Derby- shire, England, 36 miles N.W. by N. of Derby by rail, at an elevation of 1000 feet. Its popularity has been more than maintained, and it is calculated that the average annual number of people visiting the town to take the waters is nearly 63,000. Especially has there been, of late years, a steady increase in the number of winter visitors. In 1894 the duke of Devonshire erected a handsome pump-room at St Anne's Well, and the main baths are replete with every modern convenience. The, old parish church has been restored, another enlarged, and the Devonshire Hospital extended. About 3000 poor people are now treated annually with the waters at this hospital, the dome over one of the buildings of which, it may be noted, has a circumference greater than that of any other dome in Europe. Public gardens, 23 acres in area, have been provided, with a pavilion and concert hall, a theatre, and reading- and other rooms. Electric lighting has been introduced, and there is an excellent golf-course. Buxton has become an important centre for horse-breeding, and a large horse fair is held annually. Area of urban district (constituted 1894), 1275 acres; population (1881), 6021; (1891), 7540; (1901), 10,179.*~~

~~*Buzeu, a town in Eumania, chief town of the dis- trict of the same name, 80 miles from Bucarest. It is the residence of an orthodox archbishop, and has a court of first instance, a seminary, and gymnasium. The cathedral was erected in 1740 by Prince Mathieu Bassaraba on the ruins of the old church built circa 1500 by Eadu the Great. In the neighbourhood are many in- teresting monasteries. Population (1900), 21,561.*~~

~~*Byelostok (Polish, Bialystok), a district town of West TJussia, government and 57 miles by rail S.W. of Grodno, on the main line to Warsaw, at its junction with the Kieff-Graevo (Prussian frontier) line, and having a branch to Baranowiczi. Pounded in 1320, it became part of Prussia after the third partition of Poland, but was annexed to Russia in 1807, after the*~~

~~*Peace of Tilsit. Its development dates from 1845, when woollen-mills were built close by. Since that time it has grown very rapidly, its population being 13,787 in 1857, 56,629 in 1889, and 63,927 in 1897. Its sixty-eight woollen, four silk, and one felt hat factories give occupation to several thousand workers, most of whom live in its populous suburbs.*~~

~~*Byeltsy, a district town of Eusgia, government of Bessarabia, 83 miles N.W. of Kishineff, connected by rail with both Odessa and Nowoselitsy on the Austrian frontier. It is the main centre of the region for trade in cattle and horses exported from the south and south-east to Poland, Austria, Eumania, and partly Prussia. Popu- lation, 18,526.*~~

~~*Byrd, William (1543-1623), English musical com- poser (whose work has not been properly appreciated till recent years), was probably a member of one of the numerous Lincolnshire families of the name who were to be found at Lincoln, Spalding, Pinchbeck, Moulton, and Epworth in the 16th century. According to Wood, he was " bred up to musick under Thomas Tallis." He was appointed organist of Lincoln Cathedral about 1563, and on 14th September 1568 was married at St Margaret in the Close to Ellen or Julian Birley. His eldest son, Christo- pher, was baptized at the same church 18th November 1569. On 22nd February 1569 he was sworn in as a member of the Chapel Eoyal, but he does not seem to have left Lincoln immediately, for his eldest daughter, Elizabeth, was baptized there 20th January 1571-72, and on 7th December 1572 Thomas Butler was appoiated master of the choristers and organist on Byrd's "nomination and commendation." In the Chapel Eoyal he shared with Tallis the honorary post of organist, and on 22nd January 1575 the two composers obtained a license for twenty-one years from Elizabeth to print music and music-paper, a monopoly which does not seem to have been at all re- munerative. In 1575 Byrd and Tallis published a col- lection of Latin motets for five and six voices, printed by Thomas VautroUier. In 1578 Byrd and his famUy were living at Harlington, Middlesex. As early as 1581 his name occurs among lists of recusants, and though he re- tained his post in the Chapel Eoyal he was throughout his life a Catholic. About 1579 he set a three-part song in Thomas Legge's Latin play " Eicardus Tertius." In 1588 he published Psalmes, Sonets, and Songs of Sadnes and Pietie, and in the same year contributed two madrigals to Nicolas Yonge's Musica Transalpina. In 1589 appeared Songs of Sundrie*~~

~~*Natures, a second edition of which was issued in 1610. In the same year he published Liber Primus Sacrarum Cantionum, a second series of which was brought out in 1591. In 1590 two madrigals by Byrd were included in Thomas Watson's First Sett of Italian Madrigalls Englished; one of these seems to have been sung before Elizabeth on her visit to Lord Hertford*~~

~~*at Elvetham in 1591. In April 1592 Byrd was still living at Harlington, but about 1593 he became possessed of the remainder of a lease of Stondon Place, Essex, a farm of some 200 acres, belonging to William Shelley, who was shortly afterwards convicted of high treason. The property was sequestrated, and on 15th July 1595 Byrd obtained a crown lease of it for the lives of his eldest son Christopher and his daughters Elizabeth and Eachel. On the death of Shelley his son bought back his estates (in 1604), whereupon his widow attempted to oust Byrd from Stondon Place, on the ground that it ' formed part of her jointure. Byrd was upheld in his possession of the property by James I. (Calendar of State Papers, Dom. Series, James I. add. series, vol. xxxvi.), but Mrs Shelley persevered in her suit, appar- ently until her death in 1609. In the following year the matter was settled for a time by Byrd's buying Stondon Place in the names of John and Thomas Petre, part of the property being charged with a payment to Byrd of £20 for his life, with remainde? to his second son Thomas. Throughout this long suit Byrd, though in possession of property which had been confiscated from a recusant and actually taking part as a member of the Chapel Eoyal at the coronation of James I., had been excommunicated since 1598, while from 1605 until 1612, and possibly later, he was regularly presented before the archidiaconal court of Essex as a Catholic. In 1603 Easte published a work (no copies of which are known to exist) entitled Medulla Musicke. Sucked out of the sappe of two [of] the most famous Musitians that ever were in this land, namely Master Wylliam Byrd . . . and Master Alphonso Ferahosco . . . either of whom having made j0Ae, severall waies (without contention), showing most rare and intricate skill in 2 partes in one upon the playne song Miserere. In 1607 appeared two books of Oradualia, a second edition of which was issued in 1610. In the following year he published Psalmes, Songs, and Sonnets : some solemne, others joyfull, framed to the life of the Words. Probably in the same year was issued Parthenia, a collection of virginal music, in which Byrd was associ- ated with Bull and Orlando Gibbons. The last work to which he contributed*~~

~~was Sir Thomas Leighton's Teares or Lamentations of a Sorrow full Soule (1614). His death took place on 4th July 1623. It is recorded in the Cheque Book of the Chapel Eoyal as that of a "father of musicke." His will, dated 15th November 1622, shows that he remained a Catholic until the end of his life, and he expresses a desire that he may die at Stondon and be buried near his wife. Prom the same document it seems that his latter years had been em- bittered by a dispute with his eldest son, but that the matter was settled by an agreement with his daughter-in- law Catherine, to whom he left his property at Stondon, charged with the payment of £20 to his second son Thomas and £10 to his daughter Eachel, with remainder to his grandson Thomas and his second son of the same name. In 1635 the estate again came before the Court of Chancery, on the ground that the annuities had not been paid. The property seems about 1637 to have been let to one John Leigh, and in 1651 was held by a member of the Petre- family. The committee for compounding with delinquents at that date allowed Thomas Byrd the annuity of £20 bequeathed by his father. Byrd's arms, as entered in the Visitation of Essex of 1634 ex sigillo, were three stags' heads cabossed, a canton ermine. His children were (1) Christopher, who married Catherine, daughter of Thomas Moore of Bamborough, and had a son, Thomas, living at Stondon in 1634; (2) Thomas; (3) Elizabeth, who married successively John Jackson and — Burdett ; (4) Eachel, married (1) — Hook, by whom she had two children, William and Catherine, married to~~

~~Michael Walton ; in 1634 Eachel Hook-had married (2) Edward Biggs ; (5) Mary, married (1) Henry Hawksworth, by whom she had four sons, William, Henry, George, and John ; (2) Thomas Talconbridge. Anne Byrd, who IS mentioned in the proceedings Shelley v. Byrd, (Exchequer Decrees, 7 James I., series ii. vol. vii. fol. 294 and 328), was probably a fourth daughter who died young.~~

~~Besides the works already mentioned Byrd was the composer of three masses, for three, four, and five voices respectively, which seem to have been published with some privacy about 1588. There exists a second edition (also undated) of the four-part mass ; all three have recently appeared in~~

~~*modern editions, and increase Byrd's claim to rank as the greatest English composer of his age. In addi- tion to his published works, a large amoimt still remains in MS., comprising nearly every kind of composition. The Eitzwilliam Virginal Book contains a long series of in- teresting pieces for the virginal, and more still remains unpublished in Lady ISTeville's Virginal Booh and other contemporary collections. HIs industry was enormous, and though his work is unequal and the licenses he al- lowed can hardly be defended on strict grounds, his Latin church music and his instrumental compositions entitle him to high rank among his contemporaries. As a madrigalist he was inferior to Morley, Wilbye, and Gib- bons, though even in this branch of his art he often displays great charm and individuality. (w. b. s.*)*~~

~~*Byron, Henry James (1834-1884), English play- wright, son of Henry Byron, at one time British consul at Port-au-Prince, was born in Manchester in January 1834. He entered the Middle Temple as a student in 1858, with the intention of devoting his time to play-writing.*~~

~~*He soon ceased to make any pretence of legal study, and joined a provincial company as an actor. In this line he never made any real success ; and, though he continued to act for years, chiefly in his own plays, he had neither originality nor charm. Meanwhile he wrote assiduously, and few men have produced so many pieces of so diverse a nature. HIs first successes were in burlesque; but in 1865 he joined Miss Marie Wiltqp (afterwards Lady Bancroft) in the management of the Prince of Wales's Theatre, near Tottenham Court Eoad. Here several of his pieces, comedies, and extravaganzas were produced with success ; but, upon his severing the partnership two years later, and starting management on his own account in the provinces, he was financially unfortunate. The commercial success of his life was secured with " Our Boys," which was played at the Vaudeville from January 1875 till April 1879— an unprecedented " run." " The Upper Crust," another of his successes, gave a congenial oppor- tunity to Mr J. L. Toole for one of his inimitably broad character-sketches. During the last few years of his life Byron was in frail health ; he died in Clapham, 11th April 1884. H. J. Byron was the Author of some of the most popular stage pieces of his day. Yet his extravaganzas have no wit but that of violence ; his rhyming couplets are without polish, and decorated only by forced and*~~

~~*often pointless puns. HIs sentiment had T. W. Robertson's insipidity without its freshness, and restored an element of vulgarity which his predecessor had laboured to eradicate from theatrical tradition. HIe could draw a " Cockney " character with some fidelity, but his dramatis personce were usually mere puppets for the utterance of his jests. In his social relations Byron had many friends, among whom he was justly popular for geniality and im- perturbable good temper.*~~

~~*Cabailero, Fernan (1796-1877), the pseudonym by which the Spanish novelist CecUia Francisca Josefa Bohl de Paber y Larrea is known. Born at Morges in Switzer- land on 24th December 1796, she was the daughter of Johan Nikolas Bohl von Paber, a Hamburg merchant, who lived long in Spain, married a native of Cadiz, and is creditably known to students of Spanish literature as the editor of the Floresta de rimas antiguas castellanas and the Teatro espaMol anterior d Lope de Vega. Educated in Hamburg, she visited Spain in 1815, and, unfortunately for herself, in 1816 married Antonio Planells y Bardaxi, an infantry captain of bad character. In the following year Planells was killed in action, and in 1822 the young widow married Francisco Ruiz del Arco, Marques de Arco Hermoso, an officer in one of the Spanish household regiments. Upon the death of Arco Hermoso in 1836, the Marquesa found herself in straitened circumstances, and in less than two years she married Antonio Arrdn de Ayala, a man con- siderably her junior. Arrdn was appointed consul in Australia, engaged in business enterprises and made money ; but unfortunate speculations drove him to com- mit suicide in 1854. Five years earlier the name of Fernan Cabailero (taken from a village in La Mancha) became famous in Spain as the author of La Gaviota. Thewriter had already published in German an anonymous romance. Sola (1831), and it is alleged that the earliest draft of La Gaviota was written in French. This novel first appeared as the f euilleton of El Heraldo (1849), and was received with marked favour. Ochoa, a prominent critic of the day, ratified the popular judgment, and hopefully proclaimed the writer to be a rival of Scott. No other Spanish book of the 19th century has obtained such instant and universal recognition. It was translated into most*~~

~~*European languages, and, though it scarcely seems to deserve the intense enthusiasm which it excited, it is the best of its author's works, with the*~~

~~possible exception of La Familia de Alvareda. Less successful attempts are ■ Lady Virginia and Clemencia; but the short stories en- titled Cuadros de Oostumbres are interesting in matter and form, and Una en otra and Elia 6 la Espafla treinta afios ha are excellent specimens of picturesque narration. It would be difficult to maintain that Fernan Cabailero was a great literary artist or even a remarkable novelist, but it is certain that she was a born teller of stories and that she has a graceful, delicate style very suitable to her purpose. She came into Spara at a most happy moment, before the new order had perceptibly disturbed the old, and she brought to bear not alone a fine natural gift of observa- tion, but a freshness of vision, undulled by long familiarity. She combined the advantages of being both a foreigner and a native. In later publications she insisted too emphatically upon the moral lesson, and lost much of her primitive simplicity and charm ; but even here we may believe her own positive statement that, though she occa- sionally idealized circumstances, she was conscientious in choosing for her themes subjects which had occurred in her own long and varied experience. Hence she may be regarded as a pioneer in the realistic field, and this historical fact adds to her positive importance. For many years she was the most popular of Spanish writers, and the sensation caused by her death at Seville on 7th April 1877 proved that her naive truthfulness still attracted readers who were interested in records of national customs and manners. (j. v.-k.)~~

~~Cabatuan, a town in the east of Panay, one of~~

~~the Philippine Islands, in about 11° N. and 123° E., about 10 miles from Iloilo. It has a healthful climate, and is well situated on the banks of the Tigum river, in the midst of a very fertile region, which produces large quantities of rice, as well as Indian corn, tobacco, sugar, coffee, and a great variety of fruits. The language is Visayan. Population, 18,000.~~

~~Cable, George Washington (1844-~~

~~-).~~

~~*American author, was born in New Orleans, Louisiana, on 12th October 1844. At the age of fourteen he entered a mercantile establishment as a clerk ; joined the Con- federate army (4th Mississippi Cavalry) at the age of nineteen ; at the close of the war engaged in civil engineer- ing, and in newspaper work in New Orleans ; and first became known in literature by sketches and stories of old I^ench- American life in that city. These were first published in Scribner's Monthly, and were collected in book form in 1879, under the title of Old Creole Days. The characteristics of the series — of which the novelette Madame Delphine (1881) is virtually a part — are neatness of touch, sympathetic accuracy of description of people and places, and a constant combination of gentle pathos with quiet humour. These shorter tales were followed by the novels The Grandissimes (1880), Dr Sevier (1883), and Bonaventure (1888), of which the first dealt with Creole life in Louisiana a hundred years ago, while the second was related to the period of the Civil War of 1861-65. Dr Sevier, on the whole, is to be accounted Cable's master- piece, its character of Narcisse combining nearly all the qualities which have given him his place in American literature as an artist and a social chronicler. In this, as in nearly all of his stories, he makes much use of the soft French-ljnglish dialect of Louisiana. HIe does not confine himself to New Orleans, laying many of his scenes, as in the short story Belles Demoiselles Plantation, in the marshy lowlands towards the mouth of the Mississippi. Cable was the leader in the noteworthy literary movement which has influenced nearly all Southern writers since the war of 1861 — a movement of which the chief importance lay in the determination to portray local scenes, characters, and historical episodes with accuracy instead of merely imaginative romanticism, and to interest readers by fidelity and sympathy of portrayal of things well known to the authors. Other writings by Cable have dealt with various problems of race and politics in the Southern States during and after the " reconstruction period " following the Civil War ; while in The Creoles of Louisiana (1884) he pre- sented a history of that folk from the time of its appear- ance as a social and military factor. HIis dispassionate treatment of his theme in this volume and its predecessors gave increasing offence to sensitive Creoles and their sym- pathizers, and in 1886 Cable removed to Northampton, Massachusetts, thenceforward engaging in magazine writ-*~~

~~*ing and in public readings from his works. At one time he also edited a magazine in Northampton, and afterwards conducted the monthly Current Literature, published in New York.*~~

~~*Cabrera, Ramon (1806-1877), Carlist general, was born at Tortosa, province of Tarragona, Spain, on 27th December 1806. As his family had in their gift two chaplaincies, young Cabrera was sent to the semin- ary of Tortosa, where he made himself conspicuous as an unruly pupil, ever mixed up in disturbances and careless in his studies. After he had taken minor orders, the bishop refused to ordain him as a priest, telling him that the Church was not his vocation, and that everything in him showed that he ought to be a soldier. Cabrera followed this advice and took part in*~~

~~*Carlist conspiracies on the death of Ferdinand VII. The authorities exiled him, and he absconded to Morella to join the forces of the pretender Don Carlos. In a very short time he rose by sheer daring, fanaticism, and ferocity to the front rank among the Carlist chiefs who led the bands of Don Carlos in Catalonia, Aragon, and Valencia. As a raider he was often successful, and he was many times wouuded in the brilliant fights in which he again and again defeated the generals of Queen Isabella. HIe sullied his victories by acts of cruelty, shooting prisoners of war whose lives he had promised to spare, and not respecting the lives and property of non-combatants. The queen's generals seized his mother as a hostage, whereupon Cabrera shot several mayors and officers. General Nogueras un- fortunately caused the mother of Cabrera to be shot, and the Carlist leader then started upon a policy of reprisals so merciless that the people nicknamed him "The Tiger of the Maeztrazgo." It will suffice to say that he shot 1110 prisoners of war, 100 ofiicers, and many civilians, including the wives of four leading Isabellinos, to avenge his mother. When Marshal Espartero induced the Carlists of the north-western provinces, with Maroto at their head, to submit in accordance with the Convention of Vergara, which secured the recognition of the rank and titles of 1000 Carlist officers, Cabrera held out in central Spain for nearly a year. Marshals Espartero and O'Donnell, with the bulk of the Isabellino armies, had to conduct a long and bloody campaign against Cabrera before they succeeded in driving him into French territory in July 1840. The Government of Louis Philippe kept him in a fortress for some months and then allowed him to go*~~

~~to England, where he qiiarrelled with the pretender, disapproving of his abdication in favour of the count of Montemolin. In 1848 Cabrera reappeared in the mountains of Catalonia at the head of Carlist bands. These were soon dispersed, and he again fled to France. After this last effort he did not take a very active part in the propaganda and sub- sequent risings of the Carlists, who, however, continued to consult him. He took offence when new men, not a few of them quondam regular officers, became the advisers and lieutenants of Don Carlos in the war which lasted more or less from 1870 to 1876. Indeed, his long residence^ in England, his marriage with Miss Eichards, and his prolonged absence from Spain had much shaken his- devotion to his old cause and belief in its success. In March 1875 Cabrera sprang upon Don Carlos a manifesto- in which he called upon the adherents of the pretender to follow his own example and submit to the restored monarchy of Alphonso XII., the son of Queen Isabella,, who recognized the rank of captain-general and the- title of count of Morella conferred on Cabrera by the first pretender. Only a very few insignificant Carlists. followed Cabrera's example, and Don Carlos issued a proclamation declaring him a traitor, and depriving him of all his honours and titles. Cabrera, who was ever afterwards regarded with contempt and execration by th& Carlists, died in London on 24th May 1877. He did not receive much attention from the majority of his- fellow-countrymen, who commonly said that his disloyalty to his old cause had proved more harmful to him than beneficial to the new state of things. A pension which had been granted to his widow was renounced by her in 1899 in aid of the Spanish treasury, after the loss of the- colonies. (a. e. h.)~~

~~Caceres, a frontier province in the west of Spain. It is the second largest province in Spain, with an area of 8014 square miles, divided into 13 administrative districts and 222 communes. The population increased from 306,694 inhabitants in 1877 to 354,245 in 1897. The- province is badly off as regards roads, but the railway from.~~

~~Madrid to Portugal runs through it. The climate is temperate except in summer, when the hot east winds prevail. In the north, the centre, and south~~

~~there are some mountainous districts, the remainder being undu- lating ground, with sparse vegetation, few forests, and m many parts lacking water. The Tagus is the principal river. Caceres has hut few industries, outside the fast- decaymg silk industry at Plasenim, and the regular manu- factures of leather, cork, brandy, and coarse woollen staffs. The principal manufacture is phosphorite, most of which goes abroad. The province contains only 8 mines that are actually worked — 1 antimony, 3 iron, 1 argentiferous lead, and 3 phosphorite. There has been an increasing demand from abroad for wolgram and phosphate; 4600 tons of phosphorite was extracted in 1898, the proportion pro- duced amounting to an average of 48 per cent., and in anti- monium 55 per cent. As regards live stock, Caceres ranks second only to Badajoz, containing in all 1,038,435 head: in 1897 there were 13,162 horses, 17,278 mules, 34,572 asses, 74,333 cattle, 617,458 sheep, 191,264 goats, 90,368 pigs. It is famed for its sheep and pigs, and exports wool, hams, and the red sausage called " embutidos." To the culture of wheat 227,280 acres were devoted, 112,255 to that of barley, 64,310 to rye, 89,025 to oats, 362 to maize, 22,660 to chick-peas, 28,150 to vines, 72,480 to olives.~~

~~Caceres, the capital of the above province, had a population of 14,816 in 1877, but only 13,665 in 1897. The ancient part of the city is on a hill and surrounded with walls, and contrasts with the modern suburbs outside, which have broad streets and new buildings. The old town has some fine churches and residences of noble families, in good state of preservation. In the new part are the town hall, courts of justice, episcopal palace, schools, civil and foundling hospitals, and theatre.~~

~~Cachar, a district of British India, in the Surma Valley division of Assam. It occupies the upper basin of the Surma or Barak river, being bounded on three sides by high hills. The headquarters are at Silchar. The Cachar hills rank for some purposes as a separate district, under the name of North Cachar. The area (excluding the hills) is 2472 square miles ; population (1881), 293,738 ; (1891), 367,542, showing an increase of 25 per cent.; average density, 149 persons per square mile. Classified according to religion, Hindus numbered 239,944; Mahommedans, 112,846; Christians, 809, of whom 273 were Europeans; hill tribes, 13,899; "others," 44. In 1901 the popula- tion of the entire district was 456,151, showing an in-~~

~~crease of 18 per cent. The land revenue is Es.3,80,062, the incidence of assessment being nearly R.l per acre ; the number of police is 526; the number of boys at school (1896-97) was 7436, being 24-33 per cent, of the male population of school-going age; the number of girls at school was 819, being 3 per cent. ; the registered death- rate (1897) was 61 per thousand. Cachar is the most flourishing centre of tea cultivation in India. In 1897 the number of gardens was 191, with 61,190 acres under tea, employing 126,194 persons (more than one-third of the total population), of whom 5578 had been im- ported by contract, and yielding 22,000,000 ft, or 406 ft per acre. There are two timber-mills, producing tea- chests, &c., valued at Es.33,000. The Assam-Bengal railway traverses the district, and is being extended through North Cachar. A branch from Badarpur to Silchar (18 miles) was opened in November 1898.~~

~~The district of Nobth Cachak lies between the Jaintia Hills and the state of Manipur. The headquarters are at Gunjong. Area, 1728 square miles; population (1891), 20,120, mostly hill tribes ; average density, 10 persons per square mile, being far the lowest in the province. The~~

~~continuation of the railway through this hilly and un- healthy tract was a work of great difficulty.~~

~~Cadenabbia, a village of the province of Como, Lombardy, Italy, on the west shore of Lake Como, nearly opposite Bellagio, a favourite spring and autumn resort, the place being situated in the loveliest part of the lake, and sheltered against the prevailing winds. Here is the Villa Carlotta (1747), which contains the "Triumph of Alexander," one of the greatest creations of Thorwald-~~

~~Cad iliac, capital of Wexford county, Michigan, U.S.A., situated in the north-western part of the Lower Peninsula, in a heavily forested region, on the Ann Arbor and the Grand Rapids and Indiana railways, at an alti- tude of 1293 feet. Population (1880), 2213; (1890),~~

~~4461; (1900), 5997.~~

~~Cadiz, a maritime province in the extreme south of Spain. The highest mountains are the Cerro de San Cristobal and Sierra del Pinar. The~~

~~mountainous districts are very picturesque, well wooded, and abound in large game. There are numerous rivers — ^the Guadalquivir, the Guadalete, the Majaceite, the Guadiaro, the Guad- arranque Gibraltar, the Salado, the Palmorus, and the Barbate. The climate is generally mild and temperate, some parts of the coast only being unhealthy owing to a marshy soil. The main line of railway from Cadiz to Madrid runs through the centre of the province, with many branches, and new lines are being pushed forward. The province is divided into 13 administrative dis- tricts and 42 communes, more than one-third of which are thriving and populous towns. The population was 430,158 in 1877 and 434,250 in 1897, on an area of 2828 square miles. The industries are insignificant com- pared with the importance of the natural products of the soil, especially wines and olives. But the fisheries furnish more than 5,500,000 ft of fish per annum, one- fifth part of which is salted and the rest consumed in Spain. There are 40 establishments for saltiag the fish, and 4000 hands are thus employed. Naval yards exist at Cadiz, Puerto Real, and San Fernando, the last being a State arsenal and dockyard. A considerable amount of salt is obtained by evaporation of sea-water in pans near Cadiz, San Fernando, Puerto Real, and Santa Maria. In 1897 the live stock included 20,865 horses, 8298 mules, 10,612 asses, 71,865 cattle, 86,972 sheep, 68,398 goats, and 45,132 pigs. Wheat occupied 231,077 acres, barley 58,060 acres, rye 4275, oats 6587, maize 6005, chick-peas 32,472, vines 51,285, and olives 42,867.~~

~~Cadiz, a seaport and the capital of the above province, with a population of 65,028 in 1877 and 67,987 in 1897. The final severing of the connexion between Spain and Cuba and Porto Rico, in 1898, coming as it did after several years of colonial wars that had greatly depressed trade, was a severe blow for Cadiz as a com- mercial emporium. Of late years local capital and enter- prise have taken the direction of industries and ship- building, and numerous factories with their tall chimneys have sprung up in the suburbs. A private shipbuilding" yard with a capital of £400,000 was started and ob- tained some government contracts, though much ham- pered by an agreement to draw its materials from native firms in Catalonia and Biscay, in preference to foreign. The beetroot-sugar industry is progressing in the neigh- bourhood, as in the rest of Spain, through the operation of high import duties on foreign sugars. Tunny fish is caught in great quantities near the port — 83,000 in 1898 — and salted, to be sent~~

~~chiefly to Italy. The cork in- dustries exported 58,000,000 corks in 1898—14,000,000~~

~~going to England — but, owing to high export duties, only 107 tons of cork-wood. 78,228 lasts of salt, each last being 2J tons, were shipped for foreign countries in 1898, and 13,201 lasts for other Spanish ports. The number of British vessels that entered the port during 1898 was 291, of 180,635 tons, as against 267 vessels of 133,479 tons in 1897. 55 of the former brought 42,792 tons of British coal, and in all 202 entered with cargoes, while 89 were in ballast. 175 with cargoes and 5 in ballast cleared for Great Britain and British colonies, and 60 with cargoes and 50 in ballast for other countries. The total number of vessels of all nationalities that entered the port in 1898 was 2696 of 1,631,428 tons, of which 2050 of 1,216,026 tons were Spanish. The docks and quays, as well as the through railway communication, would require to be much improved to attract ocean-going steamers and make Cadiz a port of call, and a coaling station, especially with Gibraltar so near. The total value of the customs receipts in 1898 was £54,834, a falling-of£ of £27,934 on 1897 and £26,104 on 1896. Coal was one of the principal imports: 157,900 tons in 1898—94,786 from England and the rest from Spain itself. The wine trade of Jerez, Puerto Santa Maria, and Puerto Real, near Cadiz, con- tribute extensively to the exports of Cadiz.~~

~~Caen, chief town of Calvados, 148 miles N.W. of Paris by rail, and a fortified town of the third class. A monument of the "Sons of Calvados" commemorates those who fell in the war of 1870-71. The ancient Abbaye aux Hommes is now occupied by the Lycee. A natural history museum contains the collection of d'UrviUe, and an art museum has one of the richest collections of paintings in France. The number of vessels engaged in the foreign trade entered at Caen in 1899 was 644, of 205,749 tons. Iron ore has become by far the most important export. Population (1881), 34,460; (1891), 37,184 ; (1896), 37,457, (comm.) 39,105.~~

~~*Csesarea-Mazaca, now Kaisarieh, chief town of a sanjak in the Angora viMyet of Asia Minor. Mazaca, the residence of the kings of Cappadocia, later called JSusebea, and named Ccesarea by Claudius, stood on a low spur on the north side of Erjish Dagh (M. Argceus). It was taken by Tigranes, and afterwards, in a.d. 268, by Shahpur I. (Sapor). In the 4th century Basil, when bishop, established an ecclesiastical centre on the plain, about one mile to the north-east, and this gradually supplanted the old town. A portion of Basil's new city was surrounded with strong walls, and turned into a fortress by Justinian ; and within the walls, rebuilt in the 13th and 16th centuries, lies the greater part of Kaisarieh, altitude 3500 feet. The town was captured by the Seljuk sultan, Alp Arslan, 1064, and by the Mongols, 1243, before passing to the Osmanli Turks. Its early commercial importance was due to its position on the ancient trade route from Sinope to the Euphrates, on the Persian "Eoyal Road" from Sardis to Susa, and on the great Roman highway from Ephesus to the East. It is still the most important trade centre in eastern Asia Minor, and is remarkable for the enterprise of its merchants and traders. The town is noted for its fruit, especially its vines; and it exports tissues, carpets, hides, yellow berries, and dried fruit. Kaisarieh is the headquarters of the American Mission in Cappadocia, which has several churches and schools for boys and girls. It is the seat of a Greek bishop, an Armenian archbishop, and a Roman Catholic bishop, and there is a Jesuit school. On the 30th November 1895 there was a massacre of Armenians, in which several Gregorian priests and Protestant pastors lost their lives. Population, 50,000 (Moslems, 27,000; Christians, 23,000). (c. w. w.)*~~

~~*Csesarea-Palsestina, now Kaisarieh, on the coast of Palestine. In 1884 a colony of Bosnians was settled on the site, and there has since been much destruction of the ruins.*~~

~~*Cagliari, a town and archiepiscopal see of Italy, capital of the province of Cagliari and of all Sardinia. It stands at the head of a fine bay at the south end of the island. The university, which has mineralogical and zoological collections, was attended by 241 students in 1898, and had 32 professors. This town is famous for its many excellent charitable organizations. There are, further, a botanical garden, a royal school of viticulture, a school of the industrial arts and sciences, and a school of navigation. The exports consist*~~

~~*principally of metals and minerals, with timber, spirits, hides, cereals, live animals, &c., to the annual value of £533,600. The imports are of the annual value of £237,700. In addi- tion to this there is a coasting trade of abqjit £2,000,000 annually. The port was cleared in 1897 by 1617 vessels of 458,067 tons ; all the ports of Sardinia together, by 2749 vessels of 804,400 tons in 1889. Population of province (1881), 420,635; (1901), 482,000; of town*~~

~~*(1881), 38,598; (1901), 53,734.*~~

~~*Cagsaua, a town of 20,000 inhabitants, in the province of Albay, Luzon, Philippine Islands. It is 1^ miles from the town of Albay, which is its port, and its exports are those of the latter city. The language is Bicol.*~~

~~*Cahors, chief town of department Lot, France, 360 miles S.S.W. of Paris, on railway from Paris to Toulouse. Its industries include shoe manufactures, dye- works, ajid large distilleries. Coal is worked in the neigh- bourhood, and amongst minor articles of commerce are nuts, oil of nuts, and prunes. It was the birthplace of L^on Gambetta, of whom there is a bronze statue by Falguifere in the Boulevard Gambetta. The Lyc^e Gambetta is installed in old monastic buildings. There is a monument in commemoration of the war of 1870-71. The restoration of the old fortified Valentre bridge was completed in 1881. Population (1876), 11,145, comm. 12,615; (1886), 12,057; (1896), 10,882, comm. 12,331; (1901), 13,981.*~~

~~*Caibarien, a sugar-shipping port on the north coast of Santa Clara province, Central Cuba, 193 miles E. by S. of Havana. Population (1899), 7013.*~~

~~*Caird, John (1820-1898), Scottish divine and phi- losopher, was born at Greenock, 15th December 1820. After being at school until his sixteenth year he began life in his father's office, his father being partner and manager of afirm of engineers. Two years later, however, he obtained leave to continue his studies at Glasgow University. Once more, after a year of academic life, he tried business again ; he acquitted himself highly creditably at first, but he finally abandoned business in 1840, and returned to college. In 1845 he entered the ministry of the Church of Scotland, holding the livings of Newton-on-Ayr, of Lady Tester's, Edinburgh, of Errol*~~

~~in Perthshire, and of Park Church, Glasgow, until in 1862 he accepted the chair of Divinity at Glasgow. During these years he won for himself a foremost place among the preachers of Scotland, having for his contemporaries such men of great eloquence as Norman Maeleod and Guthrie. His most notable sermons were : "Religion in Common Life," "What is Religion ? " " The Universal Religion." In theology he was essentially a Board Churchman, seeking always to show forth the permanent elements in religion, and ignoring the technicalities of doctrine. In 1873 he was appointed Vice-Chancellor and Principal of Glasgow University. He delivered the GifEord Lectures in 1892-93~~

~~and in 1895-96. His Introduction to the Philosophy of Beligion, published in 1880, is an attempt to show the essential rationality of religion. It is idealistic in char- acter, being, in fact, a reproduction of Hegelian teaching in clear and melodious language. His line of argument for the Being of God is based, briefly, on the hypothesis that thought — not individual but uniyersal — is the reality of all things, the existence of this Infinite Thought being demonstrated by the limitations of finite thought. Again, his Gifford Lectures are devoted to the proof of the truth of Christianity on grounds of right reason alone. Principal Caird also wrote an excellent study of Spinoza, in which he showed the latent Hegelianism of the great Jewish philosopher. He died 30th July 1898. ^ '~~

~~Cairns, Hugh M'Calmont Cairns, 1st Eabl (1819-1885), Irish statesman, and Lord Chancellor of England, was bom at Cultra, county Down, Ireland, 27th December 1819. One of the ablest lawyers who ever adorned the woolsack, he also played in politics a more pro- minent part than la,wyers have usually sustained, leading the Conservative party in the House of Lords between 1869 and 1880. His father, William Cairns, formerly a captain in the 47th Regiment, came of a family of Scottish origin, which migrated to Ireland in the time of James I. Hugh Cairns was his second son, and was educated at Belfast Academy and at Trinity College, Dublin. He showed such talent that his tutor at Trinity College, the Rev. George Wheeler, persuaded his father that he should be trained for the Law instead~~

~~*of for the Church, for which he had been intended. Accordingly, after taking a first-class in classics, and a B.A. degree in 1838, he left Ireland for London and entered at the Middle Temple, where he was called to the bar in 1844, afterwards becoming a member of Lincoln's Inn. During his first years at the Chancery Bar, Cairns showed little promise of the eloquence which afterwards distinguished him. Never a rapid speaker, he was then so slow and diffident, that he feared that this defect might interfere with his legal career. Fortunately he was soon able to rid himself of the idea that he was only fit for practice as a conveyancer. In 1852 he entered Parliament as member for Belfast, and his Inn, on his becoming a Q.C. in 1856, made him a Bencher.*~~

~~*In 1858 Cairns was appointed Solicitor-General, and was knighted, and in May of that year made two of his most brilliant and best-remembered speeches in the House of Commons. In the first, he defended the action of Lord EUenborough, who, as President of the Board of Control, had not only censured Lord Canning for a pro- clamation issued by him as Governor-General of India, but had made public the despatch in which the censure was conveyed. On the other occasion referred to, Sir Hugh Cairns spoke in opposition to Lord John Russell's amendment to the motion for the second reading of the Government Reform Bill, winning the most cordial com-mendation of Mr Disraeli. Disraeli's appreciation found an opportunity for displaying itself some years later, when in 1868 he invited him to be Lord Chancellor in the brief Conservative administration which followed Lord Derby's resignation of the leadership of his party. Meanwhile, Cairns had maintained his reputation in many other debates, both when his party was in power, and when it was in opposition. In 1866 Lord Derby, return- ing to office, had made him Attorney-General, and in the same year he had availed himself of the retirement of Sir J. Knight Bruce, to seek the comparative rest of the Court of Appeal. While a Lord Justice he had been offered a peerage, and though at first unable to accept it, he had finally done so on a relative, a member of the*~~

~~*wealthy family of M'Calmont, providing the means necessary for the endowment of a title.*~~

~~*The appointment of Baron Cairns of Garmoyle as Lord Chancellor involved the superseding of Lord Chelmsford, an act which apparently was carried out by Mr Disraeli with less tact than might have been expected of him. Lord Chelmsford bitterly declared that he had been sent away with less courtesy than if he had been a butler, but the testimony of Lord Malmesbury is strong that the affair was the result of an understanding arrived at when Lord Chelmsford took office. Mr Disraeli held office on this occasion for a few months only, and when Lord Derby died in 1889, Lord Cairns became the leader of the Conservative opposition in the House of Lords. He had distinguished himself in the Commons by his resist- ance to the Roman Catholics' Oath Bill brought in in 1865; in the Lords, his efforts on behalf of the Irish Church were equally strenuous. His speech on Mr Gladstone's Suspensory Bill was afterwards published as a pamphlet, but the attitude which he and the peers who followed him had taken up, in insisting on their amend- ments to the preamble of the Bill, was one difficult to maintain, .and Lord Cairns made terms with Lord Granville in circumstances which precluded his con- sulting his party first. He issued a circular to explain his action in taking a course for which many blamed him. Viewed dispassionately, the incident appears to have exhibited his statesmanlike qualities in a marked degree, for he secured concessions which would have been irretrievably lost by continued opposition. Not long after this. Lord Cairns resigned the leadership of his party in the Upper House, but he had to resume it in 1870, and took a strong part in opposing the Irish Land Bill in that year. On the Conservatives coming into power in 1874, he again became Lord Chancellor; in 1878 he was made Viscount Garmoyle and Earl Cairns; and in 1880 his party went out of office. In opposition he did not take as prominent a part as previously, but when Lord Beaconsfield died in 1881, there were some Conservatives who considered that his title to lead the party was better than that of Lord Salisbury. His health, however, never robust, had for many years shown intermittent signs of fail- ing. He had periodically made enforced retirements to the Riviera, and for many years had had a house at Bournemouth, and it was here that he died on 2nd April 1886.*~~

~~*Cairns was a great lawyer, with an immense grasp of first principles and the power to express them ; his judg- ments taking the form of luminous expositions or treatises upon the law governing the case before him, rather*~~

~~than of controversial discussions of the arguments adduced by counsel, or of analysis of his own reasons. Lucidity and logic were the leading characteristics of his speeches in his professional capacity, and in the political arena. An incident of his Lord Chancellorship deserves record. In the hearing of an appeal by the HIouse of Lords, a noble lord fresh from the Appeal Court, where interruptions of counsel are still too common, kept interposing questions during the argument. Lord Cairns turned to this gentle- man and said coldly but decisively, " I think the HIouse is desirous of hearing the argument of counsel, and not of putting questions to him." In an eloquent tribute to his memory in the HIouse of Lords, Lord Chief Justice Coleridge expressed the high opinion of the legal profession upon his merits, and upon the severe integrity and single-minded desire to do his duty which animated him in his selections for the bench. As far as the higher judicial appointments filled by Lord Cairns were concerned, such eulogy was not undeserved. Giffard, V.C, HIayes, Brett, Cleasby, Archibald, Eield,~~

~~liindley, HIuddleston, Manisty, HIawkins, Lopes, Pry, iStephen, and Bowen, form a list with which no Chancellor need be ashamed to figure in the history of his profes- sion, while he was also responsible for the raising of Baggallay, Cotton, and Thesiger (son of his old rival. Lord Chelmsford) to the Court of Appeal. In filling up vacancies on the County Court bench, Lord Cairns was not quite so successful, but the complaints that were made did not contain charges of personal or political prejudice in favour of those appointed ; they suggested rather that the best chance of success attended those whose religious views or professions were of the Evan- gelistic type. Of Lord Cairns's honourable desire, how- ever, to act for the best in all things, few can doubt. HIis piety was reflected by that of his great opponent, rival and friend, Lord Selbome. Like Lord Selborne and Lord HIatherley, Cairns found leisure at his busiest for teaching in the Sunday-school, but it is not recorded of them (as of him) that they refused to undertake work at the bar on Saturdays, in order to devote that day to hunting. HIe used to say that his great incentive to hard work at his profession in early days was his~~

~~*desire to keep hunters, and he retained his keenness as a sportsman as long as he was able to indulge it. Of his personal characteristics, it may be said that he was a spare man, with a Scottish, not an Irish, cast of countenance. He was scrupulously neat in his personal appearance, faultless in bands and neck- tie, and fond of wearing a flower in his button-hole. His chilly manner, coupled with his somewhat austere reli- gious principles, had no doubt much to do with the fact that he was never a popular man. His friends claimed for him a keen sense of humour, but it was not to be detected by those whose knowledge of him was profes- sional rather than personal. Probably he thought the exhibition of humour incompatible with the dignity of high judicial position. Of his legal attainments there can be no doubt. His influence upon the legislation of the day was largely felt where questions affecting reli- gion and the Church were involved, and in matters peculiarly affecting his own profession. His power was felt, as has been said, both when he was in ofiice and when his party was in opposition. He had been chairman of the Committee on Judicature Eeform, and although he was not in oifice when the Judicature Act was passed, all the reforms in the legal procedure of his day owed much to him. He took part, when out of office, in the passing of the Married Women's Property Act, and was directly responsible for the Conveyancing Acts of 1881-82, and for the Settled Land Act, which a Chancery judge (Mr Justice Byrne, in the Law Magazine,, vol. xxv. p. 260) has called " the greatest real property revolution effected in England for centuries." Many other statutes in which he was largely concerned might be quoted. His judg- ments are to be found in the Law Eeports, and those who wish to consider his oratory should read the speeches above referred to, or that delivered in the House of Lords on the Compensation for Disturbance Bill in 1880, and his memorable criticism of Mr Gladstone's policy in the Transvaal, after Majuba Hill. (See Hansard and the Times, 1st April 1881.) His style of delivery was, as a rule, cold to a marked degree. The term " frozen oratory " has been applied to his speeches, and it has been said of them that they flowed " like water from a glacier. . . . The several stages of his speech are like steps cut out in ice, as sharply defined, as smooth and as cold." Lord Cairns married in 1856 Mary Harriet, eldest daughter of Mr John Macneill, of Park Mount, county Antrim, by whom he had issue five sons and two daughters.*~~

~~AuTHOKiTiES. — See the Times, 3rd and 14th April 1885; Law Journal, Law Times, Solicitors^ Journal, 11th April 1885 ; the~~

~~Laie Magazine, vol. xi. p. 133 ; the Law Quarterly, vol. i. p. 365 ; Harl BusselVs Becollections ; Memoirs of Lord Malmesbury ; Sir Theodore Maktin, 2%e Life of the Prince Consort; Manson, Builders of our Law. (e. A. Ar.)~~

~~Cairns, a seaport and municipality in Queensland, Australia, in the county of Nares, about 900 miles N.W. of Brisbane, on Trinity Bay, with a fine and well- sheltered harbour. It is the natural outlet for the gold-fields, tin-mines, and silver-fields of the district and for the rich copper district of ChUlagoe. In the vicinity are extensive sugar plantations, with sugar mills and refineries; the culture of coffee is rapidly extending, bananas and other fruits are exported in considerable quantities, and there is a large industry in cedar. Population, about 3000.~~

~~Cairo, the capital of modern Egypt, situated on the right bank of the Nile, 12 miles S. of the apex of the Delta, in 30° 2' N. lat. and 31° 16' E. long. It is 130 miles by rail from Alexandria, and from Suez it is dis- tant 148 miles, though only 84 by the old overland route across the desert, before the opening of the Suez Canal. It occupies a length of 5 miles on the right bank of the Nile, from the old Eoman fortress of Babylon on the S., to the new railway bridge on the N., and covers an area of about 8 square miles, occupying all the available space between the Nile and the Moqattam hills. It is built partly on the alluvial plain of the Nile valley and partly on the rocky slopes of the Moqattam hills, which rise to an altitude of 550 feet above the town, on a lower spur of which (200 feet) stands the Citadel. Though the eastern or native part has changed but little, whole new quarters have sprung up of late years to supply the demand created by the large increase of European popu- lation and the growing wealth of the country. Thus what in 1875 was an open space on the western side, is now a closely-built-over district, comprising the quarters of Qasr el Dubara on the south of the Qasr el Nil bridge ; Isma'ilia, between this bridge and the main road leading to Bulaq; and Tewfiqia to the north of the main road. In these districts the houses are large, high, and well built, resem- bling those of southern Italy and France. In most cases they consist of residential flats,~~

~~detached single houses being the exception, most of the latter being situated in the Qasr el Dubara quarter. To the south the rubbish mounds of ancient Eostat, the first Arab town on the site, have prevented any extension in that direction, but to the north and north-west growth has proceeded rapidly. Bulaq, the river port, is now a part of the city itself, and Abbassia, an outlying district on the edge of the desert, two miles from the wall of the old town, is now connected by a continuous line of houses. Large and luxurious hotels have been buUt in the newer quarters for the accommodation of the increasing number of visitors who arrive each winter; while on the island or "Gezira" of Bulaq are to be found polo, cricket, and tennis grounds, as well as a racecourse. On the west bank of the Nile, not far from the town of Giza, are the Zoological Gardens in the grounds of the former Khedivial palace of Giza. A large number of the newer houses are lighted with electric light, and electric trams traverse most of the principal streets. The improvement in the houses, the laying out of open spaces, and a good water-supply, have done much to improve the sanitary condition of the city, the death-rate for the native population being 37-5 and 36-7 per 1000 for the years 1898 and 1899 respectively. In recent years a raUway bridge has been built across the Nile, a little to the north of Bulaq, so that the Upper Egypt line, which extends to Assuan, with a break of gauge at Luxor, passes over this bridge, and is now con- nected with the railway system of the Delta. To the~~

~~south of Cairo a sliort railway line runs to the town of Helwan, 14 miles distant, situated in the desert 3 miles from the river, and much frequented by invalids on account of its sulphur baths. With the increasing pro- sperity of the country the public buildings of Cairo are being gradually improved and rebuilt. The collection of Egyptian antiquities, formerly housed in a small building at Bulaq, was removed ia 1889 to the Khedivial palace of Griza on the west bank of the Nile ; a new museum has now been constructed close to the Qasr el Nil barracks, to which the collection will be transferred. More in. the centre of the city have been built the new Law Courts, while close by is a large building which, when finished, will receive the Khedivial public~~

~~*library and the collec- tions of the Museum of Arab Art. On the bank of the river, in the south part, the Medical School and the Oovermnent Hospital occupy the old palace of Qasr el Aini. A new Observatory will be built at Helwan, as the extension of the city northwards has rendered the present site quite unsuitable. Though it is inevitable that the Oriental character of much of the town will be replaced by modern European buildings, still much that is picturesque remains ; and the careful and systematic renewal and restoration of the old mosques, fountains, &c., which represent the best styles of Arab art, are preserv- ing much that is of interest and beauty which would otherwise have fallen into decay. In 1882 the population -was 374,838, and in 1897 it amounted to 570,062, of which 35,385 were foreigners ; the suburbs of Helwan and Mataria being included in the latter census, though not in the former. (h. g. l.)*~~

~~*Cairo, capital of Alexandria county, Illinois, U.S.A., situated, at an altitude of 313 feet, in the southern part of the state where the Ohio joins the Mississippi ia the bottom-lands. It is protected from floods by the levees which surround the place. Occupying a central position, it has a large river traf&c, besides which five railways centre in it, giving it also extensive land traffic. Popula- tion (1880), 9011 ; (1890), 10,324 ; (1900), 12,566.*~~

~~*Cairoli, Benedetto (1825-1889), Italian statesman, was born at Pavia, 28th January 1825. Erom 1848 until the completion of Italian unity in 1870, his whole activity was devoted to the Eisorgimento, as Garibaldian officer, political refugee, anti- Austrian conspirator, and deputy to Parliament. He commanded a volunteer company under Garibaldi in 1859 and 1860, being wounded slightly at Calatafimi, and severely at Palermo in the latter year. In 1866, with the rank of colonel, he assisted Garibaldi in Tyrol, in 1867 fought at Mentana, and in 1870 con- ducted the negotiations with Bismarck, during which the German Chancellor is alleged to have promised Italy possession of Eome and of her natural frontiers if the Democratic party could prevent an alliance between Victor Emmanuel and Napoleon. The prestige personally acquired by Benedetto Cairoli was augmented by that of his four brothers, who fell during the wars of Eisorgi- mento, and by the heroic conduct of their mother. His refusal of all compensation or distinction further endeared him to the Italian people. When in 1876 the Left came into power, Cairoli, then a deputy of sixteen years' stand- ing,*~~

~~*became parliamentary leader of his party, and, after the fall of Depretis, Nicotera, and Crispi, formed his first Cabinet in March 1878 with a Francophil and Irredentist policy. After his marriage with the Countess Elena Sizzo of Trent, he permitted the Irredentist agitation to carry the country to the verge of a war with Austria. General irritation was caused by his policy of " clean hands " at the Berlin Congress, while the attempt of Passanante to assassinate King Humbert at Naples (12th December 1878) caused his downfall, in spite of the courage displayed*~~

~~*and the severe wound received by him in protecting the king's person on that occasion. On 3rd July 1879 he returned to power, and in the following November formed, with Depretis, a coalition miuistry, in which he retained the Premiership and the Foreign Office. Confidence in French assurances, and belief that Great Britain would never permit the extension of French influence in North Africa, prevented him from foreseeing the French oecupar tion of Tunis (11th May 1881). In view of popular indignation, he resigned in order to avoid making inop- portune declarations to the Chamber. Thenceforward he practically disappeared from political life. In 1887 he received the Knighthood of the Annunziata, the highest Italian decoration, and on 8th August 1889 died while a guest of King Humbert in the royal palace of Capodi- monte, near Naples. (h. w. s.)*~~

~~*Caithness, the mostnortherlycounty of the Scottish mainland, bounded W. and S. by Sutherlandshire, E. by the German Ocean, and N. by the Pentland Firth.*~~

~~*Area and Population. — According to the last official estimate, the area (foreshore excluded) is 446,017 acres, or about 697 square miles. The population was in 1881, 38,865 ; in 1891, 37,177, of whom 17,472 were males and 19,705 females ; in 1901, 33,859. Taking the land area only (438,878 acres or 685.7 square miles), the number of persons to the square mile in 1891 was 64, and the number of acres to the person 11'8. In the registration county, the decrease of population between 1881 and 1891 was 6-7 per cent. Between 1881 and 1891 the excess of births over deaths was 3950, and the decrease of the resident population 1474. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 :*~~
—

~~*Tear.*~~

~~*Beaths.*~~

~~*Marriages.*~~

~~*Births.*~~

~~*Percentage of lUegitimate.*~~

~~*1880 1890 1899*~~

~~*677 733 621*~~

~~*175 163 167*~~

~~*1056 970 872*~~

~~*11-5*~~

~~*11-65*~~

~~*11-5*~~

~~*The following table gives the birth-rate, death-rate, and marriage- rate per thousand of the population for a series of years : —*~~

~~*1880.*~~

~~*1881-90.*~~

~~*1890.*~~

~~*1891-98.*~~

~~*1899.*~~

~~*Birth-rate . Death-rate .*~~

~~*Marriage-rate*~~

~~*26-44*~~

~~*16-95*~~

~~*4-38*~~

~~*26-98*~~

~~*16-84*~~

~~*4-56*~~

~~*25-39*~~

~~*19-18*~~

~~*4-26*~~

~~*24-36*~~

~~*16-55*~~

~~*4-48*~~

~~*24-41*~~

~~*17-39*~~

~~*4-67*~~

~~*The number of Gaelic-speaking persons in the county in 1891 was 4068, of whom 76 spoke Gaelic only; and there were 18 foreigners. Valuation in 1889-90, £132,795 ; 1899-1900, £114,105.*~~

~~*Administration. — The county returns a member to parliament. Wick (2773) is the only royal burgh, and the parliamentary burgh of Wick (7881) is one of the Northern group of burghs. Thurso (3938) and Pulteneytown (5502) are police burghs. There are 10 civil parishes, of which all but one are included in the combina- tions of Latheron and Thurso. The number of*~~

~~paupers and dependants in September 1899 was 1480. Caithness unites with Orkney and Shetland to form a sheriffdom, and there is a resident sheriff-substitute at "Wick, who sits also at Thurso and Lybster.~~

~~Education. — Twelve school boards manage 63 schools, with an average attendance of 5604 in 1898-99, and there are 3 voluntary schools, with an average attendance of 200. There are academies at "Wick and Thurso, and six other schools earned grants in 1898-99 for higher education. The county council spent £262 out of the "residue" grant in 1898 in subsidizing elementary schools and cookery classes, and in buying apparatus for technical classes.~~

~~Agriculture. — ^About two-fifths of the arable land are good, one- fifth is bad, and the rest medium. The cold, wet, and windy climate has been successfully counteracted by improving land- lords and tenants, and a considerable part of the acreage is in large farms tiUed in a thoroughly good style. Twenty-five per cent, of the land was under cultivation in 1898. According to the return of 1895, the average size of the 2694 holdings was 41 acres. Only 24-83 per cent, were under 5 acres, compared with 64-92 in the adjacent county of Sutherland ; 59-28 were between 5 and 50, and 15-89 over 50 acres. The number between 50 and 100 was 201 ; between 100 and 300, 159 ; between 300 and 500, 38 ; between 500 and 1000, 21 ; and there were 9 over 1000. Oats are the vastly preponderant crop ; wheat-growing has died out, and the barley acreage remains fairly constant at abont 1000.~~

~~496~~

~~CAJAMAEC A — C A L B A T 0 G~~

~~The following table gives the principal acreages at intervals of five years from 1880 : —~~

~~Tear.~~

~~Area under Crops.~~

~~Corn~~

~~*Crjtpa.*~~

~~*Green Crops.*~~

~~*Clover.*~~

~~*Permanent Pasture.*~~

~~*Fallow.*~~

~~*1880 1885 1890 1895 1899*~~

~~*105,551 106,710 109,082 110,026 111,869*~~

~~*35,953 35,559 36,419 35,455 35,113*~~

~~*16,967 16,392 16,764 16,184 16,051*~~

~~*26,688 28,282 30,505 29,748 32,206*~~

~~*25,359 25,806 25,231 28,596 28,438*~~

~~*584*~~

~~*671*~~

~~*161*~~

~~*35*~~

~~*69*~~

~~*The foDowing table same years : —*~~

~~*gives particulars of the live stock in the*~~

~~*Tear.*~~

~~*Total Horses.*~~

~~*Total Cattle.*~~

~~*Cows or*~~

~~*Heifers in*~~

~~*Milk or Calf.*~~

~~*Sheep.*~~

~~*Pigs.*~~

~~*1880 1885 1890 1895 1899*~~

~~*5177 5021 5431 5580 5663*~~

~~*19,746 20,030 20,664 21,646 21,780*~~

~~*7040 7040 7406 7417 7841*~~

~~*93,969 101,378 121,127 108,621 130,006*~~

~~*1659 1736 1928 1806 1496*~~

~~*Since the commencement of the operations of the Crofters Com- mission in 1886 down to the end of 1898, 1359 fair rents have been fixed in Caithness, rents amounting to £9032 were reduced to £6143, and of £12,600 of arrears £7051 was cancelled. In the same period 117 applications for enlargement of holdings were dealt with, and 562 acres were added to existing holdings. Only 952 acres were under wood in 1895. According to the census of 1891, 4268 men and 1010 women were engaged in agriculture.*~~

~~*Industries and Trade. — Twelve thousand tons of pavement flags were quarried in 1895 and 22,089 tons, valued at £21,867, in 1899. It is fishing, however, that makes Caithness crofting possible. Thurso, Scrabster, Lybster, and Wick are the chief fishing ports. The following tables show particulars of the combined districts of Lybster and Wick, which may be taken as representing the county : —*~~

~~*Tear.*~~

~~*Boats.*~~

~~*Talue of Gear.*~~

~~*Resident Fishermen and Boys,*~~

~~*Total Value of aU Fish.*~~

~~*No.*~~

~~*Tons.*~~

~~*Value.*~~

~~*1890 1898 1899*~~

~~*920 659 639*~~

~~*10,242 6,594 6,540*~~

~~*£55,304 £28,200 £36,538*~~

~~*£53,174 £47,064 £41,778*~~

~~*3807 2878 2353*~~

~~*£109,988 £124,936 £117,539*~~

~~*The value of the herring catch alone, in 1898, was £95,216. There were 6266 persons in 1899 employed in the two districts in connexion vrith the various branches of the sea fisheries. The salmon fisheries along the coast and at the mouths of rivers are of considerable value. A light railway (13 miles) from Wick to Lybster has been sanctioned.*~~

~~*See S. Laing. Prehistoric Bemains of Caithness. Lond. and Edin., 1866 James T. Caldee. Miatory of Caithness (2nd edi- tion). Wick. — John Horne. In and About Wick. Wick. — Thomas Sinclair. Caithness Events.*~~

~~*Wick, 1899. — History of the Clan Chinn. Wick, 1890. — J. Henderson. Caithness Family History. Edinburgh, 1884. — Harvie-Brown. Fauna of Caith- ness. Edinburgh, 1887. — Principal Miller. Our Scandinavian Forefathers. Thurso, 1872. — Smiles. Robert Dick, Botanist and Geologist. London, 1878. — H. Morrison. Guide to Sutherland and Caithness. Wick, 1883. — ^A. Auld. Ministers and Men in the Far North. Edinburgh, 1891. (w. wa.)*~~

~~*C^amarca, an interior department of northern Peru, with an area of 12,538 square miles, and a population (1896) of 442,412. It is divided into 7 provinces — Jaen, Chota, HInalgayoc, Colendin, Cajamarca, Contumara, and Cajabamba, the principal towns being Cajamarca and Cajamarquilla, with populations respectively, of 12,000 and 8000.*~~

~~*Calabar. See Nigehia.*~~

~~*Calabria, a territorial division of S. Italy, prac- tically coincident with the "toe" of the "boot," and embracing the provinces of Catanzaro, Cosenza, and Eeggio, with an area of 5819 sq. miles, and a popular tion of 1,257,883 (1881), and of 1,375,760 (1901). Except the three provincial capitals, Eeggio, Catanzaro, and Cosenza, the towns are mostly small. On the coast stand Cotrone, Gerace, Scilla, Palmi, Pizzo, Paola, and some others. Inland are Castrovillari, Corigliano, Eossano, Nicastro, Monteleone, Cittanova, Acri, and San Giovanni.*~~

~~*Calafat, a town in Eumania (population, 7113 in 1900), on the left bank of the Danube, opposite Viddin. It was founded in the 14th century by Genoese colonists, who employed large numbers of workmen (Calfats) in repairing ships — which industry gave its name to the place. It is now an important centre of the grain trade, and is connected by railway with Craiova.*~~

~~*Calais, a seaport on the Strait of Dover in the arrondissement of Boulogne, department of Pas-de-Calais, France, 184 miles from Paris by rail. The manufacturing suburb of St Pierre-l^s-Calais has been incorporated with the municipality. Important industries, besides the long- established manufacture of tulle and lace, of which the value exported in 1899 amounted to £3,267,860, are the manufacture of carriages, bicycles, motor cars, and telegraph cables ; brewing, sUk-milling, brick-making, and soap-*~~

~~making are also carried on. In outlying districts important industries are — the manufacture of chairs at Audruicq; iron-founding and quarrying at Marquise; the working of phosphates near Caffiers; and sugar- refining at Port d'Ardres, employing during the busy season about 1200 persons, with an output of sugar (1899-1900) of 22,000 tons. The fitting of machinery carried on in six establishments at Calais, Marquise, and Audruicq, employs about 8000 persons. There is a proposal to establish large shipbuilding yards at Calais, only fishing boats having hitherto been built here. The number of vessels entered and cleared respectively in 1899 was- 2101, tonnage 812,815, and 2106, tonnage 786,735. Of this total, British vessels numbered 1432 entered, tonnage 392,786, and cleared 1443, tonnage 395,216. The produce of the fisheries, in which 88 boats were employed, was valued at £66,000. The total number of passengers carried between Dover and Calais in 1899 was 263,420. Port accommodation has been greatly improved. The entrance channel has a width between jetties of 430 feet, and a depth of 34 feet and 13 feet at high and low spring tides respectively. There are four principal basins, of which the East Tidal Basin (that used by the mail packets) has an area of 16 acres. The canal of Calais, 18 miles long, connects the port with the Aa and the navigable waterways of the department. Inland canal traffic in 1899 amounted to 464,066 tons. Total value of imports 1899, £3,244,000 ; of exports, £6,732,000. There are a chamber of commerce, three hospitals, and two libraries. Population (1881), 12,446 ; St Pierre-l^s-Calais, 30,155; (1891), including St Pierre-lfes-Calais), 51,056; (1896),**

50,818; (1901), 59,893.

Calais, a city of Washington county, Maine, U.S.A., at the head of navigation on St Croix river, a few miles above its mouth, and on the St Croix and Penobscot railway. It has many lumber-mills and shipyards, and considerable commerce. Population (1880), 6173 ; (1890),

7290; (1900), 7655.

Calarasi, chief town of the district of the same name, Eumania, 223 miles from Bucarest, on the left bank of the Borcea branch of the Danube. It was formerly called Stirbey in honour of the prince of that name. It has a considerable export of wheat, linseed, hemp, and timber. Population (1896), 11,000; (1900), 11,024. J> y ^ \ h

Calatafimi, a town of the province of Trapani, Sicily, Italy, 21 miles E. by S. from Trapani. A monument was erected in 1882 on the battlefield where

~~Garibaldi defeated the Neapolitan forces in 1860. It has a trade in wine, olive oil, and sumach. Two and a half miles to the north-west are the ruins of the ancient city of Segesta. Population, about 10,500.~~

~~Calbayog, a town of 30,000 inhabitants, near the~~

~~west coast of Samar, Philippine Islands, on a small river of the same name, in 12° 3' N. It does an important export business in hemp, which is shipped to Manila. Eice and copra are also produced in considerable'quantity, and there is fine timber close at hand. The climate is pleasant and healthful. The language is Visayan.~~

~~Calculating Machines. See Mathematical Instruments.~~

~~Calcutta, the capital of British India, and also of the province of Bengal, is situated in 22° 34' N. lat. and 88° 24' E. long. It lies on the left or east bank of the Hooghly, about 80 miles above the sea. It covers an area of 20 square miles. Its population in 1881 was 549,376, and in 1891 it was 681,560. Adding the suburbs, the total population was 903,374 ; and if Howrah be also included, the grand total rises to 1,018,980. Classified according to religion, Hindus numbered 444,137, or 65 per cent. ; Mahommedans, 203jl73, or 30 per cent.; Christians, 28,997, or 4 per cent., of whom 12,516 were Europeans and 9818 Eurasians, leaving 6663 for native converts; Jains and Buddhists, 2693 ; Parsis, 166 ; "others," 2394. Of the total number of inhabitants, less than one-third were born in the city. The preliminary returns of the census of 1901 gave the population of Calcutta as 843,487, showing an increase of 24 per cent., the same rate of in- crease as in the preceding decade. Adding the suburbs, the total population is 1,121,664 ; and if Howrah be also included, the grand total rises to 1,279,511. Just two- thirds of the population are males.~~

~~Calcutta is a busy commercial centre, but most of the industries are carried on outside municipal limits. Howrah, on the opposite side of the Hooghly, is the terminus of three great railway systems, and also the headquarters of~~

~~the jute industry and other large factories. It is connected with Calcutta by an immense floating bridge, 1630 feet in length, which was constructed in 1874. A project is now under consideration to build a railway bridge across the river, with a central station in Calcutta. Other railways have their terminus at Sealdah, an eastern suburb. The docks lie outside Calcutta, at Kidderpur, on the south ; and at Alipur are the Zoological Gardens, the residence of the lieutenant-governor of Bengal, canton- ments for a native infantry regiment, the central jail, and a Government reformatory. The port of Calcutta stretches about 10 miles along the river. It is under the control of a port trust, whose jurisdiction extends to the mouth of the Hooghly, and also over the floating bridge. During the five years ending 1897-98, the number of vessels entering the port rose from 991 to 1235, and the tonnage from 2,567,440 to 3,562,373. New docks were opened in 1892, which cost Es.2,87,70,000 ; and a loan of Es.15,00,000 was raised in 1898 for improvements in the docks and jetties and for new warehouses. In 1897-98 the total income of the port trust was Es.61,85,000, and the total expenditure was Es.61,05,000, of which Es.21,19,000 represents debt and sinking fund. The total amount of liabilities outstanding was Es.4,09,50,000, against which the port trust holds land, &c., estimated at a considerably higher value. The figures for the sea-borne trade of Bengal are included in those given for Bengal (q.v.). During the ten years ending 1897-98, imports of foreign merchandise rose in value from Es.25,65,12,730 to Es.27,85,49,500, or by 9 per cent.; while exports rose from Es.36,63,69,890 to Es.44,13,96,690, or by 20 per cent. In 1899-1900 the foreign trade amounted to £56,828,000 (imports, £23,511,000 ; exports, £33,317,000), of which 61 per cent, was trade with the United Kingdom and 8-4 per cent, with the United States. The inland trade of Calcutta is registered as it enters or leaves the city by country boat, by inland steamer, by rail, or by~~

~~road. The following table gives the results of this registration for 1897-98 : —~~

~~Imports.~~

~~Exports.~~

~~Total.~~

~~*By country boat . By inland steamer By East Indian*~~

~~*railway By Eastern Bengal*~~

~~*railway By road*~~

~~*Total*~~

~~*Es.*~~

~~*13,22,03,507*~~

~~*7,72,75,288*~~

~~*27,99,37,306*~~

~~*9,30,86,345 4,20,44,354*~~

~~*Es.*~~

~~*3,57,87,627 5,37,08,677*~~

~~*23,23,18,027*~~

~~5,58,64,506 2,23,47,509~~

~~Es.~~

~~16,79,91,134 13,09,83,965~~

~~51,22,55,333~~

~~14,89,50,851 6,43,91,863~~

~~62,45,46,800~~

~~40,00,26,346~~

~~1,02,45,73,146~~

~~More than half of the total is carried by the East Indianrailway, which serves the North-Western Provinces. Country boats hold their own against inland steamers, especially in imports.~~

~~The municipal government of Calcutta has been recon- stituted by an Act of the Bengal Legislature, passed in 1899. Previously, the governing body consisted of seventy- five commissioners, of whom fifty were elected. Under the new system, modelled upon that of the Bombay mimici- pality, this body, styled the Corporation, remains com- paratively unaltered ; but a large portion of their powers is transferred to a general committee, composed of twelve members, of whom one-third are elected by the Corpora- tion, one-third by certain public bodies, and one-third are nominated by the Government. At the same time, the authority of the chairman, as supreme executive of&cer, is considerably strengthened. The two most important works undertaken by the old municipality were the provision of a supply of filtered water and the construction of a main drainage system. The water-supply is derived from the river Hooghly, about 16 miles above Calcutta, where there are large pumping-stations and settling-tanks. The total length of the main is 315 miles. In 1897-98 the daily supply of filtered water was more than 20 million gallons, being 38 gallons per head of population. In addition, there was a daily supply of more than 5 million gallons of*

~~*unfiltered water, being 12 gallons per head. The drainage system consists of underground sewers, which are discharged by a pumping-station into a natural depression to the eastward, called the Salt Lake. Eefuse is also removed to the Salt Lake by means of a municipal railway.*~~

~~*The following table gives the principal heads of mtmicipal income and expenditure in 1897-98 : —*~~

~~*Inoome,*~~

~~*Expenditure.*~~

~~*Es.*~~

~~*Es.*~~

~~*General rate .*~~

~~*17,79,106*~~

~~*Interest of debt .*~~

~~*5,99,209*~~

~~*Sewage rate .*~~

~~*8,74,540*~~

~~*Repayment of debt*~~

~~*2,44,616*~~

~~*Water rate .*~~

~~*11,23,621*~~

~~*General establislmient .*~~

~~*4,02,025*~~

~~*Lighting rate*~~

~~*8,74,540*~~

~~*Oflce ....*~~

~~*1,04,884*~~

~~*Taxes on trades*~~

~~*car*~~

~~*Boads ....*~~

~~*8,60,446*~~

~~*riages, &c. .*~~

~~*6,81,809*~~

~~*Street watering .*~~

~~*98,278*~~

~~*Market .*~~

~~*1,38,656*~~

~~*Gowkhana .*~~

~~*2,17,601*~~

~~*Sale of water .*~~

~~*1,55,219*~~

~~*Conservancy .*~~

~~*1,67,616*~~

~~*Conservancy .*~~

~~*64,790*~~

~~*Bnsti cleaning*~~

~~*80,281*~~

~~*Eoads .*~~

~~*84,975*~~

~~*Sewer cleaning, &o.*~~

~~*1,28,480*~~

~~*Slaugliter-house*~~

~~*41,148*~~

~~*Hospital and vaccina-*~~

~~*Miscellaneous*~~

~~*1,87,756*~~

~~*tion .*~~

~~*67,102*~~

~~*Suburban improve-*~~

~~*ments*~~

~~*37,834*~~

~~*Sewers ....*~~

~~*2,72,006*~~

~~*Water ....*~~

~~*11,79,085*~~

~~*Lighting*~~

~~*4,56,098*~~

~~*Miscellaneous*~~

~~*Total . . .*~~

~~*4,40,682*~~

~~*Total .*~~

~~*47,51,060*~~

~~*48,45,592*~~

~~*The total amount levied by rate was Es.36, 51,807, the incidence of taxation being nearly Es.7 per head. The assessment of the annual valuation of the city amounts to Rs.2,08,54,607. The*~~

~~*S. IL — 63*~~

~~*498*~~

~~*CALDECOT T — C ALIBRATION*~~

~~*outstanding liabilities at the close of the year were Rs^, 67,72,379, the rates of interest ranging from 6 to 3J per cent.*~~

~~*The Calcutta University was constituted in 1857, as an examining body, on the model of the University of Lon- don. During the five years ending 1897, the total number of persons who matriculated was 12,602, while 1830 graduated B.A., and 329 M.A., 627 passed examinations in law, 926 in medicine, and 92 in engineering. The chief educational institutions are the Government Presidency College (with 497 students in 1897), three aided*~~

~~*mission- ary colleges (with a total of 1316 students), and four unaided native colleges (with a total of 1474 students) ; the Sanskrit College and the Mahommedan Madrasah, the Grovemment medical college (with 468 students), the Government engineering college at Sibpur, on the opposite bank of the Hooghly (with 310 students), the Government school of art (with 261 students), 49 high schools for boys, which passed 466 candidates for the matriculation; the Bethune College, and 4 high schools for girls. In 1896-97 the total number of pupils under instruction was 47,295, the proportion to population of school-going age being 81 per cent, for boys and 21 per cent, for girls.*~~

~~*Calcutta has been comparatively fortunate in escaping the plague. The disease manifested itself in a sporadic form in April 1898, but disappeared by September of that year. Many of the Marwari traders fled the city, and some trouble was experienced in shortness of labour in the factories and at the docks. The plague returned in 1899, and caused a heavy mortality during the early months of the following year; but the population was not demoralized, nor was trade interfered with. A yet more serious outbreak occurred in the early months of 1901. The total death-rate in 1900 was 43-54 per thou- sand, the number of deaths from plague being 8354, com-pared with 2332 in the preceding year.*~~

~~*Though Calcutta has been called " the city of palaces," its modern public buildings cannot compare with those of Bombay. Its chief glory is the Maidan, or Park, which is large enough to embrace the area of Fort William and a racecourse. Many monuments find a place on the Maidan, amongst the latest additions being two equestrian statues of Lord Roberts and Lord Lans- downe, which face one another on each side of the Eed Road, where the rank and fashion of Calcutta take their evening drive. In the north-eastern corner of the Maidan it is proposed to erect the Indian memorial to Queen Victoria, consisting of a marble hall, with a statue and historical relics. The Government has acquired Met- calfe Hall, in order to convert it iuto a public library and reading-room worthy of the capital of India; and also the country-house of Warren Hastings at Alipur, for the entertainment of Indian princes. Lord Curzon has restored, at his own cost, the monument which formerly commemorated the massacre of the Black Hole. A wide street, called Harrison Eoad in memory of a former chairman*~~

~~of the municipality, has been run through the centre of the city, in continuation of the line of the Hooghly bridge; but much yet remains to be done to open up the native quarters, which are densely built over, regardless of sanitary requirements.~~

~~(j. s. Co.)~~

~~Caldecott, Randolph (1846-1886), English ar- tist and illustrator, was born at Chester on 22nd March 1846. From 1861 to 1872 he was a bank clerk, first at Whitchurch in Shropshire, afterwards at Manchester; but devoted all his spare time to the cultivation of a remarkable artistic faculty. In 1872 he migrated to London, became a student at the Slade School, and finally adopted the artist's profession. He gained immediately a wide reputation as a prolific and original illustrator,~~

~~gifted with a genial, humorous faculty, and he succeeded also, though in less degree, as a painter and sculptor. His health gave way in 1876, and after prolonged suffer- ing, he died in Florida on 12th February 1886. His chief book illustrations are as follows: Old Christmas (1876) and Bracebridge Hall (1877), both by Washington Irving; NoHh Italian Folk (1877), by Mrs Comyns Carr; The Han Mountains (1883) ; Breton Folk (1879), by Henry Blackburn; picture-books (John Gilpin, The House that Jack Built, and other children's favourites) from 1878 onwards ; Some uEsop's Fables with Modem Instances, &c. (1883). He held a roving commission for the Graphic, and was an occasional contributor to Punch. He was a member of the Eoyal Institute of Painters in Water- colours.~~

~~See Henry Blackbukn : ^Randolph Caldecott, Personal Memoir of his Early Life. London, 1886. (a. L. b.)~~

~~Calgary, a port of entry and the principal town of Alberta, Canada, situated 840 miles by rail W. of Winni- peg, at the junction of the main line and Edmonton and Macleod branches of the Canadian Pacific railway, in 51° 02' N. lat. and 114° 04' W. long., at an altitude of 3421 feet above the sea. It is the centre of the ranching country and the main distributing point for the district. The population in 1901 was 4865.~~

~~*Call, a town in the department of Cauca, Colombia, South America, situated on the Call. The river is spanned by a handsome bridge, and the town has 7 churches, several convents, and a number of good public buildings. Its population is 16,000.*~~

~~*Calibration. — The term Calibration primarily sig- nifies the determination of the "calibre" or bore of a gun. The word calibre was introduced through the French from the Italian calibro, together with other terms of gunnery and warfare, about the 16th century. The origin of the Italian equivalent appears to be uncer- tain. It will readUy be understood that the calibre of a gun requires accurate adjustment to the standard size, and further, that the bore must be straight and of uniform diameter throughout. The term was subsequently ap- plied to the accurate measurement and testing of the bore of any kind of tube, especially those of thermome- ters. In modern scientific language, by a natural process of transition, it has come to denote the accurate compari- son of any measuring instrument with a standard, and more particularly the determination of the errors of its scale. It is seldom possible in the process of manufacture to make an instrument so perfect that no error can be discovered by the most delicate tests, and it would rarely be worth while to attempt to do so even if it were possi- ble. The cost of manufacture would in many cases be greatly increased without adding materially to the utility of the apparatus. The scientific method, in all eases which admit of the subsequent determination and correc- tion of errors, is to economize time and labour in produc- tion by taking pains in the subsequent verification or calibration. This process of calibration is particularly important in laboratory research, where the observer has frequently to make his own apparatus, and cannot afford the time or outlay required to make special tools for fine work, but is already provided with apparatus and methods of accurate testing. For non-scientific purposes it is generally possible to construct instruments to measure with sufficient precision without further correction. The present article will therefore be restricted to the scientific use and application of methods of accurate testing.*~~

~~*General Methods and Principles. — The process of cali- bration of any measuring instrument is frequently divis- ible into two parts, which differ*~~

~~*greatly in importance in different cases, and of which one or the other may often*~~

~~*be omitted. (1) The determination of the value of the unit to which the measurements are referred by compari- son with a standard unit of the same kind. This is often described as the Standardization of the instrument, or the determination of the Reduction factor. (2) The verifica tion of the accuracy of the subdivision of the scale of the instrument. This may be termed calibration of the scale, and does not necessarily involve the comparison of the instrument with any independent standard, but merely the verification of the accuracy of the relative values of its indications. In many cases the process of calibration adopted consists in the comparison of the instrument to be tested with a standard over the whole range of its indications, the relative values of the subdivisions of the standard itself having been previously tested. In this case the distinction of two parts in the process is un- necessary, and the term calibration is for this reason frequently employed to include both. In some cases it is employed to denote the first part only, but for greater clearness and convenience of description we shall restrict the term as far as possible to the second meaning.*~~

~~*The methods of standardization or calibration employed have much in common even in the cases that appear most diverse. They are all founded on the axiom that " things which are equal to the same thing are equal to one another." Whether it is a question of comparing a scale with a standard, or of testing the equality of two parts of the same scale, the process is essentially one of interchanging, or substituting one for the other, the two things to be compared. In addition to the things to be tested there is usually required some form of balance, or comparator, or gauge, by which the equality may be tested. The simplest of such com- parators is the instrument known as the callipers, from the same root as calibre, which is in constant use in the workshop for testing equality of linear dimensions, or uniformity of diameter of tubes or rods. The more complicated forms of optical comparators or measuring machines with scales and screw adjustments, are essen- tially similar in principle, being finely adjustable*~~

~~*gauges to which the things to be compared can be successively fitted. A still simpler and more accurate comparison is that of volume or capacity, using a given mass of liquid as the gauge or test of equality, which is the basis of many of the most accurate and most important methods of calibration. The common balance, for testing equality of mass or weight, is so delicate and so easily tested, that the pro- cess of calibration may frequently with advantage be reduced to a series of weighings, as for instance in the calibration of a burette or measure-glass by weighing the quantities of mercury required to fill it to different marks. The balance may, however, be regarded more broadly as the type of a general method capable of the widest application in accurate testing. It is possible, for instance, to balance two electromotive forces or two electrical resistances against each other, or to measure the refractivity of a gas by balancing it against a column of air adjusted to produce the same retardation in a beam of light. These "equilibrium," or "null," or "bal- ance" methods of comparison afford the most accurate measure- ments, and are generally selected if possible as the basis of any process of calibration. In spite of the great diversity in the nature of the things to be compared, the fundamental principles of the methods employed are so essentially similar that it is possible, for instance, to describe the testing of a set of weights, or the calibra- tion of an electrical resistance-box, in almost the same terms, and to represent the calibration correction of a mercury thermometer or of an ammeter by precisely similar curves.*~~

~~*Method of Substitution.— In comparing two units of the same kind and of nearly equal magnitude, some variety of the general method of substitution is invariably adopted. The same method in a more elaborate form is empteyed in the calibration of a series of multiples or submultiples of any unit. The details of the method depend on the system of subdivision adopted, which is to some extent a matter of taste. The simplest method of subdivision is that on the binary scale, proceeding by multiples of 2. With a pair of submultiples of the smallest denomination and one of each of the rest, thus 1, 1, 2, 4, 8, 16, &c., each weight or multiple is equal to the sum of all the smaller weights, which may be substituted for it, and the small difference, if any, observed. If we call the weights A, B, C, &c., where each is approximately double the following weight, and if we write a for observed excess of A over the rest of the weights, 6 for that of B over G +*~~

~~D+ &C., and so on, the ob- servations by the method of substitution give the series of equations,~~

~~A — rest = a, B – rest = b, C- rest = c, &c. . (1). Subtracting the second from the first, the third from the second, and so on, we obtain at once the value of each weight in terms of~~

~~the preceding, so that all may be expressed in terms of the largest, which is most conveniently taken as the standard~~

~~B – A/2, + (fi – a)/2, C = B/2 + (c – 6)2, &o. . (2).~~

~~The advantages of this method of subdivision and comparison, in addition to its extreme simplicity, are (1) that there is only one possible combination to represent any given weight within the range of the series ; (2) that the least possible number of weights is required to cover any given range ; (3) that the smallest number of substitutions is required for the complete calibration. These advantages are important in cases where the accuracy of calibration is limited by the constancy of the conditions of observa- tion, as in the case of an electrical resistance-box, but the reverse may be the case when it is a question of accuracy of estimation by an observer.~~

~~In the majority of cases the ease of numeration afforded by familiarity with the decimal system is the most important con- sideration. The most convenient arrangement on the decimal system for purposes of calibration is to have the units, tens, hundreds, &c., arranged in groups of four adjusted in the propor- tion of the numbers 1, 2, 3, 4. The relative values of the weights in each group of four can then be determined by substitution in- dependently of the others, and the total of each group of four, making ten times the unit of the group, can be compared with the smallest weight in the group above. This gives a sufficient number of equations to determine the errors of all the weights by the method of substitution in a very simple manner. A number of other equations can be obtained by combining the different groups in other ways, and the whole system of equations may then be solved by the method of least squares ; but the equations so obtained are not all of equal value, and it may be doubted whether any real advantage is gained in many cases by the multiplication of comparisons, since it is not possible in this manner to eliminate constant errors or personal equation,~~

~~which are generally aggra- vated by prolonging the observations. A common arrangement of the weights in each group on the decimal system is 5, 2, 1, 1, or 5, 2, 2, 1. These do not admit of the' independent calibration of each group by substitution. The arrangement 5, 2, 1, 1, 1, or 5, 2, 2, 1, 1, permits independent calibration, but involves a larger number of weights and observations than the 1, 2, 3, 4, grouping. The arrangement of ten equal weights in each group, which is adopted in " dial " resistance-boxes, and in some forms of chemical balances where the weights are mechanically applied by turning a handle, presents great advantages in point of quickness of manipulation and ease of numeration, but the complete calibra^- tion of such an arrangement is tedious, and in the case of a resistance-box it is difficult to make the necessary connexions. In all cases where the same total can be made up in a variety of ways, it is necessary in accurate work to make sure that the same weights are always used for a given combination, or else to record the actual weights used on each occasion. In many in- vestigations where time enters as one of the factors, this is a serious drawback, and it is better to avoid the more complicated arrange- ments. The accurate adjustment of a set of weights is so simple a matter that it is often possible to neglect the errors of a weU-made set, and no calibration is of any value without the most scrupulous attention to details of manipulation, and particularly to the correction for the air displaced in comparing weights of different materials. Electrical resistances are much more difficult to adjust owing to the change of resistance with temperature, and the calibration of a resistance-box can seldom be neglected on account of the changes of resistance which are liable to occur after adjustment from imperfect annealing. It is also necessary to remember that the order of accuracy required and the actual values of the smaller resistances depend to some extent on the method of connexion, and that the box must be calibrated with due regard to the conditions under which it is to be used. Other- wise the method of procedure is much the same as in the case of a box of weights, but it is necessary to pay more attention to the constancy and uniformity of the temperature conditions of the observing-room.~~

~~Method of Equal Steps. — In calibrating a continuous scale divided into a number of divisions of equal length, such as a metre scale divided in millimetres, or a thermometer tube divided in degrees of temperature, or an~~

~~electrical slide-wire, it is usual to proceed by a method of equal steps. The simplest method is that known as the method of Gay-Lussac in the calibration of mercurial thermometers or tubes of small bore. It is essentially a method of substitution employing a column of mercury of constant volume as the gauge for comparing the capacities of different parts of the tube. A precisely similar method, employing a pair of microscopes at a fixed distance apart as a standard of length, is applicable to the calibration of a divided scale. The interval to be calibrated is divided into a whole number of. equal steps or sections, the points of division at which the corrections are to be determined are called points of calibration.~~

~~Calibration of a Mercury Thermometer. — To facilitate descrip- tion, we will take the case of a flne-bore tube, such as that of a thermometer, to be calibrated with a thread of mercury. The bore of such a tube will generally vary considerably even in the best standard instruments, the tubes of which have been specially drawn and selected. The correction for inequality of bore may amount to a quarter or half a degree, and Is seldom less than a tenth. In ordinary chemical thermometers it is usual to make allowance for variations of bore in graduating the scale, but such instruments present discontinuities of division, and cannot be used for accurate work, in which a finely-divided scale of equal'parts is essential. The calibration of a mercury thermo- meter intended for work of precision is best effected after it has been sealed. A thread of mercury of the desired length is separ- ated from the column. The exact adjustment of the length of the thread requires a little manipulation. The thermometer is inverted and tapped to make the mercury run down to the top of the tube, thus collecting a trace of residual gas at the end of the bulb. By quickly reversing the thermometer the bubble passes to the neck of the bulb. If the instrument is again inverted and tapped, the thread will probably break off at the neck of the bulb, which should be previously cooled or warmed so as to obtain in this manner, if possible, a thread of the desired length. If the thread so obtained is too long or not accurate enough, it is removed to the other end of the tube, and the bulb further warmed tiU the mercury reaches some easily recognized~~

~~*division. At this point the broken thread is rejoined to the mercury column from the bulb, and a microscopic bubble of gas is condensed which generally suflSces to determine the subsequent breaking of the mercury column at the same point of the tube. The bulb is then allowed to cool till the length of the thread above the point of separation is equal to the desired length, when a slight tap suffices to separate the thread. This method is difficult to work with short threads owing to deficient inertia, especially if the tube is very perfectly evacuated. A thread can always be separated by local heating with a small flame, but this is dangerous to the thermometer, it is difficult to adjust the thread exactly to the required length, and the mercury does not run easily past a point of the tube which has been locally heated in this manner.*~~

~~*Having separated a thread of the required length, the thermo- meter is mounted in a horizontal position on a suitable support, preferably with a screw adjustment in the direction of its length. By tilting or tapping the instniment the thread is brought into position corresponding to the steps of the calibration successively, and its length in each position is carefully observed with a pair of reading microscopes fixed at a suitable distance apart. Assuming that the temperature remains constant, the variations of length of the thread are inversely as the variations of cross-section of the tube. If the length of the thread is very nearly equal to one step, and if the tube is nearly uniform, the average of the observed lengths of the thread, taking all the steps throughout the interval, is equal to the length which the thread should have occupied in each position had the bore been uniform throughout and all the divisions equal. The error of each step is therefore found by subtracting the average length from the observed length in each position. Assuming that the ends of the interval itself are correct, the correction to be applied at any point of calibration to reduce the readings to a uniform tube and scale, is found by taking the sum of the errors of the steps up to the point con- sidered with the sign reversed.*~~

~~*In the following example of the method an interval of ten degrees is taken, divided Into ten steps of 1° each. The distances of the ends of the thread from the nearest degree divisions are estimated by the aid of micrometers to the thousandth of a degree. The error of any one of these readings probably does not exceed half a thousandth, but they are given to the nearest*~~

~~*thousandth only. The excess length of the thread in each position over the corresponding degree is obtained by subtracting the second reading from the first. Taking the average of the numbers in this line, the mean excess-length is -10 -4 thousandths. The error of each step is found by subtracting this mean from each of the numbers in the previous line. Finally, the corrections at each degree are obtained by adding up the errors of the steps and changing the sign. The errors and corrections are given in thousandths of 1°.*~~

~~*Table I. — Calibration by Method of Gay-Lussac.*~~

~~*No. of step.*~~

~~*1*~~

~~*2*~~

~~*8*~~

~~*i*~~

~~*6*~~

~~*6*~~

~~*7*~~

~~*8*~~

~~*9*~~

~~*10*~~

~~*Ends) of y thread)*~~

~~*(·010 i-038*~~

~~*-·016 + ·017*~~

~~-■020 -•003~~

~~-•031 -•022~~

~~+■016 +•010~~

~~+ •008 +•005~~

~~+•013 +•033~~

~~+■017 +■018~~

~~+ •004 +•018~~

~~-•008 -•008~~

~~ExcesB- length.~~

~~Error of step.~~

~~Correc- tion.~~

~~-•028~~

~~-•088~~

~~-•017~~

~~-•009~~

~~+•006~~

~~-•008~~

~~-■020~~

~~-■001~~

~~-•004~~

~~+■005~~

~~-17-6~~

~~-22^6~~

~~-6-6~~

~~+1^4~~

~~+16^4~~

~~+7^4~~

~~-96~~

~~+9^4~~

~~+6-4~~

~~+15^4~~

~~+17-6~~

~~+W2~~

~~+i&8~~

~~+45-4~~

~~+29^0~~

~~+21-6~~

~~+81•a~~

~~+21-8~~

~~+15^4~~

~~θ~~

~~*Complete Calibration. — The simple method of Gay-Lussac does very well for short intervals when the number of steps is not excessive, but It would not be satisfactory for a large range owing to the accumulation of small errors of estimation, and the variation of the personal equation. The observer might, for instance, consist- ently over-estimate the length of the thread in one half of the tube, and under-estimate it in the other. The errors near the middle of the range would probably be large. It is evident that the correction at the middle point of the interval could be much more accurately determined by using a thread equal to half the length of the interval. To minimize the effect of these errors of estimation, it is usual to employ threads of different lengths in calibrating tiie same interval, and to divide up the fundamental interval of the thermometer into a number of subsidiary sections for the purpose of calibration, each of these sections being treated as a step in the calibration of the fundamental interval. The most symmetrical method of calibrating k section, called by Guillaume a " Complete Calibration," is to use threads of all possible lengths which are "integral multiples of the calibration step. In the example already given nine different threads were used, and the length of each was observed in as many positions as possible. Proceeding in this manner the following numbers were obtained for the excess- length of each thread in thousandths of a degree in different positions, starting in each case with the beginning of the thread at 0°, and moving it on by steps of 1°. Table II. — Complete Calibration of Interval of 10° in 10 Steps.*~~

~~*Lengths of Threads.*~~

~~*1°*~~

~~*2°*~~

~~*8°*~~

~~*4°*~~

~~*6°*~~

~~6°~~

~~7°~~

~~8°~~

~~90~~

~~mil 11~~

~~-28~~

~~-32~~

~~-67~~

~~-62~~

~~-11~~

~~-15~~

~~-48~~

~~-2~~

~~-8~~

~~-38~~

~~-21~~

~~-47~~

~~-28~~

~~+14~~

~~-8~~

~~-22~~

~~+21~~

~~+24~~

~~-17~~

~~+ 2~~

~~- 8~~

~~+ 1~~

~~+26~~

~~+28~~

~~+ 6~~

~~+58~~

~~- 9~~

~~+26~~

~~+ 5~~

~~- 8~~

~~+41~~

~~+86~~

~~+28~~

~~ft a gj 4°~~

~~+ «~~

~~+81~~

~~-7~~

~~+-4~~

~~+45~~

~~+49~~

~~Ti^Sgli s°~~

~~-8~~

~~+6~~

~~-15~~

~~-6~~

~~+43~~

~~lass's g.f°~~

~~-20~~

~~+7~~

~~-16~~

~~+-2~~

~~-1~~

~~+23~~

~~+10~~

~~1 §>>«£? 8"~~

~~- 4 + 5~~

~~+29~~

~~*The observations in the first column are the excess-lengths of the thread of 1° already given in illustration of the method of Gay- Lussac. The other columns give the corresponding observations with the longer threads. The simplest and most symmetrical method of solving these observations, so as to find the errors of each step in terms of the whole interval, is to obtain the differ- ences of the steps in pairs by subtracting each observation from the one above it. This method eliminates the unknown lengths of the threads, and gives each observation approximately its due weight. Subtracting the observations in the second line from those in the first, we obtain a series of numbers, entered in column 1 of the next table, representing the excess of step (1) over each of the other steps. The sum of these differences is ten times the error of the first step, since by hypothesis the sum of the errors of all the steps is zero in terms of the whole interval. The numbers in the second column* of Table III. are similarly obtained by subtracting the third line from the second in Table II. , each difference being inserted in its appropriate place in the table. Proceeding in this way we find the excess of each interval over those which follow it. The table is completed by a diagonal row of zeros representing the difference of each step from itself, and by repeating the numbers already found in symmetrical positions with their signs changed, since the excess of any step, say 6 over 3, is evidently equal to that of 3 over 6 with the sign changed. The errors of each step having been found by adding the columns, and dividing by 10, the corrections at each point of the calibration are deduced as before.*~~

~~*Table III. — Solution of Complete Calibration.*~~

~~*step No.*~~

~~*1*~~

~~*2*~~

~~*8*~~

~~4~~

~~5~~

~~6~~

~~7~~

~~8~~

~~9~~

~~10~~

~~1 2 3 4 6 6 7 8 9 10~~

~~0 + 5 -11 -20 -34 -25 − 7 -26 -28 -82~~

~~-5~~

~~0 . -16 -28 -39 -29 -12 -81 -28 -37~~

~~+11 +16 0 − 8 -24 -13 + 4 -15 -18 -22~~

~~+20 +28 + 8 0 -15~~

~~-5 +12~~

~~-7~~

~~-4 -18~~

~~+84 +89 +24 +15 0 + 9 +26 + 8 +10 + 2~~

~~+25 +29 +18 + 5~~

~~-9 0~~

~~+17~~

~~- 2 + 1~~

~~- 8~~

~~+ 7 +12 – 4 -12 -26 -17 0 -19 -16 -26~~

~~+26 +81 +15 + 7~~

~~- 8 + 2 +19~~

~~0 + 8~~

~~- 6~~

~~+23 +28 +18 + 4 -10~~

~~- 1 +16~~

~~- 8 0~~

~~- 9~~

~~+82 +87 +22 +18 – 2 + 8 +26 + 6 + 9 0 1~~

~~Error of step.~~

~~-17^8~~

~~-22^0~~

~~-6^4~~

~~+1^9~~

~~+16^7~~

~~+7^1~~

~~-lO^l~~

~~+8^9~~

~~+6^1~~

~~+15-1~~

~~Correc- tions.~~

~~+17-8~~

~~+S9-8~~

~~+45^7~~

~~+48^8~~

~~+27^1~~

~~+20-0~~

~~+80^1~~

~~+21-2~~

~~+15-1~~

~~0~~

~~The advantages of this method are the simplicity and symmetry of the work of reduction, and the accuracy of the result, which~~

~~exceeds that of the Gay-Lussao method in consequence of the much larger number of independent observations. It may be noticed, for mstance, that the correction at point 5 is 27-1 thousandths by the complete calibration, which is 2 thousandths less than the value 29 obtained by the Gay-Lussao~~

~~*method, but agrees well with the value 27 thousandths obtained by taking only the first and last observations with the thread of 5°. The disadvantage of the method lies in the great number of observa- tions required, and in the labour of adjusting so many different threads to suitable lengths. It is probable that sufficiently good results may be obtained with much less trouble by using fewer threads, especially if more care is taken m the miorometrio deter- mination of their errors.*~~

~~*The method adopted for dividing up the fundamental interval of any thermometer into sections and steps for calibration may be widely varied, and is necessarily modified in cases where auxili- ary bulbs or "ampoules" are employed. The Paris mercury- standards, which read continuously from 0° to 100° C, without intermediate ampoules, were calibrated by Chappuis in 'five sections of 20° each, to determine the corrections at the points 20°, 40°, 60°, 80°, which may be called the "prmcipal points" of the calibration, in terms of the fundamental interval. Each section of 20° was subsequently calibrated in steps of 2°, the cor- rections being at first referred, as in the example' already given, to the mean degree of the section itself, and being afterwards expressed, by a simple transformation, in terms of the funda- mental interval, by means of the corrections already found for the ends of the section. Supposing, for instance, that the corrections at the points 0° and 10° of Table III. are not zero, but C° and C respectively, the correction (?„ at any intermediate point n will evidently be given by the formula,*~~

~~*a.= O°-|-c„-|-(C"-O°)n/10 . . . (3) where c„ is the correction already given in the table.*~~

~~*If the corrections are required to the thousandth of a degree, it is necessary to tabulate the results of the calibration at much more frequent intervals than 2°, since the correction, even of a good thermometer, may change by as much as 20 or 30 thousandths in 2°. To save the labour and difficulty of calibrating with shorter threads, the corrections at intermediate points are usually calcu- lated by a formula of interpolation. This leaves much to be desired, as the section of a tube often changes very suddenly and capriciously. It is probable that the graphic method gives equally good results with less labour.*~~

Slide-Wire. — The calibration of an electrical slide-wire into parts of equal resistance is precisely analogous to that of a capillary tube into parts of equal volume. The Carey Foster method, employing short steps of equal resistance, effected by transferring a suitable small resistance from one side of the slide- wire to the other, is exactly analogous to the Gay-Lussac method, and suffers from the same defect of the accumulation of small errors unless steps of several different lengths are used. The calibration of a slide-wire, however, is much less troublesome than that of a thermometer tube for several reasons. It is easy to obtain a wire uniform to one part in 600 or even less, and the section is not liable to capricious variations. In all work of pre- cision the slide-wire is supplemented by auxiliary resistances by which the scale may be indefinitely extended. In accurate electrical thermometry, for example, the slide-wire itself would correspond to only 1°, or less, of the whole scale, which is less than a single step in the calibration of a mercury thermometer, so that an accuracy of a thousandth of a degree can generally be obtained without any calibration of the slide-wire. In the rare cases in which it is necessary to employ a long slide-wire, such as the cylinder potentiometer of Latimer Clark, the calibration is best efiected by comparison with a standard, such as a Thomson- Varley slide-box.

Graphic Representation of Besvlts. — The results of a calibration are often best represented by means of a cor- rection curve, such as that illustrated in the diagram, which is plotted to represent the corrections found in Table III. The abscissa of such a curve is the reading of the instru- ment to be corrected. The ordinate is the correction to be added to the observed reading to reduce to a uniform scale. The corrections are plotted in the figure in terms of the whole section, taking the correction to be zero at the beginning and end. As a matter of fact the corrections at these points in terms of the fundamental interval were found to be — 29 and — 9 thousandths respectively. The correction curve is transformed to give corrections in terms of the fundamental interval by ruling a straight line joining the points f 29 and + 9 respectively, and reckon ing the ordinates from this line instead of from the base-

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~~*3 * 6 6-7 a 9 la*~~

~~*line. Or the curve may be replotted with the new ordinates thus obtained. In drawing the curve from the corrections obtained at the points of calibration, the exact form of the curve is to some extent a matter of taste, but the curve should generally be drawn as smoothly as possible on the assumption that the changes are gradual and continuous.*~~

~~*The ruling of the straight line across the curve to express the corrections in terms of the fundamental interval, corresponds to the first part of the process of*~~

~~*so*~~

~~*4-0 30.*~~

~~*ZO*~~

~~*Calibration Cuevb.*~~

~~*calibration mentioned above under the term " Standardiza- tion." It effects the reduction of the readings to a common standard, and may be neglected if relative values only are required. A precisely analogous correction occurs in the case of electrical instruments. A potentiometer, for instance, if correctly graduated or calibrated in parts of equal resistance, will give correct relative values of any differences of potential within its range if connected to a constant cell to supply the steady current through the slide-wire. But to determine at any time the actual value of its readings in volts, it is necessary to standardize it, or determine its scale-value or reduction-factor, by com- parison with a standard cell.*~~

~~*A very neat use of the calibration curve has been made by Prof. Rogers in the automatic correction of screws of dividing machines or lathes. It is possible, by the process of grinding as applied by Rowland (see Ency. Brit. vol. xxi. pp. 552-3), to make a screw which is practically perfect in point of uniformity,- but even in this case errors may be introduced by the method of*~~

mounting. In the production of divided scales, and more particularly in the case of optical gratings, it is most important that the errors should be as small as possible, and should be automatically corrected during the process of ruling. With this object a scale is ruled on the machine, and the errors of the uncorrected screw are determined by calibrating the scale. A metal template may then be cut out in the form of the calibration- correction curve on a suitable scale. A lever projecting from the nut which feeds the carriage or the slide-rest is made to follow the contour of the template, and to apply the appropriate correc- tion at each point of the travel, by turning the nut through a small angle on the screw. A small periodic error of the screw, recurring regularly at each revolution, may be similarly corrected by means of a suitable cam or eccentric revolving with the screw and actuating the template. This kind of error is important in optical gratings, but is difl3.cult to determine and correct.

Calibration by Comparison with a Standard. — The commonest and most generally useful process of calibration is the direct comparison of the instrument with a standard over the whole range of its scale. It is necessary that the standard itself should have been already calibrated, or else that the law of its indications should be known. A con- tinuous current ammeter, for instance, can be calibrated, so far as the relative values of its readings are concerned, by comparison with a tangent galvanometer, since it is known that the current in this instrument is proportional to the tangent of the angle of deflexion. Similarly an alternating current ammeter can be calibrated by com-

parison with, an electro-dynamometer, the reading of which varies as the square of the current. But in either case it is necessary, in order to obtain the readings in amperes, to standardize the instrument for some particular value of the current by comparison with a voltameter, or in some equivalent manner. Whenever possible, ammeters and voltmeters are calibrated by comparison of their readings with those of a potentiometer, the calibration of which can be reduced to the comparison and adjustment of resistances, which is the most accurate of electrical measurements. The commoner kinds

~~of mercury ther- mometers are generally calibrated and graduated by comparison with a standard. In many cases this is the most convenient, or even the only possible method. A mercury thermometer of limited scale reading between 260° and 400° C, with gas under high pressure to prevent the separation of the mercury column, cannot be cali- brated on itself, or by comparison with a mercury standard possessing a fundamental interval, on account of difficul- ties of stem exposure and scale. The only practical method is to compare its readings every few degrees with those of a platinum thermometer under the conditions for which it is to be used. This method has the advantage of combining all the corrections for fundamental interval, &c., with the calibration correction in a single curve, except the correction for variation of zero which must be tested occasionally at some point of the scale.~~

~~Adthorities. — Mercurial Thermometers: Guillaume, Ther- mometrie de Precision, Paris, 1889, gives several examples and refereuces to original memoirs. The best examples of comparison and testing of standards are generally to be found in publications of Standards OfBces, such as those of the Bureau International des Poids et Mfesures at Paris. Dial Kesistance-Box : Ghipfiths, Phil. Trans. A, 1893. Platinum Thermometry Box: Harkee and Chappins, Phil. Trans. A, 1900. Thomson-Varley Potentiometer and Binary Scale Box : Callendar and Barnes, Phil. Trans. A, ► 1901. For general electrical methods, see text-books and articles Electric Current, &c. (h. L. C.)~~

~~Calicut, a city of British India, in the Malabar district of Madras ; on the coast, 6 miles N. of Beypur. In 1881 the population was 67,805 ; in 1891 it was 66,078 ; and in 1901 it was 75,610, showing an increase of 14 per cent. The municipal income in 1897-98 was Es.74,320. As the administrative headquarters of the district and the western terminus of the Madras railway, Calicut maintains its historical importance. It is now the chief seaport on the Malabar coast, with a lighthouse. In 1897-98 the number of vessels that entered and cleared for foreign trade was 30, with an aggregate of 23,016 tons. The principal exports are coffee, timber, and cocoa-nut products. There are factories for coffee-cleaning, em- ploying several hundred hands; for coir-pressing and timber-cutting; and also tile-works. The town has a cotton-mill, with 18,424 spindles, employing 500 hands ; an~~

~~*unaided native college, with 57 students in 1896-97 ; one missionary and two native high schools; six printing- presses, issuing two English and three vernacular news- papers; two reading-rooms and a club. A detachment of European troops is generally stationed here to overawe the fanatical Moplas.*~~

~~*California, the first and principal Pacific coast State of the American Union, second of all the States in size, with a gross area of 158,360 square miles (of which 155,980 square miles are land surface), and in 1900 twenty-first in poptdation. It is bounded on the N. by Oregon, on the E. by Nevada and Arizona, on the S. by Mexico, and on the W. by the Pacific.*~~

~~*Population. — The following table shows the population and rate of increase at each census since California was admitted to the Union : —*~~

~~*Census Tears.*~~

~~*Population.*~~

~~*Increase.*~~

~~*Number.*~~

~~*Per cent.*~~

~~*1850 1860 1870 1880 1890 1900*~~

~~*92,597*~~

~~*379,994*~~

~~*560,247*~~

~~*864,694*~~

~~*1,208,130*~~

~~*1,485,053*~~

~~287,397 180,253 304,447 343,436 276,923~~

~~310-3 47-4 54-3 40-3 22-4~~

~~In 1900, 1,117,813, or 76-3 per cent., were native-born, 367,240 foreign-born, as against 841,821 native-bom and 366,309 foreign-bom in 1890. The foreign-born include 46,753 Chinese (a f alling-off of 25,313 in the decade), and 10,151 Japanese. There were 15,377 Indians, 11,045 persons of 'Negro descent. Of the total population, 820,531 were males, 664,522 females, a gain of 35,979 more females than males in the decade. Density of population (1900), 9'6 per square mile. The death-rate in 1900, on the basis of the deaths reported to the U.S. census enumerators in that year, was about 15'1. Of the total population 43'7 per cent, was urban (i.e., resident in cities of more than 8000 inhabitants), which much exceeds the average of the United States. The chief cities and their population in 1900 were : —~~

~~City.~~

~~Population.~~

~~Increase since 1890.~~

~~San Francisco~~

~~342,782~~

~~43,785~~

~~Los Angeles .~~

~~102,479~~

~~52,084~~

~~Oakland (suburb of S.F.) Sacramento (State capital)~~

~~66,960~~

~~18,278~~

~~29,282~~

~~2,896~~

~~San Jos6~~

~~21,500~~

~~3,440~~

~~San Diego~~

~~17,700~~

~~1,541~~

~~Stockton~~

~~17,506~~

~~3,082~~

~~Alameda~~

~~16,464~~

~~5,299~~

~~Berkeley (seat State Univ.)~~

~~13,214~~

~~8,113~~

~~Fresno ....~~

~~12,470~~

~~1,662~~

There were (1900) 116 incorporated cities and towns, and 19 of them had populations of over 5000. Immense social and economic changes have taken place in California since 1876. Nearly all parts of the State have developed greatly, and particularly the seven counties south of the Tehachepi range, collectively and specifically known as "Southern California." The determining factor in the inequality of immigration was the first railway competi- tion in California. The completion of a new trans-continental line to Southern California in 1885, and a startling railway "rate- war" soon afterwards, precipi- tated an immigration which in numbers, in distance trav- elled, and in average wealth, was probably unparalleled iu history. In 1886 began an extraordinary " Land Boom " in Southern California, a wild speculation which was initiated almost entirely by the newcomers. The bubble burst in 1888, fortunately with little disaster, and sub- stantial development has since been continuous. The special attractiveness of orange-growing also had much to do with the disproportionate growth of the southern end of the State ; but development has extended over nearly the whole 900 miles of California north and south.

Education.— 'h^ 1890 the illiteracy of California was 7-7 per cent, as against 13-3 per cent, for the whole Union. The recent migration has probably reduced this illiteracy considerably, as it is almost wholly of educated people. In 1900, 6-2 per cent, of the total males of voting age, and 2-4 per cent, of the native-born males of votmg age, were unable to write. California has one college student to every 419 of total population. The State University (at Berkeley) had in 1900 resources of over $7,250,000 1895 undergraduates (exceeded only by Harvard University), 463 in- structors, and a toUl enrolment of 3226. Plans for a harmonious scheme of new buildings to cost $10,000,000 were won in a compe- tition open to the world by M. Benard of Paris. The university is liberally endowed by private benefactions, and is supported by a State tax of two cents on each $100 of valuation. The Leland Stanford Jr. University was founded by Governor

Stanford and tiis wife, and was opened in 1891. It has a total endowment of over $26,000,000, which is said to he the largest in the world. Its total

~~*enrolment is over 1500. Both universities are co-educational, and the female attendance is approximately one-third of the total. There were in 1900, 5 State noi-mal schools, 120 high schools, 7119 kindergarten, primary, and grammar schools, with a total of 7706 teachers, 272,352 enrolled scholars, and total value of school property $19,135,722. The total expenditure for public schools in 1900 was 16,195,000. According to the U.S. cen- sus of 1900, the number of persons of school age (5 to 20 years inclusive) was 420,081.*~~

~~*Charitable and Eeform Institutions. — California has two State prisons, two industrial reform schools, five asylums for the insane (with, in 1897, 4814 inmates, of whom 62 per cent, were of foreign birth), and a large number of public and private hospitals, asylums, orphanages, libraries, and associations and fraternities of all sorts. It is one of the few States in the Union which have an incorporated and active association to conserve historic land- marks.*~~

~~*Religion. — In 1890 the number of church edifices was 1505, with a seating capacity of 422,609 ; value of church property, nearly $12,000,000; number of communicants, 280,619. Of these, 156,846 were Uoman Catholics, about 37,000 Methodists, about 19,000 Presbyterians, and Baptists and Congregationalists between 11,000 and 12,000 each. The totals, however, greatly changed in the last decade of the 19th century.*~~

~~*Agriculture — For thirty years after the American occupation gold and silver mining was the only great industry. Agriculture came into prominence in wheat-raising on ranches of from 50,000 to several hundred thousand acres in extent. A few of these, par- ticularly in the Sacramento-San Joaquin valley, are still worked ; but the majority of the old Spanish land grants have been sub- divided into small farms, and the characteristic farming of Califor- nia is now diversified, intensive, and on holdings of 20 acres and less. Horticulture is now the leading industry, and along a line about 500 miles north and south. Deciduous fruits are raised on a large scale from Humboldt county south to the Mexican line ; the culture of citrus fruits preponderates in the five most southerly counties. Southern California is much more arid than the northern counties. Thousands of wells, artesian and other, have been sunk, and scores of horizontal tunnels driven. In 1899*~~

~~*alone, over 30,000 "Miners' inches," sufficient to irrigate 300,000 acres, were "devel- oped " in the seven southern counties. Some of the largest storage dams and irrigating canals in the world are in California. The principal agricultural products in 1900 were : —*~~

~~*Carloads.*~~

~~*Oranges and lemons .*~~

~~*. 18,400 .*~~

~~*$18,000,000*~~

~~*Fresh tree fruit*~~

~~*. 9,695 .*~~

~~*9,695,000*~~

~~*Walnuts .... Almonds ....*~~

~~*558 •(*~~

~~*232/-*~~

~~*1,098,000*~~

~~*Grapes " Raisins / '*~~

~~*. 5,578 .*~~

~~*3,578,400*~~

~~*Wines, sweet and dry*~~

~~*-*~~

~~*5,858,000*~~

~~*Brandies ....*~~

~~*2,214,428*~~

~~*Prunes, dried*~~

~~*‘. 5,711 ‘.*~~

~~*3,426,800*~~

~~*Other cured fruits*~~

~~*. 3,425 .*~~

~~*6,850,000*~~

~~*Canned fruits and vegetables*~~

~~*6,575,000*~~

~~*Olive oil ... .*~~

~~*1,170,871*~~

~~*Fresh vegetables shipped east*~~

~~*.’ 3,405*~~

~~*1,375,000*~~

~~*Hops ....*~~

~~*1,091,500*~~

~~*Beans ....*~~

~~*.’ 2,076 ‘.*~~

~~*1,660,600*~~

~~*Beet sugar ….*~~

~~*3,244,500*~~

~~*Honey ….*~~

~~*141*~~

~~*255,000*~~

~~*Wheat ….*~~

~~*21,000,000*~~

~~*Barley ….*~~

~~*8,460,000*~~

~~*Oats ….*~~

~~*1,020,000*~~

~~*Corn ….*~~

~~*1,080,000*~~

~~*Alfalfa and other hay Potatoes ….*~~

~~*24,444,891 1,105,815*~~

~~*Dairy products .*~~

~~*12,830,797*~~

~~*Wool ….*~~

~~…~~

~~*2,266,560*~~

~~*Total (not including many minor products) $138,301,162*~~

~~*or over $52,000,000 in excess of the greatest annual gold output. In 1875 these products, except grain, hay, and wool, were practi- cally nil, and the State led only in gold and sheep. Wheat produc- tion has increased little since 1880, barley has about doubled, hay nearly trebled, sheep have declined over 50 per cent., as lands have become more valuable under diversified farming. The largest single influence of recent growth has been the citrus industry. In 1862 there were 25,000 orange-trees, all seedlings. In 1873 two seedless orange-trees from Brazil were sent to Riverside from the Depart- ment of Agriculture, and from these two trees the modem industry has sprung. Millions of trees from their buds are now bearing a seedless orange known as the "Washington navel," which has*~~

~~*321,729 48,682 308,872 604,881 2,001,501 374,141*~~

~~*taken first rank in American markets, and is not grown " com- mercially " anywhere except in California. There are now (nearly all in the seven southern counties) 4,120,470 orange and 1,432.829 lemon trees planted, or 55,540 acres. The shipments for 1900 were 18,400 carloads, or 6,624,000 boxes, worth $18,000,000. The beauty of the groves, the fact that the crop is actually continuous (shipments being made every month in the year), and exceptional cases of fabulous profit (not infrequently up to $1000 per acre, which is at least four times the average for competent growers), made the orange almost as epidemic a fever as gold had been. By reason of the co-operative effort demanded for the large problems of irrigation, packing, and marketing, the orange has done far more for the permanent development of the State than gold or other mining ever did. Live stock numbered in 1900 :*~~

~~*Horses ....*~~

~~*Mules . . . '.*~~

~~*Milch cows*~~

~~*Other cattle*~~

~~*Sheep ....*~~

~~*Swine (1899) . Mineral Products. — California is the second State in the Union in production of gold, having been exceeded in recent years by Colorado. It has, however, produced in gold since 1848 (to 1st January 1900) $1,409,849,068 — or more than all the rest of North America since 1492. California's capital and enterprise also developed the silver "Bonanzas" of Nevada, which produced over $300,000,000 in twenty years. It produces about two-fifths of the quicksilver of the world. Since 1895 it has become a great producer of crude petroleum, and in 1900 ranked as fourth in America. Seventeen counties, in a line over 600 miles north and south, produce oil ; in July 1900 there were 1590 producing wells and 470 prospect wells, and these figures were increasing daily. The production more than doubled in five years, and in 1899 was 2,677,875 barrels. The high cost of coal makes this oil de- posit of peculiar value. Crude oil is already generally used for fuel in manufactures and even on railway locomotives. The total mineral output of the State for 1899 was : —*~~

~~*Gold*~~

~~*Copper ....*~~

~~*Petroleum .*~~

~~*Quicksilver ....*~~

~~*Borax ....*~~

~~*Lime, limestone, cement .*~~

~~*Silver*~~

~~*Asphalt and bituminous rock*~~

~~*Coal*~~

~~*Mineral waters .*~~

~~*Soda*~~

~~*Salt*~~

~~*Other mineral products*~~

~~*$15,336,031*~~

~~*3,990,534*~~

~~*2,660,793*~~

~~*1,405,045*~~

~~*1,139,882*~~

~~*523,760*~~

~~*504,012*~~

~~*424,227*~~

~~*420,109*~~

~~*406,691*~~

~~*250,000*~~

~~*149,588*~~

~~*2,102,788*~~

~~*Total . . $29,313,460 Gold production since 1875 has averaged from fifteen to sixteen millions a year. The total mineral output is now about 35 per cent, greater than it was in 1875.*~~

~~*Lumber Products. — California is one of the leading States in lumber products. Its sequoia, redwood, pine, and fir forests are the densest in "merchantable lumber" in the world. The red- woods cover about 2000 square miles. There is now a strong movement in favour of preserving the redwood forests and the groves of Big Trees (Sequoia gigantea). A Bill to*~~

~~purchase and protect one of the largest and noblest redwood forests, that of the Big Basin, has become a State law. The average annual lumber cut is as follows: redwood, 272,283,000 feet B.M. ; yellow pine, 211,115,000 do. ; sugar pine, 50,736,000 do. ; spruce, 21,963,000 do.; fir, 20,508,000 do. ; cedar, 4,882,000 do. ; with a total value of~~

~~$14,537,000.~~

~~Transportation. — ^The mileage of railroads was (1900) 5532 miles ; ten times as great as in 1876. This is practically all in the hands of the Southern Pacific railway (controlled by the Union Pacific) and the Atchison, Topeka, and Santa F6 railway, each having a transcontinental system of over 7000 miles. The long, narrow State is traversed longitudinally by their trunk lines (three running from Los Angeles to San Francisco, about 500 miles), with numerous feeders, particularly in the southern counties. There are also many lines of steamships. The principal port is San Francisco, with its magnificent harbour. San Diego, San Pedro, Port Los Angeles, and Eureka have fair harbours and con- siderable commerce. The commerce of San Francisco amounts to between eighty and ninety million dollars annually, about equally divided between exports and imports.~~

~~Manufactures. — Manufactures have greatly increased since the census of 1890. In this year there were 7923 establishments, with $146,797,102 capital ; 83,642 employees, whose aggregate annual wages were $51,538,780 ; total value of products, $213,403,996.~~

~~Perhaps the most important single development has been the rise of great shipyards. ‘ The Oregon and several other first-class vessels for the U.S. navy were built in San Francisco. California ■was in 1900 the leading State in the production of beet sugar ; it had $10,139,780 invested in this manufacture as against $20,958,619 for the whole U.S., and yielded a little over one-half the total U.S. product.~~

~~*Finances. — In 1900 the assessed valuation of real estate was $669,905,988 ; of improvements, $272,447,321 ; of personal pro- perty, $184,380,015. The total assessed valuation had more than doubled in twenty years. In 1880 it was $584,578,036, and in 1900 it was $1,218,292,457. In 1901 it was $1,241,705,803. The re- turns from agriculture by the census of 1890 were $72 per caput. The State has a nominal bonded debt of about two and a half millions, but owns the bonds. The total of county indebted- ness was in 1901 $3,333,233. The total receipts in 1900 were $11,148,204 ; total disbursements, $9,518,608.*~~

~~*Banking.— The banks on 31st August 1898 were as follows : —*~~

~~*Banks.*~~

~~*No.*~~

~~*Capital paid up.*~~

~~*Kesources. 1*~~

~~*National*~~

~~*Commercial .*~~

~~*Savings*~~

~~*Private ....*~~

~~*Total .*~~

~~*34*~~

~~*172*~~

~~*55*~~

~~*23*~~

~~*$10,825,000*~~

~~31,139,300~~

~~7,941,930~~

~~964,026~~

~~$50,660,651~~

~~125,354,783~~

~~52,123,716~~

~~2,753,385~~

~~284~~

~~$50,870,256~~

~~$230,892,535~~

~~California has the largest savings bank deposits per caput. On 31st December 1898 there were in California $637.75 per depositor, as against $392.13 for the U.S., and $507.29 for Rhode Island, the next highest State. The California depositors numbered 209,908, or nearly one in every seven of the entire population, Chinese and Indians included. The State was exceeded in 1890 only by Massachusetts and Rhode Island in assessed valuation per caput.~~

~~Political. — State politics have improved with the new immi- gration. A symptom probably of political health is the peculiar independence of Californian voters. In State elections since the Civil War, California went Democratic in 1867, 1875, 1882, 1886 (Democratic Governor and Republican Lieut. -Governor, who became Governor by his superior's death), and 1894. It went Republican in 1871, 1879, 1890, and 1898. The leading features of legislation since 1876 have been the struggle for exclusion of the Chinese, " Anti-Debris," and irrigation laws, and an elaborate system for the inspection and fumigation of fruit-trees, and the importation of predatory insects to destroy "insect pests." The Anti-Chinese agitation, though finally national in its scope, was initiated and chiefly~~

~~*carried on in California, as a majority of the Chinese in the United States were in this one State. In 1879 California voted against further immigration of Mongolians by 154,638 to 883. Exclusion has not been an unmixed blessing ; but the conviction prevailed that a very large element of popula- tion, non-citizen and non-assimilable, sending most of its earnings out of the country, living meanly at best, and practically without wives, children, or homes, was socially and economically a menace that far outweighed the undoubted convenience of cheaper (and frequently more trustworthy) menial labour than the native population afforded. The exclusion was a serious factor in making the huge single-crop ranches unprofitable, and in leading to their replacement by small farms tilled and dwelt upon by American families. There are now about 45,000 Chinese in the State, many of them wealthy, and raoe-feeling against them has practically disappeared. For many years the mining interests were supreme, and agriculture, long after it assumed large pro- portions, was invariably worsted when the two clashed. The great conflicts were over water rights and hydraulic mining. In 1880 engineers' measurements showed that in the Yuba river alone over 100,000,000 cubic yards of gravel had been washed by the hydraulics into the bed of the stream, raising it in places over 70 feet above its normal level, and burying over 15,000 acres of choicest farming lands under the detritus. In 1884 the long and bitter " Anti-D6bris " or " Anti-Slickens " fight ended in favour of the farmers. Local Option laws are in force, and a con- siderable proportion of the towns and smaller cities, particularly in the southern part of the State, adopt "prohibition." Inmost of the rest " high license " is rather strictly enforced. The Aus- tralian ballot was introduced in 1891. (c. f. l.)*~~

~~*California, Lower, a territory of the Mexican Eepublic, bounded on the N. by the United States, on the E. by the Gulf of California, and on the W. and S. by the Pacific. Its area covers 68,345 square miles. The population in 1879 was 30,208, and in 1895 it numbered 42,243. The coast-line measures 1860 miles.*~~

~~*and is bordered by numerous islands. Though the coun- try is sterile, some portions of the peninsula have natural products of value, principally orchil or Spanish moss, used for dyeing purposes. Henequen is also found in the interior and hemp in the north. Sugar-cane and tropical fruits are*~~

~~*successfully cultivated in the humid interior, as are also, to a limited extent, cereals, cotton, tobacco, &c. The principal mineral products are gold, silver, copper, lead, gypsum, and coal. There are no manufactures of any importance. The territory is divided into two dis- tricts, the Northern (pop. 7452) and the Southern (pop. 34,791). The capital of the former is La Paz (4737 inhabitants), and of the latter Ensenada de Todos Santos (1259 inhabitants). The principal towns are Santa Eosar lia, Santiago, San Antonio, and San Jos6.*~~

~~*Callander, a police burgh of Perthshire, Scotland, situated on the river Teith, and on the Caledonian rail- way, 15|- miles N.W. of Stirling. There are Established, United Free, and Episcopalian churches. The town owes its prosperity to its proximity to the Trossachs, and its general importance as a tourist centre, the sur- rounding country being renowned for the beauty of its lake, river, mountain, and woodland scenery. Within 2 miles to the N.E. are the Ealls of Bracklinn. It pos- sesses several large hotels and a hydropathic, and within recent years many villa residences have been erected. The population of the police burgh in 1891 was 1538, and in 1901 it was 1458. By way of the Pass of Leny, which begins or ends here, Callander practically forms the " gate of the Highlands." Erom here, too, the ascent of Ben Ledi is commonly made.*~~

~~*Callao, a coast department of central Peru, a littoral province, embracing only the city of Callao, with a popu- lation (1898) of 48,118. The port of Callao is the most important in Peru. In 1895 there entered 1376 merchant vessels, with a total tonnage of 563,160 tons ; in 1896, 1485 vessels of 604,257 tons; and in 1898, 1255 of 591,685 tons, of which 201 were British, with a tonnage of 293,342 tons. In 1895 the receipts of the Callao Cus- tom House were £211,763.*~~

~~*Caimar, a seaport town of Sweden, on the E. coast, 184 miles by rail N.E. from Malmo, vid Alfvesta on the Malmo-Stockholm railway. The industries embrace steam flour-mills, tobacco and match factories, and shipbuilding yards. There is an export trade in timber (£157,160 in 1898), oats, and matches; and import trade in cereals and flour (£100,000 to £200,000 a year), coffee, coal, manure, hides, petroleum, fish, tobacco, and sugar ; the total exports amounting to £184,760 in 1898, and the total imports to*~~

~~£293,600. The harbour, which in 1899- 1900 was deepened to admit vessels drawing 19 feet, is cleared by some 900 vessels of 180,000 tons annually. Population (1880), 10,963 ; (1898), 12,582.~~

~~Calne, municipal borough and railway station, in the Chippenham parliamentary division (since 1885) of Wilt- shire, England, 18 miles E. by N. of Bath. A hospital for infectious diseases has been erected and a public recreation ground opened. Area of borough (extended in 1889), 356 acres ; population on this in 1901, 3456. In 1889 the borough was constituted as the separate civil parish of Calne Within, the remainder of the ancient parish being called Calne Without.~~

~~Calorimetry signifies the measurement of quantities of heat, and must be distinguished from thermometry, which signifies the measurement of temperature. A calori- meter is any piece of apparatus in which heat is measured. This distinction of meanings is purely a matter of conven- tion, but is very rigidly observed. Quantities of heat may be measured indirectly in a variety of ways in terms of~~

~~the different effects of heat on material substances. The most important of these effects are, (a) rise of temperature, (6) change of state, (c) transformation of energy.~~

~~§ 1. The rise of temperature of a body, when heat is imparted to it, is found to be in general nearly proportional to the quantity of heat added. The thermal capacity of a body is measured by the quantity of heat required to raise its temperature one degree, and is necessarily proportional to the mass of the body for bodies of the same substance under similar conditions. The specific heat of a substance is some- tim es defined as the thermal capacity of unit mass, but more often as the ratio of the thermal capacity of unit mass of the substance to that of unit mass of water at some standard temperature. The two definitions are identical, provided that the thermal capacity of unit mass of water, at a standard temperature, is taken as the unit of heat. But the specific heat of water is often stated in terms of other~~

~~*units. In any case, it is necessary to specify the tempera- ture, and sometimes also the pressure, since the specific heat of a substance generally depends to some extent on the ex- ternal conditions. The methods of measurement, founded on rise of temperature, may be classed as thermometric methods, since they depend on the observation of change of temperature with a thermometer. The most familiar of these are the method of mixture and the method of cooling.*~~

~~*§ 2. The Method of Mixture consists in imparting the quantity of heat to be measured to a known mass of water, or some other standard substance, contained in a vessel or calorimeter of known thermal capacity, and in observing the rise of temperature pro- duced, from which data the quantity of heat may be found as explained in all elementary text-books. This method is the most generally convenient and most readily applicable of calorimetrio methods, but it is not always the most accurate, for various reasons. Some heat is generally lost in transferring the heated body to the calorimeter ; this loss may be minimized by perform- ing the transference rapidly, but it cannot be accurately calculated or eliminated. Some heat is lost when the calorimeter is raised above the temperature of its enclosure, and before the final temperature is reached. This can be roughly estimated by observing the rate of change of temperature before and after the experiment, and assuming that the loss of heat is directly pro- portional to the duration of the experiment and to the average excess of temperature: It can be minimized by making the mixing as rapid as po.ssible, and by using a large calorimeter, so that the excess of temperature is always small. The latter method was generally adopted by Joule, but the rise of temper- ature is then difficult to measure with accuracy, since it is necessarily reduced in nearly the same proportion as the correc- tion. There is, however, the advantage that the correction is rendered much less uncertain by this procedure, since the assump- tion that the loss of heat is proportional to the temperature- excess is only true for small differences of temperature. Rumf ord proposed to eliminate this correction by starting with the initial temperature of the calorimeter as much below that of its enclosure as the final temperature was expected to be above the same limit. This method has been very generally recommended, but it is really bad, because, although it diminishes the absolute magni- tude of the correction, it greatly increases the uncertainty of it, and therefore the probable error of the result. The*~~

~~*coefficient of heating of a calorimeter when it is below the temperature of its surroundings is seldom, if ever, the same as the coefficient of cooling at the higher temperature, since the convection currents, which do most of the heating or cooling, are rarely symmetrical in the two cases, and moreover, the duration of the two stages is seldom the same. In any case, it is desirable to diminish the loss of heat as much as possible by polishing the exterior of the calorimeter to diminish radiation, and by suspending it by non- conducting supports, inside a polished case, to protect it from draughts. It is also very important to keep the surrounding conditions as constant as possible throughout the experiment. This may be secured by using a large water-bath to surround the apparatus, but in experiments of long duration it is necessary to use an accurate temperature regulator. The method of lag- ging the calorimeter with cotton-wool, or other non-conductors, which is often recommended, diminishes the loss of heat considerably, but renders it very uncertain and variable, and should never be used in work of precision. The bad conductors take so long to reach a steady state that the rate of loss of heat at any moment depends on the past history more than on the tempera- ture of the calorimeter at the moment. A more serious objection*~~

~~*to the use of lagging of this kind is the danger of its absorbing moisture. The least trace of damp in the lagging, or of moisture ‘ condensed on the surface of the calorimeter, may produce serious loss of heat by evaporation. This is another objection to Rum- ford’s method of cooling the calorimeter below the surrounding temperature before starting. Among minor difficulties of the method may be mentioned the uncertainty of the thermal capacity of the calorimeter and stirrer, and of the immersed por- tion of the thermometer. This is generally calculated by assuming values for the specific heats of the materials obtained by experi- ment between 100° C. and 20° C. Since the specific heats of most metals increase rapidly with rise of temperature, the values so obtained are generally too high. It is best to make this correction as small as possible by using a large calorimeter, so that the mass of water is large in proportion to that of metal. Analogous difficulties arise in the application of other calorimetric methods. The accuracy of the work in each case depends prin- cipally on the skill and ingenuity of the experimentalist in devis- ing methods of eliminating the various sources of error.*~~

~~§ 3. Method of Cooling. — A common example of this method is the determination of the specific heat of a liquid by filling a small calorimeter with the liquid, raising it to a convenient temperature, and then setting it to cool in an enclosure at a steady temperature, and observing the time taken to fall through a given range when the conditions have become fairly steady. The same calorimeter is afterwards filled with a known liquid, such as water, and the time of cooling is observed through the same range of temperature, in the same enclosure, under the same conditions. The ratio of the times of cooling is equal to the ratio of the thermal capacities of the calorimeter and its contents in the two cases. The advantage of the method is that there is no transference or mixture ; the defect is that the whole measure- ment depends on the assumption that the rate of loss of heat is the same in the two cases, and that any variation in the con- ditions, <}T uncertainty in the rate of loss, produces its full effect in the result, whereas in the previous case it would only affect a small correction. Other sources of uncertainty are, that the rate of loss of heat generally depends to some extent on the rate of fall of temperature, and that it is difficult to take accurate observations on a rapidly falling thermometer. As the method is usually practised, the calorimeter is made very small, and the surface is highly polished to diminish radiation. It is bette^ to use a fairly large calorimeter to diminish the rate of cooling and the uncertainty of the correction for the water equivalent. The surface of the calorimeter and the enclosure should be perma- nently blackened so as to increase the loss of heat by radiation as much as possible as compared with the losses by convection and con- duction, which are less regular. For accurate work it is essential that the liquid in the calorimeter should be continuously stirred, and also in the enclosure, the lid of which must be water-jacketed, and kept at the same steady temperature as the sides. When all these precautions are taken, the method loses most of the sim- plicity which is its chief advantage. It cannot be satisfactorily applied to the case of solids or powders, and is much less generally useful than the method of mixture.~~

~~§ 4. Method of Fusion. — The methods depending on change of state are theoretically the simplest, since they do not necessarily involve any reference to thermometry, and the corrections for external loss of heat and for the thermal capacity of the con- taining vessel can be completely eliminated. They nevertheless present peculiar difficulties and limitations,~~

which render their practical appUcation more troublesome and more uncertain than is usually supposed. They depend on the experimental fact that the quantity of heat required to produce a given change of state (e.g., to convert one gramme of ice atO° C. into water at 0° C, or one gramme of water at 100° C. into steam at 100° C.) is always the same, and that there need be no change of temperature during the process. The difficulties arise in connexion with the deter- mination of the quantities of ice melted or steam condensed, and in measuring the latent heat of fusion or vaporization in terms of other units for the comparison of observations. The earlier forms of ice-calorimeter, those of Black, and of Laplace and Lavoisier, were useless for work of precision, on account of the impossibility of accurately estimating the quantity of water left adhering to the ice in each case. This difficulty was overcome by the inven- tion of the Bunsen calorimeter, in which the quantity of ice melted is measured by observing the diminution of volume, but the successful employment of this instrument requires consider- able skill in manipulation. The sheath of ice surrounding the bulb must be sufficiently continuous to prevent escape of heat, but it must not be so solid as to produce risk of strain. The ideal condition is difficult to secure. In the practical use of the instrument it is not necessary to know both the latent heat of fusion of ice and the change of volume which occurs on melting ; it is sufficient to determine the change of volume per calorie, or the quantity of mercury which is drawn into the bulb of the

apparatus per unit of heat added. This can be determined by a direct calibration, by inserting a known quantity of water at a known temperature, and observing the contraction, or weighing the mercury drawn into the apparatus. In order to be independent of the accuracy of the thermometer employed for observing the initial temperature of the water introduced, it has been usual to employ water at 100° C, adopting as unit of heat the "mean calorie," which is one-hundredth part of the heat given up by one gramme of water in cooling from 100° to 0° C. The weight of mer- cury corresponding to the mean calorie has been determined with considerable

~~*care by a number of observers well skilled in the use of the instrument. The following are some of their results -.^ — Bunsen, 15-41 mgm. ; Velten, 15-47 mgm. ; Zakrevski, 15-57 mgm. ; Staub, 15-26 mgm. The explanation of these discrepancies in the fundamental constant is not at aU clear, but they may be taken as an illustration of the difficulties of manipulation attending the use of this instrument, to which reference has already been made. It is not possible to deduce a more satisfactory value from the latent heat and the change of density, because these constants are very difficult to determine. The following are some of the values deduced by well-known experimentalists for the latent heat of fusion: — Regnault, 79-06 to 79-24 calories, corrected by Person to 79-43 ; Person, 79 99 calories ; Hess, 80-34 calories ; Bunsen, 80-025 calories. Regnault, Person, and Hess employed the method of mixture, which is probably the most accurate for the purpose. Person and Hess avoided the error of water sticking to the ice by using dry ice at various temperatures below 0° C, and determining the specific heat of ice as well as the latent heat of fusion. These discrepancies might, no doubt, be partly explained by differences in the units employed, which are somewhat uncertain, as the specific heat of water changes rapidly in the neighbourhood of 0° C. ; but making aU due allowance for this, it remains evident that the method of ice-calorimetry, in spite of its theoretical sim- plicity, presents grave difficulties in its practical application.*~~

~~*§ 5. The Method of Condensation was first successfully applied by Joly in the construction of his steam calorimeter, a full descrip- tion of which will be found in several recent text-books. The body to be tested is placed in a special scale-pan, suspended by a fine wire from the arm of a balance inside an enclosure which can be filled with steam at atmospheric pressure. The temperature of the enclosure is carefully observed before admitting steam. The weight of steam condensed on the body gives a means of calculat- ing the quantity of heat required to raise it from the atmospheric temperature up to 100° C. in terms of the latent heat of vaporiza- tion of steam at 100° C. There can be no appreciable gain or loss of heat by radiation, if the admission of the steam is sufficiently rapid, since the walls of the enclosure are maintained at 100° C. , very nearly. The thermal capacity of the scale-pan, &c. , can be determined by a separate experiment, or, still better, eliminated by the differential method of*~~

~~*counterpoising with an exactly similar arrangement on the other arm of the balance. The method requires very delicate weighing, as one calorie corresponds to less than two milligrammes of steam condensed ; but the successful application of the method to the very difficult problem of measuring the specific heat of a gas at constant volume, shows that these and other difficulties have been very skilfully overcome. The application of the method appears to be practically limited to the measurements of specific heat between the atmospheric temperature and 100° C. The results depend on the value assumed for the latent heat of steam, which Joly takes as 536-7 calories, following Regnault. Joly has himself determined the mean specific heat of water between 12° and 100° C. by this method, in terms of the latent heat of steam as above given, and finds the result -9952. Assuming that the mean specific heat of water between 12° and 100° is really 1-0011 in terms of the calorie at 20° C. (see table below), the value of the latent heat of steam at 100° C, as determined by Joly, would be 540-2 in terms of the same unit. The calorie employed by Regnault is to some extent uncertain, but the difference is hardly beyond the probable errors of experiment, since it appears from the results of recent experiments that Regnault made an error of the same order in his determination of the specific heat of water at 100° C.*~~

~~*§ 6. Energy Methods. — The third general method of calorimetry, that based on the transformation of some other kind of energy into the form of heat, rests on the general principle of the conservation of energy, and on the experimental fact that all other forms of energy are readily and completely convertible into the form of heat. It is therefore often possible to measure quantities of heat indirectly, by measuring the energy in some other form and then converting it into heat. In addition to its great theoretical interest, this method possesses the advantage of being frequently the most accurate in prac-*~~

~~*tical application, since energy can be more accurately measured in other forms than in that of heat. The two most important varieties of the method are (a) mechan- ical and (6) electrical. These methods have reached their highest development in connexion with the deter- mination of the mechanical equivalent of heat, but they may be applied with great advantage in connexion with other problems, such as the measurement of*~~

~~*the variation of specific heat, or of latent heats of fusion or vaporization. § 7. Mechanical Equivalent of Heat. — The phrase " mechanical equivalent of heat " is somewhat vague, but has been sanctioned by long usage. It is generally em- ployed to denote the number of units of mechanical work or energy which, when completely converted into heat without loss, would be required to produce one heat unit. The numerical value of the mechanical equivalent neces- sarily depends on the particular units of heat and work employed in the comparison. The British engineer pre- fers to state results in terms of foot-pounds of work in any convenient latitude per pound-degree-Fahrenheit of heat. The Continental engineer prefers kilogrammetres per kilogramme-degree-Centigrade. For scientific use the C.G.S. system of expression in ergs per gramme-degree- Centigrade, or " calorie," is the most appropriate, as being independent of the value of gravity. A more convenient unit of work or energy, in practice, on account of the smallness of the erg, is the joule, which is equal to 10' ergs, or one watt-second of electrical energy. On account of its practical convenience, and its close relation to the international electrical units, the jovie has been recom- mended by the British Association for adoption as the absolute unit of heat. Other convenient practical units of the same kind would be the watt-hour, 3600 joules, which is of the same order of magnitude as the kilo-calorie, and the Mlowatt-hour, which is the ordinary commercial unit of electrical energy.*~~

~~*§ 8. Joule. — ^The earlier work of Joule is now chiefiy of historical interest, but his later measurements in 1878, which were under- taken on a larger scale, adopting Hirn's method of measuring the work expended in terms of the torque and the number of revo- lutions, still possess value as experimental evidence. In these experiments the paddles were revolved by hand at such a speed as to produce a constant torque on the calorimeter, which was supported so as to be free to turn, but was kept at rest by the couple due to a pair of equal weights suspended from fine strings passing round the circumference of a horizontal wheel attached to the calorimeter. Each experiment lasted about forty minutes, and the rise of temperature produced was nearly 3° C. The calorimeter contained about 5 kilogrammes of water, so that the rate of heat- supply was about 6 calories per second. Joule's final result was 772-55 foot-pounds at Manchester per pound-degree-Fahrenheit at a temperature of 62°!".*~~, ~~*but individual experiments*~~

~~differed by as much as 1 per cent. This result in C.G.S. measure is equivalent to 4-177 joules per calorie at 16-5° C, on the scale of Joule's mercury thermometer. HIs thermometers were subsequently corrected to the Paris scale by Schuster in 1895, which had the effect of reduc- ing the above figure to 4-173.~~

~~§ 9. Bowland. — About the same time Rowland (Proc. Amer. Acad. XV. p. 75, 1880) repeated the experiment, employing the same method, but vising a larger calorimeter (about 8400 grammes) and a petroleum motor, so as to obtain a greater rate of heating (about 84 calories per second), and to reduce the importance of the uncertain correction for external loss of heat. He also paid greater attention to the important question of thermometry, and extended his researches over a much wider range of temperature, namely 6° to 35° C. HIs experiments revealed for the first time a diminution in the specific heat of water with rise of temperature between 0° and 30° C, amounting to four parts in 10,000 per 1°C. HIs ther- mometers have been recently compared with a mercury thermo- meter standardized in Paris, and with a platinum thermometer standardized by Griffiths. The result, has been to reduce the coeffi- cient of diminution of specific heat at 15° C. by nearly one half, but the absolute value at 20° C. is practically unchanged. Thus corrected his values are as follows : —~~

~~Temperature . 10° 16° 20° 25° 30° 36° Joules per cal. . 4-197 4-188 4-181 4-176 4-175 4-177~~

~~These are expressed in terms of the hydrogen scale, but the~~

~~difference from the nitrogen scale is so small as to be within the limits of experimental error in this particular case. Rowland himself considered his results to be probably correct to one part in 500, and that the greatest uncertainty lay in the comparison of the scale of his mercuiy thermometer with the air thermometer. The subsequent correction, though not carried out strictly under the conditions of the experiment, has shown that the order of accuracy of his work about the middle of the range from 15° to 25° was at~~

~~least 1 in 1000, and probably 1 in 2000. At 30° he considered that, owing to the increasing magnitude and un- certainty of the radiation correction, there "might be a small error in the direction of making the equivalent too great, and~~

~~Kg. 1.~~

~~that the specific heat might go on decreasing to even 40° C." The results considered with reference to the variation of the specific heat of water are shown in the curve marked Rowland in Pig. 1.~~

~~§ 10. BeynoUs and Moorhy {Phil. Trans. 1897, p. 381) have determined the mechanical equivalent of the mean thermal unit between 0° and 100° C, on a very large scale, with a Froude- Reynolds hydraulic brake and a steam-engine of 100 h.p. This brake is practically a Joule calorimeter, ingeniously designed to churn the water in such a manner as to develop the greatest possible resistance. The admission of water at 0° C. to the brake was controlled by hand in such a manner as to keep the outflow nearly at the boiling-point, the quantity of water in the brake required to produce a constant torque being regulated automatic- ally, as the speed varied, by a valve worked by the lifting of the weighted lever attached to the brake. With 300 pounds on a four-foot lever at 800 revolutions per minute, the rate of generation of heat was about 12 kilo-calories per second. In spite of the large range of temperature, the correction for external loss of heat amounted to only 5 per cent, with the brake uncovered, and was reduced to less than 2 per cent, by lagging._ This is the special advantage of working on so large a scale with so rapid a generation of heat. But, for the same reason, the method neces- sarily presents peculiar difficulties, which were not overcome without great pains aftd ingenuity. The principal troubles arose from damp in the lagging, which necessitated the rejection of several trials, and from dissolved air in the water, causing loss of heat by the formation of steam. Next to the radiation loss, the most uncertain correction was that for conduction of heat along the 4-inch shaft. These losses were as far as possible eliminated by combining the trials in pairs, with different loads on the brake, assuming that the heat-loss would be the same in the heavy and light trials, provided that the external temperature and the gradient in the shaft, as estimated from the temperature of the bearings,~~

~~were the same. The values deduced ia this manner for the equivalent agreed as closely as could be expected considering the impossibility of regulating the external condition of temperature and moisture with any certainty in an engine- room. The extreme variation of results in any one series was only from 776 'BS to 779-46 foot-pounds, or less than iper cent. This variation may have been due to the state of the lagging, which Moorby distrusted in spite of the great reduction of the heat-loss, or it may have been partly due to the difficulty of regu- lating the speed of the engine and the water-supply to the brake in such a manner as to maintain a constant temperature in the outflow, and avoid variations in the heat capacity of the brake. Since hand regulation is necessarily discontinuous, the speed and the temperature were constantly varying, so that it was useless to take readings nearer than the tenth of a degree. The largest varia- tion recorded in the two trials of which full details are given, was 4-9° r. in two minutes in the outflow temperature, and four or~~

~~five revolutions per minute on the speed. These variations, so far as they were of a purely accidental nature, would be approxi- mately eliminated on the mean of a large number of trials, so that the accuracy of the final result would be of a higher order than might be inferred from a comparison of separate pairs of trials. Great pains were taken to discuss and eliminate all the sources of constant error which could be foreseen. The results of the light trials with 400 foot-pounds on the brake differ slightly from those with 600 foot-pounds. This might be merely acci- dental, or it might indicate some constant difference in the con- ditions requiring further investigation. It would have been desirable, if possible, to have tried the effect of a larger range of variation in the experimental conditions of load and speed, with a view to detect the existence of constant errors ; but owing to the limitations im- posed by the use of a steam-engine, and the difficulty of securing steady conditions of run- ning, this proved to be impossible. There can be no doubt, however, that the final result is the most accurate direct determination of the value of the mean calorie between 0° and 100° C. in mechanical units. Expressed in joules per calorie the result is 4-1832, which agrees very closely with the value found by Rowland as the mean over the range 15° to 20° C. The value 4-183 is independently confirmed in a remark- able manner by the results of the electrical method described~~

~~*below, which give 4-185 joules for the mean calorie, if Rowland's value is assumed as the starting-point, and taken to be 4-180 joules at 20° C.*~~

~~*§ 11. Electrical Methods. — The value of the international electrical units has by this time been so accurately deter- mined in absolute measure that they afford a very good, though indirect, method of determining the mechanical equivalent of heat. But, quite apart from this, electrical methods possess the greatest value for calorimetry, on account of the facility and accuracy of regulating and measuring the quantity of heat supplied by an electric current. The frictional generation of heat in a metallic wire conveying a current can be measured in various ways, which correspond to slightly different methods. By Ohm's law, and by the definition of difference of electric pressure or potential, we obtain the following alternative expres- sions for the quantity of heat H in joules generated in a time T seconds by a current of C amperes flowing in a wire of resistance B ohms, the difference of potential between the ends of the wire being E= CB volts : —*~~

~~*H=EGT=GmT=E'T/B . . (1).*~~

~~*The method corresponding to the expression (722 T was adopted by Joule and by most of the early experimen- talists. The defects of the earlier work from an electrical point of view lay chiefly in the difficulty of measuring the current with sufficient accuracy owing to the imperfect development of the science of electrical measurement. These difficulties have been removed by the great advances since 1880, and in particular by the introduction of accu- rate standard cells for measurements of electrical pressure.*~~

~~*§ 12. Griffiths.— The method adopted by Griffiths {Phil. Trans. 1893, p. 361), whose work threw a great deal of light on the failure of previous observers to secure consistent results, corre- sponded to the last expression E^T/B, and consisted in regulating the current by a special rheostat, so as to keep the potential difference E on the terminals of the resistance B balanced against a given number of standard Clark cells of the Board of Trade pattern. The resistance B could be deduced from a knowledge of the temperature of the calorimeter and the coefficient of the wire. But in order to obtain trustworthy results by this method he found it necessary to employ very rapid stirring (2000 revolutions per minute), and to insulate the wire very carefully from the liquid to prevent leakage of the current. He also*~~

~~*made a special experi- ment to find how much the temperature of the wire exceeded that of the liquid under the conditions of the experiment. This cor- rection had been neglected by previous observers employing similar methods. The resistance B was about 9 ohms, and the potential difference E was varied from three to six Clark cells,*~~

~~*giving a rate of heat-supply about 2 to 6 watts. The water equi- valent of the calorimeter was about 85 grammes, and was deter- mined by vai-ying the quantity of water from 140 to 260 or 280 grammes, so that the final results depended on a difference in the weight of water of 120 to 140 grammes. The range of temperature in each experiment was 14° to 26° C. The rate of rise was observed with a mercury thermometer standardized by comparison with a platinum thermometer under the conditions of the experiment. The time of passing each division was recorded on an electric chronograph. The duration of an experiment varied from about 30 to 70 minutes. Special observations were made to determine the corrections for the heat supplied by stirring, and that lost by radiation, each of which amounted to about 10 per cent, of the heat-supply. The calorimeter was gilded, and completely surrounded by a nickel-plated steel enclosure, forming the bulb of a mercury thermo-regulator, immersed in a large water-bath, maintained at a constant temperature. In spite of the large corrections the results were extremely consistent, and the value of the temperature-coeflScient of the diminution of the specific heat of water, deduced from the observed variation in the rate of rise at different points of the range 15° to 25°, agreed with the value subsequently deduced from Rowland's experiments over the same range, when his thermometers were reduced to the same scale. Griffiths' final result for the average value of the calorie over this range was 4-192 joules, taking the E.MjF. of the Clark cell at 15° C. to be 1 -4342 volts. The difference from Rowland's value, 4-181, could be explained by supposing the E.M.F. of the Clark cells to have in reality been 1-4323 volts, or about 2 millivolts less than the value assumed. Griifiths has since applied the same method to the measurement of the specific heat of aniline, and the latent heat of vaporization of benzene and water.*~~

~~§ 18. Schuster and Gannon. — The method employed by Schuster and Gannon for the determination of the specific heat of water in terms of the international electric units (Phil. Trans. A, 1895, p. 415) corresponded to the expression ECT, and differed in many essential details from that of Grifflths. The current through a platinoid resistance of about 31 ohms in a calorimeter containing 1500 grammes of water was regulated so that the potential difference on its terminals was equal to that of twenty B.O.T. Clark cells in series. The duration of an experiment was about ten minutes, and the product of the mean current and the time, namely CT, was measured by the weight of silver deposited in a voltameter, which amounted to about 0-56 gramme. The uncer- tainty due to the correction for the water equivalent was minimized by making it small (about 27 grammes) in comparison with the water weight. The correction for external loss was reduced by employing a small rise of temperature (only 2-22°), and making the rate of heat-supply relatively rapid, nearly 24 watts. The platinoid coil was insulated from the water by shellac varnish. The wire had a length of 760 cms., and the P.D. on its terminals was nearly 30 volts. The rate of stirring adopted was so slow that the heat generated by it could be neglected. The result found was 4-191 joules per calorie at 19° C. This agrees very well with Griffiths considering the difficulty of measuring so small a rise of temperature as 2° with a mercury thermometer. Admitting that the electro-chemical equivalent of silver increases with the age of the solution, a fact which has since been discovered, and that the B.M.F. of the Clark cell is probably less than 1-4340 volts (the value assumed by Schuster and Gannon), there is no difficulty in reconciling the result with that of Rowland.~~

~~§ 14. Oallendar and Barnes (Brit. Assoc. JJeports, 1897 and 1899) adopted an entirely different method of calorimetry, as well as a different method of electrical measurement. A steady current of liquid, Q grammes per second, of specific heat, Jfs joules per degree, flowing through a fine tube, 1 or 2 millims. in diameter, is heated by a steady electric current during its passage through the tube, and the difference of temperature d6 between the inflowing and the outflowing liquid is measured by a single read- ing with a delicate pair of differential platinum thermometers. The difference of potential E between the ends of the tube, and the electric current O through it, are measured on a very accurately calibrated potentiometer, in terms of a~~

~~*Clark cell and a standard resistance. If hd0 is the radiation loss in watts we have the equation,*~~

~~*EO=JsQd0+hde . . . (2).*~~

~~*The advantage of this method is that all the conditions are steady, so that the observations can be pushed to the limit of accuracy and sensitiveness of the apparatus. The water equivalent of the calorimeter is immaterial, since there is no appreciable change of temperature. The heat-loss can be reduced to a minimum by enclosing the flow-tube in a hermetically sealed glass vacuum jacket. The insulation is the most perfect possible. No stirring is required, if the tube is sufficiently fine and the velocity of flow adequate. The conditions can be very easily varied through a wide range. The heat-loss hde is determined and eliminated by varying the flow of liquid and the*~~

~~*electric current simultaneously, in such a manner as to secure approximately the same rise of temperature for two or more widely different values of the flow of liquid. An example taken from the Electrician, September 1897, of one of the earliest experiments by this method on the specific heat of mercury will make the method clearer. The flow-tube was about 1 metre long and one millim. in diameter, coiled in a short spiral inside the vacuum jacket. The outside of the vacuum jacket was immersed in a water jacket at a steady temperature equal to that of the inflowing mercury.*~~

~~*Specific Heat of Mercury by continuous Electric Method.*~~

~~*Flow of Hg.*~~

~~*Kise of Temp.*~~

~~*Vfatts.*~~

~~*Heat-loss.*~~

~~*Bpeoiflo Heat.*~~

~~*gm./sec.*~~

~~8-763 4-594~~

~~ae~~

~~11-764 12-301~~

~~EO~~

~~14-862 7-912~~

~~0-655 0-685~~

~~Per gm. deg. \ -13780 joules / -03297 cals.~~

~~It is assumed as a first approximation that the heat-loss is pro- portional to the rise of temperature d9, provided that dB is nearly the same in both cases, and that the distribution of temperature in the apparatus is the same for the same rise of temperature whatever the flow of liquid. The result calculated on these assumptions is given in the last column in joules, and also in calories at 20° C. The heat-loss in this example is large, nearly 4-5 per cent, of the total supply, owing to the small flow and the large rise of temperature, but this correction was greatly reduced in subsequent observations on the specific heat of water by the same method. In the case of mercury the liquid itself can be utilized to conduct the electric current. In the case of water or other liquids it is necessary to employ a platinum wire stretched along the tube as heating conductor. This introduces additional difficulties of construction, but does not otherwise affect the method. The absolute value of the specific heat deduced necessarily depends on the absolute values of the electrical standards employed in the investigation. But for the determinju- tion of relative values of specific heats in terms of a standard liquid, or of the variations of specific heat of a liquid, the method depends only on the constancy of the standards, which can be readily and accurately tested. The result found by this method for the specific heat of water at 20° C. would agree with that of Rowland within the probable limits of eiTor, if the ohm were taken as correct, and the Clark cell at 15° C. were supposed to have an E.M.F. of 1-4333 volts. These values appear to be extremely probable in the light of recent researches, but the more important~~

~~application of electrical methods to calorimetry is to the relative measurements for which it is peculiarly adapted.~~

~~§ 16. Variation of Specific Heat of Water. — The question of the variation of the specific heat of water has a peculiar interest and importance in connexion with the choice of a thermal unit. Many of the uncertainties in the reduction of older experiments, such as those of Regnault, arise from uncertainty in regard to the unit in terms of which they are expressed, which again depends on the scale of the particular thermometer employed in the investigation. The first experiments of any value were those of Regnault in 1847 on the specific heat of water between 110° C. and 192° C. They were conducted on a very large scale by the method of mixture, but showed discrepancies of the order of 0-6 per cent., and the calculated results in many cases do not agree with the data. This may be due merely to deficient explanation of details of tabulation. We may probably take the tabulated values as showing correctly the rate of variation between 110° and 190° C, but the values in terms of any particular thermal unit must remain uncertain to at least 0-5 per cent, owing to the uncertainties of the thermometry. Regnault himself adopted the formula,~~

~~s=l4-0-000,04j-l-0-000,000,9{3 (Regnault), (3)~~

~~for the specific heat s at any temperature J C. in terms of the specific heat at 0° C. taken as the standard. This formula has since been very generally applied over the whole range 0° to 200° C, but the experiments could not in reality give any information with regard to the specific heat at temperatures below 100° C. The linear formula proposed by Bosscha from an independent reduction of Regnault's experiments is probably within the limits of accuracy between 100° and 200° C, so far as the mean rate of variation is concerned, but the absolute values requu-e reduction. It may be written —~~

~~s=»loo + ■00023(«-100) (Bossoha-Regnault) (4). The work of Pfaundler and Platter, of Him, of Jamin and Amaury, and of many other experimentalists who succeeded Regnault, appeared to indicate much larger rates of increase than he had found, but there can be little doubt that the discrepancies of their results, which often exceeded 5 per cent., were due to lack of appreciation of the difficulties of calorimetric measure-~~

~~ments. The work of Rowland by the mechanical method was the first in which due attention was paid to the thermometry and to~~

~~the reduction of the results to the absolute scale of temperature. The agreement of his corrected results with those of Griffiths by a very different method, left very little doubt with regard to the rate of diminution of the specific heat of water at 20° C. The work of Bartoli and Stracoiati by the method of mixture between 0° and 30° C, though their curve is otherwise similar to Rowland's, had appeared to indicate a minimum at 20° C, followed by a rapid rise. This lowering of the mmimum was probably due to some constant errors inherent in their method of experiment. The more recent work of Liidin, 1895, under the direction of Prof. Pernet, extended from 0° to 100° C, and appears to have attained as high a degree of excellence as it is possible to reach by the employment of mercu^ thermometers in conjunction with the method of mixture. His results, exhibited in Fig. 1, show a minimum at 25° C, and a maximum at 87° C, the values being -9935 and 1-0075 respectively in terms of the mean specific heat between 0° and 100° C. He paid great attention to the thermometry, and the discrepancies of individual measurements at any one point nowhere exceed 0-3 per cent., but he did not vary the conditions of the experiments materially, and it does not appear that the well-known constant errors of the method could have been completely eliminated by the methods which he adopted. The rapid rise from 25° to 75° may be due to radiation • error from the hot water supply, and the subsequent fall of the curve to the inevitable loss of heat by evaporation of the boiling water on its way to the calorimeter. It must be observed, how- ever, that there is another grave difficulty in the accurate determination of the specific heat of water near 100° C. by this method, namely, that the quantity actually observed is not the specific heat at the higher temperature, but the mean specific heat over the range 18° to 100°. The specific heat itself can be deduced only by differentiating the curve of observation, which greatly increases the uncertainty. The peculiar advantage of the electric method of Callendar and Barnes, already referred to, is that the specific heat itself is determined over~~

~~a range of 8° to 10° at each point, by adding accurately measured quantities of heat to the water at the desired temperature in an isothermal enclosure, under perfectly steady conditions, without any possibility of evaporation or loss of heat in transference. These experiments, which have been extended by Barnes over the whole range 0° to 100°, agree very well with Rowland and Griflaths in the rate of variation at 20° C, but show a rather flat minimum of specific heat in the neighbourhood of 38° to 40° C. At higher points the rate of variation is very similar to that of Regnault's curve, but taking the specific heat at 20° as the standard of reference, the actual values are nearly 0-56 per cent, less than Regnault's. It appears probable that his values for higher temperatures may be adopted with this reduction, which is further confirmed by the results of Reynolds, and Moorby, and by those of Ludin. Accord- ing to the electric method, the whole range of variation of the specific heat between 10° and 80° is only 0-5 per cent. Compara- tively simple formulae, therefore, suffice for its expression to 1 in 10,000, which is beyond the limits of accuracy of the observations. It is more convenient in practice to use a few simple f ormulse, than to attempt to represent the vhole range by a single complicated expression : —~~

~~Below 20° C. s=0-9982 -1-0 000,0045 (« 40)2 -0-000,0005 ({_20)s. From 20° to 60°, s= 0-9982 -1-0-000,0045 (t-ioy (5).~~

~~AhnvBfin°to2nn°/«=<"99^+"00*"'*+"'0*'°'*'°°^" (Reg. corrd.) Above 60 to 200 -[5=1.000-1-0-000,22 (S-60), (Bosscha corrd.)~~

~~The addition of the cubic term below 20° is intended to represent the somewhat more rapid change near the freezing-point. This effect is probably due, as suggested by Rowland, to the presence of a certain proportion of ice molecules in the liquid, which is also no doubt the cause of the anomalous expansion. Above 60° C. Regnault's formula is adopted, the absolute values being simply diminished by a constant quantity 0-0056 to allow for the probable errors of his thermometry. Above 100° C, and for approximate work generally, the simpler formula of Bosscha, similarly corrected, is probably adequate.~~

~~The following table of values, calculated from these f ormulse, is taken from the Brit. Assoc. Beport, 1899, with a slight modification to allow for the~~

~~*increase in the specific heat below 20° C. This was estimated in 1899 as being equivalent to the addition of the constant quantity 0-020 to the values of the total heat h of the liquid as reckoned by the parabolic formula (5). This quantity is now, as the result of further experiments, added to the values of h, and also represented in the formula for the specific heat itself by the cubic term.*~~

~~*The unit of comparison in the following table is taken as the specific heat of water at 20° C. for the reasons given below. This unit is taken as being 4-180 joules per gramme-degree-Centi- grade on the scale of the platinum thermometer, corrected to the absolute scale as explained in the article Thermometry, § 23, which has been shown to be practically equivalent to the hydrogen scale. The value 4-180 joules at 20° C. is the mean*~~

~~*pecific Heat of Water in terms of Unit at 20° C. 4-180 Joules.*~~

~~*t°0.*~~

~~*Joules,*~~

~~*s.*~~

~~*A.*~~

~~*Rowland.*~~

~~*0°*~~

~~*4-208*~~

~~*1-0094*~~

~~*θ*~~

~~*θ*~~

~~*5°*~~

~~*4-202*~~

~~*1-0054*~~

~~*5-037*~~

~~*5-037*~~

~~*10°*~~

~~*4-191*~~

~~*1-0027*~~

~~*10-056*~~

~~*10-058*~~

~~*15°*~~

~~*4-184*~~

~~*1-0011*~~

~~*15-065*~~

~~*15-068*~~

~~*20°*~~

~~*4-180*~~

~~*1-0000*~~

~~*20-068*~~

~~*20-071*~~

~~*25°*~~

~~*4-177*~~

~~*0-9992*~~

~~*26-065*~~

~~*26-067*~~

~~*30°*~~

~~*4-175*~~

~~*0-9987*~~

~~*30-060*~~

~~*30-057*~~

~~*35°*~~

~~*4-173*~~

~~*0-9983*~~

~~*35-052*~~

~~*36.053*~~

~~*40°*~~

~~*4173*~~

~~*0-9982*~~

~~*40-044*~~

~~*50°*~~

~~*4-175*~~

~~*0-9987*~~

~~*50-028*~~

~~*60°*~~

~~*4-180*~~

~~*1-0000*~~

~~*60-020*~~

~~*70°*~~

~~*4-187*~~

~~*1-0016*~~

~~*70-028*~~

~~*80°*~~

~~*4-194*~~

~~*1-0033*~~

~~*80-052*~~

~~*90°*~~

~~*4-202*~~

~~*1-0053*~~

~~*90-095*~~

~~*Shaw*~~

~~*100°*~~

~~*4-211*~~

~~*1-0074*~~

~~*100-158*~~

~~*Regnault*~~

~~*120°*~~

~~*4-281*~~

~~*1-0121*~~

~~*120-35*~~

~~*120-73*~~

~~*140°*~~

~~*4-264*~~

~~*1-0176*~~

~~*140-65*~~

~~*140-88*~~

~~*160°*~~

~~*4-280*~~

~~*1-0238*~~

~~*161-07*~~

~~*161-20*~~

~~*180°*~~

~~*4-309*~~

~~*1-0308*~~

~~*181-62*~~

~~*182-14*~~

~~200°~~

~~4-341~~

~~1-0384~~

~~202-33~~

~~220°~~

~~4-376~~

~~1-0467~~

~~223-20~~

~~between Rowland's corrected result 4-181 and the value 4-179, deduced from the experiments of Reynolds and Moorby on the assumption that the ratio of the mean specific heat 0° to 100° to that at 20° is 1-0016, as given by the formulae representing the results of Callendar and Barnes. This would indicate that Rowland's corrected values should, if anything, be lowered. In any case the value of the mechanical equivalent is uncertain to at least 1 in 2000.~~

~~The mean specific heat, over any range of temperature, may be obtained by integrating the formulae between the limits required, or by taking the difference of the corresponding values of the total heat h, and dividing by the range of temperature. The quantity actually observed by Rowland was the total heat. It may be remarked that starting from the same value at 6°, for the sake of comparison, Rowland's values of the total heat agree to 1 in 5000 with those calculated from the formulae. The values of the total heat observed by Regnault, as reduced by Shaw, also show a very fair agreement, considering the uncertainty of the units. It must be admitted that it is desirable to redetermine the variation of the specific heat above 100° C. This is very difficult on account of the steam-pressure, and could not easily be accomplished by the electrical method. The writer has, however, devised a continuous method of mixture, which appears to be peculiarly adapted to the purpose, and promises to give more certain results. In any~~

~~case it may be remarked that formulas- such as those of Jamin, Henrichsen, Baumgartner, Winkelmann, or Dieterici, which give far more rapid rates of increase than that of Regnault, cannot possibly be reconciled with his observations, or with those of Reynolds and Moorby, or Callendar and Barnes, and are certainly inapplicable above 100° C.~~

~~§ 16. On the Choice of the Thermal Unit. — So much uncertainty still prevails on this fundamental point that it cannot be passed over without reference. There are three possible kinds of unit, depending on the three fundamental methods already given: (1) Thethermometricunit,orthe thermal capacity of unit mass of, a standard substance under given conditions of temperature and pressure on the scale of a standard thermometer. (2) The latent- heat unit, or the quantity of heat required to melt or vaporize unit mass of a standard substance under given conditions. This unit has the advantage of being inde- pendent of thermometry, but the applicability of these methods is limited to special cases, and the relation of the units to other units is difB.cult to determine. (3) The absolute or mechanical unit, the quantity of heat equiva- lent to a given quantity of mechanical or electrical en- ergy. This can be very accurately realized, but is not so convenient as (1) for ordinary purposes.~~

~~In any case it is necessary to define a thermometrio unit of class (1). The standard substance must be a liquid. Water is always selected, although some less volatile liquid, such as aniline or mercury, would possess many advantages. With regard to the scale of temperature, there is very general agreement that the absolute scale as realized by the hydrogen or helium ther- mometer should be adopted as the ultimate standard of reference. But as the hydrogen tiiermometer is not directly available for~~

~~the majority of experiments, it is necessary to use a secondary standard for the practical definition of the unit. The electrical resistance thermometer of platinum presents very great advan- tages for this purpose over the mercury thermometer in point of reproducibility, accuracy, and adaptability to the practical conditions of experiment. The conditions of use of a mercury~~

~~*thermometer in a calorimetric experiment are necessarily different from those under which its corrections are determined, and this difference must inevitably give rise to constant errors in practical work. The primary consideration in the definition of a unit is to select that method which permits the highest order of accuracy in comparison and verification. For this reason the definition of the thermal unit will in the end probably be referred to a scale of temperature defined in terms of a standard platinum thermometer.*~~

~~*There is more diversity of opinion with regard to the question of the standard temperature. Many authors, adopting Eegnault's formula, have selected 0° C. as the standard temperature, but this cannot be practically realized in the case of water, and his formula is certainly erroneous at low temperatures. A favourite temperature to select is 4° C, the temperature of maximum density, since at this point the specific heat at constant volume is the same as that at constant pressure. But this is really of no consequence, since the specific heat at constant volume cannot be practically realized. The specific heat at 4° could be accurately determined as the mean over the range 0° to 8° keeping the jacket at 0° C. But the change appears to be rather rapid near 0°, the temperature is inconveniently low for ordinary calorimetric work, and the unit at 4° would be so much larger than the specific heat at ordinary temperatures that nearly all experiments would require reduction. The natural point to select would be that of minimum specific heat, but if this occurs at 40° C. it would be inconveniently high for practical realization except by the continuous electrical method. It was proposed by a committee of the British Association to select the temperature at which the specific heat was 4-200 joules, leaving the exact temperature to be subsequently determined. It was supposed at the time, from the original reduction of Rowland's experiments, that this would be nearly at 10° C, but it now appears that it may be as low as 5° C, which would be inconvenient. This is really only an absolute unit in disguise, and evades the essential point, which is the selection of a standard temperature for the water thermo- metric unit. A similar objection applies to selecting the tem- perature at which the specific heat is equal to its mean value between 0° and 100°. The mean calorie cannot be accurately realized in practice in any simple manner, and is therefore unsuit- able as a standard of comparison. Its relation to the calorie at any given temperature, such as 15° or 20°,*~~

~~*cannot be determined with the same degree of accuracy as the ratio of the specific heat at 15° to that at 20°, if the scale of temperature is given. The most prac- tical unit is the calorie at 15° or 20° or some temperature in the range of ordinary _practice. The temperature most generally favoured is 15°, but 20° would be more suitable for accurate work. These units differ only by 11 parts in 10,000 according to Callendar and Barnes, or by 13 in 10,000 according to Rowland and Griffiths, so that the difference between them is of no great importance for ordinary purposes. But for purposes of definition it would be necessary to take the mean value of the specific heat over a given range of temperature, preferably at least 10°, rather than the specific heat at a point which necessitates reference to some formula of reduction for the rate of variation. The specific heat at 15° would be determined with reference to the mean over the range 10° to 20°, and that at 20° from the range 15° to 25°. There can be no doubt that the range 10° to 20° is too low for the accu- rate thermal regulation of the conditions of the experiment. The range 15° to 25° would be much more convenient from this point of view, and a mean temperature of 20° is probably nearest the average of accurate calorimetric work. For instance 20° is the mean of the range of the experiments of GrifBths and of Rowland, and is close to that of Schuster and Gannon. It is readily attain- able at any time in a modem laboratory with adequate heating arrangements, and is probably on the whole the most suitable tem- perature to select.*~~

~~*§ 17. Specific Heat of Gases. — In the case of solids and liquids under ordinary conditions of pressure, the external work of expansion is so small that it may generally be neglected; but with gases or vapours, or with liquids near the critical point, the external vrork becomes so large that it is essential to specify the conditions under which the specific heat is measured. The most important eases are, the specific heats (1) at constant volume; (2) at constant pressure ; (3) at saturation pressure in the case of a liquid or vapour. In consequence of the small thermal capacity of gases and vapours per unit volume*~~

~~*at ordinary pressures, the difficulties of direct measure- ment are almost insuperable except in case (2). Thus the direct experimental evidence is somewhat meagre and conflicting, but the question of the relation of the specific heats of gases is one of great interest in connexion with the kinetic*~~

~~theory and the constitution of the molecule. The well-known experiments of Eegnault and Wiedemann on the specific heat of gases at constant pressure agree in showing that the molecular specific heat, or the thermal capacity of the molecular weight in grammes, is approxi- mately independent of the temperature and pressure in case of the more stable diatomic gases, such as Hj, Oj, N2, CO, &c., and has nearly the same value for each gas. They also indicate that it is much larger, and increases considerably with rise of temperature, in the case of more condensible vapours, such as Clj, Brj, or more complicated molecules, such as CO2, NjO, NHj, C2H4. The direct determination of the specific heat at constant volume is extremely difficult, but has been successfully attempted by Joly with his steam calorimeter, in the case of air and COj. Employing pressures between 7 and 27 atmospheres, he found that the specific heat of air between 10° and 100° C. increased very slightly with increase of density, but that of COj increased nearly 3 per cent, between 7 and 21 atmospheres. The following formidse represent his results for the specific heat s at constant volume in terms of the density d in gms. per~~

~~'^'°' ■ "" Air, s=0-1715-f-0-028c?,~~

~~CO2, s=0-165 +0-213d+0-3id".~~

~~§ 18. Matio of Specific Heats. — According to the elementary ki- netic theory of an ideal gas, the molecules of which are so small and so far apart that their mutual actions may be neglected, the kinetic energy of translation of the molecules is proportional to the abso- lute temperature, and is equal to 3/2 of pv, the product of the pressure and the volume, per unit mass. The expansion per degree at constant pressure is v/d=Ii/p. The external work of expan- sion per degree is equal to B, being the product of the pressure and the expansion, and represents the difference of the specific heats S— s, at constant pressure and volume, assuming as above that the internal work of expansion is negligible. If the molecules are supposed to be like smooth, hard, elastic spheres, incapable of receiving any other kind of energy except that of translation, the specific heat at constant volume would be the increase per degree of the kinetic energy, namely 3pv/20=3Ii/2, that at constant pressure would be 5B/2, and the ratio of the specific heats would be 5/3 or 1-666. This appears to be actually the case for mona- tomio gases~~

~~such as mercury vapour (Kundt and Warburg, 1876), argon and helium (Ramsay, 1896). For diatomic or compound gases Maxwell supposed that the molecule would also possess energy of rotation, and endeavoured to prove that in this case the energy would be equally divided between the six degrees of free- dom, three of translation and three of rotation, if the molecule were regarded as a rigid body incapable of vibration-energy. In this case we should have s=32J, S=ilt, S/s=i/S=l-3SS. In 1879 Maxwell considered it one of the greatest difficulties which the kinetic theory had yet encountered, that in spite of the many other degrees of freedom of vibration revealed by the spectro- scope, the experimental value of the ratio S/s was 1-40 for so many gases, instead of being less than 4/3. Somewhat later Boltzmann suggested that a diatomic molecule, regarded as a rigid dumb-bell or figure of rotation, might have only five effec- tive degrees of freedom, since the energy of rotation about the axis of symmetry could not be altered by collisions between the molecules. The theoretical value of the ratio S/s in this case would be the requu-ed 7/5. For a rigid molecule on this theory the smallest value possible would be 4/3. Since much smaller values are found for more complex molecules, we may suppose that, in these cases, relative movements of the con- stituent atoms are possible, which may be classed generally as energy of vibration. A hypothesis doubtfully attributed to Maxwell is that each additional atom in the molecule is equivalent to two extra degrees of freedom. From an ?n-atomio molecule we should then have S/s = 1 | 2/ (2m + l) This gives a series of ratios 5/3, 7/5, 9/7, 11/9, &c., for 1, 2, 3, 4, &c., atoms in the molecule, values which fall within the limits of experimental error in many cases. It is not at all clear, however, that energy of vibration should bear a constant ratio to that of translation, although this would probably be the case for rota- tion. For the simpler gases, which are highly diathermanous and~~

~~radiate badly even at high temperatures, the energy of vibration IS probably very small, except under the special conditions which produce luminosity in flames and electric discharges. For such gases, assuming a constant ratio of rotation to translation, the specific heat at low pressures would be very~~

~~*nearly constant. For more complex molecules the radiative and absorptive powers are known to be much greater. The energy of vibration may be appreciable at ordinary temperatures, and would probably increase more rapidly than that of translation with rise of temperature, especially near a point of dissociation. This would account for an increase of S, and a diminution of the ratio S/s, with rise of temperature which apparently occurs in many vapours. The experimental evidence, however, is somewhat conflicting, and fur- ther investigations are very desirable on the variation of specific heat with temperature. Given the specific heat as a function of the temperature, its variation with pressure may be determined from the characteristic equation of the gas, as illustrated for a simple case in the article Thbbmodtnamics, § 15. The direct methods of measuring the ratio S/s, by the velocity of sound and by adiabatio expansion, are sufficiently described in many text- books.*~~

~~*§ 19. Atomic and Molecular Seats. — The ideal atomic heat is the thermal capacity of a gramme-atom in the ideal state of mon- atomic gas at constant volume. This would be nearly three calories. Por a diatomic gas, the molecular heat would be nearly five calories, or the atomic heat of a gas in the diatomic state would be 2-5. Estimated at constant pressure the atomic heat would be 3-5. Some authors adopt 2-5 and some 3-5 for the ideal atomic heat. The atomic heat of a metal in the solid state is in most cases larger than six calories at ordinary temperatures. Considering the wide variations in the physical condition and melting-points, the close agreement of the atomic heats at any one temperature is very remarkable. The specific heats as a rule increase with rise of temperature, in some oases, e.g., iron and nickel, very rapidly. According to Tilden (Phil. Trans., 1900), the atomic heats of pure nickel and cobalt, as determined from experiments at the boiKng- points of Oa, and CO2, diminish so rapidly at temperatures below 0° C. as to suggest that they would reach the value 2-42 at the absolute zero. This is the value of the minimum of atomic heat calculated by Perry from diatomic hydrogen, but the observations themselves might be equally well represented by taking the imag- inary limit 3, since the quantity actually observed is the mean specific heat between 0° and —182-5° C. Subsequent experiments on other metals at low temperatures did not indicate a similar diminution of specific he^t, so that it may be doubted whether the atomic heats really approach the ideal value at the absolute*~~

~~zero. No doubt there must be approximate relations between the atomic and molecular heats of similar elements and compounds, but con- sidering the great variations of specific heat with temperature and physical state, in alloys, mixtures, or solutions, and in allotropic or other modifications, it would be idle to expect that the specific heat of a compound could be deduced by any simple additive process from that of its constituents.~~

~~Authorities. — Joule's Scientific Papers. London, 1890. Ames and Griffiths, Beports to the International Congress (Paris, 1900), "On the Mechanical Equivalent of Heat," and "On the Specific Heat of Water." Griffiths, Thermal Measurement of Energy. Cambridge, 1901. Callendar and Barijes, Phil. Trans. A, 1901, " On the Variation of the Specific Heat of Water." Eor combustion methods, see article Thermochemistry, and treatises by Thomsen, Pattison-Muir, and Berthelot. (h. l. c.)~~

~~Caltagirone, a town and bishop's see of the prov- ince of Catania, Sicily, Italy, 57 miles S.W. from Catania. Besides the cathedral, it has a technical school, school of agriculture, and several fine mansions. Population, about 33,000.~~

~~Caltanlssetta, Italian town and episcopal see and capital of the province of Caltanissetta, Sicily, 43 miles by rail N.E. from Girgenti. It has a diocesan seminary, a royal school of mines, and a technical school. Popula- tion of town (1881), 30,480 ; (1901), 44,600 ; of province~~

~~(1881), 266,379 ; (1901), 330,972.~~

~~Caluire et Cuire, a town of France, department of Ehone, in the arrondissement of Lyons, 7^ miles N. by E. of that city, on railway from Lyons to Trevaux. It has manufactures of coarse earthenware and hardware ; copper- and bronze-founding, and essence distUleries. Population (1881), 6828; (1896), 8070, (conun.) 9035;~~

~~(1901), 10,926.~~

~~Calumpit, a town of 15,000 inhabitants in the province of Bulacan, Luzon, Philippine Islands, at the junction of the Quingua river with the Eio Grande de la Pampanga. The surrounding country is a fertile plain, producing large~~

~~quantities of rice, as well as sugar, indigo, and a variety of fruits. The Manila-Dagupan railway passes through, and the bridge across the Eio Grande is the longest in the Philippines. The town was fired and completely burned by insurgent troops in 1899. The language is Tagalog.~~

~~Calvados, a department of the N. of France, bor- dering on the English Channel, watered by the Orne and Vire.~~

~~Area, 2198 square miles, distributed among 38 cantons and 763 communes. The population decreased to 487,267 in 1886 and 410,178 in 1901, a reduction due to the fact that the number of births is in steady decHne and much surpassed by the number of deaths. In 1899 the deaths numbered 9966 against 8520 births, of which 968 were illegitimate ; marriages numbered 3009. Caen, the capital, had in 1896, 45,000 inhabitants. In 1896 there were 1055 primary schools with 55,000 pupils, and the illiterate formed 2 per cent, of the population. Calvados is chiefly noted for its rearing of live stock, an industry favoured by the excellence of its pastures. Out of 1,460,498 acres forming in 1896 the total area cultivated, 617,786 acres were laid out in grass and 690,600 acres were plough-land. In 1899 the wheat crop yielded the value of £1,015,000. The total production of the green crop (trefoil, lucerne, and sainfoin) and natural pastures and grass lands amounted to 11,510,000 cwts., of the value of £1,498,000. In the way of grass lands Calvados ranked third among the departments of France. Colza, which was produced to the amount of fully a fourth of the total produce of France, returned a value of £2.30,000. Among the fruits cultivated, apples for cider gave a revenue estimated at £444,000. The live stock in 1899 included 65,000 horses, 236,614 cattle, and 68,750 pigs, and the value of milk products was £1,839,140. The horses of Calvados are much prized. Agriculture constitutes the principal wealth of this department, which supplies large quantities of butter (Isigny) and of cheese. It has, however, also a few coal-mines and seams of iron, the latter supplying 13,000 metric tons in 1898. The department produces plenty of stone. The textile industry has developed around Caen and Falaise.~~

~~Calverley, Charles Stuart (1831-1884), one of the brightest of English wits, and the literary father of what may be called the university school of humour, was born at Martley in Worcestershire, 22nd Decem- ber 1831. His~~

~~father, the Eev. Henry Blayds, re- sumed in 1852 the old family name of Calverley, which his grandfather had exchanged for Blayds in 1807. It was as Charles Stuart Blayds that most of the son's university distinctions were attained. He went up to Balliol from Harrow in 1850, and was soon known in Oxford as the most daring and most high-spirited un- dergraduate of his time. He was a universal favourite, a delightful companion, a brilliant scholar, and the playful enemy of all "dons." In 1851 he won the Chancellor's prize for Latin verse, and it is said that the entire exercise was written in an afternoon, when his friends had locked him into his rooms, declining to let him out till he had finished what they were confident would prove the prize poem. A year later he took his name off the books, to avoid the consequences of a college escapade, and migrated to Christ's College, Cambridge. Here he was again successful in Latin verse, and remains the unique example of an imdergraduate who has won the Chancellor's prize at both universities. In 1866 he took second place in the first class in the Classical Tripos. He was elected fellow of Christ's (1858), published Verses and Translations in 1862, married a cousin, and was called to the bar in 1865. Owing to an accident while skating he was prevented from following up a professional career, and during the last years of his life he was an invalid. His Translations into English and Latin ap- peared in 1866 ; his Theocritus translated into English Verse in 1869 ; Fly Leaves in 1872 ; and lAterary Remains in 1885. He died on the 17th February 1884. Calverley~~

~~was one of the most brilliant men of his day; and, had he enjoyed health, might have achieved distinction in any career he chose. Constitutionally indolent, he was endowed with singular gifts in every department of cul- ture; he was a scholar, a musician, an athlete, and a brilliant talker. What is left us marks only a small portion of his talent, but his sparkling, dancing verses, which have had many clever imitators, are still without a rival in their own line. His humour was illumined by good nature ; his satire was keen but kind ; his laughter was of that human sort which is often on the verge of tears. Imbued with the classical spirit, he introduced into the making of light verse the polish and elegance of the great masters, and even~~

~~*in its most whimsical mood his verse is raised to the level of poetry by the saving ex- cellence of style. (a. wa.)*~~

~~*Calvo, Carlos (1824-1893), Argentine publicist and historian, was born at Buenos Ayres on 26th Feb- ruary 1824, and devoted himself to the study of the law. In 1860 he was sent by the Paraguayan Government on a special mission to London and Paris. Eemaining in France, he published in 1863 his Derecho internadonal teorico y pretctico de Europa y America, in two volujnes, and at the same time brought out a French version. The book immediately took rank as one of the highest modern authorities on the subject, and by 1887 the first French edition had become enlarged to six volumes. Senor Calvo's next publications were of a semi-historical character. Between 1862 and 1869 he published in Spanish and French his great collection in fifteen vol- umes of the treaties and other diplomatic acts of the South American republics, and between 1864 and 1875 his Annales historiques de la revolution de I'Amirique latine, in five volumes. In 1884 he was one of the founders at the Ghent Congress of the Institufrde droit international. In the following year he was Argentine minister at Berlin, and published his Dictionnaire du droit international pubM et privi in that city. Calvo died on 4th May 1893.*~~

~~*Camacho, Juan Francisco (1824-1896), Spanish statesman and financier, was born in Cadiz in 1824. The first part of his life was devoted to mercantile and financial pursuits at Cadiz, and then in Madrid, where he managed the affairs of and liquidated a mercantile and industrial society to the satisfaction and profit of the share-holders. In 1837 he became a captain in the national militia, in 1852 Conservative deputy in the Cortes fot Alcoy, in 1853 secretary of congress, and was after- wards elected ten times deputy, twice senator, and life senator in 1877. Camacho took a prominent part in all financial debates and committees, was offered a seat in the Mon cabinet of 1864, and was appointed under-secre- tary of state finances in 1866 under Canovas and O'Don- nell. After the revolution of 1868 he declined the post of minister of finance offered by Marshal Serrano, but served in that capacity in 1872 and 1874 in Sagasta's cabinets. When the restoration took place, Camacho sat in the Cortes among the dynastic Liberals with Sagasta as leader, and became finance minister in 1881 at a critical moment when Spain had to convert, reduce, and consoli-*~~

~~*date her treasury and other debts with a view to resuming payment of coupons. Camacho drew up an excellent budget and collected taxation with a decidedly unpopu- lar vigour. A few years later Sagasta again made him finance minister under the regency of Queen Christina, but had to sacrifice him when public opinion very clearly pronounced against his too radical financial reforms and his severity in collection of taxes. He was for the same reasons unsuccessful as a governor of the Tobacco Monopoly Company. He then seceded from the Liberals,*~~

~~*and during the last years of his life he affected to vote with the Conservatives, who made him governor*~~

~~*Camajore, a town of the province of Lucca, Tuscany, Italy, at the foot of the Apuan Alps, 12 miles N.W. from Lucca. It is still surrounded by walls, and has a 13th-century church and an old triumphal arch. Population, about 9000.*~~

~~*Cam bay (Khambhat), a native state of India, within the Gujarat division of Bombay. It has an area of 350 square miles. Population (1891), 89,722 ; (1901), 75,122, showing a decrease of 16 per cent, due to the famine of 1899-1900. The estimated gross revenue was E.s.6,18,139 ; the tribute, Es.21,924; the number of police was 170 ; the number of schools in 1897-98 was 36, with 2490 pupils, being 3-43 per cent, of the popu- lation, compared with 2-4 for Bombay generally.*~~

~~*The town of Cambat had a population in 1881 of 36,007, and in 1891 of 31,390 ; the municipal income in 1897-98 was Es.10,229, together with Es.5,596 contributed by the state. It is proposed to connect the town by rail-way with the terminus of the Gaekwar's railway at Petlad, 19 miles distant, at a cost to the state of Es.10,00,000. There is a high school and a state printing-press, which issues a monthly gazette.*~~

~~*Cambodia, called by the inhabitants Srockhmer (Khmer province), lies between 10° 30' and 13° 46' N. lat., and 102° 50' and 106° 50' E. long. It is bounded on the W. and N. by Siam and the Laos States, on the E. and S. by Cochin-China, and on the S.W. by the Gulf of Siam. By the treaty of 3rd October 1893, between France and Siam, the latter bound herself not to maintain armed forces upon the great lake or in the adjoining provinces of*~~

Battambang and Siemrap. The whole of Cambodia lies in the lower Mekong valley, the delta of which commences at Pnom-penh. The characteristic feature of Cambodian geography is the presence of an immense lake, Tonle-Sap, in a vast depression more than 68 miles long and 16 miles wide. During the annual overflow of the Mekong (when its waters rise to a height of 40-46 feet and flow violently towards the lake along a channel 62 miles long and 1640- 4920 feet wide) this lake covers an area of about 770 square miles, but during the dry season the current reverses and the depression empties, so that the lake shrinks to an area of 100 square miles and its depth falls from 45-48 feet to 1^ and 5 feet in its shallowest parts. Tonle-Sap represents, in all probability, the chief wealth of Cambodia. It supports a fishing population of over 30,000, and provides a variable but always consider- able quantity of dried fish and nuoc-mam (sauce com- posed of fermented fish) for exportation. The climate is hot and damp. Cotton and cotton-wool reach perfection. Cotton in the pod finds its chief market at Kobe (Japan) at an average rate of 20 piastres the picul of 160 lb. The area of Cambodia is about 38,600 square miles. Its population numbers about 1,500,000, of whom 208 are French (exclusive of the land and sea forces, which, how- ever, are small, the defence of Cambodia being assured by Indo-China), 200,000 Annamese, and 1,300,000 Cam- bodians of Khmer origin. Cambodia became a French protectorate by the treaty with France of 11th August 1863, and the convention of 17th June 1884. It is an absolute monarchy, and its king (by divine right) bears a very long series of laudatory titles. As in all countries the inhabitants of which have a Khmer origin, there are in Cambodia two kings, the second being a general, the younger brother of the first king and his heir-presump- tive. King Norodom was born in 1834, crowned in

I860 at Udong, and the same year made Pnom-penh his capital. HIe has 14 sons and 22 daughters. The second king, obbarach, Prince Somdach Prea Maha, has 13 sons and 9 daughters. Since 1884 a French resident has lived near the king. In 1855 an insurrection, due to increased taxation, was utilized by the king's brother, Si-Votha, who claimed to have been despoiled

~~of the crown, but was promptly suppressed. In 1891 M. de Lanessan, governor-general, concluded an agreement with King Norodom by which the Cambodian budget was to be combined with the general one of the protectorate. This budget was established from 1st January 1892, and immediately sent up the value by 500,000 piastres in a budget which in the previous period rose only to a total value of 800,000 piastres. The income and expenditure in 1899 practically balanced at 3,146,369 piastres. On the unification of Indo-China, Cambodia was represented, on the Superior Council. On 16th August 1899 a Council of the Protectorate was instituted. The Superior Council of Indo-China sat at Pnom-penh in October 1899, the two kings being present. Cambodia is divided into seven districts, subdivided into numerous provinces administered by mandarins subject to the resident-general and vice- residents. Cambodian idiom has nothing in common with that of Annam. It is monosyllabic in character, a blend of Malayan and Chinese. The " king's language " and the royal writing, however, are apparently of Aryan origin and akin to Pali. Cambodian writing is syllabic. The books (manuscripts) are generally formed of palm-leaves upon which the characters are traced by means of a style. The gambling monopoly was condemned in 1887, and suppressed in consequence of the financial agreement of 1st January 1893. Pnom-penh, the capital, is a town of about 45,000 people, 173 miles from the sea, on the branch of the Mekong which communicates with Tonle-Sap. It is a commercial centre of great importance. During low water the largest vessels can ascend the Mekong and drop anchor within a mile of the town. During the rest of the year they come alongside the quay below the town, in the arm of the lake. House-building is changing the appearance of the town, which has grown rapidly, new quays and numerous streets having been built. (See also Indo-China.) (j. m. a. dk l.)~~

~~Camborne, a market town and railway station in the Camborne parliamentary division of Cornwall, Eng- land, 14 mUes N.W. of Palmouth. Recent erections are a free library and mining, science and art schools ; practical mining is now taught in South Condurrow mine. Area of civil parish (an urban district), 6931 acres ; population~~

~~(1881), 13,601 ; (1901), 14,737.~~

~~*Cambrai, chief town of arrondissement, department of Nord, Prance, 37 miles S.E. of Lille, and an important junction on railway from Paris to Lille. Great improve- ments have been effected in the city. The fosses have been filled up and the ramparts in part levelled to make way, as the suburbs extended, for wide avenues stretching out on all sides. A new railway station has been con- structed. Chicory is now manufactured very extensively, and one of the sugar factories is said to be the largest in the world. During the busy season 2000 persons are employed, during the rest of the year from 300 to 400. The consumption of beetroot amounts to from 200,000 to 250,000 tons annually; Port traffic on the Mons and Seine canal was 149,422 tons in 1899. Population (1881), 14,818; (1896), 14,306, (comm.) 21,948; (1901), 26,586.*~~

~~*Cambridge, a market and university town of England, capital of the county of Cambridge, stands on the river Cam, a tributary of the Ouse, 56 miles by rail N. by*~~

~~*E. from London. Since the year 1876 several ne w colleges and hostels have been opened.*~~

~~*Cavendish College, which was founded in 1873 for the purpose of affording a cheaper course to students some- what younger than the average of the older colleges, was declared a public hostel of the university in 1882, but was closed in 1891. The buildings, situated in Hills Eoad, were acquired by the authorities of Homerton College, Middlesex (founded in 1843), and under the name of Homerton New College equipped as an undenomi- national training college for schoolmistresses. Selwyn College was incorporated in 1882, and recognized as a public hostel in 1883, though the two blocks of the existing buildings, in Grange Eoad, were not erected until 1889; the chapel in 1895. The style is Tudor, from designs by Sir A. W. Blomfield. It is intended to afford a cheaper course to students belonging to the Church of England. Ayerst Hall, opened as a public hostel on Parker's Piece in 1884, was removed in 1893 to a new structure, in the Queen Anne style, on Mount Pleasant, and closed in 1896. It is now the Eoman Catholic St Edmund's Hostel. Oirton College, which was first opened at Hitchin in 1869, was removed to its present site, 2^ miles from Cambridge, on the Huntingdon Eoad, in 1873. It consists of plain red-brick structures.*~~

~~*Additions were made in 1876 and 1883, and subscriptions were col- lected in 1901 for further enlarging it. Newnham College for women was founded in 1871. The buildings, which were added to in 1887 and 1893, consist of three halls, built from designs by Basil Champneys, and a library, added in 1898. Ridley Hall, at Newnham, was erected in 1879-82 as a training college for evangelical candidates for the ministry of the Church of England. New build- ings, including the chapel, were added in 1892. West- minster College, the theological training college of the Presbyterian Church of England, was opened in 1899. The buildings are of brick, in the Jacobean style, and stand on the Madingley Eoad.*~~

~~*The following colleges, situated in parts of England other than Cambridge, have been duly affiliated to the university — University College, Nottingham ; St David's College, Lampeter, Wales ; Firth College, Sheffield ; Uni- versity College of Wales, Aberystwith; St Edmund's College, Old Hall, Ware ; as also the Universities of New Zealand (1886), Adelaide (1891), Cape of Good Hope (1892), Allahabad (1895), Bombay (1896), Punjab (1896), Toronto (1896), Madras (1897), Sydney (1898), Montreal (1899), and Tasmania (1900).*~~

~~*Besides these, various additions have been made to the older colleges. A new east wing, of red Suffolk brick and Ancaster stone, was added to Jesus College in 1883-84 ; new buildings were added to Pembroke, from designs by G. G. Scott, Jun., in 1883; new rooms to St John's in 1887-88 ; a new hostel to Emmanuel in 1886 and 1894; new buildings (1887) and a chapel (1891) to Queens'; and a third court, from designs by J. L. Pearson, to Sidney Sussex; while St Catherine's Chapel was thoroughly restored in 1896. Amongst the new scientific equipments of the university may be mentioned the museum of archse- ology (1884), divided into two departments — one clas- sical, the other general; it also contains the museum of the Cambridge Antiquarian Society. The new geological museum was erected in 1900-1901, and the Divinity School, a 15th-century Gothic structure, built from Basil Champneys' designs in 1878-79, out of the Selwyn fund, contains Bishop Lightfoot's library. A chemical laboratory (1887), new anatomical lecture-rooms, dissecting-rooms, and anatomical museum should also be mentioned. The university library was enlarged ia 1889. The Fitzwilliam Museum has been*~~

~~enriched by several valuable bequests of pictures, &c., since 1872, and now contains also valuable collections of engravings and etchings. In 1891 Mr Newall of Gates- head presented to the astronomical observatory a new equatorial telescope of 29 feet focal length and 25 inches' aperture. Addenbroke's Hospital was enlarged in 1878 and 1883, and now has over 160 beds. In the end of 1900 the university was attended by 2985 students, and the professorial staff numbered 88. The income of the university increased from £21,629 in 1879 to £45,614 in 1899. (For the history of the university, see under Univeksities.)~~

~~Turning to the town edifices, there has been consider- able activity in church building and church restoration. To the former category belong St Barnabas' (1878-80), Early English, enlarged in 1887-90 ; St John's (begun in 1896); St Philip's (1890); the Roman Catholic Church of Our Lady (1887-90), Early Decorated, with a tower 220 feet high; and the Presbyterian church (1890-91). Amongst churches that have undergone restoration are St Mary's (1874-92); St Benet's (1874-82); St Botolph's (1874-87); St GUes's (rebuilt in 1876-76), of white brick in the Early French Gothic; and St Mary's the Less (1891). Baptists, Gongregationalists, Wesleyans, Primitive Methodists, Quakers, and Salvation Army aU have places of worship in the town. A free library was built in 1885, and a branch library on Mill Eoad^in 1897; the Teachers' Training College, Wollaston Road, 1895; the Henry Martjrn Memorial HaU in 1887 ; the Cam- bridge Technical Institute in 1894 ; the Working Men's Institute in 1884; the Beaconsfield (Working Men's) Club in 1884; the police station in 1901; the Theatre Royal in 1896; a hospital for infectious diseases in 1884; and a cattle market in 1885. In 1889-90 new buildings were erected for the Perse grammar school in Hills Road, and in 1893 a science building for Leys school. The principal industries are iron and brass foundries, brick and tile works, tobacco factories, breweries, maltings, flour mills, and nursery gardens. The town is governed by a mayor, 10 aldermen, and 30 councillors representing the town, and 2 aldermen and 6 councillors~~

~~represent- ing the university. Population (1891), the census being taken during vacation, of municipal borough (area, 3233 acres), 36,983; (1901), 38,393; of parliamentary borough (area, 3976 acres) (1891), 44,330 ; (1901), 47,737.~~

~~See J. W. Clakk, Cambridge, Historical and Descriptive Notes. London, 1890. — J. Bass Mullingkk. History of the University of Cambridge. 1888. — R. Willis. Architectural History of the Uni- versity of Cambridge, 4 vols. Cambridge, 1886. — T. D. Atkinson. Cambridge Described and Illustrated, with Introduction by J. W. Clark (1897). See also Cambkidgeshike.~~

~~Cambridge, a town of Maryland, U.S.A., capital of Dorchester county, on the south bank of the Choptank river, on the eastern side of Chesapeake Bay, at the terminus of a branch of the Philadelphia, Wilmington, and Baltimore railway. Population (1890), 4192 ;.(1900), 6747, of whom 62 were foreign-born and 1958 were negroes.~~

~~Cambridge, capital of Middlesex comity, Massa- chusetts, U.S.A. Its area of 7 square miles formerly contained several villages, the chief of which were Old Cambridge, the seat of Harvard University, East Cam- bridge, and Cambridgeport, the last two being manufac- turing and commercial centres. At present the entire area is buUt up, mainly in detached residences, and the city, although under independent government, is in effect a part of Boston, with which it is connected by several bridges and tramways. It has an excellent water-supply, and the waterworks, which belong to the city, cost more than $6,000,000. Although in the main residential, it~~

~~has extensive manufactures. In 1890 the manufacturing capital was $20,331,685, employing 14,268 persons, with an output valued at $35,975,000. The principal items of production were iron and steel goods, furniture, soap, and candles, musical instruments, and crackers. Cambridge is one of the chief publishing centres, containing nine pub- lishing houses, with a capital of $1,600,000. The assessed valuation of property in 1900 was $94,465,930, or over $1000 per caput of the population, the net debt was $6,090,707, and the rate of taxation $16.90 per $1000. The receipts from all sources, including loans, were $3,626,883, and the expenditure, including loans repaid, $3,371,184. Old Cambridge, as the seat of Harvard Uni- versity, is one of the literary and scientific centres of the United States.~~

~~Population (1880), 62,669 ; (1890), 70,028 ; (1900), 91,886, of whom 3466 were foreign-born, and 3888 were negroes. The death-rate in 1900 was 18-5.~~

~~Cambridge, the county seat of Guernsey county, Ohio, U.S.A., on the Baltimore and Ohio, and the Cleve- land and Marietta (controlled by the Pennsylvania) rail- ways, at an altitude of 842 feet. Population (1880),~~

~~2883; (1890), 4361; (1900), 8241.~~

~~Cambridge, H.R.H. George William Fred*~~

~~ericic Charles (1819- ^), 2nd Duke or, K.G. (earl~~

~~of Tipperary, baron Culloden, and duke of Brunswick- Luneburg), only son of Adolphus Frederick, 1st duke of Cambridge, and grandson of King George III., was bom at Hanover, 26th March 1819. He was thus about two months older than his cousin. Queen Victoria, and was for that period presumptive heir to the British throne. He was educated at Hanover by the Rev. J. R. Wood, a canon of Worcester. On 3rd November 1837, the rank oJE colonel in the British army was conferred upon him, and he was attached to the staff at Gibraltar from 10th October 1838 to 25th AprO. 1839. After serving in Ireland with the 12th Royal Lancers as 2nd lieutenant-colonel, he was appointed in April 1842 colonel of the 17th Light Dragoons. For two years, April 1843 to April 1846, he acted as colonel on the staff in the Ionian Islands, and was then promoted major-general. In October 1846 he took command of the Limerick district, and shortly after- wards of the Dublin district. In 1850 his father died, and he succeeded to the dukedom. Being appointed in- spector of cavalry in 1852 he held that post until 1864, when, upon the outbreak of the Crimean war, he was placed in command of the two brigades of Highlanders and Guards united to form the first division of the Brit- ish army. In June of the same year he was promoted lieutenant-general, and was present at the battles of the Alma, Balaklava, and Inkerman, and at the siege of Sebastopol. On 15th July 1856 he was appointed general commanding-in-chief, on 9th November 1862, field-marshal, and by letters patent, 1887, commander-in-chief. The period of thirty-three years during which H.R.H. held the command of the army was marked by many changes. The Crimean war brought to light great~~

administrative defects, and led to a regrouping of the departments which, with the whole personnel of the army, were brought imder the authority of the secretary of state for war. A consti- tutional development was thus involved, and the relations of the army to the Crown were gradually modified in some respects. Until 1870, however, the organization of the military forces was practically unaltered. The startling successes of the Prussian arms in the Austrian and French campaigns having created a prof ound impression, drastic changes were introduced by Mr Cardwell into the entire fabric of the army. The objects of the reformers of 1870 were undoubtedly wise; but some of the methods adopted were open to question, and were strongly resented by the

duke of Cambridge, -whose views were shared by the majority of officers. The reforms of 1870-71 having largely failed to produce the results anticipated by their promoters, further changes were inaugurated in 1880, and again H.E..H. found much to criticize. His opinions stand recorded in the voluminous evidence taken by the numerous bodies appointed to inquire into the condition of the army. They contain much sound common-sense, and they show a strong attachment to the old regimental system, and a natural dread that esprit de corps might suffer from innovations. Throughout the period of change, H.R.H., while protesting, invariably accepted and loyally endeavoured to carry out the measures on which the Government decided. In a memorandum addressed to Mr Childers in 1880 he defined his attitude as follows : — " Should it , appear, however, that for reasons of state policy it is necessary that the contemplated changes should be made, I am prepared to carry them out to the best of my ability." This attitude H.E.H. consistently main- tained, and while his training and associations led him to deprecate changes the need for which was not appar- ent to him, his military judgment was sometimes indis- putably correct. This was notably the case in regard to the ill-advised reduction of the artillery carried out by Mr Stanhope. Under the Order in Council of February 1888, the whole responsibility for military duties of every kind was for the first time centred upon the Commander- in-Chief. This, as

~~*pointed out by Lord Hartington's commission in 1890, involved "an excessive centraliza- tion " which " must necessarily tend to weaken the sense of responsibility of the other heads of departments, and thus to diminish their efficiency." The duke of Cam- bridge, whose exalted position entailed many duties apart from those strictly appertaining to a Commander-in-Chief, could not give personal attention to the vast range of matters for which he was made nominally responsible. On the other hand, the adjutant-general, as " chief staff officer," coidd act in his name, and the Secretary of State could obtain military advice given behind his back by officials charged with no direct responsibility. The effect was to place the duke in a somewhat false position in the eyes of the Army and of the country, while power accumulated in the hands of this adjutant-general. If the administration of the army suffered after 1888, this was due to a system which violated principles.*~~

~~*Throughout his long term of office the duke of Cam- bridge evinced a warm interest in the welfare of the soldier, and great experience combined with a retentive memory made him master of military details. While quick to condemn deviations from the letter of regu- lations, and accustomed to insist upon great precision in drill, he was never a martinet, and his natural kindliness made him ready to bestow praise. Belonging to the pre- scientific period of the British army, he could not easily adapt himself to the new conditions, and in dispensing patronage he was somewhat distrustful of originality, while his position as a member of the royal family tended to narrow his scope for selection. He was thus inclined to be influenced by considerations of pure seniority, and to underrate the claims of special ability. The army, how- ever, always recognized that in the duke of Cambridge it had a Commander-in-Chief devoted to its interests, and keenly anxious amid many difficulties to promote its well-being. The duke resigned the Commandership-in- Chief 1st November 1895, being succeeded by Lord Wolseley. H.E.H. was colonel of the Scots Fusiliers from 1852 to 1861, of the Eoyal Artillery, 1861, and colonel of the Grenadier Guards since 1862. He was made Sanger of Hyde Park and St James's Park in 1852, and of Eichmond Park in 1857; governor of Wool- wich Academy in 1862, and its president in 1870, and*~~

~~*personal aide-de-camp to Queen Victoria in 1882. The chief honours conferred upon him were : G.C.H., 1825 ; K.G., 1835; G.C.M.G., 1845; G.C.B., 1855; K.P., 1861; K.T., 1881.*~~

~~*Cambridgeshire, a south midland county of Eng- land, bounded on the E. by Norfolk and Suffolk, on the S. by Essex and Hertford, on the W. by Bedford, Hunt- ingdon, and Northampton, and on the N. by Lincoln.*~~

~~*Area and Population.— In 1891 the area of the ancient (geogra- phical) county was 549,749 acres, and the population 188,961, of whom 92,613 were nmles, and 96,448 females, an increase of 3367 persons since 1881 (186,594), or an increase of 1-8 per cent, as compared with a decrease of 0-7 per cent, (namely 1312 persons) in the period 1871-81. In 1891 there were 0-34 persons to an acre, and 2-91 acres to a person. In the same year the area of the registration county was 566,737 acres, and the population 196,269, of whom 96,219 were males, and 100,050 females ; in 1881 the registration county contained 191,289 inhabitants (94,002 males, 97,287 females). In 1901 the population of the ancient county was 190,687. Particulars of the birth-rate, death-rate, and illegitimacy- rate, and the number of persons married per 1000 inhabitants are given in the subjoined table : —*~~

~~*1871-80.*~~

~~*1861-90.*~~

~~*1887-97.*~~

~~*1898.*~~

~~*Birth-rate Death-rate Illegitimacy-rate Marriage-rate .*~~

~~*32-3*~~

~~*18-8*~~

~~*67*~~

~~*13-0*~~

~~29-3~~

~~17-3~~

~~64~~

~~12-8~~

~~27-2~~

~~16-6~~

~~51~~

~~13-4~~

~~26-4~~

~~15-6~~

~~48~~

~~14-1~~

~~In 1891 the county contained 494 persons of Scottish birth, 438 of Irish birth, and 260 foreigners. At the same date there were 174 blind persons, 80 deaf and dumb, and 664 insane.~~

~~Adminigtration. — ^The ancient county is for parliamentary pur- poses divided into three divisions (Northern or Wisbech, Western or Chesterton, and Eastern or Newmarket), and embraces also the parliamentary borough of Cambridge, each returning one member. The University of Cambridge also returns two members. Adminis- tratively the ancient county embraces the two counties of Cam- bridge and the Isle of Ely. There are two municipal boroughs, Cambridge and Wisbech ; courts of quarter sessions at Cambridge and Ely ; and ten petty sessional divisions. The boroughs of Cambridge and Wisbech have each a separate commission of the peace; and the University of Cambridge exercises disciplinary jurisdiction over its own members. The two administrative counties contain together 172 entire~~

~~civil parishes and parts of 4 others. The ancient county contains 181 entire ecclesiastical parishes or districts, with parts of 12 others, most of them in the diocese of Ely. Spring assizes are held at Ely, summer assizes at Wisbech.~~

~~Education. — There is a day training college for schoolmasters at Cambridge, and in the same town also the New Homerton unde- nominational training college for women (see Cambridge). At Ely a theological college was founded in 1876, the building being opened in 1881. The number of elementary schools in the county, in- cluding also the Isle of Ely, on 31st August 1898 was 224, of which 66 were board schools and 158 voluntary schools, the latter including 146 National Church of England schools. The average attendance during the year at the board schools was 8920, and at the volun- tary schools 18,996. The total school board receipts for the year ending 29th September 1898 was £23,984. The income under the Technical Instruction Act was £467, and under the Agricultural Bates Act £2283.~~

~~Agriculture. — In the period 1875-99 the area under com crops decreased, as did also the area of the green crops, chiefly miscel- laneous roots and fodder plants. Potatoes, on the other hand, showed a very considerable increase. Since the year 1875 there has been a very noticeable decline in the number of sheep. The number of acres farmed by tenants was 402,450 in 1889, and 402,438 in 1899 ; whilst in 1889, 86,202 acres were farmed by their owners, and in 1899, 87,822 acres.~~

~~The table immediately following shows the area under the differ- ent kinds of crops at the periods named : —~~

~~Tear.~~

~~Ares in~~

~~Cultiva- tion.~~

~~Under Corn Crops.~~

~~Under Green Crops.~~

~~*Bare FaUow.*~~

~~*Under*~~

~~*Permanent*~~

~~*Grass.*~~

~~*1875 1880 1885 1890 1895 1899*~~

~~*483,340 485,482 487,496 491,153 488,524 490,260*~~

~~*261,327 251,479 241,777 238,414 222,073 222,434*~~

~~*85,793 82,735 82,102 75,494 76,526 76,174*~~

~~*16,776 20,422 20,040 15,940 18,776 12,806*~~

~~*96",894 108,468 117,058 117,722*~~

~~*516*~~

~~*CAMBUSLAN G — C AMEEA OBSCUEA*~~

~~*The next table shows the number of live stock at the periods named : —*~~

~~*Tear.*~~

~~*Cows and Heifers.*~~

~~*Other Cattle.*~~

~~*Total Cattle.*~~

~~*Horses.*~~

~~*Sheep.*~~

~~*Pigs.*~~

~~*1875*~~

~~*47,507*~~

~~*26,959*~~

~~*321,993*~~

~~*43,687*~~

~~*1880*~~

~~*14,106*~~

~~*32,385*~~

~~*46,490*~~

~~*29,387*~~

~~*309,260*~~

~~*39,459*~~

~~*1886*~~

~~*15,276*~~

~~*35,299*~~

~~*50,575*~~

~~*27,476*~~

~~*274,493*~~

~~*44,868*~~

~~*1890*~~

~~16,568~~

~~36,976~~

~~62,543~~

~~28,759~~

~~259,426~~

~~55,611~~

~~1896~~

~~16,519~~

~~32,618~~

~~48,137~~

~~31,056~~

~~213,482~~

~~56,191~~

~~1899~~

~~17,928~~

~~38,195~~

~~66,123~~

~~31,506~~

~~214,422~~

~~48,472~~

~~AuTHOEiTiES.— S. H. Miller and S. B. J. Skertohlt. The Fenland. Wisbech, 1878.— F. R. C. Bead. Handbook to the Geology of Cambridgeshire. Cambridge, 1897.— A. Kingston. East Anglia and the Great Ciiiil War. London, 1897.— C. C. Babing- TON. Ancient Cambridgeshire. Cambridge, 1883.— R. Bowes. Catalogue of Books printed at or relating to Cambridge. Cam- bridge, 1891, et seqq. (j. T. be.)~~

~~Cambuslang, a town of N.W. Lanarkshire, Scot- land, near the Clyde, about 5 miles S.E. of Glasgow by- rail, inhabited for the most part by Glasgow business men. There are 13 coal-mines in the vicinity, a turkey-red dyeing establishment, and the largest steel works in the kingdom. Eecent structures are United Free churches, an institute and library, a public hall, a new bridge over the Clyde, and an Established church hall. Electric light is supplied. Population (1881), 5538; (1891), 8323; (1901), 20,212.~~

~~Camden, a city and port of entry of New Jersey, U.S.A., and capital of Camden county, situated in 39° 57' N. lat. and 75° 07' W. long., on the Delaware, opposite Philadelphia, of which, it is a suburb. It is entered by three railways — ^the Pennsylvania, the Atlantic City, and the West Jersey and Seashore. It has extensive manu- factures, in which there was invested, in 1890, a capital of $15,244,500, employing 10,362 persons, with an out- put valued at $21,145,637. The principal manufactures were iron and steel, shipbuilding, woollen and worsted goods, oil-cloth, and boots and shoes. In 1900 the assessed valuation of property, real and personal, was $27,607,810. The net debt was $2,453,475, and the rate of taxation $21.40 per $1000. Population (1880), 41,659; (1890), 58,313; (1900), 75,935, of whom 10,097 were foreign-born, and 6576 were negroes. The death- rate in 1900 was 16-3.~~

~~Camera Obscura. — ^The invention of this in- strument has generally been ascribed, as in the ninth edition of this work, to the famous Neapolitan savant of the 16th century, Giovanni Battista della Porta, but, as a matter of fact, the principle of the simple camera obscura was well known and it was in practical use long before his time. He was anticipated in the discoveries he claimed to have made regarding it, and all he seems really to have done was to popularize it. The increasing importance of the camera obscura as a photographic instrument makes it desirable to bring together what is known~~

of its early history, which is far more extensive than is usually realized. In southern climes, where during the summer heat it is usual to close the rooms from the glare of the sunshine outside, we may often see depicted on the walls vivid inverted images of outside objects formed by the light reflected from them passing through chinks, or small openings, in the shutters. We do not, however, find many allusions to this appearance in the ancient writers, but the correlated problem of the image of the sun passing through a quadrilateral aperture always appearing round is explained by Aristotle (Probl. sect. xv. cap. 5), and he further describes the appearance of the eclipsed sun or moon in the same manner through the interstices of foliage or lattice-work. These problems regarding the passage of lightthrough small apertures and their practical application in the camera obscura, occupied the attention of many of

the master minds of the period between the 13th and 17th centuries, in which the foundations of modern science were laid. Among them were the following : —

Roger Bacon, about 1260 "1

John Peokham \ Optical problems.

VitelUo J ,,,,, r,u ^

Leon Baptista Alberti, the architect, 1437. Show-box.

Leonardo da Vinci, end of 15th, or early in 16th century,

Don Papnutius, or Panuce, before 1521.

Franciscus Maurolycus, 1522. Optics.

Erasmus Reinhold, 1640 > ^^j. oijgerving eclipses.

Gemma Frisius, 1544 J ° —

Jerome Card»n, 1650. Camera obscura with speculum.

Giov. Batt. Porta, 1558. Camera without lens and with speculum.

~~*Daniele Barbaro, 1568. Camera with lens as an aid for drawing.*~~

~~*Egnatio Danti, 1573. Reflecting mirror for erecting images.*~~

~~*Ferderic Risner, before 1580. For copying maps.*~~

~~*Giov. Batt. Benedetti, 1585. Camera obscura with lens.*~~

~~*Giov. Batt. Porta, 1689. Camera obscura with lens.*~~

~~*Johann Kepler, 1600. Optical theory and solar observations.*~~

~~*Johann Fabricius, 1611. Observations of sun-spots.*~~

~~*Christopher Scheiner, 1611-30. Helioscope for solar observations.*~~

~~*Gaspar Schott, 1657. Optical theory.*~~

~~*Johann Zahn, 1685. Box forms of camera and optics.*~~

~~*That Eoger Bacon was acquainted with the principle of the camera obscura is shown by his solutions of the optical problems relating to the passage of light through small round or multiangular apertures given in his Perspectiva, which are better and clearer than Peckham's or Vitellio's, but there is nothing to be found in his published writings to show clearly that he had constructed any instrument for viewing outside objects on that principle, though it seems possible from a passage of the Perspectiva, upon which Friend, in his History of Physick, gives him the credit of the invention. The arrangement of concave and plane mirrors, by which the realistic images of objects inside the house or in the street could be rendered visible, though intangible, there alluded to, may apply to a camera on Cardan's principle, or to a method of aerial projection by means of concave mirrors with which Bacon was quite familiar, and indeed was known long before his time.*~~

~~*There is no clear evidence that Alberti invented or described the camera obscura, but it appears from an extract from an anonymous biography of him, quoted by Vasari, that he constructed little boxes in which painted pictures were viewed through a small hole with great verisimilitude. He had*~~

~~two kinds, one for use at night, showing the moon and bright stars, and the other for day scenes. The account is vague, and seems to refer more to a magic lantern or show-box than to the camera obscurar^ though some forms of the lattier can be used as show- boxes (Harris's Optics). Kircher mentions some arrange- ment of this kind made by an Albertus, whom he dis- tinguishes from Albertus Magnus. Libri, in the history of the invention of the camera obscura in Italy, given in his Histoire des sciences matMmatiques en Italie, iv. 303, makes no mention of Alberti, but he draws attention to an unpublished MS. of Leonardo da Vinci, which was first brought to light by Venturi, in his JEssai sur les ouvrages physico-matMmatiques de Leonardo da Vinci (Paris, 1797), in which the appearance of the reversed images of outside objects on a piece of paper held in front of a small hole in a darkened room is quite clearly described and explained, with a diagram, as well as its application to illustrate the phenomena of vision. This is probably the earliest distinct account of the camera obscura, though Leonardo does not mention it as an invention of his own. The first published account, however, appears, as Libri has shown, in a translation, with commentary, of the Archi- tecture of Vitruvius, published at Como, in 1521, by C. Csesariano, in which he mentions an experiment made by a Benedictine monk and architect, Don Panuce, of the same kind as Leonardo's, but without the demonstration.~~

~~About the same time Maurolycus, the eminent mathemar tician of Messina, in his Theoremata de Lumine et Umbra, fully investigated the optical problems connected with vision, the passage of rays of light through small apertures with and without lenses. Eisner says he has described the application of the darkened room to the observation of eclipses. In any case his theoretical work was a great advance on that of his predecessors. It is possible that Eeinhold got this method of observing eclipses from Maurolycus, through Piirbach. He is said to have used it to observe an eclipse of the sun at Wittenberg, in 1540, and he certainly did so in 1544 and 1545. He has de- scribed his method in his edition of Pilrbach's Theoricce NovcB Planetarum, and says it can also be applied to observing~~

~~*terrestrial objects, though he only used it for the sun. Gemma Frisius has fully described the application of Eeinhold's method to making measurements and drawings of the sun during eclipses, or otherwise, and gives a figure of the arrangements he adopted in observing the eclipse of January 1544 at Louvain, in his De Radio Astronomico et Geometrico (1545), p. 31. He says it can also be used for observations of the moon and stars and for longitudes. Moestlin adopted the same method later, and handed it on to Kepler. It had the advantage of being simple and avoiding injury to the eyes. It is interesting to note this early application of the camera obscura to the field of astronomical research, in which its latest achievements have been of such pre-eminent value.*~~

~~*The addition of optical appliances to the simple dark chamber seems to have been first described by Cardan, in a,TpsiSsa,ge in his treatise DeSubtilitate (1550), p. 107, which Libri has noted : " Quod si libeat spectare ea quod in via fiunt, sole splendente, in fenestra orbem h vitro coUocabis, inde occlusa fenestra videbis imagines per foramen trans- latas in opposite piano . . . atque alia mira non solum sphaericum sed et conicum ac cylindricum." From this it would appear that he used spherical mirrors, and not a lens, which might be implied by the use of the word " orbem."*~~

~~*We now come to Porta. In his first account of the camera obscura in the Magia Naturalis, in "four books, Kaples, 1558, no mention is made of a lens, but he discloses as a great secret, that by a proper arrangement of a concave speculum in front of the aperture the colours of objects could be seen much better. This seems, however, to be very similar to Cardan's arrangement published eight years earlier. Porta also alludes to the application of the method to painting by persons ignorant of cfrawing who could lay on colour. His second edition, in which he in the same words claims the discovery of the use of a convex lens in the aperture as his own, and a secret he intended to keep, was not published till 1589, thirty-one years after the first. In this interval the use of the lens was discovered and clearly described by Daniele Barbaro, a Venetian, Pa,triarch of Aquileia, in his work on geometrical perspective. La Pratica della Prospettiva, p. 192, published in 1568, or twenty-one years before Porta mentioned it. The lens used by Barbaro was an ordinary convex, or old man's, spectacle glass ; concave, he says, will not do. He shows how the paper must be moved till it*~~

~~*is brought into the focus of the lens, the use of a diaphragm to make the image clearer, and also the application of the method for drawing objects in true perspective. That Barbaro was really the first to apply the lens to the camera obscura is supported by Bettinus in the Apiaria, and by Schott in his Magia Universalis, the former taunting Porta with the appropria- tion. In an Italian translation of Euclid's Optics, published by Egnatio Danti in 1573, after discussing the effects of plane, convex, and concave reflectors, he gives a full description of the method of showing reversed images passing through an aperture in a darkened room, and shows*~~

~~*how by placing a mirror behind the aperture unreversed images might be obtained, illustrating the two effects with diagrams.*~~

~~*Eisner, who died in 1580, has also in his Opticoe (1606) very clearly explained the reversal of the images in the camera obscura. He notes the conveniences of the method for solar observations, and its previous use by the observers already mentioned. He further points out its advantages for easily and accurately copying on an enlarged or reduced scale, especially for chorographical or topo- graphical documents. This seems to be the first notice of the application of the camera to cartography and reproduction of drawings on various scales, which, per- haps more than anything else, is its prime use at the present day. In the Diversarum Specvlationum Mathe- maticarum et Physicarum, written in 1585 by the Venetian nobleman Benedetti, there is a letter to Pirro de Arzonis, in the course of which, after discussing the destruction or weakening of the images of the camera obscura by the admission of extraneous light, he tells him of an improve- ment in that sort of thing some one had carried out by the use of a double convex glass in the aperture of the dark room, and that the images could be made erect by reflexion from any plane mirror. This was four years before Porta published it, and may refer to Barbaro. The account of the camera obscura given in Porta's second edition of the Magia Naturalis, in 1^89, is expanded from the first. The use of the lens, which is given as a great secret, in place of the concave speculum of the first edi- tion, is not so clearly described as by Barbaro ; the con- cave speculum is used for making the images larger and clearer, and also for making them erect, but no details are given. He describes some peep-show arrangements, and indicates how the camera with a concave speculum can be used for observing eclipses.*~~

~~There is no mention of a portable box or construction beyond the darkened room. In his treatise De Mefractione Optices Parte (1593), he goes into the theory of vision and the optics of the camera. He brought forward no novelty in the camera obscura, he did not improve it, his descriptions of it are vague, but were published in a book which became popular, and so he acquired credit for the invention.~~

~~The first to take up the camera obscura after Porta's second edition was Kepler, who used the method for solar observations in 1600, and in his Ad Vitellionem Parali- pomena (1604) discusses all the old problems of the passage of light through small apertures and the rationale of the camera obscura. He was the first to make iip an instrument fitted with a sight and paper screen for observing the diameters of the sun and moon in a dark room. In his later book Dioptrice (1611) he fully dis- cusses refraction and the use of lenses, showing the action of the double convex lens in the camera obscura, and the principles which regulate its use, with the reason of the reversal of the image. He also shows that enlarged images can be produced by using a concave lens at a suit- able distance behind the convex, as in modern telephoto- graphy. He extended the work of Maurolycus, and demonstrated the exact analogy between the eye and the camera and the arrangements by which an inverted image is produced on the retina.~~

~~About this time the telescope came into use, and the danger of observing the sun vrith it was soon discovered. In 1611 Pabricius published his observations of sun-spots, and describes how he and his father fell back on the old method of observing the sun's image through a small hole in a darkened room, finding that they could observe the spots just as well as in the telescope. They do not seem to have used a lens, or thought of using the telescope for projecting an enlarged image. This was done by Scheiner, who has fully described and illustrated his method in the~~

~~Hosa Ursina, published in 1636. He demonstrates very clearly and practically the advantages and disadvantages of the different methods,~~

~~*without a lens, with a single convex lens, and with a telescope, as used in his helio- scope, which was a telephotographic arrangement on a stand on Kepler's principle. Here we first find the dark chamber constructed of wooden rods covered with cloth or paper, used separately to screen the observing tablet.*~~

~~*Bettinus in his Apiaria (1645) has described several methods of measuring the sun and terrestrial objects by the images projected through an aperture, and also meth- ods for erecting the inverted images formed by lenses in the camera obscura. In 1646, Fr. Kircher published his well-known Ars Magna Lucis et Umbrae, and in it has gathered most of the information then available on the principle and use of the camera obscura and methods of optical projection. It is noticeable that he first uses the word conclave, a box or cage, like Scheiner's, as alternative to camera. The optical principles of the camera obscura with and without lens were very fully treated by Schott in the first part of his Magia Universalis Naturm et Artis (1657), and he has discussed the nature and manner of production of the image on the paper, the similarity of the eye to the camera, and the phenomena of vision. In his preface there is a useful list of early writers on optics.*~~

~~*It is difficult to ascertain when the camera first came to England. The translation of Porta' s book, Natural Magick, was published in 1658, and in the same year there is a mention of a portable tent camera obscura for sketching, in a work called Graphice, or the Most Excel- lent Art of Painting. In this the object glass of a "pro- spective image trunk," or telescope, was used alone to throw the image on a sheet of paper on which the out- line could be drawn. William Molyneux has given a number of optical problems relating to lenses in his Treatise of Dioptrics, 1692. He states the relative pro- portions between the diameters of the object and the image, and their distances from the lens, and proves it geometrically by the case of the camera and lens. The analogy of the eye and the camera is also discussed, as well as the optical theory of the dark chamber or camera with and without a lens.*~~

~~*The first notice of a box, or portable camera with lens, appears to be in Zahn's Oculus Artificialis Teledioptricus (1702). He gives figures and*~~

~~*descriptions of two forms : one a wooden box with a projecting tube, in which two or three lenses could be fitted, the image from which was thrown on a screen of oiled paper and viewed through a hole in the back of the camera about two or three inches away. The second was fitted with a reflector to throw up the image on a horizontal screen on which it would be viewed unreversed. There is also a great deal of theoretical and practical information on lenses in connexion with the camera and other optical instruments. Prom John Har- ris's Lexicon Technicum (1704), we find that the camera obscura fitted with the arrangement called the " scioptric ball," and known as Scioptricks, was on sale in London, and after this must have been in common use, either as a sketching instrument or as a show. Many patterns are described in Joseph Harris's Treatise on Optics, 1775, Hutton's Philosophical and Mathematical Dictiona/ry, and other books on Optics and Physics of that period.*~~

~~*The camera obscura was first applied to photography by Thomas Wedgwood about 1802. (j. wa.*)*~~

~~*Camerino, a town and archbishop's see of Italy, the Marches, province of Macerata, 24 miles S.W. from Macerata, on an E. spur (1139 ft.) of the Apennines. It is the seat of a " free " university, founded in 1727, and attended in 1898 by 234 students ; 18 professors. Popu- lation, about 12,000.*~~

~~*Cameron, Verney Lovett (1844-1894), African traveller, was born at Eadipole, near Weymouth, 1st July 1844. He entered the navy in 1877, and was employed for a considerable time in the suppression of the East African slave-trade. The experience thus obtained led to his being selected to commaud an expedition sent out by the Eoyal Geographical Society in 1873, to succour Dr Livingstone. Soon after the departure of the expedi- tion from Zanzibar, Livingstone's servants were met bearing the dead body of their master, but Cameron con- tinued his march, reached Ujiji, on Lake Tanganyika, in February 1874, and, after solving the principal geographi- cal problems connected with that lake, proceeded south- west, continually making discoveries in regions never before visited by any European. His travels were pub- lished, under the title Across Africa, in 1876. The re- mainder of Cameron's life was chiefly devoted to projects for the*~~

~~commercial development of Africa, and to writing tales for the young. He also visited the Euphrates valley in connexion with the proposed railway, and ac- companied Sir Richard Burton in his West African exploration in 1882. He wrote on both subjects. He was kiUed by a fall from horseback when returning from hunting, 24th March 1894.~~

~~Cameroon, or Kamerun, in West Central Africa, forms the north-west corner of the great Central African plateau. This becomes evident ia its eastern section, where axe wide-spreading plains, which farther west assume an undulating character, and gradually merge into a picturesque mountain range. This range, running from north to south, is flanked by a second lower parallel range in the west, with a wide valley between. In the north-west the Upper Guinea mountains send their east- ern spurs just across the boundary, and from a volcanic rift, which runs south-west to north-east, the Cameroon peak rises to an elevation of 12,480 feet. Inland the Chebchi and Mandara mountains indicate the direction and extent of the rift. Geologically, these three moun- tain groups belong to so many different periods. The first is composed of Archaic rocks ; the part belonging to the Guinea mountains is of more recent age, showing sandstones and clay schists; while the rift mountains and Cameroon peak are purely volcanic. The mountains of the plateau lose their meridional direction, sweeping grandly round to the east on reaching the eighth degree of N". lat. Here they give rise to a number of small rivers, which collect in the rift and form the Benue, that passes between the two chief groups of the rift moun- tains, and leaves the protectorate to join the Niger. Cameroon is thus a mountainous country, which has only, on the coastj a strip of low land. In the south, near Batango, this is very narrow; it widens towards the north. Here, at the foot of the peak, a number of estua- ries cut deep bays which form excellent harbours. The small rivers which empty into them can be ascended for some miles by steam-launches. The chief rivers of the protectorate are the Lorn and Nyoug, next to them the Lokunja and Kribi. The two former rise on the central plateau, down which they leap in splendid cascades; through the parallel coast range they break in rapids, which indicate the extent of their navigability. It is most probable that the Sannaga, an arm of the Lom, will also prove navigable for launches in its upper course on the plateau. Through the Logone and Shari the country becomes tributary to Lake Chad, through the Sanga to the Congo.~~

~~*Climate. — Cameroon has a very considerable rainfall, and though this is greater in a certain part of the year, there is hardly a month without rain. In the interior four seasons can be distinguished ; a comparatively dry*~~

~~*and a wet one alternating. Although on the northern hemisphere, the seasons show a south equatorial character. July to October are the coldest months, and also bring most rain. On the coast the temperature is high all the year round, but in the interior it falls as the country rises. Malarial fever is frequent, and even the natives, especially imported Africans, suffer from it.*~~

~~*Flpra and Fauna. — The southern part of the low coast is chiefly grass-land, while the river mouths and arms of the bay are lined with mangrove. The mountainous region is covered with primeval forest, in which timber and valuable woods for cabinet-making are plentiful. Most important are the Elaeis guineensis, SterauUa acumi- Tiaia, and the wUd coffee-tree. On Cameroon peak the forest ascends to 8000 feet; above it is grass-land. Towards the east the forest gradually grows thinner, assumes a park-like appearance, and disappears, and wide grass uplands take its place. Animals of all kinds are plentiful, including the great pachyderms and carnivora. The latter prey on the various kinds of antelopes which swarm on the grass-lands, and two kinds of buffaloes are found in the forests, which are the home of the gorilla and chim- panzee. Large rodents, like the porcupine and cane rat, are frequent. Of birds there are 316 species, and several of venomous snakes.*~~

~~*Ethnology. — The north of Cameroon is inhabited by Sudan negroes, the south by Bantus. The former only recently came from the north and north-east, gradually driving the Bantu before them. They are a fine race, probably of Hamitic origin ; they brought horses and horned cattle with them, which were unknown in these regions until then, and they founded well-organized states, like that of Adamawa, of which Yola is the capital. The Chief, or Emir, who resides here, is nominally a subject of the so-called Emperor of Sokoto, but exercises rather independent authority over the*~~

~~*people under his rule. He has a strong military force, consisting chiefly of well- mounted cavalry. In the lower parts of the country, in the vicinity of the rivers Benue, Earo, and Mao Kebbi, the people, who are good agriculturists, cultivate exten- sive fields on the hills, which, north of the river, form disconnected ranges ; while south of it they represent the slope of the great central African plateau, and stock- raising forms the chief pursuit of the inhabitants. Hand in hand with the labours of the field a considerable industry is carried on. The people forge their own arms, and manufacture their own stuffs for clothing out of the native cotton. Common villages are built in the Sudanese zeriba style, surrounded with thorn fences; more impor- tant places are enclosed by a well-built wall and strongly fortified. Being of warlike disposition, the people often wage war with their neighbours and also amongst them- selves. The Bantu negroes inhabit the country south of about 7° of N. lat.; they are active traders, who well understand how to keep the intertribal barter entirely in their own hands. They buUd square houses, and are ruled by independent chiefs, but in no case has an attempt at political organization been observed amongst them, though they quickly adapt themselves to civilization. Among the Duallas a curious system of drum signals is noteworthy.*~~

~~*Area and Population. — The western boundary of Cameroon was laid down in an agreement between Ger- many and Great Britain on 15th November 1893, and runs as follows : — From the mouth of the Eio del Eey to the rapids of the Old Calabar or Cross river under 9° 8' E. long. Thence in a straight line towards Yola, as far as the confines of that township. This, in the east, forms part of a circle, of which the radius is a line drawn from the centre of the town to a spot fully 3 miles west of where the Faro river joins the Benue. From this point,*~~

~~*on the left bank of the river, the line goes to the point of intersection of 13° E. long, with 10° N. lat., from here to the border of Lake Chad, 35 miles east of the meridian of the town of Kuka. The south and east boundaries were ^ laid down by agreements between Germany and France on 24th December 1886 and 15th March 1894. The south boundary goes in an almost straight line from the mouth of the Campo river to the river Sanga. And the eastern boundary runs irregularly north to 10° !N". lat., and thence eastwards to the Shari river, which it follows to Lake Chad. The*~~

~~*protectorate measures about 191,130 square miles, and is estimated to have 3,500,000 inhabitants. In 1899 there were 425 whites, of whom 348 were German and 36 English. The principal town is Cameroon ; and BuSa, Victoria, Bibundi, Batanga, and Campo are impor- tant trading stations; Aquatowh and Belltown are the principal native settlements.*~~

~~*Administration. — Cameroon is divided into three dis- tricts, each with an administrative ofiB.cial, subordinate to the Landeshauptmann or commissioner. The forces consist of 32 Germans and 654 natives, who are dis- tributed on a number of stations in the interior. There are two courts of law and a court of arbitration for native ofSceers.*~~

~~*Education. — The Bantu are Pagans, the Sudanese Mahommedans. There are four missionary societies (American Presbyterian, Eoman Catholic, Baptist, and Protestant). There are several well-attended schools, and it is a hopeful sign that the natives eagerly desire their children to learn to read and write. There are the Gov- ernment schools with 600 pupils, while the missionary schools are attended by 5000 pupils.*~~

~~*Finance.— The revenue for 1898-99 was 1,251,387 marks, including imperial grant in aid. The budget revenue for 1899-1900 (iacluding imperial contribution) and expenditure was 1,713,000 marks ; the imperial contribution for 1900-01 is 1,197,700 marks. There are the ordinary export and import taxes, and various other dues.*~~

~~*Shipping. — There is regular steamship communication between Hamburg and Cameroon. The Woerman line steamers leave Hamburg monthly, and call at most of the ports of the protectorate. The African Steamship Com- pany's and the British and African Steam Navigation Company's steamers also call once a month. In 1898-99, 66 vessels of 81,891 tons called at the ports.*~~

~~*Post and Telegraph.- — There is no railway. Eoads are gi-adually being built. On the rivers which run into the bay, small steam-launches ply, and communication with the Government stations in the interior is kept up through native runners. . Mails are carried by German and British steamers three times a month. The protec- torate belongs to the Postal Union, and the cable is connected with the British Telegraph Station at Bonny on the Niger.*~~

~~*Production. — Cameroon is rich in natural products; ivory is among the export articles, of which the chief are palm-oU, palm kernels, and cocoa. Eubber is collected from the Landolphia and various species of Ficus. Copal, copra, Calabar beans, and kolaruuts are exported in large quantities. There are several kinds of finely grained wood, amongst which a very dark ebony is specially remarkable. Cotton, indigo, and various fibres of plants deserve notice. The natives grow several kinds of bananas, yams and batatas, maize, pea-nuts, sugar-cane sorghum, and pepper. Valuable minerals have not yet been found in paying quantities, though signs of gold have been discovered. Iron is smelted by the natives, who, especially amongst the Sudanese, are very clever smiths, and manufacture fine lance- and arrow-heads, knives and swords, and also hoes. Smithwork is*~~

~~*about the only useful form of existing industry. The natives round the bay are clever carvers of wood, and make highly ornamental figure-heads for their canoes, ■which also sometimes show very fine workmanship. In the interior the people use the wild-growing cotton and fibres of plants to manufacture coarse drapery and plait- work. In 1898-99 the imports were valued at 10,638,955 marks, and exports at 6,145,822 marks. Of the exports, palm-oil was valued at 893,361 marks; palm kernels, 1,365,608 marks ; gum, 1,928,080 marks ; ivory, 698,470 marks ; cocoa, 813,115 marks.*~~

~~*Development. — Of old Cameroon and the neighbour- ing coast were known as the Oil Coast, and trading settlements were established at an early period. The trade, however, was always confined to the coast, because the Dualla and other tribes had become recognized intermediaries between the coast factories and the tribes in the interior, whither they allowed no strange trader to proceed. They took a quantity of goods on trust, visited the tribes in the forest, and bartered for ivory, rubber, and other produce. This method had become so universal, that it was called the trust system, under which name, though in a safer form, it still exists. It hampered the coast trade seriously, and had to be abolished before it was possible to open up the interior to settlers and traders. With the utmost difficulty, and not*~~

~~*without bloodshed, this barrier was broken down, and direct communication with the higher parts of the country established, and traders from the interior induced to visit the coast. The great labour question came next. In order to lay out plantations, workers had to be brought from the interior, for the coast tribes will only trade, and not work. But the plantations have proved a success, and though coffee, tobacco, ginger, and other plants thrive well, the best article seems to be cocoa, of which more than half a million trees have been planted, which yield yearly large quantities of excellent cocoa.*~~

~~*Authorities. — E. Zintgraph. Nord Kamerun, Berlin, 1895. — F. ■WoHLTMANN. Dsr Plantagenbau in Kamerun und seine Zu- kunft, Berlin, 1896. — Fr. Plehit. Die Kamerunkiiste, Studien zur Elimatologie, Fhysiologie, und Pathologie in den Tropen, Berlin, 1898. (j. von P.)*~~

~~*Camiling, a town of 23,000 inhabitants, in the northern part of the province of Tarlac, Luzon, Philip- pine Islands, on a branch of the river Agno. Its pro- ducts are rice, Indian corn, sugar, and indigo. Fine timber grows in the vicinity. The principal language is Pangasinan.*~~

~~*Cammarata, acommune of the province of G-irgenti, Sicily, Italy, 28 miles N. from G-irgenti by the railway to Palermo. It lies at the N.E. foot of Mount Cam- marata (5181 feet), one of the loftiest summits in Sicily. It has mines of rock-salt and sulphur springs, with a bath-house. Population, about 6500.*~~

~~*Campagna di Roma, in the wider sense, means the plains which stretch around the city of Eonie, and, in the more restricted sense, the coast-belt which extends from Civitavecchia to Terracina. By action of the Italian parliament in 1882, 1886, and 1893, great efforts have been made to cure the waterlogged condition of the marshy grounds. The methods employed have been three — (i.) the cutting of drainage channels and clearing the marshes by pumping, the method principally employed ; (ii.) the system of warping, i.e., directing a river so that it may deposit its sedimentary matter in the lower-lying parts, thus levelling them up and consolidating them, and then leading the water away again by drainage ; (iii.) the planting of firs and eucalyptus trees, e.g., at Tre Fontane and elsewhere. These efforts have not been without*~~

~~*success, though it cannot be affirmed that the malarial Campagna is anything like healthy yet. Its bare, treeless, sun-browned expanses are still given over to herds of oxen, horses, sheep (from October to June), and buffaloes ; but some fruit and wine are produced. The regulation of the rivers, more especially of the Tiber, is probably the most efficient method for coping with the problem. Since 1884 the Italian Government have been systematically enclosing, pumping dry, and generally draining the marshes of the Agro Eomano, that is, the tracts around Ostia ; the Isola Sacra, at the mouth of the Tiber ; and Maccarese. Of the whole of the Campagna less than one-tenth comes annually under the plough. As regards the Pontine Marshes, the worst district of all, in the south, the govern- ment drainage schemes have so far reclaimed them that they are now in great part adapted for pasturage, or are even cultivated. The evil in 'this tract arises chiefly from the insignificant slope of the ground, so that the surface- waters are unable to find their way readily to the sea.*~~

~~*See Field-MarshaJ Count Moltke's Wanderbuch (6tli ed., Berlin, 1892).*~~

~~*Campania, a territorial division of Italy, bordering on the Tyrrhenian (Mediterranean) Sea, both N. and S. of Naples, and embracing the provinces of Avellino, Benevento, Caserta, Naples, and Salerno, with an area of 6289 sq. miles, and a population (1881), 2,896,577; (1901), 3,142,378. The Campania proper, immediately N. of Naples, is one of the most fertile as well as one of the most densely-peopled regions in the world. The principal products are wheat, maize, olives, wine, oranges, lemons, chestnuts, tobacco, potatoes, hemp, beans, and pease. Sulphur is mined. The coast is studded with towns and villages (e.g., Naples, Castellamare, Amalfi, Sorrento, Barra, San Giorgio, Eesina, Cava dei Tirreni, &c.), which are much visited for sea-bathing in summer and as health resorts in winter. The modern history is generally coincident with the history of Naples.*~~

~~*Campanology (from late Lat. campana, a bell), in its widest sense, includes the history of bells and their uses, i.e., bell-lore ; the scientific construction of bells, i.e., bell-founding and tuning ; and the science and art of bell-ringing. The two former of these heads are treated under " Bell " (Encydopoedia Brttannica, ninth edition), and the present article will deal mainly with the third and most commonly accepted meaning of the term,*~~

~~viz., the science and art of change-ringing as practised upon church bells or hand bells.~~

~~1. When a given number of bells are rung .pver and over again in the same order, from the highest note, or " treble," to the lowest, or "tenor "—1, 2, 3, 4, 5, ' 6, 7— they are said to be rung in "rounds." r^S'; "Changes" are variations of this order — e.g., Oeaerai 213547 6, 2314567; and "change-P'"""^""" - ringing " is the art of ringing bells in « changes," so that a different "change-" or rearrangement of order is pro- duced at each pull of the bell-ropes, until, without any repetition of the same change, the beUs come back into "rounds." The general principle of all methods of change-ringing is that each bell, after striking in the first place, or "lead," works gradually "up" to the last place, or "behind," and " down " again to the first, and that no bell ever shifts more than one place in each change. Thus the ringer of any bell knows that whatever his position in one change, his place in the next will be either the same, or the place before, or the place after. He does not have to learn by heart the different changes or variations of order ; nor need he, unless he is the "conductor," know the exact order of any one change. He has to bear in mind, "first, which way his bell is working, viz., whether " up " from~~

~~1234 56 7 "Rounds."~~

~~2 13 5 4 7 6 (1st change.)~~

~~2814567~~

~~3241657~~

~~3426175~~

~~4 3 6 2 7 1 5 (5th change.)~~

~~4637251~~

~~647 3521~~

~~6745312~~

~~7654132~~

~~first to last place, or " down " from last to first ; secondly, in what place his bell is striking; thirdly, what hell or bells are striking immediately before or after him — this being ascertained chiefly by " rope-sight," i.e., the knack, acquired by practice, of seeing which rope is being pulled immediately before and after his own. He must also remember and apply the rules of the particular "method" (§3) which is being rung. The following table repre- senting the first twenty changes of a " plain course " of " Grandsire Triples " (for these terms, see § 3) illustrates the subject-matter of this section: —~~

~~7 5 614 2 3 (10th change.)~~

~~57 16243 5172684 1527364 1258746~~

~~2 15 7 3 6 4 (15th change.)~~

~~2513746 523147 6 5324167 3542617~~

~~3 4 5 6 2 7 1 (20th change.)~~

~~It will be observed that at the 1st change the third bell, and at the 15th the fifth bell, according to the rule of this " method " (see § 3), strikes a second blow in the third place ("makes third's place"). This stops the regular work of the bells which at the previous change were in the 4th, 5th, 6th, and 7th places (" in 4, 5, 6, 7 "), causing them to take a step backwards in their course "up" or "down," or as it is technically called, to "dodge." Were it not for this, the bells would come back into " rounds " at the 14th change. It is by the use of " place-making " and " dodging," according to the rules of various "methods," that the required number of changes, upon any number of bells, can be produced. But in order that this may be done, without the bells coming back into "rounds" (as, e.g., in the "plain course " of Grandsire Triples, above given, they will do in seventy changes), further modifications of the " cours- ing order," called technically "Bobs"~~

~~and "Singles," must be introduced. In ringing, notice of these altera- tions as they occur is given by one of the ringers, who acts as " conductor," calling out " Bob " or " Single " at the right moment to warn the ringers of, certain bells to make the requisite alteration in the regular work of their bells. (Hence, in ringing language, to "call" a peal or touch = to conduct it.) Particulars of these, as of other details of change-ringing, may be gathered from books dealing with the technique of the art (see § 7) ; but they are best mastered in actual practice. The term "single," applied to five-bell ringing, meant that, as the first three bells remained unchanged, only a single~~

~~^ pair of bells changed places, e.g., 1 5 4 3 2, 1 6 4 2 3. On larger numbers of bells it loses this meaning; but the effect of this " call " is that the " coursing order " of a single pair of bells is inverted. The origin of " Bob " is unknown. As a " call " it was perhaps adopted as a short, sharp sound, easily uttered, and easily heard by the ringers. As applied to a "method" or system of ringing (§ 3), it may refer to the evolution of " dodging," e.g., in "Treble Bob" to the zigzag "dodging" path of the treble bell ; but none of the old writers attempt to~~

~~■ explain it.~~

~~2. The number of possible " changes " on any given series of bells may be ascertained, according to the mathe- matical formula of " permutations," by multiply- Number of j^g the number of the bells together. Thus on pm^**" tliree bells, only 6 changes or variations of order (1×2×3) can be produced ; on four bells, 1×2 x3×4=24; on five, 24×5=120; on six, 120×6=720; on seven, 720 x 7=6040. A " peal " on any such number of bells is in ordinary language the ringing of all the~~

~~possible changes. But technically, only the fuU extent of changes upon s&ven bells (usually rung with a " tenor behind," § 3) is called a " peal " ; a shorter performance upon seven or more bells, or the full extent upon less than seven, being, in ringing parlance, a " touch." On six bells the full extent of changes must be repeated continuously seven times (720×7=6040), and on five bells forty-two times (120×42=5040) to rank as a " peal." On eight or more bells 6000 changes in round numbers is accepted as the minimum standard for a peal ; and on such numbers of~~

~~bells up to twelve (the largest number used in change-ringing), peals are so arranged that the bells come into rounds at, or at some point beyond, 6000 changes. As many as 16,000 changes, occupying from nine to ten hours, have been rung upon church bells. But the great physical strain upon the ringers — to say nothing of the effect upon those who are within hearing — makes such performances excep- tional. The word "peal" is often, though incorrectly, used (1) for a set of church bells (" a peal of six," " a peal of eight "), for which the correct term is " a ring " of bells; (2) for any shorter performance than a full peal {e.g., "wedding-peal," "muffled peal," &c.), called in ringing language a "touch." Its use as =" method" (§ 3), found in old campanological works, is now obso- lete.~~

~~3. Change-ringing upon five bells is called "Doubles," upon seven bells, "Triples," upon nine, "Caters" (Fr. quatre), and upon eleven, " Cinques," from the Methods fact that at each change two, three, four, or five o/ pairs of bells change places with each other. CAa^e- " Doubles " can be and are rung when there are "* "*' only five bells : but as a rule these " odd-bell " systems are rung with a " tenor behind," i.e., struck at the end of each change; the number of bells in a tower being usually an even number — six, eight, ten, or twelve. In "even-bell" systems the tenor is "rung in" or "turned in," i.e., changes with the other bells, and a different terminology is employed; change-ringing on six bells being called " Minor " ; on eight bells, "Major"; on ten bells, " Eoyal " ; and on twelve, " Maximus." The prin- cipal " methods " of change-ringing, each of which has its special rules, are — (1) "Grandsire"; (2) "Plain Bob"; (3) " Treble Bob" ; (4) " Stedman," from the name of its inventor, Fabian Stedman, about 1670. In " Grandsire" the treble and one other bell, in "Plain Bob" the treble alone, has a " plain hunt," i.e., works from the first place, or " lead," to the last place, or " behind," and back again, without any dodging ; in " Treble Bob " the treble has a uniform but zigzag course, dodging in each place on its way up and down. This is called a " Treble Bob hunt " ; and under these two heads, according to the work of the treble, are classified a variety of " plain methods " and "Treble Bob methods," among the latter being the so- called "Surprise" methods, the most complicated and difficult of all. " Stedman's principle," which is sui gen- eris, consists in the three front bells ringing their six pos- sible changes (§ 2^, while the remaining pair or pairs of bells dodge. It is thus an " odd-bell " method adapted to five, seven,~~

~~*nine, or eleven bells ; as also is " Grand- sire," though occasionally rung on even numbers of bells. "Treble Bob" is always, and "Plain Bob" generally, rung on even numbers — six, eight, ten, or twelve. In ringing, whenever the treble has a uniform course, un- affected by "Bobs" or "Singles," it serves as a guide to the other changing bells, according to the place in which they meet and cross its path from " behind" to the "lead." The order in which the different dodges occur, and the " course bell," i.e., the beU which he follows from behind to lead, are also useful, and on large numbers of bells indispensable, guides to the ringer.*~~

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~~*CAMPANOLOGY*~~

~~*4. Quite distinct from the art of change-ringing is the science of " composing," i.e., arranging and uniting*~~

~~*by the proper "calls" (§ 1), subject to certain uon.' fi^e*~~

~~*of changes, so that no one change, or series of changes represented in those groups, shall be repeated. A composition, long or short, is said to be "true" if it is free from, " false " if it involves, such repetition ; and the body of ascertained laws and conditions governing true composition in any method constitutes the test or " proof " to be applied to a composition in that method to demonstrate its truth or falseness. Many practical ringers know little or nothing of the principles of com- position, and are content with performing compositions received from composers, or published in ringing books and periodicals. An elaborate statement of the principles of composition in the " Grandsire " method may be found in an appendix to Snowdon's Gh-andsire (Wells Gardner and Co., 1888), by the Eev. C. D. P. Davies, M.A. Those which apply to " Treble Bob " are explained in Snowdon's Treatise on Treble Bob, Part I. But, so far as can be ascertained, there is no treatise dealing with the science of composition as a whole ; nor is it possible here to attempt a popular exposition of its principles.*~~

~~6. One of the objects kept in view by composers is musical effect. Certain sequences or contrasts of notes~~

~~strike the ear as more musical than others; and Harmony; an arrangement which brings up the more ?f"' musical changes in quicker succession improves~~

~~" "*' the musical effect of the "peal" or "touch." On seven bells aU the possible changes (§ 2) must be inserted in a true peal; but on larger numbers of bells, where the choice is from an immense number of possible changes, the composer is free to select those which are most musical. Unless, however, the bells of any given "ring" are in perfect tune and harmony with each other, their musical effect must be impaired, however well they are rung. This gives im- portance to the science and art of bell-tuning, in which great progress has been made. The researches of the late Canon Simpson, of Fittleworth in Sussex, carried out in practice by Messrs Taylor, bell-founders, of Lough- borough (who have erected special machinery for the purpose), have made it possible to tune the largest bells into perfect harmony, not only with other bells, but with themselves. A good bell, fairly struck, should give out three distinct notes — a " fundamental " note or " tonic " ; the octave above, or " nominal " ; and the octave below, or "hum-note." [It also gives out the "third" and "fifth" above the fundamental; but of these it is less necessary to take notice.] Very few bells, however, have any two of these notes, and hardly any all three, in unison ; the " hum-notes " being gen- erally a little sharper, and the " fundamentals " a little flatter, than their respective "nominals." In tuning a " ring " or series of bells, the practice of founders has hitherto been to take one set of notes (in England usually the nominals, on the Continent the fundamen- tals), and put these into tune, leaving the other tones to take care of themselves. But in different circum- stances, different tones assert themselves. Thus, when bells are struck at considerable intervals, the funda- mental notes, being fuller and more persistent, are more prominent ; but when struck in rapid succession (as in Eng:lish change-ringing, or with the higher bells of a Belgian "carillon," which take the "air"), the higher tone of the "nominal" is more perceptible. The inharmonious character of many Belgian carillons, and of certain Belgian and French rings in~~

~~England, is ascribed by Canon Simpson (in his pamphlet. Why BeUs sound out of Tune, 1897) to neglect of the " nom-~~

~~inals," the fundamentals only being tuned to each other. To tune a series of bells properly, the fundar mental tone of each bell must be brought into true octave with its nominal, and the whole series of bells, thus rectified, put into tune with each other. The " hum- note " of each, which is the tone of the whole mass of metal, should also be in tune with the others. If flatter than the nominal, it cannot be sharpened : but if sharper (as is more usual), it may be flattened by thinning the metal near the crown of the bell. The great beU ("Great Paul ") cast by Messrs Taylor for St Paul's Cathedral, London, has all its tones in true harmony, except that the tone next above the fundamental (Ei?) is a "fourth" (Ab) instead of a "third" (G or G\f). The great bell cast by the same founders for Beverley Minster is in perfect tune ; and with the improved machinery now in use, there is no reason why this should not henceforth be the case with all church bells.~~

~~6. The art of scientific change-ringing, peculiar to England, does not seem to have been evolved before the middle of the 17th century. Societies or guilds ^^^^^^ ^, of ringers, however, existed much earlier. A change- patent roll of 39 Henry III. (1266) confirms ringing. the " Brethren of the Guild of Westminster, who are appointed to ring the great bells there," in the enjoy- ment of the " privileges and free customs which they have enjoyed from the time of Edward the Confessor." In 1602 (as appears from a MS. in the library of All Souls' College, Oxford) was founded a society called the "Scholars of Cheapside." It 1637 began the "Ancient Society of College Youths," so called from their meeting to practise on the six bells at St Martin's, College Hill, a church destroyed in the Great Fire of London, 1666. At first only "rounds" and "call-changes" were rung, till about 1642, 120 " Bob Doubles " (§ 3) were achieved ; but slow progress was made till 1677, when Eabian Stedman of Cambridge published his Cam- panalogia, dedicating it to this society, his method (§ 3) being first rung about this time by some of its members. Before the end of the 17th century was founded the " Society of London Scholars," the name of which was changed in 1746 to " Cumberland Youths " in compliment to the victor of Culloden. These two metropolitan societies still exist, and include in their membership most of the leading change-ringers of Eng- land : one of the oldest provincial~~

societies being that at Saffron Walden in Essex, founded in 1623, and still holding an annual ringing festival. In the latter half of the 18th and first half of the 19th century change- ringing, which at first seems to have been an aristo- cratic pastime, degenerated in social repute. Church bells and their ringers, neglected by church authorities, became associated with the lower and least reputable phases of parochial life ; and belfries were too often an adjunct to the pothouse. In the last half of the 19th century there has been a great revival of change- ringing, leading to improvements in belfries and in ringers, and to their gradual recognition as church workers. Diocesan or county associations for the pro- motion of change-ringing and of belfry reform are spreading knowledge of the art and arousing church officials to greater interest in and care for their bells. A central council of delegates from these various societies meets annually in London or at some provincial centre to discuss ringing matters, and to collect and formulate useful knowledge upon practical questions — e.g., the proper care of bells and the means of preventing annoy- ance from their use in the neighbourhood of houses, rules for the conduct of belfries, etc. It is now less likely than ever that the Belgian carillons, extrava- gantly lauded by some writers on campanology, will be

preferred in England to the peculiarly English system of ringing bells in peal ; by wMob, whatever its difficul ties, the musical sound of bells is most fuUy brought out, and their scientific construction best stimulated.

7. The literature of campanology consists chiefly of scattered treatises or pamphlets upon the technique of different methods of change-ringing, or upon the beUs of particular counties or districts. The earliest that deal with the science and art of change-ringing are Caw- panalogia, or the Art of Ringing Improved (1677), and a chapter of " Advice to a Ringer " in the School of Recre- ations, or Gentleman's Tutor (1684), showing that in its early days (§ 6), campanology was a fashionable pastime. Then follow Campanaiogia, or the Art of Ringing made Easy (Monk, 1766), Olavis Campanaiogia, a Key to Ring- ing (1788), and Shipway's Campanaiogia (1816). The revival of change-ringing in recent years has produced many

~~*manuals: e.g., Snowdon's Rope-Sight (explaining the " Plain Bob " method), Grandsire, Treatise on Treble Bob, Double Norwich Court Bob Major, and Standard Methods (with a book of diagrams) ; Troyte on Change- Ringing; The Duffield Method, by Sir A. P. Hey wood, Bart., its inventor. Somewhat prior to these are various works by the Rev. H. T. Ellacombe, inventor of a chiming apparatus which bears his name, and a pioneer in belfry reform. Among these are accounts of the church bells of Devon, Somerset, and Gloucester, and pamphlets on Belfries and Ringers, Chiming, &c. ; much of their contents being summarized in The Ringer's Gmde to the Church Bells of Devon, by C. Pearson (1888). A Glossary of Technical Terms used in connexion with church bells and change-ringing was published (1901) under the auspices of the Central Council of Church Bell Eingers (§ 6). On the history of church bells and customs connected with them much curious information is given in North's English Bells and Bell Lore (Leek, 1888). By the same author are monographs on the church bells of Leicestershire, Northamptonshire, Lin- colnshire, and Hertfordshire. There are similar works on the church bells of Suffolk and Cambridgeshire, by Dr Raven ; and of Huntingdonshire, by the Rev. T. M. N. Owen; and one on the church bells of Essex, by the Rev. C. Deedes. See also Quarterly Review, No. cxc. (September 1854) ; Windsor Magazine, December 1896 ; and two papers in the Guardian, 20th June and 1st August 1900. (t. t. P.)*~~

~~*Campbell-Bannerman, Sir Henry (1836- -), British politician, was born on 7th September*~~

~~*1836, being the son of the late Sir James Campbell, Bart., of Stracathro, and assumed the additional name of Bannerman in 1872, in compliance with the provisions of the will of his maternal uncle. He was educated at Glasgow University and at Trinity College, Cam- bridge ; was returned to Parliament for Stirling in 1868 ; was financial secretary at the War Oface from 1871 to 1874, and again from 1880 to 1882; Secretary to the Admiralty from 1882 to 1884 ; and Chief Secretary for Ireland from 1884 to 1885. In Mr Gladstone's short- lived administration of 1886, he was Secretary for War, and filled the same office in the Radical Government of 1892-95. In June 1895 an imputed omission on , the part of the War Office to provide a due supply of small-arms ammunition for the army led to the*~~

~~*sudden overthrow of the Rosebery ministry. A still more unexpected incident affecting his political career, was the retirement of Sir William Vernon Harcourt from the leadership of the Liberal party in the House of Commons, in December 1898; Sir Henry Campbell- Bannerman being elected to fill that position with the general assent of his party, but in circumstances which*~~

~~*hardly made it a bed of roses. Wealthy, popular, and possessed of a vein of oratorical humour, Sir Henry Campbell-Bannerman had earned, before his somewhat embarrassing elevation to the leadership, the general respect of aU parties; and in 1895, when Mr Speaker Peel retired, he was marked out in the opinion of a large body of politicians for the Speakership, but it was understood that he declined to stand. As leader of the Opposition in the House of Commons from 1899 onwards. Sir Henry had a difficult task to perform, and he inter- preted his duty as chiefly consisting in the effort to keep the Radical party together in the midst of pronounced differences. In the case of the South African war, how- ever, his opposition to the Government was combined with a distinct tendency to favour the anti-war section. The result was that in 1901 the Liberal Imperialists showed signs of restiveness ; but at a party meeting on 9th July 1901 Sir Henry was unanimously confirmed in the leadership.*~~

~~*Campbellton, an incorporated town in Ristigouche county. New Brimswick, situated on the Ristigouche river, 15 miles from its mouth. The Intercolonial rail- way passes through it, and it is the eastern terminus of the Ristigouche and Victoria railway. It contains 5 churches, 2 branch banks, 2 newspapers, a good water system, several large saw-mills and factories for the manufacture of lumber, and is a distributing centre for northern New Brttnswick. Population, 4000.*~~

~~*Campbeltown, a royal and parliamentary burgh (Ayr group) of Argyllshire, Scotland, at the head of a bay near the southern end of the peninsula of Kintyre. Shipbuilding is now of some importance. The regis- tered shipping at the end of 1898 was 37 vessels of 2391 tons. Vessels entered in 1888 were 1117 of 91,204 tons ; in 1898, 1232 vessels of 108,882 tons. Of whisky 1,159,667 gallons were exported in 1889, and 1,199,376 in 1899. The port is the head of a fishery district (for statistics, see Akgyllshibe). The value of*~~

~~the fish landed at the port in 1899 was £41,176. There is a large net factory. A Jubilee Commemoration drill hall has been built. One of the schools is an academy. Population of parliamentary burgh (1881), 7558; (1901), 8234.~~

~~Campeachy (Span. Campeche), a state of Mexico, bounded on the N. and N.W. by the Gulf of Mexico, on the NJE. by Yucatan, on the S. and S.E. by the republic of Guatemala, and on the S. and S.W. by the state of Tabasco. Its area is 18,095 square miles. The popu- lation in 1879 numbered 90,413, and in 1896 it was 88,302. The climate is hot and unhealthy. The prin- cipal industries are the exploitation of campeche or logwood, and of cabinet woods, agriculture, stock-raising, fisheries, salt deposits, extraction of henequen and its manufacturing. There are barely 30 miles of railway in operation. The state is divided into 5 partidos. Amongst the principal towns, besides the capital, are Champoton, El Carmen, Bolonchen Ticul, Calkini, Hecel- chakan — all with populations of less than 6000 inhabit- ants.~~

~~Campeachy, or Campeche de Baranda, capital of the state of the same name, on the Gulf of Mexico, 825 miles from the city of Mexico. The city is one of the richest and most beautiful on the g^lf . The wharf is 150 feet long, but as the harbour is only 10 feet deep, large ships cannot approach it. Among the principal buildings are the City Hall, the Government building, the hospital, theatre, the market, and several churches. There are also a fine park and public garden, a public library, and a museum. There are several lines of street railways. Population, 16,647.~~

~~Camphausen, Otto von (1812-1896), Prussian statesman, was born at Hiinshoven in the Ehine Provinces 21st October 1812. Having studied jurisprudence and political economy at the universities of Bonn, Heidelberg, Munich, and Berlin, he entered the judicial career at Cologne, and immediately devoted his attention to financial and commercial questions. Nominated assessor in 1837, he acted for five years in this capacity at Magdeburg and Coblenz, became in 1845 counsellor in the ministry of finance, and was in 1849 elected a member of the second chamber of the Prussian diet, joining the Moderate Liberal party. In 1869 he was appointed Minister of Finance. On taking oflce, he was confronted with a deficit in the revenue, which he successfully cleared off by effecting a~~

~~*conversion of a greater part of the state loans. ‘ The French war indemnity enabled him to redeem a consider- able portion of the state debt and to remit certain taxes. He was, however, a too warm adherent of free trade principles to enjoy the confidence either of the Agrarian party or of Prince Bismarck, and his antagonism to the tobacco monopoly and the general economic policy of the latter brought about his retirement. Camphausen’s great services to Prussia were recognized by his sovereign in the bestowal of the order of the Black Eagle in 1896, a dignity carrying with it a patent of nobility. He died at Berlin on 18th May 1896.*~~

~~*Campi Bisenzio, a town of the province of Flor- ence, Tuscany, Italy, 7 miles N.W. from Florence, with a fine castle. Population, about 14,000.*~~

~~*Campion, Thomas (1566?1620), English poet and musician, whose works have only received due recognition within the last few years. The resuscita tion of his fame is largely due to the enthusiastic labour of Mr A. H. BuUen. No light has been thrown over his parentage, or the time of his birth, except that he seems to have been about twenty years of age, in 1586, when he was admitted a member of Gray’s Inn. Without proceeding to the Bar, he adopted the profession of medicine, and studied for his M.D. at Cambridge, where he was ” soundly learned” and ” gentle- manlike qualified.” Campion is first mentioned as a poet in Peele’s Honour of the Garter, 1593 ; the earliest verses of his which we possess have come down to us in a MS. dated 1596. But before this he had published a collection of Latin epigrains (in 1695), no copy of which is now believed to exist. The text is, however, supposed to be that reprinted in the second book of the Epigrammata of 1619. In 1601 appeared A Book of Airs, in which the songs are believed to be entirely written by Campion, the music by him and by Eossiter. Next year Campion appeared as a critic of prosody, with his Observations in the Art of English Poesy, a treatise in favour of abandoning the ” vulgar and unartificial custom of rhyming,” in favour of accentuated, unrhymed verse. Samuel Daniel immediately replied with his Defence of Rhyme, published in 1602, and Ben Jonson attacked both Campion and Daniel in a tract which has been lost. Campion was chosen to write the Masque at Court, on occasion of Sir James Hay’s marriage in 1607; this he dedicated to the king, and published in quarto ; it is one of the best existing examples of this class of composition. In 1613 Campion was engaged on three Court*~~

~~*masques, all of which were printed, and it is probable that he wrote many other such lyrical and musipal entertainments, which served their purpose, and were not preserved. He worked, we know, with Inigo Jones, and apparently escaped those perturbations of temper which marked Ben Jonson's dealings with the irascible architect. In 1613, also, Campion issued in*~~

~~*folio, with music, a perfunctory collection of Songs of Mourning for Prince Henry ; and a second collection of songs. Two Books of Airs, probably belongs to the same year. A Third and Fourth Book of Airs is undated, but has been shown by Mr Bullen to belong to 1617, and Campion published about the same time a technical treatise on counterpoint. In 1619 he republished what we suppose to be his Poemata of 1595, but with very large additions. On 1st March 1620, "Thomas Campion, Doctor of Physic, was buried," at St Dunstan's in the West, Fleet Street. He was probably in his fifty-fourth year. Campion's genius was recognized in his own age, and the complete oblivion into which it immediately sank is difficult to account for. This eclipse lasted, however, until a few years ago. It was dispersed by Mr Bullen, who in 1887 was the first to claim for Campion a place among the foremost lyrical poets of the Elizabethan age. The same critic persevered in drawing attention to Campion's merits, and was encouraged, in 1889, to edit a complete edition of his works. Since then, the claim of Campion has been acknowledged by com- petent judges. Of all the poets who in the reigns of Elizabeth and James I. made a practice of contributing words to the popular music-books. Campion was by far the greatest, whether as an artist in verse or as an improvisator. He had a very wide range; he ex- celled as much in an elaborate ode or epithalamium as in a simple trill of unpremeditated song. As a masque- writer, he has only one rival in English, namely Ben Jonson, and Campion's best entertainment, that on the marriage of " The Lord Hayes," is able to bear comparison with the finest of Jonson's masques. It is a curious fact that Campion, who rhymed with equal elegance and ease, and whose best songs are remarkable for their verbal music, was, at all events during some part of his career, averse from the employment of rhyme in English. The experiments he wished to introduce, his iambics, an- acreontics, and Sapphics, are unfitted to the genius of our language, and of Campion's examples of these heresies the best that can be said is that they are more nearly successful than those of*~~

~~his contemporaries. But even from his remarkably adroit " Eose-cheeked Laura," we turn with eagerness to such of his rhymed pieces as that in which " White lope " is mentioned, or to " I care not for these ladies." (b. g.)~~

~~Campoamor y Campoosorio, Ramon de~~

~~(1817-1901), Spanish poet, was born at Navia in the pro- vince of Asturias on 24th September 1817. Abandoning his first intention of entering the Jesuit order, he studied medicine at Madrid, found an opening in politics as a supporter of the Moderate party, and, after occupying sev- eral subordinate posts, became governor of Castelldn de la Plana, of Alicante, and of Valencia. His conservative ten- dencies grew more pronounced with time, and his PoUmicas con laDemocracia (1862) may be taken as the definitive ex- pression of his political opinions. His first appearance as a poet dated from 1840, when he published his Teo-nezas y flores, a collection of idyllic verses, remarkable for their technical excellence. His Ayes del Alma (1842) and his Fdbidas morales y politicas (1842) sustained his reputa- tion, but showed no perceptible increase of power or skill. An epic poem in sixteen cantos, Coldn (1853) is no more successful than modern epics usually are. Campoamor's theatrical pieces, such as El Palacio de la Verdad (1871), Dies Iroe. (1873), El Honor (1874), and Glorias Humanas (1885), are interesting experiments ; but they are totally lacking in dramatic spirit. He has always shown a keen interest in metaphysical and philosophic questions, and has defined his position in La Filosofkt de las leyes (1846)~~

~~El Personalismo (1855), Lo Absoluto (1865), and El Jdeismo (1883). These studies are chiefly valuable as embodying fragments of self-revelation, and as having led to the composition of those doloras, humoradas, and pequeflos poemas, which the poet's admirers consider as a new poetic species. The first collection of Doloras was printed in 1846, and from that date onwards new speci- mens have been added to each succeeding edition. It is difficult to define a dolora. One critic has described it as a didactic, symbolic stanza which combines the lightness and grace of the epigram, the~~

~~*melancholy of the endecha, the concise narrative of the ballad, and the philosophic intention of the apologue. The poet himself declares that a dolora is a dramatic humorada, and that a pequsflo poema is a dolora on a larger scale. These definitions are unsatisfactory. The humoristic, philosophic epigram is an ancient poetic form to which Campoamor has given a new name ; his invention goes no farther. It cannot be denied that in the Doloras Campoamor's special gifts of irony, grace, and pathos find their best expression. Taking a commonplace theme, he will render in four, eight, or twelve lines a perfect miniature of condensed emotion. By his choice of a vehicle he has avoided the fatal facility and copiousness which have led many Spanish poets to destruction. It has pleased him to affect a vein of melancholy, and this affectation has been reproduced by his followers. Hence he gives the impression of in- sincerity, of trifling with grave subjects, and of using mysticism as a mask for frivolity. The genuine Cam- poamor is a poet of the sunniest humour who, under the pretence of teaching morality by satire, is really seeking to utter the gay scepticism of a genial, epicurean nature. His influence has not been altogether for good. His formula is too easily mastered, and to his example is due a perfect plague of doloras and humoradas by very minor poets who have caricatured their model. Campoamor, as he himself has said, does not practise art for art's sake ; he uses art as the medium of ideas, and in ideas his imitators are poor. Campoamor died at Madrid on 12th February 1901. Of late years a deep silence had fallen upon him, and we are in a position to judge him with the im- partiality of another generation. The overwhelming bulk of his work will perish ; we may even say that it is already dead. His pretensions, or the pretensions put forward in his name, that he has discovered a new poetic genre will be rejected later, as they are rejected now by all competent judges. The title of a philosophic poet will be denied to him. But he will certainly survive, at least in extract, as a distinguished humorist, an expert in epigrammatic and sententious aphorism, an artist of extremely finished execution. (j. f.-k.)*~~

~~*Campobasso, capital of the province of Campo- basso, Abruzzi e Molise, Italy, situated amongst the southern Apennines, 52 miles by rail N. from Benevento. It is famous for its cutlery and arms. Population of town (1881) 14,824, (1901) 15,046 ; of province (1881)*~~

~~*365,434, (1901) 366,341.*~~

~~*Campos, Arsenio Martinez de (1831-1900), Spanish Marshal, Senator, and Knight of the Golden Eleece, was born at Segovia on 14th December 1831. He entered the staff college, graduated as a lieiitenant in 1852, and for some years was attached to the college as an assistant professor. He took part in the Morocco campaign of 1859-60, and distinguished himself in sixteen fights, obtaining the Cross of San Fernando, and the rank of lieutenant-colonel. He then returned to the staff college as a professor. Afterwards he joined the expedition to Mexico under Prim. In 1869 he was sent to Cuba, where he was promoted to the rank of generalinl872. On his return*~~

~~*to the Peninsula, the Federal Kepublican Government in 1873 confided to General Campos severalhigh commands, in which he again distinguished himself against the Cantonal Republicans and the Carlists. About that time he began to conspire with other partisans of the Alfonsist branch of the Bourbons, with a view to restore the son of Queen Isabella. Though he made no secret of his designs, Marshal Serrano, in 1874, appointed him to the command of a division which took part in the relief of Bilbao on 2nd May of that year, and in the operations around Estella in June. On both occasions General Campos tried in vain to induce the other commanders then and there to proclaim Alfonso XII, but he was rebuked by Marshal Concha at Bilbao, and at Tafalla by General Echague. He then affected to hold aloof, and would have been arrested, had not the Minister of War, Ceballos, answered for his good behaviour, and quartered him in Avila under surveillance. He managed to escape, and after hiding in Madrid, joined General Daban at Sagunto on 29th December 1874, where he proclaimed Alfonso XII. king of Spain. From that date he never ceased to exercise great influence in the politics of the restoration. He was considered as a sort of Supreme Councillor, being consulted by King Alfonso, and later by his widow, the queen-regent, in every important political crisis, and on every international or colonial question, especially when other generals or the army itself became troublesome. He took an important part in the military operations against the Carlists, and in the negotiations with their leaders, which put an end to the civil war in 1876. In the same way he brought about the pacification of Cuba in 1878. On his return from that*~~

~~island he presided over a Conservative Cabinet for a few months, but soon made way for Canovas, whom he ever afterwards treated as the leader of that party. In 1881, with other discontented generals, he assisted Sagasta in getting into office. After the death of King Alfonso, Campos steadily supported the regency of Queen Christina, and held high commands, though declining to take office. In 1893 he was selected to command the Spanish army at Melilla, and went to the court of Morocco to make an advantageous treaty of peace, which averted a war. When the Cuban rising in 1896 assumed a serious aspect, he was sent out by the Conservative Cabinet of Canovas to cope with the rebellion, but he failed in the field, as well as in his efforts to win over the Creoles, chiefly because he was not allowed to give them home rule, as he wanted. Subse- quently he remained aloof from politics, and only spoke in the Senate to defend his Cuban administration and army interests. After the war with America, and the loss of the colonies in 1899, when Senor Silvela formed a new Conservative party and Cabinet, the old marshal accepted the presidency of the Senate, though his health was failing fast. He held that post up to the time of his death in 1900, during the summer recess, at Zarauz, a village on the coast of the Basque province of Guipuzcoa, where he was" buried, very modestly, at his own request. His death was generally considered a great loss for the monarchy and for the Conservative party, and events soon proved this to be correct, as within a month the divisions in the party and the Cabinet brought about the fall of Silvela on the one hand, and the reappearance of Castilian militarism with Generals Weyler and Linares on the other. (a. e. h.)~~

~~Campu Lung, a town in Eumania, chief town of the district of Muscel, pleasantly situated on the right bank of the river Oltu. The purity of the air and the picturesqueness of the surroundings have made it a popular summer resort. It contains twenty-four churches.~~

~~Fairs are held anmially on 20th July and 24tli October. In the neighbourhood are to be found the remains of an old Roman camp, called by the peasants Jidovi or~~

~~Gradistea. Ifear the town is the monastery of Campu Lung, founded by Radu Negru. Population (1895),~~

~~12,000; (1900), 13,033.~~

~~oa:^ada.~~

~~GbOGEAPHY AliTD STATISTICS.~~

~~THE Dominion of Canada, comprising the northern half of the continent of North America and its adjacent islands, excepting only Alaska (a dependency of the United States) and Newfoundland (still a separate colony), has an estimated area of 3,664,000 square mUes. Its physical features are comparatively simple, and drawn on a large scale. Its main structural watershed is in part coincident with the Kocky Mountain range proper, or eastern member of the Cordillera, but to the northwardf ailing back to ranges situated farther to the west in the same great mountain region. As in the southern half of the continent, however, an important modification of this gftieral idea connects itself with the river systems of the great central zone. These, to the south, join themselves with the Mississippi, reaching the Gulf of Mexico; to the north with the Mackenzie, flowing to the Arctic Ocean, or with the Churchill and Nelson emptying into Hudson Bay. The boundary liae between Canada and the United States, in the central part of the continent, in the main nearly coincides with this subsidiary east and west watershed. The most important river, whether historically or com- mercially, is the St Lawrence. With the great lakes from which it flows, and the magnificent system of canals con- structed to overcome the natural obstacles to its navigation, it forms a great waterway to the centre of the continent. The Mackenzie, practically inaccessible to commerce at its mouth, the Yukon, or that part of it which is included in Canada, the Nelson, the Churchill, and other rivers of great length and volume, are either long sealed by ice and interrupted by rapids, or, because they traverse regions as yet unsettled, are of minor interest except to the physical geographer. Prom his point of view, however, there is nothing more remarkable than the intricate and compre- hensive system of rivers by which almost the entire area of Canada is covered.~~

~~*The Laurentian Plateau. — The ruling geological and physical feature of the North American continent is the great Laurentian plateau, or " Canadian shield," in which the shallow basin of Hudson Bay occupies a central position. This consists of very ancient crystalline rocks, resembling those of Scandinavia in age and character. It occupies the Labrador peninsula, and spreading round the southern extremity of Hudson Bay, extends north-westward to the Arctic Ocean. This constitutes the "protaxis " or nucleus of the continent. Around its borders the later geological series, from the Cambrian upwards, have been Geo ogy. deposited, and against it these later strata have been crushed and elevated into mountain ranges at various periods in the course of geological history. It is, there- fore, the initial feature from which the chronological de- velopment of the physiography of the continent may be deduced, and this is particularly apparent in Canada, within the limits of which it is included, and of which much of the remaining territory may be regarded as bordering upon it. From the vantage-point of this Lau- rentian plateau the main physical features of Canada may be briefly noted, with some reference to the geological conditions upon which these respectively depend. The Laurentian plateau itself, although constituting so large a part of Canada, may, from a physiographical point of view, be regarded as a unit. It is somewhat monotonous in*~~

~~*character, but constitutes a great drainage area for the supply of numerous rivers, the water-power of which, as they descend from its borders, is now beginning to be util- ized on a large scale in connexion with various industries, either directly or by means of electricity generated at favourable places. It is only in a very general way that this region can be described as a plateau or tableland, for its surface is hilly, or at least mammillated, in almost every part of its extent.*~~

~~*The Acadian Region. — The "maritime provinces" of Eastern Canada, including Nova Scotia, New Brunswick, and Prince Edward Island, may be considered together ; and to these provinces as politically bounded may be added, from a physical point of view, the analogous south- eastern part of Quebec — the entire area being designated the Acadian region. Taken as a whole, this eastern part of Canada, with a very irregular and extended coast-line on the Gulf of St Lawrence and the Atlantic, may be regarded as*~~

~~a northern continuation of the Appalachian mountain region that runs parallel to the Atlantic coast of the United States. The rocks underlying it have been subjected to successive foldings and crumplings by forces acting chiefly from the direction of the Atlantic Ocean, with alternating prolonged periods of waste and denuda- tion. The main axis of disturbance and the highest remaining land runs through the south-eastern part of Quebec, forming the Notre Dame Mountains, and termi- nates in the Gasp^ peninsula as the Shickshock Mountains. The first-named seldom exceed 1500 feet in height, but the Shickshocks rise above 3000 feet. The province of New Brunswick exhibits approximately parallel but sub- ordinate ridges, with wide intervening areas of nearly flat Silurian and Carboniferous rocks. The peninsula of Nova Scotia, connected by a narrow neck with New Brunswick, is formed by stiU another and more definite system of parallel ridges, deeply fretted on all sides by bays and harbours. A series of quartzites and slates referred to the~~

~~geoqbapht]~~

~~CANADA~~

~~527~~

~~Cambrian, and holding numerous and important veins of auriferous quartz, characterize its Atlantic or south-eastern side, while valuable coal-fields occur in Cape Breton and on parts of its shores on the Gulf of St Lawrence. In New Brunswick the Carboniferous rocks occupy a large area, but the coal seams so far developed are thin and unimportant. Metalliferous ores of various kinds occur both in Nova Scotia and in this province, but with the exception of the gold already mentioned, have not yet become the objects of important industries. Copper and asbestos are the principal mineral products of that part of Quebec included in the region now under description, although many other minerals are known and already worked to some extent. Extensive tracts of good arable land exist in many parts of the Acadian region. Its~~

~~surface was originally almost entirely wooded, and the products of the forest still continue to hold a prom- inent place. Priace Edward Island, the smallest province of Canada, is low and undulating, based on Permo-~~

~~*Caboniferous and Triassic rocks affording a red and very fertile soil, much of which is under cul- tivation.*~~

~~*The St Lawrence Plain. — The lowlands or plain of the St Lawrence valley, extending from the vicinity of the city of Quebec to Lake Huron, with an extreme length of over 600 miles, constitute the greatest connected spread of arable land in Eastern Canada, included partly in the province of Quebec and partly in Ontario, with a total area of some 38,000 square miles. This fertile region, bounded to the south-east by the Notre Dame ranges already*~~

~~*B.V.Darbiihin &* O.J.H.Howarth*~~

~~*Ox/ffid igoi*~~

~~*Map op Canada.*~~

~~*referred to, is limited on the south, farther west, by the St Lawrence river and Lakes Ontario and Erie. To the north it ends along the base of the Laurentian plateau. As its uniform topographical features would indicate, it is under- lain by nearly horizontal and undisturbed rocks. These range in age from Ordovician to Devonian (the latter chiefly developed in the peninsular part of Ontario), and are mainly limestones. Superposed on these rocks, the ■eastern part of this plain, to a line which may be drawn some distance west of Ottawa, are marine clays and sands of Pleistocene age. Farther west these are replaced by similar deposits of the same period, but without evidence of marine origin. Petroleum and natural gas occur in the rocks underlying this plain in Ontario, but metal- liferous deposits are almost wanting. The continuing wealth of this region lies in its fertile soil, and within its area the largest and oldest centres of population are situated. The greater part of the length of Lake Huron and the whole northern margin of Lake Supe- rior bathe the foot of the Laurentian plateau, which 'rises directly from these lakes. Continuing westward from Thunder Bay, on Lake Superior, a great south-*~~

~~*ern spur of this plateau is crossed, after which we reach the eastern edge of the interior continental plain.*~~

~~*The Interior Continental Plain. — This plain runs north- westward between the border of the Laurentian plateau and the line of the Rocky Mountains. It includes part of Manitoba, the whole of Assiniboia, and the greater portions of Saskatchewan, Alberta, and Athabasca. To the north- west it becomes narrowed and interrupted, but preserves its main physical features to the Arctic Ocean about the m outh of the Mackenzie. This great region of plain is 800 miles in width from east to west along the international boundary. Seven degrees of latitude farther north, it is still about 400 miles in width. To the south it constitutes the vast prairie region of Canada, with an aggregate area more than twice as large as that of Great Britain. North of the Saskatchewan river it becomes generally wooded, by reason of the greater humidity of the climate, but without essentially changing its physiographic features. Prom the vicinity of the Winnipeg group of lakes, where its elevation is about 800 feet above the sea, it rises gradually to the west or south-west until it attains an elevation of from 3000*~~

~~*to over 4000 feet along the base of the Rocky Mountains. This interior plain of the continent represents the area of an ancient sea by which it was occupied in Mesozoic times. The Cretaceous and early Tertiary rocks by which it is in the main floored still lie nearly unaltered and undisturbed where they were deposited, although now raised far above the searlevel, particularly along that border impinging upon the Eocky Mountains where they are broken into foothills along the base of the range. These strata have been subjected to great denudation, but owing to their comparatively soft character this has been, in the main, nearly uniform, and has produced no very bold features of relief. * Coals and lignite coals are the principal minerals of economic value met with in the area of this central plain, but its chief value lies in its vast tracts of fertile soil or of well- grassed uplands affording perennial pasturage for cattle, horses, and sheep.*~~

~~*Tlie Gordilleran Belt. — The wide mountainous Pacific border of the continent, constituting the "Rocky Mountain region," may best be named as*~~

~~a whole the Cordillera or CordiUeran belt. The Rocky Mountains proper in Canada comprise only the well-defined eastern system of ranges of this belt. The Cordillera includes nearly the entire prov- ince of British Columbia, with the whole of the Yukon district of the North-West Territories. Its width is about 400 miles, and it is throughout essentially a mountainous country very complicated in its orographic features and interlocking river systems, but as yet in the main very imperfectly delineated on any maps. Two principal mountain axes may, however, be defined as its ruling features — the Rocky Mountains proper, above referred to, and the coast ranges of British Columbia. These run nearly parallel, and in a direction corresponding to that of the Pacific coast. Between them are many other ranges, but less regular in trend and much shorter, such as the Selkirk Mountains, the Gold ranges, and the Cariboo Mountains. There is also, in the southern inland country of British Columbia, a region which has, because of its essential difference from the adjacent mountain ranges, and although itself rugged and broken in character, been described as the interior plateau. This, beginning near the 49th parallel of latitude or international boundary, runs north-westwards for about 500 miles, with a general width of about 100 miles. It affords the greatest areas of arable land and pasture land comprised in British Colum- bia. Similar wide tracts of less broken country occur to the southward, between the mountain ranges in the Western States, and beyond it, to the north-west, after traversing an entirely mountainous region in the northern part of British Columbia, its physical characters are again to some extent repeated in the country on the Yukon watershed, where wide valleys and rolling hUls alternate with short mountain ranges of no great altitude. The Pacific border of the coast ranges of British Columbia is dissected by a system of fiords perhaps unequalled elsewhere in the world. These represent submerged valleys, worn out by rivers on the steep western slope of the continent, when the land stood at a high level. A bordering mountain system of the continent, now also in a partly submerged condition, forms Vancouver Island and the Queen Charlotte Islands. The highest known mountains in the Cordillera of Canada are Mount Logan (19,500 feet), and Mount St Elias (18,000 feet), both situated near the intersection of the 141st meridian with the Pacific coast and on the borders of Alaska. The Rocky Mountains proper stand next in regard to altitude, frequently attaining 12,000 feet in their southern part, and with Robson Peak, the highest yet accurately measured, reaching~~

~~13,700 feet. Several sum- mits in the Selkirks are known to surpass 10,000 feet, and many points in the coast ranges reach 8000 or 9000 feet.~~

~~Closely connected with the grand orographic features of this western region are its climate and its character as regards vegetation. It may, as a whole, be described as forest-clad, but forests of extraordinary luxuriance are found in the humid coast region. The conditions favour- able to forest growth are to some extent repeated on the western slopes of the Selkirks, Rocky Mountains, and other main systems, on which the rainfall is ample. On the eastward slopes and in the intervening lower tracts the forests are less dense, and considerable areas of dry, open grass-land occur in the interior plateau and in many of the larger valleys. The geo- logical structure of the CordiUeran belt is very com- plicated, inasmuch as the rocks of this region have been subjected to repeated flexure and disturbance, recurrent up to a late date in the geological time-scale, and there- fore including all but the most recent deposits. Rocks of Archaean age occur, particularly in and near the Selkirk ranges, which, with their representatives farther to the northward, are much older than either the Eocky Moun- tains proper or the coast ranges. The Rocky Mountains proper are referable to folding and fracture caused by pressure of the earth's crust from the Pacific side, which has taken place chiefly at a date subsequent to the Lara- mie or closing stage of the Cretaceous. These mountains are mainly composed of Palaeozoic rocks, ranging from early Cambrian to Carboniferous in age, and consisting in large part of limestones. The coast ranges and that of Vancouver Island, carrying with them in their elevation portions of the Cretaceous rocks, are referable, in their present form, to the same or a not much earlier date. They comprise, however, in their central parts, and par- ticularly in the case of the coast ranges, great masses of granite that have welled up as " bathylites " along the axis of elevation. The coast ranges of British Columbia may, in fact, be considered in the main as a granite belt, over 900 miles in length, and with a width of over 100 miles in many places. The interior plateau of British Columbia presents considerable areas of formations still nearly horizontal, and referable to various stages of the Tertiary or Cainozoic. These include the products of great volcanic activity, ending in the later Miocene in wide basaltic flows. Tertiary rocks are likewise found in some places fringing the Pacific coast, but with a limited spread. The CordiUeran belt, or Eocky~~

~~Mountain region, as a whole, is the most important part of Canada in regard to mining. It constitutes the continuation to the north of the mining country of the western states of the American Union, and its length in Canada is equal to that in the United States. Its economic development has only begun in any systematic way, but great advances have already been made ; means of communication have been provided in its southern part, and gold, silver, copper, lead, and other ores are now being worked on a large scale in that region. Coal has long been an im- portant product of Vancouver Island, and valuable coal- fields are now also beginning to be worked in the Rocky Mountains proper, in the valley of the Bow river, and along the line of the Crow's Nest Pass. Attention was first directed to British Columbia as a mining country about 1858, when placer gold deposits began to be worked. The development of the rich Cariboo district followed with that of other districts less commonly known. Within the last few years the placer gold of the Yukon basin, and more particularly that of the Klondyke division, has attracted world-wide attention, and all this northern mountain country, once valued only for its scanty harvest of rich furs, is being traversed and examined by the prospector. The alluvial gold deposits are naturally those first developed, but the lodes and veins from which these have been derived, together with the deposits of other~~

~~minerals of less intrinsic value, will all in the near future be likewise utilized.~~

~~Turning back to the general physiographical features and geological history of Canada as a whole, after the above review of its several districts, it will be observed that the Laurentian plateau, with its surrounding areas of old rocks in the east, may be regarded broadly as consti- tuting an area of which the history extends to the end of the Palaeozoic era, since which it has remained compara- tively unaffected by orographic movements and relatively stable. This great region stretches westwards to Manitoba and the south-western edge of the Laurentian plateau a,long its course to the Arctic~~

~~*Ocean. From this dividing line the Cretaceous and Tertiary formations become important and widespread. During the early stages of these later times the sea, extending from the Pacific side,*~~

~~*covered much of what is now the western part of the continent, from which it was gradually excluded by recurrent movements of elevation and mountain-making that did not affect the already stable eastern half of the continent. (g. m. d.)*~~

~~*Climate. — It is misleading to speak of the climate as a whole for there are many climates. Not only do the several provinces and territories differ materially, but there are great variations according to locality within most of the provinces themselves. But it may be said, in a general way, that the climates in the neighbourhood of the oceans are milder and damper than in the interior, and that the western or sea-coast portion of British Columbia is milder and damper than the maritime provinces of the Atlantic. Throughout the greater part there are extremes of temperature in winter and summer, but in summer the nights are cool and in winter the atmosphere is dry, bracing, and healthy. The rain and snowfall of the several provinces are shown for five years in the following table : —*~~

~~*Tear.*~~

~~*Ontario.*~~

~~*Quebec.*~~

~~*Nova Beotia.*~~

~~*New Brunswick.*~~

~~*P. E.*~~

~~*Island.*~~

~~*Manitoba.*~~

~~*British Columbia.*~~

~~*N. W. Territories.* |~~

~~*Eain.*~~

~~*Snow.*~~

~~*Eain.*~~

~~*Snow.*~~

~~*liain.*~~

~~*Snow.*~~

~~*Eain.*~~

~~*Snow.*~~

~~*Eain.*~~

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~~*In.*~~

~~*In.*~~

~~*In.*~~

~~*1894*~~

~~*23-30*~~

~~*55-1*~~

~~*22-39*~~

~~*84-8*~~

~~*29-31*~~

~~*80-3*~~

~~23-74~~

~~103-3~~

~~28-65~~

~~10-58~~

~~12-62~~

~~47-9~~

~~41-92~~

~~. 70-4~~

~~9-24~~

~~41-7~~

~~1895~~

~~20-65~~

~~81-4~~

~~25-09~~

~~98-0~~

~~36-71~~

~~75-1~~

~~31-34~~

~~88-9~~

~~32-32~~

~~99-6~~

~~14-64~~

~~44-4~~

~~35-07~~

~~67-0~~

~~10-54~~

~~31-3~~

~~1896~~

~~22-36~~

~~73-3~~

~~25-68~~

~~124-0~~

~~36-88~~

~~64-8~~

~~25-56~~

~~91-1~~

~~28-86~~

~~56-7~~

~~16-00~~

~~62-9~~

~~36-38~~

~~58-5~~

~~10-57~~

~~60-3~~

~~1897~~

~~28-31~~

~~73-0~~

~~28-09~~

~~91-4~~

~~38-94~~

~~86-5~~

~~33-76~~

~~80-3~~

~~33-63~~

~~56-4~~

~~9-66~~

~~59-1~~

~~41-10~~

~~42-6~~

~~11-84~~

~~53-2~~

~~1898~~

~~30-14~~

~~89-8~~

~~26-47~~

~~105-3~~

~~44-46~~

~~89-0~~

~~32-26~~

~~112-0~~

~~34-82~~

~~65-4~~

~~16.75~~

~~53-8~~

~~43-89~~

~~26-2~~

~~10-29~~

~~52-4~~

~~*Note. — ^The articles on the several provinces should be consulted for close information as to climate. The case of British Columbia may be cited to show the need for this. The rain and snowfall for this province show an*~~

~~*average of about 41 inches of rain and 53 of snow, yet in one large division of the province it may be said to rain during nearly every day in the winter, there being hardly a week of snow, while at the same time a division of many million acres is dependent on irrigation for raising its crops.*~~

~~*Tides. — The tides of the Atlantic and Pacific coasts, with the currents dependent upon them, possess a special importance in connexion with the navigation of the St Lawrence, which forms the main commercial avenue from the east. Of late years a systematic investigation of the tides and currents has been under- taken by the Canadian Government. The tides of the St Lawrence enter the Gulf from the Atlantic chiefly through Cabot Strait, between Cape Breton and Newfoundland, which has a width of 75 miles and a depth of 250 fathoms. The tide entering through Belle Isle Strait (12 miles wide and 30 fathoms deep) is compara- tively little felt. The tide so expands in the Gulf of St Lawrence as to become almost inappreciable in places, and the greatest range is attained in Northumberland Strait and at the head of Chaleurs Bay, where it amounts to about 9 feet. At the entrance to the St Lawrence at Anticosti, it has again the oceanic range of some 6 feet, and it proceeds up the estuary with an ever-increasing range which attains its maximum of 19 feet at the lower end of Orleans Island, at 650 miles from the ocean at Cabot Strait. This must be considered as the true head of the estuary. At Quebec, 30 miles farther up, the range is nearly as great, but at 40 miles above Quebec it is largely cut off by the Richelieu rapids, and finally ceases to be felt at Three Rivers, at the lower end of Lake St Peter. On the Pacific coast the two tides of the same day are very unequal, so much so that for a month at a time there is practically only one high water and one low water during the twenty-four hours. This feature of the tide occurs widely on the western coast of America. In the Bay of Fundy the height of the tide while quite exceptional has been much exaggerated. From careful measurements made daily for four months by the engineers of the Chignecto Ship Railway, the extreme range in Cumberland basin at the head of the bay was 49-00 feet, and the average spring range was 42-21 feet. From the lowest level of low water then observed, to the level of the highest tide ever known, which flooded the country on 5th October 1869, during a severe storm, the greatest difference of level in Cumberland basin is 53 feet. At Noel Bay, near the head of the other arm of the Bay of Fundy, the range of ordinary spring tides as stated in the Admiralty charts is 50^*~~

feet. A noteworthy tidal bore occurs at Moncton on the Petitcodiac river, at the extreme head of the Bay of Fundy. Attention has also been given to the establishment of the mean sea^level at a number of places and its reference to permanent marks. A case of special interest occurs in comparing the mean levels on opposite sides of the Chignecto Isthmus, with a range of nearly 50 feet on one side and only 8 feet on the other.

Flora. — The general flora of the Maritime Provinces, Quebec and Eastern Ontario is much the same, except that in Nova Scotia a number of species are found common also to Newfoundland that

are not apparent inland. Professor Macoun gives us a few notable species — Calluna vulgaris, Bahsb., Alchemilla vulgaris, L., Bhodo- dendron maximum, L., Ilex glabia. Gray, Hudsonia ericoides, L. , Gaylussaeia dumosa, F. and G., and Schezoea pusilla, Pursh. In New Brunswick the western flora begins to appear as well as immigrants from the south, while in the next eastern province, Quebec, the flora varies considerably. In the lower St Lawrence country and about the Gulf many Arctic and sub-Arctic species are found. On the shores of the lower reaches Thalictrum alpinum, L., Vesicaria arctica, Richards, Arapis alpina, L., Saxifraga Cfppositifolia, L., Cerastium alpinum, L., Saxifraga cmspitosa, L. and S. have been gathered, and on the Shickshock Mountains of Eastern Canada Silene acaulis, L., Lychnis alpina, L., Cassiope hypnoides, Don., Rhododendron laponicum, Wahl, and many others. On the summit of these hills (4000 feet) have been collected Aspidium aculeatum, Swartz var., Scopulinum, D. C. Eaton, Pellcea densa. Hook, Gallium kamtschaticum, Sletten. From the city of Quebec westwards there is a constantly increasing ratio of southern forms, and when the mountain (so-called) at Montreal is reached the representative Ontario flora begins. In Ontario the flora of the northern part is much the same as that of the Gulf of St Lawrence, but from Montreal along the Ottawa and St Lawrence valleys the flora takes a more souQiem aspect, and trees, shrubs, and herbaceous plants not found in the eastern parts of the Dominion become common. In the forest regions north of the lakes the vegetation on the shores of Lake Erie requires a high winter temperature, while the east and north shores of Lake Superior have a boreal vegetation that shows the summer tempera- ture of this enormous water-stretch to be quite low. Beyond the forest country of Ontario come the

~~*prairies of Manitoba and the North-West Territories. In the ravines the eastern flora continues for some distance, and then disappearing gives place to that of the prairie, which is found everywhere between the Red River and the Rocky Mountains except in wooded and damp localities. North- wards, in the Saskatchewan country, the flora of the forest and that of the prairies intermingle. On the prairies and the foot-hills of the Rocky Mountains a great variety of grasses are found, several years' collection resulting in 42 genera and 156 species. Of the best hay and pasture grasses, Agropyrum elymus, Stipa, Bromus, Agrostis, Calamagrostes and Poa, there are 59 species. Besides the grasses there are leguminous plants valuable for pasture — Astragalus, Vicia (wild vetch) , Lathyrus (wild pea) of which there are many species. The rose family is represented by Prunus, Potentilla, Fragaria, Bosa, Buhus, and Amelanchier.*~~

~~*About the saline lakes and marshes of the prairie country are found Buppia maritima, L., Heliotropium curassavicum, L., natives of the Atlantic coast, and numerous species of Chenopodium, Atriplex, and allied genera. The flora of the forest belt of the North-West Territories differs little from that of Northern Ontario. At the beginning of the elevation of the Rocky Mountains there is a luxurious growth of herbaceous plants, including a number of rare umbellifers. At the higher levels the vegetation becomes more Arctic. Northwards the valleys of the Peace and other rivers differ little from those of Quebec and the northern prairies. On the western slope of the mountains, that is the Selkirk and Coast*~~

~~*[statistics*~~

~~*ranges as distinguished from the eastern or Rocky Mountains range, the flora differs, the climate being damp instead of dry. In sojne of the valleys having an outlet to the south the flora is partly peculiar to the American desert, and such species as Purshia triden- tata, T>. C, and Artemisia tridentata, Nutt., and species of Gilia, Aster, and Erigonum are found that*~~

~~*are not met with elsewhere. Above Yale, in the drier part of the Fraser valley, the absence of rain results in the same character of flora, while in the rainy districts of the lower Fraser the vegetation is so luxuriant that it resembles that of the tropics. So in various parts of the mountain- ous country of British Columbia, the flora varies according to climatic conditions. Nearer the Pacific coast the woods and open spaces are filled with flowers and shrubs. Liliaceous flowers are abundant, including Erythoniums, Trilliums, Alliums, Brodemas, Fritillarias, Siliums, Camassias, and others.*~~

~~*Fauna. — The larger animals of Canada are the musk ox and the caribou of the barren lands, both having their habitat in the far north ; the caribou of the woods, found in all the provinces ex- cept in Prince Edward Island ; the moose, with an equally wide range in the wooded country ; the Virginia deer, in one or other of its varietal forms, common to all the southern parts ; the black- tailed deer or mule deer and allied forms, on the western edge of the plains and in British Columbia; the pronghom antelope on the plains, and a small remnant of the once plentiful bison found in Athabasca and Mackenzie districts, now called " wood buffalo." The wapiti or American elk at one time abounded from Quebec to the Pacific, and as far north as the Peace river, but is now found only in small numbers from Manitoba westwards. In the mountains of the west are the grizzly bear, black bear, and cinnamon bear. The black bear is also common to most other parts of Canada ; the polar bear everywhere along the Arctic littoral. The large or timber wolf is found in the wooded districts of all the provinces, and on the plains there is also a smaller wolf called the coyote. In British Columbia the puma or cougar, sometimes called the panther, and the American lion still frequently occur ; and in all parts the common fox and the silver fox, the lynx, beaver, otter, marten, fisher, wolverene, mink, skunk, and other fur- bearing animals. Mountain and plain and Arctic hares and rabbits are plentiful or scarce in localities, according to seasons or other circum-*~~

~~*stances In the mountains of British Columbia are the bighorn or Rocky Mountain sheep and the Rocky Mountain goat. The birds of Canada are mostly migratory, and are those common to the northern and central states of the United States. The wildfowl are particularly in the west, in great numbers ; their breeding- grounds extending from Manitoba and the*~~

~~*western prairies up to Hudson Bay, the barren lands, and Arctic coasts. The several kmds of geese — including the Canada goose, the Arctic goose or wavey, the laughing goose, the brant, and others — all breed in the northern regions, but are found in great numbers throughout the several provinces, passing north in the spring and south in the autumn. There are several varieties of grouse, the largest of which is the grouse of British Columbia and the pennated grouse and the prairie chicken of Manitoba and the plains, besides the so-called pine partridge and willow partridge, both of which are grouse. While the pennated grouse (called the prairie chicken in Canada) has always been plentiful, the prairie hen (or chicken) proper is a more recent arrival from Minnesota and Dakota, to which states it had come from Illinois and the south as settlement and accom- panying wheatfields extended north. In certain parts of Ontario the wild turkey is occasionally found and the ordinary quail, but in British Columbia is found the California quail, and a larger bird much resembling it called the mountain partridge. The golden eagle, bald-headed eagle, osprey, and a large variety of hawks are common in Canada, as are the snowy owl, the horned owl, and others inhabiting northern climates. The raven frequently remains even in the colder parts throughout the winter ; these, with the Canada jay, waxwing, grosbeak, and snow bunting, being the prin- cipal birds seen in Manitoba and northern districts in that season. The rook is not found, but the common crow and one or two other kinds are there during the summer. The sea-birds include a great variety of gulls, guillemots, cormorants, albatrosses (four species), fulmars, and petrels, and in the Gulf of St Lawrence the gannet is very abundant. Nearly all the sea-birds of Great Britain are found in Canadian waters, or are represented by closely allied species.*~~

~~*Area and Population. — The following table shows the present division of the Dominion into provinces, with the capital and, as accurately as computation on such points is possible, the area and population of each : —*~~

~~*ProvlnoeB.*~~

~~*Area: Square Miles.*~~

~~*Population.*~~

~~*Official Capital.*~~

~~*Lit. N.*~~

~~*Long. W.*~~

~~*1881.*~~

~~*1901.*~~

~~*Ontario ....*~~

~~*Quebec .*~~

~~*Nova Scotia .*~~

~~*New Brunswick .*~~

~~*Manitoba*~~

~~*British Columbia .*~~

~~*Prince Edward Island .*~~

~~*North- West Territories .*~~

~~*The Yukon .*~~

~~*220,000*~~

~~*347,000*~~

~~*20,600*~~

~~*28,200*~~

~~*73,956*~~

~~*383,300*~~

~~2,000~~

~~2,330,540 1\~~

~~198,300 /~~

~~1,926,922~~

~~1,359,027~~

~~440,572~~

~~321,233~~

~~62,260~~

~~49,459~~

~~108,891~~

~~25,515~~

~~2,167,978 1,620,974 459,116 331,093 246,464 190,000 103,258~~

~~220,000~~

~~Toronto .~~

~~Quebec .~~

~~HaUfax .~~

~~Fredericton .~~

~~Winnipeg~~

~~Victoria .~~

~~Charlottetown f Regina . \ Dawson .~~

~~43° 39' 46° 48' 44° 39' 45° 57' 49° 53' 48° 24' 46° 14' 50° 27'~~

~~79° 23' 71° 13' 63° 36' 66° 38' 97° 70'~~

~~123° 19' 63° 10'~~

~~104° 37'~~

~~The Dominion~~

~~3,603,8962~~

~~4,293,879~~

~~5,338,883~~

~~Ottawa .~~

~~45° 26'~~

~~75° 42'~~

~~In 1874 Canada included nearly the whole of British America, but there still remained the Arctic islands and other districts within the Arctic circle that became a portion of the Dominion only in 1880, when all British possessions in North America, excepting Newfoundland, were annexed to Canada. West of the province of Ontario, then inaccurately defined, the provinces of Manitoba and British Columbia were the only organized divisions of the western territory, but in 1882 the provisional districts of Assiniboia, Atha- basca, Alberta, and Saskatchewan were formed, leaving the re- mainder of the north-west as unorganized territories, a certain portion of the north-east, called Keewatin, having previously been placed under the governor of Manitoba. These territories were placed under a lieutenant-governor and council appointed by the Federal Government, but from time to time the principle of self- government was expanded until they now live under almost the same political conditions as the several provinces. In 1898, owing to the influx of miners and others, an Act was passed constituting the Yukon territory under a form of government specially created for its management. The other unorganized territories are~~

~~only sparsely inhabited, and almost entirely by Indians, the people of the Hudson Bay Company's posts, and a few missions. Newfound- land, and with it Labrador, vrill probably be united to Canada before many years, as the objections on either side are disappearing, and in that event Canada will embrace the whole of British North America.~~

~~Population. — The census of the Dominion is taken every ten~~

~~1 i.e., disregarding the figures for Franklin district as "unknown." It is estimated that the area of this division is, approximately, 590,000 square miles.~~

~~2 This is the sum of the areas attributed in the table to the several~~

~~years (Manitoba every five), and the growth of population, which, however, had not at the last enumeration quite come up, in certain instances, to expectations formed on the opening up of the North- west Territories, is shown by the following figures : — 1871,~~

~~3,618,411 ; 1881, 4,336,504 ; 1891, 4,833,239 ; 1901, 5,338,883.~~

~~The density of population is greatest in Prince Edward Island, where it is 51 '6 to the square mile ; in Nova Scotia it is 22-3 ; New Brunswick, 11-6; Ontario, 9-9; Quebec, 4-7; Manitoba, 3-3; British Columbia, 0-5 ; Territories, 0-1 ; the Dominion, 1-3. This is not an indication of the density in settled parts ; as in the cases of Quebec, Ontario, and British Columbia there are enormous dis- tricts where there is no population at all, but the area of which enters into the calculation. The population is composed mainly of English- or French-speaking people. There are German settle- ments of some extent in Ontario, and of late years there has been a large immigration of people from other parts of Europej including Russians, Doukhobors, Galicians, and Polish and Russian Jews, as well as a large number of Icelanders and Mennonites. English and Scots and their descendants form the bulk of the population of Ontario, French Canadians of Quebec, Scots of Nova Scotia, the Irish of a large proportion of New Brunswick. Manitoba is largely peopled from Ontario, together with the decreasing numbers of half- breeds — French and English — who originally comprised the bulk of its inhabitants. The Territories,~~

~~particularly the ranching districts, have a larger proportion of English than of other classifications, and British Columbia contains an assorted population, of which a~~

~~provinces. The total area of the Dominion, however, disregarding Franklin district, is ofHcially returned as 3,653,946 square miles, tjie great lakes and rivers 47,000 square miles.~~

~~statistics]~~

~~CANADA~~

~~531~~

~~large proportioa in the mining districts are Americans, and in the cities of Chmese with some Japanese. The mixed nationality of tiie population is also remarkable in the town of Lethbridge, in South Alberta, as well as in the city of Victoria, British Columbia. Smce 1876 there has been a great change throughout the west, i.e., from Lake Superior to the Pacific. Then Manitoba was principally inhabited by English and French half-breeds (or Metis) , descendants of Hudson Bay Company's employees, or adventurous pioneers from Quebec, together with Scots settlers, descendants' of those brought out by Lord Selkirk, some English army pensioners and others, and the van of the immigration that shortly followed from Ontario. Beyond Manitoba bison were still running on the plains, and British Columbia having lost its mining population of 1859 and 1860 was inhabited by Indians, and its white population were principally Englishmen and others who had drifted westwards. Domestic cattle and grain have taken the place of the bison, while a rapidly increas- ing English-speaking population is supplemented by 7000 Dou- khobors, and about 18,000 Gallcians. French is the language of the people of Quebec, though English is much spoken in the eastern townships and equally with French in the cities, both lan- guages being officially recognized in that province as in the Federal~~

~~courts and parliament. Elsewhere English is ezclusively used, except by the newly-arrived foreigners. The male sex was at the census of 1891 predominant in all the provinces except Quebec (where the sexes were about equal), the males in the Dominion numbering 2,460,471 and the~~

~~*females 2,372,768. The greatest discrepancies were in British Columbia with a surplus of 27,833 males, Ontario with 24,653, Manitoba with 16,178, and the Terri- tories 8603, though this order would be entirely changed were the discrepancy to be exhibited with a percentage of the people. The figures of the census of 1891 for the occupations of the people are used here, and to them should be added about 7J per cent, to agree with the later population. The percentage of miners, however, is necessarily disturbed by the recent aggregations in British Columbia and the Yukon :— persons engaged in agriculture, 735,207; in mining, 15,168; in fishing, 27,079 1; in lumbering, 12,756 ; in manufacturing, 320,001 ; in transportation, 186,495 ; professional, 68,280 ; students for professions, 10,867. In the non-productive classes : — Indian chiefs, 143 ; members of religious orders, 9239 ; paupers, 16,950 ; pensioners, 179 ; retired persons,*~~

~~*15,607.*~~

~~*The following table shows the population by creeds : —*~~

~~*Provinces.*~~

~~*Church of England.*~~

~~*Methodists.*~~

~~*Presby- terians.*~~

~~*Baptists.*~~

~~*Other De- nominations.*~~

~~*Total.*~~

~~*Boman CathoUos.*~~

~~*Grand Total.*~~

~~*Ontario .... Quebec .... Nova Scotia New Brunswick Manitoba .... British Columbia Prince Edward Island The North- West Territories*~~

~~385,999 75,472 64,410 43,095 30,852 23,619 6,646 15,966~~

~~654,033 39,544 54,195 35,504 28,437 14,298 13,596 8,158~~

~~453,147 52,673~~

~~108,952 40,639 39,001 15,284 33,072 12,558~~

~~106,047~~

~~7,991~~

~~83,122~~

~~79,649~~

~~16,112~~

~~3,098~~

~~6,265~~

~~1,555~~

~~156,795 21,146 17,265~~

~~6,415 17,533 21,031~~

~~1,662 46,386~~

~~1,756,021~~

~~196,826~~

~~327,944~~

~~205,302~~

~~131,935~~

~~77,330~~

~~61,241~~

~~84,623~~

~~358,300~~

~~1,291,709~~

~~122,452~~

~~115,961~~

~~20,571~~

~~26,843~~

~~47,837~~

~~14,344~~

~~2,114,321~~

~~1,488,535 450,396 321,263 152,506 104,173 109,078 98,967~~

~~Canada~~

~~646,059~~

~~847,765~~

~~755,326~~

~~303,839~~

~~288,233~~

~~2,841,222~~

~~1,998,017~~

~~4,839,239~~

~~Indians. — The Indian population numbers about 100, 000. Except in British Columbia and the unorganized Territories, nearly all of these are on reservations, where they are under Government super- vision, receiving an annuity in money and a certain amount of provisions ; and where, by means of industrial schools and other methods, civilized habits are superseding the former mode of life. The Indian population slightly increased in the decade 1890-1900. British Columbia has about 25,000, most of whom are along the coast, though one of the important tribes, the Shuswaps, are in the interior. Manitoba and the North- West Territories have the next largest number of Indians. Ontario has 20,610. They are entirely civilized, and many of them are good farmers. Quebec has 10,677 ; Nova Scotia, 2027 ; New Brunswick, 1627 ; Prince Edward Island, 314. The Peace Eiver Indians number about 900, and the number computed for the outside territories is 17,648, in which are included the Eskimo of the barren lands and Arctic coasts. The Govern- ment acts as trustees for the Indians, investing their moneys accru- ing from the sale of lands, timber, &o., which in 1898 amounted to 13,725,747, and parliament annually makes a large appropria- tion for the payment of their annuities, schools, expenses of manage- ment, &c.~~

~~Chinese and Japanese. — The Chinese and Japanese are nearly all in British Columbia. By an Act of 1895 the Chinese are compelled to pay a fee of |50 on entering Canada. From 1896 to 1898, 20,017 paid this fee, and 351 entered exempt from payment. In 1897 the British Columbia legislature passed an Act to prevent the under- ground employment of Chinese and~~

~~*Japanese in the coal and other mines, but the Federal Government disallowed the Act so far as it related to Japanese.*~~

~~*Births., Marriages, and Deaths. — In the absence of aunif orm system of registration, a complete return t>f births, deaths, and marriages is not obtainable. The foUovring are the figures for 1897 : —*~~

~~*Provinces.*~~

~~*Births.*~~

~~*Deaths.*~~

~~*Marriages.*~~

~~*Illegitimate.*~~

~~*Ontario .*~~

~~*47,232*~~

~~*27,633*~~

~~*15,293*~~

~~*728*~~

~~*Quebec .*~~

~~*58,433*~~

~~*34,287*~~

~~*10,291*~~

~~*Nova Scotia*~~

~~...~~

~~...~~

~~*2,044*~~

~~*New Brunswick*~~

~~*6,026*~~

~~*2,877*~~

~~*3,872*~~

~~*Manitoba*~~

~~*3,426*~~

~~*1,933*~~

~~*2,930*~~

~~*British Columbia .*~~

~~*1,331*~~

~~*1,013*~~

~~*1,258*~~

~~*The four cities showing the largest rates (1897) are : —*~~

~~*Cities.*~~

~~*Births.*~~

~~*Deaths.*~~

~~*Marriages.*~~

~~*Montreal . Toronto . Quebec . Ottawa .*~~

~~9152 4078 2310 1273~~

~~^584~~

~~3122 1755 1242~~

~~1851~~

~~1501~~

~~418~~

~~479~~

~~Constitution. — Tlie Dominion is a federation of the British colonies in North America (Newfoundland ex- cepted), with the addition of Rupert Land and other territories formerly under the rule of the lludson Bay Company. It is governed by a parliament consisting of the Sovereign, represented by a Governor-General, an Upper HOuse called the Senate, and a HOuse of Commons. The members of the Senate are appointed for life by the Government of the day, and they are 81 in number — being 24 members each from Ontario and Quebec, 10 each from Nova Scotia and New Brunswick, 4 each from Prince Edward Island and Manitoba, 3 from British Columbia, and 2 from the organized Territories. The number of representatives in the HOuse of Commons is re-arranged after each decennial census in such a way that the province of Quebec shall always have 65 members, and every other province such number as will give the same proportion of representatives to its population as the number 65 is to the population of Quebec. By the terms of union with Canada, British Columbia was never to have less than 6 members. Each province is presided over by a lieutenant- governor appointed by the Governor-General in Council for a term of 5 years, and. has its own legislature and executive council, the jurisdiction of the provincial legis- latures being described and limited by the imperial Act of 1867 federating the colonies. At this date Quebec and Nova Scotia were given two chambers — a legislative council and legislative assembly — the one appointed and the other elected ; and on the creation of Manitoba (1870), two chambers were given to that province. Quebec and Nova Scotia are the only provinces now retaining a~~

~~*legis- lative council. These legislatures have exclusive jurisdic- tion over their own range of subjects, but their Acts are nevertheless subject to disallowance (within one year of their passage) by the Federal Government, in the same way that the Acts of the parliament of the Dominion are subject (within two years) to disallowance by the imperial Government. This power has been used, though rarely, in both cases. Matters of purely local interest are dealt with by the municipalities into which the several pro- vinces are divided. The organized Territories were at*~~

~~*1 This uomber is largely increased during short seasons of the year.*~~

~~*[statistics*~~

~~*first governed by the lieutenant-governor of Manitoba and a separate council for the North-West, then by an appointed governor and council (1876), until by succes- sive developments in the direction of self-government they obtained an almost full measure of responsible gov- ernment in 1897. The power of local taxation has, how- ever, not yet been granted. The Yukon district of the North-West Territories was, in 1898, politically separated from the rest of the territories and given a government of its own, consisting of a commissioner and appointed advisory council. The unorganized Territories are under the governance of the Dominion Government. The franchise for the Dominion electors is at present the same as that for the provinces, and is so wide as almost to amount to residential manhood suffrage. The limits of the federal and provincial powers are defined by the British North America Act (1867) with the residue of power vested in the Federal parliament, the opposite principle to that of the United States and the common- wealth of Australia. In some points the two jurisdictions overlap, but decisions of the Supreme Court of Canada and the judicial committee of the British Privy Council are gradually settling disputable points. In the working of the several Governments the customs and practices of the imperial Parliament are followed. The following is a list of the Governor-Generals since confederation : Vis- count Monk, 1st June 1867 ; Sir John Young (afterwards Baron Lisgar), 29th December*~~

1868 ; the earl of Dufferin, 22nd May 1872 ; the marquis of Lome (afterwards duke of Argyll), 5th October 1878 ; the marquis of Lansdowne, 18th August 1883 ; Lord Stanley of Preston (afterwards earl of Derby), 1st May 1888; the earl of Aberdeen, 22nd May 1893; the earl of Mmto, 20th July 1898.

Justice.— The Supreme Court is the highest in the Dominion. It has appellate, criminal, and civil jurisdiction as well as appellate jurisdiction in cases between the Dominion and any of the pro- vinces, and between one province and another on condition that legislatures pass Acts agreeing to such jurisdiction. By Act of Par- liament the Governor-General in Council may refer to the Supreme Court for an opinion upon any matter which he deems advisable in the public interest. There is a chief justice and five puisne judges, and except in criminal cases an appeal lies from the Supreme Court to the Privy Council in England. The Exchequer Court, presided over by a single judge, has exclusive jurisdiction in cases in which a claim for money is made against the Crown, or any of its officers, and also in cases where it is desired to enforce any law relating to the revenue, and it is a colonial court of Admiralty. In the pro- vinces the superior courts have various distinctive names and vary-

ing numbers of judges, in addition to the county courts with limited jurisdiction. In the Territories there are no county court judges ; police magistrates and appointed justices taking their places. The provinces create their own courts, but the Federal Government appoints and pays the judges. The commissioner and the assistant commissioner of the North-West Mounted 'Police exercise the power of a stipendiary magistrate, the inspectors that of a justice of the peace. In the unorganized Territories the law of England so far as applicable is in force.

There are five penitentiaries in Canada, containing on 30th June 1898, 1414 male prisoners and 32 females. All convictions for two years or over go to the penitentiaries.

Insane.— The, census of 1891 showed 13,355 insane in the Do- minion, of which 7162 were males and 6193 females, the greatest number, 5369, being between the ages of 40 and 69 years. The percentage showed that in every 10,000 males there were 29-1 insane, and 26 1 in every 10,000 females. Of

~~*the whole number 3044 were foreign-bom and 2793 were bom in Canada, both parents being foreigners. There are 18 asylums for the insane, most of which are supported by the Government, aided in some cases by the municipalities.*~~

~~*Education. — The British North America Act imposes the duty of legislating on educational matters on the provincial legislatures, the privileges of the minority in Ontario and Quebec — that is, the separate schools — ^being specially safeguarded. In other provinces this limitation does not exist. In 1880 the New Brunswick legisla- ture abolished the separate school system, and a contest arose which was finally settled by the authority of the legislature being sustained, but certain concessions were made to the Boman Catholic dissentients which practically met their objections. Subsequently a similar difficulty occurred in Manitoba, when the legislature in 1890 abolished the system of separate schools which had been established in 1871. Owing to ambiguity in the Acts the power of the legislature was disputed, and after going through the courts with opposing decisions the case went to the Privy Council in Eng- land. Their decision was ambiguous, but practically relegated the matter to the Dominion Government. An attempt was made by it to restore the separate schools, but was successfully resisted by the Manitoba Government, and at the general election for the House of Commons in 1896 the Manitoba school question became a principal issue, with the result of overturning the Government. Though the dissentient Roman Catholics did not acquiesce in this verdict, the question is practically settled against the restoration of the separate school system. In Canada there are public schools or common schools, high schools, model and normal schools, denominational schools, colleges, and degree-granting universities, private schools, agricultural and art colleges. The public schools are under the control of local boards of trustees, elected by the ratepayers, and at these only certificated teachers are employed. The high schools, grammar schools, and colleges, have a higher curriculum than the public schools, and are not free. The model schools are for the training of teachers desiring a 2nd or 8rd class certificate ; the nor- mal schools for those desiring a 1st class certificate. In addition to these there are night schools and kindergartens, and a few schools for the deaf and dumb. The general outline of education in the Dominion may be seen from the following tabular statement : —*~~

~~*Provinces.*~~

~~*Tear.*~~

~~*Schools.*~~

~~*Pupils In.*~~

~~*Attendance in Public Schools.*~~

~~*Public.*~~

~~*Other.*~~

~~*Public.*~~

~~*Other.*~~

~~*Average.*~~

~~*Percentage.*~~

~~*Ontario .... Quebec .... Nova Scotia New Brunswick Manitoba .... British Columbia Prince Edward Island The Territories .*~~

~~*31st Dec. 1897 30th June 1898 31st July 1898 30th June 1898 31st Deo. 1897 30th June 1898*~~

~~*Do. 31st Dec. 1898*~~

~~*6,009*~~

~~*5,167*~~

~~*2,385*~~

~~*1,778*~~

~~*1,068*~~

~~257~~

~~468~~

~~426~~

~~203~~

~~690~~

~~20~~

~~15~~

~~4~~

~~4~~

~~included~~

~~482,777 204,259 101,203 63,333 39,841 17,189 21,285 16,754~~

~~27,079~~

~~101,260~~

~~2,046~~

~~1,143~~

~~1,044~~

~~459~~

~~included~~

~~273,544 143,665 57,771 38,874 21,500 10,779 13,377 8,827~~

~~56-66 70-33 57-08 61-38 53-96 62-71 61-22 52-69~~

~~*The Dominion .*~~

~~...~~

~~*17,558*~~

~~*936*~~

~~*946,641*~~

~~*133,031*~~

~~*568,337*~~

~~*60-00*~~

~~*Teachers.*~~

~~*Revenue.*~~

~~*Expenditure.*~~

~~*Provinces.*~~

~~*Public Schools.*~~

~~*Other*~~

~~*Schools.*~~

~~*Government.*~~

~~*Other Sources.*~~

~~*Ontario*~~

~~*Quebec*~~

~~*Nova Scotia .*~~

~~*New Brunswick .*~~

~~*Manitoba*~~

~~*British Columbia .*~~

~~*Prince Edward Island .*~~

~~*The Territories .*~~

~~*9,128*~~

~~*5,909*~~

~~*2,510*~~

~~*1,864*~~

~~*1,197*~~

~~*410*~~

~~*679*~~

~~*483*~~

~~*626*~~

~~*3643*~~

~~*60*~~

~~*39*~~

~~*13*~~

~~*12*~~

~~*included*~~

~~”~~

~~$1,626,593 304,410 245,837 188,104 156,747 290,255 129,818 133,643~~

~~13,361,562~~

~~1,425,986~~

~~592,973~~

~~320,807~~

~~” 525,482~~

~~33,215~~

~~not given~~

~~$4,215,670 1,730,396 838,810 483,829 805,417 290,255 163,033~~

~~not given~~

~~The Dominion~~

~~22,080~~

~~4393~~

~~3,075,407~~

~~6,260,025~~

~~8,527,410~~

~~statistics]~~

~~CANADA~~

~~533~~

~~*In every province there are denominational colleges and insti- tutions for higher education, and there are universities, most of which have degree-conferring powers. Some of them are of old standing. With the exception of St Joseph's College University, New Brunswick, and the University of Ottawa, all are endowed either with money or land in amounts varying from $50,000 to $2,750,000. There are also a number of so-called classical colleges in Quebec, educating both boys and men, and most of these are affiliated with Laval University. As an adjunct to education may be mentioned the libraries (mechanics' institutes are now "public libraries"), of which there are law, 21 ; legislatures, 9 ; public, 325 ; collegiate, 62 ; medical and historical, 29 : special, 2 : Y.M.C.A., 32. . . i- , .*~~

~~*Finance. — The revenue is derived mainly from customs and excise duties, with subsidiary amounts from mining licenses, timber dues, post office, &c. Both the revenue and expenditure fluctuate considerably, the revenue for the decade 1890-99 ranging from 35 to nearly 47 millions. The receipts on consolidated fund account for 1899 amounted to $46,743,249 against an expenditure chargeable to consolidated fund of $41,903,500, showing an apparent surplus of $4,839,749. In 1899 the expenditure chargeable to capital, with railway and other charges, brought up the total disbursements to $51,542,635. The revenue of 1899 was derived from customs, $25,178,786 ; excise, $9,641,227 ; post office (gross), $4,336,278 ; public works, railways, arid canals, $369,044 ; weights and measures, $91,059 ; interest on investments, $1,590,447 ; fisheries, $86,502 ; miscellaneous, $5,450,907. The expenditure of the consolidated fund covers payments peculiar to Canada, including payments to Indian tribes and subsidies to provinces. The debt of the Dominion in 1879, 1889, and 1899 was :—*~~

~~*1879.*~~

~~*1889.*~~

~~*1899.*~~

~~*Gross debt Assets . Net debt .*~~

~~*$179,483,871*~~

~~36,493,654~~

~~142,990,217~~

~~$287,722,062~~

~~60,192,021~~

~~237,530,041~~

~~$345,160,902~~

~~78,887,456~~

~~266,273,446~~

~~A large part of the debt arises from the assumption of certain debts of the provinces as they entered the confederation, other debts subsequently assumed, and expenditure on canals and assist- ance given to railways. This debt does not include the debts of the provinces since confederation, a matter which concerns each province only. The canals, including the deepening of the channel of the St Lawrence, represent an amount of 875,000,000 ; the rail- ways, including the building of the Intercolonial and Prince Edward Island railway, $941,297,037, of which amount the Dominion Government contributed in money $151,609,812. The money circulation consists of Dominion notes (legal tender) and the notes of the chartered banks, together with gold, silver, and copper coin. Gold, however. Is little used in daily business. The Dominion notes are of the following denominations : $1, $2, $4, $500, $1000, the two last being exclusively used by the banks. English bank-notes, gold, and silver are subject to a variable rate of exchange, but United States notes are usually received at par in the larger cities, though subject to a discount when received in Government institutions. The average monthly circulation of Dominion notes of all denominations in 1899 was $23,229,779, against which the Treasury held specie, guaranteed sterling deben- tures, and unguaranteed $32,441,074. The only direct taxation is that imposed by the several cities, towns, and municipalities on their own inhabitants, and this taxation necessarily varies accord- ing to the needs and circumstances of each locality.~~

~~*Defence. — ^The naval forces, which at present consist of a fishery protection service, are under the minister of marine and fisheries ; the militia is managed by the minister and department of militia, and is always commanded by a general who is an imperial officer. There are three small bodies of permanent troops, called schools, designed to serve as an educational source for the militia. They number 161 dragoons, 430 artillery, and 395 Infantry, but can be increased as occasion warrants. The active militia numbers 36,650, comprising all branches of the regular army. At Kingston, Ontario, there is a military college, to the successful graduates of which a variable number of commissions in the British army is annually awarded. Though not strictly belonging to the militia, the North- West Mounted Police is a body of highly efficient cavalry, about 700 strong. There are always some imperial troops at Halifax under the command of a general, who on the absence from Canada of the Governor-General becomes administrator of the Dominion. The harbours of Halifax in Nova Scotia, and Esquimalt in Van- couver Island, British Columbia, are fortified by the imperial Gov- ernment. . ,•• .*~~

~~*Production. — Agriculture is the chief industry. Ontario, Mani- toba, and sections of the Territories are the principal wheat-growing provinces, but though cattle, sheep, and horses are successfully raised in all the provinces, the districts in which the stock ranches are found are in Western Assiniboia, Southern Alberta, and some parts of British Columbia. All kinds of grain are raised in Canada, but not uniformly throughout the several provinces, ^r, +t,o*~~

~~*In the*~~

~~*Maritime Provinces, Quebec, Ontario, and British Columbia, much of the grain is sown in autumn, and comprises different varieties of wheat and of oats. The agricultural returns will necessarily in- crease year by year as immigration continues and new lands are opened up. The largest amount in value of agricultural produce exported in 1900 was wheat, $11,995,488, to which should properly be added wheaten flour, $2,791,885 ; cheese, $19,856,324 ; bacon, $12,803,034; cattle, $9,080,776; oats, $2,143,179; butter, $5,122,156; sheep, $1,894,012 ; pease, $2,145,471 ; horses, $898,063 ; apples, $2,789,125 ; eggs, $1,457,902 ; and otheranimal*~~

~~*produce, $2,627,806. These are the only products of the farm that realized over one million dollars each, but their value, with that of other agricultural produce exported in 1900, amounted to $77,810,532, exclusive of horses. (See also under Aokicultcre below.)*~~

~~*Mining. — The mineral districts occur from Nova Scotia to the islands in the Pacific, British Columbia and the Yukon being the chief producers of 1898. The following statement shows the value of all the minerals, metallic and non-metallic, produced in Canada during 1898 :—*~~

~~*Antimony Copper . Gold . Iron ore . Lead . . Nickel . Platinum Silver .*~~

~~*lie.*~~

~~*Kon-metallic.*~~

~~*$20,000*~~

~~*Asbestos .*~~

~~*. $491,197*~~

~~*. 2,134,980*~~

~~*Chromite .*~~

~~*24,262*~~

~~*. 13,776,420*~~

~~*Coal*~~

~~*. 8,222,878*~~

~~*152,788*~~

~~*Grindstones*~~

~~*44,775*~~

~~. 1,206,399~~

~~Gypsum .~~

~~232,515~~

~~. 1,820,838~~

~~Natural gas~~

~~322,123~~

~~. . 1,500~~

~~Petroleum~~

~~. 1,061,749~~

~~. 2,593,929~~

~~Pyrites~~

~~128,872~~

~~All others~~

~~. 6,426,797~~

~~$21,705,854~~

~~$16,966,158~~

~~The mineral fields of Southern British Columbia and the Yukon territory are only in the infancy of production, and the coal-fields opened up by the Canadian Pacific railway in the eastern part of British Columbia are of very great extent. The nickel mines are on the north shores of Lake Superior, and there are indications of a large undeveloped area in the neighlDourhood of Sudbury, where the mines at present at work are situated.~~

~~*Manufctctures. — In 1898 Canada exported $31,179,113 worth of manufactures, a great proportion of this being the produce of the mine, the forest, the sea, and the farm, but since the adoption of the national policy the manufacture of goods for home consumption has very largely increased, such as cotton and woollen goods, boots and shoes, agricultural implements, and a variety of miscellaneous articles previously imported, and the countries sending the largest amounts, are, in their order, United States, Great Britain, Germany, France, and Holland. The principal classes of goods imported for home consumption are bread-stuffs, carriages, articles of cotton, articles of flax, hemp, and jute, iron and steel, oils, leather, paper, provisions, silk and woollen goods. Bread-stuffs comprise rice, sago, tapioca, and other articles not of wheat product.*~~

~~*Fisheries. — ^The principal fisheries are those on the Atlantic coast carried on by the inhabitants of Nova Scotia, New Brunswick, Prince Edward Island, and to some extent by the people of the eastern section of Quebec. Cod, herring, mackerel, and lobsters are the chief product of the fisheries, though halibut, salmon, anchovies, and so-called sardines are also exported. In British Columbian waters the main catch is of salmon, in addition to which are halibut, oolachan, herring, sturgeon, cod, shell-fish, and fish taken for their oil value — namely, the dog-fish and basking-shark and the rat-fish. Ontario and Manitoba produce white fish, sturgeon, and other fresh- water fish. In 1897 there were 78,959 persons engaged in the fish- ing industry, though only 27,079 were permanently so employed. The total production of fish in 1897 was in value $22,783,546, of which $10,841,661 was exported, and the balance consumed at home, this being augmented (for bait and other purposes) by im- portations to the amount of $784,323.*~~

~~*The business of fur-seal catching is carried on to some extent in the North Pacific by sealers from Victoria, but the returns of the last few years show it to be a decreasing industry, as well as one causing some friction with the United States. In 1895 the catch by Canadian pelagic sealers was 73,614 seals ; in 1896, 55,667 ; In 1897, 30,410; and in 1898, 28,552. Owing to the seizure of Canadian sealing vessels on the high seas, the contention that the United States were justified in making such seizures, and the re- pudiation of such claim by Great Britain, the question was sub- mitted to an*~~

~~*international commission sitting in Paris, with the result that a certain area (60 miles from shore) was prescribed round the sealing islands of Alaska in which pelagic sealing was forbidden, and damages to be settled by arbitration were awarded to the owners of vessels that had been unlawfully seized. This money was paid in 1899.*~~

~~*Commerce. — Since 1875 commerce has greatly expanded. The opening up of the fertile lands in the north-west, the increase of population, the discovery of new mineral fields, and the construction of railways have changed the conditions, methods, and channels*~~

~~*[statistics*~~

~~*of trade. The development that has taken place may be seen from the figures in the following tabular statement : —*~~

~~*Tear.*~~

~~*Total Exports.*~~

~~*Total Imports.*~~

~~*Entered for Consumption.*~~

~~*Duty.*~~

~~*1880 1890*~~

~~*1900*~~

~~*87,911,458*~~

~~*96,749,149*~~

~~*191,894,723*~~

~~$~~

~~86,964,747~~

~~121,858,241~~

~~189,622,513~~

~~71,782,349 112,765,584 180,804,316~~

~~$ 14,138,849 24,014,908 28,889,110~~

~~The exports for the decades ending 1878, 1888, and 1898, are here shown : —~~

~~18T8.~~

~~1888.~~

~~1898.~~

~~Produce of the mines .~~

~~2,762,762~~

~~4,100,893~~

~~14,460,056~~

~~Fisheries~~

~~6,853,975~~

~~7,793,183~~

~~10,841,661~~

~~Forests~~

~~5,912,1391~~

~~5,091,5461~~

~~6,013,9421~~

~~Animals and their pro-~~

~~14,019,857~~

~~24,719,297~~

~~44,301,470~~

~~duce~~

~~Agricultural~~

~~18,008,754~~

~~15,436,360~~

~~33,063,285~~

~~Manufactures~~

~~17,780,776~~

~~20,383,594~~

~~31,179,113~~

~~Miscellaneous~~

~~401,871~~

~~773,877~~

~~61,405~~

~~Coin, bullion, and short~~

~~2,418,755~~

~~3,101,856~~

~~9,250,868~~

~~returns at inland ports~~

~~The largest items of this export trade for 1898 were : Minerals — gold, quartz, dust, &c., 18,587,953; silver, $3,519,786; lead, $1,008,147; nickel, $970,531. Fisheries— cod, $2,595,005; lobsters, $2,627,597; salmon, fresh and otherwise, $3,624,212; mackerel, $76,502. Forest— pine logs, $1,616,671; spruce, $33,885; all other logs, $150,265. Lumber — ^pine deals, $3,814,947 ; spruce and other deals, $7,918,366; planks and boards, $5,611,637. Square timber : white pine, $1,636,067 ; red pine, $59,687 ; others, $28,882 ; and other products of wood, making a total of $26,511,639. Animals and their produce— cheese, $17,672,763; cattle, $8,723,292; $1,497,444; sheep, $1,272,077; butter, $2,046,686; 1,255,304; hides, skins, &c., not fur, $1,072,028; bacon, 17,291,285; besides many other articles reaching less than one million dollars' worth. Agricultural products — wheat, $17,313,916 ; $5,425,760 wheaten flour; oats, $3,041,578; apples, $1,431,517; pease, $1,813,792, &c. Manufactures — agricultural implements, $1,443,140 ; boots, shoes, and articles of leather, $1,608,352 ; wood- pulp, $1,210,421 ; other articles of wood, $1,261,618. There is a large number of items in the ejtport trade, but those are mentioned that exceed one million dollars.~~

~~Shipping. — The chief seaports from east to west are Halifax, N.S. ; St John, N.B. ; Quebec and Montreal on the Atlantic ; and Vancouver, Esquimalt, and Victoria, B.C., on the Pacific. Halifax is the ocean terminus of the Intercolonial railway ; St~~

~~John the Atlantic terminus, and Vancouver the Pacific terminus of the Canadian Pacific railway. Esquimalt is the harbour and depot of the British squadron on the Pacific, but it is little used by merchant vessels. There are four graving docks in Canada : —~~

~~Esquimalt, B.C. Kingston, Ont. Quebec HaUfax, N.S. .~~

~~*Lengtb.*~~

~~*Feet.*~~

~~*430 280 445 685*~~

~~*Width at Coping,*~~

~~*Feet.*~~

~~*90*~~

~~*79*~~

~~*100*~~

~~*102*~~

~~*Entrance.*~~

~~*Feet.*~~

~~*65 65*~~

~~*Bottom,*~~

~~*Feet.*~~

~~*41*~~

~~*47 78 72*~~

~~*Water on SiUa.*~~

~~*Feet.*~~

~~*26* 16*~~

~~*25J*~~

~~There are 1532 light stations, lighthouses, _ fog-whistles, and automatic horns. Of late the character of the shipping interest has much changed, owing to the substitution of iron and steel for wood. Shipbuilding has decreased from 490 vessels built and registered in 1874, to 278 vessels built and registered in 1898 ; the tonnage built from 183,000 in 1874 to 24,522 in 1898, but the general increase of tonnage employed in transportation has been larger during the same period, as the following table shows : —~~

~~Sea-going Tonnage arriving at and leaving Canadian Ports.~~

~~Tear.~~

~~British.~~

~~Canadian.~~

~~Foreign.~~

~~Total Tons Register.~~

~~1874~~

~~1898~~

~~3,945,822 1 5,777,068~~

~~included in~~

~~British~~

~~2,029,745~~

~~]• 2,105,539~~

~~4,778,672~~

~~6,051,361 12,685,486~~

~~*In 1874 there was but one regular passenger steamship line between Great Britain and Canada ; there are now four, with occa- sional less regular services. On the inland waters the tonnage of Canadian and American vessels arriving at and leaving Canadian ports has increased in the same period from 5,370,506 to 12,160,631 tons register, the Canadian in each case slightly preponderating. The tonnage engaged in the coasting trade increased.in the twenty- four years from 8,700,000 tons to 29,700,000 tons.*~~

~~*Internal Communications. — The internal communications are carried on both by railway and canal, and in no particular has Canada undergone greater change than in her inter-provincial traffic. In 1878 there were 6143 miles of railway in operation, carrying 6,443,924 passengers and 7,883,472 tons of freight ; in 1898 there were 16,718 miles in operation, carrying 18,444,049 passengers and 28,785,£K)3 tons of freight. There are 166 railways, but an amal- gamation of 25 of these constitutes the Grand Trunk railway system, and of 23 the Canadian Pacific railway system. These two systems, with the Intercolonial (ovroed ai/d operated by the Government), are the three principal railways. A short line across Prince Edward Island is also owned by the Government. In 1898 the condition of the railways was thus : —*~~

~~*Canadian Pacific Grand Trunk Intercolonial and Prince*~~

~~*Edward Island Total, all railways*~~

~~*Mileage.*~~

~~*6,298 3,147 1,355*~~

~~*16,717*~~

~~*Capital Paid Up.*~~

~~*323,834,067*~~

~~*342,244,928*~~

~~*69,437,021*~~

~~941,297,037~~

~~Passengers Carried.~~

~~3,327,368 6,041,551 1,664,954~~

~~18,444,049~~

~~Freight in Tons.~~

~~5,493,030 8,773,322 1,492,115~~

~~28,785,903~~

~~Total Beceipts.~~

~~25,470,796~~

~~18,396,010~~

~~3,276,620~~

~~59,716,105~~

~~Total Expenses.~~

~~14,684,791~~

~~11,536,708~~

~~3,489,067~~

~~39,137,549~~

~~It will be seen that the Government has not had equal success with public companies in the management of railways, and that the Grand Trunk's receipts are not in the same proportion to their capital as those of the Canadian Pacific. The ordinary share capital of the railways is $266,669,857 ; preference shares, $111,481,933 ; bonded debt,~~

~~*$354,946,866 ; together with aid from the Dominion and provincial Governments and other sources amounting to $208,198,381, making the total capital $941,297,037, exclusive of land grants given to the Canadian Pacific railway, the Calgarry and Edmonton, and other prairie railways. Only one railway runs across the continent. The average cost per mile of completed rail- ways has been $55,797. There has been considerable development in the employment of electricity as a motive power in railways, especially in the cities and towns. In 1898 there were thirty-five electric railway companies which made returns. These showed that there were 635 miles of track, that 28,547,900 miles had been run during the year, and 94,616,344 passengers carried. Taking in the electric railways that failed to make fuU returns, the number of passengers carried by these railways is about 100,000,000.*~~

~~*Canals. — Despite the large increase in railway facilities, the waterways remain important factors in the transportation of the country. Though railways have to some extent supplanted water for internal passenger traffic, the great lakes and the St Lawrence*~~

~~*1 This does not include sawn and other manufactured timber which are classed as manufactures.*~~

~~*constitute the route of the bulk of the grain trade of the west to the seaports. The logs and a portion of the timber, as well as of sawn lumber of the Ottawa, Lower St Lawrence and New Brunswick are carried to their destination for the most part by water, and for these two trades the canals are a necessity ; and in 1899 surveys were made with a view to connect the Georgian Bay arm of Lake Huron through the intervening water-stretches with the Ottawa river and its canals, and so to Montreal, the head of summer navigation on the Atlantic. On the great lakes route Lake Superior is connected with Lake Huron by canals round the rapids of Sault St Marie (two American, one Canadian lock). Lake Huron flows into Lake Erie by the St Clair and Detroit rivers, and this is connected with Lake Ontario by the Welland canal round Niagara (26| miles), and between Lake Ontario and Montreal there are five canals. These canals have a depth of 14 feet on the sills. Up to the end of 1898 Canada had spent on the construction, renewal, and maintenance of canals $160,076,900, of which $87,671,498*~~

~~had been taken from earnings, but the canals of the St Lawrence are regarded as public works of general utility, and are practically free of tolls. Of the total expenditure, $20,692,244 was expended before confederation (1867), of which $4,173,921 was supplied by the imperial Government. The increasing use of the canals is shown by the tons of freight carried in the two years 1888 (2,761,597 tons), and 1897 (8,560,969 tons), the difference being due mainly to grain from the west, American as well as Canadian vessels having to pass through the Welland canal to reach the ports on Lake Ontario.~~

~~statistics]~~

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~~Pos«ai.— Canada is one of the dependencies of Great Britain that adopted the 2 cents per ^ oz. inter-imperial postage in force on 25th December 1898, and on 1st January 1899 the United States and Canada agreed to a uniform rate of 2 cents between the two countries. On the 1st June 1899 the internal rate of Dominion postage was reduced from 3 to 2 cents per oz. The growth of the postal business may be seen by comparing the estimated figures of the last two decades : —~~

~~Tear.~~

~~Letters.~~

~~Post Cards.~~

~~Books, Circulars,~~

~~Newspapers not IVom Office of~~

~~Publication.~~

~~Parcels.~~

~~No. lie^.~~

~~1878 1888 1893~~

~~44,000,000 80,200,000 134,975,000~~

~~6,455,000 16,686,000 28,158,000~~

~~5,090,60O~~

~~17,610,000 5,186,0001~~

~~6,252,740 10,850,000 26,595,000~~

~~107,800 763,900 349,4141~~

~~11-02 18-22 20-27~~

~~Telegraphs. — The telegraph lines are principally o-vmed and operated by public companies, though the Government owns 2751 miles of land wire and 239 miles of cable which combined carry about 42,550 messages yearly. The bulk of the telegraph business is done by three companies, namely, the Canadian Pacific railway operating 8385 miles of wire, carrying in 1898, 1,650,000 messages ; the Great North-Western, operating 18,228 miles, carrying 2,400,185 messages ; and the Western Union (chiefly in the Maritime Pro- vinces), 2935 miles, carrying 357,080 messages; the total being 29,548 miles, 4,407,265 messages. The telephone is in general use throughout the settled parts.~~

~~Banking. — The banking system has some peculiar features of its own, but is found to work admirably. Every chartered bank may issue notes to the extent of its vmimpaired capital. It must hold 40 per cent, of its cash reserves in Dominion (Government) notes, and the shareholders are liable to the amount of twice that repre- sented by the shares they hold. A person may call himself a banker, but may not call his business a bank, or banking institution, unless duly chartered. A chartered bank, whether Canadian or otherwise, is required to deposit with the Government a sum of money, equal to 5 per cent, of its note circulation, to provide a fund for the redemption of the notes of any chartered bank that may suspend payment. On this amount it receives 3 per cent, per annum interest. When a bank~~

~~*fails, should its assets be insufficient to redeem its note issue — which is the first liability to be protected — ^the circulation redemption fund, or so much of it as may be necessary, is applied to redeem the notes, which until redeemed bear 3 per cent, interest. The banks are required to make the necessary arrangements to ensure the circulation of their notes at par, and are compelled to have agencies at the chief commercial city in each province for this purpose. The banks are required by law to make monthly returns to the finance minister, showing the condition of their business, and these are in due course published monthly in the official gazette. Once in every ten years the Banking Act is revised, for any amendments that experience may have shown to be necessary. There are 37 banks with 641 branches, besides unenumerated small private bankers in the lesser towns. The chartered banks had at the end of 1898 an aggregate paid-up capital of $62,571,920, with an average for the year of $37,873,934 in note circulation. Their liabilities were $281,076,656, with assets $370,583,991, a percentage of 75-86. The discounts given by the banks have steadily increased from $175,000,000 in 1883 to $246,670,000 in 1898. The reserve fund accumulated by the banks from earnings showed a total of $27,955,807 at the end of 1898. Clearing Houses were established in Halifax in 1887, Montreal in 1889, Toronto in 1891, Winnipeg in 1893, St John in 1896, and in Victoria and Vancouver, B.C., in 1898. The largest amount of banking business is done in Montreal, which in 1898 showed $731,264,677, or more than half of the whole clearings. Toronto comes next with $439,489,336, Winnipeg $90,754,276, Halifax $62,523,827, Hamilton $35,637,864, and St John with*~~

~~*$30 349 264.*~~

~~*Savings Banks. — There are four kinds of savings banks in Canada : (1) the Post Office savings bank ; (2) the Government savings banks of the Maritime Provinces taken over at confedera- tion and being gradually merged with the other ; (3) two special savings banks in the cities of Montreal and Quebec ; (4) the savings bank departments of the chartered banks. The rate of interest allowed by the Government is now 3 per cent, (it was higher), and the chartered banks usually follow the Government rate. The amount deposited in the Government savings banks during 1898 was $14,121,630. The total amount of deposits held by the Government and the*~~

~~*special savings banks at the end of the fiscal year 1898 was $65,593,219. This does not include the savings departments of the chartered banks, their returns not specifying the deposits on savings bank account.*~~

~~*1 Prior to this year some change of regulation as to parcels, &c., affects the comparison. The subsidies paid for carrying the mails in 1898 amounted to $589,773.*~~

~~*Insurance. — The law governing insurance requires foreign fire insurance companies to deposit with the Government $100,000 as a protection for their policy-holders, and life insurance offices $50,000. Canadian fire or life offices deposit $50,000. On these amounts interest at the rate of 3 per cent, per annum is allowed. A license is granted by the Dominion, but some of the provinces further tax insurance companies doing business in the province by a license or registration fee of $200 per annum. During 1898 there were 6 Canadian, 21 British, and 7 United States fire insurance companies doing business in Canada. The total amount of business done was $680,160,689, and premiums charged thereon amounted to $5,564,124. The total amount at risk on 31st December 1898 was $895,394,107. Of life insurance companies there were 15 Canadian, 8 British, and 10 United States, besides several mutual assessment companies and 26 companies for miscellaneous insur- ance, such as accident, guarantee, plate glass, &c. In 1898, life policies in force amounted to $368,523,982, against which latter business there was paid in death losses, endowments, dividends to policy-holders, &c., $6,782,006. Several of the fire insurance companies do an inland marine insurance business, but ocean marine insurance is confined to two Canadian companies.*~~

~~*Weights and Measures. — The legal weights and measures are the imperial yard, imperial pound avoirdupois, imperial gallon, and the imperial bushel. The imperial gallon is equal to 4-54174 litres ; the wine gallon used in the United States being equal to 3-785 litres. The capacity of a bushel measure varies according to the article measured, and is fixed by Act of parliament. In contracts a bushel measure, unless otherwise specially provided in the contract, means of wheat 60 lb ; Indian corn, 56 lb ; rye, 56 lb pease, 60 lb ; barley, 48 II) ; malt, 36 K) ; oats, 34 lb ; beans, 60 lb flax seed, 56 lb ; hemp, 44 lb ; blue grass seed, 14 lb ; lime, 80 lb castor beans, 40 lb ;*~~

~~potatoes, 60 lb ; turnips, 60 lb ; carrots, 60 lb parsnips, 60 lb ; beets, 60 ib ; onions, 50 lb ; bituminous coal, 70 lb clover seed, 60 lb; timothy seed, 48 lb; buckwheat, 48 lb. The statute fixing these weights abolished the English hundredweight of 112 R>, and the ton of 2240 lb, and declared the ton to be 2000 R) avoirdupois and the hundredweight 100 lb, thus assimilating the weights of Canada and the United States, a change of great con- venience in view of the railway and other interchange of freights.~~

~~Public Lands. — The public lands are owned and administered by the several provinces, except in Manitoba, the North- West Territories, and in the railway belt of British Columbia. Tliese are under the control of the Dominion. The public or " crown " lands of the Dominion are open to actual settlers free, under certain conditions of settlement and the payment of a nominal registration fee. The mining rights in such lands, however, are reserved and are dealt with under different regulations. Large grants of Crown lands have from time to time been made to railways, and these are sold to settlers on liberal terms of deferred payments. Public lands are surveyed on the rectangular system in sections of 1 square mile each, with an allowance for roads, and these are again divided into quarter sections of 160 acres each — the amount a settler is allowed to enter free. Two sections in each township of 6 miles square are reserved for school purposes, i.e., the proceeds of their sale belong to the school funds.~~

~~Authorities. — ^The annual reports to the Governor-General (blue books) of the several departmental ministers, and the census returns, together with the sessional papers on any particular subject, supply detailed information on the matters with which they deal. Amongst these are the trade and navigation returns, the public accounts, public works, railways and canals, fisheries, &c., but comprising the gist of all publications of the kind is the Statistical Tear Book of Canada, and Forest Wealth of Canada, by George Johnson, Statistician of the Dominion, Ottawa, and the various reports and publications of the geological survey of the Dominion. For tides, currents, mean sea-level and the bore on the Bay of Pundy, see Reports of Marine Department 1894 to date, also Trans. Royal Sac. Can. vol. ill. sect. 3, p. 51. Amongst non-official publications are the Handbook of Canada, 1897 (Toronto) ; J. G. Bourinot's Manual of the Constitution of Canada (London, 1895); G. Bryce's Manitoba (London, 1882) ; W. Kingsford's History of~~

Canada, 9 vols. (London, 1887-98) ; Canon Mockridge's The Bishops of the Church of England in Canada and Newfoundland (Toronto, 1897) ; A. J. Morgan's Canadian Parliamentary Companion (1897) ; Dominion Annual Register and Review (Ottawa, 1878-97); G. E. Parkin, The Gfreat Dominion (London, 1895). Parkman's Works — Pioneers of France in the New World, The Old Regime in Canada, Montcalm and Wolfe, The Jesuits in North America in the nth Century, Count Frontenac and New France under Louis XIV. (London, 1885) ; Wareurton Pikes's Barren Grounds of Northern Canada (London, 1896) ; A. R. Selwtn's and G. M. Dawson's Descriptive Sketch of the Physical Geography and Geology of the Dominion of Canada (Montreal, 1854); A. B. Willmott's Mineral Wealth of Canada (London, 1897); Beccles Willson's Great Company (the A. B. C.'s) (Toronto, 1899). (m. ST. J.)

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Agriculture.

About 42 per cent, of the population of Canada iDelong to families whose heads or members are engaged in agri- culture. A large number more are employed in industries arising out of agriculture; among these are millers of flour and oatmeal, curers and packers of meat, makers of cheese and butter, and persons occupied in the transporta- tion and commerce of grain, hay, live stock, meats, butter, cheese, milk, eggs, fruit, and various other products. It is estimated that the annual value of all farm crops and products in Canada is not less than 600,000,000 dollars. The country is splendidly formed for the production of food. Across the continent there is a zone about 3600 miles long and nearly as wide as France, with a climate adapted to the production of foods of superior quality. In places which are now cultivated the soil has been found fertile. That of Manitoba is rich in the constituents of plant food to a degree that surpasses nearly all the soils of Europe. The freezing of the soil in winter, which at first sight seems a drawback, retains the soluble nitrates which might otherwise be drained out. The geographical position of Canada, its railway systems, and

~~*steamship service for freight across the Atlantic are favourable for the extension of the export trade in farm products to European countries.*~~

~~*Of wheat many varieties are grown. The methods of cultivation do not involve the application of so much hand labour per acre as in Europe. The average yield of spring wheat in the Crops. province of Manitoba has varied from about 17 bushels per acre to 25 bushels per acre. The average yield of fall or winter wheat in the province of Ontario since 1883 has been 20 bushels per acre. As a rule the weather during the harvesting period permits the grain to be gathered safely without any damage from sprouting. Suitable machinery for cleaning the grain is every- where in general use, so that weed seeds are removed before the wheat is ground. This gives Canadian wheat excellent milling properties, and enables the millers to turn out flour uniform in quality and of high grade as to keeping properties. Canadian flour has been steadily gaining ground in European markets. It is becoming known as flour from which bakers can make the best quality of bread, and also the largest quantity per barrel, the quantity of albuminoids being one-tenth greater in Canadian flour than in the best brands of European. In three tests by a leading firm of London bakers, Canadian flour gave 146 lb, 152 lb, and 151 lb of bread of excellent quality from 100 lb of flour, a better result than could be obtained from any other flour imported into the United Kingdom. There are not less than 2500 flour mills, employing over 6000 men. There is room for a great extension in the cultivation of wheat and the manufacture and exportation of flour. By the growing of crops of clover alternately with wheat one main constituent (nitrogen) required in the soil to keep it fertile may be renewed perpetually. There are many millions of acres of fertile land suitable for wheat culture unoccupied. The yield of wheat in Canada for 1901 was estimated at 85,000,000 bushels. If the area of available land only be con- sidered, the yield might be ten times greater per annum, with plenty of fertile land still awaiting cultivation. Oats of fine quality are grown in large crops from Prince Edward Island on the Atlantic coast to Vancouver Island on the Pacific coast. The Canadian soil and climate are admirably adapted for producing oats of heavy weight per bushel, with thin husk. Canadian oatmeal is equal in quality to the best. It is prepared in difierent forms, and in various degrees of fineness; also as "rolled oats" and "oat flakes." As a rule, the weather is favourable for both the growth and harvesting of the*~~

~~crop. Consequently, oats and oat- meal do not become bitter from sprouted grain, or musty from the heating of the straw in stacks. Peas in large areas are grown free from serious trouble with insect pests. Split peas for soup, green peas as vegetables, and sweet peas for canning are obtained in per- fection. Barley was formerly grown in enormous quantities for export to the United States for malting purposes. After the raising of the duty on barley under the McKinley and Dingley tariffs that trade fell off. Some varieties are cultivated with success for the making of pearl or pot barley. Bye is cultivated successfully, but is seldom used as food by the people. Flour from wheat, meal from oats, and meal from Indian com are pre- ferred. Buckwheat flour is used in considerable quantities in some districts for the making of buckwheat cakes, eaten with maple syrup. These two make an exquisite breakfast dish, characteristic of Canada and some of the New England states. There are also~~

~~numerous forms of preparations from cereals, sold as breakfast foods, which, owing to the superiority of the grains grown in Canada and the care exercised in their manufacture, compare favourably with similar products in other countries.~~

~~Vegetables are grown everywhere, and form a l^rge part of the diet of the people. There is a comparatively small export, except in the case of potatoes and vegetables which have been canned or dried. Besides potatoes, which thrive well and yield large quanti- ties of excellent quality, there are turnips, carrots, parsnips, and beets. The cultivation of sugar beets for the manufacture of sugar has been begun in Quebec, Ontario, and Alberta. Among the common vegetables used in the green state are peas, beans, cabbage, cauliflowers, asparagus, Indian com, onions, leeks, toma- toes, lettuce, radish, celery, parsley, cucumbers, pumpkins, squash, and rhubarb. Say, of good quality of timothy (Phleum pratense), and also timothy and clover, is grown over extensive areas. For export it has been put up in bales of about 150 pounds each. Since 1899 a new form of pressing has been employed, whereby the hay is compressed to stow in about 70 cubic feet per ton. This has been a means of reducing the ocean freight per ton. The compact condition permits the hay to be kept with. less deteriora- tion of quality than under the old system of more loose baling.~~

~~*Austrian Brome grass {Bromus inermis) is grown for hay exten- sively in Manitoba and the North- West Territories.*~~

~~*The breeding of horses has been to some extent neglected since the use of electrical power became general. Heavy draught horses of the Clydesdale breed are reared principally in the j^iyggfg^k provinces of Ontario and Quebec. Horses suitable for general work on farms, and for omnibuses, and grocery and delivery waggons, are plentiful for local markets and for export. Useful carriage horses and saddle horses are bred in a few localities, and animals for cavalry and mounted infantry remounts are produced in all the provinces and in the North- West Territories. Thorough-bred stallions of all breeds are kept by private individuals and by agricultural societies. There are no Government stud farms.*~~

~~*Cattle, sheep, swine, and poultry are reared in abundance. The bracing weather of Canadian winters is followed by the warmth and humidity of genial summers, under which crops grow in almost tropical luxuriance, while the cool evenings and nights give the plants a robustness of quality which are not to be found in tropical regions, and also make life for the various domestic animals whole- some and comfortable. In the North-West Territories there are vast areas of prairie land, over which cattle pasture, and from which thousands of fat bullocks are shipped annually. Through-out other parts bullocks are fed on pasture land and also in stables on nourishing and succulent feed, such as hay, Indian com fodder, Indian com ensilage, turnips, carrots, mangels, ground oats, barley, peas, Indian com, rye, bran, and linseed oil cake. The breeding of cattle, adapted for the production of prime beef, has received much attention. There is government control of the spaces on the steamships in which the cattle are carried, and veterinary inspection to prevent the exportation of any animals that might be affected with disease. In recent years a trade has been growing up in the exportation of dressed beef in cold storage, and also in the exportation of beef preserved in hermetically sealed tins. Sheep thrive well on the hill pastures, and mutton and lamb of fine flavour are plentiful. Swine are reared and fattened in large numbers. The export trade in bacon grew rapidly between 1890 and 1900. Canadian hogs are fed, as a rule, on feeds suited for the production of what are known as "fleshy sides." Bacon with an excess of fat is not wanted, except in the lumber capips ; consequently*~~

~~*the farmers of Canada have cultivated a class of swine for bacon having plenty of lean and firm flesh. The great extension of the dairy business has fitted in with the rearing of large numbers of swine. Experimental work has shown that swine fattened with part of a ration of skim-milk were lustier and of a more healthy appearance than swine fattened wholly on grain. Slaughtering and curing are carried on chiefly at large packing-houses. The use of mechanical refrigerating plants for chilling the pork has made it practicable to cure the bacon with the use of a small percentage of salt, leaving it mild in flavour when delivered in European markets. Regular supplies are exported during every week of the year. Large quantities of lard, brawn, and pigs' feet are exported, and there is a growing trade in " lunch tongues." Turkeys thrive well, grow to a fine size, and have flesh of tender quality. Chickens are raised in large numbers, and of late years farmers have adopted the method of fattening them a few weeks before they are killed, thus increasing the proportion of edible material. Canadian eggs are usually packed in cases containing thirty dozens each. Cardboard fillers are used which provide a separate compartment" for each egg. There are cold storage warehouses at various points in Canada, at which the eggs are collected, sorted, and packed before shipment. These permit the eggs to be landed in Europe in a practically fresh condition as to flavour, with the shells quite full.*~~

~~*agriculture]*~~

~~*Dairy products.*~~

~~*Canada has been called the land of milk and honey. Milk is plentiful, and enters largely into the diet of the people. The healthy condition of the cows, the pure air of the country, and the cleanly habits of the people ensure the wholesome quality of the milk. There is no export trade in milk, but large quantities are now put up in hermetically sealed tins as condensed milk, for use in mining camps and on board steamships. The cheese is chiefly of a variety known as " Canadian Cheddar." It is essentially a food cheese rather than a mere condiment. 1 lb of it will furnish as much nourishing*~~

material as 2J lb of the best beefsteak. The in- dustry is largely carried on by co-operative associations of farmers. The number of cheese factories and creameries grew from 1733 in the year 1891 to 3649 in the year 1899. Butter for export is now made in creameries, where the milk, cream, and butter are handled by skilled makers. The creameries are provided with special cold storage rooms, into which the butter is placed on the same day in which it is made. Prom them it may be carried in refrigerator railway cars and in cold storage chambers on steamships to its ultimate destination. For the export trade it is packed in square boxes made of spruce or some other odourless wood. These are lined with parchment paper, and contain each 66 lb net of butter. The export trade of butter increased over seven-fold in six years, after cold storage facilities for its safe carriage were arranged for by the Government. In all settled districts of Canada lying eastward of the Great Lakes and westward of the Rooky Mountains, apples of fine quality p .. in flavour, in substance, in colour, and in size can be

™ ■ *grown ; and in areas containing hundreds of square*

miles, pears, peaches, and grapes are grown in quantities in the open air. The climate is favourable to the growth of small fruits, such as plums, cherries, strawberries, raspberries, currants, goose- berries, and there are great areas in which cranberries, black- berries, and blueberries grow plentifully.

Apples and pears are the chief sorts of fruit exported. The high flavour, the crisp, juicy flesh, and the long-keeping qualities of the Canadian apples are their chief merits. The comparatively tender, but very dainty and highly-flavoured " Tameuse " and " Graven- stein" varieties were exhibited in cold storage at the Paris Uni- versal Exposition of 1900 during the summer succeeding the one in which they were grown. Apples are exported in barrels, and also in boxes containing about one bushel each. Large quantities are also evaporated and exported. Establishments for evaporating fruit are now found in most of the larger apple-growing districts, and canning factories and jam factories have been established in many parts of Canada, and are conducted with advantage and profit. In 1899 eight million pounds of evaporated apples were exported, largely to tropical countries.

~~*Wine is made in considerable quantities in the principal vine- growing districts, and in several localities large vineyards have been planted for this purpose. An abundance of cider is also made in all the large apple-growing districts.*~~

~~*Honey is one of the minor food products of Canada. With clover blossoms perfuming the air for hundreds of miles, honey bees have plenty of pasturage. It is everywhere admitted that Canadian honey for colour, fiavour, and substance is unsurpassed. Maple sugar and syrup are made in those areas of the country where the maple tree flourishes. The syrup is used chiefly as a substitute for jam or preserved fruits, and the sugar is used in country homes for sweetening, for cooking purposes, and the making of confectionery. Buring recent years the processes of manufacture have been improved by the introduction of specially constructed evaporators, and quantities of maple sugar and syrup are now available for the export trade.*~~

~~*The , Department of Agriculture of the Pederal Government renders aid in various ways. Chief among these are the mainte- nance of the branches of the public service under the State aid. Commissioner of Agriculture and Dairying, and the Dominion Experimental Farms. Under the former the Govern- ment promotes the extension of markets for farm products; it maintains several officers in the United Kingdom who make re- ports from time to time on the condition in which Canadian goods are delivered from the steamships, and also on what they can learn from importing and distributing merchants regarding the prefer- ences of the market for different qualities of farm goods and diflerent sorts of packages. Through this branch of the public service a complete chain of cold storage accommodation between various points in Canada and markets in Europe, particularly in Great Britain, has been arranged. The Government offered a bonus to those owners of creameries who would provide cold storage accommodation at them and keep the room in use for a period of three years. It also arranged with the various railway companies to run refrigerator cars weekly on the main lines leading to Mon- treal and other export points. The food products from any ship- pers are received into these cars at the various railway stations at the usual rates, without any extra*~~

~~*charge for the icing or cold storage service. The Government offered subvention to those who*~~

~~*would provide cold storage warehouses at various points where these were necessary, and also arranged with the owners of ocean steamships to provide cold storage chambers on them by means of mechanical refrigerators.*~~

~~*Information is given to farmers regarding the various breeds of horses, cattle, sheep, swine, and poultry which have been found most suitable for diflerent districts, most profitable for keeping, and best adapted for the various markets to which they or their products can be sent. Besides furnishing technical and general information on the carrying on of dairying operations, the Govern- ment has established and maintained illustration cheese factories and creameries in different places for the purpose of introducing the best methods of carrying on co-operative dairying in both the manufacturing and shipping of butter and cheese. Inspectors are employed to give information regarding the packing of fruit, and also to see to the enforcement of the Pruit Marks Act, which pro- hibits the marking of fruit with wrong brands and packing in any fraudulent manner.*~~

~~*Experimental farms were established in 1887 in different parts of the Dominion, and were so located as to render efficient help to the farmers in the more thickly settled districts, and at the same time to cover the most varied climatic and other conditions which influ- ence agriculture in Canada. The Central Experimental Parm is situated at Ottawa, near the boundary line between Quebec and Ontario, where it serves as an aid to agriculture in these two im- portant provinces. One of the four branch farms has been placed at Nappan, Nova Scotia, near the boundary between that province and New Brunswick, where it serves the farmers of the three maritime provinces. A second branch expert- Experl- mental farm has been established at Brandon, in Mani- fe^m" toba ; a third at Indian Head, in Eastern Assiniboia, one of the North- West territories ; and the fourth at Agassiz, in the coast climate of British Columbia. At all these farms experi- ments are conducted to gain information as to the best methods of preparing the land for crop, and of maintaining its fertility, the most useful and profitable crops to grow, and how the various crops grown can be*~~

disposed of to the greatest advantage. To this end experiments are conducted in the feeding of cattle, sheep, and swine for flesh, the feeding of cows for the production of milk, and of poultry both for fiesh and eggs. Experiments are also conducted to test the merits of new or untried varieties of cereals and other field crops, of grasses, forage plants, fruits, vegetables, plants, and trees ; and samples, particularly of the most promising cereals, are distributed freely among farmers for trial, so that those which promise to be most profitable may be rapidly brought into general cultivation. Annual reports and occasional bulletins are pub- lished and widely distributed, giving the results of this work. Parmers are invited to visit these experimental farms, and a large correspondence is conducted with those interested in agriculture in all parts of the Dominion, who are encouraged to ask advice and information from the officers of the farms.

*The governments of the several provinces each have a depart- ment of agriculture. In Ontario, Quebec, and Nova Scotia there are special agricultural schools or colleges for the practical educa- tion of young men in farming ; there are also dairy schools in most of the provinces, where practical instruction and training are given. Among other provincial agencies for imparting informa- tion there are farmers' institutes, travelling dairies, live-stock associations, farmers', dairymen's, and fruit- Agrlcul- growers' associations, and agricultural and horticultural *""' societies. These are all maintained or assisted by the ^f" j several provinces. Parts of the proceedings and many edacatton. of the addresses and papers presented at the more im- portant meetings of these associations are published by the provincial governments and distributed free to farmers who desire to have them. There are also annual agricultural exhibi- tions of a highly important character, where improvements in con- nexion with agriciUtural and horticultural products, live stock, implements, &c., are shown in competition. The principles of agriculture are taught to some extent in the common schools in most of the provinces. Sir William C. Macdonald of Montreal recently gave a sum of 10,000 dollars to be distributed to boys and girls on Canadian farms as prizes in a competition in the selec- tion of seed grain. The competitors grew seed grain on specially prepared plots of land, one-quarter of an acre in each plot, selecting seed each year from these plots to sow on the plot for the succeeding year. They gathered the large well-filled heads from vigorous plants before the grain was cut, after*

~~all the conditions of growth had been observed, and then threshed these heads. By screening and hand-picking the large well-developed grain from those selected heads, the seed for next year's seed grain plot was secured. The selecting of seed in this manner was conducted on over 800 Canadian farms, fairly well distributed throughout the Dominion, and was of immense benefit to agriculture. Sir William gave a further sum of 225,000 dollars for the improvement of edu- cation at rural schools. (j. w. R.)~~

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~~HisTOBY (since Confederation).~~

~~The four provinces of Ontario, Quebec, New Bruns- wick, and Nova Scotia were confederated as the Dominion of Canada in 1867. At the request of the Dominion par- liament the territory ruled by the Hudson Bay Company was ceded to Canada by the imperial Government in 1870, on the payment of £ 300,000 to satisfy the Com- pany's claims. From a portion of this territory the province of Manitoba was immediately formed, though it became necessary to quell by military force a rebellion among the half-breeds of the Red Eiver district before the Dominion could finally take possession of the coun- try. In the following year (1871) British Columbia joined the Dominion, the chief condition of the union being that a railway should be built within ten years to connect the Pacific coast with the eastern provinces. In 1873 Prince Edward Island entered the Confederation. The Nelson River country to the west of Hudson Bay was in 1876 formed into the district of Keewatin. In the year 1880 all the remaining British possessions on the continent, except Newfoundland and the dependent district of Labrador, were formally annexed to Canada. Two years later the provisional districts of Assiniboia, Saskatchewan, Alberta, and Athabasca were created, and Eegina was fixed upon as their capital. It was not till 1895 that the great unorganized tract to the north and west was divided into four districts — Ungava, Franklin, Mackenzie, and Yukon.~~

~~*The problems with which the statesmen of confederated Canada have had to deal in connection with the vast terri- tory thus brought under their control have been numerous and of varied character. Immediately after confederation a serious agitation for repeal of the union arose in Nova Scotia, which had been brought into confederation by a vote of the Legislature, without direct appeal to the people ; this danger was only averted af tef much negotiation, and considerable modification of the terms on which that province entered the Dominion. Much friction has arisen in defining accurately the division of power between the Federal and provincial Governments. The founders of confederation had, in the troubles of the United States, an object-lesson on the necessity of strengthening the central authority. The American constitution, after clearly defining the powers of the Federal Government, leaves all unstated authority to the sovereign states. Canada adopted the opposite course. While the range of legislative control for the province was clearly defined, the residuum of un-delegated authority was given to the Federal Government. On this point several differences have arisen, the Dominion sometimes disclaiming, sometimes asserting, a right to interfere. When, in 1871, the New Brunswick legislature passed a BUI making public education non-sectarian, the opposition, on behalf of the Roman Catholic minority, appealed to the Ottawa Government to disallow the Act. This it refused to do, asserting that the province had acted within its rights. A similar policy was followed in 1888, when the Quebec legislature granted to the Jesuit order a sum of $400,000 in compensation for property forfeited to the Crown. The Dominion Government, urged to disallow this Act, ruled that it did not come within its jurisdiction. A difference of long standing was settled in 1898 by the Privy CouncU, which ruled that in the question of the control of fisheries, while the Dominion had exclusive power to make regulations, the issue of licenses and the collection of revenues from this source belong to the pro- vinces, except in the case of Manitoba and the North- West Territories, where no prior rights existed. In 1878 the Federal Government passed the Scott Act, empowering municipalities to deal with the traffic in liquor. The right of the Federal parliament to pass this Act was questioned*~~

~~*as an infringement of provincial powers, but on appeal to the Privy Council the right was maintained. It seems probable that most of the possible questions of difference between federal and provincial authority have now*~~

~~been settled by these and similar judicial decisions, and that Canadian experience in adapting a federal system to British methods of government will prove extremely use- ful in further applications of the federal idea to other parts of the empire, or to the empire itself. In this con- nexion it may be noted that dual representation, or the privilege of representing a constituency in the Dominion parliament and in a provincial assembly at the same time, was tried in the early years of confederation, but was abolished in 1872 as unsatisfactory.~~

~~Among matters demanding constructive legislation in the organization of the new state the following may be noted: — In 1871 a uniform system of decimal currency was established for the whole Dominion. The creation of a Supreme Court, after engaging the attention of the Canadian parliament for several years, was finally ac- complished in 1876. This court is presided over by a chief justice and five puisne judges, and has appellate civil and criminal jurisdiction for the Dominion. By an Act passed in 1891 the Government has power to refer to the Supreme Court any important question of law affecting the public interest. The right of appeal from the Supreme Court thus constituted to the Judicial Com- mittee of the Privy Council marks, in questions judicial, Canada's place as a part of the British empire. The ap- pointment, first made in 1897, of the chief justices of Canada, Cape Colony, and South Australia, as colonial members of the Judicial Committee, still further estab- lished the position of that body as the final court of appeal for British people. The British North America Act of 1867 provided that the control of elections for the Dominion parliament should rest with the various pro- vinces. This measure was necessary owing to the lack of machinery at the time for managing federal matters. This clause was superseded in 1885 by a franchise Bill, which provided for uniformity of suffrage and recognized pro- perty qualification as determining the right to vote. A later Act, passed in 1898, restored the provincial franchise as the basis for federal elections, thus reintroducing an element of variety in the qualifications of voters. Ontario, Manitoba, British Columbia, and Prince Edward Island have practically manhood suffrage; in Quebec, Nova Scotia, and New Brunswick a property qualification is required. A general election law was passed in 1874, which provided for vote by ballot, the holding of elections simultaneously throughout the Dominion, and the abolition of property qualification for members of~~

~~parliament. In the North- West Territories, however, elections were held by open voting until 1885. In a country of vast distances with great areas to be opened for settlement, railway deveZqpmewiwasnecessarilyfromthefirstaleadingquestion of public policy. Two great national lines were projected as an essential part of confederation : the Intercolonial, built to connect the Maritime Provinces with the provinces on the St Lawrence ; the Canadian Pacific, to unite the Atlantic and the Pacific coasts of the Dominion. The first of these was completed inl876; with the various extensions since built it now includes 1511 miles of road, and remains entirely under the control of the Government. The construc- tion of the Canadian Pacific was entrusted to a private com- pany, which received large subsidies of land, money, and completed railway. This system has grown to be one of the greatest in the world; it owns more than 7000 miles of road and controls about 3000 more; in its various ramifications it touches the most important points of Canada ; it has established steamship communication with Japan andalong the great lakes. The railway mileage of the whole Dominion~~

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~~has grown from 4022 in 1874 to 17,250 in 1899 ; and new lines are still being built as new areas become settled. The question of subsidizing railways has at various times profoundly affected the politics of the country. The completion of the Canada Pacific railway, and the consequent opening-up of the prairie lands of the north-west, have been followed by a considerable increase in immigration. But at no time has this been excessive, nor is any foreign nation represented by numbers suf- ficiently large to prevent ultimate fusion with the English- speaking element. A considerable migration has lately taken place into the north-west from the western states of America. The exodus from Iceland, begun in 1875, has resulted in greatly decreasing the population of that island. In Southern Manitoba are settled large numbers of Mennonites, a thrifty and honest if somewhat exclu- sive folk, who fled from Europe to escape militaiy service. Eor a similar reason the Doukhobors (q.v.), a peculiar religious sect from~~

~~*the Black Sea provinces of Kussia, in 1899 emigrated to Canada in a body. Scottish crofters from the Highlands, English and Irish agricul- tural labourers, Americans, Norwegians, Galicians, and Danes, help to swell a varied but hardy and industrious population. The district of Alberta is largely occupied by Englishmen who are engaged in ranching. On the Pacific slope the Chinese, though discouraged by a heavy tax, are found in considerable numbers, while the influx of Japanese coolies is creating a problem in the labour market of British Columbia. On confederation Canada assumed the care of her own land defences. The Eenian raids of 1866 and 1870 delayed for a short time the re- moval of imperial regiments, but in the latter year all British forces were withdrawn except those stationed at Halifax. During the war in South Africa (1899-1902) these, too, were temporarily replaced by a Canadian gar- rison. On the other hand, within the last few years the imperial and the Canadian Governments have entered into an agreement for the joint defence of Esquimalt, a new coaling and naval station on the Pacific coast. By the Militia Act of 1868 and 1883 the Canadian militia is divided into three classes — the permanent, the active, and the reserve. The permanent force includes about 1000 men, exclusive of the garrison at Halifax. There is also a corps of North-West Mounted Police, numbering about 1000. The active Militia numbers 45,000 men, whose term of service is three years, and who drill for two weeks each year ; while the Reserve includes all the re- maining male citizens between the ages of sixteen and forty-five. The officer commanding the militia is ap- pointed from the imperial army. A military college was established at Kingston in 1875, and in this ofiicers are trained for both the Canadian and imperial services. Several commissions are given each year to selected can- didates by the British Government, and a considerable proportion of the graduates of the college are now serving in the imperial army. The military forces of Canada were called upon to repel the Fenian attacks of 1866 and 1870, and to put down the insurrection of half-breeds in the north-west in 1885. The contribution made by Canada of two contingents of troops for service under imperial direction in South Africa is the most important military event in the later history of the Domiuion. The forces sent by the Dominion were supplemented by a body of horse raised in North- Western Canada, and equipped and paid by a Canadian, Lord Strathcona. The sea, fisheries, which are so important a source of wealth for Canada, have been the cause of no little international difficulty. With the termination of the*~~

~~*Reciprocity Treaty of 1866 all American rights to fish in Canadian waters came to an end, but in spite of this American fishiag schooners con- tinued to cany on operations within the three-miles limit.*~~

~~*Several were seized and confiscated, to the annoyance of New England fishermen. The joint commission, which met at Washington in 1871 to settle points of dispute between Great Britain and the United States decided that Americans should be allowed to fish in Canadian waters on payment of an indemnity to be fixed by a later treaty. A commission met at Halifax six years afterwards to decide the amount of this indemnity, and awarded to Canada the sum of $5,500,000, which was paid with some reluctance. But in 1885 the fisheries clauses of the Washington treaty were termi- nated by the Americans themselves; a new treaty, signed at Washington in 1888, was rejected by the United States Senate, and fishing is now carried on by the Americans under a modus vivendi which provides for the payment of licenses. A dispute, arising out of the seizure by the Americans of several Canadian vessels engaged in the seal fishery in Bering Sea, was, in 1892, referred to a board of arbitration, which decided in favour of Canada, and awarded to the owners of these vessels damages to the amount of $464,000. This sum was paid in 1898. At the same time agreements were entered into for the future conduct of the seal fishery, with a view to preventing further disputes. The discovery oi new mineral deposits, and the development of others pre- viously known, have during the last few years given a great stimulus to Canadian prosperity. Prom the Yukon field alone there was taken in 1899 gold to the value of $16,000,000, while the gold output of the whole country increased from $1,000,00.0 in 1894 to $21,000,000 in 1899. A large area of country in southern British Co- lumbia has proved extremely rich in gold, silver, and copper ; large mining towns have sprung up with great rapidity ; much capital has found profitable investment ; several hundreds of miles of railway have been buUt to meet the needs of the increasing population; and this mining population has furnished a new and profitable market for the products of western farming. New and very extensive coal deposits, lately opened up in the Crow's Nest Pass, supplement and add to the value of other mineral discoveries. In the extreme east extensive ironworks have been constructed at Sydney, Cape Breton. Both here and in Nova Scotia the existence of iron ore, coal, and flux, within easy reach of each other, offers ex- ceptional opportunities for*~~

~~*the cheap production of iron and steel on a large scale. The most important nickel deposits yet discovered in the world are at Sudbury, in Ontario ; and steps have been taken to increase the already large output of this metal.*~~

~~*Trade Policy. — Questions of trade policy have divided public opinion in Canada more deeply than almost any other. This arises from very exceptional trade relations. The chief commerce of the Dominion is carried on with two countries — Great Britain and the United States — of which the one has followed a free trade and the other a highly protectionist policy. Until 1866 Canada enjoyed great prosperity under a Reciprocity Treaty with the United States. In that year the treaty was abrogated, apparently with the intention of checking Canadian trade and foster- ing a desire for annexation. In the next seven years, however, the trade of Canada almost doubled, the opening of new markets in the West Indies and Europe having given new outlets for her products. Then followed a period of commercial depression without parallel in Canadian history. Manufactures languished, the agricul- tural classes were in great need, and the revenues of the country showed increasing deficits. Meanwhile the highly- protected industries of the United States offered a field for labour which drew thousands of Canadians over the border. Hence arose a keen conflict of opinion. It was urged, on the one hand, that a free trade policy would*~~

~~*leave the country at the mercy of the United States. On the other, it was claimed that protection would weaken the connexion with the mother country. In 1878 a pro- tective policy was adopted by a popular vote. It had the effect of checking the exodus and restoring the national credit. With the return of prosperity, and the establish- ment of the finances on a sound basis, there arose a strong feeling that some discrimination should be made in favour of Great Britain as against foreign countries with their high tariffs. This feeling took definite shape in 1897, in the adoption of a preferential tariff in favour of British goods to the extent of 25 per cent, less*~~

~~than that levied on goods from foreign countries. This preference has now been increased to 33^ per cent.~~

~~Science. — In scientific research and achievement Canada has made much progress. This is particularly true of medical science, owing to the establishment of important medical schools in the principal university centres. The munificence of the wealthy citizens of Montreal has given to that city a school of practical science, with an equip- ment unrivalled perhaps in the world. Schools of the same character have been founded in Toronto and King- ston, and the Royal Military College also provides a course in civil and military engineering. The skill and energy of the Canadian engineer find ample room for exercise in the development of the country's mining resources, and in the construction of canals and railroads. The wide application of electrical energy has been espe- cially marked. Every town of any importance has its electric street railway, its system of electric lighting, its supply of electric power for manufacturing purposes ; its telephone connexion not only throughout its own area, but with places hundreds of miles away. Even the rural dis- tricts are becoming accustomed to look upon the telephone wire as a necessity. Every new labour-saving invention is quickly adopted, for skilled labour in Canada is still scarce and dear. Improved agricultural machinery has greatly lightened the burdens of the farmer, and Canadian implements of this class have secured a special reputa, tion and market for themselves in other countries, owing to their lightness and durability. Twice since confed- eration has the British Association for the Advancement of Science selected Canadian cities for its annual meet- ings, thus furnishing a striking illustration of the con- traction of the empire under the influence of steam and electricity.~~

~~Literature. — In the domain of letters, though no great names have appeared, Gilbert Parker, Charles Roberts, Bliss Carman, W. W. Campbell, Archibald Lampman, and a few other Canadians have in prose and verse interpreted their native land and its conditions with marked distinc- tion. In 1880 the verse of Louise Frechette, the French Canadian poet, was crowned by the French Academy. Dr Drmnmond's dialect verse, embodying the speech and thought of the French habitant, has gained a wide popu- larity. Dr Goldwin Smith, who made his home in Toronto in 1871, and has issued thence several volumes of history and criticism, speaks of himself as a~~

~~*Canadian, and has devoted no small share of his time and his consummate mastery of English prose to Canadian journalism. Sir John Bourinot, Sir James Lemoine, Dr Kingsford, and the Rev. Abbe Casgrain have been chief among many laborious workers in the field of Canadian history. The Royal Society, founded in 1882, draws together at its annual meetings men of literature and science, and pub- lishes each year a volume of transactions.*~~

~~*Education. — On confederation the control of education was entrusted to the provinces, with a stipulation that all rights then enjoyed by denominational schools should be respected. This has given rise to considerable diversity of management, thoiigh in all the provinces education*~~

~~*is free, and the necessary funds are obtained from local taxation and Government grants. Ontario has a highly- organized school system, directed by a minister of educar tion, who is a member of the provincial cabinet. The other provinces have superintendents and boards of educa- tion, who report to the provincial legislatures. In Que- bec, where religious instruction is still considered the basis of education, most of the schools are controlled by the local Roman Catholic clergy. In Nova Scotia, New Brunswick, Prince Edward Island, Manitoba, and British Columbia the public schools are strictly undenomina- tional; in Ontario and Quebec separate schools are al- lowed to Roman Catholics and Protestants. Education of children between the age of seven and thirteen is compulsory except in Quebec. Secondary education is provided for by high schools and collegiate institutes in all towns and cities. Each province has a number of normal and model schools for the training of teachers. For higher education there are also abundant facilities. While the older universities have increased greatly in influence and efficiency, the following new foundations have been made since confederation : — University of Manitoba, Winnipeg, 1877 ; Presbyterian College, Win- nipeg, 1870 ; Methodist College, Winnipeg, 1888 ; Wes- leyan CoUege, Montreal, 1873; Presbyterian College, Montreal, 1868 ; School of Practical Science, Toronto, 1877 ; Royal Military College, Kingston, 1875 ; M'Mas- ter University, Toronto, 1888. All the larger universities have schools of medicine in afBliation, and have the power of conferring medical degrees. Since 1877 Cana- dian degrees have been recognized by the Medical Coun-*~~

~~*cil of Great Britain. In her treatment of the Indians Canada has met with a success which is in marked con- trast to the experience of the United States. Since in- discriminate slaughter deprived them of the bison, their natural means of subsistence, the north-west tribes have been maintained chiefly at the expense of the country. As a result of the great care used in watching over them, the last few years have shown a small but steady increase in their numbers. A most encouraging sig^n of the elevar tion of the Indian is the increasing interest taken by them in education. A system of industrial and boarding schools has been established in several of the provinces, and these, by separating the children from the degrading influences of their home life, have proved much more effectual than day schools in training them in the habits and ideas of a higher civilization. A tendency towards consolidation has been evident among the various reli- gious bodies. In 1873 the different branches of the Pres- byterians united under the name of the Presbyterian Church of Canada, and a similar step was taken by the Methodists in 1883. The first general congress of the Church of England in Canada was held at Hamilton, Ontario, in the same year, and since that time this church has completed a Dominion organization. A recognition of the increasing importance of the Roman Catholic Church in Canada was given in the appointment, in 1888, of Archbishop Taschereau as the first Canadian cardinal. Though naturally a temperate people, Canadians seem bent on controlling the traffic in intoxicants by coercive measures. The Canada Temperance Act, a local option law passed in 1878, proved abortive through the failure to provide suitable machinery for its enforcement. In 1900, however, it was still in force in twenty-eight elec- toral districts. Between the years 1892 and 1894 four of the provinces declared for prohibition by majorities aggregating 130,000 ; but a general plebiscite, held in 1898, resulted in a majority for legislative prohibition of only 13,000. This verdict was looked upon by the Govern- ment as inconclusive, and no further action was taken. Political. — The Governor — Generalship of Canada*~~

~~*became on confederation one of the greatest official appointments in the gift of the Crown. It is agreed that the statesmen who have filled the post have been uniformly successful in holding evenly the balance be- tween political parties, and Canadians are satisfied with the method of appointing the official head of the State. Canada's political history is interesting, as showing the gradual development of a policy strictly Canadian, and yet not divergent from that of the empire. The Liberal- Conservative party which gathered round Sir John A. Macdonald, the first premier, represented a practical school of statesmen. Drawn from the ranks of both parties, they adopted a system of compromise in political matters, and made the early and speedy development of the country the main object of their policy. Opposed to them were the reform party, who took as their watchword financial retrenchment, and therefore opposed the Government in its railway policy and other schemes of rapid development. On the overthrow of the Macdonald ministry in 1873, a reform Government was formed under the Hon. Alex. Mackenzie. Committed by their parliamentary record to a policy of economy, the reformers soon aroused discontent by their neglect of the Canadian Pacific railway project. As consistent believers in free trade, too, they seemed powerless in the face of the financial difficulties that then beset Canada and threatened the ruin of her manufactures. This led to their defeat in 1878. The Conservative party, on returning to power, adopted a highly protective tariff as a defence against American trade encroachment, and this has so far proved itself favourable to the commercial wellbeing of the country that it has been continued to the present day. The reform party, disorganized by defeat, remained in opposition until 1896. During this period it advocated several modifications of the trade policy of*~~

~~*Canada, most of them looking to closer commercial rela- tions with the United States. On the death of Sir John A. Macdonald in 1891, Sir John Abbott became premier, but resigned through ill-health in the following year. He was succeeded by Sir John Thompson, who died at Windsor Castle in 1894, while attending to be sworn in as a member of her Majesty's Privy Council. Sir Mackenzie Bowell then became premier and leader of the Conservative party until 1896, when he was succeeded by Sir Charles Tupper. Sir Wilfrid Laurier's leadership of the re- formers, and the appearance of a more conservative tone in the counsels of the party, had restored public confi- dence ; and in the general elections of 1896 the*~~

~~Conservar tives, weakened by internal dissensions, met with a signal defeat, which was repeated in 1900. The reform admin- istration has been marked by various measures tending to unite Canada more closely with the empire — such as the adoption of imperial penny postage ; the denunciation of the German and Belgian treaties, with the subsequent preferential treatment accorded to British commerce; the carrying-out of plans previously made for cable connexion between Canada and Australia ; the contribu- tion of men for the South African war. These measures were stamped anew with popular approval by the elec- tions of 1900, which gave Sir Wilfrid Laurier's Govern- ment another lease of power. It is manifest that the broad general result of confederation has been greatly to increase Canada's weight in the councils of the empire, and to draw still more closely the bonds with the mother- land, (g. e. p.)~~

~~Canal Dover, a village of Tuscarawas county, Ohio, U.S.A., on the Tuscarawas river and the Ohio Canal. Population (1890), 3470 ; (1900), 5422 , of whom 939 were foreign-born and 10 negroes.~~

~~CAIS^ALS AJ^D IJ^LAITD ISTAYIGATIOK~~

~~Ship Canals in Eueopb.~~

~~THE last quarter of the 19th century saw great im- provements in inland navigation,more particularly in Germany, France, and Belgium. International Congresses have been held in the principal cities of Europe to discuss the question of the enlargement of existing canals, and the advantage of affording greater facilities for the water carriage of goods and minerals is now generally recog- nized. The fact that the cost of maintenance of canals rises but slightly with enlarged trade, while the wear and tear on railways, tramways, and roads increases in direct proportion with any increased weight of traffic, gives ship canals and other navigations a considerable advantage. The great saving effected in the consumption of coal in steamers by the use of triple or quadruple expansion engines enables large cargoes to be carried inland on ship canals at a rate per ton considerably below the cost on railways. The construction in England of the Ma,n- chester Ship Canal has been of great benefit to the dis- trict it serves not only by reducing the rates of carriage on seaborne traffic, but also by causing the railway rates to be lowered. The same results have occurred on~~

other ship canals that enable large steamers to pass inland to centres of population and manufactories without tran- shipment of cargo at ports on the coast. Ship canals of early date have had to be enlarged in depth and width to meet the increased size of steamers.

Manchester Ship Caned. — The advantage of a waterway for the conveyance of goods between Lancashire and the sea was so obvious, that so far back as the year 1721 Mr Thomas Steers designed a plan for continuing to Man-

chester the barge navigation which then existed between Liverpool and Warrington. Parliamentary powers were then obtained to improve the rivers Mersey and Irwell from Warrington to Manchester by means of locks and weirs. This work was successfully carried out, and proved of great benefit to the trade of the district. The duke of Bridgewater, who had made a canal from his col- lieries at Worsley to Manchester, afterwards continued the canal to the Mersey at Kuncorn ; this extension was opened in 1722 and competed with the Mersey and Irwell Navigation, both routes being navigated by barges carry- ing about fifty tons of cargo. The Liverpool and Man- chester railway at a later date afforded further facilities for conveyance of goods, but the high rates of carriage, added to heavy charges at the Liverpool docks, prejudiced trade, and the question was mooted of a ship canal to bring cotton, timber, grain, or goods direct to Manchester without transhipment. The first plan was made by Mr Wm. Chapman La 1825, and was followed by one designed by Mr Henry Palmer in 1840, but it was not until the year 1882 that the movement was originated that culmi- nated in the opening of the Manchester Ship Canal by Queen Victoria on 21st May 1894.

In determining the plan of the canal the main point which arose was whether it should be made with locks or whether it should be on the searlevel throughout, and therefore tidal. The advantage of a still waterway in navigating large steamers, and the facilities afforded by one constant water-level for works on the banks and the quick discharge of goods at the terminal docks at Man- chester, secured the adoption of the plans for a canal with locks as designed by Sir E. Leader Williams. The fresh-

most difficult to drive by ordinary means. At the river Weaver ten Stoney roller sluices are built, eacli 30 feet span, with heavy stone and concrete piers and foundations ; at Runcorn, where the river Mersey is narrow, a concrete sea wall 4300 feet long was substituted for the embankment. At various points under the canal cast-iron siphon pipes were laid to carry off any land drainage which was at a lower level than the canal ; the largest of these siphons were constructed to allow of the tidal and fresh water of the river Gowy to pass under the canal at Stanlow Point, between Eastham and EUesmere Port. Two 12-feet siphons are there placed close together ; built of cast-iron segments, they are each 400 feet long, and were laid on concrete 4 feet below the bottom of the canal. From Euncom to Latchford the canal is nearly straight, the depth of cutting varying from 35 to 70 feet, partly in rock, but generally in alluvial deposit. The whole length of the canal passes through the New Red Sandstone formation, with its overlying beds of gravel, clay, sand, and sUt, which gave much trouble during the progress of the work ; retaining walls of stone and brickwork had to be buUt in these places to maintain the sides of the canal from slips and injury from the wash of steamers. The canal from Latchford to Manchester is in heavy cutting through the valleys of the rivers Mersey and Irwell. As these rivers are circuitous in course, only very small portions could be utilized in forming the canal ; a line as nearly straight as possible was therefore adopted, and involved many cross- ings of the river channels. During the whole progress of the work these had to be kept open for the discharge of floods and land water, and in some places temporary cuts of considerable length had to be made for the same object. In November 1890 and December 1891 high winter floods covered the whole of the river valleys, filling many miles of the unfinished canal and causing great damage to the slopes. Altogether 23 miles of canal had to be pumped out to enable the work to be completed. After the cuttings between the river channels were finished, the end dams were removed, and the rivers Irwell and Mersey were turned into the new channel now forming the upper portion of the ship canal. The total rise to the level of the docks at Manchester from the ordinary level of the water in the tidal portion of the canal below Latchford locks is 60 feet 6 inches ; this is obtained by an average rise of about 15 feet at each of the sets of locks at Latch- ford, Irlam (7-^ miles nearer Manchester), Barton (2 miles farther), and Mode Wheel (3^ miles above Barton locks at the entrance to the Manchester docks). Por the greater part

~~of this last length the canal is widened at bottom from 120 feet, its normal width, to 170 feet, to enable vessels to lie at timber and other wharves in that part of the canal without interfering with the passing of large vessels to or from the docks. The locks are in duplicate, one being 600 feet long by 65 feet wide, the other 350 feet long by 45 feet wide, with Stoney's sluices adjacent. Theyarefilled or emptied in five minutes by large culverts on each side with side openings into the lock. Concrete with facings of blue Staffordshire bricks is largely used, and the cop- ings, sills, hollow quoins, and fender courses are of Cornish granite. The lock gates are constructed of greenheart timber. The sluices near the locks take the place of the weirs used in the old Mersey and Irwell Navigation ; they are 30 feet span each, four being generally used at each set of locks. In ordinary seasons any water not used for lockage purposes passes over the tops of the sluices, which are kept closed ; in flood times the sluices are raised to a height which will pass off floods vdth a comparatively small rise in the canal. There are eight hydraulic in- stallations on the canal, each having duplicate steam- engines and boilers ; the mains exceed 7 miles in length.~~

~~water portion of the canal extended between Manchester and Runcorn, while from the latter place to Garston it was proposed to improve the upper Mersey estuary by constructing training walls and dredging to form a deep central channel. Powers to construct the canal were sought in the Session of 1883, when the Bill passed the Committee of the House of Commons, but was rejected by the Committee of the House of Lords. Brought forward again the next year, it was passed by the Lords but thrown out by the Commons. The opposition from Liverpool and the railway companies was very strong ; to meet to some extent that of the former, a continuation of the canal was proposed from Runcorn to Eastham along the Cheshire side of the Mersey, instead of a trained channel in the estuary, and in this form the Bill was again introduced in the Session of 1885, and, notwithstanding strong opposition, was passed by both Houses of Parliament. The cost of this contest to promoters and opponents exceeded £400,000, the various Committees on the Bill having sat over 175 days. Owing to difficulties in raising the cap- ital the works were not commenced until November~~

~~1887.~~

The total length of the canal is 35^ miles, and it may be regarded as divided into three sections. Prom Eastham to Runcorn it is near or through the Mersey estuary for 12i mUes, and thence to Latchford near Warrington, 8^ miles, it is inland ; both these sections have the same water-level, which is raised by high tides. At Latchford the locks stop tidal action, and the canal from that point is fed by the waters of the rivers Mersey and Irwell to Manchester, 14r|- miles from Latchford. The canal com- mences on the Cheshire side of the Mersey at Eastham, about 6 miles above Liverpool. The entrance is well sheltered, and adjoins a good low-water channel com- municating with the Sloyne deep at Liverpool. Three entrance locks have been provided close to and parallel with each other, their length and width being 600 by 80, 350 by 50, and 150 by 30 feet. These locks maintain the water-level in the canal nearly to mean high-water level (14 feet 2 inches above the Liverpool datum) ; when the tide rises above that height the lock gates are opened and the tide flows up to Latchford, giving on high spring tides an additional depth of water of about 7 feet. On the ebb tide this water is returned to the Mersey through large sluices at Randies Creek and at the junction of the river Weaver with the canal, the level of the canal thus being reduced to its normal height. The canal throughout to Manchester has a minimum depth of 26 feet, the lock sills being placed 2 feet lower to allow of the channel being dredged to a depth of 28 feet if necessary hereafter. The minimum width at bottom is 120 feet, allowing large vessels to pass each other at any point on the canal ; this width is considerably increased at the locks and other parts. The slopes are generally about 1^ to 1, but are flatter through some portions ; in rock-cutting the sides are near vertical. From Eastham to Runcorn the canal is alternately inland and on the foreshore of the estuary, on which embankments were constructed to act as dams during the excavation of the canal to keep out the tide, and afterwards to maintain the water-level at low water in the estuary ; both sides are faced with heavy coursed stone. The material for the embankments was principally clay excavated from the cuttings. In some places, where the foundation was of a porous nature, sheeting piles of timber had to be used. At EUesmere Port, where the embankment is 6200 feet long on sand, 13,000 whole timber sheeting piles were driven, to secure the base of the embankment on each side ; they were 35 feet long, water jets under pressure through 1^ inch wrought-iron pipes being used at the foot of each pile to assist the sinking of the piles, which were found

~~the pressure being 700 ft to the inch. They work the cranes, lifts, and capstans at the docks," lock gates, and culvert sluices, coal tips, swing bridges, and aqueduct.~~

~~At Barton, near Manchester, the Bridgewater Canal crossed the river Irwell on the fii-st navigable aqueduct constructed in England; it was the work of Brindley. Since it was only built at suflcient height to allow of barges passing under it, means had to be found to allow of this important canal being maintained, and yet to permit large steamers to use the ship canal below it. Brindley's canal is on one level throughout its whole length, and as its water-supply is only sufficient for the flight of locks by which it descends at Euncom to the Mersey, locks down to the ship canal would have involved the waste of a lock of water on each side and caused serious delay to the traffic. Sir E. Leader Williams sur- mounted the difficulty by means of a swing aqueduct for the Bridgewater Canal, which when closed allows of the traffic passing as heretofore, while it is opened to allow of ships crossing it on the lower level of the ship canal. The water in the swing portion of the aqueduct when opened is maintained by closing gates at each end, similar gates ^jeiag shut at the same time across the fixed portion of the aqueduct. The swing portion is a large steel trough carried by side girders, 234 feet long and 33 feet high in the centre, tapering 4 feet to the ends ; the waterway is 19 feet wide and 6 feet deep. The whole works on a central pier with similar arrangements to the largest swing bridges on the canal ; it has two spans over the ship canal of 90 feet each. It is somewhat singular that the first fixed canal aqueduct in England should, after the lapse of 136 years, be replaced by the first swing aqueduct ever constructed. The swing aqueduct is moved by hydraulic power, and has never given any trouble in working, even ia times of severe frost. The weight of the movable portion, including the water, is 1600 tons.~~

~~The manner of dealing with the five lines of railways that were cut through by the canal was one of importance, both in the interests of the travelling public and the trade on the canal ; they are all important lines, including the main line of the London and North-Western Railway near Warrington, with its important route to Scotland. Hitherto, no such alteration of a~~

~~railway had been sanctioned by Parliament, and it was only the importance of a ship canal to Manchester that secured the requisite power against the strong opposition of the railway companies. Swing bridges, although in use on some lines to cross navigations, are dangerous and inconvenient, and high-level deviation lines were adopted for each railway crossing the canal. Embankments were made close to and parallel with the old lines, commencing about a mile and a quarter from the canal on each side, the canal itself being crossed by viaducts which give a clear headway of 75 feet at ordinary water-level. Vessels trading on the canal with high masts are provided with telescopic or sliding top masts. The gradients on the railways rising up to the viaducts are 1 in 135. The span of the viaducts is so arranged as to maintain the full width of the canal for navigation 5 and as the railways generally cross the canal on the skew, this necessitated girders in some cases of 300 feet span. There are nine main roads requiring swing bridges across the canal; all below Barton have a span giving a clear waterway of 120 feet. The width of these bridges varies with the importance of the roads from 20 to 36 feet, and they are constructed of steel, their weight ranging from 600 to 1000 tons each. They work on a live ring of conical cast-iron rollers, and are moved by hydraulic power supplied by steam, gas, or oil engines. The Trafford Eoad Bridge at the docks at Manchester is the heaviest swing bridge on the canal ; being of extra width, it weighs 1800 tons.~~

~~The canal being virtually one long dock, wharves at various points have been erected to enable chemical or manufacturing works to be carried on, widenings being provided where necessary. At EUesmere Port coal tips and sheds have been erected, and the canal is in direct communication with the docks there as well as at Weston Point and Kuncorn, where a large trade is carried on with the Staffordshire Potteries and the Cheshire salt districts. At Partington branches from the railways connect the canal with the Yorkshire and Lancashire coal-fields, and the canal is widened out 65 feet on each side for six hydraulic coal tips. At Mode Wheel there are extensive abattoirs and lairages, erected by the Manchester Corpo- ration ; also large petroleum oil tanks, graving dock and pontoons, cold-air meat stores, and other accommodation for traffic. At Manchester the area of the docks is 104~~

~~*acres, with 152 acres of quay space, having over 6 miles of frontage to the docks, which are provided with a number of three-storey transit sheds, thirteen seven-storey and seven four-storey warehouses, and a large grain silo. The London and North-Western and Lancashire and Yorkshire Railway Companies have made branch lines to the docks, the railways and sidings at which are over 30 miles in length. Much traffic is also carted, or dealt with by inland canals in direct communication with the docks. The substitution of a wide and deep canal, nearly straight, for comparatively shallow and narrow winding rivers, and the use of large sluices in place of fixed weirs to carry off the river water, have been of great advantage to the district in greatly reducing the height of floods.*~~

~~*The total amount of excavation in the canal, docks, and subsidiary work amounted to over 54 mUlion cubic yards, nearly one-fourth of which was sandstone rock ; the excavated material was used in forming the railway deviation embankments, filling up the old beds of the rivers, and raising low lands near the canal. As many men were employed on the works as could be obtained, but the number never exceeded 17,000, and the greater part of the excavation was done by about eighty steam navvies and land dredgers. Por the conveyance of ex- cavation and materials, 228 miles of temporary railway lines were laid, and 173 locomotives, 6300 waggons and trucks, and 316 fixed and portable steam-engines and cranes were employed, the total cost of the plant being nearly £1,000,000. The expenditure on the works, including plant and equipment, to 1st January 1900, was £10,327,666.. The purchase of the Mersey and Irwell and Bridgewater Navigations (£1,786,651), land and compensation (£1,223,809), interest on capital during construction (£1,170,733), and parliamentary, superin- tendence, and general expenses brought up the total amount to £15,248,437.*~~

~~*The traffic on the canal has gradually increased from 925,659 tons in the year 1894 to 2,778,108 tons in 1899. After its opening considerable reductions were made in the railway rates of carriage and in charges at the Liver- pool docks in order to meet the lower cost of conveyance by shipping passing up it. The result has been of great advantage to the trade of Lancashire and the surrounding districts, and the saving in the cost of carriage, estimated at £700,000 a year, assists manufacturers to meet the*~~

~~*competition of their foreign opponents who have the advantage of low rates of carriage on the improved water- ways of America, Germany, France, and Belgium. Before the construction of the canal, large works had left Man- chester to establish them selves at ports like Glasgow, where they could save the cost of inland carriage. Since its opening, new industries have been started at Manchester and along its banks, warehouses and mills that were for- merly empty are now occupied, while nearly 10,000 new*~~

~~*feet to 121 feet 4 inches. This work, which was delayed through financial considerations and the traffic on the canal, was not completed till December 1898. The dredg- ing on the canal is being continued, and it is expected that a depth of 31 feet will be obtained by 1902. The ultimate width (at a depth of 26 feet 3 inches) is intended to be 213 feet in straight reaches, and 246 to 260 feet on curves, between Port Said and the Bitter Lakes ; thence to Suez 246 feet, increasing to 262 feet on curves. The limit of draught of vessels has been increased from 24 feet 6 inches to 25 feet 7 inches, niae additional sidings or passing- places have been provided, and the general use of the electric light has enabled steamers to continue their voy- age day and night, thus considerably shortening the time occupied in passing through the canal.*~~

~~*Corinth Canal. — This ship canal crosses the Isthmus of Corinth, the land along its route being low at each end, but high in the central portion. It is the revival of a scheme dating back so far as 600 b.c, when Periander employed Egyptian engineers to survey the isthmus ; in A.D. 66 Nero commenced the works along the site of the present canal, but at his death they were abandoned. After the failure to construct the canal, a slipway wa9 made, over which small vessels were transferred on wooden rollers. The works of the canal were commenced in 1882, but were not completed until 1893 through lack of funds. It is nearly 4 miles long, and it shortens the sea route from the Gulf of Patras to the Gulf of Athens by 180 miles. It passes through the isthmus in a straight line, with the advantage of not crossing any river ; only one bridge, serving both for railway and road traffic, was required over the canal to join the island cut off from the mainland. The bottom width of the canal is 72 feet, the depth of water 26 feet. The work*~~

~~was commenced by dredging entrance canals at each end and constructing breakwaters. Trial shafts were sunk along the line of the canal to determine the nature of the strata through which the cutting had to be made, but as has often been the case with other works of a similar character, the material proved to be of a more difficult nature than had been anticipated, and the numerous faults and irregulari- ties in the strata largely increased the cost beyond the estimate. At one point the cutting is 287 feet deep, and for a length of 2 miles it averages 200 feet. The total amount of excavation was nearly 16,000,000 cubic yards. Much of this was rock, but as it was too soft to resist erosion by the wash of steamers, long lengths of the canal had to be protected by masonry or rubble stone, 436,000 cubic yards being quarried for this purpose. Notwithstanding these costly precautions, the sides of the canal have given much trouble since its opening, and slips have occurred causing blocks to traffic. Owing to deficient width and strong currents, the traffic is principally confined to small vessels and passenger steamers. The total cost amounted to nearly £3,000,000.~~

~~Cronstadt Canal. — This canal was made with the object of bringing St Petersburg into direct connexion with the Baltic for large vessels ; these had previously been pre- vented from reaching that city by the bar of the Neva, and the transhipment of their cargoes into barges at Cronstadt caused considerable expense and delay. Peter the Great originally designed and began the canal, but the works were not proceeded with after his death. In 1877 operations were again commenced, and they were completed in 1885. Starting from the Neva at St Peters- burg, the canal diverges from the estuary channel and proceeds in a south-westerly direction for about 2 miles ; then curving round towards the north-west, it runs in a straight line to Cronstadt, the total distance being 17^ miles. For the first 7^ miles it is protected by embank- ments formed with part of the excavated material, and it~~

~~houses have been built for the accommodation of the work-people required to meet the enlarged trade of the city.~~

~~The Gloucester and Berkeley Canal. — The first Act au- thorizing the construction of this canal was passed in the year 1793 ; five subsequent Acts for making alterations in its route and raising funds were obtained, but~~

~~*the works were not completed until 1827. Mr Robert Mylne was the first engineer employed, but afterwards Mr Telford was called in to revise the plans, and they were carried out imder his direction. It was originally proposed to make the entrance at Berkeley Pill, but it was afterwards constructed at a more sheltered position at Sharpness Point. The water-supply is derived from the river Prome, which in its course to the Severn crosses the canal at a point where it is joined by the Stroud water Navigation ; this connects it with the Thames and Severn Canal and the inland navigations. The navigation of the Severn from Sharpness to Gloucester is circuitous and dangerous, and while the distance is 28 miles, the length of the canal between the same points is 16i- miles. It is on one level throughout, having basins at both ends for shipping, and locks to the Severn. The depth is 18 feet, and vessels which draw more water lighten their cargoes at Sharpness. Sailing ships were formerly towed up the canal by horses, but since 1869 steam tugs have been used. The cargoes are generally timber or grain.*~~

~~*Exeter Canal. — This canal is an interesting work, being the first canal carried out in the United Kingdom for the purpose of enabling seagoing vessels to pass to an inland port. The river Exe was very early utilized by small craft trading to Exeter, Parliament having granted powers for the improvement of the navigation by the construction of a canal 3 miles long from Exeter to the river ; at a later date this canal was extended lower down to the tidal estuary of the Exe. Previous to the year 1820 it was only available for vessels of a draught not exceeding 9 feet, but by deepening it, raising the banks, and con- structing new locks, vessels drawing 14 feet of water were enabled to pass up to a basin and wharves at Exeter. These works were carried out by Mr James Green under the advice of Mr Telford. The canal is still useful for the coasting trade in coal and timber, but the great increase in the size of steamers and saUing vessels has diminished its importance, more particularly as it does not terminate in a manufacturing or mineral district.*~~

~~*Newry Canal. — This, the only ship canal in Ireland, was constructed between the years 1761 and 1769. Like the Gloucester and some other canals, it was made to avoid the upper and shallow part of a river navigation, the river Newry being only navigable to that town on high tides*~~

for small vessels. At first the canal was only 2 miles long, from Eathom to Newry, but in 1829 it passed from the hands of the Irish Board of Navigation to a private company, who obtained powers to lengthen it 1-J- miles seawards to deeper water, and also to improve the navigation of the river thence to Carlingford Lough, according to plans prepared by Sir John Rennie. The river was improved by blasting and dredging, and the old canal enlarged to the same width and depth as the new portion, enabling vessels of 13^ feet draught to pass from the sea to Newry.

Suez Canal (see Ency. Brit. vol. iv. pp. 789-792, and vol. xxii. pp. 620-621). — The rapid increase of traffic and the greater size of the vessels using the canal caused so much delay in the passage, that a consultative commis- sion was formed in 1884 to consider the question of either enlarging the existing canal or constructing another one alongside it. After full investigation they unanimously decided in favour of increasing the depth of the canal from 26 feet to 27 feet 10 inches, and the width from 72

has a bottom width of 207 feet; for the remaining 10 miJes It has a bottom width of 275 feet, and is merely a dredged channel through the gulf, without embankments. The depth is 22 feet deep throughout. Three basins, termed by widening out the canal near St Petersburg give an area of 230 acres for the accommodation of ship- ping. The total cost of the work, about £1,300,000, was paid by the State, and there are no tolls.

Baltic and Black Sea Canal— A canal has been pro- jected from the Baltic to the Black Sea utilizing the rivers en route. It is proposed to have a bottom width of 115 feet, and a depth throughout of 28 feet, but its great length, nearly 1000 miles, brings up the estimated cost to £100,000,000. The advantage of a deep canal between the Baltic and the Black Sea, entirely through Russian territory, which would enable men-of-war and other steamers to pass inland, is obvious ; but it is probable that It would be closed by ice in the winter season, and its heavy cost also makes it very doubtful whether the Russian Government will ever undertake the work.

The Worth Sea and Baltic Canal— This canal (officially called the Kaiser-Wilhelm Canal) was constructed by the German Government between the years 1887 and 1895, at a cost of about £8,000,000 (of which £2,550,000 was paid by Russia, and the rest by the Imperial Exchequer). It affords a better and shorter route than the sea passage ; but it was mainly designed for strategic reasons, its width and depth allowing large ironclads to pass through the German territory of Holstein from the Baltic to the North Sea, without the dangers and delay of the long voyage round Jutland. The average time for passing through the canal is eight to ten hours. It begins in the river Elbe, near Brunsbilttel, and thence traversing the Kuden Lake, passes south of Rendsburg and the Lower Eider to Holtenau, in the harbour of Kiel Bay. It is 61^ miles long, with a depth of 29|- feet, and a surface breadth of 219 feet ; but as its bottom width is only 72 feet, large vessels can only pass each other at six places, about 2J miles apart, where it is specially widened out for the purpose. Locks (492 feet long between the gates, 82 feet

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Sketch Map of the Nokth Sea and Baltic Canal.

broad, and 32 feet deep) have been constructed at each end to regulate the height of the water, which is level through- out the whole \ength. The canal is crossed by two fixed bridges 138 feet above water-level, one at Grunthal, with a span of 513 feet, carrying the Neumunster-Heide railway line. The other at Lewensau, near Kiel, 535 feet in span, carrying the Kiel-Flensburg railway line. There are also three double swing bridges, worked by hydraulic power, at Brunsbilttel, Rendsburg, and between Rendsburg and Kiel. The total amount of excavation was 106,000,000 cubic yards. The work was very difficult through the low lands of the Kuden Lake, where wide sand dams had to be formed on each side of the canal on soft peaty soil; after the dams had sunk through the peat, the canal was dredged between them, the banks being now formed by the sand" dams. The advantage to Germany of a secure inland waterway for the navy is important, but the use by the mercantile marine is only slowly developing, in consequence of the saving in time

~~*being to some extent neutralized by the tolls charged on the canal.*~~

~~*The extent to which the canal has been used, together with par- ticulars of revenue and expenditure, is shown in the subjoined table : —*~~

~~*Number of*~~

~~*Percentage*~~

~~*Tear.*~~

~~*Vessels pass- ing through.*~~

~~*Tonnage.*~~

~~*Eeceipts.*~~

~~*Expenditure.*~~

~~*tonnage, German.*~~

~~*1896*~~

~~*20,068*~~

~~*1,751,065*~~

~~*£48,088*~~

~~*£111,300*~~

~~*67-8*~~

~~*1897*~~

~~*21,904*~~

~~*2,345,849*~~

~~*59,936*~~

~~*103,740*~~

~~*1898*~~

~~*25,224*~~

~~*3,009,011*~~

~~*76,780*~~

~~*113,900*~~

~~*69-3*~~

~~*1899*~~

~~*26,524*~~

~~*3,451,273*~~

~~*89,370*~~

~~...~~

~~*65*~~

~~*1900*~~

~~*29,571*~~

~~*4,282,258*~~

~~*106,658*~~

~~*62-3*~~

~~*Brussels Canal. — Brussels has long been connected with Antwerp and the Scheldt by a canal 17| miles in length with three locks ; this begins in a basin at Brussels, and terminates opposite Boom, near Willebroeck, in the*~~

~~river Rupel, by which vessels pass to the Scheldt. As the depth of the canal is only 10|- feet, its use is confined to vessels not exceeding 400 tons. It is now proposed to increase the depth to 20 feet, and to enlarge the locks in order to allow steamers of 2000 tons to reach Brussels. The necessary funds, estimated at about £1,500,000, are to be provided by the State, the city, and the neighbouring cgmmunes.~~

~~Ghent Canal. — Like other towns in Belgium and Hol- land, Ghent at an early date began to develop a water- way to the sea, and a canal was opened in 1561 to a tributary of the Scheldt at Sas-de-Gand. In 1758 the opening of the canal from Ghent to Bruges gave it another but longer route. It was found that the navigation to the Scheldt was silting up, and a canal was made from Sas-de- Gand to Terneuzen on the Scheldt, which gave a con- tinuous and direct route to the sea, passing partly through Holland and partly through Belgium. By a convention between those countries a considerable enlargement of the canal was carried out, and the work was completed in 1883. The canal is 20 feet deep, with a bottom width of about 56 feet. There are locks at Sas-de-Gand and Terneuzen 295 feet long and 39| feet wide. The docks at Ghent have been enlarged, and the result of improving the canal has been a considerable increase in the traffic, and in the trade of Ghent.~~

~~Bruges Canal — During the Middle Ages Bruges was a port of importance, having communication with the sea by means of a canal to the Zwyn estuary, which, however, ultimately filled up with sand to such an extent as to prevent navigation. A canal was afterwards made to Ostend, but owing to the increasing size of seagoing vessels, a project was sanctioned for a larger and more direct canal to Zeebrugge, on the seacoast. The work was commenced in 1896, and as it is only 6| miles long, through flat land, it is free from the difficulties that other ship canals have met with ; it is 26^ feet deep, having a bottom width of 72 feet, with flat slopes pitched with stone near the water- level. The canal is expected to be completed in 1902 ; it is being excavated by dredgers which deposit the soil direct on to the adjacent land by means of shoots, thus forming embankments on each side of the canal. As the coast is not favourable for a deep harbour, an embankment, continued by an open jetty and terminating in a solid breakwater nearly 5000 feet long, is being made to protect the entrance to the canal. The~~

embankment extends to low water west of the canal ; the open jetty is designed to permit the flow of the tide across the entrance to scour away deposits of sand or silt. The breakwater curves eastwards for the greater part of its length, when it becomes almost parallel with the shore, extending past the canal entrance. As the harbour will be used as a port of call, the breakwater is provided with a quay wall, railway

lines, and sheds. The outer part of the breakwater is formed of large concrete blocks weighing 2500 to 3000 tons each, in order better to resist the heavy seas on this exposed coast; the upper courses are blocks of 60 tons each. By an ingenious arrangement the largest blocks, which are 24^ feet thick and 26 feet in height, are made hollow in iron caissons ; when set hard, they are floated out and sunk in their position in the breakwater, the central portion of the block being then filled by concrete lowered down by means of cranes and skips. The harbour formed by the breakwater will be about 270 acres in area. From it an entrance channel extends to the sea lock, which is 840 feet long between the caissons that here take the place of ordinary gates ; the lock is 79 feet wide at the bottom, and several vessels of moderate size can be locked through at the same time. The caissons, which run on wheels into recesses in the lock walls, weigh 479 tons each, and they have the advantage of being able to maintain the level of the water in the canal either above or below the tide out- side ; to effect this with ordinary lock gates, double pairs of gates would have been required. The docks which are being constructed at Bruges are provided with railway lines, sheds, and cranes, and have communications with the Ostend and other canals. The commercial success of the canal has yet to be proved. It will have to contend with neighbouriag ports, but it is expected that this enterprise, which is being carried out at the joint cost of the State and local bodies, will restore the past prosperity of Bruges. Proposed Paumben Oanal. — ^This scheme, referred to in the 9th edition of this work, has not been proceeded with.

~~*(e. l. w.)*~~

~~*Ship Caitaxs in Ameeica.*~~

~~*Isthmian Canal Schemes. — ^Whenhe crossed the Atlantic, the object Columbus had in view was to find a western passage from Europe to Cathay. It was with the greatest reluctance and only after a generation of unremitting toil that the explorers who succeeded him. became convinced that the American continent was continuous, and formed a barrier of enormous extent to the passage of vessels. The question of cutting a canal through this barrier at some suitable point was immediately raised. In 1550 the Por- tuguese navigator Antonio Galvao published a book to demonstrate that a canal could be cut at Tehuantepec, Nicaragua, Panama, or Darien, and in 1551 the Spanish his- torian Gomara submitted a memorial to Philip II. urging in forcible language that the work be undertaken with- out delay. But the project was opposed by the Spanish Government, who had now concluded that a monopoly of communication with their possessions in the new world was of more importance than a passage by sea to Cathay. It even discouraged the improvement of the communica- tions by land. To seek or make known any better route than the one from Porto Bello to Panama was forbidden under penalty of death. Geographical research was stifled. For more than two centuries no serious steps were taken towards the construction of the canal, if excep- tion be made of the disastrous attempt at colonization at Caledonia Bay by the Scots under Paterson in 1698. In 1771 the Spanish Government, having changed its policy, ordered a survey for a canal at Tehuantepec, and finding that line impracticable, ordered surveys in 1779 at Nicar- agua, but political disturbances in Europe soon prevented further action. In 1808 the isthmus was examined by Alexander von HIumboldt, who pointed out the lines which he considered worthy of study. After the Central American Republics acquired their independence in 1823, there was a decided increase of interest in the canal question. In 1825 the Republic of the Centre, in con- sequence of receiving applications for concessions from*~~

~~*citizens of Great Britain, and also from citizens of the United States, made overtures to the United States for aid in constructing a canal, but they resulted in nothing. In 1830 a concession was granted to a Dutch*~~

~~*corporation under the special patronage of the King of the Nether- lands to construct a canal through Nicaragua, but the revolution and the separation of Belgium from Holland soon followed, and the scheme fell through. Since that date numerous concessions have been granted to citizens of the United States, France, and Belgium, both for the Nicaragua and the Panama lines, but with the exception of the concession of 1878 for Panama and that of 1887 for Nicaragua, no work of construction has been done under any of them.*~~

~~*Knowledge of the topography of the isthmus was ex- tremely vague until the great increase of travel due to the discovery of gold in California in 1849 rendered improved communications a necessity. A railroad at Panama and a canal at Nicaragua were both projected. Instrumental surveys for the former in 1849, and for the latter in 1850, were made by American engineers, and, with some small exceptions, were the first really accurate surveys made up to that time, though numerous exploring expeditions had been undertaken, some under Government auspices and others under private enterprise, some furnishing valuable information and others simply adding to the confusion already existing. But they resulted in geographical know- ledge sufficient to eliminate from consideration all but the following routes: — 1. Nicaragua; 2. Panama; 3. San Bias ; 4. Caledonia Bay ; 5. Darien ; 6. Atrato River, of which last there were four variants, the Tuyra, the Truando, the Napipi, and the Bojaya. In 1866, in response to an inquiry from Congress, Admiral Charles H. Davis, U.S. Navy, reported that "there does not exist in the libraries of the world the means of determining even approximately the most practicable route for a ship canal across the American isthmus." To clear up the subject the United States Government sent out, between 1870 and 1875, a series of expeditions under officers of the Navy, by whom all of the above routes were examined. The result was to show that the only lines by which a tunnel could be avoided were the Panama and the Nicar- agua lines ; and in 1876 a United States Commission reported, after careful consideration of all the data collected, that the Nicaragua route possessed greater advantages and offered fewer difficulties than any other. Whether they would have so reported if they had pos- sessed all the information now available may be doubted, but from that day the Nicaragua line has been the favour- ite in American public opinion. At Panama the isthmus is narrower than at any other point except San Bias,*~~

~~its width in a straight line being only 35 miles, and the height of the continental divide is only 300 feet, which is higher than the Nicaragua summit, but less than half the height on any other route. At Nicaragua the distance is greater, being about 156 miles in a straight line, but more than one-third is covered by Lake Nicaragua, a sheet of fresh water with an area of about 3000 square miles and a maximum depth of over 200 feet, the surface being about 106 feet above searlevel. Lake Nicaragua is connected with the Atlantic by a navigable river, the San Juan, and is separated from the Pacific by the continental divide, which is about 160 feet above sea-level. For a considerable portion of its length the San Juan forms the boundary between Nicaragua and Costa Rica. At Nicaragua only a canal with locks can be considered. At Panama a searlevel canal is a physical if not a financial possibility.~~

~~By the Clayton-Bulwer Treaty of 1850 with Great Britain, by the Treaty of 1846 with New Granada (Col- ombia), Article XXXV., and by the Treaty of 1867 with~~

~~Nicaragua, Article XV., the United States has guaranteed that the canal shall be neutral, and, furthermore, that it shall be used and enjoyed upon equal terms by the citizens of both countries in each case. Nicaragua guaranteed by her Treaty of 1859 with Prance that the citizens of both countries should use the canal upon equal terms, and France guaranteed its neutrality. Nicaragua guaranteed by her Treaty of 1858 with Belgium and of 1850 with Spain, that the citizens of those countries should enjoy the same advantages as are granted to the most favoured nations. Costa Eica granted by her Treaty of 1860 with Spain free transit upon the same terms as for her own citizens. All of these treaties are still in force. Colombia has not made special treaties with nations other than the United States, but in addition to the Treaty of 1846 just mentioned, she is committed in the law of concession to the principle that the canal shall be neutral. A modifi- cation of the Clayton-Bulwer Treaty being necessary to enable the United States to build the canal, a Treaty making such modifications, but preserving the principle of neutrality, known as the Hay-Pauncefote Treaty, was negotiated~~

~~with Great Britain in 1900 ; it was amended by the United States Senate, and the amendments not proving acceptable to Great Britain, the Treaty lapsed in March 1901; but a new Treaty was negotiated in the autumn, and accepted in December by the U.S. Senate.~~

~~Many elaborate investigations of the probable traffic and resulting revenue of a canal have been made. The most recent and most trustworthy are those of the new Panama Canal Company and those of the Isthmian Canal Commission. The Commission's estimates are slightly in excess of those of the Company, but being of later date, rather confirm than controvert the accuracy of both. The Commission found that the amount of shipping which would have used the canal if open in the year 1898-99 was 6,736,466 tons net register, and that the probable amount for 1909 would be about 7,000,000 tons.~~

~~The completion of the Suez Canal in 1869, and its sub- sequent success as a commercial enterprise, drew attention more forcibly than ever to the American isthmus. The citizens of France, who had gained money and fame in that enterprise, were especially eager to embark in a new, one of similar character. In the year 1876 an associa- tion entitled " Societe Civile Internationale du Canal In- teroceanique " was organized in Paris to make surveys and explorations for a ship canal. An expedition under the direction of Lieutenant L. N. B. Wyse, an officer of the French Navy, was sent to the isthmus to examine the Panama line. In May 1878 Lieutenant Wyse, in the name of the association, obtained a concession from the Colombian Government, commonly known as the Wyse Concession. This is the concession under which work upon the Panama Canal has been prosecuted. Its first holders did no work of construction.~~

~~In May 1879 an International Congress composed of 135 delegates from varfous nations — some from Great Britain, United States, and Germany, but the First majority from France — ^was convened in Paris~~

~~Oun^y. Tinder the auspices of Ferdinand de Lesseps, to consider the best situation for, and the plan of, a canal. Af^er a session of two weeks the Congress decided that the canal should be at the sea-level, and at Panama. Immediately after the adjournment of the Congress the Panama Canal Company was organized under a general, law of France, with Lesseps as~~

president, and it purchased the Wyse Concession from the company which held it at the price of ten million francs. An attempt to float this company in August 1879 failed, but a second attempt, made in December 1880, was fully successful, 600,000 shares of 500 francs each being sold. The next two years

were devoted to surveys and examinations and preliminary work upon the canal. The plan adopted was for a sea- level canal having a depth of 29^ feet and bottom width of 72 feet, involving excavation estimated at 157,000,000 cubic yards. The cost was estimated by Lesseps in 1880 at 658,000,000 francs, and the time required at eight years. The terminus on the Atlantic side was fixed by the anchorage at Colon, and that on the Pacific side by the anchorage at Panama. Leaving Colon (see Map) the canal passes through low ground by a direct line for a distance of 6 miles to Gatun, where it intersects the valley of the Chagres river ; passes up that valley for a distance of 21 miles to Obispo, where it leaves the Chagres and ascends the valley of a tributary, the Cuma- cho; cuts 'through the watershed at Culebra, and thence descends by the valley of the Eio Grande to Panama Bay. Its total length from deep water in the Atlantic to deep water in the Pacific is about 47 miles. It is laid out in such a way as to give easy curvature everywhere ; the sharpest curve, of which there is but one, has a radius of 6200 feet, four others have a radius of 8200 feet, and all others have a radius of 9800 feet or more. To secure this it was necessary to select a point for crossing the watershed where the height was somewhat greater than that of the lowest pass. The maximum height on Culebra Cut is about 328 feet above sea-level. The harbours at Colon and Panama are not first-class, but are sufficiently good for the terminus of a canal where the stay of vessels is short. The line is essentially the same as that followed by the Panama railroad, the concession for which granted a monopoly of that route ; the Wyse Concession, there- fore, was applicable only upon condition that the canal company could come to an amicable agreement with the railroad company.

The principal difficulties to be encountered in carrying out this plan consist in the enormous dimensions of the cut to be made at Culebra, and in the control of the Chagres river, the valley of which is occupied by the canal for so large a part of its length. This stream is of tor- rential character, its

~~discharge varying from a minimum of about 360 cubic feet to a maximum of over 100,000 cubic feet per second. It rose at Gamboa 1st December 1890, 18f feet in twelve hours, its volume increasing from 16,600 cubic feet to 57,800 cubic feet per second at the same time ; and similar violent changes are not uncom- mon. To admit a stream of this character to the canal would be an intolerable nuisance to navigation unless space could be provided for its waters to spread out. For a canal with locks the remedy is simple, but for a searlevel canal the problem is much more diflcult, and no satisfac- tory solution of the question was ever reached under the Lesseps plan.~~

~~Work under this plan continued until the latter part of 1887, the management being characterized by a degree of extravagance and corruption that have had few if any equals in the history of the world. By that time it had become evident that the canal could not be completed at the sea-level with the resources of time and money then available. The plan was accordingly changed to one including locks, and work was pushed on with vigour until 1889, when the company, becoming bankrupt, was dissolved by a judgment of the Tribunal Civil de la Seine, dated 4th February 1889, a liquidator being appointed by the court to take charge of its affairs. One of the more important duties assigned to this official was to keep the property together and the concession alive, with a view to the formation of a new company for the completion of the canal. He gradually reduced the number of men employed, and finally suspended the works on 15th May 1889. He then proceeded to satisfy himself that the canal project was feasible, a question about which the failure of the~~

~~company had caused grave doubts, and to this end caused an inquiry to be held by a commission of French and foreign engineers, having at their head M. Guillemain, the Director of the National School of Fonts et Chaussees. This commission reported on 9th May 1890 that a canal with locks, for which they submitted a plan, could be built in eight years at a cost of 580,000,000 francs for the works, which sum should be increased to 900,000,000 francs to include administration and financing. They reported that the plant in hand was in good condition and would probably suffice for~~

~~*finishing the canal, and they estimated the value of the work done and of the plant in hand at 450,000,000 francs.*~~

~~*The time within which the canal was to be completed under the Wyse Concession having nearly expired, the liquidator sought and obtained from the Colombian Government an extension of ten years. The law which granted this extension is dated 26th December 1890, and it provided that a new company should be formed and work upon the canal resumed on or before 28th February*~~

~~*1893. This condition not having been fulfilled, a second extension was sought and obtained 4th April 1893; it provided that the term of ten years granted by the extension of 1890 should begin to run not later than 31st October 1894. By an agreement dated 26th April 1900, the time was still further extended to 31st October 1910. For each of these extensions the Colombian Government exacted heavy subsidies. After many difficulties and delays the liquidator finally secured the organization of a new company on the 20th October*~~

~~*1894. The old company and the liquidator had raised, by the sale of stock and bonds, the sum of 1,271,682,637 francs. The securities issued to raise this money had a par value of 2,245,151,200 francs, and they are held by about 200,000 persons. In all about 72,000,000 cubic yards had been excavated, and an enormous quantity of machinery and other plant had been purchased and transported to the isthmus at an estimated cost of 150,000,000 francs. Nearly all of the stock of the Panama Eailroad — 68,534 of the 70,000 shares exist- ing— also had been purchased at a cost of 93,268,186 francs.*~~

~~*The new company has been regularly organized under French law, and has been recognized by the Colombian*~~

~~*Government. It is technically a private cor- second poration, but the great number of persons in- almˆˆ. terested in the securities of the old company, and*~~

~~*the special legislation of the French Chambers, give it a semi-national character. By the law of 8th June 1888, all machinery and tools used in the*~~

~~*work must be of French manufacture, and raw material must be of French origin. Its capital stock consists of 650,000 shares of 100 francs each, of which 50,000 shares belong to Colombia. It succeeded to all the rights of the old company in the concessions, works, lands, buildings, plant, maps, drawings, &c., and shares of the Panama Eailroad upon the following conditions, viz. : — It undertook to finish the canal if, after further careful study, that were found expedient; after completion the revenues were to be applied, first to the payment of all subsidies due to the Colombian Government, all expenses of operation and maintenance, all interest and sinking fund on loans, and all sums required by law for a reserve fund ; then five per cent, on the capital stock was to be set aside for the payment of dividends, and to provide a sinking fund for redeeming the stock, all of which must be redeemed within ninety-nine years ; and the balance remaining, if any, was to be divided into two parts, one of forty per cent, to go to the stockholders, and the remaining sixty per cent, to the liquidator. For the contingency that the canal should not be completed, special conditions were made as to the*~~

~~*Panama Eailroad shares. These are to revert to the liquidator, but the company has the privilege of purchas- ing them for 20,000,000 francs in cash and half the net annual profits of the road. The Panama Eailroad retains its separate organization as an American corporation. Its relations to the Colombian Govermnent have remained unchanged throughout the vicissitudes of the canal com- pany, its present principal stockholder. The security- holders of the old canal company thus have a contingent interest in the new company. They have no direct voice in its management, but to protect their interests the liquidator has the right to appoint an Auditing Commis- sion of three persons to inspect the works and accounts, the expense to be borne by the company. The old security-holders have the preference in subscriptions for one-half the present stock of the company and for the whole of all future issues.*~~

~~*Immediately after its organization in 1894 the new company took possession of the property (except the Panama Eailroad shares, which are held in trust for its benefit), and proceeded to make a new study of the entire subject of the canal in its engineering and commercial aspects. It resumed the work of excavation, with a moderate number of men sufficient to comply*~~

~~*with the terms of the concession, in a part of the line — the Emperador and Culebra cuts — where such excavation must contribute to the enterprise if completed under any plan. By the middle of 1895 about 2000 men had been collected, and since that time the work has progressed continuously, the number of workmen varying between 1900 and 3600. The amount of material excavated to the end of 1899 was about five million cubic yards. The amount expended to 30th June 1899 was about 35,000,000 francs, besides about 6,500,000 francs ad- vanced to the Panama Eailroad Company for building a pier at La Boca.*~~

~~*The charter provided for the appointment by the com- pany and the liquidator of a special engineering commis- sion of five members, to, report upon the work done and the conclusions to be drawn therefrom, this report to be rendered when the amounts expended by the new company should have reached about one-half its capital. The report was to be made public, and a special meeting of the stockholders was then to be held to determine whether or not the canal should be completed, and to provide ways and means. The time for this report and special meeting arrived in 1898. In the meanwhile the company had called to its aid a Technical Committee composed of fourteen engineers, European and American, some of them among the most eminent in their profession. After a study of all the data available, and of such additional surveys and examinations as it considered should be made, this committee rendered an elaborate report dated 16th November 1898. This report was referred to the above-mentioned statutory commission of five, who reported in 1899 that the canal could be built according to that project Twithin the limits of time and money estimated. The special meeting of stock- holders was called immediately after the regular annual meeting of 30th December 1899. It is understood that the liquidator (who holds about one-fourth the stock) refused to take part in it, and that no conclusions were reached as to the expediency of completing the canal or as to providing ways and means. The engineering ques- tions had been solved to the satisfaction of the company, but the financial questions had been made extremely difficult, if not insoluble, by the appearance of the United States Government in the field as a probable builder of an isthmian canal. The company continued to conduct its operations in a provisional way, without appealing to the public for capital.*~~

~~The plan adopted by the company involves two levels above the sea-level (see Map) — one of them an artificial lake to be created, by a dam at Bohio, to be reached from the Atlantic by a flight of two locks, and the other, the summit-level, to be reached by another flight of two locks from the preceding. The summit-level is to have its surface at high water 102 feet above the sea, and to be supplied with water by a feeder leading from an artificial reservoir to be constructed at Alajuela in the upper Chagres valley ; the ascent on the Pacific side to be likewise by four locks. The canal was to have a depth of 29^ feet and a bottom width of about 98 feet, with an increased width in certain specified parts. Its general plan was the same as that adopted by the old com- pany. The locks were to be double, or twin locks, the chambers to have a serviceable length in the clear of 738 feet, with a width of 82 feet and a depth of 32 feet 10 inches, with lifts vary- ing from 20 to 33 feet, according to situation and stage of water. The time required to build the canal was estimated at ten years, and its cost at 525,000,000 francs for the works, not including administration and financing. The old Panama Canal Company began its work without adequate knowledge of the physical conditions of the isthmus. It inaugurated at an early day some of the surveys and examinations required to supply the deficiency, and some of these it maintained as long as it continued to exist. Additional surveys were made by the liquidator, and very extended surveys and observations have been made by the new company. The information concerning all that relates to the topography, hydrography, and geology of the isthmus, as well as the cost of work, is now much more complete than is usual before the inauguration of an engineering enterprise in a new country, and estimates of cost are proportionately more trustworthy.~~

~~The occupation of the Panama route by Europeans, and the prospect of a canal there under foreign control, was not a pleas- TOfiSmf"" ^^S spectacle to the people of the sc em . United States. The favour with which the Nicaragua route had been considered since 1876 began to assume a partisan character, and the movement to construct a canal on that line to assume a practical shape. In 1884 a Treaty, known as the Frelinghuysen-Zarala Treaty, was negotiated with Nicaragua, by the terms of which the~~

~~United States Government was to buUd the canal without cost to Nicaragua, and after completion it was to be owned and managed jointly by the two Governments. The Treaty was submitted to the United States Senate, and in the vote for, ratification, 29th January 1885, received thirty-two votes in its favour against twenty-three. The neces- sary two-thirds vote not having been obtained, the Treaty was not ratified, and a change of administration occurring soon afterwards, it was withdrawn from further consideration. This failure led to the formation in New York by private citizens in 1886 of the Nicaragua Canal Association, for the purpose of obtaining the necessary concessions, making surveys, laying out the route, and organizing such corporations as should be required to construct the canal. They obtained a concession from Nicaragua in April~~

~~depth of 35 feet and bottom width 150 feet, the locks to be double, the lock chambers to have a length 740 feet, width 83 feet, aad depth 35 feet in the clear. The cost of a canal at Panama with these dimensions, built essentially upon the French plans, was estimated at $156,378,268. A plan, however, was recommended in which the height of the Bohio dam is increased about 20 feet, the level of Lake Bohio raised by that amount, the lake made the summit-level, and the Alajuela dam omitted. The cost upon this plan was estimated at $143,971,127.~~

~~The plan recommended by the Commission for Nicaragua is shown in the map. Beginning at Grey town on the Caribbean Sea, where an artificial harbour is to be con- structed, the line follows the valley of the San Juan for 100 miles to Lake Nicaragua ; thence across the lake about 70 miles to the mouth of Las Lajas Eiver ; then up the valley of that stream through the watershed, and down the valley of the Eio Grande, 17 miles to Brito on the Pacific, where also an artificial harbour is to be con- structed. The distance from ocean to ocean is 187 mUes. About midway between the lake and the Caribbean the San Juan receives its most important affluent, the San Carlos, and undergoes a radical change in character. Above the junction it is a clear water stream, capable of improve- ment by locks and dams. Below, it is choked with sand, and not available for slack- water navigation.~~

~~*A dam across the San Juan above the mouth of the San Carlos is to maintain the water of the river above that point on a level with the lake. The line of the canal occupies essen- tially the bed of the river from the lake to the dam ; from the dam to the Caribbean it follows the left bank of the river, keeping at a safe distance from it, and occasionally cutting through a high projecting ridge. The lake and the river above the dam constitute the summit-level, which will vary in height at different seasons from 104 to 110 feet above mean searlevel. It will be reached from the Caribbean side by five locks, the first having a lift of 36^ feet, and the others a uniform lift of 18^ feet each, making a total lift of 1104- from low tide in the Caribbean to high tide in the lake. From the Pacific side the summit will be reached by four locks having a uniform lift of 28^ feet each, or a total lift of 114 feet from low tide in the Pacific to high tide in the lake. The time required to build the canal is estimated at ten years, and its cost at $200,540,000.*~~

~~*The Commission ended its report thus : —*~~

~~*1887, and one from Costa Eica in August 1888, and sent parties to survey the canal. An Act for the incorpora- tion of an association to be known as the Maritime Canal Company of Nicaragua passed Congress and was ap- proved 20th February 1889, and on 4th May 1889 the company was organized. It took over the concessions and, acting through a construction company, began work upon the canal in June 1889. Operations upon a moder- ate scale and mainly of a preliminary character were continued until 1893, when the financial disturbances of that period drove the construction company into bank- ruptcy and compelled a suspension of the work. It has not since been resumed. At that time the canal had been excavated to a depth of 17 feet and a width of 280 feet for a distance of about 3000 feet inland from Grey- town; the canal line had been cleared of timber for a distance of about twenty miles; a railroad had been constructed for a distance of about 11 miles inland from Greytown ; a pier had been built for the improvement of Greytown harbour; a telegraph line had been placed from Greytown to Castillo; buildings for offices, quar- ters, hospitals, storehouses, &c., had been erected, and wharves and landing-places had been constructed ; and a considerable dredging plant had been purchased. In all, about $4,500,000 had been expended.*~~

~~Congress continued to take an interest in the enter- prise, and in 1895 provided for a Board of Engineers to inquire into the possibility, permanence, and cost of the canal as projected by the Maritime Canal Company. The report of this Board, dated April 1895, severely criticized the plans and estimates of the company, and led to the appointment in 1897 of another Board, to make additional surveys and examinations, and to prepare new plans and estimates. The second Board recom- mended some radical changes in the plans, and especially in the estimates, but its report was not completed when the revival of the Panama scheme attracted the attention of Congress, and led to the creation in 1899 of the present Isthmian 'Canal Commission to examine and report upon all practicable routes for a canal across the isthmus. In the meanwhile the property of the Maritime Canal Company has become nearly worthless through decay, and its concession has been declared forfeited by the Nicaraguan Government.~~

~~The interest of the United States in an isthmian canal was not essentially different from that of other maritime istbmi nations down to about the middle of the 19th Canal Century, but it assumed great strength when Com- California was acquired, and it has steadily~~

~~mtssioa. grown as the importance of the Pacific States has developed. In 1848, and again in 1884, treaties were negotiated with Nicaragua authorizing the United States to build the canal, but in neither case was the treaty ratified. The Spanish War of 1898 gave a tremendous impetus to popular interest in the matter. It seems now to be an article of the national faith that the canal must be built, and, furthermore, that it must be under Ameri- can control. To the American people the canal appears to be not merely a business enterprise from which a direct revenue is to be obtained, but rather a means of unifying and strengthening their national political in- terests, and of developing their industries, particularly in the Pacific States and Territories; in short, a means esseYitial to their national growth. The Isthmian Canal Commission created by Congress in 1899 to examine all practicable routes, and to report which was the most practicable and most feasible for a canal under the con- trol, management, and ownership of the United States, reported that there was no route which did not present greater disadvantages than those of Panama and Nic- aratma. It recommended that the canal should have a~~

~~*1. The estimated cost ol building the Nicaragua Canal is about $58,000,000 more than that of completing the Panama Canal, leaving out the cost of acquiring the latter property. This measures the difference in the magnitude of the obstacles to be overcome in the actual construction of the two canals, and covers all physical considerations, such as the greater or less height of dams, the greater or less depth of cuts, the presence or absence of natural harbours, the presence or absence of a railroad, the exemption from or liability to disease, and the amount of work remaining to be done. The New Panama Canal Company has shown no disposition to sell its property to the United States. Should that company be able and willing to sell, there is reason to believe that the price would not be such as would make the total cost to the United States less than that of the Nicaragua Canal.*~~

~~*2. The Panama Canal, after completion, would be shorter, have fewer locks and less curvature than the Nicaragua Canal. The measure of these advantages is the time required for a vessel to pass through, which is estimated for an average ship at twelve hours for Panama and thirty-three hours for Nicaragua. On the other hand the distance from San Francisco to New York is 377 miles, to New Orleans 679 miles, and to Liverpool 386 miles greater vid, Panama than vid, Nicaragua. The time required to pass over these distances being greater than the difference in the time of transit through the canals, the Nicaragua line, after completion, would be somewhat the more advantageous of the two to the United States, notwithstanding the greater cost of maintaining the longer canal.*~~

~~*3. The Government of Colombia, in which lies the Panama Canal, has granted an exclusive concession, which still has many*~~

~~*years to run. It is not free to grant the necessary rights to the united htates, except upon condition that an agreement be reached with the New Panama Canal Company. The Commission believes that such agreement is impracticable. So far as can be ascertained, the company is not willing to sell its franchise, but will allow the United States to become the owner of part of its stock. The Com- mission considers such an arrangement*~~

~~*inadmissible. The Govern- ments of Nicaragua and Costa Rica, on the other hand, are untrammelled by concessions, and are free to grant to the United States such privileges as may be mutually agreed upon.*~~

~~*In view of all the facts, and particularly in view of all the diffi- culties of obtaining the necessary rights, privileges, and franchises on the Panama route, and assuming that Nicaragua and Costa Rioa recognize the value of the canal to themselves, and are pre- pared to grant concessions on terms which are reasonable and acceptable to the United States, the Commission is of the opinion that "the most practicable and feasible route for" an isthmian canal, to be "under the control, management, and ownership of the United States," is that known as the Nicaragua route.*~~

~~*Other American Canals. — The most important ship canal now in operation in America is the short canal which flanks the rapids in the Sault Ste Marie River, connecting Lake Superior with Lake Huron. The clear dimensions of the principal lock are: length 800 feet, width 100 feet, and depth over mitre sill 21 feet, with a lift of 20 feet. The canal is owned and operated by the United States G-overnment free of tolls. It is closed to navigation by ice four or five months of each year. Its trade during the navigation season of 1899, a period of 231 days, comprised 25,255,810 tons of freight, valued at $281,364,750, or more than double the trafifte of the Suez Canal.*~~

~~*A scheme has been projected for providing a deep waterway from Lake Superior to the Atlantic Ocean, for which surveys and estimates have been made by a Board of Engineers under the direction of Congress. Under this project the channel ways now connecting Lake Huron with Lake Superior, Lake Michigan and Lake Erie, are to be enlarged, and ship canals are to be constructed from Lake Erie to Lake Ontario, and from Lake Ontario to the Hudson River. The former canal leaves th& Niagara River at La Salle above the Magara Palls, and joins it again at Lewiston below the Falls, its length being 9 miles. For 6 miles the entire excavation is through solid rock. At Lewis- ton the canal ends with a descent of nearly 320 feet by means of eight double locks, of which six have a lift of 40 feet each, and two of 39-4 feet each. The canal from Lake Ontario to the Hudson River leaves the lake at Oswego, passes up the Oswego River to Lake Oneida, uses that lake as a summit-level, cuts through the water- shed at Rome, descends the valley of*~~

the Mohawk River to Schenectady, and then cuts across country to the Hudson River at Normans Kill near Albany. The length of canal to be constructed is 102 miles, and of river to be canalized 96 miles. The lock chambers are to be 694 feet long and 80 feet wide in the clear. The bottom width of the canal is to be 250 feet. Estimates were made for a depth of 21 feet and also for 30 feet. The former was $206,358,103, and the latter $317,284,348.

(O. H. E.)

Canadian- Waterways.

Canada has the finest system of inland navigations in the world, notwithstanding their liability to being closed by ice in the winter. Previous to confederation the canals were owned by the provincial governments, but after the union of the provinces in 1867 they became the property of the Dominion Government. In 1870 a Commission was appointed to report on a " thorough and comprehen- sive improvement of the canal system," and after a care- ful inquiry they reported in favour of large locks and deeper water over the whole of the St Lawrence route,

the Welland Canal, and the Sault Ste Marie Canal. These canals, 70|- miles in length, now form links uniting the great lakes, giving an unbroken water communication from Duluth on Lake Superior, 2260 miles in the inte- rior, Chicago on Lake Michigan, and Detroit, Buffalo, and Toronto on Lakes Huron, Erie, and Ontario, bringing the great wheat-growing districts which border upon the lakes into connexion with the seaboard. The distance from Montreal to Liverpool is 316 miles less than that from New York to the same port. The locks on the improved St Lawrence and Welland Canals are 270 feet long and 45 feet wide, whereas the locks on the Erie Canal, the waterway from the lakes to New York, are much smaller, and have only a depth of water of from 7 to 9 feet, in place of 14 feet on the canals leading to Montreal. Steamers of moderate size are now able to bring cargo direct from Chicago to Europe viA Montreal ; unless the proposed enlargement of the Erie Canal is carried out, a considerable proportion of the grain trade will be diverted from the route to New York to Montreal. The construction of another waterway from Georgian Bay by way of the Ottawa River to Ottawa City, and thence to Montreal, has been sanctioned by the

~~*Legislative Council at Ottawa. The St Clair and Lake Erie Canal, in course of construction across the Canadian peninsula between the two lakes, will be 13 miles in length, with a dredged channel in Lake St Clair 19 miles long. This will give a total length of 32 miles, as against 111 miles through the Detroit River.*~~

~~*The lake traffic is very large. In 1890 the tonnage registered at American ports passing through the Detroit River both ways was 21,684,000 tons, and in 1899 it was 30,000,000 tons. Montreal is well equipped for ocean traffic, the depth of water to Quebec being 27^ feet, while the harbour and the channel are being improved to 30 feet, with new docks at the east end of the harbour; large grain elevators and warehouses are also provided. With the view of enabling large steamers to partake of the lake traffic, the Sault Ste Marie Canal has been provided with locks 900 feet long, 60 feet wide, a4d 20^ feet depth of water, and the American St Mary's Falls Canal has now locks 800 feet long, 100 feet wide, and 21 feet depth of water, enabling large steamers or a number of smaller craft to pass at one lockage.*~~

~~*The navigation of the river St Lawrence has been made easy by the construction of lateral canals with locks, to avoid rocky rapids. The principal ones are the Lachine Canal, 8|^ miles with 5 locks, cut through a wide bend in the river near Montreal; the Beauharnois Canal, 11|^ miles long with nine locks, connecting the Lakes St Louis and St Francis; and four other canals, with a total length of 23| miles with 12 locks.*~~

~~*The Welland Canal connects the waters of the Lakes Erie and Ontario across the Niagara peninsula. It was commenced in 1824 and completed in 1833. In 1842 the Canadian Government bought the canal and at once began improvements. The canal is 27^ miles long, with a total rise of 326f feet and 26 locks. In 1870 important works were put in hand to enlarge the canal throughout; from Port Dalhousie on Lake Ontario a new channel was cut, 11| miles long, to Allanburgh, and from thence to Port Colborne the old canal was enlarged.*~~

~~*The improvement of the waterways of Canada has pro- moted efficiency and reduced the cost of transit. While railways remain at their original gauge they find they can compete better with the American and Canadian canals by increasing the size of their freight cars, which are now being built to*~~

~~carry 30 to 40 tons, against 8 to 10 tons (the ordinary standard size). Shipowners find that the cost of transport is diminished by an increase in the size of their steamers, and the returns of the Board of Trade~~

~~In 1730 the river was placed in the hands of Commis- sioners, with power to levy tolls and construct new locks and weirs ; it is now a good barge navigation, notwith- standing the abstraction of a large proportion of the summer flow by the London Water Companies. As it does not pass through any mineral or manufacturing dis- trict of importance, the trade on the upper river is not large. Below Richmond, sluices and a lock have been erected across the river to maintain deeper water in the reaches above; they are of the same type as those de- scribed in use on the Manchester Ship Canal, except that when raised they take a horizontal position instead of a vertical one. In 1783 an Act was passed authorizing the construction of a 'canal 40 miles long to unite the Thames and Severn, beginning at Lechlade in Oxford- shire and terminating at Frampton-on-Severn, Gloucester- shire. The canal was worked successfully for many years, but had been allowed to fall into a state of dis- repair. In 1895 a public trust was formed for the purpose of restoration, and the works have been ex- tensive, including powerful steam-pumps for providing a better supply of water to the summit-level, which is 353 feet above the sea, about midway between Stroud and Cirencester.~~

~~The river Severn is navigable from Shrewsbury to Gloucester. Acts relating to it were passed from 1503 to 1811, mainly to meet the cost of maintenance and other charges on the towiag-paths, and it was not until the year 1842 that a body of Commissioners, representing the various interests on the river, were appointed to raise money on the security of the tolls and eve™. improve the navigation. Locks and weirs, were constructed between Stourport and Worcester, a distance of 12 miles, and thence to Gloucester (28 miles); dredging and embank- ments only were employed, because a permanent raising of the level of the river so as to give a navigable depth of 6 feet was objected to by the landowners, as floods often occurred in winter, sometimes rising 18 feet above summer level. It was held by the promoters' engineers that by the proposed plans, which showed long weirs placed~~

~~*obliquely to the current in widened portions of the river, with locks in cuts, the floods would be carried off as rapidly as before, owing to the enlarged width at the weirs and the increased velocity of the floods, which would first pass over a deep channel and an almost vertical weir, instead of a shallow bed with shoals. Eminent engineers gave evidence against this view when the Bill was before the Parliamentary Committee, and it was decided that no locks or weirs were to be built below Worcester. From Worcester to Gloucester the shoals were dredged out, a million tons of marl and gravel being removed, with the result that although only a narrow channel had been cut through the shoals, the removal of those natural weirs caused the summer water-level at Diglis locks, near Worcester, to fall 3 feet. After protracted struggles in Parliament, an Act was obtained in, 1853 to construct a lock and weir at Tewkesbury, about half-way between Worcester and Gloucester, and in 1869 further powers were got to construct locks and weirs near Gloucester. These powers were obtained largely by the evidence of landowners above Worcester, who proved that instead of the erection of the weirs damaging the land, as was ex- pected, floods, on the contrary, did not occur so frequently, and passed off the land more rapidly. The canalization of the river was then completed, and there is now a minimum depth of 10 feet of water at all seasons from Gloucester to Worcester, enabling vessels of 300 to 400 tons to reach the latter city. The Severn navigation is an important link in the chain of navigation between the ports of the Bristol Channel and the Midland districts. It connects the Gloucester and Berkeley Ship Canal at Gloucester with*~~

~~*show how rapidly the increase has been growing. This applies equally to the cost of transit on inland waterways, and it is only by following the example set by other countries in improving their canals that manufacturers and traders will gain the benefit of low rates of carriage.*~~

~~*(e. l. w.)*~~

~~*Inland Navigation.*~~

~~*Lord Bacon wrote : " There be three things which make a nation great and prosperous, a fertile soil, busy work- shops, and easy conveyance for men and commodities from one place to another." Inland navigation certainly pro- vides the most easy and the cheapest mode of conveyance for minerals*~~

~~*and goods, and the last quarter of the 19th century saw great improvements in canals and navigable rivers, more particularly in France, Belgium, Germany, and Canada. But, generally speaking, England has been indifferent to this important question, and the railway companies have been allowed to purchase the canals, with the result that they now possess 1139 miles out of a total length of 3907 miles of navigations in that country. Some of these railway-owned canals are links in main lines of communications, and independent canals in the route are therefore blocked from carrying out improve- ments that would assist through trafB.c, by deepening their waterways and enlarging the locks so as to admit of in-crease in the size of boats, a work which on the continent of Europe has been found efELcient in reducing the cost of carriage. The maintenance of the railway-owned naviga- tions is often much neglected, and generally they are useless for the purpose of active competition. The Board of Trade returns of canals and navigations for the year 1898 show that while the traffic on the independent canals had increased five million tons in Great Britain since 1888, the traffic on the railway-owned canals had decreased two million tons in the same period. There may be agricul- tural districts where the traffic would not justify the cost of bringing the early canals up to the standard of the improved navigations of the present day, but main lines of canals from large manufacturing or mineral districts, capable of taking large barges in trains towed by steam- power, would greatly benefit traders, who now undergo severe competition from other countries that have im-proved their waterways as being the most economical means of giving cheap carriage of minerals and goods. Mr Samuel Lloyd has proposed taking Birmingham, with its large manufacturing and coal and iron industries, as a centre, and joining it with the rivers Severn, Thames, Mersey, and Humber, by improved canals which, passing through other important districts, would convey exports and imports to and from the principal ports on the English coast and serve local trade.*~~

~~*Canalized Rivers. — Before canals were introduced in Great Britain, locks and weirs were constructed in rivers to improve the navigation, and the increased depth thus obtained, together with the water-power gained at the weirs for mills, was of great advantage. Previously, in dry weather, it was difficult to navigate the rivers, even with diminished cargoes, while the long*~~

deep pounds be- tween the locks on the improved navigation provide ample water for lockage-power and form natural reservoirs for dry seasons.

The first Act for the improvement of a river was for the

Thames in the year 1423, and since that date nearly forty

Acts relating to it have been passed. The

*””**■ earliest locks and weirs appear to have been made by the owners of adjoining lands, more with a view to obtain mill-power than to improve the navigation, and heavy charges were levied by the landowners for the use of the locks, which were of the rude type termed flash-locks.*

the narrow Worcester and Birmingham Canal, -which is now the property of the Gloucester and Berkeley Canal, the Midland Railway Company having failed to get powers to pTircha,se it. At present the large Severn barges have to tranship their cargoes into small canal boats at Worcester, and the question of increasing the size of the canal to Birmingham is under consideration.

*The Aire and Calder Navigation was authorized by an Act passed in 1698 ; other Acts of later date gave addi- tional powers for enlarging the navigation, and elide” * ‘^ ‘O” o^^ o^ t^6 l^^st English waterways, giving communication between Lancashire and Yorkshire and the ports of Goole and Hull. Its original capital was £150,000, but the amount expended to the year 1898 was £2,761,807. Its total length is 85 miles, part river and part canal, with 31 locks. Commencing at Goole, it terminates at Leeds with a junction with the Leeds and Liverpool Canal, thus forming a continuous navigation from the east to the west coasts. At Castle- ford it has a branch to Wakefield, where it joins the Barnsley Canal. Originally the navigation was only 3 feet 6 inches deep, but since 1860 great improvements have been carried out, the locks being made 215 feet long, 22 feet wide, with 9 feet of water on the sills. All overhead bridges have been enlarged to the width of*

the locks ; vessels carrying cargoes of 170 tons can now use the navigation, and three 50-ton barges can pass the locks together. Merchandise is generally carried in barges towed in trains by steamers, which also carry goods, but the large coal traffic is conveyed in trains of boat compartments, either towed or pushed by steamers, on a system designed by Mr W. H. Bartholo- mew. The boats, except the leading one, which has an ordinary bow, are nearly square in shape; they are coupled together by knuckle joints fitted into hollow stern-posts, and they can thus move laterally or verti- cally ; a wire rope in tension on each side of the boat enables the train to be steered. No boat crews are re- quired, the crew of the steamer regulating the train. If the boats do not exceed eleven in number, they can be pushed, but beyond that number they are towed. Each compartment carries 35 tons, and the total weight in a train varies from 700 to 900 tons. On the arrival of a train at Goole the boats are detached, and are each taken over submerged cradles under powerful hydraulic hoists, which lift boat and cradle sufficiently high to enable it to be turned ovel, and discharge the whole cargo at once into a shoot, and thence into sea- going steamers. Goole has become an important port owing to the improvements of the Aire and Calder Navi- gation Company, who have constructed docks of 24 acres in extent to give accommodation to foreign and coasting steamers.

The Eiver Weaver Navigation is about 20 miles ia length. This river rises in the south-west corner of Cheshire, passing through the salt districts of Weaver. -^ingfoj.^ and Northwich, and joins the Mersey at Frodsham. It is made navigable between those places under the powers of an Act of 1721, which ordered that any profits were to be employed iu repairing public bridges, and meeting other public charges in the county of Chester ; considerable sums have been paid accordingly. Subsequent Acts enabled a canal to be made, 4 miles in length, to avoid the lower tidal portion of the river, and to obtain a better entrance on the Mersey at. Weston Point, where docks have b^en constructed. Other cuts were made to shorten the course of the river, and the depth was increased to 7 feet, enabling craft of 100 tons to use the navigation, their cargoes being principally salt for shipment at Liverpool. An Act was obtained in 1866 authorizing further improvements, which have since been |

~~*completed, with the result that it is the best navigation in England for small coasters and large barges. The locks are in pairs, the largest being 220 feet long by 42 feet wide, with 15 feet depth on the sills ; at present the river dredging has not gone beyond 10 feet 6 inches in depth. Canalized rivers have the advantage of a good supply of water, even for large locks, and on the river Weaver there are also large natural reservoirs, formed by the subsidence of the ground owing to salt workings and brine-pumping. The locks have intermediate gates, so as to shorten them when only single vessels have to pass ; otherwise the locks can take a steamer, carrying cargo and towing barges, with total cargoes amounting to 600 to 800 tons. The lock gates are worked by tur- bines, thus utilizing the fall at the locks and the ample supply of water. The effect of the new works has been to secure the whole of the large export salt traffic to Liverpool and other ports, the railways not being able to compete with the low cost of carriage on such an improved waterway.*~~

~~*France. — M. Freycuiet, when Minister of Public Works, stated, in a report on the rivers and canals of Prance : " Navigable waterways play an important part in the pro- duction of the wealth of a country. It has been found that navigable waterways and railways are not destined to supplant but to support one another. Each has its particular attributes. Railways take the least cumbrous traffic — that which requires speed and regularity and bears most easily the cost of carriage. Waterways take heavy goods of low value, and their mere existence checks and moderates the rates on goods which are sent by railway." The principle thus laid down has been fully accepted in Prance, where the waterways, 7459 miles in length, are the property of the State, only 158 miles remaining in other hands. The navigations are divided into two classes, main and secondary, the main ones having a minimum depth of 6^ feet, with locks 126 feet long and 17 feet wide ; the second class are of smaller dimensions.*~~

~~*The improvements in the river Seine have made it a most important waterway. Not to mention the embank- ments and training walls, which with dredging have had such important results in enabling large steamers to reach Rouen, the upper portion of the river from that place to Paris affords a good example of a modern canalized river, although it is so winding that its length of 150 miles be- tween Rouen and Paris is more than double the*~~

distance between those cities measured in a straight line. On this portion of the Seine locks and weirs had been constructed between 1838 and 1866, but they only gave a navigable depth of 5 feet. In 1878 new works were authorized to secure a depth of 10^ feet, and so enable vessels of 800 to 1000 tons to reach Paris. These works have been com- pleted, dividing the river into nine reaches by locks and weirs of large size, the level of the highest pound being about 85 feet above high water of the lowest tides which reach the first lock above Rouen. Although the railway competition is severe, the lower cost of water carriage secures a traffic of over four mUlion tons a year. The navigation is toll-free, and the improvements have cost the State £2,500,000. At Rouen thecargoes of shipping for Paris and the interior are discharged into lighters, carry- ing from 300 to 900 tons each, which are towed by steam tugs ; the locks are able to take trains of barges which pass up the first-class navigations beyond Paris. Steamers trade between London and Paris, but their size is restricted by several low bridges which have yet to be altered.

The river Sa6ne has been canalized for a length of 231 miles as a first-class waterway, with a depth of Q\ feet. The most important canals in Prance have been enlarged to a similar depth, the locks being 126 feet long and 17 feet wide, and barges capable of carrying 300 tons now traverse

the main navigations. The first-class waterways in 1878 were 765 miles in length; in 1897, 2795 miles were first-class, including 401 miles of new canals. The saving in cost of carriage on first-class waterways is due to the fact that a barge of 200 to 300 tons is worked at almost the same expense of crews and haul- age as one only able to carry half that cargo. This has led to the great improvements in -the waterways of the Contiaent.

Belgium. — The total length of waterways in Belgium is 1242 miles, 341 being canalized rivers, 301 open rivers, 457 miles of canals for barges of 200 tons and upwards, and 143 miles of smaller canals. The State owns

~~*about 85 per cent, of the whole. All improvements are carried out to standard dimensions, the locks being 134 feet long and 17 feet wide, with a canal depth of 8 feet. Since the improvement of the waterways the traffic on them has largely increased, notwithstanding the complete system of railways which are pro tanto relieved of the heavy and slow traffic.*~~

~~*Germany. — Inland navigation has been fostered and improved by the State, and between the years 1880 and 1893 £17,875,350 was expended for the creation of new or the improvement of existing waterways. In 1895 their length was 6214 miles. It has been proposed to construct a Midland canal to connect the Dortmund-Ems Canal with the Rhine on one hand and the Weser and the Elbe on the other; ^this development is supported by the industrial interests, but is opposed by the Agrarians, who fear that new waterways will promote the increased import of foreign grain. The result of improvements has been to make nearly all the waterways available for steamers or steam-towing. On the Rhine the size of vessels has increased from 800 to 1300 tons and upwards, while on the Elbe and the Weser it is possible to carry nearly twice as much cargo as formerly. On the Oder the barges to and through Berlin could only carry 150 to 200 tons, while vessels of 500 to 600 tons now go direct from Breslau to Hamburg. The State levies tolls on the canals and canalized rivers amounting to about one-third of the cost of maintenance, but the tolls have not prevented a large increase in the amount of traffic.*~~

~~*Steam Haulage. — On the Bridgewater Canal, which has a large traffic between Liverpool and Manchester, steam tugs have been introduced, with the result that the traffic is conducted with greater regularity and despatch, and with, as compared with horse traction, a saving of forty per cent, in cost.. Experiments were first tried by hauling on a submerged wire rope which passed round a drum worked by steam-power on a tug ; this system has suc- ceeded on some wide navigations, but it failed on the Bridgewater Canal, ovsdng to its interference with other*~~

~~*1 The canal is intended to run via Minden, Hanover, Gifhorn, and Wolmirstedt, to Heinrichsberg on the Elbe, opposite one of the extremities of the Plaue Canal, which goes on to give connexion with the Havel and the Spree, and through these rivers and their connecting canals with the Oder*~~

~~and the Vistula, so that by this means a con- nected inland waterway, stretching east and west, will be made between the Rhine and the Vistula. The length of the Midland Canal section is estimated at 202 mUes, its width at bottom at 59 feet and at the surface at 108i feet, the depth at 8J feet, the width of the sluice gates at 28J feet, and the length of the locks at 220 feet. The highest point (185i feet) which the canal (as projected) would traverse lies only 223 feet above the terminus at Bevergern and 57| feet above the Elbe terminus near Wolmirstedt. From the main canal it is pro- posed to construct branch canals to the towns of Osnabriick, Hil- desheim. Peine, Brunswick, and Magdeburg, making an additional (total) length of 69 miles. The estimated cost of the main canal amounts to £6,250,000, of the branch canals to £2,150,000, or alto- gether a total of £8,400,000. A canal 13 miles long, starting from the Weser near Einteln, will be chiefly relied upon to furnish the water supply of the new canal. Closely connected with this Midland Canal, and really a continuation of it, is the Rhiue-Weser-Elbe Canal, the Dortmund-Ems Canal forming the intermediate link be- tween the two.~~

~~traffic and the difficulty of keeping the wire rope in the centre of the canal round sharp curves. Steam tugs were then tried with complete success, although the depth of water in the canal does not allow of larger screws than 3 feet 4 inches in diameter. Twenty tugs are now employed, each 61 feet long, 7 feet 6 inches beam, and 4 feet draft ; each can tow four barges at the rate of nearly 3 miles an hour, the barges carrying cargoes of 40 to 60 tons each. The canal has the advantage of being without locks between Runcorn and Manchester, a distance of thirty miles.~~

~~Electric Haulage. — Electric haulage has been success- fully used in Erance upon part of the Bourgogne Canal, including a tunnel over 2 miles long. It is also em- ployed on the Charleroi Canal in Belgium, which connects the coal district with Brussels. The canal is a narrow one, and barges towed by horse-power seldom reached a speed of 1\ miles an hour. The use of electric power has given a speed of 6 to 7 miles an hour at the same cost per mile. There are two generating stations, one 15 miles south of Brussels and the other at Roux, 6 miles north of Charleroi. The electric current is taken from overhead wires, and it also serves for lighting purposes and for working machinery at manufactories on the route of the~~

~~*canal, thus reducing the cost of towing by the profit made by adapting the current to secondary uses. The working of the locks is also facilitated by the use of electricity. It is very probable that electric traction will be largely used in the future for haulage on canals; it would also be useful for working wharf cranes or canal lifts.*~~

~~*Lifts. — Where the levels of the ground for a canal are such as to require several locks near each other, lifts or inclines have been adopted instead of locks, to save time in passing traffic, and also to economize water, which in dry seasons has on some canals to be pumped back again by steam-power from the lower to the upper level. The most improved type of lift is that at Anderton on the Weaver Navigation ; it was constructed to unite the Trent and Mersey Canal with the river, where the navigations are in close proximity but with a difference in level of 50 feet, the canal having no spare water for locks. The lift is a double one working vertically, barges up to 100 tons being transferred from the canal at the high level to the river in ten to fifteen minutes ; the change is made while the barge is floating in an iron trough full of water with gates at each end. The descending trough has more weight, owing to 6 inches of water being removed from the lower trough by self-acting siphons ; this gives power to the descending trough to raise the lower one, a hydraulic accumulator being used to overcome the loss of weight in the descending trough when it is immersed in the river at the lower level. The troughs are supported and worked by two cast-iron rams, 3 feet in diameter, placed under the centre of the trough, with cast-iron presses connected with a 5-inch pipe, the weight of trough and water being 240 tons. The lift was com- pleted in 1875, and has continued to work well even in hard frosts.*~~

~~*Similar lifts have since been erected on the Continent. The one at Eontinettes on the Neuffosse Canal in Erance is capable of lifting vessels of 300 tons burden. Another lift at La Louvi§re on the Canal du Centre in Belgium is able to lift vessels of 400 tons, the total weight lifted being 1037 tons. Three other lifts of the same character are being constructed on this canal.*~~

~~*The two largest lifts yet "constructed are those on the Trent Canal at Peterborough in Canada; the vertical traverse is 65 feet, and the tanks are*~~

~~139 feet long by 33 feet wide, with 8 feet depth over the sills. They are double, like those at Anderton already described, being worked in~~

~~natigation]~~

~~a similar manner on hollow cast-iron rams 74 feet in diameter, working in liydi-aulic cylinders built up of rings of steel castings 3^ inches thick, bolted together by external flanges. Pumps driven by turbines, operated by water taken from the upper reaches of the canal, work an accximulator which supplies the hydraulic plant used to move the gates closing the tanks and branches of the canal leading to them, and also capstans for handling the barges in or out of the tanks.~~

~~Canal inclines were early adopted on canals where loss of water in lockage was of importance. The Monkland Canal incline near Glasgow has a rise of 96 feet on a gradient of 1 in 10, and takes the place of eight locks which were insufficiently supplied with water in dry seasons. A carriage with twenty wheels runs on each line of a double way of 7 feet gauge, carrying a water- tight wrought-iron caisson 70 feet long, 13 feet wide, and 2| feet deep in a horizontal position on the incline by elevating the lower end of the carriage. The caissons are filled with water and balance each other ; they act like movable locks with gates, one ascending as the other descends, moved by engine-power working two vertical drums, round which is coiled the wire rope that hauls the ascending load, which is nearly counterbalanced by the descending boat. In order to prevent the boat from moving in the caisson, it does not float freely when on the incline, but rests on the bottom of the caisson, par- tially supported by water. The time taken for the whole operation is ten minutes, the saving in time being about half an hour for each barge.~~

~~The Grand Junction Canal Company have constructed an incline at Foxton on the Union Canal to take barges of 70 tons, or two canal boats of 33 tons, in place of ten locks, which were necessary to overcome a rise of 76 feet. It is in some respects like the Monkland Canal incline, but the movable~~

~~*caissons work on four pairs of rails on an incline of 1 in 14 broadside on, in consequence of the steeper grade, the boats being water-borne during the whole time. Steam-power is employed with an accumu- lator, which enables hydraulic power to be used in keep- ing the caisson in position at the top of the incline whUe boats are being moved in or out, a water-tight joint being kept against the fixed portion of the canal during the operation. The gates in the caissons and canal are also worked by hydraulic power. The incliae is capable of passing 200 canal boats in twelve hours, and the whole plant is worked by three men.*~~

~~*Beferbnces. — Vbknon Haecourt. Sivers and Canals. 2nd ed., 1896. — Priestley. Navigable Hivers and Canals. 1831. — Engineering. Vols. Iv.-lxviii.— Telford. Memoirs. 1838. — Proceedings of the Institution of Civil Engineers. — Reports of the Navigation International Congresses, 1885 to 1898. (b. l. W.)*~~

~~*Canandaigua, a village of New York, U.S.A., and capital of Ontario county, situated in the western part of the state, at an altitude of 735 feet. It has two railways, the New York Central and Hudson Eiver and the North- ern Central, and owing to its situation at the outlet of the beautiful Canandaigua lake, has become a summer resort. Population (1880), 6726; (1890), 6868; (1900), 6151 (834 foreign-born, and 110 negroes).*~~

~~*Canary Islands or Canarias, a Spanish archi- pelago in the Atlantic, about 60 miles W. of the African coast, consisting of 7 large islands and 6 smaller, the latter uninhabited. The total area of the archipelago is 2944 square miles. The population in 1877 was 283,532, in 1897, 334,621. The archipelago forms one Spanish province, of which the capital is Santa Cruz de Tenerife, the residence of the civil governor, who has under his command one of the two districts into which the archi- pelago is divided, this first district comprising Tenerife,*~~

~~*La Palma, Gomera, and Hierro. The other district in- cludes Gran Canaria, Lanzarote, Puerteventura, and has at its head a sub-governor, residing in Las Palmas, on Gran Canaria, who is independent of the governor except in regard to elections and municipal administration. The province is divided into 7 administrative districts and 90 parishes. The chief Pinance Office is at Santa Cruz de Tenerife. The Court of Appeal, created in 1626, is in Las Palmas, which is also the residence of the Bishop of Canarias. The captain-general and second commandant of the archipelago reside in Santa Cruz de Tenerife, and there is a brigadier-governor of Gran Canaria residing in Las Palmas, with 8 inferior military commandants in other isles and forts. The province furnishes no men for the Spanish peninsular army, but its annual conscrip- tion provides men for the local territorial militia of Canarias, composed of regiments of infantry, cazadores or rifles, squadrons of mounted rifles, and companies of garrison artillery — about 5000 men all told. The archi- pelago is divided into 2 naval districts, commanded by royal navy captains. The principal means of communi- cation is by sea. Some shipbuilding is carried on, mostly in Las Palmas. The sugar manufactures are yearly increasing, above all in Gran Canaria. Pishing is the principal industry, employing nearly 10,000 hands, on 2200 boats averaging below 100 tons. This fishing fleet operates over 600 miles near the north-western African coast. In 1898 wheat was grown on 138,295 acres, oats, barley, maize, rye on 130,277 acres, pod fruit on 3435 acres, and vines on 7837 acres. Though the soil is fertile, agriculture is not on the whole in a prosperous condition. The islands are not very rich in live stock, as the official statistics for 1898 only showed 2492 horses, 2380 mules, 4111 asses, 10,900 cattle, 1455 pigs, and 29,467 sheep. There were also 44,895 goats, most of which live in an almost wild state in the hilly parts of the islands. Game is abundant in some districts, especially rabbits, hares, some wild duck, and small deer. Reptiles are quite unknown, though lizards are very numerous. England is at the head of the import trade in coal, cotton textiles, and woollen goods, blankets, hardware, iron, timber, soaps, candles, and colonial products. Prance introduces sul- phur, shoe leather, and articles de Paris; Germany, earth- enware, hardware, spirits, paper, and cotton goods; Belgium, cement, starch, and glass. The principal exports are tomatoes, of which £67,350 were shipped in 1898 ; and bananas,*~~

~~£10,600. In all, imports were valued at £280,942 in 1897, and £46,651 in 1898; exports at £150,577 in 1897, and £204,796 in 1898.~~

~~Cancer. — Cancer has been the subject of much exact investigation, and of a still larger amount of theory and assumption. It is important to distinguish between them. The following points deserve notice : (1) prevar lence, (2) causation, (3) distribution, (4) treatment.~~

~~The question of most general interest is the alleged increase of the disease. The belief that cancer has increased, and is increasing rapidly, rests upon two pieces of evidence — the impression formed Prevalence. by surgeons from their own experience, and the Eegistrar-General's mortality returns. The first is obvi- ously mere opinion, the value of which depends on the number of individuals holding it and the extent of their experience. If it were the universal or the general experience of the medical profession that cancer is more frequently met with than formerly, the testimony would carry great weight, but there is no evidence of any such experience. The fact that a limited number of practi- tioners have of late years met with an increased number of cases, 'or that more cancer patients have found their way into certain hospitals, is of little value. It may be~~

~~due to accident or to extended practice. Impressions derived from such, data have often proved to be fallacious, and no weight should be attached to them in themselves. The Eegistrar-General's returns stand on a different footing, and merit very careful attention. On the face of them, the statistics show an enormous increase, and similar records in other countries tell the same tale. " In England and Wales," says Dr Eoswell Park, Professor of Surgery in the University of Buffalo, " the cancer death- rate has risen from 1 out of 5646 of population in 1840, to 1 out of every 1306 of population in 1896; that is, in fifty years the proportion has increased nearly five times. All over this country the increase is quite as alarming." In England and Wales the mean annual death-rates per million living for the ten years 1861-70 were — males, 242 ; females, 619 ; in 1891-97 they were— males, 671 ; females, 882, showing an increase of 136 per cent, and 70 per cent,~~

~~respectively; and in 1899 they had further risen to — males, 672 ; females, 977. Again, the registered mortality for both sexes in the five years 1891-95 was 712 per million; in 1896 it had risen to 764 per million, and in 1899 to 829. At first sight this great and progressive increase looks conclusive, but there are sound reasons for doubting if it represents a real increase in the prevalence of cancer. In any case the Registrar-General's figures must be largely discounted. In the first place, it has been pointed out that since cancer is a "disease of degeneracy, the frequency of which increases as age advances" (Paget), a rise of mor- tality from this cause would naturally follow on the greater longevity which has been attained in recent years, and the survival of more persons to cancer age. In particular, Dr J. F. Payne has pointed to "the greatly diminished mortality from phthisis and from in- fectious disease. Since both these causes of death act much earlier in life than cancer, in proportion as they carry ofP a small number of persons at earlier ages, a larger number will survive so as to be the victims of cancer at a later period of life." That, no doubt, is so, but Dr Newsholme has shown, by a careful comparison of the figures, that survival can only account for a small proportion of the cancer increase. The same statistician points out a far more important source of error, which applies also to other causes of death that show an ap- parent increase. The Registrar-General's returns are based on the death certificates signed by medical men, and only represent the certified, not the actual, causes of death. They are imperfect, inexact, and liable to a con- siderable amount of error. In the past the imperfection and margin of error was much larger than in later years. With improved knowledge and greater care the returns tend to become more accurate, and the large number of deaths certified from indefinite causes constantly dimin- ishes. For instance, the number of deaths so certified in 1866-68 was 143,472, and in 1894-96 only 68,650. This diminution represents an addition of 74,822 deaths ascribed to various causes, and it is quite certain that a large proportion of such additional certifications go to the credit of cancer. In 1889, as the result of special inquiries ' made by the Registrar-General, 421 deaths were trans- ferred to cancer, and in 1896 the transfers rose to 597, and in 1899 to 760. This factor makes the comparison between earlier and later periods quite untrustworthy. The influence of improved diagnosis in swelling the can- cer returns is clearly shown by the fact that the apparent increase is far greater among males than among females, for which no reason can be assigned except that cancer in men is~~

more often internal and difficult of diagnosis, and was therefore less frequently diagnosed in former years. This view is further confirmed by the carefully classified records kept for twenty-seven years at Frankfort-

on-Main. During that period cancer of "accessible" parts remained stationary, that of "inaccessible" parts showed a large increase. The difference can only be explained by improved diagnosis. Whether this is suffi- cient to account for the whole of the apparent increase, it is impossible to say at present. As the retiarns improve in accuracy the factor will drop out, and if it is respon- sible for the whole of the increase, that will tend to cease pari passu. This does in fact seem to be happening, at least in Great Britain, for the rate of increase is less year by year. In other coimtries the mortality returns are certainly neither more complete nor more accurate, and it is highly probable that the same calculation applies equally to them. On the whole, it must be held that though there has probably been some increase, it has not been satisfactorily proved and is certainly less than is supposed.

The rise of the parasitic theory of infectious disease has given a great impetus to the study of cancer from the point of view of causation. It has been shown that there are in cancers certain microscopic """ '"'■ bodies peculiar to cancer, and possibly of a parasitic nature. In some cancers they are present in enormous numbers. They have been isolated and cultivated outside the body. The cultures, when introduced into certain animals, have caused death with the production of tumours resembling cancer, from which again cultures have been made producing similar growths on inoculation. The existence of these bodies may be taken to be proved, but their nature and significance remain still undetermined. It may be that their presence is the exciting cause of that abnormal growth of the natural cells which constitutes cancer, or, on the other hand, it may be merely a stage in the process. In any case their origin is quite unknown, and if cancer be infectious at all, both experience in nature and experiment go to show that its infectivity is of a very low degree. It should not be forgotten that cancer is essentially a disease of old age, and that the in- cidence of all known diseases of a micro-parasitic nature affects rather childhood and early adult life. With regard to the influence of heredity, the trend of modern research is to minimize or deny its importance in cancer, as in phthisis, and*

~~to explain family histories by locality or other conditions. In view of the wide hold obtained nowadays by popular fallacies through the agency of elementary education and a cheap press, it may be not superfluous to add that there are no reasons for sup- posing that tomatoes have anything whatever to do with cancer.~~

~~Several years ago Mr Haviland investigated the distri- bution of cancer in England and Wales, and disclosed the existence of what he called " cancer fields," that is, districts in which the disease prevailed in a "„ *"'*" ' marked degree. Such districts were invariably associated with " seasonally flooded areas traversed by, or in close propinquity to, fully formed rivers," and were geologically characterized by alluvial and clayey soils. On the other hand, districts having the lowest mortality were found to be situated on elevated lands, well drained, not subject to floods and geologically characterized by the Carboniferous limestone formation. He has more recently returned to the question, and by comparing a later period with the former one, has shown that this distribution remains constant, though the mortality has everywhere increased. Incidentally it may be remarked that the fact of the increase being generally distributed, and not con- fined to cancer districts, is an additional reason for regard- ing the increase as only apparent. Mr Haviland concludes that flooded clays are always associated with the highest mortality, and limestones with the lowest. The Thames valley, which is the greatest cancer field in England,~~

~~forms the most striking illustration of this generalization. The river flows through a great variety of geological formations, but all the localities having the highest cancer mortality lie on clays, and are liable to floods ; those having the lowest lie on limestone and chalk, and are, for the most part, not subject to flooding. Further light has been thrown upon the subject by the investigation of localities and houses to which the term " cancer- haunted " has been applied. Certain spots, groups of buildings and single houses, seem to harbour some special liability, and that independent of their size and age. An investigation carried out by Mr d'Arcy Power in a cancer district pro- duced some remarkable examples. In one case, three~~

~~*men occupying the same house in succession all died of cancer since 1877, when the earliest case occurred. It was a new house then, built on land which had been pasture, and its first occupant was the first victim. The third was only thirty-six years of age. In another instance three cottages were under one roof, and in each of them a case of cancer occurred within six years. Many other similar instances have been recorded, and it is difficult to deny the existence of some local influence. But whether it lies in a predisposition engendered by the situation, or in the harbouring of a parasite in the soil, or in some inter- mediate host, is at present mere subject of conjecture. Animals do not appear to play any part in the matter. Cancer has been observed in horses, dogs, cattle, cats, and sheep, in the relative frequency named, but it is not very common in any of them. With regard to occupation, the following comparative mortality figures are given by the Eegistrar-General : — All occupied males, 44 ; all unoccupied males, 96 ; grocers, 34 ; clergy, 35 ; potters, 35 ; coal-miners, 36 ; farmers, 36 ; fishmongers, 42 ; medi- cal practitioners, 43 ; blacksmiths, 45 ; fishermen, 46 ; porters, 48 ; general labourers, 48 ; drapers, 49 ; shoe-makers, 50 ; dock and wharf labourers, 61 ; tobacconists, 51 ; plumbers, 53 ; innkeepers, 53 ; coal-heavers, 56 ; butchers, 57 ; coachmen and grooms, 68 ; tool and scis- sors makers, 58 ; gas-workers, 69 ; lawyers, 60 ;. merchant seamen, 60 ; maltsters, 61 ; commercial travellers, 63 ; inn and hotel servapts, 65 ; brewers, 70 ; innkeepers in Lon- don, 70 ; chimney-sweeps, 156. An examination of these figures is very suggestive. They appear more or less incompatible with any existing theory. Mental worry and overwork seem to be negatived by the low position of doctors, who come below labourers, fishermen, and sear men. The great differences in occupational incidence are not in accordance with either a parasite or a local theory, while the moderate place — considerably below lawyers — taken by innkeepers is quite at variance with the sugges- tion that alcohol is responsible. "Why should lawyers be more susceptible than clergymen and doctors ? They are not so long-lived as the former, so that old age cannot account for the greater incidence, and both less intem- perate and less worried than the latter. It looks very much as if chance had more to do with the matter than anything else ; but there is the one striking fact of the enormous susceptibility of chimney-sweeps, which is too great to be explained by chance. The well-known and long-recognized frequency of cancer in this particular class used to be advanced as proof of the*~~

~~*hypothiesis of local irritation, which is still the orthodox explanation of cancer. The soot is supposed to act as an irritant; but, if so, why are potters and coal-miners, who also work in irritating materials, so very low in the cancer scale ? No doubt the case of the chimney sweep contains one of the keys to the problem of cancer causation, but it has not been found yet.*~~^

~~*The only " cure " for cancer remains removal by operar tion. There is some ground for claiming that improve- ments in surgery offer a better chance of complete*~~

~~*Treat- weat*~~

~~*cure in favourable cases, and of a longer respite in*~~

~~*others. A number of drugs, including inocular*~~

~~*tions with thyroid extract and toxins, have*~~

~~*been tried, but such methods of treatment are*~~

~~*only in the nature of experiments. Change of residence*~~

~~*from a clay to a chalk soil is worth tryiag after removal*~~

~~*by operation. (a. sl.)*~~

~~*Candon, a town in south Ilocos province, near the west coast of Luzon, Philippine Islands, in 17° 4' N. Its climate is hot, though healthful. It is surrounded by an extensive and fertile plain, and is defended by a small fort. Its inhabitants are noted for their honesty and industry, as well as for their regard for law and order. They carry on an extensive traffic with the wild tribes of the neighbouring mountains. Indigo is grown in con- siderable quantity, as are rice and tobacco. The weaving of blankets, handkerchiefs, and cotton and silk cloths constitutes quite an important industry. The language is Ilocano. Population, 15,700.*~~

~~*Can gas de On is, a township of the province and diocese of Oviedo, with a population in 1897 of 9507, situate in a fertile, well-watered, partly wooded, undulating region. Its trade is chiefly in live stock and products of*~~

~~neighbouring copper and coal mines. It has good build- ings, a foundling hospital, schools, a town hall with a Latin inscription recording the fact that this place was the residence of the first kings of Spain after the spread of the Moors over the peninsula. Here early in the 8th century lived King Pelayo, who started the Christian reconquest of Spain. His historic cave of Covadonga is only 8 miles distant. The church of the Assumption, rebuilt in the 19th century, is on the model and site of an older church of the Middle Ages. Near Cangas are ruins and bridges of the Eoman period.~~

~~Cannanore (Kananoeb), a town of British India, in the Malabar district of Madras, on the coast, 58 miles N. from Calicut. The population in 1881 was 26,386, in 1891 it was 27,418; the municipal income in 1897-98 was Es.28,450. Here is the residence of the Mopla chief, known as the Ali Eaja, who owns most of the Laccadive Islands. Cannanore is the headquarters of a military division. It has a municipal high school and reading-room. A railway is under construction from Calicut.~~

~~Cannes, a town of France, in the arrondissement of Grasse, department of Alpes-Maritimes, on the coast, 23 miles in direct line S.W. of Nice, and on the railway from that town to Toulon. The town, which has steadily grown in favour as a winter health resort, was several times visited by Queen Victoria. In 1899, 382 vessels of 47,421 tons (including those engaged in coasting trade) entered the port, and 368 of 48,046 tons cleared. The trade is mainly in French hands. Population (1881),~~

~~14,086; (1896), 28,591 ; (1901), 34,151.~~

~~Canning. — By canning is meant the preparation of food in packages of tin or glass so as to preserve it indefi- nitely with its natural flavour and nutritive properties uninjured. To this end it is necessary that the food should be hermetically sealed and the bacteria or germs that cause fermentation be destroyed. The process was developed and given a commercial value by Nicolas Appert in France in 1807-10. Until recently it was thought that the spoiling of hermetically sealed food was due to the presence of air in the tins or jars, and the process of sterilization was carried on by cooking in an open water bath, at a temperature of 212° F. It is now known that fermentation is caused only by the presence of bacteria or micro-organisms ; if these are destroyed and the food~~

sealed against them, the presence of air would not of itself cause fermentation, provided it were sterilized. To destroy bacteria the food is heated to a sufficiently high temperature under pressure in retorts and kettles. Heat is the only agency that need be employed. The use of antiseptics is iaexcusable.

While the process of canniag is simple, extreme care is required in handling the material. Bacteria lodge upon food from utensils ; they are in the water-supply, in the air, perhaps in the fluids used in the process of canning ; and on the person or garments of workmen. Cleanliness is imperative. Moreover, certain forms of bacteria are not killed as easily as others, and unless the packer knows how long the food should be cooked and how high a temperature is necessary for sterilization, he is liable to lose an entire season's product rortunes have been lost through lack of cleanliness or of a knowledge of bacteri- ology. The simple process devised by Appert has been developed by applying steam and machinery to all parts of the work from the cultivation, gathering, preparation, and packing of raw material to the manufacture of tin cans, labels, and cases. Among the devices in common use are automatic can-making machinery, cappers, fillers, floaters, brining or syruping machines, wipers, corn cut- ters, com silkers, pea briners, huUers, corn cookers, con- veyers, labelling machines, and box fillers ; a portable process kettle has made canning possible on the farm. In treating peas, for example, the work was formerly done by hand and the peas twice cooked ; after being sub- jected to heat for ten minutes at 212° F. the tins were vented, resealed, and again processed. By the aid of modern machinery the pods are gathered by a viner, the peas are podded by a " huller," and are assorted in four or five sizes by a revolving cylinder, the sides of which have meshes of varying sizes. After being blanched the peas are covered with brine, placed in tins, and sealed by machine. They are then processed once in a retort for twenty minutes at a temperature of 240° F. One firm in Wisconsin, U.S.A., puts up over 2,500,000 tins of peas annually. As a general rule fruits and vegetables are only processed once, meats and fish twice. Method and results vary greatly. Until recently there has not

~~been any considerable scientific study of the art, and canners are generally deficient in a knowledge of scientific cook- ing and of the time and heat required to destroy the various kinds of bacteria.~~

~~The cans are made from steel plates, with little or no solder anywhere exposed to chemical action. In a perfectly closed tin chemical action is virtually suspended. Upon the access of air the acids in fruits and vegetables may decompose the tin very rapidly, forming mineral salts, and therefore the contents of a tin should be immediately removed. When properly prepared canned food will keep without deterioration for practically an unlimited period of years in all extremes of any climate. At the London Exhibitions of 1851, 1862, and 1873 tins of meat which had been put up from twenty-five to forty years were found perfectly sound. Stores of meat, &c., in tins have been left in the Arctic regions for years, annually exposed to temperatures of 92° below and 80° above zero, and when examined found as sound as the day they were put up. Condensed milk thirty-two years old was found in perfect condition except for a slight discoloration. It is attested on high medical authority that the qualities and properties of foods are not altered to any material extent by the process of preservation. Severe tests of this statement have been made both in the Arctic regions and in the torrid zone. Brigadier-general A. W. Greely, U.S.A., records that canned fruits and vegetables which were subjected to the extremes of Arctic temperatures for almost three years presented the same appearance~~

~~flavour was as the first month.~~

~~as though freshly canned, and their good when the last can was eaten as in No illness of any kind occurred prior to the famous retreat, and those most inclined to canned fruit and vegetables were the healthiest and strongest of the party. Surgeon-Major W. Simson Pratt, M.D., whose experience and judgment on this point were attested by Sir Garnet (afterwards Lord) Wolseley, reported as follows:— " Taking my experience in India and the late Nile expe- dition in which the test of tinned provisions was excep- tionaUy severe from continued exposure to the powerful direct rays of the sun, I have found that tinned provi- sions, meat, and vegetables, put up~~

~~separately or combined in the form of soups, are practically undamageable by any climatic heat."~~

~~Canning was early introduced in various parts of the Atlantic States of North America (182046). In 1848 the demand for canned meat for California became urgent, and additional impetus was given by the Civil War in America, 1861-65. From that time the industry spread over the globe. There are now canning factories in China, the East Indies, Africa, France, Great Britain, and other countries of Europe; but the industry has received its chief development in the United States and Canada. Factories line the Atlantic coast from Nova Scotia to Florida, the Gulf of Mexico, the Pacific coast as far north as points between -60° and 65° north latitude in Alaska, and are found in nearly all the forty-six States of the Union. In the whole of North America there are about 2000 canning factories besides a number of firms in the cattle trade that have canning houses in connexion with their stock-yards. One of these has placed upon the market eighty food specialties into which meat or poultry enter, and is adding one new sort every week. Besides the packing of all varieties of fruits, vegetables, meats, fish, fowl, soups, the packers put up combinations of food, and the favourite special dishes of different nations, as for instance, succotash, okra and tomatoes, stewed kidneys, clam chowder, plum pudding, Irish stew, beefsteak and onions. Hamburger steak with onions, veal loaf, ham loaf. Many of these articles are sold as low as eighty to ninety cents per dozen (3s. 2^d. to 3s. 7|d.), so as to permit of their being sold to consumers at ten cents (6d.) per tin. Full statistics are not available because packers are unwilling to make public the extent of their business, but the following figures may be relied on. In 1889 there were put up in the United States and Canada 177,718,152 No. 3 or quart tins of tomatoes, and during ten years 1891-1900, a total of 1,174,369,200 tins. Of sweet corn there were put up in 1900 a total of 155,654,976 tins, and during ten years 937,462,408 tins. In California the estimated output of table fruits reaches 60,000,000 tins every season. The output of canned salmon on the Pacific coast for ten years 1890-1899, was 1,027,510,896 one-pound tins. During the three seasons ending 1899, the average annual output was nearly 3,000,000 cases of forty-eight one-pound tins each, or 144,000,000 tins. Of this the United Kingdom takes an average of over 48,000,000 tins annually. The magnitude of the American industry is further shown by the fact that during the year~~

~~*ending 30th June 1900 the exports of canned beef were 66,553,746 pounds, of which 32,273,374 pounds went to the United Kingdom, and 12,172,889 pounds to South Africa. It is estimated that 376,000,000 pounds of milk are annually used in the United States for making condensed milk, which is equivalent to an output of 156,500,000 tins. One company engaged in the business has a capital of $20,000,000. Large corpo- rations are engaged in the same line in Switzerland and other countries. It is safe to estimate the output of canned goods in the United States and Canada at over*~~

~~*1,000,000,000 tins annually, exclusive of jams and pre- serves put up in tin cans.*~~

~~*The price of canned goods has fallen enormously, the difference being almost wholly due to machinery. The machinery for canning peas promises to stimulate the industry for years to come, and the portable process kettle has multiplied the producers of tomatoes many times over. So great has been the increase of production that the normal relation of supply to demand has been disturbed for years, and in the case of some articles is not yet adjusted to a profitable basis. The following are the comparative prices of vegetables per dozen one-pound*~~

~~*cans:*~~

~~*1870.*~~

~~*1900.*~~

~~*Corn .*~~

~~*11/ to 12/ $2.75 to 3.00*~~

~~*2/5 to 3/ $.60 to .75*~~

~~*Peas .*~~

~~*11/ to 15/ 2.75 to 8.75*~~

~~*3/5 to 4/10 .85 to 1.20 2/10 to 3/5 -70 to .85*~~

~~*Tomatoes .*~~

~~*10/ ... 2.50*~~

~~*Lima beans*~~

~~*13/ ... 3.25*~~

~~*3/ to 3/5 .75 to .85*~~

~~*String beans*~~

~~*9/ ... 2.25*~~

~~*2/ to 2/10 .50 to .70*~~

~~*Asparagus .*~~

~~*£1, 4/ ... 6.00*~~

~~*13/ ... 3.25*~~

~~*In meat products the price per dozen cans has fallen off as follows: —*~~

~~*1849.*~~

~~*1900.*~~

~~*2-Ib meats .*~~

~~*£1,1/*~~

~~*$5.25*~~

~~*10/10 $2.70*~~

~~*2-lb poultry .*~~

~~*1,10/*~~

~~*7.50*~~

~~*12/7* 3.15 3/5 .85*~~

~~*2-Ib oysters .*~~

~~*1,10/ 1,8/*~~

~~*7.50*~~

~~*2-lb clams .*~~

~~*7.00*~~

~~*9/7* 2.40*~~

~~*1-R) lobster .*~~

~~*12/*~~

~~*3.00*~~

~~*12/ 3.00*~~

~~*l-R) salmon .*~~

~~*14/6*~~

~~*3.62*~~

~~*7/5 1.85*~~

~~*(f. If. B.)*~~

~~*Cannock, a market town and railway station in the Western parliamentary division of Staffordshire, England, in the district known as Cannock Chase,*~~

~~*9 miles S.S.E. of Stafford. There are ancient and modern Anglican churches ; a Koman Catholic school-chapel, and various Nonconformist chapels ; two endowed schools ; public rooms, market-hall, urban council offices, and a public hall. The Cannock Chase district abounds in coal mines and also contains iron. Area of township (an urban district), 8010 acres ; population (1881), 17,125 ; (1901), 23,500. There is a parish of Cannock.*~~

~~*Canons of Hippolytus, The. — This book stands at the head of a series of Church Orders, which contain instructions in regard to the choice and ordina- tion of Christian ministers, regulations as to widows and virgins, conditions of reception of converts from heathen- ism, preparation for and administration of baptism, rules for the celebration of the eucharist, for fasting, daily prayers, charity suppers, memorial meals, first-fruits, &c. We shall give (1) a description of the book as we have it at present ; (2) a brief statement of its relation to allied documents ; (3) some remarks on the evidence for its date and authorship.*~~

~~*1. We possess the Canons of Hippolytus only in an Arabic version, itself made from a Coptic version of the original Greek. Attention was called to the book by Wansleben and Ludolf towards the end of the 17th century, but it was only in 1870 that it was edited by Haneberg, who added a Latin translation, and so made it generally accessible. In 1891 Achelis reproduced this translation in a revised form, embodying it in a synopsis of allied documents. He suspected much interpolation and derangement of order, and consequently rearranged its contents with a free hand. In 1900 a German trans- lation was made by Eiedel, based on fresh MSS. These showed that the book, as hitherto edited, had been thrown into disorder by the displacement of two pages near the end ; they also removed other difficulties upon which the*~~

~~*theory of interpolation had been based. Further dis- coveries, to be spoken of presently, have added to our materials for the study of the book, and a fresh investi- gation of it is urgently needed.*~~

~~*The book Is attributed to " Hippolytus, the chief of the bishops of Rome," and is divided into thirty-eight canons, to which short headings are prefixed. This division is certainly not original, but it is convenient for purposes of reference. Canon 1 is prefatory ; it contains a brief confession*~~

~~*of faith in the Trinity, and especially in the Word, the Son of God ; and it speaks of tlie expulsion of heretics from the Church. Canons 2-5 give regulations for the selection and ordination of bishops, presbyters, and deacons. The bishop is chosen by the whole congregation : "one of the bishops and presbyters" is to lay hands upon him and say a prayer which follows (3) : he is at once to proceed with " the offering," taking up the eucharistio service at the point where the sursum corda comes in. A presbyter (4) is to be ordained with the same prayer as a bishop, " with the exception of the word bishop " ; but he is given no power of ordination (this appears to be inconsistent with c. 2). The duties of a deacon are described, and the prayer of his ordination follows (5). Canons 6-9 deal with various classes in the Church. One who has suffered punishment for the faith (6) is to be counted a presbyter without ordination : " his confession is his ordination." Readers and sub-deacons (7) are given the Gospel, but are not ordained by laying-on of hands. A claim to ordination on the ground of gifts of healing (8) is to be admitted, if the facts are clear and the healing is from God. Widows are not ordained (9) : " ordination is for men only." Canons 10-15 describe condi- tions for the admission of converts. Certain occupations are in- compatible with Christian life : only under compulsion may a Christian be a soldier. Canons 16-18 deal chiefly with regulations concerning women. Canon 19 is a long one dealing with catechumens, preparation for baptism, administration of that sacrament, and of the eucharist for the newly-baptized. The can- didate is twice anointed : first, with the oil of exorcism, after he has said, with his face westward, " I renounce thee, O devil, and all thy following"; and, again, immediately after the baptism. As he stands in the water, he declares his faith in response to an interrogatory creed ; and after each of the three clauses he is immersed. After the second anointing the bishop gives thanks "for that Thou hast made them worthy that they should be bom again, and hast poured out Thy Holy Ghost upon them, so that they may belong, each one of them, to the body of the Church" : he signs them with the cross on their foreheads, and kisses them. The eucharist then proceeds : "the bishop gives them of the body of Christ and says, This is the body of Christ, and they answer Amen" ; and similarly for the cup. Milk and honey are then given to them as being " born a second time as little children." A warning is added against eating anything before communicating. Canons 20-22 deal with fast-days, daily services in church, and the fast of the passover week. Canon*~~

~~23 seems as if it closed the series, speaking, as it does, of " our brethren the bishops " who in their cities have made regulations " according to the commands of our fathers the apostles" : "let none of our successors alter them ; because it saith that the teaching is greater than the sea, and hath no end." We pass on, however, to regulations about the sick (24) who are to be visited by the bishop, " because it is a great thing for the sick that the high-priest should visit them (for the shadow of Peter healed the sick)." Canons 25-27 deal again with prayers and church-services. The "seven hours" are specified, with reasons for their observance (25) : attendance at sermons is urged (26), " for the Lord is in the place where his lordship is pro-claimed" (comp. Didache 4, part of the Two Ways). When there are no prayers in church, reading at home is enjoined (27) : " let the sun each morning see the book upon thy knees" (comp. Ath. ad. virg., § 12, "Let the sun when he ariseth see the book in thy hands"). Prayer must be preceded by the washing of the hands. "No believer must take food without communicating, especially on fast-days " ; only believers may commimicate (28). The sacred elements must be guarded, " lest anything fall into the cup, and it be a sin unto death for the presbyters." No crumb must be dropped, "lest an evil spirit get possession of it." Canons 30-35 contain various rules, and specially deal with suppers for the poor (i.e., agapae) and memorial feasts. Then we have a prayer for the offering of first-fruits (36) ; a direction that ministers shall wear fair garments at "the mysteries" (37); and a command to watch during the night of the resurrection (38). The last canon hereupon passes into a general exhortation to right living, which forms a sixth part of the whole book. In Riedel's translation we read this for the first time as a connected whole. It falls into two parts, and describes, first, the true life of ordinary Christians, warning them against an empty profession, and laying down many precepts of morality ; and then it addresses itself to the " asoete " who " wishes to belong to the rank of the angels," and who lives a life of solitude and poverty. He is~~

~~encouraged by an exposition, on somewhat strange lines, of the temptations of our Lord, and is specially warned against spiritual pride and contempt of~~

other men. The book closes with an appeal for love and mutual service, based on the parables in St Matthew

XXV.

2. It is impossible to estimate the position of the Canons of Hippolytus without some reference to allied documents, (a) The most important of these is what is now commonly called the Egyptian Church Order. This is preserved to us in Coptic and .ffithiopic versions, of which Achelis, in his synopsis, gives German translations. The subject-matter and arrangement of these canons cor- respond generally to those of Hippolytus ; but many of the details are modified to bring them into accord with a later practice. A new light has been thrown on the criticism of this work by Hauler's discovery (1900) of a Latin version (of which, unfortunately, about half is missing) in the Verona palimpsest, from which he has also given us large Latin fragments of the Didascalia (which underlies books i.vi. of the Apostolic Constitu tions, and which hitherto we have only known from the Syriac). The Latin of the Egyptian Church Order is somewhat more primitive than the Coptic, and approaches more nearly, at some points, to the Canons of Hippolytus. It has a preface which refers to a treatise Concerning Spiritual Gifts, as having immediately preceded it ; but neither this nor the Coptic-^thiopic form has either the introduction or concluding exhortation which is found in the Canons of Hippolytus. (6) The Testament of the Lord is a document in Syriac, of which the opening part had been published by Lagarde, and of which Eahmani (1899) has given us the whole. It professes to contain instruc- tions given by our Lord to the apostles after the resurrec- tion. After an introduction containing apocalyptical matter, it passes on to give elaborate directions for the ordering of the Church, embodying, in a much-expanded form, the Egyptian Church Order, and showing a know- ledge of the preface to that document which appears in the Latin version. It cannot be placed with probability earlier than the latter part of the 4th century, (c) The Apostolic Constitutions is a composite document, which probably belongs to the end of the 4th century. Its first six books are an expanded edition of a Didascalia which we have already mentioned: its seventh book similarly expands and modifies the Didachi : its eighth book begins by treating of " spiritual gifts," and then in c. 3 passes on to expand in like manner the

~~*Egyptian Church Order. The hand which has wrought up all these documents has been shown to be that of the interpolator of the Ignatian Epistles in the longer Greek recension, (d) The Canons of Basil is the title of an Arabic work, of which a German translation has been given us by Eiedel, who thinks that they have come through Coptic from an original Greek book. They embody, in a modified form, considerable portions of the Canons of Hippolytus.*~~

~~*3. We now approach the difficult questions of date and authorship. Much of the material has been quite recently brought to light, and criticism has not had time to inves- tigate and pronoimce upon it. Some provisional remarks, therefore, are all that can prudently be made. It is plain that we have two lines of tradition : (1) The Canons of Hippolytus, followed by the Canons of Basil; (2) the Egjrptian Church Order, itself represented (a) by the Latin version, the Testament of the Lord, and the Apos- tolic Constitutions, which are linked together by the same preface (or portions of it), (6) by the Coptic and .^thiopic versions. Now, the Latin preface points to a time when the canons were embodied in a corpus of similar materials, or, at the least, were preceded by a work on " Spiritual Gifts." The Canons of Hippolytus have a wholly different preface, and also a long exhortation at the close. The*~~

~~*question which criticism must endeavour to answer is, whether the Canons of Hippolytus are the original from which the Egyptian Church Order is derived, or whether an earlier body of canons lies behind them both. At present it is probably wise to assume that the latter is the true explanation. For the Canons of Hippolytus appear to contain contradictory regulations (e.g., cc. 2 and 4 of the presbyters), and also suggest that they have received a considerable supplement (after c. 23). There is, however, no doubt that they present us with a more primitive stage of Church life than we find in the Egyp- tian Church Order. The mention of sub-deacons (which, after Kiedel's fresh manuscript evidence, cannot now be dismissed as due to interpolation) makes it difficiilt to assign a date much earlier than the middle of the 3rd century.*~~

~~*The Puritan severity of the canons well accords with the temper of the writer to whom the Arabic title attri- butes them ; and it is to be noted than*~~

~~*the exhortation at the close contains a quotation from 2 Peter actually attributed to the apostle, and Hippolytus is perhaps the earliest author who can with certainty be said to have used this epistle. But the general style of Hippolytus, which is simple, straightforward, and strong, is in marked contrast with that of the closing passage of the canons; moreover, his mind, as presented to us in his extant writings, appears to be a much larger one than that of the writer of these canons ; it is as difficult to think of Hippolytus as it would be to think of Origen in such a connexion. How, then, are we to account for the attribution ? There is evidence to show that Hippolytus was highly reverenced throughout the East : his writings which were in Greek were known, but his history was entirely unknown. He was supposed to be "a pupil {yvrnpifuxK) of apostles " (Palladius, 4th century), and the Arabic title calls him " chief of the bishops of Eome," i.e., archbishop of Eome. It is hard to trust this attri- bution more than the attribution of a Coptic discourse on the Dormitio Mariae to " Evodius, archbishop of the great city Eome, who was the second after Peter the apostle " {Tea^s and Studies, iv. 2-44) — ^Evodius being by tradition first bishop of Antioch. A whole group of books on Church Order bears the name of Clement of Eome ; and the attribution of our canons to Hippolytus may be only an example of the same tendency. The fact that Hippolytus wrote a treatise Concei-ning Spiritual Gifts, and that some such treatise is not only referred to in the Latin preface to the Egyptian Church Order, but is actually found at the beginning of book viii. of the Apostolic Constitutions, introduces an interesting complication; but we cannot here pursue the matter further. Dom Morin's ingenious attribution of the canons to Dionysius of Alexandria (on the ground of Eusebius, H.E. vi. 46-5) cannot be accepteti in view of the broader church policy which that writer represents. If the Hippolytean authorship be given up, it is prob- able that Egypt will make the strongest claim to be the locality in which the canons were compiled in their present form.*~~

~~*The authorities of chief practical importance are Achelis, Texte u. Unters, vi. 4 (1891) ; Eahmani, Testamentum Domini (1899) ; Hauler, Didascalice Apostolorum (1900) ; Eiedel, Kirchenrechts- quellen des Patriarchats Alexandrien (1900). (j. x. K.)*~~

~~Canovas del Castillo, Antonio (1828-1897), Spanish statesman, was born in Malaga 8th February 1828. Educated in his native town, he went to Madrid in 1845, bent upon finding means to complete his literary and philosophical studies. His uncle Don Serafin Este- banez Calderon, found him a situation as clerk in the Madrid-Aranjuez railway, but Canovas soon took to journalism and literature, earning enough to support him-~~

~~self and pay for his law studies at the Madrid Univer— sity. During this period he published his two best works — a historical novel, Las Campanas de Huesca, and the history of the decay of Spain from Philip III. to Charles II. under the house of Austria. He became a politician through his Junius-like letters to the "Mur- cielago" — The Bat, a satirical political journal— and by drawing up the manifesto of Manzanares in 1854 for Marshal O'Donnell, of whom he always remained a loyal adherent. Canovas entered the Cortes in 1854; he was made governor of Cadiz in 1857, sub-director of the state department in 1858, under-secretary at the Home Oflace in I860, minister of the interior in 1864, minister of the colonies in 1865, minister of finance in 1866, and was exiled by Marshal Narvaez iu the same year, afterwards becoming a bitter opponent of all the reactionary cabinets until the revolution of 1868. He took no part in preparing that event. He sat in the Cortes Constituyentes of 1869 as a doctrinaire Conserv- ative, combatipg all Eadical and democratic reforms, and defending the exiled Bourbons; but he abstained from voting when the Cortes elected Amadeus king on 16th November 1870. He did not object to some of his political friends,' like Silvela and Elduayen, enter- ing the cabinets of King Amadeus, and in 1872 declared that his attitude would depend on the concessions which Government would make to Conservative principles. After the abdication of Amadeus and the proclamation of the federal republic, Canovas took the lead of the propaganda in favour of the restoration of the Bour- bons, and was their principal agent and adviser. He drew up the manifesto issued in 1874 by the young King Alphonso XII., at that time a cadet at Sandhurst ; but he dissented from the military men who were actively con- spiring to organize an Alphonsist pronunciamiento. Like~~

~~*Marshal Concha, marquis del Duero, he would have pre- ferred to let events develop enough to allow of the dynasty being restored without force of arms, and he severely blamed the conduct of the generals when he first heard of the pronunciamiento of Marshal Campos at Sagunto. Sagasta thereupon caused Canovas to be arrested (30th December 1874) ; but the next day the Madrid garrison also proclaimed Alphonso XII. king, and Canovas showed the full powers he had received from the king to assume the direction of affairs. He formed a regency ministry pending the arrival of his majesty, who confirmed his ap- pointment, and for six years Canovas was premier except during the short-lived cabinets of Marshal Jovellar in 1875 and Marshal Campos for a few months in 1879. Canovas was, in fact, the soul of the Eestoration. He had to recon- struct a Conservative party out of the least reactionary parties of the days of Queen Isabella and out of the more moderate elements of the revolution. With such followers he made the constitution of 1876 and all the laws of the monarchy, putting a limited franchise in the place of uni- versal suffrage, curtailing liberty of conscience, rights of association and of meeting, liberty of the press, checking democracy, obliging the military to abstain from politics, conciliating the Carlists and Catholics by his advances to the Vatican, the Church, and the religious orders, pandering to the protectionists by his tariff policy, and courting abroad the friendship of Germany and Austria after contributing to the marriage of his king to an Austrian princess. Canovas crowned his policy by countenancing the formation of a Liberal party under Sagasta, flanked by Marshal Serrano and other Liberal generals, which took office in 1881. He again became premier in 1883, and re- mained in office until November 1885 ; but he grew very unpopular, and nearly endangered the monarchy in 1885 by his violent repression of popular and Press demonstra- tions, and of student riots in Madrid and the provinces.*~~

~~*At the death of Alphonso XII. he at once advised the queen regent to send for Sagasta and the Liberals, and during five years he looked on quietly whilst Sagasta re- established universal suffrage and most of the liberties curtailed in 1876, and carried out a policy of free trade on moderate lines. In 1890 Canovas took office under the queen regent, and one of his first acts was to reverse the tariff policy of the Liberals, denouncing all the treaties of commerce, and passing in 1892 a highly protectionist tariff. This*~~

~~was the starting-point of the decline in for- eign trade, the advance of foreign exchanges, the decay of railway traffic, and the monetary and financial crisis which continued from 1892 to 1898. Splits iu the Conservative ranks forced Canovas to resign at the end of 1893, and Sagasta came in for eighteen months. Canovas resumed office in March 1895 immediately after the outbreak of the Cuban insurrection, and devoted most of his time and efforts, with characteristic determination, to the pre- paration of ways and means for sending 200,000 men to the West Indies to carry out his stem and unflinching policy of no surrender, no concessions, and no reforms. He was making up his mind for another effort to enable General Weyler to enforce the reforms that had been wrung from the Madrid Government, more by Ameri- can diplomacy than from a sense of the inevitable, when the bullet of an anarchist, in August 1897, at the baths of Santa Agueda, cut short his career. On the whole, Canovas must be regarded as the great- est Spanish statesman of the close of the 19th century. He was not only a politician but also a man of the world, a writer of considerable merit, a scholar well versed in social, economical, and philosophical questions, a great debater, a clever lecturer, a member of all the Madrid academies, and a patron of art and letters.~~

~~(a. e. h.)~~

~~Canrobert, Francois Certain (1809-1895), Marshal and Senator of France, was born at St Cer^, Lot, on 27th June 1809, and educated at St Cyr ; he received a commission as sub-lieutenant in the 47th Kegiment in 1828. He went to Africa in 1835, served in the expedition to Mascara, at the capture of Tlemcen, and in 1837 was wounded in the storm of Constantine (captain and Legion of Honour). Promoted lieutenant-colonel in 1846 and colonel of the 3rd Eegiment in 1847, he commanded the expedition against Ahmed Sghir in 1848, and defeated the Arabs at the Djerma Pass. Transferred to the Zouaves, he defeated the Kabyles, and, in 1849, displayed both courage and energy in reinforcing the blockaded garrison of Bou Sada, and in command of one of the attacking columns at Zaatcha (general of brigade and Commander Legion of Honour). He led the expedition against Narah in 1850 and destroyed the Arab strong- hold. Summoned to Paris, he was made aide-de-camp to the President, Louis Napoleon, and took part in the coup d'etat of 2nd December 1851. In the Crimean war he commanded the~~

1st Division at the battle of the Alma, where he was twice wounded. He succeeded St Arnaud a few days later in the supreme command of the French army. He was slightly wounded and had a horse killed under him at Inkerman when leading a charge of Zouaves. In May 1855 he resigned the command-in-chief, and, soon after his return to France, was sent on diplomatic missions to Denmark and Sweden (Marshal and Senator of France, Grand Cross Legion of Honour, and honorary G.C.B.). He commanded the 3rd army corps in Lombardy in 1859, distinguishing himself at Magenta and Solferino. He successively commanded the camp at Chalons, the 4th army corps at Lyons, and the army of Paris. In the Franco-German war he commanded the 6th army corps, and, after the disaster at Forbach, served under Bazaine

in the battles around Metz, and became a prisoner of war on the surrender of that fortress. In 1872 he was ap- pointed a member of the Supreme Council of War. He was elected Senator for Lot in 1876, and for Charente in 1879, and again in 1885. He died at Paris on 28th Jaur uary 1895, and his remains received a public funeral.

(k. h. v.)

Canstatt, or Caitostatt, a town and watering-place of Wtlrtemberg, on the Neckar, 2^ miles by rail N.E. from Stuttgart. It was connected in 1891-93 with Berg, a suburb of Stuttgart, by a bridge 990 feet long. It has railway workshops, iron-foundries, and machine shops, and manufactures of fiie-engines, zinc goods, elec- tro-technical apparatus, motor-cars, cottons, &c. ; fruit and wine are cultivated. The poet Preiligrath was buried here. Population (1885), 18,031; (1895), 22,590; (1900),

26,449.

~~*Cantal, a department in the middle of the central plateau of Prance, watered by the tributaries of the Lot, the Dordogne, and the Allier.*~~

~~*Area, 2230 square miles, distributed among 23 cantons and 267 communes. From 241,742 in 1886 the population declined to 218,941 in 1901. In 1899 there were 4978 births, of which 277 ■were illegitimate, against 4644 deaths ; marriages numbered 1672. The chief towns are Aurillac (the capital), Mauriac, Murat, St Flour, and Salers. In 1896 there were 782 schools, with 41,000 pupils, and 3 per cent, of the population was illiterate. The area under cultivation in 1896 comprised 1,161,437 acres, of which 452,218 acres were laid out in grass, employed for the rearing of a great many cattle. Rye takes the first rank among the cereals, yielding in 1899 a value of £400,000. The green crop lands yield only a minimal return, but the natural grass lands, in which Cantal ranks first among the French departments, produced in 1899 a value of £1,025,000. There is abundance of chestnuts. The live stock in 1899 included 222,790 cattle, 42,220 pigs, 369,000 sheep, and 15,500 goats. The mining comprises but a few coal-pits, turning out 99,000 metric tons in 1898, and except for the coppersmith work of St Flour there is no metaUurgic industry to speak of.*~~

~~*Canterbury, a city, county borough, and parlia- mentary borough — since 1885 returning one member only — of England, on the Stour, 62 miles E.S.E. of London by rail. The Elham Valley railway now connects Canter-bury with Polkestone. Parish churches, other than the cathedral, number fourteen. Recent erections are the Simon Langton schools, endowed with funds of an old Blue Coat school, the Sidney Cooper Art Gallery, an insti-tute containing library and museum, a Masonic temple, and a memorial (1891) of Christopher Marlowe, who was born here ; there are also a Wesleyan college, the Clergy Orphan School, and a school of art under the town coun- cil. Linen-weaving, rope-making, and tanning are among the industries. Area of county borough, 3971 acres; population (1881), 21,848; (1901), 24,868.*~~

~~*Many improvements have been made in the cathedral. The crypt, probably the finest in England, has been cleared of the lumber formerly deposited in it ; the earth placed there in the 16th century, on account of the inflow of water, has all been removed, and the bases of the Nor- man columns*~~

~~*exposed to view ; a good floor has been laid down, and the whole crypt provided with gas brackets, so that it can be used for various purposes. The chapel of the HIoly Innocents has been fitted up and is occasionally used as a place of worship. The Prench church, which for many years occupied a large portion of the south side of the crypt, has been removed to the Black Prince's chantry, and is now far more convenient for the use of the alien congregation. A judicious use of gold ornament and an elaborate reredos have added materially to the beauty of the cathedral. The chapel of St Anselm has also been restored, and is now used for early morning ser-*~~

~~*vice as well as for other services. The chapter-house, formerly in a ruinous condition, has been thoroughly re- stored. The roof has been entirely renovated, and the ceiling again appears in all its original beauty. The windows have all beenreglazed, and the east window filled with stained glass at a cost of £1000, contributed by the Freemasons of England. The interior of the walls has been redecorated, and the arcade, which extends round the whole building, has been tastefully ornamented. The old pavement has been replaced by a new one of a uni- form pattern, and arrangements for warming this splendid room and making it suitable for public meetings have been completed.*~~

~~*The old palace, at the north-western part of the cathe- dral, last occupied by Archbishop Parker, who there entertained Queen Elizabeth, of which only a part re- mained, has after many changes been rebuilt, and is now the country residence of the archbishop of Canterbury.*~~

~~*The field lying to the east of St Augustine's College, and known as the Abbey Pield, has recently been acquired by trustees. In this field are the ruins of the Chapel of St Pancras, which was probably built by St Augustine. It also contains the eastern portion of the Abbey Church of St Peter and St Paul, in which St Augustine and many of his successors were buried. There are also remains of the chapter-house, dormitory, and infirmary, and the site of the chapel of the Blessed Virgin Mary built by Eadbald, Ethelbert's son and successor. The excavations which have been commenced have laid bare many matters of interest. The ruins of the chapel of St Pancras have been uncovered, and the abbey chapter-house has been traced in part. Of the abbey church the eastern apse is now exposed to view*~~

~~*with its central and side apsidal chapels. The central chapel contains some interesting frescoes on the walls, and in the middle are the remains of an altar highly decorated. In the north apsidal chapel there is an altar almost perfect, in front of which were found the remains of an abbot, which had been enclosed in a wooden coffin. The ambulatory at the eastern end of the crypt has also been uncovered. To the east of the main church is an oblong chapel, in which was found the body of John Dygon, abbot, who died in 1509. On the head was a large leaden painted mitre, and in the grave were found a coffin plate, a leaden chalice and paten, and two finger rings. Exploration is in progress which will, it is hoped, yield much valuable information. (f. w. f.)*~~

~~*Canton, city and treaty port in southern China, capital of the province of Kwangtung, on the left bank of the river Canton, some 70 miles from its mouth. The city has continued to make good progress as one of the principal markets of China. The trade, which in 1874 was H.taels 26,139,000 (£7,841,000), amounted in 1899 to H.taels 58,641,000 (£8,769,000) . The silver valuation re- presents more accurately the volume of trade. Besides the above, which comprises the trade carried in foreign bottoms, there is a large traffic in native craft of which no statistics are kept. There is daily communication by steamer with Hong Kong, and with the Portuguese colony of Macao which lies near the mouth of the river. Inland' com muni- cation by steam is now open by the West river route to the cities of Wuchow and Nanning. The opening of these inland towns to foreign trade, which has been effected, cannot but add considerably to the volume of Canton traffic. The native population is variously estimated at from 1,500,000 to 2,000,000, the former being probably nearer the truth. The foreign residents number about 400. Canton is the headquarters of the provincial government of Kwangtung and Kwangsi, generally termed the two Kwang, at the head of which is a governor-general or viceroy, an office which next to that of Nanking is the*~~

~~*most important in the empire. It possesses a mint built m 1889 by the then viceroy Chang Chih-tung, and equipped with a very complete plant*~~

~~supplied from Eng- land. It turns out silver subsidiary coinage and copper cash. Contracts have been entered into to connect Canton by railway with Hong-Kong (Kowloon), and by a grand trunk line with Hankow on the Yangtse. It is connected by telegraph with all parts.~~

~~Canton, a city of Fulton county, Illinois, U.S.A., on the Chicago, Burlington, and Quincy, and the Toledo, Peoria, and Western railways, at an altitude of 651 feet. It has extensive manufactures of agricultural implements. Population (1880), 3762; (1890), 6604; (1900), 6564 (424 foreign-born, and 38 negroes).~~

~~Canton, capital of Stark county, Ohio, U.S.A., situated in 40° 48' N. lat. and 81° 23' W. long.,, in the eastern part of the state, at an altitude of 1031 feet. It is at the intersection of three railways, the Pennsylvania, the Cleveland Terminal and Valley, and the Wheeling and Lake Erie. The surrounding country is a rich agri-~~

~~cultural region. In 1890 the manufacturing capital was $5,621,960, and the output was valued at $7,986,627. Of this, about one-fifth consisted of agricultural imple- ments. In 1900 the assessed valuation of real and per- sonal property was $11,033,380; the net debt was $924,719, and the total tax rate $30 per $1000. Popula. tion (1880), 12,258 ; (1890), 26,189; (1900), 30,667 (4018 foreign-born and 135 negroes). Canton was the home of President McKinley.~~

~~Cantu, a town of the province of Como, Lombardy, Italy, 8 miles by rail S. by E. from Como. It is a seat of considerable industry, chiefly carried on in the inhab- itants' own houses. Silks, laces, veils, and nails are the principal articles made. There are also furniture facto- ries and a technical school. Population, about 5500.~~

~~Capannori, a town of the province of Lucca, Tuscany, Italy, 3 miles E. from Lucca. It carries on silk, thread, and paper industries. Population, about~~

~~44,000.~~

~~CAPE OOLOIN^Y.~~

~~Gbogeapht and Statistics.~~

~~CAPE COLONY, or of&cially. The Colony of the Cape of Good Hope, is a British colony in the ex- treme south of Africa. During the last twenty-five years of the 19th century, the boundaries of the colony under- went many modifications. In 1876, though various parts of independent Kaffraria^ had already been brought under the control of the Cape Government, no part of the territories now known as Transkei, Tembuland, Gri- qualand East, and Pondoland had been actually incor- porated in the colony. It was not, indeed, till 1879 that two large areas of Transkei, Eingoland and the Idutywa reserve, together with the district commonly known as Noman's- land, which was taken to comprise most of the territory belonging to modern Griqualand East, were formally proclaimed an integral part of the Cape. About this time most of the rest of Kaffraria came under British control, but it was 1885 before Galekaland, the coast region of Transkei, and the various districts com- posing Tembuland — Bomvanaland on the coast, Tembu- land Proper, and Emigrant Tembuland, were annexed to the colony. By this annexation, the frontier of the colony was carried right up to the Umtata river, beyond which it has been already stated that Griqualand East, stretching to Natal, was within the frontier line, so that by 1885, only Pondoland, fronting on the Indian Ocean, separated the Cape from Natal. In Pondoland, Port St John's, after being for some years connected with the colony, had been incorporated along with the lower reaches of the St John's river in 1884; in 1886 the Xesibe Country (Mount Ayliff) was annexed to the Ca;pe, and added to Griqualand East; and in the following year the Ehode Valley was included within the boundary line. The rest of Pondoland, chiefly in virtue of a British protectorate established over all the coast region in 1885, was already more or less under British control, and in 1894 it was annexed to the Cape in its entirety. Thus by 1894 the whole of Kaffraria had been incor- porated, and in 1901 the extreme north-eastern frontier of the Cape was conterminous all along the line with that of Natal. Looking to the west of Kaffraria, Basutoland, which became part of Cape Colony in 1871, has since~~

~~1 Though not offlcially recognized, we shall retain the term Kaffraria, which is convenient for designation.~~

~~*1884 been constituted a Crown colony. Farther west still, the intimate connexion between Cape Colony and Griqualand West resulted in the incorporation of the latter in 1880, and flfteen years later the adjacent Crown colony of British Bechuanaland, lying between the Orange and Molopo rivers, and extending west as far as the 20th meridian, was brought within the Cape boundaries. On the other hand. Great Namaqualand, stretching west to the Atlantic, has been taken over by Germany, with the exception of a small district around Walfisch Bay, which, proclaimed British territory in 1878, was incorporated in*~~

~~*1884.*~~

~~*Area and Population. — The following table shows concisely the growth of the colony, giving the extent and population of the actual colony in 1875 ; in 1891, when Transkei, Tembuland, Griqualand East, Griqualand West, and Walfisch Bay had been incorporated, and Basutoland had been disannexed ; and in 1900, when Pondo- land and British Bechuanaland had been added.*~~

~~*1875.*~~

~~*1891.*~~

~~*1900.*~~

~~*Area.*~~

~~*Population.*~~

~~*Area.*~~

~~*Population.*~~

~~*Area.*~~

~~*Pop. (estt- mated).*~~

~~*201,186*~~

~~849,160~~

~~260,918~~

~~1,598,773~~

~~277,077~~

~~2,349,908~~

~~The census of 1891 was the only one taken between 1875 and 1901. Since 1875 the limits of most of the divisions of the colony have been altered so entirely that it is impossible to ipake any com- parison between the population returns of 1901 and those of 1891 and 1875. With regard to the 1875 census, however, it should be noted that the revised returns differed slightly from those given ia the ninth edition of this work, placing the population of the colony proper at 720,984, and that of Basutoland at 128,176, thus making the total for the whole colony 849,160, as given above.~~

~~The incorporation of the various native territories in the east has considerably increased the average density of population in the colony. Thus, in 1891 the average density of population vrithin the old limits of the colony (but excluding Basutoland) was 6 00 per square mile : that of Griqualand West was only 5-49 per square mile, while that of Walfisch Bay vfas merely 1-79 ; but the density of Griqualand East being 20-10, that of Tembuland 43-77, and that of Transkei 60-16, the density of the whole colony in 1891 was brought up to 6-90. If Pondoland (46-53 per square mUe) and British Bechuanaland (1-41 per square mile) be taken into account, it is found that the density of the colony, as at present constituted, was 6-45 in 1891. Of the 1,527,224 inhabit- ants within the limits of the colony in 1891, 376,987, or about a quarter, were European or white (some 230,000 of Dutch and~~

~~[statistics~~

~~French descent ; 130,000 of British descent); 13,907 were Malay, 50,388 Hottentot, 229,680 Fingo, 608,456 Kaffir or Bechuana, and 247,806 mixed and other. In 1900 it was roughly estimated that the colony, as then constituted, contained about half a million white and a million and a half coloured inhabitants. The pro- fessional, commercial, and industrial occupations employ a com- paratively small proportion of the people. In 1891 those of the white population engaged in such pursuits numbered respectively only 14,253, 17,922, and 31,177, whereas 77,118 were engaged in domestic employment, and 74,095 in agricultural employment, while 155,333 were dependants, and the employment of 7089 was indefinite or unspecified. The natives follow the domestic and agricultural pursuits almost exclusively. The registration of births and deaths did not become compulsory till 1895. The~~

~~following table shows the numbers of the births, deaths, and marriages in that year, and in 1898 and 1899 : —~~

~~Tear.~~

~~Marriages.~~

~~Births.~~

~~Beaths.~~

~~Europeans.~~

~~Others.~~

~~Europeans.~~

~~Others.~~

~~1895 1898~~

~~1899~~

~~7360 8718 8535~~

~~14,763 15,340 15,214~~

~~31,432 37,864 39,258~~

~~6,660 6,936 6,758~~

~~24,919 34,031 30,477~~

~~Lonff- East 20* /yoTn, Gre^ruvLch,~~

~~Map op Cape Colont.~~

~~LondOQj Stanford's Oeog? £giaftff'~~

~~In 1900, 8736 marriages were solemnized, the number of births was 52,571, and the number of deaths 47,369. Among the European population the birth-rate is about 34-44 per thousand, and the death-rate 15-73 per thousand. In the same section of the population there were, in 1891, 181,031 females to 195,956 males, i.e., 92-38 females to 100 males; in the total population the pro- portion was 99-03 to 100. About one-fifth of the population was urban, the chief towns being Cape Town,' 51,251 (including suburbs, 83,718) ; Kimberley, 28,718 ; Port Elizabeth, 23,266 — Grahamstown, 10,498 ; Beaconsfield, 10,478 ; Paarl, 7668 ; Kino-William's Town, 7226 ; East London, 6924 ; Graafi Reinet, 5946'^ Worcester, 5404; and Uitenhage, 5331. From 1873-84 only 23,337 persons availed themselves of the Government aid to immigrants from England to the Cape, and in 1886 this aid was stopped. The total number of adult immigrants by sea, however rapidly and steadily increased from 11,559 in 1891 to 38,669 in 1896, while during the same period the number of departures by sea only increased from 8415 to 17,695, and most of this increase took place in the last year. But from 1896 onwards the uncertainty of the political position caused a falling ofl in the num- ber of immigrants, while the emigration figures still continued to grow ; thus in 1900 there were 29,848 adult arrivals by sea, as com- pared with 21,163 departures.~~

~~*Administration— Central Government— Since 1893 the ministry under the Crown Governor consists of a Colonial Secretary, a Treasurer, an Attorney-General, a Commissioner of Public Works and a Secretary of Agriculture. Each of these, if an elected member of either House of Parliament, may sit and speak in both*~~

~~*but vote only in that of which he is a member. The office of Secretary for Native Affairs has been abolished, and its former duties have to be discharged by the Prime Minister or such other minister as they may be assigned to by the Governor. The Prime Minister may take whichever of the five offices named above he prefers.. But if (like Mr Rhodes) he assumes none of them he may draw no salary, because no holder of any office of profit other than the five already named can be lawfully elected a member of Parliament. An unpaid prime minister may, however, sit and speak in both Houses, but vote only in that of which he is a member. Some of the Cabinets formed since 1881 have comprised a "minister without portfolio" ; but the constitutional laws do not provide for, though they do not forbid, this. The Chief Justice is ex-offlcio President of the Legislative Council (which has 24 members), with a casting vote. Election is now for only seven years. The 46 electoral divisions, constituted in 1898, return 95 members to the Legislative Assembly or Lower House. Since 1882 the debates in each House may be conducted in either Dutch or English. The members of this House, who are still elected for five years, choose a Speaker from their own number. By Act No. 9 of 1892 vote by ballot for both Houses was introduced, and by the same Act the number of electors was restricted by various modifications in , the requisite qualifications, with a view to preventing the white vote from being "swamped" by the black. The value of property, the occupation of which qualified for electorship, was raised from £26 to £75 ; an alternative to the being in receipt of wages to the amount of £60 per annum, namely, the being in receipt of £25 per annum with board and lodging,*~~

~~*statistics]*~~

~~was abolished ; and, further, it was enacted that no one should In future be registered as an elector who could not sign his name and write his address and occupation. The total number of registered electors in 1898-99 was 109,888. The qualifications for a member of the Lower House, being the same as those for an elector, under- went the same modification as those for an elector ; those which must be possessed by a member of the Upper House remain as they were. Cumulative voting is still allowed in the election of members for the Upper House, but not in the election of members for the Lower House. The members of both Houses are paid for their services during session. By Act No. 6 of 1899 the provisions of the general electoral law were temporarily set aside in the case of persons accused of treason during the Boer war. Such cases were dealt with by the Special Tribunals created for the purpose.~~

~~Local &overnment. — The colony is now divided into 79 fiscal divisions. The local affairs of each division are dealt with by a council elected every three years by the registered parliamentary voters, and presided over by a civil commissioner, who is usually also resident magistrate. The laws relating to municipalities, which now number 97, were consolidated and amended in 1882 ; each municipality is governed by a council (with a mayor at its head) , a certain number of the members of which are elected by the ratepayers every year. In 1881 there were also constituted Village Management Boards of three members for the smaller villages and hamlets. These Boards are elected annually by the registered parliamentary voters, and are now 82 in number.~~

~~Justice and Crime: Pauperism. — The administration of justice is presided over by nine judges of the Supreme Court, who are divided into three Courts of three judges each. The first, called the Supreme Court, sits in Cape Town, and is presided over by the Chief Justice and two puisne judges ; the second, known as the Eastern District Court, sits at Grahamstown, and is presided over by a Judge President and two puisne judges ; and the third, known as the High Court of Griqualand, sits at Kimberley, and is also presided over by a Judge President and two puisne judges. From 1879 to 1886 there was a five-judges Court of Appeal for the colony, but in the latter year this Court was abolished, and its powers were vested in the Supreme Court. From this, whether sitting as a Court of Primary Instance~~

~~*or as a Court of Appeal (in which latter case there must not be less than three of the nine judges sitting), there is appeal only to the Privy Council. The judges of each of the three divisional Courts go on circuit twice a year, and since 1888 a special Court has been held at Kimberley for trying cases relating to illicit diamond buying ("I.D.B."). This Court consists of two judges of the Supreme Court and one other member, hitherto the civil commissioner or the resident magistrate of Kimberley. The Transkeian territories, which fall under the jurisdiction of the Eastern District Court, are subject to a Native Territories Penal Code, which came into force in 1887. Besides the usual magistrates in these territories, there are two chief magistrates, one for Griqualand East, and the other for Tembuland (officially including Pondoland) and Transkei. At the end of 1898 the Cape Police Force comprised 68 officers, 1922 men, and 1572 horses ; the municipal and ordinary Police Force, 1401 men; and the Gaol Establishment, 689 men. There were 1233 persons convicted before the special Justices of the Peace Courts in 1899 ; 52,904 'before Magistrates' Courts, and 804 before the Superior Courts ; at the end of the year there were 3348 males and 352 females in gaol. In the colony proper, in 1898, 1410 persons received indoor relief, and an average of 638 monthly received outdoor relief.*~~

~~*Beligion. — The following table classifies the inhabitants in 1891, according to religion : —*~~

~~*Denomination.*~~

~~*Whites.*~~

~~*AU Baces.*~~

~~*Per- centage.*~~

~~*Protestants — Dutch Reformed Church . Others*~~

~~*Total ....*~~

~~*Roman Catholics . Mahommedans .*~~

~~*Jews*~~

~~*Various, including Unknown*~~

~~*and Unspecified "No Religion" .*~~

~~*Grand Total .*~~

~~*228,627 128,333*~~

~~*306,320 425,727*~~

~~*20-06*~~

~~*27-87*~~

~~*356,960*~~

~~*14,853*~~

~~*31*~~

~~*3,007*~~

~~*1,606 530*~~

~~*732,047*~~

~~*17,275*~~

~~*15,099*~~

~~*3,009*~~

~~*5,970 753,824*~~

~~*47-93*~~

~~*1-13*~~

~~•99 •20~~

~~•39~~

~~49-36~~

~~376,987~~

~~1,527,224~~

~~100-00~~

~~The general description in the ninth edition of the relative strengths of the various Protestant bodies still holds good. The Methodists have a larger number of coloured people in their denomination than any other sect, but not a larger proportion.~~

~~Education. — ^The University of the Cape of Good Hope, modelled on that of London, was granted a royal charter in 1877, and is governed by a chancellor, a vice-chancellor (who is chairman of the University Council), and a council of 33 members, of whom 16 are elected by the University Convention, 16 nominated by the Cape Government, and 3 nominated by the Governor to represent Natal — ^these last under a recent Act granting representation on the council to any other South African colony or state that agreed to give a grant to the University funds. The examinations are open to candidates irrespective of where they have studied, but under the Higher Education Act grants are paid to seven colleges that specially devote themselves to preparing students for the graduation courses. These, at which there were 658 students in 1898-99, are the South African College at Cape Town, the Victoria College at Stellenbosch, the Diocesan College at Rondebosch, St Andrew's College at Grahamstown, Gill College at Somerset East, the School of Mines at Kimberley, and the Huguenot Ladies' Col- lege at Wellington. Several denominational colleges, receiving no Government aid, do the same work in a greater or less degree, the best known being St Aidan's (Roman Catholic) College and Kings- wood (Wesleyan) College, both at Grahamstown. Graaff Reinet College, Dale College, King William's Town, and the Grey Institute, Port Elizabeth, occupy the place of high schools under the Educa- tion Department. The~~

~~*Theological Seminary at Stellenbosch pre- pares theological students for the ministry of the Dutch Church, and is not connected with University work — so long as the Univer- sity does not grant degrees in Divinity. Primary education is under the Education Department, controlled by a Superintendent- General of Education. The schools under the Education Depart- ment are classified into undenominational public schools .of three classes — mission schools, poor schools, district boarding-schools, private farm schools, evening schools, and aborigines' schools. In addition to these there are 3 art schools, 8 industrial schools for whites, 9 for aborigines, 6 training schools for whites, 11 for aborigines. Classes for adult teachers in drawing, needlework, and woodwork are held chiefiy in Cape Town. In September 1899, just before the war broke out, there were in operation 2674 schools connected with the Education Department, taught by 4506 adult teachers, and having on their rolls 147,424 children, with an average attendance of 114,842. The total Government expenditure on education in 1899-1900 was £272,214. The standard of educa- tion is rapidly improving, but education is not compulsory, and it must be remembered that among the European population 28-82 per cent, of the males and 28-02 per cent, of the females could neither read nor write in 1891.*~~

~~*Finance. — The following table shows the revenue (including loans) and expenditure (including that under Loan Acts) of the colony in various financial years, from 1880 to 1900 : —*~~

~~*Revenue,*~~

~~*Tear ending*~~

~~*Expendl-*~~

~~*Total. Loans.*~~

~~*1880 .*~~

~~*£3,556,601*~~

~~*£3,742,665*~~

~~*1885 .*~~

~~*£3,814,947*~~

~~*£496,795*~~

~~*4,211,832*~~

~~*1890 .*~~

~~*5,571,907*~~

~~*1,141,867*~~

~~*5,327,496*~~

~~*1897 .*~~

~~*7,389,966*~~

~~...~~

~~*6,360,404*~~

~~*1898 .*~~

~~*7,327,975*~~

~~*676,750*~~

~~*8,613,669*~~

~~*1899 .*~~

~~*8,781,212*~~

~~*2,317,434*~~

~~*8,190,124*~~

~~*1900 .*~~

~~*6,665,752*~~

~~*128,376*~~

~~*7,773,230*~~

~~*The principal*~~

~~*items*~~

~~*ill*~~

~~*L the revenu*~~

~~*e and expei*~~

~~*iditure for 19*~~

~~*were as follows : —*~~

~~*Mevenue. Customs . . £1,879,408*~~

~~*Stamps and licenses 328,789*~~

~~*Postage . . 302,091*~~

~~*Railways . . 2,864,880*~~

~~*Telegraphs . . 164,001*~~

~~*Expenditure. Public debt . . £1,415,685 Railways . . 2,017,424*~~

~~*Defence .*~~

~~*223,429*~~

~~*Police and gaols*~~

~~664,396~~

~~Civil establishment~~

~~191,347~~

~~Science and education~~

~~278,071~~

~~Crown lands, forests.~~

~~irrigation, har-~~

~~bours, &c. .‘~~

~~244,554~~

~~Post office and tele-~~

~~graphs~~

~~495,498~~

~~Native affairs .~~

~~286,330~~

~~The estimated expenditure (under votes) for 1900-1 was put down at £6,888,352. The colony had a public debt of £31,097,825 on 31st December 1900, including £3,483,878 raised for corporate bodies, harbour boards, but guaranteed in the general revenue. Nearly the whole of the loans have been spent in public works — eighteen millions and a half sterling on railways alone. The total value of assessed property in the colony, excluding the Transkeian Territories, in 1900 was returned at £54,591,746, excluding Govern- ment property. The total revenue of the Divisional Councils in 1900 was £187,493, and expenditure £168,901. The total Municipal~~

~~[statistics~~

~~revenue in 1900 was £942,317, and expenditure £922,992. The total debt of the Divisional Councils, 31st December 1900, was £36,440, and of the Municipalities £2,396,105.~~

~~JDe/ence. — ^The whole of the Cape peninsula is fortified against foreign attack by a series of forts and batteries ; here is situated the important naval station of Simon's Bay, which is to be greatly improved, new docks to cost three millions steriing having been already authorized. A contingent of the Imperial army is specially reserved for the defence of the peninsula, and the Imperial mili- tary expenditure in 1898 was £306,308; the naval expenditure amounted to about £200,000. Further, on the Cape and West African station generally, a squadron of 13 ships is maintained. In 1878 a law was passed whereby every able-bodied man between the age of 18 and 50 years is liable to be called upon for military service, but the only purely colonial force regularly maintained (other than some bodies of volunteers, numbering 6963 in 1898) is that known as the C.M.R. — Cape Mounted Rifies. This corps numbers about 1000 officers and men, whose ordinary duties are to preserve order in Transkei. The Cape PoUce may be called upon for defence purposes in case of emergency. The colonial expendi- ture on defence in 1899-1900 was £223,429.~~

~~Minerals and Mining. — A geological survey of the colony was commenced in 1896. Meanwhile great strides have been already made in developing the mineral resources of the colony. Diamonds have become by far the most valuable of all the products of the industry. The importance of the mines around Kimberley rose by leaps and bounds after their discovery about 1870, and how the output has increased and continues to be maintained will be seen from the figures given below under exports. Coal-mining is another industry that has greatly developed, chiefly owing to the encouragement that has been given to it by the extensive use of Cape coal on the Government railways. The total yield of the mines, which are mostly situated in the Stormbergen, was 198,451 tons in 1900. The demand for~~

~~copper has given a big impetus to the mines in Namaqualand, the output from which was returned at 42,678 tons in 1900.~~

~~Agriculture. — There are no recent statistics as to the area under cultivation, but of the 177,376,660 acres comprising the total area of the colony as at present constituted, 129,065,925 acres had been allotted by the end of 1900, while 48,696,897 acres were still un- disposed of. The area under forests throughout the colony is over 537 square miles (343,680 acres) ; they yield large quantities of valuable timber, and are under the control i of the Department of Agriculture, which was instituted in 1887, and for which a special ministry has been created. This department has done much good work since its institution, especially by introducing French- American resistant stocks into the vineyards, which had suffered very severely from the ravages of the phylloxera, by improving the breed of horses, by establishing an animal bacteriological laboratory, and by practically stamping out the rinderpest. In the old colony and native territories there were produced in the year ending 31st May 1899 — of wheat, 2,220,747 bushels ; oats, 1,810,611 bushels ; barley, 8.30,730 bushels ; mealies, 2,857,809 bushels ; Kaffir com, 2,000,000 bushels ; rye, 304,491 bushels ; and oat-hay, 14,547,044 bundles of about 5^ lb. There were 83,000,000 vine-stocks, yielding 4,824,432 gallons of wine, and 1,107,344 gallons of brandy. There were also fruit trees (peach, apricot, apple, pear, plum, fig, orange, lemon, and naartje) to the number, in 1898, of 4,195,624. The chief pastoral products were — wool, 35,179,900 K) ; mohair, 6,707,379 lb ; ostrich feathers, 278,167 Vb ; and butter, 2,879,000 lb. There were 1,077,044 head of cattle, 387,824 horses, 90,379 mules and asses, 12,639,992 sheep, 5,572,793 Angora and other goats, 245,947 pigs, and 260,672 ostriches. Except in the case of ostriches, these figures are all much lower than those returned in 1891 for the colony as then constituted, and in particular the number of cattle, owing to the ravages of rinderpest in 1896, is less than one-half that returned in the former year. Farms in tillage are comparatively small, but those devoted to the rearing of sheep are very large, ranging from .3000 acres to 15,000 acres and more. For the most part the graziers own the farms they occupy. Perhaps here may be best introduced a reference to the gradual extermination of the big game. The larger "wild animals," with the exception of the elephant and the Cape tiger (leopard), are practically extinct in the old colony. Bucks (antelopes),~~

~~*however, of all sorts, and smaller game, including many varieties of birds, are now protected by laws establishing close seasons.*~~

~~*Fisheries. — These are under the Department of Agriculture, which has done much to develop them. For several years a Government expert has been employed in exploring the fishing- grounds, and examining the habits of the fish, their probable quantity, &c., all round the coast. The result seems to show that lie fishing-grounds could furnish an abundant supply to trawlers. Salmon and trout have been introduced into the rivers with very satisfactory results.*~~

~~*Manufactures. — ^Excluding mines, industrial establishments pro- ducing goods to the value of £100 and upwards employed altogether,*~~

~~*in 1891, 17,062 persons, producing manufactures, &o., valued at £3,560,004. Food, drinks, and stimulants provided the largest item, with 3931 persons, and goods to the value of over two millions sterling; after this came, in value, animal matter, vehicles and harness, dress, buildings, printing books and stationery, and vege- table matter, on each of which, except the last, over 1000 persons were employed. No other industry produced goods to the value of over £100,000, or employed over 1000 persons.*~~

~~*Commerce. — After making every allowance for the natural growth of the colony, it will be seen from the following table, giving the total values (including specie) of the imports and exports in vari- ous years since 1885, that, up to the breaking out of the Boer war, the trade of Cape Colony underwent a great development during the later years of the 19th century.*~~

~~*1885.*~~

~~*1890.*~~

~~*1895.*~~

~~*1898.*~~

~~*1899.*~~

~~*1900.*~~

~~*Imports . Exports*~~

~~*£*~~

~~*4,991,688 6,224,261*~~

~~*£*~~

~~*10,106,466 9,910,870*~~

~~*£*~~

~~*19,094,880 16,904,766*~~

~~*£*~~

~~*16,682,488 25,818,701*~~

~~*£*~~

~~*19,207,549 28,662,588*~~

~~*£*~~

~~*17,161,811*~~

~~*7,64^,68!*~~

~~*In 1900 the specie imported was valued at £2,516,525, and the gross duty received on all imports amounted to £2,309,769. Apart from specie, the principal items in the list of imports in 1900 were textile fabrics, dress, &c., £4,301,331, and food, drinks, &c., £5,584,600. The principal items in the exports were raw gold, £336,795 (this, though not included in the imports, is first imported from the Transvaal, hence, largely, the big fall in the value of the exports in 1900) ; diamonds, £3,433,832 ; wool, £837,809 ; ostrich feathers, £876,801 ; hair (Angora), £489,905; copper ore, £498,552; and hides and skins, £346,800. During the preceding years of the decade, the*~~

~~lowest export of diamonds was £3,013,678 (1894), and the highest £4,775,016 (1895). The total value (partly estimated) of the diamond export from 1867 to 1900 was £95,447,399. The following table (specie excluded) shows the distribution of trade in 1885 and 1900. It will be seen that, in the imports, but not in the exports, the foreign trade has grown more proportionately than the British : —~~

~~Gonntay.~~

~~Imports from~~

~~Exports to~~

~~1885.~~

~~1900.~~

~~1885.~~

~~1900.~~

~~United Kingdom . . British Possessions . Foreign Countries .~~

~~Total /^^^”’^PS]. . \ Specie ;~~

~~£~~

~~3,759,387 578,810 434,707~~

~~£~~

~~11,052,428~~

~~2,477,692~~

~~3,631,691~~

~~£~~

~~*5,451,255 81,664 278,525*~~

~~*£*~~

~~*6,854,175 238,047 664,460*~~

~~*4,772,904*~~

~~*17,161,811*~~

~~*5,811,444*~~

~~*7,646,682*~~

~~*Of the imports in 1900, £1,772,580 were from the United States, and £651,101 from Germany.*~~

~~*Shipping and Navigation — Harbours. — Since 1860 work has been constantly going on at the Cape Town breakwater and docks. When the works, at present being proceeded with, are completed, there will be an area of about 94 acres so entirely enclosed as to be safe from every wind. Up to 1901 about £3,000,000 had been spent. At Port Elizabeth, on the west shore of Algoa Bay, only jetties have as yet been provided, at which cargoes are landed by lighters from vessels lying at anchor in the roadstead, though by*~~

~~*Foreign Trade.*~~

~~*1885.*~~

~~*1895.*~~

~~*1900.*~~

~~*No.*~~

~~*Tonnage,*~~

~~*No.*~~

~~*Tonnage.*~~

~~*No.*~~

~~*Tonnage.*~~

~~*Entrances . • Clearsnoes*~~

~~*716 696*~~

~~*818,666 792,999*~~

~~*851 810*~~

~~*1,974,576 1,905,600*~~

~~*1555 1506*~~

~~*4,808,466 4,701,586*~~

~~*Coasting Trade.*~~

~~*1885.*~~

~~*1895.*~~

~~*1900.*~~

~~*So.*~~

~~*Tonnage.*~~

~~*No.*~~

~~*Tonnage.*~~

~~*No.*~~

~~*Tonnage.*~~

~~*Entrances Clearances*~~

~~*1298 1800*~~

~~*1,896,892 1,904,799*~~

~~*1167 1170*~~

~~*8,141,982 8,158,895*~~

~~*1266 1266*~~

~~*4,608,898 4,658,851*~~

~~*far the largest amount of landing of goods is done here. At East London, at the mouth of the Buffalo river, works have been in*~~

~~*history]*~~

~~*CAPE COLONY*~~

~~*567*~~

~~*progress for many years, with a view to doing away with the bar at the river mouth, and at present vessels drawing about 20 feet of water can discharge cargo at the wharves in the river. At Mossel Bay the arrangements for landing passengers and goods are the same as at Port Elizabeth, only on a much smaller scale ; but rail- way communication, which this part is now for the first time to enjoy, will probably lead to a considerable development of the harbour works. At Port Alfred, at the Kowie mouth, a sum of over three- quarters of a million sterling has been expended, but the average depth of water on the bar is now only about half what it was before the works were commenced, and they have in consequence been practically abandoned. Between Cape Town and East London inclusive, there are sixteen lighthouses. The registered shipping is still comparatively small, amounting in 1900 to only 37 vessels of 5936 tons, of which 31 of 5483 tons were steamers. The tonnage of the shipping engaged in the foreign and coasting trades has, however, grown considerably, as will be seen from the*~~

~~*tables at the foot of the previous page. Of the foreign entrances in 1900, 484 of 1,544,084 tons were British; of the clearances, 856 of 2,538,463 tons.*~~

~~*Internal Communications — Bailways, &c. — In 1875 the only railway ran from Cape Town to Wellington, a distance of 45 miles, while parliamentary sanction had just been given, and money voted, for starting what have since developed into three systems: the Western, the Midland, and the Eastern, the main lines of which proceed from the three principal seaports — Cape Town, Port Elizabeth, and East London, towards Kimberley and the north. The Western System starts from Cape Town, and runs by Kimberley to Vryburg and Mafeking, from which it is continued by the Ehodesian railway to Bulawayo. The total length of the main line is over 1360 miles. Branches run from Cape Town or its immediate neighbourhood to Simon's Town (22 miles), to Caledon (67 miles), and to Pickenier's Kloof by Malmesbury (126 miles). From Worcester a line constructed by a private company, with Government subsidy, runs by Swellendam to Riversdale (147 miles) . The Midland System starts from Port Elizabeth, and the main line runs by Cradock and Naauwpoort to Nerval's Pont on the Orange river, from which it is continued through the Orange River Colony and the Transvaal by Bloemfontein to Johannesburg and Pretoria. The total length of the main line is over 740 miles. From Port Elizabeth a second line (186 miles) runs by Uitenhage and Graaff Reinet, rejoining the main line at Rosmead, from which a junction line (83 miles) runs eastwards, connecting with the eastern system at Stormberg. From Naauwpoort another junc tion line (about 70 miles) runs north-west, connecting the Midland with the Western system at De Aar. A short branch runs from Alicedale to Grahamstown, from which a line (43 miles) , owned by a private compaily, runs south-east to Port Alfred at the mouth of the Kowie. The Eastern System starts from East London, and the main line ran at first to Aliwal North on the Orange river, a distance of 280 miles. After the Midland system was completed to Johannesburg, however, a connecting line was built from Albert Junction, near Burghersdorp, by Bethulie on the Orange river to Springfontein, in what was then the Orange Free State. The distance from East London to Springfontein is 313 miles. A short branch from Blaney rims to King William's Town, and a light rail- way of the standard gauge has been opened from Queenstown to Tarkastad (31 miles). A private railway runs eastwards from Sterkstroom to the Indwe coal-mines (66 miles). From*~~

~~Cookhouse, on the eastern branch of the Midland system, a line is in process of construction by a private company subsidized by Government, westwards to Somerset East and eastwards to King William's Town ; while from Klipplaat, on the western branch of the same system, a line is being constructed under similar conditions to Oudtshoorn and Mossel Bay. It is generally believed that when the gaps in this chain of railways are filled up, they will form the main rail- way route from Cape Town to Natal. The standard gauge of the railways in South Africa is 3 feet 6 inches, the exceptions being the Beira railway, the private railway running from Port NoUoth on the west coast to the O'Okiep copper mines (92 miles), and the light two-foot-gauge railway under construction, as an experiment, from Port Elizabeth to Avontuur. At the end of 1900, the length of Grovernment railways in actual use 'was 2089, while 670 miles of line were under construction. There were also 400 miles of private railways. The capital expended on Government railways to the end of 1900 was £21,842,216, showing a cost per mile of £10,456. The gross earnings in 1900 were £3,520,537, and the expenses, £2, 198,205 ; the number of passengers conveyed was 13,640,414, and the ton- nage of goods, 1,370,248 (of 2000 lb). Electric tramways run in Cape Town and suburbs. Port Elizabeth, East London, and Kim- berley, but in the case of the last-mentioned town horse and mule trams are still more general. In the old colony there are over 8000 miles of roads.~~

~~Posts and Telegraphs.— The number of post-offices at the end of 1898 was 942 ; the revenue in 1900 amounted to £342,431, and the expenditure to £346,979. The total number of letters despatched~~

~~to England from the general post-office. Cape Town, in 1900 was 49,358,840 (nearly double the normal number), and of newspapers and book packets, 1,797,540. Almost every village in South Africa is connected with the outer world by telegraph, and at the end of 1900 there were 7467 miles of line (22,597 miles of wire), with 494 offices, besides 1723 miles of telephone wire. The number of tele- graphic messages sent in 1900 was 3,562,039. The telegraphs were constructed at the expense of the Government, 781 miles of line having been taken over from a company in 1873. The revenue in 1900 was £202,454 (exclusive of £244,766, the value of Government messages), and the expenditure, £205,986.~~

~~*Banks. — The following table gives statistics of the banks under trust laws :*~~
~~—~~

~~*81 8t*~~

~~*December.*~~

~~*InolQding Head Offices.*~~

~~*Circulation, Colony only.*~~

~~*Assets and*~~

~~*Liabilities,*~~

~~*Colony only.*~~

~~*Capital.*~~

~~*Paid Up.*~~

~~*Eeserve.*~~

~~*1890 1895 . 1900 . .*~~

~~*£5,780,610*~~

~~*7,189,090 12,166,800*~~

~~*£1,658,612*~~

~~*2,382,008 6,508,808*~~

~~*£850,489*~~

~~*1,008,837 1,810,621*~~

~~*£740,210*~~

~~*612,266*~~

~~2,042,059~~

~~£9,221,661~~

~~11,864,162 48,068,445~~

~~Money, Weights, and Measures. — Though all the standards are British, the following old Dutch measures are still used : — Liquid Measure: Leaguer=abont 128 imperial gallons; half aum=15^ imperial gallons ; anker=7^ imperial gallons. Capacity : Muid=3 bushels. The general surface measure is the old Amsterdam Morgen, reckoned equal to 2-11654 acres; 1000 Cape lineal feet are equal to 1033 British imperial feet.~~

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Farming Industries of Cape Colony. 8. London, 1896. — Wilmot. The Story of the Expan- sion of South Africa. 2nd edition. London, 1897. — Book of South African Industries. Cape Town, 1892. — History of our own Times in South Africa. 2 vols. London, 1898. — Worsfold. The Story of South Africa. London, 1898. — Younghusband. South Africa of To-day. London, 1898. (r. m'w.)

Ebcent Histoet. The year 1870 marks the dawn of a new era in South Africa. From that date the development of modern South Africa may be said to have fairly started, and in spite of political complications, arising from time to time, the progress of Cape Colony down to the outbreak of the Transvaal war of 1899 was steadily forward. The dis- covery of diamonds on the Orange river in 1867, followed immediately afterwards by the discovery of diamonds on the Vaal river, led to the rapid occupation and develop- ment of a tract of country which had hitherto been but sparsely inhabited. In 1870 Dutoitspan and Bultfontein diamond mines were discovered, and in 1871 the still richer mines of Kimberley and De Beers. These four great deposits of mineral wealth are still richly pro- ductive, and although not technically within the confines of Cape Colony till 1880, to- day they constitute the

greatest industrial asset wMch the colony possesses. At the time of the beginning of the diamond industry, both Cape Colony and the Boer Republics, as well as all the rest of the colonies of South Africa, were in a very de- pressed condition. Ostrich-farming was in its infancy, and agriculture but little developed. The Boers, except in the immediate vicinity of Cape Town, were a primitive people. Their wants were few, they lacked enterprise, and the trade of the colony was restricted. Even the British colonists at that time were far from rich. The diamond industry therefore offered considerable attrac- tions, especially to colonists of British origin. It was also the means at length of demonstrating the fact that South Africa, barren and poor on the surface, was rich below the surface. It takes ten

~~*acres of Karroo to feed a sheep, but it was now seen that a few square yards of diamondiferous blue ground would feed a dozen families. By the end of 1871 a large population had already gath- ered at the diamond fields, and immigration continued steadily, bringing new-comers to the rich fields. Among those who emigrated to South Africa at that time was Mr Cecil Ehodes.*~~

~~*So far back in the history of the colony as 1858, the then Governor, Sir G- eorge Grey, had prepared for the home authorities a scheme for the federation of the various colonies and states of South Africa, but this proposition was not entertained at the time. In 1876, Lord Carnarvon, who was Secretary of State for the Colonies, and who had been successful in aiding to bring about the federation of Canada, turned his atten- tion to a similar scheme for the confederation of South Africa. The new Parliament at Cape Town, which had received its privileges of self-government in 1872, appears to have resented the despatch in which he propounded his suggestions, and passed a resolution stating that any scheme in favour of confederation must in their opinion originate within South Africa itself. James Anthony Froude, the distinguished historian, was sent out by Lord Carnarvon to further his policy in South Africa. As a diplomatist and a representative of the British Govern- ment, the general opinion in South Africa was that Froude was not a success, and he entirely failed to induce the colonists to adopt Lord Carnarvon's views. In 1876, Fingoland, the Idutywa reserve, and Noman's- land, tracts of country on the KaiSr frontier, were an- nexed to Cape Colony, on the understanding that the Cape Government should provide for their government. Lord Carnarvon, still bent on confederation, now ap- pointed Sir Bartle Frere Governor of Cape Colony and HIgh Commissioner of South Africa.*~~

~~*Frere had no sooner taken ofH.ce as HIgh Commissioner, than he found himself confronted with serious native troubles in Zululand and on the KafBr frontier of Cape Colony. In 1877 there occurred an outbreak on the part of the Galekas and the Gaikas. A considerable force of Imperial and Colonial troops was employed to put down this rising, and the war was subsequently known as the Ninth Kaffir war. This war was the last of a long series which the colonists waged on the eastern frontier ever since the colony came into existence. At its conclusion the Transkei, the territory of*~~

~~*the Galeka tribe, under Kreli, was annexed by the British. In the meantime Lord Carnarvon had resigned his position in the British Cabinet, and the scheme for confederation which he had been pushing forward was abandoned. As a matter of fact, at that time Cape Colony was too fully occupied with native troubles to take into consideration very seriously so great a question as confederation. A wave of feeling spread amongst the different Kaffir tribes on the colonial frontier, and after the GaikarGaleka war there followed in 1879 a rising in Basutoland under*~~

~~*Moirosi, whose cattle-raiding had for some time past caused considerable trouble. His stronghold was taken after very severe fighting by a colonial force, but, their defeat notwithstanding, the Basutos remained in a rest- less and aggressive condition for several years. In 1880 the colonial authorities endeavoured to extend to Basuto- land the Peace Preservation Act of 1878, under which a general disarmament of the Basutos was attempted. Further fighting followed on this proclamation, which was by no means successful, and although peace was declared in the country in 1883, the colonial authorities were very glad in 1884 to be relieved of the adminis tration of a country which had already cost them £3,000,000. The Imperial Government then took over Basutoland as a Crown colony, on the understanding that Cape Colony should contribute for adnjinistrative pur- poses £18,000 annually. In 1880, Sir Bartle Frere, who by his energetic and statesmanlike attitude on the rela^ tions with the native states, as well as on all other questions, had won the esteem and regard of loyal South African colonists, was recalled by Lord Kimberley, the Liberal Secretary of State for the Colonies, and was succeeded by Sir Hercules Eobinson. Griqualand West, which included the diamond fields, was now incorporated as a portion of Cape Colony.*~~

~~*The Boer war of 1881, with its disastrous termination, naturally reacted throughout South Africa ; and as one of the most important results, in the year 1882 the first Afrikander Bond Congress was held at Graaff Eeinet. The organization of the Bond developed into one em- bracing the Transvaal, the Orange Free State, and Cape Colony. Each country had a provincial committee with district committees, and branches were distributed through- out the whole of South Africa. At a later date the Bond in the Cape Colony dissociated itself from its Eepublican branches. The*~~

~~*general lines of policy which this organiza- tion endeavoured to promote may best be gathered from De Patriot, a paper published in the colony, and an avowed supporter of the organization. The following ex- tracts from articles published in 1882 will illustrate, better than anything else, the ambition entertained by some of the promoters of this remarkable organization.*~~

~~*" The Afrikander Bond has for its oTDJect the establishment of a South African Nationality by spreading a true love for what is really our fatherland. No better time could be found for establish- ing the Bond than the present, when the consciousness of nation- ality has been thoroughly aroused by the Transvaal war." . . . "The British Government keep on talking about a confederation under the British flag, but that will never be brought about. They can be quite certain of that. There is just one obstacle in the way of confederation, and that is the British flag. Let them remove that, and in less than a year the confederation would be established under the Free Afrikander flag." "After a time the English will realize that the advice given them by Froude was the best — they must just have Simon's Bay as a naval and military station on the way to India, and give over all the rest of South Africa to the Afrikanders." ..." Our principal weapon in the social war must be the destruction of English trade by our establishing trading companies for ourselves." ... "It is the duty of each true Afrikander not to spend anything with the English that he can avoid."*~~

~~*De Patriot afterwards became imperialist, but 0ns Land, another Bond organ, continued in much the same strain.*~~

~~*In addition to having its press organs, the Bond from time to time published official utterances less frank in their tone than the statements of its press. Some of the Articles of the Bond's original manifesto are entirely praiseworthy, e.g., those referring to the administration of justice, the honour of the people, &c. ; such clauses as these, however, were meaningless in view of the en- lightened government which obtained in Cape Colony, and for the true "inwardness" of this document it is necessary to note Article 3, which distinctly speaks of*~~

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~~the promotion of South Africa's independence (Zelf- standigheid). If the Bond aroused disloyalty and mis- taken aspirations in one section of the Cape inhabitants, it is equally certain that it caused a great wave of loyal and patriotic enthusiasm to pass through another and more enlightened section. A pamphlet written in 1885 for an association called the Empire League by Mr Charles Leonard, who afterwards consistently championed the cause of civil equality and impartial justice in South Africa, maintained as follows : —~~

~~"(1) That the establishment of the English Government here was beneficial to all classes ; and (2) that the withdrawal of that Government would be disastrous to every one having vested in- terests in the colony. . . . England never can, never will, give up this colony, and we colonists will never give up England. . . . Let us, the inhabitants of the Cape Colony, be swift to recognize that we are one people, cast together under a glorious flag of liberty, with heads clear enough to appreciate the freedom we enjoy, and hearts resolute to maintain our true privileges ; let us desist from reproaciiing and insulting one another, and, rejoicing that we have this goodly land as a common heritage, remember that by united action only can we realize its grand possibilities. We belong both of us to a home-loving stock, and the peace and prosperity of every home in the land is at stake. On our action now depends the question whether our children shall curse or bless us ; whether we shall live in their memory as promoters of civil strife, with all its miserable consequences, or as joint architects of a happy, prosperous, and united state. Each of us looks back to a noble past. United, we may ensure to our descendants a not unworthy future. Disunited, we can hope for nothing but stagna- tion, misery, and ruin. Is this a light thing ? "~~

~~It is probable that many Englishmen reading Mr Leonard's manifesto at the time regarded it as unduly alarming, but subsequent events proved the soundness of the views it expressed. The fact is that, from 1881 onwards, two great rival ideas came into being, each strongly opposed to the other. One was that of Im- perialism — full civil rights for every civilized man, whatever his race might be, under the supremacy and protection of Great~~

~~*Britain. The other was nominally republican, but in fact exclusively oligarchical and Dutch. The policy of the extremists of this last party was summed up in the appeal which President Kruger made to the !Free State in February 1881, when he bade them " Come and help us. God is with us. It is His will to unite us as a people " — " to make a united South Africa free from British authority." The two actual founders of the Bond party were Mr Borckenhagen, a German who was residing in Bloemfontein, and Mr Eeitz, after- wards State Secretary of the Transvaal. Two interviews have been recorded which show the true aims of these two promoters of the Bond at the outset. One occurred between Mr Borckenhagen and Mr Rhodes, the other between Mr Eeitz and Mr T. Schreiner, whose brother became, at a later date, Prime Minister of Cape Colony. In the first interview Mr Borckenhagen remarked to Mr Ehodes: "We want a united Africa," and Mr Ehodes replied: "So do I." Mr Borcken- hagen then continued : " There is nothing in the way ; we will take you as our leader. There is only one small thing; we must, of course, be independent of the rest of the world." Mr Ehodes replied : " You take me either for a rogue or a fool. I should be a rogue to forfeit all my history and my traditions ; and I should be a fool, because I should be hated by my own country- men and mistrusted by yours." But as Mr Ehodes truly said at Cape Town in 1898, " The only chance of a true union is the overshadowing protection of a supreme power, and any German, Frenchman, or Eussian would tell you that the best and most liberal power is that over which Her Majesty reigns." The other interview took place at the beginning of the Bond's existence. Being approached by Mr Eeitz, Mr T. Schreiner objected that the Bond aimed ultimately at the overthrow of British*~~

~~*rule and the expulsion of the British flag from South Africa. To this Mr Eeitz replied : " Well, what if it is so ? " Mr Schreiner expostulated in the following terms : " You do not suppose that that flag is going to disappear without a tremendous struggle and hard fight- ing?" "Well, I suppose not, but even so, what of that ? " rejoined Mr Eeitz. In the face of this testimony with reference to two of the most prominent of the Bond's promoters, it is impossible to deny that from its beginning the great underlying idea of the Bond was an independent South Africa.*~~

~~*In 1882 an Act was passed in the Cape Legislative Assembly, empowering members to speak in the Dutch language on the floor of the House, if they so desired. The intention of this Act was a liberal one, but the moment of its introduction was inopportune, and its effect was to give an additional stimulus to the policy of the Bond. It was probably also the means of bringing into the House a number of Dutchmen, by no means well educated, who would not have been returned had they been obliged to speak English. By this Act an increase of influence was given to the Dutch leaders. The head of the Afrikander Bond at this time in Cape Colony, and the leader of Dutch opinion, was Mr J. H. Hofmeyr, a man of undoubted ability and astuteness. Although he was recognized leader of the Dutch party in Cape Colony, he consistently refused to take office, preferring to direct the policy and the action of others from an independent position. Mr Hofmeyr sat in the House of Assembly as member for Stellenbosch, a strong Dutch constituency. His influence over the Dutch members was supreme, and in addition to directing the policy of the Bond within the Cape Colony, he supported and defended the aggressive expansion policy of President Kruger and the Transvaal Boers. In 1883, during a debate on the Basutoland Annexation Bill, Mr Ehodes openly charged Mr Hofmeyr in the House with a desire to see a " United States of South Africa rmder its own flag." In 1884 Mr Hofmeyr led the Bond in strongly supporting the Transvaal Boer raiders in Bechuanaland, proclaiming that if the Bechuanaland freebooters were not permitted to retain the territories they had seized, in total disregard of the terms of the Conventions, there would be rebellion among the Dutch of Cape Colony. Fortunately, however, for the peace of Cape Colony at that time, Sir Charles Warren removed the invading Boers from Stellaland and no rebellion occurred. Nevertheless the Bond party was so strong in the House that they compelled the ministry under Sir Thomas Scanlen to resign in 1884. The logical and constitutional course for Mr Hofmeyr to have followed in these circumstances would have been to accept office and himself form a government. This he refused to do. He preferred to put in a nominee of his own who should be entirely dependent on him. Mr Upington, a clever Irish barrister, was the man he selected, and under him was formed in 1884 what will always be known in Cape history as the "Warming-pan" ministry. This action was denounced by many British colonists, who were sufficiently loyal, not only to Great Britain, but also to that constitution which had been conferred by Great*~~

~~*Britain upon the Cape Colony, to desire to see the man who really wielded political power also acting as the responsible head of the party. It was Mr Hofmeyr's refusal to accept this responsibility, as well as the nature of his Bond policy, which won for him the political sobriquet of "The Mole." Open and responsible exer- cise of a power conferred under the constitution of the country, Englishmen and English colonists would have accepted and even welcomed. But that subterranean method of Dutch policy which found its strongest*~~

~~*expression in Pretoria, and which operated from Pretoria to Cape Town, could not but be resented by loyal colonists. From 1881 down to 1898, Mr Hofmeyr practically determined how Dutch members should vote, and also what policy the Bond should adopt at every juncture in its history. The influence of this action on Cape politics was a demoralizing one. Other well-known politicians at the Cape subsequently found it conven- ient to adapt their views a good deal too readily to those held by the Bond. In justice to Mr Hofmeyr, how- ever, it is only fair to say that after the Warren ex- pedition in 1884, which was at least evidence that Great Britain did not intend to renounce her suprem- acy in South Africa altogether, he adopted a less hostile or anti-British attitude. The views and attitude of Mr Hofmeyr between 1881 and 1884 — when even loyal Brit- ish colonists, looking to the events which followed Majuba, had almost come to believe that Great Britain had little desire to maintain her supremacy — can scarcely be wondered at.*~~

~~*Eecognizing the difficulties of the position, Mr Rhodes from the outset of his political career showed his desire to conciliate Dutch sentiment by considerate treatment and regard for Dutch prejudices. Mr Rhodes was first returned as member of the House of Assembly for Barkly West in 1880, and in spite of all vicissitudes this con- stituency remained loyal to him. He supported the Bill permitting Dutch to be used in the House of Assembly in 1882, and early in 1884 he first took office, as Treasurer- General, under*~~

Sir Thomas Scanlen. Mr Rhodes had only held this position for six weeks when Sir Thomas Scanlen resigned, atid later in the same year he was persuaded by Sir Hercules Robinson to proceed to British Bechuanaland as Special Commissioner in succession to Mr Mackenzie. In 1885 the territories of Cape Colony were further extended, and Tembuland, Bomvanaland, and Galekaland were formally added to the colony. In 1886 Sir Gordon Sprigg succeeded Sir Thomas Upington as Prime Minister.

The period from 1878 to 1885 in Cape Colony had been one of considerable unrest. In this short time there occurred a series of native disturbances which were followed by the Boer war of 1881, and the Bechuanaland disturbances of 1884. In spite, however, of these draw-backs, the development of the country proceeded. The diamond industry was flourishing. In 1887 a conference was held ui London for " promoting a closer union be- tween the various parts of the British Empire by means of an Imperial tarifE of customs." At this conference it is worthy of note that Mr Hofmeyr propounded a sort of "ZoUverein" scheme, in which Imperial customs were to be levied independently of the duties payable on all goods entering the empire from abroad. In making the proposition he stated that his objects were "to promote the union of the empire, and at the same time to obtain revenue for the purposes of general defence." The scheme was not at the time found practicable. But its authorship, as well as the sentiments accompanying it, created a favourable view of Mr Hofmeyr's attitude. In the year 1888, in spite of the failure of statesmen and High Commissioners to bring about political confederal tion, the members of the Cape Parliament set about the establishment of a South African Customs Union. A Customs Union Bill was passed, and this in itself con- stituted a considerable development of the idea of federa^ tion. Shortly after the passing of the Bill the Orange Pree State entered the Unioti. An endeavour was also made then, and for many years afterwards, to get the Transvaal to join. But President Kruger, consistently pursuing his own policy, hoped through the Delagoa Bay Railway to make the South African Republic entirely

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independent of Cape Colony. The endeavour to bring about a Customs Union which would embrace the Trans- vaal was also little to the taste of

~~*President Kruger's Hollander advisers, interested as they were in the Nether- lands Railway schemes.*~~

~~*Another event of considerable commercial importance to the Cape Colony, and indeed to South Africa, was the amalgamation of the diamond-mining companies, chiefly brought about by Mr Cecil Rhodes, Mr Alfred Beit, and Mr Barnato in 1889. One of the principal and most beneficent results of the discovery and development of the diamond mines was the great impetus which it gave to railway extension. Lines were opened up to Worcester and Beaufort West, to Graham stown, Graaff Reinet, and Queenstown. Kimberley was reached in 1885. In 1890 the line was extended northwards on the western frontier of the Transvaal as far as Vryburg in Bechuanaland. In 1889 the Pree State entered into an arrangement with the Cape Colony whereby the main trunk railway was extended to Bloemfontern, the Pree State receiving half the profits. Subsequently the Pree State bought at cost price the portion of the railway in its own territory. In 1891 the Free State Railway was still further extended to Viljoen's Drift on the Vaal river, and in 1892 it reached Pretoria and Johannesburg.*~~

~~*In 1889 Sir Henry Loch was appointed High Com- missioner and Governor of Cape Colony in succession to Sir Hercules Robinson. In 1890 Sir Gordon Sprigg, the Premier of the colony, resigned, and a Government was formed under Mr Rhodes. Prior to the formation of this ministry (see Table at end of article), and while Sir Gordon Sprigg was still in office, Mr Hofmeyr ap- proached Mr Rhodes and offered to put him in office as a Bond nominee. This offer Mr Rhodes declined. When, however, he was invited to take office after the downfall of the Sprigg ministry, he asked the Bond leaders to meet him and discuss the situation. His policy of Customs union and railway union between the various states, added to the personal esteem in which he was at this time held by many of the Dutchmen, enabled him to undertake and to carry on successfully the business of government.*~~

~~*The colonies of British Bechuanaland and Basutoland were now taken into the Customs Union existing between the Orange Free State and Cape Colony. Pondoland, another native territory, was added to the colony in 1894, and the year was marked by a departure in native policy for which Mr Rhodes was chiefly responsible. It dealt with the natives residing in*~~

~~*certain native reserves, and in addition to providing for their interests and holdings, and in other ways protecting the privileges accorded to them, the principle of the duty of some degree of labour devolving upon every able-bodied native enjoying these privileges was asserted, and a small labour tax was levied. This Act, entitled the Glen Grey Act, enjoined that " every male native residing in the district, exclusive of natives in possession of lands under ordinary quit-rent titles, or in freehold, who, in the judgment of the resi- dent magistrate, is fit for and capable of labour, shall pay to the public revenue a tax of ten shillings per annum unless he can show to the satisfaction of the magistrate that he has been in service beyond the borders of the district for at least three months out of the previous twelve, when he will be exempt from the tax for that year, or unless he can show that he has been employed for a total period of three years, when he will be exempt altogether." This is in many respects the most states- manlike Act dealing with natives on the statute-book; and in the session of 1896 Mr Rhodes was able to report to the Cape Parliament that the Act then applied to 160,000 natives.*~~

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~~*CAPE COLONY*~~

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~~*During 1895 Sir Hercules Eobinson was reappointed Governor and High Commissioner of South Africa in succession to Sir Henry Loch, and in the same year Mr Chamberlain became Her Majesty's Secretary of State for the Colonies.*~~

~~*With the development of railways, and the extension of trade between Cape Colony and the Transvaal, there had grown up a closer relationship of political questions. Whilst Premier of Cape Colony, by means of the Cus- toms Union and in every other way, Mr Ehodes en- deavoured to bring about a friendly measure of at least commercial federation among the states and colonies of South Africa. He hoped to establish both a commercial and a railway union, and a speech which he made in 1894 at Cape Town admirably describes this policy: —*~~

~~" With full afiection for the flag which I have been bom under, and the flag I represent, I can understand the sentiment and feeling of a republican who has created his independence, and values that before all ; but I can say fairly that I believe in the future that I can assimilate the system, which I have been con- nected with, with the Cape Colony, and it is not an impossible idea that the neighbouring Republics, retaining their independence, should share with us as to certain general principles. If I might put it to you, I would say the principles of tariffs, the principle of railway connexion, the principle of appeal in law, the principle of coinage, and in fact all those principles which exist at the present moment in the United States, irrespective of the local assemblies which exist in each separate state in that country."~~

~~To this policy President Kruger and his Government offered every possible opposition. Their action in what is known as the Vaal River Drift question will best illus- trate the line of action which the Transvaal Government believed it expedient to adopt. A difficulty arose at the termination of the agreement ia 1894 between the Cape Government Eiailway and the Netherlands Railway. The Cape Government, for the purposes of carrying the railway from the Vaal river to Johannesburg, had advanced the sum of £600,000 to the Netherlands Railway and the Transvaal Government conjointly; at the same time it was stipulated that the Cape Government should have the right to fix the traffic rate until the end of 1894, or until such time as the Delagoa Bay-Pretoria line was com- pleted. These rates were fixed by the Cape Government at 2d. per ton per mile, but at the beginning of 1895 the rate for the 52 miles of railway from the Vaal river to Johannesburg was raised by the Netherlands Railway Company to no less a sum than 8d. per ton per mile. It is quite evident from the action which President Kruger subsequently took in the matter that this charge was put on with his approval, and with the object of compelling traffic to be brought to the Transvaal by the Delagoa route, instead of as heretofore by the Colonial Railway. In order to compete against this very high rate, the merchants of Johannesburg began removing their goods from the Vaal river by waggon. Thereupon President Kruger arbitrarily closed the drifts (fords) on the Vaal river, and thus prevented through waggon traffic, causing an enormous block of waggons on the banks of the Vaal. A protest was then made by the Cape Government against the action of the Transvaal, on the~~

~~*ground that it was a breach of the London Convention. President Kruger took no notice of this remonstrance, and an appeal was made to the Imperial Government ; whereupon the latter entered into an agreement with the Cape Government, to the effect that if the Cape would bear half the cost of any expedition which should be necessary, assist with troops, and give full use of the Cape Railway for military purposes if required, a protest should be sent to President Kruger on the subject. These terms were accepted by Mr Rhodes and his colleagues, of whom Mr W. P. Schreiner was one, and a protest was then sent by Mr Chamberlain stating that Her Majesty's*~~

~~*Government would regard the closing of the drifts as a breach of the London Convention, and as an unfriendly action calling for the gravest remonstrance. President Kruger at once reopened the drifts, and imdertook that he would issue no further ■ proclamation on the sub- ject except after consultation with the Imperial Govern- ment.*~~

~~*In the year 1895 the Jameson Raid occurred, and Mr Rhodes's complicity in this movement compelled him to resign the Premiership of Cape Colony in January 1896. As Mr Rhodes's complicity in the Raid became known, there naturally arose a strong feeling of resent- ment and astonishment among his colleagues in the Cape miaistry, who had been kept in complete ignorance of his connexion with any such scheme. Mr Hofmeyr and the Bond were loud in their denunciation of him. After his resignation, Mr Rhodes was proceeding to the north, when he received a summons from the Chartered Com- pany to go to London; but after interviews with the directors in London, he went back to Rhodesia, and was present in the country duriag the Matabele rebellion. While hostilities were still proceeding in Matabeleland,Mr Rhodes went unarmed to a meeting of Matabele Indunas (chiefs) in the heart of the Matoppo hills. The result was not a massacre of the great white chief, as was foretold at the time, and as has occurred on similar occasions in attempted negotiations with Bantu tribes, but a peace which terminated the rebellion. It was a master-stroke of diplomacy and courage. The Matabele rising ended, Mr Rhodes travelled down through the colony on his way to attend the iaquiry of the British South Africa Select Committee at Westminster, which had been appointed to investigate the causes of the Raid. The memory of the Raid, and Mr Rhodes's complicity iti*~~

~~*it, was still fresh in men's minds, the Cape Parliament having itself brought out the main facts by means of a committee of their own. But, nevertheless, so high was the esteem in which he was held that at both Port Elizabeth and Cape Town he met with an enthusiastic reception, and even at the Paarl, a Dutch centre in the Western Province, he was presented with an address signed by farmers, of whom the majority were Dutchmen. In 1897 a native rising occurred under Galeshwe, a Bantu chief, in Griqualand West. Galeshwe was arrested and the rebellion repressed. On cross- examination Galeshwe stated that Bosman, a magistrate of the Transvaal, had supplied ammunition to him, and urged him to rebel against the Government of Cape Colony. There is every reason to suppose that this charge was true, and it is consistent with the intrigues which the Boers have from time to time practised among the natives.*~~

~~*In 1897 Sir Alfred Milner was appointed High Com- missioner of South Africa and Governor of Cape Colony in succession to Sir Hercules Robinson, who was created a peer under the title of Baron Rosmead.*~~

~~*In 1898 commercial federation in South Africa ad- vanced another stage. Natal entering the Customs Union. A fresh convention was drafted at this time, and under it "a uniform tariff on all imported goods consumed within such Union, and an equitable distribution of the duties collected on such goods amongst the parties to such Union, and free trade between the colonies and state in respect of all South African products," was arranged. In the following year the Cape Parliamentary election occurred, and the result was the return to power of a Bond ministry under Mr W. P. Schreiner. From this time, until June 1900, Mr Schreiner remained in office as head of the Cape Government. During the negotiations which preceded the war in 1899, feeling at the Cape ran very high, and Mr Schreiner's attitude has been freely dis- cussed. As head of a party, dependent for its position*~~

~~*in power on the Bond's support, his position was un- doubtedly a trying one. At the same time, as Prime Minister of a British colony, it was strongly felt by loyal colonists that he should at least have refrained from openly*~~

interfering between the Transvaal and the Imperial Government during the course of most difficult negotiations. His public expressions of opinion were hostile in tone to the policy pursued by Mr Chamberlain and Sir Alfred Milner. The effect of them, it was believed, might conceivably be to encourage President Kruger in persisting in his rejection of the British terms. Mr Schreiner, it is true, used directly what influence he possessed to induce President Kruger to adopt a reason- able course. But however excellent his intentions, his publicly expressed disapproval of the Chamberlain-Milner policy probably did more harm than his private influence with Mr Kruger could possibly do good. On 11th June 1899, shortly after the Bloemfontein Conference, from which Sir Alfred Milner had just returned, Mr Schreiner asked the High Commissioner to inform Mr Chamberlain that he and his colleagues agreed in regarding President Kruger's Bloemfontein proposals as "practical, reason- able, and a considerable step in the right direction." Early in June, however, the Cape Dutch politicians be- gan to realize that President Kruger's attitude was not so reasonable as they had endeavoured to persuade them- selves, and Mr Hofmeyr, accompanied by Mr Herholdt, the Cape Minister of Agriculture, visited Pretoria. On arrival, they found that the Transvaal Volksraad, in a spirit of defiance and even levity, had just passed a reso- lution offering four new seats in the Volksraad to the mining districts, and fifteen to exclusively burgher dis- tricts. Mr Hofmeyr, on meeting the executive, freely expressed indignation at these proceedings. Unfortu- nately, Mr Hofmeyr's influence was more than counter- balanced by an emissary from the Tree State, Mr Abraham Fischer, who, while affecting to be a peacemaker, practi- cally encouraged the Boer executive to take extreme measures. Mr Hofmeyr's established reputation as an astute diplomatist, and as the trusted leader for years of the Cape Dutch party, made him as powerful a delegate as it was possible to find. His political insight enabled him at once to see that a concession to those moderate franchise demands which constituted the substance of Sir Alfred Milner's proposals at Bloemfontein, and which came to be known as the "Milner Minimum," might safely be accepted by the Transvaal without jeopardizing its independence. He recognized that a free admission of the Hitlanders to the franchise, with some additional ten Uitlander seats in the Volksraad, would not only leave the independence of the Transvaal unimpaired, but would leave the Boers largely masters of the situation; while he trusted to time to reconcile other

~~differences, such as the questions of voting for President and Commandant-General. If any emissary could accomplish anything in the way of persuading Mr Kruger, it was assuredly Mr Hofmeyr. Much was looked for from his mission by moderate men of all parties, and by none more so, it is fair to believe, than by Mr Schreiner. But Mr Hofmeyr's mission, like every other mission to Mr Kruger to induce him to take a reasonable and equitable course, proved entirely fruitless. He returned to Cape Town disappointed, but probably not altogether sur- prised at the failure of his mission. Meanwhile a new proposal was drafted by the Boer executive, which, before it was received in its entirety, or at least before it was clearly understood, elicited from Mr Schreiner a letter on 7th July to the South African News, in which, referring to his Government, he said : —~~

~~"While anxious and continually active with good hope in the cause of securing reasonable modifications of the existing repre-~~

~~[history~~

~~sentative system of the South African Eepublio, this Government is convinced that no ground whatever exists for active interference in the internal affairs of that Eepuhlic."~~

~~This letter was precipitate and unfortunate. On 11th July, after seeing Mr Hofmeyr on his return, Mr Schreiner made a personal appeal to President Kruger to approach the Imperial Government in a friendly spirit. At this time an incident occurred which raised the feel- ing against Mr Schreiner to a very high pitch. On 7th July 600 rifles and 1,000,000 rounds of ammunition were landed at Port Elizabeth, consigned to the Free State Government, and forwarded to Bloemfontein. Mr Schreiner's attention was called to this consignment at the time, but he refused to stop it, alleging as his reason that, inasmuch as Great Britain was at peace with the Free State, he had no right to interdict the passage of arms through the Cape Colony. The British colonist is as capable of a grim jest as the Transvaal Boer, and this action of Mr Schreiner's won for him the nickname " Ammunition Bill." At a later date he was accused of delay in forwarding artUlery and rifles for the defence of Kimberley, Maf eking, and other towns of the colony. The reason he gave for delay was that he did not anticipate war; and that he did not wish to excite unwarrantable siispicions in the minds of the Free State.~~

~~*His conduct in both instances may have been technically correct, but it was much resented by loyal colonists.*~~

~~*On 28th July Mr Chamberlain sent a conciliatory despatch to President Kruger, suggesting a meeting of delegates to consider and report on his last franchise proposals, which were complex to a degree. Mr Schreiner, on 3rd August, telegraphed to Mr Fischer begging the Transvaal to welcome Mr Chamberlain's proposal. At a later date, on receiving an inquiry from the Free State as to the movements of British troops, Mr Schreiner curtly refused any information, and re- ferred the Free State to the High Commissioner. On 28th August Sir Gordon Sprigg in the House of Assembly moved the adjournment of the debate, to discuss the removal of arms to the Free State. Mr Schreiner, in reply, used expressions which called down upon him the severest censure and indignation, both in the colony and in Great Britain. He stated that, should the storm burst, he would keep the colony aloof with regard both to its forces and its people. In the course of the speech he also read a telegram from President Steyn, in which the president repudiated all contemplated aggressive action on the part of the Free State as absurd. The speech created a great sensation in the British press. It was probably forgotten at the time (though Lord Kimberley afterwards publicly stated it) that one of the chief reasons why the Gladstone Government had granted the retrocession of the Transvaal after Majuba, was the fear thgi the Cape Colonial Dutch would join their kinsmen if the war continued. What was a danger in 1881, Mr Schreiner knew to be a still greater danger in 1899. At the same time it is quite obvious, from a review of Mr Schreiner's conduct through the latter half of 1899, that he took an entirely mistaken view of the Transvaal situation. He evinced, as Premier of the Cape Colony, the same inability to understand the Uitlanders' grievances, the same futile belief in the eventual fairness of President Kruger, as he had shown when giving evidence before the British South Africa Select Committee into the causes of the Jameson Raid. Actual experience taught him that President Kruger was beyond an appeal to reason, and that the protesta- tions of President Steyn were insincere. War had no sooner commenced with the ultimatum of the Trans- vaal Eepublic on 9th October 1899, than Mr Schreiner found himself called upon to deal with the conduct of*~~

~~*history]*~~

~~*CAPE COLONY*~~

~~*573*~~

~~*Cape rebels. The rebels joined the invading forces of President Steyn, whose false assurances Mr Schreiner had offered to an indignant House of Assembly only a few months before. The war on the part of the Eepublics was evidently not to be merely one of self- defence. It was one of aggression and conquest. Mr Schreiner ultimately addressed, as Prime Minister, a sharp remonstrance to President Steyn for allowing his burghers to invade the colony. He also co-operated with Sir Alfred Milner, and used his influence to restrain the Bond.*~~

~~*The first shot actually fired in the war was at Kraipan, a small railway station within the colony, forty miles south of Mafeking, a train being derailed, and ammuni- tion intended for Colonel Baden-Powell seized. The effect of this was entirely to cut off Mafeking, the northern- most town in Cape Colony, and it remained in a state of siege for over seven months. On 16th October Kimberley was also isolated. Proclamations by the Trans-vaal and Pree State annexing portions of Cape Colony were actually issued on 18th October, and included British Bechuanaland and Griqualand West, with the diamond fields. On 28th October Mr Schreiner signed a pro-clamation issued by Sir Alfred Milner as High Com- missioner, declaring the Boer annexations of territory within Cape Colony to be null and void. The battles of Belmont, Graspan, and Modder River were all fought by Lord Methuen in November, on colonial soil, in his endeavour to force a passage through to the relief of Kimberley. The heavy British losses at Modderfontein on 29th November were followed by a reverse in Cape Colony at Stormberg, where an expedition under General Gatacre from Queenstown marched into a Boer ambush and was defeated. On the following day Lord Methuen suffered a severe check and heavy losses at Magersfontein. The effect of these engagements at the very outset of the war, occurring as they did within Cape Colony, was to offer every inducement to a number of the frontier colonial Boers to join their kins-men of the Eepublics. The Boers are prolific, and their families large. Many*~~

~~*younger sons from the colony, with nothing to lose, left their homes with horse and rifle to join the republican forces.*~~

~~*Meanwhile the loyal Cape colonists were chafing at the tardy manner in which they were enrolled by the Imperial authorities. It was not until after the arrival of Lord Roberts and Lord Kitchener at Cape Town on 10th January 1900 that these invaluable, and many of them experienced, men were freely invited to come forward. So strongly did Lord Roberts feel on the subject, that he at once made Colonel Brabant, a well-known and respected colonial veteran and member of the House of Assembly, a Brigadier-General, and started recruiting loyal colonists in earnest. On 15th February Kimberley was relieved by General French, and the Boer General, Cronje, evacu- ated Magersfontein, and retreated towards Bloemfontein. Mr Cecil Rhodes was shut up in Kimberley during the whole of the siege, and his presence there undoubtedly offered an additional incentive to the Boers to endeavour to capture the town, but his unique position and influ- ence with the De Beers workmen enabled him to render yeoman service, and infused enthusiasm and courage into the inhabitants. The manufacture of a big gun, which was able to compete with the Boer "Long Tom," at the De Beers workshops, under Mr Rhodes's orders, and by the ingenuity of an Ameri- can, Mr Labram, who was killed a few days after its completion, forms one of the most striking incidents of the war.*~~

~~*On 11th March Barkly East, a small town on the north-east frontier of the colony, which had been seized*~~

~~*by the rebels, was reoccupied by British forces, and by the 18th of March, Burghersdorp, Aliwal North, Herschel, Lady Grey, Prieska, and other frontier towns reported that the rebel movement had collapsed. Mafeking, where the beleaguered garrison maintained their gallant defence under Colonel Baden-Powell till 17th May, was relieved by a force, chiefly colonial, sent up from Kimberley. With this incident the Cape rebel- lion ended, and the colony was at least for a time deliv- ered of the presence of hostile forces.*~~

~~*On 20th March Mr Rose-Innes, a prominent member of the House of Assembly, who for several years had held aloof from either party, and who also had defended Mr Schreiner's action with regard to the passage of arms*~~

~~*to the Free State, addressed his constituents at Claremont in support of the annexation of both republics ; and in the course of an eloquent speech he stated that in Canada, in spite of rebellions, loyalty had been secured from the French Canadians by free institutions. In South Africa they might hope that a similar policy would attain a similar result with the Boers. In June, Mr Schreiner, whose recent support of Sir Alfred Milner had incensed many of his Bond followers, resigned in consequence of the refusal of some of his colleagues to support the Dis- franchisement Bill which he was prepared, in accordance with the views of the Home Government, to introduce for the punishment of Cape rebels. The bill certainly did not err on the side of severity, but disfranchisement for their supporters in large numbers was more distasteful to the Bond extremists than any stringency towards individuals. Sir Gordon Sprigg, who after a political crisis of consid- erable delicacy succeeded Mr Schreiner, and for the fourth time became Prime Minister, was able to pass the Bill with the co-operation of Mr Schreiner and his sec- tion. Towards the end of the year 1900 the war entered on a new phase, and took the form of guerilla skirmishes with scattered forces of marauding Boers. In December some of these bands entered the Cape Colony and endeav- oured to induce colonial Boers to join them. In this endeavour they met at first with little or no success ; but as the year 1901 progressed and the Boers stiU managed to keep, the various districts in a ferment, it was deemed necessary by the authorities to proclaim martial law over the whole colony, and this was done on the 9th October*~~

~~*1901.*~~

~~*On 4th January 1901 Sir Alfred Milner was gazetted Governor of the Transvaal and Orange River Colony, being shortly afterwards created a peer as Lord Milner, and Sir Walter Hely-Hutchinson, Governor of Natal, was appointed his successor as Governor of the Cape Colony.*~~

~~*Since responsible government was first granted to Cape Colony, it must be admitted that, in spite of the sinister Transvaal influ- ence on the Bond, the system has, on the vbole, worked smoothly and well. There have at least never occurred in the Cape Chamber such scenes as have disgraced more than one European legislative assembly in recent years, while the statute-book is evidence of the many useful and enlightened measures which have*~~

passed into law. Many writers have objected that much more ought to have been done by a body of educated men in matters of excise, remedial measures for a depressed agriculture, and other schemes of a similar character, but as against this there must be set an admir- able system of colonial civil service, which administers and con- trols railways, post, telegraphs, education, and native affairs with excellent results, while the Customs Union is a real step towards a practical scheme of federation.

The public life of Cape Colony has produced many men of singular ability and accomplishments, some having been of European and others of colonial birth.

First and foremost stands the Right Hon. Cecil J. Bhodes. While quite a young man, he was sent by the Cape Government in 1884 as Deputy-Commissioner to Bechuanaland. The policy he there adopted was that of maintaining the "Suez Canal" of South Africa — the Bechuanaland route to the north — for Great

Britain at all costs. He first endeavoured to conciliate the Boers by every reasonable concession, and only when he found this task hopeless did he join the politicians at the Cape in the agitation which led to the Warren expedition. By this action the great northern trade route was kept open. In 1889 Mr Rhodes was chiefly instrumental in bringing about the amalgamation of the diamond mines of Kimberley, a measure which strengthened and conserved the great mineral resources of the diamond fields, and thus preserved for Cape Colony an industry which might have declined with over-production. It has been urged that this step greatly added to his own fortune, but of all the millionaires South Africa has produced none has recognized more liberally the obligations of wealth. It is recorded of the very negotiations which led to amalgamation that Mr Rhodes insisted on the application of what (following Mr Chamberlain in his " Radical days ") he called the doctrine of ransom, whereby a certain portion of the immense wealth won by such a huge and lucrative corporation as the De Beers Consolidated Mines should be directly devoted

~~*to the development and progress of the country from which that wealth was derived. In this action he also received the support of Mr Alfred Beit. This policy has been accepted and in a considerable measure acted on by the De Beers directors, if not by all shareholders, and £500,000 was advanced to further the opening up of Rhodesia and railway extension. Under Mr Rhodes's chairmanship all local institutions were treated with a liberality foreign to most commercial concerns, and he on at least one occasion urged the desirability of investing De Beers funds for the furtherance of the fruit industry in the Western Province, many of the fruit-growers being without enough capital or the requisite knowledge to conduct this industry with much success. In his dealings with the natives of Cape Colony and elsewhere in South A.frica, Mr Rhodes was particularly suc- cessful. He won their personal respect, and he was signally successful, both with the Pondos and the Matabele, in arranging their future government. He opposed the native liquor traffic, and at the risk of offending some of his supporters among the brandy farmers of the Western Province, he suppressed it entirely on the diamond mines, and restricted it as far as he was able in the native reserves and territories. Nevertheless the continu- ance of this traffic on colonial farms, as well as to some extent in the native territories and reserves, is a black spot in the annals of the Cape Colony. The Hottentots have been terribly demoralized, and even partially destroyed by it in the Western Province.*~~

~~*Mr Rhodes has been denounced by his enemies as an autocrat. In view of his successful conduct of the Premiership for several years, and his cordial relationship with many men of all parties, the charge cannot be considered a just one. At the same time he had a direct way of going to the heart of things, and sometimes of acting entirely on his own responsibility in matters of State importance. The leading instance of this was in the Jameson Raid. But another instance, which is not so widely known, and in which the result was beneficial to all concerned, deserves some notice. After the native territories east of the Kei had been added to Cape Colony, and were under colonial administration, a case of claim to inheritance came up for trial, and in accordance with the law of the colony, the Court held that the eldest son of a native was his heir. This decision created the strongest resent- ment among the people of the territory, as it was in distinct contradiction to native tribal law, which recognized the great son, or son of the chief wife, as*~~

~~*heir. The Government were threatened with a native disturbance, when Mr Rhodes telegraphed his assur- ance that compensation should be granted, and that such a decision should never be given again. This assurance was accepted and tranquillity restored. At the close of the next session (that of 1894), after this incident had occurred, Mr Rhodes laid on the table a Bill drafted by himself, the shortest the House had ever seen. It provided that all civil cases were to be tried by magis- trates, an appeal to lie only to the chief magistrate of the territory with an assessor. Criminal cases were to be tried before the judges of Supreme Court on circuit. The Bill was passed, and the effect of it was, inasmuch as the magistrates administered according to native law, that native marriage customs and laws (including polygamy) were legalized in these territories. Mr Rhodes had retrieved his promise, and no one who has studied and lived amongst the Bantu will question that the action taken was both beneficent and wise. When not engaged with Cape politics, Mr Rhodes turned his energies to the north, and Rhodesia has become a monument to his energy, ambition, and financial genius.*~~

~~*Sir Gordon Sprigg, four times Premier, has been associated with the Cape Parliament since 1873. In and out of office his zeal has been unflagging, and if he lacks those qualities which inspire enthusiasm, and are requisite in a great leader, he has at least been a model of industry. Among other prominent politicians have been Mr Rose-Innes, Mr J. X. Merriman, and Mr Sohreiner. Mr Rose-Innes is a lawyer whose intellectual gifts and patriotism have never been impugned ; he is not a*~~

~~*"party man," and this has made him, on more than one occasion, a somewhat difficult political ally. On the native question he has taken up a consistently strong attitude, defending their rights, and uncompromisingly opposing the native liquor traffic. Mr Thomas Fuller, the Cape Town representative, though he has remained outside office, has given staunch support to every en- lightened liberal and progressive measure which has been brought forward. A man of exceptional culture and eloquence, he has made his influence felt, not only in politics, but in journalism, and every other branch of social and public life in the colony.*~~

~~*In literature, the colony has produced at least two authors whose works have taken their place among those of the best English writers of their day. The Mstory of South Africa, by Mr G. M'Call Theal, will remain a classic work of reference. The careful industry and the lucidity which characterize Mr Theal's work, stamp him as a historian of whom South Africa may well be proud. In fiction, Olive Schreiner (Mrs Cronwright- Schreiner) produced, while still in her teens, the Story of an African Farm, a work which gave great promise of original literary genius. Her later works have scarcely fulfilled that promise. Unfortunately, she, in common with the rest of South Africa, was swept into the seething vortex of contemporary politics, and her political pamphlets will add nothing to her reputation as a writer, whatever value they may have as expressions of opinion. In music and painting there have been artists of talent in the Cape Colony, but the country is still too young, and the condi- tions of life too disturbed to allow such a development as has already occurred in Australia.*~~

~~*GOVEKNORS AT THE CaPE SINCE luTEODUCTIOlf OF ReSPONSIBLB*~~

~~*Government. 1870. Sir Henry Barkly. 1877. Sir Bartle Frere. 1880. Sir Hercules Robinson. 1889. Sir Henry Loch.*~~

~~*1895. Sir Hercules Robinson (Lord Bosmead). 1897. Sir Alfred Milner. 1901. Sir W. Hely-Hutchinson.*~~

~~*Prime Ministers.*~~

~~*1872. 1878. 1881. 1884.*~~

~~*1890. Mr C. J. Rhodes. 1896. Sir J. Gordon Sprigg. 1898. Mr W. P. Schreiner. 1900. Sir J. Gordon Sprigg.*~~

~~*Mr J. C. Molteno. Mr J. Gordon Sprigg. Mr T. C. Scanlen. Mr Upington. Sir J. Gordon Sprigg.*~~

~~*Authorities. — History of South Africa, Theal ; South African History and Geography, Theal ; Annual Begister, Cape of Good ' Hope, 1899 ; Leading Points in South African History, Pratt ; South African Studies, Hilliek ; Cecil Bhodes : Political Life and Speeches, Vindex ; Cecil Bhodes.*~~

~~*Imperialist, and Dr Jameson ; South Africa: Its History, Heroes, and War, Mackenzie and Stead ; Austral Africa : Losing it or Buling it, Mackenzie ; " The Times" History of the Boer War; Parliamentary Papers — see Colonial Office list ; Argus Annual and South African Directory.*~~

~~*(A. P. H.)*~~

~~*Cape Elizabeth, a town of Cumberland county, Maine, U.S.A., situated in the south-western part of the state, adjoining Portland, and on the Boston and Maine railway. In 1895 it was subdivided, and a part of it chartered as the city of South Portland. Population*~~

~~*(1880), 6302 ; (1890), 5459..*~~

~~*Cape Town, the capital of Cape Colony, on the south shore of Table Bay, between the sea and Table Mountain. It stands on a site at first almost flat, then of moderate ascent, and finally with steep slope as the moun- tain and its spurs are approached. It is almost completely hemmed in on the west by the Lion's Head and Eump, and less completely so on the east by the Devil's Peak. Since 1875 the town has been modernized. The " stoeps " have been cleared away, and continuous foot pavements put in their place ; the streets have been levelled up and paved or well macadamized, and an underground drainage and sewage system is now approaching completion. As the supply of water from the Molteno Reservoir at the foot of Table Mountain was found insufficient for the increasing needs of the town, another reservoir, with a capacity of several hundred million gallons, has been constructed on the top of the mountain. The town is lighted with gas and electric light, water falling from the mountain to the Molteno Reservoir supplying the motive power for the*~~

~~*production of the latter. The old flat-roofed style of archi- tecture is being gradually eliminated, and fine structures of _ modern design are rising in every part. The most noteworthy streets from the architectural point of view are Adderley Street, the fashionable business quarter, in which stand the*~~

~~*Railway Station, the new General Post- Office, and the Standard Bank; and Queen Victoria Street, looking into the Gardens, in which are the City Club, the New Supreme Courts, the Art School, the Huguenot Memorial Hall, and, at a later date, the University Buildings. At present there are no University buildings, but a site and a large sum of money for building have been bequeathed to the University. The Parliament Houses have been completed, but a new and worthier Anglican cathedral is stUl a desideror turn. Of the other public buildings, apart from those noticed in Ency. Brit, ninth edition, there are the South African College, with antiquated buildings except for the modern chemical and physical labotatories ; the South African Museum, a well-equipped modern building in the centre of the Botanical Gardens, quite apart from the Public Library ; and the Good Hope Seminary for Girls. The suburbs of Cape Town, for natural beauty of position, are among the finest in the world. On the west they extend for about three miles, by Green Point to Sea Point, between the sea and the foot of the Lion's Eump ; on the east they run round the foot of the Devil's Peak, by Woodstock, Mowbray, Eondebosch, Claremont, &c., to Wynberg, a distance of 7 miles. Though these are managed by various municipalities, there is practi- cally no break in the buildings for the whole ten miles. All the parts are connected by the suburban railway ser- vice, and by an electric tramway system. A branch of the tramway is in process of construction over the " nek " between Table Mountain and the Lion's Head, to Camp's Bay, on the west coast, and a branch of the railway is being constructed from Cape Town round the head of Table Bay towards Blaauwberg, with a view to the laying out of a new marine suburb. Trade has considerably increased in Cape Town, though it is still smaller than that of Port Elizabeth. In 1899 the goods landed amounted in value to about 5^ millions sterling. The exports cannot well be compared with those from other ports, as they include the diamonds and bar gold from the whole of South Africa. In 1899 the total was over £11,000,000. In 1891 the population of Cape Town proper was 51,261, almost equally divided between white and coloured. The population of the whole Cape peninsula at the same date was about 100,000, the bal- ance, also equally divided, being found mostly in the Cape Town suburbs. (b. m'w.)*~~

~~*Cape Verde Islands, The, on the West African coast, between 17° 13' and 14° 47' N. lat., and 22° 45' and 26° 22' W. long., consisting of fourteen*~~

~~*islands and islets, all belonging to Portugal. Area, 1475 square miles ; popu- lation (1896), 139,796. The principal product of the soil is coffee, cultivated chiefly on the islands of Santo Antao, Fogo, and Sao Thiago. The physic nut (Jatropha curcas) grows abundantly and well, also the sugar-cane, millet, and vegetables. Excellent oranges are grown. Every variety of live stock is kept, especially cattle, on Sao Thiago, Fogo, and Boa Vista. The principal industries, apart from agriculture, are the manufacture of sugar, spirits, salt, cottons, straw hats, and fish-curing. The total exports amounted in 1896 to a value of £85,800, and the imports (including £198,200 for coal for passing steamboats) to £364 670 The most important of the exports were cof- fee (£39,100), physic-tree seed (£20,450), millet (£17,- 100), sugar, spirits, salt, live animaJs, skins, and fish. This trade is principally carried on with Lisbon and the*~~

~~*Portuguese possessions on the west coast of Africa, and with passing vessels. The imports consist principally of textiles (£43,350), food-stuffs (£23,100), wine, metals, tobacco, machinery, pottery, vegetables, &c. In 1899 the ports of the archipelago were entered by a total of 3225 vessels of 3,548,065 tons. . The coal, for passing steam- boats, was imported in 106 steamers with 326,577 tons cargo. The total imports in the same year were £345,111, and the exports £47,777.*~~

~~*Capernaum, on the shore of the Sea of Galilee. The site has been placed at TeU. Hum, where are the ruins of a synagogue, now the property of the Franciscans, and extensive remains ; at Khan Minyeh ; and at et-Tabgha. At Ker^zeh, 3 miles north of Tell Hum, are the ruins of Chorazin.*~~

~~*Capital Punishment. — By this term is meant the infliction of the penalty of death for crime under the sentence of some properly constituted authority, as dis- tinguished from killing the offender as a matter of self- defence or private vengeance, or his execution under the order of some self-constituted or irregular tribunal un- known to the law, such as that of the Vigilantes of Cali- fornia, or of lynch law as practised in the Southern and Western of the United States. In the early stages of society manslayers were killed by the avengers m * ™ of blood on behalf of the family of the man killed, and not as representing the authority of the State. This mode of dealing with homicide survives in the ven- detta of Corsica and of the Mainotes in*~~

~~Greece, and in certaiu of the Southern States of North America. The obligation or inclination to take vengeance depends on the fact of homicide, and not on the circumstances in which it was committed, i.e., it is a part of the lex talionis. The mischief of this system was alleviated under the Levitical law by the creation of cities of refuge, and in Greece and Italy, both in pagan and Christian times, by the recognition of the right of sanctuary in temples and churches. A second mode of dealing with homicide was that known to early Teutonic and early Celtic law, where the relatives of the deceased, instead of the life of the slayer, received the wer of the deceased, i.e., a payment in proportion to the rank of the slain, and the king received the blood-wite for the loss of his man. But even under this system certain crimes were in Anglo- Saxon law bot-less, i.e., no compensation could be paid, and the offender must suffer the penalty of death.~~

~~United Kingdom. —~~ ~~The modes of capital punishment in England under the Saxon and Danish kings were various : hanging, beheading, burning, drowning, stoning, and precipitation from rocks. The principle on which this variety depends is that where an offence was g.^^^^^^ such as to entitle the king to outlaw the offen- foreign der, he forfeited all, life and limb, lands zsidi laws and goods, and that the king might take his life "*""'*• and choose the mode of death. William the Conqueror would not permit judgment of death to be executed, and substituted mutilation; but his successors varied somewhat in their policy as to capital punishment, and by the 13th century the penalty of death became by usage (without legislation) the usual punishment for high and petty treason and for all felonies (except mayhem and petty larceny, i.e., theft of property worth less than Is.). It therefore included all the more serious form of offences against person or property, such as mur- der, manslaughter, arson, highway robbery, burglary, (or hamesucken), and larceny ; and when statutory felonies were created they were also punishable by death unless the statute otherwise provided. The death penalty was also extended to heretics under the writ de heretico comburendo, which was lawfully issuable under statute~~

~~*from 1382 (5 Eic. II. stat. 5) until 1677 (29 Chas. II. c. 9). For this purpose the legislature had adopted the ciyil law of the Roman empire, which was not a part of the English common law (Stephen, Hist. Cr. Law, 438-469).*~~

~~*The severity of barbarian and feudal laws was miti- gated, so far as common-law offences were concerned, by the influence of the Church as the inheritor of Christian traditions and Eoman jurisprudence. The Roman law under the empire did not allow the execution of citizens except Lex Porcia. But the right of the emperors to legislate per rescriptum principis enabled them to disre- gard the ordinary law when so disposed. The 83rd novel of Justinian provided that criminal causes against' clerics should be tried by the judges, and that the convicted cleric should be degraded by his bishop before his con- demnation by the secular power, and others of the novel gave the bishops considerable influence, if not authority, over the lay judiciary. In Western Europe the right given by Imperial legislation in the Eastern empire was utilized by the Papacy to claim privilege of clergy, i.e., that clerks must be remitted to the bishop for canonical punishment, and not subjected to civil condemnatioii at all. The history of benefit of clergy is given in Pollock and Maitland, Hist. English Law, vol. i. pp. 424-440, and Stephen, Hist. Cr. Law, 463. By degrees the privilege was extended not only to persons who could prove ordina- tion or show a genuine tonsure, but all persons who had sufficient learning to be able to read the neck-verse (Ps. li. V. 1). Before the Reformation the ecclesiastical courts had ceased to take any effective action with respect to clerks accused of offences against the king's laws ; and by the time of Henry VII. for the old process of compurga- tion in use in these courts was substituted burning on the hands under the order of the king's judges.*~~

~~*The effect of the claim of benefit of clergy is said to have been to increase the number of convictions, though it mitigated the punishment; and it became, in fact, a means of showing mercy to certain classes of indi- viduals convicted of crime as a kind of privilege to the educated, i.e., to all clerks whether secular or religious (25 Edw. III. stat. 3) ; and it was allowed only in case of a first conviction, except in the case of clerks who could produce their letters of orders or a certificate of ordina- tion. To prevent a second claim it was the practice to brand murderers with the*~~

~~*letter M, and other felons with the Tyburn T, and Ben Jonson was in 1590 so marked for manslaughter.*~~

~~*The times of Henry VIII. were marked by extreme severity in the execution of criminals. After the former tion of English settlements in America the severity of the law was mitigated by the practice of reprieving persons sentenced to death on condition of their consenting to transportation to the American colonies, and entering into bond service there. The practice seems to have been borrowed from Spain, and to have been begun at the end of the 16th century (39 Eliz. c. 4). It was in full force immediately after the Restoration, and is recognized in the Habeas Corpus Act of 1677, and was applied by Cromwell after his campaign in Ireland, and to the Cameronians during Claver house's campaign in south-west Scotland. In the 18th century the courts were empowered to sentence felons to transportation instead of to execu- tion, and this state of the law continued until 1857 (6 Law Quarterly Review, p. 388). The power to sentence to transportation applied only to felonies with benefit of clergy ; and in 1705, on the abolition of the necessity of proving capacity to read, all criminals alike became entitled to the benefit previously reserved to clerks. Benefit of clergy was finally abolished in 1827 as to all persons not having privilege of peerage, and in 1841 as to peers and peeresses. By this time its beneficial effect*~~

~~*had been exhausted, since no clergyable offences remained capital crimes.*~~

~~*At the end of the 18th century the criminal law of all Europe was ferocious and indiscriminating by its admin- istration of capital punishment for almost all forms of grave crime ; and yet owing to poverty, social conditions, and the inefBciency of the police, such forms of crime were far more numerous than they now are. The policy and righteousness of the English law were questioned as early as 1766 by Goldsmith through the mouth of the vicar of Wakefield : " Nor can I avoid even questioning the validity of that right which social combinations have assumed of capitally punishing offences of a slight nature. In cases of murder their right is obvious, as it is the duty of us all from the law of self-defence to cut off that man who has shown a disregard for the life of another. Against such all nature rises in arms ; but it is not so against him who steals my property."*~~

~~*He adds later : " When by indiscriminate penal laws the nation beholds the same punishment affixed to dissimilar degrees of guilt, the people are led to lose all sense of distinction in the crime, and this distinction is the bulwark of all morality."*~~

~~*The opinion expressed by Goldsmith was strongly supported by Bentham, Romilly, Basil Montagu, and Mackintosh in England, and resulted in considerable mitigation of the severity of the law. In 1819 about 180 crimes were capital. As the resiilt of the labour of these eminent men and their disciples, and of Sir Robert Peel, there are now only four crimes capitally punishable in England, — high treason, murder, piracy with violence, and destruction of public arsenals and dockyards (12 Geo. III. c. 24). An attempt to abolish the death penalty for this last offence was made in 1837, but failed, and has not since been renewed. In the case of the last two offences sentence of death need not be pronounced, but may be recorded (4 Geo. IV. c. 48). HIgh treason is rarely prosecuted as such, but dealt with as treason felony, and since 1838 sentence of death has in practice been executed only for murder.*~~

~~*The change in the severity of the law is best illustrated by the following statistics : —*~~

~~*Tears.*~~

~~*Death Sentences.*~~

~~*Sentences Executed. |*~~

~~*For all Crimes.*~~

~~*For Murder.*~~

~~*For all Crimes.*~~

~~*For Murder.*~~

~~*1831 18331 18381 18621*~~

~~*1601*~~

~~*931*~~

~~*116*~~

~~*29*~~

~~*14*~~

~~*9*~~

~~*25*~~

~~*28*~~

~~*52*~~

~~*33*~~

~~*6*~~

~~*15*~~

~~*12 6*~~

~~*5 15*~~

~~*During the twenty years from 1879 to 1898, 1278 persons were committed for trial in England for murder, being an average of 64. The highest number was in 1884 (79), and the lowest in 1892*~~

~~*(50).*~~

~~*Of those tried in 1898, 27 were convicted, 11 were executed (all males), 16 had their sentence commuted to penal servitude for life.*~~

~~*The judicial statistics do not show whether any persons charged with murder were convicted of manslaughter.*~~

~~*Twenty persons charged with murder were sent to Broadmoor as criminal lunatics. Of these 5 were found insane on arraignment, 11 were found guilty, but insane, and 4 were certified insane by the Home Office before or after trial. It is difficult to reconcile these figures with those of the convictions, except by supposing that the persons found guilty, but insane, are not included in the con- victions.*~~

~~*The common-law method of punishing male traitors was ferocious in the extreme. According to Walcot's case (1696) 1 Eng. Rep. p. 89, the proper sentence was " quod . . . ibidem super bigam (herdillum) ponatur et abinde usque ad f ureas de [Tyburn] trahatur, et ibidem per coUum suspendatur et vivus ad terram prosternatur et quod secreta*~~

~~*1 Each of these years followed upon legislation mitigatine severitr of punishment. = o **~~

~~*CAPITALPUNISHMENT*~~

~~*577*~~

~~*membra ejus amputentur, et interiora sua intra ventrem suum capiantur et in ignem ponantur et ibidem ipso vivente comburantur, et quod caput ejus amputetur, quodque corpus ejus in quatuor partes dividatur et illo ponantur ubi dominus rex eas assignare voluit." There is a tradi- tion that Harrison the regicide after being disembowelled rose and boxed the ears of the executioner.*~~

~~*In Townley's case (18 Howell, State Trials, 350, 351), there is a ghastly account of the mode of executing the sentence ; and in that case the executioner cut the traitor's throat. In the case of the Cato Street conspiracy (1820, 33 Howell, State Trials, 1566), after the traitors had been hanged their heads were cut off by a man in a mask whose dexterity led to the belief that he was a surgeon.*~~

~~*Female traitors were until 1790 liable to be drawn to execution and burnt alive. In that year hanging was substituted for burning (30 Geo. III. c. 48).*~~

~~*In 1814, so much of the sentence as related to dis- embowelling and burning the bowels was abolished (54 Geo. III. c. 146), and the king was empowered to substi- tute decapitation for hanging. But it was not till 1870 that the portions of the sentence as to drawing and quartering were abolished (33 and 34 Vict. c. 23, § 31).*~~

~~*The mode of executing male offenders other than traitors has in England almost always been by hanging. The more primitive modes of carrying out the sentence were gradually disused, and the present system of hanging by use of the drop is said to have been inaugurated by the exertions of Earl Ferrers. The form of scaffold now in use has under the gallows a drop constructed on the principle of the trap-doors on a theatrical stage, upon which the convict is placed under the gallows, a white cap is placed over his head, and when the halter has been properly adjusted the drop is withdrawn by a mechanical contrivance, and the convict falls to a distance calculated to fracture the cervical vertebrae, the noose tightening so as to stop respiration, and the convict hangs until life is extinct.*~~

~~*It was until quite lately considered essential that*~~

~~*executions, like trials, should be public, and be carried out*~~

~~*in a manner calculated to impress evil-doers. Partly to*~~

~~*this idea, partly to notions of revenge and temporal*~~

~~*punishment of sin, is probably due the rigour of the*~~

~~*administration of the English law. But the methods of*~~

~~*execution were unseemly, as delineated in Hogarth's print*~~

~~*of the execution of the idle apprentice, and were ineffectual*~~

~~*in reducing the bulk of crime, which was augmented by*~~

~~*the inefficiency of the police and the uncertainty and*~~

~~*severity of the law, which rendered persons tempted to*~~

~~*commit crime either reckless or confident of escape. The scandals attending public executions led to an attempt to alter the law in 1841, although many protests had been made long before, among them those of the novelist Fielding. But perhaps the most forcible and effectual was that of Charles Dickens in his letters to the Times written after mixing in the crowd gathered to witness the execution of the Mannings at Horsemonger Lane Gaol in 1849. After his experiences he came to the conclusion that public executions attracted the depraved and those affected by morbid curiosity; and that the spectacle had neither the solemnity nor the salutary effect which should attend the execution of public justice. His views were strongly resisted in some quarters ; and it was not until 1868 (31 and 32 Vict. c. 24) that they were accepted, and executions for murder conducted in private in England. Under that Act (which was adopted from similar legislation already in force in the Australian colonies) convicted- murderers are hanged within the walls of a prison. As a general rule the sentence is carried*~~

~~*out at 8 A.M. on a week-day (not being Monday), in the*~~

~~*week following the third Sunday after sentence was passed. The persons required to be present are the sheriff, the gaoler, chaplain, and surgeon of the prison, and such other officers of the prison as the sheriff re- quires; justices of the peace for the jurisdiction to which the prison belongs, and such of the relatives, or such other persons as the sheriff or visiting justices allow, may also attend. It is usual to allow the attendance of some representatives of the Press. The death of the prisoner is certified by the prison surgeon, and a de- claration that judgment of death has been executed is signed by the sheriff. An inquest is then held on the body by the coroner for the jurisdiction and a jury from which prison of&cers are excluded. The certificate and declaration, and a duplicate of the coroner's inquiry also, are sent to the HIome Office, or in Ireland to the Lord-Lieutenant, and the body of the prisoner is interred in quicklime within the prison walls if space is available. It is also the practice to hoist a black flag on the prison at the moment of execution, and to display it for an hour, and to toll the prison bell, or the bell of a neighbouring church, for fifteen minutes before and fifteen minutes after the execution.*~~

~~*These regulations apply only to executions for murder ; but since the passing of the Act there have been no execu- tions for any other crime within the United Kingdom.*~~

~~*In Scotland capital punishment can be imposed only for treason, murder, and offences against 10 Geo. IV. c. 38, i.e., wilful shooting, stabbing, strangling, or throwing corrosives with intent to murder, maim, disfigure, disable, or do grievous bodily harm, in all cases where if death had ensued the offence would have been murder. Prior to 1887 Jape, robbery, wilful fire-raising, and incest, and many other crimes, were also capital offences ; but in prac- tice the pains of law were restricted at the instance of the prosecution. The sentence is carried out by hanging. It is accomplished under the supervision of the magistrates of the burgh in which it is decreed to take place ; and in lieu of the inquest necessary in England and Ireland an inquiry is held at the instance of the procurator-fiscal before a sheriff or sheriff-substitute.*~~

~~*In Ireland capital punishment can be imposed for the same offences as in England, except offences under the Dockyards Protection Act, 1772 (12 Geo. III. c. 24), and it is carried out in the same manner.*~~

~~*Offences under Military Law. — Thus far only crimes against the ordinary law of the land have been dealt with. But both the Naval Discipline Act of 1866 and the Army Act empower courts-martial to pass sentence for a number of offences against military and naval laws. Such sentences are rarely if ever passed where an ordinary court is within reach, or except in time of war. The offences extend from traitorous communication with the enemy and cowardice on the field to falling asleep while acting as a sentinel on active service.*~~

~~*British Colonies and Possessions. — Under the Indian Penal Code sentence of death may be passed for waging war against the king (§ 121) and for murder (§ 302). If the murder is committed by a man under sentence of transportation for life the death penalty must be imposed (§ 303). In other cases it is alternative. This code has been in substance adopted in Ceylon, the Straits Settle- ments, and Hong-Kong, and in the Sudan. In most of the British colonies and possessions the death penalty may be imposed only in the case of high treason, wilful murder, piracy with violence. But in New South Wales and Victoria sentence of death may be passed for rape and criminal abuse of girls under ten. In Queensland the law was the same until the passing of the Criminal Code of 1899.*~~

~~*Throughout British South Africa the criminal law is*~~

~~*based on the Eoman-Dutch law, and not on the English common law. Capital punishment is there lawful for treason (crimen perduellionis or laesae majestatis), murder and rape (van Leeuwen, c. 36). Though the Roman- Dutch modes of executing the sentence by decapitation or breaking on the wheel have not been formally abolished, in practice the sentence is*~~

~~*executed by hanging. The Roman- Dutch law as to cirime and punishments has been super- seded in Ceylon and British Guiana by ordinances based on the English system. Under the Canadian Criminal Code of 1892 the death sentence may be imposed for treason (§ 657), murder (§ 231), rape (§ 267), piracy with violence (§ 127), and upon subjects of a friendly power who levy war on the king in Canada (§ 68). But the judge is bound by statute to report on all death sentences, and the date of execution is fixed so as to give time for considering the report. The sentence is executed by hanging within a prison, and under conditions very similar to those in England (§§ 936-945).*~~

~~*Austria-Hungary. — Under the Austrian Penal Code sentence of death may be passed, inter alia, for the graver forms of high treason, for murder, robbery with violence causing death, incendiarism or damage to trains, steamers, &c., causing death. The sentence is carried out by public hanging, supplemented, if ineflfectual, by the hands of the executioner. It is very rarely executed. The criminal law of Hungary embodied in a code of 1885 has not abolished capital punishment.*~~

~~*Belgium. — \Jndi.&c the Belgian Penal Code of 1867 the death penalty is retained for certain forms of high treason, and for assassination and parricide by poisoning. It may not be pronounced on a person under 18. The sentence is executed publicly by the guillotine. But no execution seems to have taken place since 1863.*~~

~~*Denmark. — Sentence of death used to be executed by the axe ; the guillotine is now used.*~~

~~*Finland. — In Finland the death penalty is alleged not to have been inflicted since 1824 ; and it is said to have been abolished in 1826.*~~

~~*France. — Under the ancien rigime in Prance, 115 crimes had become capital in 1789. The mode of execution varied, but in some cases it was effected by breaking on the wheel or burning, and was coupled with mutilation. Under the Penal Code of 1810, as amended in or after 1832, even so late as 1871, thirty offences were capital, one being perjury against a prisoner resulting in his condemnation to death (art. 361). But juries freely exercise the power of acquitting in capital cases, or of defeating the*~~

~~capital sentence by finding extenuating circumstances in more than seven-eighths of the cases, which compels the court to reduce the punishment by one or more degrees, i.e., below the penalty of death. The sentence is executed in public by decapitation by the guillotine.~~

~~Germany. — In many of the states of Germany capital punishment had been abolished (Brunswick, Coburg, Nassau, Oldenburg in 1849; Saxe-Meiningen, Saxe- Weimar, 1862; Baden, 1863; Saxony, 1868). But it has been restored by the Imperial Criminal Code of 1872, in the case of attempts on the life of the emperor, or of the sovereign of any federal state in which the offender happens to be (§ 80), and for deliberate homi- cide (§ 211). The various states are allowed to choose their own instruments of death. In the old provinces of Prussia it is the axe. In Rhenish Prussia and the kingdom of Saxony the guillotine is used. Executions were public till 1851, but they are now conducted privately within the prison walls in the presence of certain specified persons.~~

~~Holland. — In Holland there have been no executions since 1860. The death penalty was abolished in 1870, and was not reintroduced in the Penal Code of 1886.~~

~~The mode of execution used to be by hanging, as in England.~~

~~Italy.— GsL-pital punishment was abolished in Tuscany as far back as 1786, and from Italy has come the chief opposition to the death penalty originated by Beccaria, and supported by many eminent jurists. Under the Penal Code of 1888 the death penalty was abrogated for all crimes, even for regicide. The cases of homicide in Italy are very numerous compared with those in England ; but there are no statistics available to show any connexion between this fact and the abolition of capital punishment.~~

~~Japan.— The penalty of death is executed by hanging within a prison. ,It may be imposed for executing or contriving acts of violence against the Mikado or certain of his family, and for seditious violence with the object of seizing the territory or subverting the government or laws of Japan, or conspiring with foreign Powers to commence hostilities against Japan. It is inflicted for certain forms of homicide, substantially wilful murder in the first degree.~~

~~*Norway. — Under Norwegian law sentence of death may be passed for murder with premeditation. But the court may as an alternative decree penal servitude for life. Sentence of death must be passed in cases where a person under sentence of penal servitude for life commits murder or culpable homicide, or causes bodily injuries in cir- cumstances warranting a sentence of penal servitude for life, or commits robbery or the grave forms of wilful fire- raising. The sentence is carried out by decapitation ; but there has been no execution since 1876.*~~

~~*Portugal. — There has been considerable objection in Portugal to capital punishment, and it is said to have been abolished in 1867. No one has been executed since 1846.*~~

~~*Bumania. — Capital punishment was abolished in Rumania in 1864.*~~

~~*Russia. — In 1750 under the Empress Elizabeth capital punishment was abolished ; but it has since been restored, and is certainly inflicted for forms of high treason and attempts against the royal family, and breaking the quarantine laws for keeping out plague. It is difficult to ascertain whether it applies to other forms of crime ; but it would seem that persons are put to death for some of the grave forms of homicide. The sentence is executed by shooting, beheading, or hanging.*~~

~~*Spain. — Under the Spanish Penal Code of 1870 the following crimes are capital : inducing a foreign power to declare war against Spain, killing the sovereign, parricide, and assassination. The sentence is executed in public. The criminal is conducted to the scaffold on horseback or in a cart, wearing a black tunic. A procession of priests, &c., attends him. He is seated on a scaffold and executed by the garrotte, i.e., he is fastened to an upright post by an iron collar, and a knob worked by a screw or lever dislocates his spinal column, or a small blade severs the spinal column at the base of the brain.*~~

~~*Sweden. — The severity of the law in Sweden was greatly mitigated so far back as 1777. Under the present law the penalty of death may be imposed for certain forms of treason, including attempts on the life of the sovereign or on the independence of Sweden, or its union with Norway, and for premeditated homicide (assassinat), and in certain cases for offences*~~

~~*committed by persons under sentence of imprisonment for life. Under a royal decree of 1877 it is executed by decapitation within the walls of a prison in the presence of certain officials and, if desired, of repre- sentatives of the commune in which the prison is situate. It is rarely executed, but in 1901 a man was beheaded for running amuck on a steamboat and killing and wound- ing a dozen people, and in 1901 a Bill to abolish capital punishment was rejected by both Houses of the Swedish Parliament.*~~

~~*Switzerland. — Capital punishment was abolished in Switzerland in 1874 by Federal legislation ; but in 1879, in consequence of a plebiscite, each canton was empowered to restore the death penalty for offences in its territory. The Federal Government was unwilling to take this course, but was impelled to it by the fact that, between 1874 and 1879, cases of premeditated murder had considerably increased. Seven of the cantons out of twenty-two have exercised the power given to restore capital punishment. But there do not seem to have been any cases in which the death penalty was inflicted; and on the assassination of the empress of Austria at Geneva it was foiind that the laws of the canton did not permit the execution of the assassin.*~~

~~*United States of America. — Under the Federal laws sentence of death may be passed for treason against the United States and for piracy and for murder within the Federal jurisdiction. But for the most part the punish- ment of crime is regulated by the laws of the constituent states of the Union.*~~

~~*The death penalty was abolished in Michigan in 1846 except for treason, and wholly in Wisconsin in 1853. In Maine it was abolished and subsequently re-enacted, but again abolished in 1887. In Rhode Island it was abolished in 1852, but restored in 1882, only in case of murder committed by a person under sentence of imprisonment for life. In all the other states the death penalty may still be inflicted : in Alabama, Delaware, Georgia, Mary- land, and West Virginia, for treason, murder, arson, and rape ; in Alaska, Arizona, Kansas, New Jersey, Missis- sippi, Montana, New York, North Dakota, Oregon, and South Dakota for treason and murder ; in*~~

~~*Colorado, Idaho, Illinois, Iowa, Massachusetts, Minnesota, Ne- braska, New Hampshire, New Mexico, Nevada, Ohio, Oklahoma, Pennsylvania, Utah, and Wyoming for murder only; in Kentucky and Virginia for treason, murder, and rape ; in Vermont for treason, murder, and arson ; in Indiana for treason, murder, and arson if death result ; in California for treason, murder, and train wreck- ing ; in North Carolina for murder, rape, arson, and burglary ; in Florida, Missouri, South Carolina, Tennes- see, and Texas for murder and rape ; in Arkansas and Louisiana for treason, murder, rape, and administering poison or use of dangerous weapons with intent to murder. Louisiana is cited by Girardin (le droit depunir) as a state in which the death penalty was abolished in 1830. Under the influence of the eminent jurist, Livingston, who framed the state codes, the legislature certainly passed a resolution against capital punishment. But since as early as 1846 it has been there lawful, subject to a power given to the jury, to bring in a verdict of guilty, "but no capital punishment," which had the effect of imposing a sentence of hard labour for life. In certain other states the jury has undesr local legislation the right to award the sentence. The constitutionality of such legislation has been doubted, but has been recognized by the courts of Illinois and Iowa. Sentence of death is executed by hanging by the neck except in New York and Ohio, where it is carried out by " electro- cution," or by passing through the body of the convict a current of electricity of sufficient intensity to cause death and until death is caused. The execution is carried out privately in a specified prison, only certain specified persons or classes of persons are allowed to be present, and no coroner's inquest is held (Ohio Stat §§ 7338-7344, New York State Laws of 1888, c. 489). The validity of the New York law was attacked, largely on the ground that the method of death which was pre- scribed under it was a " cruel and unusual punishment " and therefore contrary to one of the clauses of the Consti- tution of the United States; but the constitutionality of the law was finally upheld both in the state and Federal*~~

~~*courts. Through the United States as a whole public opinion is certainly not against capital punishment.*~~

~~*With the mitigation of the law as to punishment the agitations against capital punishment have lost their force. But many Continental and American writers, and some English writers and associations, advocate the*~~

~~*total abolition of the death punishment. ™* «”” ’ fimile de Girardin, writing against all forms of aMiiioa. punishment, said that he would abolish that of death last as being the least cruel and the most effectual. The ultimate argument of the opponents is that society has no right to take the life of any one of its members on any ground. But they also object to capital punish- ment : (1) on religious grounds, because it may deprive the sinner of his full time for repentance ; (2) on medical grounds, because homicide is usually if not always evidence of mental disease or irresponsibility; (3) on utilitarian groimds, because capital punishment is not really deterrent, and is actually inflicted in so few instances for murder that criminals discount the risks of undergoing it ; (4) on legal grounds, i.e., that the sentence being irrevocable and the evidence often circum- stantial only, there is great risk of gross injustice in executing a person convicted of murder ; (5) on moral grounds, that the punishment does not fit the case nor carry out the true function of punishment, namely, the reformation of the offender.*~~

~~*The punishment is probably retained, partly fronn ingrained habit, partly from a sense of its appropriate- ness for certain crimes, but also that the ultima ratio may .be available in cases of sufficient gravity to the commonweal. The apparent discrepancy between the number of trials and convictions for murder is not in England any evidence of hostility on the part of juries to capital punishment, which has on the whole lessened rather than increased since the middle of the 19th century. It is rarely if ever necessary in England, though common in America, to question the jurors as to their views on capital punishment. The reasons for the comparatively small number of convictions for murder seem to be : (1) that court and jury in a capital case lean in favorum vitce, and if the offence falls short of the full gravity of murder, conviction for manslaughter only results ; (2) that in the absence of a statutory classification of the degrees of murder, the prerogative of mercy is exercised in cases falling short of the highest degree of gravity as recognized by lawyers and public opinion ; (3) that where the conviction rests on circum- stantial evidence the sentence is not executed unless the circumstantial evidence is conclusive ; (4) that charges of infanticide against the mothers of illegitimate children are treated mercifully by judge and jury, and usually terminate in acquittal, or in a conviction of concealment of birth ; (5) that many persons tried as murderers are obviously insane ; (6) that coroners’ juries are somewhat*~~

recklessly free in returning inquisitions of murder with- out any evidence which would warrant the trial of the person accused.

The medical doctrine, and that of Lombroso, with re- spect to criminal atavism and irresponsibility have pro- bably tended to incline the public mind in favour of capital punishment, and Sir James Stephen and other eminent jurists have even been thereby tempted to advocate the execution of habitual criminals. It certainly seems strange that the community should feel bound carefully to preserve and tend a class of dangerous lunatics, and to give them, as Charles Kingsley says, " the finest air in England and the right to kill two gaolers a week."

The whole question of capital punishment was con- sidered by a royal commission appointed in 1864, which

reported in 1866 (Pari. Pap. 1866, 10,438). The com- mission took the opinions of all the judges of the supreme courts in the United Kingdom and of many other eminent persons, and collected the laws of other countries so far as this was ascertainable. The commissioners differed on the question of the expediency of abolishing or retaining capi- tal punishment, and did not report thereon. But they recommended : (1) that it should be restricted through- out the United Kingdom to high treason and murder ; (2) alteration of the law of homicide so as to classify homicides according to their gravity, and to confine capi- tal punishment to murder in the first degree ; (3) modi- fication of the law as to child murder so as to punish certain cases of infanticide as misdemeanours; (4) authorizing judges to direct sentence of death to be re- corded; (5) the abolition of public executions.

Of these suggestions Parliament has carried out only the last, from which the commissioners averse from capi- tal punishment dissented ; and it is improbable that the ■question will again assume any importance until a crimi- nal code is introduced. At the present time, when a trial for murder takes place, there is frequently a good deal of newspaper agitation for

~~reprieve of the prisoner. But this is usually dictated more by desire to re-try the case in the Press, and to criticize the evidence or the tribunal, than to advocate the theories of absolute opponents to capital punishment.~~

~~Authorities. — Becoakia. Dei Delitte e de Pene, 1790. — Ben- THAM. Rationale of Punishment. — Olivecrona. Be la Peine de Mart. — MiTTEKMAiER. Capital Punishment. — Beport of the Royal Commission on Capital Punishment (Pari. Pap. 1866. No. 10,438). — Oldfield. The Penalty of Death, 1901. — Pollock and Mait- LAWD. History of English Law. — Pike. History of Crime. — Sir J. F. Stephen. History of Crime in England. — S. Walpole. History of England, vol. i. p. 191 ; vol. iv. p. 74. (y^^j-. c.)~~

~~Capitanata, the former name, down to 1871, of the Italian province of Poggia.~~

~~Capiz, the capital of the province of the same name in the Island of Panay, Philippine Islands. . It is some five miles from the north coast, on a river of suf&cient depth to admit small steamers. It is a healthful, although rather hot, town, with good government build- ings. Alcohol is manufactured in large quantities from the fermented juice of the nipa palm, which grows plenti- fully in the neighbouring swamps. Eice and sugar are raised in abundance. Tobacco, Indian corn, and cacao are produced to a limited extent. Fishing, and the weaving of fabrics of cotton, hemp, and pine-apple fibre, are important industries. The language is Visayan. Population, 25,000.~~

~~Capo d'lstria, a fortified seaport town of Austria, in the margraviate of Istria. In addition to the produc- tion of salt, its principal industries are weaving, dyeing, and shipbuilding. Trade is chiefly in sea^salt, wine, and oil. It is also a sea-bathing resort. Population (1890), 10,706; (1900), 10,711, mostly Italian.~~

~~Capri, an island of the province of Naples, Campania, Italy, at the S. entrance of the Gulf of Naples. It is visited by some 30,000 strangers every summer, whilst many German and other artists stay there all the year round. The air is pure, the winter mean being 60° Fahr. The island is also famous for its wine. Since 1874 there has been a driving-road up to Anacapri (pop.~~

~~2500). Population of Capri, the chief town, 3700 ; of the entire island, about 6500.~~

~~Caprivi de Caprera de Montecuccoii, Ceorg Leo von, Count (1831-1899), German sol- dier and statesman, was born 24 February 1831 at~~

~~Charlottenburg. The family springs from Carniola, and the name was originally written Kopriva; in the 18th century one branch settled in Wernigerode, and several members entered the Prussian service ; the father of the Chancellor held a high judicial post, and was made a life member of the Prussian HOuse of Lords. Caprivi was educated in Berlin, and entered the army in 1849; he took part in the campaign of 1866, being attached to the staff of the 1st army. In 1870 he served as chief of the staff to the 10th army corps, which formed part of the 2nd army, and took part in the battles before Metz as well as in those round Orleans, in which he highly distinguished himself. After the peace he held several important military offices, and in 1883 was made Chief of the Admiralty, in which post he had to command the fleet and to organize and represent the department in the Eeichstag. HE resigned in 1888, when the com- mand was separated from the representation in Parliar ment, and was appointed commander of the 10th army corps. Bismarck had already referred to him as a possi- ble successor to himself, for Caprivi had shown great administrative ability, and was unconnected with any political party ; and in March 1890 he was appointed Chan- cellor, Prussian Minister President, and Foreign Minister. HE was quite unknown to the public, and the choice caused some surprise, but it was fully justified. The chief events of his administration, which lasted for four years, are narrated elsewhere,- in the article on Germany. HE showed great ability in quickly mastering the business, with which he was hitherto quite unacquainted, as he himself acknowledged ; his speeches in the Reichstag were admirably clear, dignified, and to the point. HIs first achievements were the treaty with Great Britain in 1890, for which he was bitterly attacked by the colonial parties. The commercial treaties with Austria, Rumania, &c., followed; by concluding them he earned the express commendation of the Emperor and the title of Count, but he was from this time relentlessly attacked by the Agrarians, who made it a ground for their distrust that he was not himself a landed proprietor ; and from this time he had to depend much on the support of the Liberals and other parties who~~

~~had been formerly in opposition. The reorganization of the army caused a parliamentary crisis, but he carried it through successfully, only, how- ever, to earn the enmity of the more old-fashioned soldiers, who would not forgive him for shortening the period of service. His position was seriously compromised by the failure in 1892 to carry an Education Bill which he had defended by saying that the question at issue was Christi- anity or Atheism, and he resigned the presidency of the Prussian ministry, which was then given to Count Eulen- burg. In 1894 a difference arose between Eulenburg and Caprivi concerning the bill for an amendment of the Criminal Code (the Umsturz Vorlage), and in October the Emperor dismissed both. Caprivi's fall was probably the work of the Agrarians, but it was also due to the fact that, while he showed very high ability in conducting the business of the country, he made no attempt to secure his personal position by forming a party either in Parlia- ment or at Court. He interpreted his position rather as a soldier ; he did his duty, but did not think of defending himself. He suffered much from the attacks made on hira by the followers of Bismarck, and he was closely associated with the social ostracism of that statesman ; we do not know, however, in regard either to this or to the other events of his administration, to what extent Caprivi was really the author of the policy l\,e carried out, and to what extent he was obeying the orders of the Emperor. With a loyalty which cannot be too highly praised, he always refused, even after his abrupt dis- missal, to justify himself, and he could not be persuaded~~

~~_H.IVI,5~~

~~Harfield's~~

~~Inflexible Capstan Gear.~~

~~even to write memoirs for later publication. The last years of his life were spent in absolute retirement, for he could not return even to the military duties which he had left with great reluctance at the orders of the Emperor. He died unmarried on 6th February 1899, at the age of sixty-eight.~~

~~*See Die Beden des Grafen v. Caprivi (Berlin, 1893).*~~

~~(j. w. HE.)~~

~~Capstan (Windlass), an appliance used on board ship and on dock walls in connexion with weighing anchor and transporting ship. Its earlier forms were of a com- paratively simple char- acter, but, as heavier cables were supplied to ships, the difficulty when riding was in holding and veer- ing. A new cable-holder made by Mr W. H. Har- field was tried in H.M.S. Newcastle and proved effec- tive ; its first development was the application in the form of a windlass secured to the depk driven by means of a messenger Fig. 1. chain from the capstan,~~

~~fitted in H.M.S. Inflexible (Fig. 1).~~

~~The capstans and engine are shown at A, A, A, and the windlass B is driven by messenger chains C, C. The four cables (dotted line D, D) lead to their respective cable-holders, fitted with a brake similar to that in Fig. 2, and by these means each cable-holder can be connected to the main driving shaft, and any cable hove-in or veered independently of the other ; by using steam-power instead of hand- the slow motion is obviated. In H.M.S. Gullingwood steam-power is used to work the windlass directly by means of worm gearing ; the windlass is divided into two parts, so that the one on the port side can be worked independently of that on the starboard, and vice versQ,. An independent capstan in both ships, arranged to take either of the cables, can be worked by hand or steam. In the Gollingwood's windlass, the cables remain on their holders and can be hove-in or veered without touching the chain. Fig. 2 is Harfield's frictional brake, which also acts as a connector. A is the cable-holder loose on the shaft B, C and C are a series of plates connected to the spindle by a suitable carrier, D and D another series connected to the cable-holder, and E a plate into which the bars are inserted, revolving the screw F. By means of the latter the two series of discs are pressed together, obtaining the necessary amount of friction for veering slowly or rigidly connect- ing ; when the top plate~~

~~is screwed back the harfields patent~~

~~cable-holder revolves Cqmpquhp Fr.ctiona|. b«/>ke k CoN^Ecrtg. freely. Fig. 3 is the gear fitted in the Formidable class (15,000 tons). The two~~

~~*cable-holders on the upper deck. A, are each fitted with a frictional brake for veering and connecting, the former being worked from be- _. low the armoured deck by steam-engine B and worm-wheel C, and the compound clutch at D enables the cables to be — worked together, or sep- arately, or simultane- ously, with one "heaving in" and the other veer- ing. The middle-line capstan E, on the upper deck, is not fitted with brake gear, but will take the main cables, and, by portable whelps, wire and hempen hawsers ; it can be worked by steam from engine B, through worm-wheel F, or by capstan bars GG (Capstan, ninth edition). The capstans are of cast-steel, capable of taking 2A-inch cables, and can be controlled from the upper deck or engine-room. The capstan engines have cylinders of 14 inches in diameter, with a 13-inch stroke, and are designed for a steam pressure of 300 lb to the square inch. Fig. 4 shows the upper deck of the Irresistible (Formidable class) fitted by Messrs Clarke, Chapman, and Co.*~~

~~*Fig. 2.*~~

~~*The electrical capstan (Harfleld), introduced in H.M. ships for stern moorings and warping, is illustrated in Fig. 5. The capstan is on the upper deck, the cable-holder A works the stern moorings, outside of which are the portable whelps B, B, for steel-wire hawsers ; the capstan is driven through the worm-wheel C by the motor D, and can be disconnected by the clutch E for working by*~~

~~*Fig. 3.*~~

~~*hand. The electric motor is controlled from the upper deck by the lever F, working through the main switch G and the resistances H. This design is somewhat extravagant in electrical consump- tion, but a stern capstan is seldom used, even then only for a short period, and in its favour are perfect control and noiseless working, and no automatic brake is required.*~~

~~*In the electrical capstan (Clarke, Chapman, and Co.), the motor drives the vertical shaft of the capstan by means of a worm and worm-wheel. The gear is fitted with an electric brake actuated by a solenoid ; when the current is passing in the solenoid the brake is held out of action against the force exerted by a spring, but, when the circuit is broken, the spring causes the brake to act. The con- tacts are in the upper portion of the resistance coil,*~~

~~and its control- ling spindle is worked from the deck ; from the off-contact point one direction of the rotation of the switch causes the motor to run in~~

~~Fig. 4.~~

~~one direction and the opposite direction reverses it. The motor will give up to about 60-belt horse-power. To meet the difficulty in warping when the ship remains stationary instead of moving, and when the armature of the motor would run the risk of burning owing to the rush of current, an automatic circuit-breaker is in- serted in the circuit, adjusted to break at the maximum current which the machine is intended to carry. When the automatic cir- cuit-breaker acts, it inserts a resistance in the circuit capable of taking up the whole back E.M.F. of the armature ; therefore, the current through the armature remains as it would be at full load, but cannot be exceeded. By these means the torque due to this current in the armature is maintained, but the latter cannot turn until the ship moves, when it would commence to rotate and~~

~~generate back E.M.F. ; on this being effected the automatic switch must be replaced and remain in place so long as the current keeps below the maximum for which it is adjusted. The speed of the motor is 380 revolutions per minute, and with this speed the lift is 15 tons, at the rate of 25 feet per minute.~~

~~All capstans for H.M. ships are tested for lifting power and speed ; with foremast capstans the anchor is usually~~

~~£~~

~~r AftRANSEMENr OF HARFttLSs Ek.EC TRIG~~

~~Capstan CcarCAft)~~

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Mtt.srmne Caii.:*

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rig. 5.

let go in not less than 25 fathoms' water and the speed ascertained by observing the time taken to heave-in not less than a length of cable, 75 fathoms. In the mercan- tile marine various designs of steam windlasses are used, generally fitted with warping ends for working ropes ; in case of failure of steam, hand-power with "wee-gee" motion is employed, but where a warping capstan is fitted it is worked with capstan bars. Capstans on dock walls in H.M. dockyards are usually driven by hydraulic or air pressure conveyed through pipes to small engines under- neath the capstans. (j- w. d.)

Capua, a fortified garrison town and archiepiscopal see of the province of Caserta, Campania, Italy, on the river Volturno, 7 miles N.W. from Caserta by rail. The cathedral, dating originally from the 11th century, has been entirely modernized. The other buildings embrace the Campanian Museum (archaeological, 1874), and a tower and mortuary chapel, commemorative of the slaughter of the inhabitants when the town was captured by Cesare Borgia in 1601. The fortifications were planned by Vauban, and extended in 1855. The manufacture of fire- works is a speciality. Bricks are also made. Population, about 14,500.

Caracal, a town in .Eumania, chief town of the district of Komanati. It is a seat of a court of first in- stance, and has eleven churches and a school of arts and crafts. The town derives its name from the Emperor Caracalla, who, in the year 217, built a tower there, of

which the ruins are still to be seen. Population (1895),

11,000; (1900), 12,025.

Caracas, capital city of Venezuela and of the federal district, situated in 67° 4' 45" W. long, and 10° 30' N. lat., 23 miles S.S.E. of La Guaira, its port, by rail ; 3018 feet above sea-level. The city, including the six outlying

~~*parishes, forms the federal district, which has an area of 45 square miles and a population of about 100,000. There are two telephone companies and two banking institutions — the bank of Venezuela, with a capital of 8,000,000 bolivars and a reserve of 974,753-39 bolivars, and the bank of Caracas, a joint-stock company with a capital of 6,000,000 bolivars and a reserve fund of 345,928 bolivars. Four railway lines start from Caracas. The line, to Port La Guaira is a bold undertaking because of the height of Mount Avila and the sinuosities of the land over which it travels ; but the longest line goes to Valencia and Puerto Cabello, crossing the high cordilleras surrounding Caracas, and dropping into the valleys of Aragua. Caracas is the residence of the archbishop of Venezuela, the dioceses suffragan to it being those of Ciudad Bolivar, Calabozo, Barquisimeto, Merida, and Maracaibo. The city is lighted by both gas and elec- tricity. Population, 72,429.*~~

~~*Caraman, or Karaman (Laranda, a name still used by the Christians), a town in the Konia vilayet of Asia Minor, situated on the plain north of Mount Taurus. The modern name is derived from Karaman, to whom it was granted by Sultan Ala ed-Din of Eiim. It has few industries and little trade, but the mediaeval walls and the mosques are interesting, and the old Seljiik medresse, or college, is one of the most beautiful buildings in Asia Minor. Population, 5000 (Moslems, 4500; Christians,*~~

~~*500).*~~

~~*Caraman ia, or Karamania, formerly an independ- ent province in the south of Asia Minor, named after Karaman, the son of an Armenian convert to Isl^m, who married a daughter of the Seljuk sultan of Eiim, and was granted Laranda (Karaman), and made governor of Se- lefke, 1223-45. On the collapse of the Seljuk empire, Karaman's grandson, Mahmiid, 1279-1319, founded a state, with its capital at Konia, which included Pamphylia, Lycaonia, and large parts of Cilicia, Cappadocia, and Phrygia. The state was frequently at war with the kings of Lesser Armenia, the Lusignan princes of Cyprus, and the knights of Rhodes. It was also engaged in a long struggle for supremacy with the Osmanli Turks, which only ended in 1472, when it was annexed by Muhammad II. The Osmanlis divided Karamania*~~

~~*into Kharij, north, and Ichili, south of the Taurus. The name is now often given by geographers to Ichili only.*~~

~~*Carapeq ua, an important town of Paraguay, founded in 1725. The adjacent country cultivates cotton, tobacco, corn, sugar-cane, and mandioca. It has two schools, a church, many modern edifices and business houses, a post office, and a sub-department of the Agricultural Bank. Population, 13,000.*~~

~~*Carbondale, a city of Lackawanna county, Penn- sylvania, U.S.A., situated in 41° 34' N. lat. and 75° 30' W. long., on Lackawanna river, a branch of the Susque- hanna, in the north-eastern part of the state, at an altitude of 1080 feet. It is a coal-mining town, being situated in the midst of the anthracite coal region of the United States. It is served by three railways, the Delaware and Hudson, the Lehigh Valley, and the Delaware, Lackar wanna and Western. Population (1880), 7714; (1890),*~~

~~*10,833 ; (1900), 13,536.*~~

~~*Carborundum. See Electro-Metallurgy.*~~

~~*Carcar, a town situated on high ground near the east coast of Cebu, Philippine Islands, in 10° T N. It was founded in 1624. The surrounding country, though rugged, is quite fertile, and produces sugar in con- siderable quantity. The language is Cebu-Visayan. Population, 30,000.*~~

~~*Cardenas, a town and seaport in Cuba, on the north coast, in 81° 12' W., 76 miles E. of Havana. It was founded in 1828, is one of the few towns of Cuba built in the 19th century, and is a thriving place. It lies on a spacious bay sheltered by a long promontory. It is one of the principal sugar-exporting places of the island, and is connected by rail with Matanzas, Havana, Santa Clara, and Cienf uegos, and by the regular steamers with all the coast towns. Population, 21,940.*~~

~~*Cardiff, a municipal, county (1888), and parliar mentary borough and seaport of England, on the Taff, 1 mile above its outfall into the estuary of the Severn, 40^ miles W, of Bristol, 45^ miles E.S.E. of Swansea, 170 miles by rail W. of London, capital of the princi- pality of Wales, and chief town of the county of Gla- morgan; on the Great Western railway, and in direct ■and manifold railway communication with the coal and mineral districts of South Wales. The borough is divided into 10 wards under a mayor, 10 aldermen, and- 30 councillors. Erom 2624 houses in 1851, Cardiff grew to 20,476 houses in 1891 and 28,009 houses in 1901. The waterworks, purchased by the corporation in 1879, have since been extended and a new supply, from the Taff Fawr valley, provided at a cost, up to 1897, of over £1,139,452. The corporation have laid down lines for electric tramways and built power-stations, &c. About £500,000 will be laid out on these and the purchase and equipment of the existing lines. Various other public works are being actively pushed forward. The corporation already own the electric light undertaking, which they are extending. The Great Western railway in 1899 quadrupled its lines between Cardiff and Newport, and largely ex- tended and improved its station at Cardiff, and in 1900 opened a new station at Eoath. The network of rail- ways and sidings around the Bute Docks comprises a length of about 120 miles. An iron swing bridge, Clarence Bridge, over the Taff, connecting Grangetown with the docks, was opened in 1890. New wharves and warehouses have been erected at all the principal towns and villages along the canal between Cardiff and Merthyr-Tydfil.*~~

~~*The educational institutions include the University -College (1883), a constituent college of the University of Wales, soon to be transferred to new buildings in Cathays Park ; Schools of Science and Art (1891) ; the Baptist Theological College, stationary in Cardiff since 1893 ; a higher-grade school (1896), and many other board and national schools ; 2 intermediate schools ; a school of ■cookery (1890) ; a free library and museum (1882), ex- tended and reopened (1896) at a cost of £20,000; a museum and art gallery, for which new buildings, at an estimated cost of £13,500, are to be erected in Cathays Park. Other recent public institutions are the market hall (1891) ; a new posl^ofilce (1898) costing £75,000 ; a new custom-house (1899) ; a new Government stamp- office (1900) ; baths (1896) ; a theatre ; mining engineers' institute (1890) ; the infirmary, erected (1883) at a cost*~~

~~of over £40,000 ; Eoath Park (120 acres), opened 1894; Ely Park; Canton Park; besides fifteen open •spaces acquired since 1890. Cathays Park, in the centre of the town, 60 acres in area, was purchased in 1900 for £160,000; and, in addition, £44,000 has already been spent in laying it out. In this park, moreover, new~~

~~municipal buildings and law courts are to be erected at a cost of £233,000.~~

~~At the mouth of the three rivers — Ehymney, Taff, and Ely — within a dozen miles of the great coal and iron de posits of South Wales, comprising a coalfield estimated at 1000 square miles in area, with a storage capacity of over 30,000 million tons, 60 miles nearer London than Liver- pool is, Cardiff commands unrivalled resources and an unsurpassed position as a port of trade. Accordingly, since by the construction of the canal and railways the mineral wealth of the hills has found free outlet to Car- diff, and thence, by her docks and capacious, safe, and readily accessible harbour, to all parts of the world, the export trade has gro^wn in magnitude at a rate unexam- pled, till now Cardiff is the third largest exporting port of the United Kingdom and the heaviest coal-exporting port of the world, its coal shipments, 11,925,976 tons in 1898, largely exceeding those of the Tyne ports. An ofB.cial estimate rates the increase of coal shipments at 7^ per cent, per annum for the twenty-four years 1864-87, and sees no reason to doubt the continuance of the same rate of increase.~~

~~The folio-wing is a list of the Bute docks and basins, with their respective dimensions : —~~

~~Dock.~~

~~Acre- age.~~

~~Dimensions.~~

~~Quayage~~

~~Depth on Sills.~~

~~West Dock (1839)~~

~~„ Basin (1889)~~

~~„ Lock . . . East Dock (1855) . „ Basin (1855)~~

~~„ Look . . . Eoath Dock (1887)~~

~~„ Basin (1874)~~

~~„ Look (1887)~~

~~aiam. Canal Float~~

~~(1798). . . .~~

~~G-lam. Canal Basin~~

~~18~~

~~H~~

~~44]~~

~~12~~

~~H~~

~~4000 ft. by 200 ft. 800 ft. by 200 ft.~~

~~152 ft. by 86 ft. 1000 ft. by 800 ft. 8300 ft. by 600 ft.~~

~~880 ft. by 250 ft.~~

~~200 ft. by 49 ft. 2400 ft. by 600 ft.~~

~~1000 ft. by 550 ft.~~

~~850 ft. by 80 ft.~~

~~600 ft. by 80 ft.~~

~~*5500 ft. by 100 ft.*~~

~~*485 ft. by 180 ft.*~~

~~*8800 ft.* ■~~

~~*9860 ft.* •~~

~~*7520 ft. r 2700 ft. j*~~

f

~~*11,000 ft. .*~~

~~*28 ft. 8J in.*~~

~~*springs.*~~

~~*18 ft. 8i in.*~~

~~*neaps.*~~

~~*81 ft. 8i in.*~~

~~*springs. 21 ft. sl in.*~~

~~*neaps.*~~

~~*35 ft. 9 in.*~~

~~*springs. 25 ft. 9 in.*~~

~~*neaps,*~~

~~*18 ft. 9 in.*~~

~~*springs. 8 ft. 9 m.*~~

~~*neaps.*~~

~~*Total Docks .*~~

~~*New Soath Dock . „ Look .*~~

~~*124J*~~

~~*42*~~

~~*2600 ft. by 650 ft. TOO ft. by 160 ft.*~~

~~*89,880 ft. J 7,460 ft. 1*~~

~~*42 ft.*~~

~~*springs.*~~

~~*82 ft. neaps.*~~

~~*. Grand Total .*~~

~~*169J*~~

~~*46,840 ft.*~~

~~*Graving Docks j ‘V:.^^^! Z^etTJl^*~~

~~*Timber ponds, measuring 28 acres, have also been constructed for the accommodation of the fast-growing timber trade. The South Bute Dock, still in process of construction, is on the foreshore, with a seaward embankment extending out to a line nearly opposite the mouth of the Ely river. Connecting with the Eoath Dock, it will have no basin, but a lock with sea gates, and practically serve as a low-water dock. Forty-two acres in area, it will accommodate the very largest steamers, cargo or passenger. On the completion of the new dock, the Bute Docks will have a floating area, exclusive of the Glamorgan canal, of 157 acres ; with the canal, float, and basin, 169|- acres; and fur- ther, with the timber floats, 197^ acres, an area which, apart from the other docks within the limits of the customs port, constitutes Cardiff the third port in the kingdom for extent of wet-dock accommodation. The entrance channel to the docks runs out about 1^ miles*~~

~~*to a point opposite Penarth Head, -with a low-water pier. The depth of water at high-water springs is 43 feet, 8 inches ; at low-water neaps, 15 feet. The new dock entrance lock and embankment -will extend farther out in the channel, and supersede the present pier. In the entrance channel are two floating pontoons for coasting*~~

~~*steamboat traffic. There is also a harbour, dug out of the mud to the west of the channel, for mooring the pilot boats, and ample accommodation opposite (on east side) for the large fleet of tug boats. The Windsor Dock Com- pany, furthermore, are seeking powers to construct a dock on the west side of Cardiff, at a cost of £825,000.*~~

~~*The mechanical erections at the Bute Docks include 50 coal staiths, hydraulic lifts, and cranes for loading ; 57 cranes for discharging ; 1 shear legs ; 10 graving docks ; 1 gridiron ; 2 pontoons, and 2 pontoon docks. Eleven of the cranes are " Lewis-Hunter " patent coal cranes, lifting up to 30 tons ; and, loading simultaneously as many hatches as a vessel may have, will in 24 hours stow as much as 7000 tons and load vessels carrying 10,000 tons.*~~

~~*Large warehouses and transit sheds have been erected at the West, East, and Koath Docks for housing grain, provisions, &c. One flour-mill cost £80,000. One ware- house will hold 75,000 quarters of grain. There is also extensive wharf accommodation for heavy goods such as timber and iron ore, cold storage for dead meat, and lairs for live cattle. The capital invested in these docks, in- cluding Penarth' and Barry Docks, is estimated at 8 to 9 millions.*~~

~~*The industries of Cardiff include iron-founding ; iron, steel, and copper works; flour-mills; biscuit factory; shipbuilding ; tin enamel, chemical, waggon and printing works ; sail-making, wire and hemp roperies, coach-building, &c. The Dowlais blast-furnaces employ about 300 men, and the steel works in full swing, 3000 men — the iron and steel works covering 82*~~

~~*acres. One milling firm has the capacity to supply all the flour needed by a population of 600,000.*~~

~~*Registered shipping in 1888, 290 vessels of 151,972 tons ; in 1898, 285 of 204,018 tons ; in 1899, 270 of 212,058 tons. Entered in 1888, 12,973 vessels of 5,767,616 tonnage ; in 1898, 12,136 of 6,378,189 ton- nage; in 1899, 11,824 of 8,837,234 tonnage. Cleared in 1888, 13,274 vessels of 6,083,762 tonnage; in 1898, 12,179 of 6,737,821 tonnage; in 1899, 11,845 of 9,003,275 tonnage. Imports of foreign and colonial mer- chandise in 1888 amounted to the value of £2,165,961 ; in 1898, £2,612,327; in 1899, £3,352,191. Exports of the produce of the United Kingdom in 1888 were valued at £4,873,106 ; in 1898, £5,521,350 ; in 1899, £8,662,147. Of the total imports in 1899, valued at £3,352,191, the most important articles were wheat, valued at £812,523 ; iron ore, £589,094 ; wood of all sorts, £1,112,289. Of the exports in 1899, valued at £8,662,147, coal, coke, cinders, and patent fuel alone amounted to £8,308,533. The import of timber in 1845 was 6965 loads ; in 1855, 31,829 loads ; in 1865, 103,170 loads ; in 1885, 373,398 loads ; in 1895, 689,871 loads. The iron-ore trade, first coastwise and then oversea, has increased thirteen times over since 1850. Cardiff publishes 4 daily, 1 bi- weekly, and 2 weekly newspapers, and has 15 banks. Area of municipal borough, 8408 acres ; population (1881), 82,761 ; (1891), 128,915 ; (1901), 164,315. Area of parliamentary borough, comprising the contributory boroughs of Cardiff, Cowbridge, and Llantrisaint, 12,247 acres ; population (1881), 85,862; (1891), 132,229 ; (1901), 180,000. It has been observed that from 1841 to 1891 the population increased, roundly speaking, 10,000 for every additional million tons of coal shipped. Moreover, if to the population of the municipal borough be added that of Penarth and Barry, the total population is*~~

~~*205,675 (1901).*~~

~~*Cardigan, a municipal borough, seaport, and county town of Cardigan, extending into Pembrokeshire, Wales, 274 miles W. by N. of London by rail, on the Teifi, 5 miles from its mouth. Since 1885 the parliamentary*~~

~~*representation of the borough has been merged in that of the county. The old endowed grammar-school has been united with an intermediate school. In 1898 the registered shipping was 29 vessels of 1135 tons ; in 1898, 415*~~

~~*vessels of 18,274 tons entered, and 393 of 17,401 tons cleared. Area, 4926 acres ; population (1881), 3669 ; (1901), 3511. There is a parish of Cardigan.*~~

~~*Cardigan, a maritime county of South Wales, bounded on the N. by Merioneth, on the E. by Mont- gomery, Radnor, and Brecon, on the S. by Carmarthen and Pembroke, and on the W. by Cardigan Bay.*~~

~~*Area and Population. — The area of the ancient county is 440,630 acres, or 688 square miles. The population in 1881 \was 70,270, and in 1891 was 62,630, of whom 27,365 were males and 35,265 females, the number of persons per square mile being 91, and of acres to a person 7-04. In 1901 the population was 60,237. The area of the administrative county is 443,071 acres, with a population in 1891 of 63,467. The area of the registration county is 595,285 acres, with a population in 1891 of 86,383. Within its area there was, between 1881 and 1891, a decrease in the popula- tion of 9-20 per cent. The excess of births over deaths between 1881 and 1891 was 6971, but the decrease in the resident population was 8754. The following table gives the numbers of marriages, births, and deaths, with the number and percentage of illegitimate births, for 1880, 1890, and 1899 :—*~~

~~*Tear.*~~

~~*Marriages.*~~

~~*Births.*~~

~~*Deaths.*~~

~~*Illegitimate Births.*~~

~~*No.*~~

~~*Percentage.*~~

~~*1880 1890 1899*~~

~~*543 502 506*~~

~~2625 2078 1964~~

~~1882 1641 1604~~

~~220 171 141~~

~~8-4 8-2 61~~

~~In 1891 the number of Scots in the county was 128, of Irish 98, and of foreigners 46 ; while 3979 could speak English, 61,624 Welsh, and 1711 English and Welsh.~~

~~Constitution and Government. — The county returns one member to Parliament, and it has no parliamentary borough. There are three municipal boroughs, Aberystwith (8013), Cardigan (3511), and Lampeter (1722). The urban districts are Aberayron (1327) and New Quay (1234). The county is in the south-western cir- cuit, and the assizes are held at Lampeter ; the boroughs of Aberystwith and Cardigan have separate commissions of the peace, but no separate court of quarter sessions. The aincient county contains 66 entire ecclesiastical parishes and districts, and part of one other. It is entirely in the diocese of St Davids.~~

~~Education. — At Aberystwith is a university college, in con- nexion with which there is a day training college for school- masters and mistresses. The number of elementary schools in the county on 31st August 1899 was 107, of which 75 were board and 32 voluntary schools, the latter including 27 National Church of England schools, and 5 " British and other." The average attend- ance at board schools was 5989, and at voluntary schools 2264. The total school board receipts for the year ending 29th September 1899 were over £19,129. The income under the Agricultural Rates Act was over £1905.~~

~~Agriculture. — About three-fifths of the total area of the county is under cultivation, and of this more than five-ninths is in perma- nent pasture. There are also, in addition, about 129,000 acres in hill pasture and about 16,000 acres under woods. Within the last twenty years the acreage under corn crops has decreased by about one-seventh. Wheat has only slightly decreased in acreage, and occupies about one-eighth of the com acreage,~~

~~barley occupy- ing considerably more than one-fourth and oats considerably more than one-half. Potatoes occupy a rather larger acreage than turnips. The following table gives the larger main divisions of the cultivated area at intervals of five years from 1880 :~~

~~Tear.~~

~~Total Area under Cul- tivation.~~

~~Corn Crops.~~

~~Green Crops.~~

~~Clover,~~

~~Permanent Pasture.~~

~~FaUow.~~

~~1880 1885 1890 1895 1900~~

~~276,236 281,478 283,932 269,746 272,493~~

~~61,833 58,792 56,214 52,981 49,447~~

~~13,123 13,671 13,866 12,812 13,257~~

~~44,023 44,854 47,270 42,238 51,995~~

~~155,179 162,951 164,827 160,858 156,905~~

~~2078~~

~~1210~~

~~1740~~

~~823~~

~~853~~

~~The following table gives particulars regarding the principal live stock during the same years : —~~

~~C A E D U C C I — C A R E T~~

~~585~~

~~Total~~

~~Total~~

~~Cows or Heifers~~

~~Horses.~~

~~Cattle.~~

~~in Miilc or in Ualf.~~

~~Sheep.~~

~~Pigs.~~

~~1880~~

~~13,873~~

~~62,917~~

~~25,747~~

~~213,843~~

~~18,979~~

~~1885~~

~~13,991~~

~~67,299~~

~~27,010~~

~~211,462~~

~~22,218~~

~~1890~~

~~14,714~~

~~65,500~~

~~26,811~~

~~221,652~~

~~25,489~~

~~1895~~

~~16,053~~

~~65,336~~

~~25,665~~

~~221,533~~

~~24,308~~

~~1900~~

~~17,573~~

~~72,229~~

~~26,967~~

~~274,955~~

~~22,897~~

~~Industries and Trade. — According to the annual report of the Inspector of factories for 1898 (1900), the number of persons en- gaged in all factories and workshops in 1897 was 1359, as com- pared with 1357 in 1896. The total number of persons employed in mines and quarries in 1899 was 682. Copper-mining is now almost extinct. The output of lead is also declining, 2072 tons, valued at £18,143, being dug in 1885, and 598 tons, valued at £5823, in 1899. Of zinc 3273 tons, valued at £8760, were obtained in 1885, and 3328 tons, valued £14,585, in 1898, but in 1899 only 1819 tons, valued at £10,303, were got. Clay and sandstone are also raised. The total quantity of fish landed at New Quay (Cardigan), Aberayron, and Aberystwith in 1899 was 2875 cwts., valued at £2921.~~

~~Authorities. — Sir R. Meyrick. History and Antiquities of the County of Cardigan. London, 1810. — J. G. Williams. A Short Account of the British Encampments lying between the Rivers Mheidol and Llyfnant in the County of Cardigan in their connexion~~

~~with the Mines. Aberystwith, 1866 J. E. Phillips. List of the~~

~~Sheriffs of Cardiganshire from A.D. 1539 to A.D. 1868. See also the various Guides to South Wales. Cx. -p. H.”)~~

~~Carducci, Ciosue (1836), Italian poet,~~

~~•was born at Val-di-Castello in Tuscany, 27th July 1836. His father was a physician, and Carducci received a good education. He began life as a public teacher, but soon took to giving private lessons at Florence, where he became connected with a set of young men, enthusiastic patriots in politics, and in literature bent on overthrowing the reigning romantic taste by a return to classical models. These aspirations have always constituted the mainsprings of Carducci’s poetry. In 1860 he became professor at Bologna, where, after in 1865 astonishing the public by a defiant Hymn to Satan, he published in 1867 Levia Grauia, a volume of lyrics vrhich not only gave him an indisputable position at the head of contemporary Italian poets, but~~

made him the head of a school of which the best Italian men of letters have been disciples, and which has influenced all. Several other volumes succeeded, the most important of which were the Decennalia (1870), the Nuove Eoesie (1873), and the three series of the Odi Barhare (1877-89). The employment of the antique metrical forms in these has occasioned fierce literary con- troversies, hardly yet allayed. It is not likely that Carducci's example will be largely imitated, for the excel- lent reason that it is incapable of imitation except by a consummate metrist, but its indirect inculcation of a robust and manly style has been of the highest value. Rallied to the Savoy dynasty, Carducci enjoys the dignity of a senator of the Italian kingdom, and occupies a position of authority as citizen as well as writer.

Cardwell, Edward Cardwell, Viscount (1813- 1886), English statesman, was the son of a merchant of Liverpool, where he was born on 24th July 1813. After a brilliant career at Oxford, where he gained a double first-class, he entered Parliament as member for Clitheroe in 1842, and in 1845 was made secretary to the Treasury. He supported Sir Eobert Peel's free-trade policy, and went out of ofSce with him. In 1847 he was elected for Liverpool, but lost his seat in 1852 for having supported the repeal of the navigation laws. He soon found another constitu- ency at Oxford, and upon the formation of Lord Aberdeen's coalition ministry in 1853 became president of the Board of Trade, although debarred by the jealousy of his Whig joUeagues from a seat in the Cabinet. In 1854 he carried, :4£nost without opposition, a most important and compli-

cated act consolidating all existing shipping laws, but in 1855 resigned, with his Peelite colleagues, upon the appointment of Mr Eoebuck's Sebastopol inquiry com- mittee, declining the offer of the chancellorship of the Exchequer pressed upon him by Lord Palmerston. In 1858 he moved the famous resolution condemnatory of Lord Ellenborough's despatch to Lord Canning on the affairs of Oude, which for a time seemed certain to overthrow the Derby Government, but which ultimately dissolved into nothing. He obtained a seat in Lord Palmerston's Cabinet of 1859, and after fiQ^ling the uncongenial posts of secretary for Ireland and chancellor of the duchy of Lancaster (1861), became secretary for the colonies in 1864. Here he reformed the system of colonial defence, refusing to keep

~~*troops in the colonies during time of peace unless their expense was defrayed by the colonists ; he also laid the foundation of federation in Canada and, rightly or wrongly, censured Sir George Grey's conduct in New Zealand. Eesigning with his friends in 1866, he again took office in 1868 as secretary for war. In this post be performed the most memorable actions of his life by the abolition of purchase and the institution of short service, measures which excited more opposition than any of the numerous reforms effected by the Gladstone Government of that period, but which were entirely justified by their successful working afterwards. On the resignation of the Gladstone min- istry in 1874 he was raised to the peerage as Viscount Cardwell of EUerbeck, but took no further prominent part in politics. His mental faculties, indeed, were considerably impaired during the last few years of his life, and he died at Torquay on 15th February 1886. He was not a showy, hardly even a prominent poli- tician, but effected far more than many more conspic- uous men. The great administrator and the bold innovator were united in him in an exceptional degree, and he allowed neither character to preponderate un- duly, (e. g.)*~~

~~*Cardwell, a town of Queensland, Australia, 950 miles N.W. of Brisbane, on Rockingham Bay, in the county of Cardwell. It has one of the finest harbours in the colony, easy of access in all weathers. Various min- erals, including gold; exist in the district. The dugong fishery is carried on and the oil extracted. Population, about 3500.*~~

~~*Carey, Henry Charles (1793-1879), Amer- ican political economist, was born in Philadelphia 15th December 1793, and at the age of twenty-eight suc- ceeded his father, Mathew Carey — an influential econ- omist, political reformer, editor, and publisher, of Irish birth, but between 1783 and his death in 1839 a res- ident of Philadelphia — as a member of the publishing firm of Carey and Lea, which was long the most con- spicuous in America. Among Mathew Carey's many writings had been a collection (1822) oi Essays on Political Economy, one of the earliest of American treatises favour- ing Protection, and Henry C. Carey's life-work was devoted to the propagation of the same theory. He retired from business in 1838, almost simultaneously with the appear- ance (1837-40) of his Principles of Political Economy. This treatise, which was translated into Italian and Swedish, soon became the standard representative in the United States of*~~

~~*the school of economic thought which, with some interruptions, has dominated the tariff system of that country for the past half-century ; and it exercised a manifest influence upon the writings of such later Protec- tionists as Bowen, Greeley, and Thompson. To Carey's arguments, more than to those of any other writer, was due the freedom with which his followers,, in economic literature and in legislative action, were led to consider the*~~

~~*Principles of Political Economy applied to the Condition, Resources, and Institutions of the American People (the title of Francis Bowen's text-book, 1856), instead of regarding the subject as one leading to general or absolute results. Carey's first large work on political economy was preceded and followed by many smaller volumes on wages, the credit system, interest, slavery, copyright, &c. ; and in 1858-59 he gathered the fruits of his lifelong labours into The Principles of Social Science, in three volumes. Carey laid chief stress upon the attainment,*~~

~~*through political economy, of beneficent results, in- tellectual, moral, and financial, to the individual man, whether capitalist, workman, or consumer, and upon a con- stant claim that the rise of wages is the measure of economic prosperity, inasmuch as in a period of high wages an increased proportion of the value of the product goes to the labourer, while the capitalist receives a smaller proportion, though a larger gross amount. He died in Philadelphia, 13th October, 1879. [See vol. xix. of the ninth edition of the Encyclopaedia Britannica (pp. 384-5).]*~~

~~*CARICATURE.*~~

~~*Great Britain. — ^During the last quarter of the 19th century the term caricature, somewhat loosely used at all times, came gradually to cover almost every form of humorous art, from the pictorial wit and wisdom of Sir John Tenniel to the weird grotesques of Mr S. H. Sime, from the gay and*~~

~~spirited pleasantries of Randolph Caldecott to the graceful but sedate fancies of Mr Walter Crane. It is made to embrace alike the social studies — whether satirical or sympathetic — of Du Maurier and Keene, the political cartoons of Mr Harry Furniss and Mr F. C. Gould, the unextenuating likenesses of " Ape," and " Spy," and " Max," the subtle conceits of Mr Linley Sambourne, the whimsicalities of Mr B. T. Reed, the exuberant burlesques of Mr J. F. Sullivan, the frank buffooneries of the late W. G. Baxter. Of these diverse forms of graphic humour, some have no other object than to amuse, and therefore do not call for serious notice. The perpetrations of Mr Max Beerbohm (" Max "), for instance, need not be commented upon, though too original to be overlooked ; while of the work of " Spy " (Mr Leslie Ward), in Vanity Fair, one need only say that if it does not rival the occasional brilliancy of his predecessor " Ape " (Carlo Pellegrini), it maintains a higher average of merit. The pupil, too, is much more genial than the master. Unlike " Ape " and his com- patriots of the 17th century, to whose " caricaturas " Addison's Spectator applied the description, he does not "transform the most agreeable beauty into the most odious monster " ; his feeling for comeliness forbids : when his subject is good-looking, he is content if his pencil evokes the comment, "How ridiculously like!" But caricature of this kind is merely an entertainment. Here we are concerned rather with those branches of caricature which, merrily or mordantly, reflect and com- ment upon the actual life we live. In treating of recent caricature of this kind, we must. give the first place to Punch. Mr Punch's outlook upon life has not changed much since the 'seventies. His influence upon the tone of caricature made itself felt most appreciably in the days of John Leech and Richard Doyle. Their suc- cessors but follow in their steps. In their work, says a clever German critic, is to be found no vestige of the "sour bilious temper of John Bull " that pervaded the pictures of Hogarth and Rowlandson. Keene and Du Maurier, he declares, are not caricaturists or satirists, but amiable and tenderly grave observers of life, friendly optimists. The characterization is truer of Keene, per- haps, than of Du Maurier. Keene's sketches are almost always cheerful ; almost without exception, they make you smile or laugh. In many of Du Maurier' s, on the other hand, there is an underlying seriousness. They are aphorisms, criticisms, verdicts upon character and conduct : the work of a less cynical La Rochefoucauld, expressing himself with a pencil as well as with a pen. While Keene looks on at life with easy tolerance, an~~

~~amused spectator, Du Maurier shows himself sensitive, emotional, sympathetic, taking infinite delight in what is~~

~~pretty and gay and charming, but hurt and offended by the sordid and the ugly. Thus while Keene takes things dispassionately as they come, seeing only the humorous side of them, we find Du Maurier ever and anon attacking some new phase of snobbishness, or philistinism, or cant. For all his kindliness in depicting congenial scenes, he is at times as unrelenting a satirist as ever Rowlandson was : the difference in their methods is but the difference between the sword-play of Richard and the sword-play of Saladin. The other Punch artists whose chief work is in the same field as Keene's and Du Maurier's resemble the former in this respect rather than the latter. Mr Raven-Hill recalls Charles Keene not merely in temperament but in technique ; like Keene, too, he finds his subjects principally in bourgeois life. Mr J. Bernard Partridge, though like Du Maurier, he has an eye for physical beauty, is a spectator rather than a. critic of life. Mr Phil May, a modern Touchstone, is less, easily classified. Though he wears the cap and bells, he is alive to the pity of things ; he sees the pathos no less than the humour of his street-boys and " gutter-snipes." He is, however, a jester primarily : a jester with an almost unrivalled faculty for pictorial expression; an artist, too, of high achievement. Two others stand out as masters of the art of social caricature — the late Frederick Barnard and Mr J. F. Sullivan. Barnard's illustrations to Dickens, like his original sketches, have a lively humour all their own — the humour of irrepressible high spirits — and end- less invention. High spirits and invention are characteristics also of Mr Sullivan. It is at the British artisan and petty tradesman — at the grocer given to adulteration and the plumber who outstays his welcome — that he aims his most boisterous fun. He rebels, too, delightfully, against red tape and all the petty tyrannies of officialdom. In fact, there is hardly a grievance known to London and its suburbs which has not been hilariously vented by Mr Sullivan. In political caricature Sir John Tenniel has remained the leading artist of the period. The death of Abraham Lincoln, Bismarck' s fall from power, the tragedy of Khartiim — to subjects such as these, worthy of a great painter, Tenniel has brought a classic simplicity and a sense of dignity unknown pre- viously to caricature. It is hard to say in which field Tenniel most excels — ^whether in those ingenious parables; in which the British Lion and the Russian Bear, John~~

Chinaman, Jacques Bonhomme, and Uncle Sam play their part — or in the ever-changing scenes of the great parlia- mentary Comedy — or in sombre dramas of Anarchy, or Famine, or Crime — or in tl^ose London extravaganzas in which the symbolic personalities of Gog and Magog,, Father Thames and the Fog Fiend, the duke of Mudford^ and Mr Punch himself, have become familiar. Subjects, similar to these have been treated also for many years by Mr Linley Sambourne in his fanciful and often beautiful designs. In the field of humorous portraiture also Mr Sam- bourne has made his mark, and he may be said almost to- have originated, in a small way, that practice of illustrating.

PUNCH. OH THE LONDON CUARIVAEH,

THE rOLITiriL MUS ftMlEIDfE

By Sir, JdiiN- Tenniel (Puiirh).

By LiXEEY Samrourne (Punch).

.;:i:-/

The Pursuit of Pleasure.

By Kaven- Hile (Mr. runch't: Hnlidnij Book).

"0, Pl'BLlc," said tlie CosipaK', "I notice you forgot

To say you Iiad a buttercup a-growinp in a pot :

Your drawiiig-room, wiricli liiiiiiiours it, be- comes in pi'int of fact

A Pftteable coneervatory well within the AcU"

By J. F. Sullivan (^'The Great Water Juke.") By Phil May (Phil Mcnfs Anivial).

PUNCH. OK THE LONDON CHAKIVARI.

THE HEIGHT OF MAGNIFICENCE.

~~IS. .I.]~~

~~5u- G„rg,i^. -'Thu~~

~~By Charles Keexe (Funch).~~

~~EXAMPLES OF ENGLISH CARICATURE.~~

~~By George di; Malkieu (Punch).~~

~~Bf.n.iamin Disr \rTT Tnr Fit'-t Vinii)/Fair (."ARTMnN. ; mh I tnuiM 1^1 > BvCaklo 1'eli.eokixi i Vi F)~~

~~JiKKKIlnUM (■■ Ma\ I.~~

~~PnoFE^;,=;nK OwEX, 1^" Thf Fii sj I t fij Fair Cakt'.".'> " by Lkslik AVakh r'Sr-\ ■').'~~

~~r.NRFCOKDED HlSToRV.— TllF. Top OF A KopJE~~

~~The iioeJ nij'-Van-KiU-heiier (./^vV/, /- his rKiieiiihlc 7oi, units), "Aha: Tiif only sl■|;"r^R ' ri.iMiNii in ' at last 1 "~~

~~7'ht' Last of Ihe BoefN. " Vaid a m.imexp 1~~

~~■\ o|> IiERMs Y(t|- (.IF me; AlEIX (.KiM|U.ERD INTEHENDEXOE :— oniiERVISE I lil.EIH AL VAYS nX .;..MMANT>.i." Bv E. T. liEED,~~

~~P'Ulch'f: Ai//nl/ii(c. ISH.I].~~

~~Mk Pl-ni i'- '\ //I.I -Hi:\i>Kii rmcLK. ^M. r, —Alt. HAr.rouuTs. I-'tnrh, mil Xoveluiu-r l^v,|. V^y JIaiiky Fukniss.~~

~~■' '> TiLi- <:)i;rf-:." By F. C. Gouli. UVhiii The .S! nunl pi^l,;,- Al phubti).~~

~~EXAMPLES (tF ENGLISH CARICATURE.~~

~~CARICATURE~~

~~the doings of Parliament with comic sketches in which Mr Fui'niss, Mr E. T. Keed, and Mr F. C. Gould are his most notable successors. Mr Purniss has satirized the Koyal Academy as effectively as the Houses of Parliament. But he is above all the illustrator of Parliament — the creator of Mr Gladstone's collars, the thief of Lord Ean- dolph Churchill's inches, the immortalizer of so many otherwise obscure politicians, the " artistic contortionist," to use his own expression, who has worked the House of Commons and its doings into so many hundreds of eccentric designs. Though Mr Furniss is a man of strong views, and upholds them with his pencil d, outrance, he has never been, as is Mr P. C. Gould (of the Westminster Gazette), a politician first and a caricaturist afterwards. Mr Gould is an avowed partisan, and his caricatures are among the most formidable weapons of which the Radical party can boast. Caustic and witty and tellj(ig, not specially well drawn, but well drawn enough — ^the likenesses unfailingly caught and recognizable at a glafice — his " Picture Politics," as he calls them, have in this way won him a quite unique place in the ranks of caricaturists. There is no evidence of such strenuousness in the work of Mr E. T. Eeed (of Punch). In his parliamentary sketches, as in his " Animal Land " and " Prehistoric Peeps," Mr Keed is a wholly irresponsible humorist. One finds keen satire, however, in those " Keady-made Coats of Arms " in which he has turned at once his heraldic lore and his insight into character to such excellent account ; as also in such drawings as his fancy portrait " by induction " of his laundress (a virago belabouring his shirts with a spike- studded club), and that more serious picture in which he has drawn a parallel between the tricoteuses awaiting with grim enjoyment the fall of the guillotine and those modern English gentlewomen who flock to the Old Bailey as to the play. Here we have the true Hogarthian touch.~~

~~It would be too much to say that in the field of comic journalism, since 1870, it has been a case of "Eclipse first, and the rest nowhere " ; but though there have been some notable competitors with Punch, there has never been a really " good second." In Matt Morgan the Tomahawk (1865-67) could boast an original cartoonist after Tenniel's style, but without Tenniel's power and humour, and unsupported by a staff of wits and men of~~

~~*letters such as the great Punch artist has always had behind him to keep him well stocked with ideas. Morgan's Tomahawk cartoons gained in effect from an ingenious method of printing in two colours. In Fred Barnard, W. G. Baxter, and Mr J. F. Sullivan, Judy (founded in 1867) possessed a trio of pictorial humorists of the first rank, and in W. Bowcher a political cartoonist thoroughly to the taste of those hot and strong Conservatives to whom Punches neutrality or, at the most, faint Whiggery, was but Radicalism in disguise. His successor, Mr William Parkinson, was not less loyal to Tory ideas, though more urbane in his methods. Fun has had cartoonists of high merit in Mr Gordon Thomson and in Mr John Proctor, who worked also for Moonshine (founded in 1879). Moonshine afterwards enlisted the services of Mr Alfred Bryan, to whose clever pencil the Christmas number of the World was indebted for many years. Ally Sloper, founded in 1884, is notable only as the widely circulated medium for W. G. Baxter's wild humours, kept up in the same spirit by Mr W. F. Thomas, his successor. Pick-me-up, the latest addition of any note to the comic press of London, could once count a staff which rivalled at least the social side of Punch ; Mr Raven-Hill, Mr Phil May, Mr Greiffenhagen, and Mr Dudley Hardy have all contributed in their time to its sprightly pages, while Mr S. H. Sime made it the vehicle for his ' ■ squint-brained '■' imaginings. The Will o' the Wisp, the Butter- Jly, and the Unicorn, kindred ventures, though on different lines, all met with an early death. Lika Joko, founded in 1894 by Mr Harry Furniss, who in that year abandoned Punch, was also short-lived. To this brief list of purely comic or satirical journals should be added the names of several daily and weekly publications— and among monthlies the Idler, with its caricatures by Mr Scott Rankin, Mr Sime, and Mr Beerbohm — which have made a special feature of humorous art. Among these are the Graphic, ■whose Christmas numbers were first brightened by Randolph Caldeoott ; the Daily Graphic, enlivened sometimes by Mr Phil Mav and Mr A. S. Boyd ; Vanity Fair, with its grotesque portraits ; I'ruth to whose Christmas numbers Mr F. C. Gould contributed some of his best and most ambitious work, printed in colours ; the*~~

~~*Sketch, with Mr Phil May and others ; Black and White, with Mr Henry Meyer ; the Pall Mall Gazette, first with Mr F. C. Gould, and later with Mr G. B. Halkett. The St Stephen's Beview, whose crudely powerful cartoons, the work of Tom Merry, were so popular, ceased publication in 1892. A*~~

~~tribute should be paid m conclusion to the coloured cartoons of the Weekly Freeman and other Irish papers, often remarkable for their humour and talent. (See Caktoon and Illhstkation.)~~

~~No one has -written so well and wittily upon " Social Pictorial Satire " as George du Marnier in his little volume thus entitled, in which he deals more~~

~~garticularly with the work of Leech and Keene, and with his own. Satire, oth social and political, will be found treated of or touched upon in a series of articles upon " Our Graphic Humorists," as well as in miscellaneous papers by George du Maurier, Mr Linley Sambourne, Mr M, H. Spiel- mann, and others, in recent YOlimies of the Magazine of Art. Mr Spielmann's History of Punch contains also much information on the subject. The various histories of caricature do not include many of the artists of to-day, but there are interesting allusions to some of them in Muther's Modern Paint- ing, vol. ii., and in VArt du Pire ei de la Caricature, by Ars6ne Alexandre.~~

~~(f. W. W.)~~

~~France. — In that peculiar branch of art which is based on irony, fun, oddity, and wit, and in which Daumier, next to " Gavarni," remains the undisputed master. Prance can show an unbroken series of draughtsmen of strong individuality. Though " Cham" died in 1879, Eugene Giraud in 1881, " Randon " in 1884, " Andre Gill " in 1885, " Marcelin " in 1887, Edouard de Beaumont in 1888, Lami in 1891, Gr^vin in 1892, and "Stop" in 1899, a new group has arisen under the leadership of the veterans "Nadar" and Carjat. Mirthful or satirical, and less philosophical than of yore, neglecting history for incident, and humanity for the puppets of the day, their draw- ings, which illustrate daily events, will perpetuate the manner and anecdotes of the time, though the illustrations to newspapers, or in prints which need a paragraph of explanation, show nothing to compare with the Propos de Thomas Virelocquehy "G&Yaim.." Quantity perhaps makes up for quality, and some of these artists deserve special mention. "Draner " and "Henriot" are journalists, carry- ing on the method first introduced by " Cham " in the Univers illustri : realistic sketches, with no purpose beyond the droll illustration of facts, amusing at the time, but of no value to the print-collector. M. Forain, born at Reims,~~

23rd October 1852, studied at the !fieole des Beaux Arts under G^rome and Carpeaux. He first worked for the Cour- rier Frangais in 1887, and afterwards for Figaro; he was then drawn into the polemical work of politics. Though he has created some great types of flunkeydom, the ex-planatory story is more to him than the picture, which is often too sketchy ; reduced reproductions of his work have been issued in volumes, a common form of popularity never attempted with Daumier's fine lithographs. M. Willette, born at Chtlons-sur-Marne in 1857, a son of Colonel Willette, the aide-de-camp to Marshal Bazaine, worked for four years in Cabanel's studio, and so gained an artistic training which alone would have distinguished him from his fellows, even without the delightful poetical fancy and Watteau-like grace which are somewhat unex- pected amid the ugliness of modern life. His work has the value, no doubt, of deep and various meaning, but it has also intrinsic artistic worth. M. Willette is, in fact, the ideal delineator of the voluptuous and highly spiced aspects of contemporary life. " Caran d'Ache," a native of Moscow, born in 1859, borrowed from the German caricaturists his methods of illustrating " a story without words." He makes fun even of animals, and is a master of canine physiognomy. His simple and unerring outline is a method peculiarly his own ; now and again his wit rises to grandiloquence, as in his Bellona, rushing on an automobile through massacre and conflagrations, and in his Epopie (Epic) of shadows thrown on a sheet. M. L^andre, born at Champsecret (Orne), in 1862, is, like " Andre Gill," a draughtsman of monstrosities; he can get a perfect likeness of af ace while exaggerating some particular feature, gives his figure a hump-back, as Dantan did in his

statuettes, and has a facial dexterity which sometimes does scant justice to his very original wit. M. Steinlen, born at Lausanne in 1859, came to Paris in 1881. He should he studied in his illustrations to Bruant. He knows the inmost core of the Butte-Montmartre, and depicts it with realistic and brutal relish. M. Eobida, born at Compiegne in 1848, collaborated with Decaux in 1871 to found La Caricature ; he is a paradoxical seer of the possible future

~~*and a curiosity-hunter of the past. Old Paris has no secrets from him ; he knows all the old stones and costumes of the Middle Ages, and has illustrated Rabelais; and for fertility of fancy he reminds us of Gustave Dore. " Bac," born at Vienna, 15th August 1869, has infused a strain of the Austrian woman into the Parisienne ; representing her merely as a pleasure- and love-seeking creature, as the toy of an evening, he has recorded her peccadilloes, her witch- eries, and her vices. Others who have shot folly as it flies are M. Albert Guillaume, who illustrated the Exhibi- tion of 1900 in a series of remarkable silhouettes ; " Mars " ; "Henri Somm"; Gerbault; and Griin. M. Huard is a sort of Holbein of provincial life, depicting to perfection the country townsfolk in their elementarj' psychology. M. Hermann-Paul, M. Porain's not unworthy successor on the Figaro, is a cruel satirist, who in a single face can epitomize a whole class of society, and could catalogue the actors of the com&die Juimaine in a series of drawings. M. Jean Veber loves fantastic subjects, the gnomes of fairy-tales and myths; but he has a biting irony for contemporary history, as in the Butcher's Shop, where Bismarck is the blood-stained butcher. M. Abel Paivre, a refined and charming painter, is a whimsical humorist with the pencil. He shows us monstrous women, fabu- lously hideous, drawing them with a sort of realism which is droll by sheer ugliness. Toulouse-Lautrec startles us by extraordinary dislocations, scrawled limbs, and inex- plicable anatomy; he has left an inimitable series of sketches of Mme Yvette Guilbert when she was at her thinnest. M. Valotton reproduces crows in blots of black with a Japanese use of the brush. M. Jeanniot, a notable illustrator, sometimes amuses himself by contributing to Le Eire, Le Sourire, Le Pompon, L'Assiette au Beurre, etc., drawing the two types he most affects : the fashion- able world, and soldiers. M. Ibels, Capiello, and many more might be enumerated, but it is impossible to chron- icle all the clever humorous artists of the illustrated papers.*~~

~~*It is the frequent habit of French caricaturists to employ a nom- de-guerre. We therefore give here a list of the genuine names represented by the pseudonyms given above : —*~~

~~*"Cham"*~~

~~*= Comte Am^d^e de No6*~~

~~*“Randon”*~~

~~*= Gilbert.*~~

~~*“Andr^Gill”*~~

~~*= L. A. Gosset de Guine.*~~

~~*“Marcelin”*~~

~~*= Emile Planat.*~~

~~*“Stop”*~~

~~*= L. P. Morel-Retz.*~~

~~*“Nadar”*~~

~~*= F61ix Tournachon.*~~

~~*” Gavarni”*~~

~~*= S. G. Chevallier.*~~

~~*“Draner”*~~

~~*= Jules Renard.*~~

~~*“Henriot”*~~

~~*= Henri Maigrot.*~~

~~*” Caran d’ Ache ”*~~

~~*= E. Poirg.*~~

~~*“Bac”*~~

~~*= Ferdinand Bach.*~~

~~*” Henri Somm”*~~

~~*= H. Sommier.*~~

~~*“Mars”*~~

~~*= Maurice Bonvoisin.*~~

~~*Authorities. — Champfleukt. Histoire de la Caricature en France. — Armand Datot. Les Maitres de la Caricature fran- gaise en XIX’ Siecle. — Aes^ine Alexandre. L’Art du Mire. — Emile Bayakd. Le Caricature en France. — J. Grand-Car- teret. Les Mceurs et la Caricature en France. — Ad. Brisson. Nos Humoristes. (j^^ da.)*~~

~~*Germany. — During the last quarter of the 19th century German caricature flourished principally in the comic papers Kladderadatsch and Fliegende Blatter, the former*~~

~~*a political paper with little artistic value, in which the ideas alone are clever, whilst the illustrations are merely a more or less clumsy adjunct to the text, while the Flie- gende Blatter, on the contrary, has artistic merit as well as wit. Wilhelm Busch, the most brilliant German draughts- man of the last generation, made his dibut with an illus- trated poem, ” The Peasant and the Miller,” and won a world-wide reputation with the following works: Pater Filudus, Die Fromme Helene, Max und Moritz, Der heilige Antonius, Maler Kleksel, Balduin Bdhlamm, Die Erlehnisse Knopps des Junggesellen. Busch stands alone among cari- caturists, inasmuch as he is both the author and the illustrator of these works, his witty doggerel supplying Germany with household words. The drawings that accompany the text are amazing for the skill with which he hits the vital mark ; the essential point is seized with the least possible elaboration. A flourish or two and a few touches are enough to set before us figures of intensely comical aspect. This distinguishes Busch from Adolf Oberlander, who became the chief draughtsman on Flie- gende Blatter. Busch’s drawings would have no meaning apart from the humorous words. Oberlander works with the pencil only. Men, lions, tigers, hares, dogs, trees, houses, plants, are endowed by him with a mysterious life of their own. Without the help of any verbal joke, he achieves the funniest results simply by seeing and accent- uating the*~~

~~comical side of everything. His drawings are caricature in the strict sense of the word, its principle being the exaggeration of some natural characteristic. The new generation of contributors to Fliegende Blatter do not work on these lines. Busch and Oberlander were both offshoots of the romantic school ; they made fun of modern novelties. Hermann Schlittgen, Ren^ Eeinicke, Adolf Hengeler, and Pritz Wehle are the sons of a self-satisfied time, triumphing in its own chic, elegance, and grace ; hence they do not parody what they see, but simply depict it. The wit lies exclusively in the text ; the illustra- tions aim merely at a direct representation of street or drawing-room scenes. It is this which gives to Fliegende Blatter its value as a pictorial record of the history of German manners. Its pages are a permanent authority on the subject for those who desire to see the social aspects of Germany during the last quarter of the 19th century. At the same time a falling-off in the brilliancy of this pe- riodical has been perceptible. Its fun has become domestic and homely; it has faithfully adhered to the old technique of wood-engraving, and has made no effort to keep pace with the modern methods of reproduction. These have, in fact, undergone a complete revolution in two different ways : on the one hand, wood-printing, engraving, and litho- graphy in colour have been developed to a high degree of per- fection, and the improvement in the mechanical technique of engraving allows of a reproduction in facsimile of the most delicate shades of colour ; on the other hand, the art of the poster has aroused a previously dormant feeling for dec- orative design and the expressive value of pure lines. Tou- louse-Lautrec, Steinlen, and Grasset have in Prance worked out to its utmost finality a technique derived from the style of Hokusai and Utarnaro. German caricature, to live and flourish, must keep pace with this development ; it had to take into its service the gay effects of colour, and derive fresh inspiration from the sweepinglines of the ornamental draughtsman. This led to the appearance of three new weekly papers : Jugend, Das Narrenschiff, and Simpli- cissimus. Jugend, started in 1896 by Georg Hirth in Munich, collected from the first a group of gifted young artists, more especially Bernhard Pankok and Julius Diez, who based their style on old German wood-engraving; Fidus, who lavished the utmost beauty of line in unshaded pen-and-ink work ; Eudolf Wilke, whose grotesques have much in common with Porain's clever drawings ; Angelo~~

~~i H : V h .N (.. fc A ;N C i; 111 T H b S 1 1 IJ M i: 1((, b U~~

By W. A. Rogers (frum Harper's Wei'llij).

'■An Ill-matched Team."]iy C. G. Blsii (frum the New York Worlil).

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A COlLlilON on TM£ UAib L

■'Our Natioxal (;ame. " By A. B. Brost (I'roui Ilnrpcr's HLfjazlii,:, Jan. IS'JO ; coi.yright 1890, by Harper & Biiuthers, New York & London).

■He'j.l be Lucky if he i:ets his Teousers B.vrK." By JI(LM£R Davenport (from the

Xi'V York ■fuurual).

" Who Stole the PeopleVs Mosey ? " " 'Tvvas Him." By Thomas Nast (from Hnrper's Weekly).

EXAML^LES OF AMERICAN CARICATURE

"Golf is not the only Game on Earth." By C. D. Gtbson (by permission of James Hekdeuson and Sons, Louduu).

CABICATUEE

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*Jank and K M. Eichler, who work with a delightful bonhomie. Among the draughtsmen on the Narrenscliiff (Ihe bhip of Fools), Hans Baluschek is worthy of mention [1]■[i]^'iv? ^^^^ *^® *yP^s of Berlin life all his own ; and, wmie this paper give us for the most part inoffensive satire on society, SimpKcissimus, first printed at Munich and then at Zurich, under the editorship of Albert Langen, shows a marked Socialist and indeed Anarchist tendency, subjecting to ridicule and mockery everything that has hitherto been held as unassailable by such weapons : it reminds us of the scathing satire of Honore Daumier in La Caricature at the time of Louis Philippe.*

~~*Thomas Theodor Heine is unsurpassed in this style for his power of expression and variety of technique. Here we admire his delicate draughtsmanship ; there he gives us the broad and monumental grotesque; or, again, we find him drawing his figures with the heavy line of heraldic ornament. His laughter is often insolent, but he is more often the preacher, scourge in hand, who ruthlessly unveils all the dark side of life. Next to him come Paul, the incomparable limner of student life and the manners and customs of the Bavarian populace; E. Thony, the wonderfully clever caricaturist of the airs and assumption of the Prussian Junker and the Prussian subaltern ; J. C. Eugh and P. von Eegnieek, who make fun of the townsman and political spouter in biting and searching satire. The standard of caricature is at the present time a high one in Germany ; indeed, the modern adoption of the pen-line, which has arisen since the impressionists in oil-painting repudiated line, had its origin in the influence of caricature. (k. mk.)*~~

~~*United States. — The proverbial irreverence of the Ameri- can mind even towards its most cherished personages and ideals has made it particularly fallow ground for the growth of caricature. The seeds of this, as of the other arts in whose cultivation America is now so strenuously engaged, were borne across the ocean on the winds of immigration. They were slow in taking root, and the first growths led a precarious and stunted existence, in sharp contrast with their present prevalence and prosperity, which flourish in places even to rankness. In the early period of American caricature, almost the only native name is that of E. 0. C. Darley, an illustrator of some importance ; the other names include the engraver Paul Revere (chiefly famous for a picturesque exploit in the War of Independence) ; a Scotsman, William Charles ; the Englishmen, Matt Morgan and E. P. Bellew; and the Germans, Thomas Nast and Joseph Keppler.*~~

~~*The name of Thomas Nast overshadows and sums up American political caricature, as the word Homer typifies Greek epopee. Nast, who was horn in Bavaria, 27th Sep- tember 1840, was brought to America at the age of six ; and as his training and all his interests were strongly American, he may be forgiven the accident of birth. At fourteen he was an illustrator on Leslie's Weekly, and was sent at twenty to England to illustrate the famous Sayers-Heenan prize-fight. He then went as recorder of Garibaldi's warfare. He*~~

~~*returned to America known only as an illustrator. The Civil War did not awaken his latent genius till 1864, when he published a cartoon of fierce irony against the political party which opposed Lincoln's re-election and advocated peace measures with the Southern confederacy. This cartoon not only made Nast famous, but may be said to contain the germ of American caricature; for all that had gone before was too crude in techiiique to pass muster even as good caricature.*~~

~~*The magnificent corruption of Tammany Hall- under the leadership of Alderman Tweed, the first of the great municipal " bosses," gave Nast a subject worth attacking.*~~

~~*Siegfried, earnest but light-hearted, armed with the mightier sword of the ridiculing pen, assailed the monster ensconced in his treasure-cave, and after a long battle won a brilliant victory. Nast did not always rely on a mere picture to carry his thrust ; often his cartoon con- sisted of only a minor figure or two looking at a large placard on which a long and poignantly-worded attack was delivered in cold type. At other times the most ingenious pictorial subtlety was displayed. This long series runs almost the whole gamut of caricature, from downright ridicule to the most lofty denunciation. A very happy device was the representation of Tweed's face by a money-bag with only dollar marks for features, a device which, strangely enough, made a curiously faithful likeness of the " boodle"-loving despot. When, finally, Tweed took to flight, to escape imprisonment, he was recognized and caught, it is said, entirely through the wide familiarity given to his image in Nast's cartoons. Though Nast kept up for many years a running fire of comment on the legitimate subjects open to an alert and brilliant caricaturist (a cartoon on Napoleon III. being one of his best works), and though he had technical skill enough to illustrate many subjects well (an annual Santa Clans picture being an important yearly event in the nursery world), he will always be remembered for having earned one of the most direct and most difficult material victories ever granted to caricature.*~~

~~*When Nast retired from Harper's Weekly he was suc- ceeded by Charles Green Bush (born at Boston, 1872), who speedily showed his ability to wear the mantle well. With even larger technical resources, he has poured forth a series of cartoons of remarkable evenness of skill and interest ; he soon left*~~

~~*weekly for daily journalism. Mr Bush was, in 1901, the recognized dean of American caricature. He has never won, single-handed, such a battle as Nast's, but his drawings have a more general, perhaps a more lasting interest. When he left Harper's Weekly he was succeeded by W. A. Rogers, who was called in from general illustration and has composed many ingenious and some telling cartoons.*~~

~~*The vogue which, through Nast, Harper's Weekly gave to caricature, prepared the way for the first purely comic weekly that escaped the grim fate which frequently attends the birth of comic papers. This was Puck, founded by two Germans, and for long published in a German as well as an English edition. It is worth noting that not only the founders but the spirit of American caricature have been rather German than English, the American comic papers more closely resembling Flie- geiide Blatter, for example, than Punch. One of the founders of Puck was Joseph Keppler, long its chief caricaturist. It has cast its influence generally in favour of the Democratic party. The Republican party soon found a champion in Judge, a weekly which resembles Puck closely in its crude-coloured pages, though some-what broader and less ambitious in the spirit and execu- tion of its black-and-white illustrations. These two papers have kept rather strictly to permanent staffs, and have furnished the opening for many popular draughts- men, such as Bernhard Gillam (died 1896), and his brother, Victor Gillam ; J. A. Wales ; E. Zimmerman, whose ex- tremely plebeian and broadly treated types often obscure their genuine observation and Falstafifian humour ; Grant Hamilton; Frederick Opper, for many years devoted to the trials of suburban existence, more recently concerned in combating the trusts; C. J. Taylor, a graceful technician ; H. Smith ; Frank A. Nankivell, whose pretty athletic girls are prone to attitudinizing; J. Mortimer Flagg; F. M. Howarth; Mrs Frances O'Neill Latham, whose personages are singularly well modelled and alive, and Miss Baker Baker, a skilful draughtswoman of animals.*~~

~~*A stimulus to genuine art in caricature was given by the establishment of the well-groomed society weekly, Life, edited by J. A. Mitchell, a clever*~~

~~*draughtsman as well as an original writer. It is to this weekly that America owes the discovery and encouragement of its most remarkable penman, Charles Dana Gibson, whose technique has developed through many interesting phases from an exceeding delicacy to a sculpturesque boldness of line without losing its rich texture or becoming monotonous. Mr Gibson is chiefly beloved by his public for his almost idolatrous realizations of the beautiful American woman of various types, ages, and environments. His works are, however, full of the most subtle character- observations, and American men of all walks of life, and foreigners of every type, impart as much importance and humour to his pages as his " Gibson girls " give radiance. His resemblance to Du Maurier, in reverence for the beautiful woman beautifully attired, has led some critics to set him down as a mere disciple, while his powerful individuality has led other critics to accuse him of mono- tony; but a serious examination of his work is held by others to show that he has gone beyond the genius of Du Maurier in sophistication, if not in variety of subjects and treatment, while it would be hard to find another artist who has so studiously tried new experiments in the new fields opened by modernized processes of photo- engraving. He has been an important influence in both English and American line-illustration.*~~

~~*Among other students of society, particular success has been granted to C. S. Reinhart (1844-1896), Charles Howard Johnson (died 1895), H. W. McVickar, S. W. van Schaick, A. E. Sterner, W. H. Hyde, W. T. Smedley, and A. B. Wenzell, each of them strongly individual in man- ner and often full of verve and truth.*~~

~~*Life, and other comic papers, including for many years Truth, also brought forward caricaturists of distinct worth and a marked tendency to specialization. F. G. Attwood (died 1900) was ingenious in cartoons lightly allegorical ; Oliver Herford has shown a fascination elusive of analysis in his drawings as in his verse ; T. S. SuUivant has made a quaintly intellectual application of the world-old devices of large heads, small bodies, and general upsetting of the rule of three ; Peter Newell has developed individuality both in treatment and humour ; E. W. Kemble stands well to the front among the exploiters of negro life ; and H. B. Eddy, Augustus Dirk, Robert Wagner, A. Anderson, E. Sarka, and T. Swinnerton have all found manners and moods quite their own.*~~

~~*In distinction from the earlier period, the present school of American caricature is strongly national, not only in subject, but in origin, training, and in mental attitude, exception being made of a few notable figur& such as Michael Angelo Woolf, born in England, and of a some- what Crujkshaukian technique. He came to America while young, and contributed a long series of what may be called slum-fantasies, rich in a spirit often equivocal with laughter and sorrow, at times strangely combining extravagant melodrama with a most plausible and convincing impossibility. His drawings must always lie very close to the affections of the large audience that welcomed them. American also by adoption is Henry Mayer, a German by birth, who has contributed to many of the chief comic papers of Erance, England, Germany, and America. His work is as full of variety as it is cosmopolitan, and its exuberant spontaneity finds skill ready for every flight of whim.*~~

~~*Entirely native in every way is the art of A. B. Erost (born in 1851), who is prominent in the fields of pure humour as comment on real or apparently real life among the common people. His caricature — for he is also an*~~

~~*illustrator of versatility and importance — is distinguished by its anatomic knowledge, or, rather, anatomic imagina- tion. Violent as the "action of his figures frequently is, it is always convincing. Such triumphs as the tragedy of the kind-hearted man and the ungrateful bull-calf ; the spinster's cat that ate rat-poison by mistake and went mad ; the discomfiture of the two deserters with the clothes-basket ; and many others, force the most serious to laughter by their amazing velocity of action and their unctuousness of expression ; but they fasten on the memory, and for years the mere thought of them brings back the old-time merriment. Erost is to American carica- ture what " Artemus Ward " has been to American humour. Erost's field of publication has been chiefly the monthly magazine.*~~

~~*The influence of the weekly periodicals has been briefly traced. A more recent development has been the entrance of the omnivorous daily newspaper into the field of both the magazine and the weekly. Eor many years almost every newspaper has printed its daily cartoon, generally of a political nature. Eew of the cartoonists have been able to keep up the pace of a daily inspiration, though Mr C. G. Bush has been unusually successful*~~

~~in the attempt. But an occasional success atones in the public mind for many slips, and the car- toonists are known and eagerly watched. The most influential has doubtless been Homer C. Davenport, whose slender artistic resources have been eked out by a vigour and mercilessness of assault rare even in American annals. He has a Rabelaisian complacency and skill in making a portrait magnificently repulsive, and his caricatures are a vivid example of the school of cartoonists who believe in slashing rather than merely prodding or tickling the object of attack. Charles G. Nelan frequently scores, and throughout the wide extent of the United States one finds keen wits busily assailing the manifold evils of life. Noteworthy among them are : Thos. E. Powers, H. R. Heaton, A. L. Levering, Clare Angell, and R. C. Swayne. Many of the daily papers publish a weekly comic supple- ment ; some even devote a page every day to humour. The quality of most of this is inevitably low, yet en- larged artistic opportunities usually evoke increased achievement, and entice many a brilliant mind that would otherwise have sought some other outlet. Among the increasing crowd of American caricaturists there are already enough important figures to justify a reason- able confidence in the future. (r. hu.)~~

~~Carimata (Dutch, Karimata), a group of islands in the East Indian Archipelago, west of Borneo and between 1° 11' and 1° 46' S. lat., and 108° 40' and 109° 28' E. long. Great Carimata, on which is the village (kampong) of Palembang, rises in its highest point to 2620 feet. The industries are fisheries, forest products, and iron-mining. Population, about 500.~~

~~Carinthia (German, Kdmten), a duchy and crown- land of the Cisleithan part of the Austro-Hungarian monarchy. Population (1880), 348,730 ; (1890), 361,008, equivalent to 90-12 inhabitants per square mile. Pro- portion of females to males, 1046 to 1000 : 71-6 per cent, were German, and 28-4 Slovenes ; the latter mostly settled in the districts adjoining the Slovene province of Carniola. 94-8 per cent, were Roman Catholic, the rest Protestant. Population in 1900, 367,344. In 1896 the marriage-rate was 5‘65 ; the birth-rate, 32-88, or, excluding still-births, 31-78 ; and the death- rate, 26-38. Of the births, 43-34 per cent, were illegitimate, a declining ratio. Carinthia has the largest propor- tion in Austria of illegitimacy and of cretins. The crownland returns ten members to the Reichsrath. In~~

~~the Diet there are thirty-four Germans and three Slovenes, i^iducation is decidedly backward, although an improve- ment IS now visible, the number of illiterates in 1890, 29-6 per cent., showing an improvement of 10 per cent, on the census of 1880. In 1895 there were four gymnasia, a theological seminary, seven technical institutions (in- cluding three agricultural academies and a school of mining), and 374 elementary schools. Less than 14 per cent, of the soil is arable, and the crops are insufficient for the requirements of the population. Cattle-breeding is of greater importance, and all descriptions of live stock show an increase, with the exception of sheep. The m ines (lead — the most important in the monarchy — iron, lignite, zinc), and the industries dependent upon them, are the chief resources of the population. Other trades are the manufacture of leather, paper, cloth,, and cement, brewing, distilling, &c. In 1897 the value of the minerals was £150,996, and of the furnace products £185,100. But the manufacture of lead, steel, and iron wares, including rails and railway material, agricultural implements, and small-arms, is of greater importance. In 1897 Carinthia had 447 kilometres of railway, 1754' kilometres of roads, and 393 kilometres of waterway, of which two-thirds was only available for floating timber.~~

~~Aelschkeb's Geschichte Kdrntens (Klagenfurt, 1885) ; and his Heimatskunde von K. (Klagenfurt, 1886) ; Krones, Die alte Geschichte Karntens von der Urzeit bis Kaiser Karl dem Orossen (Klagenfurt, 1893) ; and von Radios, Kdrnten, Kultur- und Heisebilder (Vienna, 1882). (^ qij^ \~~

~~Carleton Place, a town and port of entry of Lanark county, Ontario, Canada, situated 30 miles S.W. of Ottawa, on the Mississippi river, and at the junction of the main line and Brockville branch of the Canadian Pacific railway. It has abundant water-power privileges, and contains extensive railway-repair shops and woollen mills. Population (1881), 1975; (1891), 4435:~~

~~(1901), 4059.~~

~~*Carlisle, a city, municipal borough (extended 1887), parliamentary borough (since 1885 returning only one member), and county town of Cumberland, England, on the Eden, 300 miles N.KW. of London by rail, and 301 by road. Eight lines of railway converge on Carlisle, making it a very important railway junction. Eecent constructions are the Victoria railway viaduct, public baths, the city hall, the market, large public slaughter- houses, and the museum, art gallery, library, &c. The Cumberland Infirmary and the home for incurables have been extended, and large works for locomotives, carriages, and waggons established. The gas-works and the electric- light works are vested in the corporation, whilst the electric tramways (the property of a company) are worked with electric energy supplied by the corporation. Ex- tended area of municipal borough, 2025 acres ; population (1881), 36,585; (1891), 39,176; (1901), 45,478. Area of parliamentary borough, 1670 acres ; population (1881),*~~

~~*36,586 ; (1901), 43,687.*~~

~~*Carlisle, a borough of Pennsylvania, U.S.A., and capital of Cumberland county, situated in Cumberland Valley, south' of the Blue Eidge, in the southern part of the state, at the intersection of the Cumber- land Valley railway with a branch of the Philadelphia and Reading, at an altitude of 473 feet. It is the seat of Dickinson College for boys and Metzger Institute for girls, and of a training school for Indians, of whom about 1000, both boys and girls, are usually in attend- ance. Population (1880), 6209; (1890), 7620; (1900),*~~

~~*9626.*~~

~~*Carloforte, a town of Italy, Sardinia, province of Cagliari, situated on the E. side of the island of San Pietro, off the S.W. coast of Sardinia. It has grown*~~

~~*out of a Genoese colony founded here in 1737 by Charles Emmanuel of Savoy. It carries on tunny fishing and the preparation of salt, and exports these products, as well as zinc and lead from mines on the main island. The coral fishing came to an end in 1898, owing to exhaustion of the banks. Population, about*~~

~~*7000.*~~

~~Carlos (Chaeles Mabia de los Doloees Juan Isidore Joseph Francis Quicin Antony Michael~~

~~Gabriel Raphael) (1848), prince of Bourbon,~~

~~known as Don Carlos, was born at Laibach on 30th March 1848, being the eldest surviving son of Don Juan of Bour- bon and of the archduchess Maria Beatrix, daughter of Francis IV., duke of Modena. Don Carlos, who styles him- self duke of Madrid, andis sometimes called Charles VII. by his partisans, is the fourth pretender who has disputed the rights of the reigning branch of the Spanish Bourbons. He is the grandson of the first pretender, also a Don Carlos and Infante of Spain, brother of Ferdinand VII., who waged war from 1833 to 1840 against Queen Isabella II., the daughter and heiress of that king. The first pretender's eldest son, the count of Montemolin, was taken prisoner by the troops of Queen Isabella, and had to abdicate and renounce his rights in order to regain his liberty, where- upon his younger brother, Don Juan, claimed to be the representative of the rights of the first Don Carlos. Don Juan himself abdicated in favour of his son, Don Carlos, in 1868, when the latter was only twenty. The present pretender married in February 1867, at Frohsdorf, Princess Marguerite, daughter of the duke of Parma and niece of the comte de Chambord," who was born on 1st January 1847, and who bore him a son, Don Jaime, in 1870, and three daughters. Don Carlos boldly asserted his preten- sions to the throne of Spain two years after the revolution of 1868 had driven Queen Isabella II. and the other branch of the Bourbons into exile. His manifesto, addressed to his brother Alfonso, namesake of his rival, Alfonso XII., found an echo in the fanatical priesthood and peasantry of many provinces of the Peninsula, but little support among the more enlightened middle classes, especially in the towns. ^ The first rising was started in Catalonia by the brother of the pretender, who himself entered Spain by way of Vera, in the Basque provinces, on 21st May 1872. The troops of King Amadeus under General Moriones, a progressist officer, who was one of Spain's ablest and most popular commanders, surprised and very nearly captured the pretender at Oroquist^i, sending him a fugitive to France in headlong flight with a few followers. For more than a year he loitered about in the French Pyrenees, the guest of old noble houses who showed him much sympathy, while the French authorities winked at the fact that he was fomenting civil~~

~~*war in Spain, where his guerilla bands, many of them led by priests, committed atrocities, burning, pillaging, shooting prisoners of war, and not unfrequently ill-using even foreign residents and destroying their property. When the Federal Republic was proclaimed on the abdication of King Amadeus, the Carlists had overrun Spain to such an extent that they held all the interior of Navarre, the three Basque provinces, and a great part of Catalonia, Lower Aragon, and Valencia, and had made raids into the provinces of Old CastUe and Estremadura. Don Carlos re-entered Spain on 15th July 1873, just before the Carlists took Estella, in Navarre, which became, with Tolosa and Durango in the Basque provinces, his favourite residence. He displayed very lax morals and an apathy which displeased his staff and partisans. Don Carlos was present at some fights around Estella, and was in the neighbourhood of Bilbao during its famous siege of three months in 1874 until its relief by Marshals Serrano and*~~

~~*Concha on 2nd May. He was also present at the battle near Estella on 27th June 1874, in which Marshal Concha was killed and the Liberals were repulsed with loss. Twice he lost golden opportunities of making a rush for the capital — in 1873, during the Federal Eepublic, and after Concha's death. From the moment that his cousin Alfonso XII. was proclaimed king at Sagunto, at Valencia, in Madrid, and at Logrono, by General Campos, Daban, Jovellar, Primo de Eivera, and Laserna, the star of the pretender was on the wane. Only once, a few weeks after the Alphonsist restoration, the army of Don Carlos checked the Liberal forces in Navarre, and surprised and made prisoners half a brigade, with guns and colours, at Lacar, almost under the eyes of the new king and his headquarters. This was the last Carlist success. The tide of war set in favour of Alfonso XII., whose armies swept the Carlist bands out of Central Spain and Catalonia in 1876, while Marshal Quesada, in the upper Ebro valley, Navarre, and Ulava, prepared by a series of successful operations the final advance of 180,000 men, headed by Quesada and the king, which defeated the Carlists at Estella, PeSa Plata, and Elgueta, thus forcing Don Carlos with a few*~~

~~*thousand faithful Carlists to retreat and surrender to the French frontier authorities in March 1876.*~~

~~*The pretender went to Pau, and there, singularly enough, issued his proclamations bidding temporary adieu to the nation and to his volunteers from the same chateau where Queen Isabella, also a refugee, had issued hers in 1868. From that date Don Carlos became an exile and a wanderer, travelling much in the Old and New World, and raising some scandal by his mode of life. He fixed his residence for a time in England, then in Paris, from which he was expelled at the request of the Madrid Government, and next in Austria, before he took up his abode at Viarreggio in Italy. Like all pretenders, he never gave in, and his pretensions, haughtily reasserted, often troubled the courts and countries whose hospitality he enjoyed. His great disappointment was the coldness towards him of Pope Leo XIII., and the favour shown by that Pontiff for Alfonso XII. and his godson, Alfonso XIII. Don Carlos had two splendid chances of testing the power of his party in Spain, but failed to profit by them. The first was when he was invited to unfurl his flag on the death of Alfonso XII., when the perplexities and uncertainties of Castilian politics reached a climax during the first year of a long minority under a foreign queen-regent. The second was at the close of the war with the United States and after the loss of the colonies, when the discontent was so widespread that the Carlists were able to assure their prince that many Spaniards looked upon his cause as the one untried solution of the national difficulties. Don Carlos showed his usual lack of decision ; he wavered between the advice of those who told ,him to unfurl his standard with a view to rally all the discontented and dis- appointed, and of those who recommended him to wait until a gveat pronunciamiento, chiefly military, should be made in his favour — a day-dream founded upon the coquetting of General Weyler and other officers with the Carlist Senators and Deputies in Madrid. Afterwards the pretender continued to ask his partisans to go on organizing their forces for action some day, and to push their propaganda and preparations, which was easy enough in view of the indulgence shown them by all the governments of the regency and the open favour exhibited by many of the priesthood, especially in the rural districts, the religious orders, and the Jesuits, swarming all over the kingdom. After the death "of his first wife in 1893, Don Carlos married .in*~~

~~*the following year Princess Marie Bertha of Rohan. HIs son by his first wife, Don Jaime, was educated in Austrian and*~~

~~*British military schools before he entered the Russian army, in which he holds the rank of a colonel of dragoons.*~~

~~*Carlos I. (1863), king of Portugal, the third*~~

~~*sovereign of Portugal of the line of Braganza-Coburg, was the son of King Luiz I. and Maria Pia, daughter of King Vittorio Emmanuele of Italy, being born 28th September 1863. When about twenty years of age he spent a considerable time in travelling. HIe visited England in 1883. On 22nd May 1886 he married Marie Am^lie, daughter of Philippe, due d'Orleans, comte de Paris, and on the death of his father, 19th October 1889, succeeded to the throne of Portugal. In that year the British Government found it necessary to make formal remonstrances against Portuguese encroachments in South Africa, and relations between the two countries were greatly strained for some time. The king's attitude during this critical period was one of conciliation, and his temperate, though firm, speech on opening the Cortes in January 1890 did much to strengthen the party of peace. In 1900-1 also his friendly attitude towards Great Britain was shown by cordial toasts at a banquet to the officers of the British fieet at Lisbon. The king has been a great patron of science and literature ; in March 1894 he took a very active part in the celebration of the 500th anni- versary of the birth of Prince HIenry the Navigator, and a year later he decorated, the Portuguese poet Joao de Deus with much honour at Lisbon. HIe has taken a great personal interest in deep-sea soundings and marine ex- ploration, and has published an account of some of his own investigations, the results themselves being shown at an oceanographic exhibition opened by him on 12th April*~~

~~*1897.*~~

~~*Carlow, an inland county of Ireland, province of Leinster.*~~

~~*Population. — The area of the judicial county in 1900 was 221,458 acres, of which 71,486 were tillage, 122,649 pasture, 114 fallow, 3240 plantation, 688 turf bog, 2367 marsh, 10,647 barren mountain, and 10,267 water,*~~

~~*roads, fences, &c. The new adminis- trative county, under the local government (Ireland) Act, 1898, includes the portion of the town of Carlow formerly situated in Queen's County. Population (1881), 46,568 ; (1891), 41,964 ; (1901), 37,723, of whom 18,991 were males and 18,732 females, beluga decrease of 10-1 per cent., divided as follows among the different religions : — Roman Catholics, 33,381 ; Protestant Epis- copalians, 3950 ; Presbyterians, 156 ; Methodists, 198 ; others,, 38. The decrease of population between 1881 and 1891 was 121 per cent. The average number of persons to an acre was '19. Of the total population 35,345 persons inhabited the rural districts,, being an average of 119 to each square mile under crops and pasture. The following table gives the degree of education iu- 1891 :—*~~

~~*Males.*~~

~~*Females.*~~

~~*Total.*~~

~~*Percentage.*~~

~~*B.C.*~~

~~*Pr. Epis.*~~

~~*Presb.*~~

~~*Bead and write . Bead only Illiterate . . .*~~

~~*18,840 1,988 2,829*~~

~~*18,614 2,841 2,709*~~

~~*2T,854*~~

~~*4,279 5,588*~~

~~*71-5 12-4 161*~~

~~*89-4 6-2 6-4*~~

~~*94-0 10 5-0*~~

~~*In 1881 the percentage of illiterates among Roman Catholics; was 21-4. In 1891 there were 6 superior schools, with 396 pupils (344 Roman Catholics and 52 Protestants), and 83 primary schools, with 6791 pupils (5092 Roman Catholics and 699 Protestants).. The number of pupils on the rolls of the national schools on 30th September 1899 was 6275, of whom 6530 were Roman Catholicsi and 745 Protestants.*~~

~~*The following table gives the number of births, deaths, and marriages in various years : —*~~

~~*Year.*~~

~~*Births.*~~

~~*Deaths.*~~

~~*Marriages.*~~

~~*1881*~~

~~*1891 1899*~~

~~*937*~~

~~*817 847*~~

~~*754*~~

~~*772 698*~~

~~*177 140 145*~~

~~*In 1899 the birth-rate per 1000 was 20-2, and the death-rate- 16-6 ; the rate of illegitimacy was 4‘3 per cent, of the total births. The total number of emigrants who left the county between 1st*~~

~~May 1851 and 31st December 1899 was 32,009, of whom 16,425 were males and 15,584 females. The following are the chief towns in the county, with their populations in 1891 :— Carlow, 6619 ; Bagenalstown, 1920 ; TuUow, 1773.~~

~~Administration.— The county returns 1 member to Parliament, the number of registered electors in 1900 being 8132. The rateable value in 1900 was £169,401. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury and (to a less extent) of other bodies were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises 1 urban and 3 rural sanitary districts. _ Agriculture. — The following tables show the acreage under crops (including meadow and clover), and the amount of live stock, in 1881, 1891, 1895, and 1900. The figures for 1900 are for the new administrative county : —~~

~~Wheat.~~

~~Oats.~~

~~Barley, etc.~~

~~Pota- toes.~~

~~Tur- nips,~~

~~Other Green Crops.~~

~~Meadow~~

~~and Clover.~~

~~Total.~~

~~18S1~~

~~*1891 1695 1900*~~

~~*8409*~~

~~*1483*~~

~~*120*~~

~~*405*~~

~~*•20,209*~~

~~*20,174 21,902 19,428*~~

~~*6404*~~

~~*515T*~~

~~*4958 6499*~~

~~*9866 9582 8515 7918*~~

~~*4972 6192 5769 5666*~~

~~*1880 2180 1952 2046*~~

~~*81,275 81,046 88,601 80,634*~~

~~*76,955 74,718 76,707 71,486*~~

~~*For 1899 the total value of cereal and other crops was estimated by the Registrar-General at £515,840. The number of acres under pasture in 1881 was 116,694 ; in 1891, 116,175 : and in 1900,*~~

~~*122,649.*~~

~~*Horses*~~

~~*and Mules.*~~

~~*Asses.*~~

~~*Cattle.*~~

-

~~*Sheep.*~~

~~*Pigs.*~~

~~*Goats.*~~

~~*Poultry.*~~

~~*1881 1891 1895 1900*~~

~~*8649 9039 9498 8867*~~

~~*2556 2763 2876 3368*~~

~~*44,519 46,311 48,787 47,814*~~

~~*60,078 89,123 79,696 97,845*~~

~~*21,411 24,611 22,560 22,486*~~

~~*8380 8987 8887 3044*~~

~~*176,909 198,728 204,526 226,168*~~

~~*The number of milch cows in 1891 was 12,070, and in 1900 11,674. It is estimated that the total value of cattle, sheep, and pigs in 1900 was £827,223. In 1900 the number of holdings not exceeding 1 acre was 1576 ; between 1 and 5, 625 ; between 5 and 15, 817 ; between 15 and 30, 994 ; between 30 and 60, 834 ; be- tween 50 and 100, 840 ; between 100 and 200, 349 ; between 200 and 500, 108 ; and above 500, 7— total, 6150. The number of loans issued (the number of tenants being the same as the number of loans) under the Land Purchase Acts 1885, 1891, and 1896, up to 31st March 1900, was 155, amounting to £129,570. The number of loans*~~

~~sanctioned for agricultural improvements under sect. 31 of the Land Act, 1881, between 1882 and 1900, was 114, and the amount issued was £10,541. The total amount issued on loan for all classes of works under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1900, was £109,969. (w. H. PC.)~~

~~Carlsbad, or Kaiser-Karlsbad (Czech, Karlovy Vary), a royal free town and celebrated watering-place in Bohemia. The population in 1890 was 12,033 ; in 1900 (estimated), 14,640, all German and chiefly Catholic (about 9 per cent. Jewish and 2 per cent. Protestant). In 1896 the total number of visitors rose to 42,448. There has been a corresponding increase in the accommodation, the houses having been increased by 114 in the period 1887-96, 33 of these being public buildings. Carlsbad has an important poi^elain and stoneware industry, cutlery, confectionery, &c.~~

~~There is an extensive literature on the curative properties of the waters, comprising works by Mannl (^Carlsbad and its Mineral Springs, Leipzig, 1850), Hochstetter, Semler, Hertzka, Fleckles, Kraus, Sorger, Kafka, Hlawacek, Cartellieri, Stephanides, and Sipocz.~~

~~Carlscrona, the chief naval station of Sweden, on the S. coast, 53 miles S.S.W. from Calmar by rail (line opened in 1899). A bronze statue of Charles XI., the founder of the town, was unveiled in 1897. There are factories for naval equipments, canvas, leather, and rice, and granite quarries. About 550 vessels of 110,000 tons clear the port annually. Principal exports — granite and timber. Imports — coal, cereals and flour, groceries, hides, machinery, &c. Population (1880), 18,300 ; (1898),~~

~~23,507.~~

~~Carlshamn, a seaport town of Sweden, on the S. coast, 28 miles by rail W. from Carlscrona. It has a school of navigation, and an export trade in timber, spirits, and fish. The industries embrace distilleries, tanneries, tobacco factories, &c. Population (1880), 6402; (1898),~~

~~7074.~~

~~*Carlsruhe, a town of Germany, capital of grand- duchy of Baden, 33 miles by rail S. by W. of Heidelberg, and 6 miles E. of the Rhine. The fan-like form of the plan of the city, already described in the article in the ninth edition, has been rigidly adhered to in the new suburbs. The city as a whole makes the impression of uniformity and elegance. Amongst the new buildings probably the most noteworthy are the joint museum of the grand-ducal and national collections (natural history, archaeology, ethnology, art, and a library of over 160,000 volumes) ; the palace of the heir-apparent, a late Renais- sance building of 1891-96 ; the imperial bank (1893) ; the national industrial hall, with an exhibition of machinery, &c. ; and the new law courts. The hall of fine arts, which shelters a good picture gallery, was enlarged in 1896. Carlsruhe possesses further the Zahringer museum of curiosities, &c., in the left wing of the castle, an architectural school (1891), industrial art school and museum, cadet school (1892), botanical and electro-technical institutes, industrial art school, art school, trades and commercial schools, and horticultural and agricultural schools. Of its recent public monuments may be mentioned one to Von Scheffel (1892), who was born here in 1826, and died here in 1886; a bronze equestrian statue of the Emperor William I. (1896); and a memorial of the 1870-71 war. Carls-ruhe is the headquarters of the 14th German army corps. Since 1870 the industry of the town has grown rapidly, as well as the town itself. Here are large railway workshops. The principal branches of industry are concerned with the making of locomotives, vehicles, implements and machinery, silvered wares, art furniture, gloves, cement, carpets, perfumery, and beer. There is an important arms factory. Maxau, on the Rhine, serves as the river port of Carlsruhe, and is con- nected with it by a canal finished in 1901. Population*~~

~~*(1885), 61,066 ; (1895), 84,030 ; (1900), 96,876.*~~

~~*Carlstad, a town of Sweden, capital of province of Vermland, stands at the N. end of Lake Wener, 205 miles W. from Stockholm by rail to Christiania. There are ironworks and match factories, and a mineral spring. Population (1880), 7772 ; (1898), 10,015.*~~

~~*Carluke, a burgh of barony of central Lanarkshire, Scotland, 19|- miles S.E. of Glasgow by rail. Fruit is largely grown in the district, and a preserve*~~

factory and engineering works are among the industrial features. Original Secession and Congregational chapels have been erected. Population (1881), 3867; (1901), 4731. The parish contains four villages, the largest. Law, an im- portant railway junction. Population (1901), 8962.

Carlyle, Thomas (1795-1881), British essayist, historian, and philosopher, born on 4th December 1795 at Ecclefechan, in Annandale, was the eldest of the nine children of James Carlyle by his second wife, Janet Aitken. The father was by trade a mason, and after- wards a small farmer. He had joined a sect of seceders from the Kirk, and had all the characteristics of the typical Scottish Calvinist. He was respected for his integrity and independence, and a stern outside covered warm affections. The family tie between all the Carlyles was unusually strong, and Thomas regarded his father with a reverence which found forcible expression in his Reminiscences. He always showed the tenderest

love for his mother, and was the best of brothers. The narrow means of his parents were made sufficient by strict frugality. He was sent to the parish school when seven, and to Annan grammar-school when ten years old. His pugnacity brought him into troubles with his fellows at Annan; but he soon showed an appetite for learning which induced his father to educate him for the ministry. He walked to Edinburgh in November 1809, and entered the University. He cared little for any of the professors, except Sir ~ John Leslie, from whom he learned some mathematics. He acquired a little classical knowledge, but the most valuable influence was that of his contem- poraries. A few lads in positions similar to his own began to look up to him as an intellectual leader, and their correspondence with him shows remarkable interest in literary matters. In 1814, Carlyle, still looking for- ward to the career of a minister, obtained the mathemati- cal mastership of Annan. The salary of £60 or £70 a year enabled him to save a little money. He went to Edinburgh once or twice, to deliver the discourses re- quired from students of divinity. He does not seem, however, to have

~~taken to his profession very earnestly. He was too shy and proud to see many of the Annan people, and found his chief solace in reading such books as he could get. In 1816 he was appointed, through the recommendation of Leslie, to a school at Kirkcaldy, where Edward Irving, Carlyle's senior by three years, was also master of a school, Irving's severity as a teacher had offended some of the parents, who set up Carlyle to be his rival. A previous meeting with Irving, also a native of Annan, had led to a little passage of arms, but Irving now welcomed Carlyle with a generosity which entirely won his heart, and the rivals soon became the closest of friends. The intimacy, affectionately commemorated in the Meminiscencesj was of great importance to Carlyle's whole career. " But for Irving," he says, " I had never known what the communion of man with man means." Irving had a library, in which Carlyle devoured Gibbon and much French literature, and they made various excur- sions together. Carlyle did his duties as a schoolmaster puuctiliouslyj but found the life thoroughly uncongenial. INo man was less fitted by temperament for the necessary drudgery and worry. A passing admiration for a Miss Gordon is supposed to have suggested the " Blumine " of Sartor Resartus; but he made no new friendships, and when Irving left at the end of 1818 Carlyle also resigned his post.~~

~~He had by this time resolved to give up the ministry. He has given no details of the intellectual change which alienated him from the Church. He had, however, been led, by whatever process, to abandon the dogmatic system of his forefathers, though he was and always remained in profound sympathy with the spirit of their teaching. A period of severe struggle followed. He studied law for a time, but liked it no better than schoolmastering. He took a pupil or two, and wrote articles for the Edinburgh Encydopoidia under the editorship of Brewster. He occasionally visited his family, and their unfailing confi- dence helped to keep up his courage. Meanwhile he was going through a spiritual crisis. Atheism seemed for a time to be the only alternative to his old creed. It was, however, profoundly repugnant to him. At last, one day in June 1821, after three weeks' total sleeplessness, he went through the crisis afterwards described "quite literally " in Sartor Besartus. He cast out the spirit of negation, and henceforth the temper of his misery was changed to one, not of "whining," but of "indigna- tion and grim fire-eyed defiance." That, he says, was his spiritual new-birth, though~~

~~*certainly not into a life of .serenity. The conversion was coincident with Carlyle's submission to a new and very potent influence. In 1819*~~

~~*he had begun to study German, with which he soon ac- quired a very remarkable familiarity. Many of his con- temporaries were awakening to the importance of German thought, and Carlyle's knowledge enabled him before long to take a conspicuous part in diffusing the new intellectual light. The chief object of his reverence was Goethe. In many most important respects no two men could be more unlike ; but, for the present, Carlyle seems to have seen in Goethe a proof that it was possible to reject outworn dogmas without sinking into materialism. Goethe, by singularly different methods, had emerged from a merely negative position into a lofty and coherent conception of the universe. Meanwhile, Carlyle's various anxieties were beginning to be complicated by physical derange- ment. A rat, he declared, was gnawing at the pit of his stomach. He was already suffering from the ailments, whatever their precise nature, from which he never escaped. He gave vent to his irritability by lamenta^ tions so grotesquely exaggerated as to make it difficult to estimate the real extent of the evil.*~~

~~*>i^'.«J^^^ "■*~~

~~*Thomas Oarlylr. {Ftom a photograph hy Elliott and Fry, London.)*~~

~~*Irving's friendship now became serviceable. Carlyle's confession of the radical difference of religious opinion had not alienated his friend, who was settling in London, and used his opportunities for promoting Carlyle's interest. In January 1822, Carlyle, through Irving's recommendar tion, became tutor to Charles and Arthur Buller, who were to be students at Edinburgh. Carlyle's salary was £200 a year, and this, with the proceeds of some literary work, enabled him at once to help his brother John to study medicine and his brother Alexander to take up a farm. Carlyle spent some time with the elder Bullers, but found a life of dependence upon fashionable people humiliating and unsatisfactory. Heemployedhimself at intervals upon a life of Schiller and a translation of Wilhelm Meister. He received £60 for a translation of Legendre's Geometry ; and an introduction, explaining the theory of proportion, is said by De Morgan to show that he could have gained distinction as an expounder of mathematical principles. He finally gave up his tutorship in July 1824, and for a*~~

timetriedtofindemploymentinLondon. The impressions made upon him by London men of letters were most un- favourable. Carlyle felt by this time conscious of having

a message to deliver to mankind, and his comrades, he thought, were making literature a trade instead of a voca- tion, and prostituting their talents to frivolous journalism. He went once to see Coleridge, who was then delivering his oracular utterances at Highgate, and the only result was the singularly vivid portrait given in a famous chapter in his life of Sterling. Coleridge seemed to him to be ineffectual as a philosopher, and personally to be a melancholy instance of genius running to waste. Carlyle, conscious of great abilities, and impressed by such in- stances of the deleterious effects of the social atmosphere of London, resolved to settle in his native district. There he could live frugally and achieve some real work. He ■could, for one thing, be the interpreter of Germany to England. A friendly letter from Goethe, acknowledging the translation of Wilhelm Meister, reached him at the ■end of 1824 and greatly encouraged him. Goethe after- wards spoke warmly of the life of Schiller, and desired it to be translated into German. Letters occasionally passed between them in later years, which were edited t)y Professor Norton in 1887. Goethe received Carlyle's homage with kind complacency. The gift of a seal to Goethe on his birthday in 1831 "from fifteen English friends," including Scott and Wordsworth, was suggested and carried out by Carlyle. The interest in German, which Carlyle did so much to promote, suggested to him other translations and reviews during the next few years, and he made some preparations for a history of German literature. British curiosity, however, about such matters seems to have been soon satisfied, and the demand for such work slackened.

Carlyle was meanwhile passing through the most im- portant crisis of his personal history. Jane Baillie Welsh, l)orn 1801, was the only child of Dr Welsh of Hadding- ton. She had shown precocious talent, and was sent to the school at Haddington where Irving was a master. After her father's death in 1819 she lived with her mother, and her wit and beauty attracted many admirers. Her old tutor, Irving, was now at Kirkcaldy, where he

~~*became ongaged to a Miss Martin. He visited Haddington occasionally in the following years, and a strong mutual regard arose between him and Miss Welsh. They con- templated a marriage, and Irving endeavoured to obtain a release from his previous engagement. The Martin family held him to his word, and he took a final leave of Miss Welsh in 1822. Meanwhile he had brought Carlyle from Edinburgh and introduced him to the Welshes. Carlyle was attracted by the brilliant abilities of the young lady, procured books for her, and wrote letters to her as an intellectual guide. The two were to perform a new Tariation upon the theme of Abelard and Heloise. It is, however, difficult to speak with confidence of the precise •character of their relations. The letters which contain the necessary information have been read by no one except 'Carlyle's biographer, Froude, and Professor Norton. Fro- iessor Norton (in his edition of Carlyle's Early Letters, 1886) declares that Froude had distorted the significance of this correspondence in a sense injurious to the writers. He gives significant instances of misconception, and the presumption is certainly not in favour of Fronde's accur- acy. According to Professor Norton, Miss Welsh's previ- ous affair with Irving had far less importance than Froude ascribes to it ; and she soon came to regard her past love as a childish fancy. She recognized Carlyle's vast in- tellectual superiority, and the respect gradually deepened into genuine love. The process, however, took some time. Her father had bequeathed to her his whole property (£200 "to £300 a year). In 1823 she made it over to her mother, but left the whole to Carlyle in the event of her own and her mother's death. She still declared that she did not love him well enough to become his wife. In 1824 she*~~

~~*gradually relented so far as to say that she would marry if he could achieve independence. She had been brought up in a station superior to that of the Carlyles, and could not accept the life of hardship which would be necessary in his present circumstances. Carlyle, accustomed to his father's household, was less frightened by the prospect of poverty. He was determined not to abandon his vocation as a man of genius by following the lower though more profitable paths to literary success, and expected that his wife should partake the necessary sacrifice of comfort. The natural result of such discussions followed. The at- traction became stronger on both sides, in spite of occar sional spasms of doubt. An odd incident precipitated the result. A friend of Irving's, Mrs Basil Montague, wrote to*~~

~~*Miss Welsh, to exhort her to suppress her love for Irving, who had married Miss Martin in 1823. Miss Welsh replied by announcing her intention to marry Carlyle; and then told him the whole story, of which he had previously been ignorant. He properly begged her not to yield to the impulse without due consideration. She answered by coming at once to his father's house, where he was staying; and the mar- riage was finally settled. It took place on 17th October*~~

~~*1826.*~~

~~*Carlyle had now to arrange the mode of life which should enable him to fulfil his Aspiration. His wife had made over her income to her mother, but he had saved a small sum upon which to begin housekeeping. A passing suggestion from Mrs Carlyle that they might live with her mother was judiciously abandoned. Carlyle had thought of occupying Craigenputtock, a remote and dreary farm belonging to Mrs Welsh. His wife objected his utter incapacity as a farmer ; and they finally took a small house at Comely Bank, Edinburgh, where they could live on a humble scale. The brilliant conversation of both attracted some notice in the literary society of Edinburgh. The most important connexion was with Jeffrey, still editor of the Edinburgh Review. Though Jeffrey had no intellec- tual sympathy with Carlyle, he accepted some articles for the Review and became warmly attached to Mrs Carlyle. Carlyle began to be known as leader of a new " mystic " school, and his earnings enabled him to send his brother John to study in Germany. The public ap- petite, however, for " mysticism " was not keen. In spite of support from Jeffrey and other friends, Carlyle failed in a candidature for a professorship at St Andrews. His brother, Alexander, had now taken the farm at Craigen- puttock, and the Carlyles decided to settle at the separate dwelling-house there, which would bring them nearer to Mrs Welsh. They went there in 1828, and began a hard struggle. Carlyle, indomitably determined to make no concessions for immediate profit, wrote slowly and care- fully, and turned out some of his most finished work. He laboured " passionately " at Sartor Resartus, and made articles out of fraginents originally intended for the history of German literature. The money difficulty soon became more pressing. John, whom he was still helping, was trying unsuccessfully to set up as a doctor in London; and Alexander's farming failed. In spite of such drawbacks, Carlyle in later*~~

~~*years looked back upon the life at Craigenputtock as on the whole a comparatively healthy and even happy period, as it was certainly one of most strenuous and courageous endeavour. Though often absorbed in his work and made both gloomy and irritable by his anxieties, he found relief in rides with his wife, and occasionally visiting their relations. Their letters during temporary separations are most affectionate. The bleak climate, however, the solitude, and the necessity of managing a household with a single servant, were excessively trying to a delicate woman, though Mrs Carlyle concealed from her husband*~~

~~*the extent of her sacrifices. The position was gradually becoming untenable. In the autunm of 1831 Carlyle was forced to accept a loan of £60 from Jeffrey and went in search of work to London, whither his wife followed him. He made some engagements with publishers, though no one would take Sartor Resartus, and returned to Craigen- puttock in the spring of 1832. Jeffrey, stimulated perhaps by his sympathy for Mrs Carlyle, was character- istically generous. Besides pressing loans upon both Thomas and John Carlyle, he offered to settle an annuity of £100 upon Thomas, and finally enabled John to support himself by recommending him to a medical position. Carlyle's proud spirit of independence made him reject Jeffrey's help as long as possible ; and even his acknowledgment of the generosity (in the Reminiscences) is tinged with something disagreeably like resentment. In 1834 he applied to Jeffrey for a post at the Edinburgh Observatory. Jeffrey naturally declined to appoint a man who, in spite of some mathematical knowledge, had no special qualification, and administered a general lec- ture upon Carlyle's arrogance and eccentricity which left a permanent sense of injury.*~~

~~*In the beginning of 1833 the Carlyles made another trial of Edinburgh. There Carlyle found materials in the Advocates' Library for the article on the Diamond Neck-' lace, which is one of his most perfect writings, and which led him to study the history of the Erench Revolu- tion. Sartor Resartus was at last appearing in Fraser's Magazine, though the rate of payment was cut down, and the publisher reported that it was received with*~~

~~*" unqualified dissatisfaction." Edinburgh society did not attract him, and he retreated once more to Craigen- puttock. After another winter the necessity of some change became obvious. The Carlyles resolved to " burn their ships." They went to London in the summer of 1834, and took a house at 5 (now 24) Cheyne Row, Chel- sea, which Carlyle inhabited till his death ; the house has since been bought for the public. Irving, who had welcomed him on former occasions, was just dying — a vic- tim, as Carlyle thought, to fashionable cajoleries. A few young men were beginning to show appreciation. J. S. Mill had made Carlyle's acquaintance in the previous visit to London, and had corresponded with him. Mill had introduced Emerson, who visited Craigenputtock in 1833. Carlyle was charmed with Emerson, and their letters published by Professor Norton show that his re- gard never cooled. Emerson's interest showed that Car- lyle's fame was already spreading in America. Carlyle's connexion with Charles Buller, a zealous utilitarian, intro- duced him to the circle of "philosophical Radicals." Carlyle called himself in some sense a Radical ; and J. S. Mill, though not an intellectual disciple, was a very warm admirer of his friend's genius. Carlyle had some ex- pectation of the editorship of the London Review, started by Sir W. Molesworth at this time as an organ of philo- sophical Radicalism. The combination would clearly have been explosive. Meanwhile Mill, who had collected many books upon the Erench Revolution, was eager to help Carlyle in the history which he was now beginning. He set to work at once and finished the first volume in five months. The manuscript, while entrusted to Mill for annotation, was burnt by an accident. Mill induced Carlyle to accept in compensation £100, which was urgently needed. Carlyle took up the task again and finished the whole on 12th January 1837. " I can tell the world," he said to his wife, "you have not had for a hun- dred years any book that comes more direct and flamingly from the heart of a loving man. Do what you like with it, yon " i*~~

~~*The publication, six months later, of the French Revolution marks the turning-point of Carlyle's career.*~~

~~*Many readers hold it to be the best, as it is certainly the most characteristic, of Carlyle's books. The failure of Sartor Resartus to attract average readers is quite intelli- gible. It contains, indeed, some of the most impressive, expositions of his philosophical position, and some of his- most beautiful*~~

~~*and perfectly written passages. But. there is something forced and clumsy, in spite of the flashes of grim humour, in the machinery of the Clothes Philosophy. The mannerism which has been attributed to an imitation of Jean Paul appeared to Carlyle himself to be derived rather from the phrases current in his father's house, and in any case gave an appropriate dialect for the expression of his peculiar idiosyncrasy. But it could not be appreciated by readers who would not. take the trouble to learn a new language. In the French Revolution Carlyle had discovered his real strength. He was always at his best when his imagination was set to- work upon a solid framework of fact. The book shows a. unique combination : on the one hand is the singularly shrewd insight into character and the vivid realization of the picturesque ; on the other is the " mysticism " or poetical philosophy which relieves the events against a. background of mystery. The contrast is marked by the humour which seems to combine a cynical view of human folly with a deeply pathetic sense of the sadness and suf- fering of life. The convictions, whatever their value, came, as he said, "flamingly from the heart." It was, of course, impossible for Carlyle to satisfy modern require- ments of matter-of-fact accuracy. He could not in the time have assimilated all the materials even then extant, and later accumulations would necessitate a complete re- vision. Considered as a "prose epic," or a vivid utter- ance of the thought of the period, it has a permanent- and unique value.*~~

~~*The book was speedily successful. It was reviewed by Mill in the HFesiminsterandby Thackeray in the Times,a.TLd Carlyle, after a heroic struggle, was at last touching land. In each of the years 1837 to 1840 he gave a course of lectures, of which the last only (upon " Hero Worship ") was published ; they materially helped his finances. By Emerson's management he also received something during the same period from American publishers. At the age of forty-five he had thus become independent. He had also established a position among the chief writers of the day. Young disciples, among whom John Sterling was the most- accepted, were gathering roimd him, and he became an object of social curiosity. Monckton Milnes, who won uni- versal popularity by the most genuine kindliness of nature, became a cordial friend. Another important intimacy was — with the Barings, afterwards Lord and Lady Ashburton. Carlyle's conversational powers were extraordinary ; though, as he won*~~

~~*greater recognition as a prophet, he in- dulged too freely in didactic monologue. In his prophetic capacity he published two remarkable books : CJiartism (1829), enlarged from an article which Lockhart, though personally approving, was afraid to take for the Quarterly ; and Past and Present (1843), in which the recently pub- lished Mediceval Chronicle was taken as a text for the ex- posure of modern evils. They may be regarded as expositions of the doctrine implicitly set forth in the French Revolution. Carlyle was a " Radical " as sharing the sentiments of the class in which he was born. He had been profoundly moved by the widely-spread distresses in his earlier years. When the yeomanry were called out to suppress riots after the Peace, his sympathies were with the people rather than with the authorities. So far he was in harmony with Mill and the " philosophical Radicals." A fundamental divergence of principle, however, existed and was soon indicated by his speedy separation from the party and alienation from Mill himself. The Revolution, ac- cording to him, meant the sweeping away of effete beliefs .*~~

~~*and institutions, but implied also the necessity of a recon- structive process. Chartism, begins with a fierce attack upon the laissez faire theory, which showed blindness to this necessity. The prevalent political economy, in which that theory was embodied, made a principle of neglecting the very evils which it should be the great function of government to remedy. Carlyle's doctrines, entirely opposed to the ordinary opinions of Whigs and Radicals, found afterwards an expositor in his ardent ■disciple Euskin, and have obvious affinities with more recent socialism. At the time he was as one crying in the wilderness to little practical purpose. Liberals were scandalized by his apparent identification of "right" with "might," implied in the demand for a strong government; and though he often declared the true interpretation to be that the right would ultimately be- come might, his desire for strong government seemed too often to sanction the inverse view. He came into colli- sion with philanthropists, and was supposed to approve of despotism for its own sake.*~~

~~His religious position was equally unintelligible to the average mind. While unequivocally rej ecting the accepted creeds, and so scandalizing even liberal theologians, he was still more hostile to simply sceptical and materialist tendencies. He was, as he called himself, a " mystic " ; and his creed was too vague to be put into any formula be- yond a condemnation of atheism. One corollary was the famous doctrine of " hero worship " first expounded in his lectures. Any philosophy of history which emphasized the importance of general causes seemed to him to imply a simply mechanical doctrine, and to deny the ef&cacy of the great spiritual forces. He met it by making biography the essence of history, or attributing all great events to the " heroes," who are the successive embodiments of divine revelations. This belief was implied in his next great work, the Life and Letters of Oliver Cromwell, published in 1845. The great Puritan hero was a man after his own heart, and the portrait drawn by so sympathetic a writer is not only intensely vivid, but a very effective re- habilitation of misrepresented character. The " biographi- cal " view of history, however, implies the weakness, not only of unqualified approval of all Cromwell's actions, but of omitting any attempt to estimate the Protector's real relation" to the social and political development of the time. The question, what was Cromwell's real and per- manent achievement, is not answered nor distinctly con- sidered. The effect may be partly due to the peculiar form of the book as a detached series of documents and comments. The composition introduced Carlyle to the "Dryasdust" rubbish heaps of which he here and ever afterwards bitterly complained. A conscientious desire to unearth the facts, and the effort of extracting from the dullest records the materials for graphic pictures, made the process of production excessively painful. Por some years after Cromwell Carlyle wrote little. His growing accep- tance by publishers, and the inheritance of her property by Mrs Carlyle on her mother's death in 1842, finally re- moved the stimulus of money pressure.^ He visited Ireland in 1846 and again in 1849, when he made a long tour in company with Sir C. Gavan Duffy, then a young member of the Nationalist party (see SirC. Gr. Duffy's Gonversatiom with Carlyle, 1892, for an interesting narrative). Carlyle's strong convictions as to the misery and misgovernment of Ireland recommended him to men who had taken part in the rising of 1848. Although the remedies acceptable to a eulogist of Cromwell could not be to their taste, they admired his moral teaching ; and he received their atten- tions, as Sir C. G.Duffy testifies, with conspicuous~~

~~*courtesy. His aversion from the ordinary Eadicalism led to an article upon slavery in 1849, to which Mill replied, and which caused their final alienation. It was followed in 1850 by*~~

~~*the Latterday Pamphlets, containing " sulphurous " denunciations of the do-nothing principle. They gave general offence, and the disapproval, according to Proude, stopped the sale for years. The Life of Sterling (died 1844), which appeared in 1861, was intended to correct the life by Julius Hare, which had given too much prominence to theological ques- tions. The subject roused Carlyle's tenderest mood, and the Life is one of the most perfect in the language.*~~

~~*Carlyle meanwhile was suffering domestic troubles,unf or- tunately not exceptional in their nature, though the excep- tional intellect and characters of the persons concerned have given them unusual prominence. Carlyle's constitutional irritability made him intensely sensitive to petty annoy- ances. He suffered the torments of dyspepsia ; he was often sleepless, and the crowing of "demon-fowls" in neigh- bours' yards drove him wild. Composition meant for him intense absorption in his work ; solitude and quiet were essential ; and he resented interruptions by grotesque ex- plosions of humorously exaggerated wrath. Mrs Carlyle had to pass many hours alone, and the management of the household and of devices intended to shield him from an- noyances was left entirely to her. House-cleanings and struggles with builders during the construction of a " sound- proof room" taxed her energy, while Carlyle was hiding himself with his family in Scotland or staying at English country houses. Nothing could be more affectionate than his behaviour to his wife on serious occasions, such as the death of her mother, and he could be considerate when his attention was called to the facts. But he was often oblivious of the strain upon her energies, and had little command ofjbis temper. An unfortunate aggravation of the difB.cH.tly arose from his intimacy with the Ashburtons. Lady Ashburton, a woman of singular social charm and great ability, appreciated the author, but apparently accepted the company of the author's wife rather as a necessity than as an additional charm. Mrs Carlyle was hurt by the fine lady's condescension and her husband's accessibility to aristocratic blandishments. Carlyle, as a wise man, should have yielded to his wife's wishes; unluckily, he was content to point out that her jealousy*~~

was unreasonable and, upon that very insufficient ground, to disregard it and to continue his intimacy with the Ash- burtons on the old terms. Mrs Carlyle bitterly resented his conduct. She had been willing to renounce any aspirations of her own and to sink herself in his glory, but she natiirally expected him to recognize her devotion and to value her society beyond all others. She had just cause of complaint, and a remarkable power, as her letters prove, of seeing things plainly and despising sentimental consolations. She was childless, and had time to brood over her wrongs. She formed a little circle of friends, attached to her rather than to her husband ; and to one of them, Mazzini, she confided her troubles in 1846. He gave her admirable advice ; and the alienation from her husband, though it continued still to smoulder, led to no further results. A journa,l written at the same time gives a painful record of her sufferings, and after her death made Carlyle conscious for the first time of their full extent. The death of Lady Ashburton in 1852-^'femoved this cause of jealousy ; and Lord Ashburton married a second wife in 1858, who became a warm friend of both Carlyles. The cloud which had separated them was thus at last dis- persed. Meanwhile Carlyle had become absorbed in his best and most laborious work. Soon after the completion of the Cromwell he had thought of Frederick for his next hero, and had in 1845 contemplated a visit to Germany to collect materials. He did not, however, settle down finally to the work till 1851. He shut himself up in his study to wrestle with the Prussian Dryasdusts, whom

he discovered to be as wearisome as their Puritan pre- decessors and more voluminous. He went to Scotland to see his mother, to whom he had always shown the tenderest affection, on her deathbed at the end of 1853. He returned to shut himself up in the " sound- proof room." He twice visited Germany (1862 and 1858), to see Frederick's battlefields and obtain materials ; and he occasioiially went to the Ashburtons and his relations in Scotland. The first two volumes of Frederick the Great appeared in 1858, and succeeding volumes in 1862, 1864, and 1865. The success was great from the first, though it did little to clear up Carlyle's gloom. The book is in

~~*some respects his masterpiece, and its merits are beyond question. Carlyle had spared no pains in research. The descriptions of the campaigns are admirably vivid, and show his singular eye for scenery. These narratives are said to be used by military students in Germany, and at least convince the non-military student that he can understand the story. The book was declared by Emerson to be the wittiest ever written. Many episodes, describing the society at the Prussian court and the relations of Frederick to Voltaire, are unsurpassable as humorous por- traiture. The effort to fuse the masses of raw material into a well-proportioned whole is perhaps not quite suc- cessful ; and Carlyle had not the full sympathy with Frederick which had given interest to the Cromwell. A hero-worshipper with half-concealed doubts as to his hero is in an awkward position. Carlyle's general concep- tion of history made him comparatively blind to aspects of the subject which would, to writers of other schools, have a great importance. The extraordinary power of the book is undeniable, though it does not show the fire which ani- mated the French Revolution. A certain depression and weariness of spirit darken the general tone.*~~

~~*During the later labours Mrs Carlyle's health had been breaking. Carlyle, now that happier relations had been restored, did his best to give her the needed comforts ; and in spite of his immersion in Frederick, showed her all possible attention in later years. She had apparently recovered from an almost hopeless illness, when at the end of 1865 he was elected to the rectorship of the University of Edinburgh. He delivered an address there on 2nd April 1866, unusually mild in tone and received with general applause. He was still detained in Scotland when Mrs Carlyle died suddenly while driving in her carriage. The immediate cause was the shock of an accident to her dog. She had once hurt her mother's feelings by refusing to use some wax candles. She had preserved them ever since, and by her direction they were now lighted in the chamber of death. Carlyle was overpowered by the loss. His life thenceforward became more and more secluded, and he gradually became incapable of work. He went to Mentone in the winter of 1866 and began the Reminis- cences. He afterwards annotated the letters from his life, published (1883) as Letters and Memorials. He was, as Fronde says, impressed by the story of Johnson's "penance" at TJttoxeter, and desired to make a pos- thumous confession of his shortcomings in his relations to his wife. A few later utterances made known his opinions of*~~

~~current affairs. He joined the committee for the defence of Governor Eyre in 1867 ; he also wrote in 1867 an article upon " shooting Niagara," that is, upon the tendency of the Reform Bill of that year ; and in 1870 he wrote a letter defending the German case against France. The worth of his Frederick was acknowledged by the Prussian Order of Merit in 1874. In the same year Disraeli offered him the Grand Cross of the Bath and a pension. He declined very courteously, and felt some regret for previous remarks upon the minister. The length of his literary career was now softening old antipathies, and he was the object of general respect.~~

~~His infirmities enforced a very retired life, but he was constantly visited by Fronde, and occasionally by his disciple Ruskin. A small number of other friends paid him constant attention. His conversation was still in- teresting, especially when it turned upon his recollec- tions, and though his judgments were sometimes severe enough, he never condescended to the scandalous. His views of the future were gloomy. The world seemed to be going from bad to worse, with little heed to his warnings. He would sometimes regret that it was no longer permissible to leave it in the old Roman fashion. He sank gradually, and die^ on 4th February 1881. A place in Westminster Abbey was offered, but he was buried, according to his own desire, by the side of his parents at Ecclefechan. He left Craigenputtock, which had become his own property, to found bursaries at the University of Edinburgh. He gave his books to Harvard College, Massachusetts.~~

~~Carlyle's appearance has been made familiar by many portraits, none of them, according to Fronde, satisfactory. The statue by Boehm on the Chelsea Embankment, how- ever, is characteristic; and there is a fine painting by Watts in the National Portrait Gallery. During Car- lyle's later years the antagonism roused by his attacks upon popular opinions had subsided ; and upon his death general expression was given to the emotions natural upon the loss of a remarkable man of genius. The rapid publication of the Reminiscences by Froude pro- duced a sudden revulsion of feeling. Carlyle became the object of general condemnation. Froude' s biography, and the Memorials of Mrs Carlyle, published soon after- wards, strengthened the hostile feeling. Carlyle had appended to the Reminiscences an injunction to his friends not to publish them as they stood, and added that no part could ever be published without the strict- est editing.~~

~~*Afterwards, when he had almost forgotten what he had written, he verbally empowered Froude to use his own judgment: Froude accordingly published the book at once, without any editing, and with many inaccuracies. Omissions of a few passages written from memory at a time of profound nervous depression would have altered the whole character of the book. Froude in this and the later publications held that he was giving effect to Carlyle's wish to imitate John- son's "penance." No one, said Boswell, should persuade him to make his lion into a cat. Froude intended, in the same spirit, to give the shades as well as the lights in the portrait of his hero. His admiration for Carlyle prob- ably led him to assume too early that his readers would approach the story from the same point of view, that is, with an admiration too warm to be repelled by the admis- sions. Moreover, Fronde's characteristic desire for pictu- resque effect, unchecked by any painstaking accuracy, led to his reading preconceived impressions into his documents. The result was that Carlyle was too often judged by his defects, and regarded as a selfish and eccentric misanthrope with flashes of genius, rather than as a man with many of the highest qualities of mind and character clouded by con- stitutional infirmities. Yet it would, be difficult to speak too strongly of the great qualities which underlay the super- ficial defects. Through long years of poverty and obscurity Carlyle showed unsurpassed fidelity to his vocation and superiority to the lower temptations which have ruined so many literary careers. His ambition might be interpreted as selfishness, but certainly showed no coldness of heart. His unstinted generosity to his brothers during his worst times is only one proof of the singular strength of his family affections. No one was more devoted to such congenial friends as Irving and Sterling. He is not the only man whom absorption in work and infirmity of temper have made into a provoking husband, though few*~~

~~*wives have had Mrs Carlyle's capacity for expressing the sense of injustice. The knowledge that the deepest devotion underlies misunderstandings is often a very imperfect consolation ; but such devotion clearly existed all through, and proves the defect to have been relatively superficial.*~~

~~*The harsh judgments of individuals in the Reminis- cences had. no parallel in his own writings. He scarcely ever mentions a contemporary, and was never involved in a personal controversy. But the harshness certainly reflects a characteristic attitude of mind. Carlyle was throughout a pessimist or a prophet denouncing a backsliding world. His most popular contemporaries seemed to him to be false guides, and charlatans had ousted the heroes. The general condemnation of " shams " and cant had, of course, particular applications, though he left them to be inferred by his readers. Carlyle was the exponent of many of the deepest convictions of his time. Nobody could be more in sympathy with aspirations for a spiritual religion and for a lofty idealism in political and social life. To most minds, however, which cherish such aspirations the gentler optimism of men like Emerson was , more con- genial. They believed in the progress of the race and the triumph of the nobler elements. Though Carlyle, especially in his earlier years, could deliver an invigorating and encouraging, if not a sanguine doctrine, his utterances were, more generally couched in the key of denunciation, and betrayed a growing despondency. Materialism and low moral principles seemed to him to be gaining the upper hand; and the hope that religion might survive the " old clothes " in which it had been draped seemed to grow fainter. The ordinary mind complained that he had no specific remedy to propose for the growing evils of the time ; and the more cultivated idealist was alienated by the gloom and the tendency to despair. To a later generation it will probably appear that, whatever the exaggerations and the misconceptions to which he was led, his vehement attacks at least called attention to rather grave limitations and defects in the current beliefs and social tendencies of the time. The mannerisms and grotesque exaggerations of his writings annoyed persons of refinement, and suggest Matthew Arnold's advice to flee " Carlylese " as you would flee the devil. Yet the shrewd common-sense, the biting humour, the power of graphic description, and the imaginative " mysticism " give them a unique attraction for many even who do not fully sympathize with the implied philosophy or with the Puritanical code of ethics. The letters and autobio- graphical writings, whether they attract or repel sympathy, are at least a series of documents of profound interest for any one who cares to study character, and display an almost unique idiosyncrasy.*~~

The chief authorities for Carlyle's life are his own Reminiscences, the letters of Jane Welsh Carlyle, and the four volumes of Fboode's Biography. — Prof. Norton's edition of the Beminis- cences and his collection of Carlyle's Marly Letters correct some of Froude's inaccuracies. — A list of many articles upon Carlyle is given by Mr Ireland in Notes and Queries, sixth series, vol. iv. — Among other authors may be noticed Henry James, sen., in Literary Bemains. — Prof. Masson. Carlyle, Personally and in his Writings. — CouwAT. Tliomas Carlyle. — I^x^kys. The Open Secret of Carlyle" s Life. — Mrs Oliphant in Macmillan's Magazine for April 1881. — G. S. Venables in Fortnightly Bevieio for May 1883 and November 1884. (l. S.)

Carmarthen, a municipal borough (extended 1898), contributory parliamentary borough (uniting with Llanelly), and county town of Carmarthenshire, Wales, 32 miles N.W. of Swansea by rail, on the Towy, about 5 miles from the sea. The borough forms a county of itself. Eecent erections are a chapel of ease and a Masonic hall ; the county and borough infirmary has been extended. Iron-founding, woollen manufacture, tanning,

and rope-making are carried on. Population (1881), 10,514 ; (1901), 9935. There is a parish of Carmarthen.

Carmarthenshire, a maritime county of South Wales, bounded on the N. by Cardigan, on the E. by Brecon and Glamorgan, on the S. by Carmarthen Bay, and on the W. by Pembroke.

Area and Population. — The area of the ancient and the ad- ministrative county, as giv^n in the census returns, is 587,816 acres, or 918 square miles,- The population in 1881 was 124,864, and in 1891 was 130,566, of whom 62,316 were males and 68,250 females ; the number of persons per square mile being 142, and of acres to a person 4'5D.-' In 1901 the population was 1.35,325. The area of the registration county is 478,717 acres, with a population in 1891 of 118,624. Within this area the' percentage of increase between 1881 and 1891 was 6-62. Between 1881 and 1891 the excess of births over deaths was 15,234, and the increase in the resident population was 7369. The following table gives the nun? • hers of marriages, births, and deaths, with the number and pei centage of illegitimate births, for 1880, 1890, and 1898 :—

~~*Year.*~~

~~*Marnagres.*~~

~~*Births.*~~

~~*Deaths.*~~

~~*Illegitimate Births. 1*~~

~~*1880 1800 1838*~~

~~*767 767 861*~~

~~*3702 3647 3540*~~

~~*2338 2143 2328*~~

~~*190*~~

~~*156 130*~~

~~*5-1 4-3 3-7*~~

~~*In 1891 the natives of Scotland in the county numbered 232, the natives of Ireland 343, and foreigners 191 ; while 1751 persons could speak English, 63,345 Welsh, and 36,937 English and Welsh.*~~

~~*Constitution and Government. — The county is divided into two parliamentary divisions, and it also includes the Carmarthen dis- trict of parliamentary boroughs, consisting of Carmarthen and Llanelly. There are three municipal boroughs: Carmarthen (9935), Kidwelly (2285), and Llandovery (1809). The urban dis- tricts are Llandilo (1934), Llanelly (25,553), and Newcastle Emlyn (855). The county is iu the South Wales circuit, and assizes are held at Carmarthen. The borough of Carmarthen has a commis- sion of the peace and a separate court of quarter sessions. The ancient county, which is in the diocese of St Davids, contains 75 entire ecclesiastical parishes and districts, and parts of one other.*~~

~~*Education. — There is a residential training college for school- masters (National Society's) at Carmarthen, and at Llanelly there is a board school for deaf children. The number of elementary schools on 31st August 1899 was 166, of which 100 were board and 66 voluntary schools, the latter including 54 National Church of England Schools, 2 Roman Catholic, and 10 "British and other." The average attendance at board schools was 14,592, and at volun- tary schools 6421. The total school board receipts for the year ending 29th September 1899 were over £64,909. The income under the Agricultural Kates Act was over £2849.*~~

~~*Agriculture. — About three-fourths of the total area of the county is under cultivation, and of this about three-fourths is in permanent pasture. There are also over 47,000 acres in mountain pasture, and over 23,000 under woods. More than half the acreage under corn, crops is occupied by oats, about one-fourth by barley, and more than one-sixth by wheat. About one-half of the green crop acreage is occupied by turnips and swedes, and more than one-third by potatoes. The chief attentiori of the farmer is devoted to stock raising and dairy farming. The following table gives the larger main divisions of the cultivated area at intervals of five years from. 1880 :—*~~

~~*Tear.*~~

~~*Total area under Cultiva- tion.*~~

~~*Corn Crops.*~~

~~*Green Crops.*~~

~~*Clover.*~~

~~*Permanent Pasture.*~~

~~*Fallow.*~~

~~*1880*~~

~~*1885 1890 1895 1900*~~

~~*429,000 441,108 445,775 441,325 442,109*~~

~~67,265 63,258 60,205 56,557 52,333~~

~~10,079 10,601 10,806 10,114 10,191~~

~~41,592 37,207 30,370 29,855 .33,915~~

~~307,610 327,819 342,932 343,994 344,772~~

~~2454~~

~~2223~~

~~1436~~

~~744~~

~~839~~

~~The following table gives particulars regarding the principal live stock for the same years : —~~

~~Tear.~~

~~Total Horses.~~

~~Total Cattle.~~

~~Cows or Heifers~~

~~in Milk or in~~

~~Calf.~~

~~Sheep.~~

~~Pigs.~~

~~1880 1885 1890 1895 1900~~

~~19,091 19,419 20,791 21,703 22,172~~

~~106,835 115,834 116,793 115,564 123,361~~

~~48,771 51,855 52,403 51,734 51,809~~

~~194,890 213,091 243,155 234,606 271,869~~

~~25,103 30,146 36,558 39,644 36,514~~

~~Industries and Trade. — According to the report of the chief inspector of factories for 1898 (1900), the number of persons employed in factories and workshops in 1897 was 9728, as com- pared with 9805 in 1896. Of the 7829 persons employed in non- textile factories, 5068 were employed in the founding and conversion of metals. Of the 1200 persons employed in 1897 in workshops, the majority were employed in the clothing industry. The total number of persons employed in mines and quarries in 1899 was 5362. Good limestone is plentiful in the southern part of the county, no fewer than 110,066 tons being raised in 1899. In the same year 67,926 tons of sandstone were raised. Within recent years little or no ironstone has been dug. The output of fireclay is increasing, as also is that of lead (1933 tons, valued at £7683, in 1899). Coal is the principal mineral, and its production is increasing. The following table gives the tonnage and value of the production in 1890 and 1899: —~~

~~Year. Tons. Value.~~

~~1890 .... 762,032 £333,389~~

~~1899 .... 1,207,205 £421,612~~

~~The total value of fish landed at Llanelly in 1899, including shell- fish, was £979.~~

~~Authorities. — Spurell. Carmarthen and its Neighbourhood. Carmarthen, 1860, 2nd ed., 1879. — Curtis. The Antiquities of Carmarthenshire. London, 1880. — TTie Carmarthenshire Mis- cellany, and Notes and~~

~~*Queries for South- West Wales. See also the various guide-books to South Wales. (t. f. h.)*~~

~~*Carmaux, a town and railway station in the arron- dissement of Albi, department of Tarn, France, 10 miles N. of Albi, on a tributary of the Aveyron. The town gives its name to an important coal-basin, with an output in 1899 of 750,790 tons (metric) and employing over 3800 workpeople. The manufacture of glass is an im- portant industry. Population (1881), 5744; (1891), 8087; (1896), 7899, (comm.) 9993 ; (1901), 10,948.*~~

~~*Carmignano, a town of the province of Florence, Tuscany, Italy, 13 miles N. by W. from Florence, the ancient Carminianum. Over 4000 of its people are en- gaged in making straw hats and straw plait. Population, about 11,000.*~~

~~*Carmona, a town of Spain in the province of Seville, with a railway station on the line from Cordova to Seville. Population (1897), 18,478. On a large tract of land near the Seville road excavations have been made that led to the discovery of a very important example of a Roman necropolis, lying between two Roman roads, enough curiosities being found to fill a local museum founded by the Carmona Archaeological Society. In 1886, near the necropolis, an amphitheatre and more tombs were found, chiefly of the early Christian centuries. These remarkable remains are fully described in the work of Senor Rada, with illustrations by Mr Bonsor, published in 1886 under the title of Necropolis of Carmona, and in that of Senor Sales y Ferre (1887) styled Estudios arqueologicos e historicos.*~~

~~*Carnarvon, Henry Howard Molyneux Herbert, 4th Eakl of (1831-1890), was bom on 24th June 1831. He succeeded to the title in 1849, and soon after taking his degree began to play a prominent part in the deliberations of the House of Lords. In 1858 he was Under Secretary for the Colonies, and in 1866 Secretary of State. In this capacity he introduced in 1867 the Bill for the federation of the British North American provinces which set so many political problems at rest ; but he had not the privilege of passing it, having, before the measure became law, resigned, owing to his distaste for Mr Disraeli's Reform Bill. Resuming office in 1874, he endeavoured to confer a similar boon on South Africa, but the times were not ripe, and he was singularly unfortunate in his principal agent, Mr Froude. In 1878 he*~~

~~again re- signed, out of opposition to Lord Beaconsfield's policy on the Eastern Question ; but on his party's return to power in 1886 he became Lord-Lieutenant of Ireland. His short period of office, memorable for a conflict on a question of~~

~~personal veracity between himself and Mr Parnell as to his negotiations with the latter in respect of Home Rule, was terminated by another premature resignation. He never returned to office, and died on' 29th June 189(). As a statesman his career was marred by extreme sensitive- ness ; but he was beloved as a man of worth and admired as a man of culture. He was high steward of the Univer- sity of Oxford, and president of the Society of Antiquaries.~~

~~Carnarvon, a municipal and parliamentary borough, seaport, market town, and county town of Carnarvon- shire, Wales, just within the western entrance of the Menai Strait, 248 miles by rail N.W. of London. The castle has recently been restored by order of the Govern- ment. The guildhall dates from 1874. The literary institute, with free library, was erected in 1884. In the market-place is a statue (1888) to Sir Hugh Owen, a distinguished promoter of Welsh education. The Pavilion will seat 8000 persons. Three of the weekly news- papers are in the Welsh language. Vessels entering port in 1888—1667 of 123,439 tons, clearances, 1511 of 116,784 tons; in 1898— total entrances, 2020 of 146,261 tons; total clearances, 1965 of 145,297 tons. The total exports of the produce and manufactures of the United Kingdom in 1898 amounted to the value of £152,468, against £186,386 in 1888. Area of municipal borough, 2214 acres; population (1881), 10,258; (1901),~~

~~9760.~~

~~Carnarvonshire, a maritime county of North Wales, bounded on the N.W. by Menai Strait, separating it from Anglesey, and by Beaumaris Bay, on the E. by Denbigh (where is also a small detached portion), on the S.E. by Merioneth, on the S. by Cardigan Bay, and on the S.W. by Carnarvon Bay.~~

~~Area and Population. — The area of the ancient county is 361,097 acres, or 564 square miles. The population in 1881 was 119,349, and in 1891 was 118,204, of whom 56,496 were males and 61,708 females, the number of~~

~~*persons per square mile being 210, and of acres to a person 3-05. In 1901 the population was 126,836. The area of the administrative county, as given in the census returns of 1891, was 360,138 acres, with a population of 117,233, but in 1895 a small addition was made to the administrative area by the transfei-ence to Carnarvon of the part of the parish of Beddgelert in Merioneth. The area of the registration county is 372,135 acres, with a population in 1891 of 125,585. Within this area the increase of population between 1881 and 1891 was only 1-44 per cent., while within the ancient county area there was an actual decrease of 0-9 per cent. Within the registration area the excess of births over deaths was 10,244, and the decrease in resident population was 1785. The following table gives the numbers of marriages, births, and deaths, with the number and percentage of illegitimate births, for 1880, 1890, and 1898 : —*~~

~~*Tear.*~~

~~*Marriages.*~~

~~*Births.*~~

~~*Deaths.*~~

~~*Illegitimate Births.* |~~

~~*No.*~~

~~*Per cent.*~~

~~*1880 1890 1899*~~

~~*808*~~

~~*837*~~

~~*1106*~~

~~*3756 3040 3419*~~

~~*2481 2266 2483*~~

~~214 229 214~~

~~5-7 7-5 6-2~~

~~In 1891 there were in the county 421 natives of Scotland, 630 natives of Ireland, and 244 foreigners, while 12,604 persons could speak English, 78,780 Welsh, and 28,330 English and Welsh.~~

~~Constitution and Government. — The ancient county is divided into two parliamentary divisions, and it also includes the Carnarvon district of boroughs, consisting of Bangor city, Carnarvon, Conway, Criooieth, Nevin, and Pwllheli. There are four municipal boroughs —Bangor (11,269), Carnarvon (9725), Conway (4636), and Pwllheli (3675). The following are urban districts : — Bethesda (5271), Bettws-y-coed (881), Cricoieth (1410), Llandudno (9307), Llan- fairfechan (2768), Penmaenmawr (3501), and Ynyscynhaiam (4883). Carnarvon is in the North Wales circuit, and assizes are held there. The borough of Carnarvon has a separate commission of the peace, but no separate court of quarter sessions. The ancient county — which is chiefly in the diocese of Bangor, with a few parishes in that of St Asaph — contains 61 entire ecclesiastical parishes or districts, and parts of four others.~~

~~Education. — Bangor is the seat of the University College of~~

~~North Wales, in connexion with which there is a day training college for schoolmasters and schoolmistresses. There are also in the city a residential college (British and Foreign School Society's) for schoolmasters, and another (North Wales Church of England) for schoolmistresses. The total number of elementary schools on 31st August 1899 was 127, of which 62 were board and 65 were voluntary schools, the latter including 57 National Church of England schools, 2 Roman Catholic, and 6 " British and other." The average attendance at board schools was 8953, and at voluntary schools 7611. The total school board receipts for the year ending 29th~~

~~*September 1899 were over £39,044. The income under the Agricultural Rates Act was over £1135.*~~

~~*Agriculture. — Only a little more than half of the total area of the county is under cultivation, and of this area nearly two-thirds is in permanent pasture. There are, moreover, more than 114,000 acres in hill pasture and nearly 13,000 acres under woods. The chief attention of the farmer is devoted to dairy farming and the rearing of sheep. The principal corn crops are oats and barley, the former occupying nearly two-thirds, and the latter nearly one- third of the corn acreage. More than one-half of the acreage under green crops is occupied by potatoes, and about three-eighths by turnips. The following table gives the acreages of the larger main divisions of the cultivated area at intervals of five years from 1880 :—*~~

~~*Taar.*~~

~~*Total Area under Cul- tivation.*~~

~~*Corn*~~

~~*Crops.*~~

~~*Green Crops.*~~

~~*Clover.*~~

~~*Permanent Pasture.*~~

~~*Fallow.*~~

~~*1880 1885 1890 1895 1900*~~

~~*187,351 187,283 193,840 191,969 182,395*~~

~~*20,445 20,250 21,121 19,181 16,878*~~

~~*7,949 8,601 10,147 8,780 8,066*~~

~~*32,178 33,508 26,255 29,136 41,282*~~

~~*125,803 124,763 136,064 134,607 115,880*~~

~~*976 161 208 192 209*~~

~~*The following table gives particulars regarding the principal live- stock for the same years : —•*~~

~~*Tear.*~~

~~*Total Horses.*~~

~~*Total Cattle.*~~

~~*Cows or Heifers*~~

~~*in Milk or in*~~

~~*Calf.*~~

~~*Sheep.*~~

~~*Pigs.*~~

~~*1880 1885 1890 1895 1900*~~

~~*8241 8271 8724 8674 9435*~~

~~*51,168 53,623 58,094 54,320 57,357*~~

~~*21,765 21,861 22,961 22,342 23,659*~~

~~*213,458 204,733 233,332 235,707 269,692*~~

~~*16,899 20,023 26,747 24,080 19,028*~~

~~*Industries and Trade. — According to the annual report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 3302, as compared with 3231 in 1896. Of these, 1259 were employed in workshops (the majority in clothing*~~

~~*industries), and 1891 in non-textile factories. The total number of persons employed in mines and quarries in 1899 was 13,344. The slate quarries are of great importance, the two largest workings being the Penrhyn quarry near Bangor and the Dinorwic quarry near Carnarvon. In 1899 418,821 tons of limestone were raised, and 413,109 tons of " igneous rocks other than granite." The output of both copper and zinc has very greatly decreased ; that of lead is extremely variable— 198 tons in 1885, 1116 tons valued at £10,101 in 1890, and 608 tons in 1899. The following table gives particulars regard- ing the slate production in 1890 and 1899: —*~~

~~*Tear. Tons. Value.*~~

~~*1890 .... 265,157 £539,085 1899 .... 309,426 £944,796 At Pwllheli, Carnarvon, and Bangor (including Llanfairfechan, Aber, Beaumaris, and Menai), 18,246 cwt. of fish, valued at £24,833, were landed in 1899, the total value, including shellfish, being £29,372.*~~

~~*Authorities. — Ramsay. Geological Structure of Merioneth and Carnarvonshire. London, 1858. — Barker. Bala Volcanic Series of Carnarvonshire Bocks. Cambridge, 1889.— Jones. Old Carnarvon. Carnarvon, 1889.— See also guide-books for North Wales. (t. f. h.)*~~

~~*Carnegie, Andrew (1837), American manu- facturer and philanthropist, was born in Dunfermline, Scotland, 25th November 1837. In 1848 his family removed to America, and settled in Pittsburg, Pa. At an early age the boy was put to work, first in charge of a small stationary engine, later as telegraph messenger, operator, or clerk, and for a while was superintendent of a division of the Pennsylvania Eailroad. He laid the foundation of his fortune in the introduction of sleeping cars and in the purchase of oil-wells. With others he*~~

~~*established a rolling-mill, out of which grew the various, companies for the manufacture of iron and steel, known collectively as the Carnegie companies, probably the largest and most complete works of the kind in the world. In 1901 the Carnegie Steel Company was amalgamated with others in a great Steel Trust organized by Mr Pier- pont Morgan, Mr Carnegie being bought out for about £100,000,000 in bonds secured upon the property and profits of the Trust. He has given millions of money in various*~~

~~forms of charities, but chiefly for education and the building of libraries, one of his largest gifts being that to New York city. In 1901 he gave about £2,000,000 to the universities of Scotland, and established a trust to administer the fund, one half of the income of which was to be devoted to the payment of the fees of Scottish stu- dents, and the other half to buildings, apparatus, endowed professorships, research, &c. He is author of Tri- umphant Democracy, An American Four-inrHand in Britain, and other books.~~

~~Carnegie, a borough of Allegheny county, Penn- sylvania, U.S.A., a few miles S.W. of Pittsburg. It is devoted to iron smelting and manufacture, and has been built up entirely in recent years. Population (1900),~~

~~7330.~~

~~Carnieres, a town of Belgium, in the province of Hainaut, 15 miles E. of Mons, with a station on the rail- way from Mons to Charleroi. It has quarries of build- ing stone. Population (communal) (1880), 6787 ; (1901),~~

~~7328.~~

~~Carnioia (German, Krain), a duchy and crownlaud in the Cisleithan half of the Austro-Hungarian monarchy. Population (1869), 463,273; (1880), 481,243; (1890), including garrison of 2264 men, 498,958 (equivalent to 129-36 inhabitants per square mile); (1900), 608,348. Proportion of females to males, 1096 to 1000 ; 94 per cent. Slovene, 5-66 German, the rest Serbo-Croatians and Italians ; 99 per cent. Eoman Catholic, 1 per cent. Protestant. In 1896 the marriage-rate was 7 ; the birth- rate, 36-43, or, excluding still-births, 35-69 ; and the death-rate, 30-11 per thousand. Of the births 69 per cent, were illegitimate. Carnioia sends 11 members to the Eeichsrath. The Diet is composed of 26 Slovenes and 11 Germans. There are 6 gymnasia, 330 elementary schools, and about 30 other educational establishments. The proportion of illiterates in 1890, 33-5 per cent., shows an improvement of 12 per cent, on 1880. The Slovene members of the Eeichsrath, partly on political grounds, vigorously promote the educational require- ments of their nationality. The fall of the Windisch- gratz coalition ministry in 1895 was due to the grant of such an educational concession to the Slovenes in the Cilli Gymnasium. Of the 24 periodicals and newspapers~~

published, 18 are in the Slovene and 6 in the German language. Although three-fourths of the population are engaged in agriculture and forestry, only 14 per cent.- of the land is arable, and the crops (wheat, rye, barley, maize, millet, and buckwheat) do not sufB.ce for the needs of the province. Game and fish are plentiful. The timber trade is of considerable importance. The silk- worm is bred in the warmer districts adjoining Gorz. Mercurj', a monopoly of this province, is the most import- ant mining product (882,384 metre centners in 1897) ;. lignite, iron ore, and manganese being also produced, together with small quantities of lead and zinc ore, of a. total value of £121,800. The product of the furnaces — mercury, silver, iron, lead, and zinc — amounted in value to £164,200. The textile, metal, leather, and other indus- tries are of less importance. In 1897 Carnioia had 422 kilometres of railways, 5516 kilometres of roads, and 139 kilometres of waterway, of which 55 kilometres are'

only available for floating timber. There were 356 post and 71 telegraph offices, with 792 kilometres of line and 2509 kilometres of wire. The Slovenes regard the Croa- tians as their nearest relatives and exemplars among the Slav peoples. The languages are closely related, more particularly the dialects spoken in the adjoining districts of the two countries. The so-called " Young Slovenes," still affected by the temporary unification of " lUyria," as also by the aggravation of the nationality struggle, aspire to the formation of a " Greater Croatia," uniting at least the whole Catholic section of the South Slav race. The more moderate representatives of the national sentiment content themselves with advocating the unification and autonomy of the Southern Slavs in the Cisleithan half of the monarchy. German influence in the province is now very slight and is still declining. Energetic efforts are being made to cultivate literature, science, and the drama in the Slovene language. The Dramatic Association has brought out over a hundred original and translated pieces, many of which have been produced in the subsidized Slovene theatre at Laibach. The National Literary Association, which

~~*numbers over 46,000 members, distributes a quarter of a million volumes annually, while its encouragement promotes and maintains a national periodical press, which calls forth a succession of talented young writers. The anti-German and anti-Italian feeling is very strong, and has found expression in violent demonstrations of fraternity with the Czechs and in an abortive effort to make the Russian language a subject of instruction in the public schools, preliminary to elevating it to the rank of the Panslavist medium of intercommunication.*~~

~~*HoFF, Hist.-Statist.-Topogr. Gemdlde von Krain (Laibach, 1808) ; and Dimitz's historical works on the province, published at Laibach, 1874-86. (m. o'n.)*~~

~~*Carnot, Marie Fran90is Sadi (1837-1894), fourth President of the French Republic, was born at Limoges on 11th August 1837. He was grandson of the famous " organizer of victory " in the first Re- public, and son of Hippolyte Carnot, Minister of Pub- lic Instruction under the Provisional Government of 1848. He was educated as a civil engineer, and after having highly distinguished himself at the Ecole Poly- technique and the ificole des Ponts et Chaussees, obtained an appointment in the public service. His hereditary republicanism recommended him to the Government of National Defence, by which he was entrusted in 1870 with the task of organizing resistance in the departments of the Eure, Calvados, and Seine Inf^rieure, and made prefect of the last named in January 1871. In the fol- lowing month he was elected to the National Assembly by the department Cote d'Or. He took no prominent part in politics until August 1878, when he was appointed secretary to the Minister of Public Works. In September 1880 he became minister, and again in April 1885, passing almost immediately to the Ministry of Finance, which he held under both the Ferry and Freycinet administra- tions until December 1886. When the Wilson scandals occasioned the downfall of M. Grevy in December 1887, M. Carnot's high character for integrity marked him out as a candidate for the Presidency, and he obtained the support of M. Cl^menceau and of all those who objected to the candidatures of men who had been more active in the political arena, so that he was elected by 616 votes out of 827. He assumed office at a critical period, when the Republic was all but openly attacked by General Boulanger. President Carnot's ostensible part during this agitation*~~

was mainly confined to augmenting his popularity by well-timed appearances on public occar sions, which gained credit for the Presidency and the Republic. When, early in 1889, Boulanger was finally

driven into exile by the energy of the Minister of the Interior, M. Constans, it fell to President Carnot's lot to appear as the head of the State on two occasions of especial interest, the celebration of the centenary of 1789, and the opening of the Paris Exhibition of that year. The perfect success of both was regarded, not unreasonably, as a popular ratification of the Republic, and though con- tinually harassed by the formation and dissolution of ephemeral ministries, by Socialist outbreaks, and the beginnings of anti-Semitism, M. Carnot had but one serious crisis to surmount, the Panama scandals of 1892, which, if they greatly damaged the prestige of the State, increased the respect felt for its head, against whose integrity none could breathe a word. M. Carnot seemed to be arriving at the zenith of popularity, when on 24th June 1894, after delivering at a public banquet at Lyons a speech in which he appeared to imply that he neverthe- less should not seek re-election, he was stabbed by an Italian anarchist named Caserio, and expired almost immediately. The horror and grief excited by this tragedy were boundless, and the President was honoured with a splendid funeral in the Pantheon, Paris. It was felt that he had been a worthy hereditary representative of the best traditions of the first Republic, and had exemplified the type of man of which the third Republic stood especially in need. If his abilities, though respect- able, were not of the first order, the more credit was due to the weight of character which had so well supplied the place of genius. (b. g.)

Carnoustie, a police burgh and summer resort of S.E. Forfarshire, Scotland, on the German Ocean, lOf miles E.N.E. of Dundee by rail. There are various minor industries. Bathing and golfing are good. Modern erec- tions are an Episcopal church, municipal buildings, and a Union Club. Population (1881), 3321 ; (1901), 6204.

Carouge. See Geneva.

Carpathian, or Kaepathian Mountains. — Since 1875 the Carpathian Mountain Club, as well as indi- vidual scientific investigators, have done a good deal to add to our knowledge of this mountain system, especially from

~~the geological standpoint. Where fully developed, the Carpathian chain consists of four zones. ^1) An outer undulating foreland of soft Tertiary (Miocene) rocks, whose folds are inclined to the north and east, and overlie the ancient Russian platform. It is rich in deposits of salt (Wieleczka), mineral wax (Boryslav), and petroleum (Drohobycz), the last occur- ring also in the next zone. (2) A continuous sandstone zone, extending from the March to the extreme south- east, to which the name Carpathian is usually applied in the narrower sense. It corresponds to the chain of the Pre- Alps, and consists of short parallel ranges of no great height, formed mainly of Carpathian sandstone, a flysch of Cretaceous and Tertiary age. The rivers zigzag in alternate longitudinal and transverse valleys, occasionally cutting their beds in softer schistose strata. Ridges of limestone (Klippen) are prominent in the north. This zone resembles the Swi^s Jura in its simple folded struc- ture, but not in composition. (3) A crystalline zone of granites and schists intimately folded with Palaeozoic and Mesozoic rocks, and rich in minerals. It is absent in the Central Carpathians. (4) A young volcanic zone, also rich in minerals, is present on the much-faulted inner side of the chain, except in the west of Transylvania. Orographically the system is divisible into — (i) The West Carpathians, a complex, roughly circular mass, about 150 miles in diameter, lying between the March and the Poprad. (ii) The simple parallel ranges of the Central or Wooded Carpathians, 60 to 70 miles broad.~~

~~running south-eastwards from the Poprad for 170 miles to the Korosmezo pass, between the upper Pruth and Tisza. (iii) The eastern triangular mass of the Transyl- vanian plateau (1575 feet), enclosed by the Eastern Carpathians (3540 feet) for 220 miles in the east, by the I'ransylvanian Alps (3800 feet) and Banat hills (1675 feet) for a similar distance in the south, and by the Bihar mountains (1740 feet) in the west. The granitic Great T^tra rises to 8737 feet in Gerlach- falva (Gerlsdorfer or Franz Jozef peak), and is the hydrographic centre of the West Carpathians. From it the Dunayec and Poprad flow northwards to the Vistula, across the Klippen and Sandstone ranges, and divide the Western from the Eastern Beskids.~~

~~*Longitu- dinal furrows separate the Great Tatra, Little T^tra, the Ore, and Mdtra mountains. Westwards they are drained by the Vag, Gran, and Ipoly, all curving round to the Danube ; and eastwards by the fault valley of the Hernad. The Fatra, Nytra, and Little Carpathians form a connecting link between the crystalline zones of Carpathians and Alps. The trachytic Hungarian Ore mountains form the south-western quadrant of the West Carpathians, and the Matra and Hegyalya ranges the southern and eastern arcs. The trachytic Vihorlat range rises along the inner margin of the Wooded Car- pathians, which here form the main divide. The Eastern Carpathians open in wide valleys to the south-east and south. They are crossed by the Bistritza from the crystalline zone, which reappears on their concave side, and is separated in the south from the trachytic Hargita mountains by a longitudinal valley, in which the Maros flows northwards and the Aluta southwards. Near the Tomos pass, south of the Brassd or Kronstadt basin, the sandstone range abruptly ends, and the crystalline schists of the Transylvanian Alps run westwards to the Banat mountains, where the fold axes curve to south-west and south. The Aluta breaks through them at the Eoteturn pass (1155 feet) between the highest summits, Negoi (8320 feet) and Mandra (8270 feet). The Maros crosses the Transylvanian plateau and skirts the south of the Bihar mountains, which have a crystalline nucleus — possibly representing the inner portion of the West Carpathian crystalline region — surrounded by Carpathian sandstones and trachytic and other young rocks containing many minerals (Transylvanian Ore Mountains). (a. j. he.)*~~

~~*Carpeaux, Jean Baptiste (1827-1875), French sculptor, was born at Valenciennes, France, on 14th May 1827. He was the son of a mason, and passed his early life in extreme poverty. In 1842 he came to Paris, and after working for two years in a drawing-school, was admitted to the i^cole des Beaux- Arts on 9th Septem- ber 1864. The Grand Prix de Rome was awarded to his statue of " Hector bearing in his arms his son Astyanax." His first work exhibited at the Salon, in 1863, did not show the spirit of an innovator, and was very unlike the work of his master Rude. At Rome he was fascinated by Donatello, and yet more influenced by Michael Angelo, to whom he owes his feeling for vehement and passionate action. He sent from Rome a bust, "La Palombella," 1856; and a "Neapolitan Fisherman," 1858. This work was again exhibited in the Salon of 1869, and*~~

~~took a second- class medal ; but it was not executed in marble till 1863. In his last year in Rome he sent home a dramatic group, " Ugolino and his Sons," and exhibited at the same time a « Bust of Princess Mathilde." This gained him a second- class medal and the favour of the Imperial family. In 1864 he executed the " Girl with a Shell," the companion figure to the young fisherman; and although in 1865 he did not exhibit at the Salon, busts of "Mme. A.~~

~~E. Andr^," of "Giraud" the painter, and of "Mile. Benedetti " showed that he was not idle. He was working at the same time on the decorations of the Pavilion de Flore, of which the pediment alone was' seen at the Salon, though the bas-relief below is an even better example of his style. After producing a statue of the Prince Imperial, Carpeaux was made Chevalier of the Legion of Honour in 1866. Two years later he received an important commission to execute one of the four groups for the faqade of the new Opera House. His group, represent- ing "Dancing," 1869, was greeted with indignant protests ; it is nevertheless a sound work, full of movement, with no fault but that of exceeding the limitations prescribed. In 1869 he exhibited a " Bust of M. Gamier," and followed this up with two pieces intended for his native city : a statue of Watteau, and a bas-relief, " Valenciennes repelling Invasion." During the Commune he came to England and made a "Bust of Gounod" in 1871. His last important work was a fountain for the Luxembourg Gardens, representing the " Four Quarters of the World " as four female figures. Carpeaux, though exhausted by illness, continued designing indefatigably, till he died at the Chateau de Becon, near Courbevoie, on 12th October 1875, after being promoted to the higher grade of the Legion of Honour. Many of his best drawings have been presented by Prince Stirbey to the city of Valenciennes.~~

~~See also Chesneau. Le Statuaire Carpeaux. Paris, 1880. — Paul Podcart. Catalogue du Musee Carpeaux. Paris, 1882.~~

~~Carpenter, Mary (1807-1877), English educational and social reformer, was born 3rd April 1807 at Exeter, where her father, Dr Lant Carpenter, was Unitarian minister. In 1817 the family removed to Bristol, where Dr Carpenter was called to the ministry of Lewin's Mead Meeting. As a child Mary Carpenter was unusually earnest, with a deep religious vein and a~~

remarkable thoroughness in everything she undertook. She was educated in her father's school for boys, learning Latin, Greek, and mathematics, and other subjects at that time not generally taught to girls. She early showed an apti- tude for teaching, taking a class in the Sunday-school, and afterwards helping her father with his pupils. When Dr Carpenter gave up his school in 1829, his daughters opened a school for girls under Mrs Carpenter's superin- tendence. In 1833 the Eaja Rammohun Roy visited Bristol, and inspired Miss Carpenter with a warm interest in India ; and Dr Joseph Tuckerman of Boston about the same time aroused her sympathies for the condition of destitute children. One day when she was walking with him through one of the worst Bristol slums, a wretched- looking boy rushed out of a dayk entry and ran wildly past them. "That child," said her companion, "should be followed to his home and seen after." These words gave the first stimulus to what became her life-work. The first step was to help to organize, in 1835, a " Work- ing and Visiting Society." It was a sort of district-visiting scheme, which in those days seemed a startling new depar- ture. Miss Carpenter was its secretary for twenty years. In 1843 her interest in negro emancipation was aroused by a visit from Dr HIowe. HIer interest in general educa- tional work was also growing. A Bill introduced in this year "to make provision for the better education of children in manufacturing districts," as a first instalment of a scheme of national education, failed to pass, largely owing to Nonconformist opposition, and private effort became doubly necessary. So-called "Ragged Schools" sprang up in many places, and Miss Carpenter conceived the plan of starting one in Lewin's Mead. To this was added a night-school for adults. In spite of many diffi- culties this was rendered a success, chiefly owing to Miss Carpenter's unwearied enthusiasm and remarkable organ-

izing power. In 1848 the closing of their own private school gave Miss Carpenter more leisure for philanthropic and literary work. She published a memoir of Dr Tucker- man and a series of articles on ragged schools which appeared in the Inquirer, and were afterwards collected in book form. This was followed in 1851 by Reformatory Schools for the Cliildren of the

Perishing and Dangerous Classes, and for Juvenile Offenders. She sketched out three classes of schools as urgently needed — (1) Good free day-schools. (2) Feeding industrial schools. (3) Eeforma- tory schools. This book drew public attention to her work, and from that time onwards she was drawn into personal intercourse with leading thinkers and workers. She was consulted in the drafting of educational Bills, and invited to give evidence before HOuse of Commons committees. To test the practical value of her theories, she herself started a reformatory school at Bristol, and in 1852 she published Juvenile Delinquents, their Condition and Treatment, which largely helped on the passing of the Juvenile Offenders Act in 1854. Now that the principle of reformatory schools was established, Miss Carpenter returned to her plea for free day-schools, con- tending that the ragged schools were entitled to pecuniary aid from the annual parliamentary grant. At the Oxford meeting of the British Association (1860) she read a paper on this subject, and, mainly owing to her instigation, a conference on ragged schools in relation to Government grants for education was held at Birmingham, 1861. In 1866 Miss Carpenter was at last able to carry out a long- cherished plan of visiting India, where she found herself an honoured guest. She visited Calcutta, Madras, and Bombay, inaugurated the Bengal Social Science Associa- tion, and drew up a memorial to the Governor-General dealing with female education, reformatory schools, and the state of the gaols. This visit was followed by others in 1868 and 1869. HEr attempt to found a female normal school was unsuccessful at the time, owing to the inade- quate previous education 6f the women, but afterwards such colleges were founded by Government. A start, however, was made with a model HIndu girls' school, and here she had the co-operation of native gentlemen. HEr last visit to India took place in 1875, two years before her death, when she had the satisfaction of seeing many of her schemes successfully established. At the meeting of the Prison Congress in 1872 she read a paper on " Women's Work in the Reformation of Women Convicts." HEr work now began tp attract attention abroad. Prin- cess Alice summoned her to Darmstadt to help to organize a Women's Congress. Thence she went to NeufchS,tel to study the prison system of Dr Guillaume, and in 1873 to America, where she was enthusiastically received. Miss Carpenter watched with interest the increased activity of women during the busy 'seventies. She warmly supported the movement for their higher education, and herself signed the

~~*memorial to the University of London in favour of admitting them to medical degrees. She died at Bristol on 14th June 1877, having lived to see the accomplishment of nearly all the reforms for which she had worked and hoped. (a. z.)*~~

~~*Carpenter, William Benjamin (1813-1885), English physiologist, and naturalist, was born at Exeter on 29th October 1813. He was the eldest son of Dr Lant Carpenter, the celebrated Unitarian minister, and brother of the well-known philanthropist, Mary Carpenter. His bent, like that of Huxley and Herbert Spencer, was towards engineering, but, as with Huxley in his early years, medicine was his destiny. After study under the family doctor, with whom he visited the West Indies, Carpenter attended medical classes at University College,*~~

~~*London, and then went to Edinburgh, where he took the degree of M.D. in 1839. The subject of his gradua^ tion thesis, " The Physiological Inferences to be Deduced from the Structure of the Nervous System of Inverte- brated Animals," indicates a line of research which had fruition in his Principles of General and Comparative Physiology. His work in comparative neurology was recognized in 1844 by his election as a Fellow of the Royal Society, and that body awarded him a Royal medal in 1861. His appointment as Fullerian Professor of Physiology in the Royal Institution in 1845 enabled him to exhibit his powers as a teacher and lecturer, his gift of ready speech and luminous interpretation placing him in the front rank of exponents, at a time when the popularization of science was in its infancy. His manifold labours as investigator, author, editor, demonstrator, and lecturer knew no cessation through life ; but in assessing the value of his work, prominence should be given to his researches in marine zoology, notably in the lower organisms, as Foraminifera and Crinoids, among the latter being the exquisite feather- star (Comatula rosacea), the peculiar form of the nervous system of which he discovered. These re- searches gave an impetus to deep-sea exploration, an outcome of which was in 1868 the Lightning, and, later, the more famous Challenger, expedition. He took a keen and laborious interest in the evidence adduced by Canadian ^geologists as to the organic nature of the structure known as Eozoon Canadense, discovered in the Laurentian strata, and at the time of his death had nearly finished a monograph on the subject, defending the now*~~

~~discredited theory of the animal origin of that deposit. He was an adept in the use of the microscope, and his popular treatise on that instrument has stimulated a host of observers to the use of the "added sense" with which it has endowed man. In 1856 Carpenter became Registrar of the University of London, and held the office for twenty-three years ; for his services to education generally he was made a C.B. Biologist as he was. Carpenter nevertheless made reserva- tions as to the extension of the docriue of evolution to man's intellectual and spiritual nature. In his Principles of Mental Physiology he asserted both the freedom of the will and the existence of the "Ego," and one of his last public engagements was the reading of a paper in support of miracles. He died in London, from injuries occasioned by the accidental upsetting of a spirit-lamp, on 19th November 1885. (e. cl.)~~

~~Carpets. — The artistic revival of recent years in Great Britain has had a considerable influence upon the design and colouring of carpets. The pioneer in this, as in so many other decorative reforms, was William Morris. His treatment of the Kidderminster fabric was a revelation of its possibilities, but he was perhaps scarcely so successful in his "Hammersmith" carpets, on account of the coarseness of the fabric, while he was also hampered by his self-imposed rules for colour- ing, by no means always in accordance with principles derived from the best work of the East. Other leading decorative artists have until lately held aloof from carpet- designing, probably deterred by its difficulties and by want of technical knowledge. Instruction on this subject had not been given at art schools, so that designs pro- duced by students who lacked separate training under manufacturers have usually been unpractical and useless. FuU information as to technical conditions is now avail- able, and has to some extent been utilized. Several eminent decorative artists have entered the field, but while they avoid the faults of many trade productions, and while their work has much distinction and character,~~

~~it cannot on the whole be said that they have solved the problem of floor decoration. They have been confronted with the enormous difficulty of~~

~~*getting variety and oharacter, while complying strictly with the axiom that a carpet should look equally well from all sides. Con- stantly ignoring this rule, they have simply used for •carpets designs which were originally intended for walls or hangings, without any attempt to adapt them to the special requirements of a floor. The striking designs of Mr Walter Crane are free from this defect. Of many trade designs it must still be said that the more perfect the manufacturing process becomes, the more they appear to lend themselves to what is bad. At the same time many are in excellent taste, and in the all-important matter of colour great advances have been made, due almost entirely to the manufacturers, who have supplied what no school of art yet provides, namely, systematic training in colour, founded on the study of the best examples.*~~

~~*On the Continent of Europe the influence of VaH ■nouveau (the new style of art) has been strongly felt. In France some rather striking designs have been produced, which show a flat treatment of free-growing natural forms, but they have the fault of upward growth and, usually, of thin and washy colour. In Germany designers have gone to the wildest extremes. Everything has been sacrificed to novelty, the results being carpets which have no other quality, and which have been well described as monstrosities in design and nightmares in colour. The chief improvement in the manufacture of carpets has been the application to the power-loom of the moquette system of weaving, which, originally invented in France, was perfected in the United States, and introduced into England about the year 1877. Its •essential principle, common to several types of loom, and of several fabrics called by different trade-names, such as "Royal" and "Imperial" Axminster, is as follows : — A set of long " spools " or bobbins is prepared, one for each transverse row of' small squares in the design. On these spools coloured woollen threads are wound side by side, corresponding in colour and position "to the design squares. The spools being fixed in series in the loom, are brought successively into position ; rows ■of tufts (or "moquettes") are one by one cut off from "the projecting ends of the threads, and inserted by suitable mechanism in a framework of simple warp and weft, thus forming a pile surface reproducing the original ■design. Hitherto this method of weaving has been •commercially applied to narrow widths only ; there are considerable mechanical and other difficulties in the way of its application to very wide looms. Another import- ant*~~

~~manufacturing development has been the application •of the power-loom to the weaving of seamless carpets, which have to some extent taken the place of narrow widths intended for seaming. The seamless method has been applied to Brussels and tapestry looms, but the greatest development in this direction has taken place in the patent Axminster or chenille process, and in a modi- ■fication of the Kidderminster fabric known as "Roman" ■carpet. The products of these two processes are well known under the trade-names of "Parquet Carpets" and " Art Squares."~~

~~The importation of carpets from the East has very largely increased, and European and American influence has been brought to bear upon their design and colour- ing. Where the best ancient examples have been used as models, little or no harm has been done, but where attempts have been made to introduce light, delicate colour schemes wholly foreign to Oriental traditions, the results have sometimes been disastrous. The manu- facture of hand-knotted carpets on the Oriental plan~~

~~is still carried on in various parts of England, and has been introduced into the north-west of Ireland ; but the relatively high price of labour must always prevent this industry from attaining great proportions in the United Kingdom, as compared with Germany and Austria, where it is extensively carried on. Japan has entered this field, but its products have been poor in quality and disappointingly inartistic, the best being weak copies of Persian rugs. Japanese manufacturers seem to have steadfastly set their faces in this direc- tion, instead of developing along their own native artistic lines. The demands of the market probably account for this.~~

~~Various attempts have been made to produce the knotted fabric by power-loom. Some have been fairly successful, but none has as yet attained sufficient import- ance to call for more extended notice. The manufacture of carpets is very extensively carried on in America, its chief feature being the enormous extent to which the mo- quette system of weaving has been developed, (a. mi.)~~

~~Carrara, an Italian town in Tuscany, province of Massa and Carrara, 6 miles from the Mediterranean coast and 34 miles by rail N.N.W. from Pisa. In the province of Carrara there are altogether 1264 quarries, of which 311 were worked at Carrara, 54 at Massa, and 106 at Versilia in 1898 ; the~~

~~*number of workmen employed in the quarries, sawmills, and polishing works being 10,155, of whom 6522 were at Carrara, 1100 at Massa, and 2533 at Versilia in the same year. In the years 1886-97 in- clusive the annual output averaged 178,500 tons, of which 154,000 tons were exported (161,260 tons in 1898). The quarries are served by a mountain railway of 10 miles in length, opened in 1890, which descends from 1500 feet down to the sea. The art of carving and sculpturing is taught in the academy of fine arts and the school of design (1860). Population of town, including Avenza, its port (1881), 23,072; (1901), 26,325; of province (1881),*~~

~~*169,469; (1901), 195,840.*~~

~~*Carriages. — Before enumerating the developments which have taken place in the manufacture of carriages since 1875, we shall notice the period of transition, dating back some forty years earlier. At that time the means of travelling by road and horse-power, in the case of public coaches, had reached in England its utmost limits of speed and convenience, and the travelling-carriages of the no- bility and the wealthy were equipped with the completest and most elaborate contrivances to secure personal com- fort and safety. More particularly was this the case as regards Continental tours, which had become indispensable to all who had at their command the means for this costly educational and pleasurable experience. Concurrently with this development the style and character of Court equipages had also reached a consummate degree of splen- dour and artistic excellence. Not only was this the case in points of decoration, in which livery colour and heraldic devices were effectively employed, but also in the beauty of outline and skilful structural adaptation, in which respect carriages of that period made greater demands upon the capacity of the builder and the skill of the work- man than do those of the present day. For this attain- ment the art of coachmaking was indebted to a very few leading men, whose genius has left its impress upon the art, and is still jealously cherished by those who in early life had experience of their achievements. The early portion of Queen Victoria's reign was an age of much emulation; the best-equipped carriages of that period, distinctive of noble families and foreign embassies, with their graceful outline and superb appointments, and harnessed to a splendid breed of horses — all harmoniously*~~

~~*blended, perfect in symmetry and adaptation — gave to the London season, more especially on Drawing-room days, and at other times in Hyde Park, an attractiveness unequalled in any other capital. After the death of the Prince Consort, the pageantry of that period very much declined and, except as an appendage of royalty, full-dress carriages have since been comparatively few, though there are hopes of a revival in this direction. Meanwhile, owing to the rapid development of railways and the wide extension of commerce, the demand for carriages greatly increased. The*~~

~~larger types gave place to others of a lighter build and more general utility, in which in some cases an infusion of American ideas made its appearance. In accordance with the universal rule of supply meeting the demand, Mr Stenson, an iron- master of Northampton, was successful in producing a mild forging steel, which proved for some years, until the manufacture ceased, very conducive to the object of securing lightness with strength. In the early 'seventies the eminent mechanician. Sir Joseph Whitworth, in the course of his scientific studies in the perfecting of artil- lery, succeeded in manufacturing a steel of great purity, perfectly homogeneous and possessing marvellous tenacity and strength, known as " fluid compressed steel." Inci- dentally carriage-building was able to participate in the results of this discovery. Two firms well known to Sir Joseph were asked to test its merits as a material appli- cable to this industry. In this test much difficulty was experienced, the nature of the steel not being favourable to welding, of which so much is required in the making of coach ironwork ; but after much perseverance by skilful hands this ' was at length accomplished, and for some years there existed not a little rivalry in the use of this material, more especially in the case of carriages on the C and under-spring principle, which for light- ness, elegance, and luxurious riding left nothing to be desired. Many of these carriages may be referred to to-day as rare examples of constructive skill. Unfor- tunately, the original cost of the material, still more of the labour to be expended upon it, and the diffi- culty of educating men into the art of working it, were effectual barriers to its general adoption. The idea, however, had taken hold, and attention was given by other firms to the manufacture of the steel now in general use, admitting of easier application, with approximate, if not equal, results.~~

~~From C and under-spring carriages there arose another application of springs which was very prominently before the public during this period, by means of which it was professed that two drawbacks recognized in the C and vmder-spring carriages were obviated, which were caused by the perch or bar which passes under the ■body holding the front and hind parts in rigid con- nexion, and yet making use of a form of spring to which~~

~~the same terms may be applied. These objections are the weight of the perch, and the limitation which it causes to the facility of turning, which in~~

~~*narrow roads and crowded thoroughfares is an inconvenience. The objection to weight is, however, minimized by*~~

~~*the introduction of steel, and as the more advanced builders almost always construct the perch with a forked arch in front, allowing the wheels to pass under, the difficulty of a limited lock is in a great measure overcome (Fig. 1). It must be noted, however (and this cannot be too emphatically stated), that the so-called C springs*~~

~~*Fig. 2.*~~

~~*above referred to are not at all the same in action as the C spring proper ; they are but an elongation of the ordi- nary elliptic spring in the form of the letter C (Fig. 2), without adding anything to, but rather lessening their elasticity, and entirely ignoring the principle of suspension by leather braces over the C spring proper, by which alone the advantage of superior ease is to be obtained.*~~

~~*Another improvement which stamps the period under review is the introduction of indiarubber for the tyres of wheels. To produce a carriage as nearly as possible free from noise and rattle has always been the aim of high- class coachmaking. A structure composed of wood, iron, and glass, with axle-trees, doors, windows, lamps, and other parts, in use upon the road in all weathers, must from time to time require some attention with this object. To meet this difficulty, the introduction of india- rubber has been received by carriage-users as a great boon. It was about the year 1852 that Mr Eeading, who at that time was known as a builder of invalid car- riages, conceived the idea of encircling wheels with that material, but his method only admitted of its use on vehicles travelling slowly over good ro'ads. This was improved upon at a later date by Mr Uriah Scott, who, taking advantage of the tempering capacity of india- rubber by the chemical action of sulphur, produced an inner rim of such density as to hold bolts, by which it. could be secured through the felloe, forming a base for the outer covering of soft pliable rubber. This system was attended with satisfactory results, and was in favour for some years with persons whose health needed such provision. Another method, originated by Mr Mulliner of Liverpool in the early 'seventies, was to screw on iron, flanges to the outer and inner sides of the felloes, having a kind of lip to press into the indiarubber filling*~~

~~*the intervening space; but the cost of this — £36 per set — rendered its adoption prohibitive. Mean- while another invention by Mr Uriah Scott, afterwards improved upon by an American patentee, came into use ; this was known as the " rubber-cushioned axle,"' cylindrical rings being introduced between the axle-box and hub of the wheel, thus insulating the body of the- carriage from the concussion of the road. This, how- ever, necessitated the cutting away of so much of the timber of the hub as to impair its durability, and had therefore, after a few years' experience, to be abandoned in favour of an invention by a Parisian builder, who introduced indiarubber bearings between the spring and axle-tree. This was thoroughly practicable, and met. with general acceptance, and it is still used in conjunction with iron and steel tyres. In 1890 the pneumatic tyre- was first applied to road carriages, but not until 1893 were strenuous means taken in the hope of popularizing- this invention. Its bulky appearance was a great draw-*~~

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~~*back, contrasting strongly witli the qualities whicli dis- tinguish a graceful equipage; yet the practical advan- tages were such that, in the absence of other objections, this became a secondary consideration. The sanguine anticipations of the inventor have not, however, been realized in England, owing to fears as to the difficulty of keeping the tyres fully inflated under the weight of a carriage carrying four or more persons, and their liability to puncture and explosion. In Paris and its neighbourhood and many parts of France, pneumatic tyres are to be seen in frequent use both on public and private conveyances. In another form the indiarubber tyre has become of almost universal applica- tion. Owing to an ingenious inven- tion of Mr Garment, what appeared to be an insuperable difficulty in roll- ing a grooved tyre was overcome (Fig. 3). This so simplified the application as to bring the cost within practicable limits. The grooved tyre is now made in several sections, in some of which the inward projection for securing the rubber is dispensed with, this being kept in position by wires running through the whole length, and electrically welded at the point of contact. Whatever be the method chosen for securing the tyre, the best tyres, both for*~~

~~*durability and ease, are those in which the rubber provided, is most resilient in its nature.*~~

~~*In the ninth edition of this work reference is made to automatic arrangements for the lifting and lowering of the hoods of Victorias and other such carriages, and the opening and closing of Landaus. There are now many contrivances with this object, of which the most to be preferred are the simplest in their arrangements. The qiiarter-light or five-glass Landau is a carriage which has been greatly improved during this period. The compli- cated adjustments of pillars, windows, and roof have been replaced by one simple parallel movement. The first public exhibition of a finished carriage on this principle was by an English firm at the Paris Exhibition of 1876 (Fig. 4).*~~

~~*Kg. 3.*~~

~~*Kg. 4.*~~

~~*In the matter of style certain types of carriages have passed through marked changes during this period. Extreme lightness was at one time considered by many the one desideratum both as to appearance and actual weight, in providing which ease of movement and com- fortable seating of the occupants became secondary con- siderations— ^though to these extremes builders of repute were always opposed. Still, when at the International Exhibition of Paris, 1889, it was seen that the Parisian builders had suddenly gone in the opposite direction, the world of fashion in carriages was taken by surprise. From being built upon easy, flowing, graceful lines, it was seen, with some revulsion of feeling, that these were to be displaced by the deep, full-bodied Victoria, Brougham, and Landau. Only by slow degrees did this characteristic find acceptance with English connoisseurs, and then only*~~

~~*in a modified form, though eventually in a greater or less, degree it is now the prevailing style.*~~

~~*While the better types of English carriages are still pre-eminent in their constructive qualities, and represent, the well-known characteristics of individual firms, some emulation may be excited by the elegant taste and*~~

~~careful workmanship which French builders display in points of finish, both internally and externally. Of the various, types of carriages now in vogue, the Victoria, in its many varieties of form, is the most popular, accompanied, as of necessity, by the double Victoria, Sociable, Brougham,. Landaulet, and Landau. Four-in-hand coaches for private- use, as well as the " road" coaches, are built on a smaller- scale than formerly ; 6 feet 8 inches may now be taken as the standard height of the roof from the ground. Owing- to the encouragement given by the Four-in-hand and Coaching Clubs, the ascendancy of this style of driving is still preserved to Great Britain ; and in association with it the Char-a-banc, Mail Phaeton, Wagonette, and Four- wheel Dog-cart retain their popularity. Of two-wheeled vehicles the Polo-cart and Kalli-cart are most in favour, to which may be added the Governess-car, which is found convenient for many purposes not implied by it& name. For a few years an effort was made, but with very indifferent success, to bring into fashion the Tandem- cart, which may again be considered almost obsolete in England, though not so in the United States, where the taste for this style of driving obtains. For street purposes the Hansom-cab, named after the inventor, an architect in Birmingham, and greatly improved by Messrs Forder and others, remains unrivalled. Since 1875 the public omnibuses of London have been much improved in comfort and ventilation, the easy staircase and con- venient seats making the roof attractive to persons of both sexes.~~

~~America has long held a prominent position in con- nexion with the carriage industry. In all the chief cities manufactories on a colossal scale are to be found, produ- cing thousands of vehicles annually and equipped with the most perfect labour-saving machinery ; and as vehicles of any particular pattern — many of small value — are required, not singly, but in large numbers, much economy is exer- cised in their manufacture. It is remarkable that, as a. contrast to the popular Buggy, Wagon, and Kockaway of the States, which are to be found in infinite variety, carriage establishments of the wealthy are not considered complete unless furnished with some of a European character, selected from the most eminent firms of London or Paris, in addition to others of their own manu- facture. In Paris preference is given to an excess of bulk, with elaborate scroll ornamentation and diminutive windows, forming indeed, by reason of its~~

exaggeration, a distinctive class. In respect of workmanship and finish, carriages by the best-known American builders leave nothing to be desired.

The International Exhibition of Paris, 1900, brought together examples from various Continental countries, in some of which a preference for curvilinear outline was displayed, but the best examples followed very closely the well-known English styles. In the French section it was. interesting to find a revival of the once all-prevailing Chariot, Barouche, and Britzska, suspended on C and under-springs, with perch, but with ideas of lightness somewhat out of proportion to their general character.

The Sedan-chair, so fashionable a century ago (Fig. 5), was also represented by some beautifully decorated examples of that period. It is a portable chair or covered vehicle, with side-windows and entrance through hinged doorway at the front. It is borne on poles by two men. It took its name from the town of Sedan in France, where it was first used, and was introduced into England by

Sir S. Buncombe in 1634. It is still to be seen in use at the public baths at Ischl in Austria, and also in the city of Bath, England, where a revival of interest in this mode of transit in connexion with the medical baths has

Fig. 5.

taken place of late years. The Sedan can be taken into the bedroom, and the invalid is conveyed without exposure to the outer air into the mineral-water bath, and, after bathing, carried home again. The poles are so arranged that the chair may be carried up and down stairs and still preserve its horizontal position.

The Bath-chair, with a folding head, which can be used open or closed, with a glass front, mounted on three or four wheels, can be drawn or pushed by hand (Fig. 6). If required to be drawn by a donkey or small pony,

~~*Fig. 6.*~~

~~*it is then mounted on four wheels, with the usual turning arrangement. James Heath, of Bath, was the inventor. He flourished rather before the middle of the 18th century, and, though he may not have foreseen it, he has contributed very greatly to the health and comfort of invalids. (j. a. m.'s.)*~~

~~*CarrickfergUS, a maritime town and urban sani- tary district, in the county of Antrim, Ireland, on Belfast Lough and the Belfast and Northern Counties railway, '9^ miles N.E. of Belfast. It ceased to be a parliamentary borough in 1885, and in 1898 the separate county of the town of CarrickfergUS was abolished. The new harbour admits vessels of 600 tons, and is connected by rail with the Northern Counties system. Population, 8923.*~~

~~*Carriere, Moritz (1817-1895), German philosopher and historian, was born at Griedel in the Grand Duchy of Hesse Darmstadt on 5th March 1817. After studying at the universities of Giessen, Gottingen, and Berlin, he spent a few years in Italy in the study of the fine arts, and established himself in 1842 in his old university*~~

~~*town of Giessen as a decent of philosophy, becoming an extraordinary professor there a few years later. In 1853 he was appointed professor at the University of Munich, lecturing mainly on aesthetics. An avowed enemy of XJltramontanism, he contributed by his writings in no small degree to make the idea of German unity more palatable to the South Germans. Carriere identified himself with the school of Fichte as one who held the theistic view of the world which aimed at reconciling the contradictions between deism and pantheism. Among his works may be mentiorved : Der Kolner Dom als freie Deutsche Kirclie, Die philosophiscJie Welt-Anschauung der Beformationszeit, and Die sittliche Weltordnung. He died in Munich on 19th January 1895.*~~

~~*Carrington, Richard Christopher (1826-1875), English astronomer, son of a brewer at Brentford, was born in London on 26th May 1826. Though intended for the Church, his studies and tastes inclined him to astronomy, and with a view to gaining experience in the routine of an observatory he accepted the post of observer in the University of Durham. Finding, however, that there was little chance of obtaining instruments suitable for*~~

~~*the work which he wished to undertake, he resigned that appointment and established an observatory of his own (1854) at Eedhill. Here he devoted three years to a survey of the zone of the heavens within 9 degrees of the North Pole, the results of which are contained in his Redhill Catalogue of S7S5 Stars. His investigation of the motion of sun-spots, in which he determined the elements of the sun's rotation, especially his important discovery of a systematic drift of the photosphere, in virtue of .which the time of rotation of a spot varies according to the particular solar latitude at which it breaks out, is the work with which his name will be most closely asso- ciated. He died on 27th November 1875. (a. a. b.*)*~~

~~*Carrodus, John Tiplady (1836-1895), English violinist, was born on 20th January 1836 at Keighley, in Yorkshire. He made his first appearance as a violinist in his native town at the age of nine, and had the advan- tage of studying with Molique at Stuttgart, where he made such progress that on his return to England in 1853 Costa got him engagements in the leading orchestras. He was a member of the Covent Garden Opera orchestra from 1855, and succeeded Sainton as leader there in 1869. He died " in harness," for his death took place at Hainp- stead on 13th July 1895, within a very few hours of the close of a performance. For many years he had led the Philharmonic orchestra and those of the great provincial festivals. He published several pieces for violin solo, and was a very successful teacher.*~~

~~*Carson, a city of Nevada, U.S.A., capital of Ormsby (jounty, and the capital of the state, situated in 39 ° 10' N. lat. and 119° 46' W. long., in the western part of the state, at an altitude of 4720 feet, in Eagle valley, near the south base of Washoe mountains. It is on the Virginia and Truckee railway. It was founded in 1858, about the time of the discovery of the Comstock Lode, and its fortunes have been closely associated with the mines of that great ore deposit. Population (1880), 4229 ;*~~

~~*(1890), 3950 ; (1900), 2285.*~~

~~*Cartagena, a seaport, dockyard, and arsenal on the Mediterranean coast of Spain, in the province of Murcia. Cartagena is one of the three great naval departments, the other two being San Fernando, near Cadiz, and Ferrol. Each department is under an admiral, whose title is captain-general in local rank. The population of Cartagena was (1887) 84,170, and (1897)*~~

~~86,424. Not only have the land and coast defences been improved, but considerable sums have been expended on the port works, quays, and wharves. These changes and the completion of the through railway lines have contributed to an increase in both local commerce and population, as the latter was only 26,000 in 1870. The commercial importance of Cartagena was diminished at the beginning of 1898, when Pokman, or Portman, a mining village about 11 miles to the eastward, situated on a well-sheltered bay, was declared by royal order an independent port. Vessels go to Porman to land coke and coal, and to load iron ore and lead. This fact ex- plains why the number of British vessels visiting Carta^ gena slightly declined in 1899, the figures being 307 entered with 298,314 tons, and 310 cleared with 301,610 tons. The number of ships of other nationalities in the same year were 152 entered with 109,412 tons, and 153 cleared with 111,200 tons. The Spanish vessels trading direct over sea, cleared and entered, were 79 steamers of 100,303 tons in all, and 5 sailing vessels of 1398 tons. The export trade owes its importance chiefly to the ores from the surrounding districts. The exports of iron and manganiferous iron ores amounted in 1898 to 430,750 tons, those of silver lead to 56,571 tons, of soft lead to 8422 tons, and of zinc to 44,646 tons, while copper ore, copper mat, and pyrites were also exported. England imported from Cartagena in that year 8034 tons of esparto grass, while 6863 tons of fruit, cereals, barley, and oats were sent to England, France, and Belgium. The imports into Cartagena were chiefly coal, 66,516 tons from Eng- land, and coke, 18,662 tons from England, 1667 tons from Germany, and 2000 tons from North Spain. Timber came from the United States and Eussia, and 1501 tons of cod-fish from Canada and Norway.~~

~~Cartagena, a port of Colombia, on the north coast of South America, capital of the department of Bolivar, situated on a low island of the Caribbean Sea, at the entrance of Cartagena Bay. In 1898 the wharf was lengthened by 120 feet, and a wharf was also made for the construction of steamboats. Cartagena is connected with the Magdalena river, both by a canal and by rail to Calamar, 60 miles distant. It retains its pre-eminence~~

~~*for its educational establishments. Of the churches, that of San Juan de Dios is celebrated for its altar of Italian marble. The city, which within recent years has greatly increased in prosperity, is lighted by elec- tricity, and possesses a service of telephones and tram- ways. A large market — the first in the city — was erected by the municipality in 1897-98. The value of the ex- ports now averages about £380,000 annually. During the civil war of 1885 the city underwent a siege. On the anniversary of its independence, 11th November 1897, a statue of Bolivar was unveiled, the cost being about £4000. The population is estimated at 16,000.*~~

~~*CartagO, a city of Costa Eica, Central America, capital of the province of the same name, situated on the railway line from Limon, about 90 miles W.S.W. of that port, and 11 miles E.S.E. of San Jos6. Among the public buildings are a college and a hospital. At Bella Vista, a short distance from the city, are hot mineral springs, much frequented by invalids. In 1892 the popu- lation was only 3491; but the railway to Limon has already done much to revive the city's prosperity, which will be further aided by the line from San Jose to a pro- posed new port at the mouth of the Gulf of Nicoya.*~~

~~*Cartaxo, a town of the district of Santarem, Portugal, situated 4 miles from the right bank of the Tagus, and 7 miles S.W. from Santarem. It produces com and good wine, and fish from the Tagus. The parish yielded*~~

~~*1,143,260 gallons of wine, valued at £65,360, in 1892. Population, about 7000.*~~

~~*Carthage, capital of Jasper county, Missouri, U.S.A., situated in 37° 11' N. lat. and 94° 18' W. long., on the south bank of Spring river in the south-western part of the state, at an altitude of 973 feet. It is entered by two railways, the Missouri Pacific and the St Louis and San Francisco. It is in the rich lead- and zinc region of south-west Missouri and south-east Kansas. Population (1890), 7981; (1900), 9416, including 273 foreign-born and 539 negroes.*~~

~~*Cartoon, a term now applied to the principal political drawings in the humorous or satirical papers of the day. At an earlier period satirical prints were styled " caricatures," and were issued separately ; Gillray, Eowlandson, the three Cruikshanks, Heath, and others were popular*~~

~~*favourites in this class of design. Even the insignificant little cuts by Eobert Seymour in Figaro in London, the diableries in The Fly, and the vulgar and rancorous political skits in the fiood of scurrilous little papers of the time, were dignified by the same term (see Caeicatube, Ency. Brit, ninth ed.). The long series of Political Sketches by " H. B." (John Doyle) were the first examples of unexaggerated statement, and fair and deco- rous satire. With the advent of Punch and its various rivals (ZVie Peep-Show, The Great Gun, Diogenes, and the like), this general tone was elevated. Punch at first adopted the word "pencilling" to describe the "big cut," which dealt variously with political and social topics. But when in 1843 there was held in Westminster Hall the great exhibition of cartoons from which selection was to be made of designs for the decoration in fresco of the new Houses of Parliament, Punch jocularly pro- fessed to range himself alongside the great artists of the day; so that the "mad designe" of the reign of Charles I. became the "cartoon" of that of Queen Victoria. John Leech's drawing in No. 105 of that journal was the first caricature to be called a cartoon : it was "entitled " Substance and Shadow : the Poor ask for Bread, and the Philanthropy of the State accords — an Exhibition." Later, Punch dropped the word for a while, but the public took it up. Yet the Encyclopaedic Dictionary entirely ignores the word in its application to modem satirical prints, and the monumental Oxford Dictionary curiously attributes the first use of it to Miss Braddon in 1863.*~~

~~*In England the cartoon, no longer a weapon of venomous attack, has come to be regarded as a humorous or sarcastic comment upon the weekly topic uppermost in the nation's mind, a witty or saturnine illustration of views already formed, rather than as an instrument for the manufacture of public opinion. It has almost wholly lost its rancour ; it has totally lost its ferocity — the evolutionary result of peace and contentment, for satire in its more violent and more spontaneous form is but the outcome of the dissatisfaction or the rage of the multitude. The cartoon, it is agreed, must be suggestive; it must present a clear idea lucidly and, if possible, laughably worked out ; and however reserved or restrained it may be, or even, when occasion demands (as in the case of Sir John Tenniel and some of his imitators), however epic in intuition, it must always figure, so to say, as a leading article transformed into a picture in the solvent, more or less mordant, of graphic fun or feeling. Matt Morgan transgressed on at least one occasion,*~~

and paid the penalty by loss of popularity. That the cartoon has greater influence for good or evil than is usually recognized has more than once been proved, and international amenities have several times been disturbed when the

satirical papers have hurt the susceptibilities of foreign nations. Among examples may be quoted the " Fashoda " cartoon in Punch, which caused considerable irritation in France, and the insulting drawings by Willette and L^andre in 1899-1900 in Paris, which outraged British feelings by their bad taste, indecency, and lack of chivalry. The names of PuncKs cartoonists, Sir John Tenniel, John Leech, Eichard Doyle, Charles Keene, Linley Sam- bourne, among others, are household words in all Eng- lish-speaking countries. Artists of ability have likewise worked in the service of Fun, including Paul Gray, A.B. Houghton, Matt Morgan, Fred Barnard, J. F. Sullivan, and Gordon Thomson — the last named having invented and drawn the weekly cartoon from 1870 to 1892 with only the break of a single week. Other cartoonists of the past are Watts Phillips, William M'Gonnell, William Brunton, and Alfred Bryan, while those of the present, besides those already mentioned, are Harry Furniss, John Proctor, WUliam Bowcher, A. Stafford, William Parkin- son, G. K. Halkett, and F. C- Gould. In France, where political passion runs high, the cartoon continues to flourish as a political engine worked with extraordinary ability and energy. The considerable number of satirical journals, supported by a population extremely alive to the ridiculous and easily moved by party feeling, gives occu- pation to many clever caricaturists, who employ technical methods such as lithography and colour for the reproduc- tion of their cartoons to an extent unknown in England. Prominent among them are Caran d'Ache (E. Poir^), Pepin (E. GiUaumin), Forain, Willette, L^andre, Cou- turier, and Hermann-Pavil. In the other countries of Europe the cartoon does not seem to be quite so popular, or to have been so vigorously exploited as in France and England, although much talent is occasionally displayed ; indeed, it is not uncommon to see the picture to which, in Punch for

~~example, is assigned the place of honour, relegated to a corner of the back page. In the United States many artists of striking ability have arisen, but only two names — those of Thomas Nasfrand J. Keppler — may be said to have gained European celebrity. (See Cakicature and iLLUSTEATioif.)~~

~~Authorities. — James Parton. Caricature and other Comic Art. New York, 1878. — Gkaham Everitt. English Caricaturists and Ghraphic Humorists of the 19th Century. London, 1886. — M. H. Spielmann. The History of ^'-Punch." London, 1895. — J.Grand- Carteret. Les Mrnurs et la Caricature en France. Paris, 1885. Les Mceurs et la Caricature en Allemagne, &o. Paris, 1885. — Adolph Brisson. Nos Humoristes. Paris, 1900. — And various volumes by J. Grand-Carteret upon special subjects, such as the Franco-Russian alliance, the Dreyfus case, and the like.-~~

~~(m. h. s.)~~

~~Cary, Alice (1820-1871), and Phoebe (1824-1871), American poets, born near Cincinnati, Ohio, respec- tively on 20th April 1820, and 4th September 1824. Their education was largely self-acquired, and their work in literature was always done in unbroken companionship. In 1852 they removed to New York, and occupied a prominent position in the literary circles of that city at the time when their friend Eufus Wilmot Griswold, Poe's literary executor, was the gwosi-dictator of American verse, and when Horace Greeley, editor of the Tnhune, who also aided them, was making that journal the organ of the reformers in politics and the sentimentalists in letters. The prose of Alice, who was the more voluminous writer of the two, consisted of sketches and novels, now entirely forgotten ; of her verse the best volume is the progressive collection of lyrics entitled The Lover's Diary (1867). PheBbe, whose writings were first collected in a volume entitled Poems by Alice and Phoebe Gary (1850), is now best known by the hymn beginning " One sweetly solemn thought." Alice died in New York, 12th February 1871,~~

~~and Phoebe in Newport, Ehode Island, 31st July of the same year.~~

~~Casablanca. See Dab el Baida.~~

~~*Casale Monferrato, a town and episcopal see of Piedmont, Italy, province of Alessandria, 20 miles N. by W. from Alessandria by rail, and on the river Po. In 1888 the river was spanned by a handsome iron bridge. The town possesses a school of design, carries on the raising of silk cocoons, and has clothing and cement factories, ironworks, and printing. Population, about 17,000.*~~

~~*Cascina, a commune of the province of Pisa, Tus- cany, Italy, 8 miles E. by S. from Pisa on the railway to Florence. It is still surrounded with walls, and carries on cotton-weaving and furniture-making. Under its walls the troops of Pisa were defeated by Galeotto Malatesta . and the Florentines in 1364. Population, about 24,000.*~~

~~*Caserta, a town and episcopal see of Campania, Italy, capital of province of Caserta, 20 miles. N.N.E. from Naples by raU. It has a cathedral, a technical institute, and an agricultural school ; and cotton, silk, and woollen mills, macaroni factories, and pottery works. In 1898 an ancient necropolis was discovered here. Good wine is made in the vicinity. Population of town (1881), 30,650 ; (1901), 32,729; of province (1881), 714,131; (1901),*~~

~~*783,495.*~~

~~*Casimlr — Perier, Jean Paul Pierre (1847-*~~

~~*), fifth President of the French Eepublic, was*~~

~~*born in Paris on 8th November 1847, being the grand- son of the famous Premier of Louis Philippe. He entered public life as secretary to his father, who was Minister of the Interior under the presidency of M. Thiers. He was elected to the Chamber in 1874, and distinguished himself as an active supporter of the Eepublic until 1883, when he resigned his seat upon the enactment of a law disqualifying the members of French royal and imperial families from employment in the public service. After this demonstration, due to his old family connexion with the House of Orleans, he re-entered the Chamber, and, continually increasing in influence and authority, was elected President of the Eepublic after the assassination of President Camot in July 1894. The highest hopes were entertained of the government of one*~~

~~who rivalled his predecessor in integ- rity, and was thought to surpass him in firmness, and great was the disappointment when, after a stormy admin- istration of six months, during which he had in some measure alienated the Moderate party without gaining the support of the more advanced Eepublicans, President Casimir-Pdrier resigned his office. The cause assigned by himself — inability to withstand the insults continually directed against him by opponents — was evidently insuf- ficient ; but it was generally believed that the real motive was impatience at finding himself a mere cipher in the hands of his ministers. Whatever the reason, the effect was to deprive France of the services of one of the fore- most of her citizens, for, except for a brief appearance during the Dreyfus court-martial of 1899, which led to the circulation of many singular rumours, M. Casimir-P^rier ceased to take any part in public affairs.~~

~~Caspian Sea (the ancient Mare Caspium or Syr- canium ; Eussian, Easpiyskoye More, formerly Hval- ynskoye More; Persian, Dariar4-Khyzyr, or Ourzem; Tatar, Ak-Denghiz; Sikim, also Jurjan of the old Eastern geographers), an inland sea between Europe and Asia situated between 36° 40' to 47° 20' N. and 46° 60' to 55° 10' E. It has an area of 169,380 square mUes. Its surface is 86 feet below the level of the ocean (96-7 feet.~~

~~according to the Aral-Caspian levelling).^ Its shores mostly belong to Eussia, with the exception of the southern coast, which belongs to Persia. Its general description and map were given in the ninth edition of this work.~~

~~Bydrography.— The hydrography of the Caspian was carefully investigated in 1856-72 by Captain (afterwards Vice-Admiral) Ivashintseff, and by several later expeditions directed by O. Grimm, N. AndrusoS, I. Spindler, &c., whilst the subjects of its shores, its former extension, and its geological history have been studied by Russian geologists. Its basin is naturally divided into three portions. Of these the northern, extending from west to east, and forming the great gulf Mortvyi Kultuk, is the shallowest, and hardly reaches a maximum depth of 20 fathoms. It is being gradually silted up by the deposits of the Volga, the Ural, and the Terek. A depression, half~~

~~*of which has a depth of more than 50 fathoms, and reaches the maximum depth of 421 fathoms, occupies the middle portion of the sea. It may be considered as a continuation of the synclinal depression of the Sea of Azov and North Caucasia (Manyoh), and is separated from the southern and deepest portion of the Caspian by a submarine ridge, which is a continuation of the main Caucasus range, and connects it with the Kopet Dagh. The depth of the Caspian over this ridge varies from 30 to 150 fathoms. Finally, the southern portion, which lies at the foot of the high Elburz border-ridge of the Persian plateau, and which may be regarded as a continuation of the Kura valley, has a depth of more than 600 fathoms in its middle (with a maximum of 616 fathoms).*~~

~~*Salinity. — ^The salinity of the Caspian is but f of that of the ocean, and in the surface layers it is only 0-0076 in the northern portion and 0-016 in the middle. It is also smaller along the western coast than along the eastern, and the proportion of sul- phides is greater than it is in the ocean.*~~

~~*Geology. — The isolation of the Caspian from the ocean must have taken place, in the opinion of Russian geologists, at a rela- tively recent geological period. During the early Tertiary age it belonged to the great sea which covered all South Russia, and was in open communication with the ocean. Only during the Miocene period, the so-called Sarmathian Sea of the geologists, which spread from the middle Danube through Rumania, South Russia, and along both slopes of the main Caucasus ridge to the Caspian region, began to be isolated and partially to lose its salinity. Before the beginning of the Pliocene time it was broken into three separate parts, one of which was the Aral-Caspian basin. The deposits of that period are described as the Pontic, and their fossils point to a further decrease of salinity. Towards the end of the Pliocene period, and undoubtedly so during the Post-Pliocene, the fauna of that basin took the aspect which it has now in the Caspian. Its reniains, known as Aral-Caspian deposits, are widely spread round the Caspian, which then stood at a level of about 100 feet above the present, according to Sjogren, but probably even more than that. During the Ice age the Caspian covered the Steppes which now spread on its northern shore, probably joined the Black Sea (also isolated from the ocean), through the Manyoh depression, and sent northwards a narrow gulf, up the present Volga valley as far as the 56th degree of latitude (Aral-*~~

~~Caspian deposits are found on the lower Kuma). Eastwards it penetrated into the Trans- caspian territory, between the Great and the Little Balkan moun- tains, up the Uzboi — which a few years ago was supposed to represent an old bed of the Amu-Daria, but which in reality is a dried-up strait of the Aral-Caspian basin, the bottom of which is strewn with marine Post-Pliocene deposits. Joining what is now Lake Aral, it received both the Amu and the Syr. When the great ice-cap, which covered two-thirds of European Russia, had thawed, and the subsequent general desiccation of the northern hemisphere (still continued) set in, the Caspian began to diminish, its level to go down, while its connexions, both with the Black Sea and Lake Aral, were broken.~~

~~Fauna. — The fauna of the Caspian, well studied by Eichwald, Kowalewski, Grimm, Dybowski, Kessler, and Sars, gives support to the above views. It is a mixture of fresh-water and marine forms ; thus we find in it the marine herring and such fishes (Gyprinus, Perca, Silurus) as are, together with the fluviatile lobster, characteristic of fresh water. The Rhizopoda, Botalia and Textillaria, one sponge {Amor^hina)., the Amphicteis worm, the mollusc Gardium edule, and various Gardidce, and some Amphi- pods (Gumacea and Mysidce), are purely marine; but they are either such forms as easily support variations in salinity, or are espe- cially characteristic of brackish waters. Of genera which are~~

~~1 By the triangulation of 1840 its level was found to be 84 feet below the level of the Black Sea. The Caucasus triangulation of 1860-70 gave 89 feet. It remains an open question whether such a considerable difference can be explained by mere errors. But a longer series of observations of the changes of level due to accidental causes (winds, rains) is required before any positive conclusions maybe made.~~

~~specially Caspian, the following are known : one sponge (^Metchni- kovia), the Cardides {Adacna and Didacna), three Gastropods, some Mysids, two Amphipods, and the fish Glupeonella, whUe at least four other genera belong, besides to the Caspian, only to such limans or creeks of the Black Sea as have lost their salinity. As to species which belong only to the Caspian fauna, we find them among the Protozoa, the Sponges (three) , the Vermes (Oligochaetes, ST^ecies of Amphicteis), the Molluscs (twenty-five~~

~~species), numerous Amphipods and Mysids, the Fishes (species of Q-obius, Benthophilus, Gobitis, &c.), and even the Mammals {Phoca caspia). It has been shown, moreover, that most of those specifically Caspian species have had their ancestors in the Pontic fauna, and have diverged from the ancestral type since the Caspian became isolated. The irruption of the Mediterranean Sea into the Black Sea, in conse- quence of the piercing of the Dardanelles, has destroyed many of tiie species which were retained in the Caspian, as well as in some lagoons (detached fragments) of the Black Sea. One representative of the Caspian fauna {Giyptonotus entomon') does not appear either in the Black Sea or the Mediterranean, but belongs to die northern seas, while several Caspian forms (Phoca caspia), some Mysidse {Oammarus Amphicteis, &c.) have a northern character. This led to the supposition that the Caspian stood at some recent epoch in direct communication with the Arctic Sea. However, no traces of such a connexion having as yet been discovered, the conjecture was abandoned.~~

~~Level. — The level of the Caspian is now taken at 86 feet below that of the ocean ; but it has undergone several oscillations in modem times. Thus it appears from the researches of FilippofE that, during the years 1861 to 1888, it thrice stood at a maximum — in 1885, in 1868-69 (highest level), and in 1882 — while the minima fell upon the years 1853 (lowest) and 1873 — the total range of these oscillations being 3 feet 6^ inches. Besides these changes, there are also the seasonal ones (lowest level in January, highest in summer). The winds also show a certain periodicity, and they result in currents.~~

~~Glimate. — ^The northern portion of the Caspian, which experi- ences severe frosts, and is too shallow to store in large amounts of heat in the summer, freezes for three or four months along the shores, but in the middle portion ice appears only when it is brought by northern winds.~~

~~Fisheries. — There is no other Inland sea in the world so rich in fish as the Caspian is at the mouths of its great rivers, the Volga, the Ural, the Terek, and the Kura. It was estimated, in 1882 and 1892, that every year no less than from 264,000 to 297,000 tons of various fish are caught in the North Caspian and the lower Volga, while Dr O. Grimm's ihore correct estimate for 1896 gives 393,000 tons. Seal-hunting is also an important item.~~

~~JVamj'aJiore.^-Navigation on the Caspian is maintained by 213 steamers and 540 sailing vessels, representing an aggregate of nearly 220,000 tons (39 per cent, of the whole Russian commercial fleet), which transport every year about 200,000 passengers and about 3,200,000 tons of goods. The trade is partly with Persia and partly coasting, immense quantities of naphtha and other produce being exported from Caspian ports to Russia, while Russian goods are imported to Caucasia and the Transcaspian territory for Turkestan and Bokhara. A considerable amount of goods, chiefly raw cotton, has been added to the traffic since the completion of the Transcas- pian railway. The Caspian ports are entered every year by an average of 20,000 vessels (6000 at Astrakhan), mainly engaged in coasting trade. The chief Russian ports are : Astrakhan, Petrovsk, Derbent (recently improved), Baku, and Lenkoran on the west coast; Krasnovodsk (head of Transcaspian railway) andMikhailovsk on the east coast ; and Resht on Persian territory.~~

~~A detachment of the Russian navy, consisting of seven gunboats, known as the " Caspian flotilla," is kept on this sea. Its naval station iS at Ashur-ada, on an island close to the Persian coast.~~

~~The Gulf of Kaea-boghaz, or Kaba-bugaz (also Aji-daria or Kuli-daria), on the east coast of the Caspian Sea, is a vast expanse of water which is separated from the Caspian by a narrow sand-bar pierced only by a narrow strait, about 1^ miles long and from 115 to 170 yards wide — the Kara-bugaz strait. A current flows through it into the gulf at a rate of 1^ to 3f miles per hour.~~

~~The area of this gulf being about 7600 square marine miles (100 English miles from W. to E. and 87 English miles from N. to S.), its evaporation is very great. It has been proposed to dam the strait in order to raise the level of the Caspian and to increase its salinity. The suggestion has also been made that a wire net stretched across the strait would prevent fishes from entering the gulf, where they get lost. Expeditions sent in 1895 and 1896 to study these questions discovered that the~~

~~bottom of tlie gulf is covered for an area of about 1300 square miles with a layer of Epsom salt, which represents a quite unique formation in nature of a stock of about 1,000,000,000 tons of that salt. Owing to the slight depth of the gulf, this could be easily extracted.~~

~~Authorities. — Besides the works mentioned in the ninth edition, see IvASHiNTSEFF, HydrograpMo Exploration of the Caspian Sea, St Petersburg, 1866 (Russian), 2 vols., with a hydrographical atlas ; N. Pcshchin, Caspian Sea, 1877 ; Filippoff, Marine Geography of the Caspian Basin, 1877; Memoirs (Trady)o/«Ae Aral-Caspian Expedition of 1876-77, 2 vols., edited by the St Petersburg Society of Naturalists ; N. Andrusov, " A Sketch of the Development of the Caspian Sea and its Inhabitants" (^Zapiski of the Suss. Geogr. Soc. ; General Geogr., vol. xxiv.) ; (all Russian) ; Eichwald, Fauna Caspio-caucasica.~~

~~(p. A. K.)~~

~~Cassano, a town of the province of Milan, Lom- bardy, Italy, 16 miles E. by N. from Milan by rail to Brescia, and on the river Adda, here crossed by a long stone bridge. It is famous for the defeat of Prince Eugene, commanding the Austrians, by the French under Vendome in 1705, and for the defeat of Moreau by the Austro- Russian army under Suvoroff in 1799. Its manufactures include linen, silk, pottery, and ropes. Population, about~~

~~5250.~~

~~Cassel, a town of Prussia, capital of the province of Hesse-Nassau, 124 miles by rail N.N.E. from Frankfort- on-Main, on the river Fulda. A building was erected in 1871-77 to accommodate the picture gallery as well as collections of porcelain and pottery and industrial art. There are also the Bose Museum, the museums of natural history and ethnography, an industrial exhibition hall, and an industrial art school. A Lutheran church (Gothic) was erected in 1892-97, a post ofl&ce (Eenaissance) in 1881, and new administrative ofiices and law courts in 1876-80. The public library contains considerably over 150,000 volumes. The most noticeable of the public monuments recently set up are those to the Emperor William I. (1898), to the musician Spohr (1883), and the lion fountain (1881). The towers of St Martin's church were rebuilt in 1889-92. Cassel is the~~

~~headquarters of the 11th German army corps. There are here a military school, a medical college, an academy of the plastic arts, and a trades school. The industries embrace the making of railway carriages, machinery, scientific instruments, porcelain, tobacco and cigars, lithography, jute-spinning, iron- founding, brewing, and gardening. Population (1885),~~

~~64,083; (1900), 106,001.~~

~~Cass i no, a town of Campania, Italy, in the province of Caserta, 42 miles N.W. from Capua by railway. It took the place of the ancient Casinum; but all through the Middle Ages, and later, it was known as San Germano, but in 1871 returned to its original name of Cassino. The place possesses some remains of antiquity, as an amphi- theatre and an antique funeral monument, now converted into the Church of the Crucifixion. At Casinum was the villa of M. Terentius Varro, made notorious by the orgies of Mark Antony (Cic. Phil. ii. 40). Population, about~~

~~13,500.~~

~~Castelar y Ripoll, Emflio (1832-1899), Spanish statesman, was born at Cadiz on 8th September 1832. At the age of seven he lost his father, who had taken an active part in the progressist agitations during the reign of Ferdinand VII., and had passed several years as an exile in England. He attended .a grammar school at Sax. In 1848 he began to study law in Madrid, but soon elected to compete for admit- tance at the school of philosophy and letters, where he took the degree of doctor in 1853. He was an obscure republican student when the Spanish revolutionary move-~~

~~ment of 1854 took place and the young liberals and democrats of that epoch decided to hold a meeting in the largest theatre of the capital. On that occasion Castelar delivered his maiden speech, which at once placed him in the van of the advanced politicians of the reign of Queen Isabella. Prom that moment he took an active part in politics, radical journalism, literary and historical pursuits. Castelar was compromised in the first rising of June 1866, which was concerted by Marshal Prim, and crushed, after much bloodshed, in the streets by Marshals O'Donnell and Serrano. A court-marshal condemned him in contumaciam to death by " garote vil," and he had to hide in the house of a friend until he escaped to France. There he~~

~~*lived two years until the successful revolution of 1868 allowed him to return and enter the Cortes for the first time — as deputy for Zaragossa. At the same time he resumed the profes- sorship of history at the Madrid university. Castelar soon became famous by his rhetorical speeches in the Constituent Cortes of 1869, where he led the republican minority in advocating a federal republic as the logical outcome of the recent revolution. He thus gave much trouble to men like Serrano, Topete, and Prim, who had never harboured the idea of drifting into advanced democracy, and who had each his own scheme for re- establishing the monarchy with certain constitutional restrictions. Hence arose Castelar's constant and vigorous criticisms of the successive plans mooted to place a Hohenzollern, a Portuguese, the duke of Montpensier, Espartero, and finally Amadeus of Savoy on the throne. He attacked with relentless vigour the shortlived monarchy of Amadeus, and contributed to its downfall.*~~

~~*The abdication of Amadeus led to the proclamation of the federal republic. The senate and congress, very largely composed of monarchists, permitted themselves to be dragged along into democracy by the republican minority headed by Salmeron, Figueras, Pi y Margall, and Castelar. The shortlived federal republic from 11th February 1873 to 3rd January 1874 was the culminating point of the career of Castelar, and his conduct during those eleven months has been much praised by the wiser portion of his fellow-countrymen, though it alienated from him the sympathies of the majority of his quondam friends in the republican ranks.*~~

~~*Before the revolution of 1868, Castelar had begun to dissent from the doctrines of the more advanced republicans, and particularly as to the means to be employed for their success. He abhorred bloodshed, he disliked mob rule, he did not approve of military pro- nunciamientos. His ideal would have been a parlia- mentary republic on the American lines, with some traits of the Swiss constitution to keep in touch with the region- alist and provincialist inclinations of many parts of the peninsula. He would have placed at the head of his commonwealth a president and Cortes freely elected by the people, ruling the country in a liberal spirit and with due respect for conservative principles, religious traditions, and national unity. Such a statesman was sure to clash with the doctrinaires, like Salmeron, who wanted to imitate French methods ; with Pi y Margall, who wanted a*~~

~~*federal republic after purely Spanish ideas of decen- tralization; and above all with the intransigent and gloomy fanatics who became the leaders of the cantonal insurrections at Cadiz, Seville, Valencia, Malaga, and Cartagena in 1873.*~~

~~*At first Castelar did his best to work with the other republican members of the first government of the federal republic. He accepted the post of minister for foreign affairs. He even went so far as to side with hi s colleagues when serious difficulties arose between the new government and the president of the Cortes, Sefior Martos, who was backed by a very imposing commission composed of the most*~~

~~*influential conservative members of the last parliament of the Savoyard king, which had suspended its sittings shortly after proclaiming the federal republic. A sharp struggle was carried on for weeks between the executive and this commission, at first presided over by Martos, and, when he resigned, by Salmeron. In the background Marshal Serrano and many politicians and military men steadily advocated a coup d'itat in order to avert the triumph of the republicans. The adversaries of the executive were prompted by the captain-general of Madrid, Pavia, who promised the co-operation of the garrison of the capital. The president, Salmeron, and Marshal Serrano himself lacked decision at the last moment, and lost time and many opportunities by which the republican ministers profited. The federal republicans became masters of the situation in the last fortnight of April 1873, and turned the tables on their adversaries by making a pacific bloodless pronunciamiento.*~~

~~*The battalions of the militia that had assembled in the bull-ring near Marshal Serrano's house to assist the anti- democratic movement were disarmed, and their leaders, the politicians and generals, were allowed to escape to France or Portugal. The Cortes were dissolved, and the federal and constituent Cortes of the republic convened, but they only sat during the summer of 1873, long enough to show their absolute incapacity, and to*~~

~~*convince the executive that the safest policy was to suspend the session for several months.*~~

~~*This was the darkest period of the annals of the Spanish revolution of 1873-74. Matters got to such a climax of disorder, disturbance, and confusion, from the highest to the lowest strata of Spanish society, that the president of the executive, Figueras, deserted his post and fled the country. Pi y Margall and Salmeron, in successive attempts to govern, found no support in the really im- portant and influential elements of Spanish society. Salmeron had even to appeal to such well-known reac- tionary generals as Pavia, Sanchez Bregna, and Moriones, to assume the command of the armies in the south and in the north of Spain. Fortunately these officers responded to the call of the executive. In less that five weeks a few thousand men properly handled sufficed to quell the cantonal risings in Cordoba, Sevilla, Cadiz, and Malaga, and the whole of the south might have been soon pacified, if the federal republican ministers had not once more given way to the pressure of the majority of the Cortes, composed of " Intransigentes " and radical republicans. The president Salmeron, after showing much indecision, resigned, but not until he had recalled the general in command in Andalusia, Pavia. This resignation was not an unfortunate event for the country, as the federal Cortes not only made Castelar chief of the executive, though his partisans were in a minority in the Parliar-ment, but they gave him much liberty to act, as they decided to suspend the sittings of the house until 2nd January 1874. This was the turning-point of the Spanish revolution, as from that day the tide set in towards the successive developments that led to the restoration of the Bourbons.*~~

~~*On becoming the ruler of Spain at the beginning of September 1873, Castelar at once devoted his attention to the reorganization of the army, whose numbers had dwindled down to about 70,000 men. This force, though aided by considerable bodies of local militia,,and volunteers in the northern and western provinces, was insufficient to cope with the 60,000 Carlists in arms, and with the still formidable nucleus of cantonalists around Alcoy and Cartagena. To supply the deficiencies Castelar called out more than 100,000 conscripts, who joined the colours in less than six weeks. He selected his generals without respect of politics, sending Moriones to the Basque*~~

~~*provinces and Navarre at the head of 20,000 men, Martinez Campos to Catalonia with several thousand, and Lopez Dominguez, the nephew of Marshal Serrano, to begin the land blockade of the last stronghold of the cantonal insurgents, Cartagena, where the crews of Spain's only fleet had joined the revolt.*~~

~~*Castelar next turned his attention to the Church. He re- newed direct relations with the Vatican, and at last induced Pope Pius IX. to approve his selection of two dignitaries to occupy vacant sees as well as his nominee for the vacant archbishopric of Valencia, a prelate who afterwards became archbishop of Toledo, and remained to the end a close friend of Castelar. He put a stop to all persecutions of the Church and religious orders, and enforced respect of Church property. He attempted to restore some order in the treasury and administration of finance, with a view to obtain ways and means to cover the expense of the three civil wars, Carlist, cantonal, and Cuban. The Cuban insurgents gave him much trouble and anxiety, the famous Virginius incident nearly leading to a rupture between Spain and the United States. Castelar sent out to Cuba all the reinforcements he could spare, and a new governor- general, Jovellar, whom he peremptorily in- structed to crush the mutinous spirit of the Cuban militia, and not allow them to drag Spain into a conflict with the United States. Acting upon the instructions of Castelar, Jovellar gave up the filibuster vessels, and those of the crew and passengers who had not been summarily shot by General Burriel. Castelar always prided himself on having terminated this incident without too much damage to the prestige of Spain.*~~

~~*At the end of 1873 Castelar had reason to be satisfied with the results of his efforts, with the military operations in the peninsula, with the assistance he was getting from the middle classes and even from many of the political elements of the Spanish revolution that were not republican. On the other hand, on the eve of the meeting of the federal Cortes, he could indulge in no illusions as to what he had to expect from the bulk of the republicans, who openly dissented from his conservative and conciliatory policy, and announced that they would reverse it on the very day the Cortes met. Warnings came in plenty, and no less a personage than the man he had made captain-general of Madrid, General Pavia, suggested that, if a conflict arose between Castelar and the majority of the Cortes, not only the*~~

~~*garrison of Madrid and its chief, but all the armies in the field and their generals, were disposed to stand by the president. Castelar knew too well what such offers meant in the classic land of pronunciamientos, and he refused so flatly that Pavia did not renew his advice. The sequel is soon told. The Cortes met on 2nd January 1874. The intransigent majority refused to listen to a last eloquent appeal that Castelar made to their patriotism and common sense, and they passed a vote of censure. Castelar resigned. The Cortes went on wrangling for a day and night until, at daybreak on 3rd January 1874, General Pavia forcilaly ejected the deputies, closed and dissolved the Cortes, and called up Marshal Serrano to form a provisional government.*~~

~~*Castelar kept apart from active politics during the twelve months that Serrano acted as president of the republic. Another pronunciamiento finally put an end to it in the last week of December 1874, when Generals Campos at Sagunto, Jovellar at Valencia, Primo de Eivera at Madrid, and Laserna at Logrono, proclaimed Alphonso XII. king of Spain. Castelar then went into voluntary exile for fifteen months, at the end of which he was elected deputy for Barcelona. He sat in all subsequent parliaments, and just a month before his death he was elected as representative of Murcia. During that period*~~

~~*he became even more estranged from the majority of the republicans. Bitter experience had shown him that their federal doctrines and revolutionary methods could lead to nothing in harmony with the aspirations of the majority of Spaniards. He elected, to use his own words, to defend and to seek the realization of the substance of the pro- gramme of the Spanish revolution of 1868 by evolution, and legal, pacific means. Hence the contrast between his attitude from 1876 to 1886, during the reign of Alphonso XII., when he stood in the front rank of the Opposition to defend the reforms of that revolution against Senor Canovas, and his attitude from 1886 to 1891. In this latter period Castelar acted as a sort of independent auxiliary of Sagasta and of the Liberal party. As soon as Castelar saw universal suffrage re-established he solemnly declared in the Cortes that his*~~

~~task was accomplished, his political mission at an end, and that he proposed to de- vote the remainder of his life to those literary, historical, philosophical, and economic studies which he had never neglected even in the busiest days of his political career. Indeed, it was his extraordinary activity and power of assimilation in such directions that allowed him to keep his f ellow-count;rymen so well informed of what was going on in the outer world. His literary and journalistic labours occupied much of his time, and were his chief means of subsistence. He left unfinished a history of Europe in the 19th century. The most conspicuous of his earlier works were : — A Histoi-y of Civilization in the First Five Centuries of Christianity, Recollections of Italy, Life of Lord Byron, The History of the Republican Movement in Europe, The Redemption of Slaves, The Religious Revo- lution, Historical Essays on the Middle Ages, The Eastern Question, Fra Filippo Lippi, History of the Discovery of America, and some historical novels. Castelar died near Murcia on 25th May 1899, at the age of 66. His funeral at Madrid was an imposing demonstration of the sym- pathy and respect of all classes and parties, (a. b. h.)~~

~~Castelfranco, a town of the province of Bologna, Emilia, Italy, 16 miles N.W. from Bologna on the railway to Modena. It has several churches with pictures by artists of the Bolognese school, and carries on spinning of textiles and match-making. It is identified with the ancient Forum Gallorum, where Hirtius defeated Antonius in 43 B.C. Population, about 12,500.~~

~~Castelfranco Veneto, a town of the province of Treviso, Venetia, Italy, 16 miles W. from Treviso on the railway to Verona. It is famous as the birthplace of the painter Giorgione, i.e., Barbarelli (1476-1511), and for the altar-piece by him in the principal church. The people are engaged in the silk industries. Here the French defeated the Austrians under Prince Kohan in 1805. Population, about 7500.~~

~~Castellammare, a town of Campania, Italy, in the province of Naples, on the E. shore of the Gulf of Naples, 18 miles by rail S.E. from Naples. The royal arsenals and a royal dockyard are the principal industrial works ; but there are also ironworks, cotton-mills, and a small- arms factory. The royal palace has been converted into a hotel. The imports varied between~~

~~£271,000 and £1,100,000 in the eleven years ending 1899, and the exports (65 per cent, macaroni) increased from £82,400 in 1888 to £335,900 in 1899. The port is cleared by about 280 vessels of 250,000 tons annually. In 1899 the Italian Government voted £56,000 for the extension of the pier and the improvement of the harbour. Popula- tion, about 34,500.~~

~~Castello Branco, a city and episcopal see of Por- tugal, capital and district of same name, 120 miles N.E.~~

~~from Lisbon. In the upper town there is an ancient castle, now used as a lyceum. Population, 6728. The district of Castello Beanco consists chiefly of the val- leys of the Ponsul, Ocreza, and Aravil (right-hand afflu- ents of the Tagus), although about 50 per cent, of the surface is uncultivated. Area, 2556 square miles. Popu- lation, 205,211, giving 80 inhabitants to the square mile.~~

~~Castellon de la Plana, a maritime province in the E. of Spain, with an area of 2446 square miles, divided into 9 administrative districts and 140 parishes; population (1887), 292,437 ; (1897), 304,477. The sur- face is mostly mountainous, and flat only near the coast. The principal rivers are the Mijares, Palencia, Bergantes, and Cenia. The climate is cold and variable in the hilly districts, temperate in winter, and very warm in summer in the lowlands. Eighty miles of railways are already worked, and new lines are being constructed. The local industries are increasing, and are mainly con- nected with iron and copper works, salt-fish factories, paper, porcelain, woollen, cotton, silk, esparto, brandy, and oils. Wine, oranges, and oil are exported to foreign countries and other parts of Spain. About 100 vessels annually enter the ports of the province for foreign trade, and 1800 coasting vessels. The fishing fleet is composed of 300 boats. Only 3 mines — 1 zinc, 1 iron, 1 lead — are worked. The live stock includes 3803 horses, 18,672 mules, 8221 asses, 1515 cattle, 164,273 sheep, 53,373 goats, 20,473 pigs. 115,800 acres are devoted to the culture- of wheat, 2066 to that of oats, 15,600 to barley, 15,042 to rye, 4707 to maize, 15,660 to chick-peas, 128,405 to vines, 72,335 to olive groves.~~

~~Castellon de la Plana, the capital of the above province, situated 4 miles from the sea and 40 N.N.E. of Valencia. Its population was 25,195 in 1887, and 30,584 in 1897. Its port, called El Grao, is on the coast some miles~~

~~*from the town, and is entered by about 200 vessels every year. It is a comparatively modern town, of which the industries — manufactures of leather, porcelain, silk, brandy, cork, and linen — are developing. The environs are f ertUe and well irrigated by water drawn from the river Mijares.*~~

~~*Castel San Pietro, a town of the province of Bologna, Emilia, Italy, 7 miles S.E. from Bologna. It has saline and ferruginous mineral springs (64-4°-73-4" Fahr.) and baths. Population, about 12,500.*~~

~~*Castelvetrano, a town of the province of Trapani, Sicily, Italy, 46 miles S.E. from Trapani by rail. There is a small museum containing relics from Selinus, includ- ing terra-cottas and a bronze statuette of Apollo. The town has brickworks, olive-oil presses, and macaroni fac- tories. Population, about 20,500. Seven miles to the south-west at Campobello are the quarries whence the ancients extracted the stone for the temples, &c., of Selinus.*~~

~~*Castle Douglas, a burgh of barony, police burgh, and railway junction of Kirkcudbrightshire, Scotland, on Carlingwark Loch, 19^ miles S.W. of Dumfries. Its auction marts for sheep and cattle sales are now the largest in the south-east of Scotland ; at an autumn sale as many as 15,000 sheep and 1400 cattle are disposed of in one day. It has a foundry, an agricultural implement work, and a tannery ; a town hall with reading-room and library, and a Diamond Jubilee cottage hospital. Water and drainage schemes have been carried out. There are five branch banks. The churches are Established, three United Free, Episcopal, and Eoman Catholic. The public school had an average attendance of 487 in 1898-99 ; and a Eoman Catholic school of 49. Population (1881), 2565 ;*~~

~~*1(1891), 2851; (1901), 3018.*~~

~~*Castleford, a township in the Osgoldcross parlia- mentary division of Yorkshire, England, on the Aire, 10 miles S.E. of Leeds by rail. Old Watling Street ran through the parish, and Eoman remains have been found in the neighbourhood. There are Established, Eoman Catholic, and numerous*~~

~~*Nonconformist churches; also a market-hall. Large glass-bottle and earthenware-jar works, chemical works, and neighbouring collieries employ the inhabitants. Area of township (an urban district), 664 acres; population (1881), 10,630 ; (1901), 17,380.*~~

~~*Castlemaine, a town of Victoria, Australia, in the county of Talbot, 78 miles by rail KN.W. from Melbourne. There are important gold-mines in the district, which is also a fine agricultural one. Slate and flagstone are quarried. The gold-diggings were amongst the first discovered in the colony. Population (1881),*~~

~~*6787 ; (1901), 5704.*~~

~~*Castrogiovanni, a fortified town of Sicily, Italy, province of Caltanissetta, from which it is 8 miles distant by rail. It has a public library, with fine incunabula, a museum, and sulphur mines, mineral springs, olive-oil mills, and macaroni factories. Population, about 22,700.*~~

~~*Castro Urdiales, a seaport of Spain, in the pro- vince of Santander. This town has increased in size, population, and importance very rapidly since 1879, owing to the development of mining interests in its environs. The total amount of iron ore shipped rose from 277,200 tons in 1894 to 413,369 in 1898. The total exports of tinned sardines in 1898 were valued at £21,300, all prepared in the town. Castro is now con- nected with Bilbao by the coast line between the capital of Biscay and Santander. The movement of British shipping at the port in 1898 was as follows : 102 vessels in ballast with a tonnage of 133,105 entered, and 60 vessels with 101,587 tons of cargoes, valued at £40,634, cleared for Great Britain. Population (1897), 12,268.*~~

~~*Castrovillari, a fortified town of the province of Cosenza, Calabria, Italy, 44 miles N. from Cosenza. It is situated in a wide fertile valley around the foot of an old Norman castle. The people press out olive oil and make casks. Population, about 11,500.*~~

~~*Catacombs of Rome. — Discoveries since 1870. In 1873 was discovered, near the cemetery of St Domi- tilla, the semi-subterranean basilica of SS. Nereus and Achilleus, 100 feet by 60 feet. This is now covered with a roof, and the fallen columns have been raised up. The lower part of a pillar,*~~

~~*which once supported a baldachino over the altar, still preserves the name AoiLLBUs, and beneath it a bas-relief of the martyr, with his hands bound, receiving his death-blow from the executioner. The base of a similar column has only feet in the same attitude, and probably bore the name Nekbus. In a grave in the apse was found a large fragment of an inscription, composed by Pope Dama^ sus, but set up by his successor Siricius, which, from the note-book of a Salzburg pilgrim of the 8th century, can be completed thus : —*~~

~~*MilitisB nomen dederant ssevum Ofacium pariter spectantes juss Prseoentis pulsante metu servi Mira "fides rerum subito posue Conversi fugiunt ducis impia castr Projiciunt clypeos faleras tel Confess! gaudent Christi portar Credits per Damasum possit quid*~~

~~*gerebant ^anni*~~

~~*RE PAR*~~

~~*EE FVRORB "^^ A EBLINQVVNT AQ. CKVENTA E TRIVMF08 GLORIA CHRISTI*~~

~~*Nereus (see Kom. xvi. 15) and Achilleus, said to have been baptized by St Peter, refused to do the bidding of Domitian as praetorians, and entering the service of*~~

~~*Plavia Domitilla, suffered martyrdom with their mistress, Petronilla, of the Aurelian family closely connected with the Flavii, and the spiritual daughter of St Peter, was buried in a sarcophagus, with the inscription : —*~~

~~*AVKBLIAB -PETEONILL AE • FIL •!) VLCISSIMAJE*~~

~~*This is now in St Peter's, but was probably originally behind the apse of this basilica, for there is a fresco of her in an arcosolium, with a matron named Veneranda. The original entrance to the cemetery leads directly into a spacious corridor with no loculi, but recesses for sarco- phagi, and decorations of the classical style of the 2nd century. Prom this a wide staircase leads directly down to a chamber, discovered in March 1881, of a very early date. Within an arcosolium is a tablet set up by "Aurelius*~~

~~*Ampliatus and his son Gordian, to Aurelia Bonifatia, his incomparable wife, a woman of true chastity, who lived 25 years, 2 months, 4 days, and 2 hours." The letters are of the 2nd century; but above the arcosolium was found a stone with great letters, 5 or 6 inches high: "Ampliati, the tomb of Ampliatus." Now Ampliatus is a servile name: how comes it to be set up with such distinction in the sepul- chre of the Flavii ? Eomans xvi. 8 supplies the answer : "Salute Ampliatus, most beloved to me in the Lord." De Eossi thinks the identification well grounded (Bullettino, 1881, p. 74). Epitaphs of members of the Flavian family have been found here, and others stating that they are put up " Ex indulgbntia flaviae domi- TiLLAB vESPASiANi NEPTis." So that Dc Eossi did not hesitate to complete an inscription on a broken stone thus : —*~~

~~*Sepulcy^vMl FlaviX oevmI*~~

~~*De Eossi began his excavations in the cemetery of St Prisalla in 1851, but for thirty years nothing but what had been described by Bosip came to light. In 1880 he unearthed a portion near the Capella Oreca, and found galleries that had not been touched since they were filled in during the Diocletian persecution. The loculi were intact and the epitaphs still in their places, so that "they form a kind of museum, in which the development, the formula, and the symbolic figures of Christian epigraphy, from its origin to the end of the 3rd or 4th century, can be notified, and contemplated, not in artificial specimens as in the Lateran, but in the genuine and living reality of their original condition" (Bullett., 1884, p. 68). Many of the names mentioned in St Paul's Epistles are found here: Phoebe, Prisca, Aquilius, Felix Ampliatus, Epenetus, Olympias, Onesimus, Philemon, Asyncritus, Lucius, Julia, Caius, Timotheus, Tychicus, Crescens, Urbanus, Hermogenes, Tryphsena and Trypho(sa) on the same stone. Petrus, a very rare name in the Catacombs, is found here several times, both in Greek and Latin. The neighbouring Coemeterium Ostrianum was anciently known as " Fons S. Petri," " ubi Petrus baptizavit," " ubi Petrus prius sedit." This cemetery derives its name from Priscilla, mother of Pudens, who is said to have given hospitality to St Peter the Apostle. We are reminded of St Paul, and of his friends Aquila and Prisca, by a monument erected by a freedman of an emperor, both of whose names have perished, but the freedman was pkaepositvs tabebnacvlokvm — chief tent- maker. In 1888 a corridor was*~~

discovered which had at one time been isolated from the rest of the cemetery. It had no loculi, but recesses in the wall to receive sarcophagi. At the end of the corridor there was a large chamber, 23 feet by 13 feet, once lined with marble and the ceiling covered with mosaic, a few fragments of which

still remain. The only tomb here was a sarcophagus, of which the broken front bears the letters which show it to have been the epitaph of one of the Acilian family : —

AOILIO GLABRIONI FILIO

In the vicinity are fragments of the epitaphs of Maniiis Acilius and Priscilla, of Quintus Acilius and Caia Acilia in Greek, another Greek inscription "Acilius Eufinus mayest thou live in God." After careful examination of the nine Acilii, who were consuls, De Eossi concludes that this was the resting-place of that Acilius Glabrio, consul with Trajan, a.d. 91, who in the year of his consulate was compelled by Domitian to fight with beasts in the arena, and then banished, and put to death in 95. The question of his Christianity seems settled by the discovery of the sepulchre of these Christian Acilii. From this crypt a staircase led up to the basilica in which Pope Sylvester was buried, and the whole plan of which was laid bare by De Rossi. The tomb of St Sylvester could be identified, and that of Pope Siricius " at his feet," as the pilgrim noted (Bullett, 1890, pp. 106-119).

Just before De Eossi's death, Mgr Wilpert discovered in the Capella Oreca a painting of the " Fractio Panis " or Eucharistic Feast, which he cleansed' from the dust with which it had been covered. The picture of the Blessed Virgin and Child, which De Eossi ascribed to the 2nd, if not to the 1st century, has received an unexpected proof of its antiquity. In 1890 the floor of the gallery in which it stands was excavated, and another floor was found to be 6 feet below its supposed level. The loculi in this lower portion were intact, with inscriptions of the 2nd century still in their places, proving that the niche in which that picture was painted must have been

~~considerably older than the lowering of the floor. A flight of iron steps enables the visitor now to examine this venerable specimen of early Christian art.~~

~~Since the death of De Rossi, one of his pupils, M. Stevenson, since dead, discovered in 1896 a small subterranean basilica in the Catacomb of St Peter and Marcellinus on the Via Labicana, with pious acclamations on the plaster similar to those in the Papal crypt in St Callixtus. Near the well-known subterranean chapel in the Ccemeterium Ostrianum was discovered by Mgr Crosterosa, in 1877, another chapel, in which Signor Armellini found traces of St Emerentiana, foster-sister of St Agnes. Near this a whole region of galleries has been brought to light, with loculi intact. Glass has been placed before them, so that their contents can be examined on the spot.~~

~~Authorities. — De Rossi. Soma Sotterranea, Tom. iii. ; Bul- lettino di Archeologia Cristiana, 1877-92 ; Bullettino Nuova, 1895-1900. Rome. — Lanciani. Pagan and Christian Borne. Mac-millan and Co., London. — Makucchi. Les Catacombes Bomaines, Descl6es et Cie., Rome, Paris. — Mgr Wilpert. Fractio Panis. Rome. — De Rossi's fourth volume contains a full account of the Cemetery of St Domitilla. The works of Lanciani and Marucchi should be studied by those unable to consult De Eossi's great work. (w. K. B.)~~

~~Catamarca, a province in the west of the Argen- tine Eepublic. It is bounded on the N. by Salta and Tucuman, on the W. by Chile, on the E. by Santiago del Estero and Cordoba, on the S. by La Eioja. The ofGlcial area at the census of 1895 was 47,531 square miles. The population in 1869 was 79,962 ; in 1895 it -was 90,161. The province is divided into fifteen departments. In 1895 there were 6834 farms, and 39,051 acres planted in cereals. The capital, Catamaeca, had a population in 1895 of 7397.~~

~~Catania, a city of Italy, in the province of Catania, on the eastern coast of Sicily, near the foot of Mount Etna. Both population and trade underwent a remark- able increase between 1865 and 1880, during which period Catania was the only large Sicilian city with a~~

~~harbour directly connected by railway with the centres of sulphur production. Architecturally it is the most modern and regularly built~~

~~*Sicilian town, since it has several times been rebuilt in consequence of earthquakes. In 1885 the university was raised from second to first- class status, and faculties of philosophy and letters, and natural science and mathematics were added to those of jurisprudence and medicine and surgery, which it already possessed. The Consorzio Universitano, founded by the local and provincial authorities for the improvement of the university, established, with the aid of private munificence, a geographical museum, and has obtained for the university the so-called " Eocks of the Cyclops " for geological studies, and has also begun an archaeo- logical museum. These pfforts have been so successful that in 1899 the university counted 42 official and 40 free professors (liberi docenti), while there were 968 students, as compared with 536 in 1890. In 1898, 6406 vessels of 2,466,787 tons entered and cleared, loading and unloading 433,150 tons of goods. Little change in the volume of the trade has taken place of recent years. The vicinity of Etna, and the beauty of the city and its surroundings, attract large numbers of foreign visitors every year. Catania is also within easy reach of Syracuse and its Greek remains, and also of the extremely inter- esting archaeological site of Taormina. Population, of town (1881), 100,417, (1901), 149,694 ; of province (1881), 563,457, (1901), 711,923. (g. mo.)*~~

~~*Catanzaro, a town and episcopal see of Calabria, Italy, capital of the province of Catanzaro, 5 miles from the Ionian Sea, and 110 miles by rail N.E. from Eeggio. University classes are held in law, medicine, and phar- macy. There is a coasting trade in wine, olive oil, and cereals, the port being cleared by 105 vessels of 58,530 tons in 1897. Population (1881), 24,094 ; (1901), 31,887.*~~

~~*Catholic Apostolic Church, The. —This community (the title " Irvingites " is repudiated) has not changed recently in general constitution or doctrine. The community does not. publish statistics. Its growth during late years is said to have been more marked in Germany and elsewhere than in Great Britain. The sketch of the constitution given in the ninth edition of the Encyclopoedia Britannica, prescribing the 12 « prophets," 12 " evangelists," 12 " pastors," and the 24 priests for each church, is an ideal outline which has never been fidfilled. There has never been a "central episcopacy " of 48. The " Apostles " alone have always held the supreme*~~

~~*authority, though for some years there have been "coadjutors" appointed to assist the one surviving "Apostle," and to exercise the functions of the "Apostolate." The last "Apostle" died on 3rd February 1901. No readjustment of the constitution had been made up to the autumn of that year.*~~

~~*Catskill, a village of New York, U.S.A., capital of Greene county, situated in 42° 13' N. lat. and 73° 62' W. long., on the western bank of Hudson river, in the eastern part of the state. It is entered by the West Shore railway. The site is hilly and the street plan irregular. Several steamboat lines connect Catskill with New York, Albany, and other river points. Population (1880), 4320; (1890), 4920; (1900), 6484 (667 foreign- born, and 304 negroes).*~~

~~*Cattaro, the chief town of the government district of the same name in Dalmatia, Austria. In 1890 the population of the town was 3329, and of the commune 5436, mainly Slav, with a considerable German minority. It has a garrison of 1036 men. There is a steamboat service to Trieste, and a road to Cettigne. Cattaro was the*~~

~~*principal Austrian point d'appui in the insurrections which broke out in 1869 and 1881-82, in the barren mountainous district of the Krivoscie, vhich lies between the Bocche di Cattaro,, Herzegovina, and Montenegro. The system of fortifications comprising Cattaro and the small town of Castelnuova at the mouth of the gulf, now extends to the heights of the Krivoscie, which are crowned with small forts.*~~

~~*Cattegat. See Noeth Sea and Baltic Sea.*~~

~~*Cattle. See Agriculture.*~~

~~*Cauca, a department of the republic of Colombia, bounded on the N.W. by Panama, on the N. by the Caribbean Sea, on the E. by the departments of Bolivar, Antioquia, Tolima, and Cundinamarca, Venezuela, and Brazil ; on the S. by Brazil and Ecuador ; and on the W. by the Pacific Ocean. Area,*~~

~~257,463 square miles, in- cluding a number of islands along the Pacific and Atlantic coasts, covering an area of some 77 square miles. The capital, PopayEin, has 10,000 inhabitants. Other principal towns are Call (16,000), Buenaventura, Pasto, Cartago, Buga, Barbacoas.~~

~~Caucasus, a name indiscriminately applied to (a) the great chain of mountains which runs N.W. to S.E. from the Black Sea to the Caspian, and which ought alone to retain this name (Caucasus, Caucasus Range, Great Caucasus) ; (6) the whole series of mountains, highlands, and plateaux which is found in the Ponto- Caspian isthmus — the name of Little Caucasus, or AntirCaucasus, being loosely applied to both the escarpment of Trans- caucasia which faces the Caucasus Range and to the highlands of Transcaucasia altogether ; and (c) the sub- division of the Russian Empire known as Kavhazskiy Krai (Caucasus Region), or Caucasia, or Generdl- Govemor- ship, and formerly Lieutenancy, of the Caucasus. In the last- named application it is that section of the Russian dominions in Asia which occupies the isthmus between the Black Sea and the Caspian, as well as portions of the plateaux of Asia Minor and Armenia. Its northern boundary is the KumarManych depression, which is a succession of narrow, half- desiccated, and only temporarily filled lakes and river-beds connecting the Manych, a tributary of the Don, with the Kuma, a tributary of the Caspian. It is supposed to be a relic of the former post- Pliocene connexion between the Black Sea and the Caspian, and is accepted by most geographers as a natural frontier between Europe and Asia, while others take for the boundary the sinuous line of the main water-parting of the Caucasus Range. The southern frontier of Caucasia is a line which has been shifted several times during the last century, and now, separating Caucasia from Asia Minor and Persia, runs from a spot situated on the Black Sea 17 miles S. of Batum in a south-westerly and easterly direction to the Ararat, and thence along the Araxes river to within 30 miles from its junction with the Kura where the bound- ary turns once more to the S.E., reaching the Caspian Sea at Astara (lat. 37° 45' N.). This large territory, covering 180,843 sq. miles and having in 1897, 9,248,695 inhabit- ants (54 per sq. m.), may be subdivided into four natural zones : (i.) the plains in the K of the Great Caucasus Range, or North Caucasia ; (ii.) the Caucasus Range and the highlands of Daghestan ; (lii.) the valley of the Rion and the Kur£i,~~

~~*between the main ridge and the escarp- ments of the Anti-Caucasus ; and (iv.) the highlands of Transcaucasia.*~~

~~*I. The Plains of North Caucasia, which include most of the provinces of Kuban, Stavropol, and Terek, gently slope from the foot of the Caucasus Range towards the Kuma -Manych depression, the Sea of Azov, and the*~~

~~*Caspian. They consist of horizontal Tertiary strata, and only in their centre portion do they reach altitudes of from 2000 to 2500 ft., as in the " Stavropol plateau," which spreads northwards, separating the tributaries of the Kuban from those of the Terek and the Kuma. Thick forests clothe them towards the foot-hills of the Caucasus, while in the W..they merge into the prairies of South Russia, or end in marshy grounds clothed with rushes in the wide delta of the Kuban; in the N. and E. they become stony and sandy dry steppes as one approaches the Manych and the coasts of the Caspian.*~~

~~*The climate is continental, i.e., very hot in the summer and cold in the winter, and very dry, the yearly rainfall being only from 30 to 10 inches. The average temperatures at Stravopol (alt. 1919 ft.) are : year 47° Fahr., January 24°, July 70°, yearly rain- fall 29-8 inches. But the soil of these prairies is very fertile, and they have now a Russian population of nearly 2,800,000, com- posed of Cossacks and peasant immigrants, chiefly settled on the main rivers and grouped in wealthy, populous villages. They carry on agriculture — whealr-growing on a large scale, with the aid of modern machinery, North Caucasia becoming an important grain- exporting country, — and also cattle and horse breeding ; vine culture is widely spread on the low levels, and a variety of do- mestic trades is rapidly spreading in the villages. The higher portions of these plains, deeply ravined by the upper tributaries of the above-mentioned rivers, are inhabited by a variety of Cau- casian branches : the Kabardians and the Cherkess in the W., the Ossets in the middle, and a variety of branches from Daghestan described under the general name of Chechens, while nomadic Nogai Tatars and some Turkomans occupy the steppes.*~~

~~*II. The Caucasus Range, running N.W. to S.E. from the Strait of Kerch to the Caspian Sea, on a length of 940 miles (700 miles in a straight line), varying in width from 30 to 130 miles, and covering a surface of 12,000 sq. miles, appears to be of a more and more complicated structure in*~~

~~proportion as more accurate surveys are made. A new survey on the scale of 1^ inches to the mile was in 1901 being made with great accuracy (especially in Central Caucasus) in lieu of the previous 3^ miles to the inch scale.~~

~~A. In its western portion, from the Sea of Azov to the Elbruz, which runs parallel to, and at a short distance from, the N.E. coast of the Black Sea, it appears rather ajs a succession of parallel ridges, disposed en ichelon, sending out on their southern slopes numerous spurs of great steepness, which reach the very coast of the Black Sea. On its northern slope the main range is accom- panied by another ridge of mountains, the Bokovoi Khrebet, or " side range," which is composed of uplifted stratified rocks gently sloping northwards ,^nd having their escarpments turned towards the main range. /The rivers which rise on the slopes of the latter flow first in longitudinal valleys and then pierce the thickly forest-clad side range in a series of most picturesque gorges and valleys. The amount of rain received by this region, which is only 20 inches at the Sea of Azov, reaches 40 inches along the Caucasus Range as far as the 46th degree of E. long., and from 60 to 80 inches in the Black Sea coast region (80 inches at Sochi). Consequently the south-western slopes of the Caucasus are covered with a luxuriant, almost sub-tropical, vegetation. Unfortunately, in the narrow coast regions moisture and heat result in the prevalence of very severe malarial fevers, pre- senting a real obstacle to immigration. The altitude of the snow-line in Western Caucasus is about 9000 ft. on the Fisht or Oshten group, and to the east of it the crest of the main ridge is crowned with perpetual snow and numerous hanging glaciers, while larger glaciers creep down the main valleys. The southern slope, however, is extremely steep and often presents almost vertical walls, 2000 to 3000 ft. high, rendering the passes ex- tremely difficult. As a ■ rule the passes lie at a great height, and apart from those lower ones which are known at the north-western extremity of the range, they are few, namely, Pseashko, from Pitsunda to the head -waters of the Laba (6870 ft.); Marukh (11,000 ft.); Klukor (9075 ft.), along which a bridle-path is now made to connect Sukhum with Batalpashinsk ; and Nakhar (9617 ft.), also leading to the upper Kubafi. The main peaks of that part of the range are — Fisht or Oshten (9359 ft.), Shugus (10,642), and Psysh (12,427). The former inhabitants of this region — Kabardians and a few Adyghe (or Cherkess, Circas- sians) — are partly~~

~~*settled now on the northern foot-hills, while Abhazians occupy the south-western slope. The great bulk, how- ever, of the native population have been compelled by the force of*~~

~~*S. II. — 78*~~

~~*618*~~

~~*CAUCASUS*~~

~~*arms to abandon their mountain villages, and rather than settle I out of the country and emigrated to Turkey, constituting now on the northern plains, as they were offered, preferred to be driven | the hashi-bazoulcs. As to the Russians, they have but a few small*~~

~~*towns along the coast, namely, Novorossiysk (16,208 inhabitants) Sukhum-kale (7809), and Sochi, the first named of which is connected by a branch railway with the great line of North Caucasia, and becomes a great corn-exporting seaport. Immense beds of coal have been discovered at Ochemchiri.*~~

~~*B Middle Caucasus, from the sources of the Kubafi to those of the Ardon, i.e., from Mt Elbruz to the Adai-khokh, is the highest portion of the ra,nge. Immense snow-clad ridges of mountains shoot ott from the mam range on its southern slope, at small angles with Its mam axis, forming large longitudinal valleys (Legchum, Hacha*~~

~~*CAUCASUS*~~

~~*619*~~

~~*and so on), inhabited by various branches of the Georgian stem. On the northern slope the side range (Bokovoi Khrebet) runs parallel to the main one, often exceeding it in altitude, but it is cut through by many rivers, which, as in the W. Caucasus, also flow for some distance in longitudinal valleys between the two ridges, and then pierce it, to find an issue to the northern plains. Many spurs also shoot off the main range, and it is usually on these spurs that the highest peaks — some of them of volcanic origin, as*~~

~~*Elbruz and Kazbek — stand, covered with snow, and sending down mighty glaciers. The highest peaks of the Caucasus are met with in this division, there being no fewer than 20 peaks higher than Mont Blanc. The chief are in close suc- cession: Elbruz, or Minghi-tau (18,470 ft.), Ushba (15,445), Tikhtenghen, Gistola, Tetnuld (15,914), Adysh (16,291), Great Shkhara (17,049) and Little, Koshtan-tau (16,881), Janghi-tau (16,564), Dykh-tau (17,054), Pasis-mta, Adai-khokh (15,244), Tepli (14,510), Himarai-khokh (15,673), and Kazbek (16,546). None of the passes in this portion of the Caucasus is iDelow 12,000 ft., and only to the E. of Kazbek the Mamisson Pass, from Kutais to Vladikavkaz, known as the " Military Ossetian Road," lies at an altitude of 9390 ft. Mighty snow-clad ridges — Svanetian, Legchum, Eachinsky — shoot also to the W. and W.S.W. on the southern slope of the main chain, forming elevated longitudinal valleys.*~~

~~*As a rule, the snow-line lies at heights of from 11,000 to 12,000 ft., and although it remains a fact that the Caucasus, taking into account its dimensions and altitude, has fewer glaciers in proportion than the Alps, the excursions of Western European and Russian Alpinists, and especially the newest detailed survey, have disclosed in this part of the Caucasus, between the main range and the secondary ones, wide areas covered with perpetual snow and feeding mighty glaciers, not second in size to those of the Alps. It is estimated that there are in this region no fewer than 183 first- class and 679 second-class glaciers, — the number of the latter in the whole chain probably being between 900 and 1000. However, the Caucasian glaciers do not creep so low as those of the Alps. The best known of them are: Bizinghi (Shkhara and Dykh-tau), 11 miles long, reaching at its lower end the altitude of 6539 ft. ; Dykh-su, in the same locality, 7 m. long (6649 ft.) ; Karagom, 6i m. long, flowing from the Adai-khokh and reaching the 5702 ft. level (lowest in Caucasia) ; Tsanner, creeping from the Tetnuld, 7 m. long (6835 ft.) ; Devdorak, from the Kazbek, 2 J m. long (? 7531 ft.). Numerous traces of glaciation on a very large scale are found in all the valleys.*~~

~~*Farther eastwards the main range becomes much lower, and the highest peaks are grouped in the side range. They are : Tsmiakom-khokh (13,567), Zilga-khokh (12,645 ft.), Zikari (12,563), Choukhi (12,107), and Borbalo (10,807) in the main range. The rivers of the northern slope — the Ardon and the Terek — after short courses in longitudinal valleys, pierce the side*~~

~~*range in most wild gorges. The whole chain narrows, however, in the meridian of Vladikavkaz, and it is crossed there by the well-known Cross Pass (Krestovaya ; also named Gudur and Kobi Pass), along which goes the military road to Georgia, following the famous Darial gorge, which is pierced by the Terek across the side range.*~~

~~*C. It appears very probable that to the east of this gorge the Caucasus is crossed by other lines of upheaval which have a direction from S. W. to N.E. and may be considered as continua- tions of the Suram or Meskes Mountains and the Pontic Ridge. At any rate, from the Kazbek eastwards the Caucasus changes its character. It has to the N. of the main range a wide Alpine land, Daghestan, composed of several ridges — Audi, Bozdagh, and others — all running towards E.N.E., with many treeless and dry plateaux between them, so that Daghestan may be considered by the orographer as a fragment of the Transoaucasian plateaux, separated from the main body by the broad valley of the Kura, while the geologist sees in it a series of folds of Jurassic and Cretaceous deposits. As to the main range, it continues in the same south-easterly direction, but its granite axis disappears and Palaeozoic slates spread on both the southern and the northern slopes. The crest of the main ridge becomes lower and has less protruding peaks. Glaciers are scarce upon it, but attain a great development on the ridges lying to the north of the main one. The chief passes across the latter are Kodor (9300 ft.) and Satskheni, both leading from Tiflis to Daghestan. The chief peaks of the main ridge do not reach altitudes of 12,000 ft., and are, besides Borbalo, Antsal (11,742), and Shavi-kilde (11,314) ; while in the Andi ridge' are Tebulos-mta (14,781), Donos-mta (13,736), Kachu (14,027), and Balakuri in the Bozdagh ridge.*~~

~~*D. From the 47th degree of longitude (head of Samur) to the Baba-dagh Peak the main range rises once more in altitude, reaching 13,764 ft. in Thfan-dagh, 14,772 in Bazar-dyuz or Kiohen-dagh, and 18,951 ft. in Shah-dagh, while the Gudur Pass lies at an altitude of 10,118 ft. and the Salavat Pass (military road of Akhte) at 9283 ft. In this portion of the*~~

~~*Caucasus are the last glaciers. Beyond the Baba-dagh (11,934) no summit rises above 9000 ft. ; the Alty-agach Pass is at an altitude of only 4354 ft. ; the crest is devoid of perpetual snow. Finally, the great ridge is lost in hills*~~

~~*as it approaches the Caspian, to be continued, however, imder the sea as a submarine swelling, and to reappear in tlie Transcaspian territory under the name of Kopet-dagh.*~~

~~*The high valleys of the Caucasus are populated by Cherkess (Adyghe) in the W., Svanetians, Ossets, Pshaves, and Khevzurs in the middle, and a variety of stems, of which the Lezghians and the Cherkess are the most numerous, in Daghestan. Every avail- able patch in the mountain valleys is used for culture, the soil having often to be carried on the shoulders to a great height, and the villages (auls) are built house above house upon the steep mountain slopes. Unfortunately, the Cherkess having been driven out of the country, their abodes in Western Caucasus remain un- occupied, while the various Georgian stems of the middle Caucasus, pressed by want of land available for culture, have had much to suffer from the feudal servitude under which they remained till*~~

~~*1863.*~~

~~*III. The Broad Valley which runs N.W. to S.E. between the Great Caucasus and the escarpments of the Anti-Caucasus is the most fertile and the most populated portion of Caucasus. It broadly corresponds with the provinces of Kutais, Tiflis, Elisabethpol, and Baku, and has a population of over 3,000,000. It is watered in the W. by the Eion, affluent of the Black Sea, and its tributaries, and in the E. by the Kura, afluent of the Caspian (with its two tributaries, Yora, Alazan), and the lower Araxes. The Suram or Meskes Mountains, 3000 to 5000 feet high, separate the two drainage areas. This Broad Valley was peopled in a remote antiquity with Greek colonists, was later the seat of powerful Georgian kingdoms, and has been for cen- turies the stronghold of Caucasia against invasions from the east and south. It is thickly peopled, chiefly with Georgian stems (Gurians, Imeretians, Mingrelians, Svanes) in the valley of the E.ion, and Georgians mixed with Armenians in. the valley of the Kura, while the Steppes spreading along the lower course of the latter river are occupied by various Turko-Tatars. In the agricultural region the land is so well cultivated that it attains a fabulously high selling vaiue, increased now by the manganese and copper mines of the Kion and the extremely rich naphtha wells of Baku. The drainage area of the Kion (proviace of Kutais), as well as the Sukhum-kale coast region*~~

~~and the basin of the lower Chorokh (Batum district), is covered with spurs of the Caucasus, the Meskes Mountains and the Wakhan ridge, with a broad triangular delta of the Eion between them. Its climate is extremely hot, and the amounts of rain are very considerable, so as to reach a yearly average amount of 80 in. at Batum, from 80 to 60 in. round Poti, and from 60 to 40 in. elsewhere. Farther east, in the valley of the Kura, the climate is, however, much drier and more con- tinental, the averages for Tiflis being : year 55°, January 32°-5, July 77°, rainfall 20 in. ; and for Baku, year 59°, January 39°, Jidy 80°, rainfall 10 in. The chief tovms of Caucasia are situated in this valley, namely, Batum (2^,512 inhabitants) and Poti (7666), the two chief ports on the Black Sea; Kutais (34,492), on the Eion; Tiflis (160,645) ; and Baku (112,263).~~

~~IV. The Highlands of Transcaucasia present three distinct regions ; the plateaux of Asia Minor and of Armenia, and the Lenkoran region on the Caspian. The first-named plateau, intersected by the Pontic Eidge (from 10,000 to 12,152 ft. high), the Arjar and the Arsian ridges (10,000 to 11,000 ft.), and watered by the Chorokh, is chiefly inhabited by Mussulman Georgians (Lazes), who grow rice, millet, wheat, and all sorts of fruit. The Armenian plateau, separated by the deep valley of the Araxes from its continuation in Turkish Armenia, has mostly altitudes of from 5000 to 6000 feet. It consists of granites covered with Azoic, Devonian, Carboniferous,~~

~~Tertiary, and Glacial deposits, and is deeply ravined by rivers. Mountain ranges, which have their bases on the surface of the plateau, and reach altitudes of from 8000 to 9500 ft., and occasionally more, intersect it in various directions ; while huge Trachitic masses, such as the Alaghoz (13,436 ft.) and the Ararat (17,212 ft.), rise above its undulating and ravined surface. The climate^ is severe on the plateau and very hot in the deeper valleys." Thus, even at Erivan (40° 15' N.), at an altitude of 3230 ft., the averages are as low as these : year 51° Fahr., January 16°, July 75°; and at higher altitudes the winters are still more severe. The yearly amount of rain is only from ,9 to 24 inches. The population consists of Armenians, Tatars, Turks, Kurds, Turkomans, and Russians, who do not number,~~

~~*however, more than 15,000. Cattle-breeding and some agriculture are carried on on the plateau, while cotton, rice, and all sorts of fruit are grown in the deeper valleys. As to the Lenkoran district, which lies on the slopes of the Azerbaijan plateau, its climate is extremely warm and moist. The temperature of the coldest month is 37° at Lenkoran, and the yearly amount of rain exceeds 40 inches.*~~

~~*The population of Caucasia has been rapidly increasing, and it reached, in 1897, 9,248,695 (4,891,054 men and 4,357,641 women), _ , , of whom 996,248 lived in towns. Of this population, Population. 3 786,784 lived in the three North Caucasian provinces and 5,461,911 in Transcaucasia (including Daghestan). The popu- lation belongs to a great variety of stems, but it has been proved by modem ethnologicsS research, especially by Baron Uslar, Schiefner, and Zagursky, that the former opinion as to the existence of 150 or 300 different nationalities was exaggerated. Many of the languages that are spoken in different parts of the Caucasus have proved to be but local dialects of a few distinct languages. According to the classification established by Baron Uslar and Zagursky, the different nationalities of Caucasia may be classed as they are given in the table on this page.*~~

~~*Most of the Russians and the Georgians, with the exception of the Moslem Lazes, belong to the Greek Orthodox Church (4,076,173 according to estimates for 1886-97) ; but considerable numbers of the former are Nonconformists of different denominations (121,824, but probably much more). The Armenians, with the exception of a small number of Catholics (34,008), are Gregorians (979,566). The mountaineers, as also the Turks and the Tatars, are nearly all Sunnite Mussulmans (2,021,334), and the Persians Shiite Mussul- mans (884,131), while the Mongols are Buddhists (20,311), and the Kurds are Yezids (14,979).*~~

~~*The movement of population in 1897 was, 350,457 births (3-9 per cent.), and 226,295 deaths (2-5 per cent.), showing thus an increase of 1*4 per cent. (124,162).*~~

~~*Agriculture is the main occupation of the settled inhabitants, and cattle-breeding among the nomads. The total crops for 1897 were: 9,322,000 quarters of wheat and other cereals in Northern Caucasia, and 11,910,000*~~

~~quarters in Transcaucasia, it being estimated that in an average year Caucasia has an available surplus of 3,000,000 tons of cereals. The yearly crop of raw cotton (chiefly Armenian), grown mostly in Eastern Transcaucasia, is estimated at 10,000 tons, and of tobacco at 36,000,000 lbs. Various sorts of grass (rye-grass, lucerne, &c.) are widely cultivated in Transcaucasia, and nearly 60 cwts. of madder are obtained. The culture of melons and water-melons, as also of the sunflower (for oil), is widely spread; and it is estimated that nearly 54,000 acres are under vineyards in North Caucasia and 278,000 acres in Transcaucasia, giving an aggregate of 30,000,000 gallons of vrine. Gardening is brought to a high degree of perfection, and the silkworm is bred so as to obtain every year over 100,000 cwts. of cocoons and to give occupation to about twenty steam silk unwinding mills and great numbers of small native ones. The gathering of the liquorice root (about 600,000 owt.) , of laurel leaves, &c., is worthy of notice. The culture of the tea-tree has been introduced.~~

~~The prairies and steppes of both Northern Caucasia and Trans- caucasia are stocked witb live stock, and Caucasia hara 1,017,460 horses, 124,360 donkeys and mules, 5,883,000 homed cattle, 14,100,000 sheep, 960,000 swine, and 24,400 camels.~~

~~In their domestic trades many of the inhabitants of Caucasia, Including the mountaineers, attain a very high degree of perfec- tion, and their produce is mostly characterized by a high artistic taste. Carpets, woollen cloth, various goods made out of the finest goat wool, and the burkas, or Circassian fur cloaks, are among the chief items. Next come various goods made out of wood and metals (small-arms in Daghestan, chiselled silver work at~~

~~Akhaltsykh, &c.), of leather (saddlery, decorated girdles, &o.), and also the making of various sorts of oil, and so on.~~

;

~~North~~

~~Trans-~~

~~*1896.*~~

~~*Caucasia.*~~

~~*caiicaBia.*~~

~~*A. White Race.*~~

~~*I. Indo-Europeans.*~~

~~*Slavonians: Russians ....*~~

~~*2,795,122*~~

~~*122,257*~~

~~*Poles ....*~~

~~*10,598*~~

~~*3,735*~~

~~*Germans*~~

~~*25,267*~~

~~*9,356*~~

~~*Romans (French, Moldavians) . Greeks*~~

~~*1,224 55,507*~~

~~*Iranians: Persians ....*~~

~~*‘2,381*~~

~~*10,687*~~

~~*Tates, Talyshins .*~~

~~175,193~~

~~Ossets~~

~~90,000~~

~~76,445~~

~~Kurds~~

~~100,043~~

~~Armenians~~

~~31,525~~

~~239,131~~

~~Hindus (Tsiganes) ....~~

~~..~~

~~725~~

~~//. Semites.~~

~~Jews~~

~~7,812~~

~~34,386~~

~~Aisors (Chaldeans) ....~~

~~2,372~~

~~III. Caucasians.~~

~~1. Kartvelians or Iberes:~~

~~*(a) Georgians:*~~

~~*Georgians proper .*~~

~~*4,473*~~

~~*381,208*~~

~~*Tushins, Pshaves, Khev-*~~

~~*zurs, and Mtiulians*~~

~~*23,663*~~

~~*Imeretians*~~

~~*423,201*~~

~~*Gurians ....*~~

~~*76,095*~~

~~*Ajars, Enghilois*~~

~~*68,343*~~

~~*(6) Mingrelians*~~

~~*213,030*~~

~~*(c) Lazes*~~

~~*1,781*~~

~~*(d) Svanetians ....*~~

~~*14,035*~~

~~*2. Western Mountaineers : Abhazes .*~~

~~*60,445*~~

~~*Kabardians, &c.*~~

~~*183,516*~~

~~*3,971*~~

~~*3. Eastern Mountaineers :*~~

~~*Chechens*~~

~~*282,504*~~

~~*917*~~

~~*Lezghian branches :*~~

~~*Avars and Andians group*~~

~~*194,918*~~

~~*Dargo group ....*~~

~~*123,756*~~

~~*Kyurin ,,....*~~

~~*173,328*~~

~~*Undetermined kinship with the*~~

~~*above groups*~~

~~*96,731*~~

~~*Udines*~~

~~*7,301*~~

~~*B. MoKGOLiAN Race.*~~

~~*/. Turkish Stem.*~~

~~*Azerbaijan Tatars ....*~~

~~*1,139,659*~~

~~*Turks*~~

~~*70,226*~~

~~*Turkomans*~~

~~*8,893*~~

~~*Karapapakhs (Black Bonnets) .*~~

~~*24,134*~~

~~*Nogais*~~

~~*46,000*~~

~~*2,556*~~

~~*Trukhmens (Turkomans?) .*~~

~~*19,000*~~

~~*Kumyks*~~

~~*3i,519*~~

~~*60,838*~~

~~*//. Mongols.*~~

~~*Kalmycks*~~

~~10,000~~

~~III. Finnish Stems.~~

~~Esthonians, Mordovians~~

~~• • •~~

~~1,382~~

~~Total .~~

~~3,519,717~~

~~4,020,472~~

~~Total, Caucasus .~~

~~7,540,189~~

~~The mining industry is rapidly growing in importance. Copper ore is extracted in the governments of Tiflis, Elisabethpol, Kutais, and Erivan (85,000 tons of ore, 2700 tons of copper in 1897); silver ore in Terek, KubafI, and Kutais (8500 tons) ; iron ore in Elisabethpol to a small extent ; and manganese ore in Kutais (230,000 tons); also some cobalt, sulphur, and quicksilver. The extraction of coal in Kubail and Kutais is still in its infancy (22,000 tons). Naphtha, on the contrary, is obtained in very large and ever-growing quantities (6,854,000 tons in Baku, 295,000 tons in Terek, 2320 tons in Kubafi, and 460 tons in Tiflis and Daghestan). About 241,000 tons of rock salt in Erivan and Kars, and from 10,000 to 18,000 tons of lake salt, are extracted every year.~~

~~The industries are represented by 26,811 factories and workshops,~~

~~giving occupation to 91,289 persons and yielding a yearly produc- tion valued at £6,832,800.~~

~~The schools in Caucasia were in 1897 : fourteen gymnasia and progymnasia for hoys (6196 pupils) and twenty for girls (7247), 10 Bealschulen (3176), five schools for teachers (389), four town (732), five mountaineers (638), three marine (181), fourteen pro- fessional schools (987), and 160 private schools (7272 pupils). For primary education there were 1380 schools (88,182 pupils), all under the Ministry of Public Education. There were, besides, nine- teen secondary and 1308 primary schools kept by Cossacks and under other departments, and having an aggregate of 42,671 boys and 13,520 girls. In the Mussulman and Jewish schools there were 2235 and 1360 pupils respectively.~~

~~Caucasia has two main lines of railways, both running N.W. to S.E., in the N. and in the S. of the Caucasus range. The former, starting at Rostov on the Don, runs to Vladikavkaz (402 miles), and thence to Petrovsk on the Caspian Sea (180 miles), whence it has been continued along the sea-coast, vi& Derbent, to Baku (234 miles). One branch connects the Tikhoryetskaya station of this line with Novorossiysk on the Black Sea (168 miles), and is continued north-eastwards to Tsaritsyn on the Volga (333 miles); two others connect the watering-towns Kislovodsk and Pyatigorsk with the main line. A third branch to Kizlyar is being built. The Transcaucasian line, connected with the first- named at its far-eastern end only, i.e., at Baku, begins at Batura and Poti on the Black Sea and runs, through the Suram tunnel, to Tiflis and past Elisabethpol to Baku (400 miles from Batum). It has small branches to Kutais, to Tkvibuli coal-mines, to Chiaturi and Barkweti, to Stavropol, with the main line at Kavkazskaya station (96 miles), and to Borzhom, while a line of great strategic importance has been built from Tifiis to Kars (185 miles).~~

~~The Transcaucasian line and Tiflis can thus only be reached by rail on a very circuitous line mS Baku. The usual way of com- munication is by post-horses from Vladikavkaz to Tifiis, m& the Darial gorge. A road has been made from Vladikavkaz to Kutais viS. the Mamisson Pass. The other passes across the Caucasus (see above) are mere bridle-paths.~~

~~*The chief ports of Caucasia are Batum, Poti, Novorossiysk, and Sukhum on the Black Sea, Baku and Petrovsk on the Caspian. The exports from the Black Sea ports reach about 60,000,000 roubles (£6,000,000), and consist chiefiy of naphtha, manganese ore, linseed, raw silk and wool, liquorice root, corn, salt, and timber. The chief imports, about £1,000,000 worth, are tin and cheap timber (for naphtha boxes), iron, steel, tin, lead, chemicals, glass, china, and machinery. The maritime trade with Persia averages yearly £850,000 worth for the exports (naphtha, cottons, metals) and £760,000 for the imports (rice, carpets, dried fruit), to which items those of the inland trade with Persia (about £400,000 of imports and £100,000 of exports) have to be added. The internal trade of Caucasia with Russia is very considerable both by land and by sea. The ports of Caucasia were visited in 1892 by 1165 foreign ships and 4073 engaged in cabotage.*~~

~~*For the administrative subdivisions of Caucasia, see Russia.*~~

~~*Authorities. — The literature of the Caucasus is immense. The best general description in a West European language is, according to Stebnitsky and Masalsky, that of ELisf;E Reclus in Geographie Vniverselle (English version by Kbane), to which Gen. Stebnitskt has made most careful annotations in the Caucasian Zapiski. There may also be mentioned now, by way of supplementing the list of works quoted in the ninth edition : Frbshfield and others. The Exploration of the Caucasus. 2 vols. London and New York, 1896.— V. Sella and D. Vallino. N'el. Caueaso Centrale. Turin, 1890. — Abich. Geologische Forschungen. — G. Radde. Vier Vortrage. 1874. — E. Chantke. Secherches Anthropologiques dans le Caucase. 1885-87.— R. Ebckert. Der Caucasus und seine Volker. 1885.— Articles " Caucasus," &c., in Semenoff's Geo- graphical Dictionary (Slovar), and in Busskiy Encyclopedicheskiy Slovar (1894), by V. Mosalsky, Miller, &c. ; Zhivopisnaya Bossiya, vol. ix. ; also by Litvioropp, Protsenko, V. Krivenko, Nadezhdin, Egiazakoff (institution), O. Miller and M. Kovalevsky (ancient law). — The Zapiski and the Izvestia of the Caucasian and the Russian Geographical Societies and Sbornik Materialov are mines of information, while the Kavkasskiy Kalendar, published every year at Tifiis, contains, besides recent statistics and maps, full bibliographical indexes (also lately in the St Petersburg /0»es*~~

~~(p. A. K.)~~

~~Caudebec-lds-Elbeuf, a French town, in the arrondissement of Eouen, department of Seine Inferieure, 12 miles S. by W. of Eouen, on railway to Louviers. It is practically a suburb of Elbeuf, and has important manu-~~

~~factures of cloth and wool-spinning. Population (1881),~~

~~11,290; (1901), 6981.~~

~~Caudry, a town and railway station of Trance, in the department of Nord, arrondissement of Cambrai, 39 miles in direct line S.S.E. of Lille. It has important manufactures of tulle and lace: others are muslin, guipure, chicory, and sugar. Population (1881), 4956 ;~~

~~(1901), 9934.~~

~~Caulfleld, a borough (created 13th April 1901) of Victoria, Australia, in the county of Bourke, 7^ miles E. of Melbourne, with which it is connected by rail.' It has a fine racecourse, the headquarters of the Victorian Amateur Turf Club. Population (1891), 8006 ; (1901),~~

~~9607.~~

~~Cautin, a province of southern Chile, situated between 38° 25' and 39° 35' S. lat., 71° 00' and 73° 25' W. long. Its area is 3120 square miles. The population in 1895 was 78,221. It is divided into two departments, Temuco and Imperial. In 1898 there were 1837 births, 456 marriages, and 1510 deaths. Temuco is the capital.~~

~~Cava del Tirreni, a town, bishop's see, and summer resort of the province of Salerno, Campania, Italy, 6 miles N.W. from Salerno by the railway to Naples. Population, about 16,250.~~

~~Cavagnari, Sir Pierre Louis Napoleon~~

~~(1841-1879), British military administrator, was by birth a Frenchman, being the son of a French gen- eral by his marriage with an Irish lady, and was born at Stenay, in the department of the Meuse, 4th July 1841. HIe~~

~~*nevertheless obtained naturalization as an Englishman and entered the military service of the East India Com- pany. After passing through the college at Addiscombe, he served through the Oudh campaign against the muti- neers in 1858 and 1869. In 1861 he was appointed an assist- ant commissioner in the Punjab, and in 1877 became deputy commissioner of Peshawar, and took part in sev- eral expeditions against the hill tribes. In 1878 he was attached to the staff of the British embassy to Kabul, which the Afghans refused to allow to proceed. In May 1879, after the death of the Amir Sher Ali, Cavagnari negoti- ated and signed the treaty of Gandamak with his successor Yakub Khan. By this the Afghans agreed to admit a British resident at Kabul, and the post was conferred on Cavagnari, who also received the Star of India and was made a K.C.B. He took up his residence in July, and for a time all seemed to go well, but on 3rd September Cava- gnari and the other European members of the embassy were massacred in a sudden rising of mutinous Afghan troops. (See Afghanistan.)*~~

~~*Cavallotti, Felice (1842-1898), Italian politician, was born at Milan, 6th November 1842. In 1860 and 1866 he fought with the Garibaldian Corps, but first attained notoriety by his anti-monarchical lampoons in the Gazzetta di Milaiw and in the Qazzettina Rosa be- tween 1866 and 1872. Elected to Parliament as deputy for Corteolona in the latter year, he took the oath of allegiance after having publicly impugned its validity. Eloquence and turbulent combativeness in and out of Parliament secured for him the leadership of the Extreme Left on the death of Bertani in 1886. During his twelve years' leadership his party increased in number from twenty to seventy, and at the time of his death his parliamentary influence was greater than ever before. Though ambitious and addicted to defamatory methods of personal attack which some- times savoured of political blackmail, Cavallotti's eloquent advocacy of democratic reform, and apparent generosity of sentiment, secured for him a popularity surpassed by*~~

~~*that of no contemporary save Crispi. Services rendered in the cholera epidemic of 1885, his numerous lawsuits and thirty three duels, his bitter*~~

~~*campaign against Crispi, and his championship of French interests, combined to enhance his notoriety and to increase his political influ ence. By skilful alliances with the marquis di Eudini he more than once obtained practical control of the Italian Government, and exacted notable concessions to Radical demands. He died on 6th March 1898, the House of Savoy losing a relentless foe and the revolu- tionary elements in Italy a gifted, if not entirely trust- worthy, leader. (h. w. s.)*~~

~~*Cavalry. — The derivation of the word cavalry is quaintly given in the oldest English work which deals exclusively with the subject: "Cavalrie, so called of Cavallo, which in the Italian and Spanish signifieth a horse, derived from the Latin word Caballus, and this from the Greek, KajSoXATjs." Ideal cavalry consists of a body of trained and disciplined horsemen, mounted on sound and well-broken horses, under the command of efficient officers. The weapons of cavalry are now, almost universally, a magazine carbine, sighted to about 2000 yards, and I'arme blanche, that is, the sword and the lance, although the use of the latter weapon is not general in all cavalry in all European armies. The rSle of cavalry is in the ofEensive : it supplies the eyes and ears of the army ; it acts as a veil to screen the disposition of its comrades of other arms, as was well illustrated by the Germans in the campaign of 1870; and it serves as a hammer to clinch a victory and turn the retreat of a shaken foe into a disastrous rout. Murat's pursuit of the Germans after Jena is a brilliant example of this form of cavalry action. It forms a shield and sometimes a scape- goat to sacrifice itself, so that time may be gained to enable other arms to rally or retreat, as was shown by the Austrian cavalry at Koniggratz, and by the French at Worth and at Sedan. Napoleon lays down as a maxim that " it is the business of cavalry to follow up the victory and to prevent the beaten enemy from rallying," and this is the keynote of the action of victorious cavalry on a stricken field. Another golden rule which has to be im- pressed on every trooper is that with " the enemy once found touch must never be lost." Denison, in his History of Cavalry, quotes Murat's pursuit of the retreating Rus- sians beyond Moscow, when h.e resolutely set his face towards Asia in spite of every discouragement, as one of the grandest examples that history records.*~~

Improvements in the firearms of the present day have rendered a successful cavalry charge upon unshaken infan- try only possible under abnormal conditions, and it is in taking advantage of cover, and in seizing the fleeting oppor- tunities of surprise, that the cavalry charge will depend for great results. It was the sudden and unexpected charge . of Kellerman's cuirassiers at Marengo that turned the triumphant advance of the Austrians into a rout of far- reaching and disastrous consequences, and there may yet occur chances of successful enterprise of this description for well-trained cavalry under a bold and vigilant com- mander, though such golden opportunities seem likely to be few and far between. At the same time, the very improvements in firearms that make the charge difficult have conferred on cavalry an independence and self- reliance hitherto unknown. Associated with mobile horse artUlery, galloping quick-firing guns, machine-guns, and perhaps mounted infantry and cyclists, cavalry should now be able to travel far and fast, and, so long as supplies are forthcoming, to render itself to some degree independ- ent of the slow-moving infantry ; thus rapid raids may be carried out, as was so well done in the American war by both Federals and Confederates, and positions may be

seized and turning movements effected that were formerly impossible. The German uhlans in 1870, whose only firearm was a pistol, were constantly checked by French franc-tireurs, and were obliged to await the arrival of supporting infantry before they could advance. This could hardly occur nowadays.

The individual cavalryman should be able to ride and shoot, to find his way across country, to scout in such a way as to see without being seen, and to report intelli- gently what he has seen, to shift for himself and for his horse under all conditions, and last, but not least, to be master of his weapons. Intelligent, active, healthy men who can do all this are the right material for cavalry. The recruit having been medically passed, is y^^,^, put through a course of gymnastics, at the ^'

same time being taught to groom his horse and to clean his kit. Riding and foot-drill follow; he is taught the sword, lance, and carbine exercises, and how to perform the various and complicated evolutions of increasing and diminishing the front, &c., which still obtain in Great Britain, though much

simplified in other countries. In about six months he should be thoroughly trained on foot. He also goes through a recruit's musketry train- ing during his first year, consisting of preliminary drills, practices, and lectures, followed by the firing of 200 rounds at a target. After this he becomes a trained soldier, and as such undergoes an annual course of squadron training, riding, and musketry. There are, be- sides, special courses open to such men as are selected as suitable in pioneering, horse-shoeing, cooking, saddling, sketching, signalling, first aid to wounded, and working the machine-gun, as well as a voluntary school of ele- mentary education. Squadron training is a course of instruction under the squadron commander which lasts about two months every year, in which the soldier should be thoroughly taught his duties in the field and camp ; in fact, made efficient for war.

The whole secret of teaching a man to ride is to give him confidence, without which he will never develop into a dashing horseman. Every endeavour should be made to raise the pupil's courage, and care taken never to damp it; experience shows that the recruit who has been allowed to use his stirrups and to cling to his wallets or saddle with all his might, until he has gained the art of balance and acquired confidence, wUl very soon be proud to ride with crossed stirrups, loose reins, and folded arms. Lessons should not exceed an hour, and half an hour with crossed stirrups is ample. All work should be gradual : first the walk, then the trot, then the canter. The details of the ride wiU be found in Cavalry Drill, 1898, page 36. Briefly, the recruit will learn the turns, circles, inclines, bending lesson, passaging, &c., finally jumping and post practice. In four months he should begin to learn to wield his weapons — ^to cut, thrust, and guard sword exercise, pursuing practice, lance exercise, &c. In six months he should be fit to take his place in the ranks.

*The young horse on arrival in barracks is examined by the veterinary surgeon, and if free from contagious disease is sent to the stable set apart for the young horses, where he is put on soft food and given °"**' gentle exercise, being quietly led about for the first six weeks until he has sufficiently improved in condition to commence his training. This consists of steady lunging on a cavesson for about a fortnight for ten minutes to half an hour a day until he gets his paces. In addi- tion he must be regularly*

~~*exercised for an hour a day. He will then be quietly saddled, and next mounted and dismounted, then led round on a cavesson with a man on his back, and then ridden without cavesson at a walk, then a trot. He is gradually taught to bend, to rein back,*~~

~~*to passage, and to make the turns and circles ; after this he will be taught to canter. All this having been done on the bridoon or snafle-rein, he will now be bitted, steady straightforward work being done for about a fort- night, so as not to spoil his mouth. The drill of the ride is gradually taken up, and the horse is accustomed to carry the sword and the carbine bucket. After about six months' training he should be taught to jump, first of his own accord without a rider, and then mounted. He must be trained to stand fire, and after about eight months to go down the heads and posts. Finally, he may work with the other young horses in the field; and after twelve months he should be fit to take his place in the ranks, as a five- or six-year-old, as the case may be. An article in the "Badminton Library" volume on Biding, by Captain Robert Weir, gives an excellent description of how to train young horses. Throughout his training the horse must he encouraged, lessons being short, and everything done as quietly and gently as possible. " Never act with anger towards a horse is the first and best precept that can be impressed upon the mind." Xenophon wrote this twenty-three centuries ago, and it is as true now as it was in his time.*~~

~~*Generally speaking — for war naturally creates an excep- tion— the supply of troop horses for the British cavalry comes principally, but by no means exclusively, from Ireland. They are bought at ages of from rising 4 to 7 (usually rising 4 to 5 and imtrained) ; their height ranges from 16"2 to 16 hands, and the price paid is, as a rule, from £30 to £40. The remount department, with which the horse supply rests, consists of the inspector-general of lemounts, 3 assistant purchasing officers, 2 staff captains who have charge of the remount depots at Woolwich and Dublin, 2 captains and quartermasters of the Army Ser- vice Corps who deal with forage, &c., and three veterinary surgeons. The horses are sent direct to their destined regiments, or temporarily retained at one of the two remount depots at*~~

Woolwich or Dublin. Por purposes of supply in time of war there is a system of registration which was introduced by General EavenhUl in 1892, by which a retaining fee of 10s. per horse per annum is paid to owners on condition that they produce the horse at forty-eight hours' notice, or render themselves liable to a fine of £50. The price at which each horse is to be bought, if taken, is arranged between the owner and inspector from year to year; the agreement may be terminated at six months' notice on either side. For purposes of registration Great Britain and Ireland are divided into fifty districts, to each of which a veterinary surgeon is attached. It is estimated that there are 3,000,000 horses in the British isles. Selected officers are also sent to foreign countries for the purchase of remounts when occasion demands. With regard to the supply of horses to foreign armies, some are obtained by purchase as in England, but many are bred at the Government haras or breeding establishments. Horses are, as a rule, well trained before being sent to their regiments, a system which prevents men from being taken from the ranks in order to break the young horses.

The same organization of cavalry holds good, with few •exceptions, throughout the great military nations of the world. A cavalry division consists of 2 bri- organiza- ga^es ; a brigade of 2 regiments (3 in the case of ""■ England) ; a regiment of 4 to 6 service squad-

rons and a depot squadron. In the British army there are only 3 service and 1 depot squadrons, and an English cavalry regiment meeting a foreign regiment in the field would consequently be outnumbered by from 150 to 450 The tactical unit is the squadron, which consists

men.

as a rule of 150 men, and is divided into four troops of xoughly from 25 to 35 men, and each troop is divided

into three or four sections. The war establishment of an English cavalry brigade consists of the following : —

Staff — 1 officers, 17 warrant N.C.O.s, and 19 men.

3 Cavalry regiments — 75 officers and 1518 men, 3 macMne guns.

~~*1 Battery E.H.A. — 6 officers, 176 men, 6 guns. Ammunition column — 4 officers, 106 men.*~~

~~*2 Companies mounted infantry — 12 officers, 294 men, 2 machine guns.*~~

~~*Supply column — 5 officers, 120 men.*~~

~~*Bearer company — 3 officers, 94 men.*~~

~~*Field hospital — 5 officers, 86 men.*~~

~~*Total, 114 officers and 2.383 men.*~~

~~*2448 Horses, of which 9 are pack and 556 draught.*~~

~~*82 Two-horse vehicles, including 5 machine guns.*~~

~~*82 Four-horse vehicles.*~~

~~*22 Six-horse vehicles, including 6 E.H. A., guns.*~~

~~*Although the squadron system obtains throughout Europe, there are of course details of equipment which vary in different armies. Thus the Germans since the war of 1870 have armed the whole of their cavalry with lances, using hoUow steel instead of ash or bamboo poles. The Austrians, on the other hand, since 1886 have abol- ished the lance ; and the French have no lancers, but the front rank of their dragoons carry lances. In Great Britain, besides the regular lancer regiments, the front ranks of dragoon guards and dragoons are also armed with lances. The Russians have two lancer regiments of the guard, and vast numbers of Cossack lancers, but the 66 dragoon regiments of the line which form the main body of the Russian regular cavalry are armed with long rifles and bayonets. The Italians arm their first 10 regi- ments with lances. The remaining Italian cavalry carry carbines with a light bayonet, which when not wanted is inverted over the cleaning-rod. The French supplement their cavalry with infantry cyclists, using the folding cycle invented by their commander, Major Gerard. The ma- chine can be folded up and slung on the back in thirty seconds. It is claimed by the French that the cycle has proved its usefulness for military*~~

purposes, and that wherever the roads are good and the country suitable it will play an important part in future wars. Other nations are beginning to follow suit, all using cyclists as messen- gers whenever possible, to save their horses. The Berthon boat accompanies German cavalry. In Great Britain two companies of mounted infantry are attached to a cavalry brigade ; these are simply mounted riflemen, and are not expected to fight on horseback. A machine gun is attached to every British cavalry regiment and to each company of mounted infantry, but has not as yet been adopted by the cavalry of foreign nations. The French alone maintain the cuirass for war, unlike other nations who use it only for parade. The 13 regiments of cuirassiers are armed with straight swords, 47 inches long, and revolvers, and are also provided with 60 carbines per regiment. The Hungarian cavalry are all hussars. The Austrian cavalry consists of uhlans and dragoons. The Austrians supplement their cavalry with quick marching infantry, and 35 miles in a day is no unusual distance for Austrian foot to cover on manoeuvres. Signallers are trained to a great degree of proflciency in the British cavalry, but are little used by other nations. Automobiles and motors have been experi- mented with in both Austria and France for military pur- poses, and particularly for cavalry transport. The above are some of the points of difference of equipment that occur in the cavalry of Europe. Drill, except in the case of the Russian dragoons, is pr.actically the same throughout, the great desideratum being to make it as simple as possible.

Yeomanry. — The first idea of yeomanry appears in 1746, when the gentlemen of Yorkshire raised a royal regiment of hunters to fight against Prince Charles Edward. The idea was resuscitated at the end of the 18th century, when Great Britain was in dread of an invasion by Napoleon.

The British yeomanry force now numbers some 11,000 men, whose annual training lasts about ten days a year. With so short a training great results are not to be expected, but it is wonderful how much is accomplished in the time, and men and horses are excellent. The Im- perial Yeomanry employed

~~*in South Africa consisted of men specially enlisted for one year, or until the end of the war, to act as mounted infantry. (See also under Armies.) (w. a. t.)*~~

~~*Cavan, an inland county of Ireland, province of Ulster.*~~

~~*Population. — The area of the administrative county in 1900 was 497,025 acres, of which 132,391 were tillage, 261,104 pasture, 127 fallow, 5281 plantation, 13,493 turf-bog, 4685 marsh, 12,375 barren mountain, and 37,569 water, roads, fences, &c. The new adminis- trative county under the Local Government (Ireland) Act, 1898, is identical with the old judicial county. Population (1881), 129,476 ; (1891), 111,917 ; (1901), 97,368, of whom 49,982 were males and 47,386 females, divided as follows among the different religions : — Roman Catholics, 78,921 ; Protestant Episcopalians, 14,095 ; Pres- byterians, 3256 ; Methodists, 981 ; other denominations, 115. The decrease of population between 1881 and 1891 was 13-56. The average number of persons to an acre was -23. The follovring table gives the degree of education in 1891 : —*~~

~~*Males.*~~

~~*Females.*~~

~~*Total.*~~

~~*Percentage.*~~

~~*B.C.*~~

~~*Pr. Epis.*~~

~~*Preab.*~~

~~*Read and write Read only . . Illiterate . .*~~

~~*86,866 5,873 8,591*~~

~~*35,391 6,920 7,692*~~

~~*72,257 12,798 16,283*~~

~~68-8 13-6 18-1~~

~~82-9 8-9~~

~~8-2~~

~~87-9 7-8 4-8~~

~~In 1881 the percentage of illiterates among Eoman Catholics was 25-2. In 1891 there were 7 superior schools, with 150 pupils (67 Roman Catholics and 83 Protestants), and 295 primary schools, with 17,314 pupils (13,879 Roman Catholics and 3435 Protestants). The number of pupils on the rolls of the national schools on 30th September 1899 was 18,953, of whom 15,248 were Roman Catholics and 3705 Protestants. The following table gives the numbers of births, deaths, and marriages in various years : —~~

~~Tear.~~

~~Births.~~

~~Deaths.~~

~~Marriages.~~

~~1881 1891 1899~~

~~3099 2148 2003~~

~~2091 1826 1472~~

~~328 377 376~~

~~In 1899 the birth-rate per 1000 was 17-9, and the death-rate 13‘2 ; the rate of illegitimacy was 1-5 per cent, of the total births. The total number of emigrants who left the county between 1st May 1861 and 31st December 1899 was 110,468, of whom 56,084 were males and 64,384 females. The following are the chief towns in the county, with their populations in 1891 : — Cavan, 2968 ; Bel- turbet, 1675 ; Cootehill, 1593.~~

~~*Administration. — The county is divided into two parliamentary divisions. East and West, the number of registered electors in 1900 being respectively 9372 and 9944. The rateable value in 1900 was £278,596. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury and (to a less extent) of other bodies were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises 2 urban and 7 rural sanitary districts.*~~

~~*Agriculture. — The following tables show the acreage under crops (including meadow and clover), and the amount of live stock, in 1881, 1891, 1895, and 1900 :—*~~

~~*Wheat.*~~

~~*Oats.*~~

~~*Barley,*~~

~~*Beans,*~~

~~*etc.*~~

~~*Potatoes.*~~

~~*Turnips.*~~

~~*Other Green Crops.*~~

~~*Meadow*~~

~~*and Clover.*~~

~~*Flax.*~~

~~*Total.*~~

~~*1881 1891 1895 1900*~~

~~*379 474 270 504*~~

~~*46,856 39,647 84,970 30,849*~~

~~*91*~~

~~*215*~~

~~*69*~~

~~*79*~~

~~*26,866 26,989 24,781 23,664*~~

~~*2915 8421 8551 2921*~~

~~*2083 8181 2860 3028*~~

~~*60,688 70,167 70,030 70,687*~~

~~*8807 8332 4944 1219*~~

~~*148,169 147,376 141,475 182,391*~~

~~*For 1899 the total value of cereal and other crops was estimated by the Registrar-General at £906,713. The number of acres under pasture in 1881 was 246,441, and in 1900, 261,104.*~~

~~*Horses and Mules.*~~

~~*Asses.*~~

~~*Cattle.*~~

~~*Sheep.*~~

~~*Pigs.*~~

~~*Goats.*~~

~~*Poultry.*~~

~~*1881 1891 1895 1900*~~

~~*11,508 13,805 14,017 13,258*~~

~~*8131 8798 9242 9870*~~

~~*104,797 121,243 117,438 121,908*~~

~~*14,859 25,634 18,251 25,562*~~

~~*34,758 51,084 51,797 66,171*~~

~~*15,442 20,342 18,681 18,284*~~

~~*510,818 594,589 649,093 787,820*~~

~~*The number of milch cows in 1891 was 45,224, and in 1900, 45,903. It is estimated that the total value of cattle, sheep, and pigs in 1899 was £1,650,243. In 1900 the number of holdings not exceed- ing 1 acre was 1169 ; between 1 and 5, 1447 ; between 5 and 15, 6916 • between 15 and 80, 6913 ; between 30 and 50, 2471 ; be- tween 50 and 100, 931 ; between 100 and 200, 222 ; between 200 and 500 46; and above 500, 6— total 20,121. The number of loans issued (the number of tenants being the same as the number of loans) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March, 1900, was 1854, amounting to £335,831. The number of loans sanctioned for agricultural improvements under sect 31 of the Land Act, 1881, between 1882 and 1900, was 703, and the amount issued was £40,327. The toUl amount issued on loan for all classes of works under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1900, was £55,690. (w. H. Po.)*~~

~~*Cavendish, George (1500-1562?), the biographer of Cardinal Wolsey, was the elder son of Thomas Caven- dish, clerk of the pipe in the exchequer, and his wife, Alice Smith of Padbrook Hall. He was probably bom at his father's manor of Cavendish, in Suffolk. Later the family resided in London, in the parish of St Alban's, Wood Street, where Thomas Cavendish died in 1524.*~~

~~Shortly after this event George married Margery- Kemp, of Spains Hall, an heiress, and the niece of Sir Thomas More. About 1527 he entered the service of Qardinal Wolsey as gentleman-usher, and for the next three years he was divided from his wife, children, and estates, in the closest personal attendance on the great man. Cavendish was wholly devoted to Wolsey's interests, and also he sax in this appointment an oppor- tunity to gratify his master-passion, a craving _" to see and be acquainted with strangers, in especial with men in honour and authority." He was faithful to his master in disgrace, and showed the courage of the "loyal servitor." It is plain that he enjoyed Wolsey's closest confidence to the end, for after the cardinal's death George Cavendish was called before the Privy Council and closely examined as to Wolsey's latest acts and words. He gave his evidence so clearly and with so much natural dignity, that he won the applause of the hostile council, and the praise of being "a just and diligent servant." He was not allowed to suffer in pocket by his fidelity to his master, but retired, as it would seem, a wealthy man to his estate of Glemsford, in West Suffolk, in 1630. He was only thirty years of age, but his appetite for being acquainted with strange acts and persons was apparently sated, for we do not hear of his engaging in any more adventures. It is not to be doubted that Cavendish had taken down notes of Wolsey's con- versation and movements, for many years passed before his biography was composed. At length, in 1557, he wrote it out in its final form. It was not, however, pos- sible to publish it in the author's lifetime, but it was widely circulated in MS. Evidently one of these MSS. fell into Shakespeare's hands, for that poet made use of it in his King Henry VIII., although it is excessive to say, as Singer has done, that Shakespeare " merely put Cavendish's language into verse." The book was first printed in 1641, in a garbled text, and under the title of TTie Negotiations of Tliomafi Wolsey. The genuine text, from contemporary MSS., was given to the world in 1810, and more fully in 1816. Until thattime it was believed that the book was the composition of George Caven- dish's younger brother William, the founder of Chatsworth, who also was attached to Wolsey. Joseph Hunter proved this to be impossible, and definitely asserted the claim of George. The latter is believed to have died at Glemsford in or about 1562. The intrinsic value of Cavendish's Life of Cardinal Wolsey has long been perceived, for it is the sole authentic record of a multitude of events highly im- portant in a~~

particularly interesting section of the history of England. Its importance as a product of biographical

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literature was first emphasized by the late bishop of London, Dr Mandell Creighton, who insisted over and over again on the claim of Cavendish to be recognized as the earliest of the great English biographers and an individual writer of particular charm and originality. He writes with simplicity and with a certain vivid pictur esqueness, rarely yielding to the rhetorical impulses which governed the ordinary prose of his age. (e. g.)

Cawnpore (Khanpuk), a city and district of Brit- ish India, in the Allahabad division of the North- West Provinces. The city is situated on the right bank of the Ganges, 417 feet above the sea; 684 miles by rail from Calcutta. In 1881 it had a population of 161,444 ; in 1891, of 188,712, showing an increase of nearly 26 per cent. In 1901 the population was 197,000, showing a further increase of 4 per cent. The municipal income in 1896-97 was Es.3,61,899. In 1897 the death-rate was 49-69 per thousand. The municipality, with a population of 163,779, is governed by a board of 24 members, of whom 22 are elected. The waterworks provide an annual supply of about 480 million gallons of filtered water, being 8 gallons a head daily, at a total cost of four annas per thousand gallons. In 1897-98 the chief items of expenditure were : Es.72,234 on water-supply, Rs.14,657 on drainage, and E.s.66,469 on other public works. The principal educational institutions are: the aided Christ Church College, with 36 students in 1896-97; the Government agricultural school for the province; industrial schools maintained by the S.P.G. and the American mission; and several high schools. There are 29 printing-presses, issuing 5 English and 6 vernacular newspapers. Besides Government manufac- tories of leather and flour, Cawnpore possesses 4 cotton- mills, having a total capital of Es.69,00,000, with 1638 looms and 230,000 spindles, employing more than 6000 hands, producing 26,000,000 lb of yarn and woven goods valued at Es.30,43,000 ; a woollen-mill, having a capital of Es.20,00,000, with 302 looms and

~~12,000 spindles, employing 1500 hands, producing all kinds of goods valued at Es.15,35,000 ; a jute-mill, having a capital of Es.3,75,000, with 73 looms and 1574 spindles, employing 345 hands ; two flour-mills, employing 132 hands, with an out-turn valued at Es.9, 70,000 ; foui; large tanneries and leather factories ; a small iron-foundry ; and factories of ice and mineral waters. Cawnpore is also a great railway centre, where the lines of the East Indian, the Oudh and Eohilkhand, the Indian Midland, and the Eajputana railways all meet. Since 1875 the Ganges has been crossed by an iron girder bridge of 25 spans, superseding the former bridge of boats. The can- tonments, to the east of the native quarter, contain accommodation for a battery of artillery, a European and native infantry regiment, and a native cavalry regiment.~~

~~The district of Cawnpoke has an area of 2363 square miles. It had a population in 1881 of 1,181,396, and in 1891 of 1,209,696, showing an increase of 2 per cent., and an average density of 612 persons per square mile. In 1901 the population was 1,259,243, showing a further increase of 4 per cent. The land revenue and rates were Es.24,47,361, the incidence of assessment being R.l : 6: 7 per acre ; the cultivated area in 1896-97 was 737,218 acres, of which 241,883 were irrigated; the number of police was 3606 ; the number of vernacular schools in 1896-97 was 140, with 6435 pupils ; the registered death-rate in 1897 was 41-15 per thousand. The district is watered by four branches of the Ganges canal, and traversed by two lines of railway. There are 98 indigo factories, employ- ing 5000 persons, with an out-turn valued at Es.8,84,000, and sugar-works with an out-turn valued at Es.3,00,000.~~

~~Cayley, Arthur (1821-1896), English mathema- tician, born at Eichmond in Surrey, 16th August 1821, was the second son of Henry Cayley, a Eussian mer- chant, and Maria Antonia Doughty. Mr. Henry Cayley retired from business in 1829 and settled in Blackheath, where Arthur was sent to a private school kept by the Eev. G. B. F. Potticary; at the age of fourteen he was transferred to King's College School, London. He soon showed that he was a boy of great capacity, and in par- ticular that he was possessed of remarkable mathematical ability. On the advice of the' school authorities he was entered at Trinity College, Cambridge, as a pensioner. He was there coached by William Hopkins of Peterhouse, was admitted a scholar of the~~

~~college in May 1840, and graduated as Senior Wrangler in 1842, and obtained the first Smith's Prize at the next examination. In 1842, also, he was elected a Fellow of Trinity, and became a Major Fellow in 1845, the year in which he proceeded to the M. A. degree. He was assistant tutor of Trinity for three years. In 1846, having decided to adopt the law as a profession, he left Cambridge, entered at Lincoln's Inn, and became a pupil of the conveyancer Mr Christie. He was called to the Bar in 1849, and remained at the Bar fourteen years, till 1863, when he was elected to the new Sadlerian Chair of Pure Mathematics in the University of Cambridge. He settled at Cambridge in the same year, and married Susan, daughter of Eobert Moline of Greenwich. He continued to reside in Cambridge and to hold the professorship till he died, 26th January 1895. From the time he went first to Cambridge till his death he was constantly engaged in mathematical investigation. The number of his papers and memoirs, some of them of considerable length, exceeds 800 ; they were published, at the time they were composed, in various scientific journals in Europe and America, and are now embodied, through the enterprise of the syndics of the Cambridge Univer- sity Press, in thirteen large quarto volumes. These form an enduring monument to his fame. He wrote upon nearly every subject of Pure Mathematics, and also upon Theoretical Dynamics and Spherical and Physical Astron- omy. He was quite as much a geometrician as he was an analyst. Among his most remarkable works may be men- tioned his ten Memoirs on Quantics, commenced in 1854 and completed in 1878 ; his creation of the Theory of Matrices ; his researches on the Theory of Groups ; his Memoir on Abstract Geometry, a subject which he cre- ated ; his introduction into geometry of the " Absolute " ; his researches on the higher singularities of curves and surfaces ; the classification of cubic curves ; additions to the Theories of Eational Transformation and Corre- spondence ; the theory of the twenty-seven lines that lie on a cubic surface ; the theory of elliptic functions ; the attraction of ellipsoids ; the British Association Eeports, 1857 and 1862, on recent progress in general and special theoretical dynamics and on the secular acceleration of the moon's mean motion. He is justly regarded as one of the greatest of mathematicians. Competent judges have compared him to Euler for his range, analytical power, and introduction of new and fertile theories. He was the recipient of nearly every academic distinction that can be conferred upon an eminent man of science. Amongst others may be noted honorary~~

degrees by the universities of Oxford, Dublin, Edinburgh, Gottingen, Heidelberg, Leyden, and Bologna. He was Fellow or foreign corresponding member of the French Institute, the Academies of Berlin, Gottingen, St Petersburg, Milan, Rome, Leyden, Upsala, and Hungary ; and he was nominated an of&cer of the Legion of Honour by Presi- dent Carnot. At various times he was President of the Cambridge Philosophical Society, of the London Mathematical Society, and of the Eoyal Astronomical

Society. He was elected a Fellow of the Eoyal Society in 1852, and received from that body a Eoyal Medal in 1859 and the Copley Medal in 1882. He also received the De Morgan Medal from the London Mathematical Society, and the Huyghens Medal from Leyden. His nature was noble and generous, and theuniveAal apprecia- tion of this fact gave him great influence in his university. His portrait, by Lowes Dickinson, was placed in the hall of Trinity College in 1874, and his bust, by Henry Wiles, in the library of the same college in 1888. (p. a. m.)

Ceara, an Atlantic state of Brazil, situated between 2° 45' and 7° 11' S. lat., and 36° 45' and 41° 15' W. long. Its area is 40,253 square miles. The population in 1872 was 721,086, and in 1890 was 805,687. The capital, Fortaleza, has 48,000 inhabitants. Amongst the other towns are Aracaty (18,000 inhabitants), Barbalha, Cas- cavel, Crato, Granji, led, Igatti, Quixeramobim, Sant' Anna, Quixad^, and San Bernardo das Russas. There are railways from the port of Camocim to Sobral (80 mUes), and from Fortaleza to Quixeramobim-Quixad^ (117 mHes).

Cebu, capital of the island of Cebu, Philippine Islands, beautifully situated on its eastern coast, a little north of the centre. Its port, formed by the islands of Mactan and Opon, is well protected from violent winds. The streets are wide and regularly laid out. The Govern- ment buildings are fair, and the church buildings very fine. It is an episcopal see, and the palace of the bishop, although small, is noted for its interior decorations. The

~~*Augustinian church is famous for its so-called miraculous image of Santo Nino. The Recoleto monastery and the seminary of San Carlos are worthy of mention. The cathedral was finished towards the end of the 18th century. There is a leper hospital in the outskirts of the town. Historically, Cebu is famous as the scene of Magellan's landing in 1521. A cross, said to be the identical one first erected by him, is still preserved in the cathedral. The great explorer lost his life in the neighbouring island of Mactan. The first Spanish settlement in the Philip- pines was established at Cebu in 1565, and from that year to 1671 it was the capital of the colony. Com- mercially, it is the third city of the Philippines. Its trade amounts to some' $3,000,000 (gold) annually. Hemp and sugar are the most important exports. Salt, pot- tery, and fabrics of silk, sinamay, hemp, and cotton are manufactured, and sugar sacks are woven in considerable quantity. In addition to the trade with foreign ports, an important domestic commerce is carried on with Manila, Bohol, Negros, and northern Mindanao. The language is Cebu-Visayan. Population, 24,000.*~~

~~*Cedar Creek,^a small branch of the North Fork of Shenandoah river, m a valley of Virginia, U.S.A. It is known in American history as the scene of a memorable battle, which took place on 9th October 1864, between the Union army under Sheridan and the Confederates under Early. The Confederates attacked at daybreak, effecting a surprise, and driving back the Union forces in confusion. Sheridan was at this time on his way back to his army from an absence in Washington, and reached the field in the midst of the rout. By his presence he stopped the retreat, the advancing Confederates were checked, and then, taking the offensive, the Union troops drove the Confederates from the field, gaining a complete victory. The losses on both sides were heavy. Those on the Federal side were 6000 in killed and wounded, and the Confederates admitted a loss of 3100.*~~

~~*Cedar Falls, a city of Blackhawk county, Iowa, U.S.A., on the Red Cedar river. Population (1890), 3469; (1900), 5319, of whom 863 were foreign-born.*~~

~~*Cedar Rapids, a city of Linn county, Iowa, U.S.A., situated in 41° 58' N. lat. and 91° 31' W. long., on Cedar river, in the eastern part of the state, at an altitude of 732 feet. It is the headquarters of the Bur- lington, Cedar Eapids,*~~

~~*and Northern railway, with its works, and is entered also by the Illinois Central, the Chicago and North- Western, and the Chicago, Milwau- kee, and St Paul railways, which make it an important transportation centre. The city has a fine water-power . in Cedar river, and its manufactures are extensive and varied. Coe College, a Presbyterian institution, was founded in 1881. In 1898 it had a faculty numbering ten, and was attended by 106 students, more than half of whom were women. Population (1880), 10,104 ; (1890), 18,020; (1900), 25,666, of whom 4478 were foreign-born and 230 were negroes.*~~

~~*Cefalu, a seaport town and bishop's see of Sicily, Italy, in the province of Palermo, on -a promontory on the N. coast, 42 miles by rail E. by S. of Palermo on the line to Messina. A bronze statue was erected here in 1894 to the Sicilian patriot Niccolo Botta. The people carry on sardine-fishing, and there is some trade. Popu- lation, about 16,000.*~~

~~*Ceglie, a town of the province of Lecce, Apulia, Italy, 23 miles W. from Brindisi. It produces olive oil, lime, and building stone. Population, about 14,000.*~~

~~*Cehegi n , a town of Spain, in the province of Muroia, with a population in 1897 of 11,366. It is situated on the right bank of the river Quipar. On the height styled Cabecieo de Roenas stood the Roman town of Begastri, from the ruins of which the inhabitants for centuries obtained the stone for their principal church, the house of Yanez Espin, and the convent of San Francisco, on whose walls can be seen the Roman inscriptions and designs. Spanish antiquaries believe the name Cehegin came from the Berber invaders of the 10th century, Zin- hagies or Sinhachie.*~~

~~*Celaenae, in ancient geography an important city of Phrygia, situated on the great trade route to the East. Its acropolis was considered by Alexander to be impreg- nable. Beneath it were the palace of 'Xerxes and the Agora, in or near which was the cavern whence the Marsyas, one of the sources of the Mseander, issued. According to Xenophon, Cyrus had a palace and large park full of wild animals at Celsense. The town was deserted when Apamea was founded.*~~

~~*Celebes, one of the four great Sunda Isles in the Dutch East Indies. Area, including the neighbouring islands (Sangir, Talaut, Saleyer, Buton, &c.), 77,865 square miles. The eastern part of the northern peninsula, Mina- hassa, consisting of volcanic rock with conglomerates and tufas, is separated by the Mongondo chain from the granitic diorite and gneiss of the western part (Boni chain), and the old eruptive rocks and slate of the Matin- ang and Oleida chains between Bwool and the Gulf of Tomini. The same (crystalline) slate occurs in Central Celebes, near Lake Posso, but, except in Minahassa, no volcanoes are found. The older sedimentary and erup- tive rocks are surrounded by Tertiary and Quaternary alluvium, clay, and coralline limestone, but Mesozoic formations are wanting. The south- western peninsula has a volcano, the Peak of Bonthain. P. and F. Sarasin are of the opinion that the northern and southern peninsulas originally formed separate islands which were united to Central Celebes about the end of the Mesozoic period. The variations in surface relief are in conformity*~~

~~*•with the geological structure. Minahassa consists of a plateau divided into smaller sections by volcanoes (highest Klabat, 6620 feet). In the west of the northern penin- sula the interior consists in part of plateaux of consider- able extent enclosed by the coast ranges. Near Lake Posso the mountains are higher ; the Tampiko massif has a height of nearly 5000 feet, the chains south and west of the lake have a general altitude of about 5450 feet, with peaks still loftier. In the southern peninsula two chains stretch parallel with the west and east coasts ; the former is the higher, with a general altitude of 3200 feet. In the south it joins the Peak of Bonthain, a volcanic mass as colossal as Etna, 10,088 feet high. An alluvial coast plain, 7 to 9 miles wide, stretches along the foot of the western chain, and between the two chains is the basin of the Walannae, flowing northwards into Lake Sidenreng. The orography of the eastern peninsula is still unexplored.*~~

~~*The rivers of the narrow mountainous peninsulas form many rapids and cataracts ; as the Tondino, draining the lake of the same name to Menado ; the Eano i Apo, flowing over the plateau of Mongondo to the Gulf of*~~

~~Amurang ; the Poigar, issuing from a still unknown lake of that plateau ; the Lombagin, traversing narrow caiions ; and the river of Boni, which has its outfall in the plain of Gorontalo, near the mouth of the Bolango or Tapa, the latter connected by a canal with the Lake of Limbotto. All these rivers are navigable by praus or rafts for only a few miles above the mouth. In Central Celebes, the Kodina flows into Lake Posso, and the Kalaena discharges to the Gulf of Boni ; the Posso, navig- able by blottos (canoes formed of hollowed tree-trunks), is the only river flowing from the lake to the Gulf of Tomini. The rivers of the southern peninsula, owing to the relief of the surface, are navigable to a somewhat greater extent. The Walannae flows into Lake Tempo, and, continued by the Jenrana (Tienrana), which discharges into the Gulf of Boni, is navigable for little boats ; the Sadang, with many affluents, flows to the west coast, and is navigable by sampans. The Jenemaja (Djenemadja) is a broad river, navigable far from the mouth (Weber and Wichmann).~~

~~The coasts of Celebes consist of alluvium-and of Tertiary strata (except where older rocks reach the coast) ; they are often fertile and well populated ; but, as shown by the marine charts, many sand, mud, and stone banks lie near the shore, and consequently there are few accessible or natural ports or good roadsteads.~~

~~The climate of the island, everywhere accessible to the influence of the sea, is maritime-tropical, the temperature ranging generally between 77° and 80° F., the extremes being about 90° and 70° F., only on the higher mountains falling during the night to 64° or 55° F. The rainfall in the northern peninsula (north of the equator) differs from that of the southern ; the former has rains (not caused by the monsoon), and of smaller amount, 102 inches annually ; the latter has a greater rainfall, 157 inches, brought by the north-western monsoon, and of which the west coast receives a much larger share than the east. In natural vege- tation and fauna, as well as in cultivated products, Celebes presents the transitional link between the Asiatic and the Australian regions of the Malayan province. For example, rice is produced here in smaller quantity and of inferior quality to that in the western part of the archipelago, but superior to that in the eastern section, where sago and miloe form the staple articles of food. The products of the forests, which differ in like manner, amount to from £80,000 to over~~

£160,000 annually, supplying about half the total exports. Coffee in Minahassa yielded 9000 piculs in 1897. The fisheries include trepang, turtle, and pearl oysters. Gold is worked under European direction in the district of Gorontalo, but vfith only partial success ; the search for coal in the southern peninsula has yielded no satisfactory results ; tin, iron, and copper, found in the eastern peninsula and elsewhere, are utilized only for native industries. ^

Celebes is divided, for administrative purposes, into the Residency of Menado and the Government of Celebes with dependencies. The eastern peninsulas belong politi- cally to the Residency of Ternate.

The Residency of Menado comprises three districts: Minahassa, the little states along the north coast west of Minahassa, and Gorontalo, including the other states of the northern peninsula lying along the Gulf of Tomini. Total area, 22,147 square miles. The following table shows the distribution and composition of the popula- tion : —

Districts.

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Minahassa Gorontalo

836 115

3574 505

~~286 133~~

~~16~~

~~296,617 247,056~~

~~301,329 247,809~~

~~The density of population being calculated at about 2-7 to 3 per square mile for Celebes, is 16-2 for Minahassa, but only 1-5 to 2 for the Residency of Menado. Centres of population in Menado are Amurang (3000), the seat of a controller, and a calling place for the steamers of the Indian Packet Company; Menado (10,000), the chief town of the residency, the principal station of the Dutch missionaries, with a fair amount of trade (200,000 tons), but an unsafe roadstead ; Tondano (12,000 ; 10,000 Christians), near the lake and river of the same name, at an altitude of nearly 2000 feet, and one of the chief centres ; Gorontalo, one of the most important towns of Celebes, carrying on direct trade with Singapore and Europe. All the other coast places have some importance as chief villages of the little states and as ports of call for the vessels of the steam packet company, but have only from 500 to 1000 inhabitants.~~

~~The Government . of Celebes and Dependencies is sub- divided into the government territory, the vassal states (Boni and Ternate), and the federal countries. The following figures show the number and composition of the population : —~~

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~~*1*~~

~~*Government of Celebes and Dependencies*~~

~~*1414*~~

~~*3738*~~

~~*554*~~

~~*54*~~

~~*1,442,962*~~

~~*1,448,722*~~

~~*The density of population for the whole government is estimated at 3-7, or 4 per square mile, varying from 2-2 in the vassal and federated states to 14-7 to 18-4 for Macassar and the districts directly governed by the Dutch. The density of poptdation in districts outside the influence of European government sinks to 1 and less per square mile. As in the case of Minahassa, the difference must be explained by physical and moral conditions. Two- thirds of the natives live by agriculture, and one-third by trade, navigation, shipbuilding, and other industries. The difference in occupation, as compared with Menado, is shown in the following table : —*~~

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~~Government of~~

~~Celebes and~~

~~Dependencies~~

~~6753~~

~~18,419~~

~~604~~

~~248~~

~~658~~

~~188~~

~~226~~

~~6376~~

~~225~~

~~1,481~~

~~27~~

~~42~~

~~:.~~

~~;.~~

~~149~~

~~Gorontalo~~

~~1055~~

~~1,5SS~~

~~107~~

~~87~~

~~29~~

~~86.~~

~~1532~~

~~In agreement with the three principal occupations, the centres of population are found in southern Celebes, on the coast (not in the interior plains or on the lake, as in Menado). Palos (3000), with good port ; Pare-Pare, con-nected by road with Lake Tempe ; and Macassar, the seat of the governor and the centre of trade for the eastern part of the archipelago. Declared a free port in 1832, the value of the trade of Macassar increased from £125,000 in that year to £1,250,000 in 1895. Of the 17,925 inhabit- ants, Europeans nuijabered 940, Chinese 2618, and Arabs~~

~~628~~

~~CELL E — C E M E N T~~

~~168. On the south coast must also be named Bonthain (4000) ; on the east coast, Balong-Nipa ; and Buton and Saleyer, seats of administration and~~

~~*ports of call for the packet company's steamers, on the island groups of the same names.*~~

~~*Authorities. — Van Messchenbroek. Mededeelingen over N. Celebes. Tijdschr. Aardr. Gen. iv. pp. 163, 322. — Schwakz en DE Lange. De landweg hit de Minahassa naar Bolang Mongondo. Meded. Ned. Zend. Gen. xx. p. 145. — Van Schelle. Vorslag van het voor komen van gondvoerendeaderen bij Samelatta (Menado). Jaarb. v/h. Mijnwezen v. N. > I. 1889. — Van Hoevell. Todjo, Sasesoe, Posso, Gorontalo, Moetan, &c. Tijdschr. Bat. Gen. xxxv. ; Tijdschr. Aardr. Gen. viii. ix. x. — Sarasin, Paul und Fritz. Berichte aus Celebes. Zeitschr. des Ges. f. Erdk. xxix. p. 351. — WicHMANN. Die Binnenseen van Celebes, Peterm. Mitteil., 1893, pp. 225, 253, 277. — Morris, Braam. Beachrijving van de land- schappen Moewa, Doerie, &c. Tijdschr. Bat. Gen. xxxvi. p. 152. — Kruyt in the Mededeelingen ■v&n het Ned. Zendelinggen. xxv. xxvi., &c. For more detailed bibliography and recent data for the island and its population, see Kan, Celebes, in the Encyclopsedie van Nederlandsch Indie, ed. by Van der Lith and Spaan, The Hague, 1895, &o., vol. i. p. 314. (c. m. k.)*~~

~~*Celle, a to-wn of Prussia, province of Hanover, 27 miles by rail N.E. of Hanover, the former capital (14th century to 1705) of the dukes of Brunswick-Lilneburg. The ducal castle, begun in 1486, but dating in part from the 18th century, still stands. The parish church con- tains the tombs of the dukes, also of Sophia Dorothea, the divorced wife of George I. (of England). The law- courts, with a good library, the national museum, and the hall of the estates are the remaining buildings of note. There are manufactures of woollen yarn, tobacco, umbrel- las, printers' ink, &c., and a lively trade is conducted in wool, timber, honey, and wax. Gardening is also carried on. Population (1885), 18,782; (1900), 19,884.*~~

~~*Cellier, Alfred (1844-1891), English musical com- poser, was born at Hackney in 1844. As a boy he was a chorister at the Chapel Koyal, St James's, under the Rev. Thomas Helmore, where Arthur Sullivan was one of his youthful colleagues. His first appointment was that of organist at All Saints' Church, Blackheath (1862). In 1866 he succeeded Dr Chipp as director of the Ulster Hall concerts, Belfast, at the same time acting as con- ductor of the Belfast Philharmonic Society. In 1868 he returned to London*~~

~~as organist of St Alban's, Holborn. From 1871 to 1875 he was conductor atthe Prince's Theatre, Manchester ; and from 1877 to 1879 at various London theatres. During this period he composed many comic operas and operettas, of which the most successful was Tfie Sultan of Mocha, which was produced at Manchester in 1874, in London at the St James's Theatre in 1876, and revived at the Strand Theatre in 1887. In 1880 Cellier visited America, producing a musical version of Longfellow's Masque of Pandora at Boston (1881). In 1883 his setting of Gray's Elegy in the form of a cantata was produced at the Leeds Festival. In 1886 he won the great success of his life in Dorothy, a comic opera ■written to a libretto by B. C. Stephenson, which was produced at the Gaiety Theatre in September 1886, and, transferred first to the Prince of Wales's Theatre and subsequently to the Lyric Theatre, ran until April 1889. Doris (1889), and Tlie Mountebanks, which was produced in January 1892, a few days after the composer's death, were less successful. Cellier owed much to the influence of Sullivan. He had little of the latter's humour and vivacity, but he was a fertile melodist, and his writing is invariably distinguished by elegance and refinement. He died in London in 1891. (e. a. s.) '~~

~~Cement. — Any material capable of adhering to and uniting into a coherent mass fragments of a substance not in itself adhesive, is a cement. Glue, gum, paste, putty, mortar, and Portland cement are familiar exam-~~

~~ples of materials of this class. In practice, however, the term "cement" used without qualification means Port- land cement, its modifications and congeners : these are all hydraulic cements, i.e., when set they resist the action of water, and can, under favourable conditions, be allowed to set under water. It was well known to builders in the earliest historic times that certain limes would, when set, resist the action of water, i.e., were hydraulic; it was also known that this property could be conferred on ordinary lime by admixture of silicious materials such as puzzuolana or tufa. We have here the two classes into which hydraulic cements are divided.~~

~~When pure chalk or limestone is "burned," i.e., heated in a kiln until its carbonic acid has been driven off, it yields pure lime. This slakes violently with Pazzm- water, giving slaked lime, which can be made lanic into a~~

~~smooth paste with water and mixed with cemenu sand to form common mortar. The setting of the mortar is due to the drying of the lime (a purely physical pheno- menon), no chemical action occurring between the lime and the sand. The function of the sand is simply that of a diluent to prevent undue shrinkage and cracking in dry- ing. Subsequent hardening of the mortar is caused by the gradual absorption of carbonic acid from the air by the lime, a skin of carbonate of lime being formed ; but the action is superficial. Mortar made from pure or " fat " lime cannot withstand the action of water, and is only used for work done above water-level. If, however, such " fat " lime is mixed in the presence of water, not with sand but with silica in an active form, i.e., amorphous and (generally) hydrated, or with a natural silicate containing silica in an active condition, it will unite with the silica and form a silicate of lime capable of resisting the action of water. The mixture of the lime and active silica or silicate is a puzzuolanic cement. The simplest of all puzzuolanic cements would be a mixture of pure lime and hydrated silica, but though the latter is prepared artifici- ally for various purposes, it is too expensive to be used as a cement material. A similar obstacle lies in the way of using a certain native form of active silica, viz., Kieselguhr, for it is too valuable as an absorbent of nitroglycerine, for the manufacture of dynamite, to be available for making puzzuolanic cement. There are, however, many silicious substances occurring abundantly in nature which can thus be used. They are mostly of volcanic origin, and include pumice, tufa, santorin earth, trass, and puzzuolana itself. The following analyses show their general composition :—~~

~~1~~

~~Neapolitan Puzzuo- lana (per cent.).~~

~~Boman Puzzuo- lana (per cent.).~~

~~Trass~~

~~(per~~

~~cent.).~~

~~*Soluble sUica (SIO2) . Insoluble silicious residue Alumina (AlzOs) . Ferric oxide (FeaOt) . Lime (CaO) . Magnesia (MgO) . Sulphuric anhydride (SOa) Combined water (HaO) Carbonic anhydride (COa) Moisture Alkalies and loss*~~

~~*27-80 86-88*~~

~~*j- 19-80*~~

~~*6-68*~~

~~*0-85*~~

~~*Trace*~~

~~*[4-27*~~

~~*6-72*~~

~~*82-64 25-94*~~

~~*22-74]*~~

~~*4-06*~~

~~*1-87*~~

~~*Trace*~~

~~*8-92 1 4-88*~~

~~*19-82 80-40 18-86 8-10*~~

~~*0-18*~~

~~*7-67*~~

~~*6’-b4*~~

~~0-68~~

~~100-00~~

~~100-00~~

~~100-00~~

~~An artificial product which serves perfectly as a puzzuo- lana is granulated blast-furnace slag. The slag, which must contain a high percentage of lime, is granulated by being run while fused into abundance of water. This granulated slag differs from the same slag allowed to cool slowly, in that a portion of the energy which it possesses while fused is retained after it has solidified. It bears to ordinary slowly-cooled slag a similar relation to that borne by plastic sulphur to ordinary crystalline sulphur. This potential energy becomes kinetic when the slag is brought~~

~~into contact with lime in the presence of water, and causes the formation of a true hydraulic silicate of lime. The following analysis shows the composition of a typical~~

~~Insoluble residue Silica (SiOj) . Alumina (AlaOs) Manganous oxide (MnO) Lime (CaO) . .~~

~~Magnesia (MgO) Soda (NaaO) . Sulphuric anhydride (SOs) Sulphur (S) .~~

~~Deduct oxygen equivalent to sulphur~~

~~Per cent.~~

~~1-04~~

~~31-50~~

~~18-56~~

~~0-44~~

~~42-22~~

~~3-18~~

~~0-70~~

~~0-45~~

~~2-21~~

~~100-30 1-10~~

~~99-20~~

~~Granulated slag of this character is ground with slaked lime until both materials are in a state of fine division and intimately mixed. The usual proportions are three of slag to one of slaked lime by weight. The product termed slag cement sets slowly, but ultimately attains a strength scarcely inferior to that of Portland cement. Puzzuolanic cements are little used in England. Generally speaking they are only of local importance, their cheapness depend- ing largely on the nearness and abundance of some suitable volcanic deposit of the trass or tufa class. They are not usually manufactured by the careful grinding together of the puzzuolana and the lime, but are mixed roughly, a great excess of puzzuolana being employed. This excess does no harm, for that part which fails to unite with the lime serves as a diluent, much as does sand in mortar. In fact, ordinary puzzuolanic cement made on the spot where it is to be used may be regarded as a better kind of common mortar having hydraulic qualities. Good hydraulic mortars may be made from lime mixed with furnace ashes or burnt clay as the puzzuolanic constituent. Cements of the Portland type differ in kind from those of the puzzuolanic class ; they are not mechanical mixtures of lime and active silica ready to unite under suitable conditions, but consist of definite chemical compounds of lime and silica and lime and alumina, which, when mixed with water, combine therewith, forming crystalline substances of great mechani- cal strength, and capable of~~

~~adhering firmly to clean inert material, such as stone and sand. They are made by heating to a high temperature an intimate mixture of a~~

~~Portland cement~~

~~calcareous substance and an argillaceous substance. The commonest of such substances in England are chalk and ,clay, but where local conditions demand it, limestone, marl, shale or any similar material may be used, provided the correct proportions of calcium carbonate, silica, and alumina are maintained. The earliest forms of cements of the Portland class were the hydraulic limes. These are still largely used, and are prepared by burning lime- stones containing clayey matter. Some of these naturally possess a composition differing but little from that of the mixture of raw materials artificially prepared for the manufacture of Portland cement itself. Although hydraulic limes have been in use from the most ancient times, their true nature and the reason of their resistance to water have been known for less than 100 years. Next in antiquity to hydraulic lime is Roman cement, prepared by heating an indurated marl occurring naturally in nodules. Its name must not be taken to imply that it was used by the ancients ; in point of fact the manufac- ture of this substance dates back only about 100 years.~~

~~With the growth of engineering in the early part of the 19th century arose a great demand for hydraulic cement. The supply of materials containing naturally suitable proportions of calcium carbonate and clay being limited, attempts were made to produce artificial mixtures which would serve a similar end. Among those who experimented in this direction was Joseph Aspdin, of Leeds, who added clay to finely-ground limestone, calcined the mixture, and ground the product, which he called Portland cement. The only connexion between Portland cement and the place Portland is that the cement when set somewhat resembles Portland stone in colour. True, it is possible to manufacture Portland cement from Portland stone (after adding a suitable quantity of clay), but this is merely because Portland stone is substantially~~

~~lime ;~~

~~any~~

other limestone would serve

carbonate of

equally well. Although'Portland cement is later in date than either Roman cement or hydraulic lime, yet on account of its greater industrial importance, and of the fact that, being an artificial product, it is of approximately uniform composition and properties, it may con- veniently be treated of first. The greater part of the Portland cement made in England is manufactured on the Thames and Medway. The materials are chalk and Medway mud ; in a few works the latter is replaced by gault.

The composition of typical samples of chalk and clay is shown in the following analyses : —

Chalk.

Clat.

Per cent.

Per cent.

1

Silica (SiOj) . . • ■ Alumina-)- ferric oxide (AlaOs-l- FeaOs) .... Lime (CaO) .... Magnesia (MgO) Carbonic anhydride (CO2)

0-92

0-24 55-00

0-36 43-40

99-92

Insoluble silicious matter . Silica (SiOa) . Alumina (AlaOs) . Ferric oxide (FeaOs) Lime (CaO) . Magnesia (MgO) Soda (NaaO) . Potash (K2O) . Sodium chloride (NaCl) . Combined water, organic matter, and loss .

~~26-67 31-24 16-60 8-66 0-25 1-91 100 0-46 1-86~~

~~11-36~~

~~Consisting of Quartz (Si02) . Silica (Si02) . Alumina (Al^Os) Magnesia (MgO) Soda (NaaO) .~~

~~19-33 5-19 1-47 0-03 0-65~~

~~26-67~~

~~1 Felspar ^7-34 per 1 cent.~~

~~100-00~~

~~These materials are mixed in the proportion of about 3 — 1 by weight so that the dried mixture contains approxi- mately 76 per cent, of calcium carbonate, the balance being clay. The mixing may be effected in several “”’*’”*■ ways. The method once exclusively used consists in mixing the raw materials with a large quantity of water in a wash mill, a machine having radial horizontal arms~~

~~driven from a central vertical spindle and carrying harrows which stir up and intermix any soft material placed in the pit in which the apparatus revolves. The raw materials in the correct proportion are fed into this mill together with a large quantity of water. The thin watery ” slip ” or slurry flows into large settling tanks (” backs “) where the solids in suspension are deposited ; the water is drawn off.~~

~~630~~

~~CEMENT~~

~~leaving behind an intimate mixture of chalk and clay in the form of a wet paste. This is dug out, and after being dried on floors heated by flues is ready for burning. This process is now almost obsolete. According to present practice the raw materials are mixed in a wash mill with so much water that the resulting slurry contains 40 to 50 per cent, of water. The slurry, which is wet enough to flow, is ground between millstones so as to~~

~~complete the process of comminution begun in the wash mill. Thorough grinding and mixing are of the utmost importance, as otherwise the cement ultimately produced wUl be unsound and of inferior quality. The drying of the slurry is generally effected by the waste heat of the kilns, so that while one charge is burning another is drying ready for the next loading of the kilns. The kilns most commonly employed nowadays are " chamber kilns," circular struc- tures not unlike an ordinary running lime kiln, ihekiia. ^^^ having the top closed and connected at the side with a wide flue in which the slurry is ex- posed to the hot products of combustion from the kiln. The farther ends of the flues of several such kilns are con- nected with a chimney shaft. The slurry, in drying on the floor of the flue, forms a fairly tough cake which cracks spontaneously in the process of drying into rough blocks suitable for loading into the kiln. At the bottom of the kiln is a grate of iron bars, and on this wood and coke are piled to start the fire. A layer of dried slurry is loaded on this, then a layer of coke, then a layer of slurry, and so on until the kiln is filled with coke and slurry evenly dis- tributed. Fresh slurry is run on to the drying floors, and the kiln is started. The construction of an ordinary cham- ber kiln may be gathered from the accompanying diagram~~

~~.Chimney:~~

~~Plan~~

~~Kiln~~

~~Fig. 1.~~

~~(Fig. 1^. The operation of burning is a slow one. An ordi- nary kiln, which will contain about 50 tons of slurry and 12 tons of coke, will take two days to get fairly alight, and will be another two or three days in burning out. Therefore, allowing adequate time for loading and unloading, each kiln will require about one week for a complete run. The output will be about 30 tons of " clinker " ready to be ground into cement. The grinding of the hard rock-like masses of clinker is effected between millstones, or in modem plants in ball-mills, tube-mills, and edge-runners. It is an important part of the manufacture, because the finished cement should be as fine and "floury" as possible. The foregoing description represents the procedure in use in many English factories. There are various modificar tions in practice according to local conditions : a few of these may be described. In all cases, however, the main operations are the same, viz., intimately mixing the raw materials, drying the mixture, if necessary, and burning it at a clinkering temperature (about 1500° C. =2732° Fahr.). Thuswhen hard limestone is the form of calcium carbonate locally available, it is ground dry and mixed with the~~

~~other kilns.~~

~~correct proportion of clay also dried and ground. The mixture is slightly damped, moulded into rough bricks, dried and burned. A possible alternative is to bum the limestone first and mix the resulting lime with clay, the mixture being burned as before. By this method grinding the hard limestone is avoided, but there is an extra expenditure of fuel in the double burning.~~

~~Many different forms of kiln are used for burning Port- land cement. Besides the chamber kilns which have been described, there are the old-fashioned bottle kilns, which are similar to the chamber kilns, but are bottle-shaped and open at the top ; they do not dry the slurry for their next charge. Their use is becoming obsolete. There are also stage kilns of the Dietsch type, which consist of two vertical shafts, one above the other, but not in the same vertical line, connected by a horizontal channel. At this middle portion and in the upper part of the lower shaft the burning proper~~

proceeds ; the upper shaft is full of unburnt raw material which is heated by the hot gases coming from the burning zone, and the lower shaft contains clinker already burned and hot enough to heat the incomiug air which supplies that necessary for combustion at the clinkering zone. A pair of Dietsch kUns, built back to back, are shown in Fig. 2. Another form is the

Upper shaft

containing

raw material

Burning zorie:

Lovter shaft containing hat clinker

rig. 2.

Hoffmann or ring kiln, made up of a number of compart- ments arranged in a ring and connected with a central chimney; in these compartments rough brick-shaped masses of the raw materials are stacked, and between these bricks fuel is sprinkled. At a given moment one of these compartments is burning and at its full temperatijre ; the air for combustion is drawn in through one or more compartments behind it which have just finished burning and IS thereby strongly heated ; the products of combus- tion pass away through one or more compartments in front of it and heat their contents before they are sub- jected to actual combustion.. It will be seen that the principle of the ring kiln is similar to that of the stage kiln. In each case the clinker which has just been burned and IS fully hot serves to heat the air supply to the com-

pai-tment -where combustion is actually proceeding; in like manner the raw materials about to be burned are well hea,ted by the waste gases from the compartment in full activity before they themselves are burned. (It may be

~~*noted that here and generally in this article « bum" is used in the technical sense ; it is technically correct to speak of cement clinker being "burned," although it is not a fuel ; in accurate terms it is the fuel which is burned, and it is the heat it generates which raises the clinker to a high temperature, i.e., technically " burns " it.) By this device a great part of the heat is regenerated and a saving of fuel is effected.*~~

~~*A more modern method of burning cement is by means of rotatory kilns. These are largely used in the United States, Rotat ^^^ ^^^ being introduced into England and on the*~~

~~*kita. ""^ Continent. They consist of cylinders about 60 ft. long and 6 ft. in diameter placed at a slight angle with the horizontal, and carried on rollers so that they can be rotated by power. The cylinders are made of boiler plate and lined with refractory bricks. At the upper end the raw material is fed in either as a dry powder or as slurry ; at the lower end is a powerful burner. Most of the kilns used in the United States employ petroleum as a fuel, but more recently powdered coal injected by a blast of air has been adopted. The rotation and slight inclination of the cylinder cause the raw material to descend towards the lower end. At the upper end the raw material is dried and heated moderately ; as it descends it re^iChes a part of the kiln where the temperature is higher ; here the car- bonic acid of the carbonate of lime and the combined water of the clay are driven off, and the resulting lime begins to act chemically on the dehydrated clay. The material is then in a partially burnt and slightly sintered state, but is not fully clinkered and would not make Portland cement. As the kiln continues to revolve, the partly burnt material reaches the lower end of the kiln which is nearest the burner, and where the temperature is highest, and is there heated so highly that the union of the lime, silica, and alumina is complete, and fully burned clinker falls out of the kiln. It is extremely hot, and down one or more inclined rotating cylinders*~~

~~*Cemeat cllaker.*~~

~~*rock-like substance of semi-vitrified appearance and very dark colour. The product from a well-run rota- tory kiln is all evenly burnt and properly vitri- fied ; that from an ordinary fixed kiln of what- ever type is apt to contain a certain amount (5 to 15 per cent.) of underburnt material, which is*~~

~~yellowish and fri- able and is not properly clinkered. This material must be picked out, as such underburnt stuff contains free lime or un- saturated lime compounds. These may slake slowly in the finished cement and cause such expansion as may destroy the work of which it forms part. Well-burnt, well-picked clinker when ground yields good Portland cement. Noth- ing is added during or after grinding save a small amount (1 to 2 per cent.) t)f calcium sulphate in the form either of gypsum or of plaster of Paris, which is sometimes needed to make the cement slower-setting. This small addition for this specified purpose is recognized as legitimate, but the employment of various cheap materials such as rag- stone and blas»l> furnace slag, sometimes added as diluents or make-weights, is adulteration and therefore fraudulent. The composition of Portland cement varies within comparatively narrow limits, and the variations are tend- ing to become smaller as regularity and skill in manufacture increase. The following analysis may be taken as typical of cements made from chalk and clay on the Thames and Medway : —~~

~~Composi- tion.~~

~~Silica (Si02) Insoluble residue . Alumina (AI2O3) . Ferric oxide (FejOs) Lime (CaO) . Magnesia (MgO) . Sulphuric anhydride (SOs) Carbonic anhydride (CO2) Water (H2O) Alkalies~~

~~Fig. 3.~~

~~similar to the first, but acting as coolers instead of kilns. On its way down the cylinders the clinker meets a current of cold air and is cooled, the air being correspondingly warmed and passing on to aid in the combustion of the fuel used in heating the kiln. This regenerative heat- ing is similar in principle and effect to that obtained by means of the Dietsch and ring kilns. The output of one of these kilns is about 200 tons per week, as against 30 tons for an ordinary chamber kiln. A large saving in labour is also secured.^ The system presents many advantages, and is likely to replace the older methods of cement making. Fig. 3 represents diagram- matically a rotatory cement plant on the Hurry and Sea- man system. Portland cement clinker, however produced, is a hard.~~

~~Per Cent.~~

~~22‘0 10 7-5 3-5~~

~~620 1-0 1-5 0-5 0-5 0-5~~

~~100-0~~

~~There may be minor variations from this composition. . Thus the silica may range from 20 per cent, to 24 per cent., the alumina and ferric oxide jointly from 9 per cent. to 13 per cent., the lime from 60 per cent, to 65 per cent. Other things being equal, the higher the percentage of lime within the limits indicated above the stronger is the cement, but such highly limed cement is less easy to burn than cement containing about 62 per cent, of lime; and unless the burning is thorough and the raw materials are intimately mixed, the cement is apt to be unsound. Although the ulti- mate composition of cement, that is, the percentage of each base and acid present, can be accurately determined by analysis, its proximate composi- tion, i.e., the nature and amount of the compounds formed from these acids and bases, can only be ascertained indirectly and with difficulty. The best and most recent investigation on this subject has been made by M. H. le Chatelier, whose work has since been supplemented by that of Messrs Spenser B. Newberry and W. B. Newberry. According to Le Chatelier, the chief constituent of Portland cement is tri-calcium silicate, 3CaO SiOz, a substance which when mixed with water combines with it according to the equation~~

~~2[3CaOSi02]-f-9H20=2 [CaO Si02]5H20-t-4Ca(OH)2.~~

~~The products of this reaction, hydrated mono-calcium silicate and calciiim hydroxide, crystallize and form a mass of interlocking crystals which constitutes the bulk of~~

~~fu&hiiiff Rolls.~~

set cement. The other chief constituent of Portland cement is a calcium aluminate. According to Le Chatelier, this body is a tri-calcium aluminate and sets when mixed with water and lime derived from other constituents of the cement, such as unstable ferrites, or from the decom- position of the tri-calcium silicate mentioned above, according to the equation

3 CaO Al203+Ca(OH)j+ll HjO=4 CaO AlA 12 H^O.

According to Messrs Newberry, however, the aluminate is di-calcium aluminate, 2 CaOAljOj ; the mode of hydra- tion and setting of this body has not been studied. Although the precise composition of the aluminate is still a matter for discussion, it is generally admitted that it is the chief agent in the first setting of the cement. The ultimate hardening and the attainment of strength are due to the tri-calcium silicate. The function of the ferric oxide present in ordinary cement is little more than that of a flux to aid the union of the silica, alumina, and lime in the clinker ; its role in the setting of the cement is altogether secondary. Magnesia is present in most Port- land cements in quantities varying from 1 to 5 per cent. Within this range it appears to be inert, forming no cementitious compound. There is evidence that in larger proportion, e.g., 10 to 15 per cent., it may hydrate and set after the general setting of the cement, and may give rise to disruptive strains and cause the cement to " blow " and fail. In so-called natural cement (p. 633) which is comparatively lightly burnt, the magnesia appears to be inert, and as much as 20 to 30 per cent, may be present. Another constituent of Portland cement which influences its setting time is calcium sulphate, naturally formed from the sulphur in the raw materials or fuel, or intention- ally added to the finished cement as gypsum or plaster of Paris. It has a remarkable retarding effect on the hydration of the calcium aluminate, and consequently on the setting of the cement ; thus it is that a little gypsum is often added to convert a naturally quick-setting cement into one which sets slowly. It will be observed that in the hydration of tri-calcium silicate, the main constituent of Portland cement, a large portion of the lime appears as calcium hydroxide, i.e., slaked lime. It is evident that this will form a puzzuolanic cement (p. 628) if a suitable silicious material such as trass is added to the cement. The ultimate product when set may be regarded as a mixed Portland and puzzuolanic cement. The use of trass in

~~this manner as an adjunct to Portland cement has been advocated by Michaelis, but has not become general.~~

~~The quality of Portland cement is ascertained by its analysis and by determining its specific gravity, fineness, mechanical strength, and soundness. A good "^' sample will have a composition within the limits cited above and approximating to the typical figures given on p. 631. It will be ground so finely that not more than 10 per cent, will be left on a sieve of 76 x 76 meshes per square inch, the wires of the sieve being 0-006 inch in diameter. It will have, when freshly burned, a specific gravity not lower than 345, and briquettes made from it and kept in water will possess a tensile strength of 400- 500 lb per square inch seven days after they are made, while briquettes made from a mixture of 3 parts by weight of sand and 1 of cement will give about 200 lb per square inch at twenty-eight days. The soundness of the cement is ascertained by keeping thin pats of cement in water for seven and twenty-eight days at the ordinary temperature. The test is accelerated so that a valid opinion may be pro- nounced in a short time by keeping the water hot, e.g., at 110° Pahr. or 176° Pahr. In this case an unsound cement may generally be detected in twenty-four hours. Apat of sound cement under these conditions remains free from cracks~~

~~and does not buckle. A cement slightly unsoiind will show numerous small cracks, while one which is markedly unsound may even go to pieces. A rigorous and exact test for soundness is that formulated by Deval, who has shown that briquettes of 3 of sand and 1 of cement kept in water for two days at 80° C.==176° Pahr. attain approximately the same strength as similar briquettes attain at seven days in water at the ordinary temperature. In like manner briquettes kept at 176° Fahr. for seven days are equal in strength to those kept at the ordinary temperature for twenty-eight days. A cement not perfectly sound will give low residts in the hot test, and a cement of indifferent soundness will crack and go to pieces. The test is admittedly severe, but can be passed without difficulty by cement made with proper care and skill. There are many modifications and elaborations of all the tests which have been mentioned. Cement for all important work is submitted to a rigorous system of testing and analysis before it is accepted and used.~~

~~*Hydraulic Lime is a cement of the Portland as distinct from the puzzuolanic class. The most typical hydraulic lime is that known as Chaux du Theil, made from a lime- stone found at Ardfeche in France. This limestone consists of calcium carbonate most intimately intermixed with very finely divided silica. It contains but little alumina and oxide of iron, which are the constituents generally necessary to bring about the union of silica and lime to form a cement, but in spite of this the silica is so finely divided and so well distributed that it unites readily with the lime when the limestone is burned at a sufficiently high temperature. English hydraulic limes are of a different class. They contain a good deal of alumina and ferric oxide, and in composition resemble somewhat irregular Portland cement. Analyses of the two classes of hydraulic lime are as follows : —*~~

~~*Insoluble silicious matter Silica (SiOa) Alumina (AlaOj) Ferric oxide (FejOs) Lime (CaO) Magnesia (MgO) Sulphuric anhydride (SOs) Carbonic anhydride (SO2) Water (H2O) Alkalies and loss*~~

~~*Chaux de Thell.*~~

~~*Blue Lias*~~

~~*Per cent.*~~

~~*Per cent.*~~

~~*0-3*~~

~~*2-39*~~

~~*21-7*~~

~~*14-17*~~

~~*1-8*~~

~~*6-79*~~

~~*0-6*~~

~~2-34~~

~~74-0~~

~~63-43~~

~~0-7~~

~~1-54~~

~~0-3~~

~~1-63~~

~~1 0-6~~

~~3-64 2-69~~

~~•..~~

~~1-38~~

~~100-0~~

~~100-0~~

~~*Hydraulic lime contains a good deal of uncombined lime, and has to be slaked before it is used as a cement. In France this slaking is conducted systematically by the makers, the freshly burned lime being sprinkled with water and stored in large bins where slaking proceeds slowly and regularly until the whole of the surplus uncombined lime is slaked and rendered harmless, while the cementitious compounds, notably tri-calcium silicate, remain untouched. In English practice hydraulic lime is slaked by the user. Seeing that regular and perfect slakingis more easily attained when working systematically on a large scale and by storing the material for a long period, the French method is the better and more rational. The product may then be regarded as a cement of the Portland class mixed with slaked lime. When gauged with water and made into a mortar it sets slowly, but ultimately becomes almost as strong as Portland cement. Its slow setting is*~~

~~an advantage for some purposes, e.g., for foundations and abutments where settlements may occur. The structure is free to take its permanent position before the lime sets, and cracks are thus avoided. A case in point is the employment of hydraulic lime in place of Portland cement as grouting outside the cast-iron tubes~~

~~CENSUS~~

~~633~~

~~lining tunnels made by the modern shield~~

~~used for system.~~

~~■ Roman Cement is another cement of the Portland class which came into use some hundred years ago, shortly before the manufacture of artificial Portland cement was attempted. It is still in use, though only for special purposes where a quick-setting material is required. It is made from septaria nodules which are dredged up on the Kent and Essex coasts and consist of about 60 per cent, of calcium carbonate mixed with clay, the mass being suffi- ciently indurated to remain coherent under water. The nodules are not prepared in any way, but simply burned at a moderate red heat. The resulting cement varies some- what in composition, but approximates to the following figures : —~~

~~Insoluble silicious matter . . .5~~

~~Silica (Si02) Alumina (AljOs) Ferric oxide (FejOs) . Manganese dioxide (Mn02) Lime (CaO) . Magnesia (MgO) Sulphuric anhydride (SOs) Carbonic anhydride (CO2) Water (H2O) . Alkalies and loss~~

~~19-62 10-30 7-44 1-57 44-54 2-92 2-61 3-43 0-25 1-46~~

~~KG -00~~

~~The most characteristic constituent is the oxide of iron, which gives the cement a reddish colour, and the presence of manganese also differentiates Eoman from Portland cement, which rarely contains appreciable quantities~~

~~*of that element. The high percentage of alumina causes the cement to be quick-setting, and it becomes hard in about five minutes. It resists the action of water, salt or fresh, very well, and is therefore useful in situations where the work is likely to be submerged immediately after it has been put in place.*~~

~~*The term Natural Cements is applied to cements made by burning mixtures of clay and carbonate of lime natu- rally occurring in approximately suitable proportions. They may be regarded as badly-mixed Portland cements, and need no special description. American "natural" cements are of a somewhat different class. They are usually made from a silicious limestone containing magnesia, and are comparatively lightly burned. The following analysis is typical of a cement of this kind : —*~~

~~*Per cent*~~

~~*Silica (SiOa) ....*~~

~~*. 24-30*~~

~~*Alumina (AI2O8)*~~

~~*7-22*~~

~~*Ferric oxide (FeaOs) .*~~

~~*5-06*~~

~~*Lime (CaO) ....*~~

~~*. 33-70*~~

~~*Magnesia (MgO)*~~

~~*. 20-94*~~

~~*Water, carbonic anhydride, and loss .*~~

~~*8-78*~~

~~100-00~~

~~These irregular cements of the Portland class are good building materials for ordinary purposes, but are not so suitable as good artificial Portland cement for heavy and important undertakings.~~

~~The chief use of hydraulic cements, whether of the puzzuolanic or Portland class, is to act as an~~

~~adhesive material in work which is to be Uses ot exposed to water. No doubt in times of remote cemfnt^'" antiquity it was found that the jointing of~~

~~masonry which was to be immersed required the use of a cement indifferent to the action of water. Ordi- nary mortar failed in such positions ; mortar made from lime prepared from limestones or chalks containing a little clay was found to stand ; mortar made from lime mixed with trass or similar active silicious material was also found to stand. On this observation rests the whole of~~

~~the present enormous employment of hydraulic cements. It was a natural transition to utilize these cements not merely for jointing masonry but also for making concrete, and the only reason why hydraulic cements, as distinct from cements which are not hydraulic {e.g., ordinary mortar), are used for the latter purpose is their great mechanical strength. Their use in above-water work is checked by the low price of common brick. Even in such work, where it would be thought that masses of burnt clay would be the cheapest conceivable material, concrete is at least on level terms with its rival. It must be remembered that one of the great advantages of con- crete is that five-sixths of its total mass may be provided from local sand and gravel, on which no carriage has to be paid. The cement, on which alone freight is to be reckoned, converts these from loose incoherent material into a solid stone. Thus it comes about that the largest use of cement is for manufacturing concrete for dock and harbour work, and for the making of foundations. It is also employed for the building of light bridges, floors, and pipes constructed of cement mortar disposed round a skeleton of iron rods. Such composite structures take advantage at once of the high tensile strength of iron and of the high compressive strength of cement mortar.~~

~~*Good hydraulic cements are highly permanent materials, provided certain conditions be observed. It might be supposed that hydraulic cements from their nature would be indifferent to the action of water, but this is only true if the structures of which they form part are sufficiently compact. In this case the action of the water is checked by the film of carbonate of lime which eventually forms on the surface of calcareous cement. This, together with the compactness of the mortar, hinders the ingress and, egress of water, and prevents the dissolution and ultimate destruction of the cement. But where the concrete or mortar is not well made and is porous, the continual passage of water through it will gradually break up and dissolve away the calcareous constituents of the cement until its strength is utterly destroyed. This destructive action is increased if the water contains sulphates or magnesium salts, both of which act chemically on the calcareous constituents of the cement. As searwater contains both sulphates and magnesium salts, it is especially necessary in concrete for harbour work to take every care to produce an impervious structure. There are various minor external causes for the failure and ultimate destruction of cement mortar and concrete, but their discussion is a matter for the specialist. Failure from inherent vice in the cement has been already touched on ; it can always be traced to want of skill and care in manufacture.*~~

~~*Authorities. — D. B. Butler. Portland Cement. London, 1899. — F. H. Lewis. Article on cement in The Mineral Industry. New York, 1898. — Serkangek and Blount. Article on cement in The Mineral Industry. New York, 1897 ; Paper on testing cements, Journal of the Society of Chemical Industry. London, 1894. — G. R. Redgrave. Calcareous Cements. London, 1898.*~~

~~*(b. Bt.)*~~

~~*Census — United Kingdom. — The historical account of the census in the United Kingdom has been already given in detail up to and including that of 1871. Since then the changes in procedure have not been numerous, though some are of considerable importance. In England and Wales the growth of population necessitated the increase of the enumerating agency from 32,543 in 1871 to 34,711 in 1881, to 35,607 in 1891, and to 38,200 in 1901, while the operations have been complicated by the greater number of*~~

~~local subdivisions to be recognized in the returns. Between 1871 and the next census, for instance, the creation of sanitary districts entailed~~

~~the compilation of population figures for 966 new areas. In the ensuing decade 44 of these were absorbed in their neighbours, 89 fresh ones were constituted, and 138 altered in boundaries. Three-fourths of the 14,600 civil parishes, again, were similarly modified, and changes of areas under the Local Government and Redistri- bution Acts added to the labour of tabulation. Ma- terial improvements were effected in the classification of occupations ; and in 1891, upon the recommenda- tion of the Treasury Committee appointed for the purpose, additional columns were included in the schedule in order to show separately the employers of labour, the employed, and the independent worker, an innovation which, however, failed, owing to inac- curacy of return, to fulfil anticipations. The subdivision of houses into separate occupancies was also prescribed, together with the return of the number of rooms, where less than five, occupied by each family. The Act regu- lating the census of 1901 further simplified the record by substituting the term tenement for storey, and providing for the separate record of houses altogether uninhabited as distinguished from those occupied only during the daytime. The record of nationality, again, was further extended at the 1901 census beyond the mere specification of the British subjects born abroad, and included that of all persons not born within the IJnited Kingdom. In 1891 a return was obtained of all persons in Wales and Monmouth speaking either Welsh only or both Welsh and English, but owing to the imperfection of the results it was prescribed that the corresponding return for 1901 should include those who speak English only, and should exclude children under three years old. In Scotland a similar return of those who speak Gaelic was obtained in 1881, extended at the next census, and made to cor- respond with the return for Wales for the enumeration of 1901. The complexity of areas does not exist north of the Tweed to anything like the extent to which it pre- vails in England, but the Local Government Act for Scotland of 1889 afforded~~

~~means of simplification of which great advantage was taken in the census of 1891. The definition of a house in the north was changed in 1881 so as to correspond with that in use in England, since previously the tenement in the former was the house of the latter, and vice versd. For the census of 1901 Scotland was included with England in a single Act, with the necessary modification in nomenclature and other detail. The census of Ireland continues to differ from that of the sister island — first, in that the enumeration is undertaken by the constabulary and the schedule not left to be filled up by the householder ; secondly, in the wider use made of statistics other than those directly collected at the census ; thirdly, in the collec- tion of statistics of religious denomination, this part of the return, however, being left optional in 1881 and 1891 with the person enumerated. Advantage was taken of this relaxation of the rule in no more than 530 cases on the former occasion, and 871, chiefly in Ulster, on the latter. Finally, a return of temporary illness, of literacy, and fuller detail of house accommodation is here required, under the authority of the Local Gov- ernment.~~

~~The results of the enumerations described above will be found under other heads, and only their most general features need be here set forth. Between the first general census of 1801 and that of 1901 the population of the three kingdoms as a whole increased by 161 per cent. In the case of England and Wales the growth amounted to 271 -6 percent. Scotland shows an increase of 178, whilst Ireland fell off to the extent of 17-3. Thus in 1821, when the census was first taken on a uniform system, the distribution of the total population was in the proportion of 57-4 per cent, in England, 10-0 in Scotland, and .32-6 in Ireland ; in 1861 the first had risen to 65-5, the second to 10-6, and the third had fallen to 23-9 per cent., whilst in 1901 the corresponding relation was 78-4,~~

~~10-8, and 10-8 per cent. Scotland stands nearly where she did in 1821, but England has gained and Ireland lost about 21 per cent, in the scale. The following percentages show that the rate of variation has been by no means regular throughout the period in question : —~~

~~1821.81.~~

~~1831-41.~~

~~*1841-61.*~~

~~*1851-61.*~~

~~*1861-71.*~~

~~*1871-81.*~~

~~*1881-91.*~~

~~*1891-1901.*~~

~~*England and Wales Scotland . Ireland .*~~

~~*15-8 13-0 14-2*~~

~~*14-5*~~

~~*10-8*~~

~~*5-5*~~

~~*12-9 10-2 19-8*~~

~~*11-9 6‘0*~~

~~*n-8*~~

~~*13-2 9-7 6-7*~~

~~*14-4 11-2 4-4*~~

~~*11-7*~~

~~*7-8 9-1*~~

~~*12-17 11-1*~~

~~*s-s*~~

~~*United Kingdom! .*~~

~~*15-0*~~

~~*11-2*~~

~~*2-5*~~

~~*5-6*~~

~~*8-8*~~

~~*10-8*~~

~~*8-2*~~

~~*9-9*~~

~~*Comparison of the census figures with the birth and death returns indicates that since 1851 emigration has been the chief retarding influence in all three countries ; while in England, at all events, the correlation of the age, birth, and marriage returns seems to indicate a tendency to diminishing fecundity due both to relatively fewer marriages and to the later age at which women enter the conjugal state. A marked decline in the death-rate, in fact, is slightly outweighed by the falling-off in the rate of births. In relation to the area of the three countries, the weight of the population upon a square mile has risen in England and Wales from 153 in 1801 to 558 in 1901. In Scotland the addition has been from 54 to 150, and in Ireland the burden has fallen from 166 to 137.~~

~~*British Colonies and Dependencies. — In Canada and the Cape the predecessors of the British in European colonization had begun early in the history of their enterprise to take stock periodically of the population and resources of the ^;^acts occupied. In Canada the first return was prepared as early as 1665, and the Netherlands East India Company obtained a rough return in 1687 for the Cape. These, however, can scarcely be included under the head of census, since they were based upon locally-prepared reports mainly re- lating to agriculture aad cattle. Similarly, in*~~

New South Wales, ‘ ‘ musters ‘ ‘ were held annually from the year of settlement ; but it was not till 1828 that these assumed the form of a census, and the first regular enumeration was that of 1841, in which Tasmania and New Zealand joined. A census of Cape Colony was taken in 1865, and has been succeeded by others in 1875 and 1891. Natal initiated the operation in the last-named year. In Australia, Queensland has taken a census quinquennially since 1875, and New Zealand since 1881. Uniformity in the procedure of 1891 was secured by a Congress of Statists held in the preceding year. Canada took its first general census in 1871, a year which may be considered the starting-point of the imperial enumeration. India was not included in the synchronous undertaking until 1881, when a population of 254 millions, raised in 1901 to 294 millions, placed the operation at the head or all census enterprise. Each colony and dependency adopts a separate system, and adds such columns to those relating to the primary statistical facts forming the basis of the census as may be required to obtain detail for local purposes. Canada, for instance, follows the plan of the United States, and issues a schedule so voluminous that the official enumerator, specially instructed, has to fill it up, as in Ireland, instead of the householder, and is allowed a month or so for the purpose. In India the same plan is necessary for a far simpler schedule by reason of the general illiteracy of the people, and the census has to be divided accordingly into two operations, the preliminary filling up of the record and the final checking it on the census night. In several of the governments the census has been hitherto confined to the towns or to persons of European descent, and excludes altogether the often large native population, as in Natal and the settlements in Borneo and West Africa, or is, satisfied with a rough tribal tally, by families or otherwise, fur-‘ nished by the chiefs or headmen. In round numbers, the total enumerated population of the British empire is 353 millions, whilst the tracts which still remain uncensused contain an esti- mated population of about 44 millions, chiefly in Africa. As com- pared with this total of 397 millions there is the figure of 235 millions published with the census of 1871, that of 254 millions in 1881, and of 372 millions ten years later, none of them claiming more than approximation to accuracy or relating to identical areas.

Other Countries. — Partial enumerations of population and stock were undertaken in several European countries as early as the 17th century on

~~*much the same lines as those prescribed by the French authorities in Lower Canada soon after the country was settled. These operations, however, were generally directed towards a special administrative object such as taxation or military service, and, being conducted more or less independently by the authorities of parishes or similar small areas, do not come under the head of*~~

~~*Omitting Man and the Channel Islands.*~~

~~*census. Synchronous enumerations of the population, though suggested on several occasions by eminent men of science, were generally discouraged, probably on the grounds set forth by St Simon, who held that " these impious operations have always irritated the Creator and brought down His heavy hand upon those who ordained them." At all events, although prescribed by the il:ench Convention in 1791 and by its successor in 1793, the census, as we now understand it, is the offspring of the 19th century. France and England led the way in 1801 ; most of the German states were enumerated in 1816, and shortly afterwards Scandinavia improved on modern lines its already existing system. The United States of America incorporated the periodical census into their Constitution in 1787 ; but the first enumeration, in 1790, was substantially little more than an experiment. Leaving out of consideration the Turkish dominions, the census at stated intervals has now become the practice of all European States. Russia, the last to adopt it, completed its first enumeration in 1897, the operations embracing a population of 129 millions in two continents. The efforts of statisticians of all countries have been for some time directed towards the establishment of uniformity in the results derivable from the census, and by International conferences a considerable degree of success has been attained. As regards the primary facts to be ascertained, comparison is now very generally possible ; and information as to sex, age, civil condition, birthplace, and certain infirmities is becoming of more value at each period. In each country, moreover, special information has to be acquired at the census on topics of local importance which are not equally sus- ceptible of international comparison. For example, many if not most of the*~~

~~*European schedules provide columns for one or more of such subjects as mother-tongue, nationality, illiteracy, religious denomination, military service ; and in Russia, for the recognized social grades ; and in France, for the number of children in each family. Occupation, again, is recorded at nearly all enumerations, though not invariably upon a uniform system nor enjoying so much confidence as to accuracy as the rest. There are, finally, differences of practice as regards the mode of obtaining the record, whether by official agency or on the responsibility of the house- holder, and in some countries the figure of the actual, in others of the legal, population is the object in view. On the whole, the practical value of periodical enumeration has now been recognized throughout the civilized world, although, for financial or political reasons, the census has not yet become a universal institution. From the following table it will be seen that the great lacuncB in this branch of statistics are to be found in the Far East, on the one hand, and amongst the tropical states of the Old and New Worlds on the other : —*~~

~~*Continent.*~~

~~*PopuJation (in thousands).*~~

~~*Percentage*~~

~~*Enumerated*~~

~~*(1901).*~~

~~*Enumerated.*~~

~~*Estimated.*~~

~~*Europe Asia . Africa America . Oceania*~~

~~*387,308*~~

~~*323,569*~~

~~*19,741*~~

~~*135,118*~~

~~4,771~~

~~6,314~~

~~550,713~~

~~144.578~~

~~10,543~~

~~881~~

~~98-4 37-0 12-3 92-8 84-5~~

~~Total .~~

~~870,507~~

~~713,029~~

~~55-0~~

~~(a. A. B.) United States. — The United States census of 1870 probably marked the lowest ebb of census work in the United States. Its accuracy was generally denied by com- petent scholars both in and out of the census office. This unfortunate result was due partly to the unsatisfactory character of the law imposing the local work upon officials already burdened with other duties and not subject to the control of the census office, and partly to the disturbed condition of the Southern states immediately after the Civil War. The serious errors were errors of omission, were probably confined to the Southern states, and were especially frequent among the negroes. Since 1870 the development of census work in the United States has been steady and rapid. The law, which had been pre- pared for the census of 1870 by a committee of the House of Eepresentatives with much care, skill, and ability, but which had failed of enactment at the last moment in the Senate, furnished a basis for greatly improved legislation in 1879, under which the tenth census was taken. By this law the census office for the first time was allowed to call into existence~~

~~*and to control an adequate local staff of supervisors and enumerators. The scope of the work was*~~

~~*so extended as to make the twenty-two quarto volumes of the tenth census almost an encyclopaedia, not only of the population, but also of the products and resources of the United States. Probably no other census in the world has ever covered so wide a range of subjects, and perhaps none except that of India and the eleventh American cen- sus has extended through so many volumes. The topics usually contained ia a census suffered from the great addition of other and less pertinent matter, and the reputation of the work was unfavourably affected by the length of time required to prepare and publish the volumes (the last ones not appearing until near the end of the decade), the original underestimate of the cost of the work, which made frequent supplementary appropria- tions necessary, the resignation of the superintendent, Francis A. Walker, in 1882, and the disability and death of his successor, Charles W. Seaton. The eleventh census was taken under a law almost identical with that of the tenth, and extended through twenty-five large volumes, presenting a work almost as encyclopaedic, but much more distinctively statistical.*~~

~~*The popular opinion of a census, at least in the United States, depends largely upon the degree to which its figures for the population of the country, of states, and especially of cities, meet or fail to meet the expectations of the interested public. Judged by this standard, the census of 1890 was less favourably received than that of 1880. The enumerated population of the country in 1880 was larger than had been anticipated ; and in the face of these figures it was difficult for local complaints, even where they were made, to find hearing and accept- ance. But according to the eleventh census the decennial rate of growth of population fell suddenly from over 30 per cent., which the figures had shown between 1870 and 1880, and in every preceding decade of the century except that of the Civil War, to less than 25 per cent., in spite of an immigration nearly double that of any preceding decade. For this change no adequate explana^- tion was offered by the census office. Hence the protests of those who believed that the figures for population were too small swelled into a general chorus of dissatis- faction. But the census was probably more correct than the critics. Most of the motives influencing popular estimates of population in the*~~

United States tend to exaggeration. The convention which drafted the Constitution of the United States attempted to secure a balance of interests by apportioning both representatives in Congress and direct taxes according to population. A passage in The Federalist suggests the motives of the convention as follows : —

As the accuracy of the census to be obtained by Congress will necessarily depend in a considerable degree on the disposition if not co-operation of the states, it is of great importance that the states should feel as little bias as possible to swell or reduce the amount of their numbers. Were their share of representation alone to be governed by this rule, they would have an interest in exaggerating their inhabitants. Were the rule to decide their share of taxation alone, a contrary temptation would prevail. By extending the rule to both objects the states will have opposite interests, which will control and balance each other, and produce a requisite impartiality.

With the disappearance of direct taxation as a source of federal revenue, the motive mentioned for understat- ing the population disappeared. On the other hand, the desire for many representatives in Congress has been reinforced by the more influential feelings of local pride and of rivaky with other cities of somewhat similar size. Hence a complaint that the population is overstated is seldom heard, and hence, also, popular charges of an under- cOunt afford little evidence that the population was really larger than stated by the census. After the detailed tabulation had been completed, it

was shown that the number of persons under ten years of age in 1890 was surprisingly small, and that this deficiency in children was a leading cause of the slow growth in population. Before the tabulation had been made Mr Francis A. Walker wrote:— "If the birth-rate among the previously existing population did not suffer a sharp decline . . . the census of 1890 cannot be vindicated. To ascertain the facts we must await the tabulation of the population by periods of life, and ascertain how many of the inhabit- ants of the United States of 1890 were under ten years of age." These results thus

~~*confirmed the accuracy of the count of 1890. Efforts to invalidate the census returns by comparison with the registration records of Massar chusetts cannot be deemed conclusive, since in the United States, as in Great Britain, the census must be deemed more accurate and less subject to error than registration records. A strong argument in favour of the eleventh census, apart from its self consistency, is that its results as a whole fit in with the subsequent state enumerations. In eleven cases such enumerations have been taken ; and on computing from them and the results of the federal census of 1880 what the population at the date of the eleventh census should have been, if the annual rate of increase had been imiform, it appears that in no case, except New York city and Oregon, was the difference between the enumera tions and these estimates over 4 per cent. In Oregon about 30,000 more people were found in 1890 than the estimate would lead one to expect; in New York city, about 100,000 less. It seems not improbable that in the latter, where the difficulties incident to a count during the summer are almost insurmountable, serious omissions occurred. Still, such a comparison confirms the accuracy of the eleventh census as a whole.*~~

~~*The results of the twelfth census (1900) further refute the argument that would maintain the eleventh census to be inaccurate because it showed a smaller rate of increase in population during the preceding decade than had been recorded by other censuses during earlier decades. The rate of increase during the decade ending in 1900 was even less than that for the preceding decade ; and it is impossible that a falling off so marked could in two successive enumerations be the result of sheer inaccuracy. The rate of increase from 1890 to 1900, eliminating from the computation the population of Alaska, Hawaii, Indian Territory, and Indian reservations, was 20-7 ; the rate of increase if these places are included — in which case the figures of the population of Hawaii in 1890 must be taken from the census of the Hawaiian Government in that year — was 21 per cent.*~~

~~*The law regulating the twelfth census deserves to rank with those of 1790, 1850, and 1879 as one of the four important laws relative to census work. By this law the census office was far more independent than ever before. Appointments and removals were made by the Director of the Census rather than by the Secretary of the Interior, and in all plans for the execution of the*~~

~~*law the head of the office was responsible for success. The law divided the subjects of census inquiry into two parts — first, those' of primary importance, requiring the aid of the enumerator ; and, secondly, those of subsidiary importance, capable of production without the aid of the enumerator. The former had to be finished and published by 1st July 1902 ; the latter were not to be undertaken until the former were well advanced towards completion. By this means the attention of the office could be concentrated on a small number of subjects rather than distributed over the long list treated in the volumes of the tenth and eleventh censuses.*~~

~~*Under the federal form of government, with its delegation of all residuary powers to the several states, the United States have no system of recording deaths, births, and marriages. Hence there is no such basis as exists in nearly every other civilized State for a national system of registration, and the country depends upon the crude method of enumerators' returns for its information on vital statistics, except in the states and cities which have estab- lished a trustworthy registration system of their own. These are the New England states and a few others in their vicinity or influenced by their example. Envimerators' returns in this field*~~

~~*are so incomplete that hardly two-thirds of the deaths which have occurred in any community during the preceding year are obtained by an enumerator visiting the families, no satisfactory basis for the computation of death-rates is afforded, and the returns have com- paratively little scientific value. In the regions where census tables and interpretations are derived from registration records kept by the several states or cities they are often made more com- plete than those in the state or municipal documents. The census of agriculture is also liable to a wide margin of error, owing to defects in farm accounts and the inability of many farmers to state the amount or the value even of the leading crops. The census figures relate to the calendar year preceding 1st June 1900, and hurried and careless answers about the preceding year's crops are almost sure to have been given by many farmers in the midst of the summer's work.*~~

~~*The difficulties facing the manufacturing census were of a different character. A large proportion of the industries of the country keep satisfactory accounts, and can answer the ques- tions with some*~~

~~*correctness. But manufacturers are likely to suspect the objects of the census, and to fear that the information given will be open to the public or betrayed to competitors. Furthermore, the manufacturing schedule presupposes some uni- formity in the method of accounting among different companies or lines of business, and this is often lacking. Another source of error in the manufacturing census of the United States is that the words of the census law are construed as requiring an enumera- tion of the various trades and handicrafts, such as carpentering. The deficiencies in such returns are gross and notorious, but the census office feels obliged to seek for them and to report what it finds, however incomplete or incorrect the results may be. Even on the population returns certain answers, such as the number of the divorced or the number unable to read and write, may be open to question.*~~

~~*The wide range of the American census, and the publication of uncertain figures, find a justification in the fact that the develop- ment of accurate census work requires a long educational process in the office, and, above all, in the community. Kough approxi- mations must always precede accurate measurements ; and these returns, while often inaccurate, are, being the best obtainable, better than nothing, and probably improve with each decade.*~~

~~*Besides the breadth of its scope, in which the American census stands unrivalled, the most important American contribution to census work has been the application of electricity to the tabula- tion of the results, as was first done in 1890. The main difficulties which this method reduced were two. The production of tables for so enormous a population as that of the United States through the method of tallying by hand requires a great number of clerks and a long period of time, and when complete cannot be verified except by a repetition of the process. The new method abbrevi- ates the time, since an electric current can tally almost simul- taneously the data, the tallying of which by hand would be separated by appreciable intervals. The method also renders comparatively easy the verification of the results of certain selected parts. (w. F. w.)*~~

~~*Centerville, the capital of Appanoose county, Iowa, U.S.A., situated in a coal-mining region. Popu- lation (1890), 3668; (1900), 5256, of whom 499*~~

~~were foreign-born and 149 were negroes.~~

~~Central Africa, British. — The term given to what is at present a not well defined appendage of the British empire in South Central Africa. Broadly speak- ing, it may be taken to include a large territory lying between S. latitude 8° 25' on Lake Tanganyika and latitude 17° 6' on the river Shird, near its confluence with the Zambezi, and between longitude E. 36° 10' (district of Mlanje) and 28° 20' (river Luapula)! Originally the term British Central Africa was first applied by the writer of this article to all the territories under British influence to the north of the Zambezi, which were formerly intended to be under one administration ; but the course of events hav- ing obviated the connexion of Barotseland (see Bakotse) with any direct British administration north of the Zambezi, the term British Central Africa is now confined to the British Protectorate on the Shir^ and about Lake Nyasa ; the titles " North-Eastern Rhodesia " and " North-Western Rhodesia " have been officially applied to the two divisions of the British South Africa Com- pany's territory north of the Zambezi. The western boundary, however, of the territory here described has been~~

~~taken to be a line drawn from tlie south-easternmost corner of the Congo Free State frontier to the north- westernmost corner of the Portuguese possessions on the east bank of the Luangwa river. Within these limits we have a territory of about 150,000 square miles, which includes two-thirds of LakeNyasa, the south end of Lake Tanganyika, more than half Lake Mweru, and the whole of Lake Bangweulu, nearly the whole courses of the rivers Shir^ and Luangwa, the whole of the river Chambezi (the head-waters of the river CongoV the right or east bank of the Luapula (or Upper Congo) from its exit from Lake Bangweulu to its issue from the north end of Lake Mweru.~~

~~S.V.Darbishire & O.J.R.HmiartK,~~

~~E.M.~~

Skzioq Map or Bbitish Oentbai. Afbioa.

Other lesser sheets of water included, within the limits of this territory are the Great Mweru Swamp, between Tanganyika and Mweru, Moir's Lake (a small mountain tarn lying between the Luangwa and the Luapula), Lake Malombe (on the upper Shire), and the salt lake Chilwa, which lies on the borders of the Portuguese province of Mozambique. The southern border of all this territory is separated from the river Zambezi by the Portuguese possessions; nevertheless, considerably more than two- thirds of the country lies within the Zambezi basin, and is included within the subordinate basins of Lake Nyasa" and of the river Luangwa. The re- maining portions drain into the basins of the river Congo and of Lake Tanganyika, and also into the small Lake Chilwa, which at the present time has no out- let, though in past ages it probably emptied itself

into the Lujenda river, and thence into the Indian Ocean.

As regards orographical features, much of the country is high plateau, with an average altitude of 3500 feet above sea-level. Only a very minute portion of its area — the country along the banks of the river Shir^— lies at anything like a low level ; though the Luangwa valley may not be more than about 900 feet above sear level. Lake Nyasa lies at an elevation of 1700 feet above the sea, is about 350 miles long, with a breadth varying from 15 to 40 miles. Lake Tanganyika is about 2680 feet above sea -level, with a length of about 400

miles and an average

breadth of nearly 40. Lake Mweru and Lake Bangweulu are respec- tively 3000 feet and 3760 feet above sea- level ; Lake Chilwa is 1946 feet in altitude. The highest mountain found within the limits previously laid down is Mount Mlanje, in the extreme south-eastern corner of the Protector- ate. The highest peak of Mlanje reaches an alti- tude of 9683 feet. (In German territory, near the north end of Lake Nyasa, and close to the British frontier, is Mount Rungwa, the altitude of which exceeds 10,000 feet.) Other high moun- tains are Mounts Chon- gone and Dedza, in An- goniland, which reach an altitude of 7 000 feet, and points on the Nyika Plateau and in the Konde Mountains to the north- west of Lake Nyasa, which probably exceed

~~a height of 8000 feet. There are also Mounts Zomba (6900 feet) and Chiradzulu (5500 feet) in the Shire Highlands. The principal plateaux or high ridges are (1) the Shir^ Highlands, a clump of mountainous country lying between the river~~

~~Oxford, tyoi.~~

~~Shir^, the river Ruo, Lake Chilwa, and the south end of Lake Nyasa; (2) Angoniland — a stretch of elevated coun- try to the west of Lake Nyasa and the north-west of the river Shird; (3) the Nyika Plateau, which lies to the north of Angoniland; and (4) the Nyasa-Tanganyika Plateau, between the Isasin of the river Luangwa, the vicinity of Tanganyika, and the vicinity of Lake Mweru. Finally may be mentioned the tract of elevated coun- try between Lake Bangweulu and the river Luapula, and between Lake Bangweulu and the basin of the Luangwa.~~

~~The whole of this part of Africa is practically without any stretch of desert country, being on the whole favoured with an abundant rainfall. The nearest approach to a desert is the rather dry land to the east and north-east of Lake Mweru. Here, and in parts of the lower Shire~~

~~district, the annual rainfall probably does not exceed an average of 35 inches. Elsewhere, in the vicinity of the highest mountains, the rainfall may attain an average of 75 inches, in parts of Mount Mlanje possibly often reach- ing to 100 inches in the year. The average may be put at 50 inches per annum, which is also about the average rainfall of the Shire Highlands, that part of British Central Africa which at present attracts the greatest number of European settlers.~~

~~No part of the country comes within the forest region of West Africa. The whole of it may be said to lie within the savannah or park-like division of the conti- nent. As a general rule the landscape is of a pleasing and attractive character, well covered with vegetation and fairly well watered. Actual forests of lofty trees, forests of a West African type, are few in~~

~~*number, and are chiefly limited to portions of the Nyika, Angoniland, and Shire Highlands plateaux, and to a few nooks in valleys near the south end of Tanganyika. Patches of forest of tropi- cal luxuriance may still be seen on the slopes of Mounts Mlanje and Chiradzulu. On the upper plateaux of Mount Mlanje there are forests of a remarkable conifer (Widdring- tonia whytei), a relation of the cyg^ess, which in appearance resembles much more the cedar, and is therefore wrongly styled the "Mlanje cedar." This tree is remarkable as being the only conifer found growing in Central Africa between the mountains of Cape Colony and Natal in the south, and the highlands of Kilima-Njaro, Kenia, and Abyssinia in the north.^ Immense areas in the lower- lying plains are covered by long, coarse grass, sometimes reaching 10 feet in height. Most of the West African forest trees are represented in British Central Africa. A full list of the known flora has been compiled by Sir W. Thiselton-Dyer and his assistants at Kew, and is given in the first and second editions of Sir H. H. John- ston's work on British Central Africa. Amongst the principal vegetable products of the country interesting for commercial purposes may be mentioned coffee (wild coffee is said to grow in some of the mountainous districts, but the actual coffee cultivated by the European settlers has been introduced from abroad) ; indiarubber — derived chiefly from the various species of Landolphia and from other apocynaceous plants ; the Strophanthus^odi (furnish- ing a valuable drug) ; ground nuts (Arachis and Voand- zeia) ; the cotton plant ; all African cultivated cereals (sorghum, pennisetum, maize, rice, wheat — cultivated chiefly by Europeans — and eleusine) ; and six species of palms — the oil palm on the north-west (near Lake Nyasa, at the south end of Tanganyika, and on the Luapula), the Borassus and Hyphmne, Phoenix (or wild date), Baphia and the cocoanut palm. The last-named was introduced by Arabs and Europeans, and is found on Lake Nyasa and on the Lower Shire. Most of the European vege- tables have been introduced, and thrive exceedingly well, especially the potato. The mango has also been intro- duced from India, and has taken to the Shir^ Highlands as to a second home. Oranges, lemons, and limes have been planted by Europeans and Arabs in a few districts. European fruit-trees do not ordinarily flourish, though apples are grown to some extent at Blantyre. The vine hitherto has proved a failure. Pineapples give the best result amongst cultivated fruit, and strawberries do well in the higher districts. In the mountains the native wild brambles give blackberries of large size and excellent flavour.*~~

~~*The fauna is on the whole very rich. It has affinities in a few respects with the West African forest region, but*~~

~~*1 The present writer has explored the Cameroon Range in West Equatorial Africa, and found no conifer there. It would seem there- fore as though conifers had been limited in their African distribution to the eastern half of the continent.*~~

~~*differs slightly from the countries to the north and south by the absence of such animals as prefer drier climates, as for instance the oryx antelopes, gazelles, apd the ostrich. There is a complete blank in the distribution of this last between the districts to the south of the Zambezi and those of East Africa between Victoria Nyanza and the Indian Ocean. The giraffe is found in the Luangwa valley ; it is also met with in the extreme north-east of the country. The ordinary African rhinoceros is still occasionally, but very rarely, seen in the Shir^ Highlands. The African elephant is fairly common throughout the whole territory. Lions and leopards are very abundant ; the zebra is still found in great numbers, and belongs to the Central African variety of Burchell's zebra, which is completely striped down to the hoofs, and is intermediate in many particulars between the true zebra of the moun- tains and Burchell's zebra of the plains. The principal antelopes found are the sable and the roan (Hippo- tragus), flve species of Cobus or waterbuck (the puku, the Senga puku, the lechwe, Crawshay's waterbuck, and the common waterbuck) ; the pallah, the tsessebe, the hartebeest, the gnu, the duyker, the klip-springer, the oribi, the steinbok, and the reedbuck. Among tragelaphs are the bushbuck, the inyala, the water tragelaph {Tragelaphus selousi), the kudu, and Living- stone's eland. The only buffalo is the common Cape species. The hysena is the spotted kind. The hunt- ing dog is present. There are some seven species of monkeys, including two baboons and one colobus. The hippopotamus is found in the lakes and rivers, and all these sheets of water are infested with crocodiles, apparently belonging to but one species, the common Nile crocodile.*~~

~~*The human race is represented by only one indigenous native type — the Negro. No trace is anywhere found of a Hamitic intermixture. Arabs from Zanzibar have settled in the country of late years, but not, as far as we know, from any period exceeding a century back. As the present writer takes*~~

~~*the general term " Negro " to include equally the Hottentot, Bushman, and Pigmy tribes of Africa, this designation will cover all the natives of British Central Africa; they exhibit, however, in some parts signs of Hottentot or Bushman intermixture, and there are legends in some mountain districts of the former existence of un- mixed Bushman tribes, while Bushman stone implements are found at the south end of Tanganyika. At the present day the population is, as a rule, of a black or chocolate- coloured Negro type, and belongs, linguistically, entirely and exclusively to the Bantu family. The languages spoken offer several very interesting forms of Bantu speech, nota- bly in the districts between the north end of Lake Nyasa, the south end of Lake Tanganyika, and the river Luapula. In the more or less plateau country included within these geographical limits the Bantu dialects are of a very archaic type, and to the present writer it has seemed as though one of them, Kiemba — or Kiwemba — came nearer than any other spoken tongue to the original form of the Bantu mother language. Through dialects spoken on the west and north of Tanganyika these languages of the northern districts are somewhat closely connected with the Bantu dialects of Uganda. They also offer some resemblance to Zulu-KafBr, and it would seem as though the Zulu-Kaffir race must have come straight down from the countries to the north-west of Tanganyika, across the Zambezi, to their present home. Curiously enough, some hundreds of years after this southward migration, intestine ■ wars and conflicts actually determined a north-westward return migration of Zulus. Prom Matabeleland Zulu tribes crossed the Zambezi at various periods (commencing from about eighty years ago), and gradually extended their ravages and dominion over the plateaux to the west.*~~

~~*north, and north-east of Lake Nyasa. The Zulu lan- guage IS still spoken by the dominating caste in West Nyasaland. As regards foreign settlers in this part of Africa, the Arabs may be mentioned first, though they are now met with only in very small numbers. The Arabs undoubtedly first heard of this rich country— rich not alone in natural products such as ivory, but also in slaves of good quality— from their settlements on the river Zambezi, and*~~

these settlements date back to a very early period, and are possibly coeval with the pre-Islamite Arab settlements in the gold-bearing regions of South-East Africa. But the Arabs do not seem to have made much progress in their penetration of the country in the days before firearms ; and when firearms came iato use they were for a long time forestalled by the Portuguese, who ousted them from the Zambezi. But about one hundred years ago the increasing power and commercial enterprise of the Arab sultanate of Zanzibar caused the Arabs of Maskat and Zanzibar to march inland from the east coast. They gradually began to found strong slave- trading settlements on the east and west coasts of Lake Nyasa, and thence westwards to Tanganyika and the Luapula. They never came in great numbers, however, and, except here and there on the coast of Lake Nyasa, have left no mixed descendants in the population. Of Europeans British Central Africa proper (the Protec- torate) now possesses about 450 settlers, including about 100 officials and military and naval officers. The Euro-peans are chiefly natives of the United JKingdom, but there are a few Germans, Dutchmen, French, Italians, and Portuguese. The British Protectorate established over Central Africa has attracted an increasing number of Indian traders, besides whom about 300 British Indian soldiers (Sikhs) are employed as the nucleus of an armed force.

The total value of the trade of the British Central Africa Protectorate in the year 1899-1900 was £255,384, showing an increase of 75 per cent, on the figures for the previous year. Imports were valued at £ 176,035, an increase of 62 per cent., and exports at £79,449, an in- crease of 109 per cent. The principal exports are coffee, rubber, and ivory. A number of Englishmen and Scots- men (perhaps a hundred) are settled, mainly in the Shire Highlands, as coffee planters. A railway from the coast to Lake Nyasa is now considered, however, to have become an imperative necessity if the trade of the Pro- tectorate is still further to increase. The African trans-continental telegraph line runs through the Protectorate, and a branch line has been established from Lake Nyasa to Fort Jameson, the present headquarters of the Char- tered Company in North-Eastern Ehodesia. The prin- cipal European settlement or town is Blantyre, at a height of about 3300 feet above the sea, in the Shire Highlands. This place was named after Livingstone's birthplace, and was founded in 1876 by the Church of Scotland Mission. The Government capital, however, is Zomba, at the base

~~of the mountain of that name. Other townships or sites of European settlements are Port Herald (on the lower Shir^), Chiromo (at the junction of the Euo and the Shir^), Eort Anderson (on Mt Mlanje), Fort Johnston (near the outlet of the river Shire from the south end of Lake Nyasa), Kotakota and Bandawe (on the west coast of Lake Nyasa), Likoma Island (off the east coast of Lake Nyasa), Karonga (on the north- west coast of Lake Nyasa), Fife (on the NyasarTan- ganyika plateau), Abercorn (on the south end of Lake Tanganyika), and Ehodesia (on the east coast of Lake Mweru). The present political divisions of the country are as follows : — The districts surrounding Lake Nyasa and the Shir^ Province are governed directly under the Imperial Government by a Commissioner, who acts under the orders of the Foreign Office. The districts to the westward forming the province of Northern Ehodesia are governed by an official of the British South Africa Char- tered Company under the direction of the aforesaid Com- missioner and of the Foreign Office. In process of time the two administrations will probably be fused in name as they are already ia actuality.~~

~~History.— The history of the territory dealt with above is recent and slight. Apart from the vague Portuguese wanderings during the 16th and 17th centuries, the first European explorer of any education who penetrated into this country was the celebrated Portuguese official, Dr F. J. M. de Lacerda e Almeida, who journeyed from Tete on the Zambezi to the vicinity of Lake Mweru. But the real history of the country begins with the advent of Livingstone, who in 1859 penetrated up the Shir^ river and discovered Lake Nyasa. Livingstone's subsequent journeys to the south end of Tanganyika, to Lake Mweru, and to Lake Bangweulu (where he died in 1873), opened up this important part of South Central Africa and centred in it British interests in a very par- ticular manner. Liviagstone's death was soon followed by the entry of various missionary societies, who com- menced the evangelization of the country; and these missionaries, together with a few Scottish settlers, steadily opposed the attempts of the Portuguese to extend their sway in this direction from the adjoining provinces of Moqambique and of the Zambezi. From out of the mis- sionary societies grew a trading company, the African Lakes Trading Corporation. This body came into conflict with a number of Arabs who had established themselves on the~~

north end of Lake Nyasa. About 1885 a struggle began between Arab and Briton for the possession of the country, which was not terminated until the year 1896. The African Lakes Corporation in its unofficial war en- listed volunteers, amongst whom were Captain (afterwards Brigadier-General) Lugard and Mr Alfred Sharpe. Both these gentlemen were wounded, and the operations they imdertook were not crowned with complete success. The present writer was sent out in 1889 to endeavour to effect a possible arrangement of the dispute between the Arabs and the African Lakes Corporation, and also to ensure the protection of friendly native chiefs from Portuguese aggression beyond a certain point. The outcome of these efforts and the treaties made was the creation of the British Protectorate and sphere of influence north of the Zambezi. In 1891 Mr (afterwards Sir) Harry Johnston returned to the country as Imperial Commis- sioner and Consul-General. In the interval between 1889 and 1891 Mr Alfred Sharpe, on behalf of Mr Ehodes, had brought a large part of the country into treaty with the British South Africa Company. These territories, now known as Northern Ehodesia, were administered for a considerable period by the present writer in connexion with the British Central Africa Protectorate. Between 1891 and 1895 a long struggle continued between the British authorities on the one hand and the Arabs and Mahommedan Yaos on the other regarding the suppres- sion of the slave trade. By the beginning of 1896 the last Arab stronghold was taken and the Yaos were com- pletely reduced to submission. Then followed during 1896-98 wars with the Zulu tribes, who claimed to domi- nate and harass the native populations to the west of Lake Nyasa. The Zulus having been subdued, there was every prospect of the country enjoying a settled peace and considerable prosperity. The native population numbers about 2,000,000, and is well disposed towards European rule, having indeed at all times furnished the principal contingent of the armed force with which the African Lakes Company or the British Government endeavoured to oppose Arab or Zulu aggression. The

Imperial Government maintains six gunboats on Lake Nyasa and the rivers Shir^ and Zambezi. The actual native (African) strength of the 1st battalion

~~British Central Africa Regiment in 1900 was 865 ; a 2nd battalion was raised for service outside the Protectorate.~~

~~Unfortunately, though so rich and fertile, the land is not as a rule very healthy for Europeans, though of late it has shown signs of improvement in this respect. The principal scourge is black-water fever, which appears to be a result of the opening up of fresh untilled soil to cultivation. The climate is agreeable, and except in the low-lying districts is never unbearably hot ; while on the high mountain plateaux frost frequently occurs during the dry season.~~

~~See The Lands of Cazembe (Dr Lacerda's journey to Cazembe in 1898), a compilation by the late Sir R. F. Bdrton. — The Second Zambezi Expedition and Last Journeys of Dr Livingstone, by the late Rev. Horace Waller. — The Life of Livingstone, by Sir H. H. Johnston. — Captain Elton's Travels in East Africa. — Adveti- tures in Nyasaland, by L. Monte ith Foihekingham. — To the Central African Lakes and Back, by Joseph Thomson. — An Eiicylopceedic Dictionary of the Manganja Language as spoken in British Central Africa, by the Rev. D. C. Scott. — British Central Africa, by Sir H. H. Johnston. — Africana, by the Rev. Alex- ander Dupp. — The Shire Highlands, by John Buchanan. — Three Tears in Savage Africa, by Lionel Deole. (h. H. J.)~~

~~Central America, that portion of the American continent which lies between Mexico and Colombia, and comprises the area of the five states of Guatemala, Hon- duras, Salvador, Nicaragua, and Costa Kica. An attempt, in which the Guatemalan president was the chief mover, was made in 1884 and 1885 to unite these states in a Central American federation, but both constitutional methods and military coercion failed. In 1895 the three states of Honduras, Salvador, and Nicaragua united for the purposes of foreign relations in a confederation called the Greater Republic of Central America. A Diet was convened and officials were appointed for the direction of~~

~~affairs ; but in 1898, when the new regime was on the point of commencing, a revolution overthrew the Salvar dorian government, and the Greater Republic separated into its constituent states.~~

~~*Central Falls, a city in Providence county, Rhode Island, U.S.A., formed from a part of Lincoln town. It is on Blackstone river and on a branch of the New York, New Haven and Hartford railway. It has extensive manufactures, principally of cotton and woollen goods. Population (1900), 18,167.*~~

~~*Central India, the official name of a collection of native states under a political agent to the Governor- General, who resides at Indore. They cover a large tract of country eastward of Rajputana, including Malwa, and extending northwards from the Nerbudda river to the Chambal and the Sone. There are seven subordinate agencies : Gwalior, Indore, Bhopal,Bhopawar, West Malwa, Bundelkhand, and Baghelkhand. Their total area is 77,808 square miles. The population in 1881 was 9,387,119 ; in 1891 it was 10,318,812, showing an increase of 10 per cent, and an average density of 133 persons per square mile. In 1901 the population was 8,501,883, showing a decrease of 17 per cent., due to the effects of famine, which was most severely felt- in Bhopal and West Malwa. The whole is now fairly provided with railways, largely at the expense of Sindhia. There are British cantonments at Mhow, Neemuch, and Nowgong.*~~

~~*Central Provinces, the official name of a pro- vince of British India, under the administration of a chief commissioner. It lies in the very middle of the peninsula, and comprises several native states still in a backward stage of civilization. The total area, including feudatory states, occupies 115,936 square miles ; in 1891 the popu- lation was 12,944,805. The capital is Nagpur.*~~

~~*Population. — The following table gives the area and population of the Central Provinces in 1891 : —*~~

~~*British Territory.*~~

~~*Area*~~

~~*in Square*~~

~~*MUes.*~~

~~*Number of*~~

~~*Towns and*~~

~~*VUlages.*~~

~~*Population, Census of 1891.*~~

~~*Density of*~~

~~*Population*~~

~~*to Square*~~

~~*Mile.*~~

~~*Population,*~~

~~*Census of*~~

~~*1881.*~~

~~*DiviBionB.*~~

~~*Districts.*~~

~~*Males.*~~

~~*Females.*~~

~~*Total.*~~

~~*Nflgpor*~~

~~*Chhattlggiirh Jubbulpore .*~~

~~*Nerbudda*~~

~~*Nsgpnr*~~

~~*Bhandara*~~

~~*Ghanda*~~

~~*Wardha*~~

~~*Balaghat*~~

~~*Ealpnr Bllaspur Sambalpnr .*~~

~~*Jubbulpore . Baugor Damoh Beoni . Mandla*~~

~~*Hoehangabad Narslnghpur Betul . Ohlndwara . Nimar*~~

~~*8,848 3,968*~~

~~*10,T49*~~

~~*2,428 8,189*~~

~~*1,691 1,620 2,761 914 1,102*~~

~~*882,863 866,696 852,827 208,286 190,649*~~

~~*874,999 876,164 846,288 197,568 192,682*~~

~~*767,862 742,860 697,610 400,354 888,381*~~

~~*197 187 65 165 122*~~

~~*697,866 688,779 649,146 337,221 840,564*~~

~~*24,127*~~

~~*8,078*~~

~~*1,495,821*~~

~~*1,486,686*~~

~~*2,982,507*~~

~~123~~

~~2,768,066~~

~~11,724 8,841 4,948~~

~~6,088 8,806 2,862~~

~~775,786 578,077 896,374~~

~~808,691 591,081 899,689~~

~~1,634,427~~

~~1,164,168~~

~~796,418~~

~~186 140 161~~

~~1,406,171~~

~~1,017,827~~

~~693,499~~

~~25,018~~

~~11,741~~

~~1,745,687~~

~~1,799,811~~

~~8,544,998~~

~~142~~

~~8,116,997~~

~~8,943 4,007 2,631 8,198 6,066~~

~~2,316 1,883 1,188 1,402~~

~~1,767~~

~~875,964 805,712 167,329~~

~~184,841 171,258~~

~~872,182 286,081 163,284 185,926 163,120~~

~~748,146 691,748 825,618 870,767 889,878~~

~~189 148 115 116 67~~

~~687,238 664,950 812,967 884,733 801,760~~

~~19,040~~

~~8,446~~

~~1,205,099~~

~~1,170,548~~

~~2,876,642~~

~~124~~

~~2,201,638~~

~~4,594 1,916 8,824 4,680 8,867~~

~~1,688 1,012 1,166 1,746 594~~

~~270,628 184,057 162,662 202,129 181,226~~

~~259,822 182,969 160,5.84 205,865 122,260~~

~~529,945 867,026 828,196 407,494 263,486~~

~~115~~

~~192~~

~~84~~

~~88~~

~~76~~

~~488,787 866,178 304,906 872,899 281,841~~

~~18,821~~

~~6,090~~

~~960,697~~

~~980,450~~

~~1,831,147~~

~~102~~

~~1,768,106~~

~~Total British Territory~~

~~86,601~~

~~34,855~~

~~6,397,804~~

~~6,386,990~~

~~10,784,294~~

~~126~~

~~9,888,791~~

~~Total Native States ....~~

~~29,485~~

~~10,407~~

~~1,089,011~~

~~1,071,600~~

~~2,160,611~~

~~78~~

~~1,709,720~~

~~Grand Total~~

~~:~~

~~115,986~~

~~44,762~~

~~6,486,815~~

~~6,453,490~~

~~12,944,806~~

~~111~~

~~11,543,511~~

~~Between 1881 and 1891, population increased at the rate of 9-6 I native states. Classified according to religion, in British districts per cent, in~~

~~British territory, and at the rate of 26 per cent, in | only, Hindus numbered 8,831,467, or 82 per cent, of the total~~

~~population; Mahommedans, 297,604, or 2-8 per cent., mostly oon- tned to the towns, being a much smaller proportion than in any other province of India. Aboriginal tribes numbered 1,592,149, or 15 per cent., the proportion rising to as high as 46 per cent, in the four hill districts on the Satpura range. Most of these are Gonds, who still preserve their own language, spoken by 1,379,580 persons in all India. In the native states the proportion of aboriginal tribes was 23 per cent. Christians numbered 12,979, or -12 per cent., of whom 4782 were Europeans, 2105 Eurasians, and 578 Indo-Portuguese, leaving 5514 for native converts, chiefly in the two districts of Nagpur and Eaipur. In the native states the total number of Christians was 338, having risen from 24 since the previous census. Jains numbered 48,644, chiefly in Saugor dis- trict ;, Parsis, 781, chiefly in Nagpur ; and "others," 938.~~

~~The preliminary returns of the census of 1901 gave a total popu- lation for the British districts of 9,845,318, showing a decrease of 938,976 or 8-7 per cent., due to the results of famine. In the feudatory states the population in 1901 was 1,983,496, showing a decrease of 8 per cent.~~

~~Out of a total surveyed area of 55,413,037 acres, the area assessed to land revenue is 28,486,863, the average incidence being Bs.0 : 4 : 7 (say 5d.) per acre. In 1897-98 the total cultivated area was 15,390,504 acres, of which 1,134,727 acres were cropped more than once. The total irrigated area was 562,628 acres, almost entirely rice-land watered from tanks. There are no Government canals. The principal crops are rice (in Chhattisgarh), wheat (in the Nerbudda valley), millet, pulse, oil-seeds, and cotton (in the Wardha valley). In 1896-97 the total area under cotton was 737,104 acres.~~

~~Industries. — The only important industries are connected with cotton and coal. In 1897 the total number of factories under Government inspection was 35, of which 26 worked in cotton. The total number of hands employed~~

~~was 10,359, of whom 509 were children. The number of cotton-mills was 6, all owned by companies having a nominal capital of Rs.70,00,000, with 1708 looms and 124,610 spindles, working up in the year 200,000 cwt. of raw cotton, and employing 6930 hands, of whom 4830 were adult males. The total out-turn was 18,334,320 lb of yarn, chiefly of counts between Nos. 6 and 22 ; and 5,110,292 lb of woven goods. There are also about 30 factories for cleaning and pressing cotton. In 1896 a brewery was established at Jubbulpore, with an out-turn of 155,000 gallons. Two coal-mines are worked in the Central Pro- vinces, at Warora and Mopani, to each of which there is a branch line of railway. In 1897-98 the output of the Warora colliery was 115,682 tons. The number of persons employed was 1435, of whom 1263 were adult males. In connexion with the colliery there is a fireclay business, which raised 2065 tons of fireclay and sold fire-bricks and tiles to the value of Es.34,948. The Mopani colliery, which dates back to 1860, is worked by a joint-stock company. In 1898 the output was 22,472 tons, and the number of persons employed 276.~~

~~Railways. — Until recently, the only railway in the Central Provinces was the Great Indian Peninsula, with two branches, one terminating at Nagpur, the other at Jubbulpore, whence it was continued by the East Indian system to Allahabad. The Bengal-Nagpur line has now opened up the eastern portion of the country, bringing it into direct connexion with Calcutta ; and a new branch of the Indian Midland, from Saugor through Dainoh, has been partly constructed as a famine work. Large portions, however, in the hilly centre and in the south-east, are still remote from railways.~~

~~Trade. — The trade of the Central Provinces is conducted mainly by rail with Bombay and with Calcutta. The following table gives the average value of imports and exports for three quinquennial periods ending 1887-88, 1892-93, and 1897-98 :—~~

~~Imports.~~

~~Exports.~~

~~Average, 1883-84 to 1887-88~~

~~,, 1888-89 to 1892-93~~

~~*1893-94 to 1897-98*~~

~~*Es.*~~

~~*3,54,32,617 3,42,23,356 4,33,44,883*~~

~~*Rs.*~~

~~*4,16,27,507 5,19,61,509 5,11,24,312*~~

~~*The chief imports are cotton piece goods, cotton twist, salt, sugar, provisions, railway materials, raw cotton, metals, coal, tobacco, spices, and kerosene oil. The chief exports are raw cotton, rice, wheat, oil-seeds, hides, and lac. The exports of wheat are liable to extreme fluctuations. During the five years ending 1887-88 they averaged nearly 8 million maunds ; in 1888-89 they reached their maximum of 10 million maunds ; during the five years ending 1897-98 they averaged only 2 million maunds, while in the famine year, 1897-98, they dropped to 280,000 maunds.*~~

~~*Local Government. — The total number of civil and revenue courts is 245, and of criminal courts, 385. In 1898 the total number of police was 8606. The total number of municipalities*~~

~~*in the Central Provinces is 53, with an aggregate population of about 800,000. In all of them, except the hill station of Pach- marhi, a majority of the municipal committee is elected. Out of a total of 623 members, 445 are elected, and 565 are natives of India. In 1897-98 the aggregate municipal income was Rs. 13,91,958, of which Rs. 8,08, 782 was derived from octroi and Es. 86,422 from water-rates. The aggregate municipal expenditure was Rs.13,95,266, of which Es.2, 69,986 was devoted to conservancy, Es. 1,28,896 to waterworks, Es.l, 51,490 to education, Rs.73,616 to public works, and Es. 80,067 to hospitals. In every district, except Mandla, there is a district council, with subordinate local boards. The total number of members of these bodies is 1197, of whom 913 are elected and 1162 are natives of India. The aggregate income was Es.7,97,158, of which Es.3, 76,000 was derived from local rates and Es.1,95,000 from cattle pound fees. The aggregate expenditure was Rs. 7,18,221, of which Rs.2,89,000 was*~~

~~*devoted to education, Es.l, 94,000 to roads and public works, and Es.87,000 to hospitals and sanitation.*~~

~~*The net revenue and expenditure of the Central Provinces (in tens of rupees) for 1897-98 was as follows, distributed under the three heads of imperial, provincial, and local: — Net revenue, im- perial, Ex.377,503 ; provincial, Ex.835,210 ; local, Ex.75,555 ; total, Ex.1,288,268. Net expenditure, imperial, Ex.1, 189,376 ; provin- cial, Ex.821, 193 ; local, Ex.89,572 ; total, Ex.2,100,141. The chief sources of revenue were : land, Ex.664,856 ; excise, Ex.173, 168 ; stamps, Ex.158,414.*~~

~~*Education.^-'Vhe following table gives the chief statistics of education in the Central Provinces for the decennial years 1886-87 and 1896-97 :—*~~

~~*18S6-3T.*~~

~~*n896-9T.*~~

~~*Schools.*~~

~~*PupUs.*~~

~~*Schools.*~~

~~*Pupils.*~~

~~*Colleges .*~~

~~*Secondary Schools . Primary Schools . Special Schools Private Institutions.*~~

~~*Total .*~~

~~*3*~~

~~*71*~~

~~*1799*~~

~~*18*~~

~~*4*~~

~~*100*~~

~~*4,216*~~

~~*102,173*~~

~~*463*~~

~~*49*~~

~~*5*~~

~~*248*~~

~~*2262*~~

~~*9*~~

~~*312*~~

~~*26,216*~~

~~*122,616*~~

~~*363*~~

~~*1895*~~

~~*107,001*~~

~~*2524*~~

~~*149,507*~~

~~*Compared with the estimated population of school-going age (15 per cent, of the total population), the proportion of boys at school rose between 1895 and 1901 from 11‘3 to 14-2 percent., and the proportion of girls from -8 to*~~

1-1 per cent. The expenditure on education was, in 1886-87, Es.8,19,228 ; in 1896-97, Es. 10,52,^05.

Famine. — The Central Provinces have suffered from famine more severely than any other part of India. The complete failure of rain in the autumn of 1896 caused scarcity to develop suddenly into famine, which lasted until the end of 1897. The total number of persons in receipt of relief reached its maximum of nearly 700,000 in May 1897. The expenditure on relief alone was Es.l, 56,10, 739 (say 1 million sterling) ; and the total cost of the famine, including loss of revenue, amounted to nearly twice that amount. During 1897 the death-rate for the whole province rose to 69 per thousand, or double the average, while the birth- rate fell to 27 per thousand. The Central Provinces were stricken by another famine, yet more severe and widespread, caused by the complete failure of the rains in 1899. The maximum of persons relieved for the whole province was 1,971,000 in June 1900. In addition, about 68,000 persons were in receipt of relief in the native states. During the three years 1889-1902 the total expenditure on famine relief amounted to Es.6,10,81,000 (say 4 millions sterling) .

See E. H. Ckaddock. Report on The Famine in the Central Provinces in 1896 and 1897. Nagpur, 1898. (j. g. co.)

Central ia, a city of Marion county, Illinois, U.S.A., situated south of the centre of the state, on the Illinois Central railway and three smaller railways, at an altitude of 490 feet. It contains works of the Illinois Central railway, coal-mines and iron-works. Population (1880), 3621; (1890), 4763; (1900), 6721, of whom 571 were foreign-born and 418 were negroes.

Centuripe, formerly Centoebi, a town of Sicily, Italy, in the province of Catania, 32 miles K.W. from Ca- tania (28 miles by rail to Catenanuova ; thence 4 miles by road). It stands on a cliff (2307 ft.) overlooking the valley of the Simeto, and carries on sulphur-mining and flour-mill- ing. The ancient Centoripa, it was a town of considerable importance both in Sikelian and in Eoman times, but was

~~destroyed by the Emperor Frederick II. as a punishment for having revolted, and its inhabitants were removed to Augusta. Numerous antique vases, coins, &c., have been found in the vicinity. Population, about 10,000.~~

~~Cephalonia. See Gkbecb (Ionian Islands).~~

~~Ceram, or Si rang, an island of the Dutch East Indies, north of Amboyna. Area, 661 2 square miles. Pro- fessor Martin has demonstrated the similarity of its geo- logical structure — consisting chiefly of eruptive rocks and crystalline limestone — to that of northern Amboyna. The isthmus connecting the two parts of the island is very narrow, and has a height of only 460 to 490 feet. In the eastern section the prevailing rock is crystalline chalk, similar to that of Buru. No central chain of mountains stretches west and east through the island, but near the north coast mountains, rising 2300 to 2600 feet, slope steeply to the shore. Near the south coast, west of the Bay of Elpaputi, a complex mass of mountains forms a colossal pyramid, with peaks rising to nearly 5000 feet. The rivers flow north and south into bays, but are navigable only for a few miles during the rainy season. On the north coast the bays of Savai and Waru are accessible for small vessels. Besides other products, tobacco is cultivated for the European market. The island, which belongs to the Residency of Amboyna, is divided into Kairatu or West Ceram, Wahai and Amahei, the northern and the southern parts of Middle Ceram, and Waru or Eastern Ceram. Eecent estimates give only 100,000 for the population (of whom 12,000 are Christians and 16,000 Mahommedans). About 4000 persons perished in the earthquake of 1899.~~

~~Ceramics. See Pottbky.~~

~~Cernuschi, Henri (1821-1900), Italian poli- tician and economist, was born of wealthy parents at Milan in 1821, and was destined for the legal profession. During his studies he became involved in the revolu- tionary movement. He played a conspicuous part in the insurrection at Milan in 1848, and lalso at Rome in 1849, where he had a seat in the National Assembly. Ori the collapse of the Revolutionary Government he was arrested (1850), but managed to escape to Prance, where he engaged in commerce and banking, became naturalized, and acquired a large fortune.~~

~~He took a prominent part in opposing the Socialist movement, and in April 1870, having subscribed a large sum to the funds of a committee formed to combat the Napoleonic plebiscite, had to leave the country. In September the formation of the Third Republic enabled him to return, but he soon left Paris to travel in the East, whence he returned with a fine art collection, particularly of Japanese objects. Cernuschi is best known for his publications on financial questions, more especially bimetallism. Of the latter he was an ardent champion, and the word itself is commonly supposed to have originated with him — at least in its English form it is first found in his Silver Vindicated (1876). Among his other works may be mentioned: Micanique de Vichange (1861) ; Illusion des societds coopiratives (1866); Le BimetalUsme en Angleterre (1879) ; Le grand proc&s de I' Union latine (1884). He died in 1900. (j. m'f.)~~

~~Cerro de Pasco, or Pasco, a town of Peru, in the department of Junin, with a population estimated at about 15,000, wholly devoted to mining. The average annual output of the silver mines has since their opening been about 1,600,000 ounces of pure silver. It is esti- mated that the copper deposits contain 15 million tons of ore, or about 3 million tons of metallic copper. They will probably be worked as soon as the railway from Oroya can be built, which will put the mines in direct communi- cation with Callao.~~

~~Cervera, Pascual Cervera y Topete (1839- -), Spanish admiral, was born at Medina Sidonia on~~

~~18th February 1839. He showed an early inclination for the sea, and his family sent him to the Naval Cadet School at the age of twelve. As a sub-lieutenant he took part in the naval operations on the coast of Morocco during the campaign of 1859-60. Then he was for some time engaged in operations in the Sulu Islands and the Philip- pines. Afterwards he was on the West Indian station during the early part of the first Cuban war (1869-78), returning to Spain in 1873 to serve on the Basque coast against the Carlists. He distinguished himself in defend- ing the Carraca arsenal near Cadiz against the Federals in 1873. He won each step in his promotion up to flag-rank through his steadiness and brilliant conduct in action, and was awarded the crosses of the Orders of Military and Naval Merit, Isabella the~~

~~Catholic, and St Hermengilde, besides several medals. Cervera had a great reputation for decision, unbending temper, and honesty, before he was placed at the head of the Bilbao building-yards. This post he resigned after a few months in order to become Minister of Marine in 1892, in a Cabinet presided over by Sagasta. He withdrew from ^ the Cabinet when he found that his colleagues, from political motives, declined to support him in making reforms and, on the other hand, unwisely cut down the naval estimates. When the war broke out with the United States, Cervera was selected to command a squadron composed of four first-class cruisers, the Maria Theresa, his flagship, Oquendo, Vizcaya, and Columbus, and several destroyers. This ill-fated squadron only started upon its reckless cruise across the ocean after its gallant commander had repeatedly warned both the Minister of Marine and the Prime Minister, Sagasta, in despatches from Cadiz and from the Canary and Cape Verde Islands, that the ships were insufftciently provided with coal and ammunition. Some of them, indeed, even lacked proper guns. In compliance with the instructions of the Government, Admiral Cervera made for the landlocked harbour of Santiago de Cuba, where he co-operated in the defence, landing some guns and a naval brigade. In spite of his energetic representations, Cervera received an order from Madrid, dictated by political considerations, to sally forth. It meant certain destruction. The gallant squadron met forces trebly superior to it, and was totally destroyed. The admiral, three of his captains, and 1800 sailors and marines were taken by the victors to Portsmouth, in the United States. After the war, Cervera and his captains were tried before the supreme naval and military court of the realm, which honourably acquitted them all.~~

~~Cette, a seaport of France, in the arrondissement of Montpellier, department of Herault, 17 miles S.W. of that town, on the railway from Bordeaux to Montpellier. The total value of imports (general commerce) in 1899 was £5,192,000, and of the exports £1,372,000. In 1899 the number of vessels entered was 1135, tonnage 616,006 (of which 54 of 41,762 tons were from England); and cleared 1090, tonnage 656,059. Trade is chi,efly carried on with Spain (about half the total). The fore- going figures do not include the coasting trade, in con- nexion with which 767 vessels of 379,187 tons entered and 752 of 381,664 tons cleared. The harbour com- prises three basins and a comprehensive system of canals, the total area of~~

~~which is 111 acres, and the total length of quayage 9666 yards. Further improvements are in progress. Population (1881), 32,665 ; (1901), 33,065.~~

~~Cettigne (Cetinje), the capital of the principality of Montenegro, situated in a hollow plain (Polje)~~

~~deeply sunk in the heart of the limestone mountains, at a height of 2470 feet above the sea. It consists of some streets and a large market-place of little, clean houses, and has much more the appearance of a village than of a tpwn. The principal buildings are the monastery, the old palace (Bigliardo), the palaces of the prince and of the prince-royal, the hotel, the hospital, the reading-hall (CVtaomca), the women's institute, and the new military barracks. The old palace, a great quad- rangular building, contains the ministries, the gymnasium, and the tribunal.' The populaticJn of the whole hollow, including Cetinje, Bajce, Martinitche, Hum, and Donji Kraj, is about 1500.~~

~~Cetywayo, king of Zululand, was the son of King Umpanda. As early as 1856 he showed aspirations to the throne, which soon led to open war, and by victories over his father and brothers he virtually became king. By a compromise King Umpanda was made the " head " or adviser, with Cetywayo as the " feet " or administrator of the nation. The old king died in 1873, and Cetywayo was duly crowned in the presence of Mr (afterwards Sir) Theophilus Shepstone. The military power exercised by Cetywayo was, however, regarded by Sir Bartle Frere as a menace to Natal and the Transvaal, so he despatched an ultimatum to Cetywayo in December 1878, directing him to disband his formidable army, indemnify British subjects for outrages, and admit a British Eesident. No reply being vouchsafed. Lord Chelmsford, at the head of 13,000 troops, entered Zululand on 11th January 1879. The disaster of Isandlana and the defence of Eorke's Drift signalized the commencement of the campaign, but on 4th July Cetywayo was utterly routed by Lord Chelmsford, and was captured by Major Marter on 28th August. Zululand was placed under a British Eesident, and Cetywayo was taken to Cape Town, and afterwards to England, where he arrived 3rd~~

~~*August 1882. He remained in London until the following September, when the Government announced that they had decided upon his restoration, and sent him back to Africa. To his great disappointment, however, this proved to refer only to a portion of his old domains, the country north of the Umhlatusi river. Even here one of his chief enemies, Usibepu, was allowed to retain some territory allotted to him by Sir Garnet (afterwards Lord) Wolseley. Cety- wayo's enemies, headed by Usibepu, soon attacked him, and after a struggle of nearly a year's duration he was defeated and his kraal destroyed. He then took refuge in the Native Eeserve, where he died 8th February 1884. Cetywayo was a typical Zulu, brave and proud, but sunk in superstition and reckless of human life and human suffering. (g- f- b.)*~~

~~*Ceuta, a Spanish station and seaport on the north coast of Morocco, nearly opposite Gibraltar, in 36° 54' N. lat., 6° 18' W. long. It is situated on a sort of promontory connected with the African mainland by a narrow isthmus. The population has steadily grown in the last forty years, outside the penal settlement and the garrison, which have also been increased. In 1897 there were 12,868 inhabitants, as compared with 10,600 in 1887. The garrison averages 3500 men, and the number of convicts ranges from 2000 to 2500. 'The garrison is under the command of a general of division, resident in the citadel of El Hacho, with military com- mandants in charge of the principal defences, exterior lines, forts Isabel II. and Prince Alphonso, and other outworks. The local militia is composed of a squadron of mounted rifles of Africa, a marine company, and sharp- shooters of the Eiff. There is also in Ceuta one of the three African infantry regiments, and the disciplinary corps of military convicts styled " Fijo de Ceuta." The*~~

~~*Spanish forces in the other stations at Melilla, Islas Chaffarinas, Peiion de la Gomera, Alhucemas on the north coast of Morocco, are under the orders of the commander- in-chief of Ceuta. In the 'nineties the governments of the Eegency of Queen Christina were forced by public opinion to increase the garrison, fortifications, land and sea defences of Melilla. Little has been done, however, to improve the shallow harbour, much exposed to winds and gales that have often damaged its very imperfect moles and quays. The bay is commanded by the Moun- tain of the Marabout, a Moorish sepulchre better known as the Tomb of the Eenegadi. Ceuta has only lately been better fortified seawards, and guns have been mounted in works that are intended*~~

~~*to be troublesome for the highway of the seas into the Mediterranean. On the land side Ceuta is defended by three lines of fortifications, the first including only the antiquated citadel of El Hacho, between which and the third line stands the town proper, on the site of the ancient Sebta of the Arabs. On the north and west fronts of the peninsula the modern Ceuta rises in some sort in an amphitheatre. Beyond the third line of the fortification lies the neutral ground. The town has no striking public buildings: a modest cathedral of the 15th century, the town hall, barracks, a statue of Charles IV., and the convict prison in the old convent of San Francisco. Ceuta forms one of the judi- cial districts of the province of Cadiz, and is under the naval jurisdiction of Algeciras.*~~

~~*Ceylon, a large island and British colony, lying E. of the extreme southern point of India, with a grea,test length from north to south of 271-|- miles, a greatest breadth of 137^ miles, and an area of 25,363 miles, or somewhat less than four-fifths that of Ireland. Topographical, trigonometrical, cadastral, and archaeo- logical surveys have been placed upon a sound basis, but no geological survey, of which there is great need, has yet been definitely commenced.*~~

~~*Meteorology. — ^Notice should be directed to the wonderful im- munity of Ceylon from cyclones, earthquakes, or other volcanic disturbances, and from destructive hurricanes. The latest tables of rainfall and temperature are as follows : —*~~

~~*p*~~

~~*.s*~~

~~*Barometer*~~

~~*g*~~

~~*θ)*~~

~~*e*~~

~~*_e*~~

~~Name of Station.~~

~~■s~~

~~3 <~~

~~a to~~

~~a~~

~~(rednc.toS-z'f'.)~~

~~IS~~

~~■as*~~

~~|-l~~

~~Ii~~

~~P~~

~~ii~~

~~■S'S~~

~~H~~

~~Feet.~~

~~Miles.~~

~~Colombo .~~

~~40~~

~~88-81~~

~~80-072~~

~~29-607~~

~~80-07~~

~~198-2~~

~~178~~

~~11-90~~

~~Ratnapura .~~

~~84~~

~~150-13~~

~~80-008~~

~~29-314~~

~~79-1~~

~~81-0~~

~~207~~

~~11-42~~

~~Puttalam .~~

~~27~~

~~46-08~~

~~80-106~~

~~29-535~~

~~79-5~~

~~208-0~~

~~77~~

~~12-06~~

~~Anuradhapura~~

~~295~~

~~64-44~~

~~29-840~~

~~29-264~~

~~80-2~~

~~54-8~~

~~104~~

~~9-32~~

~~Mannar~~

~~12~~

~~38-24~~

~~80-108~~

~~29-588~~

~~81-7~~

~~214-7~~

~~61~~

~~11-00~~

~~Jafltaa~~

~~9~~

~~43-98~~

~~80-167~~

~~29-552~~

~~81-7~~

~~216-0~~

~~74~~

~~9-92~~

~~Trincomalee~~

~~12~~

~~62-74~~

~~30-062~~

~~29-402~~

~~81-2~~

~~241-7~~

~~112~~

~~8-21~~

~~l^atticaloa .~~

~~26~~

~~56-85~~

~~80-108~~

~~29-566~~

~~80-4~~

~~120-7~~

~~102~~

~~10-46~~

~~Hambantota~~

~~50~~

~~86-17~~

~~80-034~~

~~29-588~~

~~79-7~~

~~199-7~~

~~85~~

~~5-06~~

~~Galle .~~

~~48~~

~~91-88~~

~~30-081~~

~~29-621~~

~~79-7~~

~~150-8~~

~~206~~

~~7-66~~

~~Kandy~~

~~1654~~

~~81-65~~

~~28-426~~

~~27-975~~

~~75-3~~

~~49-5~~

~~193~~

~~8-95~~

~~HakgaUa .~~

~~5581~~

~~91-12~~

~~24-725~~

~~24-206~~

~~60-8~~

~~161-4~~

~~203~~

~~7-40~~

~~Badnlla .~~

~~2225~~

~~79-51~~

~~27-905~~

~~27-396~~

~~73-0~~

~~47-8~~

~~111~~

~~9-46~~

~~Vavuniya .~~

~~317~~

~~69-48~~

~~29-850~~

~~29-271~~

~~80-8~~

~~■ 78-7~~

~~*100*~~

~~*6-40*~~

~~*Kurunegala*~~

~~*381*~~

~~*84-30*~~

~~*79-6*~~

~~*29-6*~~

~~*172*~~

~~*6-97*~~

~~*Nuwara Eliya .*~~

~~*6188*~~

~~*94-14*~~

~~*24’-228*~~

~~*23-800*~~

~~*57-9*~~

~~*81-8*~~

~~*202*~~

~~*9-11*~~

~~*The above figures give the results of twenty-eight years’ unbroken observations.*~~

~~*Flora and Fauna. — A great change has been eflected in the appearance of the country by the introduction of the tea plant in place of the coffee plant, after the total failure of the latter owing to disease. Unlike the coffee plant, the hardy tea plant grows from sea-level to 7000 feet altitude ; but Crown forest-lands above 5000 feet are no longer sold, so that a very large area on the highest mountain ranges and plateaux is still under forest. More- over, on the tea plantations arboriculture is attended to in a way unknown in 1875 ; the Australian eucalypts, acacias, and grevilleas, Indian and Japanese conifers, and other trees of different lands, are now freely planted for ornament, protection*~~

~~*from wind, for firewood, or for timber. A great advance has been made at Hakgalla and Nuwara Eliya, in Upper Uva, and other high districts, in naturalizing English fruits and vegetables. The calamander-tree is nearly extinct, and ebony and other fine cabinet woods are getting scarce ; but the conservation of forests after the Indian system has been taken in hand under a director and trained officers, and much good has been done. The cinnamon- tree (wild in the jungles, cultivated as a shrub in plantations) is almost the only one yielding a trade product which is indigenous to the island. The cocoa-nut and nearly all other palms have been introduced.*~~

~~*A Game Preservation Society and the judicious action of Govern- ment have done much to prevent the wanton destruction of Ceylon deer, elephants, &c., by establishing a close season. It is estimated that there must be 5000 wild elephants in the Ceylon forests. Since 1864, 2800 elephants have been exported (worth nomin- ally, on the spot, £80,000), chiefly to India. A license to shoot or capture and an export royalty are now levied by Government. Capt. v. Legge includes 371 species of birds in Ceylon, of which only two have been introduced into the island. Insects and reptiles do not trouble European residents so much as in early years — at any rate in the towns, while in the higher planting districts there is almost complete exemption from their unwelcome attentions. Bungalows are more carefully built to resist white ants, drainage and cleanliness prevent*~~

~~*mosquitoes and ticks from multiplying, while snakes and leeches avoid cultivated, occupied ground.*~~

~~*Population. — The total population of Ceylon in 1891 and 1901, distributed according to the nine provinces now existing, was as follows : —*~~

~~*Area in sq. MUes.*~~

~~*Total Pop.*~~

~~*1891.*~~

~~*Total Pop.*~~

~~*1901.*~~

~~*Males,*~~

~~*1901.*~~

~~*Females,*~~

~~*1901.*~~

~~*Estate Pop. 1901 .»*~~

~~*Western . Central Northern , Southern . Eastern*~~

~~*North- Western . North-Oentral . Uva . Sabaragamuwa .*~~

~~*Total, Ceylon .*~~

~~*1,432 2,300 3,368 2,146 4,037 2,997 4,002 3,155 1,901*~~

~~*764,828 474,670 819,686 490,074 149,736 320,070 75,333 169,201 258,626*~~

~~*925,212 622,882 342,109 566,690 174,156 858,703 79,101 191,925 821,262*~~

~~403,864 339,060 172,870 288,812~~

~~91,122 195,777~~

~~43,273 106,081 176,362~~

~~481,348~~

~~283,772~~

~~169,289~~

~~277,878~~

~~83,034~~

~~157,926~~

~~85,828~~

~~85,894~~

~~144,910~~

~~26,815~~

~~286,096~~

~~897~~

~~8,608~~

~~592~~

~~9,726~~

~~51,798 58,096~~

~~26,333"~~

~~*8,012,224*~~

~~8,576,990"~~

~~1,907,161~~

~~1,669,829~~

~~-441,523~~

~~1 A more accurate survey now gives the total area as 25,868 square miles. The new provinces of Uva and Sabaragamuwa are almost entirely included in Elandyan territory.~~

~~2 Including military, 3360 ; shipping, 4104 ; Boer prisoners of war, 4918.~~

~~3 Almost entirely immigrant coolies ftom Southern India.~~

~~The distribution as to race is as follows (1901) : —~~

~~Sinhalese, including Kandyans . . . 2,334,817~~

~~Tamils 952,287~~

~~"Moormen" (Mahommedans, chiefly Arab~~

~~descendants) 224,719~~

~~Malays 11,207~~

~~Javanese, KafEres, Afghans, Parsees, &c. . 20,115~~

~~Veddahs 1,000~~

~~Burghers and Eurasians .... 23,312~~

~~Europeans, Americans, &c. .... 9,583~~

~~Altogether there are representatives of some seventy races in Ceylon. The Veddahs, who run wild in the woods, are the aborigines of the island. The~~

~~population of Colombo, the com- mercial, social, and political capital, is now 158,093, inclusive of a floating population of about 4000.~~

~~Administration. — The legislative council now includes, besides the governor as president and the nine official members, eight unofficial members — one for the Kandyan Sinhalese (or High- landers) and one for the " Moormen " having been added in 1890. The term of office for the unofficial members is limited to five years, though the governor may reappoint if he choose. The king's advocate, the deputy-advocate, and the surveyor-general are now respectively styled attorney-general, solicitor-general, and director of public works. The civil service has been recon- stituted into five classes, not including the colonial secretary as a staff appointment, nor ten cadets ; these five classes number seventy officers. The jurisdiction of the district and police courts was increased a few years ago. The district judges (numbering 19) can punish up to two years' imprisonment, and impose'fines up to Rs.lOOO. The police magistrates (numbering 25) can pass sentences up to six months' imprisonment, and impose fines of Rs. 150. The criminal law has since 1890 been codified on the model of the Indian penal code ; criminal and civil procedure have also been the subject of codification. There are twenty-three prisons in the island, mostly small ; but convict establishments in and near the capital take all long-sentence prisoners. The average annual number of prisoners is 2271, each costing about £15 per annum. The total outlay on prisons is Es.4,50,000, or £30,000, a~~

~~year. The police number 1700 men and officers, costing Rs.6,60,000, or £44,000, a year.~~

~~There are 65 hospitals and asylums (including lunatic and leper asylums and the Eoyal Victoria Home for Incurables), and 242 dispensaries. The Government Medical Department numbers 134 doctors and 227 apothecaries, and the whole establishment and administration cost annually about £80,000 net.~~

~~Beligion. — The principal religions may be distributed as follows : —~~

~~_, . ,. f Eoman Catholics 280,000 \ „o(< f^r.~~

Christians jprotestants 80,000/ 3^”’°°”

Buddhists 2,075,000

Hindus 900,000

Mahommedans 240,000

The anomaly of an ecclesiastical establishment of Anglican and Presbyterian chaplains with a bishop of Colombo paid out of the general revenues ias been abolished in Ceylon, and only the bishop and two or three incumbents remain on the list for life, or till they retire on pension. Government has had to legislate for Buddhist temporalities, owing to the great corruption pre- vailing among priestly and lay trustees of temples ; committees

S. V.Darbislare £r O.J.R Howarth.

Sketch Map of Cetlon.

Oxford, igot.

for each are now nominally appointed, but it is doubtful if they work satisfactorily. In the Kandyan district, the temples being endowed and the priests independent, the latter have generally neglected their duties of teaching the young boys and keeping up the zeal of the people. In the low country the priests, being dependent on voluntary offerings, have been generally zealous and active. Ignorance is greatest, as regards education, in the districts where Buddhism is strongest. Of late years there has been a revival of Buddhism in the towns and adjacent districts, and schools have been opened after Western models. There are about 10,000 Buddhist priests in Ceylon.

Education. — There has been a great advance in public instruc- tion since 1875, through the multiplication of vernacular, Anglo- vernacular, and English schools by Government, by the different Christian missions, and by the Buddhists and Hindus who have come forward to claim the Government grant. The Government has also started a technical college, and an

agricultural school has been reorganized. An agricultural department, recommended by a commission, should profit by the services of the entomologist, mycologist, and chemical analyst added by the governor to the staff of the Eoyal Botanic Gardens at Peradeniya. There are industrial and reformatory schools, which are partially supported by Government. In spite of the great advance that has been made, however, at the census of 1891 no fewer than 2,600,000 of the total population were entered as un-

able to read or -write their own tongue, and the census of 1901 shows nearly two millions, out of a returned population of fully three and a half millions, still unable to read or write. The official returns (for 1898) show : —

500 Government schools 1328 Aided (chiefly mission) schools 2089 Unaided schools

with 48,642 scholars „ 120,751 „

„ 38,881 „

Total/ 3917 schools „ 208,274 „ The total expenditure was Rs.8,20,134, or about £55,000.

Finance.^With the disease of the coffee plant the general revenue fell from Es. 1,70,00,000 in 1877 to Rs. 1,20,00,000 in 1882, when trade was in a very depressed state, and the general prosperity of the island was seriously affected. Since then, however, the revenue has steadily risen with the growing export of tea, cocoa-nut produce, plumbago, &c., and in 1900 it reached the unprecedented amount of Rs.2,73,25,930 against an expenditure of Rs.2,53,21,988, the rupee being fixed at 15 to the £ sterling. The railway and customs make up between them 56 per cent, of the revenue; arrack monopoly yields Rs.25,00,000, there being about 1500 taverns, selling, with the stores, 1,000,000 gallons of arrack. The salt monopoly yields Rs.10,00,000 ; stamp duties, Rs.15,00,000 ; land sales,

~~*Rs.7, 50,000. The one-sided import duty on grain, affecting about five-eighths of the people, is indefensible, since the "paddy" rent (the levy on rice locally grown) was abolished in 1892. In expenditure, public works and railways absorb one-fourth of the revenue ; military expenditure, Rs.19,00,000 ; public debt charges, Rs.30,00,000 (the public debt is about Rs.5, 60,00,000, or not much more than two years' revenue) ; medical administration and hospitals, Rs. 13,00,000 ; pensions, Rs.10,00,000 ; and the rest of the expenditure is absorbed by the various other branches of administration.*~~

~~*The Colombo municipality had a revenue for 1899 of Rs.10,88,520 against an expenditure of Rs.9,27,230. Kandy and Galle municipalities are much smaller, with revenues of about Rs. 1,40,000 and Rs.80,000 respectively, and local boards established in fourteen minor towns raise about Rs.10,00,000 altogether.*~~

~~*Minerals. — Commercially there are two established industries : (1) that of digging for precious stones, and (2) the much more im- portant industry of digging for plumbago or graphite, the one mineral of commercial importance found. Further developments may result in the shipment of the exceptionally pure iron ore found in different parts of Ceylon, though still no coal has been found to be utilized with it. Several places, too — Euanwella, Rangalla, Rangbodde, &c. — indicate where gold was found in the time of the Kandyan kings; and geologists might possibly indicate a paying quartz reef, as in Mysore. Owing to the greatly increased demand in Europe and America, plumbago in 1899 more than doubled in price, rising from £40 to £80, and even £100 a ton for the finest. Latterly there has been a considerable fall, but the permanent demand is likely to continue keen in consequence mainly of the Ceylon kind being the best for making crucibles. One consequence of the plumbago boom has been to bring European and American capitalists and Cornish and Italian miners into a field hitherto almost entirely worked by Sinhalese. Though some of the mines were carried to a depth of 1000 feet, the work was generally very primitive in character, and Western methods of working are sure to lead to greater safety and economy. Besides a royalty or customs duty of 5 rupees (about 6s. 8d.) per ton on all plumbago exported, the Government issue licenses at moderate rates for the digging of plumbago on Crown lands, a certain*~~

~~share of the resulting mineral also going to Government. The plumbago industry, in all its departments of mining, carting, preparing, packing, and shipping, gives employment to fully 100,000 men and women, still almost entirely Sinhalese. The wealthiest mine-owners, too, are Sinhalese land-owners or merchants. The ex- port has quadrupled since 1874, the increase latterly-being especially rapid— from 24,000 tons in 1898 to nearly 31,000 tons in 1899, when 15,000 tons went to the United States, 9300 tons to the United Kingdom, and nearly 6000 tons to the contment of Europe. The local customs value placed on the total export was about Rs 1,00,00,000 (nearly £700,000), but in the Western markets it was much larger. The export of plumbago in 1900 was under 20 000 tons In all there must be from 2500 to 3000 plumbago pit's or mines in Ceylon ; but many of these are abandoned or shut up and perhaps not more than from one-third to one-half are worked even under the influence of recent high prices. The finest bright silvery lump plumbago still commands prices UP to 800 rupees (nearly £54) per ton ; while the lower qualities in the form of chips and dust can be got for one-sixth (or less)~~

~~^ l-| A ^ T*f1 i" ^~~

~~As regards gems, there are perhaps 500 gem pits or quarries worked in the island during the dry season from November to June in the Ratnapura, Rakwane, and Matara districts. Some of these are on a small scale ; but altogether several thousands of~~

~~Sinhalese find a precarious existence in digging for gems. Rich finds of a valuable ruby, sapphire, cat's-eye, amethyst, alexandrite or star stone, are comparatively rare ; it is only of the commoner gems, such as moonstone, garnet, spinels, that a steady supply is obtained. The cat's-eye in its finer qualities is peculiar to Ceylon, and is occasionally in great demand, according to the fashion. The obstacle to the investment of European capital in " gemming " has always been the difficulty of preventing the native labourers in the pits — even if practically naked — from con- cealing and stealing gems. A Chamber of Mines, with a suitable library,' was established in Colombo during 1899.~~

~~Agriculture. — The area of uncultivated land must exceed 20,000 of the 25,365 square miles in the island. Of course a great deal is waste, besides~~

~~*lagoons, tanks, backwaters, &c. Thick forest land does not cover more than 5000 square miles. Scrub, or chena, and patana grass cover a very great area. The following estimate of the cultivated area is taken from Eerguson's Ceylon Handbook and Directory for 1901 : —*~~

~~*Acres cultivated.*~~

~~*600,000*~~

~~*and*~~

~~*jak. &c.*~~

~~*Rice (paddy cultivation)*~~

~~*Other grain (kurakkan, Indian corn, pulses.*~~

~~*legumes)*~~

~~*Cocoa-nuts (European and native) Areca nuts, Palmyra, and Kitul palms*~~

~~*Cinnamon*~~

~~*Cardamoms (European and native)*~~

~~*Other spices, nutmeg, clove, pepper, vanilla, ginger.*~~

~~*&c.*~~

~~*Other palms and fruit-bearing trees and shrubs.*~~

~~*breadfruit, plantains, pines, oranges, mangoes. Garden vegetables, roots, yams, cassava, manioc.*~~

~~*potatoes, cabbages, onions, chillies, cucumbers, Coffee (Arabica) European and native*~~

~~*Do. (Liberian) do. do.*~~

~~*Tea (European and native) .... Chocolate plant (cacao) (European and native)*~~

~~*Cinchona*~~

~~*Sugar-cane*~~

~~*Cotton . .*~~

~~*Tobacco*~~

~~*Citronella grass and other essential oil grasses Rhea, aloes, and other fibres*~~

~~*Rubber trees*~~

~~*Other new products*~~

~~*Blue gums and introduced timber trees*~~

~~*Cultivated grass land*~~

~~*Patana, natural pasturage, &c.*~~

~~*Total acres*~~

~~*120,000*~~

~~*625,000*~~

~~*135,000*~~

~~*45,000*~~

~~*8,000*~~

~~*10,000*~~

~~*243,000*~~

~~100,000~~

~~7,700~~

~~2,.500~~

~~392,000~~

~~30,000 2,200~~

~~13,000 1.000~~

~~25,000~~

~~40,000 1,000 2,600 5,000 8,000~~

~~15,000 1,000,000~~

~~3,434,000~~

~~Tea, cacao, cardamoms, cinchona, coffee, and indiarubber are the products cultivated by the European and an increasing number of native planters in the hill country and (for tea) part of the low country of Ceylon. It was owing to the failure of the coffee crops, as previously mentioned, that planters began extensively to grow the tea plant, which had already been known in the island for several years. By 1882 over 20,000 acres had been planted with tea, but the export that year was under 700,000 lb. Five years later the area planted was 170,000 acres, while the export had risen to nearly 14,000,000 R). By 1892 there were 262,000 acres covered with tea, and 71,000,000 ib were that year exported. In 1897, 350,000 acres were planted, and the export was 116,000,000 lb. And in 1901 the total area cultivated with tea was not under 390,000 acres, while the estimate of shipments was put at 146,000,000 lb . The maximum area ever under coffee was 272,000 acres in 1877, when the total export of that product was equal to 103,000,000 lb. Now only a few thousand (perhaps 9000) acres of coffee are all that §re left in Ceylon. Erom the first Ceylon tea found favour in the United Kingdom, Australia, and Canada, and its use is rapidly spreading throughout Europe and the United States. In 1900 the chief exports were to~~

~~the United Kingdom, nearly 114,000,000 lb ; to Australia, 17,600,000 lb ; to Russia, nearly 9,000,000 lb ; to America, 4,000,000 lb ; and to China for America, 1,260,000" R). Ceylon plantations of tea number in all about 1400, with as many European managers and assistants, giving employment to fully 400,000 Tamil men, women, and children. Nearly every plantation has its factory, with the machinery necessary to prepare the leaf as brought in from the bushes until it becomes the tea of commerce. The total amount of capital now invested in the tea industry in Ceylon cannot be less than £10,000,000 sterling. The t«a-planting industry more than anything else has raised Ceylon from the very depressed state to which it fell in 1882. Before tea was proved a success, however, cincHona cultivation was found a useful bridge from coffee to the Ceylon planter, who, however, grew it so freely that in one year 15,000,000 lb bark were shipped, bringing the price of quinine down from 16s. to Is. 6d. an ounce. Then the culture became~~

~~unprofitable, and in 1900 the export fell to 510,000 ft bark ; but with higher prices there is likely to be a revival of the product in Ceylon. More important, however, among new planting products is cacao (the "chocolate plant"), the growth and export of which have steadily extended since coflee failed, so that in 1899 the export was 42,745 cwt. Important also is the spice or aromatic product of cardamoms, of which the annual export is now about 540,000 R).~~

~~The culture of indiarubber has been begun on low-country plan- tations, and the industry is full of promise. The area of cultivation of the cocoa-nut palm has been greatly extended since 1875 by natives as well as by Europeans. The products of this palm that are exported, apart from those so extensively used in the island itself, exceed in a good year £1,000,000 sterling in value. The native trade in cinnamon has likewise greatly increased. The export of bales and chips increased from 2,335,961 lb in 1890 to 4,541,517 lb in 1900; of oil, from 108,787 oz. in 1890 to 118,778 oz. in 1899, when also over 800,000 lb of wild cinnamon were exported. Of citronella oil, 1,478,756 ft were exported in 1899 as compared with 909,942~~

~~ft in 1890, while of coir — rope, yarn, and fibre — the amount rose from just over 120,000 cwt. to close on 215,000 cwt. in 1900, the increase being almost entirely in the export of fibre. It is expected that viticulture, cotton culti- vation, and tobacco growing, the last of which is already freely carried on in the north and north-east districts, will be greatly developed along the course of the new northern railway. A scheme for growing sugar in the north-east of the island on a large scale is now under consideration. In January 1892 the immemorial rent or tax on fields of paddy (rice in the husk) was removed, but not the customs duty on imported rice. But even with the advantage of " protection " to the extent of 10 per cent, in the local markets, there has been no extension of paddy cultivation ; on the contrary, the import of grain from India grows larger year by year. In connexion with the liberal project of railway extension (see below), systematic expenditure on irrigation works, up to Es.5,00,000 (to be included in the public loan for railways) is to be undertaken, and a separate irrigation department has been formed to secure full attention in prosecuting the selected under-takings. Among these will be the full restoration of the Giant's Tank in the arid Mannar district, arojjnd which possibly some of the surplus population of southern In(ua may be settled to cultivate rice, cotton, and perhaps tobacco, besides other vegetables necessary to their subsistence. Through these multiplied irrigation works, also, and the northern railway, rice culture may be sufficiently extended to save some of the large imports (8,000,000 to 9,000,000 bushels annually) now required from India.~~

~~Taking the trade in the products mentioned as a whole, no country can compete with the United Kingdom as a customer of Ceylon. But there is a considerable trade in nearly all pro- ducts with Germany and America ; in cardamoms with India ; in cinnamon with Spain, Italy, Belgium, Australia, Austria, and Prance ; in some or other of the products of the cocoa-nut palm (cocoa-nuts, cocoa-nut oil, copra, desiccated cocoa-nut, poonac, coir) with Belgium, Russia, France, Austria, Australia, and Holland ; and in plumbago with Belgium.~~

~~Pearl Fishery. — Since 1874 there have been ten years with more or less successful fisheries at Arippu, on the north-west coast, the latest and inost successful being in 1891, when over £86,000 was gained by the Government. Seventeen years were blanks. Capt. l)onnan, on his inspection~~

~~*in March 1901, reported a prospect of successful fisheries in 1904. Professor Herdman, P.R.S., was appointed to inquire and report on the conservation and cultivation of the Ceylon pearl-oySter, and visits Ceylon in January 1902.*~~

~~*Manufactures. — Little is done save in the preparation in factories and stores, in Colombo or on the plantations, of the several products exported. The manufacture of jewellery and preparation of precious stones, and, among native women and children, of pillow lace, give employment to several thousands. Iron and engineering works are numerous in Colombo and in the planting districts. The Sinhalese are skilful cabinetmakers and carpenters. The Moormen and Tamils furnish good masons and builders.*~~

~~*Commerce. — There has been rapid development since 1882, and the returns for 1900 showed a total value for imports (including specie) of 122 millions of rupees (say, £8,130,000). The principal items were: articles of food and drink (chiefly rice from India), over 3 millions sterling; manufactured metals (with specie), £1,000,000; coal, 590,000 tons ; cotton yarns and piece goods from Manchester, about half a million sterling; machinery and mill- work, £160,000; apparel, &c., £150,000, The Ceylon customs tariff for imports is one of 6J per cwt. ad valorem, save in the case of intoxicating drinks, arms, ammunition, opium, &c. The total value of the exports, including specie, for 1900 was 95 millions of rupees, or £6,400,000 ; tea was valued at nearly £3,500,000, and products of the cocoa-nut palm at £1,100,000. For 1900 the export trade was as follows : —*~~

~~*Exports to United Kingdom ,, ,, British Colonies ,, ,, Foreign Countries*~~

~~*Bs.5,62,95,525*~~

~~*1,80,86,205 2,05,80,047*~~

~~*Es.9,49,62,277*~~

~~*i.e., goods to the value of nearly 4 millions sterling went to the United Kingdom out of a total export valued at £6,860,000 sterling.*~~

~~*Shipping and Navigation. — The headquarters of the mail steamers \have been removed from Galle to Colombo, where a magnificent breakwater has been constructed and other harbour works have been undertaken. There has been a great increase in the number and tonnage of the vessels calling and coaling, as also a great development in'the coasting trade. The total tonnage of vessels entered and cleared in 1900 was 8,316,191, of which 5,889,702 tons belonged to the United Kingdom, 207,026 tons to British colonies, and 2,219,463 tons to foreign countries.*~~

~~*Bailways and Boads. — The railway system has developed from 100 to 297 miles in length, including one of the finest mountain lines in the world— over 160 miles long, rising to 6200 feet above sea-level, and falling at the present tenninus to 4000 feet. The towns of Kandy, Matale, Gampola, Nawalapitiya, Hatton, and Haputale (and practically Nuwara Eliya) in the hills, are thus connected by rail, and in the low country the towns of Kuru-negala, Galle, Matara, Kalutara, &c. These 297 miles (all Government) cost about 53 millions of rupees, but most of the debt is paid off, and the traffic receipts now make up nearly one- third of the general revenue. At present 200 miles more of railway are under construction (all on the same wide 5J-feet gauge) to connect Jaffna and the north with the rest of the island. This northern line will run from Kurunegala vid, Anuradhapura, "the buried city" and earliest capital of the Sinhalese, through the centre of the island and across the Jaffna peninsula. Two lines on a narrow (2i-feet) gauge are also under construction — (1) to connect Colombo through Cotta — also an early royal Sinhalese seat — with Avisawella and the Kelani valley tea-growing district, 45 miles; and (2) to connect Nanuoya, on the main line, with the sanatorium (Nuwara Eliya) and on to Udapusilava, over 20 miles. Other hill lines will follow, and also, probably, a prolongation of the Kelani railway through Colombo and northwards to the towns of Negombo, Chilavr, and Puttalam, serving one of the richest and most populous of native districts. The 270 additional miles actually sanctioned and under construction will cost over 15 millions of rupees. An Indo-Ceylon railway to connect the Indian and Ceylon systems haS been the suljject of separate reports and estimates by engineers serving the Ceylon and Indian Governments, who have pronounced the work across the coral reef between Mannar and Bameswaram quite feasible. Such a line is sure to be made for strategic as well as commercial purposes, and Colombo will then be more*~~

~~*than ever the port for Southern India. Ceylon has now about 3800 miles of high roads, mostly macadamized, and the maintenance of these costs annually Es. 15,00,000 (or £100,000'). There are besides perhaps 10,000 miles of minor — estate and village — roads.*~~

~~*Banks and Currency. — Ceylon has agencies of the National Bank of India, Bank of Madras, Mercantile Bank of India, Chartered Bank of India, Australia, and China, and of the Hong- Kong and Shanghai Bank, besides mercantile agencies of other banks. Also a Government Savings Bank at Colombo and Post Office Savings Banks all over the island. In 1884, on the failure of the Oriental Bank, the notes in currency were guaranteed by Government, and a Government note currency was started in supersession of bank notes. This note currency has now reached an average of 12 millions of rupees, giving an annual income to Government exceeding Rs.2,00,000. The banks' clearing-house returns for Colombo show nearly 200 million rupees of cheques per annum. The Savings Bank shows nearly 2 millions of rupees lodged from 13,000 depositors, besides small deposits in post office, and several provident funds. The coin currency of Ceylon is in rupees and decimals of a rupee, the value of the standard following that fixed for the Indian rupee, about Is. 4d. per rupee. Of specie in 1900 the value imported was Es.77, 95,502 ; exported, Rs.29,19,796.*~~

~~*Authorities.— General works are: Major Skinner, C.M.G. Fifty Years in Ceylon. London and Colombo. — MisS Gordon CuMMiNG. Two Happy Years in Ceylon. London, 1891. — Cave. Picturesque Ceylon, in a series of illustrated volumes. London and Colombo. — Ferguson. "Papers on Ceylon," in Proceedings Boyal Colonial Institute, April 1892 and December 1899, and in Society of Arts Journal, December 1899 ; also Ceylon Handbook and JDirectory, 1901. Colombo. — Davidson. Official Handbook and Catalogue of the Ceylon Court, The Paris Exhibition, 1900, with maps and illustrations. Colombo.*~~

~~*Special works are: Dr Trimen, F.E.S., Director of Ceylon Botanic Gardens. Ceylon Flora, in 5 vols., completed by Sir Joseph Hooker. — Captain V. Legge, F.Z.S. History of the Birds*~~

~~*C H A B K I E R — C HAFFARINAS*~~

~~Chabrier, Alexis Emmanuel (1841-1894), French composer, was bom at Anibert on 18th January 1841. At first he only cultivated music as an amateur, and it was not until 1879 that he threw up an administra- tive appointment in order to devote himself entirely to i;he art. He had two years previously written an opira bouffe entitled L'Etoile, which was performed at the Bouffes Parisiens. In 1881 he was appointed chorus- master of the concerts then recently established by Lamoureux. Two years later he composed the brilliant ■orchestral rhapsody entitled Espafla, the themes of which he had jotted down when travelling in Spain. His opera Gweru^oline was brought out at Brussels on 10th April 1886, with considerable success, and was given later at the Paris Grand Opera. The following year 1887, Le Roi malgri lui, an opera of a lighter description, was pro- duced in Paris at the Opera Comique, its run being interrupted by the terrible fire 'by which this theatre was destroyed. His last opera, Briseis, was left unfin ished, and performed in a fragmentary condition at the Paris Opera, after the composer's death in Paris on the 13th September 1894. Chabrier was also the author of a :set of pianp pieces entitled Pieces Pittoresques, Valses Bomantiques, for two pianos, a fantasia for horn and piano, &c. His musical tendencies were very modern, and his great admiration for Wagner asserted itself in Gkoendoline, a work which, in spite of inequalities due to want of experience, is animated by a high artistic ideal, i s poetically conceived, and evinces considerable harmonic •originality, besides a thorough mastery over the treat ment of the orchestra. The characteristics of Le Boi malgri lui have been well summed up by M. Joncі^res when he alludes to " cette verve in^puisable, ces rythmes endiables, cette exuberance de gaiete et de vigueur, a Jaquelle venait se Joindre la note melancolique et emue." Chabrier's premature death prevented him from giving the full measure of his worth. (a. he.)~~

~~Chaco, a territory in the north of the Argentine Re- public, bounded on the N. by the territory of Pormosa, from which it is separated by the Eio Bermejo, on the S. "by Santiago del Estero and Santa Pe, on the E. by Para- •guay and Corrientes, and on the W. by Santiago del Estero and Salta. The official area at the census of 1895 -comprised 52,741 square miles, with a population of 10,422. It is divided into five departments. The~~

~~capital, Eesistencia, on the Parang, has a population of 3000. In 1895 the territory had 620 farms — 11,214 acres planted in cereals, 83,952 head of cattle, 7671 head of sheep, and .5408 horses.~~

~~Chad, a large lake of northern Central Africa, of very variable extent, generally shallow, and containing many islands. It is fed principally by the Shari, coming from the south-east, but in the rains a considerable body of water is brought down by the Waube from the west. The lake has no proper outlet, but at high water the sur- plus floods the swampy valley of the Bahr-el-Ghazal on the south-east ; it does not, if recent accounts are to be trusted, reach the depression to the north-east known as Bodele, as was supposed by Nachtigal. In 1897 the southern part of the lake was for the first time navigated "by a steamer, which had been brought from the south and launched on the Shari by the French expedition under Gentil. Lake Chad lies on the borderland between the wooded regions of the Sudan on the south and the arid steppes which merge into the Sahara on the north. Its shores are generally devoid of trees. The native sultanates of Bornu (south and west of the lake) and~~

~~Wadai and Kanem (east and north) have by international agreements fallen to the spheres of Great Britain, France, and Germany, the partition taking no account of former boundaries. European influence had, before 1900, scarcely reached the lake, but the power of Eabah, usurp- ing sultan of Bornu, was in that year finally broken by his defeat by the French. One of the long-established trade routes across the Sahara — that from Tripoli to Kuku in Bornu — strikes the lake at its north-west corner, but this has lost much of its former importance. Com- munication from Algeria to the lake vid Air was, after repeated failures, opened by M. Foureau in 1899-1900, while Lieut. Joalland, member of the expedition originally entrusted to Capts Voulet and Chanoine, also reached the lake from the Middle Niger, continuing his journey round the north end to Kanem.~~

~~See FonEEAu, in Geographical Journal, February 1901 ; Joal- land, in La Geographie, June 1901.~~

~~Chadwick, Sir Edwin (1800-1890), was bom at Longsight, near Manchester, in 1800. Called to the bar without any independent means, he sought to support himself by literary work, and his essays in the Westminster Review~~

~~(mainly on different methods of applying scientific knowledge to the business of government) introduced him to the notice of Jeremy Bentham, who engaged him as a literary assistant and left him a handsome legacy. In 1832 he was employed by the Eoyal Commission appointed to inquire into the operation of the poor laws, and in 1833 he was made a full member of that body. In conjtmction with Nassau Senior he drafted the celebrated report of 1834 which procured the reform of the old poor law. HIs special contribution was the institution of the union as the area of administration. HIe favoured, however, a much more centralized system of administration than was adopted, and he never ceased to complain that the reform of 1834 was fatally marred by the rejection of his views, which contemplated the management of poor-law relief by salaried officers controlled from a central board, the boards of guardians acting merely as inspectors. In 1834 he was appointed secretary to the Poor Law Commissioners. Finding himself unable to administer in accordance with his own views an Act of which he wa;s largely the author, his relations with his official chiefs became much strained, and the disagreement led, among other causes, to the dis- solution of the Poor Law Commission in 1846. Chad- wick's chief contribution to political controversy was his constant advocacy of entrusting certain departments of local affairs to trained and selected experts, instead of to representatives elected on the principle of local self-govern- ment. While still officially connected with the poor law he had taken up the question of sanitation in conjunction withDr South wood Smith, and their joint labours produced a most salutary improvement in the public health. HIs ' report on " The Sanitary Condition of the Labouring Population" (1842) is a valuable historical document. HIe was a commissioner of the Board of HIealth from its establishment in 1848 to its abolition in 1854, when he retired upon a pension, and occupied the remainder of his life in voluntary contributions to sanitary and econo- mical questions. HIe died on 6th July 1890. HIe had been made K.C.B. in 1889. The best account of his opinions is Tlie HIealth of Nations (1887), which is practically a biography dictated by himself to the late Sir B. W. Eichardson.~~

~~See also a volume on The Evils of Disunity in Central and Local Administration . . . and the New Centralisation for the People, by Edwin Chadwick (1885).~~

~~Chaffarinas, a Spanish station in a group of islands of the same name, on the north coast of Morocco, near the Algerian frontier, 2^ miles to the north of Cape del Agna. The largest of these isles, Del Congreso, is~~

~~rocky and hilly. It has a watch-house on the coast nearest to Morocco. The island of Isabella II. contains several batteries, barracks, and a penal convict settlement. For years the Spanish Government has been preparing works, breakwaters to unite this island with that of El Eey, with a view to enclose a deep and already sheltered anchorage. This roadstead even now can afford a safe refuge for 40 -large vessels and many of light draught. The Chaffarinas, which are the Fresinsulce of the Eomans and the Zaferin of the Arabs, were occupied by Spain in 1848. The population was 596 in 1897, including troops.~~

~~ChagOS, a group of atolls in the Indian Ocean dis- posed in circular form round the Chagos bank, in 6° 30' to 6° 30' N. and 71° 30' to 72° 30' E., separated from the Maldives by a deep channel 300 miles wide. The atolls on the south and east side of the bank, which has a cir- cumference of about 270 miles, have disappeared through subsidence ; a few — Egmont, Danger, Eagle, and Three Brothers — still remain on the east side, but most of the population (700 in 1900) is centred on Diego Garcia, which lies on the south-east side, and is nearly 13 miles long by 6 wide. The lagoon, which is enclosed by two coral barriers and accessible to the largest vessels on the north side, forms one of the finest harbours in the world, and affords every facility for establishing repairing docks, victualling and coaling stations. The group, which has a total land area of 76 square miles, is dependent for administrative purposes on Mauritius, and is regularly visited by vessels from that colony. The only product is cocoa-nut oil, of which about 4800 hectolitres are annu- ally exported. Since 1791 this industry has been in the hands of French Creoles from Mauritius.~~

~~Chaidam. See Tsaidam.~~

~~*Chalcedon, now Kadikeui, on the shore of the Bosphorus, south of Scutari. Kadikeui forms the tenth " Cercle " of the municipality of Constantinople, and has a population of about 33,000, of whom 8000 are Moslems. There are a large British colony with a church, Greek and Armenian churches and schools, and a training col lege for Roman Catholic Armenians.*~~

~~*Chaliemel-Lacour, Paul Amand (1827-1896), French statesman, was born at Avranches on 19th May 1827. After passing through the Ecole normale supiri- eure, he became professor of philosophy successive^ at Pau and at Limoges. The cxiup d'itat of 1861 caused his expulsion from France for his republican opinions. He travelled on the Continent, and in 1856 settled down as professor of French literature at the Poly- technic of Zurich. The amnesty of 1859 enabled him to return to France, but a projected course of lectures was immediately suppressed. He now supported him- self by his pen, and became a regular contributor to the reviews. On the fall of the second empire in 1870 the Government of Kational Defence appointed him prefect of the department of the Rhone, in which capacity he had to suppress the Communist rising at Lyon. Resigning his post in the following year, he was in 1872 elected to the National Assembly, and in 1876 to the Senate. He sat at first on the Ex- treme Left; but his philosophic and critical tempers/- ment was not in harmony with the recklessness of French Radicalism, and his attitude towards political questions underwent a steady modification, till the close of his life saw him the foremost representative of mod- erate republicanism. During Gambetta's lifetime, how- ever, Chaliemel-Lacour was one of his warmest supporters, and he was for a time editor of Gambetta's organ, the Ripuhlique Frangaise. In 1879 he was appointed French ambassador at Berne, and in 1880 was transferred to*~~

~~*London ; but he lacked the suppleness and command of temper necessary to a successful diplomatist. He resigned in 1882, and in February 1883 became minister of foreign affairs in the Jules Ferry Cabinet, but retired in Novem- ber of the same year. In 1890 he was elected vice- president of the Senate, and in 1893 succeeded Jules Ferry as its president. His influence over that body was largely due to his clear and reasoned eloquence, which placed him at the head of contemporary French orators. In 1893 he also became a member of the French Academy. He distinguished himself by the vigour with which he upheld the Senate against the encroachments of the*~~

~~*Chamber, but in 1895 failing health forced him to resign, and he died in Paris on 26th October 1896. HIe published a translation of Ritter's History of Philosophy (1861) ; La philosophie individualiste : itude sur Quillaume de HIumboldt (1864) ; and an edition of the works of Madame d'fipinay (1869). In 1897 appeared CEuvres oratoires de Chaliemel- Lacour . . . avec une introduction et des notices par Joseph Reinach. (h. st.)*~~

~~*Chalon-sur-Sadne, chief/town of arrondisse- ment, department of Saone-et-Loire, France, 46 miles N. of Macon, on railway from Paris to Lyon. It has manufactures of machinery, vinegar, oil-refining, and iron and copper founding. In the square opposite the Palais de Justice is a fountain erected in memory of the Thevenin family, to whom the town is indebted for its water-supply. The ancient hospital in the St Laurent suburb has been rebuilt. Population (1881),*~~

~~*19,864; (1901), 29,058.*~~

~~*Chalons-Sur-Marne, chief down of depart- ment Marne, France, 107 miles E. of Paris by rail. The town has become a great centre for the mamrfacture of beer, in part replacing that of wine. One of the large breweries occupies a series of galleries in the limestone rock originally excavated for the storage of wine. These galleries, with a total length of 6 miles, are now served by lines of railway which convey the beer directly to the station. The woollen industry has declined. ChSlons is the headquarters of the 6th army corps. The port traf&e on the Marne canal in 1899 was 47,374 tons. Population*~~

~~*(1881), 17,298 ; (1901), 21,487.*~~

~~*Chamba, a native state of India, within the Punjab, amid the HImalayas. It has an area of 3126 square miles. In 1881 the population was 115,773; in 1891 it was 124,032, giving an average density of 40 persons per square mile ; and in 1901 it was 128,005. The estimated gross revenue is Rs.3,50,000 ; the tribute, Rs.5000 ; the military force, 400. The sanitarium of Dalhousie, though within the state, is attached to the district of Gurdaspur.*~~

~~Chamberlain, Joseph (1836), British states- man, third son of Joseph Chamberlain, Master of the- Cordwainers' Company, was born at Camberwell Grove, London, on 8th July 1836. HIs father was a well-to-do^ man of business, a Unitarian in religion and a Liberal in politics. Young Chamberlain was educated at Canonbury from 1845 to 1850, and at University College School,. London, from 1850 to 1852. After two years in his- father's of6.ce in London, he was sent to Birmingham to join his cousin Joseph Nettlefold in a screw business in which his father had an interest ; and by degrees, largely owing to his own intelligent management, this business, became very successful. "Nettlefold and Chamberlain" employed new methods of attracting custoniers, and judiciously amalgamated rival firms with their own so as ta reduce competition, with the result that in 1874, after twenty -two years of commercial life, Mr Chamberlain was. able to retire with an ample fortune. Meanwhile he had in 1861 married his first wife, Miss Harriet Kenrick (she~~

~~died in 1863), and had gradually come to take an increas- ingly important part in the municipal and political life of Birmingham. He was a constant speaker at the Birming- ham and Edgbaston Debating Society ; and when in 1868 the Birmingham Liberal Association was reorganized, he became one of its leading members. In 1869 he was elected chairman of the executive council of the new INational Education League, the outcome of Mr George Dixon's movement for promoting the education of the chil- dren of the lower classes by paying their school fees and agitating for more accommodation and a better national system. In the same year he was elected a member of the town council, and married his second wife, — a cousin of his first, — Miss Florence Kenrick (d. 1876).~~

~~In 1870 he was elected a member of the first School Board for Birmingham ; and for the next six years, and~~

~~ELAIN.~~

~~{From a photograph ty liuitsell t& Sons, London.) ^~~

~~*especially after 1873, when he became leader of a majority and chairman, he actively championed the Nonconformist opposition to denominationalism. He was then regarded as a Republican — the term signifying rather that he held advanced Radical opinions, which were construed by average men in the light of the current political developments in France, than that he really favoured Republican institutions. His programme was " free Church, free land, free schools, free labour." At the general election of 1874 he stood as a parliamentary candidate for Sheffield, but -without success. Between 1869 and 1873 he was a prominent advocate in the Birmingham town council of the gospel of municipal reform preached by Mr Dawson, Dr Dale, and Mr Bunce (of the Birmingham Fost) ; and in 1873 his party obtained a majority, and he was elected mayor, an office he retained until June 1876. As mayor he had to receive the Prince and Princess of Wales on their visit in June 1874, an occasion which excited some <3uriosity because of his reputation as a Republican ; but those who looked for an exhibition of bad taste were disappointed, and the behaviour of the Eadical mayor satisfied the requirements alike of the Times and of Punch.*~~

~~*The period of his mayoralty was one of historic importance for Birmingham. New municipal buildings were erected, Highgate Park was opened as a place of recreation, the Free Library and Art Gallery were developed. But the great work carried through by Mr Chamberlain for Birmingham was the municipalization of the supply of gas and water, and the improvement scheme by which slums were cleared away and forty acres laid out in new streets and open spaces. The prosperity of modern Birmingham dates from 1875 and 1876, when these admirably administered reforms were initiated, and by his share in theni Mr Chamberlain became famous. It may be added here that the interest taken by him in Birmingham remained undiminished during his later life, and he was largely instrumental in starting the Birmingham University*~~

~~*(1900).*~~

~~*In 1876 Mr Dixon resigned his seat in Parliament, and Mr Chamberlain was returned for Birmingham in his place unopposed, as John Bright's colleague. He made his maiden speech in the House of Commons on 4th*~~

~~*August 1876, on Lord Sandon's Education Bill. At this period, too, he paid much attention to the question of licensing reform, and in 1876 he examined the Gothenburg system in Sweden, and advocated a solution of the problem in England on similar lines. During 1877 the new federation of Liberal Associations which became known as the "Cau- cus," was started under Mr Chamberlain's influence in Bir- mingham,— its secretary, Mr Schnadhorst, quickly making himself felt as a wire-puller of exceptional ability ; and the new organization had a remarkable effect in putting life into the Liberal party, which since Mr Gladstone's retire- ment in 1874 had been much in need of a stimulus. When the general election came in 1880 Mr Schnadhorst's powers were demonstrated in the successes won under his auspices. The Liberal party numbered 349, against 243 Conservatives and 60 Irish Nationalists ; and the Radical section of the Liberal party, led by Mr Chamberlain and Sir Charles Dilke, was recognized by Mr Gladstone by his inclusion of the former in his Cabinet as President of the Board of Trade, and the appointment of the latter as Under Secretary for War. In his new capacity Mr Chamberlain was responsible for carrying such important measures as the Bankruptcy Act, 1887, and the Patents Act. Another Bill which he had much at heart, on Merchant Shipping, had to be abandoned, and a royal commission substituted, but the subsequent legislation in 1888-94 owed much to his efforts. The Franchise Act of 1884 was also one in which he took a leading part as a champion of the opinions of the labouring class. At this time he took the current advanced Radical views of both Irish and foreign policy, hating coercion, disliking the occupation of Egypt, and prominently defending the Transvaal settlement after Majuba. Both before and after the defeat of Mr Glad- stone's Government on the Budget in June 1885, he asso- ciated himself with what was known as the "Unauthorized Programme," i.e., free education, small holdings, graduated taxation, and local government. In June 1885 he made a speech at Birmingham, treating the reforms just men- tioned as the " ransom " that property must pay to society for the security it enjoys — for which Lord Iddesleigh called him " Jack Cade " ; and he continually urged the Liberal party to take up these Radical measures. At the general election of November 1885 Mr Chamberlain was returned for West Birmingham. The Liberal strength generally was, however, reduced to 335 members, though the Eadical section held their own •, and the Irish vote became necessary to Mr Gladstone if he was to command a majority. In December*~~

~~*it was stated that Mr Gladstone intended to propose a Home Rule Bill, and in January Lord Salisbury's ministry was defeated on the Address, on an amendment moved by Mr Jesse Collings embodying*~~

~~*the "three acres and a cow" of the Eadical programme. Unlike Lord Hartington and other Liberals, who declined to join Mr Gladstone in view of the altered attitude he was adopting towards Ireland, Mr Chambferlain entered the Cabinet as President of the Local Government Board, but on 16th March 1886 he resigned, explaining in the House of Commons (8th April) that, while he had always been in favour of the largest possible extension of local government to Ireland consistently with the integrity of the empire and the supremacy of Parliament, and had therefore joined Mr Gladstone when he believed that this was what was intended, he was unable to consider that the scheme communicated by Mr Gladstone to his col-leagues maintained those limitations. At the same time he was not irreconcilable, and he invited Mr Gladstone even then to modify his Bill so as to remove the objections made to it. This indecisive attitude did not last long, and the split in the party rapidly widened. At Birmingham Mr Chamberlain was supported by the " Two Tftousand," but deserted by the " Caucus " and Mr Schnadhorst. In May the Eadicals who followed Mr Bright and Mr Chamberlain, and the Whigs who took their cue from Lord Hartington, decided to vote against the second readiag of the Home Rule Bill, instead of allowing it to be taken and then pressing for modifications in committee, and on 7th June the Bill was defeated by 343 to 313, 94 Liberal Unionists — as they were generally called — voting against the Government. Mr Chamberlain was the object of the bitterest attacks from the Gladstonians for his share in this result; he was stigmatized as "Judas," and open war was proclaimed by the Home Rulers against the " dissentient Liberals " — the description used by Mr Gladstone. The general election, however, returned to Parliament 316 Conservatives, 78 Liberal Unionists, and only 276 Gladstonians and Nationalists, Birmingham returning seven Unionist members. When the House met in August, it was decided by the*~~

~~*Liberal Unionists, under Lord Hartington's leadership, that their policy henceforth was essentially to combine with the Tories to keep Mr Gladstone out. The old Liberal feeling fetill prevailing among them was too strong, however, for their leaders to take office in a coalition ministry. It was enough for them to be able to tie dowuithe Conservative Government to such measures as were not offensive to Liberal Unionist principles. It still seemed possible, moreover, that the Gladstonians might he brought to modify their Home Rule proposals, and in January 1887 a Round Table con- ference (suggested by Mr Chamberlain) was held between Mr Chamberlain, Sir G. Trevelyan, Sir William Harcourt, Mr Morley, and Lord Herschell. But no rapprochement was effected, and reconciliation became daily more aad more difficult. The influence of Liberal Unionist, views upon the domestic legislation of the Government was steadily bringing about a nfore complete union in the Unionist party, and destroying the old lines of political cleavage. Before 1892 Mr Chamberlain had the satis- faction of seeing Lord Salisbury's ministry pass such important Acts, from a progressive point of view, as those dealing with Coal Mines Regulation, Allotments, County Councils, Housing of the Working Classes, Free Educa^ tion, and Agricultural Holdings, besides Irish legislation like the Ashbourne Act, the Land Act of 1891, and the Light Railways and Congested Districts Acts. In Octo- ber 1887 Mr Chamberlain, Sir L. Sackville West, and Sir Charles Tupper were selected by the Government as British plenipotentiaries to discuss with the United States the Canadian fisheries dispute, and a treaty was arranged by them at Washington on 16th February 1888. The Senate refused to ratify it ; but a protocol provided for a modus vivendi pending ratification, giving American fishing vessels similar advantages to those contemplated*~~

~~*in the treaty ; and on the whole Mr Chamberlain's mis- sion to America was accepted as a successful one in maintaining satisfactory relations with the United States. He returned to England in March 1888, and was pre- sented with the freedom of the borough of Birmingham. The visit also resulted, in November 1888, in his mar- riage with his third wife. Miss Endicott, daughter of the United States minister of war in President Cleveland's first administration.*~~

~~At the general election of 1892 Mr Chamberlain was again returned, with an increased majority, for West Birmingham; but the Unionist party as a whole came back with only 315 members against 355 Home Rulers. In August Lord Salisbury's ministry was defeated; and on 13th February 1893 Mr Gladstone introduced his second Home Rule Bill, which was eventually read a third time on 1st September. During the eighty-two days' discussion in the House of Commons Mr Chamberlain was the life and soul of the opposition, and his criticisms had a vital influence upou the attitude of the country when^the House of Lords summarily threw out the Bill. His chief contribution to the discussions during the later stages of the Gladstone and Rosebery ministries was in connexion with Mr Asquith's abortive Employers' Liability Bill, when he foreshadowed the method of dealing with this question afterwards carried out in the Compensation Act of 1897. Outside Parliament he was busy formulating proposals for Old Age Pensions, which had a prominent place in the Unionist programme of 1895. In that year, on the defeat of Lord Rosebery, the union of the Unionists was sealed by the inclusion of the Liberal Unionist leaders in Lord Salisbury's ministry; and Mr Chamberlain be- came Secretary of State for the Colonies. There had been much speculation as to what his post would be, and his nomination to the Colonial Office, then considered one of secondary rank, excited some surprise; but Mr Chamberlain himself realized how important that depart- ment had become. His influence in the Unionist Cabinet was soon visible in the Workmen's Compensation Act and other measures. This Act, though in Sir Matthew White Ridley's charge as Home Secretary, was universally and rightly associated with Mr Chamberlain; and its passage, in the face of much interested opposition from highly- placed old-fashioned Conservatives and capitalists on both sides, was principally due to his determined advo- cacy. Another "social" measure of less imlportance, which formed part of the Chamberlain programme, was the Small Houses Acquisition Act of 1899; but the problem of Old Age Pensions was less easily solved, and the subject was handed over first to a royal commission, and then to a departmental committee, both of which threw cold water on the schemes laid before them — a result which, galling enough to one who had made so much play with the question in the country, offered wel- come material to his opponents for electioneering recrim- ination, as year by year went by between 1895 and 190O and nothing resulted from all the confident~~

talk on the subject in which Mr Chamberlain had indulged when out. of office.

From January 1896 (the date of the Jameson Raid), onwards South Africa demanded the chief attention of the. Colonial Secretary. It is too soon to estimate precisely the part played by Mr Chamberlain in the affairs which at last led to war with the Transvaal. But never has a statesman's personality been more bitterly associated by his. political opponents with the developments they deplored. The report of the House of Commons committee (July 1897) definitely acquitted both Mr Chamberlain and the: Colonial Office of any privity in the Raid, but Mr Cham- berlain's detractors continued to assert the contrstry. Opposition hostility reached such a pitch that in 1899>

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there was hardly an act of the Cabinet during the negotiar tions with President Kruger which was not attributed to the personal malignity and unscrupulousness of the Colo- nial Secretary. The elections of 1900 (when he was again returned, unopposed, for West Birmingham) turned upon the individuality of a single minister more than any since the days of Mr Gladstone's ascendancy, and Mr Chamberlain, never conspicuous for inclination to turn his other cheek to the smiter, was not slow to return the blows with interest.

Apart from South Africa, his most important work was the successful passing of the Australian Commonwealth Act (1900), in which both tact and firmness were needed to settle certain differences between the Imperial

~~Govern- ment and the colonial delegates. Mr Chamberlain's tenure of the oflce of Colonial Secretary between 1895 and 1900 must always be regarded as a turning-point in the history of the relations between the British Colonies and the Mother Country. His accession to of&ce was marked by speeches breathing a new spirit of imperial consolidation, embodied either in suggestions for commercial union, or in more immediately practicable proposals for improving the " imperial estate " ; and at the Diamond Jubilee of 1897 the visits of the colonial Premiers to London em- phasized and confirmed the new policy, the fruits of which were afterwards seen in the cordial support given by the colonies in the Boer war. Even in what Mr Chamberlain called his " Eadical days " he had never supported the " Manchester " view of the value of a colonial empire ; and during the Gladstone ministry of 1880-85 Mr Bright had remarked that the junior member for Birmingham was the only Jingo in the Cabinet — meaning, no doubt, that he objected to the policy of laisser-faire and the timid- ity of what was afterwards known as " Little Englandism." While he was still under Mr Gladstone's influence these opinions were kept in subordination, but Mr Chamberlain was always an imperial federationist, and from 1887 onwards he constantly gave expression to his views on the desirability of drawing the different parts of the empire closer together for purposes of defence and commerce. In 1895 the tiine for the realization of these views had come ; and Mr Chamberlain's speeches, previously remarkable chiefly for debating power and directness of argument, were now dominated by a new note of constructive states- manship, basing itself on the economic necessities of a world-wide empire. Not the least of the anxieties of t^e Colonial Office during this period was the situation in the West Indies, where the cane-sugar industry was being steadily undermined by the European bounties given to exports of Contine'ntal beet; and though the Govern- ment restricted themselves to attempts at removing the bounties by negotiation and to measures for palliating the worst effects in the West Indies, Mr Chamberlain made no secret of his repudiation of the Cobden Club view that retaliation would be contrary to the doctrines of free trade, and he, did his utmost to educate public opinion at home into understanding that the responsi- bilities of the Mother Country are not merely to be con- strued according to the selfish interests of a nation of consumers. As regards foreign affairs, Mr Chamberlain more than once (and particularly at Leicester on 30th November 1899) indicated his leanings towards a~~

~~closer understanding between the British Empire, the United States, and Germany,— a suggestion which did not save him from an extravagant outburst of German hostility during the Boer war. The unusually outspoken and pointed expression, however, of his disinclination to sub- mit to Muscovite duplicity or to " pin-pricks " or " unman- nerliness" from France, was criticized on the score of discretion by a wider circle than that of his political ad- versaries.~~

~~Mr Chamberlain is popularly known as indulging a hobby for orchid-growing at his house, "Highbury," near Bir- mingham. An orator of a straightforward, unrhetorical type, cool, alert in debate, and hard-hitting, his personality has always had a peculiarly irritating effect on his oppo- nents ; and his spare figure, incisive features, and single eyeglass have made him a favourite subject for the carica- turist. Among other public honours, he was made Lord Rector of Glasgow University in 1897, and delivered on that occasion an address on " Patriotism." His eldest son, Austen, has also made his mark in politics as a Civil Lord of the Admiralty, 1895-1900, and as financial secretary to the Treasury (1901).~~

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~~Chamberlain, Sir Neville Bowles (1820- British field-marshal, second son of Sir Henry Chamber- lain, first baronet, consul-general and charg^ d'affaires in Brazil, was born at Eio on the 10th January 1820. He entered the Indian army in 1837, served as a subal- tern in the first Afghan war (1839-42), and was wounded on six occasions (medal and clasps). He was attached to the Governor-General's bodyguard at the battle of Maharajpur, in the Gwalior campaign of 1843 (medal), was appointed military secretary to the governor of Bombay in 1846, and honorary aide-de-camp to the Governor-General of India in 1847. He served on the staff throughout the Punjab campaign of 1848-49 (medal and clasps and brevet majority). In 1850 he was appointed commandant of the Punjab military police, and in 1852 military secretary to the Punjab Government. Promoted lieut. -colonel in 1854, he was given the command.of the Punjab Frontier Force with rank of brigadier-general, and commanded in several expeditions against the frontier tribes. In the Indian Mutiny he succeeded Colonel Chester as adjutant-general ' of the Indian army, and distinguished himself at the siege~~

~~of Delhi, where he was severely wounded (medal, brevet-colonelcy, A.D.C. to the Queen, and C.B.). He was reappointed to the command of the Punjab Frontier Force in 1868, and commanded in the Umbeyla campaign, when he was severely wounded (medal, major-general for distinguished service, and K.C.B.). He was made K.C.S.I. in 1866, lieut.-general in 1872, G.C.S.I. in 1873, G.C.B. in 1875, and general in 1877. From 1876 to 1881 he was commander-in-chief of the Madras army, and in 1878 was sent on a mission to the Amir of Afghanistan, whose refusal to allow him to enter the country precipi- tated the second Afghan war. He was for some time acting military member of the Council of the Governor- General of India. He retired in 1886.~~

~~Chambers, William (1800-1883). The story of the brothers Chambers has been so fully told in the Ency. Brit. (vol. v.), that it is only necessary to add that William Chambers (born at Peebles, 16th April 1800) was the financial genius of the firm, and that, although possessing neither the literary abilities nor the attractive character of his brother, he laid the city of Edinburgh under the greatest obligations by his public spirit and munificence. As Lord Provost he procured the passing in 1867 of the Im- provement Act, which led to the reconstruction of a great part of the Old Town, and at a later date he proposed and carried out, largely at his own expense, the restoration of the noble and then neglected church of St Giles, making it in a sense " the Westminster Abbey of Scotland." This service was fitly acknowledged by the offer of a baronetcy, which he did not live to receive, dying on 20th May 1883, three days before the reopening of the church. He was the author of a history of St Giles's, of a memoir of him- self and his brother, and of many other useful publications.~~

~~Chambersburg, a borough of Pennsylvania, U.S.A., and capital of Franklin county, situated in the~~

~~Cumberland Valley, in the southern part of the state, at an altitude of 613 feet. It has three railways, the Cum- berland Valley, the Western Maryland,~~

~~and the Mont Alto. Population (1880), 6877; (1890), 7863; (1900), 8864, of whom 769 were negroes.~~

~~Chambon, Le, or Le Chambon-Fbugeeolles, a town of France, department of Loire, in the arron- dissement of St iStienne, and 5^ ‘ miles S.W. of that town by rail, on a tributary of the Loire. Coal is mined in the neighbourhood, and there are forges, steel works, manufacture of ironmongery, and silk mills. The ancient castle of FeugeroUes is noteworthy. Population~~

~~(1901), 11,528.~~

~~Chambord, Henri Charles Ferdinand Marie Dieudonne, Comte de (1820-1883), was born in Paris on 29th September 1820. His father was the due de Berry, the elder son of the comte d’Artois (afterwards Charles X.); his mother was the Princess Marie Caroline of Naples. Born seven months after the assassination of his father, he was hailed as the ” enfant du miracle,” and was made the subject of one of Lar martine’s most famous poems. He was created duo de Bordeaux, and in 1821, as the result of a subscription organized by the G-overnment, received the ch§,teau of Chambord.^ He was educated by tutors inspired by de- testation of the French Eevolution and its principles, and from the due de Damas in particular imbibed those ideas of divine right and of devotion to the Church to which he always remaine’d true. After the revolution of July, Charles X. vainly endeavoured to save the Bourbon cause by abdicating in his favour and proclaiming him king under the title of Henry V. (2nd August 1830). The comte de Chambord accompanied his grandfather into exile, and resided successively at Holyrood, Prague, and Grorz. In 1841, during an extensive tour through Europe, he broke his leg — an accident that resulted in permanent lameness. The death of his grandfather, Charles X., in 1836, and of his uncle, the due d’AngoulSme, in 1844, left him the last male representa- tive of the elder branch of the Bourbon family ; but his marriage with the Archduchess Maria Theresa, eldest daughter of the duke of Modena (7th November 1846), remained without issue. The title to the throne thus passed to the comte de Paris, as representative of the Orleans branch of the house of Bourbon, and the history of the comte de Chambord’s life is largely an account of the efforts made to unite the~~

~~*Royalist party by effecting a reconciliation between the two princes. Though he continued to hold an informal court, both on his travels and at his castle of Frohsdorf, near Vienna, yet he allowed the revolution of 1848 and the coup d'itat of 1851 to pass without any decisive assertion of his claims. It was the Italian war of 1859, with its menace to the Pope's independence, that roused him at last to activity. He declared himself ready "to pay with his blood for the triumph of a cause which was that of France, the Church, and God Himself." Making common cause with the Church, the Koyalists now began an active campaign against the empire. On 9th December 1866 he addressed a manifesto to General Saint-Priest, in which he declared the cause of the Pope to be that of society and liberty, and held out promises of retrenchment, civil and religious*~~

~~*i This chateau is in the arrondissement of Blois, department of Loir-et-Cher, France, 10 miles E.S.E. of Blois. The park covers an area of 13,000 acres, of which 11,000 are under wood. The work of rebuilding the castle was undertaken by the comte de Chambord, con- tinued till his death in 1883, and subsequently carried on by his successor, Prince John of Parma. Only the northern portion is com- pleted. It comprises two si^uare blocks. The castle has 440 apart- ments, and the stables are said to have stalls for 1200 horses.*~~

~~*liberty, " and above all honesty." Again, on 4th September 1870, after the fall of the empire, he invited Frenchmen to accept a government " whose basis was right and whose principle was honesty," and promised to drive the enemy from French soil. These vague phrases, offered as a panacea to a nation fighting for its life, showed con- clusively his want of all political genius ; they had as little effect on the French as his protest against the bombardment of Paris had on the Germans. Yet fortune favoured him. The elections placed the Republican party in a minority in the National Assembly ; the abrogation of the law of exile against the royal family permitted him to return to his castle of Chambord; and it was thence that on 5th July 1871 he issued a proclamation, in which for the first time he publicly posed as king, and declared that he would never abandon the white standard of the Bourbons, " the flag of Henry IV., Francis I., and Joan of Arc," for the tricolour of the Revolution. He again quitted France, and answered the attempts to make him renounce his claims in favour of the*~~

~~*comte de Paris by the declaration (26th January 1872) that he would never abdicate. In the following month he held a great gathering of his adherents at Antwerp, which was the cause of serious disturbances. A constitutional programme, signed by some 280 members of the National Assembly, was presented for his acceptance, but without result. The fall of Thiers in May 1873, however, offered an oppor- tunity to the Royalists by which they hastened to profit. The comte de Paris and the prince de Joinville journeyed to Frohsdorf, and were formally reconciled with the head of the family (5th August). The Royalists were united, the premier (the due de Broglie) an open adherent, the president (MacMahon) a benevolent neutral. MM. Lucien Brun and Chesnelong were sent to interview the comte de Chambord at Salzburg, and obtain the definite assurances that alone were wanting. They returned with the news that he accepted the principles of the French Revolution and the tricolour flag. But a letter to Chesnelong, dated Salzburg, 27th October, declared that he had been misunderstood : he would give no guarantees; he would not inaugurate his reign by an act of weakness, nor become " le roi legitime de la Revolution." " Je suis le pilot necessaire," he added, "le seul capable de conduire le navire au port, parce que j'ai mission et autorite pour cela." This out- spoken adherence to the jirinciple of divine right did credit to his honesty, but it cost him the crown. The due de Broglie carried the septennate, and the Republic steadily established itself in popular favour. A last effort was made in the National Assembly in June 1874 by the due de la Rochefoucauld-Bisaccia, who formally moved the restoration of the monarchy. The comte de Chambord on 2nd July issued a fresh manifesto, which added nothing to his former declarations. The motion was rejected by 272 to 79, and on 25th February 1875 the Assembly definitely adopted the Republic as the national form of government. From this time the comte de Chambord, though continuing to publish letters on political affairs, made no further effort to regain the throne. He died at Frohsdorf on 24th August 1883.*~~

~~*See Manifestes et programmes politiques de M. le comte de Cham- bord, 1848-73 (1873), and Correspondance de la famille royale et principalement de Mgr le comte de Chambord avec le comte de Bouille (1884). Of the enormous literature relating to him, mention may be made of Henri V. et la monarchie traditionelle (1871), Le Comte de Chambord etudie dans ses*~~

~~voyages et sa correspondance (1880), and Henri de France, by H. de VksE (1885).~~

~~(h. ST.)~~

~~Champaign, a city of Champaign county, Illinois, U.S.A., ‘ situated in the eastern part of the state, on Embarras river, at an altitude of 740 feet. It is the seat of the state university, which had in 1898 a staff of~~

~~professors and instructors numbering 183. and was attended by 1582 students, including 245 women. Its property was valued at $1,544,000, and it had an income of 1355,000. The city is on the Illinois Central, the Wabash, and the Cleveland, Cincinnati, Chicago and St Louis railways. Population (1880), 5103 ; (1890), 6021 ; (1900), 9098 (973 foreign-born and 404 negroes).~~

~~Champaran, or Chumparust, a district of British India, in the Patna division of Bengal, occupies the north-west corner of Behar, lying between the two rivers Gandak and Baghmati and the Nepal hills. It has an area of 3531 square miles. Population (1881), 1,721,608 ; (1891), 1,859,465, showing an increase of 8 per cent. ; average density, 527 persons per square mile. Classified according to religion, Hindus in 1891 numbered 1,590,044 ; Mahommedans, 267,319; Christians, 2100, of whom 140 were Europeans ; ” others,” 2. In 1901 the population was 1,791,026, showing a decrease of 4 per cent. The land revenue and rates are Rs.8,45,224; the number of police is 385 ; the number of boys at school (1896-97) is 16,062, being 12*3 per cent, of the male population of school-going age, the lowest rate in the whole province ; the registered death-rate (1897) is 34 •79per thousand. The administrative headquarters are at Motihari (population, 13,108) ; Bettia is the centre of a very large estate ; Segowlie, still a small military station, was the scene of a massacre during the Mutiny. Champdran is the chief seat of indigo planting in Behar. There are 18 concerns with 42 outworks, employ- ing 37,000 hands, and producing ‘an out-turn valued at Es.22,00,000. There are also 44 saltpetre refineries, with~~

~~an out-turn valued at Es.3,09,000. The district suffered severely from drought in 1866 and 1874, and again in 1897. In the last year a small Government canal irri- gated 11,000 acres, for which no water-rates are charged; and a canal from the Gandak will irrigate 85,000 acres. The district is traversed almost throughout its length to Bettia by the Tirhut state railway. A considerable trade is conducted with Nepal.~~

~~Champigny, a town in the arrondissement of Sceaux, department of Seine, France, 7^ miles E.S.E. of Paris by rail, on the river Marne. There is a chapel in the early Renaissance style with fine stained glass. The town has manufactures of embroideries and piano-keys; and market-gardening is carried on in the vicinity. It was the scene, in 1870, of two battles during the Franco-Prussian war. A handsome monument, with crypt containing the remains of those who fell, both French and German, has been erected on the neighbouring height of Cceuilly. Population (1901), 6578.~~

~~Chancel lorsvi lie, 'a village of Spottsylvania county, Virginia, U.S.A., situated almost midway between Washington and Richmond, Virginia. It was the central point of one of the greatest battles of the Civil War, 2nd and 3rd May 1863, between the Union " army of the Potomac " under General Hooker, and the Confederate " army of Northern Virginia " under General Lee. The former, numbering about 120,000 men, crossed Rappahan- nock fiver and advanced upon the Confederates, who numbered about 60,000. After two days of severe fighting, in which the Union army lost 18,000 men and the Confederates 13,000, Hooker retreated with his army across the Rappahannock, his forward movement having been checked. Among the killed on the Confederate side was General " Stonewall " Jackson.~~

~~Chanda, a town and district of British India, in the Nagpur division of the Central provinces. In 1881 the population of the town was 16,137, and in 1891 it was 16 175. Chanda was the capital of an ancient Gond king-~~

~~dom, and is still surrounded by a stone wall 5^ miles in circuit. It has several old temples and tombs. There are manufactures of cotton, silk, brass-ware, and leather slippers, and a considerable local trade.~~

~~The district of Chanda has an area of 10,749 square miles. The population in 1881 was 649,146, and in 1891 was .697,610, showing an increase of 8~~

~~per cent, and an average density of 65 per square mile. In 1901 the population was 589,399, showing a decrease of 15 per cent. The land revenue and rates were Rs.3,34,441, the incidence of assessment being Es.0 : 2 : 9 per acre; the culti- vated area in 1897-98 was 818,434 acres, of which 157,307 were irrigated almost entirely from tanks or artificial lakes ; the number of police was 531 ; boys at school in 1896-97 numbered 7356, being 13-9 per cent, of the male popular tion of school-going age ; the registered death-rate in 1897 was 41-71 per thousand. The principal crops are rice, millet, pulse, wheat, oil-seeds, and cotton. The district con- tains the coal-field of Warora, which is connected by a branch with the Nagpur line of the Great Indian Peninsula railway. The mine, which is worked by Government, employs about 1400 hands. In 1897-98 the output was 115,682 tons, and the gross receipts were Rs.5,40,759, yielding a return of 7-7 per cent, on the capital. There is a fireclay industry under the same management. The district suffered severely from famine in 1900, when in April the number of persons relieved rose to 90,000.~~

~~Chandausi, a town of British India, in the Mor- adabad district of the North-West Provinces, 28 miles S. of Moradabad. Its population in 1891 was 28,111, and its municipal income in 1897-98 was Rs.21,837. It is an important station on the Oudh and Rohilkhand rail- way, with a junction for Aligarh. Its chief exports are of cotton, sugar, and stone. There is a factory for pressing cotton.~~

~~Changarn ier, Nicolas-Anne-Theodule~~

~~(1793-1877), French general, was born at Autun, Saone- et-Loire, on 26th April 1793. Educated at St Cyr, he served for a short time in one of the privileged companies of the bodyguard of Louis XVIII. , and entered the 60th regiment of the line as a lieutenant in January 1815. He achieved distinction in the Spanish campaign of 1823, and became a captain in October 1825. In 1830 he entered the Royal Guard and was sent to Africa, where he took part in the Mascara expedition. Promoted major in 1836, he distinguished himself under Marshal Clausel in the campaign against Achmet Bey, and became a lieutenant-colonel in 1837. The part he took in the expedition of Portes-de-Fer gained him a colonelcy, and his success against the Hadjoutes and Kabyles the cross of the Legion of Honour. Three~~

~~more years of brilliant service in Africa, during which he assisted in subjugating the tribes near Tenes, and was wounded at Medeah, won for him the rank of lieutenant- general of division in 1843, and the Algiers divisional command in 1847. He visited France early in 1848, assisted the provisional Government to establish order, and returned to Africa in May to succeed General Cavaignac in the government of Algeria. He was speedily recalled on his election to the General Assembly for the department of the Seine, and received the command of the National Guard of Paris, to which was added soon afterwards that of the troops in Paris, altogether nearly 100,000 men. He held a high place and exercised great influence in the complicated politics of the next two years (grand cross of the Legion of Honour, 5th April 1849). An avowed enemy of republican institutions, he held a unique position in upholding the power of the President ; but in January 1851 he opposed Louis Napoleon's policy, was in consequence deprived of~~

~~Ms double command, and, at the coup d'itat in December, was arrested and sent to Mazas, until his banishment from France by the decree of the 9th January 1862. He re- turned to France after the general amnesty, and resided on his estate in the department of Saone-et-Loire. During the Franco-Prussian war he served with the emperor of the French, and afterwards with Bazaine, until he became a prisoner of war on the capitulation of Metz. At the armistice he returned to Paris, and in 1871 was elected to the National Assembly by four departments, and sat for the Somme. He took an active part in politics, and served on the committee which elaborated the monarchical con- stitution, and, when the comte de Chambord refused the compromise, moved the resolution to extend the executive power for ten years to Marshall MacMahon. He was elected a life senator in 1875. He died in Paris on 14th February 1877, the funeral rites being celebrated at the •church of the Invalides. (k. h. v.)~~

~~Changra, or Kankahi (ancient Gangra, and Ger- manicopolis), altitude 2500 feet, the chief town of a sanjak of the Kastamiiri viMyet in Asia Minor, situated in a rich, well-watered valley. The ground is impregnated with salt,~~

~~*and the town is unhealthy. Population 13,000, of whom 500 are Christians. Gangra, the capital of the kingdom of Deiotarus, son of Castor, was taken injjo the Roman province of Galatia in 7 b.c, and was later the metropolitan see of Paphlagonia.*~~

~~*Channel Islands, a group of islands in the English Channel, consisting of Jersey, Guernsey, Alder- ney, Sark, Herm, and one or two smaller islets which lie in the bay of St Michael, off the coast of Normandy, 15 miles W. from Cotentin and 88 miles S. by E. from Portland Bill. Their total area is about 75 square miles, of which 46 square miles belong to Jersey; 25 to Guern- sey, and 3 to Alderney. Officially they are comprised in. the English county of Hampshire and the diocese of Win- chester. The islands of Alderney, Sark, Herm, and others are administratively counted as part of Guernsey.*~~

~~*Jersey — Agrieulture. — Between 1880 and 1899 the area of land under crops increased from 18,950 acres (65 '9 per cent, of total area) to 19,361 acres (67-4 per cent.). The largest area was occupied by pasture and meadow land, namely, 8446 acres, or 29-4 per cent, of the total, in 1880, and 8253, or 28-7 per cent., in 1899 ; and potatoes, 4671 acres, or 16-9 per cent., in 1880, and 8484 acres, or 29-5 per cent., in 1899. All the cereals together (86-4 per cent, being wheat) only covered 2920 acres, or 10-1 per cent., in 1§80 ; and 1868 acres, or 6-7 per cent., in 1899 (58-6 per cent, being wheat). Turnips, mangold, and other green crops are also grown in small quantities. The area devoted to orchards and market gardens (tomatoes, &c.) was 1569 acres in 1880 and 1209 acres in 1899. The livestock statistics show a slight increase in the numbers of horses, cattle, and pigs in 1899 as compared with 1880, but a slight decrease in sheep. The figures for the year 1899 were 2447 horses, 12,569 cattle (of which 6964 were cows or heifers in milk or in calf), 298 sheep, and 7991 pigs. The area farmed by tenant occupiers increased from 11,289 acres in 1890 to 12,934 acres in 1899 ; and the area farmed by owners decreased from 8677 acres in 1890 to 6427 acres in 1899.*~~

~~*Climate. — According to Eev. H. W. Yorke,^ the annual mean temperature for a period of 20 years was 51-7° Fahr., the mean of January 42-1° and of August 63°. The mean temperature of the sea-water ranges from 40° in*~~

~~*December to 60° in August. The annual mean rainfall (25 years) is 34-2 inches. The average amount of sun- shine was 1930 hours annually for the 15 years ending*~~

~~*1888, or 5 per cent, more than is recorded at the sunniest spot on the south coast of England ; and 1980 hours for the years since 1888.*~~

~~*St Helier. possesses good educational facilities in a ladies' college, a high school for girls, and Victoria Col- lege, and numerous private schools ; also a public library (1736), which contains some Elzevirs, Plantius, &c., and the Beresford library. Since its formation in 1873 the Societe Jersaise has excavated and examined most of the remaining megalithic monuments of the island known as hougues or pouquelayes. The harbour (40 acres) has 30 feet of water at ordinary spring tides, but is dry at low water. Prynne, the Puritan divine, was imprisoned in the (Norman) Orgueil Castle from 1637 to 1640.*~~

~~*The population of Jersey was 62,445 in 1881, 54,518 in 1891 (showing a density of 1211 inhabitants to the square mile), and 52,796 in 1901. In 1891 the birth- rate was 25-1; the death-rate, 20-9. In 1899 the ports of Jersey and Guernsey were cleared by 413 vessels of 52,227 tons ; Jersey alone owned 95 vessels of 5632 tons, also 126 fishing boats of,391 tens.*~~

~~*Guernsey and its Dependent Islands — Agriculture. — Between 1880 and 1899 the area under crops increased from 11,123 acres, or 66-7 per cent, of the total area, to 11,663, or 59-5 per cent. The largest area was occupied by pasture and hay — namely, 6065 acres, or 30-8 per cent., in 1880, and 7162 acres, or 36-6 per cent., in 1899, or an increase of 1107 acres. Green crops covered 3266 acres, or 46-6 per cent., in 1880, and 2922, or 14-9 per cent., in 1899. The area under orchards and market gardens decreased from 683 acres in 1880 to 480 acres in 1899. The principal crops are oats, potatoes (741 acres in 1899), wheat, barley, mangold, and tares. Between 1880 and 1899 there was a slight increase in the number of horses, a slight decrease in cattle and pigs, and a large decrease (from 1013 to 328) in sheep ; the figures for the latter year being 1646 horses, 7172 cattle (of which 3609 were cows and heifers in milk or in calf), and 4741 pigs. The total area*~~

~~*farmed by tenants amounted to 6050 acres in 1899, and the area farmed by the owners to 6613 acres.*~~

~~*Climate. — The mean temperature of February, computed from a period of 40 years, is 43° Fahr., and of July, 60-6°. The rainfall gives an annual mean of 37-|- inches. The amount of sunshine anually is about 2 per cent, less than in Jersey, or about 1890 hours in the year.*~~

~~*Population, &c. — Guernsey possesses two libraries, one vnth a museum attached ; also a ladies' college and a lunatic asylum. The harbour of St Peter Port is 14 to 42 feet deep at ordinary spring tides, and 6 to 32 feet at ordinary neap tides, and possesses a floating dock and shipbuilding yards. In 1899 Guernsey owned 60 vessels of 6526 tons and 99 fishing boats of 349 tons. Victor Hugo spent several years of exile in Guernsey, the house v? hich he occupied in St Peter Port being still in posses- sion of his family. The population of Guernsey increased from 32,600 in 1881 to 36,243 in 1891 (showing a density of 1410 inhabitants to the square mile), and 40,477 in 1901. The birth-rate in 1891 was 23-3; the death-rate, 19-7. Population of Alderney, Sark, &c., 2657 in 1881, 2473 in 1891, and 2568 in 1901.*~~

~~*See G. G. Chisholm in Scot. Geog. Mag. 1886.*~~

~~*Channel Tunnel.— The scheme for uniting Eng- land with France by means of a tunnel was first put upon a practical basis in 1866 by an eminent French engi- neer, M. Thome de Gamoud. His plans were exhibited at the Universal Exhibition of 1867. At the same time English engineers were also working at the same idea. Mr Low conceived the idea of connecting the railway systems of France and England, and selected on the English shore Fan Hole (see D on plan), a spot about*~~

~~*half a mile west of the South Foreland Light, and on the French shore Sangatte, about four miles to the west of Calais, as the ends of the tunnel. Between these two points he considered galleries could be made entirely- through the Dover Grey Chalk, which, owing to its comparative freedom*~~

~~*from water and the general absence of cracks and fissures, offered exceptional facilities for work. Mr Low laid his plans before the Emperor of the French in 1867. Sir John Hawkshaw had also considered the question of a tunnel, and decided to make two borings at the ends of the line which seemed approximately the best position, and to examine the bottom of the Channel for some distance on each side of that line.*~~

~~*In the year 1866 borings were begun at St Margaret's Bay and near Sangatte (see A on plan) ; these proved that*~~

~~*^ Flak of Psoposed Ghannbl Tunnel.*~~

~~*the same strata of chalk which plunge under the sea in England reappear in the cliffs of France, and their con- tinuity underneath the Channel was shown by samples obtained from the bed of the sea. The next step was the appointment of an international committee, which con- cluded that there was a reasonable prospect that the work could be done, and saw no reason to assume that its cost would exceed ten millions sterling. The French Gov- ernment, accepting the scheme, in 1870 made a formal application for the views of the British Government, but the negotiations were broken off by the Franco-German war. They were renewed in 1871, and as a result the British Government intimated that it had "no objection in principle " to the tunnel. After some further com- munications between the two Governments in 1874, set- tling the basis on which the enterprise should be allowed to proceed, a joint commission was appointed to arrange details relating to jurisdiction, the right of blocking the tunnel, &c., and this commission's report was accepted by the Treasury as a basis of an agreement between the two Governments. In consequence of these negotiations two companies were formed. The French company re- ceived its concession in 1875, and the English Channel Tunnel Company, which had applied to Parliament for leave to construct preliminary works at St Margaret's, obtained its Act in the same year. The French Sub- marine Eailway Company at once undertook costly pre- liminary operations, obtaining over 3000 samples of the bottom of the sea in the Strait, and taking more than 7000 soundings, which have rendered it possible to map the range of the chalk of the sea bottom with the same accuracy as in the cliffs. The shaft at Sangatte was sunk and the heading begun, in faith in the understanding arrived at*~~

between the two Governments. The Enghsh company was unable to obtain the necessary capital, owing to commercial depression, and its powers lapsed m 1880 The South-Eastern Eailway had obtained powers in 1874 to sink experimental shafts on their property between Dover and Folkestone, and in 1881 to acquire lands including the beach and foreshore, m that area for experimental works in connexion with the construction

of a Channel tunnel. These resulted, in 1882, in the forma- tion of the Submarine Continental Eailway Company, and, since at the same time the Channel Tunnel Company was resuscitated and made an application to Parliament, there were two rival schemes for making a tunnel from the English shore to join the French company in the middle of the Channel. The Submarine Eailway Company pro- posed that its tunnel should start from the west of Dover, close to Shakespeare Cliff, and the Channel Tunnel Com- pany selected Fan Hole for its starting-point instead of St Margaret's, as in its former scheme. The whole ques- tion was then widely discussed from various points of view and considered by several committees, the last of which — a joint select committee of the House of Lords and House of Commons — in 1883 expressed the opinion, although not unanimously, that it was "not expedient

that Parliamentary sanc- tion should be given to a submarine communica- tion between England and France." This decision prevented the carrying out of the enterprise by the English companies, and led to the formation of an amal- gamated Channel Tunnel Company, which is still in existence and ready to act should opportunity occur. The operations of the French company were also stopped, and it too awaits a reconsideration of the question by Parliament.

The physical characters of the rocks on both sides of the Strait are singularly well adapted for a tunnel from an engineering point of view.

The rocks exposed in the cliffs between Folkestone and St Margaret's, measured for the purposes of the proposed tunnel, are as follows, in descending order : — ^ Thickness

English Feet. f VI. St Margaret's Chalk .... 280 Upper. \ V. Nodular Chalk with flints . . .100

~~(IV. Chalk with few flints . . . . 100 ‘ Middle. III. Lower White Chalk with nodular layers,~~

~~without flints ..... 145 f II. Grey Chalk and Chalk Marl (No. II. of~~

~~Lower, i Price) 225~~

~~(I. Glauconitic Marl (No. I. of Price) . . 3~~

~~Gault 120~~

~~The Gault, a stiff blue impervious clay, forms a low line of cliffs on the west side of Eastwear Bay, and disappears beneath low-water mark, opposite the western end of the Abbotscliffe. It occurs in St Margaret’s Bay at a depth of 536 feet below O.D. The Glauconitic Marl, No. I., a clayey calcareous deposit, gener- ally impervious, but sometimes so full of grains of glauconite and sand as to be pervious, overlies the Gault and passes into the Chalk Marl underlying the Lower Grey Chalk, No. II. This sets in in the cliff traversed by the Folkestone tunnel at 360 feet above O.D., and descends to Ordnance datum a little to the east of Shakespeare Cliff. It constitutes the base of the cliff from Abbotscliffe as far as that point. From this as far as the west base of Eastcliffe, the cliffs are composed of the Middle Chalk Nodular, and White, No. III., rising on the west to 490-l-O.D., and plunging down to the east to a depth of— 180 O.D. at St Margaret’s. At its base is a hard nodular iron-stained layer, the Grit-bed of Price (the Melbourne Bock of the English Geo- logical Survey), forming a conspicuous band in the English and French cliffs. The three upper members of the section con- stitute the Upper Chalk, out of which the cliffs between Dover and St Margaret’s have been carved. All these strata dip steadily to the east at an inclination of about 1 in 72. On the French side, in the cliffs between St Pot and Sangatte, the Lower and Middle Chalk of the English section emerge from the sea with physical characters the same, and the thickness practically also the same. They dip also to the east, but at an angle of 1 in 46. The French survey of the sea bottom in the Strait for the pur- poses of the proposed tunnel proves that the Lower and Middle Chalk are perfectly continuous and constitute the sea floor, the~~

~~sea in the line of the tunnel being 210 feet in depth at the deepest point. It is obvious that a tunnel can be driven which would descend at an inclination of 1 in 70 or 80 on the English, sweep under the Channel, and rise with the strata on the French side, if it can be made in an impervious stratum which cannot be tra- versed by the sea-water under high pressure. The only stra.tum satisfying this condition is the Lower Grey Chalk, and especially the lower and more clayey horizon overlying the Glauconitic Marl.~~

~~Of the three English schemes, the first (Scheme A), proposed by Sir John Hawkshaw, starting from St Mar- garet's Bay, and the modification of it (Scheme D) starting from Fan Hole, present serious engineering difficulties because of the great volumes of -water in the Upper and Middle Chalk. The third (Scheme C) provides for a tunnel in the same impervious stratum throughout the ■whole of its length. The general question as to danger from the influx of water either from the sea or from the land is also satisfactorily answered. The water which percolates in enormous volumes through the chalk from the land into the sea, as may be observed between Dover and St Margaret's, does not descend lower than the top of the Lower Grey Chalk, and an examination of the cliffs on both sides of the Strait proves that even where these lower rocks are traversed by faults, the water does not descend to the bottom of the series. There are no springs at this horizon in either the French or English cliffs. These considerations led to the selection of the sites at the Shakespeare Cliff and at Sangatte for the experimental shafts, and to the placing of the experimental drift-way under the Strait twenty-two miles long in the lowest stratum of the chalk. The selection is amply justified by the experience gained in the course of the work.~~

~~The works executed on the English side, under the superintendence of Mr Brady, by the Submarine Conti- nental Railway Company, Sir Frederick Bramwell being the consulting engineer, and Professor Boyd Dawkins scientific adviser, consist of two shafts of small importance, and a third on the west side of the Shakespeare Cliff, sunk into the Chalk Marl down to a depth of 164 feet from the surface. From the bottom of this a drift-way, 7 feet in diameter^has been driven to a distance of about 2300 yards. This passes below low-water mark at a dis- tance of 1350 yards from the shaft,~~

~~leaving the shore diagonally in the direction of the head of the Admiralty Pier, and, running eastwards under the sea at an inclina- tion of 1 in 72, it maintains the same position in the rocks throughout, being within a few feet of the Gault clay. Had it not been stopped by order of the Government in 1884, there is every reason to suppose that it would have been carried easily and without mishap across to the other side. The length already made proves that no danger need be apprehended from faults. It has cut through all those visible in the Shakespeare Cliff, and although at the time of driving there was a slight weeping of salt water through them to the amount of 3‘3 gallons per minute, they gradually became blocked up and water- tight. When it was last examined by the writer of this article, after standing for five years, it was as dry as any similar drift-way could be, and the marks of the boring machine on the polished surface of the chalk were as dis- tinct as on the day when they were made. On the French side the French Submarine Railway Company sank a shaft at Sangatte 18 feet in diameter to a depth of 226 feet. Unfortunately it intersected a fault in the upper strata which was in communication with the sea, and consequently let the water down to the area of work, which was at the same horizon in the rocks as on the English side, a few feet above the Gault. Two drift- ways had therefore to be made, the upper for the excavation and the lower for the drainage of the water descending the shaft towards the working face. The former, which~~

~~was cut by Beaumont’s English machine, was 7 feet in diameter. It was carried to a distance of about one mile from the bottom of the shaft, underneath the bed of the sea, and traversed in its course several faults, which, like those on the English side, were perfectly water-tight.~~

~~Authorities. — Blue-book Correspondence respecting the pro- posed Channel Tunnel and Sailway, presented to both Houses of Parliament, 1875 (Commercial, No. 6). — Blue-book Correspondence with reference to the proposed construction of a Channel Tunnel, presented to’ the Mouses of Parliament, 1882 (C. 3358) .—Blue-book Meport from the Joint Select Committee of House of Lords and House of Commons on the Channel Tunnel, together with the Pro- ceedings of the Committee, Minutes of JEvidence, and Appendix, 1883 ^i1).— Channel Tunnel, 1869, Statement by Executive Com- mittee, with Engineers’ Beport and Diagram, &c. London, 8vo. — Bramwell. “The Making and Working of a Channel Tunnel,” Boyal~~

~~*Inst. Proc, 19th May 1882.— Ckampton. "Creusement du Tunnel sous-marin entre Calais et Douvres suivant un systfeme hydraulique proposfi par M. Crampton," Mem. Soc. Ingen. Civil., 4me s^r., 6me vol.— Ttlden Wright. "The Channel Tunnel," North of England Institute of Mining and Mech. Engin.yoX. xxii., 1882.— Boyd Dawkins. "The Channel Tunnel," Manch. Geol. Soc, 2nd May 1882; Brit. Assoc. Beports, Section C, 1882, 1899.*~~

~~*(W. B. D.)*~~

~~*Chantabun, the principal town of a province of Siam of the same name, situated on the east side of the Gulf of Siam, in 102° 6' E. long, and 12° 38' N. lat. The town lies about 12 miles from the sea, on thp banks of a river which is navigable for small boats. Inside the bar which protects the entrance to the river a wide estuary offers secure and commodious anchorage for coasters. The town has now a population of about 5000. About 900 tons of white pepper is produced per annum, and sent to Bangkok for trans-shipment to Europe. Coffee, which has been grown on a small scale, has given good results. The ruby mines are scattered over an area about 16 miles square in the district of Krat. There are now fewer than 500 men working at these diggings. The sapphires exported from Chantabun come exclusively from Pailin on the east or Battambong side of the Patat, where some 2000 Sh§,ns, mostly British subjects, and about 2000 Lao from the lower Mekong valley are em- ployed at the diggings. Some £350,000 worth of rubies and sapphires is exported annually.*~~

~~*Li 1893 the town of Chantabun was occupied by a small French force, about 400 strong, consisting mainly of Annamite tirailleurs. This occupation was effected under Act 6 of the Convention of the 3rd of October in that year, agreed to between the French and Siamese Governments, and was to last until the execution of the stipulations of the Convention, and more especially until the com- plete evacuation and pacification of the left bank of the Mekong and of the zones in which, by the treaty of the same date, the Siamese Government had to withdraw all armed forces. The occu- pation, which has in no way affected the trade or administration of the province, still continued in 1901, notwithstanding both the assurances made to the British Government in 1893 that it would*~~

~~only last a month and the repeated representations made on the subject by the Siamese Government.~~

~~Chantilly, a French town in the arrondissement of Senlis, department of Oise, 24 miles in direct line S.E. of Beauvais, on railway from Paris to Creil. The manu- facture of lace and blonde is a decayed industry. A magnificent castle was erected, 1876-85, in Chantilly Park by the due d'Aumale, on the foundations of the ancient chateau and in the style of the chatelet, the only remnant of the ancient pile of the Montmorencys. On the terrace is a bronze statue of Anne de Montmorency, and, opposite to the court of the chatelet, the pleasure ground known as Voltaire's Parterre. The whole is surrounded by fosses supplied with water from the Nonette. The due d'Aumale installed in the castle a valuable library, specially rich in incunabula and 16th- century editions of classic authors, and a collection of the paintings of the great masters, besides many other objects~~

~~of art. By a public act in 1886 the due gave the park and chateau with its superb collections to the Institute of France, in trust for the nation, reserving to himself only a life interest. He died in 1897, and the Institute then acquired full possession of the property. Population of town (1881), 3896: (1896), 3787; (comm.), 4093; (1901), 4791. ' ^ V> , v h~~

~~Chanzy, Antoine Eugene Alfred (1823-1883), French general, was born at Nouart, Ardennes, on 18th March 1823. The son of a cavalry officer, he was educated at the Naval School at Brest, but enlisted in the artillery, and subsequently passing through St Cyr, was commissioned in the Zouaves in 1843. He saw a good deal of fighting in Algeria, and was promoted captain in 1851 (Legion of Honour). As major of the 23rd Foot he served in the Lombardy campaign of 1869, and was present at Magenta and Solferino. He took part in the Syrian campaign of 1860 as a lieut.-colonel (Officer, Legion of Honour) ; and as colonel commanded the 48th regiment at Eome in 1864. He returned to Algeria as general of brigade, assisted to quell the Arab insurrection, and commanded the sub-divisions of Bel Abbes and Tlemcen in 1868 (Commander, Legion of Honour). Although he had~~

~~*acquired some profes- sional reputation, he was in bad odour at the War Office on account of suspected contributions to the press, and of the publication of some jobbery in the supply of stores which he had discovered. At the outbreak of the Franco-German war he was curtly refused a brigade command; but, after the revolution, the government of national defence made him a general of division and gave him command of the 16th corps of the army of the Loire, with which he took a brilliant part in the battles of Coulmiers and Patay. On 5th December 1870 he was made commander-in-chief of the 2nd army of the Loire. He fought stubbornly against Von der Tann, the grand-duke of Mecklenburg, and the Ked Prince, and showed conspicuous ability and military talent in the fighting from Beaugency to the Loire (6th to 11th December), in his retreat to Le Mans, where he re-formed his army m the final struggle in January, and, after the defeat of Le Mans, in the six days' fight in retiring to Laval behind the Mayenne to reconstruct his shattered forces, when the armistice stopped further operations. As Gambetta was the soul, Chanzy was the strong right arm, of French resistance to the invader. He was made a Grand Officer of the Legion of Honour for his services. He represented the Ardennes in the National Assembly, and narrowly escaped capture by the Communists. In 1872 he became a member of the Committee of Defence and commander of the 7th army corps, and in 1873 was appointed govei-nor of Algeria, where he remained for six years. In 1875 he was elected a life senator, in 1878 he received the Grand Cross of the Legion of Honour, and in 1879, without his consent, he was nominated for the presidency of the Republic, and received a third of the total votes. For two years he was ambassador at St Petersburg. He died suddenly at Chaions-sur-Marne, on 4th January 1883, only a few days after Gambetta, and his remains received a State funeral. He was the author of La deuxi&me armie de la Loire, published in 1872. (R- h. t.)*~~

~~*Chapra, or Chupea, a town of British India, the administrative headquarters of Saran district in the Behar province of Bengal, on the left bank of the river Gogra, just above its confluence with the Ganges ; with a rail- way station bn the Bengal and North-Western line towards Oudh. Population (1881), 51,670; (1891), 67,352; (1901), 45,392, showing a decrease of 21 per cent. There are a Government high school, a German*~~

~~Lutheran mission, three printing-presses, and a public library endowed by the late Maharaja of Hatwa. Chapra is the centre of trade in indigo and saltpetre, and con- ducts a large business by water as well as by rail.~~

~~Charcot, Jean Martin (1826-1893), French physician, was born in Paris on 29th November 1825.. In 1853 he graduated as M.D. of Paris University,, and three years later was appointed physician of th& Central Hospital Bureau. In 1860 he became a professor in the University, and in 1862 began that famous con- nexion with the Salpgtri^re which lasted to the end of his. life. He was elected to the Academy of Medicine in 1873, and ten years afterwards became a member of the Institute. His death occurred suddenly on 16th Augiist 1893 at Morvan, where he had gone for a holiday. Charcot, who was a good linguist and well acquainted with the literature of his own as well as of other coimtrieSf excelled as a clinical observer and a pathologist. His work at the Salpgtriere exerted a great influence on the development of the science of neurology, and his classical Legons sur les maladies du systime nerveux, the first series of which was published in 1873, represents an enormous advance in the knowledge and discrimination of nervous diseases. He also devoted much attention to the study of obscure morbid conditions like hysteria, especially in relation to hypnotism ; indeed, it is in con- nexion with his investigation into the phenomena and results of the latter that his name is popularly known. In addition to his labours on neurological and even physiological problems he made many contributions to- other branches of medicine, his published works dealing, among other topics, with liver and kidney diseases, gout, and pulmonary phthisis. As a teacher he was remarkably successful, and always commanded an enthusiastic band of followers.~~

~~Chard, a municipal borough (extended 1892) and market town in the Southern parliamentary division of Somersetshire, England, 13 miles S.S.E. of Taunton by rail. It has manufactures of linen collars and lace. Population of borough (70 acres) (1881), 2411 ; (1891), 2575 ; (1891) on the extended area (403 acres), 4315 ;;~~

~~(1901), 4437.~~

~~Charente, a department in the west of France, nowhere rising to any remarkable elevation, watered by the Charente.~~

~~*Area, 2306 square miles, with 29 cantons and 426 communes. The population was 366,408 in 1886, but only 344,376 in 1901. In 1899 the births were 6610, of which 343 were illegitimate ; the deaths, 7144 ; and the marriages. 2753. Angoul§me, the capital, had a population of 37,650 in 1901. In 1896 there were 921 schools with 48,000 pupils, the illiterate composing 7 per cent, of the population. The area under cultivation in 1896 comprised 1,307,234 acres, of which 845,130 acres were plough-land and 44,480 acres in vines. In 1899 the wheat crop gave a return of the value of £1,074,000. The green crop and grass lands, in which Charente takes a prominent place among the departments of France, produced nearly £1,000,000 in value. The yield of the vineyards amounted to the value of £438,000. Cognac is the centre of the distillation of brandy, to which the town gives its name, the annual production during the years 1886-1896 averaging' 396,168 gallons. The live stock in 1899 included 31,320 horses, 92,960 cattle, 258,100 sheep, and 97,500 pigs. The paper made at Angoulgme is much esteemed.*~~

~~*Charente Inferieure, a department in the west of France, bordering on the Atlantic Ocean and watered by the Charente.*~~

~~*Area, 2792 square miles, with 40 cantons and 480 communes. The population had dropped to 462,803 in 1886 and to 446,294 in 1901. Births in 1899, 8227, of which 393 were illegitimate ; deaths, 9136 ; marriages, 3273. La Eochelle, the capital, had a popula- tion in 1901 of 31,318. The department had in 1896, 1032 schools, with 57,000 pupils, and 3 per cent, of the population was illiterate. The area under cultivation in 1896 comprised 1,492,570 acres, 968,698 acres of which were plough-land and 79,076 acres in vines.*~~

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~~*CHARITY AND CHARITIES*~~

~~*In 1899 the wheat crop yielded the value of £1,462,120, and the produce of the vines exceeded £1,284,000. There is a considerable "distillation of*~~

~~alcohol, amounting to 1,320,000 gallons in 1898. The live stock in 1899 included 38,090 horses, 165,580 cattle,~~

~~213,140 sheep, and 78,690 pigs. Among the mineral produc- tions must be noted stone, clay, and sea-salt, the production of vrhich last, however, amounted in 1898 to only 8500 metric tons.~~

~~CHARITY A|^B CHARITIES.~~

~~THE word " charity," or love, represents the principle of the good life. It stands for a mood or habit of mind and an endeavour. From it, as a habit of mind, springs the social and personal endeavour which in the widest sense we may call charity. The two correspond. Where the habit of mind has not been gained, the endeavour fluctuates and is relatively purposeless. In so far as it has been gained, the endeavour is founded on an intelli- gent scrutiny of social conditions and guided by a definite purpose. In the one case it is realized that some social "theory must be found by us, if our action is to be right and consistent ; in the other case no need of such a theory is felt. This article is based on the assumption that there axe principles in charity or charitable work, and that these can be ascertained by a study of the development of social conditions and their relation to prevalent social aims and religious or philosophic conceptions. It is assumed also that the charity of the religious life, if rightly understood, cannot be inconsistent with that of the social life.~~

~~Perhaps some closer definition of charity is necessary. The words that signify goodwill towards the community and its mem- bers are primarily words expressive of the affections of family life in the relations existing between parents, and between parent and child. As will be seen, the analogies underlying such phrases as "God the Father," "children of God," "brethren," have played a great part in the development of charitable thought in pre-Christian as well as in Christian days. The germ, if we may say so, of the words philia, agape, amor, love ; amicitia, friend- ship, is the sexual or the parental relation. With the realization of the larger life in man the meaning of the word expands. Carltas, or charity, strikes another note — high price, and thus dearness. It is charity, indeed, expressed in mercantile metaphor ; and it would seem that it was associated in thought with the word ■charts, which has also a commercial meaning,~~

~~*but signifies as well favour, gratitude, grace, kindness. Partly thus, perhaps, it assumed and suggested a nobler conception ; and sometimes, as, for instance, in English ecclesiastical documents, it was spelt ■charitas. Agape, which in the Authorized Version of the Bible is translated charity, was used by St Paul as a translation of the Hebrew word chesed, which in the Old Testament is in the same version translated "mercy" — as in Hosea vi. 6, "I ■desired mercy, and not sacrifice." This word represents the charity of kindness and goodness, as distinguished from alms- giving. Almsgiving, tzedaka, is translated by the word elee- mosyna in the Septuagint, and in the Authorized Version by the word "righteousness." It represents the deed or the gift which is due — done or made, not spontaneously, but under a sense of religious obligation. In the earlier Christian period the word .almsgiving has this meaning, and was in that sense applied to a wide range of actions and contracts, from a gift to a beggar at a church door to a grant and a tenure of land. It also, in the word almoner, represented the fulfilment of the religious obliga- tion with the aid of an agent or delegate. The words charity or love {caritas or agape), on the other hand, without losing the tone with which the thought of parental or family love inspires them, assume a higher meaning. In religious thought they imply an ideal life, as represented by such expressions as " love {agape) of God." This on the one side ; and on the other an ideal social relation, in such words as "love of man." Thus in the word "charity" religious and social associations meet; and thus regarded the word means a disciplined and halbitual mood in which the mind is considerate of the welfare of others individually and generally, and devises what is for their real good, and in -which the intelligence and the will strive to fulfil the mind's purpose. Charity thus has no necessary relation to relief or ■alms. To give a lecture, or to nurse a sick man who is not in want or "poor," may be equally a deed of charity; though in iact charity concerns itself largely with the classes usually called "the poor," and with problems of distress and relief. Relief, however, is not an essential part of charity or charitable work. It is one of many means at its disposal. If the world were so*~~

~~*poor that no one could make a gift, or so wealthy that no one needed it, charity — the charity of life and of deeds — would remain.*~~

~~*The history of charity is a history of many social and religious theories, influences, and endeavours, that have left their mark alike upon the popular and the cultivated thought of the present day. The inconsistencies of charitable effort and argument may thus in part be accounted for. To understand the problem of charity we have' therefore (1) to consider the stages of charitable thought •; — the primitive, pagan, Greek and Eoman, Jewish and Christian elements, that make up the modern conscious- ness in regard to charity, and also the growth of the habit of " charity " as representing a gradually educated social instinct. (2) We have also to consider in their relation to charity the results of recent investigations of the con- ditions of social life. (3) At each stage we have to note the corresponding stage of practical administration in public relief and private effort — for the division between public or " poor-law " relief and charity which now prevails in England is, comparatively speaking, a novelty, and, generally speaking, the work of charity can hardly be appreciated or understood if it be considered without reference to public relief. (4) As to the present day, we have to consider practical suggestions in regard to such subjects as charity and economic thought, charity organ- ization, friendly visiting and almonership, co-operation with the poor-law, charity and thrift, parochial manage- ment, hospitals and medical relief, exceptional distress and the "unemployed," the utilization of endowments and their supervision, and their adaptation to new needs and emergencies. (5_) We have also throughout to con- sider charitable help in relation to classes of dependants, who appear early in the history of the question — widows and orphans, the sick and the aged, vagrants and way- farers.*~~

~~*First in the series come the charities of the family and of hospitality ; then the wider charities of religion, the charities of the community, and of individual donors and of mutual help. These gradually assumed importance in communities which consisted originally of self-supporting classes, within which widows and orphans, for instance, would be rather provided for, in accordance with recog- nized class obligations, than relieved. Then come habit- ual almsgiving, the charitable endowment, and the modern charitable institution and association. But throughout the test of progress or decadence appears to be the condition of the family. The family is the source, the home, and the hearthstone of charity. It has been created but slowly, and there is naturally a constant tendency to break away from its*~~

~~obligations and to ignore and depreciate its utility. Yet the family, as we now have it, is itself the outcome of infinite thought working through social instinct, and has at each stage of its development indicated a general advance. To it, therefore, constant reference must be made.~~

~~Part I. — Pkimitive Charity. The study of early communities has brought to light the history of the development of the family. " Marriage in its lowest phases is by no means a matter of affection or companionship"; and only very slowly has the position of both parents been recognized as implying different but correlative responsibilities towards their child. Only very slowly, also, has the morality necessary to the making of~~

~~the family been won. Charity is hardly recognized as a virtue, nor infanticide as an evil. Hospitality — the beginning of a larger social life — is non-existent. The self-support of the community is secured by marriage, and when relations fail marriage becomes a provision against poverty. Then by the tribal system is created another ■safeguard against want. Apart also from these methods of maintenance, at a very early stage there is charitable relief. The festivals of the solstices and equinoxes, and of the seasons, are the occasions for sacrifice and relief ; and, as Christmas customs prove, the instinct to give help or alms at such festival periods still remains. Charity is ■concerned primarily with certain elemental forces of social life; the relation between these primitive instincts and impulses that still influence charity should not, therefore, be overlooked. The basis of social life is also the basis of charitable thought and action.~~

~~The savage is the civilized man in the rough. " The lowest laces have," Lord Avebury writes, "no institution of marriage." Many have no word for "dear" or "beloved." The child belongs to the tribe rather than to the parent. In these circum- ■stances a problem of charity such as the following may arise : — "Am I to starve, while my sister has children whom she can sell? " a question asked of Burton by a negro. From the point of view of the tribe, an able-bodied man would be more valuable than dependent children, and the relationship of the larger family of brothers and sisters would be a~~

~~truer claim to help than that of mother and child. Subsequently the child is recognized as related, not to the father, but to the mother, and there is "a kind of bond which lasts for life between mother and child, although the father is a stranger to it." Slowly only is the relative position of both parents, with different but correlative responsibilities, recognized. The first two steps of charity have then been made : the social value of the bond between the mother, and then between the father, and the child has been lecognized. Until this point is reached the morality necessary to the making of the family is wanting, and for a long time after- wards it is hardly won. The virtue of chastity — the condition precedent to the higher family life — is unrecognized. Indeed, the set of such religious thought as there may be is against it. Abstract conceptions, even in the nobler races, are lacking. The religion of life is vaguely struggling with its animality, and that which it at last learns to rule it at first worships. In these circumstances there is little charity for the child and little for the stranger. " There is," Dr Sohweinfurth wrote in his Heart of Africa, "an utter want of wholesome intercourse between race and race. For any member of a tribe that speaks one dialect to cross the borders of a tribe that speaks another is to make a venture at the hazard of his life." The religious obligations that fostered and sanctified family life among the Greeks and Romans and Jews are unknown. Much later in development comes •charity for the child, with the abhorrence of infanticide— against which the Jewish-Christian charity of 2000 years ago uttered its most vigorous protests. If the child belonged primarily to the tribe or state, its maintenance or destruction was a common •concern. This motive influenced the Greeks, who are historically nearer the earlier forms of social life, than ourselves. For the •common good they exposed the deformed child ; but also "where there were too many, for in our state population has a limit," as Aristotle says, "the babe or unborn child was destroyed." And so, to lighten their own responsibilities, parents were wont to do in the slow years of the degradation of the Roman Empire, though the interest of the state then required a contrary policy. The "transition to our present feeling of responsibility for child- life has been very gradual and uncertain, through the Middle Ages and even till the 18th century. Strictly it may be said that all penitentiaries and other similar mstitutions are concrete protests on behalf of a better family life. The move- ment for the care of children in the 18th century naturally and instinctively allied itself with the penitentiary movement. The want of regard for child-life, when it~~

~~becomes a source of economic pressure suggests how in earlier stages of civilization all that ■charitable apparatus for the assistance of children becomes unnecessary, even if the need, so far as it does arise, is not adequately met by the recognized obligations of the clan-family or brotherhood. , ., , ,, . t.~~

~~In the case of barbarous races charity and self-support may be considered from some other points of view. Self-support is secured in two ways-by marriage and by slavery. "For a man or woman to be unmarried after the age of thirty is unheard of" CT H Lewin, Wild Baces of South-East India). On the other •hand 'if any one is without a father, mother, or other relative,~~

~~and destitute of the necessaries of life, he may sell himself and become a slave. Thus slavery becomes a provision for poverty when relations fail. The clan family may serve the same purpose. David Livingstone describes the formation of the clan family among the Bakuena. " Bach man, by virtue of paternity, is chief of his own children. They baild huts round his. . . . Near the centre. of each circle of huts is a spot called a 'kotla,' with a fireplace ;' here they work, eat, &c. A poor man attaches himself to the ' kotla ' of a rich one, and is considered a child of the latter." Thus the clan-family is also a poor-relief association. Studies in folk-lore bring to light many relations between the charity of the old world and that of our own day.~~

~~In regard to the charity of the early community, we may take the 8th century B.C. as the point of departure. The Odyssey (about 800 b.c.) and Hesiod (about 700 B.C.) are roughly parallel with Amos J^^^^'/ny^ (816-775), and represent two streams of thought that meet in the early Christian period. The period cov- ered by the Odyssey seems to merge into that of Hesiod. We take the former first, dealing with the clan-family and the phratry, which are together the self-maintaining unit of society, with the general relief of the poor, with hospitality, and with vagrancy. In Hesiod we find the customary law of charity in the earlier community defi- nitely stated, and indications of the normal methods of neighbourly help which were in force in country districts. First of the family and brotherhood, or phratry. The family (Od. viii. 582) included alike the wife's father and the daughter's husband. It was thus a clanlike family. Out of this was developed the phratry or brotherhood, in which- were included alike noble families,~~

~~*peasants, and craftsmen, united by a common worship and responsibili- ties and a common customary law (tliemis). Zeus, the god of social life, was worshipped by the phratry. He was the father of the law (themis). He was god of host and guest. Society was thus based on law, the brother- hood, and the family. The irresponsible man, the man worthy of no respect or consideration, was one who be- longed to no brotherhood, was subject to no customary law, and had no hearth or family. The phratry was, and became afterwards still more, "a natural guild." Out- side the self-sustaining phratry was the stranger, includ- ing the wayfarer and the vagrant ; and partly merged in these classes was the beggar, the recognized recipient of the alms of the community. To change one's abode and to travel was assumed to be a cause of reproach (H. ix. 648). The "land-louper" was naturally suspected. On the other hand, a stranger's first thought in a new country was whether the inhabitants were wild or social (dikaioi), hospitable and God-fearing (Od. xiii. 201). Hospitality thus became the first public charity; Zeus sent all strangers and beggars, and it was against all law (themis) to slight them. Out of this feeling — a kind of glorified almsgiving — grew up the system of hospitality in Greek states and also in the Roman world. The host greeted the stranger (or the suppliant). An oath of friendship was taken by the stranger, who was then received with the greeting. Welcome (Chaire), and water was provided for ablution, and food and shelter. In the larger house there was a guests' table. In the hut he shared the peasant's meal. The custom bound alike the rich and poor. On parting presents were given, usually food for the onward journey, sometimes costly gifts. The obligation was mutual, that the host should give hospitality and that the guest should not abuse it. From early times tallies were exchanged between them as evidence of this formal relationship, which each could claim again of the other by the production of the token. And further, the relationship on either side became hereditary. Thus indi- viduals and families and tribes remained linked in friend- ship and in the interchange of hospitalities.*~~

~~*Under the same pat;ronage of Zeus and the same laws of hospitality were the vagrants and beggars. The vagrant*~~

~~and loafer are sketched in the Odyssey — ^the vagrant who lies glibly that he may get entertainment, and the loafer who prefers begging to work on a farm. These and the winter idlers, whom Hesiod pictures — a group known to modern life — prefer at that season to spend their time in the warmth of ih village smithy, or at a house of common resort (lesche) — a common lodging-house, we might say — where they would pass the night. Apparently, as in modern times, the vagrants had organized their own system of entertainment, and, supported by the public, were a class for whom it was worth while to cater. The local or public beggars formed a still more definite class. Their begging was recognized as their means of maintenance ; it was a part of the method of poor relief. Thus of Penelope it was said that, if Ulysses' tale were true, she would give him better clothes, and then he might beg his bread throughout the country-side. Feasts too and almsgiving were nearly allied, and feasts have always been one resource for the relief of the poor. Thus naturally the beggars frequented feasts, and were apparently a recognized and yet inevitable nuisance. They wore, as part of their dress, scrips or wallets in which they carried away the food they received (as later the Roman clients carried away portions of food in baskets (sportula) from their patron's dinner). Ulysses, when he dresses up as a beggar, puts on a wallet as part of his costume. Thus we find a system of voluntary relief in force based on a recognition of the duty of almsgiving as complete and peremptory as that which we shall notice later among the Jews and the early Christians. We are concerned with country districts, and not with towns, and, as social conditions that are similar produce similar method.s of administration, so we find here a general plan of relief similar to that which was in vogue in Scotland till the Scottish Poor Law Act of 1845.**

~~In Hesiod the fundamental conceptions of charity are more clearly expressed. He has, if not his ten, at least his four commandments, for disobedience to which Zeus will punish the offender. They are : Thou shalt do no evil to .suppliant or guest ; thou shalt not dishonour any woman of the family ; thou shalt not sin against the orphan ; thou shalt not be imkind to aged parents.~~

~~*The laws of social life are thus duty to one's guest and duty to one's family; and chastity has its true place in that relation, as the later Greeks, who so often quote Hesiod (of. the so-called Economics of Aristotle), fully realized. Also the family charities due td the orphan, whose lot is deplored in the Iliad (xxii. 490), and to the aged are'now clearly enunciated. But there is also in Hesiod the duty to one's neighbour, not according to the " perfec-tion " of "Cristes lore," but according to a law of honourable reciprocity in act and intent. ' ' Love him who loves thee, and cleave to him who cleaveth to thee : to him who would have given, give ; to him who would not have given, give not." The groundwork of Hesiod's charity outside the family is neighbourly help (such as formed no small part of old Scottish charity in the country districts); and he put his argument thus: Competition, which is a kind of strife, "lies in the roots of the world and in men." It is good, and rouses the idle "handless" man to -work. On one side are social duty (dike) and work, done briskly at the right season of the year, which brings a full baru. On the other side are unthrift and hunger, and relief with the disgrace of begging ; and the relief, when the family can do no more, must come from neighbours, to whose house the beggar has to go with his wife and children to ask for victual. Once they may be helped, or twice, and then they will beTefused. It is better, Hesiod tells his brother, to work and so pay off his debts and avoid hunger (see Erga, 391, &c., and elsewhere). Here indeed is a problem of to-day as it appeared to an early Greek. The alternatives before the idler — so far as his own community is concerned — arg labour with neighbourly help to a limited extent, or hunger.*~~

~~*Hesiod was a farmer in BcEotia. Some 530 years afterwards a pupil of Aristotle thus describes the district and its community of farmers. "They are," he says, "well to do, but simply in their way of life. They practise justice, good faith, and hospitality. To needy townsmen and vagabonds they give freely of their sub-*~~

~~*stance; for meanness and covetousness are unknown to them." The charitable method of Homeric and Hesiodic days still continued.*~~

~~*Part II. — Charity among the Greeks.*~~

~~*Society in a Greek state was divided into two parts, citizens and slaves. The citizens required leisure for education, war, and government. The slaves*~~

*were their ministers and servants to enable J^f^f'"**^ them to secure this leisure. We have there- fore to consider, on the one hand, the position of the family and the clan-family, and the maintenance of the citizen from public funds and by public and private charities; and on the other hand the condition of the slaves, and the relation between slavery and charity.*

The slaves formed the larger part of the population. The census of Attica made between 317 and 307 B.C. gives their numbers at 400,000 out of a population of about 500,000; and even if this be considered excessive, the proportion of slaves to citizens would certainly be very large. The citizens with their wives and children formed some 12 per cent, of the community. Thus, apart from the resident aliens, returned in the census at 10,000, and their wives and children, we have two divisions of society: the citizens, with their own organization of relief and charities; and the slaves, permanently main-' tained by reason of their dependence on individual members of the civic class. Thus, the only poverty is that of the poor citizens. Poverty is limited to them. The slaves — that is to say, the bulk of the labouring population — are provided for.

From times relatively near to Hesiod's we may trace the growth and influence of the clan-family as the centre of customarj' charity within the community, the gradual increase of a ^class of poor either outside the clan-family or eventually independent of it, and the development of a new organization of relief introduced by the state to meet newer demands. We picture the early state as a group of families, each of which tends to form in time a separate group or clan. At each ex- pansion from the family to the clan the members of the clan retain rights and have to fulfil duties which, are the same as, or similar to, those which prevailed in the family. Thus, in Attica the clan-families (genos) and the brotherhoods {phratria) were "the only basis of legal rights and obligations over and above the natural family." The clan-family was " a natural guild," consisting of rich and poor members — ^the well-born or noble and the craftsman alike. Originally it would seem that the land was divided among the families of the clan by lot and was inalienable. Thus with the family was combined the means of support- ing the family. On the other hand, every youth was. registered in his phratry, and the phjatry remained till the reforms of

~~*Cleisthenes (509 b.c.) a political, and even after that time a social, organization of importance.*~~

~~*First, as to the family — the mother and wife, and the father. Already before the age of Plato and Xenophon. (460-350 B.C.) we find that the family has suffered a slow decline. The wife, according to later Greek usage, was; married as a child, hardly educated, and confined to the house, except at some festival or funeral. But with the decline came criticism and a nobler conception of family life. " First, then, come laws regarding the wife," writes, the author of the so-called Economics of Aristotle, and the law, "thou shalt do no wrong; for, if we do no wrong,, we shall not be wronged." This is the " common law," as the Pythagoreans say, " and it implies that we must not. wrong the wife in, the least, but treat her with the reverence due to a suppliant, or one taken from the altar." The sanctity of marriage is thus placed among the " com-*~~

~~*mandments " of Hesiod, beside the duty towards" the stranger and the orphan. These and other references to the Pythagoreans suggest that they, possibly in common with other mystics, preached the higher religion of marriage and social life, and thus inspired a deeper social feeling, which eventually allied itself with the Christian movement. Next, as to parents and children : the son was under an obligation to support his father, subject, after Solon's time, to the condition that he had taught him a trade ; and after Solon's time the father had no claim for support from an illegitimate son. " The possession of children," it was said (Arist. Econ.), " is not by nature for the public good only, but also for private advantage. Por-what the strong may gain by their toil for the weak, the weak in their old age receive from the strong. . . . Thus is the nature of each, the man and the woman, prearranged by the Divine Being for a life in common." Honour to parents is " the first and greatest and oldest of all debts " (Plato, Laws, 717). The child has to care for the parent in his old age. "Nemesis, the minister of justice (dike), is- appointed to watch over all these things." And "if a man fail to adorn the sepulchre of his dead parents, the magistrates take note of it and inquire" (Xen. Mem. ii., 14). The heightened conception*~~

~~*of marriage implies a fuller inter- pretation of the mutual relations of parent and child as well ; both become sacred.*~~

~~*Then as to orphans. Before Solon's time (594 b.c.) the property of any member of the clan-family who died without children went to the clan; and after his time, when citizens were permitted to leave their property by will, the property of an intestate fell to the clan. This arrangement carried with it corresponding duties. Through the clan-family provision was made for orphans. Any member of the clan had the legal right to claim an orphan member in marriage ; and, if the nearest agnate did not marry her, he had to give her a dowry proportionate to the amount of his own property. Later, there is evidence of a growing sense of responsibility in regard to orphans. Hippodamus (about 443 b.c), in his scheme of the perfected state (Arist. Pol. 1268), suggested that there should be public magistrates to deal with the afEairs of orphans (and strangers) ; and Plato, his contemporary, writes of the duty of the state and of the guardian towards them very fully. Orphans, he proposes {Laws, 927), should be placed under the care of public guardians. " Men should have a fear of the loneliness of orphans ... and of the souls of the departed, who by nature take a special care of their own children. ... A man should love the unfortunate orphan (boy or girl) of whom he is guardian as if he were his own child; he should be as careful and diligent in the management of the orphan's property as of his own — or even more careful still."*~~

~~*To relieve the poverty of citizens and to preserve the citizenhood were objects of public policy and of charity. In Crete and Sparta the citizens were wholly supported out of the public resources. In Attica the system was different. Tlje citizens were aided in various ways, in which, as often happens, legal or official and voluntary or private methods worked on parallel lines. The means were (1) legal enactment for release of debts ; (2) emigra- tion ; (3) the supply of corn ; (4) poor relief for the infirm, and relief for the children of those fallen in war ; (5) emoluments ; (6) voluntary public service, separate gifts and liberality; (7) loan societies.*~~

~~*(1) In 594 B.C. the labouring class in Attica were overwhelmed with debts and mortgages, and their persons pledged as security. Only by a sharp reform was it possible to preserve them from slavery l^is Solon effected. He*~~

~~annulled their obligations, abolished the pledge of the person, and gave the labourers the franchise And, in addition to this, besides the laws above mentioned, he gave power to the Areopagus to inquire from what sources each man obtained the necessaries of life, and to punish~~

~~those who did not work. HIs action and that of his successor, Peisistratus (560 b.c), suggest that the class of poor (^aporoi) was increasing, and that by the efforts of these two men the social decline of the people was avoided or at least postponed. Peisi- stratus lent the poor money that they might maintain themselves in husbandry. HIe wished, it is said (Arist. Ath. Pol. xvi.), to enable them to earn a moderate living, that they might be occupied with their own affairs, instead of spending their time in the city or neglecting their work in order to visit it. As rent for their land they paid a tenth of the produce.~~

~~(2) Akin to this policy was that of emigration. Athenians, selected in some instances from the two lowest political classes, emigrated, though still retaining their rights of citizenship. In 570-565 B.C. Salamis was annexed and divided into lots and settled, and later Pericles settled more than 2750 citizens in the Chersonese and elsewhere — practically a considerable section of the whole body of citizens. " By this means," says Plutarch, " he relieved the state of numerous idle agitators and assisted the necessitous." In other states this expedient was frequently adopted.~~

~~(3) A third method was the supply of corn at reduced rates — a method similar to that adopted, as we shall see, at Rome, ^ Constantinople, and elsewhere. The maintenance of the mass of the people depended on the com fleets. There were public granaries, where large stores were laid up at the public expense. A portion of all cargoes of corn was retained at Athens and in other ways importation was promoted. Exportation was forbidden. Public donations and distributions of com were frequent, and in times of scarcity rich citizens made large contributions with that object. The distributions were made to adult citizens of eighteen years of age and upwards, whose names were on the registers.~~

~~(4) In addition to this there was a system of public relief for those who were unable to earn a livelihood on account of bodily defects and infirmities. The qualification was a property test. The property of the applicant had to be~~

~~*shovm to be of a value of not more than three minas (say £12). Socrates, it may be noted, adopts the same method of estimating his comparative poverty (Xen. Econ. ii. 6), saying that his goods would realize about five minae (or about twenty guineas). The senate examined the case, and the ecclesia awarded the bounty, which amounted to 1 or 2 obols a day, rather more than IJd. or 3d. — out^door relief, as we might say, amounting at most to about Is. 9d. a week. There was also a fund- for the maintenance of the children of those who had fallen in war, up to the age of eighteen.*~~

~~*(5) But the main source of support was the receipt of emolu- ments for various public services. This was not relief, though it produced in the course of time the effect of relief. It was rather the Athenian method of supporting a governing class of citizens.*~~

~~*The inner political history of Athens is the history of the extension of the franchise to the lower classes of citizens, with the privileges of holding office and receiving emoluments. About 650 B.C., at a time when trade was increasing, the citizens were classified on the basis of property. The rich retained the franchise and the right of holding office ; the middle classes obtained the franchise ; the fourth or labouring class gained neither. By the reforms of Cleisthenes (509 b.c.) the clan-family and the phratry were set aside for the deme or parish, a geographical division superseding the social. Finally, about 478 b.c, when all had acquired the franchise, the right to hold office also was obtained by the fourth class. These changes coincided with a period of economic progress. The rate of interest was high, usually 12 per cent. ; and in trading and bottomry the returns were much higher. A small capital at this interest soon produced com- parative wealth ; and simultaneously prices were falling. Then came the reaction. "After the Peloponnesian war" (432 to 404 B.C.), writes Professor Jebb, "the wealth of the country ceased to grow, as population had ceased to grow about 50 years sooner. The rich went on accumulating ; the poor, having no means of enriching themselves by enterprise, were for the most part occupied in watching for some chance of snatching a larger share of the stationary total." Thus the poorer classes in a time of prosperity had won the power which they were able to turn to their own account afterwards. A period of economic pressure followed, coupled with a decline in the population ; no return to the land was feasible, nor was emigration ; the people had become*~~

town-folk inadaptable to new uses ; decreasing vitality and energy were marked by a new temper, the "pauper" temper, unsettled, idle, and grasping, and political power was utilized to obtain relief. The relief was forthcoming, but it was of no avail to stop the general decline. The state, it might almost be said, in giving scope to the assertion of the spirit of dependence, had mined the self-regarding energy on which both family and state alike depended. The emoluments were diverse. The number of citizens was not large ; the functions in which citizens could take part were numerous ; and when payment was forth- coming the poorer citizens pressed in to exercise their rights (cf. Arist. Pol. 1293a). All Athenian citizens could attend the public

assembly or ecclesia. Probatly the attendance at it varied from a few hundred to 5000 persons. In 395 b.c. the payment for attendance was fixed at 3 obols, or little more than 4Jd. a day— for the system of payment had probably been introduced a few years before (cf. Daremberg, Diet, des Antiq.). A juror or dikast would receive the same sum for attendance, and the courts or juries would often consist of 500 persons. If the estimate (Bockh. , Public Economy of Athens, Eng. trans., pp. 109, 117) holds good that in the age of Demosthenes (384-323 e.g.) the member of a poor family of four free persons could live (including rent) on about 3'3d. or between 2 and 3 obols a day, the pay of the citizen attending the assembly or the court would at least cover the expenses of subsistence. On the other hand, it would be less than the pay of a day labourer, which was probably about 4 obols or 6d. a day. In any case many citizens — they numbered in all about 20,000 — in return for their participation in political duties would receive considerable pecuniary assistance. Attending a great public festival also, the citizen would receive 2 obols or 3d. a day during the festival days ; and there wei^e besides frequent public sacrifices, with the meal or feast which accompanied them. But besides this there were confiscations of private property, which produced a surplus revenue divisible among the poorer citizens. (Some hold that there were confiscations in other Greek states, but not in Athens.) In these circumstances it is not to be wondered that men like

~~*Isocrates should regret that the influence of the Areopagus, the old court of morals and justice in Athens, had disappeared, for it "maintained a sort of censorial police over the lives and habits of the citizens ; and it professed to enforce a tutelary and paternal discipline, beyond that which the strict letter of the law could mark out, over the indolent, the prodigal, the undutiful, and the deserters of old rite and custom." . (6) In addition to public emoluments and relief there was much private liberality and charity. Many expensive public services were undertaken honorarily by the citizens under a kind of civic compulsion. Thus in a trial about 425 b.c. (Lysias, Or. 19. 57) a citizen submitted evidence that his father expended more than £2000 during his life in paying the expenses of choruses at festivals, fitting out seven triremes for the navy, and meeting levies of income tax to meet emergencies. Besides this he had helped poor citizens by portioning their daughters and sisters, had ransomed some, and paid the funeral expenses of others (cf. for other instances Plutarch's Cimon, Theophras. JSth., and Xen. Econ.).*~~

~~*(7) There were also mutual help societies {eranoi"). Those for relief would appear to have been loan societies (cf. Theoph. Elh.), one of whose members would beat up contributions to help a friend, who would afterwards repay the advance.*~~

~~*The criticisms of Aristotle (284-322 b.c.) suggest the direction to which he looked for reform. He {Pol. 1.S20a) passes a very unfavourable judgment on the distribution of public money to the poorer citizens. The demagogues (he does not speak of Athens particularly) distributed the surplus revenues to the poor, who received them all at the same time ; and then they were in want again. It was only, he argued, like pouring water through a sieve. It were better to see to it that the greater number were not so entirely destitute, for the depravity of a democratic govern- ment was due to this. The problem was to contrive how plenty (euporia, not poverty, aporia) should become permanent. His proposals are adequate aid and voluntary charity.- Public relief should, he urges, be given in large amounts so as to help people to acquire small farms or start in business, and the well-to-do {euporoi) should in the meantime subscribe to pay the poor for their attendance at the public assemblies. (This proves, indeed, how the payments had become poor relief.) He mentions also how the Carthaginian notables*~~

~~*divided the destitute amongst them and gave them the means of setting to work, and the Tarentines (koina poiountes) shared their property with the poor. (The Ehodians also might be mentioned (Strabo, xiv. c. 652), amongst whom the well-to-do undertook the relief of the poor voluntarily.) The later word for charitable distribution was a sharing {koinonia, Ep. Rom. xv. 26), which, would seem to indicate that after Aristotle's time popular thought had turned in that direction. But the chief service rendered by Aristotle — a service which covered indeed the whole ground of social progress — was to show that unless the purpose of civil and social life was carefully considered and clearly realized by those who desired to improve its conditions, no change for the better could result from individual or associated action.*~~

~~*Two forms of charity have still to be mentioDsd : charity to the stranger and to the sick. It will be con- venient to consider both in relation to the whole classical period.*~~

~~*With the growth of towns the administration of hos- pitality was elaborated.*~~

~~*(1) There was hospitality between members of families bound by the rites of host and guest. The guest received as a right only shelter and fire. Usually he dined with the host*~~ ~~-A~~

~~*the first day, and if afterwards he was fed, provisions straager. were supplied to him. There were large guest chambers {xenon) or small guest houses, completely isolated on the right or left of the principal house ; and here the guest was lodged.*~~

~~*(2) There were also, e.g., at Hieropolis (Prof. W. M. Ramsay's Phrygia, ii. 97), brotherhoods Of hospitality {xenoi tekmoreioi, bearers of the sign), which made hospitality a duty, and had a common chest and Apollo as their tutelary god. (3) There were inns or resting-places {hatagogion) for strangers at temples. (Thuc. iii. 68 ; Plato, Laws, 953a) and places of resort {lesche} at or near the temples for the entertainment of strangers — for instance, at a temple of Asklepios at Epidaurus (Pausanias, ii. 174); and Pausanias argues that they were common through- out the country. Probably also at the temples hospitable pro- vision was made for strangers. The evidence at present is not perhaps sufficiently complete, but, so far as it*~~

~~goes, it tends to the conclusion that in pre-Christian times hospitality was provided to passers-by and strangers in the temple buildings, as later it was furnished in the monasteries and churches. (3) There were also in towns houses for strangers (xenon) provided at the public cost. This was so at Megara ; and in Crete strangers had a place at the public meals and a dormitory. Xenophon suggested that it would be- profitable for the Athenian state to establish inns for traders (katagogia demosia) at Athens. Thus, apart from the ofBcial hospitality of the proxenus or "consul," who had charge of the affairs of foreigners, and the hospitality which was shown to persons of distinction by states or private individuals, there was in Greece a large provision for strangers, wayfarers, and vagrants based on the charitable sentiment of hospitality. Among the Romans similar customs of private and public hospitality prevailed ; and throughout the empire the older system was altered, probably very slowly. In Christian times (cf. Ramsay above) Pagan temples were (about a.d. 408) utilized for other purposes, including that of hospitality to strangers.~~

~~Eound the temples, at first probably village temples, the organization of medical relief grew up. Primitive medicine is connected with dreams, worship, and ^^^ ^^^^ liturgical "pollution," punishment, and peni- tence, and an experimental practice. Finally, systematic observation and science (with no knowledge of chemistry and little of physiology) assert themselves, and a secular administration is created by the side of the older religious organization.~~

~~Sickness among primitive races is conceived to be a material substance to be extracted, or an evil spirit to be driven away by incantation. Religion and medicine are thus at the beginning almost one and the same thing. In Anatolia, in the groups of villages (cf. Ramsay as above, i. 101) under the theocratic government of a central hieron or temple, the god, Men Karou, was the physician and saviour (soter and sozon) of his people. Priests, prophets, and physicians were his ministers. He punished wrongdoing by diseases which he taught the penitent to cure. So elsewhere pollution, physical or moral, was chastened by disease and loss of property or children, and further ills were avoided by sacrifice and expiation and public warning. In the temple and out of this phase of thought grew up schools of medicine, in whose practice dreams and religious ritual retained a place.~~

~~*The newer gods, Asklepios and Apollo, succeeded the older local divinities; and the "sons" of Asklepios became a profession, and the temple with its adjacent buildings a kind of hospital. There were many temples of Asklepios in Greece and elsewhere, placed generally in high and salubrious positions. After ablution the patient offered sacrifices, repeating himself the words of the hymn that was chanted. Then, when night came on, he slept in the temple. In the early dawn he was to dream "the heavenly dream" which would suggest his cure ; but if he did not dream, relations and others — officials at the temple — might dream for iim. At dawn the priests or sons of Asklepios came into the temple and visited the sick, so that, in a kind of drama, where reality and appearance seemed to meet, the patients believed that they saw the god himself. The next morning the prescription and treatment were settled. At hand in the inn or guest chambers of the temple the patient could remain, sleeping again in the temple, if necessary, and carrying out the required regimen. In the temple were votive tablets of cases, popular and awe-inspiring, and records and prescriptions, which later found their way into the medical works of Galen and others. At the temple of Asklepios at Epidaurus was an inn {katagogion) with four courts and colonnades, and in all 160 rooms. (Cf. Pausanias, ii. 171 ; a,nA Report, Archoeol. in Greece, R. C. Bosanquet, 1899, 1900.)*~~

~~*At three centres more particularly, Ehodes, Cnidos, and Cos, were the medical schools of the Asklepiads. If one may judge from an inscription at Athens, priests of Asklepios attended the poor gratuitously. And years afterwards, in the 11th century, when there was a revival of medicine, we find at Salerno the Christian priest as doctor, a simple and less palatable pharmacy for the poor, and gratuitous medical relief.*~~

~~*Besides the temple schools and hospitals there was a secular organization of medical aid and relief. States appointed trained medical men as physicians, and pro- vided for them medical establishments (iatreia, "large houses with large doors full of light ") for the reception of the sick, and for operations there were provided beds, instruments, medicines, &c. At these places also pupils were taught. A lower degree of medical establishment*~~

~~was to be found at the barbers' shopS. Out-patients were seen at the iatreia. They were also visited at home. There were doctors' assistants and slave doctors. The latter, apparently, attended only slaves (Plato, Leg. iv. 720) ; they do " a great service to the master of the house, who in this manner is relieved of the care of his slaves." It was a precept of Hippocrates, that if a phy- sician came to a town where there were sick poor, he should make it his first duty to attend to them ; and the ■ state physician attended gratuitously any one who applied to him. There were also travelling physicians going rounds to heal children and the poor. These methods continued, probably all of them, to Christian times.~~

~~In Rome there were consulting-rooms and dispensaries, and houses in which the sick were received. Hospitals are mentioned by Roman writers in the 1st century a.d. There were infirmaries — detached buildings — for sick slaves ; and in Rome, as at Athens, there were slaves skilled in medicine. In Rome also for each regio there was a chief physician ' who attended to the poorer people.~~

~~Slavery was so large a factor in pre-Christian and early Christian society that a word should be said on its relation to charity. Indirectly it was a cause of poverty Slavery. ^^^ social degradation. Thus in the case of Athens, with the achievement of maritime supremacy the number of slaves increased greatly. Manual arts were despised as unbecoming to a citizen, and the slaves carried on the larger part of the agricultural and industrial work of the community ; and for a time — until after the Peloponnesian war (404 b.c.) — slavery- was an economic success. But by degrees the slave, it would seem, dispossessed the citizen and rendered him unfit for competition. The position of the free artisan thus became akin to that of the slave (Arist. Pol. 1260a, &c.), and slavery became the industrial method of the country. Though Greeks, Romans, Jews, and Christians spent money in ransoming individual slaves and also en- franchised many, no general abolition of slavery was pos- sible. At last through economic changes the new status of coloni, who paid as rent part of the produce of the land they tilled, superseded the status of slavery. But this result was only achieved much later, when a new society was being created, when the slaves from the slave prisons (ergastula) of Italy joined its invaders, and the slave- owner or~~

~~*master, as one may suppose, unable any longer to work the gangs, let them become coloni.*~~

~~*In Greece the feeling towards the slave became con- stantly more humane. Real slavery, Aristotle said, was a cast of mind, not a condition of life. The slave, was not to be ordered about, but to be commanded and persuaded like a child. The master was under the strongest obligation to promote his welfare. In Rome, on the other hand, slavery continued to the end a massive, brutal, industrial force— a standing danger to the state.*~~

~~*But alike in Greece and Rome the influence of slavery on the family was pernicious. The pompous array of domestic slaves, the transfer of motherly duties to slave nurses, the loss of that homely education which for most people comes only from the practical details of life — all this in later Greece and Italy, and far into Christian times, prevented that permanent invigoration and reform of family life which Jewish and Christian influences might otherwise have produced.*~~

~~*Pakt III. — Charity in Roman Times.*~~

~~*As from the point of view of charity the well-being of the community depends upon the vigour of the deep-laid elemental life within it, so in passing to Roman times we consider the family first. The Roman ti^g" family was unique in its completeness, and by some of its conditions the world has long been bound. The father alone had independent authority (sui juris) f and so long as he lived all who were under his power — his wife, his sons, and their wives and children, and his unmarried daughters — could not acquire any property of their own. Failing father or husband, the unmarried daughters were placed under the guardianship of the nearest male members of the family. Thus the family, in the narrower sense in which we commonly use the word, as meaning descendants of a common father or grandfather, was, as it were, a single point of growth in a larger organism, the gens, which consisted of all those who shared a common ancestry.*~~

~~*The wife, though in law the property of her husband, held a, position of honour and influence higher than that of the Greek wife, at least in historic times. She seems to come nearer to the ideal of Xenophon : "the goodwife should he the mistress of every- thing within the house." "A house of his*~~

~~*bwn and the blessing of children appeared to the Roman citizen as the end and essence of life " (Mommsen, Sist. Borne). The obligation of the father to the sons was strongly felt. The family, past, present, and future, was conceived as one and indivisible. Each succeeding generation had a right to the care of its predecessor in mind, body, and estate. The training of the sons was distinctively a home and not a school training. Brought up by the father and constantly at his side, they learnt spontaneously the habits and traditions of the family. The home was their school. By their father they were introduced into public life, and though still remaining under his power during his lifetime, they became citizens, and their relation to the state was direct. The nation was a nation of yeomen. Only agriculture and warfare were considered honour- able employments. The father and sons worked outdoors on the farm, employing little or no slave labour ; the wife and daughters indoors at spinning and weaving. The drudgery of the household was done by domestic slaves. The father was the working head of a toiling household. Their chief gods were the same as those of early Greece — Zeus-Diovis and Hestia- Vesta, the goddess of the hearth and home. Out of this solid, compact family Roman society was built, and so long as the family was strong attachment to the service of the state was intense. The res publico, the c'om- mon weal, the phrase and the thought, meet one at every turn ; and never were citizens more patient and tenacious combatants on their country's behalf. The men were soldiers in an unpaid militia and were constantly engaged in wars with the rivals of Rome, leaving home and family for their campaigns and return- ing to them in the winter. With a hardness and closeness incon- sistent with — indeed, opposed to — the charitable spirit, they com- bined the strength of character and sense of justice without which charity becomes sentimental and unsocial. In the development of the family, and thus, indirectly, of charity, they stand for settled obligation and unrelenting duty.*~~

~~*Under the protection of the head of the family " in dependent freedom " lived the clients. They were in a middle position between the freemen and the slaves. The relation between patron and client lasted for several generations ; and there were many clients. Their number increased as state after state was conquered, and they formed the plebs, in Rome the plebs urhana, the lower orders of the city.*~~

~~*In relation to our subject the important factors are the family, the plebs, and slavery.*~~

~~*664*~~

~~*CHARITY AND CHARITIES*~~

~~*Two processes were at work from an early date, before the first agrarian law (486 b.c.) : the impoverishment of the plebs, and the increase of slavery. The former led to the annona civica, or the free supply of corn to the citizens, and to the sportula, or the organized food-supply for poor clients, and ultimately to the alimentarii pueri, the maintenance of children of citizens by voluntary and imperial bounty. Thie latter (slavery) was the standing witness that, as self-support was undermined, the task of relief became hopeless, and the impoverished citizen, as the generations passed, became in turn dependent, beggar, pauper, and slave.*~~

~~*The great patrician families — " an oligarchy of warriors and slaveholders" — did not themselves engage in trade, but, entering on large speculations, employed as their agents their clients, libertini or freedmen, and, later, their slaves. The constant wars, for which the soldiers of a local militia were eventually retained in permanent service, broke up the yeomanry and very greatly reduced their number. Whole families of citizens became im- poverished, and their lands were in consequence sold to the large patrician families, members of which had acquired lucrative posts, or prospered in their speculations, and assumed possession of the larger part of the land, the ager publicus, acquired by the state through conquest. The city had always been the centre of the patrician families, the patrons of the trading libertini and other dependents. To it now flocked as well the metoeci, the resident aliens from the conquered states, and the poorer citizens, land- less and unable for social reasons to turn to trade. There was thus in Rome a growing multitude of aliens, dis- possessed yeomen, and dependent clients. Simultaneously slavery increased very largely after the second Punic war (202 B.C.). Every conquest brought slaves into the market, for whom ready purchasers were found. The slaves took the place of the freemen upon the old family estates, and the free country people became extinct. Husbandry gave place to shepherding. The estates were thrown into large domains Qatifundia), managed by bailiffs and worked by slaves, often fettered or bound by chains, lodged in cells in houses of labour (ergastula), and sometimes cared for when ill in infirmaries (yale- tudinaria). In Crete and Sparta the slaves toiled that the mass of citizens might have means and*~~

leisure. In Rome the slave class was organized for private and not for common ends. In Athens the citizens were paid for their services ; at Rome no oflS.ces were paid. Thus the citizen of Rome was, one might almost say, forced into a dependence on the public corn, for as the large properties swallowed up the smaller, and the slave dis- possessed the citizen, a population grew up unfit for rural toil, disinclined to live by methods that pride considered -sordid, unstable and pleasure-loving, and yet a serious political factor, as dependent on the rich for their enjoy- ments as they were on their patrons or the prefect of the corn in the city for their food.

It is estimated, from extremely difficult and uncertain data, that the population of Rome in the time of Augustus was about 1,200,000 or 1,500,000. At that time the plebs urbana numbered 320,000. If this he multiplied by thre^, to give a low average of dependents, wives, and children, this section of the population would number 960,000. The remainder of the 1,500,000, 540,000, would consist of (a) slaves, and (6) those, the comparatively few, who would be members of the great clan-families Igentes), Pro- portionately to Attica this seems to allow too small a population of slaves. But however this be, we may picture the population of Rome as consisting chiefly of a few patrician families ministered to by a very large number of slaves, and a populace of needy citizens, in whose ranks it was profitable for an outsider to find a place in order that he might participate in the advantages of state maintenance.

In Rome the clan-family became the dominant political

factor. The family, as in England and elsewhere in the Middle Ages, and even in later times, in these circumstances assumes an influence which is out J^o„a of harmony with the common good. The social civica. advantage of the family lies in its self-main- tenance, its home charities, and its moral and educational force, but if its separate interests are made supreme, it becomes uncharitable and unsocial. In Rome this was the line of development. The stronger clan-families crushed the weaker, and became the " oligarchy of war- riors and slaveholders." In the same spirit they possessed themselves of the ager publicus. The land obtained by the Romans by right of conquest was public. It be- longed to the state, and to a yeoman state it was the most valuable acquisition. At first part of it was*

~~*sold and part was distributed to citizens without property and desti- tute (cf. Plutarch, Tib. Gracchus). At a very early date, however, the patrician families acquired possession of much of it and held it at a low rental, and thus the natural outlet for a conquering farmer race was monopo- lized by one class, the richer clan-families. This injustice was in part remedied by the establishment of colonies, in which the emigrant citizens received sufficient portions of land. But the colonies were comparatively few, and after each conquest the rich families made large pur- chases, while the smaller proprietors, whose services as soldiers were constantly required, were unable to attend to their lands or to retain possession of them. To pre- vent this (367 B.C.) the Licinian law was passed, by which ownership in land was limited to 500 jugera, about 312 acres. It was ignored, however, and more than two centuries later the evil, the double evil of the dispossession of the citizen farmer and of slavery, reached a crisis. The slave war broke out (134 b.c), and (133 b.c.) Tibe- rius Gracchus made his attempt to re-endow the Roman citizens with the lands which they had acquired by con- quest. He undertook what was essentially a charitable or philanthropic movement, which was set on foot too late. He had passed through Tuscany, and seen with resentment and pity the deserted cbuntry where the foreign slaves and barbarians were now the only shep- herds and cultivators. He had been brought up under the influence of Greek Stoical thought, with which, almost in spite of itself, there was always associated an element of pity. The problem which he desired to solve, though larger in scale, was essentially the same as that with which Solon and Peisistratus had dealt successfully. At bottom the issue lay between private property, considered as the basis of family life for the great bulk of the community, with personal independence, and pauperism, with the annona or slavery. In 133 B.C. Tiberius Grac- chus became tribune. To expand society on the lines of private property, he proposed the enforcement of "the Licinian Rogations" ; the rich were to give up all beyond their rightful 312 acres, and the remainder was to be distri- buted amongst the poor (penes). The measure was carried by the use of arbitrary powers, and followed by the death of Tiberius at the hands of the patricians, the dominant clan-families. In 132 b.c. Gains Gracchus took up his brother's quarrel, and proposed measures for emigration and for relief. The former failed ; the latter apparently were acceptable to all parties, and continued in force long after C. Gracchus had been slain (121 b.c). By the lex frumentaria he gave the citizens — those*~~

~~who had the Roman franchise — the right to purchase corn every month from the public stores at rather more than half-price, 61 asses, or about 3-3d., the peck. This, the fatal alternative, was accepted, and henceforth there was no possibility of a reversion to better social conditions.~~

~~The provisioning of Rome was, like that of Athens, a public service. There were public granaries (267 b.c).~~

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~~and there was a queestor to supervise the transit of the corn from Sicily and, later, from Spain and Africa, and an elaborate administration for collecting and conveying It. The lex frumentaria of Cains was followed by the lex Octavia, restricting the monthly sale to citizens settied in Eome, and to 5 modii (1^ bushels). According to Polybius, the amount required for the maintenance of a slave was 5 modii a month, and of a soldier 4. Hence the allowance, if continued at this rate, was practically a maintenance. The lex aodia (58 B.C.) made the corn gratuitous to the plebs urbana.~~

~~cJ,†^ CsBsar (5 e.c.) found the number of recipients to be 320,000, and reduced them to 150,000. In Augustus's time they rose to 200,000. There seems, however, to be some confusion as to the numbers. From the Ancyranum Monumentum it appears that the plebs w&ana who received Augustus's dold of 60 denarii (37s. 6d.) in his eighth consulship numbered 320,000. And (Suet. Cces. 41) it seems likely that in Caesar's time the lists of the recipi- ents were settled by lot ; further, probably only those whose pro- perty was worth less than 400,000 sesterces (£3541) were placed on the lists. It is probable, therefore, that 320,000 represents a maxi- mum, reduced for purposes of administration to a smaller number (a) by a property test, and (6) by some kind of scrutiny. The names of those certified to receive the corn were exposed on bronze tablets. They were then called (erarii. They had tickets (tesserce) for purposes of identification, and they received the corn or bread in the time of the republic at the temple of Ceres, and afterwards at steps in the several (14) regions or wards of Eome. Hence the bread was called panis gradilis. In the middle of the 2nd century there were state bakeries, and wheaten loaves were baked for the people perhaps~~

~~*two or three times a week. In Aurelian's time (a.d. 270) the flour was of the best, and the weight of the loaf (one uncia) was doubled. To the gifts of bread were added pork, oil, and possibly wine ; clothes also — white tunics with long sleeves — Were distributed. In the period after Constantine (cf. Theod. Code, xiv. 15) three classes received the bread — the palace people (palatini), soldiers (militares), and the populace {populares). No distribution was permitted except at the steps. Each class had its own steps in the several wards. The bread at one step could not be transferred to another step. Each class had its own supply. There were arrangements for the exchange of stale loaves. Against misappropriation there were (law of Valeutinian and Valens) severe penalties. If a public prosecutor {actor), a col- lector of the revenue (jproourator), or the slave of a senator obtained bread with the cognizance of the clerk, or by bribery, the slave, if his master was not a party to the offence, had to serve in the state bakehouse in chains. If the master were involved, his house was confiscated. If others who had not the right obtained the bread, they and their property were placed at the service of the bakery (jpistrini exeroitio subjugari). If they were poor (pauperes) they were enslaved, and the delinquent client was to be put to death.*~~

~~*The right to relief was dependent on the right of citizenship. HIence it became hereditary and passed from father to son. It was thus in the nature of a con- tinuous endowed charity, like the well-known family charity of Smith, for instance, in which a large property was left to the testator's descendants, of whom it was said that as a result no Smith of that family could fail to be poor. But the annona civica was an endowed charity, affecting not a single family, but the whole population. Later, when Constantinople was founded, the right to relief was attached to new houses as a premium on building operations. Thus it belonged not to persons only, but also to houses, and became a species of " immovable " property, passing to the purchaser of the house or property, as would the adscript slaves. The bread followed the house (cedes sequantur anrioncB). If, on the transfer of a house, bread claims were lost owing to the absence of claimants, they were transferred to the treasury (Jisci viribus vindicentur). But the savage law of Valentinian, referred to above, shows to what lengths such a system was pushed. Early in its history the annona civica attracted many to Rome in the hope of living there without working. For the 400*~~

~~*years since the lex Olodia was enacted constant injury had been done by it, and now (a.d. 364) people had to be*~~

~~*kept off the civic bounty as if they were birds of ptey, and the very poor man (pauperrimus), who had no civic title to the food, if he obtained it by fraud, was enslaved. Thus, in spite of the abundant state relief, there had grown up a class of the very poor, the Gentiles of the state, who were outside the sphere of its ministrations. The annona civica was introduced not only into Constan- tinople, but also into Alexandria, with baleful results, and into Antioch. When Constantinople was founded the corn-ships of Africa sailed there instead of to Eome. On charitable relief, as we shall see, the annona has had a long-continued and fatal influence.*~~

~~*(1) If the Government considers itself responsible for provision- ing the people it must fix the price of necessaries, and to meet distress or popular clamour it will lower the price. It becomes thus a large relief society for the supply of corn. In a time of distress, when the corn laws were a matter of moment in England, a similar system was adopted in the well-known Speenhamland scale (1795), by which a larger or lesser allowance was given to a family according to its size and the prevailing price of corn. A maintenance was thus provided for the able-bodied and their families, at least in part, without any equivalent in labour ; though in England labour was demanded of the applicant, and work was done more or less perfunctorily. In amount the Roman dole seems to have been equivalent to the allowance provided for a slave, but the citizen received it without having to do any labour task. HIe received it as a statutory right. There could hardly be a more effective method for degrading his manhood and denaturaliz- ing his family. HIe was also a voter, and the alms appealed to his weakness and indolence ; and the fear of displeasing him and los- ing his vote kept him, socially, master of the situation, to his own ruin. If in England now relief were given to able-bodied persons who retained their votes, this evil would also attach to it.*~~

~~*(2) The system obliged the hardworking to maintain the idlers, while it continually increased their number. The needy teacher in Juvenal, instead of a fee, is put off with a tessera, to which, not being a citizen, he has no right. "The foreign reapers," it was said, " filled Rome's belly and left*~~

~~*Rome free for the stage and the circus." The freeman had become a slave — "stupid and drowsy, to whom days of ease had become habitual, the games, the circus, the theatre, dice, eating-houses, and brothels." Here are all the marks of a degraded pauperism. ;*~~

~~*(3) The system led the way to an ever more extensive slavery. The man who could not live on his dole and other scrapings had the alternative of becoming a slave. "Better have a good master than live so distressfully " ; and "If I were free I should live at my own risk; now I live at yours," are expressions suggestive of the natural temptations of slavery in these conditions. The escaped slaves returned to " their manger." The annona did not prevent destitution. It was a half-way house to slavery.*~~

~~*(4) The effect on agriculture, > and proportionally on commerce generally, was ruinous. The largest corn-market, Eome, was withdrawn from the trade — the market to which all the necessaries of life would naturally have gravitated ; and the supply of com was placed in the hands of producers ai a few centres where it could be grown most cheaply — Sicily, Spain, and Africa. The Italian farmer had to turn his attention to other produce — ^the cultivation of the olive and the vine, and cattle and pig rearing. The greater the extension of the system the more impossible was the regeneration of Eome. The Roman citizen might well say that he was out of work, for, so far as the land was concerned, the means of obtaining a living were placed out of his reach. While not yet unfitted for the country by life in the town, he at least could not "return to the land."*~~

~~*(5) The method was the outcome of distress and political hopelessness. Yet the rich also adopted It in distributing their private largess. Cicero (De Off. ii. 16) writes as though he recognized its evil; but though he expresses his disapprobation of the popular shows upon which the (Bdiles spent large sums, he argues that something must be done, "if the people demand it, and if good men, though they do not wish it, assent to it." Thus in a guarded manner he approves a distribution of food — a free breakfast in the streets of Eome. One bad result of the annona was that it encouraged a special and ruinous form of charitable munificence.*~~

~~*The sportula was a form of charity corresponding to the annona civica. Charity and poor relief run on parallel lines, and when the one is*~~

administered without discrimination, little discrimination will usually ™ be exercised in the other. It was the charity of **" the patron — of thechief s of the clan-families to their clients.*

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CHAEITY AND CHARITIES

Between them it was natural that a relation, partly- hospitable, partly charitable, should grow up. The clients who attended the patron at his house were invited to dine at his table. The patron, as Juvenal describes him, dined luxuriously and in solitary grandeur, while the guests put up with what they could get ; or, as was usual under the empire, instead of the dinner (evena recta) a present of food was given at the outer vestibule of the house to clients who brought with them baskets (sportida) to carry ofE their food, or even charcoal stoves to keep it warm. There was endless trickery. The patron (or almoner who acted for him) tried to identify the applicant, fearing lest he might get the dole under a false name ; and at each mansion was kept a list of persons, male and female, entitled to receive the allowance. "The pilferer grabs the dole " {sportulam furunculus captaf) was a proverb. The sportula was a charity sufficiently important for state regulation. Nero (a.d. 54) reduced it to a payment in money (100 quadrantes, about Is.). Domitian (a.d. 81) restored the custom of giving food. Subsequently both practices — gifts in money and in food — appear to have heen continued.

In these conditions the Eoman family steadily decayed. Its "old discipline" was neglected; and Tacitus (a.d. 75), in his dialogue on Oratory, wrote (c. xxviii.) what might be called its epitaph. Of the general decline the laws of Caesar and Augustus to encourage marriage and to reward the parents of large families are sufficient evidence.

The destruction of the working-class family must have been finally achieved by the imperial control of the collegia.

~~*In old Rome there were corporations of craftsmen for common worship and for the maintenance of the traditions of the craft.*~~

~~*These corporations were ruined by slave labour, The and becoming secret societies, in the time of*~~

~~*reorganized, and gave scope for much of the kindly •charity of mutual help. They often existed in connexion with some great house, whose chief was their patron and whose house- iold gods they worshipped. The guilds of the poor, or rather of the lowfcr orders {collegia tenuiorum), consisted of artisans and others, and slaves also, who paid monthly contributions to a common fund to meet the expenses of worship, common meals, and funerals. Under Severus (a.d. 192) the collegia were ex- tended, and more closely organized as industrial bodies. They were protected and controlled, as in England in the 15th century the municipalities affected the cause of the craft guilds and ended by controlling them. Industrial disorder was thus prevented ; the Government were able to provide the supplies required in Rome and the large cities with less risk and uncertainty ; and the workmen employed in trade, especially the carrying trade, became almost slaves. In the 2nd century, and until the invasions, there were three groups of collegia: (1) those engaged in various state manufactures ; (2) those engaged in the provision trade ; and (3) the free trades, which gradually lapsed into a kind of slavery. If the members of these guilds fled they were brought back by force. Parents had to keep to the trade to which they belonged ; their children had to succeed them in it. A slave caste indeed had been formed of the once free workmen.*~~

~~*As a charitable protest against the destruction of chil- dren, in the midst of a broken family life, and increasing dependence and poverty, a special institution Pueri -jy-ag founded (to use the Scottish word) "for the ^'"l"' "alimentation" of the children of citizens, at first by voluntary charity, and afterwards by imperial bounty.*~~

~~*Nerva and Trajan adopted the plan. Pliny (Ep. vii. 18) refers to it. There was a desire to give more lasting and certain help than an allotment of food to parents. A list of children, whose names were on the relief tables at Rome, was accordingly drawn Tip, and a special service for their maintenance established. Two instances are recorded in inscriptions — one*~~

~~*at Veleia, one at Beneventum. The emperor lent money for the purpose at a low percentage — 2J or 5' per cent., as against the usual 10 or 12. At Veleia his loan amounted to 1,044,000 sesterces — about £8156, and 51 of the local landed proprietors mortgaged land, valued at 13 or 14 million sesterces, as security for the debt. The interest on the*~~

~~*emperor's money at 5 per cent, was paid into the municipal treasury, and out of it the children were relieved. The figures seem small ; at Veleia 800 children were assisted, of whom 36 were girls. The annual interest amounted to nearly £204, which divided among 300 gives about 13 -68. a head. The figures suggest that the money served as a charitable supplementation of the citizens' relief in direct aid of the children. Apparently the scheme was widely adopted. Curators of high position were the patrons ; procurators acted as inspectors over large areas ; and qucestores alimentarii undertook the local management. Antoninus Pius (a.d. 138), and Marcus Aurelius (a.d. 160), and subsequently Severus (a.d. 192), established these bursaries for children in the names of their wives. In the 3rd century the system fell into disorder. There were large arrears of payments, and in the military anarchy that ensued it came to an end. It is of special interest, as indicating a new feeling of responsibility towards children akin to the humane Stoicism of the Antonines, and an attempt to found, apart from temples or collegia, what was in the nature of a public endowed charity.*~~

~~*Paet IV. — Jewish and Christian Chaeitt.*~~

~~*With Christianity two elements come into fusion, the Jewish and the Greco-Eoman. To trace this fusion and its results it is necessary to describe the Jewish system of charity, and to compare it with that of the early Christian church, to note the theory of charity in Aristotle as representing Greek, and in St Paul as representing Christian thought, and to mark the Eoman influences which moulded the administration of Ambrose and Gregory and Western Christianity generally.*~~

~~*In the early history, of the Hebrews we find the family, clan-family, and tribe. With the Exodus (prob- ably about 1390 b.c.) comes the law of Moses (cf. Kittel, Hist, of the Hebrews, Eng. trans., i.* **™ *244), the central and permanent element of Jewish thought. We may compare it to the "com-*~~

~~mandments" of Hesiod. There is the recognition of the family and its obligations: "Honour thy father and mother " ; and honour included help and support. There is also the law essential to family unity : " Thou shalt not commit adultery " ; and as to property there is imposed the regulation of desire : " Thou shalt not covet thy neighbour's house." Maimonides (a.d. 1135), true to the old conception of the family (x. 16), calls the support of adult children, "after one is exempt from supporting them," and the support of a father or mother by a child, "great acts of charity; since kindred are entitled to the first consideration." To relief of the stranger the Decalogue makes no reference, but in the law it is constantly pressed ; while the Levitical law (xix. 18) first applies a new standard to social life : " Thou shalt love thy neighbour as thyself." This thought is the out- come of a deep ethical fervour — the element which the Jews brought into the work of charity. In Judges and Joshua, the " Homeric " books of the Old Testament, the Hebrews appear as a passionately fierce and cruel people. Subsequently against their oppression of the poor the prophets protested with a vehemence as great as the evil was intense; and their denunciations remained part of the national literature, a standing argument that life without charity is nothing worth. Thus schooled and afterwards tutored into discipline by the tribulation of the exile (587 b.c), they turned their fierceness into a zeal, which, as their literature shows, was as fervent in ethics as it was in religion and ceremonial. In the ser- vices at the synagogues, which supplemented and after- wards took the place of the Temple, the Commandments were constantly repeated and the Law and the Prophets read; and as the Jews of the Dispersion increased in ■ number, and especially after the destruction of Jerusalem, ' the synagogues became centres of social and charitable ' co-operation. Thus rightly would a Jewish rabbi say, "On three things the world is stayed: on the Thorah, and on worship, and on the bestowal of kindness." Also~~

~~there was on the charitable side an indefinite power of expansion. Eigid in its ceremonial, there it was free. Within the nation, as the Prophets, and after the exile, as the Psalms show, there was the hope of a universal~~

~~*religion, and with it of a universally recognized charity. St Paul accentuated the prohibitive side of the law and protested against it ; but, even while he was so doing, stimulated by the Jewish discipline, he was moving un fettered towards new conceptions of charity and life — «harity as the central word of the Christian life, and life as a participation in a higher existence — ^the "bodv of Christ." ^*~~

~~*To mark the line of development, we would compare — 1. The family among the Jews and in the early Christian €hurch ; 2. The sources of relief and the tithe, the treat- ment of the poor and their aid, and the assistance of ■special classes of poor; 3. The care of strangers; and, lastly, we would consider the theory of almsgiving, friend- ship or love, and charity.*~~

~~*1. As elsewhere, property is the basis of the family. Wife and children are the property of the father. But the wife is held in high respect. In the post-exilian period ■the virtuous wife is represented as laborious as a Roman matron, a "lady bountiful" to the poor, and to her husband wife and friend alike. Monogamy without concubinage is now the rule — is takeil for granted as right. There is no " exposure of children." The slaves are kindly treated, as servants rather than slaves — though in Roman times and afterwards the Jews were great slave- traders. The household is not allowed to eat the bread of idleness. " Six days," it was said, " must [not Tnayest] thou work." " Labour, if poor ; but find work, if rich." ■" Whoever does not teach his son business or work, teaches him robbery." In, Job xxxi., a chapter which has been called "an inventory of late Old Testament morality," we find the family life developed side by side with the life of charity. In turn are mentioned the relief of the widow, the fatherless, and the stranger — the classification of dependants in the Christian Church ; and the whole chapter is a justification of the homely charities of a good family. " The Jewish religion, more especially in the old and orthodox form, is essentially a family reli- gion " (C. G. Montefiore, Religion of Ancient Hebrews).*~~

~~*In the early documents of the Church the fifth command- ment is made the basis of family life (cf. Eph. vi. 1 ; Apost. Const, ii. 32, iv. 11 — if we take the first six books of the Apost. Const, as a composite production before a.d. 300, representing Judseo-Christian or Eastern Church thought). But two*~~

~~*points are prominent. Duties are insisted on as reciprocal (cf. especially St Paul's Epistles), as, e.g., between husband and wife, parent and child, master and servant. Charity is mutual; the family is a circle of reciprocal duties and charities. This implies a principle of the greatest importance in relation to the social utility of charity. Further reference will be made to it later. Next the " thou shalt love thy neighbour " is translated from its position as one amongst many sayings to the chief place as a rule of life. In. the Teaching of the Twelve Apostles (Jewish-Christian, early 1st cent, a.d.) the first command- ment in "the way of life " is adapted from St Matthew's Gospel thus : " First, thou shalt love God who made thee ; secondly, thy neighbour as thyself ; and all things what- soever thou wouldst not have done to thee, neither do thou to another." A principle is thus applied which touches all social relations in which the "self" Can be made the standard of judgment. Of this also later. To touch on other points of comparison : the earlier documents seem to ring with a reiterated cry for a purer family life (cf . the second, the negative, group of commandments in the Teaching, and the judgment of the apocalyptic writings, such as the Revelations of Peter, &c.) ; and sharing the*~~

~~*Jewish feeling, the riper conscience of the Christian com- munity formulates and accepts the inj unction to preserve infant life at every stage. It advocates, indeed, the Jewish purity of family life with a missionary fervour, and it makes of it a condition of church membership. The Jewish rule of labour is enforced {Ap. Const, ii. 63). If a stranger settle {Teaching, xii. 3) among the brotherhood, "let him work and eat." And the father (Constit. iv. 11) is to teach the children "such trades as are agreeable and suitable to their need." And the charities to the widow, the fatherless, are organized on Jewish lines.*~~

~~*2. The sources of relief among the Jews were the three gifts of com: (1) the corners of the field (cfi Lev. xix. &c.), amounting to a, sixtieth part of it ; (2) the gleanings, a definite minimum dropped in the process of reaping (Maimonides, Laws of the Hebrews relating to the Poor, iv. 1) ; (3) corn overlooked and left behind. So it was with the grapes and with all crops that were harvested, as opposed, e.g., to figs, that were gathered from time to time., These gifts were divisible three times in the day, so as to suit the convenience of the poor (Maim. ii. 17), and the poor had a right to them.*~~

~~They are indeed a poor-rate paid in kind such as in early times would naturally spring up among an agricultural people. Another gift " out of the seed of the earth" is the tithe. In the post-exilian period the septenniad was, in force. Each year a fiftieth part of the produce (Maim, vi. 2, and Deut. xviii. 4) was given to the priest (the class which in the Jewish state was supported by the community). Of the remainder one-tenth went to the Levite, and one-tenth in three years of the septennium was retained for pilgrimage to Jerusalem, in two given to the poor. In the seventh year "all things were in common." Supplementing these gifts were alms to all who asked; "and he who gave less than a tenth of his means was a man of evil eye" (Maim. vii. 5). All were to give alms, even the poor themselves who were in receipt of relief. Refusal might be punished with stripes at the hand of the Sanhedrim. At the Temple alms for distribution to the worthy poor were placed by worshippers in the cell of silence; and it is said that in Palestine at meal times the table was open to all comers. As the synagogues extended, and possibly after the fall of Jerusalem (a.d. 70), the collection of alms was further systematized. There were two collections. In each city alms of the box or chest (kupha) were collected for the poor of the city on each Sabbath eve (later, monthly or thrice a year), and distributed in money or food for seven days. Two collected, three distributed. Three others gathered and distributed daily alms of the basket (jtamchui). These were for strangers and wayfarers — casual relief " for the poor of the whole world." In the Jewish synagogue community from early times the president (parnass) and treasurer were elected annually with seven heads of the congregation (see Abraham's Jewish Life in the Middle Ages, p. 54), and sometimes special officers for the care of the poor. A staff of almoners was thus forthcoming. In addition to these collections were the pr^lta given to the poor before prayers (Maim. x. 15), and moneys gathered to help particular cases (cf. Jewish Life, p. 322) by circular letter. There were also gifts at marriages and funerals ; and fines imposed for breach of the communal ordinances were reserved for the poor. The distinctive feature of the Jewish charity was the belief that " the poor would not cease out of the land," and that therefore on charitable grounds a permanent pro- vision should be made for them — a poor-rate, in fact, subject to stripes and distraint, if necessary (Maim. vii. 10).~~

If we compare this with the early Church we find the following sources of relief : (1) The Eucharistic offerings, some consumed at the time, some carried home, some reserved for the absent (see Hatch, Early Church, p. 40). The ministration, like the Eucharist, was connected with the love feastj and was at first daily (Acts ii. 42, vi. 1, and the Teaching). {2) Freewill offerings and first fruits and voluntary tithes {Ap. Con. ii. 25) brought to the bishop and used for the poor — orphans, widows, the afflicted and strangers in distress, and for the clergy, deaconesses, &c. (3) Collections in churches on Sundays and week-days, alms-boxes, and gifts to the poor by worshippers as they entered church ; also collections for special purposes (cf. for Christians at Jerusalem). Apart from "the corners," &o., the sources of relief in the Christian and Jewish Churches are the same. The separate Jewish tithe for the poor, which (Maim. vi. 11, 13) might be used in part by the donor as personal charity, disappears. A voluntary tithe remains, in part used for the poor. We do not hear of stripes and distraint, but in both bodies there is a penitential system and excommunica- tion (cf. Jewish Life, p. 52), and in both a settlement of disputes within the body (Clem. Horn. iii. 67). In both, too, there is the abundant alms provided in the belief of the permanence of

poverty and the duty of giving to all who ask. As to adminis- tration in the early Church (Acts vi. 3), we find seven deacons, the number of the local Jewish council ; and later there were in Rome seven ecclesiastical relief districts, each in charge of a deacon. The deacon acted as the minister of the bishop {Ep. Clem, to Jam. xii.), reporting to him and giving as he dictated {Ap. Con. ii. 30, 31). He at first combined disciplinary powers with charitable. The presbyters also (Polycarp Ad Phil. 6 (a.d. 69-155)), forming (Hatch, p. 69) a kind of bishop's council, visited the sick, &c. The bishop was president and treasurer. The bishop was thus the trustee of the poor. By reason of the churches' care of orphans responsibilities of trusteeship also devolved on him. The temples were iu pagan times depositories of money. Probably the churches were also.

~~3. G-reat stress is laid by the Jews on the duty of gentleness to the poor (Maim x. 5). The woman was to have first attention (Maim. vi. 13). If the applicant was hungry he was to be fed, and then examined to learn whether he was a deceiver (Maim. vii. 6). Assistance was to be given according to the want — clothes, house- hold things, a wife, or a husband — and according to the poor man's station in life. For widows and orphans the " gleanings " were left. Both are the recognized objects of charity (Maim. x. 16, 17). " The poor and the orphan were to be employed in domestic affairs in preference to servants." The dower was a constant form of help. The ransoming of slaves took precedence of relief to the poor. The highest degree of alms deed (Maim. x. 7) was " to yield support to him who is cast down, either by means of gifts, or by loan, or by commerce, or by procuring for him traffic with others. Thus his hand becometh strength- ened, exempt from the necessity of soliciting succour from any created being."~~

~~If we compare the Christian methods we find but slight difference. The absoluteness of " Give to him that asketh " is in the Teaching checked by the " Woe to him that receives : for if any receives having need, he shall be guilt- less, biit he that has no need shall give account, . . . and coming into distress ... he shall not come out thence till he hath paid the last farthing." It is the duty of the bishop to know who is most worthy of assistance {Ap. Con. ii. 3, 4) ; and " if any one is in want by gluttony, drunkenness, or idleness, he does not deserve assistance, or to be esteemed a member of the church." The widow assumes the position not only of a recipient of alms, but a church worker. Some were a private charge, some were maintained by the church. The recognized " widow " was to be sixty years of age (cf . 1 Tim. v. 9 and Ap. Con. iii. 1) , a bedeswoman and gossipy pauper often, if one may judge from the texts. Remarriage was not approved, and so that resource, which would have been adopted in an English manor court, was not available for self-support, and charity had to take its place. Orphans were pro- vided for by members of the churches. The virgins formed another class, as, contrary to the earlier feeling, marriage came to be held a state of lesser sanctity. They too seem to have been also, in part at least, church workers. Thus round the churches grew up new groups of recognized dependants ; but the older theory of charity was broad and practical — akin to that of Maimonides. " Love all your brethren, performing to orphans the part of parents, to widows that of husbands, affording them~~

~~*sustenance with all kindliness, arranging marriages for those who are in their prime, and for those who are with- out a profession the means of necessary support through employment : giving work to the artificer and alms to the incapable " {Ep. Clem, to James viii.).*~~

~~*4. The Jews in pre-Christian and Talmudic times supported the stranger or wayfarer by the distribution of food {tamchui), and strangers were lodged in private houses ; and there were inns pro- vided at which no money was taken (cf . Jewish Life, p. 314) . Subse- quently, besides these methods, special societies were formed "for the entertainment of the resident poor and of strangers." There*~~

~~*were commendatory letters also. These conditions prevailed in the Christian Church also. The Xenodoeheion was the first form of Christian hospital both for the stranger and for the sect. In the Christian community the endowment charity comes into existence in the 4th century, among the Jews not till the 13th. The charities of the synagogue without separate societies sufficed.*~~

~~*We may now compare the conceptions of Jews and Christians on charity with those of the Greeks. There are two chief exponents of the diverse views — Aristotle and St Paul; for to simplify the j";*},^ issues we refer to them only. Thoughts such aad as Aristotle's recast by the Stoic Pansetius ^'■'*""" (185-112 B.C.), and used by Cicero in his De """•'• Officiis, became in the hands of St Ambrose arguments for the direction of the clergy in the founding of the mediaeval Church; and in the 13th century Aristotle reasserts his influence through such leaders of mediseval thought as St Thomas Aquinas. St Paul's chapters on charity, but little appreciated and understood, one is inclined to think, have perhaps, more than any other words, prevented an absolute lapse into the materialism of almsgiving. After him we think of St Francis, the greatest of a group of men who, seeking reality in life, revived charity ; but to the theory of charity it might almost be said that since Aristotle and St Paul nothing has been added until we come to the economic and moral issues which Dr Chalmers explained and illustrated.*~~

~~*The problem turns on the conception (1) of purpose, (2) of the self, and (3) of charity, love, or friendship as an active force in social life. To the Greek,*~~

~~*or at least to Greek philosophic thought, purpose was the measure of goodness. To have no purpose was, so far as the particular act was concerned, to be simply irrational ; and the lesp definite the purpose the more irrational the act. This conception of purpose was the touchstone of family and social life, and of the civic life also. In no sphere could goodness be irrational. To say that it was without purpose was to say that it was without reality. So far as the actor was concerned, the main purpose of right action was the good of the soul (psyche) ; and by the soul was meant the better self, " the ruling part " acting in harmony with every faculty and function of the man. With faculties constantly trained and developed, a higher life was gradually developed in the soul. We are thus, it might be said, what we become. The gates of the higher life are within us. The issue is whether we will open them and pass in.*~~

~~*Consistent with this is the social purpose. Love or friendship is not conceived by Aristotle except in relation to social life. Society is based on an interchange of services. This interchange in one series of acts we call justice ; in another friendship or love. A man cannot be just unless he has acquired a certain character or habit of mind ; and hence no just man will act without knowledge, previous deliberation, and definite purpose. So also will a friend fulfil these conditions in his acts of love or friend- ship. In the love existing between good men there is continuance and equality of service; but in the case of benefactor and benefited, in deeds of charity, in fact, there is no such equality. The satisfaction is on one side, but often not on the other. (The dilemma is one that is pressed, though not satisfactorily, in Cicero and Seneca.) The reason for this will be found, Aristotle suggests, in the feeling of satisfaction which men experience in action. We realize ourselves in our deeds — throw ourselves into them, as people say ; and this is happiness. What we make we like : it is part of us. On the other hand, in the person benefitedthere may be no corresponding action, and in so far as there is not, there is no exchange of service or the con- tentment that arises from it. The " self" of the recipient is not drawn out. On the contrary, he may be made*~~

■worse, and feel the uneasiness and discontent that result from this. In truth, to complete Aristotle's argument, the good deed on one side, as it represents the best self of the benefactor, should on the other side draw out the best self of the person benefited. And where there is not ultimately this result, there is not effective friendship or charity, and consequently there is no personal or social satisfaction. The point may be pushed somewhat further. In recent developments of charitable work the term "friendly visitor" is applied to persons who endeavour to help families in distress on the lines of associated charity. It represents the work of charity in one definite light. So far as the relation is mutual, it cannot at the outset be said to exist. The charitable friend wishes to befriend another ; but at first there may be no reciprocal feeling of friendship on the other's part — indeed, such a feeling may never be created. The effort to reciprocate kindness by becoming what the friend desires may be too painful to make. Or the t-^vo may be on different planes, one not really befriending, but giving without intelligence, the other not really endeavouring to change his nature, but receiving help solely with a view to immediate advantage. The would-be befriender may begin "despairing of no man," expecting nothing in return ; but if, in fact, there is never any kind of return, the friendship actually fails of its purpose, and the "friend's" satisfaction is lost, except in that he may " have loved much." In any case, according to this theory friendship, love, and charity re^ present the mood from which spring social acts, the value of which will depend on the knowledge, deliberation, and purpose with which they are done, and accordingly as they acquire value on this account will they give lasting satisfaction to both parties.

St Paul's position is different. He seems at first sight to ignore the state and social life. He lays stress on motive force rather than on purpose. He speaks as an outsider to the state, though technically a citizen. His mind assumes towaMs it the external Judaic position, as though he belonged to a society of settlers (paroikoi). Also, as he expects the millennium, social life and its needs are not uppermost in his thoughts. He consid- ers charity in relation to a community of fellow believ- ers— drawn together in congregations. His theory springs from this social base, though it over-arches life itself. He is intent on creating a spiritual association. He conceives of the spirit (pneuma) as "an immaterial personality." It transcends the soul (psyche), and is the Christ life, the ideal and spiritual life. Christians par- ticipate in

~~*it, and they thus become part of " the body of Christ," which exists by virtue of love— love akin to the ideal life, agape. The word represents the love that is instinct with reverence, and not love (philia) which may have in it some quality of passion. This love is the life of "the body of Christ." Therefore no act done without it is a living act— but, on the contrary, must be dead— an act in which no part of the ideal life is blended. On the individual act or the purpose no stress is laid. It is assumed that love, because it is of this intense and exalted type, will find the true purpose in the particular act. And, when the expectation of the millennium passed away, the theory of this ideal charity remained as a motive force available for whatever new conditions, spiritual or social, might arise. Kevertheless, no sooner does this chariJ^f touch social conditions, than the necessity asserts itself of submitting to the limitations which knowledge, deliber- ation, and purpose impose. This view has been depreciated or ignored by Christians, who have been content to rely upon the strength of their motives, or perhaps have not realized what the Greeks understood, that society was a natural organism (Arist. Pol. 1253a), which develops,*~~

~~*fails, or prospers in accordance with definite laws. HIence endless failure in spite of some success. For love, whether we idealize it as agape or consider it a social instinct as philia, cannot be love at all unless it quickens the intelligence as much as it animates the will. It cannot, except by some confusion of thought, be held to justify the indulgence of emotion irrespective of moral and social results. Yet, though this fatal error may have dominated thought for a long time, it is hardly possible to attribute it to St Paul's theory of charity when the very practical nature of Judaism and early Christianity is considered. In his view the misunder- standing could not arise. And to create a world or "body" of men and women linked together by love, even though it be outside the normal life of the community, was to create a new form of religious organization, and to achieve for it (so far as it was achieved) what, mutatis mutandis, Aristotle held to be the indispensable condition of social life, friendship (philia), "the greatest good of states," for "Socrates and all the world declare," he wrote, that "the unity of the state" is "created by friendship " (Arist. Pol. ii. 1262b).*~~

~~*It should, however, be considered to what extent charity in the Christian Church was devoid of social purpose. (1) The Jewish conceptions of charity*~~

~~*passed, one might almost say, in their completeness into the Christian Church. Prayer, the petition and the purging of the mind, fastjng, the humiliation of the body, and alms, as part of the same discipline, the submissive renunciation of possessions — all these formed part of the discipline that was to create the religious mood. Alms henceforth become a definite part of the religious discipline and service. Humility and poverty hereafter appear as yoked virtues, and many problems of charity are raised in regard to them. The non-Christian no less than the Christian world appreciated more and more the need of self discipline (aslcesis) ; and it seems as though in the first two centuries a.d., if any thought of reinvigorating society, they searched for the remedy rather in the preaching and practice of temperance than in the application of ideas that were the outcome of the observation of social or economic conditions. Having no object of this kind as its mark, almsgiving took the place of charity, and, as Christianity triumphed, the family life, instead of reviving, continued to decay, while the virtues of thediscipline of the body, considered apart from social life, became an end in themselves, and it was desired rather to annihilate instinct than to control it. Possibly this was a necessary phase in a movement of progress, but however that be, charity, as St Paul understood it, had in it no part. (2) But the evil went farther. Jewish religious philosophy is not elaborated as a consistent whole by any one writer. It is rather a miscellany of maxims;' and again and again, as in much religious thought, side issues assume the principal place. The direct effect of the charitable act, or almsgiving, is ignored. Many thoughts and motives are blended. The Jews spoke of the poor as the means of the rich man's salvation. St Chrysostom emphasizes this : "If there were no poor, the greater part of your sins would not be removed: they are the healers of your wounds" (Hom. xiv., Timothy, &c.). Alms are the medicine of sin. And the same thought is worked into the penitential system. Augustine speaks of "penance such as fasting, almsgiving, and prayer for breaches of the Decalogue" (Eeichel, JfamMaZ of Canon Law, p. 23); and many other references might be cited. "Pecuniary penances (Ih. 154), in so far as they vvere relaxations of or substitutes for bodily penances, were per mitted because of the greater good thereby accruing to others " (and in this case they were — a.d. 1284 — legally enforceable under English statute law). The penitential system takes for granted that the almsgiving is good for*~~

others and puts a premium on it, even though in fact it ■were done, not with any definite object,, but really for the good of the penitent. Thus almsgiving becomes de- tached from charity on the one side and from social good on the other. Still further is it vulgarized by another confusion of thought. It is considered that the alms are paid to the credit of the giver, and are realized as such by him in the after-world ; or even that by alms present prosperity may be obtained, or at least evil accident avoided. Thus motives were blended, as indeed they now are, with the result that the gift assumed a greater importance than the charity, by which alone the gift should have been sanctified, and its actual effect was habitually overlooked or treated as only partially rel- evant.

(3) The Christian maxim of "loving (agape) one's neighbour as one's self " sets a standard of charity. Its relations are idealized according as the " self " is under- stood; and thus the good self becomes the measure of charity. In this sense, the nobler the self the completer the charity ; and the charity of the best men, men who love (and understand) their neighbours best, having regard to their chief good, is the best, the most effectual charity. Further, if in what we consider " best " we give but a lesser place to social purpose, or even allow it no place at all, our " self " will have no sufficient social aim and our charity little or no social result. For this "self," however, religion has substituted not St Paul's conception of the spirit (joneuma), but a soul, conceived as endowed with a substantial nstture, able to enjoy and suffer quasi-material rewards and punishments in the after-life ; and in so far as the safeguard of this soul by good deeds or almsgiving has become a paramount object, the purpose of charitable action has been translated from the actaal world to another sphere. Thus, as we have seen, the aid of the poor has been considered not an object in itself, but as a means by which the almsgiver effects his own ulterior purpose and "makes God his debtor." The problem thus handled raises the question of reward and also of punishment. Properly, from the point of view of charity, both are excluded. We may indeed act from a complexity of motives and expect a complexity of rewards, and undoubtedly a good act does refresh the " self," and may as a

~~result, though not as a reward, win approval. But in reality reward, if the word be used at all, is according to purpose ; and the only re- ward of a deed lies in the fulfilment of its purpose. In the theory of almsgiving which we are discussing, how- ever, act and reward are on different planes. The reward is on that of a future life ; the act relates to a distressed person here and now. The interest jn the act on the doer's part lies in its post-mortal consequences to himself, and not either wholly or chiefly in the act itself. Nor, as the interest ends with the act — the giving — can the Intel ligence be quickened by it. The questions " How ? by whom ? with what object ? on what plan ? with what result?" receive no detailed consideration at all. Two general results follow. In so far as it is thus practised, almsgiving is out of sympathy with social progress. It is indeed alien to it. Next also the self-contained, self- sustained poverty that wUl have no relief and does without it, is outside the range of its thought and under- standing. On the other hand, this almsgiving is equally incapable of influencing the weak and the vicious ; and those who are suffering from illness or trouble it has not the width of vision to understand nor the moral energy to support so that they shall not fall out of the ranks of the self-supporting. It believes that "the poor" will not cease out of the land. And indeed, however great might be the economic progress of the people, it is not likely that the poor will cease, if the alms given in this spirit~~

~~be large enough in amount to affect social conditions se- riously one way or the other. When we measure the effects- of charity, this inheritance of divided thought and incon- sistent counsels must be given its full weight.~~

~~The sub-apostolic church was a congregation, like a. synagogue, the centre of a system of voluntary and per- sonal relief, connected with the congregational meals (or agapai) and the Eucharist, and under JJ^^"^^'"' the supervision of no single officer or bishop, the parish Out of this was developed a system of relief con- and trolled by a bishop, who was assisted chiefly by l^aritL. deacons or presbyters, while the agapai, consist- ing of offerings laid before the altar, still remained. Subsequently the meal was separated from the sacrament, and became a dole of food, or poor people's meal — e.g., in St Augustine's time in Western Africa — and it was not allowed to be served in churches (a.d. 391). As religious asceticism became dominant, the sacrament was taken fasting ; it appeared unseemly that men~~

~~*and women should meet together for such purposes, and the agapai fell out of repute. Simultaneously it would seem that the parish (paroichia) became from a congregational settlement a geographical area.*~~

~~*The organization of relief at Eome illustrates both a. type of administration and a transition. St Gregory's reforms (a.d. 590) largely developed it. The parochial system had been adopted probably about the middle of the 3rd century, but the diaconate probably remained central- ized. At the end of the 4th century Pope Anastasius had founded deaconries in Eome, and endowed them largely " to meet the frequent demands of the diaconate." Gregory two hundred years later reorgatuzed the system. He divided the fourteen old " regions " into seven ecclesi- astical districts and thirty " titles " (or parishes). The parishes were under the charge of sixty-six priests ; the districts were eleemosynary divisions. Each was placed under the charge of a deacon, not (Greg. Ep. xi. and xxviii.) under the priests {presbyteri titularii). Over the deacons was an archdeacon. It was the duty of the deacons to care for the poor, widows, orphans, wards, and old people of their several districts. They inquired in regard to those who were relieved, and drew up under the guidance of the bishop the register of poor (matricula).. Only these received regular relief. In each district was an hospital or office for alms, of which the deacon had charge, assisted by a steward (or oeconomus). Here food was given and meals were taken, the sick and poor were maintained, and orphan or foundling children lodged. The churches of Rome and of other large towns possessed considerable estates, "the patrimony of the patron, saints," and to Eome belonged estates in Sicily which had not been ravaged by the invaders, and they con- tinued to pay to it their tenth of corn, as they had done since Sicily was conquered. Four times a year (Milman,, Lat. Christ, ii. 117) the shares of the (1) clergy and papal officers, (2) churches and monasteries, and (3) " hospitals, deaconries, and ecclesiastical wards for the poor," were- calculated in money and distributed; and the first day in every month St Gregory distributed to the poor in kind corn, wine, cheese, vegetables, bacon, meal, fish,, and oil. The sick and infirm were superintended by persons appointed to inspect every street. Before the pope sat down to his own meal a portion was separated and sent out to the hungry at his door. The Eoman plehs had thus become the poor of Christ (pauperes. Christi), and under that title were being fed by civica. annona and sportula as their*~~

~~ancestors had been; and the deaconries had superseded the "regions" and the " steps " from which the corn had been distributed. The hospitium was now part of a common organization of relief, and the sick were visited according to Jewish and early~~

~~Christian precedent. How far kindly Eomans visited the sick of their day we do not know. Alms and the annoHa were now, it would seem, administered concur- rently ; and there was a system of poor relief indepen- dently of the churches and their alms (unless these, organized, as m Scottish towns, on the ancient ecclesi- astical lines, were paid wholly or in part to a central diaconate fund). Much had changed, but in much Roman thought still prevailed. On this model (see below) the organization of poor relief in the MiddlrAges was framed. On the one hand the officers of the Church (Charlemagne's Capit. 779)—bishops, abbots, and abbesses—were expected to give according to their means a definite sum for the relief of the' poor, or to maintain a certain number of families during the winter ; and, on the other hand, the citizens of the cathedral city and its neighbouring parishes were to support their own poor.~~

~~The change in sentiment and method could hardly be more~~

~~there is now an endeavour to find a reasoned basis for charitable action. Pauperism is recognized. "Never was the greed of beggars greater than it is now. . . . They vfant to empty the purses of the poor, to deprive them of the means of support. Not content with a little, they ask for more. . . . With lies about their lives they ask for further sums of money." "A method in giving is necessary. " But in the suggestions made there is little con- sistency. Liberality is urged as a means of gaining the love of the people ; a new and a false issue is thus raised. The relief is neither to be " too freely given to those who are unsuitable, nor too sparingly bestowed upon the needy." Everywhere there is a doctrine of the mean reflected through Cicero's De Officiis, the doctrine falsely stated, as though it were a mean of quantity, and not that rightly tempered mean which is the harmony, of opposing moods. The poor are not to be sent away empty. Those rejected by the~~

~~*Church are not to be left to ythe "outer darkness" of an earlier Christianity. They must be supplied if they are in want. The methodic giver is "hard towards none, but is free towards all." Consequently none are refused, and no account is taken of the regeneration that may spring up in a man from the effort towards self-help which refusal may originate. Thus after all it appears that method means no more than this — to give sometimes more, sometimes less, to all needy people. In the small congrega- tional church of early Christianity, each member of which was admitted on the conditions of strictest discipline, the common alms of the faithful could hardly have done much harm within the body, even though outside they created and kept alive a horde of vagrant alms-seekers and pretenders. Now in this department at least the Church had become the state, and discipline and a close knowledge of one's fellow-Christians no longer safeguarded the alms. From Cicero is borrowed the thought of "active help," which " is often grander and more noble," but the thought is not worked out. From the social side the problem is not understood or even stated, and hence no principle of charity or of charitable administration is brought to light in the investigation. Still there are rudiments of the economics of charity in the praise of Joseph, who made the people buy the corn, for otherwise "they would have given up cultivating the soil ; for he who has the use of what is another's often neglects his own." Perhaps, as St Augustine inspired the theology of the Middle Ages, we may say that St Ambrose, in the mingled motives, indeflniteness, and kindliness of this book, stands for the charity of the Middle Ages, except in so far as the movement which culminated in the brotherhood of St Francis awakened the intelligence of the world to wider issues.*~~

~~*In Constantinople the pauperism seems to have been extreme. The corn supplies of Africa were diverted there in great part when it became the capital of the empire! This must have left to Eome a larger scope for the development of the civic-religious administration of relief. St Chryso- stom's sermons give no impression of the rise of anyiUew administrative force, alike sagacious and dominant. The appeal to give alms is constant, but the positive counsel on charitable work is nil. The people had the annona civica, and imperial gifts, corn, allowances (solaria) from the treasury granted for the poor and needy, and an an- nual gift of 50 gold pounds*~~

(rather more than £1400) for funerals. Besides these there were many institu-

tions, and the begging and the almsgiving at the church doors. "The land could not support the lazy and valiant beggars." There were public works provided for them; if they refused to work on them they were to be driven away. The sick , might visit the capital, but must be registered and sent back (a.d. 382) ; the sturdy beggar was condemned to slavery. So little did alms effect. And in the East monasticism seems to have produced no firmness of purpose such as led to the organization of the Church and of charitable relief under St Gregory.

Another movement of the Byzantine period was the establishment of the endowed charity. The Jewish syna- gogue long served as a place for the reception of strangers — a religisus xenodocheion. Probably the strangers re- ferred to in "the Teaching" were so entertained. The table of the bishop and a room in his house served as the guest chamber, fbr which afterwards a separate building was instituted. In the East the Jewish charitable inn first appears, and there took place the earliest extension of institutions. There was probably a demand for an elabora- tion of institutions as social changes made themselves felt in the churches. We have seen this in the case of the agape. Similar changes would affect other branches of charitable work. The hospital (liospitalium, xenodocheion) is defined as a " house of Crod in which strangers who lack hospitality are received " (Suicer : TJiesaur.), a home sepa- rated from the church; and round the church, from the ' primitive xenodocheion of early Christian times and the entertainment of strangers at the houses of members of the community, would grow up other similar charities. In A.D. 321 license was given by Constantine to leave property to the Church. The churches were thus placed in the same position as pagan temples, and though subsequently Valentinian (a.d. 379) withdrew the permission on account of the shameless legacy-hunting of the clergy, in that period much must have been done to endow Church and charitable institutions. In the same period grew to its height the passion for monasticism. This affected the parish and the endowed charity alike. Under its influence the deacon as an almoner tends to disappear, except where, as in Eome, there is an elaborate system of relief. Nor does it seem that deaconesses, widows, and virgins con- tinued to occupy their old position

as church workers and alms-receivers. Naturally when marriage was considered "in itself an evil, perhaps to.be tolerated, but still de- grading to human nature," and (a.d. 385) the marriage of the clergy was prohibited, men, except those in charge of parishes, and women would join regular monastic bodies ; the deacon, as almoner, would disappear, and the " widows " and virgins would become nuns. Thus there would grow up a large body of men and women living segregated in institutions, and forming a leisured class able to superin- tend institutional charities. And now two new ofiBcers appear, the eleemosynarius or almoner and the oeconomus or steward (already an assistant treasurer to the bishop), who superintend and distribute the alms and manage the property of the institution. (In the first six books of the Apost. Gonstit. a.d. 300 these oificers are not mentioned.) In these circumstances the hospitium or hospital {xenon, katagogion) assumes a new character. It becomes in St Basil's hands (a.d. 330-379) a resort not only for those who " visit it from time to time as they pass by, but also for those who need some treatment in illness." And round St Basil at Caesarea there springs up a colony of institutions. Four kinds principally are mentioned in the Theodosian code : (1) the guest houses (xenodocheia) ; (2) the poor-houses {ptocheid), where the poor (mendici) were housed and maintained (the ptocheion was a general term also applied to all houses for the poor, the aged, orphans, and sick) ; (3) there were orphanages (prphanotropheia) for

orphans and wards ; and (4) there were houses for infant children (brephotropheia). Thus a large number of en- dowed charities had grown up. This new movement it is necessary to consider in connexion with the law relating to religious property and bequests, in its bearing on the Tule of the monasteries, and in its effect on the family.

ITie sacred property (res sacra) of Roman law consisted of things dedicated tq the gods by the pontiff with the authority of the civil authority, in turn, the people, the senate, and the emperor. Things ■so consecrated were inalienable. Apart from this in the empire, the municipalities as they grew up were considered "juristic per- sons " who were entitled to receive and

~~hold property. In a similar position were authorized collegia, amongst which were the mutual aid societies referred to above. Christians associated in these isocieties would leave legacies to them. Thus (W. M. Ramsay, Cities and Bishoprics of Phrygia, I. i. 119), an inscription mentions a bequest (possibly by a Christian) to the council (synedrion) of the presidents of the dyers in purple for a ceremonial, on the con- dition that, if the ceremony be neglected, the legacy shall become the property of the guild for the care of nurslings ; and in the same way a bequest is left in Rome (Orelli, 4420) for a memorial sacrifice, on the condition that, if it be not performed, double the cost be paid to the treasury of the corn-supply (fisco stationis annonai). No unauthorized coHeg'Ja could receive a legacy. "The law recognized no freedom of association." Nor could any private individual create a foundation with separate property of its own. Property could only be left to an authorized juristic person, being a municipality or a collegium. But as the problem of poverty was considered from a broader standpoint, there was a desire to ■deal with it in a more permanent manner than by the annona ■civiea. The pueri alimentarii (see above) were considered to hold theirproperty as part of the fiscus or property of the state. Pliny (Ep. vii. 18), seeking a method of endowment, transferred property in land to the steward of public property, and then took it back again subject to a permanent charge for the aid of children of freemen. By the law of Constantine and subsequent laws no such devices were necessary. Widows or deaconesses, or virgins ■dedicated to God, or nuns {x.n. 455), could leave bequests to a church or memorial church (martyrum), or to a priest or a monk, or to the poor in any shape or form, in writing or without it. Later (a^d. 475) donations of every kind, "to the person of any martyr, or apostle, or prophet, or the holy angels," for building an oratory were made valid, even if the building were promised •only and not begun ; and the same rule applied to infirmaries (noscomia) and poor-houses (ptocheia) — the bishop or steward being competent to appear as plaintiff in such cases. Later, again, (a.d. 528) contributions of 50 solidi (say about £19:10s.) to a church, hostel (xenodocheion) , &c., were made legal, though not Tegistered ; while larger sums, if registered, were also legalized. So (a.d. 529) property might be given for "churches, hostels, poor- houses, infant and orphan homes, and homes for the aged, or any such community" (consortitim) , even though not registered, and such property was free from taxation. The next year (530) it was ■enacted that prescription even for 100~~

~~*years did not alienate Church and charitable property. The broadest interpretation was allowed. If by will a share of an estate was left "to Christ our Lord," the church of the city or other locality might receive it as heir; "let these, the law says, belong to the holy churches, so that they may become the alimony of the poor." It was sufficient to leave property to the poor (Corpus Juris Civilis, ed. Krueger, 1877, li. 25). The bequest was legal. It went to the legal representative of the poor — the Church. Charitable property was thus Church property. The word "alms" covered both. It was given to pious uses, and as a kind of public institution "shared that corporate capacity which belonged to all ■ecclesiastical institutions by virtue of a general rule of law." On a pia causa it was not necessary to confer a juristic personality. Other laws preserved or regulated alienation (a.d. 477, a.d. 530), and checked negligence or fraud in management. The clergy had thus become the owners of large properties, with the coloni ■and slaves upon the estates and the allowances of civic corn (annona civiea); and (a.d. 357) it was stipulated that whatever they acquired by thrift or trading should be used for the service of "the poor and needy, though what they acquired from the labour of their slaves in the labour houses (ergastula) or inns (tabernceB) might be considered a profit of religion (religionis lucrum).*~~

~~*Thus grew up the system of endowed charities, which with certain modifications continued throughout the Middle Ages, and, though it assumed different forms in connexion with guilds and municipalities, in England it still retains, partially at least, its relation to the Church.*~~

~~*It remained the system of iiistitutional relief parallel to the more personal almsgiving of the parish.*~~

~~*Monasticism, in acting on men of strong character, en- dowed them with a double strength of will, and to men like St Gregory it seemed to give back with administrative power the relentless firmness of the Roman. In the East it produced the turbulent soldiery of the Church, in the West its missionaries ; and each mission-monastery was a centre of relief.*~~

~~*In Benedictine monasteries, on the east side (see Smith's Diet. Christian Antiq.) of the quadrangle, separated from the rest of the house (cf. the guest arrangements) were the dormitory and kitchen of the strangers. A*~~

~~hospitularius attended to their needs and novices waited on them. Guests who were laymen might stay on, either taking the vow, or working in return for board and lodging. Usually the almonry was at the gate. (Cf. Dugdale, ii. 43, &c.) Also the monasteries were centres of local relief : thus, for instance (cf. Rule ; St Dunst. Cant. Archep. p. xlii. Dugdale), every day three of those who were continuously fed in the monastery were selected to share the food of the brothers.~~

~~But whatever the services monasticism rendered, it can hardly be said to have furthered true charity from the social standpoint, even if we include its institutional work.~~

~~The movement was necessarily anti-parochial, and thus out of sympathy with the charities of the parish, where personal relations with the poor at their homes count for most. In later times, not unfrequently, property and tithe which belonged to a parish and supported its church and priest were diverted to a monastery ; and the clergy of the church first becoming canonici, or bound by rule, and then assuming the collegiate or monastic character, introduced the hybrid system of parochial management by monastic bodies. How far this was beneficial to the parish and the life and charities of the family is very doubtful. The good and evil may be weighed. — Monasticism working through St Augustine helped the world to realize the mood of love as the real or eternal life. Of the natural life of the world and its responsibilities, through which that mood would have borne its completest fruit, it took but little heed, except in so far as, by creating a class possessed of leisure, it created able scholars, lawyers, and administrators, and disciplined the will of strong men. ■ It had no power to stay the social evils of the day. Unlike the friars, at their best the monks were a class apart, not a class mixed up with the people. So were their charities. The belief in poverty as a fixed condition — irretrievable and ever to be alleviated without any regard to science or observation, subjected charity to a perpetual stagnation. Charity requires belief in growth, in the sharing of life, in the utility and nobility of what is done here and now for the hereafter of this present world. Monasticism had no thought of this. It was based on a belief in the evil of matter ; and from that root could spring no social charity. Economic difficulties also fostered monasticism. Gold was appre- ciated in value, and necessaries were expensive, and the cost of~~

~~maintaining a family was great. It was an economy to force a son or a brother into the Church. The population was decreasing ; and in spite of Church feeling Marjorian (a.d. 461) had to forbid women from taking the veil before forty, and to require the remarriage of widows, subject to a large forfeit of property (Hodgkin, Italy and her Invaders, ii. 420). Monasticism was inconsistent with the social good. As to the family — ^like the moderns who depreciate thrift and are careless of the life of the family, the monks, believing that marriage was a lower form of morality, if not indeed, as would at times appear, hardly moral at all, could feel hardly any enthusiasm for what is socially the very source of the health of the community and the well-spring of all charitable feeling. By the sacerdotal-monastic movement the moralizing force of Christianity was denaturalized. The falsity of its position revealed itself in unrecognized and degrading relations between men and women. But, worse than all, it pushed chai/ty from its pivot. Por this no monasteries or institutions, no domination of religious belief, could atone. The Church that had fostered l!hastity and marriage was betrayin" its trust. It was out of touch with the primal unit of social life, the child-school of dawning habits and the loving economy of the home. It produced no treatise on economy in the older Greek sense of the word. The home was nothing to it- and the popular worship of the family, the Holy Family, marks the reaction, expressing itself in the only way through which it could find an effective and untrammelled outlet, in a popular cult, which was, strictly speaking, inconsistent with the later tenets of the religion with which it could not but remain associated.~~

~~We may ask, then, What were the results of charity at the close of the period which ends with St Gregory and the~~

~~founding of the mediseval Church ?— for if the charity is reflected, in the social good, the results should be manifest. Economic and social conditions were adverse. With lessened trade the middle class was decaying (Dill, Roman Society in the Last Century of the Western Empire, p. 204) and a selfish aristocracy rising up. Muni- cipal responsibility had been taxed to extinction. The public service was corrupt. The rich evaded taxation, the~~

~~poor were oppressed by it. There were laws upon laws, endeavours to underpin the framework of a decaying society. Society was bankrupt of skill — and the skill of a generation has a close bearing on its charitable adminis- tration. While hospitals increased medicine was unpro- gressive. There were miserable years of famine and pestilence, and constant wars. The care of the poorer classes, and ultimately of the people, was the charge of the Church. The Church strengthened the feeling of kind- ness for those in want, widows, orphans, and the sick. It lessened the degradation of the " actresses," and, co-operat- ing with Stoic opinion, abolished the slaughter of the gladiar torial shows. It created a popular " dogmatic system and moral discipline," which paganism failed to do ; but it was unable to draw a new strength out of the patriotism of the Roman. It produced no prophet of charity, such as en- larged the moral imagination of the Jews. It ransomed slaves, as did paganism also, but it did not abolish slavery. Large economic causes produced one greatref orm. The serf attached to the soil took the place of the slave. The almsgiving of the Church by degrees took the place of annona and sportula, and it may have created pauperism. But dependence on almsgiving was at least an advance on dependence founded on a civic and hereditary right to relief. As the colonus stood higher than the slave, so did the pauper, socially at any rate, free to support himself, exceed the colonus. Bad economic conditions and tradi- tions, and a bad system of almsgiving, might enthral him. But the way, at least, was open ; and thus it became possible that charity, working in alliance with good eco- nomic traditions, should in the end accomplish the self- support of society, the independence of the whole people.~~

~~Part V. — Medieval Chakity and its Developjcent.~~

~~It remains to trace the history of thought and adminis- tration in relation to (1) the development of charitable responsibility in the parish, and the use of tithe and Church property for poor relief; and (2) the revision of the theory of charity, with which are associated the names of St Augustine (3S4-430), St Benedict (480-542), St Bernard (1091-1153), St Francis (1182-1226), and St Thomas Aquinas (1225-1274). (3) There follows, in reference chiefly to England, a sketch of the dependence of the poor under feudalism, the charities of the parish, the monastery, and the hospital — the mediaeval system of endowed charity : the rise of guild and municipal charities ; the~~

~~decadence at the close of the 15th century, and the statutory endeavours to cope with economic difBculties which, in the 16th century, led to the establishment of statutory serfdom and the poor-laws. New elements aflfect the problem of charity in the 17th and 18th cen- turies ; but it is not too much to say that almost all these headings represent phases of thought or institutions which in later forms are interwoven with the charitable thought and endeavours of the present day.~~

~~Naturally, two methods of relief have usually been prominent: relief administered locally, chiefly to residents in their own homes, and relief administered in The parish ^^ institution. At the time of Charlemagne tbariiabte (742-814) the system of relief was parochial, relief. consisting principally of assistance at the home. After that time, except probably in England, the institu- tional method appears to have predominated, and the~~

~~monastery or hospital in one form or another gradually encroached on the parish.~~

~~The system of parochial charity was the outcome, apparently, of three conditions : the position and iniluence of the bishop, the eleemosynary nature of the church funds, and the need of some responsible organization of relief. It resulted in what might almost be called an ecclesiastical poor-law. The affairs of a local church or congregation were superintended by a bishop. To deal with outlying districts he detached priests for religious work and, as in Rome and (774) Strasburg, deacons also for the administration of relief. Originally all the income of the church or congregation was paid into one fund only, of which the bishop had charge, and this fund was available primarily for charitable purposes. Church property was the patrimony of the poor. In the 4th century (IV. Council of Carthage, 398) the names of the clergy were entered on a list matricula or canon), as were also the names of the poor, and both received from the church their daily portion (cf. Ratzinger, Oeschichte der Kirch- lichen Armenpflege, p. 117). There were no expenses for build- ing. Before the reign of Constantine (306) very few churches were built (Ratzinger, p. 120). Thus the early Church, as has been said, was chiefly a charitable society. By degrees the property of the Church was very largely increased by gifts and bequests, and in the West before St Gregory's time the division of it for four separate purposes — the support of~~

~~*the bishop, of the clergy, and of the poor, and for church buildings — still further promoted decentralization. Apart from any special gifts, there was thus created a separate fund for almsgiving, supervised by the bishop, consisting of a fourth of the church property, the oblations (mostly used for the poor), and the tithe, which at first was used for the poor solely. The cathedral city, or civitas, became the parish of the mother church — ^the bishop's parish ; and there he attended to the poor personally. Around grew up neighbour parishes, of which the bishop had the supervision, and which were at first, or in some measure, supported from his funds, but which acquired by degrees tithe and property of their own. These parishes were endowed by Charlemagne. The priests were required to relieve the poor ; and their " manses" were, as the word shows, halting-places where they had to pro- vide food and lodging for strangers. The method was indeed elaborated and became, like the Jewish, that contradiction in terms — a compulsory system of charitable relief. The payment of tithe was enforced by Charlemagne, and it became a legal due (Counc. Francfort, 794; Arelat. 794). On the other hand, on the cathedral city (^civitas) and the neighbouring priests (uicojii presbyteri) was placed the obligation of relieving their own poor, so that they should not stray into other cities (II. Counc. Tours, 667). At the same time two other conditions were en- forced. Each person (unusguisque fidelium nostrorum or omnes cives) was to keep his own family, i.e., all dependent on him — all, that is, upon his freehold estate {allodium) ; and all beggars were to be set to work. No one was to presume to give them relief (Charlem. Oapit. v. 10). Thus we find here the germ of a poor-law system. As in the times of the annona civica, slavery, feudalism, or statutory serfdom, the burthen of the maintenance of the poor fell only in part on charity. Only those who could not be maintained as members of some " family " were properly entitled to relief — and in these circumstances the officially recog- nized clients of the Church consisted of the gradually decreasing nuniber of free poor and those who were tenants of Church lands.*~~

~~*Since 817 there has been no universally binding decision of the Church respecting the care of the poor (Ratzinger, p. 236) . So long ago did laicization commence in charity. In the wars and con- fusion of the 9th and 10th centuries the poorer freemen lapsed still further into slavery, or became coloni or bond servants ; and later they passed under the feudal*~~

rule. Thus the Church's duty to relieve them became the masters' obligation to maintain them. Simultaneously the activity of the clergy, regular and secular alike, dwindled. They were exhorted to increase their alms. The revenues and property of "the poor" were largely turned to pri- vate or partly ecclesiastical purposes, or secularized. Legacies went wholly to the clergy, but only the tithe of the produce of their own lands was used for relief ; and of the general tithe, only a third or fourth part was so applied. Eventually to a large extent, but more elsewhere than in England (Ratzinger, pp. 246, 269) the tithe itself was appropriated by nobles or even by the monasteries ; and thus during and after the 10th century a new organization of charity was created on non-parochial methods of relief. Alms, with prayer and fasting, had always been connected with penance. But the character of the penitential system had altered. By the 7th century private penance had superseded the public and con- gregational penance of the earlier Church (Diet. Christian An- tiquities, art. Penitence). To the penalties of exclusion from the sacraments or from the services of the Church or from its com- munion was coupled, with other penitential discipline, an elaborate

penitential system, in which about the 7th century the redemp- tion of sin by the ' ' sacrifice ' ' of property, payments of money fines, &c.,was introduced. (Cf. for instance Cone. Elberti :— Labbeus, i. 969 (a.d. 305), with Cone. Berghamstedense, Wilkins, Cone. p. 60 (a.d. 696), and the Penitential (p. 115) and Canons (a.d. 960), p. 236.) The same sin committed by an overseer {Propositus paganus) was compensated by a fine of 100 solidi ; in the case of a colonus by a fine of 50. So amongst the ways of penitence were entered in the above-mentioned Canons, to erect a church, and if means allowed, add to it land ... to repair the public roads . . . " to distribute," to help poor widows, orphans, and strangers, re- deem slaves, fast, &c. — a combination of "good deeds" which suggests a line of thought such as ultimately found expression in the definition of charities in the Charities Act of Queen Elizabeth. The confessor, too, was

~~*"spiritualismedicus," and much that from the point of view of counsel would now be the work of charity would in his hands be dealt with in that capacity. For lesser sins (cf. Bede (673-735), Som. 34, quoted by Ratzinger) the penalty was prayer, fasting, and alms; for the greater sins — murder, adultery, and idolatry — to give up all. Thus while half- converted barbarians may have been kept in moraJ subjection by material penances, the Church was enriched by their gifts ; and these traided to support the monastic and institutional methods which were in favour, and to which, on the revival of religious earnestness in the llth century, the world looked for the reform of social life.*~~

~~*To understand mediaeval charity it is necessary to return to St Augustine. According to him, the motive of man Medbevai ™- ^^^ legitimate effort to assert himself in life revision ot vras love Or desire {amor or cupido). " All tbetbeory impulses were only evolutions of this typical o-c-arty, characteristic" (Harnack, History of Dogma (trans.), v. iii.) ; and this was so alike in the spiritual and the sensuous life. Happiness thus depended on de- sire ; and desire in turn depended on the regulation of the will ; but the wUl was regulated only by grace. God was the spiritualis substantia; and freedom was the identity of the will with the omnipotent unchanging nature. This highest Being was " holiness working on the will in the form of omnipotent love." This love was grace — "grace imparting itself in love." Love ' (caritas — charity) is identified with justice ; and the will, the goodwill, is love. The identity of the will with the will of Grod was attained by communion with Him. The after-life consummated by sight this communion, which was here reached only by faith. Such a method of thought was entirely intro- spective, and it turned the mind " wholly to hope, asceti- cism, and the contemplation of God in worship." "Where St Augustine indulges in the exposition of practical piety he has no theory at all of Christ's work." To charity on that side he added nothing. In the llth century there was a revival of piety, which had amongst its objects the restoration of discipline in the monasteries and a monastic training for the secular clergy. To this Augustinian thought led the way. " Christianity was asceticism and the city of God" (Harnack vi. 6). A new religious feeling took possession of the general mind, a regard and adoration of the actual, the historic Christ. Of this St Bernard was the expositor. "Beside the sacra- mental Christ the image of the historical took its place, — majesty in*~~

~~*humility, innocence in penal suffering, life in death." The spiritual andthe sensuous were intermingled. Dogmatic formulae fell into the background. The picture of the historic Christ led to the realization of the Christ according to the spirit (kata pneuma). Thus St Bernard carried forward Augustinian thought; and the historic Christ became the "sinless man, approved by suffer- ing, to whom the divine grace, by which He lives, has lent such power that His image takes shape in other men and incites them to corresponding humility and love."*~~

~~*Humility and poverty represented the conditions under which alone this spirit could be realized ; and the poverty must be spiritual, and therefore self-imposed (" wilful," as it was afterwards called). This led to practical results.*~~

~~*Poverty was not a social state, but a spiritual ; and conse- quently the poor generally were not the pauperes Christi, but lihose who, like the monks, had taken vows of poverty. From these premisses followed later the doctrine that gifts to the Church were not gifts to the poor, as once they had been, but to the religious bodies. The Church was not the Church of the poor, but of the poor in spirit. But the immediate effect was the belief for a time, appar- ently almost universal, that the salvation of society would come from the monastic orders. By their aid, backed by the general opinion, the secular clergy were brought back to celibacy and the monasteries ncFly disciplined. But charity could not thus regain its touch of life and be a means of raising the standard of social duty.*~~

~~*Next, one amongst many stirred by a kindred inspira- tion, St Francis turned back to actual life and gave a new reality to religious idealism. For him the poor were once again the pauperes Christi. To follow Christ was to adopt the life of "evangelical poverty," and this was to live among the poor the life of a poor man. The follower was to work with his hands (as the poor clergy of the early Church had done and the clergy of the early Eng- lish Church were exhorted to do) 5 he was to receive no money; he was to earn the actual necessaries of life, though what he could not earn he might beg. To ask for this was a right, so long as he was bringing a better life into the world. All in excess of this he gave to the poor. He would possess no property, buildings, or endowments, nor was his order to do so. The fulness*~~

~~*of his life was in the complete realization of it now, without the cares of property and without any fear of the future. Hav- ing a definite aim and mission, he was ready to accept the want that might come upon him, and his life was a discipline to enable him to suffer it if it came. To him humility was the soul making itself fit to love ; and pov- erty was humility expanded from a mood to a life, a life not guarded by seclusion, but spent amongst those who were actually poor. The object ‘ of life was to console the poor — those outside all monasteries amd institutions — the poor as they lived and worked. The movement was practically a lay movement, and its force consisted in its simplicity and directness. Book learning was dis- paraged : life was to be the teacher. The brothers thus became observant and practical, and afterwards indeed learned, and their learning had the same characteristics. Their power lay in their practical sagacity, in their treat- ment of life, outside the cloister and the hospital, at first hand. They knew the people because they settled amongst them, living just as they did. This was their method of charity.*~~

~~*The inspiration that drew St Francis to this method was the contemplation of the life of Christ. But it was more than this. The Christ was to him, as to St Bernard, an ideal, whose nature passed into that of the contem- plating and adoring beholder, so that, as he said, ” having lost its individuality, of itself the creature could no longer act.” He had no impulse but the Christ impulse. He was changed. His identity was merged in that of Christ. And with this came the conception of a gracious and finely ordered charity, moving like the natural world in a constant harmonions development towards a definite end. The mysticism was intense, but it was practical be- cause it was intense. In that lay the strength of the movement of the true Franciscans, and in those orders that, whether called heretical or not, followed them — Lollards and others. Religion thus became a personal and original possession. It became individual. It was inspired by a social endeavour, and for the world at large it made of charity a new thing.*~~

~~*St Thomas Aquinas took up St Bernard’s position. Ee- nunciation of property, voluntary poverty, was in his view*~~

also a necessary means of reaching the perfect life ; and the feeling that was akin to this renunciation and prompted it was charity. "All perfection of the Chris- tian life was to be attained according to charity," and charity united us to God.

In the system elaborated by St Thomas Aquinas two lines of thought are wrought mto a kind of harmony. The one stands for Aristotle and nature, the other for Christian tradition and theology. We have thus a duplicate theory of thought and action throughout both rational and theologio virtues, and a duplicate beaititude or state of happiness correspondent to each. On the one hand it is argued that the good act is an act which, in relation to its object, wholly serves its purpose; and thus the measure of goodness (Prima SecundcB Summce Theolog. Q. xviii. 2) is the proportion between action and effect. On the other hand, the act has to satisfy the twofold law, human reason and eternal reason. From the point of view of the former the cardinal factor is desire, which, made proportionate to an end, is love (araoj-) ; and, seeking the good of others, it loses its quality of concupiscence and becomes fnendly love {amor amicUioe). But this rational love (amor') and chanty {earitas), the theologic virtue, may meet. All virtue or goodness is a degree of love (_amor), if by virtue we mean the cardinal virtues and refer to the rule of reason only. But there are also theologic virtues, which are on one side "essential," on the other side participative. As wood ignited participates in the natural fire, so does thejndividual in these virtues (II. II. i= bai. 1). Charity is a kind of friendship towards God. It is received per infusionem spiritus sancti, and is the chief and root of the theologic virtues of faith and hope, and on it the rational virtues depend. They a,re not degrees of charity as they are of (amor) love, but cha,rity gives purpose, order, and quality to them alt In this sense the word is applied to the rational virtues — as, for instance, beneficence. The counterpart of charity in social life is pity (misericordia) , the compassion that moves us to supply another's want (summa religionis ChristiaacB in misericordia consistit quantum ad exteriora opera). It is, however, an emotion, not a virtue, and must be regulated like any other emotion (. . . passio est et non virtus. Hie autem motus potest esse secundum rationem regulatus, II. II.» xxx. 3). Thus we pass to alms, which are the instrument of pity — an act of charity done through the interven- tion of pity. The act is not done in order to purchase spiritual good by a

~~*corporal means, but to merit a spiritual good (per effectum caritatis) through being in a state of charity ; and from that point of view its effect is tested by the recipient being moved to pray for his benefactor. The claim of others on our beneficence is relative, according to consanguinity and other bonds (II. II.» xzzi. 3), subject to the condition that the common good of many is a holier obligation (divinius) than that of one. Obedience and obligation to parents may be crossed by other obligations, as, for instance, duty to the Church. To give alms is a command. Alms i^ould consist of the superfluous — that is, of all that the individual possesses after he has reserved what is necessary. What is neces- sai;y the donor should fix in due relation to the claims of his family and dependants, his position in life (dignitas), and the sustenance of his body. On the other hand, his gift should meet the actual necessities of the recipient and no more. More than this will lead to excess on the recipient's part (ut inde luxurietur) or to want of spirit and apathy (ut aliis remissio et refrigerium sit), though allowance must be made for different requirements in different conditions of life. It were better to distribute alms to many per- sons than to give more than is necessary to one. In individual cases there remains the further question of correction — the re- moving of some evil or sin from another ; and this, too, is an act of charity.*~~

~~*It will be seen that though St Thomas bases his argument on a duplicate theory of thought, action, and happiness, part natural, part theologic, and states fully the conditions of good action, he does not bring the two into unison. Logically the argument should follow that alms that fail in social benefit (produce remissionem et refrigerium, for instance) fail also in spiritual good, for the two cannot be inconsistent. But iu regard to the former he (roes not press the importance of purpose, and, in spite of his Aristotle, he misses the point on which Aristotle, as a close observer of social conditions, insists, that gifts without purpose and reciprocity foster the dependence they are designed to meet. The proverb of the "pierced cask" is as applicable to ecclesiastical as to political almsgiving, as has often been proved by the event. The distribu- tion of all " superfluous " income in the form of alms would have the effect of a huge endowment, and would stereotype "the poor " as a permanent and unprogressive class. The proposal suggests that St Thomas contemplated the adoption of a method of relief which would be like a voluntary poor-law ; and it is noteworthy that*~~

~~his phrase " necessary relief " forms the defining words of the Elizabethan poor-law, while he also lays stress on the importance |~~

~~of "correction," which, on the decline and disappearance of the penitential system, assumed at the Keformation a prominent posi- tion in administration in relation not only to "sin," but also to offences against society, such as idleness, &c.~~

~~On this foundation was built up a classification of acts of charity, which St Thomas quotes — the seven spiritual acts (consule, carpe, doce, solare, remitte, fer, ora), counsel, sustain, teach, console, save, pardon, pray; and the seven corporal (vestio, poto, cibo, redimo, tego, colligo, condo), I clothe, I give drink to, I feed, I free from prison, I shelter, I assist in sickness, I bury (IT. II." xxxii. 2). These in subsequent thought became "good works," and availed for the after-life, bringing with them definite boons. Thus charity was linked to the system of indulgences. The bias of the act of charity is made to favour the actor. Primarily the benefit reverts to him. HIe becomes con- scious of an ultimate reward accruing to himself. The simplicity of the deed, the spontaneity from which, as in a well-practised art, its freshness springs and its good effects result, is falsified at the outset. The thought that should be wholly concerned in the fulfilment of a definite purpose is diverted from it. The deed itself, apart from the outcome of the deed, is highly considered. An ex- treme inducement is placed on giving, counselling, and the like, but none on the personal or social utility of the gift or counsel. Yet the value of these lies in their end. No policy or science of charity can grow out of such a system. It can produce innumerable isolated acts, which may or may not be beneficent, but it cannot enkindle the "ordered charity." This charity is, strictly speaking, by its very nature alike intellectual and emotional. Otherwise it would inevitably fail of its purpose, for though emotion might stimulate it, intelligence would not guide it.~~

~~There are, then, these three lines of thought. That of St Bernard, who invigorated the monastic movement, and helped to make the monastery or hospital the centre of charitable relief. That of St Francis, who, passing by regular and secular clergy alike, revived and reinvigorated the conception of charity and gave it once more the reality of a social force, knowing that it~~

would find a freer scope and larger usefulness in the life of the people than in the religious aristocracy of monasteries. And that of St Tlomas Aquinas, who, analysing the problem of charity and almsgiving, and associating it with defi- nite groups of works, led to its taking, in the commoa thought, certain stereotyped forms, so that its social aim and purpose were ignored and its power for good was neutralized.

We have now to turn to the conditions of social life in which these thoughts fermented and took practical shape. The population of England from the Conquest to the 14th century is estimated at between IJ fnJ'ioc/a/ and 2^ millions. London, it is believed, had a coadiuoas population of about 40,000. Other towns were '" small. Two or three of the larger had 4000 or °'™"- 5000 inhabitants. The only substantial building in a village, apart perhaps from the manor-house, was the church, used for many secular as well as religious purposes. In the towns the mud or wood-paved huts sheltered a people who, accepting a common poverty, traded in little more than the necessaries of life (Green, Town Life in the 15th Century, i. 13). The population was stationary. Famine and pestilence were of frequent occurrence (Creighton, Epidemics in Britain, p. 19), and for the careless there was waste at harvest time and want in winter. HIunger was the drill-sergeant of society. Owing to the hardship and penury of life infant mortality was probably very great. The 15th century was, however, "the golden age of the labourer." Our problem is to ascertain what was the service of charity to this people

till the end of that century.

The Family. — Largely Germanic in its origin, we may perhaps set down as elemental in tlie Englisli race what Tacitus said of the Germans. They had the home virtues. They had a high regard for chastity, and respected and enforced the family tie. The wife was honoured. The men were poor, but when the actual pressure of their work— fighting— was removed, idle. They were born gamblers. Much toil fell upon the wife ; but slavery was rather a form of tenure than a Roman bondage. As elsewhere, there was in England

~~*"the joint family or household" (Pollock and Maitland, English Law lief ore Edward I. i. 31). Each member of the community was, or should be, under some lord ; for the lordless man was, like the wanderer in HIomer, who belonged to no phratry, suspected and dangerous, and his kinsfolk might be required to find a lord for him. There was personal servitude, but it was not of one complexion ; there were grades amongst the unfree, and the general advance to freedom was continuous. By the 9th century the larger amount of slavery was bondage by tenure. In the reign of Edward I., though " the larger half of the rural population was unfree," yet the serf, notwithstanding the fact that he was his lord's chattel, was free against all save his lord. A century later (1381) villanage— that is payment for tenancy by service, instead of by quit-rent — was practically extin- guished. So steady was the progress towards the freedom and self-maintenance of the individual and his family.*~~

~~*The Manor. — In social importance, next to the family, comes the manor, the organization of which affected charity greatly on one side. It was "an economic unit," the estate of a lord, on which there were associated the lord with his demesne, tenants free of service, and villans and others, tenants by service. All had the use of land, even the serf. The estate was regulated by a manor court, consisting of the lord of the manor or his representative, and the free tenants, and entrusted with wide quasi- domestic jurisdiction. The value of the estate depended on the labour available for its cultivation, and the cultivators were the unfree tenants. HIence the lord, through the manor-court, required an indemnity or fine if a child, for instance, left the manor ; and similarly, if a vUlan died, his widow might have to remarry or pay a fine. Thus the lord reacquired a servant and the widow and her family were maintained. The courts,'too, fixed prices, and thus in local and limited conditions of supply and demand were able to equalize them in a measure and neutralize some of the effects of scarcity. In this way, till the reign of Edward I.,- and, where the manor courts remained active, till much later, a self-supporting social organization made any systematic public or charitable relief unnecessary.*~~

~~*The Parish and the Tithe. — The conversion of England in the 7th century was effected by bishops, accompanied by itinerant priests, who made use of conventual houses as the centres of their work. The parochial system was*~~

~~not firmly established till the 10th century (970). Then, by a law of Edgar, a man who had a church on his own land was allowed to pay a third of his tithe to his own church, instead of giving the whole of it to the minster or conventual church. Theodore, archbishop of Canterbury, (667), had introduced the Carlovingian system into England ; and, accordingly, the parish priest was required to provide for strangers and to keep a room in his house for them. Of the tithe, a third and not a fourth was to go to the poor with any surplus ; and in order to have larger means of helping them, the priests were urged to work themselves, according to the ancient canons of the Church (cf. Labbeus, IV. Cone. Carthag. a.d. 398). The importance of the tithe to the poor is shown by Acts of Richard II. and Henry IV., by which it was enacted that, if parochial tithes were appropriated to a monastery, a portion of them should be assigned to the poor of the parish. At a very early date (1287) the parish became the area for a quasi-compulsory rate (Pollock and Maitland, p. 614), though in the 14th and 15th centuries a church rate was seldom made. Collections were made by paid collectors, especially for Hoke money — money gathered for church purposes (Brand's Antiquities, p. 112). There were also from endowments parish doles, very many of which must have disap- peared in the break-up of the 16th century. All the greater festivals were days of feasting and the distribution of food ; at iunerals also there were often large distributions, and also at marriages. The faithful generally, subject to penance, were required to relieve the poor and the stranger. In the larger]part of England the parish and the vill were usually coterminous. Ja the north a parish contained several vills. There were thus iside by side the charitable relief system of the parish, which at ;an early date became a rating area, and the self-supporting iSystem of the manor.~~

~~The Monasteries.— As Christianity spread monasteries spread, and each monastery was a centre of relief. Sometimes they were~~

~~established, like St Albans (796), for a hundred Benedictine monks and for the entertainment of strangers ; or sometimes without any such special purpose, like the abbey of Croyland (re- organized 946) , which, becoming exceeding rich from its diversorium pauperiim, or almonry, "relieved the whole country round so that prodigious numbers resorted to it." But documents seem to prove (Denton, England in Fifteenth Century, p. 245)~~

~~*that the relief generally given by monasteries was much less than is usually supposed. Often they distributed relief at the homes of the poor, provided accommodation for the sick, and established hospitals, which served also as schools for the gentry and for the poor ; and they were pioneers of agriculture. In the 12th century, in which many monastic orders were constituted, there were many lavish endowments. In the 14th centurytheirusefulnesshad begun to wane. At the end of that century the larger estates were generally held in entail, with the result that younger sons were put into religious houses. This worldliness had its natural consequences. In the 15th century, owing to mismanagement, waste, and subsequently to the decline of rural prosperity, their resources were greatly crippled. In their relation to charity one or two points may be noted : (1) Of the small population of England the professed monks and nuns with the parish priests (Rogers, Sist. Agric. and Prices, i. 58) numbered at least 30,000 or 40,000. This number of celibates was a standing protest against the moral sufficiency of the family life. On the other hand, amongst them were the brothers and sisters who visited the poor and nursed the sick in hospitals ; and many who now succumb physically or mentally to the pressure of life, and are cared for in institutions, may Uien have found maintenance and a retreat in the monasteries. (2) Bound together by no common controlling organization, the mon- asteries were but so many miscellaneous centres of relief, chiefly casual relief. They were mostly "magnificent hostelries." (3) They stood outside the parish, and they weakened its organization and hampered its development.*~~

~~*The Hospitals. — The revival of piety in the 11th century led to a large increase in the number of hospitals and hospital orders. To show how far they covered the field in England two instances may be quoted. At Canterbury (Creighton, p. 87) there were four for different purposes, two endowed by Lanfranc (1084), one for poor, infirm, lame, and blind men and women, and one outside the town for lepers. These hospitals were put under the charge of a priory, and endowed out of tithes payable to the secular clergy. Later (Henry II.) a hospital for leprous sisters was estab- lished, and afterwards a hospital for leprous monks and poor rela- tions of the monks of St Augustine's. In a less populous parish, Luton (Cobbe, Luton Church), there were a hospital for the poor, an almshouse, and two hospitals, one for the sick and one for the leprous. The word " leper," it is evident, was used*~~

very loosely, and was applied to many diseases other than leprosy. There were hospitals for the Infirm and the leprous ; the disease was not considered contagious. The hospital in its modem sense was but slowly created. Thus St Bartholomew's in London was founded (1123) for a master, brethreii, and sisters, and for the entertain- ment of poor diseased persons till they got well ; of distressed women big with child till they were able to go abroad ; and for the maintenance, until the age of seven, of all such children whose mothers died in the house. St Thomas's (rebuilt 1228) had a master and brethren, and three lay sisters, and 40 beds for poor, infirm, and impotent people, who had also victual and firing. There were hospitals for many special purposes — as for the blind, for instance. There were also many hospital orders in England and on the Continent. They sprang up beside the monastic orders, and for a time were very popular ; brothers and sisters of the Holy Ghost (1198), sisters of St Elizabeth (1207-1231), Beguins and Beghards (about 1176), knights of St John, and others.

The Mendicant Orders. — The Franciscans tended the sick and poor in the slums of the towns with great devotion — indeed, the whole movement tells of a splendid self-abandonment and an intensity of effort in the early spring of its enthusiasm — and with the aid of reform councils and reformations it lengthened out its usefulness for two centuries.

As ifti the pre-mediseval Church, the system of relief is that of charitable endowments — a marked con- trast to the modern method of voluntary asso- "ndlwld' ciations or rate-supported institutions. charities.

(1) The Church as Legatee.— Ih^ church building among the Teutonic races was not held by the bishop as part of what was ongmally the charitable property of the Church. It was assigned to the patron samt of the church by the donor, who retained the right of administration, of which his own patronage or right of presentation is a relic. Subsequently, with the study of Roman law, the conception of the Church as a persona Jlcta pre- vailed ; and till the larger growth of the guilds and corporations

It was the only general legatee for charitable gifts. As these arise a large number of charitable trusts are created and held by lay corporations ; and " alms " include gifts ioi social as well as reli- gious or eleemosynary purposes. (2) Freedom from Taxation and i>ervice.·-Giits to the Church for charitable or other purposes were made in free, pure, and perpetual alms (" ad tenendum in puram et. perpetuam eleemosynam sine omni temporali servicio et consuetudine "). Land held under this frankalmoigne was given "in perpetual alms," therefore the donor could not retract it; m free alms, therefore he could exact no services in regard to It ; A n? ?'?" ^^™^^ *te.m^ free from secular jurisdiction (of. Pollock andMaitland). (3)* ZiemaJiOTO arecZ *ilfortmain.— To prevent alien- ation of property to religious houses, with the consequent loss of service to the superior or chief lords, a license from the chief lord was required to legalize the alienation (Magna Carta, andEdw. I., De viris religiosis) . Other statutes (Edw. I. and Rich. II.) enacted that this license should be issued out of Chancery after investiga- tion; and the principle was applied to civil corporations. The necessity of this license was one lay check on injurious alienation. (4) Irresponsible Administration.— Until after the 13th century, when the lay courts had asserted their right to settle disputes as to lands held in alms, the administration of charity was from the lay point of view entirely irresponsible. It was outside the secular jurisdiction ; and civilly the professed clergy, who were the admin- istrators, were "dead." They could not sue or be sued except through their sovereign— their chief, the abbot. They formed a large body of non-oivio inhabitants free from the pressure and the responsibilities of civil life. (5) Contro?.— Apart from the control of the abbot, friar, master, or other head, the bishop was visitor, or, as we should say, inspector ; and abuses might be remedied by the visit of the bishop or his ordinary. The bishop's ordinary (2 Henry V. i. 1) was the recognized visitor of all hospitals apart from the founder. The founder and his family retained a right of intervention. Sometimes thus an Institution was reorganized, or even dissolved, the property reverting to the founder (Dugdale, Monasticon Anglicanum, vi. 2. 715). (6) Cy-pres. — Charities were, especially after Henry V.'s reign, appropriated to other uses, either because their original purpose failed or because some new object had become important. Thus, for instance, a college or hospital for lepers (1363) is re-established by the founder's family with a master and priest, quod nulli leprosi reperiebantur ; and a similar hospital founded in Henry I.'s time near Oxford has decayed, and is given by Edward III. to Oriel College, Oxford, to maintain a chaplain and*

~~poor brethren. Thus, apart from alien- ation pure and simple, the principle of adaptation to new uses was put in force at an early date, and supplied many precedents to Wolsey, Edward VI., and the post- Reformation bishops. The system of endowments was indeed far more adaptable than it would at first sight seem to have been. (7) The Sources of Income. — The hospitals were chiefly supported by rents or the produce of land ; or, if attached to monasteries, out of the tithe of their monastic lands or other sources of revenue, or out of the ap- propriated tithes of the secular clergy ; or they might be In part maintained by collections made, for instance, by a commissioner duly authorized by a formal attested document, in which were re- counted the indulgences by popes, archbishops, and bishops to those who become its benefactors (Cobbe, p. 75) ; or, in the case of leper hospitals, by a leper with a " clapdish," who begged in the markets ; or by a proctor, in the case of more important insti- tutions in towns, who " came with his box one day in every month to the churches and other religious houses, at times of service, and there received the voluntary gifts of the congregation"; or they might receive inmates on payment, and thus apparently a frequent abuse, decayed servants of the court and others, were "farmed out." (8) Mode of Admission.— The admission was usually, no doubt, regulated by the prior or master. At York, at the hospital of St Nicholas for the leprous, the conditions of admission were : promise or vow of continence, participation in prayer, the abandonment of all business, the inmate's property at death to go to the house. This may serve as an example. The master was usually one of the regular clergy. (9) Decline of the Hospitals.— It is said that, in addition to 645 monasteries and 90 " colleges " and many chantries, Henry VIII. suppressed 110 hospitals (Speed's Chronicle, p. 778). The numbers seem small. In the economic decline at the end of the 15th and beginning of the 16th centuries many hospitals may have lapsed.~~

~~In the 15th century the towns grew in importance. First the wool trade and then the cloth trade flourished, and the English developed a large shipping trade. The towns grew up ^u"m Ji'^e "little principalities" ; and for the advancement cbartties. ^^ trade, guilds, consisting alike of masters and work- men, were formed, which endeavoured to regulate and then to monopolize the market. By degrees the corporations of the towns were worked in their interests, and the whole commercial system became~~

~~*restrictive and inadaptable. Meanwhile the towns attracted newcomers ; freedom from feudal obligations was gained with com-*~~

~~*parative ease ; and a new plebs was congregating, a population of inhabitants not qualified as burghers or guild members, women, sons living with their fathers, menial servants, and apprentices. There was thus an increasing restriction imposed on trade, coupled with a growing pZefis. Naturally, then, lay charities sprang up for members of guilds, and for burghers and for the commonalty. Men left estates to their guilds to maintain decayed members, to educate their children, portion their daughters, and assist their widows. The middle-class trader was thus in great measure insured against the risks of life ; and so large a stake did these guilds hold in the country that it has been argued (Rogers, iv. 5) that if they had been preserved instead of abolished in Edward VI.'s reign the enactment of Queen Elizabeth's poor-law might have been unnecessary. They were one sign of the new temper and wants of burghers freed from feudalism. Another sign was a new standard of manners. Rules and saws, Hesiodio in their tone, became popular, — ^in regard, for instance, to such a question as "how to enable a man to live on his means, and to keep himself and those belonging to him." The boroughs established other charities also, hospitals and almshouses for the people, a move- ment which, like the guilds, began very early — in Italy as early as the 9th century. They sometimes gave outdoor relief also to registered poor (Green, i. 41), and they had in large towns courts of orphans presided over by the mayor and aldermen, thus taking over a duty that previously had been one of conspicuous importance in the Church. As early as 1257 in Westphalian towns there was a rough-and-ready system of Easter relief of the poor ; and in Frankfort in 1437 there was a town council of almoners with a systematic programme of relief (Ratzinger, p. 352). Thus at the close of the Middle Ages the towns were gradually assuming what had been charitable functions of the Church.*~~

~~*While a new freedom was being attained by the labourer in the country and the burgher in the town, the difficulty of obtaining a sufficient supply of labour for agriculture must have been constant, f^omf especially at every visitation of plague and famine. The state accordingly stepped in as arbiter and organizer. By Statutes of Labourers beginning in 1351 it aimed at*~~

~~enforcing a settled wage and restraining migration. From 1388 it endeavoured to suppress mendicity, and in part to systematize it in the interest of infirm and aged mendicants. Each series of enactments is the natural complement of the other. In the main their signification, from the point of view of charity, lies in the fact that they represent a persistent endeavour to prevent social unsettlement, and in part the distress which unsettlement causes, and which vagrancy in some measure indicates, by keeping the people within the ranks of recognized dependence, or forcing them back into it by fear of the gaol or the stocks. The extreme point of this policy was reached when by the laws of Edward VI. and Elizabeth, possibly founded on Byzantine edicts, the despairing legislator offered to give the men- dicant as a slave or bondman for a period to any one who would take him. On the other hand, it was desired that relief should be a means of preventing migration. In any time of general pressure there is a desire to organize mendicity, to prevent the wandering of beggars, to create a kind of settled poor, distinguished from the rest as infirm and not able-bodied, and to keep these at least at home sufficiently supported by local and parochial relief ; and this, in its simpler form all the world over, has in the past been by response to public begging. The argument may be summed up thus : We cannot have begging, which implies that the beggar is cared for by no one, belongs to no one, and therefore throws himself on the world at large. Therefore, if he is able-bodied he must be punished as unsocial, for it is his fault that he belongs to no one ; or we must make him some one's dependant, and so keep him ; or if he is infirm, and there- fore of no service to any one — if no one will keep him — we must organize his mendicity, for such mendicity is justified. If he cannot dig for the man to whom he does or should belong, he must beg. Then out of the failure to organize mendicity — for relief of itself is no remedy, least of all casual relief — a poor-law springs up, which, after-~~

~~wards associated with the provision of employment, will, it is hoped, make relief in some measure remedial by- increasing its quantity by means of compulsory levies. This argument, which combined statutory serfdom and~~

~~*statutory poor relief, seems to have been firmly bedded in the English legislative mind for more than two centuries, from 1381 till after 1600; and until 1834 these two series of laws effectually reduced the English labourer to a, new serfdom. To people imbued with ideas of feuda- lism the way of escape from villanage seemed to be not independence, but a new reversion to it.*~~

~~*Many elements produced the social and economic catastrophe of the 16th century, for the condition into*~~

~~*which the country fell can hardly be considered cadence. ^^^^ than a catastrophe. With the growing*~~

~~*independence of the people there was created after the 13th century an unsettled " masterless " class, a residue of failure resulting from social changes, which was large and important enough to call for legislation. In the 15th century, "the golden age of the English labourer," the towns increased and flourished. Both town and country did well. At the end of the century came the decadence. The measure of the strain, when perhaps it had reached its lowest level, is indicated by the following comparison : " The cost of a peasant's family of four in the early part of the 14th century was £3, 4s. 9d. ; after 1540 it was £8 " (Rogers, iv. 756).*~~

~~*The cause of this has now been fairly investigated. The value of land in the 13th century generally depended chiefly on "the head of labour" retained upon it. Its fertility depended on main- oeuvre (manure). To keep labour upon it was therefore the aim of the lord or owner. The enclosing of lands for sheep began early, and in the time of Edward III., in the great days of the wool staple, must have been extensive. So long as the demand for the exportation of wool, and then for its consumption at home in the cloth trade, continued, the towns prospered, and the enclosures did not become a grievance. Even before the reign of Henry VII., with the decay of trade, the towns decayed, and their population in some cases diminished extraordinarily. This reacted on the country, where the great families had already become impoverished and were hardly able to support their retainers. In Henry VIIL's time the lands of the religious houses were confiscated. Worked on old lines, the custom of tillage remained in force on them. Accordingly, when these estates fell into private hands they were*~~

~~*transferred subject to the condition that they should be tilled as heretofore. The condition was evaded by the new owners, and the disbandment of farm labourers went on apace. In England and Wales these changes, it is said, affected a third of the country, more than 12,000,000 acres, if the estimates be correct, or rather a third of the best land in the kingdom. With towns decaying the effect of this must have been terrible. What were really "latifundia" were created, "great landes," "enclo- sures of a mile or two or thereabouts . . . destroying thereby not only the farms and cottages within the same circuits, but also the towns and villages adjoining." A herdsman and his wife took the place of eighteen to twenty-four farm hands. The people thus set wandering could only join the wanderers from the decaying towns. At the same time the economic difSculty was aggravated by a new patrician or commercial greed ; and once more the land question — the absorption of property into a few hands instead of its free exchange — led to lasting social demoralization. A few years after the alienation of the monasteries the coinage (1543) was debased. By this means prices were arbitrarily raised, and wages were in- creased nominally ; but nevertheless the price of necessaries was "so enhanced" that neither "the poor labourers can live with their wages that is limited by your grace's laws, nor the artificers can make, much less sell, their wares at any reasonable price" (Lamond, The Commonweal of this Bealm of England, p. xlvii.). No social reformation, such as the charitable instincts of More, Hales, Latimer, and other men suggested, was attempted, or at least persistently carried out. In towns the organization of labour had become restrictive, exclusive, and inadaptable, or, judged from the moral standpoint, uncharitable. There had been a time of plenty and extravagance, of which in high quarters the famous " field of the cloth of gold" was typical ; and probably, in accordance with the frequently observed law of social economics, as the advance in wages and their purchasing power in the earlier part of the 15th century had not been accompanied by a simultaneous advance In self-discipline and intelligent expenditure, it resulted in part in*~~

~~*lessened competence and industrial ability on the part of the workmen, and thus in the end produced pauperism. —*~~

~~*The poverty of the country was very great in the reigns of Edward VI. and Elizabeth. Adversity then taught the people new manners, and households*~~

~~*became more simple and thrifty. In the reign of James I., with enforced economy and thrift, a "slow but substantial improvement in agriculture" took place, and a new growth of commer- cial enterprise. The vigour of the municipalities had abated, so that in Henry VIII.'s time they had become the very humble servants of the Government; and the Government, on the other hand, had become strongly centralized — in itself a sign of the general withdrawal of self-sustaining activity in all administration, in the ad- ministration of charitable relief no less than in other departments. A system of endowed charities had been built up, supported chiefly by rents from landed property. These now had disappeared, and thus the means of relief, which Edward VI. and Queen Elizabeth might have utilized at a time of general distress, had been dissipated by the acts of their predecessors. The civil independence of the monasteries and religious houses might have been justified, possibly, when they were engaged in missionary work and were instilling into the people the precepts of a higher moral law than that which was in force around them. But afterwards, as the ability and intelligence of the community increased, their privileges became more and more antagonistic to charity, and tended to create a non- social, and even anti-social, ecclesiastical democracy actu- ated by aims and interests in which the general good of the people had little or no place. There was a growing alienation between religious tradition and secular opinion, as Lollardism slowly permeated the thought of the people and led the way to the Eeformation. While this aliena- tion existed no national system of charity, civic and yet religious, could be created. But worse than all, the ideal of charity had been degraded. A self-regarding system of relief had superseded charity, and it was productive of nothing but alms, large or small, isolated and unmethodic, given with a wrong bias, and thus almost inevitably with evil results. Out of this could spring no vigorous co-operative charity. Charity — ^not relief — ^indeed seemed to have left the world. The larger issues were overlooked. Then the property of the hospitals and the guilds was wantonly confiscated, though the poor had already lost that share in the revenues of the Church to which at one time they were admitted to have a just claim. A new beginning had to be made. The obligations of charity had to be revived. A new organization of charitable relief had to be created, and that with an empty exchequer and after a vast waste of charitable resources. There were signs of a new congregational and parochial energy, yet the task could not be entrusted to the religious*~~

~~bodies, divided and disunited as they were. In their stead it could only be imposed on some authority which represented the general community, such as municipalities ; and in spite of the centralization of the Government there seemed some hope of creating a system of relief in connexion vsath them. They were tried, and, very naturally, failed. In the poverty of the time it seemed that the poor could be relieved only by a compulsory rate, and the admmistration of statutory relief naturally devolved on the central Government— the only vigorous administrative body left in the country. The Government might indeed have adopted the alternative of letting the industrial difficulties of the country work themselves out, but they had inherited a policy of minute legislative control, and they continued it. Eevising previous statutes, they enacted the Poor Law, which still remains on our statute book. It could be no remedy for social offences~~

~~against charity and the community. But in part at least It was successful. It helped to conceal the failure to find a remedy.~~

~~Paet VI. — Aftek the Eeeoemation.~~

~~During the Eeformation, which extended, it should be understood, from the middle of the 14th century~~

~~to the reign of James I., the groundwork of Reforma- *^? theory of charity was being recast. The ma theory ?1°- System and the narrow theory on which of charity, it had come to depend were discredited. The~~

~~recoil is startling. To a very large extent charitable administration had been in the hands of men and women who, as an indispensable condition to their participation nn it, took the vows of obedience, chastity, and "wilful" poverty. Now this was all entirely set aside. It was felt (see HOmilies on Faith and Good Works, &c., A.D. 1547) that socially and morally the method had been a failure. The vow of obedience, it was argued, led to a general disregard of the duties of civic and family life. Those who bound themselves by it were outside the state and did not serve it. In regard to~~

~~*chastity the Homily states the common opinion : " How the profession of chastity was kept, it is more honesty to pass over in silence and let the world judge of what is well known." As to wilful poverty, the regulars, it is urged, were not poor, but rich, for they were in possession of much wealth. Their property, it is true, was held in communi, and not personally, but nevertheless it was practically theirs, and they used it for their personal en- joyment ; and " for all their riches they might never help father nor mother, nor others that were indeed very needy and poor, without the license of their father abbot" or other head. This was the negative position. The posi- tive was found in the doctrine of justification — the central point in the discussions of the time, a plant from the gar- den of St Augustine. Justification was the personal con- viction of a lively (or living) faith, and was defined as "a true trust and confidence of the mercy of God through our Lord Jesus Christ, and a steadfast hope of all good things to be received at His hands." Without this justifi- cation there could be no good works. They were the signs of a lively faith and grew out of it. Apart from it, what seemed to be " good works " were of the nature of sin, phantom acts productive of nothing, " birds that were lost, unreal." So were the works of pagans and heretics. The relation of almsgiving to religion was thus entirely al- tered. The personal reward here or hereafter to the actor was eliminated. The deed was good only in the same sense in which the doer was good ; it had in itself no merit. This was a great gain, quite apart from any question as to the sufficiency or insufficiency of the Protestant scheme of salvation. The deed, it was realized, was only the out- come of the doer, the expression of himself, what he was as a whole, neither better nor worse. Logically this led to the discipline of the intelligence and the emotions, and undoubtedly "justification" to very many was only con- sistent with such discipline and implied it. Thus under a new guise the old position of charity reasserted itself. But there were other differences.*~~

~~*The relation of charity to prayer, fasting, almsgiving, and penance was altered. The prayerful contemplation of the Christ is preserved in the mysticism of Protestantism ; but it is dis- sociated from the "historic Christ," from the fervent idealization of whom St Francis drew his inspiration and his active charitable impulse. The tradition did not die out, however. It remained with many, notably with George Herbert, of whom it made, not unlike St Francis, a poet as well as a practical parish priest ; but*~~

~~the absence gf it indicated in much post-Beformation endeavour a want if not of devotion, yet of intensity of feeling which may in part account for the fact that sectarianism in relief has since proved itself stronger than charity, instead of yielding to charity I~~

~~as its superior and its organizer. Fasting was parted from prayer and almsgiving. It was " a thing not of its own proper nature good as the love of father or mother or neighbour, but according to its end." Almsgiving also as a "work" disappears, and with it a whole series of inducements that from the standpoint of the pecuniary and material supply of relief had long been active. It was no wonder that the preachers advocated it in vain, and re- proached their hearers with their diminished bounty to the poor ; the old personal incentive had gone, and could only gradually be superseded by the spontaneous activity of personal religion very slowly wedding itself to true views of social duty and purpose. Penance, once so closely related to almsgiving, passes out of sight. Charity, the love of God and our neighbour, had two offices, it was said, "to cherish good and harmless men," and "to correct and punish vice without regard to persons." Correction as a means of discipline takes the place of penance, and it becomes judicial, regu- lating and confrolling church membership by the authority of the church, a, congregation, minister, or elder; or dealing with laziness or ill-doing through the municipality or state, in con- nexion with what now first appear, not prisons, but houses of correction.~~

~~The religious life was to be democratic — not in religious bodies, but in the whole people ; and in a new sense — in relation to family and social life — it was to be moral. That was the significance of the Reformation for charity.~~

~~Consistently with this movement of religious activity towards a complete fulfilment of the duties of civic life, the older classical social theory, fostered by the Renaissance, assumed a new influence — the organiza- great conception of the state as a community tionof bound together by charity and friendship, •nunicipai " We be not born to ourselves," it was said, " but partly to the use of our country, of our parents, of our kinsfolk, and partly of our friends and neighbours ; and therefore all good virtues are grafted on us naturally, whose effects be to do good to others, when it showeth forth the image of God in man, whose property is ever to do good~~

~~*to others " (Lamond, p. 14). Economic theory also changed. Instead of the mediaeval opinion of the " theologian or social preacher," that " trade coidd only be defended on the ground that honestly conducted it made no profit " (Green, ii. 71), we have a recognition of the advantages resulting from exchange, and individual interests, it is argued, are not necessarily inconsistent with those of the state, but are, on the contrary, a source of solid good to the whole community.*~~

~~*Municipal laws for the suppression of the mendicity of the able-bodied and the organization of relief on behalf of the infirm were common in England and on the Continent (Colmar, 1362 ; Nuremberg, 1478; Strasburg, 1523; London, 1514). Vives (Ehrle, Beitrage zur Geschichte und Beform der Armenpflege, p. 26) , a Spaniard, who had been at the court of Henry VIII. , in a book translated into several languages and widely read, seems to have summed up the thought of the time in regard to the manage- ment of the poor. He divided them into three classes : those in hospitals and poor-houses, the public homeless beggars, and the poor at home. He would have a census taken of the number of each class in the town, and information obtained as to the causes of their distress. Then he would establish a central organization of relief under the magistrates. Work was to be supplied for all, while begging was strictly forbidden. Non-settled poor who were able-bodied were to be sent to their homes. Able-bodied settled poor who knew no craft were to be put on some public work — the undeserving being set to hard labour. For others work was to be found, or they were to be assisted to become self-supporting. The hospitals provided with medical advice apd necessaries were to be classified to meet the needs of the sick, the blind, and lunatics. The poor living at home were to work with a view to their self-support. What they earned, if insufficient, might be supplemented. If a citizen found a case of distress he was not to help it, but to send it for inquiry to the magistrate. Children were to be taught. Private relief was to be obtained from the rich. The funds of endowed charities were to be the chief source of income ; if more was wanted, bequests and church col-lections would suffice. The scheme was put in force in Ypr6s in 1524. The Sorbonne approved it, and similar plans were adopted in Paris and elsewhere. It is in outline the scheme of London municipal charity promoted by Edward VI., by which the poor were classified, St Bartholomew's and St*~~

~~*Thomas's hospitals appropriated for the sick, Christ's hospital for the children*~~

~~*of the poor, and Bridewell for the correction of the able-bodied. Less the institutional arrangements and plus the compulsory rate, the methods are those of the Poor Relief Act of Queen Elizabeth of 1601. At first the attempt had been made to introduce state relief in reliance on voluntary alms (1 Mary 13, 5 Eliz. 3, 1562-63), subject to the right of assessment if alms were refused. But the position was anomalous. Charity is voluntary, and spontaneously meets the demands of distress. Such demands have always a tendency to increase with the supply. HIence the very limitations of charitable finance are in the nature of a safeguard. At most economic trouble can only be assuaged by relief, and it can only be met or prevented by economic and social reforms. If a compulsory rate be not enforced, as in Scotland and formerly in some parishes in England, a voluntary rate may be made in supplementation of the local charities. In Scotland, where the compulsory clauses of the Poor Relief Act of James I. were not put in force, the country weathered the storm without them, and the compulsory rate, which was extended throughout the country by the Poor Act of 1844, came in very slowly in the 18th and 19th centuries. In France (1566) a similar Act was passed and set aside. If a compulsory rate be enforced, it is inevitable that the resources of charity, unless kept apart from the poor-law and administered on different lines from it, will diminish, and at the same time, as has happened often in the case of endowed charities, the interest in charitable administration will lapse, while the charges for poor-law relief, drawn without much scruple from the taxation of the community, will mount to millions either to meet increasing demands or to provide more elaborate Institutional accommodation. The principle once adopted, it was enacted (1572-73), that the aged and infirm should be cared for by the overseers of the poor, a new authority ; and in 1601 the duplicate Acts were passed, that for the relief of the poor (43 Eliz. 2) , and that for the furtherance and protection of endowed charities. Thus the poor were brought into the depend- ence of a legally recognized class, endowed with a claim for relief,*~~

~~on the fulfilment of which, after a time, they could without diffi culty insist if they were so minded. The civic authority had indeed taken over the alms of the parish, and an eleemosyna civica had taken the place of the annona civica. It was a similar system under a different name.~~

~~A phrase of Cecil's indicates the minute domestic character of the Elizabethan legislation (D'Ewes, 674). Poor Relief '^^^ question (1601) was the repeal of a statute Acts and of tillage. Cecil says : " If in Edward I.'s time statutory a law was made for the maintenance of the fry serfdom. ^^^ g^j^^ ^^^ ^^ Henry VII.'s for the preserva tion of the eggs of wild fowl, shall we now throw away a law of more consequence and import ? If we debar tillage, we give scope to the depopulating. And then, if the poor being thrust out of their houses go to dwell with others, straight we catch them with the statute of inmates ; if they wander abroad, they are within the danger of the statute of the poor to be whipt. So by this undo this statute, and you endanger many thousands." A strong central Government and a network of legislation controlled the whole movement of economic life. On this reliance was placed to meet economic difB.culties. Since 23 Edw. III. there had been labour statutes ; and in 1562 a new statute was passed— not repealed till 1775 — em- powering the magistrates in quarter sessions to fix the rate of wages for husbandmen and artificers, and enforce it by fine and imprisonment (Rogers, v. 611) ; requiring yearly service in many employments ; compelling persons between 15 and 60, not otherwise employed or apprenticed, to serve in husbandry ; preventing migration from city or parish without a testimonial, and compelling single women to work by the year, week, or day ; controlling apprentice- ship, and ordaining that persons refusing to be apprenticed should be imprisoned. By this, in conjunction with other measures, the labouring classes were finally com- mitted to a new bondage, when they had freed themselves from the serfdom of feudalism, and when the control exercised over them by the guild and municipality was relaxed. The statute was so enforced that to earn a year's livelihood would have taken a labourer not 52, weeks, but sometimes two years, or 58 weeks, or 80 weeks, or 72 weeks ; sometimes, however, less — 48 or 36. The rate fixed during the Commonwealth remained practically**

~~unchanged till the last quarter of the 18th century. It followed that on such a system the country could only with the utmost good fortune free itself from~~

~~*the economic difficulties of the century, and that the need of a poor-law was felt the more as these difficulties per- sisted. A voluntary or a municipal system could not suffice, even as a palliative, while such statutes as these were in force to render labour immobile and unpro- gressive. Also, while wages were fixed by statute or order, whether chiefly in the interest of the employers or not, obviously any shortage on the wages had to be made good by the community. The community, by fixing the wages to be earned in a livelihood, made itself responsi- ble for their sufficiency. And accordingly we find that in the year in which the Statute of Labourers (1562) was passed, that for the enforcement of assessments of poor- rate was also enacted. The Law of Settlement passed in the reign 'of Charles II. was due, it is said, to a migrar tion of labourers southward from counties where less favourable statutory wages prevailed; but it was, in fact, only a corollary of the Statute of Labourers and the Poor Eelief Acts of 1562 and 1601. These laws, it may be said, were the means of making the English labourer, until the poor-law reform of 1834, a settled but landless serf, supported by a fixed wage and a state bounty. By the poor-law it was possible to continue this state of things till, in consequence of an absolute economic breakdown, there was no alterna- tive but reform.*~~

~~*The philanthropic nature of the poor-law is indicated by its antecedents : once enacted, its bounties became a right ; its philanthropy disappeared in a quasi-legal claim. Its object was to relieve the poor by home industries, apprentice children, and provide necessary relief to the poor unable to work. The Act was commonly interpreted so as to include the whole of that indefinite class, the "poor" ; by a better and more rigid interpretation it was, at least in the iSth century, held to apply only to the "destitute." The economic fallacy of home industries founded on rate-supplied capital early declared itself, and the method could only have continued as long as it did because it formed part of a general system of industrial suppression. When in the 18th century workhouses were established, the same industrial fallacy, as records show, repeated itself under new conditions. Within the parish it resulted in the farmer paying the labourer as small a wage as possible, and leaving the parish to pro- vide whatever he might require in addition during his working life and in his old age. Thus, indeed, a gigantic experiment in civic employment was made for centuries on a vast scale throughout the country — and failed. As was natural, the lack of economic*~~

~~*independence reacted on the morals of the people. With pauperism came want of energy, idleness, and a disregard for chastity and the obligations of marriage. The law, it is true, recognized the mutual obligations of parents and grandparents, chil- dren and grandchildren; but in the general poverty which it was itself a means of perpetuating such obliga- tions became practically obsolete, while at all times they were difficult to enforce. Still, the fact that they were recognized implies a great advance in charitable thought. The Act, passed at first from year to year, was very slowly put in force. Even before it was passed the poor- rate assessed under the Act of 1562 was felt to be "a greater tax than some subsidies," and in the time of Charles II. it amounted to a third of the revenue of England and Wales (Rogers, v. 81).*~~

~~The service of villan and cottar was, as we have now seen, in part superseded by what we have called a statu- tory serfdom founded on a basis of wage supplemented by relief ; to such a system a poor-law was a necessary~~

~~adjunct. But it follows that with the decay of this serf- dom the poor-law itself should have disappeared, or should take some new and very limited form. Unfortunately, as m Roman times, state relief proved to be a popular and vigorous parasite that outlived the tree on which it was rooted : the labour statutes were repealed in 1775, and a century later the Act against illegal combinations of working men ; but the serfdom of the poor-law, the eleemosyna civica, remained, to work for half a century the grayest evil to the labouring classes, and after that period to impede and hamper greatly the recovery of their independence. Nevertheless, by a new law of state alms for the aged, or by increased outdoor relief, it is now proposed to bring them once again under a thraldom similar to that from which they have so slowly emanci- pated themselves.~~

~~The policy adopted by Queen Elizabeth for the relief of the poor (1601) included a scheme for the reorganiza- tion of voluntary charity as well as plans for endowed *^® extension of rate-aided relief. During the charities. Century, as we have seen, endeavours had been made to create a system of voluntary charity. This it was proposed to safeguard and promote concur- rently with the extension of the poor-rate. Accordingly, in the poor-law it was arranged that the overseers, the new civic authority, and the churchwardens, the old paro- chial and charitable authority, should act in conjunction, and, subject to magisterial approval, together "raise weekly or otherwise" the necessary means "by taxa- tion of every inhabitant." The old charitable organi- zation was based on endowment, and the church- warden was responsible for the administration of many such endowments. What was not available from these and other sources was to be raised " by taxation." The object of the new Act was to encourage charitable gifts.~~

~~*Towards the end of the 18th century, when the adminis- tration of poor relief fell into confusion, many charities were lost, or were in danger of being lost, and many were mismanaged. In 1786 and 1788 a committee of the House of Commons reported on the subject. In 1818, chiefly through the instrumentality of Lord Brougham, a commission of inquiry on educational charities was appointed, and in 1819 another commission to investigate (with some exceptions) all the charities for the poor in England and Wales. These and subsequent commissions continued their inquiries till 1835, when a select com- mittee of the House of Commons made a strong report, advocating the establishment of a permanent and inde- pendent board, to inquire, to compel the production of accounts, to secure the safe custody of charity property, to adapt it to new uses on Cy-pres lines, &c. A commis- sion followed in 1849, and eventually in 1853 the first Charitable Trusts Act was passed, under which "The Charity Commissioners of England and Wales" were appointed.*~~

~~*The following are details of importance :— (1) Definition.— The definition of the Act of 1601 (Charitable Uses, ^3 Eliz. 4) still holds good. It enumerates as charitable objects all that was once called " alms " : (a) " The relief of aged, impotent, and poor*~~

~~*people " the normal poor ; " the maintenance of sick and maimed*~~

~~*soldiers and mariners " — the poor chiefly by reason of war, some- time a class of privileged mendicants ; (6) education, "schools of learning, free schools, and scholars in universities" ; and then (c) a group of objects which include general civic and religious purposes, and the charities of guilds and corporations; "the repair of bridges, ports, havens, causeways, churches, sea- banks, and highways ; the education and preferment of orphans ; the relief, stock, or maintenance for houses of correction; marriages of poor maids, supportation, aid, and help of young tradesmen, handicraftsmen, and persons decayed" ; and there follows (d) "the relief or redemption of prisoners or captives" ; and lastly, (e) "the aid and ease of any poor inhabitants con- cerning payment of fifteens" (the property-tax of Tudor times), setting out of soldiers, and other taxes. The definition might*~~

~~*be illustrated by the charitable bequests of the next 60, or indeed 225, years. It is a fair summary of them. (2) Charitable Gifts. — A public trust*~~

~~*and a charitable trust are, as this definition shows, synonymous. It is a trust which relates to public charities, and is not held for the benefit of private persons, e.g., relations, but for the common good, and, subject to the instruc- tions of the founder, by trustees responsible to the community. Gifts for charitable purposes, other than those affected by the law of mortmain, have always been viewed with favour. "Where a charitable bequest is capable of two constructions, one of vfhich would make it void and the other would make it effectual, the latter will be adopted by the court" (Tudor' s Charitable Trusts, ed. 1889, by L. S. Bristowe and W. I. Cook, p. 28). Gifts to the poor, or widows, or orphans, indefinitely, or in a particular parish, were valid under the Act, or for any purpose or institu- tion for the aid of the "poor." Thus practically the Act covered the same field as the poor-law, though afterwards it was decided that, " as a rule, persons receiving parochial relief were not entitled to the benefit of a charity intended for the poor " (Tudor, p. 104). (3) Seligious Differences. — In the administration of charities which are for the poor the broadest view is taken of religious differences. (4) Superstitious Uses. — The superstitious use is one that has for its object the propagation of the rites of a religion not tolerated by the law (Tudor, p. 18). Consequently, so far as charities were held or left subject to such rites, they were illegal, or became legal only as toleration was extended. Thus by degrees, since the Toleration Act of 1688, all charities to dissenters have become legal — that is, trusts for schools, places for religious instruction, education, and charitable purposes generally. But bequests for masses for the soul of the donor, or for monastic orders, are still void. (5) Administration. — The duty of administering charitable trusts falls upon trustees or corporations, and under the term "eleemosynary corporations" are included endowed hospitals and colleges. Under schemes of the Charity Commissioners, where charities have been re- modelled, besides trustees elected by corporations, there are now usually appointed ex officio trustees who represent some office or institution of importance in connexion with the charity. (6) Jurisdiction by Chancery and Charity Commission. —*~~ ~~*The Court of Chancery has jurisdiction over charities, under the old principle that " charities are trusts of a public nature, in regard to which no one is entitled by an immediate and peculiar interest to prefer a complaint for compelling the performance by the trustees of their obligations." The court, accordingly, represents the Crown SiS parens patrice. Now, by the Charitable Trusts Act, 1853, and subsequent Acts, a charity commission has been formed which is entrusted with large powers, formerly enforced only by the Court of Chancery. (7)*~~

~~*Jurisdiction by Visitor. — A further jurisdiction is by the "visitor," a right inherent in the founder of any eleemosynary corporation, and his heirs, or those whom he appoints, or in their default, the king. The object of the visitor is "to prevent all perverting of the charity, or to compose differ- ences among members of the corporation." Formerly the bishop's ordinary was the recognized visitor (2 Henry V. i. 1) of hospitals, apart from the founder. Subsequently his power was limited (14 Eliz. c. 5) to hospitals for which the founders had appointed no visitors. Then (1601) by the Charitable Uses Act commissions were issued for inquiry by county juries. Now, apart from the duty of visitors, inquiry is conducted by the charity com- missioners and the assistant commissioners. By subsequent Acts (see below) ecclesiastical and eleemosynary charities have been still further separated and defined. (8) Advice. — Trustees, or other persons concerned in the management of a charity, may apply to the charity commissioners for their opinion, advice, or direction ; and any person acting under such advice is indemnified, unless he has been guilty of misrepresentation in obtaining it. (9) Limitation of Charity Commissioners Powers. — The commissioners cannot, however, make any order with respect to any charity of which the gross annual income amounts to £50 or upwards, except on the application of the trustees or a majority of them. Their powers are thus very limited, except when put in motion by the trustees. If a parish is divided they can apportion the charities if the gross income does not exceed £20. (10) General Powers of the Charity Commission. — Subject to the limitation of £50, &c., the charity commissioners have power (Charitable Trusts Act, 1860) to make orders for the appointment or removal of trustees, or of any officer, and for the transfer, payment, and vesting of any real or personal estate, or "for the establishment of any scheme for the administration" of the charity. (11) Schemes arid Bemodelling of Charities.— JJndeT this power charities are remodelled, and small and miscellaneous charities put into one fund and applied to new purposes. The cy-pr6s doctrine is applied, by which if a testator leaves directions that are only indefinite, or if the objects for which a charity was founded are obsolete, the charity is applied to some purpose, as far as possible, in accordance with the charitable intention of the founder. This*~~

~~doctrine probably received its widest application in the City of London Parochial Charities Act of 1883. Under other Acts doles have been applied to education and to allotments. About 380 schemes are issued in the course of a year. (12) Objects adopted in remodelling Charities. — In the remodelling of charities for the general benefit of the poor some one or more of thirteen objects are usually included in the scheme. These are subscriptions to a medical charity, to a provident club or coal or clothing society, to a friendly society ; for nurses, for annuities, for outfit for ser- vice, &c. ; for emigration ; for recreation grounds, clubs, reading- rooms, museums, lectures ; for temporary relief to a limited amount in each year ; for clothes, fuel, tools, medical aid, food, &c. , or in money "in cases of unexpected loss or sudden destitution" ; for pensions. (13) Parochial Charities. — By the Local Government Act of 1892, local ecclesiastical charities, i.e., endovnnents for " any spiritual purpose that is a legal purpose " (for spiritual per- sons, church and other buildings, for spiritual uses, &c.) are sepa- rated from parochial charities, "the benefits of which are, or the separate distribution of the benefits of which is, confined to inhab- itants of a single parish, or of a single ancient ecclesiastical parish, or not more than five neighbouring parishes." These charities are now brought under the supervision of the recently established parish councils, who appoint trustees for their management in lieu of the former overseer or vestry trustees, or, under certain condi-~~

~~tions, "additional trustees." The accounts have to be submitted to the parish meeting, and the names of the beneficiaries of dole charities published. (14) Official Trustees.— There is also "an official trustee of charity lands," who as " bare trustee " may hold the land or stock of the charity managed by the trustees or admin- istrators. At present the stock transferred to the official trustees amounts to £20,173,654. (15) Audit.— The charity commissioners have no power of audit, but the trustees of every charity have to prepare a statement of accounts annually, and transmit it to the commission. The accounts have to be " certified under the hand of one or more of the trustees and by the auditor of the charity." (16) Taxation. — In the case of rents and profits of lands, &o., be- longing to hospitals or almshouses, or vested in trustees for chari- table purposes, allowances are made in diminution of income-tax (56 Vict. 35, § 61). From the inhabited house duty any hospital charity school, or house provided for the reception~~

~~*or relief of poor persons, is exempted (48 Geo. III. c. 55). Also there is an ex- emption from the laud-tax in regard to land rents, &c., in possession of hospitals before 1693. (17) The Digest.—A di- gest of endowed charities in England and Wales was compiled in the years 1861 to 1876. A new digest of reports and finan- cial particulars is now in progress. The following table gives the income of endowed charities at that time and its chief*~~

~~*According to Inquiry,*~~

~~*1861-76.*~~

~~*Income from*~~

~~*Total.*~~

~~*Total former Income. 1819-3T.*~~

~~*Apprenticing*~~

~~*and Advancement.*~~

~~*Almshouses*~~

~~*and Pensioners.*~~

~~*Distribution*~~

~~*in*~~

~~*Kind.*~~

~~*Distribution*~~

~~*in*~~

~~*Money.*~~

~~*General*~~

~~*Uses of*~~

~~*Poor.*~~

~~*Medical Charities.*~~

~~*Real Estate.*~~

~~*Personal EsUte.*~~

~~*Counties, including Cities of London and Westminster*~~

~~*Diocesan charities Society of Friends'*~~

~~*charities General charities*~~

~~*1,148,955*~~

~~*1,315 17,185*~~

~~*390,795*~~

~~*£*~~

~~*394,726*~~

~~*9,486 10,240*~~

~~*225,761*~~

~~*£*~~

~~*1,543,681*~~

~~*10,801 27,425*~~

~~*616,556*~~

~~*£*~~

~~966,573 232,654~~

~~61,476~~

~~77 1,978~~

~~24,334~~

~~£~~

~~408,426~~

~~2,248 1,100~~

~~140,346~~

~~123,298~~

~~9~~

~~804~~

~~143f687~~

~~7,747 8,990~~

~~16,566~~

~~34,707~~

~~2,279~~

~~27,832~~

~~19,085 180,055~~

~~1,558,250~~

~~640,213~~

~~*2,198,463*~~

~~*1,199,227*~~

~~*87,865*~~

~~*552,120*~~

~~*124,111*~~

~~*176,890*~~

~~*64,818*~~

~~*199,140*~~

~~*The income of endowed charities is now, no doubt, considerably larger than it was in 1876. Partial returns show that at least a million a year is now available in England and Wales for the as- sistance of the aged poor and for doles. Between the poor-law, which, as it is at present administered, is a permanent endowment provided from the rates for the support of a class of permanent "poor," and endowed charities, which are funds available for the poor of successive generations, there is no great difference. But in their resources and administration the difference is marked, tooal endowed charities were constantly founded after Queen Elizabeth's time till about 1830, and the poor rate was at first sup- plementary of the local charities. When corn and fuel were dear and clothes very expensive, what now seem trivial endowments for food, fuel, coal, and clothes were important assets in the thrifty management of a parish. But when the poor were recognized as a Class of dependents entitled by law to relief from the community, the rate increased out of all proportion to the charities. A distinc- tion then made itself felt between the "parish" poor and the " second " poor, or the poor who were not relieved from the rates, and relief from the rates altogether overshadowed the charitable aid. Charitable endowments were ignored, ill-administered, and often were lost. After 1834 the poor-law was brought under the control of the central Government. Poor relief was placed in the hands of boards of guardians in unions of parishes. The method of co-operation between poor-law and charity suggested by the Acts of Queen~~

~~*Elizabeth was set aside, and, as a responsible partner in the public work of charity relief, was disestablished. In the parishes the endowed charities remained in general a disorgan- ized medley of separate trusts, jealously guarded by incompetent administrators. To give unity to this mass of units, so long as the principles of charity are misunderstood or ignored, has proved an almost impossible and certainly an unpopular task. So far as it has been achieved, it has been accomplished by the piecemeal legislation of schemes cautiously elaborated to meet local preju- dices. Active reform has been relented, and politicians have often accentuated this resentment. Eeoently several inquiries have been made by Parliamentary committees into the action of the charity commissioners, but no serious grievances were substan- tiated. The committees' reports are of interest, however, as an indication of the initial difficulties of all charitable work, the gen- eral ignorance that prevails in regard to the elementary conditions that govern it, the common disregard of these principles, and the absence of any accepted theory or constructive policy that should regulate its development and its administration.*~~

~~*After the Poor-Law Act of 1601 the history of the voluntary*~~

~~*parochial charities in a town parish is marked by their decreasing amount and utility, as poor-law relief and pauperism in- crease. The Act, it would seem, was not adopted with Charity la much alacrity by the local authorities. From 1625 to *^'"!™? 1646 there were many years of plague and sickness, but " "" in St Giles's, London, as late as 1649, the amount raised by the " collectors " (or overseers) was only £176. They disbursed this to "the visited poor" as "pensions." In 1665 an extra levy of £600 is mentioned. In the accounts of St Martin's-in-the-Fields, where, as in St Giles's, gifts were received, the change wrought by another half-century (1714) is apparent. The sources of charitable relief are similar to those in all the Protestant churches — English, Scottish, or Continental : church collections and offertories ; cor- rectional fines, such as composition for bastards and conviction money for swearers ; and besides these, income from annuities and legacies, the parish estate, the royal bounty, and "petitions to per- sons of quality. " In all £2041 was collected, but, so far as relief was concerned the parish relied not on it, but on the poor-rate, which produced £3765. All this was collected and disbursed on their own*~~

authority by collectors, to orphans, "pensioners" or the "known or standing" poor, or to casual poor (£1818), including nurse children and bastards. The begging poor were numerous and the infant death-rate enormous, and each year three-fourths of those christened were "inhumanly suffered to die by the barbarity of nurses." The whole administration was uncharitable, injurious to the community and the family, and inhuman to the child. If one may judge from later accounts of other parishes even up to 1834, usu- ally it remained the same, purposeless and unintelligent ; and it can hardly be denied that, generally speaking, only in the last fifty years has any serious attention been paid to the charitable side of parochial work. Parallel to the parochial movement of the poor-law in England, in France (about 1617) were established the bureaux de bienfaisanoe, at first entirely voluntary institutions, then recognized by the state, and during the Revolution made the central administration for relief in the communes.

In the 17th century in England, as in France, opinion favoured the establishment of large hospitals or maisons Dieu for the reception of the poor of different charitable classes. In Prance throughout the century there movements ■was a continuous struggle with mendicancy, "'«'■ "'"'^• and the hospitals were used as places into which offenders were summarily driven. A new humanity was, however, beginning its protest. The pitiful condition of abandoned*

*chiWren attracted sympathyin both countries. St Vincent de raul established homes for the enjants trouvis, followed /^-^r T I *^® establishment of the Foundling Hospital (IJdy). In both countries the method was applied incon- siderately and pushed to excess, and it affected family life most injuriously. Grants from Parliament supported the foundling movement in England, and homes were opened ui many parts of the country. The demand soon became overwhelming; the mortality was enormous, and the cost so large that it outstripped all jfinancial expedients. The lesson of the experiment is the same as that of the poor-law catastrophe before 1834: only, instead of the able-bodied poor of another age infants were made the object of a compassionate but undiscermng philanthropy. With widespread relief there*

~~came widespread abandonment of duty and economic bantruptey. Had the poor-rates instead of charitable relief been used in the same way, the moral injury would have been as great, but the annual draft from the rates would have concealed the moral and postponed the economic disaster. To amend the evil changes were made by which the relation between child and mother was kept alive, and a personal application on her part was required; the character of the mother and her circum- stances were investigated, and assistance was only given when it would "be " the means of replacing the mother in the course of virtue and the way of an honest liveli- hood." Oeneral i-eforms were also made, especially through the instrumentality of Jonas Hanway, to check infant mortality, and metropolitan parishes were required to provide for their children outside London. A kindred movement led to tho establishment of penitentiaries (1758), of lock hospitals and lying-in hospitals (1749-~~

~~1752).~~

~~In Queen Anne's reign there was a new educational movement — "the charity school" — ^" to teach poor children the alphaibet and the principles of religion," followed by the Sunday-school movement (1780), and about the same time (1788) by " the school of industry " — to em- ploy children and teach them to be industrious. In 1844 the Kagged School Union was established, and until the Education Act of 1870 continued its volun- tary educational work. As an outcome of these move- ments, through the efforts of Miss Mary Carpenter and many others, in 1854-55 industrial and reformat tory schools were established, to prevent crime and reform child criminals. The orphanage movement, beginning in 1758, when the Orphan Working Home was established, has been continued to the present day on a vastly extended scale. In 1772 a society for the discharge of persons imprisoned for small debts was established, and in 1773 Howard began his prison reforms. This raised the standard of work in institutional charities generally. After the civil wars the old hospital founda- tions of St Bartholomew and St Thomas, municipalized by Edward VI., became endowed charities partly sup- ported by voluntary contributions. The same fate befell Christ's Hospital, in connexion with which the voting system, the admission of candidates by the vote of the whole body of subscribers — that peculiarly English invention — ^fiist makes its appearance. A new interest~~

~~*in hospitals sprang up at the end of the 17th century. St Thomas's was rebuilt (1693) and St Bartholomew's (1739) ; Guy's was founded in 1724, and on the system of free " letters " obtainable in exchange for donations, voluntary hospitals and infirmaries were established in London (1733 and later) and in most of the large towns. Towards the end of the century the dis- pensary movement was developed, — a system of local dis- pensaries with fairly definite districts and home visiting, a substitute for attendance at a hospital, where "hos-*~~

~~*pital fever" was dreaded, and an alternative to what was then a very ill^administered system of poor-law medical relief. After 1840 the provident dispensary was introduced, in order that the patients by small contribu- tions in the time of health might provide for illness without having to meet large doctors' bills, and the doctor might receive some sufficient remuneration for Ms attend- ance on poor patients. This movement was largely extended after 1860. Three Hospital Funds for col- lecting contributions for hospitals and making them grants, a movement that originated in Birmingham in 1859, were established in London in 1873 and 1897. Since 1868 the poor-law medical system of Great Britain has been immensely improved and extended, while at the same time the number of persons in receipt of free medical relief in most of the large towns has greatly increased. The following figures lefer to London : in- patients at hospitals (1900) during the year, 103,765; out-patients and casualty cases, 1,584,987; patients at free, part-pay, or provident dispensaries, about 280,000 ; in poor-law infirmaries (1897), 36,294; orders issued for attendance at poor-law dispensaries and at home, 109,653. There are in London 12 general hospitals •with, 13 without, medical schools, and 86 special hospitals. Thus the population in receipt of public and voluntary medical relief is very large, indeed alto- gether excessive.*~~

~~*Each religious movement has brought with it its several charities. The Society of Friends, ,the Wesleyans, the Baptists have large charities. With the extension of the High Church movement there have been established many sisterhoods which support penitentiaries, convalescent homes and hospitals, schools, missions, &c.*~~

The magnitude of this accumulating provision of charit- able relief is evident, though it cannot be summed up in any single total.

At the beginning of the 19th century anti-mendicity societies were established ; and later, about 1869, in Eng- land and Scotland a movement began for the organization of charitable relief, in connexion with which there are now societies and committees in most of the larger towns in Great Britain, in the Colonies, and in the United States of America. More recently the movement for the establish- ment of settlements in poor districts, initiated by Canon Barnett at Toynbee Hall — "to educate citizens in the knowledge of one another, and to provide them with teaching and recreation " — has spread to many towns in England and America.

These notes of charitable movements suggest an altogether new development of thought. On behalf of the charity school of Queen Anne's time were preached very formal sermons, which showed but i??" **1 *little sympathy with child life. After the first la istb half of the century a new humanism, with which «"<' t^th we connect the name of Rousseau, slowly super- """"■'^*' seded this formal beneficence. Rousseau made the world open its eyes and see nature in the child, the family, and the community. He analysed social life, intent on explain- ing it and discovering on what its well-being depended ; and he stimulated that desire to meet definite social needs which is apparent in the charities of the century. Little as it may appear to be so at first sight, it was a period of charit- able reformation. Law revised the religious conception of charity, though he was himself so strangely devoid of social instinct that, like some of his successors, he linked the utmost earnestness in belief to that form of almsgiving which most effectually fosters beggardom. Howard in- troduced the era of inspection, the ardent apostle of a new social sagacity; and Bentham, no less sagacious, propounded opinions, plans, and suggestions which, perhaps it may be said, in due course moulded the prin-*

ciples and methods of tlie poor-law of 1834. In the broader sense the turn of thought is religious, for while usually stress is laid on the religious

~~*scepticism of the century, the deeper, fervent, conscientious, and evan-gelical charity in which Nonconformists, and especially " the Friends," took so large a part, is often forgotten. Sometimes, indeed, as often happens now, the feeling of charity passed into the merest sentimentality. This is evident, for instance, from so ill-considered a measure as Pitt's Bill for the relief of the poor. On the other hand, during the 18th century the poor-law was the object of constant criticism, though so long as the labour statutes and the old law of settlement were in force, and the relief of the labouring population as state " poor " prevailed, it was impossible to reform it. Indeed, the criticism itself was generally vitiated by a tacit acceptance of "the poor" as a class, a permanent and irrevocable charge on the funds of the community; and at the end of the 18th century, when the labour statutes were abrogated, but the conditions under which poor relief was administered remained the same, serfdom in its later stage, the serfdom of the poor-law, asserted itself in its extremest form in times of dearth and difficulty during the Napoleonic war. In 1802-03 it was calculated (Marshall's Digest) that 28 per cent, of the population were in receipt of permanent or occasional relief. Those in receipt of the former numbered 734,817, including children — so real had this serfdom of the poor become. In 1832 the expendi ture on pauperism in England and Wales was £7,036,968. In the early years of the 19th century the mendicity societies, established in some of the larger towns, were a sign of the general discontent with existing methods of administration. The Society for Bettering the Condition of the Poor — representing a group of men such as Colqu- houn, Bernard, Lettsom, Haygarth, Neald, and others — took a more positive line and issued many useful publicar tions (1796). After 1833 the very atmosphere of thought seems changed. There was a general desire to be quit of the serfdom of pauperism. The Poor-Law Amendment Act was passed in 1834, and since then male able-bodied pauperism has dwindled to a minimum. The bad years of 1860-70 revived the problem in England and Scotland, and the old spirit of reform for a time prevailed. Im- proved administration working with economic progress effected still further reductions of pauperism, till in 1900 it stood at 688,505, or 21-7 per thousand of the population, instead of at 45 per thousand as in 1851. (See article Pook-Law.) Charity organization societies were formed after 1869, with the object of " improving the condition of the poor," or, in other words, to promote independence by an ordered and co-operative charity ; and the*~~

~~*Associa- tion for Befriending Young Servants, and workhouse aid committees, in order to prevent relapse into pauperism on the part of those who as children or young women received relief from the poor-law. The Local Government Board adopted a restricted out-door relief policy, and a new interest was felt in all the chief problems of local administration. The movement was general. The results of the Elberfield system of municipal relief administered by unpaid almoners, each dealing with but one or two cases, influenced thought both in England and America. The experience gained by Mr Joseph Puckerman of New York of the utility of registering applications for relief, and the teaching of Miss Octavia Hill, led to the founda^ tion of the system of friendly visiting and associated charity at Boston (1880) and elsewhere. Since that time the influence of Arnold Toynbee and the investigations of Mr Charles Booth have led to a better appreciation of the conditions of labour ; and to some extent, in London and elsewhere, the spirit of charity has assumed the form*~~

~~*of a new devotion to the duties of citizenship. But per- haps, in regard to charity in Great Britain, the most important change has been the revival of the teaching of Dr Chalmers (1780-1847), who (1819) introduced a system of parochial charity at St John's, Glasgow, on independent lines, consistent with the best traditions of the Scottish Church. In the development of the theory of charitable relief on the economic side this has been a main factor. His view, which he tested by experience, may be summed up as follows. Society is a growing, self-supporting organism. It has within it, as between family and family, neighbour and neighbour, master and employee, endless links of sympathy and self-support. Poverty is not an absolute, but a relative term. Naturally the members of one class help one another; the poor help the poor. There is thus a large invisible fund available and constantly used by those who, by their proximity to one another, know best how to help. The philanthropist is an alien to this life around him. Moved by a sense of contrast between his own lot, as he understands it, and the lot of those about him, whom he but little understands, he concludes that he should relieve them. But his gift, unless it be given in such a way as to promote this self- support, instead of weakening it, is really injurious. In the first place, by his interference he puts a check on the charitable resources of another class and lessens their social energy. What he gives they do not give, though they might do so. But next, he does more harm than this. He stimulates*~~

~~*expectation, so that by a false arithmetic his gift of a few shillings seems to those who receive it and to those, who hear of it a possible source of help in any difficulty. To them it represents a large command of means ; and where one has received what, though it be little, is yet, relative to wage, a large sum to be acquired without labour, many will seek more, and with that object wUl waste their time and be put off their work, or even be tempted to lie and cheat. So social energy is diverted from its proper use. Alms thus given weakens social ties, diminishes the natural relief funds of mutual help, and beggars a neighbour instead of bene- fiting him. By this argument a clear and well-defined purpose is placed before charity. Charity becomes a science based on social principles and observation. Not to give alms, but to keep alive the saving health of the family, becomes its problem: relief becomes altogether subordinate to this, and institutions or societies are ser- viceable or the reverse according as they serve or fail to serve this purpose. Not poverty, but distress is the plea for help; not almsgiving, but charity the means. To charity is given a definite social aim, and a desire to use consistently with this aim every method that increasing knowledge and trained ability can devise. Under such influences as these, joined with better economic conditions, a great reform has been made. The poor-law, however, remains — our modern eleemosyna civica. It now, indeed, absorbs a proportionately lesser amount of the largely increased national income, but, excluding the maintenance of lunatics, it costs Great Britain nearly ten millions a year ; and among the lower classes of the poor, directly or indirectly, it serves as a bounty on dependence and is a permanent obstacle to thrift and splf-reliance. The num- ber of those who are within the circle of its more imme- diate attraction is now perhaps, in different parts of the country, not more than 20, 25, or 30 per cent, of the popu- lation. Upon that population the statistics of a day census would show a pauperism not of 2-50, but of 12-50 to 8-33 per cent. ; and the percentage would be much greater — twice as large perhaps — ^if the total number of those who in *ome way received poor relief in the course of a year were taken into account. The poor-law is thus among the*~~

~~*lower classes, those most tempted to dependence — say some six or seven millions of the people — a very potent influence definitely antagonistic to the good development of family life, unless it be limited to very narrow propor- tions; as, for instance, to restricted indoor or institu- tional relief for the sick, for the aged and infirm, who in extreme old age require special care and nursing, and for the affticted, for whom no sufftcient charitable provision is procurable. As ample experience shows, only on these conditions can poor-law relief be justified from the point of view of charity and the common good. In marked contrast to this opinion is the agitation for pen- sions. These, it was at first proposed, should be given out of the national exchequer to all persons over 65, at the rate of five shillings a week; and, were the plan adopted in spite of its great cost, a system of state alms for the aged would be set on foot, unlike the annona civica, since it would be available not for citizens only, a comparatively small part of the population, but for the whole population, yet like the annona, since it would be claimed as a right — a huge charity endowed with unlim- ited funds, funds which ultimately may largely exceed the normal cost of the army or the navy. Schemes of the kind are being adopted in some colonies — in New Zealand, for instance, and Victoria — with some apparent safeguards. In England, failing any such plan, the Local Government Board in 1900 urged the boards of guardians to give large outdoor relief to aged deserving people, and laid no stress on the test of destitution, the neglect of which led to many of the dif&culties of the old poor-law. HIstory has proved that demoralization results from the wholesale relief whether of the mass of the citi- zens, or of the able-bodied, or of the children, and the fact that it is now proposed to limit the endowment to the aged makes no substantial difference. The social re- sults must be similar; but social forces work slowly, and usually only the unanswerable argument of financial bank- ruptcy suffices to convert a people habituated to depend- ence, though the inward decay of vitality and character may long before be manifest. Ultimately the distribution of pensions by way of outdoor relief, corrupting a far more independent people, would work a far greater injury than the annona civica. Such an endowment of old age might indeed be justified as part of a system of regu- lated labour, which, as in earlier times, could not be enforced without some such extraneous help, but it could not be justified otherwise. It is naturally asso- ciated, therefore, with socialistic proposals for the regu- lation of wage.*~~

~~*In the light of the principles of charity, which we have^ considered historically, we have now to turn to two ques- tions : charity and economics, and charity and socialism.*~~

~~*The object of charity is to render to our neighbour the services and duties of goodwill, friendship, and love. To prevent distress charity has for its further The eco- object to preserve and develop the manhood chXify."' and womanhood of individuals and their self- maintenance in and through the family; and any form of state intervention is approved or disapproved by the same standard. By self-maintenance is meant self-support throughout life in its ordinary contingencies — sickness, widowhood, old age, &c. Political economy we would define as the science of exchanges. Here it has to be considered in relation to the purposes of charity. By way of illustration we take, accordingly, three points: distribution and use, supplementation of wage, and the standard of well-being in relation to wage.*~~

~~*m Distribution and ITse.— Economy in the Greek sense begins at this point — the use of means and resources. Political economy ignores it. Yet from the point of view of charity it is cardinal to the whole issue. The distribution of wage may or may not be*~~

~~*largely influenced by trades unions ; but the variation of wage, as is generally the case, by the increase or decrease of a few pence is of less importance than its use. Comparing a careful and an un- thrifty family, the difference in use may amount to as much as a third on the total wage. Mere abstention from alcohol may make, in a normal family, a difference of 6s. in a wage of 25s. On the other hand, membership of a friendly society is at a time of sick- ness equivalent to the command of a large sum of money, for the common stock of capital is by that means placed at the disposal of each individual who has a share in it. Further, even a small amount saved may place the holder in a position to get a better market for his labour ; he can wait when another man cannot. Kent may be high, but by co-operation that too may be reduced. Other points are obvious and need not be mentioned. It is evident that while the amount of wage is important, still more important is its use. In use it has a large expansive value. (2) Supplementa- tion of Wage. — The exchange between skill and wage must be free if it is to be valid. The less the skill the greater is the temptation to philanthropists to*~~

~~*supplement the lesser wage ; and the more important is non-supplementation, for the skilled can usually look after their own interests in the market, while the less skilled, be- cause their labour is less marketable, have to make the greater effort to avoid dependence. But the dole of endowed charities, outdoor relief, and any constant giving, tend to reduce wage, and thus to deprive the recipients of some part of the means of independence. The employer is pressed by competition himself, and in return he presses for profit through a reduced wage, if circumstances make it possible for the workman to take it. And thus a few individuals may lower the wages of a large class of poorly skilled or unskilled hands. In these conditions unionism, even if it were likely to be advantageous, is not feasible. Unionism can only create a coherent unit of workers where there is a limited market and a definite sale- able skill. Except for the time, insufficient wage will not be reme- died in the individual case by supplementation in any form — doles, clothes, or other kinds of relief ; and in that case, too, the relief will probably produce lessened energy after a short time, or in other words lessened ability to live. An insufficient wage may be prevented by increasing the skill of the worker, who will then have the advantage of a better series of economic exchanges, but hardly otherwise. If the supplementation be not immediate, but post- poned, as in the case of old-age pensions, its effect will be similar. To the extent of the prospective adventitious gain the attraction to the friendly society and to mutual help and saving will grow less. Necessity has b^en the inventor of these ; and where wage is small, a little that would otherwise be saved is quickly spent if the neces- sity for saving it is removed. Only necessity schools most men, especially the weak, to whom it makes most difference ultimately, whether they are thrifty or whether or not they save for the future in any way. (3) The Standard of Well-being or Comfort in Ee- lation to Wage. — With an increase of income there has to be an increase in the power to use income intelligently. Whatever is not so used reacts on the family to its undoing. Constantly when the wife can earn a few shillings a week, the husband will every week idle for two or three days. So also if the husband finds that in a few days he can earn enough to meet what he considers to be his requirements for the week. In these circumstances the standard of well-being falls below the standard of wage ; the wage is in excess of the energy and intelligence necessary to its economic use, and in these cases ultimately pauperism often ensues. The family is demoral- ized.*~~

Thus, with a view to the prevention of distress in good times, when there is the less poverty there is the more need of charity, rightly understood ; for charity would strive to promote the right use of wage, as the best means of prevent- ing distress and preserving the economic well-being of the family.

The theory of charity separates it entirely from social- ism, as that word is commonly used. Strictly socialism means, in questions affecting the community, a dominant regard for the common or social good ^"^f'jf "'"' in so far as it is contrary to private or individual advantage. But even so the antithesis is misleading, for the twoneednotbeinconsistent. On the contrary, the common good is really and ultimately only individual good (not ad- vantage) harmonized to a common end. The issue, indeed, is that of old Greek days, and the conditions of a settlement of it are not substantially different. In fact, however, the word socialism is used to mean the acquisition of class bene- fits of a personal nature for a particular class, usually called the working or labouring class, at the expense of the rest of the community. In this sense the annona civica, the poor- law, and old-age pensions, and many other schemes, are so-

cialistiCi And, as has been shown, since they inj ure the fam- ily and weaken independence, they cannot be charitable. They are naturally associated with regulated or statutory labour, whether in connexion with a statute of wages or the laws of a trades union, for where such measures fail, or seem to fail to provide a sufficient livelihood, relief in some form is called in to supplement the actual or assumed de- ficiency. Thus charity and socialism, in the usual meaning of the word, imply two quite different theories of social life, and are not in any way compatible.

The springs of charity lie in sympathy and religion. To organize it is to give to it the " ordered nature " of an

organic whole, to give it a definite social purpose, The organ- j^^^j ^q associate the members of the community charity. for the fulfilment of that purpose. This in turn

depends on the recognition of common principles, the adoption of a common method, self-disciplineand train- ing, and co-operation. In a mass of people there may be a large variation in motives coincident with much unity in action. Thus there may be acceptance of a common social purpose in charity, while in one the impulse is similar to that which moved St Francis or George Herbert, in another to that which moved Howard or Dr Chalmers, or a modern poor-law reformer like Nicholls or Denison. Accepting, then, the principles of charity, we pass to the method in relation to assistance and relief. Details may vary, but on the following points there is general agreement among student and workers : —

(1) The Committee or Conference. — There are usually two Muds of local relief : the public or poor-law relief, and relief connected with religious agencies. Besides, there is the relief of endow- ments, sociej^ies, and charitable persons. Therefore, as a condition precedent to all organization, there must be some local centre of association for information and common help. A town should be divided for this purpose into manageable areas coincident with parishes or poor-law divisions, or other dis- tricts. Subject to an acceptance of general principles, those engaged in charity should be members of a local conference or committee, or aUied to it. The committee would thus be the rallying-point of a large and somewhat loosely knit association of friends and workers. (2) Inquiry, Aid, and Begistration. — The object of inquiry is to ascertain the actual causes of distress or dependence, and to carry on the work there must usually be a staff of several honorary and one or two paid workers. Two methods may be adopted : to inquire in regard to applications for help with a view to forming some plan of material help or friendly aid, or both, which wUl lead to the ultimate self-support of the family and its members, and, under certain conditions, in the case of the aged or sick, to their continuous or their sufficient help ; or to ascertain the facts partly at once, partly by degrees, and then to form and carry out some plan of help, or continue to befriend the family in need of help, in the hope of bringing them to conditions of self-support, leaving the work of relief entirely to other agencies. The committee in neither case should be a relief com- mittee— itself a direct source of relief. On the former method it has usually no relief fund, but it raises from relations, employers, charities, and charitable persons the relief required, according to the plan of help agreed upon,

~~unless, indeed, it is better not to relieve the case, or to leave it to the poor-law. The committee thus makes itself responsible for endeavouring to the best of its ability to raise the necessary relief, and acts as trustee for those who co-operate without it, in such a way as to keep intact and give play to all the natural obligations that lie within the inner circles of a self-supporting community. On the latter method the work of relief is left to general charity, to the private persons, or to the poor-law, to whom the case is notified ; and the effort is made to help the family to self-support by a friendly visitor. This procedure is that adopted by the associated charities in Boston, Mass. , and other similar societies in America. The method of associated belp, combined with personal work, represents the usual practice of charity organization societies. Mutatis mutandis, the plan can be adopted on the simplest scale in parochial or other relief conunittees, subject to the safeguards of sufficient training and settled method. The inquiry should cover the following points : names and address, and ages of family, previous addresses, past employment and wages, present income, rent and liabilities, membership of friendly or other society, and savings, relations, relief (if any) from any source. These points should be verified, and reference should be made to the clergy, the poor-law authorities, and others, to ascertain if they know the applicant. The result~~

~~should be to show how the applicant has been living, and what are the sources of possible help, and also what is his character. The problem, however, is not whether the person is "deserving" or "undeserving," but whether, granted the facts, the distress can be stayed and self-support attained. If the help can be given privately from within the circle of the family, so much the better. Often it may be best to advise, but not to interfere. In some cases but little help may be necessary ; in others again the friendly relation between applicant and friend may last for months and even years. Usually in charitable work the question of the kind of relief available — money, tickets, clothes, &c.— governs the decision how the case should be assisted. But tiis is quite wrong : the opposite is the true rule. The wants of the case, rightly understood, should govern the decision as to what charity should do and what it should provide. Cases are overwhelming in number, as at the out-patient apd casualty departments of a hospital, where the admissions are made without inquiry, and subject practically to no restrictions ; but when there is inquiry, and each case is~~

~~*seriously considered and aided with a view to self-support, the numbers will seldom be overwhelming. On this plan appeal is made to the strength of the applicant, and requires an effort on his part. Indiscriminate relief, on the other hand, attracts the applicant by an appeal to his weakness, and it requires of him no effort. Hence, apart even from the differentiating effect of inquiry, one method makes applicants, the other limits their numbdr, although on the latter plan much more strenuous endeavours be made to assist the lesser number of claimants. For the routine work of the office an extremely simple system of records with card index, &c., has been devised. In some cities, particularly in the United States of America, there is a central registration of cases, notified by individual charities, poor- relief authorities, and private persons. The system of charity organization or associated charity, it will be seen, allows of the utmost variety of treatment, according to the difficulties in each in- stance and the remedies available, and the utmost scope for personal work. (3) Training. — If charitable work is an art, those who un- dertake it must needs be trained both in practice and method and in judgment. It requires, too, that self-discipline which blends intelligence with emotion, and so endows emotion with strength and purpose. In times of distress a reserve of trained workers is of the utmost service. At all times they do more and produce, socially, better results ; but when there is general distress jof any kind they do not lose their heads like new recruits, but prevent at least some of the mischief that comes of the panic which often takes possession of a community, when distress is apprehended, and leads to the wildest distributions of relief. Also trained workers make the most useful poor-law guardians, trustees of charities, secretaries of charitable societies, and district visitors. All clergy and ministers and all medical men who have to be engaged in the administration of medical relief should learn the art of charity. Poor-law guardians are usually elected on political or general grounds, and have no special knowledge of good methods of charity ; and trustees are seldom appointed on the score of their qualifications on this head. To provide the necessary education in charity there should be competent helpers and teachers at charity organization committees and elsewhere, and an alliance for this purpose should be formed between them and professors and teachers of moral science and economics and "settlements." Those who study social problems in connexion with what a doctor would call "cases" or "practice" see the limits and the falsity of schemes that on paper seem*~~

~~logical enough. This puts a check on the inflvience of scheme-building and that literary sensationalism which makes capital out of social conditions. (4) Co-operation. — Organization in charity depends on extensive co-operation, and ultimately on the accept- ance of common views. This comes but slowly. But with much tribulation the goal may be reached, if in case after case the effort is made to provide friendly help through charities and private persons, unless, as may well be, it should seem best not to interfere, but to leave the applicant to apply to the adminis- trators of public relief. Experience of what is right and wrong in charity is thus gained on both sides. Many sources may have to be utilized for aid of different kinds even in a single case, and for the prevention of distress co-operation with members of friendly societies and with co-operative and thrift agencies is indispensable.~~

~~Where there is accord betweeen charity and the poor- law pauperism may be largely reduced. The poor-law in most countries has at its disposal certain in- stitutional relief and outdoor allowances, but it '"'^poor- has no means of devising plans of help which "'■ may prevent application to the rates or « take " people "off the rates." Thus a widow in the first days of widowhood applies and receives an allowance according~~

~~to the number of her children. Helped at the outset by charity on some definite plan, she may become self- supporting ; and if her family be large one or two of her children may be placed in schools by the guardians, while she maintains the remaining children and herself. As far as possible there should be a division of labour between the poor-law and charitj. Except where some plan such as that just mentioned is adopted, one or the other should take whole charge of the case relieved. There should be no supplementation of poor-law relief by charity. This will weaken the strength and dissipate the resources of charity without adding to the efficiency of the poor-law. Unless the guardians adopt a restrictive out-door relief policy, there is no scope for any useful division of labour between them and charity; for the many cases which, taken in time, charity might save from pauperism, they will draw into chronic dependence by their allowances a~~

very much larger number. But if there is a restrictive out-door policy, so far as relief is necessary, charity may undertake to meet on its own lines distress which the poor-law would otherwise have met by allowances, and, subject to the assistance of urgent cases, poor-law relief may thus by degrees become institutional only. Then, in the main, natural social forces would come into play, and dependence on any form of annona civica would cease.

Open-handed hospitality always creates mendicants. This is what the hospitals offer in the out-patient and casualty departments, and they have created a osptas. (jig^gg Qf hospital mendicants. The cases are quickly dealt with, without inquiry and without regard to home conditions. The medical man in the hospital does not co-operate with any fellow-workers outside the hospital. Where his physic or advice ceases to oper- ate his usefulness ceases. He regards no conditions of morality. In a large number of cases drink or vice is the cause of application, and the cure of the patient is dependent on moral conditions ; but he returns home, drinks, and may beat his wife, and then on another visit to the hospital he will again be physicked, and so on. The man is not even referred to the poor-law infirmary for relief. Nor are conditions of home sanitation re- garded. One cause of constant sickness is thus entirely overlooked, while drugs, otherwise unnecessary, are con- stantly given at the hospital. The hospitals are thus large isolated relief stations which are creating a new kind of pauperism. So far as the patients can pay — and many can do so — ^the general practitioners, to whom they would otherwise go, are deprived of their gains. Still worse is it when the hospital itself charges a fee in its out-patient department. The relief is then claimed even more abso- lutely as a right, and the general practitioners are still further injured. The doctors, as a medical staff, are not only medical men, but, whether they recognize the fact or not, they are also almsgivers or almoners ; what they give is relief. Yet few or none of them have ever been trained for that work, and consequently they do not realize how very advantageous, even for the cure of their own patients, would be a thorough treatment of each case both at the hospital and outside it. Nor can they understand how their methods at present protract sickness and promote habitual dependence. Were this side of their work studied by them in any way they would be the first, probably, to press upon the governors of their hospitals the necessity for a change.

~~*Unfortunately, at present the governors are themselves untrained, and to finance the hospital and to make it a good institution is their sole object. Hospitals, however, are, after all, only a part of the general administration of charity, though as they are now managed they have seldom any systematic connexion with that administration. Nor is there any co-ordination*~~

~~*between the several hospitals and dispensaries. If one rightly refuses further treatment to certain applicants, they have only to wander to some other hospital, there to be admitted with little or no scrutiny. For usually out- patients and casualty patients are not even registered, nor can they be identified if they apply again. Practically they come and go at will. The definite limitation of cases, according to some standard of effectual work, association with general charity, trained almonership and inquiry, and a just regard for the interests of general practitioners, are stepping-stones to reform. In towns where medical charities are numerous a representative board would promote mutual help and organization.*~~

~~*Like the poor-law, endowed charities may be perma- nent institutions established to meet what should be passing and decreasing needs (cf . the arguments in The State and Charity, by T. Mackay). f^^^^'^ Administered as they usually are in isolation — apart from the living voluntary charities of the generation, and consisting often of small trusts diflB.cult to utilize satisfactorily, they tend to create a permanent demand which they meet by fixed quantities of relief. Also, as a rule, they make no systematic inquiries with a view to the verification of the statements of the applicants, for they have no staff for these purposes; nor have they the assistance of almoners or friendly visitors. Nor does the relief which they give form part of any plan of help in conjunction with other aid from without; nor is the administration subject to frequent inspection, as in the case of the poor-law. All these conditions have led to a want of progress in the actual administration of endowed charities, in regard to which it is often very difBcult to prevent the exercise of an undue patronage. But there is no reason why these charities should not become a responsible part of the country's administration, aiding it to reduce outdoor pauperism. It was never intended that the poor-law should extinguish the endowed charities, still less, as statistics now prove, that where endowments abound the rate of*~~

pauperism should be considerably above the average of the rest of the country. This shows that these charities often foster pauperism instead of preventing it. As a step to reform, the publication of an annual register of endowed charities in England and, Wales is greatly needed. The consolidating schemes of the charity commissioners have done much good; still more may be done in some counties by extending to the county the benefits of the charities of well-endowed towns, as has been accomplished by the extension of the eleemosy- nary endowments of the City of London to the metropolitan police area. Nor, again, until quite lately, and that as yet only in one or two schemes, has the principle been adopted that pensions or other relief should be given only in supplementation of the relief of relations, former em- ployers, and friends, and not in substitution of it. Hence hitherto, in the main, the system has tended to weaken the family and to pauperize.

*In many places funds are raised for the relief of school children by the supply of meals during the winter and spring. Usually a very large number of children are said to be underfed, but inquiry shows that such statements may be taken '^//?' '" as altogether excessive. They are sometimes based on t h"! information drawn from the children at school, or " *" o" • sometimes on general deductions ; they are seldom founded on any systematic and competent inquiry at the homes. When this has been made, the numbers dwindle to very small proportions. Teachers of experience have noted the effect of the meals in weakening the independence of the family. While they are forthcoming women sometimes give up cooking meals at hoine, use their money for other things, and tell the child he can get his meal at school. Great temptations are put before a parent to neglect her family, and very much distress is due to this. The meals — just at a time when, owing to the age of her children, the mother's care is most needed, and just in those families where the*

temptation is greatest and where the family instinct should be strengthened — stimulate this neglect. So in the case of the fathers : men who are lazy, and whose wives can earn a little, get the benefit of this help, and work for

~~two or three days a week instead of for the whole week. Winter after winter, hard or mild, the meals are given, forgetful of the fact that man is made provident and responsible only by the pressure of nature ; and thus winter, with its possibilities of want of employment, provides one of the strongest incentives to the practice of thrift, which, if it be encouraged, will do more for the health and contentment of the children than the meals of all their school life. Such relief, indeed, is wrong by all the canons of reasonable charity, and, appealing to the weakness of the poor, it creates an increasing demand which it cannot meet. Thus, for instance, in Paris the municipal subvention for the meals rose from 545,900 francs in 1892 to 912,885 francs in 1897, and the number of meals from 6,971,340 to 8,229,870. Mutatis mutandis the same result follows when charitable funds for the same purpose are forthcoming. The cause of distress in these cases is usually to be found in the home ; the cases are comparatively few ; being few, they should be syste- matically dealt with individually, with the object of preserving the family life ; or, if the family be so vicious that its true life is en- tirely lost, and there is no alternative, as privately as possible some separate provision should be made for the children, so that they may grow up strong and healthy, to become the fathers and mothers of healthy families when they in turn make their start in life.~~

~~At a time of exceptional distress the following suggestions~~

~~founded on much English experience may be of service. Usually~~

~~at such a itime proposals are made to establish~~

~~Bxceptlonal special funds, and to provide employment to men~~

- ~~***■ and women out of work. But it is best, if possible,~~

~~and as long as possible, to rely on existing agencies and to strengthen them. Round them there are usually workers more or less trained. A new fund usually draws to it new people, many of whom may not have had any special experience at all. If a new fund is inevitable, it is best that it should make its grants to existing agencies after consultation with them. In any case a clear policy should be adopted, and people should keep their heads. The exaggeration of feeling at a time of apprehended or actual distress is~~

~~*sometimes extraordinary, and the unwise action which it prompts is often a cause of continuing pauperism after- wards. Where there is public or poor-law relief the follow- ing plan may be adopted : — ^In any large town there are usually different recognized poor-law, charitable, or other areas. The local people already at work in these areas should be formed into local committees. In each case a quick inquiry should be made, and the relieving officer communicated with, some central facts verified, and the home visited. Roughly, cases may be divided into three classes : the irresponsible casual labouring class ; a middle class of men with decent homes, who have made no provision for the future, and are not members of either friendly society or trades union ; and a third class, who have made some provision. These usually are affected last of all ; at all hazards they should be kept from receiving public relief, and should be helped, as far as possible, privately and personally. If there are public works, the second class might be referred to them ; if there are not, probably some should be left to the poor-law, some assisted in the same way as members of class three. Much would turn upon the family and the home. The first class should be left to the poor-law. If there is no poor-law system at work they should be put on public works. Working men of independent position, not the creatures of any political club, but such as are respected members of a friendly society or are otherwise well qualified for the task, should be called into consultation. The relief should be settled according to the requirements of each case, but, if the pressure is great, at first at least it may be necessary to make grants according to some generally sufficient scale. There should be as constant a revision of cases as time permits. Great care should be taken to stop the relief as soon as possible, and to do nothing to make it the stepping-stone to permanent dependence.*~~

~~*As an alternative to relief, employment on public works is often suggested. It must be remembered, however, that where there is distress nothing should be done to prevent the migration of the workman, nothing to attract unsettled labour or vagrancy to the town. Employment, artificially provided, may cause as many difficulties as relief. If resort must be had to it, it should be work within the skill of all ; it should be fairly remunerated, so that at least the scantiness of the pay may not be an excuse for neglect ; and it should be paid for according to measured or piece work. The discipline should be strict, though due regard should be paid at first to*~~

~~those unaccustomed to digging or earthwork. In England and Wales the guardians have power to open labour yards. These, like charities which provide work, tend to attract and keep in employment a low class of labourer or workman, who finds it pays him to use the institution as a convenience. It is best, therefore, to avoid the opening of a labour yard, if possible.~~

~~If it is opened, the discipline should be very strict, and when there is laziness or insubordination, relief in the workhouse should at once be offered. The relief furnished to men employed in a labour yard, of which in England at least half has to be given in kind, should, it has been said, be dealt out from day to day. This leads to the men giving up the work sooner than they otherwise would. They have less to spend.~~

~~In some of the English colonies Homeric hospitality- still prevails, but by degrees the station-house or some refuge is established in the towns as they grow y^^g^^^ more populous. Finally, some system of labour in exchange for relief is evolved. At first this is volun- tary, afterwards it is ofiScially recognized, and finally it may become part of the system of public relief. As bad years come these changes are made step by step. In England the vagrant or wayfarer is tolerated and dis- couraged, but not kept employed. He should maintain himself, it is thought. His relief is public relief, and now, usually after he has had a bath and food, he is admitted to a separate room or cell in a casual ward. Before he leaves he has to do a task of work, and, subject to the discretion of the master, he is detained two nights. This plan has reduced vagrancy, and, if it were universally adopted, clean accommodation would everywhere be pro- vided for the vagrant without the attractions of a common or " associate " ward ; and probably vagrancy would dimin- ish still further. It seems almost needless to say that in these circumstances, at any rate, casual alms should not be given to vagrants. They know much better how to provide for themselves than the almsgiver imagines, for vagrancy is in the main a mode of life not the result of any casual difficulty. Vagrancy and criminality are also nearly allied. The magistrate, therefore, rather than the almsgiver, should usually interfere ; and, as a rule, where the magistrates are strict vagrancy in a county diminishes. Still undoubtedly vagrancy has its economic side. In a bad year the number of tramps is increased by the addi- tion of unskilled and~~

~~*irresponsible labourers, who are soon- est discharged when work is slack. As a part-voluntary system under official recognition the German Arbeiter-colonien are of interest. This in a measure has led to the introduction of labour homes in England, the justification of which should be that they recruit the energy of the men who find their way to them, and enable them to earn a living which they could not do otherwise. In a small percentage of cases this result may be achieved. Chari- table refuges or philanthropic common lodging-houses, usually established in districts where this class already congregate, only aggravate the difficulty. They give addi- tional attractions to a vagrant and casual life, and make it more endurable. They also make a comfortable avoid- ance of the responsibilities of family life comparatively easy, and, in so far as they do this, they are clearly injurious to the community.*~~

~~*The English colonists of the New England States and Pennsylvania introduced the disciplinary religious and relief system of Protestantism and the Eliza- bethan poor-law. To the former reference has United already been made. With an appreciation of* eH *the fact that the cause of distress is not usually poverty, but weakness of character and want of judgment, and that relief is in itself no remedy, those who have inherited the old Puritan traditions have, in the light of toleration and a larger social experience, organized the method of friendly visiting, the object of which is illus trated by the motto "Not alms, but a friend." To the friendship of charity is thus given a disciplinary force, capable of immense expansion and usefulness, if the friendship on the side of those who would help is sincere and guided by practical knowledge and sagacity, and if on the side of those in distress there is awakened a reciprocal regard and a willingness to change their way of life by*~~

~~*degrees. Visiting by " districts " is set aside, for « friend- liness " is not a quality easily diffused over a wide area. To be real it must be limited as time and ability allow. Consequently, a friendly visitor usually befriends but one or two, or in any case only a few, families. The friendly visitor IS the outcome of themovement for " associated char- ities," but in America*~~

~~*charity organization societies have also adopted the term and to a certain extent the method. Between the two movements there is the closest affinity. The registration of applicants for relief is much more complete in American cities than in England, where the plan meets with comparatively little support. At the ofBce of the associated charities in Boston there is a central and practically a complete register of all the applications made to the public authority for poor relief, to the associated charities, and to many other voluntary bodies.*~~

~~*The Elizabethan poor-law system, with the machinery of overseers, poor-houses, and out-door relief, is still main- tained in the New England states and Pennsylvania, but with many modifications, especially in New York State. A chief factor in these changes has been immigration. While the county or town remained the administrative area for local poor relief, the large number of immigrant and " unsettled " poor, and the business connected with their removal from the state, entailed the establishment of a secondary or state system of administration and aid, with special classes of institutions to which the counties or towns could send their poor, as, for instance, state reform schools, farms, almshouses, &c. For the oversight of these institutions, and often of prisons also and lunatic asylums, in many states there have been established state boards of "charity or corrections and charity." The members of these boards are selected by the state for a term of years, and give their services honorarily. There are state boards in Massachusetts, Kew York, Rhode Island, Pennsylvania, Minnesota, Michigan, Wisconsin, Iowa, Colorado, and elsewhere. There is also a district board of charities in the District of Columbia. These boards publish most useful and detailed reports. Besides the state board there is sometimes also, as in New York State, a State Charities Aid Association, whose members, in the counties in which they reside, have a legal right of entry to visit and inspect any public or charitable insti- tution owned by the state and any county and other poor- house. A large association of visitors accustomed to inspect and report on institutions has thus been created. Further, the counties and towns in New York State, for instance, and Massachusetts, and the almshouse districts in Pennsylvania, are under boards of supervision. Usually the overseers give out-door relief, and the pauperism of some areas is as high as that in some English Unions, 3, 4, and 5 per cent. On the whole population of the States, however, and of*~~

individual states, consisting to a great extent of comparatively young and energetic immigrants, the pauperism is insignificant. In Massachusetts " it has been the general policy of the state to order the removal to the state almshouse of unsettled residents of the sev- eral cities and tovras in need of temporary aid, thus avoiding some of the abuses incident to out-door relief." In New York State, in the city of New York, including Brooklyn, the distribution of out-door relief by the de- partment of charities is forbidden, except for purposes of transportation and for the adult blind. Most counties m the state have an almshouse, and the county superin- tendents and overseers of the poor "furnish necessary relief to such of the county poor as may require only temporary assistance, or are so disabled that they cannot be safely removed to the almshouse." Public attention is in many cases being drawn to the inutility and injury of out-door relief. _ _ r ■■,• ■

In some states and cities the system of subsidizing

voluntary institutions is in full force, and it is in force also in many English colonies. At first sight it has the advantage of providing relief for public purposes without the creation of a new staff or establishment. There is thus an apparent economy. But the evils are many. Political partisanship and favour may influence theapiount and disposition of the grants. The grants act as a bounty on the establishment and continuance of charitable insti- tutions, homes for children, hospitals, &c., but not on the expansion of the voluntary charitable funds and efforts that should maintain them; and thus charitable homes exist in which charity in its truer sense may have little part, but in which the chief motive of the administration may be to support sectarian interests by public subsidies. Claimants for relief have little scruple in turning such institutions to their own account; and the institutions, being financially irresponsible, are not in these circum- stances scrupulous on their side to prevent a misdirection of their bounties. " Parents unload their children upon the community more recklessly when they know that such children will be provided for in private orphan asylums and protectories, where the religious training that the parents prefer will be given them " (Amos G. Warner, in International Congress: Charities and Correction, 1893). Sometimes, as in New York, the admission is entirely in the hands of the managers. They admit ; the city pays. In New York City the population between 1870 and 1890 increased about 80 per cent. ; the

~~*subsidies for prisoners and public paupers increased by 43 per cent., but those for paupers in private iastitutions increased from $334,828 to $1,845,872, or about 461 per cent. The total was at that time $3,794,972 ; in 1898 it was rather less, $3,132,786. The alternative to this system is either the establishment of state or municipal institutions, and possibly in special cases payments to voluntary homes for the maintenance of inmates admitted at the request of a state authority, as at certified and other homes in England, with grants made conditional on the work being conducted on specified lines, and subject to a certain increasing amount of volun- tary financial support; or a close general and financial inspection of charitable institutions ; or payment for only those inmates who are sent by public authorities and admitted on their request.*~~

~~*The enormous extent to which children's aid societies have been increased in the United States, sometimes with the help of considerable public grants, suggests the greatest need for caution from the point of the preservation of the family as the central element of social strength in the community. The problem of charity in relation to medical relief in the large towns of the United States is similar to that of England : its difficulties are alike.*~~

~~*Books. — As good translations of the classics become accessible it is easy for the general reader or student to combine a study of the principles of charity in relation to the community with a study of history. Thus, and in connexion with some special investigations (such as those made by Mr Charles Booth) and the conditions of practical charity, social economics may best be studied. In Chalmers on Charity, N. Mabtekman (1900), Methods of Social Reform, T. Mackat, and Some Aspects of the Social Problem, this point of view is generally assumed. For the history of charity there is no good single work. On details there are many good articles in Daremberg's Dictionary of Classical Antiquities, and in other similar works. Apart from books and official documents mentioned in the text as to the present state of charitable and public relief, or as aids to practical work, the following may be of service : — England : Annual Charities" Register and Digest, with Introduction on " How to help Cases of Distress" (1901); the Charity Organisation Review; and Reports of Pro- ceedings of Conferences ofPoor-Law Guardians; Occasional Papers (two vols.), published by the London Charity Organisation Society (1896 and 1900).*~~

~~*United States of America : The Proceedings of the International Conference on Charities and Correction (1894), and the proceedings of the annual conferences. — Friendly visiting among the Poor, by Mary E. Richmond (1899) ; American*~~

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~~*C H A R J U I — C HAELESTON*~~

~~*Charities, by Amos G. Waenbr (}&Qb). — Eandw‘6rteTbuch der Staatswissenschaften, Dr J. Conead, &c., vol. ii. supplement : Das Armenwesen in den Vereinigten Staaten von America, Dr Francis G. Peabody (1897). — The Charities Beview, published monthly by the New York Charity Organisation Society, The Papers and Reports of the Boston and Baltimore societies. France : La Bibliographie charitable, by Camille Geaniee (1891). — La Charite avant et depuis 1789, by P. Hubert Vallerodx. — Fascicules of the Conseil Supferieur de I’assistance publique. — Revue d” Assistance, published by the Socifitg Inter- nationale pour I’fitude des questions d’ assistance. Germany : Beports and Proceedings of the Deutsche Verein fur Armenpflege und Wohlthdtigheit ; Die Armenpflege, a practical handbook, by Dr E. MiJNSTERBERG, 1897. Austria : Oesterreichs Wohlfarts — Einrichtungen, 1848-98 ; Dr Ernest Mischlee, 1899. (c. s. L.)*~~

~~*Charjui, to-wn of Eussia, Transeaspian territory, 74 miles by rail S.W. of Bokhara, and 662 miles by rail from KrasnoTodsk. It is a great entrepSt for raw cotton. Tkere is a railway bridge across the Amu-Daria.*~~

~~*Charkhari, a native state of India, in the Bundel- khand agency. Area, 788 square miles ; population (1891), 143,108 ; average density, 183 persons per square mile ; estimated revenue, Es.5,00,000. The chief, whose title is maharaja, is a Eajput of the Bundela clan, de- scended from Chhatar Sal, the champion of the indepen- dence of Bundelkhand in the 18th century. The town of Chakkhaki is situated in 25° 44' N. lat. and 79° 47' E. long., about 40 miles W. of Banda.*~~

~~*Charleroi, a town of Belgium, in the province of Hainaut, 23 miles E. of Mons, on the Sambre, at an important junction of railways. In 1886 Socialist ex- cesses led to sanguinary encounters with the forces of order. The output of coal still continues on an extensive scale. Population (1880), 16,372 ; (1897), 23,480.*~~

~~*Charleroi, a borough of Washington county, Penn- sylvania, U.S.A., on the Monongahela river and a branch of the Peimsylvania railway. It is an iron manufactur- ing town of recent growth. Population (1900), 5930.*~~

~~*Charles (Kabl Eitel Zephtein Ludwig), King*~~

~~*of Kumania (1839), second son of Prince Karl Anton*~~

~~*of HohenzoUern, was born 20th April 1839. He was educated at Dresden, 1860-56, and passed through his university course at Bonn. Entering the Prussian army in 1869, he won considerable distinction in the Danish war of 1864, and was a captain in the 2nd regiment of Dragoon Guards when he was elected domn or lord of Rumania, 20th April 1866, after the compulsory abdica- tion of Prince Alexander John Couza. Regarded at first with distrust by Turkey, Russia, and Austria, he succeeded in gaining general recognition within six months ; but he had to contend for ten years with the fierce party struggles that raged between the Boyars and the Liberals until the latter were finally victorious in 1876. During this period, however, Charles displayed great tact in his dealings with both parties, and kept his country in the path of admin- istrative and economical reform, organizing the army, developing the railways, and establishing commercial relations with foreign powers. The sympathy of Rumania with Prance in the Eranco-Prussian war, and the conse- quent interruption of certain commercial undertakings, led to a hostile movement against Prince Charles, which, being fostered by Russia, made him resolve to abdicate, and it was with difficulty that he was persuaded to remain. In the Russo-Turkish war of 1877-78 he hurried to the help of the Russians before Plevna, and being placed in command of the combined Russian and Rumanian forces, he captured the enemy's camp and took Osman Pasha prisoner. As a consequence of the prince's vigorous action the independence of Rumania, which had been proclaimed in May 1877, was confirmed by*~~

~~*various treaties in 1878, and recognized by Great Britain, France, and Germany in*~~

~~*1880. On 26th March 1881 Prince Charles (Carol) was proclaimed king of Rumania, and was crowned with his consort on the 23rd May following. Erom that time he has pursued a successful career in home and foreign policy, and has raised the financial and military position of his country far beyond that of the other Balkan states, while his appreciation of the fine arts has been shown by the formation of an important collection of paintings of all schools in his palaces at Sinaia and Bucarest. HIs consort, the Queen Elizabeth (Pauline Elizabeth Ottilie Louise), widely known by her literary name " Carmen Sylva," was born 29th December 1843, being the daughter of Prince Hermann of, Neuwied. She first met the future king of Rumania at Berlin in 1861, and was married to him 15th November 1869. Early distinguished by her excel- lence as a pianist, organist, and singer, she also showed considerable ability in painting and illuminating ; but a lively poetic imagination ha^ led her to the path of litera- ture, and more especially to poetry, folklore, and ballads. In addition to numerous original works, she has put into literary form maxiy of the legends current among the Rumanian peasantry. In the Russo-Turkish war of 1877-78 she devoted herself to the care of the wounded, and founded the Order of Elizabeth (a gold cross on a blue ribbon) to reward distinguished service in such work. She fostered the higher education of women in Rumania, and established societies for various charitable objects. The following is the chronicle of her literary work, the books marked with an asterisk being written in collabora- tion with Erau Mite Kremnitz : — 1880, Sappho, Hammer- stein ; 1881, Stiirme, Bumdnische Dichtuiigen (translar tions) ; 1882, Leidens Erdengang, Jehovah, Ein Gebet, Pensies d'une Seine, Die Hexe, Aus Zwei Welten*; 1883, Das Leben meines Bruders, Aus Carmen Sylva' s Konigreidh (in two parts : I. Pelesch-Mdrchen ; II. Durdh die Jahr- hunderte) ; 1884, Handzeichnwigen, Mein Rhein, Meine Buh, Pelesch im Dienst ; 1886, Mein Buch ; 1886, Feld^ post, Astra,* Anna Boleyn* ; 1887, Es Klopft, In der Irre* ; 1888, Cuvinte Sufletesci, Rache,* Islandflscher (from the French of Pierre Loti) ; 1889, Lieder aus dem Dimbovitzathal (from the Rumanian of H. Vacftrescu); 1890, Frauenmuth, Deficit, Vom Amboss ; 1891, Handwer- kerlieder, Meerlieder, Heimath,*~~

~~*Weihnachtskerzchen ; 1892, Meister Manole, Bucarest (in Les Capitales du Monde).*~~

~~*As the only child of the marriage, a daughter, died in 1874, the succession was finally settled upon the king's nephew. Prince Ferdinand of Hohenzollern-Sigmaringen, who was created prince of Rumania, 18th March 1889, and who married, on 10th January 1893, Princess Marie, daughter of the late Duke Alfred of Saxe-Coburg. Their children are Prince Carol (b. 1893) and Princess Elizabeth (b. 1894).*~~

~~*Charleston, capital of Coles county, Illinois, U.S.A., at the intersection of the Cleveland, Cincinnati, Chicago, and St Louis, and the Toledo, St Louis, and Kansas City railways. Population (1890) , 4136 ; (1900) , 6488, of whom 139 were foreign-born and 45 negroes.*~~

~~*Charleston, the principal city and seaport of South Carolina, U.S.A., capital of Charleston county, situated on a peninsula between Ashley and Cooper rivers in 32° 46' N. lat. and 79° 66' W. long. It has three railways, the Atlantic Coast Line, the Plant System, and the South Carolina and Georgia, which bring to it the products of the interior — cotton, phosphates, and turpen- tine. The bar at the entrance to its deep and spacious harbour has been cut away by the use of jetties, so as to make entrance for vessels of 24-5 feet draught. In 1898 the export trade amounted to $11,440,130, and consisted mainly of cotton and phosphates. There are regular*~~

~~steamship lines to the great northera and southern sear ports. Charleston is thus a commercial rather than a manufacturing city, but its manufactures had in 1898 a capital of $7,345,000, employed 5500 persons, and the out- put was valued at $9,000,000. The College of Charleston, founded m 1785, had in 1898 a faculty of six professors and an attendance of 36 students. It had property val- ued at $372,000, and an income of $12,627. The city contains also the South Carolina MUitary Academy. The assessed valuation of real and personal property (the former being assessed on a basis of about 40 per cent, of the full value) was in 1900, $17,246,142, the net debt of the corporation was $3,798,200, and the municipal tax rate $29.50 per $1000. The death-rate in 1900 was 37-5 per 1000. In 1886 an earthquake destroyed a large part of the city, and many lives were lost, but the city has been rebuilt and fewtraces of the disaster remain. Population (1880), 49,984; (1890), 54,955; (1900), 55,807, of whom 2592 were foreign-born and 31,522 were negroes. Out of 14,167 males of voting age 2259 were illiterate (unable to write), of whom 2163 were negroes. The city has profited by the deepening of its harbour entrance, and also by the discov- ery of valuable beds of phosphates in the neighbourhood.~~

~~Charleston, a city of West Virginia, U.S.A., capi- tal of Kanawha county and of the state. It is situated near the centre of the state, in 38° 22' N. lat. and 81° 38' W. long., on the north bank of Kanawha river, at the mouth of Elk river, at an altitude of 600 feet. It has a level site on land lying above the river, and the plan is regular. Among its buildings is a fine new state capitol. It is on the main line of the Chesapeake and Ohio railway, and is entered by two smaller railways. It has large trafiic by rail and river, especially in the shipment of bituminous coal. This is mined from horizontal beds, which outcrop on the face of the river bluffs in the neighbourhood. Population (1880), 4192; (1890), 6742; (1900), 11,099.~~

~~Charlotte, capital of Mecklenburg county, North Carolina, U.S.A., situated in the south-western part of the state, on the Southern railway and on two branches of the Seaboard Air line. It is at an altitude of 725 feet, is siuTounded by a fertile farming district, and is a shipping-point for cotton and tobacco. Biddle University and Elizabeth College are situated in this~~

~~*place. Popu- lation (1880), 7094; (1890), 11,557; (1900), 18,091, of whom 287 were foreign-born and 7151 were negroes.*~~

~~*Charlottenburg, a town of Prussia, on the Spree, lying immediately to the west of Berlin, of which it practically forms the entire western suburb. Although retaining its own municipal government, it was in 1900, together with the adjacent suburban towns of Schoneberg and Eixdorf, included in the police district of the capital. Of new public buildings, the technical academy and the Kaiser Wilhelm memorial church are referred to in the article Berlin. There are also a new Catholic church and two high schools for music and art respectively. It was in the Schloss that the Emperor Frederick III. took over the reins of government in 1888, and resided for nearly the whole of his three months' reign. In the mausoleum in the castle grounds the Emperor William I. and the Empress Augusta lie interred in two white mar- ble sarcophagi — masterpieces of the sculptor Encke. In addition to the famous royal porcelain manufactory, which has of late been much enlarged, Charlottenburg has many fiourishiag industries, notably iron-works, grouped along the banks of the Spree. Its main streets are laid out on a spacious plan, while there are many quiet streets containing pietty villa residences. Population (1880),*~~

~~*30,483; (1890), 76,859 ; (1900), 189,290.*~~

~~*Charlottesville, a city of Virginia, U.S.A., situated a little north of the centre of the state, in the Piedmont region, on Eivanna river, at an altitude of 451 feet. Though within Albemarle county, and containing the court-house, it is independent of the county government. It is entered by the Chesapeake and Ohio and the South- ern railways. The University of Virginia, near Char- lottesville, had, in 1898, 24 professors and was attended by 489 students. Its property was valued at nearly $1,500,000, and its total income was $125,000. Popula- tion (1880), 2676 ; (1890), 5591 ; (1900), 6449.*~~

~~*Charlottetown, a city of Canada, the capital of Prince Edward Island, situated on Hillsborough river. It is well supplied with gas, electric light, and splendid water-works, and contains 8 churches, 3 banks, 3 daily and 6 weekly newspapers, and numerous factories. It exports large quantities of butter, cheese, potatoes, &c. The head ofSces and workshops of the Prince Edward Island railway are situated here. For the fiscal year 1900 the*~~

exports were $1,147,574 and the imports $435,032. Population, about 12,000.

CHARTERED COMPAJNTIES.

ACHAETEEED company is a trading corporation enjoying certain rights and privileges, and bound by certain obligations under a special charter granted to it by the sovereign authority of the State, such charter defining and limiting those rights, privileges, cfi^rerf and obligations, and the localities in which they com- are to be exercised. Such companies existed in

P’”’^^- early times, but have undergone changes and modifications in accordance with the developments which have taken place in the economic history of the states where they have existed. Eor the influence of the early trading companies on mediaeval industry and commerce the reader is referred to the articles Commekce, Shipping, and Hanseatic League, in the ninth edition of this work. In Great Britain the first trading charters were granted, not to English companies, which were then non-existent, but to branches of the Hanseatic League, and it was not till 1597 that England was finally relieved from the presence of a foreign chartered company. In that year Queen Elizabeth closed the steel-yard where Teutons had been established for 700 years.

The origin of all English trading companies is to be sought in the Merchants of the Staple. They lingered on into the 18th century, but only as a name, for their busi- ness was solely to export English products which, as English manufactures grew, were wanted at home. Of all early English chartered companies, the “Merchant Adventurers ” conducted its operations the most widely. Itself a development of very early trading guilds, at the height of its prosperity it employed as many as 50,000 persons in the Netherlands, and the enormous influence it was able to exercise undoubtedly saved Antwerp from the institution of the Inquisition within its walls in the time of Charles V. In the reign of Elizabeth British trade with the Netherlands reached in one year 12,000,000 ducats, and in that of James I. the company’s yearly com- merce with Germany and the Netherlands was as much as £1,000,000. Hamburg afterwards was its principal depot, and it became known as the ” Hamburg Company.” In the “Merchant Adventurers’” enterprises is to be seen the germ of the trading

companies which had so remarkable a development in the 16th and 17th centuries.

These old regulated trade guilds passed gradually into joint stock associations, whicli were capable of far greater extension, both as to the number of members and amount of stock, each member being only accountable for the amount of his own stock, and being able to transfer it at will to any other person.

It was in the age of Elizabeth and the early Stuarts that the chartered company, in the modern sense of the term, had its rise. The discovery of the New World, and the opening out of fresh trading routes to the Indies, gave an extraordinary impulse to shipping, commerce, and industrial enterprise throughout Western Europe. The English, French, and Dutch Governments were ready to assist trade by the granting of charters to trading associations. It is to the " Russia Company," which re- ceived its first charter in 1654, that Great Britain owed its first intercourse with an empire then almost unknown (see art. Russia, Ency. Brit. vol. xxi.). The first re- corded instance of a purely chartered company annexing territory is to be found in the action of this company in setting up a cross at Spitzbergen in 1613 with King James's arms upon it. Among other associations trading to the continent of Europe, receiving charters at this time, were the Turkey Company and the Eastland Com- pany. Both the Russia and Turkey Companies had an important effect upon British relations with tjiose em- pires. They maintained British influence in those coun- tries, and even paid the expenses of the embassies which were sent out by the English Government to their courts. The Russia Company carried on a large trade with Persia through Russian territory ; but from various causes their business gradually declined, though the Turkey Company existed in name until 1825.

The chartered companies which were formed during this period for trade with the Indies and the New World have had a more wide-reaching

~~*influence in history. The extraordinary career of the East India Company is told in Enqi. Brit. vol. xii. p. 798.*~~

~~*Charters were given to companies trading to Guinea, Morocco, Guiana, and the Canaries, but none of these enjoyed a very long or prosperous existence, principally owing to the difficulties caused by foreign competition. It is when we turn to North America that the importance of the chartered company, as a colonizing rather than a trading agency, is seen in its full development. The "Hudson Bay Company," which still exists as a com- mercial concern, is dealt with in detail in Ency. Brit. vol. xii. p. 333, but most of the thirteen British North American colonies were in their inception chartered com- panies very much in the modern acceptation of the term. The history of these companies will be found under the heading of the different colonies of which they were the origin. It is necessary, however, to bear in mind that two classes of charters are to be found in force among the early American colonies : (1) Those granted to trad- ing associations, which were often useful when the colony was first founded, but which formed a serious obstacle to its progress when the country had become settled and was looking forward to commercial expansion; the existence of these charters then often led to serious conflicts between the grantees of the charter and the colonists; ultimately elective assemblies everywhere superseded control by trading companies. (2) The sec- ond class of charters were those granted to the settlers themselves, to protect them against the oppressions of the Crown and the provincial governors. These were highly prized by the colonists.*~~

~~*In France and Holland, no less than in England, the institution of chartered companies became a settled prin- ciple of the Governments of those countries during the whole of the period in question. In France, from 1599*~~

~~*to 1789, more than 70 of such companies came into existence, but after 1770, when the great "Compagnie des Indes Orientales" went into liquidation, they were almost abandoned, and finally perished in the general sweeping away of privileges which followed on the. out- break of the Revolution.*~~

~~*If we inquire into the economic ideas which induced the granting of charters to these earlier companies and animated .their promoters, we shall*~~

~~*find that they were entirely consistent with the general p^nci^ies principles of government at the time and what ot the were then held to be sound commercial views. ^^^^^^^ Under the old regime everything was a matter ”””* of monopoly and privilege, and to this state of things the constitution of the old companies corresponded, the sovereign rights accorded to them being also quite in accordance with the views of the time. It would have been thought impossible then that private individuals could have found the funds or maintained the magnitude of such enterprises. It was only this necessity which induced statesmen like Colbert to countenance them, and Montesquieu took the same view (Esprit des Lois, t. XX. c. 10). John de Witt's view was that such com- panies were not useful for colonization properly so called, because they want qiiick returns to pay their dividends. So, even in France and Holland, opinion was by no means settled as to their utility. In England historic protests were made against such monopolies, but the chartered companies were less exclusive in England than in either France or Holland, the governors of prov- inces almost always allowing strangers to trade on re- ceiving some pecuniary inducement. French commercial companies were more privileged, exclusive, and artificial than those in Holland and England. Those of Holland may be said to have been national enterprises. French companies rested more than did their rivals on false principles ; they were more fettered by the royal power, and had less initiative of their own, and therefore had less chance of surviving. As an example of the kind of rules which prevented the growth of the French com- panies, it may be pointed out that no Protestants were allowed to take part in them. State subventions, rather than commerce or colonization, were often their object ; but that has been a characteristic of French colonial enterprise at all times.~~

~~*Such companies, however, under the old commercial system could hardly have come into existence without exclusive privileges. Their existence might have been prolonged had the whole people in time been allowed the chance of participating in them.*~~

~~*To sum up the causes of failure of the old chartered companies, they are to be attributed to (1) bad adminis- tration ; (2) want of capital and credit ; (3) bad economic organization ; (4) distribution of dividends made prema- turely or fictitiously. But those survived the longest which extended the most*~~

widely their privileges to out- siders. According to contemporary protests, they had a most injurious effect on the commerce of the countries where they had their rise. They were monopolies, and therefore, of course, obnoxious ; and it is undoubted that the colonies they founded only became prosperous when they had escaped from their yoke.

On the other hand, it must not be forgotten that they contributed in no small degree to the commercial progress of their own states. They gave colonies to the mother country, and an impulse to the development of its fleet. In the case of England and Holland, the enterprise of the companies saved them from suffering from the monopolies of Spain and Portugal, and the wars of the English, and those of the Dutch in the Indies with Spain and Portugal, were paid for by the companies. They furnished the

mother country with luxiiries which, by the 18th century, had become necessaries. They offered a career for the younger sons of good families, and sometimes greatly assisted large and useful enterprises.

*During the last twenty years of the 19th century there was a great revival of the system of chartered com- Chartered P^^nies in Great Britain. It is a feature of the companies general growth of interest in colonial expansion tim'es"^" ^^^ commercial development which has made "***• itself felt almost universally among European*

nations. _ Great Britain, however, alone has succeeded in establishing such companies as have materially con- tributed to the growth of her empire. These com- panies succeed or fail for reasons different from those which affected the chartered companies of former days, though there are points in common. Apart from causes inherent in the particular case of each company, which necessitates their being examined separately, recent ex- perience leads us to lay down certain general principles regarding them. The modern companies are not like those of the 16th and 17th centuries. They are not privileged in the sense that those companies were. They are not monopolists ; they have only a limited sovereignty, always being subject

~~*to the control of the home Govern- ment. It is true that they have certain advantages given them, for without these advantages no capital would risk itself in the lands where they carry on their operations. They often have very heavy corresponding obligations, as will be seen in the case of one (the East Africa) where the obligations were too onerous for the company to discharge, though they were inseparable from its position. The charters of modern companies differ in two points strongly from those of the old : they contain clauses prohibiting any monopoly of trade, and they generally confer some special political rights directly under the control of the secretary of state. The political freedom of the old companies was much greater. In these charters State control has been made a distinguish- ing feature. It is to be exercised in almost all directions in which the companies may come into contact with' matters political. Of course, it is inevitable in all dis- putes of the companies with foreign Powers, and is extended over all decrees of the company regarding the administration of its territories, the taxation of natives, land mining regulations. In all cases of dispute between the companies and the natives the secretary of state is ex officio the judge, and to the secretary of state (in the case of the South Africa Company) the accounts of administration have to be submitted for his approba^ tion. It is deserving of notice that the British character of the company is insisted upon in each case in the charter which calls it into life. The Crown always retains complete control over the company by reserving to itself the power of revoking the charter in case of the neglect of its stipulations. There are special clauses in the charters of the British East Africa and South Africa Companies enabling the Government to forfeit their charters if they do not promote the objects alleged as reasons for demanding a charter. This binds them still more strongly, and in the case of the South Africa Company the duration of the charter is fixed at twenty-five years. The chartered company of these days is therefore very strongly fixed within limits imposed by law on its political*~~

~~*action. As a whole, however, very remarkable Results results have been achieved. This may be attri- anrf iimita- j^^^g^ i^ .qq small degree to the personality of*~~

~~*the men who have had the supreme direction at home and abroad, and who have, by their social posi- tion and personal qualities, acquired the*~~

~~*confidence of the public. With the exception of the Eoyal Niger Company, it would be incorrect to say that they have*~~

~~*been financially successful, but in the domain of govern- ment and colonization they have achieved remarkable results. This may be seen more clearly by considering each case by itself, but generally it may be said that they have added vast territories to the British empire (in Africa about 1,700,000 square miles), and in these territories they have acted as a civilizing force. They have made roads, opened facilities for trade, enforced peace, and laid at all events the foundation of settled administration. It is not too much to say that they have often acted unselfishly for the benefit of the mother-country and even humanity. We may instance the anti- slavery and anti-alcohol campaigns which have been carried on, the latter certainly being against the immedi- ate pecuniary interests of the companies themselves. It must, of course, be recognized that to a certain extent this has been done under the influence of the home Government. The occupation of Uganda certainly, and of the Upper Niger territory and Rhodesia probably, wiU prove to have been rather for the benefit of posterity than of the companies which efifected it. In the two cases where the companies have been bought out by the State, they have had no compensation for much that they have expended. In fact, it would have been impos- sible to take into account actual expenditure day by day, and the cost of wars. To use the expression of Sir William Mackinnon, the shareholders have been com- pelled in some cases to " take out their dividends in philanthropy."*~~

~~*The existence of such companies to-day is justified in certain political and economic conditions only. It may be highly desirable for the Government to occupy certain territories, but political exigencies at home will not permit it to incur the expenditure, or international relations may make such an undertaking inexpedient at the time. In such a case the formation of a chartered company maybe the best way out of the difficulty. But it has been demon- strated again and again that, directly the company's in- terests begin to clash with those of foreign Powers, the home Government must assume a protectorate over its territories in order to simplify the situation and save perhaps disastrous collisions. So long as the political relations of such a company are with savages or semi- savages, it may be left free to act, but directly it becomes involved with a civilized Power the State has (if*~~

~~*it wishes to retain the territory) to acquire by purchase the political rights of the company, and it is obviously much easier to induce a popular assembly to grant money for the purpose of maintaining rights already existing than to acquire new ones. With the strict system of Government supervision enforced by the modern charters it is not easy for the State to be involved against its will in foreign complications. Economically such companies are also justifiable up to a certain point. When there is no other means of entering into commercial relations with remote and savage races save by enterprise of such magnitude that private indi- viduals could not incur the risk involved, then a company may be well entrusted with special privileges for the pur- pose, as an inventor is accorded a certain protection by law by means of a patent which enables him to bring out his invention at a profit if there is anything in it. But such privileges should not be continued longer than is necessary for the purpose of reasonably recompensing the adventurers. A successful company, even when it has lost monopoly or privileges, has, by its command of capital and general resources, established so strong a position that private individuals or new companies can rarely compete with it successfully. This is clearly shown in the case of the Hudson Bay Company as at present constituted, and it will probably be so in the case of the Niger and North Borneo Companies. In colonizing new lands these*~~

~~*companies often act successfully. .They have proved more potent than the direct action of governments. This may be seen in Africa, where France and England have of late acquired vast areas, but have developed them with very different results, acting from the opposite principles of private and State promotion of colonization. Apart from national characteristics, the individual has far more to gain under the British system of private enterprize. A strong point in favour of some of the British companies has been that their undertakings have. been practically extensions of existing British colonies rather than entirely isolated ventures. But a chartered company can never be anything but a transition stage of colonization ; sooner or later the State must take the lead. A company may act beneficially*~~

so long as a country is undeveloped, but as soon as it becomes even semi-civilized its conflicts with private interests become so frequent and serious that its authority has to make way for that of the central Government.

The companies which have been formed in Prance dur- ing recent years do not yet afford material for profitable study, for they have been subject to so much vexatious in- terference from home owing to lack of a fixed system of control sanctioned by Government, that they have not been able, like the British, to develop along their own lines.

In the sketch which follows of certain chartered com- panies which have existed since 1880, or still exist, the application of the principles stated above may be seen.

The Bkitish South Africa Company.

At the time when this company received its charter of incorporation, October 1889, South Africa was inhabited by three races exclusive of native tribes — the soaib British, the Portuguese, and the Dutch. The ini^g. first named held roughly the south, the Portu guese retained little more than the eastern coast-line from Beira to Delagoa Bay, while more in the centre lay the Dutch republics of the Transvaal and Orange Free State. Germany had shortly before estab- lished herself on the west. Meanwhile in the central portion of the country north of the Transvaal and Bechuanaland lay the extensive territories of various native tribes, among whom the Mashonas and the warlike Matabele occiipied the richest and largest areas. These tribes were under the sway of one powerful chief, Lo- Bengula, whose royal kraal was situated at Bulawayo. The portion of these territories known as Matabeleland had before 1889 only been traversed by explorers such as Kirk, Baines, and Livingstone, but the reports they had brought back of its fertility, and especially its mineral wealth, had excited the cupidity and enterprise of white people, and the prompt action of Mr Cecil Rhodes and others alone saved them for the British flag. Mr Ehodes, after consolidating the conflicting interests of different owners into the great diamond-mining company of De Beers, had devoted his energies to the development of South Africa, and had become the life and soul of its financial enterprises. His was the guiding hand which directed British adventure into these vast fields of prom- ise. Before 1888 Lo-Bengula had had frequent relations with

~~foreign "prospectors." Among them two English- men, Mr Baines in 1871 and Sir John Swinburne in 1872, had obtained concessions of mineral rights, but little effort had been made to put them in force. Now the neighbouring nations began to move, but in 1888 the British Government, at the instance of Sir Sidney Shippard, K.C.M.G., then administrator of British Bechu- analand, took steps which for ever excluded other nation- alities from acquiring control over the country. On the 11th February of that year Lo-Bengula signed a treaty of peace and amity with Great Britain, under which he agreed that he would refrain from entering into any cor-~~

~~respondence or treaty with any foreign State or Power without the previous knowledge and sanction of H.B.M.'s high commissioner for South Africa. Shortly after the conclusion of this treaty, representatives of influential syndicates directed by Mr Ehodes were sent, with the knowledge of the British Government and the high commissioner, to negotiate with Lo-Ben- Origin gula, and on the 30th October of the same year "connuaty. he concluded an arrangement with Messrs Rudd, Eochfort Maguire, and Thompson, by which, in return for the payment of £100 a month made to him by the syndicate, together with 1000 Martini-Henry rifles and 100,000 rounds of ammunition, he gave the syndicate complete control over all the metals and minerals in his kingdom, with power to exclude from his dominions " all persons seeking land, metals, minerals, or mining rights therein," in which action, if necessary, he promised to render them assistance. This concession once obtained, Mr Ehodes proceeded with rapidity to prosecute his great enterprise. He extinguished the interests of earlier con- cessionaires by purchase (giving, for instance, £10,046 for the Baines and Swinburne interests), and then formed "The Central Search Association," with a capital of £121,000. Of this total, £92,000 was represented by shares of £1, which were distributed to the shareholders in payment of rights they had surrendered or advances made, while the rest, to the number of 29,000 shares, was subscribed in ready money to be employed in preparing the ground for future operations. This pioneer company soon merged in "The United Concessions Company." The latter undertook to explore and develop, the former bought its concessions, and they were to share equally the profits. Before long these companies became the " British South Africa Company," commonly known as the "Chartered Company."~~

~~*On 30th April 1889 Lord Gifford addressed to the British Government, on behalf of the founders, an outline of a scheme for the formation of a company to develop the Bechuanaland Protectorate and th^ territories lying to the north. It may be stated that Bechuanaland is native territory lying north of Cape Colony, between it and what was then Lo-Bengula's land, and west of the Transvaal. Bechuanaland had been occupied by England a few years previously and divided into two parts — ^the south a Crown colony and the north a protectorate only. The Govern- ment, having ascertained the substantial nature of the company's resources and the composition of the proposed directorate, and also that they were prepaied to begin immediately the development of the country, granted the charter which bears date 29th October 1889.*~~

~~*The Charter. — A few points in the charter itself deserve to be noted. In the first place, it gives a considerable extension to the terms of the original concessions by Lo-Bengula. In short, it trans- forms the rights of working minerals and metals, and preventing others from doing so, into rights practically sovereign over the regions in which the company's activity is to be employed. These rights the Crown grants directly itself , not merely confirming a pre- vious grant from another source. In this it differs from charters granted to other companies. By Article X. the company was em- powered to " make ordinances (to be approved by our secretary of state), and may establish and maintain a force of police." A strict supervision is provided for, to be exercised by the secretary of state over the relations between the company and the natives. It is worth noting that in clausel (where the sphere of the company's operations is defined) its limits are very clearly laid down on all sides but the north, where it was left by implication entirely free. The British Government reserved to itself entire power to repeal the charter at any time that it did not consider the company was fulfilling its obligations or endeavouring duly to carry out the objects for which the charter was granted. The share capital of the company was fixed at £1,000,000 in shares of £1 each. The original directors were the duke of Abercorn, the duke of Fife Lord Gifford, Mr (afterwards Earl) Grey, MrCawston, Mr Rhodes' and Mr A. Beit. '*~~

~~*CHARTERED COMPANIES*~~

~~The company at the commencement of its operations had to deal with a country absolutely untouched by the~~

~~hand of civilization. The size of the territory ofdeZop. ^^^ 500,000 square miles at least, as large as ment. France and Germany combined, ruled over by~~

~~Lo-Bengula, whose power was supported by hordes of savage warriors. The only possessions of the natives were enormous herds of cattle ; there was no cultivation of the soil or attempt to work its mineral riches. Of course there was at every step a grave danger of incurring the hostility of the natives. The first move of the company was to extend northwards the railway and the telegraph. In 1889 the former only went as far as Kimberley and the latter to Mafeking. The Cape Government agreed to make the railway to Vryburg, and the company was to continue it. A police force of 260 men under experienced officers was enrolled. In order to open up the new territories it was necessary to set on foot a pioneer expedition. This was done by an arrange- ment between the company and Mr Frank Johnson, who undertook to fit out and conduct the expedition on cer- tain terms which included grants of reef claims and farms to each pioneer. Among the pioneers was Mr F. C. Selous, the well-known explorer. After the pioneer force had been duly inspected by General Lord Methuen, its advance was authorized by the high commissioner, and it set out in June 1890, accompanied by a force of police, the whole expedition being under the command of Lt.Col. Pennefather. Its results were striking. It constructed a road 400 miles long, known as the " Selous Eoad " ; it bridged streams ; it established fortified stations at Tuli, Victoria, Charter, and Salisbury; it brought peace and security to Mashonaland, which had formerly been a prey to its more warlike neighbours — and all this without losing a rifle or firing a shot. Mashonaland was taken in hand by Mr A. R. Colquhoun, and its administration organized; but his health gave way, and he was succeeded by Dr Jameson. During the first two years of its occupation the white population of that country reached 3000. In 1891 the company suc cessfully interfered to prevent a large Boer trek into the south-east portion of Matabeleland and the occupation by them of that territory by force.~~

~~*About this time there were serious threats that Germany would attempt to stretch her hinterland boundary across Lake Nyasa to the Congo State, but this was averted by the establish- ment of Forts Fife and Abercorn at the southern end of Lake Tanganyika and midway between the two lakes. The company also agreed to buy up a company called « The African Lakes Company," which had unsuccessfully endeavoured to open up the districts north of the Zambezi. This was a Scottish company founded in 1878 to protect the mission stations and to trade between the lakes of Mweru, Tanganyika, and Nyasa, but its capital had been expended in strife with the slave-traders. The shareholders in the " African Lakes Company " exchanged their shares for shares in the South Africa Company, and the latter in return acquired aU their rights. By 1893 the absorp- tion of that company in the South Africa Company was complete. In the early part of 1891 the British Govern- ment extended the field of the company's operations so as to include the whole of the British sphere immediately north of the Zambezi, except Nyasaland, towards the ex- pense of the administration of which district the company was contributing at this time £10,000 a year. The im- perial commissioner for Nyasaland was allowed to act also as administrator of the company's sphere north of the Zambezi, and in 1894 the Government took over all liabilities connected with this Nyasaland territory.*~~

~~*The company took early steps to open up its territory by the construction of railways and telegraphs. As has*~~

~~*been stated, the railway running north from Cape Town went no farther than Kimberley when the company began its operations, but in November 1889 the extension was taken in hand, and by December 1890 the section to Vryburg was open, about 120 mUes ; and at the same time the telegraph was carried on to Mafeking ; by the end of 1892 the telegraph had reached Victoria. Mean- while prospects of mining development had brought into the country a large number of settlers, who had marked out claims.*~~

~~*During the first three years the opening up of Mashona- land proceeded apace. Salisbury, Umtali, and Victoria began to grow into towns, and building plots fetched at the lowest £35. The company also entered upon a regular system of agricultural development, and by the end of 1892 as many*~~

~~*as 600 concessions of farms had been made, and the number of immigrants in 1892 reached 1121. Administration had also been satisfactorily and rapidly organized. Dr Jameson reduced the standing police force to 40, and set on foot a volunteer corps which soon had 500 members. The Transvaal burgher system was also adopted, which allows the Government to demand on necessity the services of every able-bodied citizen, supply- ing him at the same time with rifle and ammunition. A regular postal service was established. Under Mr Selous the road system was completed, and the headquarters of the administrator were fixed at Salisbury.*~~

~~*Though Mashonaland was being civilized, Matabeleland was still the home of Lo-Bengula and his savage warriors. Their continued raids into the company's territories led to war, which broke .out in July 1893 and lasted till the end of the year. This war cost the company 100 men and £110,000. Lo-Bengula died, and his lands passed under the sway of the company. Charges were made against the latter of having provoked the natives in order to bring on this war, but after inquiry they were expressly exonerated from the charge by Lord Ripon, then colonial secretary. The conditions under which Matabeleland was handed over to the company were set out in the "Matabeleland Order in Council" of 18th July 1894. The administrator was given a council of four to assist him. Local taxes and customs dues were to be fixed by the company with the approbation of the secretary of state. A high court and a laud commission were estab- lished. Magistracies were established, and resident magistrates and civil commissioners appointed at Salis- bury, Umtali, Victoria, and Tuli, with functions similar to those exercised by like officials in Cape Colony, the law administered being the Roman-Dutch law of that colony.*~~

~~*During 1894 and 1896 the company continued the development, of its territory, now increased to 750,000 square miles. It stretched uninterruptedly to the southern end of Lake Tanganyika in the north, i.e., roughly to the 8th degree of latitude. This increase of territory led at first to a great increase of expenditure, and the original capital of £1,000,000 was raised to £2,000,000 by a resolution passed at an extraordinary meeting of the shareholders held in November 1893; and this was increased by another £500,000 in July 1895, and by further issues in 1896 and 1898.*~~

By a proclamation of 3rd May 1895 the company's territory received officially the name of " Rhodesia," and was divided into three provinces, Mashonaland, Matabele- land, and Northern Zambezia. The two provinces com- prising Southern Rhodesia were subdivided into districts. The districts, for convenience of administration, were grouped into fiscal and mining divisions, and the civil magistrates and mining commissioners were reappointed to the new divisions. A native commissioner was, as hereto- fore, appointed to each district, the whole being under the

control of the chief native commissioners at Salisbury and Bulawayo respectively. The system of land appor- tionment adopted in Mashonaland was followed in the new territory. "Stands" or plots were sold at extra^ ordinary prices in Bulawayo; 639 fetched a total of £163,312, about £285 a stand. In within nine months Bulawayo had a population of 1900 whites, and in the various goldfields over 2000 prospectors. The construc- tion of telegraphs proceeded with great rapidity, and by the end of 1895, 500 miles of new lines had been con- structed, making about 1500 in all. A new company, the " African Transcontinental Company," had been founded under the auspices of Mr Ehodes, with the ultimate purpose of connecting the Cape with Cairo. By the end of 1895, 313 mUes of these lines had been laid.

The events of 1896 brought a rude change on this smiling prospect. In that disastrous year occurred the Jameson Eaid, the Mashona and Matabele revolt, and the outbreak of rinderpest, which killed nearly all the beasts of burden in the country. The rebellions were finally pat down in the early part of 1897, but when the cost to the company of these misfortunes came to be reckoned up it was found to amount to at least £2,500,000 sterling. All this involved the company in a heavy debt, and in April 1898 it was resolved, at a general meeting of share- holders, to increase the capital by £1,500,000 sterling, only one-sixth of which was issued in shares at once. At the same meeting it was enthusiastically resolved to pro- ceed again with the work of the company. In conse- quence of the events of 1896 the British Government imposed a new or supplemental charter on the company, This charter gave

~~*the Government a much stronger hold on the whole administration of the company than it pos- sessed before. By this charter the power of the company to make ordinances was to pass to a legislative council to be established for Southern Rhodesia. Duly authorized agents of the secretary of state were to have access to all the company's documents. All resolutions passed by the directors regarding the administration were to, be sub- mitted to the secretary of state within eight days for his approval or rejection, and any neglect to comply with these conditions was to subject the company's servant guilty of the same to the possibility of instant dismissal. Still the opening of the railway to Bulawayo in Novem- ber 1897 seemed to promise a new era of development, and it greatly reduced the cost of transport. The popu- lation began to increase rapidly, and by 1898 Bulawayo had more than 5000 inhabitants The value of the public buildings was estimated at £140,000. There were 1664 miles of telegraphs and nearly 850 miles of roads brought into existence through the energy of the company. By the last balance-sheet issued by the com- pany previous to the outbreak of the Boer war it would appear that the revenue of Rhodesia for the year ending 31st March 1898 amounted to £260,616 net, of which amount the sale of land plots accounts for £63,628 ; stamps and licenses, £69,658 ; and posts and telegraphs, £46,745, so that the machinery of civilized life was already in full activity where Lo-Bengula's kraal had stood in 1894. The Government buildings were esti- mated in March 1898 to be worth £165,672, and the assessed value of the town property at Bulawayo was £2,045,000, and that at Salisbury £750,000. Education was arranged under the supervision of Government in- spectors, and various religious communities have now brought their own organizations to a high state of efft- ciency. In the years 1897-98, 2485 miles of road were being maintained by the company at a cost of £23,600. A police force of 1322 men maintained order in the two provinces, and the hut tax paid by the natives throughout the territory amounted to over £19,000. At this time the*~~

~~*relations between the natives and the company's servants appear to have been most satisfactory, an inference which is borne out by the peaceable attitude of the former during the Boer war. In 1896 it was found necessary to appoint a puisne judge to preside over the high court at Bulawayo. So far back as 1891 a system of municipal as distinguished from military police had been inaugu- rated, and, following the precedent of Cape Colony,*~~

~~*sanitary boards were formed to regulate the municipal affairs of the several townships. At the public request, and in order that the ratepayers should enjoy a fuller measure of control, regulations for the constitution of municipalities were framed by the administration and promulgated in September 1897. Under the provisions thus enacted, the sanitary boards of Salisbury and Bula- wayo gave place to duly constituted municipal councils, and the first mayors were elected for the two towns in that year.*~~

~~*On the 26th November 1898 the Southern Rhodesia Order in Council became law. Southern Rhodesia was divided into two provinces, Mashonaland and Matabele- land, with separate administrators. The order further provided for a high court of Southern Rhodesia and for the constitution of executive and legislative councils, and made other changes in the administrative organization.*~~

~~*North- Western Rhodesia is also known as Barotseland. The principal native chief is King Lewanika, and the representative of the company resides at his court. He is favourably disposed to white men. There is a force of thirty white police quartered in the Batoka plateau, besides a force of native police. This latter is necessary, for much of this country is almost uninhabitable by whites in the rainy season. A new mail service has been arranged. Runners leave Francistown weekly for Kazun- gala, returning with outgoing mails. The delimitation of the boundary is not yet completed between Barotseland and the Portuguese territory.*~~

~~*North-Eastern Rhodesia is divided into districts in charge of collectors and subdistricts in charge of assist- ant collectors. There are four districts, and through them run 700 or 800 miles of road constructed by the col- lectors. Defence is conducted under an arrangement with the British Central Africa Protectorate. The civil police number about 200. The revenue for the year ending 31st March 1899 amounted to £2275, 18s. 3d., of which about £1000 is claimed as owing from sales of ivory given as tribute, and about £665 came from postal charges. As there are no import or export duties except on ivory, no complete record of imports and exports is possible. The area of this province is estimated at 120,000 square miles, the whole of which (with the excep- tion of a small portion of the valley of the Loangwa river) lies over 3000 feet above the sea.*~~

~~*By the beginning of 1899 the company appeared to be starting on a new career after the unfortunate reverses it had sustained in 1896, but a stop was put to all progress by the Boer war. The company can point with satisfac- tion to the fact that Rhodesia contributed nearly 1500 men to the forces serving in the war, or 12^ per cent, of the European population. Of these British South Africa police supplied 300 ; Mashonaland volunteers, 800 ; Ma- shonaland squadron, 160; independent volunteers esti- mated at 250. Rhodesia itself was not subjected to invasion, but the withdrawal of so large a number of able-bodied men seriously interfered with the progress of the country.*~~

~~*It must be remembered that the company possesses vast territories north of the Zambezi already in great part explored, and it is believed that the future will show them to be rich in mineral wealth and containing immense resources for agricultural and commercial development.*~~

~~*This country has been traversed by several travellers, among them Major St Hill Gibbons and Colonel Goold Adams. Traders, prospectors, and the company's officials pass through it, but generally leave no printed records. It is now divided into two provinces, North-Eastern and North-Western Rhodesia, each having its own adminis- trator, and regulated by Orders in Council of 1899 and July 1900.*~~

~~*BaUways.—Th.e railway from Mafeking to Bulawayo, completed in 1897, shows a steady increase in revenue. The net earnings had risen from £11,877 in the year ending 31st October 1895 to £99,290 in the year ending 31st October 1898. The Mashonaland railway from Umtali to Salisbury, begun in October 1897, reached Salisbury on 1st May 1899. The share interests of these railways were amalgamated under the "Rhodesia Railways Trust," Limited, with a capital of £1,000,000. To sum up the work accomplished in this direction, the British South Africa Company first built the railway from Kimberley to Vryburg (a distance of 127 miles), which was soon afterwards purchased by the Cape Government. The company then continued the line to Bulawayo, a distance of 590 miles. It also obtained the*~~

~~capital and built the railway from Beira on the east coast through Portuguese territory to Umtali, a distance of 210 miles. This line was afterwards continued to Salisbury, a distance of 170 miles. The British South .A.frica Company has therefore built, or Ras caused to be built, 717 miles of railway from the south to Bulawayo, and 380 miles from Beira to Salisbury, giving a total of 1097 mijes of com- pleted railways. Contracts have been entered into for a further 300 miles of railway which will connect Bulawayo with Salisbury, and Bulawayo with Gwanda, 93 miles. This work is in active progress. A survey has also been made 250 miles northwards from Bulawayo through the Wankie coalfields to Victoria Falls.~~

~~Beira and Mashonaland Eailways.~~

~~717 miles~~

~~Beira to Salisbury ....~~

~~380 miles~~

~~Bhodesia Bailways. Kimberley to Vryburg Vryburg to Bulawayo~~

~~127 „ 590 „~~

~~Total mileage completed .~~

~~1097 „~~

~~In Course of Construction. Bulawayo to Salisbury Bulawayo to Wankie Bulawayo to Gwanda~~

~~300 miles 200 „ 93 „~~

~~Total mileage in hand . . 593 ,, Telegraphs.— The telegraph system now under the company's control is as follows : —~~

~~Bhodesian System on 31st March 1900. Railway 1755 miles of line~~

~~Police telephone lines~~

~~3309 471~~

~~471~~

~~wire line wire~~

~~African Transcontinental Telegraph Line. Mileage of line .... 1225 miles MUeage of wire .... 1225 ,,~~

~~Total Mileage of Line and Wire under the Control of the Bhodesian Postal Department.~~

~~Mileage.~~

~~Line. Wire.~~

~~Rhodesian lines proper .... 1755 3309~~

~~Police telephone lines . . • • , II ,,,Ii~~

~~I African Transcontinental Company's lines. 1225 1225~~

~~3451 5005~~

~~Mines —With regard to mines, numerous concessions to pro- snectors" have been granted by the company, and some extensive finds of precious metal have been made. Extensive pegging has been done by prospectors under licenses issued by the com- Tianv and also by subsidiary companies and individuals who have acauired erants. The results of development operations here given and conducted, in spite of adverse conditions prevailing in~~

~~consequence of the war of 1893, the rinderpest, the native rising in 1896 and 1897, and later the Boer war, should be studied in order to gauge the probable future of Rhodesia as a gold- producing country. There are sixteen gold-mining companies actually milling, with a total crushing power of 269 stamps, while a further 240 stamps have been ordered by other companies whose properties are approaching the producing stage. Two mines have already erected cyanide plant for the treatment of tailings, and further plant~~

~~*has been ordered for ten other mines. The total output of gold from Rhodesia from the occupation of the country to the 31st August 1898 was 6532 oz. ; from that date to the 31st December 1899 the output was 72,940 oz. ; while for the year ended 31st December 1900 the Rhodesian output reached 85,534 oz., giving a total output to that date of 165,006 oz. In Northern Rhodesia valuable deposits of copper are being opened up, and in Southern Rhodesia coal of excellent quality has been proved to exist in enormous quantities in the Wankie district, a short distance south of the Victoria Falls.*~~

~~*Whatever the judgment of history may be as to the career of the company as a whole, it must be admitted that it has performed a great work as a civilizing agency, and that this has been done entirely at the expense of the shareholders without their coming upon the Government for a single shilling. At present the investors have reaped no pecuniary advantage from their enterprise, for, except in 1896-96, the expenses of administration have exceeded every year the income from revenue, as a glance at the following table will show : —*~~

~~^*BTdnue.*~~

~~*Expenditure £91,189*~~

~~*1892-93*~~

~~*. £34,153*~~

~~*1893-94*~~

~~*44,489*~~

~~*183,9791*~~

~~*1894-95*~~

~~*. 118,883*~~

~~*153,60'*~~

~~*1895-96*~~

~~*. 399,090*~~

~~*227,626*~~

~~*1896-97*~~

~~*. 122,542*~~

~~*2,512,5293*~~

~~*1897-98*~~

~~*. 258,179*~~

~~*1,122,3342*~~

~~*1898-99*~~

~~*. 275,609*~~

~~*1,049,635»*~~

~~*Capital. — The following are the complete statistics of the com- pany's capital : —*~~

~~*Date of Meeting.*~~

~~*Authorized.*~~

~~*Issued.*~~

~~*THb. Nos. of Shares.*~~

~~*Original issue*~~

~~*£1,000,000*~~

~~*£1,000,000*~~

~~*1/1,000,000*~~

~~*20.11.93, and)*~~

~~*19.12.93, purchase V*~~

~~*2,000,000*~~

~~*1,000,000*~~

~~*1,000,001*~~

~~*of R. R. concession J*~~

~~*(f-p.)*~~

~~*500,000(3/, 10/-)*~~

~~*2,000,000*~~

~~*12.7.95*~~

~~*2,500,000*~~

~~*2,000,000*~~

~~*2,500,000*~~

~~*6.11.96*~~

~~*3,500,000*~~

~~*500,000 (2/-)*~~

~~*2,500,001*~~

~~*Nov. '96*~~

~~*3,000,000*~~

~~*Jan. '97*~~

~~*500,000 (2/-)*~~

~~*3,000,001 3,500,000*~~

~~*21.4.98*~~

~~*5,000,000*~~

~~*May '98*~~

~~*2-50,000 (2/-)*~~

~~*3,500,001 3,750,000*~~

~~*Jan. '99*~~

~~*625,000(2/, 10/-)*~~

~~*3,750,001 4,375,000*~~

~~*Leaving unissued £625,000, Nos. 4,375,001/5,000,000, at January*~~

~~*1901.*~~

~~*Debentures and debenture stock bearing 6 per cent, interest for £750,000 were paid off in February 1896, but in July 1896 there was an issue of £1,250,000 debentures, bearing interest at the rate of 5 per cent.*~~

~~*On the unissued balance of £625,000 the company gave the subscribers to £3,125,000 debentures of Rhodesia Railways, Limited, an option to exchange their debentures for these shares at £5 per share of £1 each, on or before the 15th May 1901, or, as an alternative, an option, on or before that date, to apply for an allotment of an equivalent number of shares at £5 per share of £1 each, paying cash, and retaining their debentures. As has been pointed out before, this expenditure does not include the cost of the Jameson Raid (which was not borne by the company), and the expenses of*~~

suppressing the native rebellions in 1896-97, which came in all to £2,266,976.

Into the general question of the value of such acquisitions of territory as have been made by the British South Africa Company it is not our function to inquire here, but the history of this corporation demonstrates very forcibly the

T

1 Including war. " Including rebeUion.

8 Includes £241,460 expended on stores.

dangers and advantages of development by chartered com- panies. Lack of control over its officers, and irritation excited among other nationalities, have led undoubtedly to serious complications ; on the other hand, its adminis- tration is now under strict supervision by Government, and the territories occupied by the company could hardly have been British unless through the agency of a char- tered company. Had not the territory of Rhodesia been in British hands in 1889, Germany, the Transvaal, and possibly Portugal would almost certainly have asserted claims. The action of Government is slow, and is ham- pered by public opinion, which it takes time to inform fully in such matters. Even had the British Govern- ment occupied the territory, it is more than doubtful if ten years could have seen the development which has taken place under the administration of the chartered company. No one can doubt that the native popidation is infinitely better off under the company's administration than in the days of raid and massacre under Lo-Bengula.

The Eoyal Niger Company.

~~The charter of the Eoyal Niger Company was granted on 10th July 1886, but its real origin was earlier. Since trade began between Europeans and the native orjgia and races inhabitiug the coast round the mouths of action. ° tlie Niger and its hinterland, it had been practi- cally monopolized by the British. The Niger itself had been discovered by British travellers. Mungo Park traced its course from its source to Bussa, and from Bussa to the sea. It was a Scotsman, Laird, who first organized, in 1882, the navigation from the sea to a point above the confluence of the river with the Benue. Within the next twenty-five years expeditions were despatched into the ulterior, and a consul was posted at Lokoja ; but the deadly climate discouraged Government efforts, and the consulate was abandoned in 1866. Thus no effective attempt was made to connect these rich regions of the interior with British possessions on the coast. With regard to the delta of the river there is much the same story to tell. By the end of the 18th century British enterprise had almost entirely displaced the Portuguese, who had traded principally in slaves. The coast-line of the Niger delta may be said roughly to extend from Lagos to the mouth of the river Kwo-ibo, 200 miles eastward. The various streams into which the great river is divided at its mouth became known as the " Oil Rivers," from the palm oil which formed the staple article of commerce after the suppression of the slave trade. By the fourth decade of the 19th century British interests had grown so important that a permanent consulate was established, but up to the year 1880 no event of political importance calls for comment. From that year onwards constant pressure exerted by the United Africa Company, here- after mentioned, on the Eoreigu 0£5ce and the Board of Trade caused the Government to contemplate taking over all the coast from Lagos to the Gaboon. Owing to complications elsewhere, however, this was not done, and Germany seized a portion of Cameroon. Then the Brit- ish flag was planted in other parts of that district, but eventually the last patch of British territory in Cam- eroon was surrendered to Germany in 1887. Afterwards by agreement with Germany the eastern boundary of the Oil Rivers Protectorate was extended to the upper waters of the Benue and the shores of Lake Chad. Thus the entrance to the Niger territory passed iuto British hands.~~

~~It was in the development of the hinterland and the delta above mentioned that the Niger Company played so important a part. The French~~

~~Government had been beforehand with the British in that district. Before 1880~~

~~two French companies, actively encouraged by Gambetta, had set up trading stations along the Lower Niger, and the administration of Senegal had stretched out its arms towards the upper waters of the river. There was every likelihood of British trade being throttled. At this junc- ture Mr George Goldie-Taubman, previously an officer in the Royal Engineers, went to the Niger in 1877 for the purpose of crossing the continent to the waters of the Upper NUe. HIe then conceived the idea of creating a British province there, and in 1879 formed all the petty British firms trading on the main Niger into the United Africa Company. In 1881 he applied to Government for a charter, having found that the company could not exercise jurisdiction over foreigners without it. The capital of the company (£100,000) being too small for it to be entrusted with sovereign rights, he formed in 1882 the National Africa Company, with a capital of £1,000,000 subscribed. Even then the charter could not be issued until the two existing large French companies had been got rid of. These were bought out, and antici- pating the Germans, Mr Goldie-Taubman (better known as Sir George Taubman Goldie) secured himself in the south by concluding treaties with the sultans of Sokoto and Gando. By the time of the Berlin Conference (1884) Great Britain could show that she alone possessed sub- jects with trading firms on the river. HIer claim to a protectorate was admitted, and the company (now known as the Eoyal Niger) received its chaf ter. It was antici- pated that the new chartered company would extend the sphere of its operations, for provision was made in the first article for its authority over future acquisitions, and its political powers were defined. Any attempt on the part of the company to acquire a commercial monopoly in the regions under its sway was distinctly forbidden, and taxation could only be imposed sufficient to cover the actual expenses of the government.~~

~~The territories hereby put under the company's control did not include those on the coast which were directly under the British Government and known as the Niger Coast Protectorate. The interior, however, lay open to it, but here it was exposed to keen competition from foreign rivals. Its treaties also covered about half of the coast-line between Lagos and Cameroon, as well as all the delta behind that half of the coast-line. The greater part of the~~

~~Niger delta was thus secured and saved by the company, as well as the two great entrances to that river, the Forcados branch and the Nun branch. On the south- east lay German Cameroon. The frontier had been set- tled by a convention in 1886, which was confirmed by another made in November 1893. The line was drawn from Rio del Rey to the rapids of Cross river, thence through Yola to the southern bank of Lake Chad. On the north and west the frontier coterminous with French territory was not yet settled; and this uncertainty led ultimately to dangerous complications, which were finally settled in June 1898. The territories over which the company exercised its sway were more than 500,000 square miles in extent, and contained from 20,000,000 to 40,000,000 of inhabitants. Their lower portion was occupied principally by small tribes in the most abject stage of barbarism, but above the Lower Niger a very different country lay open to its enterprise. The Central (British) Sudan is one of the richest and most populous districts in Africa. Cereals, fruits, cotton, and indiarubber are among its products, and it possesses many large and thriving towns, some with as many as 100,000 inhabitants, and all capable of becoming centres for trade and com- merce. Haussaland is the home of a stalwart race, many members of which have embraced Mahommedanism, and from them comes the finest material for the native soldiery. The company brought the greatest activity to bear upon~~

~~this promising region, and within a few years had ex- tended Its operations in all directions, concluding more than 400 treaties with various native chiefs. In 1888 the company was authorized to issue a loan of £250,000. This sum represented the amount that had been ex- pended in the acquisition and maintenance of concessions. The interest was to be paid by means of taxation, gathered from customs duties which might be levied up to the amount of £12,500 a year. It is to be observed that for the payment of this interest the company as a trading concern was to be in no way responsible. The company was, in fact, twofold in its nature. It was, on the one hand, a political and governing body, on the other a purely commercial corporation. Within its own territory it acted as a simple trader, competing~~

~~*with others, and did not include State revenues among its assets. As a trading concern it has paid since 1882 an average dividend of 6 to 6| per cent, on a paid-up capital of £493;680 and a subscribed capital of £1,027,080.* ^~~

~~*The organization of the company as a political body prospered rapidly after it had received its charter. The executive powers in Africa were entrusted to an agent- general, three provincial and twelve district superin- tendents. A chief-justice directed the judicial staff, and a commandant the troops. The entire direction was in the hands of a court sitting in London, with whom all the above officials communicated direct. This was called the " governing council" The first president or governor was Lord Aberdare,whowas succeeded by Sir George Taubman Goldie, the founder of the company, and who was its " political administrator " during the whole period of its charter. The territory of the company was divided into districts, over each of which was placed a European governor, only a few commercial stations being in the hands of blacks. In 1891 the whole number of agents conducting the company's affairs in Africa only reached the number of 71. There was a judiciary at work in the territories of the company. The chief justice had his residence at Asaba. The company had a fleet of about 30 steamers, two of which were protected by armour plating and guns, and capable of carrying 300 or 400 men each. The army of the company consisted of about 1000 men, mostly drawn from the Haussas and under the com- mand of British officers. Dues to defray the cost of administration were imposed on gunpowder, salt, alcohol, and tobaccoy and there were also taxes on many articles of export.*~~

~~*Not long after coming into existence the company con- cluded a treaty with the sultan of Sokoto, by which, in return for the payment to him of a pension of £1600 a year, it enjoyed sovereign rights over the greater part of his states. This treaty was followed by others concluded with other chiefs, until rights had been obtained over nearly the whole of Haussaland. Disputes arose with France regarding the possession of the sultanate History ^^ Borgu, especially the important ports of develop- Nikki and Boussa. At times these seemed to "*"*■ threaten the peace of the world, but fortunately*~~

~~they were amicably arranged in 1898. The progress of the company naturally involved some military operations, for collisions with the natives occasionaHy took place, especially with the slave-traders. The most important expedition was that of 1897, undertaken against the sultans of Nupe and Ilorin, whose power had become extremely menacing. A force was despatched under the command of Sir George Taubman Goldie himseH. The principal object in view was to destroy once for all the extensive slave trade which found its chief centre and support in the dominions of these potentates. The . . expedition consisted of native troops (600 Haussas) under~~

~~30 white officers with machine guns. In January 1897 the force left Lokoja, and in three weeks had decisively defeated the sultan of Nupe and 20,000 men; he was deprived of most of his dominions, and a sovereign was set up in his stead who was a vassal of the company. From Bida the company's forces marched upon Ilorin, the sultan of which was defeated, and the whole district then submitted to the company's authority. On 22nd June 1897 the legal status of slavery within the com- pany's territory was abolished by statute. Long before this the importation of alcohol had been forbidden north of the 7th degree of north latitude. By this provision the consumption of spirits was reduced to one-quarter of the amount to which it had previously attained. Charges were frequently made against the company of unjust and excessive taxation, overstepping the limits allowed by the charter. These were formulated in the most comprehensive manner by Herr von Puttkamer, who was sent to the Niger as the Imperial German com- missioner, and the same accusations were made by British and French traders. An independent commission, however, was despatched by the British Government under Sir Claude Macdonald, which exonerated the company from all charges of violating its charter and spoke in terms of high praise of the work it had effected.~~

~~After the settlement with France in 1898 it was impossible that the company could long continue to hold sway over half a million square miles of territory in the immediate neighbourhood of the possessions of great Powers, which often refused to recognize the acquisitions made by so ambiguous a competitor. The resources of the company also no longer sufficed for the work of administration and police required by so vast a~~

~~*dominion. Its leading minds had always foreseen the ultimate probability of the State stepping forward to acquire their rights of sovereignty. There was no disposition, therefore, to resist the inevitable, the only question being the amount which was to be accepted as an adequate com- pensation for the surrender of these rights. The Act which enabled the British Government to purchase the ^ company's rights under the charter became law in August 1899, and in January 1900 it took over the company's territories. The terms did not, perhaps, err on the side of generosity, but they were as high as any Government could venture to propose to the House of Commons. No allowance was made to the shareholders as compensation for the risks which they had undergone before their venture became a pronounced success, but, in return for the surrender of the charter and the transfer of all the political rights which the company had acquired by " treaties, conquest, or other lawful means," the Govern- ment was to repay the amount of £300,000 which the company had advanced out of its private trading profits to cover the costs of administration. The company was to receive the further sum of £160,000 for the surrender of their private land and mining rights, and it was also to be entitled to one-haII of any royalties which the Govern- ment of Nigeria might receive during the next 99 years in respect of minerals exported from such portions of the territory as were bounded on the west by the main stream of the Niger, and on the east by a line running direct from Yola towards Zinder, provided that such minerals were exported from a British port or passed through a British custom house. The barracks, stores, wharves, steamers, &c., which were purchased from the- company were surrendered at a price fixed by agreement at £ 115,000. The Imperial Government, of course, assumed the payment of the interest (£12,500 per annum) on the loan men- tioned above which the company had been authorized to raise for the purpose of administration. On these terms*~~

~~*the transfer to the Government was completed, and though the company still continues its existence as a trading concern, it has ceased to have any connection with the administration of Nigeria.*~~

~~*It now remains to sum up the results accomplished by the Niger Company during the fourteen years of its existence. Before the company got to work the settle- ments on the Oil Eivers might at any time have had their markets in the interior closed to them. There was no administration even at the Oil Eivers until 1891. To the energetic action of the company the colony of Lagos owes its mainland sphere, for it had saved the hinterland of these coast districts from falling into the hands of France and Germany. Indeed, it was only by a margin of a few months that the eastern por- tion of Nigeria was snatched from the encroachments of the latter Power. It may be doubted whether the British Government itself could ever have accomplished the task, since little interest at the time was felt in the Niger territories, which were looked upon rather as an unhealthy locality of which little was to be made. Among the greatest obstructives were the private traders, who always opposed annexation on the ground of in- creased taxation, but whose eyes were opened to a certain extent by the seizure of Cameroon by Germany. Five years of struggle with that Power ended in 1890 in the Anglo-German agreement, which recognized British rights which had been acquired by the company against the strenuous opposition of Flegel, Hoenigsberg, and other explorers backed up by Prince Bismarck. Nor was Germany the only Power with which the company had to reckon. It constantly opposed the increase of French influence. Since 1879 that Power had. adopted an aggressive colonial policy in those regions. The plan was very simple, and was succinctly described by Sir George Taubman Goldie as " pushing inland from her coastal possessions, and then adopting lateral extensions and occupying the land in the rear of the coastal possessions of her neighbors, cutting them off from their markets in the interior." France had pursued this policy successfully in the case of Gambia. Though Great Britain had been established for seventy years on the coast, France annexed the rich districts on the Upper Niger now known as French Sudan, and thus spoiled the markets for Gambia. The same policy was partially successful with regard to the Gold Coast and Sierra Leone colonies, but the progress of the Niger Company aroused public attention in Great Britain, and the further progress of this design was frustrated. By buying up the rival companies before the Berlin Conference of 1884, the company secured recognition of the supremacy of the British flag on the Niger, and later by its enter- prise enabled the British Government to insure a satis- factory*~~

~~*settlement of claims in the regions of the Upper Niger and the possession of the vast dominions of the Sokoto sultanate.*~~

~~*Apart from political considerations, the work effected by the company for civilization must not be ignored. The absolute prohibition of the trade in alcohol in certain districts, and the severe blow dealt to the slave trade by the campaign of 1897, entitle it to the respect and grati- tude of humanity. In ten years the company established in a barbarous region an organized system of justice and police supported by an adequate military force, placed on the waterways a fleet of 30 steamboats, founded a num- ber of trading stations, and set on foot a regular scheme of cultivation in certain districts, besides conducting a large and lucrative commerce. All this was done without costing Great Britain a penny, while the neighbouring settlements of France and Germany were not only mulct- ing these countries of vast sums, but bringing in no return.*~~

~~*COMPANIES*~~

~~*At the close of the company's existence as a governing body, when the administration of its territories definitely passed from its hands into those of the imperial authorities, a con- statistics sideration of the following figures will supply some data for estimating the progress made under its administration and also as a trading concern : —*~~

~~*The Niger Trading Company. — The first balance-sheet was is- sued in July 1888, and carries the transactions of the company to 31st December 1887. The trading account for 1887 amounted to . . £46,765 10 6*~~

~~*leaving a balance to profit of ... . 26,005 11 5 The total assets of the company amounted to . 470,317 6 8 With slight fluctuations the profits gradually*~~

~~*rose, and in December 1898 there was a*~~

~~*balance to profit of 36,396 9 6*~~

~~*In that year the total assets of the company*~~

~~were valued at . 700,035 6 0~~

~~To show the increase in the volume of commodities dealt with, it is interesting to compare the inventory of goods, stores, produce, &c., in Africa in December 1887 and December 1898. In 1887 the stock of goods, stores, &c., in~~

~~Africa was valued at £158,023 18 8~~

~~Goods awaiting shipment 723 18 7~~

~~Produce in England and afloat .... 30,799 13 10~~

~~Total £189,547 11 1~~

~~In 1898 stock of goods, &c., in Africa . . £247,961 2 9~~

~~Goods awaiting shipment 2,237 19 5~~

~~Produce in England and afloat .... 89,717 2 0~~

~~Total £339,916 4 2~~

~~Niger Government. — If we now consider the company in its administrative capacity for the same period, the statistics are no less instructive.~~

~~In 1887 the company's revenue stood at . . £42,396 0 0~~

~~And its expenditure at 71,324 0 0~~

~~The revenue from imports amounted to . . 24,037 0 0~~

~~,, ,, exports to ... . 16,781 0 0~~

~~,, ,, licenses to ... . 1,280 0 0 In that year the expenditure on the constabulary~~

~~force amounted to . • 13,395 0 0~~

And the salaries of the stafi in Africa to . . 10,269 0 0 At the end of 1898 the revenue amounted to a

total of 113,305 0 0

And the expenditure to 135,093 0 0

The revenue from imports now amounted to . 63,054 0 0

„ „ exports to 48,981 0 0

„ „ licenses to 480 0 0

The expenses of administration and revenue were thus showing a tendency to balance themselves at the time the company's territory was taken over.

Private Traders. — One point is worth noting in considering these balance-sheets, as bfearing out what has been said above as to the capacity pf gceaX trading companies to kill private com- petition within their own districts, even without any unfair

In 1887 the revenue from the imports of private

traders amounted to . . 1 . . £998 0 0

From the exports to 1335 0 0

And licenses to private traders to . . . 660 0 0 In 1898 the revenue from private imports

amounted only to 260 0 0

While that from exports and licenses was . . riil.

The Imperial British East Africa Company.

This company came into existence in 1888, but its ori- gin may be traced 10 years earlier. In 1877 the sultan of Zanzibar had offered to Mr (afterwards Sir) William Mackinnon, or to a company to be origia aad formed by him, a

~~lease for 70 years of the ^^^„mg^ customs and administration of the whole of the Zanzibar dominions, including all rights of sovereignty, with certain reservations. This was declined owing to a lack of support by the Foreign Oifice. Between 1880 and 1885, however, the large number of German concessions acquired aroused the interest of those who recognized the paramount importance of the maintenance of the British influence in those regions, and in May 1887 a concession bearing that date was voluntarily made by~~

~~the sultan and accepted by the association which had now been formed by Mr Mackinnon. This association became the Imperial British East Africa Company by a founder's agreement of April 1888, having received a royal charter in September of the same year. To this company the sultan made a further concession dated October 1888, to be read with the previous concession. On the faith of these concessions and the charters an amount of £240,000 was subscribed, and the company received formal charge of their concessions. The rights of which they believed that they were to assume possession were " all the powers and authority to which the sultan was entitled on the mainland-in the Mrima, and all his territories and depend- encies from Wanga to Kipini inclusive, also the islands em- braced in such territory," saving, of course, all obligations already incurred by that potentate with Great Britain or other Power. The first difaculties which the company had to encounter arose out of the aggressions of the German East Africa Company, supported by the German Government. This company also received a grant from the sultan in October 1888, and its appearance on the coast was followed by grave disturbances among the native tribes which had welcomed the British. This out- break led to a joint British and German blockade, which seriously hampered trade operations. It had also been anticipated, in reliance on certain assurances of Prince Bismarck, emphasized by Lord Salisbury, that German enterprise in the interior of the country would be confined to the south of Victoria Nyanza. Unfortunately this expectation was not realized. It was necessary that the British company should enjoy the command of all the ports from which it was to draw its~~

~~*customs revenue, but from the first disputes arose between them and German subjects who formulated claims over certain portions of the same districts. A German claim was put forward to the petty sultanate of Witu, where there were some German plantations subsequently bought up, and the German Government endeavoured unsuccessfully to obtain a concession of the island of Lamu, which contains the principal town on the coast north of Mombasa. These claims were submitted for arbitration to Baron de Lambermont, the Belgian secretary of state, who decided against the German contention. German intrigues did not thereby come to an end,' and native resistance to the company's authority was fomented. Similar difficulties arose over the possession stnd administration of Manda and Pata, and of the port of Wanga, though in those cases the German claims had even slighter foundation than at Witu. In all these disputes the German Govern- ment countenanced its own subjects, while the British Foreign OfSce did little or nothing to assist the company, sometimes directly discouraging its activity. The great importance to the trading operations of the company involved in the peaceable possession of these places may be gathered from a brief study of the terms on which the company's right to exact revenue in its territories had been granted by the sultan. The basis of this arrangement is to be found in article 9 of the concession of 9th October*~~

~~*1888*~~

~~*The company guaranteed to the sultan the whole amount of the customs duty he received at the time the concession was entered into, the annual average payable being fixed according to the original understanding by the experience of the first year, but, at the time this agreement was actually entered into, the Germans were pressing for a grant of Lamu, and the British company had to accept the sultan's interpretation of these financial clauses. It was therefore agreed that (1) the annual revenue was to be based not on an average, but on the actual results of the first year ; (2) the payment to the sultan was to be determined by the amount of the gross revenue without*~~

~~*allowing for expenses of collection. These concessions seemed worth making from a business point of view, as it might reasonably be supposed that they would largely increase their customs duties under the company no*~~

~~less than from an imperial point of view, for they con- firmed the sultan in loyalty to BritisL interests, and these would have virtually vanished in East Africa had he transferred Lamu and the northern stations to Germany. The importance attached by the company to the possession of these places may be gauged, therefore, by the sacrifices they were prepared to make to retain them. Unfortunately, by a curious combination of circumstances, the first year's revenue was unusually large ; the German ports were closed and some of their trade came to the British ports, and a sudden impulse was given to trade by the appearance of the British company. All this was idtimately much to its dis- advantage.~~

~~The next serious difficulty encountered by the comptoy arose from what was known as " the race for Uganda." By the hinterland doctrine, accepted both by Great Britain and Germany in the diplo- matic correspondence of July 1887, there was no doubt that Uganda would be taken to fall within Great Britain's "sphere of influence," but German public opinion evidently did not so regard the matter. The maps published in that country assigned the territory to Germany, and in England public opinion as strongly expected British influence to be paramount. HOwever, in~~

~~1889 Dr Peters led what was practically a raiding expedition into that country after running a blockade of the ports. The British Government made no attempt to put a stop to this beyond a formal protest to the German Government, which expressed its determination not to countenance Peters. They were not, however, pressed to stop his advance by force, and he managed to make his way into the back of the company's territory. Early in~~

~~1890 Emin Pasha made an arrangement with the German Government to lead an expedition in the direction of Uganda. As the British Government did not feel inclined to undertake the protection of British interests in Uganda, the company had to protect itself. In March 1890 it despatched an expedition thither under Captain Lugard. An expedition under Mr Jackson, which had left the year previously, with instructions to avoid Uganda, had been diverted there on receipt of the news regarding Peters and Emin Pasha. Peters retired at Jackson's approach, claiming, however, to have made certain treaties which constituted " effective occupation," and Emin threatened to complete Peters's work. The dispute came to an end by the~~

~~Anglo-German agreement of 1890. Uganda was assigned to the British sphere of influence. The country was in a dangerous state of ferment; Roman Catholic and Protestant converts were arrayed against each other, and the French missionaries unfortunately fomented the ill- feeling. By the middle of 1890, however. Captain Lugard had established peace and the authority of the company had become supreme. In July 1890 repre- sentatives of the Powers assembled at Brussels and agreed on common efforts for the suppression of the slave trade. The interference of the company in Uganda had been a material step towards that object, but no really satisfactory occupation could be brought about except by the con- struction of a railway, and this the company's resources did not allow them to undertake. Though the British prime ministerlpaid the highest tribute to their labours, and a preliminary grant for the survey had been practically agreed upon, the scheme was wrecked in Parliament. The company had imported some 50 miles of light, narrow- gauge rails, which were actually laid for a distance of 14 miles. Locomotives were tried, but the line was too~~

~~light for safety, and serious accidents happened. The line in the island of Mombasa is still worked by human labour. Finally, the company decided to withdraw Cap tain Lugard and his forces in August 1891 ; the occupa- tion was, however, prolonged to 31st March 1893, on the promise of the Crovemment to bear the expense.~~

~~The company found itself involved in further difficulties through having to undertake the administration of the coast towns. Witu it took over with great fratfve'*' J' luctance, as it did not regard it as part of rfyfljcu/tfes. the contract under the charter, though the Government held the opposite view. Kismayu, however, was a port of little importance to Great Britain, for it is a poor harbour, difficult of approach, and much exposed to tlie south-west monsoon. The trade is small, for there is no trade route there to the interior. To facilitate trade the company had adopted the policy of subsidizing the Somali tribes in the hinterland, and the Government agents took exception to this method of proceeding. The pecimiary interests of the company further sustained a severe blow owing to the action of the British Government in Zanzibar, which had been taken under the protectorate of Great Britain in October 1891, by the agreement with~~

~~Germany made in 1890, though its administration remained in tie hands of the Zanzibar Government.' In June 1892 the Britisli Gov- ernmeut declared the dominions of the sultan of Zanzibar, including the mainland territory under the company's rule, to be within the free zone. This act extinguished the treaties regulating all tariffs and duties with f orei Powers, and gave free trade all along the line. This was plainly a violation of the rights of the company under its original agreement with the sultan. The answer of the British Foreign Office to the company's protest was that there was only a "delegation" of the sultan's powers, which he had a right to withdraw when he liked ; yet the company was still held liable to pay the compensation for customs dues which it had originally undertaken to pay. The result for the company was that dues were now swept away without compensation, and the company was left saddled with the payment of the rent, and with the cost of administration in addition, though administration had been the inevitable corollary of taking the dues over. In June 1894 the sultan signified his willingness to negotiate with the company for its with drawal from the contract.~~

~~A final difficulty between the company and the British Government remains to be noted. At the invitation of the Foreign Office the company had instituted efficient tribunals and secured consular powers in the coast towns for the benefit of British subjects, and had been invited to prepare a scheme of taxation which might be offered for the approval of the Government. Such a scheme was duly drawn up and submitted, but never approved, and ultimately the Foreign Office took up the position that, in instituting a system of administration, the company had been merely fulfilling its obligations to the untaxed pop- ulation (principally British-Indian), and that the whole question must be considered apart from that of taxation and jurisdiction over foreigners. With regard to British subjects residing beyond the concession limits the diffi- culties were very great. The company found itself responsible for the maintenance of order, yet was not permitted to arrest offenders who were British subjects and bring them to the coast for trial.~~

~~In every direction the company's affairs had drifted~~

~~1 In giving his assent to the Berlin Act the sultan had (on the advice of H.M. Government) reserved his fiscal rights against the operation of the free~~

~~trade provisions of that Act. Subseqnently the reservation was overruled, and without any quid pro quo his highness's dominions were included in the free-zone system.~~

~~into an impasse. In addition to the causes already indicated, this may be attributed to insufficient capital, want of funds, and small revenue. Plantations had been, taken over on the coast and worked at a loss, money had been advanced to native traders and lost, and expectations of trade had been disappointed. At a meeting of share- bolders on 8th May 1894 an offer to surrender the charter to the Government was approved, though not without strong protests. Negotiations dragged on for over two years, and ultimately the terms of settlement were that the Government should purchase the property, rights, and assets of the company in East Africa for £250,000. Uganda had been made a protectorate before the extinc- tion of the company, on the Portal report being received by the Foreign Office.~~

~~Altogether, considering the slow development which this region has since shown, the commercial prospects of the company, and the cost to it of administra- tion, it cannot be said that the price paid at the time by the British Government was so insufficient as it appears at first sight. Sir William Mackinnon, through whose judgment, foresight, and patriotism British influence had become predominant in East Africa, had died in June 1893. He was fated to see the company by no means a success commercially, yet it had accom- plished a solid work in advancing the civilization of the dark continent. In exploring and. development it could point to several successful expeditions : to the founding of the Scottish Industrial Mission at Kibwezi (which is now extinct), about 200 miles from the coast on the way to Uganda, and its connexion with the sea by a track known as the " Mackinnon road " ; and to the establish- ment of telegraphic and telephonic communication be- tween Mombasa and Lamu. It had set up a system of administration which had helped to create confidence and stimulate trade. In 1893 the cost of transport for a ton of merchandise between Mombasa and Ugajida had been as much as £300. It had made pioneer experiments in transport, the results of which were reaped by later traders; its official reports afforded valuable information about the tribes of the interior, and under its administra^ tion more than 3000 slaves had been freed, though this is a small number compared with~~

~~those saved in stopping the trade itself. The drink' traffic, too, had been pro- hibited. On the successful termination of the Sudan war in 1898, the importance of its work in establishing British infiuence in the region of Victoria Nyanza became clear.~~

~~When the company's affairs were finally wound up in March 1897, it was found that In acquiring, developing, and administering the territories ultimately taken over ty H.M. Govern- ment there was a total deficit of £193,757, 7s. 8d., Statistics. which was made up as follows : —~~

~~(1) Outlay within the sultan of Zanzibar's 10-~~

~~miles limit under deduction of all revenues £139,404 14 1~~

~~(2) Outlay in the interior, including Uganda~~

~~and Witu, under deduction of grants hy Sir W. Mackinnon and friends of Church Missionary Society (£26,633, 13s. 6d.) . 122,542 2 6~~

~~(3) Costs of all assets handed over to H.M.~~

~~Government 145,780 12 4~~

~~(4) HOme charges, including costs of charter~~

~~less amount recovered on forfeited shares~~

~~(£2825) 36,029 18 »~~

~~Payment from H.M. Government~~

~~Total £443,757 7 8~~

~~250,000 0 0~~

~~Total deficit £193,757 7 »~~

~~At the time of the company's liquidation the accounts showed a total revenue during the whole period of its existence of £171,469, Os. Id.~~

~~This was principally made up of : —~~

~~Gross customs collections £89 067 3 10~~

~~Revenue from various sources, departmental~~

~~and otherwise 51,373 15 4~~

~~The amount expended on the survey and construction of rail- ways, tramways, &c., was more than £67,000,~~

~~The British Kokth Eokneo Company.~~

~~The occupation of the island of Labuan by the British Government in 1847 is the starting-point from -which to trace the connexion of Great Britain with North Borneo. In 1872 the Labuan Trading Company was established in Sandakan, and in 1878, through the instrumentality of Mr Dent, the sultan of Sulu transferred all his rights in North Borneo to a syndicate, the chief promoters of ■which were Sir Rutherford Alcock, Admiral the Hon. Sir Henry Keppel, and Mr E. B. Martin. Early in 1881 the British North Borneo Provisional Association, Limited, was formed to take over the cession with all rights and properties. A petition -was addressed to Queen Victoria for a royal charter in November 1881, and the British North Borneo Company, which was formed in May 1882, took over, in spite of some diplo matic protests on the part of the Dutch and Spanish Grovernments, all the rights, territorial and sovereign, in the original grants, and proceeded under the charter to organize the administration and development of the territory in question. The company has since acquiied further territories : the Putatan river in May 1884, the Padas district in November 1884 (including two import- ant rivers, the Padas and the Kalias), the Kawang river in February 1885, and the Mantanani islands in April 1886. In 1888 H.M. Government declared the whole territory to be under the protection of Great Britain, and thenceforth it was officially known as "The State of North Borneo." In 1890 the British Government~~

~~placed the island of Labuan under the administration of the company. In March 1898, after the suppression of the Mat Salleh rebellion, arrangements were made whereby the sultan of Brunei transferred to the company all the sovereign and other rights over the districts north of the Padas river which had previously been in his possession. This cession was of the highest importance, for it meant that a large number of enclaves, which had formerly been resorts for disaffected natives, and therefore a continual source of annoyance, passed under the control of the company, which was also enabled to consolidate its some- what scattered possessions into a compact territory. (See~~

~~also BOBNEO.)~~

~~Administration. — There are now ten Government stations on the coast administered by Europeans, and five inland, the most important heing at Sandalian, Darvel Bay, and Gaya Bay. The entire population of the company's territory is estimated at 200,000, including some 20,000 Chinese, and about 150,000 of the population are distributed throughout the west coast. The population of Sandakan, the capital, is estimated at from 6000 to 7000.~~

~~The form of govemmeut adopted by the company is practically that of a British colony. It is vested in a court of directors, appointed under royal charter, administered by a resident governor with the assistance of a colonial secretary. Under them are three residents of districts, several assistant residents, and de- partments of the Government service, such as treasury, land and survey, public works, harbour, medical, judicial, and constabu- lary. At the head of the judiciary is the governor, who is the chief judicial officer of the supreme court and court of appeal. The residents are the senior judges and judges of the courts of appeal. There are also district magistrates and justices of the peace. The Indian penal code and the Indian Civil Procedure and Evidence Acts have been adopted almost as they stand, but the rights and customs of the natives receive special recognition, and the land regulations are so framed as to encourage immi- grants. The higher officers of the Government form the legis- lative council. The native chiefs and headmen are responsible to the Government for the preservation~~

~~*of order in their o-wn districts, a trust which tliey discharge on the whole remarkably*~~

~~*well. The Government police number about 500 ; the majority of these are Sikhs, with some Pathans and Dyaks.*~~

~~*Sevenue. — The principal sources of revenue are the following : license for purchasing and retailing opium, spirits, &c. , all of which are in the hands of private persons. Eive to ten per cent, duty is placed on imports, and the same amount of royalty on jungle produce exported. The old source of revenue among the natives was a poll-tax, and this has been retained in lieu of land taxes ; there is also a stamp duty. Proceeds of sales of Govern- ment land, quit-rents, and fees on transfers, mate up the land revenue. Judicial fees and post and revenue stamps make up the sources of revenue.*~~

~~*When the company obtained its charter the northern portion of the island was in a state of chaos, the interior was divided up among a number of small chieftains whose authority was hardly recognized, and the coasts "were devastated by pirates. All this has been changed, and at a rate of taxation which barely reaches one shilling and threepence per head of the inhabitants, as compared with five to twelve shillings in India, or six to sixteen shillings in Java. Prom, an imperial point of view the change is no less remarkable. In 1881 the influence of Great Britain went for nothing. To-day she is mistress of the best part of the island, and her commerce is predominant.*~~

~~*Literature dealing with the subject of chartered companies generally : — ^Bonassietjx. Les grandes compagnies de commerce. Paris, 1892. — Chaillt-Bert. Les compagnies de colonisation sous V ancien r&gime. Paris, 1898. — Cawston and Keake. The Early Chartered Companies. Xondon, 1896. — Cunningham, W. A History of British Industry and Commerce, 2 vols. Cambridge, 1890, 1892.— Egekton. A Short History of British Colonial Policy. London, 1897. — J. Scott Kbltie. 37i« Partition of Africa. London, 1895. — Leroy-Beaulieu. De la colonisation Chez les peuples modernes. Paris, 1898. Les nouvelles, societes Anglo-Saxonnes. Paris, 1897. — ^Lucas. Historical Geography of the British Colonies. Oxford, 1888-97, i vols. — Macdonald. Select Charters illustrative of American History, 1606-1775. New York, 1899. — Carton de Wiart. Les grandes*~~

~~compagnies coloniales Anglaises au 19™' siecle. Paris, 1899. Also see articles "Compagnies de Charte," "Colonies," "Privilfege," in Nouveau dictionnaire d'economie politique, Paris, 1892 ; and article " Chartered Companies " in Encyclopoedia of the Laws of England, edited by A. Wood Benton, London, 1897. (w. B. Do.)~~

~~Charters Towers, a municipality and mining to-wn, Queensland, Australia, in the county of Devonport, 82 miles S.W. from To-wnsville, with which it is connected by rail. It is in the centre of an important gold-field, the output of which was valued, in 1899, at £1,216,750. Abundant water supply is obtained from the Burdekin river, about 8 mUes distant. Altitude about 1000 feet. Population, 4697.~~

~~Charts. — A chart is a marine map intended spe- cially for the use of seamen. It is constructed for the purpose of ascertaining the position of a ship with ref- erence to the land, of finding the direction in which she has to steer, the distance to sail or steam, and the hidden dangers to avoid. The surface of the sea on charts is studded with numerous small figures. These are known as the soundings, indicating in fathoms or in feet (as shown upon the title of the chart), at low water of ordinary spring tides, the least depth of water through which the ship may be saihng. Charts show the nature of the unseen bottom of the sea — with the irreg- ularities in its character in the shape of hidden rocks or sand-banks, and give information of the greatest import- ance to the mariner. No matter how well the land may be surveyed or finely delineated, unless the soundings are sho-wn a chart is of little use.~~

~~The early charts were plane charts, drawn on the prin- ciple of the earth being an extended plane. This construc- tion is suitable for harbours, coastal sheets, limited districts, such as the English Channel, or for coasts within the tropics, but becomes incorrect and even dangerous if used on voyages extending over the oceans. To remedy this defect, in 1569 Gerard Mercator, a Fleming, conceived~~

~~the idea of representing the earth's surface on a cylinder, in which the length of the degrees of latitude were in- creased as they approached the pole in the same proportion as those of longitude decreased on the globe. This idea ■was perfected about 1590 by Edward Wright, an English- man, and it is on his principle that the present charts are~~

~~drawn on what is known as " Mercator's pro- pn^on. jection." The advantage of this projection to~~

~~the sailor is that the ship's course between any two places is represented by a straight line. On a sphere the meridians all converge towards the pole, the degrees of latitude are equal, those of longitude decreasing towards the pole ; on a Mercator's chart the meridians are drawn as parallel lines, and the degrees of longitude are all equal. To compensate for this error, the degrees on the Mercator chart are increased as they approach the pole beyond their actual lengths, in the same proportion as the degrees of longitude on the sphere diminish in length as they approach the pole. The length of a degree of latitude in the parallel of 70° is consequently three times that of a degree at the equator. It is, however, only when equatorial and polar regions are contrasted that the dis- tortion becomes evident — contiguous countries and seas appear but little out of proportion to each other, and no other projection is known that so well meets nautical re- quirements. Distances on a Mercator chart are measured on the latitude scale, on the sides of the chart, taking care to use that part of the scale which is in the same latitude as the ship ; e.g., distances between places within the parallels of 50° and 60° must be measured upon the latitude scale between 50° and 60°.~~

~~The British Admiralty charts are compUed, drawn, and issued by the Hydrographic Office. This department of~~

~~the Admiralty was established under Earl Spen- Hydro- cer by an order in council in 1795, and consists office." ^^ *^® hydrographer, one assistant, and a~~

~~draughtsman. The first hydrographer was Mr Alexarj^er Dalrymple, a gentleman in the East India Com- pany's civil service. Eromthis small beginning arose the important department which is now the main source of~~

~~*the supply of hydrographical information to the whole of the maritime world. The charts prepared by the officers and draughtsmen of the Hydrographic Office, and published by order of the lords commissioners of the Admiralty, are over 3100 in number. They are compiled chiefly from the labours of British naval officers employed in the surveying service ; and also from valuable contributions received from time to time from officers of the royal navy and mercantile marine. In addition to the work of British sailors, the labours of other nations have been collected and utilized. Charts of the coasts of Europe have naturally been taken from the surveys made by the various nations, and in charts of other quarters of the world considerable assistance has been received from the labours of Erench, Spanish, Dutch, and American surveyors. The Admiralty charts are published with the view of meeting the wants of the sailor in all parts of the world. They may be classed under five heads, viz., ocean, general, and coast charts, harbour plans, and physical charts ; for instance, the Indian Ocean, the Mediterranean, approaches to Plymouth, Plymouth Sound, and wind and current charts. The harbour plans and coast sheets are constructed on the simple principles of plane trigonometry by the sur- veying officers. (See Surveying, Nautical.') That im- portant feature, the depth of the sea, is obtained by the ordinary sounding line or wire ; all soundings are reduced to low water of ordinary spring tides. The times and heights of the tides, with the direction and velocity of the tidal streams, are also ascertained. These MS. charts are forwarded to the Admiralty, and form the foundar tion of the hydrography of the world. The ocean and*~~

~~*general charts are compiled and drawn at the Hydro- graphic Office, and as originals, existing charts, latest surveys and maps, have to be consulted, their compilation requires considerable experience and is a painstaking work, for the compiler has to decide what to omit, what to insert, and to arrange the necessary names in such a manner that while full information is given, the features of the coast are not interfered with. As a very slight error in the position of a light or buoy, dot, cross, or figure, might lead to grave disaster, every symbol on the Admiralty chart has been delineated with great care and considerar tion, and no pains are spared in the effort to lay before the public the labours of the nautical surveyors and explorers, not only of England, but of the maritime world ; reducing their various styles into a comprehensive system furnish- ing the intelligent seaman with*~~

~~an intelligible guide, which common industry will soon enable him to appreciate and take full advantage of.~~

~~As certain abbreviations are used in the charts, atten- tion is called to the " signs and abbreviations adopted in the charts published by the Admiralty." Certain parts of the world are still unsurveyed, or not surveyed in sufficient detail for the requirements that steamships now demand. Charts of these localities are therefore drawn in a light hair-line and unfinished manner, so that the experienced seaman sees at a glance that less trust is to be reposed upon charts drawn in this manner. The charts given to the public are only correct up to the time of their actual publication. They have still to be kept up to date. Eecent publications by foreign Governments, newly reported dangers, changes in character or position of lights and buoys, are as soon as practicable inserted on the charts and due notice given of such insertions in the Admiralty " Notices to Mariners."~~

~~During the year 1900, 102 new plates of charts and plans were engraved, 30 plates received the addition of 8 new plans, and 224 plates were largely improved by corrections and additions ; 4520 corrections were made to the plates by the engraver; 35,500 received minor corrections at the hands pt the draughtsmen, and 876 "Notices to Mariners" were issued. The number of charts printed for the requirements of the Royal Navy, and to meet the demand of the general public, during 1900, amounted to 580,207.~~

~~These facts show the necessity of charts being closely watched by sailors and shipowners using them, to insure their being supplied with the most recently corrected charts. The dates of the corrections are noted at the foot of the charts — those of large corrections, and additions, for which the charts have been can- celled, being written in full against the imprint ; while the date of smaller corrections, such as changes in lights and buoys, are noted in Roman numerals on the left-hand lower corner. Por the mercantile marine the Board of Trade collects and publishes the above information in a small pamphlet, Notices to Mariners for Foreign-going Ships. This pamphlet, supplemented by a weekly issue, is supplied free of charge to the ships of the mercantile marine.~~

~~The Admiralty charts, when issued from the London chart agent (J. D. Potter) , have received all necessary corrections to date. Once out of his~~

hands, there is no guarantee that further corrections are made before sale, by local firms at different ports ; and purchasers should obtain some assurance that they are correct to date. The charts are also supplemented by the Admiralty Pilots, or books of sailing directions, with tide tables, and lists of lighthouses, light vessels, &c., for the coasts to which a ship may be bound. The physical charts are the continuation of the work so ably begun by Maury of the United States and FitzRoy of the Royal Navy, and give the sailor a good general idea of the world's ocean winds and currents at the difierent periods of the year ; the probable tracks and seasons of the tropical revolving or cyclonic storms ; the coastal winds ; the extent or months of the rainy seasons ; localities and times where ice may be fallen in with ; and, lastly, the direction and force of the stream and drift currents of the oceans. ("x. a. h.")

Chaskoi, Chaskovo, Khaskoi, Haskoi, or Has- Kovo, the chief town of a department in Bulgarian East- ern Eumelia, 46 miles E.S.E. of Philippopolis, It has

manufactures of carpets and woollens, and some trade in tobacco and silk. The' quantity of cocoons raised in the district in 1899 was 109,218 kilogrammes, valued at £12,494. Population, 14,392.

Chassepot. — The Chassepot rifle, so named after

its designer, was a modification of the Dreyse rifle ^the

so-called Prussian " needle gun" of 1841. It was adopted by France in 186^, and was the weapon with which her troops were armed in the Franco-German war of 1870-71.

It is a breech-loader, with its breech closed by a bolt very similar in shape and action to those now in use (see Small Arms). The cartridge case is, however, cylindrical throughout, and of paper, with stout cardboard wads at the top and bottom, the per- cussion cap being imbedded in the latter, and

~~*also covered in rear with a disc of india-rubber. The bullet is rolled up in greased paper and attached to the case by the paper wrapping being extended over the sides of the case and bound with twine. The cartridge case plays no part in obturation (except the india-rubber disc over the cap, as will be explained), and the bolt therefore has to perform this function. The arrangements to effect this are as follows : — In front of, and attached to, the bolt proper is a mushroom-shaped bolt-head, capable of a slight longitude move- ment independent of the bolt. Threaded on to the spindle of the bolt-head, and between its rear face and the front of the bolt proper, is an india-rubber ring. On closing the bolt this ring is compressed between the faces of the bolt and bolt-head and forced outwards against the sides of the breech recess. When the rifle fires the pressure of the gas compresses the india-rubber still more, and so seals escape. (The arrangement is very similar to the " de Bange " obturator in heavy guns.) The escape round the striker point is fairly sealed by the india-rubber disc over the percussion cap. This is pierced by the striker, and is therefore blown back over the anuulus between the striker and the hole for it in the bolt- head. The metallic self-obturating cartridge case was adopted by all nations very shortly after 1870), Great Britain having already done so in the Snider rifle in 1865.*~~

~~*The details of the Chassepot are*~~

~~*Weight with bayonet*~~

~~*Weight without bayonet*~~

~~*Length with bayonet .*~~

~~*Length without bayonet*~~

~~*Calibre*~~

~~*Number of grooves*~~

~~*Depth ,,*~~

~~*Twist of rilling Sights {?'S'*~~ ~~"**°'^~~

~~*Cartridge*~~

~~*Bullet –*~~

~~*Lowest f Length \ Weight Material Length Diameter Weight*~~

~~*Charge Muzzle velocity*~~

~~*10 R) 12 oz.*~~

~~*9 R) 5 oz.*~~

~~*6 ft. 2 in.*~~

~~*4 ft. 4 in.*~~

~~*•433 in.*~~

~~*4.*~~

~~*•012. (“one turn in 21^2 \ inches, left hand.*~~

~~*1312 yards.*~~

~~*219 „*~~

~~*2-68 inches.*~~

~~*494 grains. /*~~

~~*Lead.*~~

~~*•98 inch.*~~

~~*•465 „*~~

~~*386 grains.*~~

~~*86-4 „ (black powder).*~~

~~*1328 feet per second.*~~

~~*(h. w. b.)*~~

~~*Chateau briant, chief town of arrondissement, department ,of Loire Inf ^rieure, France, 40 miles N.N.E. of JSTantes. It has become an important railway centre on lines to Paris and Orleans. Population (1881), 3748 ; (1896), 5808, (comm.) 6884.*~~

~~*Chatelineau, a town of Belgium, in the province of Hainaut, on the Sambre, 27 mUes E. of Mons, with a station on the railway between Charleroi and Namur. It has coal-mines and iron-works. Population (communal)*~~

~~*(1880), 8290 ; (1897), 11,950.*~~

~~*Chatham, a municipal (1890) and parliamentary borough of Kent, England, on the Medway, adjoining the city of Eochester, 34 miles E.S.E. of London by rail. The town is divided into three wards, under a mayor, 6 aldermen, and 18 councillors. It has large and important naval and military stations, and a royal dockyard. Christ Church Luton, was erected in 1885. Eecent*~~

~~*erections are a Congregational church, a town hall and municipal offices (opened 1900, cost about £28,000), a technical in- stitute and' school of art. Among the schools are a Eoyal Engineers' school of 'military engineering, a Eoyal*~~

~~*Marines' school, and two garrison schools. The royal dockyard has a river frontage of more than three miles and an "area of about 600 acres. One basin is 800 feet wide, with a quay frontage of 6000 feet. The rope-house is 1140 feet long by 60 feet wide. The dockyard employs 7000 workmen. Extensive naval barracks are in course of construction, also a naval hospital. A pier was built in 1886, and belongs to the corporation, and a railway bridge over the Medway was finished in 1890. In front of the Eoyal Engineers' Institute is a statue (1890) of General Gordon, and near the railway station another (1888) to Waghorn, promoter of the overland route to India. Area of municipal borough, 4336 acres ; popula- tion (1881), 26,424; (1891), 31,657; (1901), 36,937.*~~

~~*Chatham, an incorporated town and port of entry, Canada, New Brunswick, on the Miramichi river, 24 miles from its mouth and 10 miles by rail from Chatham junc- tion on the intercolonial railway. The town contains the Eoman Catholic pro-cathedral, 4 churches, 2 branch banks, and 2 newspapers, many large saw-mills, 2 pulp-mills, and several establishments for exporting fish. The lum- ber trade, the fisheries, and the manufacture of pulp are the chief industries. Exports in 1899-1900 were valued at $1,483,563, imports at $161,378. Population (1900), about 6000. The town is also called Mieamichi.*~~

~~*Chatham, a town and port of entry of Ontario, Canada, and the capital of Kent county, situated 64 miles S.W. of London, and 11 miles N. of Lake Erie, on the Thames Eiver and the Grand Trunk, Canadian Pacific, and Lake Erie and Detroit Eiver railways. There is also steamboat communication with Detroit. It contains an extensive waggon factory, planing and flour mills, manu- factories of fanning mills, woven wire goods, engines, windmills, ^c. Incorporated as a city in 1895, it had a population of 7873 in 1881 and of 9068 in 1901.*~~

~~*Chatham Islands, a small group of islands form- ing part of New Zealand, 636 miles due E. of Lyttelton in the South Island. Little change has taken*~~

place since 1875, except that cultivation has somewhat extended, and the native population, the Morioris (who belong to the same race as the Maoris of New Zealand, and are but slightly modified by long isolation), have consider- ably decreased. The larger island of the group — Whairikauri — whose highest point reaches about 1000 feet, is remarkable for the number of lakes and tarns it contains, and for the extensive bogs which cover the surface of nearly the whole of the uplands. There are no indigenous mammals; the reptiles belong to New Zealand species. The birds — the largest factor in the fauna — have become very greatly reduced through the introduction of cats, dogs, and pigs, as well as by the con- stant persecution of every sort of animal by the natives. The larger bell-bird (Antlwrnis melanocephala) has become quite scarce; the magnificent fruit-pigeon (Carpophaga chathamensis), the two endemic rails (Nesolimnas dieffen- bachii and Cabalus modestits), the one of which was con- fined to Whairikauri and the other to Mangare Island, have become exterminated. Several fossil or subfossil" avian forms, very interesting from the point of view of geographical distribution, have in the interval been dis- covered by Dr H. 0. Forbes, namely, a true species of raven (Palceocorax moriorum), a remarkable rail (Diaphor- apteryx), closely related to the extinct Aphanapteryx of Mauritius, and a large coot (Palceolimnas chathamensis). There have come to light also the remains of a species of swan belonging to the South American genus Chenopis and of the tuatara (Hatterid) lizard, the unique species of an ancient family now surviving only in New Zealand. The swan is identical with an extinct species found in

caves and kitchen-middens in New Zealand, which was contemporaneous with the prehistoric Maoris and was largely used by them for food. One of the finest of the endemic flowering plants of the group is the boraginaceous " Chatham Island lily " (Myositidium nobile), a gigantic forget-me-not, which grows on the shingly shore in a few places onl^, and always just on the high-water mark, where it is daily deluged by the waves ; while dracophyllums, leueopogons, and arborescent ragworts are characteristic

~~*forms in the vegetation. The chief export from the group is wool, grown upon runs farmed both by Europeans and Morioris. There is also a small export by the natives of the flesh of young albatrosses and other sea birds, boiled down and cured, for the Maoris of New Zealand, by whom it is reckoned a delicacy. The imports consist of the usual commodities required by a population where little of the land is actually cultivated.*~~

~~*BiBUOGKAPHT. — ^FoKBEs, H. O. " The Chatham Islands and their Story." Fortnightly Meview, 1893, vol. liii. p. 669. "The Chatham Islands: their Relation to a former Southern Conti- nent." Supplementary Papers, S.G.S., vol. iii. 1893. — Soott, J. H. "The Osteology of the Maori and the Moriori." 2Vans. iVew Zealand Institute, vol. xxvi. 1893. — ^Andkews, C. W. " The Ex- tinct Birds of the Chatham Islands." Ifovitates Zoologiea, vol. ii. p. 73, 1896. (h. o. r.)*~~

~~*Chattanooga, capital of Hamilton county, Ten- nessee, U.S.A., in 35° 2' N. lat. and 86° 21' W. long., on the left bank of Tennessee river, just north of the state line, at an altitude of 681 feet. It is an important railway centre, being at the intersection of eight railways, five of ■which are trunk lines. In manufactures it is of great importance, its invested capital amounting in 1890 to $7,400,000, with 5741 employees and an output of $10,216,000, the leading industries being iron and steel. This city is the seat of the U.S. Grant University, a Methodist Episcopal institution, founded irf 1867. In 1898 this had a faculty of 42 teachers and was attended by 491 students. The assessed valuation of the real and personal property of Chattanooga, on a basis of about 65 per cent, of the full value, was in 1900, $12,552,090 ; the net debt was $879,032, and the rate of taxation, including that for the state and county, $27 per $1000. During the CivU War a series of engagements look place near Chattanooga on 23rd to 25th November 1863, when Grant ■with 60,000 men defeated the Confederates under Bragg (40,000 to 50,000 men). The Federal losses were 5616, those of the Confederates 8684 and 6142 prisoners. Population (1880), 12,872; (1890), 29,100; (1900), 30,154, of whom 994 were foreign-born and 13,122 were negroes. Out of 9133 males of voting age, 1347 were illiterate (unable to write), of whom 1200 were negroes.*~~

~~*Chautauqua, a summer educational village on the shores of Chautauqua Lake, in western New York, U.S.A. The lake is a beautiful sheet of water, 1212 fee't above the sea, 20 miles long, and one to two miles in ■width, and flows out by Conewango Creek into Allegheny river. The village is situated on the western side of the lake, near its northern end, at the terminus of the Chautauqua and Jamestown railway. It was founded in 1874 by the Chautauqua Assembly, and contains some 600 cottages, with hotels and numerous buildings for educational purposes. All municipal improvements, in- cluding water-supply, drainage, fire department, electric lighting, &c., have been provided. Every summer classes are held in literature, art, pedagogy, and kindred subjects, when the population is estimated at 10,000 and the attendance at the various schools at 1000 to 1600.*~~

~~*Chaux de Fonds, La, a to^wn in the Swiss can- ton of Neuchatel. It is 18f miles N.W. of Neuchatel by rail, and stands at a height of about 3281 feet in a*~~

~~*valley (5 miles long) of the same name in the Jura. It is still the centre of the watchmaking industry. In 1896 it exported watches to the value of nearly 2^ million pounds sterling. It* boasts of being "le plus grand village de I'Europe," and certainly, despite many handsome build- ings, has preserved some features of a big village. Pop- ulation (1888), 25,603 (mostly Protestant and French- speaking) ; (1900), 35,890.*~~

~~*Cheboygan, capital of Cheboygan county, Michi- gan, U.S.A., situated on M'Leod Bay, Strait of Mackinac, in the northern part of the lower peninsula, at an alti- tude of 598 feet. It is a lumber city, and has consider- able lake commerce. It is on a branch of the Michigan Central tailway. Population (1880), 2269 ; (1890), 6235 ; (1900), 6489, of whom 2101 were foreign-born.*~~

~~*Chefoo, or Chifu, a treaty port in the province of Shantung, China, 260 miles S.E. by E. of Peking. It has continued to show fair progress as a place of trade, but the total volume is inconsiderable, having regard to the area it supplies. In 1880 the total exports and im- ports were valued at H. taels 9,906,000 (£2,724,000), and in 1889 amounted to H. taels 28,154,000 (£4,228,000). Communication -with the interior is only by roads, which are extremely defective, and nearly all the traf&c is by pack animals. In the*~~

~~*event of the German Government building the railways which are now in contemplation from their newly-acquired port of Kiaochow, situated on the south side of the peninsula of Shantung, it is prob- able that the trade of Chefoo will dwindle into insignifi- cance. From its salubrious situation and the convenience of its anchorage, Chefoo has become a favourite rendez- vous for the fleets of the European Powers in Chinese waters, and consequently it has at times been an import- ant coaling station. It lies in close proximity to Korea, Port Arthur, and Wei-hai-Wei, and it shared to some ex- tent in the excitement to which the military and naval operations in these quarters gave rise. The Chefoo con- vention was signed here in 1876 between Sir Thomas Wade and Li Hung-Chang.*~~

~~*Chelmsford, a municipal borough (1888), market to-wn, and county town of Essex, England, on the Chel- mer, 29 miles N.E. of London by raU, in the mid-parlia- mentary division of the county. It has agricultural implement and iron foundries, large electric light and engineering works, breweries, maltings, extensive corn- mills and large cattle and corn markets, a large tannery, and fine shops. The rateable value (1888) was £42,220, (1901) £ 61,46a. Area of borough (a civil parish), 2033 acres. Population (1881), 9793 ; (1901), 12,580.*~~

~~*Chelmsford, Frederic Theisiger, 1st Baeoit*~~

~~*(1794-1878), Lord Chancellor of England, was the seventh and youngest child of Charles Thesiger, and was born in London on 15th April 1794. His father, Charles Thesiger, collector of customs at St Vincent's, was the son of a Saxon gentleman who had migrated to England and become secretary to Lord Rockingham, and was the brother of Sir Frederick Thesiger, naval A.D.C. to Nelson at Copenhagen. Young Frederick Thesiger was originally destined, like another Chancellor, Lord Erskine, for a naval career, and he served as a midship- man on board the Cambrian frigate in 1807 at the second bombardment of Copenhagen. His only surviving brother, however, died about this time, and he became entitled tO' succeed to a valuable estate in the West Indies, so it was decided that he should leave the navy and study law, with a view to practising in the West Indies and event- ually managing his property in person. Another change of fortune, however,*~~

awaited him, for a volcano destroyed the family estate, and he was thrown back upon his

prospect of a legal practice in the West Indies. He proceeded to enter at Gray's Inn in 1813, and was called on ISth November 1818, another change in his pro- spects being brought about by the strong advice of Mr Godfrey Sykes, a special pleader in whose chambers he had been a pupU,Nthat he should remain to try his for- tune m England. He accordingly joined the home cir- cuit, and soon got into good practice at the Surrey sessions, while he also made a fortunate purchase in buying the right U appear in the old Palace Court, where were tried small causes arising within twelve miles of Westminster, and where only four counsel were privi- leged to practise. In 1824 he was briefed to defend Hunt when on his trial at Hertford with Thurtell for the murder of Mr Weare, and was considered to have dis- tinguished himself in his conduct of the case ; and eight years later at Chelmsford assizes he won a hard-fought action after three trials, to which he attributed so much of his subsequent success, that when he was raised to the peerage he assumed the title Lord Chelmsford in grateful remembrance of the circuit town and of that particular achievement. In 1834 he was made king's counsel by Lord Lyndhurst, and in 1835 was briefed in the Dublin election inquiry which unseated Daniel O'Connell. In 1840 he decided to enter Parliament. He accordingly contested Newark in the Conservative interest without success, but soon after obtained a seat as member for Woodstock. In 1844 he becamei solicitor-general in suc- cession to Sir W. FoUett, and was knighted, but having ceased to enjoy the favour of the duke of Marlborough, lost his seat for Woodstock and had to find another at Abingdon. In 1845 FoUett died, and Sir Frederick Thesiger, who next to FoUett had for long been the most popular and most successful advocate at the bar, succeeded him as attorney-general, holding the post until the fall' of the Peel administration on 3rd July 1846. Thus by three days Thesiger missed being Lord Chief Justice of the Common Pleas, for on 6th July Sir Nicholas Tindal died, and the seat on the bench, which would have been Thesiger's as of right, fell to the Liberal attorney-general, Sir Thomas

~~Wilde. Sir Frederick Thesiger remained in Parliament, changing his seat, however, again in 1852, and becoming member for Stamford. During this period he enjoyed a very' large practice at the bar, his talents as an advocate causing lum to be employed in many causes ciMres, including the action for breach of promise brought by Miss Smith against Lord Ferrers, his speech in which was highly praised, and the action arising out of an impostor's claim to be the son of Sir Hugh Smyth. On Lord Derby coming into office for the second time in 1858, Sir Frederick Thesiger was raised straight from the bar to the Lord ChanceUorship (as were Lord Brougham, Lord Selborne, and Lord Halsbury). In the following year Lord Derby resigned and his Cabinet was broken up. Again in 1866, on Lord Derby coming into office for the third time, Lord Chelmsford became Lord Chancellor for a short period. In 1868 Lord Derby retired, and Disraeli, who took his place as Prime Minister, wished for Lord Cairns as Lord Chan- cellor. Lord Chelmsford was very sore at his super- session and the manner of it, but, according to Lord Malmesbufy, he retired under a compact made before he took office. -Ten years later Lord Chelmsford died on 6th October 1878, after having industriously 'fulfilled during his two periods of retirement from office the usual iudicial functions that devolve upon an ex-ChanceUor. Lord Chelmsford had married in 1822 Anna Maria Tinling, niece of Major Pierson, whose name is associated with the defence of Jersey. He left surviving him four sons and three daughters, of whom the eldest, second Lord Chelmsford, earned distinction as a soldier, while the**

third, Alfred Henry, was made a lord justice of appeal and a privy councillor in 1877, at the early age of thirty- nine, but unfortunately died only three years later.

Lord Chelmsford was a brilliant and successful advocate rather than a distinguished lawyer or a great Lord Chancellor. He com- bined with ability and marked industry a high sense of honour and spotless integrity, while his fine presence and sparkling wit con- tributed to his success both in Parliament and his profession. Many stories are told of his ready tongue. " I have a right to deal with my witnesses as I please," said a learned serjeant once, when Thesiger had objected that he was suggesting answers to the per- son giving evidence. "My friend," said Thesiger promptly, addressing the coiirt, " may deal, if he likes, my lord, but I submit that he~~

~~must not lead." Lord Denman used to narrate how he had complained to Thesiger of the length of a certain barrister's speeches, " ever ending, still beginning." " Yes," said Thesiger ; "his windings up are like the winding up of a watch, which only gives it a fresh start." On another occasion, Warren (author of the novel Ten Thousand a Tear), who was always anxious to claim that he moved in high social circles, said, " I dined the other night at the duke of Leeds's, and — would you believe it ? — ^there was no fisli." " Indeed ! " replied Thesiger ; "I suppose they had finished it all upstairs." In 1869, when the HOuse of Lords divided over the Irish Church Bill, a Conservative peer, seeing that Samuel Wilberforce was about to vote with the Government, re- marked, " The Bishop of Oxford is going the vreong way." " No, no," said Lord Chelmsford; "he is going the road to Winchester" — a prophecy fulfilled when Mr Gladstone made Wilberforce bishop of Winchester later in the year. (b. A. Ab.)~~

~~Chelsea, a city of Suffolk county, Massachusetts, U.S.A., situated in 42° 25' N. lat. and 71° 0' W. long., on a peninsula between Mystic and Chelsea rivers, and fronting on Boston harbour. Its manufactures employed in 1890 a capital of $7,028,356 and 3470 persons. The value of the output was $8,158,207, one-third of which consisted of rubber goods. The assessed valuation of property was in 1899 $23,405,294, the net debt $1,290,051, and the tax-rate $17.40 per $1000. Popu- lation (1880), 21,782 ; (1890), 27,909 ; (1900), 34,072.~~

~~Cheltenham, a municipal and parliamentary borough (one member) and market town of Gloucester- shire, England, on the Chelt, a tributary of the Severn, 9 mUes E.N.E. of Gloucester, 121 miles W.N.W. of London by rail. The place was little known until 1716, when its mineral water springs were accidentally dis- covered. It is now equally weU known as a great educational centre and a health resort. Cheltenham College (incorporated 1894) and the Ladies' College are famous aU over the world. There are several other large scholastic institutions, and a free library, art gallery, and museum. The architectural appearance of Chelten- ham is deservedly admired. The parish church (St Mary's) is an old Gothic building, with an elegant spire. The town possesses twelve other places of worship connected with the Established Church, and twenty-three Nonconformist churches or chapels. The HIgh Street contains many fine buildings (notably the new~~

grammar school). The celebrated Promenade, the most beautiful and verdant of English streets, has been compared to Unter den Linden, Berlin. The town is well lighted (by electricity), well paved and drained, and has an excellent water-supply. There are other attractions in the shape of beautiful gardens (Montpellier and Pitt- ville, the latter with a lake for boating) and splendidly equipped baths, both being the property of the cor- poration. The area of the municipal borough is 4677 acres. Population (1901), 49,439.

Chelyabinsk, a district town o^ Eussia,363 miles N.E. of Orenburg, on Mias river, situated at the east foot of the Urals, at the begianing of the lowlands of W. Siberia. It is the head of the Siberian raUway,and is 428 miles by rail E.N.E. of Samara and 154 mUes S.S.E. of Ekaterinburg, with which it is also connected by a rail- way. It is the centre of the trade in corn and produce of cattle, shipped to the Ural iron works. Population, 19,891.

CHEMISTKY.

THE final paragraph of the article Chemistet in the Encydopmdia Britannica, ninth edition, vol. v. p. 644, although written at a time when Mendeldeff's classical essay, clearly defining the periodic character of the re- lationship among the elements, was barely five years old, may well be taken as an appropriate introduction to the present supplementary article, as calling attention to important points of view from which it is desirable, in the first instance, to consider the progress that has been made. It is as follows : —

The establishment of the periodic law may truly be said to mark an era in chemical science, and we may anticipate that its applica- tion and extension will be fraught with the most important con- sequences. It reminds us how important above all things is the correct determination of the fundamental constants of our science — ^the atomic weights of the elements, about which in many cases great uncertainty prevails ; it is much to be desired that this may not long remain the case. It also affords the strongest encourage- ment to the chemist to persevere in the search for new elements.

DiSCOVEET OF !N"eW ELEMENTS.

~~*To deal first with the question of new elements. An interval of no less than twelve years elapsed between the discovery of indium (in 1863) and that of another new element, gallium (in 1875), but since the latter date our knowledge of the elements — ^the primary materials with which the chemist works — has been very considerably extended, ten or more having been added to the list, and now the number of well-defined species borders on eighty. Such discoveries serve a far higher purpose than that of gratifying the mere collector's instinct, for the introduction of law among the elements has led us to realize that progress in our knowledge of the true relationships subsisting between them generally depends more on the completion of the record than on anything else. As Mendel^eff himself pointed out in his Faraday lecture {Trans. Ohem. Soc. 1889, p. 634) :—*~~

~~*Before the promulgation of the periodic law the chemical ele- ments were mere fragmentary incidental facte in nature ; there was no special reason to expect the discovery of new elements, and the new ones which were discovered from time to time appeared to be possessed of quite novel properties. The law of periodicity first enabled us to perceive undiscovered elements at a distance which formerly were inaccessible to chemical vision, and long ere they were discovered new elements appeared before our eyes possessed of a number of well-defined properties.*~~

~~*MendeMefE here refers to the fact that in his original essay he fully described in advance the properties of three*~~

~~*elements, which he named ekaaluminium, eka- Predict^ boron, and ekasilicium, and that elements were*~~

~~*subsequently discovered which were found to be endowed with properties for the most part in closest accord with his predictions. Indeed it is from this circumstance more than any other, perhaps, that the periodic law at an early date acquired its extreme popularity. It will be evident from the following brief statements that the circumstances attending the discovery of new elements in recent times have often been of peculiar interest : —*~~

~~*Qedlmm= Ekaaluminium. — The discovery of gallium was made in 1875 by Lecoq de Boisbaudran {0. B. 81, p. 493, cf . Ann. Phys. Chim. (6) 2, p. 176), who was led by means of the spectroscope to recognize its presence in very*~~

~~minute proportion in a zinc blende from the Pyrenees. He afterwards found it in blendes from other sources. Although a very rare element, gallium seems to be widely distributed : thus Hartley and Eamage have shown that it is present in Cleveland iron ores (Proc. B. Soc. 1896, €0, p. 393), and have even separated it from the crude~~

~~cerium group.~~

~~blast-furnace metal ; although, according to their estimate, only 1 part is present in 30,000 of the iron, the propor- tion is larger than in any other known material.~~

~~8candium==Ekaboron. — The existence of this element was first noticed by Nilson in 1879, in the course of an examination of ytterbia prepared by Marignac's method from the rare mineral gadolinite. Cleve, who had suc- ceeded in carrying the purification much further, shortly afterwards gave a description of the properties of scan- dium — remarkable for its completeness in view of the very small amount of material at his disposal — in which he proved that it corresponds to Mendel^eff's hypothetical ekaboron. According to Cleve, it is present in gadolinite and yttrotantalite to the extent of only about 0-005 per cent., but euxenite, according to Nilson, contains a larger proportion.~~

~~Germamum= Ekasilicium. — The original source of this element, and the only one known up to the present time, is argyrodite, a double sulphide of silver and germanium, 3Ag2S.GeS2 (Jour.prakt. Chem. 1886, 34, p. 177), of which several hundred kilogrammes were found in 1885 quite locally deposited in an adit in the Himmelsfilrst mine near Freiberg. Clemens Winkler was led to recognize the presence of a new element in this mineral in conse- quence of the difB.culties he experienced in effecting its analysis.~~

~~Since thoria has been required in quantity for the manufacture of the mantles devised by Auer von Welsbach as a means of producing the incandescent gas light, new and abundant sources of the minerals yttrium- in which it is contained have been discovered. The attendant earths are consequently almost waste products, and the designation "rare earths," which has so long served to characterize the oxides of the yttrium-cerium group of elements, is scarcely applic- able. The field of work that these~~

~~*elements present is one of extraordinary dif&culty, and we are clearly still but at the threshold of knowledge. The history of dis- covery in this branch of chemistry has been set out in a clear and concise manner by the Scandinavian chemist Cleve — the highest living authority on the group — in a lecture delivered in memory of the Swiss chemist Marignac, who specially devoted himself to the investi- gation of the rare earths (Trans. Chem. Soc. 1895, p. 468). Crookes, a noted worker in this field, who has added very largely to the methods of discriminating the rare earths, has tnllj discussed the question of the individuality of the various earths in two presidential addresses to the Chemical Society of London (Trans. Chem. Soc. 1888, p. 487 ; 1889, p. 267). Cleve classes the elements of the group in two divisions — one containing " perfectly char- acterized," the other " not yet thoroughly characterized " elements. The former includes the following four new elements : —*~~

~~*Ytterbium. — This element was isolated by Marignac in 1878 from erbia separated from gadolinite, and was sub- sequently studied by Nilson. It yields a white oxide and colourless salts; its spark spectrum is rich in lines although its salts have no absorptive effect.*~~

~~*Samarium. — Attention was called to the existence of a new element in the earths from samarskite in 1878, first by Delafontaine, and soon afterwards by Lecoq de Bois- baudran ; their observations were extended by Marignac in 1880, but we owe our knowledge of samarium mainly to Cleve (Trans. Chem. Soc. 1883, p. 362; cf. Betten- dorf, Liebig's Annalen, 1891, 263, p. 164). The oxide of*~~

~~*samarium is white; its salts are yellow, and are charac- terized by definite absorption spectra.*~~

~~*Gadolinium. — This element was discovered in 1880 by Marignac among the samarskite earths ; it was subse- quently studied by de Boisbaudran, Cleve, and Bettendorf . Its oxide and salts resemble in appearance those of ytter- bium, but it has a much lower atomic weight than that element.*~~ ^

~~*Praseodymium and Neodymium. — Didymia — one of the most fully studied of the rare earths — which yields salts either rose-red or violet in colour, was always regarded as a definite substance until Auer von Welsbach, in 1885, by an extended and most laborious series of fractional crystallizations of the mixed nitrates .of ammonium, lan- thanum, and didymium, succeeded in resolving it into two constituents, praseodymia and neodymia. The former gives green salts and solutions, the latter amethyst-col- oured salts and rose-coloured solutions. The elements differ in atomic weight by nearly three units, but while the contrast between their physical properties is very marked, they differ chemically to an extraordinarily slight extent. Auer's observations have been abundantly confirmed, except that, curiously enough, it has been shown by both Brauner and Jones that in assigning atomic weights to the two elements he interchanged the values. But opinion is divided as to the individuality of the products described by Auer. Cleve, while accepting praseodymium as a new element, doubts the individuality of neodymium (cf . Muthmap and Stritzel, Ber. deut. cJiem. Qes. 1899, 32, p. 653). Crookes goes farther, and points out that when the absorption spectra of the two sub- stances are superposed, a spectrum is obtained nearly identical with that of the original didymia, except that two bands are missing. From this circumstance it might be presumed that a third substance is present, but his own work on the fractionation of didymia leads him to conclude that it must not be regarded as compounded of only two, but rather as an aggregation of many closely allied elements. Krllss and Nilson have arrived at a similar conclusion.*~~

~~*Victorium. — In discriminating the elements of the yttrium-cerium group, the spectroscope plays an all-im- portant part, several of them being characterized by their absorption spectra, whilst others, although they exert no absorbent action in solution, afford definite spark-spectra. A third method introduced by Crookes consists in sub- mitting the oxides, or preferably the basic sulphates, to the influence of the negative electric discharge in vacuo, and viewing the phosphorescence thus produced with the spectroscope. By a refinement of this method — ^by photo- graphing the spectrum of the phosphorescent light, using lenses and'prisms of quartz — ^he has been able to study the invisible ultra-violet spectra afforded by the rare earths, and in consequence to detect and separate a new element*~~

~~*victorium — from yttria. Starting from crude yttria,*~~

~~*separated in the ordinary way from metals of the cerium • subgroup, and subjecting the nitrate prepared from this, time after time, to the well-known process of alternate heating and then boiling the partially decomposed salt with water, thereby separating each time an insoluble basic nitrate from a soluble nitrate, he obtained fractions giving different spectra — a group of lines high, up in the ultra-violet attaining a maximum brUliancy in certain intermediate fractions. By fractionally recrystaUizing the oxalates prepared from these intermediate fr^tions a great number of times, further concentration was effected of the substance affording the spectrum referred to. Eesort was then again had to the nitrate method; and finally fractions selected with the aid of the spectroscope as likely to be the richest were converted into sulphates, and fractionally precipitated by potassium sulphate. The*~~

~~*substance ultimately isolated in this maimer contained the new element, victorium.*~~

~~*Cleve's list of "not yet thoroughly characterized" ele- ments of the yttrium-cerium group contains holmium, thulium, — ^these two he himself discovered in ordinary erbia, but has not yet satisfactorily separated, — terbium and dysprosium, and in addition a dozen or more not yet dignified with names the existence of which is suspected by Crookes or de Boisbaudran in various earths (cf. DemarQay, C. B. 1900, 130, p. 1185; 131, p. 387).*~~

~~*The inchoate state of knowledge of the rare earth elements will be suf&ciently inferred from the foregoing statements ; it may safely be said that no single element of the group is known in a state of practical purity, or can be regarded as "thoroughly characterized."*~~

~~*With a view of redetermining the densities of the elementary gases, and thus obtaining data for the further discussion of Prout's hypothesis that the atomic weights of the elements generally stand in "l^g. simple relation to that of hydrogen, Lord sphere. Rayleigh was led, in the course of experimeilts commenced in 1882, to redetermine the density of nitro- gen. Operating with the gas prepared by various chem- ical interactions, as well*~~

~~*as with that separated from atmospheric air, he was led, in 1894, to discover that the nitrogen from air was very distinctly denser than that prepared from any nitrogen compound, a litre of the former weighing under standard conditions 1-2572, and one of the latter only 1-2505 gram. HIaving considered and tested the various possible explanations of the anom- aly. Lord Eayleigh was at last led to ask what was the evidence on which the prevailing view was founded that the inert residue from air is a single substance. It then appeared that this was based entirely on the experiment made as far back as 1785 by the celebrated Cavendish in which what was then called " phlogisticated air," i.e., nitrogen, was combined with oxygen by passing sparks from a frictional electric machine through a mixture of the two gases confined over potash, and so con'ferted into nitre. On repeating the experiment Lord Kayleigh obtained results in accordance with those described by Cavendish, a small residue of uncombined gas b^eing always left ; and as he found that this residue was in proportion to the amount of air operated upon, and that its spectrum was not that of nitrogen, the initial discovery of a previously unknown constituent of our atmosphere was made. Meanwhile Bamsay had also succeeded in obtaining a gas differing from nitrogen, by passing air deprived of oxygen, etc., over heated Argon. magnesium — a well-known absorbent of nitro- gen. Pursuing the investigation conjointly, Rayleigh and Eamsay ultimately proved that the superior density of atmospheric nitrogen is due to the admixture of a small proportion (about 1 per cent.) of a gas which they have termed argon (q.v.) — on account of its complete chemical indifference — of superior density to nitrogen in the ratio 14-003 : 19-9 (cf. Phil Trans. 1895, A. p. 187).*~~

~~*At the time the discovery of argon was made public, Eamsay's attention was called by Miers to an observation recorded by an American chemist, HiUebrand, that on boiling the mineral uraninite with acid a gas was given off which appeared to be nitrogen. On examining cleveite, an allied uranium mineral, Eamsay obtained a gas almost free from nitrogen, and having observed that its spectrum contained a yellow line close to, but not coincident with, the D lines characteristic of sodium, he submitted it to Crookes for examination. On mapping the spectrum, Crookes found that the line referred to was the line D3 first noticed by Lockyer in 1878 in the spectrum of the solar chromosphere, and ascribed by Frahkland and Lockyer to a hypothetical element helium. HIelium very*~~

~~HeUam,~~

~~etc~~

~~closely resembles argon, being also an entirely inert gas ; its density is only about twice that of hydrogen (cf . Proc. Chem. Soc. 1895, p. 59; Trans, ditto, 1895, p. 1107; Proc. Boy. Soc. 60, p. 442). Helium has since been extracted from a variety of minerals consisting of salts of uranium, yttrium, thorium, and other rare earths. It is present in the gas evolved from the Bath springs and in other natural waters. De- war has shown that it may be separated from the Bath spring gas by subjecting this to a process of fractional liquefactions by means of liquid air (Proc. Chem. Soc. 1897, p. 187). By adopting such a method, as well as by the fractional distUlation of liquefied argon and liquefied air, Eamsay and Travers have more recently succeeded in obtaining evidence of the presence in excessively mi- nute proportions of three other inert gases besides helium and argon in air ; they have named these neon, krypton, and xenon. In the account of their work laid before the Eoyal Society on 30th N"ovember 1900, the relative den- sity of neon was stated to be nearly 10 (9-97), that of krypton 40-88, and that of xenon 64. The quantities of the three gases dealt with were so small, however, that these values must be regarded^as provisional. When vac- uum tubes charged with the gases are excited, that con- taining neon assumes an intense flame colour, the krypton tube a pale violet, and the xenon tube a sky blue. Neon can be liquefied only with the aid of liquid hydrogen. Krypton melts at —169° and boils at about —162°, whilst xenon melts at —140° and boils at 109°; the melting-point of argon, it may be mentioned, is —188°, and its boUing- point -186-4°. They appear to resemble helium and argon in properties. According to Liveing and Dewar (Proc. Boy. Soc 1901, 67, p. 467), the spectra of the more volatile gases of atmospheric air and of the Bath spring gas which are not condensed at the temperature of hquid hydrogen contain numerous lines occupying positions very near to those assigned to lines in the spectra of the solar corona and of the aurora. It may, therefore, be an- ticipated that yet other elements will be discovered in the air.~~

~~Shortly after the discovery of the Eontgen rays, the discovery, if possible more remarkable, was made by Henri Becquerel that uranium salts have the power of Radio- emitting rays capable — even after traversing thin sheets of glass, ebonite, and metals — of producing photographic effects, as well as of rendering air a conductor of electricity. Thorium com pounds were subsequently found to emit similar rays. The early experiments appeared to show that the inten- sity of the effect was proportional to the, amount of ura- nium present, the metal being more active than any of its salts ; but it was then found that certain uranium minerals — ^pitchblende and chalcolite — were more active even than the metal. Led by this fact, M. and Mme Curie undertook the investigation of these materials, and suc- ceeded in showing that at least two radio-active "elements " are present in them. One of these, polonium, occurs along with bismuth in the precipitate produced by sul- phuretted hydrogen in a solution of the mineral in acid. The other, radium, occurs in the barium chloride prepared from pitchblende. Barium chloride so obtained is not only (iiaracterized by great radio-activity, but also affords a spectrum in which there are a number of Hues not hitherto noticed in the spectrum of any element. More- over, according to Mme Curie, the atomic weight of radio- active "barium " increases as the intensity of the radiant effect increases, a substance exerting an activity 3000 times that of uranium giving the value 140, while in one exerting an activity 7500 times as great the value is as high as 145-8. Her latest determination, made with a substance which, from its spectrum, appeared to contain~~

~~active elements.~~

~~rather more radium than barium, gave the value 174. Quite recently (Proc. Boy. Soc. 1900, p. 409) Crookes has shown that the uranium salts of commerce may be puri- fied until free from radio-activity, one method being to re-crystallize uranium nitrate from ether, in which it is readily soluble. Crookes proposed to term the radio- active constituent — which becomes concentrated in the residue^provisionally Ux. It closely resembles " tsl- dium," but its exact nature remains to be determined. According to Crookes, polonium is distinguished from radium by the inability of the rays which it emits to penetrate glass. Radium compounds axe self-luminous even after they have been kept for months in the dark. Hitherto only~~

~~uranium and thorium minerals have been observed to exhibit radio-activity, and apparently the property is common to all of these. As a small propor- tion of radium raises the atomic weight of barium con- siderably, it is evident that the " element " must have a high atomic weight ; its constant and exclusive associa- tion in nature with the two elements of highest atomic weight known is therefore particularly remarkable.^ It will be noticed that in the case of the rare-earth metals, the elements from air, and the radio-active elements, the discovery of new elements has frequently been conse- quent on the introduction of novel methods rather than on the discovery of new materials : in fact, in only one case, that of germanium, has a previously untouched ma- terial been dealt with.~~

~~CLASSinCATION OP ELEMENTS.~~

~~Before discussing the bearing of the new discoveries of elements, it is necessary to consider briefly the rectifica- tions effected in our knowledge of atomic weights within recent years. It must be remembered that although atomic weight is the factor of primary importance in the classification of the elements from the point of gg^f, view of the periodic law, it can obviously only tion of serve as a basis of classification in cases in atomic which it is clear that the value has been ascer- "'**•**»• tained with a sufB.ciently close approach to accuracy. It is therefore one of its chief recommendations that the law itself affords a means of correcting atomic weights; indeed its acceptance as a valid generalization has been most materially promoted by the manner in which Mendel^eff's early proposals to alter the values assigned to a number of the rarer elements have been justified. To understand this, it is only necessary to bear in mind that when the elements are arranged in the order of atomic weight, instead either of an irregular or of a continuous variation in properties, a more or less obviously regular periodic variation is noticed — a given property coming to a maxi- mum, then gradually diminishing to a minimum, from which point it again rises to a maximum. Consequently, at intervals throughout the series, element^ are met with having similar properties. These elements serve as guide- posts, and in constructing atable are placed in correspond- ing positions. This principle being recognized, it is pos- sible to locate correctly elements of which the atomic weights are but approximately known. Thus osmium, iridium, and platinum were at the outset placed by~~

~~Men- del^ff in advance of gold, although their then accepted weights were superior to that of gold, for the reason that the other platinum metals, as well as iron, cobalt, and nickel, came in advance of tlie superior terms of the family in which gold is included. Determinations made by Seubert completely justified Mendel^eff's action, while~~

~~1 According to Debieme, pitchblende contains, a radio-active~~

~~" element " of the iron group, resembling thorium in its properties~~

~~actininm. Hofmann has separated from a number of rare-earth min- erals an element resembling lead, but distinguished by radio-activity, the equivalent of which is about 65, and the atomic weight perhaos about 260. s r f~~

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~~711~~

~~Kruss, Mallet, and Thorpe and Laurie have shown that the valiie long accepted for gold needs but slight correc- tion. Again, although the values assigned to titanium ranged from 48 to 57, Mendeleeff gave the preference to the former number as placing titanium relatively to silicon m the same position that vanadium bears to phosphorus, and It was shown by Thorpe in 1885 that 48 is the correct value.~~

~~Tellurium alone is regarded by some as an exception. Being a member of the sulphur family it should come between antimony and iodine, just as sulphur comes between phosphorus and chlorine, and consequently its atomic weight should be lower than that of iodine. This has not yet been found to be the case,' but there are spe- cial difBculties attached to the determination of the atomic weight of this element, and there is reason to suppose that the determinations are affected with unperceived constant errors. At the time Mendeleeff's first essay was published in 1871, only the equivalents were known of a number of the elements, and it is therefore noteworthy that, solely from a consideration of their properties, he came to the conclusion that it was necessary to take as the atomic weights other multiples of the equivalents than those commonly adopted in the case of~~

~~beryllium, yttrium, indium, lanthanum, cerium, didymium, thorium, and uranium. Excepting in the case of lanthanum his proposals have all been justified. Eesults such as these certainly justify his statement that the periodic law enables us to master the facts relating to atomic weights, whereas before it was formulated atomic weights were purely empirical numbers, which could never be directly tested by considering the values themselves but only by critically examining the methods by which they were ascertained. The work done by Stas, and those who have been fired by his example, in seeking to place the determination of atomic weights on the most exact basis possible, will be more appropriately referred to later.~~

~~It is impossible to overlook the importance of the dis- covery of so many new elements as have been referred to ; obviously we cannot be too cautious in any olthe”’”^ conclusions we may deduce as to the number periodic likely to exist, and especially in imposing any theory. narrow limit. Moreover, the discovery of ele- ments like argon, helium, etc., destitute of positive chemi- cal properties, opens out an altogether fresh field of view, and at the same time greatly increases the difficulty of the discussion. What positions are to be assigned to them in the periodic series ? On what basis are they to be classified ? As all the elements previously known are chemically active substances, and as there is nothing to foreshadow the existence of inert elements, chemical con- siderations afford no help in such a case, and it is only possible to classify them on the basis of their atomic weights. Their molecular weights can be deduced from their densities, but what of their atomic weights — the data by which alone their position can be decided ? Eay- leigh and Eamsay have found the ratio of specific heat at constant pressure to that at constant volume in argon to be 1-66:1, which is the theoretical ratio for a gas in which all energy imparted at constant volume is expended in effecting translatory motion; they therefor^ assume that, like mercury, argon is a monatomic element. Helium, according to Ramsay, for a similar reason is also mon- atomic ; in fact, all the companions of argon in air appear to exhibit “monatomic” behaviour. On this view the atomic weight of helium is about 4, whilst that of argon is about 40. The former could be placed without diffi-~~

~~1 Steiner, however, by analysing ^tellurium diphenyl, TePhj, has arrived at the value 126-4 (5er. cl^ut. chem. Ges. 1901, p. 570).~~

~~culty between hydrogen and lithium, but as the value 40 belongs to calcium, a place cannot be found for the latter. The element most nearly resembling argon is nitrogen. As we know it in atmospheric air, this is by far the least active of the elements, and yet we are satisfied that atomic nitrogen is gifted with intense affinities. The inactivity of molecular nitrogen, Nj, may be ascribed to the exhaustion consequent on the union of two atoms which attract and bind each other so firmly that little opportunity is left for them to exercise external influence. It is only necessary to apply and somewhat extend this view to find an explanation of the apparently absolute in- difference manifested by helium, argon,^and similar gases. None of the non- metallic elements are known as mon- atomic molecules under any ordinary conditions ; in fact, only metallic elements affect a monatomic state except at very high temperatures, and as the known gaseous elements — hydrogen, oxygen, nitrogen, fluorine, chlorine — all occur as diatomic molecules, it is permissible provi- sionally to make the assumption that this is true of helium and argon. HIelium then follows hydrogen; and argon fluorine, both being apj)ropriately placed after elements of exceptional activity. A difficulty of another kind, to which Crookes has specially drawn attention, occurs in the case of the rare-earth group of elements, of which, as already indicated, besides the considerable number now known, there is reason to believe many more exist. The differences they exhibit, judged by chemical standards, are extraordinarily slight ; often there is at most a minute difference in basicity or solubility which makes it possible to separate one from the other by a process of fractiona- tion repeated perhaps many himdred times. Are such slight differences to be regarded as proof Definition of chemical individuality ? Crookes thinks not. "m-'t'' HIs views on didymia have already been referred to. Another case is that of yttria. Starting from as definite a substance as possible, prepared in such a man- ner that it would be commonly regarded as pure, he has succeeded, by long- continued fractionation, in separating from it six distinct fractions, each of which affords a spectrum in which the dominant band is a different mem- ber of the set of bands in the phosphorescent spectrum of the original material. Crookes does not consider, how- ever, that the yttria is in this way separated into dis- tinct earths. To explain these results, as well as those obtained in other similar cases, he has intro- duced a novel conception — that of meta-elements : that is to say, he would modify and widen the concep- tion of an element, and would substitute that pf an elementary~~

~~*group composed of meta-elements. His con- ception of an element may be gathered from the follow- ing passage : —*~~

~~*In defining an element, let us not take an external boundary, but an internal type. Let us say, e.g., the smallest ponderable quantity of yttrium is an assemblage of ultimate atoms almost infinitely more like each other than they are to the atom of any other approximating element. It does not necessarily follow that the atoms shall all be absolutely alike among themselves. The atomic weight which we ascribe to yttrium, therefore, merely re- presents a mean value around which the actual weights of the individual atoms of the "element" range within certain limits. But if my conjecture is tenable, could we separate atom from*~~

~~*2 In the very stable gases the atoms in the molecule are combined very firmly, and therefore little internal work is done on heating them ; in the less stable, the combination being looser, more work is done in- ternally on heating. The ratio Gp/Co, on this assumption, should be greater for the more stable gases, as appears to be the case judging from the values given by Clausius : —*~~

~~*1-io*~~

~~*141*~~

~~*1-41*~~

~~*CI2*~~

~~*1-30*~~

~~*Br,*~~

~~*1-29*~~

~~*If helium and argon are Hei; and A^, and the atoms are gifted with a very high degree of mutual affinity, the molecules might well be so stable that no internal work is done on heating the gases.*~~

~~*712*~~

~~atom, we should find them varying within narrow limits on each side of the mean (Trans. Chem. Soc. 1888, p. 491).~~

~~Exception may be taken to this view, if only on the ground that it is somewhat premature. Belief in atomic ■weights as constants was never more firmly held than at the present time, the refinements introduced by Stas and later workers who have followed in his footsteps having, in all cases, led to results which serve to confirm and in no wise to weaken the conception. In fact, the views expressed by Clerk Maxwell in the article Molecule (Ency. Brit. vol. xvi.) still represent current opinion. Then, although much weight must be given to his arguments, ,it is in no way certain that the complexity of the rare earths is so great as Crookes would have us believe. As he and others have shown, the spectra on which he relies are excessively sen- sitive, traces of a foreign substance, and even the as- sociation of two earths, often sufficing to produce marked changes in them. But until the question has been far more thoroughly worked out from the chemical side, no valid conclusion can be drawn ; the resolution of didymia and the recent discovery of victorium, etc., show that the means at our disposal are not yet exhausted. Moreover, the fact that the reputed elements in the rare earths differ~~

~~so slightly in properties is not after all an argument of real weight, as it cannot be contended that differences such as have been observed are insufficient to characterize an element. Our powers of perception seem, indeed, to have been blunted by constantly dealing with elements widely different in general properties, and we are con- sequently unprepared to give willing recognition to species which cannot well be distinguished by chemical tests.~~

~~Crookes favours the opinion that there would be a dif- ficulty in finding place within the periodic system for the large number of elements of which the existence in the rare earths is foreshadowed. But is this the case ? It is true' that the latest table put forward by Mendeleeff in his Faraday lecture (Trans. Chem. Soc. 1889, p. 656) contains only a small number of blank spaces, but as he remarked on that occa- sion, " although but a recent scientific generalization, it has already stood the test of laboratory~~

~~*verification, and ap- pears as an instrument of thought which has not yet been compelled to undergo modification ; but it needs not only new applications, but also improvements, further develop; ment, and plenty of fresh energy." Now that so many new elements are being discovered, the time for its devel- opment is at least approaching, if not already at hand.*~~

~~*Classifica- tion ot elementB.*~~

~~*Table of the Elements.*~~

~~*IH*~~

~~*17 33*~~

~~*53*~~

~~*2 He*~~

~~*18 34*~~

~~*54*~~

~~*3*~~

~~*19 F 35 CI*~~

~~*65 Un*~~

~~*78*~~

~~*125*~~

~~*79*~~

~~*99*~~

~~*126*~~

~~*80 Br*~~

~~*100*~~

~~*1271*~~

~~*4*~~

~~*20 A*~~

~~*56 Fe*~~

~~*57*~~

~~*58*~~

~~*Co Ni*~~

~~*59*~~

~~*81*~~

~~*101*~~

~~*102 Ru*~~

~~*103 Rh*~~

~~*104*~~

~~*105 Pd*~~

~~*128*~~

~~*1910s*~~

~~*192*~~

~~*193 Ir*~~

~~*194*~~

~~195 Pt~~

~~60~~

~~82~~

~~106~~

~~129~~

~~196~~

~~61~~

~~83~~

~~107~~

~~130~~

~~197~~

~~7 Li 23 Na 39 K~~

~~62~~

~~84~~

~~85 Rb~~

~~108 Ag~~

~~131 132~~

~~133 Cs~~

~~198 An~~

~~8~~

~~24 Mg 40 Ca~~

~~63 Cu~~

~~64~~

~~65 Zn~~

~~86~~

~~87 Sr~~

~~109 110~~

~~HI 112 Cd~~

~~134 135 136~~

~~137 Ba~~

~~199~~

~~200 Hg 1 R~~

~~9Be~~

~~25 41~~

~~66~~

~~88~~

~~113~~

~~138 La~~

~~140 Ce~~

~~141 Pr 144 Nd~~

~~*10 Ne*~~

~~*11 B*~~

~~*12 C*~~

~~*13*~~

~~*26*~~

~~*27 Al*~~

~~*28 Si*~~

~~*29*~~

~~*42 Kr*~~

~~*43 Sc*~~

~~*44 45 46*~~

~~*47*~~

~~*48 Ti*~~

~~*49*~~

~~*67X*~~

~~*68 69*~~

~~*70 Ga*~~

~~*71*~~

~~*72 Ge*~~

~~*73*~~

~~74~~

~~89~~

~~90 Yt~~

~~91 Zr~~

~~92~~

~~93~~

~~94~~

~~114 In~~

~~115 116~~

~~117 Vc~~

~~118 Sn~~

~~119~~

~~120~~

~~121 Sb~~

~~14 H~~

~~30~~

~~50~~

~~75 As~~

~~95~~

~~122~~

~~*[150 Sm 156 Gd 163 Tb 166 Er 173 Yb]*~~

~~*[204 Tl 207 Pb 208 Bi] I I 232 Th I*~~

~~*15*~~

~~*31 P*~~

~~*51V*~~

~~*76*~~

~~*96 Nb*~~

~~*123*~~

~~*183 Ta*~~

~~*16 0*~~

~~*32 S*~~

~~*52 Cr*~~

~~*77 Se*~~

~~*97 Mo*~~

~~*124 Te*~~

~~*184 W*~~

~~*240U*~~

~~*CHEMISTRY*~~

~~*713*~~

~~*If the periodic generalization give any clue whatever to the nature of the elements and the character of their inter-relationship, it certainly tends to*~~

~~*justify the con- clusion that a genetic relationship exists betvi^een them. It is, in fact, impossible for any one fully imbued with the facts of organic chemistry to avoid being struck by the obvious, although often distant, analogies presented by the elements to genetically-related carbon compounds—analogies which are the more remarkable in that the exact mass relationships met with in the case of such compounds are not apparent among the elements. But as so many arguments have been advanced in support of the view that the elements undergo decomposition at high temperatures, it is perhaps well to note here that the evidence of genetic relationship among them is entirely inferential. Judging from the chemist's point of view, no, valid proof of the occurrence of elementary dissocia- tion under terrestrial conditions has yet been given, while as to its occurrence under solar or stellar conditions, until the interpretation which it is sought to put upon spectro- scopic observations is accepted by those who should be best able to appreciate their force, the subject is one on' which we can only hold our judgment entirely in abey- ance. The discovery of helium justifies the belief that several new elements may yet become known having lower atomic weights even than oxygen. Therefore supposing that genetic relationships exist, since in a large proportion of cases coiresponding elements among those having small atomic weights differ in atomic weight by very nearly 16 units, and since successive elements differ in so many cases by about a single unit, the assumption may be made that the series from hydrogen to oxygen should comprise a period of 16 terms. It then becomes a ques- tion whether the remaining elements can be arranged below these. An attempt to answer this is made in the preceding Table; the results are both remarkable and encouraging.*~~

~~*The first line or period calls for no special comment. Noteworthy points in the second period are the appearance of magnesium in a column in advance of that containing beryllium, and of phosphorus as the analogue of an unknown element coming between nitrogen and oxygen. No serious objection can be taken to such results, as beryllium in some respects more closely resembles aluminium than magnesium, and nitrogen and phosphorus, though they are in many ways analogous elements, also differ in im- Anew portant particulars. In the third period, the periodic homology difference 16 changes at the twelfth arrange- term, and owing to a sudden increase in thepro- """"^ gression difference becomes 20 between sDicon*~~

~~*and titanium. Proceeding by units, vanadium and chromium take up their proper positions, but scandium, it will be noticed, occupies position 43, whereas the atomic weight at present assigned to it is 44 ; as it occurs to-gether with elements of much higher atomic weight it is not unlikely that the value is over-estimated. In the fourth period many points of interest are brought out. Proceeding from chromium by units, manganese and iron take their proper places, but it then becomes impossible to proceed by units, as copper and zinc would be thereby entirely thrown out of position. If, however, the as- sumption be made that cobalt and nickel are members of the iron group, i.e., immediate homvlogues of iron instead of terms in the progression series (also that perhaps they are " isomeric " elements), order may be restored by pro- ceeding from them, copper being thus brought into the eighth or magnesium group, of which it is not an inappro- priate occupant ; but zinc must then be reckoned in the same family. It will be seen that "steps down" again occur in two (the eleventh and twelfth) groups in place of the one in the previous period ; if, however, the atomic*~~

~~*weight of gallium be over-estimated by about two units, progression might occur as in the previous period. The subsequent values are arranged so as to secure the proper position for bromine, the atomic weight of which is certainly known with a close approach to accuracy. Arsenic is in consequence placed in the fourteenth group instead of in the fifteenth, next to selenium, and the weight assigned to-this latter element is two units below the value at present accepted, which is certainly an anomalous value, bearing in mind the fact that the difference between sulphur and chlorine is more than three units. Little can be said of the fifth period as it contains so few elements. In the sixth period the conditions appear to be similar to those in the fourth, but the tendency to the development of extended families is even more marked. The value 124 is assigned to tellurium in order to bring iodine into position, and antimony is in consequence thrown somewhat out of its usual position ; in addition, the atomic weight assigned to it is a unit higher than the preferred value deduced from Cooke's determination. In the seventh period the probable existence of families of immediate homologues is again forced upon the attention. Thus caesium, like rubidium, does not follow in the immediate order of progression; nor does barium, but like zinc, strontium, and cadmium, seems to belong to an extended family of which the superior terms are missing. The mystic*~~

~~elements of the cerium group closely follow barium. Whether the period terminates shortly afterwards with a final term having an atomic weight near to 154, or whether a great develop- ment of the rare-earth elements occur in it, so that the period terminates with tantalum and tungsten, it is impossible to say. The eighth (or ninth) period com- prises the heaviest of the platinum metals and a number of other heavy metals ; it clearly comes to an early close. The last period (the ninth or tenth) has at present only two representatives, and of these uranium must be almost the final term ; perhaps radium belongs to this period.~~

~~Such a treatment of the subject obviously brings into prominence the possible existence of a far larger number of elements than has hitherto been contemplated, and attention is specially directed by it to the probable occurrence of numerous sets of closely-related elements besides the long-recognized three triads which appear in the fourth group (Fe, Co, Ni— Eu, Eh, Pd— Os, Ir, Pt). The extreme importance of extending the search for new elements in every possible direction is thus brought into view.~~

~~Atomic Weights.~~

~~As atomic weight is the ultimate criterion of position, everything depends on the exact determination of the proportions in which the elements combine. The field of investigation open to the chemist ae^miaa- in this direction is immense, and there is none tions ot in which he can labour with greater advantage ; 'tomic it is a fortuna;te circumstance that an enthusi- t^_ astic and most skilful band of workers in America is engaging in such labours with rare devo- tion. If the arrangement of elements above adopted be in any way justified, it is clear that considerable altera- tions must be made in the atomic weights of elements in a number of instances — even in cases in which the determinations have been carried out with such care that the results are commonly regarded with confidence. When the methods which have been adopted are studied, it is obvious that in not a few cases, although extreme care may have been taken in the actual determination of the numerical values, the proof obtained that the material dealt with has been free from all admixture is often far from complete. Much more must be done in~~

~~future to characterize the materials used, either by means of spectroscopic examination or by methods of equivalent delicacy — if indeed such can be found ; so-called chemical methods must often prove too coarse for such purposes. The difficulty — it may almost be said the impossibility — of separating the constituents of mixtures of isomorphous substances under limited conditions is well known, but it may well be that some of the materials hitherto regarded as uniform single substances are in reality mixtures of this kind. The need of studying the rare earths from such a point of view is beyond question ; indeed, it is time that the opportunities which this group of elements presents of solving some of the most difficult but entranciug problems in chemistry were appreciated. But there can be little doubt that the main sources of error in estimating atomic weights occur in carrying out the operations, and that constant unperceived errors often affect determinations which have been conducted with the most scrupulous care. The conception that a genetic relationship exists among the elements almost necessarily involves the idea that Relation- their atomic weights are in some way com- shipsot mensurable numbers. Prout first gave expres- "'Tite ^^°^ *° ^^^ view in his well-known hypothesis that the atomic weights of the elements gener- ally are exact multiples of that of hydrogen. Stas com- menced his work fully persuaded of the validity of this hypothesis, but his results led him to an entire change in his opinion, and the tendency of all modern investiga^ tions has been to disprove it. Nevertheless the feeling remains that the question is still open. Thus Mallet, in his lecture delivered in memory of Stas (Trans. Chem. Soc. 1893, 36), after fully discussing the question, said : —~~

~~But the fact that so many well-determined atomic weights, re- ferred to hydrogen as unity, present numbers nearly approaching integers, is very striking, and calls for further investigation. The writer of this paper is in a position to quote Stas himself as admit- ting this much. Having enjoyed the pleasure of a conversation of considerable length with the eminent Belgian chemist at his home in Brussels in the summer of 1887, and having urged upon him the improbability of this near approach to integer values for so~~

~~*many atomic weights being due to chance alone, the writer was answered by the remark, ^^ II faut croire quIIl y a quelque chose la-dessous. " i*~~

~~*Apart from Stas's great work, which can now be studied without difficulty in the three volumes of his (Euvres complies published after his death, no more important or more interesting literature dealing with this subject can be consulted than that relating to the numerous and per- sistent attempts made during recent years to fix the ratio between hydrogen and oxygen. The problem has engaged*~~

~~*1 In view of this pronouncement, it may be well to direct attention to the opinion expressed by Mendeleeff in 1871 in his original essay on the periodic law (Liebig's Ann. sup. viii. p. 206) : "Even if it be allowed that the matter of elements is entirely and uniformly the same, there is no reason to presuppose that n parts by weight of an element, or n atoms, in being changed to an atom of the second ele- ment, would produce the same n parts by weight ; or that the atom of the second element will be n times heavier than in the first case. The law of the conservation of weight can be regarded as a special case of the law of the conservation of energy, or of motion. Weight is, of course, caused by a special kind of motion of matter, and no reason exists for denying the possibility of a transformation of these motions in the formation of elementary atoms into chemical energy or one or other form of motion. Two of the phenomena that are to be observed in elements, viz., the constant weight of atoms and the impossibility of further decomposing them, have hitherto been in intimate, even his- torical connexion; if then a known element should decompose or a new one be formed, these phenomena might be attended by an in- crease or reduction of weight. In this way, moreover, the difference in the chemical energy of various elements might to a certain extent be explained. But in giving expression to this theory, I intend noth- ing further than this, that there is a certain possibility of bringing the opinion tacitly entertained by chemists of the composite charac- ter of the elements into harmony with the non-acceptance of Front's hypothesis."*~~

~~*the attention of workers all over the civilized world, and we are much indebted to the American chemists, and to Morley in particular, who have spared no trouble to arrive at trustworthy results. Stated in very few words,*~~

~~*the result uniformly arrived at is that far from being in the integral ratio 1 : 16, which was so long accepted, the two atomic weights stand to each other in the relation of 1 : 15-88. But the difficulty of attaining to finality in such work is well illustrated by the case of nickel and cobalt. These elements have over and over again attracted attention on account of their atomic weights being so nearly alike. Eecently. Eichards, assisted by Cushman and Baxter, has again attacked the problem, and the accounts given of the work are such as to impress the reader with the greatest confidence in the results. A variety of independent methods was used, and the con- sistency of the results obtained is remarkable. The conclusion ultimately arrived at is that cobalt has a slightly higher atomic weight (59) than nickel (58-7). Unfortunately, however, this does not settle the question, for, as Mallet observes in his Stas lecture — after pointing out that the general tendency of investigation up to that time had been to assign to cobalt a rather higher atomic weight than to nickel — on comparing the properties of the three sets of metals — Fe, Co, M — E.u, Eh, Pd — Os, Ir, Pt — cobalt plainly occupies a position intermediate between iron and nickel, and therefore its atomic weight should be lower than that of nickel.' No better example can be given of the severity of the struggle that is being waged between theory and practice, and of the difficulty with which the victory is to be won.*~~

~~*Those desiring to study the subject of atomic weights more fully should consult F.W. Clarke's Becalculation of the Atomic Weights, issued by the Smithsonian Institution in 1897. In this invaluable monograph reference is made to all that had been done in this department of chemistry. The subject is kept up to date in the annual reports published in the Journal of the American Chemical Society.*~~

~~*MoLECULAE Weights.*~~

~~*The conception the chemist forms of the properties of an element is a very complex one, and is based not only on the study of the element as it occurs in a separate form, but of every available compound. The series of impressions thus obtained are ultimately combined into an ideal, which in the chemist's mind constitutes the "character" of the element, and it is such a series of ideals that he has before him when considering the periodic system. He is, in fact, to a great extent guided by instinct. But in the case of*~~

elements, as in that of individuals, the determination of character is often at- tended with very great difficulty, a true estimate being only slowly arrived at, and when at last such an estimate is formed, it can only be very partially expressed in words. It is therefore justifiable to say that imagination and even sentiment play an important part in chemistry, and that if too rigidly and narrowly interpreted, facts may become very misleading factors.

One of the greatest difficulties in the way of form- ing a correct estimate of the properties of an element arises from the extraordinary manner in which properties are dependent on molecular composition; the task is equivalent to that of studying indi- viduals through observations of crowds in which they are barely distinguishable. Pamiliar instances are af- forded by oxygen and ozone, and by ordinary yellow and red phosphorus. No two substances aZ" 'hc. are more unlike in behaviour than are oxygen "lar com- and ozone, yet both are composed of the same p^'^o"- " stuff," the difference being that the one has diatomic (O2) and the other triatomic (O3) molecules. Again, the inactivity of nitrogen, as we know it, is altogether

remarkable in view of the impression which a study of nitrogen compounds conveys that the element is a highly active one. An extreme instance is afforded by carbon. No conception of the properties of this element can be obtained by studying it in any of the forms in which It IS ordinarily met with, and the reason is not far to seek. As ordinary amorphous carbon is converted by oxidation into mellitic acid, CeCCOaH),, a derivative of benzene, it may be assumed that it contains at least 12 atoms m its molecule ; but mellitic acid contains a ring composed of 6 atoms of carbon— the benzene ring, and for the reason, among others, that there is an obvious tendency on the part of carbon to form such rings, it is not iraprobable that each of the six atoms associated with the ring in mellitic acid was originally present in the carbon in a benzene ring which underwent destruction during oxidation. On this assumption the carbon mole- cule contains at least 42 atoms of carbon. What is true of elements is equally true of compounds—

~~*especially of oxides. Thus, whereas carbon and silicon yield compar- able chlorides of simple composition, CCI4 and SiCli, their oxides are totally different, carbon dioxide being gaseous, whilst silicon dioxide is a non-volatile solid that fuses with difficulty. The difference is undoubtedly due to the fact that the molecule of the latter is complex, x in the formula (SiOj)^ having possibly a high value. Another striking illustration of the dependence of properties on molecular composition is afforded by the two oxides of nitrogen, NOj and NA ; the former is an intensely coloured gas characterized by an absorption spectrum of extraordinary complexity, whereas the latter is a colour- less crystalline solid. Although the force of such facts has long been recognized, they are by no means suffi- ciently brought under the notice of students. Even in the case of gases, although Avogadro's theorem is accepted as the basis of our system, its consequences are too often disregarded in the text-books, many of which are disfig- ured by the appearance of II, 0, and N as symbols of hydrogen, oxygen, and nitrogen, for example. Canizzaro's striking Paraday lecture, delivered in 1872 {Jcmrn. Ckem. JSoc. pp. 941-967), dealing specially with the application of Avogadro's theorem, may be consulted with advantage by all who wish to gain correct views on such a question. Ultimately all peculiarities such as have been referred to must be traceable to peculiarities , inherent in the ele- ments ; in order that this may be done, and that the extent to which properties depend on molecular composition may be ascertained, the determination of molecular weight becomes an operation of the first importance, and it is not to be forgotten that the determination of molecular weight is a necessary step in the determination of atomic weight. Very great improvements in the methods of determining gaseous densities have been. effected in recent times, chiefly by Victor Meyer, and whereas formerly "tb it was only possible to deal with gases, methods ""* ' are now available for the determination of the molecular weights of liquids and of solids in solution. The form of apparatus introduced by Victor Meyer (in 1877) is known and in use everywhere. It consists of a cylindrical bulb attached to a long narrow stem, which is closed at the upper end by a stopper. Near this end a side tube is sealed on through which gas can escape and be collected. By surrounding the bulb and part of the stem with the vapour from a liquid of constant bojl- ing-point, or by placing it in a furnace, the temperature may be raised to any desired point. The only limit is that imposed by the material of which the*~~

apparatus is con- structed ; if porcelain or platinum be used, observations can be conducted at very high temperatures. At the time of his death Meyer was engaged in attempts to construct vessels which would permit of experiments being made at

temperatures far higher than those which platinum will withstand. In using the apparatus, the bulb is heated to a- constant temperature, which is easily ascertained by watching whether air — or whatever gas the apparatus may contain — escapes from the side tube ; the stopper is then -withdrawn, a weighed quantity of the substance to be examined is deftly introduced into the tube, and the stopper reinserted. When the substance reaches the bottom of the bulb it quickly volatilizes, and displaces the gas from the bulb; this is collected and measured. There is no need to notice the temperature. The gas collected is measured under the prevailing atmospheric conditions ; its volume is that of the vapour derived from the substance, assuming this to have been gasified under atmospheric conditions.

*By means of this apparatus, Victor Meyer, in conjunc- tion with Carl Meyer, was led in 1879 to inake the alto- gether unexpected discovery that chlorine has a much lower density at high than at low temperatures. The experiment was made by dropping a known weight of platinous chloride into the bulb ; this underwent decom- position into solid platinum and gaseous chlorine. At temperatures between 1200° and 1500° the value obtained was only about two-thirds of that to be expected on the assumption that ordinary chlorine was dealt with. Crafts and Meier, who repeated the Meyers' experi- Molecular ments, using ordinary chlorine, did not confirm aissocia- their results. But both parties were right. It "<"• *»' is now generally admitted that when the halo- **"*■ gens are strongly heated the ordinary diatomic molecules undergo dissociation into monatomic molecules, e.g.,*

Jai^J + J-

V

This change takes place comparatively readily in the case of iodine, much less easily in the case of bromine, and only to a very slight extent when ordinary gaseous chlorine is heated. When platinous chloride is strongly heated, how- ever, the chlorine is initially separated from the compound in

~~the monatomic state, and hence it is that much lower values are then obtained. The same is true of platinous bromide as compared with ordinary bromine. The result is one of great interest theoretically, and justifies the assumption often made that in the nascent state substances may exercise different and more powerful effects than they do ordinarily. Meyer found that the complex (tetrar tomic) molecules of phosphorus and arsenic also undergo simplification at a white heat — ^the values approaching those calculated for diatomic molecules. When zinc and bismuth are volatilized, they — ^like mercury and cadmium — afford monatomic molecules ; thallium, however, yields diatomic molecules. Numerous attempts have been made to determine the vapour densities of the alkali metals, but unfortunately they attack both platinum and porcelain vessels, and it is difficult to place confidence in the results. The "freezing-point" and "boiling-point" methods referred to later have been applied to a number of the (heavy) metals in the form of alloys or amalgams. The results seem to show that, in most cases, the liquid metal consists of monatomic molecules. Speaking gener- ally, in fact, there seems to be a far greater tendency on the part of non-metals than of metals to form complex molecules. It is more than probable that many of the properties connected with, and indeed characteristic of, the true metallic state have their origin in this circumstance. It is also not unlikely that important variations in the properties of metals, such as are occasioned by the presence of small amounts of foreign substances, may be the out- come of changes in molecular structure. Osmond has made this assumption in the case of iron, for example, to explain the existence of hard and soft varieties, and it is**

~~difficult to account for the extraordinary behaviour of iron in any other way/~~

~~Numerous experiments have been made by Victor Meyer and others to determine, with the aid of his appa^ ratus, the molecular weight of metallic chlorides toreMd' ^* ^^S^ temperatures, such knowledge being of molecular great importance in discussing the valency of composi- metallic elements. The results as a whole fa- vour the view that in many cases the~~

~~chlorides have the simplest possible composition at high temperar tures, whilst they undoubtedly form more complex mole- cules at temperatures near to their boiling-point; stannous chloride, for example, is represented by the formula SnClj at high, but by SujCli at low, temperatures. The case of aluminium is of special interest. This element occurs below boron in the periodic system and therefore should behave as a triad, but, as shown by Deville many years ago, the vapour of aluminium chloride not far above its boiling-point would seem to consist of molecules of the formula AljCle (compare Crafts, Trans. Chem. Soc. 1900, p. 993). Determinations made at much higher tempera- tures, however, give lower values, and the conclusion that aluminium is really a triad metal is apparently con- firmed by the observa,tions first made by Odling and Buckton in 1865, and supported by later experiments (cf. Quincke, Zeits. phys. Chem. 1889, p. 164), that alumi- nium methide, even at a temperature only 10° above its boiling-point, has a vapour density 20 per cent, lower than the value corresponding to the formula Alj(CHs)8, and that as the temperature is raised the density ap- proaches to that required by the formula A1(CH3)8. But such inquiries need to be carried out in a much more sys- tematic and exact manner than heretofore, especially now that a new field has been opened up by H. B. Baker's recent important observations, which show that ammo- nium and mercurous chlorides may be volatilized un- changed if only the presence of moisture be most scrupu- lously avoided ; all previous observers had found that both undergo decomposition when volatilized {Trans. Chem. Soc. 1900, p. 646).~~

~~Vaienoy. The conception of valency, introduced into chemistry by Frankland in 1852, may be said to be the dominant principle on which our entire system of rational or con- stitutional formulae is founded, and therefore the subject is one of the utmost importance. It may be defined as the doctrine of the functional activity of the elements, and includes the consideration not merely of the extent to which, but also of the manner and mode in which, an element or radicle enters into combination with others. The valency of an element is usually defined as merely its atom-fixing power relatively to that of hydrogen — elements being classed as uni-, hi-, ter-, quadrirvalent, or as monads, dyads, triads, tetrads, according as their atoms unite with one, two, three, four atoms of hydrogen or their equivalent. In this form the conception is not only a narrow one, but a totally inadequate expression of~~

~~the facts. Proof is not wanting that this is gradually being realized, and it may be hoped that ere long the complex character of the function will be more clearly recognized. The first step will then have been taken towards a truer appreciation of the phenomena. An admirable although brief summary of the historical de- velopment of the conception of valency is to be found in the lecture delivered by Professor Japp in memory of Kekule (Trans. Chem. Soc. 1898, p. 97).~~

~~lA valaable summary of our knowledge of the metals, from the points of view referred to in this paragraph, hy Mr F. H. Neville, is to he found in the Report of the British Association for 1900. A table of " intermetallic " compounds is given in this Report which is of interest as hearing on intermetallic valency.~~

~~The view that has met with almost general acceptance is that put forward by Frankland, according to which, whilst each element exhibits a maximum val- ency, it may manifest one or more subordinate vaien~~

~~The first difficulty that arises in determining the val- ency of an element is in the selection of a measure. In ' the case of elements capable of forming volatile hydrides an unexceptionable standard is at hand oimcaities in hydrogen, but few come under this category, wfjauoa. HIydrocarbon radicles such as methyl (CHg) are so entirely comparable with hydrogen that they form an equally efficient standard, and as many elements form methides which do not furnish volatile hydrides, some assistance may be obtained by calling such radicles into requisition. But in cases to which these criteria are inapplicable the difficulty becomes very great ; indeed, it is doubtful if a trustworthy standard can then be found. A difficulty of another order is met with in determining whether the atom-fixing power of an element is to be~~

~~regarded as a constant or variable quantity— or perhaps it is better to say, in determining the maximum valency of an element. In substance this difficulty arises from the difficulty previously referred to of obtaining and applying a satisfactory standard of valency. A third, and perhaps the~~

~~*greatest difficulty of all arises from the circumstance that valency is a dependent variable, the degree in which it is manifest depending on the conditions under which the element is placed.*~~

~~*Apparently the only saturated molecules known to us at present, I.e., molecules destitute of all power of exer- Saturated °^^^^S an external influence, are those of gases molecules. ^^°^ ^^ helium and argon. Even hydrogen is to some extent unsaturated, to judge from its behaviour towards the metals platinum and palladium. On account of its properties generally, however, and of the extreme difficulty with which it is compelled to assume the liquid state, it may be said to follow helium closely; consequently it may be supposed that the hydrogen atom is a strictly univalent atom, and that when it is associated either with itself or with another radicle its affinity becomes all but neutralized.*~~

~~*Tested by their power of combining either with hydrogen or methyl, the elements generally (in so far as these tests are applicable) may be resolved into the four groups of which the four hydrides HCl, HjO, H3N, H^C are types. But, except in the last of these groups, the compounds produced are unsaturated. Hydrogen chloride and ammonia very readily liquefy in presence of water, in which they are intensely soluble ; and water, considering its composition in comparison with that of hydrogen chloride and ammonia, and the fact that the analogous sulphur compound is gaseous and but slightly soluble in water, is altogether remarkable on account of its high boiling-point, its high capacity for heat, and its extraordinary power of dissolving oxygenated com- pounds generally and also chlorides, bromides and iodides. Apparently the only plausible — if not the only possible — interpretation of these peculiarities is that the three hydrides in question are all eminently imsaturated compounds. Assuming this to be the case, their attrac- tive power may be regarded as exercised either (1) by the molecules as wholes; or (2) by their constituents independently, although not necessarily to equal extents ; or (3) by one or other of the constituents.*~~

~~*The study of carbon compounds appears to justify the belief that in very many cases the activities which they display proceed rather from centres than from the mole- cules as wholes. Taking into account the estimate we are able to form on general grounds of the properties of hydrogen, on the*~~

~~one hand, and on the other ‘m”u‘ of elements such as chlorine, oxygen and nitro- ” ” gen, it therefore seems probable that in the~~

~~hydrides of these elements the attractive power is exer-” cised entirely by the element which is associated with the hydrogen ; that chlorine in hjrdrogen chloride, oxygen in water, and nitrogen in ammonia are each possessed of considerable residual affinity. It is to be noted that this residual affinity is by no means indiscriminately exercised. To put the point in conventional terms, whereas oxygen is prepared to behave as a dyad to all comers— to associate with them by means of its two affinities— fluorine alone being scorned, it is prepared to exhibit residual affinity only in presence of a select few; and most interesting of all, it seems to accord preferen tial treatment to itself and its near allies, the halogens. The behaviour of oxygen is all the more remarkable when it is contrasted with that of sulphur, the element with which it is most nearly allied ; as tested by its power of combining with other substances, m com- parison with water, sulphuretted hydrogen is absolutely~~

~~inert, and yet sulphur commonly ranks as an element of higher valency than oxygen. The peculiarity of oxygen referred to is specially manifest in the properties of ordinary water ; the production of a substance so remarkable among hydrides, it may almost be said, can only be explained by the assumption that the residual affinity of the oxygen in the molecule of the dihydride OH2 compels molecule to unite with molecule. To what extent complication proceeds we cannot yet say — ^the estimates vary ; but of one thing we are certain, that placid as the fluid is in appearance, it must be pictured as at all times the seat of an extraordinary turmoU of dissociative changes. The view that oxygen is not to be regarded as capable of acting only as a dyad, but that it can also manifest a higher valency, has been definitely advocated in various quarters of late years — ^notably by Meldola, by Briihl in explanation of the properties of hydrogen peroxide, and by Collie (cf. Trans. Gliem. Soc. 1899, p. 715) ; but in all these cases the oxygen has been pictured as acting as a tetrad, not merely as displaying residual affinity.~~

~~The argument which leads us to regard the oxygen in water and many other compounds as possessed of residual affinity would lead us also to conclude~~

that this is also manifested — although in very different degrees — by the chlorine in hydrogen chloride and by the nitrogen in ammonia. The question then arises whether the union of these two compounds, when ammonium chloride is formed, takes place in such a way that the elements become redistributed and separately centred around the nitrogen atom so that this acts as a pentad ; or whether merely the residual affinity of each molecule comes into operation. This is the old historic question which was discussed by Kekul^ and his con- otam^" temporaries in the 'sixties, and decided by him monium in the latter seiise, but wldch the general ver- '*""". diet of chemists has decided in favour of the '"' *' doctrine of varying valency. In the interval numerous facts have come to light which bear on the problem although they do not solve it. Baker's recent observa- tion, already referred to, may be held to meet Kekul's objection that ammonium chloride cannot be volatilized tmchanged ; but as the compound at once breaks down in presence of a mere trace of water, it is a question whether the objection does not retain its force. An argument of real weight in favour of nitrogen being regarded as a true pentad in the ammonium compounds has been furnished by the discovery of derivatives of the hypothetical amine oxide H3NO, corresponding with those which have long been known of the equally hypothetical phosphine oxide H3PO ; their existence was first recognized by Wemick and Wolffenstein in 1898. Such compounds are formed on oxidizing tertiary amines — dimethylaniline, for example — by means of hydrogen peroxide, and by the action of methyl and ethyl iodides on hydroxylamine. They are Ijighly basic substances, which combine directly with acids (cf. Bamberger, Dunstan and Goulding, Trans. Chem. Soc. 1899, p. 792).

On the assumption that the ammonium salts are molecular compounds, a quaternary ammonium derivative formed by uniting an amine Nabc with the iodide Id should differ from one produced from the amine Nabd and the iodide Ic. Experiments to test this assumption were made in 1875 by Meyer and Leceo, who on the one hand combined ethyldimethylamine with ethyl iodide, and on the other methyldiethylamine with methyl iodide; finding the products to have identical properties, they expressed the opinion that the ammonium derivatives were to be re- garded as atomic compounds. Similar experiments made by Ladenburg at about the same date led to inconclusive

~~results. Lessen pointed out at the time that Meyer's results did not necessarily justify the interpretation he gave to them, inasmuch as the differences likely to arise in such a case might be so slight as to escape detection, particularly as crystallographic identity — on which Meyer and Lecco had placed special reliance — ^was, as a matter of fact, to be expected. At a later date, owing to the in- troduction of stereo-chemical considerations, the problem assumed a different aspect, and it became clear that the existence of isomeric asymmetric optically active am monium compounds was to be expected. The existence of such compounds was rendered probable, but not proved, by observations made by Le Bel in 1891, and has lately been established beyond question by Pope and Peachey {Trans. (Jhem. Soc. 1899, p. 1127), who have succeeded in resolving benzylphenylallylmethylanimonium iodide into two powerfully optically-active isomerides. Al- though the problem is not solved by this important dis- covery, as. it is conceivable that a molecular compound might also exist in isomeric optically-active forms, it is brought nearer solution, as a possible method of determin- ing the structure of ammonium derivatives is at last placed in our hands. Yet it is evident that there may, and indeed wUl, be exceptional difficulty in ajriving at a conclusion, and that the utmost caution must be used in interpreting even negative results, as the possibility must be foreseen of interchanges of position readily taking place within the molecule. Le Bel has laid particular emphasis on this, but from a point of view which is open to question.~~

~~In the case of compounds of non-metallic elements generally with halogens, the halogen is invariably dis- placed with great readiness by the use of alkalies. It is therefore highly remarkable that the compound N(CH3)4l, for example, should not be in the least affected by even the strongest caustic alkali, and that the halogen in such compounds behaves much as does that in alkylic haloids. This would seem to be a strong argument in favour of the view that the halogen is not simply associated with the nitrogen, but retained in combination with the hydro- carbon radicle. An even stronger case may be based on the similar behaviour of the phosphonium haloids, seeing that the compoimds of phosphorus with halogens are so readily attacked even by water. It may be, however, that it is an effective answer to~~

~~this argument to say that such behaviour affords proof of the error of the current view which asserts that when an alkali acts on ammonium haloids the halogen is attacked by the metal ; in reality hydrogen is attacked by hydroxyl, the halogen only in- directly " f allLng a victim " to the metal, so that in the absence of hydrogen there can be little or no action. The case is one which well illustrates the difficulty of interpreting facts.~~

~~A class of facts which more than any other favours the view that the ammonium derivatives are molecular com- pounds may now be referred to. The basic qualities of ammonia, it is well known, are inyariably diminished by the introduction of other radicles in place of hydrogen, and the extraordinary variations in basicity manifest amongst its derivatives cannot fail to arrest attention. Aniliae, for example, is a very weak base in comparison with ammonia. But the chloranilines are still weaker, trichloraniline being so feeble that although soluble in acids it is precipitated on adding water. A more remark- able case is that of phenylhydrazine, CsHj.NH.NHj, which yields only monacid salts ; and hydrazine itself, H2N.NH2, although capable of forming diacid salts, has a marked tendency to combine with only a single equiva- lent of acid.~~

~~A large number of compounds are now known in which several nitrogen atoms are united in a ring, frequently in~~

~~conjunction with carbon. The nitrogen atoms seem to be united within the ring, on the one side by one and on the other by two affinities, so that the three affinities are entirely engaged within the ring. It is remarkable that the nitrogen in such compounds is in many cases entirely destitute of basic properties, and in fact inactive to an extraordinary degree. The s'ame may be said of the nitrogen in compounds such as azobenzene, as the few compounds these form with acids are decom- posed by water. But the most striking example of inactivity is afforded by the remarkable compound diazoimide, N2-NH — which may or may not have a ring structure; not only is this compound des- titute of basic properties, but it actually behaves as a weak acid.~~

~~Therefore it cannot be asserted that nitrogen is a " basic " element. It is basic, as a rule, only in the aminic condition ; the " ammonium function " is a strictly dependent function and highly discriminative.~~

~~The determination of the valency of the halogen elements is of primary importance, as we axe practically forced to rely upon them as standards in many cases. They commonly rank as well-defined monads, '^^"^ but as it is clear that iodine may exercise triadic aiogen. functions, the remaining halogens can scarcely be denied the rank of potential triads. The question to be settled is whether any effects they may produce beyond the functions of a true monad are to be ascribed to residual affinity, or whether they are actual triads. At present the evidence is inferential, as there are no valid methods available of determining iiie structure of the compounds comiag under consideration — for example, phosphorus pentaehloride and the double chlorides generally. In all such instances we have to deal with at least two un- knowns. Chemists have long been in the habit of dividing double chlorides into two classes — one comprising mere "double salts," of which very little proper notice was taken ; the other compounds of a somewhat higher order of stability, such as the platinichlorides, and aurichlorides, which have been regarded by many as atomic compounds, and in conjunction with compounds such as Os04have been quoted as proof that platinum may function as an octad. Obviously, in the present state of our knowledge, the only fact of which they afford proof is that chlorides may com- bine. The supposition that the constituents in double chlo- rides generally may be held together through the agency of the chlorine atoms is one which cannot be dismissed from consideration ; we do not hesitate to explain the formation of double cyanides, which are analogous compounds, by such an assumption, and, moreover, the existence of compounds such as the chtorates and perchlorates, and the extra- ordinary inertness of a part of the halogen in some of the cobaltamine compounds, almost compel belief in the existence of stable rings containing halogen atoms in which the halogen acts as a linking element. The applica- tion of this view to fluorine is of particular importance. There can be no question that this element is possessed of residual affinity in a far higher degree than any of the allied elements. The vapour of hydrogen fluoride near to its boiling-point (19°) consists of complex molecules (Mallet), which, as Thorpe and Hambly have shown, are only completely resolved into simple molecules at a temperature near to the boiling-point of water (Trans. Chem. Soc. 1889, p. 163). Double fluorides of remarkable stability are formed with'exceptional ease. The properties of some of these are worthy of special consideration — notably hydrogen silicon fluoride, a compound analogous in composition to~~

~~hydrochloroplatinic acid. In conse- quence of its relation to carbon the valency of silicon may be regarded as established. If silicon be a tetrad, we are, how- ever, almost compelled to assume that in hydrofluosilicic~~

~~acid two molecules of hydrogen fluoride are associated with the molecule of silicon tetrafluoride through the agency of fluorine atoms ; and it is worth while noticing that the stability of silicon tetrafluoride in presence of water is increased in a remarkable manner through its association with hydrogen fluoride. In view of these considerations, it is impossible to accept phosphorus pentafluoride as proof that phosphorus is a pentad. The still more remarkable compound sulphur hexafiuoride, a gas which is not acted upon even by potash, recently discovered by Moissan (C. M. 1900, 130, p. 865), in like manner cannot be re- garded as proof that sulphur is a hexad. It may almost be said that its extraordinary inertness is only com- patible with the view that the sulphur and fluorine atoms form a closed chain or ring.~~

~~Sulphur is commonly supposed to be capable of acting not only as a dyad, as in sulphuretted hydrogen, but also as a tetrad on the evidence afforded by the sul- Mu^bZ. " plionium compounds, and as a hexad in conse- quence of the existence of the oxide SO3. The sulphonium compounds are the sulphur analogues of the quatenary ammonium compounds, and according as the latter are regarded as atomic or molecular compounds, so must the former be equally so regarded. Most important observations bearing on this problem have been recently made by Pope and Peachey (Trans. Chem. Soc. 1900, p. 1072), who have shown that it is possible to obtain the sulphonium compound which is formed on combining methylethyl sulphide with bromacetic acid in isomeric optically-active forms — a discovery which appears to prove that sulphur can function as a tetrad much as carbon does. Inasmuch as we are at present unable to determine the structure of sulphur trioxide, its exist- ence cannot be accepted as proof that sulphur functions as a hexad. As bearing on this subject, the following striking passage may be quoted from Mendeleeff's Faraday lecture (p. 653): —~~

~~The periodic law has demonstrated that the maximum extent to which different non-metals enter into combination with oxygen is determined by~~

~~the extent to which they combine with hydrogen, and that the sum of the number of equivalents of both must be equal to 8. Thus chlorine which combines with 1 atom, or 1 •equivalent of hydrogen, cannot fix more than 7 equivalents 'of oxygen, giving CI2O7 ; while sulphur, which fixes 2 equivalents of iydrogen, cannot combine with more than 6 equivalents, or 3 atoms of oxygen. It thus becomes evident that we cannot recog- nize as a fundamental property of the elements the atomic valencies ■deduced from their hydrides; and that we must modify, to a certain extent, the theory of atomicity if we desire to raise it to -the dignity of a general principle capable of affording an insight iiito the constitution of all compound molecules. In other words, it is only to carbon, which is quadrivalent with regard both to oxygen and hydrogen, that we can apply the theory of constant valency and of bonds, by means of which so many still endeavour to explain the structure of compound molecules.~~

~~Mendeleeff in these remarks altogether leaves out of account the possibility that the oxygen atoms in the oxides are not always separately attached, and apparently he does so advisedly ; yet the properties of ruthenium and, osmium tetroxide and of the perchlorates, for example, almost necessitate such an admission. As an empirical generalization, the limit he fixes to oxidation is of remark- able interest and importance, and it is noteworthy, bearing in mind the resemblance fluorine bears to oxygen, that the sum of the equivalents in the highest fluoride is the same as in the highest oxide of sulphur. May it be that the same " law " applies to the oxides and fluorides of non- metallic elements ? ^ n ^ • t,..~~

~~It remains to point out that an argument of great weight in favour of the view that iodine functions as a triad is supplied by Victor Meyer's discovery in 1889 of the iodon- ium compounds, which apparently bear the same relation to iodine that the sulphonium compounds bear to sulphur,~~

~~719~~

~~Diphenyl-~~

~~and the ammonium compounds to nitrogen.~~

~~iodonium hydroxide, I -; CeHj, is readily soluble in water,~~

~~(oh~~

~~forming a strongly alkaline solution. On adding potass- ium iodide to a solution of the base, the correspond- ing iodide is thrown down as a yellow precipitate closely resembling lead iodide. When heated, this iodide is very readily converted into iodobenzene, heat being developed. It is very diificult, indeed impossible, to apply the molecular compound hypothesis to such substances.~~

~~From the above sketch, in which only a few of the main points are touched on, it will be obvious that the problems to be solved are many and difficult. At present we have little but shadowy impressions to guide us ; certain dogmas are taught in the schools, and these in- fluence our judgment, if indeed we can be said to exercise any judgment in the matter. It is time the facts were more carefully correlated, and that systematic inquiries were instituted, as the determiaation of the valency of elements may be regarded as in a measure a determination of their structure. Fortunately a new beginning has been made in this direction by the recent extension of stereo-chemical . conceptions to elements other than carbon; indeed, the facts brought to light are already sufficient to carry the problem a stage farther. As sulphur is found to yield optically-active sulphonium derivatives, and therefore to resemble carbon, it must be supposed that this element can act as a tetrad ; and on similar grounds the nitrogen in the ammonium compounds must be allowed to rank as a pentad. But seeing that the formation both of ammonium and of sulphonium com- pounds takes place only within very narrow limits, and that, as previously pointed out, nitrogen is basic only under special conditions, it is clear that in the case of the four affinities of the sulphur and of the five of the nitrogen atom, two of the former and three of the latter differ greatly from the remainder, and it would seem both in magnitude and character. A similar argument applies to other elements- the valency of which apparently varies. If such a conclusion be warranted, the problem after all remains very much what it was when the question was raised by Kekule.~~

~~In recent years the attempt has been made — largely on the authority of Helmholtz (Faraday lecture. Trans. Chem. Soc. 1881, p. 277) — to give a more precise form to the conception of valency, by regarding it from an~~ ‘^^

~~electrical standpoint — by assummg that definite indivisible charges of electricity, positive or negative, are associated with the atoms of matter, the number of charges corresponding with the number of units of affinity manifested by the atom, i.e., its valency. These charges are supposed to condition the formation of compounds, the atoms clinging to the charges, and the charges of opposite sign clinging to each other. This hypothesis is the basis of the ionic dissociation hypothesis, to be discussed later, which has become so popular in recent years. But the new view is but a paraphrase of the old view. If the nitrogen atom, for example, carry five unit charges, it is difficult to understand why two of them should so often remain in abeyance ; on the other hand, if only three charges are associated with the atom, it becomes necessary to admit that the unit charge may be divided — a supposition which is contrary to the hypothesis. The hypothesis does not take into account the fact that the fundamental molecules, even of so-called atomic compounds — water molecules, for example, — rarely, if ever, behave as saturated, but more or less readily and firmly unite with other molecules to form molecular aggregates. Helmholtz, seeing the difficulty, said that he did not suppose that the existence of other molecular forces, working directly from atom to atom,~~

~~was to be excluded. But, apart from the fact that a hypothesis which requires so much helping out is of little practical use from the chemist's point of view, it seems necessary to admit that whatever may be the nature of chemical affinity, the same forces are active throughout — that what sometimes is termed residual affinity is of the nature of ordinary affinity, and that the difference is in quantity rather than in quality.~~

~~Stkuctuee and Isomerism.~~

~~The study of structure is correlative with that of valency ; in fact they are strictly interdependent studies, our views on valency being founded on the success with which we are able to apply them in deducing satisfactory structural formulae. Of late years chemists ha,ve devoted their attention almost exclusively to the investigation of carbon compounds, to such an~~

~~extent as even to provoke the complaint that they are guilty of unduly neglecting the study of other elements. But even if true there would be slight reason t6 deplore this. In consequence of the extraordinary activity displayed by workers in organic chemistry, our knowledge of carbon compounds has reached a high degree of development, and materials are fast being accumulated from which it will be possible ultimately to deduce precise conclusions as to the manner in which properties are dependent on structure ; since it is now clear that the properties of the carbon compounds are primarily functions of their structure, and only in a minor degree dependent on their composition. The number of carbon compounds already known is legion, and there are still in- finite possibilities before us. The technique of the subject is also highly developed, and new combinations o/ deter- ^re readily effected ; it is easy, therefore, as a mining rule, to test any hypothesis that may be framed, structure, ĵ^ ultimately to secure evidence which is sufficient either to prove or disprove its accuracy. But in the case of all other elements a far less plastic material is dealt with, and the field of investigation is a compara- tively narrow one; it is therefore less easy to avoid a dogmatic construction of the evidence. The difficulty of dealing even with such simple compounds as the chlorides has already been referred to. To deal with the oxides is still more difficult. Indeed, there can be little doubt that our knowledge of the structure of inorganic compounds generally is far less definite than is often supposed to be the case, and that much is taught in the text-books for which there is no justification. To take two examples, the alkalies and acids. Caustic soda and potash are now invariably represented by the formulae NaOH, KOH, but there is no evidence which can be called evidence that these are correct : they are but an expression of a prevail- ing fashion, being used because the view is held that the relationship of the alkalies to water is — or ought to be — that represented by such formula, and because of the existence of alcohols. It is, at least, as probable that they are but hydrates of the oxides, e.g., NajO.OHj. Again, sulphuric acid is always represented as S022; the arguments on which this formula rests, however, are equally applicable to the old Berzelian formula, SO3.OH2. The statement commonly made that by the action of phosphorus pentachloride sulphuric acid is first converted into SO3HCI and then into SO2CI2, and that thereby proof is obtained of the existence of two OH groups in the acid, to begin with, is half wrong, as the second product is pyrosulphuryl chloride, SjOsClj, not sulphuryl chloride,~~

~~*SO2CI2. Moreover, the production of the compound SOgHCl cannot be held to prove that the acid contains the hydroxyl group ; as this compound is readily obtained by combining sulphuric anhydride with hydrogen chloride, its production may be a consequence of the removal of*~~

~~*" water " from the acid by the action of the pentachloride, and the consequent union of the residual oxide with hydrogen chloride formed by the interaction of water and phosphorus pentachloride. It is not impossible that SO3HCI is a molecular compound, and not an acid chloride, as the corresponding compound formed by combining ethyl chloride with sulphuric anhydride behaves as a mild form of the latter, i.e., as a sulphonating agent, not as an acid chloride. Lastly, it may be pointed out that the properties of sulphuryl chloride, SO2CI2, are alto- gether peculiar, and not those of an acid chloride ; as a rule it acts as a chlorinating agent, consequently its con- version into sulphuric acid by water affords no proof of the constitution of the acid. It may well be that water is initially " chlorinated " by it, and that in consequence the SO2 group becomes oxidized to SO3, which then unites with water, forming sulphuric acid.*~~

~~*It is unnecessary to pursue such arguments farther. It is sufficient to point out that in many cases our views of structure are of the nature of preconceived opinions, being based on a too narrow interpretation of the facts. It is time that students were made more fully aware of the precise value of the formulae they are in the habit of using, as it is essential that the chemist should pre- serve a free and balanced judgment. The dogmatic treatment too frequently accorded to our subject is abso- lutely subversive of true scientific method and serves to retard progress.*~~

~~*Passing to carbon compounds, the greatest advance to be noted in our knowledge of structure is that due to the introduction of geometrical conceptions by van't Hoff and Le Bel independently in 1874, f^^'^^ which has given rise to the now well-known doctrines of stereoisomerism, i.e., isomerism due to differ- ences in the arrangement of the atoms in space. In this doctrine it is assumed that the molecule is a stable sys- tem of material points, and that the radicles associated with a carbon atom occupy fixed positions ; it is further supposed that they are situated in the manner represented by taking the tetrahedron as the model of the carbon atom and grouping the four radicles with which it is associated in all saturated compounds at the four corners of the model — of which the carbon atom may be supposed to occupy the centre of gravity. On this assumption, a compound CR'4 can exist in only one form, so long as any two of the radicles are identical, but when all four are unlike two forms are possible. The models of these two forms are two tetrahedra which cannot be superposed but bear to each other the relation of right to left hand; the two forms are therefore said to be enantiomorphously related, and as neither planes nor centre of symmetry can exist in such forms, the carbon atom which is their central feature is termed an asymmetric carbon atom.*~~

~~*Of greatest importance is the explanation this doctrine affords of cases of isomerism such as that met with in the two tartaric acids, the separation of which from racemic acid was Pasteur's great achievement and the one which first gave him fame. Pasteur, indeed, in discovering the relationship of these acids and their possible structure, clearly foreshadowed the hypothesis (cf . Frankland, Pas- teur Memorial Lecture, Trans. Chem. Soc. 1897, p. 691). It is now known that in all cases in which carbon compounds*~~

manifest the power in solution of rotating the plane of polarized light — as do the two tartaric acids — they con- tain one or more asymmetric carbon atoms. On the other hand, it has been shown that in the case of a large number of compounds represented by a formula containing an asymmetric carbon atom, but initially produced in an optically-inactive form, it is possible, by methods such as were introduced by Pasteur, to resolve the inactive pro- duct into two isomerides of equal but opposite optical

activity.! The formation of optically-active nitrogen compounds foreseen by Le Bel and established by Pope and Peachey, and the still more recent discovery of such compounds derived from the metal tin and from sulphur by these latter chemists (Proc. Chem. Soc. 1900, p. 42 ; Trans. Chem. Soc. 1900, p. 1072), have aiforded proof that the doctrine of asymmetry may be extended to elements other than carbon, and it may be confidently expected that these are not the only cases in which it will be found to be applicable. The extraordinary value of the doctrine of asymmetry will be appreciated when its application to compounds such as those of the sugar group — which are all optically-active — is understood, especially when it is borne in mind that prior to the introduction of the theory it was impossible to explain in any satisfactory manner several cases of isomerism, occurring in this group, and this too at a time when the number of compounds included in the group was far smaller than is now the case.

Among the many investigations into minute structure carried out in recent years, none ranks higher in import- ance or is more full of interest than that of gUiooses. ^- I'ischer on the sugars, in the course of which he has been led not only to synthesize glucose, but also to prepare a large number of new isomeric hex- oses, and to place their constitution beyond all doubt with the aid of the van't Hoff-Le Bel theory. As a mon- ument of experimental skill the inquiry stands unrivalled, and no better illustration can be given of the perfection to which analytic and synthetic methods have been car- ried by organic chemists. The carbohydrates — a class of compounds of supreme importance on account of the part they play as structural and food materials in the economy of plants and animals — stand

~~*in close genetic relationship, and glucose (dextrose) being the end term of the series, and the product into which most of the more complex members of the group are resolved by hydrolysis, has long attracted the attention of chemists. At an early date it was discovered that both glucose and fructose (Isevulose) — the two isomeric hexoses of the formula CeHijOe which are formed on hydrolysing cane sugar — are derivatives of the parafSn hydrocarbon' normal hexane, CsHu, in which the six carbon atoms are known to be arranged just as the links are in a simple branchless chain. Both yield mannitol, CeHi^Oe, a well-known natural product, on re-duction. Mannitol is proved to be a hexhydric' alcohol, C6H8e, by its conversion into a hexanitrate, and as it is a highly stable compound (alcohols containing several hydroxjsl groups attached to one carbon atom being un- stable), there can be no doubt that the six atoms of oxygen which it contains, and which were originally present in the hexoses, are each separately associated with a carbon atom. When mannitol is distilled with a solution of hydVogen iodide, it is converted into hexylic iodide, Ce HisI, which on further reduction yields the hydrocar- bon normal hexane. Glucose behaves as an aldehyde on oxidation, being converted into monobasic gluconic acid, so that one of the oxygen atoms is present as COH ; consequently its formula may be written :—*~~

~~*CH,(OH).CH(OH).CH(OH).CH(OH).CH(OH).COH.*~~

~~*The behaviour of fructose, on the other hand, is that of a ketone rather than that of an aldehyde ; but two ketoses can be derived from an alcohol such as mannitol:—*~~

~~*Ketoses, { cH2(OH).CH(OH).CH(OH).CO.CH(OH).CH2(OH^ It was not until 1^85 that Kiliani succeeded in discrim-*~~

~~*1 Ti-or a full discussion of the doctrine and its consequences see ^raJtkoe'BArravo-ment of Atoms in Space. English translation by Eiloart (Longmans, Green, and Co.).*~~

~~*inating between these two formulae, as well as in proving the correctness of the formula commonly assigned to glucose. The method he adopted consisted in, as it were, attaching a label to the CO group, apd subsequently determining the position of the label. The label used was carboxyl, CO2H,*~~

~~the group characteristic of acids, which was attached by afB^ng hydrogen cyanide to the CO group and tfhen hydrolysing the cyanogen group : —~~

~~/OH :CO-|-H.Clf= :C<~~

~~\CN~~

~~/OH /OH :C/ 2-l-0H^= ;C< + 'STL3-~~

~~>^CN~~

~~' X!0,~~

~~H~~

~~CH2~~

~~CHs~~

~~CH(OH)~~

~~CHj~~

~~CH(OH)~~

~~CH2~~

~~CH(OH)~~

~~CH2~~

~~CH(OH)~~

~~CH2~~

~~CHaCOH)~~

~~CH2.CO2H~~

~~Mannitol.~~

~~*Normal heptyllo acid.*~~

~~*To determine the position of the carboxyl group the acids were then reduced, i.e., the OH groups were displaced by hydrogen by means of hydrogen iodide, and they were thus converted into acids of the acetic series of the formula C7H14O2 (heptylic acids). The acid from glucose proved to be the normal acid, and that from fructose butylmethyl- ac^tic acid, proving that the CO group in glucose was at the end of the chain, but that it formed, as it were, the second link in fructose : —*~~

~~*CHs*~~

~~*CH2*~~

~~*CH2*~~

~~*CH2*~~

~~*6H.C02H*~~

~~*CHs*~~

~~*Butylmethyl- acetic acid.*~~

~~*E. Fischer's entry on the scene dates from the year 1884, when he made the all-important discovery of phenylhydr- azine,C6H5.NH.NH2 0rPh.NH.NH2. Although ^*~~

~~*not the Eosetta stone which enabled him to fgHarcbes. decipher the minute structure of glucose and its congeners, this compound made possible for the first time the separation and identification of such compounds. Its use and value depend on the fact that keto-compounds generally are converted by it into hydr- azones, which are usually well-defined crystalline sub- stances : —*~~

~~*: C0-|-Ph.NH.NH2= : C:N.NHPh-fOH2.*~~

~~*In the case of the hexoses, which are readily oxidized, the action, however, usually proceeds a stage farther, an osazone being formed by the oxidation,*~~

~~at the expense of the phenylhydrazine, of the " alcohol " group contiguous to the hydrazo-group, and the action on the new keto- compound thus produced of another molecule of phenyl- hydrazine; thus: —~~

~~CHaCOH) CH2 CHzCOH)~~

~~CH(OH) CH(OH) CH(OH)~~

~~CH(OH) CH(OH) CH(OH)~~

~~CH(OH) CH(OH) CH(OH)~~

~~CO C:N.NHPh C:N.NHPh~~

~~CH:N.NHPh CHO CH:N.NHPh~~

~~I. II. in.~~

~~The first of these formulae represents the intermediate product formed from glucosehydrazone ; No. II., that derived in like manner from f ructosehydrazone ; No. III. represents glucosazone, the final product whether glucose or fructose* be used. The production of one and the same substance from the two hexoses is a result of peculiar importance as bearing on their structure, for it will be obvious that it affords the proof that a greater part — the four upper tiers, as it were — of their molecules is identi- cally constituted. On reference to the formula of glucose, it will be noticed~~

~~that each of the four carbon atoms in the four CH(OH) groups is combined with four different radicles, so that there are four asymmetric carbon atoms in the formula. The number of modifications of an asymmetric compound — ^which is not itself symmetric — is 2", where n is the number of such carbon atoms ; it is therefore to be sup- posed that 16 isomeric aldohexoses~~

~~of the formula CeHijOs can exist. At the time. Fischer began to work at the group only one was known besides glucose — galactose, which is obtained together with glucose on hydrolysing milk sugar. In 1894, when Fischer summarized the re- sults of his work, he was able to speak of no fewer than eleven of the sixteen, and to define their structure precisely.~~

~~The next chapter of discovery to be considered relates to the synthesis of fructose and glucose, one of the most memorable achievements in chemistry in view of the part these play in plant economy. Butlerow, a distinguished Russian chemist, as far back as 1861, by digesting trioxymethylene, the solid polymeride of formic aldehyde, HjCO, with lime, obtained a sugar-like substance, methylen- itan, to which he assigned the formula CjHmOb. Atten- tion was specially directed to this research by Baeyer, in 1879, in the course of the celebrated paper in which~~

~~he discussed the formation of sugar in the plant. offnctase -^^^7®^ maintained that formic aldehyde must~~

~~be regarded as the primary product formed by the'reduction of carbon dioxide in the plant, and as that from which glucose and similar substances are gradually built up. Owing to the diificulty of preparing formic aldehyde, the subject was left untouched for a considerable time until Low, in 1886, greatly improved the method of producing the aldehyde — so much so, that it is now manu- factured on a very large scale, and used in making certain aniline dyes and also as an antiseptic agent. Low carefully repeated Butlerow's work, and obtained results which he regarded as confirmatory of Baeyer's suggestion ; he de- scribed the product as a sweet, unfermentable syrup, of the formula CjHuOe, and termed it formose. Low, how- ever, assigned the formula CisHjaNiOg to the osazone pre- pared from this formose, whereas that of glucosazone is C18H22N4O4. To explain this discrepancy, E. Fischer repeated Butlerow's and Low's experiments, and arrived at the conclusion that the main product was in reality a compound of the same composition as glucose, though resembling it only distantly in properties, for which formose was a very suitable name. At the same time he discovered in the praduct a relatively small proportion of an isomeric substance which was subsequently identified as the a-acrose to be referred to later. Meanwhile, Low had continued his experiments, and by using~~

magnesia in place of lime, had obtained a fermentable product which he named methose. In Fischer's hands this also proved to be a-acrose. This substance was discovered by Fischer and Tafel in 1887, and was first obtained by cau- tiously adding baryta to a solution of acrolein dibro- mide, prepared by combining the aldehyde acrolein, CHjiCH.COH, with bromine. A better method of pro- ducing it, subsequently discovered, is to oxidize ordinary glycerol by means of bromine and alkali, and to subject the product to the action of very dilute alkali at 0°. Glycerol yields two compounds when oxidized — ^the corresponding aldehyde and the corresponding ketone, and apparently a-acrose is formed from these by " condensation " in the manner indicated in the equation : — •

CHj(OH).CH(OH).COH+CH2.CO.CH2 =

CHj(0H).CH(0H).CH(0H).CH(0H).C0.CH2.

It should be mentioned, however, that it is only one of several products. The osazone prepared from a-acrose was found to

resemble most closely that obtained from glucose and fructose, acrosazone differing only from glucosazone in being optically inactive. This observation showed that a most important step had been taken towards synthesizing the natural hexoses, as it justified the conclusion that a-acrose was merely the inactive form of either glucose or fructose — a view which was ultimately confirmed, but only after years of work. In the first place, it was necessary to reproduce the hexose from the osazone, the form in which alone it can be isolated from the crude synthetic product. Ultimately it was found that the action of phenylhydrazine on the hexoses could be reversed by means of muriatic acid, the group N.NHIPh being thereby removed and displaced by oxygen, giving rise to an osone or onal — a compound combining in itself the pro- perties of aldehyde and ketone, which on reduction by means of zinc dust and acetic acid is converted into a ketose; thus —

CH2

CHaCOH)

~~*chjCOH)*~~

~~*CH(OH)*~~

~~*CH(OH)*~~

~~*CH(OH)*~~

~~*CH(OH)*~~

~~*CH(OH)*~~

~~*CH(OH)*~~

~~*CH(OH)*~~

~~*CH(OH)*~~

~~*CH(OH)*~~

~~*C:N.NHIPh*~~

~~*C:θ*~~

~~*C:θ*~~

~~*CH:N.NHIPh*~~

~~*CH:θ*~~

~~*CHaCOH)*~~

~~*Glucosazone.*~~

~~*GIucoBone.*~~

~~*Eetose.*~~

~~*The compound prepared from acrosazone was found to have the properties of fructose, to be fermentable by yeast, to give Isevulinic acid when boiled*~~

with muriatic acid, and to be converted by the action of sodium amalgam into a-acritol, a substance indistinguishable from mannitol except by its inactivity toward polarized light. As illustrating the difficulties met with in the research, it may be mentioned that starting from a kilogram of glycerol, only 0-2 gram of a-acritol could be obtained, in consequence of the number of the operations and the bad yields afforded by some of them. The character of a-acritol was ultimately deciphered by a method of indirect approach. Prior to Fischer's investigations, the attempt had' often been made to reconvert mannitol and the isomeric alcohol dulcitol — which, besides being a natural product like mannitol, is formed on reducing galactose from milk sugar — into sugars by subjecting them to oxidation, but the results obtained were in- conclusive owing to the difficulties met with in isolating the products. It was here that phenylhydrazine again proved to be an invaluable agent. With its aid Fischer and Hirschberger were able to show in 1887 that when mannitol is oxidized by means of nitric acid, it yields, besides fructose, an isomeride of glucose, mannose, which is the true aldehyde of mannitol, glucose belong- ing to a stereoisomeric series. Mannose and glucose are, however, most intimately related, as both ultimately yield glucosazone when subjected to the action of phenylhydrazine ; hence it follows that they differ only in respect of the first asymmetric carbon atom above the COH ^oup.

The investigation was assisted by the discovery made at this stage that mannose, the existence of which had so long lain hidden, was easily procurable from natural sources — ToUens and Gans obtaining it by hydrolysing salep mucilage, and Reis from so-called reserve cellulose, vegetable ivory turnings being a particularly suitable material from which to prepare it. On oxidation, mannose, like glucose, yields a monobasic acid — mannonic acid, which is a stereoisomeride of gluconic acid. When the aqueous solution of this acid is evaporated, the acid loses the elements of a molecule of water and is converted into a lactone, CeHjoOe, which crystallizes well. Now

it had been observed by Kiliani that when arabinose a

sugar belonging to the pentose group, i.e., one containing

five atoms of carbon — is combined with hydrogen cyanide, and the cyanide is hydrolysed, an acid isomeric with ordinary gluconic acid is obtained, and Kiliani had pre- pared from this acid the correspondiag lactone. Kiliani's lactone and that obtained from mannonic acid were found by Fischer to be extraordinarily similar, but to differ in optical activity; by mixing the two lactones m equal proportions he obtained an optically-inactive product.

The final step was taken at this stage. It was found that the lactones referred to could all be converted into corresponding sugars by combining them with hydrogen by means of sodium amalgam, the mannolactone giving ordinary mannose, the isomeric lactone an isomeric man- nose of equal but opposite activity, and the inactive lactone an iaactive mannose. Corresponding mannitols were obtained by subjecting these aldoses to further reduction, and it was found that the inactive mannitol was identical with a-acritol. Hence it followed that the a-acrose separated from aerosazone was an inactive mix- ture of ordinary fructose with an isomeride of equal but opposite rotatory power. A separation was effected by destroying the ordinary fructose by fermentation with beer yeast, and then adding phenylhydrazine. An osazone was thus obtained which was the stereoisomeride of glu- cosazone prepared from ordinary fructose.

Although fructose had been obtained, it yet remained to prepare glucose. Bearing in mind the relation of mannose

to glucose, it was to be expected that the one ftgi^msl. °^.^^ convertible into the other, but it could

be foreseen that owing to their instability it would be difficult in practice to effect the conversion. Fischer, therefore, preferred to attempt to convert the correspond- ing monobasic adids into each other, as these were more stable, andPasteur's researches already provided a method, viz., that used in preparing Isevotartaric acid from ordi- nary dextrotEurtaric acid. He soon found that ordinary gluconic acid could be obtained from mannonic acid, and vice versd, by heating their solutions with quinoline under pressure at 140°. The final step in solviag the problem was then easily taken

~~by converting ordinary gluconic acid into its lactone and reducing this latter.~~

~~Having thus succeeded in preparing substances identical with natural dextrose and laevulose entirely by artificial means, and starting from formic aldehyde — which can itself be produced from carbon dioxide, the material from which the plant derives its carbon — ^Fischer devoted his attention to the preparation of other stereoisomerides of glucose in order to obtain the data necessary to determine the exact configuration of the individual compounds. To understand his methods, it is necessary to bear in mind the manner in which the sixteen possible hexaldoses are structurally related. An asymmetric carbon system in which the four radicles attached to the carbon atom are~~

~~arranged in a given order — say clockwise — may Configura- ^e termed a positive (f), and one in which tion of the /del> ^^^ arranged counter-clockwise a negative bexaiaoses. " gygtem. When there are two such systems in a compound, four different arrangements are possible, provided the compound as a whole be asymmetric, viz. —~~

~~But if, as in the case of tartaric acid,~~

~~(C02H).CH(OH).CH(OH).(C02H),~~

~~the compound is symmetric, being composed of two like systems two of the four forms (those included in brackets) are identical, and the number of stereoisomerides is re- duced to three ; moreover, in this latter case only two of the forms will manifest optical activity, the third being~~

~~inactive, as it consists of two equal systems of opposite sign. In the case of the hexaldoses, which are all repre- sented by unsymmetrical formulaB, symmetry is produced when the terminal groups become identical, as in the formation either of the corresponding hexhydric alcohol or of the correspondiag tetrhydric di-acid : —~~

~~Hexhydric alcohol Hezaldose Tetrhydric di-acid~~

~~CHjCOH) . [CH(OH)]4.CH2~~

~~*CH2rOH).[CH(OH)]4.COH*~~

~~*C0(0H).[CH(0H)]4.C0(0H).*~~

~~*Consequently, whereas there are sixteen possible hexal- doses, there are only ten corresponding hexhydric alco- hols and ten di-acids. In the following table the possible configuration of the four asymmetric systems are arranged so as to indicate the pairs of forms (5 11, 6 12, etc.) which give rise to one and the same substance when the molecule becomes symmetrical.*~~

~~*11*~~

~~*12*~~

~~*13*~~

~~*14*~~

~~*15*~~

~~*16*~~

~~*1*~~

~~+~~

~~*1*~~

~~*1*~~

~~+~~

~~-~~

~~+~~

~~*H-*~~

1

-

-

1

+

-

-

+

-

-

-

4-

-

-

-

-

f

f

-

-

+

-

-

-

-

+

-

H-

-

+

-

-

+

-

-

+

-

1

-

1

1

1

-

-

1

+

1

-

-

+

+

+

+

1

-

1

2

3

4

5

~~6~~

~~7~~

~~8~~

~~9~~

~~10~~

~~*Besides proving that the hexaldoses can be reproduced by reducing the lactones formed from the monobasic acids into which they are first converted by oxidation, Fischer has shown that it is possible to effect a similar reversal even in the case of the dibasic acids which are formed by continuing the oxidation. This discovery is of funda- mental importance, as it gives a means of dealing, as it were, with both extremities of the molecule, and even of reversing the positions of the terminal groups in the hexaldoses. Taking the case of the saccharic acid, Co2H.[CH(OH)]4.C02H, formed on oxidizing ordinary glucose, if the configuration be one of those represented under 1, 2, 3, or 4 in the above table, it must be a matter of indifference which of the two COjH groups is reduced to CH2 and which to COH — the result will be the same; but not so in any other case. Ex- periment has shown that the hexaldose obtained from ordinary saccharic acid is not glucose, but an isomeride now known as gulose. The optical isomeride of this gulose is obtained by making use of the gluconic acid which is the optical isomeride of that prepared from ordinary glucose. The importance of such a result is obvious ; not only is the series extended, but it is placed beyond question that configurations 1-4 do not occur in either glucose or gulose, and iu view of the simple rela^ tion which mannose bears to glucose, and seeing that the difference resides in the asymmetric system adjoining the COH group, it becomes possible to establish the con- figuration of glucose, gulose, and mannose.*~~

~~*Since d-glucose^ and d-gulose both yield d-saccharic*~~

~~*1 To distinguish the isomerides of opposite optical activity, it is usual to prefix the letters d- and 1-, but these are used only to indicate the genetic relationship, and not the character of the optical activity ; ordinary*~~

fructose, for example, being represented as d-fructose — al- though it exercises a Isevorotatory power — because it is derived from d-glucOse.

acid on oxidation, the configuration in this and the Coafigun- corresponding 1-acid must be sought from tfpn o/ among those numbered 5-10 in the above table. Isomeric Nos. 7 and 8 can be at once ruled out, how- giacoses. g^gj.^ ^^ acids SO constituted would be optically- inactive and the saccharic acids are active. If the con- figuration of d-saccharic acid were given by either 6 or 10, bearing in mind the relation of mannose to glucose, it would then be necessary to represent d-mannosaccharic acid by either 7 or 8 — as the forms 6 and 10 pass into 7 and 8 on changing the sign of a terminal group ; but this cannot be done as mannosaccharic acid is optically active. Nos. 6 and 10 must, in consequence, also be ruled out. No. 5, therefore, represents the configuration of one of the saccharic acids, and ISo. 9 that of the isomeride of equal opposite rotatory power. As there is no means of distinguishing between the configuration of a dextro- and laevo- modification, an arbitrary assumption must be made. No. 5 may therefore be assigned to the d- and No. 9 to the 1-acid. It then follows that d-mannose is represented by No. 1, and 1-mannose by No. 4, as mannose i^ produced by reversing the sign of the asymmetric system adjoining the terminal COH group.

It remains to distinguish between 5 and 11, 9 and 15 as representing glucose and gulose. To settle this point it is necessary to consider the configuration of the isomeric pentoses — arabinose and xylose — from which they may be prepared. Arabinose being convertible into 1-glucose and xylose into 1-gulose, the alternative formulae to be considered are —

CHjCOH) -f. COH

CH2 + + + _ COH.

If the asymmetric system adjoining the COH group, which is that introduced in synthesizing the hexose from the pentose, be climated, the formulae at

~~disposal for the two pentoses are —~~

~~CHsCOH) COH~~

~~CH2 -^ COH.~~

~~When such compounds are converted into corresponding dibasic acids, C02H.[CH(OH)]3.C02H, the number of asymmetric carbon atoms becomes reduced from three to two, as the central carbon atom is then no longer associated with four, but with only three different radicles. Hence it follows that the " optical " formulae of the acids derived from two pentoses having the configuratiop given above will be —~~

~~COOH — 0 — COOH COOH + 0 — COOH,~~

~~and that consequently only one of the acids will be optically active. As a matter of fact, only arabinose gives an active product on oxidation; it is, therefore, to be~~

~~supposed that arabinose is the — compound, and~~

~~consequently —~~

~~CH^COH) h COH = 1-glucose~~

~~CHj(OH) f COH = 1-gulose.~~

~~When xylose is combined with hydrocyanic acid and the cyanide is hydrolysed, together with 1-gulonic acid, a second isomeric acid, 1-idonic acid, is produced, which on reduction yields the hexaldose 1-idose. When 1-gulonic acid is heated with pyridine, it is converted into 1-idonic acid, and vice versd; and d-gulonic acid may in a similar manner be converted into d-idonic acid, from which it is possible to prepare d-idose. It follows from the manner in which 1-idose is produced that its configuration is~~

~~CH^COH) + 4- COH.~~

~~The remaining aldhexoses discovered by Fischer are derived from d-galactose from milk-sugar. When oxidized this aldhexose is first converted~~

into the monobasic galactonic acid, and then into dibasic mucic acid; the

latter is optically inactive, so that its configuration must be one of those given in the sixth and seventh coluiins of the table. On reduction it yields an inactive mixture of galactonic acids, some molecules being attacked at one end, as it were, and an equal number of others at the other. On reducing the lactone prepared from the in- active acid, an inactive galactose is obtained from which 1-g^actose may be separated by fermentation. Lastly, when d-galactonic acid is heated with pyridine^ it is con- verted into talonic acid, which is reducible to talose, an isomeride bearing to galactose the same relation that mannose bears to glucose. As it can be shown that d-galactose is CH2 4- — J — COH, d-talose is CHjCOH) I — + f COH.

*Apart from the value they possess as extending our knowledge of a particular group of compounds, and because they furnish a complete justification of the doctrine of isomerism due to asymmetry, *•’”” Fischer’s researches supply evidence which can- Ttauiu^ not be gainsaid that the systems with which the chemist has to deal are intrinsically of a high order of stability,, and that the changes they undergo are rarely, if ever, simply the outcome of a state of ” intramolecular wobble”; in fact, they afford clear proof that such changes are dependent on and conditioned by extra-molecular or catalytic infiuences. It will sufiBce to call attention to a single example in illustration — ^that afforded by the conversion of gluconic into mannonic acid, and vice versd. If in the case of a series of compounds such as the penthydroxypentanecarboxylic acids any tendency to “wobble” existed, it is to be supposed that of the numerous possible configurations one would prove to be the most stable, and that eventually this would be produced whichever of the isomerides were subjected to the influence of a degree of heat sufiBcient to cause a change. But nothing of the kind occurs, the change being strictly limited and confined to a particular region within the molecule — ^to a region which, on various grounds, is to be regarded as particularly susceptible to external influences. The change, in fact, affects only the carbon atom to which the carboxyl group is attached, and it is easy to understand and explain its character. There is every reason to suppose that in the first instance the carboxyl group combines with water — for it will suflJce to regard the effect as produced by water alone — and becomes converted into the group -COCOH) + OH2=-C(OH)8. By the removal of*

~~one of the OH groups in conjunction with an atom of hydrogen from the contiguous CH.OH group, an ethenoid, compound is formed containing the group •C(0H):C(0H)2. In the final stage this compound combines with water, but in two ways, the ethenoid linkage being split partly on the one side and partly on the other, so that two stereoisomeric acids are formed, but in unequal proportions, owing to the unequal influence exercised by the C4H54 and OH groups attached to the one member of the pair of ethenoid carbon atoms.~~

~~The glucoses are much more sensitive to change than are the acids to which they give rise. Lobry de Bruyn has, in fact, shown that when merely left in contact at ordinary temperatures with weak alkali they undergo change in a manner precisely similar to that in which the more stable acids are changed on heating with water. Thus glucose, mannose and fructose are reciprocally converted the one into the other, and although, owing to the formation of acid products, actual equilibrium is never established, the state of reciprocal transformation is practically that represented by the symbols —~~

~~glucose 5 fructose ^ mannose.~~

~~It is easy to conceive that changes may take place with~~

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~~725~~

~~such readiness that their complex character and the part played by the catalyst may be entirely overlooked, so that they may come to be regarded as simple intramo- lecular changes.~~

~~Much discussion has taken place on the subject of dynamic isomerism during recent years, and the view Dynamic ^^? "-^^ ^^^^ advocated that substances may Isomerism, ^^^^t in an unsteady state, having at one mo- ment one configuration and an altogether dif- ferent one at another. Although there is no reason to suppose that such is the case, and the evidence to the contrary is almost conclusive, as a matter of convenience it is well to distinguish isomerides which are so sensitive that they change spontaneously under the influence of necessarily adherent impurities as~~

~~soon as the conditions are such as to render change possible. Such substances have been called tautomeric ; they are more appropriately distinguished as dynamic isomerides, being dynamically equivalent compounds. The conditions which limit the stability of isodynamic compounds have been fully dis- cussed by Lowry {Trans. Chem. Soc. 1899, p. 211). The point of chief importance to be borne in mind in con- nexion with such compounds is that in the fluid state they occur in admixture in dynamic equilibrium, and can only exist separately in a stable condition when in the solid state at temperatures below the stability limit, al- though the proportion of one of the forms present when equilibrium is reached may be infinitesimal, and the sub- stance consequently appear to be homogeneous. The recognition of dynamic isomerides has an important bearing on the determination of structure from chemical considerations. The outcome of the discussion which has arisen on the subject has been to emphasize the need of extreme care in basing final conclusions on chemical con- siderations alone, as well as to show the value of physical properties as determinants of configuration. What is of even greater importance, it has drawn attention to the fact that what were formerly regarded as direct products of substitution are in reality very frequently, if not always, simply end products of a series of changes involving, in the first instance, addition — not displace- ment — and attended with an alteration in type. Ethylic acetoacetate may be referred to as a compound of special interest in connexion with the question under discussion. Under most conditions its behaviour is such as to require its representation as a ketonic compound, CH3.CO.CH2.C02Et, but in some cases compounds are ob- tained from it which are clearly derivatives of an^enolic form, CH3.C(0H):CH.C02Et, i.e., a form which is both an ethenoid and an ol or alcohol. It is easy to understand how the one form may pass into the other — in the case of the action of sodium ethylate, for example. Instead of hydrogen being displaced by sodium, the ethylate is at- tracted to the ketonic oxygen — a compound being formed from which alcohol separates, leaving the sodium in com- bination with the oxygen. The oxygen therefore ceases to be ketonic and becomes " hydroxylic " ; thus~~

~~MeCO.CH2.COijEt-|-NaOEt=MeC(ONa):CH.C02Et+EtOH. When the product is subjected to the axjtion of an alkylic iodide the operation is reversed, and the ketonic type is reverted to ; thus~~

MeC(ONa):CH.C02Bt-|-MeI=MeCO.CHMe.C02Et-fNaI.

In the year 1875 chemists had prominently under their notice only two types of hydrocarbons—open chain hydrocarbons, such as those of the paraflm, structure ethylene and acetylene series, and cycloid or oti' *">- (jiosed chain hydrocarbons, such as benzene, "* **' naphthalene and anthracene. Not only has our knowledge of these types been considerably extended in the interval, particularly in the case of benzenoid hydro-*

carbons, but other distinctly different types have been discovered. The chief interest attaching to these discov- eries has lain in the fact that they have disclosed remark- able differences in behaviour depending on the size and structure of the cycloids. The study of the dimensions and characters of such compounds has in consequence assumed considerable importance. It has gradually been placed beyond doubt that the formation of cycloids can only occur in many cases within certain narrow limits, and many facts have been put on record which tend to show that the " aflSnity " exercised by carbon and other elements in cycloids is a distinctly directed or directive effect.' It appears probable, indeed, that considerations inherent, perhaps, in the van't Hoff-Le Bel doctrine of " tetrahedral " carbon may find application, although in quite a different manner, in this field as well as in that of stereoisomerism.

It was long supposed that the simplest ring obtainable contained six atoms of carbon, and the discovery of trimethylene by Freund in 1882 came some- ^^jg^g what as a surprise, especially in view of its rings. behaviour with bromine and hydrogen bromide. Trimethylene is formed on withdrawing the bromine from trimethylene bromide.

CHj BrCH2.CH2.CH2Br-2Br= A

H2C CH2

In comparison with the isomeric ethenoid (ethylene or ethene-like) hydrocarbon propylene, CH3.HC:CHj, it is remarkably inert, being only very slowly attacked by bromine, which readily combines with propylene. But on the other hand, when digested with a saturated solution of hydrogen bromide it is readily converted into normal propyl bromide,

~~CH3.CH2.CH2Br. The separation of car- bon atoms united by single affinities in this manner at the time the observation was made was altogether without precedent. A similar behaviour has since been noticed in other trimethylene derivatives, but the fact that bromine, which usually acts so much more readily than hydrogen bromide on unsaturated compounds, should be so inert when hydrogen bromide acts readily is one still needing a satisfactory explanation. A great impetus was given to the study of poly-methylene derivatives by the important and unexpected observatipn made by W. H. Perkin, junr. in 1883, that ethylene and trimethylene bromides are capa- ble of acting in such a way on the sodium derivative of ethylic acetoacetate as to form tri- and tetrarmethylene rings. Perkin has himself contributed largely to our knowledge of such compounds. Penta- and hexa-methylene derivatives have also received considerable attention, and the presumed presence of rings of this kind in camphor and allied compounds has led to an increased interest being taken in their study. The uniform result of all inquiries up to the present time has been to show that the instability of the trimethylene ring is exceptional.~~

~~Von Baeyer has sought to explain the variations in stability manifest in the various poly-methylene rings by a purely mechanical hypothesis (Ber. deut. chem. Baeyer's Ges. 1885, 2279). Assuming the four valencies strain of the carbon atom to be directed from the centre Aypo- of a sphere towards the four corners of a regular ****'*• tetrahedron inscribed within the sphere, the angle at which ' they meet is 109° 28'. Baeyer supposes that in the formation of carbon " rings " the valencies become deflected from their positions, and that the tension thus introduced may be deduced from a comparison of this angle with the angles at which the strained valencies would meet. He regards the amount of deflection as a measure of the stability of the " ring." The readiness with which ethyl- ene is acted on in comparison with other types of hydro-~~

~~carbon, for example, is in harmony, he considers, with the circumstance that the greatest distortion must be in- volved in its formation, as if~~

~~deflected into parallelism each valency will be drawn out of its position through ^.109° 28'. The values in other cases are —~~

~~CHg CHj~~

~~CHg — CHg HgC CH2 H2C CH2~~

~~CHg — CH2 H2C CHg HjO CHj~~

~~CH2 24° 44' 9° 34' 0° 44' -5° 16'~~

~~CH2~~

~~HoC CHi~~

~~The general behaviour of the several types of hydro- carbons is certainly in accordance with this conception, and it is a remarkable fact that when benzene, apparently the 'most stable of all cycloids, is reduced by heating with hydrogen iodide, it is not, as was long supposed to be the case, converted into hexamethylene, but into methyl- pentamethylene (cf. Maxkowmko^ lAebig's Annalen, 1898, 302,1); and by no means a few other cases of the conversion of six-carbon rings into five-carbon rings have been recorded in recent years. Similar considerations will apply to rings containing other polyad elements besides carbon, but it is impossible to discuss these cases at present on account of the inadequacy of the evidence as to the " valency " of such elements. As an illustration it may be pointed out, how- ever, that in the case of the two known types of lactones — the half-acid, half-alcoholic ethers formed from hydroxy- acids by internal condensation — ^the y-lactones, which eon- tain four carbon atoms and one oxygen atom in the ring, are more readily formed and more stable (less readily hydrolysed) than the 8-lactones, which contain one oxygen and five carbon atoms in the ring. That the number of atoms which can be associated in a ring by single affini- ties is limited there can be no doubt, but there is not yet sufficient evidence to show where the limit must be placed.~~

~~Baeyer has suggested that his hypothesis may also be applied to explain the instability of acetylene and its derivatives, and the still greater instability of~~

~~the poly- acetylene compounds. The objections toall.such"explar nations " is their purely " mechanical " character, and in using them it is necessary to bear this in mind. More especially must it be remembered that what is needed is not so much an explanation of instability as of the greater activity of certain types of compound. This dynamical side of the problem has hitherto been practically entirely left out of account, it being impossible to deal with it with 'the means at present at our command.~~

~~In the case of closed chain hydrocarbons in which the carbon atoms are not fully saturated with hydrogen as they are in the poly-methylenes, conditions prevail Kekaie's vv^hich have the effect of introducing limitations, 'tormttUt. so that apparently there are but few forms pos sible. Of these the benzene ring, composed of six atoms of carbon, is the most stable, this ring, or colloca- tions of such rings, being produced particularly in changes occurring at very high temperatures — as in the formation of coal-tar for example. The question of the intimate structure of benzene is therefore of special interest. It has been a subject of constant discussion since Kekul^ in 1866 enunciated the conception that the six carbon atoms are directly united together in a closed chain, each of them being also united with a single hydrogen atom, so that the cycloid consists of six CH groups, and is therefore a symmetrical structure. This has been proved to be the case in the most absolute manner possible. Each carbon atom in the ring is, ex hypothesi, associated with neighbour-~~

~~ing carbon atoms in such a manner that at least two of its affinities are engaged — one on either side — and a third affinity of each atom is in combination with hydrogen. To account for the disposal of the fourth affinity Kekul6 suggested as most probable that the carbon atoms were united alternately by one and two affinities, and to the present day this hypothesis is regarded with favour. Two great objections have been urged against it, however. The first is that di-derivatives in which the radicles are associated with contiguous carbon atoms — so-called ortho- compounds — should differ according as these carbon atoms are associated by a single or by two affinities. No such difference has been observed. This objection has always been felt to be of the greatest weight. To dispose of it, Kekul^ suggested that the distribution of the affinities within the ring must be supposed to vary, so that at one moment the configuration wiU be that~~

~~represented by the first, and at the next that represented by the second of the following figures : —~~

~~A~~

~~■ A~~

~~HC CB~~

~~HC ^IB~~

~~i II HC CH~~

~~J in~~

~~\c/~~

~~\c^~~

~~H~~

~~H~~

~~On this assumption the compound AB is a mixture in equal proportions of substances which cannot be separately dealt with. The explanation has never been regarded as satisfactory, no independent evidence having been obtained which would make it necessary to admit that such an oscillation of the affinities can and does take place. On the contrary, the results of modem inquiry appear uniformly to favour the view that when such changes occur they are not the result of mere internal oscillation, but are occasioned by catalytic influences, and take place only because the molecule becomes included with other bodies in a system. An argument of far greater weight against the ethenoid formula of bepzene is furnished by the behaviour of benzenoid compounds generally in comparison with that of ethenoid compounds. Ethylene, and practically all of its derivatives, are eminently unsaturated compounds, com- bining— ^under appropriate conditions — with bromine, the halhydrides, &c., with the greatest readiness. Benzene, therefore, if it contain these ethenoid linkages, should be even more active than ethylene. But such is not the case, the behaviour of benzenoid~~

~~compounds generally being rather that of saturated than of unsaturated compounds, as in most cases they afford substitution derivatives. This argument becomes convincing when dihydro- and tetrar hydro-benzene are taken into account. These behave as ethenoid compounds, being prone to change and combin- ing as readily as the corresponding open chain derivatives do with various other substances. It cannot, therefore, be argued that the association of several ethenoid linkages in a ring has the effect of reducing their activity.~~

~~The diagonal formula advocated by Claus, in which the affinities are represented as united in pairs across the ring, although not open to the criticisms which apply to Kekule's formula, has met with but little sup- O'**" port ; there would seem, in fact, to be an instinc- fyf" "i%, tive objection to the assumption that affinities can act across one another. This difficulty is got over in the " centric " formula proposed by the writer (PJiil. Mag. ; Trans. Chem. Soc. 1887, 264), and shortly afterwards by V. Baeyer, in which the fourth affinity of each carbon atom is assumed to be only directed towards the centre of the ring — ^no one of the carbon atoms being regarded as~~

~~connected -with any other carbon atom not contiguous to it in the ring, although each is supposed in a measure to exercise an influence over each and all the other carbon atoms. This conception is represented by the following symbol : — °~~

~~Notwithstanding its vagueness, the centric symbol appears to be better adapted than any of those hitherto proposed as a means of formulating the behaviour of benzene.~~

~~Whatever its structure, the benzene complex has alto- gether peculiar properties. The hydrocarbon itself, under Properties certain conditions, combines readily enough with of the chlorine and bromine, forming a hexachloride and~~

benzene hexabromide ; but none of its homologues and complex, scarcely any of its derivatives furnish similar compounds. Under all "ordinary" conditions benzene and its homologues yield substitution derivatives. When subj ected to the action of either chlorine or br om ine, benzene responds somewhat sluggishly, but much depends on the catalyst used in determining the interchange; compara- tively little heat is developed. The homologous hydrocar- bons, as a rule, are far more easily acted on by halogens. The benzene hydrocarbons are also readily converted into nitro-deri vatives by nitric acid, and into sulphonic acids by sulphuric acid, the action of both agents taking place more readily in the case of the higher than of the lower terms of the series. There is every reason, however, to suppose that substitution is not directly efEected. In the case of mono-derivatives, probably the centric mechanism breaks down initially, and a compound is formed by the union of the agent with contiguous carbon atoms of the hydro- carbon ; this change is immediately followed by one in the reverse direction in which one of the radicles thus introduced into the molecule becomes separated together with an atom of hydrogen. Tor example : —

^.—θ

B

+ HB

B + "HA

The action may take place in one or the other direction, or in both, according to circumstances. Thus, on nitrat- ing benzene by nitric acid (HO.NO2) alone, both nitro- benzene and phenol are produced, the latter, of course, undergoing further nitration, as it is readily acted on ; but if the nitration be effected in presence of sulphuric acid, the separation of water. from the compound first formed by the union of the benzene with the nitric acid is promoted owing to the affinity of this agent for water, and consequently nitro-benzene is practically the sole

^^The mono-derivatives of benzene are all convertible into higher derivatives, and in some cases are far more readily acted on than is the original hydrocarbon; but the ben- zene hydrocarbons are not peculiar in

~~this respect, as it is well known that even in the paraffin series, the higher terms are much more readily acted on than are the lower ones and that the alcohols, for example, are readily attacked under conditions under which the hydrocarbons from which they are derived are unaffected. As it is to be supposed that in most, if not in all cases, the available~~

~~energy of the system becomes reduced in the formation of the substitution derivative, it is rather to be expected that if acted on in the same way, i.e., if the nature of the process be the same, substitution derivatives would be less amenable than the parent compounds. The fact that this is not always' so may, therefore, be regarded as pu„ctioa proof that the radicle introduced into a hydro- „/ radicle carbon in some cases itself plays an important la substi- part in conditioning change, and is itself attrac- '"*""'• tive. This view derives much support from the study of the behaviour of phenol and aniline, both of which are extraordinarily sensitive in comparison with benzene — the mere addition of bromine in excess to an aqueous solution of either giving rise immediately to a precipitate of the tribromo-derivative, although benzene itself is but slowly and imperfectly converted into monobromo-benzene when placed in contact with an excess of the halogen. In like manner the nitration of phenol is readily effected by means of dilute, nitric acid, being without difficulty ex- tended to the formation of the tri-nitro compound, while to nitrate benzene it is necessary to use a fairly concen- trated acid, and nitration is with difficulty extended beyond the formation of the di-derivative. Again, phenol is rapidly sulphonated by ordinary concentrated sulphuric acid, which acts but very slowly on benzene. In the case of the carbinols — ^the alcohols derived from the open chain hydrocarbons — the action of acids is to form an ethereal salt ; ordinary alcohol, for example, yields ethylic hydrogen sulphate. Being alcohols the phenols should behave similarly, and there is reason to suppose that they do. The explanation of their apparently different behaviour is to be found in the fact that in the case of the sulphates derived from the carbinols there is no tendency for the SO3 group to separate from the oxygen atom of the ear- binol, and eventually to enter into combination with the hydrocarbon radicle ; in the case of the sulphate derived from the phenol, however, such a change readily occurs, it being necessary, for example, to heat the salt KSOa-OCeHs only moderately to convert it into~~

the sulphonate HO.CeH4.SO3K. On this accoimt the for- mation of the sulphate from the phenol is easily over- looked.

But it is necessary to go further in order to explain the behaviour of benzenoid derivatives generally, and to con- sider the cases in which the formation of intermediate compounds such as the sulphate cannot take place. The behaviour of the mixed ethers formed from phenols by introducing alkylic radicles in place of the hydroxylic hydrogen is specially suggestive. These compounds re- semble phenol in being more amenable to treatment than is benzene, but they are very distinctly less active than phenol. The difference is most striking, however, when corresponding derivatives are contrasted. Phenol is con- verted by sulphuric acid into phenolparasulphonic acid, HO.C6H4.SO3H. If bromine be added to an aqueous solution of this compound, diorthobromophenolparasul- phonic acid is produced almost immediately ; if an excess of bromine be used, the sulphonic group is also displaced by bromine, tribromophenol being formed, but this action does not set in until the whole of the phenolsulphonic acid has been dibrominated. The corresponding sulphonate derived from methylphenyl ether, CHj.O.CeHj, formed by introducing methyl in place, of the hydrogen in the OH group in the phenolparasulphonic acid, behaves in a re- markably different manner towards bromine, yielding no trace of dibromo-acid, but only the monobrominated acid. But only a part of the compound is thus acted upon ; from the remainder the bromine simply displaces the sulphonic group. Acid radicles have a still more marked effect, bromine being without action on benzoylated phenolpara- sulphonic acid (C6H5.CO). O.C6H4 under conditions

under -which the unbenzoylated acid is entirely converted into tribromophenol.

Results such as these show that the introduction of various radicles in place of the hydroxy lic hydrogen most materially affects the character of the influence exercised by the oxygen in phenol, and they afford ^ clue to the

~~manner in which the action takes place. It can scarcely be doubted that initially the oxygen attracts the bromine to itself, and that when the bromine has thus been made a part of the molecule, it is capable — under proper condi- tions — of producing further changes, and eventually of displacing hydrogen in the hydrocarbon portion of the molecule. " Ge n'est que le premier pas qui coute " — every- thing depends on the bromine becoming introduced into the molecule. The afBnity of oxygen ior bromine — and it may be supposed for other agents — is evidently of a somewhat fickle character; it varies greatly accord- ing to the nature of the groups with which the oxygen is associated, some rendering the oxygen altogether in- different.*~~

~~The properties of anilineparasulphonic acid are modi- fied in precisely the same way as are those of phenol- parasulphonic acid by introducing hydrocarbon and acid radicles in place of the hydrogen atoms in the NHj group. Thus dimethylanilineparasulphohic acid yields only a monobromo- derivative, whereas the unmethylated acid is at once converted into tribromaniline by bromine; in this case the sulphonic group does not become displaced. If, however, acetyl or benzoyl be introduced in place of one of the hydrogen atoms of the NHj group, bromine is at once able to displace the sulphonic g^oup, parar brom-acet- or benz-aiiilide being formed together with the monobrominated sulphonic acid. Evidently, therefore, the influence of nitrogen, like that of oxygen, varies greatly according to the nature of its associates.~~

~~Assuming that the first stage in the formation of the substitution derivative from the phenol or amine consists Changes ^ *^® attraction by the oxygen or nitrogen of the Involved particular agent used, it remains to determine In cbiorin- ■^iia,^; are the consequent changes. With this~~

~~"' "^ object in view, the behaviour of acetanilide on chlorination is especially deserving of study. Initially this compound exchanges its aminic hydrogen for chlorine, and probably a change of this kind invariably takes place when amines are chlorinated. The compound thus pro- duced, phenylacetylchloramine, C6HJ.N(C2HsO)Cl, when- carefully purified, is a fairly stable substance, but if vt be brought into contact with a trace of hydrogen chloride, it is rapidly converted into parachloracetanilide, much~~

~~heat being developed ; on this account, in preparing it and similar compounds it is necessary to avoid the presence of hydrogen chloride. The transference of chlorine from the nitrogen atom into the hydrocarbon radicle~~

~~NAoCl NAoH~~

~~which is provoked by hydrogen chloride, would seem to be dependent on the combination of the chloramine with hydrogen chloride, whereby a condition of extreme instability is engendered. Probably the first change to follow this is one in which the atom of chlorine associated with the nitrogen atom escapes together with an atom of hydrogen from the hydrocarbon complex. It may be sup- posed that 'this would lead to a "wave of disturbance" being generated within the ring, and that for the moment~~

~~1 The discovery of diethylperoxide, CjHj.O.O.CjHs, a relatively stable compound, by Baeyer and Villiger, has afforded direct proof that the "activity" of oxygen is much reduced by association with hydrocarbon radicles.~~

~~the nitrogen atom would also be unsaturated ; as a con- sequence, the centric mechanism might break down and lapse into the ethenoid condition. If, at such a moment, hydrogen chloride were again to combine with the mole- cule, a compound might be formed which could undergo decomposition in such a way that the chlorine atom remained in the orthoposition, the hydrogen atom separat- ing with the chlorine atom attached to the nitrogen atom — or the two chlorine atoms might attract each other, in which case the chloramine would be reduced. As a matter of fact, only a relatively small proportion of orthochloracetanilide is formed, the par^arcompound being always the chief, and under most conditions, the sole product ; it therefore seems probable that when the condi- tions permit, instead of the two chlorine atoms actually separating from the system in the manner pictured, they attack the para-position, removing the hydrogen atom and taking its place. With regard to the possible reduc- tion of the chloramine, although unobserved in the case of phenylacetylchloramine, such an action actually does take place in some cases, parachlorophenylacetylchloramine, for example, being converted into parachloracetanilide and chlorine by the action of a concentrated' solution~~

~~of hydrogen chloride, although if heated with water and a trace of hydrogen chloride it undergoes isomeric change into dichloracetanilide. No more striking proof could well be given that the hydrocarbon radicle is insensitive to direct attack by chlorine, and that its chlorination is effected indirectly.~~

~~That sulphonation involves a similar series of changes there can be little if any doubt, as acetanilide behaves towards sulphonating agents just as it does on chlorination; when cautiously dissolved in moderately strong fuming sulphuric acid, it is in the first instance converted into the sulphaminic acid C6Hj.N(C2H3Q)(S08H). If the liquid mixture be at once poured into water, and the solution boiled, only aniline pararsulphonic acid is obtained,"but if the mixture be preserved at a low temperature and allowed gradually to hydrate, and then boiled with water, besides para^acid a considerable amount of ortho-acid is also produced. In^^his Case, as on chlorinating acetanilide, the ortho-compound is formed when the substituting radicle is, as it were, let down gently ; otherwise the parar derivative is alone produced.~~

~~As compounds such as dimethylaniline, C6H5.l!l(CH3)j, are chlorinated, sulphonated, &c., without difficulty, it can- not be supposed that the introduction either of chlorine or of the sulphonic group into the aminic group is an essential preliminary to the introduction of either the one or the other of these radicles into the nucleus. The explanation given above, in fact, does not necessarily require the direct transference of the radicle from the aminic group into the nucleus, but it is clear that such a direct transference may take plac'e, in view of the fact that nitrosomethylaniline, C6H5.N(CH3) (NO), for ex- ample, is entirely converted into paranitrosomethylaniline, NO.C6H4.NH.CH3, by the action of hydrogen chloride, inasmuch as it can scarcely be doubted that if the NO group ever became separated from the molecule, it would not be entirely returned. A similar argument may be based on the complete conversion of diorthonitropara- bromophenol into orthoparadinitroorthobromophenol by the action of bromine; and on the formation from orthiodanisol of pariodorthonitranisol on nitration~~

~~OCHs~~

~~OCHs~~

~~OH N02^n02~~

~~Br NO2 i~~

~~As iodine substitutioii derivatives are rarely formed by~~

~~CHEMISTKY~~

~~729~~

~~the direct action of iodine, the latter change is a par- ticularly striking proof of the transference of a radicle from one position to another -within the molecule. That such transferences are but the end result of a series of changes more or less of the character of those pictured above is more than probable.~~

~~In the case of phenol and aniline, whatever the agent used in effecting substitution, the entering radicle as a rule always takes up either the para- or the ortho-position relatively to the OH or NH^ group ; in fact, when this is not the case, and a meta-derivative is formed, it is probably because— as will be explained later— the com- pound no longer acts as an OH or NHj derivative. In other cases in which para- and ortho-derivatives are ex- clusively formed, the influence exercised by the radicle present in the mono- derivative may obviously be regarded as of the same order as that exercised by either oxygen or nitrogen, and it is a logical extension of this argument to assume that the process by which the higher deriva- tive is formed is similar in character, whether the mono- derivative contain OH, NHj, CI, CHj, or any other radicle which conditions the entry of the second group into the parar and ortho-positions only. If this conclusion be accepted, it follows that CH3 and other hydrocarbon radicles must be regarded as possessed of considerable attractive power, as the homologues of benzene are so much more readily acted on than benzene itself.~~

~~Certain radicles, notably acid radicles such as NO2, SO3H and COjH, condition the formation of meta-di- derivatives, mono-derivatives of benzene containing these radicles yielding but a small proportion of the~~

~~ortho- and para-compounds. Thus nitrobenzene is almost entirely converted into metabromonitrobenzene when brominated, although when bromobenzene is nitrated the chief pro- duct is parabromonitrobenzene, no meta-compound being formed. Agents generally act on all mono-derivatives which afford meta-di-derivatives less readily than on benzene ; hence it may be inferred that radicles such as KO2 have little if any power of attracting " acid " agents such as the halogens, nitric and sulphuric acids, &c. It may further be supposed that not only do they not attract, but that they actually protect the ortho- and para-positions against attack, exercising an inhibiting power similar to, but even stronger than, that which — as previously pointed out — the oxygen and nitrogen of phenol and aniline appear to exert when associated with acid radicles. Consequently, if mqno-derivatives con- taining acid-radicles are acted on by agents which are sufficiently powerful to act on the hydrocarbon ring, they behave much as benzene behaves, but the position attacked is that which is least exposed to the influence of the acid radicle — that is to say, the meta-position. Proof of the correctness of this argument is afforded by the fact, that if an agent be used which is attracted by the acid radicle, substitution no longer takes place in the meta-position; thus when nitrobenzene is heated with powdered caustic soda it is converted into ortho- nitrophenol. On the other hand, if the basic or acid- attracting power of aniline be sufficiently lowered or neutralized, as for instance by combination with sulphuric acid or by benzoylation, meta-derivatives are formed in no inconsiderable proportion on nitration and~~

~~^^n will be obvious that the issues raised by the study of the formation of substitution derivatives from benzene are many and complicated, and that, in ftrder to Value of get behind the facts, it is necessary to take many to""^'/a considerations into account. In studying phenol "" ' and aniline, the peculiarities of oxygen and nitro- gen must be reckoned with as much as those of benzene ; on the other hand, much is learnt of the manner in which~~

~~these elements exercise their functions by studying phenol and aniline. It is too often forgotten that phenol is a derivative of oxygen, and aniline a derivative of nitrogen, and that these compoands are not merely to be regarded as derivatives of benzene ; in point of fact, it is only when they are considered from the former point of view that their benzene function can be~~

~~*properly under- stood, and that it becomes apparent how false an esti- mate is' usually formed of this function. In the formation of benzenoid derivatives, in cases in which the attack proceeds from a radicle in position 1, the para- derivative is almost invariably the chief if not the sole product, and so much is this the case that attention has been called, over and over again, to the need of giving expression to the fact in the formula of benzene. The centric symbol, more than any other, may be said to in- dicate and almost to require such a result. For if the view be taken that, as explained above, addition precedes substitution, whatever change takes place in region 1, it is to be supposed that the opposite centric valency wUl be the one most affected ; and if the effect be^as it most probably is — to release it either partially or entirely, region 4 will, as a rule, prevail over the other regions as a centre of activity into which the entering group will be determined. From this point of view the formation of ortho-derivatives is to be regarded as a consequence of the immediate contiguity of regions 1 and 2. But con- tiguity constitutes a disadvantage as well as an advan- tage, as it renders the possibility of reversal greater, and it is only in cases in which reversal occurs with compar- ative difficulty that the ortho-compound is formed in any considerable proportion. Thus the fact that phenol yields only a small proportion of the ortho-bromo-, but a considerable proportion of the ortho-chloro-derivative, may be ascribed to the circumstance that when once introduced chlorine is both more firmly held and less liable to be displaced by a reversal of the interchange.*~~

~~*Although similar to benzene in general behaviour, the hydrocarbons formed by the " fusion " of two or more benzene rings all exhibit distinctive properties ; _^. _ the study of these is of special interest and cycloid importance in considering the manner in which bydm- properties are correlated with structure. Naph- e^*""*- thalene, anthracene and phenanthrene may be taken as examples.*~~

~~*Naphthalene, CioH,, is proved beyond question to con- sist of two benzene rings with one pair of carbon atoms in common. It is also certain that the two rings are alike, and that the compound as a whole is symmetrically con- stituted; consequently naphthalene is represented by the double hexagon symbol, and for all practical purposes this symbol is sufficient. As in the case of benzene, the determination of the inner structure of the molecule is*~~

~~a matter of great difficulty. It is noteworthy, in the first place, that naphthalene is much more sensitive to attack than is benzene ; as no distortion of either ring is involved in the " fusion " of two rings, this fact is not in harmony with v.Baeyer's mechanical hypothesis. If the carbon atoms are represented as alternately singly and doubly linked, as in Kekule's formula of benzene, there would be no fewer than five pairs of doubly-linked carbon atoms in the molecule. The behaviour of naphthalene cannot, however, be said to be that which a compound so constituted would be likely to exhibit, although it is distinctly more ethenoid in character than that of benzene. To apply the centric hypothesis to naphthalene, it is necessary to assume that one of the affinities of each of the two central carbon atoms common to the two rings acts into both rings, as pictured in the symbol, which is an assumption involving a somewhat wide departure from all ordinary views as to the manner in which affinity acts. Nevertheless the~~

~~m~~

~~place, it harmonizes two rings are in-com- one responding to the other. Then, on tiyely slight — be- ence which would be two rings by the~~

~~symbol is one with the aid of which alone, perhaps, the general behaviour of naphthalene may be satisfactorily ex- pressed. In the first with the fact that the plete sympathy, the every change made in account of the relar u i v cause divided — influ- V/V./ exercised upon the * v~~

~~two afB.nities commou to both, the remaining four centric affinities of each ring would presumably be less attracted into the ring than in the case of benzene ; consequently they would be more active outwards, and combination would set in more readily. When, as in the formation of naphthalene tetrachloride, for example, the one ring be- comes saturated, the other might be expected to assume the normal centric form and become~~

~~*relatively inactive. This is absolutely the case. On the other hand, if substi- tution be effected in the one ring, and the affinities in that ring become attracted inwards, as apparently happens in the case of benzene, the adjoining ring should become relatively more active because the common affinities would act less into it. Hence, unless the radicle introduced be one which exercises a special attractive influence, substitu- tion should take place in preference in the previously unsubstituted ring. In practice this usually occurs ; for example, on further bromination, a-bromonaphtha- lene yields a mixture of the two dibromonaphthalenes*~~

~~*Br Br*~~

~~*and*~~

~~*Br*~~

~~*; and when nitronaphthalene is*~~

~~*either brominated, or nitrated or sulphonated, the action is practically confined to the second ring. An alternative centric formula for naphthalene is that proposed by Bam- berger. Instead of representing it as a dicyclic hydrocarbon, formed by fusion of two benzene rings, this indicates that it is a monoeycloid composed of ten atoms of carbon. The for- mula has the advantage that it may be con- structed froni tetrahedral models of the carbon atom ; but it involves the assumption that the molecule has within it a mechanism, equivalent in a measure to a sys- tem of railway points, which can readily close up and pass into that characteristic of benzene.*~~

~~*The isomeric hydrocarbons anthracene and phen- anthrene, CuHio, are to be regarded as formed by the fusion of three benzene rings in the manner represented by the symbols*~~

~~*Antliracene.*~~

~~*Fhenantbrene.*~~

~~*Their behaviour, and therefore their inner structure, is very different, however, and particularly noteworthy in comparison with that of*~~

naphthalene. In both cases the median ring is most easily acted on ; but whereas phen- anthrene behaves as a symmetrical compound, the behav- iour of anthracene is that of an unsymmetrical compound, one of its lateral rings being far more readily attacked than the other. For example, both hydrocarbons at once combine with bromine, forming unstable dibromides, which are readily resolved into hydrogen bromide and mono- bromo- substitution derivatives; the further action of bromine leads to the production of a di-substitution- derivative. The action then stops in the case of phenanthrene, unless forced, but dibromanthracene readily combines with bromine, forming dibromanthra- cene tetrabromide. In both cases the dibromo-substitu-

tion derivatives axe formed by the displacement of the hydrogen atoms in the median ring. •The following formulae afford a satisfactory expression of these facts, it being understood that the hexagons marked C have the centric structure : —

An entire change of properties is produced by saturating the two carbon atoms of the median ring in anthracene, and there can be little doubt that the lateral ethenoid ring lapses into the centric state, a symmetrical compound being produced. Thus anthracene dihydride has more of the properties of a saturated hydrocarbon, and anthrar

θ

quinone (C

C I is characterized by extreme inert-

Θ

ness ; moreover, when the latter is attacked both lateral rings are equally readily acted upon. On the other hand, the behaviour of phenanthraquinone in no way differs in principle from that of phenanthrene. It i? noteworthy that although the lateral rings in phenan- threne are in the condition of ortho-di-derivatives of benzene, they do not display the activity of ortho- homo- logues of benzene — which is a fact not without bearing on the question as to the character of the influence exercised by hydrocarbon

~~*radicles in promoting substitution. It has been previously pointed out that the evidence favours the view that the open chain hydrocarbon .radicle in a benzenoid hydrocarbon has an attractive influence com- parable with that exercised by oxygen in phenols and by nitrogen in amines ; as it is not to be expected that the median closed chain which in phenanthrene occupies the place of the two separate radicles in an ortho-di- derivative of benzene would have any such influence, the behaviour of phenanthrene lends considerable support to this view. The argument may be one on which no great stress should be laid ; it is advanced mainly with the object of calling attention to the way in which the study of polycyclic hydrocarbons may serve to elucidate ques- tions of general importance. The bearing of individual facts on the broad problems of chemistry is too commonly overlooked nowadays, and it is very necessary that chem- ists should seek to appreciate more fully than they do at present the general interdependence of chemical pheno- mena, and to correlate their observations more carefully with the existing body of facts.*~~

~~*It remains to consider the behaviour of mixed cycloids in which multivalent elements other than carbon are included ; this is in many respects very remark- able. Pyridine and thiophene may be taken as ”” **1‘7J examples. Pyridine, C5NH5, is derived from ”””** benzene by the displacement of one of the CH groups by an atom of nitrogen. The effect of this change is to lower materially the activity of the cycloid in comparison with that of benzene. Although the nitrogen in pyridine exhibits marked basic properties, apparently it has little or no influence — such as is exercised by the nitrogen in aniline — in promoting the introduction of substituting groups into the ring in place dS hydrogen, substitution being effected only with difficulty. The arguments which favour’ the adoption of the centric formula for benzene apply with even greater force to pyridine, and render such a formula for this compound almost a necessity, but the adoption of the centric formula for pyridine has important consequences, as it involves the conclusion that the addi- tion of a nitrogen affinity to five carbon affinities not only*~~

~~*has no disturbing effect, but apparently even strengthens the affinity of these latter for each other.*~~

~~*The case of thiophene is even more remarkable. In this compound two of the CH groups in benzene are displaced by a single atom of sulphur. Notwithstanding the great dafference m composition, in general chemical behaviour the two compounds are almost indistinguishable, corre- sponding derivatives manifesting the most remarkable similarity, extending even to their boiling-points. Thio- phene IS more readily acted upon by halogens than is benzene, being attacked even by iodine, but it shows no tendency to combine with them, and yields only substitu- tion derivatives. The most striking circumstance in con- nexion with thiophene, however, is the complete inertness of the sulphur atom, which shows no tendency to combiue, and cannot even be oxidized ; yet it cannot well be present otherwise than as a dyad. This behaviour appears the more remarkable when thiophene is compared with the correspondiag compounds f urfurane and pyrrole, contain- ing respectively oxygen and the imido (NH) group instead of sulphur, these latter being far more active substances and remarkably sensitive to the action of acids. Whether the oxygen and imidogen exercise a special attractive influ- ence, such as has been previously referred to, which sulphur cannot exercise, or whether the difference originates in a difference in constitution, cannot at present be decided, though the former appears to be the more probable ex- planation. It is noteworthy that in diphenylene sulphide (dibenzothiophene) — a compound which bears the same relation to thiophene that anthracene bears to benzene — the sulphur behaves normally in the sense that it is oxidizable, like the sulphur in open chain sulphides such as ethyl sulphide (02115)28. As thiophene in no way exhibits the behaviour of an ethenoid compound, it is ap-*~~

~~*N7*~~

~~■*propriately represented by the centric formula in the margin. But it is conceivable that the sul-*~~

~~*Diphenylene sulphide.*~~

~~\/ phur, although acting only as a dyad, has its extra ^ affinities twisted inwards into the ring : hence their inactivity. No such condition need prevail in diphenylene sulphide, as there would be no carbon affinities directed inwards in the median ring if the lateral rings had a centric structure. This, again, is an example of the manner in which an instructive comparison may be made between single and complex cycloids. The difference be- tween a "strutted" benzenoid system and a flaccid saturated cycloid is well shown in the fact that, although it is impossible to obtain an anhydride from metaphthalic acid, hexhydrometaphthalic acid, like glutaric acid, is with- out difficulty converted into an anhydride ; and the same kind of difference appears to exist between thiophene and dibenzothiophene.~~

~~In concluding this section, the question may be raised whether the centric structure may still be preserved in compounds formed from benzene by satisfying two of the centric units of afBnity. In the case of the derivatives of dihydrobenzene, G^B.^, such as the dihydrophthalic acids, there can be little doubt that the compound has lapsed into the ethenoid form, as these readily combine not only with bromine, but also with the halhydrides. But quiuone, on the other hand, is a relatively inert compound, and it is therefore not improbable that it retains the centric structure, and may consequently be so represented — as in the margia. Sufficient will have been said to indicate the nature of some of the chief problems presented by cycloid com- pounds The number of varieties, especially of hetero- cvcloids, made known since 1876 is very large, but appar rently these may all be referred to a very limited number~~

~~of fundamental types, and it is therefore justifiable to assume that their formation is governed by comparatively simple laws.~~

~~In comparison with that of the closed chain compounds the behaviour of open chain compounds is in principle far simpler. In the case of saturated compounds substitution appears to take place directly, but open chain there is no evidence to show the precise manner ^^jg. in which it is effected ; in fact, little more can be said than that it occurs the more easily the higher the molecular weights. Whether or not at the moment of colli- sion of the interacting molecules weak associations are established between them cannot at present be determined : the most that can be said is that it is by~~

~~no means improb- able that such is the case, and that the assumption is one which apparently would bring the behaviour of saturate^ into harmony with that of unsaturated compounds gener- ally. A point of importance to be noted in this connexion, however, is the fact that the occurrence of several carbon atoms in association usually constitutes a position of weak- ness in the molecule. Por example, to take the simplest case, propane, CH3.CH2.CH5, is chiefly attacked in the median CHj group, a larger proportion of isopropyl chloride, CH3 CHCI.CH3, than of the isomeric propyl chloride, CH3.CH2.CH2CI, being formed when the hydro- carbon is chlorinated. In the case of a hydrocarbon of the type CHE. '3, the hydrogen atom of the CH group is still more sensitive to attack than that in the CHj group of the type"^CH2E.'2. Facts such as these ser^e to suggest that even in what are conventionally regarded as saturated compounds carbon exercises an attractive influence similar to that pictured above as exercised by oxygen, nitrogen, etc. Such a conclusion is in harmony with that already arrived at with reference to the influence exercised by saturated hydrocarbon radicles in the case of the homologues of benzene.~~

~~Effects similar to those produced by the association of several carbonatomsareobservedto follow the introduction of negative radicles such as chlorine, bromine, or OH, the rule being that negative radicles Bttectot tend to accumulate. Thus the primary alcohols ndicies. of the formula E'.0H2(0H), are converted into aldehydrols, B,'.0H(OH)2, by most oxidizing agents ; and bromethane, CHs.CH2Br, when heated with bromine, yields chiefly ethylidene bromide, OH3.CHBr2. But there are many apparent exceptions to this rule. Thus, although aldehyde, CH3.COH, is entirely converted into acetic acid, OH3.CO2H, when oxidized by bichromate mixture — the aldehydrol being presumably converted into the acid- hydrol, E'.0(OH)3, which breaks up into acid and water — when oxidized by nitric acid it yields glycolic acid, OH2.C02H, and glyoxal, OOH.OOH. Similarly, if bromethane be brominated in presence of ferric bromide, it is converted into ethylene bromide, 0HjBr.CH2Br ; in fact, experiments made by V. Meyer and his pupils have shown that when bromides or chlorides are brominated in presence of ferric bromide, or chlorides chlorinated by means of antimony pentachlor ide, instead of a second atom of halogen becoming attached to the one carbon atom, it associates itself with the contiguous atom. In the case of the more complex~~

hydrocarbons, by continuation of this treatment, the action may be extended from atom to atom along the chain — hexane, for example, giving a hexbromide in which each carbon atom is associated with a bromine atom. Such departures from the rule, however, but serve to prove it. In seeking to explain such variations, it is necessary to bear in mind that variations in the course of the inter- change may be conditioned by the use of different agents, and that intermediate unperceived changes occur in all such cases. A catalyst such as ferric bromide plays an

all-important part, not merely in facilitating the occur- rence of change, but also in determining its course. Probably it acts in more ways than one, both determin- ing the initial attack by coupling halogen with hydride and also promoting the separation of halhydride (hydro- gen bromide or chloride). If it be assumed that the cat- alyst combines either with the halogen atom or with the carbon atom with which this latter is associated, it would in a measure protect the hydrogen also associated with with the carbon atom, and project the attack, as it were, upon the hydrogen atom associated with the contiguous carbon atom. In such cases it may well happen that an ethenoid compound is either potentially or actually formed as an intermediate product. Thus when aldehyde is oxi- dized in presence of nitric acid, perhaps a nitrate is first produced which loses water, and the compound thus formed then combines with the elements of the water molecule in the reverse order, giving rise to a derivative of glycol,

CHa -> CHj > ‘ CHj(OH)

CH(0H)(0.]Sr02) CH(0N02) CHjCONO^),

which on oxidation yields glycolic acid, CH2.C02H.

That oscillatory reversible changes are of far more frequent occurrence than is commonly supposed cannot Reversible ® doubted, and there is every reason to suppose changes that many apparently obscure or abnormal cases ofteaua- are to be explained as consequences of such perceived, changes. One or two such instances may be referred to in

~~illustration. It is well known that paraifin radicles are readily introduced into benzene and its homologues by the interaction of the benzene and an alky lie chloride in presence of aluminium chloride — one of the most remarkable of condensing agents. It is a peculiar property of this agent, however, that very frequently the entering radicle takes up- the meta- rather than the ortho- or para- position, which is that assumed when milder agents producing similar effects — such as ferric chloride, and in some cases sulphuric acid — are used. Aluminium chloride, however, is not only a most powerful synthetic agent, but — as its discoverers, Friedel and Crafts, have shown — equally powerful as an analytic agent, destroying as readily as it builds up. Apparently reversal takes place much more readily in the case of para- or ortho- than of meta-compounds. To take a specific case, that of the butylation of toluene — the initial product is probably a mixture of para- and metarbutyltoluene in which the former largely preponderates, but the action being reversible in the manner expressed by the equation C6Hs.CH34-BuCl p CsH4(Bu).CH3|-HCl, and the para~~

~~compound being chiefly attacked as the action proceeds, the meta-compound is formed in an increasing proportion — so that ultimately little or no pararbutyltoluene remains.~~

~~Regarding the behaviour of saturated compounds to- wards agents generally from the point of view discussed in this section, it is obviously analogous to that of benze- noid compounds ; in fact there is no need to draw any radical distinction between the two classes. In both cases action takes place initially in much the same way, but different secondary changes supervene, chiefly owing to the fact that in saturated compounds, usually two, and sometimes three hydrogen atoms are associated with the carbon atom which is the centre of attack, but never more than one in the case of the benzenes.~~

~~The primary change in all interactions in which the ethenoid compounds are concerned appears always to be one involving the conversion of the ethenoid, by BibenoU combination with the agent, into a saturated Touads. (paraffinoid) compound. The action probably takes place in two stages — in the first, the two molecules associate as wholes; in the second, the two~~

~~radicles, into which the agent is resolved, become distrib- uted and combine with the ethepoid carbon atoms. Such changes occur, as a rule, very readily ; indeed, there is reason to suppose that the combining power of ethenoids has been considerably underrated. Their activity must be ascribed to the ”~~

~~attractiveness " of the two contiguous carbon atoms united by ethenoid afiBnities, a form of union which leaves these atoms endowed with considerable residual affinity. Whatever the nature of this form of union may be, it has clearly less than twice the force of that by which carbon atoms are held together in paraf- finoid compounds; consequently the use of the terms, "united by double bonds" and "by two affinities of each " is to be deprecated. The same may be said of the conventional method of formulating such compounds. Julius Thomsen has argued from his therm ochemical observations that the two carbon atoms in ethylene are even less firmly united than are those in the corrjespond- ing paraffin ethane, and that the carbon atoms in acetylene have a negative affinity, but, as the writer has pointed out (Phil. Mag. Feb. 1887), the argument is based on a fallacy. In point of fact, although the ethenoid configu- ration is an unstable one, there is no reason to suppose that the carbon atoms are less firmly united than they are in ethane, but quite the contrary ; the only conclusion to be safely deduced from chemical considerations is that the ethenoids are unsaturated, and in consequence ca- pable of entering readily into interactions. The problem to be solved in connexion with them is the precise man- ner in which the carbon valencies operate effectively in such compounds ; as yet we have no clue. A noteworthy property of the acetylenes is that of forming metallic derivatives — a property only observed in this class of hydrocarbons. It is commonly supposed that the hydro- gen is directly displaceable by the metal, but it is more probable that it is only indirectly displaced, and that the formation of metallic derivatives from such hydro- carbons is an outcome of their highly unsaturated condition — ^not of any specific property of the hydro- gen— ^which renders them capable of associating with metallic compounds. The formation of sodium acety- lide, for example, may be represented in the following manner : —**

~~CjHj-l-NaOH=CjH2(OH)Na=CjHN"a-f-HOH.~~

~~In like manner it may be said that the displacement of the hydrogen in water by sodium is due to the attraction of the sodium by the oxygen, and merely a secondary phenomenon.~~

If the facts taught by the study of carbon compounds generally are considered from the point of view of the lessons they convey as to the valency of that element, and as to the manner in which carbon pj^'ity of combines with carbon, it is clear that the carbon immense variety of compounds may be referred "" ' '"^'e- to four simple types— the paraffinoid, the ethenoid, the acetylenoid and the benzenoid — ^the first two in- cluding both open and closed chain forms. In other words carbon atoms tend to combine — to exert their four units of affinity — in only four different ways. The maxi- mum stability is attained in the cycloids, especially in benzenoids. When the tendency of carbon to form ben- zenoids of a high degree of complexity, and the great stability of these is taken into account, it appears to be almost a necessary consequence that the carbon molecule should itself be highly complex. Apparently it should be possible to "fuse" cycloid upon cycloid, much as cell may be added to cell in a honeycomb, and the stability of the system should increase rather than diminish with increased complexity, provided the con- ditions which obtain in a compound like anthraquinone

are satisfied, i.e., that the cycloids be so arranged as to give rise only to centric and saturated (paraffinoid) hexa- cycloids, and to exclude the formation of ethenoid rings such as presumably occur in anthracene. It is possible fi!^^*2.° f^i'tJier, and from this point of view to explain the differences observed between the different forms of carbon. The diamond may well be a complex of the anthraqumone type, while both graphite and amorphous carbon may more nearly resemble anthracene in struc- ture, the low stability of the former as compared with the latter being due to the presence in amorphous car- bon of a greater number of ethenoid rings. Such assumptions would probably also serve to account for the colourlessness of the diamond, and for the opacity of the allotropic forms. .For like reasons it is probable that amorphous carbon will be found to be the most, and diamond the least, refractive of the three forms. In order that the marginal afanities in a system of cycloids extending laterally may be satisfied, it is obviously necessary to assume that the cycloids may be

~~arranged in two or more planes, i.e., in layers. It is conceivable that in a system in which the marginal elements were all either centric or ethenoid the marginal aflnities to be satisfied would all lie in a single plane ; but if the mar- ginal elements were partly paraffinoid they would not all lie in a single plane. It is well known that the diamond as well as amorphous carbon at high temperatures is converted into graphite, which is the most stable of the three forms : it may well be that the change which takes place is that of a system of centric and paraffinoid ele^ ments into one in which the marginal paraffinoid elements become either centric or ethenoid.~~

~~The conception that the carbon atom may be sym- bolized by a tetrahedron affords an explanation of~~

~~numerous cases of isomerism besides those in~~

~~' CIS- and which an asymmetric arrangement of the radi-~~

~~isomerism. "^^^ such as would condition optical activity is~~

~~to be postulated. In the case of ethenoid derivatives, in which a pair of carbon atoms are associ- ated by two affinities of each, the afiSnities uniting the two atoms lie in one plane, whilst the remaining four~~

~~^ -n affinities lie in a second plane at right angles~~

~~^^ II ^^ to the first. Hence an ethenoid compound 3 ■'*4 ma,y be represented by such a symbol as is~~

~~shown in the margin, in which the double vertical line indicates the "double bond" between the carbon atoms.~~

~~In such a case isomerism will arise if merely the posi- tion of EsEi relatively to EiEj be varied, the radicles lying in the one case on the same, and in the , other on opposite sides of the plane uniting the two carbon atoms. Isomerides of this kind are not optically-active, as the radi- cles are all situated in one plane. So simple a difference in structure often involves a considerable difference in pro- perties, as in the case of maleic and fumaric acids, for example. Of these the former alone yields an anhydride, and is~~

~~*therefore represented as the cis-form by symbol 1, f lynaric acid, the trans-form being represented by symbol 2*~~

~~*CO2H.CH*~~

~~*(1)*~~

~~*CH.COOH CH.COOH ;*~~

~~*(2)*~~

~~*CH.COOH.*~~

~~*Cis- and trans-isomerism occurs, it is supposed, not only among ethenoid compounds, but also in the case of saturated ring systems generally ; in fact, the ethenoid compounds present but a special case of this kind of isomerism. In a ring system — whether composed of carbon atoms alone or of such in conjunction with other polyad elements — the affinities of the atoms which are united within the ring lie in the plane of the ring, and the two remaining affinities of each carbon atom lie in*~~

~~*planes at right angles to the ring plane. Numerous instances of this kind of isomerism are presented by the benzene-carboxylic acids, which have been studied more particularly by von Baeyer.*~~

~~*Enough will have been said to make clear the uge that is made of the conception that the affinities of carbon are directed effects. The hypothesis has been of the utmost service, as with its aid it is possible to give a rational explanation of every case of isomerism hitherto described. But after all the model used is but a model, and probably a very imperfect expression of, if indeed it in any way app;roaches to, the actual state. There is little doubt that what is true of carbon is true of many if not of all the other polyad elenjents. *~~

~~*Chemical Change.*~~

~~*Chemical text-books teem with equations representing changes as occurring between pO'i'rs of substances, so that from the outset of his career the*~~

~~student becomes imbued with the notion that such expressions are faithful repre- sentations of the facts — especially as he witnesses many experimenjts in which apparently two substances are caused to interact ; he is "rarely made aware that the materials used are always more or less impure — that a pure substance in €act is, and must ever be, an ideal conception, and he is still less rarely led to reflect on the possible influence of " impurity " as causative of change. Yet, of late years, instance after instance has been brought forward of a " third substance " playing an all- important and indeed deterrdinative part in conditioning the chemical interchange ; so much is this the case that it is now seen to be more than probable that every interchange involves the co-operation of a " third " substance.~~

~~Many years ago Wanklyn stated (Chem. News, xx. 271) that dried chlorine is without action on sodium even when the latter is heated; but until Cowper pointed out, in 1883 (Trans. Chem. Soc. 1883, ot third p. 153), that while dried chlorine is without tubstaace action on copper and a number of other metals, "e«s"'y. the moist gas at once attacks them, the influence of moisture in promoting such interactions did not attract attention. In 1884 the important discovery was made by H. B. Dixon (Phil. Trans. 1884, p. 617), that a dried mixture of carbonic oxide and oxygen gases does not explode, but that a mere trace of steam renders it ex- plosive, the rate at which the explosive wave travels in such a mixture being dependent, up to a certain point, on the amount of moisture present. H. B. Baker then showed (Phil. Trans. 1888, p. 571) that when moisture is, as far as possible, excluded, carbon, sulphur and phosphorus can be heated in an atmosphere of oxygen without undergoi&g visible combustion. Holt and Sims subsequently observed that dried oxygen does not oxidize either sodium or potassium (Trans. Chem. Soc. 1894, p. 432). In 1893 H. B. Baker extended his ex- periments to compounds, and made the very remarkable discovery that neither does oxygen combine with nitric oxide nor ammonia with hydrogen chloride when the gases are very carefully dried. The same observer has found that the reverse effect — ^the occurrence of decomposition — is also affected by the presence of moisture, it being possible, for example, to vaporize ammonium chloride and mercurous chloride without their undergoing decomposi- tion if moisture be rigorously excluded. The utmost care, however, must be taken to secure such a result, it~~

being necessary, for instance, in determining the density (by V. Meyer's method) to use an apparatus constructed of hard glass, since soft glass apparently retains sufficient moisture to invalidate the experiment. In some cases, although it has not been found possible to prevent the

occurrence of change, evidence that moisture exercises a determining influence is afforded by the observation that the rate of change is affected by the withdrawal of moisture. Thus Pringsheim, Dixon, and Baker have all found that the rate at which hydrogen and chlorine interact is diminished by carefully drying the gases. Experiments made by V. Meyer, in conjunction with Krause and Askenasy (Liebig's Ann, 264, p. 85 ; 269, p. 49), show that the same mixture of hydrogen and oxygen sealed up in a number of bulbs and heated to various temperatures behaved irregularly, interaction occur-ring in some to a far greater extent than in others placed under apparently the same conditions. Such results may be regarded as proof that even the inter- action of hydrogen and oxygen is determined by a third substance.

But there are a number of cases in which the attempt

has been unsuccessfully made to check the occurrence

of change by removing moisture (cf. Cowper,

:?S!lf^1fL toe. cit; H. B. Baker, Trans. Ghem. Soc. 1894,

exceptions, ^^^^ i i. ,i ■, i -i*

611); of none of these can it be asserted, however, that the precautions taken have been sufficient to preclude the assumption that with still greater care positive results would be obtained. Among the most, indeed the most, carefully conducted experiments of the kind are those of Shenstone on the production of ozone, and on the interaction of mercury and halogens (Trans. Ghem. Soc. 1897, p. 471). According to this observer " well-dried oxygen ozonizes exceedingly badly," whence it may fairly be assumed that

~~dry oxygen would not ozonize. On the other hand, when the well-dried gas was ozonized the ozone produced appeared to undergo decomposition very rapidly, while that produced when moist oxygen was used seemed to be stable. Shenstone therefore assumes that water vapour, at the ordinary temperature, retards the reversion of ozone to oxygen in a very remarkable degree. That this should be the case appears highly improbable, and it is necessary to seek for an explanation of the anomaly in some other direc- tion. It is conceivable that a minute amount of " acid " impurity may intervene in the case of the dried gas and determine its decomposition, but that in the wet gas this impurity is rendered more or less harmless by condensa- tion. Such impurity might be derived from the interac- tion of nitrogen and oxygen under the i influence of the discharge, for it is known that "oxides of nitrogen" determine the decomposition of ozone. As regards the interaction of halogens, and mercury, Shenstone was unable to detect any alteration in their activity conse- quent on drying. Bat when the complex character of his apparatus is taken into account, as well as the fact that it was not all made of hard glass, and that it could not be dried at a high temperature, it is more than prob- able that he was not able to carry the drying sufficiently- far, especially when it is remembered how extraordi- narily minute, according to H. B. Baker's later observa^ tions, is the amount of moisture required to induce decomposition in the case of mercurous chloride. Chlo- rine being a far more active agent than oxygen under ordinary conditions, it is to be expected that it will be far more difftcult to check the occurrence of change when it is used than is generally the case with oxygen.~~

~~There can be little doubt that the evidence is sufficient to justify the conclusion that chemical interactions are not generally of the simple form~~

~~AB-1-CD=AC-|-BD,~~

~~and that their occurrence is, as a rule, dependent on the introduction of some " third component " into the system. It is even probable that this is a rule absolute. If the attempt be made to determine the conditions which~~

~~must prevail in order that an interchange may occur, with a view of determining the nature of the Nature "third component," the only conclusion at pre- of third sent possible is that they are essentially those~~

~~substance. which obtain in a voltaic circuit; in fact, if Faraday's doctrine of the unity of chemical and electrolytic change be accepted it follows that both are determined by like conditions. On this assumption, a circuit of change must comprise three distinct terms or components, one of which must be an electrolyte. On this view, it is easy to under- stand the occurrence of change in many cases on the introduction of moisture. It is only necessary to bear in mind that as we invariably operate in glass vessels which are to some extent soiled, it is impossible to avoid the presence of traces of acid or " salts," which render the water an electrolyte, and therefore that the introduction of moisture means the introduction of an electrolyte. Thus, in the case of the combustion of carbonic oxide, the system within which change occurs may be regarded as consisting of oxygen, carbonic oxide, and impure, i.e., conducting water, which conjoined form a conducting circuit within which the interaction occurs, viz. : —~~

~~CO CO~~

~~OH2 OH,~~

~~0_C02 O-CO2~~

~~H3O~~

~~HnO~~

~~As early as 1830 it was shown by de la Rive that the readiness with which zinc is attacked by an aqueous solution of sulphuric acid depends upon the amount of impurity it contains, and that the acid which acts most readily is that which has the highest electric conducting power. When purified as far as possible zinc is all but insoluble, and therefore it may fairly be supposed that ideal pure zinc would be insoluble in diluted sulphuric acid. It at once dissolves when coupled up with any relatively electro-negative conductor at a rate depending on the resistance in the circuit in which it is arranged and on the electro-motive force developed in the inter- action.' The conditions which determine the dissolution of zinc may therefore be said to be that it forms one of the three components in a conducting circuit compris ing itself, a relatively electro-negative chemically inert conductor, and an electrolyte which can exchange its electro-positive constituent for the zinc. The~~

~~apparent inactivity of " pure " zinc has been ascribed to the cir- cumstance that when placed in acid it immediately becomes coated with a protecting film of hydro- gen— varnished, as it were — and that ^e part ^nd"'" played by the impurity is that of depolarizer : chemical that, in fact, it conditions the escape of the hy- ch^ge drogen. That the impurity, to some extent, J'"'^ exercises this latter function there can be no doubt; but, on the other hand, there is every reason to believe t^at three "components" are required to form a voltaic circuit. It is well known that the elec- tromotive force of a zinc-sulphuric acid-couple (or triplet, to use a far more suitable expression) is a fluctuating value, and that the nature of the conductor is of some importance. Thus a cell containing a polished silver plate as positive element is less effective than one in which the plate is coated with finely divided platinum. It is not difficult to understand this, as the extent to which hydrogen escapes from the positive is much in- fluenced by the character of its surface, and it is well known that finely divided platinum promotes the escape of gases from solution. Therefore when finely divided platinum is thus used, not only is the effect diminished which retention of hydrogen on the surface of the plate would have in increasing the resistance in the circuit, but the extent to which "polarization" or reversal takes place is also considerably diminished. In fact, it must not be forgotten that the action is a reversible one, i.e.,,~~

~~Zn+H2S04.<— s-Ha+ZnSOi, and that the extent to which reversal takes place depends on the power possessed by the positive electrode of conditioning the return of hydro- gen into circuit.~~

~~In cells of the Daniel type a constant electromotive force IS secured owing to the complete prevention of pol- arization and Its consequences, but the depolarizer not only prevents back action and maintains the resistance constant by acting as a scavenger, but also always con- tributes to the development of energy in the circuit. Change, m fact, 13 often conditioned by the presence of a depolarizer, an exothermic series of changes being thereby converted into an endothermic series. Thus copper is insoluble in dilute sulphuric acid, its " heat of dissolution " in such acid being a~~

~~negative value, which may readily be calculated from the known heat of formation of copper oxide and that of copper sulphate and water from the oxide and dilute sulphuric acid; thus~~

~~Cu-|-^=CuO=37,160 gram. deg. C units~~

~~CUO+H2SO4, aq.=CuS04, aq.-fH20= 18,800 units~~

~~H24-^=H2O=68,360 units~~

~~Cu-FHjSO^ aq.=H2-|-CuS04, aq. = -12,400 units.~~

~~In presence of oxygen, however, the metal readily dis- solves, the gas acting as the depolarizer,~~

~~CU-I-H2SO4, aq.l^=H20-FCuS04, aq.=65,960 units.~~

~~A cell consisting of copper, dilute sulphuric acid, and oxygen, therefore, has an electromotive force of about ■||^f^=l-2 volts. Actually, copper sulphate is manu- factured on a very large scale by the action of dilute sulphuric acid on granulated copper in presence of air.~~

~~In the case just considered, the third term of the system is not a substance which acts as a conductor in ordinary circumstances ; but it is merely one which can become included in the system. It would therefore seem to be necessary, in order that chemical change may take place, that a circuit be established in a system composed of at least three " elements," which is conducting as a whole, and which contains, together with an electrolyte and a, substance which sooner or later is attacked by the electro- lyte, a third substance which may or may not take a material part in the change.~~

~~In the case of the combustion of carbonic oxide by moist oxygen, Dixon has argued that since carbonic oxide is inert towards oxygen, its oxidation in presence Oaseoas of moisture is a secondary effect, the steam act- ing catalytically as a carrier of oxygen. It is well known that at a high temperature carbonic oxide decomposes steam (CO f 0H2= Ha-F CO2), and Dixon supposes that the whole of the oxidation is effected in this way, the hydrogen ^eing alternately oxidized and de- prived of oxygen {Trans.~~

~~*Chem. Soc. 1898, p. 774). That a part of the carbonic oxide may be oxidized in this simple manner cannot be denied, but probably it is only a minor part; there must be some collisions in which only carbonic oxide and water molecules nieet, but con- sidering the proportions in which carbonic oxide and oxygen are present, it must frequently happen that their molecules will together collide with water molecules, in which case the iuteraction CO-f-OIl2-f-y=C02-fH20 is bound to occur ; especially as it is a change in which heat is liberated, i.e., exothermic, whereas the interaction of carbonic oxide and water is one in which heat is absorbed i.e., endothermic. But apart from the question which is' the preponderating change, they may equally be regarded as electrolytic changes, i.e., as taking place only under the conditions which render the occurrence of*~~

~~*Inter- actions.*~~

~~*electrolysis possible — whatever these may be in the case of gases.*~~

~~*In order to test whether the high stability of the oxygen molecule renders a mixture with carbonic oxide inexplo- sive, and whether oxygen in the "nascent" state is more active, Dixon has made the interesting experiment of exploding a well-dried mixture of carbonic oxide and chlorine peroxide, the result being that much of the former remained unbumt just as when well-dried oxygen is used (ibid. 1896, p. 605). As it must be supposed that at the moment of explosion oxygen atoms are liberated, it inight be expected that the oxygen from such a source should be specially active. On the other hand, when, cyanogen is exploded with an excess of oxygen, it is entirely burnt to carbon dioxide, and Dixon supposes that the carbonic oxide formed in the wave front is slowly burnt behind the wave front. It should be mentioned that a spark of considerable intensity is required to initiate an explosion in such a mixture, and that the presence or absence of moisture apparently makes no difference in the readiness with which the mixture is inflamed. As it cannot be assumed that Dixon dealt with really dry gases, this probably means that a much smaller proportion of moisture suffices in the case of cyanogen to promote the interchange, and the complete- ness of the oxidation may be ascribed to the fact that cyanogen has a very hig"h " heat of combustion." In the case of the explosion with chlorine peroxide, the chlorine would interfere by decomposing a portion of the water, and the*~~

effect of the atomic oxygen in promoting the change would be counterbalanced by the withdrawal of moisture. In general chemical behaviour, carbonic oxide is a far more saturated and less active substance than cyanogen, and water molecules would have less tendency perhaps to couple up with it than with cyanogen. It is desirable to call attention to this point in order to lay emphasis on the need, in discussing chemical interchanges, of taking into account both the compatibility of the various molecules present and the stability of the loose molecular complexes which may form prior to the occur- rence of any interchange.

Although it may be said that a fairly general agreement exists to regard chemical changes as essentially electrolytic in their nature, there is far from being any Mechanism agreement as to what really takes place — as to ot chemical the character of the " mechanism " concerned in ‘“ter- their occurrence. Williamson, in 1851, in his ‘“°*- paper on the " Theory of Etherification," put forward in explanation of " the general process of chemical decom- position," the view that in an aggregate of molecules of any compound there is an exchange constantly going on between the elements which are contained in it. Thus in a drop of hydrochloric acid, supposed to be made up of a great number of molecules of the composition CIH, each atom of hydrogen does not remain quietly in juxtaposition with the atom of chlorine with which it first united, but on the contrary is constantly changing places with other atoms of hydrogen. Supposing the hydrochloric acid to be mixed with some sulphate of copper (of which the component atoms are undergoing a similar change of place), the hydrogen does not merely move from one atom of chlor- ine to another, but in its turn also replaces an atom of copper. Thus it i that at any moment of time at which we examine the mixture the bases are divided between the acids {Quart. Journ. Chem. Soc. 4, 110). Practically the same view was applied by Clausius in 1857 in explanation of the phenomena of electrolysis ; but -^-hereas Williamson had spoken only of exchanges going on, Clausius ascribed the occurrence of these to collisions taking place between the molecules of sufficient violence to cause some to split ijp iuto their constituents, which then wandered about till

~~they met with others of the opposite kind and united with them to form new molecules. On the assumption that the electromotive force acts on the molecular fragments during the intervals of freedom but does not produce disruption of the molecules, it is possible to understand that any electromotive force, however small, can produce sensible electrolysis.~~

~~Kekul^, in 1858, in discussing the manner in which inter- changes are effected, took the very different view that in the first instance the molecules attract each other and become associated, and that atomic affinities then come into operation and cause the redistribution. He pictured the state of affairs in the following manner : —~~

~~a 6~~

~~a b~~

~~ab~~

~~a' b'~~

~~a'V~~

~~a'V~~

~~Before.~~

~~During.~~

~~After.~~

~~He went so far as to speak of this conception as the simplest and as being universally applicable.~~

~~For many years practically no attention was paid to the dissociation hypothesis, and it was not until 1884 that interest was revived in it by Airhenius, who gave a quan- titative form to the hypothesis of Clausius by treating electrolytic conductivity as a measure of the extent to which dissociation may be supposed to have taken place in a solution. A still greater advance was made in 1887 by van't Hoff, who fully discussed the~~

~~*properties of so- lutions, and showed that the equations for the ordinary gaseous laws are equally applicable to solutions, provided that in the case of conducting solutions the increase in the number of molecules due to the " dissociation " be taken into account.*~~

~~*In the modern form of the hypothesis, substances which afford conducting solutions (acids, bases and salts) are assumed to undergo disruption or dissociation 'sMiamn. ^*° separate ions when dissolved in water, the extentto which the ionic dissociation is effected depending not only on the substance, ,but also on the degree of dilution. Neutral substances, on the other hand, such as alcohol, sugar, &c., which do not behave as elec- trolytes in solution, are assumed to be undissociated. But ionic or electrolytic dissociation differs from ordinary dissociation — ^in which a compound is resolved into mutually independent simple molecules — in that the two ions into which the electrolyte is resolved are associated with opposite equal electric charges. These electric charges, like matter, are, in a sense, to be regarded as "atomic," a unit charge corresponding to a unit valency, so that each ion is capable of conveying only a certain charge ; consequently the electric conductivity of a dis- solved electrolyte is quantitatively proportional to the degree of ionization. The dissolved substance in its dissociated state — not the solution as a whole — is there- fore the effective conductor. To deduce m, its molecular conductivity, the specific conductivity, k, of the solution is multiplied by v, the 'number of litres containing a gram molecular proportion of the substance. The molecular conductivities are, therefore, values which express the degree of conductivity due to the introduction of equal numbers of molecules of dissolved substances between the electrodes. If m, be the molecular conductivity of a substance in a solution of dilution v, and m ^— deduced by extrapolation from the m, values — that in an infinitely dilute solution, in the case of compounds of univalent ions, the degree of dissociation or ionization i,, in the solution of the concentration v and the molecular con- ductivity of the dissolved substance are so related that*~~

~~*In the case of compounds containing multivalent ions a more complex relation obtains. In a system consisting of*~~

~~*water together with an undissociated substance and its ions, the ordinary laws of equilibrium govern the relation between the degree of dilution and the extent to which the substance undergoes dissociation; therefore, in the simplest case, that of a binary electrolyte E, the two ions of which are A and B, if e, a, and 6 are the molecular concentrations of the undissociated material and of its two ions respectively;*~~

~~*a6=eK, and a=h*~~

~~*where K is a constant. If the total quantity of dissolved material be taken as unity and the dissociated fraction as i,*~~

~~*a=zb=i/v and (lT-i)/'U=e.*~~

~~*The relation between the degree of dissociation and- the dilution is therefore that expressed by the „„„ ;*~~

~~*n ■% BttCCt Or*~~

~~*formula ailatloa on*~~

~~*The case of dichloracetic acid may be cited as '"'■ one in which, as van't 'Hoff points out, the agreement be- tween the calculated and observed results is especially close.*~~

~~*Wo/TTfcoO*~~

~~*Wtj/wtoo*~~

~~*Obs.*~~

~~*Oslo.*~~

~~*20*~~

~~*51-6*~~

~~*0-166*~~

~~0-163~~

~~205~~

~~132~~

~~0-423~~

~~0-43~~

~~408~~

~~170~~

~~0-547~~

~~0-543~~

~~2,060~~

~~251~~

~~0-806~~

~~0-801~~

~~4,080~~

~~274~~

~~0-881~~

~~0-88~~

~~10,100~~

~~295~~

~~0-948~~

~~*0-944*~~

~~*20,700*~~

~~*300*~~

~~*0-963*~~

~~*0-971*~~

~~*00*~~

~~*311*~~

~~*1 •*~~

~~*1*~~

~~*Whereas carboxylic acids generally are but slightly dis- sociated in moderately dilute solutions, strong mineral acids, the alkalies, and most metallic salts — especially those of alkali metals — are highly dissociated. This is well shown in the following table of results originally published by Ostwald in 1885, in which the molecular conductivities are given in arbitrary units : —*~~

~~*D.*~~

~~*HCl.*~~

~~*HBr.*~~

~~*HI.*~~

~~*HF.*~~

~~*Nitric Acid.*~~

~~*Sulphuric Acid.*~~

~~2~~

~~77-9~~

~~80-4~~

~~80-4~~

~~77-9~~

~~92-7~~

~~4~~

~~80-9~~

~~83-4~~

~~-83-2~~

~~6-54~~

~~80-4~~

~~96-4~~

~~8~~

~~83-6~~

~~85-1~~

~~84-9~~

~~7-59~~

~~82-8~~

~~100-6~~

~~16~~

~~85-4~~

~~86-6~~

~~86-4~~

~~10-00~~

~~84-9~~

~~1074~~

~~32~~

~~87-0~~

~~87-9~~

~~87-6~~

~~13-14~~

~~86-3~~

~~116-3~~

~~64~~

~~88-1~~

~~88-9~~

~~88-7~~

~~17-38~~

~~87-4~~

~~127-3~~

~~128~~

~~88-7~~

~~89-4~~

~~89-4~~

~~23-11~~

~~88-2~~

~~139-2~~

~~256~~

~~89-2~~

~~89-6~~

~~89-7~~

~~30-30~~

~~88-4~~

~~150-6~~

~~512~~

~~89-6~~

~~89-7~~

~~89-7~~

~~39-11~~

~~88-8~~

~~160-9~~

~~1,024~~

~~89-5~~

~~89-5~~

~~89-3~~

~~49-49~~

~~88-9~~

~~169-1~~

~~2,048~~

~~89-5~~

~~88-9~~

~~89-0~~

~~59-66~~

~~88-2~~

~~174-4 177-1'~~

~~4,096~~

~~88-6~~

~~87-6~~

~~87-8~~

~~69-42~~

~~86-6~~

~~It will be noticed that in the case of the three halhydrides, for example, a steady value is very soon reached, dissociar tion being practically complete at very moderate dilutions in comparison with those necessary to produce anything like the same degree of change in the case of dichloracetic acid quoted above. Moreover, the initial value differs but slightly from the final value — which is an indication that the acids are almost completely dissociated even in concentrated solutions; in fact, if 90 be taken as the hmiting value, in the case of the halhydrides, HCl,HBr and HI as well as in that of nitric acid, about 80/90= 9 of a molecular proportion of the electrolyte is resolved mto its ions when dissolved in only 2 litres of water The different behaviour of hydrogen fiuoride is of interest, as this hydride, it is well known, tends to form complex aggregates ; apparently these only gradually undergo simplification on dilution, and consequently the electro~~

~~CHEMISTRY~~

~~737~~

~~(?)=1000)~~

~~Kxion~~

~~0125~~

~~0 0018~~

~~0-692~~

~~0-156~~

~~0-981~~

~~5-1~~

~~0-999~~

~~121-0~~

~~lytic dissociation of the fundamental molecules is consid- erably retarded. A striking illustration of the influence of composition on the extent to which dissociation takes place IS afforded by the substituted acetic acids, thus :—~~

~~Acetic acid . Chloracetic acid . Dichloracetic acid Trichloracetic acid~~

~~It is generally noticeable that the value of the dissocia- tion constant K is subject to great variation as the struc- ture changes ; consequently this factor becomes of great importance in diagnosing the structure of electrolytes.~~

~~Ethereal salts, cane sugar, and other substances which undergo hydrolysis in presen9e of acids and alkalies are acted upon at rates which differ not only as the conditions of temperature and concentration are varied, but also accord- ing as the change is conditioned by the one or the other hydrolyst. Investigation shows that the relative activity of hydrolysts corresponds with the electric conductivity of their solutions ; hence it is assumed that acids, &c., do not act as such in these cases, but that the ions are the active agents. From this point of view, the constant K is the measure not only of the extent to which a substance is dissociated, but also — ^with certain limitations — of its activity in chemical interchanges. The following results obtained by Ostwald with cane sugar may be cited as proof that the rate at which inversion is effected by the acids referred to, in comparison with that deduced for hydrogen chloride (in ^ normal solution at 25°), is almost proportional to the degree of dissociation : —~~

~~Degree of DlBsoclation.~~

~~0 006 0-0245 0-0542 0-272~~

~~As the hydrolysis of cane sugar is effected only by acids and not by alkalies or salts, it is customary to re- gard the action as brought about solely by the hydrogen ions, which are abundantly present in most acid solutions, but not in those of alkalies and salts. It should be noted, however, that although it is true, especially in the case of weak acids, that acids act the more readily the more highly they are dissociated, there is only a roughly ap- proximate~~

~~numerical proportionality between the inversion velocity and the quantity of hydrogen ions. It is also noteworthy, and difficult to explain, that the catalytic activity of the hydrogen ions is greatly stimulated by the presence of other ions ; thus on adding to an acid solution an equivalent proportion of the corresponding potassium salt, the velocity of inversion is increased by some 10 per cent, in the case of strong acids, although it is decreased in the case of the weaker acids.~~

~~The ionic dissociation hypothesis is held to afford a simple explanation of the phenomena underlying the pro- cesses in use in analytical chemistry. Thus it is 'aJsiJ^'^' ■n^ell known that the tests applied in detecting applied to metallic and also non-metallic radicles are, with chemical fg^ exceptions, of general application — a metal, analysis. ^^^ example, being detected by the same test whatever the salt may be in which it is present as positive constituent. This must be the case, on the ionic hypothesis, as the chemicallv active components in a solution are not the dissolved substances, but the ions into which they are resolved on entering into solution. The state of a salt AB is such that the undissociated salt and its ions A and B are in equilibrium ; a second salt CD also exists m solution partly as CD and partly as the ions C and D. On mixing two such solutions interchanges occur, and a~~

~~Bate of~~

~~Inversion~~

~~Acetic acid .~~

~~, 0 0040-~~

~~Formic acid~~

~~0-0153~~

~~Mooochloracetic acid .~~

~~0-0484~~

~~*Dichloracetic acid*~~

~~*0-271*~~

~~*new state of equilibrium is established in which the salts AD and CB also exist along with AB,, AC, A, B, C, and D. The new salts are produced in quantities determined by the concentration, and if the solution be sufficiently dilute, the salts AB, AD, CD, CB are present in negligibly small quantities ; consequently the properties of the solu- tion are simply the properties of the dissolved ions, and there is no appreciable change on mixing AB with CD. But this is only true if the products are soluble. If the ions A and D are capable of uniting to form a substance which is insoluble under the conditions of the experiment, the compound AD is removed from the system as rapidly as it is formed, until eventually, when equilibrium is attained, only a very minute proportion of the ions A and D remains in solution. The effect on each other which two electrolytes having an ion in common often exercise by the one diminishing the solubility of the other is easily understood from this point of view. In the case of a saturated solution of a salt AB, the solid present is in equilibrium with the undissociated dissolved salt AB, which, in turn, is in equilibrium with its ions A and B ; if now another salt containing either the ion A or the ion B be brought into the solution, the extent to which AB undergoes dissociation is reduced, because the proportion in which the one or the other of its ions is present in the liquid is increased. Consequently AB is partially thrown out of solution. The precipitation of sodium chloride on saturating its solutioii with hydrogen chloride, and the fact that the solubility of barium sulphate in water is reduced by the addition of either sulphuric acid or barium chloride, may be instanced as cases to which this explana- tion is applicable. The same principle is applicable in explanation of the lowering of the activity of weak acids by their salts. The fact that chlorine in chlorates, iron in f errocyanides, &c., are not to be detected by the " ordinary" tests, is ascribable to the fact that they are not present in solution as simple ions, but as complex ions having alto- gether different and peculiar properties.*~~

~~*The considerable evolution of heat which occurs in neutralizing an acid by an alkali is apparently a contra- vention of the rule that practically no*~~

~~change ^, ^ ^ , occurs on mixing solutions of highly dissociated slightly" subsliances if there be no insoluble product, dissoci- This, however, is held to be due to the fact "'*"• that water itself is peculiar in being dissociated only to a very minute extent. Consequently water is the one product formed in the solution, and the heat evolved is to be regarded as that liberated by the combination of its constituent ions, thus : —~~

~~(H+X)-|-(Y-|-0H)=H0H-1-X-FY~~

~~Ions of acid. Ions of base.~~

~~In the case of all strong {i.e., highly dissociated) acids and bases, therefore, the character of the change is independent of the nature of the acid and base. This conclusion is in striking accord with the well-known fact that the strong acids and alkalies all have practically the same heat of neutralization (cp. Ency. Brit. vol. v. p. 487). Further evidence of the same kind is afforded by the observation that in dilute aqueous solution all the metallic salts of a strong optically-active acid, such as bromocamphorsul-phonic acid, have the same molecular rotatory power, viz., that of the acid ion.~~

~~If water be regarded as very ^lightly dissociated, it is also easy to understand that it should act as a weak acid towards salts of very feeble acids and bases, which, in solution, undergo dissociation to an extent comparable with the degree of dissociation of water ; in such cases, the ions A and B of the salt should combine with those of water, and recognizable quantities of the acid and base~~

~~derivable from the salt should, be produced. The fact that solutions of pyanides smell of hydrogen cyanide is traceable to this cause. Another illustration is the liberation of the very weak base ammonia on boiling solutions of ammonium salts.~~

~~The study of ionic or electrolytic dissociation, and of the properties of solutions generally, in the main, involves~~

~~the investigation of homogeneous equilibria, to so/utfonr *^® principles governing which have long been ‘ familiar in connexion with the laws of mass action, developed by Harcourt and Esson (1866), and Guldberg and Waage (1867). The discussion of the facts relating to the saturation of solvents with dissolved matter is, however, now recognized as lying within a totally distinct province, and as involving the consideration of heterogeneous systems. Neglect of this fact has proved a constant source of error in the past, while its recognition has led within recent years to far-reaching and fruitful generalizations. The subject has received very full treat- ment at the hands of van’t Hoff in his Lectures on Theoreti- cal and Physical Chemistry. Formerly it was the custom to talk of a solution as being saturated with a certain dissolved material, but it is now recognized that it must be spoken of as saturated with respect to a particular material. The distinction lies in the fact, not formerly appreciated, that for a solution to become saturated it must be in contact with undissolved material. For example, on shaking water with excess of sodium chloride at 14°, each 100 parts of water dissolve 35-87 parts of sodium chloride, and being in contact with the solid salt, the solution is both in equilibrium with, and saturated with respect to, the solid. If the solution be separated from the solid it can no longer be described as a saturated salt solution, because it is no longer in contact with, and consequently not in equilibrium with solid sodium chloride. This modem method of regarding a state of saturation as a condition of equilibrium in a heterogeneous system, i.e., one in which there are at least two regions of different composition or concentration, leads immediately to a rational explanation of the phenomena of supersat- uration which long perplexed chemists. Two cases may**

~~be cited in illustration. It is possible to dissolve sataration. ^^ parts of sodium sulphate in 100 parts of water~~

~~at 30°, and on cautiously cooling the solution to 10° no separation takes place, although at 10°, in con- tact with the salt, water will only take up 9 parts of sodium sulphate per 100 parts. The solution containing 40 parts of the salt- at 10° is commonly said to be supersaturated, but it cannot even be~~

~~said to be saturated in the modern sense of the term. On dropping into it a fragment of the deeahydrated salt, this salt at once crystallizes out, heat being evolved, and when, eventually, the temperature is reduced to 10°, the solution contains only 9 parts of the salt in 100 of water; this is because equUibrium has been established between solid and solution. Similarly, the solubility curve of sodium sulphate in water exhibits a break at 33°. The existence of this was long regarded as anomalous, but it occurs because below 33° the solid in contact with the saturated solution is the compound !N'a2SO4.10H2O, whilst above 33° it is the anhydrous sulphate. The hydrated salt decomposes at 33°, losing its water, and this temperature is therefore termed the transition temperature. At the transition temperature the solution is in contact and in equilibrium with both hydrated and anhydrous salt.~~

~~In the case of two salts capable of forming a double salt the conditions are somewhat more complex. The results obtained by Trevor (at 25°) with potassium and copper sulphates may be quoted in illustration. If the solution be in contact with the two salts, and be saturated with~~

~~respect to each, it contains 5-2 per cent, of potassiuni, and 10-4 per cent, of copper sulphate. But if, instead of being in equilibrium with the single salts, it is in contact only with the double salt K2SO4.Cu8O4.6H A f;Jj^°f/ it contains 11-14 per cent, of the salt in solu- sn/fe. tion. Lastly, the solution may be saturated with respect to the double salt and either of the single salts. At the same temperature, therefore, four different conditions of saturation equilibrium are possible, the condition which obtains depending solely on the salts in contact with the solution. If the temperature be also varied, the con- ditions become still more complex, owing not only to the changes in solubility, but also because alterations may take place in the degree of hydration and in the composi- tion of the double salts. Thus, in the case of potassium and magnesium sulphates in solution at different tem- peratures,, the conditions under which equilibrium ob- tains vary according as they lead to the separation of one or other of the compounds HjO (as ice), K2SO4, MgS04.6H20, MgS04.7H20, K2SO4.MgSO4.6H2O, or K2SO4.MgSO4.4H2O.~~

~~It should be pointed out that the great advance made in recent years in studying problems such as those just re- ferred to is mainly due to the application by Willard Gibbs of the second law of thermo- ^on”*”’ dynamics to the study of the physical equilibria etHcients. underlying chemical changes. It is character- istic of the results arrived at with the aid of this law, that they deal only with the difference in condition obtaining between the various parts of a system, and their validity does not depend upon the differences being of any particu- lar chemical or physical type. The principles governing heterogeneous equilibrium have been formally expressed by Willard Gibbs in the so-called phase rule. This rule, however, is merely a convenient method of classifying the various cases of equilibrium which may arise, and in itself is of little use in diagnosing the conditions which hold in any particular case. Nernst has applied the principles enunciated by Willard Gibbs with signal success to the consideration of the equilibrium established when a soluble substance is distributed between two practically immiscible solvents in contact. For example — on shaking small quantities of succinic acid with a mixture of ether and~~

~~p~~

~~water, the ratio -~· of the amount of acid taken up by the~~

~~unit volume of ether, Cj, and of water, C2, respectively, is found to be independent of the total concentration. This is known as the law of constant distribution co- efficient. In the form given, it is obeyed only when the dissolved material has the same molecular weight in both solvents. On taking benzene, water, and benzoic axiid, which consists of double molecules in benzene solu- tion, the distribution of this acid takes place in such a~~

~~manner that -~· is constant, Cj being the amount of acid~~

~~V C2~~

~~taken up by the unit volume of water, and C2 that taken up by the benzene. The study of distribution coefficients, therefore, affords valuable information- as to the molecular weights of substances in different liquid~~

~~*solvents. Its application to electrolytes in water and in non-dissociating liquids has furnished evidence supporting the electrolytic dissociation hypothesis. The method m ay even be applied to solids. In the case of isomorphous mixtures it affords evidence that these may properly be regarded as solid solu- tions of the one substance in the substance with which it is isomorphous. Thus thallium and potassium chlorates are isomorphoiTs, and on crystallizing thallium chlorate from an aqueous solution containing a small proportion of potassium chlorate crystals of the former containing a small proportion of the potassium salt are deposited. Judging*~~

~~*from the ratio in which the potassium chlorate becomes distributed between the solid solvent (TlClOg) and the liquid, it appears that the molecular weight of potassium chlorate is the same in both the liquid and the crystal- line condition.*~~

~~*One of the most brilliant and fruitful generalizations of recent times has been van't Hoff's extension to dilute solu- tions of the well-known laws coimecting pres- sure, volume, and molecular weight in gases. Although a liquid exerts no pressure other than that due to its mass upon the surface of a con- taining vessel, the existence in solutions of a state comparable with that which obtains in gases becomes evident on studying the phenomena of liquid diffusion. If, for example, a solution of sugar be enclosed in a vessel having semi-permeable walls — le.,permeable by the water, but not by the dissolved substance, — and then the vessel be placed in water, diffusion of water into the solution sets in and continues until a certain pressure is attained: this is termed the osmotic pressure, and is found to be pro- portional to the number of molecules dissolved in the unit volume of liquid. Variations in temperature affect osmotic pressure in the same way that they affect gaseous pressure, consequently Avogadro's theorem is directly applicable to dilute solutions ; in other words, equal volumes of dilute solutions (of any one solvent) under like conditions of temperature and*~~

~~osmotic pressure contain equal numbers of molecules. If osmotic pressure could be easily measured, a simple method of determining the molec- ular weight of dissolved substances would be to determine the osmotic pressures they develop; but, unfortunately, this is not the case, and the determinations are affected by considerable experimental errors. But there are certain properties of dilute solutions which can be easily measured which vary pari passu with the osmotic pressure. It has long been known that aqueous solutions of equimolecular concentration of salts such as sodium chloride, potassium chloride, &c., deposit ice when cooled to the same tempera- ture, and van't Hoff has shown that the depression of the freezing-point of a solvent by addition of small proportions of a soluble substance is proportional to the variation in the osmotic pressure. The law that the freezing-point of a solvent is .depressed to an extent proportional to the number of molecules of dissolved salt present in unit volume forms the basis of the now well-known freezing- point method of determining the molecular weight of dissolved substances. In a similar manner the vapour pressure of a solvent is lowered by the presence of dissolved material to an extent which is proportional to the osmotic pressure, and in weak solutions the decrease in vapour pressure is directly proportional to the rise in boiling-point of the solvent. On this is based the now familiar method of determining molecular weights by observing the rise in boiling-point of a solvent produced when known small amounts of soluble substances are dis- solved in it. Both methods afford anomalous results when applied to aqueous solutions of electrolytes ; but these meet with an explanation when the diminution m aver- age molecular weight, i.e., the increase in the number of active molecules, consequent on the occurrence of ionic dissociation, is allowed for. . , , , ,,~~

~~The ionic dissociation hypothesis is undoubtedly a con- ppTition of great beauty, and the success that has attended its application in the case of dilute solutions is loaic Qf ^jjg most striking character. But it would~~

~~^a^ffi- be unscientific to yield to its charms without cleat having fully considered the probability and sufficiency of the explanation which it affords, and the difficulties which stand in the way of its acceptance. Chemistry is so wide a subject, chemical phenomena are so complex and so hard to analyse and interpret, the~~

~~difficulty of giving a quantitative expression to them is so great, that chemists are but rarely prepared to undertake such a discussion ; and it is easy to accept guidance and to yield allegiance to high authority, especially when it is exer- cised in the most autocratic and dogmatic manner possible hitherto. Unfortunately the advocates of the dissociation hypothesis have declined even to consider the objections which may be raised against it from the chemist's side.~~

~~One of the most fundamental objections to the hypo- thesis is that the number of compounds which are per se electrolytes being limited — to only a few fused salts, in fact — the explanation it affords of the occurrence of chemical change is at best only a very partial one. Water and all other liquids appear to be non-conductors in the pure state, and the arguments on which the assumption is based that water is dissociated to a very slightextent all involve reason- ing in a circle. Pure water — apwre substance — is and must ever be an ideal conception ; but as the resistance which water opposes to a current of electricity gradually increases as it is purified, and at last becomes enormously high, the facts warrant no other assumption than that it would be a non-conductor in the simple and pure state. The argu- ments based on the observation that it is slightly active chemically are of no independent value, since an impurity which would condition conductivity would equally condi- tion chemical activity. The assumption which is made, in order to explain the constancy in the heat of neutralization of strong acids generally by alkalies, that water is only very slightly dissociated, involves a sharp distinction between water and other compounds, and consequently between oxygen and other elements, which is in no way warranted and is in opposition to the periodic generaliza- tion. It is generally recognized that oxygen and the halogens present many analogies, so that water should — and does — in many ways resemble the halhydrides ; to assume, therefore, that water resists " ionic " dissociation whilst hydrogen chloride suffers almost completb disrup- tion into " ions " is altogether unjustifiable and illogical.~~

~~When water is mixed, say with hydrogen chloride, a non-conductor per se, a solution is obtained which is readily electrolysed. But solvents generally do not act in this manner~~ ~~in fact, only a limited number have the power of forming conducting solutions~~ ~~andnone isso active as water. To account for the influence~~

~~of the solvent, F. Kohlrausch, in 1876, put forward the view that Peculiar the ions which Clausius assumed to be present 'otwa^'^ in a liquid are thereby prevented from coming too frequently into contact apd merely recombining,and that consequently they are free during a sufficient length of time to be amenable to the guiding influence of the electro- motive force. Parenthetically it may be pointed out that the dissociation postulated by Clausius was supposed to affect only a relatively small number of molecules at any one moment, whereas the dissociation postulated by the ionic hypothesis, in the case of strong acids and metallic, salts, affects the major proportion of the molecules. More- over, the process supposed to attend dissolution is one of a, most extraordinary character ; it may be likened to the case of a number of individuals jumping into a swimming- bath, and nearly all of them instantly parting with their arms and legs. If the solvent act as a mere screen, any solvent should suffice to render a potential electrolyte a conductor, but this is not the case. Moreover, as a number of substances when fused (silver chloride, stannous chloride, &c.) are conductors in the absence of any solvent, the screen hypothesis is not only an unsatis- factory and incomplete explanation of the facts, but its in- troduction appears to be uncalled for. Again, if the Clau- sius hypothesis be accepted, and it be assumed that some of the molecules in a liquid collide with sufficient violence to bring about their decomposition, it is to be expected~~

~~that this would happen in liquids generally, although to different extents. Kor is it clear why the disruption should be of so partial a character, and lead only to the production of ions in the case of complex molecules ; for example, acetic acid, ex hypothesi, is resolved only into H and C2H3O2, instead of the molecule being more or less shattered to pieces. From this point of view it is impos- sible also to understand why only protochlorides and not perchlorides are electrolytes.~~

~~The discovery that chemical interchanges are in many cases not of the form AB + CD=AC+BD, but require the intervention of a third substance — the presence of an electrolyte being a sine qud non — and that this is probably~~

~~*equally true of decompositions and isodynamic changes, indeed of every case of change, is almost conclusive evi- dence against the acceptance of the dissociation hypothesis either in the form suggested by Williamson or in that suggested by Clausius ; in fact, no satisfactory evidence has been adduced that molecules are per se intrinsically so unstable as is suggested, or that they are in the habit of colliding with such violence as to smash each other to pieces.*~~

~~*As solvents generally do not condition electrolysis, but only particular solvents, it must be supposed that the Electro- Solvent exercises a definite influence, and one lysis a which is not of a merely mechanical order ‘ ; and dependent that the molecules of solvent and solute in some process. ^^j influence each other, and interact so as to pull each other to pieces as it were — in other words, that electrolysis is a dependent process. It is not a little remarkable that Faraday's prescience guided him to such a conclusion as the following passage (§ 523) in his fifth series of researches shows : —*~~

~~*The theory which I have ventured to put forth (almost) requires an admission that in a compound body capable oi electro- chemical decomposition the elementary particles have a mutual relation to and influence upon each other, extending beyond those with which they are immediately combined. Thus, in water, a particle of hydrogen in combination with oxygen is considered as not altogether indiSerent to other particles of oxygen, although they are combined with other particles of hydrogen ; but to have an affinity of attraction towards them which, though it does not at all approach in force under ordinary circumstances to that by which it is combined with its own particle, can, under the electric influence exerted in a definite direction, be made even to surpass it. This general relation of particles already in combination to other particles with which they are not combined is sufficiently distinct in numerous results of a purely chemical character . . . and it probably has a direct relation to and connexion with attraction of aggregation both in solids and fluids. It is a remarkable circum- stance that in gases and vapours, where the attraction of aggrega- tion ceases, there likewise the decomposing powers of electricity apparently cease, and there also the chemical action of quantity is no longer evident. It seems not unlikely that the inability to suffer*~~

decomposition in these cases may be dependent upon, the absence of that mutual attractive relation of the particles which is the cause of aggregation.

In fact, when the phenomena generally of chemistry — and not merely the isolated behaviour of electrolytes — are taken into account, there can be little doubt that chemical changes are primarily associative and not dissociative in character, as was seen by Faraday ; and that the force at work by which they are initiated is in all probability that which has been termed residual affinity. That tionhypo- tliis has not been more commonly recognized thesis ot probably arises from the circumstance that it chemical j^^g ;gg-customary as a rule only to consider ' the end results of chemical operations. The -view taken by Kekule as to the manner in which chemical change is brought about needs but slight alteration to be

1 It has been contended of late that the superior influence of water is due to its high specific inductive capacity. It is more probable that the power of water to condition electrolysis and its high specific inductive capacity are but correlated properties which have tlieir origin in the high residual affinity of the oxygen.

in harmony with such an argument ; it is merely neces- sary to assume that when the complex formed by the association of the interacting or potentially interacting substances meets with the necessary third component, a conducting system is established, and that so soon as this is formed the change sets in. Eesidual affinities are in all probability the polarizing forces at work in such cases, by which the various components are led to associate and take up compatible positions. This hypothesis involves the assumption that complication, not simplification, precedes chemical change; that complex molecular sys- tems are first formed from the interacting substances, and that these, on breaking down, suffer rearrangement of the parts — such rearrangement taking place in conse- quence of elements which were previously separate being brought into one common "sphere of activity" within which it is possible for them to interact. The function of condensing and other agents — of catalysts generally — on this hypothesis is that of collecting into one system the various elements necessary for the occurrence of a particular change. Such systems may be regarded as, and in fact would be, closed voltaic circuits. The action of aluminium chloride,

~~*for example, in conditioning the formation of homologues of benzene from the two sub- stances benzene and methyl chloride — both undoubtedly dielectrics, which when together alone are entirely with- out action on each other — may be ascribed to the forma- tion of an unstable compound of both with the metallic chloride. In like manner ferric chloride probably con- ditions the interaction of bromine and benzene by com- bining with both, and so bringing them within each other's range in an unstable system.*~~

~~*Ordinary cases of chemical change differ from those effected by an electric current merely in being cases of exothermic change which take place without any energy being supplied from without. How the current acts in promoting disruption cannot apparently at present be determined, but it is highly probable that it circulates within complex systems such as have been referred to. A rasping contact may be said to exist between the mole- cules of the dissolved substance and the solvent, and the action of the current upon each complex may be roughly compared with that of a dredging machine scraping mud from the bottom of a stream. A number of such dredgers arranged in series, each one of which picks up the mud delivered by the machine below, and thus carries it a stage higher up, so that mud only is visibly delivered at the one end of the system, may be taken as a simile of the manner in which the transport of the negative ion is effected; the water taken up in the buckets, but returned into the stream down which it flows, corresponds to the positive ion. But although both are concerned in the process, it cannot at present be determined whether the water or the dissolved substance in an aqueous solution is primarily split up; it is doubtful whether either is ever at once separately resolved into its ions. Probably in the first instance the system is resolved into two parts, one of which escapes — ^unless it act on the water — while the other being unstable often gives rise to secondary products. A solution of sulphuric acid, for example, appears to yield hydrogen and " oxidized sulphuric acid " ; the extent to which this latter persists depends entirely on the conditions, i.e., the con- centration, the temperature, and the size and character of the electrode. That water should be the most active among liquids both as a solvent and in promoting electro- lysis is in no way surprising, as no other compound exhibits residual affinity in so high a degree. To account for the behaviour of conducting chlorides, it is only neces- sary to suppose that*~~

~~individual like molecules exercise among themselves an influence similar to that exercised in~~

~~other cases between the molecules of solvent and solute. The existence of compounds such as potassium triiodide renders it probable that the electrolysis of conducting chlorid.es, such as silver chloride, is conditioned by the attraction which they exercise for chlorine, and the behaviour of protochlorides in comparison with that of perchlorides is readily explained from this point of view.~~

~~Among the objections to the ionic hypothesis in explanation of chemical change, that afforded by the behaviour of enzymes as hydrolytic catalysts is one of the strongest. The hydrolysis of ethereal salts and of carbohydrates such as cane sugar by acids is supposed to be conditioned by the hydrogen ions, but enzymes— which act even more powerfully than acids on the carbo- hydrates— are not electrolytes, and therefore cannot be supposed to furnish hydrogen ions. Moreover they act selectively, a particular carbohydrate as a rule beiag hydrolysed only with the aid of a particular enzyme ; in fact, there must be a correspondence somewhat like that of key to lock, and there is no doubt that the geometrical configuration of the enzyme relatively to that of the carbohydrate is the determining factor on which its action depends.~~

~~Although it is unquestionable, however, that besides being in many respects incompatible with the facts and irrational, the ionic dissociation hypothesis tioaot" makes demands upon the imagination which it solvent is practically impossible to grant, it is equally com- beyond question that the substances classed as~~

~~pexes. electrolytes in effect behave as though they were dissociated in solution._ What is the explanation of this remarkable circumstance ? Can any rational process be imagined comparable with that of ionic disso- ciation and susceptible of similar treatment ? Such an explanation is perhaps not far to seek, and may be found in the fact — too commonly~~

~~overlooked — that in solvents generally there are always present two sets of molecules in equilibrium, viz., simple or fundamental molecules and complex aggregates formed by the association of several such simple molecules. The internal state of a mass of liquid must be pictured as one of intense activity and turmoil — as one in which dissociation is constantly going on, but inter-molecular, not intra-molecular or ionic dis- sociation. Liquid water, for example, is a mixture of fundamental molecules or monads such as are represented by the symbol OH2 with complexes formed by the union of several of these simple molecules, in proportions de- pending on the temperature, and these two kinds of mole- cules are ever changing backwards and forwards the one into the other. The monads are presumably the chemically active molecules, but the complexes have little if any chemical activity. If it be assumed that chemical change and electrolytic conduction in liquids are dominated by the process expressed in the equation of equilibrium~~

~~M,==a!M,~~

~~M being the symbol of the fundamental molecule or monad any condition which increases the proportion of monads will render the solvent more "active." The effects produced on dissolving non-electrolytes are wrongly attributed to the dissolved substance ; they are m reality due to the solvent monads, and it is the solvent, not the dissolved substance, that alone undergoes alteration m the case of substances which enter into solution as monads. Thus to take the case of the osmotic pressure developed on dissolving any non-electrolyte in water — if a vessel containing water be divided into compartments by a permeable diaphragm, the equilibrium will be the same on either side, and therefore the pressure will be the same. But if a substance which cannot penetrate the diaphragm be dissolved in the water in the one compartment, its~~

~~molecules will interpose themselves as screens between those of the solvent, and prevent the reassociation of the monads ; consequently these will be present in a greater proportion in the solution than in water. The monads will necessarily exercise an attractive influence over those in and beyond the walls of the diaphragm, and a flow will take place into the compartment containing the dissolved substance until equilibrium is restored. The~~

~~*osmotic pressure developed is therefore a measure of the extent to which the dissociation of solvent complexes into monads takes place. All substances which enter into solution as monads, if non-electrolytes, should produce the same effect when present in equimolecular propor- tions under like conditions of temperature and pressure — and Avogadro's law should therefore hold for dilute solutions. This is the well-known classic conclusion formulated by van't Hoff. In the case of associated non- electrolytes a disturbing factor is introduced if the mole- cule only gradually undergo dissociation into monads as dilution proceeds, and the behaviour of such compounds must be irregular. The depression of the freezing-point and the rise in boiling-point brought about by dissolving a substance in a liquid are necessary consequences of the presence of an increased proportion of monads.*~~

~~*Electrolytes, besides acting as mere mechanical screens, also exercise a specific influence in excess of that exercised by non-electrolytes, by themselves com- bining with solvent molecules. In such cases an attrac- tive influence is exerted not only between the solvent monads, but also between these and the solute monads. If it be granted that electrolysis is the outcome of an interaction of the fundamental molecules of solvent and solute under the influence of an electromotive force, there is no dif&culty in understanding the apparent in- crease in conductivity of electrolytes as the solution is diluted. The apparent effect produced by a dissolved substance must be greatest in a highly dilute solution, because in such a solution the solute is resolved to the maximum possible extent into its fundamental molecules, and these come most fully under the influence of the solvent monads, which are then necessarily present in maximum proportion.*~~

From the point of view of the hypothesis here devel- oped ions need have no separate existence, and the phe- nomena exhibited by solutions — ^whether physical or chemical — axe mainly influenced by changes in the molec- ular composition of the solvent, the chief if not the only factor by which the changes are conditioned being the obscure function of the atoms termed residual afi&nity.

It wiil be appropriate to introduce here a brief refer- ence to the nature of the chemical interchanges involved in vital processes, whether in plants or animals. Owing to the great advance in our knowledge. Chemistry especially of synthetic processes, it is possible to "processes. form some conception of their general character, although such changes are necessarily to a great extent enshrouded in mystery. In the main they are of four kinds — reductive, synthetic, hydrolytic, and oxidative. It is generally believed that the first stage in assimilation in- volves the reduction of carbon dioxide under the influence of light, and that it proceeds pari passu with the separar tion of oxygen, somewhat in the manner formulated in the equation: C02-|-II20=COH2-|-02; it is difficult, however, at present to regard this as more than a mere statistical expression. To judge from its properties, chlorophyll belongs to the class of quinones. But a quinone cannot cause reduction ; on the contrary, it acts as an " oxidizing " agent in consequence of the readiness with which it combines with hydrogen, forming a hydro- quinone or quinol. It is, therefore, probable that chloro- phyll first undergoes reduction at the expense of some

*easily oxidizable substance, and that the reduction of carbon dioxide is effected, wholly or in part, by the quinol of chlorophyll — one at least of these changes taking place under the influence of light. Assuming that for- maldehyde, CHjO, is the immediate product, it is highly probable that this is at once converted into a carbohydrate — in many cases into starch. To appreciate the import- ance of this change, it is necessary to consider the phe- nomena of fermentation ; it is then obvious that ta«Mi!"' *^® energy stored up in the carbohydrate system plays an all-important part.*

~~*Fermentation is certainly at bottom a process of hydrocatalysis, and it can scarcely be doubted that the function of the enzyme is to introduce water into the circuit of change — ^to establish a circuit in which hydrolytic changes can occur, although not of the ordiuary kind, but reductive on the one hand and oxidative on the other. Baeyer, in 1870, was the first to point out that the resolution of glucose' during fermentation into alcohol and carbon dioxide, and, indeed, the phenomena of fermentation generally, may be ac- counted for by the assumption that translocation of hy- drogen and oxygen atoms is iuduced through the alternate separation of the elements of water and their addition iu a different order — changes which would involve the accu- mulation of oxygen atoms at certain parts of the molecule, thus constituting points of weakness where disruption of the molecule would inevitably occur. This is shown in the following formulae, iu the second of which the separ rating elements are indicated by dots : —*~~

~~*CH2.OH CH.OH CH.OH CH.OH CH.OH (iH(0H)3*~~

~~*CH0…OH*~~

~~*OH…H*~~

~~*C…OH…H*~~

~~*(';.OH…H*~~

~~*C.OH…H*~~

~~*6h.*~~

~~*.(OH), n.*~~

~~*CH3 CH.OH*~~

~~*(i(OH)j*~~

~~*(I;(OH)j III.*~~

~~*It will be seen that in the product of rehydration (III.), the terminal groups are fully reduced, whilst there has been an accumulation of OH groups in*~~

~~other parts of the system. In a molecule so constituted, changes might set in. similar to those involved in the resolution of oxalic acid into carbon dioxide and formic acid.~~

~~The conception is one of remarkable beauty, and un- doubtedly a sufficient explanation, as changes precisely similar to those attending fermentation may be effected by simple hydrolysis. Thus glucose may be converted into lactic acid by heating it with. alkali, and on boiling fructose with muriatic acid an acid is formed, i.e., Isevulinic acid, CH3.CO.CH2.CH2.CO2H, the production of which clearly involves a reduction of some of the CH2.OH and CH.OH groups, and oxidation of others, in the man- ner pictured by Baeyer. The changes attending fermen- tation are presumably functions of the protoplasm — in other words, they probably occur within very complex molecular systems of extreme instability, perhaps under the influence of, in contact with, the very same hydrolyst (enzyme) which, when separated from the cell, is so active in promoting the hydrolysis of cane sugar, or, if not, of substances of a similar nature. On inspecting Baeyer's formulae it will be noticed that during rehydra- tion the elements of the water molecule become added on to non-contiguous carbon-atoms; this appears to be a special feature of such changes. Supposing that the protoplasmic hydrolyst were to condition the formation of a conducting circuit in which any two of the carbon systems (CH2.OH, CH.OH or COH) of the glucose mole- cule and water molecules were included, if the total~~

~~hydrolytic change which could take place in such a circuit were exothermic, even if the change affecting the one group involved an expenditure of energy, water would be " electrolysed," and its hydrogen would effect the withdrawal of OH from the one group and its dis- placement by hydrogen, while oxygen would be added to the other group, it may be directly, or in consequence of the displacement of H by OH. The different effects pro- duced by different organisms, on this hypothesis, would be the consequence of the hydrolysis affecting different systems. As most, if not all, f ermentahle compounds are asymmetric, and the enzymes are undoubtedly also asym- metric bodies, the direction of attack would depend on the character of the asymmetry of both hydrolyte and hydrolyst, and only compatible hydrolists, i.e., those com- patible with the hydrolyte, would condition the hydrolysisj i.e. fermentation.~~

If only the conversion of glucose into alcohol and carbon dioxide be considered, there is a dangei? of regarding fer- mentation as a purely destructive process, but it must not be forgotten that in some cases products are obtained which afford the clearest evidence of the occurrence of constructive changes. It is, however, probable that some of these are the outcome of interactions occurring, as it were, naturally and independently between products of enzymic change, and that the direct function coastmc- of the enzyme in fermentation may after aU be tive aspect only to induce simplification, not complication. 9^, "" "' Thus, to explain the production of isobutyl-car- '"'■ binol (the inactive amyl alcohol of fusel oU) from glucose, it may be supposed that in the first instance the glucose is resolved by enzymic action into a mixture of glyceraldose, CH2.CH(0H).C0H,with the isomeric glyceroketose, CH2.CO.CH2, which interact spontaneously, a new hexose, (CH2.0H)2.C(OH).CH(OH), CH(OH).COH, being formed, and that this in turn becomes transformed by enzymic influences into amyl alcohol. Again, to ac- count for the production of butyric and caproic acids from lactic acid, it may be supposed that the latter is partly reduced by "fermentation" to the aldehyde CH3.CH(0H).C0H, and that an interaction then occurs spontaneously between this aldehyde and unchanged acid, giving rise to the complex acid CHs.[CH(0H)]4.C00H, which on further fermentation yields acetic, butyric, and caproic acids. The formation of fat from carbohydrates is doubtless a process of the same kind, in which at an early stage at least three molecules of glucose, or some substance closely related thereto, become condensed into one, much as three molecules of acetone C3H5O, yield a single molecule of phorone, C9H14O ; the reduction of the complex so produced is then effected by enzymic influ- ence. Eecent observations, however, prove beyond ques- tion that the ordinary hydrolytic changes effected by enzymes are reversible, and therefore that the enzymes must be credited with synthetic powers. Croft HIll was the first to observe that glucose is partially converted into a biose by diastase, and he supposed that maltose was formed ; later observations seem to show that it yields isomaltose : it may be that both are formed. Emil Fischer and E. Prankland Armstrong have since found that a mixture of glucose and lactose in contact with the kephir enzyme yields a biose closely related to if not identical with milk sugar.

~~Ordinary alcoholic fermentation is a nicely-balanced action in which the products of the presumed " electro- lysis" of water are fully utilized, so that neither oxygen nor hydrogen is liberated. In butyric and many other fermentations, however, hydrogen is freely evolved, and in these cases somewhat more highly oxidized products (acids instead of alcohols) are formed; in fact, the evolution of hydrogen involves the occurrence of an amount of oxida-~~

~~tion corresponding to the hydrogen liberated, and in excess ot that observed when no hydrogen is liberated. The production of butyric and caproic acids, of amylic alcohol, and also that of fat, can only be explained on the assump- tion that while one set of molecules undergoes reduction another set undergoes oxidation. The separation of oxy- gen as such has not yet been observed to take place during fermentation, but if hydrogen be evolved as the result of " excessive " oxidation, it would seem to follow that oxygen should be evolved if reduction took place to an extreme extent.^ It is conceivable, and indeed probable, that the oxygen evolved from plants in sunlight owes its origin to an effect of this kind, and that it may be con- nected with the reduction of chlorophyll previously re- ferred to as a necessary step in the reduction of carbon dioxide. In other words, the chlorophyll acts, in a meas- ure, as a polarizable electrode or catalyst, against which hydrogen is delivered, and at which the dioxide suffers reduction, being one term in a complex circuit in which hydrolytic change is proceeding. It is a noteworthy fact that a tendency to form fat — the most highly-reduced nor- mal product of vital metabolism — is particularly notice- able in the case of animals, and that oxidative changes occur in these to a far greater extent than in plants.~~

~~It is commonly supposed that interactions such as occur in animals and plants are not to be regarded as mere chem- ical changes, but that they take place within the wlaj"" ' protoplasm, and in subjection to its influence. processes. I* is possible to accept this interpretation, and yet to regard such processes as cases of chemical interchange pure and simple. The formation of starch and of fat may be taken as examples. It is impossible at pre- sent~~

~~*to explain under what conditions and precisely how these are formed, and yet they are so easily formed that it is probable that they are produced in a comparatively simple manner. The formation of starch from glucose is a process in which a large number of molecules of the latter become associated, and one in which, doubtless, molecule must be "presented" to molecule in some very definite manner. It may well be that glucose does not exist in an ordinary aqueous solution in the proper form to undergo considera- tion. There are at least two isodynamic forms of glucose :*~~

~~*CH,(OH).CH(OH).CH(OH).CH(Oir).CH(OH).(COH) CH, (OH).CH(OH).CH.CH(OH).CH(OH).CH(OH).*~~

~~*\ 0 — ^ — ^*~~

~~*Of these the second appears to be a relatively inert form, and this perhaps is the dominant, if not the only form, existing in a dilute solution. It is conceivable that such a molecule might enter into loose combination with a protoplasmic molecule in such a way as to cause its con- version, so to speak, into the more active aldehydic form, in consequence of the OH groups becoming attached to the protoplasm. The aldehydic group would then be in a position to operate freely. It is also possible that in the case of a compound such as glucose the configuration is such that the OH groups mutually interfere, and, as it were, promote a policy of vacillation, and that on one set becoming neutralized by attachment to the proto- plasm another set becomes free to act uniformly, so that their activity can be manifested in a direction before impossible.*~~

~~*Phtsical Peopebtibs.*~~

~~*That physical and chemical properties are strictly cor- relative there is not the slightest doubt, but the exact nature of the relationship is far from understood, more*~~

~~*lit has recently been stated by Pakes and JoUyman (Trans. Chem. Soc 1901, 322) , that a little oxygen is contained in the gases produced by JS. pyocyaneus when grown anaerobically.*~~

~~*particularly because of the many difficulties in the way of arriving at really cotaparable values. In the case of gases, as the molecules are widely separated, they may be regarded as independent entities and outside the range of intermolecular attractions. But this is not the case with liquids or solids, and our knowledge of physical properties relates mainly to the liquid state. The molecules in liquids are undoubtedly held together with a degree of firmness — and to an extent — which varies from series to series, and even within series, so that although in the case of liquids composed of molecules which are easily separable, it may be possible to make comparisons at corresponding temperatures at which the character of interrelationship of the molecules is of the same order, or nearly so, for all the substances, in other instances this is impossible. Acetic acid may be cited as an extreme case. As the vapour of this compound, even at temperatures consider- ably above its boiling-point, is not composed of the funda- mental molecules represented by the formula C2H4O2, but mainly consists of complex molecules formed by their union, it is impossible to contrast acetic acid properly with compounds which are readUy reduced to the unimo- lecular form. Whenever possible the boiling-point has usually been selected as the temperature at which there is likely to be the closest approach to uniformity of in- termolecular conditions, but it is clear that this is by no means always the case. Thorpe and Rodger, who have very carefully studied the relationship between the viscosity of liquids and their chemical nature (PM. Tranis. 1894, p. 397), have shown that " tempera- tures of equal slope" — i.e., those at which dri/dt is the same for different liquids — tend to reveal much more definite relations between the values of the viscosity co- efficients (17) and the chemical nature of substances than can be deduced from observations made at the boiling- point.*~~

~~*At one time there was a strong tendency to believe in physical constants, and to regard the molecular values as the sums of certain fixed atomic values. As the area of discussion has been widened,however, f'''? and not only compounds of relatively simple con- %aiues. stitution, but also those more complex in struc- ture have been studied, the conviction has gained ground that the " atomic " values are subject to considerable varia- tion. Such variations almost always occur in cases in which they are to be expected on chemical grounds. Thus the nearest approach to constancy is observed in the paraf- finoid hydrocarbons, which are remarkable on*~~

~~account of the simplicity and uniformity of their chemical behaviour as well as on account Qf their inertness. Ethenoid hydro- carbons differ entirely in many of their properties from the paraffinoids, the ethenoid linkage exercising a peculiar physical effect ; the extent to which variation occurs within the series, however, cannot be judged of, as the material available for discussion is altogether insufficient. Ben- zenoid hydrocarbons exhibit an altogether peculiar and variable behaviour.~~

~~Not only are the peculiarities of the hydrocarbons repro- duced in their derivatives, but in many cases other peculiarities become apparent which are clearly traceable to the influence exerted by the radicle introduced into the hydrocarbon complex. There is reason to suppose that in the case of paraffiioid compounds the hydrocarbon radicle has a practically constant influence, and that the variations observed in ascending the series may be referred to differ- ences in the influence exerted by its associates. In other series probably both radicles are variants. In ethenoid compounds, in which two of the carbon atoms may be regarded as united by two affijiities of each, but in such a way that the full force of each affinity is far from being exerted, the affinities are deflected from the mean positions~~

~~which they tend to take up in the unrestrained carbon atom, and it may be supposed that the extent to which the affinities of the paired carbon atoms are deflected varies according to the natiire of their associates. But the deflec- tion would vary only within narrow limits ; consequently, the limits within which the ethenoid " constant " may be expected to vary are narrow. In the case of benzenoid compounds a much wider variation may be possible. In discussing their chemical properties, it has already been pointed out that the centric system must be regarded as a plastic group within which considerable variation of the affinity relationships may take place. Physical properties tell the same tale. To give but one or two examples. No property affords a more sensitive test of changes in structure than the refractive power. If the refractive power of the Cg group in benzene be calculated by deduct- ing from the molecular refractive power the value of six hydrogen atoms — hydrogen being supposed to have a con- stant~~

~~*value in all compounds — and the difference be di- vided by 6, the value for the carbon atom is very nearly 6. If a similar calculation be made for the methylated homo- logues of benzene, assigning to CH3 the value that it has in other series, the value for the carbon atom (in the Ce group) is found to increase from 6 in benzene to 6-15 in trimethyl-benzene (mesitylene). If a similar calcula- tion be made for aniline, assuming that NHj has the value assigned to it in paraffinoid amines (7-7=5-l+2.1-3), a still higher value is obtained for carbon, viz. 6-3. Whether these variations are to be ascribed solely to variations in the centric system, or whether the associated radicles also vary, it is at present impossible to decide ; the question has already been raised in discussing the occurrence of chemical change in the case of benzenoid compounds, and it has been pointed out that there is some reason to sup- pose that even the CH3 group has special properties in benzenoid hydrocarbons, but the argument is by no means conclusive.*~~

~~*With regard to the alteration in physical properties consequent on the introduction of other elements into*~~

~~*hydrocarbons, oxygen exercises a greater effect f'S^'n perhaps than any other, and one which is espe- 0/ oxygen, cially noticeable in the case of properties which*~~

~~*are mainly " intermolecular " effects. Thus the introduction of hydroxyl into the parafiB.ns has the effect of converting very slightly viscous compounds of low boiling-point into relatively highly viscous compounds boiling at temperatures far above those at which the parent hydrocarbons are vaporized. There can be little if any doubt that the peculiar physical properties of oxygen compounds are to be correlated with their excep- tional chemical activity — that the residual affinity which is possessed by oxygen in most of its compounds in so high a degree, and which conditions the preliminary associations determinative of chemical change, is also operative in causing the fundamental molecules to cling together and form complexes to an extent not met with in compounds of other elements, so that the special pecul- iarities of oxygen compounds may be ascribed to the oxygen. Whether the properties of the paraf&noid radicle are in any way modified by association with oxygen or other elements is a difftcult question to decide. In dis- cussing it geometrical considerations must needs be taken*~~

~~*into account. In the normal paraffins and in the corre- sponding primary alcohols, the carbon atoms are arranged in a branchless chain, but in the secondary alcohols the hydrocarbon radicles have two, and in the tertiary alcohols three branches. The primary alcohols may, therefore, be pictured as simple filaments progressing, it may be, with a wave-like motion. As the hydrocarbon radicle is com- posed of saturated elements, it may be regarded as prac- tically indifferent to all external attractions, and the*~~

~~*activity of the compound may be located at the oxygen- ated extremity or head, the hydrocarbon radicle being supposed to oscillate about a mean position relatively to the OH group. In the secondary and tertiary alcohols, in which the filaments are branched, the hydrocarbon radicles are brought into closer proximity with the OH group, and they will also tend to oscillate on one side of the mean position taken up by the primary radicle, unless the constituent groups are of such dimensions as to bal- ance one another. Such differences in structure might alone condition a materially different behaviour of the molecules towards each other, which would be apparent in the viscosity, density, and boiling-point relationships. Optical properties, on the other hand, which are mainly conditioned by intermolecular structure, would be but slightly affected ; and chemical properties should not be materially altered. As a matter of fact, considerable differences are noticed on contrasting the chemical behav- iour of the lower with that of the higher terms of the series in the case not only of the alcohols, but also of the ketones and acids derived from the paraffins. As there is no reason to suppose that the hydrocarbon radicle under- goes any modification, it may be assumed that the oxygen is the inconstant element ; but as only the lowest terms differ to any marked extent, it woidd seem that when a certain point is reached variation can no longer take place. To draw a rough parallel, the oxygen appears to behave much as if it were connected with the hydrocarbon radicle by a spring which cannot be extended beyond a certain limit ; in the lower terms of the series the spring is not fully extended, but the limit is soon reached. Differences such as are observed between phenol, for example, and the paraffinoid alcohol, hexylic alcohol, are of interest from this point of view. Although of lower molecular weight, phenol is a crystalline solid at temperatures at which the alcohol is liquid, and as a liquid it is more viscid than the alcohol. Phenol also manifests weak acid properties, which may be regarded as evidence that the oxygen*~~

has some power of attracting bases. It has been shown also that phenol exists in many solutions as a double molecule. On all grounds, therefore, it seems probable that the oxygen in phenol has more residual affinity than that in hexylic alcohol. The great increase in viscosity which attends the introduction of several hydroxyl groups is also corroborative of the argument here used. The extreme viscosity of polyhydric alcohols, such as glycerol, is possibly a consequence of the arrange- ment of the three oxygen atoms in one plane in such a way as to constitute an " oxygen surface." Exact deter- minations of the viscosity relationships of isomeric asym- metric polyhydric alcohols of known configuration would be of great value as testing a point of this kind. Varia- tions in the physical effects produced by oxygen are particularly apparent in compounds in which oxygen is associated with carbon by two affinities, much in the way that carbon is associated with carbon in ethenoids. Speak- ing generally, oxygen apparently behaves as though its two affinities took the form of a looped filament, the two ends of which represent its ordinary affinities, and the loop the dependent or residual affinity. The variations it exhibits may then be pictured as variations in the size of the loop, no secondary point of attachment remaining when it is reduced to a mere knot.

A factor of the highest importance, which in many cases conditions striking physical peculiarities, remains to be re- ferred to, viz., that of co-operative action. If the heat of formation of chlorinated paraffinoid com- " " pounds be calculated from the heats of combus- tion, it appears, as J. Thomsen has pointed out, that on an average about 13,500 gram. deg. C. units of heat are developed in the fixation of a single atomic proportion of

operative etiect"

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chlorine ; but that in the case of di-derivatives the average amount of heat developed is far greater, viz., lipo = 16,500

*Q5 nnX ■^ t?^® ^^^^^ *°^°'^ *°^ tri-derivatives is only drf,000-|-13,6()0, it is to be supposed that the extra-out- going of affinity is in some way due to*

~~an interaction of the two halogen atoms. Similar differences are apparent m the case of other properties. Thus the refraction equi- valents of chlorine and bromine, calculated from observa- tions made with compounds such as ethylene chloride and bromide, are distinctly higher than those deduced from observations made with monochlorides and bromides. Again, Thorpe and Rodger have shown that the viscosity constants of dichlorides and dibromides are remarkably different from those of the monochlorides and monobro- mides. But the effect is most obvious in the case of iodo-compounds. Thus the refraction equivalent (58-2) of methylene iodide, CH^Ij, is far higher than that calculated (52-1) on the assumption that the value of each atom of iodine is that of the iodine atom in methyl iodide. In all the cases referred to the two atoms of halogen are asso- ,ciated either with a single carbon atom or with contiguous carbon atoms, and there is little doubt that this will be found to be necessary to the production of the effect under consideration. One of the very few observations bearing on this point is that of Perkin, showing that the molecular rotatory power acquired in a magnetic field is considerably higher in the case of propylene bromide, CHj.CHBr.CHaBr, (10-82), than in that of the isomeric trimethylene bromide, CH2Br.CHj.CH2Br, (10-34). The "co-operative effect" is most obvious, however, in compounds in which several benzenoid and ethenoid systems are conjoined. Thus if the atomic refractive power of carbon be calculated from the molecular refractive power of diphenyl, CsHj.CsHj, its apparent value is about 6-4, whereas in benzene it is only about 6. Stilbene, in which an ethenoid group is interposed betwe.en two phenyl groups, Ph.CH:CH.Ph, is still more " abnormal " in its behaviour, its molecu- lar refractive power (113-4) exceeding the calculated value by 12 units. The very high refractive power of cinnamic aldehyde, which exceeds the calculated value by ten units, may be accounted for in a similar way, and even seems to suggest that this compound is to be represented as Ph.CH:C:CH.OH, rather than as Ph.CH:CH.COH, i.e., that it is the isodynamic form of the aldehyde.~~

~~It is by no means improbable that the principle here developed may prove to be of wide application, and that it will afford an explanation of the many " anomalies " which are apparent on contrasting the properties especially of benzenoid compounds with those of the paraffinoids ; it may also serve to explain the fact that they often differ from paraffinoids in physical~~

~~*properties to an extent alto- gether disproportionate to the extent to which they differ from them in their chemical properties. Perkin's observa- tions on the rotation of polarized light in the magnetic field by benzenoid compounds afford many striking illus- trations of their peculiar behaviour (Trans. Chem. Soc. 1896, p. 1026). Thus, on contrasting the rotatory power of phenol with that of benzene, and that of heptylic alcohol with that of heptane, the difference due to the displacement of H by OH is 0-866 in the case of phenol, but only 0-181 in the case of the alcohol. That the superior effect exercised by the OH group is at least mainly due to the co-operative action of the centric system and the oxygen appears probable from the fact that the difference between toluene, Ph.CHj, and benzylic alcohol, Ph.CH2.OH (0-243), is but slightly in excess of the paraf- finoid value. Co-operative action can only be exerted by contiguous radicles. A comparison of the values for ben- zene nitrobenzene, and the mono-derivatives containing halogens, leads to similar conclusions : —*~~

~~*Mol. rot.*~~

~~*Nitrobenzene*~~

~~*. 9-361,*~~

~~*Benzene*~~

~~*. 11-284*~~

~~*Fluorbenzene .*~~

~~*. 9-970*~~

~~*Chlorobenzene*~~

~~*. 12-510*~~

~~*Bromobenzene*~~

~~*. 14-50ft*~~

~~*lodobenzene .*~~

~~. 19-108>~~

~~Dlff.~~

~~1-923 1-314 2-540 1-996 4-602~~

~~The fact that the differences are negative in the case of nitro- and fluorbenzene is in itself almost a proof of co-operation. When the effects produced by the other halogens in benzene are contrasted with those they pro- duce in propylic compounds, the differences observed are —~~

~~Chlorine-0-253. Bromine-0-086. Iodine 0-321.~~

~~In benzene, therefore, chlorine' has a slight negative influ- ence, and only iodine has a marked extra positive effect : such a result is in harmony with the fact that in carbon compounds generally iodine alone has a marked tendency to exhibit residual affinity.~~

~~But by far the strongest argument in favour of the view here advocated is afforded by the consideration of the con- ditions which determine the appearance of colour cj,/„„,. ,„ in carbon compounds. The majority of col- carbon cured compounds may be referred to «« "- one type, that of quinone (a). Speak- p" " "*- ing generally, they contain two ethenoid groups C : E", in ortho- or para-positions, in association with an unsaturated benzenoid nucleus. As compounds such as diketohexamethylene (&), in which the nucleus is saturated, are colourless, colour must be supposed to originate in the co-operation of the two ethenoids with the un- saturated nucleus, and each must be regarded as an independent light-absorbing centre. Whether the nucleus be _ represented as a centric or as an ethenoid structure matters~~

~~θ~~

~~θ~~

~~θ~~

~~CO~~

~~*H/^H.*~~

~~*Hi^H,*~~

~~*CO*~~

~~*little; suffice it to say that coloured com- pounds are known of the dihydrobenzene type (c), so that it is to be supposed that either the centric or the ethenoid-system- may act as the third centre. A colour-producing system such as is present in quinone may, therefore,*~~

~~*be represented by the symbol =. If this symbol be*~~

~~*adopted as a broad definition of quinonoid structure, it is probably safe to assert that all coloured substances are quinonoids. Iodoform is a compound of particular interest from this point of view. Attention has already been directed to the exceptionally high refractive power of methylene iodide, CKJ.^ and to the probability that this is due to the co-operation of the two iodine atoms. Such a compound may be regarded as the analogue of diketohexamethylene, each iodine atom exercising an influence similar to that exercised by the CO group in the keto-compoimd. When a third atom of iodine is introduced, forming iodoform, CHI,, an effect is produced equivalent to that observed when diketohexamethylene is converted into qiunone and a third absorbing centre is developed —~~ ~~*the highly refractive di-iodide becoming intensely yellow when converted into the tri-iodo-derivative. The introduction of a fourth iodine atom has the effect of greatly intensifying the colour. From this point of view it is easy to understand that all tri- and tetriodides, but onlj polymerized di-iodides such as mercuric iodide (Hglj)*~~ ~~*should be coloured.*~~

~~*The appearance of colour in an open 01 pseitdo-quinonoid system, as distinguished from a closed or true quinonoid system, is dependent on a certain intensity of effect being developed. Chlorine and bromine do not act sufficiently powerfully to condition colour, neither does the presence of three phenyl groups in association with a single carbon*~~

~~atom suffice, triphenylmethane, CHPhj, being colourless, although abnormally refractive. It is also noteworthy that benzil, Ph.CO.CO.Ph, if coloured at all, is at most a very pale yellow substance ; if not a consequence of its symmetrical structure, this may be due to the fact that the compound is one in which there is but little residual affinity. The colour of substances such as azobenzene, Ph.N : N.Ph, may be ascribed to the co-operation of the two phenyl systems with the diazo N : N system.~~

~~Quinone and its homologues, and indeed the simple quinones generally, are at most either yellow, or orange,~~

~~or orange-red in colour ; as a rule pararquinones laiensifica- are yellow, and the unsym metrical ortho- coiour. quinones orange to red. The introduction of~~

~~oxygen (as OH) or halogens usually has the effect of deepening the colour — a result, it may be sup- posed, of the introduction of a further slight co-operative effect. Colours other than yellows and reds — blue shades of red, greens and blues — are met with only in mixed quinonoids, i.e., compounds in which the two C : E" groups are dissimilar, one at least being a more or less complex group. The colours of the rosaniline group, for example, are all derivatives of the complex E," : GgB-t : CPh2, E" being usually either NH or NE', and either NHj or a substi- tuted NH2 group being present in each of the Ph groups. The colour is much intensified by the association of several quinonoid or pseudo-quinonoid systems. Thus the simple diazo-dyes, formed from the diazo-benzenes and either phenol or aniline, or their homologues, are all derivatives of azobenzene, CsHj.N : N.CbHj, and resemble this compound in being yellows. The derivatives of azonaphthalene, CioH,.N : N.C10H7, are much deeper in colour, many pro-nounced reds being met with amongst them ; the intensifi- cation of the colour is doubtless a consequence of the greater influence exerted by the naphthyl group. By diazotizing the amido-derivative of a diazo-dye, and then coupling the diazo-compound with amines or phenols,' disazo-compounds are produced in which the azobenzene or azonaphthalene complex is contained twice. Still more complex substances are easily prepared by repeating such a series of operations. Many of these polyazo-~~

dye stuffs absorb light so completely that they are almost black. The hydroxy-derivatives of anthraquinone afford another striking example of the influence exercised by accumulated effects. The lower derivatives are orange-red or red, the higher greens and blues ; it is impossible to account for the difference on the assumption that it is due to the mere accumulation of hydroxyl groups in the one molecule, but it is easily understood if it be granted that anthraquinone itself is not the basis of the colour to which it gives rise, but an isodynamic compound. Thus the formation of alizarin may be assumed to involve the isodynamic change

0 OH /V\/\OH

Dihydroxyanthraquinone.

OHO

kXJ%)

Alizarin.

The corresponding heteronucleal tetrhydroxy anthraquin- one may be supposed to undergo change, thus : —

0 OH OHO

HO

^i?iA

/

HOl!

V«i

r

In the one compound a quinonoid system is developed on only one, but in the other on both sides of the complex.

~~If the argument here adduced be accepted as valid, there is no difficulty in understanding why a limited meaning must be attached to the conception of atomic constants. It would seem that, except perhaps in the paraffin series, we are called upon to study the behaviour of more or less elastic systems — not of atoms which can freely exert a constant individual influence. In such systems the affinities are more or less deflected and con- trolled and subject to change according to the influence which is brought to bear upon them, and therefore they exercise a varying effect. Still more important, probably, is the variation due to the degree of influence which the systems exercise by acting in co-operation.~~

~~A similar doctrine may be found to apply to metallic salts and to inorganic metallic compounds generally. That a profound difference exists between met- als and non-metals there can be no doubt, and £°’ “J)*” that the latter tend to form complexes com- Taits.&c. parable in some cases with the ethenoid and centric hydrocarbon systems is also in the highest degree probable. But the investigation of metallic salts is com- plicated and rendered much more difficult than that of carbon compounds by the tendency they display to form complex molecules, and also by the readiness with which they enter into combination with water. The conclusion that coloured carbon compounds are quinonoids, using this term in a broad sense, if extended to elements, would involve the conclusion that the structure of these is in many cases comparable with that of quinonoids. The increase in the intensity of the colour as atomic weight increases in the case of the halogens ; the intense blue colour of ozone in comparison with that of oxygen ; and especially the intense colour and extraordinarily compli- cated absorption spectrum of nitrogen dioxide, are of interest from this point of view. In all these cases in- tensity of colour is associated with a high degree of chemical activity, and the conclusion is irresistible that the existence of residual affinity determines the appear- ance of colour. In any case it should be worth while to take into account the apparent simplicity of the mechanism by which colour is produced in carbon compounds, and to consider whether it may not be sufficient even to account for the complicated absorption spectra which characterize many compounds : it may well be that these have their origin in the superposition of effects produced at a very limited number of absorbing centres, and that colour is the outcome of intramolecular interferences.~~

In this article the attempt has been made to pass briefly under notice what appear to the writer to be the more im- portant problems in chemistry which have been the subject of discussion during the period 1875- '^"' 1900, and besides indicating the directions in " " "' which progress has been made, to give some idea of the problems which press for solution. The end the chemist has in view is to gain clear conceptions of the nature of the primary materials, i.e., the elements, with which he has to deal, and an understanding of the operations into which they enter. He is called upon, however, to study their beha,viour in crowds and companies in circumstances of great difficulty, in order that he may form an opinion of their behaviour as individuals and depict their characters. That so much success has already attended his labours is proof that the methods in use are essentially sound, but the opportunities awaiting future inquirers are infinite.*

(h. b. a.)

lit IS a question of interest whether the blue colour of oxygen be not due to the presence of complexes (Oj)i. Abney's observations show that solutions of colourless salts in water are less absorptive in the infra-red region than in water per se ; this may be regarded as proof that the colour of water is at least in part conditioned by the presence of molecular complexes.

C H E M N I T Z — C HERBULIEZ

747

Chemnitz, a town of Saxony, Germany, in the fertile valley of the Mulde, 50 mUes by rail W. by S. from Dres- den and 61 S.E. of Leipzig. It is one of the principal commercial and industrial centres of Germany. Its im- portance arises from its cotton-spinning, hosiery, furniture, textile, and glove manufactures, in which a very considera- ble trade is done with the United Kingdom and the United btates of America. Its locomotive and agricultural imple- ment works are of world-wide reputation. It is also the seat of considerable dyeworks, bleachworks, chemical and woollen factories, and produces leather and straps, cement, small vehicles, wire-woven goods, carpets, beer, and bricks. The churches of St Peter (1888), of St Nicholas (1888), and St Mark (1895), and the synagogue (1899) are the principal

~~new buildings of interest. The town is especi- ally well provided with technical schools for training in the various industries, including a commercial, public, economic, and agricultural schools, and has a chamber of commerce. There are also industrial and historical museums, and collections of paintings and natural history. To the north-west of the town is the Gothic church of a former Benedictine monastery, dating from 1514-25, with a tower of 1897. Chemnitz is a favourite tourist centre for excursions into the Erzgebirge, the chain of mountains separating Saxony from Bohemia. Population (1885),~~

~~110,817; (1890), 138,954; (1895), 161,017; (1900),~~

~~206,584. The commune of Alt-Cheiotitz (6398 in 1890) was incorporated with Chemnitz in 1894.~~

~~Chenee, a town of Belgium, in the province of and 3 miles S.E. of Li^ge, on railway to Verviers. It has forges, iron and copper foundries, and manufacture of glass. Population (communal) (1880), 5765 ; (1897), 8334.~~

~~Chenery, Thomas (1826-1884), English scholar and editor of the Times, was bom in 1826 at Barbados, and educated at Eton and Caius College, Cambridge. Having been called to the bar, he went out to Constanti- nople as Times correspondent just before the Crimean war, and it was under the influence there of Mr Algernon Smythe (afterwards Lord Strangf ord) that he first turned to those philological studies in which he became eminent. After the war he returned to London and wrote regularly for the Times for many years, and eventually succeeded Delane as editor in 1877. He was then an experienced publicist, particularly well versed in Oriental affairs, an indefatigable worker, with a rapid and comprehensive judgment, though he lacked Delane's intuition for public opinion. It was as an Orientalist, however, that he had meantime earned the highest reputation, his knowledge of Arabic and Hebrew being almost unrivalled and his gift for languages exceptional. In 1868 he was appointed Lord Almoner's professor of Arabic at Oxford, remaining professor till he became editor of the Tim^s, and he was one of the company of revisers of the Old Testament. He was secretary for some time to the Eoyal Asiatic Society, and published learned editions of the Arabic classic The Assemblies ofAl-Hariri and of the Machberoth Ithiel. He died in London, 11th February 1884.~~

~~*Cher, a department in the centre of France, watered by the river of the same name.*~~

~~*Area 2819 square miles, with 29 cantons and 292 communes. Tlie population decreased from 355,349 in 1886 to 842,889 in 1901. Births in 1899, 6843, of which 527 illegitimate ; deaths, 6336 ; marriages 2615. In 1896 there were 684 schools, with 50,000 pupils and 6 per cent, of the population was illiterate. Bourges, the capital, had a population of 44,000. The area under culti- vation in 1896 amounted to 1,645,780 acres, 1,035,408 acres of which were plough-land and 296,536 acres woods and forests. In 1899 the wheat crop returned a value of £1,414,000, and oats £648 000. The produce of the vines was valued at £135,000. The live stock in 1899 included 38,090 horses, 155,580 cattle, 369 000 sheep, and 42,220 pigs. The mining industry in 1898*~~

~~*registered 18,000 metric tons of iron, and the working in metals 17,000 metric tons of cast iron of the value of £480,000.*~~

~~*Cherbourg, a seaport and chief town of arrondisse- ment, department of Manche, France, 46 miles N.N.W. of St L5, and 230 miles from Paris by rail. The manufactur- ing industries of Cherbourg, other than those connected with the Government works, are now limited, the most important being engineering, steamboat-building, an^d the manufacture of agricultural implements. Shipping in 1899 comprised 946 vessels entered, tonnage 989,043, and 1021 cleared, tonnage 985,882. Of this Great Britain's share was, vessels entered 774, tonnage 408,707, and cleared 826, tonnage 198,011. Wines have become one of the principal imports, and the export of stone to England has largely increased during recent years. Cherbourg is a port of call for several lines of English and American transatlantic companies. There are a chamber of com- merce, a civil and naval hospital, and four libraries. In the commercial harbour the inner basin has now a length of 1311 feet, a width of 650 feet, a depth on sill at ordinary spring tide of 25 feet, and 3026 feet of quayage ; in the tidal harbour the depth of water varies from about 26 feet high spring to 7 feet low neap tide ; length of quays 2952 feet. The military port with the connected buildings covers an area of 54 acres. It comprises three principal*~~

~~basins, with a minimum depth of 30 feet. Pop- ulation (1881), 27,439; (1901), 42,962.~~

~~Cherbuliez, Charles-Victor (1829-1899), French novelist and miscellaneous writer, was bom 19th July 1829, at Geneva, where his father was a classical pro- fessor at the university. He was descended from a family of Protestant refugees, and many years later resumed his French nationality, taking advantage of an Act passed in the early days of the Eevolution. Geneva was the scene of his early education ; thence he proceeded to Paris, and afterwards to the universities of Bonn and Berlin. He returned to his native town and engaged in the profession of teaching. After his resumption of French citizenship he was elected a member of the Academy (1881), and having received the Legion of Honour in 1870, he was promoted to be officer of the Order in 1892. He died 1st July 1899. Cherbuliez was a voluminous and successful writer of fiction. His first book, originally published in 1860, reappeared in 1864 under the title of Un Cheval de Phidias: it is a romantic study of art in the golden age of Athens. He went on to produce a series of novels, of which the follow- ing are the best known: — Le Comte Kostia (1863), Le Prince Vitale (1864), Le Boman d^une honnSte Femme (1866), L'Aventure de Ladislas BolsJd (1869), Miss Bovel (1875), Samuel Brohl et Cie. (iSTT), LUdie de Jean TMoral (1878), Noirs et Bouges (1880), La Voca- tion du Comte Ohislain (1888), Une Gageure (1890), Le Secret du Pricepteur (1893), Jacquine Vanesse (1898), &c. Most of these novels first appeared in the Bevue des Deux Mbndes, to which Cherbuliez also contributed a number of political and other learned articles, usually printed with the pseudonym G. Valbert. Many of these have been published in collected form under the titles VAUetnagne politique (1870), L'Espagne politique (1874), Projils Strangers ,(1889), L'Art et la Nature, (1892), &c. The volume Etudes de littirature et d'art (1873) includes articles for the most part reprinted from Le Temps. The earlier novels of Cherbuliez have been said with truth to show marked traces of the influence of George Sand ; and in spite of modification, his method was that of an older school. He did not possess the sombre power or the in- tensely analytical skill of some of his later contemporaries, but his books are distinguished by a freshness and honesty, fortified by cosmopolitan knowledge and lightened by~~

unobtrusive humour, which, fully account for their wide popularity in many countries besides his own. His genius was the reverse of dramatic, and attempts to present two of his stories on the stage have not succeeded. His essays have all the merits due to liberal observation and thorough- ness of treatment ; their style, like that of the novels, is admirably lucid and correct. (c.)

Cheribon (Dutch, Tjeribon), the most easterly resi- dency of West Java, with an area of 262,064 square miles. It is separated from Tegal in the E. by the small river Losari, which also marks the boundary between the Sundaese of West and the Javanese of Middle and East Java. The northern part of the residency, with the ex- ception of the volcano Tjeri Mai (10,000 feet), consists of an alluvial coast plain, drained by the Manuk, which rises in the high mountains of Preanger. The Tandui, which also rises in Preanger, forms the southern boundary. Rice is cultivated on the low marshy grounds, and in addition to other products, tea is a special culture. The total population in 1897 was 1,577,521, comprising 867 Europeans, 21,108 Chinese, 1896 Arabs, other Oriental foreigners 120, natives, 1,653,530. Cheeibon-, the chief town, has a roadstead, safe during the west monsoon, from which it is protected by the north and south trend of the coast. Imperfect drainage and the silting up of the little river Tjeribon long rendered the town imhealthy and the port almost inaccessible. Improvements have, however, been recently effected — a channel 900 feet long has been constructed, and the large number of Chinese and Arab residents indicate the commercial activity. Sugar and coffee are exported in considerable quantity, and the total port trafiic amounts to about 200,000 tons annually. Railways and tramways afford land commu- nication with Batavia, Samarang, and the neighbouring residencies, and steamers with the other islands of the archipelago.

Chernomorskaya, formerly a province of Russia, North Caucasia, now a separate military district of Kuban. It includes the narrow strip of land along the east coast of the Black Sea, from Novorossiysk, its capital, to nearly as far as Pitsunda, between the sea-coast and the water- parting of

~~the main Caucasus range, which sends many spurs to the coast, leaving a narrow and extremely malarial belt between the mountains and the sea. A rich vegeta- tion of a southern character, favoured by copious rains, grows along the coast ; but the country, since the forced exodus of the Tcherkesses, is very thinly populated. It is divided into three districts : Novorossiysk, capital of the province (20,511), Veliaminovsk, and Soch (chief town Dakhovskiy Posad, 1040). Novorossiysk is con- nected by rail with the main line of North Caucasia, and a mountain road is being made from Veliaminovskaya (Tuapse) to Maikop in Kuban. A road runs all along the coast, upon which small Russian and pretty Czech villages are growing up. Population (1896), 49,745, chiefly Russians, also Greeks, Czechs, Armenians, and about 1300 Tcherkesses.~~

~~Cherso (Serbo-Croatian, Ores), an island belonging to the Austrian province of Istria, in the Gulf of Quarnero. Population, 10,180 — ^two-thirds Serbo-Croatians and one- third Italians. The chief town, which bears the same name, has 4725 inhabitants. It is a harbour, and is provided with a shipwright's wharf. The principal re- sources of the population are the cultivation of the vine and olive, fishing and seafaring.~~

~~Chesham, a parish, urban district (1894), and market town of England, on the Chess, an affluent of the Colne, 13 miles S.E. of Aylesbury by rail, in the Aylesbury parliamentary division of Buckinghamshire. Under a local board from 1885, it was by the Local Government~~

~~Act, 1894, erected into an urban district. Besides the ancient church of St Mary, Christchurch (1864), and a church built in 1887, there is a Congregational chapel (re- built in 1886), a Baptist chapel (rebuilt in 1898), a Wes- leyan chapel (erected in 1897), and a Calvinistic chapel. Other buildings are the town hall and a mechanics insti- tute. There are numerous charities. All sorts of small dairy utensils, chairs, malt-shovels, &c., are made of beech, the growth of which forms a feature of the surround- ing country. Shoemaking is also carried on. In Water- side hamlet, adjoining the town, are flour mills, duck farms, and watercress beds. Chesham publishes two weekly newspapers. In consequence of the constitution in 1898 of three new parishes the area of Chesham has been~~

~~*reduced to 10,360 acres. Its population on the old area of 12,746 acres was in 1881, 6602 ; on the new area*~~

~~*(1891), 6075; (1901), 7246.*~~

~~*Cheshire or Chester, a north-western county of England, bounded on the N. by the Mersey, which separ rates it from Lancashire, on the N.B. by York and Derby, on the S.E. by Stafford, on the S. by Shropshire, on the W. by Denbigh, Flint, and the estuary of the Dee, and on the N.W. by the Irish Sea.*~~

~~*Area and Population. — The area of the ancient county is 667,068 acres or 1027 square miles. The population in 1881 was 644,037, and in 1891 was 730,058, of whom 352,936 were males and 377,122 females, the number of persons per square mile being 711, and of acres to a person 0-91. In 1901 the population was 814,555. The area of the administrative county, as given in the census retiirns of 1891, was 656,036 acres, with a population of 743,869 ; but since then several alterations have been made in the administrative area. In 1896 the parish of Tittenley in Cheshire was transferred to Shropshire ; in 1896 part of the parish of Threapwood in Flint was transferred to Cheshire ; in the same year part of the townships of Appleton-with-Hull, Latchford Without, and Walton Inferior was transferred from Cheshire to Lancashire ; and in 1898 part of the township of Ashton-under-Lyne was transferred from Lancashire to Cheshire, and part of the township of Dukinfield from Cheshire to Lancashire. The area of the registration county is 643,791 acres, with a population in 1891 of 707,978, of whom 508,498 were urban and 199,480 rural. Within this area the increase of population between 1881 and 1891 was 13-76 per cent. The excess of births over deaths between 1881 and 1891 was 84,417, and the increase in resident population was 85,665. The following table gives the numbers of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 :—*~~

~~*Tear.*~~

~~*Marriages.*~~

~~*Births.*~~

~~*Deaths.*~~

~~*Illegitimate Births.*~~

~~*Male.*~~

~~*Female.*~~

~~*1880 1890 1898*~~

~~*4269 6171 5671*~~

~~*20,823 21,161 22,064*~~

~~*12,303 13,684 13,467*~~

~~*526 536*~~

~~*473*~~

~~*509 509 457*~~

~~*The number of marriages in 1899 was 5957, of births 22,004, and of deaths 13,893.*~~

~~*The following table gives the marriage, birth, and death rates per 1000 of the population, with the percentage of illegitimate births, for a series of years : —*~~

~~*1870-79.*~~

~~*1880.*~~

~~*1880-89.*~~

~~*1890.*~~

~~*1887-98.*~~

~~*1898.*~~

~~*Marriages*~~

~~*15-5*~~

~~*13-8*~~

~~*13-6*~~

~~*14-7*~~

~~*14-1*~~

~~*14-7*~~

~~*Births .*~~

~~*35-4*~~

~~*33-8*~~

~~*32-1*~~

~~*30-2*~~

~~*30-0*~~

~~*28-7*~~

~~*Deaths .*~~

~~*21-4*~~

~~*19-9*~~

~~*19-0*~~

~~*19-5*~~

~~18-4~~

~~17-5~~

~~Percentage of ille-~~

~~5-4~~

~~6-0~~

~~5-1~~

~~4-9~~

~~4-6~~

~~4-2~~

~~gitimacy~~

~~In 1891 there were in the county 8651 natives of Scotland, 20,006 natives of Ireland, and 2254 foreigners.~~

~~Constitution and Government. — ^The ancient county is divided into eight parliamentary divisions ; and it also includes the parlia- mentary borough of Birkenhead, returning one member, part of Stockport, returning two members, and parts of Ashton-under- Lyne, Chester, Stalybridge, and Warrington, returning one mem- ber each. The administrative county contains nine municipal boroughs: Birkenhead (110,926), Chester (86,281), Congleton (10,706), Crewe (42,075), Dukinfield (18,929), HIyde (32,768), Macclesfield (34,635), Stalybridge (27,674), and Stockport (78,875). Birkenhead, Chester, and Stockport are county~~

~~^oQ?fl? » ", ^^^ following are urban districts: Alderley Edge)iion}' -^ ,? ^^"^ (2597), Altrinoliam (16,831), Ashton-upon-Mersey >,1n^^ BoUmgton~~

~~(5244;, Bowdon (2788), Bredbury and Romiley (7107), Bromborough (1891), Buglawton (1452), Cheadle and watley (10,807), Higher Bebington (1540), HoUingworth (2447), Hoole (5341), Hoylake and West Kirby (10,911), Knutsford (5172),~~

~~■T'..?lJ™^°'^ (^^^")' I-y™™ (4707), M'arple (6595), Middle- wien (4669), Mottram in Longendale (3128), Nantwich (7722), 7n®l i'"*^S^'i'^^^^Sate (4154), Northwioh (17,609), Euncom (16,491), Sale (12,088), Sandbaoh (5556), Tarporley (2644), Wal- lasey (53,580), Wilmslow (7361), Winsford (10,382), and Yeardsley- cum-Whaley (1487). The county is in the North Wales circuit, and assizes are held at Chester. The boroughs of Congleton, Crewe, Macclesfield, Stalybridge, and Stockport have separate commissions of the peace and separate courts of quarter sessions. The ancient county— which is chiefly in the diocese of Chester and partly in those of Lichfield, Manchester, and St Asaph— contains 264 entire ecclesiastical parishes.~~

~~Education. — There is a residential training college (Chester, Manchester, and Liverpool diocesan) at Chester. The total number of elementary schools on 31st August 1899 was 488, of which only 36 were board, and 452 were voluntary schools, the latter including 334 National Church of England schools, 28 Wesleyan, 29 Roman Catholic, and 61 "British and other." The average attendance at board schools was 10,024, and at volun- tary schools 93,609. The total school board receipts for the year ended 29th September 1898 were over £67,693. The income under the Technical Instruction Act was over £55, and that under the Agricultural Rates Act was over £802.~~

~~Communications. — Besides being traversed by a network of railways and numerous small canals, Cheshire is now skirted on the north by the Manchester Ship Canal, opened in 1894. (See under Lancashihe.)~~

~~Agriculture. — Within recent years much attention has been paid to the improvement of agriculture by special training in dairy work and in farming. Nearly five-sixths of the total area is under cultivation, and of this about three-flfths is in permanent pasture, chiefly for dairy-farming purposes — the manufacture of cheese and milk supply. More than 14,000 acres are in hill pastur- age, nearly 2500 acres under orchards, and over 24,000 acres under woods. Oats occupy about three-fourths of the acreage~~

~~*under corn crops, and potatoes more than one-half of that under green crops, only about one-fourth being planted with turnips and swedes. There is a considerable acreage under small fruit. The following table gives thje larger main divisions of the cultivated area at intervals of five years from 1880 :—*~~

~~*Tear.*~~

~~*Total Area under Cul- tivation.*~~

~~*Corn Crops.*~~

~~*Green Crops.*~~

~~*Clover.*~~

~~*Pennanent Pasture.*~~

~~*Fallow.*~~

~~*1880 1885 1890 1895 1900*~~

~~*536,348 540,551 541,348 539,655 536,332*~~

~~*79,534 79,472 80,986 78,242 82,449*~~

~~*37,043 42,091 38,887 39,483 41,933*~~

~~*54,644 58,818 62,390 63,621 70,987*~~

~~*363,420 359,580 357,128 355,760 339,023*~~

~~*1707 590 771 495 266*~~

~~*The following table gives particulars regarding the principal live stock for the same years :—*~~

~~*1880 1885 1890 1895 1900*~~

~~Total Horses.~~

~~23,081 21,966 22,314 26,143 26,917~~

~~Total Cattle.~~

~~151,866 172,019 167,465 170,136 182,633~~

~~Cows or Heifers~~

~~in Milk or in~~

~~Calf.~~

~~91,174 101,892~~

~~99,650 102,791 107,406~~

~~Sheep.~~

~~97,892 86,343~~

~~106,418 92,456~~

~~103,456~~

~~Pigs.~~

~~49,971 62,988 77,464 78,392 70,126~~

~~Industries and 3>ade.— According to the report of the chief insnector of factories for 1898 (1900) the total number of persons em- Tiloved in factories and workshops in 1897 was 112,598, as compared with 114 391 in 1?96. The number employed in textile factories oT/iq 182 • between 1895 and 1896 there was an increase in the rCber of 2-3 per cent., but between 1896 and 1897 a decrease of nT The main textile industry is cotton, employing 34,446 per- RnnV silk employs 8025 persons. The non-textile factories in 1 897 'emnloyed 60,936 persons, there being an increase between laoi tiTiH 1896 of 6-4 per cent., and a decrease between 1896 and 1897 of 3-0 per cent. Over a third (20,766) were in 1897 employed in the manufacture of~~

~~*machines, conveyances, tools, &c. On the Mersey there are a number of shipbuilding yards, in addition to several large engine, machine, and iron works. In the manu- facture of chemicals 5874 persons were employed, in clothing industries 9556, in print, bleach, and dye works 4474, and in the founding and conversion of metal 6068. Workshops in 1897 em- ployed 8480 persons, of whom 4205 were employed in the clothing*~~

~~*industry and 1054 in that of food. In 1899 there were 3489 per- sons employed in mines and quarries. In the same year 127,972 tons of sandstone were raised, 26,785 of gravel and sand, and 20,967 of clay ; but the principal minerals are coal and salt. The output of coal in 1890 was 637,402 tons, valued at £191,221 ; and in 1899 it was 721,431 tons, valued at £270,637. Rock-salt is obtained at Northwich and Winsford, and salt from brine is manufactured at Lawton, Wheelock Valley, Middlewich, North- wich, and Winsford. In the case of rock-salt the value in the returns is lumped with that of Lancashire, and in the case of salt from brine the quantity is lumped with that of Staffordshire, so that exact statements of the tonnage and value of the annual pro- duction are impossible ; but in 1899 the amount was at least con- siderably over 1,000,000 tons, and the value must have closely approached £400,000.*~~

~~*AuTHOKiTiES. — Among the principal works are : Sir John Dodd- EiDGE. History of the Ancient and Modern State of the Principality of Wales, Duchy of Cornwall, and Earldom of Chester. London, 1630; 2nd ed. 1714. — King. The Vale-Boyall of England, or the County Palatine of Cheshire Illustrated, 4 parts. London, 1666 ; abridged by T. Hughes, London, 1852. — Hanshall. History of the County Palatine of Chester. Chester, 1817-23. — J. O. Halliwell. Palatine Anthology. London, 1850. — Baines. Lancashire and Cheshire, 2 vols. London, 1868-69. — Ormbkod. History of the County Palatine and City of Chester, 3 vols. London, 1819; new ed. 3 vols., London, 1875-82. — Eaewaker. East Cheshire, 2 vols. London, 1877. — Wilbraham. Glossary. London, 1820; 2nd ed., London, 1826; and Glossary founded on Wilbraham by E. Leigh, London, 1877. — Croston. Historic Sites of Cheshire, Manchester, 1883 ; and County Families of Cheshire, Manchester, 1887. — Axon. Cheshire Gleanings. Man- chester, 1884. — Watkin. Roman Cheshire. Liverpool, 1886. — Holland. Glossary of Words used in the County of Cheshire. London, 1884-86. — Philips. Views of Old*~~

~~*Halls in Cheshire. London, 1893. — Thoknley. Monumental Brasses of Cheshire. Hull, 1893; and Andrews, Byegone Cheshire. Chester, 1895. See also various volumes of the Chetham Society and of the Record Society of Manchester, as well as the Proceedings of the Cheshire Antiquarian Society, and Cheshire Notes and Queries. (t. p. h.)*~~

~~*Cheshunt, a town and railway station in the Hert- ford parliamentary division of Hertfordshire, England, on the Lea, 7 miles S. of Hertford. Cheshunt College for theological instruction was established here in 1792 by the countess of Huntingdon. There are an ancient church, recently restored, two halls for public meetings, church rooms, a cottage hospital, and a recreation ground of 8 acres. Nursery and market gardening, largely under glass, brick-making, and saw-mills are the chief industries. Area of parish (an urban district), 8480 acres ; population (1881), 7736; (1901), ^2,288.*~~

~~*Chesney, Sir George Tomkyns (1830-1895), English general, colonel-commandant of Royal (late Bengal) Engineers, youngest son of Captain Charles Corn- wallis Chesney of the Bengal Artillery, was born at Tiv- erton, Devonshire, on 30th April 1830. Educated at Blundell's School, Tiverton, and at Addiscombe, he entered the Bengal Engineers as second lieutenant on 8th Decem- ber 1848. He was employed for some years in the Public Works Department and, on the outbreak of the Indian Mutiny in 1857, joined the Ambala column, was field- engineer at the battle of Badli-ke-serai, brigade-major of engineers throughout the siege of Delhi, and was severely wounded in the assault (medal and clasp and a brevet majority). In 1860 he was appointed head of a new department in connexion with the Public Works accounts. His work on Indian Polity (1868), dealing with the administration of the several departments of the Indian Government, attracted wide attention and remains a permanent text-book. The originator* of the Royal Indian Civil Engineering College at Cooper's Hill, Staines, he was also its first president (1871-80). In 1871 he contributed to Blackwood's Magazine a brilliant skit called "The Battle of Dorking" — a picture of what might happen if the victorious German army, after defeat- ing France, invaded England — which was republished in many editions and translations, and produced a profound*~~

impression. He was promoted lieut-colonel, 1869 ; col- onel, 1877; major-general, 1886; lieut.-general, 1887; colonel-commandant of Eoyal Engineers, 1890 ; and gen- eral, 1892. From 1881 to 1886 he was secretary to the Military Department of the Grovernment of India, and was made a C.S.I, and a CLE. From 1886 to 1892, as mili- tary member of the Governor-General's Council, he car- ried out many much-needed military reforms. He was

made a C.B. at the jubilee of 1887, and a K.C.B. on leav- ing India in 1892. In that year he was returned to Parlia- ment, in the Conservative interest, as member for Oxford, and was chairman of the committee of service members of the House of Commons until his death on 31st March 1895. He wrote some novels. The Dilemma, The Private Secretary, The Lesters, &c., and was a frequent contribu- tor to periodical literature. (e. h. v.)

CHESS.

THK article on Chess in the ninth edition of the EncyclopcBdia Britannica was written in 1875. W. Norwood Potter, who appended his initials, was one of the foremost English players and writers on the game ; he died in 1895. The article was, in essentials, the joint work of Steinitz and Zukertort. Dr J. H. Zukertort died in 1888, five years after his famous victory in the London tourna- ment in 1883, and W. Steinitz survived his great rival about thirteen years. In 1876 England was in the van of the world's chess army. Two years previously Staunton, for years the English champion, had died. De Vere died a year later in the prime of life, being only twenty-nine years old. The latter was an irreparable loss, and England has produced no chess genius since. English-born players then were Boden, Bum, MacDonnell, Bird, Blackburne, and Potter; whilst among naturalized English players were Lowenthal, Steinitz, Zukertort, and Horwitz. Of this remarkable array of talent only Bird, Blackburne, and Burn survived in 1901. This illustrious contingent was rein- forced in 1878 by Mason, an Irish-American, who came over for the Paris tournament, and by Gunsberg, a Hun- garian, and more recently by Teichmann, who also made England his home. English

~~*chess under the leadership of the masters mentioned flourished. The chief prizes in tournaments, up to within comparatively recent years, were consistently carried off by the English representa- tives, as will be seen from the following list of tourna- ments from 1878 up to date : —*~~

~~*Paris, 1878. — First, Zukertort ; second, Winawer ; third, Black- burne ; fourth, Mackenzie ; fifth, Bird. Winawer made an equal score with Zukertort, but was beaten in the tie match. Winawer, ■whose name was unknown, competed for the first time in the Paris tournament, 1867, and to the surprise of everybody he won the second prize (Kolisch being first) amongst competitors like De Vere, Steinitz, Neumann, and Rosenthal. He tied and divided the first and second prizes with Steinitz in Vienna, 1882, and won the first prize at Ntiremberg, 1883. In this tournament B. Eng- lisch of Vienna made his first appearance, and the promising talent of which he then gave evidence was fully justified in his career during the next nineteen years. It was also Mason's first appear- ance in Europe.*~~

~~*WiESBADEK, 1880. — ^First, second, and third a tie between Black- burne, Englisoh, and A. Schwarz.*~~

~~*Beklin, 1881. — ^First, Blackburne ; second, Zukertort ; third and fourth, Tchigorin and Winawer ; fifth, Mason. Blackburne, who previously to this tournament was beaten in a match by Zukertort, rehabilitated his reputation by winning the first prize with three games to spare, Zukertort being second. Tchigorin made his first public performance in this contest.*~~

~~*Vienna, 1882. — First and second, Steinitz and Winawer ; third, Mason ; fourth and fifth, Mackenzie and Zukertort ; sixth, Blackburne.*~~

~~*London, 1883. — First, Zukertort ; second, Steinitz ; third, Blackburne ; fourth, fifth, and sixth equal, Mackenzie, Mason, and Englisch. This tournament, played in two rounds, endowed with large prizes, and the third draw only counting one-half each, was one of the most severe contests held hitherto. Zukertort won the first prize very easily, and also played the finest games. Steinitz challenged him shortly afterwards to a match, but it only came ofi three years later in America, and ruined Zukertort both in body and mind. Winawer, for the first time in his career, was not even placed.*~~

~~*NiJRBMBEKG, 1883. — First, Winawer ; second, Blackburne ; third. Mason ; Bardeleben and Bird taking the other prizes. This*~~

~~*tournament is a milestone in modem chess history. The prizes having been comparatively small, it was thought that it necessarily must be a failure, the munificently endowed London tournament having just been concluded. But, strange to say, whilst in London fourteen players competed, there were nineteen entries in Nurem- berg. Winawer, not placed in the former, won the first prize in the latter. A number of young and talented players made their first appearance, amongst them being Fritz, Bardeleben, Hruby, Eiemann, Schottlander, Gunsberg, and of older masters L. Paul- sen and the famous Dr Max Lange. It is also noteworthy that, having won the "Haupt" tournament at this congress, the after- wards famous Dr Tarrasch gained the title of " master."*~~

~~*Hamburg, 1885. — First, Gunsberg, the next prizes being divided by Blackburne, Mason, Englisch, Dr Tarrasch, and Weiss ; seventh, Mackenzie. Max Weiss of Vienna, Englisoh's rival, made his first appearance here. This tournament was remarkable for the fact not only that five players made an equal score, and divided the five prizes after the first, but that Gunsberg wired to London that he had won the first prize, when Mason, who had to finish several adjourned games, could still have tied with him.*~~

~~*Hereford, 1885. — First, Blackburne ; second and third, Bird and Schallopp ; fourth, Mackenzie. In this tournament Mason and the late W. H. K. Pollock competed, as well as the well-known amateurs Rev. A. B. Skipworth, Rev. C. E. Ranken, and the late E. Thorold.*~~

~~*London, 1886. — ^First, Blackburne ; second. Bum ; third and fourth equal, Gunsberg and Taubenhaus; fifth. Mason; Mac- kenzie, Bird, Lipschtitz, and Hanham not placed.*~~

~~*Nottingham, 1886. — First, Bum ; second, SchaUopp ; third and fourth equal, Gunsberg and Zukertort.*~~

~~*Frankfort, 1887. — First, Mackenzie ; second and third, Black- burne and Weiss ; fourth, Bardeleben ; fifth and sixth, Berger and Tarrasch, followed*~~

~~*by Englisch and L. Paulsen. Gunsberg, first in Hamburg, was not placed, nor Burn nor Zukertort. Macken- zie, of Scottish extraction, living in America, deservedly won first prize.*~~

~~*Bradford, 1888.—First, Gunsberg ; second, Mackenzie ; third and fourth. Mason and Bardeleben ; fifth. Bum, followed by Blackburne and Weiss.*~~

~~*New York, 1889. — Fh-st and second equal, Tchigorin and Weiss; third, Gunsberg; fourth, Blackbume ; fifth. Bum, followed by Lipschtitz and Mason. There were twenty com- petitors, some Americans playing. Of the latter Lipschtitz only was placed.*~~

~~*Breslah, 1889.—First, Dr Tarrasch ; second. Bum ; third, Weiss, followed by Bardeleben and Bauer, Gunsberg and Paulsen equal ; Blackburne and Mason, the former for the first time not placed. This tournament is remarkable for the advent of Lasker, who gained his mastership in the "Haupt" toumament. Here also Mieses scored his first success.*~~

~~*Amsterdam, 1890.—First, Burn ; second, Lasker ; third. Mason; fourth, van Vliet; fifth, Gunsberg. There were only nine competitors, Lasker unexpectedly losing to van Vliet by a trap.*~~

~~*Manchester, 1890.—First, Dr Tarrasch ; second, Blackburne ; third and fourth, Bird and Mackenzie ; fifth and sixth, Gunsberg and Mason, followed by Alapin, Scheve, and Tinsley.*~~

~~*Dresden, 1892.—First, Dr Tarrasch ; second and third, Makovetz and Porges; fourth and fifth, Marco and Walbrodt; sixth and seventh, Bardeleben and Winawer. Blackbume received only a special prize, Mason not being placed at all. Makovetz, a talented Hungarian, who never played afterwards, made his first appear- ance, as well as Walbrodt, a Berlin player of promise. The latter did not, however, justify the very high expectations formed of him.*~~

~~*Leipzig, 1894.—First, Dr Tarrasch ; second and third, Lipke and Teichmann; fourth and fifth, Blackburne and Walbrodt- sixth, Janowsky and Marco. It was the first appearance of two great players, Lipke of Halle, and Janowsky, of Polish extraction, hvmg in Paris ; also of Teichmann, a well-*~~

~~*known English resident who gave great promise at the time when Lasker became known!*~~

~~*CHESS*~~

~~*751*~~

~~*The success of this tournament was mainly due to the enthusiastic etforts of the late Dr Max Lange.*~~

~~*Hastings, 1895.— First, PiUsbury ; second, Tchigorin; third, Lasker ; fourth, Tarrasch ; fifth, Steinitz ; sixth, Schiffers, fol- lowea by Bardeleben and Teichmann. This tournament is histo- rical tor the advent of Pillsbury, the American champion, and Maroczy, the Hungarian champion; Lasker being only third; larra,sch after four successive first prizes, being only fourth ; and btemitz, fifth ; whilst Schlechter, Blackburne, Marco, Janowsky, Mason, Walbrodt, Mieses, Bird, and Gunsberg were not placed at all. Hastings must be considered the beginning of the greater tournaments. It is also a curious fact that Maroczy, the eminent Hungarian, was refused admission to the minor tournament because his name was not known to the committee. Fortunately a vacancy gave him a chance of showing his skUl. He won the first prize.*~~

~~*NuREMBERo, 1896.— Flrst, Lasker; second, Maroczy; third and fourth, PiUsbury and Tarrasch; fifth, Janowsky; sixth, Steinitz, followed by Schlechter and Walbrodt. Eemarkable for the first appearance of Charousek, and for the fact that Dr Tarrasch was again low in the list, and Blackburne, Tchigorin, Marco, Wmawer, and Charousek not placed at all. Charousek was just as obscure at Ntiremberg as Maroczy was at Hastings. Dr Tar- rasch detected the genius of the youthful candidate," and admitted him to the tournament.*~~

~~*Budapest, 1896.— First, Tchigorin ; second, Charousek ; third, PUlsbui-y ; fourth and fifth, Janowsky and Schlechter ; sixth and seventh, Walbrodt and Winawer. Remarkable features : Maroczy not placed at all, and Dr Tarrasch only receiving a special prize for the best score against prize-winners.*~~

~~*Berlin, 1897.— First, Charousek ; second, Walbrodt ; third, Blackburne ; fourth, Janowsky ; fifth. Burn, followed by Alapin, Marco, and Schlechter. Tchigorin, Winawer, and Teichmann not placed, whilst Englisch had to abandon the tournament and return to Vienna iU. He never recovered, and died a few weeks later.*~~

~~*Vienna, 1898.— First, Dr Tarrasch ; second, Pillsbury ; third, Janowsky ; fourth, Steinitz ; fifth, Schlechter ; sixth and seventh. Bum and Tchigorin ; eighth and ninth, Lipke and Maroczy ; tenth, Alapin. Blackburne received a special prize. Dr Tarrasch achieved a remarkable victory in this important tournament. Pillsbury's chances were better than his, but he managed to run him neck and neck, and beat him in the tie match which followed. Although Lasker did not compete, the tournament was quite as important as that at Hastings.*~~

~~*Cologne, 1898. — First, Burn; second, third, and fourth, Charousek, Cohn, and Tchigorin ; fifth, Steinitz ; sixth and seventh, Schlechter and Showalter, followed by Berger and Janowsky. It is curious that Cohn stood first up to the last round ; in the end he gave way. Charousek, who was convalescent and played against the advice of the doctors, made a slip in one of the games, a serious drawback in so short a contest.*~~

~~*London, 1899. — First, Dr Lasker ; second, third, and fourth equal, Janowsky, Maroczy, and Pillsbury ; fifth, Schlechter; sixth, Blackburne ; seventh, Tchigorin ; eighth, Showalter ; ninth. Mason. A very important tournament, organized under the auspices of the British Chess Club. It was a two-game tournament, and a one-round tournament was held simultaneously. In the latter Marco, Mieses, and Marshall of America competed with some well-known British amateurs. Marshall won the first prize. The chief tournament was noteworthy for the fine games which occurred, and for the fact that Janowsky sacrificed the second prize by trying to vrin a game against Steinitz when with an easy draw in hand he could have secured it.*~~

~~*Mdnich, 1900.— Tie between Maroczy, Pillsbury, and Schlechter for the three chief prizes ; fourth. Burn ; fifth, Marco ; sixth, Cohn ■ seventh and eighth divided between Berger, Janowsky, Showalter, and Wolf. Lasker did not compete, but a new star was found in Wolf of Vienna, whilst France was*~~

~~*represented by a talented amateur, M. Billecard. It was a close contest between Pillsbury Maroczy, and Schlechter. Maroczy abandoned the contest owing to ill-healtb, and the two others fighting out the tie made even games, and divided first and second prizes. A big "Haupt" tournament with twenty-two entries was held, and several other tournaments.*~~

~~*Paris 1900.— First, Dr Lasker ; second, Pillsbury ; third and fourth Maroczy and Marshall; fifth. Burn; sixth, Tchigorin; seventh Marco and Mieses. Schlechter, with an equal score to the latter two, did not obtain a prize, because his total was made up by a large number of drawn games, and under the rules this total was of inferior quality to the totals made up of won games. Marshall was unexpectedly successful ; he beat both Lasker and Pillsbury and for some time he had expectations of a higher place eyen than the one he eventually obtained. This was a two-game tournament, and a number of very fine games were produced. Janowsky, Showalter, and Mason were not placed. Didier, a French amateur, showed more talent than steadiness.*~~

~~*MoNTB Carlo, 1901.— First, Janowsky ; second, Schlechter ; third and fourth, Scheve and Tchigorm ; fifth, Alapin, followed by Mieses and Blackburne ; Gunsberg, Marshall, Mason, Marco, and Winawer not being placed. This ,toumament was originated by the Soci6t6 des Bains de Mer, M. Blanc, the director, entrust- ing the veteran master, M. Amous de Rivifere, with the carrying out of the scheme. A novel rule was introduced, viz., the first drawn game to count J each, to be replayed, and in case of a draw again to count J each, and in case of win ^ to the winner. Theo- retically this seems logical, but in practice it did not work as well, the result being just the contrary to what was expected. Some players indulged in too many draws. Otherwise the touma^ ment was a success.*~~

~~*Problems.*~~

~~*A chess problem has ' been described as " merely a position supposed to have occurred in a game of chess, being none other than the critical point where your antagonist announces checkmate in a given number of moves, no matter "what defence you play." Correct enough so far as it goes, the above description conveys no notion of the degree to which problem composing has become a specialized study of late years. At first but a*~~

~~*modest adjunct of the game proper, owing its inception doubtless to the practice of recording critical phases from actual play, wherein the issue turned upon some particu- larly subtle and instructive manoeuvre or strikingly brilliant move, the art of the problem composer has grown in favour until its numerous devotees justifiably style it the "poetry" of the game. The growing percep- tion of the fact that the construction of problems, being in the nature of an "art," was governed by certain aesthetic rules of taste, had the effect of gradually lessen- ing their practical utility to players of the game, and in course of time the positions themselves ceased to bear necessarily any but the remotest resemblance to such as would be likely to arise in the course of play. The reason of this change, the first step in the evolution of the chess problem, is not far to seek.*~~

~~*A good chess problem exemplifies chess strategy ideal- ized and concentrated. In the finest extant examples of actual play there will necessarily remain on the board both white and black pieces immaterial to the issue (checkmate), whereas in the " idealized " problematic presentation of the same combination the composer, being free to select his own materials, employs only indispensable force so as to focus attention on the idea, avoiding all material which would tend to "obscure the issue." Whilst the element of dif&culty is a highly desirable one in a chess problem, it must be due solely to the intrinsic depth of ideas and the artistic manner in which it is expressed. Hence the use of otiose force is rigorously eschewed, and the first object in a problem composed in accordance with modern theories is to extract the maximum of finesse with a sparing use of the pieces. "Economy of force" must be combined with "purity of the mate," in the chief lines of play at least. A proper understanding of what is meant by " economy of force" will help to a better appreciation of the lines upon which the evolution of the chess problem has proceeded. A very common mistake until comparatively recent years was that of appraising the economy of a position according to the slenderness of the force used, regardless of the fact that economy is not a question of absolute values. The only true criterion is the ratio of force employed to the sum total of meritorious play in the course of the solution. The earliest composers strove to give their productions every appearance of real play, and indeed their composi- tions partook of the nature of ingenious end-games. The entire*~~

~~*interest is usually centred in a single forced line of play. It was usual to give Black a predominance of force, and to leave the White King in apparent jeopardy. From this critical predicament he was extricated by a long series of checking moves, usually involving a number of brilliant*~~

~~*sacrifices. The number of moves was rarely less than five, and the conditions were not infrequently cumbered by restrictions on the movements of certain pieces. In the course of time the solutions were reduced to shorter limits, and the beauty of quiet {i.e., non-checking) moves began to make itself felt. The early " transition " school, as it has been called, was the first to recognize the importance of economy as then understood, i.e., the representation of the main point of strategic worth without any extraneous force. The mode of illustrating single-theme problems, often of depth and beauty, was being constantly improved, and the problems of C. Bayer^ E. WiUmers, S. Loyd, J. G. Campbell, F. HealeyJ. B. of Bridport, and W. Grimshaw are, of their kind, stiU unsurpassed. In the year 1845 the "Indian" problem attracted much notice, and in 1861 appeared Healey's famous "Bristol" problem. To the transition period must be ascribed the discovery of most of those clever ideas which have been turned to such good account in the more richly varied contents of the modern school. In an article written in 1899 P. M. Teed men- tions the interesting fact that his incomplete collection of " Indians " totalled over three hundred.*~~

~~*In the early 'seventies, which may be called the later transition period, a more general tendency was manifest (as it became recognized that further improvements were well — nigh impossible in the construction of one — idea problems), to illustrate two or more finished ideas in a single problem with strict regard to "purity" and "economy." In the years 1872-75 the theory of the art received greater attention than it had done previously, and the essays of C. Schwede, Kohtz and Kodcelkorn, Lehner and Gelbfuss, helped to codify hitherto unwritten rules of taste. The last quarter of the 19th century, and its last decade especially, saw a marked advance in technical accomplishment, until it became a common thing to find as much deep and quiet play embodied in a single first- class problem as in three or four of the*~~

~~*old-time problems. This broader conception of the idea of " economy " gave a great impetus to the practice of blending several distinct ideas in one elaborate whole, even at the cost of a slight increase of force, provided always that the principle of "■purity" was regarded, if thereby the ratio aforesaid is enhanced.*~~

~~*In the composition of " two-movers " it is customary to allow greater elasticity and no very rigorous application of the principles of purity and economy. By this means a greater superficial complexity is attained ; but neither the Teutonic nor the Bohemian school countenances this con- travention of what they regard as fundamental aesthetic rules, and even amongst the English and American two- move specialists it is recognized that complexity, at the cost of discarding the canons of construction which obtain in the construction of problems of heavier calibre, is liable to abuse. Mr A. F. Mackenzie of Jamaica, however, is an uncompromising advocate of a relaxation of ordinary rules where two-movers are concerned, and he and a few others (notably T. Taverner, W. Gleave, H. and E. Bettman, and P. F. Blake) have won some of their greatest successes with problems which, under the stricter ruling of Con- tinental authorities, would be tabooed.*~~

~~*Whilst in a sense it is fruitless to discuss the degrees in which composers of varying nationalities may claim to have advanced the art, since the true style is cosmopolitan, Bohemian (Czechish) composers have long stood unrivalled as exponents of that blending of ideas which is the distinguishing trait of the present-day problem. It would not, indeed, be too much to say that they were pioneers, and by their exceptional technical skill popularized the theories which nowadays find almost universal acceptance. Such is their skill in construction that the distinction*~~

~~*between main lines of play and subsidiary variations dis- appears entirely. Indeed, it is rare to find in a problem of the Bohemian school fewer than three or four lines of play which, so far as economy and purity are concerned, are unimpeachable. Amongst the earliest composers of the small band that was destined to revolutionize the standard of composition so widely, Anton Konig, the founder of this school, Makovky, Drtina, Palct, and Pilnacek deserve to be honourably mentioned, but it was not until the starting of a chess column in the weekly journal Svetozor that the merits of*~~

~~*the new school were fuUy asserted. It was in 1871 that Jan Dobrusky contributed his first composition to that paper. In 1872 the name of G. Chocholous first appeared, and three years later that of C. Kondelik. These three great composers set up a tradition for finished workmanship which has been worthily upheld without cessation to the present day. Pospisil, Dr.Mazel, Kviciala, Kesl, Tuzar, Musil, and J. Kotrc ; and later still, Havel, Traxler, and Z. Mach, are no unworthy followers of Dobrusky. The influence of the Bohemian school upon the somewhat conservative pro- clivities of the older English composers is commonly traced back to the publication of the second prize set of problems from the Leipzig tourney 1879, the work of G. Chocholous.*~~

~~*The characteristic faculty for blending several variations into one harmonious whole is not without " the defects of its qualities," and consequently we find amongst the less gifted exponents that the mere agglomeration of clean and economical variations is apt to be regarded as an end in itself. Hence a certain tendency to repeat combinations of similar companion ideas is discernible at times. The danger that mere virtuosity in facile construction should be allowed to usurp the place of freshness of invention and strategic depth was already apparent to Chocholous when, in an article on the classification of chess problems (Deutsche Schachzeitung, 1890), he warned the younger practitioners of the Bohemian school against what had been dubbed by H. v. GottschaU " Varianten-leierei," or the " grinding-out of variations." When this one reserva- tion is made few will be inclined to dispute the pre- eminence of the Bohemian school. To some tastes, however, a greater appeal is made by the generally deeper if less richly varied play typical of the older German school, the quaint fancy untrammelled by hard-and-fast rules of the genial American composer, Samuel Loyd, or the almost ultra-studious immunity from "duals" which is the distinguishing trait of the English school.*~~

~~*The following masters in practical play are also known as composers of distinction : J. Berger, J. H. Blackbume, C. Schlechter, K. Teichmann, Dr H. von GottschaU, J. Mieses, and the late Professor Anderssen, whilst Dr E. Lasker and Steinitz and Zukertort have not disdained to contribute occasionally to the "poetry" of the game. Similarly the following composers are, or were in their time, noted players : Professor J. Berger, S.*~~

~~*Loyd, J. G. Campbell, C. D. Locock, and F. M. Teed; and among ladies : Sophie Schett, Mrs T. B. Kowland, and Mrs W. J. Baird, whose record of tourney successes and remarkable accuracy entitles her to a place in the foremost ranks of British composers.*~~

~~*It is somewhat singular that a study, the pursuit of which entails high powers of imagination as well as deep and accurate analysis, has proved to be within the powers of those afflicted with blindness. Yet by universal acclaim Mr A. F. Mackenzie of Jamaica is unsurpassed at the present day. In one tourney he won the prize for three- movers, whilst that for two-movers fell to H. F. Lane, who has likewise to compose sans voir. Mr Mackenzie also won the first prize in the self-mate tournament of the*~~

~~*British Chess Magazine and first prize in the problem tournament of the Wiener Schachzeitimg.*~~

~~*Problem Tournaments.— The idea of holding a problem competition open to the world was first mooted in con- nexion with the Chess Congress of 1851. The projected toinrnament was for the time abandoned, but in the year i»54: a tourney confined to British composers was held, and this— the earliest recorded— resulted in the two prizes tailing to W. Grimshaw and Silas Angas respectively. A brief summary of the more important tournaments is appended, in which, however, no mention is made of the competitions held in the leading provincial chess columns of the United Kingdom, as to enumerate all would require too miich space, whilst a choice would be invidious. Mention may be made of a few of the organs which have been conspicuously successful in attracting the participa- tion of composers of the highest repute : Leeds Merawry Supplement, Mamehester Weekly Times, Liverpool Weekly Mercwry, Bristol Mercury, Brighton Society, and The English Mechanic and Knowledge. Amongst the prize- winners in these the most notable successes have fallen to G. Heathcote, Mrs Baird, P. F. Blake, P. H. Williams, W. Gleave, and P. G. L. Fothergill.*~~

~~*In the following list the winners of first prizes only are given. Where two or more names occur they repre- sent winners in different sections of the same tourney ; —*~~

~~*Era ....*~~

~~*New York*~~

~~*Bristol*~~

~~*London*~~

~~*Le Palamede Franjais*~~

~~*Paris*~~

~~*British Chess Association*~~

~~*Paris*~~

~~*Leipzig*~~

~~*Berlin*~~

~~*Brentano' s Magazine . Chess Monthly .*~~

~~*Nuremberg*~~

~~*Chess Monthly .*~~

~~*British Chess Association*~~

~~*Prague .*~~

~~*Counties Chess Association*~~

~~*Frankfort .*~~

~~*Andrews Memorial*~~

~~*(B.G.M.) Breslau*~~

~~*Miinchener-neueste Nach*~~

~~*richten Bahn Frei St. John's Globe Dresden . Chess Monthly .*~~

~~*Miinchener-neueste Kach- richten*~~

~~*Schachmatny Journal*~~

~~*Prague*~~

~~*Warsaw Courier*~~

~~*Buy Lopez*~~

~~*Neues illustrirtes Blatt*~~

~~*St. Petershurger Zeitwng*~~

~~*British Chess Magazine*~~

~~*Prague*~~

~~*British Chess Magazine Nuova Bevista . Wiener Sehachzeitung*~~

~~*Problem Literature. — The following are some of the best works in the English language to consult on chess problems :— J. B. of 3vidVort. Chess Strategy. 1865.— F. Healey. A Collection of ^00 Chess Problems. 1866. — English Chess Problems. Edited by James and "W. T. Pibece. 1876.— H. J. C. Andebws, E. N. Frankenstein, B. G. Laws, and C. Planok. The Chess Problem*~~

~~*1855 C. Bayer. 1857 R. Willmers.*~~

~~*1861 F. Healey.*~~

~~*1862 C. Bayer. 1865 D. Lamourouz. 1867 C. Bayer. 1872 S. A. Sbrensen.*~~

~~*1878 J. Berger.*~~

~~*1879 Kohtz and Kookelkorn*~~

~~*(joint).*~~

~~*1881 E. Pradignat, L. Noack,*~~

~~*and F. Dubbe.*~~

~~*1882 J. Dobrusky.*~~

~~*1882 H. Leprettel, Rev. A. Cyril*~~

~~*Pearson.*~~

~~*1883 J. Berger (2), F. Schrufer,*~~

~~*F. Geyerstam 1884-86 A. E. Studd and F. Healey. 1886 J. Pospisil.*~~

~~*1886 J. Kotrc and J. Pospisil.*~~

~~*1887 B. G. Laws.*~~

~~*1887 J. Berger and J. Jespersen.*~~

~~*1888 J. Kotrc.*~~

~~*1889 G. Chooholous, R. Adam,*~~

~~*and J. Pospisil.*~~

~~*1889 F. Sohindler, A. Norlin,*~~

~~*J. Pospisil.*~~

~~*1890 L. de Yong and Z. Bennecke.*~~

~~*1891 W. A. Shinkman.*~~

~~*1892 0. Fuss and J. Pospisil. 1895 B. G. Laws, J. Jespersen,*~~

~~*and V. Marin. 1893-9 M. Karstedt, F. Mbller, F. Meyer, and R. Wein- heimer.*~~

~~*1894 K. Musil.*~~

~~*1895 W. Tuzar and P. K. Trailer.*~~

~~*1896 L. Vetesnik.*~~

~~*1897 v. Marin.*~~

~~*1898 J. Sveida. 1898 J. FridUzius.*~~

~~*1898 A. F. Mackenzie, M. A.*~~

~~*Dahl, and 0. Nemo.*~~

~~*1899 A. F. Mackenzie.*~~

~~*1900 P. K. Traxler.*~~

~~*1901 E. Pradignat. 1901 A. F. Mackenzie.*~~

~~*Text-Booi;. 1887.— A. F. Mackenzie. Chess : its Poetry and its Prose. Jamaica, 1887. — J. A. Miles. Chess Stars (self-mates). 1888.— James Rayner. Chess Problems. 1890.— B. G. Laws. The Two-Move Chess Problem. 1890.— TA« Chess Bouquet. Com- piled by F. R. GiTTlNS. 1897. — Mr and Mrs T. B. Rowland. The Problem Art (second edition). 1898.— E. B. Cook, T. Heneey, and C. A. Gilberq. American Chess-Nuts. 1868. — Samuel LoYD. Chess Strategy. 1878.— W. H. Lyons. Chess-Nut Burrs and how to open them. 1886. — C. A. Gilbbeq. Crumbs from the Chess Board. 1890. — Canadian Chess Problems. Edited by C. F. Stubbs. 1890. — W. Pulitzer. Chess Harmonies. 1894. —G.E. Carpenter (N. Preti of Paris). WO Chess Problems. 1900. History. — According to Mr W. S. Branch of Cheltenham, an authority on problem lore, the earliest known problem dates from the 9th century, and is ascribed to an Arabian caliph. The first known collection is that in a manuscript (in the British Museum) of Alfonso, king of Castile, dated 1250, containing 103 problems ; whilst the collection*~~

~~*of Nicholas de Nicolai of Lombardy, dated 1300, comprises 192 problems. Problems are to be found in the works of the undermentioned : — Lucena (1437), Damiano (1512), Polerio (1616), Carrera (1617), Stamma (1737), Ercole del Rio (1750), Lolli (1763), Ponziani (1769), Lewis (1817), Mendheim (1832), Alexandre (1846). Other early composers were : Bone, Bolton, D'Orville, L'Hermet, Capraez, Kling, Berlin, Kuiper, Angas, Mioheson, Pavitt, Plachutta, Kieseritsky, and Silberschmidt. Coming to the period of the "transition" and "modern" problems (roughly speaking from the middle of the 19th century), the foremost composers of various nationalities have been : (Great Britain), J. G. Campbell, W. Grimshaw, J. B. of Bridport, F. Healey, C. W. of Sunbury, G. J. Slater, A. E. Studd, Mrs Baird, B. G. Laws, C. Planck, C. A. L. Bull, G. Heathcote, P. F. Blake, Rev. A. Cyril Pearson, Sir J. 0. S. Thursby, and E. B. Schwann, the latter one of the foremost authorities on the problem in England ; (Germany and Austria), C. Bayer, P. Klett, R. Willmers, J. Kohtz, C. Kockelkorn, R. Braune, F. Schriifer, A. Bayersdorfer, J. Berger, M. Ehrenstein, H. V. Gottaohall, R. Schindler, R. Weinheimer, 0. Nemo, M. Feigl, and C." Erlin ; (Bohemia), J. Dobrusky, J. Pospisil, G. Chocholous, K. Kondelik, P. K. Traxler, and J. Kotrc ; (United States), S. Loyd, G. Cheney, G. E. Carpenter, C. A. Gilberg, W. A. Shinkman, F. M. Teed, and 0. Wurzhurg ; (Canada), J. N. Babson ; (Jamaica), A. F. Mackenzie ; (France), H. Leprettel and E. Pradignat ; (Italy), G. B. Valle ; (Scandinavia), Fr. af Geyerstam and A. S. Sbrensen ; (Spain), Tolosa Carreras and Y. Marin ;*~~

~~*I. By Stamma,*~~

~~*BLACK*~~

~~*Examples of ProbleTns.*~~

~~*H. By W. Bone.*~~

~~*WHITE.*~~

~~*White to play and mate in tbiee (3)*~~

~~*moves.*~~

~~*IIL By A. Anderasen.*~~

~~*WHITE.*~~

~~*Wliite to play and mate in seven (7)*~~

~~*moves.*~~

~~*IV. By Rev. C. Loveday.*~~

~~*WHITE. White to play and mate in tliree (3)*~~

~~*WHITE.*~~

~~*White to play and mate in four (i) moves.*~~

~~*S.II.-95*~~

~~*754*~~

~~*CHESS*~~

~~*V. By J. G. Campbell*~~

~~*BLACK.*~~

~~*TI. By S. Loyd.*~~

~~*BLACK.*~~

~~*WHITE. WHITE.*~~

~~*White to play and mate in foaz (4) 'WUte to play and mate ia three (S)*~~

~~*moves. moves*~~

~~*Vn. By F. Healey. BLACK.*~~

~~*VIII.*~~

~~*By J. B. of Bridport.*~~

~~*BLACK.*~~

~~*M*~~

~~*WHITE. WHITE.*~~

~~*White to play and mate in tbiee (3) White to play and mate in three (3)*~~

~~*moves. moves.*~~

~~*IX. By P. Elett.*~~

~~*BLACK.*~~

~~*X. By "W. Grimshaw.*~~

~~*BLACK.*~~

~~*WHITE.*~~

~~*White to play and mate In fonr (*~~

~~*moves.*~~

~~*iXI.TBy T. Taverner.*~~

~~*BLACK.*~~

~~*WHITE. White to play and mate iu three (3)*~~

~~*XII. By v. Marin.*~~

~~*BLACK.*~~

~~*WHITE. White to play and mate In two (2)*~~

~~*WHITE.*~~

~~*White to play and mate in two (2)*~~

~~*moves.*~~

~~*XIII. By Eev. J. Jespersen. BLACK.*~~

~~*XIV.*~~

~~*By Eev. H. “W. S*~~

~~*lerrard.*~~

~~*BLACK.*~~

~~*EkM*~~

~~“^~~

~~*J^m3*~~

~~*IM.*~~

~~*^m*~~

~~*M^M*~~

~~*^1*~~

~~^~~

~~*^^^m*~~

~~*J*~~

~~■ ” ”~~

~~*s*~~

~~*e*~~

~~*WHITE. WHITE.*~~

~~*White to play and mate in three (S) White to play and mate in three (3)*~~

~~*moves. moves.*~~

~~*XV. By J. PospisiL*~~

~~*BLACK.*~~

~~*XVI. By J. Kesl and K. Musil*~~

~~*BLACK.*~~

~~*WHITE. WHITE.*~~

~~*White to play and mate in three (3) White to play and mate in three (3)*~~

~~*moves. moves.*~~

~~*XVII. By 0. Behting.*~~

~~*BLACK.*~~

~~*XVIII. By A. F. Mackenzie.*~~

~~*BLACK.*~~

~~*WHITE.*~~

~~*WHITE.*~~

~~*White to play and mate in three (3) White to play and mate in three (3)*~~
~~*moves. moves.*~~

~~*XIX. By J. Fridlizius.*~~

~~*BLACK.*~~

~~*XX. By B. G. Laws.*~~

~~*BLACK.*~~

~~*WHITE. WHITE.*~~

~~*White to play and mate in three (8) White to play and se!/-mate in three (3)*~~

~~*CHESS*~~

~~*755*~~

~~*^^?S??'^^' ?\t^-„^"'J«" *"d 0. Colpa; (Russia), Dr A. W. Galitzky and N. Maximoff.*~~

~~*The following eminent composers are no longer living, the*~~

~~*rBifH"°"nril ' "^ being^hown. "J. b/ (John f^own)*~~

~~*1877 '. RW-y,'^^ ^)^lt^ ' ^ S- Wonnald (1874); O. GelSfuss m V ' hZ'^^Tftil^^^^ ' ^- ^"dersaen (1879) ;H. Leprettel (H. E. PeUetret) (1882) ; P. T. Duffy (1888) ; J. H. Obe?mann*~~

~~*(1888); Count Pongracz (Hermitof Tyrnau) (1890) ; "W. Grimshaw (1890) ; Fr. af Geyerstam (1890) ; J. G. Campbell (1891) ; A. Abela (1892) ; G. Szabo (1892) ; J. Pierce (1892) ; G. E. Barbier (1895) ; G. C. Heywood (1895) ; D. Lamouroux (1895) ; A. S. Sbrenseu (1896) ; L. K. Istomin (1897) ; F. Dubbe (1897) ; C. Bayer (1897); F. Moucka (1898); J. Rayner (1898); C. A. Gilberg (1898) ; "W. C. Spens (1900) ; A. Bayersdorfer (1901) ; A. C. Vasquez (1901) ; J. Minckwitz (1901).*~~

~~*Solutions.*~~

~~*Problem No.*~~

~~*Composer.*~~

~~*White 1.*~~

~~*Black 1.*~~

~~*Wliite2.*~~

~~*Black 2.*~~

~~*Whites.*~~

~~*I.*~~

~~*11.*~~

~~*Stamma*~~

~~*Kt-Kt4 (ch)*~~

~~*RxKt*~~

~~*R-B5(ch), &c.*~~

~~*W. Bone*~~

~~*Q-B5 (oh)*~~

~~*K-E4*~~

~~*Q-Kt4(oh)*~~

~~*K-Kt3*~~

~~*Q-Q4(ch)*~~

~~*(3)K-R4*~~

~~*(4)B-Kt4(ch)*~~

~~*(4)K-E5*~~

~~*(5)B-Ksq. (ch)*~~

~~*III.*~~

~~*Prof. A. Anderssen*~~

~~*Q-KE5*~~

~~*(6)K-Kt6 QxQ*~~

~~*(6)Q-Kt4(ch), &c. P-Q7, &c.*~~

~~*IV.*~~

~~*V.*~~

~~*Rev. C. Loveday*~~

~~*B-KKt5*~~

~~*P-Kt5*~~

~~*B-QBl*~~

~~*P-Kt4*~~

~~*R-Q2, &c.*~~

~~*J. G. Campbell*~~

~~*P-K5*~~

~~*B-R2(ch)*~~

~~*P-KB5*~~

~~*BxP(ch)*~~

~~*K-Q4, &c.*~~

~~*rK-E8*~~

~~*Q-R2(ch), &c.*~~

~~*K-R6*~~

~~*Kt-E2*~~

~~*VI.*~~

~~*S. Loyd*~~

~~*Kt-Kt4 (ch)*~~

~~*K-B6 K-B8 K-Kt8*~~

~~*Q-B2*~~

~~*R-QR8*~~

~~*R-QR8, alsoR-QB8*~~

~~*VII.*~~

~~*F. Healey*~~

~~*R-KRl*~~

~~*B-Q2*~~

~~*Q-QKtl*~~

~~*B-Kt4*~~

~~*Q-KKtl(mate)*~~

~~*P-K4*~~

~~*Q — QR7, &c.*~~

~~*VIII.*~~

~~*J. B. of Bridport*~~

~~*P-Q6*~~

~~■~~

~~*K-K4 K-B5*~~

~~*Q-QBl, &o. Q-B5, &o.*~~

~~*IX.*~~

~~*P. Klett*~~

~~*R-ER6 fQ-KtS*~~

~~*P-B4 PxQ*~~

~~*R-KRl*~~

~~*Kt — QKt5, &o.*~~

~~*PxB*~~

~~*R-QEl, &c.*~~

~~*X.*~~

~~*W. Grimshaw*~~

~~*-| also solved by (.Kt-KB5*~~

~~*BxKt*~~

~~*Q-K6!*~~

~~*XI.*~~

~~*T. Tavemer*~~

~~*R — ER4, &o.*~~

~~ł~~

~~*XII.*~~

~~*V. Marin*~~

~~*Q-QB7, &c..*~~

~~*fKtxQ*~~

~~*Kt-Kt5, &c.*~~

~~*XIII.*~~

~~*Rev. J. Jespersen*~~

~~*Q-Q5*~~

~~*iPxQ [other (B-Kt3*~~

~~*Kt-B6, &c. B X P (ch), &o. P-Q8(= Kt)(ch),&c.*~~

~~*XIV.*~~

~~*Eev. H. "W. Sherrard*~~

~~*PxP*~~

~~■*{K-B3*~~

~~*[KxB*~~

~~*rBxP*~~

~~*PxB(= B), &o. PxR(=K), &o. Q — KKt4 (oh)*~~

~~*XV.*~~

~~*J. Pospisil*~~

~~*Q-Ql*~~

~~*Ib-KB4 1k-Q4 U-B4 [K-Q6 P-B4*~~

~~*Q-QR4 Q-Kt3 (oh) Q-B3 (oh) B-Bl (oh) B-Kt2(oh)*~~

~~*XVI.*~~

~~*f J. Kesl and K. Musill \ (joint composition) /*~~

~~*B-R3*~~

~~*JP-Kt4 IPxP P-K4 IP-K3*~~

~~*B-B5(ch) Kt-B5 (oh) Kt-Q6 (ch) B-Bl, &c.*~~

~~*XVII.*~~

~~*0. Behting*~~

~~*B-E7*~~

~~*/K-B3 1p-B5 fP-KKt5*~~

~~*Q-QKtl Q — Kt5 (oh) Q — R6, &c.*~~

~~*P-Q4*~~

~~*Q-KKt6(mate)*~~

~~*XVIII.*~~

~~*A. F. Mackenzie*~~

~~*Q-E3*~~

~~*-^KxR tK-K6 |'P-Q8(= Q)*~~

~~*Kt-Q7(ch), &e; Kt-Q5(ch), &c. Q-R4 (ch), &c.*~~

~~*XIX.*~~

~~*J. Fiidliziua*~~

~~*R-KB3*~~

~~*IBxR JKtxP IBxP*~~

~~*Q-El(oh), &o. R-Q3 (ch), &o. P-B3 (ch), &o.*~~

~~*fQxP*~~

~~*Q-K5(ch)*~~

~~*PxQ*~~

~~*RxP(ch), &c.*~~

~~*XX.*~~

~~*B. G. Laws*~~

~~*B-Ktl*~~

~~*4QorB-E2*~~

~~*Q-K3(ch)*~~

~~*KxQ*~~

~~*Kt-B2(ch), &o.*~~

~~*LQ-R3*~~

~~*QxP(oh)*~~

~~*KxQ*~~

~~*RxP(ch)*~~

~~*Semarks. — Problems I. to X. are selected to illustrate' the old and transition styles of composition, whilst Nos. XI. to XX. belong to the later transition and modern period.*~~

~~*I. and II. are early examples of problem composition.*~~

~~*IV. is the " Indian" in its original, but not wholly sound form. A. F." Mackenzie describes this now weU-worn theme as "covering an ambush in a stale-mating position, giving the king a loophole of apparent escape, and then mating by double check " {Chess : its Poetry and its Prose). ,. t • ^*~~

~~*V. is from a set in the Sra tourney, 1855. It is a fine early example of the cross-check theme, the "White King exposing hims^f to the enemy's fire both on the first and second moves.*~~

~~*VI. A prize problem of the year 1859, is an early example of the introduction of several distinct ideas in a single problem. According to later ideas, the check upon the first move would be considered as a key-move of too aggressive a character. In this case, however, compensation is found in the interesting quiet continuations which it introduces. , „ , —*~~

~~*VII. is the famous Bristol tourney prize problem, 1861, from which thcterm " Bristol " theme is derived, of which the essen- tial idea consists in moving a piece to a most out-of-the-way place for the simple object of making room for another piece to reach a desired square. Compare with No. XVII., in which the*~~

~~*"Bristol" idea is worked in accordance with modern ideas of economy and purity.*~~

~~*VIII. A characteristic example of J. B. of Bridport's peculiar style, in which neat construction and elegance are more marked features than complexity.*~~

~~*Problem No. IX. is a masterpiece of difficulty. It was com- posed in 1871 for a solution tourney at Crefeld.*~~

~~*Problem No. X. is worthy of note as containing a oook {i.e., an unintended second solution) of almost equal obscurity to that intended by the author. A*~~

~~*comparison of this problem with No. XIII. by J. Jespersen affords another illustration of the progress in the art of composition. Not only is the latter problem sound, but the unfortunate threat of immediate mate is avoided, and a second idea of equal merit is combined with that common to both. This it will be seen lies in the sacrifice of the Q on the first move, to prevent subsequently a black pawn from moving two squares, so as to nullify the double threat of mate which a quiet second move of the Kt introduces.*~~

~~*Problem No. XIV. is a fine example of the " pawn promotion " theme, the point of which lies in the fact that White (having the right to claim a Q, on advancing his pawn to the eighth square) finds it more effectual to claim pieces of less power, -nz., a Knight, a Bishop, and a Rook in the three several variations.*~~

~~*Problem No. XV. is a good example of a theme recurrent. It will be seen that the leading mate given by Q, B, and Kt is repeated, in all cases being perfectly pure, no less than four times.*~~

~~*Problem No. XV I. is given to show the extraordinary lengths to which variety can be carried consistently with a scrupulous regard to the principles of construction. Every single variation results in a mate perfect in form.*~~

~~*Problem No. XVII. is a modern (1896) version of the " Bristol," and shows the advance made, not only in the lighter, cleaner style, but in the addition of a secondary idea of merit.*~~

~~*Problems XVIII. and XIX. are typical "modern style" prize- winners in leading tourneys, and illustrate the blending of several equally fine variations into a harmonious and finished whole.*~~

~~*Problem XX. is an example of a sui-mate.*~~

~~*Important Matches since 1834.*~~

~~A~~

~~*1*~~

~~*1*~~

~~*1831*~~

~~*London*~~

~~*Labourdonnais v. MacDonnell*~~

~~*46*~~

~~*26*~~

~~*11*~~

~~*1843*~~

~~*Paris*~~

~~*Staunton v. St Amant .*~~

~~*11*~~

~~*6*~~

~~*4*~~

~~*1847*~~

~~*London*~~

~~*Philidor v. Stamma*~~

~~*8*~~

~~*1*~~

~~*1*~~

~~*1851*~~

~~*London*~~

~~*Anderssen v. Lowentlial*~~

~~*6*~~

~~*2*~~

~~*0*~~

~~*1853*~~

~~*London*~~

~~*Horwitz V. Lowenthal*~~

~~*11*~~

~~*10*~~

~~*10*~~

~~*1853*~~

~~*Paris*~~

~~*Anderssen v. Horwitz*~~

~~*3*~~

~~*1*~~

~~*3*~~

~~*1858*~~

~~*London*~~

~~*Morphy v. Lowenthal .*~~

~~*9*~~

~~*3*~~

~~*3*~~

~~*1858*~~

~~*Paris*~~

~~*Morphy v. Horwitz*~~

~~*5*~~

~~*2*~~

~~*1*~~

~~*1858*~~

~~*Paris*~~

~~*Morphy v. Anderssen .*~~

~~*7*~~

~~*2*~~

~~*2*~~

~~*1861*~~

~~*London*~~

~~*Anderssen v. Kollsch .*~~

~~*i*~~

~~*3*~~

~~*2*~~

~~*1861*~~

~~*London*~~

~~*Paulsen v. Kolisch (drawn) .*~~

~~*7*~~

~~*6*~~

~~*18*~~

~~*1862*~~

~~*London*~~

~~*Anderssen v. Paulsen (drawn) .*~~

~~*3*~~

~~*3*~~

~~*2*~~

~~*1863*~~

~~*London*~~

~~*Steinitz v. Blackbume*~~

~~*7*~~

~~*1*~~

~~2~~

~~1866~~

~~London~~

~~Steinitz v. Anderssen .~~

~~8~~

~~6~~

~~0~~

~~1870~~

~~London~~

~~Steinitz v. Blackbume~~

~~5~~

~~0~~

~~1~~

~~1872~~

~~London~~

~~Steinitz v. Zukertort .~~

~~7~~

~~1~~

~~4~~

~~1876~~

~~*Leipzig*~~

~~*Paulsen v. Anderssen .*~~

~~*6*~~

~~*4*~~

~~*1*~~

~~*1876*~~

~~*London*~~

~~*Steinitz v. Blackbume*~~

~~*7*~~

~~*0*~~

~~*0*~~

~~*1877*~~

~~*Leipzig*~~

~~*Paulsen v. Anderssen .*~~

~~*5*~~

~~*3*~~

~~*1*~~

~~*1881*~~

~~*London*~~

~~*Zukertort v. Blackbume .*~~

~~7~~

~~2~~

~~6~~

~~1881~~

~~London~~

~~Blackburne v. Ounsberg~~

~~7~~

~~4~~

~~3~~

~~1886~~

~~America~~

~~Steinitz v. Zukertort .~~

~~10~~

~~5~~

~~5~~

~~1887~~

~~London~~

~~Blackburne v. Zukertort .~~

~~5~~

~~1~~

~~*8*~~

~~*1887*~~

~~*London*~~

~~*Gunsberg v. Blackbume*~~

~~*5*~~

~~*2*~~

~~*6*~~

~~*1889*~~

~~*Havana*~~

~~*Steinitz v. Tchigorin .*~~

~~*10*~~

~~*6*~~

~~*1*~~

~~*1890*~~

~~*Havana*~~

~~*Gun.sberg v. Tchigorin .*~~

~~*9*~~

~~*9*~~

~~*5*~~

~~*1891*~~

~~*Havana*~~

~~*Steinitz v. Ounsberg (drawn)*~~

~~*6*~~

~~*4*~~

~~*9*~~

~~*1892*~~

~~*Havana*~~

~~*Steinitz v. Tchigorin . Lasker v. Blackbume .*~~

~~*10*~~

~~*8*~~

~~*5*~~

~~*1892*~~

~~*London*~~

~~*6*~~

~~*0*~~

~~*4*~~

~~*1893*~~

~~*Bt Petersburg*~~

~~*Dr Tarrasch v. Tchigorin (drawn)*~~

~~*9*~~

~~*9*~~

~~*4*~~

~~*1894*~~

~~*America*~~

~~*Lasker v. Steinitz*~~

~~*10*~~

~~*5*~~

~~*4*~~

~~*1894*~~

~~*Xilremberg*~~

~~*Dr Tarrasch v. Walbrodt*~~

~~*7*~~

~~*0*~~

~~*1*~~

~~*1896*~~

~~*Moscow*~~

~~*Lasker V. Steinitz*~~

~~*10*~~

~~*2*~~

~~*5*~~

~~*Comments.*~~

~~*Blackiurne (1863). — A remarkable victory, judging ‘ ‘^’ ‘ ‘ ».•... severe cold all*~~

~~*Steinitz from the figures, but Blackbume suffered from through the contest, and should have won at least three games on the merits of the positions.*~~

~~*Paulsen v. Anderssen (1877). — Paulsen’s victory was out of pro- portion considering the respective strength of the players.*~~

~~*Zukertort v. Blacklv/rne (1881). — A legitimate victory, Zukertort being then at the height of his power.*~~

~~*Blackbume v. Ounsberg (1881). — A fair average number of wins for Gunsberg, who was then gradually making his way to the front rank.*~~

~~*Steinitz v. Zukertort (1886). — A memorable match. Zukertort started well ahead ; the second series of games was played at St Louis after an interval, which gave Steinitz time to recover from his despondency at the New York defeat. Zukertort lost courage in proportion as Steinitz gained it, so that the concluding series at New Orleans proved Zukertort’s dibdcle.*~~

~~*Blackbume v. Zukertort (1887).— — Blackbume took full revenge for his previous defeat, but Zukertort was already merely the shadow of himself.*~~

~~*Steinitz v. Tchigorin (1889). — A good fight on the part of Tchigorin, the result being exactly what was anticipated.*~~

~~*Gunsberg v. Tchigorin (1890). — Even games being played, Gunsberg would not stake the result of the match upon a single decisive game, which Tchigorin proposed.*~~

~~*Steinitz v. Ounsberg (1891). — Steinitz should have won by a larger majority, but he persisted in playing a number of Evans gambits, defending compromisingly with one of his own inferior variations*~~

~~*Steinitz v. Tchigorin (1892). — Here the Kussian master made a better stand than in the previous match, also owing to Steinitz indulging in hobbies.*~~

~~*Lasker v. Blackbume (1892). — The first noteworthy achievement of the future champion. This was a better result, as far as quality is concerned, than Steinitz's against the latter opponent, for whereas in the match against Steinitz Blackbume had chances of winning some of the games, he had none in this.*~~

~~*Dr TarraschY. Tchigorin (1893). — A fine match, well fought and*~~

~~*producing instructive games. This, and Tchigorin's victory at Budapest, were his best performances. It must be remembered that Dr Tarrasch was then considered the greatest living player.*~~

~~*Lasker v. Steinitz (1894). — A memorable match. It was said at the time that Steinitz was ill-advised to accept the challenge of the rising master. So he was. But pecuniary circumstances compelled him to play and to stake a lifelong reputation upon the issue of this contest, even if he had known that he would be beaten. In better circumstances he refused to play with Mason, who challenged him after the match with Blackbume.*~~

~~*Dr Tarrasch v. Walbrodt (1894). — The latter was no match against the famous doctor, and no other comment is required.*~~

~~*Lasker v. Steinitz (1896). — This return match should never have been played. Pecuniary circumstances again induced Steinitz to venture upon a hopeless task. In fact, ne insisted on playing, Lasker not being particularly eager. The result was a foregone conclusion, Lasker standing at the height of his fame, having just won the first prize at the great Niiremberg tournament. After the match Steinitz had an attack of mental aberration, which was erroneously ascribed to the "strain upon his mind" which the contest involved. But age and a shattered career, coupled with a predisposition to hypochondria, were the real causes.*~~

~~*Games.*~~

~~*The following is a selection of noteworthy games played by famous masters :—*~~

~~*Queen's Gambit Declined.*~~

~~*White. W. Steinitz.*~~

~~*1. P-Q4*~~

~~*2. P-QB4*~~

~~*3. Kt-QB3*~~

~~*4. B — B4*~~

~~*5. P-K3 6; R-Bsq*~~

~~*7. QP X P*~~

~~*8. PxP*~~

~~*9. Kt-B3*~~

~~*10. B-Q3*~~

~~*11. PxP*~~

~~*12. Castles*~~

~~*13. Kt-QKt5*~~

~~*14. PxB*~~

~~*15. B-K5*~~

~~*16. K-Rsq*~~

~~*17. B — Kt3*~~

~~*18. Q-B2*~~

~~*19. QR-Qsq*~~

~~*20. Q — Kt3 This game was played in the St Petersburg tournament 1895, a*~~

~~*fine specimen of Lasker's style. The final attack beginning with 21. ..with Kt- Q5 furnishes a gem of an ending.*~~

~~*Bishop's Gambit.*~~

~~*Black. Tchigorin. P-K4*~~

~~*' Black. Dr E. Lasker. P-Q4 P-K3 Kt-KB3 B-K2 Castles P-B4 BxP PxP Kt-B3 P-Q5 KtxP B — KKt5 BxKt Kt-K3 Kt-R4 Q-Kt4 QR-Qsq Q-R3 R-B sq P-ES*~~

~~*White. W. Steinitz.*~~

~~*21. Kt-B3*~~

~~*22. Q X P*~~

~~*23. PxKt*~~

~~*24. Q X P*~~

~~*25. Q — B4*~~

~~*26. P-KR4*~~

~~*27. B-K4*~~

~~*28. P-B4*~~

~~*29. B-Kt2*~~

~~*30. Q-Q3*~~

~~*31. Kt-K4*~~

~~*32. R-B3*~~

~~*33. KxR*~~

~~*34. K-R2*~~

~~*35. K-Kt2*~~

~~*36. K-R2*~~

~~*37. E — QKt sq*~~

~~*38. R-Kt5*~~

~~*39. P-R3*~~

~~*Black. Dr E. Lasker. Kt-Q5 Kt X B (ch) R-Ktsq E-Kt3 ExP B-E2 Q-Q3 Q-Q2 Q — Kt5 Kt-B4 B-K6 ExB*~~

~~*KtxP (ch) Kt x E (ch) Kt-E5(ch) Kt-B4 P-E4 E-Esq ExP*~~

~~*White. Charousek.*~~

~~*1. P-K4*~~

~~*2. P-KB4*~~

~~*3. B — B4*~~

~~*4. P-Q4 5..P-K5*~~

~~*6. B-Kt3*~~

~~*7. Q-Q3*~~

~~*8. Kt-KE3*~~

~~*9. Q — QB3*~~

~~*10. Castles*~~

~~*11. B-R4(ch)*~~

~~*12. B X P (oh)*~~

~~*PxP*~~

~~*Kt-QB3*~~

~~*Kt-B3*~~

~~*P-Q4*~~

~~*B-Kt5*~~

~~*Kt-KE4*~~

~~*Kt-Kt5*~~

~~*Kt-R3*~~

~~*B-K7*~~

~~*P-B3*~~

~~*PxB*~~

~~*White. Charousek.*~~

~~*13. Q X P (ch)*~~

~~*14. KtxP*~~

~~*15. B X Kt*~~

~~*16. Kt-B3*~~

~~*17. P-K6*~~

~~*18. B-B7*~~

~~*19. B X Q (ch)*~~

~~*20. Q — Kt7 (ch)*~~

~~*21. R-B7(ch)*~~

~~*22. Q X R (ch)*~~

~~*23. E-Ksq*~~

~~*24. P-QKt3*~~

~~*Black. Tchigorin.*~~

~~*K-K2 KtxKt P-R3 B-B5 E-Bsq PxP ExB E-Q2 KxE B-K2 E-Ksq Resigns.*~~

~~*This pretty game was played in the tie match for first prize at the Budapest tournament 1896.*~~

~~*White. Professor Rice.*~~

~~*1. P-K4*~~

~~*2. P-KB4*~~

~~*3. Kt-KB3*~~

~~*4. P — KR4*~~

~~*5. Kt — K5*~~

~~*6. B — B4*~~

~~*7. PxP*~~

~~*8. Castles*~~

~~*9. R-Ksq*~~

~~*10. P — B3*~~

~~*11. P-Q4*~~

~~*12. Kt-Q2*~~

~~*13. Kt — B3*~~

~~*14. Q-R4(oh)*~~

~~*Rice Gambit.*~~

~~*Black. M^or Hanham. P-K4 PxP P-KKt4 P-Kt5 Kt-KB3 P-Q4 B-Q3 BxKt Q-K2 P-Kt6 Kt — Kt5 QxP Q-E3 P-B3*~~

~~*White. Professor Rice.*~~

~~*15. Q-R3*~~

~~*16. RxB(ch)*~~

~~*17. K-Bsq*~~

~~*18. Kt-Ktsq*~~

~~*19. PxKt*~~

~~*20. B — Kt5*~~

~~*21. K-Ksq*~~

~~*22. K-Q2*~~

~~*23. K — Q3*~~

~~*24. P X B (ch)*~~

~~*25. Q-K7(ch)*~~

~~*26. Q — Q8 (ch)*~~

~~*27. B X Q and mates*~~

~~*Black. Major Hanham Kt-B7 B-K3 Q — E8 (oh) Kt-E6 P-B6 Q — Kt7 (ch) P-B7 (ch) P-B8 = Kt*~~

~~*(ch) K-Q2 If-B2 K-Kt3 ExQ*~~

~~*CHESS*~~

~~*757*~~

~~*The Rice Gambit (so called after its inventor, Prof. Isaac L. Kioe of New York), whether right or not, is only possible if Black plays 7…B-Q3. Paulsen's 7…B-Kt2 is better, and avoids unnecessary complications. 8. P-Q4 is the usual move. Leaving the Knight en prise, followed by 9. R- K sq, constitutes the Kice Gambit. The interesting points in the game are that wmte subjects himself to a most violent attack with impunity, lor in the end Black could not save the game by 22. P-B8 claiming a second Queen with a discovered check, nor by claiming a Knight with double check, as it is equally harmless to White. ^ '*~~

~~*White. Halprin.*~~

~~*1. P-K4*~~

~~*2. Kt-KB3*~~

~~*3. B—Kt5*~~

~~*4. Castles*~~

~~*5. P-Q4*~~

~~*6. PxP*~~

~~*7. P-QR4*~~

~~*8. P-K6*~~

~~*9. PxKt*~~

~~*10. Kt-B3*~~

~~*11. Kt-Kt5*~~

~~*12. Q-R5*~~

~~*13. B X B*~~

~~*Rut Lopez.*~~

~~*Black. Fillsbuiy P-K4 Kt-QB3 Kt-B3*~~

~~*White. Black.*~~

~~*Halprin. Plllaburji*~~

~~*14. P-Kt6 BPxP*~~

~~*15. Kt-Q5 PxKt*~~

~~*16. KB-Ksq(ch)K-Bsq*~~

~~*KtxP 17. R-K3 ‘ Kt-K4"*~~

~~*Kt-Q3 18. RxKt PxR*~~

~~*KtxB 19. R-B3(ch) K-Ktsq*~~

~~*P-Q3 20. B-R6 Q-K2*~~

~~*PxP 21. BxP KxB*~~

~~*Kt-K2 22. R-Kt3(ch) K-Bsq*~~

~~*Kt – Kt3 23. B – B3 (ch) K – Kt2 B-K2 24. R-Kt3(ch) K-Bsq*~~

~~*BxKt 25. R-B3(ch) K-Ktsq*~~

~~*Q-Q2 Draw.*~~

~~*This brilliant game, played at the Munich tournament, 1900, would be unique had the combinations occurred spontaneously in the game. As a matter of fact, however, the whole variation had been elaborated by*~~

~~*Maroczy and Halprin previ- ously, on the chance of Pillsbury adopting the defence in the text. The real merit belongs to Pillsbury, who had to find the correct defence to an attack which Halprin had committed to memory and simply had to be careful to make the moves in regular order.*~~

~~*Sicilian Defence.*~~

~~*White. Fillsburv.*~~

~~*1. P-K4*~~

~~*2. Kt-KB3*~~

~~*3. P-Q4*~~

~~*4. KtxP*~~

~~*5. Kt-QB3*~~

~~*6. KKt-Kt5*~~

~~*7. P-QR3*~~

~~*8. Kt X B*~~

~~*9. PxP*~~

~~*10. B — KKt5*~~

~~*11. B — K2*~~

~~*12. Kt-K4*~~

~~*13. P-Kt4*~~

~~*14. Kt X Kt (ch)*~~

~~*15. B — R6*~~

~~*Black.*~~

~~*Uieses. P-QB4 P-K3 PxP Kt-KB3 Kt-B3 B-Kt5 B X Kt (oh) P-Q4 PxP Castles P-Q5 Q-R4(oh) Q-K4 PxKt P-Q6*~~

~~*White. Pillsbury.*~~

~~*16. PxP*~~

~~*17. BxR*~~

~~*18. R-R2*~~

~~*19. R-Q2*~~

~~*20. Castles*~~

~~*21. Q — Kt sq*~~

~~*22. B — Q sq*~~

~~*23. K X B B sq KU*~~

~~*26. R-Ktsq*~~

~~*27. B-R5*~~

~~*28. B X Kt*~~

~~*29. R-Kt2*~~

~~*30. Q — QB sq*~~

~~*24. K-*~~

~~*25. B-*~~

~~*Drawn eventually.*~~

~~*Black.*~~

~~*Mieses. Kt-Q5 KxB B-K3 B-Ksq B-Kt6 B-Q4 BxP*~~

~~*Q-Kt4 (ch) QxR Q-B5 P-B4 Kt-B6 QxB(ch) R-K7 QxQP*~~

~~*This brilliant game occurred at the Paris touinament, 1900.*~~

~~*GiiToco Piano.*~~

~~*White. Steinitz.*~~

~~*1. P-K4*~~

~~*2. Kt-KB3 S. B-B4*~~

~~*4. P-B3*~~

~~*5. P-Q4*~~

~~*6. PxP*~~

~~*7. Kt-B3*~~

~~*8. PxP*~~

~~*9. Castles*~~

~~*10. B-KKt5*~~

~~*11. B X Kt*~~

~~*12. Kt X B*~~

~~*13. B X B*~~

~~*Black. Baideleben. P-K4 Kt-QB3 B-B4 Kt-B3 PxP*~~

~~*B-Kt5(oh) P-Q4 KKtXjP B-K3 B-K2 QBxB QxKt KtxB*~~

~~*White. Steinitz.*~~

~~*14. R-Ksq*~~

~~*15. Q-K2*~~

~~*16. QR-Bsq*~~

~~*17. P-Q5*~~

~~*18. Kt-Q4*~~

~~*19. Kt-K6*~~

~~*20. Q-Kt4*~~

~~*21. Kt-Kt5 (oh)*~~

~~*22. R X Kt (ch)*~~

~~*23. R-B7(ch)*~~

~~*24. B-Kt7(ch)*~~

~~*25. RxP(ch)*~~

~~*Black. Bardeleben P-KB3 Q-Q2 P-B3 PxP K-B2 KR-QBsq P-KKt3 K-Ksq K-Bsq K-Ktsq K-Rsq 'sns.*~~

~~*As a matter of fact, Bardeleben left the board here, and lost the game by letting his clock run out the time Umit; but Steinitz, Iho remained at the board, demonstrated afterwards the foUow- ing variation leading to a forced win :—*~~

~~*White.*~~

~~*Steinitz.*~~

~~*25*~~

~~*26. R-Kt7(oh)*~~

~~*27. Q-R4(ch)*~~

~~*28. Q-R7(ch)*~~

~~*29. Q-R8(oh)*~~

~~*30. Q-Kt7(oh)*~~

~~*Black. Bardeleben. K-Ktsq K-Rsq KxR K-Bsq K-K2 K-Ksq*~~

~~*White. Steinitz.*~~

~~*31. Q-Kt8(ch)*~~

~~*32. Q-B7(oh)*~~

~~*33. Q-B8(ch)*~~

~~*34. Kt-B7(ch)*~~

~~*35. Q — Q6 mate.*~~

~~*Black. Bardeleben. K-K2 K-Qsq Q-Ksq K-Q2*~~

~~*This game was awarded the prize for "brilUancy" at the HIastings tournament, 1896.*~~

~~*Evans Gambit.*~~

~~*White. AndeiBsen.*~~

~~*1. P-K4*~~

~~*2. Kt-KB3*~~

~~*3. B-B4*~~

~~*4. P-QKt4*~~

~~*5. P-B3*~~

~~*6. P-Q4*~~

~~*7. Castles*~~

~~*8. Q-Kt3*~~

~~*9. P-K5*~~

~~*10. R-Ksq*~~

~~*11. B-E3*~~

~~*12. Q X P*~~

~~*Black. Dnfresne P-K4 Kt-QB3 B-B4 BxP B-R4 PxP P-Q6 Q-B3 Q-Kt3 KKt-K2 P-Kt4 R-QKtsq*~~

~~*White. Anderssen.*~~

~~*13. Q-R4*~~

~~*14. QKt-Q2*~~

~~*15. Kt-K4*~~

~~*16. BxP*~~

~~*17. Kt-B6(ch)*~~

~~*18. PxP*~~

~~*19. QR-Qsq*~~

~~*20. R X Kt (ch)*~~

~~*21. Q X P (ch)*~~

~~*22. B-B5(ch)*~~

~~*23. B-Q7(ch)*~~

~~*24. B X Kt mate.*~~

~~*Black. Dufresne. B-Kt3 B-Kt2 Q-B4 Q-R4 PxKt R-Ktsq QxKt KtxR KxQ K-Ksq K moves*~~

~~*This game is still more remarkable and more brilliant than the ‘ ‘ immortal game ” published in the Ency. Brit. vol. v. p. 596. The coup de repot of 19. QR – Q sq is the key-move to the brilliant final combination, the depth and subtlety of which have never been equalled, except perhaps in the following game between Zukertort and Blackburne.*~~

~~*English Opening.*~~

~~*White.*~~

~~*Black.*~~

~~*Zukertort.*~~

~~*Blackburne.*~~

~~*1. P-QB4*~~

~~*P-K3*~~

~~*2. P-K3*~~

~~*Kt-KB3*~~

~~*3. Kt-KB3*~~

~~*P-QKt3*~~

~~*4. B-K2*~~

~~*B-Kt2*~~

~~*5. Castles*~~

~~*P-Q4*~~

~~*6. P-Q4*~~

~~*B-Q3*~~

~~*7. Kt-B3*~~

~~*Castles*~~

~~*8. P-QKt3*~~

~~*QKt-Q2*~~

~~*9. B-Kt2*~~

~~*Q-K2*~~

~~*10. Kt-QKt5*~~

~~*Kt-K5*~~

~~*11. KtxB*~~

~~*PxKt*~~

~~*12. Kt-Q2*~~

~~*QKt-B3*~~

~~*13. P-B3*~~

~~*KtxKt*~~

~~*14. Q X Kt*~~

~~*PxP*~~

~~*15. B X P*~~

~~*P-Q4*~~

~~*16. B — Q3*~~

~~*KB-Bsc*~~

~~*17. QR-Ksq*~~

~~*R-B2*~~

~~*Black. Blackburne. QR-QBsq Kt-Ksq P-Kt3 P-^4 KtxP Kt-K5 PxB R-B7 K-Bsq P-K4 QB-B4 KxP K-Kt2 KxR K-Ktsq*~~

~~*White. Zukertort.*~~

~~*18. P-K4*~~

~~*19. P-K5*~~

~~*20. P-B4*~~

~~*21. R-K3*~~

~~*22. PxPe.p.*~~

~~*23. P-B5*~~

~~*24. B X Kt*~~

~~*25. PxKtP*~~

~~*26. P X P (ch)*~~

~~*27. P-Q6dis.(ch)*~~

~~*28. Q — Kt4*~~

~~*29. R-B8(ch)*~~

~~*30. Q X P (ch)*~~

~~31. B X P (ch)~~

~~32. B-Kt7(ch)~~

~~33. (JxQ~~

~~This game, played in the London tournament, 1883, is one of the most remarkable productions of modern times, neither sur- passed nor indeed equalled hitherto.~~

~~End Games.~~

~~A game of chess consists of three branches — the opening, the middle, and the end game. The openings have been analysed, and are to be acquired by the study of the books on the subject. The middle game can only be acquired practically. The combinations being inex- haustible in their variety, individual ingenuity has its full scope. Those endowed with a fertilfe imagination will evolve plans and combinations leading to favourable issues. The less endowed player, however, is not left quite de- fenceless ; he has necessarily to a,dopt a different system, namely, to try to find a weak point in the arrangement of his opponent's forces, and concentrate his attack on that weak spot. As a matter of fact, in a contest between players of equal strength finding the weak point in the opponent's armour is the only possible plan, and this may be said to be the fundamental principle of the modern school. In the good old days the battles were mostly fought in the neighbourhood of the King, each side striving for a checkmate. Nowadays the battle may be fought anywhere. It is quite immaterial where the advantage is gained, be it ever so slight. Correct continuation will necessarily increase it, and the opponent may be com- pelled to surrender in the end game without being check- mated, or a position may be reached when the enemies, in consequence of the continual fight, are so reduced that the Kings themselves have to take the field — the end game. The end game, therefore, requires a special study. It has its special laws, and the value of the pieces undergoes a considerable change. The Kings leave their passive rdle and become attacking forces. The pawns increase in value, whilst that of the pieces may diminish in certain cases.~~

~~*Two Knights, for instance, without pawns, become value- less, as no checkmate can be effected with them. In the majority of cases the players must be guided by general principles, as the standard examples do not meet all cases. The handbooks as a rule give a sprinkling of elementary endings, such as to checkmate with Queen, Book, Bishop and Knight, two Bishops, and pawn endings pure and simple, as well as pawns in connexion with pieces in*~~

~~*Position from a Game played by the late J. &. Campbell m 1863.*~~

~~*BLACK.*~~

~~*Obviously White has to lose the game, not being able to pre- vent the pawns from queening. By a remarkably ingenious de- vice White averts the loss of the game by stale-mating himself as follows : —*~~

~~*1. B-Q2,P-Et7; 2.B-R5, P-Kt8 = Q; 3. P-Kt4 stale- mate.*~~

~~*Position hy Surratt, 1808.*~~

~~*BLACK.*~~

~~*WHITE.*~~

~~*White wins as follows : —*~~

~~*1. P-Kt8, KPxP;2. P-B6, P (Kt2) X P ; 3. P — E6 and wins by queening the pawn. If 1. . . . BPxP then 2. P-R6, KtPxP; 3. P-B6 and queens the pawn.*~~

~~*Position hy B. Borvritz,*~~

~~*BLACK.*~~

~~*WHITE.*~~

~~*Without Black's pawn White could only draw. The pawn being on the board, White wins as follows : —*~~

~~*1. Kt-B4, K-Kt sq; 2. Kt (B4)-K3, K-R sq; 3. K-Kt4, K-Kt sq; 4. K-E3, K-Rsq; 5. Kt-B4, K-Ktsq; 6. Kt (B4)-Q2, K-E sq; 7. Kt-Kt3 ch, K-Kt sq; 8. Kt — B3 mate.*~~

~~*WHITE.*~~

~~*As a rule the game should be drawn. Supjtosing by a series of checks White were to compel Black to abandon, the pawn, ne would move K — KB ; Q x P and Black is stale-mate. Therefore the ingenious way to win is : —*~~

~~*1. K-B4, P-B8=Qch; K- Kt3 and wins. Or 1. ... K- E8 (threatening P-B8=Kt); then 2. Q-Q2 preliminary to E — Et3 now wins.*~~

~~*Position hy B. SorwUz.*~~

~~*BLACK.*~~

~~*various forms. In the 'eighties a valuable work on end games was published in England by the late B. Horwitz ; thus for the first time a theoretical classification of the art was given. This was followed by a more comprehensive work by Professor J. Berger of Graz, which was translated a few years later by the late Mr Freeborough.*~~

~~*A few specimens of the less accessible positions are given below : —*~~

~~*Position by B. Sormtz.*~~

~~*BLACK.*~~

~~*White wins with two pieces against one — a rare occurrence.*~~

~~*1. Kt-K6, B-E3; 2. B-Q4 ch, K-E2 ; 3. B-B3, B moves anywhere not enprise; 4. B — Kt7 and Kt mates.*~~

~~*Position hy 0. Schiibert.*~~

~~*BLACK.*~~

~~*WHITE.*~~

~~*WHITE.*~~

~~*White wins as follows : — 1. P – Kt5, Kt – Kt5 ; 2. K – B3, Kt – K6 ; 3. B – K6, Kt-B8; 4. BxP, Kt-Q7 ch ; 5. K-Kt4, KtxP; 6. P-Kt6, Kt-B3,ch; 7. K-Kt5, P-K5 ; 8. K X Kt, P – K6 ; 9. B – B4, KxB; 10. P-Kt7, P-K7; 11. P-Kt8=Q ch, and wins by the simple process of a series of checks so timed that the King may approach systematically. The fine points in this instruc- tive ending are the two Bishops' moves, 3. B – K6, and 9. B – B4, the latter move enabling White to queen the pawn with a check.*~~

~~*Position hy F. Amelvmg.*~~

~~*BLACK.*~~

~~*White with the inferior posi- tion saves the game as follows : —*~~

~~*1. P-E6, PxP; 2. K-B3 dis. ch, K moves ; 3. E – E2, or Kt2 ch, KxR; 4. K-Kt2 and draw, as Black has to give up the Rook, and the EP cannot be jueened, the Black Bishop having no power on the White diagonal. Extremely subtle.*~~

~~*Position hy B. Sorwitz.*~~

~~*BLACK.*~~

~~*WHITE.*~~

~~*The main idea being to check- mate with the Bishop, this is accomplished thus : — 1. B – K4 ch, K-E4; 2. QxE, QxQ; 3. K-B7, Q-B sq ch; 4. KxQ, BxP; 5. K-B7, BxP; 6. B-Kt6mate.*~~

~~*WHITE,*~~

~~*WHITE.*~~

~~*CHESS*~~

~~*759*~~

~~*White wins as follows : —*~~

~~*1. P-E8 = Q, E-Kt7 ch; 2. K-Kt5, ExQ; 3. Kt-Q7 ch, K-Kt2; 4. P-B6 oh, K-E2; 5. QPxKt,E-Esq; 6. Kt-B7 ch, ExKt; 7. PxE=Ktmate.*~~

~~*WHITE.*~~

~~*A position from actual play. White plays 1. E-B5 threaten- ing to win a piece. Black replies with the powerful Kt — Kt5, threatening two mates, and fin- ally White (Mr Hoffer) finds an ingenious sacrifice of the Queen — the saving clause.*~~

~~*The following are the moves: —*~~

~~*1. E-B5,Kt-Kt5;2. Q-Kt8 ch,K-Kt3;3.Q-K6ch,K-E2; 4. Q — Kt8 oh, and drawn by per- petual check, as Black cannot capture the Queen with K or B without losing the game.*~~

~~*Fosition hy Hoffer,*~~

~~*BLACK.*~~

~~*WHITE.*~~

~~*Progress of the Game*~~

~~*To gauge the enormoua strides ■wHch chess has made since 1875, it will suffice to give the following statistics. In London Simpson's Divan was formerly the chief re- sort of chess players ; the St George's Chess Club was the principal chess club in the West End, and the City of London Chess Club in the east. Now the British Chess Club is the principal West End club, whilst about a hundred or more clubs are disseminated all over the metropolis. Formerly only the British Chess Associa- tion existed ; after its dissolution the now defunct Counties' Chess Association took its place, and this was superseded by the re-establishment by Mr Hoffer of the British Chess Association, which again fell into abey- ance after having organized three international tourna- jjients — ^London, 1886 ; Bradford, 1888 ; and Manchester, 1890 — and four national tournaments. There were various*~~

~~reasons why the British Chess Association ceased to exercise its functions, one being that minor associar tions did not feel inclined to merge their identity into a central association. The London League was established, besides the Northern Chess Union, the Southern Counties' Chess Union, the Midland Counties' Union, the Kent County Association ; and there are associations in Surrey, Sussex, Essex, Hampshire, Wiltshire, Gloucestershire, Somersetshire, Cambridgeshire, Herefordshire, Leicester shire, Northamptonshire, Staffordshire, Worcestershke, Lancashire. AH these associations are supported by the affiliated chess clubs of the respective counties.~~

~~Scotland has its own association and a large number of clubs. Wales counts nine chess clubs, and Ireland several clubs in Dublin, Belfast, and other chief pkcas, altogether about twenty-five.~~

~~In spite of aU this array of temples devoted to the worship of Caiissa, England did not produce one emi- nent player between 1875 and 1901. First-class chess remained in the hands of the few veterans remain- ing from the Old Guard — Burn, Blackburne, Mason, and Bird. The old amateurs — with the exception of the Eev. C. E. Kanken — passed away, their place~~

~~being taken by a new generation of powerful amateurs, so well equipped that Great Britain could hold its own in an amateur contest against the combined forces of Germany, Austria, Holland, and Eussia. It must be distinctly understood that the terms " master " and "amateur" are not used in any invidious sense, but simply as designating, in the former case, first-class players, and in the latter, those just on the border-land of highest excellence. The professional element as it existed in the heyday of Simpson's Divan is almost extinct, the reason being the increased number of chess clubs where enthusiasts and students may indulge in their favourite pastime to their hearts' content/ tournaments with attractive prizes being arranged during the season. The former occupation of the masters has gone in con- sequence ; the few who stiU exist depend upon the pass- ing visitors from the provinces who are eager to test their strength by the standard of the master. Blackburne has visited the provinces annually, keeping the interest in first-class chess alive by his simultaneous play and his ex- traordinary skUl as a blindfold player — unsurpassed untU the advent of PUlsbury,~~

~~who has done similar good work in America. PiUsbury is the only first-class player pro- duced by the United States. America has a number of amateurs — Showalter, Delmar, Hymes, Barry ; and they have also beaten Great Britain in producing a second Morphy. Still the Americans have difficulties in recruit- ing a team of ten for the annual cable match against Great Britain.~~

~~It stands to reason that first-class chess can only be acquired by an interchange of opinions with and by the advice of first-class players, and until this fact is recog- nized and acted upon by the officers of clubs, the un-doubted talent of the amateurs may be diverted into the furrows of mediocrity. A club trophy or a cup should not be considered the Ultima Thule of a skilful chess player.~~

~~Germany has produced Dr Tarrasch, Dr E. Lasker, Lipke, Fritz, Bardeleben, Walbrodt, Mieses, and a goodly number of amateurs, to replace Anderssen, Paulsen, TassUo von Heydebrand und der Lasa, and others. Austria has worthy substitutes for Kolisch, Bauer, Falkbeer, in Max Weiss, Schlechter, Marco, and Hruby. It has also such fine players as the Fleissigs, Dr Mertner, Dr Kauf- mann, Fahndrich, Jaques Schwarz, and others. Hungary is worthily represented by Maroczy, Makovetz, and Brody, Maroczy being the best since Charousek's death. Eussia, having lost Jaenisch, Petroff, and Schumoff, is now represented by Tchigorin, Janowsky, Schiffers, Alapin, Winawer, and Taubenhaus, and some younger players are ready to take their place in future. France has been on the decline for many years, and at present has only the veteran M. Arnous de Eiviere and the naturalized M. Eosenthal left. Next come Goetz and two good amateurs, MM. Didier and Billecard. Italy has only Signer Salvioli, although latterly Signer Eeggio has come to the fore. Holland has a fair number of players equal to English amateurs, but no master since the promising young Van Lennep died. Fortunately the periodical international tournaments contribute in a large measure to maintain the standard of first-class chess. A collection of the games is generally published in book form, whilst the press disseminates a selection of the best games during the progress of these contests.~~

~~Past and Present.~~

~~*The theory of the game has not advanced in proportion to the enormous strides in popularity of chess. . The tend- ency has been one of elimination, and therefore progress has been negative, if the expression may be used. For-*~~

~~*merly the theory had been enriched by such enthusiasts as Dr Max Lange, Louis Paulsen, Professor Anderssen, Neu- mann, Dr Suhle, Falkbeer, Kieseritzky, Howard Staunton, Dr Zukertort, W. N. Potter, and Steinitz, foremost amongst them being Louis Paulsen. The openings were thoroughly overhauled, new variations discovered and tested in prac- tical play over the board. These are now tempi passati. The masters who find flaws in old and discover new variations bring them to light only in matches or tourna- ments, as new discoveries have now a market value ; new discoveries may gain prizes in matches or tournaments. For the same reason the romantic school is extinct, and the eliminating process alluded to above has resulted in the retention of a small repertoire only, sufficient for practical purposes in important contests. Gambits and kindred openings containing elements of chance are avoided, and the whole stock which a first-class player requires is a thorough knowledge of the Buy Lopez, the Queen's Pawn Openings, and the French and Sicilian Defences — openings which contain the least element of chance. The repertoire being restricted, it necessarily follows that the scope for grand combioations is also diminished, and only strategy or position play remains. The romantic school invariably aimed at an attack on the king's position at any cost ; nowadays the struggle is to obtain a "minute" advantage, and the whole plan consists in finding a weak spot in the opponent's arrange- ment of forces, or to create such a weak spot — and this is the theory of the modern school, conceived and advo- cated by Steinitz (mentioned under " End Games "). But it is a curious fact that Steinitz founded the modern school rather late in life. He felt his powers of com- bination waning, and being the " world's champion," and eager to retain that title, he started the new theory. This novel departure revolutionized chess entirely. The attacking and combination style was sacrificed to a sound, sober, and dry style ; but Steinitz, strange to say, was*~~

~~*not even the best exponent of his own theory, this position falling to younger players, Dr Siegbert, Tarrasch, Schlechter, Mr Amos Burn, and Dr Emanuel Lasker. PiUsbury and Janowsky adhere to both styles, the former in a high degree, and so did the late Dr Zukertort and Charousek, whilst Tchigorin is a free-lance, with a style of his own. The old charm of the game has gone — in match and tournament play at least — and beauty has been sacrificed to exact calculation and to scoring points. This is to be regretted, for the most beautiful games occur still if a player resorts to the gambits. One of the finest games in the Hastings tournament was played by Tchigorin against Pillsbury, and this was a King's Gambit Declined ; Charousek won a Bishop's Gambit against Dr Lasker in the Nuremberg tournament ; and some brilliant games occur in Queen's Ga/mhit Declined, if either white or black sacrifices the KP. • Another reason why gambits should be adopted by players in tournaments is tlmt com petitors would necessarily be readily prepared for the regu- lation openings, so that the gambits might take them by surprise. After all, the new school is a natural consequence of the progress of the game. Paulsen, Anderssen, and Tchi- gorin devoted a lifetime to the Evans gambit, and volumes of analyses were written on it, and then comes Dr Lasker, revives an obsolete defence, and the Evans gambit dis- appears ! Dr Zukertort achieved a great success with 1 Kt to KB 3 in the London tournament, 1883, and since then this or the kindred 1 P to Q 4 opening has become the trusty weapon in serious encounters. Dr E. Lasker wrote Common Sense in Chess, and gave the best defences of the Buy Lopez (a certain form of it) ; and the " common sense" was demolished in the Paris and Nuremberg tournaments, and old forms of that remarkable opening*~~

~~*have to be refurbished. Any number of similar in- stances could be cited, but those mentioned will suffice to show the reason for the cautious style of the present day — the Moltkes have replaced the Napoleons.*~~

~~*The former versatility of style could be revived gradu- ally if club tournaments were organized difierently. The players should be compelled to adopt one single opening only in a two-round contest, each player thus having attack and defence in turn. The next season another opening should form the programme, and so on. Even in international tournaments this condition might be imposed, and the theory would be enriched ; full scope*~~

~~*would be given to power of combination and ingenuity, whilst the games would be more interesting* The raison d'etre of tournaments being to further the progress of the game, the suggestion, it would seem, might be seriously considered. Lovers of the game generally give special prizes for brilliant games, but these prizes are only an allurement to those competitors who no longer hope to gain any of the regular prizes. So as a last resource, having nothing to lose, they adopt a more enterprising style, even at the expense of soundness.*~~

~~*The club trophies and the sums devoted to brilliancy prizes might be devoted to a more useful purpose — namely, as prizes for essays on the Openings, so as to induce experts to devote their leisure to the advancement of the theory. All these suggestions, however, could only be thoroughly carried out by a powerful central authority such as a British Chess Association. If amateurs like Sir George Newnes, Captain A. S. Beaumont, and Mr F. G. Neumann should take steps to reconstitute such an administrative body, a new era for English chess would dawn. ,*~~

~~*There are still amateurs who devote their energies to the theory of the game ; but so long as innovations or new discoveries are not tested by masters in serious games, they are of no value. A case in point may be cited. Steinitz used to keep a number of new discoveries ready to be produced in masters' contests, the result being that his novelties were regularly demolished when it came to a practical test. The mistake was that he did not try his novelties over the board with an opponent of equal strength, instead of trusting to his own judgment.*~~

~~*Literature. Chess literature has grown pari passu with the popular progress of the game. Gossip's Manual and Wormald's Openings were the last old-form works. No sooner did the Westminster Papers (the chief monthly magazine) cease publication, than the Chess Monthly was started in its stead by Hofifer and Zukertort, and was continued single- handed by the former after Dr Zukertort's death. It ceased publication after seventeen years' existence. The former Huddersfield Magazine was converted into the British Chess Magazine, and this is now the only English monthly periodical. The demand for such a publication diminished as the daily press opened its pages to regular chess columns. After the famous London*~~

tournament in 1883, the Standard, Morning Post, and Daily News led the way in this matter, other papers following suit ; and within recent years the Tim^ has had an occasional chess column in its daily and a regular column in its weekly issue. The provincial papers devote still more space to chess than the London press, especially in their Saturday issues. The principal towns have two or more chess columns. Scotland has chess columns in Aberdeen, Edinburgh, and Glasgow ; Ireland in Belfast and Dublin; and Wales in the Cardiff Evening Express. There are chess columns in every important town in Canada, in New South Wales, Victoria, Melbourne,

Soutli Australia, Queensland, West Australia, New Zea- land, British India, Jamaica, Cape Town, Johannesburg, Calcutta, and Malta. In the American press liberal space is devoted to chess, and the same is the case on the Con- tinent of Europe, Germany leading. There are chess publications m Havana, Peru, and even in China.

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~~*Chess Ending King and Queen against King and Book, London, 1895. — Tassilo von Hbtdebrand und der Lasa. — Leitfaden des Sehachspiels. — Dr Laskbr. Common Sense in Chess, London, 1896.. — Oscar Cobdbl. N'euester Leitfaden des Sehachspiels, Ber- lin, 1896 ; and a vast number of other publications.*~~

~~*Further, The London Tournament Book, 1883 ; Twelve Touma/- ment Books of the Tournaments of the German Chess Associa^ tion, Veit and Co., Leipzig ; The Hastings Tournament Book, London, 1896 ; The Vienna Tournament Book, by Halprin and Marco, 1900 ; The Nuremburg Tournament Book, by Dr Tarrasch ; The Book of the London Congress, by L. Hopper, Longman, 1899; The Paris Tournament Book, Paris, 1900, by Rosenthal, &o. (l. h.)*~~

~~*Chester, a city and county of itself, municipal county (1888) and parliamentary borough, episcopal city, seaport, and county town of Cheshire, England, on the Dee, 179 miles N.N.W. of London by rail. A station on the Great Central railway was opened in 1890, whence branch lines have since been made to Hawarden and South Wales. The parliamentary representation was in 1885 reduced to one. The churches include St Mary's-without-the-Walls (1887) and the parish church of St Mary-on-the-Hill (1887). Among the schools are Blue Coat School (1700), the Diocesan Training College for schoolmasters, and the Queen's School for girls (1878). Other buildings are the Eoyal Theatre (1882), Grosvenor Museum and School of Art (1886), Campbell Memorial Hall (1895). Handbridge Park was opened in 1892. Extensive alterations of the castle are in progress. The navigation of the Dee has been much improved. In 1898, 86 vessels of 7240 tons were registered at the port ; entrances numbered 2194 of 167,923 tons ; clearances 2092 of 170,232 tons. Imports of foreign and colonial produce for 1898, £29,205, against £49 576 in 1888. Exports of the produce and manu- factures of the United Kingdom in 1898 amounted to the value of £16,058, against £1621 in 1888. The area of the municipal borough, according to the delimitation made in 1898, measures 2860 acres. Before then the flrpa of city and county borough was 2960 acres; popular tion on the old area (1881), 36,794 ; (1901), 36,281. Area of parliamentary borough, whose limits reach into thp ancient county of Elint, 3455 acres; population*~~

~~*(1881), 40,972; (1891), 42,295 ; (1901), 46,204.*~~

~~*Chester, a city of Delaware county. Pa., U.S.A., situated in 39° 54' N. lat. and 75° 21' W. long., on Delaware river. It is regularly laid out on a level site, with broad streets and has extensive cotton manufactures and a large shipbuilding industry, mainly of iron vessels. It is the*~~

~~*site of the Pennsylvania Military College. Three rail- ways traverse it : the Philadelphia, Wilmington, and Baltimore, the Baltimore and Ohio, and the Philadelphia and Reading. The assessed valuation of real property in 1900, on a basis of about two-thirds of the full value, was $14,883,773, the net debt f 769,647, and the tax-rate $19.50 per flOOO. Population (1880), 14,997; (1890), 20,226; (1900), 33,988, of whom 5074 were foreign-born and 4403 negroes.*~~

~~*Chesterfield, a municipal borough (enlarged 1892_) and market town in the Chesterfield parliamentary divi- sion of Derbyshire, England, 24 miles N. of Derby by rail. A gas and water board has been incorporated, and the gas-works reconstructed. A George Stephenson Memorial Hall has been erected, containing a free library, a lecture room, art and science class-rooms, the rooms of the Chester- field Institute, and a theatre. A large theatre was built in 1895. Chesterfield Hospital has been enlarged, and a public park purchased. There are slate and sandstone quarries in the neighbourhood. Extended area, 1219 acres; population (1881), 19,835; (1901), 27,185.*~~

~~*Chester- le- Street, a town in the Chester-le-Street parliamentary division of Durham, England, 6 miles N. of Durham city by rail. Two Koman altars with in- scriptions have been foimd. A church founded towards the end of the 13th century, and containing interesting memorials, has been restored. There are Congregational and Methodist chapels; also a mechanics' institute and a church institute; an infectious diseases hospital has been opened. Confectionery is manufactured. Area of civil parish, 2900 acres ; population (1881), 6911 ; (1891),*~~

~~*8623; (1901), 11,753.*~~

~~*Chesterton, a parish and village in the Chesterton division of Cambridgeshire, England, the village being li miles N. from Cambridge station, on the north bank of the Cam. It is the goal for boat-races from Cam- bridge, and several picturesque boat-houses have been erected along ,the river by the University Boat Club. Boat-building and tile manufacture are local industries. In 1894 an urban district council was established. Area, 2778 acres. Population (1881), 5706; (1901), 9583.*~~

~~*Chevalier, Michel (1806-1879), French political economist, was born at Limoges, 13th January 1806. In his early manhood, while employed as an engineer, he became a convert to the theories of Saint Simon ; these he ardently advocated in the Globe, the organ of the Saint Simonians, which he edited until his arrest in 1832 on a charge of outraging public morality by its publication. He was sentenced to a year's imprisonment, but was released in six months through the intervention of M. Thiers, who sent him on a special mission to the United States to study the question of land and water transport. In 1836 he published, in two volumes, the letters he wrote from America to the Journal des Dibats. These attracted so much attention that he was sent in the same year on an economic mission to England, which resulted in his publication (in 1838) of Les intirMs materiels de la France. The success of this made Ms position secure, and in 1840 he was appointed professor of politi- cal economy in the College de Prance. He sat for a short time (1845-46) as a member of the Chamber of Deputies, but lost his seat owing to his enthusiastic adop- tion of the principles of free trade. Under Napoleon III. he was restored to the position of which the revolution of 1848 had temporarily deprived him. In 1850 he became a member of the Institute, and in the following year published an important work in favour of free trade, under the title of Examen du systime commercial connu sous le nom de syst&me proiecteur. His chief public triumph was*~~

~~*the important part he played in bringing about the conclu- sion of the commercial treaty between France and Great Britain in 1860. Previously to this he had served, in 1855, upon the commission for organizing the Exhibition of 1855, and his services there led to his forming one of the French jury of awards in the London Exhibition of 1862. He was created a member of the Senate in 1860, and continued for some years to take an active part in its discussions. He retired from public life in 1870, but was unceasingly industrious with his pen. He became grand officer of the Legion of Honour in 1861, and during the later years of his life received from many quarters public recognition of his eminence as a political economist. He died at Mont- pellier, 28th November 1879. Of his works, many of which have been translated into English and other languages, some of the more important (in addition to those already mentioned) are : Cours d'dconomie politique (1842-50) ; Essais de politique industrielle (1843) ; De la baisse probable d'or (1869), which was translated into English by Cobden; L' Expedition du Mexique (1862) ; Introduction aux rapports du jury international (1868). (e. f. s.)*~~

~~*Chevreul, Michel Eugene (1786-1889), French chemist, was born, on 31st August 1786, at Angers, where his father was a physician. At about the age of seventeen he went to Paris and entered Vauquelin's chemical laboratory, afterwards becoming his assistant at the Natural History Museum in the Jardin des Plantes. In 1813 he was appointed professor of chemistry at the Lycee Charlemagne, and subsequently undertook the directorship of the famous Gobelins tapestry works, where he carried out his researches on colour contrasts. In 1826 he became a member of the Academy of Sciences, and in the same year was elected a foreign member of the Eoyal Society of London, whose Copley medal he was awarded in 1857. He succeeded his master, Vauquelin, as professor of organic chemistry at the Natural History Museum in 1830, and thirty-three years later assumed its ' directorship also ; this he relinquished in 1879, though he still retained his professorship. In 1886 the completion of his hundredth year was celebrated with public rejoic- ings; and after his death, which occurred in Paris on 9th April 1889, he was honoured with a public funeral. In 1901 a statue was erected to his memory in the museum with which he was connected for so many years. His scientific work covered a wide range, but his name is best known for the classical researches he carried out on animal fats, published in 1823*~~

~~(Becherches sur les cotps gras d'origine animale). These enabled him to elucidate the true nature of soap ; he was also able to dis- cover the composition of stearin and olein, and to isolate stearic and oleic acids, the names of which were invented by him. A practical consequence of these investigations was the manufacture of stearin candles, to the supersession of the old tallow dips. Chevreul was a determined enemy of charlatanism in every form, and one of his less-known books, inspired by the " spiritualistic " movement that arose in America about 1848 and spread to Europe a few years later, was devoted to an exposure of the foUy of attaching any importance to the manifestations of the diviuing-rod and table-turning.~~

~~Cheyenne, the largest and most important city of Wyoming, U.S.A., capital of Laramie county and of the state, situated near the southern boundary of the state, on the high jilains near the east foot of the Laramie range, at an altitude of 6054 feet. It is on the main line of the Union Pacific railway, and is the terminus of branches of the Burlington and Missouri Eiver, ^nd the Union Pacific, Denver, and Gulf railways. The surrounding country is~~

~~a vast cattle range, of which Cheyenne is the shipping and supply point. Near Cheyenne is the large military post of Fort Russell. Population (1880), 3456 ; (1890), 11,690 ; (1900), 14,087, of whom 1691 were foreign-born and 295 were negroes.~~

~~Chhatarpur, a native state of India, in the Bun- delkhand agency. Area, 1178 square miles; popula- tion (1891), 174,148 ; average density, 148 persons per square mile ; estimated revenue, Es.2,60,000. The chief, whose title is Raja, is a Eajput of the Puar clan, whose ancestor dispossessed the descendant of Chhatar Sal, the founder of Bundelkhand independence, towards the end of the 18th century. The town of Chhatarpue, which is named after Chhatar Sal, and contains his cenotaph, is situated in 24° 54' N. lat. and 79° 38' E. long., 70 miles by road S. W. of Banda. Population, 13,474. It has manu- factures of paper and coarse cutlery, and a high school.~~

~~Chhattisgarh, a division of the Central Provinces, India. The total feudatory area is 29,435 square miles ; the population in 1891 was 2,160,611, giving an average density of 73 persons per square mile. In 1901 the population was 1,983,496, showing a decrease of 8 per cent., due to famine. Much of~~

~~*the soil is still covered with forest, but it includes fertile rice land. The British division of Chhattisgarh comprises the three districts of Eaipur, Bilaspur, and Sambalpur. Its area is 25,013 square miles ; in 1881 the population was 3,115,997, and in 1891 it was 3,544,998, giving an average density of 142 persons per square mile. In 1901 the population was 3,274,113, showing a decrease of 8 per cent. This tract has been opened out by the Bengal-Nagpur railway, which crosses it on its way from Nagpur city to Calcutta. Several of the feudatory states have been under British management, while the chiefs were being trained during their minority in the Eajkumar college at Eaipur. The number of children at school has risen from 8121 in 1892-93 to 14,839 in 1896-97, being 4-6 per cent, of the population of school-going age.*~~

~~*Chhindwara, a town and district of British India, in the Nerbudda division of the Central Provinces. The population of the town in 1881 was 8220, and in 1891 was 8973. The area of the district is 4630 square miles. In 1881 it had a population of 372,899, in 1891 of 407,494, showing an average density of 88 persons per square mile. In 1901 the population was 408,105. The land revenue and rates were Es.3,34,441, the incidence of assessment beiug Es.0:3:4 per acre ; the cultivated area in 1897-98 was 691,697 acres, of which 8877 were irri- gated from wells; the number of police was 283; the boys at school in 1896-97 numbered 3012, being 9-9 per cent, of the male population of school-going age, com- pared with 15-4 per cent, for the whole province; the registered death-rate in 1897 was 52-30 per thousand. It has manufactures of cotton cloth and brass-ware. Coal exists, but cannot be worked profitably in the absence of a railway.*~~

~~*Chiapas, a state of Mexico, bounded on the N. by the state of Tabasco, on the "W. by those of Veracruz and Oaxaca, on the S. by the Pacific, and on the E. by the republic of Guatemala. Its area is 27,230 square miles. The population in 1879 was 206,362 ; 319,599 in 1895. The eastern plains have not yet been thoroughly explored. The principal industries are agricidture, fruit exploitation, salt extraction, and stock-raising. In 1897 it produced 2,466,100 kilograms of coffee, 10,126,998 kilograms of sugar-cane and products, 382,001 kilograms of tobacco, and 144,491 kilograms of cocoa. The state is. divided politically into 11 departments and 101 municipalities.*~~

~~The capital is Tuxtla Gutierrez (population, 10,952), about ^ files from tlie river Sabinas and 138 miles from the P°u U-. s ^. Amongst other towns are Comitan (9316 inhabitants), Pichucalco (8549), Tapachula (8472), Tene-japa (7936) San Antonio (6715), Cuitalape (6455), La Concordia (6291), San Carlos (5977), Ococingo (5667).~~

~~Chiavari, a town of Liguria, Italy, province of Genoa, on the coast of the E. Eiviera, 23 miles E.S.E. from Genoa! It possesses a citadel (restored in 1887), the shrine of the Madonna dell' Orto, with a miraculous image, and statues ot Garibaldi and Mazzini. Population, about 11,000;~~

~~j!^"?®"" '^ " ^ of Lombardy, Italy, province of Sondrio, 6^ miles K. from the N. end of Lake Como. its famous beer and wine are kept in cellars hewn out ot the sides of ravines. The pottery for which it has been~~

~~noted since Eoman times is made out of a natural stone Qavez). Population, about 4500.~~

~~Chicacole, a town of British India, in the Ganjam district of Madras, situated in 18° 75' N. lat. and 83° 56' E. long., on the right bank of the river Languliya, here crossed by a bridge, 4 miles from the sea. Population (1881), 16,355; (1891), 18,204; municipal income (1897-98), Es.27,600. Formerly the capital of a Mahom- medan province, and afterwards of a British district. Several old mosques still remain. The town was famous for its muslins, but the industry is now decayed. The roadstead and lighthouse of Calingapatam are about 16 miles to the north, and the East Coast railway has a station inland. The town has a municipal high school, two printing-presses, each issuing a vernacular newspaper, and a club.~~

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PREFATORY ESSAY.

THE INFLUENCE OF MODERN RESEARCH ON THE SCOPE OF WORLD-HISTORY.

By Henry Smith Williams, M.D., B.Sc.

WHEN Queen Victoria came to the throne, the year 4004 B.C. was accepted, in all sobrietj’-, as the date of the creation of the world. Perhaps no single statement could more vividly emphasize the change in the point of view from which scholars regard the chronology of ancient history than the citation of this indisputable fact. To-day, though Bibles are still printed with the year 4004 B.C. in the margin of the first chapter of Genesis, no scholar would pretend to regard this reference seriously. On the contrary, the scholarship of to-day regards the fifth millennium B.C. as well within the historical period for such nations as the Egyptians and the Babylonians. It has come to be fuUy accepted, that when we use such a phrase as ” the age of the world ” we are dealing with a period that must be measured not in thousands but in millions of years ; and that to the age of man must be allotted a period some hundreds of times as great as the five thousand and odd years allowed by the old chronologists. This changed point of view, needless to say, has not been reached without ardent and even bitter controversy. Yet the transformation is unequivocal ; and the revised conception no longer seems to connote the theological implications that were at first ascribed to it. It has now become obvious that the data afforded by the Hebrew writings should never have been regarded as sufficiently accurate for the purpose of exact historical computations : that, in short, no historian working along modern scientific lines could well have made the

mistake of supposing that the genealogical lists of the Pentateuch afforded an adequate chrono- logy of world-history. But it should not be forgotten that to many generations of close scholarship these genealogical lists seemed to convey such knowledge in the most precise terms, and that at so recent a date as, for example, the year in which Queen Victoria came to the throne, it was nothing less than a rank heresy to question the historical accuracy and finality of chronologies which had no other source or foundation.

This changed point of view regarding the chronology of history may without hesitation be ascribed to the influence of evidence obtained in a single field of inquiry, the field, namely, of Archaeology. No doubt the evidence as to the age of the earth and as to the antiquity of man was gathered by a class of workers not formally included in the ranks of the archaeologist : workers commonly spoken of as palaeon- tologists, anthropologists, ethnologists, and the like. But the distinction scarcely covers a real difference. The scope of the archaeologist's studies must include every department of the ancient history of man as preserved in antiquities of whatever character, be they tumuli along the Baltic, fossil skulls and graven

bones from the caves of France, the flint implements, pottery, and mummies of Egjrpt, tablets and bas- reliefs from Mesopotamia, coins and sculptures of Greece and Rome, or inscriptions, waxen tablets, parch- ment rolls, and papyri of a relatively late period of classical antiquity.

If at one time the monuments of Greece and Rome claimed the almost undisputed attention of the archaeologist, that time has long since passed. For the most important historical records that have come to us in recent decades we have to thank the Orientalist, though the classical explorer has been by no means idle. It is the purpose of the present essay to point out in general terms the import of the message of archaeological discovery in the Victorian Era in its bearings upon the great problems of world- history. Perhaps this purpose may be best attained if we take up these problems one

after another, con- trasting in each case the old point of view with the new, and briefly outUning the evidence on which the present decision rests. This, of course, is not the place for details as to the archaeological discoveries involved. Here we have to do with only such discoveries as have led to broad historical generalizations regarding such subjects as the Antiquity of Man, the Antiquity of Culture, the Chronology of Ancient History, the Status of Bible History, the Credibility of Early Classical History, the Origin and Develop- ment of the Art of Writing, and the Evolution of the Fine Arts.

The Antiquity of Man, the Antiquity of Civilization, and the Chronology of Ancient History.

With regard to the changed conception as to the age of the earth, it is necessary to recall that this came about through the efforts of the palaeontologists and geologists, with only indirect or incidental aid from the archaeologists. The reform movement began actively with James Hutton in the later years of the 18th century, and was forwarded by the studies of WiUiam Smith in England and of Cuvier in France ; but the really efficient champion of the conception that the earth is very old was Sir Charles Lyell, who published the first edition of his epoch-making Principles of Q-eology only a few years before Queen Victoria came to the throne. Lyell demonstrated to the satisfaction, or — ^perhaps it should rather be said — to the dissatisfaction, of his contemporaries that the story of the geological ages as recorded in the strata of the earth becomes intelligible only when vast stretches of time are presupposed. Of course the demonstration was not accepted at once. On the contrary, the champions of the tradition that the earth was less than six thousand years old held their ground most tenaciously, and the earlier years of the Victorian Era were years of bitter controversy. The result of the contest was never in doubt, however, for the geological evidence, once it had been gathered, was unequivocal ; and by about the middle of the century it was pretty generally admitted that the age of the earth must be measured by an utterly different standard from that hitherto in vogue. This concession, however, by no means implied a like change of view regarding the age of man. A fresh volume of evidence required to be gathered, and a new controversy to be waged, before the old data for the creation of man could be abandoned. Lyell again was in the

forefront of the progressive movement, and his work on The Antiquity of Man, published in 1863, gave currency for the first time to the new opinions. The evidence upon which these opinions were based had been gathered by such anthropologists as Schmerling, Boucher de Perthes, and others, and it had to do chiefly with the finding of implements of human construction associated with the remains of extinct animals in the beds of caves, and with the recovery of similar antiquities from aUuvial deposits the great age of which was demonstrated by their depth. Every item of the evidence was naturally subjected to the closest scrutiny, but at last the conservatives were forced reluctantly to confess them- selves beaten. Their traditional arguments were powerless before the array of data marshalled by the new science of prehistoric archaeology. Looking back even at the short remove of a single generation, it is difiicult to appreciate how revolutionary was the conception of the antiquity of man thus inculcated. It rudely shocked the traditional attitude of scholarship towards the history of our race. It disturbed the most cherished traditions and the most sacred themes. It seemed to threaten the very foundations of religion itself. Yet the present generation accepts the antiquity of man as a mere matter of fact. Here as so often elsewhere, the heresy of an elder day has come to seem almost an axiomatic truth.

This is not the place to suggest, even in the roughest outline, the social, ethical, and religious ifopli- cations that were bound inseparably with the revolutionary conception as to man’s creation. It may not be amiss to add, however, that in establishing the broad fact of man’s antiquity, prehistoric archaeology as yet falls short of the power to estimate, even roughly, in terms of years the periods with which it deals ; and history, in the narrower sense, can hardly be said to exist without chronology. On the other hand, some of the most remarkable advances for which the historian must thank the archaeologist have to do with the chronology of the early periods of Oriental history. Indeed, the greatest feat of the archaeologist has been the opening up to our observation, and the bringing within the scope of the historian, of long periods which, without his aid, must still have belonged to the vague realms of the prehistoric.

If we go back in imagination to the beginning of the Victorian Era and ask what was then known of the history of Ancient Egypt, Mesopotamia, and Asia Minor, we find ourselves confronted with a startling paucity of knowledge. The key to the mysteries of Egyptian history had indeed been found, thanks to the recent efforts of Thomas Young and ChampoUion, but the ‘deciphering of inscriptions had not yet progressed far enough to give more than a vague inkling of what was to follow. It remained, then, virtually true, as it had been for two thousand years, that for all that we could learn of the history of the Old Orient in pre-classical days, we must go solely to the pages of the Bible and to a few classical authors, notably Herodotus and Diodorus. A comparatively few pages summed up, in language often vague and mystical, all that the modern world had been permitted to remember of the history of the greatest nations of antiquity. To these nations the classical writers had ascribed a traditional importance, the glamour of which still lighted their names, albeit revealing them in the vague twilight of tradition rather than in the clear light of history. It would have been a bold, not to say a reckless, dreamer who dared predict that any future researches could restore to us the lost knowledge that had been forgotten for more than two millenniums. Yet the Victorian Era was scarcely ushered in before the work of rehabilitation began, which was to lead to the most astounding discoveries and to an altogether unpre-cedented extension of historical knowledge. Early in the ‘forties the Frenchman Botta, quickly followed by Sir Henry Layard, began making excavations on the site of ancient Nineveh, the name and fame of which were a tradition having scarcely more than mythical status. The spade of the discoverer soon showed that all the fabled glories of the ancient Assyrian capital were founded on realities, and evidence . was afforded of a state of civilizatioin and culture such as few men supposed to have existed on the earth before the Golden Age of Greece. Not merely were artistic sculptures and bas-reliefs found that demon- strated a high development of artistic genius, but great libraries were soon revealed, — books consisting of bricks of various sizes, or of cylinders of the same material, inscribed while in the state of clay with curious characters, which became indelible when baking transformed the clay into brick. No one was able to guess, even in the vaguest way, the exact interpretation of these odd characters ; but, on the other hand, no one could doubt that they constituted a system of writing, and that the piles of inscribed tablets were veritable books. Thei^e were

numerous sceptics, however, who did not hesitate to assert that the import of the message so obviously locked in these curious inscriptions must for ever remain an absolute mystery. Here, it was said, were inscriptions written in an unknown character and in a language that for at least two thousand years had been absolutely forgotten. In such circumstances nothing less than a miracle could enable human ingenuity to fathom the secret. Yet the feat pronounced impossible by mid-centary scepticism was^ accomplished by contemporary scholarship, amidst the clamour of opposition and incredulity. Its success contains at^once a warning to those doubters who are always crying out that we have reached , the limitations of knowledge, and an encouragement and stimulus to would-be explorers of new intellectual

realms.

In a few words the manner of the discovery was this. It appears at a glance that the Assyrian written character consists of groups of horizontal, vertical, or oblique strokes. The characters thus com- posed, though so simple as to their basal unit, are appallingly complex in their elaboration. The Assyrians, with all their culture, never attained the stage of analysis which demonstrates that only a few fundamental

sounds are involved in human speech, and hence that it is possible to express all the niceties of utterance with an alphabet of little more than a score of letters. Halting just short of this analysis, the Assyrian ascribed syllabic values to the characters of his script, and hence, instead of finding twenty odd characters sufficient, he required about five hundred. There was a further complication in that each one of these characters had at least two different phonetic values ; and there were other intricacies of usage which, had they been foreknown by inquiries in the middle of the 19th century, might well have made the problem of decipherment seem an utterly hopeless one.

Fortunately it chanced that another people, the Persians, had adopted the Assyrian wedge-shaped stroke as the foundation of a written character, but, making that analysis of which the Assyrians had fallen short, had borrowed only so many characters as were necessary to represent the alphabetical sounds. This made the problem of deciphering Persian inscriptions a relatively easy one. In point of fact this problem had been partially solved in the early days of the 19th century, thanks to the sagacious guesses of the German philologist Grotefend. Working with some inscriptions from Persepolis which were found to contain references to Darius and Xerxes, Grotefend had established the phonetic values of certain of the Persian characters, and his successors were perfecting the discovery just about the time when the new Assyrian finds were made. It chanced that there existed on the. polished surface of a cliff at Behistun in Western Persia a tri-lingual description which, according to Diodorus, had been made by Queen Semiramis of Nineveh, but which, as is now known, was really the work of King Darius. One of the languages of this inscription was Persian ; another, as it now appeared, was^^ssyrian, the language of the newly discovered books from the libraries of Nineveh. There was reason to suppose that the inscriptions were identical in meaning ; and fortunately it proved, when the inscriptions were made accessible to investigation through the efforts of Sir Henry Rawlinson, that the Persian inscription contained a large number of proper names. It was well known that proper names are usually transcribed from one language into another with a tolerably close retention of their original sounds. For example, the Greek names Ptolemaios and Kleopatra became a part of the Egyptian language and appeared regularly in Egyptian, inscriptions after Alexander’s general became King of Egypt. Similarly, the Greek names Kyros, Darios, and Xerxes were as close an imitation as practicable of the native names of these Persian monarchs. Assuming, then, that the proper names found in the Persian portion of the Behistun inscription occurred also in the Assyrian portion, retaining virtually the same sound in each, a clue to the phonetic values of a large number of the Assyrian characters was obviously at hand. Phonetic values known, Assyrian was found to be a Semitic language cognate to Hebrew.

These clues were followed up by a considerable number of investigators, with Sir Henry Rawlinson in the van. Thanks to their efforts, the new science of Assyriology came into being, and before long the message of the

Assyrian books had ceased to be an enigma. Of course this work was not accomplished in a day or in a year, but, considering the difficulties to be overcome, it was carried forward witk marvellous expedition. In 1857 the new scholarship was put to a famous test, in which the- challenge thrown down by Sir George Cornewall Lewis and Ernest Kenan was met by Rawlinson, Hincks, Oppert> and Fox Talbot in a conclusive manner. The sceptics had declared that the new science of Assjnriology was itself a myth : that the investigators, self-deceived, had in reality only invented a language, and read into the Assyrian inscriptions something utterly alien to the minds of the Assyrians themselves. But when a committee of the Royal Asiatic Society, with George Grote at its head, decided that the translations of an Assyrian text made independently by the scholars just named were at once perfectly intelligible and closely in accord with one another, scepticism was silenced, and the new science was. admitted to have made good its claims.

Naturally the early investigators did not fathom all the niceties of the language, and the work of grammatical investigation has gone on continuously under the auspices of a constantly growing band of workers. Doubtless much still remains to be done ; but the essential thing, from the present standpoint, is- that a sufficient knowledge of the Assyrian language has been acquired to ensure trustworthy translations of

the cuneiform texts. Meanwhile, the material found by Botta and Layard, and other successors, in the ruins of Nineveh has been constantly augmented through the efforts of companies of other investigators, and not merely Assyrian, but much earlier Babylonian and Chaldtean texts in the greatest profusion have been brought to the various museums of Europe and America. The study of these different inscriptions has utterly revolutionized our knowledge of Oriental history. Many of the documents are strictly historical in their character, giving full and accurate contemporary accounts of events that occurred some thousands of years ago. Exact dates are fixed for long series of events that previously were quite unknown. Monarchs whose very names had been forgotten are restored to history, and the records of their deeds inscribed under their very eyes are before us, — contemporary

documents such as neither Greece nor Rome could boast, nor any other nation, with the single exception of Egypt, until strictly modern times.

There are, no doubt, gaps in the record ; there are long periods for which the chronology is still uncertain. Naturally there is an increasing vagueness as one recedes further into the past, and for the earlier history' of Chaldsea there is great uncertainty. Nevertheless, the Assyriologist speaks with a good deal of confidence of dates as remote as 3800 B.C., the time ascribed to King Sargon, who was once regarded as a mythical person, but is now known to have been an actual monarch. Indeed, there are tablets in the British Museum labelled 4500 B.C.; and later researches, particularly those of the expedition of the University of Pennsylvania at Nippur, have brought us evidence which, interpreted with the aid of estimates as to the average rate of accumulation of dust deposits, leads to the inference that a high state of civilization had been attained in Mesopotamia at least 9000 years ago.

While the Assyriologists have been making these astonishing revelations, the Egyptologists have not been behindhand. Such scholars as Lepsius, Brugsch, de Rouge, Lenormant, Birch, Mariette, Maspero, and Erman have perfected the studies of Young and ChampoUion ; while at the same time these and a considerable company of other explorers, most notable of whom are Gardner Wilkinson and Professor Flinders Petrie, have brought to light a vast accumulation of new material, much of which has the highest importance from the standpoint of the historian. Lists of kings found on the temple wall at Abydos, in the fragments of the Turin papyrus and elsewhere, have cleared up many doubtful points in the lists of Manetho, and at the same time, as Professor Petrie has pointed out, have proved to us how true a historian that much-discussed writer was. Manetho, it will be recalled, was the Egyptian who wrote the history of Egypt in Greek in the time of the Ptolemies. His work in the original unfortunately perished, and all that we know of it we learn through excerpts made by a few later classical writers. These fragments have until recently, however, given us our only clue to the earlier periods of Egyptian history. Until corroboration was found in the Egyptian inscriptions themselves, not only were Manetho's lists in doubt, but scepticism had been carried to the point of denying that Manetho himself had ever existed. This is only one of many cases where the investigations of the archseologist have proved not iconoclastic but

reconstructive, tending to restore confidence in classical traditions which the scientific historians of the age of Niebuhr and George Cornewall Lewis regarded with scepticism.

As to the exact dates of early Egyptian history there is rather more of vagueness than for the corresponding periods of Mesopotamia. Indeed, approximate accuracy is not attained until we are within sixteen hundred years of our own era ; but the sequence of events of a period preceding this by two thousand years is well established, and the recent discoveries of Professor Petrie carry back the record to a period which cannot well be less than five thousand, perhaps not less than six thousand, years B.C. Both from Egypt and Mesopotamia, then, the records of the archaeologist have brought us evidence of the existence of a highly developed civilization for a period exceeding by hundreds, perhaps by thousands, of years the term which had hitherto been considered the full period of man's existence.

We may note at once how these new figures disturb the historical balance. If our forerunners of eiffht or nine thousand years ago were in a noonday glare of civilization, where shall we look for the

much-talked-of " dawnings of history " ? By this new standard the Romans seem our contemporaries in latter-day civilization ; the " Golden Age " of Greece is but of yesterday ; the pyramid-builders are only relatively remote. The men who built the temple of Bel at Nippur, in the year (say) 5000 B.C., must have felt themselves at a pinnacle of civilization and culture. As Professor Mahaffy has suggested, the era of the Pyramids may have been the veritable autumn of civilization. Where, then, must we look for its springtime ? The answer to that question must come, if it come at all, from what we now speak of as pre-historic archaeology ; the monuments from Memphis and Nippur and Nineveh, covering a mere ten thousand years or so, are records of recent history.

Archceology and Bible History.

The efforts of the students of Oriental archaeology have been constantly stimulated by the fact that their studies brought them more or less within the

field of Bible history. A fair proportion of the workers who have delved so enthusiastically in the fields of Egyptian and Assyrian exploration would never have taken up the work at all but for the hope that their investigations might substantiate the Hebrew records. For a long time this hope proved illusory, and in the case of Egyptian archaeology the results have proved disappointing even up to the very present. Considering the important part played by the Egyptian sojourn of the Hebrews, as narrated in the Scriptures, it was certainly not an over-enthusiastic prediction that the Egyptian monuments when fully investigated would divulge important references to Joseph, to Moses, and to the all-important incidents of the Exodus ; but half a century of expectant attention in this direction has led only, to disappointment. It would be rash, considering the buried treasures that may yet await the future explorer, to assert that such records as those in question can never come to light. But, considering the fulness of the contemporary Egyptian records of the XlXth dynasty that are already known, it becomes increasingly doubtful whether the Hebrews in Egypt played so important a part in history, when viewed from the Egyptian standpoint, as their own records had seemed to imply. As the forgotten history of Oriental antiquity has been restored to us, it has come to be understood that, politically speaking, the Hebrews were a relatively insignificant people, whose chief importance from the standpoint of material history was derived from the geographical accident that made them a sort of buffer between the greater nations about them. Only once, and for a brief period, in the reigns of David and Solomon, did the Hebrews rise to anything like an equal plane of political importance with their immediate neighbours. What gave them a seeming importance in the eyes of posterity was the fact that the true history of the Egyptians, Mesopotamians, Arabians, and Hittites had been well-nigh forgotten. The va)rious literatures of these nations were locked from view for more than two thousand years, while the literature of Israel had not merely been preserved, but had come to be regarded as inspired and sacred among all the cultured nations of the Western world. Now that the lost literatures have been restored to us, the status of the Hebrew writings could not fail to be disturbed. Their very isolation had in some measure accounted for their seeming importance.

All true historical perspective is based upon comparison, and where only a single account has been preserved of any event or of any period of history,

it is extremely difficult to judge that account with historical accuracy. An illustration of this truth is furnished in profane history by the account which Thucydides has given us of the Peloponnesian War. For most of the period in question Thucydides is the only source ; and despite the inherent merits of a great writer, it can hardly be doubted that the tribute of almost unqualified praise that successive generations of scholars have paid to Thucydides must have been in some measure qualified if, for example, a Spartan account of the Peloponnesian War had been preserved to us. Professor Mahaffy has pointed out that many other events in Greek history are viewed by us in somewhat perverted perspective because the great writers of Greece were Athenians rather than Spartans or Thebans. Even in so important a matter as the great conflict between Persia and Greece it has been suggested more than once that we should be able to gain a much truer view were Persian as well as Greek accounts accessible.

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Not many years ago it would have been accounted a heresy to suggest that the historical books of the Old Testament had conveyed to our minds estimates of Oriental history that suffered from this same defect ; but to-day no one who is competent to speak with authority pretends to doubt that such is really the fact. Even conservative students of the Bible urge that its historical passages must be viewed precisely in the light of any other historical writings of antiquity ; and the fact that the oldest Hebrew manuscript dates only from the 8th century a.d., and therefore of necessity brings to us the message of antiquity through the fallible medium of many generations of copyists, is far more clearly kept in mind than it formerly was. Every belief of mankind is in the last analysis amenable to reason, and finds its origin in evidence that can appeal to the arbitrament of common sense. This evidence may in certain cases consist chiefly of the fact that generations of our predecessors have taken a certain view regarding a certain question ; indeed most of our cherished beliefs have this foundation. But when such is the case, mankind has never failed in the long-run to vindicate its claim to rationality by showing a readiness to give up the old belief whenever tangible evidence of its fallaciousness was forthcoming.

The case of the historical books of the Old Testament furnishes no exception. These had been sacred to almost a hundred generations of men, and it was difficult for the eye of faith to see them as other than absolutely infallible documents. Yet the very eagerness with which the champions of the Hebrew records searched for archaeological proofs of their validity, was a tacit confession that even the most unwavering faith was not beyond the reach of external evidence. True, the believer sought corroboration with full faith that he would find it; but the very fact that he could think such external corroboration valuable implied, however little he may have realized it, the subconscious concession that he must accept external evidence at its full value, even should it prove contradictory. If, then, an Egyptian inscription of the XlXth dj'^nasty had come to hand in which the names of Joseph and Moses, and the deeds of the Israelites as a subject people who finally escaped from bondage by crossing the Red Sea, were recorded in hieroglyphic characters, such a monument would have been hailed with enthusiastic delight by every champion of the Pentateuch, and a wave of supreme satisfaction would have passed over all Christendom.

It is not too much, then, to say that failure to find such a monument has caused deep disappointment to Bible scholars everywhere. It does not follow that faith in the Bible record is shaken, although in some quarters there has been a pronounced tendency to regard the history of the Egyptian sojourn as mythical ; yet it cannot be denied that Egyptian records, corroborating at least some phases of the Bible story, would have been a most welcome addition to our knowledge. Some recent finds have, indeed, seemed to make inferential reference to the Hebrews, and the marvellous collection of letters of the XVIIIth dynasty found at Tel el-Amarna — letters to which we shall refer later — have the utmost importance as proving a possible early date for the Mosaic accounts. But such inferences as these are but a vague return for the labour expended, and an almost cruelly inadequate response to seemingly well-founded

expectations.

When we turn to the field of Babylonian and Assyrian archseology, however, the case is very different. Here we have documents in abundance that deal specifically with events more or less referred to in the Bible. The

records of kings whose names hitherto were known to us only through Bible references have been found in the ruins of Nineveh and Babylon, and personages hitherto but shadowy now step forth as clearly into the light of history as an Alexander or a Csesar. Moreover, the newly discovered treasures deal with the beliefs of the people as well as with their history proper. The story of the books now spoken of as the “Creation” and “Deluge” tablets of the Assyrians, in the British Museum, which were discovered in the ruins of Nineveh by Layard and by George Smith, has been familiar to every one for a good many years. The acute interest which they excited when George Smith deciphered their contents in 1872 has to some extent abated, but this is only because scholars are now pretty generally agreed as to their bearing on the corresponding parts of Genesis. The particular tablets in question date only from about the 7th century B.C., but it is agreed among Assyriologists tVi t thev are copies of older texts current in Babylonia for many centuries before, and it is obvious

that the compilers of Genesis had access to the Babylonian stories. In a word, the Hebrew Genesis shows unequivocal evidence of Babylonian origin, but, in the words of Professor Sayce, it is but “a paraphrase and not a translation.” However disconcerting such a revelation as this would have been to the theologians of an elder day, the Bible scholars of our own generation are able to regard it with entire composure.

From the standpoint of the historian even greater interest attaches to the records of the Assyrian and Babylonian kings when compared with the historical books of the Old Testament. For some centuries the inhabitants of Palestine were subject to periodical attacks from the warlike inhabitants of Mesopotamia, as even the most casual reader of the Bible is aware. When it became known that the accounts of these invasions formed a part of the records preserved in the Assyrian libraries, historian and theologian alike waited with breathless interest for the exact revelations in store ; and this time expecta- tion was not disappointed. As, one after another, the various tablets and cylinders and annalistic tablets have been translated, it has become increasingly clear that here are almost inexhaustible fountains of knowledge, and that sooner or later it may be possible to check the Hebrew

accounts of the most important “periods of their history with contemporaneous accounts written from another point of view. It is true that the cases are not very numerous where precisely the same event is described from opposite points of view, but, speaking in general terms rather than of specific incidents, we are already able to subject considerable portions of history to this test.

The records of Shalmaneser II., Tiglath-Pileser III., and Sennacherib, kings of Assyria, of Nebuchad- rezzar, king of Babylon, and of Cyrus, king of Persia, all contain direct references to Hebrew histo^3^ An obelisk of Shalmaneser II. contains explicit reference to the tribute of Jehu of Samaria, and graphic- ally depicts the Hebrew captives. .Tiglath-Pileser III., a usurper who came to the throne of Assyria in 745 B.C., and whose earlier name of Pul proved a source of confusion to the later Hebrew writers, left records that have served to clear up the puzzling chronology of a considerable period of the history of Samaria. Most interesting of all, perhaps, are the annals of Sennacherib, the destruction of whose hosts by the angel of God is so strikingly depicted in the Book of Kings. The court historian of Sennacherib naturally does not dwell upon this event, but he does tell of an invasion and conquest of Palestine. The Hebrew account of the death of Sennacherib is corroborated by a Babylonian inscription. Here, however, there is an interesting qualification. The account in the Book of Kings is so phrased that one might naturally infer from it that Sennacherib was assassinated by his sons immediately after his return from the disastrous campaign in Palestine ; but in point of fact, as it now appears, the Assyrian king survived that campaign by twenty years. One cannot avoid the suspicion that in this instance the Hebrew chronicler purposely phrased his account to convey the impression that Sennacherib’s tragic end was but the slightly delayed culmination of the punishment inflicted for his attack upon the “chosen people.” On the other hand, the ambiguity may be quite unintentional, for the Hebrew writers were notoriously lacking in the true historical sense, which shows itself in a full appreciation of the value of chronology.

One of the most striking instances of the way in which mistakes of chronology may lead to the perversion of historical records is shown in the Book of Daniel in connexion with the familiar account of the capture of

Babylon by Cyrus. Within the past generation records of Cyrus have been brought to light, as well as records of the conquered Babylonian king himself, which show that the Hebrew writers of the later day had a peculiarly befogged impression of a great historical event — their misconception being shared, it may be added, by the Greek historian Herodotus. When the annalistic tablet of Cyrus was translated, it was made to appear, to the consternation of Bible scholars, that the city of Babylon had capitulated to the Persian — or more properly to the Elamite — conqueror without a struggle. It appeared, further, that the king ruling in Babylon at the time of the capitulation was named not Belshazzar, but Nabonidos. This king, as appears from his own records, had a son named Belshazzar, who commanded Babylonian armies in outlying provinces, but who never came to the throne. Nothing

could well be more disconcerting than such a revelation as this. It is held, however, that the startling discrepancies are not so difficult to explain as may appear at first sight. The explanation is found, so the Assyriologist assures us, in the fact that both Hebrew and Greek historians, writing at a considerable interval after the events, and apparently lacking authentic sources, confused the peaceful occupation of Babylon by Cyrus with its siege and capture by a successor to that monarch, Darius Hystaspes. As to the confusion of Babylonian names, — in which, by the way, the Hebrew and Greek authors do not agree, — it is explained that the general, Belshazzar, was perhaps more directly known in Palestine than his father the king. But the vagueness of the Hebrew knowledge is further shown by the fact that Belshazzar, alleged king, is announced as the son of Nebuchadrezzar (misspelled Nebuchadnezzar in the Hebrew writings), while the three kings that reigned after Nebuchadrezzar, and before Nabonidos usurped the throne, are quite overlooked.

Our present concern with the archaeological evidence thus briefly outlined, and with much more of the kind, may be summed up in the question : What in general terms is the inference to be drawn by the world-historian from the Assyrian records in their bearings upon the Hebrew writings ? At first sight this might seem an extremely difficult question to answer. Indeed, to

answer it to the satis- faction of all concerned might well be pronounced impossible. Yet it would seem as if a candid and impartial historian could not well be greatly in doubt in the matter. On the one hand, the general agreement everywhere between the Hebrew accounts and contemporaneous records from Mesopotamia proves beyond cavil that, broadly speaking, the Bible accounts are historically true, and were written by persons who in the main had access to contemporaneous documents. On the other haiid, the discrepancies as to details, the confusion as to exact chronology, the manifest prejudice and partizanship, and the obvious limitations of knowledge make it clear that the writers partook in full measure of the shortcomings of other historians, and that their work must be adjudged by ordinary historical standards.

As much as this is perhaps conceded by most, if not all, schools of Bible criticism of to-day. Professor Sayce, one of the most distinguished of Oriental Assyriologists, writing as an opponent of the purely destr,uctive ” Higher Criticism,” demands no more than that the Book of Genesis ” shall take rank by the side of the other monuments of the past as the record of events which have actually happened and been handed on by credible men ” ; that it shall, in short, be admitted to be ” a collection of ancient documents which have all the value of contemporaneous testimony,” but which being in themselves ” wrecks of vast literatures which extended over the Oriental world from a remote epoch,” cannot be understood aright ” except in the light of the contemporaneous literature of which they form a portion.” From the point of view implied by such words as these, it is only necessary to recall the mental attitude of our grandfathers to appreciate in some measure the revolution in thought that has been wrought in this field within the last half -century, largely through the instrumentality of Oriental archaeology.

Archceology in Classical History.

We have just seen that the general trend of Oriental Archaeology has been reconstructive rather than iconoclastic. Equally true is this of recent Classical Archaeology. Here no such revolution has been effected as that which virtually created anew the history of Oriental Antiquity ; yet the bearings of the new knowledge are similar in kind if different in degree.

The world had never quite forgotten the history of the primitive Greeks as it had forgotten the Mesopotamians, the Himyaritic nations, and the Hittites ; but it remembered their deeds only in the form of poetical myths and traditions. These traditions, finding their clearest delineation in the lines of Homer, had been subjected to the analysis of the critical historians of the early decades of the 19th century, and their authenticity had come to be more than doubted. The philological analysis of Wolf and his successors had raised doubts as to the very existence of Homer, and at one time the main current of scholarly opinion had set strongly in the direction of the belief that the Iliad and the Odyssey were in reality but latter-day collections of divers

recitals that had been handed down by word of mouth from one generation to another of bards through ages of illiteracy. It was strenuously contended that the case could not well be otherwise, inasmuch as the art of writing must have been quite unknown in Greece until after the alleged age of the traditional Homer, whose date had been variously estimated at from 1000 to 800 B.C. by less sceptical generations. It had come to be a current belief that the Iliad was first committed to writing in the age of Pisistratus. A prominent controversialist, Mr Paley, even went so far as to doubt whether a single written copy of the Iliad existed in Greece at the time of the Peloponnesian War. The doubts thus cast upon the age when the Homeric poems first assumed the fixed form of writing were closely associated veith the universal scepticism as to the historical accuracy of any traditions whatever regarding the early history of Greece. Cautious historians had come to regard the so-called ” Heroic Age ” as a prehistoric period regarding which nothing definite was known, or in all probability could be known. It was ably argued by Sir George Cornewall Lewis, in connexion with his inquiries into early Roman history, that a verbal tradition is not transmitted from one generation to another in anything like an authentic form for a longer period than about a century. If, then, the art of writing was unknown in Greece before, let us say, the 6th century B.C., it would be useless to expect that any events of Grecian history prior to about the 7th century B.C. could have been transmitted to posterity with any degree of historical accuracy.

Notwithstanding the allurements of the subject, such conservative historians as Grote were disposed to regard the problems of early Grecian history as inscrutable, and to content themselves with the recital of traditions without attempting to establish their relationship with actual facts. It remained for the more robust faith of a Schliemann to show that such scepticism was all too faint-hearted, by proving that at such sites as Tiryns, Mycenae, and Hissarlik evidences of a very early period of Greek civilization awaited the spade of the excavator. Thanks to the enthusiasm of Schliemann and his successors, we can now substitute for the mythical “Age of Heroes ” a historical ” Mycensean Age ” of Greece, and give tangible proof of its relatively high stage of civilization. Schliemann may or may not have been correct in identifying one of the seven cities that he unearthed at Hissarlik as the fabled Troy itself, but at least his efforts sufficed to give verisimilitude to the Homeric story. With the lessons of recent Oriental archaeology in mind, few will be sceptical enough to doubt that some such contest as that described in the Iliad actually occurred. And now, thanks to the efforts of a large company of workers, notably Dr Arthur Evans and his associates in Cretan exploration, we are coming to speak with some confidence not merely of a Mycenaean but of a pre-Mycenaean Age.

As yet we see these periods somewhat darkly. The illuminative witness of written records is in the main denied us here. Some most archaic inscriptions have indeed been found by the explorers in Crete, but these for the present serve scarcely any other purpose than to prove the antiquity of the art of ■writing among a people who were closely in touch with the inhabitants of HeUas proper. Most un- fortunately for posterity, the Greeks wrote mainly on perishable materials, and hence the chief records even of their later civilization have vanished. The only fragments of Greek manuscripts antedating the Christian era that have been preserved to us have been found in Egypt, where a hospitable climate granted them a term of existence not to be hoped for elsewhere. No fragment of these papyri, indeed, carries us further back than the age of the Ptolemies ; but the Greek inscriptions on the statues of Rameses II. at Abu-Simbel, in Nubia, give conclusive proof that the art of writing was widely disseminated among the Greeks at least three centuries before the age of Alexander. This carries us back towards the traditional age of Homer.

The Cretan inscriptions belong to a far older epoch, and are written in two non-Grecian scripts of undetermined affinities. Here, then, is direct evidence that the -^gean peoples of the Mycenaean Age knew how to write, and it is no longer necessary to assume that the verses of the Tliad were dependent on mere verbal transmission for any such period as has been supposed.

But even were direct evidence of the knowledge of the art of writing in Greece of the early day

altogether lacking, none but the hardiest sceptic could doubt, in the light of recent archaeological dis- coveries elsewhere, that the inhabitants of ancient Hellas of the ” Homeric Age ” must have shared with their contemporaries the capacity to record their thoughts in written words. We have seen that Oriental archaeology has in recent generations revolutionized our conceptions of the antiquity of civiliza- tion. We have seen that written documents have been preserved in Mesopotamia to which such a date as 4500 B.C. may be ascribed with a good deal of confidence ; and that from the third millennium B.C. a flood of contemporary literary records comes to us both from Egypt and Mesopotamia. But until recently it had been supposed that Hellas was shut out entirely from this Oriental culture. Historians have found it hard to dispel the idea that civilization in Greece was a very late development, and that the culture of the age of Solon sprang, in fact, suddenly into existence, as it seems to do in the records of the historian. But the excavations that have given us a knowledge of the Mycensean Age have proved conclusively, not alone that civilization existed in Greece in an early day, but that this civilization was closely linked with the civilization of Egypt. Not only have antiquities been found in Crete that point to Egyptian inspiration, but quite recently Professor Petrie has found at Tel el-Amarna Mycenaean pot- tery. The latter find has a peculiar significance, since the date of the Tel el-Amarna collection is definitely fixed between the years 1400 and 1370 B.C.

It is demonstrated, then, that as early as the beginning of the 14th century B.C. the Mycenaean civilization was in touch with the ancient civilization of Egypt. One must not infer from this, however, that the two civilizations

met on anything like an equality. Indeed, in the wonderful Tel el-Amarna collection there is a suggestive absence of literary documents from the ^gean that demands a word of notice. The Tel el-Amarna collection, it will be recalled, consists of the royal archives of King Amenophis IV. of the XVIIIth Egyptian dynasty, who in the latter years of his reign chose to be known as Khu-n-Aten, ” the glory of the solar disc.” This monarch had retired from Thebes and established his court on the site now known as Tel el-Amarna, where he founded the city which existed only during the brief period of thirty years ending with the death of the monarch about 1370 B.C. The date of the documents found in the royal library is, therefore, fixed within very narrow limits. The documents in question consist chiefly of letters, and constitute one of the most important of archaeological finds. These letters came to the king from almost every part of Western Asia, including Palestine and Phoenicia, Babylonia, and Asia Minor. Strangely enough, all the letters are written in the Babylonian character, and most of them are in the Babylonian language. They afford, therefore, most striking evidence of a widespread diffusion of Babylonian culture. Incidentally they prove, to the utter confusion of a certain school of Bible critics, that the art of writing was familiarly known in Canaan, and that Egypt and Western Asia were in full literary connexion with one another, long before the time of the Exodus. Hence all the elaborate arguments based on the supposition that Moses probably could not write fall to the ground. On the other hand, the absence of letters from Mycenae among the tablets of Tel el-Amarna must be regarded as at least suggestive. Seemingly the widespread Babylonian culture had not reached the ^gean peoples ; yet these peoples cannot have been wholly ignorant of things with which commercial intercourse brought them in contact. The point is of no very great significance, how- ever, since no one has pretended that the Western civilization compared with the Eastern in point of antiquity ; and in any event, no amount of negative evidence weighs a grain in the balance against the positive evidence of the Cretan inscriptions.

In short, then, the researches of the archaeologist are tending to reconstruct the primitive classical history ; and here, as in the Orient, it is evident that historians of the earlier day were constantly blinded by a misconception as to the antiquity of civilization. Such a fruitage as that of Greek culture of the age of Pericles does not come to maturity without a long period of

prepara- tion. Here, as elsewhere, the laws of evolution hold, permitting no sudden stupendous leaps. But it required the arduous labours of the archaeologist to prove a proposition that, once proven, seems self- evident.

Archaeology and the Evolution of Art.

What is true of Greek civilization in general is specifically true of the flower of that civilization, Greek art. Whoever would see the story of the evolution of Greek art illustrated, should go to the British Museum and pass from the Egyptian hall, with its grotesque colossi, to the Assyrian rooms, with their marvellous bas-reliefs, and then on to the Elgin Marbles from the Parthenon. In particular, the art treasures of the Assyrian collection should demand the closest scrutiny. In the Nineveh gallery, for example, where one finds collections of strange Assyrian books, the walls are flanked everywhere with bas-reliefs that come from some buried palace that once stored the literary treasures.

It appears that the kings of that far-off time and land were connoisseurs of art as well as patrons of literature; and the art treasures of their palaces certainly form the most striking, if not the most important, part of the mementoes they have left to us. The more closely these figures in low relief are examined, the more wonderful they will seem. They take the place of the Egyptian carvings in the round ; and if they are less striking to first view than the great sarcophagi, the grotesque gods, and colossal animal forms of that people, they will prove infinitely more expressive and incomparably more artistic on closer inspection. For these flat sculptures depict, not alone gods and sacerdotal scenes, but everyday affairs and the events of Assyrian history. The bas-relief was clearly the focal point of Assyrian art. Even the great bulls and lions that guarded the palace entrances were only partially detached from their background, and a frescoed statue of King Assur-nazir-pal shows the same tendency. The full rounded statue was not indeed unknown to them, as several examples testify ; but their real forte lay in mural decoration in low relief. And the particular walls on which the artists mainly expended their skill, if we may judge from what the ruins have

revealed to us, were not the walls of temples but the palaces of kings. It is quite clear that these great conquerors of antiquity were very human, very like their successors of after times. They loved to have their heroic deeds, real or alleged, heralded to the world, and recalled incessantly to their own memories. So one finds whole histories epitomized on these walls, — wars, conquests, victories ; the storming of cities, the slaughter of the enemy, the leading of captives, and bringing of tribute by subject people, — everything, in short, but Assyrian reverses ; the court artist, true to his colours then as now, never made the mistake of depicting those.

As historical records these sculptures are of priceless value, both for what they tell of political history and for the light they throw on the powers and limitations of antique art. But before you venture to judge the Assyrian artist in the latter regard, you must pass on to the room of Assur-nazir-pal, and from that to the adjacent room, where the mural decorations of the dining-hall of the last of the great Assyrian kings, Assur-bani-pal, have been placed in situ, reproducing an effect which they first made in the palace of Nineveh in the 7th century B.C. Here you may see at once both another phase of royal life in Assyria and another stage of Assyrian art. Not war, but the chase is now the theme. King Assur-bani-pal is seen in pursuit of the goat, the wild ass, the lion. The king, of course, towers above his attendants, though not in the grotesque disproportion of the Egyptian paintings. To the Oriental mind such excessive stature seemed indissoluble from royal station. One recalls how the mother of Darius, made captive at Issus, mistook Hephsestion for the king, because he was taller than Alexander ; and how Agesilaus, when he went to Egypt as an ally of the Egyptians, was held in contempt, despite his renown, because of his diminutive stature ; and one cannot help wondering what would have been the real aspect of the Assyrian and Egyptian monarch could they have been subjected to the camera. Be that as it may, there was apparently no doubt in the mind of the court artist as to what his chisel should reveal in this respect, and the king may always be distinguished by his stature, without regard to his royal robes. Still, it is notable, as a distinction between Egyptian and Assyrian art, that the realistic eye of the Assyrian, sculptor never let him depict the king as a Brobdingnag among the pigmies, after the Egyptian fashion. At the most he is a head taller than those about him.

The royal hunter pursues his quarry sometimes on foot, more usually standing in his chariot. His

weapon is usually the bow, sometimes the spear ; on one occasion he grapples with the lion, hand to jowl, and stabs the quarry to the heart with a short sword. The quiet dignity and royal calm with which the feat is achieved must hate ensured the artist a high and enduring place in the royal favour. The action, however, of the human figures in these sculptures is always sedate and reposeful, suggestive of reserved strength perhaps, or possibly of the artist's limitations. Whichever it is, the real power of the artist is not shown in the human figures. These, to be sure, are in part strongly anatomized ; in the main, they are fairly proportioned, and, unlike the Egyptian figures, they have the shoulders drawn in proper per- spective. But the faces are fixed, impassive ; the eyes are not in perspective, and, as a whole, they cannot claim high merit as works of art, viewed from an abstract modern standpoint. Considered in relation to their time, they are wonderful enough, so far ahead are they of anything that we could suppose to have been accomplished in the world of that day. But they fall far short of the standard which the same artist has himself given us in animal figures of his composition. It seems as if the human figures might have been done from memory, whereas the animal forms are clearly enough from the natural model. Indeed, when we turn to these animal figures we may criticize them, not with reservation as to their age, but from the standpoint of modern art, and as individual figures they will not be found wanting. The three funda- mental canons — " proportion, action, aspect " — have been successfully met. The lions skulk sullenly from their cages, spring furiously into action, or roll in death-agony at the will of the depicter. The lioness, with spine broken by an arrow, dragging her palsied hind-quarters, is a veritable masterpiece. The same is true of many of the figures of goats, of running and pacing wild asses, and of dogs. As a whole, these animal frescoes are nothing less than wonderful. It is worth a visit to London from the remotest land to see these sculptures from the palace of the old Assyrian king.

Still, though these bas-reliefs have intrinsic merits as works of art, their chief value is for what they teach regarding the evolution of art in the world. Previously to their discovery it had been supposed that the stiff formalism of Egyptian sculpture represented the fullest flight' of pre-Grecian art ; and that Greek art itself had stepped suddenly forth, rather a new creation than an evolution. But the pick and shovel of Layard at Nineveh dispelled that illusion. For these art treasures, that had lain there under the deposits of centuries, were found to represent an enormous advance upon Egyptian models, precisely in the direction of that realism for which Greek art is distinguished.

If we would judge how direct and unequivocal was the impulse which the dying nation transferred to the adolescent one in point of art, we have but to take a few steps in the British Museum, from the Assyrian rooms to the wonderful hall that holds Lord Elgin's trophies from the desecrated Parthenon. Look then upon the frieze of bas-relief that bears the magic name of Phidias. If anything can reconcile us to the act that deprived Greece of her priceless heirlooms, it is the fact that they have found lodgment here close beside their Oriental prototypes, where half a million visitors each year may at least have an opportunity to learn the lesson that human progress is an accretion, a growth, a building upon foundations ; and, specifically, that Greek art, no less than other forms of human culture, was an evolution, and not an isolated miracle. For what is the Parthenon frieze, as we now come to it fresh from the palaces of Nineveh, but an Assyrian fresco adapted to the needs and ideals of another race and developed by the genius of a newer civilization ? The profiled figures in low relief coursing together, are they different in conception from the profiled figures of the palaces we have just left ? The horses of the Parthenon frieze might almost seem to have stepped bodily from the palaces of Assur-bani-pal. They have gained some- thing in suppleness of limb, have altered their attitude in a measure, to be sure, thanks to their new environment. But their type has not changed by so much as an actual breed of horses might be changed in as many generations. Note the head, the most typical and characteristic feature of this Grecian steed. Line for line it is the same head, trappings aside, that we have just seen at Nineveh. Even the defects of the Assyrian drawing are there — the too small and slender face, and receding lower jaw, the tiny ear, the far too full and " chuffy " neck.

Possibly no horse in nature was ever like this, but the Assyrian artist so conceives it ; the Greek copies that conception ; and the distorted type will be transmitted down

the generations to the Italian of the Renaissance, to the classical painters of Spain, the Netherlands, and Germany, and France; nay, even to the artist of the 19th century. The court artist of an Oriental prince of the 9th or 10th century B.C. conceives a certain ideal; and, following him, a certain type of sculptured horse, such as the artist who carved it has never seen, steps before the chariots on Napoleon's Arc de Triomphe, in 19th-century Paris.

We have only been able to indicate some of the most important of the issues raised by modern research. Enlightening as the results have been, they are even more striking as the promise of further investigation. At the opening of the Twentieth Century the field of inquiry stretched out on all sides, and the method of cultivating it for the profit of all mankind — since the true history of man on the earth must always be of the supremest interest to intelligent people — had been brought home to us by the new treasures already at our disposal. Strangely enough, there were still obstacles — pecuniary or political — to be faced by those expert archaeologists who had best proved their title to support. But in the light of accomplished facts, it is not reasonable to suppose that a work so successfully begun will not be pushed forward further and further, till every available source of knowledge has been tapped.

ENCYCLOPEDIA BRITANNICA.

(NEW VOLUMES.)

CHICAGO.

Chicago, the second city in size in the United States, situated in Cook county, state of Illinois, in 41° 60′ N. lat. and 87° 34′ W. long. It stretches along the west shore of Lake Michigan for nearly 30 miles. The Chicago river, which empties into the lake, is about a mile long, being formed by the junction of branches from the north-west and south-west. The main river

and the branches are an important part of the harbour, vessels being docked all along the banks. A series of break- waters protect the mouth of the river from the lake storms and make a secure basin. The rivers divide the city into three divisions, the north, south, and west sides. The streets generally intersect at right angles. The total area of the city is 190^ square miles. There are 4074 miles of streets and alleys — 1269-4 improved and 2804-6 unim- proved. The extreme length of the city is 26|- miles and the extreme breadth 14|- miles. In 1880 the population numbered 503,185; in 1890, 1,099,850; and in 1900, 1,698,575. The native-born population (1900) was 1,111,- 463, and the foreign-born 687,112; the total coloured population was 31,435, of whom 30,160 were negroes, and the balance Chinese, Japanese, and Indians. Out of 511,- 048 males of voting age (21 years and over), 20,572 were illiterate (unable to write), of whom 19,336 were foreign- born. Of the total number of males of voting age, as given above, 237,688 were native-born and 273,360 were foreign-born. Of the latter number, 186,660 were natu- ralized, 10,398 had filed their first naturalization papers, 35,897 were aliens, and the citizenship of 40,405 was re- turned by the U.S. census enumerators as unknown. The number of births registered in 1900 was 29,568. The number registered is thought to be perhaps 80 per cent, of the total. The number of deaths in the census year ending 31st May 1900 was 27,633, showing a death- rate of 16-2 per thousand. In 1890 the death-rate was 19-1. As the number of births is only slightly in excess of the number of deaths, it is obvious that the growth of the city in population comes mainly from immigration.

Railways. — Chicago is one of the great railway centres in the United States. Trunk lines reach east to Montreal, Boston, New York, Philadelphia, Baltimore; south to Charleston, Savannah, Florida, Mobile, New Orleans, Texas; west to the Pacific by all the Overland routes. Nearly all the traffic between the northern Atlantic sea- board and the Far West passes through Chicago, and the trade of the city extends in every direction. The Illinois and Michigan canal connects the Chicago river with the waters of the Mississippi for small craft, and it seems not unlikely that some day the new drainage canal will be- come a ship canal, thus making it possible for large ves- sels to ply between New Orleans and Chicago. Local transit is provided partly by the trunk railways, partly by four elevated railways, one on the south side, two on the west side, and one on the north side, all

worked by electricity. The trams are operated by cables or elec- tricity. The local lines, both elevated and tram, belong to private corporations which hold charters for a term of years from the city. One important effect of the abun- dant provision for local travel is seen in the concentration of business in the comparatively small area south of the main river and between the south branch and the lake. Another effect is the wide diffusion of the residential quarter, there being many areas within the city limits very sparsely built up. In consequence of the enormous value of land in the down-town district, the erection of very high buildings for business purposes has become imperative. The highest is the Masonic temple, which has 22 storeys, with a total height of 302 feet. The Monadnock, an office building, has no less than 6000 occupants, and constitutes a postal district by itself — as is the case, indeed, with other such buildings.

Ediication. — Education, as generally in the United States, is largely in the hands of the state, but is liberally supplemented by private effort, by corporations endowed from private munificence, and by church schools. Besides the usual primary, secondary, and higher institutions, there are technical and professional schools and a variety of

special bodies. In addition to institutions with a dis- tinctly scholastic aim, there are libraries, museums, art galleries, and semi-public musical organizations. The free public-school system includes elementary schools, high schools, and a normal school. The following statis- tics are for the school year ending 30th June 1900 : —

Number of Schools.

Number of Teachers.

Number of Pupils.

Elementary schools . High schools Normal schools .

Totals .

130

15

1

5420

349

31

203,880

8,902

552

146

5800

213,134

In 1900 there were 526,013 persons of school age (5 to 20 years).

The cost of the public schools for the year ending 30th June 1900 was $7,096,674. Of this sum $6,295,133 came from taxation and $801,541 from the income on in- vested funds. In 1898 the private schools had 323 teachers and 7625 pupils, and the parochial and church schools 1301 teachers and 78,989 pupils, exclusive of numerous kindergarten and business schools. There are three universities, situated wholly or in part in. Chicago — Lake Porest University, North- Western University, and the University of Chicago. They were founded under Presbyterian, Methodist, and Baptist auspices respectively. The academic departments of the two former are in the suburbs of Lake Forest and Evanston, the professional departments being in Chicago. Lake Forest, for the year ending June 1900,

had 126 students in the college at Lake Forest, 561 in the college of dentg,l surgery, and 364 in the college of law — a total of 1051. North- Western University had an attendance, for the year ending June 1900, of 572 students in the college of liberal arts, 42 in the graduate school, 182 ia theology, 211 in law, 413 in medicine, 235 in pharmacy, 566 in dentistry, and 292 in music, there being a total of 2358 (excluding repetitions). There were in the same depart- ments 277 professors and instructors. The University of Chicago alluded to ia the ninth edition of this work went out of existence in 1886. In 1890 a new institution of the same name (see separate heading below) was in- corporated under the laws of Illinois, and was opened on 1st October 1892. Schools of law and medicine in- clude those connected with the North- Western and Lake Forest Universities, the Rush Medical College (affiliated with the University of Chicago), the College of Phy- sicians and Surgeons (the medical department of the University of Illinois), and several which are indepen- dent. Theological schools, besides those of the uni- versities, are the M'Cormick Theological Seminary (Presbyterian), the Chicago Theological Seminary (Con- gregational), the Western Episcopal Theological Semi- nary, the German Lutheran Theological Seminary, and some others. The Lewis Institute, on the west side, and the Armour Institute of Technology, on the south side, both largely endowed, provide education in which technical instruction is prominent. The Chicago Insti- tute, founded and endowed by Mrs Anita M'Cormick Blaine as an independent school for the training of teachers, is now a part of the University of Chicago. The Chicago Art Institute conducts an art school and maintains a collection of pictures, reproductions of sculpture and bronzes, and original Egyptian antiqui- ties. The library, consisting of over 2000 volumes and 16,000 photographs, is used in connexion both with the school and with the museum. The building, which stands on the Lake Front Park and is the property of the city, cost a little over $700,000. Of this sum $200,000 was paid by the World's Columbian Exposi-

tion, and the rest by the institute and by gifts from its friends. The art school had 1904 students in 1899- 1900. The collection of pictures contains excellent ex- amples of the works of old and modern masters. The Field Columbian Museum occupies the building in Jack- son Park which was the art gallery of the Columbian Exposition of 1893. The nucleus of the

collection was in large gifts from exposition exhibitors, and many additions have been made since. Besides the libraries of the various institutions of learning,- there are a public library and two endowed libraries, the Newberry and the Crerar. The public library has an annual appropria^ tion of about $276,000 from the Common Council, aiid has 272,000 volumes on its shelves. The Newberry Library, on the north side, possesses an endowment fund of about $2,500,000, and has 230,000 volumes. It is especially rich in Americana. The John Crerar Library has an endowment fund of $3,500,000, an in- come (for 1900) of $157,285, and 70,406 books. This library is limited to books on science (including the social sciences). The library of the University of Chi- cago has 337,915 volumes, and that of the Chicago Law Institute (which is accommodated in the Court House) has upwards of 37,000 titles. The Chicago orchestra, mainly supported by voluntary contributions, is devoted to ren- dering classical music.

Religion and Charity. — There are in Chicago 775 churches, or parishes, representing 36 distinct ecclesi- astical organizations. The Baptists have 60 parishes, the Congregationalists 83, the Episcopalians 42, the Lutherans 87, the Methodist Episcopalians 145, the Presbyterians 48, and the Roman Catholics 118. There are also upwards of a hundred missions maintained by the various churches. There are 45 hospitals and several infirmaries and dispensaries in the city. The Cook County Hospital belongs to the county. The others are in the main supported by churches or by private benevolence. Provision is made for indigent patients as well as for those who are able to pay for treatment. There are 55 asylums and homes for the destitute, for orphans, for the aged, the erring, for those afflicted with incurable disease, for the friendless, and the like. Of these the Cook County Insane Asylum and the Cook County Poor House belong to the public. The rest, like the hospitals, are supported by churches or by private benevolence. Chicago has its full share of temporary distress, of habitual mendicancy, of economic inefficiency, of vicious poverty. The city is, however, well equipped with the customary institutions for dealing with such cases. Moreover, to prevent the overlapping of charitable work, and also as a precaution against fraud, there has been organized since the World’s Fair the bureau of charities. For this purpose the city is divided into districts, in each of which there is a local organization, under the general direction of a

central committee. All cases are registered, new cases being examined in detail. Nearly 50,000 family records axe on file in the bureau registration. During 1899, 11,274 applications were made for the services of the bureau. About 26 per cent, of these were sent to the bureau for investigation by co-operating agencies.

Commerce and Industry. — Chicago is a centre of manu- facturing and commerce on the largest scale. Among the leading industries may be enumerated meat-packing, agri- cultural implements, railroad cars, printing, electrical apparatus, brewing, bicycles, pianos, mill machinery, and shipbuilding. Chicago is the greatest grain market in the world. Some idea of the extent of the industries of the city may be obtained from the following statistics for 1899. The receipts of live stock amounted to 14,623,435 head, valued at $233,711,180, and the shipments were 3,006,532 head. There were also shipped during the same

I Lincoln.

SCALE OF MILES.

‘A ‘h. I

Razbvays and. StaHons tfm£

22ndStr.St.

1. GnmdCerdr.Depot t.YerrwTLFark Z. DearioTTi 5iati/)R ^MmtmercwlSanh Z.IUi}wisdepot i.St. James OmrA i.‘NewbenylibTajy W.ESisFark

■Jackson

SjSiteof COLUMBIAN

EXPOSITION 1893

\Park

Plan of Chicago.

year 1,061,868,376 ft) of dressed beef, 506,834,067 lb of lard, 203,464 barrels of pork, and 863,363,437 lb of other hog products. The receipts of sheep were 3,682,832. The Union stock-yards include 475 acres of land, of which 320 acres are floored with planks or brick. Within the yards are 13,000 pens, 8500 of which are covered, for housing hogs and sheep. These covered pens occupy 76 acres. There are also within the yards 25 miles of streets, 38 miles of water troughs, 90 miles of water pipes, and 50 miles of sewerage. The receipts of grain and of flour in the grain equivalent were 320,670,440 bushels, and the shipments were 246,369,099 bushels. The port of Chicago showed 8048 arrivals, with a tonnage of 6,281,355, and 8126 clearances, with a tonnage of 6,317,884. The duties collected on imported goods at the Chicago custom- house amounted to $7,551,400. The greater part of these imports came by rail in bond. The bank clearings were $6,612,311,611, as against $60,761,791,901 for New York, $7,086,286,271 for Boston, and $4,811,079,611 for Philadelphia. The gross receipts of the post ofiice for the fiscal year ending 30th June 1899 were $6,131,123, as against $8,881,547 for New York, $3,143,929 for Philadelphia, and $2,920,383 for Boston.

Government. — The constitution of the state of Illinois forbids the legislature to grant special charters for muni- cipal corporations, and requires that all such incorporations shall be in accordance with a general law. The govern- ment of Chicago, therefore, is framed by the statute which provides for all cities in the state alike. The city is divided into thirty-five wards. Each of these elects two members of the city council, one being chosen each year for a term of two years. Thus the council is a con- tinuous body, one half of its seventy members being renewed annually. The powers of the council are very extensive, including the granting of franchises for the supplying of light and locomotion. The supreme executive of&cer is a mayor, elected by the qualified voters of the city for two years. Legislation requires his assent to be valid, unless a two-thirds vote of the council adopts the measure notwithstanding his veto. The mayor has large power of appointment and removal of ofiftcers, and it is his duty to enforce the laws. The administrative departments are organized in general on the plan of a single head for each, appointed by the mayor with the approval of the

council, the subordinates being appointed by the head with the approval of the mayor. These departments are those of finance, law, public works, fire, police, health, and buildings. The department of education and the public library are administered by boards, whose mem- bers are appointed by the mayor with the approval of the council. The courts of law are courts of the state of Illinois, but a certain number of justices of the peace are designated by the mayor to act as police magistrates.

Local Works. — The water supply is derived from Lake Michigan, there being a series of pumping stations from one mile to five miles from the shore. The system belongs to the city, and is maintained and operated by the depart- ment of public works. The main drainage of the city has been into the lake. In order to preserve the lake water from pollution a drainage canal has been constructed from the south branch of the Chicago river to the Desplaines river, a total distance (including the improved portion of the river) of 34 miles. By this means the water flows from the lake into the Desplaines, and thence by way of the Illinois river into the Mississippi. The water was turned into the channel on 2nd January 1900. The present flow is limited to 360,000 cubic feet per minute, but the canal is designed to have a maximum capacity of 600 000 cubic feet per minute. The entire cost- (1st January 1900) was $34,000,000. The cost is defrayed

from taxes paid by the owners of property in the sanitary district, which includes the greater part of the city and certain suburban areas, a total of 185 square miles. The work is in the hands of a board of trustees elected by the people of the district.

Parks. — An extensive system of parks and connecting drives girdles the city from the shore of the lake on the north to the shore on the south. There are three distinct divisions of the system, known as the north, west, and south parks, each being managed by a board of trustees. The trustees of the north parks and those of the west parks are appointed by the governor of Illinois, while the south park trustees are appointed by the judges within Cook county. There are also several minor parks, which are controlled by the city government. The entire park area comprises 2232‘1 acres — 323-7 on the north side, 627-3 on the west side, and 12814 on the south side. Lincoln Park on the north side, and Jackson Park on the south side, are on

the lake shore. The parks contain someinteresting monuments — especially noteworthy being the bronze statue of Lincoln, the equestrian statue of Grant, and the memorials of Lassalle, Schiller, and Linnaeus in Lincoln Park, and the equestrian statue of Logan in Lake Front Park. The monument dedicated to the Ottawa Indians, in Lincoln Park, and that commemorating the Indian massacre of 1812, are also of interest. In the Oakwoods Cemetery is a monument to the memory of the Union soldiers of the Civil War, and also one to the memory of the Confederate soldiers who died while prisoners in Camp Douglas in the suburbs of Chicago between 1861 and 1866.

Finance. — The total receipts of the city for the fiscal year 1900 were $34,962,473. They were derived from taxation on real estate and on personal property, and from various other sources. The main items' of the receipts, in addition to $2,966,734 cash on hand at beginning of the year, were — property tax, $14,295,829 ; liquor licenses, $3,174,003; other licenses, $638,092; special assessments, $3,246,124; water-works, $3,292,759; loans, $6,138,000.

The total expenditures for the year were $28,733,848, of which the expenditures for construction and other capital outlay amounted to $9,215,772, and those for maintenance and operation to $19,618,076. The main items of the former class of expenditures were — schools, $608,109; streets, $898,699; and loans repaid, $6,060,511. The main items of the latter class were — ^police department, $3,773,423; fire department, $1,617,225; schools, $6,200,433; parks and gardens, $643,089; street clean- ing and sprinkling, $688,662 ; water-works, $1,240,001 ; and interest on debt, $1,313,916. The assessed valu- ation of real property in 1900, on a basis of about 20 per cent, of the full value, was $202,884,012 ; of personal property, on the same basis, $73,681,868. The general tax-rate was $74-87 per $1000. The net debt was

$32,989,819.

By an anomaly in the laws, the rural towns over which the city has extended retain their political structure and some of their functions. It is also true that the dual system of city and county government — the city area paying nine-tenths of the city taxes — is clumsy and burdensome. The rapid growth of

the city makes it necessary to ^provide public improvements on a large scale, and under the laws of the state the income here- tofore has been insufficient to cover necessary expenses. How to provide an adequate income without an exces- sive burden on taxpayers, and without incurring a crushing debt, is one of the grave problems of the near future.

Tlie World's Fair, 1893.— The four-hundredth anni- versary of the discovery of America was commemorated

by a World's Fair at Chicago (see article Exhibitioks). The site was at Jackson Park, on the lake shore, and included 666 acres. On 21st October 1892 (corresponding to 12th October, o.s.), the date of the discovery, occurred the formal dedication of the grounds. ' The fair was opened on 1st May 1893, and was continued untU 15th November. The buUdings, planned by a commission of architects, formed a collection of rare beauty, while the grounds,

intersected by lagoons and bordered by the waters of the lake, gave an appropriate setting. The principal nations of the world, and nearly all the states of the "Union, had appropriate buildings, and the exhibits were on an extensive scale. A notable feature was the series •of congresses on important subjects, of which the parlia- ment of religions was perhaps the most successful. The total number of paid admissions was 27,529,401. Two permanent results of the fair remain in Chicago. The Tield Columbian Museum found the nucleus of its great •collection in many exhibits which were presented to it. The Chicago Art Institute was given by the World's Fair

board $200,000 towards the permanent building on the lake front, used during the fail- as a place of meeting for the various congresses.

Municipal Reform. — In the spring of 1893 the Civic Federation was organized by a number of public-spirited citizens, and through that agency, as well as by other means, much has been accomplished in the direction of giving Chicago better government and better civic con- ditions. In 1895 the state adopted a municipal civU service law, which might be put in force by any city on affirmative vote of the people. It was ratified in Chicago by a majority of over 50,000. Later an improved revenue law and a law for the protec- tion of primary elections have been enacted. All these measures were secured by the efforts of Chicago reformers. In 1896 the Municipal Voters' League was organized. This body has devoted itself to securing a better common council. The league examines and publishes the record of each candidate, no matter by what party nominated, and recom- mends election or defeat, as the case may be. As a result the council has been largely redeemed from the corrupt element which at one time controlled it.

Authorities. — Andkeas. History of Chi- cago. 3 vols. — Blanchakd. History of Chicago and, the Nbrth^West. — ^Bross. His- tory of Chicago. — Land. Chicago : Her Trade and Commerce. — Moses and Kiskland. His- tory of Chicago. 2 vols. — Sheahan and TJpTON. Chicago : Laws and Ordinances of Chicago; Industrial Chicago. 1891-96. 6 vols. — Sparling. Municipal History of Chi- cago.— School Census Reports; Forty-third Annual Statement of the Finances of City of Chicago, from 1st January 1899 to 31st December 1899. — The Lakeside City Directory, 1899. — Forty-second Annual Report of the Trade and Commerce of Chicago {to the Board of Trade) for the year ending 31st December 1899. — Reports of the City Departments and of the various Institutions. — Report of the Committee of the Common Council on Street Railways.

(h. p. J.)

Chicago, University of, sit- uated at Chicago, 111., U.S.A., was founded by John D. Eockefeller, and opened its doors in October 1892. In 1899-1900 it had 223 teachers and 3183 students. It oc- cupies eight blocks in the city of Chicago, upon which seventeen stone been erected ; seven additional ones built. The library contains 305,000

buildings have are now being

volumes. The value of grounds, buildings, and eqviipment is nearly $4,000,000, and the invested funds approximate $6,500,000. The only professional school is in divinity, but fully one-third of the students are engaged in graduate work in arts, literature, and science. The university extension division is important, and the university press publishes twelve scientific periodicals. By a system of affiliation close relationship is sustained with a number of colleges and secondary schools. Students of both sexes are admitted on equal terms. The Yerkes observatory of

the university, -which contains the largest telescope in the world, is situated on Lake Geneva in Wisconsin, 60 miles from Chicago. (w. r. h.)

Chicago Heights, a village of Cook county, Illinois, U.S.A., a few miles S. of Chicago, of which it is a suburb. Population (1900), 5100, of whom 1530 were foreign-born and 47 were negroes.

Chichester, an ancient Roman city and municipal borough in the Chichester parliamentary division of Sussex, England, about 14 miles N.E. of Portsmouth by raU. In 1897 a tramway to Selsey Beach was completed, and the town was thoroughly drained in 1894 at a cost of £33,000. The restoration of the cathedral, which was commenced in 1830, is still in progress, the cloisters being the portions most recently restored (1890-91). The city and borough has been twice extended, and in 1901 had an area of 1596 acres. Population (1881), 8149 ;

(1901), 12,241.

Chiclcamauga Creel(, a small branch of Ten- nessee river, joining it about 6 miles above Chattanooga. It gave the name to a desperate battle during the Civil War, fought on 19th and 20th September 1863, between the Federal forces under Eosecrans and the Confederates under Bragg; and after terrible fighting Eosecrans was repulsed. The Union loss was reported at 16,000, that of the Confederates 18,000. The site of this battle has been converted into a national park by the general Government.

Chicopee, a city of Hampden county, Massachu- setts, U.S.A., situated in 42° 10′ K. lat. and 72° 31′ W. long., on Connecticut river, which is here not navig- able, and on the Boston and Maine railway, 6 miles N. of Springfield. It was chartered as a city in 1890, with an area of 26 square miles of level surface, in which there are the three villages of Chicopee Center, Chicopee Palls, and Willimansett. It has fine water-power in Chicopee river, which joins the Connecticut within the city limits, and has extensive cotton mills and factories for iron “and steel goods, especially for bicycles, arms, cutlery, and agricultural tools. Population (1880), 11,286; (1890), 14,050; (1900), 19,167, of whom 8139 were foreign- born and 10 were negroes.

Chidambaram, or Chblumbbum, a town of British India, in the South Arcot district of Madras, 7 miles from the coast and 151 miles S. of Madras by rail. The population in 1881 was 19,837, and in 1891 it was 18,634 ; the municipal income in 1897-98 was Es.23,690. Its tem- ples are among the most famous in Southern India, and attract 60,000 pilgrims every December. The great temple has a court of 1000 pillars, each a solid block of granite, and its roof is covered with copper and gold. There are a high school and three printing-presses.

Chieng iVIai (Burm. Zimmi), the capital of the Lao state of the same name and the residence of a Siamese high commissioner appointed from Bangkok. This official has jurisidiction over the neighbouring less im- portant states of Lampun, Lakawn-Larapang, Pre, and Nan, each of which, like Chieng Mai itself, retains its hereditary chief, or chao muang, and other hereditary officers. The town, surrounded by the remains of long ineffectual fortifications, is situated on the right bank of of the river Meping, one of the chief branches of the Menam, in E. long. 99° 0′ and N. lat. 18° 46’, in a plain about 800 feet above sea-level, and surrounded by densely forested hill ranges. The population of the town consists chiefly of Lao, with a number of Chinese, Siamese, Shans, and Ka hillmen, and about fifty Europeans, and numbers

from 12,000 to 15,000. The place is growing fast, and a considerable population, probably over 100,000 in number, inhabits the plain in the neighbourhood of the capital. Situated as it is, midway between Moulmein

and Yunnan and between the valley of the Menam and the northern Sh§,n states, it has long been of commercial importance ; while as the centre of the principal teak forests of Siam it has since 1880 attracted a considerable number of British, Sh§,n, and Burmese foresters. By the treaty of 3rd September 1883 between Siam and Great Britain a British consul resides at Chieng Mai, and an International Court has been constituted, with civil and criminal jurisdic- tion in all cases in which British subjects are parties. Surveys have been made for railways from both Bangkok (500 miles) and Moulmein (230 miles). The total value of the annual import and export trade with Burma, China, and Bangkok of the consular district of Chieng Mai, is approximately £1,000,000 sterling, excluding teak. The output of teak will probably be somewhat restricted by the conservancy regulations enforced by the Siamese Porest Department.

Chihuahua, a state of Mexico, bounded on the N. by the United States, on the W. by Sonora, on the E. by Coahuila, and on the S. by Sonora, Sinaloa, and Durango. It has an area of 87,820 square miles. The popula- tion in 1879 was 225,541, and in 1895 it was 262,771, or 3-0 per square mile. It is divided politically into eighteen departments. Mining and stock-raising are the principal industries, though the agricultural interests are also considerable. The state contains some 200 towns and villages. The exports are principally gold and silver, lead, copper, cattle, sheep, and hides. It is estimated that $90,000,000 (gold) represents the American capital in- vested in mining. The value of the agricultural products in 1896 was $2,381,565. The capital. Chihuahua, had a population in 1895 of 18,279, and an estimated one in 1898 of 24,000. It is on the Mexican Central railway, 226 miles south of El Paso (Texas) and 6400 feet above sea-level. It is lighted by electricity, has tramways and good sewerage. The principal public buildings are the cathedral, the state palace, and the Hospital Porfirio Diaz. Other important towns are Parral (7269), Ciudad Juarez (6917), and Jimenez (5381).

Chi las, an insignificant hill village, dominated by a fort, on the left bank of the Indus, about 50 miles below Bunji. It is situated in 35° 27′ N. lat. and 34° 8′ E. long., 4100 feet above sea-level. It was occupied by a British force early in 1893, when a determined attack was made on the place by the Kohistanis from the Indus valley districts to the south-west, aided by

contingents from Darel and Tangir west of Gilgit and north of the Indus. Its importance consists in its position with reference to the Kashmir-Gilgit route vi& Astor, which it flanks. It is now connected with Bunji by a metalled road. Chilas is also important from its command of a much shorter and more direct route to Gilgit from the Punjab frontier than that of Kashmir and the Burzil pass. By the Kashmir route Gilgit is 400 miles from the rail-head at Eawal Pindi. By the Khagan route it would be brought 100 miles nearer, but the unsettled condition of the country through which the road passes is at present a bar to its general use.

Child, Francis James (1825 – 1896), Ameri- can scholar and educationalist, was born in Boston, 1st February 1825. He graduated at Harvard University in 1846, taking the highest rank in his class in all sub- jects; at once became tutor in mathematics (1846-48); and in 1848 was transferred to a tutorship in history, political economy, and English, serving in that capacity for one

year. After two years of study in Europe, in 1851 he succeeded Edward T. Channing, who had helped to shape the style of so many Harvard authors during his occu- pancy of the chair of the Boylston professorship of rhetoric and oratory. He studied ihe English drama (having edited Four Old Flays in 1848) and Germanic philology, the latter at Berlin and Gottiagen during a leave of absence, 1849-51 ; and took general editorial su- pervision of a large collection of the British poets, pub- lished in Boston in 1853 and following years. Spenser was newly and thoroughly edited, with life and notes, by him. At one time he planned an edition of Chaucer in the same series, but contented himself with a. treatise, in the Memoirs of the American Academy of Arts and Sciences for 1863, entitled Observations on the Language of Chaucer’s Canterbury Tales, which did much to establish Chaucerian grammar, pronunciation, and scansion as now generally understood. His largest undertaking, however, grew out of an original collection, in his British Poets series, of English and Scottish Ballads, selected and edited by himself, in eight volumes (Boston, 1857-59). Thence- forward the leisure of his life — much increased by his transfer, in 1876, to the professorship of English — ^was devoted to the comparative

study of British vernacular ballads. He accumulated, in the university library, one of the largest folk-lore collections in existence, studied manuscript rather than printed sources, and carried his investigations into the ballads of all other tongues, mean- while giving a sedulous but conservative hearing to popular versions still surviving. At length his final collection was put to press, as The English and Scot- tish Popular Ballads, at first issued in parts (1882- 98), and then gathered into five folio volumes, which remain the authoritative treasury of their subject. Professor ChUd worked — and overworked — to the last, dying in Boston, 11th September 1896, having completed his task save for a general introduction and bibli- ography. A full and sympathetic biography was pre- fixed to the work by his pupil and successor George L. Kittredge.

Childers, Hugh Cuiring Eardley (1827-1896), British statesman, was born in London on 26th June 1827. On leaving Cambridge he went out to Australia (1850), and became a member of the Government of Vic- toria, but in 1857 returned to England as Agent-Greneral of the colony. Entering Parliament in 1860 as Liberal member for Pontefract (a seat that he continued to hold till 1885), he became Civil Lord of the Treasury in 1864, and in 1865 Einancial Secretary to the Treasury. A de- voted admirer of Gladstone, Childers occupied a succession of prominent posts in the various Gladstone Ministries. He was First Lord of the Admiralty from 1868 to 1871, and as such inaugurated a policy of retrenchment. Ill- health compelled his resignation of oflce in 1871, but next year he returned to the Ministry as Chancellor of the Duchy of Lancaster. Eroni 1880 to 1882 he was Secretary for War, a post he accepted somewhat un- willingly ; and in that position he had to bear the responsibility for the reforms which were introduced into the War OfB.ce under the parsimonious conditions which were then part of the Liberal creed. During his term of ofB.ce the Egyptian war occurred, in which Childers acted with creditable energy; and also the Boer war, in which he and his colleagues showed to less advantage. Erom 1882 to 1885 he was Chancellor of the Exchequer, and the beer and spirit duty in his budget of the latter year was the occasion of the Gov- ernment’s fall Defeated at the general election at Pontefract, he was returned as a Home Ruler (one of the few Liberals who adopted this policy before Mr

Gladstone’s conversion) in 1886 for South Edinburgh, and was Home Secretary in the Ministry of 1886. When the first Home Eule Bill was introduced he demurred privately to its financial clauses, and their withdrawal was largely due to his threat of resignation. He retired from Parliament in 1892, and died on 29th January 1896, his last piece of work being the drafting of a report for the Eoyal Commission on Irish Financial Relations, of which he was chairman. Childers was a capable and industrious administrator of the old Liberal school, and he did his best, in the political conditions then pre- vailing, to improve the naval and military administration while he was at the Admiralty and War Office. His own bent was towards finance, but no striking reform will be associated with his name. His most ambitious effort was his attempt to effect a conversion of Con- sols in 1884, but the scheme proved a failure, though it paved the way for the subseqiient conversion by Mr Goschen in 1888. The Life of Mr Childers, pub- lished by Murray in 1901, throws some interesting side-lights on the inner history of more than one Gladstonian Cabinet.

Children, Cruelty to. — English law has always in theory given to children the same remedies as to adults for ill-usage, whether by their parents or by others, and has never recognized the patria potestas as knovra. to earlier Roman law ; and while powers of discipline and chastisement have been recognized as necessarily incident to paternal authority, the father is civilly liable to his children for wrongs done to them. The only points in which infancy created a defect in civil status were that infants were subject to the restraints on complete freedom of action involved in their being in the legal custody of the father, and that it was and is lavrful for parents, guardians, employers, and teachers to inflict corporal punishment proportioned in amount and severity to the nature of the fault committed and the age and mental capacity of the child punished. But the Court of Chancery, in delegated exercise of the authority of the sovereign as parens patriae, has always asserted the right to take from parents, and if necessary itself to assume the ward- ship of children where parental rights were abused or serious cruelty was inflicted; while abuse of the power of correction is regarded as giving a cause of action or prosecution for assault ; and if attended by fatal results renders the parent liable to indictment for murder or manslaughter.

The conception of what constitutes cruelty to children ‘ has undoubtedly changed considerably with the relaxation of the accepted standard of severity in domestic or schol- astic discipline and the growth of new ideas as to the duties of parents to children, which in their latest devel- opments tend enormously to enlarge the parental duties without any corresponding increase of filial obligations.

Starting from the earlier conception, which limited ill- treatment legally punishable to actual threats or blows, the common law came to recognize criminal liability in cases where persons, bound under duty or contract to supply necessaries to a child, unable by reason of its tender years to provide for itself, wilfully neglected to supply them, and thereby caused the death of the child or injury to its health, although no actual assault had been com- mitted. Questions have from time to time arisen as to what could be regarded as necessary within this rule ; and quite apart from legislation, popular opinion has influenced courts of justice in requiring more from parents and employers than used to be required. But Parlia- ment has also intervened to punish abandonment or ex- posure of infants under two years (24 and 25 Vict. c. 100, § 27), and the neglect or ill-treatment of apprentices or

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CHILE

servants (24 and 25 Vict. e. 100, § 26 ; 38 and 39 Vict. c. 86, § 6) ; and by the Poor Law Amendment Act, 1868, parents were rendered summarily punishable who wilfully neglected to provide adequate food, clothing, medical aid, or lodging for their children under 14 in their custody, whereby the health of the child was or was likely to be seriously injured. This enactment made no express ex- ception in favour of parents who had not sufficient means to do their duty without resort to the poor law, and was construed as imposing criminal liability on parents whose peculiar religious tenets caused them advisedly to refrain from calling in a doctor to a sick child.

But the chief gain in the direction of adequate protec- tion of children prior to 1889 lay less in positive legal enactment on the subject than in the

institution of an effective system of police, whereby it became possible to discover and repress cruelty punishable under the ordinary law. It is quite inaccurate to say that children had very few rights in England, or that animals were better pro- tected. But before the constitution of the present police force, and in the absence of any proper system of public prosecution, it is undeniable that numberless cases of neglect and ill-treatment went unpunished and were treated as nobody's business. In 1889 a special statute was passed to prevent cruelty to children, which was super- seded in 1894 by the Prevention of Cruelty to Children Act, which now regulates the matter and specifically deals with the offence of "cruelty" to children. This offence can only be committed by a person over 16 in respect of a child under 16 of whom he has " custody," " charge," or " care." The Act presumes that a child is in the custody of its parents, step-parents, or a person cohabiting with its parent, or of its guardians ; that it is in the charge of a person to whom the parent has committed such charge (e.g., a schoolmaster), and that it is in the care of a person who has actual possession or control of it. Cruelty is defined as consisting in assault, ill-treatment (falling short of actual assault), neglect, or abandonment of the child in a manner likely to cause unnecessary suffering or injury to health, including injury to or loss of sight, hearing, or limb, or any organ of the body or any mental derange- ment ; and the act or omission must be wilful, i.e., deliberate and intentional, and not merely accidental or inadvertent. Though medical aid is not specified, it has been decided that for a member of the sect of Peculiar People not to call in a doctor may amount to an offence under the Act. The offence may be punished either summarily or on indictment, and the offender may be sent to penal servitude if it is shown that he was pecuniarily interested in the death of the child, e.g., by having taken out one of these

pernicious policies permitted under the Friendly Societies Acts. By § 23 (2) parents may be guilty of cruelty by neglect if they fail to apply for poor relief for their children in the event of their inability otherwise to main- tain them.

This enactment overlaps the common law and the statutes already mentioned. Its real efficacy lies in the main in the provisions which facilitate the taking of evidence of young children, in permitting boards of

guardians to prosecute at the expense of the rates, and in permitting a constable on arresting the offender to take the child away from the accused, and the court of trial on conviction to transfer the custody of the child from the offender to some fit and willing person. The Act has been utilized with great zeal and on the whole with much discretion by various philanthropic societies, whose mem- bers make it their business to discover the ill-treated and neglected children of all classes in society.

Besides the provisions above indicated directly dealing with cruelty to children, there was during Queen Victoria's reign much legislation in the interests of children, requir- ing their parents to procure their elementary education, forbidding the employment of children under 10 in busi- ness or trade for gain (except in the case of children licensed by justices to perform in public), and restricting the employment of children of school age unless they have attained a certain standard of proficiency, which in practice prevents children under 13 from being put to work (the Elementary Education Act, 1876). The labour of boys under 12 underground in mines is forbidden. And where children may legally be employed in factories or shops limitations are imposed with respect to their hours of labour and other matters. The special legislation against the em- ployment of children in agricultural gangs and in sweep- ing chimneys is virtually obsolete, owing to changes in the conditions of these occupations and the subsequent enactments above indicated.

The Act of 1894 also prohibits custodians, &c., of chil- dren from taking them, or letting them be, in the street to beg or receive alms, or to sing, play, perform, or sell in the street or in public-houses between 9 p.m. and 6 a.m. These provisions apply to boys under 14 and girls under 16. There are further prohibitions (1) on allowing chil- dren under 11 to perform, &c., for gain in public-houses or places of public amusement at any hour without a license from a justice, which is granted only as to children over 7 and under stringent conditions ; (2) on allowing children under 16 to be trained as acrobats or for any dangerous performance except by their parents or legal guardians. (w. f. o.)

CHILE.

Geography and Statistics. — Chile, or Chili, extends along the S.W. coast of South America, from the Peruf^ian frontier at 17° 67′ S. lat. to Cape Horn at 55° 59′ S. lat.; total area about 266,460 square miles. After controversies extending over many years, the boundaries have been within recent years settled ^by treaties oan ar es. ›^^1^^^^^ ^^jj^ Bolivia, Peru, and the Argen- tine Republic. Of Northern Chile, the portion extending from 23° S. lat. to the river Loa, comprising the province of Antofagasta, formerly belonged to Bolivia; it was occupied by Chile in accordance with the truce agreement of 4th April 1884, and was definitely ceded by Bolivia by treaty of 1st May 1896. The province of Tarapaca, extending from the river Loa northwards to the river Camarones, 19° 12′ S. lat., was formerly Peruvian. It

was occupied by Chile in 1880, and was definitely re- linquished by Peru by agreement of 28th March 1884. Between the Camarones and the Sama rivers lies the province of Tacna, consisting of the departments of Tacna and Arica. Under the treaty of 20th October 1883 this province was to be held by Chile for ten years, after which a popular vote was to decide whether it should be definitely incorporated with Chile or should revert to Peru, the country retaining it to pay a sum of 10,000,000 pesos to the other. In consequence of disagreement as to the manner of voting and the persons entitled to vote, no action was taken at the end of the ten years' term ; and a convention, signed at Santiago on 16th April 1898, for the taking of the plebiscite was in 1900 rejected by the Chilian Congress.

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The coast of Chile, especially towards the south, is broken by islands. Opposite the province of Atacama is Easter or Pascua Island; facing the coast of Con- cepcion is the small island of Quirquina; farther south are Santa Maria and Mocha; more important are the Chiloe archipelago, consisting of about 96 islands, the Chonos archipelago with over 1000 islands, and, in the extreme south, the archipelago of which the most im- portant islands are Tierra del Fuego, Desolation, Santa Ines, Clarence,

Dawson, and Diego Ramirez islands. The island of Juan Fernandez is 390 miles west of Valparaiso.

Population. —The population of Chile, according to census enumerations from 1876 to 1895, is given as follows : —

Year. Population. Increase.

1875 . . . 2,075,971 256,748

1885 . . . 2,527,820 451,349

1895 . . . 2,712,145 184,825

For the purpose of comparison these figures are of little value.

Prior to 1885 the provinces of Antofagasta, TarapacA, and Tacna

were not included, and the returns for 1885 are imperfect. The

area of the provinces and their population, according to the census

of 1885 and of 1895, with the population per square mile in 1895, are

given as follows : —

Pro-rinoes.

Area, Sq. Miles.

Population,

1885.

Population,

1895.

Pop. per

Sq.Mlle,

1895.

Magallanes Territory

75,270

2,085

5,170

0-06

Chilofe .

4,008

73,420

77,750

19-40

Llanquihu^

7,820

62,809

78,315

10-01

Valdivia .

8,313

60,938

60,687

7-30

Cautin

3,127

33,291

78,221

25-01

Malleco .

2,856

59,492

98,032

34-29

Bio-Bio .

4,157

101,768

88,749

21-35

Arauco

4,246

73,658

59,237

13-95

Concepcion

3,534

182,459

188,190

53-25

Nuhle

3,555

149,871

152,936

43-02

Maule

2,930

124,146

119,791

40-88

Linares .

3,488

110,662

101,858

29-20

Talca

3,677

133,472

128,961

35-07

Curic6

2,912

100,002

103,242

35-46

Colchagua

3,794

155,687

157,666

41-53

O’Higgins

2,523

87,641

85,277

33-80

Santiago .

5,221

329,753

415,636

79-60

Valparaiso

1,659

203,320

220,756

13-30

Aconcagua

6,225

144,126

113,165

18-18

Coquimbo

12,869

176,344

160,898

12-50

Atacamd .

28,371

76,566

69,713

2-10

Antofagasta

47,918

21,213

44,085

0-92

Tarapaci .

19,300

45,086

89,751

4-65

Tacna Total .

8,685

29,523

24,160

2-78

266,458

2,527,320

2,712,145

10-18

It is estimated that in the enumeration of 1895, 10 per cent, of the population, or about 271,214, were omitted. The total population at the date of the census would therefore be 2,983,359. The popu- lation on 31st December 1898 was officially estimated at 3,082,178. The foreign population of Chile in 1885 was returned at 65,000 ; in 1895 at 72,812. Of the number in 1895, 42,105 were European, 29,687 were American, 1020 were from Asiatic and other countries. Of the Europeans 8269 were Spanish, 7809 were French, 7687 Italian, 7049 German, 6241 British, 1670 Swiss, 1490 Austro-Hungarian.

The marriages, births, and deaths registered in the 277 registra- tion circumscriptions in 1897 and 1898 were : —

189T 1898

Marriages . . 13,454 13,921

Births . . . 109,057 104,536

Deaths . • . 88,456 83,919

The civil marriage law of 10th January 1884 and the civil registra- tion law of 17th July 1884 came into force on 1st January 1885. The cost of registration is borne by the State. The registration of deaths is required before burial, so that it is fairly trustworthy ; but the registration both of marriages and births is stated to be frequently eluded. The death-rate is hig;h. In the cities of San- tiago and Valparaiso it is stated to be little under

60 per 1000, the mortality among children being very great. With a view to remedy this evil an Act was passed in February 1896 making drain- age compulsory in the centres of population. Immigration goes on under the care of colonization agencies, which in 1896 introduced 988 agricultural and 1114 industrial immigrants from Europe. In 1897 the total number introduced was 807. In 1898 the Govern- ment voted the sum of £46,300 to the assistance of immigration,

1895.

256,413

1898. 311,704

122,447

140,262

39,837

51,781

33,232

40,237

28,738

32,769

33,031

30,000

13,530

16,795

12,669

14,326

10,431

14,284

and in 1899 £38,680 to the same purpose. The result, however, proved so unsatisfactory that the Government have discontinued their direct subsidies for the encouragement of immigration. The agricultural portion of Chile is in the south, where rain is almost incessant, the forest growth dense, and the labour of clearing a few acres out of all proportion to the profits. Moreover, roads are wanting, and there is no adequate protection for life and property against outlaws and other dangerous characters. The Government has therefore turned its attention to the improvement of existing settlements, and for this purpose a sum of money is provided in the budget of 1900. The enumerated population in 1895 consisted of 1,240,353 inhabitants of towns and 1,471,792 of rural districts. The principal cities and towns, with the census population of 1895 and the estimated population on 31st December 1898, are-: —

Santiago .

Valparaiso .

Concepcion

Talca .

Chilian

Iquique

Antofagasta

Curled

Talcahuano

The political constitution of 1833 is, with some amend- ments, in force. The principal amendments were made by laws of 9th August 1888, 11th August 1890, 20th August 1890, 22nd December 1891, 7th ^”^f”’”” July 1892. The Chamber of Deputies consists of members elected for three years directly by the reg- istered electors of each department — one deputy for 30,000 inhabitants. The republic is divided into electoral districts and subdivided into sections of 160 inscriptions, the registers of which are kept by the municipal authori- ties. On the basis of the census returns of 1885, the number of deputies was fixed at ninety-four. Senators are similarly elected, but for six yearsL and they are chosen, not in departments, but in the provinces — one senator for every three deputies. For the Chamber of Deputies and for the Senate there are triennial elections, the Chamber being renewed entirely and the Senate to the extent of one-half every three years. For the Chamber and for the Senate the system of voting is cumulative. Senators and deputies are unpaid.

At the head of the executive power is the President of the Republic, chosen for five years indirectly by the nar tion, the electors being specially chosen by the provinces — three electors for each deputy. The election of the president takes place on 25th June of the last year of the presidential term, and the new president is inaugurated on 18th September following.

Local Government. — The Republic is divided Into provinces, departments, and 282 municipal districts. Each municipal dis- trict has, by law of 22nd December 1891, a municipality or council of at least nine members chosen by popular election. At the ses- sions of the municipalities or councils the intendentes, governors, or sub-governors of the national government preside. In the municipal districts assemblies of electors are held under the presi- dency of the first mayor for the election of councillors, the sanc- tioning of the local budget or of local loans (which are limited in amount), and for other business. The total municipal revenues in 1896 amounted to 8,767,780 pesos, and the expenditure to 9,010,730 pesos. If the peso is taken at Is. 6d., the revenues were equivalent to £657,580 and the expenditure to £676,800 sterling. The principal police force, the fiscal police, is maintained and commanded by the national government, but the municipal force is still under the control of the municipalities. In Tacna municipal administration is carried on conjointly by the political heads of

the departments and by councils (juntas) of three members appointed for three years by the president of the republic. There is a similar system in the territory of Magallanes.

Education. — Public education is free (at the cost of the State), but not compulsory. It is directed by a council, at the head of which is the minister of public instruction. Higher and secondary education are given in the university and the national institute at Santiago, and in the provincial colleges or liceos. In 1899 there were 573 university degrees and diplomas conferred. Besides the State university, there is a Catholic university giving instruction

statistics]

in theology, in law, and in mathematical and physical science. In 1899 the national institute had 1168 pupils. There are in Chile six clerical seminaries which receive a small government subven- tion. Three colleges for. girls are maintained by the State, and many schools for girls receive subventions. There are, besides, normal, agricultural, technical, and commercial schools. The estimates for 1898 provided a sum of £150,000 for higher and secondary education. In 1899 there were in Chile 1403 public primary schools (435 for boys, 276 for girls, and 692 mixed), with 2299 teachers (748 male and 1551 female) ; the enrolled pupils numbered 115,635 (56,278 boys and 59,257 girls), and the average attendance 70,607 (33,746 boys and 36,861 girls). The cost of primary instruction was £156,000. There were also, in 1899, 445 private elementary schools (148 for boys, 60 for girls, and 247 mixed) with 26,294 enrolled pupils (15,885 boys and 10,409 girls). Private schools devoted solely to popular education are assisted by the State. The German colonies of Valdivia and Llanquihu6 have excellent schools.

Crime. — The penal establishments of Chile, 87 in number (in- cluding the two penitentiaries at Santiago and Talca), have been under direct government administration since 1891. On 1st Janu- ary 1900 they

contained 7051 criminals (6219 men and 832 women). The total number of prisoners they received during the year 1899 was 34,429, of whom 28,037 were male and 6392 female. In 1899, 432 boys were sent to the two correctional schools.

Charity. — In Chile there are numerous charitable institutions supported by endowments, legacies, donations, subscriptions, and government contributions. In 1897 State assistance was given to 79 hospitals to the amount of £65,000 ; to two lunatic asylums to the amount of £18,400; and to other institutions,, £17,015. In Santiago in 1898 over £15,000 was spent in enlarging and im- proving the hospitals, but in many of the provinces the distress and poverty are very great, and the hospital accommodation is insufficient.

Finance. — The ordinary revenue and expenditure of Chile in 1892 and in the last four years were as follows (1 peso=18d.): —

Years.

Bevenue.

Expenditure.

£

£

1892

4,680,000

4,667,500

1896

6,099,600

6,271,000

1897

6,407,900

6,346,000

1898

6,635,300

6,579,500

1899

6,475,460

6,059,500

The estimated revenue and expenditure for 1900 were as’ follows (pesos at 18d.): —

Revenue.

Expenditure.

Ordinary — £ Export duties . 3,486,320 Import duties . 1,537,500 Railways . . 937,500 Posts, telegraphs . 90,000 Various . . 333,750

Ordinary— £ Interior . . 758,100 Einance . . 1,531,680 “War, marine . 1,450,870 Railways . . 1,542,770 Justice, instruction 793,960 Various . . 365,900

Total . 6,385,070 Extraordinary . 1,625,830

Grand total . 7,910,900

Total . . 6,443,280 Extraordinary . 1,125,000

Grand total . 7,568,280

The export duties are levied mainly on nitrate and iodine.

Recent additions to the external debt of Chile have been in- curred mainly for the satisfaction of claims arising out of the occupa^ tion of Peru, for railway construction, and other public works, and for the payment of floating and municipal debts. The internal debt consists of municipal debts, annuities (“censos”), a 3 per cent, debt, and the debt arising from the issue of notes under the law of 7th July 1898, amounting to 46,691,400 pesos. There is due . also a balance on treasury bills discounted in London. The debt outstanding on 31st December 1899, and the debt charge were as follows : —

Description of Debt,

• Capital.

Charge. £965,105

External debt .

. £17,541,785

Internal obligations —

Amount, 72,892,118 pesos

5,466,908

...

Charge, 1,343,485 „

.

100,261

Treasury bills, due in 1900

166,666

166,666

Total .... £23,175,359 £1,232,332 To be set off against this debt is the value of government pro- perty, which (exclusive of government buildings) was estimated in 1897 to amount to 371,260,258 pesos or £27,846,800 sterling. A more recent estimate, based on actual prices, puts the value as follows in sterling : Nitrate fields, £3,000,000 ; guano deposits, £100,000 ; State railways, £12,000,000 ; State telegraphs, £50,000;

‹hm

AjilofagSS

I Antofagasta

Jujuy

aCoDJtfpO

=B’

-oacepq

Chiloe\

Ihonos ,

-^ PROVINCES Ta. Tacna

Coq. Coquimbo

A. Aconcagua V, Valparaiso S. Santiago O. O’Higgins Co. Colcbagua Cu. Curico

T Talca

M. Maula

L Linares

N. Nuble

C. Concepcion

B. Biobio 41 Ma. M^lleco Ar. Arauco

Ca, Cautinf Vald. Valdivia Ll. Llanquihue

Arch.JSfi

^Desolatio^i^J.

\

Stines f. _ Magellan Str,

i^Qoi

State lands, £2,600,000 ; Talcahuano dock, £450,000 ; movable property, £80,000— total, £18,180,000.

The value of the real property held in 1896 by corporations was returned at 55,875,021 pesos (£4,190,630), and that held by private persons at 1,436,125,688 pesos (£107,709,430)— total, 1,492,000,709 pesos (£111,900,060). The mortgages on private estates amounted to 200,236,400 pesos (£16,018,730). In 1899, however, the price of land had fallen 30 or 40 per cent., so that the value of real estate in private ownership did not exceed 950,000,000 pesos (£71,250,000,) while the mortgages had risen to 215,000,000 pesos (at par £16,125,000). The total value of real property (exclusive of gov- ernment property) in 1899 may be put at about 1,000,000,000 pesos (£75,000,000 at par, or about £63,000,000 at the current rate of exchange).

Defence. — The army of Chile, according to the law of 24th November 1897, must not exceed 9000 men. The strength for 1900 was fixed at 5885, with 913 officers. This force is organized in 1 regiment (2 battalions) of coast artillery, 6 regiments of field artillery, 10 of infantry, 8 of cavalry, 1 corps of engineers (4 companies), 2 corps of pen- sioners, and the whole is distri- buted among the four military zones into which Chile is divided. For

the last ten years German drill instructors have been em- ployed; Mauser and Mannlicher rifles are used, and the batteries have Krupp guns of the newest type. By law of 12th February 1896 the National Guard con- sists of three branches — the active, comprising all citizens of 20 and 21 years of age ; the pas- sive, all over 21 years of age who have completed their service in the active ; the sedentary, all from 30 to 40 years of age who are married. The total number in the National Guard is about 613,000, with 2400 officers. The Territorial Guard, numbering 19,862, organized in 1896 to de- fend the passes of the Andes, was disbanded in 1898. In Chile there are three military schools, a military museum, a cartridge factory, and other military estab- lishments. The navy in 1899 consisted of 3 battleships, launched respectively in 1890, 1874, and 1865 ; 2 armoured cruisers ; 2 second-class and 2 third – class cruisers ; 11 gun- vessels and gunboats ; 4 de- stroyers, launched at Birkenhead in 1896, and all of a speed of more than 30 knots ; 15 first- class and 4 second-class torpedo- boats. There are also training and school ships, and craft for special service. In order to re- duce expenditure, several vessels were laid up in 1899. In 1898 the navy had 368 commissioned and staff officers and 3794 warrant officers and men. Naval schools were founded in 1893. A num- ber of steamers of the South American Steamboat Company are subventioned and held at the disposal of the Government for transport service.

Agriculture. — The region most favourable for agriculture ex- tends from Santiago to Concepcion, where large quantities of wheat are grown, and barley, maize, oats, and rye are also cultivated. Many industrial plants prosper in this region, notably the sugar beet, flax, colza, sorghum, hops, and tobacco. The grape thrives well, and nearly 15,000 acres are planted with vines. South of the agricultural region the climate is rainy, but the forest growth is luxuriant, and a great timber traffic is carried on. Stock- raising has considerable importance in Chile, more especially the rearing of sheep, vicuna, and hogs. The country is estimated to contain

„ Cape Hori}’ -Diego Rnmirraja^

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Sketch Map op Chile,

[statistics

about 3 million head of cattle and 3J million sheep, but there are no official statistics on the subject. About H millions of the population are dependent on agriculture, and the country produces annually some 28J million bushels of wheat and 8J million bushels of other cereals, apart from fruits, vegetables, &o. Bee-keeping has some importance in the south, the annual export of honey being about 2800 tons.

Nitrate Production. — By the acquisition of the provinces of Tara- pacd and Antofagasta (1880-84) and the occupation of the province of Tacna, Chile obtained a vast addition to its mineral resources. The guano deposits lying on the coast of this region are nearly ex- hausted, but farther inland lies the nitrate zone, stretching, with a breadth of about three miles, from the Azapa valley in the province of Tacna, through the province of Tarapacd and into the desert of Atacama, a total length of about 250 miles. In the provinces of Tara- paca and Antofagasta there are many refineries for purifying the crude nitrate or caliche, the centre of the industry being at Iquique.

The weight (metric tons) and value of nitrate of soda exported from 1879 onwards were as follows : —

Tears.

Tons.

Value.

Tears.

Tons.

Value.

1879

59,348

£751,690

1889

921,380

£5,771,220

1880

226,090

2,290,710

1890

1,026,290

5,950,470

1881

358,100

3,624,530

1891

891,720

5,174,500

1882

489,340

4,543,900

1892

797,820

5,030,630

1883

584,790

5,073,560

1893

947,020

6,208,650

1884

559,640

3,984,140

1894

1,081,330

7,018,680

1885

429,660

3,191,040

1895

1,220,420

7,208,680

1886

452,780

3,044,750

1896

1,111,750

6,955,850

1887

712,760

4,456,070

1897

1,057,630

5,928,290

1888

784,240

5,361,730

1898

1,294,220

6,800,650

The output for export in 1899 was estimated at 1,360,000 tons, ■worth about £9,375,000 at the prices quoted in October.

From the saline waters iodine is extracted in large quantities. The quantity of iodine exported in 1897 was 535,430 R), and in 1898, 517,460 lb.

Other Minerals. — Copper is found in abundance, notably in the provinces of Tarapaci, Antofagasta, AtacamA, Coquimbo, Acon- cagua, Santiago, and Maule. In 1876 the quantity of bar copper exported reached 41,766 tons, and in 1878, 40,894 tons ; but since then the output and the exportation have declined. During the eight years 1891-98 the export was as follows: —

Tears.

Tons.

Tears.

Tons.

1891 1892 1893 1894

17,464 19,144 19,328 19,640

1895 1896 1897 1898

20,042 20,592 19,011 20,600

Copper is exported in other forms in small quantities. In 1898, 3078 tons of copper ingots, 419 tons of copper and silver ingots, and 20,301 tons of copper ore were sent abroad. The production of copper in 1899 was estimated at 25,000 tons.

Gold and silver mining are carried on in various parts of Chile. Gold mining prospers at Taltal in the north, at several places in the central region, in the Magallanes territory, and in Tierra del Puego. Rich alluvial deposits have been found at Lonquimai, in the province of Temuco, and the future output will probably show a large increase. The exact amount of silver produced is not easily ascertained, as the official statement includes a quantity of

Bolivian silver passing through Chilian ports as if it were Chilian. The export of bar gold and silver from 1893 to 1898 was : —

_ Gold. Silver.

^ ^^^^- Ounces. Ounces.

1893

24,224

4,512,850

1894

47,435

4,942,200

1895

38,082

4,782,210

1896

34,321

4,861,930

1897

36,383

4,614,850

1898

52,420

4,493,170

The value of gold exported in 1897 was £160,000, and of silver £540,000. Iron, manganese, lead, cobalt, nickel, zinc, bismuth are abundant in various provinces. The city of Coronel is the centre of the coal industry ; in 1898 the coal output amounted to 282,600 tons.

The most important industries are connected with the mineral output. There are about 65 nitrate refineries in the nitrate district, the chief being at Lagunas ; and there are works for the extraction of iodine. There are silver works at Playa Blanca ; copper works at Lota, in Concepcion, and other places; sulphur works at Valparaiso, Santiago, and Concepcion. In Valdivia there are iron- foundries for the manufacture of saws and other tools for forest work. Other industries are distilling from native produce, brew- ing, flour-milling, and sugar-refining.

The distribution of the industries and the number of hands employed in the several groups are shown thus : —

Localities. Northern Chile North and Central Chile Central and South Chile

Nnmber of Workers.

55,000 30,000 44,704 400,000 12,000

Industries. Nitrate Mining

Manufacturing Agricultural Stock-raising

Commerce.— The annual value of the imports and exports, at intervals of five years from 1886 and in the years 1897-99, is shown in the subjoined table. Conver.sions have been made for years up to and including 1896 at the rate of 38d. to the peso, for 1897-99 at 18d. to the peso : —

Tears.	Imports.	Exports.
1886 . . .	£6,993,600	£8,113,100
1891 . . .	10,005,700	10,401,800
1896 . . .	11,729,800	11,773,500
1897 . . .	10,365,800	10,247,300
1898 . . .	7,669,700	12,605,200
1899 . . .	7,969,500	12,232,960

Of the imports in 1898, 71 per cent, in value, and of the exports 56 per cent, in value were subject to duty. The import duties amoimted to £1,602,770 ; the export duties to £3,106,100. The most important article of export is nitrate, the value of the ship- ments of which amounted in 1886 to £3,044,760; in 1891, to £6,122,900 ; in 1896, to £6,955,900 ; in 1897, to £5,943,700 ; in 1898, to £6,800,660. The value of the iodine exported m 1891 was £671,342 ; in 1896, £326,790 ; in 1897, £384,647 ; in 1898, to £270,720. Of metals, the most important exports are copper in bars, amounting in 1886 to £1,296,183 ; in 1891, to £771,600 ; in 1896, to £815,100; in 1897, to £893,780; in 1898, to £1,248,896. Bar silver was exported in 1886 to the value of £1,039,410 ; in 1891, £713,670 ; in 1896, £662,300 ; in 1897, £598,680 ; in 1898, to £523,986. Of agricultural produce the chief export is wheat, amounting in 1886 to the value of £773,360 ; in 1891, to £1,146,290 ; in 1896, to £663,450 ; in 1897, to

£411,400 ; in 1898, to £575,234. The chief imports and exports in 1899 were as follows (conversion for both being made at 18d. to the peso) : —

Imports.

Exports.

rood articles .

. £1,827,250

Mineral .

£10,822,800

Textiles .

. 2,179,850

Agricultural .

794,860

Eaw materials .

. 1,626,700

Manufactures .

239,650

Watches, jewellery, &o.

156,850

Animals and animal

Machinery, &c. .

952,130

products Wines, &c.

878,760

Domestic articles

426,460

24,946

Paper, &c.

220,600

Drugs, &c.

126,800

Of the value of imports in 1899, 41 per cent, were from Great Britain, 28 per cent, from Germany, 8 per cent, from the United States. Of the exports, 67 per cent, in value went to Great Britain, 13 per cent, to Germany, 5 per cent, to France, 4 per cent, to the United States. Of the imports in 1899, 63 per cent, in value was landed at Valparaiso, 12 per cent, at Talcahuano, 10 per cent, at Iquique. Of the exports in 1899, 43 per cent, in value was shipped froon Iquique, 11 per cent, from Valparaiso, 9 per cent, from Pisagua. During 1899 trade was hampered by the depreciation of the currency and the fluctuation in the exchange value of the peso consequent on the suspension of the conversion law.

Shipping. — In 1898, 7691 vessels of a total tonnage of 10,162,443 entered, and 7671 of 10,032,661 tons cleared. Of the vessels entered, 1923 of 3,167,579 tons, and of those cleared, 1831 of 2,944,209 tons were engaged in foreign trade. British vessels numbering 1004, ‘ with a total tonnage of 1,738,362, entered from, and 947 with a tonnage of 1,578,326 cleared for, ports outside of Chile. In the coasting trade 2067 British vessels with a tonnage of 3,164,515 entered, and 2081 of 2,246,230 tons cleared. In 1899, in the foreign and coasting trade, 7267 vessels of altogether 10,016,704 tons entered and 7154 of 9,738,769 tons cleared at the ports of Chile. At the end

of 1899 the merchant marine of Chile consisted of 142 vessels with an aggregate tonnage of 71,214 tons, including 39 steamers with a total of 27,387 tons. Chile is in regular com- munication with other American countries and with Europe by Chilian, English, German, and French lines of steamers.

Communications. — Chile has about 43,500 miles of public high- ways, with 25,000 miles of less important roads, and the length of navigable rivers is put at 2800 miles.

The total extent of railway line within the republic in 1899 reached 2886 miles, of which 1458 miles belonged to the State and the remainder to companies. The projected trans-continental railway has been constructed on the Chilian side as far as Salto del Soldado, but 46 miles of line are still required to unite it with the Argentine section. The capital invested in the State railways up to the end of 1899 was approximately 86,907,165 pesos, which (at

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18d.=l peso) would be equivalent to £6,443,440. The gross revenue in 1899 amounted to 13,997,799 pesos (£1,049,840) and the expenditure to 13,911,782 pesos (£1,048,280).

At Santiago there are 65 miles of tramway in process of conver- sion so as to be worked by electric traction. At Valparaiso the tramways are worked by horse-power.

Post, Telegraph, and Telephone. — In 1899 the Chilian post-office despatched 13,033,608 letters and post-cards, and 18,907,252 printed and other packets ; the gross postal revenue amounted to 1,023,377 pesos (£76,750), and the expenditure to 1,065,612 pesos (£79,920). In the same year the State had 9970 miles of telegraph and telephone line, with 11,200 miles of wire, by which during the year 1,183,691 telegrams were sent and

17,831,234 conversations held, the total telegraph receipts having amounted to 613,003 pesos (£45,975). There were, besides, about 2610 miles of railway and private telegraph line. Telephonic communication has been established in all the principal towns, and two companies, one British, the other Chilian, furnish connexion between Santiago and Valparaiso, and between these cities and many smaller towns.

Money and Credit. — In Chile there are 23 joint-stock banks of issue, with an aggregate registered capital of 40,689,665 pesos (£3,051,720) and a note issue in July 1898 of 12,733,160 pesos (or, at par, £954,990). On 31st July 1898 the national government advanced to the banks notes amounting to 27,989,929 pesos (£2,099,240) at 2 per cent, interest per anumn — the total note issue for which the banks were responsible being thus raised to 40,723,089 pesos (£3,054,230). In addition, the treasury put in circulation at the same date notes amounting to 17,693,890 pesos (£1,327,040), and is also responsible for notes for 1,193,641 pesos (£89,520), issued before 1896. There are four banks not banks of issue, and also 15 mortgage banks. The latter issue bonds on real property for, professedly, not more than half its value, and these bonds are sold in open market. The value in circulation in 1899 was officially stated to amount to 155,827,119 pesos (£11,687,030) ; but as the price of land has recently fallen, several estates having been sold at 40 per cent, of their nominal value, while large arrears of interest (probably not less than 3,000,000 pesos, or £225,000) are due to the banks, the condition of landed property seems unsatisfactory.

Monetary System. — The monetary unit of Chile is the uncoined gold peso. Under the law of 11th February 1895 the gold coins are the condor of 20 pesos, the doblon of 10 pesos, and the escudo of 5 pesos. All gold coins are eleven-twelfths fine. The doblon weighs 5-99103 grammes or 92-4536 grains. The gold peso is of the value of 18d., or 13J pesos are equivalent to £1 sterling. The peso is equivalent also to 36 United States cents. Under the same law silver coins are -835 fine. The silver peso weighs 20 grammes or 308-64 grains, and the fractional coinage is of corre- sponding weight. By law of 10th January 1899, however, the coinage of fractional silver money only five-tenths fine to the amount of 5,000,000 pesos within two years was authorized.

Specie payments and the exchange of gold for silver by the mint resumed on 1st June 1895 were suspended by Act of 31st July 1898, which

authorized the issue of 50,000,000 pesos in paper money with a forced circulation, and empowered the president to raise a loan of £4,000,000 sterling for the ultimate withdrawal of the notes. T^e immediate result was the withdrawal of gold and silver from circulation and a rapid fall in the value of the notes, which at the end of 1899 were still at a discount of 18 per cent. In 1901 the conversion scheme was postponed till October

1903.

Weights and Measures. — The metric system of weights and measures is the legal standard of Chile, but the old Spanish methods are still widely used, especially in reference to mining and farm produce. Nitrate of soda, even in official reports, is almost invariably calculated by the quintal (101-40 English pounds). In silver and copper mining the marc (8 ounces) is commonly used to express the richness of the metal. Farm produce is generally sold by the arroba or fanega, whilst the vara in lineal measurement, and the cuadra for indicating the superficial area of land, are customary amongst the country people.

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(w. W. K. ; c. E. A.)

Political History since 1881. — At the opening of 1881 the war between Chile and Peru had reached a stage when the final struggle was close at hand. On 13th January of that year the Chilian forces under command of General Baquedano attacked the entrenched positions of the Peruvians at daybreak in the vicinity of Chorillos, a village some few miles from Lima and forming the outer line of defence for the capital. The fight was a very severe one — ^the defenders, close ot posted behind loop-holed mud walls, offering a yfitbPem. most stubborn resistance to the advance of the invading army. The day ended in victory for the attacking forces, but with a loss of 800 killed and 2500 wounded ; the Peruvian casualties were 6000 killed, 4000 woimded, and 2000 officers and men taken prisoners. On the following day negotiations for peace were attempted by the representatives of the foreign powers in Lima, the object being to avoid, if possible, any further bloodshed. This attempt to end the conflict proved, however, abortive, and on 15th January at 2 p.m. hostilities recommenced in the neighbourhood of Miraflores. After severe fighting for some four hours the Chilians again proved victorious, and drove the Peruvians from the second line of defence back upon the city of Lima. In this battle the invaders lost 500 men killed and 1625 wounded, the Peruvians about 3000 killed and wounded. Lima, the capital of Peru, was at the mercy of the Chilians after this last action, and on 17th January a division of 4000 men of all arms, under the command of General Cornelio Saavedra, was sent forward to occupy the Peruvian capital and restore order within the town limits. A portion of the Chilian forces was shortly afterwards withdrawn from Peru, and the army of occupation remaining in the conquered country was in charge of Admiral Patricio Lynch, an officer who had been specially promoted for distinguished services during the war. President Anibal Pinto of Chile now set about to find means to conclude a treaty of peace with Peru, but his efforts in this direction were frustrated by the armed resistance offered in the country districts to the Chilian authorities by the remainder of

the Peruvian forces under command of General C^eres. So matters continued — ^the Chilians administering on the seaboard and in the principal towns, the Peruvians maintaining a guerilla warfare in the mountainous districts of the interior. In September 1881 the term of office of President Pinto expired, and he was succeeded in the post of chief executive of Chile by President Domingo Santa Maria. Ex-President Pinto died three years later in Valparaiso, leaving a memory respected and admired by all political parties in his country. The name of Pinto will always occupy a prominent place in the annals of Chilian history, not only because the war with Peru took place during his term of office, but also on account of the fact that it was largely due to the intelligent direction of all details by the President during the struggle that the Chilian arms proved so absolutely successful by land and sea.

Senor Domingo §anta Maria, who now acceded to the presidency of Chile, was a Liberal in politics, and had previously held various important posts under the Govern- ment. Under the rule of President Montt he had been

an active member of the Opposition and involved in va- rious revolutionary conspiracies ; for his participation in these plots he was at one time exiled from the country, but returned and received official employment under President Perez. The principal task confronting Presi- dent Santa Maria on assuming the presidency was to

negotiate a treaty of peace with Peru and pro- Snta’” ^ ^°’ *^® evacuation of the Chilian army of Matia. occupation. The presence of the Peruvian

General Caceres and his forces in the interior of Peru prevented for some two years the formation of any Peruvian national administration in Lima with which the Chilian authorities could deal. In August of 1883 the Peruvians were defeated by the forces commanded by Admiral Lynch, and a Government was then organized under the leadership of General Iglesias.

A provisional treaty of peace was then drawn up and signed by General Iglesias and the Chilian representative, and this was finally ratified by the Chilian and Peruvian Congresses respectively in April 1884. By the terms of this treaty Peru ceded to Chile unconditionally the province of Tarapaca, and the provinces of Tacna and Arica were placed under Chilian authority for the term of ten years, the inhabitants having then to decide by a general vote whether they remained a part of Chile or elected to belong Once more to Peru. In the event of the decision being favourable to Peru a sum of 10,000,000 dollars was to be paid by Peru to Chile. On the ratification of this treaty the Chilian forces were immediately withdrawn from Lima and other points of occupation in Peruvian territory. The Government of Bolivia also attempted to negotiate a treaty of peace with Chile in 1884, and for this purpose sent representatives to Santiago. No satisfactory terms, however, could be arranged, and the negotiations ended in only an armistice being agreed to, by which Chile re- mained in occupation of the Bolivian seaboard pending a definite settlement at some future period.

The administration of President Santa Maria met with violent opposition from the Conservatives, who included the Clerical party in their ranks, and also from a certain section of the Liberals. The dislike of the Conservatives to President Santa Maria was occasioned by his introduc- tion of the law of civil marriage, the civil registration of births and deaths, and the freeing of the cemeteries. Hitherto no marriage was legal unless celebrated accord- ing to the rites of the Eoman Catholic religion, and all registers of births and deaths were kept by the parish priests. Civil employees were now appointed under the new laws to attend to this work. Formerly the cemeteries were entirely under the control of the Church, and, with the exception of a few places specially created for the purpose, were reserved, solely for the burial of Eoman Catholics. Under the new regime these cemeteries were made common to the dead of all religions. Under Presi- dent Perez, in 1865, a clause in the law of constitution had been introduced permitting the exercise of all creeds of religion, and this was now put into practice, all restrictions being removed. On several occasions, notably in 1882 and 1885, President Santa Maria used his influence in the elections of senators and deputies to Congress for the purpose of creating a substantial majority in his favour. He was induced to take this course in conse- quence of the violent opposition raised in the Chambers by the liberal policy he pursued in connexion with

Church matters. This intervention caused great irritation amongst the Conservatives and dissentient Liberals, and the political situation on more than one occasion became so strained as to bring the country to .the verge of armed revolution. No outbreak, however, took place, and in 1886 the five years of of&ce for which President Santa

Maria had been elected came to an end, and another Liberal, Senor Balmaceda, then succeeded to power.

The election of Balmaceda was bitterly opposed by the Conservatives and dissentient Liberals, but was finally successfully carried by the ofiicial influence exercised by President Santa Maria. On as- f,^”’’* suming office President Balmaceda endeavoured president to bring about a reconciliation of all sections of the Liberal party in Congress and so form a solid majority to support the administration, and to this end he nomin- ated as ministers representatives of the different political groups. Six months later the Cabinet was reorganized, and two most bitter opponents to the recent election of President Balmaceda were accorded portfolios. Be- lieving that he had now secured the support of the majority in Congress on behalf of any measures he decided to put forward, the new President initiated a policy of heavy expenditure on public works, the building of schools, and the strengthening of the naval and military forces of the republic. Contracts were given out to the value of £6,000,000 for the construction of railways in the southern districts; some 10,000,000 dollars were expended in the erection of schools and colleges ; three cruisers and two sea-going torpedo boats were added to the squadron ; the construction of the naval port at Talcahuano was actively pushed forward ; new armament was purchased for the infantry and artillery branches of the army, and heavy guns were acquired for the purpose of permanently and strongly fortifying the neighbour- hoods of Valparaiso, Talcahuano, and Iquique. In itself this policy was not unreasonable, and in many ways ex- tremely beneficial for the country. Unfortunately cor- ruption crept into the expenditure of the large sums necessary to carry out this programme. Contracts were given by favour and not by merit, and the progress made in the construction of the new public works was far from satisfactory. The opposition in Congress to President Balmaceda began to increase rapidly towards the close of 1887, and further gained groiind in 1888. In order to ensure a majority favourable

to his views, the President threw the whole weight of his official influence into the elections for senators and deputies in 1888 ; but many of the members returned to the Chambers through this official influence joined the Opposition shortly after taking their seats. In 1889 Congress became distinctly hostile to the administration of President Balmaceda, and the political situation became grave, and at times threat- ened to involve the country in civil war. According to usage and custom in Chile, a ministry does not remain in office unless supported by a majority in the Chambers. Balmaceda now found himself in the impossible position of being unable to appoint any ministry that could control a majority in the Senate and Chamber of Deputies and at the same time be in accordance with his own views of the administration of public affairs. At this juncture the President assumed that the Constitution gave him the power of nominating and maintaining in office any ministers he might consider fitting persons for the purpose, and that Congress had no right of interference in the matter. The Chambers were now only waiting for a suitable opportunity to assert their authority. In 1890 it was stated that President Balmaceda had determined to nominate and cause to be elected as his successor at the expiration of his term of office in 1891 one of his own personal friends. This question of the election of another President brought matters to a head, and Congress refused to vote supplies to carry on the Government. To avoid trouble Balmaceda entered into a compromise with Con- gress, and agreed to nominate a ministry to their liking on condition that the supplies for 1890 were voted.

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This Cabinet, however, was of short duration, and re- signed when the ministers understood the full amount of friction between the President and Congress. Balmaceda then nominated a ministry not in accord with the views of Congress, and, to prevent any expression of opinion upon his conduct in the matter, refrained from summon- ing an extraordinary session of the legistature for the discussion of the estimates of revenue and expenditure for 1891. When 1st January 1891 arrived, the President

published a decree in the Diario Oficial to the effect that the budget of 1890 would be considered the ofi&cial budget for 1891. This act was illegal and beyond the Outbreak ‘t›ibutes of the executive power. As a pro- ot the test against the action of President Balmaceda, revolution the Vice-President of the Senate, Senor Waldo otrni. %i\y2,, and the President of the Chamber of Deputies, Senor Eamon Barros Luco, issued a proclama- tion appointing Captain Jorje Montt in command of the squadron, and stating that the navy could not recognize the authority of Balmaceda so long as he did not admin- ister public affairs in accordance with the constitutional law of Chile. The majority of the members of the Chambers sided with this movement, and on 7th January Seiiores Waldo Silva, Barros Luco, and a number of sen- ators and deputies embarked on board the Chilian war- ship Blanco Enccdada, sailing out of Valparaiso harbour and proceeding northwards to Tarapac to organize armed resistance a,gainst the President. It was not alone this action of Balmaceda in connexion with Congress that brought about the revolution. He had alienated the sympathy of the aristocratic classes of Chile by his personal vanity and ambition. The oligarchy composed of the great landowners have always been an important factor in the political life of the republic; when Pres- ident Balmaceda found that he was not a persona grata to this circle he determined to endeavour to govern without their support, and to bring into the admin- istration a set of men who had no traditions and with whom his personality would be all-powerful. The Clerical influence was also thrown against him in consequence of his radical ideas in respect of Church matters.

Immediately on the outbreak of the revolution President Balmaceda published a decree declaring Montt and his companions to be traitors, and without delay organized an army of some 40,000 men for the suppression of the in- surrectionary movement. Meanwhile the squadron under Montt had obtained possession of Iquique after some severe fighting, the garrison of that district offering a stout resistance to the landing of the rebel forces from the men- of-war. Tarapaca was the key of the position in Chile at this moment, the possession of that district and the port of Iquique meaning that money could be obtained freely from the export duties on nitrate of soda. A lull now occurred in the struggle while both sides were preparing for the final shock. President Balmaceda administered the government under dictatorial powers with a Congress of his own nomination. In June 1891 Balmaceda ordered the presidential election to be held, and Senor Claudio Vicuna was duly declared chosen as President of the republic for the term

commencing in September 1891. The resources of Balmaceda were running short on account of the heavy military expenses, and he determined to dispose of the reserve of silver bullion accumulated in the vaults of the Casa de Moneda in accordance with the terms of the law for the conversion of the note issue. The silver was conveyed abroad in a British man-of-war, and disposed of partly for the purchase of a fast steamer to be fitted as an auxiliary cruiser and partly in payment for other kinds of war material.

The organization of the revolutionary forces went on

slowly. Much difficulty was experienced in obtaining the necessary arms and ammunition. A supply of rifles was bought in the United States, and embarked on board the Itata, a Chilian vessel in the service of the rebels. The United States authorities refused to allow this steamer to leave San Diego, and a guard was stationed on the ship. The Itata, however, slipped away and made for the Chilian coast, carrying with her the representatives of the United States. A fast cruiser was immediately sent in pursuit, but only succeeded in overhauling the rebel ship after she was at her destination. The Itata was then forced to return to San Diego without landing her cargo for the insur- gents. The necessary arms and ammimition were arranged for in Europe ; they were shipped in a British vessel, and transferred to a Chilian steamer at Portune Bay, in Tierra del Puego, close to the Strait of Magellan and the Falk- land Islands, and thence carried to Iquique, where they were safely disembarked early in July 1891. A force of 10,000 men was now raised by the junta of the revolution, and preparations were rapidly pushed forward for a move to the south with the object of attacking Valparaiso and Santiago. Early in August a portion of the revolutionary squadron, comprising the Blanco Encalada and other ships, was sent to the southward for reconnoitring pur- poses, and put into the port of Caldera. During the night, and whilst the Blanco Encalada was lying quietly at anchor, a torpedo boat called the Almirante lAjnch, be- longing to the Balmaceda faction, steamed into the bay of Caldera and discharged a torpedo at the rebel ship. The Blanco Encalada sank in a few minutes, and 300 of her crew perished.

In the middle of August 1891 the rebel forces were embarked at Iquique, numbering in all about 9000 men, and sailed for the south. On 21st August

the insurgent army was disembarked near Concon, about twenty miles north of Valparaiso. A severe fight ensued, in which the troops of President Balmaceda were defeated with heavy loss. This reverse roused the worst passions of the President, and he ordered the arrest and imprisonment of all persons suspected of sympathy with the revolutionary cause. The population generally were, however, distinctly antagonistic to Balmaceda ; and this feeling had become accentuated since 17th August 1891, on which date he had ordered the execution of' a number of youths belong- ing to the military college at San Lorenzo on a charge of seditious practices. The shooting of these boys created a feeling of horror throughout the country, and a sensation of uncertainty as to what measures of severity might not be practised in the future if Balmaceda won the day. After the victory at Concon the insurgent army, under command of General Campos, marched in a southerly direction towards Vina del Mar, and thence to Placilla, where the final struggle in the conflict took place. Balmaceda had massed his troops in the vicinity, and confidently expected a victory on account of the superior number of his forces. The fighting was fierce, but the rebel artillery was well directed and thoroughly prepared the way for an assault of the positions. The rebels drove their opponents at the point of the bayonet from one line of trenches to another, until they remained absolute masters of the field and the Balmacedist army was in full fiight without attempting to preserve any sort of order or discipline. Three days later the victorious insurgents suidde'of entered Santiago and assumed the government Baima- of the republic. After the battle of Placilla it '^'• was clear to President Balmaceda that he could no longer hope to find a sufficient strength amongst his adherents to maintain himself in power, and in view of the rapid approach of the rebel army he abandoned his official duties to seek an asylum in the Argentine Legation.

The President remained concealed in this retreat until 18th September. On the evening of that date, when the term for which he had been elected President of the republic terminated, he committed suicide by shooting

himself. The excuse for this act, put forward in letters written shortly before his end, was that he did not believe the conquerors would give him an impartial trial. The death of Balmaceda finished all cause of contention in Chile, and was the closing act of the most severe and bloodiest struggle that country had ever witnessed. In the various engagements throughout the conflict more than 10,000 lives were lost, and the joint expenditure of the two Governments on military prepara- tions and the purchase of war material exceeded £10,000,000, sterling. (See also the section on the war below.)

An unfortunate occurrence soon after the close of the revolution brought strained relations for a short period between the Governments of the United States and Chile. A number of men of the U.S.S. Baltimore having been given liberty on shore, an argument arose between some of them and a group of Chilian sailors in a drinking den in Valparaiso. Words led to blows. The Americans were badly handled, one of their number being killed and others severely hurt. The United States Government characterized the affair as an outrage, demanding an in- demnity of $1,000,000 as satisfaction. The Chilian authorities demurred at this attitude, and attempted to argue the matter. Mr Blaine, then Secretary of State, refused peremptorily to listen to any explanations. In the end Chile paid an indemnity as asked, but the affair left bad feeling in its train.

The close of the revolution against Balmaceda left the government of Chile in the hands of the junta under whose guidance the failitary and naval opera- Monu.^”* tions had been organized. Admiral Jorje Montt had been the head of this revolutionary com- mittee, and he acted as President of the provisional Govern- ment when the admiriistration of the country changed hands after the victory of the Congressional party. An election was now immediately ordered for the choice of a President of the republic and for representatives in the Senate and Chamber of Deputies. Admiral Montt, as head of the execu- tive power, staunchly refused to allow ofiBcial influence to be brought to bear in any way in the Presidential cam- paign. The great majority of the voters, however, required no pressure to decide who was in their opiaion the man most fitted to administer the affairs of the republic. For the first time in the history of Chile a perfectly free election was held, and Admiral Montt was duly chosen by a nearly unanimous vote to be chief

magistrate for the constitutional term of five years. The Senate and Chamber of Deputies were formally constituted iadue course, and the Government of the republic resumed normal conditions of existence. The new President showed admirable tact in dealing with the difficult problem he was called upon to face. Party f eeliag stUl ran high between the partisans to the two sides of the recent conflict. Admiral Montt took the view that it was politic and just to let bygones be bygones, and he acted conscientiously by this principle in all administrative measures in con- nexion with the supporters of the late President Balmaceda. Early in 1892 an amnesty was granted to the officers of the Balmaceda rigime, and they were freely permitted to return to Chile without any attempt being made to molest them. The first political act of national importance of the new Government was the grant of control to the municipalities, which hitherto had possessed little power to direct local affairs, and were not even permitted to dis- pose of the municipal revenues to any important amount without first obtaining the consent of the central Govern-

ment. Almost absolute power was now given these cor- porations to manage their own concerns, and the organiza- tion of the police was placed in their hands ; at a later period, however, it was found necessary to modify this latter condition.

President Montt next turned his attention towards the question of how best to repair the damage occasioned to the country by eight months of civil warfare. The plan of public works authorized iu 1887 was reconsidered, and the construction of portions of the various undertakings recommenced. The army and navy were reorganized. Additional instructors were brought from Germany, and all arms of the military service were placed on a thoroughly efficient footing in matters of drill and discipline. Several new and powerful cruisers were added to the navy, and the internal economy of this branch of the national defence was thoroughly inspected and many defects were remedied. President Montt then took in hand the question of a reform of the currency, the abolition of inconvertible paper money, and the re-establishment of a gold basis as the monetary standard of the republic. This reform of the. currency became the key-note of the President’s policy during the remainder of his term of office. Great opposition was raised by the representatives of the debtor class in Congress to the suppression of the

inconvertible paper money, but in the end President Montt carried the day, and on 11th February 1895 a measure finally became law establishing a gold currency as the only legal tender in Chile. In July 1896 the Conversion Act was put in force, a dollar of 18d. beiug the monetary unit adopted. In 1895 relations with the neighbouring republic of Argentina began to become somewhat strained in regard to the interpretation of the treaty concerning the boundary between the two countries. The treaties of 1881, 1893, and 1895 left doubts in the minds of both Chilians and Argentines as to the position of the frontier line. On 17th April 1896 anofiier protocol was drawn up, by which the contending parties agreed to submit any differences to the arbitration of Great Britain, at the instance of one or both Governments. President Montt had now fulfilled his term of office, and on 18th September 1896 he handed over the presidential power to his successor, Senor Pederico Errazuriz, who had been duly elected in the month of June previously.

The election for the position of President of the republic was closely contested in 1896 between Senor Errazuriz and Senor Reyes, and ended in the triumph of the former candidate by the narrow majority of ^s’*”’ one vote. The father of the new President had been chief magistrate of Chile from 1871 to 1876, and his administration had been one of the best the country had ever enjoyed; his son had therefore traditions to uphold in the post he was now called upon to fill. At the commencement of 1897 the public attention was absorbed by foreign political questions. The problems to be solved were the frontier difficulty with Argentina, the question of the possession of Tacna and Arica with Peru, and the necessity of fulfilling the obligation contracted with Bolivia to give that country a seaport on the Pacific coast. The treaty made in 1896 with the Argentine Government, referring to the arbitration of disputed points concerning the boundary, became practically for the moment a dead letter, and both Argentines and Chilians began to talk openly of an appeal to arms to settle the matter once for all. The Governments of both countries began to purchase large supplies of war material, and generally to make preparations for a possible conflict. In these circumstances no final settlement with Peru and Bolivia was possible, the authorities of those republics holding back to see the issue of the Chile-Argentine

dispute, and Chile being in no position at the time to insist on any terms being arranged. So matters drifted until the beginning of 1898. In July of that year the crisis reached an acute stage. Both Chile and Argentina put forward certain pretensions to territory in the Ata- cama district to the north, and also to a section of Pata- gonia in the souths Neither side would give way, nor was any disposition exhibited to refer the matter to arbi- tration under the protocol of 1896. The cry of an acute financial crisis emanating from the fear of war with Argentina was now raised in Chile. The President was advised that the only way of averting the financial ruin of the banking institutions of the republic was to suspend the conversion law and lend from the national treasury inconvertible notes to the banks. Senor Errazuriz weakly gave way, and a decree was promul- Argen^n^ gated placing the currency once more on an inconvertible paper money basis until 1902. In August of 1898 the Chilian Government determined to insist upon the terms of the protocol of 1896 being acted upon, and intimated to Argentina that they demanded the fulfilment of the clause relating to arbitration on disputed points. This was practically an ultimatum, and a refusal on the part of the Argentine Government to comply with the terms of the 1896 agreement meant a declaration of war by Chile. Por a few days the issue hung in the balance, and then the Argentine Government accepted the provisions made in 1896 for arbitration. The dispute concerning the Atacama district was sub- mitted to an arbitration tribunal, consisting of the repre- sentative of the United States in Argentina, assisted by one Argentine and one Chilian commissioner. This tribunal, after due investigation, gave their decision in April 1899, and the verdict was accepted unreservedly by both Governments. The dispute regarding the Patagonian territory was submitted to the arbitration of Great Britain, and a commission (consisting of Lord Macnaghten, Sir John Ardagh, and Sir T. H. Holdich) was appointed in 1899 to hear the case.

The Argentine dif&culty was ended, but Chile still had to find a settlement with Peru and Bolivia. The treaty made with the former country in 1893

was not ratified, as it was thought to concede too much to Peru, and the subsequent ad referendum treaty was rejected on account of Peru claiming that only Peruvians, and not all resi- dents, should have the right to vote in the plebiscite to be taken by the terms of the treaty of 1883 for the pos- session of Tacna and Arica. By the terms of the armis- tice of 1883 between Chile and Bolivia, a three years' notice had to be given by either Government wishing to denounce that agreement. By the protocol of 1895 Chile agreed to give to Bolivia the port of Arica, or some other suitable position on the seaboard. On these lines a set- tlement was proposed. Vitor, a landing-place a little to the south of AriCa, was offered by the Chilian Govern- ment to Bolivia, but refused as not complying with the conditions stated in the protocol of 1895 ; the Bolivians furthermore preferred to wait and see if Arica was finally ceded by Peru to Chile, and if so to claim the fulfilment of the terms of the protocol.

After the accession to office of President Errazuriz there was no stability of any ministry. Political parties in Congress were so evenly divided that a vote against the ministry was easy to obtain, and the resignation of the Cabinet immediately followed in accordance with the so-called parliamentary system in vogue in Chile. The President of the republic has no power to dissolve the Chambers, to endeavour to remedy the evil by one or another political party obtaining a substantial working majority, but must wait to see the results of the triennial elections. As a consequence of these conditions Conser-

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vative. Liberal, and coalition ministries held ofBce at short intervals. These unsettled political circumstances checked any continuity of policy, and tended to block the passage of all useful legislation to help forward the economic development of the country and inhab- itants; on the other hand the financial situation was better by the end of 1899 than in the previous year, since all proposals for a fresh paper issue had been vetoed; and the elections for Congress and municipal ofiice at the opening of 1900 returned a majority favour- able to a stable currency policy.

In September 1900 a fresh outburst of hostile feeling against Chile was created in Argentina by a note addressed by the Chilian Government to

Bolivia, intimating that Chile was no longer inclined to hand over the port of Arica or any other port on the Pacific, but considered the time ripe for a final settlement of the questions connected with the Chilian occupation of Bolivian territory, which had now been outstanding for sixteen years. The foreign policy of Chile, as indicated by this note, was considered by Argentina to be grasping and unconciliatory, and there were rumours of an anti-Chilian South American federa- tion. Chile disclaimed any aggressive intentions ; but in December the Bolivian Congress declined to relinquish their claim to a port, and refused to conclude a definite treaty of peace. The year closed with a frontier incident between Chile and Argentina in the disputed territory of Ultima Esperanza, where some Argentine colonists were ejected by Chilian police; but both Governments signed protocols agreeing not to take aggressive action in consequence.

At the opening of 1901 the country was chiefly inter- ested in the forthcoming Presidential election, for which the candidates were Don Pedro Montt (Conser- vative and Clerical) and Senor Perman Eiesco (Liberal). The relations between President Errazuriz and Congress became rather strained, owing to the former's inclination to retain in ofiice a ministry on which Congress had passed a vote of censure ; but Errazu- riz had been in ill-health for more than a year, and on 1st May he resigned, and died in July. At the ensuing elec- tion Eiesco was elected President. The attitude of Chile towards the Pan-American Congress at Mexico became a matter of interest in the autumn, particularly in connex- ion with the proposal for compulsory arbitration between all American Governments. The Chilian Governmentmade it quite clear that they would withdraw from the Congress if this proposal was meant to be retroactive ; and their un- yielding attitude testified to the apprehensions felt by Chile concerning United States interference. In October the Chilian Government announced that the contemplated conversion scheme, for which gold had been accumulated, would be postponed for two years (till October 1903), the gold being held as a reserve fund pending the result of the arbitration over the Argentine frontier. This was generally considered to be a reasonable and statesmanlike course. Unfortunately, a recrudescence of the excitement over the boundary dispute was occasioned by the irritation created in Argentina by the fact that, pending a decision, Chile was constructing roads in the disputed territory. During December 1901 relations were exceedingly

strained, and troops were called outon both sides. But at the end of the month it was agreed to leave the question to the British arbitrators, and the latter decided to send one of their number (Sir T. H. Holdich) to examine the territory.

(c. E. A.)

The Civil War of 1891. — The military aspects of the conflict between President Balmaceda and Congress of the Chilian republic, which began in 1890, and led, early in the following years, to civil war, are worth considering separately. The merits of the original dispute

are not by any means clear, but powerful foreign interests were arrayed on the side of Congress, and financial sup- port was forthcoming in defence of those interests. The geographical conditions of Chile are such as to render sea power the dominating factor in any internal or ex- ternal conflict. The country is practically a long strip of seaboard, with few or no longitudinal communications on shore. Sea transport was therefore vital to military operations. On 7th January 1891 the Chilian fleet, which included the armour-clads Blanco Encalada, Coch- rane, and Huascar, declared for Congress. The army, consisting at this time of about 6000 men, adhered to the President. One side was thus driven to create an army, while the other sought to improvise a fleet. The Con- gressionalists determined therefore to seize Iquique as a base and to carry on their preparations in the province of Tarapac^. Hostilities commenced by the bombard- ment and capture of Pisagua, a coast town about 35 miles to the north of Iquique. Pisagua was retaken by the Presi- dent’s forces, and again occupied by the Congressionalists after a heavy naval bombardment. Colonel Robles, the commander-in-chief of the army, endeavouring to recap- ture Pisagua, was defeated, and the garrison of Iquique being withdrawn to his assistance, the Congressionalists occupied the place. Collecting part of his forces, Colonel Eobles succeeded in retaking Iquique, which was then heavily bombarded on 17th February, and was surren- dered upon terms arranged on board H.M.S. Warspite, the British flagship. The Congressionalists, under Colonel

Canto, made great preparations to hold their position, and Colonel Eobles, without waiting to concen- trate a sufiicient force, attacked them at Pozo al Monte. The troops, about 1400 in number, were disastrously de- feated and the commander-in-chief was killed. The rest of the President's forces in this district then crossed the Andes and made their way southwards under great diffi- culties. The effect of these preliminary operations was to give the Congressionalists a good base at Iquique and a firm footing in the province of Tarapaca, which is isolated by desert country from the rest of Chile. Time was on their side, and, moving gradually south, they occu- pied Caldera and set about the creation of an army. Mannlicher repeating rifles and large stores of ammuni- tion were purchased in Europe, and the services of Colonel Korner, a German expert, were obtained. By August about 10,000 men had been armed, organized, and drilled.

Meanwhile the 700-ton torpedo gunboats Condell and Lynch had arrived at Valparaiso from Europe, and the Imperial, a mail steamer of 3300 tons and 16 knots, had been chartered by the President and was armed to serve as an extemporized cruiser. These three vessels went to sea on 18th April, and on the night of the 22nd the Coti- dell and Lynch found and attacked the Blanco Encalada at anchor in Caldera Bay. Many of the Congressionalist officers were dining on shore, and a bad look-out was kept. The Condell discharged three torpedoes at about 100 yards' distance without result ; but the Lynch, closing the armour-clad on the other side, succeeded in striking her amidships. The Blanco Encalada sank in a few minutes, the Condell and Lynch escaping without much damage to either, and with a loss of one killed and ten wounded. This was a striking achievement, carried out with great gallantry ; but the attack would probably have failed if a proper watch had been kept on board the Blanco Enca- lada ; and although the gunboats made other cruises, nothing further was effected.

On 20th August the Congressionalist forces, 9280 strong, disembarked in Quinteros Bay, about 28 miles north of Valparaiso. On the following day the Presi- dent's troops holding the southern bank of the Aconcagua

river were attacked and defeated. The position was a strong one, and the defenders were greatly superior in field artillery, but suffered somewhat from the fire of the Congressionalist vessels. The troops were, however,

badly handled, and both flanks were turned. The battle of Concon was the first in which one side was armed wholly with repeating rifles. The Congressionalists took 1500 prisoners, ” most of whom asked for and obtained leave ” to change their flag. The advance on Valparaiso continued, and it was intended to attack the position of Vina del Mar, about 4 miles from the town, on the 23rd. The attack was not delivered, as the Congressionalist troops did not reach their appointed positions in time and two of the brigade commanders considered the en- trenchments impregnable. After an ineffective artillery engagement the plan was abandoned in favour of a flank march with a view to approach Valparaiso from the south. This offered a great opportunity, which the Balmacedist forces totally neglected. On 27th August the Congres- sionalist army arrived in front of the heights of La Placilla, where the enemy, about 14,000 strong, were attacked on the following day. The left flank of the position was turned and the victory was complete, the loss of the defending and attacking forces being about 3400 and 1800 respectively. The Mannlicher rifles doubt- less contributed to the victory, but the waste of ammuni- tion was great, and the imported arms showed some weakness. The Balmacedist troops were, however, badly commanded throughout this brief campaign, which af- fords few military lessons. After the battle of La Placilla, Valparaiso at once surrendered, and the triumph of the Congressionalist party was complete.

The Chilian civil war supplies a remarkable example of the influence of sea power. The revolt of the navy proved fatal to President Balmaceda’s cause. Unable to reinforce his troops in the north, he lost Iquique, the province of Tarapac^, and the nitrate revenues. It was thus open to the Congressionalists to raise and equip an army at leisure and to disembark it wherever they chose. Military success, for which the way was prepared by the navy, produced decisive results, and the Chilian civil war conformed exactly to the teaching of history, (g. s. c.)

Chilian, a town of Chile, capital of the province of Nuble and of the department of Chilian, 248 miles S. of Santiago by rail. It is reputed to be one of the most picturesque cities of Chile, with fine streets and public squares. Population (1898), 32,769.

Chilllcothe, capital of Livingston county, Missouri, U.S.A., situated in the northern part of the state, on Grand river, at an altitude of 765 feet. It has three railways, the Chicago, Burlington, and Quincy, the Chi- cago, Milwaukee, and St Paul, and the Wabash. Popula- tion (1880), 4078 ; (1890), 5717 ; (1900), 6905, of whom 255 were foreign-born and 538 were negroes.

Chillicothe, capital of Boss county, Ohio, U.S.A., situated in 39° 8′ N”. lat. and 82° 62′ W. long., in the southern part of the state, at an altitude of 620 feet. It has a regular plan with broad streets, on a level plain on the right bank of Scioto river, which here is not navigable. It is at the intersection of three great railways, the Balti- more and Ohio South-Western, the Cincinnati, Hamilton, and Dayton, and the Norfolk and Western. Population (1880), 10,938; (1890), 11,288; (1900), 12,976, of whom 910 were foreign-born and 986 were negroes.

Chimkent, a district town of Russian Central Asia, province Syr-dari-insk, on the mountain stream Badam. It has seven cotton-cleaning mills and soapworks, and its trade is mainly in cattle, hides, wool, raw cotton, grain, oil, and leather. Population, 10,766.

CHII^A.

I. Gbogeapht and Statistics.

Physical Geography. — Important additions to our know- ledge of the physical geography of China were made within the period 1875-1900. Chief among these is the work of Baron F. von Eichthof en, published at Berlin in 1§82, including his geological maps of the northerly part of the empire. The hitherto unknown tracks of western and south-western China have attracted numerous travel- lers, and the trade routes and markets of Szechuen and Yunnan have been explored and described by officers of the British consular service. And within the last year or two of the 19th century private enterprise undertook a survey of the whole route from the Burma frontier to the Yangtse at Chungking, with a view to the construction of a through line of railway. Several eminent French ex- plorers have traversed the same

region with the like object of finding a feasible route from Tongking into Szechuen. For details reference should be made to the works cited at the close of this article, but the following general remarks on the country as a whole are submitted.

The ancient stratified rocks of China form beds of stu- pendous thickness. Of these the most widely diffused is a characteristic limestone to which von Eichthof en gives the name ” Sinian,” its prevalence being so universal that it deserves to take its name from the whole country. In the provinces bordering on the lower Yangtse this lime- stone belt occupies the centre of a group of formations, — the lower being quartzose sandstone and argillite schists, and the upper again argillaceous sandstone often locally altered into quartzite. In Szechuen the limestone attains a thickness of upwards of 11,000 feet in some parts. Ex- tending, as the formations do, over nearly the whole of China, they vary indefinitely in their relations to one another, but the whole points to a long period of quiescence when the central and northern parts of China were sub- merged under deep water. The period corresponds to the Silurian and Devonian epochs in the geology of Europe. Outflows of granitic rock and other violent disturbances brought the period of quiescence to a close. Over the limestone formations there is next found a series of Carboniferous strata almost equally widely diffused. This also varies greatly in various parts of the country. In some parts, as in Shansi, the seams of pure coal are of great thickness, as much as 30 feet or more, in others the beds are thin, and separated by layers of lime- stone and argillaceous strata. These conditions point to a general elevation of the ocean bed alternating with periods of subsequent depression. The Coal Measures are in turn overlain by sedimentary deposits of sandstone, shales, and conglomerates, to a depth of many thou- sand feet. A general elevation then took place prob- ably soon after the close of the Carboniferous epoch, and there is no evidence to point to any subsequent depression beneath the level of the sea. The Jurassic and Creta- ceous series of rocks do not appear to be represented in China. The dominant feature in the geography of China is the existence of the enormous mountain masses on which her western frontier abuts. From these main ranges, spurs or outliers run into China, having generally an east or west trend, and these have determined the courses of the great rivers. Having their sources at a great height, and draining very extensive basins, these rivers have for ages been bringing

down quantities of silt which have been deposited on the beds of ancient lakes, and on the sea bottom, thus forming the Great

Plain of China, which is now so large and important a part of the empire. It fills an area of about 200,000 square miles, and is still growing. Denudation has thus been the prin- cipal agency in giving to Chinese scenery its characteristic features. In Hunan and in Szechuen, where a soft red sandstone abounds, it has converted what at one time was probably a uniform plateau into a thoroughly hilly country. Although large masses of eruptive granite and other igneous rocks are to be found in various parts, it does not appear that volpanic energy has for many ages had any part in determining the configuration of the country. There is no trace anywhere of recent active volcanoes. Intrusive dykes of granite, porphyry, &c., are frequent, more especially in the northerly provinces and Shantung, and in a few places metamorphic action has altered the character of the rocks, but on the whole the sedimentary deposits have not been greatly disturbed by subterra- neous activity. In the province of Shansi a plateau stands out above the plain where the several strata can be traced in a nearly horizontal position over a superficial area of 30,000 square miles. Looking from the plain westwards there is seen to be, first, a rugged barrier made up of very ancient formations ; second, a general substructure of lime- stone of 2000 feet in thickness; third, a series of coal- bearing strata of 500 feet ; fourth, the post-Carboniferous strata of 3000 feet ; and, lastly, a general cover of loess. This is the largest coal field in China, and probably in the world, but a similar sequence of strata is found pre- vailing generally. Though no recent volcanic agency has been traced, there have been, subsequent to the limestone and carboniferous periods, very considerable upheavals, due either to subterranean forces or to the puckering con- sequent on lateral compression. The ridges thus thrown up have taken generally a north-east and south-west trend. They do not rise to any great height, seldom reaching 5000 feet, nor does any one ridge stand out as the pre- dominant mountain chain, but the result is to give a gen- eral mountainous character to large areas of the country. One such belt of hills runs through all the soiith-eastern provinces from Tongking to Hangchow Bay, terminating in the rocky islands of the Chusan Archipelago. Another runs through Szechuen, and is cut transversely by the Yangtse river, which there flows between limestone cliffs forming the picturesque scenery of the Yangtse gorges. A

third series starts from the Mongolian plateau and runs through Chihli and Shansi, forcing the Yellow river to take a long sweep southwards until it finds its way through a similar series of gorges at Lung- men. In the provinces of Kweichow and Yunnan the north-east and south-west system meets the outlying spurs of the central Asian system, which run nearly at right angles to the former, thus causing a confused mass of lofty mountain peaks which defies description. Along such ridges the limestone strata are tilted up and exposed to view, and in a few cases the still deeper strata of ancient plutonic rocks, granitic gneiss, and schists are also exposed. At one of the gorges in the Yangtse, where the river has cut its way across the ridge, the formation is well seen. There is, first, a central core of granite, then a thin bed of metamorphic schist, then the limestone inclined at a high angle on each side, then carbon- iferous strata, and, lastly, the superincumbent layer of sand- stone and other recent deposits, — ^the latter, however, being often eaten away by erosion down to the limestone. This north-east south-west system, however, is on the whole sub- ordinate to the dominant east and west ranges, stretching

from the highlands of central Asia, which have determined the main watersheds. The general course of the rivers is thus from west to east, and whenever they meet these subordinate ranges they ultimately break across, though occasionally diverted for a time. Their course is thus sometimes a series of zigzags, now flowing parallel with the trend, and now breaking through at right angles, flowing in a deep rocky gorge. The formation of these

gorges — some of which on the upper Yangtse, and also on the west or Canton river, are 2000 feet in depth — points to immense antiquity, and probably was preceded by a series of inland lakes. The extensive areas now filled with red sandstone such as exist in Hunan and Szechuen were doubtless the beds of such lakes.

A specially characteristic feature of north China is the deposit termed loess, which not merely imparts to the

■¥ .

‘ Buildings ■ ■ ■ Railways Conceded : —

British Control ,

German

Anglo German

Italian

Anglo Italian

Belgian

Anglo American

Russian . French . .

Sea Frozen in fVifUe

B. V.DarbisHre&O^nffm^R

120

Engl.Miles -

JflO = 0^ 155 800

Sketch Map of China, showing Railway Concessions.

Oxford igoi

country the physical character of the scenery, but also determines the agricultural products, the transport, and general economic life of the people.

It is peculiar to north China, and is not found south of the Yangtse. The loess is a solid, but friable earth of brownish yellow colour, and when triturated with water is not unlike loam, but differs from the latter by its highly porous and tubular structure. Among its constituents, next to the argillaceous basis, fine sand and carbonate of lime predominate. It spreads alike over hills and valleys, smoothing over the irregularities, and has a depth, in many places, of over 1000 feet.

It is not stratified, and has a tendency to vertical cleavage. It is full of fossil land shells, and contains bones of quadrupeds, but has no remains of either marine or freshr water shells. From its porous nature water never lies on the surface. The rainfall is at once absorbed as by a sponge. On the other hand, moisture is retained in the lower portions for long periods. The drainage is conse- quently not carried on the top. Whatever streams or rivulets there are, at once cut their way through the friable earth to the subsoil, carrying down the debris to be de- posited as alluvium on the plains. As the cleavage is

vertical tlie banks fall in, in perpendicular slabs, leav- ing a vertical wall on each side, often hundreds of feet in height. This is always the case in the newly-formed small affluents of the larger streams, and even in the older rivers the valley never slopes gradually down to the river bed, but approaches by a series of terraces, each backed by a vertical wall separating it from the next above. The consequence of this is that communication in a loess-covered country is extremely difficult. Seen from a distance, the valley may present a gentle undulat- ing appearance, but as it is approached it shows a perfect labyrinth of deep cuts with perpendicular walls, among which the traveller without a guide may wander in- definitely, vainly seeking an exit. The loess soil is extremely favourable to agriculture. It bears excellent crops, and not merely on the lower grounds, but at altitudes of 6000 and 8000 feet. Wherever loess is found the peasant can live and thrive. Only one thing is essential, and that is the annual rainfall. As no artificial irrigation is possible, if the rain fails the crops must necessarilyfail. Thus seasons of great famine alternate with seasons of great plenty. It

appears, also, that the soil needs little or no manuring, and very little tillage. From its extremely friable nature the soil is easily broken up, and thus a less amount of labour is required than in other parts. The extreme porosity of the soil probably also accounts for the length of time it will go on bearing crops without becoming exhausted. The rainfall penetrating deeply into’the soil in the absence of stratification, comes into contact with the moisture retained below, which holds in solution whatever inorganic salts the soil may contain, and thus the vegeta- tion has an indefinite store to draw upon. Another peculiarity of loess in China is that it lends itself readily to the excavation of dwellings for the people. In many places whole villages live in cave dwellings dug out in the vertical wall of loess. They construct spiral staircases, selecting places where the ground is firm, and excavate endless chambers and recesses which are said to be very comfortable and salubrious dwellings.

“With respect to its origin. Baron von Eichthofen is of opinion that loess is a subaerial formation. The entire absence of stratification, except in what he calls regener- ated loess, i.e., original loess washed down and deposited in lake bottoms, and the entire absence of marine or fresh- water shells, forbid the supposition that it is an aqueous deposit. The only other agency that can be suggested is air currents combined with rainfall. The latter carries down certain debris, while the former carries the fine dust and sand from the steppes among the herbaceous vegetation, where it is retained and mixed with the de- caying leaves and roots. No strati’fication can take place, and any approach to it will be completely effaced by the roots which descend vertically, and. are probably the chief agents in producing the vertical cleavage.

Meteorology. — The figures in the Table are taken from the observations recorded at the French mission station at Shanghai They give the average of eight years’

Minimum

Maximum

Rainfall

Temperature Fshr.

Temperature Fahr.

Inches.

January

17-8

57°2

2-27

February .

24-3

61-0

2-88

March

30-2 .

75-9

2-87

April

36-7

84-2

3-69

May

46-9

89-2

2-87

June

57-7

92-8

7-86

July

67-8

97-2

3-56

August)

65-3

95-5

4-65

September .

55-8

90-7

5-72

October

40-1

82-6

2-84

November .

28 9

72-7

1-96

December .

21-2

65-3

1-39

observations. The absolute maximum and minimum temperatures during the period were 102° and 12-2° re- spectively.

Climate. — The climate of Shanghai, which is that of the lower Yangtse valley generally, is on the whole favourable. The three months from July to September are somewhat trying to Europeans. The temperature is high and the air is often laden with moisture. The pre- vailing winds duringthis season are south-easterly, caused by heat and the ascending current of air over the sandy deserts of central Asia, thus drawing in a current from the Pacific Ocean. In the winter the converse takes place, and the prevailing winds are north and north-west, which are cold and dry. During the eight or nine months from October to May the climate is bracing and enjoyable. The rainfall is moderate and regular, and a failure of the crops owing to prolonged droughts is very rare. Farther north, however, this is not the case. The provinces of Shantung and Shansi are peculiarly liable to prolonged periods of drought, with consequent severe famines such as that of 1877-78, when many millions died for sheer want of food. In these regions the air is

generally extremely dry, and the daily variations of temperature consequent on excessive radiation are much greater than farther south. Dust storms are also prevalent during the spring months., In the southern and south-western provinces, especially Szechuen, the rainfall is much greater than that above recorded, and the summer heat, though not higher as a maximum than that of Shanghai, is naturally more prolonged and more enervating. But as a whole the climate of China compares favourably with that of any other part of the world lying between the same parallels of latitude. The greater part of it is what may be called a White Man's land, and in no part is it specially trying for Europeans. Certain areas of the province of Yunnan have a reputation among Chinese for iinhealthiness, being mostly those lying at the bottom of deep valleys of the Mekong and Salween rivers, where malarial fever aboimds, and it may be mentioned that certain areas in this pro- vince are the home of the bubonic plague, an epidemic which has recently been attracting so much attention. On the other hand, the plateaus of Yuiman, and notably the plain of Talifu, have the reputation of an excellent climate, the latter, according to Indian travellers, compar- ing favourably with Kashmir.

Area and Population. — The only change in area since 1875 is the annexation to Japan of the island of Formosa, with a population of about 2,000,000. In regard to population no accurate statistics are yet forthcoming. The Chinese Government continues from time to time to print in the Peking Gazette returns of the population made by one or other of the various provincial authorities, but, so far as is known, no systematic attempt has been made to take a general census on European principles. The method of numerar tion is to count the households, and from that to make a return of the total inhabitants of each province. As every province is divided for administrative purposes into so many hsien or districts, and every district into so many hundreds, there would be no great difficulty, as the population is nearly all rural and tax-paying, in obtaining fairly accurate returns if sufficient care were taken. It does not appear, however, that much care is taken. The standing orders are that the returns are to be made every three years, but as no allowance is made to meet the expenses, it is probable that in the majority of cases the last return is taken, and a round sum is added or subtracted to meet the supposed facts of the ease. Mr E. H. Parker published in the number of the Statistical Society's Journal for March 1899 a series of tables translated from Chinese records, giving

tlie popiilation from year to year bet-ween 1651 and 1860. These tables show a gradual rise, though with many fluctuations, up till 1851, when the total population is stated to be 432 millions. From that point it decreases till 1860, when it is put down at only 261 millions. The following table gives as nearly as can be ascertained the actual population at the present time : —

Area

Population

Provillcos.

Square

Population.

per Square

Miles.

Mile.

Anhwei

53,000

20,600,000

388

Cheklang

34,700

11,600,000

334

Chihli .

57,800

17,900,000

309

Fuhkien

41,300

23,500,000

668

Honan .

61,300

22,100,000

360

Hunan .

74,400

21,000,000

295

Hupeh .

65,900

33,500,000

508

Kansuh

131,000

9,400,000

72

Kiangsi

67,500

24,000,000

355

Kiangsu

36,900

25,000,000

568

Kwanggi

80,100

5,100,000

63

Kwangtung

79,300

30,000,000

378

Kweichow

58,800

4,800,000

80

Shansi .

66,700

11,800,000

177

Shantung

55,500

36,000,000

649

Shensi .

74,000

8,300,000

112

Szechuen

160,000

67,100,000

418

Yunnan

155,000

6,200,000

40

Total for eighteen

provinces .

1,353,200

377,900,000

Manchuria .

362,310

12,500,000

, 34

1,715,510

390,400,000

GonstUvtion and Government. — The Government of China is in theory an absolute monarchy. The Emperor is the sole and supreme head of the state. His will is absolute alike in the highest affairs of state and in the humblest details of private life. The highest form of legislation is an imperial decree, whether promulgated in general terms or to meet a special case. In either form it is the law of the land, and no privilege or prescriptive right can be pleaded against it. AU ofiBcers of state, all judges and magistrates, hold their offices entirely at the imperial pleasure. They can be dismissed, degraded, punished with- out reason assigned, and without form of trial —

even with- out knowing by whom or of what they are accused. There are no constitutional checks upon the arbitrary acts of the monarch. He is provided with an advisory council, but he is not bound by their advice, nor need he pretend that he is acting by and with their advice and concurrence. In practice, however, this arbitrary power is tempered in several ways. Firstly, although the constitution confers this absolute and unchecked power on the Emperor, it is not for his gratification but that he may exercise it for the good of his people. He rules by divine authority, and as the vice-regent of Heaven upon earth. If he rules corruptly or unjustly Heaven will send disasters and calamity on the people as a reproof ; if the rule becomes tyrannical Heaven may withdraw its favour entirely, and then rebellion may be justified. Though treason and re- bellion are ordinarily the most heinous of crimes, yet history applauds a successful revolt as evidence of the iniquities of the fallen dynasty. The Manchu dynasty came to the throne as foreign conquerors, nevertheless they have adopted this theory, and base their right to rule, not on the power of the sword, but on divine approval. On this moral ground they claim the obedience of their sub- jects, and submit themselves to the corresponding obliga^ tions. A more effective check upon the caprice of the Emperor, however, is the second which we wiU notice, namely, that the constitution prescribes that the Emperor shall live in seclusion. He is consequently dependent for

his facts on such information as the courtiers and high officers of state permit to reach him, and he is further dependent for the execution of his decrees on such means as these same officers supply him with. Though in theory he can command the services and money of his subjects to an unlimited extent, yet the crown as such has no revenues peculiarly its own. It is dependent for the pay of the troops, as well as for the ordinary expenses of the imperial household, on contributions levied through the high officials on the several provinces, and without their con- currence and co-operation nothing can be done. The power of the purse and the power of the sword are thus exercised mediately through the instruments recognized by the constitution, and it thus comes about that the auto- cratic power is in practice transferred to the general body of high functionaries, or to that clique of them who for the time being have the ear of the emperor, and who are united enough and powerful enough to impose their will on the others. The high functionaries of state who thus really wield the supreme power are

almost without excep- tion civil officials who have risen from the ranks of the people. There is no hereditary aristocracy in the European sense of the term. Hereditary rank is indeed bestowed on a few public servants usually for a limited number of lives, and there are among the descendants of the Manchu chief- tains, who helped to found the dynasty, a few who hold titles of nobility, but in either case the rank per se gives them no status in the constitution. Among the princes of the blood there are a small number who hold high office and take an important part in the Government, such as the late Prince Kung and Prince Ching, the former and the present head of the Tsung-Li-Yamen, but their right to have a voice in public affairs is in virtue of their holding office, not in virtue of their nobility. Practically all the high officials who now constitute the Government of China have risen through the junior ranks of the civil service, and obtained their high position as the reward — so it must be presumed — of long and distinguished public service.

The functions of Government are divided between (o) the central administration and (6) the provincial admin- istration. The empire proper is divided into eighteen provincial governments, each of which has a complete ad- ministrative machinery of its own, and possesses a quasi- independence in financial and military affairs. In some cases two or three are grouped together under a governor- general, often called a viceroy, without, however, affecting their independent status. At the head of each province is a governor, whose main functions are to keep the peace and preserve order, to collect the taxes, to raise and pay his own troops, pay the salaries of the civil service, remit the regulation quota of the taxes in money and in kind, as the case may be, to Peking, and to find and remit the extra ” squeezes ” which the needs of the central Government may demand. If he does all that and things go smoothly, the central Government does not interfere with him. He renders pro formd accounts to the Board of Revenue at Peking, but no effective scrutiny is maintained. He is not responsible for disorder beyond his own border, nor bound to send military aid to his neighbours even against foreign invasion. The functions of the central Govern- ment, on the other hand, are mostly confined to checking and registering the acts of the provincial governments, and seeing that things are done in conformity with precedent and with established rules. If the central authorities take the initiative, and issue orders, as they occasionally are

forced to do, under foreign pressure, it by no means follows that they will be carried out. The orders, if unwelcome, are not directly disobeyed, but rather ignored, or specious pleas are put forward, showing the difficulty or impossi- bility of carrying them out at that particular juncture.

The central Government always ~~wields the power of removing or degrading a recalcitrant governor, and no case has been known where such an order was not promptly obeyed. But the central Government being composed of officials, stand by their order, and are extremely reluctant to issue such a command, especially at the bidding of a foreign Power. Generally the opinion of the governors and viceroys has great weight with the central Govern~~ ment, and probably no great measure of policy would be entered upon without their advice and concurrence The Boxer troubles and the flight of the court from Peking on the approach of the foreign expeditionary force (Aug. 1900) shook the whole governmental fabric of the Chinese Empire This and the following sections must therefore be taken as representing the normal condition of things before the outbreak of disturbances in 1900.

Central Administration. — The following are the principal departments of the central Government : —

1. The Grand Secretariat {Neiko), consisting of four grand secretaries and two assistant grand secretaries, half of whom, according to a general rule applicable to nearly all the high offices in Peking, must be Manchu and half Chinese. This was originally the Supreme Council of the empire, but under the present dynasty it has ceased to be of active importance It constitutes the Im- perial Chancery or Court of Archives, and admission to its ranks confers the highest distinction attainable by Chinese officials, though with functions that are almost purely nominal. Members of the Grand Secretariat are distinguished by the honorary title of Chung-tang. The most distinguished viceroys are usually advanced to the dignity of grand secretary while continuing to occupy their posts in the provinces.

2. Grand Council (Chun Chi Chu). — This department, the actual Privy Council of the sovereign, in whose presence its members daily transact the business of the state, is composed of a small knot of men holding various high offices in the Government boards at Peking. The num- ber is undetermined, but at present it is five. The literal meaning of the Chinese name Chun Chi Chu is “place of plans for the army,” and the institution derives its name from the practice established by the early emperors of the dynasty of treating public affairs on the footing of a military council. The usual time of transacting business is, in accordance with Chinese custom, from 4 to 6 a.m.

3. Tsung-Li-Yamen. — This, the best known of all the Chinese departments, was created after the Anglo- Chinese war in 1860 as a Board for Foreign Affairs. Previously to that war, which established the right of foreign Powers to have their representatives in Peking, all foreign business was transacted by one of the provincial viceroys, chiefly the viceroy of Canton. The only department at Peking which dealt specially with foreign affairs was the Li Fan Tuen or Board of Control for the dependencies, which regulated the affairs of Mongolia, Tibet, and the tributary states generally. With the advent of formally accredited ambassadors from the European Powers something more than this was required, and a special board was appointed to dis- cuss and if possible settle all questions with the foreign envoys. The number was originally four, with Prince Knng, a brother of the late emperor Hsien Feng at their head. It has since been raised to ten, another prince of the blood. Prince Ching, being now president. The members are spoken of collectively as the prince and ministers. For a long time the board had no real power, and was looked on rather as a buffer between the foreign envoys and the real Government. The im- portance of foreign affairs, however, especially since the Japanese war, has identified the Yamen more with the Grand Council, several of the most prominent men being

members of both. At the same time that the Tsung-Li- Yamen was created two important offices were established in the provinces for dealing with foreign commercial questions, viz., the Superintendencies of Trade for the northern and southern ports, the former being given to the governor-general of Chihli, and the latter to the governor-general at Nanking. Li Hung-Chang

held the former for a number of years, and this position, com- bined with his personal talents and his influence at court, made him practically minister for foreign affairs over the heads of the Tsung-Li-Yamen.

4. The six Boards (Liu Pu). — The administrative work of the Chinese Government is divided between six departments termed boards, viz., the Board of Civil Office, the Board of Eevenue, the Board of Ceremonies, the Board of War, the Board of Punishment, and the Board of Works. Each board has two presidents and four vice-presidents, half being Manchu and half Chinese. The official constitution of each is practically the same. They control each in its own sphere, the nature of which is sufficiently indicated by the names, the execution of that system of minute regulation for the conduct of public business which is the special function of the central Government. The presidents and vice-presidents of the boards, together with the heads of the censorate and the Hanlin college, may be said to constitute the central Government. They have not all an equal voice in the decisions of questions of state, but they are all qualified to tender advice to the sovereign, and it is from their number that the smaller executive councils above-mentioned, viz , the Chun Chi Chu and the Tsung- Li-Yamen, are selected.

5. The Censorate (Tu Cha Yuen). — This is an insti- tution peculiar to China. As the Emperor is condemned to live in seclusion, and has no means of learning what may be going on in the various parts of his dominions, the constitution endeavours to supply a remedy by pro- viding a paid body of men whose duty it is to keep him informed of all facts affecting the welfare of the people and the conduct of Government, and in particular to keep an eye on the malfeasance of his officers. These men are termed Yu shih, generally translated censors. There are fifty-six of them, divided into fifteen divisions, each division taking a particular province or area, so as to embrace the whole eighteen provinces, besides one metropolitan division. With the growth of a native press this institution loses its raison d’itre, and will probably fall into desuetude. It seems at the present moment to be more powerful for mischief than for good.

6. The Hanlin College (Hanlin Yuen). — The only other institution of the metropolitan administration that need be noticed is the Hanlin College, and

this chiefly because the heads of the college, who are presumably the most eminent scholars of the empire, have the right of advising the throne on all public affairs, and are eli- gible as members of the Grand Council, or of the Tsung- Li-Yamen. In other respects its functions are purely literary. The Chinese set fire to it during the fighting in Peking in June 1900 in the hope of burning out the adjoining British Legation. The whole of the valuable library, containing some of the most ancient manuscripts in the world, was destroyed.

Provincial Administration. — No change has been made in the provincial administration since the article in the ninth edition of this work was written, where its organi- zation is briefly described (Ency. Brit. v. 668). The ex- tension of the telegraph system and the growth of native newspapers enable the central Government to take a more active supervision in provincial affairs than it has hitherto been wont to do.

Civil Service : how recruited. — The bureaucratic element

is so vital a feature of the government of China, that a short notice of the public examinations whereby the ranks are recruited may not be out of place. As a general rule students preparing for the public examination read with private tutors. There are neither high schools nor uni- versities where a regular training can be got. In most of the provincial capitals, and at some other places, there are indeed institutions termed colleges, supported to a small extent from public funds, where advanced students can prosecute their studies, and where both students and tutors receive a small stipend, but they hardly count as factors in the national education. The work is done by private tutors, who, on the other hand, are plentiful and cheap. After a series of preliminary trials the student obtains his first qualification by examination held before the literary chancellor in the prefecture to which he belongs. This is termed the Siutsai, or licentiate’s degree, and in itself confers no claim to office, but is merely a qualifi- cation to enter for the higher examinations. The number of licentiate degrees to be given is, however, strictly limited; those who have failed to get in are set back to try

again, which they may do as often as they please. There is no limit of age. Those selected next proceed to the great examination held at the capital of each province, once in three years, before examiners sent from Pekiug for the purpose. Here again the number who pass are strictly limited. Out of 10,000 or 12,000 competitors only some 300 or 350 can obtain degrees. The others, as before, must go back and try again. This degree, termed Ghu jen, or provincial graduate, is the first substantial reward of the student's ambition, and of itself, without more, qualifies for the public service, though it does not immediately nor necessarily lead to active employment. The third and final ex- amination takes place at Peking, and is open to provincial graduates from all parts of the empire. About 6000 competitors enter for this final test, which is held tri- ennially, of whom 325 to 350 succeed in obtaining the degree of Tsin shih, or metropolitan graduate. These are the finally selected men who in due course become the officials and administrators of the empire. Several other doors are, however, open by which admission to the ranks of bureaucracy can be obtained. In the first place, to encourage scholars to persevere, a certain number of those who fail to reach the chu jen, or second degree, are allowed, as a reward of repeated efforts, to get into a special class from which selection for office may be made. Further, the Government reserves to itself the right to nominate the sons and grandsons of distinguished deceased public servants without examination. And, lastly, by a system of " recommendation," young men from the insti- tution termed the Imperial Academy, or from the Manchu schools, or men who have served as clerks in the boards, may be put on the roster for substantive appointment. But over and above the foregoing, which are all deemed fair and legitimate methods of entering the public service, the necessities of the Chinese Government have from time to time compelled it to throw open a still wider door, namely, admission by purchase. During the Taiping rebellion, when the Government was at its wits' end for money, formal sanction was given to what had previously been only intermittently resorted to, and since then im- mense sums of money have been received by the sale of patents of rank, either to secure admission to office, or more rapid promotion of those already employed. As a result of this policy, the country has been saddled with thousands of titular officials far in excess of the number of appointments to be given away. The more deserving men are thus kept waiting for years, while inferior and less capable officials are push ed aJiead, because they have money wherewith to

bribe their way. The evils of the purchase system are recognized, and efforts from time to time are

made to check it, but with indifferent success. The evil, however, is not altogether unmixed, as it has admitted into the service a number of men who are free from that bigoted adherence to Confucian doctrine which characterizes the literary classes, and more in touch with modern progress. All candidates who thus succeed, whether by examination, recommendation, or purchase, in entering the official ranks are then eligible for active employment, but as the number of candidates is far in excess of the number of appointments a period of weary waiting ensues. A few of the best scholars get admitted at once into the Hanlin coUege, or into one or other of the boards at Peking. The rest are drafted off in batches to the various provinces to await their turn for appointment as vacancies occur. During this period of waiting they are termed ” expectants,” and draw no regular pay. Occasional service, however, falls in their way, as when they are commissioned for special duty in outlying districts, which they perform as Wei yuens, or deputies of the regular officials. The period of expectancy may be abridged by recommendation or purchase, and it is generally supposed that this last lever must invariably be resorted to to secure any lucrative local appointment. A poor but promising official is often, it is said, financed by a syndicate of relations and friends, who look to recoup themselves out of the illegal, but customary perquisites which attach to the post. The appointments to the junior provincial posts are usually left to the provincial Government, but the central Government can always interfere directly. Appointments to the lucrative posts of customs taotai at the treaty ports are usually made direct from Peking, and the officer selected is not neces- sarily nor usually from the provincial staff. It would perhaps be safe to say that this appointment is always the residt of a pecuniary arrangement of greater or less magnitude.

Beligion.^~~As stated in the ninth edition (v. 671), the three prin~~ cipal religions of China are Confucianism, Buddhism, and Taoism. To these should be added ancestor-worship, which is practised universally by all classes, and which as a guiding principle of life has a more potent influence over the Chinaman than any other doctrine. It may be regarded as a branch of Confucianism. It did not, indeed, originate with that philosopher, having

been practised long before he flourished, but the duty was strongly inculcated by him. He enjoined also the due observance of the ritual prescribed by the state for the worship of all recognized deities, including the worship of heaven and earth by the Em- peror, and the worship by state officials of local divinities and deceased worthies who may from time to time have been canonized by imperial decree. Confucianism has no priesthood. The acts of worship are performed by the Emperor in person, by the officials, and by the head of every household, each acting within his own prescribed sphere. But Confucianism has always been a tolerant and non-aggressive religion. While enjoining the per- formance of ancestor-worship, and the observance of the pre- scribed formalities to recognized deities, it does not at all object to devotion being paid to other possible divinities, so long as the followers do not profess corrupt and heterodox doctrine. The line of division between what is orthodox and heterodox is more political than religious. Any cult which preaches a doctrine subirersive of the fundamental and sacred principles of the constitution is hetero- dox and unlavrfnl, and its practice renders the followers liable to severe penalties as savouring of rebellion. But mere belief in gods not recognized by the state is harmless, so long as it does not lead to action likely to be subversive of the existing order of things. Thus a Confucianist may at the same time be a Buddhist or a Taoist, or he may be all three. The three religions are not mutu- ally exclusive, but run into one another, and hence it is impossible to give any statistics of the respective numbers of each. The Christian religion was long deemed heterodox, but since the con- clusion of the treaties it has officially been proclaimed to be per- missible. A Confucianist might now, from the Chinese point of view, be also a Christian, and probably many would become so it the Christian religion would accept them on these terms. One of the powerful congregations of the Roman Catholic Church was in the last century prepared to do so ; at least it was prepared to allow converts to continue ancestor-worship. The proposal was over- ruled by the Pope, but had it been permitted there would possibly have been by this time as many nominal Christians in China as there are professors of Buddhism, which was itself a foreign religion.

The state of religion in China may thus be summed up: — Con- fucianism in the wider meaning, as including ancestor-worship, is accepted universally. Ancestor-worship is practised by practically all classes. Confucianism, in the narrow sense of the worship of Con- fucius, is compulsory on all officials, and is voluntarily practised by all scholars and aspirants to literary honours. Buddhism is more or less practised, so far as occasional visits to the temples and to sacred shrines are concerned, by about half the population. Taoism is practised to a considerably smaller extent. The services of the priests of one or other sect are generally invoked for funeral cere- monies. The priests of both these sects live solely in temples and monasteries, and do not enter private houses except when invited, in which case their services are paid for. Neither class attempts to exercise any influence over the people, and both are held in low esteem. Mahommedanism in a modified form is professed by some thirty or forty millions scattered over the north and west of China. They usually perform ancestor-worship as well, and if officials, they take part in the Confucian ceremonies.

Christian missions, both Boman Catholic and Protestant, are now established in every province in China. Freedom to embrace the Christian faith is guaranteed by the Chinese Government, and as a rule the missionaries have free scope in teaching and preaching, though local disturbances are not infrequent. The number of Catholic converts is about one million, and that of all Protestant sects is reported to be slightly over 100,000.

An imperial decree which was made public in 1897, conferring a sort of official status on the hierarchy of the Roman Catholic Church in China, deserves a short notice. Since the conclusion of the treaties in 1860, permitting the practice and teaching of the Christian religion, the missionary question has been ne of the most important which the Chinese Government has had to deal with. Though the average Chinaman is naturally tolerant and indeed indifferent in matters of religion, the preaching of Christianity has in many parts aroused fierce opposition, leading to attacks on mis- sion stations with loss of life and property. These attacks have iu turn given rise to serious diplomatic controversy, and questions connected with missions have formed no inconsiderable part of the work thrown upon the foreign legations in Peking. In general, a missionary is under the protection of his own Government, no matter what his creed may be ; but Prance has

from the first con- stituted herself the protector of Roman Catholic missions, irrespec- tive of the nationality of the priest concerned, and she has thereby been able to bring pressure to bear on the Chinese Government out of all proportion to her commercial interests. An effort was made by the Chinese in 1886 to get rid of French domination by inducing the Pope to send a special legate to Peking as controller of Roman Catholic missions. The Vatican was disposed to consent ; but the French Government made such strenuous opposition, threatening to withdraw the concordat in France, that the papal authorities were obliged to decline. France was unwilling to forgo the political influence which the position of protector of one or two thousand priests and about a million of converts gave her, and she has used that influence to obtain redress of grievances and to im- prove the position of the Roman Catholic missionaries. In 1896 formal permission was given for the missions to acquire and hold real estate in any part of China ; but a still more important privi- lege is the one we have mentioned, namely, the giving a recognized official status to the several grades of the priesthood, and so placing them on terms of equality with the local officials. Bishops are to rank with governors of a province, pro-vicars with judges, taotais, and so on. International matters are to be discussed and settled locally, and in grave cases appeal is to be made to the minister of the nation "specially entrusted by the Pope with the protec- tion of Roman Catholic missions." This last clause has been repudiated by the British Government as far as its own nationals are concerned. It is apprehended that the privilege, while en- hancing the status of the priests, wfll tend to widen the breach already existing between converts and their fellow-countrymen. The interference of priests in matters of litigation where one of their converts is concerned has often been made matter of com- plaint, and the fact that they are in effect authorize to interfere is not likely to diminish the friction.

Instruction. — Veiy little was done by the Chinese Government during the period 1875-1900 for the better education of the people. Elementary education is stiU left to take care of itself. The most noteworthy fact to be noticed is the great number of mission schools that are now maintained in various parts of the Empire. Though insignificant as compared with the vast popula- tion, these schools are doing valuable service in imparting a know- ledge of English to a smWl proportion of the youth, who in turn, not infrequently, become instructors to a wider class. But among the great mass of the people the densest ignorance prevails, even as regards their own language and history, and much more as to any knowledge of other countries. In respect of advanced educa^ tion the Chinese Government has

done a little better. There are in mo.st provincial capitals institutions termed colleges, where |

tutors or professors are maintained at the public expense, and where a limited number of students are admitted. There are also in every district two or three paid officials who are termed directors of studies. Their function, however, is not to teach, but to examine, and they act as registrars of the students entering for the public examinations. The object aimed at is not the general education of the people, but to aid poor and deserving students to pass the examinations, and so enter the public service. The idea of educating the people so as to make them more capable citizens is nowhere to be found, and apparently has never been conceived as one of the duties of Government. At Peking, a college, termed the Tung Wen Kwan, was instituted about 1870, and is still maintained with a staff of foreign professors and teachers. It is mainly a school of languages to enable young Chinese to qualify as interpreters in English, French, etc. Similar schools have been established at Canton, Foochow, and one or two other places, with but indifferent results, and as a factor in the education of the nation they can hardly be said to count. A more promising plan was conceived in 1880, or thereabouts, by the then governor-general of Nanking, who sent a batch of thirty or forty young students to America to receive a regular training, on the understanding that on their return they would receive official appointments. The promise was not kept, however. A report went about that these students were becoming too Americanized. They were hastily recalled, and when they returned they were left in obscurity.

Native Press. — In connexion with the subject of education we may notice the growth of a native press, which promises to have an important influence on the development of the nation. The Peking Gazette, which is sometimes called the oldest paper in the world, is not a newspaper at all in the ordinaiy sense, but merely a court gazette for publishing imperial decrees and such public documents as the Government may wish to give out. It never contains original articles nor any discussion of public affairs. The first genuine native newspaper was published at Shanghai about 1870. It was termed the Shen Pao, or Shanghai News, and was issued under foreign auspices, the first editor being an Englishman. It was some years before it made much headway, but success came, and it was followed by various

imitators, some published at Shanghai, some at other treaty ports, and at Hong-Kong. In 1895 there were eleven native newspapers in circulation, and since then the number has largely increased. There are now some thirty-five in circulation, almost all dailies, of which half are issued from Shanghai. Besides the dailies there are at least as many magazines or other periodicals, most of which are issued from the various mission presses, and several of which are exceedingly well written. The effect of this mass of literature on the public mind of China cannot but be of first-rate importance. It must tend, more than anything else, to dispel the darkness and to promote ideas of reform and progress. The attitude of the central Government towards the native press is somewhat undefined. There are no press laws, but as every official is a law unto himself in these matters, there is nothing to prevent him from summarily suppress- ing an obnoxious newspaper and putting the editor in prison. The Emperor, among other reform edicts which preceded and provoked the coup cCetat of 1898, declared that newspapers were a boon to the public, and appointed one of them a Government organ. The Empress-dowager revoked this decree after the deposition of the Emperor, and declared that the public dis- cussion of affairs of state in the newspapers was an impertinence, and ought to be suppressed. The existence of the press, however, is tolerated, and by some officials at least would seem to be encouraged. In any case no interference could be offered to those native papers which are published by foreigners, inasmuch as the latter are, by the extra-territorial clauses of the treaty, exempted from Chinese jurisdiction. The regulation of the press is one of those problems which the Chinese Government has yet to solve.

Social Condition. — The social condition of the people relative to European standards must be put as very low. Agriculture is the one great industry. Four-fifths of the population may be put down as peasant cultivators of the soil. Of these fully one-half are small peasant proprietors owning the land they til], subject to the payment of the state taxes. Nearly all the other half hold land on lease, paying rent ; and only a comparatively small proportion are agricultural labourers. But whether as proprietors or farmers the holdings are always very small — so small that the condition of the holders is hardly above that of ordinary field labourers. The minute subdivision of the holdings is due to two causes — firstly, over-population ; and, secondly, the land laws. As to the latter, the invariable rule of succession is equal

division among all male children. Not only is there no primogeniture, but a parent cannot, even if he wished to do so, leave all his land to one son. There must be substantially an equal division, the will of the father notwithstanding. As early marriages and large families are the rule, this process of continual division and subdivision has brought things down to the irreducible minimum in many places. In the Journal of the China Branch of the Eoyal Asiatic Society for

1888 a series of short papers was printed, contributed by mis- sionaries and others living in the Interior of the country, describing the social condition of the peasantry. From these it appears that the irreducible minimum, is, in the more fertile parts, as low as a sixth of an acre per head. In other words, a family of six persons can make a living out of a farm of one acre. This would make a possible population of 3840 to the square mile. As a matter of fact, the subdivision has in numberless cases been carried even below that limit. Small patches of one-tenth, or even one- twentieth, are to be found as the estate of an individual land- owner, and the vast majority of holdings run between one and three acres. With three acres a family is deemed very comfortable, and the possession of ten acres or more means luxury. Three acres is about the largest quantity which one family can manage without employing hired labour. In the northern provinces, where wheat, maize, &c., which do not require irrigation, are grown, five acres can be worked by one household. If the family possesses more land than that the balance is almost invariably let, and always in similar small holdings. Nowhere is the system of farming by capitalists with hired labour to be found. The fol- lowing is an instance given by one of the writers in the above- named journal, and may be taken as typical of the bulk of the rural population : —

“Pong Hia lives in a village of 300 persons, in which about 30 are landowners. Pong Hia owns more than any other man in his class, having 2 acres (12 mow). His family consists of 10 per- sons. He is 46 years old, his wife is 41, his son is 22, his son’s wife is 22, his four daughters are from 10 to 17, and his two grandchildren are 3 and 8 years old. He and his son till

the land, hiring help in harvest-time. The womenfolk weave and make clothing for the family, rear pigs and fowls, and do all the housework. The house in which these ten persons live is worth £12, including the site ; the furniture is worth £4 : 10s., the clothing worth about £4. The family lives comfortably upon the produce of the land, and is reckoned afSuent.”

To this it may be added that land such as the foregoing will yield two, or sometimes three, crops in the year. The spring crop is wheat, sown in November and reaped in April ; the summer or principal crop is rice, planted in May and reaped in August or September ; and an autumn crop of cabbages, beans, or other green stuff can usually be got in, sometimes overlapping with the wheat. In’ the southern provinces two rice crops can be got in succession during the summer, besides the winter crop.

It will be gathered from the foregoing that there is no class of wealthy territorial magnates, corresponding to the aristocracy of this and other European countries. The only class which at all resembles them is the class of retired officials. As the bureaucracy monopolize all the power in the country, they generally contrive to monopolize a good deal of the wealth. This is not infrequently invested in laud, and consequently there are to be found in most provinces several such families with a country seat and the usual insignia of local rank and influence. On the decease of the heads or founders such families would, in the natural course of things, be broken up and the land divided, but it is considered more dignified for the sons to refrain from dividing, and to live together, sharing the rents and profits in common. This Is sometimes continued for several generations, until the country seat becomes an agglomera- tion of households and the family a sort of clan. A family of this kind, with literary traditions, and with the means to educate the young men, is constantly sending its scions into the public service, who in turn bring their earnings to swell the common funds, while the rank and dignity which they may earn add to the importance and standing of the group as a whole. The members of this class are usually termed the literati, or gentry. Though the constitu- tion does not recognize them as having any share in the local government, yet they can exercise an enormous influence in public aflairs. The peasantry who farm their lands are, of course, under their control. The official rank which most of the members have acquired by promotion or purchase enables them to resist,

and perhaps browbeat, the local officials, while they further terrorize the latter by threatening to denounce them to the Emperor, which they can often manage to do through some one or other of their many relations or marriage connexions who may happen to have the ear of the court. Being usually intensely bigoted and conservative, they present a serious barrier to progress, especially if there is a foreign element in it, such as the introduction of rail- ways, or making of roads, or renting of inland residences by foreign merchants or missionaries. Not infrequently have projects for the improvement of trade, assented to by the local officials, been blocked by the opposition of the gentry, the former not daring to incur their resentment. But such families, unless their wealth is kept up by continual accessions, tend, in course of time, to decline through the levelling operation of the law of succession. As the members among whom the wealth must be shared increase rapidly with every generation, a point is soon reached when the individuals of the family are no better off than the peasantry who till their

land, and then a break-up is inevitable. If possible, however, the eldest branch preserves the family records and the ancestral hall, some portion of the domain being put in mortmain for this pur- pose. When scattered, the collateral branches of such a family contrive to keep In touch, the common bond being the ancestral hall and the right to join in the family ancestor-worship. Numerous instances can be found where families no better off than the commonalty can trace their descent back through twenty generations.

Finance. — In fiscal matters, as for many other purposes, the Chinese empire is an agglomeration of a number of quasi-inde- pendent units. Each province has a complete administrative staff, collects its own revenue, pays its own civil service, pays its own militia and naval forces, and out of the surplus contributes towards the expenses of the imperial Government a sum which varies with the imperiousness of the needs of the latter and with its own comparative wealth or poverty. The imperial Government does not collect directly any part of the revenues, unless we except the imperial maritime customs, though these, too, pass through the books of the provincial authorities. We may also except a few of the old native customs stations which are deemed perquisites of the imperial court, as, for instance, the native custom-house at Canton, Hwei Kwan on the Grand Canal, and

various stations in the neighbourhood of Peking. The superintendent of these stations is a nominee of the court, always a Manchu, who makes his returns direct to the throne and not to the governors. But otherwise the court and the central Government in Peking are dependent upon the sums they can levy on the provinces. It has hitherto been extremely difficult to obtain anything like trustworthy figures for the whole revenue of China, for the reason that no statistics are published by the central Government at Peking. The only avail- able data are, first, the returns published by the imperial Maritime Customs for the duties levied on foreign trade ; and, secondly, the memorials sent to Peking by the provincial authorities on revenue matters, certain of which are published from time to time in the Peking Gazette. These are usually fragmentary, being merely reports which the governor has himself received from his subordi- nates, detailing, as the case may be, the yield of the land tax or the likin for his particular district, with a dissertation on the causes which have made it more or less than for the previous period. Or the return may be one detailing the expenditure of such and such a department, or reporting the transmission of a sum in reply to a requisition of the Board of Revenue, with a statement of the source from which it has been met. It is only by collating these returns over a long period that anything like a complete statement can be made up. And even then it is quite certain that these returns do not represent anything like the total of taxation paid by the people, but, as far as they go, they may be taken to represent the volume of taxation on which the Peking Government can draw revenue.

The following figures i give as nearly as can be done the actual revenue of the Chinese empire as returned by the responsible officers of Government : —

1. Land tax in silver .... Taels 25,000,000

2. „ „ (in grain) value . . 6,500,000

3. Salt tax • 13,500,000

4. Likin 13,000,000

5. Foreign maritime customs . 22,500,000

6. Native customs 2,000,000

7. Duty on native opium . . . 2,200,000

8. Miscellaneous 5,500,000

Total ....

Equal to £13,580,000. Sources of Bevenue. — 1. Land, Tax. — In China, as in most Oriental countries, the land has from time immemorial been the mainstay of the revenue. In the early years of the present dynasty there was levied along with the land tax a poll tax on all adult males, but in 1712 the two were amalgamated, and the whole burden was thrown upon land, families not possessing land being thereafter exempted from taxation. At the same time it was decreed that the amount of the land tax as then fixed should be permanent and settled for all time coming. As a matter of fact it would appear from the records that this promise has been kept as far as the central Government has been concerned. In all its many financial difficulties it does not seem ever to have tried to increase the revenue by raising the land tax. The amount of tax leviable on each plot is entered on the title deed, and, once entered, it cannot be changed. The tax on almost all lands is thus stated to be so much in silver and so much in rice, wheat, or whatever the principal crop may be. ilxcept in two provinces, however, the grain tax is now commuted and paid in silver. The exceptions are the provinces of Kiangsu and Chekiang, which still

Taels 90,200,000

1 Throughout this article the tael spoken of is the Haikwan tael, the present value of which Is about 3s. It fluctuates with the value of silver.

send forward their taxes in grain. This is despatched in hulk through a department of the Government to Peking, where it is distributed as rations among the Manchu soldiery and retainers in and about the capital. The

value of the grain forwarded (gener- ally called tribute rice) is estimated to amount to taels 6,500,000. The total collection in silver, as reported by the responsible officials, amounts in round numbers to taels 25,000,000. The total yield of the land tax, therefore, is taels 31,500,000, or say £4,725,000. It will readily be granted that for such a large country as China this is a very insignificant one. In India the land tax yields £17,000,000, and China has undoubtedly a larger cultivated area, a larger population, and soil that is on the whole more fertile ; but it is certain that this sum by no means represents the amounts actually paid by the cultivators. It is the sum which the various magistrates and collectors have to account for and remit in hard cash. But as nothing is allowed them for the costs of collection, they add on a percentage beforehand to cover the cost. This they usually do by declaring the taxes leviable not in silver, but in copper “cash,” which indeed is the only currency that circulates in country places, and by fixing the rate of exchange to suit them- selves. Thus while the market rate is, say, 1500 cash to the tael, they declare by general proclamation that for tax-paying purposes cash will be received at the rate of 3500 or 4000 to the tael. Thus while the nominal land tax in silver remains the same it is in effect doubled or trebled, and, what is worse, no return is made or account required of the extra sums thus levied. Each magistrate or collector is in effect a farmer. The sum standing opposite the name of his district is the sum which he is bound to return under penalty of dismissal, but all sums which he can scrape together over and above are the perquisites of office less his necessary expenses. Custom, no doubt, sets bounds to his rapacity. If he went too far he would provoke a riot ; but one may safely say there never is any reduction, what change can be effected being in the upward direction. What the actual sums may be which are thus levied and not accounted for it is impossible to tell, but a rough idea may be gathered from a calculation of the probable area under cultivation and the average actual payment. The area of the eighteen provinces constituting China proper is roughly 1,300,000 square miles, and assuming that one-fourth of this is under cultiva- tion, we should have a taxable area of over 300,000 square mUes, say 190,000,000 acres, which is probably under the mark. Accord- ing to the best information obtainable a moderate estimate of the sums actually paid by the cultivators would give two shillings per acre. This for the eighteen provinces should give £19,000,000 as being actually levied, or more than four times what is returned.

2. The Salt Duty. — The trade in salt is a Government mono- poly. Only licensed merchants are allowed to deal in it, and the import of foreign salt is forbidden by the treaties. Tor the purpose of salt admininistration China is divided into seven or eight main circuits, each of which has its own sources of production. Each circuit has carefully-defined boundaries, and salt produced in one circuit is not allowed to be consigned into or sold in another. There are great differences in price between the several circuits, but the consumer is not allowed to buy in the cheapest market. He can only buy from the licensed merchants in his own circuit, who in turn are debarred from procuring supplies except at the depot to which they belong. Conveyance from one circuit to another is deemed smuggling, and subjects the article to confiscation.

Duty is levied under two heads, the first being a duty proper payable on the issue of salt from the depot, and the second being hkin levied on transit or at the place of destination. The two together amount on an average to about taels 1.50 per picul of 133^R) or 3s. 9d. per cwt. The total collection returned by the various salt collectorates amounts to taels 13,500,000 (£2,025,000) per annum. The total consumption of salt for all China is estimated at 25 million piculs, or nearly IJ million tons, which is at the rate of 9R) per annum per head of the population. If the above amount of taels 1.50 were uniformly levied and returned, the revenue ought to be 37J million taels instead of 13J.

3. Likin on General Merchandise.— By the term likin is meant a tax on inland trade levied while in transit from one district to another. It was originally a war tax imposed as a temporary measure to meet the military expenditure required by the Taiping and Mahommedan rebellions of 1850-70 ; but the Government has never been able to dispense with it since, and it is now one of the permanent sources of income. In the present disorganized con- dition of China it would perhaps be difficult to impose any other form of taxation which would yield a like return, but at the same time’ it is in form as objectionable as a tax can be, and is equally obnoxious to the native as to the foreign merchant. Tolls or barriers are erected at frequent intervals along all the principal routes of trade, whether by land or water, and a small levy is made at each on every conceivable article of commerce. The individual levy is small, but over a long transit it may amount to 15 or 20

per cent. The objectionable feature is the frequent stoppages with overhauling of cargo and consequent delays. By

treaty foreign goods may commute all transit dues for a single payment of one-half the import tariff duty, but this stipulation is but indifferently observed, giving rise to frequent complaints on the part of foreign merchants. The difficulty in securing due ob- servance of this treaty right lies in the fact that the likin revenue is claimed by the provincial authorities, and the transit dues when commuted belong to the central Government, so that the former are interested in opposing the commutation by every means in their power. As a further means of neutralizing the commutation they have devised a new form of impost, viz., a terminal tax which is levied on the goods after the termination of the transit. The amount and frequency of likin taxation are fixed by provincial legislation — that is, by a proclamation of the governor. The levy is authorized in general terms by an imperial decree, but all details are left to the local authorities, who in this, as in all other matters, have a general legislative power. The yield of this tax is esti- mated at present at taels 13,000,000 (£1,950,000), a sum which probably represents one-third of what is actually paid by the merchants, the balance being costs of collection.

4. The Imperial Maritime Customs. — The Maritime Customs is the one department of finance in China which is managed with probity and honesty, and this it owes to the fact that it is worked under foreign control. It collects all the duties leviable under the treaties on the foreign trade of China, and also all duties on the coasting trade so far as carried on by vessels of foreign build, whether Chinese or foreign-owned. It does not control the trade in native craft, the so-called junk trade, the duties on which are still levied by the native custom-house officials. By arrangement between the British and Chinese Governments, the foreign customs levy at the port of entry a likin on Indian opium of 80 taels per chest, in addition to the tariff duty of 30 taels. This levy frees the opium from any further duty on transit into the interior. The revenue of the Maritime Customs has risen from taels 11,000,000 in 1873, to taels 22,500,000 in 1898. In sterling figures, however, it would seem to have fallen, owing to the fall in the gold price of silver. The revenue of 1873, converted into gold at the exchange of the day, was about £3,666,000, whereas that of 1898 would only give £3,375,000.

From the point of view of the Chinese Gpvern- ment, which values everything in silver, the revenue has satis- factorily increased.

5. Native Customs. — The administration of the Native Customs continues to be similar to what prevailed in the Maritime Customs before the introduction of foreign supervision. Each collector is constituted a farmer, bound to account for a fixed minimum sum, but practically at liberty to retain all he may collect over and above. If he returns more he may claim certain honorary rewards as for extra diligence, but he generally manages to make out his accounts so as to show a small surplus, and no more. Only im- perfect and fragmentary returns of the native collectorates have been published, but the total revenue accruing to the Chinese Government from this source does not appear much to exceed two million taels (£300,000). It is believed that if this department were included in the purview of the foreign staff of the Maritime Customs the sum might easily be trebled.

6. I>.uty on Native Opium. — The growth and manufacture of opium was up till recent years forbidden by the laws of China. It was, however, openly connived at by the officials in several pro- vinces, especially in the south-west, where indeed it seems to have been cultivated from time immemorial, and its taxation formed a main source of their income. The restrictions are now withdrawn, and the central Government have been endeavouring to appropri- ate the taxation to their own uses. The collection remains in the hands of the provincial officials, but they are required to render a separate account of duty and likin collected on the drug, and to hold the sum at the disposal of the Board of Eevenue. Opium is pre-eminently a fit article of taxation, and if the levy were faithfully carried out at a rate corresponding, ad valorem, to that which is levied on Indian opium, it would give a revenue sufficient to enable the Government to remit the whole likin taxation on internal trade. The annual import into China of Indian opium amounts to about 50,000 chests, on which the Chinese Government receives from duty and likin combined about 5 million taels (£825,000). The total amount of native-grown opium is estimated at about 400,000 chests (53,000,00011)), and if this were taxed at taels 60 per chest, which in proportion to its price is a similar rate to what is levied on Indian opium, it should give a revenue of 24 million taels. Compared with this the sums actually levied, or at least re- turned by the local officials as levied, are insignificant. The returns so far as published give a total levy for all the eighteen provinces of only taels 2,200,000 (£330,000).

7. Miscellaneous. — Besides the foregoing, which are the main and regular sources of income, the provincial officials levy sums which must in the aggregate amount to a very large figure, but which hardly find a place in the returns. The principal are land transfer fees, pawnbrokers' and other licenses, duties on reed flats, commutation of corvee and personal services, &c. The fee on

land transfers is 3 per cent., and it could be shown, from a calcu- lation based on the extent and value of the arable land and the probable number of sales, that this item alone ought to yield an annual return of between one and two millions sterling. Practi- cally the whole of this is absorbed in office expenses. Under this heading should also be included certaiu items which, though not deemed part of the regular revenue, have been so often resorted to that they cannot be left out of account. These are the sums derived from sale of office or of brevet rank, and the subscriptions and be- nevolences which under one plea or another the Government suc- ceeds in levying from the wealthy. Raising money by sale of title or official rank has long been and still is a favourable device for special emergencies, such as the great famine in Shansi, the inunda- tion of the Yellow river, and so forth, the sale being stopped when the emergency has passed. But excluding these, the Government is always ready to receive subscriptions, rewarding the donor with a grant of official rank entitling him to wear the appropriate "but- ton." The right is much sought after, and indeed there are very few Chinamen of any standing that are not thus decorated, for not only does the button confer social standing, but it gives the wearer certain vei-y substantial advantages in case he should come into con- tact with the law courts. The minimum price for the lowest grade is taels 120 (£18), and more of course for higher grades. The pro- ceeds of these sales go directly to the Peking Government, and do not as a rule figure in the provincial returns. The total of the miscel- laneous items accruing for the benefit of the Government is estimated at taels 5,500,000.

Expenditure. — In regard to expenditure, a distinction has to be drawn between that portion of the revenue which is controlled by the central Government, and that controlled by the several pro- vincial authorities. In theory, no doubt, the imperial Govern- ment is supreme, and can spend the revenue of the nation in any way it chooses, but in practice it is not so. As the provinces collect the revenue, and as the authorities there are held responsi- ble for the peace, order, and good government of their respective territories, it follows that the necessary expenses of the provinces form a sort of first charge on the revenue. If the Peking Govern- ment asks for more than the province can afford, they simply cannot get it. The order is not, in so many words, refused, it is simply disregarded, and the Peking Government have no means of enforcing it. The' method of working is as follows : — ^The Board of Revenue at Peking, which is charged with a general supervision of finance matters all over the empire, makes up at the end of the year a general estimate of the funds that will be required for imperial purposes during the ensuing year, and apportions the amount among the several provinces and the several coUectorates in each province. The estimate is submitted to the Emperor, and, when sanctioned, instructions are sent to all the viceroys and governors in that sense, who, in turn, pass them on to their subordinate officers. In ordinary times these demands do not materially vary from year to year, and long practice has created a sort of equilibrium between Imperial and provincial demands. The remittances to the capital are, as a rule, forwarded with reason- able regularity, mostly in the form of hard cash, and though there are frequent complaints of the falling-off of revenue, yet, by good luck, some other fund is found to have a little to spare, and the amount can be made up. It would, indeed, appear to be the cue of every governor to minimize the resources of his own province as much as possible, so as to stave off importunate demands from Peking, and get them foisted on to some other province. Hence the frequent references to the Taiping rebellion (a favourite stalk- ing-horse, though now a generation old), the lamentations over the falling-ofi of revenue, and the decaying state of the province — all for the most part fictions of the imagination. There is thus a constant pull going on between Peking and the provinces — the former always asking for more, the latter resisting and pleading impecuniosity, yet generally able to find the amounts required, or at all events a percentage. Whatever the provinces can

retain can be spent practically as they choose. The Peking control over local expenditure is very feeble, though nominal accounts are rendered.

The expenses which the central Government has to meet are : — (1) Imperial household ; (2) Pay of the Manchu garrison in and about Peking ; (3) Costs of the civil administration in the capital ; (4) Pay of the foreign drilled troops termed the army of the North as distinct from the provincial troops (vide “Army ” below) ; (5) The admiralty so far as regards the northern squadron ; (6) Naval dockyards, forts, guns, &c. ; (7) Foreign loans — interest and sink- ing fund. To meet all these charges the Peking Government has, for some years past, drawn on the provinces for about taels 20,000,000 (£3,000,000), including the value of the tribute rice, which goes to the support of the Manchu bannermen. No estimates are furnished of the sums allowed under each heading. The im- perial household appears to receive in silver about taels 1,500,000 (^225,000), but it draws besides large supplies in kind from the pro- vinces, e.g., silks and satins from the imperial factories at Soochow and Hangchow, porcelain from the Kiangsi potteries, &c., the cost

of which is defrayed by the provinces. The imperial Government has also at its disposal the revenue of the Foreign Customs. Prior to the Japanese war this revenue, which, after allowing for the costs of collection, amounted to about 20,000,000 taels (£3,000,000), was nominally shared with the provinces in the proportion of four-tenths and six-tenths. It was from this fund mainly that means were found to equip and maintain the northern fleet (almost extinguished by the Japanese war), to build the forts of Port Arthur and Wei- hai-wei (now also lost to the nation), and to keep going the several arsenals recently established. But the whole of the customs revenue being now pledged to foreign bondholders {vide “External Debt “), and absorbed by the service of the several loans, funds for these and the like purposes must now be procured, if at all, else- where. An entire readjustment of revenue and expenditure is manifestly necessary, but what form it will take i

A rough analysis of the expenditure of the Chinese empire, as it stood at the commencement of the Japanese war, would show the follovidng division : —

Expenditure 1894.

Imperial household

Central administration, pay of banner troops 1 and foreign drilled forces . . . f

Board of Admiralty (Peiyang quadron)

Southern naval squadron

Ports, guns, and coast defence

Defence of Manchuria ....

Kansuh and Central Asia

Aids to Yunnan and Kweichow .

Interest and repayment of foreign loans

Railway construction ....

Public works, river embankments, &c.

Customs administration, including main-1 tenance of lighthouses, beacons, revenue j- cruisers .J

General administration of eighteen provinces

Taels.

1,500,000

19,500,000

5,000,000 5,000,000 8,000,000 2,000,000 4,000,000 1,600,000 2,500,000 500,000 1,500,000

2,500,000

86,600,000

90,200,000

External Debt. — ^Prior to the Japanese war the foreign debt of China was almost nil. A few trifling loans had been contracted at 7 and 8 per cent., but they had been punctually paid off, and only a fraction of one remained. The expenses of the war, how- ever, and the large indemnity of 230,000,000 taels (£34,500,000) which Japan exacted, forced China for the flrst time into the European market as a serious borrower. The foreign loans con- tracted up to 1900 amounted altogether to £54,455,000, bearing interest mostly at 5 per cent. Some of the earlier and smaller issues carry 6 and 7 per cent., and one of £16,000,000 guaranteed by the Russian Government carries 4 per cent. This last was raised in Paris, the others were all made in London through the Hong-Kong and Shanghai Bank. The charges for interest and sinking fund, which amount to over £3,000,000, are secured on the revenue of the Maritime Customs, and on the likin taxes of certain specified provinces. At present the net income from these two sources amounts to over taels 24,000,000, equivalent at present rate of exchange to £3,400,000, which is amply sufficient. Besides theforegoing, the Chinese Government recently borrowed £2,300,000 for railway extension, also at 5 per cent., the charges on which are secured on the revenue of the Imperial Northern Railway (vide “Railways”).

There is no internal debt worth mentioning. The Chinese Gov- ernment have several times attempted to borrow money in their own country, offering Government bonds as security, but uniformly without success. It is felt that no reliance can be placed on the good faith of the Government towards its own subjects, and no machinery exists whereby payment could be enforced in case of default.

Defence — Army. — The Chinese constitution provides for two independent sets of military organizations — namely, the Manchu army and the several provincial armies. On the establishment of the dynasty in 1644, the victorious troops, composed mainly of Manchus, but including also Mongols and Chinese, were perma- nently quartered in Peking, and

constituted a hereditary national army. The force was divided into eight banners, and under one

or other of these all Manchus and all the descendants of the members of other nationalities are yet enrolled. They form the bulk of the population of the ” Tartar city ” of Peking. Each adult male is by birth entitled to be enrolled as a soldier, and by virtue of his enrolment has a right to draw rations — i.e., his allowance of the tribute rice, whether on active service or not. Detachments from one or other of the banners were also stationed as garrisons in the chief provincial centres, as at Canton, Foochow, and Hang-chow, &c., and their descendants still occupy the same position. They are, like their kinsmen in Peking, entitled to draw a pittance from the provincial taxes as rations. Both in the capital and in the provinces the Manchu garrisons are exempt from the jurisdiction of the local authorities, and are justiciable only before their own officers. As a fighting force the Manchu garrisons both in the capital and in the provinces have long become quite effete. In the capital, however, the elite of the Manchu soldiery have been formed into a special corps termed the Peking Field Force. Its nominal strength is 20,000, the men are armed and drilled after the European fashion, and fairly well paid. There are other corps of picked Manchus better paid and better armed than the ordinary soldier, and it is computed that the Manchu army in or near Peking could muster 75,000, all more or less efficient. The second organization is termed the army of the Green Standard, being the Chinese provincial forces. The nominal strength is from 20,000 to 30,000 for each province, or about 500,000 in all ; the actual strength is about one-third of this. They are enrolled for the purpose of keeping the peace within their own province, and resemble a militia or local constabulary rather than a national army. They are distributed in small camps or garrisons in the principal towns, and the most serious duty they are likely to be called on to perform is that of putting down a local rebellion. The bulk of each provincial army is under the command of a general-in-chief, but certain brigades are under the orders of the governor

and the governor-general. They are generally poorly paid and equally badly drilled and armed. As a fighting force they are of no practical account.

The only real fighting force which China possesses is made up of certain special corps which are not provided for in the constitu- tion, and which consequently used to be termed yung, ” braves ” or irregulars, but which have now acquired various distinctive names. They are enlisted for service generally, and have all had some smattering of foreign drill. They are also fairly well paid and armed. Since the Japanese war these corps have been quartered near Peking and Tientsin, and are generally spoken of as the army of the North. They are now grouped in five divisions under the command of Generalissimo Jung Lu, and are supposed to number 75,000 men. In addition to these the Government could count on 20,000 men more who are now scattered in garrisons in Manchuria.

Navy. — Since the destruction of the northern fleet by the Japanese at the capture of Wei-hai-wei in 1895, the Chinese navy may be said to be non-existent. It formerly consisted of two divisions, the northern and the southern, of which the former was by far the more formidable. The southern was under the control of the viceroy of Nanking, and took no part in the Japanese war. While the northern fleet was grappling in a death-struggle, the southern was lying snugly in the Yangtse waters, the viceroy of Nanking apparently thinking that as the Japanese had not attacked him there was no reason why he should risk his ships. Since the close of the war an attempt has been made to restore the northern fleet, which now consists of five small cruisers and a few torpedo boats. The southern squadron consists of seven small cruisers, old-fashioned, and four torpedo boats. The viceroys of Fooohow and Canton possess a few gun- boats meant to repress piracy, but of no fighting value.

Arsenals and Dockyards.—Smce the loss of Port Arthur, China possesses no dockyard except a small one at Foochow, which can- not dock vessels over 3000 tons. Many years ago the Chinese Government established at Foochow a shipbuilding yard, placing it in the hands of French engineers. Training schools both for languages and practical navigation were at the same time organized, and a training ship was procured and put under the command of a British naval officer. Some twenty-five or thirty small

vessels were built in the course of as many years, but gradually the whole organization was allowed to fall into decay. Except for petty repairs this establishment is valueless to the Chinese Government. Well-equipped arsenals have been established at Shanghai and at Tientsin, but as they are both placed up shallow rivers they are useless for naval repairs. Both are capable of turning out heavy guns, and also rifles and ammunition in large quantities. There are also military arsenals at Nanking, Wuchang, Canton, and Chengtu, besides smaller establishments at other provincial centres.

Forts.— A great number of forts and batteries have been erected along the coast and at the entrance to the principal rivers. Chief among these, now that the Taku forts formerly commanding the entrance to Tientsin have been demolished, are the Kiangym forts commanding the entrance to the Yangtse, the Min forts at the entrance of the Foochow river, and the Bogue forts at the

entrance to the Canton river. These are supplied vrith heavy armament from the Krupp and Armstrong factories, but the garri- sons share the weakness common to all Chinese military establish- ments.

Production and Industry : Minerals. — The Chinese Government has hitherto shown a great repugnance to permitting foreign com- panies to work minerals in any part of the country. As a conse- quence very little is known of the actual resources of the empire, which, however, are believed to be very great. A Bureau of Mines, however, has been created with a view to granting concessions, and probably much progress vnll be made in the near future.

Coal. — This mineral is worked on foreign principles at only one place, viz., the Kaiping collieries in the north-east of the province of Chihli. The mines are connected with the seaport of Taku by a railway. The coal is a soft bituminous coal with a large pro- portion of dust. The output is about 1,500,000 tons per annum. A mine has also been opened in the province of Hupeh, about 60 miles below Hankow, and near the Yangtse, in connexion with the iron-works recently erected by the viceroy of that province. Numerous small mines have been worked for a long period by the natives in the province of Hunan. There are two principal local fields in this province, one lying in the basin of the Lui river and yielding anthracite, and the other

in the basin of the Siang river yielding bituminous coal. Both rivers drain into the Yangtse, and there is thus an easy outlet by water to Hankow. The quality of the coal, however, is inferior, as the stratification has been much disturbed, and the coal seams have been in consequence crushed and broken. No statistics of the output are obtainable, but it is estimated to be over 300,000 tons per annum — mostly destined for local consumption. The largest coal-field in China lies in the province of Shansi. Coal and iron have here been worked by the natives from time immemorial, but owing to the diflficulty of transport they have attained only a limited local circulation. The whole of southern Shansi, extending over 30,000 square miles, is one vast coal-field, and contains, according to the estimate of Baron von Eichthofen, enough coal to last the world at the present rate of consumption for several thousand years. The coal seams, which are from 20 to 36 feet in thickness, rest conformably on a substructure of limestone. The stratification is throughout undisturbed and practically horizontal. As the limestone bed is raised some 2000 feet above the neighbouring plain, the coal seams crop out in all directions. Mining is thus carried on by adits driven into the face of the formation, rendering the mining of the coal extremely easy. The coal-field is divided into two by a mountain range of ancient granitic formation running north-east and south-west, termed the Hoshan. It is of anterior date to the limestone and coal formations, and has not affected the uniformity of the stratification, but it has this peculiarity, that the coal on the east side is anthracite, and that on the west side is bituminous. A concession to work coal and iron in certain specified districts in this area has been granted to a British company, together with the right to connect the mines by railway with water navi- gation, and it is expected that important developments will follow on this grant. At present the mines, in default of railway facilities, are practically valueless. At the pit’s mouth coal can be had for a shilling a ton, but as transport costs from 2^d. to 5d. per ton per mile, the price becomes prohibitive after a short distance. In spite of these drawbacks the present output must be consider- able, considering the great area and the number of openings that are being worked, but it is impossible to state it with any degree of accuracy. There are various other sources of coal-supply, such as the western hills near Peking, many parts of Szechuen, and some districts in Shantung and Kwangtung, which, however, do not call for detailed notice. It may, indeed, be said generally that there is hardly a province which does not possess coal

mines more or less valuable — the one drawback to their development being the absence of railways.

Iron. — Iron ore of various qualities is found almost as widely diffused as coal. The districts where it is most worked at present lie within the coal-field of Shansi, viz., Tse-chou-fu and Ping-ting- chou. The ore is a mixture of clay iron ore and spathic ore, together with limonite and hematite. It is found abundantly in irregular deposits in the Coal Measures, and is easily smelted by the natives in crucibles laid in open furnaces. This region supplies nearly the whole of north China with the iron required for agricultural and domestic use. The out-turn must be very con- siderable, but no data are available for forming an accurate estimate. The province of Szechuen also yields an abundance of iron ores of various kinds. They are worked by the natives in numerous places, but always on a small scale and for local consumption only. The ores occur in the Coal Measures, predominant among them being a clay iron ore. Hunan, Fuhkien, Chekiang, and Shantung all furnish iron ores, but only a petty industry is carried on at any one place.

Of other minerals copper comes next in importance. It is found chiefly in the provinces of Kweichow and Yunnan, where a rich belt of copper-bearing ores is found running east and west

across both provinces, and including south Szechuen. The chief centres of production are at the cities of Tung-chuan-fu, Chao- tung, and Ning-yuan. The mines are worked as a Government monopoly, private mining being nominally prohibited. No con- cessions have so far been granted to foreign companies. The output is considerable, but no statistics are published by Govern- ment. The supply is not, however, enough to meet the requirements of the country, as foreign copper is imported to the extent of about 28,000 tons a year. It is generally supposed that if the mines were thrown open to foreign enterprise, not only would the home demand be met, but there would be a large available supply for export.

Precious Metals. — ^There is no known source of supply in China proper where gold and silver are worked to any appreciable extent. A little gold washing is done in the sandy beds of certain rivers, for instance, the Han river and the upper Yangtse, above Suifu, ■which here goes by the name of the “Goldsand” river. The amount so extracted is extremely small and hardly pays the labour of washing, but the existence of gold grains points, no doubt, to a matrix higher up. The whole of south-western China has the reputation of being highly metalliferous, and it is probable that valuable deposits may be found when permission to prospect has been granted by the Chinese Government. Gold is obtained, however, in some quantities on the upper waters of the Amur river, on the frontier between China and Siberia. The washings are carried on by Chinese, no foreigners so far having been allowed to participate. Gold has also been found in quartz veins at Ping- tu, in the province of Shantung, but hardly in paying quantities.

Manufactures. — In regard to manufactures the only point to be noticed is the recent establishment of cotton spinning and weaving mills by foreign companies at Shanghai. Permission to carry on tliis industry was refused to foreigners until the right was secured by the Japanese treaty following on the war. Some native- owned mills had been working before that date, and were reported to have made large profits. Eight mills with an aggregate of 300,000 spindles are now working, five of which are under foreign management. There are also four or five mills at one or other of the ports working 80,000 spindles more. These mills are all engaged in the manuJEacture of yarn for the Chinese market, very little weaving being done. Chinese-grown cotton is used, the staple of which is short, and only the coarser counts can be spun. So far these mills have not had the financial success which was predicted for them, but many of the initial difficulties were due to inexperience, and it is probable that the cotton manufacturing industry in China will attain considerable pro- portions. The only other manufacture that deserves mention is that of silk weaving. This is carried on solely by native looms, and chiefly in the cities of Hangchow, Soochow, and Nanking. The native looms have long been famous for their beautiful silks and brocades. The greater part is destined for home consump- tion, but there is now also a considerable export. In 1898 the export of silk piece goods amounted in value to £1,400,000. The reeling of silk cocoons by steam machinery has also come into vogue in recent years, and is gradually

supplanting the native methods. Notwithstanding the large foreign importations the spinning and weaving of cotton on native hand-looms is still carried on almost universally. The whole of the large import of Indian yarn, as well as that locally manufactured, is worked up into cloth by the women of the household. Four-fifths of the clothing of the lower classes is supplied by this domestic industry.

Commerce. — ^The progress of the foreign trade of China is set out in the following table. The values are given both in currency and sterling, but it is to be remarked that during the period when silver was falling, that is from 1875 to 1893, the silver valuation repre- sents much more accurately variations in the volume of trade than does the gold valuation. Gold prices fell continuously during this period, while silver prices were nearly constant. Since 1893 silver prices have tended to rise, and the gold valuation is then more accurate. The conversion from silver to gold is made at the rate of exchange of the day, and therefore varies from year to year. Table of Imports and Exports, exclusive of Bullion.

Tear.

Imports.

Exports. 1

Value in Taels.

Equivalent in Sterling.

Value in Taels.

Equivalent in Sterling.

1875 1880 1885 1890 1895 1896 1897 1898

66,344,000 76,689,000 84,803,000 113,082,000 154,685,000 184,897,000 185,194,000 189,991,000

£19,903,000

22,368,000 22,618,000 29,213,000 25,136,000 25,816,000 27,779,000 28,498,000

77,308,000

87,694,000

73,899,000

96,695,000

154,964,000

141,685,000

175,229,000

170,743,000

£23,193,000

25,582,000 19,206,000 24,980,000 25,181,000 23,114,000 26,284,000 25,612,000

The distribution of the trade among the various countries of the world is shown in the following table : —

Imports into China. (OOO’s omitted.)

Imports from

18T5.

IssO.

1885.

ISSO.

1896.

1898.

Un. Kingdom

£6,340

£6,382

£6,396

£6,357

£5,518

£5,244

Hong-Kong .

8,282

8,829

9,404

18,615

14,331

14,582

India . . .

4,451

6,039

4,306

2,661

2,753

2,870

Other British

Possessions

396

346

542

571

732

721

United States

304

351

884

949

827

2,574

Continent of

Europe (ex-

cept Russia)

230

671

671

638

1,227

1,410

Russia in

Europe . .

...

..>

177

291

218

Russia in Asia

30

50

52

54

18

45

Japan . . .

746

1,021

1,404

1,909

2,794

4,156

Exports from

China.

(OOO’E

omitted.)

Exports to

1875.

1880.

1885.

1390.

1895.

1898.

United Kingdom Hong-Kong . . India ....

£8,749

3,824

72

£8,125

4,844

323

£5,864

4,232

157

£3,383

8,507

273

£1,718

5,651

449

£1,607

9,312

198

Other British

Possessions .

948

874

818

886

586

558

United States . Continent of

2,302

2,906

2,213

2,109

2,499

1,798

Europe (except

Russia) . . .

Russia in Europe

2,524 411

3,760 8

1,948 252

3,004 959

3,440 727

3,889 751

Russia in Asia . Japan ....

928 586

1,252 642

1,041 398

1,829 1,248

1,808 2,408

1,919 2,414

The principal exports from the United Kingdom to China are cotton piece goods, woollen manufactures, metals, and machinery. China is next to India the greatest consumer of Manchester goods. The export of plain cotton cloths to China and Hong-Kong has for some years averaged 500,000,000 yards per annum. The only competitor which Great Britain has in this particular branch of trade is the United States of America, which within recent years has been supplying China with very large quantities of cotton goods. In 1888 China imported 70,000,000 yards of American- made goods, but in 1898 the import had risen to 165,000,000 yards. The value in sterling of the total imports into China from the United Kingdom has remained nearly constant for the last 26 years, but inasmuch as the gold prices have been falling the volume of the export has been in reality steadily growing. The imports into England, however, of Chinese produce have fallen off enormously, mainly through the fact that China tea has been driven out of the English market by the growth of India and Ceylon, and also because the bulk of the China silk is now shipped directly to Lyons and other Continental ports instead of to London as formerly was the rule. The growth of the import of Indian yam into China has been very rapid. In 1884 the import was 35,000,000 lb and in 1898 it reached 188,000,000 ft.

Arranged in categories the imports into China from all foreign countries for the year 1898 were as follows : —

Cottons and cotton yam

WooUen manufactures

Metals and machinery

Petroleum

Opium .

Sundries

Total

£11,012,000

440,000

1,600,000

1,600,000

3,460,000

10,370,000

£28,482,000

The principal exports from China are silk and tea. These two articles, indeed, up to 1880 constituted more than 80 per cent, of the whole export. Owing, however, mainly to the fall in silver, and partly also to cheap ocean freights, it has become profitable to place on the European market a vast number of miscellaneous articles of Chinese produce which formerly found no place in the returns of trade. The silver prices in China did not change materially with the fall in silver, and Chinese produce was thus able to

compete favourably with the produce of other countries. The following table shows the relative condition of the export trade in 1880 and 1898 :—

Exports of

1880.

1898.

Silk. Tea . Miscellaneous .

Total .

£9,750,000

11,774,000

4,058,000

£9,074,000

4,178,000

12,360,000

£25,582,000

£25,612,000

In the miscellaneous class the chief items of export are beans and beancake, £1,624,000 ; raw cotton, £473,000 ; hides, £562,000 ; mats and matting, £552,000 ; oils, £475,000 ; furs and skin rugs, £461,000 ; sugar, raw, £311,000 ; tobacco, £576,000 ; strawbraid, £470,000 ; and wool, £214,000. The export of all cereals except pulse is forbidden.

Movements of Bullion. — The following table shows the export and import of the precious metals for the past eleven years. The net import or export only is given.

Imports,

Exports,

, Value in H. Taels.

Value in H. Taels.

Gold

Silver

Gold

Silver

H. Tl8.

H. Tl8.

H. TlB.

H. TIb.

1888

...

1,678,000

1,911,000

1889

6,005,000

1,625,000

1890

...

1,783,000

3,557,000

1891

...

3,693,000

3,113,000

1892

7,332,000

4,825,000

1893

9,873,000

7,459,000

1894

26,389,000

12,774,000

1895

36,685,000

6,624,000

1896

1,720,000

8,114,000

1897

1,641,000

8,512,000

1898

4,722,000

7,704,000

Total 1 11 years J ■

87,035,000

67,298,000

13,406,000

There has thus been over the whole period a net import of silver of H. taels 73,629,000, equivalent to about 95,000,000 ounces. Nearly tlie whole of this, however, was imported during the years 1894-95, and was the proceeds of loans raised by the Chinese Government in Europe to meet the costs of the Japanese war. Very little comes into China in discharge of the annual balance of trade, inasmuch as the exports, including gold, and imports nearly counterbalance each other. There is a regular export of gold amounting on an average to about a million sterling per annum. A part of it would seem to be the hoardings of the nation brought out by the high price of gold in terms of silver, but a part is virgin gold derived from gold workings in Manchuria on the upper waters of the Amur river.

Shipping and Navigation. — All the foreign trade of China and a great part of the coasting trade is carried on by foreign-owned vessels. The only Chinese-owned steamers are those of the China Merchants' Steamship Company, which has its headquarters at Shanghai, and a few colliers belonging to the Kaiping Mining Com- pany. The following table shows the nationality and tonnage of the vessels entering and clearing at the ports of , China for 1898 : —

Flag.

Tonnage entered and cleared.

Percentage of total foreign.

British .

German

Japanese

French .

American

Russian

Other Powers

21,265,966 1,685,098 1,569,134 420,078 239,152 178,768 686,812

81-7 6-5 6

1-6

0-9i

0-7 2-6

Total foreign "t tonnage J

26,045,008

100

In addition to the foregoing, 8,187,572 tons of Chinese-owned shipping entered and cleared at the open ports during 1898. These were wholly small vessels engaged in the coasting trade.

Treaty Ports. — In addition to the coast and’ river ports declared open to foreign trade under the treaty of Tientsin, the following places have since been thrown open at various times : —

On the Canton or West River, Samshui, Wuchow, and Nanning.

On the Yangtse, Wuhu, Shasi, Ichang, Chungking, and Yochow — the last being at the entrance to the Tungting lake.

On the Shanghai inland waters the cities of Soochow and Hang- chow were opened by the Japanese treaty of 1895. They are connected with Shanghai by canal.

On the Tongking and Burma frontiers, the cities of Lungchow, Mengtze, Szemao, and Momien.

The German naval station in Kiaochow Bay (Tsingtao) is also open to trade, and it is understood that Talienwan, which was similarly acquired on lease by Russia, and which is to be the commercial terminus of the Russian Manchurian Railway, will in due course also be thrown open. An anchorage termed Chlng- wan-tao, near Shanhai-kwan, in the Gulf of Pe Chili, was opened in 1900. It lies close to the Imperial Northern Railway, and being ice-clear during the winter affords access to Peking when the other northern ports are closed.

Internal Communication — Bailways. — The ninth edition article on China closed with the notice of the opening of a short line of railway between Shanghai and Woosung, and the writer hazarded the remark, that notwithstanding the fact that the trains were daily crowded with passengers, the approbation was that of the people only, and that the Government were

more determined than ever to withstand the adoption of the vcoxi road (v. 672). The fate of this pioneer railway may be mentioned as an intro- duction to what follows. It must be admitted that the ofl&cials had some justification for their opposition. The railway was really built without any regular permission from the Chinese Govern- ment, but it was hoped that once finished and working, the irregularity would be overlooked in view of the manifest benefit to the people. This might have been accomplished but for an unfortunate accident which happened on the line a few months after it was opened. A Chinaman was run over and killed, and this event, of course, intensified the official opposition, and indeed threatened to bring about a riot. The working of the line was stopped by order of the British minister, and thereupon negotia- tions were entered into with a view to selling the line to the Chinese Government. A bargain was struck sufficiently favour- able to the foreign promoters of the line, and it was further agreed that, pending payment of the instalments which were spread over a year, the line should continue to be worked by the company. The expectation was that when the officials once got the line into their own hands, and found it a paying concern, they would continue to run it in their own interest. Not so, however, did things fall out. The very day that the twelve months were up the line was closed ; the engines were dismantled, the rails and sleepers were torn up, and the whole concern was shipped off to the distant island of Formosa, where carriages, axles, and all the rest of the gear were dumped on the shore and left for the most part to disappear in the mud. The spacious area of tlie Shanghai station was cleared of its buildings, and thereon was erected a temple to the queen of Heaven by way of purifying the sacred soil of China from such abomination. This effectually put a stop to all efforts on the part of foreigners to introduce railways into China, and more than twenty years elapsed before the subject was taken up again. It is only within quite recent years that the Chinese Government have been induced to move in the matter. The first short line built was a mineral line, to connect the coal mines of Kaiping in North Chihli with the mouth of the Peiho river at Taku. The Government next authorized the formation of a Native Merchants' Company, under official control, to build a line from Taku to Tientsin, which was opened to traffic in 1888. It was not, however, till nine years later, viz., in 1897, that the line was completed as far as Peking. Meantime, however, the extension had been continued north-east along the coast as far as Shanhai-kwan, and a

further extension will connect with the treaty port of Newchwang. The money for these extensions was mostly found by the Government, and the whole line is now known as the Imperial Northern Railway. A loan of £2,300,000 for the Newchwang extension was raised through the Hong-Kong and Shanghai Bank in 1899, and secured by a mortgage on the completed section as far as Shanhai-kwan. The length of the line is 340 miles, and, including the Newchwang extension, it will be when completed 600 miles in length. Mean- while the high officials of the empire had gradually been brought round to the idea that railway development was in itself a good thing. Chang Chih-tung, then viceroy of the Canton provinces, memorialized strongly in this sense, coupled, however, with the condition that the railways should be built with Chinese capital and of Chinese materials. In particular, he urged the making of a line to connect Peking with Hankow for strategic purposes. The Government took him at his word, and he was transferred from Canton to Hankow with authority to proceed forthwith with his railway. True to his purpose he at once set to work to con- struct iron-works at Hankow. Smelting furnaces, rolling mills, and all the machinery necessary for turning out steel rails, locomotives, &c., were erected. Several years were wasted over this preliminary work, and over £1,000,000 sterling was spent only to find that the works after all were a practical failure. Steel rails could be made, but at a cost two or three times what they could be procured for in Europe. After the Japanese war the hope of building railways with Chinese capital was abandoned. A prominent official named Sheng Hsuan-hwai was appointed director-general of railways, and empowered to enter into nego- tiations with foreign financiers for the purpose of raising loans. It was still hoped that at least the main control would remain in Chinese hands, but the diplomatic pressure of France and Russia caused even that to be given up, and Great Britain insisting on equal privileges for her subjects, the future of railways in China will be in the hands of the various concessionaires, at least until their redemption by the Chinese Government.

The following is a list of the several railway concessions which have been granted up to date : —

(1) English. — 1. (a) Shanghai to Nanking ; (6) Shanghai to

Hangchow and Ningpo ; (c) Puiou (on the north bank of the Yangtse opposite Nanking) to Siuyang, a station on the Luhan line. Total length 650 miles. 2. Hong-Kong to Canton, 100 miles. 3. In the provinces of Shansi and Honan, die Peking Syndicate, besides mining rights, have the right to connect mines with naviga- ble waters. Lines not yet determined, but will probably extend to 300 or 400 miles.

(2) Anglo-German. — A trunk line from Tientsin to Chinkiang, 600 miles. Northern or Shantung half to be built and equipped by the German syndicate ; the southern or Yangtse half by English syndicate. Total length 600 miles.

(3) Anglo-American. — A trunk line from Canton to Hankow, 600 miles.

(4) German. — Lines in Shantung. Kiaochow to Tsinanfu, and Kiaochow to Yihsien, 420 miles.

(5) Russian. — (a) Permission to carry the Siberian main line now in course of construction from Stretensk through Chinese territory vid, Petnne to Vladivostock, 1000 miles. (6) A Une to connect Port Arthur and Talienwan with the above, 400 miles, (c) A line from Taiyuenfu, the capital of the province of Shansi, to connect with the Luhan line at Chengting, 130 miles.

(6) Belgian or Franco-Belgian. — A trunk line from Hankow to Peking, generally termed the Lu-Han line, length 700 miles.

(7) French. — (a) From Tonking up the Red river to Yimnanfu, 200 miles. (6) Langson to Lungchow and Nanning, 100 miles, (c) Pakhoi to Nanning, 120 miles.

The British Government has also obtained the right to extend the Burma railway system through Yunnan and north to the Yangtse so soon as a company is prepared to take it up.

Many years will doubtless elapse before these lines are made, involving as they do an outlay of something like 60 or 80 millions of capital, and some of them will probably not be made at all. The Russian lines are being pushed on with activity, and the Belgian or more properly Franco-Belgian syndicate, which has the Peking-Hankow, commonly called the Lu-Han, line in hand, has commenced work from the Hankow end. The section Peking to Paoting^u has been already built, and has been transferred for operation to the Belgian syndicate. The lower Yangtse lines as well as the Hong-Kong- Canton line will no doubt be made, and passing as they do through the richest and most populous districts of China, they ought to pay well.

Boads and Canals. — In regard to these nothing new need be said. The Chinese Government spends nothing on these objects. Occasionally the local authorities make an effort by employing the corvfee system to dig out thfe bed of a canal, but as a rule roads are left to take care of themselves. Even the Grand Canal has been suffered to silt up, so that for nearly half its length it is quite useless for through trafBc. It is only employed by the annual fleet of tribute rice boats, which are still required by unyielding regulations to carry their freight by this route. They choose the time of high water, when the country is more or less flooded, and even then it is only by dint of sheer hauling for miles along a muddy bottom that they are got through. Pages are filled by the reports of the officer in charge, describing the superhuman exertions of himself and his men in getting the boats hauled through. It does not appear to occur to any one that a moderate sum spent in dredging, with a few locks here and there, would make the passage cheap and easy.

Telegraphs. — Here the case is different. Every important city in China is now connected by wire with the capital, and the service is reasonably efficient. Connexion is also established with the English lines in Burma and the Russian lines in Siberia. The Great Northern Telegraph Co. (Danish) and the Eastern Extension Telegraph Co. (English) connect Shanghai by cable with Hong- Kong, Japan, Singapore, and Europe. An imperial postal service has also been recently established under the general control of the Maritime Customs. It serves all the open ports, and is gradually being extended to the interior. The treaty Powers, however, stni maintain their

separate post offices at Shanghai for the despatch and receipt of mails from Europe.

Mining Concessions. — The only mining concession of any value granted to a foreign company is that secured by the Peking Syndi- cate, which gives the right to work coal, iron, and petroleum in the province of Shansi. It is expected that this concession will lead to very important industrial developments. Several prelimi- nary contracts have been entered into for mining concessions in other provinces, but they are clogged with conditions imposed by recent regulations issued by the Chinese Government, and for the present they seem of doubtful value.

Banks and Banking. — Native banks for purposes of inland exchange are to be found in most large cities. They are private banks using their own capital, and seldom receiving deposits from the public. The best known are the Shansi banks, which have branches all over the empire. They work on a small capital, seldom over £50,000 each, and do a smaU but profitable business by selling their drafts on distant places. None of these issue

notes, although they are not debarred from doing so by law. They lend money on personal security, but do not advance against shipments of goods. In some places there are small local banks, usually called cash shops, which issue paper notes for small sums and lend money out on personal secvirity. The notes never reach more than a very limited local circulation, and pass current merely on the credit of the institution. There is no law regulating the formation of banks or the issue of notes. Pawnshops occupy a prominent position in the internal economy of China. They lend on deposit of personalty at very high rates, 18 and 24 per cent., and they receive deposits of money from the public, usually allowing 6 to 10 per cent. They are the real banks of deposit of the coun- try, and the better class enjoy good credit.

Currency. — The currency of China consists of : — (1) Silver, which may be either uncoined ingots passing cui-rent by weight, or imported coins, Mexican dollars and British dollars ; and (2) Copper “cash,” which has no fixed relation to silver. The standard is silver, the unit being the Chinese ounce or tael, con- taining 565 grains. The tael is not a coin, but a weight. Its value in sterling consequently fluctuates with the value of silver ; in 1870 it was worth about 6s. 8d., it is now worth rather less than 38. The

name given in China to uncoined silver in current use is “sycee.” It is cast for convenience’ sake into ingots weighing about 50 taels each. Its average fineness is 916-66 per 1000. When foreign silver is imported, say into Shanghai, it can be converted into currency by a very simple process. The bars of silver are sent to a quasi-public office termed the “Kung Ku,” or public valuers, and by them melted down and cast into ingots of the customary size. The fineness is estimated, and the premium or bettemess, together with the exact weight, is marked in ink on each ingot. The whole process only occupies a few hours, and the silver is then ready to be put into use. The Kung Ku is simply a local office appointed by the bankers of the place, and the weight and fineness are only good for that locality. The Government takes no responsibility in the matter, but leaves merchants and bankers to adjust the currency as they please. For pin^oses of taxation and payment of duties there is a standard or treasury tael, which is about 10 per cent, heavier than the tael of commerce in use at Shanghai. Every large commercial centre has its own customary tael, the weight and therefore the value of which differ from that of every other. Silver dollars coined in Mexico, and British dollars coined in Bombay, also circulate freely at the open ports of trade and for some distance inland, passing at a little above their intrinsic value. Carolus dollars, introduced long ago and no longer coined, are retained in current use in several parts of the interior, chiefly the tea-growing districts. Being preferred by the people, and as the supply cannot be added to, they have reached a considerable premium above their intrinsic value. Provincial mints in Canton, Wuchang, and other places, have recently been issuing silver coins of the same weight and touch as the Mex- ican dollar, but very few have gone into use. As they possess no privilege in debt-paying power over imjjorted Mexican dollars there is no inducement for the people to take them up unless they can be had at a cheaper rate than the latter, and these are laid down at so small a cost above the intrinsic value that no profit is left to the mint. The coinage has in consequence been almost discontinued. Subsidiary coins, however, are com- ing largely into use, issued by the local mints. The only coin officially issued by the Government is the so-called copper cash. It is a small coin which by regulation should weigh .fg of a tael, and should contain 50 parts of copper, 40 of zinc, and 10 of lead or tin, and it should bear a fixed ratio to silver of 1000 cash to one tael of silver. In practice none of these . conditions are observed. Being issued from a number of mints, mostly

provincial, the standard was never uniform, and in many cases debased. Excessive issues lowered the value of the coins, and for many yearS the average exchange was 1600 or more per tael. Within the last few years the rise in copper has led to the melting down of all the older and superior coins, and as for the same reason coining was suspended, the result has been an appreciation of the “cash,” so that a tael now ex- changes for only 1180 or 1200. Inasmuch as the “cash” bears no fixed relation to silver, and is moreover of no uniform com- position, it forms a sort of mongrel standard of its own, varying with the volume in circulation at any particular time. It is however, the universal medium of exchange for all retail trans- actions, and the quantities in circulation are enormous. The fluctuations in regard to silver ^ve rise to great complaints among the people. The introduction of a uniform system of coinage is one of the most pressing wants of China.

II. Eecent Histoey. In the article in the ninth edition of the Encyclopedia Britannica, the history of China was carried down to the accession of the Emperor Kwan^ Su in January 1875. As an introduction to what

follows we shall first take a brief survey of the condition of the empire at that period. The decade 1854-64 had witnessed low- water mark in the political fortunes of the Manchu dynasty. The central provinces had been overrun and devastated by the Taiping rebels. Nanking, the ancient capital of the empire, was in their hands, and throughout the whole of the lower Yangtse valley, even down to Shanghai and Ningpo, bands of marauders burnt, pillaged, and murdered at their will. In the south-west the province of Yunnan was the scene of another rebellion. A Mahommedan tribe known as Panthays had risen in revolt, captured the city of Talifu, and proclaimed a chief, Tu Win Siu, as their sultan. In the north-west a similar Mahommedan rebellion broke out in the province of Kansuh. This was followed by a revolt of the whole of the central Asian tribes, which for 2000 years had more or less acknowledged the imperial sway. In Kashgaria, a native chief termed Yakoob Beg, otherwise known as the Atilik Ghazi, had made himself Ameer, and seemed likely to establish a strong rule. The fertile

province of Kuldja or Hi, lying to the north of the Tien- shan range, was temporarily taken possession of by Russia in order to put a stop to the prevailing anarchy, but with a promise that when China should have succeeded in re-establishing order in her central Asian dominions it should be given back. To add to. all these misfortunes, and even when they were at their height, the Chinese Government embroiled itself in a foreign war. Redress being refused for long-standing grievances, a combined British and French expedition was sent to operate in the north. The emperor fled to Mongolia, Peking was surrendered, and terms of peace were dictated within the walls of the capital (24th October 1860). This last calamity, which might have seemed to some the worst of all, was in reality the salvation of the country. The foreign Powers had gone there for the sole purpose of estabUshing fair and equitable terms of trade — terms which would be just as advantageous to the people of China as to themselves. The treaty having once been made with the imperial Government, it was their interest to uphold its authorityj and to see a speedy end to the forces of anarchy and disorder. No sooner, therefore, had the war with China been finished, than Great Britain and France proceeded to lend the Chinese active assistance. The services of General Gordon at this juncture are too well known to need further mention. With the first of his victories the tide began to turn, and from that time fortune smiled on the imperial arms. By degrees the Taiping rebellion was crushed ; indeed the movement had for some years been collapsing through internal decay ; and, with the fall of Nanking in 1864, it finally disappeared. The next ten years (1864-74) witnessed a general revival of the strength of the empire. The Panthay rebellion in Yunnan was put down in 1873, and order had been re-established somewhat earlier in the north- western provinces of Shensi and Kansuh. The central Asian states still remained under the rule of the Ameer Yakoob Khan, and China was at this time strongly counselled by many to leave things alone in that region. Russia had in the course of the disorder possessed herself of the khanate of Khokand, and it was pointed out that a strong state like that of Kashgaria under Yakoob Khan might be a convenient buffer against farther progress on that side from the great western Power. This counsel, however, as will be seen, did not prevail.

Such, briefly, was the state of affairs at the accession of the reigning emperor, Kwang Su, in January 1875. He was not then four years old, and

his accession attracted little notice outside of China, as the supreme power continued to be vested in the two dowager empresses whose long regency had been only nominally determined in favour of the emperor Tung Chi when the latter attained his majority in 1873 — the empress Tsu An, principal wife of the emperor Hsien Fung, and the empress Tsu Tsi, secondary wife of the same emperor, and mother of the emperor Tung Chi. Yet there were circumstances connected with. the emperor Kwang Su's accession which might well have arrested attention. The emperor Tung Chi, who had himself succumbed to an ominously brief and mysterious illness, left a young widow in an advanced state of pregnancy, and had she given birth to a male child her son would have been the rightful heir to the throne. But even before she sickened and died — of grief, it was officially stated, at the loss of her imperial spouse — the dowager empresses had solved the question of the succession by placing Kwang Su on the throne, a measure which was not only in itself arbitrary, but also in direct conflict with one of the most sacred of Chinese traditions. The solemn rites of ancestor-worship, incumbent on every Chinaman, and, above all, upon the emperor, can only be properly performed by a member of a younger generation than those whom it is his duty to honour. The emperor Kwang Su, being a son of Prince Chun, brother to the emperor Hsien Fung, and thus first cousin to the emperor Tung Chi, was not therefore qualified to offer up the customary sacrifice before the ancestral tablets of his predecessor. So profound was the prejudice created against the young emperor on this score, that fifteen years later, when, having reached the age of manhood, he proceeded for the

first time to the Temple of Heaven to perform the ancestral rites, one of the censors committed suicide in his presence as a protest against so grave a breach of the dynastic tradition. The accession of an infant in the place of Tung Chi achieved, however, for the time being what was doubtless the paramount object of the policy of the two empresses, namely, their undisturbed tenure of the regency, in which the junior empress Tsu Tsi, a woman of unques- tionable ability and boundless ambition, had gradually become the predominant partner. j^^

The first question that occupied thj^BKition of the Government under the new reign was one of t^»^ivest importance, and nearly led to a war with Great Britai^ The Indian Government was desirous of seeing the old trade relations between Burma and the south-west provinces, which had been interrupted by the Yunnan rebellion, re-established, and for that purpose

proposed to send a mission across the frontier into China. The Peking Government assented and issued passports for the party. Mr A. R. „ ^ Margary, a young and promising member of the China g^/Ar” consular service, was told off to accompany the expedi- Margary. tion as interpreter. All went well until the mission, which was under the command of Colonel Browne, was nearing the Chinese frontier, when rumours of trouble ahead began to reach them. Mr Margary, who had a month previously crossed overland from Shanghai with no dilBculty, made light of the reports, but offered to ride on ahead and ascertain the state of affairs. He left, accompanied only by his Chinese servants, and never returned. Two days afterwards news reached Colonel Browne that he had been treacherously murdered by Chinese at the small town of Maawyne, and almost simultaneously an attack was made on the expedition by armed forces wearing Chinese uniform (January 1875). Colonel Browne with difficulty made his way back to Bhamo, and the expedition was abandoned. Demands were made on the Peking Government for a thorough inquiry on the spot in the presence of British officers. The Chinese reply was that the murder and the attack were alike the work of irresponsible savages and hillmen, animated with a desire for plunder. Enough evidence was collected on the Burma side to show that this was not true, and it could not be doubted that the orders for the attack emanated from the provincial government of Yunnan, if not from higher quarters. After , infinite shuffling and delay an imperial com- mission was despatched to hold an inquiry, three British officers being sent at the same time to watch piroceedings. The trial proved an absolute farce. Eleven half-naked savages were pro- duced as the culprits, and the only evidence tendered was such as had manifestly been manufactured for the purpose. The British officials protested and withdrew from the burlesque. The trial, however, proceeded, and the eleven hillmen were sentenced to death. A report in that sense was addressed to the throne, and with this it was hoped the British sense of justice would be satisfied. Sir Thomas Wade, then British minister at Peking, promptly declared that if this report were published or acted on he would at once haul down his flag,, rightly deeming that such a reparation was a greater insult than the original offence. Tedious negotiations followed, which more than once threatened to end in a rupture, but finally, more than eighteen months after the outrage, an arrangement was come to on the basis of guarantees for the future, rather than vengeance for the past, The arrange- ment was embodied in the Chefoo

convention, dated 13th September 1876. The terms of the settlement comprised (1) a mission of apology from China to the British court ; (2) the promulgation throughout the length and breadth of the empire of an imperial proclamation, setting out the right of foreigners to travel under passport, and the obligation of the authorities to protect them ; and (3) the payment of an indemnity. The con- vention comprised besides a number of clauses which, though meant to improve commercial relations, were severely criticized by the mercantile communities. The stipulation most objected to was one by which the Chinese Government were debarred from levying likin within the area of the foreign concessions, thereby implying, it was argued, the recognition of the right to levy it ad libitum elsewhere. Ratification of this article was refused by the British Government, and additional articles were subsequently signed in London relative to the collection of likin on Indian opium and other matters.

While these events were going on the imperial authority had been re-established in the north-western provinces of Shensi and Kansuh under Tso Tsung-tang as governor-general, and prepara- tions were made for the reconquest of Kashgaria. Money was supplied by a foreign loan for £1,600,000, being the first appear- ance of China as a borrower. It was a formidable expedition ; not so much from the warlike nature of the enemy, as from the im- mense distances to be traversed and the extreme difficulty of transport Nevertheless after two years of dogged perseverance China succeeded. Manas, the last stronghold of the Jungaris, was captured ([November 1876), and the death of the- Ameer Yakoob Khan in the following year greatly facilitated the com-

pletion of the task. By degrees the emperor’s authority was established from the confines of Kansuh to Kashgar and Yarkand, and Chinese garrisons were stationed in touch with the Russian outposts in the region of, the Pamirs (December 1877). There remained only the north-eastern province of Kuldja, occupied by Russia, but under a promise made in 1871 to restore it when China was in a position to maintain order. This promise Russia was now called upon to redeem. It is probable that, in making this promise,

Russia calculated that the day was far distant when China would be in a position to fulfil the condition ; at all events she showed no desire to comply with the request. China de- spatched Chung-how, a Manchu of the highest rank, who had been notoriously concerned in the Tientsin massacre of 1871, to St Peterburg to negotiate a settlement. After some months of discussion a document was signed (September 1879), termed the

treaty of Livadia, whereby China recovered, not indeed

/H *^^ whole, but a considerable portion of the disputed

masouaa- territory, on her paying to Russia five million roubles

as the cost of occupation. At first sight it was con- sidered by Western diplomatists that, having regard to the small amount of pressure he could bring to bear, Chung-how had acquitted himself of his mission rather well. The treaty was, however, received with a storm of indignation in China. Li Huug- Chang and Tso Tsung-tang took up the cry. Chung-how was placed under arrest as soon as he returned. Memorials poured in from all sides denouncing the treaty and its author. Foremost among these was one by Chang Chih-tung, then occupying a subordinate post in the Hanlin, who has since become the most distinguished of the viceroys, and is actually governor-general of Hupeh and Hunan. Its publication raised him at once into eminence. He demonstrated seriatim the objections to the treaty, chief of which was that, under guise of trading facilities, it opened a way for the military aggression of Russia from the west, and he wound up with declaring, “If we do not alter this treaty we are not worthy to be called a nation.” Prince Chun, the emperor’s father, came into prominence at this juncture as an advocate for war, and under these combined influences the unfortunate Chung- how was tried and condemned to death (3rd March 1880). For some months warlike preparations went on, and the outbreak of hostilities was Imminent. In the end calmer counsels prevailed ; the foreign ministers interceded for Chung-how, and he was first reprieved and finally released. Li Hung-Chang, though he had been one of the first to raise the storm, became alarmed at the near prospect of war, for which he well knew China was unpre- pared, and threw in his voice with Prince Kung on the side of peace. A visit from Greneral (Jordon, and the sound, though probably unpalatable, advice which he gave, weighed in the same direction.

It was decided to send the Marquis Tseng, who in the meantime had become minister in London, to Russia to negotiate a new treaty. With more adroitness he avoided his predecessor's mistakes, and produced a treaty which, though not very materially different from the old, inasmuch as it still left Russia in possession of part of the Hi valley, pleased everybody, and was universally accepted. This was ratified 19th August 1881. The Chinese Gov- ernment could now contemplate with satisfaction the complete recovery of the whole extensive dominions which had at any time owned the imperial sway. The regions directly administered by the officers of the emperor extended from the borders of Siberia on the north to Annam and Burma on the south, and from the Pacific Ocean on the east to Kashgar and Yarkand on the west. But even that did not complete the tale, for outside these boun- daries there was a fringe of tributary nations which still kept up the ancient forms of allegiance, and which more or less acknow- ledged the dominion of the central kingdom. As most of China's subsequent misfortunes have been in connexion with one or other of these tributary states, a brief notice may here be permitted of the actual relationship subsisting at this date. The principal tributary nations then were Korea, Liuohiu, Annam, Burma, and Nepaul. The dynastic records enumerate several others, including even England, Lord Macartney's mission of 1793 having been gravely described as bringing tribute, but these were more or less accidental. The tie which bound these states to ,their suzerain was of the loosest description. China accepted their homage with calm superiority, but conceived herself to be under no reciprocal obligation. It was usual for the kings, on succession, to seek investiture, which consisted in the grant of a patent and a seal, but even that was not invariably insisted on. In any case, it was no part of the duty of China to keep the king on his throne. If his subjects chose to depose him and set up another, they might do so, and she received a successful usurper and bestowed a new patent and a new seal with the same nonchalance as she had mani- fested to his predecessor. This happened more than once in Annam. Such was the attitude which China still maintained when foreign nations first began to come into contact with these tribu- tary states. She did not recognize that the position of suzerain involved responsibilities as well as rights, and to this non-

perception are to be attributed all the vagaries of her diplomacy and the complications in which she became involved. Korea was the first of the

dependencies to come into notice. In 1866 some Roman Catholic missionaries were murdered, and about the same time an American vessel was burnt in one of the rivers and her crew murdered. China refused satisfaction, both to France and America, and suffered reprisals to be made on Korea without pro- test. America and Japan both desired to conclude commercial treaties for the opening up of Korea, and proposed to negotiate with China. China refused and referred them to the Korean Government direct, saying she was not wont to j”” *”” interfere in the affairs of her vassal states. As a result ^”’ Japan concluded a treaty in 1876, in which the independence of Korea was expressly recognized. This was allowed to pass with- out protest, but as other nations proceeded to conclude treaties on the same terms China began to perceive her mistake, and endeav- oured to tack on to each a declaration by the king that he was in fact a tributary — a declaration, however, which was quietly ignored. Japan, however, was the only Power with which controversy immediately arose. In 1882 a faction fight, which had long been smouldering, broke out, headed by the king’s father, the Tai Won Kun, in the course of which the Japanese legation was attacked and the whole Japanese colony had to flee for their lives. China sent troops, and by adroitly kidnapping the Tai Won Kun, order was for a time restored. The Japanese legation was replaced, but under the protection of a strong body of Japanese troops. Further revolutions and riots followed, in which the troops of the two countries took sides, and there was imminent danger of war. To obviate this risk, it was agreed in 1885 between Count Ito and Li Hung-Chang that both sides should withdraw their troops, the king being advised to engage officers of a third state to put his army on such a footing as would maintain order, and each under- took to give the other notice, should it be found necessary to send troops again. In this way a modus vivendi was established which lasted till the events which preceded the outbreak of war in 1894. Chinese influence continued predominant, but the unhappy king- dom was constantly disturbed by faction.

We can only glance briefly at the domestic affairs of China during the period 1875-82. The years 1877-78 were marked by a famine in Sbansi and Shantung, which for duration and intensity has probably never been equalled. For two successive seasons the crops failed. The population affected numbered 30 to 40 millions, the districts lay far from the coast, there was no water communication, and the roads were unfit for wheeled

vehicles. Transport broke down, pack animals were not to be had, and sheer starvation stared the unfortunate people in the face. It was computed that 12 or 13 millions perished. It was hoped that this lamentable loss of life, due mainly to defective com- munications, would induce the Chinese Government to listen to proposals for railway construction, but even this argument had no effect. The fate of the experimental line at Shanghai has been already mentioned. The Russian scare had, however, taught the Chinese the value of telegraphs, and in 1881 the first hne was laid from Tientsin to Shanghai. Further construction was continued without intermission from this date. A beginning also was made in naval affairs. The arsenal at Foochow was turning out small composite gunboats, a training ship was bought and put under the command of a British officer. Several armoured cruisers were ordered from Armstrong, and some progress was made with the fortifications of Port Arthur and Wei-hai-wei. Forts were also built and guns mounted at Foo- chow, Shanghai, Canton, and other vulnerable points. Money for these purposes was abundantly supplied by the customs duties on foreign trade, and China had learnt that at need she could borrow from the foreign banks on the security of this revenue. In all the elements of material strength she had grown enormously within the previous ten years, and her prestige had grown even more, for she was believed to be very much stronger than she really was.

In 1881 the senior regent, the empress Tsu An, was carried off by a sudden attack of heart disease, and the empress Tsu Tsi remained in undivided possession of the supreme power during the remainder of the emperor Kwang Su’s minority. Li Hung- Chang, firmly established at Tientsin, within easy reach of the capital, as viceroy of the home province of Chihli and superin- tendent of northern trade, enjoyed a larger share of his imperial mistress’s favour than is often granted by the ruling Manchus to officials of Chinese birth, and in all the graver questions of foreign policy his advice was generally decisive.

While the disputes with Japan were still going on regarding Korea, China found herself involved in a more serious quarrel in respect of another tributary state which lay on the southern frontier. By a treaty made between France Tong- and Annam in 1874, the Red river or Songkoi which, klagaad

rising in south-western China, flows through the Hanoi. province of Tongking, was opened to trade together with the cities

of Haiphong and Hanoi situated on the delta. The object of the French was then, as it is now, to find a trade route to Yunnan and Szechuen from a base of their own, and it was hoped the Red river would furnish such a route. Tongking at the time, however, was infested with bands of pirates and cut-throats, many of whom were Chinese rebels or ex-rebels who had been driven across the frontier by the suppression of the Yunnan and Taiping rebellions, conspicuous among them being an organization called the Black Flags. The Annamese Government undertook by the treaty to restore order, and France had promised help. Some years having passed without any improvement, France, which meanwhile had kept a small guard at Haiphong, sent reinforcements (1882), nominally to assist the Annamese troops in putting an end to disorder. The Annamese officials, however, declined to receive them as friends, opposed their progress, and the expedition took the form of a military occupation. China, meanwhile, began to take alarm at the near approach of a strong military power to her southern frontier. When the treaty of 1874, which gave France trading privileges, was communicated to her, she seems to have treated it with indifference as she treated the Japanese treaty with Korea, and neither in the one case nor in the other took any steps to see that the provisions were carried out. Now, however, she began to protest, claiming that Annam was a vassal state and under her protection. France took no notice of the protest, declaring that the claim had merely an archaeological interest, and that, in any case, China in military affairs was a quantite negligeable. France found, however, that she had undertaken a very serious task in trying to put down the forces of disorder in Tongking. The Black Flags were, it was believed, being aided by money and arms from China, and as time went on, her troops were more and more being confronted with regular Chinese soldiers. Several forts, well within the Tongking frontier, were known to be garrisoned by Chinese troops. Operations continued with more or less success during the winter and spring of 1883-84. Both sides, however, were desirous of an

arrangement, and in May 1884 a convention was signed between Li Hung-Chang and a Captain Fournier, who had been commissioned ad hoc, whereby China agreed to withdraw her garrisons and to open her frontiers to trade, France agreeing, on her part, to respect the fiction of Chinese suzerainty, and guarantee the frontier from attack by brigands. The arrangement was satisfactory to both sides, but, strange to say, it was completely frustrated by a series of un- fortunate misunderstandings which led to a renewal of hostili- ties. No date had been fixed in the convention for the evacu- ation of the Chinese garrisons, and Fournier endeavoured to supplement this by a memorandum to Li Hung-Chang, at the same time announcing the fact to his Government. In pursuance of this arrangement the French troops proceeded to occupy Langson on the date fixed (21st June 1884). The Chinese commandant refused to evacuate, alleging, in a despatch which no one in the French camp was competent to translate, that he had received no orders, and begged for a short delay to enable him to communicate with his superiors. The French com- mandant ordered an attapk, which was repulsed with severe loss. Mutual recriminations ensued, the French declaring the resistance an act of treachery, and the Chinese declaring that the French had broken faith by advancing before the date fixed. The whole question turned on the unfortunate memorandum of Captain Fournier. The Chinese alleged that in deference to Li Hung-Chang's representation. Captain Fournier had a|greed to postpone the date of evacuation, and himself erased the original figures and inserted others, attesting the alteration by putting his initials in the margin ; and they produced the original document so altered. Captain Fournier affirmed, on his honour, that he had made no alteration, and declared the whole thing an impudent forgery. On whichever side the truth lay, the result was greatly to embitter the feeling on both sides. From Paris there caine a demand for a huge indemnity as reparation for the insult. The Peking Government offered to carry out the convention, and to pay a small indemnity for the lives lost through the misunder- standing. This was refused, and hostilities recommenced, or, as the French preferred to call them, reprisals, for the fiction was still kept up that the two countries were not at war. Under cover of this fiction the French fleet peaceably entered the harbour of Foochow, having passed the forts at the entrance to the river without hindrance. Once inside, they attacked and destroyed the much inferior Chinese fleet which was then quietly at anchor, destroying at the same time a large part of the

arsenal which adjoins the anchorage (23rd Aug. 1884). Retracing its steps, the French fleet attacked and destroyed with impunity the forts which were built to guard the entrance to the Min river, and could offer no resistance to a force coming from the rear. After this exploit the French fleet left the mainland and continued its reprisals on the coast of Formosa. Keelung, a treaty port, was bombarded and taken, Oct. 4th. A similar attempt, however, on the neighbouring port of Tamsuy was unsuccessful, the landing party having been driven back to their ships with severe loss.

The attempt was not renewed, and the fleet thereafter confined itself to a semi-blockade of the island, which was prolonged into 1885, but led to no practical results. Desultory operations were continued in the neighbourhood of Shanghai and Ningpo, two old vessels were taken and burnt, but the two or three really powerful boats which the Chinese then possessed took refuge behind the guns of Port Arthur, whither the French admiral did not care to follow them. By way of bringing pressure on the Chinese Govern- ment, the French at this time declared rice contraband of war, in order to stop the supplies going forward to the capital by sea. Even this, though raising an interesting point in international law, had no practical effect. Meanwhile the Chinese had been greatly em- boldened by the successful defence of Tamsuy, and the failure of the French to push home such successes as they had gained. Preparations on a great scale were made to continue the war, and a rising tone was noticed, not only in the acts of the Government, but throughout the country. The new-born native press assiduously encouraged this feeling, and from this time forward began to count as a factor in the situation. Troops were massed on the frontier of Tongking, and the French forces which had pushed their way as far as the border were compelled by overwhelming masses of the enemy to fall back on their base in the delta of the river. Nego- tiations for peace, however, which had been for some time in progress through the mediation of Sir Robert Hart, were at this juncture happily concluded (April 1885), and the French cabinet was thereby relieved from a very embarrassing situation. The terms were practically those of the Fournier convention of the year before, the demand for an indemnity having been quietly dropped.

China, on the whole, came out of the struggle with greatly in- creased prestige. She had tried conclusions with a flrst-class European Power and

had held her own. In material resources she had not been weakened. The provincial fleet at Foochow had indeed been destroyed, but it was of no serious value as a fighting force. On the other hand she had saved her three armoured cruisers, the value of the new fortress of Port Arthur as a naval base had been proved, and, most satisfactory of all, she was not crippled by the exaction of an indemnity.' Morally she might claim a victory. Reasonings such as these, however, omitted to take note of the fact that France was never more than half-hearted over the war. No effective support was given to the French admiral from home, the number of troops sent to Tongking was inadequate to the task they were called on to perform, and no opportunity was afforded to see how Chinese soldiers would stand up against regular European troops. Incorrect conclusions as to the military strength of China were consequently drawn, not merely by the Chinese themselves^which was excusable — but by European and even British authorities, who ought to have been better informed. China was lulled into a false security which proved disastrous when the day of trial came. For the time, however, the lessons of the war were so far learned that the necessity for a strong fleet became generally recognized, and means were at once adopted to that end. War vessels were ordered both from England and Germany, and Admiral Lang, who had withdrawn his services while the war was going on, was re-engaged together with a number of British officers and in- structors. The completion of the works at Port Arthur was taken in hand, and a beginning was made in the construction of forts at Wei-hai-wei as a second naval base. A new department was created for the control of naval affairs, at the head of which was placed Prince Chun, father of the Emperor, who since the downfall of Prince Kung in 1884 had been taking a . more and more prominent part in public affairs. A tour made by Prince Chun in the spring of 1886, in the course of which he visited Port Arthur and Chefoo escorted by the fleet, attracted much attention, as being the first time that a prince so near the throne had emerged from palace seclusion and exchanged friendly visits with foreign admirals and other representatives.

From 1885 to 1894 the political history of China does not call for extended notice. Two incidents, however, must be recorded, the first being the conclusion of a convention between Great Britain and China, in which the latter undertook to recognize British sovereignty in Burma, to delimit the frontier, and to pro- mote overland trade intercourse between the two

countries. Great Britain, on the other hand, consented to the con- tinuance of the customary decennial tribute mission to ™f” be despatched by the ” highest autkority in Burma,” the members, however, to be Burmese, and she also consented not to press a mission which the Indian Government were proposing to send to Tibet and to which China had agreed. The recogni- tion of Chinese suzerainty implied in the sending a tribute mission was sharply criticized, but in point of fact it has never been acted on and is now forgotten. The other incident was the temporary occupation of Port Hamilton by the British fieet (May 1885). Rumours of Russian intrigues in Korea, coupled with recent proceedings in Afghanistan, made it appear desirable that Great Britain should have a naval base farther north than Hong-

Kong. For this purpose a small group of islands at the southern point of the peninsula of Korea, forming the harbour known as Port Hamilton, were occupied. Objections, however, were raised by the Chinese Government to their continued occupation, and Great Britain expressed her willingness to withdraw on receiving sufficient guarantees against their cession to any other Power. A trilateral agreement was thereupon come to, by which Russia bound herself to China to respect the integrity of Koreau territory, and Great Britain thereupon agreed to evacuate Port Hamilton, which was carried out in February 1887. In 1890 occurred an event which, though seemingly insignificant in itself, marks a turning-point in Chinese history, viz., the resignation of Admiral Lang from the command of the Chinese fleet. One of the lessons which the Chinese Government seemed to have learned from the French war was the recognition of the value of a strong fleet. Money was not spared, and a really efficient squadron had been got together and put under the joint command of Ad- miral Ting and his British colleague Admiral Lang. By tact and judgment the latter had so far avoided directly raising the ques- tion of who was really chief. Order and discipline were well maintained, and both men and officers were steadily improving in the knowledge of their profession. During a temporary absence of Admiral

Ting, however, the Chinese second in command claimed the right to take charge, — a claim which Admiral Lang naturally resented. The question was referred to Li Hung-Chang, who decided against Admiral Lang, whereupon the latter, feeling that his authority to maintain discipline was gone, threw up his commission. His resignation was accepted, and he left, never to return. From this point the fleet on which so much depended began to deteriorate. Superior officers again began to steal the men's pay, the ships were starved, shells filled with charcoal instead of powder were supplied, accounts were cooked, and all the corruption and malfeasance that were rampant in the army crept back into the navy. It is needless to point the moral. Chinese super- ciliousness, jealousy of foreigners, and contempt of foreign instruc- tion, once more proved her ruin. "What the dismissal of Admiral Lang cost her was soon to be proved in the fatal battle of the Yaloo. Meanwhile things had not been going well in other respects. Exces- sive taxation and misgovernment produced a general feeling of unrest which continued throughout 1889-90-91. Rumours of risings and rebellions were prevalent, promoted, it was said, by secret societies, chief of which wasthe "Kolaohwei," or Old Brotherhood Society. Numerous arrests and executions took place, especially ia the Yangtse valley. In 1891 there was a series of violent anti-foreign outbreaks in the same region. At Wusieh, two Englishmen were murdered, and at Wuhu, Ichang, and Kiukiang, attacks were made on the foreign settlements and serious damage was done. Many missionary establishments in the interior were destroyed. The origin of these outbreaks was the same old story. Placards were circulated accusing foreigners of kidnapping children and of murdering them in order to boU down their eyes, brains, etc., for medicine. Mis- sionaries were charged with the grossest immorality, and with using religion as a cloak to the vilest; offences. It was found that a society in Hunan, at the head of which was a notorious ex- official named Chou Han, had been -flooding the country with incendiary literature of this class. Repeated efforts were made to secure the punishment of these instigators, but with indifferent success ; the Chinese Government, "though not. exactly screening the offenders, took no energetic measures to put a stop to the calumnies. The anti-foreign agitation, however, gradually died out and things reverted to the normal condition. There appeared even a prospect of considerable railway development — ^the leading officials having at last come round to the opinion that railways might be beneficial at least for strategic purposes.

We pass on to 1894, a year which was fraught with momentous consequences to China, inasmuch as it witnessed the outbreak of the Japanese war. It opened auspiciously, for in Warwiib November was to be celebrated the 60th anniversary Japan. ^^ ^^^ birth of the empress-dowager. It was resolved

that it should be marked with imusual magnificence, and loyal contributions poured in from all parts. In the spring, however, the state of Korea began to attract attention. A series of chronic rebellions had baffled the authorities, and help from China was asked for. China responded and sent 2000 men under General Teh, notifying Japan of the fact, as she was bound to do under the convention of 1885. Japan replied by sending troops also, nominally to guard her legation, which she had a right to do under the same convention. The rebellion was stamped out, and then China proposed that both sides should withdraw. Japan made a counter proposal that both should join in imposing such reforms on Korea as would prevent a recurrence of these internal dissensions. This, in turn, China refused, alleging once more that she was not wont to interfere with the domestic affairs of/ her vassals. Again Japan retorted, denying the alleged suzerainty, and intimating that whether China joined or not she proposed to prosecute her schemes of reform, and would keep

her troops there until the necessary guarantees had been obtained for the security of her trade. At the same time categorical schemes of civil and military reform were laid before the Korean Government, and the Japanese force in Seoul was largely in- creased. By the beginning of July she had over 10,000 men there. The Chinese Government thereupon proceeded to send more troops to reinforce General Yeh, who was stationed at Asan, a short distance south of Seoul. Among other transports a British steamer, the Kowshing, was chartered and despatched with some 1200 troops. On the way, and when nearing the coast of Korea, the Kowshing met a Chinese man-of-war steaming back full speed to China with evident signs of disorder. As subse- quently became known, this vessel, the Chi-yuen, had exchanged hostile shots a few hours previously with a Japanese man-of-war and got the worst of it. The Kowshing was presently accosted by a Japanese war vessel, the Naniwa, and was called upon to surrender. This the Chinese soldiery refused to permit, and the British officer in charge then proposed to

take the troops back to China. This in turn the Japanese refused to allow, and after a warning the Naniwa opened fire on the doomed vessel. A scene of indescribable confusion followed. The vessel sank with her living freight, a few escaped by swimming to a neighbouring island, three of the British officers were picked up by Japanese boats, and all the rest perished. Formal declarations of war soon followed. The first battle was fought at Asan on the 27th July. The Japanese attack was repulsed, but the Chinese evacuated their position during the night and retreated northwards. A series of desultory skirmishes followed, but the only real stand the Chinese made was at Pingyang. The division under General Tso — ^the only capable and honest general in the Chinese army — offered a stubborn resistance till their leader was killed, when they turned and fied. The defeat became a rout, and left the road to China open to the victorious Japanese. Two days afterwards, on the 17th September, the naval engagement of Yaloo was fought. The Chinese fleet possessed two Ironclads heavier than anything in the Japanese navy, but it was hope- lessly out-manoBuvred by the Japanese and lost heavily. Five vessels were sunk, burnt, or driven ashore. Night coming on, the Japanese drew off, and the remainder of the Chinese squadron was allowed to seek shelter in Port Arthur. They did not ven- ture to put to sea again, and in the end were captured or destroyed in the harbour of Wei-hai-wel in February of the following year. On land the Japanese continued their progress, crossed the Yaloo river, and entered Chinese territory on 24th October. City after city fell into their hands, and Newchwang, a treaty port, was occupied on the 4th March. Meanwhile a second Japanese army had landed on the Liaotung peninsula, and captured the naval stronghold of Port Arthur on 22nd November. A third expedition was launched against Wei-hai-wei, where the Chinese fleet had now sought refuge. In spite of the inclemency of the vrinter, operations were vigorously pursued by land and sea, and on 12th February 1895 the fortress and fleet were surrendered. Admiral Ting and the general commanding committed suicide. Further resistance was hopeless, and negotiations were opened for peace. After two abortive missions, which the Japanese re- fused as being, unprovided with sufficient powers, Li Hung-Chang was sent as plenipotentiary, and on 17th April 1895 the treaty of Shimonoseki was signed. The terms included the cession of Liao- tung peninsula, then in actual occupation by the Japanese troops, the cession of the island of Formosa, an indemnity of H. taels-200,000,000 (about £30,000,000) , and various commercial privileges. The

signature of this treaty brought the Evu:opean Powers on the scene. It had been for some time the avowed ambition of Russia to obtain an ice-free port as an outlet to her Siberian possessions — an ambition which was considered by British states- men as not unreasonable. It did not, therefore, at all suit her purposes to see the rising power of Japan seated along the Gulf of Liaotung, and by implication commanding the whole of the coast-line of Korea. Even before proceeding to Shimonoseki, Li Hung- Chang is believed to have received assurances from Russia that she would not allow any cession of territory in that region to become operative. At any rate, in the interval between the signature and the ratification of the treaty, invitations were addressed by Russia to the Great Powers to intervene with a view to its modification on the ground of the dis- turbance of the balance of power, and the menace to Buropeaa China which the occupation of Port Arthur by the ’”<«"«"- Japanese would involve. France and Germany ac- cepted the invitation, Great Britain declined. In the end the three powers brought such pressure to bear on Japan that she gave up the whole of her continental acquisitions, retaining only the island of Formosa. The indemnity was on the other hand increased by H. taels 30,000,000. For the time the integrity of China seemed to be preserved, and Russia, France, and Germany could pose as her friends. Great Britain, who had taken no hand in the retrocession, was looked on with coldness, and China

even bore her a grudge because she had not at an early period stepped in and put a stop to the war. Li Hung-Chang, who had had his honours restored, was personally grateful to Russia- for having extricated him from a very awkward position, and cherished the general grudge against England in an unusual degree, a state of mind of which Russia is believed to have taken full advantage dur- ing that statesman’s sojourn at the Russian court as special repre- sentative of the Chinese emperor at the Tsar’s coronation. Ample evidence was indeed soon forthcoming that Russia and France had not been quite disinterested in rescuing Chinese territory from the Japanese grasp, for each began to claim a reward as evidence of the imperial gratitude. Russia obtained the right to carry the Siberian railway, which, for

the past four or five years, she had been pressing on with eagerness, across Chinese territory from Stretenesk to Vladivostock, thus avoiding a long d§tour, besides giving a grasp on northern Manchuria. France obtained, by a convention dated 20th June 1895, a rectification of frontier in the Mekong valley and certain railway and mining rights in Kiangsi and Yunnan. Both Powers obtained concessions of land at Hankow for the pur- poses of a settlement. Russia was also said to have negotiated a secret treaty, frequently described as the ” Cassini Convention,” but more probably signed by LI Hung-Chang at Moscow, giving her the right in certain contingencies to Port Arthur, which was to be refortified with Russian assistance. And by way of further securing herhold,Russia guaranteed a 4 per cent, loan of £15,000,000 issued in Paris to enable China to pay off the first instalment of the Japanese indemnity.

The Convention between France and China’of 20th June 1895

brought China into sharp conflict with Great Britain, and gave

rise to important negotiations which must be briefly

Mekoag noticed. China, having by the Burma convention of

dloatA ^^^ agreed to recognize British sovereignty over

‘ Burma, her quondam feudatory, also agreed to a

delimitation of boundaries at the proper time. Effect was given to this last stipulation by a subsequent convention con- cluded in London (1st March 1894), which traced the boundary line from the Shan states on the west as far as the Mekong river on the east. In the Mekong valley there were two semi-inde- pendent native territories over which suzerainty had been claimed in times gone by both by the kings of Ava and by the Chinese emperors. These territories were named Meng Lun and Kiang Hung — ^the latter lying partly on one side and partly on the other of the Mekong river, south of the point where it issues from Chinese territory. The boundary line was so drawn as to leave both these territories to China, but in consideration of the fact that Great Britain was surrendering to China territory over which she might claim sovereignty as successor to the kings of Ava, and in respect

of which sovereign rights had in point of fact been recently exercised, it was stipulated that China should not alienate any portion of these territories to any other Power without the pre- vious consent of Great Britain. The Power contemplated, though not named, was France, who by a treaty with Siam, concluded in 1893, had pushed the boundary of her Annamese possessions up to the left bank of the Mekong, and it was desired to interpose tEs particular territory as a sort of buffer, so as to avoid any conflict of French and British interests in this remote and difficult region. This object was frustrated by the convention between France and China of 1895. Yielding to French pressure, and regardless of the undertaking she had entered into with Great Britain, China so drew the boundary line as to cede to France that portion of the territory of Kiang Hung which lay on the left bank of the Mekong. Compensation was demanded from China for this breach of faith, and at the same time negotiations were entered into with France for the better determining of the interests of the two countries in Siam and the territories lying between Siam and the Chinese frontier. These resulted in a joint declaration by the Govern- ments of France and Great Britain, dated 15th January 1896, by which it was agreed as regards boundary that the Mekong from the point of its confluence with the Nam Huok north- wards as far as the Chinese frontier should be the dividing line between tha possessions or spheres of influence of the two Powers. It was also agreed that any commercial privileges obtained by either Power in Yunnan or Szechuen should be open to the subjects of the other. The negotiations with China resulted in a further agreement, dated 4th February 1897, whereby con- siderable modifications in favour of Great Britain were made in the Burma boundary dravm by the 1894 convention. The net result of these various conventions is, that from the Gulf of Tong- king westwards, as far as the Mekong, the French Annaraese possessions are coterminous with the southern frontier of China, and from the Mekong as far as the confines of Assam the British Burmese possessions are coterminous with the south-western frontier. In the middle where the possessions meet, the Mekong, from the frontier of China down to the northern boundary of Siam, is the dividing line.

While Russia and France were profiting by what they were

pleased to call the generosity of China, Germany alone ha4 so far received no reward for her share in compelhng the retrocession of Liaotung; but, in November 1897, she proceeded to help herself by seizing the Bay of Kiaochow in the province of Shan- tung. The act was done ostensibly in order to compel ^'^J***"'' satisfaction for the murder of two German missionaries.

Port Arthur,

which had been perpetrated a few weeks before, but it ive/.^^, soon was found that she was determined to hold the place ^g/. in any event. A cessioji was ultimately made by way of a lease for a term of ninety-nine years — Germany to have full terri- torial jurisdiction during the continuance of the lease, with liberty to erect fortifications, build docks, and exercise all the rights of sovereignty. In December the Russian fleet was sent to winter in Port Arthur, and though this was at first described as a temporary measure, its object was speedily disclosed by a request made, in January 1898, by the Russian ambassador in London that two British cruisers, then also anchored at Port Arthur, should be withdrawn " in order to avoid friction in the Russian sphere of influence." They left shortly afterwards, and their departure in the circumstances was regarded as a blow to Great Britain's prestige in the Far East. In March the Russian Government peremptorily demanded a lease of Port Arthur and the adjoining anchorage of Talienwan — a demand which China could not resist without foreign support. After an acrimonious correspond- ence with the Russian Government Great Britain acquiesced in the fait accompli. The Russian occupation of Port Arthur was imme- diately followed by a concession to build a line of railway from that point northwards to connect with the Siberian trunk line in north Manchuria. As a counterpoise to the growth of Russian influence in the north, Great Britain obtained a lease of Wei-hai-wei, and formally took possession of it on its evacuation by the Japanese troops in May 1898.

After much hesitation the Chinese Government had at last resolved to permit the construction of railways with foreign capital. An influential official named Sheng Hsuan-hwai was appointed director-general of railways, and empowered to enter into negotiations with foreign capitalists for that purpose. A keen competition thereupon ensued between syndicates

of different nationalities, and their claims being espoused by their various Governments an equally keen international rivalry was set up. Germany had insisted upon obtaining as part of the Kiaochow settlement certain preferential railway and mining rights in the province of Shantung. France had previously obtained a similar recognition for the southern provinces of Kwangsi and Yunnan, and Russia indicated clearly that she considered Manchuria as her particular field of exploitation. Great Britain, though in- timating her preference for the ” open door ” policy, meaning equal opportunity for all, yet found herself “Open compelled to fall in with the general movement to-

In 1899 Talienwan and Kiaochow were respectively thrown open by Russia and Germany to foreign trade, and, encouraged by these measures, the United States Government initiated in September of the same year a correspondence with the great

European Powers and Japan, with a view to securing their definite adhesion to the ” open-door ” policy. The British Government gave an unqualified approval to the American proposal, and the re- plies of the other Powers, though more guarded, were accepted at Washington as satisfactory. A further and more definite step towards securing the maintenance of the “open door” in China was the agreement concluded in October 1900 between the British and German Governments. The signatories, by the first two articles, agreed to endeavour to keep the ports on the rivers and littoral free and open to international trade and economic activity, and to uphold this rule for all Chinese territory as far as (wo in the German counter- part) they could exercise influence ; not to use the existing compli- cations to obtain territorial advantages in Chinese dominions, and to seek to maintain undiminished the territorial condition of the Chinese empire. By a third article they reserved their right to come to a preliminary understanding for the protection of their interests in China, should any other Power use those complications to obtain such territorial advantages under any form whatever. On the submission of the agreement under the fourth and last article to the Powers interested, Austria, France, Italy, and Japan accepted

its principles without express reservation — Japan first requesting and obtaining assurances that she signed on the same footing as an original signatory. The United States accepted the first two articles, but expressed no opinion on the third. Russia construed the first as limited to ports actually open in regions where the two signatories exercise ” their ” influence, and favour- ably entertained it in that sense, ignoring the reference to other forms of economic activity. She fully accepted the second, and observed that in the contingency contemplated by the third, she would modify her attitude according to circumstances.

Meanwhile, negotiations carried on by the British minister at Peking during 1898 resulted in the grant of very important privi- leges to foreign commerce. The payment of the second instalment of the Japanese indemnity was becoming due, and it was much discussed how and on what terms China would, be able to raise the amount. The Russian Government, as has been stated, had made China a loan of the sum required for the first portion of the indemnity, viz., £15,000,000, taking a charge on the customs revenue as security. The British Government was urged to make a like loan of £16,000,000 both as a matter of friendship to China and as a counterpoise to the Russian influence. An arrangement was come to accordingly, on very favourable terms financially to the Chinese, but at the last moment they drew back, being overawed, as they said, by the threatening attitude of Russia. Taking advantage of the position which this refusal gave him, the British minister obtained from the Tsung-Li-Yamen, besides the declaration as to the non-alienation of the Yangtse valley above mentioned, an undertaking to throw the whole of the inland waterways open to steam trafiSc. The Chinese Government at the same time undertook that the post of inspector-general of customs should always be held by an Englishman so long as the trade of Great Britain was greater than that of any other nation. Minor concessions were also made, such as the opening of new ports, but the opening of the waterways is by far the greatest ad- vance that has been made since 1860. The privilege is hampered as yet by the obstruction of the likin service, but as the Chinese have applied for a general revision of the treaty tariffs it may be presumed that the occasion will be used to put the inland revenue tariff on a more satisfactory footing.

Of still greater importance are the railway and mining con- cessions granted during the same year ^1898), a list of which has already been given above. The Chinese Government had been generally disposed to railway construction since the con- clusion of the Japanese war, but hoped to be able to retain the control in their own hands. The masterful methods of Russia and Germany had obliged them to surrender this control so far as concerned Manchuria and Shantung, the lines in which were left to be financed and worked by the Powers interested. In the Yangtse valley, Sheng, the director-general of railways, had been negotiating with several competing syndicates, playing one off against the other to force better terms. One of these was a Franco-Belgian syndicate, which was endeavouring to obtain the trunk line from Hankow to Peking. A British company was tendering for the same work, and as the line lay mainly within the British sphere it was considered not unreasonable to expect it should be given to the latter. At a critical moment, however, the French and Russian ministers intervened, and practically forced the Yamen to grant a contract in favour of the Franco- Belgian company. The Yamen had only a few days before explicitly promised the British minister that the contract should not be ratified without his having an opportunity of seeing it. As a penalty for this breach of faith, and as a setoff to the Franco-Belgian line, the British minister required the immediate grant of all the railway concessions for which British syndicates were then negotiating, and on terms not inferior to those granted to the Belgian line. In this way all the lines in the lower

Yangtse, as also the Shansi Mining Companies' lines, were secured. A contract for a trunk line from Canton to Hankow was negotiated in the latter part of the same year (1898) by an American company, which completed the list for the time being. It would have been more satisfactory if these various concessions, instead of being vyrung out of the weakness of China by the rivalry of foreign Powers, had been freely granted in the confidence of strength.

There can indeed be little doubt that the Powers, engrossed in the diplomatic conflicts of which Peking was the centre, had entirely underrated the reactionary forces gradually mustering for a final struggle against the aggressive The reform spirit of Western civilization. The lamentable con-

‘“o^o’”” - sequences of administrative corruption and incompetence, and the superiority of foreign methods which had been amply illus- trated by the Japanese war, had at first produced a consider- able impression, not only upon the more enlightened commercial classes, but even upon many of the younger members of the official classes in China. The dowager-empress, who, in spite of the emperor Kwang Su having nominally attained his majority, had retained practical control of the supreme power until the conflict with Japan, had been held, not unjustly, to blame for the disasters of the war, and even before its conclu- sion the young emperor was adjured by some of the most responsible among his own subjects to shake himself free from the. baneful restraint of ” petticoat government,” and himself take the helm. In the following years a Reform Movement, un- doubtedly genuine, though opinions differ as to the value of the popular support which it claimed, spread throughout the central and southern provinces of the empire. One of the most signi- ficant symptoms was the relatively large demand which suddenly arose for the translations of foreign works and similar publica- tions in the Chinese language which philanthropic societies, such as that “for the Diffusion of Christian and General Knowledge amongst the Chinese,” had been trying for some time past to popularize, though hitherto with scant success. Chinese news- papers published in the treaty ports spread the ferment of new ideas far into the interior. Fifteen hundred young men of good family applied to enter the foreign university at Peking, and in some of the provincial towns the Chinese themselves subscribed towards the opening of foreign schools. Reform societies, which not infrequently enjoyed official countenance, sprang up in many of the large tovms, and found numerous adherents amongst the younger literati. Early in 1898 the emperor, who had gradually emancipated himself from the dowager-empress’s control, sum- moned several of the reform leaders to Peking, and requested their advice with regard to the progressive measures which should be introduced into the government of the empire. Chief amongst these reformers was Eang Yu-wei, a Cantonese, whose scholarly attainments, combined with novel teachings, earned for him from his followers the title of the ” Modem Sage.” Of his more or less active sympathizers who had subsequently to suffer with him in the cause of reform, the most prominent were Chang Yin-huan, a member of the Grand Council and of the Tsung-Li-Yamen, who had represented his sovereign at Queen Victoria’s jubilee in 1897 ; Chin-Pao-

chen, governor of Hu-nan; Liang Chi-chao, the editor of the reformers' organ, Chinese Progress ; Su Chi-ching, a reader of the Hanlin College, the educational stronghold of Chinese conservatism ; and his son Su In-chi, also a Hanlin man and pro- vincial chancellor of public instruction in Hu-nan.

It soon became evident that there was no more enthusiastic advocate of the new ideas than the emperor himself. Within a few months the vermilion pencil gave the imperial sanction to a succession of edicts which, had they been ''** reform carried into effect, would have amounted to a revolu- “”'*• tion as far-reaching as that which had transformed Japan thirty years previously. The fossilized system of examinations for the public service was to be altogether superseded by a new schedule based on foreign learning, for the better promotion of which a number of temples were to be converted into schools for Western education ; a state department was to be created for the transla^ tion and dissemination of the standard works of Western literature and science ; even the scions of the ruling Manchu race were to be compelled to study foreign languages and travel abroad ; and last, but not least, all useless offices both in Peking and in the provinces were to be abolished. A further edict was even reported to be in contemplation, doing away with the queue or pigtail, which, originally imposed upon the Chinese by their Manchu conquerors as a badge of subjection, had gradually become the most character- istic and most cherished feature of the national dress. Had China possessed a governing class imbued with similar enlightened patriotism to that which induced the Japanese daimios in 1869 to sacrifice their feudal rights in the interests of national regeneration, even the crude series of imperial edicts drawn up by Kang Yu-wei might have proved the starting-point of a new era. But the bureaucracy of China, which had battened for cen- turies on corruption and ignorance, had no taste for self-sacrifice.

histokt]

Other vested interests felt themselves equally threatened. The priests, whose temples were to be alienated ; the military man- darins, who were led to believe that the army was going to be handed over to foreign instructors ; and, above all, the imperial clansmen and bannermen, the eunuchs, and other hangers-on of the palace, whose existence was bound up with all the worst traditions of Oriental misgovemment, were all equally alarmed, and behind them stood the whole latent force of popular supersti- tion and unreasoning conservatism.

The dowager-empress saw her opportunity. The Summer Palace, to which she had retired, had been for some time the centre of resistance to the new movement, and in the rfvLT”’’ ™W^1^ °* September 1898 a report became current d etat. that, in order to put an end to the obstruction which hampered his reform policy, the emperor intended to seize the person of the dowager-empress and have her deported into the interior. Some colour was given to this report by an official announcement that the emperor would hold a review of the foreign-drilled troops at Tientsin, and had summoned Yuan Shih- kai, their general, to Peking in order to confer with him on the necessary arrangements. But the reformers had neglected to secure the goodwill of the army, which was still entirely in the hands of the reactionaries. During the night of the 20th of Sep- tember the palace of the emperor was occupied by the soldiers, and on the following day Kwang Su, who was henceforth virtually a prisoner in the hands of the empress, was made to issue an edict restoring her regency. Kang Yu-wei, warned at the last moment by an urgent message from the emperor, succeeded in escaping, but many of the most prominent reformers were arrested, and six of them were promptly executed. The Peking Gazette announced a few days later that the emperor himself was danger- ously ill, and his life might well have been despaired of had not the British minister represented in very emphatic terms the serious consequences which might ensue if anything happened to him. Drastic measures were, however, adopted to stamp out the reform movement in the provinces as well as in the capital. The reform edicts were cancelled, the reformers’ associations were dis- solved, their newspapers suppressed, and those who did not care to save themselves by a hasty recantation of their errors were imprisoned, proscribed, or exiled. In October the reaction had already been accompanied by such a recrudescence of anti-foreign feeling that the foreign ministers at Peking

had to bring up guards from the fleet for the protection of the legations, and to demand the removal from the capital of the disorderly Kansu soldiery which subsequently played so sinister a part in the troubles of June 1900. But the unpleasant impression produced by these incidents was in a great measure removed by the demonstrative reception which the empress^Tsu Tsi gave on 15th October to the wives of the foreign representatives — an international act of courtesy unprecedented in the annals of the Chinese court.

One of the most significant features of the coup d'etat of 1898 was the decisive part played in it by the Manchus, whose ascend- ancy in the councils of the dowager-empress became more and more marked. Manchus were substituted for Chinamen in many of the higher ofiSces of the state, and even Li Hung-Chang's position was shaken. Though he was the only prominent Chinese statesman who had actively supported the empress, he was temporarily removed from the capital, under pretext of a special mission to inspect the course of the Yellow river in Shantung. The reactionary tide continued to rise throughout the year 1899, but it did not appear materially to affect the foreign relations of China, the dilatoriness and ill-will exhibited by the Tsung-Li-Yamen with respect to the punishment of the murderers of Mr Fleming and to other anti- foreign outrages amounting to little more than the usual practice of the Chinese Government in such matters. On 24th January 1900 the Peking Gazette published an Imperial edict appointing as heir-presumptive to the throne Pu ChUn, a son of Prince Tuan (himself son to Prince Tun and grandson to the emperor Tao-kwang), which was generally regarded in China as a pre- liminary step to the formal deposition of the emperor Kwang Su. Influential memorials from Chinese officials deprecating any such measure would seem to have deterred the empress from following up her original intention, but the choice of two rabid anti-foreign officials as tutors to Pu Chtin, together with the prestige conferred upon Prince Tuan, one of the most reactionary of the Manchu princes, afforded a startling indication of the spirit which already prevailed in court circles.

A few weeks earlier the brutal murder of Mr Brooks, an English missionary, in Shantung, had compelled attention to a popular movement which had been spreading rapidly through- Tbe Boxer Q^(. ^^iaX province and the

adjoining one of Chih-li “”“”T ‘^^ ^^^ connivance of certain high officials, if not ” under their direct patronage. The origin of the

“Boxer” movement is obscure. Its name is derived from a literal translation of the Chinese designation, “The fist of righteous harmony.” Like the kindred “Big Sword” Society,

Maacha ascend- ancy.

it appears to have been in the first instance a secret association of malcontents chiefly drawn from the lower classes. Popular disaflection in China generally assumes some such shape, and there can be little doubt that with the waning prestige of the dynasty, undermined by the Japanese war and foreign encroach- ments, not less than by the family feud between the emperor and the dowager-empress, a dangerous spirit of unrest was abroad amongst all classes. The Tsing dynasty was reaching what would seem to be the allotted span of Chinese dynasties, its tenure of power having already lasted longer than that of any of the last twenty dynasties, excepting its immediate predecessors, the Mings, and neither omens nor predictions were wanting to foreshadow its downfall. Whether the empress Tsu Tsi and her Manchu advisers had deliberately set themselves from the begin- ning to avert the danger by deflecting what might have been a revo- lutionary movement into anti-foreign channels, or whether with Oriental heedlessness they had allowed it to grow until they were powerless to control it, they had unquestionably resolved to take it under their protection before the foreign representatives at Peking had realized its gravity. Yu Hsien, one of its earliest patrons, had indeed been recalled on their representations from Shantung, where he had given open support to the Boxer organiza- tion, but only to be loaded with honours by the empress and transferred to the province of Shansi. The outrages upon native Christians and the threats against foreigners generally went on increasing. The Boxers openly displayed on their banners the device: ” Exterminate the foreigners and save the dynasty,” yet the representatives of the Powers were unable to obtain any effective measures against the so-called ” rebels,” or even a definite condemnation of their methods.

Four months (January-April 1900) were spent in futile inter- views with the Tsung-Li-Yamen, who, encouraged, no doubt, by the fact that the Russian

minister for a long time held conspicuously aloof from the protests of his Diplomacy colleagues, treated the remonstrances of the Powers ‘““y- with growing contempt. In May a number of Christian villages were destroyed and native converts massacred in the neighbourhood of the capital, and Mgr Favier, the venerable head of the Roman Catholic missions in China, described the situation as the gravest within his long memory. On the 2nd June two English missionaries, Mr Robinson and Mr Norman, were murdered at Yung Ching, 40 miles from Peking. The whole country was overrun with bands of Boxers, who tore up the rail- way and set fire to the stations at different points on the Peking- Tientsin line. Fortunately a mixed body of marines and bluejackets of various nationalities, numbering 18 officers and 389 men, had reached Peking on 1st June for the protection of the legations. The whole city was in a state of turmoil. Murder and pillage were of daily occurrence. Prince Tuan and the Manchus generally, together with the Kansu soldiery under the notorious Tung-fu-hsiang, openly sided with the Boxers> The European residents and a large number of native converts took refuge in the British legation, the largest and most central compound in the foreign quarter, where preparations were hastily made on all sides in view of a threatened attack. On the lltli the chancellor of the Japanese legation was murdered by Chinese soldiers. On the night of the 13th most of the foreign buildings, churches, and mission houses in the eastern part or the Tartar city were pillaged and burnt, and hundreds of native Christians massacred. The work of destruction continued for days unchecked by any Chinese authority, and on 20th June the German minister. Baron von Ketteler, was mvirdered whilst on his way to the Tsung-Li-Yamen, and there is little doubt that the same fate had been prepared for all the other foreign representatives, who were expected to visit the Yamen, as negotiations were proceeding with regard to a summons sent to them on the previous day to leave Peking within twenty-four hours. At 4 p.m. on the after- noon of the 20th the Chinese troops opened fire upon the legations, and the eight weeks’ siege began which will remain memorable in history as one of the most splendid instances of what the heroism and intelligence of a handful of Europeans can achieve against Asiatic hordes.

Meanwhile Peking had been completely cut off since the 14th from all communication with the outside world, and in view of the gravity of the situation, naval and military f(5rces were being hurried up by all the Powers

to the gulf J^ctlon of Pe Chili. On 10th June Admiral Seymour had already left Tientsin with a mixed force of 2000 British, Russian, French, Germans, Austrians, Italians, Americans, and Japanese, to repair the railway and restore communication with Peking. But his expedition met with unexpectedly severe resistance, the line was torn up in its rear, and, unprovided with transport or supplies, it had great difficulty in making good its retreat after suffering heavy losses. Great anxiety prevailed for some days as to its fate, and no definite tidings of its whereabouts were received until it had fought its way back to within a day's march of Tientsin. When it reached Tientsin again on 26th

otthe Powers.

June, the British contingent of 915 men had alone lost 124 killed and wounded out of a total casualty list of 62 killed and 218 wounded. The Chinese had in the meantime made a deter- mined attack upon the foreign settlements at Tientsin, and com- munication between the city and the sea being also threatened, the allied admirals had demanded on the 16th the surrender of the Taku forts at the mouth of the Pei-ho. The Chinese replied to the ultimatum by opening fire with great vigour during the fol- lowing night, whereupon a flotilla of British, French, German, Japanese, and Russian gunboats bombarded the forts, which were captured by landing parties early on the 17th. The situation at Tientsin, nevertheless, continued precarious, and it was not till the arrival of considerable reinforcements that the troops of the allied Powers were able to assume the offensive, taking the native city by storm on 14th July, at a cost, however, of over 700 killed and wounded. Even in this emergency international jeal- ousy had grievously delayed the necessary concentration of forces. Three British brigades were ordered up from India, a few French colonial regiments were sent on from Saigon, the Americans de- tached a body of troops from the Pliilippines, the Russians despatched a brigade from Port Arthur, though their military resources were severely taxed by the simultaneous outbreak of hostilities in Manchuria, and preparations were made in Germany, France, and Italy, to send out fresh- contingents, the German force alone numbering over 20,000 men. But the situation required im- mediate action. No power was so favourably situated to take such action as Japan, and the British Government, who had strongly urged her to act speedily and energetically, undertook at her request to sound the other Powers with regard to her interven- tion. No definite objection was raised, but the replies of Germany and Russia barely disguised their ill-humour. Great Britain her- self went so far as to offer Japan the assistance of the British treasury, in case financial difficulties stood in the way, but ou the same day on which this proposal was telegraphed to Tokio (6th July) , the Japanese Government had decided to embark forthwith the two divisions which it had already mobilized. By the begin- ning of August one of the Indian brigades had also reached

Tientsin, together with smaller reinforcements sent by the other Powers, and thanks chiefly to the energetic counsels of the British commander. General Sir Alfred Gaselee, a relief column, number- ing 20,000 men, at last set out for Peking on 4th August, a British naval brigade having started up river the previous afternoon. It met with only half-hearted resistance, and after a series of small engagements and very trying marches it arrived within striking distance of Peking on the evening of the 13th. The Russians tried to steal a march upon the allies during the night, but were checked at the walls and suffered heavy losses. The Japanese attacked another point of the walls the next morning, but met with fierce opposition, whilst the Americans were delayed by getting en- tangled in the Russian line of advance. The British contingent was more fortunate, and skilfully guided to an unguarded water- gate, General Gaselee and a party of Sikhs were the first to force tiieir way vrith trifiing loss through to the British legation. About 2 P.M. on the afternoon of 14th August, the long siege was raised. For nearly six weeks after the first interruption of communica- tions, no news reached the outside world from Peking except a few belated messages, smuggled through the Chinese ’”’ lines by native runners, urging the imperative necessity “Lmaoas °^ prompt relief. During the greater part of that ■ period the foreign quarter was subjected to heavy rifle and artillery fire, and the continuous fighting at close quarters with the hordes of Chinese regulars, as well as Boxers, decimated the scanty ranks of the defenders. The supply of both ammuni- tion and food was slender. But the heroism displayed by civilians and professional combatants alike was inexhaustible. Some of the legations were totally or partially destroyed. In their anxiety to burn out the British legation, the Chinese did not hesitate to set fire to the adjoining buildings of the Hanlin, the ancient seat of Chinese classical learning, and the store- house of priceless literary treasures and state archives. The Fu, or palace, of Prince Su, separated only by a canal from the British legation, formed the centre of the international position, and was held with indomitable valour by a small Japanese force under Colonel Sheba, assisted by a few Italian marines and volunteers of other nationalities and a number of Christian Chmese. The French legation on the extreme right, and the section of the city wall held chiefly by German? and Ajnericans, were also points of vital importance which had to bear the brunt of the Chinese attack. Little is known as to what passed m the councils of the Chinese court during the siege. But there is reason to believe that throughout that period

grave divergences of opinion existed amongst the highest officials. The attack upon the legations appears to have received the sanction of the dowager-empress, acting upon the advice of Prince Tuan and the extreme Manchu party, at a grand council held during the night of 18th-19th June, upon receipt of the news of the capture of the Taku forts by the international forces. The emperor himself, aa

well as Prince Ching and a few other influential mandarins, strongly protested against the empress's decision, but it was acclaimed by the vast majority of those present. The moderate party was probably not in a position to do more than act as a drag upon the more violent faction. Three members of the Tsung-Li-Yamen were publicly executed for attempting to modify the terms of an imperial edict ordering the massacre of all foreigners throughout the provinces, and most of the Manchu nobles and high officials, and the eunuchs of the palace, who have played an important part in Chinese politics throughout the dowager-empress's tenure of power, were heart and soul with the Baxers. But it was noted by the defenders of the legations that Prince Ching's troops seldom took part, or only in a half-hearted way, in the fighting, which was chiefiy con- ducted by Tung-fu-hsiang's soldiers and the Boxer levies. The modern artillery which the Chinese possessed was only spasmodi- cally brought into play. Nor did any of the attacking parties ever show the fearlessness and determination which the Chinese had somewhat unexpectedly displayed on several occasions during the fighting at and. around Tientsin. Nevertheless, the position of the defenders at the end of the first four weeks of the siege had grown well-nigh desperate. Mining and incendiarism proved far greater dangers than shot and shell. The Japanese had been forced back to their third and last line of defence in the Fu, and two-thirds of the French legation had been destroyed or wrested from its heroic defenders. The British legation was being hard pressed from the Mongol market as well as from the Imperial Carriage Park, and the fighting on the city walls was severe and unceasing. The casualty list, amongst the officers especially, was heavy, and the need of constant watchfulness along the whole line of defences was a great strain upon the physical endurance of the attenuated garrison. Suddenly, just when things were looking blackest, on the 17th of July the Chinese ceased firing, and a sort of informal armistice secured a period of respite for the beleaguered Europeans. The capture of the native city of Tientsin by the

allied forces had shaken the self-confidence of the Chinese authorities, who had hitherto not only countenanced, but themselves directed the hostilities. By a curious coincidence it was just at the time when the besiegers were relaxing their efforts that the intense anxiety of the civilized world with regard to the fate of the besieged reached its culminating point. Circumstantial accounts of the fall of the legations and the massacre of their inmates were circulated in Shanghai and telegraphed to Europe, and coupled with the despairing tone of the few messages which had been smuggled out of Peking in June — ^more especially Sir Robert Hart's message of 24th June — and with the admissions made by Chinese provincial officials, these reports found general cre- dence. Mr Brodrick, under-seciSetary of state for Foreign Affairs, officially stated in the House of Commons on 17th July, tiiat though the British Government had no direct con- firmation of these painful rumours, they had, unfortunately, little reason to regard them as otherwise than substantially correct. It was not till the following week that an authentic message received through the Chinese legation at Washington from the American minister proved these fears to be prema- ture. Similar telegrams followed from Sir Claude Macdon^d and other foreign representatives, and various communications from the Chinese Government, though the pacific assurances they con- tained were largely mendacious, showed that they were at any rate growing alarmed at the consequences of their outrageous action. Desultory fighting, nevertheless, continued, and grave fears were entertained that the approach of the relief column would prove the signal for a desperate attempt to rush the legations before effectual assistance could reach them. The attempt was made, but failed. The relief, however, came not a day too soon. Of the small band of defenders which, including civilian volunteers, had never mus- tered 500, 66 had been killed and 131 wounded. Ammunition and provisions were almost at an end. Even more desperate was the situation at the Pei-tang, the Roman Catholic northern cathedral and mission house, where, with the help of a small body of French and Italian marines, Mgr Favier had organized an independent centre of resistance for his community of over 3000 souls. Their rations were abscilutely exhausted, when on 15th August a relief party was despatched to their assistance from the legations.

The ruin wrought in Peking during the two months' fighting was appalling. Apart from the wholesale destruction of foreign property in the Tartar city

— mission houses, churches, hospitals, native stores where foreign goods had been **‘,|^ sold, native houses suspected of any connexion or “”^1”’ sympathy with foreigners — and of Chinese as well ”’”’’*** as European buildings in the vicinity of the legations, the wealthiest part of the Chinese city had been laid in ashes. The flames from a foreign drug store fired by the Boxers had spread to the adjoining buildings, and finally consumed the whole of the business quarter with all its invaluable stores of silks, curiosities, furs, &c. The retribution which overtook

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Peking after its capture by the international forces was scarcely less terrible. Looting was for some days almost vmiversal. But it would have been well, for the credit of Western civilization and Christianity, had the reprisals exercised by some of the foreign contingents been confined to looting. The whole city was divided up into separate areas of occupation between the contingents of different nationalities, and in the Russian and French quarters unbridled license prevailed for some time. It should be added that the French force at that period consisted chiefly of colonial troops from Tongking and Annam. Order was, however, gradu- ally restored, first in the Japanese and then in the British and American quarters, though several months elapsed before there was any real revival of native confidence.

So unexpected had been the rapid and victorious advance of the allies, that the dowager-empress with the emperor and the rest

of the court did not actually leave Peking until the

tih ^^^ ^^^^ ^^^ legations had been relieved. But the

Chinese iiorthem and western portions of the Tartar city had

court. not yet been occupied, and the fugitives made good

their escape on the afternoon of the 15th in the direction of the Western Hills. When the allies some days later marched through the Forbidden City, they only found a few eunuchs and subordinate officials in charge of the imperial apart- ments. At the end of September, Field-Marshal Count von Waldersee, with a German expeditionary force of over 20,000 men, arrived to assume the supreme command conferred upon him with the more or less willing assent of the other Powers. As a matter of fact, his authority was never practically rec- ognized by either the French or the American commanders, and was only effectively exercised over the British and the small Italian and Austrian contingents. A large portion of the Japanese troops was shipped back to Japan soon after the relief of the legations, and the bulk of the Russian forces was withdrawn into Manchuria. There were indeed no longer any important military operations to be carried out. After a few punitiye ex- peditions had been sent to Paoting-fu and other districts in the neighbourhood of Peking, where exceptionally brutal outrages had been committed during the summer, the duties of the foreign troops were henceforth chiefly in the nature of police work. The Germans, however, having arrived too late to take any part in the relief of Peking, often showed a mischievous anxiety to extend the sphere of operations. Their discipline, especially in their treatment of the defenceless Chinese population, fell lamentably short of the high standard expected from a great military nation, and their predatory raids in search of Boxers resulted only in increasing the confusion and misery which pre- vailed in the zone of foreign occupation. The removal by the Germans of the ancient astronomical instruments from Peking wa.s condemned even in the German press as an act of unjustifiable vandalism. Towards the end of February 1900 preparations were made at the German headquarters for an extensive forward move- ment in the direction of Si-nghan-fu, but it was ultimately abandoned, owing to the refusal of the other Powers, and more especially of Great Britain and Japan, to countenance such an adventurous enterprise. Strangely enough, the German con- tingent, which saw less actual fighting than any other foreign force, suffered the two most conspicuous losses during the whole campaign. Count York, a staff officer of the greatest promise, died of asphyxia in a Chinese inn during a VTinter march, and General von Schwarzhofl, chief of the staff to Count von Waldersee, lost his life in the fire which destroyed the apartments in the Winter Palace occupied by the German headquarters (17th

April). The political task which confronted the Powers after the occupation of Peking was far more arduous than the military one.

The action of the Russians in Manchuria, even in a iHi I treaty port like New-chwang, the seizure of the railway

TlbieMoa. ‘° °°* °°^y *° ^^ °^ °^ ^^^ **‘/strong> ‘^^^’ ^^* ^^° from Shanhai-kwan to Peking, by the Russian military**

authorities, and the appropriation of an extensive line of river frontage at Tientsin as a Russian ” settlement,” were difficult to reconcile with the pacific assurances of disinterestedness which Russia, like the rest of the Powers, had officially given. Great anxiety prevailed as to the effect of the flight of the Chinese court in other parts of the empire. The anti-foreign movement had not spread much beyond the northern provinces, in which it had had the open support of the throne and of the highest provincial officials. But amongst British and Americans alone, over 200 defenceless foreigners, men, women, and children, chiefly mission- aries, had fallen victims to the treachery of high-placed mandarins like Yii Hsien, and hundreds of others had had to fly for their lives, many of them ovring their escape to the courageous protection of petty officials and of the local gentry and peasantry. The Roman Catholic missionaries and communities throughout the north had met, or been threatened, with the same fate, and sporadic outbreaks such as that which had occurred at Su-chan, south of the Yangtse,’ showed that there were explosive materials scattered all over the empire. In the Yangtse valley order had

been maintained by the energy of the viceroys of Nanking and Wu-chang, who had acted throughout the critical period in loyal co-operation with the British consuls and naval commanders, and had courageously disregarded the imperial edicts issued during the ascendancy of the Boxers. After some hesitation, an Indian brigade, followed by French, German, and Japanese contingents, had been landed at Shanghai for the protection of the settlements, and though the viceroy, Liu Kun-yi, had welcomed British sap- port, and even invited the joint occupation of the Yangtse forts by British and Chinese troops, the appearance of other European forces in the Yangtse valley

was viewed with great suspicion. In the south there were serious symptoms of unrest, especially after Li Hung-Chang had left Canton for the north, in obedience, as he alleged at the time, to an imperial edict which, there is reason to believe, he invented for the occasion. The Chinese court, after one or two intermediate halts, had retired to Si-nghan-fu, one of the ancient capitals of the empire, situated in the inaccessible province of Shen-si, over 600 miles south-west of Peking. The influence of the ultra-reactionaries, headed by Prince Tuan and General Tung- fu-hsiang, still dominated its councils, although edicts, illusory if genuine, were from time to time stated to have been issued for the punishment of some of the leading officials concerned in the anti-foreign outrages, and credentials were sent to Prince Ching and to Li Hung-Chang, who, after waiting for some weeks upon events at Shanghai, had proceeded to Peking, authorizing them to treat with the Powers for the re-establishment of friendly relations.

On 16th October the Anglo-German agreement, to which reference has already been made, was signed in London, and its publication immediately upon signature . , , *created some excitement at the time. The nego- Jp^^^g'O- tiations which had led up to it had been con- I^™™ ducted with great celerity and secrecy, and it would appear, from a despatch which was subsequently published from Lord Salisbury to the British representative in St Peters- burg, that the British negotiator was in no small degree influenced by the aggressive features of Russia's action at the time in northern China. Germany, on the other hand, would seem to have been chiefly actuated by the desire to forestall any isolated action on the part of Great Britain in the Yangtse valley. The agreement certainly had no immediate effect upon the political situation. It did not modify Germany's attitude with regard to Russia, for Count von Waldersee continued to lend his support as far as possible to the Russian military authorities in northern China whenever differences of opinion arose between them and the British, and the German Government a few months later openly denied that the agreement applied to Manchuria, in spite of the contrary opinion entertained by the British Government. But it has given Germany a claim to a footing in the Yangtse valley which it is difficult to reconcile with the policy propounded by British ministers when they published**

the Yangtse ” assurance,” obtained in 1898 from the Tsung-Li-Yamen. In one of his state- ments to the Reichstag, the imperial chancellor referred to the Anglo-German agreement as “the Yangtse agreement,” and that designation has ever since been universally adopted in Germany.

The harmony of the Powers, which had been maintained with some difficulty up to the relief of the legations, was subjected to a severe strain as soon as the basis of negotiations _. with the Chinese Government came to be discussed. tMlo^’ The eleven Powers having diplomatic represen- tatives in Peking, including, therefore, such minor Powers as Spain, Holland, and Belgium, claimed to have an equal voice in these discussions, and the conferences held between the foreign ministers in the Chinese capital had constantly to be supplemented by references to their governments and by prolonged corre- spondence between the different cabinets. While for various reasons Russia, Japan, and the United States were inclined to treat China with great indulgence, Germany insisted upon the signal punishment of the guilty officials as a conditio sine qut non, and in this she had the support not only of the other members of the Triple Alliance, whose interests in China were only of secondary importance, but also of Great Britain, and to some extent even of France, who, as protector of the Roman Catholic Church in Eastern countries, could not allow the authors of the atrocities committed upon its followers to escape effectual punishment. It was not until after months of laborious nego- tiations that an agreement was finally arrived at with regard to the general tenour of the demands to be formally made upon the Chinese Government. They were embodied in a joint note signed by all the foreign ministers on 20th and 21st December 1900. The preamble recited the chief crimes committed by the Chinese, denounced the treachery of the Chinese Government in declaring, through its representatives abroad, that it was pro- tecting the legations while it was actually besieging them, and announced that the allied Powers consented to accede to China’s petition for peace on “irrevocable conditions” therein stated. These were substantially as follows : — Honourable reparation for

the murder of Baxon von Ketteler and of M. Suglyama was to be made in a specified form, and expiatory monuments were to be erected in cemeteries where foreign tombs had been desecrated. “The most severe punishment befitting their crimes” was to be inflicted on the personages designated by the decree of 21st September, and also upon others to be designated later by the foreign ministers, and the ofBcial examinations were to be suspended in the cities where foreigners had been murdered or ill-treated. An equitable indemnity, guaranteed by financial measures acceptable to the Powers, was to be paid to states, societies, and individuals, including Chinese who had suffered because of their employment by foreigners, but not including Chinese Christians who had suffered only on account of their faith. The importation or manufacture of arms or materiel was to be forbidden ; permanent legation guards were to be maintained at Peking, and the diplomatic quarter was to be fortified, whUe communication with the sea was to be secured by a foreign military occupation of the strategic points and by the demolition of the Chinese forts, including Sie Taku forts, between the capital and the coast. Proclamations were to be posted throughout China for two years, threatening death to the members of anti-foreign societies, and recording the punishment of the ringleaders in the late outrages ; and the viceroys, governors, and provincial officials were to be declared by imperial edict responsible, on pain of imme- diate dismissal and perpetual disability to hold office, for anti-foreign outbreaks or violations of treaty within their jurisdictions. China was to facilitate commercial relations by negotiating a revision of the commercial treaties. The Tsung-Li-Yamen was to be reformed, and the ceremonial for the reception of foreign ministers modified as the Powers should demand. Compliance with these terms was de- clared to be a condition precedent to the arrangement of a time limit to the occupation of Peking and of the provinces by foreign troops. Under instructions from the court, the Chinese plenipotentiaries affixed their

signatures on 14th January 1901 to a protocol, by which China pledged herself to accept these terms in principle, and the conference of ministers then proceeded to discuss the definite form in which compliance with them was to be exacted. This further stage of the negotiations proved even more laborious and protracted than the preliminary proceedings. No attempt was made to raise the question of the dowager-empress's respon- sibility for the anti-foreign movement, as Russia had from the first set her face against the introduction of what she euphemisti- cally termed "the dynastic question." But even with regard to the punishment of officials whose guilt was beyond dispute, grave divergencies arose between the Powers. The death penalty was ultimately waived in the case even of such conspicuous offenders as Prince Tuan and Tung-fu-hsiang, but the notorious Yii Hsien and two others were decapitated by the Chinese, and three other metropolitan officials were ordered to commit suicide, whilst upon others sentences of banishment, imprisonment, and degradation were passed, in accordance with a list drawn up by the foreign representatives. The question of the punishment of provincial officials, responsible for the massacre of scores of defenceless men, women, and children, was unfortunately reserved for separate treatment, and, when it came up for discussion, it became impos- sible to preserve even the semblance of unanimity, the Russian minister at once taking issue with his colleagues, although he had originally pledged himself as formally as the others to the principle. Count Lamsdorff frankly told the British ambassador at St Petersburg that Russia took no interest in missionaries, and as the foreigners massacred in the provinces belonged mostly to that class, she declined to join in the action of the other Powers. Fortunately the rest of the Powers, including even Japan, who, as a non-Christian state, might have been excused for adopting the same attitude as Russia, preserved a united front, and though the satisfaction ultimately obtained was not altogether adequate, the list of punishments proposed by the British minister. Sir Ernest Satow, was presented to the Chinese plenipotentiaries vrith the signatures of all the foreign representatives except the Russian. The real explanation of Russia's cynical secession from the concert of Powers on this important issue must be sought in her anxiety to conciliate the Chinese in view of the ™* separate negotiations in which she was at the same

yWancflur/an ^.jjjjg engaged with China in respect of Manchuria. When the Boxer movement was at its height at the end of June 1900, the Chinese authorities in Man- churia had wantonly “declared war” against Russia, and for a moment a great wave of panic seems to have swept over the Russian administration, civil and military, in the adjoining provinces. The reprisals exercised by the Russians were propor- tionately fierce. The massacre at Blagovestchensk, where 5000 Chinese — ^men, women, and children — were flung into the Amur by the Cossacks, was only one incident in the reign of terror by which the Russians sought to restore their power and their prestige. The resistance of the Chinese troops was soon over- come, and Russian forces overran the whole province, occupying

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even the treaty port of New-chwang. The Russian Government officially repudiated all responsibility for the proclamations issued by General Gribsky and others, foreshadowing, if not actually proclaiming, the annexation of Chinese territory to the Russian empire. But Russia was clearly bent on seizing the opportunity for securing a permanent hold upon Manchuria. In December 1900 a preUminary agreement was made between M. Korostovetz, the Russian administrator-general, and Tseng, the Tartar general at Mukden, by which the civil and military administration of the whole province was virtually placed under Russian control. In February 1901 negotiations were opened between the Russian Government and the Chinese minister at St Petersburg for the conclusion of a formal convention of a still more comprehensive character. The Russian Govemtnent refused to disclose its terms, but the draft prepared by the Russian Foreign Office was inform- ally communicated through Chinese channels to the British and other friendly governments. In return for the restoration to China of a certain measure of civil authority in Manchuria, Russia was to be confirmed in the possession of exclusive military, civil, and commercial rights, constituting in all but name a pro- tectorate, and she was ajfeo to acquire preferential rights over all the outlying

provinces of the Chinese empire bordering on the Russian dominions in Asia. The clauses relating to Chinese Turkestan, Kashgar, Yarkand, Khotan, and Mongolia were sub- sequently stated to have been dropped, but the convention never- theless provoked considerable opposition both in foreign countries and amongst the Chinese themselves. Most of the Powers, including Germany, who, however, denied that the Anglo- German agreement of 16th October 1900 applied to Manchuria, advised the Chinese Government not t'o pursue separate nego- tiations vrith one Power whilst collective negotiations were in progress at Peking, and both Japan and Great Britain pressed for defSiite information at St Petersburg with regard to the precise tenour of the proposed convention. At the same time the two viceroys of the lower Yangtse memorialized the Throne in the strongest terms against the convention, and these protests were endorsed not only by the great majority of Chinese officials of high rank throughout the provinces, but by popular meetings and influential guilds and associations. Ultimately the two viceroys, Chang Chih-tung and Liu Kun-yi, took the extreme step of warning the Throne that they would be unable to recog- nize the convention, even if it were ratified, and notwithstanding the pressure exercised in favour of Russia by Li Hung-Chang, the court finally instructed the Chinese minister at St Petersburg to decline his signature. The attitude of Japan, where public feeling ran high, was equally significant, and on 3rd April the Russian Government issued a circular note to the Powers, stating that, as the generous intentions of Russia had been misconstrued, she withdrew the proposed convention.

The work of the conference at Peking, which had been tempor- arily disturbed by these complications, was then resumed, and soon reached a stage which brought the possibility of an early evacuation within the range of discussion. '^^^ It was generally felt that the prolonged occupation P™""'- and the inaction to which the majority of the foreign troops were necessarily condemned were detrimental to the maintenance of discipline, and the friction which led to such unpleasant incidents as those which occurred in March and April at Tientsin, where conflicts between British troops and French, Germans, and Russians were with difficulty averted, gave additional cause for anxiety.**

The Anglo-Russian dispute over the construction of certain roads and railway sidings at Tientsin also showed that, although the Russians had been induced to hand over the Peking- Shan-hai-kwan railway (18th January) to the German military authorities, who in their turn surrendered it (21st February) to the British, an International occupation was still fraught with manifold dangers. Early in April Count von Waldersee invited all the foreign commanders to meet him and discuss the feasibility of a partial withdrawal of troops. The discussion led to no imme- diate results, but it helped to stimulate the proceedings of the diplomatists. The question of indemnities, however, gave rise to renewed friction. Each Power drew up its own claim, and whilst Great Britain, the United States, and Japan displayed great moder- ation, other Powers, especially Germany and Italy, put in claims which were strangely out of proportion to the services rendered by their military and naval forces. Not only the amount of the indem- nity, but the mode of payment and the ear-marking of revenues out of which China was to meet it, gave rise to great differences of opinion. Germany proposed an immediate 10 per cent, increase of the Chinese customs tariff on foreign imports, but this proposal met with determined opposition from other commercial Powers, and especially from Great Britain, whose trade would have to bear the chief part of the burden. It was at last settled that China should pay altogether an indemnity of 450 million taels, to he secured (1) on the unhypothecated balance of the customs revenue administered by the imperial maritime customs, the import duties

being raised forthwith to an effective 5 per cent, basis; (2) on the revenues of the “native ” customs in the treaty ports ; (3) on the total revenues of the salt gabelle. Finally, after more than sixty plenary conferences and innumerable meetings of sub-committees had been held by the diplomatists in Peking, the peace protocol ■was drawn up in a form which satisfied all the Powers as well as the Chinese court. The formal signature was, however, delayed at the last moment by a

fresh difHoulty concerning Prince Chun's penitential mission to Berlin. The prince, an amiable and enlight- ened youth, half-brother to the emperor, had reached Basel towards the end of August on his way to Germany, when he was suddenly informed that he and his suite would be expected to perform kotow before the German emperor. The prince resented this unexpected demand, and referred home for instructions. The Chinese court appear to have remained obdurate, and the German Government perceived the mistake that had been made in exacting from the Chinese prince a form of homage which Western diplo- macy had for more than a century refused to yield to the Son of Heaven, on the ground that it was barbarous and degrading. The point was waived, and Prince Chun was received in solemn audi- ence by the Emperor William at Potsdam on 4th September. Three days later, on 7th September, the peace protocol was signed at Peking by the two Chinese plenipotentiaries and the representa- tives of Great Britain, Germany, Prance, Russia, the United States, Japan, AustriarHungary, Italy, the Netherlands, Belgium, and Spain.

Article 1 recorded the satisfaction to be given to Germany for the murder of Baron von Ketteler.

Article 2 repited the punishments inflicted on the guilty officials and the posthumous honours rendered to the three mandarins who had been executed during the siege for their endeavours to stem the anti-foreign movement. It also placed on record the suspension of official examinations in all cities where anti-foreign outrages of an aggravated character had been perpetrated.

Article 3 recorded the satisfaction to be given to Japan for the murder of M. Sugiyama.

Article 4 provided for the erection by the Chinese of expiatory monuments.

Article 6 dealt with the prohibition of the Importation of arms and warlike material.

Article 6 set forth the amount and mode of payment of the indemnity.

Articles 7, 8, and 9 defined the area of the new legation quarter at Peking, and dealt with its protection and with that of the railway and the whole line of communication between Peking and the sea.

Article 10 recorded the measures taken by the Chinese Govern- ment to prevent the recurrence of anti-foreign agitation or troubles.

Article 11 provided for the amendment of existing treaties of commerce and navigation, and for river conservancy measures at Tientsin and Shanghai.

Article 12 dealt with the reorganization of the Chinese Ministry of Foreign Affairs, and modifications of court ceremonial as regards the reception of foreign representatives.

The British Government at once appointed a Special Commis- sion, with Sir J. Mackay, member of the Council of India, as chief commissioner, to proceed to Shanghai to carry on the commercial negotiations, provided for in article 11, with the commissioners appointed by China. These negotiations were also to deal with the removal of existing obstacles to foreign tradA, such as likin, &c., and with regulations for facilitatingif steamer navigation on inland waters. ,

In accordance with the terms of the protocol, all the foreign troops, with the exception of the legation guards, were withdrawn from Peking on 17th September, and from the rest of Chih-li, with the exception of the garrisons at the different points specified along the line of communications, by 22nd September. On 7th October it was announced that the Chinese court had left Si-nghan- fu on its way back to the northern capital. A month later (7th November) the death of Li Hung-Chang at Peking removed, if not the greatest of Chinese statesmen, at any rate the one who had enjoyed a larger share of the empress-dowager's confidence and figured in the eyes of the outside world more prominently than any other during that long chapter of wasted opportunities which had opened for the Chinese empire after the suppression of the great Taiping rebellion, and was brought to a close by the Boxer movement, the international occupation of Peking, and the peace protocol of 1901.

With this settlement a new era opens. What it will produce none can venture to foretell. On the one hand, the Powers have been induced to display great leniency with regard to the punish- ment of the court and the high officials implicated in the anti- foreign outrages of 1900 ; and on the other, the pecuniary compen- sation they have exacted is calculated to weigh heavily on the Chinese people, and on the innocent not less than on the guilty. In the north of China the excesses committed by some of the

foreign contingents unquestionably lowered the reputation of all Western powers collectively, notwithstanding the high standard of discipline maintained by the British, American, and Japanese forces, and by the later French contingent sent out direct from France. It must be noted also that amongst progressive Chinese officials a widespread feeling of disappointment prevailed that the Powers should have failed to avail themselves of the opportunity to insist upon the introduction of administrative reforms into China. The necessity of such reforms had been more widely realized by the Chinese themselves during the recent crisis than at any previous moment in the modern history of China, and several high officials like the Yangtse viceroys, the viceroy of Canton, and the governor of Shantung, Yuen Shih-kai, one of the ablest of the young Chinese mandarins, repeatedly memorialized the Throne in this sense. Imperial edicts were from time to time issued from Si-nghan-fu announcing important reforms, especially in the system of education and qualifications for the public ser- vice, but their value remained speculative so long as most of the appointments made by the court continued to be bestowed on members of the old reactionary party.

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China-Japan War of 1894-95. — The causes of the war between China and Japan arose out of the rival claims of the two Powers to assert influence in Korea. It was an old tradition in Japan, dating back to the legen- dary achievements of the Emperor Jingu, that Korea occu- pied a position of quasi-vassalage to the empire. At the end of the 16th century an expedition sent by the Emperor Hideyoshi occupied Seoul andiPhyong-yang. The Koreans invoked the aid of China, and after a prolonged war the Japanese forces were withdrawn shortly before the death of Hideyoshi. Inadequate sea power, rendering the supply of the Japanese troops precarious, seems to have been the cause of the ultimate failure, although the Chinese were frequently defeated in the field. In 1627, and again in 1637, Korea was invaded from the north by the Manchus, who soon afterwards established their dynasty at Peking. According a purely nominal allegiance to China, the Koreans subsequentljj maintained their isolation for more than two centuries. After the revolution which ended in 1868 — when Japan, adopting Western reforms, started upon a wonderful career of progress — it was

natural that her ambitions in regard to Korea should receive a fresh impulse. In 1875 a Japanese force landed on Kang-hwa Island, and after a naval demonstration at Chemulpo a treaty was obtained opening Fusan to Japanese trade. From this time Japan began to play an active part in Korean affairs, and under her influence a progressive party arose in Seoul, which soon found itself in conflict

witli the -ways of the mass of the people. In July 1882 the legations were burned by a mob and some Japanese officers were massacred. The minister who succeeded in reaching the sea and escaping was sent back with a military escort, and an indemnity was demanded and obtained. The Chinese at the same time sent a small force to Korea. In December 1884 a fresh outbreak occurred at Seoul. A plot to seize the king and establish a progressive government failed, and the Japanese were again driven out of the capital by the Koreans, assisted by Chinese. Japan sent troops and enforced the payment of a second indemnity. In April 1886 a convention was signed at Tientsin by Count Ito and Li Hung-Chang, by which both Powers undertook to withdraw their mili- tary forces from Korea, each being pledged to inform the other of any decision to despatch troops in the event of future disturbances. This convention secured compara- tive tranquillity in Korea for nine years. The murder at Shanghai, on 28th March 1894, of Kim-ok-kim, one of the leaders of the abortive revolution of 1884, created much excitement in Seoul, where the Tong-Hak rebellion was beginning to cause alarm. At the end of May the Tong- Haks defeated the Korean forces, and early in June the Government appealed to China for military assistance. A small Chinese force was at once sent to Asan ; and the Japan Government being informed, according to the terms of the convention of Tientsin, promptly ordered its minister, Otori, who was on leave, to return to Seoul. Warships were sent to Chemulpo, and Otori with an escort of marines reached Seoul on 10th June. The Japanese rapidly followed up this step by the despatch of

about 5000 troops under Major-General Oshima, who relieved the marines by the middle of June. A complicated situation thus arose. Chinese troops were present in Korea by the request of the Government with a view to put down an armed rebellion. The Japanese controlled the capital, and were determined to carry out reforms by force if necessary. An interesting diplomatic correspondence led only to a deadlock. Japan absolutely declined to recognize Korea "as a tributary state of China," to limit her military forces in the peninstda, or to place any restrictions upon their movements ; but she proposed that the two Powers should "unite their efforts for the speedy suppression of the disturbance," and should subsequently send commissioners to inaugurate jointly certain specified measures of reform. The Tsung-Li-Yamen considered that " the idea may be excellent, but the measures of reform must be left to Korea herself. Even China herself would not interfere with the iaternal administration of Korea, and Japan having from the very first recognized the independence of Korea, cannot have the right to interfere." The Japanese foreign minister replied that " the Imperial Government, much to their regret, cannot share the hopeful views " thus expressed, and considered that the government of Korea "is lacking in some of the elements which are essential to responsible independence." Ultimately — on 16th July — the Tsung-Li-Yamen was informed that as the Chinese Government appeared "disposed to precipitate complications," Japan was " relieved of all responsibility for any eventuality that may in future arise." War was now inevitable unless the Peking Government was willing to abdicate all claims over Korea. The claims were valueless ; but Chinese troops were already in the coun- try by invitation, and in these circumstances it was not to be expected that the shadowy suzerainty would be abandoned.

At Seoul the issue was forced by the Japanese minister, who delivered an ultimatum to the Korean Government on 20th July. On the 23rd the palace was forcibly occupied ; and the pro- Chinese party being removed from power, the control of the Government passed into the hands of the Japanese. Meanwhile

China had made efforts to reinforce the detachment at Asan, and had despatched about 8000 troops to the Yalu river. The out- break of war thus found the Japanese in military possession o£ Seoul and ready to send large forces to Korea, while the Chinese occupied Asan (about 40 miles southward of the capital), and had a considerable body of troops in Manchuria in addition to those despatched to the Yalu river. To Japan the command of the sea was essential for the secure transport and supply of her troops. Without it the experience of the war of the 16th century would be repeated. China, on the other hand, could utilize overland routes to Korea ; but difficulties and delays would necessarily be entailed. To both Powers the naval question was thus all-important.

War was not finally declared till 1st August, by which time collisions had occurred on sea and land. On 25th July Major- General Oshima, with about 2500 men, started for Asan and found the Chinese entrenched at Sung-hwan. The position was suc- cessfully attacked on the 29th, with a loss of about 90 killed and wounded ; but Yeh, the Chinese commander, escaped with the greater part of his force, and reached Phyong-yang by a wide detour. Meanwhile the Japanese squadron was proceeduig to Chemulpo, the cruisers Akitsushima, Toshino, and Naniwa being sent on in advance. On the morning of 25th July these vessels met the Tsi-yuen and the Kuang-yi near Phung Island. An engagement occurred, in which the Kuang-yi was disabled and run aahore, the Tsir^uen escaping to Wei-hai-wei, chased by the Toshino. The Chinese vessels, hopelessly overmatched, seem to have been well fought. At this juncture the wooden despatch boat Tsao-kiang approached from the south-east, and was captured by the AJcitsushima, while the British steamer Kovj- shing, carrying 1200 Chinese troops from Taku to Asan, also arrived, and was ordered by the Naniwa to bring-to and anchor. The Kowshing having been directed to follow the „ . . Naniwa, the Chinese threatened to kill the officers if / „°^*„”’ they complied or attempted to leave the ship. The Naniwa tJien opened fire and sank the Kowshing in less than half an hour. More than 1000 of the Chinese troops were drowned. The destruction of the Kowshing undoubtedly contributed to the Japanese success at Sung-hwan, and the intention of the Chinese to crush their enemies at Seoul between forces moving from the north and south was frustrated.

Henceforth the Japanese had to deal only with the forces north of the capital.

It was now of vital importance to the Chinese to prevent the transport of Japanese troops to Chemulpo, which was carried on with the greatest energy. The Chinese fleet, however, remained in port, and the Japanese made no attempt to obtain and keep touch with it. During August and September the Japanese were busied in landmg troops and stores at Chemulpo and Gensan, while the Chinese forces in Manchuria moved slowly to the Yalu river. On 8th August the Japanese began to move northwards. By 12th September about 14,000 men had converged upon Phyong-yang in three columns from Gensan, Sak- riong, and Chung-hua, and the main body under Lieutenant- General Nodzu from Huang-ju. A general attack was made on 15th September, and the strongly entrenched position was captured, with a loss of about 650 killed and wounded. The Chinese, numbering about 12,000, suffered heavily, and retreated northwards over the river Yalu. Korea being thus cleared, the war entered upon another phase.

Two days after the capture of Phyong-yang the hostile fleets came in contact. Admiral Ito seems to have taken no direct measures to prevent the landing of troops in the Yalu, and five Chinese transports left Taku on 14th Septem- ber with a cruiser escort, picking up the Pei-yang squadron, under Admiral Ting, en route. About 4000 men were disembarked on the 16th, and the Chinese warships weighed early on the 17th for the return voyage. They were sighted at about half-past eleven in the forenoon by the Japanese squadron, which was reconnoitring in the neighbourhood of the island of Hai-yang.

The tables on the following page give a detail of the fleets, which were not unevenly matched, the Japanese having the advantages of more modem ships, quick-firing guns, speed, and homogeneity, while the Chinese fleet contained two second-class battleships, the Ting- Yuen and the Chen- Tuen.

Admiral Ting attempted to form his force in quarter-line abreast, but the evolution was not accomplished, and the Chinese fleet bore down in a somewhat irregular line, the two battleships being in the centre and

the weakest vessels— the Chao- Tung and the Tang- Wei — on the wings. Admiral Ito divided his squadron into two parts, which were separately handled throughout the action, moving always in single column line ahead. The flying squadron, consisting of the fast vessels Toshino, Naniwa, Taka- chiho, and Akitsushima, was ordered to pass round the Chinese right wing and atuck the rear. In place of turning to starboard as intended, the squadron bore away to attack two detached Chinese vessels, which with some torpedo boats appeared to be

Yala battle.

CHIN A-J A P A N WAR

43

Chinese Squadron.

GlMslflcatlon.

Ships' Names.

Date of Launch,

Displace- ment,

Armour (In Inches).

Speed.

Guns.

Torpedo charges.

On Belt.

On Turret,

Barbette,

or Battery.

Battieships— 2nd class . . | Armoured cruisers Cruisers— 3rd class, protected.

Do. do. unprotected

Armoured cruiser Torpedo vessel .

Gunboats . . . . ■ Torpedo boats— 1st class . –

Ting- Yuen . Chen- Yuen .

Lai-Yuen 1 King- Yuen / Tsi-Yuen . Chi-Yuen “I Ching-Yuen j Chao-Ynng “t Yang-Wei /

Kwan-Chia

iPing-Yuen .

iKwang-Ping

lEpsilon >Kappa iFoo-Lung . iTyoJih

1881 1882

1887 1883 1886

1881

1887 1888

1889

1879 1881 1886 1887

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16

16-5 12

16-5

10

24 23

C Four 12-in. , two 6-in., two 4-in. “| i (Four 6-pdr., two 3-pdr.) I Q.F., 8 M. J

Two 8J-in., two 6-in., 8 M. .

Two 8-4-in., one 6-in., 10 M. .

Three 8-4-in., two 6-in., 16 M.

Two 10-in., four 40-pdr., 7 M. .

f Three 4-7-in. Q.F., three 6-pdr. I t Q.F., 4M. / One 12-in., two 6-in., 8 M.

/Three 4-7-in. Q.F., two 6-pdr. \ t Q.F., 4M.]•

Onell-in. M.L., 2L.,4M. .

Two 3-pdr. Q.F. . Two 3-pdr. Q.F.

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^ Ships that took little Japanese

or no part in the action. Squadron.

Classiflcation.

Ships’ Names.

Date of Launch.

Displace- ment.

Armour (in inches).

Speed.

Guns.

Torpedo charges.

On Belt.

On Turret,

Barbette,

or Battery.

Cruisers— 2nd class, protected- Armoured cruiser

Cruisers— 2nd class, protected ■

Battleship — 3rd class . Armoured cruiser

Gun-vessel .... Armoured transport .

Matsushima . Itsukushima. Hasidate

Chiyoda

Toshino

Naniwa \ Takachiho /

Akitsushima

Fuso .

Hi-Yei .

Akagl . Sakio-Maru .

1890 1889 1891

1890

1892

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1892 1877

1878

1889 1888

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f 2 One 13-in.; twelve 5-in. Q.F., \ I fifteen 3-pdr. and 2J-pdr.Q.F. J

/ Ten 5-in. Q.F., fourteen 3-pdr. > \ Q.F., and 3 M. / / Four 6-in., eight 5-in., twenty- \ \ two 3-pdr., all Q.F. / /Two 10-in., six 6-in.; two 6-\ I pdr., Q.F., and 12 M. / / Four 6-in., six 5-in., six 3-pdr., 1 t aUQ.F.]■ Four 9J-in., two 7-in., 8 M. .

Three 7-in., six 6-in., 8 M.

/ One 9J-in., one 6-in.; six 3-pdr. 1

Four Q.F., probably 6-pdrs. .

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2 Aft in Matsushima ; forward in her two sister-ships.

attempting to join the fleet. Meanwhile the main squadron, led by the flagship Matsushima, followed, and circling round the Chi- nese line passed its left wing. The flying squadron, recalled by signal, again engaged the right wing. The courses became some- what complicated ; but, broadly speaking, the two Japanese squad- rons continued to steam independently round the Chinese vessels, concentrating their fire upon individual groups. On the other hand, the Chinese almost from the first lost all order and attempted no manoeuvring; but the t*o battleships Ting-Tuen 2iid. Ghen-Tuen supported each other, and their armour proved a match for the Japanese ordnance, which was unable to disable them. Before sunset the Yang-Wei, Chao-Yung, Kirj,g-Yuen, and Chi-Yuen had been sunk by shells, and the Matsushima and Si-Yei were much damaged. The crews of both fleets were much ex- hausted. The Japanese pursuit seems to have been half-hearted, and contact was lost during the night. The total Japanese loss amounted to 115 killed and 103 wounded, of which nearly halt oc- curred on board the Matsushima. The Chinese lost about 600 men in the sunken ships, in addition to about 100 killed and between 200 and 300 wounded. . The action was decided solely by gun fire, although the Chinese discharged two torpedoes against the armed transport Sakio-Maru without effect. The result of the action was to confer upon the Japanese the full command of the sea, and to enable them to prosecute the land aaxapaiga. without hindrance. The surviving Chinese ships, with the exception of one which went aground near Ta-lien-wan and was destroyed, reached Port Arthur, and subsequently steamed to Wei-hal-wei. The Japanese now determined to invade Manchuria with the

army under Marshal Yamagata, and to embark a second army, consisting of the 1st division and a brigade of the 6th division with siege artillery, under Marshal Oyama, for the capture of Port Ar- thur, and subsequently to move up the Liao-Tung peninsula and join hands with the northern force. The Japanese crossed the Yalu on 24th and 25th of October, meeting little resistance, and success- fully occupied Antung,

Chin-lien-cheng, and Feng-huang. Thence on the 9th November General Tachimi, with the 5th division, advanced along the road to Mukden, and reconnoitred the Mo-tien-ling Pass on the 12th, while the 3rd division under General Oseko, operating to the south, occupied Tar-tung-kau on the 5th. By a combined attack of Greneral Oseko's force and a battalion of infantry under Colonel Mihara moving from Fung-huang, Hsin-yen, on the route to Hai- cheng, was taken on the 18th. Leaving a garrison at Hsin-yen, General Oseko's main force returned to Ta-ku-shan. A pause in the general advance of the first army now occurred, and holding their advanced positions, the Japanese explored the country by means of reconnoitring parties.

The detached brigade of the second army disembarked on 24th October about 38 miles to the north-east of Ta-lien-wan, and its advanced guard occupied Pi-tzu-wo on the following day. The landing of the whole force, with its horses /^J^iur and stores, required twelve days. On 6th November the important tovm of Chin-chau was attacked and taken, and on the 7th Ta-lien-wan, with its three modem coast forts, was occupied without resistance, the fleet arriving in the bay on the same day. The Japanese were now in possession of a good har- bour, where their siege train could be landed, 10 miles from Port

Arthur. Here the Chinese possessed a strongly fortified position held by about 9000 men. The attack was delivered on 21st November after a bombardment of the forts by 36 siege and 60 field and mountain guns. The resistance was contemptible, and Port Arthur was captured with a loss of only 270 killed and wounded.

Meanwhile in Manchuria the Chinese assumed the offensive. On 25th November the Japanese outpost at Tsao-ho-kau, 5 miles from the Mo-tien-ling Pass, was attacked in force. The attack was repulsed, and a flying column under Colonel Tachimi, leaving Fung-huang on the following day, reached Tsao-ho-kau by a mountain road, defeating a Chinese force in the neighbourhood. The difficulties of supplying an

advanced party, which was now confronted by superior forces, caused the Japanese to withdraw from Tsao-ho-kau, and to concentrate nearer Fung-huang, to- wards which the Chinese moved in three columns. On 14th December the Chinese were defeated. Meanwhile on 10th December the 3rd division began its advance from Hsin-yen upon Hai-cheng, which was taken on the 13th. The Japanese now occupied a somewhat exposed position, threatened by considerable Chinese forces at Ying-kau and Liao-Yang. General Sung, advanc- ing from the former with about 9000 men, was attacked and defeated on 19th December; but the Japanese, who had about 4500 men present, lost nearly 400, the Chinese offering a compara- tively stubborn resistance. On 17th January the Liao-Yang force, estimated at 14,000 strong, appeared in front of Hai-cheng and opened an ineffective long-range fire, dispersing in disorder when the Japanese advanced against them. A similarly futile attack was made on 22nd January, the Japanese loss being trifling.

The advance of the second army northward was long delayed by difficulties of transport, aggravated by the rigours of the climate. At length, on 1st January, a brigade of infantry and a regiment • of cavalry, with three batteries of artillery, started from Chin-chau under General Nogi and attacked a Chinese force strongly posted at Kai-ping on the 10th. The position was carried after three hours' fighting, with a loss of more than 300 killed and wounded, the Chinese showing some steadiness. Communication with the force occupying Hai-cheng was at once established.

The situation in Manchuria being thus secured, the Japanese proceeded to attack Wei-hai-wei, where lay the surviving vessels Wel-bal- °^ ^^^ Pei-yang squadron. On 18th January a naval ^gl' ' demonstration was made at Teng-ohau, 70 miles west of Wei-hai-wei, and on the 19th the Japanese began their disembarkation at Yung-cheng Bay, about 12 miles from Wei-hai-wei. The force employed consisted of the 2nd division, newly mobilized, and a brigade from the second army, under Marshal Oyama. The Chinese made no attempt to oppose the landing, and on the 26th the troops advanced. The eastern forts were captured on the 30th, the only effective opposition being that offered by the

Chinese ships, which, steaming near to the land, infiicted some loss upon the Japanese. The guns in the western defences were disabled by a landing party on 1st February, and these defences were joccupied by the Japanese on the following day. On the night of 4th February the Chinese squadron in harbour was attacked by ten torpedo boats. Two boats were lost, but the armour-clad Ting- Yuen was sunk. On the following night a second attack was made by four boats, and the Wei-T%en, Lai- Tuen, and a gunboat were sunk. On 9th February the Ohing- Tuen was sunk by the guns in one of the eastern forts manned by Japanese sailors. It was now seen that the remaining vessels were at the mercy of the Japanese, and on the 12th Admiral Ting wrote to Admiral Ito offering to surrender, and then took poison, other officers following his example. On the 16th the Japanese occupied Lien-kung island, and the remnant of the Chinese squadron passed into their hands.

While the Wei-hai-wei campaign was in progress the Chinese despatched a great peace mission to Japan, which arrived at Hiroshima on 31st January with credentials which were pro- nounced by Count Ito to be "fatally defective." The original draft made by the United States minister at Peking had been replaced by another of Chinese composition, and the idea of the Tsung-Li-Yamen seems to have been to ascertain the views of the Japanese Government without themselves being committed. The Japanese declined to treat in these circumstances, and the mission returned to China.

In February the Chinese made two feeble attacks on Hai-cheng which were easily repulsed, and the Japanese at Kai-ping having been reinforced, advanced along the coast road, and after occupy- ing Tai-ping-shan dislodged a considerable Chinese force under General Sung from an entrenched position. The Chinese were now concentrated in three groups at Ying-Kau, New-chwang, and Liao-Yang ; and General Katsura at Hai-cheng having been rein- forced, advanced on 28th February with the 3rd division, and captured New-chwang on 4th March. The Chinese suffered heavy loss. Two days later. Marshal Yamagi with the western column moved towards Ying-kau, which was occupied on 7th March,

General Sung retreating across the Liao river. The Japanese forces at Ying-kau and New-chwang now combined in attacking Tien-chwang-tai, which was taken on 9th March.

The Chinese forces in Manchuria being thoroughly broken and dispersed, there was nothing to prevent the Japanese from proceed- ing to the occupation of Peking, since the melting of the ice which forms along the northern shores of the Gulf of Pe-chi-li would per- mit them to land and supply large forces at Shan-hai-kwan, within 170 miles of the capital. Negotiations were therefore opened, and Li Hung-Chang proceeded to Shimonoseki, where a treaty was signed on 17th April. The terms included the ” full and complete independence and autonomy of Korea,” and the cession of the southern portion of the province of Shin-king (with a frontier extending from the Yalu river to Ying-kau), of Formosa and adjacent islands, and of the Pescadores group. Article IV. fixed an indemnity of 200 millions of taels. By Article VI. four addi- tional cities and ports were opened to Japanese trade, and rights of navigation on Chinese rivers were extended. Wei-hai-wei was to be occupied as a guarantee of performance. The cession of territory in the province of Shin-king was subsequently cancelled by the joint action of Kussia, France, and Germany.

The China-Japan war presents little interest from the military point of view. The proved excellence of the Japanese organization was, however, a revelation. The operations were carried through to complete success in a most difficult country during all the severity of a northern winter. The Japanese commanders were not only able to move and supply their troops, but they showed exact knowledge of the liberties which could be taken in face of Chinese forces. No European army could have accom- plished so much in so short a time. In aU that relates to the despatch of troops over-sea the Japanese organization fulfilled every requirement. Their navy showed itself to be a formidable weapon of war, well capable of holding its own among the fleets of the world. Politically the main results of the war were two : 1st, the raising of Japan to the position of a great naval and military power ; and, 2nd, the hastening by some years of the accomplishment of the plans of Russia for the absorption of Manchuria and the Liao-Tung peninsula. (g. s. c.)

Chinandega, or Chinendega, capital of a depart- ment of the same name in the republic of Nicaragua, Central America, situated on the Managua railway, 18 miles N.W. of Leon and 12 E. of Corinto. It has con- siderable trade in cotton and sugar, and is surrounded by banana plantations. In 1849 it was the temporary capital of the three united republics of Nicaragua, Honduras, and Salvador. Population, about 12,000.

Chindwin. — This river, like the Irrawaddy, of which it is the largest tributary, has its entire course in Burmese territory. It is called Ningthi by the Manipuris. The Chindwin is formed by the junction of the Tanai, the Tawan, and the Tar5n or TurSng, but it- is still uncertain which is the main stream. The Tanai has hitherto been looked on as the chief source. It rises in about 25° 30′ N. lat. and 97° E. long., on the Shwedaung-gyi peak of the KumSn range, 12 miles N. of Mogaung, and flows due north for the first part of its course untU it reaches the Hukawng valley, when it turns to the west and flows through the middle of the plain to the end of the valley proper. There it curves round to the south, passes through the Tar6n or Turong valley, takes the name of the Chind- win, and maintains a general southerly course until it enters the Irrawaddy, after flowing through the entire length of the Upper and Lower Chindwin districts, in about 21° 30′ N. lat. and 95° 15′ E. long. Its extreme outlets are 22 miles apart, the interval forming a succes- sion of long, low, partially populated islands. The most southerly mouth of the Chindwin is, according to tradition, an artificial channel, cut by one of the kings of Pagan. It was choked up for many centuries until in 1824 it was opened out by an exceptional flood. The Tanai (it is fre- quently called Tanaikha, but kha is merely the Kachin

word for river), as long as it retains that name, is a swift, clear river, from 50 to 300 yards wide and from 3 to 15 feet deep. In the Hukawng valley it has steep banks, fringed to a depth of a mile or more inland with wild plantain-trees. The river is navigated by native boats in the

Hukawng valley, but launches cannot come up from the Chindwin proper because of the reefs below Taro. The earlier tributaries are on the right bank ; they are the Tabye, the Tawan, and the Turong or Taron. The Tar wan, at its junction with the Tanai, close to the Mashi ferry, measures about 400 yards from bank to bank, and the breadth of the actual stream in the dry weather is 150 yards. It probably flows from the range which forms the south-west boundary of Hkamti Long, whose peaks are snow-covered during the dry season. The TarSn, TurSng, or Towang river seems to be the real main source of the Chindwin. It flows into the Hukawng valley from the north, and has a swift current with a succession of rapids. At Ningpyen it is 300 to 400 yards wide, and has well-defined banks. Its sources are in the hills to the south of Sadiya, rising from 10,000 to 11,000 feet above sea-level. For the first portion, of its course the river flows through a deep valley, with a general east and west direction, as far as its junction with the Loglai. It then turns south, and after draining an intricate sys- tem of hills, breaks into the Hukawng valley a few miles to the north of Saraw, and joins or receives the Tanai about 10 miles above Kintaw village. Except the Tanai, the chief branches of the Upper Chindwin rise in moun- tains that are covered at least with winter snows. Below the Hukawng valley the Chindwin is interrupted at sev- eral places by falls or transverse reefs. At the village of Haksa there is a fall, which necessitates transhipment from the large boats which ply below to canoes. Not far below this the Uyu river comes in on the left bank at Homalin, and from this point downwards the steamers of the Irrawaddy Flotilla Company ply for the greater part of the year. The Uyu flows through a fertile and well-culti- vated valley, and during the rainy season it is navigable for a distance of 150 miles from its mouth by steamers of light draught. Ordinarily regular steam communica- tion with Homalin ceases in the dry weather, but from Kindat, nearly 150 miles below it, there are regular weekly steamers all the year round. Below Kindat the only considerable affluent of the Chindwin is the Myit-tha, which receives the Chin hills drainage. As far as Mingin the general course of the Chindwin is south-westerly ; be- low that town it curves eastwards towards the Irrawaddy. The Chindwin rises very considerably during the rains, but in March and April it is here and there so shallow as to make navigation difficult even for small

steam launches. Whirlpools and narrows and shifting sandbanks also give some trouble, but much has been done to improve naviga- tion since the British annexation. (j. g. sc.)

Chindwin, Uppee and Lower, two districts in the Sagaing division of Upper Burma. Upper Chindwin has an area of 19,062 square miles, and a population, according to the census of 1891, of 111,533, living in 980 villages, and paying in 1898-99 a revenue of Es.3,22,057. Lower Chindwin has an area of 3481 square miles, and a popular tion of 233,316, living in 893 villages, and paying in 1898-99 a revenue of Es.5,53,982. Upper Chindwin lies to the north of the lower district, and is bounded on the N". by the Chin Naga and Kachin hills ; on the E. they are bounded by the Myit Kyina, Katha, and Shwebo districts ; Lower Chindwin is bounded on the S. by the PakSkku and Sagaing districts; and both districts are bounded on the W. by the Chin hills, and by Pakokku on the southern stretch. The chief flat country is along the banks of the Chindwin river, which runs through the

centre of both districts, and the plain to the east of the river in Lower Chindwin is very extensive and fertile. The western portion of both districts is hilly, and the greater part of Upper Chindwin is of the same character. In Upper Chindwin, out of 12,199,680 acres, only 112,388 were cultivated in 1899; in Lower Chindwin 296,326 acres out of a total of 2,227,584. In Upper Chindwin 1,640,823 acres more were available, and 541,085 acres in the lower district. Both have valuable teak forests. The area of forest land in Lower Chindwin is 301,440 acres, and in the upper district 1,085,120 acres. The area of reserved forest is yearly being extended. In 1898 there were 471 square miles of reserved tracts in Lower Chindwin. The total rainfall in 1898-99 was in Lower Chindwin 27-96 inches, and in Upper Chindwin 60-94. Both registered a highest temperature in May of 106° F., and the lowest reading in December was 54° at M5ny wa, and 62° at Kinday in Upper Chindwin. In Lower Chind- win the population was made up of 232,158 Buddhists and Jains, 426 Mahommedans, 374 Hindus, 320 Chins and other hill races, and 38 Christians. In Upper Chindwin there were 108,816 Buddhists and Jains, 1112 Hindus, 1048 Chins and Other hill races, 481 Mahommedans, and 76 Christians. Coal exists in extensive fields, but

these are not very accessible. Eice forms the great crop, but a certain amount of til-seed and of indigo is also cultivated. Kinday, with a population of 24i23, is the headquarters of the upper district, and M&nywa, with * a population of 6316, of the lower. Both are on the Chindwin river, and are served by the steamers of the Irrawaddy Flotilla Company. A16n, close to MSnywa, and formerly the headquarters, is the terminus of the railway from Sagaing westwards, which was opened in 1900. (j. G. sc.)

Chlngieput, or Chengalpat, a town and district of British India, in the Madras Presidency. The town, situated 36 miles by rail from Madras, had a population in 1881 of 5617 ; in 1891 of 9763. It has two high schools. The district of Chingleput surrounds the city of Madras, stretching along the coast for about 115 miles. The administrative headquarters are at Saidapet. It contains an area of 2842 square miles and a population in 1891 of 1,136,928, being 400 persons per square mile. In 1901 the population was 1,312,722, showing an increase of 9 per cent. The land revenue and rates were Es.20,07,908, the incidence of assessment being Es.2:2:6 per acre ; the number of police was 735. In 1897-98, out of a total cultivated area of 659,898 acres, 419,298 were irrigated. Salt is extensively manufactured all along the coast. Cotton-weaving is also largely carried on. There are 574 indigo vats, with an out-turn valued at Es. 2,00,000 ; 83 tanneries, with an out-turn valued at Es.29,00,000 ; and an English cigar factory. In 1896-97 the number of schools was 1047, attended by 29,291 pupils.

Chinl(iang, or Chin-Keang-fu, a treaty port in China, situated on the river Yangtse above Shanghai, from which it is distant 160 miles. It is a place of consider- able importance as a distributing centre, but has no direct trade with foreign countries. It lies at the point where the Grand Canal running north and south intersects the Yangtse, which runs east and west, and thus is peculiarly well situated to be a commercial entrepSt. Its trade, however, lies mainly with the north bank, where the Grand Canal is navigable for vessels drawing 8 to 10 feet of water. On the south bank the canal has been allowed to silt up so as to be impassable during the winter months. Eailway communication with

Shanghai on the one hand and with Nanking on the other will no doubt improve its prospects. Chinkiang is also the proposed terminus of the

Anglo-German railway to be built from Tientsia soutli- ■wards through. Shantung. The total value of exports and imports for 1899 was H. taels 25,691,000 (£3,854,000). In 1880 the total was H. taels 14,297,000 (£3,932,000). Chinkiang was the seat of a serious riot on the 5th Febru- ary 1898, when the British consulate and several foreign houses were burned down by a native mob. The popula- tion is estimated at 240,000, The number of foreign residents is very small, the trade being almost entirely in the hands of natives.

Chippenham, a municipal borough and market town in the Chippenham parliamentary division (since 1885) of Wiltshire, England, on the Avon, 13 miles N.E. of Bath by rail. Works for milk-condensing, bacon- curing, and making railway signals, guns, and carriages have been establi^ed. Area, 359 acres; population

(1881), 4495; (1901), 6074.

Chippewa Falls, capital of Chippewa county, Wisconsin, U.S.A., situated in 44° 45′ N. lat. and 91° 23′ W. long., in the north-western part of the state, on the Chippewa river, at an altitude of 831 feet. It is at the intersection of three railways, and possesses a fine water- power, which has given rise to extensive manufactures, largely of lumber. Population (1880), 3982; (1890), 8670 ; (1900), 8094, of whom 2357 were foreign-born.

Chishima, the Japanese term (literally ” a thousand islands “) for the Kuriles (q.v.).

Chitral. — The state of Chitral (see also Hnrou Kush) is somewhat larger than Wales, and supports a population of between 70,000 and 80,000 rough, hardy hillmen. Both the state and its capital are called

Chitral, the latter being situated about 47 miles from the main watershed of the range of the Hindu Kush, which divides the waters flowing down to India from those which take their way into the Oxus and onto Turkestan and Central Asia. Chitral is an important state because of its situa- tion at the extremity of the country over which the Government of ladia exerts its influence, and for some years before 1895 it had been the object of the policy of the Government of India to control the external affairs of Chitral in a direction friendly to British interests, to secure an effective guardianship over its northern passes, and to keep watch over what goes on beyond these passes. This policy resulted ia a British agency being established at Gilgit (Kashmir territory), with a subordinate agency in Chitral, the latter being usually stationed at Mastang (65 miles nearer to Gilgit than the Chitral capital), and occasional visits being paid to the capital.

In December 1894 Surgeon-Major Robertson, C.S.I. (India Medical Service) — ^afterwards Sir George RobertBon, K.C.S.I. — ^the British agent, was at Gilgit ; and his assistant, Lieutenant Gurdon, with ten men of his escort, was staying on a visit to the Chitral capital, the remainder of his escort of 100 men remaining at Mastang. On the 1st January 1895 the Mihtar (or Ruler) of Chitral was treacherously murdered at the secret instigation of Sher Afzul, who himself was an ex-Mihtar, and had been dethroned by a stronger party in the state and forced to fly for refuge to Cabul. His chief ally was Umra Khan, chieftain of Jhandol, whose restless ambition, not satisfied with numerous small conquests and increases of territory, had long been set on the Mihtarship of Chitral. For the time being, however, he posed as an ally of Sher Afzul ; but without waiting for the latter's arrival from Cabul, he himself, on hearing of the Mihtar's murder, hastened with his forces to seize Chitral. He met with some success, capturing Killa Dresh, 25 miles to the south of Chitral Fort ; but here he was opposed and beaten by the Chitralis themselves. At this juncture he was joined by Sher Afzul, who quickly won over the Chitralis ; and the two forces amalgamated and made common cause against the British, whose presence at Chitral was considered likely to interfere with the return of Sher Afzul to the throne. The combined force at once marched to attack Chitral Fort.

On hearing of the Mihtar's assassination, Lieutenant Gurdon at Chitral immediately informed Dr Robertson at Gilgit, and with

great discretion avoided all collision with the new Mihtar (the assassin Amir-ul-Mulk). Gurdon was soon reinforced by 50 men from his headquarters at Mastang, and on the 1st February Dr Robertson himself arrived from Gilgit and assumed political charge. The situation remained unchanged until TJmra Khan, marching on Chitral, captured Killa Dresh ; and on Sher Afzul joining him, a joint letter was sent to Dr Robertson, ordering his immediate with- drawal to Mastang. The demand was ignored, and in their turn the Government of India ordered Umra Khan to withdraw to his own territory. As he refused, the Government of India prepared for war ; and, abandoning the route through Gilgit and over the snow-bound passes as impracticable, they decided on an advance fromNowshera (British India), less than 200 miles from Chitral, through Swat and Jhandol (Umra Khan's state). Major-General Sir R. Low was selected to command this relieving force, and on the 1st April an army of some 16,000 men was concentrated beyond Nowshera at Hoti-Mardan on the frontier. On 3rd April Sir R. Low stormed the Halakand Pass, and won a decisive victory over the Swatis, who had been induced by Umra Khan to oppose the British. The position was considered impregnable by the enemy, but was carried with great gallantry. After this victory the force pushed on into Swat, and a few days later crossed the Swat river in the teeth of a stubborn resistance and continued the forward march.

Dr Robertson, on arrival at Chitral, determined to try to open up communication with Gilgit and Mastang. Accordingly, he despatched Lieutenants Fowler and Edwardes vnth a small party for this purpose. After two marches they were attacked by the enemy, but managed to send Word on to Mastang. A Mastang party under Captain Ross advanced to relieve them, but was in its turn attacked by overwhelming numbers, and eventually had to cut its way back, losing Captain Ross and 54 men killed. Fowler and Edwardes held out for a week with magnificent bravery, but eventually were, through treachery, overwhelmed and captured. Mastang itself was now besieged, and Chitral completely cut ofE. The garrison of the former place made a

gallant defence, and were able to hold out until relieved by Colonel Kelly, whose march will be presently described.

Sir R. Low's force had pushed forward to the Faingkna river, and on the 13th April Lieutenant Edwardes was released by Umra Khan and sent into the British camp. The same day a third success- ful battle was fought, and on the 16th the force crossed the river, finally defeated the enemy, and pushed on towards Chitral. A few days later Lieutenant Fowler also was sent in by Umra Khan, who had brought these officers down with him from Chitral, and hoped by releasing them to prevent the invasion of his country. But this was not General Low's view of the matter, and on the 18th inst. his force occupied Umra Khan's deserted stronghold in Jhandol, th« latter fleeing with his family and treasure towards Cabul. He was not overtaken, and remained at Cabul a refugee.

Meantime the siege at Chitral had begun, and was being prose- cuted with the utmost vigour by Sher Afzul, Umra Khan having proceeded south to oppose Sir R. Low. The defence of Chitral will always be counted among the finest exhibitions of British pluck. The garrison numbered only 543, of whom 137 were non- combatants. On the first day of the siege a reconnaissance by the garrison was repulsed with heavy loss, Captain Baird and 24 men being kiUed. This engagement was the hardest fought during the whole war. The military command was in the hands of Captain Townshend, to whose skill, energy, and valour the successful resistance of the garrison was practically due ; Dr Robertson, though ranking himself as a non-combatant, assisting most gallantly in the perilous duties of the defence, in the performance of which he was severely wounded. The siege lasted 46 days. One of its most brilliant features was a sortie by Lieutenant Harley to destroy the besiegers' mines on the 17th April.

The relief of Chitral was at last accomplished by Colonel Kelly. This officer, with his regiment, the 32nd Pioneers, was at this time employed at road-making in the Gilgit district. On the 22nd March (the siege of Chitral having begun on the 4th) Colonel Kelly was ordered by the Government of India to assume military command of all the troops

under the Gilgit agency. He was made acquainted with what had taken place at Chitral, and was given practically a free hand to make such dispositions and movements of the troops under his command as he considered necessary. He immediately decided to march over the snow passes on a relief expedition, in spite of the fact that this route had been considered impracticable by the Government of India and the road through Swat, Jhandol, and Dir decided on. The troops at Colonel Kelly's disposal were entirely native troops, consisting of 400 men of the 32nd Pioneers, with 2 mountain guns, 40 sappers and miners, and some 150 ragged and undisciplined levies from the wilds of surrounding native states. With this small force he had to march through 220 miles of hostile country yielding scarcely any supplies ; and above all, he had to cross the terrible Shandur Pass, 12,230 feet high, at this time covered with deep snow. In the face of all

these difficulties Colonel Kelly set out on the 23rd March, the day after receiving his orders. Marching rapidly, the little force suc- cessfully crossed the Shandur Pass on the 28th March. On the 9th April Colonel Kelly fought and defeated the Chitralis, and on the same day relieved the garrison of Mastang. On the 13th April Colonel Kelly again fought a successful action at Nisa Gol. The enemy having now been dispersed, the road to Chitral was left clear, and on the 20th April the gallant little force relieved Chitral Fort without opposition from Sher Afzul and his followers, who had fled during the previous night. General Low's army was then at Umra Khan's stronghold, and no news arriving of the relief by Colonel Kelly, one lightly -equipped brigade under General Gatacre was pushed on towards Chitral. On 1st May they crossed the Lewarai Pass (10,000 feet high) over deep snow. Here they halted, as all opposition was over. Colonel Kelly's force soon returned to G'ilgit; but Sir Robert Low's troops held the line from Nowshera to Chitral for six months while the future policy was being arranged. At one time during the occupation the force had actually received orders to evacuate the whole country ; but before this was commenced a change of

Government occurred in England, and the new Cabinet immediately reversed the orders of their predecessors. Eventually the force was withdrawn during September and October 1895, a brigade being left at Killa Dresh. This was to be relieved every two years. The Khan of Dir (to whom were returned the lands seized by Umra Khan) and the Khan of Nawayai were subsidized to keep the road in repair and to ensure the safety of the biennial reliefs to and from Killa Dresh. Umra Khan was not permitted to return to his country. Sher Afzul, finding resistance hopeless, surrendered with his force. He and twenty of his chief men, with the assassin Amir-ul-Mulk, were sent to India to remain perpetually domiciled at Dharmsala, a hill-station in the Himalayas. (c. j. B.)

Chittagong, a seaport of British India, giving its name to a district and a division of Bengal. It is situ- ated on the right bank of the Kamaphuli river, about 12 miles from its mouth. It is the terminus of the Assam-Bengal railway. The inunicipal area covers about 9 square miles; population (1881), 20,969 ; (1891), 24,069. Chittagong is the second seaport of Bengal. In 1897-98 the sea-borne exports were valued at Es.1,12,63,036, of ■which more than half was jute, other items being tea, law cotton, rice, and hides. There is also a large trade by country boats, which brought imports in 1897-98 valued at Ils.33,87,916, chiefly cotton, rice, spices, sugar, and tobacco. There is one rice-husking mill, employing 65 persons, with an out-turn valued at Rs.1,60,000. There are a Government college, a law class, a high school, and two Roman Catholic convent schools. Two of the five printing-presses issue vernacular newspapers.

The district of Cfittagoitg is situated at the north-east corner of Bengal, occupying a strip of coast and hills between the sea and the mountains of Burma. Its area (excluding the Chittagong Hill Tracts) is 2563 square mUes. The population in 1891 was 1,290,167, giving an average density of 503 persons per square mile. Classified according to religion, Hindus numbered 302,333 ; Mahommedans, 924,849 ; Buddhists (JErom Arakan), 61,615; Chris- tians 1191, of whom 256 were Europeans; “others,” 179. In 1901 the population was 1,352,722, showing an increase of 5 per cent. The land revenue and rates are

Rs.10,16,834 ; the number of police is 497 ; the death-rate in 1897 was 49-46. This high mor- tality was partly due to the destructive cyclone of October, In 1896-97 the number of boys at school was 56,593, being 62 per cent, of the male population of school-going age. The northern portion of the district is traversed hy the Assam-Bengal railway. Tea cultivation is moderately successful. In 1897-98 there were 23 gardens, with 4025 acres under tea, employing permanently 3556 persons and producing more than two million lb. The Chit- tagong forests yielded in 1897-98 a gross revenue of Es. 77,406.

The Chittagong Hill Tracts, formerly an independent dis- trict, have been reduced to the status of a subdivision. They occupy the ranges between Chittagong proper and the south Lushai hills. The area covers 5419 square miles. In 1891 the population was 107,286, giving an average density of 20 persons per square mile. In 1901 the population was 124,851, showing an increase of 16 per cent. The inhabitants, who are either Araka^ nese or aboriginal tribes, are almost all Buddhists. The head- quarters are at Rangamati (population 2336), which was entirely wrecked by the cyclone of October 1897. There is one tea garden with 100 acres under tea, employing 120 persons and producing 27,000 R). The division of Chittagong lies at the north-east comer of the

Bay of Bengal, extending northward along the left bank of the Meghna. It consists of the three districts of Chittagong (includ- ing the Hill Tracts), Noakhali, and Tipperah. Its area covers 12,118 square miles; the population in 1891 was 4,190,081, giving an average density of 345 persons per square mile.

Chittore, a town of British India, ia the North Arcot district of Madras, situated in 13° 13′ N. lat. and 79° 8′ E. long. ; station on the South Indian railway. Population (1881), 6809 ; (1891), 9965. Formerly a mili- tary cantonment, it is now only the civil headquarters of the district. It has an English church, mission chapel, and Roman Catholic chapel, a high school, two printing- presses, and several literary institutes.

Chitty, Sir Joseph William (1828-1899), Eng- lish judge, was born in London in 1828. He was the second son of Mr Thomas Chitty (himself son and brother of well-known lawyers), a celebrated special pleader

and writer of legal text-books, in whose pupil-room Earl Cairns, Lord O'Hagan, Chief Justice "Whiteside, Mr Jus- tice Wil'les, Mr Justice Quain, Sir James Hannen, and many other distinguished lawyers began their legal educa- tion. Joseph Chitty was educated at Eton and Balliol, Ox- ford, gaining a first-class in 1851, in the old honour school of lAtercB Humamores, and being afterwards elected to a fellowship at Exeter College. His principal dis- tinctions during his school and college career had been •earned in athletics, and he came to London as a man who had stroked the Oxford boat and captained the Oxford cricket eleven, besides bearing a well-known legalname and being possessed of first-class abilities. In these circumstances he had little difiiculty in making his mark. He became a member of Lincoln's Inn in 1861, was called to the bar in 1856, and made a queen's counsel in 1874, electing to practice as such in the court in which Sir George Jessel, Master of the Rolls, presided. Chitty was highly successful in his method of dealing with a very masterful if exceedingly able judge, and soon gained the reputation of having the ear of the court to such an extent that his practice became very large, his fees being statedto have amounted at one time to £13,000 a year, a large sum for one not a law ofileer of the Crown. In 1880 he entered the House of Commons, being returned as Liberal member for Oxford (city) at the general election of that year. His parliamentary career was short, for in 1881 the Judicature Act required that the Master of the Rolls should cease to sit regularly as a judge of first instance, and Chitty was selected to fill the vacancy thus created in the Chancery division. It was remarked that two other judges during the century. Lord Hatherley and Sir "William Erie, had represented Oxford in Parliar ment. Sir Joseph Chitty was for sixteen years a popiilar judge, in the best meaning of the phrase, being- noted for his courtesy, geniality, patience, and scrupulous fairness, as well. as for his/'legal attainments, and being much respected and liked by those practising, before him, in spite of a habit of interrupting counsel, possibly acquired through the example of Sir George Jessel — a habit which in the case of Mr Justice Chitty did not accelerate the despatch of business as it did with his predecessor, but which no doubt was inspired, as a rule, by his desire to appreciate every detail of the ease before him. His ready ejaculation " Fiat justitia mat caelum " when a piece of the ceiling of his court fell while he was on the

bench, is deserving of record. He remained a puisne judge until 1897, when, on the retirement of Sir Edward Kay, L.J., he was promoted to the Court of Appeal. There he more than sustained— in fact, he appreciably increased — his reputation as a lawyer and a judge, proving himself to possess considerable knowledge of the common law as well as of equity, during the short time which elapsed before

his death. He died in London on 15th February 1899, after a very short illness, originating in an attack of the prevailing epidemic of influenza.

Many legal contemporaries of Sir Joseph Chitty had been distinguished athletes while young. Lord Esher, M.E.., Lord Justice A. L. Smith, Mr Justice Denman, and Lord Macnaghten may be mentioned as instances of university oars who were on the bench while he was a judge, while Sir Richard Webster (afterwards Lord Alverstone, L.C.J.) and Sir E. T. Reid, both law officers of the Crown, had been ” blues ” for running and cricket respectively. During four seasons Chitty kept wicket for the Eton eleven, of which he was captain in 1847 (he was afterwards held to be the best amateur wicket-keeper in England), and in those four years Eton won seven matches out of the eight played against Harrow and Winchester. At Oxford he played at cricket against Cambridge in 1848 and 1849, and won still greater fame on the river. He rowed 2 in the Oxford eight in the inter-university boat-race of March 1849, and 4 in the second of the two races rowed in that year. No inter- university race as such took place in 1850 or 1851, but in the latter year Oxford with Chitty stroke won the Grand Challenge Cup at Henley, Cambridge being a competitor; and in 1852 the inter-university race was again held, and Chitty stroked a strong Oxford crew to victory. In after life he acted as umpire in the inter- university boat-race for twenty-four years, ceasing to do so ia 1881, and he was an active member of the Inns of Court Rifle Volunteers (the Devil’s Own), holding a major’s commission from 1869 to 1877, having been one of those who organized it in 1860, and having then been given a commission as a captain. In a profession largely filled by university men such a record was not likely

to be forgotten. Sir Joseph Chitty married in 1858 Clara Jessie, daughter of Chief Baron Pollock, and left children who can thus claim descent from two of the best-known legal families of the 19th century.

Authorities. — The Times, 16th February 1899. — Law Jour- nal, 18th February 1899.— iaw Times, 18th February 1899. — Law Quarterly, vol. xv. p. 128. — Law Magazine, vol. xxv. p. 257. (e. a. ak.)

Choisy-le-Roi, a town in the arrondissement of Sceaux, department of Seine, Eranee, 4 miles in direct line S.E. of Paris, on the left bank of the Serue and on the railway to Orleans. A monument was erected iu 1882 to Rouget de I'lsle, author of the " Marseillaise," who died here 1836. It has manufactures of cloth, felt, gloves, earthenware, porcelain, and glass, and con- siderable river trade. Population (1881), 6700 ; (1901),

11,287.

Cholera. — Much light has been thrown upon Asiatic cholera since 1880. Western experience has been enlarged by several epidemic outbreaks in different countries, and by one pandemic visitation of great violence ; and the study of the disease by modern methods has resulted in important additions to our previous knowledge of its nature, causation, mode of dissemination, and prevention.

The cause is a micro-organism identified by Koch in 1883. An account of it will be found under Pathology (Parasitic Diseases). For some years it was called the " comma bacillus," from its supposed resemblance in shape to a comma, but it was subsequently found to be a vibrio or spirillum, not a bacillus. The dis- covery was received with much scepticism in some quar- ters, and the claim of Koch's vibrio to be the true cause of cholera was long disputed, but is now universally acknowledged. Few micro-organisms have been more elaborately investigated, but very little is known of its natural history, and its epidemiological behaviour is still

Causittloa.

surrounded by obscurity. At an important discussion on the subject, held at the International Hygienic Congress in 1894, Professor Gruber of Vienna declared that the deeper investigators went the more difficult the problem became, while M. MetschnikofE of the Pasteur Institute made a similar admission. The difficulty lies chiefly in the variable characters assumed by the organism and the variable effects produced by it. The type reached by cultivation through a few generations may differ so widely from the original in appearance and behaviour as to be hardly recognizable, while, on the other hand, of two organisms apparently indistinguishable one may be innocuous and the other g^ve rise to the most violent cholera. This variability offers a possible explanation of the frequent failure to trace the origin of epidemic out- breaks in isolated places. It is commonly assumed that the micro- organism is of a specific character, and always introduced from without, when cholera appears in coun- tries or places where it is not endemic. In some cases such introduction can be proved, and in others it can be inferred with a high degree of probability, but sometimes it is impossible to trace the origin to any possible chan- nel of communication. A remarkable case of this kind occurred at the Nietleben Lunatic Asylum near Halle, in 1893, in the shape of a sudden, explosive, and isolated outbreak of true Asiatic cholera. It was entirely con- fined to the institution, and the peculiar circumstances enabled a very exact investigation to be made. The facts led Professor Arndt, of Greifswald, to propound a novel and interesting theory. No cholera existed in the sur- rounding district and no introduction could be traced, but for several months in the previous autumn diarrhoea had prevailed in the asylum. The sewage from the establish- ment was disposed of on a farm, and the effluent passed into the river Saale above the intake of the water-supply for the asylum. Thus a circulation of morbid material through the persons of the inmates was established. Dr Arndt's theory was that by virtue of this circidation cholera was gradually developed from previously existing intestinal disease of an allied but milder type. The out- break occurred in winter, and coincided with the freezing of the filter-beds at the water-works. The theory is worth notice, because a similar relation between the drainage and the water-supply frequently exists in places severely attacked by cholera, and it has repeatedly been observed that the latter is preceded

by the prevalence of a milder form of intestinal disease. “The inference is not that cholera can be developed de novo, but that the type is unstable, and that a virulent form may be evolved under favourable conditions from another so mild as to be unrecognized, and consequently undetected in its origin or introduction. This is quite in keeping with the ob- served variability of the micro-organism, and with the trend of modem research with regard to the relations between other pathogenic germs and the multifarious gradations of type assumed by other zymotic diseases. The same thing has been suggested of diphtheria.

Cholera is endemic in the East over a wide area, rang- ing from Bombay to Southern China, but its chief home is British India. It principally affects the alluvial soil near the mouths of the great rivers, f”^”” and more particularly the delta of the Ganges. Lower Bengal is pre-eminently the standing focus and centre of diffusion. In some years it is quiescent, though never absent ; in others it becomes diffused, for reasons of which nothing is known, and its diffusive activity varies greatly from equally inscrutable causes. At irregular intervals this property becomes so heightened that the disease passes its natural boundaries and is carried east, north, and west, it may be to Europe or beyond to the American continent. We must assume

that the micro-organism, like those of other epidemic diseases, acquires greater vitality and toxic energy, or greater power of reproduction at some times than at others, but the conditions that govern this behaviour are quite unknown, though no problem has a more important bearing on public health. Bacteriology, as already intimated, has thrown no light upon it, nor has meteorology. Some results of modern research, indeed, tend to assign increasing importance to the relations between surface soil and certain micro-organisms, and suggest that changes in the level of the subsoil water, to which Pettenkofer long ago drew attention, may be a dominant factor in determining the latency or activity of pathogenic germs. But this is

largely a matter of con- jecture, and, so far as cholera is concerned, the conditions which turn an endemic into an epidemic disease must be admitted to be still unknown.

On the other hand, the mode of dissemination is now well understood. Diffusion takes place along the lines of human intercourse. The poison is carried chiefly by in- fected persons moving from place to place; but soiled clothes, rags, and other articles that have come into con- tact with persons suffering from the disease may be the means of conveyance to a distance. There is no reason to suppose that it is air-borne, or that atmospheric influences have anything to do with its spread, except in so far as meteorological conditions may be favourable to the growth and activity of the micro-organisms. Beyond all doubt, the great manufactory of the poison is the human body, and the discharges from it are the great source of con- tagion. They may infect the ground, the water, or the immediate surroundings of the patient, and so pass from hand to hand, the poison finding entrance into the bodies of the healthy by means of food and drink which have become contaminated in various ways. Flies which feed upon excreta and other foul matters may be carriers of contagion. Of all the means of local dissemination, con- taminated water is by far the most important, because it affects the greatest number of people, and this is par- ticularly the case in places which have a public water- supply. A single contaminated source may expose the entire population to danger. All severe outbreaks of an explosive character are due to this cause. It is also possible that the cholera poison multiplies rapidly in water under favourable conditions, and that a reservoir, for instance, may form a sort of forcing-bed. But it would be a mistake to regard cholera as purely a water- borne disease, even locally. It may infect the soil in localities which have a perfectly pure water-supply, but have defective drainage or no drainage at all, and then it will be found more difficult to get rid of, though less for- midable in its effects, than when the water alone is the source of mischief. In all these respects it has a great affinity to enteric fever. With regard to locality, no situation can be said to be free from attack if the disease is introduced and the sanitary conditions are bad ; but, speaking generally, low-lying places on alluvial soil near rivers are more liable than those standing high or on a

rocky foundation. Of meteorological conditions it can only be said with certainty that a high temperature favours the development of cholera, though a low one does not prevent it. In temperate climates the summer months, and particularly August and September, are the season of its greatest activity.

Cholera spreads westwards from India by two routes — (1) by sea to the shores of the Eed Sea, Egypt, and the

Mediterranean; and (2) by land to Northern ^ffusioa In

Central Asia, and so to Eussia. In the great invasions of Europe during the 19th century it some- times followed one route and sometimes the other. Four

such invasions are mentioned in the article in the ninth edition of the Encydopcedia — ^those of 1830-39, 1847-49, 1863-54, and 1865-67 — but by some writers the epidemic of 1853 is regarded as a recrudescence of that of 1847. The earlier ones followed the land route by way of Afghanistan and Persia, and took several years to reach Europe. That of 1865 travelled more rapidly, being carried from Bombay by sea to Mecca, from there to Suez and Alexandria, and then on to various Mediterranean ports. Within the year it had not only spread extensively in Europe, but had reached the West Indies. In 1866 it invaded England and the United States, but during the following year it died down in the West. The subsequent history of cholera in Europe may be stated chronologically.

1869-74. — This invasion was traced to the great gathering of pilgrims at Hardwar on the Upper Ganges in the month of April 1867. From there the return- ing pilgrims carried it to the Punjab, Cashmere, and Afghanistan, whence it spread to Persia and the Caspian, but it did not reach Eussia until 1869. During the next four years a number of outbreaks occurred in Central Europe, and notably one at Munich in the winter of 1873. The irregular character of these epidemics suggests that they were rather survivals from the pandemic wave of 1867 than fresh importations, but there is no doubt that cholera was carried overland into Eussia in the manner described.

1883-87. — This visitation, again, came by the Mediter- ranean. In 1883 a severe outbreak occurred in Egypt, causing a mortality of above 25,000. Its origin remained unknown. During this epidemic Koch discovered the comma bacillus. The following year cholera appeared at Toulon. It was said to have been brought in a troopship from Saigon in Cochin China, but it may have been con- nected with the Egyptian epidemic. A severe outbreak followed and reached Italy, nearly 8000 persons dying in Naples alone. In 1885 the south of France, Italy, Sicily, and Spain all suffered, especially the last, where nearly 120,000 deaths occurred. Portugal escaped, and the authorities there attributed their good fortune to the insti- tution of a military cordon, in which they have had implicit confidence ever since. In 1886 the same countries suffered again, and also AustriarHungary. From Italy the disease was carried to South America, and even travelled as far as Chile, where it had previously been unknown. In 1887 it still lingered in the Mediterranean, causing great mortality, in Messina especially. According to Dr Wall, this epi- demic cost 250,000 lives in Europe and at least 50,000 in America. A particular interest attaches to it in the fact that a localized revival of the disease was caused in Spain in 1890 by the disturbance of the graves of some of the victims who had died of cholera four years previously.

1892-95. — ^This great invasion reverted again to the old overland route, but the march of the disease was of unprecedented rapidity. Within less than five months it travelled from the North-West Provinces of India to St Petersburg, and probably to Hamburg, and thence in a few days to England and the United States. This speed, in such striking contrast to the slow advance of former occasions, was attributed, and no doubt rightly, to im- proved steam transit, and particularly the Transcaspian railway. The progress of the disease was traced from place to place, and almost from day to day, with great precision, showing how it moves along the chief highways and is obviously carried by man. The main facts are as follows : — Cholera was extensively and severely prevalent in India in 1891, causing 601,603 deaths, the highest mortality since 1877. In March 1892 it broke out at the Hardwar fair, a day or two before the pilgrims dispersed ; on 19th

April it was at Kabul, on 1st May at Herat, and 26th May at Meshed. From Meshed it moved in

three directions — due west to Tehran in Persia, north-east by the Transeaspian railway to Samarkand in Central Asia, and north-west, by the same line in the opposite direction, to Uzun-ada on the Caspian Sea. It reached Uzun-ada on 6th June; crossed to Baku, 18th June; Astrakhan, 24th June; then up the Volga to Nijni Novgorod, arriving at Moscow and St Petersburg early in August. The part played by steam transit is clear from the fact that the disease took no longer to travel all the way from Meshed to St Petersburg by rail and steamboat than to traverse the short distance from Meshed to Tehran by road. On 16th August cases began to occur in Hamburg; on 19th August a fireman was taken ill at Grangemouth in Scotland, where he had arrived the day before from Hamburg; and on 31st August a vessel reached New York from the same port with cholera on board. On 8th September the disease appeared in Galicia, having moved somewhat slowly westwards across Russia into Poland, and on 26th September it was in Budapest. Holland and Servia were also attacked, while isolated cases were carried to Norway, Denmark, and Italy. Mean- while two entirely separate epidemics were in progress elsewhere. The first was confined to Arabia and the Somali coast of Africa, and was connected witii the remains of an outbreak in Syria and Arabia in 1890-91. The second arose mysteriously in Trance about the time when the overland invasion started from India. The first known case occurred in the prison at Nanterre, near Paris, on 31st March. Paris was affected in April, and Havre in July. The origin of this outbreak, which was of a much less violent character than that which came simultaneously by way of Russia, was never ascertained. Its activity was confined to France, particularly in the neighbourhood of Paris, together with Belgium and Holland, which was placed between two fires, but escaped with but little mortality. The number of persons killed by cholera in

1892, outside of India, was reckoned at 378,449, and the vast majority of those died within six months. The countries which suffered most severely were as follows: — European Russia, 151,626; Caucasus, 69,423 ; Central Asian Russia, 31,804 ; Siberia, 15,037— total for Russian empire, 267,890; Persia, 63,982; Somaliland, 10,000; Afghanistan, 7000; Germany, 9563; France, 4550; Hungary, 1255; Belgium, 961. Curiously enough, the south of Europe, which had been the scene of the previous epidemic visitation, escaped. The disease was of the most virulent character. In European Russia the mortality was 45-8 per cent, of the cases, the highest rate ever known in that country ; in Germany it was 51-3 per cent. ; and in Austria-Hungary, 57-5 per cent. Of all the localities attacked, the case of Hamburg was the most remarkable. The presence of cholera was first suspected on 16th August, when two cases occurred, but it was not officially declared until 23rd August. By that time the daily number of victims had already risen to some hundreds, while the experts and authorities were making up their minds whether they had cholera to deal with or not. Their decision eventually came too late and was superfluous, for by 27th August the people were being stricken down at the rate of 1000 a day. This rate was maintained for four days, after which the vehemence of the pestilence began to abate. It gradually declined, and ceased on 14th November. During those three months 16,956 persons were attacked and 8605 died, the majority within the space of a few weeks. The town, ordinarily one of the gayest places of business and pleasure on the Continent, became a city of the dead. Thousands of persons fled, carrying the disease into all parts of Germany; the rest shut themselves indoors ; the shops were closed, the trams ceased to run.

the hotels and restaurants were deserted, and few vehicles or pedestrians were seen in the streets. At the cemetery, which lies about 10 miles from the town, some hundreds of men were engaged day and night digging long trenches to hold double rows of coffins, while the funerals formed an almost coatinuous procession along the roads ; even so the victims could not be buried fast enough, and their bodies lay for days in sheds hastily run up as mortuaries. Hamburg had been attacked by cholera on fourteen previous occasions beginning with 1831, but the mortality had never approached that of 1892 ; in the

worst year, which was 1832, there were only 3687 cases and 1765 deaths. The disease was believed to have been introduced by Jewish emigrants passing through on their way from Russia, but the importation could not be traced. The Jews were segregated and kept under careful supervision from the middle of July onwards, and no recognized case occurred among them. The total number of places in Germany in which cholera appeared in 1892 was 269, but it took no serious hold anywhere save in Hamburg. The distribution was chiefly by the waterways, which seem to affect a larger number of places than the railways as carriers of cholera. In Paris 907 persons died, and in Havre 498. Between 18th August and 21st October 38 cases were imported into England and Scotland through eleven different ports, but the disease nowhere obtained a footing. Seven vessels brought 72 cases to the United States, and 16 others occurred on shore, but there was no further dissemination.

During the winter of 1892-93 cholera died down, but never wholly ceased in Russia, Germany, Austria-Hungary, and France. With the return of warm weather it showed renewed activity, and. prevailed extensively throughout Europe. The recorded mortality for the principal countries was as follows : — Russia (chiefly western pro-vinces), 41,047 ; Austria-Hungary, 4669 ; France, 4000 ; Italy, 3036; Turkey, 1500; Germany, 298; Holland, 376; Belgium, 372; England, 139. Hardly any country escaped altogether ; but Europe suffered less than Arabia, Mesopotamia, and Persia. Cholera broke out at Mecca in June, and owing to the presence of an exceptionally large number of pilgrims caused an appalling mortality. The chief shereef estimated the mortality at 50,000. The pilgrims carried the disease to Asia Minor and Constanti- nople. In Persia also a recrudescence took place and proved enormously destructive. Dr Barry estimated the mortality at 70,000. At Hamburg, where new waterworks had been installed with sand filtration, only a few sporadic cases occurred until the autumn, when a sudden but limited rush took place, which was traced to a defect in the masonry permitting unfiltered Elbe water to pass into the mains. In England cholera obtained a footing on the Humber at Grimsby, and to a lesser extent at Hull, and isolated attacks occurred in some 50 different localities. Excluding a few ship-borne cases, the registered

number of attacks was 287, with 135 deaths, of which 9 took place in London. It is interest- ing to compare the mortality from cholera in England and Wales, and in London, for each year in which it has prevailed since registration began : —

Tear.

England and Wales.

London.

Deaths.

Deaths per 10,000 Uving.

Deaths.

Deaths per 10,000 living.

f 1848 \1849 ri853

11864

fl865

11866

fl893 \1894

1,908

53,293

4,419

20,097

1,297

14,378

136

nil

•1-1

30-3

2-4 , 10-9

06

6-8

0-06

nil

662

14,137

883

10,738

196

5,596

9

nil

2-9 61-8

3-6 42-8

0-6 18-4

0 002

nil

C H 0 L E E A

51

Prevea- tloa.

In 1894 no deaths from cholera were recorded in England, but on the Continent it still prevailed over a wide area. In Russia over 30,000 persons died of it, in Germany about 500, but the most violent outbreak was in Galicia, where upwards of 8000 deaths were regis- tered. In 1895 it still lingered, chiefly in Russia and Galicia, but with greatly diminished activity. In that year Egypt, Morocco, and Japan were attacked, the last severely. Since then cholera has been in abeyance until the severe epidemic in India in 190O.

The great invasion just described was fruitful in lessons for the prevention of cholera. It proved that the one real and sufficient protection lies in a stand- ing condition of good sanitation backed by an efficient and vigilant sanitary administration. The experience of Great Britain was a remarkable piece of evidence, but that of Berlin was perhaps even more striking, for Berlin lay in the centre of four fires, in direct and frequent communication with Hamburg, Russia, Erance, and Austria, and without the advantage of a sea frontier. Cholera was repeatedly brought into Berlin, but never obtained a footing, and its success- ful repression was accomplished without any irksome interference with traffic or the ordinary business of life. The general success of Great Britain and Germany in keeping cholera in check by ordinary sanitary means completed the conversion of all enlightened nations to the policy laid down so far back as 1865 by Sir John Simon, and advocated by Great Britain at a, series of international congresses — the policy of abandoning quar- antine, which Great Britain did in 1873, and trusting to sanitary measures with medical inspection of

persons arriving from infected places. This principle was formally adopted at the international conference held at Dresden in 1893, at which a convention was signed by the delegates of Germany, Austria, Belgium, France, Great Britain, Italy, Russia, Switzerland, Luxemburg, Montenegro, and the Netherlands. Under this instru- ment the practice is broadly as follows, though the pro- cedure varies a good deal in difEerent countries : — Ships arriving from infected ports are inspected, and if healthy are not detained, but bilge-water and drinking-water are evacuated, and persons landing may be placed under medical supervision without detention ; infected ships are detained only for purposes of disinfection ; persons suffer- ing from cholera are removed to hospital; other persons landing from an infected ship are placed under medical observation, which may mean detention for five days from the last case, or, as in Great Britain, supervision in their own homes, for which purpose they give their names and places of destination before landing. All goods are freed from restrictions, except rags and articles believed to be contaminated by cholera matters. By land, passengers from infected places are similarly inspected at the frontiers and their luggage ” disinfected “—in all cases a pious ceremony of no practical value, involving a short but often vexatious delay; only those found suffering from cholera can be detained. Each nation is pledged to notify the others of the existence within its own borders of a ” foyer ” of cholera, by which is meant a focus or centre of infection. The precise interpretation of the term is left to each Government, and is treated in a rather elastic fash- ion by some, but it is generally understood to imply the oc- currence of non-imported cases in such a manner as to point to the local presence of infection. The question of guarding Europe generally from the danger of diffusion by pilgrims through the Red Sea was settled at another conference held in Paris in 1894. The provisions agreed on included the inspection of pilgrims at ports of departure, detention of infected or suspected persons, and supervision of pilgrim ships and of pilgrims proceeding overland to Mecca.

The substitution of the procedure above described for the old measures of quarantine, and other still more drastic interferences with traffic, presupposes the exist- ence of a sanitary service and fairly good

sanitary condi- tions if cholera is to be effectually prevented. No doubt if sanitation were perfect in any place or country, cholera, along with many other diseases, might there be ignored, but sanitation is not perfect anywhere, and therefore it requires to be supplemented by a system of notification with prompt segregation of the sick and destruction of infective material. These things imply a regular organi- sation, and it is to the public health service of Great Britain that the complete mastery of cholera has mainly been due in recent years, and particularly in 1893. Of sanitary conditions the most important is unquestion- ably the water-supply. So many irrefragable proofs of this fact were given during 1892-93 that it is no longer necessary to refer to the time-honoured case of the Broad Street pump. At Samarkand three regiments were en- camped side by side on a level plain close to a stream of water. The colonel of one regiment took extraordinary precautions, placing a guard over the river, and compel- ling his men to use boiled water even for washing. Not a single case of cholera occurred in that regiment, while the others, in which only ordinary precautions were taken, lost over 100 men. At Ashkabad the cholera had al- most disappeared, when a banquet was given by the governor in honour of the Czar's name-day. Of the guests one-half died within twenty-four hours ; a military band, which was present, lost 40 men out of 50; and one regi- ment lost half its men and 9 officers. Within forty-eight hours 1300 persons died out of a total population of about 13,000. The water-supply came from a small stream, and just before the banquet a heavy rain-storm had occurred, which swept into the stream all surface refuse from an in- fected village higher up and some distance from the bank. But the classical example was Hamburg. The water-sup- ply is obtained from the Elbe, which became infected by some means not ascertained. The drainage from the town also runs into the river, and the movement of the tide was sufficient to carry the sewage matter up above the water- intake. The water itself, which is no cleaner than that of the Thames at London Bridge, underwent no purification whatever before distribution. It passed through a couple of ponds, supposed to act as settling tanks, but owing to the growth of the town and increased demand for water, it was pumped through too rapidly to permit of any sub- sidence. Eels and other fish constantly found their way into the houses, while the mains were lined with vegeta- tion and Crustacea.

The water-pipes of Hamburg had a peculiar and abundant fauna and flora of their own, and the water they delivered was commonly called JFleisch- brilhe, from its resemblance to thick soup. On the other hand, at Altona, which is continuous with Hamburg, the water was filtered through sand. In all other respects the conditions were identical, yet in Altona only 328 persons died, against 8605 in Hamburg. In some streets one side lies in Hamburg, the other in Altona, and cholera stopped at the dividing line, the Hamburg side being full of cases and the Altona side untouched. In the follow- ing year, when Hamburg had the new filtered supply, it enjoyed equal immunity, save for a short period when, as we have said, raw Elbe water accidentally entered the mains.

But water, though the most important condition, is not the only one affecting the incidence of cholera. The ease of Grimsby furnished a striking lesson to the contrary. Here the disease obtained a decided hold, in spite of a pure water-supply, through the fouling of the soil by cesspits and defective drainage. At Havre also its prevalence was due to a similar cause. Further, it was

conclusively proved at Grimsby that cholera can be spread by sewage-fed shell-fish. Several of the local outbreaks in England were traced to the ingestion of oysters obtained from the Grimbsy beds. In short, it may be said that all insanitary conditions favour the prevalence of cholera in some degree. Preventive inoculation with an attenuated virus was introduced by M. Haffkine, and has been extensively used in India, with consider- able appearance of success so far as the statistical evidence goes.

As already remarked, the latest manifestations of cholera show that it has lost none of its former virulence Trextm i. ^^^ fatality. The symptoms, about which nothing need be said, are now regarded as the effects of the toxic action of the poison formed by the micro-organisms upon the tissues and especially upon the nervous system. But this theory has not led to any effective treatment. Drugs in great variety

were tried in the Continental hospitals in 1892, but without any distinct success. The old controversy between the aperient and the astringent treatment reappeared. In Russia the former, which aims at evacuating the poison, was more generally adopted ; in Germany the latter, which tries to conserve strength by stopping the flux, found more favour. Two methods of treatment were invariably found to give great relief, if not to prolong life and promote recovery — the hot bath and the injection of salted water into the veins or the subcutaneous tissue. These two should always be tried in the cold and collapsed stages of cholera.

Cliolera Nostras. — The word nostras, which is good Latin, and used by Cicero, means "belonging to our country." It is applied to the original form of cholera, known from time immemorial, in order to distinguish it from the Asiatic variety, which was unknown until the 19th century. The relations between the two are very obscure. Clinically they may exactly resemble each other, and bacteriology has not been able to draw an absolute line between them. The real difference is epidemiological. Cholera — that is, cholera nostras — was described by Sydenham two centuries ago as sometimes epidemic, but only the Asiatic variety has been known to behave as a destructive pestilence; by cholera nostras is generally meant a disease which may be violent in individual cases, but possesses no epidemic significance.

See Local Government Board Beports, 189S-9S-94-95. — Clemow. The Cholera Epidemic of 1892 in the Bussian Empire. — Wall. "Asiatic Cholera." — Nottee. Epidemiological Society's Transac- tions, vol. xvii. (a. sl.)

Chorley, municipal borough, parish, and market town, England, in the Chorley division of Lancashire, 22 miles K.W. from Manchester by rail. Recent public buildings include St George's church institute and a cottage hospital and public dispensary. There is a public free library. Cotton-spinning and the manufacture of cotton and muslin are extensively carried on, and there are also iron and brass foundries and boiler factories. Area of municipal borough, 3614 acres. Population

(1881), 19,478; (1891), 23,087; (1901), 26,850.

Chdrum, ancient Euchaita, altitude 2300 feet, a town of Asia Minor, in the Yuzgat sanjak of the Angora viMyet, situated at the edge of a wide plain. Euchaita was attacked by the Huns a.d. 508, and became a centre of religious enthusiasm. Population, 12,600, including a few Christians.

Chota (or Chutia) Nagpur, a division of British India in Bengal, consisting of five British districts and nine tributary states. It is a hilly, foresi>clad plateau, inhab- ited mostly by aboriginal races, between the basins of the Sone, the Ganges, and the Mahanadi. The five British

districts are Hazaribagh, Lohardaga, Palamau, Manbhum, and Singhbhum. The total area is 26,966 square miles, and in 1891 the population was 4,628,792, giving an average density of 172 persons per square mile, compared with 471 for Bengal generally. Christian missions have been specially active in this tract. In 1891 the number of native converts was 88,897, mostly in Lohardaga, being more than half the total for all Bengal. In 1896-97 five missions maintained 203 schools, attended by 5063 boys and 1208 girls. The nine tributary states of Chota Nagpur are Sirguja, Gangpur, Udaipur, Jashpur, Bonai, Korea, Changbhakar, Kharsawan, and Seraikella. The two last are tiny areas within the British district of Singhbhum, on the line of the Bengal-Nagpur railway. The others stretch over a large tract of hills separating Bengal from the Central Provinces. The total area comprises 16,054 square miles. The population in 1891 was 883,359, giving an average density of 55 persons per square mile, ranging from 238 in Kharsawan to 20 in Changbhakar. In 1901 the total population was 982,439, showing an increase of 11 per cent. The total gross revenue of the chiefs is Estimated at Rs.2,40,000; the number of schools is 79, with 1626 pupils. The Bengal-Nagpur railway touches on Udaipur, and runs through a considerable part of Gangpur. In this last state there were serious disturbances in 1896, but the administration is improving under closer British supervision.

Christadelphians (X/dio-toC aSeXc^oi), a com- munity founded by John Thomas (1848), who studied medicine in London and then migrated to America. There he at first joined the ” Campbellites,” but afterwards struck out independently, preaching largely upon the

application of Hebrew prophecy and of the language of the Apocalypse to current and future political events. In America and in Great Britain he gathered a number of adherents, and formed a com- munity which is said to have extended to most English- speaking countries. It consists of exclusive ” Ecclesias,” with neither ministry nor organization. The members meet on Sundays to ” break bread ” and discuss the Bible. Their theology is strongly millenarian, centring in the hope of a world-wide theocracy, with its seat at Jerusa- lem. They believe that they alone have the true exegesis of Scripture, and that the “faith of Christendom” is ” compounded of the fables predicted by Paul.” No sta- tistics are published.

See BoBEKTs. Dr. Thomas : His Life and Work, and A Decla- ration of the Truth, &o. Birmingham.

Christchurch, town in Selwyn county. New Zealand, next to Dunedin the most populous town in South Island. Its manufactures are of importance, though its position is still due mainly to the large agricultural district round it. Its cathedral church, museum, public library, public gardens, agricultural show-ground, and chief cricket-grounds are the best of their kind in the colony. Three hundred students attend lectures at Canterbury College. Steam tramways connect the town with the sea-side, and though flat, it is well drained and healthy. Its fine public park has been well planted and improved. Its suburbs are noted for the number and taste of their private gardens. Mean temperature for the year, 52°; average yearly rainfall, 26 inches. Population (1901), 17,537; including suburbs,

57,041.

■),

Christian IX., King of Denmark (1818- fourth sou of Duke Wilhelm of Schleswig-Holstein-Sond- erburg Gliicksburg, was born 8th April 1818,and succeeded to the throne on the death of King Frederick VII., 15th November 1863, in accordance with the provisions of the

CHRISTIAN CHURCH, THE

Treaty of London of 8th May 1852, and the Danish law of succession of 31st July 1863. On 26th August 1842 he married Louise, daughter of Landgrave Wilhelm of Hesse-Cassel. In 1846, when the whole house of Schles- wig-Holstein signed the famous ” Protest,” Christian held back, and he was the only prince of that house who remained in the military service of Denmark from 1848-50. He was therefore clearly indicated as the proper person to fill the vacant place of heir to the Danish throne, to which he had a claim in right of his wife, the cousin and heiress of Frederick VII., and he was so recognized by the Treaty of Warsaw of 5th January 1851. Upon coming to the throne his first act was to ratify the Eider Danish constitution, by which the Duchy of Schleswig was incorporated with Denmark. This led to a war with Prussia and Austria, which ended with the Peace of Vienna, 30th October 1864, Christian ceding Schleswig-Holstein and Lauenburg to Germany. The king’s pronounced conservatism has led to serious collision

in the Danish Parliament, which from 1873-95 regularly refused to vote the budgets presented by his Majesty’s ministers. On 29th September 1898 the king lost his consort Louise, who died at the age of eighty-one. Their numerous children made brilliant marriages : (1) Frederick, born 3rd June 1843; married, 26th April 1898, to Princess Alexandra of Mecklenburg; (2) Alexandra, born 1st Decem- ber 1844 ; married, 10th March 1863, to the Prince of Wales, now King Edward VII. ; (3) Wilhelm, born 24th December 1845, elected King of the Hellenes, under the title of Georgios, by the Greek National Assembly, 31st March 1863; married, 27th October 1867, to Olga Constantinowna, grand duchess of Russia; (4) Marie Dagmar, born 26th November 1847 ; married, 9th November 1866, to Alexander III., ,Czar of Russia ; (5) Thyra, born 29tli September 1863 ; married, 21st December 1878, to Prince Ernest Augustus, duke of Cumberland ; (6) Waldemar, born 27th October 1858; married, 22nd October 1885, to Princess Marie d’Orl^ans.

CHRISTIA]^ CHURCH, THE.

THE present article does not deal with the state, con- dition, or progress of any particular or national church. The recent history of various Christian communions will be found under their special and appropriate titles ; but, in addition to those articles which treat of the present position and prospects of particular churches, it has been thought well to devote some space to a wider purpose^ and to endeavour to measure the progress of what may for convenience' sake be called the Christian Church at large. The object, therefore, of this article is to deal with the advance of the Church of Christ generally; it aims at putting before its readers the present position of Christen- dom in relation to the moving forces and influences of the world ; in brief, it is an attempt to answer the question. How far has the Christian idea advanced among men ? Naturally and necessarily the question suggests a wide range of inquiry, and, to be fully answered, would require a treatise rather than a brief article; but while it will be need- ful, from time to time, to take a backward glance at other and earlier ages, we shall, as far as is possible, restrict our- selves to the movements of recent years, and the period which we wish to keep specially in mind will be the last generation. Roughly speaking, our sketch will be mainly occupied with the period covered by the latter half of the 19th century. We shall endeavour to measure the progress of Christianity in various ways, by reference to statistical facts, to influences in matters not reducible to statistics, and, lastly, by reference to certain changes in the direction of Christian energy and methods observable in recent years.

I. The Measurement of the Progkbss of Christianity AS expressed by Statistics. Statistics are proverbially misleading; but while we may well use them with caution, and exercise careful self- restraint in making hasty inferences from them, they are valuable within their measure and scope. The individual items must not be unduly pressed ; we must even bear in mind that the apparent significance of their details may be readily misunderstood ; but they furnish the basis of judging the general direction of a given movement ; they enable us to discriminate between the inrush of the wave and the incoming of the tide. Thus we n ote in the history of Christianity certain periods of reaction; the rapid progress in one age is checked in another. There were times when the very life of Christianity seemed to be threatened ; there are places

where flourishing Christian churches existed, and from which they have vanished. To

take an example of a period of reaction, it seems well established that towards the close of the 2nd century the Christian population in the Roman empire declined. Persecution diminished the numbers of the Church. In the 18th century Voltaire felt justified in predicting that Christianity was about to disappear from among men. He spoke more from his wishes than his judgment, perhaps; but he was too shrewd an observer of his times to have com- mitted himself to prophecy without some real or apparent justification. He saw that to a large extent the intellectual classes of his countrymen had been alienated or seduced from their faith. He did not perceive the religious forces which were even then at work preparing for the rejuvenar tion of Christian energy. As there have been epochs of arrested progress in Christian history, so there have been places where Christianity has made progress, but where the promise of eairlier successes has not been sustained. Readers of Christian history have asked. What became of the half- million converts in South India who owed their faith to Xavier, or of the 300,000 in Ceylon who were the fruits of Dutch missionary effort ? Still more, readers will recall the story of Christianity in North Africa, and the vigorous churches in Carthage, Alexandria, and Hippo. Few facts mark more eloquently the temporary ebb of Christian influence than the decay of the churches which were once the churches of Cyprian, Augustine, and Origen.

Christianity — it is well to realize the fact — has been subject to certain human influences, or, to speak more correctly, the Christian Church numbered among its adherents multitudes who were swayed by the ordinary emotions and passions of mankind, and were open to the influences of fear or gain. There were favourable as well as unfavourable times. This was frankly recognized by the earliest Christian historian, when he noted the fact that when persecution ceased the Church was multiplied (Acts ix. 31). There were, in fact, periods which tested the stability of men's faith, and which enabled men to distinguish between the transitory wave, whose size and bulk was due to some favourable wind, and the rising tide, which owed its

strength to more heavenly influence. The table which we present below reflects these fluctuating conditions, but, on the whole, witnesses to a steady and continuous advance.

(i.) The proportion of the Christian population to the population of the world is the subject of our first statistical inquiry. Gibbon estimated that on the most favourable estimate the Christian population of the empire before

the days of Constantine was one-twentieth of the whole {Hist, Milman's edit., 1846, vol. i. p. 620). Bishop Lightfoot so far agreed with Gibbon that he regarded {Historical Essays, pp. 79, 80) the estimate as too favour- able, but he accepted it as a sufficiently just one for purposes of comparison. He reckoned that the empire of Rome ruled over from one-seventh to one-tenth of the then population of the world ; thus the Christian popula- tion in the close of the 3rd century could only claim at the most one-twentieth of one-seventh of the human race^ — i.e., only one in every 140. Bishop Lightfoot, in conclusion, adopted ytw as the proportion of Christians to the world population at that time. He claimed that the proportion in the present day was one in five. But there is reason to think that this is below the true pro- portion. The Christian Church to-day can, it is believed, claim one-third of the population of the world.

The following tables can only be accepted as rough and approximate estimates. We have very few data for de- termining either the population of the world or the Christian population from century to century, but on the whole the proportions set out here are probably suffi- ciently near the fact for general purposes of comparison.

The accompanying table exhibits at a glance the general progress of Christianity: —

A.D.

World Population.

Christian Popnlatton

5,000,000

100

200

2,000,000

300

...

5,000,000

400

...

10,000,000

800

...

30,000,000

900

...

40,000,000

1000

...

50,000,000

1500

...

100,000,000

1600

125,000,000

1700

155,000,000

1800

1,000,000,000

200,000,000

1875

1,396,842,000

394,000,00a

1880

...

410,000,000

1890

493,000,000

1896

1,500,000,000

500,000,000

The diminution between a.d. 100 and a.d. 200 is accounted for by persecution ; the rapid increase between A.D. 300 and a.Di 400 to the patronage of the Emperor Constantine. The Christian reader will note, however, with satisfaction that the increase within the last hun- dred years has been more rapid than in any similar period, and that the ratio of increase has been augmented since 1880. The Protestant reader will observe that the in- crease within the last three or four hundred years has been more rapid than in the period preceding the Reformation.

The increase in the 19th century is represented by the following figures. The percentage of the Christian popu- lation to the world population, which was 20 in 1800, was 28‘5 in 1875 and was 33-3 in 1896; and whereas the average yearly increment between 1800 and 1875 was something over 2,600,000, it was over 6,000,000 be- tween 1876 and 1896; or, to put the result in quarter- century periods, whereas the average gain for each of the first three quarters of the 19th century was 66,000,000, the average gain of the last quarter of the century was 106,000,000. It is worthy of note that this coincides with the period during which intercession for missions became a recognized duty on the part of the Church. Dr Dorchester speaking of the United States, says in his Problems of Religious Progress that whereas in the be- ginning of

the century the proportion of communicants to the population was one in fourteen or fifteen, in 1890 it was one in four or five ; or, in other words, while the population had grown 11-8-fold, the communicants had increased 38-fol^

Thus it would seem that simultaneously with the deep- ening of the religious spirit in. the Christian churches

there has been rapid progress in the spread of Christianity. We can only indicate this advance by the general figures we have cited ; but it may serve to illustrate the general character of the progress in non-Christian lands if we set down here the figures which relate to India. The number of Christians in India between 1841-61 was estimated at 91,000; between 1861-61 at 138,000; and between 1861- 71 at 224,000; between 1871-81 at 897,216; and between 1881-91 at 2,284,380. These figures represent a growth of 50 per cent, for each decade. Beside this we may place two very remarkable results of the missionary work in West Africa. In Sierra Leone, where missionary work can scarcely be said to have commenced till 1815, there is now a self-supporting, self-governing, self-extending church, and seven out of eight of the inhabitants are Christian.

(ii.) The measure of Christian progress may also be given by statistics indicating world influenceat ascendancy.

(a) More remarkable than the growth in the number of adherents is the increase of the influence and power of the Christian nations. Thus it has been reckoned that three hundred years ago 3,480,900 square ,^j^j^ miles of the world's surface were under the government of the Christian nations, and 46,619,100 square miles were under the government of non-Christian peo- ples— Le.f one mile out of every thirteen was under Christian governing influence. Now, however, the figures are altered : the number of square miles under Christian government is 40,317,200, that under non-Christian influ- ence is 8,782,300-—i.e., the Christian nations rule between four and five square miles for every one governed by non-Christian peoples, or 82 per cent, of the governed area of the world.

(6) The supremacy of Christian governing power is shown in the statistics of the populations now dependent upon the Christian nations. In 1500 only 100,000,000 of people were under Christian rule, now there are

900,000,000.

(c) It may be interesting to note the relative ascendancy of the different forms of Christianity in this world-influ- ence. For convenience' sake we may take the three broad divisions, viz. : the Greek, the Roman Catholic, and the Protestant nations respectively. The area of the world ruled by Christian and non-Christian people is between 49,000,000 and 50,000,000 square miles. Of these the rule is distributed as follows: — ^Non-Christian nations, 8,782,000 ; Greek (Christian), 8,762,000 ; Roman Catholic (Christian),14,147,000; Protestant (Christian), 17,417,000; or in percentages, non-Christian, 18 per cent. ; Greek, 18 per cent. ; Roman Catholic, 28 per cent. ; Protestant, 36 per cent. If we examine the populations under these governments respectively, we have the following results : — Under Christian rule, 890,000,000 ; distributed as fol- lows: under Greek, 128,000,000 ; under Roman Catholic, 242,000,000 ; iinder Protestant, 620,000,000. The result may be exhibited by the following table, which compares the populations under these governments in 1700 and in 1900 respectively : —

Date.

Greek.

Eoman Catholic.

Protestant.

Total.

1700 1900

33,000,000 128,000,000

90,000,000 242,000,000

32,000,000 520,000,000

155,000,000 890,000,000

(d) Alongside these figures we may place another fact. There has been a marked change in the diffusion of Eiiropean languages during the last 100 years, and it will be readily seen that the diffusion of language is, if not a diffusion of influence, yet a measure of its diffusion. In 1800 French was spoken by 31,000,000 of people ; German and Russian tongue each by 30,000,000 ; the Spanish by 26,000,000; and English by 20,000,000. In 1890 the figures stood thus: French, 51,000,000; German and

Euasian, each 75,000,000; Spanish, 42,000,000; and English, 111,000,000. In other words, English, which was the least influential of European languages, now holds the leading place, while Erench has fallen from the first to the fourth place ; or, to put this fact into percentages, the increase of the diffusion of these languages has been in ninety years as follows : —

French. G«rman1 Russiaoi j Spanish English

64 ‘5 per cent.

150

61-5 „

450

It will be seen that the increase of the Teutonic races is far in excess of that of the Latin races ; and when we keep in mind the greater birth-rate in the Teutonic races,* we can realize that, unless some great and

unexpected change takes place, the future influence of the Christian nations will be increasingly in the hand of the Teutonic or Protestant division of Christendom.

(e) The importance and significance of the ascendancy of Christian nations will be best realized by placing side by side the population and area of a selected number of the Christian nations and the native or colonial popula- tions and areas now under their rule. We draw our sta- tistics from an interesting monograph carefully brought up to date by Lieut-Colonel V. Murari Br^, instructor in geography in the Seuola di Guerra in Italy.

Mother Country.

Bependencies.

Area.

Population.

Area.

Population.

1 Great Britain Germany Holland Denmark United States France. Italy . Spain . Russia .

314,950

640,658

33,000

38,830

9,450,000

‘ 536,408

286,648

497,244

22,430,000

41,220,000

56,000,000

5,200,000

2,175,000

78,500,000

38,800,000

32,000,000

18,100,000

135,000,000

27,861,000

2,605,100

2,045,700

194,560

443,060

8,812,710

477,300

709,450

310,000

348,496,000

9,230,000

35,500,000

130,000

9,636,000

50,340,000

600,000

340,000

3,000,000

34,127,738

406,995,000

43,458,900

457,272,000

If we group the nations according to kinship, arranging them under the classes of Teutonic, Latin, and Slav races respectively, we get the following results : —

Mother Countries.

Dependencies.

Area.

Population.

Area.

Population.

Teutonic 1°™?-“!

Latin .... Slav ....

927,438

1,820,800 22,480,000

104,595,000

88,900,000 185,000,000

82,706,380

9,999,460 810,000

893,356,000

61,280,000 8,000,000

Thus the governing power of the Teutonic, Latin, and Slav races in Europe may be represented by the following figures : — For every square kilometre or square mile of mother country, the Teutonic races govern 35, the Latin races govern 7 5, and the Slav 00-13 square miles; and for every inhabitant in the mother country there are in the dependencies of the Teutonic nations 3-7 inhabitants, in the Latin -057, and in the Slav 002. It is no flight of rhetoric to say that almost two-thirds of the world’s population and four-fifths of its area are now under the government of Christian nations, and by far the largest share of this has fallen into the guardianship of the Teutonic nations, who govern not far short of 600,000,000 of people, or more than two-thirds of the whole popula-

1 The birth-rate of all European countries declined between 1875 and 1900 but the statement in the text Is still substantially true, inasmuch as

the birth-rate in Germany is still greatly m excess of the birth-rate in the Latin kingdoms. The decline m the birth-rate in Great Britain is serious, but it is nothing like the dechne m France ; though all English-speaking people should earnestly consider the population question as it affects their own race.

tion now under Christian rule. So far then as political and administrative influence is concerned, the ascendancy of the Christian nations is beyond all doubt.

In this influence wealth counts as an important factor, and the accumulations of that class of power which be- longs to what is called wealth are chiefly in the hands of Christian lands They make the ^° °^J^ markets of the world ; they direct by far the largest portion of its commerce. And when wealth is measured as so much per head of the population, the non- Christian peoples scarcely enter into the calculation of the political economists. It is no doubt true that in countries not yet commercially organized there are no materials on which to base a calculation, but it is also true that in a sense it is only when the means of produc- tion are organized that wealth in any economic sense may be said to exist ; and it is in the Christian countries that these means of power are practically concentrated. The wealth per head of the Christian nations varies from £60 in Eussia to £302 in England; France stands here at the head of the Latin nations with £253 per head, as England does at the head of the Teutonic na- tions. The average wealth of the Teutonic nations is £226 per head, that of the Latin £140, and that of the Slav about £6.

(iii.) As a statistical measure of Christian energy, it will be convenient to notice some phases of Christian activity which have marked recent years.

(a) There has been a very marked development of missionary enterprise (see Missions). It is diflScult to present a statistical estimate of the force of this development. It will be best to point out a few salient facts. We shall first confine ourselves to that which is popularly called missionary work, viz.. Christian labours carried on among heathen or non- Christian peoples. The number of separate societies for that

purpose has largely increased during the last century. It has been estimated that in 1790 there were in Great Britain only two societies which con- templated missionary work as within the scope of their operations, viz., the Society for the Promotion of Christian Knowledge and the Society for the Propagation of the Gospel. Neither of these societies, however, directed its work solely towards the heathen world : the former aimed at circulating Christian literature in all quarters ; the latter paid, and rightly paid, special atten- tion to the needs of Britons in the colonies and in foreign parts. A century has seen the establishment of numerous societies for direct and exclusive missionary work. It has been estimated that the number of mis- sionary societies is little short of 300 ; some of these are small and comparatively poor, but others are large and important organizations, resembliag great State depart- ments, commanding and distributing large revenues, and entailing upon their committees of management wide and varied responsibility and an almost statesmanlike judg- ment in the handling of difficult and delicate problems.

(&■) There are in Great Britain alone twenty -nine foreign missionary societies. Four or five of these administer each an income of over £100,000 a year. They occupy nearly 10,000 stations and sub-stations; they employ 2739 European missionaries, upwards of 1800 women workers, and more than 27,000 native helpers. In the article on Missions a full survey of the condition and prospects of various missionary societies is given. Here it may be enough to notice that the United States missionary societies employ about half the number of male missionaries sent out by Great Britain, while their women missionaries nearly equal the British, being over 1700; their native agents are about 13,000; and the estimated missionary contributions (Protestant) of the

English-speaking world amount to nearly £3,000,000 annually.

(c) In this connexion may be instanced the diffusion of the Bible in the world. The British and Foreign Bible Society was founded in 1804 ; the American Bible Society twelve years later ; in 1891 these two societies were but two out of 80 Bible societies in the world. In 1800 the translations of the Bible were 47 in number; there are now 90 complete and 230 partial versions, making a total of 320 translations more or less complete.

(d) Evidence of the continuous growth of aggressive Christian energy may be found in the rapid increase of missionary bishoprics which has taken place of recent years. In the first half of the 19th century 23 new bishoprics were founded; in the latter half there were 69 ; the rate of increase was trebled in the second period. The same feature is shown in the Protestant Episcopal Church of America. During the 19th century it has added 73 new bishoprics, and 62 of these belong to the latter half of it. The two churches added to their organization 165 new sees in the same century, and no fewer than 73 of these have come into existence since 1870.

(e) But apart from figures, the whole position of Chris- tian business has undergone a change in public estimation. Missionary meetings used to be dull, and missionary literature flat and insipid. Now all this is changed. Meetings are large and enthusiastic, and missionary literature displays a culture and breadth of treatment unknown to our fathers. The journals or magazines issued by societies treat of every land from Greenland to Patagonia, from Japan to the Southern Islands, and they set forth with intelligence and learning questions of geography, philology, sociology, art and science, native manners and customs, in addition to, or in illustration of, direct missionary information. The popular sympathy which so often waits on popular knowledge has been further enlisted by what are known as missionary loan exhibitions. In these vivid illus- trations of native life and missionary work are given by means of costumes, curiosities, and models. To such an exhibition in Birmingham there were as many as 100,000 visitors ; and everywhere similar exhibitions have been crowded.

As a witness to the changed popular feeling towards missionary enterprise, perhaps nothing can be more striking than the fact that there are now in England and America public monuments commemorating the zeal and devotion of the missionaiy. In Washington Square in New York there is a church which is a memo- rial to Judson the missionary ; in Westminster Abbey there is a monument to David Livingstone, who lies in the ancient national shrine where the greatest of English- men are buxied.

II. The Measure of Chkistian Progress in Matters

NOT B.BDUCIBLE TO STATISTICS.

(i.) The Alleged Decline of Christian Influence. — In estimating the present position and prospects of the Christian religion, it is necessary to refer to matters which are regarded by its friends and foes as tokens of its declining influence.

Eirst, it is said that there are signs that Christianity has lost, or is losing, its moral influence. Ordinances and institutions which owe their sanctity to Christian influence are no longer socially observed. The Sunday, for instance, is being slowly transformed into a day of pleasure. Still more significant, it is alleged, is the lowering of moral standards : that which was once re- garded as harmful is now treated as legitimate ; the increase of luxury has led many to treat indulgencies as though they were necessaries ; the wish to live according

to a liberal. scale, and after an easeful fashion, has stimu^ lated a passionate eagerness for wealth, and the determi- nation to have it has led to a disregard of the code of honour, while the possession of the good things of life, as they are called, has produced enervation of character; restlessness, born of ease, has destroyed steadiness of habit; and impatience of toil has driven men to seek riches in doubtful rather than in diligent methods. In these ways, it is said, the claims of the Christian life are subordinated to the interests of the moment.

Against this must be set the fact that the apprehensions which here find expression have been common in all ages ; they cannot be accepted as

evidence of the declining influence of Christianity without some more tangible evidence. Earnestness, ambitious of greater Christian consistency, is always alive to contemporary evils. ” The Lord’s day is become the devil’s market day ” was the complaint of a bishop in 1724. Immorality at the same time was considered to be so rampant that men said, “Our light looks like the evening of the world.” It is thus that men who measure public manners by the measure of their philanthropic desires will ever speak. But for the purpose of the scientific historian, contemporary morals must be measured by a comparison of facts and statistics, and not by the despondency of the good. When, therefore, we find a steady diminution in pauperism and crime, and a marked increase of longevity owing to a more careful regard for human life and its conditions of health and happiness, we shall see that the advance of moral improvement is steady and sure, even if not rapid enough to satisfy the desires of the good. The most wholesome sign, under these circumstances, is the dissatisfaction of the good, for it is the witness that the spirit of earnestness and devotion is still a powerful factor in social life. When we quit the warm realms of zeal and enter the cold sphere of statistics, we find that the progress of moral standards advances with slow but decisive foot. The percentage of crime is strikingly lower ; the paupers are proportionately fewer ; greater care for the condition of the poor indicates a more tender public conscience. Social ambitions among us are becoming more unselfish. The general moral sense is higher. Intemperance is now a disgrace; slavery is illegal, and would be impossible to any enlightened Chris- tian society. The ethical principles of Christianity have been planted deep among our social ideas, and have revo- lutionized manners. In our judgment, whatever undesir- able features remain as blemishes on our civilization, the standards of moral life are gradually improving, and this improvement is largely due to the prevailing force of Christian ethics.

Secondly, it is said that everywhere men are increasingly reluctant to identify themselves with the Christian religion. Many discard the outward forms of Christian worship; attendance at worship is declining ; and, perhaps most startling of all, the number of those who join the ranks of the Christian ministry is steadily diminishing among all Christian denominations. This last fact is the one which Christian

churches should face: a searching inquiry into the causes for the decline of candidates for the ministry of the Church would be of the greatest interest. Till such inquiry has been made we can only speculate upon causes. Among these the following have been suggested : — (a) The unsettled condition of theo- logical opinion, due to the progress of historical criticism. TMs is probably one cause, and it has given rise to the question how far the Christian churches should relax the terms of subscription required by their ministers. There can be no doubt that many of the dogmas to which sub- scription is required are, if not obsolete, yet expressed in terms which are at least incongruous with modern ideas.

On the other hand, the results of recent criticism are at present felt to be less destructive than the criticism of t-wo generations ago. (6) The Christian ministry is a severer test of religious earnestness to-day than it was in the days of our fathers. The increase of luxury has set the scale of living higher. To maintain the position of a simple gentleman is more costly than it ~~was. The re~~ muneration of the Christian minister has not kept pace virith the growing expenses of life, but the demands upon his time and resources have increased, (c) There is a widespread feeling that there are other ways open to Christian zeal besides those of the stated ministry, and the number of those who devote their lives in independent fashion to works of Christian benevolence has greatly increased of late years.

On the whole, the argument that Christianity has lost, or is losing, influence ends probably in the conclusion that certain formal aspects of Christianity have less hold upon men than formerly, but the increase of the influence of the Christian spirit is great and growing. Whether the present tendencies will end in a fatal relaxation of Christian ordinances, or in a better-proportioned estimate of their value; whether the decline of attachment to certain formal aspects of Christianity will lead to a renunciation of some of its essential principles, or will bring about a federation or union of Christian churches, are questions of

deep interest, but are outside the scope of the present inquiry. It is enough for us to indicate our belief that, however much there may be to deplore in modern life, there is no real ground for believing that the social and ethical influence of Christianity has declined or is declining in the world.

(ii.) Christianity and Moral?. — Chiefest among those signs of progress is the influence of Christian ideas upon the principles, whether of law or custom, which now govern the world. It will no doubt always be a matter of controversy how much of the humane principles now accepted among civilized nations is due to education, ex- perience, and evolution, and how much to direct Christia,n influence. Results are complex, and we must seek their ancestry in more than one line, but no reasonable person who reads the story of modern civilization can doubt that the slow acceptance of the principles taught by Christ has powerfully affected its development. "The great characteristic of Christianity," says Mr Lecky, " and the proof of its divinity, is that it has been the main source of the moral development of Europe." Only by degrees, indeed, have the principles of Christianity been accepted or, indeed, understood.

For example, take the matter of slavery. The habit of enslaving prisoners of war received its first check when the sense of Christian brotherhood created a strong feeling among Christian peoples against the enslavement of their fellow-Christians when taken prisoners. The Crusades, when Christian nations fought side by side against a pagan foe, no dojibt served to strengthen this feeling of repugnance against such enslavement. By degrees, how- ever, the sense of brotherhood extended ; the family of Christ were not only those who called themselves by His name, but all those who were sharers of His redemption. To enslave a brother meant to enslave any man, for every man was a brother for whom Christ died. Thus the anti- slavery movement arose out of a better appreciation of the spirit of Christ; and Christian men were all along the inspiration of the movement. This example may serve as a type of many other humane movements which have imposed a sort of unwritten law upon the conscience

of civilized nations. – . ^ i. ■

What is called international law, for instance, has in one sense no real existence. Nations have not yet ac- cepted any definite written code of laws by which they

are content to abide ; but the broad and popular maxims, which expressed the Christianized feeling of mankind, became the basis of various erudite and influential works which may, broadly speaking, be called treatises on inter- national law. Grotius, for example, definitely proclaimed that his book De Jure, &c., was an endeavour to present in orderly and codified form the customs and maxims which had grown out of the appreciation of Christian principles.

It has often been stated, and arguments have been founded on the statement, that Christianity laid down no rules respecting some of the great evils of the world — such as the status of women, slavery, and war. This is true, for Christianity is not a religion of rules, but a religion of principles ; it is the introduction into human life of a new spirit, and that spirit is love. The improve- ments in the condition of the world, the spreading abroad of humaner principles of conduct, including humaner methods of war, are little more than the apprehension of the principles laid down by Christ and expressed by the apostolic declaration — ” Love worketh no ill to his neigh- bour.” The width of the application of the principle was made plain by Christ when He answered the question, “Who is my neighbour?” by the parable of the good Samaritan. The indications of the recognition of these principles mark stages in the history of civilization. Alcuin noted the influence of Christian principles in the treatment of slaves. Under the sceptre of Charlemagne an abhorrence of needless bloodshed gained hold upon the public mind, while in more modern times the Eed Cross Society and the Geneva Convention have assuaged the horrors of the battlefield. The substitution of arbitration for war belongs to the future, but great progress has been made in the direction of peaceful solutions of interna- tional diflculties. The subject enlists Christian and humane sympathy in an increasing degree. The confer- ence of bishops of the Anglican Church in 1897 directed attention to it, and issued a

report which showed how largely both the idea and practice of arbitration had' become familiar to the civilized world.

The changed conditions of modern life present, no doubt, new problems and new difiBculties. There are some who despair of the application of Christian prin- ciples to the political and social questions which confront our times ; but such persons overlook both the progress which has already been made, and also the fact that many of the problems which confront us to-day — e.g., the in- dustrial problems — are problems of recent growth, which owe their existence to the rapid commercial and political changes of the 19th century. Meanwhile the remarkable widening of the direction of Christian energy, of which we shall speak later on, shows that Christian public opinion is not likely to rest satisfied with a half-hearted application of the teaching of Christ, and that, whether idtimately successful or not, there is not a department of public life, nor a phase of human need or suffering, which the Christian conscience will allow to remain outside the reach of the Christian spirit.

The widened sweep of Christian energy is evidenced in the expanded conception of missionary effort. Missionary societies have almost universally enlarged the sphere of their work — the elevation of woman, ministry to the sick, the amelioration of social conditions enter into the aim of the missionary. Time and space forbid our dis- cussing these at length, but two or three examples will make clear how closely allied the introduction of gentler or humaner customs are with the preaching of Christianity. The Christian missionary has been in- fluential in bringing about the mitigation, if not the cessation, of cruel popular customs like suttee and infanticide.

(a) Suttee.— Among the changes for the better which the 19th century witnessed was the abolition of suttee or sati, i.e., the self-destruction of

the widow on the grave or funeral pyre of her husband. This was viewed in India as a virtuous or good act ; hence its name, Sati, from a root signifying good or pure. The good or loyal wife was expected to follow her husband beyond the grave, to minister to him in the unseen. The custom prevailed almost universally in India in the ~~beginning of the 19th century. In 1817 on an average two widows were burned daily in Bengal alone. In 1829 Lord William Bentinck declared the practice criminal. The English Government, in spite of many petitions declaring the religious character of the custom, sup~~ ported Lord William Bentinck. The Christian Church led the way in this great reform. The agitation against the custom was begun by Carey, the missionary, in 1801. The extent of the benefit of the change may be judged when it is remembered that there are (1895) upwards of 22 millions of widows in India, all of whom would have been doomed by this cruel custom to a premature death, and more than 70,000 of these mere children under ten years of age.

(/3) Infanticide. — This was, and still is, largely prevalent in China, but Christian influence has reduced the practice, and Christian philanthropy, by providing orphanages, has rescued numbers of children from an early death. One missionary tells us that at Amoy there was a pond in the town known as the babies' pond ; into it babies were flung by their mothers, the little bodies were seen floating in the water, and the inhabitants looked on with indifference. Christian teaching rendered the practice less popular ; the pond is now dried up, while foundling institutions provide for some 2000 children in the district. This is one illus- tration among many. Infanticide is practised in India. In the judgment of one writer, at the lowest estimate fully one-third of the girls born among the natives are still secretly murdered (Houghton, Women of the Orient, p. 71 ; Dennis, vol. i. p. 133). In Formosa and in the Pacific Islands the same custom prevails ; in the latter not less than two-thirds of the children were put to death. Against this cruel custom the missionary exercises a restraining influence. Our churches, said an agent, are practically anti-infanticide societies.

(7) General Beneficence. — But Christian energy has not confined its influence to the mitigation of great evUs. It has become the minister of active benevolence. Orphanages and asylums spring up in missionary stations as well as hospitals and dispens- aries, and on the stafi of missionary societies are now found a certain proportion of medical missionaries. These are, if we mistake not, the product of the 19th century. It is safe to say that not a single medical missionary existed in any part of the heathen world a century ago ; now there are no fewer than 217 in China alone. Evidence of the widespread humanizing influence of such agencies may be gathered from the fact that in a single year in the province of Shantung 200,000 cases were treated {Methodist New Connexion Missionary Report, 1900, p. 34). Much prejudice existed at first in the minds of Christian people. The undertaking of medical work appeared to them likely to interfere with the more distinctively religious aims of the missionary, but this feeling has almost entirely disappeared ; and since Dr S. F. Green, a young American Presbyterian, went out (1847) to Ceylon, the value of the medical missionary has been recognized, and there are few missionary societies who have not some fully quali- fied doctors upon their staff. To take an example, the Church Missionary Society employs more than 50 medical missionaries, and the number of patients treated in one year (1900) was — of in-patients, 11,557 ; and of out-patients, 641,006.

(iii.) The Happier Relations between Scientific and Beligious Thought. — There has been a marked change in the general feeling of the Church towards what is loosely- called Science. Broadly speaking, we may say that the attitude of irreconcilable hostility on the part of the Church has almost entirely disappeared. The intelligent part of the Church has now consented to give to science the things which are science's. It is recognized that there is no part of the world of phenomena on which science has not a right to speak and to be heard. We must, however, remember that this is only a rough general estimate, and represents rather the existence of an altered feeling than an exact measurement of results. The improved feeling, it must be allowed, is due both to the larger and more scientific spirit which has pervaded Christendom, and also to the more reverent spirit which has

characterized scientific inquiry. The contemptuous spirit of arrogant unbelief has passed away from scientific circles ; the

widening range of knowledge has left room for wonders which a narrower age of science would have scorned ; there is scope for the play of activities undreamed of half a cen- tury ago. Amongthebest circles of scientific and Christian thought the dogmatic temper has given place to the spirit of the historical investigator. The statement must not be taken too widely. The dogmatic temper is still upper- most in some questions of the Church. The infallibility which is so dear to the religionist has fostered this dog- matic temper, and alike among the unenlightened advisers of the Vatican and in the circles of evangelical ignorance the voice of knowledge is refused and its messengers are cast out.

On the whole, however, everywhere except in such strongholds of idolized ignorance a calmer and more equable spirit possesses Christendom. It is recognized that the so-called conflict between science and religion never truly existed ; the conflict was seen to be a battle between certain theological opinions and some conclusions of science. It was seen that in some cases the conclusions of science had been misunderstood, and in more cases the theological opinions were in no way parts of essential Christianity, but were rather doubtful inferences, stated in forms incidental to a particular epoch. The wide admix- ture of error with truth, the facility with which mistaken deductions were accepted as of equal authority with pri- mary principles, and the diverse measures applied to lan- guage by scientific and theological thinkers were recog- nized; and with this recognition the most potent factors of dispute disappeared and a happier epoch alike for science and theology was inaugurated. As marks of the changes we have spoken of we may notice the totally different way in which essays in Imx Mundi were received from the way in which Essays and Reviews were met by an earlier generation, and the significant difference between the titles of two books — one published in 1860 and the other in 1889 — both dealing with the relations of science and Christianity. Mr Draper called his book the Conflict between Science and Religion. Dr Andrew White called his far abler and more judicious work, The Conflict of Science and Theology. One reason for the happier spirit

which now prevails probably lies in the conviction that the battle for intellectual freedom has been finally won. No investigator now needs to veil his conclusions in a demoralizing ambiguity or to apologize for pursuing truth. Simultaneously with this secured position of the scientific inquirer there came faster to the world= — and the fact is most significant — treatises on behalf of faith from the studies and laboratories of men of science.

The prevalence of this happier spirit has brought about a more wholesome and benevolent view of non-Christian beliefs. The science of comparative religion has been of service here. The faiths of the world have been investi- gated in a calm and impartial spirit. No thoughtful Christian man would use the language which was common fifty or sixty years ago when speaking of the creeds of other lands. The elements of truth in other creeds are now sought for ; criide forms of worship are no longer looked upon as half hypocritical ; Mahommed is no longer denounced as an impostor. This more temperate view of other men's creeds has naturally been followed by a great tenderness of spirit, and in some quarters the fear has been expressed that this tenderness may give rise to a kind of indifference in matters of faith. It is probable that, in their effort to do justice to heathen religions, some writers have overlooked or minimized the grave moral and social evils which are inextricably woven up with low theological ideas ; but, nevertheless, on the whole it is remarkable that the generation which has learned to look with kindlier eyes upon other religions coincides with the generation which has shown the most ardent missionary

enthusiasm. The truth seems to be that the result of calm investigation has brought out into clearer relief the true significance and the moral and spiritual superiority of Christianity. Men in separating their thoughts of Christianity from the symbols of the churches, and in forming through the witness of their creeds clearer con- ceptions of human need, have been able to realize alike the simplicity and the marvellous fitness of Christianity to promote the elevation of human

character, and thus they are able to recognize Christianity as a great evolu- tionary force in human history.

(iy.) The Question of Beunion. — The progress of Chris- tianity has, in the view of many, been hindered by the numberless parties and organizations into which it has been divided. It is possible, however, that those who regard the divisions of Christendom with dismay may have overlooked the possible advantages of the conditions which they deplore. Apart from the energy which rivalry may stimulate, it must not be forgotten that only by the recognition of such divisions could some of the most precious of human inheritances have been preserved. Eeligious freedom, the shield and guardian of intellectual integrity in matters of faith, was purchased at the price of division. The endeavour to preserve union by external pressure failed, and it is now realized that the outward union of Christendom must begin with the promotion of an inward harmony. The prospects of a great external reunion of Christendom involve questions too large to be discussed here. It may, however, be well to notice that there are in recent times features, unfavourable as well as favourable, to the hopes of reunion. The stifOening of the attitude of the Roman Catholic Church which has been noticeable since the declaration of infallibility ; exagger- ated or mistaken ecclesiastical conceptions favoured by ■certain schools of thought; the tendency to treat varia- tions of custom as transgressions of an imaginary divine law ; the creation of new sins, of which denominationalism is only too fruitful : these and other features of modern Ohristianity are unfavourable to reunion. On the other hand, the development of a passionate yearning for re- union which has found voice all the world over ; thefrajik Tecognition of the disastrous results of division, especially in the modern mission field ; the growth of the practical, and the decay of the dogmatic spirit, are all favourable. Meanwhile the desire for reunion has not been confined to empty wishes. Practical steps have not been wanting. The fusion of two important bodies in Scotland — ^the Free Church and the United Presbyterian Church— is perhaps the most remarkahle example of successful negotiation. Other negotiations are in process, and in Scotland devout men are working for a better understanding between the €hurch of Scotland and the Scottish Episcopal Church. Complete

reunion is as yet far off, but some concordat •or federation among the churches of the Reformation is a vision which many good and wise men cherish as neither unreasonable nor impossible. In the view of many the •existence of common work carried on by interdenomina- tional societies is calculated to show that some such fed- eration may be legitimately and hopefuUy desired, if not expected.

The strength of the practical and individual movements in Christendom is illustrated in what follows.

TTT. The Measuke oe Christian Pkogkess in the

Light of cektain Altered Conditions. Modern life, and what is called the modern spirit, haye altered the conditions of Christendom. Men can more clearly measure the relation of Christian churches to one another; they can more clearly see their duty to the w^orld. The scientific spirit has helped to reduce to their fitting proportion many matters which were once deemed

of primary importance. Questions which former ages discussed are not left untouched; theological acrimony, if not extinct, does not cover the same field as before. The dogmatic temper has given way to a kindlier and more practical spirit, and we are able to measure the progress of Christianity by the aspirations which are now cherished, and by the change of Christian methods in practical, personal, and co-operative directions.

(i.) The Growth of the Practical Spirit. — There has been a marked change in ideals in recent times, and the change has mainly been in the very strong preference for work which, for distinction's sake, we may call practical. It is needful, perhaps, to explain what is meant: the energies of Christian bodies were in the main directed in former years to work which was almost exclusively ecclesiastical and controversial — i.e., the members of different Christian societies or churches endeavoured to enlarge the borders of these societies by bringing in those who were careless in life or hostile in creed. There was, if we may

use the phrase, a certain egotistic flavour about their work; and they were satisfied if they could maintain their own services, and bring in some aliens into their fold. Of recent years men have been desirous of wider and more practical benevolence ; they have not merely wished to bring men into their church ; they sought to carry the power of Christian influence and of the Christian spirit among men. They have looked at the great world, and they have been filled with the practical compassion which has prompted the inquiry, ” What can we do for them ? ” The result has been the development of a vast amount of practical activity, more or less unrelated to the dogmatic restraints of former times. This spirit of practical Christianity has found expression in a variety of organizations — in societies, guilds, brigades, institutes, and what are known as settlements. The ” settlement ” means the residence in the very centre of the poorer quarters of great cities of men and women who are ready to labour — not always on distinctly or distinctively religious lines — ^among the needy and uncultivated classes. The aim is to bring culture, knowledge, harm- less recreation, and above all, personal influence, to the very doors of the neglected. The watchword of such settlements is personal service. A young Oxford man, brilliant and devoted, Arnold Toynbee by name, has the credit of leading the way in this class of beneficent work ; at all events, it was his name that was given to the Hall in Whitechapel which, under the fostering care and influence of the Eev. S. A. Bamett, was the first mate- rial embodiment of the movement. Since his time many settlements of the same or similar nature have sprung up in O-reat Britain and America. Young men at the uni- Tcrsities were found to sympathize with this class of move- ment ; and now there is in London an Oxford house, a Cambridge, an Eton, and a Harrow mission, besides many others, which act as channels for the guidance and employ- ment of Christian or philanthropic energy. Some of these — indeed, many — are now in connexion with some one or other of the kindred bodies ; but the general features of all these settlements is the recognition of any practical work calculated to minister to the cultivation and happiness of the too long neglected classes. The practical spirit shows itself also in the formation of guilds, camps, and institutes. Lads and girls, and even children axe gathered together ; efforts are made to organize for them not only educational and

religious opportunities, but harmless recreation — holidays and excursions are arranged, games are provided, and devoted men and women identify themselves in kindly and sympathetic fashion as partners in these recreations and sharers in these games. Almost universally the influence of Christian people has been drawn into channels which an earlier generation

would have regarded as somewhat too secular to be worthy of Christian zeal. Societies like the Kyrle So- ciety have sprung up, and endeavoured to brighten and beautify the life of the poor. The very remarkable movement known as the Salvation Army (q.v.) came under the influence of the practical spirit we are speak- ing of, and the social side of its work has been in some respects its most successful and satisfactory achievement.

The signs of this practical spirit meet us on all sides — at home in orphanages and asylums; abroad in dis- pensaries, medical missions (of which we have spoken), and leper settlements. Looking at these facts, observers of history have pointed out that the guiding force of Christian life has passed through the hands of various races. The Hebrew race gave it inspiration, the Greek gave it intellectual expression, the Roman gave it oppor- tunity of world ascendancy, the Teutonic intensified its spiritual individualism, and the Anglo-Saxon race is now giving to it wide and varied practical application. How- ever this may be, the practical work is now multitudinous and its development rapid. Toynbee Hall, the first of the settlements, was started in 1885; and there are now more than 70 such establishments in existence — 35 in the United States ; the resident workers in these are reckoned to be at least 300. It would be impossible to chronicle all the forms in which the practical energy dis- plays itself. It is enough to notice that it includes reformatories, homes for waifs and strays, rescue societies, inebriates' homes, charity organizations, nursing institu- tions for the sick poor, holiday funds, boys' brigades, workingmen's clubs, reading rooms, athletic associations, homes for working girls,

newspaper boys, bootblacks, drift children's missions, and others too numerous to mention. The work, though mainly directed towards the poor, does not overlook the wealthier classes ; the sea-side camps and public school missions are evidence pf this fact.

(ii.) Individualism, in Work. — The practical direction of Christian activity has been accompanied by a great outburst of free and individual effort. The various Christian bodies have their agencies and societies for practical work, but one feature of modern Christian en- thusiasm is its strong and marked individualism. Many of the most remarkable and successful efforts of practical energy have been due to individual rather than ecclesias- tical initiative. Mr Mtiller's work at Bristol, Mr Quarrier's in Scotland, Dr Barnardo's in London, the enormous and world-wide organizations known as the Young Men's Christian Association, the Christian En- deavour Society, the St Andrew's Brotherhood, all owe their beginning to personal devotion.

(iii.) Interdenominational Movements. — There is a cer- tain quantity of Christian energy and force which does not seem able to work through existing organizations. It is not for us to suggest reasons — ^we can only chronicle results. It may be that the advance of critical thought has made it im- possible for certain minds to accept the real or supposed theological bondage of the churches, and that, as a conse- quence, a considerable portion of Christian and philanthro- pic earnestness has escaped into other channels ; it may be that the discords or jealousies of the denominations have alienated certain ardent natures ; but however this may be, there is no doubt of the great increase of independent and undenominational religious and humanitarian work.

IV. Conclusion.

The present force of Christianity in the world is the result of a steady growth in numbers and influence. The religion which was the religion of an obscure handful of men is now, after a lapse of nineteen hundred years, the religion of a third of the human race and by far the most vigorous and influential nations. Further,

the religion which took its rise among the Semites has become the religion of the most powerful branch of the Aryan family ; and, lastly, the race which is possessed of the greatest power of expression, the keenest sense of liberty, which possesses the freest institutions and the most marked individuality, is the race which includes the churches of the Reformation. It is in this race of strongly marked individuality that, as might be expected, the largest variety of denominations is to be found. These divisions are partly a strength and partly a weak- ness ; in the past they have been of service in preserving intellectual independence, liberty of conscience, and re- ligious toleration. It may be doubted, however, whether, now that the cause of freedom has been won, these di- visions may not be a source of growing weakness, but against any possible ill results must be set the unifying influence now at work, the desire for reunion, the press- ure of political circumstances, and the experiences of missionary enterprise. The modern spirit, moreover, if we may use a vague but useful term, tends to treat eccle- siastical and dogmatic differences as matters of lessening importance. The value of denominational barriers is de- preciated in public esteem. With larger views of life and nature, of the world's history and of human interests, the minds of men are seeking the common principles on which the denominations are united, and are willing to minimize matters of difference. There is arising a power- ful religious movement which is bent on service and not on controversial theology. Vast organizations on this basis are appearing in all parts of the world. In the view of some of these non-denominational organizations are the seminal principles of the future Christian brother- hood— the church of the latter days — destined to grow larger and more vigorous while the more formal ecclesias- tical systems slowly wither away. These are conjectures. The simple and striking fact which meets our view is not merely the widespread character of Christianity, but the marvellous way in which the forces and influences of the world are gathered into the hands of Christian nations.

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(w. B. R.)

Christian Science, a system of theosophic and therapeutic doctrine, which was originated in America about 1866 by Mrs Mary Baker Eddy, of Lynn, Massachusetts, and has in recent years obtained a number of adherents both in the United States and in European countries. Mrs Eddy based her teaching on the Bible, and on the principles that man’s essential nature is spiritual, and that the Spirit of God being Love and Good, moral and physical evils are contrary to that Spirit, and represent an absence of the True Spirit which was in Jesus Christ. There is but one Mind, one God,

one Christ, and notlimg real but Mind. Matter and sickness are subjective states of error, delusions which can be dispelled by the

mental process of a true knowledge of God and Christ, or Christian science. Jesus himself healed by those means, which were therefore natural and not miraculous, and promised that those who believed should do curative works like his. About the year 1867 Mrs Eddy came forward as a healer by Mind-cure, and rapidly obtained fellow-workers and students. In 1876 a Christian Scientist Association was organized. Mrs Eddy had published in the preceding year a book entitled Science and Health, with Key to the Scriptures. In 1879 she became the pastor of a ” Church of Christ, Scientist ” in Boston, and also founded there her “Massachusetts Metaphysical College ” for the purpose of medical instruc- tion. In 1883 she started an official organ of her teaching, 27ie Christian Science Journal. The first denominational chapel was built at Oconto, Wisconsin, in 1886 ; and in 1894 a great memorial church was erected in Boston. Mrs Eddy’s publications also include Retrospection and Introspection (1891), Unity of Good and Unreality of Evil (1887), Bvdimental Divine Science (1891), Christian Healing (1886).

Christiania, the capital of Norway, forming a county (amt) to itself, and situated on the Aker river, at the head of Christiania Fjord, in 59° 54′ 44″ N. lat. and 10° 43′ 28″ E. long. During the second half of the 19th century the city grew rapidly, many buildings of .wood giving place to structures of brick or stone. New suburbs, spread over a wide area, were built on the rising ground to the west and north-west, around and beyond the royal park. This rapid expansion was due for the most part to the increase in the population. It was also due in part to the advance which the people made in material prosperity. For instance, in the ten years ending with 1898 it was estimated that the gross value of the property owned in Christiania had increased by 68 per cent, and the gross value of the incomes of the inhabitants by 83 per cent. In the year 1898 alone the gross value of the property was estimated to have risen from 17^ millions sterling to nearly 20:|- millions sterling, and the gross value of the incomes from 4 millions to over 4i millions sterling — re- markable figures for a place of only 200,000 inhabitants. The university, which had in 1897 some 60 professors and 1200 students (1600 in 1889), embraces five faculties (theology, law, medicine, history and philology, mathe- matics and natural sciences), and possesses several valuable collections— a library of 360,000 vols. ; museum of

Norse antiquities, especially rich in objects of the Viking age, including two ancient viking ships; an ethnographical museum, a numismatic collection, a cabinet of minerals, a botanical collection, and a zoological collection. In 1899-1900 a large historical museum was built to shelter the Norwegian National Museum, the museum of northern antiquities, and certain of the university collections. Other buildings deserving mention are the national theatre (1899) ; the sculpture museum (1882), an Italian Renaissance building ; the industrial arts museum (1876); the new Freemasons' lodge (1894), one of the handsomest structures m the city ; and a conservatory of music (1883). The city is tolerably well adorned with monuments to dis- tinguished Norwegians— Wergeland, Asbjornsen, Eilert Sundt, Schweigaard, Kjerulf, besides King Christian IV.

and others. _ u u ^

On the east side of the river Aker is the suburb ot Oslo, with the existing episcopal palace, and an old bishop's palace, in which James VI. of Scotland (1. ot England) was bethrothed to Princess Anne of Denmark. In the environs of the city are the royal pleasure castle

of Oscarshal (1847-52), on the peninsula Bygdo (Ladu- gaard) to the west of the city, with a historical museum (1881), and some ancient churches and houses brought there from different parts of the country. On Hovedo (Head Island) in the fjord, immediately opposite to Akershus (not Agershus), are the ruins of a Cistercian monastery, founded in 1147 by monks from Kirkstead (Lincolnshire), and burnt down in 1532. Then there are the pleasure resorts of St Hans Haugen (150 ft.), Frognersaeter (1362 ft.), HolmenkoUen sanatorium (1116 ft.), where the famous ski (snow-shoe) races are held in February, and VoksenkoUen sanatorium (1660 ft.), opened in 1900.

Christiania is a place of considerable industrial activity, which developed rapidly in the last two decades of the 19th century. Except for two large shipbuilding yards, one with a floating dock, the other with a dry dock, most of the manufactories are concentrated in the suburb of Sagene, on the ngrth side of the city, deriving their motive power from the numerous falls of the river Aker. They embrace

factories for cotton and woollen spinning and weaving, paper, flour, soap and oil, bricks and tiles, matches, nails (especially horse-shoe nails), margarine, foundries and engineering shops, wood-pulp^ tobacco, matches, linen, glass, sail- cloth, hardware^ gunpowder, chemicals, with sawmills, breweries, and distilleries. In 1898 there were 375 factories at work in Christiania, and they employed 17,383 hands. There is also a busy trade in the prepar ration of granite paving-ston!es, and in the storing and packing of ice. From about the middle of the 19th century Christiania has been the principal emporium of South Norway, and has long since far outstripped Bergen in the volume of its commerce. The total value of the trade of the port increased from £4,958,600 (imports, £3,862,000; exports, £1,096,600) in 1872, to £5,492,000 in 1882, to £7,738,000 in 1892, and to £8,567,200 in 1898. The imports are more than four times the exports in respect of value, the figures for 1898 being £7,987,600 and £1,579,600 respectively. The former consist principally of grain and flour (£550,000 to £650,000), woollens (£450,000 to £550,000), coffee (£425,000 to £475,000), iron — raw and manufactured (£750,000 in 1898; £367,000 in 1894), cottons (£350,000 to £400,000), coal (£250,000 to £275,000), bacon and salt meat (£260,000 to £275,000), oils (£175,000 to over £250,000), sugar (£185,500 to £230,000), machinery (£362,000 in 1898 ; £149,000 in 1894), flax, jute, and hemp, paper-hangings, paints, colours, &c., wines and spirits, raw tobacco, copper, zinc, leap, and tin, silk, molasses, and other commodities. The principal exports are wood-pulp (£226,000 to £325,000), timber (£155,000), nails, paper, butter and margarine (£103,000), matches, condensed milk, fish, leather and hides, ice, sealskins, &c. Of the imports. Great Britain supplies the greater part of the cotton and woollen yarn, the machinery (including ships), and the raw metals ; the United States about one-half of the oils and fats, and a large proportion of the food-stuffs, and skins, feathers, &c. Of the exports, almost the whole of the timber goes to Great Britain, together with the larger portion of the paper and food-stuffs (butter, &c.). In 1872 the port was entered by 1787 vessels of 393,600 tons burden; in 1891 by 2078 vessels of 817,800 tons ; and in 1899 by 2710 vessels of 1,000,740 tons. Although Christiania owns a smaller merchant fleet than Bergen, her shipping increased from 264 vessels of 104,000 tons in 1881 to 401 vessels of 206,160 tons in 1892, and to 398 vessels of 380,526

tons in 1900. Early in 1899 the municipality voted £47,000 for the construction of a pier, a harbour for fishing-boats, protected by a mole and a quay, 345 ft. long, on the shore

underneath the fortress of Akershus. These works are intended to be the first in a general rearrangement of the entire harbour of the city. Population (1885), 128,301, counting in the suburbs ; (1891), 151,239 ; (1898), 203,- 337, of whom 93,695 males, 109,642 females: (1900),

225,686.

Christiansand, a fortified seaport town of Nor- way, on the S. coast. It is an important port of call for the Baltic steamboats, and a fishing centre. It was burnt down in 1892, and subsequently rebuilt of brick. It ex- ports timber (nearly 3 million cubic feet annually), wood- pulp, paper, fish, and felspar. The total trade is under half a million sterling. Christiansand owns about 100 vessels of 62,000 tons. An impetus was given to the trade and tourist trafB.c by the opening of the Ssetersdal railway, tapping the interior, in 1895-96. Sawmills, wood-pulp factories, shipbuilding yards, and mechanical workshops are the principal industrial works. The cathedral was rebuilt after a fire in 1880. Population

(1875), 11,766 ; (1900), 14,007.

Christianstad, a fortified town of Sweden, on a peninsula which juts out into Lake Sjovik, an expansion of the river Helge, 10 miles from the Baltic and 66 miles E. from Helsingborg by rail. It is the headquarters of several railway companies, and has flour mills, engineer- ing works, distilleries, a weaving mill, sugar factory, &c., and exports granite and wood-pulp, and. imports coal (40,000 to 70,000 tonsV and wheat and rye. In 1896-97 its harbour at Ahus (pop. 1547) was enlarged and deep- ened to admit vessels drawing 18 ft., and a new entrance channel made.

In 1899 it was entered by 530 vessels of 100,150 tons. A new town hall was buUt in 1889. Popu- lation (1880), 9203 ; (1900), 10,318.

Christiansund, a seaport town of Norway, co. Eomsdal, 83 miles W.S.W. from Trondhjem. It exports cod-fish, herrings, cod-liver oU, fish manure, &c., to the annual value of £350,000 to £550,000, and imports salt, coaJ, and colonial wares to about £55,000. Since 1894 butter has been exported to Great Britain. In 1892 an outlook tower was erected to commemorate the 150th anniversary of the founding of the town. Population

(1875), 8251 ; (1898), 11,680.

Christina, Maria Christina Henrietta De- sir6e F6licit6 R6nidre, Queen-Eegent of Spain

(1858 -), widow of Alfonso XII. and mother of

_ Alfonso XlII., was bom at Gross Seelowitz, in Austria, on ‘ 21st July 1858, being the daughter of the Archduke Charles Eerdinand and the Archduchess Elizabeth of Austria. She was brought up by her mother as a rigid Catholic, and great care was taken with her ediication. At eighteen she was appointed, by the Emperor Francis Joseph, abbess of the House of Noble Ladies of Saint Theresa in Prague, where she made herself very popular and distinguished herself by her intellectual parts. It is said that at the Court of Vienna the archduchess saw the young Prince Alfonso of Spain when he was only a pretender in exile, before the restoration of the Bourbons. A few years later, when Alfonso XII. had lost his first wife and cousin. Queen Mercedes, daughter of the due de Montpensier, his ministers, especially Sefior Canovas, urged him to marry again. He told them that if he did so it would only be with the young Austrian Archduchess Maria Christina. After some negotiations between the two Courts and Governments, it was agreed that the Arch- duchess Elizabeth and her daughter should meet Alfonso XII. at Arcachon, in the south of France, where a few days’ personal acquaintance was sufficient to make both come to a decision. The Duke of Bailen went ofiacially to Vienna to get the Emperor of Austria’s authorization, and

on 14th November 1879, in the throne-room of the Imperial palace, the archduchess solemnly abdicated all her rights of succession in Austria, in accordance with the law obliging all princesses of the Imperial house to do so when they wed a foreign prince. On 17th November the archduchess and her mother, with a numerous suite, started for Spain, arriving at the royal castle of El Pardo, near Madrid, on 24th November. The wedding took place in the Atocha cathedral, on 29th November, in great state, and was followed by splendid festivities. Queen Christina bore her husband two daughters, before he died in 1885 — Dona Mercedes, bom 11th September 1880, and Dona Marie Theresa, bom 12th November 1882. During her husband^s lifetime the yoimg queen kept studiously apart from politics, so much so that her inexperience caused much anxiety in November 1885, when she was called upon to take the arduous duties of regent. During the long minority of the posthumous son of Alfonso XII., the present King Alfonso XIII., the Austrian Queen-Kegent acted in a way that obliged even the adversaries of the throne and the dynasty to respect the mother and the woman. The people of Spain, and the ever-restless civU and military politicians, found that the gloved hand of their constitutional ruler was that of a strong-minded and tenacious regent, who often asserted herself in a way that surprised them much, but always, somehow, commanded obedience and respect. More could not be expected by a foreign* ruler from a nation little prone to waste attach- ment or demonstrative loyalty upon anybody not Castilian born and bred.

Christinehamn, or KsisTLNEHAMKr, a town of the province of Vermland, Sweden, near the N.E. corner of Lake Wener, 25 miles by rail E. by S. from Carlstad. It has ironworks, a tobacco factory, &c., and large fairs are held every AprU and October. A part of the town was burnt down in 1893. Population (1880), 5039;

(1900), 6776.

Christison, Sir Robert, Bart. (1797-1882), Scottish toxicologist and physician, was born in Edinburgh on 18th July 1797. After graduating at the university of that city in 1819, he spent a short time in London,

studying under Abernethy and Lawrence, and in Paris, where he learnt analytical chemistry from Eobiquet and heard lectures by Orfila, the famous toxicologist. In 1822 he returned to Edinburgh as professor of Medical Jurisprudence, and set to work to organize the study of his subject on a sound basis. On poisons in particular he speedily became a high authority; his well-known book on them was published in 1829, and in the course of his inquiries he did not hesitate to try such daring experiments on himself as taking large doses of Calabar bean. His attainments in medical jurisprudence and toxicology procured him the appointment, in 1829, of medical officer to the Crown in Scotland, and from that time till 1866 he was called as a witness in many celebrated criminal cases. In 1832 he gave up the chair of Medical Jurisprudence and accepted that of Medicine and Thera- peutics, which he held till 1877 ; at the same time he became professor of Clinical Medicine, and continued in that capacity till 1855. His fame as a toxicologist and medical jurist, together with his work on the pathology of the kidneys and of fevers, secured him a large private practice, and he succeeded to a fair share of the honours that commonly attend the successful physician, being appointed physician to Queen Victoria in 1848 and re- ceiving a baronetcy in 1871. Among the books which he published were a treatise on Granular Degeneration of the Kidneys (1839), and a Commentary on the Pharma- copoeias of Great Britain (1842). Sir Eobert Christison, who retained remarkable physical vigour and activity

down to extreme old age, died at Edinburgh on 23rd January 1882.

Christmas Island, a British possession under the government of the Straits Settlements, situated in the eastern part of the Indian Ocean (in 10° 25′ S. lat. 105° 42′ E. long.), about 190 miles S. of Java. It is not known when and by whom the island was discovered, but under the name of Moni it appears on a Dutch chart of 1666. It was first visited in 1688 by Dampier, who found it uninhabited. In 1886 Captain Maclear of H.M.S. Flying Fish, having discovered an anchorage in a bay which

he named Flying Eish Cove, landed a party and made a small but interesting collection of the flora and fauna. In the following year Captain Aldrich on H.M.S. Egeria visited it, accompanied by Mr J. J. Lister, E.E.S., who formed a larger biological and mineralogical collection. Among the rocks then obtained and submitted to Sir John Murray for examination there were detected specimens of nearly pure phosphate of lime, a discovery which eventually led, in June 1888, to the annexation of the island to the British Crown. Soon afterwards a small settlement was established in Flying Fish Cove by Mr G. Clunies Eoss, the owner of the Keeling Islands, which lie about 750 miles to the westward. In 1891 Mr Eoss and Sir John Murray were granted a lease, but on the further discovery of phosphatic deposits they disposed of their rights in 1897 to the company now in possession. In the same year a thorough scientific exploration was piade, at the cost of Sir John Murray, by Mr C. W. Andrews, of the British Museum.

Physical Features and Geology. — The island is a quadrilateral with hollowed sides, about 12 miles in greatest length and 9 in extreme breadth. It is about 190 miles from the nearest land, and is probably the only tropical island that had never been inhabited by man. When the first settlers arrived, in 1897, it was covered with a dense forest of great trees and luxuriant under-shrubbery. The settlement in Flying Fish Cove now numbers some 250 inhab- itants, consisting of Europeans, Sikhs, Malays, and Chinese, by whom roads are being out and patches of cleared ground cultivated. The island is the flat summit of a submarine mountain more than 15,000 feet high, the depth of the platform from which it rises being about 14,000 feet, and its height above the sea being upwards of 1000 feet. The submarine slopes are steep, and within 20 miles of the shore the depth of the sea reaches 2400 fathoms. It con- sists of a central plateau descending to the water in three terraces, each with its “tread” and “rise.” The shore terrace descends by a steep cliH to the sea, forming the “rise” of a submarine “tread” in the form of fringing reef which surrounds the island and is never uncovered, even at low water, except in Flying Fish Cove, where the only landing-place exists. The central plateau is a plain whose surface presents ” rounded, flat-topped hills and low ridges and reefs of limestone,” with narrow intervening valleys. On its northern aspect this

plateau has a raised rim having all the appearances of being once the margin of an atoll. On these rounded hills occurs the deposit of phosphate of lime which gives the island its commercial value. The phosphatic deposit has doubtless been produced by the long-continued action of a thick bed of sea-fowl dung, which converted the carbonate of the under- lying limestone into phosphate. The flat summit is formed by a succession of limestones — all deposited in shallow water — ^from the Eocene (or Oligocene) up to recent deposits in the above-mentioned atoll with islands on its reef. The geological sequence of events appears to have been the following : — After the deposition of the Eocene (or Oligocene) limestone — which reposes upon a floor of basalts and trachytes— basalts and basic tufts were ejected, over which, during a period of very slow depression, orbitoidal lime- stones of Miocene age — which seem to make up the great mass of the island— were deposited ; then elapsed a long period of rest, during which the atoll condition existed and the guano deposit was formed ; from then down to the present time there has succeeded a series of sea-level subsidences, resulting in the formation of the terraces and the accumulation of the detritus now seen on the first inland cliff, the old submarine slope of the island. The occurrence of such a series of Tertiary deposits appears to be unknown elsewhere. The whole series was evidently deposited in shallow water on the summit of a submarine volcano standing in its present isolation, and round which the ocean floor has prob- ably altered but a few hundred feet since the Eocene age. Thus

although the rocks of the southern coast of Java in their general characters and succession resemble those of Christmas Island, there lies between them an abysmal trough 18,000 feet in depth, which renders it scarcely possible that they were deposited in a continuous area, for such an enormous depression of the sea-floor could hardly have occurred since Miocene times without involving also Christmas Island. One of the main purposes of the explora- tion was to obtain light on the question of the foundation of atolls. As a result of the investigation it has been found that “the great thickness of reef limestone required by the Darwinian theory of atoll formation” does not exist, and “although there may be some evidence that subsidence did occur in the earlier history of the island, it is clear that it was

neither continuous for any long period nor of any great extent" {Andrews). If Christ- mas Island cannot, perhaps, be proved to have been a typical atoll, it can, however, " be shown that at one time it must have consisted of reefs and islands approximating very nearly to those seen on atolls which are regarded as typicsS, and the determina- tion of the nature of the foundation upon which those reefs and islands rested is, at least, a step in the right direction" {Andrews).

Flora and Fauna. — The flora consists of 129 species of angio- sperms, 1 Cycas, 22 ferns, and a few mosses, lichens, and fungi, 17 of which are endemic, while a considerable number — not speci- fically distinct — ^form local varieties nearly all presenting Indo- Malayan affinities, as do the single Cycas, the ferns, and the cryptogams. As to its fauna, the island contains 319 species of animals — 54 only being vertebrates — 145 of which are endemic. A very remarkable distributional fact in regard to them, and one not yet fully explained, is that a large number show affinity with species in the Austro-Malayan rather than in the Indo-Malayan, their nearer, region. The ocean currents, the trade-winds blowing from the Australian mainland, and north-westerly storms from the Malayan islands, are no doubt responsible for the introduction of many, but not all, of these Malayan and Australasian species.

Climate. — The climate is healthy, the temperature varying -from 75° to 84° F. The prevailing wind is the S.E. trade, which blows the greater part of the year. The rainfall in the wet season is heavy, but not excessive, and during the dry season the ground is refreshed with occasional showers and heavy dews. Malarial fever is not prevalent, and it is interesting to note that there are no swamps or standing waters on the island.

See Andrews, C. W. A Monograph of Christmas Island {Indian Ocean), London, 1900, to which Uie present writer has been greatly indebted. (h. o. f.)

Chronographs. — ^In the article Gunnbet (ETicif. Brit. vol. xi.) descriptions were given of some chrono- graphs adapted for the

determination of the velocities of projectiles. Some additional forms of instruments both for this and for other purposes are here described.

&un Chronographs. — ^Probably the earliest forms of chrono- graphs, not based on the ballistic pendulum method, are due to Colonel Grobert, 1804, and Colonel Dabooz, 1818, both officers of the French army.

In the instrument by Grobert two large discs, attached to the same axle 13 ft. apart, were rapidly rotated ; the shot pierced each disc, the angle between two holes giving the time of flight of the ball, when the angular velocity of the discs was known. lu the instrument by Colonel Dabooz a cord passing over two light pulleys, one close to the gun, the other at a given distance from it, was stretched by a weight at the gun end and by a heavy screen at the other end. Behind this screen there was a fixed screen. The shot cut the cord and liberated the screen, which was perforated during its fall. The height of fall was measured by superposing the hole in the moving screen upon that in the fixed one. This gave the approximate time of flight of the shot over a given distance, and hence its velocity.

In the early form of chronoscope invented by Wheatstone in 1840 the period of time was measured by means of a species of clock, driven by a weight ; the dial pointer was started and stopped by the action of an electromagnet which moved a pawl engaging with a toothed wheel fixed on the axle to which the dial pointer was attached. The instrument applied to the determination of the velocity of shot is described thus by Wheatstone : —

“A wooden ring embraced the mouth of the gun, and a wire connected the opposite sides of the ring. At a proper distance the target was erected, and so arranged that the least motion given to it would establish a permanent contact between two metal points. One of the extremities of the wire of the electromagnet (before mentioned) was attached to one pole of a small battery ; to the other extremity of the electromagnet were attached two wires, one of which communicated with the contact piece of the target, and the other with one of the ends

of the wire stretched across the mouth of the gun ; from the other extremity of the voltair. battery

two wires were taken one of which came to the contact piece of the target, and the other to the opposite extremity of the wire across the mouth of the gun. Before the firing of the gun a con- tinuous circuit existed, including the gun wire ; when the target was struck the second circuit was completed ; but during the passage of the projectile both circuits were interrupted, and the duration of this interruption was indicated by the chronoscope."

Professor Henry (Journal Franklin Inst., 1886) employed a cylinder driven by clockwork, making ten revolutions per second. The surface was divided into 100 equal parts, each equal to ttsW second. The time marks were made by two galvanometer needles, when successive screens were broken by a shot. Henry also used an induction-coil spark to mark the cylinder, the primary of the coil being in circuit with a battery and screen. This form of chronograph is in many respects similar to the instrument of Konstantinoff, which was constructed by Breguet and has been sometimes attributed to him (ies Comptes Sendus, 1845). This chronograph consisted of a cylinder 1 m. in circumference and 0-36 m. long, driven by clockwork, the rotation being regulated by a governor provided with wings. A small carriage geared to the wheelwork traversed its length, carrying electromagnetic signals. The electric chronograph signal usually consists of a small arma- ture,(furnisbed with a style which marks a moving surface) moving in front of an electromagnet, the armature being suddenly pulled oft the poles of the electromagnet by a spring when the circuit is broken {Journal of Physiology, vol. ii. p. 408). The signals in Breguet's instrument were in a circuit, including the screens and batteries of a gun range. The measurement of time depended on the regularity of rotation of the cylinder, on which each mm. represented y^ second.

In the Navez chronograph (1848) the time period is found by means of a pendulum held at a large angle from the vertical by an electromagnet, which is in circuit with a screen on the gun range. When the shot cuts this screen, the circuit is broken and the pendulum liberated and set swinging. When the next screen on the range is broken by the shot, the position of the pendulum is recorded and the distance it has passed through measured on a divided arc. From this the time of traversing the space between the screens is deduced. By means of an instrument known as a disjunctor {Ency. Brit. vol. xi. p. 300) the instrumental time-loss or latency of the chronograph is determined. In Benton's chrono- graph (1869) two pendulums are liberated, in the same manner as in the instrument of Navez, one on the cutting of the first screen, the other on the cutting of the second. The difference between the swings of the two pendulums gives the time period sought for. The disjunctor is also used in connexion with this instrument. In Vignotti's chronograph (1857) again a pendulum is employed, furnished with a metal point, which moves close to paper impregnated with f erro-cy anide of potassium. The gun-range screens are included in the primary circuits of induction coils ; when these circuits are broken a spark from the pointer marks the paper. From these marks the time of traverse of the shot between the screens is determined.

Colonel Sebert {Extraits du Memorial de I'Artillerie de la Marine) devised a chronograph to indicate graphically the motion of recoil of a cannon when fired. A pillar fixed to the ground at the side of the gun-carriage supported a tuning-fork, the vibration of which was maintained electrically. The fork was provided with a tracing point attached to one of the prongs, and so adjusted that it drew its path on a polished sheet of smoke -blackened metal attached to the gun-carriage, which traversed past the tracing point, when the gun ran back. The fork used made 500 com- plete vibrations per second. A central line was drawn through the curved path of the tracing point, and every entire vibration out the straight line twice, the interval between each intersection equalling y^ji^ second. The diagram so produced gave the total time of the accelerated motion of recoil of the gun, the maximum velocity of recoil, and the rate of acceleration of recoil from the beginning to the end of the motion. By means of an instrument

furnished with a microscope and micrometers, the length and amplitude, and the angle at which the curved line cut the central line, were measured. At each intersection (according to the in- ventor) the velocity could be deduced. The motion at any inter- section being compounded of the greatest velocity of the fork, while passing through the midpoint of the vibration and the velocity of recoil, the tangent made by the curve with the straight line represents the ratio of the velocity of the fork to the velocity of recoil. If a be the amplitude of vibration, considered constant, V the velocity of the fork at the midpoint of its path, r the velocity of recoil, o the angle made by the tangent to the curve with the straight line at the point of intersection, and t the line a complete vibration ; then,

2«(. f—J^

t tan a

In Colonel Watkin's chronograph (" Chronographs and their Application to Gim Ballistics," Froc. Boy. Inst., 1896) a metal

drum, divided on its edge so that when a vernier is used a minute of angle may be read, is rotated rapidly by a motor ati a practically uniform speed. The points of a row of steel-pointed pins, screwed into a frame of ebonite, can be brought within ^ inch of the surface of the drum. Each pin is a part of the secondary circuit of an induction coil, the space between the pins and the drum forming spark gaps. The drum is rubbed over with a weak solution of paraffin wax in benzol, which causes the markings produced by the sparks to be well defined. . The records are read by means of a fine hair stretched along the drum and just clear of it, the dots being located under the hair by means of a lens. The velocity of rotation is found by obtaining spark marks, due to the primary circuits of two induction coils being successively broken by a weight falling and knocking over two light levers. The distance between the levers is about 3'77 inch, and the time of fall between the levers is 0-018948 sec. In practice two drop weights are used, to avoid the chance of an experiment being wasted. This chrono- graph has been used for finding the velocity of projectiles after leaving the gun, and also for finding the rate at which a shot traverses the bore. For the

latter purpose the shot successively cuts insulated wires fixed in plugs screwed into the gun at known intervals ; each wire forms a part of the primary of an induction coil, a.nd as each is cut a dot is made on the rotating drum by the induced spark.

Jervis-Smith's tram chronograph was devised for measuring periods of time varying from about one-fourth to one twenty-thousandth part of a second {Froc. Boy. Soc. vol. xlv. p. 452. Improved from Pat. 1894. The Tram Chronograph, by F. J. Jervis-Smith, F. R. S.) . It consists of a metal girder having a T-shaped end. This carries two parallel steel rails, the edges of which lie in the same vertical plane. The girder is supported at its end, and at the extremities of the T-piece, on the V-groove, trihedral hole, and plane system. A carriage or tram furnished with three grooved wheels runs on the rails, and a slightly-smoked glass plate is attached to its vertical side. The tram in the original instrument was propelled by a falling weight, but in an improved form one or more spiral springs are employed. All time traces are made immediately after the propelling force has ceased to act. The tram is brought to rest by a gradually applied brake, consisting of two crossed leather bands stretched by two springs ; a projec- tion from the tram runs between the bands, and brings it to rest with but little lateral pressure. When, for certain physiological experiments, a low velocity of traverse is required, a, heavy fly- wheel is mounted on the tram and geared to its wheels. A pillar also mounted on the hole, groove and plane method, is placed vertically in front of the glass, to carry the electromagnetic signals, which can be brought into contact with the glass by means of a tangent-screw. A standard fork by Koenig fixed to a pillar also makes a trace on the glass, being automatically thrown into vibration. Tuning-forks may be calibrated by obtaining two signal markings on the plate, controlled by a standard clock of known rate. Two motions of a slide on the pillar, viz., of rotation and translation, allow a number of observations to be made. The traces are counted out on a sloping glass desk, and the time of flight of a projectile between two or more screens is found. When very close readings are required, they are made by means of a traversing micrometer microscope. If the instrument is used for gun work, the tram is driven at full speed ; when the distance between the screens is known, and also the time of flight, the midpoint

velocity is found by applying Bashforth's formula. When the velocity of shot from a shot-gun has to be found, a thin wire stretched across the muzzle takes the place of the first screen, and a thin sheet of metal or cardboard carrying an electric con- tact, or a Branly coherer, takes the place of the second screen. The electric firing circuit is provided with a safety key attached by a cord to the man who loads the gun and prepares the electric fuse, thus preventing him from getting into the line of fire when the gun is fired by the chronograph. {Pat. Becord, 1897.) The tram, when the instrument is adjusted, has a practically constant velocity of traverse.

The polarizing photo-chronograph, designed and used by Dr A. Gushing Crehore and Dr G. Owen Squier at the United States Artillery School {Journal United States Artillery, 1895, vol. vi. p. 271), depends for its indications upon the rotation of a beam of light by a magnetic field, produced by a solenoidal current, which is opened and plosed by the passage of the projectile. The general arrangement is as follows : — A beam of light from an electric lamp traverses a lens, then a Nicol prism, next a glass cylinder furnished with plane glass ends and coiled with insulated wire, then an analyser and two lenses, finally impinging on a photographic plate to which rotation is given by an electric motor, the plane of rotation being perpendicular to the direction of the beam of light. The same plate also records the shadow of a pierced projection attached to a tuning-fork, light from the electric lamp being diverted by a mirror for this purpose. The solenoid used to pro- duce a magnetic field across the glass cylinder, which is filled with carbon bisulphide, is in circuit with a dynamo, resistances, and

the screens on the gun range. It is a well-known phenomenon in physics that when, with the above-mentioned combination of polarizing Nicol prism and analyser, the light is shut off by rotating the analyser, it is instantly restored when the carbon bisulphide is placed in a magnetic field. This phenomenon is utilized in this instrument. The projectile, by cutting the wire screens, causes the magnetic field to cease and light to

pass. By means of an automatic switch the projectile, after cutting a screen, restores the electric circuit, so that successive records are registered. After a record has been made it is read by means of a micrometer microscope, the angle moved through by the photographic disc is found, and hence the time period between two events. In the photo-chronograph described in Untersuchungen uber die Vibration des Gewehrlaufs, by C. Cranz and K. R. Koch, Munchen, 1899, also note on the same, Nature, vol. Ixi. p. 68, a sensitive plate moving in a straight line receives the record of the movement of the barrels of firearms when discharged. It was mainly used to determine the "angle of error of departure" in ballistics.

Astronomical Chronographs. — The astronomical chronograph is an instrument Whereby an observer is enabled to register the time of transit of a star on a sheet of paper attached to a revolving cylinder. A metal cylinder covered with a sheet of paper is rotated by clockwork controlled by a conical pendulum, or by a centrifugal clock governor such as is used for driving a telescope. By means of a screw longer than the cylinder, mounted parallel with the axis of the cylinder and rotated by the clockwork, a carriage is made to traverse close to the paper. In some instru- ments this carriage is furnished with a metal point, and in others with a stylographic ink pen. The point or pen is made to touch the paper by an electromagnet the electric current of which is closed by the observer at the transit instrument, and a mark is recorded on the revolving cylinder. The movement of the same point or pen is also controlled by a standard clock, so that at the end of each second a mark is made. The cylinder makes one revolution per minute, and the minute is indicated by the omission of the mark. In Dent's form (Nature, vol. xxiii. p. 59) continuous observations can be recorded for 6f hours. The conical pendulum used to govern the rotation of the cylinder was the invention of Sir G. B. Airy. The lower end is geared to a metal plate vrhioh sweeps through an annular trough filled with glycerine and vrater. When the path of the pendulum exceeds a certain ■diameter it causes the plate to enter the liquid more deeply, its motion being thereby checked ; also, when the pendulum moves in a smaller circle, the plate is lifted out of the liquid and the resistance is diminished in the same proportion as the force. The compensatory action is

considerable ; doubling the driving power produces no perceptible difference in the time. To prevent the injury of the conical pendulum and the wheel work by any sudden ■check of the cylinder, a ratch-wheel connexion is placed between the cylinder and the train of wheel work ; this enables the pendulum to run on until it gradually comes to rest. The pen- ■dulum, which weighs about 18 lb, is compensated, and makes one revolution In two seconds ; it is suspended from a bracket by means of two flexible steel springs placed at right angles to one another. In the astronomical chronograph designed by Sir Howard Grubb, r.R.S. (iVoc. Inst.Mech. Eng., July 1888), the recording cylinders — ^two in number — are driven by a weight acting on a train of wheel work controlled by an astronomical telescope governor. The peculiar feature of this instrument is that the axle is geared -to a shaft which communicates motion to the cylinders through a mechanism whereby the speed of rotation is constantly corrected by a standard clock. Should the rotation fall below the correct speed, it is automatically accelerated, and if its speed of rotation rises above the correct one, it is retarded. The accelerator and retarder are thrown into action by electromagnets, controlled by a "detector " mounted on the same shaft. The rather complicated mechanism employed to effect the correction is described and fully illustrated in the reference given. The cylinders are covered with paper, but all the markings are made with a stylographic pen. The marks indicating seconds are dots, but those made by the observer are short lines. When an observation is about to be made, the observer first notes the hour and minute, and, by pressing a contact iey attached to a flexible cord at the transit instrument, marks -the paper with a letter in Morse telegraph characters, indicating the hour and minute ; he then waits till a micrometer wire cuts a star and at the instant closes the circuit, so that the second and fraction of a second are registered on the chronograph paper. When a set of observations have been taken, the paper is removed from the cylinder, and the time results are obtained by applymg a suitably divided rule to the marked paper, fractions of a second being estimated by applying a piece of glass ruled with eleven straight lines converging to a point. The ends of these lines on the base of the triangle so formed are equidistant on one edge of the glass, so

that when the first and last lines are so placed as to coincide with the beginning and end of the markings of a second,

that second is divided into ten equal parts. The base of the triangle is always kept parallel with the line of dots. The papers, after they have been examined and the results registered, are kept for reference.

The observatory of Washburn, University of Wisconsin, is furnished with a chronograph of the same type as that of Dent (Annals Harvard Coll. Obs. vol. i. pt. ii. p. 34), but in this instrument the rotation of the cylinder is controlled by a double conical pendulum governor of peculiar construction. When the balls fly out beyond a certain point, one of them en- gages with a hook attached! to a brass cylinder which embraces the vertical axle loosely. When this mass is pulled aside the work done on it diminishes the speed of the governor. The pendulum ball usually strikes the hook from 60 to 70 times per minute. Governors on this principle were adopted by Alvan Clark for driving heliostats in the United States Transit of Venus Expedition, 1874.

Acoustic Chronographs. — A chronograph was devised by Regnault (Acad, des Sc, 1868) to determine the velocity of sound propa- gated through a great length of pipe. A band of paper 27 mm. wide was continuously unrolled from a bobbin by means of an electromagnetic engine. In its passage over a pulley it passed over a smoky lamp flame, which covered it with a thin deposit of carbon. It next passed over a cylinder in contact with the style of a tuning-fork kept in vibration by electromagnets placed on either side of its prongs, the current being interrupted by the fork ; it was also in contact with an electric signal controlled by a standard clock. Also an electromagnetic signal marked the beginning and end of a time period. Thus three markings were registered on the band, viz., the time of the pendulum, the vibrations of the fork, and the marking of the signal due to the opening and closing of the current by electrical contacts attached to diaphragms on which the sound wave acted. The contacts consisted of minute hammers resting on metal points fixed to the centre of diaphragms which closed the end of the experimental pipes. The signal marked the instant at which a sound wave impinged on a diaphragm. The markings on the

paper band gave the period of time between two events, and the number of vibrations of the tun- ing-fork per second were estimated by means of markings due to the clock. The sound wave was usually originated by flring a pistol into the pipe furnished with diaphragms and contact pieces.

In the chronographic use of the Morse telegraph instrument (Stewart and Gee, Elementary Practical Phys. p. 234) a circuit is arranged which includes a seconds pendulum furnished with a fine platinum wire below the bob, which sweeps through a small mass of mercury forming a part of the circuit. There is a Morse key for closing the circuit. A fast-running Morse instrument and a battery are placed across this circuit as a shunt. A succession of dots is made on the paper ribbon by the circuit being closed by the pendulum, and the space between each adjacent dot indicates a period of one second's duration. Also, when the key is de- pressed, a mark is made on the paper. To measure a period of time, the key is depressed at the beginning and end of the period, causing two dots to be made on the ribbon ; the interval between these, when measured by the intervals due to the pendulum, gives the length of the period in seconds, and also in fractions of a second, when the seconds' interval is subdivided into convenient equal parts. This apparatus has been used in determination of the velocity of sound. In the break circuit arrangement of pendulum key and Morse instrument the markings appear as breaks in a line which would otherwise be continuous. This combination was em- ployed by Professors Ayrton and Perry in their determination of the acceleration of gravity at Tokio, 1877-78 (Proc. Phys. Soc. London, vol. iii. p. 268).

In the tuning-fork electro-chronograph attributed to Hipp a metal cylinder covered with smoked glazed paper is rotated uniformly by clockwork, a tuning-fork armed with a metallic style being so adjusted that it makes a clear fine line on the smoked paper. The tuning-fork is placed in the secondary circuit of an induction coil, so that when the primary circuit is broken an induced spark removes a speck of black from the paper and leaves a mark. The time period is deduced by counting the number of vibrations and fractions of vibration of the tuning-fork as recorded by a sinuous line on the cylinder. In later forms

of this instrument the cylinder advances as it rotates, and a spiral line is traced. To obtain good results the spark must be very small, for when large it often leaps laterally from the end of the style, and does not give the true position of the style when the circuit is broken. The same arrangement of tuning-fork and revolving cylinder, with the addition of a standard clock, has been used by Mayer (Trans. National Academy of Sciences U. S.A. vol. iii.) and others for calibrating tuning-forks, and comparing their vibrations directly with the beats of the pendulum of a standard clock the rate of which is known. The pendulum makes and breaks the primary circuit by carrying a small platinum wire through a small mercury meniscus. Better and apparently certain contacts can be obtained from platinum contact-pieces,

brought together above the pendulum by means of a toothed wheel on the scape-wheel arbor. Sparking at the contact points is greatly reduced by placing a couple of led plates in dilute sulphuric acid as a shunt across the battery circuit.

For physiological purposes. — Fick's pendulum myograph or mus- cle-trace recorder is described in Vierteljahrschr. der Naturforsch. Ges. in Zurich, 1862, s. 307, and in Text-hook of Physiology, M. Foster, pp. 42, 45. It was used to obtain a record of the contrac- tion of a muscle when stimvilated. In many respects the instru- ment is similar to the electro-ballistic chronograph of Navez. A long pendulum, consisting of a braced metal frame, carries at its lower end a sheet of smoked glass. The pendulum swings about an axis supported by a wall bracket. Previous to an experiment, the pendulum is held on one side of its lowest position by a spring catch ; when this is depressed it is free to swing. At the end of its swing it engages with another spring catch. In front of the moving glass plate a tuning-fork is fixed, also a lever actuated by the muscle to be electrically stimulated. When the pendulum swings through its arc, it knocks over the contact key in the

primary circuit of an induction coil, the secondary of which is in connexion with the muscle. The smoked plate receives the traces of the style of the tuning-fork and of the lever attached to the muscle, and also the trace of an electromagnetic signal which marks the instant at which the primary circuit is broken. After the traces are made, they are ruled through with radial lines, cutting the three traces, and the time intervals between difierent parts of the muscle curve are measured in terms of the period of vibration^ of the tuning-fork, as in other chronographs in which the tuning-fork is employed.

In the spring myograph of Du Bois Beymond (Mnnk's Physiolo- gic der Menschen, p. 398) a smoked glass plate attached to a metal rod is shot by a spiral spring along two guides with a ve- locity which is not uniform. The traces of a style moved by the muscle under examination, and of a tuning-fork, are recorded on the glass plate, the shtjoter during its traverse knocking over one or more electric keys, which break the primary circuit of an induc- tion coil, the induced current stimulating the muscle.

In the photo-electric chronograph devised by Mr G. J. Burch (Journal of Physiology, vol. xviii. p. 125 ; Electrician, vol. xxxvii. p. 436) the rapid movements of the column of mercury in a capillary electrometer used in physiological research are recorded on a sensitive plate moving at a uniform angular velocity. The trace of the vibrating prongs of a tuning-fork of known period is also recorded on the plate, the light used being that of the electric arc. The images of the meniscus of the mercury column and of the moving fork are focussed on the plate by a lens. Excellent results have been obtained with this instrument.

An important development of a branch of chronography is due to Marey {Gomptes Bendus, 7, Aout 1882, and Le Mouvement, par E. S. Marey, Paris, 1894), who employed a photographic plate for receiving successive pictures of moving objects, at definite times, when investigating the movements of animals, birds, fishes, in- sects, and also microscopic objects such as vorticellse. The instrument in one of its forms consisted of a camera and lens. In front of the sensitive plate and close to it a disc, pierced with radial slits, revolved at a given angular

velocity, and each time a slit passed by the plate was exposed. But since, in the time of passage of the space between the slits, the object had moved by a certain amount across the field of view, a fresh impression was produced at each exposure. The object, well illuminated by ^un-tight, moved in front of a black background. Since the ang\ilar .velocity of the disc was known, and the number of slits, the time between the successive positions of the object was also known.

Marey (ia Methode Graphique, pp. 133, 142, 456), by means of pneumatic signals and a rotating cylinder covered with smoked glazed paper, measured the time of the movements of the limbs of animals. The instrument consists of a recording cylinder rotated at a uniform angular velocity by clockwork controlled by a fan governor, and pneumatic signal, constructed thus. One end of a closed shallow cylinder, about 4 em. dia., is furnished with a stretched rubber membrane. A light lever, moving about an axis near the edge of the cylinder, is attached to the centre of the membrane by a short rod, its free end moving as the membrane is distended. The cylinder is connected by a flexible tube with a similar cylinder and membrane, but without a lever, which is attached to that part of the body of the animal the movement of which is under investigation. The system is full of air, so that when the membrane attached to the animal is compressed, the membrane which moves the lever is distended and the lever moved. Its end, which carries a scribing point, iqarks the smoked paper on the rotating cylinder. The pneumatic signal is called by Marey ” tambour k levier.”

Refekences to Chkonooraphic Methods. — (i.) Chronographs used in Physiology : — Helmholtz. Verhandlungen derphysikal- isch-medicinischen Gessellschaft in Wurtzburg. N. F. 1872, Bd. II. S. 147. — Haeless. ” Das Atwood’sche Myographion,” ^h- handlungen der k. Bayerischen Akademie der Wissenschaften. II.

CI. Bd. IX. Abth. 11, Mtinchen, 1862, S. 361.— Fall-Myographion aufgestellt in der Wiener Weltausstellung in der Abtheilung fiir das Unterrichtswesen von Ungam, Budapest, 1873. — Hensen. “Myographion mit vibratorischer Bewegung,” Arbeiten aus dem Kieler

physiol. Instit. 1868, S. 108.— Bkijcke. Sitzungsber. d. Wiener Acad. LXXV. 3. Abth., Sep. Abdr. 1877.— Pfluegek. “Myographion ohne Bewegung,” Untersuchungen uber die Physi- ologic des Electrotonas. S. 106, Berlin, 1859.— Pouillet. Compt. iitencJ. xix. p. 1384. 1844.— Ludwig. ” Kynographion.”— Pflue- GEK. ” Cylinder governed by conical pendulum,” Phys. der Men- schen, Munk. — Young, Thos. “Early form of cylinder chrono- graph,” Life in Motion, M’Kendrick, p. 55. (ii.) Chronographs used in gun work and for other purposes : — Sabine. Phil. Mag. 1876.— Schultz. Moisson, ed. Tanera. Paris. — Paul la Cour. La Roue Phonique. Copenhagen, 1878. — Mach. Collected pa- pers on chronographs, Nature, vol. xlvii. p. 250. — Boys. “Bullets photographed inflight,” B. A. meeting, Edinburgh, 1892 ; reported in Nature, vol. xlvii. p. 415. — Pneumatic Tube Co., Paris. “Chronograph,” Nature, vol. viii. p. 106.— Foster. Nature, vol. xiii. p. 139. — Holden. Nature, vol. xxvi. p. 368.— D’Arson- val. La Lumiere Electrique. 1887.— Dunn. ” The Photo-Re- tardograph,” Journal U. 8. Artillery, vol. vii. p. 29.— ~~Deprez. ” Acca^rographe,” La Methode graphique, Marey, p. 174. Paris, 1878.— Siemens (Werner). ” Electric spark chronograph,” Anna~~ len der Phys., Poggendorff, 66. 1846. (p. j. j.-s.)

Chronological Table. — The following table of the leading events in every country in the world has been prepared in continuation of the table published in the ninth edition of this work, which brought down the record to the close of 1875. It must alvrays be difiieult to determine what events should or should not appear in such a chronicle, but in this brief abstract the aim has been to include rather than to exclude, with a view to making the table a really useful aide-mhnoire : —

1876. Chapter of Knights of the Star of India held by the Prince of Wales in Calcutta, January 1. Death of Francis Deik, January 28. Administrative reform Note presented to Turkey by the Great Powers, January 31. Perak River insurgents defeated by the British, February 4. Prince Bismarck’s reply to the charge of warlike designs, February 10. Purchase of Suez Canal shares voted by the House of Commons, February 21. Don Carlos retires from Spain, February 27. Incorporation of Khokand in the Russian Empire, March 13. Royal

Titles Bill passed by the House of Commons, March 23. Philadelphia Centennial Exhibition opened, May 10. British fleet arrives in Besika Bay, May 26. Turkish massacres in Bulgaria, May. Deposition of Sultan Abdul Aziz, May 30. First railway opened in China, June 3. Death of Lord Sandhurst, June 23 (bom, 1819). Slaughter of United States troops by Sioux Indians, June 25. Death of Miss Harriet Marti- neau, June 27 (born, 1802). Servia and Montenegro declare war against Turkey, July 2. Mr Disraeli created Earl of Beacons- field, August 16. Deposition of Sultan Murad V., August 31. Sir T. Wade's treaty with China ratified, September 17. Gen- eral Tchemaieff proclaims Prince Milan ICing of Servia, Septem- ber 20. Mr Gosohen's financial mission to Egypt, October 14. Spanish army under General Martinez Campos sent to Cuba to suppress the insurrection, October 15. Capture of Alexinatz by the Turks : Russian demand for an armistice between Turkey and Servia, October 31. Speech by Lord Beaconsfleld on the Turkish question, November 9. Porfirio Diaz, having defeated the Govern- ment troops, becomes Provisional President of Mexico, November 20. Death of the Duke of Saldanha, November 21 (bom about 1790). Mr Hayes elected President of the United States, De- cember 6. Meeting in Constantinople of the Plenary Conference on Turkish affairs, December 24.

1877. Queen Victoria proclaimed Empress of India at Delhi, January 1. Turkish issue of £7,000,000 paper money, January 6. National Defence Society formed in Athens, January 7. German general election : majority for National Liberal party, January 10. Continued famine in India announced, January 12. The Porte declines the administrative reform proposals of the Powers, Janu- ary 20. Anti-clerical Bill passed by the Italian Chamber of Depu- ties, January 24. Banishment of the Midhat Pasha, Grand Vizier of Turkey, February 5. Death of Sir W. Fergusson, February 10 (born, 1808). Col. Gordon appointed Governor of the Sudan, February 12. Death of Gen. Changamier, February 14 (bom, 1793). Gen. Porfirio Diaz elected President of Mexico, February 18. Defeat of Japanese rebels near Kagoslma, February 23. Death of Sir Jung Bahadur ot Nepal, February 25. Peace treaty between Turkey and Servia, March 1. Papal allocution on restriction of liberty, March 12. Protocol signed by the Great Powers regarding the eastern question,

March -31. Arrival of Sir Bartle Frere at Cape Town as High Commissioner, March 31. Annexation of

the Transvaal to the British Empire, April 12. Bussia declares war against Turkey, April 24. British reply to Prince Gortohakoffl's circular. May 1. Defeat of Mr Gladstone's motion censuring the Eastern policy of the Government, May 14. Resignation of the French Ministry as the result of a reproof by Marshal MacMahon, May 16. Rumania proclaimed independent. May 21. Death of Marshal Cabrera, May 24 (bom, 1810). Death of Mr J. L. Motley, May 29 (bom, 1814). Bombardment of Kars by the Russians, June 1. Death of Lord Justice Mellish, June 15 (born, 1814). Russians cross the Danube, June 24. Dissolution of the French Chamber of Deputies by Marshal MacMahon, June 26. Russian loan of 200,000,000 roubles, June 26. British fleet returns to Besika Bay, July 5. Death of Yakub Beg of Kashgar, July 11. Turkish massacre at Yeni Saghra, July 15. Russian assault on Plevna repulsed, July 30. Rumanian army crosses the Danube, August 9. Insurrection in Crete, August 17. Russian defeat at Kizil Tepe by Mukhtar Pasha, August 25. Death of Brigham Young, August 29 (born, 1800). Death of Thiers, September 3 (born, 1797). Prosecution of Gambetta, September 11. Death of Admiral Canaris, September 14 (born, 1787). Turkish defeat in the Shipka Pass by General Gourko, September 17. Rout of the Turkish army under Mukhtar Pasha at Aladja Dagh by the Rus- sians, October 15. Resignation of the Duo Decazes, October 30. Death of Field-Marshal von Wrangel, November 1 (born, 1784). Karsstormed by the Russians, November 18. Marshal MacMahon's " Cabinet of Business," November 23. Canadian fisheries award, November 24. Bill abolishing capital punishment passed by the Italian Chamber of Deputies, November 28. Fall of Plevna, Decem- ber 10. Turkish appeal to the Powers to mediate, December 12. Servian declaration of independence and war against Turkey, De- cember 13. State visit of Queen Victoria to Lord

Beaconsfleld at Hughenden, December 15. Passage of the Balkans by General Gourko, December 29.

1878. Native rising in the Transvaal, January 1. Death of General la Marmora, January 6 (born, 1804). Death of King Victor Emmanuel, January 9 (born, 1820) . Surrender of Vesoul Pasha's army to the Russians in the Shipka Pass, January 9. Russian occupation of Adrianople, January 20. Arrival of Cleo- patra's Needle in the Thames, January 21. Marriage of King Alfonso XII., January 23. British fleet at the Dardanelles ; resig- nation of Lord Carnarvon, January 25. Great famine in China reported, January 26. Commission of inquiry into Egyptian finances ordered, January 29. Armistice between Russia and Turkey, January 31. Greek troops ordered to occupy Thessaly, Epirus, and Macedonia, February 1. Death of George Cruik- shank, Febraary 1 (born, 1791). Vote of £6,000,000 by the House of Commons to strengthen the army and navy, February 7. Death of Pope Pius IX., February 7 (born, 1792). Occupation of Erzemm by the Russians, February 13. Passage of the Dardanelles by British fleet, February 13. Mr Bland's Silver Bill passed by the U.S. Senate, February 16. Election, of Pope Leo XIII., February 20. Peace between Turkey and Servia, March 2. Treaty of San Stefano, March 3. Bill for the abolition of capital punishment defeated in the House of Commons, March 13. Indian Vemacular Press Act passed, March 14. Loss of the Eurydice, March 24. Death of Sir Gilbert Scott, March 27 (born, 1814). Resignation of Lord Derby, March 28. Circular to the Powers by Lord Salisbury regarding the treaty of San Stefano ; British reserves called out, April 1. Murder of Lord Leitrim, April 2. Indian troops ordered to Malta, April 17. Opening of the Paris Exhibi- tion May 1. Attempted assassination of the German Emperor, by Hodel, May 11. Death of Eari Russell, May 28 (born, 1792). Foundering of the German ironclad Grosser Knrfurst, May 31. Attempt on the life of the German Emperor by Dr Nobiling, June 2 Ano-lo-Turkish Convention signed ; Cyprus to be occupied by Great Britain, June 4. Death of King George of Hanover, June 12 (born, 1819). Opening of the Beriin Congress, June 13. Death of Charles Mathews, actor, June 24 (born, 1803). Death of Queen Mercedes of Spain, June 26 (born, 1860). Fgte de la R6pubhque in France, June 30. Beriin Treaty signed, July 13. ^Cyprus annexed to

the British Empire, July 14. Return of Lord Beacons- field from the Berlin Congress—" peace with honour, July lb. Russian Mission at Kabul, July 22. Austrian occupation of Bosnia and Herzegovina, August. Nihilist tnals at Odessa, Ausust 5. Orange riots at Ottawa, August 12. Death of Queen Christina of Splin, August 21 (bom, 1806). Earthquakes m Holland, Belgium, and Germany, August 27. Reforms promised by the Khedive of Egypt, August 30 Princess Alice disaster, about 700 lives lost, September 3. Abercame colliery explosion, September 11. Cleopatra's Needle erected on the Thames Em-bankment, September 12. British mission to Afghanistan stopped o™ frontier, September 22 City of Gl^gow Bank failure, October 1 Death of Lord Chelmsford, October 5 (bom, 1794). Itoraurs of Lome appointed Governor-General of Canada, October J^Terman Inti-Socialist Bill passed, October 19. Attempt on the life of King Alfonso XII., October 25. British ultimatum to Afghanfetan, November 1. Death of Samuel Phelps, actor. No-

vember6 (born, 1806). .Attempted assassination of King Humbert, November 17. Halifax award paid by America, November 21. War with Afghanistan announced ; capture of Ali Mesjid by the British, November 22. Rumania occupies the Dobrudja, November 26. Peiwar Pass crossed by General Roberts, December 1. Flight of the Ameer Shere Ali, December 13. Death of Princess Alice, Grand Duchess of Hesse, December 14 (born, 1843). British occupation of Jalalabad, December 20. Bulgarian Assembly of Notables elected, December 31. Invention of the microphone and phonograph.

1879. Resumption of specie payments in America, January 2. Marriage of King William III. of Holland to Princess Emma of Waldeck, January 7. Gteneral Roberts enters Kandahar, January 8. Death of Marshal Espartero, January 8 (born, 1791). British advance into Zululand, January 19. Battle of Isandlwhana ; defence of Rorke's Drift, January 22. Resignation of Marshal MacMahon, January 30. Eusso-Turkish treaty of peace signed, February 8. Death of General Peel, February 13 (born, 1799). Numerous assassinations ordered by the King of Burma, February 16. Death of Field-Marshal Count von Roon, February 23 (bom, 1803). Rejection of the " Muzzling Bill " by the German Reich-

stag, March 7. Marriage of the Duke of Connaught, March 13. Russian evacuation of Adrianople, March 20. Zulu defeat at Ginghilova, April 2. Chile declares war against Peru, April 5. Dismissal of European advisers by the Khedive, April 7. Attempted assassination of the Tsar, April 14. Prince Alexander of Battenberg elected Prince of Bulgaria, April 29. Anglo-German treaty for suppression of the African slave trade, April 30. Russian ukase against Nihilism, May 8. Naval engagement between Chilians and Peruvians ofE Iquique, May 21. American Silver Bill passed. May 24. Anglo-Afghan treaty of Gandamak, May 26. Sir 6. Wolseley appointed High Commissioner for Natal and the Trans- vaal, May 26. Prince Louis Napoleon killed by Zulus, June 1 (bom, 1856). Death of the Prince of Orange, June 11 (born, 1840). Deposition of Ismail Pasha ; Tewfik appointed Khedive, June 26. Death of Lord Lawrence, June 27 (bom, 1811). Battle of Ulundi, July 4. Protective TariH Bill passed by the German Reichstag, July 13. Bombardment of Iquique by the Chilians, July 16. Death of Mr Fechter, actor, August 5 (bom, 1823). Resignation of Count Andrassy, August 14. European controllers appointed for Egypt, August 25. Death of General Lazareff, commanding the Russian expedition in Central Asia, August 25. Capture of Cetywayo, August 28. Massacre of Sir L. Cavagnari, suite, and escort at Kabul, September 3. New insurrection in Cuba, Septem- ber 14. International Exhibition opened at Sydney, N.S.W., September 17. British rupture with Burma, October 7. General Roberts enters Kabul, October 12. Abdication of Yakub Khan, Ameer of Afghanistan, October 21. First Legislative Assembly of Bulgaria opened, October 30. Chilian victory at Pisagua, Novem- ber 2. Administrative reforms in Asiatic Turkey ordered by the Sultan, November 20. Death of Mr J. T. Delane, editor of The Times, November 22 (bom, 1817). Capture of Moirosi's Mountain, Zululand, by the British, November 24. Mr Gladstone's Mid- lothian campaign : Edinburgh Music Hall speech, November 25. Marriage of King Alfonso XII., November 29. Attempt on the life of the Tsar near Moscow, December 2. Attempted assassination of LordLytton, December 12. Rout of the Afghans by General Roberts, December 23. The Tay Bridge disaster, December 28. Direct telegraphic communication opened between Great Britain and South Africa, December 29. Attempt to shoot the King and Queen of Spain, December 30.

1880. Death of the Due de Gramont, January 14 (bom, 1819). British defeat of Mohmunds near Dakka, January 15. Spanish Bill abolishing slavery in Cuba passed, January 16. Death of M. Jules Favre, January 20 (bom, 1809). Parliament opened by the Queen, February 5. Attempt to blow up the Tsar at the Winter Palace, February 17. Supreme Executive Commission of protection appointed in Russia, February 24. Irish Distress Relief Bill passed, March 1. Attempt to assassinate Count Loris Melikoff, dictator of Russia, March 3. Capture of MoUendo by the Chilians, March 12. Grand Shereef of Mecca assassinated, March 14. Dis- solution of Parliament, March 24. M. Tricoupis Prime Minister of Greece, March 27. French anti-Jesuit decree, March 29. New German Army Bill passed, April 9. Death of Lord Hampton, April 9 (born, 1799). Death of Dr Kenealy, April 16 (born about 1818). Albanian proclamation of independence, April 19. Afghan defeat at Ahmedkhel, April 19. Great fire at Hull, Ottawa, April 21. Resignation of Lord Beaconsfield, April 21. Mr Gladstone appointed Prime Minister, April 23. Afghan defeat at Charasiab, April 25. Expulsion of foreign Jews from St Petersburg, April 30. French amnesty decree. May 10. Mr Goschen's special mission to Constantinople, May 28. Death of the Empress Maria of Russia, June 3 (born, 1824). Death of Sir Stephen Cave, June 7 (born, 1820). Conference in Berlin as to the Greek and Montenegrin frontiers, June 16. Tichborne claimant's appeal dismissed, June 25. Capture of the Kelly gang of bush- rangers in Victoria, June 28. Diplomatic rupture between Belgium

and the Vatican, June 28. French annexation of Tahiti, June 29. Death of Mr Tom Taylor, July 12 (bom, 1817). Abdurrahman proclaimed Ameer of Afghanistan, July 22. British disaster at Maiwand, July 27. French General Councils election ; 240 Re- publican gains, August 1. Sir Bartle Frere recalled from the Cape, August 1. General Roberts's march from Kabul to Kandahar, August 9. Death of Lord Stratford de Redcliffe, August 14 (born, 1788). Cologne Cathedral completed, August 14. Defeat of Ayub Khan by General Roberts, September 1.

Rising in Basuto- land, September 13. Death of Sir Fitzroy Kelly, September 17 (bom, 1796). Naval demonstration of the Powers at Dulcigno, September 17. Landslip at Naini Tal, September 18. Land League persecution of Captain Boycott, September 22. Murder of Lord Mountmorres, September 25. Melbourne Exhibition opened, October 1. Death of Jacques Offenbach, October 4 (born, 1819). Death of Baron Ricasoli, October 23 (bom, 1809). Rev. Pelham Dale imprisoned under the Public Worship Act, October 30. General Garfield elected President of the United States, November 2. Kurd invasion of Persia, Novembers. Arrest of Mr Pamell for conspiracy, November 3. Great earthquake at Agram, Croatia, November 9. Trial of Nihilists in St Petersburg, November 10. Death of Lord Chief Justice Cockbum, November 20 (born, 1802). Death of Field-Marshal Sir C. Yorke, November 20 (bom, 1790). Surrender of Dulcigno to Montenegro by Turkey, November 26. Penygraig colliery explosion, December 10. The Transvaal pro- claimed a republic by Mr Kruger and others, December 16. Boer attack on British troops at Bronker's Spruit, December 20. Death of George Eliot, December 22 (bom, 1820). Greek refusal of arbitration on the frontier question, December 26. Serious floods in Holland, December 30. Land Lea^e agitation in Ireland ; numerous agrarian outrages.

1881. Employers' Liability Act in force, January 1. Great strike of Lancashire miners, January 14. Attempt to blow up Salford barracks, January 14. Capture of G«ok Tepe by the Russians, January 16. Lima taken by the Chilians, January 21. End of the trial of Mr Pamell and his associates for conspiracy : disagreement of the jury, January 25. Repulse of Sir G. Colley by the Boers at Lang's Nek, January 28. Panama Canal begun, February 1. Removal of Mr ParneL and thirty-four other Irish members from the House of Commons for obstruction, February 3. Death of Thomas Carlyle, Febmary 6 (born, 1795). Battle of Ingogo, February 8. Battle of Majuba ; death of Sir G. Colley, February 27. Irish Coercion Bill passed, March 2. Armistice with the Boers, March 6. Assassination of the Tsar Alexander II., March 13. Peace with the Boers ; surrender of Potchefstroom, March 21, 22. Earthquake at Chios, 5000 lives lost, April 3. European Note to Turkey on the Greek question, April 19. Death of Lord Beaconsfield, April 19 (born, 1805). International monetary conference in Paris, April 19.

British evacuation of Kandahar, April 21. French occupation of Bizerta, April 30. H.M.S. Doterel blown up in the Strait of Magellan, May 4. Ex- pulsion of Mr Bradlaugh from the House of Commons, May 10. Marriage of the Crown Prince Rudolph of Austria, May 10. French treaty with Tunis, May 12. Attempt to blow up the Central Police Station, Liverpool, May 16. Revised edition of the New Testament published. May 17. Prince Leopold created Duke of Albany, May 23. Prince of Rumania crowned king. May 23. Johann Most, proprietor of Die Freiheit, found guilty of incitement to murder. May 25. Fortune Bay fishery award : Great Britain to pay America £15,000, May 28. Great fire at Quebec, June 8. tScrutin de liste rejected by the French Senate, June 9. Attempt to blow up Liverpool Town Hall, June 10. Death of M. Duf aure, June 27 (bom, 1798). President Garfield shot, July 2 ; died, Sep- tember 20 (bom, 1831). Death of Lord Hatherley, July 10 (born, 1801). Capture of Sfax (Tunis) by the French, July 16. Death of Dean Stanley, July 18 (bom, 1815). Convention with the Transvaal : British suzerainty reserved, August 3. Irish Land Bill becomes law, August 22. Mutiny of Egyptian troops imder Arabi Bey, September 9. Evacuation of Thessaly by the Turks, September 15. Meeting of the German and Russian Emperors at Danzig, September 16. General Arthur sworn President of the United States, September 22. Defeat of Ayub Khan by the Ameer Abdurrahman of Afghanistan, September 22. Severn tunnel borings completed, September 27. Death of Baron Haymerle, October 10 (born, 1828). Arrest of Mr Pamell, October 13. Swansea docks opened by the Prince and Princess of Wales, October 18. “No rent” manifesto by the Irish Land League, October 18. The Land League proclaimed an illegal association, October 20. First meeting of the Irish Land Courts, October 20. Death of Professor Bluntschli, October 21 (bom, 1808). Arrest of the Maori chief Te Whiti for sedition, November 6. British North Bomeo Company receives a charter, November 8. M. Gambetta becomes French Premier, November 12. Burning of the Ring Theatre, Vienna, several hundred lives lost, December 8. ” Reign of Terror ” in Ireland.

1882. Death of Mr W. Harrison Ainsworth, January 3 (born, 1805). Death of Mr Bernal Osborne, January 4 (bom, 1814).

Anglo-French Note supporting the authority of the Khedive, January 8. Death of Mr John Linnell, artist, January 20 (born, 1792). Resignation of M. Gambetta's Ministry, January 26. Arabi Pasha appointed Egyptian Minister of War, February 2. Nihilist trials in St Petersburg, February 28. Prince of Wales proposes to found a Royal College of Music, February 28. Attempt to shoot the Queen by R. Maclean at Windsor, March 2. Servia proclaimed a kingdom, March 6. Death of Longfellow, March 24 (bom, 1807). Retirement of Prince Gortchakoff from the Russian Ministry for Foreign Affairs, April 9. Death of Dante Gabriel Rossetti, April 9 (bom, 1828). Death of Darwin, April 19 (bom, 1809). Marriage of the Duke of Albany to Princess Helen of Waldeck-Pyrmont, April 27. Death of Ralph Waldo Emerson, April 27 (born, 1803). Earl Spencer appointed Lord-Lieutenant of Ireland, April 28. Murder of Lord Frederick Cavendish, Secretary for Ireland, and Mr T. A. Burke, Under-Secretary, in Phcenix Park, Dublin, May 6. Death of General Kaufmann, con- queror of Turkestan, May 12 (born, 1818). New Eddystone Light- house opened by the Duke of Edinburgh, May 18. Anglo-French ultimatum to Egypt ; removal of Arabi Pasha and resignation of the Ministry demanded. May 25. Reappointment of Arabi Pasha as Egyptian Minister of War, May 28. Death of Garibaldi, June 2 (bom, 1807). Riot at Alexandria, many Europeans killed, June 11. Death of General Skobeleff, July 7 (bom, 1843). Bombard- ment of the Alexandria forts by the British fleet, July 11 ; marines landed, July 17. Irish Prevention of Crimes Bill passed, July 11. British vote of credit for an expedition to restore order in Egypt, July 27. The French Chamber decline to furnish funds for the protection of the Suez Canal, July 29. Death of Professor Jevons, August 13 (bom, 1835). Arrival in Egypt of Sir G. Wolseley, commanding the British expedition against Arabi Pasha, August

15. Massacre of the Joyce family at Maamtrasna, Galway, August 17. Suez Canal held by British troops, August 19. Battle of Kassassin, August 28. Death of Sir G. Grey, September 9 (bom, about 1798). Rout of the Egyptian army at Tel-el-Kebir, Septem- ber 13. Occupation of Cairo by the British and surrender of Arabi Pasha, September 14. Death of Dr Pusey, September 16 (bom, 1800). Return of the Khedive to Cairo, September 25. Attempted assassination of Mr Justice Lawson in

Dublin, Novem- ber 12. Review of the army from Egypt by the Queen in St James's Park, November 18. Arabi Pasha banished from Egypt for life, December 3. Death of Archbishop Tait, December 3 (bom, 1811). Royal Courts of Justice opened by the Queen, December 4. Death of Louis Blanc, December 6 (bom, 1811). Death of Anthony TroUope, December 6 (born, 1815). Great fire in Wood Street, Cheapside, December 8. Belt v. Lawes libel case : £5000 damages for plaintiff, December 28. Death of Gambetta, December 31 (bom, 1838).

1883. Married Women's Property Act in force, January 1. Death of General Chanzy, January 4 (born, 1823). Arrest of Prince Napoleon for publishing a manifesto against the Republic, January

16. Death of Gustave Dor6, January 22 (born, 1832). Cetywayo restored King of Zululand, January 29. Mr Davitt, Mr Healy, and Mr Qulnn imprisoned for sedition, February 8. Death of Sir Salar Jung, February 8. Death of Professor Henry Smith, February 9 (born, 1827). Murderers of Lord F. Cavendish and Mr Burke identified, Febmary 10 ; James Carey turns informer, February 11. Death of Richard Wagner, February 13 (bom, 1813). M. Jules Ferry, Premier of France, February 21. Orleanist princes removed from the French army, February 25. Death of Mr J. R. Green, historian, March 7 (born, 1887). Death of Prince Gortcha- koff, March 11 (bom, 1798). Death of Karl Marx, March 14 (bom, 1818). Attempts to blow up the Local Government Board oflice and The Times office with dynamite, March 15. Lord DufEerin's Egyptian reform scheme published, March 20. Death of Sir G. Jessel, March 21 (born, 1824). Two infernal machines seized at Liverpool, March 28. Murder of M. de Majlath, Chief Justice of Hungary, March 29. Louise Michel arrested in Paris for incitement to plvmder, March 29. Explosives Bill passed, April 9. Trial of Irish " Invincibles," April 10. Impeachment of the Norwegian Ministry, April 23. Death of Prince Batthyany, April 25 (bom, 1804). Amsterdam International Exhibition opened. May 1. Death of Lord Justice Deasy, May 6 (bom, 1812). Opening of the Royal College of Music by the Prince of Wales, May 7. Mr Kruger elected President of the Transvaal, May 9. Condemnation of the Land League by the Pope, May 11. Inter- national Fisheries Exhibition, South Kensington, opened by the Prince

of Wales, May 12. Execution of five of the Phoenix Park murderers. May 14-June 9. Lord Lansdowne appointed Governor- General of Canada, May 21. French force under Commander Rivifere destroyed by “Black Flags” at Ha Noi, Tongking, May 20. French bombardment of Mojanga, Madagascar, May 24. Coronation of the Tsar Alexander III., May 27. Bombardment and capture of Tamatave, Madagascar, by the French, June 13. Death of Bishop Colenso, June 20 (bom, 1814). Death of Sir Wm KnoUys, June 24 (born, 1797). Death of Mr W. Spottis- woode, June 27 (born, 1825). Prussian modification of the ” Falk

CHRONOLOGICAL TABLE

Laws,” July 2. Captain Webb drowned in attempt to swim Niagara Rapids, July 24. James Carey, Irish informer, shot, July 29. Spanish miliUry risings suppressed, August 4-9. Death of Dr R. Moflat, August 9 (born, 1796). Death of the Comte de Chambord, August 24 (born, 1820). French protectorate over Tongking and Annam, August 25. Eruption of Krakatoa : many thousand lives lost, August 27. Death of Ivan Turguenieff Sep- tember 3 (bom, 1818). Riot at Canton, European quarter sacked September 11. German war monument unveiled on the Nieder- wald, Rildesheim, September 27. King Alfonso of Spain insulted by a Pans mob ; apology by President Gr6vy, September 29, 30. Surrender of Cetywayo to the British, October 16. Death of Cap- tain Mayne Reid, October 22 (bom, 1819). Peace between Chile and Peru, October 20. Hicks Pasha’s army destroyed by the Mahdi at El Obeid, November 3. Death of Lord Overstone No- vember 17 (born, 1796). Death of Sir William Siemens, Novem- ber 18 (bom, 1823). Death of Signor Mario, December 11 Irish ” national tribute ” of £38,000 presented to Mr Pamell in Dublin December 11. Capture of Son Tai, Tongking, by the French’ December 18. Ten dynamiters sentenced to penal servitude at Glasgow, December 21. Assassination of Colonel Soudeikin, chief of the Russian police, by Nihilists, December 28. Australian federation movement. Internal troubles in Austria^Hungary

1884. Dismissal of the Egyptian Ministry of Sherif Pasha, Janu- ary 7. The Poet Laureate created Lord Tennyson, January 16. General Gordon sent to Khartum on a special mission, January is! The Ilbert Bill passed by the Calcutta Legislative Council, January 25. Death of M. Rouher, February 3 (born, 1814). Defeat of Baker Pasha by Osman Digna near Tokar, Febmary 4. Death of King Cetywayo, Febmary 8. Arrival of General Gordon at Khar- tum, February 18. Death of Mr T. Chenery, editor of The Times, February 12 (born, 1826). Retbement of Sir H. Brand from the Speakership of the House of Commons ; Mr A. Peel chosen to succeed him, Febmary 25, 26. Dynamite explosion at Victoria railway station, Febmary 26. Convention between Great Britain and the Transvaal signed in London, Febmary 27. Sudanese defeated at EI Teb by General Graham, Febmary 29. Defeat of Osman Digna at Tamanieb by General Graham, March 13. Death of the Duke of Albany at Cannes, March 28 (bom, 1853). Great fire at Mandalay, April 2. Death of Charles Reade, April 11 (born, 1814). Death of Sir Michael Costa, April 29 (born, 1810). German Protectorate over Angra-Pequeiia, April 24. Health Exhibition opened at South Kensington, May 8. Provisional treaty of peace between France and China, May 11. Fall of Berber, May 23. Admiral Hewett's treaty with Abyssinia, May 26 (about). Death of Sir Bartle Frere, May 29 (born, 1815). Dynamite explo- sions in St James's Square and Scotland Yard, May 30. Marriage of the Grand Duke Serge of Russia to Princess Elizabeth of Hesse, June 15. Railways sanctioned by the Chinese Government, June 20. Death of the Prince of Orange, June 21 (born, 1851). Col- lision between French and Chinese at Lang Son, June 23. Euro- pean conference on Egypt meets in London, June 28. Interna- tional Forestry Exhibition opened in Edinburgh, July 1. Death of General Todleben, July 1 (born, 1818). Death of the Rev. Mark Pattison, July 30 (born, 1813). International Conference on Education opened at South Kensington, August 4. Bombardment of Ki-lung, Formosa, by the French, August 6. Death of Sir Erasmus Wilson, August 8 (bom, 1809). Death of Lord Ampthill, August 25 (bom, 1829). French attack on Foo-chow, August 26-28. Lord Northbrook leaves London for Egypt on a financial mission, August 31. Political riots in Brussels and Antwerp, September 7. Arrival of Lord Wolseley in Cairo to command an expedition to Khartum, September 9. Lord Dufferin

appointed Viceroy of India in succession to Lord Kipon, September 10. Revival of the ” League of the Three Emperors,” September 15. Wreck of H.M.S. Wasp at Tory Island, 52 lives lost, September 22. Colonel Stewart, Mr Power, M. Herbin, and about forty men massacred by Arabs on the Nile, reported October 6. Death of Mr Fawcett, November 6 (born, 1833). British protectorate over part of New Guinea, November 6. Mr Cleveland elected President of the United States, November 7. Berlin Conference on West African afiairs opened, November 15. Imperial Federation League formed, No- vember 18. Finney u.Garmoyle, breach of promise case, plaintiff awarded £10,000, November 20. Adams v. Coleridge, libel case, plain- tiffawarded £3000 damages ; verdict reversed by Mr Justice Manisty, November 22. Rising in Korea, December 4. Franchise Bill passed, December 6. Attempt to blow up London Bridge with dynamite, December 13. Arrival of Lord Wolseley at Korti, on the Nile, De- cember 15. Earthquakes in Spain, over 1000 lives lost, December 25-31. Sir P. Lumsden’s Afghan frontier mission. British expedi- tion to Bechuanaland under Sir C. Warren. Skye crofters’ a^tation. 1885. Death of Cluny Macpherson, January 10 (bom, 1805). Battle of Abu Klea ; Colonel Fred. Bumaby killed, January 17 (born, 1842). Battle near Metammeh ; General Stewart wounded, January 19. Dynamite outrages at the Houses of Parliament and the Tower, January 24. Fall of Khartum ; General Gordon killed,

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January 26 (bom, 1833). Wreck of Sir C. Wilson’s steamers re- turning from Khartum ; rescue by Lord Charles Beresford, January 28- Febmary 9. Defeat of Sudanese at Kirbekan ; General Earle killed, February 10 (born, 1833). Capture of Lang Son, Tongking by the French, Febmary 12. Death of General Sir H. Stewart at Gakdul, Febmary 16 (bom, 1843). Sir C. Warren Military Governor of Bechuanaland, Februa,ry 23. New South Wales troops leave Sydney for the Sudan, March 3. Lord Wolseley’s army at Korti, March 12. Arab attack on Sir J. M’Neill’s force near Suakin, March 22. Death of Sir Hany Parkes, March 22 (born, 1828). British reserve forces called out, March 26. Chinese recapture Lang Son, March 28. Fall of M. Ferry’s

Ministry, March 30. Russians under General Komarofl attack Afghan positions on the Kushk, March 30. Visit of the Ameer of Afghanistan to Lord Dufferin at Rawal Pindi, March 31. Death of Lord Caims, April 2 (bom, 1819). Prince and Princess of Wales visit Ireland, April 7. Rising of half-breeds and Indians under Louis Eiel in Canada, April 24. Opening of the International Inventions Exhibition, South Kensington, May 4. Death of Sir Watkin Williams Wynn, May 9 (Jorn, 1820). Capture of Louis Riel, May 15. Publication of the Revised Version of the Bible, May 18. Vote of credit of £11,000,000 passed. May 20. Death of Victor Hugo, May 22 (born, 1802). Death of Sir Julius Benedict, June 6 (bom, 1804). Peace between France and China, June 9. Redistribution Bill passed, June 12. Resignation of Mr Gladstone, June 12. Lord Salisbury appointed Prime Minister, June 15. Evacuation of Dongola by the British, June 15. Death of Prince Frederick Charles of Prussia, June 15 (bom, 1828). Death of Field-Marshal Manteuffel, June 17 (born, 1809). Death of the Mahdi reported, about June 20. Opening of the Hull and Bamsley railway, July 16. Death of General Grant, July 23 (born, 1822). Marriage of Princess Beatrice to Prince Henry of Battenberg, July 23. Death of Sir Moses Monteflore, July 28 (born, 1784). Panjdeh sur- rendered to Russia. German occupation of one of the Caroline Islands, August 14. Expiration of the Crimes Act, August 14. Sir H. D. Wolff's Egjrptian mission to Constantinople, August 22. Meeting of the Austrian and Russian Emperors at Kremsier, August 25. Severn tunnel completed, September 5. First inter- national yacht race off New York, won by the American yacht Puritan, September 14. Union of Eastern Rumelia to Bulgaria proclaimed, September 18. Death of Lord Shaftesbury, October 1 (bom, 1801). Death of Lord Strathnaim, October 16 (bom, 1803). Conference in Constantinople on the Eastern question, November 5. British ultimatum to Burma; advance of General Prender- gast's force, November 9. War declared between Servia and Bulgaria, November 13. Battle of Slivnitza, November 17-19. Dis- solution of Parliament, November 18. Death of Marshal Serrano, November 25 (bom, 1810). Death of King Alfonso XII., Novem- ber 26 (born, 1857). Surrender of King Thebaw of Burma ; occu- pation of Mandalay, November 27, 28. Death of Mr W. H. Van- derbilt, December 8 (bom, 1821). Federation favoured by the Australasian Colonies, excepting New South Wales and New Zealand,

December 9. Death of King Ferdinand of Portugal, December 15 (bom, 1816). M. Gr6vy re-elected President of the French Ilepublic, December 28. Sudanese defeat at Kosheh, December 30. British general election ; Liberal success. Revival of Irish Nationalist tyranny.

1886. Upper Burma annexed by Great Britain, January 1. Mersey tunnel opened by the Prince of Wales, January 20. Parliament opened by the Queen, January 21. Defeat of Lord Salisbury's Government on the agricultural labourers' holdings question; return of Mr Gladstone to power, January 28-Feb- ruary 1. Social Democratic riots in London, Febmary 8. Craw- ford V. Crawford and DUke divorce case, decree nisi granted, February 12. Death of Randolph Caldecott, February 12 (born, 1846). Death of Lord Cardwell, Febmary 15 (born, 1813). Suspension of the Commercial Bank of South Australia, February 24. Peace signed between Servia and Bulgaria, March 3. Death of Archbishop Trench, March 28 (born, 1807). Guildhall meeting to protest against the proposed Irish Home Rule Bill, April 2. Death of Mr W. E. Forster, April 5 (bom, 1818). Conference of the Powers in Constantinople; Prince Alexander of Battenberg nominated Govemor-Greneral of Eastern Rumelia, April 5. Euro- pean ultimatum to Greece to cease arming against Turkey, April 26. Colonial and Indian Exhibition opened by the Queen, May 4. Socialist riots at Chicago and Milwaukee, May 4, 5. European blockade of Greek ports. May 8. British evacuation of Suakin, May 16. Death of Lord Farnborough, May 17 (bom, 1815). Death of Leopold von Eanke, historian, May 23 (bom, 1795). Serious riots in Belfast, June 6. Irish Home Rule Bill rejected by the House of Commons, June 8. Eruption of Mount Tarawera, New Zealand; the "Pink Terraces" destroyed, June 9. Suicide of King Ludwig of Bavaria at Tegernsee, June 16 (bom, 1845). Death of the Maharajah Holkar of Indore, June 17 (bom, 1832). Death of the Maharajah Scindia of Gwalior, June 20 (born, 1835). French Princes' Expulsion Bill passed, June 22.

Dissolution of Parliament, June 26. General election ; Conserva- tive victory. Eesignatlon of the Gladstone Cabinet, July 21. British convention with China, July 24. Death of Liszt, July 31 (born, 1811). Lord Salisbury's Ministry accept seals of office : Lord R. Churchill Chancellor of the Exchequer, August 3. Conspiracy at Sofia ; Prince Alexander kidnapped, August 21. Abdication an- nounced, September 4. Death of the Due Decazes, September 16 Cborn, 1819). Death of Mr J. L. Hatton, September20 (born, 1809). Death of Lord Monkswell, October 27 (born, 1817). Irish " Plan of Campaign " proclaimed unlawful, December 18. Lord R. Churchill resigns the Chancellorship of the Exchequer, December 23.

1887. Death of Serjeant Ballantine, January 9 (born, 1812). Death of Lord Iddesleigh, January 12 (bom, 1818). Meetings at St James's Palace and the Mansion House to found an Imperial Institute, January 12. Meeting of the " Round Table Conference ' ' at Sir W. Harcourt's house, January 14. Mr H. M. Stanley leaves London to relieve Emin Pasha, January 21. Death of Sir Joseph Whitworth, January 22 (born, 1803). Serious riots at Belfast, January 29. Queen Victoria's Jubilee celebrated in India, February 16. Earthquake on the Riviera, many lives lost, February 22. Death of Father Beckx, formerly " General" of the Jesuits, March 4 (bom, 1794). German Army Bill passed by the Reichstag, March 9. Triple Alliance said to have been signed, March 13. British Colonial Conference at the Foreign Office, April 4. Arrest of M. Schnaebele, French Commissary at Pagny, by Germans on the frontier, April 20. Defeat of dervishes by Egyptians at Sarras, April 29. Jubilee Exhibition at Manchester opened by the Prince and Princess of Wales, May 4. Address of congratulation presented to the Queen by the Lord Mayor and Corporation of London, May 9. Inaugural stone of the North Sea and Baltic Canal laid by the German Emperor, June 3. Fiftieth anniversary of Queen Victoria's accession to the throne, June 20. General celebration of the Queen's jubilee; State procession from Buckingham Palace to Westminster Abbey, June 21. British annexation of East Zululand, June 21. Metropolitan school children visited by the Queen in Hyde Park, June 22. " Women's Jubilee Offering" of £75,000 accepted by the Queen, June 22. Jubilee thanksgiving in St Paul's Cathedral, June 23. Review of volunteers by the Queen at Buckingham

Palace, July 2. First stone of the Imperial 6istltute laid by the Queen, July 4. Prince Ferdinand of Saxe-Coburg elected Prince of Bulgaria, July 7. Irish Crimes Bill passed by the House of Commons, July 8. Great review at Aldershot by the Queen, July 9. Death of Herr Krupp, July 13 (born, 1810). Russo-Afghan boundary settled, July 20. Naval review at Spithead, July 23. Death of Michael Katkoff, editor of the Moscow Gazette, August 1 (born, 1820). Meeting of the German and Austrian Emperors at Gastein, August 6. Offer by the Nizam of Haidarabad of £200,000 a year for three years for Indian North- West frontier defences, August 26. Trafalgar Square demonstration against the proclamation of the Irish National League, August 27. Nationalist riot at Mitchels- town, September 9. Centenary of the United States Constitution celebrated, September 15-17. Mr W. O'Brien, M.P., sent to prison for incitement to resist the law, September 24. Anglo- French Convention neutralizing the Suez Canal, October 24. French agree to withdraw from the New Hebrides, October 24. Lord Lytton appointed British Ambassador to France, October 29. Death of Sir G. Macfarren, October 31 (bom, 1813). Death of Jenny Lind, November 2 (born, 1820). Death of Lord Wolverton, November 6 (bom, 1824). Surrender of Ayub Khan to the Indian Government, November 9. Great riot in Trafalgar Square, November 13. Death of Lord and Lady Dalhousie, November 24, 25. Quetta and other districts incorporated as British Baluchistan, November. Resignation of M. Gr^vy, President of the French Republic ; succeeded by M. Sadi Camot, December 2. Death of Lord Lyons, December 5 (born, 1817). Attempt to murder M. Jules Ferry, December 10. Articles on "Parnellism and Crime " published by The Times, March-June.

1888. One hundredth anniversary of 27ie Times, January 1. New South Wales centenary celebrated, January 24. Death of Sir Henry Maine, February 3 (born, 1822). Austro-German alliance of 1879 published, February 3. German Army Bill (increase of 700,000 men) passed, February 8. Resignation of the Viceroyalty of India by Lord Dufferin ; Lord Lansdowne ap- pointed, February 8. Canadian Fisheries Treaty signed in Washington, February 15. Death of the Emperor William I., March 9 (born, 1797). General Boulanger removed from the French army, March 27. Death of Matthew Arnold, April 15 (bom, 1822).

Panama Canal Lottery Loan Bill passed by the French Chamber of Deputies, April 28. Glasgow International Exhibition opened by the Prince of Wales, May 8. Tibetans defeated by the British at Gnatong, May 23. Death of Marshal LeboBuf, June 7 (bom, 1809). Lord Stanley of Preston sworn in as Governor-General of Canada, June 11. Death of the Emperor Frederick, June 15 (born, 1831). Duel between M. Floquet and General Boulanger, July 13. Death of Sir J. H. Brand, President

of the Orange Free State, July 14 (born, 1823). Armada tercen- tenary, July 19. Meeting of the Emperor William II. and the Tsar oft Kronstadt, July 19. Death of General Sheridan, August 6 (born, 1831). Local Government Bill passed, August 9. Defeat of Italians by Abyssinians at Sanganeiti, August 13. Meeting between Prince Bismarck and Signer Crispi at Friedrichsruh, August 21. Retaliatory measures against Canada recommended by President Cleveland, August 24. Imperial British East Africa Company chartered, September 7. Defeat of Ishak Khan by the Ameer of Afghanistan, September 29, 30. Black Mountam Expedition : British successes, October 4, 5, 9, and 18 ; final submission of tribes, November 18. Visit of the German Emperor to the Pope, October 12. Opening of the Special Commission appointed to examine into the charges made by J%e Times in "Parnellism and Crime," October 22. Marriage between King Milan and Queen Natalie dissolved, October 24. General Harrison elected President of the United States, November 6. Death of Lord Lucan, November 10 (born, 1800). Death of Sir R. Baggallay, November 13 (born, 1813). Anglo-German blockade of Zanzibar on account of the slave trade, December 2. British victory at Suakin, December 20. Death of Count Loris Melikoff, December 22 (born, 1835). Suez Canal Convention ratified by the Powers, December 22. Death of Lord Eversley, December 28 (bora, 1794) . Rising in Zululand ; surrender of Dinizulu, July-November. Continued Irish agitation. Separation movement in Wales.

1889. Death of the Crown Prince of Austria, January 30 (born, 1858). Anti-rent riot near Gweedore ; DistricHnspector Martin murdered by the mob, February 3. Mr Pamell's Scottish action against TTie Times dismissed, February 5. New Japanese con- stitution proclaimed,

February 12. Collapse of the Paris copper syndicate ; panic checked by Government and other support, March 5-9. Abdication of King Milan of Servia, March 6. French decree of banishment against the Due d'Aumale dismissed, March 9. Abyssinians defeated by the Mahdi, March 10-12. Death of Mr John Bright, March 27 (born, 1811). Meeting between Queen Victoria and the Queen-Regent of Spain at San Sebastian, March 27. Flight of General Boulanger from Paris, April 1. Death of the Duchess of Cambridge, April 6 (born, 1797). Death of Father Damien, missionary to the Sandwich Island lepers, April 10 (bom, 1841). Conference on Samoa in Berlin, April 29. Murder of Dr Cronin in Chicago by members of the Clan-na^Gael, May 4. Centennial celebration of the opening of the States General at Versailles, May 4. Opening of the Paris Exhibition, May 6. Death of Lord Sidney Godolphin Osborne, May 9 (born, 1808). Great floods in Pennsylvania, about 10,000 lives lost. May 31. Delagoa Bay railway seized by Portugal, June 25. Arrival of the Shah of Persia at Gravesend, July 1. Defeat of dervishes at Arguin by Colonel Wodehouse, July 2. Marriage of the Princess Louise of Wales and the Duke of Fife, July 27. Visit of the German Emperor to Queen Victoria at Osborne, August 2. Rout of dervishes at Toski by General Grenfell, August 4. Mrs Maybrick convicted of poisoning her husband at Liverpool, August 7. Death oi Signer Cairoli, Italian statesman, August 8 (born, 1826). Sentence of perpetual imprisonment passed upon General Boulanger by the Paris High Court, August 12. Great strike of London dock labourers, August 15 (ended September 16). French general election ; Republican success, September 22. Death of Wilkie Collins, September 23 (born, 1824). Death of General Faidherbe, September 29 (bom, 1818). Death of the King of Portugal, October 9 (bom, 1838). Charter granted to the British South Africa Company, October 15. Visit of the German Emperor and Empress to Constantinople, November 2. Death of Lord Falmouth, November 6 (bom, 1819). Forth Bridge com- pleted, November 6. Revolution in Brazil ; deposition of the Emperor, republic proclaimed, November 15. Anti-slavery Conference opened in Brussels, November 18. Close of the Parnell Commission, after sitting for 129 days, November 22. Arrival of Mr Stanley and Emin Pasha at Bagamoyo from Central Africa, December 4. Death of Jefferson Davis, December 6 (bom, 1808). Death

of Robert Browning, December 12 (born, 1812). Collapse of the Panama Canal Company, December 14. Death of Count Karolyi, December 26 (born, 1825). Disturbances in Crete.

1890. Death of Dr DoUinger, January 10 (born, 1799). British ultimatum respecting East Africa accepted by Portugal, January 12. Death of Lord Napier of Magdala, January 14 (born, 1810). Death of Sir William Gull, January 29 (bom, 1816). Federation of shipowners formed, February 4. South Metropolitan Gas Company's strike ended, February 5. Parnell Commission report issued, Febuary 13. Death of Count Julius Andrassy, February 18 (born, 1823). Forth Bridge opened, March 4. Resignation of Prince Bismarck, March 17. General von Caprivi appointed German Chancellor, March 19. Arrival of Mr H. M. Stanley in England from Africa, April 26. Return of Prince Albert Victor from India, May 2. Anglo-German agreement with reference to Africa and Heligoland signed in Berlin, July 1. Anti-Jewish edicts in Russia, July 25. Anglo- French Convention with refer-

ence to Africa signed in Paris, August 6. Heligoland formally transferred to Germany, August 9. Death of Cardinal Newman, August 12 (born, 1801) . Death of M. Chatrian, September 3 (born, 1826). Revolution in Manipur, September 21. M'Kinley Tariff Bill became law, October 1. Death of Sir Richard Burton, October 20 (bom, 1821J. Constitution of West Australia pro- claimed, October 22. Fmanoial crisis in London ; suspension of Baring Brothers averted by the help of the Bank of England and leading financial houses, November 14, 15. Decree in the divorce suit of O'Shea v. O'Shea and Parnell, November 17. Judgment by the Archbishop of Canterbury in the Bishop of Lincoln's case, November 21. Death of King William III. of the Netherlands, November 23 (bom, 1817). Letter from Mr Gladstone to Mr John Morley regarding Mr Pamell's leadership of the Irish party, November 24. Disruption of the Irish parliamentary party, December 6. Arrival of the Cesarevitoh at Bombay, December 24. Death of Dr

Schliemann, December 27 (born, 1822). Death of Octave Feuillet, December 29 (aged 70).

1891. Death of A. W. Kinglake, January 2 (aged 79). Naval revolt in Chile against President Balmaceda, January 7. Death of Charles Bradlaugh, January 27 (born, 1833). Death of Meissonier, January 31 (aged 75). Death of General Sherman, February 14 (born, 1820). Tokar captured by Egyptian troops, February 19. Successes of Chilian insurgents, February 15-20. Australasian Federal Convention at Sydney opened, March 2. Death of Dr Windthorst, March 14. Reverse to British troops in Manipur, March 25. Boer trek into Mashonaland stopped, April 22. Death of Field-Marshal Count von Moltke, April 24. Manipur occupied by British expedition, April 27. Death of Sir J. Maodonald, June 6 (born, 1815). Anglo-Portuguese treaty with reference to East Africa signed at Lisbon, June 11. Regent and Senaputty of Manipur found guilty of waging war against the Queen, June 20. Triple Alliance renewed for six years, June 28. Arrival of the German Emperor and Empress in England, July 4. Free Educa- tion Bill read a third time in the Commons, July 8. Visit of the French fleet to Kronstadt, July 23. Death of J. R. Lowell, August 12 (born, 1819). Execution of the Senaputty of Manipur, August 13. Arrival of French squadron at Spithead, August 19. Capture by Chilian insurgents of Valparaiso, August 27, and Santiago, August 31. Death of ex-President Gr^vy, September 9 (born, 1807)i Suicide of ex-President Balmaceda, September 19. Suicide of General Boulanger, September 30 (born, 1837). Meet- ing of the National Liberal Federation at Newcastle-on-Tyne, Octo- ber 1. Death of Mr W. H. Smith, October 6 (born, 1825). Death of Mr C. S. Parnell, October 6 (born, 1846). Mr A. J. Balfour becomes leader of the House of Commons, October 15. Severe earthquake in Japan, October 28. Death of the Earl of Lytton, November 24 (bom, 1831) . Mongolian rebels defeated by Chinese, December 6. Betrothal of the Duke of Clarence to Princess May of Teok announced, December 7.

1892. Death of the Khedive Tewfik, January 7 (bom, 1852). Death of the Duke of Clarence, January 14 (bom, 1864). Death of Cardinal Manning, January 14 (born, 1808). Death of Mr C. H. Spurgeon,

January 31 (born, 1834). Death of Professor Freeman, March 16 (bom, 1823). Death of Walt Whitman, March 26 (born, 1819). Bering Sea modus vivendi ratified, April 18. Ravachol, French dynamiter, condemned to penal servitude for life for murder and conspiracy, April 26. Terrible hurricane at Mauritius, April 29. Death of Lord Bramwell, May 9 (born, 1808). Irish Local Government Bill read a second time in the Commons, May 24 (abandoned, June 13). Durham miners' dispute settled after lasting ninety days, June 1. Ravachol sen- tenced to death for murder, June 23. British Parliament dissolved, June 28. Great fire at St John's, Newfoundland, July 8. Execution of Ravachol, July 11. Archbishop of Canterbury's decision in Bishop of Lincoln's case upheld by the Privy Council, August 2. Meeting of Parliament, August 4. Defeat of Lord Salisbury, August 11, Mr Gladstone forming a Liberal administration. Death of J. G. Whittier, September 7 (born, 1807). Failure of com- panies connected with the Liberator Building Society, Septem- ber 8. Behanzin, King of Dahomey, defeated by the French under Colonel Dodds, October 4. Death of Lord Tennyson, October 6 (born, 1809). Lancashire cotton strike, October 5. Mr Cleveland, Democrat, elected President of the United States, October 8. Defeat of the French Ministry in connexion with the Panama scandals, November 21. Warrants issued for arrest of Panama directors, December 16. Death of Sir Richard Owen, December 18 (bom, 1804). .

1893. Khedive's anti-British Ministers dismissed, January 17. MM. Lesseps sentenced for Panama frauds by Court of Appeal, February 9. Home Rule Bill introduced in the Commons, Feb- ruary IB. Death of John Pettie, B-A., Februaxy 21 (born^ 1839) Death of M. Taine, March 5 (born, 1828). Death of M. Jules Feriy, March 17 (bom, 1832). Sir G. Portal's mission reaches Mengo (Uganda), March 17. Panama bribery trial concluded, March 21. ^ Australian bank failures, April 4-May 9 Hull dock strike riots, April 5. Death of Lord Derby, April 11 (bom, 1826).

Serious earthquake in Zante, April 17. Home Rule Bill passed second reading, April 21. Chicago World's Fair opened, May 1. Hull dock strike ended, May 19. Loss of H.M.S. Victoria, June 22. Nansen's Polar expedition started, June 24. Indian legis- lation fixing value of rupee,

June 26. Death of Guy de Maupas- sant, July 4 (aged 43). Marriage of the Duke of York, July 6. French ultimatum to Siam, July 20. Great colliery strike began, July 28. French ultimatum accepted by Siam, August 1, Bering Sea award delivered, August 15. Duke of Edinburgh succeeded to duchy of Coburg, August 22. Home Rule Bill read a third time in the Commons, September 1. Featherstone strike riot, September 7. Home Rule Bill rejected by the Lords, September 8. War with the Matabele begun, October 2. Sir M. Durand's mission at Kabul, October 2. Death of Ford Madox Brown, October 6 (born, 1821). Russian fleet at Toulon, October 13. Death of Marshal MacMahon, October 17 (born, 1808). Death of M. Gounod, October 18 (bom, 1818). Decisive victory over the Matabele, November 2. Death of Peter Tschaikowsky, Novem- ber 4 (aged 53). Coal strike ended, November 17. Death of Prince Alexander of Bulgaria, November 17 (born, 1857). Major Wilson and thirty-four men pursuing Lo-Bengula surrounded and killed on Shangani river, December 3. Death of John Tyndall, December 4 (bom, 1820). Bomb outrage in French Chamber by » Vaillant, December 9. Death of Benjamin Jowett, December 12 (born, 1817). Collision between British and French troops at Waima, West Africa, December 23. Matabeleland thrown open to prospectors, December 25. Rio bombarded by Brazilian rebels, December 28.

1894. Manchester Ship Canal opened for traffic, January 1. Serious riots in Sicily, January 2. Death of M. Waddington, January 13 (bom, 1826). Jabez Balfour arrested in Argentina, January 22. Death of Sir Gerald Portal, January 25 (born, 1858). Vaillant guillotined, February 5. Bomb outrage at Terminus Caf6, Paris, February 12. Anarchist killed in Green- wich Park by bomb explosion, February 15. Death of Lo- Bengula, Febmary 16. Resignation of Mr Gladstone, March 3, Lord Rosebery succeeding as Prime Minister. Bomb outrage at the Madeleine, Paris, March 15. Death of Louis Kossuth, March 20 (born, 1802). Bomb explosion at Caf6 Foyot, Paris, April 4. Sir W. Harcourt's Budget introduced, April 16. Violent earthquakes in Greece, April 21-27. Mr Coxey, United States labour leader, arrested at Washington, May 2. Finance Bill second reading, May 10. Chicago railway strike begun. May 11. Bomb explosion in the Avenue K16ber, Paris, May 11. Coup d'etat in Servia, May 20. Resignation of M. Stambuloff, May 29.

Death of Lord Coleridge, June 14 (born, 1821). Attempt on Signor Crispi, June 16. British Protectorate of Uganda, June 19. Prince Edward of York born, June 23. Death of Mme Alboni, June 23 (bom, 1828). President Camot assassinated by Caserio, June 24 (bom, 1837). Coal strike in Scotland, June 26. M. Casimir-Perier elected President of the French Republic, June 27. Brazil rebels finally defeated, June 27. Inter-Colonial Con- ference at Ottawa, June 28. Tower Bridge opened, June 30. United States railway strike ended, July 13. Death of Leconte de Lisle, July 17 (aged 75). Finance Bill thirdreading, July 17. Trans- port Kowshing sunk by Japanese, July 25. War against China declared by Japan, August 1. Discovery of gold at Coolgardie, August 9. Lord Rayleigh's paper on argon at the British Associ- ation, August 13. Caserio executed, August 16. New com- mercial treaty with Ja{)an, August 25. Death of the Comte de Paris, September 8 (born, 1838). Death of Professor Helm- holtz, September 8 (aged 73). Chinese defeated at Ping-yang (Korea) on land, and in the battle of the Yalu by sea, September 16. Death of Oliver Wendell Holmes, October 7 (born, 1809). Death of Earl Grey, October 9 (born, 1802). Death of J. A. Froude, October 20 (born, 1818). Scottish coal strike ended, October 22. Count von Caprivi resigned, October 26. Prince Hohenlohe appointed German Chancellor, October 30. Death of Tsar Alexander III., November 1 (born, 1845), succeeded by Nicholas II. Death of John Walter, of The Times, November 3 (born, 1818). Death of Anton Rubinstein, November 20 (bom, 1829). Port Arthur captured by Japanese, November 21. Death of R. L. Stevenson, December 3 (born, 1850). Death of Ferdinand Lesseps, December 7 (born, 1805). Captain Dreyfus, of the French army, condemned for treason, December 22. Death of Christina Rossetti, December 29 (born, 1830). Plague epidemic in Hong-Kong, May to August. Turkish outrages on Armenians in Sassun district.

1895. Captain Dreyfus degraded, January 4. President Casimir- Perier resigns, January 15. M. Fglix Faure elected President, January 17. Death of Lord Randolph Churchill, January 24 (bom, 1849). Death of M. de Giers, Russian Chancellor, January 26 (bom, 1820), succeeded by Prince Lobanof, February 27. Death of Marshal Canrobert, January 28 (born, 1809). Japanese naval victory off Wei-hai-wei, February 4.

Death of Archduke Albrechtof Austria, February 18 (born, 1817). Mr Stokes, an Englishman, hanged in Congo State by order of Captain Lothaire,

in February. Death of Ismail Pasha, March 2 (bom, 1830). Death of Professor Blackie, March 2 (bom, 1809). Niu-chwang captured by Japanese, March 4. Sir R. Low's advance to relieve Chitral begun, April 1. Mr Gully appointed Speaker to succeed Lord Peel, April 10. Treaty of Shimonoseki signed, April 15. Chitral relieved by Colonel Kelly, April 20. Death of Lord Selbome, May 4 (bom, 1812). French expedition under General Duchesne arrives at Madagascar, May 6. Kiel Canal opened, June 21. Resignation of the Rosebery Ministry, June 22. Lord Salisbury appointed Prime Minister, June 25. Death of T. H. Huxley, June 29 (bom, 1825). Parliament dissolved, July 12. Murderous assault on M. Stambuloff, July 15 ; he died July 19 (bom, 1852). Death of Professor von Gneist, July 21 (born, 1816). Anglo-Russian Pamirs Commission completes its work, September 18. Death of M. Pasteur, September 28 (born, 1822). Antananarivo captured by the French, September 30. Lord Wolseley became Commander-in-Chief, November 1. Clyde ship- ping strike, November 6. Sir F. Scott, commanding Ashanti expedition against King Prempeh, leaves England, November 22. Death of Barth^lemy St Hilaire, November 25 (bom, 1805). Death of A. Dumas, fils, November 27 (bom, 1824). Jabez Balfour sentenced for Liberator frauds, November 28. Defeat of Italians in Abyssinia, December 7. President Cleveland's Venezuela message to Congress, December 17. Dr Jameson with Chartered Company's troops invades the Transvaal, December 29.

1896. Mr Alfred Austin made Poet Laureate, January 1. Dr Jameson's force defeated by the Boers near Krugersdorp, January 1. Surrender of Dr Jameson, January 2. Kaiser's telegram to Kruger published, January 3. Resignation of Mr Rhodes as Premier of Cape Colony, January 6. Dr Jameson and of&oers surrendered by Boers to British authorities, January 7. British flying squadron commissioned, January

7. Death of Paul Ver- laine, January 8 (aged 51). Arrest of Johannesburg reformers, January 9, 10. Anglo-French difficulty regarding Siam settled, January 15. Kumassi occupied by Bx'itish, January 18. Death of Prince Henry of Battenberg, January 20 (born, 1858). Clyde shipping strike settled, January 21. Death of Lord Leighton, January 24 (bom, 1830). General Weyler leaves Spain to com- mand against rebels in Cuba, January 25. Sir J. B. Millais elected President of the Royal Academy, February 20. Mr Steyn made President of the Orange Free State, February 21. Italians defeated by Abyssinians at Adowa, March 1. General Kitchener leaves Cairo to command Dongola expedition, March 22. Rising of the Matabele, March 25. Li Hung-chang left China to visit Europe, March 28. Johannesburg reformers sentenced, April 28 ; death sentences commuted same day. Major Lothaire acquitted in connexion with the hanging of Mr Stokes, April 28. Shah of Persia assassinated, May'l. Dervishes defeated near Akasheh, Sudan, May 1. Hungarian millenary exhibition. May 2. Mata- bele defeated at Gwelo, May 9. Tsar's coronation. May 26. Dervishes defeated at Ferkeh, June 7. Death of Jules Simon, June 8 (bom, 1814). Dr Jameson and officers committed for trial, June 16. Japanese towns destroyed by sea wave, June 15. Madagascar declared a French colony, June 20. Death of Mrs Beecher Stowe, July 1 (bom, 1812). Dr Jameson and officers convicted under Foreign Enlistment Act, July 28. Li Hung-chang arrived in England, August 2. Defeat of the Matabele, August 5. Death of Sir J. E. Millais, August 13 (born, 1829). Conference by Mr Rhodes with Matabele chiefs, August 20 ; followed by submission of natives. Zanzibar bombarded by British, August 27. Massacre of Armenians in Constantinople, August 25-27. Death of Prince Lobanof, August 30 (born, 1824). Return of Dr Nansen to Christiania, September 9. Dongola occupied by Egyptian troops, September 23. Death of William Morris, October 3 (bom, 1834). Tsar's arrival in Paris, October 6. Death of Archbishop Benson, October 11 (bom, 1829). Bishop Temple made Archbishop of Canterbury, October 26. Treaty of peace between Italy and Abyssinia, October 26. Mr M'Kinley elected President of the United States, November 3. Anglo-Ameri- can agreement about Venezuela announced, November 9. Russo- Chinese treaty re Manchurian railway published, December 8.

1897. Unarmed British party attacked and massacred near Benin, January 2. Niger Company's expedition against Nup6 and Ilorin starts, January 6. Olney-Pauncefote arbitration treaty signed, January 11, Death of Sir I. Pitman, January 22 (aged 84). Submission of Nup6, February 5. Greek force under Colonel Vassos landed in Crete, February 14. South Africa Committee's sittings begun, February 16. Submission of Ilorin, February 18. Benin city captured by British, February 18. International force sent to Crete by the Powers, March 18. Death of Johannes Brahms, April 3 (aged 63). War declared by Turkey against Greece, April 17. Maluna Pass captured by the Turks, April 18. Canadian Differential Tariff Bill introduced, April 23. Greek retreat from Larissa, April 25. Disastrous fire at a charity bazaar in Paris, causing great loss of life. Including the Duchesse d'Alenjon, May 4. Olney-Pauncefote arbitration treaty rejected by United States

Senate, May 5. Greek retreat from Phersala, May 6. Death of the Duo d'Aumale, May 7 (bom, 1822). Arrival of Sir A. Milner in South Africa as High Commissioner, May 7. Intervention of the Powers between Turkey and Greece, May 11. Disaster to a British force in the Tochi Valley, Indian frontier, June 10. Severe earthquakes in Assam and other parts of India, June 12. Queen Victoria's Diamond Jubilee, June 22. British pla^e officials murdered near Bombay, June 22. Death of Mrs Oliphant, June 25 (born, 1828). Naval review at Spithead, June 26. Death of Henri Meilhac, July 7 (aged 66). Herr Andrfie's balloon expe- dition started for the North Pole, July 10. South Africa Com- mittee's report issued, July 13. Death of Jean Ingelow, July 20 (a|ged 71). Excitement over Klondike gold discoveries, July 23. Rising in the Swat Valley, July 26. Capture of Abu Hamed, Sudan, August 7. Assassination of Seiior Canovas del CastUlo, Spanish Premier, August 8. General cessation of Swat Valley hostilities, August 21. Rising of Afridis, August 23. Arrival of President Faure at Kronstadt to visit the Tsar, August 23. Farewell luncheon on board the Fothuau at Kronstadt, August 26. Berber occupied by Egyptian troops, September 13. Severe fighting with the Mamunds, September 17. Preliminary treaty of peace between Turkey and Greece signed, September 18. Gen- eral Weyler recalled from Cuba, October 8. Advance against Afridis begun by Sir W. Lockhart, October 19. Dargai heights stormed, October 20. Herr von

Bulow appointed German Foreign Minister, October 22. Death of the Duchess of Teck, October 27 (born, 1833). Dreyfus bordereau published by the Matin, November 10. Kiao-chow Bay occupied by Germans, November 14. Great fire in Cripplegate, November 19. Final treaty of peace between Turkey and Greece signed, December 4. Departure of Prince Henry of Prussia for China, December 16. Death of Alphonse Daudet, December 16 (bom, 1840). British retirement from Tirah highlands to winter quarters, about December 20. Famine and plague very severe in India during the year.

1898. Major Esterhazy acquitted of treason by court-martial, January 11. M. Zola's letter, " J'accuse," published in the Aurore, January 13. Death of "Lewis Carroll," January 14 (aged 65). Death of Mr C. P. Villiers, January 16 (bom, 1802). Uganda rebels defeated, January 29. The United States warship Maine blown up in Havana harbour, February 15. M. Zola convicted for libel, February 23. Death of Sir Henry Bessemer, March 16 (bom, 1813). Port Arthur and Ta-Uen-wan ceded to Russia, March 23. Great coal strike in South Wales, April 1. Sub- mission of Khaibar tribesmen, April 1 ; the frontier pacified. Wei-hai-wei ceded to Great Britain, April 2. Dervishes defeated on the Atbara, April 8. War between tiie United States and Spain, April 21. Spanish fleet at Manila destroyed by Commodore Dewey, May 1. Serious riots in Milan, May 7. Deathof W.E.Gladstone, May 19 (bom, 1809) . Spanish fleet under Admiral Cervera arrived at Santiago de Cuba, May 19. The Merrimac sunk by Lieutenant Hobson at the entrance to Santiago harbour, June 3. Bankruptcy of Mr E. T. Hooley, June 8. Agreement with France re West Africa signed, June 14. Resignation of M. M^line, French Premier, June 15, succeeded by M. Brissou. Death of Sir E. Bume-Jones, June 17 (bom, 1833). Cervera's squadron destroyed by Admiral Sampson near Santiago, July 3. Major Marchand reached Fashoda, July 10. Santiago occupied by Americans, July 17. Death of Prince Bismarck, July 30 (bom, 1815). Canadian preferential tariff in favour of Great Britain came into operation, August 1. Sudanese troops decisively defeated in Uganda by Major Martyr, August 4 ; they had been in mutiny since October, 1897. Spanish- American peace preliminaries settled, August 12. Manila surren- dered to Americans, August 13. United States and Canadian

Conference at Quebec opened, August 23. Tsar's disarmament pro- posals issued, August 24. Suicide of Colonel Henry while under arrest for forging evidence in the Dreyfus case, August 30. Com- plete defeat of the Khalifa at Omdurman, September 2. Assassina- tion of the Empress of Austria at Geneva, September 10. Terrible hurricane in the West Indies, September 11. Death of Sir George Grey, September 19 (bom, 1812). Meeting between the Sirdar and Major Marchand at Fashoda, September 21. Coup d'JStat in China, Dowager-Empress becoming regent, September 22. Dreyfus case remitted to the Court of Cassation, September 26. Death of Puvis de Chavannes, October 25 (aged 72). Resignation of M. Brisson, October 25 ; succeeded by M. Ch. Dupuy. Arrival of the Kaiser at Haifa on his tour in the Holy Land, October 27. French Government decided to evacuate Fashoda, November 4. Prince George of Greece nominated High Commissioner of Crete, Novem- ber 26. Spanish-American treaty of peace signed, December 10. Death of William Black, December 10 (bom, 1841). Withdrawal of Major Marchand from Fashoda, December 11. Retirement from the Liberal leadership by Sir W. Haroourt announced, December 13. Imperial penny postage came into force, December 25. Plague was again prevalent in India this year, especially in Bombay.

1899. Native disturbances in Samoa, January 1. Anglo-Egyp- tian agreement regarding the Sudan, January 19. Fighting at

Manila between United States troops and Filipinos, February 4. Death of Count von Caprivi, February 6 (bom, 1831). Death of President Faure, February 15 (born, 1841). Emile Loubet elected French President, February 18. Russian manifesto issued limit- ing Finnish autonomy, February 20. Death of Lord Herschell, March 1 (bom, 1837). Agreements regarding railways and tele- graphs in Africa negotiated with the German Government by Mr Rhodes in Berlin, March 10-16. Apia shelled by British and American warships, March 16. Anglo-French convention signed regarding possessions in Africa,

March 21. Death of ifedouard Pailleron, April 20 (bom, 1834). British and Italian squadrons reviewed in Aranci Bay by King Humbert, April 22. The Hague Peace Conference opened. May 18. Death of Sefior Castelar, May 25 (born, 1832). Death of Rosa Bonheur, May 25 (born, 1823) . Conference opened at Bloemfontein between Sir A. Milner and President Kruger, May 31. Sale announced of Spanish Pacific islands to Germany, June 2. Death of Johann Strauss, June 3 (born, 1826). Dreyfus verdict annulled by Court of Cassation and new court-martial ordered, June 3. Bloemfontein Conference concluded without result, June 6. Provisional Government for Samoa appointed, June 9. Defeat of French Ministry, June 12. Venezuela arbitration proceedings begun in Paris, June 15. French Ministry formed by M. Waldeck-Rousseau, June 22. Dreyfus landed in France for retrial at Rennes, July 1. Death of Victor Cherbuliez, July 1 (born, 1829). London Government Bill passed the Lords, July 4. Lieutenant^Colonel Klobb, of the French marines, killed in the Sudan by Captain Voulet's troops, July 14. Close of The Hague Conference, July 29. Retrial of Dreyfus begun, August 7. M. Labori, counsel for Dreyfus, shot in the back, August 14. Death of Professor Bunsen, August 16 (born, 1811). Dreyfus found guilty by the Rennes court-martial, September 9 ; pardoned, September 19. Last British despatch in Transvaal negotiations succeeding the Bloemfontein Conference, September 22. Decision of the Venezuela Arbitration Court, October 3. Boer ultimatum, October 9 ; war begun, October 11. Battle of Talana Hill, October 20 ; Sir W. P. Symons mortally wounded. Battle of Elandslaagte, October 21. British disaster at Nicholson's Nek, October 30. Arrival of Sir R. BuUer at the Cape, October 31. Anglo-German Samoa Convention signed, November 14. Successful advance by Lord Methuen, driving the Boers from Belmont, November 23 ; Graspan, November 25 ; and Modder River, November 28 ; but with severe British losses. Defeat and death of the Khalifa at Om Debrika, November 25. Serious reverse to General Gatacre at Stormberg, December 10. Lord Methuen repulsed at Magersfontein, December 11 ; General Wauchope killed. Sir R. BuUer repulsed at Colenso, December 15 ; eleven guns lost. Lord Roberts appointed to chief command in South Africa, with Lord Kitchener Chief of the Staff, December 16. New South Wales, Victoria, South Australia, Queensland, and

Tasmania this year agreed on a scheme of federation. Famine and distress in Russia.

1900. Enrolment of members of the C.I.V. corps, January 1. Boer assault on Ladysmith repulsed, January 6. Arrival of Lord Roberts and staff at Cape Town, January 10. Osman Digna captured near Tokar, January 19. Death of John RusMn, January 20 (born, 1819). Death of R. D. Blackmore, January 20 (bom, 1826). Fresh advance by General Buller repulsed after heavy fighting at Spion Kop, January 24. Lord Roberts's advance from Modder River begun, Febraary 11. Relief of Kimberley by General French, Febmary 15. Indian Famine Mansion House Fund opened, February 15. Severe fighting in Natal by General BuUer's force, February 18-23. Surrender of Cronje and 4000 Boers at Paardeberg, February 27. Relief of Ladysmith, February 28. Theatre Fran9ais destroyed by fire, March 8. Bloemfontein occu-

pied, March 13. Death of General Sir W. Lockhart, March 18 (born, 1841). Death of Commandant General Joubert, March 27. Delagoa Bay award issued after eleven years, March 29. British force caught in ambush at Sanna's Post, March 31. Surrender of 600 British at Reddersburg, April 3. Queen's visit to Dublin, April 4. Attempt on the Prince of Wales by Sipido at Brussels, April 4. Death of Ghazi Osman Pasha, April 4 (aged 68). News received of a rising in Ashanti, April 9. Paris Exhibition opened, April 14. Death of the Duke of Argyll, April 24 (born, 1823). Death of M. de Munkacsy, May 1 (born, 1844). Advance from Bloemfontein begun, May 2. Relief of Mafeking, May 17. Anxiety in Peking over the Boxer outbreak, May 20. Orange Free State annexed. May 26. Johannesburg occupied, May 31. Pretoria occupied, June 6. Start of Admiral Seymour's expedition to relieve Peking Legations, June 10 ; forced to retreat, June 19 ; returned to Tientsin, June 26. Resignation of Mr Schreiner's Cape Ministry, June 13 ; succeeded by Sir J. Gordon Sprigg. Massacre of native Christians in Peking, June 13. Taku forts captured by the allied squadrons, June 17. Baron von Ketteler, German Minister, murdered in Peking, June 20 ; siege of the Legations begun. Death of Count Muravieff, Russian Chancellor, June 21 (born, 1845) ; succeeded by Count Lamsdorff. Australian Commonwealth Bill received the royal assent, July 9. Earl

of Hopetoun appointed Governor-General of Australian Common-wealth, July 13. Russians attacked by Chinese in Eastern Siberia, July 14 ; resulting operations ended in occupation of Manchuria by Russian troops. Native city of Tientsin captured by the allies, July 14. Kumassi garrison relieved by Colonel Willcocks, July 15. Assassination of King Humbert of Italy, July 29 (born, 1844). Death of the Duke of- Coburg, July 30 (born, 1844). Surrender of General Prinsloo and 3000 Boers, July 30-31. West Australia decided to join the Commonwealth, August 2. Death of Lord Russell of Killowen, August 10 (born, 1832). Relief of the Peking Legations, August 14. Mansion House War Fund exceeded £1,000,000, September 3. Komati Poort occupied by the British, September 24. Parliament dissolved, September 25 ; the Unionists again returned, with a majority of 134. Lord Roberts appointed Commander-in-Chief, September 30. Anglo-German agreement regarding China, October 16. Resignation of Prince Hohenlohe, German Chancellor, October 17 ; succeeded by Count von Billow. Mr Kruger sailed for Europe, October 20. Transvaal annexed by Royal proclamation, October 25. Death of Mr Sims Reeves, October 25 (bom, 1822). Death of Professor Max MUller, October 28 (bom, 1823). Defeat of De Wet near Bothaville, November 5. Re-election of President M'Kinley, November 6. Death of Sir Arthur Sullivan, November 22 (born, 1842). Arrival of Mr Kruger at Marseilles, November 22. Dewetsdorp captured by De Wet, November 23. Command in South Africa handed over to Lord Kitchener, November 29. Mr Kruger left Paris for Germany, December 1 ; refused an inter- view by the German Emperor ; proceeded to Holland. Attempted invasion of Cape Colony by De Wet foiled, December 2-8. Mr Healy expelled by the Irish Nationalist party, December 11. Reverse to General Clements's force at Nooitgedacht, December 13. Invasion of Cape Colony by Boers under Kritzinger and Hertzog, December 16. Hay-Pauncefote Treaty ratified by the United States Senate with amendments, December 20. D^ath of Field-Marshal Count von Blumenthal, December 22 (born, 1810). Death of Lord Armstrong, December 27 (born, 1810). Mr Barton appointed first Premier of the Australian Commonwealth, Decem- ber 30. Allies' terms to China accepted in principle, December 30. Proposed Russo-Chinese agreement re Manchuria known in Peking, December 31. Terribly severe famine in India this year. (w. w. s.*)

CHRONOLOGY, BIBLICAL.

1. Old Testament.

A SENSE of the importance of a fixed standard of chronology was only acquired gradually in the his- tory of the world. Nations in a primitive state of civil- ization were not, and are not, conscious of the need. When the need began to be felt events were probably at first dated by the regnal years of Bngs ; the reigns of successive kings were then arranged in order, and grouped, if necessary, in dynasties, and thus a fixed standard was gradually con- structed. Particular statesalsonotunfrequentlymtroduced fixed eras, which obtained a more or less extensive cur- rency, as the era of the first Olympiad (776 b.c), of the foundation of Rome (753 b.c), and of the Seleucidse at

Antioch (312 b.c), which is followed by the Jewish author of the first book of Maccabees. Some of the earliest documents which we possess are dated by the year in which some noticeable event took place, as in contract- tablets of the age of Sargon of Agadfe (3800 b.c, or, according to other authorities, 2800 b.c), "In the year in which Sargon conquered the land of Amurru [the Amorites]"; or, "In the year in which Samsu-satana [c. 2200 B.C.] made the statue of Marduk " : Is. vi. 1 (" In the year of King Uzziah's death "), xiv. 28, xx. 1, are examples of this method of dating found even in the Old Testament. In process of time, however, the custom of dating by the regnal year of the king became general. The Babylonians and Assyrians were probably the first to construct and

employ a fixed chronological standard ; and the numerous contract-tablets, and lists of kings and yearly officials, discovered within recent years, afford striking evidence of the precision with which they noted chronological details. Biblical chronology is, unfortunately, in many

respects uncertain. Prior to the establishment of the monarchy the conditions for securing an exact and con- secutive chronology did not exist ; the dates in the earlier period of the history, though apparently in many cases precise, being in fact added long after the events described, and often (as will appear below) resting upon an artificial basis, so that the precision is in reality illusory. And after the establishment of the monarchy, though the con- ditions for an accurate chronology now existed, errors by some means or other found their way into the figures ; so that the dates, as we now have them, are in many cases at faiilt by as much as two to three decades of years. The exact dates of events in Hebrew history can be determined only when the figures given in the Old Testament can be checked and, if necessary, corrected by the contemporary monuments of Assyria and Baby- lonia, or (as in the post-Exilic period) by the knowledge which we independently possess of the chronology of the Persian kings. In the following parts of this article the chronological character of each successive period of the Old Testament history will be considered and explained as far as the limits of space at the writer's disposal permit.

I. From the Creation of Man to the Exodus. — In the whole of this period the chronology, in so far as it consists of definite figures, depends upon that part of the Pentar teuchal narrative which is called by critics the " Priestly Code" (see Pentateuch in Ency. Brit, ninth edition, vol. xviii.). The figures are in most, if not in all cases artificial, though the means now fail us of determining upon what principles they were calculated. It is also to be noted that in the Samaritan text of the Pentateuch, and in the LXX., the figures, especially in the period from the Creation to the birth of Abraham, differ considerably from those given in the Hebrew, yielding in Sam. a lower, but in the LXX. a much higher total. The following tables will make the details clear : —

(1) From the Creation of Man to the Flood (Gen. v., and vii. 11).

Age of each at birth of next.

Heb.

Sam.

LXX.

Adam (930) ....

130

130

230

Seth (912) .

105

105

206

Enosh (905)

90

90

190

Kenan (910)

70

70

170

Mabalalel (895)

65

65

166

Jared (962) .

162

62

162

Enoch (365)

65

65

165

Methuselah (969)

187

67

1871

Lamech (777) .

182

63

188

Noah (950) ; age at Flood . Total from the Creation of

600

600

600

1656

1807

2262

Man to the Flood

The figures in parentheses indicate the entire ages assigned to the several patriarchs; these are generally the same in the three texts. The Sam., however, it will be noticed, makes in three cases the father's age at the birth of his eldest son less than it is in the Heb. text, while the LXX. makes it in several cases as much as 100 years higher, the general result of these differences being that the total in the Sam. is 349 years less than in the Heb., while in the LXX- it is 606 years more. The names,

1 Or, according to some MSS., 167.

it need hardly be remarked, belong to the prehistoric period, and equally with the figures are destitute of historical value.

(2) From the Flood to the Gall of Abraham (Gen. xi.).

Age of each at birth of next.

Heb.

Sam.

LXX.

Arphaxad (438) = .

36 »

136

136

Cainan (460) [of. Luke iii

.27

...

130

Shelah (433) .

30

130

130

Eber (464)

34

134

134

Peleg (239)

30

130

130

Eeu (239)

32

132

132

Serug (230)

30

130

130

Nahor (148)

29

79

79

Terah (205) .

70

70

70

Abraham (175) ; age at

Call

(Gen. xii. 4) Total from the Flood to the

75

76

75

365

1015

1145

Call of Abraham

The variations are analogous to those under (1), except that here the birth-years of the patriarchs in both Sam. and LXX. differ more consistently in one direction, being, viz., almost uniformly higher by 100 years. It has been much debated, in both cases, which of the three texts preserves the original figures. In (2) it is generally agreed that the Heb. does this, the figures in Sam. and LXX. having been arbitrarily increased for the purpose of lengthening the entire period. The m aj ority of scholars hold the same view in regard also to (1) ; but DUlmann gives here the preference to the figures of the Sam. The figures, of course, in no case possess historical value: accepting even Ussher's date of the Exodus, 1491 B.C., which (see below) is earlier than is probable, we should obtain from them for the creation of man 4157 B.C., or (LXX.) 5328*, and for the confusion of tongues, which, according to Gen. xi. 1-9, immediately followed the Flood, 2501 B.C., or (LXX.) 3066 b.c. But the monuments of Egypt and Babylonia make it certain that man must have appeared upon the earth long before either 4157 b.c. or 5328 B.C.; and numerous inscriptions, written in three distinct languages — ^Egyptian, Sumerian, and Babylonian — are preserved, dating from an age considerably earlier than either 2501 b.c. or 3066 b.c' The figures of Gen. V. and xi. thus merely indicate the manner in which the author of the priestly narrative — and probably to some extent tradition before him — pictured the course of these early ages of the world's history. The ages assigned to the several patriarchs (except Enoch) in Gen. v. are much greater than those assigned to the pati-iarchs mentioned in Gen. xi., and similarly the ages in Gen. xi. 10-18 are higher than those in Gen. xi. 19-26 ; it is thus a collateral aim of the author to exemplify the supposed gradual diminution in the normal years of human life.

The Babylonians, according to Berossus, supposed that there were ten antediluvian kings, who they declared had reigned for the portentous period of 432,000 years : 432,000 years, however, it has been ingeniously pointed out by Oppert {Gott. Gel. Nach- Hchten, 1877, p. 205 ff.) = 86,400 lustra, while 1656 years (the Heb. date of the Flood) =86,400 weeks (1666=72×23; and 23 years being=8395 days-f6

intercalary days=8400 days=1200 weeks); and hence the inference has been drawn that the two periods have in some way been developed from a common basis, the Hebrews taking as their unit a week, wjiere the Babylonians took a lustrum of 5 years.

2 Shem, the father of Arphaxad, is aged 100 at the time of the Flood, and lives for 600 years.

‘ Disregarding the ” two years ” of Gen. xi. 10 : see v. 32, vii. 11.

- **Taking accoant of the reading of LXX. In Ex. xii. 40 (p. 75) .**

5 See further the present writer’s essay in Hogarth’s Authority and Archaeology (1899), pp. 32-34.

CHRONOLOGY, BIBLICAL

(3) From the Call of Abraham to the Exodus. From the Call of Abraham to the birth of Isaac

(Abraham being then aged 100, Gen. xxi. 6). 25 years Age of Isaac at the birth of Esau and Jacob

(Gen. XXV. 26) gQ

Age of Jacob when he went down into EevDt ” ”

(Gen. xlvii. 9) ^^P. 130 „

The period of the Patriarchs’ sojourn in Canaan

was thus 215

But the period of the Israelites’ sojourn in Egypt,’ ‘ ‘

according to Ex. xii. 40, 41, was . . . 430 , We thus get — From the Call of Abraham to the Exodus (Heb.

text). . . . . 215+430=645 years

From the Flood to the Call of Abraham (Heb.

text) 365

From the Creation of Man to the Flood (Heb. ”

text) 1656 „

From the Creation of Man to the Exodus (Heb. text) 2666 „

On these figures the following remarks may he made :

(i.) In Genesis the chronology of the Priestly Code (” P “) is not consistent with the chronology of the other parts of the book (« JE “). Three or four illustrations will sufftce : (a) The author of Gen. xii. 10-20 evidently pictures Sarai as a comparatively young woman, yet, according to P (xii. 4, xvii. 17) she was 65 years old. (6) In Gen. xxi. 15 it is clearly implied that Ishmael has been carried by his mother, yet according to xvi. 16, xxi. 5, 8, he must have been at least 15 years old. (c) In Gen. xxvii. Isaac is to all appearance on his deathbed (cf. ver. 2), yet according to P (xxv. 26, xxvi. 34, xxxv. 28} he survived for eighty years, dying at the age of 180. Ussher and others, arguing back from the dates in xlvii.- 9, xlv. 6, xii. 46, xxxi. 41, infer that Jacob’s flight to Haran took place in his 77th year. This reduces the 80 years to 43 years, though that is scarcely less incredible. It involves, moreover, the incongruity of supposing that thirty-seven years elapsed between Esau’s marrying his Hittite wives (xxvi. 34) and Eebekah’s expressing her apprehensions (xxvii. 46) lest Jacob, then aged seventy-seven, should follow his brother’s example, {d) In Gen. xliv. 20 Benjamin is described as a “little one”; in P, almost immediately afterwards (xlvi. 21), he appears as the father of ten sons ; for a similar anomaly in xlvi. 12, see the Oxford Hexateuch, i. p. 25 n. (ii.) The ages to which the various patriarchs lived (Abraham, 175 ; Isaac, 180 j Jacob, 147), though not so extravagant as those of the antediluvian patriarchs, or (with one exception) as those of the patriarchs between Noah and Abraham, are much greater than is at all probable in view of the structure and constitution of the human body, (iii.) The plain intention of Ex. xii. 40, 41 is to describe the Israelites as having dwelt in Egypt

for 430 years, which is also in substantial agreement with the earlier passage, Gen. xv. 13 (" shall sojourn in a land that is not theirs, . . . and they shall afflict them 400 years "). It does not, how- ever, accord with other passages, which assign only four generations from Jacob's children to Moses (Ex. vi. 16-20 ; Num. xxvi. 5-9 ; cf. Gen. xv. 16), or five to Joshua (Josh, vii. 1) ; and for this reason, no doubt, the Sam. and LXX. read in Ex. xii. 40, "The sojourning of the children of Israel in the land of Egypt, and in the land of Canaan, was 430 years," reducing the period of the sojourn in Egypt to half of that stated in the Hebrew text, viz., 215 years. This computation attained currency among the later Jews (Josephus and others ; cf. the "400 years" of Gal. iii. 17). The forced and unnatural rendering of Ex. xii. 40 in the A.V. (contrast E.V.), which was followed by Ussher, is intended for the purpose of making it possible, (iv.) The interval between Abraham and the

Exodus appears to be greater than is permitted by the synchronisms with external history. It is diflacult (see below) to place the Exodus much earlier than c. 1200 b c If, however the Amraphel of Gen. xiv. is rightly identi- fied by scholars with the Babylonian king Khammurabi (whose reign is assigned variously by Assyriologists to dates ranging between 2376-2333 b.c. to 2120-2065 b c) ^ and if, further, the part ascribed to Abraham in the same chapter is historical, the interval between Abraham's entry into Canaan and the Exodus cannot be less than c. 900 years, and may very possibly be more, as against the 645 years allowed by the Hebrew text, or the still shorter period of 430 years allowed by Ussher's computation. From the facts that have been here briefly noted it must be evident how precarious and, in parts, how impossible the Biblical chronology of this period is. (v.) It has been observed as remarkable that 2666, the number of years (ia the Hebrew text) from the Creation of Man to the Exodus is, in round numbers, just two-thirds of 4000 ; and the fact has suggested the inference that the figure was reached by artificial computation.

The Date of the Exodus. — Is it possible to determine this, even approximately, upon the basis of external data ? (i.) The correspondence between the Egyptian governors established in different parts of Palestine and the Egyp- tian kings Amen-hotep III. and IV. of the 18th dynasty, which was discovered in 1887 at Tel el-amama, makes it evident that Palestine could not yet have been in the occupation of the Israelites. It was still an Egyptian province, and the Babylonian language, in which the correspondence is written, shows that the country must have been for a considerable time past, before it came into the possession of Egypt, under Babylonian in- fluence. One of the kings, now, who corresponds with Amen-h6tep IV. is Burnaburiash II., king of Babylon, and Egyptologists and Assyriologists are agreed that the date of these monarchs was c. 1400 b.c. The conquest of Canaan, consequently, could not have taken place till after 1400 b.c. (ii.) It is stated in Ex. i. 11 that the Israelites built in Egypt for the Pharaoh two store- cities, Pithom and Eaamses. The excavations of M. Naville have, however, shown that Eamses II. of the 19th dynasty was the builder of Pithom; and though the other city has not at present been certainly identified, its name is sufficient to show that he was its builder likewise. Hence the Pharaoh of the Exodus is commonly supposed to have been Eamses II. 's successor, Merenptah. Egyptian chronology is unfortunately imperfect, but Professor Petrie, who has paid particular attention to the subject, and who assigns the reign of Amen-h6tep IV. to 1383-1365 B.C., assigns Eamses II. to 1275-1208 b.c' In Merenptah's fifth year the Delta was invaded by a formid- able body of Libyans and other foes ; ' and it has been

1 Early Babylonian chronology is itself, in some of its details, diffi- cult and uncertain, the figures given in the two important dynastic lists discovered by Mr Pinches in 1874 and 1880 (see Records of the Past, 2nd ser. vol. i. p. 13 ff.) not harmonizing completely ~~with state~~ ments made by later Assyrian and Babylonian kings as to the years which had elapsed since the reigns of certain of their predecessors. The figures in the dynastic lists would lead most naturally to such dates as 2376-2333 b.c. (Sayce, Early Israel, 1899, p. 281) , 2342-2288 (E.W. Rogers, Bist. of Babylonia and Assyria, New York, 1900, i. 338 —at least approximately, p. 387 n.) , 2287-2232 (Maspero, Struggle of the

Nations, 1897, p. 27), c. 2285 (L. W. King, Eneyd. Biblica, 1899, i. 445) ; hut other scholars argue with much force that there are errors in some of the transmitted figures, and so arrive at the dates 2248-2194 (Lehmann, Zwei Sauptprobleme der Altor. Chronologie, 1898, p. 99 and tab. 3), 2120-2065 (Rost, Untersuchungen zur Altor. Gesch. 1897, p. 23), or 2130-2087 (Hommel, Expository Times, x. 1898, p. 210 /.). On Khammurabi himself, see further Maspero, op. cit. pp. 39-44 ; and on the chronological question Boeers. ov. cit.m. 312-348. 01 b , r

2 Petrie, Bist. of Egypt, i. (1895), p. 251 ; ii. (1897), p. 29.

- **See Merenptah's account of the defeat of these invaders in Maspero, op. at. pp. 432-437.**

conjectured that the Israelites took the opportunity of escaping during the unsettlement that was thus occasioned.

Alternative dates for Ramses II. : Sayce, Early Israel, p. 277, 1348-1281 B.C. (the Exodus [p. 286], 1276) ; Maspero, op. cit. p. 449, c. 1320-1255 ; Lehmann, 1324-1258 (at earliest). Attempts have been made to identify the Khabiri, who are mentioned often in the Tel el-amarna letters as foes, threatening to invade Pales- tine and bring the Egyptian supremacy over it to an end, with the Hebrews. The Exodus, it has been pointed out, might then be placed under Amen-h6tep II. (1490-1474 B.C., Maspero; 1449- 1423, Petrie), the successor of Thothmes, and more time would be allowed for the events between the Exodus and the time of David (c. 1000), which, if the date given above be correct, have been thought to be unduly compressed (see Orr in the Expositor, March 1897, p. 161^.) ; but there are difiSculties attaching to this view, and it has not been adopted generally by scholars.

The mention of Israel on the stel6 of Merenptah, discovered by Petrie in 1896 (" Israel is desolated ; its seed [or fruit] Is not "), is too vague and indefinite in its terms to throw any light on the question of the

Exodus. See the discussion (with the references) in Hogarth's Authority and Archceology, pp. 62-65.

II. From the Exodus to the Foundation of the Temple (in the fourth year of Solomon, 1 Kings vi. 1). — In the chronological note, 1 Kings vi. 1, this period is stated to have consisted of 480 (LXX. 440) years. Is this figure correct ? If the years of the several periods of oppression and independence mentioned in the Book of Judges (Judges iii. 8, 11, 14, 30 ; iv. 3 ; v. 31 ; vi. 1 ; viii. 28 ; ix. 22 ; X. 2, 3, 8 ; xii. 7, 9, 11, 14 ; xiii. 1 ; xv. 20 ; xvi. 31) be added up, they will be found to amount to 410 years ; to these must be added further, in order to gain the entire period from the Exodus to the foundation of the Temple, the 40 years in the wilderness, x years under Joshua and the elders (Judges ii.,7), the 20 years' judgeship of Eli (1 Sam. iv. 18), the judgeship of Samuel (perhaps 20 years ; cf. 1 Sam. vii. 2), the y years of Saul (the two years of Sam. xiii. 1 [E..V.] seem too few), the 40 years of David (1 Kings ii. 11), and the first four years of Sol- omon, i.e., 14A+x+y years, in all 554 years, ¦ two unknown periods denoted by x and y — in any case considerably more than the 480 years of 1 Kings vi. 1. This period might no doubt be reduced to 480 years by the supposition, in itself not improbable, that some of the judges were local and contemporaneous ; the suggestion has also been made that, as is usual in Oriental chronologies, the years of foreign domination were not counted, the beginning of each judge's rule being reckoned, not from the victory which brought him into power, but from the death of his predecessor; we should in this case obtain for the period from the Exodus to the foundation of the Temple 440-f-a;-|-y years,^ which if 30 years be assigned conjecturally to Joshua and the elders, and 10 years to Saul, would amount exactly to 480 years. The terms used, however ("and the land had rest forty years," iii. 11 ; similarly, iii. 30 ; v. 31 ; viii. 28), seem hardly to admit of the latter supposition ; and even if they did, it would still be scarcely possible to maintain the correctness of the 480 years : it is difficult to har- monize with what, as we have seen, appears to be the most probable date of the Exodus ; it is, moreover, open itself to the suspicion of having been formed artificially, upon the assumption that the period in question consisted of twelve generations " of 40 years each. In the years assigned to the different judges, also, the frequency

of the number 40 (which certainly appears to have been regarded by the Hebrews as a round number) is suspicious.

1 Namely, 40 years in the wilderness ; Joshua and the elders (Judges ii. 7), X years ; Othniel (iii. 11), 40 years ; Ehud (iii. 30), 80 years ; Barak (v. 31), 40 years; Gideon (viii. 28), 40 years; Jephthah and five minor judges (x. 2, 3; xii. 7, 9, 11, 14), 76 years; Samson (xvi. 31), 20 years; Eli (1 Sam. iv. 18), 40 ” .... – —

years ; Saul, y years ; David, 40 years ; and —in all i40+x+y years.

a Namely, Moses (in the wilderness), Joshua, Othniel, Ehud, Deborah, Gideon, Jephthah, Samson, Eli, Samuel, Saul, and David.

years; Samuel (vii. 2), 20 Solomon’s first four years,

On the -whole no certain chronology of this period is at present attainable.’ . .

III. From the Fourth Tear of Solomon to the Captivity of JwdaA.— During this period the dates are both more abundant, and also, approximately, far more nearly cor- rect, than in any of the earlier periods ; neverthdess m details there is still much uncertainty and difficulty. The Books of Kings are a compilation made at about the beginning of ,the Exile, and one object of the compiler was to. give a consecutive and complete chronology of the period embraced in his work. With this purpose in view, he not only notes carefully the length of the reign of each king ia both kingdoms, but also (as long as the northern kingdom existed) brings the history of the two kingdoms into relation with one another by equating the commencement of each reign in either kingdom with the year of the reign of the contemporary king in the other kingdom.

The following are examples of the standing formulae used by the compiler for the purpose:— “In the twentieth year of Jero- boam King of Israel began Asa to reign over Judah. And forty and one years reigned he in Jerusalem ” (1 Kings xv. 9, 10). ” In the third year of Asa

king of Judah began Baasha the son of Ahijah to jeign over all Israel in Tirzah, (and reigned) twenty and four years ” (ibid. ver. 33).

In these chronological notices the lengths of the reigns were derived, there is every reason to suppose, either from tradition or from the state annals — ^the “book of the chronicles of Israel ” (or ” Judah “), so constantly referred to by the compiler as his authority (e.g., 1 Kings xv. 23, 31; xvi. 6); but the “synchronisms” — i.e., the corre- sponding dates in the contemporary reigns in the other kingdom — ^were derived, it is practically certain, by com- putation from the lengths of the successive reigns. Now in some cases, perhaps, in ths lengths of the reigns them- selves, in other cases in the computations based upon them, errors have crept in, which have vitiated more or less the entire chronology of the period. The existence of these errors can be demonstrated in two ways : (1) The chronology of the two kingdoms is not consistent with itself; (2) the dates of various events in the history, which are mentioned also in the Assyrian inscriptions, are in serious disagreement with the dates as fixed by the contemporary Assyrian chronology.

(1) That the chronology of the two kingdoms is in- consistent with itself is readily shown . After the division of the kingdom the first year of Jeroboam in Israel coincides, of course, with the first year of Rehoboam in Judah ; and after the death of Jehoram of Israel and Ahaziah of Judah in battle with Jehu (2 Kings ix. 24, 27), the first year of Jehu in Israel coincides similarly with the first year of Athaliah in Judah : there are thus in the history of the two kingdoms two fixed and certain synchronisms. Now, if the regnal years of the kings of Israel from Jeroboam to Jehoram be added together, they will be found to amount to 98, while if those of the kings of Judah for the same period (viz., from Eehoboam to Ahaziah) be added together, they amount only to 95. This discrepancy, if it stood alone, would not, however, be serious. But when we proceed to add up similarly the regnal years in the two kingdoms from the division after Solomon’s death to the fall of Samaria in the sixth year of Hezekiah (2 Kings xviii. 10), we find in the southern kingdom 260 years, and in the northern kingdom only 241 years 7 months. This is a formidable discrepancy. TJssher, in order to remove it, has recourse to the doubtful

‘The “300 years” of Judges li. 26 agrees very nearly with the sum of the years (namely, 319) given in the preceding chapters for the successive periods of oppression and independence. The verse occurs in a long insertion (xi. 12-28) in the original narrative ; and the figure was most probably arrived at by computation upon the basis of the present chronology of the book.

expedient of artificially lengthening the northern series of years, by assuming (without any authority in the text) an ” interregnum of 11 years ” after the death of Jeroboam II., and an “anarchy for some years” between Pekah and Hoshea (see the margin of A.V. at 2 Kings xiv. 29: XV. 8, 29).

(2) As we now know, the methods of chronological com- putation adopted by the Assyrians were particularly exact. Every year a special officer was appointed, who held office for that year, and gave his name to the year ; and “canons,” or lists, of these officers have been dis- covered, extending from 893 to 666 b.c.^ The accuracy of these canons can in many cases be checked by the full annals which we now possess of the reigns of many of the kings — as of Asshur-nazir-abal (886-860 b.c), Shal- maneser II. (860-825), Tiglath-pileser III. (745-727), Sargon (722-705), Sennacherib (704-781), Esarhaddon (681-668), and Asshurbanipal (668-626). Thus from 893 B.C. the Assyrian chronology is certain and precise. Eeducing now both the Assyrian and Biblical dates to a common standard,^ and adopting for the latter the com- putations of Ussher, we obtain the following singular series of discrepancies : —

Dates according

Dates according

to UsBher’s

to Assyrian

****

Chronology.

Inscription.

B.C.

B.O.

Beign of Ahab ....

918-897

Ahab mentioned at the battle of

Karkar

>• •

854

Reign of Jehu ....

884-856

Jehu pays tribute to Shalmaneser

II

• ••

842

Beign of Menahem

772-761

Menahem mentioned by Tiglath-

pileser III

• ..

738

Beign of Pekah ....

759-739

Beign of Hoshea ....

730-721

Assassination of Pekah and suc-

cession of Hoshea, mentioned

by Tiglath-pileser III. .

...

733 (or 732)»

Capture of Samaria by Sargon in

1 See George Smith, The Assyrian Eponym Canon (1875), pp. 29 ff., 57 ff. ; Schrader, Keilinsehriftliche Bibliothek (translations of Assyrian and Babylonian inscriptions), 1. (1889), p. Wiff.

^ It may he explained here that the dates of the Assyrian and Babylonian kings can be reduced to years B.c. by means of the so-called "Canon of Ptolemy," which is a list of the Babylonian and Persian kings, with the lengths of their reigns, extending from Nabonassar, 747 B.C., to Alexander the Great, drawn up in the 2nd century a.d. by the celebrated Egyptian mathematician and geographer Ptolemy: as the dates B.C. of the Persian kings are known

independently, from Greek sources, the dates B.C. of the preceding Babylonian kings can, of course, be at once calculated by means of the Canon. The recently-discovered contemporary monuments have fully established the accuracy of the Canon.

8 Or, in any case, between 734 and 732; see Bost, Die Keil- sahrifttexte Tiglathpilesers III., 1893, pp. xii. 39, 81, with the dis- cussion, pp. xxxii.-xxxiv., xxxv.-xxsvi.

721 713

722 701

Hezekiah's sixth year (2 Bangs

xviii. 10)

Invasion of Judah by Sennacherib in Hezekiah's fourteenth year (ibid. ver. 13)

Manifestly all the Biblical dates earlier than 733-32 B.C. are too high, and must be considerably reduced: the two events, also, in Hezekiah's reign — the fall of Samaria and the invasion of Sennacherib — which the com- piler of the Book of Kings treats as separated by an inter- val of eight years, were separated in reality by an interval of twenty-one years.*

Much has been written on the chronology of the kings and many endeavours have been made to readjust the Biblical figures so as to bring them into consistency with themselves and at the same time into conformity with the Assyrian dates. But, though the fact of there being errors in the Biblical figures is patent, it is not equally clear at what points the error lies, or how the available years ought to be redistributed between the various reigns. It is in any case evident that the accession of Jehu and Athaliah must be brought down from 884 to 842 b.c; and this will involve, naturally, a corresponding reduction of the dates of the previous kings of both kingdoms, and of course, at the same time, of those of Solomon, David, and Saul. The difficulty is,

however, greatest in the 8th century. Here, in JudaJi, from the accession of Athaliah to the accession of Ahaz, tradition gives 143 years, whereas, in fact, there were but 106 years (842-736); and in Israel, from the death of Menahem to the fall of Samaria, it gives 31 years, whereas from 738 (assuming that Menahem died in that year) to 722 there are actually only 16 years. The years assigned by tradition to the reigns in both kingdoms in the middle part of the 8th century b.c have thus to be materially reduced. But in the following period, from the fall of Samaria in 722 to the capture of Jerusalem by the Chaldseans in 586, the Biblical dates, so far as we can judge, are substantially correct. (See further the table beginning below.)

IV. From the Destruction of Jerusalem in 586 to the close of the Old Testament History. — Here, though it is true that there are events in the Biblical history which are not fully or 'unambiguously dated, there is otherwise no diffi- culty. The lengths of the reigns of Nebuchadnezzar and his successors on the throne of Babylon, and also, after the conquest of Babylon, of Cyrus and the following Persian kings, are known from the "Canon of Ptolemy," referred to above, the particulars in which, for the earlier part of this period, are also confirmed by the testimony of the monuments.

- **This interval does not depend upon a mere list of Eponym years ; we have in the annals of Sargon and Sennacherib full particulars of the events in all the intervening years.**

Cheom-ological Table. The dates printed in black type are certain, at least within a unit.

Chronology of Ussher.

Probable Eeal Dates.

Biblical Events.

Events in Contemporary History. 1

Babylonia.

Assyria.

Egypt.’

4004

[4157>]

Indeterminable, but ■ much before 7000 b.c.

Creation of man

7-6000.’ Temple of Bel et Nippur founded

e. 4000.* Lugal-ZKgisi, king of TJruk (Erech, Gen. X.10)

\ 4777. Menes, the first histori- cal king of Egypt

8998-3721. Fourth Dynasty

8969-3908. Cheops. The Great

Pyramid built

> The real Biblical dates, TJssher in Gen. xi. 26 Interpolating 60 years, because It is said In Acts vit 4 that Abraham left Haran after his fither Terah’s death (Gen.

“*! mfnre?ht^sVaTeffi’A?ol»“I»‘°^^^^ VMvirsity of Penmylvarda, vol. i. pt. 1. 1893, pp. 11, 12 ; pt. ii. 1896, pp. 23, 24, 43, 44).

. pZvs dates (as to assSak),^*. ofMgypi, vol. i. (1896), pp. 20, 80, 288, 251, 252 ; vol. ii. (1897), p. 29.**

Chronological Table — Continued.

Chronology of Ussher.

Probable Real Dates.

13JV11…1 “Ci..^ »..

Events in Contemporary History.

:tJtuU\Ml JJ.VClli.Q.

Babylonia.

Assyria.

Egypt.

3800.1 Sargon of Agad6, who

carries his arms as far

as the Mediteranean Sea

0. 2800.’ Ur-bau and Dungi,

2848

The Delage

kings of Uru (0r, Gen.

[2501 »]

li. 28, 81) Between 2376-2388 and 2120-

1996-1821

Between o. 2850 and

Abraham

2066.’ Khammurabl

[2211-2086 «]

c. 2100 (as deter- mined by the syn- chronlBm with

(uniSes Babylonia and constructs in it many

great works)

Ehammnrabi ; see

801)

2098-1B87. FifUenth to Smm- ieenth Dynastiet. Kule

oftheHyksoB

c. 1820. Ishmi-dagan, priest-

king of Nineveh

1587-1827. Eighteenth Dynasl/y 1508-1449. Thothmes III. (leads

victorious expeditions

into Asia)

c. 1460. Asshur – bel – nish^shu.

first king of Assyria at

present known

c. 1400. Bnmaburlash II. Tel

1414-1888. Amen-h6tep III.

el-Amarna correspon-

1888-1865. Amen-hdtep IV.

dence

0. 1800. Shahnanescr I. (builder ofCalah, Gen. X. 11)

1827-1181. MneteemthDynael/i/ 1275-1208. Ramses II.

1491

c. 1200 (?)

The Exodns

..

1208-1187. Merenptah II.

1099-1058

c. 1020-1000 »

Saul (2)” David (40)

1058-lOlT

c. 1000-970

lOlT-977

c. 970-988

Solomon (40)

960-810. Ttomiy-aecond Dy-

naitiy 960-989. Sheshonq (Shishak).

Judah.

Jtrael.

9T7

988. Eehoboam (17)

■988. Jeroboam I. (22)

959

916. Abiiah (3)

Bhlsbak invades Judah

956

918. Asa (41)

in the fifth year of Eeho-

956

912. Nadab (2)

boam (1 Ki. xiT. 25/.)

964

911. Baasha (24)

980

888. Elah (2)

929

887. Zimrl (T days)

929

887. Omri (12)

88S-880. Asshnr-naidr-abal

918

876. Ahab (22)

914

878. Jehoshaphat (25)

860-825. Shalmaneser II.

898

864. Ahariah (2)

864. AlMb mentioned at the

896

858. Jehoram (12)

battle of Earkar

892

849. Jehoram (8)

885

842. Abaziah (1)

884

8^. Athallah (6)

842. John (28)

842. ./eAM pays tribute to Shal- maneser II.

878

886. Jehoash (40)

856

814. Jehoahaz (17)

841

798. Jehoash (16)

826-812. Shamshi-Bammfin

889

797. Amaziah (29)

747-733. Nabonassar

812-783. RammAn-Nirarilll.

828

788. Jeroboam II. (41)

810

779. Uzzlah (62) c. 760. Jotham (16), as regent (2 Ki.

XT. 5)

745-727. Tigkth-pileser III.

778

748. Zechariah (6 mo.)

772

748. Shallum (1 mo.)

772

748. Menahem (10)

758

740. Jotham, sole rnler

761

788. Pekahiah (2)

738. JfeiMiAeOT pays tribute to Tiglath-pfieser III. (cf.

769

787. Pekah (20)

742

786.‘Ahaz(i6)

2 Ki. XT. 19)

780

733 (or 732). Hoshea(9)

733 (or 732). Assassination of Pekahy and succession of Honhea^ mentioned by Tiglath-pileser III.

732. Capture of Damascus by Tiglath-pileser III. (2 Ki. xvi. 9 ; cf. Is. viii. 4,^

729-724. Tiglath-pileser, under

xvii. 1)

7.26

727.’ Hezekiah (29)

the name of Pulu (fit. 2 Ki. XT. 19), king of Babylon

727-722. Shalmaneser IV.

721

722. Fall of Samaria and end of the northern king- dom

722-705. Sargon 722. Capture of Samaria in Sar- gon’s accession-year

1 So Sayce, Bogere, and others. The date rests upon a statement of Naba-naUd’s, that Sargon reigned 8200 rears before himself. Lehmann holds that there are reasons for believing that the engraver, by error, put a stroke too many, and that 2200 should be read instead of 8200.

- **The real Biblical dates, Ussher in Gen. xi. 26 interpolating 60 years, because it is said in Acts vii. 4 that Abraham left Haran after his father Terah’s death (Gen. xi. 82), and also (as explained above) interpreting wrongly Ex. xii. 40.**

8 Rogers, i. 378-75 (where Ur-bau is called Ur-gur).

- **tiee p. 75, n. Many monuments and inscriptions of other kings in Babylonia, between B.C. 4000 and 2100, are also known.**

0 The dates of the kings are, in most cases, those given by Kautzsch in the table in his Outline of the Hist, of the Literatwre of the 0. T. (tr. by Taylor, 1898) p. 167^. The dates given by other recent authorities seldom diflFer by more than three or four years.

« The figures after a king’s name indicate the number of years assigned to his reign in the Old Testament. For Saul, see 1 Bam. xiii. 2, E.V.

7 If these dates are correct, there must be some error in the ages assigned to Ahaz and Hezekiah at their accession, viz., 20 and 25 respectively, for it would otherwise follow from them that Ahaz was bom when his father was not more than 4 years old I The date 727 for Hezekiah's accession rests upon the assumption that of the two inconsistent dates (see p. 77) In 2 Ki. xviii. 10, 18, the one in ver. 10 (which places the fall of Samaria in Hezekiah*s 6th year) is correct; but some scholars (as Wellhausen, Kamphansen, and Stade) suppose that the date in vet 10 (which places Sennacherib's invasion in Hezekiab's 14th year) is correct, and assign accordingly Hezekiah's accession to 715. This removes, or at least mitigates, the difficulty referred to, and leaves more room for the reigns of Jotham and Ahaz; but it requires, of course, a corresponding reduction in the reigns of the kings succeeding Ahaz.

Chronological Table — Continued.

Chronology of Ussher.

Bibllciil Events.

Events in Contemporary History.

Babylonia.

Assyria.

Egypt.

698. Manasseb (55)

641 639

610 610

599

588

586

Ml. Amon(2) 689. Joslah(81)

626. Call of the prophet Jeremiah in Josiab's 13th year (Jer. i. 2 ; xxv. 8)

621. Discovery of the £ooh of the Za/io (Deutero- nomy) in Josiab's 18tb year (2 Kings xxiii. Sff.)

608. Jeboahaz (8 mo.)

608. Jeboiakim(ll)

697. Jeboiaohln (8 mo.). Mrst deportation of captives (including Jebolachfn) to Baby- lonia, in the Stb year of Nebuchadnezzar (2 Kings xxlv. 12-16)

697. Zedekiab (11)

686 Destruction of Jerusalem by the Chaldseans in the 19tb year of Nebuchadnezzar (2 Kings XKv. 8). Second deportation of captives to Babylonia (2 Kings xxv. 4-21)

661 Jehoiaohin released fl-om prison by Evil- merodach in the 87 th year of his captivity (2 Kings xxv. 27-80)

515

457 445 434

JvAdh a province of the Persian Empire 638 Edict of Cyrus, permitting the Jews to return to Palestine. Many return under the leadership of Zerubbabel (Ezra i.-u.)

616 Completion of the second Temple in the 6th year of Darius (Ezra vi. 16)

458 Return of exiles with Ezra, in the 7tb year

of Artaxerxes(Ezravii.7) 445. Nehemiah's first visit to Jerusalem (Neb.

432. Nehemiah's second visit to Jerusalem (Neh. xiii. 6)

721-710. The Chaldffian prince, Merodach-baladan, king of Babylon (of. 2 Ki. xx. 12 = Is. xxxtx. 1)

711. Siege and capture of Ash-

dod (cf. Is. XX. 1) 705-681. Sennacherib

701. Campaign against Phce-

nicia, Fhilistia, and

Judah (2 Kings xviii. 18-xix. 85)

681-668. Esarbaddon

670. Esarbaddon conquers

Egypt 668-626. Asshur-banipal

668. Asshur-banipal invades Egypt, and sacks Thebes (Nah. iii. 8-10)

T16-666 (or 664). Tioenty-ftfth

(Ethiopian) Dynasty 716.1 Sabako

704.1 Shabltoku

!i (al. 690). Tabarqa (Tlr- hakah, Is. xxxvli. 9)

666 (or 664)-525. Twenty-sixth

Dynasty 6G6 (al. 664). Fsammeticbus I.

Chaldoean Dynasty 626. Nabopolasear

605. Defeat of Egyptians by Nebuchadnezzar (as his father's general) at Car- chemish (Jer. xlvi. 2)

604. Nebuchadnezzar

561. AmM-marduk (Evil-me-

rodach, 2 Kings xxv. 27) 559. Nergal-sharuzur (Neri-

glissar) 565. (9 months) L4bashimar-

duk (Laborisoarchod) 555. Nabu-na'id (Nabonnedus,

Nabonidus) 539. Capture of Babylon by

Cyrus

Persian Kings 638. Cyrus

607. Destruction of Nineveh by the Medea, and end of the empire of Assyria

610. Necbo

608. Battle of Megiddo, and death of Josiah (2 Kings

629. Cambyses

622. (7 months) Ganm&ta

(Pseudo-Smerdis) 522. Darius Hystaspis

490. Battle of Marathon

485. Xerxes

480. Battles of Thermopylw

and Salamis 465. Artaxerxes

694. Fsammeticbus II. (Fsam-

mls) 689. Apries (Hophra, Jer. xliv.

80)

670. Amasis (.jointly with

Apries) 564. Amasis alone

526. Fsammeticbus III. 525. Conquest of Egypt by Cambyses

1 Maspero's dates (Passing of the Empires, 1900, p. 238).

Cheonological Table — Continued.

Chronology of Ussher.

Biblical Events.

Events in Contemporary History.

Babylonia.

Assyria.

Egypt.

0. 850. Many Jews carried away captive to Hyrcania and Babylonia, probably on account of a revolt against the Persians

423. Darius II. (Nothus) 404. Artaxerxes II. (Mnemon) 369. Artaxerxes III. (Oohus)

338. Arses

336. Darius III. (Codoman- nus)

333. Persian Empire over- thrown by Alexander the Great

Palestine now becomes a province, first of the empire of Alexandsr, and afterwards of that of one or other of Alexander's successors.

332. The Jews submit to Alexander the Great.

323. Death of Alexander in Babylon.

322. Alexander's general, Ptolemy Lagi, becomes Satrap of Egypt.

320. Ptolemy Lagi gains possession of Palestine, which, with short interruptions, continues in the hands of the Ptolemies till 198.

312. Beginning of the era of the Seleucidse (re.ckonedfrom the time when Seleucus Nicator, Alexander's former heavy cavalry officer, finally established himself in the satrapy of Baby- lonia. He founded Antioch as his capital, 300 b.c).

305. Ptolemy Lagi assumes the title of king.

198. Antioohus the Great, king of Syria (223-187), defeats Ptolemy Epiphanes at Panias (B3,niyas, near the sources of the Jor- dan), and obtains possession of Palestine.

17S-164. Antiochus Epiphanes, king of Syria (Dan. xi. 21-45).

168. Antiochus's attempt to suppress the religion of the Jews (1 Mace. i. 41-63 ; cf. Dan. vii. 8, 21, 24-26 ; viii. 9-14 ; xii. 10-12). Public worship suspended in the Temple for three years.

167. Rise of the Maccabees (1 Mace. ii.).

166-165. Victories of Judas Maccabseus over the generals of Antiochus (1 Mace, iii.-iv.).

165. Ke-dedication of the Temple on 25th Chisleu (December), 1 Mace. iv. 52-61.

160. Death of Judas Maccabseus (1 Mace. ix. 1-22).

160-142. Jonathan, younger brother of Judas, leader of the loyal Jews (1 Maoc. ix. 23-xii. 53).

142-135. Simon, elder brother of Judas (1 Mace, xiii.-xvi.).

135-105. John Hyrcanus, son of Simon.

105-104. Aristobulus I. (ion of Hyrcanus), king.

104-78. Alexander Jannseus (brother of Aristobulus), king.

78-69. Salome (Alexandra), widow of Alexander Jannseus.

69. Aristobulus II. (son of Alexandra).

65. Capture of Jerusalem by Pompey. Palestine becomes a part of the Roman province of Syria.

See, for further information on the subject, the article Chkono- LOGY in the JEncyclopcedia Biblica, cols. 773-799, with the literature referred to on col. 819 (especially the writings of Noldeke, Well-havisen, and Kamphausen there mentioned). (s. E. D.)

II. New Testament.

The subject of the clironology of the 'New Testament falls naturally into two distinct sections — the chronology of the Gospels, that is, of the life of Christ ; and the chronology of the Acts, that is, of the apostolic age.

The Chronology of the Gospels.

The data group themselves around three definite points and the intervals between them: the definite points are the Nativity, the Baptism, and the Crucifixion; the age of Christ at the time of the Baptism connects the first tvfo points, and the duration of His public ministry connects the second and third. The results obtained under the different heads serve mutually to test, and thereby to correct or confirm, one another.

1. The date of the Nativity as fixed- according to our common computation of Anni Domini (first put forward by Dionysius Exiguus at Rome early in the 6th century) has long been recognized to be too late. The fathers of the primitive church had been nearer the truth with the years 3 or 2 B.C. (see Ireneeus, Hoer. III. xx. 3 [xxiv. 2] ; Clement of Alexandria, Strom, i. 21, p. 147; Hippolytus,

in Danielem iv. ed. Bonwetsch, p. 242 ; [TertuUian], adv. Judceos, 8). What may be called the received chronology during the. last two centuries has pushed the date farther back to 4 b.c. But the considerations now to be adduced make it probable that the true date is earlier still.

(a) Evidence of St Matthew's Gospel (i. 18-ii. 22). — The birth of Christ took place before the death of Herod, and the evidence o£ Josephus fixes the death of Herod, with some approach to certainty, in the early spring of 4 B.C. Josephus, indeed, while he tells us that Herod died not long before Passover, nowhere names the exact year ; but he gives four calculations which serve to connect Herod's death with more or less known points, namely, the length of Herod's own reign, both from his de jure and from his de facto accession, and the length of the reigns of two of Ms successors, Archelaus and Herod Philip, to the date of their deposition and death respectively. The various calculations are not quite easy to harmonize, but the extent of choice for the year of Herod's death is limited to the years 4 and 3 b.c, with a very great preponderance of probability in favour of the former. How long before this the Nativity should be placed the Gospel does not enable us to say precisely, but as Herod's decree of ex- termination included all infants up to two years of age, and as a sojourn of the Holy Family in Egypt of

unknown length intervened between the massacre and Herod's death, it is clear that it is at least possible, so far as the evidence of this Gospel goes, that the birth of Christ pre- ceded Herod's death by as much as two or three years. What is thus shown to be possible would, of course, be necessary if we went on, with the astronomer Kepler, to identify the star of the Magi with the conjunction of the planets Jupiter and Saturn which occurred, in the con- stellation Pisces, in May, October, and December of 7 b.c'

(6) Evidence of St Luke's Gospel (ii. IrS). — The birth of Christ took place at the time of a general census of the empire ordered by Augustus: "it was the first census, and was made at the time when Quirinius was governor of Syria." Against this account it has been urged that we know that the governorship of Syria from 10 or 9 b.c. down to and after Herod's death was held successively by M. Titius, C. Sentius Saturninus, and P. Quintilius Varus ; and further, that when Judsea became a Eoman province on the^ deposition of Archelaus in a.d. 6, Quirinius was governor of Syria, and did carry out an elaborate census. The notice in the Gospel, it is suggested, grew out of a confused recollection of the later (and only historical) census, and is devoid of any value whatever. At the other extreme Prof. W. M. Eamsay (Was Christ Bom at Bethlehem? 1898, p. 149 Jf.) defends the exact accuracy of St Luke's " first census " as witnessing to the (otherwise of course unknown) introduction into Syria of the periodic

1 It is a curious coincidence that a mediaeval Jew, E. Abarbanel, records that the conjunction of these particular planets in this par- ticular constellation was to be a sign of Messiah's coming. It is just conceivable that his statement may ultimately depend on some such ancient tradition as may have been known to Chaldean magi.

fourteen years' census ~~whicli the evidence of papyri has lately established for Egypt, at least from a.d. 20 on~~ wards. Beckoning back from a.d. 20, the periodic cen- sus should fall in 9 b.c, but Eamsay

alleges various causes for delay, which would have postponed, the actual execution of the census tiU 7 b.c, and supposes that Quirinius was an imperial commissioner specially ap- pointed to carry it out. The truth seems to rest midway between these extremes. St Luke's statement of a gen- eral census is in all probability erroneous, and the intro- duction of the name Quirinius appears to be due to con- fusion with the census of a.d. 6. But the confusion in question would only be possible, or at any rate likely, if there really was a census at the time of the Nativity ; and it is no more improbable that Herod should have held, or permitted to be held, a local census than that Archelaus of Cappadocia in the reign of Tiberius (Tacitus Ann. vi. 41) should have taken a census of his own native state "after the Eoman manner." But St Luke's account, when the name of Quirinius is subtracted from it, ceases to contain any chronological evidence.

(c) Evidence of TertulUan. — Strangely enough, however, the missing name of the governor under whom the cen- sus of the Nativity was carried out appears to be supplied by an author who wrote more than a century after St Luke, and has by no means a good reputation for histo- rical trustworthiness. Tertullian, in fact (adv. Marcianem, iv. 19), employs against Marcion's denial of the true hu- manity of Christ the argument that it was well known that Sentius Satuminus carried out a census under Augus- tus in Judea, by consulting which the family and relation- ships of Christ could have been discovered. This Satur- ninus was the middle one of the three governors of Syria named above, and as his successor Varus must have ar- rived by the middle of 6 b.c. at latest (for coins of Varus are extant of the twenty-fifth year of the era of Ac- tium), his own tenure must have fallen about 8 and 7 b.c, and his census cannot be placed later than 7 or 7-6 b.c The independence of Tertullian's information about this census is guaranteed by the mere fact of his knowledge of the governor's name ; and if there was a census about that date, it would be unreasonable not to identify it with St Luke's census of the Nativity.

The traditional Western day for the Christmas festival, 25th December, goes back as far as Hippolytus, loc. cit. ; the traditional Eastern day, 6th January, as far as the Basilidian Gnostics (but in their case only as

a celebrar tion of the Baptism), mentioned by Clement of Alexan- dria, loc. cit.

2. The interval between the Nativity and the Baptism. Evidence of St Ijuke's Gospel (iii. 23).— At the time of

His baptism Jesus was apxoiM^

3. The date of the Baptism.

(a) Evidence of St Luke's Gospel (iii. 1) : a terminus a quo for the Baptism is the synchronism of the commence- ment of the Baptist's public ministry with the fifteenth year of the rule (■qyt/wvia) of Tiberius. Augustus died

on 19th August, a.d. 14, and, reckoned from that point, Tiberius's fifteenth year might be, according to different methods of calculation, either a.d. 28, or 28-29, or 29. None of these alternatives would be at all easy to recon- cile with the results yielded by other lines of investiga- tion in this article, and the choice seems to lie between the following views : (i.) The years of Tiberius are here reckoned from some earlier starting-point than the death of his predecessor — probably from the grant to him of co-ordinate authority with Augustus over the provinces made in a.d. 11 (see, for the parallel with the case of Vespasian and Titus, Ramsay, St Paul the Roman Trav- eller, p. 387), so that the fifteenth year would be roughly A.D. 25 ; or (ii.) St Luke has made here a second error in chronology, caused perhaps in this case by reckoning back from the Crucifixion, and only allowing one year to the ministry of Christ.

(6) Evidence of St John's Gospel (ii. 13, 20) : a terminus ad quern for the Baptism is the synchronism of the first Passover mentioned after it with the forty-sixth year of the building of Herod's Temple. Herod began the Temple in the eighteenth year of his reign, probably 20-19 B.C., and the Passover of the forty-sixth year is probably that of a.d. 27. While too much stress must not be laid on a chain of reasoning open to some uncer- tainty at several points, it is difficult to suppose with Loisy, Revue d'histoire et de liMrature religieuses, 1900, p. 536, that

the number was intended by the evangelist as purely figurative, and is therefore destitute of all his- torical meaning.

On the whole, the Baptism of Christ should probably be placed in a.d. 26-27 ; and as the Nativity was placed in 7-6 B.C. (at latest), this would make the age of Christ at his Baptism to be about thirty-two, which tallies well enough with St Luke's general estimate.

4. The interval between the Baptism and the crucifixion, or, in other words, the duration of the public ministry of Christ.

(a) Evidence of the Synaptic Tradition and of St Mark's Gospel (ii. 23, vi. 39, xiv. 1). The order of events in the primitive synoptic tradition appears to be faithfully re- produced in St Mark ; and if this order is chronological, Christ's ministry lasted at least two years, since the plucking of the ears of corn (April-June) marks a first spring ; the feeding of the ^ve thousand when the grass was fresh green (xAupos : about March), a second ; and the Passover of the Crucifixion a third : and these three points are so far removed from one another in the narra- tive that the conclusion would hold, even if the general arrangement in St Mark were only roughly, and not minutely, chronological. On the other hand, it may be true that an impression of a briefer period of ministry naturally results, and in early generations did actually result, from the synoptic account considered as a whole.

(&) Evidence of St Luke's Gospel(ix. 51-xix. 28 compared with iv. 14-ix. 50 ; iv. 19). Still stronger is the im- pression of brevity suggested by St Luke. The second and larger half of the narrative of the ministry is intro- duced at ix. 51 with the words, " It came to pass as the days of His assumption were coming to the full. He set His face firmly to go to Jerusalem," under which phrase the evangelist cannot have meant to include more than a few months, perhaps not more than a few weeks ; so that even if the earlier and shorter half of the account, which describes a purely Galilean ministry (" Judaea " in iv. 44, if it is the true reading, means Judaea in the sense of Palestine), is to be spread over a longer period of time, the combined narrative can hardly have been planned on the scale of more than a single year. St Luke himself

may have understood literally, like so many of his readers in ancient times, the reference which he records to the

” acceptable year of the Lord ” (iv. 19= Isaiah Ixi. 2) : see, too, above, 3 (a) ad Jin.

(c) Evidence of St John’s Gospel (ii. 13, ” the Passover of the Jews was neai-,” and 23, ” He was in Jerusalem at the Passover at the feast ” ; v. 1, ” after these things was a feast [or, ‘ the feast ‘] of the Jews ” ; vi. 4, ” and the Passover, the feast of the Jews, was near”; vii. 2, ” and the feast of the Jews, the Tabernacles, was near ” ; X. 22, ” at that time the feast of dedication took place at Jerusalem ” ; xi. 55, ” and the Passover of the Jews was near ” : besides iv. 35, ” say ye not that there is yet a period of four months and harvest cometh ? behold, I tell you, lift up your eyes and see the fields that they are white to harvest “). This catena of time-references is of course unique in the Gospels as a basis for a chronol- ogy of the ministry; and it is not reasonable to doubt (with Loisy, loc. eit., who suggests that the aim was to produce an artificial correspondence of a three and a half years’ ministry with the half-week of Daniel; but many and diverse as are the early interpretations of Daniel’s seventy weeks, no one before Eusebius thought of connecting the half -week with the ministry), that the evangelist intended these notices as definite historical data, possibly for the correction of the looser synoptic narratives and of the erroneous impressions to which they had given rise. Unfortunately, difficulties, either (i.) of reading, or (ii.) of interpretation, or (iii.) of arrangement, have been raised with regard to nearly all of them ; and these difficulties must be briefly noticed here.

(i.) Readings (a) v. 1, fopri) A B D, Orlgen, Epiphanius, Chrysostom, Paschal Chronicle; ij ioprii KCLA 1-118, 33, the Egyptian versions, Eusebius, Cyril-Alex. (Irenseus?). ‘‘he balance of internal evidence — copyists

being more likely to accentuate than to diminish the precision of a note of time — inclines, like the balance of external evidence, against the article. (') vi. 4, tA irdffxa is read by all known MSS. and versions ; but it has been argued by Hort (in Westcott's and Hort's New Testament in Oreek, appendix, pp. 77-81) that four ancient authorities omitted the words, and that their omission simplifies the whole chronology, since "the feast" which was "near" in vi. 4 would then be identical with the feast of Tabernacles mentioned in vii. 2, and all the time-notices of the Gospel could be arranged to fall within the space of a single year, between the Passover of ii. 13 and the Passover of xi. 56. But of the four authorities alleged, Ireneeus (II. xxii. 3 [xxxiii. 1]) and the Alogi (^ap. Epiphanius, J(sr. Ii. 22) were giving catalogues of Passovers "observed" by Christ (at Jerusalem), and therefore naturally omitted a mere chronological reference like vi. 4 : Cyril of Alexandria, in so far as his evidence is adverse to the words, appears to be incorporating a passage from the Commentary of Origen, not extant in loc. ; and the only writer who perhaps really did omit the words — with the view, no doubt, of reconciling the witness of the fourth Gospel with the then widely-spread tradition of the single-year ministry — is Origen himself.

(ii.) Interpretation (a) iv. 35 : which is to be taken literally, the "four months to harvest" (about January), or the "fields white to harvest " (about May) ? It does not seem possible to rule out either interpretation ; the choice between them will follow from the view taken of the general chronological arrange- ment of the Gospel. (/3) v. i: if "the feast" is read, a choice remains between Passover and Tabernacles (the definite article would not be very definite after all) ; if the more probable " a feast," the greater feasts are presumably excluded, but a choice remains between, at any rate, Pentecost (May), Trumpets (Sep- tember), Dedication (December), and Purim (February). Here again the decision will follow on the general chronological arrange- ment which may be adopted.

(iii.) Arrangement. — So far the amount of possible latitude left is not so great as to obscure the main outline of the chronology. For a first (ii. 13, 20), second (vi. 4), and third (xi. 55) Passover are established, with two indeterminate notices (iv. 35, v. 1) between the first and second,

and two determinate notices (vii. 2 Tabernacles in October, x. 22 Dedication in December) between the second and third. But of late years an increasing desire has been manifested, especially in Germany and America, to mani- pulate the fourth Gospel on grounds of internal evidence, at first only in the way of particular transpositions of more or less attractiveness, but latterly also by schemes of thoroughgoing rearrangement. The former class of proposals will, however, as a rule hardly affect the chronology of the Gospel ; the latter will

affect it vitally. The distinction here drawn may be illustrated from the earliest instance of the former and the latest of the latter. In 1871 Archdeacon J. P. Norris {Journal of Philology) wished to transpose chapters v. and vi. — ch. vi. was, like ch. xxi., a Gali- lean appendix, and was inserted by mistake at somewhat too late a point in the body of the Gospel — and to read ” the feast ” in v. 1, identifying it with the Passover which was near in vi. 4: in any case, whether ” the feast ” = Passover, or ” a feast ” = Pente- cost, were read in v. 1, the transposition would not affect the two years’ ministry. In 1900 Prof. B. W. Bacon (American Journal of Theology, p. 770) proposed a rearrangement of the whole Gos- pel, according to which the time-notices would occur in the follow- ing order : vi. 4, Passover is near ; iv. 35, the fields white to harvest = May ; v. 1, ” a feast ” = Pentecost ; vii. 2, Tabernacles ; X. 22, Dedication ; xi. 55, Passover is near ; xii. 1, Jesus at Bethany six days before Passover; ii. 13, Passover is near and Jesus goes up to Jerusalem (ii. 23, an interpolation) for the Pass- over of the Crucifixion ; and the ministry would thus be reduced to a single year. Such a scheme does not lend itself to discussion here ; but as far as evidence is at present obtainable, the conclu- sion that St John drew up his narrative on the basis of a two years’ rather than a one year’s ministry appears to be irrefragable.

Not only do the fourth and second Gospels thus agree in indications of a two years’ ministry, but the notes of the middle spring of the three (John vi. 4, Mark vi. 39) both belong to the feeding of the 6000, one of the few points of actual contact between the two Gospels.

The question, however, may stUl be raised, whether these time-indications of the two Gospels are exhaustive, whether (that is) two years, and two years only, are to be allotted to the ministry. Irenaeus (II. xxii. 3-6 [xxxiii. 1-4]), in favour of a ministry of not less than ten years, appeals (i.) to the tradition of Asia Minor ; (ii.) to the record in St John that Christ, who was thirty years old at the time of His baptism, was addressed by the Jews as ” not yet [i.e., nearly] fifty years old ” : but both his arguments are probably derived from a single source, Papias’s interpretation of John viii. 67. With this ex- ception, however, all ancient writers, whether they enumerated two or three or four Passovers in the Gospel history, believed that the enumeration was exhaustive ; and their belief appears correctly to represent the mind of St John, whose notes of time were probably in in- tentional contrast to the looser synoptic accounts. More- over, the wide currency in early times of the tradition of the single-year ministry (Ptolemaeus, op. Iren. loc. cit.; Clementine Homilies, xvii. 19 ; Clem. Alex. Strom, i. 145, vi. 279 ; Julius Africanus, ap. Routh, Bell. Sacr. ii. 240, 306; Hippolytus, Paschal Cycle and Chronicle; Origen m Levit. Horn. ix. 6, de Principiis, iv. 5) becomes more diffi- cult to account for the farther it is removed from the actual facts.

5. The date of the Crucifixion.

(a) The Roman Governor. — ^Pontius Pilate was on his way back to Eome, after ten years of office, when Tiberius died on 16th March a.d. 37 (Josephus, Ant. XVIII. ii. 2, iv. 2). Luke xiii. 1, xxiii. 12, show that he was not a new- comer at the time of the Crucifixion. Por the Crucifixion “under Pontius Pilate “the Passover of a.d. 28 is therefore the earliest possible and the Passover of a.d. 36 the latest.

(6) The Jewish High-Priest. — Caiaphas was appointed before Pilate’s arrival, and was deposed at a Passover apparently not later than that of the year of Herod Philip’s death, a.d. 34 {Ant. XVIII. ii. 2, iv. 3-v. 3). The Crucifixion at some previous Passover would then fall not later than a.d. 33.

(c) The Day of the Week. — The Eesurrection on ” the first day of the week ” (Sunday) was ” on the third day ” after the Crucifixion ; and

that ” the third day ” implies an interval of only two days hardly needed to be shown, but has been shown to demonstration in Field’s Notes on the Translation of the New Testament (on Matt. xvi. 21). The Crucifixion was therefore on a Friday in some year between a.d. 28 and 33 inclusive.

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(d) TJie Day of the Jewish Month Msan.— The Passover was kept at the full moon of the lunar month Nisan, the first of the Jewish year ; the Paschal lambs were slain on the afternoon of the 14th, and the Passover was eaten after sunset the same day — which, however, as the Jewish day began at sunset, was by their reckoning the 15th ; the first fruits (of the barley harvest) were solemnly offered on the 16th. The synoptic Gospels appear to place the Crucifixion on the 15th, since they speak of the Last Supper as a Passover ; St John’s Gospel, on the other hand (xiii. 1, 29, xviii. 28), distinctly implies that the feast had not yet taken place, and thus makes the Cruci- fixion fall on the 14th. Early Christian tradition is unanimous on this side ; either the 14th is mentioned, or the Crucifixion is made the antitype of the slaughter of the Paschal Lamb (and the resurrection of the first fruits), in the following authorities anterior to a.d. 235 : St Paul, 1 Cor. v. 7, xv. 20; Quartodecimans of Asia Minor, who observed the Crucifixion on the ” 14th,” no matter on what day of the week it fell ; Claudius Apol- linaris, Clement of Alexandria, Hippolytus, all three quoted in the Paschal Ghronicle; Irenaeus (apparently) IV. x. 1 [xx. 1] ; [TertuUian] adv. Judoeos, 8 ; Africanus, in Kouth, Hell. Sacr. ii. 297. The Crucifixion, then, should be placed rather on the 14th than on the 16th of Nisan. These four lines of inquiry have shown that the Cruci- fixion fell on Friday, Nisan 14 (less probably 15), in one of the six years 28-33 a.d. ; and therefore, if it is possible to discover (i.) exactly which moon or month was reckoned each year as the moon or month of Nisan, and (ii.) exactly on what day that particular moon or month was reckoned as beginning, it will, of course, be possible to tell in which of these years Nisan 14 (or 15) fell on a Friday. To neither question can an answer be given in terms so precise as to exclude some latitude, but to both with sufficient exactness to rule out at once three of the six years, (i.) The

difficulty with regard to the month is to know how the commencement of the Jewish year was fixed — in what years an extra month was intercalated before Nisan. If the Paschal full moon was, as in later Christian times, the first after the spring equinox, the difficulty would be reduced to the question on what day the equinox was reckoned. If, on the other hand, it was, as in ancient Jewish times, the first after the earliest ears of the barley harvest would be ripe, it would have varied with the forwardness or backwardness of the season from year to year, (ii.) The difficulty with regard to the day is, quite similarly, to know what precise relation the first day of the Jewish month bore to the astronomical new moon. In later Christian times the Paschal month was calculated from the astronomical new moon; in earlier Jewish times all months were reckoned to begin at the first sunset when the new moon was visible, which in the most favourable circumstances would be some thirty-six hours later than the astronomical new moon.

Direct material for answering the question when and how far astronomical calculations replaced simple observa- tions as the basis of the Jewish kalendar is not forth- coming. Jewish traditions represented the Sanhedrim as retaining to the end its plenary power over the~ kalendar, and as still fixing the first day of every month and the first month of every year. But as it is quite inconceivable that the Jews of the Dispersion should not have known beforehand at what full moon they were to present them- selves at Jerusalem for the Passover, it must be assumed as true in fact, whether or no it was true in theory, that the old empirical methods must have been qualified by permanent, that is in effect by astronomical, rules for the commencement of years and months. The first of each month was within a certain limit from the astronomical new moon. Nisan was fixed with reference to the equinox,

though with regard to the day of the equinox it must be remembered (i.) that even of Christian calculations, while the Alexandrine reckoning in the 4th century adopted 21st March, Anatolius in a.d. 277 had employed 19th March, and Hippolytus in a.d. 221 18th March; (ii.) that Christian controversialists from Anatolius onwards accused the Jews of

disregarding the (Christian) equinoctial limit, and of sometimes placing the Paschal full moon before it ; the Jewish equinox may therefore have gone back even as far as 17th March. In the following table the first column gives the terminus pasclialis, or 14th of the Paschal moon, according to the present Christian kalendar ; .the second gives the 14th, reckoned from the time of the astronomical new moon of Nisan ; the third the 14th, reckoned from the first appearance of the new moon at sunset. Alternative moons are given for a.d. 29, accord- ing as the full moon falling about 18th March is or is not reckoned after the equinox.

A.D.

. 28 29

30 31 32 33

Sat. Mar. 27 Th. Mar. 17 F. Ap. 16 Tu. Ap. i Sat. Mar. 24 Sat. Ap. 12 W. Ap. 1

Mar. 28 Mar. 17 Ap. 16 Ap. 6 Mar. 25 Ap. 12 Ap. 1-2

Mar. (29-) 30 Mar. (18-) 19 Ap. (17-) 18 Ap. (6-) 7 Mar. (26-) 27 Ap. (13-) 14 Ap. (2-) 3 or (3-) 4

The first and third columns may safely be taken to represent the possible extremes for Nisan 14, so that it will be seen at once that Friday cannot have fallen on Nisan 14th or 15th in any of the three years a.d. 28, 31, and 32. The choice is narrowed down to a.d. 29, Friday 18th March (Friday 15th April would probably be too early even for Nisan 14); a.d. 30, Friday 7th April; and a.d. 33, Friday 3rd April.

(e) The CivU Year (consuls, or regnal years of Tiberius) in early Christian tradition. It is not d, priori improbable that the year of the central event from which the Christian Church dated her own existence should have been noted in the apostolic age and handed down to the memory of succeeding generations ; and the evidence does go some way

to suggest that we have in favour of a.d. 29, the consulate of the two Gemini (15th or 16th year of Tiberius), a body of tradition independent of the Gospels and ancient, if not primitive, in origin.

The earliest witness, indeed, who supplies material for a definite date for the Crucifixion gave not 29, but 33 a.d. The pagan chronicler, Phlegon, writing in the reign of Hadrian, noted under Olympiad 202-4 (=a.d. 32-33), besides a great earthquake in Bithynia, an eclipse so phenomenal that it became night " at the sixth hour of the day." The eclipse meant is, of course, that of the Cruci- fixion (so Origen, contra Celsum, ii. 33 [but see in Matt. 134, Delarne iii. 922], Eusebius's Chronicle Tib. 19 [=a.d. 33], Anon, in Cramer's Catena in Matt. p. 237), but as the notice of it was clearly derived by Phlegon, pagan as he was, directly or indirectly from the Gospel narrative, there is no reason at all to ascribe any independent value to the date. Phlegon may have had grounds for dating the Bithynian earthquake in that year, and have brought the dateless portent into connexion with the dated one. Eusebius adopted and popularized this date', which fell in with his own system of Gospel chronology, but of the year 33 as the date of the Passion there is no vestige in Christian tradition before the 4th century.

The only date, in fact, which has any real claim to represent Christian tradition independent of the Gospels, is the year 29. Tiberius 16 is given by Clem. Alex. Strom, i. 147 ; Origen, Ham. in Jerem. xiv. 13 ; cf. c. Cels. iv. 22. Tiberius 16 by Julius Africanus (Routh, Bell. Sacr. ii. 301-304), and pseudo-Cyprian de pascha

computus (a.d. 243), § 20. The consulship of the two Gemini by Lactantius Div. Inst. IV. x.l8, and (Lactantius?) de morte pers. § 2; the consulship of the two Gemini = Tiberius 18 by Hippolytus Comm. m Banielem, iv. (ed. Bonwetsch, p. 242) ; the consulship of the two Gemini= Tiberius 15 by [Tertullian] adv. Judceos, § 8 ; the consul- ship of the two Gemini = Tiberius 15 (al. 18 or 19) = 01. 202. 4 [this last is a later interpolation from Eusebius] in the Acts of Pilate. Other methods

of expressing the year 29 appear in Hippolytus's Paschal Cycle and Chronicle, and in the Abgar legend (op. Eusebius, H. E. i. 13). No doubt it would be possible to explain Tiberius 16 as a combination of Luke iii. 1 with a one year ministry, and even to treat Tiberius 15 as an unintelligent repetition from St Luke — though the omission to allow a single year for the ministry would be so strange as to be almost unintelligible — but the date by the consuls has an independent look about it, and of its extreme antiquity the evidence gives two indications: (i.) Hippolytus's Commentary on Daniel (now generally dated c. a.d. 200) combines it with an apparently inconsistent date, Tiberius 18 ; the latter is clearly his own combination of the length of the ministry (he says in the same passage that Christ suffered in His 33rd year) with Luke iii. 1 — the consulship must have been taken from tradition without regard to consistency; (ii.) the names of the Gemini are divergently given in our oldest authorities; in [Tert.] adv. Judceos correctly as Rubellius Geminus and Fufius (or Rufius) Geminus, but in Hippolytus and the Acts of Pilate as Eufus and Rubellio. But if the tradition of the consulships was thus, it would seem, already an old one about the year 200, there is at least some reason to conclude that trustworthy information in early Christian circles pointed, independently of the Gospels, to the year 29 as that of the Crucifixion.

(/) TJie Civil Month and Day. — The earliest known calculations, by Basilidian Gnostics, quoted in Clem. Alex. Strom, i. 147, gave alternative dates, Thamenoth 25, Pharmuthi 25, Pharmuthi 19 ; that is, according to the fixed Alexandrine kalendar of b.c. 26, 21st March, 20th April, 14th April ; in the older, not wholly superseded, Egyptian kalendar the equivalents with Eoman days varied from year to year. But in all probability these dates were only one development of those speculations in the region of numbers to which Gnosticism was so prone ; and in any case to look for genuine traditions among Egyptian Gnostics, or even in the church of Alexandria, would be to misread the history of Christianity in the 2nd century. Such traditions must be found, if anywhere, in Palestine and Syria, in Asia Minor, in Eome, not in Egypt; within the church, not among the Gnostics. The date which makes the most obvious claim to satisfy these conditions would be 25th March, as given by Hippolytus, [Tert.] adv. Judceos, and the Acts of

Pilate (according to all extant MSS. and versions, but see below), locc. eitt. — ^the same three authorities who bear the earliest witness for the consuls of the year of the Crucifixion — and by many later writers. It cannot be correct, since no full moon occurs near it in any of the possible years ; yet it must be very early, too early to be explained with Dr Salmon {Dictionary of Christian Biography, iii. 926), as originated by Hippolytus's Paschal cycle of a.d. 221. Now Epiphanius {H(Br. 1. 1) had seen copies of the Acts of Pilate in which the day given was not 25th March, but a.d. XV. kal. Apr. (=18th March); and if this was the primitive form of the tradition, it is easy to see how 25th March could have grown out of it, since the 18th would from comparatively early times have been thought impossible as falling before the equinox (see above, 5 d), and no substitution would be so natural as that of the day week, Friday, 26th March. But Friday, 18th March

A.D. 29, was one of the three alternative dates for the Crucifixion which on astronomical and kalendar grounds were fotmd (see above, 5d) to be possible.

Thus A.D. 29 is the year, 18th March is the day, to which Christian tradition (whatever value, whether much or little, be ascribed to it) appears to point. Further, the Baptism was tentatively placed in a.d. 26-27; the length of the ministry was fixed, with great preponderance of probability, at something over two years ; and here too the resultant date for the Crucifixion would be the Pass- over of A.D. 29.

To sum up: the various dates and intervals, to the approximate determination of which this article has been devoted, do not claim separately more than a tentative and probable value. But it is submitted that their harmony and convergence give them some additional claim to acceptance, and at any rate do something to secure each one of them singly — the Nativity in 7-6 B.C., the Baptism in a.d. 26-27, the Crucifixion in A.D. 29 — ^from being widely or even appreciably in error.

The Chronology of the Apostolic Age.

The chronology of the New Testament outside the Gospels may be defined for the purposes of this article as that of the period between the Crucifixion in a.d. 29 (30) on the one hand, and on the other the persecution of Nero in a.d. 64 and the fall of Jerusalem in a.d. 70. Of the events in Christian history which fall between these limits it must be admitted that there are many which with our present information we cannot date with exactness. But the book of acts our only continuous authority for the period, contains two synchronisms with secular history which can be dated with some approach to certainty and constitute fixed points by help of which a more or less complete chronology can be constructed for at least the latter half of the apostolic age. These are the death of Herod Agrippa I. (xii. 23) and the replacement of FeUx by Festus (xxiv. 27).

1. The death of Herod Agrippa I. This prince, son of Aristobulus and grandson of Herod the Great, was made (i.) king over the tetrarchy which had been Herod Philip's, " not many days " after the accession of Gains, 16th March A.D. 37 ; (ii.) ruler of the tetrarchy of Antipas, in a.d. 39-40 ; (iii.) ruler of the whole of Palestiue (with Abilene), on the accessionofClaudiusatthebeginningof A.D.41. Josephus's Jewish Wars and Antiquities differ by one in the number of years they allot to his reign over the tetrarchies (the former work says three years, the latter four), but agree in the more important datum, that he reigned three years more after the grant from Claudius, which would make the latest limit of his death the spring of a.d. 44. The Antiquities also reckon it in the seventh year of his reign, which would suggest a.d. 4344. On the other hand, coins whose genvdneness there is no apparent reason to doubt are extant of Agrippa's ninth year ; and this can only be reconciled even with a.d. 44 by supposing that he commenced reckoning a second year of his reign on Nisan 1, a.d. 37, so that his ninth would run from Nisan 1, a.d. 44. On the balance of evidence the only year which can possibly reconcile all the data appears to be A.D. 44 after Nisan, so that it wUl have been at the Passover of that year that St Peter's arrest and deliver- ance took place.

After Agrippa's death Judsea was once more governed by procurators, of whom Cuspius Fadus and Tiberius Alexander ruled from a.d. 44 to

48 ; the third, Cumanus, was appointed in a.d. 48 ; and the fourth, Felix, in a.d. 52. Under Tiberius Alexander, i.e., in a.d. 46 or 47, occurred the great famine which Agabus had foretold, and in which the Antiochene church sent help to that of Jerusalem by the

ministry of Barnabas and Saul (Acts xi. 30, xii. 25). Thus the earliest date at which the commencement of the first missionary journey (Acts xiii. 4) can be placed is the spring of a.d. 47. The journey extended from Salamis « throughout the whole island ” of Cyprus as far as Paphos, and on the mainland from Pamphylia to Pisidian Antioch, Iconium, Lystra, and Derbe, at each of which places indications are given of a prolonged visit (xiiL 49, xiv. 3, 6? 7, 21). The same places were visited in reverse order on the return journey, as far as Perga on the Pamphylian coast; but instead of revisiting Cyprus the voyage to Syria was this time made direct. In estimating the length of time occupied by this first missionary journey, it must be remembered that a sea voyage could never have been undertaken, and land travel only rarely, during the winter months, say November to March ; and as the amount of the work accomplished is obviously more than could fall within the travelling season of a single year, the winter of 47-48 must have been spent in the interior, and return to the coast and to Syria made only some time before the end of autumn a.d. 48. The succeeding win- ter, at least, was spent again at Antioch of Syria (xiv. 28). The council at Jerusalem of Acts xv. will fall at earliest in the spring of a.d. 49, and as only “certain days” were spent at Antioch after it (xv. 36), the start on the second missionary journey might have been made in the (late) summer of the same year. The ” confirmation ” of the existing churches of Syria and Cilicia, and of those of the first journey beginning with Derbe (xv. 41, xvi. 5), cannot have been completed under several months, nor would the Apostle have commenced the strictly missionary part of the journey, in districts not previously visited, before the opening of the travelling season of a.d. 50. No delay was then made on the Asiatic side : it may still have been in spring when St Paul crossed to Europe and began the course of preaching at Philippi, Thessalonica, Bercea, and Athens which finally brought him to Corinth. The stay of

eighteen months at the last-named place (xviii. 11) will naturally begin at the end of one travelling season and end at the beginning of another, t.e., from the autumn of A.D. 50 to the spring of a.d. 62. l^om Corinth the Apostle went to Jerusalem to ” saJute the church,” and then again to Antioch in Syria, where he stayed only for “a time ” (xviii. 22), and soon left — on the third mission- ary journey, as conventionally reckoned — ^proceeding “in order” through the churches of the interior of Asia Minor. These journeys and the intervening halts must have occupied seven or eight months, and it must have been about the end of the year when St Paul established his new headquarters at Ephesus. The stay there lasted between two and three years (xix. 8, 10, xx. 31), and can- not have terminated before the spring of a.d. 55. From Ephesas he went into Europe, and after ” much teaching ” given to the churches of Macedonia (xx. 2), spent the three winter months at Corinth, returning to Philippi in time for the Passover (xx. 3, 6) of a.d. 56. Pentecost of the same year was spent at Jerusalem, and there St Paul was arrested, and kept in prison at Csesarea for two full years, until Festus succeeded Felix as governor (xx. 16, xxiv. 27), an event which, on this arrangement of the chronology of the missionary journeys, would therefore fall in A.D. 68.

Care, however, must be taken to remember exactly what this line of argument amounts to — what it can fairly be said to have proved, and what it still leaves open. It has been shown, firstly, that the missionary journeys cannot have commenced before the spring of a.d. 47, and, secondly, that between their commencement and the end of the two years’ imprisonment at Caesarea not less than eleven full years must have elapsed. Consequently a.d. 58 appears to be the earliest date possible for the arrival of Festus.

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On the other hand, a later date for Festus is not absolutely excluded. It is possible that the first missionary journey should be placed in a.d. 48 instead of a.d. 47 ; and it is possible, though not probable, that the missionary journeys should be spread over one year more than has been suggested above. At any rate, then, the alternative is open that

every date given above, from a.d. 47 to a.d. 58, should be moved on one year, with the result of placing Festus's arrival in a.d. 59.

It is now time to turn to the direct evidence for the date of Festus's arrival as procurator, in order to test by it the result already tentatively obtained.

2. The replacement of Felix by Festus. This is the pivot date of St Paul's later life, but unfortunately two schools of critics date it as differently as a.d. 65 and A.D. 60 (or 61). The former are represented by Harnack, the latter by Wieseler, whom Lightfoot follows. It can be said confidently that the truth is between these two extremes (though in what exact year it is not easy to say), as wUl be evident from a consideration of the arguments urged, which in each case appear less to prove one ex- treme than to disprove its opposite.

Arguments for the Later Date, a.d. 60 or 61. — (a) St Paul, at the time of his aiTest, two years before Felix's recall, addresses him as "for many years past a judge for this nation" (Acts xxiv. 10, 27). It is certain that Pelix succeeded Cumanus iu A.D. 52, for Tacitus njentions Cumanus's recall under that year ; Josephus immediately before the notice of the completion of Claudius's twelfth year [January, a.d. 63] ; Eusebius probably under Claudius 11, that is, between September 51 and September 52 (for the meaning of the regnal years in the Chronicle of Euse- bius see the present writer's article in JowtmI of Theological Studies, January 1900, pp. 188-192). It is argued that "many years" cannot mean less than six or seven, so that St Paul must have been speaking at earliest in 58 or 5&, and Pelix will have left Judsa at earliest in 60 or 61. But this argument overlooks the fact that Felix had been in some position which might properly be described as that of "judge for this nation" before he became governor of all Palestine in a.d. 52. In the words of Tacitus, Felix was at the time of that appointment iampridem ludcex impositus (Annals, xii. 54) ; he certainly supposes Felix to have been already governor of Samaria, and apparently of Judsea too, and only recognizes Cumanus as governor of Galilee ; and Josephus, though he says nothing of this, and treats Cumanus as the sole procurator dovm to A.D. 52, implies that Felix

had been in some position where the Jewish authorities could judge of his fitness when he tells us that the high priest Jonathan used to press on Felix, as a reason for urging him to govern well, the fact that he had asked for his appointment to the procuratorship (Ant. XX. viii. 5). If Felix had acted in some position of responsibility in Palestine before 52 (perhaps for some time before), St Paul could well have spoken of " many years " at least as early as 56 or 57.

(j3) Josephus enumerates after the accession of Nero (October 54) a long catalogue of events which all took place under the procuratorship of Felix, including the revolt of "the Egyptian" which was already "before these days" at the time of St Paul's arrest, two years from the end of Felix's tenure. This suggests, no doubt, that the Egyptian rebelled at earliest in 54-55, and makes it probable that St Paul's arrest did not take place before (the Pentecost of) a.d. 56 ; and it implies certainly that the main or most important part of Felix's governorship fell, in Josephus's view, under Nero. But as two years only of Felix's rule (52-54) fell under Claudius, this procedure would be quite natural on Josephus's part if his recall were dated in 58 or 59, so that four or five years fell under Nero. And there is no need at all to suppose that all the incidents which the historian masses under his account of Felix were succes^ve : events in Emesa, Chalois, Csesarea, and Jerusalem may easily have been synchronous.

The arguments, then, brought forward in favour of a.d. 60 or 61 do not do more than bring the rule of Felix down to 68 or 59.

Arguments for an Early Pate, a.d. 55 or 56. — (a) Eusebius's Chronicle places the arrival of Festus in Nero 2, October 55-56, and Eusebius's chronology of the procurators goes back probably through Julius Africanus (himself a Palestinian) to contemporajy authorities like the Jeicish kings of Justus of Tiberias. But (i.) Nero 2 is really September 56-September 57 ; (ii.) it is doubtful whether Eusebius had any authority to depend on here other than Josephus, who gives no precise year for Festus — Julius Africanus is hardly probable, since we know that his chronicle

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•was very jejune for the Christian period— and if so, Eusebius had to find a year as best he oould.i

(;3) Felix, on his return to Rome, was prosecuted by the Jews for misgovernment, but was acquitted through the influence of his brother Pallas. Pallas had been minister and favourite of Claudius, but was removed from ofBce in the winter following Nero's accession, 54-55. Pelix must therefore have been tried at the very beginning of Nero's reign. But this argument would make Felix's recall — if Festus came in summer, as Acts xxv. 1, xxvii. 1, 9, seem to prove— fall actually under Claudius. And, in fact, it would be a mistake to look upon Pallas's retirement as a disgrace. He stipulated that no inquiry should be made into his conduct in office, and was left for another seven years un-molested in the enjoyment of the fortune he had amassed. There is, therefore, every likelihood that he retained for some years enough influence to shield his brother.

Of these arguments, then, the first, so far as it is valid, is an argument for the summer, not of a.d. 55 or 56, but of a.d. 57 as that of the recall, while the second will apply to any of the earlier years of Nero's reign.

In the result, then, the arguments brought forward in favour of each extreme fail to prove their case, but at the same time prove something against the opposite view. Thus the point that Josephus catalogues the events of Felix's procuratorship under Kero cannot be pressed to bring down Felix's tenure as far as 60 or 61, but it does seem to exclude as early a termination as 56, or even 57. Conversely, the influence of Pallas at court need not be terminated by his ceasing to be minister early in 55 ; but it would have been overshadowed not later than the year 60 by the influence of Poppsea, who in the summer of that year^ enabled the Jews to win their cause in the matter of the Temple wall, and would certainly have supported them against Felix. Thus the choice again appears to lie between the years 58 and 59 for the recall of Felix and arrival of Festus.

Identical results follow from another line of argument which, though somewhat precarious, was undtdy neglected before Ramsay recalled attention to it, namely, the data of St Paul's stay at PhUippi and Troas in Acts xx. 6, 7. Being anxious to arrive at Jerusalem for Pentecost, the apostle left Philippi, it may be presumed, on the first day after the days of unleavened bread, took four days, according to our method of reckoning, on the voyage to Troas, and stayed there six days, leaving on a Monday. He arrived, therefore, at Troas on a Tuesday, and left Philippi on the preceding Friday, Nisan 22. Nisan 14, therefore, fell on Thursday. This would be possible in a.d. 66 (Thursday, 18th March) or A.D. 57 (Thursday, 7th April), but hardly in either a.d. 55 or 58. As this journey of St Paul immediately pre- ceded his arrest, and his imprisonment under Felix lasted two years, 58 and 59 again appear as the possible alterna- tives for Felix's recall.

If St Paul was arrested in 56 or 57, an^ appealed to Caesar on the arrival of Festus in 58 or 59, then, as he reached Rome in the early part of the year following, and remained there a prisoner for two full years, we are brought down to the early spring of either 61 or 62 for the close of the period recorded in the Acts. That after these two years he was released and visited Spain in the west, and in the east Ephesus, Macedonia, Crete, Troas, Miletus, and perhaps Achaia and Epirus, is probable, in

1 Dr. C. Erbes (Texte und Untersuchungen,new series, iv. 1) attempts to interpret the evidence of Eusebius in favour of the later date for Festus as follows : Eusebius's date for Festus is to be found in Nero 1, by striking a mean between the Armenian, Claudius 12, and the Latin, Nero 2; it is really to be understood as reckoned, not by years of Nero, but by years of Agrippa; and as Eusebius erroneously antedated Agrippa's reign by five years, commencing it with a.d. 45 instead of a.d. 50, his date for Festus is five years too early also, and should be moved to Nero 6, Aj). 59-60. The whole of this theory appears to the present writer to be a gigantic mare's nest : see Journal of Theological Studies, October 1901, pp. 120-23.

2 This date appears to be satisfactorily established by Eamsay, ” A Second Fixed Point in the Pauline Chronology,” JBxpoHtor, August

1900.

the one case, from the evidence of Romans xv. 28, Clem. ad Cor. v., and the Muratorian canon, and, in the other, from the Pastoral Epistles. These journeys certainly cannot have occupied less than two years, and it- is more natural to allow three for them, which takes us down to 64-65.

Early evidence is unanimous in pointing to St Peter and St Paul as victims of the persecution of Nero (Clem. ad Cor. v. vi., Dionysius of Corinth ap. Ens. H. E. ii. 25, &c., combined with what we know from Tacitus of the course of the persecution, and from Gains of Rome, ap. Eus. ii. 25, of the burial-places of the two apostles) ; and tradition clearly distinguished the fierce outbreak at Rome that followed on the fire of the city in July 64 from any permanent disabilities of the Christians in the eye of the law which the persecution may have initiated. There is therefore no reason at all to doubt that both apostles were martyred in 64^65, and the date serves as a confirmation of the chronology adopted above of the imprisonment, release, and subsequent journeys of St Paul.

Investigation, then, of that part of the book of Acts which follows the death of Agrippa, recorded in chap, xii. — i.e., of that part of the apostolic age which follows the year 44 — ^has shown that apparent difficulties can be to a large extent set aside, and that there is nowhere room between a.d. 44 and 64 for. doubt extending to more than a single year. The first missionary journey may have begun in 47 or 48 ; the arrival of Festus may have taken place in the summer of 58 or of 59 ; the two years of the Roman imprisonment recorded in the last chapter of Acts may have ended in the spring of 61 or 62 ; and the dates which fall in between these extremes are liable to the same variation. The present writer leans to the earlier alternative in each case, 47, 68, 61 ; but he willingly con- cedes that the evidence, as he understands it, is not inconsistent with the later alternative.

But if the events of a.d. 44-64 can thus be fixed with a fair approximation to certainty, it is unfortunately otherwise with the events of a.d. 29-44. Here we are dependent (i.) on general indications given in the Acts ; (ii.) on the evidence of the Epistle to the Galatians, which, though in appearance more precise, can be and is interpreted in very different ways.

(i.) The book of Acts is divided, by general summaries from time to time inserted in the narrative, into six periods : i. 1-vi. 7 ; vi. 8-ix. 31 ; ix. 32-xii. 24 ; xii. 25-xvi. 6 ; xvi. 6-xix. 20 ; xix. 21-xxviii. 31. Of these the three last extend respectively from the death of Herod to the start for Europe in the second missionary journey (a.d. 44 to the spring of 50 [51]), from the start for Europe to the end of the long stay at Ephesus (a.d. 60 [51] to the spring of a.d. 65 [56]), and from the departure from Ephesus to the end of the two years' captivity at Rome (A.D. 56 [66] to the beginning of a.d. 61 [62]). It will be seen that these periods are of more or less the same length, namely, six (or seven) years, five years, six years. There is therefore some slight presumption that the three earlier periods, which together cover about fifteen years, were intended by so artistic a writer as St Luke to mark each some similar lapse of time. If that were so, the preaching of the apostles at Jerusalem and organization of the Church at the capital — the preaching of the seven and the extension of the Church all over Palestine — the extension of the Church to Antioch, and the commence- ment of St Paul's work — ^might each occupy five years more or less, that is to say, roughly, a.d. 29-34, 34-39, 39-44. The conversion of St Paul, which falls within the second period, would on this arrangement fall somewhere between five and ten years after the Crucifixion. Such conclusions are, however, of course general in the extreme.

(ii.) A nearer attempt to date at least the chronology of

St Paul's earlier years as a Christian could be made by the help of the Galatian Epistle, if we could be sure from what point and to what point

its reckonings are made. The apostle tells us that on his conversion he retired from Damascus into Arabia, and thence returned to Damascus ; then after three years (from his conversion) he went up to Jerusalem, but stayed only a fortnight, and went to the regions of Syria and Cilicia. Then after fourteen years (from his conversion? or from his last visit?) he went up to Jerusalem again to confer with the elder apostles. Now, if either of these visits to Jeru- salem could be identified with any of the visits whose dates have been approximately settled in the chronology of A.D. 44-64, we should have a fixed point from which to argue back. Unfortunately, even less agreement exists on this head than on the question whether the fourteen years of the last-mentioned visit are to be reckoned from the conversion or from the previous visit. Most critics, indeed, are now agreed that the fourteen years are to be calculated from the conversion; and most of them still hold that the visit of Galatians ii. is the same as the council of Acts xv., partly, no doubt, on the ground that the latter visit was too important and decisive for St Paul to have omitted in giving even the most summary description of his relations with the twelve. This ground would, however, be cut away from their feet if it were possible to hold (with J. V. Bartlet, Apostolic Age, 1900, and V. Weber, Die Abfassung des Galaterbriefs vor dem Apostelkonzil, Eavensburg, 1900) that the epistle was actually written just before the council, i.e., in the winter of 48-49 [49-60]. In that case, of course, the two visits of Galatians i. and ii. would be those of Acts ix. 26 and xi. 30. The fourteen years reckoned back from the latter (c. A.D. 46) would bring us to a.d. 32-33 as the latest possible date for the conversion. With the older view, on the other hand, the fourteen years reckoned from the council in a.d. 49 [50] would allow us to bring down the conversion to a.d. 36. The new view clears away some manifest difficulties in the reconciliation of the Epistle and the Acts, and the early date for Galatians in relation to the other Pauline Epistles is not so improbable as it may seem ; but the chronology still appears more satis- factory on the older view, which enables the conversion to be placed at least three years later than on the alterna- tive theory. But it is clear that the last word has not been said, and that definite results for this period cannot yet be looked for.

The sum up: an attempt has been made, it is hoped with some success, to provide a framework of history equipped with dates from the time of St Peter's arrest by Herod Agrippa I. at the Passover of a.d. 44 down to the martyrdom of St Peter and St Paul in the persecu- tion of Nero, a.d. 64-65. Tor the previous period, on the other hand, from a.d. 29 to a.d. 44, it appeared im- possible in our present state of knowledge to state con- clusions other than in the most general form.

AuTHOKiTiES. — The views >stated in this article are in general (though with some modifications) the same as those which the pre- sent writer worked out with more fulness of detail in Hastings's Dictionary of the Bible, i. (1898) 403-424. Of older books should be mentioned : — Ideler. Sandbuch der matJiematiscken und tech- nischen Chronologie, 2 vols. (1825).— Wieseleh. Ohronologie des apostoUschen Zeitalters (1848).— Lewis's Fasti Sacri (1865).— The most important modern contributions are to be found in Prof. W. M. Ramsay's various works, and in Harnack's Chronologie der altchristUchen Litteratur bis Eusebius, i. 233-244.

(c. H. T.)

Chrudim, a town in Bohemia, Austria. It has an important horse market, besides manufactures of sugar, spirits, beer, sodarwater, and agricultural machinery. There are also steam corn-mills and saw-mills. Chrudim is the birthplace of Joseph Eessel (1793-1857), who is

honoured in Austria as the inventor of the screw pro- peller. Population, 13,017.

Chubut, a territory of the Argentine Eepublic, Patagonia, bounded on the N. by Eio Negro, on the S. by Santa Cruz, on the E. by the Atlantic, and on the W. by Chile. Its official area at the census of 1895 was 93,427 square miles; and in 1895 its population was 3748, as compared with 153 in 1869. The capital, Eaw- son, is situated 3 miles from the mouth of the Chubut. The territory is divided into three departments. In 1895 there were 29,944 head of cattle, 47,306 sheep, 12,907 horses, 310 farms, and 12,355 acres planted in cereals.

Chulalongkorn, Phra Paramindr Maha

(1853), king of Siam, eldest son of King Maha

Mongkut, was born 21st September 1853. His full sig- nature, used in all important state documents, consists of twenty-seven names, but it is by the first four that he is usually known. Educated in his childhood by English teachers, especially by Captain John Bush, he acquired a good knowledge of the English language and a due appreciation of Western culture. But his surround- ings were purely Oriental, and as his boyhood was spent, according to custom, in a Buddhist monastery, he re- mained in sympathy with his people. He succeeded to the throne on the death of his father, 1st October 1868, and was crowned on 11th November following, when JEuropeans were present for the first time at such a cere- mony. Until his majority in 1873 the government was carried on by a regent, the young king retiring to a Buddhist monastery, and then making a long tour through India and the Dutch East Indies, an event hitherto un- heard of among the potentates of Eastern Asia. But he had no sooner taken the reins of power than he gave evidence of his recognition of the importance of modem culture by abolishing slavery, which existed in Siam in its most extended form. He also did away with the custom of approaching the king on all fours. Still more important, in view of the numerous races and creeds in- cluded among his subjects, was the proclamation of liberty of conscience. This was followed by the erection of schools and hospitals, the construction of roads and rail- ways, and the further development of the army and fleet which his father had commenced. To him Siam is in- debted for its standard coinage, its postal and telegraph service, and for the police, sanitation, and electric-lighting of Bangkok. Two of the king's sons were sent to school in England, and in the summer of 1897 King Chulalong- korn paid a visit to Europe, arriving at Portsmouth in his yacht on the 29th July. On the 4th August he was received by Queen Victoria at Osborne. After a tour in Great Britain he proceeded to Berlin, Brussels, and The Hague, and arrived in Paris on 11th September, and after spending some weeks in the Erench capital, re- turned to Siam late in the year.

Chumla. See Shumla.

Chungking, a city in the province of Szechuen, China, on the left bank of the Yangtse, at its point of junction with the Kialing, in 29° 33′ N. lat. and 107° 2′ E. long. It is the commercial centre for the trade, not only of Szechuen, but of all south-western China. The one highway between Szechuen and the eastern provinces is the Yangtse river route, as owing to the mountain- ous nature of the intervening country land transit is almost impracticable. The import trade brought up by large junks from Ichang, and consisting of cotton cloth, yarn, metals, and foreign manufactures, centres here, and is distributed by a class ‘of smaller vessels up the various rivers of the provinces. Native produce, such as

yellow silk, white wax, hides, rhubarb, musk, and opium, is here collected and repacked for conveyance to Hankow, Shanghai, or other parts of the empire. The city was opened to foreign trade by convention with the British Government in 1891, with the proviso, however, that foreign steamers should not be at liberty to trade there until Chinese-owned steamers had succeeded in ascending the river. This restriction was abolished by the Japanese treaty of 1895, which declared Chungking open on the same terms as other ports. Since that date the problem of steam navigation on the section of the river between Ichang and Chungking has been occupying the attention of practical men. A small steamer has been navigated up the rapids, but it is a question how far steam navi- gation can be made a practical success. At present the trade is carried by native craft, which are hauled up against the strength of the current in the worst places by a line of trackers on the bank. Another difficulty is the great rise in the river during the summer months. At Chungking this rise is ordinarily 70 feet, and occasion- ally it is as much as 96 feet. The population of Chung- king, including the city of Kiangpeh on the opposite bank of the Kialing river, is about 300,000. The foreign residents are very few. In 1898 the value of the trade passing through the maritime customs was H. taels

17,426,000 (£2,614,000), and in 1899 H. taels 25,792,000 (£3,868,000), of which imports, chiefly Manchester goods, counted for £1,961,000.

Chuquisaca, a department of Bolivia, bounded on the N. by the departments of Cochabamba and Santa Cruz, on the S. by that of Tarija, on the E. by the Eio Paraguay, and on the W. by the department of Potosi. It has an area of 39,850 square mUes, and had a population in 1893 of 286,710. Its capital is Sucre (26,000). . The department is divided into four provinces, Yamparaez, Cinti, Tomina, and Azero, and has 29 schools with about 2000 pupils.

Church, Richard William (1815-1890), Dean of St Paul's, was the son of John Dearman Church, an Irish merchant of Quaker ancestry. He was born at Lisbon, 25th April 1815, his early years being mostly spent at Plorence. After his father's death in 1828 he was sent to a school of a pronounced evangelical type at Eedlands, Bristol, and went in 1833 to Wadham College, Oxford, an evangelical college. He took first-class honours in 1836, much to his own surprise, and in 1838 was elected fellow of Oriel. One of his contemporaries, Eichard Michell, commenting on this election, said: "There is such a moral beauty about Church that they could not help taking him." He was appointed tutor of Oriel in 1839, and was ordained the same year. He was an intimate friend of Newman's at this period, and closely allied to the Tractarian party. In 1841 No. 90 of Tracts for the Times appeared, and Church resigned his tutorship. In 1844- 1845 he was junior proctor, and in that capacity, in con- cert with his senior colleague, vetoed a proposal to censure Tract 90 publicly. In 1846 Church, with others, started the Guardian newspaper. In 1850 he became engaged to Miss H. F. Bennett, of a Somersetshire family, a niece of Bishop Moberly. After again holding the tutorship of Oriel, he accepted in 1852 the small living of Whatley in Somersetshire, near Frome, and was married in the follow- ing year. He was a diligent parish priest and a serious student, and contributed largely to current literature. In 1869 he refused a canonry at Worcester, but in 1871 he accepted, most reluctantly (calling it " a sacrifice en pure perte "), the deanery of St Paul's, to which he was nomi- nated by Mr Gladstone. His task as dean was a compli- cated one. It was (1) the restoration of the cathedral.

(2) the adjustment of the question of the cathedral reve- nues with the Ecclesiastical Commissioners, (3) the reorganization of a conservative cathedral staff with anomalous vested rights. He described the intention of his appointment to be "that St Paul's should waken up from its long slumber." The first year that he spent at St Paul's was, writes one of his friends, one of " misery " for a man who loved study and quiet and the country, and hated official pomp and financial business and ceremonious appearances. But he perform'ed his difficult and uncon- genial task with almost incredible success, and is said never to have made an enemy or a mistake. The dean was distinguished for uniting in a singular degree the virtues of austerity and sympathy. He was pre-eminently endowed with the faculty of judgment, characterized by Canon Scott Holland as the faculty of "high and fine and sane and robust decision." Though of unimpressive stature, he had a strong magnetic influence over all brought into contact with him, and though of a naturally gentle temperament, he never hesitated to express censure if he was convinced it was deserved. In the pulpit the voice of the dean was deliberately monotonous, and he employed no adventitious gesture. He may be described as a High Churchman, but of an essentially rational type, and with an enthusiasm for religious liberty that made it impossible for him to sympathize with any unbalanced or inconsider- ate demands for deference to authority. He said of the Church of England that there was " no more glorious church in Christendom than this inconsistent English Church." The dean often meditated resigning his office, though his reputation as an ecclesiastical statesman stood so high that he was regarded in 1882 as a possible successor to Archbishop Tait. But his health and mode of life made it out of the question. In 1888 his only son died; his own health declined, and he appeared for the last time in public at the funeral of Canon Liddon in 1890, dying on 9th December 1890, at Dover. He was buried at Whatley. The dean's chief published works are a lAfe of St Anselm (1870), the lives of Spenser (1879) and Bacon (1884) in Macmillan's " Men of Letters " series, an Essay on Dante (1878), The Oxford Movement (1891), together with many other volumes of essays and sermons. In these writings he exhibits a great grasp of principles, an accurate mastery of detail, and the same fusion of intelligent sympathy and dispassionate judgment that appeared in his handling of

business. His style is lucid, and has the charm of austerity. He stated that he had never studied style per se, but that he had acquired it by the exercise of translation from classical languages ; that he watched against the temptation of using unreal and fine words ; that he employed care in his choice of verbs rather than in his use of adjectives, and that he fought against self-indulgence in writing just as he did in daily life. His sermons have the same quality of self- restraint. His private letters are fresh and simple, and contain many unaffected epigrams ; in writing of religious subjects he resolutely avoided dogmatism without ever sacrificing precision. The dean was a man of genius, whose moral stainlessness and instinctive fire were indi- cated rather than revealed by his writings, (a. c. bb.)

Church Army. — The Church Army is an Eng- lish religious organization, which was founded in 1882 by the Eev. Wilson Carlile, who banded together in an orderly army of ” soldiers ” and ” officers ” a few working men and women, whom he and others trained to act as ” Church of England evangelists ” among the outcasts and criminals of the Westminster slums. Previous experience had convinced him that wickedness and irre- ligion among the lowest classes of the people could best be overcome by new and aggressive action on the part

of tlie Church, and that this iwork ~~was most effectively done by zealous laymen and women of the same class as those whom it was desirous to touch. ” Evangelistic zeal with Church order” is the principle of the Church Army, and it is essentially a working men’s and women’s mission to working people. As the work grew, a training institution for evangelists was started in Oxford, but soon moved (1886) to 130 Edgware Road, London, W., where the headquarters of the Army are established. Working men are trained as evangelists, and working women as mission nurses, and are supplied to the clergy whenever asked for. The men evangelists have to pass an examina~~ tion by the archdeacon of Middlesex, and are then (since 1896) admitted by the bishop of London as ” lay evan- gelists of the Church”; the mission

nurses must likewise pass an examination by the diocesan iaspector of schools. All Church Army workers (of whom there are over 1200 of one kind and another) are entirely under the control of the incumbent of the parish to which they are sent. They never go to a parish unless invited, nor stay when asked to go by the parish priest. Officers and nurses are paid a limited sum for their services by the vicar or by voluntary local contributions. Church Army mission and oolportage vans circulate throughout the country parishes, if desired, with itinerant evangelists, who hold simple missions, without charge, and spread wholesome literature. Each van missioner has a ” clerical adviser.” Missions are also held in prisons and workhouses, at the invitation of the authorities. In 1888 (before the similar work of the Salvation Army was inaugurated) the Church Army established labour homes in London and else- where, with the object of giving a ” fresh start in life ” to the outcast and destitute. The Church Army homes deal with the outcast and destitute in a plain, simple, straightforward way. They demand that the persons should show a desire for amendment ; they subject them to firm discipline; they give them hard work; they give them decent clothes ; and they strive to win them to a Christian life. The inmates earn their board and lodging by piece-work, for which they are paid at the current trade rates, while by a gradually lessening, scale of work and pay they are stimulated to obtain situa- tions for themselves and given time to seek for them. There are about 103 homes in London and the provinces, and 56 per cent, of the 26,000 cases helped iu 1900 made the successful beginning of an honest, self-supporting life. Selected and tested cases are enabled to emigrate. The Church Army has lodging hornet, an employment bureau, cheap food depot, old clothes department, dispensary, and other social works, and an inebriates’ reformatory under the Act of 1898. The whole of the work is done in loyal subordination to the diocesan and parochial organ- ization of the Church of England. (m. b. s.)

Churchill, Missinnippi, or Em-glish, a river of Athabasca and Keewatin districts, Canada. It rises in La Loche— a small lake in 56° 30′ N. lat. and 109° 30′ W. long., at an altitude of 1577 feet above the sea— and flows in a north-easterly direction to Hudson Bay, passing through a number of lake expansions. Its principal tribu- taries are the

Beaver— 350 miles long, Sandy, Montreal, Reindeer, and Little Churchill rivers. Between Erog and Methy portages — 480 miles— it formed part of the old vomgeur route to the Peace, Athabasca,' and Mackenzie. Its largest affluent. Reindeer river, discharges the waters of Reindeer lake (with an area of 2490 square miles and 1150 feet above the sea) and Wollaston lake (altitude, 1300 feet) The Churchill is 925 miles long. Port Churchill, at its mouth, is the best harbour in the southern portion of Hudson Bay.

Churchill, Lord Randolph Henry Spencer (1849-1895), English statesman, third son of John, seventh duke of Marlborough, by Frances, daughter of the third marquis of Londonderry, was born at Blenheim Palace, on 13th February 1849. His early education was conducted at home, and at Mr Tabor's preparatory school at Cheam. In January 1863 he went to Eton, where he remained tiL. July 1866. He was not specially distinguished either ia school work or games while at Eton; his contemporaries describe him as a vivacious and rather imruly lad. In October 1867 he matriculated at Merton College, Oxford. He was fond of amusement, and had carried to Oxford an early taste for sport which he retained throughout life. But he read with some industry, and obtained a second class in jurisprudence and modern history in 1870. In 1874 he was elected to Parliament in the Conservative interest for Woodstock, defeating Mr George Brodrick, a fellow, and afterwards Warden, of Merton College. His maiden speech, delivered in his first session, made no impression on the House, nor did he become in any way conspicuous till 1878. In that year he forced himself into public notice as the exponent of a species of independent Conservatism. He directed a series of furious attacks against some of the occupants of the front ministerial bench, and especially that " old gang " who were distinguished rather for the respectability of their private characters, and the un- blemished purity of their Toryism, than for striking talent. Mr Sclater Booth,, president of the Local Government Board, was the especial object of his ire, and that minister's County Government Bill was fiercely denounced as the " crowning dishonour to Tory principles," and the " supreme violation of political honesty." The audacity of Lord Randolph's attitude, and the vituperative fluency of his invective, made him a parliamentary figure

of some importance before the dissolution of the 1874 Parliament, though he was not as yet taken quite seriously. In the new Parliament of 1880 he speedily began to play a more notable r51e. With the assistance of his devoted adherents, Sir Henry Dnimmond Wolff, Mr John Gorst, and occasionally of Mr Arthur Balfour, and one or two others, he constituted himself at once the audacious opponent of the Liberal administration and the unsparing critic of the Conservative front bench. The "fourth party," as it was nicknamed, was effective at first not so much in damaging the Government as in awaken- ing the Opposition from the apathy which had fallen upon it after its defeat at the polls. ChurchUl roused the Conservatives and gave them a fighting issue, by putting himself at the head of the resistance to Mr Bradlaugh, the member for Northampton, who, though an avowed atheist or agnostic, was prepared to take the Parliamentary oath. Sir Stafford Northcote, the Con- servative leader in the Lower House, was forced to take a strong line on this difficult question by the energy of the fourth party, who in this case clearly expressed the views of the bulk of the Opposition. The long and acri- monious controversy over Mr Bradlaugh' s seat, if it added little to the reputation of the English legislature, at least showed that Lord Randolph Churchill was a parliamentary champion who added to his audacity much tactical skill and shrewdness. He continued to play a conspicuous part throughout the Parliament of 1880-85, dealing his blows with almost equal vigour at Mr Gladstone and at the Conservative front bench, some of whose members, and particularly Sir Richard Cross and Mr W. H. Smith, he assailed with extreme virulence. From the beginning of the Egyptian imbroglio Lord Randolph was emphatically opposed to almost every step taken by the Government. He declared that the suppression of Arabi Pasha's rebellion

was an error, and the restoration of the Khedive's au- thority a crime. He called Mr Gladstone the " Moloch of Midlothian," for whom

torrents of blood had been shed in Africa. He was equally severe on the domestic policy of the administration, and was particularly bitter m his criticism of the Kilmainham Treaty and the rapprochement between the Gladstonians and the Par- nellites. It is true that for some time before the fall of the Liberals in 1885, he had considerably modified his attitude towards the Irish question, and was himself cultivating friendly relations with the Home Rule members, and even obtained from them the assistance of the Irish vote in the English constituencies in the general election. By this time he had definitely for- mulated the policy of progressive Conservatism which was known as ” Tory democracy.” He declared that the Conservatives ought to adopt, rather tliau oppose.

LOKI) KAXDOLPH CHUECHILL. {From a photograph by Ellioti *& Fry, London.)

reforms of a popular character, and to challenge the claims of the Liberals to pose as the champions of the masses. His views were to a large extent accepted by the official Conservative leaders in the treatment of the Gladstonian Franchise Bill of 1884. Lord Randolph insisted that the principle of the Bill should be accepted by the Opposition, and that resistance should be focussed upon the refusal of the Government to combine with it a scheme of redistribution. The prominent, and on the whole judicious and successful, part he played in the debates on these questions still further increased his influence with the rank and file of the Conservatives in the constituencies. At the same time he was actively spreading the gospel of democratic Toryism in a series of platform campaigns. In 1883 and 1881 he invaded the Radical stronghold of Bir- mingham itself, and in the latter year took part in a Conservative garden party at Aston Manor, at which his opponents paid him the compliment of raising a serious riot. He gave constant attention to the party organization, which had fallen into considerable disorder

after 1880, and was an active promoter of the Primrose League, which owed its origin to the happy inspiration of one of his own ” fourth party ” colleagues. In 1884 the struggle between stationary and progressive

Toryism came to a head, and terminated in favour of the latter. At the conference of the Central Union of Conservative Associations, Lord Randolph was nominated chairman, notwithstandiing the strenuous opposition of the parlia- mentary leaders of the party. The split was averted by Lord Randolph's voluntary resignation ; but the episode had confirmed his title to a leading place in the Tory ranks. It was further strengthened by the prominent part he played in the events immediately preceding the fall of the Liberal Government in 1885 ; and when Mr Childers's budget resolutions were defeated by the Conservatives, aided by about half the Parnellites, Lord Randolph Churchill's admirers were justified in proclaiming him to have been the "organizer of victory." His services were, at any rate, far too important to be refused recognition ; and in Lord Salisbury's Cabinet of 1885 he was appointed to no less an office than that of secretary of state for India. During the few months of his tenure of this great post the young free-lance of Tory democracj' surprised the perma- nent officials and his own friends by the assiduity with which he attended to his departmental duties and the ra- pidity with which he mastered the complicated questions of Indian administration. In the autumn election of 1885 he contested Central Birmingham against Mr Bright, and though defeated here, was at the same time returned by a very large majority for South Paddington. In the contest which arose over Mr Gladstone's Home Rule scheme, both in and out of Parliament, Lord Randolph again bore a conspicuous part, and in the electioneering campaign his activity was only second to that of some of the Liberal Unionists, the marquis of Hartington, Mr Goschen, and Mr Chamberlain. He was now the recognized Conservative champion in the Lower Chamber, and when the second Salisbury administration was formed after the general election of 1886 he became chancellor of the exchequer and leader of the House of Commons. His management of the House was on the whole successful, and was marked by tact, discretion, and temper. But he had never really reconciled himself with some of his colleagues, and there was a good deal of friction in his relations with them, which ended with his sudden resigna- tion on 20th December 1886. Various motives influenced him in taking this surprising step ; but the only ostensible cause was that put forward in his letter to Lord Salis- bury, which was read in the House of Commons

on 27th January. In this document he stated that his resignation was due to his inability, as chancellor of the exchequer, to concur in the demands made on the treasury by the ministers at the head of the naval and military establish- ments. It was commonly supposed that he expected his resignation to be followed by the unconditional surrender of the Cabinet, and his restoration to office on his own terms. The sequel, however, was entirely different. The Cabinet was reconstructed with Mr Goschen as chancellor of the exchequer, and Lord Randolph's own career as a Conservative chief was practically closed. .He con- tinued, for some years longer, to take a considerable share in the proceedings of Parliament, giving a general, though decidedly independent, support to the Unionist administration. On the Irish question he was a very candid critic of Mr Balfour's measures, and one of his later speeches, which recalled the acrimonious violence of his earlier period, was that which he delivered in 1890 on the report of the Parnell Commission. He also fulfilled the promise made on his resignation by occasionally advocating the principles of economy and retrenchment in the debates on the naval and military estimates.

In April 1889, on the death of Mr Bright, he was asked to come forward as a candidate for the vacant seat in Birmingham, and the result was a rather angry contro- versy with Mr Chamberlain, terminating in the so-called " Birmingham compact " for the division of representa- tion of the Midland capital between Liberal Unionists and Conservatives. But his health was already pre- carious, and this, combined with the anomaly of his position, induced him to relax his devotion to Parlia- ment during the later years of the Salisbury administrar tion. He bestowed much attention on society, travel, and sport. He was an ardent supporter of the turf, and in 1889 he won the Oaks with a mare named the Abbesse de Jouarre. In 1891 he went to South Africa, in search both of health and relaxation. He travelled for some months through Cape Colony, the Transvaal, and Rho- desia, making notes on the politics and economics of the countries, shooting

lions, and recording his impressions in letters to a London newspaper, which were afterwards republished under the title of Men, Mines, and Animals in South Africa. He returned with renewed energy, and in the general election of 1892 once more flung himself, with his old vigour, into the strife of parties. His seat at South Paddington was uncontested ; but he was active on the platform, and when Parliament met he returned to the Opposition front bench, and again took a leading part in debate, attacking Mr Gladstone's second Home Rule Bill with especial energy. But it was soon ap- parent that his powers were undermined by the inroads of disease. As the session of 1893 wore on his speeches lost their old effectiveness, and in 1894 he was listened to not so much with interest as with pity. His last speech in the House was delivered in the debate on Uganda in June 1894, and was a painful failure. He was, in fact, dying of general paralysis. A journey round the world was undertaken as a forlorn hope. Lord Randolph started in the autumn of 1894, accom- panied by his wife, but the malady made so much progress that he was brought back in haste from Cairo. He reached England shortly before Christmas, and died at 50 Grosvenor Square on 24th January 1895.

Lord Randolph Churchill married, in January 1874, Jennie, daughter of Mr Leonard Jerome of New York, U.S.A., who survived him. He left two sons, Winston and John, the former of whom, after serving for some time in the 4th Hussars and acting as a special corre- spondent in the South African war, was elected member of Parliament for Oldham in October 1900.

The earlier speeches of Lord Randolph Churchill have been edited, with an introduction and notes, by Louis Jennings ; two vols., London, 1889. See also T. H. S. Escott, Bandolph Spencer Churchill, 1895 ; and H. W. Lucy, Diary of Two Parliaments, 1892.

(s. J. L.)

Chust, a town of Russian Turkestan, province of Fergana, district of Namangan, 110 miles north-east of Kokan, on Narym river. Population, 13,686.

Cialdini, Enrico (1811-1892), Italian soldier and politician, was born at Castelvetro, in Modena, Italy, 10th August 1811. In 1831 he took part in the insurrec- tion at Modena, fleeing afterwards to Paris, whence he proceeded to Spain to fight against the Carlists. Re- turning to Italy in 1848, he commanded a regiment at the battle of Novara. In 1859 he organized the Alpine Brigade, fought at Palestro at the head of the 4th Divi- sion, and in the following year invaded the Marches, won the battle of Castelfidardo, took Ancona, and subsequently directed the siege of Gaeta. For these services he was created duke of Gaeta by the king, and was assigned a pension of 10,000 lire by Parliament. In 1861 his inter- vention envenomed the Cavour-Garibaldi dispute, royal

mediation alone preventing a duel between him and Garibaldi. Placed in command of the troops sent to oppose the Garibaldian expedition of 1862, he defeated Garibaldi at Aspromonte. Between 1862 and 1866 he held the position of Lieutenant-Royal at Naples, and in 1864 was created Senator. On the outbreak of the war of 1866 he resumed command of an army corps, but dis- sensions between him and Lamarmora prejudiced the issue of the campaign and contributed to the defeat of Custoza. After the war he refused the command of the General Staff, which he wished to render independent of the War Office. In 1867 he attempted unsuccessfully to form a Cabinet sufficiently strong to prevent the threat- ened Garibaldian incursion into the Papal States, and two years later failed in a similar attempt, through disagree- ment with Lanza concerning the army estimates. On 3rd August 1870 he pleaded in favour of Italian intervention in aid of France, a circumstance which enhanced his influence when in July 1876 he replaced Nigra as ambas- sador to the French Republic. This position he held until 1882, when he resigned on account of the publicar tion by Mancini of a despatch in which he had com- plained of arrogant treatment by M. Waddington. He died at Leghorn, 8th September 1892. (h. w. s.)

Cider. — The recent development of the cider-making industry, coupled with certain changes in the mode of manufacture, render it necessary to supplement the two articles omCiDBR and Peeet in the

ninth edition of the Encydopmdia Britannica with additional information.

Cider and perry are liquors containing from as little as 2 per cent, of alcohol to 7 or 8 per cent., seldom more, and rarely as much, produced by the vinous fermentation of the expressed juice of apples and pears; but cider and perry of prime quality can only be obtained from vintage fruit, that is, apples and pears grown for the purpose and unsuited for the most part for table use. A few table apples make good cider, but the best perry is only to be procured from pears too harsh and astrin- gent for consumption in any other form. The- making of perry is in England confined, in the main, to the counties of Hereford, Worcester, and Gloucester. These three counties, together with Somerset and Devon, con- stitute, too, the principal cider-making district of the country ; but the industry, which was once more widely spread, still survives in Norfolk, and has lately been revived in Kent, though, in both these counties, much of the fruit used in cider-making is imported from the west country and some from the Continent. Speaking generally, the cider of Herefordshire is distinguished for its lightness and briskness, that of Somerset for its strength, and that of Devonshire for its luscious- ness.

Inasmuch as English orchards are crowded with innu- merable varieties of cider apples, many of them worthless, a committee composed of members of the Herefordshire Fruit-Growers' Association and of the Fruit and Chrysan- themum Society was appointed in 1899 to make a selection of vintage apples and pears best suited to Herefordshire and the districts adjoining. The following is the list drawn up by the committee : —

Apples. — Old Foxwhelp, Cherry Pearmain, Cowarne Red, Dymock Red, Eggleton Styre, Kingston Black or Black Taunton, Skyrme's Kernel, Spreading Redstreak, Carrion apple. Cherry Norman, Cummy Norman, Royal Wilding, Handsome Norman, Strawberry Norman, White Bache or Norman, Broad-leaved Norman, Argile Grise, Bramtot, De Boutville, Frequin Audi^vre, MedaiUe d'Or, the last five

being French sorts introduced from Nor- mandy about twenty years ago, and now established in the orchards of Herefordshire.

Pears.— Taynton Squash, Borland, Oldfield, Moorcroft or Malvern Hill, Eed-pear, Thurston's Eed, Longland, Pine pear.

No equally authoritative selection has been made for the Somerset and Devon districts, but the following varieties of cider apples are held in good repute in those parts : — Kingston Black, Jersey Chisel, Hangdowns, Fair Maid of Devon, Woodbine, Duck's Bill, Slack-my-Girdle, Bottle Stopper, Golden Ball, Sugar-loaf, Red Cluster, Royal Somerset, and Cadbury (believed to be identical with the Royal Wilding of Herefordshire). As a rule the best cider apples are of small size. " Petites pommes, gros cidre," say the French.

Cider and perry not being taxable liquors in England, it is impossible to estimate with even an approach to accuracy the amount of the annual production of them. In 1896 Mr Sampson, the then secretary of the National Association of English Cider-makers, in his evidence be- fore the Royal Commission on Agriculture, put it at 55^ million gallons. Since that date the increased demand for these native wines has given such an impetus to the industry that this figure might with safety be doubled. In Prance of&cial statistics are available, and these show not only that that country is the largest producer of cider (including perry) in the world, but that the output is yearly increasing. In the ten years ending 1888 the annual average production amounted to 14 million hecto- litres. This average was, however, largely exceeded in 1899 and 1900, the production in 1899 reaching 21 million, and in 1900 nearly 30 million hectolitres, or within 5 million hectolitres of the output of wine in the last-men- tioned year. Although some cider is made in sixty-five departments, by far the largest amount comes from the provinces of Normandy and Brittany. In Germany cider- making is a considerable and growing industry. Manu- factories on a small scale exist in North Germany, as at Guben and Griinberg, but the centre of

the industry is at Prankfort-on-MaiQ,Sachsenhausen,andtheneighbourhood, where there are five large and twenty-five small factories employing upwards of 1000 hands. Of late years the production of cider in Wlirtemburg has greatly increased, and large quantities of fruit are imported from foreign countries, especially from Switzerland, where there are numerous orchards of cider apples. Stuttgart is the prin- cipal depot for foreign fruit. Out of 2857 truckloads brought in by rail in 1898, 1973 came from Switzerland and 661 from Austria. In Baden, Hesse, Wlirtemburg, and the Palatinate the highways have within the last twenty-five years been extensively planted with cider fruit. The trees belong to the respective states, which derive an increasing revenue from the sale of the fruit. Speak- ing generally, however, the native-grown fruit used in Germany for cider-making consists of inferior and under-sized table apples not worth marketing. The cider thus made is of poor quality, but, as it is chiefly used for ” bowle ” — a kind of cider cup flavoured with ” Mai- kraut ” (the common woodruff) — ^the quality is not of con- sequence. The bottled cider for export is treated much like champagne and is usually fortified and fiavoured until, in the words of an acknowledged French authority, M. Truelle, it becomes a hybrid between cider and white wine rather than pure cider.

The practice which formerly prevailed in England of making cider on the farm from the produce of the home orchards has within the last few years been to a large extent given up, and, as in Germany and many parts of France, farmers now sell their fruit to owners of factories where the making of cider and perry is carried on as a business of itself. In these hand or horse power is super- seded by steam and sometimes by electricity, as in the factory of E. Seigel in Grunberg, and the old-fashioned

appliances of the farm by modern mills and presses capar ble of turning out large quantities of liquor. The clear- ing of the juice, too, which used to be effected by running it through bags, is in the factories accomplished more quickly by forcing it through layers of compressed cotton in a machine of German origin known as Lumley’s filter. The actual process of cider and perry making is a simple one, and is as

described in the ninth edition of this work, but, owing in the main to the investigations of German scientists, it is now possible to trace the causes of those changes, familiar to all practical cider-makers, which occur in both cider and perry during fermentation, and thereby to impart to the manufacture of these liquors a degree of exactitude unattainable hitherto. Cider made from a judicious mixture of several varieties of apples is to be preferred.to cider made from one variety only, inas- much as it is less difficult to find the requisite degrees of richness, astringency, and flavour in several varieties than in one ; but the contrary is the case with pears, of which the most noted sorts, such as the Barland, the Taynton Squash, and the Oldfield, produce the best perry when unmixed with other varieties. It is not now considered advisable to crush the seeds or pips in making cider from the best fruit, as their aromatic taste would mask or destroy the delicate flavour of the juice ; but where the latter is of poor quality the crushing of the pips is admissi- ble in order to supplement its deficiency in flavour.

Some fining of an albuminous nature is generally req- uisite in order to clear the juice and facilitate its passage through the filter, but the less used the better. The simplest and cleanest is skim milk whipped to a froth and blended gradually with the cider as it is pumped into the mixing vat. Many nostrums are sold for the clearing of cider, but none are necessary and most are harmful.

Of late years the practice has largely obtained of using preservatives for the purpose of checking fermentation. The principal preservatives employed are salicylic and boracic acid and formalin. The two former are ineffective except in quantities likely to prove hurtful to health,, while formalin, in itself a powerful and deleterious drug, though it stops fermentation, renders the liquor cloudy and undrinkable. Other foreign ingredients, such as saccharin and porcherine, both coal-tar derivatives — the latter a recent discovery of a French chemist, after whom it is named — are used by many makers, chiefly for the purpose of rendering bad and therefore unwholesome cider palatable and saleable. Provided that cider and perry be properly filtered and attention paid to perfect cleanli- ness of vessels and appliances, there is no need of pre- servatives or sweeteners, and their use ought to be for-

bidden by law in England, as it is in most continental states in the case of liquors to be consumed within their borders, though not, it is significant to note, in the case of liquors intended for exportation.

Within the last few years the wholesome properties of cider and perry when pure and unadulterated have been recognized by medical men, who recommend them as pleasant and efficacious remedies in affections of a gouty or rheumatic nature, maladies which, strange to say, these ‘ very liquors were once supposed to foster, if not actually to originate. Under a similar false impression the notion is general that hard rough cider is apt to cause diarrhoea, colic, and kindred complaints, whereas, as a fact, dis- orders of this kind are conspicuous by their absence in those parts of the country where rough cider and perry constitute the staple drinks of the working-classes. This is especially the case in Herefordshire, which is said also to be the only county in England whence no instance of the occurrence of Asiatic cholera has ever been reported.

C I E C H A N 0 W — C I L I C I A

Now that the increasing demand for cider and perry- has drawn attention to its importance to agriculturists, the cider-making industry has received a certain amount of assistance and encouragement from public or quasi- public sources. Many agricultural societies, including the Eoyal and the Bath and West, offer prizes for cider and perry in cask and bottle, and the latter society gives a grant of £100 a year towards the cost of some interest- ing experiments at Butleigh in Somersetshire. The county councils in the cider-producing districts have included cider-making among the subjects in which they give gratuitous instruction, though as yet these bodies are hampered by the difficulty of procuring competent teachers. The Herefordshire county council has, through the co-operation of certain landowners, obtained the use of six pomological stations in different parts of the county, consisting of small fruit plantations, where dem- onstrations are given in various branches of fruit culture. In addition to these the council has established a central pomological and experimental garden close to Hereford, where, as one of the principal aims of the council is to

promote the cider industry, a branch of agriculture of special importance to Herefordshire, a large number of cider apples and perry pears have been planted. Included among these is a nice collection of approved French sorts obtained from Normandy ; and as the varieties introduced thence, as already mentioned, about 1880, have turned out to be valuable additions to the orchards of the county, it is probable that some of these still newer importations will prove to be well suited to English soil and climate.

Fruit-growers who look to cider-making ” as a means of utilizing windfalls and small and inferior apples of cook- ing and dessert varieties not worth sending to market ” (to quote from a paper lately read by a fruit-grower before a learned society) should be warned that it is as important to the cider industry that good cider only should be on sale as it is to the fruit-growing industry that good fruit only should be sent to market. Bad cider of English make brings discredit on the beverage and lets in the foreigner, just as inferior fruit does. The juice of the apple is naturally affected by the condition of the fruit itself, and if this be unripe, unsound, or worm-eaten the cider made from it will be inferior to that made from full-grown, ripe, and sound fruit. If such fruit be not good enough to send to market, neither will the cider made from it be good enough to place before the public. Nevertheless, it may furnish a sufficiently palat- able drink for home consumption, and may therefore be so utilized. But when, as happens from time to time in fruit-growing districts, there is a glut, and even the best table fruit is not saleable at a profit, then, indeed, cider-making is a means of storing in a liquid form what would otherwise be left to rot on the ground; whilst if a proportion of vintage fruit were mixed therewith, a drink would be produced which would not discredit the eider trade, and would bring a fair return to the maker. (c- w.e. c.)

Ciechanow, a district town of Eussian Poland, government Plock, on the Prussian frontier, 105 miles north-west of Warsaw. Population, 10,670.

Cienfuegos, one of the principal cities of Cuba, near the central portion of the south coast. It lies on a land-locked harbour known as the bay- of

Jagua, which Columbus visited on his second voyage, and which Father Las Casas described as the most magnificent port in the world. It was settled in 1819 by refugees from Santo Domingo. Since 1880 its trade has in- creased enormously. A circular railway leads to the wharves and large warehouses, thereby facilitating the

loading and unloading of vessels. Many local steamers connect the town with Batabano, Trinidad, Santiago, and the Isle of Pines. The streets are regularly laid out ; the houses are well built, and there are beautiful shade trees and plazas, one of which is the largest in Cuba. There is a handsome main avenue, at the end of which are statues. It is lighted by gas and electricity, has abundant water- supply, excellent clubs, and a theatre. It has also an imposing governor's house, military and government hospitals, maxket-place, and railway station. Some of the largest and finest sugar estates in the world are situated in the vicinity, including the Soledad and others. Prob- ably no place on the island offers greater advantages for seeing sugar-making in its most favourable aspects. Population (1899), 30,038.

Cieza, a town of Murcia, Spain, on the railway and high road from Madrid to Cartagena, and on the river Sigura. Population (1897), 11,717. Its environs are very fertile, and produce cereals, raisins, oranges, olive, spart grass. In the town itself are flour and paper mills, sawmills, distilleries. The streets are broad, and have fine private residences, a modern town hall on the principal square, a large renaissance parish church, and a promenade styled La Glorieta.

Cilicia, the Koman Province, extended along the south coast of Asia Minor from the Alara Su, which separated it from Pamphylia, to the Giaour Dagh, M. Amanus, which parted it from Syria. Its northern limit was the crest of M. Taurus ; its southern the sea. It was naturally divided into Cilicia Trachea, west of the Lamas Su, and Cilicia Pedias, east of that river. Cilicia Trachea is a rugged mountain district formed by the spurs of Taurus, which run southwards to the sea, and often ter- minate in rocky headlands with small sheltered harbours, — a feature which, in classical times, made the coast a favourite resort of pirates,

and, in the Middle Ages, led to its occupation by Genoese and Venetian traders. The district is watered by the Geuk Sti (Calycadnus and its tributaries), and is covered to a large extent by forests which still, as of old, supply timber to Egypt and Syria. There were several towns but no large trade centres. In the interior were Koropissus(Z)a Bazdr),Olha. (Uzunjaburj), and, in the valley of the Calycadnus, Claudiopolis (M-dt), and Germanicopolis (Ermenek). On, or near the coast were Coracesium (Alaya), Selinus-Trajanopolis (Selinti), Anemeurium, Kelenderis (Kilindria), Seleucia (Selefke), Korykus (Korghoz), and Elseusa-Sebaste (Ayash). Eoads connected Laranda, north of the Taurus, with Kelenderis and Seleucia.

Cilicia Pedias included the rugged spurs of Taurus and a large plain which consists, in great part, of a rich stoneless loam. Its eastern half is studded with isolated rocky crags, which are crowned with the ruins of ancient strongholds, and broken by the low hills that border the plain of Issus. The plain is watered by the Cydnus (Tersus Chai), the Sarus (^SihUri), and the Pyramus {Jih'u.n), each of which brings down much silt. The Sarus now enters the sea almost due south of Tarsus, but there are clear indications that at one period it joined the Pyramus, and that the united rivers ran to the sea west of Kara-tash. Such appears to have been the case when Alexander's army crossed Cilicia. The plain is extremely productive, though now little cultivated (see Adana). Through it ran the great highway, betwfeen the east and the west, on which stood Tarsus on the Cydnus. Adana on the Sarus, and Mopsuestia {Missis), on the Pyramus. North of the road between the two last places were Sision-Flaviopolis {Sis), Anazarbus {Anazarba), and Hieropolis-Kastabala {Budr'u.m) ; and on the coast were Soli-Pompeiopolis, Mallus {Kara-tash), Mg3i {Ayash), Issus, Baiae {Piyas), and Alexandria ad Issum {Alexand- retta) . The great highway from the west, on its long rough descent from the Anatolian plateau to Tarsus, ran through a narrow pass between walls of rock called the Cilician Gate, Qhulek Boghaz. After crossing the low hills east of the Pyramus it passed through a masonry (Cilician) gate, Demir Kapu, and entered the plain of Issus. From that plain one road ran southward through a

masonry (Syrian) gate to Alexandretta and thenoe crossed M. Amanus by the Syrian Gate, Beilan Pass, to Antioch and Syria ; and another ran northwards through a masonry (Amanian) gate, south of Toprak Kaleh, and crossed M. Amanus by the Amanian Gate, Baghehe Pass, to North Syria and the Euphrates. By the last pass, which was apparently unknown to Alexander, Darius crossed the mountains prior to the battle of Issus. Both passes are short and easy, and connect Cilicia Pedias geographically and politically with Syria rather than with Asia Minor. Another im- portant road connected Sision with Kokusos and Melitene. In Roman times Cilicia exported the goats'-hair cloth, Cilicium, of which tents were made.

Cilicia has been identified by some authorities with the Kuah and Helak of the emended texts of 1 Kings x. 28, and Ezek. xxvii. 11, and by Maspero with the Keti of the Egyptian Inscriptions. The Cilicians appear to have belonged to that great family of non- Aryan tribes which included the Syro-Cappadocians, or Hittites, and the Proto-Armenians. Under the Persian Empire, Cilicia was apparently governed by tributary native kings who bore the name Syennesis. After Alexander's death it was loosely held by the Seleucid kings, and Cilicia Trachea became the haunt of pirates who were subdued by Pompey. Cilicia Pedias became Roman territory in 103 e.g., and the whole was organized by Pompey, 64 B.C., into a province which extended to and included part of Phrygia. It was reorganized by Csesar, 47 b.c, and about 27 B.C. became part of the province Syria-Cilicia^Phcenice. At first the western district was left independent under native kings or priest-dynasts, and a small kingdom, under Tarkondimotus, was left in the east ; but these were finally united to the province by Vespasian, a.d. 74. Under Diocletian, circ. 297, Cilicia, with the Syrian and Egyptian provinces, formed the Diocesis Orientis. In the 7th century it was invaded by the Arabs, who held the country until it was reoccupied by Nioephorus II. in 965.

The Seljiik invasion of Armenia was followed by an exodus of Armenians southwards, and In 1080 Rhupen, a relative of the last king of Ani, founded in the heart of the Cilician Taurus a small principality which gradually expanded into the kingdom of Lesser Armenia. This Christian kingdom — situated in the midst of Moslem states, hostile to the Byzantines, giving valu- able support to the leaders of the Crusades, and trading with the great ‘ commercial cities of Italy — had a stormy existence of about 300 years. Gosdantin I. (109-5-1100) assisted the Cru- saders on their march to Antioch, and was created knight and marquis. Thoros I. (1100-1123), in alliance with the Chris- tian princes of Syria, waged successful war against Byzantines and Seljiiks. Levond II., “the Great” (118-5-1219), extended the kingdom beyond Mount Taurus and established the capital at Sis. He assisted the Crusaders, and was crowned king by the archbishop of Mayence, and married one of the Lusignans of Cyprus. Haithon I. (1224-69) made an alliance with the Mongols, who, before their adoption of Isl&m, protected his king- dom from the Memliiks of Egypt. When Levond V. died (1342), John of Lusignan was crowned king as Gosdantin IV. ; but he and his successors alienated the Armenians by attempting to make them conform to the Roman Church, and by giving all posts of honour to Latins, and at last the kingdom, a prey to internal dissensions, succumbed (1375) to the attacks of the Egyptians. Cilicia Trachea was occupied by the Osmanlis in the 15th century, but C. Pedias was only added to the empire in 1515. From 1833 to 1840 Cilicia formed part of the dominion of Mahommed All, who was compelled to evacuate it by the Allied Powers.

Ramsey. Historical Geography of Asia Minor, 1890. — ^Bent and Hicks in Journal of Hellenic Studies, 1890. — Stekkett in Journal Archailog. Inst, of America, 1884-85. — Maequardt. Bomische Staatsverwaltung. (c, -w. w.)

Cilli (Slovene, Celje), an old and picturesque town ■with special charter and seat of a district administration in Styria (Austria). It is situated on the left bank of the Sann river, and is a station on the Southern Railway from Vienna to Trieste. Apart from the parish church, dating from the 14th century, Cilli furnishes some inter- esting

specimens of mediseval architecture, such as the beautiful Gothic chapel and the so-called German church in the Romanesque style. Remains of the old walls and towers with which the town was once surrounded are yet visible, and memorials of a still earlier period of its his- tory— Roman antiquities — are to be seen in the municipal museum. Cilli owes a good deal of its recent prosperity to the growing popularity of its river baths, which have converted it into a favourite summer resort. During the bathing season the water has a temperature of 75° to 85°

Fahr. It has also a considerable trade in timber, iron, leather, corn, and coal, while its industries include zinc smelting and metal works, and the manufacture of chemicals, explosives, veneers, leather, brick and tiles, flour and beer. The town has latterly taken a somewhat prominent part in the nationality struggle ; it was an educational concession to the Slovene element of the population which brought about the fall of the German, Clerical, and Polish coalition in June 1895. Population (1890), 6264; (1900), 6743 (about 75 per cent. German, and 25 per cent. Slovene ; 99 per cent. Roman Catholic, and 1 per cent. Protestant).

Cilli, which is mentioned by the Elder Pliny, and whose origin was attributed to the Celts, was taken possession of by the Romans (15 B.C.) under the Emperor Claudius and received the name of Claudia Celeja. It was incorporated with Aquileia, under Constantine ; and towards the end of the 6th century was destroyed by the invading Slavs. It had a period of exceptional prosperity from the middle of the 14th to the latter half of the 15th century under the Counts of Cilli, on the extinction of which family it fell to Austria. In the 16th century it suffered greatly both from revolts of the peasantry and from the Counter-Reformation, Protestantism having made many converts in the district, particu- larly among the nobles. (m. o'n.)

Cincinnati, the capital of Hamilton county, Ohio, U.S.A., situated on the north bank of the Ohio river, N. lat. 39° 6', W. long. 84° 26', the tenth city in popular tion in the Union. ,The population in 1890 was 296,908, 71,408 being foreign-born, chiefly German, Irish, British, and Russian; in 1900 it was 325,902, of whom 57,961 were foreign-born and

14,482 were negroes. These flgures do not include suburbs, with an estimated population of 60,000 ; nor the cities of Covington and Newport and adjoining towns on the south bank of the Ohio, with a population of 71,329. Five bridges connect Cincinnati with these cities, over three of which trolley cars run. There are forty-four lines of street cars extending many miles in all directions from a common central point in the city. These have pushed the area of residence and manu- facture far beyond the surrounding hills on which are the original suburbs. The hill-tops are also reached by four inclined-plane cable railways. The climate is salu- brious ; the mean temperature in summer is 75-5° F., in winter 38-1°, and for the year 55-9°. The mean relative humidity is 71 per cent. According to the U.S. census, the death-rate of Cincinnati in 1890 was 21-0; in 1900 it was 19-2, showing a considerable decrease. There are 376 miles of improved streets largely paved with granite, asphalt, and brick. The adjoining parts of Ohio, Indiana, and Kentucky are thickly settled, and Cincinnati is the commercial centre of a rich, fertile, and populous region comprising parts of ten states. Sixteen lines of railway enter it from all directions, one of which — that to Chattanooga, 334 miles long — was built and is owned by the city. It cost $18,000,000, and is run by a lessee, at an annual rental of $1,000,000. Steam river navi- gation has declined as railways have increased, there being, in 1899, ninety vessels registered with a ton- nage of 16,827. The National Government has improved and lighted the channel, and large quantities of coal, ore, iron, lumber, and salt float down in flatboats. Cincinnati is a growing seat of education. Besides the university of Cincinnati, with law, medical, and other departments, it contains St Xavier and other colleges and schools for general and special instruction, a college of music, an art school, a technical school, a mechanics' in- stitute, a college of pharmacy, and a Hebrew union college for the education of rabbis, which is the only one of the kind in the United States. Scientific, social, historical, political, and other societies, are numerous, many having buildings and libraries. There are 246 churches of 25

sects. There are 1 city, 1 United States, 4 private and 11 charity hospitals. A fresh-air home and farm for poor children has been established by private subscriptions. The art museum in Eden Park with galleries, &c. (cost of building, $350,000 ; endowment, f 580,000), and separate buildings for art school and library, are the gift of citi- zens ; as are also the music hall, with a seating capacity of 5000, where musical festivals occur biennially ; and the library and two other buildings of the university in Burnet Woods Park. A large, well-appointed zoological garden is privately maintained, but not for profit. Among other new buildings are the United States building, which cost $5,000,000; the city hall, which cost f 1,500,000; the court house, which replaces that burned by a mob in 1884; Chamber of Commerce, Armoury, Turner's hall. Odd Fellows' temple, Young Men's Christian Association, Union Trust Co., 17 storeys high ; Queen City, Phoenix, and Cincinnati clubs. In the parks are statues of Pre- sidents W. H. Harrison, Garfield, and Lincoln, and of Captain Desmond, killed in defending the court house. There are 11 daily newspapers and 214 other regular publications. The central situation of the city and its accessibility make it a common meeting-place for general bodies. The government is by a mayor, a board of legis- lation, and a general administrative board of public service of five members, all elective. The rate of taxation is 2-574 per cent. ; the public debt $25,546,456.43 (including the cost of the railway to Chattanooga) ; the city's credit is high, 3 per cent, bonds commanding a premium. The greatest recent growth of Cincinnati has been industrial. There are over 200 industries.

Year.

Establish- ments.

Cash Capital and Property occupied.

Hands employed.

Products.

1880 1890 1898

5493 7832 8667

$108,635,220 136,419,558 171,581,264 .

74,798

96,689

115,944

$148,957,280 196,063,983 236,162,060

Cincinnati ranks first in the United States in the manu- facture of vehicles, harness, leather, hardwood lumber, wood-working machinery, machine tools, printing ink, soap, pig-iron, tobacco, and whisky, second in that of shoes, and fourth in that of clothing, cooperage, and pianos. The statistics for 1899 were : —

Clothing .f25,457,000

Cooperage 3,288,500

Harness 5,250,000

Hardwood lumber 24,000,000

Leather 4,664,000

Machine tools 3,340,000

Pianos 2,500,000

Pie-iron 38,375,000

Pnntingink 1,000,000

Shoes 9,619,838

Soap 9,826,500

Tobacco 9,256,414

Vehicles 9,750,000

•Whisky 38,603,000

Wood-working machinery . . 1,550,000

There are 19 banks— other than Savings and Building and Loan Associations, which are numerous— with a capital of $8,415,000, and total clearings in 1899 of $748,490,360. (j- h^-)

Cinematograph.— The cinematogralph is an appli- cation of photography to the zoStrope. This apparatus shows in rapid sequence a series of views representing closely successive phases of a moving object, and persist- ence of vision creates the illusion that the object is m motion. The cinematograph, invented by Edison m 1894, is the result of the introduction of the flexible film into photography in place of glass. A long sensitized film is moved across the focal plane of a camera and exposed intermittently to moving objects. A series of images

results, which when passed in rapid and intermittent succession before the eye gives the appearance of a photo- graph in motion. The original apparatus showed the film to a single observer, but in its perfected form it throws the successive images on a screen by means of a lantern so that an entire audience can see them. In one apparatus for making the exposures a cam jerks the film across the field once for each picture, the slack being gathered in on a drum at a constant rate. In another four lenses are rotated so as to give four images for each rotation, the film travelling so as to present a new portion in the field as each lens comes in place. Twenty-five to fifty pictures may be taken per second. At the slower rate it is found in practice that during the operation the film should be stationary about of the time. The films are developed on large drums, within which a ruby electric light may be fixed to enable the process to be watched. In the magic lantern an electric lamp or lime light of high power projects, through an objective lens, the successive images of the film upon a distant screen. Such subjects as an army on the march, or an express train at full speed, are presented with marvellous distinctness and completeness of

detail. To regulate the feed in the lantern a hole is punched in the film for each picture. These holes must be extremely accurate in position. As they wear the feed becomes irregular, and the picture dances or vibrates in an unpleasant manner. For an hour's exhibition 50,000 to 165,000 pictures are needed, and they are fed at the rate of 26 miles an hour. A very simple system of exhibiting the views consists in attaching them by their lower edge transversely to a band which moves over two rollers. A detent at the top holds back the top edges so that they fly across, as the band rotates, like the leaves of a book. By looking at them at this point the effect of motion is produced. This method has been so simplified that little books of cinetoscopic views are sold, from which the moving effect is obtained by simply letting the leaves escape rapidly from the thumb as the book is bent backwards. (t. o'c. s.)

C intra, a picturesque town of Portugal, district Lisbon, 16 miles north-west from Lisbon, in great repute as a summer resort owing to its salubrious climate. Many new villas have recently been built. Population, 4928.

Ciotat, La, a coast town and railway station, France, department of Bouches-du-Eh5ne, arrondissement of Marseilles, 20 miles south-east of that town. The port, easily accessible for vessels drawing 19 feet, is well sheltered, and defended by a battery. Large shipbuilding yards and repairing docks give employment to about 3000 workmen. Other important industries are the fisheries and the coral fishery. Coasting trade is actively carried on ; the town is frequented for searbathing. Population

(1881), 8045 ; (1901), 11,311.

Circleville, capital of Pickaway county, Ohio, U.S.A., on the east bank of Scioto river, which here is not navigable. It is on the Cincinnati and Muskingum Valley, and the Norfolk and Western Eailways, at an altitude of 707 feet. Its manufactures consist in large part of furniture and agricultural implements. It occu- pies the site of ancient earthworks of the mound-builders, from one of which, a circle, it derives its naipe. Popu- lation (1880), 6046; (1900), 6991.

Circulation of the blood. See under Physiology (Vascular System) and Pathology (Circular tion).

Cittadella, a town of Italy, Venetia, province of Padua, 23 miles north by west from Padua. It is still

surrounded with mediaeval walls and towers, and possessed of a fine parish church, theatre, and botanical garden. It was founded in 1220 as a border defence of the people of Padua against Treviso. It has a technical school. Population, about 9500.

Cittanova, a town of Calabria, Italy, province of Eeggio, 31 miles north-east from Eeggio. It was built up out of the ruins of the former Casalnuovo (destroyed by an earthquake in. 1783), and took its present name in 1852. It has olive-oil presses. Population, about 11,400.

Ciudad Bolivar, capital of the state of Bolivar in Yenezuela, on the right bank of the Orinoco river, about 240 miles from the mouth, at an elevation of 187 feet above the sea. Up to 1846 it was known as Angostura. Its population numbers over 15,000. It is a great commercial centre for the whole Guiana region; the port through which all the gold is exported ; maintains steam- ship communication with Trinidad; and is the starting- point for the steamers furnishiag the mail, passenger, and freight service to all points on the upper Orinoco and between Apure and Nutrias. The market, cathedral, masonic temple, custom-house, university, and theatre are the most important buildings. The customs receipts for the year ending 30th June 1896 were 3,285,371 bolivars. The returns of shipping for 1898 were — entered 70 ships of 22,326 tons, cleared 59 ships of 21,762 tons. The value of the exports in 1897 was £339,197, and in 1898 it was £354,008. In 1897 the imports were valued at £243,845, and in 1898 at £233,800.

Ciudad Real, a province of South Central Spain divided into 10 administrative districts and 96 parishes, with an area of 7840 square

miles. The population was 292,291 in 1887 and 305,002 in 1897. Only about 8000 acres are properly irrigated, 670,000 acres are covered with forests, and about 1200 square miles are covered with sparse vegetation and meagre brushwood. It is the grazing ground of large flocks, but the locust plague often destroys vast extents of pasture. Some of the rivers of Ciudad Eeal, like the Yavalon and Azuel, curiously rise from chalky soil, and from their very sources give abundant supplies of water to many mills. Almost the whole province is in the upper basin of the Guadiana, except the southernmost part, 'where several tributaries of the Guadalquivir water some districts. The means of communication, except the railways, are in a very bad condition. In 1897, out of 53,944 boys and girls between the ages of 4 and 14, there were 32,338 on the school registers, but only 22,601 really attended classes. The province has 280 miles of railways, and one will connect the important coal-mines of Puertoliano with Cordova. One quicksilver, one zinc, 6 coal, and 18 lead mines were worked in 1898. The province produced 19,945 tons of quicksilver ore, 201,097 of coal, 4261 of lead, and 23,514 of argentiferous lead. The net increase of coal was 70,550 tons in 1898, being 54 per cent, over the figures of 1897. The mines employed in all 5257 men, 679 lads, 177 women. The live stock includes 12,001 horses, 36,051 mules, 33,380 asses, 21,680 cattle, 337,892 sheep, 196,501 goats, and 57,790 pigs. 288,437 acres are devoted to wheat crops, 136,037 to barley, 15,042 to rye, 7607 to oats, 3688 to pod fruit, 150,744 to vines, 80,045 to olives.

Ciudad Real, the capital of the above province, had a population of 14,700 in 1887, and 14,547 in 1897. It has fijie modern schools, an institute, a training school for teachers, and some good public buildings, town hall, barracks, casinos, prison. The chief commerce of the town is in agricultural products and live stock at the weekly fairs.

Civil List. — The civil list is the account in which are contained all the expenses immediately applicable to the support of the British sovereign's household and the honour and dignity of the crown. An annual sum is settled by Parliament at the beginning of the reign on the sovereign, and is charged on the Consolidated Fund. But it is only from the reign of William IV. that the sum thus voted has been restricted

solely to the personal expenses of the crown. Before his accession many charges properly belonging to the ordinary expenses of Government had been placed on the civil list. The his- tory of the civU list dates from the reign of William and Mary. Before the Eevolution no distinction had been made between the expenses of Govern- ment in time of peace and the expenses relating to the personal dignity and support of the sovereign. The ordinary revenues derived from the hereditary revenues of the crown, and from certain taxes voted for life to the king at the beginning of each reign, were supposed to provide for the support of the sovereign's dignity and the civil Government, as well as for the public defence in time of peace. Any saving made by the king in the expenditure touching the government of the country or its defence would go to swell his privy purse. But with the B,evolution a step forward was made towards the establishment of the principle that the expenses relating to the support of the crown should be separated from the ordinary expenses of the State. The evils of the old sys- tem under which no appropriation was made of the ordi- nary revenue granted to the crown for life had been made manifest in the reign of Charles II. and James II. ; it was their control of these large revenues that made them so independent of Parliament. Moreover, while the civil Government and the defences suffered, the king could use these revenues as he liked. The Parliament of William and Mary fixed the revenue of the crown in time of peace at £1,200,000 per annum ; of this sum about £700,000 was appropriated towards the "civil list." But from this the sovereign was to defray the expenses of the civil service and the payment of pensions, as well as the cost of the support of the royal household and his own per- sonal expenses. It was from this that the term "civil list " arose, to distinguish it from the statement of military and naval charges. The revenue voted to meet the civU list consisted of the hereditary revenues of the crown and a part of the excise duties. Certain changes and ad- ditions were made in the sources of revenue thus appro- priated between the reign of William and Mary and the accession of George III., when a different system was adopted. Generally speaking, however, the sources of revenue remained as settled at the Eevolution.

Anne had the same civil list, estimated to produce an annual income of £700,000. During her reign a debt of £1,200,000 was incurred. This debt was paid by Parliament and charged on the civil list aeorgei., itself. George I. enjoyed the same revenue by and parliamentary grant, in addition to an annual <'«•"'•?« ^^• sum of £120,000 on the Aggregate Fund. A debt of £1,000,000 was incurred, and discharged by Parliament in the same manner as Anne's debt had been. To George II. a civil list of £800,000 as a minimum was granted. Parlia- ment undertaking to make up any deficiency if the sources of income appropriated to its service fell short of that sum. Thus in 1746 a debt of £456,000 was paid by Parliament on the civil list. On the accession of George III. a change was made in the system of the civil list. Hitherto the sources of revenue appropriated to the service of the civil list had been settled on the crown. *’*°‘S’e ’”• If these revenues exceeded the sum they were computed to produce annually, the surplus went to the king. George III., however, surrendered the life-interest in the hereditary

revenues and the excise duties hitherto voted to defray the cml list expenditure, and any claim to a surplus for a fixed amount. The king still retained other large sources of revenue which were not included in the civil list, and were free from the control of Parlia^ ment. The revenues from which the civil list had been defrayed were henceforward to be carried into, and made part of, the Aggregate Fund. In their place a tixed civil list was granted— at first of £723,000 per annum, to be increased to £800,000 on the falling in of certain annuities to members of the royal family. From this £800,000 the king’s household and the honour and dignity of the crown were to be supported, as well as the Civil Service offices, pensions, and other charges still laid on the list.

During the reign of George III. the civil list played an important part in the history of the struggle on the part of the king to establish the royal ascendancy. From the revenue appropriated to its service came a large

portion of the money employed by the king in creating places and pensions for his supporters in Parliament, and, under the colour of the royal bounty, bribery was practised on a large scale. No limit was set to the amount applicable to the pensions charged on the civil list, so long as the sum granted could meet the demand ; and there was no principle on which the grant was regulated. Secret pensions at the king's pleasure were paid out of it, and in every way the independence of Parliament was menaced ; and though the more legitimate expenses of the royal household were diminished by the king's penurious style of living, and though many charges not directly connected with the king's personal expenditure were removed, the amount was constantly exceeded, and applications were made from time to time to Parliament to pay off debts incurred ; and thus opportunity was given for criticism. In 1769 a debt of £513,511 was paid ofE in arrears ; and in spite of the demand for accounts and for an inquiry into the cause of the debt, the ministry suc- 'aessof ceeded in securing this vote without granting civil list such information. All attempts to investigate the civil list were successfully resisted, though Lord Chatham went so far as to declare himself convinced that the funds were expended in corrupting members of Parliament. Again, in 1777, an application was made to Parliament to pay off £618,340 of debts ; and in view of the growing discontent Lord North no longer dared to withhold accounts. Yet, in spite of strong opposition and free criticism, not only was the amount voted, but also a further £100,000 per annum, thus raising the civil list to an annual sum of £900,000.

In 1779, at a time when the expenditure of the country and the national debt had been enormously increased by the American war, the general dissatisfaction found voice in Parliament, and the abuses of the civil list were specially singled out for attack. Many petitions were presented to the House of Commons praying for its reduction, and a motion was made in the House of Lords in the same sense, though it was rejected. In 1780 Burke brought forward his scheme of economic reform, but his name was already associated with the growing desire to remedy the evils of the civil list by the publication in 1769 of his pamphlet on "The Causes of the Present Discontent." In this scheme Burke freely anjmadverts on the profusion and abuse of the civil list, criticizing the

useless and obsolete offices and the offices performed by deputy. In every department he discovers jobbery, waste, and peeular tion. His proposal was that the many offices should be reduced and consolidated, that the pension list should be brought down to a fixed sum of £60,000 per annum, and that pensions should be conferred only to reward merit or fulfil real public charity. All pensions were to be paid at

the Exchequer. He proposed also that the civil list should be divided into classes, an arrangement which later was carried into effect. In 1780 Burke succeeded in bringing in his Establishment Bill ; but though at first it met with considerable support, and was even read a second time. Lord North's Government defeated it in committee. The next year the Bill was again introduced into the House of Commons, and Pitt made his first speech in its favour. The Bill was, however, lost on the second reading.

In 1782 the Eockingham Ministry, pledged to economic reform, came into power ; and the Civil List Act, 1782, was introduced and carried with the express object of limiting the patronage and infiuence '^^',^gf of ministers, or, in other words, the ascendancy of the crown over Parliament. Not only did the Act effect the abolition of a number of useless offices, but it also imposed restraints on the issue of secret service money, and made provision for a more efEectual supervision of the royal expenditure. As to the pension list, the annual amount was to be limited to £96,000 ; no pension to any one person was to exceed £1200, and all pensions were to be paid at the Exchequer, thus putting a stop to the secret pensions payable during pleasure. Moreover, pensions were only to be bestowed in the way of royal bounty for persons in distress or as a reward for merit. Another very important change was made by this Act : the civil list was divided into classes, and a fixed amount was to be appropriated to each class. The following were the classes : —

1. Pensions and allowances of the royal family.

2. Payment of salaries of Lord Chancellor, Speaker, and judges.

3. Salaries of ministers to foreign courts resident at the same.

4. Approved bills of tradesmen, artificers, and labourers for any article supplied and work done for His Majesty's service.

5. Menial servants of the household.

6. Pension list. /

7. Salaries of all other places payable out of the civil list revenues.

8. Salaries and pensions of treasurer or commissioners of the treasury and of the Chancellor of the Exchequer.

Yet debt was still the condition of the civil list down tothe end of the reign, in spite of the reforms established by the Eockingham Ministry, and notwithstanding the removal from the list of many charges unconnected with the king's personal expenses. The debts discharged by Parliament between 1782, the date of the passing of the Civil List Act, and the end of George III.'s reign, amounted to £2,300,000. In all, during his reign £3,398,061 of debt owing by the civil list was paid off.

With the regency the civil list was increased by £70,000 per annum, and a special grant of £100,000 was settled on the Prince Eegent. In 1816 the annual amount was settled at £1,083,727, including the establishment of the king, now insane; though the civil list was relieved from some annuities payable to the royal family. Nevertheless, the fund still continued charged with such civil expenses as the salaries of judges, ambassadors, and officers of state, and with pensions granted for public services. Other reforms were made as regards the defini- tion of the several classes of expenditure, while the ex- penses of the royal household were henceforth to be audited by a Treasury official — the auditor of the civil list. On the accession of George IV. the civil list, freed from the expenses of the late king, was settled at £845,727. On William IV. coming to the throne a sum of £510,000 per annum was fixed for the service of the civil list. The king at the same time

surrendered all the sources of revenue enjoyed by his predecessors, apart from the civil list, represented by the hereditary revenues of Scotland — the Irish civil list, the droits of the crown and admiralty, the 4|- per cent, duties, the West India duties, and other

casual revenues hitherto vested in the crown, and inde- pendent of Parliament. The revenues of the duchy of Lancaster were still retained by the crown. In return for this surrender and the diminished sum voted, the civil list was relieved from all the charges relating rather to the civil Government than to the support of the dignity of the crown and the royal household. The future ex- penditure was divided into five classes, and a fixed annual sum was appropriated to each class. The pension list was reduced to £75,000. The king resisted an attempt on the part of the select committee to reduce the salaries of the officers of state on the grounds that this touched his prerogative, and the ministry of Earl Grey yielded to his remonstrance.

The civil list of Queen Victoria was settled on the same principles as that of William IV. A considerable

reduction was made in the aggregate annual Queen ^ sum voted, from £510,000 to £386,000, and cirUUst *^® pension list was sepaiated from the ordinary

civil list. The civil list proper was divided into the following five classes, with afixed sum appropriated to each : —

Privy purse

. £60,000

Salaries of household

. 131,260

Expenses of household

. 172,500

Royal bounty, &o. .

13,200

Unappropriated

Tj’ ji – r

8,040

__-|—Tl_ J_l_ _ _ J!I_’ – –

In addition the Queen might, on the advice of her ministers, grant pensions up to £1200 per annum, in accordance with a resolution of the House of Commons of 18th February 1834, “to such persons as have just claims on the royal beneficence, or who, by their personal services to the crown, by the performance of duties to the public, or by their useful discoveries in science and at- tainments in literature and art, have merited the gracious consideration of the sovereign and the gratitude of their country.” The service of these pensions increased the annual sum devoted to support the dignity of the crown and the expenses of the household to about £409,000. The list of pensions must be laid before Parliament within thirty days of 20th June. Thus the civil list was reduced in amount, and relieved from the very charges which gave it its name as distinct from the statement of military and naval charges. It now really only dealt with the support of the dignity and honour of the crown and the royal household. The arrangement was most successful, and during the last three reigns there was no application to Parliament ■ for the discharge of debts incurred on the civil list.

The death of Queen Victoria rendered it necessary that a renewed provision should be made for the civil list ; and King Edward VII., following former pre- ^cl'i90l cedents, placed unreservedly at the disposal of Parliament his hereditary revenues. A select committee of the House of Commons was appointed to consider the provisions of the civil list for the crown, and to report also on the question of grants for the honourable support and maintenance of Her Majesty the Queen and the members of the royal family. The committee in their conclusions were guided to a consider- able extent by the actual civD. list expenditure during the last ten years of the last reign, and made certain recom- mendations which, without undue interference with the sovereign's personal arrangements, tended towards in- creased efficiency and economy in the support of the sovereign's household and the honour and dignity of the crown. On their report was based the CivU List Act, 1901, which established the new civil list. The system that the hereditary revenues should as before be paid into the exchequer and be part of the consolidated fund was maintained. The amount payable for the civil list was

increased from £385,000 to £470,000. In the application of this sum the number of classes of expencfiture to which separate amounts are to be appropriated is in- creased from five to six. The following is the new arrangement of classes : — 1st class. Their Majesties' privy purse, £110,000; 2nd class, salaries of His Majesty's household and retired allowances, £125,800; 3rd class, expenses of His Majesty's household, £193,000; 4th class, works (the interior repair and decoration of Buck- ingham Palace and Windsor Castle), £20,000 ; 5th class, royal bounty, alms, and special services, £13,200 ; 6th class, unappropriated, £8000. The system relating to civil list pensions, established by the Civil List Act, 1837, continues to apply, but the pensions are not to be regarded as chargeable on the sum paid for the civU list. The committee also advised that the mastership of the Buckhounds should not be continued ; and His Majesty, on the advice of his ministers, agreed to accept their recommendation. The maintenance of the royal hunt thus ceases to be a charge on the civil list. The annuities of £20,000 to the prince of Wales, of £10,000 to the princess of Wales, and of £18,000 to His Majesty's three daughters, are not included in the civil list, though they are

conferred by the same Act. Other grants made by special Acts of Parliament to members of the royal family are also excluded from it. (h. s. s.)

Civil Service. — British Empire. — The civil service is the generic name given to all public servants. It is the machinery by which the executive, through the various administrations, carries on the central govern- ment of the country. The cost of the civil services has increased of late years. The net total of the estimates for the civil services for 1901-2 was £23,630,120, as op- posed to £22,838,808 for 1900-1. The increase (after the adjustment of certain items) was £783,812, as opposed to the increase of £659,143 in 1900-1.

The appointments to the civil service until the year 1855 were made by nomination, with an examination not sufficient to form an intellectual or even a physical test. It was only after much consideration and almost years of discussion that the nomination system was abandoned. Various commissions reported on the civil service, and Orders in Council were issued. Finally in 1855 a qualify- ing examination of a stringent character was instituted, and in 1870 the principle of open competition was adopted as a general rule. On the report of the Playf air Com- mission (1876), an Order in Council was issued dividing the civil service into an upper and lower division. The Order in Council directed that a lower division should be constituted, and men and boy clerks holding permanent positions replaced the temporary assistants and writers. The ” temporary” assistant was not found to be advanta^ geous to the service. In December 1886 a new class of assistant clerks was formed to replace the men copy- ists. In 1887 the Ridley Commission reported on the civil service establishment. In 1890 two Orders in Council were issued based on the reports of the Ridley Commission, which sat from 1886 to 1890. The first Order constituted what is now known as the second division of the civil service. The second Order in Council concerns the officers of the 1st class, and provision was made for ihe possible promotion of the second division clerks to the first division after eight years’ service.

The whole system is under the administration of the Civil Service Commissioners, and power is given to them, with the approval of the Treasury, to prescribe the subjects of examination, limits of age, &c. The age is fixed for compulsory retirement at sixty -five. In exceptional cases a prolongation of five years is within the powers of the Civil

Service Commissioners. The examination for 1st class clerkships is held concurrently with that of the civil service of India and Eastern cadetships in the colonial service. Candidates can compete for aU three or for two. In addition to the intellectual test the candidate must fulfil the conditions of age (22 to 24), must present rec- ommendations as to character, pass a medical examina- tion, and must also pay a fee of £6. The subjects include the language and literature of England, France, Germany, ancient Greece and Rome, Sanscrit and Arabic, mathemat- ics (pure and applied), natural science, history (English, Greek, Eoman, and general modern), political economy and economic history, mental and moral philosophy, Roman and English law and political science. The candidate is obliged to reach a certain standard of know- ledge in each subject before any marks at all are allowed him. This rule was made to prevent success by mere cramming, and to ensure competent knowledge on the basis of real study. Clerks of Class I. are employed in the following departments and offices : — Head Office and

Admiralty, Outposts.

Agriculture, Board of.

Chief Secretary's Office, Ireland.

Civil Service Commission.

Colonial Office.

Constabulary .Ireland (Inspector- Greneral's Office).

Customs.

Exchequer and Audit Depart- ments.

Home Office.

India Office (Correspondence, Political, Accountant-Gene- ral's Store and Audit Depart- ments).

Inland Kevenue.

Local Government Board, Eng- land and Ireland.

Lunacy Commission.

Patent Office.

Post Office.

Privy Council Office.

Record Offices, England and Ireland.

Science and Art Department.

Scottish Office.

Supreme Court Pay Office, Eng- land.

Trade, Board of.

Treasury.

"War Office.

The maximum scale of the salaries of clerks of Class I. is as follows : — 3rd class, £200 a year, increasing by £20 a year to £500 ; 2nd class,

£600, increasing by £25 a year to £800 ; 1st class, £850, increasing by £50 a year to £1000. Their pensions are fixed by the Superannua^ tion Act 1859, 22 Vict. c. 26 :—

“To any person who shall have served ten years and upwards, and under eleven years, an annual allowance of ten-sixtieths of the annual salary and emoluments of his office :

” For eleven years and under twelve years, an annual allowance of eleven-sixtieths of such salary and emoluments :

“And in like manner a further addition to the annual allow- ance of one-sixtieth in respect of each additional year of such service, until the completion of a period of service of forty years, when the annual allowance of forty-sixtieths may be granted ; and no additions shall be made in respect of any service beyond forty years.”

The “ordinary annual holidays allowed to officers” (1st class) “shall not exceed thirty-six week-days during-each of their first ten years of service and forty-eight week-days thereafter. ” Order in Council, 15th August 1890.

““Within that maximum heads of departments have now, as they have hitherto had, an absolute discretion in fixing the annual leave.”

Sick leave can be granted on full salary for not more than six months, on half salary for another six months.

The scale of salary for 2nd division clerks begins at £70 a year, increasing by £5 to £100 ; then £100 a year, increasing by £7, 10s. to £190 ; and then £190 a year, increasing by £10 to £250. The highest is £300 to £500. Advancement in the 2nd division to the higher ranks depends on merit, not seniority. The ordinary annual holiday of the 2nd division clerks is 14 working days for the first five years, and 21 working days afterwards. They can be allowed sick leave for six months on full pay and six months on half pay. The subjects of their examination are :— (1) handwriting and orthography, including copying MS ; (2) arithmetic; (3) English composition; (4) precis,

including indexing and digest of returns; (5) book- keeping and shorthand writing; (6) geography and

English history; (7) Latin or Erench or German; (8) elementary mathematics ; (9) inorganic chemistry with elements of physics. Not more than four of the subjects, (4) to (9), are to be taken. The candidate must be between the ages of 17 and 20. The fee is £2. A certain number of the places in the 2nd division were reserved for the candidates from the boy clerks appointed under the old system. The severity of the competition is shown by the fact that in February 1900 there were 932 candidates for 120 places. Candidates are allowed a choice of departments subject to the exigencies of the services. The departments are as follows : —

(Edin-

Pay Office of the Supreme Court.

Post Office (London).

Post Office (Edinburgh).

Post Office (Dublin).

Prisons Board (Dublin).

Prisons Department (Edin- burgh).

Privy Comicil Office.

Public “Works Loan Office.

Public Works Office (Dublin).

Reformatories Office.

Registrar-General’s Office (Lon- don).

Registrar-General’s Office (Edin- burgh).

Registrar-General's Office (Dub- lin).

Science and Art Department (London).

Science and Art Department (Dublin).

Scotland, Office of Secretary for.

Scottish Education Department.

Stationery Office.

Supreme Court of Judicature (Ireland) Accounting Office.

Teachers' Pension Office (Dub- lin).

Trade, Board of.

Trade," Board of ; Bankruptcy Department.

Trade, Board of ; Commercial, Labour, and Statistical De- partment.

Trade, Board of ; Patents Office.

Seaman's Registry Office.

Treasury.

Treasury, Remembrancer's Office (Dublin).

Valuation Office (Dublin).

"War Office.

"War Office, Royal Army Cloth- ing Depot.

"Works, Office of.

The total number of 2nd division clerks employed is 2945.

A new class of assistant clerks or abstractors was formed in 1886. The appointments are made from the ranks of the men copyists. The maximum salary is about £150. Now only 93 men copyists remain, so this source for candidates is practically exhausted, but open competition has not yet been instituted for the assistant clerkships. The subjects of the examination that is held are — handwriting, orthography, arithmetic, English com- position, digesting returns into summaries, and geography. A competent amount of general proficiency is insisted upon. This new class has been introduced into the following offices: — Admiralty, Board of Agriculture, Census Office, Charity Com- mission, Customs, Education Department, General Registrar Office, Home Office, Irish Land Commission, Inland Revenue, Local Government Board (England and Ireland), General Post Office (Savings Bank Department, London and Dublin), Prisons Commission (England and Scotland), Public Works Loan Board, General Prisons Board (Ireland), Registrar-General's Office (Dublin), Science and Art Department, Seamen's Registry Office, Board of Trade, Treasury, War Office, and Office of Woods (Quit Rent Office, Dublin).

A new class of boy copyists has also been established. They are almost entirely employed in London, a few in Dublin and Edinburgh, and, very seldom, in some provincial towns. The subjects of their examination are : Obligatory — handwriting and orthography, arithmetic, and English composition. Optional — (any two of the following) : (1) copying MS. ; (2) geography ; (3)

Agriculture, Board of.

Admiralty.

British Museum.

Chancery Department burgh).

Charity Commission.

Chelsea Hospital.

Chief Secretary's Office (Dublin).

Chief Secretary's Office, Veteri- nary Department.

Civil Service Commission.

Colonial Office.

Constabulary (Ireland), In- spector-Genersd's Office.

Customs (London, Liverpool, and Outposts).

Deeds, Registry of (Dublin).

Dublin Metropolitan Police Office.

Education Department.

Exchequer and Audit Office.

Exchequer Office (Scotland).

Fisheries Office (Dublin).

Fishery Board (Scotland).

Foreign Office.

Friendly Societies Registry.

Home Office.

Inland Revenue — Offices in London. Offices in Edinburgh. Offices in Dublin.

Local Government Board (Lon- don).

Local Government Board (Edin- burgh).

Local Government Board (Dub- lin).

Lunacy Commission.

Mint.

National Debt Office.

National Education Office (Dub- lin).

Paymaster-General's Office (Lon- don and Dublin).

English history; (4) translation from one of the following languages— Latin, French, or Gertnan ; (5) Euclid, bk. i. and ii., ^nd algebra, up to and including simple equations ; (6) rudiments of chemistry and physics. Candidates must be between the ages of fifteen and eighteen. They have no claims to superannuation or compensation allowance. Boy copyists will not be retained aiter the age of twenty.

Candidates for the Civil Service of India take the same examination as for 1st class clerkships. Candidates suc- cessful in the examination must subsequently spend one year in England. They receive for that year £100 if they elect to live at one of the universities or colleges approved by the Secretary of State for India. At the close of this year they will be submitted to a final ex- amination in the following subjects — Indian Penal Code and the Code of Criminal Procedure, the principal vernacular language of the province to which they are assigned, the Indian Evidence Act (these three subjects are compulsory), the Code of Civil Procedure and the Indian Contract Act, Hindu and Mahommedan Law, Sanscrit, Arabic, Persian, the history of British India, Chinese (for Burma only). Of these seven two are to be selected,

but a candidate may not take Arabic or Sanscrit both in the first examination and in the final. They must also pass a thorough examination in riding, which is con- ducted at the Eoyal Artillery Elding School at Woolwich. On reaching India their salary begins at 400 rupees a month. In 1899 the value of the rupee was permanently fixed by Government at Is. 4d. They may take, as leave, one-fourth of the time on active service in periods strictly limited by regulation. After twenty-five years' service (of which twenty-one must be active service) they can retire on a pension of £1000 a year. The unit of administration is the district. At the head of the district is an executive officer called either collector-magistrate or deputy-commissioner. In mostprovinces he is responsible to the commissioner, who corresponds directly with the provincial government. The Indian civilian after four years' probation in both branches of the service is called upon to elect whether he will enter the revenue or judicial department, and this choice as a rule is held to be final for his future work.

Candidates for the Indian Forest Service have to pass a com- petitive examination, one of the compulsory subjects being German. They have also to pass a severe medical examination, especially in their powers of vision and hearing. They must be between the ages of seventeen and twenty. Successful candidates are required to pass a three years' course, with a final examina- tion, seven terms of the course at Cooper's Hill, the rest of the time receiving practical instruction in Continental forests. The obligatory expenses at Cooper's Hill are £61 a term, and £160 is charged for the time abroad. On reaching India they start as assistant conservators at 260 rupees a month. The highest salary, that of inspector-general of forests, in the India Forest Service is 2000 rupees a month.

The Indian Police Service is entered by a competitive examina- tion of very much the same kind as for the Forests, except that special subjects such as German and botany are not included. The candidates are limited in age to nineteen and twenty-one. They must pass a riding examination. A free passage out is given them. They are allotted as probationers, their wishes being consulted as far as possible as to their province. A probationer receives 250 rupees a month. A district

superin- tendent can rise to 1000 rupees a month, while there are a few posts with a salary of 2500 rupees a month in the Police Service. The leave and pension in both these departments follow the general rules for Indian services.

The Civil Service also includes student interpreter- ships for China, Japan, and Siam, and for the Ottoman dominions, Persia, Greece, and Morocco. Both these classes of student interpreters are selected by open com- petition. Their object is to supply the consular service in the above-named countries with persons having a thorough knowledge of the language of the country in which they serve.

In the first case, China, Japan, &c., they learn their language in the country itself, receiving £200 as probationers. Then they become assistants in a consulate. The highest post is that of consul-general. In the . case of student interpreters for the Ottoman dominions, Persia, Greece, and Morocco, the successful candidates learn their languages at Oxford. Turkish is taught gratuitously, but they pay the usual fees for other languages. At Oxford they receive £200 a year for two years. On leaving Oxford they become assistants under the embassy at Constantinople, the legations at Teheran, Athens, or Morocco, or at one of H.B.M. consulates. As assistants they receive £300 a year. The consuls, the highest post to which they can reach, receive in the Levant from £500 to £1600 a year. The civil services of Ceylon, Hong- Kong, the Straits Settlements, and the Malay Peninsula are supplied by the Eastern cadetships. The limits of age for the examination are twenty-one and twenty-four. The cadets are required to learn the native language of the colony or dependency to which they are assigned. In the case of the Straits Settlements and Malay cadets they may have to learn Chinese or Tamil, as well as the native language. The salaries are : passed cadets, 3600 rupees per annum, gradually increasing until first-class offi- cers receive from 12,000 to 18,000 rupees per annum. They are allowed three months' vacation on fuU pay in two years, and leave of absence on half pay after six years' service, or before that if urgently needed. They can retire for ill-health after ten years with fifteen-sixtieths of their annual salary. Otherwise they can add one-sixtieth of

their annual salary to their pension for every additional year's service up to thirty-flve years' service.

In spite of the general rule of open competition, there are still a few departments where the system of nomination obtains, accompanied by a severe test of knowledge. In the following offices it is so for some of the appointments.

Foreign Office (all the following posts) : — 8 ambassadors, 16 ministers plenipotentiary, 10 ministers resident, 2 agents and consuls-general, 8 secretaries of embassy, 15 secretaries of legation, 6 commercial attach^, 34 2nd secretaries, 23 3rd secretaries (attaches) ; Metropolitan police courts ; mines ; naval service, assistant clerks ; post office secretary's office, supplementary, office of the controller of stores ; British Museum ; clerks of the two Houses of Parliament ; Royal Irish Constabulary ; Board of Education ; Education Office for Ireland ; Inspectors of Factories.

The employment of women in the Civil Service has not yet been much developed except in the Post Office. Women are employed in the Post Office as female clerks, counter clerks, telegraphists, returners, sorters, and post- mistresses all over the United Kingdom. In 1881 the Postmaster-General took a decided step in favour of female employment, and with the consent of the Treasury instituted female clerkships. Female clerks do not come in contact with the public. Their duties are purely clerical, and entirely in the accountant-general's depart- ment at the Savings Bank.

Their leave is one month per annum, their pension is on the ordinai-y civil service scale. The elimination is competitive, the subjects are handwriting and spelling, arithmetic, English composi- tion, geography, English history, French or German. Candidates must be between the ages of 18-20. Whether unmarried or widows they must resign on marriage. The class of girl clerks take the same subjects in a competitive examination. They must be between the ages of 16-18 ; they serve only in the Savings Bank department. If competent they can pass on later to female clerkships. The salaries of the female clerkships range from £200 to £500 in the higher grade, £56 to £190 in the second

class, whilst girl clerks are paid from £35 to £40, with the chance of advance- ment to higher posts. The total of women employed by the Post Office and telegraphs Is not to be found in official returns, but women are now so largely employed not only in the higher grades, but as sorters, counter clerks, telegraphists in London and through- out the country that the aggregate number is very considerable. For instance, there are 778 sorters, counter clerks, and telegraphists in the Metropolitan district alone.

In other departments thei-e is a notable increase in female employment. The Board of Agriculture, the Customs, and the India Office employ women. The department of Agriculture, Technical Education, the Board of Education generally, the Local Government Board, all to a certain extent employ women, whilst in the Home Office there are seven women inspectors of Workshops and Factories. (jno. s.)

United States. — Civil Service Eeform,like other great ad- ministrative reforms, began in America in the latter half of the 19th century. Personal and partisan government, with

all the entailed evils of the patronage system, culminated in Great Britain during the reign of G-eorge III., and was one of the efiicient causes of the American rcYolution. Trevelyan characterizes the use of patronage to influence legislation, and the giving of colonial positions as sinecures to the privileged classes and personal favourites of the administration, by saying, ” It was a system which, as its one achievement of the first order, brought about the American war, and made England sick, once and for all, of the very name of personal Government.” It was natural that the founders of the new Government in America, after breaking away from the mother-country, should strive to avoid the evils which had in a measure brought about the revolution. Their intention that the administrative of&cers of the

Government should hold oflce during good behaviour is manifest, and was given thorough and practical effect by every administration during the first forty years of the life of the Government. The constitution fixed no term of oflce in the executive branch of the Government except those of president and vice-president ; and Madison, the expounder of the con- stitution, held that the wanton removal of a meritorious ofBcer was an impeachable offence. Not until nine years after the passage of the Four Years' Tenure of Office Act in 1820 was there any material departure from this traditional policy of the Government. This act (suggested by an appointing officer who wished to use the power it gave in order to secure his own nomination for the presi- dency, and passed without debate and apparently without any adequate conception of its full effect) opened the doors of the service to all the evils of the " spoils sys- tem." The foremost statesmen of the time were not slow to perceive the baleful possibilities of this legislation, Jefferson,^ Webster, Clay, Calhoun, Benton, and many others being recorded as condemning and deploring it in the strongest terms. The transition to the " spoils sys- tem " was not, however, immediate, and for the next nine years the practice of reappointing all meritorious officers was practically universal ; but in 1829 this practice ceased and the Act of 1820 lent the sanction of law to the system of proscriptions which followed, which was a practical

application of the theory that "to the victor ??"' f, belong the spoils of the enemy." In 1836 Byitom. the provisions of this law, which had at first

been confined mainly to officers connected with the collection of revenue, were extended to include also all postmasters receiving a compensation of $1000 per annum or more. It rapidly became the practice to regard all these four years' tenure offices as agencies not so much for the transaction of the public business as for the ad- vancement of political ends. The revenue service from being used for political purposes merely came to be used for corrupt purposes as well, with the result that in one administration frauds were practised upon the Govern- ment to the extent of $76,000,000. The corrupting in- fluences permeated the whole body politic. Political retainers were

selected for appointment not on account of their ability to do certain work but because they were followers of certain politicians ; these « public servants ” acknowledged no obligation except to those politicians, and their public duties, if not entirely disregarded, were negligently and inefficiently performed. Thus grew a saturnalia of spoils and corruption which culminated m the assassination of a president.

Acute conditions, not theories, give rise to reforms. In the congressional election of November 1882, following the assassination of President Garfield as an incident in

iSee letter to Monroe, 29th November 1.820,.Jefferson’s^Wims’«, vii n 190 A quotation from this letter is given at p. 454 of the ^tienth Report of the U.S. Civil Service Commission.

the operation of the spoils system, the voice of the people commanding reform was unmistakable. Congress assem- bled in December 1882, and during the same month a bill looking to the improvement of the civil service, which had been pending in the Senate for nearly two years, was finally taken up and considered by that body. In the debate upon this bill its advocates declared that it would ” vastly improve the whole citil service of the country,” which they characterized as being at J°’ that time “inefficient, expensive, and extra var gant, and in many instances corrupt.” ^ This bill passed the Senate on 27th December 1882, and the House on 4th January 1883, and was signed by the president on 16th January 1883, coming into full operation on 16 July 1883. It is now the national civil service law. The fundamental principles of this law are : — (1) selection by competitive examination for all appointments to the ” classified ser- vice,” with a period of probationary service before absolute appointment; (2) apportionment among the states and territories, according to population, of all appointments in the departmental service at Washington ; (3) freedom of all the employees of the Government from any necessity to contribute to political campaign funds or to render political , services. For putting these principles into effect the Civil Service Commission was created, and penalties were imposed for the solicitation or

collection from government employees of contributions for political purposes, and for the use of official positions in coercing political action. The commission, in addition to its regular duties of aiding in the preparation of civil service rules, of regulating and holding examinations, and certify- ing the results thereof for use in making appointments, and of keeping records of all changes in the service, was given authority to investigate and report upon any viola- tions of the Act or rules. The ” classified ” service to which the Act applies has grown, by the action of succes- sive presidents in progressively including various branches of the service within it, from 13,924 positions in 1883 to some 80,000 (in round numbers) in 1900, constituting now about 40 per cent, of the entire civil service of the Govern- ment and including practically all positions above the grade of mere labourer or workman to which appointment is not made directly by the president with the consent of the Senate.’ A very large class to which the Act is ex- pressly applicable, and which has not been brought within its provisions by executive action, is that of fourth-class postmasters, of whom there are between 70,000 and

80,000.

In order to provide registers of eligibles for the various grades of positions in the classified service, the United States Civil Service Commission now holds annually throughout the country about 300 different kinds of examinations. In the work of preparing these examinar tions and of marking the papers of competitors in them, the commission is authorized by law to avail itself, in addition to its own corps of trained men, of the services of the scientific and other experts in the various executive departments. In the work of holding the examinations it is aided by about 1300 local boards of examiners, which are its local representatives throughout the country and are located at the principal post offices, custom houses, and other government offices, being composed of three or more Federal employees in those offices. About 50,000 persons

2 See Senate Report No. 576, 47th Congress, 1st session; also U.S. Civil Service Commission’s Third Report, p. 16 et seq., Tenth Report, pp.

136, 137, and Fifteenth Report, pp. 483, 484.

8 The progressive classification of the executive civil service, show- ing the growth of the merit system, is discussed, with statistics, in the U.S. Civil Service Commission's Sixteenth Report, pp. 129-37. A revision' of this discussion, with important additions, appears in the Seventeenth Report.

annually compete in these examinations, and about 10,000 of those who are successful receive appointments through regular certification. Persons thus appointed, however, must serve six months " on probation " before their ap- pointment can be made absolute. At the end of this probation, if his service has not been satisfactory, the appointee is simply dropped ; and the fact that less than 1 per cent, of those appointed prove thus deficient on trial is high testimony to the practical nature of the examinations held by the commission, and to their aptness for securing persons qualified for all classes of positions.

The effects of the Civil Service Act withiu the scope of its actual operation have amply justified the hopes and promises of its advocates. After its passage, absentee holders of lucrative appointments were required to report for duty or to sever their connexion with the service. Improved methods were adopted in the departments, and superfluous and useless work was no longer devised in order to provide a show of employment and a locus standi for the parasites upon the public service. Individual clerks were required, and by reason of the new conditions were enabled, to do more and better work; and this, coupled with the increase in efficiency in the service on account of new blood coming in through the examinations, made possible an actual decrease in the force required in many offices, notwithstanding the natural growth in the amount of work to be done.^ Experience proves that the desire to create new and unnecessary positions was in direct proportion

to the power to control them, for where the Act has taken away this power of control the desire had disappeared naturally. There is no longer any desire on the part of heads of departments to increase the num- ber or salaries of classified positions which would fall by law within the Civil Service rules and be subject to com- petitive examinations. Thus the promises of improve- ment and economy in the service have been fulfilled.

The chief drawback to the full success of the Act within its intended scope of operation has been the withholding of certain positions in the service from the application of the vital principle of competition. The Civil Service Act con- templated no exceptions, within the limits to which it was made applicable, to the general principle of competition upon merit for entrance to the service. In framing the first Civil Service rules, however, in 1883, the president, yielding to the pressure of the heads of some of the de- partments, and against the urgent protest of the CivU Service Commission, excepted from the requirement of examination large numbers of positions in the higher grades of the service, chiefly fiduciary and administrative positions such as cashiers, chief clerks, and chiefs of di- vision. These positions being thus continued under the absolute control of the appointing officer, the effect of their exception from examination was to retain just that much of the old or ” spoils ” system within the nominal jurisdiction of the new or ” merit ” system. Even more : under the old system, while appointments from the out- side had been made regardless of fitness, still those ap- pointments had been made in the lower grades, thp higher positions being filled by promotion within the service, usually of the most competent, but under the new system with its exceptions, while appointments to the lower grades were filled on the basis of merit, the pressure for spoils at each change of administration forced inexpe- rienced, political, or personal favourites in at the top. This blocked promotions and demoralized the service. Thus, while the general effect of the Act was to limit very greatly the number of vicious appointments, at the same time the effect of these exceptions was to confine them to

1 For details justifying these statements, see U.S. Civil Service Commission's Fourteenth Report, pp. 12-14.

the upper grades, where the demoralizing effect of each upon the service would be a maximum. By constant efforts the Civil Service Commission succeeded in having position after position withdrawn from this excepted class, until by the action of the president, on 6th May 1896, it was finally reduced almost to a minimum. By subsequent presidential action, however, on 29th May 1899, the excepted class was again greatly extended.^ _

A further obstacle to the complete success of the merit system, and one which prevents the carrying forward of the reform to the extent to which it has been carried in Great Britain, is inherent in the Civil Service Act itself. All postmasters who receive compensation of f 1000 or more per annum, and all collectors of customs and collec- tors of internal revenue, are appointed by the president and confirmed by the Senate, and are therefore, by express provision of the Act, not " required to be classified." The universal practice of treating these offices as political agencies, instead of as administrative business offices, is therefore not limited by the Act. Such officers are active in political work throughout the country, and their official position adds greatly to their power to affect the political prospects of the leaders in their districts. Accordingly the Senate, from being, as originally intended, merely a confirming body as to these officers, has become in a large measure, actually if not formally, a nominating body, and holds with tenacity to the power thus acquired by the iudividual senators. Thorough Civil Service reform re- quires that these positions also, as well as those of fourth- class postmasters (which are already classifiable under the Act), be made subject to the merit system, for in them is the real remaining stronghold of the spoils system. Even though all their subordinates be appointed through ex- amination, it will be impossible to carry the reform to ultimate and complete success so long as the officers in charge are appointed mainly for political reasons and are changed with every change of administration.

The purpose of the Act to protect the individual em- ployees in the service from the rapacity of the ” political barons” has been measurably, if not completely, successful. The power given the Civil Service Commission, to investi- gate and report upon violations of the law, has been used to bring to light such abuses as the levying of political contributions, and to set the machinery of the law in motion against them. While comparatively few actual prosecutions have been brought about, and although the penalties imposed by the Act for this offence have been but seldom inflicted, still the publicity given to all such cases by the commission’s investigations has had a wholesome deterrent effect. Before the passage of the Act, positions were as a general rule held upon a well-understood lease- tenure, the political contributions for them being as securely and as certainly collected as any rent. !Now, however, it can be said that these forced contributions have almost entirely disappeared. The efforts which are still made to collect political funds from government employees in evasion of the law are limited in the main to persuasion to make ” voluntary ” contributions, and it has been possible so to limit and obstruct these efforts that their practical effect upon the character of the service is now very small.

The same evils that the Federal Civil Service Act was designed to remedy exist to a large degree in many of the state governments, and are especially aggravated in the administration of the local governments ‘*| . of some of the larger cities. The chief, if not ^^^ the only, test of fitness for office in many cases has been party loyalty, honesty and capacity being seldom

•^ For the scope of these exceptions, see Civil Service Eole VI., at p. 57 of the U.S. Civil Service Commission’s Fifteenth and Sixteenth Reports. A statement of the nomber of positions actually affected by this action of the president appears in the Seventeenth Report.

more than secondary considerations. The result has been the fostering of dishonesty and extrayagance, which have brought weakness and gross corruption into the adminis- tration of the local governments. In consequence of this there has been a constantly growing tendency, among the more intelligent class of citizens, to demand that honest business methods be applied to local public service, and that appointments be made on the basis of intelligence and capacity, rather than of party allegiance. The move- ment for the reform of the civil service of cities is going hand in hand with the movement for general municipal reform, those reformers regarding the merit system of appointments as not merely the necessary and only safe bulwark to preserve the results of their labours, but also as the most ef&cient means for bringing about other reforms. Hence Civil Service Reform has been given a leading position in all programmes for the reform of state and municipal governments in recent years. This has undoubtedly been due, in the first instance, at least, to the success which attended the application of the merit system to the Federal service, municipal and state legislation following in the wake of the national civil service law. In New York an Act similar to the Federal Civil Service Act was passed on 4th May 1883, and in 1894 the principles of the merit system were introduced by an amendment into the State Constitution, and made applicable to cities and villages as well. In Massachu- setts an Act was passed on 3rd June 1884, which in its general features was based upon the Federal Act and the New York Act. Similar laws were passed in Illinois and Wisconsin in 1895, applying both to the state gov- ernments and to the city governments of Chicago, Mil- waukee, and several other cities. In New Orleans, La., and in Seattle, Wash., the merit system was introduced by an amendment to the city charter in 1896. The same result was accomplished by New Haven, Conn., in 1897, and by San Francisco, Cal., in 1899. In still other cities the principles of the merit system have been enacted into law, in some cases applying to the entire service and in others to only a part of it.

The application of the merit system to state and muni- cipal governments has proved successful wherever it has been given a fair trial.^ As experience has fostered public confidence in the system, and at the same time shown those features of the law which are most

vulnerable, and the best means for fortifying them, numerous and im- portant improvements upon the pioneer Act applying to the Federal service have been introduced in the more recent legislation. This is particularly true of the Acts now in force in New York (passed in 1899) and in Chicago. The power of the commission to enforce these Acts is materially greater than the power possessed by the Federal Commission. In making investigations they are not confined to taking the testimony of voluntary wit- nesses, but may administer oaths, and compel testimony and the production of books and papers where necessary; and in taking action they are not confined to the making of a report of the findings in their investigations, but may themselves, in many cases, take final judicial actfon. Further than this, the payment of salaries is made de- pendent upon the certificate of the commission that the appointments of the recipients were made m accordance with the civil service law and rules. Thus these commis- sions have absolute power to prevent irre^ar or lUegal appointments by refractory appointing officers. Their powers' being so much greater than those of the national commission, their action can be much more drastic m most cases, and they can go more directly to the heart of

1 Tn tho US Civil Service Commission's Fifteenth Report, pp. 489- B02?he" growth of the civil service reform in states and cities" is Sstoricallf tr^ted, hriefly, bnt with some thoroughness.

an existing abuse, and apply more quickly and effectually the needed remedy.

Upon the termination of the Spanish- American war, the necessity for the extension of the principles of the merit system to the new territories, the responsibility for whose government the results of this war had thrown upon the United States, was realized.^ By the acts pro- viding for civil government in Porto Eico (12th April 1900) and Hawaii (30th April 1900), the provisions of the Civil Service Act and Kules were applied to those islands. Under this legislation the classification applies to all positions which are analogous to positions in the Federal service, those which correspond to positions in the municipal and state

governments being considered as local in character, and not included in the classi- fication.

On 19th September 1900 the United States Philippine Commission passed an Act ” for the establishment and maintenance of an efficient and honest civil service in the Philippine Islands.” This Act, in its general features, is based upon the national civil service law, but includes also a number of the stronger points to be found in the state and municipal laws mentioned above. Among these are the power given the Civil Service Board to administer oaths, summon witnesses, and require the production of official records ; and the power to stop payment of salaries to persons illegally appointed. Promotions are to be de- termined by competitive examiaations, and are to be made throughout the service, as there are no excepted positions. A just right of preference in local appoint- ments is given to natives. The president of the Philip- pine Commission in introducing this bill said: “The purpose of the United States Government ... in these islands is to secure for the Filipino people as honest and as efficient a government as may be possible. ... It is the hope of the commission to make it possible for one entering the lowest ranks to reach the highest, under a tenure based solely upon merit.” It is too early as yet to give positive testimony as to its actual operation, but judging by past experience it is believed that this law is well adapted to accomplish the purpose above stated.

For fuller information upon the details of the present workings of the merit system in the Federal service, recourse should be had to the publications of the U.S. Civil Service Commission, which are to be found in the public libraries in all the principal cities in the United States, or which may be had free of charge upon applica- tion to the commission. The Manual of Examinations, published semi-annually, gives full information as to the character of the examinations held by the commission, together with the schedule of dates and places for the holding of those examinations. The Annual Reports pi the commission contain full statistics of the results of its work, together with comprehensive statements as to the difficulties encountered in enforcing the law, and the means used to overcome them. In the Fifteenth Report, pp. 443-485, will be found a very valuable historical

compilation from original sources, upon the ” practice of the presidents in appointments and removals in the Ex- ecutive Civil Service, from 1789 to 1883.” In the same report, pp. 511-517, is a somewhat comprehensive bibli- ography of ” civil service ” in periodical literature in the 19th century, brought down to the end of 1898. (j. e. p.)

Civita Castellana, a town and episcopal see of Italy, province of Eome, 49 miles north from Eome by raU. In 1887 remains of an Etruscan temple, and also the remains of a temple attributed to Juno Quiritis, were

2 See V.S. Civil Service Commission’s Fifteenth Report, p. 37 and pp. 521-559, in which the application of civil service reform principles to colonial governments was discussed in connexion with a review of the experience of Great Britain and Holland in this regard.

discovered here. Six miles to the south-east is the Mount Soraete of Horace (Carm. i. 9) and Virgil (^n. xi. 785). Population, about 4500.

Civitavecchia, a seaport town and episcopal see of Italy, province of Eome, on the west coast, 50 miles north-west from Eome by rail. It is the port of Rome ; the harbour has been deepened, though only in part, to 21 feet ; the northern entrance was deepened to 26\ feet iu 1899-1900. A new quay was completed in 1895, a new breakwater begun in 1900, and other improvements have been effected since 1887. There are shipbuilding yards, blast furnaces, cement and patent fuel factories, and an arsenal, a cathedral, a theatre, and on the south mole a citadel built to the plans of Michel Angelo. The port is cleared by some 1610 vessels of 410,550 tons annually (1233 of 455,000 tons in 1899). Alum is extensively mined. This town supplies Eome with a large portion of its fish. Population, about 14,000.

Clackmannanshire, the smallest county in Scotland, bounded on the N. by Perthshire, on the E. by Perth and Fife shires, on the S.W. by the

Porth, and on the W. by Stirling and Perth shires.

Area and Population. — In 1891 the Stirling part of the parish of Alva was transferred to Clackmannan, and tie Clackmannan part of the parishes of Stirling and Logie to Stirling. The area of the county (exclusive of foreshore) as officially estimated is 35,160 acres, or about 55 square miles. The population was in 1881, 25,677 ; in 1891, 28,432 ; in 1891, on the above area, 33,140, of whom 15,834 were males and 17,306 females; in 1901 it was 32,019. On the old area, taking land only (30,477 acres, or 47-6 square miles), the number of persons to the square mile in 1891 was 605, and the number of acres to the person 1-1. In the registration county the population increased between 1881 and 1891 by 9-8 per cent. Between 1881 and 1891 the excess of births over deaths was 3495, and the increase of the resident population was 2975. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 :—

Year.

Deaths.

Marriages.

Births.

Percentage of lUegitimate.

1880 1890 1899

417 456 560

138 154 178

820

784 786

8-1 51 3-6

The birth-rate, death-rate, and marriage-rate are all below the rates for Scotland. The following table gives the birth-rate, death- rate, and marriage-rate per thousand of the population for a series of years : —

1880.

1881-90.

1890.

1391-98.

1899.

Birth-rate . Death-rate . Marriage-rate

34-32

17-45

5-77

30-90

17-12

6-65

29-57

17-20

5-80

26-40

15-17

5-63

22-02

15-69

4-98

In 1891 there were 215 Gaelic-speaJdng persons in the county, and 89 foreigners. Valuation in 1889-90, £137,084; 1899-1900, £165,706.

Administration. — The county unites with Kinross-shire to return a member to parliament. Clackmannan is the county town, but Alloa (11,417), Alva (4624), and Tillicoultry (3337), which are police burghs, take precedence in population and trade. There are 5 parishes, all but one of which belong to the Stirling Combination. In September 1899 the number of paupers and dependants was 556. Clackmannan forms a sheriffdom with Stirling and Dumbarton shires, and a sheriS-substitute sits at Alloa.

Education. — Six school boards manage 16 schools, which had an average attendance of 5334 in 1898-99, while 3 voluntary schools (one Episcopal and one Roman Catholic) had 437. There is a famous endowed secondary school, the Institution, at Dollar, and three other schools in the county earned grants in 1898 for giving higher education. A large part of the "residue" grant is spent in subsidizing Dollar Institution and science and art classes in the burghs.

Agriculture. — The Ochil hills in the north afford excellent pas- turage. Farming is high, and is mixed pastoral and arable. In 1898, 44-5 per cent, of tiie area was under cultivation, the county ranking thirteenth in this regard in Scotland. In 1895 the average size of the 197 holdings in the county was 80 acres. The percentage under 5 acres was 21-32; between 5 and 50 acres, 34-52; and

above 50 acres 44-16. There were 22 between 50 and 100, 66 between 100 and 300, and 9 between 300 and 500 acres. In 1895, 3026 acres were under wood. Oats are the principal com crop, and wheat and barley cover about equal acreages. The following table gives the principal acreages at intervals of five years from 1880 :—

Tear.

Area under Crops.

Corn Crops.

Green Crops.

Clover.

Perma- nent Pasture.

Fallow.

1880 1885 1890 1895 1899

15,691 15,858 15,857 15,687 16,567

5772 5278 4829 4703 4265

1479 1358 1219 1244 1146

3171 3530 4459 3345 3474

4926 5392 5102 6149 6569

■343

300 234 236 189

The f ollovring table gives particulars of the live stock during the same years : —

Tear.

Total Horses.

Total Cattle.

Cows or

Heifers in

Milk or Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1899

694 690 644 687 699

3383 3902 3930 4042 3686

1349 1499 1503 1630 1522

10,399 9,749 10,656 12,692 14,446

1473 1980 1772 2985 1729

Industries and Trade. — Paper-making has been added to the industries, of which coal-mining is the most important. 402,733 tons of coal, valued at £140,956, were raised in 1890 ; 366,697 tons, valued at £137,511, in 1899. 7097 tons of sandstone were obtained in 1895, and 15,605 tons, valued at £5416, in 1899. Alloa is the only fishing port in the county.

Authorities. — James Wallace. The Sheriffdom of Clack- mannan .- A Sketch of its History. Edinburgh, 1890. — D. Bever- iDGE. Between the Ochils and the Forth. Edinburgh, 1888. — John Crawford. Memorials of Alloa. 1886. — James Lotbian. Alloa and its Environs. 1871. (w.iWA.)

Clacton-on-Sea, a seaside town and flourishing watering-place of Essex, England, 16 miles south-east of Colchester by rail, in the Harwich parliamentary division. A Eranciscan convent, a higher middle-class day school in connexion with it, a board school, two convalescent homes, a ” holiday ” home, and a town-hall (£20,000) have been recently erected ; and modern improvements include a pier (1873) 1150

feet long, a sea-wall (1880), a promenade 1^ mile long, and a marine parade (1896). A drainage system was effected in 1894. Area of urban district, 4074 acres; population (1891), 3584 ; (1901), 7463.

Clanvowe, Sir Thomas (14th and 15th cen- turies), is a name which was first mentioned in the history of English literature by William Morris in 1895, when, in editing the text of The Cuckoo and the Nightingale for the Kelmseott Press, he stated that Professor Skeat had discovered that at the end of the best of the MSS. the author was called Clanvowe. In 1897 this information was confirmed and expanded by Professor Skeat himself in the supplementary volume of his Oxford Chaucer (1894-1897). The beautiful romance of The Cuckoo and tJie Nightingale was published by Thynne in 1532, and was attributed by him, and by successive editors down to the days of Henry Bradshaw, to Chaucer. It was due to this error that for three centuries Chaucer was supposed to be identified with the manor of Woodstock, and even painted, in fanciful pictures, as lying

Under a maple that is fair and green. Before the chamber-window of the Queen At Wodestock, upon the greene lea.

But this queen could only be Joan of Navarre, who arrived in 1403, three years after Chaucer's death, and it is to the spring of that year that Professor Skeat attributes the composition of the poem. Sir Thomas Clanvowe was of a Herefordshire family, settled near Wigmore. He was a prominent figure in the courts of

Richard II. and Henry IV., and was one of those who " had begun to mell of Lollardy, and drink the gall of heresy." The date of his birth is unknown, and his name is last mentioned in 1404. The historic and literary importance of 77*6 Cuckoo and the Nightirv- gale is great. It is the work of a poet who had studied the prosody of Chaucer with more intelli- gent care than either Occleve or Lydgate, and who therefore forms an important link between the 14th and 15th centuries in English

poetry. Clanvowe writes with a surprising delicacy and sweetness, in a five-line measure almost peculiar to himself. Professor Skeat points out a unique characteristic of Clanvowe's versification, namely, the unprecedented freedom with which he employs the suffix of the final ~~e, and rather avoids than seeks elision. The Cuckoo and the Night~~ ingale was imitated by Milton in his sonnet to the Nightingale, and was rewritten in modern English by Wordsworth. It is a poem of so much individual beauty, that we must regret the apparent loss of everything else written by a poet of such unusual talent. (e. g.)

Clare, a maritime county of Ireland, province of Munster.

Fopulation. — The area of the administrative county in 1900 was 784,956 acres, of which 145,959 were tillage, 478,411 pasture, 243 fallow, 7840 plantation, 28,312 turf-bog, 8098 marsh, 79,432 barren mountain, and 86,661 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, includes 3 electoral divisions, formerly situated in Galway. The population in 1881 was 141,457, and in 1891, 124,483, of whom 63,138 were males and 61,345 females, divided as follows among the different religions : — Roman Catholics, 122,047 ; Protestant Episcopalians, 2246 ; Presbyterians, 106 ; Methodists, 53 ; and other denominations, 31. The decrease of population between 1881 and 1891 was 12-00 per cent. The average number of persons to an acre was -15. Of the total population, 114,928 inhabited the rural districts, being an average of 123 persons to each square mile of crops and pasture. The population in 1901 was 112,129 (Roman Catholics, 109,899 ; Protestant Episcopalians, 2007 ; Presbyterians, 151 ; Methodists, 45 ; others, 27), being a decrease of 11-2 per cent. The following table gives the degree of education in 1891 : —

crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900. The figures for 1900 are for the new administrative county : —

Wheat.

Oats.

Barley,

Eye,

Beaue.

Potatoes.

Turnips.

Other Green Crops.

Meadow

and Clover.

Total.

1881- 1891 1895 1900

2697

2025

886

1268

16,215 18,100 12,765 11,103

2891 1652 1638 1541

25,681 20,665 20,547 18,694

6664 6410 5661 4846

3862 6098 6316 5770

85,236

90,625

98,261

102,852

141,686 188,495 144,908 145,959

Males.

Females.

Total.

Percentage.

E.O.

Pr. Epis.

Presb.

Kead and write Head only. . Illiterate . .

42,052 4,678 10,088

88,820 4,977 11,891

80,872 9,565 21,474

71-8 8-7 19-5

93-9 2-7 8-4

92-2 8-8 4-5

In 1881 the percentage of illiterates among Roman Catholics was 27-8. In 1891 there were 4 superior schools with 253 pupils (all Roman Catholics), and 250 primary schools with 20,549 pupils (Roman

Catholics 20,228, and Protestants 321). The number of pupils on the rolls of the national schools on 30th September 1899 was 22,967, of whom 22,693 were Roman Catholics and 274 Pro- testants. The following table gives the number of births, deaths, and marriages in various years : —

Tear.

Births.

Deaths.

Marriag'es.

1881 1891 1899

2981 2566 2333

1899 1851 1694

370 463 378

In 1899 the birth-rate per 1000 was 18-5, and the death-rate was 13-4 ; the rate of illegitimacy was 1'6 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1899 was 149,084, of whom 72,984 were males and 76,100 females. The following are the chief towns in the county, with their populations in 1891 : Ennis, 5460 ; Kilrush, 4095 ; Kilkee, 1556.

Administration.— The county is divided into two parliamentary divisions, East and West, the number of registered electors in 1900 being respectively 12,028, and 10,683. The rateable value in 1900 was £323,998. By the Local Government (Ireland) Act, 1898 the fiscal and administrative duties of the grand jury and (to a less extent) of other bodies were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises 2 urban and 9 rural sanitary

Agriculture.— The following tables show the acreage under

For 1899 the total value of the cereal and other crops was estimated by the Registrar-General at £968,331. The number of acres under pasture in 1881 was 475,316 ; in 1891, 463,061 ; and in 1900, 478,411.

Horses

and Mules.

Asses,

Cattle.

Sheep.

Pigs.

Goats.

Poultry.

1881 1891 1895 1900

16,960 19,070 20,616 18,057

9,596 10,649 11,812 12,092

156,158 178,282 171,288 175,756

108,121 141,899 118,065 117,864

41,847 88,290 41,481 43,489

14,994 17,882 17,721 18,038

423,072 409,098 429,274 465,367

The number of milch cows in 1891 was 45,224, and in 1900, 55,351. It is estimated that the total value of cattle, sheep, and pigs in 1899 was £2,390,014. In 1900 the number of holdings not exceeding 1 acre was

1584 ; between 1 and 5, 1347 ; between 5 and 15, 3286 ; between 15 and 30, 4753 ; between 30 and 50, 3676 ; be- tween 50 and 100, 2799 ; between 100 and 200, 939 ; between 200 and 500, 353 ; and above 500, 55— total, 18,792. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1900, was 463, amounting to £127,912. The number of loans sanctioned for agricultural improvements under sect. 31 of the Land Act, 1881, between 1882 and 1900, was 778, and the amount issued was £54,034. The total amount issued on loan for all classes of works under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1900, was £177,819. (w. H. Po.)

Claremont, a town of Sullivan county. New Hamp- shire, U.S.A. It is situated in the western part of the state, bordering on Connecticut river, and contains several villages, the principal among them being Claremont, Claremont Junction, and West Claremont. It is trav- ersed by the Boston and Maine Railway. Population

(1880), 4704; (1900), 6498.

Clark, Sir Andrew, 1st Bakt. (1826-1893), Brit- ish physician, was born at Aberdeen on 28th October 1826. His father, who also was a medical man, died when he was only a few years old. After attending school in Aberdeen, he was sent by his guardians to Dundee and apprenticed to a druggist; then returning to Aberdeen he began his medical studies in the univer- sity of that city. Soon, however, he went to Edinburgh, where in the extra-academical school he had a student's career of the most brilliant description, ultimately be- coming assistant to Dr Hughes Bennett in the Patho- logical Departmeijit of the Royal Infirmary, and assistant demonstrator of anatomy to Dr Robert Knox. But symptoms of pulmonary phthisis brought his academic life to a close, and in the hope that the sea might benefit his health he joined the medical department of the navy in 1848. Next year he became pathologist to the Haslar Hospital, where Huxley was one of his colleagues, and in 1863 he was the successful candidate for the newly-insti- tuted post of curator to the museum of the London Hospital. Here he intended to

devote all his energies to pathology, but circumstances brought him into active medical practice. In 1864, the year in which he took his doctor's degree at Aberdeen, the post of assistant physi- cian to the Hospital became vacant and he was prevailed upon to apply for it. He was fond of telling how his phthisical tendencies gained him the appointment. " He is only a poor Scotch doctor," it was said, " with but a few months to live; let him have it." He had it, and two years before his death publicly declared

that of those who were on the staff of the Hospital at the time of his selection he was the only one remaining alive. In 1854 he became a member of the College of Physicians, and in 1858 a fellow, and then went in succession through all the offices of honour the College has to offer, ending in 1888 with the presidency, which he continued to hold till his death. From the time of his selection as assistant physician to the London Hospital, his fame rapidly grew until he became a fashionable doctor with one of the largest practices in London, counting among his patients some of the most distinguished men of the day. The great number of persons who passed through his consult- ing-room every morning rendered it inevitable that to a large extent his advice should become stereotyped and his prescriptions often reduced to mere stock formulae, but in really serious cases he was not to be surpassed in the skill and carefulness of his diagnosis and in his attention to detail. In spite of the claims of his practice he found time to produce a good many books, all written in the precise and polished style on which he used to pride himself. Doubtless owing largely to personal reasons, lung diseases and especially fibroid phthisis formed his favourite theme, but he also discussed other subjects, such as renal inadequacy, anaemia, constipation, &c. He died in London on 6th November 1893, after a paralytic stroke which was probably the result of persistent overwork.

Clarke, Sir Andrew (1824-1902), British soldier and administrator, son of Colonel Andrew Clarke, of County Donegal, governor of West Australia, was born at Southsea, England, on 27th July 1824, and educated at King's School, Canterbury. He entered the E,.M.A., Woolwich, and obtained his commission in the army in 1844 as second lieutenant in the Royal Engineers. He was appointed to his father's staff in West Australia, but was transferred to be A.D.C. and military secretary to the Governor of Tasmania ; and in 1847 he went to New Zealand to take part in the Maori war, and for some years served on Sir George Grey's staff. He was then made Surveyor-General in Victoria, took a prominent part ia framing its new Constitution, and held the ofB.ce of Minis- ter of Public Lands during the first administration (1855-57). He returned to England in 1857, and in 1863 was sent on a special mission to the West Coast of Africa. In 1864 he was appointed Director of Works for the Navy, and held this post for nine years, being responsible for great improvements in the naval arsenals at Chatham, Portsmouth, and Plymouth, and for fortifications at Malta, Cork, Bermuda, and elsewhere. In 1873 he was made K.C.M.G, and became Governor of the Straits Settlements, where he did most valuable work in consolidating British rule and ameliorating the condition of the people. From 1875 to 1880 he was Minister of Public Works ia India ; and on his return to England in 1881, holding then the rank of lieutenant-colonel in the army, he was first ap- pointed commandant at Chatham and then Inspector-Gen- eral of Fortifications (1882-86). Having attained the rank of lieutenant-general and been created G.C.M.G., he retired from of&cial life, and in 1886 and 1893 unsuccessfully stood for Parliament as a supporter of Mr Gladstone. During his last years he was Agent-General for Victoria. He died 29th March 1902. Both as a technical and strategical engineer, and as an Imperial administrator. Sir ~~Andrew Clarke was one of the ablest and most useful public servants of his time; and his contributions to periodical literature, as well as his official memoranda, con~~ tained valuable suggestions on the subjects of Imperial defence and Imperial consolidation, which received too little consideration at a period when the Home Govern- ments were not properly alive to their importance. He is entitled to remembrance as one of those who first in-

culcated, from a wide practical experience, the views of Imperial administration and its responsibilities which in his last years he saw accepted by the bulk of his country- men, (h. OH.)

Clarke, James Freeman (1810-1888), Ameri- can preacher and author, was born in Hanover, N.H., on 4th April 1810. He was of a family which runs back, as he supposed, to the captain of the Mayflower. He was prepared for college at the Public Latin School of Boston, and after four years in Harvard College took his first degree in 1829. In his class were S. F. Smith, the author of the American National Hymn, and Oliver Wendell Holmes. After three years more of study at Cambridge Clarke was ordained as minister of a Unitarian congregation at Louisville, Kentucky, which was then a slave state. From the beginning, therefore, Clarke watched the institution of slavery, and he threw himself heart and soul into the national movement for its aboli- tion. At the end of seven years he returned to Boston, where he and his friends established the ” Church of the Disciples.” It brought together a body of men and women active and eager in applying the Christian reli- gion to the social problems of the day; and he would have said that the feature which distinguished it from any other church was that they also were ministers of the highest religious life. Ordination could make no distinction be- tween him and them. For fifty years from the beginning of his active life until his death he wrote freely for the press. With Eliot of St Louis, and James Perkins of Cincinnati, he established and carried on a magazine called the Western Messenger. Its business was to carry to read- ers in the Mississippi valley simple statements of “liberal religion,” involving what were then the most radical ap- peals as to national duty, especially the abolition of slavery. The magazine is now of value to collectors because it con- tains the earliest printed poems of Ralph Waldo Emerson, who was Clarke’s personal friend. Most of Clarke’s earlier published writings were addressed to the immediate need of establishing a larger theory of religion than that espoused by people who were still trying to be Calvinists, people who maintained what a good American phrase calls ” hard-shelled churches.” But it would be wrong to call his work controversial. He was always declaring that the business of the Church is Eirenic and not Polemic. Such books as the Ih-uth and Errors of Orthodoxy have been

read more largely by members of orthodox churches than by Unitarians. In the great moral questions of the time Clarke was a fearless and practical advocate of the broad- est statement of human rights. Without caring much what company he served in, he could always be seen and heard, a leader of unflinching courage in the front rank of the battle. He published but few verses, but at bottom he was a poet. He was a diligent and accurate scholar, and among the books by which he is best known in Amer- ica is one called The Ten Great Religions of the World. Few men in the United States have done more than Clarke to give breadth to the published discussion of the subjects of literature, ethics, and religious philosophy. He died at Jamaica Plain, Mass., on 8th June 1888. His Life — compiled mainly from his autobiography, letters, and diaries — was published in Boston in 1892.

(b. e. h.)

Clarksville, capital of Montgomery county, Ten- nessee, U.S.A., situated in the northern part of the state, at an altitude of 394 feet, on Cumberland river, at the mouth of Red river, and on the Louisville and Nashville railway. The Cumberland is navigable at this point. Clarksville is one of the greatest tobacco markets, being in a region largely devoted to the culture of the plant. It

ia the seat of the South-West Presbyterian Universitv Population (1880), 3880 ; (1890), 7924 ; (1900), 9431.

HoPo’^”’”‘ “‘‘t’o’f Julius Emmanuel (1822- 1888), German physicist, was born on 2nd January 1822 at Koslm, in Pomerania. After attending the Gym- nasium at Stettin, he studied at Berlin University from 1840 to 1844. In 1848 he took his degree at Halle, and m 1850 was appointed professor of physics in the Royal Artillery and Engineering School at Berlin. Late in the same year he delivered his inaugural lecture as privat docent in the University. In 1855 he became an ordinary professor at Zurich Polytechnic, accepting at the same time a professorship in the University of Zurich. In 1867 he moved to Wilrzburg as professor of physics, and two years later was appointed to

the same chair at Bonn, where he died on 24th August 1888. During the Franco- German war he was at the head of an ambulance corps composed of Bonn students, and received the Iron Cross for the services he rendered at Vionville and Gravelotte. The work of Clausius, who was a mathematical rather than an experimental physicist, was concerned with many of the most abstruse problems of molecular physics. By his restatement of Camot's principle he put the theory of heat on a truer and sounder basis, and he deserves the credit of having made thermo-dynamics a science ; he enunciated the second law, in a paper contributed to the Berlin Academy in 1860, in the well-known form, "Heat cannot of itself pass from a colder to a hotter body." His results he applied to an exhaustive development of the theory of the steam-engine, laying stress in particular on the conception of entropy. The kinetic theory of gases owes much to his labours, Clerk Maxwell calling him its principal founder. It was he who raised it, on the basis of the dynamical theory of heat, to the level of a theory, and he carried out many numerical determinations in con- nexion with it, e.g., of the mean free path of a molecule. To Clausius also was due an important advance in the theory of electrolysis, for he put forward the idea that molecules in electrolytes are continually interchanging atoms, the electric force not causing, but merely directing, the interchange. This view found little favour until 1887, when it was taken up by Arrhenius, who adduced addi- tional arguments in its support, and formed from it the hypothesis of electrolytic dissociation now widely ac- cepted.

Clay, Charles (1801-1893), English surgeon, was born at Bredbury, near Stockport, on 27th December 1801. He began his medical education as a pupil of Mr Kinder Wood in Manchester (where he used to attend Dalton's lectures on chemistry), and in 1821 went to Edinburgh to continue his studies there. Qualifying in 1823, he began a general practice in Ashton-imder-Lyne, but in 1839 removed to Manchester to practise as an operative and consulting surgeon. It was there that, in 1842, he first performed the operation of ovariotomy with which his name is associated. On this occasion it was perfectly successful, and when fifteen years afterwards he published an analysis of his cases he was able to show a mortality only slightly above 25 per cent; Although his merits in this matter have sometimes been denied,

his claim to the title ” Father of Ovariotomy ” is now gener- ally conceded, and it is admitted that he deserves the credit not only of having shown how that operation could be made a success, but also of having played an important part in the advance of abdominal surgery for which last centuiy was conspicuous. In spite of the claims of a heavy practice. Clay found time for the pursuit of geology and arch£eology. Among the books of which he was the author were a volume of Geological Sketches of Manchester

and a History of the Currency of the Isle of Man, and his collections included over a thousand editions of the Old and New Testaments, and a remarkably complete series of the silver and copper coins of the United States of America. He died at Poulton-le-Fylde, near Preston, on 19th September 1893.

Clay Cross, a town in the Chesterfield division of Derbyshire, England, 5 miles south from Chesterfield, with a station on the Midland railway. Since 1894 it has been governed by an urban district council. The Clay Cross Colliery and Ironworks Company employ a great number of hands. Population (1891), 7727 ; (1901), 8348.

Clay, Frederic (1840-1889), English musical composer, was born in Paris in 1840. He studied music under Molique in Paris, and Hauptmann at Leipzig. With the exception of a few songs and two cantatas, The Knights of the Cross (1866) and Lalla Rookh (1877), his composi- tions were all written for the stage ; but he will be best remembered as the composer of ” I’ll sing thee songs of Araby.” Clay’s first public appearance was made with an opera entitled Court and Cottage, the libretto of which was written by Tom Taylor. This was produced at Covent Garden in 1862, and was followed by Constance (1865), Ages Ago (1869), and Princess Toto (1875), to name only three of many works which have long since been forgotten. The last two, which were written to libretti by W. S. Gilbert, are among Clay’s most tuneful and most attractive works. He wrote part of the music for Babil and Bijou (1872), and Tlie Black Crook (1873), both of which were produced at the Alhambra. He also furnished incidental music for a

revival of Twelfth Night, and for the production of James Albery's Oriana. His last works, The Merry Duchess (1883), and The Golden Sing (1883), the latter written for the reopening of the Alhambra, which had been burned to the ground the year before, showed an advance upon his previous work, and rendered all the more regrettable the stroke of paralysis which crippled his physical and mental energies during the last few years of his life. He died at Great Marlow in 1889. (e. a. s.)

Clays, Paul Jean (1819-1900), Belgian artist, was born at Bruges in 1819, and died at Brussels in 1900. He was one of the most esteemed marine painters of his time, and early in his career he substituted a sincere study of nature for the extravagant and artificial conventionality of most of his predecessors. When he began to paint, the sea was considered by Continental artists as worth representing only under its most tempestuous aspects. Artists cared only for the stirring drama of storm and wreck, and they clung still to the old-world tradition of the romantic school. Clays was the first to appreciate the beauty of calm waters reflecting the slow procession of clouds, the glories of sunset illuminating the sails of ships or gilding the tarred sides of heavy fishing-boats. He painted the peaceful life of rivers, the poetry of wide estuaries, the regulated stir of roadsteads and ports. And while he thus broke away from old traditions he also threw off the trammels imposed on him by his master, the marine painter Gudin. Endeavouring only to give truthful expression to the nature that delighted his eyes, he sought to render the limpid salt atmosphere, the weight of waters, the transpar- ence of moist horizons, the gem-like sparkle of the sky. A Fleming in his feeling for colour, he set his palette with clean strong hues, and their powerful har- monies were in striking contrast with the rusty, smoky tones then in favour. If he was not a " luminist " in the modern use of the word, he deserves at any rate to be classed with the founders of the modern naturalistic school. This conscientious and healthy interpretation, to which the artist remained faithful, without any important change,

to the end of an unusually long and laborious career, attracted those minds which aspired to be bold, and won over those which were moderate. Clays soon took his place among the most famous Belgian painters of his generation, and his pictures, sold at high prices, are to be seen in most public and private galleries. We may mention, among others, ” The Beach at Ault,” ” Boats in a Dutch Port,” and ” Dutch Boats in the Flushing Eoads,” the last-named in the National Gallery of London. In the Brussels Gallery are ” The Port of Antwerp,” ” Coast near Ostend,” and a ” Calm on the Scheldt ” ; in the Antwerp Museum, ” The Meuse at Dordrecht ” ; in the Pinakothek at Munich, “The Open North Sea ” ; in the New York Gal- lery, “The Festival of the Freedom of the Scheldt at A.ntwerp in 1863 ” ; in the palace of the king of the Bel- gians, ” Arrival of Queen Victoria at Ostend in 1857 ” ; in the Bruges Academy, ” Port of Feirugudo, Portugal.” P. J. Clays was a member of several Academies, Belgian and foreign, and of the Order of Leopold, the Legion of Honour, &c.

See Camille Lemonnieb. Sistoire des Beaux Arts. Brussels, 1887. (o. M.*)

Clayton-le- Moors, a township and parish of Lan- cashire, England, 2 miles north-north-west of Accring- ton by rail, in the Accrington parliamentary division. In 1894 the parish was placed under an urban district coun- cil of twelve members. Besides the church of All Saints, restored in 1882, the parish has a Eoman Catholic church (1819), a Primitive Methodist (1858), a Wesleyan (1862), and a Baptist (1882) chapel ; there are also five schools, one of them Roman Catholic. Other buildings are the district council offices, a mechanics’ institute, and a fire- station. The industries comprise cotton mills, calico printing, engineering, soap, brick, and tile works. Area of urban district, 1059 acres ; population (1881), 6695 ;

(1901), 8153.

Clearfield, capital of Clearfield county, Pennsyl- vania, U.S.A., on the western branch of the Susquehanna river, and on the Pennsylvania, the Beech Creek, and the Buffalo, Eochester, and Pittsburg railways. Population

(1890), 2248; (1900), 6081.

Cleator Moor, a town in the Egremont parliar mentary division of Cumberland, England, 2^ miles north of Egremont by rail. There are public oflSces, a market hall, and a free library. The staple industry is the work- ing of coal mines and of iron-ore mines, in connexion with which there are four blast furnaces. Area of urban dis- trict, 2947 acres ; population (1881), 10,420 ; (1901), 8121.

Cleburne, capital town of Johnson county, Texas, U.S.A., 25 miles south of Fort Worth, at the intersection of two branches of the Gulf, Colorado, and Santa F^ Eailway. Population (1890), 3278 ; (1900), 7493.

Cleckheaton, a township and parish in the Spen Valley parliamentary division of the West Eiding of Yorkshire, England, 12 miles by rail south-west of Leeds. There are a town hall, a hospital for infectious diseases, a mechanics' institute, and a technical school. A chamber of commerce has held meetings here since 1878. The in- dustries comprise the manufacture of woollens, blankets, flannel, wire-card, and machinery. Area of urban district, 1755 acres; population (1881), 10,653; (1901), 12,523.

Clemenceau, Georges (1841), French

politician, was born at Mouilleron-en-Pareds, La Vendue, 28th September, 1841. Having adopted medicine as his profession, for which he had been educated at Nantes and Paris, he settled in 1869 in Montmartre ; and after the

revolution of 1870 he had become sufficiently well known to be nominated mayor of the 18th arrondissement of Paris (Montmartre) — an unruly district over which it was a difficult task to preside. In February 1871 he was elected as a Radical to the National Assembly for the department of the Seine, and voted against the peace preliminaries. The execution, or rather murder, of Gen- erals Lecomte and Clement Thomas by the communists on 18th March, which he vainly tried to prevent, brought him into collision with the Central Committee sitting

at the H5tel de Ville, and they ordered his arrest, but he escaped ; he was accused, however, by various witnesses, at the subsequent trial of the murderers (29th November) , of not having intervened when he might have done, and though he was cleared of this charge it led to a duel, for his share in which he was prosecuted and sentenced to a fine and a fortnight's imprisonment. Meanwhile, on 20th March 1871, he had introduced in the National Assembly at Versailles, on behalf of his Radical colleagues, the bill establishing a Paris Municipal Council of eighty members ; but he was not returned himself at the elections of 26th March. He tried with the other Paris mayors to mediate between Versailles and the Hotel de Ville, but failed, and accordingly resigned his mayoralty and his seat in the Assembly, and temporarily gave up politics ; but he was elected to the Paris Municipal Council on 23rd July 1871 for the Clignancourt qv/irtier, and retained his seat till 1876, passing through the offices of secretary and vice- president, and becoming president in 1875. In 1876 he stood again for the Chamber of Deputies, and was elected for the 18th arrondissement. He joined the Extreme Left, and his energy and mordant eloquence speedily made him the leader of the Radical section. In 1877, after the Seize Mai (see Fbance, History), he was one of the republican majority who denounced the Broglie ministry, and he took a leading part in resisting the anti-republican policy of which the Seize Mai incident was a symptom, his demand in 1879 for the indictment of the Broglie ministry bringing him into particular prominence. In 1880 he started his newspaper, La Justice, which became the principal organ of Parisian Radicalism; and from this time onwards throughout M. Gravy's presidency his reputation as a political critic, and as a destroyer of ministries who yet would not take office himself, rapidly grew. He was an active opponent of M. Jules Ferry's colonial policy and of the Opportiuiist party, and in 1885 it was his use of the Tongking disaster which prin- cipally determined the fall of the Ferry Cabinet. At the elections of 1885 he advocated a strong Radical pro- gramme, and was returned both for his old seat in Paris and for the Var, selecting the latter. Refusing to form or enter a ministry, he supported the Right in keeping M. Freycinet in power in 1886, and was responsible for the inclusion of General Boulanger in the Freycinet Cabinet as war minister. Boulanger, depending on the Radicals, and

supported by them, inaugurated his career by measures congenial to them, but when he began to assert himself and to take advantage of Grevy's unpopu- larity to pose as a Pretender, with the help of some of the Extreme Left and of the Royalists, Clemenceau withdrew his own support and became a vigorous combatant against the Boulangist movement, though the Radical press and a section of the party continued to patronize the general. By Ms exposure of the Wilson scandal, and by his personal plain-speaking, M. Clemenceau contributed largely to M. Grevy's resignation of the presidency in 1887, having him- self declined Grevy's request to form a Cabinet on the down- fall of that of M. Rouvier ; and he was primarily responsible, by advising his followers to vote neither for Floquet, Ferry, nor Freycinet, for the election of an " outsider " as presi- dent in M. Carnot. He had arrived, however, at the height

of his influence, and several factors now contributed to his decline. The split in the Kadical party over Boulangism ~~weakened his hands, and its collapse made his help unnecessary to the moderate republicans. A further misfortune occurred in the Panama affair, Clemenceau's relations with Cornelius Herz leading to his being involved in the general suspicion ; and, though he remained tjie leading spokesman of French Radicalism, his hostility to the Eussian alliance so increased his unpopularity that in the election for 1893 he was defeated for the Chamber after having sat in it continuously since 1876. After his defeat for the Chamber, M. Clemenceau confined his poli~~ tical activities to journalism, his career being further overclouded — so far as any possibility of regaining his old ascendancy was concerned — by the long-drawn- out Dreyfus case, in which he took an active and hon- ourable part as a supporter of M. Zola and an opponent of the anti-Semitic and Nationalist campaign. He was the founder of the newspaper L'Aurore, in which M. Zola published his famous open letter " J'accuse," and thus prepared the way for the revision of the first Dreyfus trial.

Clemens Romanus (see Ency. Brit., ninth ed., vol. ii. p. 196). Further knowledge requires a re- statement of the facts concerning the Epistle of Clement of Rome to the Corinthians. This epistle was occasioned by a dispute in the Church of Corinth, which had led to the ej ection of several presbyters from their ofiice. It does not contain Clement's name, but is addressed by " the Church of God which sojourneth in Eome to the Church of God which sojourneth in Corinth." But there is no reason for doubting the universal tradition which ascribes it to Clement, or the generally accepted date, c. a.d. 96. No claim is made by the Roman Church to interfere on any ground of superior rank ; yet it is noteworthy that in the earliest document outside the canon which we can securely date, the Church in the imperial city comes for- ward as a peacemaker to compose the troubles of a Church in Greece. Nothing is known of the cause of the discon- tent ; no moral offence is charged against the presbyters, and their dismissal is regarded by Clement as high-handed and unjustifiable, and as a revolt of the younger members of the community against the elder. After a laudatory account of the past conduct of the Corinthian Church, he enters upon a denunciation of vices and a praise of virtues, and illustrates his various topics by copious citations from the Old Testament scriptures. Thus he paves the way for his tardy rebuke of present disorders, which he re- serves until two-thirds of his epistle is completed. Clement is exceedingly discursive, and his letter reaches twice the length of the Epistle to the Hebrews. Many of his general exhortations are but very indirectly con- nected with the practical issue to which the epistle is directed. Indeed, his latest editor, Rudolf Knopf, is con- vinced that he was drawing largely upon the homiletical material with which he was accustomed to edify his Roman congregation. This view receives some support from the long liturgical prayer at the close, which almost certainly represents the intercession which he was wont to use in his Roman Eucharists. But we must not allow such a theory to blind us to the true wisdom with which the writer defers his censure. He knows that the roots of the quarrel lie in a wrong condition of the Church's life. His general exhortations, courteously expressed in the first personal plural, are directed towards a wide reformation of manners. If the wrong spirit can be exorcised, there is hope that the quarrel will end in a general desire for reconciliation. The most permanent interest of the epistle lies in the

conception of the grounds on which the Chris- tian ministry rests according to the view of a prominent

teacher before the first century has closed. The orderli- ness of Nature is appealed to as expressing the mind of its Creator. The orderliness of Old Testament worship bears a like witness ; everything is duly fixed by God ; high priests, priests and Levites, and the people in the people's place. Similarly in the Christian dispensation all is in order due. " The apostles preached the gospel to us from the Lord Jesus Christ ; Jesus Christ was sent from God. Christ then is from God, and the apostles from Christ. . . . They appointed their first-fruits, having tested them by the Spirit, as bishops and deacons of those who should believe. . . . Our apostles knew through our Lord Jesus Christ that there would be strife about the name of the bishop's ofiice. For this cause, therefore, having received perfect foreknowledge, they appointed the aforesaid, and afterwards gave a further injunction (eTrtvo/iiji/ has now the further evidence of the Latin legem) that, if these should fall asleep, other approved men should succeed to their ministry. .... It will be no small sin in us if we eject from the bishop's oflce those who have offered the gifts blamelessly and holily " (cc. xlii. xliv.).

The epistle was published in 1633 by Patrick Young from Cod. Alexandrinus, in which a leaf near the end was missing, so that the great prayer (cc. Iv.~~lxiv.) remained unknown. In 1876 (six years after Lightfoot's first edition) Bryennius published a com~~ plete text from the MS. in Constantinople (dated 1055), from which in 1883 he gave us the Didache. In 1876 Bensly found a complete Syriao text in a MS. recently obtained by the University Library at Cambridge. Lightfoot made use of these new materials in an Appendix (1877) ; his second addition, on which he had been at work at the time of his death, came out in 1890. This must remain the standard edition, notwithstanding Dom Morin's most interesting discovery of a Latin version (1894), which was prob- ably made in the 3rd century, and is a valuable addition to the authorities for the text. Its evidence is used in a small edition of the epistle by E. Knopf, Leipzig, 1899. (j. a. e.)

Clemens, Samuel Langhorne, better known

as Mark Twain (1835), the most widely popular

of American humorists, and a writer of striking vigour and directness, was born 30th November 1835, at Florida, Missouri. His father was a country merchant from Tennessee, who moved soon after his son's birth to Hannibal, Missouri, a little town on the Mississippi. When the boy was only twelve his father died, and there- after he had to get his education as best he could. Of actual schooling he had little. He learned how to set type, and as a journeyman printer he wandered widely, going even as far east as New York. At seventeen he went back to the Mississippi, determined to become a pilot on a river steamboat. In his lAfe on the Mississippi he has recorded graphically his experiences while " learning the river." But in 1861 the war broke out, and the pilot's occupation was gone. After a brief period of uncertainty the young man started west with his brother, who had just been appointed lieutenant-governor of Nevada. He went to the mines for a season, and there he began to write in the local newspapers, adopting the pen name of " Mark Twain." He drifted in time to San Francisco, and it was a newspaper of that city which in 1867 supplied the money for him to join a party going on a chartered steamer to the Mediterranean ports. The letters which he wrote during this voyage were gathered in 1869 into a volume, The Innocents Abroad, and the book immediately won a wide and enduring popularity. This popularity was of service to him when he appeared on the platform with a lecture — or rather with an apparently in- formal talk, rich in admirably-delivered anecdote. He edited a daily newspaper in Buffalo for a few months, and in 1870 he married Miss Olivia L. Langdon, removing a year later to Hartford, where he established his home. Roughing It was published in 1872, and in the year after he coUaboratedwith Charles Dudley Warner in Tlie Gilded Age

from which he made a play, acted many hundred times with John T. Raymond as ” Colonel Sellers.” In 1875 he published Tom Sawyer, the sequel to which, HucTdeherry Finn, did not appear until 1884. The result of a second visit to Europe was humorously recorded in A Tramp Abroad, published in 1882, in which year he also issued a more or less historical romance, The Prince and the Pauper; and a year later came Life on the Mississippi. Huckleberry Finn, the next of his books, was published (in 1884) by a firm in which the author was chief partner. This firm prospered for a while, and issued in 1889 Mark Twain’s own comic romance, A Connecticut Yankee at King Arthur’s Court, and in 1892 a less successful novel. The American Claimant. But after a severe struggle the publishing house failed, leaving the author charged with its very heavy debts. Since this disaster he has issued

ilTEL C’lEMENB.

f^From a photo hy Elliott and, Fry, London.)

a third Mississippi Valley novel, Pudd’nhead Wilso7i, in 1894, and in 1896 another historical romance, Joan of Arc, ■wherein the maid is treated with the utmost sympathy and reverence. He went on a tour round the world, partly to make money by lecturing and partly to get material for another book of travels, published in 1897, and called in America Following the Equator, and in England Afore Tramps Abroad. From time to time he had collected into volumes his scattered sketches ; of these the first, Tlie Jumping Frog, appeared in 1867, and the latest, The Man that Corrupted Hadleyburg, in 1900. To be recorded also is a volume of essays and literary criticisms. How to Tell a Story, printed in 1897. A complete edition of his works was published in twenty-two volumes in 1899-1900 by the American Publishing Company of Hartford. And in this last year, having paid off all his debts, he returned to America to be most cordially welcomed by his fellow-countrymen.

Mark Twain is commonly considered as a humorist, and no doubt he is a humorist of a remarkable comic force and of a refreshing fertility. But the books in which his humour is broadly displayed, the travels and the sketches,

are not really so significant of his power as the three novels of the Mississippi, Tom Sawyer, Huckleberry Finn,^ and Pudd'nhead Wilson, wherein we have preserved a vanished civilization, peopled with typical figures, and presented with inexorable veracity. There is no lack of humour in them, and there is never a hint of affectation in the writing; indeed, the author, doing spontaneously the work nearest to his hand, was very likely unconscious that he was making a contribution to history. But such Huckle- berry Finn is, beyond all question ; it is a story of very varied interest, now comic, now almost tragic, frequently poetic, unfailingly truthful, although not always sustained at its highest level. And in these three works of fiction there are not only humour and pathos, character and truth, there is also the largeness of outlook on life such as we find only in the works of the masters. Beneath his fun-making we can discern a man who is fundamentally serious, and whose ethical standards are ever lofty. Like Cervantes at times, Mark Twain reveals a depth of melancholy beneath his playful humour, and like Moliere always, he has a deep scorn and a burning detestation of all sorts of sham and pretence, a scorching hatred of humbug and hypocrisy. Like Cervantes and like Molifere, he is always sincere and direct. (b. m.)

Clermont-Ferrand, chief town of department Buy -de-Dome, 261 miles south of Paris by rail. It is the headquarters of the 13th army corps, and there are a commercial museum and a meteorological observatory. Amongst the principal manufactures are india-rubber goods and alimentary pastes ; textile industries are no longer important. It has mineral waters in repute locally. Population (1881), 32,266; (1896), 38,913; (comm.)

43,688; (1901), 52,933.

Clermont-Canneau, Charles Simon (1846-

), French orientalist, the son of a sculptor of some

repute, was born in Paris, 19th February 1846. After an education at the Ecole des Langues Orientales, he entered the diplomatic service as dragoman to the consul- ate at Jerusalem, and afterwards at

Constantinople. He laid the foundation of his reputation by his discovery (in 1870) of the ” stele ” of Mesha, which bears the oldest Semitic inscription known. In 1874 he was employed by the British Government to take charge of an archaeological expedition to Palestine, and was subsequently entrusted by his own Government with similar missions to Syria and the Bed Sea. He was made Chevalier of the Legion of Honour in 1875. After serving as vice-consul at Jaffa from 1880 to 1882, he returned to Paris as ” Secretaire- Interpr^te ” for oriental languages, and in 1886 was appointed consul of the first class. He subsequently accepted the post of director of the ficole des Langues Orientales and professor at the CoUfege de France. In 1889 he was elected a member of the Academic des Inscriptions et Belles Lettres, of which he had been a correspondent since 1880. His chief publications, besides a number of contributions to journals, are : — Palestine Inconnue (1886), Etudes d’ Archeologie Orientale (1880, &c.), Les Fraudes ArchMogiques (1885), Recueil d’ArcMologie Orientale (1885, &c.). Album d’Antiquitis Orientales (1897, &c.). He was principally instrumental in exposing the famous Shapira forgeries of Hebrew texts.

Cleveland, the seventh largest city in the United States, and the largest of the state of Ohio, situated at the mouth of the Cuyahoga river, on the southern shore of Lake Erie, in lat. 41° 30′ N. and long. 81° 47′ W. Divided unequally by the river, it stretches along the shore for 10 miles, with a maximum depth of 6 miles. It is connected by steamship lines with all the lake ports

from Duluth to Buffalo, Toronto, Ogdensburgh, and with those along the St Lawrence. It lies on or near all the trunk lines from New York to Chicago. The Lake Shore and Michigan Southern, the New York, Chicago, and St Louis (Nickel Plate) Railways pass through ; the Erie, Pennsylvania, Baltimore, and Ohio have terminal facilities; while the Cleveland, Columbus, Cincinnati, and St Louis (Big Four), and several Ohio lines start from the city. The Ohio Canal, which gave Cleveland

its original prosperity, is little used, and in 1879 its ter- minal facilities were granted to the Valley, now the Bal- timore and Ohio Eailway. Seven suburban electric railways, from 20 to 40 miles long, radiate from the Public Square, and carry package freight as well as pas- sengers. There are 160 miles of streets, paved chiefly with Medina dressed stone. The improved public dock frontage on the river and lake amounts to 2500 feet, the unimproved to 3000 feet. Since 1879 the national Gov- ernment has been building and improving a breakwater to create a harbour of refuge, which already affords a protected shore- line of over 2 miles. The widening of the river mouth from a minimum of 165 feet to a uniform width of 325 feet, and the widening and straightening of the lower course of the river, are also far advanced. These improvements were vital to the city, which is the greatest ore market in the world. At its own docks, not to mention the harbours within the customs district, the business of which is nearly all done in the city, were re- ceived in 1890, 1,945,432 tons of Lake Superior iron ore, and in 1900, 3,823,314 tons. The total tonnage in 1890 was 4,668,040; in 1900, 7,488,396. As a manufacturing town Cleveland owes its greatness to the facility with which iron can be brought from the Lake Superior dis- trict by water-route, and coal by rail from the Ohio and Pennsylvania mines. The capital invested in national banks in 1890 was f 7,550,000; in 1900, $10,966,000. The deposits were for these years $15,037,606 and $48,780,227. For the same years capital in savings banks was $2,469,460 and $7,725,000; the deposits, $36,914,354 and $96,328,461. Of these deposits $34,632,732 were in one institution, the Society for Savings. The population in 1890 was 261,353. In 1900 it was 381,768, of whom 124,631 were foreign-born and 6988 were negroes. The death-rate in 1890 was 20-2 ; in 1900 it was 17-1. The water-supply from the old tunnel into the lake became unsatisfactory, and a new tunnel 26,000 feet in length was projected, of which 16,000 feet were completed in 1900. The school system was reorganized in 1892 by a law which placed the management of school affairs in the Tiands of a director and an elective council of seven mem- bers. The director was given power to appoint a super- intendent of instruction, who was to receive authority to name the whole teaching force. Besides large private schools, among which is the University School for boys, with an eight years' course, emphasizing manual training and the supervision

of athletic exercises, there are the Western Eeserve University, with its medical school (opened 1843), the School of Law (1892), the Dental College (1893), the Adelbert College (until 1882 the Western Eeserve College (1826) at Hudson, Ohio), the College for Women (1888) ; the Case School of Applied Sciences, the Cleveland College of Physicians (a part of Ohio Wesley an University, Delaware, Ohio), and the Cleveland Homoeo- pathic Medical College. There are 15 hospitals, includ- ing the United States Marine Hospital. The Public Library, the Case Library, the University Library, and the Western Eeserve Historical Society possess about 300,000 volumes. There are over 245 churches, and the leading sects are the Eoman Catholics with 39 churches, the Methodists with 24, the Baptists with 24, and the Congregationalists with 24. By the Municipal Eef orm

Bill, 16th March 1891, a new city charter embodying the federal plan was granted. The mayor appoints as his cabinet six directors — law, public works, police, fire, accounts, and charities and corrections. In order that responsibility might be fixed these directors were to appoint their subordinates. At first the system worked well, but in course of time interested officials, to serve their own ends, constructed a dangerous ” machine,” the ramifications of which reached into the council, the courts, and the state legislature. At length the inde- pendent voters organized a revolt, and overthrew the ” boss ” in the April elections of 1899. The total valua tion of property in the city in 1880 was $73,647,194 ; in 1890, $99,614,055; in 1900, $142,768,280. The tax-rate for all purposes, city, county (Cuyahoga), and state, was in 1890, $29.30, and in 1900, $30.00. The total indebt- edness in 1890 was $8,330,035, and in 1900, $14,121,530. The park system includes 22 parks and drives, with an extent of 1326-19 acres. There are 27-94 miles of roads. Since much of the land was presented to the city the money expended ($3,032,944 from 1st January 1894 to 1st January 1900) on the system has largely gone for improvements. In recent history the most notable events were the elaborate celebration of the centennial of the city in 1896 and the street railway strike of 1899,. in which the workers attempted to force a redress of grievances and’ a recognition of their union. Mobs at- tacked the cars, and cars were blown up by dynamite. The strikers were beaten, but certain abuses were cor- rected.

Charles Whittlesey. Early History of Cleveland, 1867. — J. H. Kennedy. History of the City of Cleveland, 1896.

(h. e. b.)

Cleveland, C rover (1837), President of the

United States from 1885 to 1889, and again from 1893 to 1897, was born in the village of Caldwell, New Jersey, 18th March 1837. His father was a clergyman of the Presbyterian Church. The Clevelands were of good colonial stock, descendants of Moses Cleveland who emi- grated from Ipswich, England, in 1635. Grover was the fifth in a family of nine children. They removed to Fayetteville, and afterwards to Clinton, New York. It was intended that Grover should be educated at Hamil- ton College, but this was prevented by his father's death in 1852. A few years later he drifted westward with twenty-five dollars in his pocket. The autumn of 1855 found him in a law office in the city of Buffalo, where he was privileged to use the books in the library and pick up knowledge by observing what was going on around him. This was the customary way at that time for a young man to equip himself for the legal profession. At the end of four years he passed the required examination for admission to the bar. During these years he had made a place for himself by force of character in the office where he had studied. Industry, intellectual in- tegrity, and calm courage were then, as in after life, his marked traits. It cost him no effort to stand firmly by any principle which he deemed right or to defend any opinion which he had espoused. In 1863 he was ap- pointed assistant district attorney, or public prosecutor, of Erie county, of which Buffalo is the chief city. This was his first public office, and it came to him, like all later preferments, without any solicitation of his own. He was a member of the Democratic party, and Erie county was usually Eepublican by a decisive majority. In 1869 Mr Cleveland was named by his party for the office of sheriff and was elected. In 1881 he was elected mayor of Buffalo, and in the following year governor of New York, receiving a majority of nearly 200,000 votes. As governor Mr Cleveland's course was marked by the sterling qualities that he had displayedjn his other public

positions. His appointees were chosen for their business qualifications. The demands of party leaders were made subordinate to public interests. He promoted the passage of a good civil service law. All bills passed by the legislature were subjected to the governor's laborious personal scrutiny, and the veto power was used without fear or favour.

The Democratic party had been out of power in national affairs more than twenty years. In the interval a great civil war had been fought, slavery had been abolished, and the Union reconstructed. New subjects of national concern had begun to awaken attention. Serious abuses had crept into the civil service, and some scandals of considerable magnitude had been exposed from time to time, pointing to the necessity of radical measures of reform. While the public mind was in a sensitive state on this subject (1884), the Eepublican party nominated

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Gkover Cleveland. (From a photograph by B. J. Fatk, IValdorf-Astoria, N. Y.)

James G. Blaine for president, and the Democrats nominated Mr Cleveland. The latter was elected, gaining the vote of the state of New York by a plurality of 1047 in a total of 1,171,26.3. He took the oath of office and delivered the usual address 4th March 1885. He had never been in Washington City in a public capacity before. He had been

known to the country at large only two years. He was a stranger to most of the men who stood around him at the ceremony of inauguration. Yet it was noticed that he entered upon his new duties with the same equipoise that he had shown in the humbler stations he had filled. When his brief inaugural address was finished, the older statesmen present felt that no apologies were needed for his being there, and that the executive branch of the Government was in safe hands.

Mr Cleveland's first term of four years was uneventful, but was marked by firmness, justice, and steady adherence on his part to the princij^les which he deemed salutary to the nation. He was especially concerned in promoting a non-partisan civil service. Congress had passed a law in

1883 to classify the subordinate places in the service, and to make entrance to it, and promotion therein, depend upon competitive examination of applicants, instead of mere political influence. The first test of the efficiency and permanence of this law came with the shifting of political power at Washington. The new president stood firmly by the new law. It applied only to places of the rank of clerkships, but the president was authorized to add others to the classified service from time to time. He added 11,757 during his first term.

President Cleveland made large use of the veto power upon bills passed by Congress. The most important one vetoed was the Dependent Pension Bill, a measure of ex- treme profligacy opening tjie door, by the vagueness of its terms, to enormous frauds upon the Treasury. In 1887 there was a large and growing surplus in the Treasury. As this money was drawn from the channels of business and locked up in the public vaults, the president looked upon the condition as fraught with danger to the commercial community, and he addressed himself to the task of reducing taxation. About two- thirds of the public revenue was derived from duties on imports, in the adjustment of which the doctrine of protection to native industry had a large place. Mr Cleveland attacked the system with great vigour in his annual message of 1887. He did not propose the adoption of free trade. Yet he alarmed and exasperated the

protected classes, among whom were many Democrats, and spurred them to extraordinary efforts to prevent his re-election.

In the following year (1888) the Democrats re- nominated Mr Cleveland, and the Republicans nominated Benjamin Harrison of Indiana. The latter received a majority of the electoral votes and accordingly became president. Mr Cleveland retired to private life and resumed the practice of the legal profession in the city of New York. He had married, 2nd June 1886, Miss Frances Folsom, a daughter of a former law partner in Buffalo.

Congress had passed a law in 1878 requiring the Treasury department to purchase a certain amount of silver bullion each month and coin it into silver dollars to be full legal tender. As no time had been fixed for this operation to cease, it amounted to an unlimited increase of a kind of currency that circulated at a nominal value much above its real value. Both political parties were committed to this policy, and strong passions were aroused whenever it was called in question. Mr Cleveland had written a letter for publication before he became president, saying that a financial crisis of great severity must result if this coinage were continued, and expressing the hope that Congress would speedily put an end to it. In 1890 Congress, which was now controlled by the Eepublican party, passed the McKinley Tariff Act, which repealed the duties on sugar, from which about f 60,000,000 of revenue was derived. Simultaneously it passed a new Pension Bill that added $50,000,000 to the public disbursements. Another measure was enacted which nearly doubled the Government's purchases of silver, to be added to the already vitiated currency. Steps had thus been taken which would change an annual surplus of .$100,000,000 into a deficit of $70,000,000 as soon as the new laws should take full effect.

In 1892 Mr Cleveland was nominated for president a third time in succession. The only other man in the nation's history thus distinguished was General Jackson. Mr Cleveland was nominated against the unanimous vote and protest of the delegates in the Democratic National Convention from his own state. New York. This

was something quite unprecedented. Mr Harrison ‘was the opposing candidate. Mr Cleveland received 277 electoral

votes and Mr Harrison 145. Mr Cleveland’s second term embraced some notable events. The most important was the repeal of the silver legislation, which had been a growing menace for fifteen years. Nearly $600,000,000 of “fiat money” (currency circulating on the faith of the Government) had been thrust into the channels of commerce in addition to $346,000,000 of legal tender notes that had been issued during the civil war. A reserve of $100,000,000 of gold had been accumulated for the redemption of these notes. In April 1893 the reserve fell below this sum. A panic ensued. President Cleve- land called an extra session of Congress to repeal the silver law. The House promptly passed the repealing act. In the Senate there was a protracted struggle. The Democrats now had a majority of that body and they were more decidedly pro-silver than the Eepublicans. The president had undertaken to coerce his own party to do something against its will. This was perhaps his greatest public service. The repealing bill passed the Senate 30th October. The mischief, however, was not ended. The deficit in the Treasury made it inevitable that the gold reserve should be used to meet current expenses. Holders of the Government’s legal tender notes anticipating this fact presented them for redemp- tion. Borrowing was resorted to by the Government. Bonds were issued and sold to the amount of $162,000,- 000. The business world was in a state of constant agitation. Bank failures were numerous and commercial distress widespread. The Republican party, which had laid the train for this disaster, escaped unhurt, because the final explosion took place during a Democratic ad- ministration. The underlying causes were too involved and intricate for popular understanding. Among the consequences of the panic was a reduction of wages in many employments, accompanied by labour troubles more or less serious. The centre of disturbance was at Chicago where one Debs, a labour agitator, undertook to compel the Pullman Palace Car Company to

raise the wages of its workmen, by boycotting its cars. Twenty- three railways were disabled at one time by the refusal of their employees to operate trains containing Pullman cars, or allow others to do so. The disorder extended to the Pacific coast, causing riot and bloodshed in several places. President Cleveland waited a reasonable time, as he conceived, for the governor of Illinois to put an end to the disorder in that state. On 6th July 1894 he directed the military forces of the United States to clear the way for trains carrying the mails. The rioters in and around Chicago were dispersed in a single day, and within a week the boycott was everywhere broken. No act of his career gave Mr Cleveland more eclat than the suppression of the Debs riots.

On 17th December 1895 President Cleveland astounded the country and the civilized world by sending a special message to Congress virtually recommending war against Great Britain unless she should accept his views respect- ing an undetermined boundary line between Venezuela and British Guiana. Mr Cleveland's foreign policy hitherto had been marked by prudence, conservatism, and a scrupulous regard for the rights of other peoples. He had put a strong curb on Cuban filibustering. He had withdrawn a treaty negotiated by his predecessor to annex Hawaii, because, as he said, its lawful government had been overthrown by the diplomatic and naval representa- tives of the United States. In short, he had won almost unbounded confidence, and now when his voice was for war he carried the country with him as no other man could have done. Yet a large body of sober-minded people throughout the country, who had been Mr Cleve- land's firm supporters and his chief reliance m all pre- vious emergencies, were now detached from him, more in

sorrow than in anger. In the money market the Vene- zuela message came as " a bolt from the blue." A panic of great severity ensued, a run on the Treasury began, and the president was compelled to make a fresh loan, in time of peace, of $100,000,000. On 12th November 1896 an agreement was made for arbitration of the Vene- zuelan controversy, in which the contention of Great Britain was safeguarded by a clause that adverse holding during a period of fifty years should make a good title. It has been said that Mr Cleveland was vindicated by

the result, but this view overlooks two facts of importance, viz., that war was avoided only by the calmness of the British ministry and the British public; and that Mr Cleveland gave the greatest spur and impetus to the war spirit among his countrymen that the present generation has known. On 8th January 1897 Mr Cleveland trans- mitted to the Senate a treaty for the arbitration of all future differences between the United States and Great Britain, earnestly recommending its approval. The Senate did not ratify this treaty, but its aims have been partially accomplished on a larger scale by the agree- ments of the Hague Conference.

During his second term Mr Cleveland added 44,004 places in the civil service to the classified list, bringing them within the rules of the merit system. This was a greater number than all that had been placed in the list before, and brought the whole number up to 86,932.

Mr Cleveland's second term expired 4th March 1897, and he then retired into private life in the university town of Princeton, New Jersey. (h. wh.*)

Cleves, in German Kleve, a town and watering-place of Prussia, in the Rhine province, between the Rhine and the frontier of Holland, 40 miles by rail north-north-west from Crefeld. It has a monument to the legendary Knights of the Swan (1882) ; a collection of antiquities, preserved in the town hall ; and an agricultural school ; also, manufactures of cheese, tobacco, agricultural imple- ments, &c. Population (1885), 10,170 ; (1895), 10,986 ;

(1900), 14,678.

Clichy, or Clichyla Gaeenne, a town of France, department of Seine, in the arrondissement of St Denis, and immediately north of the outer circle of Paris, of which it is a suburb. Its manufactures include oil and starch. It was a residence of the Merovingian kings, and was then known as Clippiacum. Population (1881),

24,223 ; (1891), 30,561 ; (1901), 39,621.

Clifford, William Kingdon (1845-1879), Eng- lish mathematician and philosopher, was born 4th May 1845 at Exeter, where his father was a prominent citizen. He was educated at a private school in his native town, at King's College, London, and at Trinity College, Cambridge, where he was elected fellow in 1868, after being second wrangler in 1867 and second Smith's prizeman. In 1871 he was appointed professor of mathematics at University College, London, and in 1874 became fellow of the Royal Society. In 1875 he married Lucy, daughter of John Lane of Barbadoes, a lady who has since won distinction as a novelist. In 1876 Clifford, a man of high-strung and athletic, but not robust, physique, began to fall into ill- health, and after two voyages to the South died during the third of pulmonary consumption, at Madeira, 3rd March 1879. His works, published wholly or in part since his death, are Elements of Dynamic (1879-87), Seeing and Thinking, popular science lectures (1879), Lectures and Essays, with an introduction by Sir F. Pollock (1879), Mathematical Papers, with an introduction by Henry J. S. Smith (1882), and The Common Sense of the Exact Sciences, completed by Professor Karl Pearson (1885). Owing to his early death, Clifford's abilities and achievements cannot be fairly iudged without reference to the opinion formed of

Hm by his contemporaries. He impressed every one as a man of extraordinary acuteness and originality ; and these solid gifts were set off to the highest advantage by quickness of thought and speech, a lucid style, wit and poetic fancy, and a social warmth which made him delightful as a friend and companion. His powers as a mathematician were of the highest order. It harmonizes with the concrete visualizing turn of his mind that, to quote Professor Henry Smith, "Clifford was above all and before all a geometer." In this he was an innovator against the excessively analytic tendency of Cambridge mathematicians. Among his best papers are those " On the Theory of Distances " and " On the Classification of Loci." In his theory of

graphs, or geometrical representa- tions of algebraic formulae, there are valuable suggestions which have been worked out by others. He was much interested too in those curious investigations into imagin- ary kinds of space by Gauss, Riemann, and Lobatschewsky, which suggest thoughts upon the ultimate nature and source of mathematical truth. As a philosopher Clifford's name is chiefly associated with two phrases of his coining, " mind-stuff " and the " tribal self." The former symbol- izes his metaphysical conception, which was suggested to him by his reading of Spinoza. " Briefly put," ^ys Sir F. Pollock, " the conception is that mind is the one ulti- mate reality ; not mind as we know it ia the complex forms of conscious feeling and thought, but the simpler elements out of which thought and feeling are built up. The hypo- thetical ultimate element of mind, or atom of mind-stuff, precisely corresponds to the hypothetical atom of matter, being the ultimate fact of which the material atom is the phenomenon. Matter and the sensible universe are the relations between particular organisms, that is, mind organized into consciousness, and the rest of the world. This leads to results which would in a loose and popular sense be called materialist. But the theory must, as a metaphysical theory, be reckoned on the idealist side. To speak technically, it is an idealist monism." The other phrase, " tribal self," gives the key to Clifford's ethical view, which explains conscience and the moral law by the development in each individual of a " self," which pre- scribes the conduct conducive to the welfare of the " tribe." Much of Clifford's contemporary prominence was due to his attitude towards religion. Animated by an intense love of truth and devotion to public duty, he waged war on such ecclesiastical systems as seemed to him to favour obscurantism, and to put the claims of sect above those of human society. The alarm was greater, as theology was still unreconciled with the Darwinian theory ; and Clifford was regarded as a dangerous champion of the anti-spiritual tendencies then imputed to modern science. (h. st.)

Clifton. See Bristol.

Clinton, capital of Clinton county, Iowa, U.S.A., situated in 41° 51′ K. lat. and 90° 11′ W. long., on the west bank of the Mississippi river, at an altitude of 589 feet. It is entered by four great railway systems, the

Burlington, Cedar Eapids, and Northern, the Chicago, Burlington, and Quincy, the Chicago and North- Western, and the Chicago, Milwaukee, and St Paul railways, and it is in the main a commercial city. The Mississippi is here crossed by a fine iron bridge. Some 4000 feet in length. Clinton is the site of Wartburg College, a Lutheran insti- tution. Population (1880), 9052 ; (1890), 13,619. By the addition of the city of Lyons in 1895 the population was increased to 23,377, and in 1900 it was 22,698.

Clinton, capital of Henry county, Missouri, U.S.A., situated in 38° 23′ N. lat. and 93° 46′ W. long., in the western part of the state, at an altitude of 800 feet. It has three railways, the Missouri, Kansas, and Texas, the

Kansas City, Fort Scott, and Memphis, and the Kansas City, Osceola, and Southern. Population (1880), 2868;

(1890), 4737; (1900), 5061.

Clinton, a town of Worcester county, Massachusetts, U.S.A., situated near the centre of the state, on branches of the Boston and Maine, and the New York, New Haven, and Hartford railways, at an altitude of 308 feet. It is small in area, containing but 7 square miles of hilly surface. The village of Clinton is on Nashua river, and has extensive manufactures of cotton and woollen goods, wire-cloth, and iron and steel. Population (1880), 8029; (1900), 13,667.

Clitheroe, a municipal borough and market town in the Clitheroe parliamentary division (since 1885) of Lancashire, England, on the Eibble, 20 miles south-west of Burnley by rail and 12 miles by road. A public hall has been erected, and in 1895 Clitheroe Castle, formerly extra- parochial, became part of Clitheroe borough. Area, 2381 acres; population (1881), 10,177 ; (1901), 11,414.

Clonmel, an inland town, ia the province of Munster, Ireland, oi; the river Suir, 104 miles south-west of Dublin, on the Waterford, Limerick, and Western rail- way. It ceased to be a parliamentary borough in 1885, and in 1898 the portion situated in Waterford was added to

Tipperary. By the Local Government Act, 1898, the borough retains its mayor and corporation, which, how- ever, has now practically the status of an urban district council. It is an agricultural centre, and there are frequent fairs. Population (1881), 9325 ; (1891), 8480 ; (1901), 10,163. The area of the borough was recently extended and now comprises 1301 acres.

Closure. See Parliament.

Clovelly, a fishing village of Devonshire, England, which climbs up the sides of a rocky cleft of the steep (400 feet) south coast of Barnstaple Bay, 11 miles west from Bideford. Its quaintness and the charm of its sur- roundings make it a favourite excursion from Ilfracombe. Dickens describes the place in A Message from the Sea. Population (1901), 621.

Clyde, The, a river and firth of Scotland. The river rises as the Daer water in the parish of Crawford, Lanark- shire, 1600 feet above sea-level. Its length from that point to Dumbarton, where the fir\;h may be taken to begin, is 106 mUes, and the drainage area is estimated at 1481 square miles. At Lanark (61 miles) it is broken by four falls, which occur within a distance of 3f miles, the river descending in that space 230. feet, or about 61 feet in. the mile. Thence to the sea the fall is about 4 feet and ^ inch in the mile. The firth measures about 64 miles from Dumbarton to Ailsa Craig, an island lying between Girvan on the Ayrshire coast and the Mull of Kintyre in Argyll- shire, and its breadth varies from a mile at Dumbarton to 37 miles on a line drawn through Ailsa Craig. In depth it varies from a minimum of 22 feet (in the navigable channel) at Dumbarton to 99 fathoms between Ardlamont and Kintyre. The tide ascends above Glasgow, to which its rise is to be limited by the construction of a weir, replacing an older one which was destroyed in 1884. Head ports are Glasgow, Port-Glasgow, Greenock, Ardrossan, Irvine, Troon, Ayr, and Campbeltown.

Clydebank, a police burgh of Dumbartonshire, Scotland, on the right bank of the Clyde, 6f miles from Glasgow by road. There are eight stations. Shipbuilding works were planted in 1875 in a purely rural district, and were followed by a large sewing-machine factory. In 1886 the villages of Dalmuir and Yoker and Kilbowie were formed into a

burgh, and the municipality is one of the most enterprising in Scotland. The works and factory each

employ about 7000 hands. There are various other works, including the building and repairing yards of the Clyde Navigation Trust. Municipal buildings, including baths, are being erected at a cost of £40,000. Population (1891), 9998 ; (1901), 18,654. ^

Coahuila, a state of Mexico, bounded on the N. by the United States, on the E. by the state of Nuevo Le6n, on the S. by those of San Luis Potosi and Zacatecas, on the W. and S.W. by Durango, and on the N.W. and W. by Sonora, has an area of 62,376 square miles. In 1879 the population was 130,026, and in 1895 it was 241,026. The flora comprises over sixty varieties of trees of the cold and temperate zones, and fifty belonging to the hot lands. Agriculture is the principal industry, cotton, maize, wheat, beans, sugar-cane, linseed, and about thirty species of leguminous plants being the chief pro- ducts. Cattle-raising is also extensively followed. The mines are being rapidly developed, especially in the Sierra Mojada, Sierra del Carmen, and in the valley of Santa Eosa. The state, which is divided into five districts and thirty-three municipalities, is one of the most prosperous commercial regions of the Eepublic, due principally to its excellent railway system. The capital, Saltillo (popu- lation, 26,801), is 615 miles from Mexico City by rail. It has good public buildings, a State college, public library, &c., and is noted for its manufacture of shawls (sarapes), cotton cloth, knit goods, and flour. Amongst other towns are Parras (8326), Monclova, Ciudad Porfirio Diaz, Viesca, Matamoros.

Coal. — During the period that has elapsed since the publication of the article contained in the ninth edition of this Encyclopaedia, the development in the methods of winning and working coal has been very considerable, especially in the direction of increasing the output from individual centres of production concurrently with a general diminution in the length of the working day. This has been attended, at

any rate in the older coal-fields, with a rapid increase in the depth of workings and greatly increased cost and dif&culty in opening new mines, with the result that the comparatively rough methods and appliances of earlier times have given way to more economical methods of working underground, and machinery of more refined construction. The main winding engines, especially, are now constructed upon the most improved types, in order to save fuel in working. Similar improvements have been introduced in the methods of underground haulage, and horses on under- ground lines have been largely replaced by mechanical traction, the substitution of electric for steam driven motors, and the use of electric locomotives being specially noticeable. In the main operation of getting or removing the coal,machine-cuttinghas to some extent taken theplace of hand labour, although the progress in this direction has been/ more marked in America than in Europe, and even there the proportion of the output obtained with the use of such mechanical aids is only small when compared with that due to hand labour. This, however, is rapidly chang- ing, owing to the increased flexibility in working of electric motors, which will in the near future probably take the first place in this as in other branches of coal- mining. To enter, however, into the details of these and other changes would involve discussion of mechanical and other technical matters beyond the scope of the present work, which is to be regarded as supplementary to the article in the ninth edition, the additional matter being noticed somewhat in the same order as that pre- viously adopted. . .

During the past few years the question of the origin and mode of formation of coal has received considerable attention from geologists, but it cannot be said that any

authoritative new solution of the problem has been propounded. Speaking generally, the tendency is towards a modification of the view of which Logan, De q^^. ^ la Beche, Dawson, and Newberry may be taken comimsf-” as the principal exponents, that coal seams are ’”” »’ essentially the remains of forests upon the sites “^^ of their original growth, a detrital origin being supposed for a part, if not the whole, of the carbonaceous material, which may have been derived from

adjacent higher- lying land by the action of river currents. This view, known as the delta hypothesis, has found considerable favour in France, especially from study of the coal-field of Saint fitienne, where the seams vary very irregularly in thickness and character, in a way which seems to be incompatible with the hypothesis of a tranquil accumu- lation in situ. As regards the changes involved in the actual transformation of plant structures into lignite and coal, one of the most important series of researches is due to M. B. Renault {Bulletin de la Soci6ti de V Industrie Minirale, 3 Ser., vol. xiii. p. 866), who, starting from the study of peat, finds that the chief agents in the trans- formation of cellulose into peaty substances are sapro- phytic fungi and bacterial ferments. As the former are only active in the presence of air, while the latter are ‘ anaerobic, the greater or less activity of either agent is conditioned by variation in the water-level of the bog. The destructive agency of bacteria spems to be limited by the production of ulmic acid of the composition, carbon 65-31, hydrogen 3-85 per cent., which is a powerful antiseptic. By the progressive elimination of oxygen and hydrogen, partly as water and partly as carbon dioxide and marsh gas, the ratio of carbon to oxygen and hydrogen in the residual product increases in the following manner : —

Cellulose Peat

Lignite, imperfect ,, perfect

C:H.

C:0

7-2

0-9

9-8

1-8

12-2

2-4

12-6

3-6

The constituents of lignite are generally similar to those of peat, with the addition of someanimal(infusorial)remains, the degraded vegetable tissues forming a paste originally plastic, which has converted the more resisting parts of the plants into a compact mass. Erom the figures given above it will be seen that oxygen is less rapidly eliminated than hydrogen, the change to lignite being similar to that obtaining in the case of peat, but further advanced.

Bituminous shale and Boghead or Torbane Hill coal are considered by Renault to be mainly alteration- products of masses of gelatinous fresh-water algae, which by an almost complete elimination of oxygen have been transformed into substances approximating to the formulae C2H3 and C3H5, where C : H = 7-98 and C : 0 ¦]Sr= 46-3. In cannel coals the prevailing vegetable constituents are spores of cryptogamic plants, algae being rare and in many cases absent. The detection of bacilli in coal is a difficult matter, owing to its opacity; but by making very thin sections and employing high magnification, 1000 to 1200 diameters, Renault has been enabled to detect numerous forms in the woody parts included in coal. One of these, named Micrococcus carbo, in many respects resembles the living Cladothryx found in the wood of trees buried in peat-bogs in process of formation. Clearer evidence has been obtained from wood partially mineralized by silica or carbonate of lime included in the coal.

The transformation of woody fibre into coal is attended with considerable contraction, which may be from tt to 44 of the original volume, but this is unequally distributed ; it is mainly in the direction of the thickness, so that minute objects seen on the flat may keep nearly their

original dimensions. The evidence for this is to be seen in the large number of microphotographs in the memoir just referred to, which represents the result of twenty-one years' work. Approximately the change of wood into coal, and the proportion of the valuable product elimi- nated, may be represented as follows : —

4(CeHio05) = C9HeO-f7CH,~~f8COj~~|-3HA Cellulose. Coal. Methane. Carbon Water.

dioxide.

The solid product CaHgO corresponds to an average bituminous coal of the composition, carbon 83-1, hydrogen 4-6, oxygen 12-3 per cent., and represents about 20 per cent, of the original weight of cellulose and 45 per cent, of its heating power. Another aid to the study of the structure of coal has been found by H. M. Couriot {Annates de la Sociite Qiologique de Belgigue, vol. xxiii. p. 105) in Eontgen photography, the carbonaceous or combustible portion being readily permeable by X-rays, while the mineral matter is comparatively opaque. In this way photographs showing the arrangement of the ash in parallel thin bands may be obtained from a piece of coal about an inch thick when exposed perpendicularly to the planes of bedding; included masses of iron pyrites appear as dark spots. The suggestion has also been made to use this agent as a means of determining the proportion of incombustible matter in coal, the sample being ground to powder and enclosed in a wooden box of a long, tapered wedge form, with a fluorescent screen along one side, which becomes sensitive to the rays pass- ing through a greater or less thickness of the coal wedge in proportion to its freedom from mineral matter. According to Kotte (Stahl u. Eisen, vol. xx. p. 392), however, this method is unreliable for quantitative purposes, since for equal contents of ash the permeability varies with the nature of the mineral matter, a small proportion of iron being more effective in increasing the opacity than much larger amounts of the ordinary ash constituents, silica, alumina, &c. Thus for equal total amounts of ash, that containing the least amount of iron, 0-

07 per cent., gave the clearest photograph, and that with 5-4 per cent, the worst.

The existence of coal-fields below the secondary strata in the south-east of England, along the line joining the Develop- South Wales and Westphalian basins, as in- ment of fcrrcd by the late Mr Goodwin Austen, has of ”’^’” late years been verified by the discovery of car-

- ***■ boniferous strata with workable coal seams below the chalk and other secondary formations in the vicinity of Dover, where in 1890 a borehole reached coal at a depth of 1180 feet from the surface, and in a further depth of 1042 feet several seams were subsequently proved of various thicknesses up to 4 feet. In another boring at Eopersole, between Dover and Canterbury, 1774 feet deep, the last 197 feet are in carboniferous strata with two coal seams. In the Dover sinking a bed of oolitic brown iron ore, resembling that of Cleveland and Luxem- burg, has been discovered at a depth of 600 feet. Most extensive developments have also been made on the eastern side of the great Midland coal-field, and numerous pits have been sunk through the magnesian limestone and other overlying strata along the whole length of the basin, from Yorkshire to Nottinghamshire. At South Carr, near Gainsborough, in Lincolnshire, the regular succession of the seams in the coal-field has been proved under 1700 feet of New Red Sandstone rocks down to the Barnsley hard coal at 3186 feet, the greatest depth at which coal has as yet been proved in the United King- dom. It has been suggested that the coal brought up by the trawlers on the fishing bank known as the Coal Pit in the North Sea, 65 miles east of the mouth of the Humber,**

may be derived from the eastern outcrop of the seams in this basin, which, if this be the case, would be the largest coal-field in Europe.

In the Rhenish Westphalian coal basin, the most important one in Continental Europe, great activity pre- vails both in exploration and opening of new mines. This is in many respects similar in structure to that of South Wales, a large number of seams, none very thick, being distributed through a great thickness of strata. These axe folded

transversely into three principal troughs whose axes have a general north-westerly strike, but with the important difference that the carboniferous strata are .exposed for only a short distance along the southern margin, the greater part being covered by secondary and tertiary rocks, which increase in thickness rapidly to the north. The newer sinkings have therefore to pass through constantly increasing depths of water-bearing measures, with the result that special methods of over- coming such difilculties have been brought to a high degree of perfection in this region. According to Schultz {Mittheilungen iiber den Mederrheinisch – Westfalischen Steinkohlen-Bergbau, 1901, p. 28) the proved area in 1900 was 1157 square miles, estimated to contain in workable seams: —

Tons. Down to 700 metres (2300 feet) . . . 11,000,000,000 700 to 1000 metres (3280 feet) . . . 18,300,000,000 1000 to 1500 metres (4920 feet) . . . 25,000,000,000

Total within maximum working depth . . 54,300,000,000 At greater depths 75,000,000,000

The development of the coal-fields of the newer mining regions can be best appreciated by the statistical table compiled by Mr B. H. Brough in the Journal of the Iron and Steel Institute : —

1899

1900

Europe —

United Kingdom 1900

Germany, coal . ‘ . . . • „

„ lignite „

France

Belgium

Austria, coal

„ lignite ....

Hungary, coal ....

„ lignite ....

Spain

Bussia „

Holland 1899

Bosnia, lignite „

Bumania, „ „

Servia, „ 1896

Italy, 1899

Sweden, „ „

Asia —

India „

Japan 1898

Borneo 1899

Africa —

Transvaal 1898

Natal 1899

Cape Colony „

America —

United States 1900

Canada 1899

Mexico „

Peru 1898

Australasia —

New South Wales 1900

Queensland 1899

Victoria „

Western Australia . . . . „

Tasmania „

New Zealand … ■ „

Tons.

225,170,360

109,271,726

40,279,332

33,270,385

22,072,068

11,455,139

21,751,794

1,238,855

4,292,584

2,680,193

13,104,000

212,973

303,425

78,000

11,726

388,534

239,344

4,937,000

6,598,033

35,676

1,938,424 324,161 209,000

238,877,182

4,142,242

113,191

10,000

5,507,497

494,000

262,380

54,000

42,000

975,234

In putting down new pits, while the methods formerly described are generally followed, much has been done towards accelerating the rate of work. i^^^' In hard ground for instance, boring machines, * " "" supported on radial arms attached to a central pillar, are

substituted for hand labour. Twelve or more holes are bored and charged, and after the removal of the machines and their support to a safe height, are fired either simultaneously or in groups, the boring frame being replaced after the removal of the broken stuff. Much time can also be saved when sinking and walling are carried on simultaneously by the method used in several deep sinkings in South Wales by Professor W. Galloway, where the bricklayers work upon a suspended platform with hinged flaps which completely fill the hollow of the shaft when in use, but can be rapidly shifted by the engine at the surface as the top of the wall rises. One or more central holes are provided with wire-rope guides, to allow of the passage of the bucket bringing up the debris broken by the sinkers. In sinking through soft or water- bearing strata within moderate depths, excavation by hand is practised, the ground being secured with seg- mented cast-iron tubbing and pumps or water tubs used to keep the bottom dry when the inflow does not exceed 6 or 8 tons of water per minute. Beyond this, the water-cost becomes so great that the Kind and Chaudron system of boring,

which has of late years been considerably im- proved in detail, particularly by the addition of methods for continuously removing the boring detritus, is usually to be preferred. With increase in depth, however, the thickness and weight of the cast-iron tubbing in a large . shaft become almost unmanageable ; in one instance, at a depth of 1215 feet, the bottom rings in a shaft 14^ feet in diameter are about 4 inches thick, which is about the limit for sound eastings. It has therefore been proposed, for greater depths, to put four columns of tubbings of smaller diameters, 8^ and 5^ feet, in the shaft, and fill up the remainder of the boring with concrete, so that with thinner and lighter castings a greater depth may be reached. This, however, has not as yet been tried. Another extremely useful method of sinking through water-bearing ground, introduced by Messrs A. & H. T. Poetsch in 1883, and originally applied to shafts passing through quicksands above brown coal seams, has of late years been applied with advantage in opening new pits through the secondary and tertiary strata above the Coal measures in the north of France and Belgium, some of the most successful examples being those at Lens, Anzin and Vicq, in the north of France basin. In this system the soft ground or fissured water-bearing rock is rendered temporar rily solid by freezing the contained water within a surface a few feet larger in diameter than the size of the finished shaft, so that the ground may be broken either by hand tools or blasting in the same manner as hard rock. The miners are protected by the frozen wall, which may be 4 or 5 feet thick. The freezing is effected by circulating brine (calcium chloride solution) cooled to 5° F. through a series of vertical pipes closed at the bottom, contained in boreholes arranged at equal distances apart around the the space to be frozen, and carried down to a short dis- tance below the bottom of the ground to be secured. The chilled brine enters through a central tube of small diameter, passes to the bottom of the outer one and rises through the latter to the surface, each system of tubes being connected above by a ring main with the circulating pumps. The brine is cooled in a tank filled with spiral pipes, in which anhydrous ammonia, previously liquefied by compression, is vaporized in vacuo at the atmospheric temperature by the sensible heat of the return-current of brine, whose temperature has been slightly, raised in its passage through the circulating tubes. When hard ground is reached, a seat is formed for

the cast-iron tub- bing, which is built up in the usual way and concreted at the back, a small quantity of caustic soda being sometimes used in mixing the concrete, to prevent freezing. In a

recent application of this method at Vicq, near Anzin, two shafts of 12 and 16-4 feet diameter, in a covering of cretaceous strata, were frozen to a depth of 300 feet in fifty days, the actual sinking and lining operations re- quiring ninety days more. The freezing machines were kept at work for 200 days, and 2191 tons of coal were consumed in supplying steam for the compressors and circulating pumps. In some cases cement concrete has been usefully employed in lining shafts instead of brick- work, a layer about 10 inches thick being much stronger than an equal thickness of brickwork. This is especially applicable to the repair of old shafts, and also to the lin- ing of the excavations for uiiderground pumping engines. Some excellent examples of this method were shown at Paris in 1901 by the Cockerill Company of Seraing. The cement used, as well as the ballast in the concrete, was produced from blast-furnace slags.

With the increased activity of working characteristic of modern coal mining, the depth of the mines has rapidly increased, and at the present time the level of f,^j_ 4000 feet, formerly assumed as the possible limit working for working, has been nearly attained. The at great following list gives the depths reached in the '•'*• deepest collieries in Europe in 1900, from which it will be seen that the larger number, as well as the deepest, are in Belgium : —

Metres.

Feet.

Saint Henriette, Cie des Produits, Tlenu

, Belgium

1150

3773

Viviers Gilly ....

1,

1143

3750

Marcinelle, No. 11, Charleroi

„

1075

3527

Marchienne, No. 2 „

„

1066

3494

Agrappe, Mons ....

1 J

1060

3478

Pend eton dip workings

Lancashire

1059

3474

SacT^ Madame, Charleroi

Belgium

1055

3461

Ashton Moss dip workings

Lancashire

1024

3360

Ronchamp, No. 11 pit .

France

1015

3380

Viemoy, Anderlues

Belgium

1006

3301

Astley Pit, Dukinfleld, dip workings

Cheshire

960

3150

Saint Andr^, Poirier, Charleroi

Belgium

950

3117

The greatest depth attained in the Westphalian coal at the present time is at East Recklinghausen, where there are two shafts 841 metres (2769 feet) deep.

The subject of the limiting depth of working has been very fully studied in Belgium by Professor Stassart of Mons (" Les Conditions d' exploitation a grande pro- fondeur en Belgique," Bulletin de la SociMe de V Industrie Minirale, 3 Ser., vol. xiv.), who finds that no special dif&culty has been met with in workings above 1100 metres deep from increased temperature or atmospheric pressure. The extreme temperatures in the working faces at 1150 metres were 79 degrees and 86 degrees F., and the maximum in the end of a drift, 100 degrees ; and these were quite bearable on account of the energetic ventilation maintained, and the dryness of the air. The yield per man on the working faces was 4-5 tons, and for the whole of the working force underground, 0'846 tons, which is not less than that realized in shallower mines. From the experience of such workings it is considered that 1500 metres would be a possible workable depth, the rock temperature being 132 degrees, and those of the intake and return galleries, 92 degrees and 108 degrees respectively. Under such conditions work would be practically impossible except with very energetic ven- tilation and dry air. It would be scarcely possible to circulate more than 120,000 to 130,000 cubic feet per minute under such conditions, and the number of working places would thus be restricted, and consequently the out- put reduced to about 600 tons per shift of ten hours, which could be raised by a single engine at the surface without requiring any very different appliances from those in current use.

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COAL

Except in modifications of details, no great alterations in the methods of working away coal seams are to be noted, the pillar-and-stall system of removal by two worjdng.” stages and the long-wall or continuous method being representative of all the systems in use. In Europe the tendency is toward the substitution of the latter method wherever possible, but in America pUlar-and-stall work in some form is most prevalent. In France and Germany the method of filling the space left by the removal of the coal with waste rock, quarried under- ground or sent down from the surface, which was originally used in connexion with the working of thick inclined seams by the method of horizontal slices, is now largely extended to long-wall workings on thin seams, and in Westphalia is made compulsory where workings extend below surface buildings, and safety pillars of unwrought coal are found to be insuflScient. With carefxd packing it is estimated that the surface subsidence will not exceed 40 per cent, of the thickness of the seam removed, and will usually be considerably less. The material for filling may be the waste from earlier workings stored in the spoil banks at the surface ; where there are blast furnaces in the neighbourhood, granulated slag mixed with earth affords excellent packing. In thick seams packing adds about 5d. per ton to the cost of the coal, but in thinner seams the advantage is on the other side. In America culm and waste are washed into the workings by water, giving a compact mass when the water has drained away.

In securing the roof and sides of coal workings, malleable iron and steel are now used to some extent instead of timber, although the consumption of the latter material is extremely large, the forest areas of Northern Europe and Eussia and other countries being laid under contribution, in addition to native woods, to furnish the ever-increasing quantities of pit wood required. As a substitute for timber props at the face, pieces of steel joists, with the web cut out for a short distance on either end, with the flanges turned back to give a square-bearing surface, have been introduced by Mr Pirth. In large levels only the cap pieces for the roof are made of steel joists, but in smaller ones complete arches made of pieces of rails fish-jointed at the crown are used. For

shaft linings steel rings of H or channel section supported by intermediate struts are also used, and cross-bearers or buntons of steel joists and rail guides are now generally substituted for wood.

The substitution of machinery for hand labour has been comparatively slow as compared with the changes in other directions, and is by no means general in Europe, Coal' although in America the progress has been con-

'macbfaes siderable, especially since the systematic intro- duction of electric power underground. Of the earlier types, those with a swinging pick, imitating the action of a miner in undercutting, represented by the machines of Firth & Donisthorpe and Jones & Levick, have been superseded by those of the circular or chain saw types, to which have been added others with percussive and rotatory drill cutters. In the North of England and Midland districts the circular-saw type, cutting in a horizontal plane at or near the ground-level, is largely used, one of the best known being the Diamond coal- cutter of Mr W. Garforth, which is similar in construction to Winstanly & Barker's machine (vol. vi. Fig. 14, p. 68), but cuts to a depth of 5| or 6 feet. The Baird type of chain-saw machine, working round a fixed over- hanging frame, is still used in Scotland, and a modified form adapted for electric driving has been lately proposed by Mr E. K. Scott {Proc. Inst. Civ. Eng. vol. cxliv. p. 247). In the United States percussive and chain-saw machines are used almost exclusively. The former of these are

represented by the Harrison, Sullivan, &Ingersoll-Sergeant machines, which are essentially large rock-drills without turning gear for the cutting tool, and mounted upon a pair of wheels placed so as to allow the tool to work on a forward slope. When in use the machine is placed upon a wooden platform inclining towards the face, upon which the miner lies and controls the direction of the blow by a pair of handles at the back of the machine, which is kept stationary by wedging the wheels against a stop on the platform. These machines, which are driven by com- pressed air, are very handy in use, as the height and direction of the cut may be readily varied ; but the work is rather severe to the driver on account of the recoil shock of the piston, and an

assistant is necessary to clear out the small coal from the cut, which limits the rate of cutting to about 125 square feet per hour. The chain machines represented by the Jeffrey, Link-Belt, and Morgan-Gardner coal-cutters are similar in principle to the Baird machine, the cutting agent being a flat link chain carrying a double set of chisel points, which are drawn across the coal face at the rate of about

6 feet per second ; but, unlike the older machines, in which the cutting is done in a flxed plane, the chain with its motor is made movable, and is fed forward by a rack-and-pinion motion as the cutting advances, so that the cut is limited in breadth (S^ to 4 feet), while its depth may be varied up to the maximum travel (8 feet) of the cutting frame. The carrying frame, while the work is going on, is fixed in position by jack-screws bearing against the roof of the seam, which, when the cut is completed, are withdrawn, and the machine shifted laterally through a distance equal to the breadth of the cut and fixed in position again. The whole operation requires from 8 to 10 minutes, giving a cutting speed of 120 to 150 square feet per hour. These machines weigh from 20 to 22 cwt., and are mostly driven by electric motors of 25 up to 35 H.P. as a maximum. By reason of their intermittent action they are only suited for use in driving galleries or in pillar-and-stall workings. The saving effected by the substitution of machines for hand coal- cutting in English Midland collieries varies from about 9-75d. to 21d. per ton, about two-thirds of this being due to the smaller fall of slack as compared with that produced in hand driving. In America the saving is less apparent, owing to the increased wages demanded by the drivers and assistants, and the principal advantage is in the increased rate of production, which is from 6 to

7 tons daily per man underground, instead of 3 to 4 tons with hand work. In 1898, 25-3 per cent, of the output of Pennsylvania (15 out of 69 million tons) was obtained by machine cutting, which was exclusively confined to the bituminous coal district ; the coal in the anthracite districts is too hard and the seams too much disturbed to allow the cutting to be done except by hand.

In new mines the ventilation is now generally effected by an exhausting fan, the old system of ventilating furnaces being almost obsolete. The large slow- going fan of the Guibal type still maintains its ”’“j character for efBciency, although the tendency is lighting. towards using smaller and more rapidly-driven machines ; and the heavy casings and chimneys in brick- work are generally giving way to lighter structures in sheet- iron. Fans with curved instead of flat blades, and with spiral diffusers resembling turbines, are now largely us6d, that of M. Eateau being specially popular with Continental colliery engineers, on account of its high mechanical efficiency. The use of small auxiliary blowing ventilators underground, for carrying air iuto workings away from the main circuits, which was largely advocated a few years since, has lost its popularity, but a useful substitute has

been found in the induced draught produced by jets of compressed air or high-pressure water blowing into ejectors. With a jet of ^-inch area, a pipe discharg- ing 1| gallon of water per minute at 165 Mb pressure per square inch, a circulation of 860 cubic feet of air per minute was produced at the end of a level, or about five times that obtained from an equal volume of air at 60 R) pressure. The increased resistance, due to the large extension of workings from single pairs of shafts, the ventilating currents having often to travel several miles to the upcast, has led to great increase in the size and power of ventUating fans, and engines from 250 to 500 H.P. are not uncommonly used for such purposes. Electric driving from central-power stations has been found to be well suited for this particular use.

The numerous forms of safety-lamps employed in fiery mines have received several additions in late years, and old forms have been improved and modified to meet the requirements of safety in air-currents travelling at a high velocity. Prominent among the new forms is the Hepplewhite-Gray lamp, which has a conical glass sur- rounding the light, with a gauze chimney, protected by an outer metal cylinder; the air supply to the flame is carried downwards through three tubes

forming the standards of the cage. This, in addition to giving a good light overhead owing to the shape of the glass, is peculiarly sensitive to gas, and therefore valuable in testing for fire-damp. Other approved lamps are the Deflector and those of Marsaut & Mueseler when specially bonneted to resist extra high-speed currents. The illuminant now generally used in Great Britain is a mixture of rape oil with half its volume of petroleum, which is more suitable than vegetable or animal oil alone. In Germany Wolf's lamp, burning benzoline or petroleum spirit upon an asbestos wick, is very popular, as giving a much better light than oil. Special care is, however, required in filling, so that no free liquid may be left in the holder ; the spirit must be entirely absorbed by a filling of sponge, and any superfluous quantity poured off. Portable electric lamps, supplied by accumulators or dry batteries, have been introduced into coal-mines ; but owing to the weight and cost, their use is as yet very restricted. For the use of exploring parties after explosions, where irrespirable gases are encountered and compressed air or oxygen must be carried, they are especially valuable, as light is obtained without any demand on the air supply. Fire-damp, when present in the air, lengthens the flame of an ordinary safety-lamp, but the effect is not apparent with less than about 2^ per cent, of gas ; and for more delicate testing, special lamps with non-luminous flames are adopted. In Pieler's lamp, which is of the ordinary Davy form, alcohol is burned on a sUk wick, and a screen is provided so that the flame can be hidden. When exposed in air containing J per cent., a cap of 1| inch is formed, which increases to 2 inches with ^ per cent., and with 1-^ per cent, the lamp is filled with a deep blue glow. Another and more useful method is that of Dr F. Clowes, who uses a hydrogen flame 04 inch long, obtained by attaching a cylinder containing compressed hydrogen to an ordinary safety-lamp ; the gas is turned into the oil flame, which is for the time extinguished, and relighted when the observation is finished. As little as 0-2 per cent, of gas can be detected by this method.

The danger arising from the presence of coal dust in the air of dry mines, with or without the addition of fire- damp, has, since it was first pointed out by Coal dust. YvoiessoT W. Galloway, been made the subject of special inquiries in the principal European countries

interested in coal mining ; and although certain points are still debatable, the fact is generally admitted as one

calling for special precautions. The conclusions arrived at by the Eoyal Commission of 1891, which may be taken as generally representative of the views of British colliery engineers, are as follows : —

1. The danger of explosion when gas exists in very small quantities is greatly increased by the presence of coal dust.

2. A gas explosion in a fiery mine may be intensified or in- definitely propagated by the dust raised by the explosion itself.

3. Coal dust alone, without any gas, may cause a dangerous explosion if ignited by a blown-out shot ; but such cases are likely to be exceptional.

4. The infiammability of coal dust varies with different coals, but none can be said to be entirely free from risk.

5. There is no probability of a dangerous explosion being produced by the ignition of coal dust by a naked light or ordinary flame.

Danger arising from coal dust is best guarded against by systematically sprinkling or watering the main roads leading from the working faces to the shaft, where the dust falling from the trams in transit is liable to accumulate. This may be done by water-carts or hose and jet, but preferably by finely divided water and compressed air distributed from a network of pipes carried through the workings. This is now generally done, and in some countries is compulsory, when the rocks are deficient in natural moisture. According to Behrens, the quantity of water required to keep down the dust in a mine raising 850 tons of coal in a single shift was 28-8 tons, apart from that required by the jets and motors. The distributing network extended to more than 30 miles of pipes, varying from 3^ inches to 1 inch in diameter.

In all British coal-mines, when gas in dangerous quantities has appeared within three months, and in all places that are dry and dusty, blasting is pro- _ . , hibited, except with permitted explosives, whose

exp^ires composition and properties have been examined at the testing station at the Eoyal Arsenal, Woolwich. A list of those sanctioned is published by the Home Ofiice. They are mostly distinguished by special trade names, and are mainly of two classes — those containing ammonium nitrate and nitro-benzole or nitro-naphthalene, and those containing nitro-glycerine and nitro-cellulose, which are essentially weak dynamites. The safety property attributed to them is due to the depression of the tem- perature of the flame or products of explosion to a point below that necessary , to ignite fire-damp or coal dust in air from a blown-out shot. New explosives that are found to be satisfactory when tested are added to the list from time to time, the composition being stated in all cases.

The most noticeable feature in the arrangements for draining modern collieries is the general abandonment of surface engines, with heavy wooden or iron rods – in the shaft, in favour of high-speed engines °*^

placed underground, and supplied with power either by steam sent down from the surface, or in a less direct manner by water circulating under high pressure or by electric transmission. Compressed air may also be used, but is mostly restricted to small installations, on account of its low mechanical efficiency. The earlier underground steam-pumps were very wasteful machines, on account of the low steam pressures available and the loss by condensation in the steam conduit pipes, but with improvements in construction and the adoption of multiple expansion in several cylinders with high initial steam pressure, the fuel consumption has been reduced nearly to the level of that of good surface or marine engines. Several engines of this class of considerable size have been erected in the deep Westphalian pits, e.g., one of 1900 to 2000 H.P., lifting a maximum quantity of 17 tons of water per minute 1300 feet high, with an expenditure of

10^ to 11 tons of steam at 180 lb pressure per hour, the loss by condensation in the steam supply pipe, which is rather more than a

quarter of a mile long, being only 12 cwt. per hour. The engines are of the four-cylinder triple expansion class in twin tandem form. A still larger example of the same kind, now under construction for the Harpen Collieries, is intended for a maximum duty of 25 tons of water raised 1640 feet per minute, rep- resenting about 3500 H.P. Probably the heaviest exist- ing colliery pumping plant is that at the Miike Colliery in Japan, which has a capacity of 40-3 tons per minute lifted 900 feet. This is done by four Davy compound engines placed side by side at the surface, each working two lines of rods in the shaft, which is of the unusual size of 40 by 12 feet. In the indirect system of hydraulic transmission a steam-engine at the surface pumps water continuously into a system of pipes against a resistance of 2500 to 3000 lb per square inch, and the pressure so obtained drives a pump underground through a pipe carried down the shaft, the water returning by another pipe to the surface engine in a continuous circuit. This system, originally used as a method of transmitting small power underground by Messrs West & Darlington in Cornwall, and since developed to a high degree by Mr R. Moore, Mr H. Davey, Messrs Kaselowsky & Prott, and other hydraulic engineers, has many advantages, particu- larly in the small dimension of the engines, which require much smaller walled chambers in the mine than steam- engines of similar power ; but great care is required to keep the driving water perfectly clean, to prevent wear on the valves, as on account of the high pressure employed a very small leakage gives rise to a large waste of power. Engines of this class are made in a great variety of forms, both reciprocating with long stroke, and rotating with short stroke high speed pumps. The largest class in use forces 7 tons per minute 2000 to 2300 feet high. Pump- ing by electric transmission, although of comparatively recent introduction, has taken up a leading position in deep mining, and probably will be almost exclusively used at no very distant date. At first it was mainly applied to small special purposes, such as raising feeders of water from isolated workings to a main pumping engine, but now large self-contained installations, with generating dynamos from 800 to 1000 H.P., are in use. In the largest plant of this class, intended for a maximum duty of 15 tons per minute lifted 1260 feet, three com- pound engines of 750 H.P. are provided, each driv- ing its pump by a separate generator and motor by an alternating current of 2000 volts. Under

ordinary conditions the water charge in coal mining is considerable, and in old mines with a large extent of open workings it becomes very burdensome, the weight of water to be lifted being often many times that of the coal produced. In the Westphalian coal-field in 1899, 169-5 million tons of water were lifted for an output of 55 million tons of coal, or rather more than 3 tons to 1 ton of coal. In the older and partly worked-out districts the proportion rises to as much as 8 to 1. In South Staffordshire, where the ground is honeycombed with old thick coal workings, from 24 to 28|- tons of water per ton of coal raised were pumped in

1898.

The principal improvements in the hoisting arrange- ments of modern colliery plants have been in the direction of larger engine power, and arrangements for ^m'deep ^o^ding and discharging the cages with the mines. Smallest loss of time. Where deep cages, carry- ing from four to six tiers of tubs superposed, are employed, Fowler's hydraulic arrangement, using auxil- iary cages upon hydraulic lifts at the surface and pit bot- tom (Ency. Brit. vol. vi. p. 76), is one of the best devices

for the latter purpose. It has been lately extended by Tomson to six- and eight-decked cages. In another ar- rangement by Darphin the cage is received at the surface by hydraulic keeps, which support it at its highest level and progressively lower it to bring each deck in succession down to the landing place, when the loaded tubs are run out and replaced by empty ones without moving the main engine. The time occupied in landing and changing the load of twelve tubs is from 20 to 25 seconds. Many improvements have been made in the construction of winding engines of late years, in order to reduce the consumption of steam, by the adoption of variable expan- sion gear, and the substitution of compound for single engines. The two-cylinder compound engine has been used in some cases, but a preferable form is the twin tandem compound adopted by Mr W. Galloway at Llan- bradach in 1894, and since introduced into many of the deep pits in France and Germany. The steam is exhausted into a central condenser,

where a permanent vacuum is maintained, as the intermittent nature of the work pre- vents the use of a separate condenser.

In very deep mines the moment of the load at different points of the lift varies considerably when a cylindrical drum is used, and becomes negative during the last part of the lift, owing to the excess weight of the rope on the descending side. In order to keep the work of the engines more nearly constant, various systems of counterbalancing by auxiliary chains, &c., have been adopted, as previously described. In addition to these, Koepe's method of wind- ing has of late years obtained some favour. In this system the drum is replaced by a disc with a grooved rim for the rope, which passes from the top of one cage over the guide pulley, round the disc, and back over the second guide to the second cage, and a tail rope, passing round a pulley at the bottom of the shaft, connects the bottoms of the cages, so that the dead weight of cage, tubs, and rope is completely counterbalanced at all positions of the cages, and the work of the engine is confined to the useful weight of coal raised. Motion is communicated to the rope by f rictional contact with the drum, which is covered through about one-half of the circumference. This system was used for some time at Bestwood, in Nottinghamshire, and is still employed at Sneyd, in North Staffordshire. In Belgium it was tried in a pit 940 metres deep, but has since been replaced by flat hempen ropes, and is now restricted to shallower workings at 260 metres. In West- phalia it is applied in about thirty different pits to a maximum depth of 761 metres. The system of counter- balancing by the use of spiral drums is limited by their excessive size and weight when both ropes wind on the same drum. This has to some extent been met by Tom- son's modification, where a separate conical drum is used for each rope. They are mounted upon parallel axes, but turned in opposite directions, the base of one towards the point of the other. In this way the weight and breadth of the drum is notably diminished, but the engine is com- plicated by the addition of a rocking beam and additional coupling rod for working the second drum. An engine of this kind has been in use since 1896 at Preussen Col- liery, Westphalia, and has also been adopted for the 1015- metre pits at Eonchamp, in France.

As regards the form and material of winding ropes, while round ropes of steel wire of high tensile strength and tapered in thickness for great depths are generally pre- ferred in England and Germany, opinion in Belgium, and to some extent in the north of France, favours the use of flat ropes made of ” aloes ” or Manillahemp, really plantain fibre. Those in deep pits are of considerable size and weight, e.g., tapering from 16-6 inches to 9 inches in breadth and 2 inches to 1^ inch in thickness, and weighing 14-3

tons per 1200 metres. Stassart Qoc. dt. p. 465) considers that they should be used in preference to flat steel wire ropes down to 1500 metres. The new large engine of the Anzi Company, to lift a gross load of 15 tons from 750 metres, is also fitted with flat ropes. These are 3 inches thick and 22-|- inches broad at the drum end, weigh 18 tons each, and coil upon a diameter increasing from 14 to 26-3 feet.

The continuous change in direction experienced by the rope between the head-gear pulley and the drum in coil- ing on or off (the so-called ” angling ” of the rope) is a source of wear when the depth becomes considerable. This is to some extent diminished by placing the engine at some distance from the pit, up to 60 or 60 yards ; but a complete remedy has been proposed by Mr W. Morgan, who uses a winding engine upon a frame carried upon two lines of railway, which is shifted laterally though a distance equal to the thickness of the rope at each revolution of the drum, so that the end of the coil is always irb the same vertical plane with the guide pul- ley and the cage. The first engine of this class has just been erected at Dolcoath tin mine in Cornwall, at a shaft which is to be carried down to 3000 feet in depth.

In the United Kingdom the drawing of coal is generally confined to the day shift of eight or ten hours, with an output of 100 to 150 tons per hour, according to the depth, capacity of coal tubs, and facilities for landing and changing tubs. With Fowler’s hydraulic arrange- ment 2000 tons are raised 600 yards in eight hours. In the deeper German

pits, where great thicknesses of water-bearing strata have to be traversed, the first estab- lishment expenses are so great that in order to increase output the shaft is sometimes provided with a complete double equipment of cages and engines. In such cases the engines may be placed in line on opposite sides of the pit, or at right angles to each other. According to Kohne, the output of single shafts has been raised by this method to 3500 and 4500 tons in the double shift of sixteen hours. It is particularly well suited to mines where groups of seams at different depths are worked simul- taneously. Some characteristic figures of the yield for British collieries in 1898 are given below: —

Albion Colliery, South”! 551,000 tons in a year for one shaft Wales . . . . / and one engine.

SilksworthCoUiery, North- 1 535,000 tons in a year for shaft 580 umberland . . . J yards deep, two engines.

Bolsover Colliery, Derby . 598,798 tons in 279 , days, shaft 365

yards deep.

Denaby Main Colliery, 1629,947 tons in 281 days, maximum Yorkshire . . . / per day 2673 tons.

Coal as raised from the pit is now generally subjected to some final process of classification and cleaning before

being despatched to the consumer. The nature Surface ^ and extent of these operations vary with the meats.”’ character of the coal, which if hard and free from

shale partings may be finished by simple screen- ing into large and nut sizes and smaller slack or duff, with a final hand-picking to remove shale and dust from the larger sizes. But when there is much small duff, with intermixed shale, more elaborate sizing and washing plant becomes necessary. Where hand-picking is done, the larger-sized coal, separated by 3-inch bar screens, is spread out on a travelling band, which may be 300 feet long and from 3 to 5 wide, and carried past a

line of pickers stationed along one side, who take out and remove the waste as it passes by, leaving the clean coal on the belt. The smaller duff is separated by vibrating or rotating screens into a great number of sizes, which are cleaned by washing in continuous-current or pulsating jigging machines, where the lighter coal rises to the surface and

is removed by a stream of water, while the heavier waste falls and is discharged at a lower level, or through a valve at the bottom of the machine. The larger or ” nut” sizes, from ^ inch upwards, are washed on plain sieve plates, but for finer-grained duff the sieve is covered with a bed of broken felspar lumps about 3 inches thick, forming a kind of filter, through which the fine dirt passes to the bottom of the hutch. The cleaned coal is carried by a stream of water to a bucket elevator and delivered to the storage bunkers, or both water and coal may be lifted by a cen- trifugal pump into a large cylindrical tank, where the water drains away, leaving the coal sufficiently dry for use. Modern screening and washing plants, especially when the small coal forms a considerable proportion of the out- put, are large and costly, requiring machinery of a capacity of 100 to 150 tons per hour, which absorbs 350 to 400 horse-power. In this, as in many other cases, electric motors supplied from a central station are now preferred to separate steam-engines.

In addition to its use as fuel, there are two principal outlets for small coal, namely, as briquettes, or patent fuel, and coke, the former being adopted for non-caking and the latter for caking coals. For ” ’”“■ briquettes the small coal, if previously washed, is dried to reduce the moisture to at most 4 per dent., and, if necessary, crushed in a disintegrator and incorporated in a pug mill with from 8 to 10 per cent, of gas pitch, softened by heating to between 70° and 90° C. to a plastic mass, which is then moulded into blocks and compacted by a pressure of ■!■ to 2 tons per square inch in a machine with a rotating die plate somewhat like that used in making semi-plastic clay bricks. When cold, the briquettes, usu- ally weighing from 7 to 20 lb each, although smaller sizes are made for domestic use, become quite hard, and can be handled with less breakage than the original coal. Their principal use is as fuel for marine and locomotive boilers, the evaporative value being**

about the same or somewhat more than that of coal. The principal seat of the manu- facture in Great Britain is in South Wales, where the dust and smalls resulting from the handling of the best steam coals (which are very brittle) is obtainable in large quantities and finds no other use. Some varieties of lignite, when crushed and pressed at a steam heat, soften sufiiciently to furnish compact briquettes without requir- ing any cementing material. These are now made to a very large extent from the tertiary lignites in the vicinity of Cologne, and are used mainly for house fuel on the Lower Rhine and in Holland.

The principal novelty of interest in connexion with coke-making is the development of the so-called by-product ovens, where, in addition to the carbonized fuel, cbi^g. volatile products, such as tar, benzol, and am- waking. monia, are recovered by condensation from the gases evolved in the oven before the latter are burnt to supi- ply the necessary heat for the coking process. The first suc- cessful application of this principle was made by Mr Carves at Besseges, in France, and it was introduced into Great Britain, with some modifications in details, by the late Mr H. Simon, under the name of the Simon-Carves system. Other and subsequent developments were those of Semet- Solvay and Htlssener. The whole of these iiave a com- mon feature, in the narrow Q -shaped oven, which is heated by a series of parallel horizontal flues in the side walls, while in the Otto-Hoffmann system, which has been most largely adopted, the Copp^e oven with vertical heating flues is used. The condensing arrangements, which are generally similar for all the systems, resemble those of an ordinary gas-works, somewhat simplified. The gas given off by the coal is led by one or two openings in the roof, through water-sealed dip-pipes, to a collecting main leading to a system of atmospheric condensers, pipes cooled by exposure

to the air, where its temperature is reduced, and the tar is condensed and removed. The flow of gas is maintained by rotating exhausters,

which force it forward through a series of scrubber towers, where the ammonia vapour is separated by a graduated system of washing with water and ammoniacal liquor. The final removal of benzol is effected by washing the partially purified gas with creosote oil. When the condensible products are removed, the gas is returned by a common supply pipe for distribution to the heating flues of the ovens. In the Otto-HofPmann oven of the earlier and most generally used form, the gas is fired with heated air in a horizontal flue running along the bottom of the cooking chamber ; this is divided into two parts by a partition in the middle of its length, and the flame rises through the vertical side passages of the first half of the oven to two horizontal collectors at the top, where the direction being reversed, it passes down-wards along the second half to the chimney, after giving up some of the surplus heat to a Siemens regenerator, in which the air for combustion is heated after the next reversal. The gas supply is introduced alternately from the front and back of the oven, there being a regenerator for air-heating at either end. In the newer form of this oven the air regenerators and reversal of the flame have been abandoned in favour of a system of continuous heating, the gas distributed by pipes in a chamber below the bottom of the oven supplying a series of large Bunsen burners at equal distances apart along the bottom, whose flames pass continuously upward through the side flues. There is some difference of opinion as to the merits of the two forms, but the new system is generally held to give more uniform heating, as well as being simpler in con- struction. In the horizontally-heated ovens the flues are arranged as parallel superposed passages along the length of the wall. The gas entering the lowest one is fired, and passes four times backwards and forwards to the chimney flue. This is usually of thin brickwork, so that a portion of the waste heat is transmitted to the air supplied for combustion, which passes in the opposite direction through adjacent parallel flues in the brickwork of the foundation, forming a continuous "recuperator," as distinguished from the intermittent Siemens regenerator.

The time of coking in retort ovens varies with the quality of the coal and size of the charge, which may be from 5^ to 7 tons, about thirty-six hours being required in the newer kinds. The coke produced is not so

dense or brilliant as that made in beehive ovens, but the waste being less, there is a decided saving, apart from the value of the condensed products. In one instance the coke was found to be about 5 per cent, less efficient in the blast furnace, whUe the yield was increased 10 per cent. In the further treatment of the condensed products by distillation the tar gives burning oil and pitch, the benzol is separated from the creosote oil by steam-heated stills, and the ammoniacal liquor, after some lime has been added to decompose fixed ammonium compounds, is heated to vaporize the ammonia, which is condensed in lead or copper lined tanks containing strong sulphuric acid to produce a crystalline powder of ammonium sulphate, which accumulates in the receiver and is fished out from time to time. The yield of by-products averages about 1 per cent, of sulphate of ammonium, about 3^ per cent, of tar, and 0-6 to 0-9 per cent, of benzol of the weight of the coal carbonized. Besides heating the ovens and supplying steam for the machinery of the condensing plant and the coke ovens, there is usually a considerable surplus of gas, which may be used for lighting or driving gas-engines. For the latter purpose, however, it is neces- sary to remove the last traces of tar, which acts very prejudicially in fouling the valves when the gas is not completely purified.

Ebfbebnces. — Most of the detailed information concerning improvements in the practice of coal mining and the improvement in plant and machinery is contained in the published proceedings of the different professional societies, including the TYansactions of the Institution of Mining Engineers, The South Wales Institute of Engineers, the British Society of Mining Students, and the American Institute of Mining Engineers. Among special works dealing with modern practice. Professor Galloway's lectures (published by the South Wales Institute, Cardiff, 1900), and the larger Text-Book on Coal Mining, hjMTR. W. Hughes (fourth edition, London, 1901), are the most notable, the latter being especially valuable for the de- tailed classified list of original authorities given at the end of each chapter. Very complete references are also given in the systematic abstracts published in the half-yearly volumes of the Journal of the Iron and Steel Institute. (h. B.)

Coaling Stations. — Maritime war in all ages has required that the ships of the belligerents should have the use of sheltered waters for repairs and for replenish- ment of supplies. The operations of commerce from the earliest days demanded natural harbours, round which, as in the conspicuous instance of Syracuse, large populations gathered. Such points, where wealth and resources of all kinds accumulated, became objects of attack, and great efforts were expended upon their capture. As maritime operations extended, the importance of a seaboard increased, and the possession of good natural harbours became more and more advantageous. At the same time, the growing size of ships and the complexity of fitments caused by the development of the sailing art, imposed new demands upon the equipment of ports alike for pur- poses of construction and for repairs ; while the differentia- tion between warships and the commercial marine led to the establishment of naval bases and dockyards provided with special resources. Prom the days when the great sailors of Elizabeth carried war into distant seas, remote harbours began to assume naval importance. Expedition- ary forces required temporary bases, such as Guantanamo Bay, in Cuba, which was so utilized by Admiral Vernon in 1741. As outlying territories began to be occupied, and jurisdiction to be exercised over their ports, the harbours available for the free use of a belligerent were gradually reduced in number, and it became occasionally necessary to take them by force. Thus, in 1782, the capture of Trincomalee was an object of sufficient importance to justify special effort, and Suffren gained a much-needed refuge for his ships, at the same time compelling his opponent to depend upon the open roadstead of Madras, and even to send ships to Bombay. In this case a distant harbour acquired strategic importance, mainly because sheltered waters, in the seas where Hughes and Suffren strove for naval supremacy, were few and far between. A sailing man-of-war usually carried from five to six months' provisions and water for 100 to 120 days. Other needs required to be met, and during the wars of the French Eevolution it was usual, when possible, to allow ships engaged in blockade to return to port every five or six weeks "to refresh." For a sailing fleet acting on the offen- sive, a port from which it could easUy get to sea was a great advantage. Thus Raleigh protested against the use of closely landlocked harbours. " Certain it is," he wrote, " that

these ships are purposely to serve His Majesty and to defend the kingdom from danger, and not to be so penned up from casualitie as that they should be less able or serviceable in times of need." Nelson for this reason made great use of Maddalena Bay, in Sardinia, and was not greatly impressed with the strategic value of Malta in spite of its fine natural harbour. The introduction of steam gave rise to a new naval requirement — coal — which soon became vital. Commerce under steam quickly settled down upon fixed routes, and depots of coal were estab- lished to meet its needs. Coaling stations thus came into existence by a natural process, arising from the exi-

geneies of trade, and began later to supply the needs of navies.

For many years there was no inquiry into the war requirements of the British fleet as regards coal, and no attempt to regularize Rritish °^ *° fortify the ports at which it was stored. Suo- ooallnz cessful naval war had won for Great Britain many stations. points of vantage throughout the world, and in some cases the strategic value of ports had been proved by actual experience. The extreme importance of the Cape of Good Hope, obscured for a time after the opening of the Suez Canal, was fully realized in sailmg days, and the naval conditions of those days to some extent determined the choice of islands and harbours for occupation^ There does not, however, appear to have been any pareful study of relative strategic values. Treaties were occasionally drafted by persons whose geographical know- ledge was at fault, and positions were, in some cases, abandoned which ought to have been retained, or tenaciously held when they might have been abandoned. It was left to the personal exertions of Sir Stamford Raffles to secure such a supremely important roadstead as that of Singapore for the empire. Although, therefore, the relative values of positions was not always recognized, Great Britain obtained as a legacy from sailing days a large number of harbours admirably adapted for use as coaling stations. Since the dawn of the era of steam, she has acquired Aden, Perim, Hong-Kong, North Borneo, Fiji, part of New Guinea, Fanning Island,

and many other islands in the Pacific, while the striking development of Australia and New Zealand has added to the long roll of British ports. The coaling stations, actual and potential, of the empire are unrivalled in number, in con- venience of geographical distribution, and in resources. Of the numerous British ports abroad which contained coal stores, only the four so-called "fortresses" — Gibraltar, Malta, Halifax, and Bermuda — were at first fortified as naval stations after the iutro- duction of rifled ordnance. The term fortress is a misnomer in every case except Gibraltar, which, being a peninsula separated only by a neck of neutral ground from the territory of a foreign Power, exists under fortress conditions. Large sums were expended on these places with little regard to principles, and the defences of Bermuda, which were very slowly constructed, are monuments of misapplied ingenuity.

In 1878 great alarm arose from strained relations with Russia. Rumours of the presence of Russian cruisers in many waters, and of hostile projects, were readily believed, although the Russian navy, which had just shown itself unable to face that of Turkey, would at this period have been practically powerless. Carnarvon Widespread fears for the security of coaling stations led Commis- jQ ^.jjg appointment of a strong royal commission, under "■ the presidency of the earl of Carnarvon, which was

instructed to inquire into and report upon the protection of British commerce at sea. This was the first attempt to formulate any principles, or to determine which of the many ports where coal was stored should be treated as coaling stations essential for the purposes of war. The terms of the reference to the commis- sion were ill-conceived. The basis of all defence of sea-borne commerce is a mobile navy. It is the movement of commerce upon the sea during war, not its security in port, that is essential to the British Empire, and a navy able to protect commerce at sea must evidently protect ports and coaling stations. The first object of inquiry should, therefore, have been to lay down the necessary standard of naval force. The vital question of the navy was not referred to the royal commission, and the four fortresses were also strangely excluded from its purview. It followed inevitably that the protection of commerce was approached at the wrong end, and that the

labours of the commission were to a great extent vitiated by the elimination of the principal factor. Voluminous and important evidence, which has not been made public, was, however, accumulated, and the final report was completed in 1881. The commissioners recalled attention to the extreme importance of the Cape route to the East; they carefully examined the main maritime communications of the empire, and the distri- bution of trade upon each ; they selected certain harbours for defence, and they obtained from the War OfBce and endorsed proiects of fortification in every case ; lastly, they condenined the great dispersion of troops in the West Indies, which had arisen m days when it was a political object to keep the standing army out of sight of the British people, and had since been mam- tained by pure madvertence. Although the principal outcome of the careful inquiries of the commission was to initiate a great system of passive defence, the able reports were a distinct lain Some principles were at last formulated by authority, and the information collected, if it had been rendered accessible to the public, would have exercised a beneficial mfluence upon opinion. Moreover, the commissioners, overstepping the bounds of their charter, delivered a wise and statesmanhke warmng as to the position of the navy.

Meanwhile, the impulse of the fears of 1878 caused indifferent armaments to be sent to Cape Town, Singapore, and Hong-Kong, there to be mounted after much delay in roughly designed works. At the same time, the great colonies of Australasia began to set about the defence of their ports with commendable earnestness. There is no machinery for giving effect to the recommendations of a royal commission, and until 1887, when extracts were laid before the first colonial Conference, the valuable report was veiled in secrecy. After several years, during which Lord Carnarvon per- sistently endeavoured to direct attention to the coaling stations, the work was begun. In 1885 a fresh panic arose out of the Panjdeh difficulty, which supplied an impetus to the belated pro- ceedings. Little had then been accomplished, and the works were scarcely completed before the introduction of long breech-loading guns rendered their armaments obsolete.

The fortification of the coaling stations for the British Empire is stiU proceeding on a scale which, in some cases, cannot easily be reconciled with the principles laid down by the president of the Cabinet committee of defence. At the Guildhall, London, on 3rd December 1896, the duke of Devonshire stated that "The mainte- nance of sea supremacy has been assumed as the basis of the system of imperial defence against attack from over the sea. This is the determining factor in fixing the whole defensive policy of the empire." It was, however, he added, necessary to provide against " the predatory raids of cruisers " ; but " it is in the highest degree improbable that this raiding attack would be made by more than a few ships, nor could it be of any permanent effect unless troops were landed." This is an unexceptionable statement of the requirements of passive defence in the case of the coaling stations of the British Empire. Their protection must depend primarily on the navy. Their immobile armaments are needed to ward off a raiding attack, and a few effective guns, well mounted, manned by well-trained men, and kept in full readiness, will amply suffice.

If the command of the sea is lost, large expeditionary forces can be brought to bear upon coaling stations, and their security wUl thus depend upon their mobUe garrisons, not upon their passive defences. In any case, where coal is stored on shore, it cannot be destroyed by the fire of a ship, and it can only be appropriated by landing men. A small force, well armed and well handled, can effectually prevent a raid of this nature without any assistance from heavy guns. In war, the possession of secure coal stores in distant ports may be a great advantage, but it will rarely suffice for the needs of a fleet engaged in offensive operations, and requiring to be accompanied or met at prearranged rendezvous by colliers from which coal can be transferred in any sheltered waters. In the British naval manoeuvres of 1892, Admiral Sir Michael '"odern Seymour succeeded in coaling his squadron at ^"ns' sea, and by the aid of mechanical appliances this is frequently possible. In the Spanish- American war of 1898 some coaling was thus accomplished ; but Guan- tanamo Bay served the purpose of a coaling station during the operations against Santiago. Watering at sea was usually carried out by means of casks in sailing days, and must have been almost as difficult as coaling. As, how- ever, it is certainty of

coaling in a given time that is of primary importance, the utilization of sheltered waters as improvised coaling stations is sure to be a marked feature of future naval wars. Although coaling stations are now eagerly sought for by all Powers which cherish naval ambitions, the annexation of the Sandwich Islands by the United States being a case in point, it is probable that they will play a somewhat less important part than has been assumed. A fleet which is able to assert and to maintain the command of the sea, will not find great difficulty in its coal supply. Moreover, the increased coal endurance of ships of war tends to make their necessary replenishment less frequent. On the other hand, the modern warship, being entirely dependent upon a mass of complex machinery, requires the assist- ance of workshops to maintain her continuous efficiency, and unless docked at intervals suffers a material reduction of speed. Prolonged operations in waters far distant from home bases will therefore be greatly facilitated in the case of the Power which possesses local docks and means of

executing repairs. Injuries received in action, wWcli might otherwise disable a ship during a campaign, may

thus be remedied. During the hostilities be- ^xidaiy t^ggj^ France and China in 1884 the French

ship La Galissonnih-e was struck by a shell from one of the Min forts, which, though failing to burst, inflicted serious damage. As, by a technical fiction, a state of war was not considered to exist, the La Galisscmr nih-e was repaired at Hong-Kong and enabled again to take the sea. Local stores of reserve ammunition and of spare armaments confer evident advantages. Thus, independently of the question of coal supply, modern fleets employed at great distances from their bases re- quire the assistance of ports furnished with special resources, and a Power like Japjin with well-equipped naval bases in the China Sea, and possessing large sources of coal, occupies, for that reason, a favoured position in regard to naval operations in the Far East. As the term

“coaling station” refers only to a naval need which can often be satisfied without a visit to any port, it appears less suitable to modern conditions than ” secondary base.” Secondary bases, or coaling stations, when associated with a powerful mobile navy, are sources of maritime strength in proportion to the services they can render, and to their convenience of geographical position. In the hands of an inferior naval Power, they may be used, as was Mauritius in 1809-10, as points from which to carry on operations against com- merce; but unless situated near to trade routes, which must be followed in war, they are probably less useful for this purpose than in sailing days, since convoys can now be more effectively protected, and steamers have considerable latitude of courses. Isolated ports dependent on sea-borne resources, and without strong bodies of organized fighting men at their backs, are now, as always, hostages offered to the Power which obtains command of the sea. (g. s. c.)

Coatbridge, a municipal burgh (since 1885) of Lanarkshire, Scotland, about 9 miles east of Glasgow by rail. The surrounding coal and iron field is the most im- portant in the country. There are some 20 active collieries, and the iron and steel industry of the town is very important. Modern erections are a theatre, three churches, a technical school and mining college (1891, under parish school board), and municipal buildings (at a cost of £40,000). There are two public parks, one opened in 1887. Population (1881), 24,812; (1891), 30,034; (1901), 36,981. The parish of Old Monkland contains ten villages in addition to Coatbridge.

Coatesville, a borough of Chester county, Penn- sylvania, U.S.A., on Brandywine Creek, 40 miles west of Philadelphia. It contains rolling-mills and boiler-works. Population (1890), 3680; (1900), 5721.

Coban, a city of Guatemala, Central America, has greatly increased in prosperity, owing partly to the fer- tility of the district, but chiefly to the amazing industry of the Quecchi Indians, who are its main inhabitants. The chief trade is in coffee and Peruvian bark. An ex- ceptionally large number of foreigners, especially Ger- mans, have settled in the city, but it consists mainly of native cottages embosomed in gardens of flowering shrubs. It is divided into eleven ” barrios ” or

wards, each named after a particular saint. In the plaza is the great church, with the convento. The population is about 18,000.

Cobar, a town in New South Wales, Australia, 459 miles west of Sydney, in the county of Robinson, with a terminal station on the railway line from Nyngan. Large quantities of copper ore are raised in the district, and gold-bearing reefs have been discovered and worked suc-

cessfully of late years. The Great Cobar copper mine is the most important in the state. Population (1881), 1859; (1901), about 5500.

Cobet, Carel Gabriel (1813-1889), one of the most famous classical scholars of the 19th century, was born at Paris on 28th November 1813, of a Dutch father and French mother. It has often been said that the twofold origin is apparent in his work, which shows traces of Gallic brilliancy along with Dutch erudition. Cobet was educated in Holland at the Hague Gymnasium, where he was fortunate enough to have as his master a man of remarkable teaching power and genuine love of learning, Kappeyne van de Capello. In 1832 Cobet entered the University of Leyden, and devoted himself exclusively to classical scholarship. In 1836 he won a gold medal for an essay entitled ” Prosopographia Xenophontea,” a brilliant characterization of all the persons introduced into the “Memorabilia,” “Sympo- sium,” and ” (Economicus ” of Xenophon. In 1840 he published and defended a thesis entitled Observationes criticoe in Platonis comici reliquias, which first revealed his remarkable critical faculty. The university now conferred on him an honorary degree, since he had de- clined to follow the course that led to the ordinary one, and recommended him to the Government for a travelling pension, to enable him to study manuscripts in foreign libraries. The ostensible purpose of his journey was to collate the texts of Simplicius, but the Aristotelian commentator seems to have engaged but little of Cobet’s time, and he never even published an edition of Simplicius. Instead, he contrived to make a careful study of almost every Greek manuscript in the Italian libraries, and returned after five years with an intimate knowledge of the peculiarities of copyists and the history of manu- scripts. In 1846 he married, and in the same year he was appointed to a professorship at

Leyden. His in- augural address, De arte interpretandi grammatices et critices fundamentis innixa, has been called the most perfect piece of Latin prose written in the century. The rest of his life was passed uneventfully at Leyden in study and work. In 1856 he became joint editor of Mnemosyne, a philological review, which he soon raised to a leading position among classical journals. In it appeared from time to time critical notes and suggested emendations from Cobet's pen, dealing with a great variety of Greek authors. These were afterwards collected in book form under the titles Nbvce Lectiones, Varim Lectiones, and Miscellanea Critica. In 1875 he took a prom- inent part at the Leyden Tercentenary, and impressed all hearers by his wonderful facility in Latin improvisa- tion. In 1884, when his health was failing, he retired as emeritus professor. He died on 26th October 1889. Cobet's special weapon as a critic was his consummate knowledge of palaeography, but he was no less distin- guished for his rare acumen and the extensive command of classical literature with which he illustrated and defended his criticisms. He has been sometimes blamed for rash- ness in attempting to emend difficult passages, and for neglecting the comments of other scholars. He had little sympathy for the German school of criticism, and main- tained that the best combination for a scholar was English good sense with French taste. He always expressed his obligation to the English, saying that his masters were three Richards — Bentley, Porson, and Dawes, (a. z.)

Coblenz, or Coblentz, a town of Prussia, capital of the Rhine province, on the left bank of the Rhine, 67 miles south-gouth-east from Cologne by rail, headquarters of the Eighth German Army Corps. About a mile above the town the river is crossed by an iron bridge of double span (completed in 1879), carrying the Berlin-Metz railway.

In 1890 the demolition of the landward defences was begun, and since then a great alteration has taken place on that side of the town. In 1897 a magnificent monu- ment by Bruno Schmitz and Hundrieser to the

Emperor William I. was erected at the point where the Moselle meets the Ehine. Coblenz also boasts of a museum (1891) of antiquities ; monuments to General von Goeben (died here in 1880), the physiologist Johannes Mifller (born here in 1801), the poet_ Max von Schenkendorf (died here in 1817), and the Empress Augusta (1896), who loved to reside at Coblenz ; a new Eoman Catholic church, St Joseph's (1896-98) ; a handsome promenade by the Rhine, 1^ miles long ; a theatre and a musical institute. Coblenz is a principal seat of the Ehenish and Moselle wine trade, and its manufactures include pianos, paper, cardboard, machinery, and boats and barges. It is an important transit centre for the Rhine railways and those of the Lahn and Moselle, and for the Rhine navigation. Population (1885), 31,669; (1900), 45,039.

Cobourg, the capitol of Northumberland county, Ontario, Canada, 70 miles east of Toronto by rail, on Lake Ontario. It has a safe and commodious harbour, and has steamboat communication with St Lawrence and Lake Ontario ports. It contains car-works, carpet and woollen factories, and foundries. Population (1881), 4957;

(1900), 4239.

Coburg, a town of Germany, capital (alternating with Gotha) of the duchy of Saxe-Coburg-Gotha, 72 miles by rail north from Nuremberg. The most notable addition to the public buildings is the Edinburgh palace (1881). The old castle of Coburg now contains a museum of art and antiquities ; the town also possesses an anthropolo- gical museum. A bronze statue of Prince Albert (con- sort of Queen Victoria), by Theed, adorns the market- place (1865) ; and there is a monument of the 1870-71 war in Ernest Square. Both trade and industry are flourishing, the chief branches of the latter being brew- ing, manufactures of machinery, colours, and porcelain, iron-founding, and saw-milling. Population (1885), 16,-

210; (1895), 18,688.

Cocanada or Coconada, a town of British India, in the Godavari district of Madras, on the seacoast in the extreme north of the Godavari delta, about 315 miles north of Madras. It had in 1881 a

population of 28,856, in 1891 of 40,068, and in 1901 of 47,866, show- ing an increase of 18 per cent. The muncipal revenue in 1897-98 was Rs*. 2,09,460. As the administrative head- quarters of the district, and the chief port on the eastern coast after Madras, Cocanada is steadily growing in im- portance. It is connected by navigable channels with the canal system of the Godavari delta, and by a branch line with Samalkot on the East Coast railway. The, anchor- age is an open roadstead, with two lighthouses. In 1897-98 the total sear-borne trade amounted to Rs.2,07,- 82,027, of which just one-half was conducted with foreign countries; 25 vessels entered and cleared for foreign trade, with an aggregate burthen of 23,367 tons. The chief exports are rice, cotton, sugar, and oilseeds. Mills have been established for cleaning rice. It contains a college, a high school with 408 pupils, a literary association, and five printing-presses.

Cochabamba, a department of Bolivia, bounded on the N. by that of La Paz, on the E. ty Santa Cruz, on the S. by Chuquisaca and Potosi, and. by Oruro and La Paz on the W., has an area of 21,420 square miles In 1893 the population numbered 360,220, and was estimated in 1898 at 376,800. The capital.

Cochabama, has 40,000 inhabitants. The department is divided into nine provinces. It had in 1878, 120 schools, attended by 8337 pupils.

Cochin, a feudatory state of Southern India, in political subordination to Madras, with an area of 1362 square miles. The population in 1891 was 722,906, being 531 persons per square mile ; in 1901 the population was 815,218, showing an increase of 13 per cent. More than one-fifth are. Christians, mostly Syrians and Roman Catholics. The revenue is estimated at Es.20,00,000, subject to a tribute of Rs. 2,00,000. During recent years a balance has been accumulated , of Rs.44,00,000, most of which is invested in securities of the Indian Government. The principal products are rice, coconuts, timber, cardamoms, pepper, and a little coffee. Salt is manufactured along the coast. The capital is Ernakolam, but the raja resides at Tripunthora. Apart from the British town of Cochin, the principal seaport is Malipu- ram. The chief means of communication is by boat along the backwaters ; but a metre gauge

line is being constructed at the cost of the state across the hills, from Ernakolam to Shoranur on the Madras railway. The length will be 65 miles, and the estimated cost is £337,- 000. In 1897-98 the total number of schools was 1020, attended by 30,550 pupils.

The town of Cochin is comprised within the British district of Malabar. Its population in 1891 was 16,147 ; the muncipal income in 1897-98 was Rs.21,530. Con- siderable sea-borne trade is still carried on. In 1897-98 the number of vessels that entered and cleared for foreign trade was 68, with an aggregate burthen of 99,775 tons. A lighthouse stands on the ruins of the old fort. The chief exports are coconut products, for the prepa- * ration of which there are factories. There are a missionary high schoQl, three printing-presses, and a library.

Cochin-China. — This term formerly included the whole Annamese Empire— Tongking, Annam, and Lower Cochin-China, but it now comprises only the Prench colony of Lower Cochin-China ; this consists of the six southern provinces of the Annamese Empire which were taken possession of by Prance after a war with the Emperor Tu Due. It lies between 8° and 11° 30′ N. lat. and 104° 25′ 65″ and 107° 29′ 65″ E. long., and is bounded on the N. by Annam and Cambodia, on the W. by Cam- bodia, on the E. by the China Sea, and on the S. and W. by the Gulf of Siam. It embraces almost the whole of the Mekong delta, which is intermingled with themouths of the Saigon river and of the two rivers Vaico, and con- sists mainly of a vast plain, almost entirely flooded. In the east, however, lies a mountain group of moderate altitude (extending from Cape St Jacques to the frontier of Annam), from which descend the rivers Donnai and Saigon. This region is inhabited by the Mois. The Mekong enters the sea by numerous mouths, which shift position under the varying effects of flood currents. Canals from Chaudoc to Hatien (Cancao) and from Long-Xuyen to Rash-Gia unite it with the Gulf of Siam. Several canals connect the Saigon river with the eastern arm of the Mekong. The ports of Saigon and Mytho are accessible to the largest vessels, and are connected by a railway. The roadsteads of Rash-Gia, Camao, and Hatien can accommodate only vessels of low tonnage. The climate, which is hot and damp, is divided into two very regular seasons by the north-east and

south-west monsoons, the former prevailing from October 15th to April 15th, the latter from April 15th to October 15th. The temperature varies from 60°-8 to 86° F. during the former, to 82°-4 to 95° P., or even higher, during the latter. Rains and tornadoes occur daily from

May to July, and from the middle of August to the end of September.

The area of Cochin-China is returned at 23,160 square miles, and in 1899 the inhabitants numbered 2,323,499, of whom 4461 were Europeans, 1601 being of&cials, and 1023 the members of their families. The Annamese number 2,064,831; the Cambodians, 182,659; the Mois, 6374; the Chams, 2656; the Chinese, 66,801; the Malays, 4130. The remainder consists of Tagals, Indians, Japanese, &c. Saigon, ■which in 1882 num- bered only 13,000 inhabitants, has now a population of 44,764, and is the capital not only of Cochin-China, but also of French Indo-China. In 1899 -there were in the colony 232 schools, with 116 European and 1183 native teachers, and 28,000 pupils. The Roman Catholic population numbered 73,234 ; and the Buddhists, 1,688,270. Cochin-China was autonomous until 1887, when it was divided into six provinces under the authority of a governor, assisted by a Colonial Council. The prosperity of the colony grew rapidly, and when Tongking and Annam were conquered, Cochin-China contributed 5,000,000 piastres to the Tongking budget.

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SKETCH MAP OP COCHIN-CHINA.

This contribution fell in 1892 to 4,000,000 piastres, and on the unification of Indo-China it ceased, Cochin- China furnishing, as do the other countries, its share to the general budget. The local budget for

1900 was estimated at 4,439,600 piastres for revenue and expen- diture; for 1901 it was estimated at 4,204,244 piastres, revenue and expenditure. According to ofB^cial accounts, the actual receipts to August 31, 1899, amounted to 4,263,192 piastres. The local government is now ad- ministered by a lieutenant-governor, who has a seat on the Superior Council of Indo-China, and is assisted by a Colonial Council composed of fifteen members, of whom eight are Europeans and seven Asiatics. Four of the European members are elected by universal suffrage, two are delegated by the Chamber of Commerce, and two by the Privy Council, which assists the governor-general. Cochin-China is divided into six provinces, Saigon, Mytho, Vinh-Long, Bassac, Saigon, and Cholon ; and twenty districts, each having at its head an administrator of native affairs, who presides over all civil service not undertaken by the general government. The self-adminis- tering municipalities of Saigon and Cholon districts used to be, but by a recent decision these arrondissements were

made provinces, to secure uniformity of nomenclature of administrative areas. Cochin-China is represented in the French Chamber by a deputy. Asiatic foreigners are subjected to a declaration de sijour, and also pay a capita^ tion fee. Besides French troops maintained by France, there are 2406 native 'soldiers maintained by the budget of Indo-China.

CoTnmerce. — About one-sixth of the total area is culti- vated, the chief crop being rice. The imports of merchan- dise in 1898 amounted to 54,964,222 francs ; the exports to 108,010,322 francs. The chief exports in 1898 were rice, 772,789 tons (of which 296,846 tons were cargo rice, and 286,841 tons white rice), of a total value, according to the customs returns, of £3,667,525; fish, value £233,440 ; cotton, £64,928 ; silk, £77,226 ; hides, isinglass, pepper, cardamom. Coffee culture is increasing, the num- ber of coffee plants in 1899 being 429,228, mostly belong- ing to Europeans. Cochin-China and Cambodia now forms a single customs district, and the commercial statistics for both are included under one head. The total trade for 1889 amounted to 177,238,958 francs, of which 66,234,008 francs represented imports and 111,004,950 francs exports. At Saigon, in 1899,

669 vessels of 811,157 tons entered ; of these, 234 of 333,714 tons were French, and 435 of 477,443 tons foreign. There are 51 miles of railway, Saigon to Mytho, and 2676 miles of telegraph line, and 86 telegraph offices. There are 79 post offices. The construction of 860 miles of new rail- way is proposed.

See also Indo-China. (j. m. a. de l.)

Cock, Edward (1806-1892), British surgeon, was born in 1806. He was a nephew of Sir Astley Cooper, and through him became at an early age a member of the staff of the Borough Hospital in London, where he worked in the dissecting room, for thirteen years. Afterwards he became in 1838 assistant surgeon at Guy's, where from 1849 to 1871 he was surgeon, and from 1871 to 1892 consulting surgeon. He rose to be president of the College of Surgeons in 1869. He was an excellent anatomist, a bold operator, and a clear and incisive writer, and though in lecturing he was afflicted with a stutter, he frequently utilized it with humorous effect and emphasis. From 1843 to 1849 he was editor of Guy's Hospital Reports, which contain many of his papers, particularly on stricture of the urethra, puncture of the bladder, injuries to the head, and hernia. He was the first English surgeon to perform pharyngotomy with success, and also one of the first to succeed in trephining for middle meningeal haemorrhage ; but the operation by which his name is known is that of opening the urethra through the perinseum (see Guy's Hospital Reports, 1866). He died at Kingston in 1892.

Cockburn, Sir Alexander James Edmund,

Bakt. (1802-1880), Lord Chief Justice of England, was born on 24th December 1802, and came of ancient Scottish stock. An ancestor, Alexander de Cockburn (descended from Petrus de Cockburn of Berwickshire, A.D. 1214), was granted in 1368 the barony of Carri- den, county Linlithgow, and was appointed with his heirs for ever Ostiarius Parliamenti (usher of the White Eod) by King David II. A subsequent ances- tor. Sir William Cockburn, who was created a baronet of Nova Scotia in 1627, had some difficulty in assert- ing his right to this office, but ultimately succeeded, and afterwards alienated

a moiety of it, becoming a joint usher with Colonel Cunningham. His son, Archi- bald, however, in 1674, bought back the half-right so disposed of, and obtained a fresh grant. The fifth baronet fell at Fontenoy in 1745, and his cousin, James Cockburn, at one time M.P. for Peebles, succeeded him as sixth

baronet. This gentleman, who in 1757 sold Langton, which had been the seat of the family since the fourteenth century, had a large family. His three elder sons held the title in succession, while the future Lord Chief Justice of England was the only son of the fourth son, Alexander, and eventually in 1858 followed his uncle. Sir William Cockburn, dean of York, as tenth baronet. Mr Alex- ander Cockburn, the father of Sir Alexander, was British Envoy Extraordinary and Minister Plenipotentiary to the State of Colombia, and married Yolande, daughter of the Vicomte de Vignier. Young Alexander was at one time intended for the diplomatic service, and frequently during the legal career which he ultimately adopted he was able to make considerable use of the knowledge of foreign languages, especially French, with which birth and early education had equipped him. He went eventually to Trinity Hall, Cambridge, where he did well, winning prizes for Latin and English composition, and appearing second in the first class of the law-tripos in 1825, although he does not seem to have proceeded to his degree until 1829. H« was elected a fellow, and afterwards an honorary fellow of his college, and having entered at the Middle Temple in 1825, was called to the Bar in 1829 ; but though he had shown himself a young man of considerable gifts, he had not exhibited promise of the industry and energy which, in spite of a pleasure-loving temperament, ultimately won for him success. He joined the Western Circuit, and for some time such practice as he was able to obtain lay at the Devon Sessions, Quarter Sessions at that time affording an opening and a school of advocacy to young counsel not to be found anywhere fifty years later. In London he had so little to do that only the persuasion of friends induced him to keep his London Chambers open. Three years

after his call to the Bar, however, the Reform Bill was passed, and the petitions which followed the ensuing general election gave rise to a large number of new questions for the decision of Election Committees, and afforded an opening of which he promptly availed himself. The decisions of the Committees had not been reported since 1821, and with Mr Eowe, another member of the Western Circuit, Cockburn undertook a new series of Eeports. They only published one volume, but the work was well done, and in 1833 Cockburn had his first parliamentary brief on behalf of Mr Henry Lytton Bulwer, and Mr EUice, Secretary to the Treasury, the sitting members for Coventry. In 1834 Cockburn was well enough thought of to be made a member of the Commission to inquire into the state of the corporations of England and Wales. Other parliamentary work followed; but he had ambition to be more than a parliamentary counsel, and he at- tended diligently on his Circuit, besides appearing before Committees. In 1841 he was in a position to take silk ; and in that year a charge of simony, brought against his uncle, the Dean of York, enabled him to appear conspicuously in a case which attracted con- siderable public attention, the proceedings taking the form of a motion for prohibition duly obtained against the Ecclesiastical Court, which had deprived Dr Cock- burn of his office. Not long after this, Sir Eobert Peel's secretary, Mr Drummond, was shot by the crazy Scotchman, M'Kaughten, and Cockburn, briefed on behalf of the assassin, not only made a very brilliant speech, which established the defence of insanity, but also secured the full publicity of a long report in the Morning Chronicle of the 6th of March 1843. Another well-known trial in which he appeared a year later was that of Wood v. Peel (Times, 2nd and 3rd July 1844), the issue being in form to determine the winner of a bet (the Gaming Act was passed in the following year) as to the age of the

Derby winner Eunning Eein— in substance to deter- mine, if possible, the vexed question whether Eunning Eein was a four-year-old or a three-year-old when he was racing as the latter. Eunning Eein could not be pro- duced by Mr Wood, and Baron Alderson took a strong view of this circumstance, so that Cockburn found him- self on the losing side, while his strenuous advocacy of his client's cause had led him into making, in his opening speech, strictures on Lord George Bentinck's

conduct in the case which had better have been reserved to a later stage. He was, however, a hard fighter, but not an unfair one, — a little irritable at times, but on the whole a courteous gentleman, and his practice went on increasing. ‘ In 1847 he decided to stand for Parliament, and was elected without a contest at Southamp- ton, standing as a Liberal and a reformer. During his first year or two in Parliament he showed himself to be a useful speaker on topics of legal reform, and gained the respect of his fellow members ; and in 1850 he had a chance, of which he availed himself to the utmost. The ” Pacifico ” dispute with Greece related, it will be remembered, to the treatment of a M. Pacifico, and other persons said to be British subjects, by a Greek mob, and to the forcible methods of Lord Palmerston in causing a British fleet to blockade the Piraeus in order to enforce attention to his demands for compensation. The Government was defeated in the House of Lords on this question, and in the House of Commons had a hard fight to carry the vote of confidence proposed by Mr Eoebuck, member for Sheffield. A lawyer was wanted to bring out the legal position of the Government. Mr Crowder, afterwards a judge, was not equal to the task; but on the third night of the debate Cockburn moved the adjournment of the House after Mr Gladstone had spoken, and on the following night made a speech, of which Lord Palmerston wrote to Lord Normanby : — “As to Cockburn’s, I do not know that I ever in the course of my life heard a better speech from anybody, without any exception.” Cockburn made another excellent speech very soon after this on the question of the treat- ment by Austria of the Magyar rebels ; and when, less than a month later. Sir John Jervis retired, and Sir John Eomilly was promoted to be Attorney-General, he became Solicitor-General and was knighted. He succeeded to the Attorney-Generalship in 1851, on the appointment of Eomilly as Master of the EoUs.

In February 1852 the Ministry resigned, and Cockburn vacated his post. During the short administration of Lord Derby which followed, Thesiger was Attorney-General, and Cockburn was engaged against him in the case of E. V. Newman, on the prosecution of Achilli. This was the trial of a criminal information for libel filed against John Henry Newman, who had denounced a scandalous and profiigate friar named Achilli, then lecturing on Eoman Catholicism in England. Newman

pleaded justifi- Ci3,tion ; but the jury who heard the case in the Queen's Bench, with Lord Campbell presiding, found that the justification was not proved except in one particular : a verdict which, together with the methods of the judge and the conduct of the audience, attracted considerable com- ment. The verdict was set aside, and a new trial ordered, but none ever took place. In December 1852, under Lord Aberdeen's Ministry, Cockburn became again Attorney- General, with Bethell as Solicitor-General, and so remained until 1856, taking part in many celebrated trials, such as the Hopwood Will Case in 1855, and the Swynfen Will Case, but notably leading for the Crown in the trial of William Palmer of Eugeley in Staffordshire, — an ex- medical m an who had taken to the turf , and who had poisoned a friend of similar pursuits named Cook with strychnine, in order to obtain money from his estate by forgery and

otherwise. Sir Alexaaider Cockburn made an exhaustive study of the medical aspects of the case, and the prisoner's comment when convicted after a twelve days' trial was, alluding to the Attorney-General's advocacy, "It was the riding that did it." In 1854 Cockburn was made recorder of Bristol. In 1856 Sir John Jervis died, and Cockburn became Chief Justice of the Common Pleas. In 1859 Lord Campbell became Chancellor, and Cockburn became Chief Justice of the Queen's Bench, continuing as a judge for twenty-four years, and dying in harness. On Friday, the 19th of November 1880, he tried causes with special juries at Westminster; on Saturday, the 20th, he presided over a Court for the consideration of Crown Cases Reserved ; he walked home, and on that night he died of angina pectoris at his house in Hertford Street. It is characteristic of the man that when he learnt that he was dying, his comment to his doctor was, " Well, I have had a good time."

Sir Alexander Cockbxirn earned and deserved a high reputation as a judge. He was a man of brilliant cleverness and rapid intuition, rather than of profound and laboriously cultivated intellect. He had been a

great advocate at the Bar, with a great charm of voice and manner, as well as a fluent and persuasive tongue, rather than a learned lawyer, but he was considered to be a good lawyer before he died, some assigning his unquestioned improvement in this respect to his frequent association on the bench with Blackburn. He had notoriously little sympathy with the Judicature Acts. Many were of opinion that he was inclined to take an advocate's view of the cases before him, making up his mind as to their merits prematurely and, in consequence, wrongly, as well as giving undue prominence to the views which he so formed ; but he was beyond doubt always in intention, and generally in fact, scrupulously fair. Lord Eussell of Killowen, L.C.J., writing of his immediate predecessor Lord Coleridge in 1894, gave his opinion that the beauty of Lord Coleridge's voice was un- surpassed in his experience, except perhaps by Sir Alexander Cock- burn, Mr Gladstone, Sir Robert Peel, and Father Burke of the Dominican Order. Coleridge, he further says, "could not have made the great Don Pacifioo speech of Sir Alexander Cockburn ; but then, who could ? " Commenting on the case of Saurin v. Starr (Feb. 1869), in which Coleridge led for the plaintiff, Lord Russell also wrote : "Sir Alexander Cockburn tried the case, and it afforded a strong illustration of a peculiarity in that remarkable man which those who practised before him will recognize. He began by being breast-high for the plaintifi, and so continued during the earlier stages of the trial ; but as the trial progressed, and especially after Mr Mellish's opening speech, he speedily turned round, and did all he could to secure a verdict for the defendants. But it was too late. The case was of a kind, not unnaturally, to excite prejudice against them, and the minds of the jury could not be turned back from the direction which the earlier action of the Chief Justice had given them." This criticism is interesting as coming from so great an advocate and so master- ful a Lord Chief Justice, himself by no means given to concealing his prejudices. It will further be remembered, however, that in this case Lord Russell, then Mr Charles Russell, was counsel on the losing side, that the case involved charges against a Roman Catholic reUgious establishment, and that he was himself a staunch Roman Catholic. Mr Justin M'Carthy calls Cockburn " one of the few great advocates who ever made a political figure in the House of Commons." Disraeli, in a characteristic speech,

once said of him in the House : ” He is a man of transcendent abilities ; ... he sustained the reputation which he had attained here and in the Courts of his country with learning and majesty ... He has shown himself a jurist and a publicist of the highest character” {Times, 24th April 1875). This was on the occasion of an attack upon him by Dr Kenealy, M.P., the Tichborne claimant’s counsel in the trial at Bar which consigned the claimant to penal servitude for perjury. Sir Alexander Cockburn, with Mr Justice Mellor and Mr Justice Lush, had tried him, the case lasting one hundred and eighty-eight days, of which the Lord Chief Justice’s summing up occupied eighteen. It is not necessary to enumerate the many causes eelebres at which Sir Alexander Cockburn presided as a judge. It was thought that he went out of his way to arrange that they should come before him, and his successor, Lord Coleridge, writing in 1881 to Lord Bramwell, to make the offer that he should try the murderer Lefroy as a last judicial act before retiring, added, “Poor dear Cockburn would hardly have given you such a chance.” Be this as it may, Cock- bum tried all cases which came before him, whether great or small, with the same thoroughness and with great courtesy and dignity, so that no counsel or suitor could complain that he had not been

fully heard in a matter in which the issues were seemingly trivial ; while he certainly gave great attention to the elaboration of his judgments and charges to juries.

The greatest public occasion on which Sir Alexander Cockburn acted, outside Ws usual judicial functions, was that of the Alabama Arbitration, held at Geneva in 1872, in which he represented the British Government, and dissented from the view taken by the majority of the arbitrators, without being able to convince them. He prepared, with Mr C. F. Adams, the representative of the United States, the English translation of the award of the arbitrators, and published his reasons for dissenting in a vigorously worded document which did*not meet with universal commend- ation. He admitted in substance the liability of England for the acts of the Alabama, but not on the grounds on which the decision of the majority was based, and he held England not to be liable in respect of the Florida and the Shenandoah. His

opposition to the appointment of Sir Robert Collier to the Judicial Committee of the Privy Council had, shortly before the arbitration, so embroiled him with the Government that, stung. by a speech of the duke of Argyll, he had threatened to resign his position as arbitrator. His views on the Collier controversy were chiefly expressed in letters to Lord Westbury ; he was at all times fond of controversy and controversial writing.

In personal appearance Sir Alexander Cockburn was of small stature, but his dignity of deportment caused this to be forgotten. His courtesy and polish of manner have been referred to. In private life he was fond of sport, and he was engaged in writing a series of articles on the ” History of the Chase in the Nineteenth Century ” at the time of his death. He took his relaxation during his last years in his yacht the Zouave, and he was also fond of music. He was fond, too, of society ; and in the interesting debate on the Tichborne trial, to which reference has been made, some aid was lent to KeneaJy’s attack by a jocular, but somewhat imprudent, remark of Cockbum’s to a lady at a dinner-party, which she was foolish enough to repeat. He was also throughout his Ufe addicted to frivolities not altogether consistent with advancement in a learned profession, or with the positions of dignity which he successively occupied. Shooting once at Hinton with Lord Westbury, when a high rocketing pheasant was nearly dropped on his head by another gun. Sir Alexander Cockburn, who had not seen the bird, called out, “Fire high, fire high.” Whereupon Lord Westbury said, ” Don’t be alarmed. Chief Justice : you are quite safe. You are not as near heaven as that bird was when it was shot, and I am sadly afraid, after those stories of yovirs at luncheon, that you never will be.” At the same time he showed no lack of dignity in his public capacity. He had a high sense of what was due to, and expected from, his profession ; and his utterance upon the limit- ations of advocacy, in his speech at the banquet given in the Middle Temple Hall to Mons. Berryer, the celebrated French advocate, may be called the classical authority on the subject. Lord Brougham, replying for the guests other than Berryer, had spoken of “the first great duty of an advocate to reckon everything sub- ordinate to the interests of his client.” The Lord Chief Justice, replying to the toast of ” the Judges of England,” dissented

from this sweeping statement, saying, amid loud cheers from a distinguished assembly of lawyers, ” The arms which an advocate wields he ought to use as a warrior, not as an assassin. He ought to uphold the interests of his clients per /as, not per ne/as. He ought to know how to reconcile the interests of his clients with the eternal interests of truth and justice” {Times, 9th Nov. 1864). Sir Alexander Cockburn was never married, and the baronetcy became extinct at his death.

Authorities. — Times, 22nd Nov. 1880; Law Journal; Law Times; Solicitors^ Journal, 27th Nov. 1880 ; Law Magazine, new series, vol. xv. p. 193, 1851 ; Ashley’s Life of Lord Palmer- ston; Nash’s Life of Lord Westbury; “Reminiscences of Lord Chief Justice Coleridge,” by Lord Russell of Killowen, in the North American JRevieM, Sept. 1894 ; The Greville Memoirs ; Croker’s Correspondence and Diaries ; Justin M’Carthy ‘s History of Our Oion Times; Serjeant Ballantine’s Experiences; Bench and Bar, by Serjeant Robinson ; Fairchild’s ii/e of Lord Bramwell; Manson’s Builders of Our Law; Bvirke’s Peerage, ed. 1879; Fosters’ Peerage, 1880. (e. a. ak.)

Cockermouth, a market-town in the Cocker- mouth parliamentary division (since 1885) of Cumberland, England, on the Derwent, 27 miles south-west of Carlisle by rail. A statue was erected in 1875 to the sixth earl of Mayo, who represented the borough in parliament and was subsequently viceroy of India. Ironworks, tanneries, and confectionery works have been established. Area of township (an urban district), 2426 acres. Population

(1881), 5353; (1901), 5355.

Cocos Islands. See Keelikg Islakds.

CODEX B E Z M

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Codex Bexae. — The MS. which is known by the name of Codex Bezae, after the great Eeformer, and which is marked amongst the MSS. of the

New Testament by the sign D (or rather by the two signs D, d, according as its Greek or Latin side is under discussion), is a bilingual [Grseco-Latin] codex, containing, with some lacunae, the text of the Four Gospels and the Acts, in an uncial hand which is commonly ascribed to the sixth century. From the fact that a fragment of the 3rd Epistle of John pre- cedes the Acts, it has been inferred that it at one time contained the Catholic Epistles, though not in the common order, and from a study of the ancient numbering of the quires, it appears that the missing matter was not confined to the Catholic Epistles, and that some other book was also included, but no satisfactory conjecture has yet been made as to the character of the missing portion. The order of the Gospels is that which was once common in the West, in which the Apostolic Evangelists come first, namely, Mt, Joh, Lu, Mc, the whole book being denoted by Mt + Joh + Lu + Mc + X + Cath + Acts, where X stands for the unknown missing matter, and Cath for the portions of the Catholic Epistles which it once contained (the three epistles of John, at the least).

The MS. was presented by Beza to the University of Cambridge, in whose public library it has since been preserved, in the year 1582. If Baza's own account can be trusted, it was brought to him from the monastery of St Irenaeus at Lyons, where it had been lying mutilated and covered with dust, the time of its discovery being the sack of lines in 1562. Some superficial grounds for doubting the exactness of this statement are found in the facts (1) that Beza in his latest Greek Testament (1598) calls ~~it Claromon~~ tanus, and not Lugdunensis (a term he never seems to apply, using instead the colourless vetustissimus) ; (2) that it was in Italy shortly before 1550, for this is undoubtedly the MS. marked /3′ from which readings are given on the margin of Robert Stephen's edition of the N.T. in that year, and which is expressly stated by him to have been collated by " our friends in Italy." But these statements can be reconciled by adding the further evidence of Marianus Victorius as to the production at the Council of Trent (in 1546 ?) of an ancient Greek MS. confirming the Latin reading of John 212^. This MS. was produced by William k Prato, bishop of Clermont in the Auvergne, and the neighbourhood of Clermont Ferrand to Lyons may be thought suflBcient to explain at once the presence of the book

in Italy and the fluctuation as to its title in the last Bezan N.T. It should be remarked, however, that there has recently been a recrudescence of suspicions as to the accuracy of Beza's state- ments concerning the Codex, and that some modern scholars, becoming sceptical as to its connexion with Lyons at all, are looking for a home for the Codex in Italy, previous to its passing into Beza's hands.

Whatever may be the outcome of this demand for re-exammation of the Bezan statements, it should be noted that Beza had not the slightest suspicion that his beloved vetustissimus was the same as the /3′ of Stephen ; for he quotes them as if they were two separate authorities, even in places where the Bezan Codex is most singular. Perhaps we must not be too severe on him in this, for the very

pericope ae nomme operante , , _ .

cussed is the most conspicuous singularity in the whole MS., the passage at which the MS. usually stands open in the University Library at Cambridge. If Bianchini fell into the same trap, we must not judge Beza too hardly. In any case he cannot have known that his MS. had been collated for Robert Stephen in Italy. One would like to know something more about this collation. Who were the friends that collated ? The term seems too vague for his son Henry, who probably was in Italy just at the right time for making the collation. Was there another hand ? Perhaps that of Vatablus? And was the collating done at Trent? On these points some further information may be accessible. Meanwhile we adhere provisionally, but with some hesitation, to the belief that it is a Lyons MS.

We have already alluded, in passing, to two singular readings of the MS. in which it appears to be unique, namely, the reading in Joh 2V% eav avrov OtXai fievuv o«r

e-iriKaTaparoi Kai Trapa/Sarijs a tov vop.ov = " on the same day having observed one working on the Sabbath he said to him, Man, if thou knowest what thou dost, blessed art thou ; but if thou knowest not, thou art accursed and a transgressor of the law"). These singular readings and interpolations are characteristic of the Codex Bezse, and

apparently Beza himself, though he quotes many of the most surprising readings, felt some alarm at them, for he explained to the University of Cambridge that the MS. ought not to be published, for fear of giving offence (asservandum poiius quam publicandum). At the same time he was alive to its critical value, and appears to have recognized its relation to the old Latin and Syriac texts of the New Testament.

The MS. was not long in the possession of the university before its text was transcribed, more or less completely. It was tran- scribed in 1583 for Archbishop Whitgift, and partly collated by Patrick Young. Archbishop Usher collated it for Walton's Poly- glot (1657), and Wetstein studied it closely in 1716. In 1732 it was collated by John Dickinson, with a view to remedy the errors in the critical apparatus of Mill. However imperfect these and other collations may be, they have an occasional scientific value at the present day in cases where the MS. has become illegible or damaged, e.g., Ac 21^*, where Whitgift's transcript should be consulted, along with the other early readers and collators. Whit- gift's copy is in the Trinity College Library, Dickinson's in Jesus College Library, the others are to be consulted in the several New Testaments to whicb they belong. In 1793 the first great attempt was made by the University of Cambridge to publish an accurate transcript of the whole text. The work was entrusted to Dr Thomas Kipling, and splendidly issued in two folio volumes. The prolegomena were poor, but the transcript was fairly accurate ; the work was, however, fiercely attacked on two sides on which it was singularly vulnerable, the Latin of the preface and its logic. Thomas Edwards, of Clare Hall, produced a tract on Kipling's work, which was written in the liveliest style of 18th century polemic. The tract is, however, hardly intelligible without a knowledge of contemporary university politics into which Edwards frequently diverges, and which have little interest at the present day. A more serious defect was the use of a single fount of type, both for the text and the marginal annotations, which are centuries later than the body of the text, a fault which led Credner, and in our own time Resch, into serious errors with regard to the origin of the text. The next great step in the knowledge of the text was taken when the MS. was edited by the Rev. F. H. Scrivener, in 1864, with a very complete series of annotations and prolegomena, in which

everything was done, or almost everything that an editor could do, to furnish the student with an exact representation, in ordinary type, of the contents of the MS., and to supply at the same time criteria for discriminating the various hands by which the MS. had experienced correction or annotation, and generally recording the fortunes and the history both of the MS. and the peculiar text which it transmits. Facsimiles were engraved of two corresponding pages of the Greek and Latin, and of a number of places where correcting or annotating hands had been at work ; and, on the whole, a notable advance was made in the materials for the history of the Codex. In 1900 the whole MS. was photo- graphically reproduced for the university by the hands of Dujardin of Paris, the very fragile and much worn book being thus rendered the secure possession of scholars everywhere. The use of the photo- lithograph may sometimes mislead the reader, in cases where the shades of colour of the inks employed are no longer discriminated, and where the extreme tenuity of the vellum has allowed both the obverse and reverse of a leaf to appear at once in the transcript.

A word should be said at this point with regard to the text and its annotators and correctors. Naturally, after Kipling and Scrivener there is not much to be added in the way of readings to the text ; but it should be observed that Blass (to whom we shall presently refer) has read several places in the text where Scrivener had to resort to conjecture, e.g., the reading of Scrivener in Acts 18′ is /AETttjSas [8e ttTTO aKv^ \a

[^a.TOV [o]i[kJov Ttvos, where Blass reads

/t£Ta;8as [aire rov] aKvXa in the first line, and Harris reads

KM TjXOev CtS TOV [o]t[K]oi’ TlVOi

in the second line.

The importance of the correction lies in the explanation

that Paul left, not Aquila, but Aquila's house ; and in the restoration of a curious syntactical construction which is peculiar to Codex Bezae. Other corrections may be made. But it is in the annotations that the student will, by the aid of the facsimile, add most to the Scrivener transcript, and where he will make many corrections both as to the matters deciphered and the dates to which the hands are assigned. Of publications which in recent times have dealt with the Codex Bezae, and the peculiar West- ern text of which it is the chief representative, the follow- ing should be noted: — (1) J. Eendel Harris, Study of Codex BezoB (1891), in which the problem of the Bezan text was reopened, and an attempt was made to explain the peculiarities by the hypothesis of Latin reactions upon a Greek text, accompanied in a lesser degree by some Syriac reactions, the additional matter being largely due to a glossator who was probably under the influence of the Montanist movement. (2) F. H. Chase, Old Syriac Element in the Codex Bezos (1893) and The Sylo-Latin Text of the Gospels (1895), in which substantially the whole of the Bezan peculiarities were referred to Syriac influence, and an attempt was made to find the original home of the text in Antioch. (3) The reply by Harris in Fotir Lec- tures on the Western Text (1894) should be studied, both for what it contradicts and what it concedes, and espe- cially for the proof it contains of the early diffusion of the Bezan accretions to the Acts in Mesopotamia and other parts of the East. (4) But these and other attempts to explain the genesis of the Bezan text were cast into the shade by a brilliant hypothesis of Professor Blass of Halle, who maintained that the Lucan writings (St Luke and the Acts) in which the deviation of the Codex Bezae from canonical form is most conspicuous, were in reality extant in two separate editions produced by St Luke himself, one of which he calls Antiochian, and the other Eoman, a hypothesis which Blass defends with astonishing learn- ing and skill, and in which he enlisted, almost at once, a body of sympathizers such as Nestle, Hilgenfeld, Belser, Salmon, and others, whose writings must be referred to. Blass himself not only published the Acts in what he sup- posed to be the

original double edition, but defended himself against all attacks with amazing vigour, so that even Harnack has hardly succeeded in demolishing his theory. Whether, however, this theory can be finally sustained is still in lite. What is certain is that the Western text, as represented in the Codex Bezae and cog- nate authorities, is older and more widely diffused than had been generally recognized; that it was extant in Greek, Latin, and Syriac in the earliest times ; and that no single series of linguistic reactions can explain it away. And whatever be the exact value of the Blass demonstra- tions and reconstructions, it is evident that a great in- crease of critical weight has accrued to the Western readings generally in consequence of them ; so that, even if it be conceded, as it must be, that the Codex Bezae is subject to all kinds of corrupting influences, such as lec- tionary prefaces, harmonizations, and bad transcriptions, the nucleus of the text is as old as anything which we have in evidence for the text of the New Testament. A striking instance of this may be found in a far-reaching observation of a pupil of Professor Blass, named Lippelt, who found on examining the spelling of the name 'Icoawjys in the Codex Bezae, that the name was almost uniformly spelt with one v in the two Lucan books, although in the rest of the Codex the conventional spelling has prevailed. This striking testimony to the fact that the Bezan Luke and Acts once circulated together in a separate volume, though they are not now side by side, may be further extended by examining the Latin version, from which it appears that the spelling with one n prevails in Luke, but not in Acts, the inference being that the combined Lucan

volume was not translated all at once, but at two diffei^ent times and by two different hands. The Bezan text, there- fore, retains traces of the history and collection of the books of the N.T. and of their translation which are not to be found in any other MS., and to be faithful thus in minimis renders it certain that it is also trustworthy in greater matters. The ultimate discrimination of the various elements in the Bezan (Western) text has yet to be made, and the suspicion is that the problem has not yet found its Newton. (j- k. ha.)

Ccelentera form a Group or Grade of the Animal Kingdom, the zoological importance of which has risen considerably since the time

(1887) of the publication of the original article in the Ency. Brit., even though their numbers have been reduced by the elevation of the Sponges or Porifera to the rank of an independent Phy- lum under the title Parazoa (SoUas, 1884). For the Ccelentera thus restricted, the term Enterocoela, in contrast to Ccelomocoela (the old Ccelomata), was sug- gested by Lankester (1900). From the more complex colonial Protozoa the Ccelentera are readily separated by their possession of two distinct sets of cells, with diverse functions, arranged in two definite layers, — a condition found in no Protozoan. The old criterion by which they and other Metazoa were once distinguished from Protozoa, namely, the differentiation of large and small sexual cells from each other and from the remaining cells of the body, has been broken down by the discovery of numerous cases of such differentiation among Protozoa. The Ccelentera, as contrasted with other Metazoa (but not Parazoa), consist of two layers of cells only, an outer layer or ectoderm, an inner layer or endoderm. They have hence been described as Diploblastica. In the remaining Met- azoa certain cells are budded off at an early stage of development from one or both of the two original layers, to form later a third layer, the mesoderm, which lies between the ectoderm and endoderm ; such forms have therefore received the name Triploblastica. At the same time it is necessary to observe that it is by no means certain that the mesoderm found in various groups of Metazoa is a similar or homologous formation in all cases. A second essential difference between Ccelentera and other Metazoa (except Parazoa) is that in the former all spaces in the interior of the body are referable to a single cavity of endodermal origin, the ” gastro-vascular cavity,” often termed the coelenteron : the spaces are always originally continuous with one another, and are in almost every case permanently so. This single cavity and its lining serve apparently for all those functions (digestion, excretion, circulation, and often reproduction) which in more com- plex organisms are distributed among various cavities of independent and often very diverse origin.

In the Ccelentera the ectoderm and endoderm are set apart from one another at a very early period in the life- history ; generally either by delamination or invagination, processes described in the article Embryology. Be- tween these two cell-layers a mesogloea (Bourne,

1887) is always intercalated as a secretion by one or both of them ; this is a gelatinoid, primitively structureless lamella, which in the first instance serves merely as a basal support for the cells. In many cases, as, for example, in the Me- dusae or jelly-fish, the mesogloea may be so thick as to con- stitute the chief part of the body in bulk and weight. The ectoderm rarely consists of more than one layer of cells : these are divisible by structure and function into nervous, muscular, and secretory cells, supported by interstitial cells. The endodermis generally also an epithelium one cell in thickness, the cells being digestive, secretory, and some- times musciilar. Reproductive sexual cells may be found in either of these two layers, according to the class and

snb-class in question. The mesogloea is in itself an inert non-cellular secretion, but the immigration of muscular and other cells into its substance, both from ectoderm and endoderm, gives it in many cases a strong resemblance to the mesoderm of Triploblastica,^a resemblance which, ■while probably superficial, may yet serve to indicate the path of evolution of the mesoderm.

The Ccelentera may thus be briefly defined as Metazoa ■which exhibit two embryonic cell-layers only, — the ecto- derm and endoderm, — their body-cavities being referable to a single cavity or ccElenteron in the endoderm. Their position in the Animal Kingdom and their main sub- divisions may be expressed in the follo’wing table : —

I. Protozoa. II. Pakazoa. III. Metazoa.

Ccelentera :Diploblastica.

Triploblafitioa (including Coelomata).

HydromedussB.

Scyphozoa.

Ctenophora.

Scypliomedusse.

1

Anthozoa.

On a comparison of these subdivisions with those adopted by Professor Lankester in the article Hydrozoa (Ency. Brit. vol. xii.), it will be noticed that the Scypho- medusse then included with the Hydromedusae as Hydro- zoa are here placed nearer to the Anthozoa than to their old pendants. The reasons for this may be stated briefly.

The' Hydkomedus^ are distinguished from the Scy- phozoa chiefly by negative characters ; they have no sto- modseum, that is, no ingrowth of ectoderm at the mouth to form an oesophagus ; they have no mesenteries (radiating partitions) which incompletely subdivide the coelenteron ; and they have no concentration of digestive cells into spe- cial organs. Their ectodermal- muscles are mainly longitu- dinal, their endodermal muscles are circularly arranged on the body-wall. Their sexual cells are (probably in all cases) produced from the ectoderm, and lie in those radii which are first accentuated in development. They typically pre- sent two structural forms, the non-sexual hydroid, and the sexual medusoid ; in such a case there is an alternation of generations (metagenesis), the hydroid giving rise to the medusoid by a sexual gemmation, the medusoid bearing sexual cells which develop into a hydroid. In some other cases medusoid develops directly from medusoid (hypo- genesis), whether by sexual cells or by gemmation. The medusoids have a muscular velum of ectoderm and mesogloea only.

The Scyphozoa have the following features m com- mon : — They typically exhibit an ectodermal stomodseum ; partitions or mesenteries project into their ccelenteron from the body-wall, and on these are generally concen- trated digestive cells (to form mesenterial filaments, phar ceuse, etc.) ; the external musculature of the body-wall is circular

(except in Gerianthus) ; the internal, longitudinal ; and the sexual cells probably always arise in the endoderm.

The SoYPHOMEDUSJE, like the Hydromedus^, typically ■present a metagenesis, the non-sexual scyphistomoid (cor- responding to the hydroid) alternating with the sexual medusoid. In other cases the medusoid is hypogenetic, medusoid producing medusoid. The sexual cells of the medusoid lie in the endoderm on interradii, that is, on the second set of radii accentuated in the course of develop- ment The medusoids have no true velum ; m some cases a structure more or less resembling this organ, termed a velarium, is present, permeated by endodermal canals.

The Anthozoa differ from the Scyphomedusse in hav- ing no medusoid form ; they all more or less resemble a sea-anemone, and may be termed actinioid. They are (with rare exceptions, probably secondarily acquired) hypogenetic, the offspring resembling the parent, and both being sexual. The sexual cells are borne on the mesen- teries in positions irrespective of obvious developmental radii.

The Ctenophoba are so aberrant in structure that it has been proposed to separate them from the Ccelentera altogether: they are, however, theoretically deducible from an ancestor common to other Ccelentera, but their extreme specialization precludes the idea of any close relationship with the rest (see Ctenophora).

As regards the other three groups, however, it is easy to conceive of them as derived from an ancestor, represented to-day to some extent by the planularlarva (Ency. Brit, H^YDKOzoA, vol. xii. p. 548), which was Coelenterate in so far as it was composed of an ectoderm and endoderm, and had an internal digestive cavity (I. of the table).

HydromedussB.

ScyphonaedussB.

Anthozoa.

Ctenophora ?

At the point of divergence between Scyphozoa and Hydromedusse (II. of the table of hypothetical descent), we may conceive of its descendant as tentaculate, capable of either floating (swimming) or fixation at ■will like Lucernaria to-day ; and exhibitingincipient differentiation of myoepithial cells (neuro-muscular cells of Hydkozoa, loc. cit. p. 649). At the parting of the ways which led, on the one hand, to modem Scyphomedusse, on the other to Anthozoa (III.), it is probable that the common ances- tor was marked by incipient mesenteries and by the limitation of the sexual cells to endoderm. The lines of descent — II. to Hydromedusae, and III. to Scyphomedusse — represent periods during which the hypothetical ances- tors II. and III., capable of either locomotion or fixation at will, were either differentiated into alternating genera- tions of fixed sterile nutritive hydroids (scyphistomoids) and locomotor sexual medusoids, or abandoned the power of fixation in hypogenetic cases. During the period represented by the line of descent — III. to Anthozoa — this group abandoned its power of adult locomotion by s^wimming. During these periods were also attained those less important structural characters which these three groups present to-day. (g. h. fo.)

Cognac, chief town of arrondissement, department of Charente, France, 32 miles west by north of Angou- 16me, by rail. Large quantities of brandy and wine are exported to England, America, and Australia, and the total trade in alcoholic liquors of Cognac alone has a mean annual value of £1,200,000. Population (1881),

13,096; (1896), 18,932.

Cohn, Ferdinand (1828-1898), Germaa botanist, was born on 24tli January 1828 at Breslau. He was educated at Breslau and Berlin, subsequently being Pro- fessor of Botany at Breslau University. He had. a re- markable career owing to his Jewish origin. He was contemporary

with Pringsheim, and worked with Goep- pert, Nees von Esenbeck, Ehrenberg, and Johannes Mllller. At an early date he exhibited astonishing ability with the microscope, which he did much to improve, and his researches on cell-walls and the growth and contents of plant-cells soon attracted attention, especially as he made remarkable advances in the establishment of an improved cell-theory, discovered the cilia in, and analysed the movements of, zoospores, and pointed out that the protoplasm of the plant-cell and the sarcode of the zoolo- gists were one and the same physical vehicle of life. Although these early researches were especially on the Algae, in which group he instituted marked reforms of the rigid system due to Klltzing, Cohn had already dis- played that activity in various departments which made him so famous as an all-round naturalist, his attention at various times being turned to such varied subjects as Aldorovanda, torsion in trees, the nature of waterspouts, the effects of lightning, physiology of seeds, the proteid crystals in the potato, which he discovered, the format tion of travertin, the rotatoria, luminous worms, &c. &c., the mere notice of which would carry us too far.

It is, however, in the introduction of the strict biologi- cal and philosophical analysis of the life-histories of the lower and most minute forms of life that Cohn's greatest achievements consist, for he applied to these organisms the principle that we can only know the phases of growth of microscopic plants by watching every stage of develop- ment under the microscope, just as we learn how differ- ent are the youthful and adult appearances of an oak or a fern by direct observation. The success with which he attempted and carried out the application of cultural and developmental methods on the Algae, Fungi, and Bacteria can only be fully appreciated by those familiar with the minute size and elusive evolutions of these organisms, and with the limited appliances at Cohn's command. Nevertheless his account of the life-histories of Protococais (1850), Stephanosphcera (1852), Volvox (1856 and 1875), Hydrodictyon (1861), and Sphceroplea (1855- 67) among the Algae have never been put aside. The first is a model of what a study in development should be; the last shares with Thuret's studies on Fucus and Pringsheim's on Vaucheria the merit of establish- ing the existence of a sexual process in Algae. Among the Fungi Cohn contributed

important researches on Pilobolus (1851), Empusa (1855), Tarichium (1869), as well as valuable work on the nature of parasitism of Algae and Fungi.

It is as the founder of bacteriology that Cohn's most striking claims to recognition will be established. He seems to have been always attracted particularly by curious problems of fermentation and coloration due to the most minute forms of life, as evinced by his papers on Monas prodigwsa (1850) and "Ueber blutalmliche Farbungen" (1850), on infusoria (1851 and 1852), on organisms in drinking-water (1853), " Die "Wunder des Blutes " (1854), and had already published several works on insect epidemics (1869-70) and on plant diseases, when his first specially bacteriological memoir (Creno- ihrix) appeared in the journal {Beitratje zur BMogie) which he then started (1870-71), and which has since become so renowned. Investigations on other branches of bacteriology soon followed, among which " Organismen der Pockenlymphe " (1872), " Untersuchungen Tiber Bac- terien," I. (1872), II. (1875), IV. (1876), are most impor- tant, and laid the foundations of the new department of

science which has now its own laboratories, literature, and votaries specially devoted to its extension in all di- rections. When it is remembered that Cohn brought out and helped Koch in publishing his celebrated paper on Anthrax (1876), the first clearly worked out case of a bacterial disease, the significance of his influence on bacteriology becomes apparent.

Among his. most striking discoveries during his studies of the forms and movements of the Bacteria may be mentioned the nature of Zooglaea, the formation and germination of true spores, — which he observed for the first time, and which he himself discovered* in BaciUus subtilis, — and their resistance to high temperatures, and the bearing of this on the fallacious experiments sup- posed to support abiogenesis ; as well as works on the bacteria of air and water, the significance of the bright sulphur-granules in sulphur bacteria, and of the iron- oxide deposited in the walls of Crenothrix. His dis- coveries in these and in other departments all stand forth as mementoes of his

acute observation and reasoning powers, and the thoughtful (in every sense of the word) consideration of the work of others, and suggestive ideas attached to his principal papers, bear the same charac- teristics. If we overcome the always difficult task of bridging in imagination the interval between our present platform of knowledge and that on which bacteriologists stood in, say, 1870, we shall not undervalue the impor- tant contributions of Cohn to the overthrow of the then formidable bugbear known as the doctrine of ” Sponta- neous Generation,” a dogma of despair calculated to im- pede progress as much in its day as that of ” Vitalism” did in other periods. Cohn had also clear perceptions of the important bearings of Mycology and Bacteriology in infective diseases, as shown by his studies in insect- killing fungi, microscopic analysis of water, &c. He was a foreign member of the Royal Society and of the Linnean Society, and received the gold medal of the latter in 1895. He died in 1898. Lists of his papers will be found in the Catdlogtie of Scientific Papers of the Royal Society, and in Ber. d. d. hot. Gesellsch., 1899, vol. xvii. p. 196. The latter also contains (p. 172) a full memoir by F. Rosen. (h. m. w.)

Cohoes, a city of Albany county, New York, U. S. A., situated in 42° 46′ N. lat. and 73° 4^’ W. long., in the eastern part of the state. Two railways enter the city — ^the Delaware and Hudson and the N^w York Central and Hudson River. It was built for manufac- turing purposes at the Falls of the Mohawk, which furnish power. In 1890 there was an invested capital of $11,275,137, employing 8939 persons, with a product amounting to f 10,836,260. Of this amount one-half was represented by hosiery and knit goods, for which the place is famous. Population (1880), 19,416; (1890),

22,609; (1900), 23,910.

Coimbatore, a town and district of British India, in the Madras Presidency. The town is situated on the left bank of the Noyil river, 304 miles by rail from Madras. In 1881 it had a population of 38,967, in 1891 of 46,383, and in 1901 of 52,931, showing an increase of 14 per cent. The municipal income in 1896-97 was Rs.55,730. The town stands 1437 feet above sea-level, and is well laid out and healthy. It has a

station on the Nilgiri branch of the Madras railway. It has two aided colleges, three high schools with 1185 pupils, several

1 In Angust 1872 Cohn wrote: “So hat sich hei den Bakterien iiherhaupt keine eigentliche Fortpflanzung (Ei-oder Sporen- bildung) bis jetzt nachweisen lassen” (Beitr. B. i. H. 2, p. 179). In 1876 (Beitr. B. ii. H. 2, p. 263) he described the spores and tlieir formation in B. subtilit.

missionary bodies and literary institutions, and four printing-presses. There is one cotton mill, with 20,384 spindles, employing 1000 hands.

The DISTRICT OF CoiMBATORE has an area of 7860 square miles. The population in 1891 was 2,004,839, being 255 persons per square mile. In 1901 the population was 2,202,312, showing an increase of 10 per cent. The land revenue and rates were Es. 33,82,127, the incident of assessment being E. 1-2-5 per acre; the number of police was 906. In 1897-98, out of a total cultivated area of 2,266,851 acres, 390,262 were irrigated, including 74,973 from Government canals. The principal crops are millet, rice, other food grain, pulse, oilseeds, cotton, and tobacco, with a little coffee. Forests cover nearly 1^ million acres, yielding valuable timber (teak, sandal-wood, &c.), and affording grazing ground for cattle. There are eight factories for pressing cotton, and two for cleaning coffee, two oilcake presses, three tanneries with an outturn valued at Es. 50,00,000, a sugar refinery, and 822 saltpetre refineries. The south-west line of the Madras railway runs through the district. In 1896-97 the number of schools was 1242, attended by 35,477 pupils, being one pupil to every 57 of the total population. The registered death-rate in 1897 was 20-1 per thousand.

Coimbra, a city and episcopal see of Portugal, capital of district Coimbra, on the right bank of the Mondego, about 24 miles above its mouth. It has a scientific and literary institute. The average attendance at the university is 1350 students annually. There are manufactures of

earthenware, hats, and leather; and lamprey fishing is important. Population (1900), 18,424. The district of Coimbra has an area of 1499 square miles, and a population of 333,505, giving a density of 211 inhabitants to the square mile. It has a fertile soil, and produces millet and wine, and possesses large herds of cattle. At Cape Mondego coal is mined.

Coinage. See Numismatics.

Co ire, or Chub (often now spelt "Cur"), the capital of the Swiss canton of the G-risons or Graubunden. It is 1952 feet above the level of the sea. The new Eaetian Museum has many antiquities, books, &c., re- lating to ancient Raetia, and includes also the geological collection of the monk Placidus a Spescha, who about 100 years ago thoroughly explored his native country. Father Theodosius, the founder of the hospital, died in 1865, and has a monument in front of the cathedral. Population, 9259 in 1888, and 11,513 in 1900. In 1888 Coire contained 6518 Romanists and 2729 Protestants, while 7799 spoke German and 1158 Eomonsch. The see of Coire dates probably from the second half of the 4th century, and the first known bishop, Asimo, is mentioned in 455. In the troubled times of the 8th century the bishops were also great temporal lords, while in 831 Louis the Pious granted the bishop "immunity" for his territories, so that henceforth he was dependent simply on the empire. In 1170 he became a prince of the holy Eoman Empire, and later extended his power over many of the neighbouring regions. In 1392 he became the chief of the "League of the House of God," originally formed in 1367 against him by his chapter, the city of Coire, &c. In 1526, by the "articles of Ilanz," the bishop lost all his temporal possessions and rights, having, so to speak, fulfilled his historical role of bring- ing together the elements of one of the three Eaetian leagues that in 1803 formed the canton of the Grisons. The guild constitution of the city of Coire lasted from 1465 to 1839.

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Colchester, a municipal and parliamentary borough (coextensive; since 1885 returning only one member) and seaport of Essex, England, on the Colne and the Great Eastern railway. The ancient church of the Holy Trinity has been restored, and St Eunwald's re- moved. Eecent erections are a new bridge over the Colne, assembly rooms, a corn exchange, a town-hall, a technical and university extension college, a drill-hall, a reading-room, a library, a dozen almshouses, and a new cattle market. The Essex and Colchester general hospital has been enlarged. Castle Park, of 9 acres, containing Colchester Castle, was opened in 1892. The harbour was taken over by the corporation in 1898. The oyster fisheries belonging to the corporation are held on a ninety-nine years' lease by the Colne Fishery Company, incorporated under an Act of 1870. The registered shipping at the end of 1900 consisted of 157 vessels of 4717 tons. In 1900, 537 vessels of 38,731 tons entered, and 505 of 34,338 tons cleared. These entrances and clearances do not include those of vessels trading between Colchester and London or other ports on the estuary of the Thames. Area, 11,331 acres. Popula- tion (1881), 28,374; (1891), 34,559; (1901), 38,351.

Colchester, a town of Chittenden county, Ver- mont, U.S.A., on the Lake Champlain. The principal village of the town is Winooski, on Onion river, a few miles above its mouth, and on the Central Vermont rail- way, at an altitude of 326 feet. Population (1880), 4421 ;

(1890), 6143; (1900), 6352.

Cold Harbor, a village of Hanover county, Virginia, U.S.A., 10 miles north-east of Eichmond. It was the scene of a succession of battles, June 1, 2, and 3, 1864, between the Union army under Grant and the Confederate forces under Lee. The Union troops, who took the

offensive in most of the fighting, lost heavily, the total number being reported at 12,738.

Cold Storage. See Eefeigekating Machinery.

Coldwater, capital of Branch county, Michigan, U.S.A., situated in the south of the lower peninsula, on the east branch of Coldwater river, and on the Lake Shore and Michigan Southern railroad, at an altitude of 982 feet. Population (1880), 4681; (1900),

6216.

Cole, Sir Henry (1808-1882), the English public servant whose name will always be associated with the early organization of "South Kensington," was born at Bath on 15th July 1808, and was the son of an officer in the army. At the age of fifteen he became clerk to Sir Francis Palgrave, then a subordinate officer in the Record Office, and, helped by Charles Buller, to whom he had been introduced by Thomas Love Peacock, and who became chairman of a Eoyal Commission for inquiry into the condition of the public records, worked his way up until he became an assistant keeper. He largely assisted in influencing public opinion in support of Sir Eowland Hill's reforms at the Post Office. A connexion with the Society of Arts caused him to drift gradually out of the Eecord Office : he was a leading member of the Commis- sion that organized the great Exhibition of 1851, and upon the conclusion of its labours was made secretary to

the School of Design, which by a series of transformations became in 1853 the Department of Science and Art. Under its auspices the South Kensington Museum was founded in 1855 upon land purchased out of the surplus of the Exhibition, and Cole practically became its director, retiring in 1873. His proceedings were frequently criti- cized, but the Museum owes everything to his energy. Indefatigable, genial, and masterful, he drove everything before him, and by all sorts of schemes

and devices built up a great institution, whose variety and inequality of composition seemed imaged ia the anomalous structure in which it was temporarily housed. He also, though to the financial disappoiatment of many, conferred a great benefit upon the metropolis by originating the scheme for the erection of the Eoyal Albert Hall. He was active in founding the national training schools for cookery and music, the latter the germ of the Eoyal College of Music. He edited the works of his benefactor Peacock ; and was in his younger days largely connected with the press, and the author of many useful topographical handbooks published under the pseudonym of ” Felix Summerly.” He died on 18th April 1882. (r. g.)

Cole, Vicat (1833-1893), English painter, born at Portsmouth on 17th April 1833, was the son of the land- scape painter, George Cole, and in his practice followed his father’s lead with marked success. He exhibited at the British Institution at the age of nineteen, and was first represented at the Royal Academy in 1853. His election as an Associate of this institution took place in 1870, and he became an Academician, ten years later. He died in London on 6th April 1893. The wide popularity of his work was due partly to the simple directnees of his technical method, and partly to his habitual choice of attractive material. Most of his subjects were found in the counties of Surrey and Sussex, and along the banks of the Thames. One of his largest pictures, ” The Pool of London,” was bought by the Chantrey Fund Trustees in 1888, and is now in the National Gallery of British Art.

See RoBEBT Chiqneli,. Hie Life and Paintings of Vicat Cole, B.A. London, 1899.

Colenso, John William (1814-1883), Bishop of Natal, was born at St Austell, Cornwall, on 24th January 1814. His family were in embarrassed circumstances, and he was indebted to relatives for the means of univer- sity education. Second Wrangler at Cambridge, and Fellow of St John’s College, his mathematical distinction led him to be invited to Harrow ia 1837, but the step proved an unfortunate one. The school was just then at the lowest ebb under an unpopular headmaster, and Colenso not only got few pupils, but lost most of his property by a

fire which destroyed his house. He went back to Cambridge, and in a short time paid off heavy debts by diligent tutoring, and the proceeds of his marvellously successful series of manuals of algebra and arithmetic, which were adopted all over England. In 1846 he became rector of Forncett St Mary, Norfolk, and in 1853 was appointed Bishop of Natal. Full of zeal, he devoted himself on his arrival to acquiring the native language, of which he compiled a grammar and dictionary, and into which he translated the New Testament and other portions of Scripture. His ardour, however, was soon diverted into another channel by the puzzling objections of natives, who convinced him that the verbal inspiration and Mosaic authorship of the Pentateuch could not be maintained. Colenso brought his arithmetical attainments to bear upon the question, and published his conclusions, positive and negative, in a series of treatises

on the Pentateuch, extending from 1862 to 1879. His conclusions were naturally disputed with a fervour of conviction equal to his own. While controversy raged in England, the South African bishops, whose suspicions Colenso had already incurred by the liberality of his views respecting polygamy among native converts and a commentary upon Eomans alleged to savour of heresy, met in conclave to condemn him, and pronounced his deposition (December 1863). Colenso, who had refused to appear before their tribunal otherwise than as sending a protest by proxy, appealed to the Privy Council, which pronounced that the Cape Town Metropolitan had no coercive jurisdiction and no authority to interfere with the Bishop of Natal. No decision, therefore, was given upon the merits of the case; but it is significant that although many eminent clergymen have since expressed views agreeing in essentials with Bishop Colenso's, no prosecution has been instituted against any of them. His adversaries, though unable to obtain his condemnation, succeeded in causing him to be generally inhibited from preaching in England, and set up a rival bishop in Natal, who, however, assumed a different title. The contribu- tions of the missionary societies were withdrawn, but an attempt to deprive him of his episcopal income was frus- trated by a decision of the Courts. Colenso, encouraged by a handsome testimonial raised in England, to which many clergymen subscribed, returned to his diocese, and devoted the latter years of his

life to further labours as Biblical commentator and translator, and especially to the defence of the natives against what he considered oppression and wrong. By this course he made more enemies among the colonists than he had ever made among the clergy. He died at Durban on 20th June 1883. The character of the man and of his works are summed up in ten words of Jowett : ” He has made an epoch in criticism by his straightforwardness.” (e. g.)

Coleraine, a maritime town and urban sanitary district, in the county of Londonderry, Ireland, on the river Bann and the Belfast and Northern Counties rail- way, 145 miles north of Dublin. It ceased to be a parlia^ mentary borough in 1885. The harbour has been much improved from grants by the Irish Society of London and from a loan under the Eiver Bann Navigation Act, 1879. In all 420 vessels of 46,526 tons entered in 1899, and 256 of 32,631 tons cleared. The number of per- sons employed in the salmon fishery district in 1899 was 731. Population (1881), 6694: (1891), 6845;

(1901), 6929.

Coleridge, John Duke Coleridge, IstBabok (1820-1894), Lord Chief Justice of England, was the eldest son of Sir John Taylor Coleridge (see Ency. Brit, 9th edition, vol. vi. p. 135). He was born at Heath’s Court, Ottery St Mary, on the 3rd of December 1820. He was educated at Eton, an institution which, as managed in the ‘thirties, sent most of its pupils into the world slenderly enough equipped for the battle of life. It was otherwise in the case of Coleridge, the system then prevailing, with its worship of Latin verses and the elegancies of classic scholarship in general, being just suited to bring out the rhetorical talents which did so much to make his fame ; but he owed even more to his innate love of letters than he did to any formal teaching. He gained a scholarship at Balliol, and entered that college at a very auspicious moment, for the scholars’ table there has never been occupied by a more brilliant company. The late Principal Shairp of St Andrews published in the year 1873 a poem called ” The Balliol Scholars from 1840-43,” which well described it.

COLEEIDGE

Here is the sketch of Coleridge as he appeared to a con- temporary : —

Fair-haired and tall, slim but of stately mien,

Inheritor of a high poetic name, Another, in the bright bloom of nineteen,

Fresh from the pleasant fields of Eton came : Whate'er of beautiful or poet sung Or statesman uttered, round his memory clung ;

Before him shone resplendent heights of fame.

With friends around the board, no wit so fine To wing the jest, the sparkling tale to tell ;

Yet ofttimes listening in St Mary's shrine, Profounder moods upon his spirit fell :

We heard him then, England has heard him since,

Uphold the fallen, make the guilty wince. And the hushed Senate have confessed the spell.

The other Balliol scholars celebrated in the same poem were Clough, Pritchard, Archbishop Temple of Canter- bury, Riddell, Matthew Arnold, and Seymour. The last of these, a man of very great promise, died early at Lai- bach in Carniola. His sister was Coleridge's first wife ; they were married when Coleridge was only five and twenty, and just about the same time he was called to the Bar. Coleridge used to say that the difference be- tween his father and himself was that the former had started in life with a thousand pounds he had borrowed, while, with better fortune, he had started with a thousand pounds of his own. He was called to the Bar on 6th No- vember 1846, and went the Western Circuit, rising stead- ily, through more than twenty years of hard work, till in July 1865 he was returned as member for Exeter in the Liberal interest. The impression which he made on the heads of his party was so favourable that they deter- mined, early in the session of 1867, to put him forward as the protagonist of their attack on the Coiiservative Gov- ernment. But that move seemed to many of their staunch- est adherents unwise, and it was frustrated by the active opposition of a section, including Hastings Russell (later ninth duke of Bedford), his brother Arthur, member for Tavistock, Alexander Mitchell of Stow, Kinglake, and Henry Seymour. They met to deliberate in the Tea- room of the House, and were afterwards sometimes con- founded with the Tea-room party which was of subse- quent formation and under the guidance of a different group. The protest was sufficient to prevent the contem- plated attack being made, but the Liberals returned to power in good time with a large majority behind them in 1868. Coleridge was made, first, Solicitor-, and then Attorney -General .

As early as 1863 a small body of Oxford men in Par- liament had opened fire against the legislation which kept their University bound by ecclesiastical swaddling clothes. They had made a good deal of progress in converting the House of Commons to their views before the General Election of 1865. That election having brought Cole- ridge into

Parliament, he was hailed as a most valuable ally, whose great University distinction, brilliant success as an orator at the Bar, and hereditary connexion with the High Church party, entitled him to take the lead in a movement which, although gathering strength, was yet very far from having achieved complete success. The clerically-minded section of the Conservative party could not but listen to the son of Sir John Coleridge, the god- son of Keble, and the representative of the man who had been- the indirect cause of the Anglican revival of

1833, for John Stuart Mill was right when he said that

Coleridge and Bentham were, so far as England was con- cerned, the leaders of the two chief movements of their times: "it was they who taught the teachers, and who were the two great seminal minds."

Walking up one evening from the House of Commons to dine at the Athenaeum with Henry Bruce (afterwards

Lord Aberdare) and another friend, Coleridge said: " There is a trial coming on which will be one of the most remarkable causes cil^bres that has ever been heard of." This was the Tichborne case, of which so much was said ere many weeks had passed over, and which led to proceedings in the criminal courts rising almost to the dignity of a political event. These two trials were the most conspicuous features of Coleridge's later years at the Bar, and tasked his powers as an advocate to the uttermost, though he was assisted by the splendid abili- ties and industry of Charles (afterwards Lord) Bowen. In November 1873 Coleridge succeeded Sir W. Bovill as Chief Justice of the Common Pleas, and was im- mediately afterwards raised to the Peerage as Baron Coleridge of Ottery St Mary. In 1880 he was made Lord Chief Justice of England on the death of Sir Alexander Cockburn.

In jury cases his quickness in apprehending facts and his lucidity in arranging them were very remarkable indeed. He was not one of the most learned of lawyers, but he was a great deal more learned than many people believed him to be, and as an ecclesiastical lawyer had perhaps few or no superiors. His fault — a natural fault in one who had been so successful as an advocate — was that of being too apt to take

one side. He allowed, also, certain political or class prepossessions to interfere some- what with the even course of justice. A game-preserv- ing landlord had not to thank the gods when his case, however buttressed by undoubted rigjit, came before Cole- ridge. Towards the end of his life his health failed, and he became somewhat indolent. On the whole, he was not so strong a man in his judicial capacity as Campbell or Cockburn ; but when all has been said that could reason- ably be said in his disparagement, even Ehadamanthus would have to admit that his scholarship, his refinement, his power of oratory, and his character raised the tone of the Bench while he sat upon it, and that if it has been adorned by greater judicial abilities, it has hardly ever been adorned by a greater combination of varied merits. It is curious to observe that of all judges the man whom he put highest was one very unlike himself, the great l^aster of the Rolls, Sir William Grant. He died in har- ness. Early in the 'nineties his friends could see that he began to feel his age. He made, indeed, no secret of it ; but he might have lasted a little longer if a summer cold had not precipitated the end. He died on 14th June

1894.

Coleridge's work, first as a barrister and then as a judge, prevented his publishing as much as he otherwise would have done, but his addresses and papers would, if collected, fill several volumes and do much honour to his memory. One of the best, and one most eminently characteristic of the man, was his Inaugural Address to the Philosophical Institution at Edinburgh in 1870. He was an exception- ally good letter-writer. Of travel he had very little expe- rience. He had hardly entered Paris ; once, quite near the end of his career, he spent a few days in Holland, and came back a willing slave to the genius of Rembrandt ; but his longest absence from England was a visit to the United States, which had something of a business char- acter. It is strange that a man so steeped in Greek and Roman poetry, so deeply interested in the past, present, and future of Christianity, never saw Rome, or Athens, or the Holy Land. The chief cause, no doubt, was the fatal custom of neglecting modern languages at English schools. He felt himself at a disadvantage when he passed beyond Engish-speaking lands, and

cordially dis- liked the situation. No notice of Coleridge can omit to make mention of his extraordinary store of anecdotes, which were nearly always connected with Eton, Oxford, the Bar, or the Bench. His exquisite voice, considerable

power of mimicry, and perfect method of narration added greatly to the charm. He once told, at the table of Dr Jowett, master of Balliol, anecdotes through the whole of dinner on Saturday evening, through the whole of breakfast, lunch, and dinner the next day, through the whole journey on Monday morning from Oxford to Pad- dington, without ever once repeatiag himself. He was frequently to be seen at the Athenaeum, was a member both of Grillion's and The Club, as well as of the Literary Society, of which he was president, and whose meetings he very rarely missed. Bishop Copleston is said to have divided the human race into three classes, — men, women, and Coleridges. If he did so, he meant, no doubt, to imply that the men of the family whose chief example was the poet of " Christabel " had a certain feminine charm combined with a trace of feminine weakness. In John Duke Coleridge the charm was certainly present.

Coleridge's first wife died in 1878. She was an artist of real genius, and her portrait of Cardinal Newman was considered much better than the one by Millais. A short notice of her by Dean Church of St Paul's was published in the Guardian on 13th February 1878, and was reprinted in her husband's privately printed collection of poems. Coleridge remained for many years a widower, but mar- ried in 1886 Amy Augusta Jackson Lawford, daughter of Henry Baring Lawford, Esq., who survived him. He was succeeded in the peerage by his eldest son, Bernard John Seymour. (m. g. d.)

Colfax, Schuyler (1823-1885), vice-president of the United States, was born in New York City on the 23rd of March 1823, and died in Mankato, Minn., 13th January 1885. After a meagre education he served as a clerk in Indiana, and then turned to journalism. From 1855

to 1869 he was a Republican representative in Congress from Indiana. In 1863 he was elected Speaker of the House, and served for three terms. In 1868 he was elected vice-president on the ticket with General Grant. Owing to his alleged connexion with the corrupt distribution of shares of stock in the Credit Mobilier he was not renominated. In later years he was best known as a popular lecturer.

Col i ma, one of the smallest states of Mexico, bounded by the state of Jalisco on the N., N.E., and W., by that of Michoacan on the E., and by the Pacific on the S., with an area of 2273 square miles, including the islands of Eevill Gigedo. The population in 1879 was 65,827, and in 1895 it was 55,752. The principal industries are agriculture, stock-raising, and the exploita- tion of the salt deposits ; the products are coffee, cacao, tobacco, rice, cotton, indigo, sugar-cane, cereals, and leguminous plants. The state is divided into three par- tidos and seven municipalities. The capital, Colima, 570 miles from Mexico City has a population of 18,977, and is situated in a beautiful and fertile valley, irrigated by the Colima river. The city has good public buildings, a cathedral, theatre, and a fine market-house. It has tramways and an electric light system. Amongst other towns are ManzanUlo, Coquimatlan, Ixtahuacan, Almo- loyan, Comala.

Colle di Val d'Elsa, a town and episcopal see of the province of Siena, Tuscany, Italy, 21 miles north-west from Siena, 13 by rail to Poggibonsi. It con- sists of two quarters, the upper old town, with a 13th- century cathedral, and the lower new town, with busy ironworks, glass, pottery, paper, and brick factories. There is a technical school (1873). Here the Florentines defeated the Sienese in 1269. Population, about 6000.

College Point, formerly a village of Queens county. New York, U.S.A., but since January i, 1898, a part of the borough of Queens, one of the five boroughs constituting the city of New York; on the east shore of Flushing Bay, an arm of Long Island Sound. Population (1880), 4192; (1890), 6127. (See New York City.)

Colley, Sir George Pomeroy (1835-1881), Brit- ish general, third son of George Pomeroy Colley of Eathangan, Co. Kildare, Ireland, and grandson of the fourth Viscount Harberton, was born on the 1st of

November 1835, and entered the 2nd Queen's Regiment from Sandhurst as ensign in 1852. From 1864 to 1860 he served in South Africa, and was employed in surveying and as a magistrate in charge of the Bashi river district in Kaffraria. Early in 1860 he went with his regiment to China to join the Anglo-French Expedi- tion, and took part in the capture of the Taku Forts and the entry into Peking (medal and clasp), returning to South Africa to complete his work in Kaffraria (brevet- majority). In 1862 he entered the Staff College and passed out in one year with honours. After serving as brigade-major at Devonport for five years he went to the War OfBce in 1870 to assist in the preparation of Mr Cardwell's measures of army reform. He was appointed professor of military administration at the Staff College in 1871. Early in 1873 he joined Sir Garnet Wolseley at the Gold Coast, where he took charge of the transport, and the success of the Ashanti Expedition was in no small degree due to his exertions (medal, brevet colonelcy, and C.B.). In 1875 he accompanied Wolseley to Natal (C.M.G.). On his return home he was appointed military secretary to Lord Lytton, Governor-General of India, and in 1877 private secretary (K.C.S.I.V In 1879 he joined Wolseley as Chief of the Staff and Brigadier-General in S.E. Africa, but, on the murder of Cavagnari at Kabul, returned to India. In 1880 he succeeded Wolseley in S.E. Africa as High Commissioner and General Com- manding, and conducted the operations against the rebel Boers. He was defeated at Lang's Nek and at the Ingogo river, and killed at Majuba Hill on 27th Febru- ary 1881. Colley contributed to periodical literature, and wrote the article "Army" in the ninth edition of the Encydopmdia Britannica. He had a very high reputatioa not only for a theoretical knowledge of military affairs, but also as a practical soldier ; and his disastrous failure against the Boers completely upset all the estimates that had been made of his abilities.

Collier, John Payne (1789-1883^, English critic, was born in London, 11th January 1789. His father's connexion with the press obtained for him a position on the Morning Chronicle as leader writer, dramatic critic, and reporter, which continued till 1847; he was also called to the Bar. All the time he could spare, however, was given to the study of Shakespeare and the early English drama. After some minor

publications he pro- duced, in 1831, his History of English Dramatic Poetry and Annals of the Stage, a badly arranged but valuable work. It obtained for him the post of librarian to the duke of Devonshire, and access to the chief collections of early English literature throughout the kingdom. These opportunities were unhappily misused to effect a series of literary fabrications, which maybe charitably, and perhaps not unjustly, attributed to literary monomania, but of which it is difB.cult to speak with patience, so completely did they for a long time bewilder the chronology of Shakespeare's writings, and such suspicion have they thrown upon MS. evidence in general. After New Facts, New Particulars, and Further Particulars respecting

Shakespeare had appeared and passed muster, Collier produced (1852) the famous Perkins Folio, claiming to possess numerous MS. emendations of Shakespeare by " an old corrector." The authenticity of these was dis- puted in several quarters on internal evidence ; and when in 1859 they were submitted to experts at the British Museum they were incontestably proved to be forgeries. The point whether Collier was deceiver or deceived was left undecided, but it must be feared that the falsifications of which he was unquestionably guilty among the MSS. at Dulwich College have left little doubt respecting it. Apart from these unhappy mystifications, which have thrown so much suspicion upon his antiquarian work that no state- ment of his can be accepted without verification, his literary career was useful and honourable. He published excellent editions of Shakespeare and Spenser, reprinted a great number of early English tracts of extreme rarity, and rendered good service to the numerous antiquarian socie- ties with-which he was connected. His Old Man's Diary is an interesting record, though even here the taint of fabrication is not absent. Unfortunately what he did amiss is more striking to the imagination than what he did aright, and he will be chiefly remembered by it. He was active with his pen almost to the end of his life ; and died at Maidenhead, where he had long resided, on 17th September 1883. (e. g.)

Collingwood, a town and railway station of Simcoe county, Ontario, Canada, 71 miles north-north-west of Toronto, on Lake Huron. It is the eastern terminus of two lines of steamers plying to Lake Huron and Lake Superior ports. It contains a large stone dry-dock and shipyard, pork factory, and saw and planing mills, and has a large lumber, grain, and produce export trade, besides large shipbuilding plant and steel works. Ex- ports for the year 1899-1900 were valued at $2,657,413; imports at f 277,770. Population (1881), 4435: (1900),

5687.

Collins, William Wilkie (1824-1889), English novelist, the elder son of William Collins, R.A., the well- known landscape painter, was born in London, 8th January 1824. He was educated at a private school in Highbury, and when only a small boy of twelve was taken by his parents to Italy, where the family lived for three years. On their return to England Wilkie Collins was articled to a firm in the tea trade, but four years later he abandoned that business for the law. He found little pleasure in his new career, however ; though what he learned in it was exceedingly valuable to him later. On his father's death in 1847 young Collins made his first essay in literature, publishing the Life of William Collins, in two volumes, in the following year. This gave him an incentive towards writing, and in 1850 he put forth his first work of fiction, Antonina, or the Fall of Rome, which was clearly inspired by his life in Italy. Basil appeared in 1852, and Hide and Seek in 1854. About this time he made the acquaint- ance of Charles Dickens, and began to contribute to ^owse- hold Words, where After Dark (1856) and Tlie Dead Secret (1857) ran serially. His great success was achieved in 1860 with the publication of Tlie Woman in Wliite, which was first printed in All the Year Bound. Erom that time he enjoyed as much popularity as any novelist of his day, and was continually employed in writing, No Name (1862), Armadale (1866), and The Moonstone (1868) being among his most successful achievements. The last-named story, for many of the details of which Collins was indebted to the curious history of the Eoad murder, is certainly the best detective novel ever written in the English language. After The New Magdalen (1873) his

ingenuity became gradually exhausted, and his later stories were little more

than faint echoes of earlier successes. He died in Wimpole Street, London, 23rd September 1889. CoUins's gift was of the melodramatic order, and while many of his stories made excellent plays, several of them were actually recon- structed from pieces designed originally for stage produc- tion. But if his colours were occasionally crude, and his methods violent, he was at least a master of situation and effect. His trick of telling a story through the mouths of different characters is sometimes irritatingly disconnected ; but it had the merit of giving an air of actual evidence and reality to the elucidation of a mystery. He possessed in the highest degree the gift of absorbing interest ; the turns and complexities of his plots are surprisingly ingenious, and many of his characters are not only real, but un- common. Count Eosco in Tlie Woman in White is perhaps his masterpiece; the character has been imitated again and again, but no imitation has ever attained to the subtlety and humour of the original. (a. wa.)

Col mar, a town of Germany, in the imperial territory of Alsace-Lorraine, district of Upper Alsace, 40 miles south-south-west from Strasburg by the railway to Basel. The town still has numerous narrow and picturesque streets, with good houses of the 16th and 17th centuries. It is the seat of several textile industries, and manufac- tures sewing thread, starch, sugar, and machinery ; there are also bleachfields, breweries, and cultivation of wine and fruit. Population (1885), 26,537 ; (1900), 36,824.

Colne, a municipal borough (1896) and market-town in the Clitheroe parliamentary division of Lancashire, England, 6 miles north-north-east of Burnley by rail. Area of borough, 5330 acres. Population (1901), 23,000.

Cologne, in German Koln (ofiicially Coin, since 1900), a town and archiepiscopal see of Prussia, in the Rhine province, on the left bank of the Rhine, by rail 44 miles east by north from Aix-larChapelle, 24

south by east from Diisseldorf, and 57 north-north-west from Coblenz. It is a much improved town, and is no longer distinguished by its smells as it used to be. In 1881-85 the old f ortifica^ tions were dismantled and the site (bought by the munici- pality from the War Office for £600,000) converted into a fine boulevard, the Ring Street, nearly 4 miles long. Beyond the Ring Street now extends a new continuous line of fortifications, covering an area of 1000 acres, thus doubling the area of the city of Cologne. Within the outer municipal boundary are further included (1888) the suburbs of Bayenthal, Lindenthal, Ehrenfeld, Nippes, Deutz (on the opposite side of the river), Siilz, Bickendorf, Niel, and Poll, protected by another widely extended cir- cle of detached forts on both banks of the Rhine. Of the former city gates four have been retained^ restored, and converted into museums : the Severin gate, on the south, contains the geological section of the natural history museum ; the Hahnen (cocks) gate, on the west, is fitted as the historical and antiquarian museum of the city ; and the Eigelstein gate, on the north, accommodates the zoological section of the natural history museum. Along this same promenade are the technical trades school, the Roman Catholic church of the Heart of Jesus (1900), a monumental fountain to the memory of the Emperor William I. (1897), and the industrial art museum (1899- 1900) . The building of the cathedral was finally completed in 1880. It has since been supplied with fine bronze doors. The Great Bell (Kaiserlocke), cast in 1874, weighs 543 cwt., and is the largest and heaviest bell that is rung ; it was put up in 1880. The view of the cathedral has been much improved by a clearance of the old houses in the Dom Platz, including the Archiepiscopal Palace. The new Platz is now flanked by fine buildings. Many new

churches have been built {e.g., St Michael’s, churches in Wiehl and in Riehl, the Church of Christ, &c.), and several of the older churches have been more or less

completely restored, e.g., the church of the Apostles (1875-88 and 1895-97), St Peter (1890-92), St Ursula (1890-91), St Gereon, and St Cecilia. A handsome Eoman

Catholic church was completed in Deutz in 1896; and in 1896-99 a large synagogue, west of the Eing. The church of St Andreas (1220 and 1414) contains the remains of Albertus Magnus in a gUded shrine. Turning to the secular buildings — the ground floor of the Gurzenich was in 1875 converted into a stock exchange.

and in 1890-91 provided with a fine staircase. In the street Burgmauer stands the supreme court for the Rhine province, and off the street are the post oflBlce (1893), a fine early Gothic building, and the Imperial Bank (1897), also in the early Gothic style. Farther west is the municipal library and archives (1894^-97), also Gothic.

A handsome central railway station (high level) was built in 1889-94. The railway now foUows the line of the ceinture of the new inner fortifications, and there are three city stations in addition to the central. Like all important German towns, Cologne has of recent years been beautified by fine monuments. The most con- spicuous is the colossal equestrian statue (22^ feet high) of Frederick William III. in the Heumarkt. There are also monuments to Moltke (1881), to Johann von Werth (1885), the cavalry leader of the Thirty Years' War, and to Bismarck (1879). Near the cathedral is an archi- episcopal museum of church antiquities. Cologne has, further, a large civic hospital, a conservatory of music, a commercial school (1900), a commercial high school (1901), a girls' commercial high school (1900), theological and teachers' seminaries, a girls' college (1900), and lunatic asylums. Commercially, Cologne is one of the chief centres on the Ehine, and has a very important trade in corn, wine, mineral ores, coals, drugs, dyes, manufactured wares, groceries, leather and hides, timber, porcelain, and many other commodities. A large new harbour, with spacious quays, has been constructed towards the south of the city. In 1898 a

total of 3461 vessels of 1,323,800 tons entered and cleared the port. Industrially, too, Cologne is a place of very considerable importance. The manufacture of machinery, bricks, cottons and woollens, and indiarubber goods, and printing are carried on on a large scale, and there are factories for sugar, chocolate, and many others. The famous Eau de Cologne is pro- duced in large quantities. Population (1885), 239,437;

(1900), 370,685.

Colomb, Philip Howard (1831-1899), British vice-admiral, historian, critic, and inventor, the son of General T. Colomb, was born in Scotland, on the 29th. of May 1831. He entered the Navy in 1846, and served first at sea off Portugal in 1847; afterwards he served, in 1848, in the Mediterranean, and from 1848-51 as mid- shipman of the Reynard in operations against piracy in Chinese waters ; as midshipman and mate of the Sei-pent during the Buimese War of 1852-53; as mate of the Phoenix in the Arctic Expedition of 1854 ; as lieutenant of the Hastings in the Baltic during the Eussian War, taking part in the attack on Sveaborg. He became what was known at that time as a ” Gunner’s Lieutenant ” in 1857, and from 1859 to 1863 he served as flag-lieutenant to Eear- Admiral Sir Thomas Pasley at Devonport. Be- tween 1858 and 1868 he was employed in home waters on a variety of special services, chiefly connected with gun- nery, signalling, and the tactical characteristics and capacities of steam warships. From 1868 to 1870 he commanded the Dryad, and was engaged in the suppres- sion of the slave trade. In 1874, while captain of the Audacious, he served for three years as flag-captain to Vice-Admiral Eyder in China; and finally he was appointed, in 1880, to command the Thunderer in the Mediterranean. Next year he was appointed captain of the Steam Eeserve at Portsmouth; and after serving three years in that capacity, he remained at Portsmouth as flag-captain to the Commander-in-Chief until 1886, when he was retired by superannuation before he had attained flag-rank. Subsequently he became Eear- Admiral, and finally Vice-Admiral on the retired list.

Pew men of his day had seen more active and more varied service than Colomb. But the real work for the Navy on which his title to fame and remembrance rests was done in another sphere. He was, in his day, essen- tially the thinker of the service. Many of his contem- poraries were his equals, not a few were his superiors, in the practical gifts and aptitude of the naval officer. But perhaps no officer of his time has left a more indelible

mark on the thought and practice of the Navy. His mind was at once inquiring, aspiring, logical, reflective, and inventive. He was one of the first to perceive the vast and momentous changes which must ensue from the introduction of steam into the Navy. He foresaw that it must eventually carry aU before it, that it would im- mensely increase the tactical mobility of ships, and would for that reason entail a complete revolution in the methods he found in use for the direction, conduct, and control of their movements — in other words, that it required a new system of signals and a new method of tactics. These he set himself to devise as far back as 1858. Por the purposes of signalling Colomb adapted to naval use the methods employed by the electric telegraph. It is well known that for purposes of electric transmission the letters are represented by symbols composed of two elements variously combined, according to the Morse system. The idea of varying form is thus replaced by that of varying duration ; and by suitable combinations of two intervals of different duration, one longer and one shorter, the whole alphabet and all numbers can be repre- sented. If an electric current is continuous, its interrup- tion for a longer or a shorter period can be made to represent the two intervals required, and the symbols thus transmitted to a distance can by suitable mechanism be recorded on paper in the form now universally known as ” dots and dashes.” Similarly, a beam of light can be made to transmit the same symbols to the eye by alternate periods, varying in duration, of occultation and display. Colomb invented a lantern for this purpose in 1861, but it was not adopted by the Navy until 1867. In some form or other it is now in use in every important navy in the world. In daytime a hand flagstaff, with flag attacked, is made to transmit the required symbols by giving it a greater or less inclination from the perpendicular. In a fog, long and short blasts sounded on a fog-horn, steam- whistle, or steam-siren

are employed for the same purpose. Before these methods were adapted by Colomb to naval use, the only signals employed were, in daytime, flags of different colours and shapes, and by night, lanterns vari- ously disposed. In fog there was nothing, and at night the range of signalling was very restricted and its method very inefficient. Nowadays, thanks mainly to Colomb, and to others who have developed his methods on the same lines, it is almost as easy to manoeuvre a fleet at night, or even in a thick fog, as it is in broad and clear daylight.

What he had done for signals Colomb next did for tactics. Having first determined by experiment — ^for which he was given special facilities by the Admiralty — what are the manoeuvring powers of ships propelled by steam under varying conditions of speed and helm, he pro- ceeded to devise a system of tactics based on these data. In the sequel he prepared a new evolutionary signal-book, which was adopted by the Eoyal Navy, and still remains in substance the foundation of the existing system of tactical evolutions at sea. The same series of experi- mental studies led him to conclusions concerning the chief causes of collisions at sea ; and these conclusions, though, stoutly combated in many quarters at the outset, have since been generally accepted, and were ultimately em- bodied in the International Code of Eegulations now adopted by the leading maritime nations on the recom- mendation of a Conference held at Washington in 1889.

After his retirement Colomb devoted himself rather to the history pi naval warfare, and to the laxge principles disclosed by its intelligent study, than to experimental inquiries having an immediate practical aim. As in his active career he had wrought organic changes in the order- ing, direction, and control of fleets, so by his historic studies, pursued after his retirement, he helped greatly to effect, if he did not exclusively initiate, an equally moment-

ous change in the popular, and even the professional, way of regarding sea-power and its conditions. He did not invent the term “searpower,”

— it is, as is shown else- where (Sea-Powee), of very ancient origin, — nor did he employ it until Captain Mahan had made it a household word with all. But he thoroughly grasped its conditions, and in his great work on Naval Warfare (first published in 1891) he enunciated its principles with great cogency and with keen historic insight. The central idea of his teaching was that naval supremacy is the condition prece- dent of all vigorous military offensive across the seas, and, conversely, that no vigorous military offensive can be undertaken across the seas until the naval force of the enemy has been accounted for — either destroyed or defeated and compelled to withdraw to the shelter of its own ports, or at least driven from the seas by the menace of a force it dare not encounter in the open. This broad and indefeasible principle he enunciated and defended in essay after essay, in lecture after lecture, until what at first was rejected as a paradox came in the end to be accepted as a commonplace. He worked quite indepen- dently of Captain Mahan, and his chief conclusions were published before Captain Mahan's works appeared. In the last edition of Naval Warfare he showed how, in the Cuban War, Captain Mahan had been driven by force of circumstances to adopt in practice the sound doctrine of the Command of the Sea, which in some of his works he had seemed in some measure to impugn. There was no jealousy and no rivalry between these two great writers on the philosophy of naval warfare. They worked on independent lines — Colomb perhaps with deeper and more consistent thought, but Mahan assuredly with a broader historical outlook, and with finer powers of lucid and orderly exposition.

Colomb died quite suddenly and in the full swing of his literary activity on October 13, 1899, at Steeple Court, Botley, Hants. His latest published work was a bio- graphy of his friend Sir Astley Cooper Key, and his last article was a critical examination of the tactics adopted at Trafalgar, which showed his acumen and insight at their best. He left much valuable literary material in an unfinished state at his death. He was often thought too speculative, and even too visionary, by his contemporaries of a profession which is eminently practical, and little given to speculation even on the theory of its own occu- pation. He was indeed essentially a pioneer, and his larger range of thought often

supplied the Navy with well-considered methods, of which practical men discerned neither the rationale nor the origin. But no naval officer of his time left a deeper or more lasting impression on the thought and action of the great service he adorned.

(j. R. T.)

Colombes, a town in the arrondissement of St Denis, department of Seine, France, 7 miles north-north- west of Paris, near the left bank of the Seine, and on the railway from Paris to Havre. It has a 16th-century church with 12th-century tower, numerous villa residences and boarding schools, and manufactures of gelatine and starch. A castle formerly stood here, in which died Henrietta Maria, queen of Charles I. of England and daughter of Henry IV. of France. Port traffic (1899), 55,350 tons. Population (1901), 23,061. The adjacent town of Bois Colombes had a population (1896) of 10,404.

Colombia, a country of South America extending from 12° 20′ N. lat. to the still undefined boundaries of Ecuador, Peru, and Brazil. The boundary towards Venezuela, according to the arbitration of the Spanish Government in 1891, runs from the Bay of Calaboso west-wards to the mountains of Oca, then southwards along the watershed between the Magdalena river and Lake Mara-

caibo as far as the Rio de Oro, whence it crosses the Cor- dillera and follows successively the rivers Oira, Arauca, Meta, Orinoco, and Atabapo. Then it passes to the Piedra del Cocuy and follows the course of the Guainia to the frontier of Brazil. The boundary dispute with Peru and Ecuador was, by treaty of 1894, submitted to the arbitra- tion of Spain. The question of the frontier towards Costa Eica was in 1899 submitted to the president of the French Eepublic, who gave his award on 15th September 1900. The boundary between the two republics is formed by the spur of the cordilleras starting from Cape Mona on the Atlantic and enclosing on the north the valley of the Eio Tarire, and by the watershed between the Atlantic and Pacific up to the parallel of 9° N. lat. It then follows the watershed between the Chiriqui Viejo and the afflu- ents of the Dolce Gulf, ending at Burica Point on the Pacific. The islands east and south of Cape Mona are Colombian, to the west and

north-west Costa Eican ; but seven islands at a greater distance, lying between the Mosquito coast and the isthmus of Panama, are Colombian. On the Pacific coast Colombia possesses Burica and the islands to the east ; Costa Eica, those to the west.

Area and Population. — ^According to a census taken In 1871 the total population was 2,951,323, consisting of 1,434,129 males and 1,517,194 females. An ofBcial estimate published in 1881, and considered to be approximately correct for the present date, gave the following details as regards area and population : —

Departments.

Areata Square Miles.

Population ta 1881.

Population

per Square

MUe.

Antioquia (1884) . Bolivar . Boyacil . Cauca

Cundinamarca (1884) Magdalena Panama . Santander Tolima (1884)

22,316 21,345 33,351 257,462 79,810 24,440 31,571 16,409 18,069

470,000 280,000 702,000 621,000 569,000 90,000 285,000 555,000 306,000

21 13 21

2-4

7

3-7

9 35 17

Total .

504,773

3,878,000

7-7

This estimate includes some 220,000 uncivilized Indians, and the population of the different territories attached to departments. A later statement, published in 1893, estimates the total population at 4,060,000, but without precise data showing where the increase occurred. The principal towns are Bogota (the capital), with 110,000 inhabitants ; Medellin, with 50,000 ; Panama, 30,000 ; Cartagena, 20,000 ; Bucaramanga, 20,000.

No statistics of the movement of population are compiled. An official calculation in 1893 estimated the death-rate at 21 per 1000, 20 per cent, of the deaths being those of children under one year, and 30 per cent, of the total deaths those of children under five years of age. Of the total population 68-8 per cent, are engaged in agriculture ; 10-6 per cent, are labourers ; 8-6, mechanics ; 8-4, commercial ; 2-0, miners.

Spanish is spoken throughout Colombia, except among some of the tribes of Indians in the districts adjoining the Meta, Orinoco, and the affluents of these two rivers. The highlands are generally healthy, the lowlands and plains infected to some extent with malarial fever. The annual mean temperature at Bogota, 8300 feet above sea-level, is said to be 63° Fahr.

Constitution and Government. — The constitution of 1863 was superseded in 1886 by that now in force, which adopted a central- ized organization and named the state the Republic of Colombia. The legislative power is entrusted to the Senate and the House of Representatives, together constituting the Congress, which meets at the capital every two years, on the 20th of July. ^ The Senate consists of

twenty-seven members, three from each department, who are elected for six years by the departmental assemblies (legis- latures). The House of Representatives consists of sixty-eight members — one member for every 50,000 inhabitants; they are elected for four years directly by citizens able to Tead and write, or who have an income of §500 a year, or real estate worth §1500. The executive authority is vested in lie President of the Republic, who is assisted by ministers chosen by him, and a Council of State consisting of seven members. He is elected by electoral colleges for six years, and when for any reason he ceases to act, the vice- president takes his place.

Local Government. — Each of the nine departments is divided into provinces, and these into municipal districts, of which there are 991. The departments are under governors appointed by the President, and each has an elective assembly, meeting every two years. The municipal districts are under alcaldes, and each has an elective municipal council. The governors and alcaldes are agents both of the central and local authorities.

Justice. — Justice is administered by a supreme court composed of seven members, the president of the court being elected by the members for a term of four years. In each of the judicial districts there are superior tribunals, lower courts, and magistrates. The law, both civil and criminal, is written and codified. The foundation of the Colombian legal system is Spanish law, modified in certain directions to suit local conditions. Many complaints are made of the administration of justice throughout the republic, and there can be no question that legal procedure is extremely dilatory.

Seligion. — The religion is the Roman Catholic. The ecclesi- astical establishment consists of an archbishop, ten bishops, eight vioars-general, and 2170 priests of all classes, besides monks, who do not belong to tl^e regular priesthood. The number of monks in 1894 in thirteen monasteries was 469, and the number of nuns in ten

communities was 731. In 1894 the number of churches was 714, and chapels 312, in the whole republic.

Education. — Education, especially in ^he primary branches, has been much neglected, although attention has from time to time been directed to the subject. Primary education is under the control of the municipal authorities, grants in aid of the schools being given by the central Government. It is free, but not com- pulsory. The number of primary schools in 1898 was stated to be 2036, and the number of pupils on the rolls about 110,820. For secondary education there are thirty-four public colleges ; fifteen normal schools, with 600 pupils ; four technical colleges, with 800 students ; two academies of music, with 300 pupils ; one school of fine arts, with 160 pupils ; a Salesian institute, with 200 pupils ; and a national night institute for artisans, with 150 pupils. There is a national university, and four departmental universities. The na- tional Government devotes a sum of nearly 800,000 pesos annually to educational purposes. There is a national library containing 40,000 volumes, and a museum of antiquities and natural curiosities, both situated in the capital of the republic. Seminaries for priests are maintained by their own revenues and are free from civil control.

Defence. — The peace footing of the army was fixed at 2158 men in the budget for the biennial period 1899-1900. The military strength, however, consists principally of a national militia com- prising about 130,000 men, with 3203 officers, who can be called to serve if required. The small arm in use is the Mannlicher rifle. The police force consists of 1000 men.

Finance. — The actual revenue recorded in 1895 was 16,273,259 pesos ; in 1896, 20,444,489 pesos ; in 1897, 19,519,431 pesos ; in 1898, 17,941,569 pesos. For the biennium 1897-98 the revenue was 57,461,000, and the expenditure 41,429,180 pesos, leaving a deficit of 3,968, 180 pesos. The principal sources of revenue are the duties on imports and exports, these yielding 10,750,889 pesos in 1895, 13,697,823 pesos in 1896, and 13,256,353 pesos in 1897. The falling ofl in 1897 was stated to be in consequence of the reduction of the duties on salt, and the suppression of the export duty on coffee. Other sources of income in

1897 were— the saladero tax, 1,767,607 pesos ; the sale of stamped paper, 733,762 pesos ; and the post office and telegraphs. The war department absorbs more than one-half of the annual expenditure; but details of actual expenditure are not accessible. The budgets of revenue and expenditure are voted for periods of two years. For 1899-1900 the revenue was estimated at 34,305,000 pesos, and the expenditure at 34,000,000 pesos. , ^ . -.oon rr^u

The service of the foreign debt was suspended m 1880. ine amount of this obligation was then £1,913, 500, bearing interest at the rate of 4i per cent, per annum. In 1896, when the debt and arrears amounted to £3, 514,442, an agreement was made to issue bonds for £2 700,000 in exchange for old bonds, arrangements being made for a reduction in the rates of interest and amortization. Of the authorized issue the sum of £2,500,000 had been emitted m 1899, but the payment of interest by Colombia ceased in 1899. The internal indebtedness consists of a consolidated debt of 6,000,000 pesos ; a floating debt of 5,000,000 pesos ; and the paper money in circulation, increased by recent issues to 40,000 000 pesos. The total internal obligations are, therefore, 51,000,000 pesos m round

^^Production.— Economic development has been retarded by the difficulties of transport, and by the frequent recurrence of re-volutionary disturbances. The production of wheat and other bread ‘ Ituffs is insufficient for local demand. The principal mdus ry is mffee nlanting The export of coffee in 1895 amounted to 21,504, tons ft 28^521 tons ; fn 1897, 17,564 tons ; in 1898, 38 480 tons. Colombian coffee shipped at the Venezuelan port of Maracaibo do snot figure in the return of Colombian exports Tobacco is exported in large quantities, amounting for 1898 to 6120 tons ,

cocoa and sugar are also grown — the former in sufficient quantities for export. Ivory nuts and dye-woods are collected for shipment abroad, and various medicinal products. Of india-rubber, 404 tons were exported in 1898. The rubber trees are principally found in the low-lying forest regions bordering the Orinoco river, and southwards towards the affluents of the river Amazon.

Pastoral industry extends over the whole country, but is practised on a large scale only on the great plains of the interior adjoining the rivers flowing into the Orinoco, where the number of cattle is estimated to be not far short of 3,500,000. Dried beef, tasajo, is prepared, and animals are driven to populous centres for sale ; but the outlet is much restricted. In 1899 the scarcity of cattle in Cuba caused a demand, and a large number of live animals were exported from the port of Cartagena. Sheep, goats, and swine are raised for the home market.

The mining industry has hitherto been chiefly directed towards the search for gold and emeralds, and, to a lesser extent, silver. The production of gold and silver in three years is given as follows, in troy ounces : —

1896.

189T.

1898.

Gold . Silver .

oz.

106,416 3,407,610

oz.

107,734 5,048,257

oz.

109,470 5,484,725

In July 1899 a sudden fever for speculation in emeralds set in and lasted for some weeks. During this period stones to the value of 4,000,000 pesos were stated to have changed hands, often at prices above the values in Europe. Iron ore of good quality is abundant. The

salt mines are worked as a Government monopoly, and the supply is large.

Manufacturing industry is only in its infancy. The Pradera iron- works to the north-east of Bogota have a capacity for a daily out- put of 30 tons of pig-iron, and this establishment also produces wrought iron, rails, sugar-mills, and castings. Manganese is found in the vicinity of these works. Breweries and distilleries have been established in the principal cities. Soap and candle factories, boot- and shoe-making, tanneries, and other small local industries are found scattered over the republic to supply the local needs of the population.

Commerce.— The imports consist mainly of tissues, groceries, wines and spirits, hardware, and 0|ther articles of common use or consumption, while the principal exports are coffee, gold and silver, tobacco, live-stock, hides and skins, bananas, and some medicinal products. The values of the imports and exports, expressed in sterling (gold peso=4 sh.), for six years were as follows: —

Years.

Imports.

Exports.

Tears.

Imports.

Exports.

1893 1894 1895

£

2,680,660 2,142,240 2,305,670

£

2,926,060 3,192,400 3,017,680

1896 1897 1898

£

3,389,420 3,627,400 2,216,610

£

3,719,470

3,364,080 ■

3,831,540

In 1898 the imports at Panama and Colon amounted to the value of £722,468 ; and tjie exports to £212,220. The exports in 1898 from the ports of Panama, Colon, Barranquilla, Cartagena, and Santa Marta comprised coffee to the value of £1,384,184; gold dust, £595,343 ; silver and silver ore, £182,018 ; tobacco, £309,609; hides and skins, £175,684; live-stock, £192,507; bananas, £116,720 ; rubber, £84,822. Of the exports in 1898, the value of £1,061,175 went to the United States, £963,270 to Great Britain, £674,350 to France, £613,980 to Germany, and £200,130 to Venezuela. According to British statistics, the imports into the United Kingdom from Colombia in 1899 amounted to £574,021 ; and the exports of home produce from the United Kingdom to Colombia, to £668,986 of which £356,693 was for cottons. Accord- ing to American statistics, the imports into the United States from Colombia in 1899 amounted to £1,067,900, of which £506,.320 was for coffee ; and the exports of home produce from the United States to Colombia, to £622,830.

The principal commercial centre for the direct trade of Colombia is Barranquilla, slightly more than one-half of the total passing by way of that place through the port of Sabanilla ; about one-quarter of the balance goes to Cartagena, and the remainder is chiefly divided between Buenaventura, Riohacha, and Santa Marta. The transit trade

by way of Panama to and from Europe and the east and west coasts of North America averages annually about 130,000 tons for the outward freights, and about 120,000 tons for those to Europe and the Atlantic ports. The import and export trade is largely in the hands of British, German, Spanish, Italian, and French merchants.

Shipping and GommMKicaJions. -Thirty-three regular steamers visit Colombian ports monthly ; of these, 15 are British, 9 Ameri- can, 4 German, 3 French, 1 Spanish, and 1 Italian. The number of ships entering Colombian ports in 1897 was 1897, with a total

tonnage of 858,457 tons ; the number cleared in the same year was 1860, with a tonnage of 800,710 tons. In 1898, 266 vessels of, altogether, 441,673 tons entered, and 263 of 442,777 tons cleared at Barranquilla and Sahanilla — more than half the tonnage being British. The shipping belonging to Colombian ports had, in 1898, a total tonnage of 2227 tons.

Means of transport for both passengers and freight are confined to a large extent to conveyance by mule or donkey. The so-called roads are little more than bridle tracts. The total length of the railways open to public service in 1899 was only 419 miles ; but about 80 additional mUes are in course of construction. These railways are in isolated sections, running as a rule from the sea^ board to inland towns at different points of the coast. The Panama-Colon Une has a length of 48 miles ; the Cartagena- Calamar line, 65 miles. The Magdalena river forms an important artery of trade. It is navigable for 780 miles ; steamers ascend to La Dorada, 590 miles from BairanquiUa ; tributaries supply 215 miles more of navigable river, and on these waters 42 steamers, with a total tonnage of 7330 tons, ply regularly. At present the journey from the coast to Bogota requires at least twelve days of continuous travel by rail, steamer, and mule. There are some 8600 miles of telegraph lines, with 448 stations open to the public ; and a telephone system has been established in the principal towns. The

republic is connected with the outside world by the cable of the Central and South American Cable Company.

The postal service is well organized ; in the two years 1896-97 the letters and post-cards conveyed numbered 2,794,069 ; printed papers, 1,233,313 ; other packets, 161,217, — total pieces, 4,188,599.

Panama Canal. — The construction of a ship canal, 46 miles in length, across the Isthmus of Panama was in 1881 undertaken by a company which went into liquidation in 1889. A new company, formed in 1894, carried on the work, and their concession was ex- tended to the year 1910, by which time it was estimated the canal and looks might be completed, at a cost of £20,480,000. The total sum raised for the purpose of constructing the canal was 772,545,412 francs by the old company, and 65,000,000 francs by the new com- pany. But when the American Government took up the question of constructing an Isthmian Canal, the position of the Panama Company was necessarily involved. See the articles Canals and Lesseps.

Credit and Currency. — The law, passed in 1894, for the redemp- tion of the inconvertible paper currency has not been carried into effect. The amount in circulation is stated to be 51,000,000 pesos, the value constantly fluctuating, to the injury of trade. In Panama the silver dollar of 25 grammes, ‘835 fine, is the coinage in common use, but Peruvian silver is also current. The principal banking institutions are the Banco Nacional, the Banco de Colombia, and the Banco de Bogota, besides a number of private banks. The Banco Nacional is exclusively a State bank, and through it the paper money is put in circulation. The metric system of weights and measures is the legal system, but is not customarily in use, except at the Custom House and other Government offices. For ordinary purposes the Spanish pound, of 1-102 lb avoirdupois ; the arroba, of 25 ft) ; and the carga, of 250 lb, are invariably employed. Corn is measured by the fanega. In lineal measurement the vara (80 centimetres) is used. The litre is the standard for liquid measure.

Mecent History. — The term of oflS^ce for which President Aquiles Parra had been elected in 1876 came to a con- clusion in 1878, and in

April of that year General Trujillo was inaugurated as President of the republic for the two succeediag years. His administration was marked by a strong effort to place the financial position of the Govern- ment on a more satisfactory footing, and the internal in- debtedness was substantially reduced during his rule. In April 1880 Senor Rafael Nunez acceded to the Presidency. During his term of office revolutionary disturbances occurred in the provinces of Cauca and Antioquia, but were suppressed with no great difficulty. Provision was made in .1880 for a settlement of the boundary dispute with Costa Eica, and in July of that year the federal Congress authorized the formation of a naval squadron. A movement was now set afoot in favour of a confederation of the three republics of Colombia, Ecuador, and Venezuela on the basis of the original conditions existing after the expulsion of Spanish authority, and a resolution was passed by the Chamber of Deputies to that effect. The opposi- tion shown by Venezuela and Ecuador to this project prevented any definite result from being achieved. In April 1882 Senor Laldua became President, but, his death occurring a year later. General Otalora was

nominated to exercise the executive power for the unexpired portion of the term. In 1883 the dispute in connexion with the boundary between Colombia and Venezuela was submitted by the two Governments to the arbitration of Alphonso XII., king of Spain, and a commission of five members was appointed to in- vestigate the merits of the respective claims. The decision in this dispute was finally given by the Queen Eegent of Spain on 16th March 1891. In April 1884 Senor Eafael Nunez was again proclaimed President of the re- public in his absence abroad. Pending his return the ad- ministration was left in the hands of General Campo Serrano and General Eliseo Payan. The Liberal party had been instrumental in the re-election of Nunez, and looked f for a policy in conformity with their views and political convictions. President Nunez had no sooner returned to Colombia than the Liberals discovered that his political opinions had changed and had become strongly Conservative. Discontent at this conditioh of affairs soon spread. Nvinez from motives of ill-health did not openly assume the Presidential office, but from his house near Cartagena he practically directed the government of the republic. The Liberals now began to

foment a series of revolutionary movements, and these led in 1885 to a civil war extending over the departments of Boyaca, Cundinamarca, Magdalena, and Panama. General Reyes and General Velez were the two principal leaders of the revolt. In order to protect the passage of the traffic across the Isthmus of Panama during these disturbed times de- tachments of United States marines were landed atPanama and Colon, in accordance with the terms of the concession under which the railway had been constructed. After a number of defeats the leaders of the revolt surrendered in August 1885, and on 5th September following peace was officially proclaimed. Nunez, who had meanwhile assumed the Presidential duties, now brought about a movement in favour of a fresh Act of Constitution for Colombia, and a new law to that effect was finally approved and promulgated on 4th August 1886. Under the terms of tMs act the federal system of government for Colombia was abolished, the states becoming departments, the governors of these political divisions being appointed by the President of the republic. Each department has a local legislative assembly elected by the people. The National Congress is constituted of the Senate and the House of Representatives. The Senate is composed of twenty-seven members elected for six years, one-third retir- ing every two years, three of whom are nominated by each of the nine departments. The Houseof Representatives com- prises members elected for fouryears by universal suffrage, each department forming a constituency and returning one member for every 60,000 inhabitants. The Congress con- venes every two years. The Presidential term of office under the new Act was fixed at six years in place of the two years formerly prevailing. The judiciary was irremovable, and trial by jury was allowed for criminal offences. Capital punishment was re-established, and the press was made re- sponsible for matter published. The unlicensed trade in arms and ammunition hitherto existing was prohibited. Previous to 1886 the crime of murder was only punish- able by 10 years' imprisonment, a sentence which in practice was reduced to two-thirds of that term ; slander and libel were formerly offences which the law had no power to restrain, and no responsibility attached to sedi- tious publications.

After the promulgation of this new Act of Constitution President Nunez was proclaimed as President of the repub- lic for the term ending in 1892. He was unable, however, in consequence of ill-health, to reside at Bogota and discharge the presidential duties, and, consequently, in August 1888 Senor C&los Holguin was designated to act for him.

In 1892 President Nunez was again elected to the Presi- dency for a term of six years, his continued ill-health, how- ever, forcing him to place the active performance of his duties in the hands of the Vice-President, Senor Miguel Caro. In 1895 the Liberals made another attempt to seize the Government of the country, but the movement was suppressed without any very great difficulty. In this same year Nunez died, and Vice-President Caro became the actual President, an office he had practically filled during the three previous years. In 1898 Senor M. A. Sancle- mente, a strong Conservative, and supported by the Church party, was elected to the Presidency for the period ending in 1904. In October 1899 the Liberals organized another revolutionary outbreak for the purpose of trying to wrest the power from Conservatives, but this attempt had no better success than the movements of 1885 and 1895. In January 1900, however, Vice-President Marro- quin seized upon the Government, imprisoned President Sanclemente (died in prison in March 1902), and another period of disturbance began. The rebels were defeated in May in a desperate battle at Cartagena; and continuous fighting went on about Panama, where British marines had to be landed to protect foreign interests. As the year 1900 advanced, the conflict went on with varying success, but the Government troops were generally victorious, and in August Vice-President Marroquin was recognized as the acting head of the executive, with a Cabinet under General Calderon. In 1901 the rebellion continued, and severe fighting took place ^ about Colon. Further complications arose in August, when trouble occurred between Colombia and Venezuela. On the one hand, there were grounds for believing that the Clericals and Conservatives in both countries were acting together ; and, on the other, it was

expected that President Castro of Venezuela would not be sorry to unite his own country- men, and to divert their attention from internal affairs, by a war against Colombia. The Colombian revolutionary leaders had made use of the Venezuelan frontier as a base of operations, and the result was an invasion of Venezuelan territory by Colombian Government troops, an incident which at once caused a diplomatic quarrel. The United States Government in September offered its good offices, but President Castro refused them, and the state of affairs became gradually more menacing. Meanwhile both Panama and Colon were seriously threatened by the rebel forces, who in November succeeded in capturing Colon by surprise. The situation was complicated by the fact that the railway traffic on the Isthmus was in danger of inter- ruption, and on the capture of Colon it became necessary for the American, British, and French naval authorities to land men for the protection of the railway and of foreign interests.

The chief foreign treaties entered into by Colombia in the last quarter of the 19th century were: — (1)A treaty with Great Britain, signed on 27th October 1888, for the extradition of criminals ; (2) a treaty of friendship, commerce, and navigation with Italy, signed 27th October 1892 ; (3) two protocols with Italy, signed respectively 24th May and 25th August 1886, in connexion with the affair of the Italian subject Cerruti ; (4) a consular convention with Holland, signed 20th July 1881 ; (5) a treaty of peace and friendship with Spain, signed 30th January 1881 ; (6) a con- vention with Spain for the reciprocal protection of intellectual ■property ; (7) a concordat with the Vatican, signed 31st December 1887 ; (8) an agreement with the Vatican, signed aoth August 1892, in connexion with ecclesiastical jurisdiction ; (9) an agree- ment with the republic of San Salvador, signed 24th December 1880, in regard to the despatch of a delegate to an international congress : (10) a treaty of peace, friendship, and commerce with Germany, signed 23rd July 1892 ; (11) a treaty with the republic of Costa Rica, signed in 1880, for the delimitation of the boundary ;

(12) the postal convention, signed at Washington, 4th July 1891 ;

(13) a convention with Great Britain, signed 31st July 1896, in connexion with the claim of Messrs Punchard, M'Taggart, liowther, & Co. ; (14) a treaty of friendship, commerce, and navigation with Peru, signed 6th August 1898 ; (15) an extradi-

tion treaty with Peru, signed 6th August 1898 ; (16) a treaty of peace, friendship, and defensive alliance with Venezuela, signed 21st November 1896, and on the same date a treaty regulating the frontier commerce.

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Colombo, the capital and principal seaport of Ceylon, in the west coast. It has greatly changed since 1875. The formation of a commodious harbour (though the works are still in progress), and of 300 miles of railway, has made the port a very important one, mail steamers calling regularly, as well as men-of-war and mercantile marine of all nations, while the island's export traffic is concentrated in it. The demolition of the landward side of the old Dutch fort enabled new roads and buildings to be constructed; much land was reclaimed; and the banks, many commercial and steamer offices now occupy fine buildings. A new suburb has been built over with handsome bungalows beyond the Public Museum (a very fine structure) and Victoria Park. The water supply is drawn from a hill region 30 miles off. A scientific scheme of drainage is contemplated. Most of the town is lighted by gas, and certain quarters with electric light, and electric tramways have been laid over 7 miles of city roads. The packing, blending, and shipping of tea (rather than of coffee) is now the great industry, along with the prepara- tion and packing of cocoanut oil, cocoa(chocolate)plumbago, spices, &c. 607 steamers called to coal in 1900. Popula- tion (1891), 128,870 ; (1901), 154,279. There is a floating population in the harbour of from 5000 to 16,000.

Colon, formerly known as Aspinwall, a city and port on the northern coast of Panama, in the republic of Colombia, South America, on the north-east side of the Bay of Limon, 41 miles north-west of Panama by rail. Having been burned down during the revolution of 1885, it was rebuilt on improved plans, but owing mainly to careless- ness in the administration and the untidy habits of the inhabitants, chiefly West Indians from Jamaica, it is still rather unhealthy. The streets, though wide and originally well paved, are badly kept, but are lighted by electricity. The harbour is only an open bay, and therefore dangerous at certain seasons. There are four piers, affording accom- modation for eight ocean steamers at one time, in addition to a number of sailing craft. The northern portion of the city, owned by the Panama Eailway Company, is supplied with water from the Chagres river, but the remainder depends mainly on rain water. There are a number of important commercial houses, an aerated water factory, and a

distillery. The average tonnage of vessels entering is over 600,000 annually. Colon possesses a bronze statue

of Columbus, presented by the Empress Eugenie in 1870. The population is about 10,000.

Colon, an important railway town of Matanzas province, Cuba, and the centre of a rich sugar-planting country. Population (1899), 7175.

Colonne, Edouard (properly Judas) 1838),

French conductor , was born at Bordeaux on 23rd July 1838. He entered the Paris Conservatoire in 1866, and obtained there the first prizes in harmony and violin- playing in 1858 and 1863. He became a member of the orchestra at the Grand Opera in 1858, and at the founda- tion of Pasdeloup's Concerts Populaires was one of the firstviolins. The success of these concerts induced Colonne to start some on his own account. With the aid of Messrs Duquesnel and Hartmann,he founded Le Concert National. The first concert took place at the Odeon Theatre on 2nd March 1873. The following year the Concert National changed its title to that of Association Artistique, and migrated to the Theatre du ChStelet. M. Colonne has done a great deal to popularize the works of Hector Berlioz, besides bringing forward compositions of the younger French school of music. He was " chef d'orchestre " at the Paris Grand Opera from 1891 to 1893, and conducted the first performance there of Wagner's Die Wcdhure. M. Colonne has travelled with his orchestra, and he visited London in the autumn of 1896, when he gave four concerts at the Queen's Hall.

Colorado, a western State of the American Union, situated between 41° and 37° N. lat. and 102° and 109° W. long., bounded on the N. by Wyoming and Nebraska, on the E. by Nebraska and Kansas, on the S. by Oklar homa and New Mexico, and on the W. by Utah. Its largest and most important development has occurred since 1876. During this

period the growth of its mining, railway, manufacturing, and agricultural interests has been much greater than during all its previous history, while its educational institutions have nearly all of them been estab- lished since it was admitted to the Union, and its popu- lation has increased several-fold. Many of its towns have sprung into existeiice during this time, and its larger towns have changed from straggling and poorly constructed villages into important residential and manufacturing cities. Its area is 103,925 square miles, or over 66,000,000 acres. The western half of the State was part of the Mexican Cession of 1848. The south-east corner was part of the Texas Cession of 1850, and the north-western part of the Louisiana Purchase of 1803. It was organized as a Territory in 1861, and admitted as a State on 1st August 1876. At the first State election 30,000 votes were polled, the entire Republican ticket being elected, with John L. Routt (Republican) as Governor. The second Governor was E. W. Pitkin, who held office for four years, and was elected on the Republican ticket. He was followed by James B. Grant, a Democrat, who was succeeded by B. H. Eaton, a Republican. Alva Adams, a Democrat, was elected in 1887, and J. R. Cooper, a Republican, in 1890, being followed by John L. Routt. David H. Waite, a Populist, was chosen in 1893, Albert W. M'Intire, a Re- publican, in 1895; Alva Adams was again chosen in 1897, on a fusion ticket of Democrats and Populists, and on the same ticket Chas. S. Thomas was elected in 1899, and James B. Orman in 1901. The question of the free coinage of silver played &,n important part in the last three elections. Woman's suffrage prevails, having been adopted in the election of 1893 by a majority of about 5000 votes.

Population. — In 1876 the population was estimated at 136,000 ; the census of 1880 showed an increase to 194,327, that of 1890 to 412,198, and that of 1900 to 639,700. The average numher of

persons to the square mile was 5-2 in 1900, as compared with 3 '9 in 1890. The population in 1900 was made up as follows :— 295,332 (64-7 per cent.) males and 244,368 (45-3 percent.) females, 448,645 native-bom and 91,155 foreign-bom, 629,046 white and 10,654 coloured (Including 8670 negroes, 599 Chinese, 48 Japanese, and 1437 Indians). Out of 185,708 males 21 years of age and over, 7689 were illiterate

(unable to write), including 3804 foreign-bom, 448 negroes, 138 Chinese, 10 Japanese, and 246 Indians. The death-rate of the entire state in 1900, on the basis of the deaths reported to the U.S. census enumerators, was about 13-7. In 1900 there were 166 incorporated cities, towns, and villages in Colorado, of which 27 had a population of more than 2000, and of these 7 had a population of over 6000, namely, Denver, with 133,859 ; Pueblo, with 28,157 ; Colorado Springs, with 21,085 ; Leadville, with 12,456 ; Cripple Creek, with 10,147 ; Bovdder, with 6150 ; and Trinidad, with 6346 inhabitants. The growth of Denver has been as foUows: (1870), 4759; (1880), 35,629; (1890),

106,713 ; (1900), 133,869.

Mineral Besources. — The pioneers in the settlement of the State were attracted by its mineral resources. Gold and silver are found in 67 counties ; iron, copper, lead, and zinc in 37 ; and aluminium in 5. The first discovery of gold was made on January 7, 1859 ; since then the coin value of the gold and silver produced, including the output of 1899, has been $665,039,636. The coin value of the gold product for 1899 was $26,265,487, and that of silver §29,679,706, making a total of •?56,946,193. The total product for 1898 was 153,484,649. The chief gold-producing counties are Gilpin, Boulder, San Miguel, El Paso, Teller, Clear Creek, and Lake. The Cripple Creek district produced in 1900 about $1,250,000 of gold per month, and since 1891 had yielded $43,450,000. The largest silver production was in 1892, when the coin value of the product was $31,478,972. Iron ores are found in great abundance, and all materials necessary for making steel of excellent quality. The total value of the steel and iron products for 1899 was §7,681,719, in which year 134,936,223 pounds of steel rails and 215,640,332 pounds of pig iron were manufactured. Colorado stood ninth in 1898 in the list of coal-producing States. The aggregate area of coal beds is estimated at 18,100 square mUes, and the accessible coal at 33,897,800,000 tons. In 1899 the total tonnage mined was 4,806,879, and 466,783 tons of coke were produced, the number of men employed being 7321. There are 35 oU wells in Fremont county, which are sunk to a depth of about 1500 feet. The oil ordinarily rises to within 400 feet of the surface, although there have been a number of flowing wells. The

product increased from 76,295 barrels in 1887 to 842,000 in 1892 ; in 1900 it was about 500,000. It is refined, for the most part, at Florence, where there are two modern refineries. The value of lead produced in 1898 was §4,394,917 ; of copper, $1,831,600. The number of men employed in mining of all kinds was 30,231. Building stone of many varieties and of excellent quality is produced, valued at $2,000,000 annually. Mineral springs are found in all parts of the State. They vary in temperature from 40° to 150° F., and many possess medicinal value. The chief springs are at Manitou, Glenwood, Idaho Springs, Poncho Springs, Buena Vista, and Cafion City.

Agriculture and Stock-Raising. — Early experiments in farming indicated that regular crops could be secured only by means of irrigation, and in 1872 irrigation ditches were exempted from taxation. Extensive systems of canals were developed. In 1877 English capitalists constructed a canal over 150 mUes in length. This was followed by a canal that cost $2,500,000. Since then extensive canals have been built in the Arkansas and Grand Valleys, the San Luis Park, and other parts of the State. In 1889 there were over 6000 miles of main irrigating ditches. In 1900 the mileage had increased to more than 15,000, and the valuation of aU irrigation enterprises was $6,000,000. The amount of land under irrigation in 1883 was 416,694 acres, and in 1899, 1,976,400 acres. The average annual cost of water per acre is 79 cents. The soil is fertile in the north central section and in the river bottoms and large valleys, producing cereals, fmits, and vegetables of a superior quality. As early as 1866 the Surveyor- General estimated that of the population of 36,000 one-half were engaged in agriculture. In 1870 the agricultural production was estimated at $3,600,000, or within half a million of the bullion product. The total value of all fariu, range, ranch, and orchard products in 1882 was $8,947,500, and in 1899,'$45,774,261. The assessed valuation of all agricultural lands in 1900 was $19,566,124, and of grazing lands $9,901,701. The natural fruits are rare and almost worthless. In 1873 fruit trees began to be planted in various parts, and in 1882 the amount of land in orchards was 2500 acres, and the estimated value of the fruit crop $250,000 ; in 1898 the number of acres of fruit land was 118,752, and the value of the fruit crop $5,226,000 ; and there was still much open for settlement and

improvement. Apples, peaches, plums, apricots, pears, cherries, and melons of exceptionally fine flavour are raised in increasingly large quantities. The most productive sections are along the Arkansas Valley, and in the western and south-western portions of

the State. Melons from Rocky Ford and peaches from Mesa county are shipped to the east, and in small quantities to Europe. The report for 1898 shows that the staple grains gave the following yield in bushels: wheat, 6,729,565; corn, .3,113,892; barley, 353,952 ; oats, 3,063,191 ; rye, 47,484. The hay product was 1,760,728 tons, and potatoes, 2,564,3.31 bushels. The total value of these products was estimated at 117,349,251, as against |3,047,750 in 1882. It has been discovered by experiments conducted by the United States Government, through the Agricultural College, that the soil along the South Platte, the Arkansas and Grand rivers, and also in the San Luis Valley, is adapted for the cultivation of sugar beets, the average crop being 16 tons to the acre, and the proportion of saccharine matter unusually large. Sugar factories have been built at Grand Junction, Rocky Ford, and Sugar City; the first with a daily capacity of 3500 tons, and the others of 7500 tons. Stock-raising has always played an important part in the development of the State. The native grasses are especially adapted for fodder. The grama, buffalo, and bunch varieties cure on the stem and furnish nutritive food throughout the year. Be- fore the plains were fenced, large herds drifted to the south during the winter ; but sufficient hay and alfalfa are now cut to feed the cattle during the storms, which at longest are brief. As the in- dustry has grown, laws have been enacted concerning branding, herding, and protection from disease ; and a State Board of In- spectors has been formed. In 1884 the number of cattle was given as 1,005,000, and the number of sheep as 1,497,000. In 1899 the number was as follows : cattle, 754,039 ; sheep, 930,839 ; horses, 194,923 ; and mules, 7480. The total assessed valuation was 511,627,730, the assessment being about one-third of the market value. Wool in 1898 averaged seven pounds per fleece, the total

clip yielding $840,000. The total value of cattle slaughtered in the packing houses in 1898 was $3,168,000. The value of the dairy product in the same year was $13,267,849.

Manufactures. — Since 1888 there has been a considerable growth of manufacturing. There are 18 smelters and reduction plants in the State, situated mainly at Denver, Leadville, Durango, and at Pueblo, where there are also blast-furnaces, a steel plant, and rolling mills. The most improved methods of treating ore are used. The cyanide process, introduced in 1890, is now one of the most important factors in the treatment of low-grade and refractory gold and silver ores. The improved dioxide cyanide process was adopted in 1895. One million barrels of flour were produced dur- ing 1899, the fifty mills having a capacity of 2,000,000 per annum. Cotton and paper manufactures are carried on in t]je vicinity of Denver. According to the United States' Census of 1900, there were in the State 1792 manufacturing establishments (excluding 1778 classified as hand trades, and 292 others, with a product of less than $500 each). They had a total capital of $59,515,279, an average number of 19,948 wage-earners, and products valued at $91,639,495. , This sum includes the value of the gold, silver, lead, and copper smelted, which amounted to $44,625,305. Of the other products, iron and steel (valued at $6,108,295), fiour- ing and grist mill products (valued at $4,528,062), and foundry and machine shop products (valued at $3,986,915), were the most important.

Railways. — The Denver Pacific, built from Cheyenne, reached Denver in June 1870, and the Kansas Pacific in August of the same year. Then followed the Denver and Rio Grande, to which the earlier development of the State is largely due. In 1886 the Colo- rado Midland started from Colorado Springs westwards, up the Ute Pass, and through the South Park to Leadville, and then over the Continental Divide to Aspen and Glenwood Springs ; it has right of way over the Denver and Rio Grande line to Grand Junc- tion, there connecting with the Rio Grande Western for Salt Lake City and Ogden, and the Pacific Coast. The Colorado and Southern, connecting Colorado with the south, has become an im- portant system. In 1900 there were fifteen railways, with

4685 miles, in operation. The assessment on railways, tramways, telephones, and telegraphs was $35,533,586.

Finances. — The assessed valuation in real and personal property in 1876 was $44,130,205 ; in 1899 the total assessed valuation of all properties was $203,861,746 ; but this was regarded by the State Board as too low, and 5 per cent, increase was recommended. Taxes were levied in 1899 to the amount of $4,688,458. The total State debt in 1899 was $2,584,443. The cash in the treasury and uncollected taxes, $849,275, leaving a balance of indebtedness of $1,735,167. The total deposits in the 36 national banks on 13th February 1900, was $45,802,863.

Education.— 01 the public lands, 3,715,555wacres were granted for the support of schools, 46,080 acres for the University, and 90,000 acres for the Agricultural College. In 1900 the number of persons of school age (5 to 20 years inclusive) was 160,531. The amount apportioned to the various school districts for 1900 was $62 577, and the total value of all school properties was $6,495,850. The salaries paid to the teachers in the public schools during 1899 and 1900 amounted to $1,423,680. Graded schools are found throughout the State, and high schools in all the larger towns.

The State institutions are : the University of Colorado, at Boulder ; the School of Mines, at Golden ; the Agricultural College, at Fort Collins ; the Normal School, at Greeley ; the School for the Deaf and Blind, at Colorado Springs ; the Industrial School for boys, at Golden, and for girls at Aurora. These are supported by a mill tax, and special appropriations. The State University has an an- nual income of $70,000, and a library of 19,000 volumes ; the School of Mines, an income of $37,000 ; and the Normal School an income of $32,000, and a library of 10,000 volumes. The Agri- cultural College has an income of $65,500, of which $23,000 is from the -United States Government. Experiment stations are conducted in rionnexion with the college at Fort Collins, Rocky Ford, and Cheyenne Wells. There are two institutions for higher education on an independent foundation. Colorado College, at Colorado Springs, is the oldest existing college in

the State. Its property in equipment and endowment is $1,500,000, and it has a library of 30,000 volumes. The University of Denver, under Methodist control, is an outgrowth of the Colorado Seminary, the charter of which was granted in 1864. It has associated Law and Medical Schools. The Chamberlin Astronomical Observatory, with a 20-inch aperture telescope, is part of its equipment.

(w. F. 8.)

Colorado Springs, capital of El Paso county, Colorado, U.S.A. It is situated near tlie centre of the state, upon the high plains near the base of the Eocky Mountains, on Fontaine qui Bouille river, at the mouth of Monument creek, in 38° 60′ N. lat. and 104° 49′ W. long, at an altitude of 6986 feet. Its situation is fine, commanding a superb view of the mountains, whose culminating point. Pike's Peak, rises to a height of 14,108 feet, or more than 8000 feet above the city. It is entered by five railways : the Denver and Eio Grande ; the Atchison, Topeka, and Santa Fe ; the Colorado and Southern; the Chicago, Eock Island, and Pacific; and the Colorado Midland. It is the site of Colorado College, which in 1899 had a faculty numbering thirty- three, and was attended by 336 students. Colorado Springs was founded in 1871, upon the construction of the Denver and Eio Grande railway and has had a rapid growth. In its earlier years this was due to the beauty of its situation and its reputation as a health resort for consumptives. In later years the development of the gold mines at Cripple Creek has given it importance as a supply-point for this great mining camp. Population (1880), 4226 ; (1890), 11,140 ; (1900), 21,085, of whom 2300 were foreign-bom and 875 negroes.

Colossse, once the great city of South-West Phrygia, was situated at an altitude of 1150 feet on rising ground on the left bank of the Lycus {Churuk Su), a tributary of the Maeander, at the upper end of a narrow gorge 2^ miles long, through which the river runs between cliffs from 50 to 60 feet high. It stood on the great trade route from Sardis to Celaenae and Iconium, and was a large, prosper- ous, and populous city (Herod, vii. 30 ; Xenophon, Anab. i. 2, § 6), until its prosperity was ruined by the founda- tion of Laodicea in a more

advantageous position. The town was celebrated for its wool, which was dyed a purple colour called colossinus. Colossse was the seat of an early Christian Church, possibly founded by Epaphras, to which St Paul addressed an epistle. Eor some cen- turies it continued to prosper, but during the 7th and 8th centuries it was gradually deserted under pressure of the Arab invasions. Its place was taken by Khonse (Khonas) — a strong fortress on a rugged spur of Mt Kadmus, 3 miles to the south, which became a place of importance during the wars between the Byzantines and Turks, and was the birthplace of the historian, Nicetas Khoniates. The worship of angels alluded to by St Paul (Col. ii. 18), and condemned in the 4th century by a council at Laodi- cea, reappears in the later worship of St Michael, in whose honoiir a celebrated church, destroyed by the Seljiiks in the 12th century, was built on the right bank of the Lycus (Eamsay, Cities and Bishoprics of Phrygia, vol. i. 1895).

COLOURS OF AlSriMALS.

1. Bionomics.

THE scope of this article includes the uses of colour in the struggle for existence among animals and in their sexual relationships, but not the physiological uses of coloured pigments or the discussion of pigments of un- certain meaning.

Use of Colour for Concealment — Cryptic Colouring is by far the commonest use of colour in the struggle for existence. It is employed for the purpose of attack (Aggressive Resemblance or Anticryptic Colouring) as well as of defence {Protective Resemblance or Procryptic Colour- ing). The fact that the same method, concealment, may be used both for attack and defence has been well ex- plained by Belt (The Naturalist in Nicaragua, London, 1888), who suggests as an illustration the rapidity of movement which is also made use of by both pursuer and pursued, which is similarly raised to a maximum in both by the

gradual dying out of the slowest through a series of generations. Cryptic colouring is commonly associated with other aids in the struggle for life. Thus well-con- cealed mammals and birds, when discovered, will generally endeavour to escape by speed, and will often attempt to defend themselves actively. On the other hand, small ani- mals which have no means of active defence, such as large numbers of insects, frequently depend upon concealment alone. Protective Resemblance is far commoner among animals than Aggressive Resemblance, in correspondence with the fact that predaceous forms are as a rule much larger and much less numerous than their prey. In the case of insectivorous Vertebrata and their prey such differ- ences exist in an exaggerated form. Cryptic colouring, whether used for defence or attack, may be either General or Special. In General Resemblance the animal, in con- sequence of its colouring, produces the same effect as its environment, but the conditions do not require any special adaptation of shape and outline. General Resemblance is especially common among the animals inhabiting some uniformly coloured expanse of the earth's surface, such as an ocean or a desert. In the former, animals of all shapes are frequently protected by their transparent blue colour ; on the latter, equally diverse forms are defended by their sandy appearance. The effect of a uniform appearance may be produced by a combination of tints in startling contrast. Thus the black and white stripes of the zebra blend together at a little distance, and " their proportion is such as exactly to match the pale tint which arid ground possesses when seen by moonlight " (Galton, South Africa, London, 1889). Special Resemblance is far com- moner than General, and is the form which is usually met with on the diversified surface of the earth, on the shores, and in shallow water, as well as on the floating masses of Algse on the surface of the ocean, such as the Sargasso Sea. In these environments the cryptic colour- ing of animals is usually aided by special modifications of shape, and by the iustinct which leads them to assume particular attitudes. Complete stillness and the assump- tion of a certain attitude play an essential part in General Resemblance on land ; but in Special Resemblance the attitude is often highly specialized, and perhaps more important than any other element in the complex method by which concealment is effected. In Special Resemblance the combination of colouring, shape,

and attitude is such as to produce a more or less exact resemblance to some one of the objects in the environment, such as a leaf or twig, a patch of lichen, or flake of bark. In all cases the resemblance is to some object which is of no interest to the enemy or prey respectively. The animal is not

hidden from view by becoming indistinguishable from its background, as in the cases of General Resemblance, but it is mistaken for some well-known object.

In seeking the interpretation of these most interesting and elaborate adaptations, attempts have been made along two Unes. First, it is sought to explain the effect as a result of the direct influence of the environment upon the individual (Buff on), or by the inherited effects of effort and the use and disuse of parts (Lamarck). Second, natural selection is believed to have produced the result, and afterwards .maintained it by the survival of the best concealed in each generation. The former suggestions break down when the complex nature of numerous Special Resemblances is appreciated. Thus the arrangement of colours of many kinds into an appropriate pattern requires the co-operation of a suitable shape and the rigidly exact adoption of a certain elaborate attitude. The latter is instinctive, and thus depends on the central nervous system. The cryptic effect is due to the exact co-operation of all these factors ; and in the present state of science the only possible hope of an interpreta- tion lies in the theory of natural selection, which can accumulate any and every variation which tends towards survival. A few of the chief types of methods by which concealment is effected may be briefly described. The colours of large numbers of Vertebrate animals are darkest on the back, and become gradually lighter on the sides, passing into white on the belly. Abbot H. Thayer (The Auk, vol. xiii., 1896) has suggested that this gradation obliterates the appearance of solidity, which is due to shadow. The colour-harmony, which is also essential to concealment, is produced because the back is of the same tint as the environment (e.g., earth) bathed in the cold blue-white of the sky, while the belly, being cold blue-white bathed in shadow and yellow earth reflexions, produces the same effect. Thayer has made models (in the Natural History Museums

at London, Oxford, and Cambridge) which support his interpretation in a very convincing manner. This method of neutraliz- ing shadow for the purpose of concealment by increased lightness of tint was first suggested by E. B. Poulton in the case of a larva (Trans. Ent. Soc. Land., 1887, p. 294) and a pupa (Trans. Ent. Soc. Lond., 1888, pp. 596, 597), but he did not appreciate the great importance of the principle. In an analogous method an animal in front of a background of dark shadow may have part of its body obliterated by the existence of a dark tint, the remainder resembling, e.g., a part of a leaf (Mliller, Zool. Jahr. J. W. Spengel, Jena, 1886). This method of rendering invisible any part which would interfere with the resemblance is well known in Mimicry. A common aid to concealment is the adoption by different individuals of two or more different appearances, each of which resembles some special object to which an enemy is indifferent. Thus the leaf-like butterflies (Kallima) present various types of colour and pattern on the under side of the wings, each of which closely resembles some well-known appearance presented by a dead leaf ; and the common British Yellow TJnderwing Moth (Tryphcena pronuba) is similarly polymorphic on the upper side of its upper wings, which are exposed as it suddenly drops among dead leaves. Caterpillars and pupae are also commonly Dimorphic, green and brown. Such differences as these extend the area which an enemy is compelled to search in order to make a living. In many cases the cryptic colouring changes appropriately during the course of an individual life, either seasonally, as in the ptarmigan or Alpine hare, or, according as the

individual enters a new environment in the course of its growth (such as larva, pupa, imago, &c.). In insects with more than one brood in the year, Seasoned Dimorphism is often seen, and the differences are sometimes appropriate to the altered condition of the environment as the sear sons change. The causes of change in these and Arctic animals are insufficiently worked out : in both sets there are observations or

experiments which indicate changes from within the organism, merely following the seasons and not caused by them, and other observations or ex- periments which prove that certain species are susceptible to the changing external influences. In certain species concealment is effected by the use of adventitious objects, which are employed as a covering. Examples of this Allocryptic defence are found in the tubes of the caddis worms (Phryganea), or the objects made use of by crabs of the genera Hyas, Stenorhynchus, &c. Such animals are concealed in any environment. If sedentary, like the for- mer example, they are covered up with local materials ; if wandering, like the latter, they have the instinct to reclothe. Allocryptic methods may also be used for aggressive purposes, as the ant-lion larva, almost buried in sand, or the large frog Ceratophrys, which covers its back with earth when waiting for its prey. Another form of Allocryptic defence is found in the use of the colour of the food in the digestive organs showing through the transparent body, and in certain cases the adventitious colour may be dissolved in the blood or secreted in super- ficial cells of the body : thus certain insects make use of the chlorophyll of their food (Poulton, Proc. Boy. Soc. vol. liv. p. 417). The most perfect Cryptic powers are possessed by those animals in which the individuals can change their colours into any tint which would be appro- priate to a normal environment. This power is widely prevalent in Fish, and also occurs in Amphibia and Eep- tilia (the chameleon affording a well-known example). Analogous powers exist in certain Crustacea and Cepha- lopoda. All these rapid changes of colour are due to changes in shape or position of superficial pigment cells controlled by the nervous system. That the latter is it- self stimulated by light through the medium of the eye and optic nerve has been proved in many cases. Animals with a short life-history passed in a single environment, which, however, may be very different in the case of dif- ferent individuals, may have a different form oi Variable Cryptic Colouring, namely, the power of adapting their colour once for all (many pupae), or once or twice (many larvse). In these cases the effect appears to be produced through the nervous system, although the stimulus of light probably acts on the skin and not through the eyes. Particoloured surfaces do not produce particoloured pupae, probably because the antagonistic stimuli neutralize each other in the central nervous system which then disposes

the superficial colours so that a neutral or intermediate effect is produced over the whole surface (Poulton, Trans. Ent. Soc. Land., 1892, p. 293). Cryptic colouring may incidentally produce superficial resemblances between animals; thus desert forms concealed in the same way may gain a likeness to each other, and in the same way Special Resemblances, e.g., to lichen, bark, grasses, pine- needles, &c., may sometimes lead to a tolerably close sim- ilarity between the animals which are thus concealed. Such likeness ma,j he called Syncryptic or: Common Pro- tective (or Aggressive) Resemblance, and it is to be distin- guished from Mimicry and Common Warning Colours, in which the likeness is not incidental but an end in itself. Syncryptic Resemblances have much in comnion with those incidentally caused by functional adaptation, such as the mole-like forms produced in the burrowing Insec- tivora, Rodentia, and Marsupialia. Such likeness may be called Syntechnic BeseTnblance, incidentally produced by

dynamic similarity, just as Syncryptic Resemblance is produced by static similarity.

Use of Colour for Warning and Signalling. — The use of colour for the purpose of warning is the exact opposite of the one which has been just described, its object being to render the animal conspicuous to its enemies, so that it can be easily seen, well remembered, and avoided in fu- ture. Warning colours are associated with some quality or weapon which renders the possessor unpleasant or dan- gerous, such as unpalatability, an evil odour, a sting, the poison-fang, &c. The object being to warn an enemy off, these colours are also called Aposematic. Recognition markings, on the other hand, are JEpisematic, assisting the individuals of the same species to keep together when their safety depends upon numbers, or easily to follow each other to a place of safety, the young and inexperi- enced benefiting by the example of the older. Episematic characters are far less common than Aposematic, and these than Cryptic ; although, as regards the latter comparison, the opposite impression is generally produced from the very fact that concealment is so successfully attained. Warning or Aposematic Colours, together with the qualities they indicate, depend, as a rule, for

their very existence upon the abundance of palatable food supplied by the ani- mals with Cryptic colouring. Unpalatability, or even the possession of a sting, is not sufficient defence imless there is enough food of another kind to be obtained at the same time and place (Poulton, Proc. Zool. Soc, 1887, p. 191). Hence insects with Warning Colours are not seen in temperate countries except at the time when insect life as a whole is most abundant ; and in warmer countries, with well-marked wet and dry seasons, it will probably be found that Warning Colours are proportionately less developed in the latter. In many species of African but- terflies belonging to the genus Junonia (including Precis) the wet-season broods are distinguished by the more or less conspicuous under sides of the wings, those of the dry season being highly cryptic. Warning Colours are, like Cryptic, assisted by special adaptations of the body-form, and especially by movements which assist to render the colour as conspicuous as possible. On this account animals with Warning Colours generally move or fly slowly, and it is the rule in butterflies that the "Warning patterns are similar on both upper and under sides of the wings. Many animals, when at- tacked or disturbed, " sham death " (as it is commonly but wrongly described), falling motionless to the ground. In the case of well-concealed animals this instinct gives them a second chance of escape in the earth or among the leaves, &c., when they have been once detected ; animals with Warning Colours are, on the other hand, enabled to assume a position in which their characters are displayed to the full (Portschinski, Lepidopterorum Bossice Biologia, St Petersburg, 1890, plate i. figs. 16, 17). In both cases a definite attitude is assumed, which is not that of death. Other warning characters exist in addition to colouring : thus sound is made use of by the disturbed Rattle-snake and the Indian Echis, &c. Large birds, when attacked, often adopt a threatening attitude, accompanied by a terrifying sound. The Cobra warns an intruder chiefiy by attitude and the dilation of the flattened neck, the effect being heightened in some species by the " spec- tacles." In such cases we often see the combination of Cryptic and Sematic methods, the animal being con- cealed until disturbed, when it instantly assumes an Aposematic attitude. The advantage to the animal itself is clear : a poisonous snake gains nothing by killing an animal it cannot eat ; while the poison does not cause immediate death, and the enemy

would have time to injure or destroy the snake. In the case of small unpal- atable animals with Warning Colours the enemies would

only first become aware of the unpleasant quality by tasting and often destroying their prey ; but the species would gain by the experience thus conveyed, even though the individual might suffer. An insect-eating animal does not come into the world with knowledge: it has to be educated by experience, and Warning Colours enable this education as to what to avoid to be gained by a small instead of a large waste of life. Furthermore, great tenacity of life is usually possessed by animals with Warning Colours. The tissues of Aposematic insects generally possess great elasticity and power of resistance, so that large numbers of individuals can recover after very severe treatment.

The brilliant Warning Colours of many caterpillars attracted the attention of Darwin when he was thinking over his hypothesis of sexual selection, and he wrote to Wallace on the subject (Darwin, Xi/e and Letters, London, 1887, vol. iii. p. 93). Wallace, in reply, suggested their interpretation as Warning Colours, a suggestion since verified by experiment (Proc. Ent. Soc. Land., 1867, p. Ixxx ; Trans. Ent. Soc. Lond., 1869, pp. 21 and 27). Although animals with Warning Colours are probably but little attacked by the ordinary enemies of their class, they have special enemies which keep the numbers down to the average. Thus the cuckoo appears to be an insect- ivorous bird which will freely devour conspicuously coloured unpalatable larvae. The effect of the Warning Colours of caterpillars is often intensified by gregarious habits. Another Aposematic use of colours and structures is to divert attention from the vital parts, and thus give the animal attacked an extra chance of escape. The large, conspicuous, easily torn wings of butterflies and moths act in this way, as is found by the abundance of individuals which may be captured with notches bitten symmetrically out of both wings when they were in contact. The eye-

spots and ” tails ” so common on the hinder part of the hind wing, and the conspicuous apex so frequently seen on the fore wing, probably have this meaning. Their position corresponds to the parts which are most often found to be notched. In some cases {e.g., many Lyccenidce) the ” tail ” and eye-spot combine to suggest the appearance of a head with antennae at the posterior end of the butterfly, the deception being aided by movements of the hind wings. The flat-topped ” tussocks ” of hair on many caterpillars look like con- spicuous fleshy projections of the body, and they are held prominently when the larva is attacked. If seized, the ” tussock ” comes out, and the enemy is greatly inconvenienced by the fine branched hairs. The tails of lizards, which easily break off, are to be similarly ex- plained, the attention of the pursuer being probably still further diverted by the extremely active movements of the amputated member. Certain crabs similarly throw off their claws when attacked, and the claws continue to snap most actively. The tail of the dormouse, which easily comes off, and the extremely bushy tail of the squirrel, are probably of use in the same manner. Animals with Warning Colours often tend to resemble each other superficially. This fact was first pointed out by H. W. Bates in his paper on the Theory of Mimicry (Trans. Linn. Soc. vol. xxiii., 1862, p. 495). He showed that the conspicuous, presumably unpalatable, tropical American butterflies, belonging to very different groups, which are mimicked by others, also tend to resemble each other, the likeness being often remarkably exact. These resemblances were not explained by his theory of Mimicry, and he could only suppose that they had been, produced by the direct influence of a common environment. The problem was solved in 1879 by Fritz Miiller (see Proc. Ent. Soc. Lond., 1879, p. xx), who suggested that life is saved by this resemblance between

Warning Colours, inasmuch as the education of young inexperienced enemies is facilitated. Each species which falls into a group with Common Warning (Synaposematic) Colours contributes to save the lives of the other mem- bers. It is sufliciently obvious that the amount of learning and remembering, and consequently of injury and loss of life involved in the process, are reduced when many species in one place possess the same Apose- matic colouring, instead of each exhibiting a

different ” danger-signal.” These resemblances are often described as ” Miillerian Mimicry,” as distinguished from true or “Batesian Mimicry” described in the next section. Similar Synaposematic resemblances between the specially protected groups of butterflies were afterwards shown to exist in tropical Asia, the East Indian Islands, and Poly- nesia by F. Moore (Proc. Zool. Soc, 1883, p. 201), and in Africa by E. B. Poulton (Report Brit. Assoc, 1897, p. 688). R. Meldola (Ann. and Mag. Nat. Hist, x., 1882, p. 417) first pointed out and explained in the same manner the remarkable general uniformity of colour and pattern which runs through so many species of each of the dis- tasteful groups of butterflies ; while, still later, Poulton (Proc. Zool. Soc, 1887, p. 191) similarly extended the interpretation to the Synaposematic resemblances between animals of all kinds in the same country. Thus, for example, longitudinal or circular bands of the same strongly contrasted colours are found in species of many groups with distant affinities. ■

Certain animals, especially the Crustacea, make use of the special defence and Warning Colours of other animals. Thus the English Hermit-crab, Pagurus bei-nhardus, commonly carries the Sea-anemone, Sagartia parasitica, on its shell; while another English species, Pagurus prideauoeii, inhabits a shell which is invariably clothed by the flattened Adamsia palUata.

The white patch near the tail which is frequently seen in the gregarious Ungulates, and is often rendered con- spicuous by adjacent black markings, probably assists the individuals in keeping together ; and appearances with probably the same interpretation are found in many birds. The white upturned tail of the rabbit is probably of use in enabling the individuals to follow each other readily. The difference between a typical Aposematic character appealing to enemies, and Epise- matic intended for other individuals of the same species, is well seen when we compare such examples as (1) the huge banner-like white tail, conspicuously contrasted with the black or black and white body, by which the slow-moving skunk warns enemies of its power of emit- ting an intolerably offensive odour; (2) the small up- turned white tail

of the rabbit, only seen when it is likely to be of use and when the owner is moving, and, if pursued, very rapidly moving, towards safety.

Mimicry, or Pseudo-sematic Colours. — The fact that animals with distant affinities may more or less closely resemble each other was observed long before the existing explanation was possible. Its recognition is implied in a number of insect names with the termination -formis, usually given to species of various Orders which more or less closely resemble the stinging Hymenoptera. The usefulness of the resemblance was suggested in Kirby and Spence's Introduction to Entomology, London, 1817, vol. ii. p. 223. H. W. Bates (Trans. Linn. Soc. vol. xxiii. 1862, p. 496) first proposed an explanation of Mimicry based on the theory of Natural Selection. He supposed that every step in the formation and gradual improvement of the likeness occurred in consequence of its usefulness in the struggle for life. The subject is of additional interest, inasmuch as it was one of the first attempts to apply the theory of Natural Selection to a large class of phenomena up to that time well known but unexplained. Numerous

examples of Mimicry among tropical American butterflies were discussed by Bates in his paper ; and in 1866 A. E.. Wallace extended the hypothesis to the butterflies of the tropical East (Trans. Linn. Soc. vol. xxv., 1866, p. 19); Eoland Trimen (Trans. Linn. Soc. vol. xxvi., 1870, p. 497) to those of Africa in 1870. The term Mimicry is used in various senses. It is often extended, as indeed it was by Bates, to include all the superficial resemblances between animals and any part of their environment. Wallace, however, separated the Cryptic Eesemblances already described, and the majority of naturalists have followed this convenient arrangement. In Cryptic Eesemblance an animal resembles some object of no interest to its enemy (or prey), and in so doing is concealed ; in' Mimicry an animal resembles some other animal which is specially disliked by its enemy, or some object which is specially

attractive to its prey, and in so doing becomes conspicu- ous. Some naturalists have considered Mimicry to in- clude all superficial likenesses between animals, but such a classification would group together resemblances which have widely different uses. (1) The resemblance of a mollusc to the coral on which it lives, or an external parasite to the hair or skin of its host, would be Pro- cryptic; (2) that between moths which resemble lichen, Syncryptic; (3) between distasteful insects, Synaposematic ; (4) between the Insectivor mole and the Eodent mole-rat, Syntechnic; (5) the essential element in Mimicry is that it is a false warning (Pseud-aposematic) or false recognition (Pseud-episematic) character. Some have considered that Mimicry indicates resemblance to a moving object; but apart from the non-mimetic likenesses between animals classified above, there are ordinary Cryptic Eesemblances to drifting leaves, swaying bits of twig, &c., while truly Mimetic Eesemblances are often specially adapted for the attitude of rest. Many use the term Mimicry to include Synaposematic as well as Pseudo-sematic Resem- blances, calling the former ” Miillerian,” the latter ” Bates- ian,” Mimicry. The objection to this grouping is that it takes little account of the deceptive element which is essential in Mimicry. In Synaposematic colouring the warning is genuine, in Pseud-aposematic it is a sham. The term Mimicry has led to much misunderstanding from the fact that in ordinary speech it implies delib- erate imitation. The production of Mimicry in an in- dividual animal has no more to do with consciousness or “taking thought” than any of the other processes of growth. Protective Mimicry is here defined as an advan- tageous and superficial resemblance of one animal to another, which latter is specially defended so as to be disliked or feared by the majority of enemies of the groups to which both belong — a resemblance which appeals to the sense of sight, sometimes to that of hearing, and rarely to smell, but does not extend to deep-seated characters except when the superficial likeness is affected by them. Mutatis mutandis this definition will apply to Aggressive (Pseud-episematic) Eesemblance. The, conditions under which Mimicry occurs have been stated by Wallace :—« (1) that the imitative species occur in the same area and occupy the same station as the imitated ; (2) that the imitators are alwavs the more defenceless ; (3) that the imitators are always less numerous in individuals ; (4) that the imita^ tors differ

from the bulk of their allies ; (5) that the imi- tation, however minute, is external and visible only, never extending to internal characters or to such as do not affect the external appearance." It is obvious that conditions 2 and 3 do not hold in the case of Miillerian Mimicry. Mimicry has been explained, independently of Natural Selection, by the supposition that it is the common expression of the direct action of cominon causes, such as climate, food, &c. ; also by the supposition

of independent lines of evolution leading to the same result without any selective action in consequence of advantage in the struggle ; also by the operation of Sexual Selection. It is proposed, in conclusion, to give an account of the broad aspects of Mimicry, and attempt a brief discussion of the theories of origin of each class of facts (see Poulton, Linn. Soc. Journ. Zool., 1898, p. 558). It will be found that in many cases the argument here made use of applies equally to the origin of Cryptic and Somatic Colours. The relationship between these classes has been explained: Mimicry is, as Wallace has stated (Darwinism, London, 1889), merely "an exceptional form of protective resemblance." Now, protective (cryptic) resemblance cannot be explained on any of the lines suggested above, except natu- ral selection ; even sexual selection fails, because cryptic resemblance is especially common in the immature stages of insect life. But it would be unreasonable to explain Mimetic Eesemblance by one set of principles and Cryptic by another and totally different set. Again, it may be plausible to explain the mimicry of one butterfly for another on one of the suggested lines, but the resemblance of a fly or moth to a wasp is by no means so easy, and here selection would be generally conceded ; yet the appeal to antagonistic principles to explain such closely related cases would only be justified by much direct evidence. Furthermore, the mimetic resemblances between butter- flies are not haphazard, but the models almost invariably belong only . to certain sub-families, the Danaince and Acraeince in all the warmer parts of the world, and, in tropical America, the Ithomiince and Heliconinoe as well. These groups have the characteristics of Aposematic spe- cies, and no theory but natural selection explains their in- variable occurrence as models wherever they exist. It is impossible to suggest, except by natural selection, any explanation of the fact that mimetic resemblances are confined to

changes which produce or strengthen a super- ficial likeness. Very deep-seated changes are generally involved, inasmuch as the appropriate instincts as to attitude, &c., are as important as colour and marking. The same conclusion is reached when we analyse the nature of mimetic resemblance and realize how complex it really is, being made up of colours, both pigmentary and struc- tural, pattern, form, attitude, and movement. A plausible interpretation of colour may be widely improbable when applied to some other element, and there is no explanation except natural selection which can explain all these ele- ments. The appeal to the direct action of local conditions in common often breaks down upon the slightest investi- gation, the difference in habits between mimic and model in the same locality causing the most complete divergence in their conditions of life. Thus manyinsectsproducedfrom burrowing larvae mimic those whose larvae live in the open. Mimetic resemblance is far commoner in the female than in the male, a fact readily explicable by selection, as suggested by Wallace, for the female is compelled to fly more slowly and to expose itself while laying eggs, and hence a resem- blance to the slow-flying freely exposed models is especially advantageous. The facts that mimetic species occur in the same locality, fly at the same time of the year as their models, and are day-flying species even though they may belong to nocturnal groups, are also more or less difficult to explain except on the theory of natural selection, and so also is the fact that mimetic resemblance is produced in the most varied manner. A spider resembles its model, an ant, by a modification of its body-form into a superficial resemblance, and by holding one pair of legs to represent antennae ; certain bugs (Hemiptera) and beetles have also gained a shape unusual in their respective groups, a shape which superficially resembles an ant ; a Locustid (Myrmecophana) has the shape of an ant painted, as it were, on its body, all other parts resembling the back-

ground and invisible ; a Membracid (Homoptera) is en- tirely unlike an ant, but is concealed by an ant-like shield. When we further realize that in this and other examples of Mimicry "the likeness is almost always detailed and remarkable, however it is attained, while the methods differ absolutely," we recognize that natural selection is the only possible explanation hitherto sug- gested. In the cases of Aggressive Mimicry an animal resembles some object which is attractive to its prey. Examples are found in the flower-like species of Mantis, which attract the insects on which they feed. Such cases are generally described as possessing " alluring colours," and are regarded as examples of Aggressive (Anticryptic) Resemblance, but their logical position is here.

Colours displayed in Courtship, Secondary Sexual Char- acters, Epigamic Colours. — Darwin suggested the explana- tion of these appearances in his theory of Sexual Selection (The Descent of Man, London, 1874). The rivalry of the males for the possession of the females he believed to be decided by the preference of the latter for those in- dividuals with especially bright colours, highly developed plumes, beautiful song, &c. Wallace does not accept the theory, but believes that natural selection, either directly or indirectly, accounts for all the facts. Probably the majority of naturalists follow Darwin in this respect. The subject is most difficult, and the interpretation of a great proportion of the examples in a high degree uncertain, so that a very brief account is here expedient. That selection of some kind has been operative is indicated by the diversity of the elements into which the effects can be analysed. The most complete set of observations on Epigamic dis- play was made by George W. and Elizabeth Gr. Peckham upon spiders of the family Attidce (Nat. Hist. Soc. of Wisconsin, vol. i., 1889). These observations afforded the authors " conclusive evidence that the females pay close attention to the Iqve-dances of the males, and also that they have not only the power, but the wUl, to exercise a choice among the suitors for their favour." Epigamic characters are often concealed except during courtship ; they are found almost exclusively in species which are diurnal or semi-diurnal in their habits, and are excluded from those parts of the body which move too rapidly to be seen. They are very commonly directly associated with the nervous

system ; and in certain fish, and probably in other animals, an analogous heightening of effect accom- panies nervous excitement other than sexual, such as that due to fighting or feeding. Although there is Epigamic display in species with sexes alike, it is usually most marked in those with secondary sexual characters specially devel- oped in the male. These are an exception to the rule in heredity, in that their appearance is normally restricted to a single sex, although in many of the higher animals they have been proved to be latent in the other, and may appear after the essential organs of sex have been removed or be- come functionless. This is also the case in the Aculeate Hymenoptera when the reproductive organs have been destroyed by the parasite (Stylops). Cunningham has re- cently argued (Sexual Dimorphism in the Animal Kingdom, London, 1900) that secondary sexual characters have been produced by direct stimulation due to contests, &c., in the breeding period, and have gradually become hereditary, a hypothesis involving the assumption that acquired charac- ters are transmitted. Wallace suggests that they are in part to be explained as ” Eecognition Characters,” in part as an indication of surplus vital activity in the male.

AuTHOKiTiES. — The following works may also be consulted : — EiMEK. Orthogenesis der Sehmetterlinge. Leipzig, 1898. — Poui/- TON. The Colours of Animals. London, 1890. — Beddaed. Animal Coloration. London, 1892. — Haase. Researches on Mimicry (translation). London, 1896. — Wallace. Natural Selection and Tropical Nature. London, 1895. Darwinism.

London, 1897. Many of the memoirs and volumes quoted in the text also contain further references. (e. B. P.)

II. Chemistet.

The coloration of the surface of animals is caused either by pigments, or by a certain structure of the surface by means of which the light falling on it, or reflected through its superficial transparent layers, undergoes diffraction or other optical change. Or it may be the result of a com- bination of these two causes. It plays an important part in the relationship of the animal to its environment, in concealment, in

mimicry, and so on; the presence of a pigment in the integument may also serve a more direct physiological purpose, such as a respiratory function. The coloration of birds' feathers, of the skin of many fishes, of many insects, is partially at least due to structure and the action of the peculiar pigmented cells known as " chromatophores " (which Garstang defines as pigmented cells specialized for the discharge of the chromatic func- tion) and is much better marked when these have for their background a " reflecting layer " such as is provided by guanin, a substance closely related to uric acid. Such a mech3,nism is seen to greatest advantage in fishes. Among these, guanin may be present in a finely granular form, causing the light falling on it to be scattered, thus producing a white effect; or it may be present in a peculiar crystalline form, the crystals being known as " iridocytes " ; or in a layer of closely apposed needles forming a silvery sheet or mirror. In the iris of some fishes the golden red colour is produced by the light reflected from such a layer of guanin needles having to pass through a thin layer of a reddish pigment, known as a " lipochrome." Again, in some lepidopterous insects a white or a yellow appearance is produced by the deposi- tion of uric acid or a nearly allied stibstance on the surface of the wings. In many animals, but especially among invertebrates, colouring matters or pigments play an im- portant role in surface coloration; in some cases such coloration may be of benefit to the animal, but in others the integument simply serves as an organ for the excretion of waste pigmentary substances. Pigments (1) may be of direct physiological importance ; (2) they may be excre- tory ; or (3) they may be introduced into the body of the animal with the food.

"Of the many pigments which have been described up to the present time, very few have been subjected to ele- mentary chemical analysis, owing to the great difficulties attending their isolation. An extremely small amount of pigment will give rise to a great amount of coloration, and the pigments are generally accompanied by impurities of various kinds which cling to them with great tenacity, so that when one has been thoroughly cleansed, very little of it remains for ultimate analysis. Most of these sub- stances have been detected by means of the spectroscope, their absorption bands serving for their recognition, but mere identity of spectrum does not necessarily mean chemical identity,

and a few chemical tests have also to be applied before a conclusion can be drawn. The ab- sorption bands are referred to certain definite parts of the spectrum, such as the Eraunhofer lines, or they may be given in wave-lengths. Eor this purpose the readings of the spectroscope are reduced to wave-lengths by means , of interpolation curves; or if Zeiss's microspectroscope be used, the position of bands in wave-lengths (denoted by the Greek letter \) may be read directly. Examples of the absorption bands yielded by colouring matters will be found in Ency. Brit. vol. xx. p. 483.

Haemoglobin, the red colouring matter of vertebrate blood, C758Hi208Ni85S3FeO2i8, and its derivatives haematin, CsjHjoNiFeOa, and hsematoporphyrin, CieHuNjOg, are

colouring matters about which we possess definite chem- ical knowledge, as they have been isolated, purified, and analysed. Most of the bile pigments of mammals have likewise been isolated and studied chemically, and all of these are fully described in the text-books of physio- logy and physiological chemistry. Haemoglobin, though physiologically of great importance in the respiratory process of vertebrate animals, is yet seldom used for sujface pigmentation, except in the face of white races of man or in other parts in monkeys, &c. In some worms the transparent skin allows the haemoglobin of the blood to be seen through the integument, and in certain fishes also the haemoglobin is visible through the integument. It is a curious and noteworthy fact that in some inverte- brate animals in which no haemoglobin occurs, we meet with its derivatives. Thus haematin is found in the so-called bile of slugs, snails, the limpet, and the cray- fish. In searanemones there is a pigment which yields some of the decomposition-products of haemoglobin, and associated with this is a green pigment apparently identical with biliverdin (Ci8Hi8!N'204), a green bile pigment. Again, haematoporphyrin is found in the integuments of star-fishes and slugs, and occurs in the " dorsal streak " of the earth-worm (Lwrnbricus terrestris), and perhaps in other

species. Haematoporphyrin and biliverdin also occur in the egg-shells of certain birds, but in this case they are derived from haemoglobin. Haemo- globin is said to be found as low down in the animal kingdom as the Echinoderms, e.g., in Ophiactis virens, and Thyonella gemmata. It also occurs in the blood of Planorbis corneus, and in the pharyngeal muscles of other moUusca.

A great number of other pigments have been described ; for example, in the muscles and tissues of animals, both vertebrate and invertebrate, are the histohaematins, of which a special muscle pigment, myohaematin, is one. In vertebrates the latter is generally accompanied by haemo- globin, but in invertebrates — with the exception of the pharyngeal muscles of the moUusca — it occurs alone. Although closely related to haemoglobin or its derivative haemochromogen, the histohaematins are yet totally distinct, and they are found in animals where not a trace of haemoglobin can be detected. Another interesting pigment is turacin, which contains about 7 per cent, of nitrogen, found by Professor Church in the feathers of the Cape lory and other plantain-eaters, from which it can be extracted by water containing a trace of ammonia. It has been isolated, purified, and analysed by Professor Church. From it may be obtained tura- coporphyrin, which is identical with haematoporphyrin, and gives the band in the ultrarviolet which Soret and subsequently Gamgee have found to be characteristic of haemoglobin and its compounds. Turacin itself gives a peculiar two-banded spectrum, and contains about 7 per cent, of copper in its molecule. Another copper-containing pigment is haemocyanin, which in the oxidized state gives a blue colour to the blood of various moUusca and arthropoda. Like haemoglobin, it acts as an oxygen- carrier in respiration, but it takes no part in surface coloration.

A class of pigments widely distributed among plants and animals are the lipochromes. As their name denotes, they are allied to fat and generally accompany it, being soluble in fat solvents. They play an important part in surface coloration, and may be greenish, yellow, or red in colour. They contain no nitrogen. As an example of a lipoehrome which has been isolated, crystallized, and purified, we may mention

carotin, which has recently been found in green leaves. Chlorophyll, which is so often associated with a lipoehrome, has been found m some Infusoria, and in Hydra and Spongilla, &c. In some cases

it is probably formed by the animal ; in other cases it may be due to symbiotic algae, while in the gastric gland of many MoUusca, Crustacea, and Echinodermata, it is derived from food-chlorophyll. Here it is known as entero-chlorophyll. The black pigments which occur among both vertebrate and invertebrate animals often have only one attribute in common, viz., blackness, for among the discordant results of analysis one thing is certain, viz., that the melanins from vertebrate animals are not identical with those from invertebrate animals. The melanosis or blackening of insect blood, for instance, is due to the oxidation of a chromogen, the pigment produced being known as a uranidine. In some sponges a somewhat similar pigment has been noticed. Other pigments have been described, such as aetiniochrome, echinochrome, pentacrinin, aiite- donin, polyperythrin (which appears to be a haematopor- phyrin), the floridines, spongioporphyrin, &c., which need no mention here; all these pigments can only be distinguished by means of the Spectroscope.

Most of the pigments are preceded by colourless substances' known as " chromogens," which by the action of the oxygen of the air and by other agencies become changed into the corresponding pigments. In some cases the pigments are built up in the tissues of an animal, in others they appear to be derived more or less directly from the food. Derivatives of chlorophyll and lipochromes especially, seem to be taken up from the intestine, prob- ably by the agency of leucocytes, in which they may occur in combination with, or dissolved by, fatty matters and excreted by the integument. In worms especially, the skin seems to excrete many effete substances, pigments included. No direct connexion has been traced between the chlorophyll eaten with the food and the haemoglobin of blood land muscle. Attention may, however, be drawn to the work of Dr Schunck, who has shown that a substance closely resembling haematoporphyrin can be prepared from chlorophyll ; this is known as phyllopor- phyrin. Not only does the visible spectrum of

this substance resemble that of haematoporphyrin, but the invisible ultrar violet also, as recently shown by Mr C. A. Schunck.

The reader may refer to Schaf er's Text-Book of Physiology (1898) for Gamgee's article "On Haemoglobin, and its Compounds" ; to tlie writer's papers in the Fhil. Trans, and Froc. Hoy. Soc. from 1881 onwards, and also Quart. Journ. Micros. Science a,niJourn. of Physiol. ; to Krukenberg's Vergleichende physiologische Studien from I879 onwards, and to his Vortrdge. Miss Newbigin has collected' in Colour in Nature (1898) most of the recent literature of this subject. Dr Schunck' s papers will be found under the heading "Contribution to the Chemistry of Chlorophyll" in Proc. Roy. Soc. from 1885 onwards; and Mr C. A. Schunok's paper in Proc. Boy. Soc. voh Ixiii. (c. A. macm.)

Columbia, capital of Boone county, Missouri, U.S.A., situated in 38° 57′ E". lat. and 92° 19′ W. long., in the central part of the state, on the Wabash railway, at an altitude of 783 feet. It is the site of the State University, and of Christian and Stephens Female Colleges. Population (1880), 3326 ; (1890), 4000; (1900), 5651.

Columbia, a borough of Lancaster county, Penn- sylvania, U.S.A., situated on the east bank of Susquehanna river, in the south-eastern part of the state, on branches of the Pennsylvania and the Philadelphia and Beading railways, at an altitude of 251 feet. It has extensive maijufactures, principally of iron. Population (1880),

8312; (1890), 10,599; (1900), 12,316.

Columbia, capital of Eichland county. South Caro- lina, U.S.A., and of the state, situated in 34° 00′ N. lat. and 80° 57′ W. long, on the east bank of Con- garee river, at the junction of the Saluda and Broad, near the centre of the state, at an altitude of 244 feet.

Five railways enter it, namely, the Atlantic Coast Line, the Southern, the South Carolina and Georgia, the Florida Central and Peninsula,

and the Columbia, Newberry, and Laurens. It is the seat of South Carolina College, which in 1898 had twelve professors and 188 students. Popula- tion (1880), 10,036; (1890), 15,353 ; (1900), 21,108.

Columbia, capital of Maury county, Tennessee, U.S.A., situated on Duck river, in the central part of the state, at an altitude of 646 feet. It has two rail- ways, the Louisville and Nashville and the Nashville, Chattanooga, and St Louis. Population (1880), 3400;

(1890), 5370 ; (1900),6052.

Columbia, District of. See Washingtok.

Columbia University, in the city of New York, U.S.A., includes both a college and a university in the strict sense of the word as used in the United States. It com- prises the faculties of law, medicine, philosophy, political science, pure science, and applied science. It is the successor of the corporation known as ” The Governors of King’s College, in the Province of New York,” founded in 1754 by royal charter. In the educational system is also included Barnard College for Women, a separate corporation founded in 1889, and a teachers’ college, also a separate corpora- tion. In 1897 the university moved from the centre of the city northwards to Morningside Heights, which over- look the Hudson from an altitude of 150 feet. The Medical School (the College of Physicians and Surgeons) remains in its old location opposite Eoosevelt Hospital. The entire plant of the university represents a cost of about $9,500,000. In the year ending 30th June 1900 the expenditures for educational purposes were $942,460, leaving a deficiency of $17,328, which was met by a special guarantee fund. In 1901 there were registered in the college for men (Columbia) 475 students, and in the college for women (Barnard) 293 students, making a total of 768 undergraduates. The total of non-professional graduate students was 412. The scientific schools con- tained 539 students, the law school 422 students, the medical school 775 students, the teachers’ college 498 students — making a total of 2234 professional students. The total number of students in the university was thus 3830 (including 417 summer session students). In addition to these there were 29 auditors and 679 members of exten- sion courses, making a grand total of 4538.

The number of teachers of all grades for the same year was 375. The library, which numbers about 300,000 volumes, is thor- oughly modern, and is selected with special reference to scholarly uses. The university is growing in all depart- ments. (See also Universities and Education.) (s. l.*)

Columbus, capital of Muscogee county, Georgia, U.S.A., situated on the western boundary of the state, at an altitude of 260 feet, on Chattahoochee river, which is navigable to this point. Just above the city the river crosses the fall line, producing falls and rapids which furnish excellent water-power. This has been turned to account in extensive cotton manufactures. Three railways enter the city, the Southern, the Central of Georgia, and the Georgia and Alabama. Population (1880), 10,123 ;

(1890), 17,303 ; (1900), 17,614.

Columbus, capital of Bartholomew county, Indiana, U.S.A., situated on the east fork of White river, a little south of the centre of the state, at an altitude of 629 feet. It is at the intersection of lines of the Pittsburg, Cincinnati, Chicago, and St Louis and the Cleveland, Cincinnati, Chicago, and St Louis railways. The centre of population of the United States was in 1900 very near this place. Population (1880), 4813 ; (1890), 6719 ; (1900), 8130.

Columbus, capital of Lowndes county, Mississippi, U.S.A., at the intersection of the Southern and the Mobile and Ohio railways, on the Tombigbee river. It contains large cotton mills. Population (1890), 4559 ; (1900, with limits enlarged), 6484, including 3366 negroes.

Columbus, capital of Franklin county, Ohio, U.S.A., and of the state of Ohio. The site was purposely se- lected in 1813 near the centre of the state, in 39° 57′ N. lat. and 82° 59′ W. long., at an altitude of 743 feet, the elevation of the lines at the Union Station. It is a railway centre of the first importance. Fourteen different lines of railway, belonging to eight companies, enter the fine new Union Station in the heart of the city, thence radiating in all directions. The manufactures employed in 1890 a capital of $16,178,703, with 13,421 hands and an output of

$22,887,586. The principal manufacture was that of carriages and waggons, valued at $3,199,287. Foundry and machine-shop products were second, with a value of $2,139,185. Then followed the manufacture of steam cars, the product of which was valued at $1,670,078. The Ohio State University, situated here, had in 1898 a faculty of 95 professors, and was attended by 1150 students, one-fifth of whom were women. Its property was valued at $2,600,000, and its income at $292,000. It has schools of law, medicine, dentistry, pharmacy, and veterinary surgery. Capital University, a Lutheran institution, also here, had in 1898 a faculty of 10 teachers and 113 students. The death-rate in 1899 was but 10-83 per thousand; this is less than half the average of American cities, and little more than half that of the Union. The assessed valuation of property, real and personal, was, in 1899, $64,344,990. The income from all sources was $2,612,301, the expenditure $2,570,038, and the net debt $6,059,146. The tax rate per $1000 was $27.50. Population (1880), 51,647; (1890), 88,150; (1900), 125,560; death-rate (1900), 15-8.

Combaconum, or Kumbakonam, a city of British India, in the Tanjore district of Madras, in the delta of the Kaveri ; with a railway station on the South Indian railway, 194 miles from Madras. In 1881 it had a population of 50,098, and in 1891 of 54,307, of whom nearly one-fifth were Brahmans. In 1901 the population was 59,688, showing an increase of 10 per cent. The munici- pal income in 1897-98 was E.s.80,480. It contains a Gov- ernment college, two high schools, four printing-presses, and a reading-room.

Cornbinatorial Analysis. — The Combinatorial Analysis, as it was understood up to the end of the 18th century, was of limited scope and restricted application. P. Nicholson, in his Essays on the ^'^j"""' Combinatorial Analysis, published in 1818, auction. states that "the Combinatorial Analysis is a branch of mathematics which teaches us to ascertain and exhibit all the possible ways in which a given number of things may be associated and mixed together ; so that we may be certain that we have not missed any collection or arrangement of these things that has not been enumer- ated." Writers on the subject seemed to recognize fully that it was in need of cultivation, that it was of much

service in facilitating algebraical operations of all kinds, and that it was the fundamental method of investigation in the theory of Probabilities. Some idea of its scope may be gathered from a statement of the parts of algebra to which it was commonly applied, viz., the expansion of a multinomial, the product of two or more multinomials, the quotient of one multinomial by another, the reversion and conversion of series, the theory of indeterminate equations, &c. Some of the elementary theorems and various particular problems appear in the works of the

earliest algebraists, but the true pioneer of modem researches seems to have been Abraham Demoivre, who first published in 1697 {Phil. Trans. R. S.) the law of the general coefficient in the expansion of the series a + hx + cx^ + da? + . . . raised to any power. (See also Miscellanea Analytica, Bk. iv. chap. ii. prob. iv.) His work on Probabilities would naturally lead him to consider questions of this nature. An important work at the time it was published was the De Partitione Nvmierorum of Euler, in which the consideration of the reciprocal of the product (1 -a;2)(l -x'i)(~~afiz)... establishes a funda~~ mental connexion between arithmetic and algebra, arith- metical addition being made to depend upon algebraical multiplication, and a close bond is secured between the theories of discontinuous and continuous quantities. The multiplication of the two powers »", a;*, viz., x^ x a;" = «""""" showed Euler that he could convert arithmetical addition into algebraical multiplication, and in the paper referred to he gives the complete formal solution of the main problems of the partition of numbers. He did not obtain general expressions for the coefficients which arose in the expansion of his generating functions, but he gave the actual values to a high order of the coefficients which arise from the generating functions corresponding to various conditions of partitionment. Other writers who have contributed to the solution of special problems are James Bernouilli, Boscovitch, Hindenburgh, Emerson, Wood- house, Simpson, and Barlow. Problems of combination were generally undertaken as they became necessary for

the advancement of some particular part of mathematical science : it was not recognized that the theory of combina- tions is in reality a science by itself, well worth studying for its own sake irrespective of applications to other parts of analysis. There was a total absence of orderly develop- ment, and until the first third of the 19th century had passed, Euler's classical paper remained alike the chief result and the only scientific method of combinatorial analysis.

In 1846 Jacobi studied the partitions of numbers by means of certain identities involving infinite series that are met with in the theory of Elliptic Functions. The method employed is essentially that of Euler. Interest in England was aroused, in the first instance, by De Morgan in 1846, who, in a letter to Henry Warburton, suggested that combinatorial analysis stood in great need of development, and alluded to the theory of partitions. "Warburton, to some extent under the guidance of De Morgan, prosecuted researches by the aid of a new instrument, viz., the theory of finite differences. This was a distinct advance, and he was able to obtain expressions for the coefficients in parti- tion series in some of the simplest cases {Trans. Camb. Phil. Soc, 1849). This paper inspired a valuable paper by Sir John Herschel {Phil. Trans. Roy. Soc, 1850), who, by introducing the idea and notation of the circulating function, was able to present results in advance of those of Warburton. The new idea involved a calculus of the imaginary roots of unity. Shortly afterwards, in 1855, the subject was attacked simultaneously by Cayley and Sylvester, and their combined efforts resulted in the practical solution of the problem that we have to-day The former added the idea of the prime circulator, and the latter applied Cauchy's theory of Residues to the subject, and invented the arithmetical entity termed a "denumerant." The next distinct advance was made by Sylvester, Franklin, Durfee, and others, about the year 1882 {Amer. Joum. Math. vol. v.) by the employment of a graphical method. The results obtained were not only valuable in themselves, but also threw considerable light upon the theory of algebraic series. So far it will be seen that researches had for their object the discussion of the

partition of numbers. Other branches of combinatorial analysis were, from any general point of view, absolutely neglected. In 1888

MacMahon investigated the general problem of distribution, of which the partition of a number is a particular case. He introduced the method of sym- metric functions and the method of differential operators, applying both methods to the two important subdivisions, the theory of composition and the theory of partition. He introduced the notion of the separation of a parti- tion, and extended all the results so as to include multi- partite as well as unipartite numbers. He showed how to introduce zero and negative numbers, unipartite and multipartite, into the • general theory ; he extended Sylvester's graphical method to three dimensions ; and finally, 1898, he invented the " Partition Analysis " and applied it to the solution of novel questions in arithmetic and algebra. An important paper by G. B. Mathews, which reduces the problem of compound partition to that of simple partition, should also be noticed. This is the problem which was known to Euler and his contemporaries as " the Problem of the Virgins," or " the Eule of Ceres " ; it is only now, nearly 200 years later, that it has been solved.

The most important problem of combinatorial analysis is connected with the distribution of objects into classes. A number n may be regarded as enumerating n similar objects ; it is then said to be unipartite. Panda- On the other hand, if the objects be not all p/^^„. similar they cannot be effectively enumerated by a single integer ; we require a succession of integers. If the objects be p in number of one kind, 3 of a second kind, r of a third, &c., the enumeration is given by the succession pqr . . . which is termed a multipartite number,

and written

pqr…,

where p + q + r+ ... =n. If the order of magnitude of the numbers p, q, r, ... is immaterial, it is usual to write them in descending order of magnitude, and the succession may then be termed a partition of the number n, and is written {pqr…). The succession of integers thus has a twofold signification : (i.) as a multipartite number it may enumerate objects of different kinds ; (ii.) it may be viewed as a partitionment into separate parts of a unipartite number. We may say either that the

objects are represented by the multipartite number pqr ... , or that they are defined by the partition {pqr ...) of the unipartite number n. Similarly the classes into which they are dis- tributed may be m in number all similar ; or they may be Pi of one kind, q^^ of a second, r-^ of a third, &c., where Pi + qi + r^ + ...=m. We may thus denote the classes either by the multipartite numbers PiqiT^ . . . , or by the partition {Piqir^ . . .) of the unipartite number m. The distributions to be considered are such that any number of objects may be in any one class subject to the restriction that no class is empty. Two cases arise. If the order of the objects in a particular class is immaterial the class is termed a parcel; if the order is material the class is termed a group. The distribution into parcels is alone considered here, and the main problem is the enumeration of the distributions of objects defined by the partition {pqr …) of the number n into parcels defined by the partition {p^qir^ ...) of the number m. (See "Symmetric Functions and the Theory of Distributions," Proa. London Mathematical Society, vol. xix.) Three particular cases are of great importance. Case I. is the " one-to-one dis- tribution," in which the number of parcels is equal to the number of objects, and one object is distributed in each parcel. Case II. is that in which the parcels are all differefit, being defined by the partition (1111 ...), con-

veniently written (l"") ; this is the theory of the composi- tions of unipartite and multipartite numbers. Case III. is that in which the parcels are all similar, beins defined by the partition (m) ; this is the theory of the partitions of unipartite and multipartite numbers. Previous to dis- cussing these in detail, it is necessary to describe the method of symmetric functions which wiU be largely utilized.

Let a, /?, y, . . . be the roots of the equation

n-l

X’

.71 _

a.,x

■-a^

= 0.

TbeDistri- The symmetric function ª^‘y*^..., where button p + g, + ^ + ... = jj ig^ jn the partition notation, Function, written W …). Let A, „ .denote

\^^) (p3r…X ({11911…)

the number of ways of distributing the n objects defined by the partition {pqr…) into the m parcels defined by the partition (Pi2’i‘“i •••)• The expression

(J)ar…), (pisiri…) • "” ■”’’

where the numbers p-^, q^, r-^... are fixed and assumed to be ia descending order of magnitude, the summation being for every partition {pqr ...) of the number n, is defined to be the distribution function of the objects defined by {pqr…) into the parcels defined by {Piqir-^...). It gives a complete enumeration of n objects of whatever species into parcels of the given species.

1. One-to-One Distribution. Parcels m m ntiTnJer ^i.«. m=n). — Case I ^^* ^’ ^® ^^^ homogeneous product-sum of degree s of the quantities a, p, y, ... so that

(l-ax. l-/3a!. X-yx. ...)-‘\+\x+h+h^ + ... Ai=2a=(l)

Aj=2a2-|-2a;8=(2) + (l2) A,=Sa3+Sa2/S-h2o;87=(3) + (21)-l-(l3).

Form the product Jipjiqihn…

Any term in Api may be regarded as derived from p^ objects distributed into^i similar parcels, one object in each parcel, since the order of occurrence of the letters a, p, y, ... in any term is immaterial. Moreover, every selection of p^ letters from the letters in aPp^-/ ... will occur in some term of hpy, every further selection of q^ letters will occur in some term of hq^, and so on. Therefore in the product hpihgti hri ... the term oP/3*y'" . . . , and there- fore also the symmetric function (pqr …) will occur as many times as it is possible to distribute objects defined by {pqr…) into parcels defined by {piq^r^ ...) one object in each parcel. Hence

This theorem is of algebraic importance ; for consider the simple particular case of the distribution of objects (43) into parcels (52), and represent objects and parcels by smaU and capital letters respectively. One distribution is shown by the scheme

A AAAABB ti a a a b b b

wherein an object denoted by a small letter is placed in a parcel denoted by the capital letter immediately above it. We may interchange small and capital letters and derive from it a distribu- tion of objects (52) into parcels (43) ; viz. : —

AAAABBB. a a a a a b b'

The process is clearly of general application, and establishes a one- to-one correspondence between the distributions of objects (pqr …) into parcels 0'i?i"i ■••) ^^^ the distributions of objects (piJiri …) into parcels (pqr ...). It is in fact, in Case I., an intuitive observa- tion that we may either consider an object placed in or attached to a parcel, or a parcel placed in or attached to an object. Analyti- cally we have

Theorem. — "The coefficient of symmetric function (pqr…) in the development of the product hpihqihr^ ... is equal to the coeffi- cient of symmetric function (pigiri …) in the development of the product TipJiqhr ... ."

The problem of Case I. may be considered when the distribu- tions are subject to various restrictions. If the restriction be to the effect that an aggregate of similar parcels is not to contain more than one object of a kind, we have clearly to deal with the elementary symmetric functions a^, a^, a^, ... or (1), (1^), (1'), ... in b'eu of the quantities ftj, h^, h^, ... The distribution function has then the value OpiOSg orj … or (1*^) (1") (1*^) .... and by inter-

change of object and parcel we arrive at the well-known theorem of symmetry in symmetric functions, which states that the co- efficient of symmetric function (pqr . . .) in the development of the product apiaq^o/ri… in a series of monomial symmetric functions, is equal to the coefficient of the function (PiJi*"! ..) in the similar

development of the product opogctr

The general result of Case I. may be further analysed with important consequences.

Write Xi=»(l)a!i,

X^=(2)x2 + (V')x„ X3=(3)a!3 + (21)ai^ + (l«)a:?

and generally X« = S(\/u' . . .)X)Jk^x^ . . .

the summation being in regard to every partition of s. Consider the result of the multiplication —

XpiX^iXri . . . = ZPx'^x'$^{x'}$ . . .

'■^—^i i Sl S

To determine the nature of the symmetric function P a few definitions are necessary.

Definition I. — Of a number n take any partition (XjXjXj… \s) and separate it into component partitions thus : —

(\)(W\)(\) ...

in any manner. This may be termed a separation of the partition, the numbers occurring in the separation being identical with those which occur in the partition. In the theory of symmetric functions the separation denotes the product of symmetric functions —

Sa^i/S^Sa^3|3A4yA52(j^ . . .

The portions (XiXj), (X3X4X5), (Xj), ...are termed separates, and if Xi-HXj=yi, X3-|-X4-I-X5=g'i, X5=ri, ...be in descending order of magnitude, the usual arrangement, the separation is said to have a species denoted by the partition (Piqir^ ...) of the number n.

Definition II. — If in any distribution of m objects into 7i parcels (one object in each parcel), we write down a number |, whenever we observe | similar objects in similar parcels we will obtain a succession of numbers li, fj. ia> ■■ > where (fifsfs …) is some parti- tion of n. The distribution is then said to have a spedfiMition denoted by the partition (Iil2fs ••)•

Now it is clear that P consists of an aggregate of terms, each of which, to a numerical factor pres, is a separation of the partition

(s^s^s^...) of species (piqir^ ...). Further, P is the distribution

function of objects into parcels denoted by (piq^r-^ ...), subject to the restriction that the distributions have each of them the

specification denoted by the partition (sf^sf^sf'---)- Employing

a more general notation we may write

X'^X'^X"' . . . = •ZVx'^x'^x" . . . Pi Pa Pa si % «3

and then P is the distribution function of objects into parcels (pJ^J'i'")~~)'~~ ~~^^^ distributions being such as have the speci~~ fication (sf s^'s.-.). Multiplying out P so as to exhibit it as a sum of monomials, we get a result —

x'x"'x'...=22e(\W'^...yv^x'^ ...

Pi PS PS \ 1 -2 3 y^Si S2 S3

indicating that for distributions of specification (s'^s'^h"'...) there are 6 ways of distributing n objects denoted by (x'^x'^X...)

amongst n parcels denoted by {p^p^p^'—), one object in each

parcel. Now observe that as before we may interchange parcel and object, and that this operation leaves the specification of the distributions unchanged. Hence the number of distributions must be the same, and if

then also

n-ra jTs ^ _ .^ B('}\S'?- ■ .')x'^x'^x"\ .. + ...

Pi Pi P3 ^ 1 2 a / «! »2 SS

*J-lyhyls _^*

Ai A2 A3 "V.^! .^2.3 · Si ^2 S3*

This extensive theorem of algebraic reciprocity includes many known theorems of symmetey in the theory of Symmetric Functions.

The whole of the theory has been extended to include sym- metric functions symbolized by partitions which contain as well zero and negative parts.

2. The Compositions of Multipartite Slumbers. Parcels denoted by (1"). — There are here no similarities between the parcels.

COMBINATORIAL ANALYSIS

Cue //.

*Let (xi TTj iTj ...) be a partition of m (pTpT'pT"') * ps^rtition of ».*

Of the whole number of distributions of the n objects, there will be a certain number such that xj parcels each contain pi objects, and in

general ir, parcels each contain _?), objects where

«=1. 2, 3 Consider the product hT^h”/„” ... which can be

n ps ps

permuted in ^^,^^^ , __ ways. For each of these ways

^ft^Ps^Ps’” ‘^ ‘^^ ” ‘is”‘“i*i°’ function for distributions of the specified type. Hence, regarding all the permutations, the distribution function is*

^ ! TTi ira ITS

7rilir,\ws...“‘Pi“‘P2”-P3 — and regarding, as well, all the partitions of n into exactly m parts, the desired distribution function is

m !

~XK [=^,:s^P=ni

TTj ItTj llTg ! ... Pl P2 P3

that is, it is the coefficient of ar” in {hix+h^+h^+ .,.)<". The valueof A ^^„^^___^_ ^^„yis the coefficient of (p^plY/.-.y

in the development of the above expression, and is easily shown to have the value

M+«i-n”>/i),+«2-i'^A

Pi+m-l

)

-{l)[Pl) { P.) [P,) –

- ... to TO terms. Observe that when pj^=p2=pg= ...=Wi=ir^=Trg= ... = 1 this ex- pression reduces to the mth divided difference of 0”. The expression

gives the compositions of the multipartite number pP'p^Y^---

into m parts. Summing the distribution function from to=1 to TO =00 and putting x=l, as we may without detriment, we find

that the totality of the compositions is given by = — \ — \ — ' which may be given the form 'z — % — – — – — — — ;. Adding i we

1—2(01 — 02+0^ — ...)

bring this to the still more convenient form

i I

"l-2(csi-ai2+a3-...)

Let ^(p^P^P^---") denote the total number of compositions of the multipartite p^p^^p'... Then J— 5=i + SF(p)ee", and

thence F(^)=5

Again Jr

=i + 2F(^iP,)aV,

n-2(a+/3-a/S) and expanding the left-hand side we easily find

i.,,,,_9Pl+K oPi+Pa-Z (yi+j'2-1)!

iP,)-^ 0\p,\p^r^ l!(^i-l)

, nPi+Pa – 3 {Pi+Pi-2)i

We have found that the number of compositioAs of the multi- partite PiP2Ps…ps is equal to the coefficient of symmetric function (PiPiPs — Ps) or of the single term a^^al'af'- • • "j" in t^e development according to ascending powers of the algebraic fraction

*■ 1 – 2(Sai – 2aia2 + Soia^as ~~... + (~~ y+laia^a^ . . . o/ This result can be thrown into another suggestive form, for it can be proved that that portion of the expanded fraction

- • {1 – «i(2ai-Ha2H-...+a.)} {1 – (2{2ai+2<.2+...+a,)} ... {1 – f/2ai+2aa+...+2a.^} '

which is composed entirely of powers of

tiHij t^a^ ^gOs, • ■ • iefh

has the expression

- ■ 1 – 2(2«iai – 2

and therefore the coefficient of af of … of" in the latter fraction.

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when

i (20l^-02^- ... +a,fi{2ai+2a2+ ... +a,f '...(2ai+2a^+ ... + 2o.f '• This result gives a direct connexion between the number of compositions and the permutations of the letters in the product

a^'af . . . af ". Selecting any permutation, suppose that the letter a, occurs q, times in the last pr+Pr+i+... -i-p, places of the permu- tation ; the coefficient in question may be represented liy JS221+32+- -+Ss, the summation being for every permutation, and since qi=Pi this may be written

23'i – l22'2+5s+— +9». Me. Gr. — For the bipartite 22 , ^j =^2 = 2 , and we ha ve the follow- ing scheme :-

»1"1

OaOa

?2 = 2

Ojaj

ttiOj

= 1

O1O2

OjOi

= 1

OjOi

ttitta

= 1

Ojai

Qg Oi

= 1

02 aa

»i«i

= 0

Hence F(22) = 2(22-h2-l-2 + 2 + 2-)-2”)=26.

“We may regard the fraction

*i.{l-*l(2al-|-*

as a redundant generating function, the enumeration of the compositions being given by the coefficient of

The transformation of the pure generating function into a factor- ized redundant form supplies the key to the solution of a large number of questions in the theory of ordinary permutations, as will be seen later,

[The transformation of the last section involves j-^^ Theory a comprehensive theory of Permutations, which otPermw it is convenient to discuss shortly here. tations.

If Xj, Xj, Xg, ... X„ be linear functions given by the matricular relation

(Xi, Xj,... XJ=(

Oni a fa •■■ that portion of the algebraic fraction,

1

(l-SiXi)(l-S2X2)...a-s„X„)'

which is a function of the products s^x^, s^, s^ ... s,^„ dnly is

1

\{^--)0—

where the denominator is in a symbolic form and denotes on

expansion

l-2laiilSiIi-hSlaii022|SiS2lia^-...(-(-t)n|aiias2a83— "nnll!— »naia!2… Xn,*

where loul , louajal, ... |oiios^... OnnI denote the several co- axial minors of the determinant

\a^a^...ann

of the matrix. (For the proof of this theorem see MacMahon, "A certain Class of Generating Functions in the Theory of Numbers," Phil. Trans. E. S. vol. clxxxv. A, 1894). It follows that the coefficient of

Xj x^ —x^ in the product

*(ail!Ci-t-ai2l2+- ■ -t-airt»i)”(«2li<^+'»22»^+" “2ii«n)’^. .(.OnlXl-i-(ln2*2— -H«fm«n)f”*

is equal to the coefficient of the same term in the expansion ascending-wise of the fraction

l-2\aj^\xi + X[ajia^\xiX2- ... + {-)”]aiia^...a„„\Xj!>:^...x„’

If the elements of the determinant be all of them equal to unity, we obtain the functions which enumerate the unreslJicted permu- tations of the letters in

J1J2 _Jn

*1 2 *n ‘*

VIZ.,

and

(iBi-Ha!j-f-...-l-aj„)’

1

h+h+—+in

-{Xi+Xi+...+x„y

Suppose that we wish to find the generating function for the enumeration of those permutations of the letters in kI’iCj •■•a;„” which are such that no letter x, is in a position originally occupied by an x, for all values of »■. This is a generalization of the “Probleme des rencontres” or of “derangements.” We have merely to put

and the remaining elements equal to unity. The generating product is

{X3 + X3+ ... +X„)^\Xi+Xsi+ ...+X„)^'...iXi + X^+ ...+X„—i),

and to obtain the condensed form we have to evaluate the co-axial minors of the invertebrate determinant —

1 1 1 ... 0

The minors of the 1st, 2nd, 3rd … mth orders have respectively the values

0

-1

+ 2

therefore the generating fimction is

1

1).

l-Sa^iiBa

- 2^XjpC^3 –

-iSaJiXj..

•a^H-i-

..(»

-Vf^xt.

.Xn

or writing

this is

x{){x.

-X,).

.{x

-x„)=3i”

1

~~a^~~

‘+<"'

-...

1-02-203-804- ...-(7i-l)a„ Again, consider the general problem of “derangements.”

“We

have to find the number of permutations such that exactly to of the letters are in places they originally occupied. We have the particular redundant product

(oa^ + asj + . . . + a!„)”(a!i + fl«>!a + . . . + a!„)” . . . (Xi + aij + . . . + oa! „r “.

in which the sought number is the coefiBcient of o a!piB|’...a;”. The true generating function is derived from the determinant*

111.,

loll.. 1 1 o 1 . . 1 1 1 o . .

and has the form

1

1 – a2ii+(a – lXo+l)2a;ixa ~~..+(~~)”(a – 1)” – l(o+ii – l)iiX2.. .a»i.

It is clear that a large class of problems in permutations can be solved in a similar manner, viz., by giving special values to the elements of the determinant of the matrix. The redundant product leads uniquely to the real generat- ing function, but the latter has generally more than one representation as a^ redundant product, in the cases in ■which it is representable at aU. For the existence of a redundant form, the coefficients of x-^, Xj, ... Xja^j, ... in the denominator of the real generating function must satisfy 2" – 71^ + 71 — 2 conditions, and assuming this to be the case, a redundant form can be constructed •which involves n. — 1 undetermined quantities. We are thus able to pass from any particular redundant generating function to one equivalent to it, but involving n-\ undetermined quantities. Assuming these quantities at pleasure we obtain a number of different algebraic products, each of which may have its own meaning in arithmetic, and thus the number of arithmetical correspondences obtainable is subject to no finite limit (cf. MacMahon, loc. cit., pp. 125 et se?.)]

3. The Theory of Partitions. Parcels defined by (m). — When an _ „, ordinary unipartite number n is broken up into other Case III. numbers, and the order of occurrence of the numbers is immaterial, the collection of numbers is termed a partition of the number n. It is usual to arrange the numbers comprised in

tlie collection, termed the parts of the partition, in descending order of magnitude, and to indicate repetitions of the same part by the use of exponents. Thus (32111), a partition of 8, is written (321”). Euler’s pioneering work in the subject rests on the observa- tion that the algebraic multiplication

a?” X a X af X . . . = a!°+***<". • ■ is equivalent to the arithmetical addition of the exponents*

a, b, c, He showed that the number of ways of composing n

with p integers drawn from the series o, b, c, ... , repeated or not, is equal to the coefficient of p’al^ in the ascending expansion of the fraction

1

l-fa!». l-i-a!».l-fa;°....' which he termed the generating function of the partitions in question.

If the partitions are to be composed of p, or fewer parts, it is

merely necessary to multiply this fraction by t^v Similarly, if

the parts are to be unrepeated, the generating function is the algebraic product

(l + fa:»)(l-Hia)(l-ffa!')...,*

if each part may occur at most twice,

{l + taf+!:^{ke}){l+ia+t'x^){l + ^+i'h?')..., and generally if each part may occur at most k-1 times it is l-^a!*» l-j-*a!» 1-^-*° l-fa* ■ l-f!B» ■ 1-^af "" It is thus easy to form generating functions for the partitions of numbers into parts subject to various restrictions. If there be no restriction in regard to the numbers of the parts, the generating function is*

1

l-K«.l-iI».l-Z°. ...

and the problems of finding the partitions of a number n, and of determining their number, are the same as those of solving and enumerating the solutions of the indeterminate equation in positive integers

eKC + by + cz+ ... =n.

Euler considered also the question of enumerating the solutions of the indeterminate simultaneous equation in positive integers

ax+by + cz+...=n a'x+b'y+c'z + ...=n' a!'x+b"y+(i'z+...=n"

which was called by him and those of his time the ” Problem of the “Virgins.” The enumeration is given by the coefficient of o^y’s?”... in the expansion of the fraction*

1

(1 -a?^»«»...)(l -a!»Vy…)(l ~~a^V”«°”~~) — which enumerates the partitions of the multipartite number nmV… into the parts

06c … , a’b’c’... , a”b”c”..

Sylvester has determined an analytical expression for the co- efficient of a;” in the expansion of

{l-xf){l-xf)...{l-s^y To explain this we have two lemmas : —

Lemma 1. — The coefficient of -, i.e., after Cauchy, the residue

in the ascending expansion of (1 – e)”* is – 1. For when i is unity, it is obviously the case, and*

(1 ~~e»)~~‘-i=(l ~~«’)~~’~~:~~ 6^(1 ~~e’)~~-!*

Here the residue of j- (1 – e’)- – is zero, and therefore the residue*

of (1 – e’)~’, is unchanged when i is increased by unity, and is, therefore, always – 1 for all values of i.

Lemma 2. — The constant term in any proper algebraical fraction developed in ascending powers of its variable is the same as the residua, with changed sign, of the sum of the fractions obtained by substituting in the given fraction, in lieu of the variable, its exponential multiplied in succession by each of its values (zero excepted, if there be such), which makes the given fraction infinite. For write the proper algebraical fraction

Fai=SS

(o^ – xy- x^’

The constant term is

,“A,

Let a^ be a value of x wMch makes the fraction infinite. The residue of

S2S.

“‘i,

+ S-1L

is equal to the residue of

{ai^-a^)” fls^e’

SSS-

“A.f

and when »=ii, the residue vanishes so that we have to consider

a^(l-eY and the residue of this is, by the first lemma,

-SS

“A,!/.

which proves the lemma. Take ¥x=

z——;,, since the sought

“a!»(l-a!»Kl-ai»)...(l-a!’) a;”’

number is its constant term.

Let pvbe a root of unity which makes fx infinite when substi- tuted for X. The function of which we have to take the residue is Sp-“e™/(pe-^)

“■ (1 – p«e-“)(l – ffie-’”) ... (1 – p’e-“)’

We may divide the calculation up into sections by considering separately that portion of the summation which involves the primitive qth roots of unity, g being a. divisor of one of the numbers a, b, ...I. Thus the jth wave is

‘^8

which, putting – for p, and i/ = m + i(a + 6 + . . . + Z), may be written

and the calculation in simple cases is practicable. Thus Sylvester finds for the coefficient of a!” in

1

l-x.l-x^A-s? y’ 7 1 1

the expression 12 ~ 72 ~ 8 ^ ~ ^’ ^ 9 (”’ “” ‘”’” “^ where v=n + Z.*

Sylvester, Franklin, Durfee, Ely, and others, have evolved a Constructive Theory of Partitions, the object of which is the contemplation of the partitions Sylvester’s themselves, and the evolution of their properties graphical ^^^^ ^ study of their inherent characters. It Method. .^ concerned for the most part with the parti- tion of a number into parts drawn from the natural series of numbers 1, 2, 3…. Any partition, say (521) of the number 8, is represented by nodes placed in order at the points of a rectangular lattice,

>

when the partition is given by the enumeration of the nodes by lines. If we enumerate by columns we obtain another partition of 8, viz., (32P), which is termed the coniugate of the former. The fact of conjugacy was first pointed out by Ferrers. If the original partition is one of a number n in i parts, of which the largest is 3, the

conjugate is one into j parts, of which the largest is i, and we obtain the theorem : — ” The number of partitions of i parts

any number into part

*i parts or fewer’ ”” ∧∧∧””∧ *∧∧ ‘∧’∧*

, ” , 1, . remains the same when the equal or less than j,

numbers i andj are interchanged.”

The study of this representation on a lattice (termed by

Sylvester the “graph”) yields many theorems similar to

that just given, and, moreover, throws considerable light

upon the expansion of algebraic series.

The theorem of reciprocity just established shows that the number of partitions of n into / parts or fewer, is the same as the number of ways of composing n with the integers 1, 2, 3, ...j.

Hence we can expand = ^ 1 5—:; = , . , in

‘^ l-a.-ax.- ax’ . 1 – oar. . . ad mf.

ascending powers of a ; for the coefficient of o-‘aj” in the expansion is the number of ways of composing n with j or fewer parts, and this we have seen in the coefficients of a;” in the ascending expan- sion of :; ~~^; 5 —; ——i~~ Therefore

l-a!.l-

a;»....l-

1

of

, 1 -aa?...

-=1 + ^

~~x'T~~

,1-ar'^ at

l-a!.l-

....1-a)'

+ ...

The coefficient of a^af in the expansion of

1

1 – a . 1 – aa; . 1 –

. 1 — ax'

denotes the number of ways of composing n with j or fewer parts, none of which are greater than i. The expansion is known to be

l-a!'<u>'. l-x/</u>. ...l-x'' ,*

2 — 5 -, 5 q i — a^.

1-x. l-x'. ...1 -X'

It has been established by the constructive method by F. Franklin (Amer. Jour, of Math. vol. v. p. 254), and shows that the generat- ing function for the partitions in question is

l-aJ'+i.l-aj'+2. ...l-a)'+«

l-a!.l-

*...1-a;**

which, observe, is unaltered by interchange of i and j.

Franklin has also similarly established the identity of Euler —

(l-a!)(l-ar')(l

- a^) . . . (Kf i»/. = S(– y'ajKSJ^+J),

known as the "pentagonal number theorem," which on interpre- tation shows that the number of ways of partitioning n into an even number of unrepeated parts is equal to that into an uneven number, except when n has the pentagonal form iiSj^+j), j posi- tive or negative, when the difference between the numbers of the partitions is (– y.

To illustrate an important dissection of the graph we will con- sider those graphs which read the same by columns as by lines ; these are called self-conjugate. Such a graph may be obviously dissected into a square, containing say 8' nodes, and into two graphs, one lateral and one subjacent, the latter being the conjugate of the former. The former graph is limited to contain not more than 0 parts, ■ • • but is subject to no other condition. • • Hence the number of self-conjugate • partitions of n which are associated with a square of $' nodes, is clearly

equal to the number of partitions of l{n – 8^) into $ or few parts, i.e., it is the coefficient of a^»-s^) in

,l-a!2. l-a;»....l-

x9'

or of x" in ; ~j— , . , ,

1 ~~a:". .1~~ a;'. 1 -a;"

and the whole generating function i?

9= CO

1+S

«=l l-a!'.l-a^.l-a!8….1-a!^*'

Now the graph is also composed of ff angles of nodes, each angle containing an uneven number of nodes ; hence the partition is transformable into one containing S unequal uneven numbers. In the case depicted this partition is (17, 9, 5, 1). Hence the number of the partitions based upon a square of $'^ nodes is the coefficient

of aOa^ in the product (l+aa!)(l + aa!S)(l+aa^) ... (l + oaZs+l) . and thenoe the coefficient of a in this product is*

*x^*

l-a!2.1-

= 1 + ^

and we have the expansion

{l + ax){l+a!>?){l + a3fi) ...ad inf.

— 2" +r- ~~x^ 1~~

ia'+-

5«' +

l-a^~ ' l-ai'.l-aii'"' ~^ l-x'.l-ai'. 1-afi

Again, if we restrict the part magnitude to i, the largest angle of nodes contains at most 2i — 1 nodes, and based upon a square of 6^ nodes we have partitions enumerated by the coefficient of a x in the product {l + ax) {l + aa?){l+aaf) ...(J + as^i-‹) ; moreover the same number enumerates the partition of

*J(w — 6) into 6 or fewer parts, of which the largest part is equal to or less than i-6, and is thus given by the coefficient of aji^""^ in the expansion of l_a;i-«+l.l-a!-«+2.1-a;«-»+3….1-a!**

1 —X. 1 — x

.1-0?. ...l-xS

*.l-x^a-^'-i-oi^*

or of a;" in

l-a!^.

hence the expansion

(1 + aa!)(l + aa^^Xl + aar^) . . . (1 + aa;2i – 1)

Si

= l + s ^^ — 9=1 1-3?

2«+2

l-a;:

,2i-29+4

*...i-mV_*

There is no difficulty in extending the graphical method to Extension ^^^^ dimensions, and we have then a theory of a to three Dimen- sions.

special kind of partition of multipartite numbers, such kind is the partition

Of

of the multipartite number

if

(ai + ii + Ci+ ... , 02+J5j+ftj+ ... , O3 + 63 + C3+ , .

Oi^a^^aa^ ... ; b^^h^^b^^ ... , ... a,^b,^c,... ,

for then the graphs of the parts a^a^^ ... , bjbj>s … , ... are superposable, and we have what we may term a regular graph in three dimensions. Thus the partition (643 , 632 , 411) of the multi- partite (16,8,6) leads to the graph

O

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@ ® © •

(§) ® .

y

and every such graph is readable in six ways, the axis of z being perpendicular to the plane of the paper. Mx. Gr.

Plane parallel to xy, direction Oa; reads (643,632,411)

xy, „ Oy „ (333211^332111^31110q)_ yz, „ Oy „ (333,331,321,211,110,110) „ „ yz, „ Oz „ (333,322,321,310,200,200)

„ „ 23!, „ Oz „ (333322, 322100, 321000)

zx, „ Ox „ (664,431,321)

the partitions having reference to the multipartite numbers 16, 8, 6, 976422 , 13, 11, 6, which are brought into relation through the medium of

the graph. The graph in question is more conveniently represented by a numbered diagram, viz. —

3 3 3 3 2 2 3 2 2 1 3 2 1

and then we may evidently regard it as a unipartite partition on the points of a lattice,

0 ._

the descending order of magnitude of part being maintained along

e-oery line of route which proceeds from the origin in the positive directions of the axes.

This brings in view the modem notion of a partition, which has enormously enlarged the scope of the theory. We consider any number of points in piano or in solido connected (or not) by lines in pairs in any desired manner and fix upon any condition, such as is implied by the symbols, ^, >, = <:, ^, ^, as affecting any pair of points so connected. Thus in ordinary unipartite partition we have to solve in integers such a system as

ii-^^a^^as^ ^dn

01 + 03+ 03+. .. + o„=«.,

the points being in a straight line. In the simplest example of the three-dimensional graph we have to solve the system

^1 11/ Oo ^ a.

01 + 02 + 03 + 04 = ™,

and a system for the general lattice constructed upon the same principle. The system has been discussed by MacMahon, Phil. Trans. B. S. vol. cLxxxvii. A, 1896, pp. 619-673, with the conclusion that if the numbers of nodes along the axes of x, y, z be limited not to exceed the numbers to, n, I

respectively, then writing for brevity l-a;'=(s), the generating function is given by the product of the factors

(?+l) (Z + 2)

(1) ■ (2)

(?+2) (;+3)

(2) ■ (3)

(?+7i) (Z+m + l) (7s) ■ (»+l)

(?+to)

(TO)

(;+TO+i)

(m + l)

(Z-I-TO + 7I-1)

(m.+7i-l)

one factor appearing at each point of the lattice.

In general, partition problems present themselves which depend upon the solution of a number of simultaneous relations in integers of the form

XiOi + XjOj + XjOj + . . . ib 0,

the coefficients X being given positive or negative integers, and in

some cases the generating function has been determined in a

form which exhibits the fundamental solutions of the problems

from which all other solutions are derivable by addition. (See

MacMahon, Fhil. Trans. U.S. vol. cxcii. (1899), pp. 351-401 ; and

Trans. Camb. Fhil. Soc. vol. xviii. (1899), pp. 12-34.)

The number of distributions of « objects (piP2P3.-) iuto parcels

(m) is the coefficient of i” {PiJPiPa ...)a!“in the develop-*

*i» . 1 <• . ■ * Method of*

Symmetric

Functions.

ment of the fraction.

(l-Joa;. 1-J;8a!. 1- Jto!...)

><.{\-ba^o?.l-iapii?.\-b^3?...) x(l-io'a;3.1-6a2/3a!8. l-6a;87a!'...)

and if we write the expansion of that portion which involves pro- ducts of the letters a, p, y, ... of degree r in the form

l+A^,Ja;’-+A^5V+..., we may write the development

n {l+h^jixc’+h^V +...), and picking out the coefficient of 6” of we find*

where ST=m, 2TS=ra.

The quantities h are symmetric functions of the quantities o, ft 7, . . . which in simple cases can be calculated without difficulty, and then the distribution function can be formed.

Sx. gr. — Required the enumeration of the partitions of all multipartite numbers {p^piPs ■■■) into exactly two parts. We find

and paying attention to the fact that in the expression of h^ the

term h^ is absent when r is uneven, the law is clear. The generating function is

COMETS

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+ {h^i+ h^ + hihs)x' + (As + 2AeAj + hl)3fi+ .,. Taking ^4 + ^1=^4+ {(2) + (12)}2

= 2(4) + 3(31) + 4(22) + 5(212) + 7(4) the term 5(21^) indicates that objects such as a, a, b, c can be partitioned in five ways into two parts. These are a\a, b, c ; h\a, u, c; cla, a, b ; a, a\b, c; a, b\a, c. The function A^ has been studied. (See MacMahon, Proe. Land. Math. Soc. vol. xix.) Putting X equal to unity, the function may be written (^2+^4+^.5+ ...) (l+hi + h2+hg+h^+ ...), a convenient formula.

The method of DiflFerential Operators, of wide applicar tion to problems of combinatorial analysis, has for its

*leading idea the designing of a function and of ^iw**"' "' ^ differential operator, so that when the opera- OpemUirs. ^^ ^® performed upon the function a number*

is reached which enumerates the solutions of the given problem. Generally speaMng, the problems considered are such as are connected with lattices, or that it is possible to connect with lattices.

To take the simplest possible example, consider the problem of finding the number of permutations of n different letters. The

function is here a;", and the operator (t-) =^xi yielding

S^a?"=» 1 the number which enumerates the permutations. In fact —

Sa^ = fij;. x.x.x.x. X….,

and differentiating we obtain a sum of n terms by striking out an X from the product in all possible ways. Fixing upon any one of these terms, say

k . 0 . a . a; . . . ., we again operate with 5,: by striking out an X in all possible ways, and one of the terms so reached is

x.·x·.x Fixing upon this term, and again operating and

continuing the process, we finally arrive at one solution of the problem, which (taking say »=4) may be said to be in corre- spondence with the operator diagram —

S»:

or say

1

s.

1

s«

1

1

5«

the number in each row of compartments denoting an operation of Sj. Hence the permutation problem is eq^uivalent to that of placing n units in the compartments of a square lattice of order n in such manner that each row and each column contains a single unit. Observe that the method not only enumerates, but also gives a process by which each solution is actually formed. The same problem is that of placing n Books upon a chess-board of m" compartments, so that no Book can be captured by any other Book.

Eegarding these elementary remarks as introductory, we proceed to give some typical examples of the method. Take a lattice of m columns and n rows, and consider the problem of placing units in the compartments in

such wise that the sth column shall contain \ units (s=l, 2, 3,...m), and the ith row Pt units [t=l, 2, 3,... 91). Writing

l + aiX+aiX'+. .. + ... = (l + aix){l+a)0. + a^)...

and 'Dp=—^{Sa^ + a^Sa^ + a^S^+...f, the multiplication being sym- bolic, so that Dp is an operator of order p, the function is

and the operator DpjDp^Djjj … Dj)„. The number

Dp Dp ... Djj„a;^ aj^axs… a;^,„ enumerates the solutions. For the

mode of operation of Dp upon a product reference must be made to the section on " Ditferential Operators "in the article Alge- BKAic FoEMS. Writing

or, in partition notation,

(l^')(l'''')...(l^) = ...H-A(piP2…^„)...+, Dj,jD;„...Dp„(lAl)(lA2)...(lM = A,

and the law by which the operation is performed upon the pro- duct shows that the solutions of the given problem are enumer- ated by the number A, and that the process of operation actually represents each solution.

Ex. GV.— Take Xi = 3, \=2, \ = 1,

Pl = 2,i?2 = 2,^3 = l,^4=l,

DiDiaz"^ = 8, and the process yields the eight diagrams : —

1

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1

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1

1

1

—

viz. , every solution of the problem. Observe that transposition of the diagrams furnishes a proof of the simplest of the laws of symmetry in the theory of Symmetric Functions.

For the next example we have a similar problem, but no restriction is placed upon the magnitude of the numbers which may appear in the compartments. The function is now h)^ hx….h;^^, h)^ being the homogeneous product sum of the quantities o, of order ^. The operator is as before

DpiDpj.-.D;)™, and the solutions are enumerated by

D„D„ ...D. hih^ ...hj, .

Putting as before Xi = 3, X2=2, X3=l, ^1=2,^2=2, ;P3=1 ,^74=1, the reader will have no diificulty in constructing the diagrams of the eighteen solutions.

The next and last example of a multitude that might be given shows the extraordinary power of the method by solving the famous problem of the "Latin Square," which for hundreds of years had proved beyond the powers of mathematicians. The problem consists in placing n letters a, 6, c, ... n. in the compart- ments of a square lattice of ifi compartments, no compartment being empty, so that no letter occurs twice either in the same row or in the same column. The function is here

(2.f

*2 \^*

71-1 /

and the operator D „ , the enumeration being given by

n / 271-1 71-2 2 \n.

D2»_i^,Soi a? -a„_iO«;

See Trans. Camb. Phil. Soc. vol. xvi. pt. iv. pp. 262-290.

Authorities. — MacMahon. "Combinatory Analysis: A Beview of the Present State of Knowledge," Proceedings London Mathematical Society, vol. xxviii. London, 1897. Here will be found a bibliography of the Theory

of Partitions. — Whitwoeth. Choice and Chance. — Lucas. Thiorie des Nombres. Paris, 1891. — Catlet. Collected Mathematical Papers, Cambridge, 1898, vol. ii. p. 419 ; vol. iii. pp. 36, 37 ; vol. iv. pp. 166-70 ; vol. v. pp. 62-65, 617 ; vol. vii. p. 575 ; vol. ix. pp. 480-83 ; vol. x. pp. 16, 38, 611 ; vol. xi. pp. 61, 62, 357-64, 589-91 ; vol. xii. pp. 217-19, 273-74 ; vol. xiii. pp. 47, 93-113, 269.— Stlvbstbr. American Journal of Mathematics, vol. v. pp. 119, 251. — MacMahon. Proceedings London Mathematical Society, vol. xix. p. 228 et seg. ; Phil. Trans._ Poyal Society of London, vol. clxxxiv. pp. 835-901 ; vol. clxxxv.' pp. 111-60 ; vol. clxxxvii. pp. 619-73 ; vol. cxcii. pp. 351-401 ; Trans. Camb. Phil. Soc. vol. xvi. pp. 262-90.

(p. A. M.)

Come'tSa — ^All comets move in orbits that are conic sections — eUipses, parabolas, or hyperbolas. The periodic comets move in elliptic orbits, and are usually seen at more than one return. Non-periodic comets move in parabolas (or in hyperbolas), and are seen at only one return. The comets of each calendar year are provisionally designated as 1895 A, 1895 B, 1895 C, &c., the letters A, B, C, &c. indicating the order of discovery. The name of the dis-

coverer is often added as 1895 C (Perrine). Comets are definitely designated as 1899 L, 1899 U., 1899 in.,

*In the following table the first column contains a current number for reference ; the second, the date A. D. (new style after 1580), in Fans mean tune, and the number of the comet in its year, as I., II., &C. ; the third, the argument of perihelion or, tt-O, where ir= longitude of perihehon ; the fourth, longitude of the ascending node of the comet's orbit, 0 ; the fifth, the inclination of the orbit ; the sixth, the perihelion distance of the comet in terms of the earth's mean distance =1*000 ; the seventh, the comet's semi-major axis ; the eighth, the periodic time in years ; the ninth, the eccentricity ; and the tenth, the name by which the*

comet is com- monly known. The data in this form record every appearance of known periodic comets, whose periods are less than one hundred years. The data for Nos. 1-111 are from Winlock's Tables in Publ. Ast. Soc. Pac. vol. viii. p. 141 ; the data for Nos. 112-122 have been furnished by C. D. Perrine.

Table of the Approximate Elements at each Return of all Taumn Periodic Comets whose Periods are less than One Hundred Years.

Longi-

1 Peri-

Semi-

Time of Perihelion

ir-n

tude

Inclina-

helion

Major

Period.

Eccen-

No.

Passage.

.Ascending Node.

tion.

Dis- tance.

tricity.

Comet of

T.

a>

a

t

a

a

V

e

A.D. O.S.

•

-

.

1

1378, Nov. 8-8

107-8

47-3

162-1

0-583

• ••

...

Halley.

2

1456, June 8-2

104-8

43-8

162-4

0-580

17-97

75-0

0-968

3

1531, Aug. 25-8

104-3

45-5

163-0

0-580

1779

75-0

0-967

If

4

1607, Oct. 26-7

107-0

487

162-8

0-588

17-87

75-5

0-967

5

1678, Aug. 18-3

159-5

163-3

2-9

1-145

3-070

5-38

0-627

Lahire.

6

1682, Sept. 14-8 1743 I., Jan. 8-2

109-3

51-2

162-3

0-583

18-17

77-5

0-968

Halley.

7

6-4

86-9

1-9

0-862

3-10

6-73

0-721

Grischow.

8

1759 I., Mar. 12-6

110-6

53-8

162-4

0-585

18-09

76-9

0-968

HaUey.

9 i 1766 II., AprU 27-0

177-0

74-2

8-0

0-399

2-934

5-025

0-864

Helfenzrieder.

10 ; 1770 I., Aug. 13-5

224-3

132-0

1-6

0-674

3-163

5-626

0786

Messier.

11

1772, Feb. 16-7

213-0

257-3

17-1

0-986

3-58

6-77

0725

Biela.

- 12

1783, Nov. 19-9

354-6

557

45-1

1-459

3-260

5-888

0-552

Pigott.

13

1786. 1., Jan. 30-9

182-5

334-1

13-6

0-335

2-208

3-281

0-848

Encke.

14

1790 II., Jan. 30-9

207-1

268-6

54-1

1-044

5-78

13-90

0-819

Tuttle.

15

1795, Dec. 21-4

182-0

3347

1^7

0-334

2-213

3-292

0-849

Encke.

16

1805, Nov. 21-5

182-5

334-3

13-6

0-340

2-213

3-292

0-846

17

1806 I., Jan. 2-0

218-2

251-3

13-6

0-907

3-567

6-737

0-746

BieK

18

1812, Sept 15-3

199-3

253-0

74-0

0-777

17-5

73-

0-956

Pons.

19 1 1815, April 26-0

65-6

83-5

44-5

1-213

17-63

74-

0-931

Olbers.

20 ‘ 1819 I., Jan. 28-0

182-4

334-6

13-6

0-335

2-214

3-295

0-849

Encke. –

21 1 1819 III., July 18-9

161-5

113-2

107

0774

3-160

5-618

0755

Winnecke.

22

1819 IV., Nov. 20-3

350-1

77-2

9-0

0-893

2-849

4-810

0-687

Blanpain.

23

1822 II., May 24-0

182-8

334-4

13-3

0-346

2-224

3-318

0-845

Encke.

24

1825 III., Sept. 16-3

182-8

334-5

13-4

0-345

2-223

3-315

0-845

25

1826 I., Mar. 18-4

218-3

251-5

13-6

0-903

3-561

6720

0-747

Biela.

26

1829 Jan. 97

182-8

334-5

13-3

0-346

2-224

3-316

0-845

Encke.

27

1832 1., May 4-0

182-8

334-5

13-4

0-343

2-222

3-312

0-845

28

1832 III., Nov. 26-1

221-8

248-3

13-2

0-879

3-537

6-652

0751

BiJl'a.

29

1835 II., Aug. 26-4

182-8

334-6

13-4

0-344

2-223

3-314

0-845

Encke.

30

1835 III., Nov. 15-9

110-6

55-2

162-2

0-587

17-99

76-29

0-967

Halley.

31

1838, Dec. 19-0

182-8

334-6

13-4

0-344

2-222

3-313

0-845

Enoke.

32

1842 I., AprU 12-0

182-8

3347

13-3

0-345

2-223

3-314

0-845

33

1843 III., Oct. 17-1

200-1

209-5

11-4

1-693

3-812

7-442

0-556

Faye.

34

1844 I., Sept. 2-5

2787

63-8

2-9

1-186

3-100

5-459

0-617

De Vico.

35

1845 IV., Aug. 9-6

183-4

334-3

13-1

0-338

2-216

3-300

0-847

Encke.

/36 1.37

1846 II., Feb. 11-0

223-1

245-9

12-6

0-856

3-520

6-603

0-757

Biela (A). \ Biela (B).j”

1846 II., Feb. 11 -1

223-1

245-9

12-6

0-856

3-519

6-601

0757

38

1846 III., Feb. 25-4

13-8

102-7

30-9

0-650

3-142

5-569

0793

Brorsen.

39

1846 IV., Mar. 5-6

12-9

77-6

85-1

0-664

17-90

757

0-963

De Vico.

40

1846 VI., June 1-1

339-6

260-4

307

1-529

5-635

13-38

0729

C. H. F. Peters.

41

1847 v., Sept. 9-5

129-3

309-8

19-1

0-488

187

81-1

0-974

Brorsen.

42

1848 II., Nov. 26-1

183-4

334-4

13-1

0-337

2-215

3-296

0-848

Encke.

43

1851 I., April 1-9

200-2

209-5

11-4

1-700

3-819

7-462

0-555

Faye.

44

1851 II., July 8-7

174-5

148-4

13-9

1-173

3-444

6-390

0-659

DArrest.

45

1852 I., March 147

183-5

334-4

13-1

0-337

2-215

3-297

0-848

Encke.

f46

147

1852 III., Sept. 237

223-3

245-9

12-6

0-861

3-526

6-621

0756

Biela (A). \ Biela (B). J

1852 III., Sept. 23-1

223-3

245-9

12-6

0-861

3-525

6-619

0-756

48

1852 IV., Oct. 12-8

57-1

346-2

40-9

1-250

15-44

607

0-919

Westphal.

49

1855 III., July 1-2

183-4

334-4

13-1

0-337

2-215

3-295

0-848

Encke.

50

1857 II., March 29-3

14-0

101-8

29-8

0-621

3-130

5-538

0-802

Brorsen.

51

1857 VII., Nov. 28-2

174-6

148-5

13-9

1-170

3-440

6-380

0-660

D’Arrest.

52

1858 I., Feb. 23-5

206-8

269-1

54-4

1-025

5736

13-74

0-821

Tuttle.

53

1858 II., May 2-0

162-1

113-5

10-8

0-769

3-317

5-555

0-755

Winnecke.

54

1858 III., May 3-0

257

175-1

19-5

1-149

3-523

6-609

0-674

Tuttle.

55

1858 v., Sept. 12-9

200-2

2097

11-4

1-694

3-813

7-445

0-556

Faye.

56

1858 VIII.. Oct. 18-4

183-5

334-5

13-1

0-341

2-218

3-304

0-846

Encke.

57

1862 I., Feb. 6-3

183-5

334-5

13-1

0-340

2-217

3-302

0-847

58

1865 II., May 27-9

183-5

334-5

13-1

0-341

2-218

3-304

0-846

59

1866 I., Jan. 11 “l

171-0

231-4

1627

0-977

10-32

33-18

0-905

Tempel.

60

1866 II., Feb. 14-0

200-2

2097

1

11-4

1-682

3-802

7-413

0-558

Faye.

COMETS

161

TMe of the Approximate Elements — contirmed.

Time of PerilieUon

TT-O

Longi- tude

iQClina.

Peri- helion

Semi- Major Axis.

Period.

Eccen-

Na

Passage.

^cending

tion.

Dis-

tricity.

Comet of

Node.

tance.

T.

u

a

i

9

a

U

e

A.D. H.S.

D

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61

1867 I., Jan. 20-2

357-5

78-5

18-2

1-577

1171

40-09

0-865

Stephan.

62

1867 II., May 23-9

135-0

101-2

6-4

1-563

3-189

5-695

0-510

Tempel (I.).

63

1868 I., April 17-4

14-8

101-2

29-4

0-597

3-109

5-482

0-808

Brorsen.

64

1868 III., Sept. 14-6

1837

334-5

13-1

0-334

2-212

3-289

0-849

Eucke.

65

1869 I., June 29-9

162-4

113-6

10-8

0-781

3-150

6-592

0752

Winnecke.

66

1869 III., Nov. 18-8

106-2

296-8

5-4

1-063

3-109

5-483

0-658

Tempel-Swift.

67

1870 III., Sept. 22-7

172-3

146-4

157

1-280

3-507

6-57

0-635

D’Arrest.

68

1871 III., Dec. 1-8

206-8

259-3

54-3

1-030

9757

13-811

0-821

Tuttle.

69

1871 v., Dec. 28-8

183-6

334-6

13-1

0-333

2-210

3-285

0-849

Enoke.

70

1873 I., May 9-8

159-3

787

9-8

1-771

3-296

5-984

0-463

Tepapel (I.).

71

1873 II., June 25-2

185-2

120-9

12-8

1-344

3-004

5-207

0-553

Tempel (II.).

72

1873 III., July 18-5

200-4

209-6

11-4

1-683

3-801

7-412

0-557

Faye.

73

1873 VI., Oct. 10-5

14-8

101-2

29-4

0-594

3-106

5-475

0-809

Brorsen.

74

1875 I., March 12-1

165-1

111-6

11-3

0-829

^201

5-726

0-741

Winnecke.

75

1875 II., April 13-0

1837

334-6

13-1

0-333

2-211

3-287

0-849

Eneke.

76

1877 IV., May 10-5

173-0

146-2

157

1-318

3-541

6-664

0-628

D’Arrest.

77

1878 II., July 26-2

1837

3347

13-1

0-333

2-212

3-285

0-849

Encke.

78

1878 III., Sept. 7-3

185-1

121-0

12-8

1-340

3-001

6-202

0-554

Tempel (II.),

79

1879 I., March 30-5

14-9

101-3

29-4

0-590

3-101

5-470

0-810

Brorsen.

80

1879 III., May 7-1

159-5

78-8

9-8

1-771

3-295

5-982

0-463

Tempel (I.).

81

1880 IV., Nov. 8-0

106-2

296-9

5-4

1-067

3-113

5-493

0-657

Tempel-Swift.

82

1881 I., Jan. 227

201-2

209-6

11-3

1-738

3-854

7-566

0-549

Faye.

83

1881 v., Sept. 13-3

312-5

65-9

6-9

0725

4-226

8-687

0-828

Denning.

84

1881 VII., Nov. 15-3

183-9

334-6

12-9

0-343

2-221

3-310

0-845

Encke.

85

1884 I., Jan. 257

199-2

254-1

74-0

0776

17-2

71-56

0-955

Pons-Brooks.

86

1884 II., Aug. 16-5

301-0

5-1

5-5

1-279

3-078

. 5-400

0-584

Barnard.

87

1884 III., Nov. 17-8

172-7

206-3

25-3

1-571

3-580

6-774

0-661

Wolf.

88

1885 I., March 7-6

183-9

334-6

12-9

0-342

2-220

3-307

0-846

Eucke.

89

1885 IV., Sept. 11-1

206-8

269-7

54-3

1-024

5742

1376

0-822

Tuttle.

90

1886 IV. June 67

176-8

53-5

12-7

1-327

3-152

5-595

0-579

Brooks.

91

1886 VI., Sept. 4-4 1886 VII., Nov. 22-4

172-0

104-1

14-5

0-885

3-234

5-816

0726

Winnecke.

92

315-1

52-5

3-0

0-998

3-536

6-648

0-71!

Finlay.

93

1887 v., Oct. 8-5

65-3

84-5

44-6

1-199

17-41

72-65

0-931

Olbers.

94

1888 II., June 28-0

184-0

334-6

12-9

0-343

2-220

3-308

0-846

Encke.

95

1888 IV., Aug. 19-9

201-2

209-6

11-3

1-738

3-854

7-566

0-649

Faye.

96

1889 v., Sept. 30-3

343-6

18-0

6-1

1-950

3-684

7-072

0-471

Brooks.

97

1889 VI., Nov. 29-5

697

330-6

10-2

1-354

4-176

8-534

0-676

Swift.

98

1890 v., Sept. 17-5

173-0

146-3

157

1-324

3-551

6-691

0-627

D'Arrest.

99

1890 VII., Oct. 26-5

328-2

45-1

12-9

1-970

3-448

6-402

0-471

Spitaler.

100

1891 II., Sept. 3-4

172-8

206-4

25-2

1-593

3-597

6-821

0-557

Wolf.

101

1891 III., Oct. 18-0

184-0

334-7

12-9

0-340

2-218

3-303

0-846

Encke.

102

1891 v., Nov. 15-0

1067

296-5

5-4

1-087

3-129

5-534

0-653

Tempel-Swift.

103

1892 III., June 13-2

14-2

3317

20-8

2-139

3-626

6-904

0-410

Holmes.

104

1892 IV., June 30-9

172-1

104-1

14-5

0-887

3-235

5-818

0726

Winnecke.

105

1892 v., Dec. ll'l

170-3

206-7

31-2

1-428

3-384

6-226

0-578

Barnard.

106

1893 III., July 12-2

315-5

52-5

3-0

0-989

3-526

6-622

0-720

Finlay.

107

1894 1., Feb. 9-5

46-3

84-4

5-5

1-148

3-804

7-42

0-698

Denning.

108

1894 III., April 23-2

185-6

121-2

127

1-351

3-008

6-218

0-561

Tempel (II.).

109

1894 IV., Oct. 12-2

296-6

487

3-0

1-392

3-252

5-863

0-572

De Vico-Swift.

110

1895 I., Feb. 47

184-0

334-7

12-9

0-341

2-218

3-303

0-846

Encke.

111

1895 II., Aug. 20-9

167-8

170-3

3-0

1-296

3-680

7-059

0-648

Swift.

112

1896 II., March 19-3

201-2

209-8

11-3

1-738

3-854

7-566

0-549

Faye.

113

1896 v., Oct. 26-0

139-5

192-1

11-6

1-482

3-500

6-549

0-586

Giacobini.

114

1896 VI., Nov. 4-2

343-8

18-0

. 6-1

1-959

3-693

7-097

0-469

Brooks (1889 v.).

115

1896 VII., Nov. 24-6

163-9

246-6

13-6

1-110

3-462

6-441

0-679

Perrine.

116

1897 II., May 24-0

1898 II., March 20-4

173-1

146-4

157

1-324

3-551

6-675

0-627

D'Arrest.

117

173-4

100-9

17-0

0-924

3-240

5719

0715

Winnecke.

118

1898 III., May 27—8

1898 IV., July 4-6

1899 II., April 28‘1 1899 III., May 4-5

184-0

334-8

12-9

0-341

2-218

3-303

0-846

Encke.

119

172-9

206-4

25-2

1-604

3-597

6-821

0-557

Wolf.

120

14-1

3317

20-8

2-139

3-615

6-874

0-411

Holmes (1892 III.).

121

2067

269-8

54-5

1-024

5742

13-664

0-822

Tuttle (discovered

by photography).

122

1899 IV., July 28-5

185-6

121-0

12-6

1-351

5-28

5-281

0-542

Tempel (II.).

During the decade 1890-1900 our knowledge of cometic orbits was greatly increased by a systematic effort to pro- vide computers for tbe orbits of comets wbose elements require revision. Keports on this matter are printed by Dr Kreutz, at intervals, in the V. J. S. of the Astronomische Geselhchaft. All the computations relating to periodic comets are in thoroughly competent hands The orbit of Wolf's comet, for example, is so well determined by its calculator (Pastor Thraen) that at its

last return observation agreed with computation exactly within the limits of accuracy set by five-place logarithms. The non-periodic comets appearing since 1700 are nearly all in the hands of computers ; only nineteen comets of the 18th and twenty -eight of the 19th century were unassigned at the date of Dr Kreutz's report in

1898.

The most important periodic comets are given in the fol- lowing table ; —

S. III. — 21

162

COMETS

Name.

Encke

Period in years.

3-303

BemarlcB.

Regularly returning since 1786, last observed in 1901. Its brightness in 1891 was about the same as in 1858. Sudden changes of brilliancy were observed at some of its returns (1865 and 1898 for example). Computers — Backlund, Ivanow.

Tempel (II)

Barnard Brorsen

Tempel – L. Swift .

Winnecke

De Vico – E. Swift

Brooks . Tempel (I.)

5-218 Last observed 1899. Com-

puter— SchulhofT.

5-400 Last observed 1884.

6-456 Last observed 1879, See the

remarks under Denuing's comet below.

5-534 Last observed 1891. Com-

puter— Bossert.

5-818 Lastobserved 1898. Computers

Von Haerdtl and HiUebrand.

6-863 Last observed 1894. It is the

comet 1844 I. (De Vico). Computer — Chandler.

5-595 Last observed 1886.

5-98 Observed in 1867, 1873, and

1879 ; subject to large per- turbations by Jupiter 1879-85, and not since seen. Computer — Gautier.

Barnard

Spitaler

Perrine

Giacobini Biela(I. and IL)

6-226

Com-

Com-

Last observed 1892.

puter — Coniel. Last observed 1890.

puter — Spitaler. Discovered 1896. Computers —

Ristenpart, Hadley. Discovered 1896. Discovered 1772; seen 1805,

1826, and 1832. In 1846 it divided into two parts, which were widely separated at its re- turn of 1852. It has not since been observed.

6-402

6-441

6-549 6-6

Einlay

6-622

Last observed 1893 (second re- turn). Computer — Schulhoff. Observed in 1851, 1867, 1870, 1877, 1890, 1897. Com- puter— Leveau. Regularly returning; last ob- served 1898. Computer — Thraen. Last observed 1896. Its orbit somewhat resembles that of comet Faye. Computer — Pokrowsky. Last observed 1899 within its calculated place by 28 s. in Its calculated period required a correction of This comet was, in 1892, subject to changes of brightness suggesting internal changes. The question arises why so bright a comet was not earlier discovered. Its orbit is more nearly circular than that of any other comet, and lies wholly between the orbits of Mars and Jupiter, in the region of asteroids therefore. Its spectrum shows only a trace of one bright line. Computer — Zwiers.

D’Arrest

y\oU

Giacobini

Holmes

6-691

6-821

6-904

R. A., 5′ in Deo 0-3 of a day only.

Swift

7-059

Brooks .

Last observed 1895. It is not unlikely to be a return of LexeU’s comet of 1770. 7-097 Last observed 1896. Its spec-

trum was continuous. It was at first supposed to be a return of LexeU’s comet, but the re- searches of Dr C. L. Poor make the identity unlikely. Denning (II) . 7-42 Last observed 1894. Its orbit

lies within 0-16 of Jupiter’s orbit, and near that point crosses the orbit of Brorsen’s comet. The two comets were near the point of intersection in 1881 (though Jupiter was not then near) which may account for the disappear- ance of Brorsen’s comet since its return in 1879.

Last observed 1896. Last observed 1889.

puter — Coniel. Last observed 1881. Last observed 1899,

puter — Rahts. Last observed 1866. Last observed 1867. Last observed 1852. Observed in 1812 and 1884. Observed in 1815 and 1887. Last observed 1846. Regularly returning. The next appearance is 1910.

In the course of tie ten years 1890-99 tUrty-seven

Faye

7-566

Swift .

8-534

Denning (I.)

8-867

Tuttle .

13-76

Tempel .

33-18

Stephan

40-09

Westphal

60-7

Pons-Brooks .

71-48

Olbers .

72-63

De Vico

75-7

HaUey .

76-37

Com-

Com-

unexpected comets were discovered (four on photographic plates, the others after search with visual telescopes) besides a number of expected (periodic) comets. During the years 1782 to 1841 eighty-seven comets of both classes were observed, or 1-45 per year, while from 1842 to 1897 there were 241 comets, or 4-30 per year. The difference in the average numbers probably represents nothing more than the increased attention paid to com6tary discovery in late years. For example, ten comets were discovered during 1898, thi-ee of them being known periodic comets. In the year 1840 a gold medal was founded by Christian VIII., king of Denmark, to be given to discoverers of telescopic comets, but after his death the award was discontinued. The comet medal (bronze) of the Astronomical Society of the Pacific was founded by Hon. Joseph A. Donohoe in the year 1890, and is presented to the discoverer of every unexpected comet on the report of a committee of the society. A list of the awards constitutes, therefore, a history of recent cometary discoveries.

List of Unexpected Comets discovered since 1st January

1890.

Discovered

on

March

19,

1890

July July Nov.

18, 23, 15,

1890 1890 1890

Nov.

16,

1890

March

29,

1891

October

3,

1891

March

6,

1892

March

18,

1892

August October

28, 12,

1892 1892

Nov.

6,

1892

Nov.

19,

1892

April October

16,

16,

1893 1893

March

26,

1894

April Nov.

2,

20,

1894 1894

August Nov.

20,

17,

1896 1895

Nov.

21,

1895

Feb.

15,

1896

April August Sept. Nov.

13,

31,

4,

2,

1896 1896 1896 1896

Dec.

8,

1896

October

16,

1897

March

20,

1898

June

11,

1898

June

14,

1898

June

18,

1898

Sept. October

13, 20,

1898 1898

Nov.

14,

1898

March

3,

1899

Sept.

29,

1899

Discovered by W. R. Brooks Jerome Coggia W. F. Denniag T. Zona R. Spitaler E. E. Barnard E. E. Barnard Lewis Swift W. F. Denning W. R. Brooks E. E. Barnard Edwin Holmes "W. R. Brooks J. M. Schaeberle W. R. Brooks W. F. Denning W. F. Gale E. D. Swift Lewis Swift C. D. Perrine "W. R. Brooks C. D. Perrine Lewis Swift W. E. Sperra E. Giacobini C. D. Perrine C. D. Perrine C. D. Perrine C. D. Perrine E. F. Coddington C. D. Perrine

E. Giacobini C. D. Perrine W. R. Brooks

F. L. Chase Lewis Swift E. Giacobini

At Geneva, N.Y. Marseilles, France Bristol, England Palermo, Italy Vienna, Austria Lick Observatory, Cal.

JJ)i)y

Rochester, N.Y. Bristol, England Geneva, N.Y. , Lick Observatory, Cal.' London, England Geneva, N.Y. Lick Observatory, Cal.^ Geneva, N.Y. Bristol, England Paddington, N.S.W. Lowe Observatory, Cal.

>) ti),

Lick

Geneva, N.Y. Lick Observatory, Cal. Lowe

Randolph, Ohio Nice, France Lick Observatory, Cal.

Nice, France Lick Observatory, Cal. Geneva, N.Y.^ New Haven, Conn.' Lowe Observatory, Cal. Nice, France

A few of the remarkable comets of the years 1888-1900 are here briefly described. Comet 1888 I. exhibited peculiar variations in its head like those which distin- guished the comets 1882 II. and 1884 I. Two (or according to one observer three) nuclei were enclosed in a nebulous sheath, as in 1882 11. On 2l8t May, two months after perihelion passage, the head sudderdy be- came about two stellar magnitudes brighter, and two jets were ejected from it, both much brighter than the main

' This is the first comet discovered by photography.

' This comet was discovered on the photographs of the total solar eclipse taken by the Lick Observatory eclipse expedition to Chile.

^ Discovered by photography.

- *The orbit of this comet resembles that of Schaeberle's comet of*

1881.

° Discovered by photography.

tail. The causes of such changes must be sought for within the comet, as, in all likelihood, they were not the direct result of solar action. Several other comets have shown like variations. Comet 1889 I. is remarkable for the long period (971 days) during which it was under observation. It was observed at four oppositions to the sun, the last observation being 1st May 1891. At this time its distance from the earth was 7-40 ; from the sun, 8-22, which is not very different from the distance of Saturn =9-54. The bright comet of 1811 was not observed beyond 4-53 from the sun, and the great comet of 1882 was lost at 5-16. Comet 1892 I. was photographed at

various observatories, and the photographs show that its tail was of a very complex character and subject to great variations. W. H. Pickering (Annals H. C. 0. vol. xxxii.) concludes that the variations were periodic, and that the whole comet rotated in a period of about four days on an axis through the head, coinciding with the general direction of the tail. The motion of condensations in the tail led him to the conclusion that the total repulsive force of the sun was 39-51 times the force of gravity. Professor Campbell, at the Lick Obser- vatory, notes a diminution in the wave-length of the green band of the spectrum after perihelion passage. The changes in Holmes's periodic comet of 1892 have already been referred to. The periodic comet 1889 V. (Brooks) was discovered on 6th July. It passed perihelion on 30th September. On 1st August Professor Barnard, at the Lick Observatory, discovered two companion comets near by, and later two more. It has been suggested that the com- panion comets were separated from the main body by the attraction of Jupiter about May 1886, when the comet and planet were in proximity. The periodic comet (Tempel- Swift) came within 0-13 of Jupiter in 1880 (earth's dis- tance from the sun=l), and it is worthy of remark that at its return in 1891 it was reported by some observers to have a companion comet. Comet 1892 V. was the first one (except the eclipse comet of 1882) to be discovered by photography (by Professor Barnard at the Lick Obser- vatory). The first comets photographed were those of 1881 (H. Draper) ; 1881 (Janssen) ; 1882 (Gill). All comets sufSciently bright are now studied to great advan- tage by photography. The next bright comet that is favourably situated will yield important discoveries, which are foreshadowed by the results of Professor Hussey of the Lick Observatory on the bright comet 1893 II. (see Publications of the Astronomical Society of the Pacific, vol. vii., 1895, pp. 161-185). Professor Hussey's photo- graphs show marked changes in the nucleus, coma, and tail. The comet sent off a series of condensations or nebulous masses whose motions were determined to be between 40 and 60 miles per second. The photographs obtained by Professor Barnard of the Lick Observatory of the comet 1893 IV. also show extraordinary variations in the quantity of matter ejected by the head to form the tail, and in the direction of its motion (see Knowledge, February and May 1894). e. s. h.

Comilla, or Kumilla, a town of British India, head- quarters of Tippera district in Bengal, situated on the river Gumti, with a station on the Assam-Bengal railway, 96 miles from the coast terminus at Chittagong. Popula- tion (1881), 13,372 ; (1891), 14,680. The town has many large tanks ; an English church, built in 1875 ; a high school; the Elliott artisan school; four printing-presses, one of which issues a vernacular newspaper ; and a public library.

Comiso, a town of the province of Syracuse, Sicily, iialy, 90 miles by rail west by south from Syra- cuse, on the line to Licata. It has a fine spring, the

fabled "bath of Diana," and limestone quarries. The people make pottery. Population, 19,333.

Commentry, a town of France, in the arrondisse- ment of MontluQon, department of AUipr, 42 miles south- west of Moulins by rail. It gives its name to a coal-field, the output of which in 1899 amounted to 778,417 tons (metric) ; over 4000 persons are employed in connexion with the mines. There are very important foundries and forges. Population (1881), 9394 ; (1896), 9197 ; (1901),

11,165.

Commercial Treaties. — A commercial treaty is a contract between States relative to trade. It is a bilateral act whereby definite arrangements are entered into by each contracting party towards the other — not mere concessions. As regards technical distinctions, an " agreement," an " exchange of notes," or a "convention " properly applies to one specific subject; whereas a " treaty " usually comprises several matters, whether commercial or political.

In ancient times foreign intercourse, trade, and navigation were in many instances regulated by international arrangements. The text is extant of treaties of commerce and navigation concluded between Carthage and Rome in 509 and 348 e.g. Aristotle mentions that nations were connected by commercial treaties ; and other classical writers advert to these engagements. Under the Roman Empire the matters thus dealt with

became regulated by law, or by usages sometimes styled laws. When the territories of the empire were contracted, and the imperial authority was weakened, some kind of international agreements again became necessary. At Constantinople in the 10th century treaties cited by Gibbon protected "the person, effects, and privileges of the Russian merchant " ; and, in Western Europe, intercourse, trade, and navigation were carried on, at first tacitly by usage derived from Roman times, or under verbal permission given to merchants by the ruler to whose court they resorted. Afterwards, security in these ' transactions was afforded by means of formal docu- ments, such as royal letters, charters, laws, and other instruments possessing the force of Government measures. Instances affecting English commercial relations are the letter of Charlemagne in 796, the Brabant Charter of 1305, and the Russian Ukase of 1569. Mediaeval treaties of truce or peace often contained a clause permitting in general terms the renewal of personal and commercial communication as it subsisted before the war. This custom is still followed. But these mediaeval arrangements were precarious : they were often of temporary duration, and were usually only effective during the lifetime of the contracting sovereigns.

Passing over trade agreements affecting the Eastern Empire, the modern commercial treaty system came into existence in the 12th century. Genoa, Pisa, and Venice were then well-organized com- munities, and were in keen rivalry. Whenever their position in a foreign country was strong, a trading centre was established, and few or no specific engagements were made on their part. But m serious competition or difficulty another course was adopted : a formal agreement was concluded for the better security of their commerce and navigation. The arrangements of 1140 between Venice and Sicily ; the Genoese conventions of 1149 with Valencia, of 1161 with Morocco, and of 1181 with the Balearic Islands ; the Pisan conventions of 1173 with Sultan Saladin, and of 1184 with the Balearic Islands, were the earliest Western commercial treaties. Such definite arrangements, although still of a personal character, were soon perceived to be preferable to general provisions in a treaty of truce or peace. They afforded also greater security than privileges enjoyed under usage ; or under grants of various kinds, whether local or royal. The policy thus inaugurated was adopted gradually throughout Europe. The first treaties

relative to the trade of the Netherlands were between Brabant and Holland in 1203, Holland and Utrecht in 1204, and Brabant and Cologne in 1251. Early northern commercial treaties are those between Riga and Smolensk 1229, and between Liibeck and Sweden 1269. The first commercial relations between the Hanse Towns and foreign countries were arrangements made by guilds of merchants, not by public authorities as a governing body. For a long period the treaty system did not entirely supersede conditions of inter- course between nations dependent on permission.

The earliest English Commercial Treaty is that with Norway in 1217. It provides " ut mercatores et homines qui sunt de potestate vestra liberfe et sine impedimento terram nostram adire possint, et homines et mercatores nostri similiter vestram." These stipula- tions are in due treaty form. The next early English treaties are '—with rianders, 1274 and 1314 ; Portugal, 1308, 1352, and 1386 ; Baltic Cities, 1319 and 1388 ; Bfecay and Castile, 1351 ; Burgundy,

1417 and 1496 ; France, 1471, 1497, and 1510 ; Florence, 1490. The commercial treaty policy in England was carried out system- atically under Henry IV. and Henry VII. It was continued under James I. to extend to Scotland English trading privileges. The results attained in the 17th century were — regularity in treaty arrangements; their durable instead of personal nature; the conversion of permissive into perfect rights ; questions as to con- traband and neutral trade stated in definite terms. Treaties were at first limited to exclusive and distinct engagements between the contracting States ; each treaty differing more or less in its terms from other similar compacts. Afterwards by extending to a third nation privileges granted to particular countries, the most favoured nation article began to be framed. Cromwell continued the commercial treaty policy in order to obtain a formal recognition of the Commonwealth from foreign Powers. His treaty of 1654 with Sweden contains the first reciprocal English most favoured nation clause. Article IV. provides that the people, subjects, and inhabitants of either

confederate "shall have and possess in the countries, lands, dominions, and kingdoms of the other as full and ample privileges, and as many exemptions, immunities, and liber- ties, as any foreigner doth or shall possess in the dominions and kingdoms of the said confederate." The Government of the Restoration replaced and enlarged the Protectorate arrangements by fresh agreements. The general policy of the Commonwealth was maintained, with further provisions on behalf of Colonial Trade. In the new treaty of 1661 with Sweden, the privileges secured were those which "any foreigner whatsoever doth or shall enjoy in the said dominions and kingdoms on both sides."

In contemporary treaties France obtained from Spain (1669) that French subjects should enjoy the same liberties as had been granted to the English; and Eng- land obtained from Denmark (1661) that the English should not pay more or greater customs than the people of the United Provinces and other foreigners, the Svredes only excepted . The colonial and navigation policy of the 17th century, and the proceedings of Louis XIV., provoked animosities and retaliatory tariffs. Dur- ing the war of the Spanish Succession the Methuen Treaty of 1703 was concluded. Portugal removed pro- hibitions against the importation of British ■woollens; Great Britain engaged that Portuguese wines should pay one-third less duty than the rate levied on French wines. At the Peace of Utrecht in 1713 political and commercial treaties were concluded. England agreed to remove pro- hibitions on the importation of French goods, and to grant most favoured nation treatment in relation to goods and merchandise of the like nature from any other country in Europe ; the French general tariff of Septem- ber 18, 1664, was to be again put in force for English trade. The English provision was at variance with the Methuen Treaty. A violent controversy arose as to the relative importance in 1713 of Anglo-Portuguese or Anglo-French trade. In the end the House of Commons, by a majority of 9, rejected the Bill to give effect to the commercial treaty of 1713 ; and trade with France remained on an unsatisfactory footing until 1786. The other commercial treaties of Utrecht were very complete in their provisions, equal to those of the present time; and contained most favoured nation articles — England secured in 1715 reduction of duties on woollens imported into the Austrian Netherlands; and trading privileges in Spanish America. Moderate import duties for woollens were

obtained in Eussia by the Com- mercial treaty of 1766. In the meanwhile the Bourbon family compact of August 16, 1761, assured national treatment for the subjects of France, Spain, and the Two Sicilies, and for their trade in the European territories of the other two States ; and most favoured nation treatment as regards any special terms granted to any foreign ■country. The first commercial treaties concluded by the United States with European countries contained most favoured nation clauses : this policy has been continued hy the United States, but the wording of the clause has often varied.

In 1786 France began to effect tariff reform by means

of commercial treaties. The first was with Great Britain, and it terminated the long-continued tariff warfare. But the wars of the French Revolution swept away these reforms, and brought about a renewal of hostile tariffs. Prohibitions and differential duties were renewed, and prevailed on the Continent until the sixth decade of the 19th century. In 1860 a Government existed in France sufi&ciently strong and liberal to revert to the policy of 1786. The bases of the Anglo-French treaty of 1860, beyond its most favoured nation provisions, were in France a general transition from prohibition or high customs duties to a moderate tariff; in the United Kingdom abandonment of all protective imposts, and reduction of duties maintained for fiscal purposes to the lowest rates compatible with these exigencies. Other European countries were obliged to obtain for their trade the benefit of the conventional tariff thus estab- lished in France, as an alternative to ithe high rates inscribed in the general tariff. A series of commercial treaties was accordingly concluded by different European States between 1861 and 1866, which effected further reductions of customs duties in the several countries which came within this treaty system. In 1871 the Eepublican Government sought to terminate the treaties of the Empire. The British negotiators nevertheless obtained the relinquishment of the attempt to levy protective duties under the guise of compensation for imposts on raw materials ; the duration of the treaty of 1860 was prolonged; and stipulations better worded than those before in force were agreed to for shipping and most favoured nation treatment. In 1882, however, France terminated her existing European tariff treaties. Belgium and some other countries concluded

fresh treaties, less liberal than those of the system of 1860, yet much better than anterior arrangements. Great Britain did not formally accept these higher duties; the treaty of February 28, 1882, with France, which secures most favoured nation treatment in other matters, provides that customs duties shall be ” henceforth regu- lated by the internal legislation of each of the two States.” In 1892 France also fell out of international tariff arrangements; and adopted the system of double columns of customs duties — one, of lower rates, to be applied to the goods of all nations receiving most favoured treatment; and the other, of higher rates, for countries not on this footing. Germany then took up the treaty tariff policy; and between 1891-1894 concluded com- mercial treaties of twelve years’ duration with Austria- Hungary, Belgium, Italy, the Netherlands, Russia, and Switzerland, to favour and develop her trade with those countries. An important series of commercial arrange- ments was concluded between 1884-1900 respecting the territories and spheres of interest of European powers in western, central, and eastern Africa. In these regions ex- clusive privileges are not claimed; most favoured nation treatment is recognized, and there is a disposition to ex- tend national treatment to all Europeans and their trade. The Turkish Capitulations are grants made by succes- sive Sultans to Christian nations, conferring rights and privileges in favour of their subjects resident or trading in the Ottoman dominions. In the first instance capitulations were granted specially to each Christian State, beginning with the Genoese in 1463, which entered into pacific relations with Turkey. Afterwards new cap- itulations were obtained which summed up in one docum ent earlier concessions, and added to them in general terms whatever had been conceded to one or more other States ; a stipulation which became a most favoured nation article. The English final capitulations are of this nature ; they are dated 1675, and have been confirmed by treaties of subsequent date “now and for ever.”

Capitulations signify that which is arranged under dis- tinct headings ; the Turkish phrase is ” ahid nameh,” whereas a treaty is”mouahede” —

the latter does, and the former does not, signify a reciprocal engagement. Thus, although the Turkish capitulations are not in them- selves treaties, yet by subsequent confirmation they have acquired the force of commercial treaties, of perpetual duration as regards substance and principles, while de- tails, such as rates of customs duties, may, by mutual consent, be varied from time to time.

The most favoured nation article already referred to concedes to the State in the treaty with which it is con- cluded whatever advantages in the matters comprised within its stipulations have been allowed to any foreign or third State. It does not in itself directly confer any particular rights, but sums up the whole of the rights in the matters therein mentioned which have been or may be granted to foreign countries. The value of the privi- leges under this article accordingly varies with the con- ditions as to these rights in each State which concedes this treatment.

The article Is drafted in different form :

(1) That contracting States A. and B. agree to extend to each other whatever rights and privileges they concede to countries C. and D., or to C. and D. and any other country. The object in this instance is to ensure specifically to B. and A. whatever advantages C. and D. may possess. A recent instance is Article XI. of the treaty of May 10, 1871, between Trance and Germany, which binds them respectively to extend to each other whatever advan- tages they grant to Austria, Belgium, Great Britain, the Nether- lands, Russia, and Switzerland.

(2) The present general formula : A. and B. agree to extend to each other whatever advantages they concede to any third country; and engage that no other or higher duties shall be levied on the importation into A. and B. respectively of goods the produce or manufacture of B. and A. than are levied on the like goods the produce or manufacture of any third country the most favoured in this respect. There is a similar clause in regard to exportation.

(3) The conditional or reciprocity formula, often used in the 18th and in the early part of the 19th century, namely, that when- ever A. and B. make special concessions in return for correspond- ing concessions, B. and A.

respectively are either excluded from participation therein, or must make some additional equivalent concession in order to participate in those advantages.

It may further be observed that the word ” like” relates to the goods themselves, to their material or quality, not to conditions of manufacture, mode of conveyance, or anything beyond the fact of their precise description ; small local facilities allowed to traffic between conterminous land districts are not at variance with this article.

Colonies. — The application of commercial treaties to colonies depends upon the wording of each treaty. The earlier colonial policy of European States was to subor- dinate colonial interests to those of the mother country, to reserve colonial trade for the mother country, and to abstain from engagements contrary to these general rules. France, Portugal, and Spain have adhered in principle to this policy. Germany and Holland have been more liberal. The self-government enjoyed by the larger British colonies has led since 1886 to the insertion of an article in British commercial and other treaties whereby the assent of each of these colonies, and likewise of India, is reserved before they apply to each of these possessions. And further, the fact that certain other British colonies are now within the sphere of commercial intercourse controlled by the United States, has since 1891 induced the British Government to enter into special agreements on behalf of colonies for whose pro- ducts the United States is now the chief inarket. As regards the most favoured nation article, it is to be re- membered that the mother country and colonies are not foreign countries with respect to each other. The most favoured nation article, therefore, does not preclude special arrangements between the mother country and colonies, nor -between colonies.

Termination. — Commercial treaties are usually con- cluded for a term of years, and either lapse at the end of this period, or are terminable then, or sub- sequently, if either State gives the required notice. When a portion of a country establishes its indepen- dence, for example the several American Eepublics, according to present usage foreign trade is placed on a uniform most favoured nation footing, and fresh treaties are entered into to regulate the commercial relations of the new communities. In the

case of for- mer Turkish provinces, the capitulations remain in force in principle until they are replaced by new engage- ments. If one State is absorbed into another, for in- stance Texas into the United States, or when territory passes by conquest, for instance Alsace to Germany, the commercial treaties of the new supreme Government take effect. In administered territories, Bosnia and Cyprus for instance, and in protected territories, it de- pends on the policy of the administering power how far the previous fiscal system shall remain in force. When the separate Italian States were united into the Kingdom of Italy in 1861, the commercial engagements of Sar- dinia superseded those of the other States, but fresh treaties were concluded by the new kingdom to place international relations on a regular footing. When the German Empire was established under the king of Prus- sia in 1871, the commercial engagements of any State which were at variance with a ZoUverein treaty were superseded by that treaty.

The present scope of commercial treaties is well exptessed by Monsieur Calvo in his work on International Law. They provide for the importation, exportation, transit, transhipment, and bond- ing of merchandise ; customs tariffs ; navigation charges ; quaran- tine ; the admission of vessels to roadsteads, ports, and docks ; coasting trade ; the admission of consuls and their rights ; fisheries; they determine the local position of the subjects of each State in the other country in regard to residence, property, payment of taxes or exemptions, and military service ; nationality ; and a most favoured nation clause. They usually contain a termination, and sometimes a colonial Article. Some of the matters enumerated by Monsieur Calvo— ,consular privileges, fisheries, and nationality — are now dealt with by separate conventions. Contraband and neutral trade are not included as frequently as they were in the 18th century.

The preceding statement shows that commercial treaties afford to foreigners, personally, legal rights, and relief from technical disabilities : they afford security to trade and navigation, and regu- late other matters comprised in their provisions. In Europe the general principles established by the series of treaties 1860-66 hold good, namely, the substitution of uniform rates of customs duties for prohibitions or

differential rates. The disadvantages urged are that these treaties involve Government interference and bargain- ing, whereas each State should act independently as its interests require, that they are opposed to free trade, and restrict the fiscal freedom of the legislature. It may be observed that these objec- tions imply some confusion of ideas. All contracts may be desig- nated bargains, and some of the details of commercial treaties in Monsieur Calvo's enumeration enter directly into the functions of government ; moreover, countries cannot remain isolated. Tariff arrangements are, however, open to controversy. Without discuss- ing the Methuen Treaty (notice was given by the Portuguese Government in 1835 that it should be no longer operative) , it may be admitted that its policy would not now be adopted. If, how- ever, two countries agree by simultaneous action to adopt fixed rates of duty, this agreement is favourable to commerce, and it is not apparent how it is contrary to free trade principles. If the Legislature is restricted from imposing prohibitions or differential duties, this restriction is not injurious ; and when maximum rates of duty are settled, this restriction cannot do harm if its duration is for a limited period ; security in business transactions is pro- vided by such tariff arrangements.

Our conclusions are —

(1) that under the varying jurisprudence of nations commercial treaties are adopted by common consent ;

(2) that their provisions depend upon the general and fiscal policy of each State ;

(3) that tariff arrangements, if judiciously settled, benefit trade ;

(4) that prohibitions, and discriminating or differential duties, are injurious to trade ; and to international relations ;

(5) that the most favoured nation clause leads to equality of

treatment and simplification of tariffs, and has become a most valuable provision alike for persons, trade, and navigation ;

(6) that commercial treaties are now entered into by all States ; and that they are necessary under modem conditions of commercial intercourse between nations. (c. M. K.)*

Commons. — Early History. — Commons are a relic of the system on which the lands of England were for the most part cultivated during the Middle Ages. The country was divided into vills, or townships — often, though not necessarily, or always, coterminous with the parish. In each stood a cluster of houses, a village, in which dwelt the men of the township, and around the village lay the arable fields and other lands, which they worked as one common farm. Save for a few small inclosures near the village — for gardens, orchards, or paddocks for young stock — the whole township was free from permanent fencing. The arable lands lay in large tracts, divided into compartments or fields, usually three in number to receive in constant rotation the triennial succession of wheat (or rye), spring crops (such as barley, oats, beans, or peas), and fallow. Low-lying lands were used as meadows, and there were sometimes pastures fed according to fixed rules. The poorest land of the township was left waste — to supply feed for the cattle of the com- munity, fuel, wood for repairs, and any other commodity of a renewable or practically inexhaustible character.' This waste land is the common of our own days.

It would seem likely that at one time there was no division, as between individual inhabitants or house- holders,'of any of the lands of the township, but only of the products. But so far back as accurate information extends the arable land is found to be parcelled out, each householder owning strips in each field. These strips are always long and narrow, and lie in sets parallel with one another. The plough for cultivating the fields was maintained at the common expense of the village, and the draught oxen were furnished by the householders. From the time when the crop was carried till the next sowing, the field lay open to the cattle of the whole vill, which also had the free run of the fallow field throughout the year. But when two of the three fields were under crops, and the meadows laid up for hay, it is obvious that the cattle of the

township required some other resort for pasturage. This was supplied by the waste or common. Upon it the householder turned out the oxen and horses which he contributed to the plough, and the cows and sheep, which were useful in manuring the common fields, — in the words of an old law case : " horses and oxen to plough the land, and cows and sheep to compester it." Thus the use of the common by each householder was naturally measured by the stock which he kept for the service of the common fields ; and when, at a later period, questions arose as to the extent of the rights on the common, the necessary practice furnished the rule, that the commoner could turn out as many head of cattle as he could keep by means of the lands which were parcelled out to him, — the rule of levancy and couchancy, which has come down to the present day.

In the earliest post-Conquest times the vHl or town- ship is found to be associated with an over-lord. There has been much controversy on the question, whether the vill originally owned its lands free from any control, and was subsequently reduced to a state of subjection and to a large extent deprived of its ownership, or whether its whole history has been one of gradual emancipation, the ownership of the waste, or

status ot township.

1 There is an entry on the Court Rolls of the Manor of Wimbledon of the division amongst the inhabitants of the vill of the crab-apples growing on the common.

common, now ascribed by the law to the lord being a remnant of his ownership of all the lands of the vill. (See Manok.)

At whatever date the over-lord first appeared, and whatever may have been the personal relations of the villagers to him from time to time after his appearance, there can Ije hardly any doubt that the village lands, whether arable, meadow, or waste, were substantially the property of the villagers for the purposes of use and enjoyment. They resorted freely to the common for such purposes as were incident to their system of agriculture, and regulated its use amongst themselves. The idea that the common was the " lord's waste," and that he had the power to do what he

liked with it, subject to specific and limited qualifying rights in others, was, there is little doubt, the creation of the Norman lawyers.

One of the earliest assertions of the lord's proprietary interest in waste lands is contained in the Statute of Merton, a statute which, it is well to notice, g^^^g was passed in one of the first assemblies of the of Merton Barons of England, before the Commons of the and west- Eealm were summoned to Parliament. This ^"second. statute, which became law in the year 1235, pro- vided "that the great men of England (which had en-feoffed knights and their freeholders of small tenements in their great manors)" might "make their profit of their lands, wastes, woods, and pastures," if they left sufficient pasture for the service of the tenements they had granted. Some fifty years later, another statute, that of Westminster the Second, supplemented the Statute of Merton by enabling the lord of the soil to inclose common lands, not only against his ovm tenants, but against " neighbours " claiming pasture there. These two pieces of legislation undoubtedly mark the growth of the doctrine which converted the over-lord's territorial sway into property of the modern kind, and a corre- sponding loosening of the hold of the rural townships on the wastes of their neighbourhood. To what extent the two Acts were used, it is very difficult to say. We know, from later controversies, that they made no very great change in the system on which the country was cultivated, a system to which, as we have seen, commons were essential. In some counties, indeed, inclosures had, by the Tudor period, made greater progress than in others. Tusser, in his eulogium on inclosed farming, cites Suffolk and Essex as inclosed counties by way of contrast to Norfolk, Cambridgeshire, and Leicestershire, where the open or " champion " (champain) system prevailed. The Statutes of Merton and Westminster may have had something to do with the progress of inclosed farming ; but it is probable that their chief operation lay in furnishing the lord of the manor with a farm on the new system, side by side with the common fields, or with a deer park.

*The first event which really endangered the village system was the coining of the Black Death. This scourge is said to have swept away half the population of the country. The disappearance, by no 2*1^^/*"* means uncommon, of a whole family gave the over-lord of the vill the*

opportunity of appropriating, by way of escheat, the holding of the household in the common fields. The land-holding population of the townships and the persons interested in the commons were thus sensibly diminished.

During the Wars of the Roses the small cultivator is thought to have again made headway. But his diminished numbers, and the larger interest which the lords had acquired in the lands of each vill, no doubt facilitated the determined attack on the common-field system which marked the reigns of Henry VIII. and Edward VI.

This attack, ~~which had for its chief object the conver~~ sion of ai'able land into pasture for the sake of sheep- breeding, was the outcome of many causes. It was no longer of importance to a territorial magnate to possess Tbe Tudor ^ l^rge body of followers pledged to his in- agrariaa terests by their connexion with the land. On rmi/u- tiie other hand, wool commanded a high price, and the growth of towns and of foreign com- merce supplied abundant markets. At the same time the confiscation of the monastic possessions introduced a race of new over-lords — not bound to their territories by any family traditions, and also tended to spread the view that the strong hand was its own justification. In order to keep large fiocks and send many bales of wool to market, each landowner strove to increase his range of pasture, and with this view to convert the arable fields of his vill into grass land. There is abundant evidence both from the complaints of writers such as Latimer and Sir Thomas More, and from the Statutes and Eoyal Com- missions of the day, that large inclosures were made at this time, and that the process was effected with much injustice and accompanied by great hardship. "Where," says Bishop Latimer in one of his courageous and vigor- ous denunciations of " inclosers and rent-raisers," " there have been many householders and inhabitants, there is now but a shepherd and his dog." In the full tide of this movement, and despite Latimer's appeals, the Statutes of Mei-ton and Westminster the Second were confirmed and re-enacted. Both common fields and commons no doubt disappeared in many places ; and the

country saw the first notable instalment of inclosure. But from the evidence of later years it is clear that a very large area of the country was still cultivated on the common-field system for another couple of centuries. When inclosure on any considerable scale again came into favour, it was effected on quite different principles ; and before describing what was essentially a modern movement, it will be convenient to give a brief outline of the principles of law applicable to commons at the present day.

*Law. — The distinguishing feature in law of common land is, that it is land the soil of which belongs to one person, and from which certain other persons oSimoa'. **^® certain profits — for example, the bite of the grass by the mouth of cattle, or gorse, bushes, or heather for fuel or litter. The right to take such a profit is a right of common; the right to feed cattle on common land is a right of common of pasture ; while the right of cutting bushes, gorse, or heather (more rarely of lopping trees) is known as a right of ooinmon of estovers or botes (from the Norman-French estouffer, and the Saxon botan, to furnish) ._ Another right of common is that of turbary, or the right to cut turf or peat for fuel. There are also rights of taking sand, gravel, or loam for the repair and maintenance of land. The persons who enjoy any of these rights are called commoners.*

From the sketch of the common-field system of agriculture which has been given, we shall readily in- fer that a large proportion of the commons of the country, and of the peculiarities of the law relating to commons, are traceable to that system. Thus, common rights are mostly attached to, or enjoyed with, certain lands or houses. A right of common of pasture usually consists of the right to turn out as many cattle as the farm or other private land of the commoner can sup- port in winter; for, as we have seen, the enjoyment of the common, in the village system, belonged to the householders of the village, and was necessarily measured by their holdings in the common fields. The cattle thus commonable are said to be levant and couchant, i.e., uprising and down-lying on the land.

But it has now been decided that they need not in fact be so kept. At the present day a commoner may turn out any cattle belonging to him, wherever they are kept, provided they do not exceed in number the head of cattle which can be supported by the stored summer produce of the land in respect of which the right is claimed, together with any winter herbage it produces. The animals which a commoner may usually turn out are those which were employed in the village system — horses, oxen, cows, and sheep. These animals are termed com- monable animals. A right may be claimed for other animals, such as donkeys, pigs, and geese ; but they are termed non-commonable, and the right can only be estab- lished on proof of special usage. A right of pasture attached to land in the way we have described is said to be " appendant " or " appurtenant " to such land. Common of pasture appendant to land can only be claimed for commonable cattle ; and it is held to have been originally attached only to arable land, though in claiming the right no proof that the land was originally arable is necessary. This species of common right is, in fact, the direct survival of the use by the vijlage householder of the com- mon of the township ; while common of pasture appur- tenant represents rights which grew up between neigh- bouring townships, or, in later times, by direct grant from the owner of the soil of the common to some other landowner, or (in the case of copyholders) by local custom.

The characteristic of connexion with house or land also marks other rights of common. Thus a right of taking gorse or bushes, or of lopping wood for fuel, called fire- bote, is limited to the taking of such fuel as may be necessary for the hearths of a particular house, and no more may be taken than is thus required. The same con- dition applies to common of turbary, which in its more usual form authorizes the commoner to cut the heather, which grows thickly upon poor soils, with the roots and adhering earth, to a depth of about 9 inches. Similarly, wood taken for the repairs of buildings (house-bote), or of hedges (hedge-bote or hey-bote), must be limited in quantity to the requirements of the house, farm build- ings, and hedges of the particular property to which the right is attached. And heather taken for litter cannot be taken in larger quantities than is necessary for manur- ing the lands in respect of which the right is enjoyed. It is illegal to take the wood or heather from the com- mon, and to sell it to any one who has not himself a right to take it. So, also, a right

of digging sand, gravel, clay, or loam is usually appurtenant to land, and must be exercised with reference to the repair of the roads, or the improvement of the soil, of the particular property to which the right is attached.

We have already alluded to the fact that, in Norman and later days, every vill or township was associated with some over-lord, — some one responsible to the crown, either directly or through other superior lords, for the holding of the land and the performance of certain duties of defence and military support. To this lord the law has assigned the ownership of the soil of the common of the vill ; and the common has for many centuries been styled the waste of the manor. The trees and bushes on the common belong to the lord, subject to any rights of lopping or cutting which the commoners may possess. The ground, sand, and subsoil are his, and even the grass, though the commoners have the right to take it by the mouths of their cattle. To the over-lord, also, was assigned a seignory over all the other lands of the vill ; and the vill came to be termed his manor. At the present day it is the manorial system which must be invoked in most cases as the foundation of the curiously conflicting rights which co-exist on a common. (See Manor.)

COMMONS

Within the bounds of a manor, speaking generally, there are three classes of persons possessing an interest ^ZoL in the land, viz.:-

(a) Persons holding land freely of the manor, or freehold tenants.

(6) Persons holding land of the manor by copy of Court Roll, or copyhold tenants.

(c) Persons holding from the lord of the manor, by lease or agreement, or from year to year, land which was originally demesne, or which was once freehold or copyhold and has come into the lord's hands by escheat or forfeiture.

Amongst the fir st two classes we usually find the maj ority of the commoners on the wastes or commons of the manor. To every freehold tenant belongs a right of common of pasture on the commons, such right being " appendant " to the land which he holds freely of the manor. This right differs from most other rights of common in the characteristic that actual exercise of the right need not be proved. When once it is shown that certain land is held freely of the manor, it follows of necessity that a right of common of pasture for commonable cattle attaches to the land, and therefore belongs to its owner, and may be exercised by its occupant. "Common appendant," said the Elizabethan judges, " is of common right, and commences by operation of law and in favour of tillage."

Now this is exactly what we saw to be the case with reference to the use of the common of the vill by the householder cultivating the arable fields. The use was a necessity, not depending upon the habits of this or that householder ; it was a use for commonable cattle only, and was connected with the tillage of the arable lands. It seems almost necessarily to follow that the freehold tenants of the manor are the representatives of the householders of the vlU. However this may be, it is amongst the freehold tenants of the manor that we must first look for commoners on the waste of the manor.

Owing, however, to the light character of the services rendered by the freeholders, the connexion of their lands with the manor is often difficult to prove. Copyhold tenure, on the other hand, cannot be lost sight of ; and in many manors copyholders are numerous, or were, till quite recently. Copyholders almost invariably possess a right of common on the waste of the manor ; and when (as is usual) they exist side by side with freeholders, their rights are generally of the same character. They do not, however, exist as of common right, without proof of usage, but by the custom of the manor. Custom has been defined by a great judge (the late Sir George Jessel, M.E.) as local law. Thus, while the freehold tenants enjoy their rights by the general law of the land, the copyholders have a similar enjoyment by the local law of the manor. This, again, is what one might expect from the ancient constitution of a village community. The copyholders, being originally serfs, had no rights at law ; but as they had a share in the tillage of the land, and gradually became possessed of strips

in the common fields, or of other plots on which they were settled by the lord, they were admitted by way of indulgence to the use of the common ; and the practice hardened into a custom. As might be expected, there is more variety in the details of the rights they exercise. They may claim common for cattle which are not com- monable, if the custom extends to such cattle ; and their claim is not necessarily connected with arable land.

In the present day large numbers of copyhold tenements have been enfranchised, i.e., converted into freehold. The effect of this step is to sever all connexion between the land enfranchised and the manor of which it was previously held. Technically, therefore, the common rights previously enjoyed in respect of the land would be gone. When, how- ever, there is no indication of any intention to extinguish

such rights, the courts protect the copyholders in their continued enjoyment; and when an enfranchisement is effected under the statutes passed in modern years, the rights are expressly preserved. The commoners on a manorial common then will be, primd facie, the freeholders and copyholders of the manor, and the persons who own lands which were copyhold of the manor but have been enfranchised.

The occupants of lands belonging to the lord of the manor, though they usually turn out their cattle on the common, do so by virtue of the lord's ownership of the soil of the common, and can, as a rule, make no claim to any right of common as against the lord, even though the ' practice of turning out may have obtained in respect of particular lands for a long series of years. When, however, lands have been sold by the lord of the manor, although no right of common attached by law to such lands in the lord's hands, their owners may subsequently enjoy such a right, if it appears from the language of the deeds of conveyance, and all the surrounding circumstances, that there was an intention that the use of the common should be enjoyed by the purchaser. The rules on this point are very technical ; it is sufficient here to indicate that lands bought from a lord of a manor are not necessarily destitute of common rights.

So far we have considered common rights as they have arisen out of the manorial system, and out of the still older system of village communities. There may, however, be rights of common quite un- !^°!!

.’ c> ^ 1 cy 1 common

connected with the manorial system. Such not con- rights may be proved either by producing a necua wUb specific grant from the owner of the manor or by f’^^f’ long usage. It is seldom that an actual grant is produced, although it would seem likely that such grants were not uncommon at one time. But a claim founded on actual user is by no means unusual. Such a claim may be based (a) on immemorial usage, i.e., usage for which no commencement later than the coronation of Richard I. can be shown, (6) on a presumed modern grant which has been lost, or (c) (in some cases) on the Prescription Act. There are special rules applicable to each kind of claim.

A right of common not connected with the manorial system may be, and usually is, attached to land ; it may be measured, like a manorial right, by levancy ajid couch- ancy, or it may be limited to a fixed number of animals. Eights of the latter character seem to have been not un- common in the Middle Ages. In one of his sermons against inclosure, Bishop Latimer tells us his father “had walk (i.e., right of common) for 100 sheep.” This may have been a right in gross, but was more probably attached to the “farm of £3 or £4 by year at the uttermost ” which his father held. In a recent case a right of common for 200 sheep over the waste of the manor of Banstead was established in respect of the manor of South Tadworth. Such a right may be sold separately, and enjoyed by a purchaser in- dependently of the tenement to which it was originally appurtenant. It then becomes a right of common in gross.

A right of common in gross is a right enjoyed irre- spective of the ownership or occupancy of any lands. It may exist by express grant, or by user implying a modem lost grant, or by immemorial usage. It must be limited to a certain number of cattle, unless the right is claimed by actual grant. Such rights seldom arise in connexion with commons in the ordinary sense, but are a frequent incident of regulated or stinted pastures ; the right is then generally known as a cattle-gate or beast-gate.

There may be rights over a common which exclude the owner of the soU from all enjoyment of some particular product of the common. Thus a

person, or a class of persons, may be entitled to the whole of the corn, grass, underwood, or sweepage (i.e., everything which falls to the

common fields.

sweep of tlie scythe) of a tract of land, without possessing any ownership in the land itself, or in the trees or mines. Such a right is known as a right of, sole vesture.

A more limited right of the same character is a right of sole pasturage — the exclusive right to take every- thing growing on the land in question by the mouths of cattle, but not in any other way. Either of these rights may exist throughout the whole year, or during part only. A right of sole common pasturage and herb- age was given to a certain class of commoners in Ash- down Forest on the partition of the forest at the end of the 18th century.

We have seen that the common arable fields and common meadows of a vill were thrown open to the stock of the community between harvest and Rights la seed-time. There is still to be found, here and there, a group of arable common fields, and occasionally a piece of grass land with many of the characteristics of a common, which turns out to be a common field or meadow. The Hackney Marshes and the other so-called commons of Hackney are really common fields or common meadows, and along the valley of the Lea a constant succession of such meadows is met with. They are still owned in parcels marked by metes ; the owners have the right to grow a crop of hay between Lady Day and Lammas Day ; and from Lammas to March the lands are subject to the depasturage of stock. In the case of some common fields and meadows the right of feed during the open time belongs exclusively to the owners ; in others to a larger class, such as the owners and occupiers of all lands within the bounds of the parish. Anciently, as we have seen, the two classes would be identical. In some places new-comers not owning strips in the fields were admitted to the right of turn out ; in others, not. Hence the distinction. Similar

divergences of practice will be found to exist in Switzerland at the present day; nieder-gelassene, or new-comers, are in some communes admitted to all rights, while, in others, privileges are reserved to the burger, or old inhabitant householders.

Some of the largest tracts of waste land to be found in England are the waste or commonable lands of Royal Forests or Chases. The thickets and pastures Rights la of Epping Forest, now happily preserved for Fcurests. London under the guardianship of the City Corporation, and the noble woods and far- stretching heaths of the New Forest, will be called to mind. Cannock Chase, unhappily inclosed according to law, though for the most part still lying waste, Dartmoor, and Ashdown Forest in Sussex, are other instances; and the list might be greatly lengthened. Space will not permit of any description of the forest system ; it is enough, in this connexion, to say that the common rights in a forest were usually enjoyed by the owners and occu- piers of land within its bounds (the class may differ in exact definition, but is substantially equivalent to this) without reference to manorial considerations. Epping Forest was saved by the proof of this right. It is often said that the right was given, or confirmed, to the inhabit- ants in consideration of the burden of supporting the deer for the pleasure of the king or of the owner of the chase. It seems more probable that the forest law prevented the growth of the manorial system, and with it those rules which have tended to restrict the class of persons entitled to enjoy the waste lands of the district.

We have seen that in the case of each kind of common

there is a division of interest. The soil belongs to one

person; other persons are entitled to take

Prevea- certain products of the soil. This division of

“ncioLre. interest preserves the common as an open

space. The commoners cannot inclose, because

the land does not belong to them. The owner of the soil cannot inclose, because inclosure is inconsistent with the enjoyment of the commoners' rights. At a very early date it was held that the right of a commoner proceeded out of every part of the common, so that the owner of the soil could not set aside part for the commoner and inclose the rest. The Statutes of Merton and Westminster the Second were passed to get over this difficulty. Biit under these statutes the burden of proving that sufficient pasture was left was thrown upon the owner of the soil ; such proof can very seldom be given. Moreover, the statutes have never enabled an inclosure to be made against commoners entitled ~~to estovers or turbary. It seems clear that the statutes had become obsolete in the time of Edward VI., or they would not have been re~~ enacted. And we know that the zealous advocates of inclosure in the 18th century considered them worthless for their purposes. Practically it may be taken that, save where the owner of the soil of a common acquires all the lands in the township (generally coterminous with the parish) with which the common is connected, an inclosure cannot legally be effected by him. And even in the latter case it may be that rights of common are enjoyed in respect of lands outside the parish, and that such rights prevent an inclosure.

Modem Indosure. — When, therefore, the common-field system began to fall out of gear, and the increase of population brought about a demand for an increased production of corn, it was felt to be ™ taodera necessary to resort to .Parliament for power to^""" effect inclosure. The legislation which ensued was based on two principles. One was, that all persons in- terested in the open land to be dealt with should receive a proportionate equivalent in inclosed land ; the other, that inclosure should not be prevented by the opposition, or the inability to act, of a small minority. Assuming that inclosure was desirable, no more equitable course could have been adopted, though in details particular Acts may have been objectionable. The first Act was passed in 1709 ; but the precedent was followed but slowly, and not till the middle of the 18th century did the annual number of Acts attain double figures. The high-water mark was reached in the period from 1765 to 1785, when on an average forty-seven Acts were passed every year. From some cause, possibly the very consider- able expense attending upon the obtaining of an Act, the numbers then began slightly to fall off. In the year 1793 a Board of Agriculture, apparently similar in char- acter to the*

Chambers of Commerce of our own day, was established. Sir John Sinclair was its president, and Arthur Young, the well-known agricultural reformer, was its secretary. Owing to the efforts of this body, and of a Select Committee appointed by the House of Commons on Sinclair's motion, the first General Inclosure Act was passed in 1801. This Act would at the present day be called an Inclosure Clauses Act. It contained a number of provisions applicable to inclosures, which could be incorporated, by reference, in a private Bill. By this means, it was hoped, the length and complexity, and consequently the expense, of inclosure Bills would be greatly diminished. Under the stimulus thus applied inclosure proceeded apace. In the year 1801 no less than 119 Acts were passed, and the total area inclosed probably exceeded 300,000 acres. Three inclosures in the Lincolnshire Fens account for over 53,000 acres. As before, the movement after a time spent its force, the annual average of Acts falling to about twelve in the decade 183040. Another Parliamentary committee then sat to consider how inclosure might be pro- moted ; and the result was the Inclosure Act, 1845, which, though much amended by subsequent legislation, still stands on the statute-book. The chief feature of that

Act was the appointment of a permanent Commission to make in each case all the inquiries previously made (no doubt capriciously and imperfectly) by Committees of the two Houses. The Commission, on being satisfied of the propriety of an inclosure, was to draw up a pro- visional order prescribing the general conditions on which it was to be carried out, and this order was to be submitted to Parliament by the Government of the day for con- firmation. It is believed that these inclosure orders afford the first example of the provisional order system of legislation, which has recently attained such large proportions.

Again inclosure moved forward, and between 1845 and 1869 (when it received a sudden check) 600,000 acres passed through the hands of the

Inclosure Commission. Taking the whole period of about a century and a half, when Parliamentary inclosure was in favour, and making an estimate of acreage where the Acts do not give it, the result may be thus summarized : —

From 1709 to 1797 ....

„ 1801 to 1842 ....

„ 1845 to 1869 ....

Add for Forests inclosed under Special

Acts .....

Acres.

2,744,926

1,307,964

618,000

100,000

4,770,890

The total area of England being 37,000,000 aeres, we shall probably not be far wrong in concluding that about one acre in every seven was inclosed during the period in question. During the first period, the lands inclosed consisted mainly of common arable fields ; during the second, many great tracts of moor and fen were reduced to severalty ownership. In the third period, inclosure probably related chiefly to the ordinary manorial com- mon ; and it seems likely that, on the whole, England would have gained, had inclosure stopped in 1846.

As a fact it stopped in 1869. Before the Inclosure Commission had been in existence twenty years the feel- ing of the nation towards commons began to movement cli^nge. The rapid growth of towns, and espe- cially

of London, and the awakening sense of the importance of protecting the public health, brought about an appreciation of the value of commons as open spaces. Naturally, the metropolis saw the birth of this sentiment. An attempted inclosure in 1864 of the commons at Epsom and Wimbledon aroused strong opposition; and a Select Committee of the House of Commons was appointed to consider how the London commons could best be preserved. The Metropolitan Board of Works, then in the vigour of youth, though eager to become the open-space authority for London, could make no better suggestion than that all persons interested in the commons should be bought out, that the board should defray the expense by selling parts for building, and should make parks of what was left. Had this advice been followed, London would probably have lost two-thirds of the open space which she now enjoys. Fortunately a small knot of men, who after- wards formed the Commons Preservation Society, took a broader and wiser view. Chief amongst them were the late Mr Philip Lawrence, who acted as solicitor to the Wimbledon opposition, and subsequently organized the Commons Preservation Society, Mr George Shaw- Lefevre, chairman of that Society since its foundation, the late Mr John Locke, and the late Lord Mount Temple (then Mr W. F. Cowper). They urged that the conflict of legal interests, which is the special character- istic of a common, might be trusted to preserve it as an open space, and that all that Parliament could usefully do, was to restrict Parliamentary inclosure, and to pass a measure of police for the protection of commons as

open spaces. The Select Committee adopted this view. On their report, was passed the Metropolitan Commons Act, 1866, which prohibited any further Parliamentary inclosures within the Metropolitan police area, and provided means by which a common could be put under local management. The lords of the manors in which the London commons lay felt that their opportunity of making a rich harvest out of land, valuable for building, though otherwise worthless, was slipping away ; and a battle royal ensued. Inclosures were commenced, and the Statute of Merton prayed in aid. The public retorted by legal proceedings taken in the names of commoners. These proceedings — which culminated in the mammoth suit as to Epping Forest, with the Corporation of London as plaintiffs and fourteen lords of manors as defendants — were uniformly success- ful ;

and London commons were saved. By degrees the manorial lords, seeiag that they could not hope to do better, parted with their interest for a small sum to some local authority; and a large area of the common land, not only in the county of London but in the suburbs, is now in the hands of the representatives of the rate- payers, and is definitely appropriated to the recreation of the public.

Moreover, the Commons Preservation Society was able to base, upon the uniform success of the commoners in the law courts, a plea for the amendment yi„g„j. of the law. The Statute of Merton, we have me„t of seen, purports to enable the lord of the soil statute of to inclose a common, if he leaves sufficient ^^'"'- pasture for the commoners. This statute was constantly vouched in the litigation about London commons; but in no single instance was an inclosure justified by virtue of its provisions. It thus remained a trap to lords of manors, and a source of controversy and ex- pense. In the year 1893 Lord Thring, at the instance of the Commons Preservation Society, carried through Parliament the Commons Law Amendment Act, which provided that in future no inclosure under the Statute of Merton should be valid, unless made with the consent of the Board of Agriculture, which was to consider the expediency of the iuclosure from a public point of view.*

The movement to preserve commons as open spaces soon spread to the rural districts. Under the Inclosure Act of 1845 provision was made for the allot- ment of a part of the land to be inclosed for ^^^ field gardens for the labouring poor, and for recreation. But those who were interested in effecting an inclosure often convinced the Inclosure Commissioners, that for some reason such allotments would be useless. To such an extent did the reservation of such allotments become discredited that, in 1869, the Commission pro- posed to Parliament the inclosure of 13,000 acres, with the reservation of only one acre for recreation, and none at all for field gardens. This proposal attracted the attention of the late Mr Fawcett, who, after much inquiry and consideration, came to the conclusion that inclosures were, speaking generally, doing more harm than good to the agricultural labourer, and that, under such conditions as the Commissioners were prescribing, they constituted a serious evil. With characteristic intrepidity he opposed the annual Inclosure Bill (which had

come to be considered a mere form) and moved for a Committee on the whole subject. The ultimate result was the passing, seven years later, of the Commons Act, 1876. This measure, introduced by a Conservative Government, laid down the principle that an inclosure should not be allowed unless distinctly shown to be for the benefit, not merely of private persons, but of the neighbourhood generally and the public. It imposed many checks upon

*commons^*

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the process, and, following the course already adopted in the case of Metropolitan commons, offered an alternative method of making commons more useful to the nation, viz., their management and regulation as open spaces. The effect of this legislation and of the changed attitude of the House of Commons towards inclosure has been almost to stop that process, except in the case of common fields or extensive mountain wastes. Only some twenty- four commons, comprising about 26,000 acres, have been inclosed by Act of Parliament since 1876.

We have alluded to the regulation of commons as open spaces. The primary object of this process is to bring a common under the jurisdiction of some con- tfon" "' stituted authority, which may make bye-laws, enforceable in a summary way before the magis- trates of the district, for its protection, and may appoint watchers or keepers to preserve order and prevent wanton mischief. There are several means of attaining this object. Commons ^within the Metropolitan police district — the Greater London of the Eegistrar-General — are in this respect in a position by themselves. Under the Metropolitan Commons Acts, schemes for their local management may be made by the Board of Agriculture (in which the Inclosure Commission is now merged) with- out the consent either of the owner of the soil or the commoners — who, however, are entitled to compensation if they can show that they are injuriously affected. Outside the Metropolitan police district a provisional order for regulation may be made under the Commons Act, 1876, with the consent of the owner of the

soil and of persons representing two-thirds in value of all the interests in the common. And under an Act passed in 1899 the council of any urban or rural district may, with the approval of the Board of Agriculture and without recourse to Parliament, make a scheme for the management of any common within its district, pro- vided no notice of dissent is served on the Board by the lord of the manor or by persons representing one-third in value of such interests in the common as are affected by the scheme. There is yet another way of protecting a common. A parish council may, by agreement, acquire an interest in it, and may make bye-laws for its regu- lation under the Local Government Act, 1894. It is probable that in future commons outside the Metropolitan police area will be managed chiefly under the Acts of 1894 and 1899. They undoubtedly proceed on right lines. For, with the growth of efficient local government, commons naturally fall to be protected and improved by the authority of the district.

It remains to say a word as to the extent of common land still remaining open ia England and Wales. In 1843 it was estimated that there were still 10,000,000 statistics, g^gjgg Qj common land and common-field land. In 1874 another return made by the Inclosure Com- mission made a guess of 2,632,772. These two returns were made from the same materials, viz., the Tithe Com- mutation Awards. As less than 700,000 acres had been inclosed in the intervening period, it is obvious that the two estimates are mutually destructive. In July 1875 another version was given in the Eeturn of Landowners (generally known as the Modem Domesday Book), compiled from the valuation lists made for the purposes of rating. This return put the commons of the country (not including common fields) at 1,524,648 acres. It is impossible to view any of these returns as accurate. Those compiled from the Tithe Commutation Awards are based largely on estimates, since there are many parishes where the tithes had not been commuted. On the other hand, the valuation lists do not show waste and unoccupied land (which is not rated), and consequently the information as to such lands in the Return of Landowners

was based on any materials which might happen to be at the disposal of the Clerk of the Guardians. All we can say, therefore, is that the acreage of the remaining common land of the country is probably somewhere between 1,500,000 and 2,000,000 acres. It is most capriciously distributed.

In the Midlands there is very little to be found, while in a county of poor soil, like Surrey, nearly every parish has its common, and there are large tracts of heath and moor. In 1866, returns were made to Parliament by the Overseers of the Poor of the commons within 15 and within 26 miles of Charing Cross. The acreage within the larger area was put at 38,450 acres, and within the smaller at 13,301 ; but owing to the difference of opinion which sometimes prevails upon the question, whether land is common or not, and the carelessness of some parish authorities as to the accuracy of their returns, even these figures cannot be taken as more than approximately correct. The Met- ropolitan police district, within which the Metropolitan Commons Acts are in force, approaches in extent to a circle of 15 miles' radius. Within this district nearly 12,000 acres of common land have been put under local manage- ment, either by means of the Commons Acts or under special legislation. London is to be congratulated on hav- ing, secured so much recreation ground on its borders. But when the enormous population of the capital and its rapid growth and expansion are considered, the conclusion is inevitable, that not one acre of common land within an easy railway journey of the metropolis can be spared.

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Como, chief town of the Italian province of Como, and situated at the south-western extremity of the lake of the same name. Next to Milan, Como has made more rapid progress than any Lombard city since 1875. Its popular tion, which numbered 25,560 in 1881, was 38,902 in 1901,

while the population of th^ province was 576,276 in 1901, having increased by 61,226 since 1881. The density of the population is 2-16 per square kilometre. In Como and its immediate neighbourhood many large silk-weaving establishments have been founded. In con- sequence of the construction of a funicular railway from Como to Brunate Hill, 716 metres above the city, a new quarter and climatic station have grown up at Brunate. Between 1881 and 1900, 179 kilometres of new railways were built in the province of Como, besides two funicular railways and an electric tramway. A further electric line is in course of construction. The making of provincial and State roads has kept pace with the growth of railway communication. At the same time, the navigation of the three lakes of Como, Maggiore, and Lugano, both by steam and sailing vessels, has notably increased. A telephone system, 310 miles in length, connects Como with the chief communes of the province. In 1900 the industrial establishments of the province of Como num- bered 870, of which nearly one-half are devoted to various branches of the silk industry. There are, besides, cotton industries, paper-making, iron-working, telegraph cables, lime-kilns, and cement factories. The number of work- men and workwomen employed in the silk industry is

55,000. In 1860 Como possessed 3000 hand looms; in 1899, 11,000, while 3500 machine looms had been introduced. Since one machine loom is equal to three hand looms, the weaving potentiality of Como has been multiplied sevenfold in thirty years. The importance of this development is the more noteworthy in view of the fact that, while Como possesses 3500 steam looms, only 2000 exist in the rest of Italy. The Como factories yield products of an estimated annual value of 60,000,000 lire. Most of the Como silk is exported, especially to London and to the Levant.

The mountainous character of the province of Como and the excessive subdivision of landed property retard the introduction of improved methods of agriculture. The Agricultural Unions, however, have succeeded in promoting the use of artificial manure and in increasing the pro- ductivity of the soU. The most important improvements have taken

place in regard to the raising of silk-worms by the introduction of a system of selecting the eggs, and by modifications of the peasants' houses. Industrial progress and agricultural improvements have combined in producing in the province an unusual degree of prosperity. The spirit of initiative and the activity of the inhabitants found expression in 1899 in the Silk and Electrical Exhibition, organized to celebrate the first centenary, of the invention of the electric pile by Alessandro Volta, a native of Como. The Exhibition, opened in May 1899, was destroyed by fire in the following July, but was rebuilt and reopened within a few weeks by its original organizers. An International Electrical Congress took place in connexion with the Exhibition. The distinction gained as early as the ninth century in building and architecture by the Mayistri Comacini still excites the emulation of the inhabitants of the region, who, as specialists in the art of building, emigrate to all parts of Europe. The spirit of reverence for historical buildings and local artistic memories has led to the restoration during the last few years of Como Cathedral, and of the churches of Sant' Abbondio, San Fedele, San Carpoforo, and other minor monuments of the province. (l. bi.)

Como, a lake of North Italy, lying at the foot of the Ehsetic Alps, directly north from Milan. Area, according to Marinelli, 56^ square miles ; maximum depth, 1368 ft. ; altitude above searlevel, 653 ft.; temperature at the bottom, 42°-8 Fahr. During the ^ay a southerly wind, the Breva, blows pretty constantly, and during the night a northerly wind, the Tivano. The difference between " high " water and " low " water levels amounts to as much as 16 ft. Its shores are thickly studded with silk factories.

Comoro Islands, a group of islands belonging to France, situated half-way between Madagascar and the African continent, to the north of the Mosambique Channel. The following table of the area and population of the only four of any size gives one of the sets of figures offered by various authorities : —

Island.

Area (square miles).

Population.

Mayotte

Great Comoro, . . .

Moheli

Anjouan

140

385

90

145

9,000 50,000

9,000 12,000

Total ....

760

80,000

The islands are of volcanic formation and bristle with mountains, the highest of which is Coratola (8500 feet). The soil is very fertile, and covered with forests of cocoanut

and fig trees. The climate is in general warm, but not torrid nor unsuitable for Europeans. The dry season lasts from May to October, the rest of the year' being rainy. The natives, who form practically the whole of the popu- lation, are of Malagasy, Negro, and Arab blood. The more important localities are Dzaudai, a small island off Mayotte, where are the government headquarters ; M'sapere, on the opposite mainland,

which is the chief centre of trade in the island; Bambao, in Anjouan; Fomboni, in Moheli; and Movoni, in Great Comoro.

Mayotte was occupied as a colony in 1843, and has long been completely subject to the French, who, how- ever, have experienced some trouble in the other islands, over which they extended a protectorate in 1886. The administration, as regulated by the decree of September 1899, is under a governor of the whole group, who himself administers Mayotte, but governs the other three islands through administrators. At Mayotte there are a tribunal of first instance and a paymaster. Each island has its own local budget. That of Mayotte, which alone receives a subvention from France, shares more than half the totals, which in 1901 were estimated to balance at about £20,000. Mayotte also appropriated £1055 in the 1901 colonial budget of France, and in consequence of a destructive cyclone in 1898 borrowed £20,000, to be paid in 20 years, without interest. Great Comoro has a debt of £38,000. Mayotte produces sugar, vanilla, rice, coffee, cacao. For the rest, Anjouan is the most favourable to cultivation, especially of vanilla, but the cocoanut is gathered. In Great Comoro copra is prepared and zebras are reared. The only industrial establishments in the group are sugar-works and saw-mills. Trade statistics are only issued for Mayotte, but this term may include the whole group. In 1898 imports totalled £28,300 (France £21,200). In 1898 exports totalled £49,320 (France £47,890). The movement of the vessels of the Messageries Maritimes at Mayotte reaches 5000 tons for vessels with cargoes. At present it is rather because of their strategic than their commercial value that the Comoros are of importance. A' coaling station has been established among them.

See Henrique. Les Colonies Franqaises. Paris, 1889. — Lee. French Colonies. Foreign Office Report, 1900. VAnnee Coloniale, Paris, 1900. (p. l.)

Company. — Joint stock enterprise derives its vitality from the co-operative principle, by which a multi- tude of small investors create a fund to be used in further- ance of some commercial undertaking for the common benefit of all. The natural growth and expansion of this fruitful principle was checked until the middle of the nine- teenth century by the

notorious risks attachingto unlimited liability. In the case of an ordinary partnership, though their liability is unlimited, the partners can generally tell what risks they are incurring. Not so the shareholders of a company. They delegate the management of their business to a board of directors, and they may easily find themselves committed by the fraud or folly of its members to engagements which in the days of unlimited liability meant ruin. Failures like those of Overend and Gurney, and of the Glasgow Bank, caused widespread misery and alarm. It was not until limited liability had been grafted on the stock of the co-operative system that the real potency of the principle of industrial co-operation be- came apparent. We owe the adoption of the limited liability principle to the clear-sightedness of Lord Sher- brooke — then Mr Robert Lowe — and to the vigorous advocacy of Lord Bramwell. We owe it to Lord Bramwell also that the principle was made a feasible one. The practical difficulty was how to bring home to persons deal- ing with the company notice that the liability of the share-

holders was limited. Lord Bramwell solved the problem by a happy suggestion — « ~~write it on my tombstone," he said humorously to a friend. This was that the company should add to its name the word " Limited " — paint it up on its premises, and use it on all its invoices, bills, pro~~ missory notes, and other documents. The proposal was adopted by the Legislature and has worked successfully. The best evidence of the influence which the introduction of limited liability has exercised is to be found in the returns of companies registered under the Act of 1862. That Act contemplates three classes of companies — (1) companies limited by shares, (2) companies limited by guarantee, (3) unlimited companies. The number of companies limited by shares which were registered, from the commencement of the Act to the year 1901 is 60,000 ; of companies limited by guarantee, 1300 ; of unlimited companies, 140. The companies limited by shares show a progressive increase from 689 in 1863 to 4675 in 1897 ; the unlimited companies registered in 1863 were 8 in number, in 1897 they were nil. The unlimited company is practically an extinct

species. The company limited by shares has become the normal type : it is incomparably the most important, and as such it is chiefly dealt with in this article.

Companies Limited by Shares. — The Companies Act, 1862, was intended to constitute a comprehensive code of law applicable to joint stock trading companies for the whole of the United Kingdom. Eecognizing the mischief of large trading concerns being carried on by fluctuating bodies, the Act begins by declaring that no company, association, or partnership, consisting of more than twenty persons, or ten in the case of banking, shall be formed after the commencement of the Act for the purpose of carrying on any business which has for its object the acquisition of gain by the company, association, or partnership, or by the individual mem- bers thereof, unless it is registered as a company under the Act, or is formed in pursuance of some other Act of Parliament or of letters patent, or is a company engaged in working mines within and subject to the jurisdiction of the Stannaries. Broadly speaking, the meaning of the Act is that all commercial undertakings, as distinguished from literary or charitable associations, shall be registered. "Business" has a more extensive signification than "trade." Having thus cleared the ground the Act goes on to provide in what manner a company may be formed under the Act. The machinery is simple, and is described as follows : —

" Any seven or more persons associated for any lawful purpose may, by subscribing their names to a memoran- dum of association and otherwise complying with the requisitions of this Act in respect of registration, form an incorporated company with or without limited liability " (§ 6). The fact that six of the subscribers are mere dum- mies, clerks, or nominees of the seventh, will not affect the validity of the company; so the House of Lords decided in Salomon v. Salomon and Co. (1897, A. C. 22). The document to be subscribed— the Memoran- aadumot dum of Association— Corresponds, in the case of Associa- companies formed under the Companies Act, tioo. 1^Q2, to the charter or deed of settlement in

the case of other companies. The form of it is given in the schedule to the Act, and varies slightly according as the company is limited by shares or guarantee, or is un- limited. (See the 2nd schedule to the Act, forms A, B,

C, D.) It is required to state, in the case of a company limited by shares,- the five following matters :—

1. The name of the proposed company, with the addition of the word " limited " as the last word in such

name. „;„ n

2. The part of the United Kingdom, whether England,

Scotland, or Ireland, in which the registered ofBce of the company is proposed to be situate.

3. The objects for which the proposed company is to be established.

4. A declaration that the liability of the members is limited.

5. The amount of capital with which the company pro- poses to be registered, divided into shares of a certain fixed amount.

No subscriber of the memorandum is to take less than one share, and each subscriber is to write opposite his name the number of shares he takes.

These five matters the Legislature has deemed of such intrinsic importance that it has required them to be set out in the company's Memorandum of Association. They are the essential conditions of incorporation, and as such they must not only be stated, but the policy of the Legislature has made them unalterable, with certain exceptions.

The most important of these five conditions is the third, and its importance consists in this, that the objects defined in the memorandum circumscribe the sphere of the com- pany's activities. This principle, which is one of public policy and convenience, and is known as the " ultra vires doctrine," carries with it important consequences, because every act done or contract made by a,^ company ultra vires, i.e., in excess of its powers, is absolutely null and void. The policy, too, is a sound one. Shareholders contribute their money on the faith that it is to be employed

in prosecuting certain objects, and it would be a violation of good faith if the company, i.e., the majority of share- holders, were to be allowed to divert it to something quite different. So strict is the rule that not even the consent of every individual shareholder can give validity to an ultra vires act. -The consent of all the shareholders was, till quite recently, equally incompetent to alter the objects defined in the memorandum, as being part of the so-called charter. The inconveniences attending this unalterability of the objects were, however, so sensibly felt that in 1890 the Companies (Memorandum of Association) Alteration Act was passed, qualifying the prohibition against altera- tion, but only to a limited extent. This Act enables a company to obtain the sanction of the Court to an alter- ation of the objects in its memorandum when it appears that the alteration is required for certain specified purposes, such as the carrying on of the company's business more economically or more ef&ciently.

A company's Memorandum of Association was described by Lord Cairns as its charter. The Articles of Association are the regulations for its internal management — the terms of the partnership agreed upon by Articles the shareholders among themselves. Theyregu- ation.° late such matters as the transfer and forfeiture of shares, calls upon shares, the appointment and qualifi- cation of directors, their powers and proceedings, general meetings of the shareholders, votes, dividends, the keeping and audit of accounts, and other such matters. In regard to these internal regulations the Legislature has left the company free to adopt whatever terms of association it chooses. It has furnished in the schedule to the Com- panies Act, 1862 (Table A), a model or specimen set of regulations, but their adoption, wholly or in part, is op- tional ; only if a company does not register articles of its own these statutory regulations are to apply. When, as is commonly the case, a company decides to have articles of its own framing, such articles must be expressed in separate paragraphs, numbered arithmetically, and signed by the subscribers of the memorandum. They must also be printed, stamped like a deed, and attested. When so perfected, they are to be delivered, with the Memoran- dum of Association, to the Registrar of Joint Stock Com-

COMPANY

panies, who is to retain and register them. The stamp duty charged on the company's capital must at the same time be paid. The Memorandum and Articles of Association thereupon become public documents, and any person may inspect them on payment of a fee of one shilling. This ias important consequences, because every person dealing Trith the company is presumed to be acquainted with its constitution, and to have read its memorandum and articles. The articles also, upon registration, bind the company and its members to the same extent as if each member had subscribed his name and affixed his seal to them.

The capital which is required to be stated in the Memorandum of Association is what is known as the _ . . nominal capital. This nominal capital must be distinguished from the subscribed capital, which is the aggregate amount agreed to be paid by those who have taken shares in the company. Under the Companies Act, 1900, a "minimum subscrip- tion " may be fixed by the articles, and if it is, the directors cannot go to allotment on less: if it is not, then the whole of the capital ofEered for subscrip- tion must be subscribed. A company may increase its capital, consolidate it, subdivide it into shares of smaller amount, or convert paid-up shares into stock, and for this purpose modify its Memorandum of Association ; but a hmited company cannot reduce its capital either by direct or indirect means without the sanction of the Court. The inviolability of the capital is a condition of incorporation — ^the price of the privilege of trading with limited liability, and by no subterfuge will a company be allowed to evade this cardinal rule of policy, either by paying dividends out of capital, or buying its own shares, or returning money to shareholders. But the prohibition against reduction means that the capital must not be reduced by the voluntary act of the company, not that a company's capital must be kept intact. It is embarked in the company's business, and it must run the risks of such business. If part of it is lost there is no obligation on the company to replace it and to cease paying dividends until such lost capital is repaid. The company may in such a case — and no course can be more beneficial to it — ^write off the lost capital and go on trading with the reduced amount. But for this purpose the sanction of the Court must be obtained by petition.

A company being a legal abstraction, invisible and intangible, can do nothing in its own person. It must Directo ^ through agents. These agents are com- monly called directors, though they are occa- sionally described by other names, such as committee men, council, or managers. The first directors of a com- pany are generally appointed by the Articles of Association. Their consent to act must now, under the Companies Act, 1900, be filed with the Eegistrar of Joint Stock Companies. Directors other than the first are elected at the annual general meeting, a certain proportion of the acting directors — usually one-third — retiring under the articles by rotation each year, and their places being filled up by election. A share qualification is often required, on the well-recognized principle that a substantial stake in the undertaking is the best guarantee of fidelity to the company's interests. A director once appointed cannot be removed during his term of office by the shareholders, unless there is a special provision for that purpose in the Articles of Association; but a company may dismiss a director if the articles — as is usually the case — authorize dismissal. The authority and powers of directors are primd facie those necessary for carrying on the ordinary business of the company, but as a rule they are more particularly defined by the Articles of Association. For*

instance, it is commonly prescribed how and when the directors may make calls, to what amount they may borrow, in what circumstances they may forfeit shares, or veto transfers, or invest funds, and what shall con- stitute a quorum of the board. Whenever, indeed, specific directions are desirable they may properly be given by the articles. But superadded to and supplementing these specific powers there is usually inserted in the articles a general power of management in terms similar to those of Clause 68 of the statutory regulations known as Table A. The powers, whether general or specific, thus confided to directors are in the nature of a trust, and the directors must exercise them with a single eye to the benefit of the company. It would, however, give a very erroneous idea of their positions and functions to speak of them as trustees. They have to carry on the company's business, to extend and consolidate it, and to do this they must have a free hand and a large discretion to deal with the

exigencies of the commercial situation. This large discre- tion the faw allows them, so long as they keep within the limits set by the company's Memorandum and Articles. They are not to be held liable for mere errors of judgment, stUl less for being defrauded. That woidd make their position intolerable. All that the law requires of them is that they should be faithful to their duties as agents — "honest and diligent." They must not, for instance, delegate their duties, or accept a bribe, or make a secret profit, or pay dividends out of capital, or misapply the company's funds.

Where in these or in any other ways directors are guilty of misfeasance or breach of trust in regard to the company or its property, the remedy of the company, if it is a going concern, is by action against the delinquent; but where a company is being wound up, the Legislature has pro- vided a summary mode of proceeding under the Winding- up Act, 1890, by which the official receiver or liquidator, or any creditor or contributory of the company may take out what is known as a misfeasance summons, to compel the delinquent director or officer to repay the misapplied moneys or make compensation. Directors who circulate a prospecjtus containing statements which they know to be .false, with intent to induce any person to become a shareholder, may be prosecuted under §84 of the Larceny Act, 1861. They, are also liable criminally for falsification of the company's books, and for this or any other criminal offence the Court in winding-up may, on the application of the liquidator, direct a prosecution.

A share is an aliquot part of a company's nominal capital. The amount may be anything from Is. to £1000. The tendency of late years has been to keep the „, denomination low, and so to appeal to a wider public. Shares of £100, or even £10, are now the ex- ception. The most common amount is either £1 or £5. Shares are of various kinds, — ordinary, preference, de- ferred, founders', and management. Into what classes of shares the original capital of the company shall be divided, what shall be the amount of each class, and their respective rights, privileges, and priorities, are matters for the consideration of the promoters of the company, and must depend on its special circumstances and requirements.

A company may issue preference shares even if there is no mention of them in the Memorandum of Association, but it is, as a rule, desirable

that the Memorandum define the rights of preference shareholders, as their rights cannot then be altered or infringed. The preference given may be as to dividends only, or as to dividends and capital. The dividend, again, may be payable out of the year's profits only, or cumulative. The question for the company is, what must be offered to attract investors. Founders'

shares — -which originated with private companies — are shares which usually take the whole or half the profits after payment of a dividend of 7 or 10 per cent, to the ordinary shareholders. They are much less in favour than they used to be.

An agreement to take shares is like any other agree- ment. It is constituted by offer, acceptance, and com- munication of the acceptance to the offerer. The offer in the case of shares is usually in the form of an application in writing to the company, made in response to a pro- spectus, requesting the company to allot the applicant a certain number of shares in the undertaking on the terms of the prospectus, and agreeing to accept the shares, or any smaller number, which may be allotted to the appli- cant. Under the Companies Act, 1900, an allottee is entitled to rescind his contract unless the minimum sub- scription has been obtained. When an application is accepted the shares are allotted, and a letter of allotment is posted to the applicant. Allotment is the usual, but not the only, evidence of acceptance. As soon as the letter of allotment is posted the contract is complete, even though the letter never reaches the applicant. An application for shares can be withdrawn at any time before accept- ance. As soon as the contract is complete, it is the duty of the company to enter the shareholder's name in the register of members, and to issue to him a certificate under the seal of the company, evidencing his title to the shares.

The register of members plays an important part in the scheme of the company system, under the Companies Act,

1862. The principle of limited liability having Register of ^ggjj once adopted by the Legislature, justice

required not only that such limitation of liability should be brought home by every possible means to persons dealing with the company, but also that such persons should know as far as possible what was the limited capital — the sole fund available to satisfy their claims, what amount had been called up, what remained uncalled, who were the persons to pay, and in what amounts. These data might materially assist a person dealing with the company in determining whether he would give it credit or not ; in any case they are matters which the public had a right to know. The Legislature, recognizing this, has exacted as a condition of the privilege of trading with limited liability that the com- pany shall keep a register with those particulars in it, which shall be accessible to the public at all reasonable times. In order that this register may be accurate, and correspond with the true liability of membership for the time being, the Court is empowered under the Companies Act, 1862, to rectify it in a summary way, on application by motion, by ordering the name of a person to be entered or removed. This power can be exercised by the Court, whether the dispute as to membership is one between the company and an alleged member, or between one alleged member and another, but the machinery of the section is not meant to be used to try claims to rescind agreements to take shares. The proper proceeding in such cases is by action.

The same policy of guarding against an abuse of limited liability is evinced in the provision of the Act

that shares in the case of a limited company ^”’^ttt gjjg^ji be paid for in full. The Legislature has for Shares, y^^^^ g^^j^ companies to trade with limited liability, but the price of the privilege is that the limited capital to which alone the creditors can look shall at least be a reality. It is therefore ultra vires for a limited company to issue its shares at a discount ; but there was nothing in the Companies Act, 1862, which required that the shares of a limited company, though they must be paid up in full, must be paid up in cash. They might be paid “in meal or in malt,” and it accordingly became

common for shares to be allotted in payment for furni- ture, plate, advertisements, or services. The result was that the consideration was often illusory, shares being issued to be paid for in some coinmodity which had no certain criterion of value. To remedy this evil the Legislature enacted in the Companies Act, 1867 (§ 25), that every share in any company should be held subject to the payment of the whole amount thereof in cash, unless otherwise determined by a contract in writing filed with the Eegistrar of Joint Stock Companies at or before the issue of the shares. This section not infre- quently caused hardship where shares had been honestly paid for in the equivalent of cash, but owing to inadvert- ence no contract had been filed; and it has now been repealed by the Companies Act, 1900, and the old law restored. In reverting to the earlier law, and allowing shares to be paid for in any adequate consideration, the Legislature has, however, exacted a safeguard. It has required the company to file with the Eegistrar of Joint Stock Companies a return stating, in the case of shares allotted in whole or in part for a consideration other than cash, the number of the shares so allotted, and the nature of the consideration — ^property, services, &c. — for which they have been allotted.

Though every share carries with it the liability to pay up the full amount in cash, the liability is only to pay when and if the directors call for it to be paid up. A call must fix the time and place for payment, otherwise it is bad.

When a person takes shares from a company on the faith of a prospectus containing any false or fraudulent representations of fact material to the contract, he is entitled to rescind the contract. The com- "^'f pany cannot keep a contract obtained by the meat misrepresentation or fraud of its agents. This is an elementary principle of law. The misrepresenta- tion, for purposes of rescission, need not be fraudulent ; it is suf&cient that it is false in fact : fraud or reck- lessness of assertion will give the shareholder a fur- ther remedy by action of deceit, or under the Directors' Liability Act, 1890 ; but, to entitle him to rescind, the shareholder must show that he took the shares on the faith or partly on the faith of the false representation : if not, it was innocuouSi A shareholder claiming to

rescind must do so promptly. It is too late to commence proceed- ings after a winding-up has begun.

The shares or other interest of any member in a company are personal estate and may be transferred in the manner provided by the regulations of the company. As Lord Blackburn said, it J^^s, was one of the chief objects with which joint stock companies were established, that the shares should be capable of being easily transferred; but though every shareholder has a primd facie right to transfer his shares, this right is subject to the regulations of the company, and the company may and often does by its regulations require that a trans- fer shall receive the approval of the board of direc- tors before being registered, — the object being to secure the company against having an insolvent or undesirable shareholder (the nominee perhaps of a rival company) substituted for a solvent and acceptable one. This power of the directors to refuse a transfer must not be exercised arbitrarily or capriciously. If it were, it would amount to a confiscation of the shares. Directors, for instance, cannot veto a transfer because they dis- approve of the purpose for which it is being made {e.g., to multiply votes), if there is no objection to the transferee.

A company can only pay dividends out of profits — defined as the "earnings of a concern after deducting

the expenses of earning them." To pay dividends out of capital is not only ult7-a vires but illegal, as constituting a Dividends ^^^^^^ °^ Capital to shareholders. Before pay- ing dividends, directors must take reasonable care to secure the preparation of proper balance-sheets and estimates, and must exercise their judgment as business men on the balance-sheets and estimates submitted to them. If they fail to do this, and pay dividends out of capital, they wUl not be held excused. The onus is on them to show that the dividends have been paid out of profits. The Court as a rule does not uiterfere with the discretion of directors in the matter of paying dividends, unless they are doing something ultra vires.

The Companies Acts, and the regulations under them, regard the directors of a company as the persons in ■whom

the management of the company's affairs is ngs. ^gg^g^_ g^^ they also contemplate the tdti- mate controlling power as residing in the shareholders. A controlling power of this kind can only assert itself through general meetings ; and that it may have proper opportunities of doing so, every company is required to hold a general meeting, commonly called the statu- tory meeting, within — as now fixed by the Companies Act, 1900 — three months from the date at which it is entitled to commence business, and thenceforward one general meeting at least every year. This annual general meeting is usually called the ordinary general meeting. Other meetings are extraordinary general meetings. Notices convening a general meeting must inform the shareholders of the particular business to be transacted ; otherwise any resolutions passed at the meeting will be invalidated. Voting is generally regu- lated by the articles. Sometimes a vote is given to a shareholder for every share held by him, but more often a scale is adopted; for instance, one vote is given for every share up to ten, with an additional vote for every five shares beyond the first ten shares up to one hun- dred, and an additional vote for every ten shares beyond the first hundred. In default of any regulations, every member has one vote only. Sometimes preference share- holders are given no vote at all.

The machinery of company formation is generally set in motion by a person known as a promoter. This is a

term of business, not law. It means, to use romo er. Q}^^gf.J^g^j(,g Cockburn's words, a person " who undertakes to form a company with reference to a given project and to set it going, and who takes the necessary steps to accomplish that purpose." Whether what a person has done towards this end constitutes him a promoter or not, is a question of fact ; but once an afBxmative conclusion is reached, equity clothes such promoter with a fiduciary relation towards the company which he has been instrumental in creating. This doctrine is now well established, and its good sense is apparent when once the position of the promoter towards the company is understood. Promoters — ^to use Lord Cairns's language

in Erlanger v. New Sombrero PhosphcUe Co. (3 App. Cas. 1236) — " have in their hands the creation and moulding of the company. They have the power of defining how and when and in what shape and under what supervision it shall start into existence and begin to act as a trading corporation." Such a control over the destinies of the company in- volves correlative obligations towards it, and one of these obligations is that the promoter must not take advantage of the company's helplessness. A promoter may sell his property to the company, but he must make full and fair disclosure of his interest in order that the company may determine whether it will or will not authorize its trustee or agent to make a profit out of the sale. It is not a sufficient disclosure in such a case

for the promoter merely to refer in the prospectus to a contract which, if read by the shareholders, would inform them of his interest. They are under no obligation to inquire. It is for the promoter to bring home notice, not constructive but actual, to the shareholders. When a company is promoted for acquiring property- — to work a mine, for instance, or carry on a going business — the usual course is for the promoter to frame a draft agree- ment for the sale of the property to the company or to a trustee on its behalf. The memorandum and articles of the intended company are then prepared, and an article is included authorizing or requiring the directors to adopt the draft agreement for sale. In pursuance of this authority the directors at the first meeting after incor- poration take the draft agreement into consideration ; and if they approve, adopt it — provisionally, that is — for under the Companies Act, 1900, no contract is to bind a company unless it has obtained a certificate from the Registrar of Joint Stock Companies that it has complied with certain formalities entitling it to commence business. Where they do so in the exercise of an honest and independent judgment, no exception can be taken to the transaction ; but where the directors happen to be nomi- nees of the promoter, perhaps qualified by him and acting in his interest, the plan is obviously open to grave abuse.

When a company intends to appeal to the public to sub- scribe its capital, the usual way of doing so is by issuing a prospectus. A prospectus is an invitation to the public to take shares on the faith of the ™"* *' statements therein contained, and is thus the basis of the agreement to*

take the shares ; there therefore rests on those who are responsible for its issue an obligation to act with the most perfect good faith — uberrima fides — and this obligation has been repeatedly emphasized by judges of the highest eminence. (See the observations of Lord Herschell in Derry v. Peek, 14 App. Cas. 376.) Directors must be perfectly candid with the public ; they must not only state what they do state with strict and scrupulous accuracy, but they must not omit any fact which, if disclosed, would falsify the statements made. This is the general obligation of directors when issuing a prospectus ; but on this general obligation the Legislature has engrafted special requirements. By the Companies Act, 1867, it required the dates and names of the parties to any contract entered into by the company or its pro- moters or directors before the issue of the prospectus, to be disclosed in the prospectus ; otherwise the prospectus was to be deemed fraudulent. This enactment has now been repealed by the Companies Act, 1900, but only in favour of more stringent provisions. Under the new' Act not only is every prospectus to be signed and filed with the Eegistrar of Joint Stock Companies before it can be issued, but the prospectus must set forth a series of specified particulars about the company — the contents of the Memorandum of Association, with the names of the signatories, the share qualification (if any) of the directors, the minimum subscription on which the directors may proceed to allotment, the shares and debentures issued otherwise than for cash, the names and addresses of the vendors, the amount paid for underwriting the company, the amount of preliminary expenses, of promotion money (if any), and the interest (if any) of every director in the promotion or in property to be acquired by the company. Neglect of this statutory duty of disclosure will expose directors to personal liability. For false or fraudulent statements — as distinguished from non-disclosure — in a prospectus directors are liable in an action of deceit or under the Directors' Liability Act, 1900. This Act was passed to meet the decision of the House of Lords in Peek V. Derry (12 App. Cas. 33), that a director could not

be made liable in an action of deceit for an untrue state- ment in a prospectus, unless the plaintiff could prove that the director had made the untrue statement fraudulently. The Directors' Liability Act enacts in substance that when once a prospectus is proved to contain a material statement or fact which is untrue, the persons responsible for the prospectus are to be liable to pay compensation to any one who has subscribed on the faith of the prospectus, unless they can prove that they had reasonable ground to believe, and did in fact believe, the statement to be true. Actions under this Act have been extremely rare, but it may have had the eifect of making directors more careful in their statements.

It has become very common of late years for a private trader to convert his business into a limited company, with a view not to offering the shares to the mmlLies. Public, but to Securing the advantages incident to incorporation. Companies of this kind form one-third of the whole number of companies registered yearly, and are known as " Private Companies," to dis- tinguish them from companies which appeal to the public to subscribe their capital. The special characteristic of the private company is not, however, the manner in which the capital is raised, but the fact that the shares are held in a few hands.

The so-called " one-man company " is a variety of the private company. The fact that a company is formed by one man, with the aid of six dummy subscribers, is not in itself (as was at one time supposed) a fraud on the policy of the Companies Acts, but it is occasionally used for the the purpose of committing a fraud, as where an insolvent trader turns himself into a limited company in order to evade, bankruptcy ; and it is to an abuse of the Act of this kind that the term "one-man company" owes its oppro- brious signification.

Companies Limited by Chmrantee. — The second class of limited companies are those limited by guarantee, as dis- tinguished from- those limited by shares. In the company limited by guarantee each member agrees, in the event of a winding-up, to contribute a certain amount to the assets. The interests of the members of a guarantee company have no nominal value in money like the shares of other companies, a form of constitution which was designed, as has been stated by Lord Thring, who

drafted the Com- panies Act, 1862, to give a superior elasticity to the com- pany. The property of the company simply belongs to the company in certain fractional amounts. This makes it convenient for clubs, syndicates, and other associations which do not require the interest of members to be expressed in terms of cash.

Companies not for Gain. — Associations formed to pro- mote commerce, art, science, religion, charity, or any other useful object may, with the sanction of the Board of Trade, register under the Companies Act, 1862, with limited liability, but without the addition of the word " Limited," upon proving to the Board that it is the intention of the association to apply the profits or income of the association in promoting its objects, and not in payment of dividends to members (C. A., 1867, § 23). In lieu of the word " Company," the association may adopt as part of its name some such title as chamber, club, college, guild, institute, or society. The power given by this section has proved very useful, and many kinds of associations have availed themselves of it, e.g., medical institutes, law societies, nursing homes, and chambers of commerce. IS'o such association can hold more than two acres of land without the license of the Board of Trade.

Cost-Book Mining Companies. — These are in substance mining partnerships. They derive their name from the partnership agreement, the expenses and receipts of the

mine, the names of the shareholders, and any transfers of shares being entered in a " cost-book." The affairs of the company are managed by an agent known as a " purser," who from time to time makes calls on the members for the expenses of working. A cost-book company is not bound to register under the Companies Act, 1862, but it may do so.

British Companies Abroad. — The status of British companies trading abroad, so far as Germany, France, Belgium, Greece, Italy, and Spain are concerned, is expressly recognized in a series of conventions en- tered into between those coimtries and Great Britain. Where no such convention exists the status of an im- migrant corporation depends upon international comity, which allows foreign corporations, as it does foreign persons, to sue, to make contracts, and hold real estate, in the same way

as domestic corporations or citizens ; provided the stranger corporation does not offend against the policy of the State in which it seeks to trade.

A company once incorporated under the Companies Act, 1862, cannot be put an end to except through the machinery of a winding-up, though the name of a company which is commercially defunct may ’’‘“e- be struck off the register of Joint Stock Com- panies by the registrar under § 7 of the Companies Act, 1880. Winding-up is of two kinds : (1) voluntary winding- up, either purely voluntary or carried on under the super- vision of the Court ; and (2) winding-up by the Court. Of these by far the more common is a voluntary . winding-up. Ninety per cent, of the companies ” ”” ”” that come to an end are so wound up ; and this is in accordance with the policy of the Legislature, evinced throughout the Companies Acts, that shareholders should manage their own affairs — winding-up being one of such affairs. A voluntary winding-up is carried out by the shareholders passing a special resolution requiring the company to be wound up voluntarily, or an extraordinary resolution to the effect that it has been proved to the shareholders’ satisfaction that the company cannot, by reason of its liabilities, continue its business, and that it is advisable to wind it up (C. A., 1862, § 129). The resolution is generally accompanied by the appointment of a liquidator. In a purely voluntary winding-up there is a power given by § 138 for the company or any contributory to apply to the Court in any matter arising in the winding-up, but seemingly by an oversight of the Legislature the same right was not given to creditors. This has now been rectified by the Companies Act, 1900, § 25. A creditor may also in a proper case obtain an order for continuing the voluntary winding-up under the supervision of the Court. Such an order has also the advantage of operating as a stay of any actions or executions pending against the company. Except in these respects, the winding-up remains a voluntary one. The Court does not actively intervene unless set in motion; but it requires the liquidator to bring his accounts into chambers every quarter, so that it may be informed how the liquidation is proceeding. When the affairs of the company are fully wound up, the liquidator calls a meeting, lays his accounts before the shareholders, and the company is dissolved by operation of law three months after the date of the meeting (C. A., 1862, §§ 142, 143).

Irrespective of voluntary winding-up, the Legislature has defined certain events in which a company formed under the Companies Act, 1862, may be wound up by the Court. These events are: (1) Jj when the company has passed a resolution requiring the company to be wound up by the Court; (2) when the company does not commence its business

within a year or suspends it for a year; (3) when the members are reduced to less than seven ; (4) when the company is unable to pay its debts, and (5) whenever the Court is of opinion that it is just and equitable that the company should be wound up (C. A., 1862, § 79). A petition for the purpose may be presented either by a creditor, a contributory, or the company itself. Where the petition is presented by a creditor who cannot obtain payment of his debt, a winding-up order is ex debito justitice as against the company or shareholders, but not as against the wishes of a majority of creditors.

The procedure on the making of a winding-up order is now governed by §§ 7, 8, 9 of the Winding-up Act, 1890. The official receiver, as liquidator pro tern., requires a statement of the affairs of the company verified by the directors, and on it reports to the Court as to the causes of the company's failure, and whether further inquiry is desirable. If he further reports that in his opinion fraud has been committed in the promotion or formation of the company by a particular person, the Court may order such person to be publicly examined.

A liquidator's duty is to protect, collect, realize, and distribute the company's assets ; and for this purpose he advertises for creditors, makes calls on contributories, sues debtors, takes misfeasance proceedings, if necessary, against directors or promoters, and carries on the com- pany's business, supposing the goodwill to be an asset of value — with a view to selling it as a going concern. He is assisted, like a trustee in bankruptcy, by a committee of inspection, composed of creditors and contributories.

A large number of companies now wind-up only to reconstruct. The reasons for a reconstruction are gener- ally either to raise fresh capital, or to get rid stiv^ioa. °^ onerous preference shares, or to enlarge the scope of the company's objects, which is other- wise impracticable owing to the unalterability of the Memorandum of Association. Reconstructions are car- ried out in one of two ways : (1) by sale and transfer of the company's undertaking and assets to a new company, either under a power to sell contained in the Company's Memorandum of Association or under § 161 of the Com- panies Act, 1862; or (2) by a scheme of arrangement, sanctioned by the Court, under the Joint Stock Companies Arrangements Act, 1870.

Public Companies. — Besides trading companies there is another large class, which for shortness may be called public companies, i.e., companies constituted by special Act of Parliament for the purpose of constructing and carrying on some undertaking of public utility, such as railways, canals, docks, waterworks, gasworks. The rights of members of these companies, the duties and lia- bilities of the undertakers and directors, depend on the conjoint operation of the Companies Special Act and of the Companies Clauses Acts, 1845, 1863, 1869. The spe- cial Act supplies the peculiar powers and provisions which the particular company requires, and the Companies Clauses Acts those general powers and provisions which are necessarily or usually inserted in the constitution of such public company, — regulating the distribution of capital, the transfer of shares, payment of calls, borrow- ing, and general meetings. A distinguishing feature of these companies is that, being sanctioned by the Legisla- ture for undertakings of public utility, the policy of the law will not allow them to be broken up or destroyed by creditors. It gives creditors only a charge on the re- ceipts— " the fruit of the tree."

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Comparetti, Domenico (1835), Italian

scholar, was born at Eome, 27th June 1835. His father, a native of Liguria, who had fought under Napoleon, had destined his son for a military career, but the boy had such a marked distaste for physical exertion that this idea had to be abandoned. Instead, he began to study at the University of Eome, and took his degree in 1865 in natural science and mathematics. Directly afterwards he entered his uncle's pharmacy as assistant. Here he diligently pursued his profession, though he was gradu- ally learning that his real bent was for literature, not science. His scanty leisure was now given to study, and every coin he could spare was spent on books. He learned Greek by himself, and gained facility in the modern lan- guage by conversing with the Greek students at the university. In spite of all disadvantages, he not only mastered the difficulties of the language, but became before long one of the chief classical scholars of Italy. In 1857 he made a translation of some recently discovered fragments of Hyperides, and added to it a dissertation on that orator. This was published in the Bheinisches Museum, and was followed by a notice of the annalist Granius Licinianus, and one on the oration of Hyperides on the Lamian War. He also wrote some articles for the Spettatore Fiorentino and the Archivio Storico Italiano. In 1859 he was appointed professor of Greek at Pisa on the recommendation of the Duke of Sermoneta. A few years later he was called to a similar post at Florence, remaining emeritus professor at Pisa also. At this time he made the acquaintance of a Jewish lady from Odessa, who became his wife. Residing in Rome, and lecturing on Greek antiquities, he has taken an active interest in the Forum excavations. He is a member of the govern- ing bodies of the academies of Milan, Venice, Naples, and Turin. The list of his writings is long and varied. Of his works in classical literature, the best known are an edition of the Euxenippus of Hyperides, and mono- graphs on Pindar and Sappho. In the Kalewala and the Traditional Poetry of the Finns, he discusses the national epic of Finland and its heroic songs, with a view to solving the problem whether an epic could be

composed by the interweaving of such national songs. He comes to a negative conclusion, and applies this reasoning to the Homeric problem. He treats this question again in a treatise on the so-called Peisistratean edition of Homer. His Vergil in the Middle Ages, which has been translated into English, traces the strange vicissitudes by which the great Augustan poet became successively grammatical fetich. Christian prophet, and wizard. Together with Professor Alessandro of Ancona, Comparetti edited a col- lection of Italian national songs and stories, many of which had been collected and written down by himself for the first time.

Compass. — The Mariner's compass is an instrument by means of which the directive force of that great magnet, the Earth, upon a freely-suspended needle, is utilized for a purpose essential to navigation. The needle is so mounted that it only moves freely in the horizontal plane, and there- fore the horizontal component of the earth's force alone directs it. The direction assumed by the needle is not generally towards the geographical north, but diverges towards the east or west of it, making a horizontal angle with the true meridian, called the Magnetic Variation or Declination ; amongst mariners this angle is known as the Variation of the compass. In the usual navigable waters of the world the variation alters from 30° to the east to 45° to the west of the geographical meridian, being

westerly in the Atlantic and Indian oceans, easterly in the Pacific. The vertical plane passing through the longi- tudinal axis of such a needle is known as the Magnetic Meridian. Following the first chart of lines of equal variation compiled by Halley in 1700, charts of similar type have been published from time to time embodying recent observations and corrected for the secular change, thus providing seamen with values of the variation accu- rate to about 30' of arc. Possessing these data it is easy to ascertain by observation the effects of the iron in a ship in disturbing the compass, and it will be found for the most part in every vessel that the needle is deflected from the magnetic meridian by a horizontal angle

called the Deviation of the compass ; in some directions of the ship's head adding to the known variation of the place, in other directions subtracting from it. Local magnetic disturb- ance of the needle due to magnetic rocks is observed on land in all parts of the world, and in certain places extends to the land under the sea, affecting the compasses on board the ships passing over it. The general direc- tion of these disturbances in the northern hemisphere is an attraction of the north-seeking end of the needle ; in the southern hemisphere, its repulsion. The approaches to Cossack, North Australia-; Cape St Francis, Labrador ; the coasts of Madagascar and Iceland, are remarkable for such disturbance of the compass. The compass as we know it is the result of the necessities of navigation, which have increased from century to century. It con- sists of five principal parts — ^the card, the needles, the bowl, a jewelled cap, and the pivot. The card or " fly," formerly made of cardboard, now consists of a disc either of mica covered with paper, or of paper alone, but in all cases the card is divided into points and degrees as shown

Fig. 1. — Compass Card.

in Fig. 1. The outer margin is divided into degrees with 0° at north and south, and 90° at east and west ; the 32 points with half and quarter points are seen immedi- ately within the degrees. The north point is marked with a. fleur-de-lis, and the principal points, N.E., E., S.E., &c., with their respective names, whilst the intermediate points in the figure have also their names engraved for present information. Thfe arc coiJtained between any two points is 11° 15'. The mica card is generally mounted on a brass framework, F F, with a brass cap, C, fitted with a sapphire centre and carrying four magnetized needles, N N N, N, as in Fig. 2. The more modern form of card consists' of a broad ring of paper marked with degrees

and points, as in Fig. 1, attached to, a frame like that in Fig. 3, where an outer aluminium ring, A A, is connected

Fio. 2. — ^Admiralty GompasB (Frame and Needles).

Fig. 8. — Thomson's (Lord Kelvin's) Compass (Frame and Needles).

by 32 radial silk threads to a central disc of aluminium, in the centre of which is a round hole designed to receive an aluminium cap with a highly-polished sapphire centre worked to the form of an open cone. To directthe card eight short light needles, N N, are suspended by silk threads from the outer ring. The magnetic axis of any system of needles must exactly coincide with the axis passing through the north and south points of the card. Single needles are'never used, two being the least number, and these so arranged that the moment of inertia about every diameter of the card shall be the same. The combination of card, needles, and cap is generally termed "the card" ; on the continent of Europe it is called the " rose." The section of a compass bowl in Fig. 4 shows the mounting of a Thomson card on its pivot, which in common with the pivots of most other compasses is made of brass, tipped with osmium-iridium, which although very hard

Fig. 4. — Section of Thomson's Compass Bowl. C, aluminium cap with sapphire centre ; N, N', needles ; P, pivot stem with pivot.

can be sharply pointed and does not corrode. Fig. 4 shows the general arrangement of mounting all compass cards in the bowl. In Fig. 5 another form of compass called a liquid or spirit compass is shown partly in sec- tion. The card nearly floats in a bowl filled with dis- tilled water, to which 35 per cent, of alcohol is added to prevent freezing; the bowl is hermetically sealed with pure india-rubber, and a corrugated expansion chamber i,s attached to the bottom to allow for the expansion and contraction of the liquid. The card is a mica disc, either painted as in Fig. 1, or covered with linen upon which the degrees and points are printed, the needles being enclosed in brass.

Great steadiness of card under severe shocks and vibra- tions, combined with a minimujn of friction in the cap and pivot, is obtained with this compass. All compasses are fitted with a gimbal ring to keep the bowl and card level under every circumstance of a ship's motion in a seaway, the ring being connected with the binnacle or pedestal by means of journals or knife edges. On the inside of every

compass bowl a vertical black line is drawn, called the "lubber's point," and it is imperative that when the compass is placed in the binnacle the line joining the

Fio. 6.— Liquid Compass. A, bowl, partly in section ; B, expansion chamber ; D, the glass ; Q, gimbal ring ; L, nut to expand chamber when HUlng bowl ; M, screw connector ; N, liole for filling, with screw plug ; 0, O, magnetic needles ; P, buoyant chamber ; Q, iridium pivot ; B, sapphire cap ; S, mica card.

pivot and the lubber's point be parallel to the keel of the vessel. Thus, when a degree on the card is observed op- posite the lubber's point, the angle between the direction in which the ship is steering and the north point of the compass or course is at once seen ; and if the magnetic variation and the disturbing effects of the ship's iron are known, the desired angle between the ship's course and the geographical meridian can be computed. In every ship a position is selected for the navigating or standard compass as free from neighbouring iron as possible, and by this compass all courses are shaped and bearings taken. It is also provided with an azimuth circle or mirror and a shadow pin or style placed in the centre of the glass cover, by either of which the variable angle between the compass north and true north, called the "total error," or variation and deviation combined, can be observed. The binnacles or pedestals for compasses are generally constructed of wood about 45 inches high, and fitted to receive and alter at pleasure the several magnet and soft iron correctors. They are also fitted with different forms of suspension in which the compass is mounted to obviate the mechanical disturbance of the card caused by the vibration of the hull in ships driven by powerful engines.

The effects of the iron and steel used in the construction of ships upon the compass have occupied the attention of the ablest physicists of the 19th century, with results which enable navigators to conduct their ships with per- fect safety. The hull of an iron or steel ship is a magnet, and the distribution of its magnetism depends upon the direction of the ship's head when building, this result being produced by induction from the

earth's magnetism, developed and impressed by the hammering of the plates and frames during the process of building. The disturb- ance of the compass by the magnetism of the hull is generally modified, sometimes favourably, more often unfavourably, by the magnetized fittings of the ship, such as masts, conning towers, deck houses, engines, and boil- ers. Thus in every ship the compass needle is more or less subject to deviation differing in amount and direction for every azimuth of the ship's head. This was first demonstrated by Commander Matthew Minders by ex- periments made in H.M.S. Investigator in 1800-3, and in 1810 led that ofB.cer to introduce the practice of placing the ship's head on each point of the compass, and noting the amount of deviation whether to the east or west of the magnetic north, a process which is in full exercise at the present day, and is called " swinging ship." When speaking of the magnetic properties of iron it is usual to adopt the terms " soft " and " hard." Soft iron is iron

which becomes instantly magnetized by induction when exposed to any magnetic force, but has no power of re- taining its magnetism. Hard iron is less susceptible of being magnetized, but when once magnetized it retains its magnetism permanently. The term "iron" used in these pages includes the " steel " now commonly employed in shipbuilding. If an iron ship be swung when upright for deviation, and the mean horizontal and vertical mag- netic forces at the compass positions be also observed in different parts 'of the world, mathematical analysis shows that the deviations are caused partly by the permanent magnetism of hard iron, partly by the transient-induced magnetism of soft iron both horizontal and vertical, and in a lesser degree by iron which is neither magnetically hard nor soft, but which becomes magnetized in the same manner as hard iron, though it gradually loses its mag- netism on change of conditions, as, for example, in the case of a ship, repaired and hammered in dock, steaming in an opposite direction at sea. This latter cause of deviation is called sub-permanent magnetism. The hori- zontal directive force on the needle on board is nearly always less than on land, sometimes much less, whilst in armour-plated ships it ranges from -8 to -2 when the directive force on land =1-0. If the ship be inclined to starboard or to port additional deviation will be observed, reaching a maximum on north and south points, decreas- ing to zero on the east and west points. Each ship

has its own magnetic character, but there are certain con- ditions which are common to vessels of the same type.

Instead of observing the deviation solely for the purposes of correcting the indications of the compass when disturbed by the iron of the ship, the practice is to subject all deviations to mathematical analysis with a view to their mechanical correction. The whole of the deviations when the ship is upright may be expressed nearly by five coefficients, A, B, C, D, E. Of these A is a deviation constant in amount for every direction of the ship's head. B has reference to horizontal forces acting in a longi- tudinal direction in the ship, and caused partly by the permanent magnetism of hard iron, partly by vertical induction in vertical soft iron either before or abaft the compass. C has reference to forces acting in a transverse direction, and caused by hard iron. D is due to transient induction in horizontal soft iron, the direction of which passes contimiously under or over the compass. E is due to transient induction in horizontal soft iron unsymmetri- cally placed with regard to the compass. When data of this character have been obtained the compass deviations may be mechanically corrected to within 1° — always adher- ing to the principle that " like cures like." Thus the part of B caused by the permanent magnetism of hard iron must be corrected by permanent magnets horizontally placed in a fore and aft direction; the other part caused by vertical soft iron by means of bars of vertical soft iron, called Flinders bars, before or abaft the compass. C is compensated by permanent magnets athwartships and horizontal ; D by masses of soft iron on both sides of the compass, and generally in the form of cast-iron spheres, with their centres in the same horizontal plane as the needles ; E is usually too small to require correction ; A is f qrtunately rarely of any value, as it cannot be corrected. The deviation observed when the ship inclines to either

side is due — (1) to hard iron acting vertically upwards or

" ; (2) ■ ■ ; " ■

the compass ; (3) to vertical induction in horizontal soft

downwards ; (2) to vertical soft iron immediately below

iron when inclined. To compensate (1) vertical magnets are used ; (3) is partly corrected by the soft iron correctors of D ; (2) and the remaining part of (3) cannot be con- veniently corrected for more than one geographical posi- tion at a time. Although a compass may thus be made practically correct for a given time and place, the

magnetism of the ship is liable to changes on changing her geographical position, and especially so when steaming at right angles or nearly so to the magnetic meridian, for then sub-permanent magnetism is developed in the hull. Some vessels are more liable to become sub-permanently magnetised than others, and as no corrector has been found for this source of deviation the navigator must determine its amount by observation. Hence, however carefully a compass may be placed and subsequently com- pensated, the mariner has no safety without constantly observing the bearings of the sun, stars, or distant terres- trial objects, to ascertain its deviation. The results of these observations are entered in a compass journal for future reference when fog or darkness prevails.

Every compass and corrector supplied to the ships of the Eoyal Navy is previously examined in detail at the Compass Observatory established by the Admiralty at Deptford. A trained observer acting under the super- intendent of compasses is charged with this important work. The superintendent, who is a naval officer, is also charged with the investigation of the magnetic character of all H.M. ships, to point out the most suitable positions for the compasses when a ship is designed, and subse- quently to keep himself informed of their behaviour from the time of the ship's first trial. A museum containing compasses of various types invented during the 19th century is attached to the Compass Observatory at Deptford. i

The mariner's compass during the early part of the 19th century was still a very imperfect instrument, although numerous inven- tors had tried to improve it. In 1837 the Admiralty Compass Committee was appointed to make a scientific investigation of the subject, and propose a form of

compass suitable alike for azimuth and steering purposes. The committee reported in July 1840, and after minor improvements by the makers the Admiralty compass, the card of which is shown in Figs. 1 and 2, was adopted by the Government. Until 1876, When Sir William Thomson introduced his patent compass, this compass was not only the regulation com- pass of the Eoyal Navy, but was largely used in foreign countries in the same or a modified form. The introduction of powerful engines causing serious vibration to compass cards of the Admiralty type, coupled with the prevailing desire for larger cards, the deviation of which could also be more conveniently compensated, led to the gradual introduction of the Thomson compass. Several important points were gained in the latter : the quadrantal devia- tion could be finally corrected for all latitudes ; f rictional error at the cap and pivot was reduced to a minimum, the average weight of the card being 200 grains ; the long free vibrational period of the card was found to be favourable to its steadiness when the vessel was rolling. The first liquid compass used in England was invented by Francis Crow, of Faversham, in 1813. It is said that the idea of a liquid compass was suggested to Crow by the experi- ence of the captain of a coasting vessel whose compass card was oscillating wildly until a sea broke on board filling the compass bowl, when the card became steady. Subsequent improvements were made by Dent, and especially by Ritchie, of Boston, U.S.A. In 1888 the form of liquid compass (Fig. 5) now solely used in torpedo boats and torpedo boat destroyers was introduced. It has also proved to be the most trustworthy compass under the shock of heavy gun fire at present available. The deflector is an instru- ment designed to enable an observer to reduce the deviations of the compass to an amount not exceeding 2° during fogs, or at any time when bearings of distant objects are not available. It is certain that if the directive forces on the north, east, south, and west points of a compass are equal, there can be no deviatipn. With the deflector any inequality in the directive force can be detected, and hence the power of equalizing the forces by the usual soft iron and magnet correctors. Several kinds of deflector have been invented, that of Lord Kelvin (Sir William Thomson) being the simplest, but Dr Waghorn's is also very effective. The use of the deflector is generally confined to experts.

The Magnetism of Ships.— In 1814 Flinders first showed (see Flinders's Voyage, vol. ii. appx. ii.) that the abnormal values of the variation observed in the wood-built ships of his day was due to deviation of the compass caused by the iron in the ship ; that the deviation was zero when the ship's head was near the north and south points ; that it attained its maximum on the east and west points, and varied as the sine of the azimuth of the ship's head reckoned from the zero points. He also described a method of correcting deviation by means of a bar of vertical iron so placed

as to correct the deviation nearly in all latitudes. This bar, now known as a "Flinders bar," is still in general use. In 1820 Dr Young (see Brande's Quarterly Journal, 1820) investigated mathe- matically the magnetism of ships. In 1824 Professor Barlow introduced his correcting plate of soft iron. Trials in certain ships showed that their magnetism consisted partly of hard iron, and the use of the plate was abandoned. In 1835 Captain Johnson, R.N., showed from experiments in the iron steamship Garry Owen that the'vessel acted on an external compass as a magnet. In 1838 Airy (Astronomer-Koyal) magnetically examined the iron steamship Rainbow at Deptford, and from his mathematical investigations (see Phil. Trans. B. S., 1839) deduced his method of correcting the compass by permanent magnets and soft iron, giving practical rules for the same in 1840. Airy's and Flinders's correctors form the basis of all compass correctors to this day. In 1838 Poisson published his Memoir on the Deviation of the Compass caused by the Iron in a Vessel. In this he gave equations resulting from the hypothesis that the magnetism of a ship is partly due to the permanent magnetism of hard iron and partly to the transients induced magnetism of soft iron ; that the latter is proportional to the intensity of the inducing force, and that the length of the needle is infinitesimally small compared to the distance of the surrounding iron. From Poisson's equations Archibald Smith deduced the formulae given in the Admiralty Manual for Deviations of the Compass (1st ed., 1862), a work which has formed the basis of numerous other manuals since published in Great Britain and other countries. In view of the serious diflBculties connected with the inclining of every ship. Smith's formulae for ascertaining and providing for the correction of the heeling error with the ship upright continue to be of great value to safe navigation. In 1855

the Liver- pool Compass Committee commenced its work of investigating the magnetism of ships of the mercantile marine, resulting in three reports to the Board of Trade, all of great value, the last being presented in 1861.

See articles on Magnetism of Ships and Deviations of the Com- pass, Phil. Trans. 1839-83, Journal United Service Inst. 1859- 1889, Trans. Nav. Archit. 1860-61-62, Beport of Brit. Assoc. 1862, London Quarterly Bev. 1865 ; also Admiralty Manual, edit. 1862- 63-69-93-1900 ; and Towson" s Practical Information on Deviations of the Compass, 1886. (e. w. 0.)

Compensation. — The term "compensation" is app] ied in English law to a number of different forms of legal reparation, e.g., to persons injured by felony, or — under the Eiot (Damages) Act, 1886 — to persons whose property has been stolen, destroyed, or injured by rioters. It is due, under the Agricultural Holdings Act, 1883, for agri- cultural improvements ; and, under the Workmen's Com- pensation Act, 1897, to workmen, in respect of accidents in certain forms of employment. The word is, however, in its strict and most familiar sense, a nomen juris for the reparation or satisfaction made to the owners of property which is taken by the executive government or by local bodies or corporations, under statutory authority, for public purposes. There are two main legal theories on which such appropriation of private property is justi- fied. The American may be taken as a representative illustration of the one, and the English of the other. Though not included in the definition of "eminent domain," the necessity for compensation is recognized as incidental to that power. The normal procedure is admir- ably described in Bouvier's Law Diet., ed. Eawle, 1897, s.v. "Eminent Domain." According to the law of tLe United States, there resides in every sovereign State, either as a residuum of the proprietary rights which it creates or protects, or (which is the better opinion) as an incident of its sovereignty, power to take, without reference to the question of compensation, the property of its subjects for purposes of a public character. This power is called "Eminent Domain." In English law the only exact analogue to this doctrine is to be found in the prerogative right (which now exists chiefly in ^^"f"' theory) of the Clrown to expropriate the lands of subjects for the purposes of the

defence of the realm (see Attorney-General v. Tomline, 1879, 12 Ch. D. 214). With that exception, the rule of English constitutional law is that the property of the citizen cannot be seized for purposes which are really " public " without a fair pecuniary

equivalent being given to him ; and, as the money for such compensation must come from Parliament, the prac- tical result is that the seizure can only be effected under legislative authority. An action for illegal interference with the property of the subject is not maintainable against officials of the Crown or Government sued in their ofiBcial capacity or as an official body. But Crown or Government ofiicials may be sued in their individual capacity for such interference, even if they acted with the authority of the Government (cp. Raleigh v. Goschen, 1898, 1 Ch. 73 ; 67 L. J. Ch. 59).

Lands Clauses Acts. — Down to 1845 every Act author- izing the purchase of lands had, in addition to a number of common form clauses, a variety of special clauses framed with a view to meeting the particular circum- stances with which it dealt. In 1845, however, a statute based on the recommendations of a select committee, appointed in the preceding year, was passed ; the object being to diminish the bulk of the special Acts, and to introduce uniformity into Private Bill legislation by classifying the common form clauses, embodying them in general statutes, and enabling them to be incorporated into the special statutes by reference. The statute by which this change was initiated was the Lands Clauses Consolidation Act, 1845 ; and the policy has been con- tinued by -a series of later statutes which, together with the Act of 1846, are now grouped under the generic title of " The Lands Clauses Acts."

The public purposes for which lands are taken are threefold. Certain public departments, such as the War Office and the Admiralty, may acquire lands for national purposes. Local authorities are enabled to exercise sim- ilar powers for an enormous variety of municipal purposes, e.g., the housing of the working classes, the improvement of towns,

elementary and technical education. Lastly, the promoters of public undertakings of a commercial character, such as railways and harbours, carry on their operations under statutes in which the provisions of the Lands Clauses Acts are incorporated.

Lands may be taken under the L>nds Clauses Acts either by agreement or compulsorily. The first step in the proceedings is a "notice to treat," or intimation by the promoters of their readiness to purchase the land, coupled with a demand for particulars as to the estate and the interests in it. The landowner on whom the notice is served may meet it by agreeing to sell, and the terms may then be settled by consent of the parties themselves, or by arbitration, if they decide to have recourse to that mode of adjusting the difficulty. IE the property claimed is a house, or other building or manu- factory, the owner has a statutory right to require the promoters by a counter-notice to take the whole, even although a part would serve their purpose. This rule, however, is, in modern Acts, often modified by special clauses. On receipt of the counter-notice the promoters must either assent to the requirement contained in it, or abandon their notice to treat. On the other hand, if the landowner fails within twenty-one days after receipt of the notice to treat to give the particulars which it requires, the promoters may proceed to exercise their compulsory powers and obtain assessment of the compensation to be paid. As a general rule, it is a condition precedent to the exercise of these powers by a company that the cap- ital of the undertaking should be fully subscribed. Com- pensation, under the Lands Clauses Acts, is assessed in four different modes : — (1) by justices, where the claim does not exceed £50, or a claimant who has no greater interest than that of a tenant for a year, or from year to year, is required to give up possession before the expiration of his tenancy; (2) by arbitration (a) when the claim exceeds £50, and the claimant desires arbitration, and the

Better- meat,

interest is not a yearly tenancy, (6) when the amount has been ascertained by a surveyor, and the claimant is dis- satisfied, (c) when superfluous lands are to be sold, and the parties and the promoters cannot agree as to the price ; lands become " superfluous " if taken compulsorily on an

erroneous estimate of the area needed, or if part only was needed and the owner compelled the promoters under the power above mentioned to take the whole, or in cases of abandonment; (3) by a jury, when the claim exceeds £50, and (a) the claimant does not signify his desire for arbitration, or no award has been m.ade within the prescribed time, or (6) the claimant applies in writing for trial by jury ; (4) by surveyors, nominated by justices, where the owner is under disability, or does not appear at the appointed time, or the claim is in respect of common- able rights, and a committee has not been appointed to treat with the promoters.

Promoters are not allowed without consent of the owner to enter upon lands which are the subject of proceedings under the Lands Clauses Acts, except for the purpose of making a survey, unless they have executed a statutory bond and made a deposit, at the Law Courts Branch of the Bank of England, as security for the performance of the conditions of the bond.

Measure of Value. — (1) Where land is taken, the basis on which compensation is assessed is the commercial value of the land to the owner at the date of the notice to treat. Potential value may be taken into account, and also good- will of the property in a business. This rule, however, ex- cludes any consideration of the principle of " betterment," according to which promoters would be allowed to set off against an owner's claim for compensation any enhancement of the value of his land by the use of the land taken by the promoters. Statutory recognition has been given to this principle in some of the American states and in some British colonies (e.g., Victoria, &c.) ; and in England public bodies have been empowered in local Acts to recoup themselves for their outlay by receiving from the owners of premises and lands part of the enhanced value created by local im- provements. [See Browne and Allan, Compensation, 1896, pp. 121, 683 ; and the report of a select committee of the House of Lords on the subject, ih. p. 684 ; and the Lon- don County Council (Tower Bridge, Southern Approach) Act, 1894.] (2) Where land, although not taien, is "injuriously aifected" by the works of the promoters, compensation is payable for loss or damage resulting from any act, legalized by the promoters' statutory powers, which would otherwise

have been actionable, or caused by the execution (not the use) of the works authorized by the undertaking.

AuTHOBiTiEs. — BALrouB Browne and Allan. Compensation. London, 1896. — Ceipps. Compensation, 4th edition. London, 1900. — ^Llotd. Compensation (6th edition by Brooks). Lon- don, 1895. — Clifford. Private Bill Legislation, 2 vols. London, 1885 (vol. i.), 1887 (vol. ii.). — ^Boovibr. Law Dictionary, edited by Rawle. London and Boston, U.S.A., 1897. — Lewis. Eminent Domain. Chicago, 1888. — Mills. Eminent Domain, 2nd edition. St Louis, 1888. (a. w. k.)

Compiegne, chief town of arrondissement, depart- ment of Oise, France, 37 miles east of Beauvais, on rail- way from Paris. The famous castle of Compifegne now serves as a museum, and contains an important collection of Cambodian and Gallo-Eoman antiquities. A monu- ment to Joan of Arc was erected in 1880. In the vicinity are important sugar-mills. Population (1881), 11,116;

(1891), 11,877; (1896), 12,380; (1901), 16,503.

Compressed Air. See Power, Transmission of (Pneumatic).

Concarneau, a seaport and railway station,

CONCEPCION — CONDENSATION OF GASES

Prance, department of Finist^re, arrondissement of Quim- per, 14 miles south-east of that town. The town occupies a very picturesque situation. The old portion stands on an island, and is surrounded by ramparts, parts of which date from the loth century. It is an important centre of the sardine and mackerel fisheries, in which in 1899, 555 boats with 2966 men were employed. Lobsters are also largely reared. Population (1881), 5006 ; (1896), 6343.

Concepcion, a city in Chile, capital of a province and department of the same name, near the mouth of the Bio-Bio, in 36° 49′ 37″ S. lat. and 73° 06′ W. long., 355 miles south of Santiago. Its altitude above the sea is 40 feet. Its population in 1895 was 39,837, and in 1898 it was 51,781. It is

connected with the rest of the country by three lines of railway. It is an episcopal see, has a public school for boys, one for girls, an agricultural school, a seminary, and various other establishments. It publishes four newspapers. It is the principal commercial centre of Southern Chile, larfee quantities of wheat, flour, and wool being exported from it, through Talcahuano.

Concepcion, or Villa Concepcion, the prin- cipal city in the' northern part of Paraguay, with a population, including its suburbs, of 16,000, 125 miles north-north-east of Asuncidn, and about 345 feet above sea-level. It has a national college, two public schools, a custom-house, a good harbour, a large market, two banks, a sub-department of the Agricultural Bank, a post office, street railway, and telephone company. It is the point whence most of the yerba mate is exported, and to which importation is made direct from all countries. Across the river is the English missionary station, the territory of which extends many miles into the interior, among the Indians.

Concord, a town and village of Middlesex county, Massachusetts, U.S.A., in the north-eastern part of the state, on the Boston and Maine and the Fitchburg (now a part of the Boston and Maine) railways. Besides its distinction in revolutionary history, the town is known as the home of Emerson, Hawthorne, Thoreau, and other literary men. Population (1880), 3922; (1890), 4427;

(1900), 5652.

Concord, capital of Merrimac county, New Hamp- shire, U.S.A., and of the state. It is situated in the southern part of the state, in 43° 12' N. lat. and 71° 30' W. long., at an altitude of 252 feet, on Merrimac river, which here is not navigable, but furnishes excellent water-power. The city has an area of 64 square miles, and is on the Boston and Maine railway. Population

(1880), 13,843 ; (1890), 17,004; (1900), 19,632.

Concord, capital of Cabarrus county, North Caro- lina, U.S.A., in the Piedmont region, on the Eocky river, and on the Southern railway.

Population (1890), 4339 ; (1900), 7910, including 1789 negroes.

Condensation of Cases. — If the volume of a gas continually decreases at a constant temperature, for which an increasing pressure is required, two cases may occur : — (1) The volume may continue to be homogeneously filled. (2) If the substance is contained in a certain volume, and if the pressure has a certain value, the sub- stance may divide into two different phases, each of which is again homogeneous. The value of the temperature T decides which case will occur. The temperature which is the limit above which the space will always be homo- geneously filled, and below which the substance divides into two phases, is called the critical temperor Critical ture of the substance. It differs greatly for tempera- different substances, and if we represent it by “”’ T„, the condition for the condensation of a gas

is that T must be below T.. If the substance is divided

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into two phases two different cases may occur. The denser phase may be either a liquid or a solid. The limiting temperature for these two cases, at which the division into three phases may occur, is called the trii^le point. Let us represent it by T3 ; if the term ” condensar tion of gases ” is taken in the sense of ” liquefaction of gases” — which is usually done — the condition for con- densation is T^T>Tj. The opinion sometimes held that for all substances T3 is the same fraction of T (the value being about |), has decidedly not been rigorously confirmed. Nor is this to be expected on account of the very different form of crystallization which the solid state presents. Thus for CO2, for which T„=304° on the absolute scale, and for which we may put T3=216°, this fraction is about 0-7; for water it descends down to 0-42, and for other substances it may be still lower.

If we confine ourselves to temperatures between T„ and T3 the gas will pass into a liquid if the pressure is sufficiently increased. When the formation of liquid sets in we call the gas a saturated vapour. If the decrease of volume is continued the gas pressure remains con- stant till all the vapour has passed into liquid. The invariability of the properties of the phases is in close connexion with the invariability of the pressure

(called maximum tensiori). Throughout the course of the process of condensation these properties remain unchanged, pro- vided the temperature remain constant ; only the relative quantity of the two phases changes. Until all the gas has passed into liquid a further decrease of volume will not require increase of pressure. But as soon as the lique- faction is complete a slight decrease of volume will require a great increase of pressure, liquids being but slightly compressible.

The pressure required to condense a gas varies with the temperature, becoming higher as the temperature rises. The highest pressure will therefore be found at T, and the lowest at T3. We shall represent the pressure at T^ by js^. It is called the critical pressure. The pressure at T3 we. shall represent by p^. It is called the 'i'J^s'„ pressure of the triple point. The values of T and Pc for different substances will be found at the end of this article. The values of T3 andpa are accurately known only for a few substances. As a rule p^ is small, though occasionally it is greater than 1 atmosphere. This is the case with CO2, and we may in general expect it if the value of Ta/Tj is large. In this case there can only be a question of a real boiling-point (under the normal pressure) if the liquid can be supercooled.

We may find the value of the pressure of the saturated vapour for each T in a geometrical way by drawing in the theoretical isothermal a straight line parallel to the v axis

in such a way, that \pdv will have the same value

whether the straight line or the theoretical isothermal is followed. This construction, given by Maxwell, may be considered as a result of the application of the general rules for co-existing equilibrium, which we owe to Willard Gibbs. The construction derived from the rules of Gibbs is as follows : — Construe the free energy at a constant temperature, i.e., the quantity —yjjc?^ as ordinate, if the abscissa represents v, and determine the inclination of the double tangent. Another construction derived from the rules of Gibbs might be expressed as follows : — Construe the value of pv —/ pdv as ordinate, the abscissa representing p, and detremine the

point of intersection of two of the three branches of this curve. As an approximate, half-empirical formula for the

calculation of the pressure, — log — =/f ”” j may be used.

Critical volume.

It would follow from the law of corresponding states that in this formula the value of / is the same for all substances, the molecules of which do not associate to form larger molecule-complexes. In fact, for a great many substances, we find a value for /, which differs but little from 3, e.g., ether, CO2, benzene, benzene derivatives, chloric ethyl, ethane, &c. As the chemical structure of these substances differs greatly, and asso- ciation, if it takes place, must largely depend upon the structure of the molecule, we conclude from this ap- proximate equality that the fact of this value of / being equal to about 3 is characteristic for normal sub- stances in which, consequently, association is excluded. Substances known to associate, such as organic acids and alcohols, have a sensibly higher value of /. Thus M. Estreicher (Cracow, 1896) calculates that for fluor- benzene / varies between 3-07 and 2-94; for ether between 3-0 and 3-1; but for water between 3‘2 and 3-33, and for methyl alcohol between 3-65 and 3-84, &c. For isobutyl alcohol / even rises above 4. It is, how- ever, remarkable that for oxygen / has been found almost invariably equal to 2-47 from Olszewski’s ob- servations, a value which is appreciably smaller than 3. This fact makes us again seriously doubt the correctness of the supposition that /=3 is a characteristic for non- association.

It is a general rule that the volume of saturated vapour decreases when the temperature is raised, while that of the co-existing liquid increases. We know only one exception to this rule, and that is the volume of water below 4° C. If we call the liquid volume Vi, and the vapour %, v,~~v,~~ ~~decreases if the temperature rises, and becomes zero at T^. The limiting value, to which Vi and v„ converge at T,„ is called the critical volume, and we shall represent it by v.. According to the law of corre~~ sponding states

the values both of v^/v^ and v,/v^ must be the same for all substances, if T/T, has been taken equal for them all. According to the investigations of Sydney Young, this holds good with a high degree of approximation for a long series of substances. Important deviations from this rule for the values of v,/vi are only found for those sub- stances in which the existence of association has already been discovered by other methods. Since the lowest value of T, for which investigations on v, and v, may be made, is the value of T3; and since Ta/T^, as has been observed above, is not the same for all substances, we cannot expect the smallest value of vjv^ to be the same for all substances. But for low values of T, viz., such as are near T3, the influence of the temperature on the volume is but slight, and therefore we are not far from the truth, if for normal substances we take the minimum value of v/v^ as being equal for all normal substances, and put it at about . Moreover, the influence of the polymerization (association) on the liquid volume appears to be small, so that we may even attribute the value ^ to substances which are not normal. The value of «,/v„ at T=T3 differs widely for different substances. If we take p^ so low that the law of Boyle-Gay-Lussac may be applied, we can calculate v^/v^ by means of the

formula ^^=A;^°, provided k be known. According to

the observations of Sydney Young this factor has proved to be 3-77 for normal substances. In consequence

^=3-77 T. A similar formula, but with another value'

Vc Pi Tc

of k, may be given for associating substances, provided the saturated vapour does not contain any complex molecules. But if it does, as is the case with acetic acid, we must also know the degree of association. It can, however, only be found by measuring the volume itself. Matthias has remarked that the following relation ex-

ists between the densities of the saturated vapour and of the co-existing liquid : —

p,-|-p.=2p,{H-a(l-fJ},

Rale ot the rectilinear diameter.

Latent heat.

and that, accordingly, the curve which represents the densities at different temperatures possesses a rectilinear diameter. According to the law of corresponding states, a would be the same for all substances. Many substances, indeed, actually appear to have a rectilinear diameter, and the value of a appears approximatively to be the same. In a Mimoire prisenti d, la sociiti roycde d, Li^ge, 16th June 1899, Matthias gives a list of some twenty sub- stances for which a has a value lying between. 0-95 and 1-05. It had been already observed by Sydney Young that a is not perfectly constant even for normal sub- stances. For associating substances the diameter is not rec- tilinear. Whether the value of a, near 1, may serve as a characteristic for normal substances is rendered doubtful by the fact that for nitrogen a is found equal to 0-6813, and for oxygen to 0-8. At T=T,/2, the formula of Mat- thias, if p„ be neglected with respect to p„ gives the value 2+atoipi/p,.

The heat required to convert a molecular quantity of liquid coexisting with vapour into saturated vapour at the same temperature is called molecular latent heat. It decreases with the rise of the temper- ature, because at a higher temperature the liquid has already expanded, and because the vapour into which it has to be converted is denser. At the critical tempera- ture it is equal to zero on account of the identity of the liquid and the gaseous states. If we call the molecular weight m and the latent heat per unit of weight r, then, according to the law of corresponding states, mr/T is the same for all normal substances, provided the temperatures are corresponding. According to Trouton the value of mr/T is the same for all substances if we take for T the boiling-point. As the boiling-points under the pressure of one atmosphere are generally not equal fractions of T„ the two theorems are not identical ; but as the values of Pc for many substances do not differ so much as to make the ratios of the boiling-points under the pressure of one atmosphere differ greatly from the ratios of T„ an ap- proximate confirmation of the law of Trouton may be compatible with an

approximate confirmation of the con- sequence of the law of corresponding states. If we take the term boiling-point in a more general sense, and put T in the law of Trouton to represent the boiling-point under an arbitrary equal pressure, we may take the pressure equal to p^ for a certain substance. For this substance mr/T would be equal to zero, and the values of mr/T would no longer show a trace of equality. At present direct trustworthy investigations about the value of r for different substances are wanting; hence the question whether as to the quantity mr/T the substances are to be divided into normal and associating ones cannot be answered. Let us divide the latent heat into heat neces- sary for internal work and heat necessary for external work. Let r' represent the former of these two quanti- ties, then : —

r=r'+p{v„—Vi).

*Then the same remark holds good for mr'/T as has been made for mr/T. The ratio between r and that part that is necessary for external work is given in the formula, r _T dp p(Vv-v,) p dT By making use of the approximate formula for the vapour tension: – Nap. log. ^ =f(I^\ g g^*

r ^f,Tc P(.v,-v,) •' T ■

(JUXDENSATION OF GASES

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At T=To -we find for this ratio /, a value whicL, for normal substances is equal to 3/0-4343=7. At the critical temperature the quantities r and v^-^i are both equal to 0, but they have a finite ratio. As we may equate p(y^-^i) with p«^=ET at very low temperatures, we get, if we take into consideration that B, expressed in calories is equal to 2/m, the value 2/'Tc=14Te as limit- ing value for mr for normal substances. This value for mr has, however, merely the character of a rough approximation — especially since the factor /' is not perfectly constant.

All the phenomena which accompany the condensation of gases into liquids may be explained by the supposi- tion, that the condition of aggregation which we a1^q7u/ °^^^ liquid differs only in quantity, and

not in quality, from that which we call gas. We imagine a gas to consist of separate molecules of a certain mass ij., having a certain velocity depending on the tem- perature. This velocity is distributed according to the law of probabilities, and furnishes a quantity of vis viva proportional to the temperature. We must attribute extension to the molecules, and they will attract one another with a force which quickly decreases with the distance. Even those suppositions which reduce molecules to centra of forces, like that of Maxwell, lead us to the result that the molecules behave in mutual collisions as if they had extension — an extension which in this case is not constant, but determined by the law of repulsion in the collision, the law of the distribution, and the value of the velocities. In order to explain capillary phenomena it was assumed so early as Laplace, that between the molecules of the same substance an attraction exists which quickly decreases with the distance. That this attraction is found in gases too is proved by the fall which occurs in the temperature of a gas that is expanded without performing external work. We are still perfectly in the dark as to the cause of this attraction, and opinion differs greatly as to "its dependence on the distance. Nor is this knowledge necessary in order to find the influence of the attraction, for a homogeneous state, on the value of the external pressure which is required to keep the moving molecules at a certain volume (T being given). We may, viz., assume either in the strict sense, or as a first approximation, that the influence of the attraction is quite equal to a pressure which is proportional to the square of the density. Though this molecular pressure is small for gases, yet it will be considerable for the great densities of liquids, and calculation shows that we may estimate it at more than 1000 atmos., possibly increasing up to 10,000. We may now make the same supposition for a liquid as for a gas, and imagine it to bonsist of molecules, which for non-associating substances are the same as those of the rarefied vapour; these, if T is the same, have the same mean vis viva as the vapour mole- cules, but are more closely massed together. Starting from this supposition and all its consequences, the author of this article has derived the following formula, which would hold both for the liquid state and for the gaseous state: —

(p+S)

(v-b)=‘RT.

It follows from this deduction that for the Rarefied gaseous state b would be four times the volume of the mole- cules, but that for greater densities the factor 4 would decrease. If we represent the volume of the molecules by (8, the quantity 6 will be found to have the following form : —

Only two of the successive coefficients y^, y^, &c., have

been worked out, for the determination requires very lengthy calculations, and has not even led to definitive results (Boltzmann, Proc. Royal Acad. Amsterdam, March 1899). The latter formula supposes the molecules to be rigid spheres of invariable size. If the molecules are things which are compressible, another formula for 6 is found, which is different according to the number of atoms in the molecule {Proc. Royal Acad. Amsterdam, 1900-1). If we keep the value of a and h constant, the given equation will not completely represent the net of isothermals of a substance. Yet even in this form it is sufficient as to the principal features. From it we may argue to the existence of a critical temperature, to a minimum value of the product pv, to the law of corre- sponding states, &c. Some of the numerical results to which it leads, however, have not been confirmed by experience. Thus it would follow from the given equation

that fr=5 ST, if the value of v is taken so great that the

gaseous laws may be applied, whereas Sydney Young has foundl/3‘77foranumber of substances instead of thefactor 3/8. Again it follows from the given equation, that if a is

thought to be independent of the temperature, ~^-^A =4,

whereas for a number of siibstances a value is found for it which is near 7. If we assume with Clausius that a

depends on the temperature, and has a value a’=, we

That the accurate knowledge of the equation of state is of the highest importance is universally acknowledged, because in connexion with the

results of thermodynamics it will enable us to explain all phenomena relating to ponderable matter. This general conviction is shown by the numerous efforts made to complete or modify the given equation, or to replace it by another, for instance, by Clausius, Tait, Amagat, Boltzmann, Jager, Dieterici, Galit- zine, Eose Innes, and Eeinganum.

If we hold to the supposition that the molecules in the gaseous and the liquid state are the same — which we may call the supposition of the identity of the two conditions of aggregation — then the heat which is given out by the condensation at constant T is due to the potential energy lost in consequence of the coming closer of the molecules which attract each other, and then it is equal to

a ( ). If a should be a function of the tempera-

ture, it follows from thermodynamics that it would be

equal to («—T^] (——)• Not only in the case of

liquid and gas, but always when the volume is diminished,

a quantity of heat is given out equal to a(1 or

fa-T^,)(^-i).

If, however, when the volume is diminished at a given temperature, arid also during the transition from the gaseous to the liquid state, combination into larger molecule-complexes takes place, the total internal heat may be considered as the sum oJE that which is caused by the combination of the molecules into greater molecule-complexes and by their approach to-^J^°^^^ wards each other. We have the simplest case of possible greater complexity when two molecules combine to one. Prom the course of the changes in the density of the vapour we assume that this occurs, e.g., with NOg and acetic acid, and the somewhat close agreement of the observed density of the vapour with that which is calculated from the hypothesis of such an association to double- molecules, makes this supposition almost a certainty. In

such cases the molecules in the much denser liquid state must therefore be considered as double-molecules, either completely so or in a variable degree depending on the temperature. The given equation of state cannot hold for such substances. Even though we assume that a and 6 are not modified by the formation of double-molecules, yet ET is modified, and since it is proportional to the number of the molecules, it is diminished by the combi- nation. The laws found for normal substances will, there- fore, not hold for such associating substances. Accord- ingly for substances for which we have already found an anormal density of the vapour, we cannot expect the general laws for the liquid state, which have been treated above, to hold good without modification, and in many respects such substances will therefore not follow the law of corresponding states. There are, however, also sub- stances of which the anormal density of vapour has not been stated, and which yet cannot be ranged under this law, e.g., water and alcohols. The most natural thing, of course, is to ascribe the deviation of these substances, as of the others, to the fact that the molecules of the liquid are polymerized. In this case we have to account for the fol- lowing circumstance, that whereas for NO2 and acetic acid in the state of saturated vapour the degree of association increases if the temperature falls, the reverse must take place for water and alcohols. Such a difference may be accounted for by the difference in the quantity of heat released by the polymerization to double-molecules or larger molecule-complexes. The quantity of heat given out when two molecules fall together may be calculated for NO2, and acetic acid from the formula of Gibbs for the density of vapour, and it proves to be very consider- able. With this the following fact is closely connected. If in the pv diagram, starting from a point indicating the state of saturated vapour, a geometrical locus is drawn of the points which have the same degree of association, this curve, which passes towards isothermals of higher T if the volume diminishes, requires for the same change in T a greater diminution of volume than is indicated by the border-curve. For water

and alcohols this geometri- cal locus will be found on the other side of the border- curve, and the polymerization heat will be small, i.e., smaller than the latent heat. For substances with a small polymerization heat the degree of association will continually decrease if we move along the border-curve on the side of the saturated vapour in the direction towards lower T. With this, it is perfectly compatible that for such substances the saturated vapour, e.g., under the pressure of one atmosphere, should show an almost normal density. Saturated vapour of water at 100° has a density which seems nearly 4 per cent, greater than the theoretical one, an amount which is greater than can be ascribed to the deviation from the gas-laws. For the relation between v, T, and x, if x represents the fraction of the number of double-molecules, the following formula has been found (Moleculartheorie Zeitschrift Ph. Ch., 1890, Leipzig) :

from which

log^(¯) :

KiT

+ C,

T

‘%

RiT

vrhich may elucidate what precedes.

By far the majority of substances have a value of T„

above the ordinary temperature, and diminution of volume (increase of pressure) is siifiicient to condense such gaseous substances into liquids. If T^ is but little above the ordinary temperature, a great increase of pressure is in general required to effect condensation. Substances for which

Tj is much higher than the ordinary temperatiire Tj, e.g.,

Condensa' Hon of substances wHb low Tc-

Te>Y3To, occur as liquids, even without increase of pressure ; that is, at the pressxu-e of one atmosphere. The value Ys is to be considered as only a mean value, because of the inequality of p„. The substances for which T„ is smaller than the ordinary temperature are but few in number. Taking the temperature of melting ice as a limit, these gases are in successive order : CH4, NO, Oj, CO, ISTs, and Hj (the recently-discovered gases are left out of account). If these gases are compressed at 0° centigrade they do not show a trace of liquefaction, and therefore they were long known under the name of " per- manent gases." The discovery, however, of the critical temperature carried the conviction that these substances would not be " permanent gases " if they were compressed at much lower T. Hence the problem arose how " low temperatures " were to be brought about. Considered from a general point of view the means to attain this end may be described as follows : we must make use of the above-mentioned circumstance that heat disappears when a substance expands, either with or without per- forming external work. According as this heat is de- rived from the substance itself which is to be condensed, or from the substance which is used as a means of cool- ing, we may divide the methods for condensing the so- called permanent gases into two principal groups.

In order to use a liquid as a cooling bath it must be placed in a vacuum, and it must be possible to keep the pressure of the vapour in that space at a small value. According to the boiling-law, the t-iQuUsas temperature of the liquid must descend to that ‘ung. at which the maximum tension of the vapour is equal to the pressure which reigns on the surface of the liquid. If the vapour, either by means of absorption or by an air-pump, is exhausted from the space, the temperature of the liquid and that of the space itself depend upon the value of the pressure which finally prevails in the space. From a practical point of view the value of T3 may be regarded as the limit to which the temperature falls. It is true that if the air is exhausted to the utmost possible extent, the tempera- ture may fall still lower, but when the substance has become solid, a further diminution of the pressure in the space is of little advantage. At any rate, as a solid body evaporates only on the surface, and solid gases are bad conductors of heat, further cooling will only take place very slowly, and will scarcely

neutralize the influx of heat. If the pressure jps is very small, it is perhaps practically impossible to reach T3 ; if so, Tj in the fol- lowing lines will represent the temperature practically attainable. There is thus for every gas a limit below which it is not to be cooled further, at least not in this way. If, however, we can find another gas for which the critical temperature is sufficiently above T3 of the first chosen gas, and if it is converted into a liquid by cooling with the first gas, and then treated in the same way as the first gas, it may in its turn be cooled down to (T3)2. Going on in this way, continually lower tempera- tures may be attained, and it would be possible to con- dense all gases, provided the difference of the successive critical temperatures of two gases fulfils certain con- ditions. If the ratio of the absolute critical temperar tures for two 'gases, which succeed one another in the series, should be sensibly greater than 2, the value of T3 for the first gas is not, or not sufficiently, below the T„ of the second gas. This is the case when one of the gases is nitrogen, on which hydrogen would fol- low as second gas. Generally, however, we shall take atmospheric air instead of nitrogen. Though this mixture of Nj and O2 will show other critical phenomena than a simple substance, yet we shall continue to speak of a T for air, which is given at — 140° C, and for which, there-

fore, T„ amounts to 133° absolute. The lowest T •which may be expected for air in a highly rarefied space may be evaluated at 60° absolute — a value w^hich is higher than the T,, for hydrogen. Without new contrivances it would, accordingly, not be possible to reach the critical temperature of Hj. The method by which we try to obtain successively lower temperatures by making use of successive gases is called the " cascade method." It is not self-evident that by sufficiently diminishing the pressure on a liquid, it may be cooled to such a degree that the temper- ature will be lowered to Tj, if the initial temperature was equal to T„, or but little below it, and we can even pre- dict with certainty that this will not be the case for all substances. It is possible, too, that long before the triple point is reached the whole liquid will have evaporated. The most favourable conditions will, of course, be attained when the influx of heat is reduced to a minimum. As a limiting case we imagine the process to be adiabatic. Now the question has become, Will an isentropic line, which starts from a point of the border-curve on the side of the liquid not far

from the critical point, remain throughout its descending course in the heterogeneous region, or will it leave the region on the side of the vapour ? As early as 1878 the author of this article (Verslagen Kon. dkad. Amsterdam) pointed out that the former may be expected to be the case only for substances for which Cp/c„ is large, and the latter for those for which it is small; in other words, the former will take place for substances the molecules of which contain few atoms, and the latter for substances the molecules of which con- tain many atoms. Ether is an example of the latter class, and if we say that the quantity h (specific heat of the saturated vapour") for ether is found to be positive, we state the same thing in other words. It is not neces- sary to prove this theorem further here, as the molecules of the gases under consideration contain only two atoms and the total evaporation of the liquid is not to be feared.

In the practical application of this cascade-method some variation is found in the gases chosen for the suc- cessive stages. Thus chloric methyl, ethylene, and oxygen are used in the cryogenic laboratory of Leyden, while Professor Dewar has used air as the last term. Carbonic acid is not to be recommended on account of the comparatively high value of T3. In order to prevent loss of gas a system of "circulation" is employed. This method of obtaining low temperatures is decidedly labo- rious, and requires very intricate apparatus, but it has the great advantage that very constant low temperatures may be obtained, and can be regulated arbitrarily within pretty wide limits.

In order to lower the temperature of a substance down to Tg, it is not always necessary to convert it first into the liquid state by means of another substance, as CooHagby ^3,3 assumed in the last method for obtaining expansion. ^^^ temperatures. Its own expansion is suifi- cient, provided the initial condition be properly chosen, and provided we take care, even more than in the former method, that there is no influx of heat. Those conditions being fulfilled, we may, simply by adiabatic expansion, not only lower the temperature of some substances down to Tg, but also convert them into the liquid state. This is especially the case with substances the molecules of which contain few atoms.

Let us imagine the whole net of isothermals for homogeneous phases drawn in a ^ diagram, and in it the border-curve. Within this border-curve, as in the heterogeneous region, the theoretical part of every isothermal must be replaced by a straight line. The isothermals may therefore be divided into two groups, viz., those which keep outside the heterogeneous region,

and those which cross this region. Hence an isothermal, belonging to the latter group, enters the heterogeneous region on the liquid side, and leaves it at the same level on the vapour side. Let us imagine in the same way all the isentropic curves drawn for homogeneous states. Their form resembles that of isothermals in so far as they show a maximum and a minimum, if the entropy-constant is be- low a certain value, while if it is above this value, both the maximum and the minimum disappear, the isentropic line

in a certain point having at the same time -— and —4 =0

for this particular value of the constant. This point, which we might call the critical point of the isentropic lines, lies in the heterogeneous region, and therefore cannot be realized, since as soon as an isentropic curve enters this region its theoretical part will be replaced by an empiric part. If an isentropic curve crosses the heterogeneous region, the point where it enters this region must, just as for the isothermals, be connected with the point where it leaves the region by another curve. When Cy/c„=k (the limiting value of Cp/c, for infinite rarefaction is meant) approaches unity, the isentropic curves approach the isothermals and vice versd. In the same way the critical point of the isentropic curves comes nearer to that of the isothermals. And if k is not much greater than 1, e.g., Jc

Now the gases which were considered as permanent are exactly those for which k has a high value. From this it would follow that every adiabatic expansion, provided it be sufficiently continued, will bring such substances into the heterogeneous region, i.e., they can be condensed by adiabatic expansion. But since the final pressure must not fall below a certain limit, determined by experimental convenience, and since the quantity which passes into the liquid state must remain a fraction as large as possible, and since the expansion never can take place in such a

manner that no heat is given out by the walls or the surroundings, it is best to choose the initial condition in such a way that the isentropic curve of this point cuts the border-curve in a point on the side of the liquid, lying as low as possible. The border-curve being rather broad at the top, there are many isentropic curves which penetrate the heterogeneous region under a pressure which differs but little from p^. Availing himself of this pro- perty, Olszewski has determined p^ for hydrogen at 20 atmospheres. Isentropic curves, which lie on the right and on the left of this group, will show a point of condensa^ tion at a lower pressure. Olszewski has investigated this for those lying on the right, but not for those on the left.

Fromtheequationofstate^p+^V'y— 6) =ET, the equa- tion of the isentropic curve follows as (p+^) («— 6)'=C,

and from this "we may deduce T («— 6)'-^=C'. This latter relation shows in how high a degree the cooling depends on the amount by which fc surpasses unity, the change in v—b being the same.

What has been said concerning the relative position of the border-curve and the isentropic curve may be easily tested for points of the border-curve which represent rarefied gaseous states, in the following way. Following

the border-curve we found before / — for the value of

*— -^. Following the isentropic curve the value of — -^*

is equal to — ^. If — ^

more steeply than the border-curve. If we take/=7 and choose the value of T5/2 for T — a temperature at which the saturated vapour may be considered to follow the gas- laws — then fc/fc— 1 = 14, or A=l-07 would.be the limiting value for the two cases. At any rate fc=l-41 is great enough to fulfil the condition, even for

other values of T. Pictet has availed himself of this adiabatic expansion for condensing many permanent gases, and it must also be used when, in the cascade method, T3 of one of the gases lies above T of the next.

A third method of condensing the permanent gases is applied in Linde's apparatus for liquefying air. Under a high pressure pi a current of gas is conducted appai^tus through a narrow spiral, returning through another spiral which surrounds the first. Be- tween the end of the first spiral and the beginning of the second the current of gas is reduced to a much lower pressure p^ by passing through a tap with a fine orifice. On account of the expansion resulting from this sudden decrease of pressure, the temperature of the gas, and consequently of the two spirals, falls sensibly. If this process is repeated with another current of gas, this cur- rent, having been cooled in the inner spiral, will be cooled still further, and the temperature of the two spirals will become still lower. If the pressures pi and P2 remain constant the cooling will increase with the lowering of the temperature. In Linde's apparatus this cycle is re- peated over and over again, and after some time (about two or three hours) it becomes possible to draw off liquid air.

The cooling which is the consequence of such a decrease of pressure was experimentally determined in 1854 by Lord Kelvin (then Professor W. Thomson) and Joule, who represent the result of their experiments in the formula

In their experiments P2 was always 1 atmosphere, and the amount of pi was not large. It would, therefore, be certainly wrong, even though for a small difference in pressure the empiric formula might be approximately correct, without closer investigation to mate use of it for the differences of pressure used in Linde's apparatus, where 2)1=200 andp2=18 atmospheres. For the existence of a most favourable value of pi is in contradiction with the formula, since it would follow from it that Tj— T2 would always increase with the increase oipi. Nor would it be right to regard as the cause for the existence of this most favourable value of pi the fact that the heat produced in the compression of the expanded gas, and therefore Pi/pi, must be kept as small as possible, for the simple

reason that the heat is produced in quite another part of the apparatus, and might be neutralized in different ways.

Closer examination of the process shows that if jSj is given, a most favourable value of pi must exist for the

cooling itself. If^ is taken still higher, the cooling decreases again, and we might take a value for pi for which the cooling would be zero, or even negative.

If we call the energy per unit of weight e and the specific

volume V, the following equation holds ; — ei+piVi-p2V2 = e2,

or ei+PiVi=e2+p2V2.

According to the symbols chosen by Gibbs, xi=Xi- As X is determined by Ti and pi, and xa hy T2 and pi, we obtain,

if we take Ti and pa as being constant,

(?2^] clp,=.(^] dT2. If T2 is to have a minimum value, we have

(l =0, orf^i =0. From this follows

\Svi)ti L Svi Jtj

As (-G I is positive, we shall have to take for the maximum

cooling such a pressure that the product pv decreases with v, viz. , a pressure larger than that at which pv has the minimum value. By means of the equation of state mentioned already, we find for the value of the specific volume that gives the greatest cooling, the formula

RT16 _2a

(1)1-6)2 »»'

and for the value of the pressure

P.-74>-Vi|][s^-l].

If we take the value 2Tc for Ti, as we may approximately for air when we begin to work with the apparatus, we find for^i about 8pc, or more than 300 atmospheres. If we take Ti=Tc, as we may at the end of the process, we find pi=2.5pc, or 100 atmospheres. The constant pressure which has been found the most favourable in Linde's apparatus is a mean of the two calculated pressures. In a theoretically perfect apparatus we ought, therefore, to be able to regulate pi according to the temperature in the inner spiral.

The critical temperatures and pressures of the perma^ nent gases are given in the following table, the former being expressed on the absolute scale and the latter in atmospheres : —

Tc

Pc

T.

Pc

CHi

191-2°

55

CO

133-5°

35-5

NO

179-6°

71-2

N2

127°

35

O2

155°

50

Air

133°

39

Argon

152°

50-6

H2

40°

20

According to Professor Dewar the critical temperature of H2 is about 82° absolute, and the critical pressure about 16 atmospheres (^Proc. Boy. Inst. Great Britain, 7th June 1899). (See also Liquid Gases.) (j. d. y. d. - v^r.)

Conduction of Heat. — The mathematical theory of conduction of heat was developed early in the IQth century by Fourier and other workers,

and was brought to so high a pitch of excellence that little has remained for later writers to add to this department of the subject. In fact, for a considerable period, the term " theory of heat" was practically synonymous with the mathemati- cal treatment of conduction. A summary of Fourier's analysis will be found in Heat {Ency. Brit., vol. xi.), and the theory need not be considered in detail here, except in so far as it is required for the definition and explanation of fundamental terms. The main object of the present article is to describe more recent work, and to discuss experimental difficulties and methods of measurement.

1. Mechanism of Conduction. — Conduction of heat im- plies transmission by contact from one body to another or between contiguous particles of the same body, but does not include transference of heat by the motion of masses or streams of matter from one place to another. This is termed Convection (see Radiation), and is most im-

portant in the case of liquids and gases owing to their mobility. Conduction, however, is generally understood to include diffusion of heat in fluids due to the agitation of the ultimate molecules', which is really molecular convection. It also includes diffusion of heat by internal radiation, which must occur in transparent substances. In measuring conduction of heat in fluids, it is possible to some extent to eliminate the effects of molar convection or mixing, but it would not be possible to distinguish between diffusion, or internal radiation, and conduction. Some writers have supposed that the ultimate atoms are con- ductors, and that heat is transferred through them when they are in contact. This, however, is merely transferring the properties of matter in bulk to its molecules. It is much more probable that heat is really the kinetic energy of motion of the molecules, and is passed on from one to another by collisions. Further, if we adopt Weber's hypothesis of electric atoms, capable of diffusing through metallic bodies and conductors of electricity, but capable of vibration only in non-conductors, it is possible that the ultimate mechanism of conduction may be reduced in all cases to that of diffusion in metallic bodies or internal radiation in dielectrics. The high

conductivity of metals is then explained by the small mass and high velocity of diffusion of these electric atoms. Assuming the kinetic energy of an electric atom at any temperature to be equal to that of a gaseous molecule, its velocity, on Professor J. J. Thomson's estimate of the mass, must be upwards of forty times that of the hydrogen molecule.

2. Law of Conduction. — The experimental Law of Con- duction, which forms the basis of the mathematical theory, was established in a qualitative manner by Fourier and the early experimentalists. Although it is seldom explicitly stated as an experimental law, it should really be re- garded in this light, and may be briefly worded as follows: — " The rate of transmission of heat by conduction is pro- portional to the temperature gradient."

The " rate of transmission of heat " is here understood to mean the quantity of heat transferred in unit time through unit area of cross- section of the substance, the unit area being taken perpendicular to the lines of flow. It is clear that the quantity transferred in any case must he jointly proportional to the area and the time. The " gradient of temperature " is the fall of temperature in degrees per unit length along the lines of flow. The Thermal Conductivity of the substance is the constant ratio of the rate of transmission to the temperature gradient. To take the simple case of the " wall " or flat plate considered by Fourier for the definition of Thermal Conductivity, suppose that a quantity of heat Q passes in the time T through an area ^ of a plate of conductivity fc and thickness x, the sides of which are constantly main- tained at temperatures 6' and 6". The rate of transmis- sion of heat is Q/AT, and the temperature gradient, supposed uniform, is {e'~~e")/x, so that the law of con~~ duction leads at once to the equation —

Q/A r= k(e'-e")/x=MO/dx.

(1)

This relation applies accurately to the case of the steady flow of heat in parallel straight lines through a homo- geneous and isotropic solid, the isothermal surfaces, or surfaces- of equal temperature, being planes perpendicular to the lines of flow. If the flow is steady, and the

temperature of each point of the body invariable, the rate of transmission must be everywhere the same. If the gradient is not uniform, its value may be denoted by dO/dx. In the steady state, the product M6/dx must be constant, or the gradient must vary inversely as the conductivity, if the latter is a function of 6 or x. One of the simplest illustrations of the rectilinear flow of heat is

the steady outflow through the upper strata of the earth's crust, which may be considered practically plane in this connexion. This outflow of heat necessitates a rise of temperature with increase of depth. The corre- sponding gradient is of the order of 1° C. in 100 feet, but varies inversely with the conductivity of the strata at different depths.

3. Variable State. — A different type of problem is pre- sented in those cases in which the temperature at each point varies with the time, as is the case near the surface of the soil with variations in the external conditions be- tween day and night or summer and winter. The flow of heat may still be linear if the horizontal layers of the soil are of uniform composition, but the quantity flowing through each layer is no longer the same. Part of the heat is used up in changing the temperature of the suc- cessive layers. In this case it is generally more conven- ient to consider as unit of heat the thermal capacity c of unit volume, or that quantity which would produce a rise of one degree of temperature in unit volume of the soil or substance considered. If Q is expressed in terms of this unit in equation, (1) it is necessary to divide by c, or to replace k on the right hand side by the ratio Jc/c. This ratio determines the rate of diffusion of temperature, and is called the Tliermometric Conductivity or, more shortly, the Dfffusivity. The velocity of propagation of temperature waves will be the same under similar condi- tions in two substances which possess the same diffusivity, although they may differ in conductivity.

4. Emissivity. — Fourier defined another constant ex- pressing the rate of loss of heat at a bounding surface per degree of difference of temperature between the surface of the body and its surroundings. This he called the Ex- ternal Conductivity, but the term Emissivity is more con- venient. Taking Newton's law of cooling, that the rate of loss of heat is simply proportional to the excess of temperature, the emissivity would be

independent of the temperature. This is generally assumed to be the case in mathematical problems, but the assumption is admissi- ble only in rough work, or if the temperature difference is small. The emissivity really depends on every va- riety of condition, such as the size, shape, and position of the surface, as well as on its nature ; it varies with the rate of cooling, as well as with the temperature ex- cess, and it is generally so difficult to calculate, or to treat in any simple manner, that it forms the greatest source of uncertainty in all experimental investigations in which it occurs.

5. Experimental Methods. — Measurements of con- ductivity present peculiar difficulties oh account of the variety of quantities to be observed, the slowness of the process of conduction, the impossibility of isolating a quantity of heat, and the difficulty of exactly realizing the theoretical conditions of the problem. The most im- portant methods may be classified roughly under three heads— (1) Steady Flow, (2) Variable Flow, (3) Electrical. The methods of the first class may be further subdivided according to the form of apparatus employed. The fol- lowing are some of the special cases which have been utilized experimentally : —

6. The ” WalV or Plate Method. — This method endeavours to realize the conditions of equation, (1) namely, uniform rectilinear flow. Theoretically this requires an infinite plate, or a perfect heat insulator, so that the lateral flow can be prevented or rendered negligible. This condition can generally be satisfied with suffi— cient approximation with plates of reasonable dimensions. To find the conductivity, it is necessary to measure all the quantities which occur in equation (1) to a similar order of accuracy. The area A from which the heat is collected need not be the whole surface of the plate, but a measured central area where the flow is most nearly uniform. This variety is known as

the “Guard-Ring” method, but it is generally rather difficult to determine the effective area of the ring. There is little difficulty in measuring the time of flow, provided that it is not too short. The measurement of the

temperature gradient in the plate generally presents the greatest difficulties. If the plate is thin, it is necessary to measure the tliickness with great care, and it is necessary to assume that the temperatures of the surfaces are the same as those of the media with which they are in contact, since there is no room to insert thermometers in the plate itself. This assumption does not present serious errors in the case of bad conductors, such as glass or wood, but has given rise to large mistakes in the case of metals. The conductivities of thin slices of crystals have been measured by Lees by pressing them between plane amalgamated surfaces of metal. This gives very good contact, and the conductivity of the metal being more than 100 times that of the crystal, the temperature of the surface is determinate.

In applying the plate method to the determination of the conductivity of iron. Hall has recently succeeded in overcoming this difficulty by coating the plate thickly with copper on both sides, and deducing the difference of temperature between the two surfaces of junction of the iron and the copper from the thermo-electric force observed by means of a number of fine copper wires attached to the copper coatings at different points of the disc. The advantage of the thermo-junction for this purpose is that the distance between the surfaces of which the temperature- difference is measured, is very exactly defined. The disadvantage is that the thermo-electric force is very small, about ten-miUionths of a volt per degree, so that a small accidental disturbance may produce a serious error with a difference of temperature of only 1° between the junctions. The chief imcertainty in applying this method appears to have arisen from variations of temperature b.t different parts of the surface, due to inequalities in the heating or cooling effect of the stream of water flowing over the surfaces. Uniformity of temperature could only be secured by using a high velocity of flow, or violent stirring. Neither of Uiese methods could be applied in this experiment. The temperatures indicated by the different pairs of wires differed by as much as 10 per cent., but the mean of the whole would probably give a fair average. The heat transmitted was measured by observing the flow of water (about 20 gm./sec), and the rise of temperature (about 0‘5° C.) in one of the streams. The results appear to be entitled to considerable weight on account of the directness of the

method, and the full consideration of possible errors. They were as follows : —

Cast-iron, ^=0-1490 C.G.S.at 30° C, temp, coef.- 0-00075. Pure iron, &=0-1530 at 30° C, temp. coef. -0-0003.

The discs were 10 cms. in diam., and nearly 2 cms. thick, plated with copper to a thickness of 2 mm. The cast-iron contained about 3-5 per cent, of carbon, 1-4 per cent, of silicon, and 0-5 per cent, of manganese.

7. Tube Method. — If the inside of a glass tube is exposed to steam, and the outside to a rapid current of water, or vice versd,, the temperatures of the surfaces of the glass may be taken to be very approximately equal to those of the water and steam, which may be easily observed. If the thickness of the glass is small compared with the diameter of the tube, say one-tenth, equation (1) may be applied with sufficient approximation, the area A being taken as the mean between the internal and external surfaces. It is necessary that the thickness x should be approximately uniform. Its mean value may be determined most satisfactorily from the weight and the density. The heat Q transmitted in a given time rmay be deduced from an observation of the rise of temperature of the water, and the amount which passes in the interval. This is one of the simplest of all methods in practice, but it involves the measurement of several different quantities, some of which are difficult to observe accurately. The employment of the tube form evades one of the chief difficulties of the plate method, namely, the uncertainty of the flow at the boundary of the area considered. Unfortunately the method cannot be applied to good conductors, like the metals, because the difference of temperature between the surfaces may be five or ten times less than that between the water and steam in contact with them, even if the water is energetically stirred.

8. Cylinder Method. — A variation of the tube method, which can be applied to metals and good conductors, depends on the employment of a thick cylinder with a smaU axial hole in place of a thin tube. The actual temperature of the metal itself can then be observed by inserting thermometers or thermo-couples at measured distances from the centre. This method has been applied by Callendar and Nicolson (Brit. Assoc.

Beport, 1897), to cylinders of cast-iron and mild steel, 5 Inches in diam. and 2 feet long, vrith one-inch axial holes. The surface of the central hole was heated by steam under pressure, and the total flow of heat was determined by observing the amount of steam condensed in a

given time. The outside of the cylinder was cooled by water circulating in a spiral screw thread in a very narrow space with high velocity under a pressure of 120 R) per square inch. A very uniform surface temperature was thus obtained. The lines of flow in this method are radial. The isothermal surfaces are coaxial cylinders. The areas of successive surfaces vary as their radii, hence the rate of transmission §/^r varies inversely as the radius r, and is Q/2irrlT, if I is the length of the cylinder, and Q the total heat, calculated from the condensation of steam observed in a time T. The outward gradient is d6/dr, and is negative if the central hole is heated. We have therefore the simple equation — -kdB/dr=.q/iTrlT. (2)

If fc is constant the solution is evidently, ff=a log r--b, where a= — Q/ivklT, and 6 and k are determined from the known values of the temperatures observed at any two distances from the axis. This gives an average value of the conductivity over the range, but it is better to observe the temperatures at three distances, and to assume ft to be a linear function of the temperature, in which case the solution of the equation is still very simple, namely —

8+68^/2=0 log r+b, (3)

where e is the temperature-coefficient of the conductivity. The chief difficulty in this method lay in determining the effective distances of the bulbs of the thermometers from the axis of the cylinder, and in ensuring uniformity of flow of heat along different radii. For these reasons the temperature-coefficient of the conduc- tivity could not be determined satisfactorily on this particular form of apparatus, but the mean results were probably trustworthy to 1 or 2 per cent. They refer to a temperature of about 60° C, and were —

Cast-iron, 0-109 ; mild steel, 0-119, C.G.S.

These are much smaller than Hall's results. The cast-iron con- tained nearly 3 per cent, each of silicon and graphite, and 1 per cent, each of phosphorus and manganese. The steel contained less than 1 per cent, of foreign materials. The low value for the cast-iron was confirmed by two entirely different methods given below.

9. Forbes' s Bar Method. — Observation of the steady distribution of temperature along a bar heated at one end was very early employed by Fourier, Despretz, and others for the comparison of conductivities. It is the most convenient method in the case of good conductors on accoimt of the great facilities which it per- mits for the measurement of the temperature gradient at different points, but it has the disadvantage that the results depend almost entirely on a knowledge of the external heat loss or emissivity, or, in comparative experiments, on the assumption that it is the same in different cases. The method of Forbes (in which the conductivity is deduced from the steady distribution of temper- ature on the assumption that the rate of loss of heat at each point of the bar is the same as that observed in an auxiliary experiment in which a short bar of the same kind is set to cool under con- ditions which are supposed to be identical), is too well known to require detailed description, but a consideration of its weak points is very instructive, and the results have been most remarkably misunderstood and misquoted. 'I'he method gives directly, not k, but k/o. Tait repeated iForbes's experiments, using one of the same iron bars, and endeavoured to correct his results for the variation of the specific heat e. Mitchell, under Tait's direction, repeated the experiments with the same bar nickel-plated, correct- ing the thermometers for stem-exposure, and also varying the conditions by cooling one end, so as to 'obtain a steeper gradient. The results of Forbes, Tait, and Mitchtell, on the same bar, and Mitchell's two results by different methods, are quoted by Landoldt and Bornstein as if they referred to different metals. This is not very surprising, it the values in the following table are compared : —

Table I. Thermal Conductivity of Forbes' s Iron Bar D (1-25 Inches Square). C.Q.S. Units.

Temp. Cent.

Uncorrected for Variation of c.

Corrected for Variation of o.

Forbes.

Tait.

Mitoliell: Cooled.

Forbes.

Tait.

MitcheU: Cooled.

0° 100° 200°

-207

•157

-136

•231

-198

■176

•197

-178 -160

•178 •190 •181

•213

-168

•162

•238 •212 •196

•203 •190 •178

•184 •197 •210

The variation of c is uncertain. The values credited to Forbes are those given by Everett on Balfour Stewart's authority. Tait gives different figures. The values given in the column headed "cooled" are those found by Mitchell with one end of the bar cooled. The discrepancies are chiefly due to the error of the

fundamental assumption that the rate ol cooUng is the same at the same temperature under the very different conditions existing m the two parts of the experiment. They are also partly caused by the large uncertainties of the corrections, especially those of the mercury thermometers under the peculiar conditions of the experi- ^^^^' r. ^ '■esults of Forbes are interesting historically as having been the first approximately correct determinations of conductivity in absolute value. The same method was applied by R W Stewart (Phil. Trans., 1892), with the substitution of thermo- couples (following Wiedemann) for mercury thermometers. This avoids the very uncertain correction for stem-exposure, but it is doubtful how far an insulated couple, inserted in a hole in the bar, may be trusted to attain the true temperature. The other uncer- tainties of the method remain. R. W. Stewart found for pure iron, ^=-175 (1—0015 f) C.G.S. Hall using a similar method found for cast-iron at 50° C. the value -105, but considers the method very uncertain as ordinarily practised.

10. Calorimetric Bar Method.— To avoid the uncertainties of surface loss of heat, it is necessary to reduce it to the rank of a small correction by employing a large bar and protecting it from loss of heat. The heat transmitted should be measured calori- metrically, and not in terms of the uncertain emissivity. The apparatus shown in Fig. 1 was constructed by Callendar and

Fig. 1.

Nicolson with this object. The bar was a special sample of cast- iron, the conductivity of which was required for some experiments on the condensation of steam (Proc. Inst. O.E., 1898). It had a diameter of 4 inches, and a length of 4 feet between the heater and the calorimeter. The emissivity was reduced to one quarter by lagging the bar lilie a steam-pipe to a thickness of 1 inch. The heating vessel could be maintained at a steady temperature by high-pressure steam. The other end was maintained at a tempera- ture near that of the air by a steady stream of water flowing through a well-lagged vessel surrounding the bar. The heat trans- mitted was measured by observing the difference of temperature between the inflow and the outflow, and the weight of water which passed in a given time. The gradient near the entrance to the calorimeter was deduced from observations with five thermometers at suitable intervals along the bar. The results obtained by this method at a temperature of 40° C, varied from -116 to -118 C.G.S. from observations on different days, and were probably more accurate tha^ those obtained by the cylinder method. The %ame apparatus was employed in another series of experiments by Angstrom's method described below.

11. Q-uard-Bing Method. — This may be regarded as a variety of the plate method, but is more particularly applicable to good con- ductors, which require the use of a thick plate, so that the tem- perature of the metal may be observed at different points inside it. Berget {Journ. Phys. vii. p. 503, 1888) has applied this method directly to mercury, and has determined the conductivity of some other metals by comparison with mercury. In the case of mer- cury he employed a column in a glass tube 13 mm. in diam. sur- rounded by a guard cylinder of the same height, but 6 to 12 cm. in diam. The mean section of the inner column was carefully determined by weighing, and found to be 1-403 sq. cm. The top of the mercury was heated by steam, the lower end rested on an iron plate cooled by ice. The temperature at different heights was measured by iron wires forming thermo-junctions with the mer- cury in the inner tube. The heat-flow through the central column amounted to about 7-5 calories in 54 seconds, and was measured by continuing the tube through the iron plate into the bulb of a Bunsen ice calorimeter, and observing with a chronometer to a fifth of a second the time taken by the mercury to contract through a given number of divisions. The calorimeter tube was

calibrated by a thread of mercury weighing 19 milligrams, which occupied eighty-five divisions. The contraction corresponding to the melting of 1 gramme of ice was assumed to be -0906 c.c, and was taken as being equivalent to 79 calories (1 calorie=15-59 mgrm. Hg.). The chief uncertainty of this method is the area from which the heat is collected, which probably exceeds that of the central column, owing to the disturbance of the linear flow by

the projecting bulb of the calorimeter. This may partly account for the discrepancy in the following results : —

Mercury, A=0-02015 C.G.S. Berget. ft=0-01479 „ Weber. „ i=0-0177 „ Angstrom.

12. Variable-Flow MetJiods. — In these methods the flow of heat is deduced from observations of the rate of change of temperature with time in a body exposed to known external or boundary conditions. No calorimetric obser- vations are required, but the results are obtained in terms of the thermal capacity of unit volume c, and the measurements give the diffusivity Jc/c, instead of the calorimetric conductivity 7c. Since both k and c are generally variable with the temperature, and the mode of variation of either is often unknown, the results of these methods are generally less certain with regard to the actual flow of heat. As in the case of steady-flow methods, by far the simplest example to consider is that of the linear flow of heat in an infinite solid, which is most nearly realized in nature in the propagation of tempera- ture waves in the surface of the soil. One of the best methods of studying the flow of heat in this case is to draw a series of curves showing the variations of tem- perature with depth in the soil for a series of consecutive days. The curves given in Fig. 2 were obtained from

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Fig. 2.

the readings of a number of platinum thermometers buried in undisturbed soil in horizontal positions at M'Grill College, Montreal. The method of deducing the diffusivity from these curves is as follows : —

The total quantity of heat absorbed by the soil per unit area of surface between any two dates, and any two depths, %' and x", is equal to c times the area included between the corresponding curves. This can be measured graphically without any knowledge of the law of variation of the surface temperature, or of the laws of propagation of heat waves. The quantity of heat absorbed by the stratum (x'a;") in the interval considered can also be expressed in terms of the calorimetric conductivity k. The heat trans- mitted through the plane x is equal per unit area of surface to the product of To by the mean temperature gradient (dd/dx) and the interval of time, T-T. The mean temperature gradient is found by plotting the curves for each day from the daily observations. The heat absorbed is the difference of the quantities transmitted through the bounding planes of the stratum. We thus obtain the simple equation —

ki ide'/dx') – k"(d0"/dx") =c (area between curves) / (T- T') , (4)

by means of which the average value of the diflusivity k/c can be found for any convenient interval of time, at different seasons of the year, in different states of the soil.

For the particular soil in question it was found that the diffusivity varied enormously with the degree of moisture, falling as low as ~~0010 C.G~~.S. in the winter for the surface layers, which became extremely dry under the protection of the frozen ice and snow from December to March, but rising

to an average of -0060 to ~~0070 in the spring and autumn. The greater part of the diffusion of heat was certainly due to the percolation of water. On some occasions, owing to the sudden melt~~

ing of a surface layer of ice and snow, a large quantity of cold water, percolating rapidly, gave for a short time values of the diffusivity as high as -0300. Excluding these exceptional eases, however, the variations of the diffusivity appeared to follow the variations of the seasons with considerable regularity in successive years. The presence of water in the soil always increased the value of A;/c, and as it necessarily increased c, the increase of h must have been greater than that of k/c.

13. Periodic Flow of Heat. — The above method is perfectly general, and can be applied in any case in which the requisite observations can be taken. A case of special interest and importance is that in which the flow is periodic. The general characteristics of such a flow are illustrated in Fig. 3, showing the propagation

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Fig. 3.

of temperature waves due to diurnal variations in the temperature of the surface. The daily range of temper- ature of the air and of the surface of the soil was about 20° F. On a sunny day, the temperature reached a maximum about 2 p.m., and a minimum about 5 a.m. As the waves were propagated downwards through the soil the amplitude rapidly diminished, so that at a depth of only 4 inches it was already reduced to about 6° F., and to less than 2° at 10 inches. At the same time, the epoch of maximum or minimum was retarded, about 4 hours at 4 inches, and nearly 12 hours at 10 inches, where the maximum temperature was reached between 1 and 2 a.m. The form of the wave was also changed. At 4 inches the rise was steeper than the fall, at 10 inches the reverse was the case. This is due to the fact that the components of shorter period are more rapidly pro- pagated. For instance, the velocity of propagation of a wave having a period of a day is nearly twenty times as great as that of a wave with a period of one year, but on the other hand the penetration of the diurnal wave is nearly twenty times less, and the shorter waves die out more rapidly.

14. A Simple-Harmonic or Sine Wave is the only kind which is propagated without change of form. In treating mathematically the propagation of other kinds of waves, it is necessary to analyse them into their simple-harmonic components, which may be treated as being propagated independently. To illustrate the main features of the calculation, we may suppose that the surface is subject to a simple- harmonic cycle of temperature variation, so that the temper- ature at any time { is given by an equation of the form —

e~e^=Asm2Tnt=Asm2Trt/T, (5)

where 0^ is the mean temperature of the surface, A the amplitude of the cycle, n the frequency, and T the period. In this simple

case the temperature cycle at a depth a; is a precisely similar curve of the same period, but with the amplitude reduced in the pro- portion e"", and the phase retarded by the fraction mx/2ir of a

cycle. The index-coefficient m is (vnc/k)K The wave at a depth X is represented analytically by the equation —

e—ea=Ae”^ sin (_2irnt+ mx) . (6)

A strictly periodic oscillation of this kind occurs in the working of a steam-engine, in which the walls of the cylinder are exposed to, regular fluctuations of temperature with the admission and release of steam. The curves in Pig. 4 are drawn for a particulci’

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Fig. 4.

case, but they apply equally to the propagation of a simple-har- monic wave of any period in any substance changing only the scale on which they are drawn. The dotted boundary curves have

the equation S=Jre””, and show the rate of diminution of the amplitude of the temperature oscillation with depth in the metal. The wave-length in Fig. 4 Is 0-60 inch, at which depth the amplitude of the variation is reduced to less than one-five hun-

dredth part (e) of that at the surface, so that for all practical purposes the oscillation may be neglected beyond one wave- length. At half a wave-

length the amplitude is only l/23rd of that at the surface. The wave-length in any case is 2ir/m.

The diffusivity can be deduced from observations at different depths x' and x", by observing the ratio of the amplitudes, which

is e" " for a simple-harmonic wave. The values obtained in this way for waves having a period of one second and a wave- length of half an inch agreed very well with those obtained in the same cast-iron by Angstrbm's method (see below), with waves having a period of 1 hour and a length of 30 Inches. This agree- ment was a very satisfactory test of the accuracy of the funda- mental law of conduction, as the gradients and periods varied so widely in the two cases.

15. Annual Variation. — A similar method has fre- quently been applied to the study of variations of soil- temperatures by harmonic analysis of the annual waves. But the theory is not strictly applicable, as the phenomena are not accurately periodic, and the state of the soil is continually varying, and differs at different depths, par- ticularly in regard to its degree of wetness. An additional difiiculty arises in the case of observations made with long mercury thermometers buried in vertical holes, that the correction for the expansion of the liquid in the long stems is uncertain, and that the holes may serve as channels for percolation, and thus lead to exceptionally high values. The last error is best avoided by employing platinum thermometers buried horizontally. In any case results deduced from the annual wave must be expected to vary in different years according to the distribution of the rainfall, as the values represent averages depending chiefly on the diffusion of heat by percolating water. For this reason observations at different' depths in the same locality often give very concordant results for the same period, as the total percolation and the average rate are necessarily nearly the same for the various strata, although

-the actual degree of wetness of each may vary considerably. The following are a few typical values for sand or gravel deduced from the annual wave in different localities : —

Table II.

DiffusMty of Sandij Soils.

C.G.8. Units.

Observer.

Soil.

Locality.

Thermo- meter.

Diffus- ivity.

Kelvin, 1860 . Neumann, 1863 Everett, 1860. Angstrom, 1861

Angstrom \ Rudberg . [■ Quetelet . J Callendar, 1895 Rambaut, 1900

Garden sand. Edinburgh. Mercury. Sandy loam. ... ^^ Gravel. Greenwich. „ Sandy clay. Upsala. „

„ ” ” ” >i Coarse sand. „ „

The same soil, place, and nstruments

reduced for different years.

Garden sand. Montreal. Platinum.

Gravel. Oxford. „

•0087

•0136

■0125

•0057

•0045

(-0094

\ -0061

(. -0074

•0036

■0074

The low value at Montreal is chiefly due to the absence of percolation during the winter. Eambaut's results were obtained with similar instruments similarly located, but he did not investigate the seasonal variations of diffus- ivity, or the effect of percolation. It is probable that the coarser soils, permitting more rapid percolaition, would generally give higher results. In any case, it is evident that the transmission of heat by percolation would be much greater in porous soils and in the upper layers of the earth's crust, than in the lower strata or in solid rocks. It is probable for this reason that the average conductivity of the earth's crust, as deduced from surface observations, is too large ; and that estimates of the age of the earth based on such measurements are too low, and require to be raised ; they would thereby be brought into better agreement with the conclusions of geologists de- rived from other lines of argument.

16. Angstrom's Method consists in observing the propagation of heat waves in a bar, and is probably the most accurate method for measuring the diffusivity of a metal, since the conditions may be widely varied and the correction for external loss of heat can be made comparatively small. Owing, however, to the laborious nature of the observations and reductions, the method does not appear to have been seriously applied

since its first invention, except in one solitary instance by the writer to the case of cast-iron (Fig. 1). The equation of the method is the same as that for the linear flow with the addition of a small term representing the radiation loss. The mathematical solution is given in the article Heat {Ency. Brit. vol. xi.), assuming that h and c are bothi constants, and the coefficient of cooling also constant, over the range of the experiment. This is an admissible approxima- tion if the range is small. The apparatus of Tig. 1 was designed for this method, and may serve to illustrate it. The steam pressure in the heater may be periodically varied by the gauge in such a manner as to produce an approximately simple harmonic oscilla- tion of temperature at the hot end, while the cool end is kept at a steady temperature. The amplitudes and phases of the temper- ature waves at different points are observed by taking readings of the thermometers at regular intervals. In using mercury ther- mometers, it is best, as in the apparatus figured, to work on a large scale (4-inch bar) with waves of slow period, about 1 to 2 hours. Angstrom endeavoured to find the variation of conduct- ivity by this method, but he assumed c to be the same for two different bars, and made no allowance for its variation with tem- perature. He thus found nearly the same rate of variation for the thermal as for the electric conductivity. His final results for copper and iron were as follows : —

Copper, A;=0-982 (1 – 0-00152 0) assuming c=-84476.

Iron, ft=0-1988 (1- 0^00287 fl) „ c=-88620. Angstrom's value for iron, when corrected for obvious numerical errors, and for the probable variation of c, becomes — Iron, A:=0-164 (1-0-0013 S),

but this is very doubtful, as c was not measured.

The experiments on cast-iron with the apparatus of Fig. 1 were varied by taking three different periods, 60, 90, and 120 minutes, and two distances, 6 inches and 12 inches, between the thermo- meters compared. In some experiments the bar was lagged with 1 inch of asbestos, but in others it was bare, the heat-loss being

thus increased fourfold. In no case did this correction exceed 7 per cent. The extreme divergence of the resulting values of the diffusivity,

including eight independent series of measurements on different days, was less than 1 per cent. Observations were taken at mean temperatures of 102° C. and 54° C, with the following results : —

Cast-iron at 102° C, i/c=1296, c=-858, ;fc=^1113. „ 54° C.,/c= ■1392, c=-823,A;= -1144.*

The variation of c was determined by a special series of experi- ments. No allowance was made for the variation of density with temperature, or for the variation of the distance between the ther- mometers, owing to the expansion of the bar. Although this cor- rection should be made if the definition were strictly followed, it is more convenient in practice to include the small effect of linear expansion in the temperature-coefficient in the case of solid bodies. 17. Lorentz^s Method. — Neumann, Weber, Lorentz, and others have employed similar methods, depending on the observation of the rate of change of temperature at certain points of bars, rings, cylinders, cubes, or spheres. Some of these results have been widely quoted, but they are far from consistent, and it may be doubted whether the difficulties of observing rapidly varying tem- peratures have been duly appreciated in many cases. From an experimental point of view the most ingenious and complete method was that of Lorentz (TTJeti. Jljin. xiii. p. 422,1881). He deduced the variations of the mean temperature of a section of a bar from the sum S of the E.M.F's. o| a number of couples, inserted at suit- able equal intervals I and connected in series. The difference of the temperature gradients D/l at the ends of the section was simultaneously obtained from the difference D of the readings of a pair of couples at either end connected in opposition. The external heat-loss was eliminated by comparing observations taken at the same mean temperatures during heating and during cooling, assuming that the rate of loss of heat /(/S) would be the same in the two cases. Lorentz thus obtained the equations —

Heating, qh D/l=cql dS/dt+f(S). Cooling, qk Di/l=cql dS'/dt'+f(S'). Whence k=cl\dS/dt-dS'/dti)/(^D-D').

(7)

It may be questioned whether this assumption was justifiable, since the rate of change and the distribution of temperature were quite different in the two cases, in addition to the sign of the change itself. The chief difficulty, as usual, was the determination of the gradient, which depended on a difference of potential of the order of 20 microvolts between two junctions inserted in small holes 2 cms. apart in a bar 1^5 cms. in diameter. It was also tacitly assumed that the thermo-electric power of the couples for the gradient was the same as that of the couples for the mean tem- perature, although the temperatures were different. This might give rise to constant errors in the results. Owing to the difficulty of measuring the gradient, the order of divergence of individual observations averaged 2 or 3 per cent., but occasionally reached 5 or 10 per cent. The thermal conductivity was determined in the neigh- bourhood of 20° C. with a water jacket, and near 110° C. by the use of a steam jacket. The conductivity of the same bars was inde- pendently determined by the method of Forbes, employing an ingenious formula for the heat-loss in place of Newton's law. The results of this method differ 2 or 3 per cent, (in one case nearly 15 per cent.) from the preceding, but it is probably less accurate. The thermal capacity and electrical conductivity were measured at various temperatures on the same specimens of metal. Owing to the completeness of the recorded data, and the great experimental skill with which the research was conducted, the results are prob- ably among the most valuable hitherto available. One important result, which might be regarded as established by this work, was that the ratio Jc/k' of the thermal to the electrical conductivity, though nearly constant for the good conductors at any one temper- ature such as 0° C, increased with rise of temperature nearly in proportion to the absolute temperature. The value found for this ratio at 0° C, approximated to 1500 C.G.S. for the best conductors, but increased to 1800 or 2000 for bad conductors like German silver and antimony. It is clear, however, that this relation can- not be generally true, for the cast-iron mentioned in the last section had a specific resistance of 112,000 C.G.S. at 100° C, which would make the ratio k/k' = 12,500. The increase of resistance with temperature was also very small, so that the ratio varied very little with temperature.

18. Electrical Methods. — There are two electrical meth- ods which have been recently applied to the measurement of the conductivity of metals,

(a) the resistance method, devised by the writer, and applied by him, and also by King and Duncan, (6) the thermo-electric method, devised by Kohlrausch, and applied by Jaeger and Dieselhorst. Both methods depend on the observation of the steady

distribution of temperature in a bar or wire heated by an electric current. The advantage is that the quantities of heat are measured directly in absolute measure, in terms of the current, and that the results are independent of a knowledge of the specific heat. Incidentally it is possible to regulate the heat supply more perfectly than in other methods.

(a) In the praxjtioe of the resistance method, both ends of a short bar are kept at a steady temperature by means of solid copper blocks provided with a water circulation, and the whole is surrounded by a jacket at the same temperature, which is taken as the zero of reference. The bar is heated by a steady electric current, which may be adjusted so that the external loss of heat from the surface of the bar is compensated by the increase of resistance of the bar with rise of temperature. In this case the curve representing the distribution of temperature is a parabola, and the conductivity k is deduced from the mean rise of tem- perature (Ii—li°)/aJS by observing the increase of resistance Jt — R° of the bar, and the current C. It is also necessary to measure the cross-section q, the length I, and the temperature- coefiBcient a for the range of the experiment.

In the general case, the distribution of temperature is observed by means of a number of potential leads. The differential equa- tion for fhe distribution of temperature in this case includes the majority of the methods already considered, and may be stated as follows. The heat generated by the current C at a point x where the temperature-excess is B is equal per unit length and time (t) to that lost by conduction — d{qkd9/dx)/dx, and by radiation hp8 (emissivity h, perimeter^), together

with that employed in raising the temperature q(^/dt, and absorbed by the Thomson effect sCdff/dx. We thus obtain the equation —

C^B„(l+ae)/l=-d(qkde/dx)/dx+hpe+qcde/dt+sCde/dx. (8)

If C=0, this is the equation of Angstrom's method. If h also is zero, it becomes the equation of variable flow in the soil. If d9/dt=0, the equation represents the corresponding cases of steady flow. In the electrical method, observations of lie variable flow are useful for finding the value of c for the specimen, but are not otherwise required. The last term, representing the Thomson effect, is eliminated in the case of a bar cooled at both ends, since it is opposite in the two halves, but may be determined by observ- ing the resistance of each half separately. If the current C is chosen so that O'^B^a^hpl, the external heat-loss is compensated by the variation of resistance with temperature. In this case the solution of the equation reduces to the form —

e=x(l-x)Cmj2lqk. (9)

By a property of the parabola, the mean temperature is 2/3rds of the maximum temperature, we have therefore —

(iJ-iJ<,)/aiJ„=iC2iJ„/12gft, (10)

which gives the conductivity directly in terms of the quantities actually observed. If the dimensions of the bar are suitably chosen, the distribution of temperature is always very nearly parabolic, so that it is not necessary to determine the value of the critical current C^=hpl/a]i^ very accurately, as the correction for external loss is a small percentage in any case. The chief difficulty is that of measuring the small change of resistance accurately, and of avoiding errors from accidental thermo-electric effects. In addition to the simple measurements of the conduct- ivity (M'Gill College, 1895-96), some very elaborate experiments were made by King (Proc. Amer. Acad., June 1898) on the temperature distribution in the case of long bars with a view to measuring the Thomson effect. Duncan (M'Gill College Re- ports, 1899), using the silnple method under King's supervision, found the conductivity of very pure copper to be 1'007 for a temperature of 33° C.

(6) The method of Kohlrausch, as carried out by Jaeger and Dieselhorst (^Berlin Acad., July 1899), consists in observing the difference of temperature between the centre and the ends of the bar by means of insulated thermo-couples. Neglecting the external heat-loss, and the variation of the thermal and electric conductivities k and k', we obtain, as before, for the difference of temperature between the centre and ends, the equation —

e^-e^=C^Bl/Sqk=ECl/8q=E^ki/8k, (11)

where E is the difference of electric potential between the ends. Lorentz, assuming that the ratio k/k'=ae, had previously given — '"»^-«c'=-^V4«, (12)

which is practically identical vrith the preceding for small differ- ences of temperature. The last expression in terms of k/k' is very simple, but the first is more useful in practice, as the quantities actually measured are E, C, I, q, and the difference of temperature.

The current C was measured in the usual way by the difference of potential on a standard resistance. The external heat-loss was estimated by varying the temperature of the jacket surrounding the bar, and applying a suitable correction to the observed differ- ence of temperature. But the method (o) previously described appears to be preferable in this respect, since it is better to keep the jacket at the same temperature as the end-blocks. Moreover, the variation of thermal conductivity with temperature is small and uncertain, whereas the variation of electrical conductivity is; large and can be accurately determined, and may therefore be legitimately utilized for eliminating the external heat-loss.

From a comparison of this work with that of Lorentz, it is; evident that the values of the conductivity vary widely with the purity of the material, and cannot be safely applied to other specimens than those for which they were found.

19. Conduction in Oases and Liquids. — The theory of conduction of heat by diffusion in gases has a particular interest, since it is possible to predict the value on certain assumptions, if the viscosity is known. Some

account of this will be found in the article on Diffusion of Gases, or in Meyer's Theory of Gases. The experimental investi- gation presents dif&culties on account of the necessity of eliminating the effects of radiation and convection, and the results of different observers often differ considerably from theory and from each other. The values found for the conductivity of air at 0° C. range from -000048 to •000057, and the temperature-coefficient from ~~0016 to •0028. The result should be independent of the pressure within wide limits if molar convection is eliminated, and should be proportional to the product of the viscosity and the specific heat at constant volume ; but the numer~~ ical factor is probably different for different gases accord- ing to the complexity of the molecule.

The conductivity of liquids has been investigated by similar methods, generally variations of the thin plate or Guard-Ring method. A critical account of the subject is contained in a paper by Chree (Phil. Mag., July 1887). Many of the experiments were made by comparative methods, taking a standard liquid such as water for reference. A recent determination of the conductivity of water by Milner and Chattock, employing an electrical method, deserves mention on account of the careful elim- ination of various errors (Phil. Mag., July 1899). Their final result was fc= •001433 at 20° C, which may be compared with the results of other observers, Lundquist (1869), ^00155 at 40° C. ; Winkelmanri (1874), -00104 at 16° C. ; Weber (corrected by Lorberg), ^00138 at 4° C, and ^00152 at 23^6° C. ; Lees (Phil. Trans., 1898), ^00136 at 25° C, and ^00120 at 47° C. ; Chree, ^00124 at 18° C, and -00136 at 19-5° C. The variations of these results illustrate the experimental difficulties. It appears prob- able that the conductivity of a liquid increases consider- ably with rise of temperature, although the contrary would appear from the work of Lees. A large mass of material has been collected, but the relations are obscured by experimental errors. (h. l. c.)

Coney island, a sand bar at the west end of the south shore of Long Island, New York, U.S.A., within the corporate limits of Greater New York City. It is five miles long east and west, and about a mile in average breadth, and is separated from the mainland by a nairow creek and a stretch of marsh. It is about ten miles distant from the centre of Brooklyn,

with which it is connected by several lines of railway, while with New York in summer it is connected by several lines of steamboats. It is a popular resort for the metropolis. On a fine sandy beach five miles in length, which gently shelves to the Atlantic and has little undertow, several seaside places — Manhattan Beach, Brighton Beach, West Brighton, and West End — face the sea. The first two have immense hotels, with ample pleasure-grounds and bath-houses. West Brighton is, in the season, the most crowded and most popular. All the

fun of the fair is to be found there, and the scene on a fine Sunday in summer beggars description.

Confession. — The confession of sins is commanded in the New Testament (James v. 16 ; 1 John i. 9) ; and it has always formed part of Christian worship. But further questions arise. To whom is the confession to be made ? To the Church, or to a priest, or to one's neighbour ; or is it due to God alone ? Must all sins be confessed, or only the most heinous ? Must they be counted up, and specified in detail ? Again, all Christians agree that God fprgives the sins of the penitent, and baptism is generally regarded as the sacrament of forgiveness; but is there further provision for sins committed by baptized Christians, who (it is agreed) cannot be baptized again ? Has any authority to convey and apply God's pardon been given to man beyond the command to baptize ?

Once more, it is generally agreed that to the Church or her ministers belong the right and the duty of excom- municating notorious sinners ; and therefore (as most have thought) of readmitting them to communion, when satis- fied of the genuineness of their repentance. But disputes on this subject gave rise to bitter struggles in early days (see Ency. Brit., 9th ed., arts. Montanism, Novatian, DoNATiSTs), and the modes of exercising discipline and ascertaining penitence have varied widely in the Church. Moreover, the most deadly sins are by no means always notorious, and the publication of some offences would only produce further scandal and mischief ; and so there grew up a sort of compromise between public

discipline and private confession to God alone ; and the existing penitential systems of the Roman and Greek Churches have their roots rather in Church discipline and questions of admis- sion to, and refusal of, communion than in the need the pious sinner feels of being personally reconciled to God. In the Middle Ages a theory that each sin, even though the sinner be forgiven by God, entails a definite quantity of purgative punishment, and so constitutes a debt to be discharged either in this world or the next, caused the idea of the reconciliation of the penitent to be further obscured by that of assessing his penalty; and in consequence it was necessary that he should in his confession enumerate all his " mortal " sins, reckoning up as precisely as possible the exact number of times he had been guilty of each. Audit was even held that provided the sinner thus submitted to the tribunal of penance, it did not matter whether he was really contrite or not. But the intricate subject of mediaeval teaching on " satis- faction " and on the sacramental character of penance fall beyond the scope of this article.

Teaching of the Book of Common Prayer. — The Church of England holds since the Eef ormation a central position in this as in many other matters ; and to draw out her teaching will sufiiciently illustrate the different views that are held. The Prayer-Book does not appoint that any public confession of sins shall be made by the adult candidate for baptism, and all it says on the subject is concerned with post-baptismal sin, which (it is implied) can be forgiven, however heinous. Confession of some sort is clearly regarded as a necessary element in the life of every Christian, for (since 1552) it forms part of each of the regular public services of the Church, and this acknowledgment of sin is to be made not merely in private to God, but twice daily (at least by the clergy) in the presence of the congregation. Though these confessions are naturally expressed in general terms, the rubric in the Forms of Prayer to be used at Sea (a service added in 1661) iadicates that each person is intended to apply the words to his own case — " in which (humble confession) everyone ought seriously to reflect upon those particular

sins of which his conscience shall accuse him." Moreover, at the beginning of the Communion service the Ten Com- mandments are recited one by one, and each is followed by a petition for pardon, in such

a way as plainly to imply that each person is secretly to remember and confess his own breaches of each Commandment in turn. Thus the method of confes,sion adopted in the public services of the Church of England, with which the Book of Common Prayer is primarily concerned, may be described as one of general confession to God in the face of the Church, to be in secret used by each member of the congregation for the confession of his own particular sins, and to be followed by public absolution. But three other methods of con- fession for private use are mentioned in the exhortations in the Communion service, which constitute the princi- pal directory for private devotions among the authori- tative documents of the English Church. First, all men are urged to practice secret confession to God alone. Ye are " to examine your lives and conversations by the rule of God's commandments; and whereinsoever ye shall perceive yourselves to have offended, either by will, word, or deed, there to bewail your own sinfulness, and to con- fess yourselves to Almighty God, with full purpose of amendment of life." Here clearly thesius are to be acknow- ledged in detail. Secondly, where the nature of the offence admits of it, the sinner is to acknowledge his wrong-doing to the neighbour he has aggrieved, and so far as he can to make restitution. And thirdly, an d here we reach the chief point of controversy, the sinner who cannot satisfy his con- science by these other methods, is invited to open his grief to a minister of God's Word. Similarly, the sick man is to be moved (this word was inserted in 1661) to make a special confession of his sins if he feel his con- science troubled with any weighty matter. The Prayer- Book does not absolutely require that in this case the penitent should enumerate every sin he has committed ; but evidently he is to unfold the whole of that which burdens his conscience. The priest is bound under the most stringent penalties never to divulge what he has thus learnt. See the 113th Canon of 1604, which, however, excepts crimes, " such as by the laws of this realm the priest's own life may be called into question for conceal- ing the same."

The history of the passages in the Exhortations about private confession is interesting. The first Prayer-Book of Edward VI. (1549) gives direction as follows: — "And if there be any of you whose conscience is troubled and grieved in anything, lacking comfort or counsel, let him come to me, or to some other discreet and learned priest, taught in the law of God, and

confess, and open his sin and grief secretly, that he may receive such ghostly counsel, advice, and comfort that his conscience may be relieved, and that of us (as of the ministers of God and of the Church) he may receive comfort and absolution, to the satisfaction of his mind, and avoiding of all scruple and doubtfulness ; requiring such as shall be satisfied with a general confession not to be offended with them that do use, to their further satisfying, the auricular and secret confession to the priest ; nor those also which think needful or convenient, for the quietness of their own consciences, particularly to open their sins to the priest, to be offended with them that are satisfied with their humble confession to God, and the general confession to the Church." This was considerably shortened in the second Prayer-Book (1552) . The word minister was substituted for priest. The objects of the private ministration are thus described : " that he may receive such ghostly counsel, advice, and comfort as his conscience may be relieved ; and that by the ministry of God's Word he may receive comfort and the benefit of absolution, to the quieting of his conscience and avoiding of all scruple and doubtful- ness." And the words about mutual toleration were unfortunately cut out. Further changes were made in 1661, when the passage was brought into its present shape.

As regards discipline, the rubrics upon the Communion service provide for the exclusion of notorious sinners, and the Commination service regrets the disuse of the public

discipline by which such were punished. The 33rd of the 39 Articles and certain Canons assume the existence of ecclesiastical courts for the excommunication and restoration of such persons; but it is long since such courts were put in motion, and for the most part notori- ous sinners excommunicate themselves.

The Prayer-Book uses very strong language on minis- terial absolution. Power and commandment have been given to ministers to declare and pronounce the remis- sion of sins (Mattins), and Christ's authority, which

was primarily left to the Church, has been committed to the priest for this purpose (Visitation of the Sick ; see also Ordering of Priests). This absolving power is exercised both in the public services of the Church and in private ministrations.

Thus Bishop Latimer in his 6th Sermon on the Lord's Prayer (1552) wrote : " The priest or minister, call him what you will, he hath power given unto him from our Saviour to absolve in such wise as he is commanded by Him ... I would have them that are grieved in con- science to go to some godly man, which is able to min- ister God's Word, and there to fetch his absolution, if he cannot be satisfied in the public sermon ; it were truly a thing which would do him much good ... I may absolve you, as an officer of Christ, in the open pulpit in this wise, ' As many as confess their sins unto God . . . and believe . . . Ego dbsolvo vos; I as an officer of Christ, as His treasurer, absolve you in His Name.' This is the absolution that I can make by God's Word."

The Prayer-Book of 1549 pointed out that the benefit is conditional on the sincerity of the repentance. " For neither the absolution of the priest can anything avail (the impenitent), nor the receiving of this Holy Sacra- ment doth anything but increase their damnation." These words referred primarily, but not exclusively, to the public absolution in the Communion service. It is maintained by some that, except in the case of the sick, the only legitimate method of receiving absolution in the Church of England is in the public services of the con- gregation ; and the Church of Ireland has recently made important alterations even in the passages that concern the sick, while the Protestant Episcopal Church of the United States has omitted that part of the Visitation Service altogether.

The main point of recent controversy in the Church of England has been the question of auricular confession, i.e., confession made into the ear of the priest. Its essential features are that a priest hears the penitent " open his grief" in secret, and if he is satisfied of the sincerity of the repentance, he pronounces a special authoritative absolution. It is common also for him to give "ghostly counsel and advice," technically called " direction." And he may further impose certain con- ditions, such as the restitution of stolen property, and defer the absolution until these have been fulfilled.

The priest thus hears secrets, has to form a judgment on the penitent's sincerity, and may lay definite commands upon the man or woman who has come to consult him. The early history of this practice has been sketched in the article Confession in the 9th edition of this En- cyclopaedia, and it is there stated that it was not the Reformers' intention to abolish it, but that it was still common even at the end of the 17th century for priests to hear confessions. It is probably not too much to say that auricular confession has never altogether died out in the Church of England, but it is obvious that evidence on the subject must always be hard to find. Eecently there has been a great increase and development of the practice, dating from the Oxford Movement in the early part of the 19th century. Two chief difficiilties have attended this revival. In the first place, owing to the

general disuse of such ministrations, there were very few English clergy who had experience in delicate questions of conscience; and there had been no treatment of casuis- try since Sanderson and Jeremy Taylor (see Ency. Brit, 9th ed., Casuistet). Those, then, who had to hear peni- tents unburden their souls were driven to the use of Roman writers on the subject. A book called ITie Priest in Absolution was compiled, and at first privately circu- lated among the clergy ; but in 1877 a copy was produced in Parliament, and gave rise to much scandal and heated debate, especially in the House of Lords and in the newspapers. In the following year Dr Pusey published a translation of the Abbe Gaume's Manual for Con- fessors, abridged and " adapted to the use of the English Church." The other chief difficulty arose from the absence of any authoritative restraint on the hearing of confessions by young and unqualified priests. With characteristic love of liberty, the Church of England allows the penitent who wishes for special help to resort to any " discreet and learned minister," instead of send- ing him to his parish priest, as is the Eoman rule (though in practice there are large exceptions). In 1873 a peti- tion signed by 483 clergy was presented to Convocation asking for the " education, selection, and licensing of duly qualified confessors." The bishops declined so to act, but drew up a report on the subject of confession. The question excites the keenest feeling, and extreme views are held on either side. On the one hand, it is suggested that indecent questions might be asked of the young and innocent ; and that frequent

secret interviews give rise to scandal if not to sin. None will deny the reality of this last risk, but it may be doubted whether any other method of individual dealing with souls does not lead to the same dangers ; and the greater formality of confession, especially if it takes place in church, may even afford something of protection to both sides. In consequence of recent outcry, inquiry was made in 1900 by the bishops, at the request of the House of Lords, into the number of confessional-boxes erected in parish churches within their dioceses. On investigation, the number of alleged cases dwindled into a mere handful. In 1898 the Bishop of Salisbury advised ” the minister to sit within the altar rails . . . and to let the penitent kneel outside it” (Considerations on Public Worship and on the Ministry of Penitence). On the other hand, there are those who speak as if auricular confession were a necessary element in every Christian life (it is obligatory in the Soman Church at least once a year), and hold that post-baptismal sin of a grave sort can receive for- giveness in no other way. Such a view cannot be found within the covers of the English Prayer-Book.*

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(W. 0. B.)

Confirmation. — Confirmation, in the religious sense, is the initiatory rite supplementary to and com- pleting baptism, which is especially connected with the gift of the Holy Ghost to the candidate. The word ” con- firmation ” has only been used in this technical sense since the 5th century, and only in the Western Churches of Christendom and in their offshoots; but the rite itself has been practised in the Church from the beginning. The history of confirmation has passed through three stages.

In the first ages of the Church, when it was recruited chiefly by converts who were admitted in full age, con-

firmation, or the laying-on of hands (Heb. vi. 2), followed close upon baptism, and in the majority of cases the two were combined in a single service. But only the highest order of ministers could confirm (see Acts viii. 14-17) ; whereas priests and deacons, and in an emergency lay men and even women, could baptize. There was therefore no absolute certainty that a believer who had been bap- tized had also received confirmation (Acts xix. 2). But two circumstances tended to prevent the occurrence of such irregularities. In the first place, there were in early days far more bishops in proportion to the number of believers than is the custom now ; and secondly, it was the rule (except in cases of emergency) to baptize only in the season from Easter to Pentecost, and the bishop was always present and laid his hands on the newly baptized. Moreover, in the third and fourth centuries the infants of Christian parents were frequently left unbaptized for years, e.g., Augustine of Hippo. Later, when the Church had come to be tolerated and patronized by the State, her numbers increased, the rule that fixed certain days for baptism broke down, and it was impossible for bishops to attend every baptismal service. Thereupon East and West adopted different methods of meeting the difficulty. In the East greater emphasis was laid on the anointing with oil, which had long been an adjunct of the laying-on of hands : the oil was consecrated by the bishop, and the child anointed or " sealed " with it by the parish priest, and this was reckoned as its confirmation. With its bap- tism thus completed, the infant was held to be capable of receiving Holy Communion. And to this day in the Eastern Church the infant is baptized, anointed, and communicated by the parish priest in the course of a single service ; and thus the bishop and the laying-on of hands have disappeared from the ordinary service of con- firmation. The West, on the other hand, deferred con- firmation, not at first till the child had reached years of discretion, though that afterwards became the theory, but from the necessities of the case. The child was baptized at once, that it might be

admitted to the Church, while the completion of its baptism was put off till it could be brought to a bishop. Western Canons insist on both points at once ; baptism is not to be deferred beyond a week, nor confirmation beyond seven years. And to give an historical example, Henry VIII. had his daughter, afterwards Queen Elizabeth, both baptized and con- firmed when she was only a few days old. And still the rubrics of the English Prayer-Book direct that the person who is baptized as an adult is to " be confirmed by the bishop so soon after his baptism as conveniently may be."

But Theologians in the West had elaborated a theory of the grace of confirmation, which made its severance from baptism seem natural; and at the time of the Eeformation, while neither side favoured the Eastern practice, the Eeformers, with their strong sense of the crucial importance of faith, emphasized the action of the individual in the service, and therefore laid it down as a rule that confirmation should be deferred till the child could learn a catechism on the fundamentals of the Chris- tian faith, which Calvin thought he might do by the time he was ten. Many of the Protestant bodies have aban- doned the rite, but it remains among the Lutherans (whether Episcopal or not), and in the group of churches in communion with the Church of England.

At the last revision of the Book of Common Prayer an addition was made to the service by prefixing to it a solemn renewal of their baptismal vows by the candidates in their own persons ; and in the teeth of history and of the wording of the service, this has often been taken ,to be the essential feature of confirmation. Practically, the preparation of candidates for confirmation is the most

important and exacting duty of the parish priest, as the administration of the rite is the most arduous of a bishop's tasks ; and after a long period of slovenly neglect, these duties are now generally discharged with great care : classes are formed and instruction is given for several weeks before the coming of the bishop to lay on hands " after the example of the Holy Apostles " (prayer in the Confirmation Service). Of late years there has been a controversy among Anglican theologians as to the exact nature of the gift conveyed through confirmation, or in other words whether the

Holy Spirit can be said to have come to dwell in those who have been baptized but not confirmed. The view that identifies confirmation rather than baptism with the Pentecostal outpouring of the Spirit on the Church has had to contend against a long- established tradition, but appeals to Scripture (Acts viii. 16) and to Patristic teaching.

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(w. O. B.)

Confirmation of Bishops. — In canon law, con- firmation is the process by which the election of a new bishop receives the assent of the episcopate. This can be traced back to the 3rd century, and indeed may be said to be involved, in principle, in the fact of consecrar tion. From the 4th century it has been regarded as the definite ratification of the election by the bishops of the province (Cone. Nic. can. iv.) ; and by degrees it has come to be made, as a rule, through the metropolitan, and very often at the will of the civil power. In the East it has to a large extent thrown the actual election into the shade. In the churches of the Roman commun- ion the right of confirmation, like many other episcopal rights, has gradually been appropriated by the papacy. Eor a time indeed, from the 14th century onwards, the. popes reserved to themselves the whole appointment of bishops. This is no longer the case, but the confirma- tion of bishops is still in their hands, however they may have been chosen. In England various attempts were made before, the Reformation to resist this tendency. One of the demands of the English Embassy sent to Bruges in 1373 was that confirmation should remain in the hands of the metropolitan ; and in 1415 an ordinance was passed, having the force of law, directing that during the voidance of the papal see bishops-elect should be con- firmed by their metropolitan, according to ancient custom and the practice of foreign churches. In accordance with this, Chichele confirmed John Wakering, elect of Nor- wich, in 1416. At the Reformation the share of the papacy in appointing bishops was abolished, but the con- firmation became almost formal in character. By 25 Hen.*

VIII. c. 20, s. 4, it is provided that after an episcopal election a royal mandate shall issue to the archbishop of the province ” requiring him to confirm the said election,” or, in case of an archbishop-elect, to one archbishop and two bishops, or to four bishops, ” requiring and command- ing ” them ” with all speed and celerity to confirm ” it. This practice still prevails, in the case of dioceses which have chapters to elect. The confirmation has usually been performed by the archbishop’s vicar-general, and, in the southern province, at the church of St Mary-le-Bow, London ; but since 1901 it has been performed, in part, at the Church House, Westminster, in consequence of the disorder in the proceedings at Bow Church on the con- firmation there of Dr Winnington Ingram as Bishop of London. All objectors are cited to appear on pain of contumacy after the old form; but although the know-

ledge that opposition might be offered has been a safe- guard against improper nominations, e.g., in the case of Dr Clarke the Arian, confirmation has never been refused since the Reformation. In 1628 Dr Eives, acting for the vicar-general, declined to receive objections made to Eichard Montague’s election to the see of Chichester on the ground that they were not made in legal form. An informal protest against the confirmation of Dr Prince Lee of Manchester in 1848 was almost immediately followed by another in due form against that of Dr Hampden, elect of -Hereford. The vicar-general refused to receive the objections, and an application to the Queen’s Bench for a mandamus was unsuccessful, the judges being divided, two against two. In 1869, at the confirmation of Dr Temple’s election as Bishop of Exe- ter, the viear-general heard counsel on the question whether he could receive objections, and decided that he could not. When the same prelate was elected to Can- terbury, the course here laid down was followed, as also at the confirmation of Dr Creighton’s election to the see of London. Objections were again raised, in 1902, against Dr Gore, elect of Worcester ; and an application was made to the King’s Bench for a mandamus against the archbishop and his vicar-general when the latter de- clined to

entertain them. By a unanimous judgment (10th February) the Court, consisting of the L. C. J. (Lord Alverstone) and Justices Wright and Ridley, refused the mandamus. Without deciding that objections (e.g., to the identity of the elect, or the genuineness of documents) could never be investigated by the vicar-general or .the archbishop, it held that they could not even entertain ob- jections of the kind all

Authorities. — Thomassinus. Vetus et Nova Diseiplina, pars il. lib. ii. tit. 1-4. — Gibson. Codex juris ecclesiastici anglicani, tit. i. cap. 5. — R. Jebb. Beport of the Sampden Case. London, 1849. — Phillimoee. Ecclesiastical Law, pp. 36-47. London, 1895. — Art. "The Confirmation of Archbishops and Bishops" in the Guardian for Jan. 20, 1897, pp. 106-7.

(w. E. Co.)

Congleton, a municipal borough and market-town of England, on the Dane, 8 miles south-south-west of Macclesfield, in the Macclesfield parliamentary division of the county of Chester. Station on the North Stafford- shire Railway, and situated on the Macclesfield Canal. The town is divided into three wards, under 6 aldermen and 18 councillors. There are four Ecclesiastical parish churches and a Roman Catholic church. A Congregational chapel was erected in 1877, and a Unitarian chapel in 1883. A Primitive Methodist chapel was rebuilt in 1890. There are Church of England, a Roman Catholic, and Wesleyan schools. The industries include fustian, towel, couch, chair, and nail factories, iron and brass foundries, stone quarries, and corn mills. Area of "municipal borough, 2572 acres. Population (1881), 11,116; (1891),

10,744 ; (1901), 10,706.

Congo, formerly known also as Zaire, the largest and second in length of the rivers of Africa, and second in size of all the rivers of the world, with a length of probably at least 3000 miles, and a drainage area, accord- ing to the calculation of Dr Bludau, of 1,425,000 square miles. This vast area, measuring some 1400 miles in either diameter, falls from all sides to the Equatorial basin by which the interior plateaux of Africa are broken in the west, and which seems once to have been occupied

by an inland sea, having its deepest part somewhat south of the Equator, and in about 17°-18° E. To the west and north this basin is bounded by comparatively narrow bands of higher ground, while to the east and south the drainage area of the river includes considerable portions of the high plateau lands of East and South Africa. The main drainage of the Congo system is thus to the north and west, and these two directions dominate the great sweep of the main stream before it is deflected south on approaching the western highlands, through which it finally forces a way to the Atlantic Ocean. From the high lands of the south and east the land falls in a succession of steps, generally marked by gorges or rapids in the course of the streams. Many of these occur along a line of broken country, sometimes known as the Mitumba Mountains, which previous to the cutting of the gorges may have held back a series of extensive lakes, now in great part drained, in the upper valleys of the separate streams.

Head-Streams. — The most remote of these, the Chambezi, rises, with the Chozi and other feeders, on the southern versant of the high plateau between Lakes Nyasa and Tanganyika, at an elevation of about 6000 feet above the sea. Its source is placed by Mr L. A. Wallace in about 9° 6′ S., 31° 20′ E., while the Chozi rises in the same lati- tude about half a degree to the east. After the junction of the two streams, the Chambezi skirts the southern borders of the Awemba country, receiving many tributa- ries, and soon becoming a wide river with steep wooded banks and many islands. The river enters Lake Bang- weulu at its south-east corner, the actual mouth being apparently choked with aquatic vegetation, through which narrow channels admit the passage of canoes. When seen in 1899 by Codrington, about 15 miles from the lake, it had a width of 2 miles and a depth of 19 feet, the altitude being here 3800 feet. Near the south point of Bangweulu, in 11° 31′ S., the Luapula makes its exit through a vast marsh, with isolated lakelets, the whole of which was surveyed by Weatherley in 1896-99. In about 12° S. the Luapula, after receiving the Luombwa and Moengashe from the south, turns north and precipi- tates itself down the Mumbotuta Falls, the thunder of which can be heard on a still night 8 or 9 miles. The river, the width of which varies from 250 to 1200 yards, is almost unnavigable until below the Johnston Falls (Mambilima of the natives), a series of rapids extending from 10° 46′ to 10° 33′ S. Before entering Lake Mweru the Luapula again passes through

a swampy region of deltaic character, the water escaping eastwards by various channels, and after spreading over a wide area, finally passing into Mweru by lagoon-like channels east of the main Luapula mouth. The most southerly portion of the lake, a shallow bay extending to south., lies west of the Luapula, from which it is separated by a tongue of land. Although generally deeper than Bangweulu, Mweru (2800 feet) seems to have decreased in extent, the cliffs to the west being bordered by a strip of low ground once covered with water. The Luapula (known also as the Lufira) makes its exit at the north-west corner of the lake, and bending westwards in a winding course, passes, with many rapids, across the zone of the Mitumba Mountains, falling during this interval nearly 1000 feet. Practically the whole course of the river has been explored by Captain Hinde, Lieutenant Brasseur, and others, with the result that the lake formerly marked on the maps as Lange or Ulenge is proved to be non-existent. In about 6° 40′ S. the Luapula joins the Kamolondo, the western main branch of the Upper Congo, which, as it flows in a broad level valley at a lower level than the eastern branch, is held by some to be the true head-stream. Four principal streams — the Kuleshe, Lubudi, Nzilo' or Lualaba, and Lufira, all

rising on the southern limits of the Congo basin, between 11° and 12° S. — combine to form the Kamolondo, the val- ley of which contains many small lakes and backwaters. The Nzilo and Lufira pass through the Mitumba Moun- -tains in deep gorges, their courses being broken by rapids for distances of 40 to 60 miles.

The Upper Congo or Lualaba. — During its northerly 'Course to the Equator, the united stream of the Congo — after breakiug through the ridge of the Bambara Hills in another series of rapids in 4°-3° S. — becomes a majestic river, often over a mile wide, with flat wooded banks, the only real impediment to navigation between 4i° and the Stanley Falls being the rapids near Nyangwe m 3° 55', and at TJkassa in 3° 15'. Between the junction of the two main upper branches (about 1700 feet above the sea) and the first of the Stanley Falls (1520 feet) the fall of the

river is less than 200 feet, in a distance of 500 miles. During the whole of this section the Lualaba receives most of its tributaries from the east. Of these, the Lukuga, the outflow from Lake Tanganyika, has been followed throughout its whole length, and has been found to be broken by rapids, falling 1000 feet during its course -of some 300 miles. Farther north the streams which 'drain the forest region between 4° S. and the Equator have been only partially explored, the Elila or Lira, the Urindi, and the Lowa being the most important. Their • sources lie on an upland region west of the Central -African rift valley. The Urindi in its middle course - has a general width of 60 to 100 yards, but the Lowa :is larger, receiving two important afluents, the Ozo •and Luvuto, both from the north. Its lower course is very tortuous.

The Middle Congo. — ^After passing the Stanley Falls, — '7 in number besides minor rapids, with a total fall of ;some 200 feet, — the Congo enters, at an altitude of some 1320 feet, the great alluvial plain of West Equatorial Africa, assuming a westerly direction, and also changing :its character. This section of the river, navigable for a ■distance of at least 1000 miles, may be designated the Middle Congo. Gradually widening out and becoming .strewn with low alluvial islands, it forms great lacustrine ■expansions, sometimes (as, e.g., in 21° and 22° 30′ E.) 16-20 miles wide, but is from time to time contracted by the approach of high ground on either side. The islands, like the banks, which appear to be often raised above the level of the surrounding country, are forest-clad, but are inun-dated at high water. In 22° E. the river reaches its most northern point (about 2° 12′ N. on the north bank), be- yond which its course gradually bends south, and in 2° ~~45′ S., on approaching the western continental highlands, it again contracts to a width of a mile and under, remain~~ ing, however, unbroken by rapids until after passing the lake-like expansion of Stanley Pool. Here its elevation •above the sea is just over 1000 feet.

Northern Tributaries. — Of the right bank tributaries of the Middle Congo, the Chopo and Lindi, which enter by ■ one mouth in about 25° 4′ E., are little known. Their basins do not extend to the Outer Congo watershed, but the next feeder, the great Aruwimi, was found by Stanley to rise, as the Ituri, in close proximity to Albert Nyanza, flowing generally from east to west. It is formed of many branches, including the Nepoko

from the north, and its upper basin extends over 2|-° of latitude. The upper river, to about 27° E., is much broken by rapids, but apart from those of Yambuya in 25°, which form the limit of navigation from the mouth, the lower section is generally navigable. The Aruwimi flows almost entirely through the great equatorial forest, which here seems to reach its maximum density. The next tributary, the Eubi, rises in about 26° E., and flowing generally west, joins the Congo by two mouths, 22° 40'-50'. Within the

bend of the Ubangi, the greatest northern tributary, the Mongalla or Dua flows in a somewhat similar curve (on a smaller scale) from beyond 23° E. The identity of the Ubangi with the Welle of Schweinfurth was finally proved by Vangele in 1888, and its upper basin has since been explored by French and Belgian officers. Next to the Welle (principal tributary Bomokandi, from the south), its largest upper branch is the Mbomu, which, rising in 27° 12′ E., 4° 50′ S., on the confines of the Bahr- el-Ghazal region, itself receives two large streams, the Shinko and Bali, from the north. The junction of the Welle and Mbomu is in 22° 37′ E., and a short distance farther west the Kotto, coming from beyond 8° N., on the borders of Darfur, and forming the most northerly extension of the Congo basin, enters the united stream on the right bank. The remaining tributaries (still mostly coming in on the right bank) are smaller, but the Kemo, which joins the Ubangi near its most northern point (5° 8′ N.), is of some importance as offering water- communication within a short distance of the Shari basin. The Upper Ubangi is broken in many places by rapids, between which are navigable stretches in which the river is often (especially west of 25°) wide and strewn with islands. The Zongo series of rapids near the great bend of the Ubangi, do not form an insuperable obstruc- tion at all states of the river, but navigation is quite blocked by the MokwanguFalls in 23°5'E. (lOfeet), by the rapids of Goie (the worst on the upper river) in 25°, and by those of Panga in 26° 40'. A little below the mouth of the Ubangi, the Sanga, a large stream flowing from north to south, enters the Congo. Its lower course is tortuous, as it flows across level, often swampy, plains ; but though comparatively narrow, it is navigable for a long distance. The main northern branch rises in southern Adamawa in about 7° N., while an almost equally large western branch, the Ngoko, rises in the German territory of Cameroon

(probably in about 12° 10′ E.), traversing a vast tract of uninhabited forest. It is navigable to about 13° 40′ E. The Likuala, Licona, and Alima, which all join the Congo within 30 miles of the mouth of the Sanga, are much smaller streams. The Licona is still almost unexplored.

Southern Tributaries. — The first of the southern tribu- taries of the Middle Congo, the Boloko or Lubilash of Grenfell, which enters in 24° 17′ E., has been proved to be identical with the Lomami of Cameron, rising in nearly 9° S., and thus flowing through more than nine degrees of latitude. Its course is generally parallel to the Upper Congo, which it approaches within 40 miles between 2° and 3° S. It is comparatively narrow and tortuous, but deep, with a strong current, and is hardly broken by rapids north of 4° S. About 3° S. it traverses a region of swamps, which may have given rise to reports of a great lake in this locality. Below the mouth of the Lomami there is a long stretch with no southern tributary, as the great plain within the Congo bend is drained by streams flowing from east to west parallel to the main river. The northern branch of the Lulonga, which enters in 0° 40 'N., approaches the latter within 20 miles in its upper course. The main branch of the Kuki, which enters just north of the Equator, and the Lukenye or Lukeni, the northern unit of the great Kasai system, have their sources between 24° and 25° E. in the vicinity of the Lomami swamp above alluded to. These streams have tortuous courses, for the most part not broken by rapids, flowing across a level country once occupied by a lake, of which the present Lake Leo- pold II., connected with the lower course of the Lukenye, is the scanty remnant. Its shores are low and inundated in the rains, so that its outline is very ill-defined. Besides the Lukenye, the chief units of the Kasai system all flow north in parallel courses before acquiring the east to west

direction of the Lower Kasai on reaching the latitude of 3°-4° S. The most important in order from east to west are the Lubefu, Lubilash or Sankuru, Lulua ; Upper Kasai, with its tributaries Luembo, Chihumbo, Luajimo, Chikapa, and Lowo; Loange, Juma or Kwilu, Wamba, and Kwango, the last three uniting before joining the Kasai. Most of these are

broken by rapids along a line running from north-east to south-west between 5° and 8° S., which marks the descent from the higher to the lower plateau; but their lower courses are navigable. The Lulua, Kasai, Chihumbo, and Kwango all spring from the southern Congo watershed, traced in 1899-1900 by the Belgian expedition under Lemaire, who showed the incorrectness of the old idea that the basins of the Congo and Zambezi are connected through Lake Dilolo. This small lake, though situated on the water-parting, was found to have normally no connexion with either system, though apparently sending water to the Zambezi after heavy rains. Near its mouth the Kasai, which in its lower course is generally a broad stream strewn with islands, is narrowed to about half a mile on passing through a gap in the first line of the West African high-lands, by the cutting of which the old lake of the Kasai basin must have been drained.

The Lower Congo. — As already stated, the Congo is greatly narrowed on first reaching, the more elevated ground in 2° 45′ S. ; the actual rapids, however, begin only imniediately below Stanley Pool. The whole system of highlands (sometimes known generally as the Serra do Crystal) seems to consist of two principal mountain zones with an intermediate zone of lower elevation. The passage of this last is marked by a more navigable stretch on the Lower Congo, extending from Manyanga to Isangila — a distance of 70 miles, during which the only serious rapids are those of Chumbo and Itunzima, the latter in 13° 54′ E. ; while above and below, rapids succeed each other at short intervals. Some eighteen main rapids or falls occur dur- ing the upper section (87 miles), in the course of which the level drops about 500 feet ; and about ten in the lower sec- tion (66 miles), during which the fall is about 300. The last rapid occurs a little above Matadi, beyond which the river is navigable for large vessels to the sea, a distance of about 85 miles. It gradually widens out into an estuary, bordered by creeks and islands of a deltaic character and traversed by a deep canon, in which soundings of 900 feet have been obtained. This canon or gully is continued into the open sea for over 100 miles, with depths as much as 4000 feet below the general level of the sea floor. Just below Matadi, where the width is about half a mile, depths of 276 and 360 feet have been found, the current here run- ning at from 4 to 8 knots, according to the season; while the difEerence in level between high and

low water (not in any way due to tidal action) is 20-25 feet. The tides are felt as far as Bom a, but the rise is here not above 1 foot ; while at the mouth of the river it is 6 feet. The investi- gations carried out by Commander Puiey-Cust in 1899 showed that the canon above mentioned is occupied by salt water, which is nearly motionless. Above it the fresh water runs with increasing velocity, but decreasing depth, so that just within the mouth of the river it reaches only a few feet from the surface. (b. he.)

Congo, a Portuguese district on the west coast of Africa, comprising the territory of Kabinda on the north side of the Congo and the northern parts of the province of Angola on the south side of the river. Its exports embrace oil, india-rubber, coffee, cocoar-nuts, gums, and ivory ; and the export trade increased from £149,100 in 1888 (the first full year of the Portuguese administration) to £222,000 in 1896. The chief town is Kabinda, on the coast, 35 miles north of the mouth of the Congo.

Congo Free State. — The Congo Free State (Etat Indipendant du Congo) is one of the largest of the political divisions of Equatorial Africa. It occupies a unique position among modern states, as it may be said to owe its existence to the ambition and force of character of a. single individual. It dates its formal inclusion among- the independent states of the world from 1885, when its founder, Leopold II., king of the Belgians, became its head. But to understand how it came into existence, a brief account is needed of its Sovereign's connexion with the African continent. In 1876 King Leopold summoned a conference at Brussels of the leading geographical ex- perts in Europe, which resulted in the creation of " The International Association for the Exploration and Civili- zation of Africa." To carry out its objects an International Commission wasfounded, with Committees in the principal countries of Europe. Committees were in fact so estab- lished, but the Belgian Committee at Brussels, where also were the headquarters of the International Com- mission, displayed from the first greater activity than did any of the other committees. It turned its attention in the first place tef East Africa, and several expeditions were sent out, which resulted in the founding of a. Belgian station at Karema on Lake Tanganyika. But the return of Mr (afterwards Sir) H. M. Stanley from his great journey of exploration down

the Congo, forcibly- directed the attention of King Leopold to the possi- bilities for exploration and civilization offered by thfr Congo region. On the invitation of the king, Mr Stanley visited Brussels, and on November 25th 1878 a separate committee of the International Association was organized at Brussels, under the name " Comity d'^tudes du Haut Congo." Shortly afterwards this committee became the- " International Association of the Congo," which in its turn was the forerunner of the Congo Free State. The Association was provided with a nominal capital of £40,000, but from the first its funds were largely supple- mented from the private purse of King Leopold ; and by a gradual process of evolution the work, which was originally, in name at least, international in character, became a purely Belgian enterprise. Mr Stanley, as agent of the Association, spent four years on the river, in ex- ploring and concluding treaties with local chiefs. The first station was founded in February 1880 at Vivi, and before returning to Europe in August 1884 Mr Stanley had established twenty-two stations on the Congo and its- tributaries. Numerous expeditions were organized by King Leopold in the Congo basin, and the activity of the- International Association and its agents began seriously to engage the attention of the European Powers interestei in Africa.. On behalf of Portugal, claims were advanced, to the Congo, based on the discovery of its mouth by Portuguese navigators centuries before. In the interests of France, M. de Brazza was actively exploring on the northern banks of the Congo, and had established various posts, including one where the important station of Brazzaville is now situated. The fact that the Interna- tional Association of the Congo had no admitted status- as a sovereign power rendered the tenure of its acquisition somewhat precarious, and induced King Leopold to make- determined efforts to secure for his enterprise a recog- nized position. Early in 1884 a series of diplomatic events brought the question to a head. Lord Granville, then British Foreign Secretary, in February of that year concluded a convention with Portugal, recognizing both banks of the mouth of the Congo as Portuguese territory. This convention was never ratified, but it led directly to- the summoning of the Berlin Congress of 1884-85, and to- the recognition of the International Association as a- sovereign state.

The United States of America was the first Great-

CONGO FEEE STATE

Power, in a convention signed on the 22nd of April 1884, to recognize the Association as a properly constituted state. Simultaneously, King Leopold had been Sorf tte ii^goti^ting with the French Government, the Powers. Association's most serious rival, not only to ob- tain recognition but on various boundary ques- tions, and on the 23rd April 1884 Colonel Strauch, the president of the Association, addressed to the French Minister for Foreign Affairs a Note in which he formally •declared that the Association would not cede its possessions to any Power, " except in virtue of special conventions which may be concluded between France and the Association for iixing the limits and conditions of their respective action." The Note further declared that, as a fresh proof of its Jriendly feeling towards France, the Association engaged to

give France the right of preference if, through unforeseen circumstances, it were compelled to sell its possessions. The right of pre-emption thus given to France was, by an exchange of Notes in April 1887, declared to be without prejudice to the right of Belgium to take over the possessions of the Congo Free State as a Belgian colony. Germany was the next Great Power to recognize the position of the Free State, on the 8th November 1884, and the same recognition was subsequently accorded by Great Britain on 16th December ; Italy, 19th December; AustriarHungary, 24th December ; Holland, 27th Decem- ber ; Spain, 7th January, 1885 ; France and Eussia, 5th February; Sweden and Norway, 10th February ; Portugal, 14th February ; and Denmark and Belgium, 23rd February. While negotiations with Germany for the recognition of

M. V.Dartli/i,re& O.y.R.Hauiiirlh

SKETCH MAP OF CONGO FREE STATE.

Oxford l^ot.

"the status of the Congo Free State were in progress. Prince Bismarck issued invitations to the Powers to an Inter- national Conference at Berlin. The Conference assembled on the 15th of November 1884, and its

deliberations ended on the 26th of February of the following year by the signature of a General Act, which dealt with the relations of the European Powers to other regions of Africa as well as the Congo basin. The provisions affecting the Congo may be briefly stated. A Conventional Basin of the Congo was defined, which comprised all the regions watered .by the Congo and its affluents, including Lake Tanganyika, with its eastern tributaries, and in this Conventional Basin it was declared that "the trade of all nations shall -enjoy complete freedom." Freedom of navigation of the •Congo and all its affluents was also secured, and diffetential "dues on vessels and merchandise were forbidden. Trade

monopolies were prohibited, and provisions made for civil- izing the natives, the suppression of the slave trade, and the protection of missionaries, scientists, and explorers. Provision was made for the Powers owning territory in the Conventional Basin to proclaim their neutrality. Only such taxes or duties were to be levied as had " the character of an equivalent for services rendered to navigation itself " ; and it was further provided that (Article 16) " The roads, railways, or lateral canals which may be constructed with the special object of obviating the innavigability or correct- ing the imperfection of the river route on certain sections of the course of the Congo, its affluents, and other water- ways, placed under a similar system as laid down in Article 15, shall be considered, in their quality of means of communication, as dependencies of this river and as equally open to the traffic of all nations. And as on the

river itself, so tliere shall be collected on these roads, rail- ways, and canals only tolls calculated on the cost of con- struction, maintenance, and management, and on the profits due to the promoters " ; while as regards the tariff of these tolls, strangers and natives of the respective territories were to be treated " on a footing of perfect equality." The International Association not- having possessed, at the date of the assembling of the Conference, any recognized status, was not formally

represented at Berlin, but the flag of the Association having, before the close of the Conference, been recognized as that of a sovereign state by all the Powers, with the exception of Tur- key, the Association formally adhered to the General Act.

Thus early in 1885 King Leopold had secured the recognition of the Association as an independent state, but its limits were as yet not clearly defined. On the 5th of February, as the result of prolonged negotiations, France conceded the right of the Association to the course of the Lower Congo below Manyanga, and accepted the Chiloango river and the water-parting of the waters of the Niadi Kwilu and the Congo, as far as beyond the meridian of Manyanga, as the boundary between her possessions and those of the Association on the lower river. From Man- yanga the frontier was to follow the Congo up to Stanley Pool, the median line of Stanley Pool, and the Congo again "up to a point to be settled above the river Agreements Licona-Nkundja," from which point a line was umits. to be drawn to the 17th degree of longitude east of Greenwich, following as closely as pos- sible the water-parting of the LiconarNkundja basin. The identity of the Licona-Nkundja subsequently gave rise to considerable discussions with France, and eventually a protocol, signed at Brussels on the 29th of April 1887, continued the boundary along the Congo to its confluence with the Mobangi, whence it followed the tJmlweg of that river to its intersection with the 4th parallel of north latitude, below which parallel it was agreed that the northern boundary of the Congo Free State should in no case descend. In accepting this frontier King Leopold had to sacrifice all claims to the valley of the Niadi Kwilu, in which he had founded fourteen stations, and to the right bank of the Mobangi. With Portugal the Association concluded an agreement on the 14th of February 1885, by which the northern bank of the Congo was recognized as belonging to the Association, while Portugal retained the southern bank of the river as far as Nokki. North of the Congo Portugal retained the small enclave of Kabinda, while south of the river the frontier left the Congo at Nokki and followed the parallel of that place to the Kwango river.

In April 1885 the Belgian Chamber authorized King Leopold " to be the chief of the state founded in Africa by the International Association of the

Congo," and de- clared that "the union between Belgium and the new State of the Congo shall be exclusively personal." This act of the Belgian Legislature regularized the position of King Leopold, who at once began the work of organizing an administration for the new state. In a circular-letter addressed to the Powers on the 1st of August 1885, His Majesty declared the neutrality of the "Independent State of the Congo," and set out the boundaries which were then claimed for the new state, but it was not until fifteen years later that the frontiers of the Free State were finally settled. At the date of the issue of the circular the agreements with France and Portugal had partially defined the Free State boundaries on the lower river, and the 30th degree of longitude east of Greenwich was recognized as the limit of its extension eastwards.

The following is a list of the agreements subsequently

made with reference to the boundaries of the State (see- also Africa, Eecent History) : —

1. 22nd November 1885, ~~with France. — ^Protocol for delimita~~

tion of the Manyanga region.

2. 29th April 1887, with France. — Protocol for delimitation of

the Mobangi region.

3. 25th May 1891, with Portugal. — ^Treaty for delimitation of

the Lunda region, and Convention of even date for the settlement of frontiers on Lower Congo.

4. 24th March 1894, ~~with Portugal. — Declaration approving~~

delimitation of Lunda region.

5. 12th May 1894, with Great Britain. — Agreement as to Nile

valley and boundaries -with British Central Africa.

6. 14th August 1894, with France. — Agreement as to Mbomu.

river, and Congo and Nile basins.

7. 5th February 1895, with France. — Agreement as to Stanley

Pool.

The net result of the above agreements is to leave the Congo Free State with France, Portugal, and Great- Britain as her neighbours on the north, with History Great Britain and Germany as her neighbours on the east, and with Great Britain and Portugal on her southern frontier. The external history of the young- state is traced in these agreements. The main object of King Leopold's ambition was to obtain an outlet on the Nile, and for the history of the incidents connected with the ~~two important agreements made in 1894 with Great. Britain and France reference must be made to the article= Africa. The sacrifices made by the king to attain his~~ object were great, and involved a heavy strain on the finances of the state, reacting on its internal policy. The avowed object of the Free State was to develop the resources of the territory with the aid of the natives, but it early became apparent that the Arab slave traders, who- had established themselves in the country between Lake Tanganyika and Stanley Falls ahd on the upper river, offered an insuperable bar to the realization of this pro- gramme. The scanty resources at the disposal of the state imposed a policy of restraint on the officers who were brought into relations with the Arabs on the upper – river, of whom Tippu Tib was the chief. In 1886 the Arabs had destroyed the state station at Stanley Falls, and it was apparent that a struggle for supremacy was- inevitable. But the Free State was at that time ill prepared for a trial of strength, and at Mr Stanley's suggestion the bold course was taken of appointing- Tippu Tib governor of Stanley Falls, as the representa— tive of King Leopold. This was in 1887, and for five- years the modus vivendi thus established continued in operation. During those years fortified camps were established by the Belgians on the Sankuru, the Lomami, and the Aruwimi, and the Arabs were quick to see that- each year's delay increased the strength of the forces, against which they would have to contend. In 1891 the imposition of an export duty on ivory excited much ill- will, and when it became known that, in his march towards the Nile,

van Kerckhoven had defeated an Arab- force, the Arabs on the Upper Congo determined to- precipitate the conflict. In May 1892 the murder of M. Hodister, the representative of a Belgian trading com- pany, and of ten other Belgians on the Upper Lomami, marked the beginning of the Arab war. When the news reached the lower river a Belgian expedition under the command of Commandant (afterwards Baron) Dhanis was making its way towards Katanga. This expedition was diverted to the east, and, after a campaign extending over several months, during which several battles were fought and the Arab strongholds of Nyangwe and Kasongo were captured, the Arab power was broken and many of the leading Arabs were killed. The political and commercial results of the victory of the Free State- troops are thus described by Captain Hinde, who was- Baron Dhanis's second in command: — "The political-

geography of the Upper Congo basin has been completely- changed, as a result of the Belgian campaign against the Arabs. It used to be a common saying in this part of Africa that all roads lead to Nyangwe. This town, vis- ited by Livingstone, Stanley, and Cameron, until lately one of the greatest markets in Africa, has ceased to exist, and its site, when I last saw it, was occupied by a single house. Kasongo, a more recent though still larger centre, with perhaps 60,000 inhabitants, has also been swept away, and is now represented by a station of the Eree State nine miles away on the river bank. In harmony with this political change the trade routes have been completely altered, and the traffic which used to follow the well-beaten track from Nyangwe and the Lualaba across Tanganyika to Ujiji, or round the lake to Zanzibar, now goes down the Congo to Stanley Pool and the Atlantic."

These results had been attained largely by the aid of native levies and allies, and a number of the men who had taken part in the Arab campaign were enlisted as permanent soldiers by the Belgians. Among these were some Batetelas, who in 1895 revolted in the Lulua and Lomami districts. The mutineers were eventually de- feated ; but in 1897, while Baron Dhanis was making his way with a large expedition towards the Nile, the

Bate- telas again revolted, murdered several of their white officers, and took possession of a large area of the eastern portions of the state. Although defeated on several occar sions by the Free State forces, the mutineers were not finally dispersed until near the end of 1900, when the last remnants were reported to have crossed into German territory and surrendered their arms.

The international position of the Free State is a some- what anomalous one. It is an independent state admin- istered as if it were a colony. By his will dated the 2nd August 1889, King Leopold bequeathed to Belgium " all our sovereign rights over the Independent State of the Congo, as they are recognized by the declara- interna- tions, conventions, and treaties concluded since 1884 between the foreign Powers on the one side, the International Association of the Congo and the Independent State of the Congo on the other, as well as all the benefits, rights, and advantages attached to that sovereignty." It was subsequent to the execu- tion of this will that the Belgian State in July 1890 acquired the right, already referred to, of annexing the Free State in ten years and six months from that date. In the year 1895, owing to its financial difficulties, the Free State was obliged to ask the conseat of the Belgian Government to a project for raising a further loan. The Belgian Ministry of that time believed the occasion opportune for advancing the date of the annexation of the Free State as a Belgian colony. A Bill was introduced with this object into the Belgian Legislature, but after long delays and a violent Press campaign the Ministry fell, the Bill was withdrawn, and the Chambers voted a further loan to the Free State to enable it to tide over its immediate difficulties. However, either on the decease of the sovereign, or at some earlier date, the Belgians must come to a decision whether or not they will accept the responsibility for King Leopold's African kingdom. In the event of their refusal, the right of pre-emption given to France by the International Association in 1884 might give rise to questions of a somewhat complicated and serious character.

Except for Its short coast-line on the Atlantic, and for a small area on its north-eastern frontier, the Free State lies wholly within _. , , the geographical basin of the Congo. It may roughly he Physical divided into three zones— (1) the small coast zone west features. ^^ ^^^ Crystal

Mountains, through which the Congo breaks in a succession of rapids to the Atlantic ; (2) the great cen- tral zone bounded on the north by the Congo and the Mobangi

tlonal posUloa,

river, on the east by the Mitumba range of mountains, and on the south by the Congo-Zambezi watershed and the Portuguese fron- tier ; and (3) the smaller zone east of the Mitumba range, includ- ing the upper courses of some of the Congo tributaries which have forced their way through the mountains, and west of Lake Mwera and the upper course of the Luapula, as well as a small area which belongs geographically to the Nile valley. The Crystal Mountains form the western edge of the Great Central African plateau and run, roughly, parallel to the coast. The Mitumba range extends from Mount Kaomba, on the southern frontier of the Free State, in a north-easterly direction to Lake Tanganyika, and then strikes northwards along the western shore of that lake, past Lakes Kivu and Albert Edward to Albert Lake, forming the western edge of the Great Central African rift valley. This immense mountain chain has numerous subsidiary local names. It varies in altitude from 5000 to 10,000 feet. Baumann estimates its height where it forms the western limit of the Eusisi valley at the latter figure, while to the west of Lake Kivu von GOtzen calculates it at 9000 feet. The eastern escarpment is precipitous, but on its western face it slopes more gently into the Congo basin. North of the Lukuga river the main chain throws out into the Central zone, in a north-westerly direction, a secondary range, known as the Bambara Mountains, which forms one of the boundaries of the Manyema country. The interior, or Lake, zone is a high plateau with an average elevation of 3000 feet above sea^level. The Central zone dips with a westerly inclination from the Mitumba Mountains towards the western edge of the plateau. It is described by Wauters as "a country of alluvial plains, without any marked mountain features, very well watered, covered with forests and wooded savannahs." The Coast zone is small in area, dipping down from the Crystal Mountains to the Atlantic, where the Free State frontier is reduced to some 20 miles of coast-line. The Congo and its tributary streams form, both from the point of view of the physical geography and the commercial development of the Congo Free State, its

most important feature ; but next in importance are the immense forests which clothe the banks of the rivers, the remains of the great forest which appears at one time to have covered the whole of the centre of the continent. The wooded savannahs, where it is anticipated that in the course of time numerous herds of cattle may be reared, are mostly situated on the higher lands of the Central zone, where the land dips down from the Mitumba Mountains to the Congo.

Climate. — Situated on the Equator, between about 6° N. and 11° S. lat., the Congo Free State shows only a slight variation of tem- perature all the year round. From July to August the heat in- creases slightly, with a more rapid rise to November. During December the thermometer remains stationary, and in January begins to rise again, reaching its maximum in February. March is also a month of great heat; in April there is a steady de- cline into May, with a more rapid decline in June, the minimum being reached again in July. There is a marked distinction between the wet and dry seasons in the western districts on the Lower Congo, where rains fall regularly from October to May, the dry season being from June to September. But nearer the centre of the continent the seasons are less clearly marked by the amount of precipitation, rain falling more or less regularly at all times of the year. The seasons of greatest heat and of the heavy rains are thus coincident on the lower river, where fever is much more prevalent than on the higher plateau lands nearer the centre of the continent. The amount of the rainfall shows great varia- tions in different years, the records at Banana showing a total fall of 16 inches in 1890-91 and of 38 inches in 1893-94. Even in the rainy season on the lower river the rain does not fall continuously for a long period, the storms rarely lasting more than a few hours, but frequently attaining great violence. The greatest fall regis- tered as occurring during a single tornado was 6 inches at Bolobo. In July grass fires are of common occurrence, and frequently sweep over a great expanse of country. Mons. A. Lancaster, the Belgian meteorologist, has formulated, as the result of a study of all the available data, the following rule: — That the rainfall Increases in the Congo basin (1) in proportion as one nears the Equator from the south, (2) as one passes from the coast to the Interior. On the Lower Congo the prevailing winds are from the west and the south-west, but this prevalence becomes less and less marked towards the interior, until on the upper

river they come froip the south-east. The wind, however, rarely attains any exceptional velocity. Storms of extreme violence, accompanied by torrential rain, and in rare instances by hail- stones, are of not uncommon occurrence. On the coast and along the course of the lower river fogs are very rare, but in the interior early morning fogs are far from uncommon. Europeans are sub- ject to the usual tropical diseases, and the country is not suited for European colonization.

Area and Population. — ^The area is roughly estimated at 900,000 square miles, and the native population is variously estimated at from 30,000,000 (Stanley) to 14,000,000 (Saint Martin). The

estimated area is probably above rather than below the proper figure. The vast bulk of the population belongs to the Bantu stock, bnt there are found, in the great forests along the river banks, sparsely distributed liands of the pigmy people, who prob- ably represent the aboriginal inhabitants of Central Africa. In the north-eastern comer of the State, in the upper basin of the Welle and the Mbomu, the Azandfe, a race of warriors and hunters with a social, political, and military organization superior to that of the Bantu tribes of the Congo basin, had intruded from the north, and were forcing their way southwards towards the Congo when the agents of the State appeared in that region and arrested their farther progress. Traces of Arab blood are still found in the districts where the slave traders from the east coast had established stations. The European population at the end of 1886 numbered 254, of whom 46 were Belgians. In 1890 there were 744 Euro- peans, of whom 338 were Belgians ; in 1895, 1076, of whom 691 were Belgians. In January 1900 the European population was as follows:— Belgians, 1187 ; Italians, 176 ; British, 99 ; Dutch, 95 ; Swedes, 81 ; Portuguese, 72 ; French, 53 ; Germans, 42 ; Danish, 39 ; Americans, 33 ; Norwegians, 25 ; Swiss, 13 ; Austrians, 7 ; Spaniards, 6; and other nationalities, 30, — a total of 1958.

Stations. — There are no large towns in the European sense, but a number of stations have been established, some of which have acquired a

certain importance and have become the centre of a comparatively large European population. Of these, Boma is the headquarters of the local administration, and the residence of a British vice-consul. It is situated on the right bank of the Lower Congo, about 60 miles from its mouth, is one of the principal ports of call for steamers, and the centre of a considerable trade. In 1899 the number of steamers entering the port of Boma was 84, of 164,035 tons, and the number of coasting vessels 196, of 6484 tons. Banana, close to the mouth of the Congo and Banana Point, possesses one of the best natural harbours on the west coast of Africa, and is capable of sheltering vessels of the largest tonnage. There are a number of European factories, some of them dating from very early days, and the place is still the centre of a considerable commerce. The French consulate is situated at Banana. In 1899 the number of seagoing vessels entering the port was 108, of 205,610 tons, and the number of coasting vessels 244, of 13,353 tons. Matadi is situated on the left bank of the Congo, at the highest point of the lower river which can be reached by seagoing vessels. It is the point of departure of the Congo railway. The railway company has constructed two jetties at which steamers can discharge their cargo. Matadi is probably destined to eclipse both Boma and Banana as a port, but at present no statistics are available as to the number or tonnage of the vessels calling there. Lukunga, situated on the banks of the river of that name, a southern tributary of the Congo, about half-way between Matadi and Stanley Pool, was formerly the capital of the Falls district, and the chief recruiting station for porters on the Lower Congo. Tumba, the present capital of the district, is a station on the Congo railway, the half-way house between Matadi and Stanley Pool, where the trains stop for the night. It is about 117 miles from Matadi and 143 from Ndolo, the terminus of the railway on Stanley Pool. Ndolo is situated a short distance from the Pool, and has two channels by which vessels can enter and leave the port. Extensive works have been undertaken, and it is intended to make Ndolo the headquarters of tlie steamers that ply on the inland waterways. Quays and a slip for launching vessels have been constructed. ‘ Leopoldville is the capital of the Stanley Pool district, and was one of the earliest stations founded by the Association. It is situated about 7 miles from Ndolo on the flanks of Mount Leopold, and it is considered probable that it may some day supplant Boma as the headquarters of the administration when the

increased importance of the middle and upper river regions makes it necessary to move the centre of administration from the lower river. Other places of importance are Luluaburg, on the Lulua river; Lusambo, the capital of the Lualaba-Kasai district on the Sankuru river ; Coquil-katville, the capital of the Equatorial district, at the mouth of the Ruki; Stanley Falls, the principal station of the district of that name ; New Antwerp, a thriving little town, the capital of the Bangala district, situated on the right bank of the Congo close to the 19th parallel of east longitude ; Banzyville, the capital of the Mobangi district, on the river of that name ; Basoko, at the junction of the Aruwimi and the Congo ; an(} Nyangwe, which is beginning to recover some of the importance it possessed before it was destroyed in the Arab campaign of 1892-93. Djabir is the capital of the Welle district, and in the leased territories on the Upper Nile valley the principal places are Rejaf, Lado, Dufile, and Wadelai.

Constitution. — The Free State is an absolute monarchy, but the Sovereign has never set foot in his African territory, which is administered from Brussels. There is no " constitution," but King Leopold's power is circumscribed in certain directions by the General Act of Berlin, to which the Free State adhered in 1885,

by which freedom of trade and free navigation of the Congo and its affluents are secured. Civil and criminal codes have been pro- mulgated by decrees, and in both cases the laws of Belgium have been adopted as the basis of legislation, ^"Jf' and modified to suit the special requirements of the '«™"on. Free State. In addition to the decrees, which are signed by the Sovereign and countersigned by the Secretary of State, provision is made for the issue of Regulations and Ordinances by the Governor- General. The Governor-General may, in case of urgency, issue an Ordinance suspending for a limited period a Decree issued by the Sovereign. Ordinances issued by the Governor-General remain in force for six months, at the termination of which period they expire, unless they have in the meantime been superseded by Decree. All Decrees are published in the Bulletin Offleiel, which is issued monthly at Brussels. The Sovereign is assisted in the task of government by a Secretary of State, whose duty it is not only to countersign all Decrees, but to superintend their execution. There are three Departments of State, each

presided over by a Secretary- General in subordination to the Secretary of State. These depart- ments are :— (1) Foreign Affairs, (2) Finance, (3) Interior. There is also a Treasurer-General, and a chief of the Cabinet of the Secretary of State. All these olficials have their headquarters at Brussels. The headquarters of the local administration are at Boma, on the lower river, the King being represented by a Governor-General, who is the head both of the naval and military authorities. He is assisted by a Deputy Governor-General, by a number of Inspectors, a Secretary-General, and several Directors. A Consultative Committee or Council of the heads of the various departments and higher officials advises the Governor-General on all matters which he may lay before it. There are seven depart- ments of the administration : — (1) Justice, (2) Transports, Marine and Public Works, (3) Superintendence of State Lands, (4) Agri-culture and Industry, (5) Defence, (6) Force Publique, and (7) Finance. For administrative purposes the Free State is divided into 14 districts, each of which is governed by a Commissary, with a staff of Assistant Commissaries, Sub-Commissaries, and clerks. The Districts are Banana, Boma, Matadi, Falls, Stanley Pool, Kwango Oriental, Mobangi, Stanley Falls, Lualaba-Kasai, Lake Leopold II., Equator, Aruwimi, Bangala, and Welle. In 1898 the territoiy in the valley of the Upper Nile leased from Great Britain was placed for administrative purposes under the same rfigime as the districts.

Judicial Machinery. — Until May 1897 the Upper Congo was under military law, but from that date civil law has been administered " throughout the State, wherever the authority of the State extended. Courts of First Instance have been instituted in the various dis- tricts, and there is a Court of Appeal at Boma which revises the decisions of the inferior tribunals. There is a further appeal, in all cases where the sum in dispute exceeds a thousand pounds, to a Superior Council at Brussels composed of a number of juris- consults, who sit as a Cour de Cassation. In consequence of repeated charges of the ill-treatment of natives being made against officers of the Administration, King Leopold instituted a Commis- sion for the Protection of Natives, and nominated several mission- aries of different denominations to serve on it. It is the duty of the Commission to report to the judicial authorities, or to the Governor-

General, any cases of the ill-treatment of the natives which may come to the knowledge of its members.

Beligion and Instruction. — The native population are pagans, fetish worshippers, and on a very low plane of civilization. The State makes no provision for their religious teaching, but by the Berlin Act missionaries of all denominations are secured perfect freedom of action. The State has established three agricultural and technical colonies for lads up to the age of fourteen. Each of these colonies, which are situated at Boma, Leopoldville, and New Antwerp, makes provision for the training of five hundred boys, who are recruited from those rescued from slavery, from orphans, and from children abandoned or neglected by their parents. Practical instruction is given in various subjects, but the main object is to provide recruits for the armed force of the State, and only such lads as are unfitted to be soldiers are drafted into other occupations. A few native children are sent to Belgium to be educated. Missionaries have displayed great activity on the Congo, and are encouraged by the Administration. In 1900 there were 300 missionaries, of whom 180 were Roman Catholics and 120 Protestants, scattered among 76 mission stations. The mission- aries do not confine themselves to religious instruction, but seek to raise the general level of the native population. In many districts cannibalism is rife, and degrading ceremonies are prac- tised. There are two Roman Catholic bishops, one of whom resides at Leopoldville, the other at Baudouinville, and Roman Catholic churches for the European population are maintained at Boma and Matadi.

Finance. — In the years that preceded the founding of the Congo Free State the funds for carrying on the work of the International Association of the Congo were provided by King Leopold out of

His Majesty's privy purse, and for some time after the recognition of the Free State this system was continued. Mr Demetrius Boulger states that, in the first ten years of his work on the Congo, King Leopold spent £1,200,000 from his private fortune. The first five years of the existence of

the new State were greatly hampered by the provision of the Berlin Act prohibiting the imposition of any duties on goods imported into the Congo region, but at the Brussels Conference, in the summer of 1890, a declaration was signed by the Powers signatory to the Berlin Act authorizing the imposition of import duties not exceeding 10 per cent, ad valorem, except in the case of spirits, which were to be subject to a higlier duty. By agreement with France and Portugal, a common tariff was adopted by these Powers and the Congo Free State. In the same year the Belgian Government agreed to advance 25 millions of francs without interest, 5 millions to be paid at once and the balance in annual payments of 2 millions spread over ten years. At the end of that period Belgium acquired the option of taking over the Free State as a Belgian colony. At the same time the King undertook to make an annual contribution of a million francs out of his privy purse to the revenue of the State. In addition to the 2 million francs per annum received from Belgium, the 1 million francs from the King, and the proceeds of the Customs, the State derives a small portion of its revenues from direct taxation of the European population, but it is mainly dependent on the profits derived from the State domains. The Free State is in fact a great commercial undertaking as well as a governing body. It has established plan- tations in various parts of the State domains, or Crown lands, but these are mainly in the experimental stage, and the bulk of the revenue from the State domains is derived from the collection of caoutchouc, or rubber, from the forest, and the trade in ivoiy. In 1886 the total revenue of the State only amounted to 74,261 francs. The following table shows the revenue and expenditure as set forth in the Budgets of 1891, the first year in which complete figures are available, and at intervals since that year : —

Tear.

Eevenue.

Expenditure.

1891 1895

1898 1899 1900

Francs.

4,554,931

6,004,764

; 14,765,050

‘ 19,966,500

26,256,500

Francs.

4,554,931 7,370,939

17,251,975 , 19,672,965

*27,731,25^*

The Budget for 1900 estimated the revenue and expenditure as follows : —

Eevenue.

Expenditure. ‘

Francs.

Francs.

Advance by Belgium

2,000,000

Central Office .

110,360

Grant by King

1,000,000

Dept. of Interior

11,050,013

Customs .

4,680,000

,, Finance

15,423,681

Transport, &o.

3,800,000

,, Foreign

State Domain, &c. .

11,200,000

Affairs 1

158,000

Portfolio

2,950,000

and

“Various .

626,500

Justice;

Contingencies .

989,200

26,256,500

27,731,254

The following table shows the rapid advance made in the revenue derived from the State domains : —

Tear.

From State Domains.

1886 . . < . 1891 .... 1896 .... 1900 ....

Francs.

74,261

1,319,145

5,887,404

11,200,000

In July 1887 bonds bearing interest at 2J per cent, were issued to the amount of 11,087,000 francs to represent sums advanced to the old Committee and Association, the advantage of which was taken over by the Free State. The bulk of these bonds were issued

to King Leopold, but in January 1895 His Majesty cancelled the bonds in his possession, and in 1901 there only remained an in- debtedness of 422,200 francs in respect of this issue. In 1888 and 1889 bearer bonds to the amount of 70 million francs were issued out of an authorized issue of 150 million francs. These bonds are redeemable in 99 years by annual drawings, and are entitled to an addition of 5 per cent, per annum when drawn. The Redemp- tion Fund is administered by a Committee

representing the bond- holders. The Belgian Government in 1890 advanced the 25 million francs already referred to, without interest, as well as two further sums of 5,287,415 francs and 1,517,000 francs, the former to enable the State to repay a loan and so prevent the forfeiture of an im- mense territory which had been pledged as security to an Antwerp banker, and the latter to balance the 1895 Budget. In October 1896 a small loan of 1,500,000 francs was raised at 4 per cent., and in June 1898 a further sum of 12,500,000 francs was raised at the same rate of interest. The Central Administration has experienced considerable difficulty in adjusting the State's revenue and ex- penditure, and, apart from other considerations, it is extremely probable that the increasing difficulty of providing funds will oblige the Belgian Government to assume direct responsibility for the Congo territories.

Defence. — The Administration was at first compelled to recruit- soldiers among races outside the State territories, but in 1886 a small beginning was made in recruiting among the local tribes. The greater part of the army consisted in 1901 of locally-raised levies, recruited partly by voluntary enlistment and partly by the enforced enlistment of a certain number of men in each district, who are selected by the Commissary in conjunction with the local chiefs. In 1899 the effective force was fixed at 11,850 men, divided into 23 companies, and commanded by 200 European commissioned officers and 241 sergeants. The term of service for volunteers does not exceed seven years, while the militiamen raised by enforced enlistment serve for five years on active service, and for two years in the reserve. The men are armed with the Albani, the officers with the Mauser rifle. There are seven camps of instruction, and the artillery includes Krupps, Maxims, and Nordenfeldts. A fort has been erected at Chinkakassa near Boma, commanding the river below the Falls, and there is another fort at Kinshassa on Stanley Pool to protect Leopoldville and the railway terminus. The Governor-General is Commander-in-Chief of the armed forces of the State, and the Commissaries are in command of the military forces in their districts. In the 1891 Budget the expenditure on the army was given at 2,271,628 francs; in 1896 it had risen to 4,820,793 francs ; in 1898, to 6,870,631 francs; and in 1900, to 7,803,408 francs.

Land and Production. — On the 1st of July 1885 it was decreed that "unoccupied lands are considered as belonging to the State." There are three forms of ownership recognized in the d..o„,™. Free State — (1) the right of the natives to land in their actual occupation; (2) private ownership by Europeans of land which they have acquired, and of which they are the registered owners; and (3) State ownership of all the land not included in either of the two former categories. The system of land registra- tion adopted was based on the Torrens system, and offers great facilities for easy transfer. There is a separate department for the management of the Domain or Crown lands. Plots for factories and blocks of agricultural land are sold at certain fixed rates, but the main contribution to the State revenue from the Domain lands is obtained, as has been seen, from the collection of rubber and ivory. In 1891 and 1892 the State endeavoured to obtain a monopoly of the rubber trade, and circulars were issued to the Commissaries in certain districts instructing them that not only was the collection of rubber by the natives to be regulated, but that in future the natives were to be compelled to sell their rubber to the State. Vigorous protests by the private trading companies were made against this attempted violation of the freedom of trade secured by the Berlin Act, and eventually the circulars were withdrawn and an arrangement made by which certain areas were reserved to the State and certain areas to private traders ; while the question of the rfigime to be established in the basins of the Lualaba, the Upper Lomami, and in Urua and Katanga was reserved until such time as these districts were more effectually brought under control.

Minerals'. — Comparatively little is known of the mineral wealth of the country. Iron is widely distributed, and worked In a primi- tive fashion. It has been found in the Manyanga country, the Manyema country, on the Upper Congo, in the Urua country, in the basins of the Kasai and the Lualaba, and in Katanga. Immense ironstone hills, estimated to contain millions of tons of ironstone of superior quality, have been reported In the south- eastern region. The wealth of Katanga in copper has been described by several travellers, and the expedition sent out in 1891 reported that the richest deposits are to be found in the southern districts on the bank of the Lufira river. Copper is also reported in other districts, such as Mpala and Ulvira on Lake

Tanganyika. Gold has been discovered in Katanga, but before the advent of Europeans was held in less repute than copper. Lead, tin (Mobangi basin), sulphur, and mercury are also reported to exist, but until the introduction of European methods it is im- possible to say what are the mineral resources of the Congo region, and whether they can be worked at a profit.

Animal and Vegetable Products. — Elephant and hippopotamus ivory formed for some years the most important article of export. When Europeans first entered the Congo basin tiie natives were found to have large stores of "dead ivory" in their possession. These stores are still being drawn on for export, supplemented by the "live ivory" obtained by the killing of elephants in the present day. In July 1889, as a precaution against the extermina- tion of the elephant, the King issued a decree prohibiting the MUing of elephants without special permission. Large herds still exist in the Congo forests, especially in the eastern and north-•eastern districts. A reference to the commercial statistics will show that ivory is still the second most important export from the Free State. It is, however, a bad second to caoutchouc, the rubber of commerce, which is obtained from the rubber-bearing liana — Landolphiaflorida — which exists in practically inexhaustible quantities. In 1886 the value of the rubber exports only amounted to 159,000 francs. In 1900 the value had risen to 28,973,505 francs. Palm oil, palm nuts, gum copal, and timber are other natural products which swell the volume of exports, though not at present to any considerable extent. Timber is as yet only exported to the value of between £3000 and £4000, but the vast forests contain many trees, the wood of which is sufBciently valuable lo pay the cost of transport to Europe. Ebony, teak, African cedar, mahogany are a few onl}' of the woods that abound on the Congo. Coffee and tobacco are found in a wild state, and there is an immense number of fruit-bearing trees, and of plants yielding spices and essences which may in time be turned to profitable account.

Agriculture. — Until the advent of Europeans the natives, except in the immediate neighbourhood of some of the Arab settlements, did little more than cultivate small patches of land close to their villages. They grew bananas, manioc, the Spanish potato, the sugar cane, maize, sorghum, rice, millet, eleusine, and other fruits and vegetables, as well as tobacco, but the constant state of fear in which they lived, both from their neighbours and from the Arabs, offered small inducement to industry. Future agricultural development will depend on the success which attends the efforts to turn the native into a regular labourer. Plantations have been established both by the State and by private companies, and already small quantities of coffee, cocoa, tobacco, and maize have been exported. There are no statistics of the number of domestic animals in the country, but there is a number of horses, mules, donkeys, cattle, and pigs, and it is believed that cattle-rearing may be profitably undertaken in the eastern portions where the country rises towards the Mitumba Eange, when the political conditions and improved transport arrangements make such an experiment possible.

Industries. — In some districts the natives possess considerable skill in working in wood, ivory, and metals, but the Congo industries are at present purely local. Iron and copper are extracted by certain tribes, which enjoy a practical monopoly of this kind of work. The knives, spears, and shields of native workmanship frequently show both ingenuity and skill, alike in design and in execution. European fabrics have, among the tribes nearest the coast, already affected the weaving of cloths by the natives, but over a great part of the State territory the natives still manufacture cloth from vegetable fibres. They employ four dif- ferent colours, yellow, the natural colour, black, red, and brown, which are obtained by dyeing, and these colours they combine into effective designs. In some tribes a rude form of printing designs on cloth is practised, and on the Sankuru and Lukenye a special kind of cloth, with a heavy pile resembling velvet, is made by the Basongo-Meno and other tribes.

Commerce. — The following table shows the total exports under the headings — (1) Special Commerce, which includes only such articles as orginate from the Congo Free State ; and (2) General Commerce, which

includes exports of all kinds from the Free State, whatever their place of origin: —

Tear.

Special.

General.

1887 .

1890 . 1895 .

1898 .

1899 .

1,980,441

8,242,199

10,943,019

22,163,482

36,067,959

7,667,949 14,109,781 12,135,656 25,396,706 39,138,283

exported from the Free State (Special Commerce) at three periods : —

The following table shows the value of the principal products

Articles.

Caoutchouc Ivory . Palm nuts . Palm oil . Timber Miscellaneous

188T.

Francs.

116,768

795,700

590,781

462,609

14,583

1,980,441

1896.

Francs,

2,882,585

5,844,640

1,242,898

935,658

12,200

25,038

10,943,019

1899.

Francs.

28,100,917

5,834,620

1,293,413

734,511

91,312

13,186

36,067,959

The increasing importance of the trade with Belgium is shown in the following table, in which will be found the value of the general exports to Belgium, Holland, and Great Britain at three periods : —

Country.

Belgium Holland Great Britain

1890.

Francs.

2,217,599 8,073,208

833,941

Francs.

8,999,660 885,405 592,496

1899.

Francs.

32,367,828

1,656,561

281,593

The first year for which full statistics of imports are available is 1893. The following table shows the Special and General Imports in that year and in two subsequent years. ” Special ” imports are goods intended for conisumption immediately on their arrival, or on their being taken out of the entrep6t : —

Tear.

Special.

General.

1893 . 1897 . 1899 .

Francs.

9,175,103 22,181,462 22,325,846

Francs.

10,148,418 23,427,197 27,102,581

Of the special imports in 1899, Belgium sent 15,592,745 francs ; Great Britain, 2,922,739; Germany, 1,359,688; and Holland, 882,426. The principal articles imported in 1899 were textile fabrics and clothing, 5,147,610 francs ; food substances, 3,887,912; steamers and machinery for steamers, 2,704,819 ; drinks, 1,718,627 ; metal and metal goods, 1,667,391 ; machinery other than for steam- ers, 1,492,310; arms, ammunition, &c., 932,073.

Shipping and Navigation. — There is a fortnightly service of steamers between Antwerp and Boma and Banana. There is also frequent steam communication with Liverpool, Hamburg, Eotter- dam, and Lisbon. In 1899 there entered at Boma and Banana 192 seagoing vessels of 369,645 tons, and cleared 197 vessels of 375,715 tons. Of the tonnage entered, 191,843 was Belgian; 79,037, British ; and 65,682, German. Of the tonnage cleaned 1§9,933 was Belgian ; 85,588 was British ; and 67,113,

German. During the same year 440 coasting vessels of 19,838 tons entered, and 451 vessels of 20,557 tons cleared from the same ports.

Internal Communications. — From the mouth of the Congo tothq beginning of the rapids, which render the river unnavigable — a distance of about a hundred miles — the State maintains a fleet of seven steamers, in which passengers and goods are transported from the larger ocean-going steamers to Matadi, the point of departure of the railway. Matadi can, however, be approached by ships of considerable burden. Before the railway, all merchandise and goods for the interior had to be carried by porters from the coast to Stanley Pool. This method was both costly and inconvenient. The journey took three weeks. In 1887 the King granted to the Congo Industrial and Commercial Company a concession to con- struct a railway from the lower rivgr to Stanley Pool, and, after a survey had been made, a Congo Railway Coinpany was founded in Brussels in July 1889, with a capital of 25 million francs, of which the Belgian Government subscribed 10 millions. The mov- ing spirit in this great enterprise was Colonel Thys. The work was begun almost immediately, but nearly insuperable difficulties were encountered, both engineering and financial. The line was finally completed in March 1898, and formally opened to traffic in the following July— nine years after its practical inception. The length of the line is 260 miles, and its inland terminus is at Ndolo on Stanley Pool, a short distance from Leopoldville. There

is a weekly service of three passenger trains in each direction, two days being occupied on the journey. The trains do not run during the night. The single through fare for Europeans is £20, and the freight charges are proportionately high, judged by European standards, though considerably below the charges which had to be paid before the railway was built. The cost of constructing and equipping the railway was 68 millions of francs. Other railways which are projected are a short line from Boma to the Lukulu river, for the purpose of opening up the Mayumbe province ; a line or lines of railway between the navigable waters of the Upper Congo

and Lake Tanganyika, with subsidiary lines which would ■develop the rich provinces of Manyema, Urua, and Katanga ; and a railway in the Upper Welle district, for the purpose of opening up the north-eastern provinces and affording rapid access to the leased territories on the Upper Nile.

Waterways. — It is, however, in the splendid navigable water- ways of the main Congo stream and its tributaries that the Eree State has found, and will continue to find, its most powerful in- strument in the development of its resources. Eor a full account of the river and its tributaries reference may be made to the article on the Congo Rivek, but the following table, printed in the Mouvement Oeographique, shows approximately the extent of the waterways open to navigation : —

Congo (from Stanley Pool

Lake Mantumba

220 miles

to Stanley Tails)

. 990 miles

Mobangi

750 „

Lefini

• 70 „

Nghiri .

140 „

Kasai

. 500 „

Ibenga .

90 „

Mfini Lukeynia .

. 680 „

Lebai

60 „

Lake Leopold II.

. 590 „

Ombfila .

50 „

Kwango .

. 220 „

Kuangu .

80 „

Juma

. 400 „

Euki

530 „

Sankuru

400 „

Momboyo

370 „

Lubefu

• 140 „

Lulonga .

400 „

Lubi

60 „

Lopori .

280 „

Lulua

. 160 „

Mangala .

230 „

Alima

. 200 „

Eubi

90 „

Dikwalea

200 „

Aruwimi

160 „

Sanga

560 „

Lomami .

470 „

Goko

100

Mamb6r6

‘. 160 “,

Total

9350 miles

The State maintains on these waterways a fleet of steamers which in 1900 numbered 26 vessels, for the purpose of preserving authority, provisioning the stations, promoting trade, and operat- ing the postal service. Private trading companies, French, Belgian, and Dutch, and several Missionary Societies also maintain steamers on the inland waters, and the number is being rapidly increased since the docks have been built at Ndolo and the railway offers increased facilities for transport. Away from the railway and the waterways, transport is still mainly effected by porters.

Posts and Telegraphs. — The Free State is included in the Postal Union. There were in 1899, 20 post offices. Steamers leave Leo- poldville at regular intervals with mails. In 1898 the postal authorities dealt with 103,032 letters, papers, and other postal matter in the Internal service, and with 343,077 in the ex- ternal service. There is not as yet any direct

cable com- munication with Europe, messages being sent either vid St Thomas or vid, St Paul de Loanda. In 1893 a Decree was issued authorizing the construction of a telegraph line from Boma to Lake Tanganyika. In 1895 the line had been made as far as Matadi, and in 1898 it reached Stanley Pool simultaneously with the railway. The line is an aerial one, and is now being carried up the banks of the river towards Stanley Falls, while an expedi- tion under Mr Mohun, an ex-Consul of the United States, was in 1900 engaged in constructing the line from the Tanganyika end. In 1898 a Decree authorized the construction of two branch lines to Rejaf, in the Upper Nile valley, and to Katanga. There is a telephone from Matadi to Stanley Pool, foUowmg the railway line.

Trading and Exploring Companies.— Theve are no banks in the Free State, financial operations being conducted either by the State or by the private companies which have been founded principally by Belgian capitalists. Mr A. J. Wauters, Secretary-General of the Compagnie du Congo pour le Commerce et 1' Industrie, which was established in December 1886, and has promoted several subsidiary companies, including the Congo Railway Company, says that in 1898 there were 25 companies represented in the Free State, which had been founded in Belgium, Holland, and Portugal, with a total capital of about 60 millions of francs. Half of this sum was represented by the capital of the railway company, the next largest companies in point of capital being the Belgian Company of the Upper Congo, with a capital of 5 mil- lions of francs, and the Katanga Company with 3 millions. There were other five companies, with their headquarters in the Free State, which had been founded by virtue of special Decrees issued by King Leopold, and were subject to the law of the

Congo Free State. The capital of two of these companies is not stated, but the other three have a joint capital of 6J millions of francs. By a Decree issued on the 7th of February 1896 the King authorized the issue of State notes payable to bearer, and a first issue of 400,000 francs was sanctioned. These notes are pay- able at the State Treasury at Brussels, and are accepted by the State in payment of moneys due to it.

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Congo (French). See Feench Congo.

Congregationalism. — Congregationalism as a designation of a Christian denomination has of late in some respects modified its significance. In Great Britain there is to be observed among Congregationalists a growing tendency towards a mutual connexion or combination of churches, as distinguished from a bare Independency. This movement is seep, not only in the multiplying of conven- tions and conferences for religious and educational pur- poses, but also in more permanent forms of ecclesiastical federation. It appears in the increased vigour and influence of the Congregational Union of England and Wales, which are manifest, for example, in the series of Volumes entitled Congregational Lectures, together with ^'ntain. the Hymnals, all of which have been issued under its auspices. The merging of the Evangelical Union of Scotland in the Scottish Congregational Union is a circumstance illustrating the prevailing tendency. It may be added that the participation of the British Congregational

churches with their foreign brethren of the same ecclesi- astical form in two international councils, is one sign of the prevailing disposition to unite with the continued self-government of each local church a closer

connexion with churches abroad as well as at home. The various local unions of Congregationalists in England likewise indi- cate a spirit which is in marked contrast with the isolation of earlier times. It is to be observed, however, that the system of councils, with their part not only in the adjust- ment of differences but also in the ordination and installa- tion of ministers — the system which has been in America a distinguishing feature of Congregationalism, — has not gained a place in the British Congregational churches. The work accomplished by Congregationalists in England dur- ing the last few decades in providing new means of edu- cation, in particular for the education of ministers, is worthy of special remark. The establishment of Mans- field College at Oxford, by the transformation of Spring Hill College, Birmingham, through the act of Dr Dale and his co-trustees, was an event of much consequence in its direct effect in elevating the character of the ministry, not to dwell on its stimulating influence in other direc- tions. The newly constituted University for London is of much service to Congregationalists, as well as to other Nonconformists, by having a Faculty of Theology, and by affiliating their theological colleges, all of whose pro- fessors are recognized as theological teachers. In 1870 there were 3069 Congregational churches in Great Britain and Ireland, in 1900, 4851 ; in 1870, 2468 ministers, in 1900, 3132 : in the British colonies, in 1870, 296 churches, in 1900, 765; in 1870, 236 ministers, in 1900, 459. In 1900 in Great Britain and Ireland there were 1,- 733,065 church sittings, and 415,664 church members ; 684,006 Sunday-school pupils, 64,334 teachers, and 5484 lay preachers.

Congregationalism in America has spread from New England, its primitive home, over the West to the Pacific, but has never had more than a slight foothold in the Southern States of the Union. The remarkable junction or fusion of the Independents or " Separatists " who emigrated from Leyden to Plymouth, Massachusetts, with the Puritan Nonconformists of Massachusetts Bay, modified Independency by the introduction of positive fraternal relations among the churches. This gave rise to Congregationalism in the more proper sense of the term. Beyond the limits of New England the progress of the denomination was a good deal hindered for a long period by the willingness of New Englanders going West either to join the Presbyterians, with whom they were

substantially agreed in doctrine, or to combine with them in a mixed scheme of policy in which the Presbyterian element was uppermost. It was not until about 1850 that American Congregationalists began to draw more closely together, and to propagate in the Western States and Territories their own distinctive policy. They have since established not a few colleges and a number of well-organized theological seminaries, which have exerted much power in building up their communion. Meanwhile, without giving up the main principle of the autonomy of the local church, they have developed in various ways an active disposition to co- operate as a united religious body. This is seen in the organization of strong voluntary societies for the promotion of education and the increase of the ministry, and for the prosecution of missions. To these organizations a great deal of money is annually contributed. Their public services bring together large assemblies, which meet from year to year in different cities, often widely remote from each other. This tendency to denominational union is specially manifest in the institution of the National Council, which convenes at intervals of three years, and is composed

United States.

of ministers. and lay delegates, representing the churches- The Council, like minor councils which it is the old custom, to call together to consider matters of local concern, is each time dissolved at its adjournment. It is possessed of no authority. Its function is to deliberate on subjects of common concern to the entire denomination, and to publish such opinions and counsels as a majority may see fit to send forth to the churches. The first of the National Councils (1865) issued a brief statement of doctrine, descriptive of the religious tenets generally accepted by the denomination. Later (1883) a large committee, previously appointed, framed a more full Confession of Faith, with the same end in view. Of course neither of these creeds- was in the least binding upon ministers or upon churches, except so far as in each instance they might be adopted. The movement in the direction of union has been still further promoted by the J; wo International Councils referred to above, in which the American Congregationalists have met the representatives of their brethren in Great Britain and its Colonies having the same faith and

polity. In the different States, Conferences, composed likewise of re- presentatives of the several " churches and their pastors, have sprung up. These meet at stated intervals for the consideration of practical subjects of moment, and for the promotion of a religious spirit. There is a tendency, moreover, to accord to the Conferences the function of determining the tests of ministerial standing in the Con- gregational denomination. In some of the States the licensing of preachers, which was formerly left to the voluntary associations of ministers in the different local- ities, has been made a function of the State Conferences. At the very first, in New England, the theory was held that a minister, on ceasing to be the pastor of a particular church, falls into the rank of laymen. But the view was very soon adopted, and since has universally prevailed, that a minister in such cases still retains his clerical character. In later times the measure of authority conceded to a pastor as the shepherd of a flock has been much diminished in consequence of the gradual development of democratic feelinginboth minister and congregation. This loss of clerical prestige has been in no small degree pro- moted by the increasing habit of dispensing with a form of installation, and of substituting for a permanent pastor- ate, instituted with the advice and consent of a council, an engagement to serve as a minister for a fixed term of one or more years. Under this custom of " stated supplies " ordination may be granted to those whose ministry in a particular church is made and dissolved by no other process than a mutual agreement. The Congregational churches, as distinct from the churches retaining the same polity, but separated by the adoption of Unitarian opinions, have in times past professed to be Calvinists of stricter or more moderate types. But as early as 1866, Arminians were welcomed to Congregational fellowship. In the last few decades, with the spread in the community of innovations in doctrinal and critical opinions, a wider diversity of belief has come to prevail, so that " Evangelical," in the popular sense of the term, rather than " Calvinistic," is the epithet more suitable to apply to the American Congregational preachers and churches. The Year-Book for 1900 reported the total number of communicants in all the States at 629,874, the number of Sunday-school scholars as 682,907, the total number of ministers as 5604, the amount of benevolent contributions by the churches as $2,110,413. Within the denomination are seven theological seminaries for the training of preachers.

The Congregational Year-Book for 1901 gave the following fig- ures for Great Britain, Ireland, and the Channel Islands : — churches, branch churches, chapels, and mission stations, 484.3 ; church members, 431,517 ; scholars, 693,347; ministers, 3123 ; evangelists

and lay pastors, 227 ; lay preachers, 5185. In comparing these figures with those for the preceding year, which are given in the body of this article, it must be borne in mind that in 1901 "99 churches in England and Wales have not made returns, and are not included in this summary," whereas in 1900 no less than 417 churches, including mission stations, were omitted ; so that the figures for 1901 mark, if anything, a slight decline. The bulk of the foreign mission work of the British Congregationalists is done through the agency of the London Missionary Society. This society, although originally founded on an unsectarian basis by members of various denominations (including Churchmen), has become more and more closely connected with the Congregation- alists, as other bodies came to have denominational societies of their own. In fact, at the present day the L.M.S. is " mainly de- pendent both for its missionaries and for its funds upon Congre- gationalists" ; and a special responsibility for the society was formally recognized by the Congregational Union at the meeting held at Hull in the autumn of 1889. /f^_ f. v)

Congreve, Richard (1818-1899), English Posi- tivist, viras bom at Leamington, 4th September 1818, and was educated at Kugby under Dr Arnold, who is said to have expressed a higher opinion of him than of any other pupil. After taking first-class honours at Oxford and gaining a fellowship at Wadham, he spent some time as a master at Rugby, but returned to Oxford as a tutor, and there published a small work on the history of the Eoman Empire of the West, and an annotated edition of Aristotle's Politics. About 1857 the attachment which he had conceived to the Positivist philosophy of Comte induced him to resign his fellowship, and the remainder of his life was devoted to the propagation of the Positive Philosophy. Unlike Mr Frederic Harrison, Professor Beesly, and

Dr Bridges, he accepted Comte's -teaching in its totality, — ^the worship and ritual, and the general philosophy, — and a split in the ranks of English Positivism was the result, Mr Harrison and his school setting up at Newton Hall on more independent lines than those of the complete surrender to Comte which Congreve inculcated. He translated several of Comte's works, and in 1874 published a large volume of essays, in which Comte's views as to the duty of Great Britain towards her foreign possessions, which usually consisted in renouncing them, were advocated with solemn earnestness, but without carrying conviction. In private life Mr Congreve was the most amiable and urbane of men. He died at Hampstead on the 5th of July 1899.

Conjeeveram, or Kanchipur, a town of British India, in the Chingleput district of Madras, 46 miles south-west of Madras by rail. Population (1881), 37,275 ; (1891), 42,548 ; (1901), 46,140, showing an in- crease of 8 per cent. The municipal income in 1897-98 was Rs.48,000. It has two high schools, two printing- presses, and several literary institutions.

Conjuring. See Magic.

Conlding, Roscoe (1829-1888), American senator and lawyer, was born in Albany, N.Y., on the 30th of October 1829. He was admitted to the Bar in 1860, and in 1858 was elected as a republican representative in Congress. Except during the years 1863 and 1864 he remained in the House until 1867, when he was chosen for the Senate. His abilities, aggressive leadership, and a haughty bearing always attracted much attention. In the republican national convention of 1876 he was a candidate for nomination for the Presidency. In 1881 he resigned his senatorship and sought re-election by the state legislature as a personal vindication, because Pres- ident Garfield, without consulting him, had appointed a political opponent as collector of the port of New York. Being unsuccessful, he took up the practice of law in New York City, and appeared in some very important cases. He died in New York City, 18th April 1888.

Connaught, H.R.H. Arthur William

Patrick Albert, Duke of, (1850), third son

and seventh child of Queen Victoria, was born at Bucking- ham Palace on 1st May 1850. Being destined for the. army, the young prince was entered at the Eoyal Military College, Woolwich, in 1866. He received his com- mission on 'the 19th June 1868, being gazetted to the Eoyal Engineers. In the following November he was. transferred to the Eoyal Artillery, and on the 3rd August 1869 to the Eifle Brigade. He got his company in 1871,, and changed to the 7th Hussars in 1874 ; was promoted, major in 1875, and returned to the Eifle Brigade as. lieutenant-colonel in September 1876. He was promoted, colonel and major-general in 1880, lieutenant-general in. 1889, and general in 1893. He accompanied the expedi- tionary force to Egypt in 1882, and commanded the Brigade of Guards at the battle of Tel-el-Kebir (medal and clasp) ; he was mentioned three times in despatches,, received the C.B., and was thanked by Parliament. In 1886 the duke went to India and commanded the Bombay army until 1890, when he returned home and was appointed to the command of the Southern District from 1890 to 1893, and to that of Aldershot from 1893 to 1898. On the departure of Lord Eoberts for South Africa, the duke succeeded him as Commander-in-Chief of the forces in Ireland, 9th January 1900 ; and in 1901 was given the command of the Third Army Corps. On attaining his majority in 1871, an annuity of £15,000 was granted to. Prince Arthur by Parliament, and in 1874 he was created Duke of Connaught and Strathearn and Earl of Sussex. On 13th March 1879 he married H.E.H. Princess Louise Marguerite of Prussia, third daughter of Prince Prederick Charles, and received an additional annuity of £10,000. The marriage at Windsor Castle was the most magnificent that had taken place there since the wedding of the Princess Eoyal in 1858. The Duke and Duchess repre- sented Queen Victoria at the coronation of the Czar Nicholas II. at Moscow, in May 1896, when eight-and- twenty foreign princes were present.

Conneaut, a village of Ashtabula county, Ohio, U.S.A., on the shore of Lake Erie, on three railways. It has a good harbour and is a shipping-point of some im- portance. It was the first settlement in the Western Eeserve. Population (1890), 3241 ; (1900), 7133.

Connecticut. — One of the New England States of the American Union, with a land area (according to the Census Bulletin) of 4845 square miles,

or of 5004 accord- ing to the official survey of 1893. The highest land is the summit of Bear Mount in Salisbury, Litchfield county, 2355 feet above the mean high tide point at the sea. The highest elevation reached by any railway in the State is 1335 feet, about two miles east of Norfolk. According to the official survey (1893), 38|- per cent, of the State was in woodland. Population (1870), 537,454; (1880), 622,700; (1890), 746,258; (1900), 908,420. Of the total popula- tion in 1900, 454,294 were males and 454,126 females ; 238,210 were foreign-born and 15,996 coloured (including 15,226 negroes, 599 Chinese, 18 Japanese, and 153 Indians). Out of 280,340 adult males 18,984 were illiterate ; 16,696 of these being foreign-born. The death- rate in 1900 was 17 per thousand ; (1890), 18-6. The average number of persons to the square mile in 1900 was 187-4. The State contains 24 incorporated cities or boroughs, with a population of over 5000 and with an aggre- gate population of 532,123. These figures show that 58-58 per cent, of the total population was urban. There were 5 cities with a population of 25,000 or over, namely. New Haven, Hartford, Bridgeport, Waterbury, and New Britain.

The General Assembly (Senate and House) is elected

biennially by a plurality vote, and meets at Hartford. There are 24 Senators and 255 members of the Lower House, making 279 in all: 87 towns have 2 members of the House each, and 81 have 1 each. This difference in membership is of historic origin, depending on the establishment of the town, except that every town which the decennial census shows to have 5000 inhabitants is entitled to 2 members. With the shifting of population, many old towns with two members each are now smaller than younger towns, allowed only one each. The result has been a demand from the larger towns for more repre- sentation. On the other hand, it has been contended that the town is the political unit under the Connecticut scheme of government, that one body is designed to be popular and the other representative, and that the two Houses of the

National Congress, agreed upon in the Constitutional Convention of 1787 under the " Connecticut Compromise," illustrate the same scheme with the titles reversed. Several constitutional amendments have accordingly been pro- posed, including one for the plurality election of State officers. To elect these a clear majority of the votes cast ■was, in 1901, still required. Otherwise the General Assem- bly selects one from the two highest candidates for each position. Woman suifrage is permitted in school matters, but very few women vote. Local option prevails as to liquor-selling, and in 1899 there were 79 licence and 89 no-licence towns. The executive officers of the State, chosen biennially, are governor, lieutenant-governor, secretary, treasurer, coinptroller. There is also an attorney-general, elected once in four years. This office was established in 1898. State supervision is very general ; 21 State boards and commissions having offices in the State House. In 1883 a State board of pardons was established ; up to that time pardons had been granted by the General Assembly.

Finance.— The funded debt in 1901 was f2,131,100, of which $495,000 was at 3J per cent, and $1,636,300 at 3 per cent. From this sliould be deducted the cash in hand, usually from $500,000 to $750,000. Except for the military commutation tax of $2 per caput on male citizens between 21 and 45 years of age, the revenue of the State since 1890 has been collected by indirect taxation and almost entirely from corporations. The receipts for the year ending September 30, 1899, were $2,749,273, which, however, in- cluded the income of various funds. The direct tax laid upon the towns was suspended in 1891. A rapid increase followed in State expenditures, from $1,767,512 in 1891 to $2,550,080 in 1897— an increase of 50 per cent., while the income increased only about 30 per cent. In 1898 and 1899, however, the income exceeded the receipts by ample margins. While there is no direct State tax, citizens are taxed locally by the county, the town, the city, or the borough, and the school district. Many of the tax laws are antiquated, and the need of general revision has long been urged.

Boads. — In 1896 a " good roads movement " began, under which in the first six years the State expended about $700,000, con- ~~tingent upon contributions of about $500,000 from town and county treasuries. When~~

~~the work began the highway com~~ mission reported 5558 miles of main roads and 8530 of side roads in the State — total, 14,088 miles. About 250 miles were improved between 1895 and 1901.

Bailways. — There are 1013-35 miles of steam railway. Of these all but the New London Northern, from New London to Brattle- boro, Vt. (56-1 miles in Connecticut) : the Central New England, from Hartford to the Hudson (67-25 miles in Connecticut) ; and the South Manchester, from South Manchester to Manchester (2-25 miles), are included in the system of the New York, New Haven, and Hartford Railroad Company, which controls 2047-19 miles, of which 887-75 are in Connecticut. It controls all the rail routes between New York and Boston, and the entire Old Colony system in Massachusetts, and also practically all the steamboat lines on Long Island Sound. Between New Haven and New Rochelle, N.Y., where the line divides, the company has four tracks. The company has an authorized capital of $100,000,000, of which in 1899 about $55,000,000 had been issued. It had then 8654 stockholders, of whom 2620, holding $16,036,500 of the stock, were residents of Connecticut. The majority of its board of directors must be citizens of Connecticut. It reported 28,211 employees in 1899. In that year the railways of the State carried 50,269,468 passengers and 15,891,642 tons of freight. Efforts have been made for several years to abolish grade

crossings of rail and waggon roads, but in 1899 there still remained 988 of these death-traps.

Other Means of Communication. — The first successful trolley road was established in Connecticut in 1885. In 1899 there were 31 companies working 462-92 miles of trolley, not counting sidings, and these roads carried that year 59,084,702 passengers. Their capital stock aggregated $12,715,948, and their bonded debt $10,608,800. They had 2465 employees. During 1899 the trolley roads injured 324 persons, and the steam roads 327. The trolley has brought wide outlying rural districts into close touch with the cities, and has connected centres of population, so as to make them practically one community. The store, the church, the theatre, and the farm have all received a new impulse from the movement. Besides the trolley, a ” third rail ” electric system is being developed in

Connecticut. The New York, New Haven, and Hartford Rail- way, at a power-house at Berlin, produces electricity, which is carried on a central rail between the rails of the road bed of one of its regular tracks. The power is taken up by a shoe that travels along the third or middle rail, and heavy cars on the solid road bed can make very fast time. The third rail operates between New Britain and Berlin, 3 miles, and between Hartford and Bristol, through New Britain, 17 miles. Electric lighting is very general, and in many instances water-power is utilized for this purpose.

Manufactures. — The great demand for copper wire and for other parts of electric outfit has given an immense impetus to the copper and brass mills, which are the largest consumers of copper in the world, and are situated chiefly in the Naugatuck Valley in Water- bury, Torrington, and Ansonia. The State holds a leading place in the production of silk, woollen, and cotton goods, fire-arms and ammunition, edge tools, hardware, needles, bicycles, motor- carriages, rubber goods, thread, sewing machines, clocks, hats, silverware, knit goods, &c. Connecticut maintains its reputation for inventions, and for the skill of its mechanics. In 1900 the number of manufacturing establishments in the State (excluding 977 having a product of less than $500 each, but including 4630 classified as hand-trades) was 9128, with a total capital (includ- ing land, buildings, machinery, &c., but not capital stock) of $314,696,736. There were 9981 salaried employees receiving salaries amounting to $12,286,050 ; an average number of 176,694 wage- earners, receiving total wages of $82,767,725 ; and 9381 proprietors and firm members. The cost of materials (including mill supplies, freight, fuel, &c.) was $185,641,219. The added values of the pro- ducts in the different establishments amounted to $352,824,106. If from this gross value be deducted, in order to avoid duplication, the value ($144,809, 625) of materials purchased in a partly manufactured form — where the finished product of one industry is used later as the raw material for another — the total net value of the products is found to be $208,014,581. The most important industries and the value of their products were : textile manufactures, $49,265,752 ; brass manufactures (including rolled brass and copper), $48,526,868 ; foundry and machine shops products, $18,991,079;; hardware, $16,301,198; plated and britannia ware, $9,538,397.

Banks. — ^There were, in 1 899, 88 mutual savings banks, with de- posits of $174,135,195 belonging to 393,137 depositors. Of these depositors 341,362 had each less than $1000 on deposit, whose total deposits amounted to $68,420,853. These banks do much to en- courage thrift. They pay as a rule 4 per cent, interest on the deposits. In June 1900 there were 81 national banks in the State ; capital, $20,747,070 ; surplus and undivided profits, about $11,000,000; deposits, $42,700,000. There were also 8 State banks ; capital, $2,240,000 ; surplus, &c., $864,000 ; deposits, $6,726,563 ; and thirteen trust companies ; capital, $1,317,800 ; surplus, $880,000, deposits, $7,420,608. The total deposits of all the banking interests were thus $230,982,366.

Insurance. — The 8 stock fire insurance companies had in 1900 $10,250,000 of capital, $13,896,791 of net surplus, and $41,956,826 of assets, and insured about $2,700,000,000 of property. Besides these were 17 mutual companies with $2,000,000 of assets and $111,500,000 of risks. The fire losses paid by Connecticut companies in 1899 were $12,417,000. In life insurance, 6 com- panies with assets of $156,972,000, including $15,656,721 of surplus, were in 1900 insuring 356,661 persons for a total of $507,246,300. The assets of the fire and life companies of the State together exceed $200,000,000. It was in Connecticut that accident insurance was first undertaken in the United States. The deposits of the banks and the assets of the life and fire insurance companies aggregate nearly $475,000,000.

Education. — ^Almost every town grew up around a' church, and every town has also its school. Education has been an object of concern from the founding of the colony, and the State ranks among the first in this respect. Yale University, at New Haven, founded in 1701, has a total of 2642 students and a faculty of 271. Trinity College at Hartford, founded in 1823, reported for 1900, 137 students and 24 instructors. Wesleyan University at Middle- town, founded in 1829, had 339 students and a faculty of 26. Common school education is compulsory between the ages of

7 and 16. In 1899 there were 1546 public schools, 76 high schools, 77 kindergartens, and 19 evening schools ; also 177 private schools, with 30,083 registered scholars. The State furnishes $200 to •establish, and up to -f 100 a year to maintain, a free public library in any town that will contribute an equal sum. In 1899, 6 years after the passage of the law, 51 towns had established free libraries Tinder its provision, and there were 40 others, making 91 free public libraries in the State, with 566,706 volumes and a yearly circulation of 1,609,788 volumes. There were also 43 •' travelling libraries," which move from one town to another, the gifts of individuals or associations. /c_ jj_ cl.)

Connelisville, a borough of Fayette county, Penn- sylvania, U.S.A., situated in the south-western part of -the state, on Youghiogheny river and on branches of the Pennsylvania and the Baltimore and Ohio railways, at an altitude of 915 feet. It is the centre of the well-known Connelisville coking coal region, in which most of the •coking coal used in iron-smelting in the United States is produced. Out of 47,142 coking ovens in the United States in 1899, 19,294 are in this district ; while of the total .amount of coke produced in the Union (19,640,798 tons), not less than 10,389,335 tons were made in this district. Population (1880), 3609 ; (1890), 5629 ; (1900), 7160.

Connersvilie, capital of Fayette county, Indiana, U.S.A., situated on Whitewater river, in the eastern part of the state, at an altitude of 828 feet. It is at the intersection of the Cincinnati, Hamilton, and Dayton, ~~the Cleveland, Cincinnati, Chicago, and St Louis, and the Fort Wayne, Cincinnati, and Louisville railways. Popu~~ lation (1880), 3228 ; (1890), 4548 ; (1900), 6836,

Conscience, Hendrik (1812-1883), the most eminent of modern Flemish writers, was born at Antwerp on the 3rd of December 1812. Although he invariably .signed his name Hendrik, his baptismal name was Henri. He was the son of a Frenchman, Pierre Conscience, from Besanqon, who had been chef de timonerie in the navy of Napoleon, and who was appointed under-harbourmaster at Antwerp in 1811, when that city formed part of France. Hendrik's mother was a Fleming, Cornelia Balieu. When, in 1815, the French abandoned Antwerp after the

Congress of Yienna, they left Pierre Conscience behind them. He was a very eccentric person, and he "took up the business of buying and breaking-up worn-out vessels, of which the port of Antwerp was full after the jpea'ce. The child grew iip in an old shop stocked with marine stores, to which the father afterwards added a •collection of unsaleable books ; among them were old romances which inflamed the fancy of the child. His mother died in 1820, and the boy and his younger brother had no other companion than their grim and somewhat sinister father. In 1826 Pierre Conscience married again, i}his time a widow much younger than himself, Anna Catherina Bogaerts. Hendrik had long before this developed an insatiable passion for reading, and revelled all tday long among the ancient, torn, and dusty tomes which passed through the garret of "The Green Corner" on Ttheir way to destruction. Soon after his second marriage Pierre took a violent dislike to the town, sold the shop, :and retired to that Kempen or Campine which Hendrik Conscience so often describes in his books — the desolate iflat land that stretches between Antwerp and Venloo. Here Pierre bought a little farm, with a great garden round it, and here, while their father was buying ships in distant havens, the boys would spend weeks, and even months, with no companion but their stepmother. At ^;he age of seiventeen Hendrik left the paternal house in Kempen to become a tutor in Antwerp, and to prosecute Ms studies, ~~which were soon broken in upon by the revo~~ lution of 1830. He volunteered as a private in the new Belgian army, and served in barracks at Venloo, and iafterwarde ,at Dendermonde, until 1837, when he retired

with the grade of sergeant-major. Thrown in this way with Flemings of every class, and made a close observer of their mental habits, the young man formed the idea of writing in the despised idiom of the country, an idiom which was then considered too vulgar to be spoken, and much less written in, by educated Belgians. Although, close by, across the Scheldt, the Dutch possessed a rich and honoured literature, many centuries old, written in a language scarcely to be distinguished from Flemish, a foolish prejudice denied recognition to the language of the Flemish provinces of Belgium. As a matter of fact, nothing had been written in it for many years, when the separation in 1831 served to make the chasm between the nations and the languages one which could never be bridged over. It was therefore with the foresight of a prophet that Conscience wrote, in 1830

itself, ” I, do not know how it is, but I confess I find in the real Flemish something indescribably romantic, mysterious, profound, energetic, even savage. If I ever gain the power to write, I shall throw myself head over ears into Flemish composition.” His poems, however, written while he was a soldier, were all in French. He received no pension when he was discharged, and going back idle to his father’s house, he determined to do the impos- sible, and write a Flemish book for sale. A passage in Guicciardini fired his fancy, and straightway he wrote off that series of scenes in the war of Dutch Independence which lives in Belgian literature under the title of In’t Wonderjaar 1566; this was published in Ghent in 1837. His father thought it so vulgar of his son to write a book in Flemish that he turned him out of doors, and the celebrated novelist of the future started for Antwerp, with a fortune which was strictly confined to two francs and a bxmdle of clothes. An old schoolfellow found him in the street and took him to his home ; and soon various people of position, amongst them the eminent painter, Wappers, interested themselves in the brilliant and unfortunate young man. Wappers even gave him a suit of clothes, and presented him to the King, who expressed a wish, which was not immediately carried out in consequence of some red tape, that the Wonderjaar should be added to the library of every Belgian school. But it was under the patronage of Leopold I. that Conscience published his second work. Fantasy,, in the same year, 1837. A small appointment in the Provincial Archives relieved him from the actual pressure of want, and in 1838 he made his first great success with the historical romance called The Lion of Flanders, which still holds its place as one of his masterpieces. To this followed How to become a Painter, 1843 ; WJiat a Mother can Suffer, 1843 ; Siska van Boose- mael, 1844; Lambrecht Hensmans, 1847; Jacob van Artevelde, 1849 ; and Tlie Conscript, 1850. During these years he lived a variegated existence, for some thirteen months actually as an under-gardener in a country house, but finally as Secretary to the Academy of Fine Arts in Antwerp. It was long before the sale of his books, greatly praised but seldom bought, made him in any degree independent. His ideas, however, began to be generally accepted. At a Flemish Congress which met at Ghent so early as 1841, the writings of Conscience were mentioned as the seed which was most likely to yield a crop of national literature. Accordingly the patriotic party undertook to encourage their circulation, and each fresh contribution from the pen of

Conscience was wel- comed as an honour to Belgium. In 1845 Conscience was made a Knight of the Order of Leopold. To write in Flemish had now ceased to be regarded as a proof of vulgarity ; on the contrary, the tongue of the common people became almost fashionable. The poet K. L. Ledeganck (1805-1849), who celebrated the "Three Sister-Cities " of Ghent, Bruges, and Antwerp, was the

*■st to follpw in the steps of Conscience. Another itioual writer who, though much older than the novelist, scame his eager disciple, was J. F. Willems (1793-1846), id Flemish literature began to live. In 1846 Conscience iblished a History of Belgium, but he was well advised return to those exquisite pictures of Flemish home-life hich must always form the most valuable portion of his pertory. He was now at the height of his genius, and lind Rosa, 1850; Bikketikketak, 1851; TJie Decayed entleman, 1851 ; and 27*6 Miser, 1853, rank among the ost important of the long list of his novels. These had 1 instant effect upon contemporary fiction, and Con- ience had many imitators. Nevertheless, not one of the tter has approached Conscience in popularity, or has sserved to approach him. In 1855 the earliest transla- ons of his tales began to appear in English, French, erman, and Italian, and his fame became universal. In $67 the post of Keeper of the Eoyal Belgian Museums as created, and this important sinecure was given to Dnscience. He continued to produce novels with great igularity, and his separate publications amounted at last I nearly eighty in number. He was now the most emi- jnt of the citizens of Antwerp, and his seventieth birth- ly was celebrated by public festivities. After a long Iness he died, in his house in Antwerp, on the 10th of jptember 1883 ; he was awarded a public funeral. The jrtraits of Conscience present to us a countenance rather cench than Flemish in type, with long smooth hair, intemplative dark eyes under heavy brows, a pointed 3se, and a humorous broad mouth ; in late life he wore le ornament of a long white beard. Whether the his- irical romances of Conscience will retain the enormous)pularity which they have enjoyed is much less than irtain, but far more likely to live are the novels in which 3*

undertook to be the genre-painter of the life of his own ly. In spite of too rhetorical a use of soliloquizing, and : a key of sentiment often pitched too high for modern ste, the stosies of Conscience are animated by a real)irit of genius, mildly lustrous, perhaps, rather than artlingly brilliant. Whatever glories may be in store ir the literature of Flanders, Conscience is always sure of distinguished place as its forerunner and its earliest assic. (b. g.)

Consett, a town and railway station in the north- estern parliamentary division of Durham, England, 12 iles north-west of Durham city and 14 south-west of ewcastle. Besides the parish church there are Baptist, /'esleyan, and other chapels ; also a town-hall. There ■e extensive collieries in the district, and large iron orks. Area of urban district, 1024 acres. Population

.891), 8460 ; (1901), 9694.

Conshohocken, a borough of Montgomery county, ennsylvania, U.S.A., situated in 40° 04' N. lat. and 75° i' W. long., on the north bank of Schuylkill river, 13 iles north-west of Philadelphia, in the south-east part : the state. It is entered by the Pennsylvania and the hiladelphia and Eeading Eailways. Population (1880),

561; (1890), 5470; (1900), 6762.

Constance, a city in the grand duchy of Baden, on le south bank of the Rhine at its exit from the Lake of onstance, and 30 miles from Schaffhausen by rail. It ands at a height of 1316 feet above the level of the sea. he Vincent collection of painted glass in the chapter- 3use has now been sold. The Dominican convent has sen converted into a hotel ; in its tower John Hus was »nfined for three months, before he was burnt on 6th Illy 1415 on a field in the suburb of Brtlhl. In the arket-place are two historical houses — one wherein arbarossa signed the peace of Constance with the Lom- ird cities in 1183, and the other in which Frederick of

Hohenzollern was inl417 invested with the Marchof Bran- denburg. The population of Constance was 21,363 in 1901.

S. J. Capper. The Shores and Cities of the Bodensee. London, 1881.— G. Gsell-Fels. Der Bodensee. Munich, 1893 (Bruck- mann's illustrierter Reisef uhrer) . — E. Issel. Die Reformation iii Konstanz. Freiburg i/B., 1898. — F. X. Krads. Die Kunstdenk- mdler des Kreises Konstanz. Freiburg i/B., 1887. — J. Laible. Geschichte der Stadt Konstanz. Konstanz, 1896. — Ph. Rcppert. Die Chroniken der Stadt Konstanz. Konstanz, 1891. — Schriften. d. Vereins filr die Geschichte d. Bodensee und seiner Umgebung. Constance, from 1869. — J. Werder. Konstanz und die Eidgenos- senschaft. Basel, 1885.

Constance, Lake of, or the " Swabian Sea," on the north-east frontier of Switzerland. According to the latest measurements, its area is 207 square miles (of which 81-^ square miles belonged to Switzerland, viz., 59f square miles to Canton Thurgau, and 21^ square miles to Canton St Gall), its height above the sea-level 1309 feet, its greatest length 40 miles, its greatest depth 1014 feet, and its greatest width 7^ miles.

*Constanta (or Kustendji), a town and seaport of Eumania on *the Black Sea, 140 miles by rail from Bucharest. The bridge at Cernavoda across the river Danube was opened by the king in 1896. A line of fast passenger steamers, owned by the Eumanian Government, in connexion with the Orient express and Ostend express, conveys passengers and mails to Constantinople. The town has greatly developed of late years, owing to its improved communications by land and sea, and is now much used as a summer bathing resort. The streets are clean and well kept. Constanta is on the site of the ancient Tomi, where Ovid lived and died in exile. There is a statue erected to his memory in the chief square of the town. Population (1895), 10,607 ; (1900), 12,726, about one-half of whom are of the Orthodox faith, and the remainder pretty equally divided between Eoman Catholics, Moslems, Armenians, and Jews.*

Constantina, a town and railway station of Spain, in the north of the province of Seville. Population in 1897, 9983. The neighbourhood is chiefly agricultural, with some mines, lead and iron, in the sierra not far off. The local industries are those connected with cork, wood, alcohol, and tanneries, and the market days every week are very animated. It is

one of the most important towns of the province, though its public buildings offer nothing- worthy of notice.

Constantino, capital of the department of the same name in the east of Algeria, picturesquely perched, 2130' feet above the sea, on a rock rising perpendicularly nearly 1000 feet from the bed of the Eummel, which surrounds it on the north and the east, while on the west the city is. connected by an isthmus with the mainland. It is 54 miles by rail south by west of Philippeville, its seaport, and has railway connexion also with Algiers, Bona, Tunis, and Biskra. Important strategically, Constantine by its beauty of situation annually attracts crowds of visitors. There are no important buildings of recent erection. Eail- ways have taken away from the city its monopoly of the traffic in wheat, though its share in that trade still amounts to from 10 to 12 million francs (£400,000-£480,000) a year. Its industry also is considerable, its peltry business employing 1000 persons and supplying the wants of 2 millions. It also manufactures woollen stuffs. There is a project to surround the city with capacious reservoirs, such as would transform the face of the country. The population in 1891 was 46,680, and in 1900 it was 51,997, of whom 18,387 were French. The indigenous element, numbering 28,000, grows faster than the colonial.

Constantinople, the capital of the Turkish Empire, situated on the strait between the Black Sea and the Sea of Marmora. The last quarter of the 19th

century wrought little change in the outward aspect of the city, but throughout that period, during the reign of Sultan Abdul Hamid II., many of the conditions of life in the Turkish capital underwent considerable alteration. This arises from the fact that Sultan Abdul Hamid's mode of life and method of government were wholly different from those of his predecessors. Constantly preoccupied with apprehension for his personal security, he transferred his abode, shortly after coming to the throne, from the palace of Dolma Baghtch^ on the bank of the

Golden Horn, where he did not feel safe, to Yildiz Kiosk, a pleasure resort of his predecessors on a hiU behind Beshiktash, overlooking Pera, Stamboul, the lower Bosphorus, and the Sea of Marmora. The park is surrounded by a great wall, in some parts 50 feet high, and contains two small lakes, the

one natural and the other artificial. Early in 1901 the Sultan, in order to extend the park towards Ortakeui, bought a large adjacent estate, consisting of a mansion and extensive grounds, which are now enclosed within the mural fence of Yildiz. Within this carefully guarded enclosure are numerous buildings, which include an observatory, baths, a museum of arms, a porcelain factory, a furniture manufactory, armouries, stabling for 150 horses, and a harness factory, besides a number of chalets and other fanciful edifices. The most conspicuous amongst these latter is the Merassim Kiosk, built spec- ially for the occupation of the German Emperor on his first visit in 1889, and enlarged for his later visit in 1898. Some of the smaller chalets are used as prisons for political prisoners, or as houses of detention for persons undergoing

B. V.DarKshire & OJ .RMmiarih.

PLAN or ANCIENT AND MODERN CONSTANTINOPLE.

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inquisitorial treatment. Within the main enclosure, a second wall surrounds the kiosk which the Sultan, with his four principal wives, inhabits, and which he himself designed. About it are grouped smaller kiosks in which the other ladies of the harem reside. The doors of this inner barrier are all locked at sunset, and therein, protected by his bodyguard, the Sultan passes his nights in assured security. In March 1901 the OfBLces of the Privy Purse, from the windows of which — commanding a view of the road between the palace gateway and the Hamidieh Mosque — approved visitors witnessed the Selamlik pro- cession on Fridays, were demolished by Imperial order, called forth by the Sultan's ever-increasing fear of assassin- ation. The palace domain is guarded by two batteries of artillery, and by the whole of the 2nd division of the

Eirst Army Corps, composed of 12 battalions, each 600 strong. These are lodged in spacious barracks built on the outer side of the park wall, with a mosque adjacent thereto for the special use of the troops. The Sultan's guard consists of (1) the " Tufenkdjis," or bodyguard, of whom there are 94, Albanians and Circassians ; (2) the " Silahsors," drilled soldiers, numbering about 300, Albanians and Bosniaks ; (3) the " Hademes " {garde de luxe), employed only on State occasions, and comprising the musicians of the Palace, about 500 in number ; (4) the " Tchaush," of whom there are between 60 and 60, and who are messengers as well as guards ; (5) the Bek- djis or watchmen, numbering 200, who keep watch by relays all over the park by day and night. The most important of the material changes since 1880

is the construction of the quays on each side of the Golden Horn. Begun in 1891 by a French company with a capital of nearly a million sterling, the quay was com- pleted in 1899 on the Galata side to its full length of 756 metres, with a breadth of 20 metres; and the portion on the Stamboul side, of which the total length is 378 metres, was finished and opened in 1900. The appearance of the port is much improved by the demolition of the dilapidated structures which previously bordered either shore, and which are replaced by substantial buildings. Tramways have also conduced to the embel- lishment of the city, for — besides causing improvement in the streets they traverse — they have promoted much new building in salubrious localities, commandingfine prospects, which were previously out of reach. On both sides of the

line, extending north-west of Pera, a large number of detached houses with gardens have been built, forming a new and extensive faubourg, which on one side reaches out in the direction of Eyub and the Sweet Waters of Europe, and on the other along the heights overlooking the lower Bosphorus and the Marmora. Excepting the streets trav- ersed by the tramways, a few of those in which the departments of State are situated, aud spme of the sub- urban roads, the other highways and byways remain unimproved, wearing the old ragged pavement, destitute of

footways, and flanked by buildings, mostly wooden, of mean design and more or less decayed.

The ravages of the great fire of 1870, which consumed 5000 buildings in Pera, have been almost, though not yet completely, made good. In the renovated quarters stone

SanStefemo SEA OF MARMORA

SCALF OF MILES 0 I 2 3 4 s

PBINCES' ISLANDS

SKETCH MAP OP THE ENVIRONS OP CONSTANTINOPLE.

buildings mostly replace the wooden structures which the conflagration swept away. All the dwelling-houses are stone-built, and of late the fashion has set in of building large and lofty blocks divided into suites of apartments. This tendency to erect costly and substantial buildings has been promoted by the increased facilities for insuring against fire. Year by year new insurance agencies have been established, and by 1900 no less than forty-three companies (about half of them British) were represented in Constantinople. Some new public buildings in con- spicuous positions fix the eye in viewing the city from the sea. Such are the Armoury at Matchka, on the heights of Nishan-Tash, above Dolma Baghtch^; the Imperial Otto- man Bank, in Galata; the offices of the Public Debt, in Stamboul ; and the School of Medicine, between Scutari and Haidar Pasha.

The appearance of the Bosphorus has greatly faded in recent years, owing to the large number of yalis and konahs which, through the dispersal of many old Turkish families, have been left empty and become dilapidated. The new generation eschews the Bosphorus, — where the price of land is still nominally high, although there is no demand for it, — and has bought ground largely along the course of the Anatolian railway, between the terminus at Haidar Pasha and the station of Pendik on the Mar- mora. This region, which is mild, picturesque, and well wooded and watered, with a very productive soil, is now overspread with

newly-built houses of the better sort in more or less spacious gardens, all occupied by the Turks who built them. Since 1855, when Constantinople was much shaken and somewhat damaged by the earthquake which destroyed Brusa, the Turkish capital had not ex-

perienced any severe seismic convulsion until July 10, 1894. On that day there was a violent shock lasting nearly twenty seconds. The damage wrought by it was chiefly in the quarters lying between the Mosque of Sultan Ahmed and the Adrianople Gate. All the damage has been repaired, and the ruined part of the grand Bazaar has been rebuilt on a much better plan. «

Trade. — The diminution of the trade of Constantinople caused by the territorial changes prescribed by the Congress of Berlin was heavily supplemented by that produced by the annexation of Eastern Rumelia to Bulgaria in 1885, as that province drew all its supplies of foreign merchandise from the capital from which a cus- toms frontier now divides it. Of recent years, moreover, mainly owing to governmental interference with the passenger traffic be- tween the capital and the Asiatic provinces, a large proportion of the provincial dealers now import for themselves by Ismid, Trebizond, Samsun, or Kerasund, instead of buying their supplies in Constantinople. About forty per cent, of the import trade of Constantinople is British ; France, Germany, Austria, Belgium, and Italy share the balance, in proportions following the order in which they are mentioned. Constantinople produces nothing, and consequently exports nothing but waste products, but it receives much merchandise in transit. Latterly, however, a large propor- tion of it has been diverted — like the import trade, and for the same reasons — to the ports of the Black Sea and to Ismid, which latter as a shipping-port is much assisted in its competition with Constantinople by the Anatolian railway. The transit trade of Constantinople included, until quite recent years, yellow-berries, gall-nuts, madder-roots, and other colouring matters; but these products have been superseded by the aniline dyes. In connexion with this decrease of trade it is noteworthy that several joint-stock banks have liquidated.

Only the Imperial Ottoman Bank and a branch of the Credit Lyonnais remain.

As far as can be ascertained, the average annual value of the goods passing through the port was, at the opening of the twentieth century, about £T11,000,000 (a Turkish lira=18s.). It is, how- ever, impossible to obtain exact figures, and it should be clearly understood that this is only an estimate, arrived at indirectly from a study of the custom receipts. The total given is made up as follows : —

Imports.

Total

7,000,000

Exports.

^

£T

£T

Manufactured goods —

Cereals

. 1,000,000

cotton, woollen, silk,

Mohair

. 800,000

&c. .

.■

3,500,000

Carpets

. 700,000

Haberdashery,

iron-

Silk.and cocoons

. 500,000

mongery

700,000

Opium

. 400,000

Sugar

500,000

Gum tragaoanth

. 150,000

Petroleum .

400,000

Wool

. 100,000

Flour

400,000

Hides

, 100,000

Coffee

300,000

Various .

. 350,000

Rice

250,000

Cattle

100,000

“Various .

850,000

Total

4,100,000

The shipping visiting the port, counting all seagoing craft (including liners) other than coasters, numbered 13,357 vessels of 11,453,332 tons in 1893, 14,387 vessels of 12,501,102 tons in 1896, and 10,777 vessels of 10,288,091 tons in 1900.

The minor industries in Constantinople, never very important, are declining, and foreign industrial undertakings have had little success.

Education.— 1i^ the department of Education the only important fact is that the Turkish School of Arts and Crafts has been rebuilt and reorganized. Otherwise the educational record of the years 1885 to 1900 is limited to the opening of a few schools of the more elementary sort. There are thirty-two foreign schools, one only of which is British. Two new charitable institutions, founded by the Sultan and supported by the Civil List, claim notice, namely, the Asylum for the Poor and the Hamidieh Hospital for Children. The Imperial Museum of Antiquities, opened in 1892, contains the celebrated Greek Sarcophagi, twenty-one in number, discovered at Saida, the ancient Sidon, in 1888. _

Local GoeerremereJ.— Constantinople contains four districts or divisions (Beladr-i-Sele^si),na,Ta.Ay, Stamboul, Pera-Galata, Beshik- tash, and Scutari, of which the government is in the hands of the Minister of Police, who is ex-offlcio Governor of Stamboul. The other three districts have each their Governor (mutessartf), who is appointed by the Sultan, and is subordinate to the Mmister of Police. All matters concerning public order and security are con-

trolled by these four Governors, each of whom is provided with a separate staff of pofloe and gendarmery, each district having its own police court, of which the Governor is the presiding magistrate, 'rte municipal government of the four metropolitan divisions is- vested in the Prefect of Stamboul, who is appointed by the Sultan. He is the President of a Council of twenty-four members, who are appointed either by the Sultan, or by the Minister of the Interior in cases where there is no Palace candidate. The Prefecture has charge of all that concerns the streets, the markets, and the bazaars, in- cluding the street porters and the public weighers. It has also control over the public baths and the hospitals, of which latter there are three ; and is charged with the collection of all city dues, including the Verghi (Property Tax). The Prefecture is divided into ten cercles, or wards, each of which has a president, vice- president, secretary, engineer, and physician, all of whom are appointed by the Council of the Prefecture. The Prefect is imme- diately subordinate to the Minister of the Interior. A military commandant, having under his orders a detachment of the garrison of Stamboul, is appointed to each of the four districts, the supreme military commander being the Dersaadet Merkes

Commandani — i.e., Commandant de la Piace— Commander of the Garrison of Constantinople.

The outlying parts of the city are divided into six districts (Cazas), namely. Princes' Islands, Guebzeh, Beicos, Kartal, Ku1> chuk-Tchekmedj^, and ShilS — each of which has its Governor (JfcaJmofcan), who is usually chosen by the Palace. These districts are dependencies of the Ministry of the Interior, and their municipal affairs are directed by agents of the Prefecture.

Population. — The city population, according to official estimate, numbers 880,000 ; the aggregate population of the six suburban dis- tricts is officially estimated at 320,000; giving a grand total of 1,200,000, which is the official estimate of the entire population of the city of Constantinople and its faubourgs. The Armenian ele- ment of the population was appreciably reduced by the events of 1895-96 ; but no trustworthy figures in connexion with this dimi- nution are obtainable.

In the four central districts of the city the first-class thorough- fares and a considerable proportion of those of the second and third order are now fairly well lighted with gas.

Water Supply. — From the time of the conquest of Constantinople by the Turls up to the year 1882 one method of obtaining water for the city was followed to the exclusion of all others. This method was to trap the rain in the natural hollows of the forest of Belgrade (about 18 miles north-east of Constantinople), together with the water of the rivulets which trickle through some of them. It was effected by throwing a dam across the lowest end of each depres- sion, thus stopping the outflow of water, and forming a reservoir called Send in Turkish. There are nine of these "Bends." The water from the "'Bends " is conveyed to its destination in earthen- ware pipes set in cement, and laid underground except in places where depressions of the soil necessitate an -aqueduct. In several cases where that occurs the remains of the ancient aqueducts are utilized. The pipes convey the water to the public fountains, from which the poorer classes take it as they require, and it is distributed by the corporation of water-carriers {sakka) to those who can afford to pay the cost of delivery. This was the only water system of Constantinople up to the year 1885.

The radical defects of this system suggested to Kiamil Bey, Grand Master of Ceremonies at the Court of the Sultan, in conjunction with a foreigner residing in Constantinople, to apply for a concession to bring water from Lake Derkos, which is about 28 miles west of the Black Sea mouth of the Bosphorus, and about 3 miles from the Black Sea shore. The application was finally granted in 1881 to the associate of Kiamil Bey, who had himself died in the meanwhile. A French company was formed, with a capital of twenty million francs, to carry out the undertaking ; the works were begun in 1882, and on 1st July 1885 the new water supply was inaugurated. Lake Derkos has a. total length of 8 miles, and a mean breadth of 2 miles. It is abundantly supplied by the river Karaman and its tributaries flow- ing down from the Strandja Dagh. The water, when taken from the lake, is first filtered, and then raised by a steam elevator (600 h.p.) to a height of 365 feet, where it enters the main con- duit, 29 miles long, and is thence distributed by the delivery-pipes, of which the total length at the present time is 165 miles. The quality of the Derkos water is excellent, and the service is thoroughly well conducted. Until the year 1893 the Asiatic suburbs had n» water supply but such as individual families obtained by cisterns, wells, &c. In 1888 a (Jerman firm obtained a concession for estab- lishing water-works at the Sweet Waters of Asia — a lake lying- between the villages or Kandili and Anatoli-Hissar, which is fed by mountain streams from the Kaish-Dagh and Alem-Dagh. A com- pany called the Compagnie des Eaux de Scutari-Kadikeui was- formed in 1890, with a share capital of £144,000 and a debenture capital of £160,000. The works were commenced in January 1891, and the supply service began in October 1893.

AniHORiTiES. — P. DE TcHiHATCHEP. Bospliore et Constantin-

ople. Paris, 1877. — Grosvenoe (Professor of European History -at Amlierst College). Constantinople. London, 1895. — Van MlLLiNGEN, M.A. Byzantine Constantinople, with maps, plans, and illustrations. London, 1899. — Coufopodlos. A Guide to Constantinople. London, 1899.

(e. w.) ArchcEology. Considerable attention has been devoted in recent years to the archaeology of Constantinople, and although the study is seriously hampered by the impossibility of making excavations, a real advance has been made in this department of knowledge. Many mistakes have been corrected, important facts haye been discovered, and problems remaining to be solved have been more clearly re- cognized and more precisely stated than heretofore. The city of Byzantium, out of which Constantinople sprang, and from which it inherited characteristic features, occupied, when it reached its greatest extent, most of the territory comprised by the two hills nearest the apex of the promontory and by the level ground at their base. The western wall of the city started from a point near the Stamboul Custom House and reached the ridge of the Second Hill, a short distance to the east of the column popularly named Tchemberli Tash and the Burnt Column. There stood the prin- cipal gateway of the city, opening upon the Egnatian Road. From that point the wall ran southwards for some distance towards the Sea of Marmora, and then turned eastwards until it reached that .sea in the neighbourhood of the present Seraglio Lighthouse. The Acropolis was situated on the summit of the First Hill, where the courts of the Old Palace of the Sultans are found ; and within the citadel stood, as was customary, the chief temples of the city — the Temples of Artemis, Aphrodite, Apollo, Zeus, Poseidon, and Demeter. The harbours of the city were upon the Golden Horn — one, the Portus Prosforianus, in the bay indenting the shore in front of the station of the Chemius de Fer Orientaux ; the other, the Neorium, in the bay before the Stamboul Custom House. On the level tract behind the former was the Strategion, the Champs de Mars of the city ; while another public square, known as the Tetrastoon, because surrounded by four porticos, is represented by the open space between S. Sophia and the Hippo- drome. There stood the Baths of Zeuxippus. Two theatres were built against the steep eastern side of the Acropolis Hill, and a Stadium stood on the level ground at the foot of the Acropolis beside the Golden Horn. A large portion of the Hippodrome, so iamous in the history of Constantinople, was constructed by Septimius Severus for the benefit of the citizens of Byzantium, when he rebuilt the city in a.d. 196. The graceful granite column which stands on the high ground near the apex of the promontory is a monument erected*

by Byzantium in honour of the victory of Claudius Gothicus over the Goths. It still bears most of the original inscription

REDUCI rOETUN^ OB DEVICTOS GOTHOS.

According to the measurements given by Zosimus and the Notitia, it would appear that the walls of Constantinople, as built by the founder of the city in 328, ran across the promontory from the neighbourhood of Daoud Pasha Kapoussi (Porta S. Aemiliani) on the Sea of Marmora^to Oun-Kapan Kapoussi (Porta Platsea) on the Golden Horn, near "the Stamboul head of the inner bridge, trav- ersing in their course the seventh, fourth, and fifth hills of the prom- ontory. By extending the old seaward walls of Byzantium to the •extremities of the new western fortifications, the capital was placed within strong bulwarks. The only vestige of the western walls is found in the name Isa Kapoussi (Gate of Jesus), attached to a locality on the heights above the quarter of Psamathia. An ancient ■city gate which stood there as late as 1508, when it was overthrown by an earthquake, marked a point in the Constantinian line of for- tifications, exactly as Temple Bar indicated a point in the old walls of London long after they had otherwise disappeared. Possibly a portion of the seaward walls bounding the old harbour, which is now converted into the vegetable gardens of Vlanga Bostan, may date from the time of Constantine. Two suburbs outside the walls were considered as parts of the city — ^the suburb of Sycae (Galata), and the suburb of Blachernae, now the quarters of Aivan Serai and Bgri Kapou. The latter suburb stood within fortifications of its own. For municipal purposes the city was divided into fourteen Regions, on the model of Rome. But ere a century had passed, the growth of the new metropolis on the one hand, and military considerations in view of the threatening attitude of the Barbarians on the other, demanded the enlargement of the city's bounds and the erection of stronger defences. Accordingly, in 413, in the reign of Theodosius II., under the direction of Anthemius, Prae- torian Prefect of the East and Regent during the emperor's mi- nority, the landward fortifications were carried farther west, to the line of the inner wall in the crumbling but picturesque ramparts which extend from the Sea of Marmora, a short distance south of the Seven Towers (Yedi KouW) to the

old Byzantine Palace (Tekfour Serai), above the quarter of Egri Kapou. Authorities differ on the

question how the city was then defended from the last-named point to the Golden Horn ; some maintaining that the Theodosian Walls turned north-eastwards and reached the Grolden Horn near Balat Kapoussi, others being of the opinion that the new walls joined the old fortifications which protected the suburb of Blachernae. On the whole, the latter view seems the more probable. The sea- ward walls required by this enlargement of the city were built in 439, during the administration of the Prefect Cyrus.

The wall of Anthemius was, however, terribly injured by a severe earthquake which shook the city in 447, while Theodosius II. was still upon the throne. The disaster was the more serious because Attila and his Huns were then carrying everything before them in the Balkan Peninsula ; but the desperateness of the situation roused the energies of the Roman Government to the highest pitch, and in less than two months, if we may trust inscriptions to that efiect, the city was again fully armed, and even more secure than before the catastrophe. The Praetorian Prefect Constantine, whom some authorities identify with the Prefect Cyrus named above, not only repaired the wall of Anthemius, but placed another wall in front of it, and protected this double line of fortifications by a moat, with a batlJement along its inner margin. Each wall was flanked by ninety-six towers, while the terrace between the two walls, and the terrace between the outer wall and the moat, allowed room for the action of large bodies of troops, in addition to the troops upon the walls themselves. Comparatively slight changes were made in the boundaries of the city after the reign of Theo- dosius II. The lower portion of the suburb of Blachernae, namely, the plain to the north of the Sixth Hill, was enclosed within forti- fications in 627, after the siege of the city by the Avars in the reign of Heraclius ; in 813 Leo the Armenian strengthened the wall of Heraclius by constructing a wall and a moat in front of it, thus to withstand better an expected assault by the Bulgarians under Crum ; lastly, in the reign of Manuel Comnenus the fine wall extending from the north-western corner of the court of Tekfour Serai to the square tower below Egri Kapou was erected to defend more efiect- ively the Palace of

Blachernae, on the Sixth Hill, which had become the favourite residence of the Byzantine emperors. Of course all these fortifications were frequently repaired (e.g., the seaward walls by the Emperor Theophilus), and to them Constantinople owed her long lite and her ability to repel, for more than a thousand years, the assaults of barbarism upon the civilization of Christendom. They present to the archseologist a splendid specimen of mediaeval fortifications constructed under the strong influence of old Roman military traditions, and they afiord endless interest to the student of history on account of the events associated with them.

The most noteworthy points in the circuit of the walls are : the Golden Gate, in the form of a triumphal arch with three arch- ways, erected (before the Theodosian Walls were built) in honour of the victory of Theodosius the Great over the usurper Maximus ; the Gate of S. Romanus (Top Kapoussi), memorable as the gate near which Constantine Dragases fell, and through which Sultan Mahomet II. rode into the captured capital in 1453 ; the great breach in the Valley of the Lycus, through which the Turks entered the city ; Tekfour Serai, long erroneously identified with the Palace of the Hebdombn, the finest specimen of Byzantine civil archi- tecture left in the city ; the two Towers commonly known respect- ively as the Towers of Anemas and Isaac Angelus, with the chambers in the body of the wall to the north ; the wall of Leo the Armenian, the point at which the army of the Fourth Crusade, which had its camp on the hill opposite, delivered the chief attack in 1203 ; the wall protecting the quarters of Phanar and Petri Kapou, where the fleet and troops of the Fourth Crusade assaulted and carried the city in 1204, to found the Latin Empire of Con- stantinople ; Yali Kiosk Kapoussi, the point to which the northern end of the chain drawn across the harbour in time of siege was attached ; the ruins of the Palace of Hormisdas, once the residence of Justinian the Great and Theodora, known in later times as the Bucoleon, near Tchatlady Kapou ; the sites of the old harbours between that gate and Daoud Pasha Kapoussi ; the fine Marble Tower near the junction of the Land Walls with the walls along the Sea of Marmora.

The interior arrangements of the city were largely determined by the configuration of its site, which falls naturally into three divisions: the level ground and the slopes towards the Sea of Marmora, the range of hills running through the midland portion of the promontory ,the slopes and level ground towards the Golden Horn. In each of these divisions a great street ran from one end of the city to the other, generally lined with arcades on one side, but sometimes, when passing through the busier and the finer parts of the city, on both sides. The street on the ridge of the hills formed the principal thoroughfare, and owing to its central position was known as the Mes6. It connected the principal Fora of the city : the Augustaion (to the south of S. Sophia) ; the Forum of Constantine (on the summit of the Second Hill) ; the Forum of Theodosius the Great, or of Taurus (on the summit of the Third Hill, beside the present War Office) ; the Forum of the Amastrianon

(uear the Mosque Shah Zad6) ; the Forum of the Bous (at Ak Serai) ; the Forum of Arcadius, or of Theodosius II. (on the summit of the Seventh Hill, at Avret Bazaar). A branch of the Mes6 led to the Church of the Holy Apostles, on the summit of the Fourth Hill, and to the Gate of Adrianople (Gate of Charisius) in the city walls.

Of the edifices and monuments which adorned the Fora just men- tioned, it must here suffice to say that the Augustalon (so named in honour of Augusta Helena, the mother of Constantine the Great) was the heart of the city's political and ecclesiastical life. The great cathedral of Eastern Christendom rose on the north side of the square ; the splendid gateway of the Chalet, leading to the Imperial Palace, the baths of Zeuxippus, with the Hippodrome behind them, stood on the south ; the Senate House was on the east ; while to the west, at a short distance off the Mes6, which issued from the square, were the Law Courts. In the area of the square stood the Milion, whence distances from Constantinople were measured ; the eques- trian statue of Justinian the Great, on a lofty column ; the statue of the Empress Eudoxia, famous in the history of Chrysos- tom, and the inscribed pedestal of which remains. With the Forum of

Constantine the Great the commercial activity of the city was closely associated, the most remarkable monument in the forum being the porphyry column which still stands there, and which carried aloft the statue of that emperor. In the Forum of Theodo- sius I. rose a column in his honour, constructed on the model of the hollow column of Trajan at Rome ; there also stood the Anemodou- lion, a beautiful structure surmounted by a vane to indicate the direc- tion of the wind ; and close to the Forum, if not within its precincts, was the Capitol, in which the University of Constantinople was estab- lished. The most conspicuous object in the Forum of the Bous was an ancient bronze figure of an ox, which gave name to the Forum, and beside which criminals were sometimes burned to death. Another hol- low column, the pedestal of which still remains, rose in the Forum of Arcadius in honour of that emperor. The city possessed also a column in honour of the Emperor Marcian, which still stands in the valley of the Lycus, below the Mosque of Sultan Mahomet II. In the decoration of the Fora and streets of the city there was a strange mingling of works belonging to good periods of Greek and Roman Art, with works made when Art had fallen on evil days.

An immense number of churches, enriched by the reputed relics of saints, prophets, and martyrs, made Constantinople a holy city, attracting to its shrines devout pilgrims from every part of the empire. Only some twenty of these sanctuaries survive, and most of them are now used as mosques for Moslem worship, exhibiting few traces of the beauty created by the combination of dome and arch, of marble revetment and mosaics. But S. Sophia still im- presses the mind as one of the grandest buildings ever reared by human hands, while the Churches of S. Irene, SS. Sergius and Bacchus (Kutchuk Aya Sofia), S. Mary Diaconissa (Kalender Djamissi), S. Saviour of the Chora (Kahriyeh Djamissi), and S. Saviour Pantocrator (Kliss6 Djamissi) are interesting monuments of Byzantine art. The Church of the Holy Apostles, to which the Imperial Cemetery was attached, on the summit of the Fourth Hill, has been replaced by the Mosque of Sultan Mahomet II., the conqueror of the city.

Of the imperial palaces in and around the city we can mention only the Great Palace, a group of detached edifices scattered over the ground descending to the Sea of Marmora from the Hippodrome and the eastern

side of the Augustaion ; the Palace of Hormisdas, or of the Bucoleon, near Tchatlady Kapou; the Palace of the Porphyrogenitus, Tekfour Serai ; the Palace of Blachernae, in the quarters of Egri Kapou and Aivas Effendi ; the suburban Palace of Feg6, at Balukli; the Palace of the Hebdomon, at Makrikeui. The last has generally been identified with Tekfour Serai, but the fact that the suburb and palace at the Hebdomon stood at Makrikeui, beside the Sea of Marmora, at the seventh milestone from the Milion, is one of the surest results of recent archaeological investigations. The fortress of the Cyclobion was in the same vicinity.

The Hippodrome, which entered so much into the life of the city, is represented by the large open space to the west of the Mosque of Sultan Achmet. An Egyptian obelisk on a pedestal covered with sculptured work portraying Theodosius I., sometimes accompanied by his empress and his sons, presiding at scenes in the Hippodrome ; the Serpent Column, which stood originally at Delphi, in commemoration of the battle of Plataea ; and a lofty pile of masonry in the form of an obelisk, once covered with gilded plates of bronze, indicate the line of the Spina ; while under the prison and offices along the western side of the area arches are visible, against which seats for the spectators were built.

Water was brought to the city from the country to the west and north-west by aqueducts, sometimes above and sometimes under ground, and was stored within the city in large open reservoirs (now changed into vegetable gardens) and in cisterns covered with vaulted roofs supported on columns. They are important speci- mens of Byzantine architecture, as the works of Andr^ossy (Con- stantinople et le Bosphore), of Forohheimer and Strzygowski (^Die

Byzantinischen Wasserbehdlter von Konstantinopel), and of Choisy {L'Art de Batir ches les Byzantins) testify. The Aqueduct of Valens spans the valley between the Fourth Hill and the Third Hill of the city, and still carries on its beneficent work. The Cistern of Bin-Bir-Derek (Cistern of lUus) and the Cistern of Yeri-Batan-Serai (Cisterna Basilica) are noteworthy. Much of the, water introduced into the city was used in the public baths and fountains, which formed as characteristic a feature of Byzantine- Constantinople as similar erections do of Stamboul.

Byzantine Constantinople was a great emporium of trade, and a striking evidence of its commercial activity is seen in the number of harbours with which the city was provided. In addition to the Golden Horn and its bays, several artificial harbours, traces of which remain, were constructed on the shore of the city beside the Sea of Marmora. First (beginning from the east) came the Harbour of the Bucoleon, attached to the palace of that name, for the service of the Imperial Court. Then, at a short distance to the west of Tchatlady Kapou, came the Harbour of the Emperor Julian (Kad- riga Limani), or of Sophia, as it was called after its reconstruction by the empress of Justin II. ; the Harbour of Condoscalion (Koum Kapou) followed ; next came (a little to the east of Yeni Kapou) the Harbour of Kaisarius, or the Heptascalon ; then, the Harbour of Theodosius I., or of Eleutherius Vlanga Bostan); and lastly, the Harbour of the Golden Gate, on the shore south of that entrance.

Besides the works mentioned above, the following will assist the student of the archseology of the city : — Petrus Gylhus. De Topographia Constantinopoleos et de illius Antiquitatibus. — Du Cange. Constantinopolis Christiana. — Paspates. Bvfavnvai Me\4- Tai. — Salzenberg. Altchristliche Baudenkmale von Konstantino- pel.— Lethaby and Swainson. The Church of Sancta Sophia. — PuLGHEK. Les Anciennes ^glises Byzantines de Constantinople. — Labahte. Le Palais Imperial de Constantinople et ses Abords. — MoRDTMANN. Esquisse Topographique de Constantinople.

(a. VAN M.)

Contract. — The purpose of this article is not to give technical details and authorities for professional use, but to exhibit the characteristic features of English law in connexion with their historical and rational grounds. Enforcement of good faith in matters of bargain and promise is among the most important functions of legal justice in modern civilized countries. It might not be too much to say that, next after keeping the peace and securing property against violence and fraud so that business may be possible, it is the most important. Yet we shall find that the importance of contract is developed comparatively late in the history of law. The common- wealth needs elaborate rules about contracts only

when it is advanced enough in civilization and trade to have an elaborate system of credit. The Eoman law of the empire dealt with contract, indeed, in a fairly adequate manner, though it never had a complete or uniform theory ; and the Roman law, as settled by Justinian, appears to have satisfied the Eastern empire long after the Western nations had begun to recast their institutions, and the traders of the Mediterranean had struck out a cosmopolitan body of rules, known as the Law Merchant, which claimed accept- ance in the name neither of Justinian nor of the Church, but of universal reason. It was amply proved afterwards that the foundations of the Eoman system were strong enough to carry the fabric of modern legislation. But the collapse of the Eoman power in western Christendom threw society back into chaos, and reduced men's ideas of ordered justice and law to a condition compared with which the earliest Roman law known to us is modern.

In this condition of legal ideas, which it would be absurd to call jurisprudence, the general duty of keeping faith is not recognized except as a matter of religious or social observance. Those who desire to be assured of anything that lies in promise must exact an oath, or a pledge, or personal sureties ; and even then the court of their people — in England the Hundred Court iu the first instance — will do nothing for them in the first case, and not much in the two latter. It is more a question of acquiring a good title to help one's self than of becoming entitled to active assistance from any person in authority.

Probably the settlement of a blood-feud, with provisions for the payment of the fine by instalments, was the nearest approach to a continuing contract, as we now understand the term, which the experience of Germanic antiquity could furnish. It is also probable that the performance of such undertakings, as it concerned the general peace, was at an early time regarded as material to the common- weal ; and that these covenants of peace, rather than the rudimentary selling and

bartering of their day, first caused our Germanic ancestors to realize the importance of put- ting some promises at any rate under public sanction. We have not now to attempt any reconstruction of archaic judgment and justice, or the lack of either, at any period of the darkness and twilight which precede the history of the Middle Ages. But the history of the law, and even the present form of much law still common to almost all the English-speaking world, can be understood only when we bear in mind that our forefathers did not start from any general conception of the State's duty to enforce private agreements, but, on the contrary, the State's powers and functions in this regard were extended gradually, unsystematically, and by shifts and devices of ingenious suitors and counsel, aided by judges, rather than by any direct provisions of princes and rulers. Money debts, it is true, were recoverable from an early time. But this was not because the debtor had promised to repay the loan ; it was because the money was deemed still to belong to the creditor, as if the identical coins were merely in the debtor's custody. The creditor sued to recover money, for centuries after the Norman Conquest, in exactly the same form which he would have used to demand possession of land; the action of debt closely resembled the " real actions," and, like them, might be finally determined by a judicial combat; and down to Blackstone's time the creditor was said to have a property in the debt — property which the debtor had " granted " him. Giving credit, in this way of thinking, is not reliance on the right to call hereafter for an act, the payment of so much current money or its equivalent, to be performed]fy the debtor, but merely suspension of the immediate right to possess one's own particular money, as the owner of a house let for a term suspends his right to occupy it. This was no road to the modern doctrine of contract, and the passage had to be made another way.

*In fact the old action of debt covered part of the ground of contract only by accident. It was really an action to recover any property that was not d^t" *" ^^^^ ; for the remedy of a dispossessed owner of chattels, afterwards known as Detinue, was only a slightly varying form of it. If the property claimed was a certain sum of money, it might be due because the defendant had received money on loan, or because he had leceived goods of which the agreed price remained unpaid ; or, in later times at any rate, because he had become liable in some way by judgment, statute, or other*

authority of law, to pay a fine or fixed penalty to the plaintiff. Here the person recovering might be as con- siderable as the lord of a manor, or as mean as a ” common informer ” ; the principle was the same. In every case outside this last class, that is to say, when- ever there was a debt in the popular sense of the word, it had to be shown that the defendant had actually received the money or goods ; this value received came to be called quid pro quo — a term unknown, to all appear- ance, out of England. Nevertheless the foundation of the plaintiff’s right was not bargain or promise, but the Tinjust detention by the defendant of the plaintiff’s money or goods.

We are not concerned here to trace the change from the ancient method of proof — oath backed by ” good suit,” i.e.,

Modes 0/ proof.

the oaths of an adequate number of friends and neigh- bours— through the earlier form of jury trial, in which the jury were supposed to know the truth of their own knowledge, to the modern establishment of facts by testimony brought before a jury who are bound to give their verdict according to the evidence. But there was one mode of proof which, after the Norman Conquest, made a material addition to the substantive law. This was the proof by writing, which means writing authenticated by seal. Proof by writing was admitted under Roman influence, but, once admitted, it acquired the character of being conclusive which belonged to aU proof in early Germanic procedure. Oath, ordeal, and battle were all final in their results. When the process was started there was no room for discussion. So the sealed writing was final too, and a man could not deny his own deed. We still say that he cannot, but with modern refinements. Thus the deed, being allowed as a solemn and probative document, furnished a means by which a man could bind himself, or rather effectually de- clare himself bound, to anything not positively forbidden by law. Whoever could afford parchment and the services of a clerk might have the benefit of a “formal contract” in the Boman sense of the term. At this day the form of deed called a bond or “obligation” is, as it stands settled after various experiments, extremely artificial ; but it is essentially a solemn admission of liability, though its conclusive stringency has been

relaxed by modem legis- lation and practice in the interest of substantial justice. By this means the performance of all sorts of undertakings, pecuniary and otherwise, could be and was legally secured. Bonds were well known in the 13th century, and from the 14th century onwards were freely used for commercial and other purposes ; as for certain limited purposes they stUl are. The " covenant " of modern draftsmen is a direct promise made by deed ; it occurs mainly as incident to conveyances of land. The mediaeval " covenant," con- ventio, was, when we first hear of it, practically equivalent to a lease, and never became a common instrument of miscellaneous contracting, though the old books recognize the possibility of turning it to various uses of which there are examples ; nor had it any sensible influence on the later development of the law. On the whole, in the old common law one could do a great deal by deed, but very little without deed. The minor bargains of daily life, so far as they involved mutual credit, were left to the juris- diction of inferior courts, of the Law Merchant, and — last, not least — of the Church.

Popular custom, in all European countries, recognized simpler ways of pledging faith than parchment and seal. A handshake was enough to bind a bargain. Whatever secular law might say, the Church said it was an open sin to break plighted faith; a matter, therefore, for spiritual correction, in other words, for compulsion exercised on the defaulter by the bishop's or the archdeacon's court, armed with the power of excommunication. In this way the ecclesiastical courts acquired much business which was, in fact, as secular as that of a modem county court, with the incident profits. Mediaeval courts lived by the suitors' fees. What were the king's judges to do ? However high they put their claims in the course of the rivalry between Church and Crown, they could not effectually prohibit the bishop or his official from dealing with matters for which the king's court pro- vided no remedy. Continental jurists had seen their way, starting from the Roman system as it was left by Justinian, to reduce its formalities to a vanishing quantity, and expand their jurisdiction to the full breadth of current usage. English judges could not do this in the 15th century, if they could ever have done so. Nor would simplification of the requisites of a deed, such as

CONTEACT

has now been introduced in many jurisdictions, have been of much use at a time when only a minority even of well- to-do laymen could write with any facility.

There was no principle and no form of action in Eng- lish law which recognized any general duty of keeping promises. But could not breach of faith by which a party had suffered be treated as some kind of legal wrong? There was a known action of trespass and a known action of deceit, this last of a special kind, mostly for what would now be called abuse of the process of the court; but in the later Middle Ages it was an admitted remedy for giving a false warranty on a sale of goods. Also there was room for actions " on the case," on facts analogous to those covered by the old writs, though not precisely within their terms. If the king's judges were to capture this important branch of business from the clerical hands which threatened to engross it, the only way was to devise some new form of action on the case. There were signs, moreover, that the Court of Chancery would not neglect so promising a field if the Common Law judges left it open.

The mere fact of unfulfilled promise was not enough, in the eyes of mediaeval English lawyers, to give a handle ■Assampsit. *° *^® ^^^' ^^^ i^^jury caused by reliance on another man's undertaking was different. The special undertaking or "assumption" creates a duty which is broken by fraudulent or incompetent miscarriage in the performance. I profess to be a skilled farrier, and lame your horse. It is no trespass, because you trusted the horse to me ; but it is something like a trespass, and very like a deceit. I profess to be a competent builder ; you employ me to build a house, and I scamp the work so that the house is not fit to live in. An action on the case was allowed without much difficulty for such defaults. The next step, and a long one, was to provide for total failure to perform. The builder, instead of doing bad work, does nothing at all within the time agreed upon for completing the house. Can it be said that he has done a wrong ? At first the judges felt bound to hold that this was going too far; but suitors anxious to have the benefit of the king's justice persevered, and in the course of the 16th century the new form of action,

called assumpsit from the statement of the defendant's undertaking on which it was founded, was allowed as a remedy for non-performance as well as for faulty performance. Being an action for damages, and not for a certain amount, it escaped the strict rules of proof which applied to the old action of debt ; being in form for a kind of trespass, and thus a privileged appeal to the king to do right for a breach of his peace, it escaped likewise the risk of the defendant clearing himself by oath according to the ancient popular procedure. Hence, as time went on, suitors were em- boldened to use " assumpsit " as an alternative for debt, though it had been introduced only for cases where there was no other remedy. By the end of the 16th century they got their way ; and it became a settled doctrine that the existence of a debt was enough for the court to pre- sume an undertaking to pay it. The new form of action was made to cover the whole ground of informal contracts, and, by extremely ingenious devices of pleading, developed from the presumption or fiction that a man had promised to pay what he ought, it was extended in time to a great variety of cases where there was in fact no contract at all. The new system gave no new force to gratuitous promises. For it was assumed, as the foundation of the jurisdiction, that the plaintiff had been induced Coasiaera- ^yy the defendant's undertaking, and with the '"'" defendant's consent, to alter his position for the

worse in some way. He had paid or bound hiinself to pay money, he had parted with goods, he had spent time in labour, or he had foregone some profit or legal right. If

he had not committed himself to anything on the strength of the defendant's promise, he had suffered no damage and had no cause of action. Disappointment of expectations is unpleasant, but it is not of itself damnum in a legal sense. To sum up the effect of this in modern language, the plaintiff must have given value of some kind, more or less, for the defendant's undertaking. This something given isj the promisee and accepted by the promisor in return for his undertaking is what we now call the con- sideration for the promise. In cases where debt would also lie, it coincides with the old requirement of value received {quid pro quo) as a condition of the action of debt being available. But the conception is far wider, for the consideration for a promise need not be

anything capable of delivery or possession. It may be money or goods ; but it may also be an act or series of acts ; further (and this is of the first importance for our modern law), it may itself be a promise to pay money or deliver goods, or to do work, or otherwise to act or not to act in some specified way. Again, it need not be anything which is obviously for the promisor's benefit. His acceptance shows that he set some value on it; but in truth the promisee's burden, and not the promisor's benefit, is material. The last refinement of holding that, when mutual promises are exchanged between parties, each promise is a consideration for the other and makes it binding, was conclusively accepted only in the 17th century. The result was that promises of mere bounty could no more be enforced than before, but any kind of lawful bargain could; and there is no reason to doubt that this was in substance what most men wanted. An- cient popular usage and feeling show little more en- couragement than ancient law itself to merely gratuitous alienation or obligations. Also (subject, till quite modern times, to the general rule of common-law procedure that parties could not be their own witnesses, and subject to various modern statutory requirements in various classes of cases) no particular kind of proof was necessary. The necessity of consideration for the validity of simple contracts was unfortunately confused by commentators, almost from the beginning of its history, with the per- fectly different rules of the Eoman law about nudum pactum, which very few English lawyers took the pains to understand. Hasty comparison of misunderstood Koman or canon law is answerable for a large proportion of the worst faults in our old-fashioned text-books. Doubtless many canonists, probably some common law- yers, and possibly some of the judges of the Eenaissance time, supposed that ex nudo pacta nan oritur actio was in some way a proposition of universal reason ; but it is a long way from this to concluding that the Koman law had any substantial influence on the English.

The doctrine of consideration is in fact peculiar to those jurisdictions where the common law of England is in force, or is the foundation of the received law. Substantially similar results are obtained in other modern systems by professing to enforce all deliberate promises, but imposing stricter conditions of proof where the promise is gratuitous.

As obligations embodied in the solemn form of a deed were thereby made enforceable before the doctrine of consideration was known, so they still remain. When a man has by deed declared himself bound, there is no need to look for any bargain, or even to ask whether the other party has assented. This rugged frag- ment of ancient law remains embedded in our elaborate modern structure. Kevertheless gratuitous promises, even by deed, get only their strict and bare rights. There may be an action upon them, but the powerful remedy of specific performance — often the only one worth having — is denied them. Eor this is derived from the extraordinary jurisdiction of the Chancellor, and the equity administered

by the Chancellor ~~*was not for plaintiffs who could not show substantial merit as well as legal claims. The singular position of promises made by deed is best left out of account in considering the general doctrine of the formation of contracts ; and as to interpretation there is no difference. In what follows, therefore, it will be need*~~ *less, as a rule, to distinguish between ” parol ” or ” simple” contracts, that is, contracts not made by deed, and obli- gations undertaken by deed.*

From the conception of a promise being valid only when given in return for something accepted in considerar tion of the promise, it follows that the giving of the promise and of the consideration must be simultaneous. Words of promise uttered before there is a considera- tion for them can be no more than an offer ; and, on the other hand, the obligation declared in words, or inferred from acts and conduct, on the acceptance of a considerar tion, is fixed at that time, and cannot be varied by sub- sequent declaration, though such declarations may be material as admissions. It was a long while, however, before this consequence was clearly perceived. In the 18th century it was attempted, and for a time with con- siderable success, to extend the range of enforceable promises without regard to what the principles of the law would bear, in order to satisfy a sense of natural justice. This movement was checked only within living memory, and traces of it remain in certain apparently anomalous rules which are indeed of little practical importance, but which private writers, at any

rate, can- not safely treat as obsolete. However, the question of ” past consideration ” is too minute and technical to be pursued here. The general result is that a binding contract is regularly constituted by the acceptance of an offer, and at the moment when it is accepted ; and, however complicated the transaction may be, there must always, in the theory of English law, be such a moment in every case where a contract is formed. It also fol- lows that an offer before acceptance creates no duty of any kind (“A revocable promise is unknown to our law” — Anson) ; which is by no means necessarily the case in sys- tems where the English rule of consideration is unknown. The question what amounts to final acceptance of an offer is, on the other hand, a question ultimately depending on common sense, and must be treated on similar lines in all civilized countries where the business of life is carried on in a generally similar way. The rules that an offer is understood to be made only for a reasonable time, accord- ing to the nature of the case, and lapses if not accepted in due time ; that an expressed revocation of an offer can take effect only if communicated to the other party before he has accepted ; that acceptance of an offer must be according to its terms, and a condibional or qualified acceptance is only a new proposal, and the like, may be regarded as standing on general convenience as much as on any technical ground.

Great difficulties have arisen, and in other systems as well as in the English, as to the completion of contracts between persons at a distance. There must be f°^®’”””“some rule, and yet any rule that can be framed must seem arbitrary in some cases. On the whole our modern doctrine is to some such effect as the following: —

The proposer of a contract can prescribe or authorize any mode, or at least any reasonable mode, of acceptance, and if he specifies none he is deemed to authorize the use of any reasonable mode in common use, and especially the post. Acceptance in words is not always required ; an offer may be well accepted by an act clearly referable to the proposed agreement, and constituting the whole or part of the performance asked for — say the despatch of goods in answer to an order by post, or the doing of work

bespoken ; and it seems that in such cases further com- munication— ^unless expressly requested — ^is not necessary as matter of law, however prudent and desirable it may be. Where a promise and not an act is sought (as where a tradesman writes a letter offering goods for sale on credit), it must be communicated ; in the absence of special direction letter post or telegraph may be used ; and, further, the acceptor having done his part when his answer is committed to the post, English courts now hold (after much discussion and doubt) that any delay or miscarriage in course of post is at the proposer's risk, so that a man may be bound by an acceptance he never received. It is generally thought — though there is no English decision — that, in conformity with this last rule, a revocation by telegraph of an acceptance already posted would be inoperative. Much more elaborate rules than the English rules' are laid down in some Continen- tal codes. It seems doubtful whether their complication achieves any gain of substantial justice worth the price. At first sight it looks easy to solve some of the difficul- ties by admitting an interval during which one party is bound and the other not. But, apart from the risk of starting fresh problems as hard as the old ones, English principles, as above said, require a contract to be con- cluded between the parties at one point of time, and any exception to this would have to be justified by very strong grounds of expediency. We have already assumed, but it should be specifically stated, that neither offers _ nor acceptances are confined to communications made ' in spoken or written words. Acts or signs may and constantly do signify proposal and assent. One does not in terms request a ferryman to put one across the river. Stepping into the boat is an offer to pay the usual fare for being ferried over, and the ferryman accepts it by putting off. This is a very simple case, but the principle is the same in all cases. Acts fitted to convey to a reasonable man the proposal of an agree- ment, or the acceptance of a proposal he has made, are as good in law as equivalent express words. The term " implied contract " is current in this connexion, but it is unfortunately ambiguous. It sometimes means a contract concluded by acts, not words, of one or both parties, but still a real agreement ; sometimes an obli- gation imposed by law where there is not any agreement in fact.

The obligation of contract is an obligation created and determined by the will of the parties. Herein is the characteristic difference of contract from

all other branches of law. The business of the law, '^^""' therefore, is to give effect so far as possible to the intention of the parties, and all the rules for interpret- ing contracts go back to this fundamental principle and are controlled by it. Every one knows that its application is not always obvious. Parties often express themselves obscurely ; still oftener they leave large parts of their intention unexpressed, or (which for the law is the same thing) have not formed any intention at all as to what is to be done in certain events. But even where the law has to fill up gaps by judicial conjecture, the guiding principle still is, or ought to be, the consideration of what either party has given the other reasonable cause to expect of him. The court aims not at imposing terms on the parties, but at fixing the terms left blank as the parties would or reasonably might have fixed them if all the possibilities had been clearly before their minds. For this purpose resort must be had to various tests: the court may look to the analogy of what the parties have expressly provided for other specified events, to the con- stant or general usage of persons engaged in like business, and, at need, ultimately to the court's own sense of what is just and expedient. All auxiliary rules of this kind*

are subject to the actual will of the parties, and are applied only for want of sufficient declaration of it by the parties themselves. A rule which can take effect against the judicially known will of the parties is not a rule of construction or interpretation, but a positive rule of law. However artificial some rules of construction may seem, this test will always hold. In modern times the courts have avoided laying down new rules of con- struction, preferring to keep a free hand and deal with €ach case on its merits as a whole.

There are certain rules of evidence which to some extent guide or restrain interpretation. In particular, oral Evidence, testimony is not allowed to vary the terms of an agreement reduced to writing. This is really in aid of the parties' deliberate intention, for the object of reducing terms to writing is to make them certain. There are apparent exceptions to the rule, of which the most con- spicuous is the admission of evidence to

show that words were used in a special meaning current in the place or trade in question. But they are reducible, it will be found, to applications (perhaps over-subtle in some cases) ■of the still more general principles that, before giving legal force to a document, we must know that it is really what it purports to be, and that when we do give effect to it according to its terms we must be sure of what its terms really say. The rules of evidence here spoken of are modern, and have nothing to do with the archaic rule already mentioned as to the effect of a deed.

Every contracting party is bound to perform his promise according to its terms, and in case of any doubt in the sense in which the other party would reasonably Perform- understand the promise. Where the perform- ance on one or both sides extends over an appre- ciable time, continuously or by instalments, questions may arise as to the right of either party to refuse or sus- pend further performance on the ground of some default on the other side. Attempts to lay down hard and fast rules on such questions are now discouraged, the aim of the courts being to give effect to the true substance and intent of the contract in every case. Nor will the court hold one part of the terms deliberately agreed to more or less material than another in modern business dealings. ■" In the contracts of merchants time is of the essence," as the Supreme Court of the United States has said in our own day. Certain ancient rules restraining the apparent literal effect of common provisions in mortgages and other instruments were in truth controlling rules of policy. New rules of this kind can be made only by leg- islation. Whether the parties did or did not in fact intend the obligation of a contract to be subject to unex- pressed conditions is, however, a possible and not un- •common question of interpretation. One class of cases giving rise to such questions is that in which perform- ance becomes impossible. by some external cause not due to the promisor's own fault. As to promises obviously absurd or impossible from the first, they are unenforce- able only on the ground that the parties cannot have .seriously meant to create a liability. For precisely the same reason, supported by the general usage and under- standing of mankind, common social engagements, though they often fulfil all other requisites of a contract, have never been treated as binding in law.

In all matters of contract, as we have said, the ascer- tained will of the parties prevails. But this means a will both lawful and free. Hence there are limits to iilegauty. ^jjg f qj-cc of the general rule, fixed partly by the law of the land, which is above individual will and in- terests, partly by the need of securing good faith and justice between the parties themselves against fraud or misadventure. Agreements cannot be enforced when their performance would involve an offence against the

law. There may be legal offence, it must be remembered, not only in acts commonly recognized as criminal, dis- loyal, or immoral, but in the breach or non-observance of positive regulations made by the Legislature, or persons having statutory authority, for a great variety of pur- poses. It would be useless to give details on the subject here. Again, there are cases where an agreement may be made and performed without offending the law, but on grounds of " public policy " it is not thought right that the performance should be a matter of legal obligation, even if the ordinary conditions of an enforceable contract are satisfied. A man may bet, in private at any rate, if he likes, and pay or receive as the event may be ; biit for many years the winner has had no right of action against the loser. Unfortunate timidity on the part of the judges, who attempted to draw distinctions instead of saying boldly that they would not entertain actions on wagers of any kind, threw this topic into the domain of legislation ; and the laudable desire of Parliament to dis- courage gambling, so far as might be, without attempting impossible prohibitions, has brought the law to a state of ludicrous complexity in both civil and criminal jurisdic- tion. But what is really important under this doctrine of public policy is the confinement of "contracts in restraint of trade' within special limits. In the Middle Ages and down to modern times there was a strong feeling — not merely an artificial legal doctrine — against monopolies and everything tending to monopoly. Agreements to keep up prices or not to compete were regarded as crim- inal. Gradually it was found that some kind of limited security against competition must be allowed if such transactions as the sale of a going concern with its good- will, or the retirement of partners from a continuing firm, or the employment of confidential servants in matters in^ volving trade secrets, were to be carried on to the satis- faction of the parties. Attempts to lay down fixed rules in these matters were made from time to time, but they were finally*

discredited by the decision of the House of Lords in the Maxim-Nordenfelt Company's case in 1894. Contracts " in restraint of trade " will now be held valid, provided that they are made for valuable consideration (this even if they are made by deed), and do no't go be^ yond what can be thought reasonable for the protection of the interests concerned, and are not injurious to the public. (The Indian Contract Act, passed in 1872, has unfortunately embodied views now obsolete, and remains unamended.) All that remains of the old rules in Eng- land is the necessity of valuable consideration, whatever be the form of the contract, and a strong presumption — but not an absolute rule of law — that an unqualified agreement not to carry on a particular business is not reasonable.

Where there is no reason in the nature of the contract for not enforcing it, the consent of a contracting party may still not be binding on him because not praud given with due knowledge, or, if he is in a relar tion of dependence to the other party, with independent judgment. Inducing a man by deceit to enter into a con- tract may always be treated by the deceived party as a ground for avoiding his obligation, if he does so within a reasonable time after discovering the truth, and, in par- ticular, before any innocent third person has acquired rights for value on the faith of the contract (see Fraud). Coercion would be treated on principle in the same way as fraud, but such cases hardly occur in modern times. There is a kind of moral domination, howeverj which our courts watch with the utmost jealousy, and repress under the name of " undue influence " when it is used to obtain pecuniary advantage. Persons in a position of legal or practical authority — guardians, confidential advisers, spiritual directors, and the like — must not abuse their

authority for selfish ends. They are not forbidden to take benefits from those who depend on them or put their trust in them ; but if they do, and the givers repent of their bounty, the whole burden of proof is on the takers to show that the gift was in the first instance made freely and with understanding. Large voluntary gifts or beneficial contracts, outside the

limits within which natural affection and common practice justify them, are indeed not encouraged in any system of civilized law. Professional money-lenders were formerly checked by the usury laws ; now that no rate of interest is in itself unlawful, courts and juries have shown a certain astute- ness in applying the rules of law as to fraud and undue influence — ^the latter with certain special features — to transactions with needy " expectant heirs " and other improvident persons which seem on the whole unconscion- able. In the case of both fraud and undue influence, the person entitled to avoid a contract may, if so advised, ratify it afterwards ; and ratification, if made with full knowledge and free judgment, is irrevocable. A con- tract made with a person deprived by unsound mind or intoxication of the capacity to form a rational judg- ment is on the same footing as a contract obtained by fraud, if the want of capacity is apparent to the other party.

There are many cases in which a statement made by one party to the other about a material fact will enable the other to avoid the contract if he has relied on it, and it was in fact untrue, though it may have been made at the time with honest belief in its truth. This is so wher- ever, according to the common course of business, it is one party's business to know the facts, and the other practi- cally must, or reasonably may, take the facts from him. In some classes of cases even inadvertent omission to dis- close any material fact is treated as a misrepresentation. Contracts of insurance are the most important ; here the insurer very seldom has the means of making any effec- tive inquiry of his own. Misdescription of real property on a sale, without fraud, may according to its importance be a matter for compensation or for setting aside the con- tract. Promoters of companies are under special duties as to good faith and disclosure which have been worked out at great length in the modern decisions. But company law has become so complex within the present generation that, so far from throwing much light on larger principles, it is hardly intelligible without some previous grasp of them. Sometimes it is said that misrepresentation (apart from fraud) of any material fact will serve to avoid any and every kind of contract. It is submitted that this is certainly not the law as to the sale of goods or as to the contract to marry, and therefore the alleged universal rule does not exist. But it must be remembered that parties can, if they please, and not necessarily by the express terms of the contract

itself, make the validity of their contract conditional on the existence of any matter of fact whatever, including the correctness of any particular statement. If they have done this, and the fact is not so, the contract has no force ; not because there has been a misrepresentation, but because the parties agreed to be bound if the fact was so and not otherwise. It is a question of interpretation whether in a given case there was any such condition.

Mistake is said to be a ground for avoiding contracts, and there are cases which it is practically convenient to group under this head. On principle they seem to be mostly reducible to failure of the acceptance to correspond with the offer, or absence of any real consideration for the promise. In such cases, whether there be fraud or not, no contract is ever formed, and therefore there is nothing which can be ratified — a distinction which may have important effects. Eelief against mistake is given where

parties who have really agreed, or rather their advisers, fail to express their intention correctly. Here, if the original true intention is fully proved — as to which the court is rightly cautious — the faulty document can be judicially rectified.

*By the common law an infant (i.e., a person less than twenty-one years old) was bound by contracts made for " necessaries," i.e., such commodities as a jury holds, and the court thinks they may reason- *" ably hold, suitable and required for the person's condi- tion ; also by contracts otherwise clearly for his benefit ; all other contracts he might confirm or avoid after coming of age. An extremely ill-drawn Act of 1874 absolutely deprived infants of the power of contracting loans, con- tracting for the suppl}' of goods other than necessaries, and stating an account so as to bind themselves ; it also disabled them from binding themselves by ratification. The liability for necessaries is now declared by legislative authority in the Sale of Goods Act, 1893. Practically,, people who give credit to an infant do so at their peril, except in cases of obvious urgency.*

Married, women were incapable by the common law of contracting in their own names. At this day they can hold separate property and bind

themselves to the extent of that property — not personally — by contract. The law before the Married Women's Property Acts (1882 and 1893, and earlier Acts now superseded and repealed) was a very peculiar creature of the Court of Chancery ; the number of cases in which it is necessary to go back to it is of course decreasing year by year. But a married woman can still be restrained from anticipating the income of her separate property, and the restriction is still commonly inserted in marriage settlements.

There is a great deal of philosophical interest about the nature and capacities of corporations, but for modem practical purposes it may be said that the legal powers of British corporations are directly or indirectly deter- mined by Acts of Parliament. For companies under the Companies Acts the controlling instrument or written constitution is the memorandum of association. Com- pany draftsmen, taught by experience, nowadays frame this in the most comprehensive terms. Questions of either personal or corporate disability are less fre- quent than they were. In any case, they stand apart; from the general principles which characterize our law of contract.

Authorities. — History: Ames. " The History of Assumpsit," Harvard Law Rev. ii. 1, 53. Cambridge, Mass., 1889. — Pollock and Maitland. History of English Law, 2nd ed., ii. 184-289.. Cambridge, 1898. Modem: Pollock, article "Contract" in Uncyclopcedia of the Laws of England, vol. iii., London, 1897, a. tecliuical summary of the modern law. Of the text- books, Anson, English Law of Contract, is now in a ninth edition, 1899 ; Harri- MAN, Law of Contracts, in a second, 1901 ; Pollock, Principles- of Contract, in a seventh, 1902. — 0. W. Holmes (afterwards Chief Justice of Massachusetts), The Common Law, Boston, Mass., 1881, is illuminating on contract as on other legal topics, though the. present writer cannot accept all the learned judge's historical conjectures. (p. po.)

Conveyancing is the art or science of effecting the^ transfer of property, or modifying interests in relation to- property, by means of written documents.

In early legal systems the main element in the transfer- of property was the change, generally accompanied by some public ceremony, in the actual physical posses- „. . sion : the function of documents, where used,

*being * *”’■ merely the preservation of evidence. Thus, in Great Britain in the feudal period, the common mode of conveying an. immediate freehold was by feoffment with livery of seisin — a proceeding in which the transferee was publicly invested with the feudal possession or seisin, usually through the medium of some symbolic act performed in.*

*.j^^*

the presence of witnesses upon the land itself. A deed or charter of feoffment was commonly executed at the same time by way of record, but formed no essential part of the conveyance. In the language of the old rule of the common law, the immediate freehold in corporeal hereditaments lay in livery, whereas reversions and re- mainders and all incorporeal hereditaments lay in grant, i.e., passed by the delivery of the deed of conveyance or grant without any further ceremony. The process by which this distinction was broken down and the present uniform system of private conveyancing by simple deed was established, constitutes a long chapter in English legal history.

The land of a feudal owner was subject to the risk of forfeiture for treason, and to military and other burdens. The common law did not allow him to dispose of it by will. By the law of mort- main religious houses were prohibited from acquiring it. The desire to escape from these burdens and limitations gave rise to the practice of making feoffments to the use, of, or upon trust for, per- sons other than those to whom the seisin or legal possession was delivered. The common law recognized only the legal tenant ; but the cestui que use or beneficial owner gradually secured for his wishes and directions concerning the profits of the land the strong protection of the chancellors as exercising the equitable jurisdiction of the king. The resulting loss to the Crown and the great lords of the feudal dues and privileges, coupled with the public disadvan- tages arising from ownership of land which, in an increasing degree, was merely nominal, brought about the passing in the year 15.35 of the famous Statute of Uses, the object of which was to destroy altogether the

system of uses and equitable estates. It enacted, in substance, -that whoever should iave a use or trust in any hereditaments should be deemed to have the legal seisin, estate, and possession for the same interest that he had in the use ; in other words, that he should become in effect the feudal tenant without actual delivery of possession to him by the actual feoffee to uses or trustee. In its result the statute was a fiasco. It was solemnly decided that the Act transferred the legal possession to the use once only, and that in the case of a conveyance to A to the use of B to the use of or upon trust for C, it gave the legal estate to B, and left C with an interest in the position of the use before the statute. Thus was completed the foundation of the modern system of trusts fastened upon legal estates and protected by the equitable doctrines and practice of the judicature.

But the statute not only failed to abolish uses : it also opened the way to the evasion of the public ceremony of " livery of seisin," and the avoidance of all notoriety in conveyances. Other ways, besides an actual feoffment to uses, of creating a use had been in vogue before the statute. If A bargained with B, in writing or not, for the sale of land, and B paid the price, but A remained in legal possession, the Court of Chancery enforced the use or equitable interest in favour of B. The effect of a " bargain and sale " (as such a transaction was called) after the statute was to give B the legal interest without any "livery of seisin." This fresh danger was met in the very year of the statute itself by an enactment that a bargain and sale of an estate of inheritance or freehold should be made by deed publicly enrolled. But the Statute of Enrolments was in terms limited to estates of freehold. It was allowed that a bargain and sale for a term, say, of one year, must transfer the seisin to the bargainee without enrolment. And since what remained in the bargainor was merely a reversion which " lay in grant," it was an easy matter to release this by deed the day after. By this ingenious device was the publicity of feoffment or enrolment avoided, and the lease and release, as the process was called, remained the usual mode of conveying a freehold in pos- session down to the 19th century.

It was not until 1845 that the modern system of transfer by a single deed was finally established. By the Real Property Act of that year it was

enacted that all corporeal hereditaments should, as regards the immediate freehold, be deemed to lie in grant as well as in livery. Since this Act the ancient modes of conveyance, though not abolished by it, have in practice become obsolete. Traces of the old learning connected with them remain, however, embedded in the modern conveyance. Many a purchase-deed recites that the vendor is seised in fee-simple of the property. It is the practice, moreover, to convey not only " to " but also " to the use of " a purchaser. Tor before the Statute of Uses, a conveyance made without any consideration or declaration of uses was deemed to be made to the use

of the party conveying. In view of the operation of the statute upon the legal estate in such circumstances, it is usual in all conveyances, whether for value or not, to declare a use in favour of the party to whom the grant is made.

In its popular usage the word " conveyance " signifies the document employed to carry out a purchase of land. But the term " conveyancing " is of much wider import, and comprises the preparation and completion of all kinds of legal instruments. A well-known branch of the conveyancer's business is the investigation of title — an important function in the case of purchases or mortgages of real estate. With personal estate (other than lease- hold) he has perhaps not so much concern. Chattels are usually transferred by delivery, and stocks or shares by means of printed instruments which can be bought at a law-stationer's. The common settlements and wills, how- ever, deal wholly or mainly with personal property ; and an interest in settled personality is frequently the subject of a mortgage. Of late years, also, there has been an enormous increase in the volume of conveyancing busi- ness in connexion with limited joint-stock companies.

In the preparation of legal documents the practitioner is much assisted by the use of precedents. These are outlines or models of instruments of all kinds, exhibiting in accepted legal phraseology their usual form and con- tents with additions and variations adapted to particular circumstances. Collections of them have been in use from early times, certainly since printing became common. The modern precedent is, upon the whole, concise and businesslike. The prolixity which formerly character- ized

most legal documents has largely disappeared, mainly through the operation of recent statutes which enable many clauses previously inserted at great length to be, in some cases, e.g., covenants for title, incorporated by the use of a few prescribed words, and in others safely omitted altogether. The Solicitors' Remuneration Act, 1881, has also assisted the process of curtailment, for there is now little or no connexion between the length of a deed and the cost of its preparation. So long as the draftsman adheres to recognized legal phraseology and to the well-settled methods of carrying out legal operations, there is no reason why modern instruments should not be made as terse and businesslike as possible.

It is not usual for land to be sold without a formal agreement in writing being entered into. This precaution is due, partly to the Statute of Frauds (§ 4), which renders a contract for the sale of land unenforceable by action " unless the agreement upon which such action shall be brought, or some memo- randum or note thereof, shall be in writing and signed by the party to be charged therewith or some other person thereunto by him lawfully authorized," and partly to the fact that there are few titles which can with pru- dence be exposed to all the requisitions that a purchaser under an " open contract " is entitled by law to make. Such a purchaser may, for example, require a forty years' title (Vendor and Purchaser Act, 1874). Under an open contract a vendor is presumed to be selling the fee-simple in possession, free from any incumbrance, or liability, or restriction as to user or otherwise ; and if he cannot deduce a title of the statutory length, or procure an incumbrance or restriction to be removed, the purchaser may repudiate the contract. The preparation of an agreement for sale involves accordingly an examination of the vendor's title, and the exercise of skill and judgment in deciding how the vendor may be protected against trouble and expense without prejudice to the sale. Upon a sale by auction the agreement is made up of (1) the particulars, which describe the property; (2) the conditions of sale, which state the terms upon which it is oifereri and

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Abstract ot title.

(3) the memorandum of formal contract at the foot of the conditions, which incorporates by reference the particulars and conditions, names or sufficiently refers to the vendor, and is signed by the purchaser after the sale. The object of the agreement, whether the sale is by private contract or by auction, is to define accurately what is sold, to provide for the length of title and the evidence in support of or in connexion with the title which is to be required except so far as it is intended that the general law shall legulate the rights of the parties, and to fix the times at which the principal steps in the transaction are to be taken. It is also usual to provide for the payment of interest at a prescribed rate upon the purchase money if the completion shall be delayed beyond the day fixed for any cause other than the vendor's wilful default, and also that the vendor shall be at liberty to rescind the contract without paying costs or compensation if the purchaser insists upon any requisition or objection which the vendor is unable or, upon the ground of expense or other reasonable ground, is unwilling to comply with or remove. Upon a sale by auction it is the rule to require a deposit to be paid by way of security to the vendor against default on the part of the purchaser.

The signature of the agreement is followed by the delivery to the purchaser or his solicitor of the abstract of title, which is an epitome of the various in- struments and events under and in consequence of which the vendor derives his title. A pur- chaser is entitled to an abstract at the vendor's expense unless otherwise stipulated. It begins with the instrument fixed by the contract for the commencement of the title, or, if there has been no agreement upon the subject, with an instrument of such character and date as is prescribed by ~~the law in the absence of stipulation between the parties. Trom its commencement as so determined the abstract, if properly prepared, shows the history of the title down to the sale ; every instrument, marriage, birth, death, or other fact or event constituting a link in the chain of title, being sufficiently set forth in its proper order. The next step is the verification of the abstract on the purchaser's behalf hy a comparison of it with the originals of the deeds,~~

~~*the probates of the wills, and offtce copies of the instruments of record through which the title is traced. The vendor is bound to produce the original documents, except such as are of record or have been lost or destroyed, but, unless otherwise stipulated, the expense of producing those which are not in his possession falls upon the purchaser (C. A., 1881). After being thus verified, the abstract is perused by the purchaser's advisers with the object of seeing whether a title to the property sold is deduced according to the contract, and what evidence, information, or objec*~~ *tion, in respect of matters appearing or arising upon the abstract, ought to be called for or taken. For this purpose it is necessary to consider the legal effect of the abstracted instruments, whether they have been properly completed, whether incumbrances, adverse interests, de- fects, liabilities in respect of duties, or any other burdens or restrictions disclosed by the abstract, have been already got rid of or satisfied, or remain to be dealt with before the completion of the sale. The result of the considera- tion of these matters is embodied in " requisitions tiMtsf" ^P° ° title," which are delivered to the vendor's solicitors within a tim e usually fixed for the pur- pose by the contract. In making or insisting upon requisitions regard is had, among other things, to any special conditions in the contract dealing with points as to which evidence or objection might otherwise have been required or taken, and to a variety of provisions con- tained in the V. and P. Act, 1874, and the Conveyancing Act, 1881, which apply, except so far as otherwise agreed.*

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and of which the following are the most important: (1) Recitals, statements, and descriptions of facts, matters, and parties contained in instruments twenty years old at the date of the contract are, unless proved inaccurate, to be taken as sufficient evidence of the truth of such facts, matters, and descriptions; (2) a purchaser cannot require the production of, or make any requisition or objection in respect of, any document dated before the commencement of the title ; (3) the cost of obtain- ing evidence and information not in the vendor's possession must be borne by the purchaser. The possibility of the rescission clause now commonly found in contracts for the sale of real estate being exercised in order to avoid com- pliance with an onerous requisition, is also an important factor in

the situation. The requisitions are in due course replied to, and further requisitions may arise out of the answers. A summary method of obtaining a judicial determination of questions connected with the contract, but not affecting its validity, is provided by the V. and P. Act, 1874. Before completion it is usual for the purchaser to cause searches to be made in various official registers for matters required to be entered therein, such as judgments, land charges, and pending actions, which may affect the vendor's title to sell, or amount to an incumbrance upon the property.

When the title has been approved, or so soon as it appears reasonably certain that it will be accepted, the draft conveyance is prepared and submitted to the vendor. This is commonly done by and at the expense of the purchaser, who is entitled to determine the form of the conveyance, provided that the vendor is not thereby prejudiced, or put to additional expense. The common mode of conveying a freehold is now, as already mentioned, by ordinary deed, called in this case an indenture, from the old practice, where a deed was made between two or more parties, of writing copies upon the same parchment and then dividing it by an indented or toothed line. Indenting is, however, not necessary, and in modern practice is disused. A deed derives its efficacy from its being sealed and delivered. It is still a matter of doubt whether signing is essential. It is not necessary that its execution should be attested except in special circumstances, as, e.g., where made under a power requiring the instrument exercising it to be attested. But in practice conveyances are not only sealed, but also signed, and attested by one or two witnesses. The details of a conveyance in any particular case depend upon the subject-matter and terms of the sale, and the state of the title as appearing by the abstract. The framework, how- ever, of an ordinary purchase-deed consists of (1) the date and parties, (2) the recitals, (3) the testatum or witnessing- part, containing the statement of the consideration for the sale, the words incorporating covenants for title, and the operative words, (4) the parcels or description of the property, (5) the habendum, showing the estate or interest to be taken by the purchaser, and (6) any provisos or covenants that may be required. A few words will illustrate the object and effect of these component parts.

(1) The parties are the persons from whom the property, or some estate or interest in or in relation to it, is to pass to the purchaser, or whose concurrence is rendered neces- sary by the state of the title in order to give the pur- chaser the full benefit of his contract and to complete it according to law. It is often necessary that other persons besides the actual vendor should join in the conveyance, e.g., a mortgagee who is to oe paid off and convey his estate, a trustee of an outstanding legal estate, a person entitled to some charge or restriction who is to release it, or trustees who are to receive the purchase-money where a limited owner is selling under a power (e.g., a tenant for life

under the power given by the Settled Land Act, 1882). Parties are described by their names, addresses, and occupations or titles, each person with a separate inter- est, or filling a distinct character, being of a separate part. (2) The recitals explain the circumstances of the title, the interests of the parties in relation to the prop- erty, and the agreement or object intended to be carried into effect by the conveyance. Where the sale is by an absolute owner there is no need for recitals, and they are frequently dispensed with ; but where there are several parties occupying different positions, recitals in chrono- logical order of the instruments and facts giving rise to their connexion with the property are generally necessary in order to make the deed intelligible. (3) It is usual to mention the consideration. Where it consists of money the statement of its payment is followed by an acknow- ledgment, in a parenthesis, of its receipt, which, in deeds • executed since the C. A., 1881, dispenses with any en- dorsed or further receipt. A vendor, who is the absolute beneficial owner, now conveys expressly "as beneficial owner," which words, by virtue of the C. A., 1881, imply covenants by him with the purchaser that he has a right to convey, for quiet enjoyment, freedom from incum- brances, and for further assurance — limited, however, to the acts and defaults of the covenantor and those through whom he derives his title otherwise than by purchase for value. A trustee or an incumbrancer joining in the deed conveys " as trustee " or " as mortgagee," by which words covenants are

implied that the covenantor individually has not done or suffered anything to incumber the prop- erty, or prevent him from conveying as expressed. As to the operative words, any expression showing an intention to pass the estate is effectual. Since the C. A., 1881, "convey" has become as common as "grant," which was formerly used. (4) The property may be described either in the body of the deed or in a schedule, or com- pendiously in the one and in detail in the other. In any case it is usual to annex a plali. Different kinds of pro- perty have their appropriate technical words of descrip- tion. Hereditaments is the most comprehensive term, and is generally used either alone or in conjunction with other words more specifically descriptive of the property conveyed. (5) The habendum begins with the words " to hold," and the estate, on a sale in fee-simple, is lim- ited, as already mentioned, not only to, but also to the use . of, the purchaser. Before the C. A., 1881, it was neces- sary to add, after the name of the purchaser, the words , " and his heirs," or " his heirs and assigns," though the word " assigns " never had any conveyancing force. But since that Act it is sufiBcient to add "in fee-simple" without using the word "heirs." Unless, however, one or other of these additions is made, the purchaser will even now get only an estate for his life. If the property is to be held subject to a lease or incumbrance, or is re- leased by the deed from an incumbrance previously exist- ing, this is expressed after the words of limitation. (6). Where any special covenants or provisions have been stipulated for, or are required in the circumstances of the title, they are, as a rule, inserted at the end of the conveyance. In simple cases none are needed. Where, however, a vendor retains documents of title, which he is entitled to do where he sells a part only of the estate to which they relate, it is the practice for him by the con- veyance to acknowledge the right of the purchaser to production and delivery of copies of such of them as are not instruments of record like wills or orders of Court, and to undertake for their safe custody. This acknow- ledgment and undertaking supply the place of the lengthy covenants to the like effect which were usual before the C. A., 1881. A trustee or mortgagee joining gives an acknowledgment as to documents retained by him, but

not an undertaking. The foregoing outline of a convey- ance will be illustrated by the following specimen of a simple purchase-deed of part of

an estate belonging to an absolute owner in fee : —

This Indentdre made the day of

between A. B. of, &c., of the one part and C. D. of, &c., of the other part Whereas the said A. B. is seised (among other hereditaments) of the messuage hereinafter described and hereby conveyed for an estate in fee simple in possession free from incumbrances and has agreed to sell the same to the said C. D. for £100 Now this In- denture WITNESSETH that in pursuance of the said agreement and in consideration of the sum of £100 paid to the said A. B. by the said C. D. (the receipt whereof the said A. B. doth hereby acknow- ledge) the said A. B. as beneficial owner doth hereby convey unto the said C. D. All that messuage or tenement situate &c., and known as, &c. To Hold the premises unto and to the use of the said C. D. his heirs and assigns [or in fee simple] And the said A. B. doth hereby acknowledge the right of the said C. D. to pro- duction and delivery of copies of the following documents of title [mentioning them] and doth undertake for the safe custody thereof In witness, &c.

It will be observed that throughout the deed there are no stops, the commencement of the several parts being indicated by capital letters. The draft conveyance having been approved on behalf of the vendor, it is engrossed upon stout paper or parchment, and there remains only the completion of the sale, which usually takes place at the office of the vendor's solicitor. A purchaser is not entitled to require the vendor to attend personally and execute the conveyance in his presence or that of his solicitor. The practice is for the deed to be previously executed by the vendor and delivered to his solicitor, and for the solicitor to receive the purchase-money on his client's behalf, since a purchaser is, under the C. A., 1881, safe in paying the purchase-money to a solicitor producing a deed so executed, when it contains the usual acknow- ledgment by the vendor of the receipt of the money. Upon the completion, the documents of title are handed over except in the case above referred to, and any claims be- tween the parties in respect of interest upon the purchase-money, apportioned outgoings, or otherwise, are settled. The conveyance is, of course, delivered to the purchaser, upon whom rests the obligation of affixing the proper stamp — which he may do without penalty within

thirty days after execution (Stamp Act, 1891). It may be added that, subject to any special bargain, which is rarely made, the costs of the execution by the vendor and other parties whose concurrence is necessary, and of any act required to be done by the vendor to carry out his contract, are borne by the vendor.

Ordinary leases at rack-rents are not generally preceded by a formal agreement, such as is common on a sale of land, or by an investigation into the lessor's title. As a rule, the principal terms are arranged between the parties, and embodied with various ancillary provisions in a draft lease, which is prepared by the lessor's advisers and submitted to the lessee, the ultimate form and contents of the instrument being adjusted by negotiation. If an intending lessee desires to examine the title he must make an express bargain to that effect, for under a contract to grant a lease the intended lessee is not entitled, in the absence of such express stipulation, to call for the title to the freehold (V. and P. Act, 1874). By the Statute of Prauds all leases, except leases for a term not exceeding three years, and at not less than two-thirds of the rack-rent, were required to be in writing. And now by the Eeal Property Act, 1845, leases required by law to be in writing are void at law unless made by deed. An instrument, void as a lease under the Act, may, however, be valid as an agreement to take a lease ; and since the Judicature Act, 1873, under which equitable doctrines pre- vail in the High Court, a person holding under an agree-

ment for a lease, of which specific performance ■would be granted, is treated in all branches of that court as if such a lease were already executed. Unless otherwise agreed, a lease is always prepared by a lessor's solicitor at the expense of the lessee ; but the cost of the counterpart {i.e., the duplicate executed by the lessee) is usually borne by the lessor.

Upon the sale and conveyance of a leasehold property substantially the same procedure is observed as above in- dicated in the case of a freehold. A few '^^'•8""°'" additional points, however, may be specially holds. mentioned. Under an open contract the vendor cannot be called upon to show the title to the freehold reversion (V. and P. Act, 1874 ; C. A., 1881). Accordingly the abstract of title begins with the lease, however old ; but the subsequent title need not be carried back for more than forty years before the sale. The purchaser, apart from stipulation, must assume, unless the contrary appears, that the lease was duly granted, and upon production of the receipt for the last payment due for rent before completion, that all the covenants and pro- visions of the lease have been duly performed and observed up to the date of actual completion. The appropriate word of conveyance is " assign," and a conveyance of lease- holds is generally called an assignment. The vendor's covenants for title implied by his assigning " as beneficial owner " include, in addition to the covenants implied by those words in a conveyance of freehold, a covenant limited in manner above mentioned, that the lease is valid, and that the rent and the provisions of the lease have been paid and observed up to the time of conveyance (C. A. 1881). Where the vendor, as is the common case, remains liable after the assignment for the,rent and the perform- ance of the covenants, the purchaser must covenant to pay the rent, and perform and obsprve the covenants and pro- visions of the lease and keep the vendor indemnified in those respects.*

A mortgage is prepared by the solicitor of the mortgagee, and the mortgagor bears the whole expenses of the trans- action. It is seldom that there is any prelim- o gages. ^jjj^j,y agreement, because (1) a contract to lend money is not specifically enforceable ; and (2) inasmuch as the primary object of a mortgagee is to have his money well secured, he is not, generally, willing to submit to re- strictions as to title or evidence of title which might give rise to difficulty or expense in the event of a sale of the mortgaged property. An intending mortgagor is ac- cordingly required to show a title easily marketable, and to verify it at his own cost. A mortgage follows the same general form as a conveyance on sale, the principal points of difference being that the conveyance of the property is preceded by a covenant for the payment of the mortgage money and interest, and followed by a proviso for recon- veyance upon such payment,

and by any special provi- sions necessary or proper in the circumstances, such as a covenant for insurance and repairs where the security comprises buildings. The covenants for title implied by a mortgagor conveying " as beneficial owner " are the same as in the case of a vendor, but they are absolute and not qualified in the manner above pointed out.

The beneficial operation of the C. A., 1881, in shortening con- veyances is well illustrated by a modern mortgage. For, by virtue of the Act, a mortgagee by deed executed after its commencement has, subject to any contrary provisions contained in the deed, the following powers to the like extent as if they had been conferred in terms : (1) a power of sale exercisable after the mortgage money has become due (a) if notice requiring payment has been served and not complied with for three months ; (6) if any interest is in arrear for two months ; or (c) there has been a breach of some obligation under the deed or the Act other than the covenant for payment of the mortgage money or interest ; (2) a power to insure subject to certain restrictions ; (3) a power, when entitled to sell,

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to appoint a receiver ; and (4) a power while in possession to cut and sell timber. The Act contains ancillary provisions enabling a mortgagee upon a sale to convey the property for such estate or interest as is the subject of the mortgage, and to give a valid receipt for the purchase-money, and the purchaser is amply pro- tected against any irregularities of which he had no notice. There are also large powers of leasing conferred by the Act upon mortgagor and mortgagee while respectively in possession, and a power for the mortgagor, whilst entitled to redeem, to inspect and take copies of title deeds in the mortgagee's possession. The elaborate provisions for all these purposes which were formerly inserted in mortgage deeds are now omitted ; but sometimes the operation of the Act is modified in certain respects. The procedure upon a sale by a mortgagee is the same as in the case of any other vendor. He conveys, however, " as mortgagee," these words implying only a covenant by him against incumbrances arising from his own acts.

The frame of a strict settlement of real estate, which is usually made either on marriage or by way of resettlement on a tenant in tail under an

existing settlement attaining twenty-one, has been much simplified ; but such settlements still remain the most technical and most complicated of legal instruments. By virtue of the Settled Land Acts, 1882 to 1890, tenants for life and many other limited owners have extensive powers of sale, of leasing, and of doing numerous other acts required in a due course of management. These powers cannot be excluded or fettered by settlors. They are, as a rule, considered in practice to be sufficient, and the corre- sponding elaborate provisions formerly inserted in settle- ments are now omitted, the operg,tion of the Acts being merely supplemented, where desirable, by some extension of the statutory powers, in relation, e.g., to the invest- ment and application of capital money. To complete the statutory machinery it is desirable that persons should be nominated by the settlement trustees for the purposes of the Acts. Since the C. A., 1881, provisions for the pro- tection of jointresses or persons entitled under settlements to rent charges or annual sums issuing out of the land are no longer required, as all such persons have now powers of distress and entry, and of limiting terms to secure their respective interests. Terms for raising portions must still, however, be expressly created. The C. A., 1881, also con- fers large powers of management during the minorities of infants beneficially entitled upon persons either appointed for the purpose by the instrument or being such trustees as are mentioned in § 42. An estate in tail may now be limited by the use of the words "in tail " without the words " heirs of the body " formerly necessary. And a settlor generally conveys " as settlor," by which only a covenant for further assurance is implied under the C. A., 1881. Personal settlements are most often made upon marriage. The settled property is vested in trustees, either by the settlement itself, or in the case of cash, mortgage debts, stocks or shares, by previous delivery or transfer, upon trusts declared by the instrument.

The normal trusts after the marriage are (1) for investment ; (2) for payment of the income of the husband's property to him for life, and of the wife's property to her for life for her separate use without power of anticipation whilst under coverture ; (3) for pay- ment to the survivor for his or her life of the income of both properties ; (4) after the death of the survivor, both as to capital and income, for the issue of the marriage as the husband and wife shall jointly by deed appoint, and in default of joint appointment as the survivor shall by deed or will appoint,, and in default

of such appointment for the children of the marriage who attain twenty-one, or being daughters marry, in equal shares, with the addition of a clause (called the hotchpot clause) precluding a child who or whose issue takes a part of the fund by appointment from sharing in the unappointed part without bringing the appointed share into account. Then follows a power for the trustees with the consent of the parents whilst respectively living to raise a part (usually a half) of the share of a child and apply it for his or her a;dvancement or benefit. Power to apply income, after the death of the life tenants, for the maintenance and education of infants entitled in expectancy. Is conferred upon trustees by the C.A., 1881. The ultimate trusts in the event of there being no children who attain vested interests are (1) of the husband's property for him

absolutely ; and (2) of the wife's property for such persons as she shall when discovert by deed, or whether covert or discovert by will, appoint, and in default of appointment, for her absolutely if she survive the husband, but if not, then for her next of kin under the Statute of Distributions, excluding the husband. For all ordi- nary purposes the trustees have now under various statutes sufBl- cient powers and indemnities. They may, however, in some cases need special protection against liability. A power of appointing new trustees is supplied by the Trustee Act, 1893. It is usually made exercisable by the husband and wife during their joint lives, and by the survivor during his or her life.

The form and contents of -wills are extremely diverse. A ~~will of, perhaps, the commonest type (a) appoints executors and trustees ; (6) makes a specific dis~~ position of a freehold or leasehold residence ; (c) gives a few legacies or annuities ; and (d) devises and bequeaths to the executors and trustees the residue of the real and personal estate upon trust to sell and convert, to invest the proceeds (after payment of debts and funeral and testamentary expenses) in a specified manner, to pay the income of the investments to the testator's widow for life or until another marriage, and

subject to her interest, – to hold the capital and incoine in trust for his children who attain twenty-one, or being daughters marry, in equal shares, with a power of advancement. Daughters' shares are frequently settled by testators upon them and their issue on the same lines and with the same statutory incidents as above mentioned in the observations upon settlements; and sometimes a will contains in like manner a strict settlement of real estate. It is a point often overlooked by testators desirous of benefiting remote descendants that future interests in property must, under what is known as the rule against perpetuities, be restricted within a life or lives in being and twenty-one years afterwards. In disposing of real estate " devise " is the appropriate word of conveyance, and of personal estate " bequeath." But neither word is at all necessary. " I leave all I have to A. B. and appoint him my executor" would make an effectual will for a testator who wished to give all his property, whether real or personal, after payment of his debts, to a single person. By virtue of the Land Transfer Act, 1897, Part I., real estate of an owner dying after 1897 now vests for administrative purposes in his executors or administrators, notwithstanding any testamentary disposition.

It remains to mention that by the Land Transfer Act, 1897, a system of compulsory registration of title, limited for the present to the county of London, has been estab- lished. (See Land Kegistration.)

United States. — Conveyances of real estate in the United States are simple in form, and are often prepared by those who have had no professional training for the purpose. Printed blanks, sold at the law-stationers, are commonly employed. The lawyers in each state have devised forms for such blanks, sometimes peculiar in some points to the particular state, and sometimes copied verbatim from those in use elsewhere. Deeds intended to convey an abso- lute estate are generally either of the form known as warranty deed or of that known as release deed. The release deed is often used as a primary conveyance withoui warranty to one who had no prior interest in the land. Uniformity in deeds is rendered particularly desirable 'from the general prevalence of the system of recording all conveyances at length in a public ofSce. Record books are printed for this purpose, containing printed pages corresponding to the printed blanks in use in the particular state, and the

recording officer simply has to fill up each page as the deed of similar form was filled up. One set of books may thus be kept for recording warranty deeds, another for recording release deeds, another for recording mortgage deeds, another for leases, &c. '

AuTHOEiTiES.— Davidson. Precedents and Forms in Convey- ancing. London, 1877 and 1885.— Key and Elphinstone. Com- pendium of Precedents in Conveyancing. London, 1899.— Elphinstonb. Introduction to Conveyancing. London, 1900. — Pollock. The Land Laws. London, 1896.

(s. WA. ; s. B. B.)

Conway (or Abeeconwat), a summer resort, munici- pal town, and parish in the county of Carnarvon, Wales,

14 miles by rail north-east from Bangor and 225 north- west from London. It is built on the side and at the foot of a hill (800 f t^ at the mouth of the river Conway, with Great Orme's Head and Llandudno 4 miles to the north. The river is crossed by two bridges — a tubular railway bridge, similar to that at Menai and only 40 feet shorter, built by Stephenson in 1846—48, and a handsome sus- pension bridge, designed by Telford and built of white stone, in keeping with the castle, in 1822-26. One of the old Jiouses of the town, the Elizabethan Plas Mawr, is the headquarters of the Royal Cambrian Academy of Art. There are still a few fragments of the Cistercian abbey founded in 1185. The principal public buildings are the guildhall and the market hall; and there are a new bronze fountain, a convalescent home for children, and golf links. Area of the parish, 2437 acres ; of the municipal borough, 3312 acres. Population of borough (1891), 3442 ; (1901), 4660. The river Conway, about 30 miles long, drains the beautiful Vale of Conway, in which stand Bettws-y-Coed, Llanrwst, and Trefriw, the last- named a favourite artists' haunt.

Cooch (or Kuch) Behar, a native state of India, in Bengal, a submontane tract, not far from Darjiling, entirely surrounded by British territory. Area, 1307 sq. m. Popula- tion (1881), 602,624 ; (1901), 567,037. The gross revenue in 1897-98 was Es.22,39,668. The present Maharaja,

Nripendra ISTarayan, G.C.I.E., was born in 1862 and edu- cated under British guardianship at Patna and Calcutta. He is Hon. Lieutenant-Colonel of the 6th Bengal Cavalry. In 1897-98 he served in the Tirah campaign on the staff of General Yeatman-Biggs, and received the distinction of a C.B. In 1878 he married a daughter of Keshub Chundra Sen, the Brahmo leader. His eldest son has beeu educated in England. Among other improvements, a railway has been constructed, with the assistance of a loan from the British Government, for a length of 22 miles, which is now being extended for a farther 12 miles. The ear&-quake'of 12th June 1897 caused damage to public build- ings, roads, &c., in the state to the estimated amount of Rs.15,00,000.

The town of Cooch Bbhae is situated on the river Torsha, and has a railway station ; population, 9535.

Cook, Eliza (1818-1889), English author, was born in 1818, in Southwark, being the daughter of a local tradesman. She was self-taught, and began when a girl to write poetry for such periodicals as the Weekly Dispatch and New Monthly. In 1840 she published Melaia and other Poems, and from 1849 to 1854 conducted a paper for the family called Eliza Cook's Journal. She also published Jottings for my Journal (1860), and New Echoes (1864) ; and in 1864 she was given a Civil List pension of £100 a year. As the author of a single poem, " The Old Arm- chair," Eliza Cook's name was for a generation after 1838 a household word both in England and in America, her kindly domestic sentiment making her a great favourite with the working-class and middle-class public. She died at Wimbledon, 25th September 1889.

Cook, Thomas (1808-1892), travelling agent, was born at Melbourne in Derbyshire on 22nd November 1808. Beginning work at the age of ten, he was suc- cessively a gardener's help and a wood-turner at Mel- bourne, and a printer at Loughborough. At the age of twenty he became a Bible-reader and village missionary for the county of Rutland ; but in 1832, on his marriage, combined his wood-turning business with that occupation. In 1840 he became actively associated with the temper- ance movement, and printed at his own expense various publications in its interest, notably

the Children's Temper- ance Magazine, the first of its kind to appear in England.

In June 1841 a large meeting was to be held at Lough- borough in connexion with this movement, and Cook was struck with the idea of getting the railway company to run a special train from Leicester to the meeting. The company consented, and on 5th July there were carried 570 passengers from Leicester to Loughborough and back at a shilling a head. This is believed to be the first publicly-advertised excursion train ever run in England — private " specials," reserved for members of institutes and similar bodies, were already in use. The event caused great excitement, and Cook received so many applications to organize similar parties that he henceforward deserted wood-turning, while continuing his printing and publishing. The summers of the next three years were occupied with excursio/is like the first ; but in 1845 Cook advertised a pleasure-trip on a more extensive scale, from Leicester to Liverpool and back, with opportunities for visiting the Isle of Man, Dublin, and Welsh coast. A Handbook of the Trip to Liverpool was supplied for the use of travellers. A trip to Scotland followed, and the excursionists were received in Glasgow with music and salute of guns. The next great impetus to popular travel was given by the Great Exhibition of 1851, which Cook helped 165,000 visitors to attend. On the occasion of the Paris exhibition of 1855 there was a Cook's excursion from Leicester to Calais and back for £1, 10s. The following year saw the first grand circular tour in Europe. This part of Cook's activity largely increased after 1863, when the Scottish railway managers broke off their engagements with him, and left him free for more distant enterprise. Switzerland was opened up in 1863, and It^ly in 1864. Up to this time "Cook's tourists" had been personally conducted, but now he began to be an agent for the sale of English and foreign tickets, the holders of which travelled independently. Switzerland was the first foreign country accessible under these conditions, and in 1865 nearly the whole of Europe was included in the scheme. Its extension to the United States followed in 1866. Eor the

benefit of visitors to the Paris exhibition, Cook made a fresh departure and leased a hotel there. In the same year began his system of " hotel-coupons," providing accommodation at a fixed charge. The year 1869 was marked by an extension of Cook's tours to Palestine, followed by further develop- ments of travel in the East, his son, John Mason Cook, being appointed in 1870 agent of the Khedivial Govern- ment for passenger trafiic on the Nile. The Franco- Prussian war of 1870-71 was expected to damage the tour- ist system, but, as a matter of fact, encouraged it, through the demand for combination, international tickets enabling travellers to reach the south of Europe without crossing the belligerent countries. At the termination of the war a party of American freemasons visited Paris under Mr J. M. Cook's guidance, and became the precursors of the present vast American tourist traffic. At the beginning of 1872 Mr J. M. Cook entered into formal partnership with his father, and the firm first took its well-known appellar' tion of Thomas Cook and Son. In 1882, on the outbreak of Arabi Pasha's rebellion, Cook and Son were commis- sioned to convey Sir Garnet Wolseley and his suite to Egypt, and to transport the wounded and sick up the Nile by water, for which they received the thanks of the War Office. The firm was again employed in 1884 to convey General Gordon to the Sudan, and the whole of the men (18,000) and stores necessary for the expedition after- wards sent to relieve him. In 1889 Cook and Son acquired the exclusive right of carrying the mails, specie, soldiers, and officials of the Egyptian Government along the Nile. In 1891 the firm celebrated its jubilee, arid on 19th July of the following year Thomas Cook died. He had been afflicted with blindness in his declining years, (j. m'f.)

Cook or Hervey Islands, a Polynesian archipelago lying about the Tropic of Capricorn, some 700 miles south by east of Samoa, mainly between 150°-160° E. long. It comprises ten partly volcanic, partly coralline, islands, the more important of which are Rarotonga, hUly, fertile, and well watered, with several cones 300 to 400 feet high, above which towers the majestic Rarotonga vol- cano (4000 feet), the culminating point of the archipelago ; Mangaia (Mdngid) ; Aitaluki, with luxuriant cocoanut palm groves; Atui {Vatm) ; Mitiero; Mauki; Fenuaiti; and the two Hervey islets, which give an alternative name to the group. The total area is 142 square miles, and the population in 1900 was 8400. Owing to its healthy, equable

climate, the archipelago is well suited for European settlement ; but the dangerous fringing coral reefs render it difficult of access, and it suffers also from the absence of good harbours. The natives, who are of Polynesian stock and speech, are nearly all Protestants, and since 1890 have enjoyed a general Legislature and an Executive Council, of which the Arikis ("Kings" and "Queens ") are members. But all enactments are subject to the approval of the British Resident at Rarotonga, and a British Protectorate, proclaimed in 1888, was followed by the annexation of the whole archipelago by the Gov- ernor of New Zealand in November 1900.

Cooktown, a seaport in Queensland, Australia, in the county of Banks, at the mouth of the Endeavour river, about 1050 miles north-west of Brisbane. It is visited by the ocean steamers of several lines, and is the centre of a very extensive Mche de mer and pearl fishery. Tin and gold are worked in the district. The population in 1898 was estimated at 2560.

Coolgardie, a town in West Australia, about 310 miles by rail east by north of Perth and Ereemantle, and 528 miles by rail north-east of Albany. Its gold- field, now considered a permanent one, was discovered in 1891. In course of time it will probably be connected with Esperance, the natural port of the goldfield, by railway. Its population was estimated in 1898 at 13,000 ; that of the goldfield at about 30,000.

Cooper, Peter (1791-1883), American manufac- turer, inventor, and philanthropist, was born in New York on 12th February 1791. As a boy he worked with his father at hat-making, brewing, and brick-making, and had little opportunity for attending school. At the age of seventeen he was apprenticed to a carriage-builder. When he became of age he engaged in the manufacture of machines for shearing cloth, and during the wax of 1812 his business was very profitable. Later he took up with success the manufacture of glue. About 1828 he erected the Canton Iron Wor]is at Baltimore, Md., and in this enterprise laid the foundations of his fortune. In 1830 he designed and constructed the first locomotive built in America. He subsequently sold his works at Baltimore, and erected at Philippsburgh, Pa., the largest blast fur- naces erected in America up to that time, and enlarged his enterprise by purchasing iron mines in the vicinity and building a railway to transport their ore to his furnaces. He

was actively interested in the laying of the first Atlantic cable. His memory is perpetuated in the Cooper Union for the Advancement of Science and Art, which he founded in New York in 1854. This splendid institution is designed especially to furnish educational opportunities to the working classes. Its principal features are a free library and reading-room, lecture courses, and night and day classes. In the election of 1876 he was the candidate of the National Independent party for the presidency. He died in New York, 4th April 1883.

Cooper, Thomas Sidney (1803-1902), English painter, was born at Canterbury on 26th September 1803. In very early childhood he showed in many ways the strength of his artistic inclinations, but as the circum- stances of his family did not admit of his receiving any systematic training, he began before he was twelve years old to work in the shop of a coach painter. A little later he obtained employment as a scene painter ; and he alter- nated between these two occupations for about eight years. But the desire to become an artist continued to influence him, and all his spare moments were given up to drawing and painting from nature. At the age of twenty he went to London, drew for a while in the British Museum, aud was admitted as a student of the Eoyal Academy. He then returned to Canterbury, where he was able to earn a living as a drawing-master and by the sale of sketches and drawings. In 1827 he settled in Brussels ; but four years later he returned to London to live, and by showing his first picture at the Eoyal Academy (1833) began an un- precedentedly prolonged career as an exhibitor. Cooper's name is mainly associated with pictures of cattle or sheep, and the most notable of the many hundred he has pro- duced are: "A Summer's Noon" (1836), "A Drover's Halt on the Pells " (1838), " A Group in the Meadows " (1845), « The Half-past One O'clock Charge ^t Waterloo " (1847), " The Shepherd's Sabbath " (1866), " The Monarch of the Meadows" (1873), " Separated but not Divorced " (1874), "Isaac's Substitute" (1880), "Pushing off for Tilbury Fort" (1884), and "On a Farm in East Kent" (1889). He was elected an Associate of the Royal Acad- emy in 1845, and*

a Eoyal Academician in 1867. He presented to his native place, in 1882, the Sidney Cooper Art Grallery, built on the site of the house in which he was born. He wrote his reminiscences, under the title of My Life, in 1890 ; and died on 7th February 1902.

Co-operative Societies. — The progress of co- operation, during the last twenty years of the 19th century, was very remarkable, both in the United King- dom and abroad. Not only have the societies, in spite of numerous failures, greatly increased in number, mem- bership, capital, and trade, but they have come into close relations, both commercial and for propaganda, with other co-operative societies in their own country and abroad ; and finally an important International Co-operative Alli- ance has been formed for promoting mutual helpfulness and international trading relations.

The following figures show the growth of co-operation — that is to say, of working-class co-operation — in the United Kingdom : — Societies. Members. Capital. Business.

1876 . . 1113 493,189 £5,742,2971 £18,647,8171

1899 . . 1858 1,675,998 28,267,398 76,422,895

Practically all these societies are registered with limited liability imder the Industrial and Provident Societies Acts, their government is democratic, based on one vote for man or woman ; and their members (or shareholders) and committeemen are almost exclu- sively the more provident of the working classes or belong to the class just above.

By far the greater part of these figures represent Workmen's Distributive Societies or stores, flourishing chiefly in the North and Midlands of England and in Scotland, and numbering 1446, with 1,613,461 members, £22,294,624 capital, and sales of £45,047,446 in the year. The largest is that of Leeds, with 49,000 members and £1,500,000 sales. The shares in these societies are withdrawable in cash and not transferable. Their method is the " Rochdale system," now spread over the world, by which the twenty-eight poor weavers of Roch- dale made co-operation, until then little but a dream and a series of failures, into a great practical success. A

record is kept, by means of metal checks or otherwise, of each member's purchases ; and at the end of each quarter, after payment of a fixed interest (never more than 5 per cent., and in very many societies less) on shares, and sometimes a proportion of proflt to the employees, the surplus is divided to the members in proportion to their purchases.

Distrlba Hon.

Thus they in effect obtain their necessaries at cost price. Not far from £7,000,000 is thus returned in the year, averagingnearly2s. 8d. in the £ of purchases. In many successful societies an even higher dividend on purchases is paid, but the average prices of goods sold are often fixed above those current in the neighbourhood, so that the members, in addition to saving the retailer's profit, use their Society as a sort of savings bank, where they put away a halfpenny or so for every shilling they spend. In addition to retailing, a store often manufactures bread, clothes, boots, or flour, or farms land, usually for its own members only, but occasionally for sale to other societies also. Their productions in this way reach about £4,000,000 a year. They also invest large and increasing sums in building cottages to sell or let to their members ; and they lend largely to'their members to enable them to buy cottages.

Outwardly these stores may look like mere shops, but they are really much more. Pirst, they are managed with a view not to a proprietor's proflt but to cheap /and good com- modities. Secondly, they have done an immense work Aims. for thrift and the material prosperity of the working classes, and as teachers of business and self-government. But, further, they have a distinct social and economic aim, namely, to correct the present inequalities of wealth, and substitute for the com- petitive system an industry controlled by all in the common interest and distributing on principles of equity and reason, mutually agreed on, the wealth produced. With this view they acknowledge the duties of fair pay and good conditions for their own employees, and of not buying goods made under bad conditions. The best societies fuither set aside a small proportion of their profits for educational purposes, including concerts, social gatherings, classes, lectures, reading-rooms, and libraries. They often make grants to causes with which they sympathize ; and their members

are often prominent in local government affairs, co— operative candidates being occasionally run for school-boards and town councils. Though the societies are non-political, they are usually centres of " progressive " ideas. There are of course many defects, and of their mfllion and two-thirds members a large, and many fear an increasing, proportion, attracted, by the prosperity of the societies, think chiefly of what they themselves gain ; but the government of the movement has, hitherto at least, been largely in the hands of men of ideas who believe that stores are but a step to co-operative production and on to the " co-operative commonwealth."

It is indeed only when we come to federations of co-operative societies, and above all to production, with its large number of em- ployees, that the industrial and educational side of the movement is most seen. The Co-operative Union, Limited, for instance, is a propagandist federation of all the chief co-operative societies in Great Britain, and some in Ireland, which does a great amount of educational work. Its income is over £8000 a year ; it looks after the legal and parliamentary interests of the societies, carries on much educational work by means of literature, lectures, classes, scholarships, summer meetings at the universities, and so on ; organizes numerous local conferences for discussion, and once a year a great national Co-operative Congress and Exhibition of pro- ductions, it some chief centre of population. The Cooperative Wholesale Society, Limited, is a trading^federation of nearly 1100 stores, which include over 1,300,000 individuals. Pounded in 1863 on a small scale, in 1901 its capital was £3,314,887 and its employees about 11,000. Its sales in 1901 were estimated to reach £17,000,000. Besides its merchant trade, it manufactures to the value of £2,500,000, owning factories, wiirehouses, and land in _^ many districts. It owns steamships and is a large "^""“'O"- importer, and is also the bank of the Co-operative Societies, and the chief outlet for the always redundant capital of the stores. The Scottish stores also have their Wholesale Society, not less im- portant relatively. Por many purposes these two societies are in partnership. Their net profits are returned to the stores as a dividend on purchases, and thence to the whole body of members. There are also smaller local federations of stores, mostly for corn- milling and baking.

Strongly contrasting with this production by associations of consumers or ” consumers’ production,” is the co-partnership or “Labour Co-partnership” branch of co-operation. The simplest form of such co-operation is an association Co’P’rt-

of producers formed to carry on their own industry.

nersblp.

1 Figure not quite complete.

Originally such associations were intended to consist solely of the workers employed, but membership is now open to the distributive societies, which are their chief customers, and usually to all sympathizers. Shares are transferable, not with- drawable. Profits first pay the agreed ” wages of capital,” and of what remains the main part goes to the employees as a dividend on their wages and to the customers as a dividend on their purchases. In well-established societies the dividends on wages average about Is. on the £ of wages. This is not usually paid in cash, but credited to the employees as share capital, whereby all may become members. Besides other producers’ associations,

more or less co-operative, there were, at the end of 1900, 90 such co-partnership associations at -work in England. Some of them are very small, while others have businesses of £40,000 a year or more ; the majority show fair, sometimes large, profits. Each is governed by a committee, or directors, who are elected by the members and appoint a manager.

We constantly hear that co-operative production is a failure. There have no doubt been many failures, espe- cially of big experiments attempted among men totally unprepared. But many of the failures counted were not truly co-operative. At the present day consumers’ pro- duction is successful beyond all question, while the net growth of producer’s

associations in recent years has been marked both in number and importance. These two forms of production best illustrate the two rival theories which divide British co-operation, and between whose partisans the conflict has at times been sharp. The consumers' theory maintains that all profit on price is

abstracted from the consumer and must be aeories returned to him; while to him should also

belong all capital and control, subject to such regulations as the State and the Trade Unions enforce. This theory is fully exemplified in the English Wholesale Spciety, and in one of the corn mills, w^hich employ workmen, whether co-operators or not, for wages only and admit no individual, but only co-operative societies, to membership. It is also exemplified by the great major- ity of the stores, though in their case the employee may become a member in his capacity as a consumer. The co-partnership theory, on the other hand, maintains that the workers actually employed in any industry, whether distributive or productive, should be partners with those who find the capital, and those who buy the produce, and should share with them profit, responsibilities, and control. The, consumers' party contend that societies of producers make a profit out of the consumers, and thus are never truly co-operative, while as they multiply they must compete against each other. The co-partnership party answer that labour at least helps to make the profit, and that competition, as yet almost insignificant between their societies, can be avoided by federating them (a process long ago beg^in) for buying and selling in common, and for other common purposes, while leaving each the control and responsibility of its own affairs. They further advo- cate the eventual federation of the productive wing of co-operation with the distributive wing for settling prices and all matters in which their interests might conflict. In this way they say the co-operative system may extend in- definitely without sacrificing either individual responsi- bility and freedom, or a general unity and control, so far as these are necessary to secure the common interest. On the other hand they hold that the opposing system tends more and more to centralization and bureaucracy, and divorces the individual workman from all personal inter- est in his work and from any control over its conditions. They contend, moreover,

that, in spite of the great advan- tages consumers' production has in its command of a market and of abundant capital, only a smaU part of industry can ever be carried on by associations of the persons who actually consume the produce.

On the working out of these two principles depends the future of co-operation. The example of Scotland probably throws light on the problem. There co-operative production, amounting in 1900 to £1,816,042, is nearly all carried on by federations of consumers' societies, including the Scottish Wholesale, applying more or less successfully the co-partnership principle — i.e., their employees are admitted to share in profits, and may become members, whereby they are further admitted to share capital and control. The type of organization hence resulting is very much the same as where a society of producers admits consumers' societies to mem-bership and sets aside a proportion of the profits to be returned to them as dividend upon their purchases. To this type, we have seen, English productive societies started by producers have come,

and it would appear that those started by consumers must tend to it. Besides the societies already mentioned, the Irish co- operative dairies rank as co-partnership. The earliest and latest statistics of British and Irish co-operative productive societies, of whatever origin, accepting that principle are : —

1883.

1900.

Societies at work

15

265

Trade

£160,751

£3,553,593

Capital

£106,436

£1,547,729

Profits

£9,031

£158,315

Losses

£114

£7,418

Dividend on Wages

Unknown

£20,545

An association of co-operative societies and individuals, called the Labour Association, exists to maintain this principle of co- partnership in co-operative production and also promote its gradual adoption in businesses of a capitalistic character. Some progress in Uiis latter direction is being made, there being a tendency to improve upon mere profit-sharing by capitalizing the workman's "bonus," whereby he becomes a shareholder and the business is gradually modified in a co-operative direction. There are renjark- able instances of such modification abroad, notably that of tie great iron-foundry and " Familistfere " at Guise in France; the most noteworthy in England is that of the South Metropolitan Gas Company. After only a few years of the system 3000 workers own shares worth over £103,000 besides £33,000 on

deposit ; they also elect two of themselves directors of the Company. Unfortunately this example is marred by a feud with the Trade Unions, whereas there is usually friendship and even alliance between Trade Unionism and co-partnership, and other, co-operative societies.

In Ireland stores have not hitherto flourished, though a few exist. Irish co-operation is agricultural, and dates from the foundation of one co-operative dairy in 1889. Thence has grown a movement already of great import- ance and rapidly advancing. In 1890 there was still only one such society, in 1891 there were 17, but on 31st December 1900 there were 412, of which 171 were dairies, 106 agricultural societies, and 'f^i^re"^" 76 banks. By August 1901 the societies numbered about 470, of which of course not all were yet at work, and the members about 54,000. To form a dairy the small working farmers of a district register a society and take up shares of £1 each, in proportion to the number of their cows. Each brings his milk to be separated, is paid for the butter-making material it contains, and receives back skim milk. Any profit is divisible, nine-tenths to the suppliers of milk in proportion to the value of their supplies, and one-tenth to the dairy employees as dividend on wages. These dairies in 1900 produced butter worth more than £700,000. Their rapid spread is d^ue to their great influence in improving the quality of butter, and hence raising the farmers' gains. The "agricultural" societies are chiefly engaged in buying farm requisites pure and cheap, and retailing them among their members ; in this way they have saved the farmers very large sums. Their trade is about £100,000. The co-operative banks, many of them just beginning, are of the Eaiffeisen type described later (though a few have limited liability) and aim at providing the peasants with necessary capital and expelling the usurer. They are increasing rapidly. Among miscellaneous objects of co-operation are selling eggs, poultry, barley, and pigs, joint ownership of machinery, joint grazing, potato-spraying, producing flax, and so on, and these promise a great growth in number and variety. The dairy societies, moreover, have federated into an agency for reaching the English market ; and the agricultural societies into an Irish Wholesale for purchasing to the best advantage. Besides the direct profits and economies of these societies, they have greatly benefited Ireland by teaching men of all classes, parties, and religions to act together for peaceful progress ; they have led to a wide diffusion of better

agricultural know- ledge, and to the establishment by Government of the Agricultural Department.

Turning abroad we find, in almost all civilized countries,

important and growing movements roughly similar to

those above described, but, on the whole, less counties, identified with the working classes, and less

coloured by their social and economic ideals. The most prominent fact since 1877 is the great growth of agricultural co-operation from small dimensions, till it amounts to a great force almost everywhere, and in some countries to a revolution; notably in Denmark, where almost every village is an example of varied co- operation, dealing with butter, eggs, bacon, stock, bee- keeping, or fruit-growing, or with the supply of household or farm requisites, to the great enrichment of the coun- try. Co-operative dairies first appeared in Denmark in 1882 ; in 1900 they numbered 1052, dealt with four-fifths of all the milk of the country, and produced butter worth £7',000,000. Co-operative bacon factories began in 1887, and in 1900 dealt with six-tenths of aU the pigs ; and so on. Agricultural co-operation is now the strongest branch of the movement in France, and its backbone are the agricultural syndicates or associations. These, though they began only in 1883, numbered! 1600 in 1895, and now probably number 2500, with 700,000 to 800,000 members. They are not technically co-operative societies, but rather trade unions, and they have certain political and pro- fessional aims ; but they do an immense amount of co- operative work, especially in associated buying, and they spread the spirit of association everywhere, and promote many strictly co-operative societies. Everywhere the main features of this agricultural movement, alike in France, Germany, Italy, Belgium, Holland, or in Canada, New Zealand, and the United States, are similar to those we have seen in Ireland and Denmark ; it is supplemen- tary to individual cultivation ; hardly ever does it appear as associations for cultivating in

common, and, speaking generally, it has no very ideal aims, but seeks chiefly to give the farmer a better profit: especially it briags within reach of the peasant many of the advantages of large farming. In England there are a number of farms worked by stores, and several large associations for the supply of farm requisites, but the typical agricultural co-operation, based on the small village societies and federations of such societies, has been almost unknown. An attempt is, however, being made to promote such a movement on the lines which have been successful in Ireland.

As part of agricultural co-operation we may reckon the development of an entirely new type of credit co-operation.

The Schultze-Delitzseh credit societies are prim- Raiffeisea ^rily town institutions, and while they have mul- j^ts. tiplied and grown great, and sometimes grown

capitalistic, many thousands of country folk have learnt to bless the little Eaiffeisen loan banks. Such a bank is an association of neighbours uniting to borrow a sum of money, in order to lend it out as cheaply as possible in small sums to such of themselves as need loans. It also receives savings deposits, which often produce a large part or even all the capital the society needs to lend. Usually a few of the members are persons of rather more means than the others, and join to help their neighbours by increasing the society's credit. These have no special privilege, but by common consent they usually take a leading part. In the true Raiffeisen bank the liability of each member is unlimited, but limited liability has been introduced in some of its modifications. The society con- fines its operations strictly to a small area, say a parish, where every one knows every one. Each borrower must specify the purpose for which he wants a loan, say to buy a cow or drain a field, or pay off a moneylender, and this is rigorously inquired into. Any member, however poor, can obtain a loan for a profitable approved purpose, and no one, however rich, can obtain one on any other terms.

Practically all the mambers see that the money is applied as agreed, and while the loans are often made for long periods — a year or two, or several, so as to repay them- selves out of the profit — power is reserved to call them in at short notice if misapplied. No bills, mortgages, or other

securities are taken, except a note of hand with sometimes one or two sureties. There are two committees, one to lend and do the work of the societj', and the other to supervise the first. While the directors of the Schultze- Delitzseh societies get commission on the business done, there is no remuneration for services in the Eaiffeisen societies except that the accountant gets a small salary. There are no shares, or only shares of a very small value, and practically nothing is paid on them as interest or dividend.

These Eaiffeisen banks boast that neither member nor creditor has ever lost a penny by them, and while this is denied, it seems at least near the truth. Their credit is so good that they can obtain money at very low rates, and as their expenses are trifling they can re-lend to tiieir members at very little more. In Germany they usually lend at about 5 per cent. Only men of good character can obtain membership, and thus, besides spreading prosperity, these societies have everywhere been great promoters of sobriety and good conduct. They exist solely for the sake of the members as borrowers, and make no profit, except a little for reserve, whereas the Schultze-Delitzseh Bank works for profit, and puts first the interest of the members as small capitalists and lenders. The Eaiffeisen banks have a purely mutual character, free from any element of capitalism ; it is even alleged that the members can never divide out the reserve ; if they fall short of the co-operative ideal it is in the matter of self-help, seeing that the presence of some richer members is necessary, or at least very desirable. In self-help the Schultze-Delitzseh system is specially strong. Eaiffeisen founded the first such bank in 1849, just before Schultze-Delitzseh founded his first ; the second in 1854. The third began in 1862, and so on. Not till 1880 did they begin really to spread.

Though co-operative credit societies are split up into innumer- able groups, insisting on various minor modifications, and making various compromises between the two systems, these two types really include them all. They have spread from Germany into almost all European countries, even at last to Ireland and England, besides America and Asia. In Germany there were in March 1901, out of a total of 19,557 co-operative societies, 12,140 credit associations, and these lent out in 1900 more than £120,000,000. In Italy, Austria, and Hungary they are also strong. In

1896 it was estimated that £150,000,000 a year must be very well within the total amount lent by money co-operation on the Continent of Europe : £190,000,000 may be estimated for 1900. Of this total only a small percentage represents loans by banks of the Eaiffeisen type, which, though very numerous, often lend only a few hundred pounds each in the year.

While English and some other forms of co-operation have always repudiated State help, and probably rightly so far as their own work is concerned, it is very noticeable that in the modern development of f^^, agriculture the action of the State and of local authorities has played a great part in performing or assist- ing functions which neither voluntary association nor individual enterprise could well perform alone ; in pro- viding technical education, expert advisers, exhibitions and prizes ; in distributing information in all forms ; in finding out markets, controlling railway rates, subsidizing steamboats, and even grading, branding, warehousing, and freezing produce, and maintaining trade agents abroad. These things have of course not been done for co-operative societies alone, but for agriculture in general; but co- operation has benefited, and much has been done expressly to encourage the formation of associations of cultivators, and provincial and national federations of such associa- tions; and government departments of agriculture are found acting through such bodies, and with their advice and assistance. Indeed, harm has sometimes been done by subsidizing and forcing co-operative societies, whether for political motives or merely from mistaken policy. Ex- perience shows that governments can do a very great deal, at least for agricultural co-operation, but only on condition that they encourage and do not undermine self-help and

private initiative. Thus while we sometimes find volun- tary association advocated as a step towards, and some- times on the other hand as a substitute for and bulwark against, state-socialism, we find in practice these two forces working each in its own sphere and in a manner com-

plementary one to the other, while underlying and essen- tial to both is the force of individual action and self-help.

Amongst minor but still important developments may be mentioned the steady growth of co-operative production in France ; the co-operative labour gangs, or rather societies, which undertake building and nawying work in Italy ; the socialist co-operation, which supports political organizations, a press, and members of parliament, in Belgium ; and the letting out of railway construction to

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Coorg (Kodagu= stee^p mountains), a province of India, administered by a Commissioner, subordinate to the Governor-General through the Eesident of Mysore, who is officially also Chief Commissioner of Coorg. It lies in the south of the peninsula, on the plateau of the Western Ghats, sloping inland towards Mysore. It is now an attractive field of coffee cultivation, though the greater part is still under forest. The administrative headquarters are at Mereara (population, 7034).

Its area is 1583 square miles. In 1881 the population was 178,302 ; in 1891 it was 173,055, showing a decrease

of 3 per cent., and an average density of 109 persons per square mile. This decrease is attributed partly to the decline of the coffee industry, and partly to the high mortality among immigrant coolies. The indigenous pop- ulation increased by no less than 16 per cent., while the immigrant

population decreased by 29 per cent. In 1897, which was an exceptionally unhealthy year, the registered death-rate was as high as 50-38 per thousand. Classified according to religion and race, the indigenous Coorgs numbered 32,611; Hindus, 124,234; Mahommedans, 12,665; native Christians, 2931; Europeans, 249; Eurasians, 212 ; Jains, 114 ; Parsis, 39. In 1901 the population was 180,461, showing an increase of 4 per cent.

The gross revenue in 1897-98 was Es.8,38,000, and the total expenditure B,s.5,73,100. The cultivated area is 206,541 acres, of which 95,247 are under rice and 86,155 under coffee. The total area assessed for coffee is 106,- 611 acres, of which 31,732 acres are held by European planters. Some abandoned coffee land has been planted with tea, as an experiment. The cultivation of cinchona has proved unprofitable. The total exports are estimated at E.s.22,49,000, including 2462 tons of coffee, valued at Ils.19,69,600. The imports are estimated at Rs.29,02,000. There is no railway. In 1896-97 the number of schools was 120, attended by 5115 pupils. The proportion of boys at school was 30 per cent, of those of school-going age, compared with 2-3 per cent, for all India ; the pro- portion of girls was 7 per cent., compared with 2-3 per cent, for all India. There are no colleges, but 24 scholar- ships are given to maintain Coorg students at colleges in Madras and Mysore. There are two secondary schools, at Mereara and Virajendrapet, with 647 pupils, two print- ing-presses, one of which issues the Coorg Gazette, and seven dispensaries.

Copan. — Since the time of Stephens this ruined city of the Mayas in North Honduras has again been several times visited by Mr A. P. Maudsley during the eighth and ninth decades of the 19th century. His chief finds have been some elaborately sculptured monoliths, standing still erect, or inclined like the Tower of Pisa, and a fine ornar mental doorway of a temple. He has also made the im- portant discovery that all the truncated pyramidal mounds were at one time crowned with temples, and are thus shown to be of the same character as those at Uxmal, Chichen-Itza, and other places in Yucatan, i.e., teocalU, ” God’s Houses,” like the pyramids of Cholula, Teotihua- can, and Papantla in Mexico. Drawings, castings, and rubbings were taken of several of the monuments, and are published in the Biologia CentralirAmericana. Pro-

fessor Eduard Seler of Berlin also explored the place in 1897, that is, less than three years after Maudsley's last visit, and found that in that short interval many of the re- mains had again become so thickly moss-grown that it was difficult to distinguish their outlines, while the forest clear- ings made by former explorers to reach the sites of the an- cient buildings were once more overgrown with dense bush.

Copenhagen (Danish, Kjobenhavn, "the mer- chants' haven"), the capital of Denmark, situated in 55° 41' 13" N. lat. and 12° 34' 44" E. long. Since 1875 the population has doubled itself, and in 1901, inclusive of the, suburbs, amounted to 491,340. Not only has the city grown in extent also during this period, but considerable public improvements have been effected, the only alteration in the opposite direction being the destruction of the palace of Christiansborg by fire in 1884. Eortunately most of the art trea^ sures which the palace contained were saved, but the edifice still remains a roofless ruin. The new public buildings are mostly found on the strip of land on which

the ramparts of the city formerly stood, and are in part intended to replace older less convenient structures, such as the new Royal Library, the new Polytechnic School, the new Mineralogical Museum, and the new Town Hall, an extensive and imposing edifice ornamented with a tower, of which the spire, when finished, will be the tallest in the North of Europe — about 330 feet. The Glyptothek was built by the State and the municipality, to accommodate a considerable collection of modern objects of art, the gift of a wealthy citizen, M. Jacobsen, who has spent very large sums upon objects of national interest. The new Museum of Industrial Art is an outcome of the movement for applying art to the commoner objects of industry. The fflld Royal Picture Gallery and the Collection of Engravings, which formerly occupied a portion of the upper storey of the palace of Christiansborg, are now located in the new State. Museum of Art, which is situated in a corner of the Ostre Anlseg, a fine public garden formed out of a portion of the old ramparts. A similar garden, but smaller, is the so-called Orstedspark. Besides these new Museum buildings,

another is in contemplation, destined to receive the Museums of Northern Antiquities, the Ethnographic Museum, and some others, which are now very inconveniently housed in the so-called Prindseus Palais ; but this new National Museum is to be built near the latter palace, and in part to replace it. Two private collections must also be mentioned, which, though the property of private persons, are accessible to the public. One of them is the New Glyptothek, a collection of antique sculptures belonging to M. Jacobsen, aud preserved at his private residence. It contains a number of important speci- mens, and is one of the largest, if not the largest private collection of its kind out of Italy. The other is styled Dansk Folke-museum, and illustrates the domestic life of the Danish nation, particularly the peasantry, since 1600, by means of specimens of furniture, utensils, costumes, &c. The Erederik or Marble Church, the erection of which was begun in 1749 but discontinued in 1770, remained a ruin until 1874, when it was purchased by a wealthy banker, M. Tietgen, at whose expense the work was recom- menced. The edifice was not carried up to the height originally intended, but the magnificent dome, which reminds one of the finest examples in Italy, is conspicuous far and wide. The diameter is only a few feet less than that of St Peter's in Rome. As the church now stands it is one of the principal works of the architect, E. Meldahl.

Not only is Copenhagen the political capital, but it is also the centre of the higher culture of the nation. It is the seat of the university, which has 80 professors and lecturers, with an average number of about 1900 students, and is fully equipped with the requisite scientific apparatus, such as a library, observatory, botanical garden, museums for natural history, and other collections, laboratories, &c. The Royal Library is one of the largest institutions of its kind. The learned societies comprise the Royal Society of Sciences, the Society of Northern Antiquaries, and numerous others. Technical instruction is provided by the Polytechnic School, which is a State institution ; the School of the Technical Society, which, though a private foundation, enjoys public subvention; and also by the High School of Agriculture, Veterinary Art, and Forestry, with 30 professors and lecturers. The schools which pre- pare for the university, &c., are nearly all private, but are all under the control of the State. Elementary instruc-tion is mostly provided by the communal schools, of which there are thirty

within the area of the muni- cipality. Twenty of these are free; ten, in which a somewhat , fuller education is given, exact fees. The expense incurred by the municipality for schools, over and above the amount of the school fees, was in 1897,

£110,000. The number of children in the area men- tioned was 49,337, of whom 37,248 received instruc- tion in the communal schools.

Copenhagen is by far the most important commercial town in Denmark, and has fully shared the steady and considerable increase in the trade of the country during the last thirty years. According to an estimate furnished by the director of the Statistical Bureau of Denmark, the annual value of the exports by sea may be taken at 168 million crowns, or £9,600,000; that of the imports at 295 million crowns, or £16,400,000. The trading capa^^ bilities have been much increased by the construction of the new Eree Port, at the northern extremity of the town, well supplied with warehouses and other conveniences. It is connected with the main railway station by means of a new circular railway, while a short branch connects it with the ordinary custom-house quay. Advantage has been taken of the facilities afforded by the free port to establish a more perfect steam communication with Swe- den particularly in order to accommodate through traffic. Within a short distance of the free port is the situation of the new Eastern railway, which runs along the shore of the Sound, connecting Copenhagen with Elsinore by a direct line. At the end of 1899, 284 sailing vessels above four tons, with an aggregate tonnage of 18,145 tons, belonged to Copenhagen, while the steamers numbered 292, with a collective tonnage of 219,055 tons. In 1899, 9200 clear- ances inwards were effected by sailing vessels, 9177 by steamers. Of the former, 4391 were Danish vessels, 4181 Swedish, only 14 English. Of the steamers, 7057 were Danish, 338 were English. Besides these, a limited num- ber of passing vessels touched the port. The inward- bound cargoes amounted to 1,580,002 tons, of which 955,567 were carried in Danish bottoms. The cargoes which arrived from foreign ports amounted to 1,366,637 tons, of which 750,257 tons were in Danish bottoms. The total of the outward-bound cargoes was 720,671 tons, of which 673,233 were carried in Danish bottoms; of this total, 391,052 were destined for foreign ports, of which 248,945 were in Danish bottoms. The total of the

cargoes ex- changed between Copenhagen and other Danish ports was 642,984 tons, of which but a very small proportion was carried by foreign vessels. The total of exports and imports by sea was 2,300,670 tons, of which 1,895,569 tons were carried by steamers. Copenhagen is not an industrial town. The manufactures carried on are mostly only such as exist in every large town, and the export of manufactured goods is inconsiderable. The only very large establishment is one for the construction of iron steamers, engines, &c., but some factories have been erected within the area of the free port for the purpose of working up imported raw niaterials duty free. (o. a. g.)

Coppee, Francis Edouard Joachim (known

as Francois) (1842), French poet and novelist,

'was born'in Paris, 12th January 1842. His father held a small post in the Civil Service, and he owed much to the care of an admirable mother. After passing through the Lycee Saint-Louis, he became a clerk in the Ministry of War, and soon sprang into public favour as a poet of the young " Parnassian " school. His first verses date from 1864. They were republished with others in 1866 in a collected form (Le Eeliquaire), followed (1867) by the successful Intimitis and Poimes Modemes (1867-69). In the latter year his first play, Le Passant, was received with marked approval • at the Odeon Theatre, and later Fais ce que dois and Les Bijoux de la Delivrance, short metrical dramas inspired by the war, were warmly applauded. After filling a post in the Library of the Senate, M. Coppee was chosen in 1878 as archivist of the Comedie-FrauQaise, an office which he held till 1884. In

that year his election to the Academy caused him to re- tire altogether from his public appointments. Meanwhile he continued to publish volumes of poetry at frequent intervals, including Les Humbles (1872), Le

Cahier Eouge (1874), Olivier (1875), L'Exilie (1876), Contes en Vers, &c. (1881), Po^mes et Ricits (1886), Arrih-e-Saison (1887), and others. Of late years he has printed but little poetry, unless aroused by some occasion of public interest, such as the visit of the Tsar to Paris (1896). Besides the plays mentioned above, two others written in collaboration with M. d'Artois, and some light pieces of little importance, M. Coppee has produced Madame de Maintenon (1881), Severn Torelli (1883), Les Jacobites (1886), and other serious dramas in verse, including Pour la Oouronne (1896). The performance of a short episode of the Commune, Le Pater, was prohibited by the Government (1885). M. Coppee's first story in prose, Une Idylle pendant le Si&ge, appeared in 1875. It was followed by various volumes of short tales, by Toute une Jeunesse, — an attempt to reproduce the' feelings, if not the actual wants, of the writer's youth, — ^by Les Vrais Riches (1892), by Le Coupable (1896), &c. A series of reprinted short articles on miscellaneous subjects, styled Mon Franc Parler, appeared from 1893 to 1896; and in 1898 was published La Bonne Souffrance, the outcome of M. Coppee's reconversion to the Roman Catholic Church, which has gained very wide popularity. The immediate cause of his return to the faith was a severe illness which twice brought him to the verge of the grave. Hitherto he had taken little open interest in public affairs, but he now joined the most violent section of Nationalist politicians, while retaining contempt for the whole apparatus of democracy. He took a leading part against the prisoner in the Dreyfus case, and was one of the originators of the notorious Ligue de la Patrie Frangaise. M. Coppee, who became an ofBeer of the Legion of Honour in 1888, has a home at Mandres, near Boissy St Leger. He has published a collected edition of his poetry and another of his plays, and remains one of the most popular of Prench writers. Alike in verse and prose, he concerns himself with the plainest expressions of human emotion, with elemental patriotism, and the joy of young love, and the pitifulness of the poor, bringing to bear on each a singular gift of sympathy and insight. The lyric and idyllic poetry, by which he will chiefly be remembered, is animated by musical charm, and in some instances, such as La Binediction and La Gr^ve des Forgerons, displays a vivid, though not a sustained, power of expression. There is force, too, in the gloomy tale Le Coupable. But he exhibits all the defects of his qualities. In prose especially, his sentiment often degenerates into sentimentality, and he

continually approaches, and sometimes oversteps, the verge of the trivial. INevertheless, by neglecting that canon of contemporary art which would reduce the deepest tragedies of life to mere subjects for dissection, he has won those common suffrages which he fully deserves, and which, where literature is concerned, he probably does not undervalue.

Copper. — The sources of copper, its applications and its metallurgy, have undergone great changes. Porty years ago Chile was the largest producer, reaching her maximum in 1869 with 54,867 tons ; but in 1899 her production had fallen off to 25,000 tons. Great Britain, though she had made half the world's copper in 1830, held second place in 1860, making from native ores 16,968 tons ; in 1898 her production was only 640 tons. The United States made only 672 tons in 1850, and 12,600 tons in 1870 ; but she to-day makes more than 60 per cent, of the world's total. Le Play estimated the world's production in 1850 at 52,400

tons. It is now about ten times as great. The statistics for 1899, prepared by H. R. Merton and Co., are as follows, in English tons of fine copper : —

United States . Spain and Portugal

Chile

Germany

Australia

Mexico

Producers of under 10,000 tons eaoli

Total .

262,206 53,720 27,560 25,000 23,460 20,750 19,335 44,835

476,866

As the stock on hand rarely exceeds three months' demand, and is often little more than a month's supply, it is evident that consumption has kept close pace with production. This extraordinary increase corresponds closely with that of pig iron, of which the world's production was about 3,600,000 tons in 1860, and 35,921,617 tons in 1898. The world, therefore, has needed these two metals in almost equal proportions for the development of modern mechan- ical industry. Great Britain is still the largest copper con- sumer. The statistics of consumption for 1898 assign to —

Great Britain . 139,704 tons, or 32-1 % of the world's production

United States . 120,348 „ „ 27-7 % „ „ „

Germany – . 70,000 „ „ 16-1 % „

France . . 42,652 „ „ 9-7% „ „ „

The large demand for copper to be used in sheathing ships ceased on the introduction of iron in shipbuilding because of the diflculty of coating iron with an impervious layer of copper ; but the consumption in the manufacture of electric apparatus and for electric conductors has far more than compensated.

The scale on which modern mines are worked and modern smelters planned has reached proportions formerly unknown. Por example, the Rio Tinto Company in Spain and the Anacond a in Butte, Montana, each handles between one and a half and two million tons of ore a year ; and these companies, with the Calumet and Hecla, and the Boston and Montana Companies, make more than one-third of the world's total. This has brought about a corresponding increase in the scale of the machinery used : — (1) mechanical calciners have in great measure taken the place of hand furnaces ; (2) both reverberatory and cupola furnaces, as. well as their auxiliary apparatus, have been enlarged ; and mechanical appliances have been adapted to both for the purpose of saving hand labour ; (3) the pneumatic method in Bessemer converters of concentrating ore to metallic copper has been applied very extensively ; (4) some pro- gress has been made towards smelting ores by the heat of

combustion of their own elements, through what is known as pyritic smelting; and some new smelting methods have been introduced, notably the direct process of Messrs NichoUs and James ; (6) the electrolytic refining of copper has come into general use.

Calcination and calcining furnaces. — As most copper ores contain sulphur, which can be driven off at low temperatures as sulphurous acid gas, calcination is a preliminary to smelting. To aid in extracting the sulphur mechanical agitation is almost universally resorted to. Three types of mechanical calciners are used, all developments of English inventions. In the White-Howell revolving cylinder furnace with lifters — a modification of the Oxland — ^the ore is fed and discharged in a continuous stream. The Bruckner cylinder resembles the Elliot and Russell black ash furnace; its cylinder tapers slightly towards each end and is generally 18 feet long by 8 feet 6 inches in its greatest diameter. Its charge of from 8 to 12 tons of ore or concentrates is slowly agitated at a rate of three revolutions a minute, and in from 24 to 36 hours it is reduced from say 40 or 35 per cent, to 7 per

cent, of sulphur. The ore is under better control than is possible with the continuous feed and discharge, and when sufficiently roasted can be passed red-hot to the reverberar tory furnace. These advantages compensate for the wear- and tear and the cost of moving the heavy dead-weight. The M'Dougall furnace is turret-shaped, and consists of a series of circular hearths, on which the ore is agitated by rakes attached to revolving arms and made to faU. from hearth to hearth. It has been modified by Herreshoff, who uses a large hollow revolving central shaft cooled by a current of air. The shaft is provided with sockets, into which movable arms with their rakes are readily dropped. The Peter Spence type of calcining furnace has been fol- lowed in a large number of inventions. In some the rakes are attached to rigid frames, with a reciprocating motion, in others to cross-bars moved by revolving chains. Some of these furnaces are straight, others circular. Some have only one hearth, others three. This and the previous type of furnace, owing to their large capacity,

are at present in greatest favour. The M'Dougall-Herreshoff, working on ores of over 30 per cent, of sulphur, requires no fuel ; but in furnaces of the Spence-O'Hara type fuel must be used, as an excess of air enters through the slotted sides and the hinged doors which open and shut frequently to permit the passage of the rakes. The consumption of fuel, however, does not exceed 1 of coal to 10 of ore. The quantity of ore which these large furnaces, with a hearth area as great as 2000 feet and over, will roast varies from 40 to 60 tons a day. Shaft calcining furnaces like the Gerstenhoffer, Hasenclaver, and others designed for burning pyrites fines have not found favour in modern copper works. Kilns and stalls roast so small a quantity that they would cover too much ground and involve too much handling.

Tlie fusion of ores in reverberatory and cupola furnaces. — After the ore has been partially calcined, it is smelted to extract its earthy matter and to concentrate the copper with part of its iron and sulphur into a matte. In rever- beratory furnaces it is smelted by fuel in a fireplace, separate from the ore, and in cupolas the fuel, generally coke, is in direct contact with the ore. When Swansea was the centre of the copper-smelting industry in Europe, many varieties of ores from different mines were smelted in the same furnaces, and the Welsh reverberatory furnaces were used. To-day more than eight-tenths of the copper ores of the world are reduced to impure copper bars or to fine copper at the mines ; and where the character of the ore permits, the cupola furnace is found more economical in both fuel and labour than the reverberatory.

The Welsh method, with its seven or eight operations, finds adherents only in Wales and Chile. In America the usual method is to roast ores or concentrates so that the matte yielded by either the reverberatory or cupola fur- nace will run from 45 to 50 per cent, in copper, and then to transfer to the Bessemer converter, which blows it up to 99 per cent. In Butte, Montana, reverberatories have in the past been preferred to cupola furnaces, as the charge has consisted mainly of fine roasted, concentrates ; but even there the cupola is gaining ground. To smelt Butte ores there are about 75 reverberatories, but the number will be reduced by the replacement of small by large furnaces, heatecj by gas instead of solid fuel. At the Boston and Montana works tilting reverberatories, mod- elled

after open hearth steel furnaces, were first erected ; but they were found to possess objectionable features. Now both these and the egg-shaped reverberatories are being abandoned for furnaces as long as 43 feet 6 inches from bridge to bridge and of a width of 15 feet 9 inches, heated by gas, with regenerative checker work at each end, and fed with ore or concentrates, red-hot from the calc'iners, through a line of hoppers suspended above the

roof. Furnaces of this size smelt 200 tons of charge a day. But even when the old type of reverberatory is preferred, as at the Argo works, Colorado, where rich gold- and silver-bearing copper matte is made, the growth of the furnace in size has been steady. Richard Pearce's rever- beratpries in 1878 had an area of hearth of 15 feet by 9 feet 8 inches, and smelted 12 tons of cold charge daily, with a consumption of 1 ton of coal to 2-4 tons of ore. His present furnaces are 35 feet by 16 feet, and smelt 50 tons daily of hot ore, with the consumption of 1 ton of coal to 3-7 tons of ore.

The home of cupola smelting was Germany, where it has never ceased to make steady progress. In Mansfeld brick cupola furnaces are without a rival in size, equip- ment, and performance. They are round stacks, designed on the model of iron blast furnaces, 29 feet high, fed me- chanically, and provided with stoves to heat the blast by the furnace gases. The low percentage of sulphur in the roasted ore is little more than enough to produce a matte of 40 to 45 per cent., and therefore the escaping gases are better fitted than those of most copper cupola furnaces for burning in a stove. But as the slag carries on an average 46 per cent, of silica, it is only through the utmost skill that it can be made to run as low on an average as 0-3 per cent, in copper oxide. As the matte contains on an aver- age 0-2 per cent, of silver, it is still treated by the Zier- vogel wet method of extraction, the management dreading the loss which might occur in the Bessemer process of concentration, applied as preliminary to electrolytic sepa- ration. Blast furnaces of large size, built of brick, have of late years treated the richest and more silicious ores of Rio Tinto, and at present the Rio Tinto Company is introducing converters at the mine. This method of ex- traction contrasts favourably in time with the leaching process, which is so slow that over 10,000,000 tons of ore are always under treatment on the immense leaching floors of the company's works

in Spain. In the United States the cupola has undergone a radical modification in being built of water-jacketed sections. The first water-jacketed cupola which came into general use was a circular inverted cone, with a slight taper, of 36 inches' diameter at the tuyeres, and composed of an outer and an inner metal shell, between which water circulated. As greater size has been demanded, oval and rectangular furnaces — as large as 180 inches by 56 inches at the tuyeres — have been built in sections of cast or sheet iron or steel. A single section can be removed and replaced without entirely emptying the stack, as a shell of congealed slag always coats the inner surface of the jacket. The largest furnaces are those of the Boston and Montana Company at Great Palls, Montana, which have put through 500 tons of charge daily, pouring their melted slag and matte into large wells of 10 feet in diameter. A combined brick- and water-cooled furnace was first used by the Oxford Copper Company, and has been adopted by the Iron Mountain Company at Kerwick, Cal., for matte concentration. In it the cooling is effected by water pipes, interposed horizontally between the layers of bricks. The Mt Lyell smelting works in Tasmania, which are of special interest, will be referred to later.

Concentrating matte to copper in the Bessemer converter. — As soon as the pneumatic method of decarburizing pig iron was accepted as practicable, experiments were made with a view to Bessemerizing copper ores and mattes. One of the earliest and most exhaustive series of experiments was made on Rio Tinto ores at the John Brown works by Mr John HoUoway, with the ambitious aim of both smelting the ore and concentrating the matte in the same furnace, by the heat evolved through the oxidation of their sulphur and iron. Experiments along the same lines were made by Prancis Bawden at Rio Tinto and Claude Vautin in Australia. The difficulty of effecting

this double object in oue operation was so great that in subsequent experiments the aim was merely to concen- trate the matte to metallic copper in converters of the Bessemer type. The concentration was effected

without any embarrassment till metallic copper commenced to separate and chill in the bottom tuyeres. To meet this obstacle M. Manhes proposed elevated side tuyeres, which could be kept clear by punching through gates in a wind box. His invention was adopted by the Vivians, at the Aiguelles works in Trance, and at Leghorn in Italy. But the greatest expansion of this method has been in the United States, where now more than 400,- 000,000 lb of copper are annually made in Bessemer converters. Vessels of several designs are used — some modelled exactly after steel converters, others barrel- shaped, but all with side tuyeres elevated about 10 inches above- the level of the bottom lining. Practice, however, in treating copper matte differs essentially from the treatment of pig iron, inasmuch as from 20 to 30 per cent, of iron must be eliminated as slag and an equivar lent quantity of silica must be supplied. The only prac- tical mode df doing this, as yet devised, is by lining the converter with a silicious mixture. This is so rapidly consumed that the converters must be cooled and par- tially re-lined after 3 to 6 charges, dependent on the iron contents of the matte. When available, a silicious rock containing copper or the precious metals is of course pre- ferred to barren lining. The material for lining, and the frequent replacement thereof, constitute the principal expense of the method. The other items of cost are labour, the quantity of which depends on the mechanical appliances provided for handling the converter shells and inserting the lining ; and the blast, which in barrel-shaped converters is low and in vertical converters is high, and which varies therefore from 3 to 16 lb to the square inch. The quantity of air consumed in a converter which will blow up about 35 tons of matte per day is about 3000 cubic feet per minute. The operation of raising a charge of 50 per cent, matte to copper usually consists of two blows. The first blow occupies about 25 minutes, and oxidizes all but a small quantity of the iron and some of the sulphur, raising the product to white metal. The slag is then poured and skimmed, the blast turned on and converter re-tilted. During the second blow the sulphur is rapidly oxidized, and the charge reduced to metal of 99 per cent, in from 30 to 40 minutes. Little or no slag results from the second blow. That from the first blow contains be- tween 1 per cent, and 2 per cent, of copper, and is usua,lly poured from ladles operated by an electric crane into a reverberatory, or into the settling well of the cupola. The matte also, in all economically planned works, is conveyed, still molten, by electric cranes

from the fur- nace to the conyerters. When lead or zinc is not present in notable quantity, the loss of the precious metals by volatilization is slight, but more than 5 per cent, of these metals in the matte is prohibitive. Under favourable conditions in the larger works of the United States the cost of converting a 60 per cent, matte to metallic copper is generally understood to be only about -j^ to -j^ of a cent per lb of refined copper.

Pyritic smelting. — The heat generated by the oxidation of iron and sulphur has always been used to maintain com- bustion in the kilns or stalls designed for roasting pyrites. Since Holloway's and other early experiments, no serious attempts have been made to utilize the heat escaping from a converting vessel in smelting ore and matte either in the same apparatus or in a separate furnace. But con- siderable progress has been made in smelting highly sulphuretted ores by the heat of their own oxidizable constituents. At Tilt Cove, Newfoundland, the Cape Copper Company smelted copper ore, with just the proper

proportion of sulphur, iron, and silica, successfully with- out any fuel, when once the initial charge had been fused with coke. The furnaces used were of ordinary design and built of brick. Lump ore alone was fed, and the re- sulting matte showed a concentration of only 3 into 1. When, however, a hot blast is used on highly sulphuretted copper ores, a concentration of 8 of ore into 1 of matte is obtained, with a consumption of less than one-third the fuel which would be consumed in smelting the charge had the ore been previously calcined. A great impetus to pyritic smelting was given by the investigations of Mr W. L. Austin, of Denver, Colorado, and both at Leadville and Silverton raw ores are successfully smelted with as Iowa fuel consumption as 3 of coke to 100 of charge. But the largest establishment in which advantage is taken of the self-contained fuel is at the smelting works of the Mt. Lyell Company, Tasmania. There the blast is raised from 600° to 700° F. in stoves heated by extraneous fuel, and the raw ore smelted with only 3 per cent, of coke. The ore is a compact iron pyrites containing, of copper 2-6 per cent., of silver 3-83 oz., of gold 0-139 oz. It is smelted raw with hot blast in cupola furnaces, the largest being 210 in. by 40 in. The resulting matte runs 25 per cent. This is reconcentrated raw in hot-blast .cupolas to 66 per cent., and blown directly into copper in converters. Thus these ores, as heavily

charged with sulphur as those of the Eio Tinto, are speedily reduced by three operations and without roasting, with a saving of 97-6 per cent, of the copper, 93-2 per cent, of the silver, and 93-6 per cent, of the gold.

The Nicholls and James process. — Messrs Nicholls and James have applied, very ingeniously, well-known reac- tions to the refining of copper, raised to the grade of white metal. This process is practised by the Cape Cop- per and Elliot Metal Company. A portion of the white metal is calcined to such a degree of oxidation that when fused with the unroasted portion, the reaction between the oxygen in the roasted matte and the sulphur in the raw material liberates the metallic copper. The metal is so pure that it can be refined by a continuous operation in the same furnace.

Electrolytic refining and separation of gold and silver. — The principles have long been known on which is based the electrolytic separatibn of copper from the certain elements which generally accompany it, whether these, like silver and gold, are valuable, or, like arsenic, antimony, bismuth, silenium, and tellurum, are merely impurities. But it was not until the dynamo was improved as a machine for generating large quantities of electricity at a very low cost that the electrolysis of copper could be practised on a commercial scale. To-day, by reason of other uses to which electricity is applied, electrically deposited copper of high conductivity is in ever-increasing demand, and commands a higher price than copper refined by fusion. This increase in value permits of copper with not over £2 or $10 worth of the precious metals being profitably subjected to electrolytic treatment. Thus many million ounces of silver and a great deal of gold are re- covered which formerly were lost. The mining district of Butte, Mont., alone produces annually about 10,000,000 ounces of silver and 40,000 ounces of gold, all of which is recovered by electrolytic separation. The methods of electrolytic refining used in Europe and America necessarily differ only in detail. (See Electeo- Chemistry.) Most of them employ the multiple system, in which the soluble anodes of cast copper and cathodes of thin copper strippings are hung in lead-lined vats. A few works have adopted the series system, in which the anodes are sheets of rolled copper, one side of which is being dissolved while the refined copper is being deposited on the reverse from the adjacent sheet.

These are usually suspended in slate vats, owing to the higher voltage used. In the multiple system the anodes are generally cast plates of from 1 inch to 1^ inches in thickness, -while in the series system they must be rolled sheets, usually \ inch thick. The multiple sy stem anodes are sometimes cast directly from the blister furnace or the converter, but they are smoother, more compact, and make less scrap if roughly refined. At the Anaconda works the Bessemer copper is poured into a revolving cylindrical refinery, where it is poled, and thence poured into large ladles mechanically handled, which hold the measured weight of an anode. At other works similar ladles capable of holding 150 lb are moved by overhead trolleys. At the Baltimore works Walker's travelling tables present the moulds in rotation to the pouring ladle. The old method of slow hand-ladling has been discarded in the United States works, and the refining furnace, whether for making anodes or casting the cath- odes, has been enlarged to a capacity of from 80,000 lb to 120,000 K) to a charge. The electrolyte is invari- ably an acidulated solution of cupric sulphate. The current density seldom if ever exceeds 18 amperes to the square foot, and it can be economically raised to that point only when a high temperature and rapid circulation of the electrolyte is maintained. In some rare instances where water power is in excess of requirements, the electrolyte is heated by raising the resistance and by forcing the current through small conductors. With an 18-ampere current^ anodes of 1 inch thickness are dis- solved in 15 days, and therefore a plant of given size to-day, using a current of high density, turns out at least three times more copper than formerly, when a current density of 6 amperes per square foot was deemed the highest safe maximum limit. The accumulation of dangerous quantities of impurities in the electrolyte is corrected in most works by withdrawing at intervals a given proportion of the whole, recovering its valuable contents and replacing it by pure electrolyte. The metals which it is the aim of most works to recover from copper anodes are copper, gold, and silver. The former is de- posited on the cathode, while the precious metals separate and collect as slime, with their valuable or valueless in- gredients, in the bottom of the vat, or as a

coating on the anodes. Copper is invariably used as the conductor, and almost every works adopts different methods of attaching the electrodes to the permanent conductors.

The only published statement of the cost of refining copper on a large scale is that given in the report of the Anaconda Company, which turns out from its works in Anaconda about 80,000,000 ft of copper annually. The total cost, including taxes but not interest on plant, was in 1897-98, f cent per pound. This is in excess of the cost on the Atlantic seaboard and in Europe, where fuel and labour are both cheaper. Only electrolytic copper, together with that from Lake Superior, has sufficient purity and con- ductivity to be used for electrical purposes. It enters the market as cathodes, which are the rough plates, as with- drawn from the tanks, or cast into ingots, wire bars, and cakes. The conductivity of the cathodes is higher than that of the copper cast from them. Copper can be electro- lytically deposited on irregular moulds, or as tubes on revolving mandrils. To ensure density, where this is done, agate burnishers travel over the surface of the tube during deposition, as in the Elmore process.

Modern methods in copper smelting have therefore effected enormous economy in time, space, and labour. To-day with pyritic smelting a sulphuretted copper ore, fed into a cupola in the morning, can be passed directly to the converter, blown up to metal, and shipped as 99 per cent, bars by evening — an operation which formerly, with heap roasting of the ore and repeated roasting of the

mattes in stalls, would have occupied not \ess than four months. A large furnace and a Bessemer converter, the pair capable of making a million pounds of copper a month from a low-grade sulphuretted ore, will not occupy a space of more than 25 feet by 100 feet ; and whereas, in making metallic copper out of a low-grade sulphu- retted ore, one day's labour used to be expended on every ton of ore treated, to-day one day's labour will carry at least four tons of ore through the different mechanical and metallurgical processes necessary to reduce them to metal. (j. ds.)

Coppermine, a river of Mackenzie district, Canada, about 475 miles long, taking its rise in a lake in approxi- mately 110° 20′ W. long, and 65° 50′ N. lat., and flowing south and then north-westward to Coronation Gulf in

the Arctic Ocean. It was discovered by Hearne in 1771, and was explored from Point Lake to the sea by Captain (afterwards Sir John) Franklin in 1821.

*Coptic Cliurcll. — Racially the Copts are de- scendants of the ancient Egyptians, the name Egypt meaning ” land of the G-ypt,” as the Copts are ^^ ^ to this day called in Arabic. By the Coptic *’”’■ church, therefore, is meant the native church of Egypt or church of Alexandria. Its founder was St Mark, after whom was called the cathedral, which survived the Arab conquest. From St Mark the succession has been main- tained to the present time, but not unbroken. Up to the 5th century the church of Alexandria played a part in the Christian world scarcely second to that of Eome : the names of Origen, Athanasius, and Cyril bear witness to her greatness. But in the time of Dioscorus, 25th patriarch, the church, always fond.of speculation, was rent asunder by the controversy concerning the single or two- fold nature of our Lord, as stated by Eutyches. The Eutychian doctrine, approved by the council of Ephesus, was condemned by that of Chalcedon in 451. But to this decision, though given by 636 bishops, the Copts refused assent — a refusal which profoundly affected both the religious and the political history of their country. From that moment they were treated as heretics. The emperor appointed a new bishop of Alexandria, whose adherents the Copts styled Melkites or Imperialists, while the Copts were called Monophysites and Jacobites. The court party and the native party each maintained its own line of patriarchs, and each treated the other with bitter hostility. For nearly two centuries strife and persecution continued. The well-meant ecthesis of Heraclius was a failure and was followed by repression, till in 640 the Copts found their opportunilj- in the Saracen invasion. The fall of the Byzantine empire meant the fall of the Byzantine church, and after some resistance the Copts ac- cepted a change of masters, which gave them religious free- dom. The orthodox or Melkite party, consisting mostly of Byzantine Greeks, was swept away, and the double suc- cession of patriarchs practically ceased. True, even in 1901 there was an orthodox patriarch of Alexandria living in Cairo, but he had only a few^ Greeks for followers, and scarcely a nominal succession has been maintained. But the Coptic succession has been continuous and real.*

»” The most holy Pope and patriarch of the great city of Alexandria and of all the land of Egypt, of Jerusalem the holy city, of Nubia, Abyssinia, and Penta- polls, and all the preaching of St Mark,” as he is ”’”’” ^’ still called,, had originally jurisdiction over all the places named. ■ ‘Jurisdiction over Abyssinia remains, but from Nubia and Pentapolis Christianity has disappeared. The ancientrule isthat no bishop is eligible for the patriarchate. The requirement of a period of desert life has so far pre- vailed that no one but a monk from one of the desert monasteries is now qualified. This rule, harmless perhaps

when the monasteries were the great schools of learning and devotion, now puts a premium on ignorance, and is disastrous to the church. The patriarch is chosen by an assembly of bishops and elders. The candidate is brought in chains from the desert, and if only in monk’s orders is passed through the higher grades except that of bishop. The patriarch’s seat was transferred some time after the Arab conquest from Alexandria to the fortress town of Babylon (Old Cairo), and ia modern times it was shifted to Cairo proper. ‘The other orders and oflS.ces in the church are metropolitan, bishop, chief priest, priest, arch- deacon, deacon, reader, and monk. The number of bishoprics in ancient times was very large — Athanasius says nearly 100. At present there remain ten in Egypt, one kt Khartum, and three in Abyssinia.

The numerous remaining churches in Egypt but faintly represent the vast number standing in ancient times. Rufinus says that he found 10,000 monks in “”*■ the one region of Arsinoe. Later, in 616, the Persians are described as destroying 600 monasteries near Alexandria. Abu S3,lih (12th century) gives a list of churches surviving in his day, and their number is as- tonishing. The earliest were cut out of rocks and caverns. In the days of Constantino and Justinian basilicas of great splendour were built, such as the church of St Mark at Alexandria, and the Eed Monastery in Upper Egypt. This type of architecture permanently influenced Coptic builders, but there prevailed also a type, probably native in origin, though possessing Byzantine features, such as the domed*

roofing. There is no church now standing which bears any trace of the fine glass mosaics which once adorned the basUicas, nor is there any example of a well- defined cruciform ground-plan. But the use of the dome by Coptic architects is almost universal, and nearly every church has at least three domes overshadowing the three altars. The domes are sometimes lighted by small win- dows, but the walls are windowless, and the churches con- sequently gloomy. Among the most interesting churches are those of Old Cairo, those in the Wadi Natrun, and the Eed and White Monasteries.

Every church has three altars at the eastern end in three contiguous chapels. The central division is called the haikal or sanctuary, which is always divided ^mings from the choir by a fixed partition or screen with a small arched doorway closed by double doors. This resembles the Greek iconostasis. Haikal screen and choir screen are often sumptuously carved and inlaid. A marble basin for the mandatum in the nave, and an epiphany tank at the west, are common features. The altar is usually built of brick or stone, hollow within, and having an opening in the interior. A wooden altar- slab covered with crosses, &c., lies in a rectangular de- pression on the surface, and it is used in case of need as a portable altar. Chalice and paten, ewer and basin, crewet and chrismatory, are found as in the western churches. The aster consists of two crossed half -hoops of silver and is used to place over the wafer. The flabellum is used, though now rarely made of precious metal. Some examples of silver-cased textus now remaining are very fine. Every church possesses thuribles — the use of incense being universal and frequent — and diadems for the marriage service. The use of church bells is forbidden by the Moslems, except in the desert, and church music consists merely of cymbals and triangles which accompany the chaunting.

The sacramental wine is usually made from raisins, but the juice must be fermented. Churches even in Cairo ifugg have a press for crushing the raisins. The

and cere- eucharistic bread is baked in an oven built near monies. ^j^g sanctuary. The wafer is a small loaf about 3 inches in diameter and 1 inch thick, stamped with the

trisagion and with crosses. Communion must be received fasting. Confession is required, but of late has somewhat fallen into disuse. Laymen receive dn both kinds. The wafer being broken into the chalice, crumbs or "pearls " are taken out in a spoon and so administered, as in the Greek rite. Reservation is uncanonical. Renaudot states that it was permitted in cases of great extremity, when the host remained upon the altar with lamps burning and a priest watching, but it is not now practised, and there is no evidence of any such vessel as a pyx in Coptic ritual. Small benedictional crosses belong to each altar, and processional crosses are common. The crucifix is unknown, for while paintings and frescoes abound, graven images are absolutely forbidden. The liturgy is still read in the extinct Coptic language, but the gospel and lessons are also read in the vernacular Arabic. Seven sacraments are recognized — baptism, confirmation, eucharist, penance, orders, matrimony, and unction of the sick. The chief fasts are those of Advent, of Nineveh, of Heraclius, Lent, and Pentecost. Pilgrimage to Jerusalem is a duty and sometimes a penance.

Vestments are a difficult subject, obscured by writers like Renaudot and Denzinger, who found their statements on written evidence without having visited Egypt. The majority of the Coptic vestments have peculiarities in form and name, not corresponding closely with vestments of western ritual. But the pallium is the symbol of patriarchal office. Cope and chasuble formerly existed, and for both there is pictorial as well as documentary evidence ; but the chasuble has disappeared, and the super vestment of the celebrant is now the cope or humus. The dalmatic remains in use and is often enriched with embroidered figures and texts. The shamlah and tailasdn are peculiar vestments, something like an amice. The patrashU corresponds to the Greek epitrachelion, and the kamds, or armlets, to epimanikia. The girdle is a liturgical vestment and is worn over the dalmatic. Mitre and pastoral staff are used by bishops, although the mitre is not of we'stern shape and resembles rather a crown, as it is in fact called in Arabic.

The whole of the Coptic ritual deserves much fuller study than it has received. Since the 7th century the church has been so isolated as to be little influenced by changes affecting other communions. Consequently it

remains in many respects the most ancient monument of primitive rites and ceremonies in Christendom. But centuries of subjection to Moslem rule have much weakened and degraded it. The priesthood are very ill-paid and mostly very ignorant. Among the younger Copts, however, there is now a strong reforming party who are anxious to remove the reproach of the clergy by education, remembering the time when the church of Alexandria was as famous for learning as for zeal. They desire also to resist the serious encroachments of Roman Catholic, American Presbyterian, and other foreign missions upon their ancient faith. Their great need is an enlightened patriarch of strong character, with funds to found a theological college.

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Copyhold. — Since the publication of the article in the ninth edition of the Ency. Brit, the law relating to the

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statutory enfranchisement of copyhold, first established by the Copyhold Act, 1841, has been consolidated by the Copyhold Act, 1894. Owing to the incidents attaching to land "holden by copy of court roll according to the custom of the manor" in the shape of fines and heriots, the inability to grant a lease for a term exceeding a year, and to the peculiar rules as to descent, waste, dower, curtesy, alienation, and other matters, varying often from manor to manor and widely differing from the uniform law applicable to land in general, enfranchise- ment, or the conversion of land held by copyhold tenure into freehold, is often desired. This could and may still be effected at common law, but only by agreement on the part'of both the lord and the tenant. Moreover, it was subject to other disadvantages. The cost fell on the tenant, and the land when enfranchised was subject to the encumbrances attaching to the manor, and so an in- vestigation into the lord's title was necessary. In 1841 an Act was passed to provide a statutory method of enfranchisement, removing some of the barriers existing at common law ; but the machinery created was only available where both lord and tenant were in agreement. The Copyhold Act, 1852, went further, and for the first time introduced the principle of compulsory enfranchisement on the part of either party. By the Copyhold Act, 1894, which now governs statutory enfranchisement, the former Copyhold Acts, 1841-87, were repealed, and the law was consolidated and im- proved. Enfranchisement is now effected under this Act, though in certain cases it is also to be obtained under special Acts, such as the Land Clauses Consolida- tion Act, 1848; and the old common-law method with all its disadvantages is still open. The Copyhold Act, 1894, deals both with compulsory and with voluntary en- franchisement. In either case the sanction of the Board of Agriculture must be obtained ; and powers are bestowed on it to decide questions arising on enfranchisement, with an appeal to the High Court. The actual en- franchisement, where it is compelled by one of the parties, is effected by an award made by the board; in the case of a voluntary ~~enfranchisement it is completed by deed. Under the Act it is open to both lord and tenant to compel enfranchisement, though the expenses are to be borne by the party requiring it. The compen~~ sation to the lord, in the absence of an agreement, is ascertained under the direction of the board on a valuar tion made by a valuer or valuers appointed by the lord and tenant ; and may be paid either in a gross sum or by way of an annual

rent charge issuing out of the land enfran- chised, and equivalent to interest at the rate of 4 per cent, on the amount fixed upon as compensation. This rent charge is redeemable on six months' notice at twenty- five times its annual amount. The tenant, even if he is the compelling party, may elect either method ; but the lord has not the same option, and where the enfranchise- ment is at his instance, unless there is either an agree- ment to the contrary or a notice on the part of the tenant to exercise his option, the compensation is a rent

charge. Power is conferred on the lord to purchase the tenant's interest where a change in the condition of the land by enfranchisement would prejudice his mansion house, park, or gardens ; while on the other hand, in the interest of the public or the other tenants, the board is authorized to continue conditions of user for their benefit.

So far the provisions relating to compulsory enfranchise- ment have been dealt with; but even in the case of a voluntary agreement the lord and tenant are only en- titled to accept enfranchisement with the consent of the Board of Agriculture. The consideration in addition to a gross sum or a rent charge may consist of a conveyance of land, or of a right to mines or minerals, or of a right to waste in lands belonging to the manor, or partly in one way and partly in another. The effect of enfranchise- ment, whether it be voluntary or compulsory, is that the land becomes of freehold tenure subject to the same laws relating to descent, dower, and curtesy as are applicable to freeholds, and so freed from Borough English, Gavel- kind (save in Kent), and other customary modes of descent, and from any custom relating to dower, or free- bench, or tenancy by curtesy. Nevertheless, the lord is entitled to escheat in the event of failure of heirs, just as if the land had not been enfranchised. The land is held under the same title as that under which it was held at the date at which the enfranchisement takes effect ; but it is not subject to any estate right, charge, or interest affecting the manor. Every mortgage of the copyhold estate in the land enfranchised becomes a mortgage of the freehold, subject though to the priority of the rent charge paid in compensation under the Act. All rights and interests of any person in the land and all leases re- main binding in the same manner. On the other hand the tenant's rights of common still continue attached to the freehold

; and, without express consent in writing of the lord or tenant respectively, the right of either in mines or minerals shall not be affected by the change. Some other changes are also made by the Act. No creation of new copyholds by granting land out of the waste is per- missible, save with the consent of the Board of Agri- culture ; and it would seem as if the Act had rendered the customary court a very shadowy institution by enact- ing that a valid admittance of a new copyholder may be made without holding a court.

Under the earlier Acts, machinery to free the land from the burden of the old rents, fines, and heriots was set up, commuting them into a rent charge or a fine. Commutation, however, is never compulsory, and differs from enfranchisement in that, whereas by enfranchise- ment the land in question is converted into freehold, by commutation it still continued parcel of the manor, though subject to a rent charge or a fine, as might have been agreed. The ordinary laws of descent, dower, and curtesy were, however, substituted for the customs in relation to these matters incidental to the land in question before commutation, and the timber became the tenant's. (jno. s.)

OOPYRiaHT.

SINCE 1877 the system of international copyright has been remodelled by the Bern Convehtion ; the United States has conferred a species of international copy- right on foreign authors ; and considerable changes havte been made in the English law of copyright.

So far as the English law of copyright in books is con- cerned the chief developments have been by decisions of the Courts explaining the exact limits to which protection

extends. The most marked and certain progress has been in the application of the law of copyright to the periodical press (in 1877 it was not clear whether a newspaper was for all purposes within the Copyright Act), in order to protect within reasonable limits the labour and expenditure of newspapers that obtain for the public the earliest news and arrange it for publication. The old common-law theory that a perpetual copyright existed over literary

work, as laid down by Lord Mansfield, no doubt has been abandoned. But the Copyright Act, 1842, has been liberally construed as to what is a literary work and what is original matter. It is now settled law that a newspaper* is a book within the meaning of the Act, and can claim all rights that a book has under the Copyright Act. Thus, at the present time, leading articles, special articles, and even news items are protected. Current prices of stocks and shares, translations, the compilation of a directory, summaries of legal proceedings, and other similar literary work, so far as the literary form, the labour, and money are concerned, are equally protected. In short, the test may now be broadly stated to be, whether labour of the brain and expenditure of money have been given for the production; whilst the old requirement of original matter is not strictly maintained, or, at any rate, is broadly interpreted. Thus, the St James's Gazette was restrained from making extracts from a descriptive article by Rudyard Kipling in the Times, and the Pall Mall Gazette protected its cable reports of Australian cricket-matches. The latest leading case, however, on the subject is Walter v. Lane (decided in the House of Lords, 6th August 1900). The question raised was, whether or not copyright applied under the Act of 1842 in respect of verbatim reports of speeches. Four of the law lords, viz., the Lord Chancellor, Lord Davey, Lord James of Hereford, and Lord Brampton, upheld the claim to copyright in such cases, whilst Lord Robertson was the sole dissentient. The point of law was examined by each judge with great care ; but the gist of their decision is to be found in the opening sentences of the judgment of the Lord Chan&ellor (Lord Halsbury), who said: — "My lords, I should very much regret if I were compelled to come to the conclusion that the state of the law permitted one man to make profit out of and to appropriate to himself the labour, skill, and capital of another. And it is not denied that in this case the defendant seeks to appropriate to himself the labour, skill, and capital of another. In the view I take of this case, I think the law is strong enough to restrain what to my mind would be a grievous injustice."

Apart from newspapers, protection has been extended to publications having no literary character; Messrs Maple's furniture catalogue, and the Stock Exchange prices on the " tape " have been awarded the same pro- tection as directories. On the other hand, it has been decided that there is no copyright in a title, though if a new title is so like one with an established reputation that it will mislead the public, it may be restrained, not on grounds of copyright, but as a use of a title akin to common-law fraud. The Sphere and Spear, titles of mis- leading similarity, assumed by two weekly periodicals that appeared almost simultaneously in London in 1900 — the latter, however, being but short-lived — could not successfully attack each other, because neither had an established reputation when the title of the other was first adopted. The Courts have declined to protect works which are mere copies of railway time-tables, or the "tips" of a sporting prophet, or mechanical devices with no independent literary matter, such as patterns for cutting ladies' sleeves.

A committee of the House of Lords has considered proposals and heard evidence concerning various Bills for the amendment of the law of copyright, both literary and artistic. The general tendency of all the proposals is to increase the protection given to authors and artists, by lengthening the term of protection to thirty years after the death of the author, by increasing the amoimt of protection given (as by forbidding abridgments, dramatiza- tion of novels, and translations), and by increasing the efficacy of the remedies for infringement. Many difficult

questions, however, remain for consideration, especially in artistic copyright.

Plays and Music. — The only decision of importance affecting the drama has been the " Little Lord Fauntleroy " case, in which the person who dramatized the novel of another without his consent, an operation up to that time believed to be unassailable in law, was attacked success- fully, by preventing him from using printed or written copies of the play, either to deposit with the Lord Chamberlain or as prompt-books. In every case where much of the original dialogue of the novel is taken, this stops the production of the dramatization. In music, statutes of 1882 and 1888 have prevented the use of the provisions inflicting penalties for the

performance of copy- right songs for purposes of extortion, by allowing the Court to inflict a penalty of one farthing and make the plaintiff pay the costs, if justice requires it. Authors reserving the right of public performance are required to print a notice to that effect on all copies of the music. An important decision on musical copyright is the recent case in which it has been held that the reproduction of copy- right tunes on perforated slips for an ^olian mechanical organ is not an infringement of the copyright in the tune.

Artistic Copyright. — The most striking decisions have been those in the "Living Picture" cases (in which it was decided that tableaux vivants are not infringements of the copyright of the pictures from which they are taken), and a series of cases relating to photographs, which were not much in the contemplation of the framers of the Artistic Copyright Act of 1862. It has been decided that the " author " of a photograph is the person who groups and effectively superintends the picture, and not his employer, nor the sun, which has some claims to the title. The private sitter has restrained the photo- grapher from exhibiting or selling the photographs for which he has been paid, but in several cases the celebrity who has sat to a photographer at his request and with- out payment, has not been allowed to distribute his photograph to newspapers for reproduction without the consent of the photographer. (See Aetistic Copteight below.) '

Colonial Copyright. — The International Copyright Act, 1886, contains provisions designed to extend the benefit of the British Copyright Acts to works first produced in the colonies, while allowing each colony to legislate separately for works first produced within its own limit. The latter permission has been adopted by several of the colonies. The desire of Canadian printers to allow or require copy- right works to be reprinted or printed in Canada has given rise to a very difficult controversy. The colonies at present are all included in the system of international copyright established by the Bern Convention hereafter explained.

International Copyright. — Until 1886 international copyright in Great Britain rested on a series of Orders in Council, made under the authority of the International Copyright Act, 1844, conferring on the authors of a

par- ticular foreign country the same rights in Great Britain as British authors, on condition of their registering their work in Great Britain within a year of first publication abroad. A condition of the granting of each order was that the Sovereign should be satisfied that reciprocal protection was given in the country in question to British authors.

The Bern Convention. — As the result of conferences at Bern in 1885 and 1887, this system was simplified and made more general by the treaty known as " The Bern Convention," signed at Bern on 5th September 1887. The contracting parties were the British Empire, Belgium, France, Germany, Italy, Spain, Switzerland, Tunis, and Hayti. Luxemburg, Monaco, Norway, and Japan have since joined. Austria and Hungary have a separate con-

vention with Great Britain, concluded on 24tli April 1893. The notable absentees among European powers are Holland and Russia. The basis of the Bern Conven- tion was that authors of any of the countries of the Union, or the publishers of works first published in one of them, should enjoy in each of the other countries of the Union the same rights as the law of that country granted to native authors. The only conditions were that the work should comply with the necessary formalities, such as registration, in the country where it was first published, in which case it was exempt from all such formalities elsewhere ; and that the protection required from any country should not exceed that given in the country of origin. The rights conferred included the sole right of making a translation of the work for ten years from its first publication. The Convention was retrospective ; that is to say, it applied to copyright works published before its coming into existence, each country being allowed to protect vested interests, or copies already made by others, as it should think best.

The rights of foreign authors in Great Britain rest on legislation giving effect to the Bern Convention, namely, the International Copyright Act of 1886 (49 and 50 Vict, c. 33), and an Order in Council made under that

Act, dated 28th November 1887. These confer on the author or publisher of a work of literature or art first published iu one of the countries which are parties to the Conven- tion, after compliance with the formalities necessary there, the same rights as if the work had been first published in the United Kingdom, provided that those rights are not greater than those enjoyed in the foreign country.

The rights of British authors in foreign countries rest in each country on the domestic legislation by which the particular country has given effect to its promise con- tained in the Bern Convention, and are enforced by the courts of that country. The Bern Convention was revised in minor details not affecting its broad principles by a conference meeting in Paris, and Great Britain adopted the results of their labours by an Order in Council dated 7th March 1898.

AuTHOKiTiBS. — BiKRELL, A. Copyright in Books. London, 1899. — Cohen, B. A. Law of Copyright. London, 1896.— Edmunds, L. Copyright in Designs. London, 1895. — Knox and Hind. Copy- right in Designs. London, 1899. — Scrutton, T. E. Law of Copyright, third edition. London, 1896. (t. E. S.)

Amekican Copyright.

An Act of the United States, known as the Act of March 1891, which replaced the Act of July 1870, and which is still in force, constituted the most important modification in copyright law since the original Act of 1790. Under all Acts preceding it, copyright had been granted to " citizens or residents of the United States," the term "resident" having been, in decisions prior to 1891, construed to mean a person domiciled in the United States with the intention of making there his permanent abode. The works of foreigners could thus be reproduced without authorization, and they were so reproduced in so far as there was prospect of financial gain. The leading publishers, however, had from the earliest times made terms with British authors, or with their representatives, the British publishers, for producing authorized American editions. But at most they were only able to secure by this means an advantage of a few weeks' priority over the unauthorized editions, and the good-will of the con- scientious buyer ; so that if they paid the author any considerable sum,

the price of the authorized editions had to be made so high that it was not easy to secure a remunerative sale. The unauthorized editions had the further advantage in competition, that for the purpose of

being manufacturedmore promptly and more economically, they could be and often were issued in an abbreviated and garbled form, an injury which to not a few writers seemed more grievous than the lack of pecuniary profit. In Great Britain, during the first half of the 19th century the copyright law had been so interpreted as to secure recognition of the rights of American authors for such works as were produced there not later than in any other country, so that authors like Washington Irving and Fenimore Cooper secured for a time satisfactory returns ; but after 1850 the conditions became the same as in the United States. Unauthorized editions were published, and were often incomplete and garbled.

As from decade to decade the books produced on either side of the Atlantic, which possessed interest for readers of the other side, increased in quantity and in importance, the evil of these unrestricted piracies increased. The injury to British authors was greater only in proportion as the English books were more numerous. The pressure from Great Britain during the last half of the 19th century for international copyright was continuous ; and in America it was recognized by authors, by representative publishers, and by the more intelligent people everywhere, that the existing conditions were of material disadvantage. The loss to American authors was direct; and the loss to legitimate American publishers was also clear, in that better returns could be secured by adequate payments for rights that could be protected by law than by "courtesy" payments for authorizations that carried no legal rights. An injury was being done to American literature ; for, when authorized editions of American works had to com- pete against unauthorized and more cheaply produced editions of English works, the business incentive for literary production was seriously lessened. In fiction particularly, authors had to contend against a flood of cheaply produced editions of "appropriated" English books. Equally to be condemned were the ethics of a relation under which one class of property could be appro- priated while other classes secured legal protection. On these several grounds

efforts had long been made to secure international copyright. Between 1843 and 1886 no less than eleven international copyright Bills were drafted, for the most part at the instance of the copyright associations or copyright leagues. They were one after the other killed in committee. In 1886 the twelfth international copyright Bill was brought before the Senate by Senator Jonathan Chace of Ehode Island, and was referred to the Committee on Patents. In 1887 the American Publishers' Copyright League (succeeding the earlier American Publishers' Asso- ciations) was organized, with William H. Appleton as pre- sident, and G. H. Putnam as secretary. The Executive Committee of this league formed, with a similar committee of the Authors' Copyright League, a Conference Committee, under the direction of which the campaign for copyright was continued until the passage of the Act of March 1891. Of the Authors' Copyright League James Eussell Lowell was the first president, being succeeded by Edmund Clarence Stedman. The secretary during the active work of the League was Mr Robert U. Johnson. Under the initiative of the Conference Committee copyright leagues were organized in Boston, Chicago, St Louis, Cincinnati, Minneapolis, Denver, Colorado City, and other places. The Chace Bill was introduced in the House in March 1888. In May 1890 this Bill, with certain modifications, came before the House, and was there defeated. In March 1891 the same measure, with certain further modifications, secured a favourable vote in the House during the last hour of the last day of the session, was passed by the Senate, and was promptly signed by President Harrison. Thus, after a struggle extending over fifty-three years, the United States accepted the principle of international copyright.

The Act of 1891. — The provisions of the copyright law, as amended by the Act of 1891, may' be briefly summarized as follows : —

A. Works of Literature. — 1. Copyright is granted to authors, whether resident or non-resident, for a term of twenty-eight years. A further term

of fourteen years is granted to the author if at the expiration of the first term he be still living, or to his widow or children if he be dead. Unless the author survives the first term, or leaves vridow or children, the copyright is limited to twenty-eight years. The essential change indicated in this section of the law is the extension of copyright privileges to non-resident producers. 2. In order to secure copyright, all editions of the works of all authors, resident or non-resident, must be entirely manufactured within the United States, the term " manufactured" including the setting of type as well as printing and binding. Prior to 1891 the works of American authors could be put into print on either side of the Atlantic. This manufacturing condition was insisted on by the typographical unions. 3. The country of which a non-resident auUior is citizen must concede to American authors copyright privileges equivalent to those which it concedes to its own authors. 4. As under the British Act, the works of resident as well as of non-resident authors must be published in the home country not later than in any other country. 5. The regulations previously in force for making the entries of copy- right are continued. 6. WTule the importation of editions of the books so copyrighted is prohibited, whether the authors of the same be American or foreign, invoices may be imported of not more than two copies each, said copies being certified to be "for use and not for sale." 7. Foreign periodicals, of which there are no editions printed from type set in the United States, cannot secure an American copyright. The importation of such periodicals is unrestricted except for such numbers as contain reprints of material that has already in some other form secured an American copyright. An English author who copyrights and publishes a volume in the United States, some chapters of which have previously been printed in an English magazine, is not able to prevent the reprinting in the United States of an unauthorized issue of those chapters. In case all the chapters have been printed in a foreign periodical before the publication of the American edition, its American copyright has probably been forfeited. 8. The foreign author has the same control as the native author over translations of such of his books as have been copyrighted in the United States. There is, however, no prohibition of the importation of an edition of a work printed in a language other than that in which it has secured its copyright. 9. Authors or their assigns have the exclusive right

to dramatize and to translate any of their works for which copyright has been obtained under the laws of the United States.

B. Works of Art. — Foreign artists and designers are accorded the term or terms accorded to foreign authors and to domestic artists. To reproductions in the form of chromos, lithographs, or photographs the condition of American manufacture is attached, but not to the more artistic forms of reproduction, so that foreign authors can control engravings or photogravures of their designs, whether these are manufactured in Europe or in the United States. This provision is held by artists and art publishers of the Continent, who had in past years suffered severely from American appropriations of their productions, to be of special importance. In the case of a painting, drawing, statue, statuary, or a model or design for a work of the Fine Arts, in addition to the title, if there be one, a description and a photograph must be sent.

C. Music. — ^Foreign composers are given the same terms that are accorded to Americans. American manufacture is not necessary, but the condition of reciprocity is the same as in the case of books.

The Act came into effect 1st July 1891. The provisions having to do with international copyright become oper- ative in the case of a foreign state only when the President proclaims that the state has fulfilled the condition of reciprocity. The Act has been put into force with foreign states as follows : — 1st July 1891, Great Britain, Belgium, France; Switzerland ; 8th March 1892, Germany (by sep- arate treaty) ; 31st October 1892, Italy; 8th May 1893, Den- mark; 15th July 1895, Spain; 20th July 1895, Portugal; 27th February 1896, Mexico; 13th April 1896, Sweden and Norway; 25th May 1896, Chile ; 19th October 1899, Costa Eica ; 20th November 1899, the kingdom of the Nether- lands. In the case of each state the territory covered by the provisions of the law includes the possessions, depend- encies, &c. The copyright agreement with Great Britain, therefore, covers the Crown colonies of the empire, such as India, and the independent dominions and states, such as Canada, Australia, &c. An American work which has been

duly entered for copyright in Great Britain secures, as a British publication secures, the protection of copyright under the provisions of

the Bern convention throughout the territory of the several states that are parties to that convention.

Amendments to the copyright law have been made as follows : — Srd March 189S — Producers of article entitled to copyright who had heretofore faUed to make delivery, according to the rfegulation in force, of two copies of the article to be copyrighted, but who had complied with all the other provisions of the Act, and who shall before 1st March 1893 make such delivery, shaU be entitled to complete the entry of copyright accordingly. Snd March 1895 — The penalty to be paid in case of the infringement of the copyright of a photograph made from any object not a work of the Fine Arts shall be limited to a maximum of $5000 ; and in case of the infringement of a work of the Fiue Arts, or of a photograph of the same, to a maximum of $10,000, one-half of said penalties to be paid to the proprietors of the copyright, and the other half to the Treasury of the United States. 1st January 1897 — The performance of dramatic and musical compositions without the consent of the authors involves a liability for damages of not less than $100 for the first performance, and $50 for every subsequent performance as to the Court shaU appear just. If the unlawful performance be wUful and for profit, the party responsible shall be guilty of a misdemeanour, and upon conviction shall be imprisoned for a period not exceeding one year. 19th February 1897 — A BiU establishing as the Copyright Department of the Library of Congress a Bureau of Copyrights, the head of which bears the title Register of Copyrights. Srd March 1897 — Through a modification of section 4963, the 're- sponsibility for enjoining the publication or the selling of any article made or imported in violation of the United States copyright laws is placed upon the Circuit Court of the United States in the city of the person complaining of violation.

The salaries of the staff of the Bureau of Copyrights, as established in 1897, amounted to $36,440. The Appro- priation Bill passed by Congress in March 1900, in- creasing the appropriation for the library as a whole, gave the staff of the Copyright Biireau an additional allowance, making the total $51,080. According to the annual statement of the Register of Copyrights of 30th December 1899, the fees received diiring the twelve pre- ceding months for copyright entries and for the recording of

assignments aggregated $60,803.50. The copyright entries comprised 78,370 titles of United States produc- tions, and 8122 titles of foreign productions. These figures include works of art and musical compositions. During the years immediately preceding 1900 the pro- ducers of copyright property paid into the United States Treasury from $15,000 to $20,000 annually in excess of the cost of carrying on the Copyright Bureau, and with the increased expenditure for the maintenance of the bureau there will still apparently be a surplus of fees amounting to $10,000. In addition to this, the producers of copyrighted books deliver to the library of Congress a copy required as a voucher for the copyright entry and a further copy for the use of the nation. The books so delivered aggregate from 6100 to 6500 works each year.

The existing American copyright law is defective in several respects, and the following considerations are submitted with a view to its amendment : —

1. The condition that books or works of art must be " manu- factured " in America in order to secure American copyright should be eliminated. In case it may not prove practicable to secure the abolition of the manufacturing condition, consideration ought cer- tainly to be given promptly to the just claims of authors whose books are originally produced in some language other than Eng- lish. There is no logical connexion between the right of an

author or artist to the control of his production and the interests of American workmen; the attempt to legislate for them jointly has brought about no little confusion and inequity. If American working men cannot secure a living in competition with labourers on the other side of the Atlantic, their needs should be cared for under the provisions of the protective tariff. It is, however, the belief of a large number of those who are engaged in the manu- facturing of books that, with his advanced methods of work, the skilled American labourer has no reason to dread the competition of European craftsmen. With this manufacturing

condition out of the way,- there would be nothing to prevent the United States from becoming a party to the Convention of Bern. This would place intellectual property on both sides of the Atlantic on the same footing.

2. The requirement of publication in the United States simul- taneously virith that in the country of origin practically debars the authors of France, Germany, and other Continental countries from securing any substantial benefit from the publication of American editions of their works, although these states have extended to American authors, without restrictions, the full advantages of their statutes. The amended law should provide that a work in a foreign language, emanating from a country with which the United States has copyright relations, should be registered for copyright in regular course with the deposit for purposes of identification of two copies of the work in the text of the original, and with the further deposit of a copy of the title- page in English. The law should provide that, in case within a specified term (say twelve months) there should be published a version in English, which had been printed from type set within the United States, and which had in other respects complied, with the conditions of the American law, the work should secure the full protection of American copyright, not only for the English version as copyrighted, but for the original text. Under the present conditions the copyrighting of an American edition does not protect the original text from unauthorized translations. If, within the term specified, no edition should be produced for which the conditions of the American Act had been complied with, the right to reproduce the work in English might th^n fall into the public domain. A provision to such effect, while by no means sufficient to do full justice to Continental authors, would secure for such of these authors, whose books were available for the American-reading public, the substantial advantages of American copyright.

3. The term of copyright in force in the United States is shorter than that accorded under the law of any other literature-producing country, excepting Greece. In France and in Russia the term covers the life of the author, and fifty years thereafter. In Germany, since 1834, the term has been for the life of the author and for thirty years thereafter. Under such a term of property the author is in a position to work, not only for himself, but for his children. The United States, with its increasingly important

literary interests, ought not to be contented with a shorter term than that in force in Germany. (g. h. p.)*

Artistic Copyright.

History. — Copyright, whether artistic or literary, is the creation of statute. Attempts were raade by the first claimants of copyright to place property in ideas on a footing with other forms of property, and to claim for it rights in perpetuity; but in the year 1774 a decision in the House of Lords made it clear that neither public opinion nor law would recognize copyright as property in this sense. Since that time it has been recognized that property in copyright exists only by statute, and that its terms and conditions depend entirely upon Acts of the Legislature, and are liable at all times to alteration at the will of Parliament. Literary authors had protection for their work much earlier than artists. The first literary copyright Act came into existence in the reign of Queen Anne, but it was not until the reign of George II. that the Legislature afforded any protection for the work of artists. The first Artists' Copyright Bill was passed in the interest of William Hogarth, one of the greatest of English painters, who was engraver as well as painter, and who devoted a considerable portion of his time to engraving his own works. Ko sooner, however, were these published than his market was seriously damaged by the issue of inferior copies of his engravings by other publishers. To protect Hogarth from such piracy an Act was passed on 24th June 1735, which provided

that "every person who should invent and design, en- grave, etch, or work in mezzotinto or chiaroscuro, any historical or other print or prints, should have the sole right and liberty of printing and representing the same for the term of fourteen years, to commence from the day of the first publishing thereof, which shall be truly engraved with the name of the proprietor on each plate, and printed on every such print or prints." The penalty for piracy was the forfeiture of the plate and all prints, with a fine of 5s. for every pirated print.

Thirty-one years later (1766), in the reign of George III., a second Engraving Act was passed "to amend and render more effectual" the first Act, and "for vesting and securing to Jane Hogarth, widow, the property

in certain prints," which extended the protection beyond the designer, who was also engraver, to any person who, not being himself a designer, made, or caused to be made, an engraving from any picture or other work of art. Jane Hogarth, the widow of the painter, found herself nearing the termination of the fourteen years' term of copyright granted by the first Act, with the probability that immediately on its expiry the engravings of her husband then on sale, and on which her livelihood depended, would be immediately pirated. It was mainly to save her from the loss of her livelihood that this second Copyright Bill extended the term of the copyright to twenty-eight years.

The engravers and publishers of the day were not over- scrupulous, and they sought to evade the penalties of the copyright Acts by taking the designs, and adding to them or taking from them, or both, and producing fresh engrav- ings, seeking to make it appear that they were producing new works. These practices assumed such proportions that it became necessary, eleven years after the passing of the second Act (1777), to call upon Parliament to put through another short measure still further to protect the engraver, by prohibiting the copying "in whole or in part " (a clause not contained in the previous Acts), by varying, adding to, or diminishing from, the main design of an engraving without the express consent of the pro- prietor or proprietors. These three Acts remain in force to the present day. In 1852^ in an international copy- right Act, it was declared that the Engraving Acts collectively were intended to include prints taken by lithography or any other mechanical process.

In May 1814 an Act was passed to give protection to sculptors. The term of copyright for sculptors was a peculiar one. It was to last for fourteen years, with the proviso that, should the author be still alive, he should enjoy a further period of fourteen years, the copyright returning to him for the second fourteen should he have disposed of it for the first period. It is a condition of copyright with the sculptor that the author must put his name with the date upon every work before putting it forth or publishing it. A curious and interesting point in the interpretation of this Act is that according to the opinion of eminent jurists it is necessary to an infringement of the copyright of a piece of sculpture that the copy of it must take the form of another piece of sculpture; that a photograph,

drawing, or engraving of a piece of sculpture is not to be considered a reproduction of it, and is, there- fore, not an infringement of the sculptor's copyright.

The Act of 1862. — Strange as it may seem, painting was the last branch of the arts to receive copyright pro- tection. The cause of the painters was taken up by the Society of Arts, who endeavoured, in the first instance, to pass an amendment and consolidation Bill dealing with engraving, sculpture, and painting ; but, failing in their first effort, they limited their second to an attempt to pass a BiU in favour of painting, drawing, and photography. It was in the year 1862 that this Act, having passed

through Parliament, came into force. The absence of any antecedent protection for the painter is clearly stated in its preamble, which reads as follows : " Whereas by law as now established, the authors of paintings, drawings, and photographs have no copyright in such their works, and it is expectant that the law should in that respect be amended. Be it, therefore, enacted," &c. This preamble makes it clear that there is no copyright in any paintings, drawings, or photographs executed and dealt with before the year 1862 ; to be exact, 29th July of that year. The duration of the term of copyright in this Act of 1862 differs from its predecessors, by being made dependent on the life of the author, to which life seven years were added. In the Literary Copyright Act there are two terms — the life of the author and seven years, or forty- two years, whichever may prove the longer. In taking a fixed term like forty-two years it is necessary to have something to start from, and with a literary work it was easy to start from the date of publication. But pictures are not published. They may pass from the studio to the wall of the purchaser without being made public in any way. The difB.culty was evidently before the author of this Act, and the artist's term was made his life and seven years after his death without any alternative. This term applies equally to photographers. Perhaps no Bill which ever passed through Parliament ostensibly for the purpose of benefiting a certain set of people has failed so com- pletely as has this Bill to accomplish its end. It started

by proposing to give copyright to authors of paintings, drawings, and photographs, and it would seem that no difl- culty ought to have arisen as to whom such copyright should rightly belong; but the following clause of the Act has introduced confusion into the question of ownership: —

Provided that when any painting, or drawing, or the negative of any photograph, shall for the first time after the passing of this Act be sold, or disposed of, or shall be made, or executed for, or on behalf of any other person for a good or valuable consideration, the person so selling or disposing of, or making or executing the same, shall not retain the copyright thereof unless it be expressly reserved to him by agreement in writing, signed at or before the time of such sale or disposition, by the vendee or assignee of such painting or drawing, or such negative of a photograph or by the person on whose behalf the same shall be so made or executed ; but the copyright shall belong to the vendee or assignee of such painting, or drawing, or such negative of a photograph, or to the person for or on whose behalf the same shall have been made or executed ; nor shall the vendee or assignee thereof be entitlei to such copyright unless at or before the time of such sale or dis- position an agreement in writing, signed by the person so selling or disposing of the same, or by his agent duly authorized, shall have been made to that effect.

That is to say, after promising the author copyright in his work for life and seven years, the Act stipulates that in order to get it the author must, at the time of the first sale or disposition of his picture, obtain a document in writing from the purchaser of the picture, reserving the copyright to the author, and the Act goes on to say that if he does not take this step the copyright becomes the property of the purchaser of the picture, but with the proviso, in order to secure it to him, he must have a document signed by the artist assigning the copyright to him ; but if neither of these things is done, and no document is signed, the copyright does not belong to either the artist who sells or the client who buys, and the Act is silent as to whom it does belong to. It has dis- appeared and belongs to no one. There is no copyright existing in the work for any one. It has passed into the public domain, and any one who can get access to the work may reproduce it. Now, as most purchases are made from the walls of exhibitions, in ninety-nine cases out of a hundred the copyright is

absolutely lost. And where the sale is arranged directly between the artist and his client, the difficulty experienced by the artist in raising the

question as to whom the copyright shall belong to is so great, owing to the dread lest the mere mention of the signing of a document should cause the selling of the pic- ture to fall through, that in numerous such cases the copyright lapses and becomes public property. Photo- graphers are not affected by tljis clause, because they do not as a rule sell the negatives they produce, and with them the copyright lies in the negative. They carry on their trade in prints without the question of the negative arising. The picture-dealer, also, who buys a picture_and copyright is not subjected to the same disability >&s the painter. The picture-dealer can sell a picture without saying a word to his client as to the copyright, which he, nevertheless, retains intact ; the provision is applicable only to the first sale of the work, which, therefore, throws the whole of the disability upon the painter.

The Act gives the copyright of every work executed on commission to the person by whom it is commissioned. It makes it compulsory upon every owner of a copyright that he should register it at Stationers' Hall before he can take any action at law to protect it. The copyright does not lapse if unregistered, but so long as it remains un- registered no action at law can be taken on account of any infringement. A copyright can be registered at any time, even after an infringement, but the owner of the copyright cannot recover for any infringement before registration.

The Act provides for both penalties and damages in the following cases : —

1. For infringing copyright in the ordinary way by issuing unlawful copies.

2. For fraudulently signing or aflixing a fraudulent signature to a work of art.

3. For fraudulently dealing with a work so signed.

4. For fraudulently putting forth a copy of a work of art, whether there be copyright in it or not, as the origi- nal work of the artist.

5. For altering, adding to, or taking away from a work during the lifetime of the author if it is signed, and put- ting it forth as the unaltered work of the author.

6. For importing pirated works.

The incongruities of this Act were so apparent that its pro- moters desired to stop it, feeling that it would be better to have no Bill at all than one which conferred so little upon the public it was intended to benefit; but Lord.Westbury, the Lord Chan- cellor, who had charge of the Bill in the House of Lords, advised them to let it go through with all its imperfections, that they might get the right of the painter to protection recognized. This advice was followed, and the Bill had no sooner become law than a fresh effort was started to have it amended. Year by year the agitation went on, with the exception only of a period when Irish affairs took up all the attention of Parliament, and domestic legislation was rendered impossible. But within the last few years copyright has been again "in the air," and several independent committees have been at work upon the subject ; and in 1898 the Copyright A^ociation of Great Britain promoted a Bill, which was introduced into the House of Lords by Lord Herschell. It was a measure designed to deal with all forms of copyright — literary, musical, dramatic, and artistic, — and was remitted by the House of Lords for consideration to a committee, which, having sat for three sessions, decided not to proceed with Lord Herschell's measure, but to treat literature and art in separate Bills. It had under its consideration an artistic Bill, drafted for and presented by the Eoyal Academy, and a literary Bill and an artistic Bill drafted by the Committee itself. The main proposals in the latter were to give copyright to the author of any artistic work or photograph for a period of life and thirty years, unless the work be commissioned, in which case the copyright was to be the property of the employer, except in the case of sculpture in- tended to be placed' in a street or public place. The Bill provides summary remedies for dealing with pirated works. It omits altogether any reference to registration, and it provides for inter- national copyright.

To sum up the position of artistic copyright, we have five British Acts, three dealing with engraving, one with sculpture, and one with painting, drawing, and photo- graphy, and between them there is very little relation.

COPYEIGHT

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We have three terms of duration of copyright — 28 years • for engraving, 14 for sculpture, with a second 14 if the artist be alive at the end of the first, life and 7 years for painting,- drawing, or photography. There are two different relations of the artist to his copyright. The sculptor's right to sell his work and retain his copyright has never been questioned so long as he signs and dates it. The painter's copyright is made to depend upon the signing of a document by the purchaser of his work. The engraver and the sculptor are not required to register ; but the author's name, and the date of putting forth or publishing, must appear on his work. The painter cannot protect his copyright without registration, but this registration as it is now required is merely a pitfall for the unwary. Designed to give the public information as to the ownership and duration of copy- rights, the uncertainty of its operation results in the prevention of information on these very points.

DifRcult and complicated as is this whole subject of artistic copyright, it is perhaps not to be wondered at that ignorance of the law on the subject is very widespread, even amongst those who are most interested in its action. One of the commonest beliefs amongst artists is, that all they have to do to secure copyright is to register a picture at Stationers' Hall; but the authorities at Stationers' Hall ask no questions, and simply enter any particulars submitted to them on their printed form. Some artists make a practice, when they send a picture away to exhibi- tion, to fill up one of these forms, reserving the copyright by their entry to themselves, in the belief that, if accom- panied by the Is. fee required by the Stationers' Hall, its entry will reserve the copyright to them, oblivious of the fact that the only thing which can reserve the copyright to them is the possession of a document assigning the copyright to them by the purchaser of the picture. Another useless method of attempting to reserve artists' copyrights is that adopted by the promoters of public exhibitions, with

whom it is an almost constant practice to print on some portion of the catalogue of the exhi- bition a statement that "copyrights of all pictures are reserved," the impression apparently prevailing that a notice of this kind effectively reserves the copyright for the artist ^hile selling his picture from the walls. It, of course, does no such thing, and the copyright of any picture sold in these circumstances, without the neces- sary document from the purchaser, must be lost to the artist, and pass irrevocably into the public domain.

In a work of art the work itself and the copyright are two totally distinct properties, and may be held by different persons. The conditions differ materially from those of a work of literature, in which as a rule there is no value apart from publication. There is a value in a work of art for its private enjoyment quite apart from its commercial value in the form of reproductions; but when the two properties exist in different hands, the person holding the copyright has no power to force the owner of the work of art to give him access to it for purposes of reproduction ; this can only be effected by private arrangement. It has been argued that, as the two properties are so distinct, the owner of the copjrright ought to have the right of access to the picture for the purpose of exercising his right to reproduce it. But it is easy to see that it would destroy the value of art property if proprietors knew that at any moment they might be forced to surrender their work for the purpose of reproduction, though for a time only.

There is often a strong sympathy between the artist and the person who buys his picture, and it is not at all un- usual, when application is made to the owner of the picture for access to it, for him to submit the question of repro-

duction to the artist. Although the latter may really have no right in it, it is felt, as a practical matter, that he is largely interested in the character of the reproduction it is proposed to make. Hence the courtesy which is usually extended to him.

Of late years, owing to the increased facilities of repro- duction, the practice has become very common of splitting up copyrights and granting licenses in what may be de- scribed as very minute forms. It would, of

course, be impossible for a publisher to pay an artist the sum at which he values his entire copyright, simply that he might reproduce his picture in the form of a black-and- white block in a magazine, and it has consequently become quite common for the artist to grant a license for any and every particular form of reproduction as it may be required, so that he may grant the right of repro- duction in one particular form in one particular publica- tion, and even for a particular period of time, reserving to himself thus the right to grant similar licenses to other publishers. This is apparently not to the injury of the artist; it is probably to his advantage, and it certainly promotes business.

The great obstacle in the way of securing a really good Artistic Bill has been the introduction into it of photo- graphy. It was by a sort of accident that th^ photographer was given the same privileges as the painter in the Bill of 1862. The promoters of the Bill thought that the photo- grapher would be protected by the Engraving Acts which covered prints ; but since the photographers feared that, as their prints were of a different character from the prints from a plate, the Engraving Acts might not protect them, it was at the last moment decided to put photography into the Art Bill. The result of this was that the painter lost his chance of copyright on all works executed on com- mission. Legislators feared that if photographers held copyright in all their works the public would have no protection from the annoyance of seeing the photographs of their wives and daughters exhibited, and sold in shop windows by the side of " professional beauties " and other people, and made articles of commerce. So in the case of commissioned works, the copyright was denied to both painters and photographers, and there seems considerable fear that in any new legislation the attempt to give the same terms to both painter and photographer may lead to great injury and injustice to the public.

The Royal Commission which reported on the subject in 1878 proposed two distinct terms of copyright for painting and photography. The term for the painter was dependent on his life ; that for the photographer was a definitely fixed term of years from the date of publication of his photographs ; and there can be little doubt that this is the right way to deal with the two branches of copy- right. The artist who paints a picture signs it, and there is no diflculty in knowing who is the author of a painting and in whom the term of copyright is vested. But who knows anything as to the authorship of a photograph ? In a very large number of cases a photograph is taken by an employee, who is here to-day and gone to-morrow, and even his employer knows nothing of his existence. Of course, it may suit an employer to be able to maintain secrecy as to the authorship of his negative, inasmuch as it enables him to go on claiming copyright fees in- definitely ; but it is not to the public interest. In most countries on the Continent a photographer has the fixed term of five years' copyright in an original photograph dating from its publication, which date, together with the name and address of the photographer, has

to be stamped on every copy issued. In the public interest some such method of dealing with photographs should be introduced into any new Act. If the choice is between the Continental method and registration, the photographer would probably

choose the former, as it would entail no registration fees.

See also Walter Arthur Copingbr, F.S.A. The Law of Copyright in Works of Literature and Art. London, 1893. — Richard Winslow, M.A., LL.B. The Law of Artistic Copyright. London, 1889. Ce. ba)

Coquelin, BenoTt Constant (1841-

-), French

actor, was born at Boulogne, January 24, 1841. He was originally intended to follow his father's trade of baker, but his love of acting led him to the Conservatoire, where he entered Regnier's class in 1859. He won a prize for comedy less than a year afterwards, and made his dibut in December 1860 at the Comedie Frangaise, of which house he became a sociitaire four years later. His first successes, which were made in classical comedy, were brilliantly sustained during the twenty years that suc- ceeded his election as sod&taire. During that time he " created " the leading parts in a number of new plays, including Oringoire (1867), Taharin (1871), Pavl Forestier (1871), L'Etrangire (1876), Jean Dacier (1877), Le Monde oil Von s'ennuie (1881), Les Bantzau (1884), and others. In consequence of a dispute with the authorities over the question of his right to make provincial tours in France, he resigned his position at the Comedie Frangaise in 1886. Three years later, however, the breach was healed ; and, after a successful series of tours in Europe and the United States, he rejoinedtheComddie Franqaise as pensionnaire in 1889. He remained there three years, during which time the most notable events were the dihut of his son Jean in 1890, and the production of Thermidor (a play suppressed, for political reasons, on the third occasion of its

performance), and of a version of The Taming of the Shrew under the title of La M6g&re Apprivoisie, both in 1891. In 1892 he broke definitely with the Comddie FrauQaise, and toured for some time through the capitals of Europe with a company of his own.

In 1895 he joined the company at the Renaissance Theatre in Paris, and played there until he became director of the Porte-Saint-Martin Theatre in 1897. There his latest successes have been in Cyrano de Bergerac (1897) and Plus que Seine (1899). In 1900 he once more undertook an American tour. He has published: L'Art et le ComMien (1880), Mbliire et le Misanthrope (1881), essays on Eugene Manuel (1881) and Sully-Prudhomme (1882), L'Amolphe de Moliire (1882), Les ComMiens (1882), L'Art de dire le Monologue (with his brother, 1884), Tantuffe (1884), L'Art du ComMien (1894).

Coquimbo, a town and important port in Chile, in the province and department of the same name, situated in 29° 57′ 4″ S. lat. and 71° 21′ 12″ W. long. The popu- lation in 1895 was 7322. In 1898 it had 5-44 per cent, of the total export trade of Chile, and 3-34 per cent, of the import trade. In the same year it was visited by 484 ships (foreign and coastwise trade), of a total tonnage of 775,981 tons.

CoratO, a town in the province of Bari, Apulia, Italy, 25 miles west from Bari, with olive and wine production. In the neighbourhood stands the Emperor Frederick II.'s hunting-seat, Castel del Monte. The population (1901) was 41,573.

Cordoba, a province in the centre of the Argentine Republic. The ofiB.cial area at the census of 1895 was 62,160 square miles ; the population in 1895 amounted to 351,223— urban, 94,760 ; rural, 256,463. The province is divided into twenty-five departments. In 1895 there were 18,545 farms, 1,070,532 acres planted in cereals, 1,884,926 head of cattle, and 489,926 horses.

Cordoba, a city of the Argentine Republic, capital of the province of Cordoba, on the Rio Primero in 31° 25′ S. lat. and 63° 42′ W. long., about 435 miles north-west of Buenos Ayres ; in communication by rail with all the principal towns of the Republic. It has greatly in- creased in

importance since 1875 : the population of the town in 1896 was 42,783 ; of the suburbs, 11,679. Besides- its other educational and scientific institutions, it contains the National Meteorological Bureau of the Argentine, the National Academy of Sciences (1894), a national secondary school, two national schools for teachers, and a good public library. There is a bronze equestrian statue of General Paz, and another of the legislator Dr Sarsfield. Bridges have been constructed to connect the town with two new districts which have sprung up as a result of the introduction of an extensive scheme of irrigation. The water supply is excellent. For internal communication there is an efficient service of electric and other trams.

Cordova, a province in the south of Spain, with a population of 420,714 in 1887 and 443,582 in 1897. Its area is 5300 square miles, divided into 16 administrative districts and 74 parishes. The river Guadalquivir divides the province into two very dissimilar portions. On the right bank is the mountainous region of the Sierra Morena, less peopled and fertile than the left bank, with its great plains and slightly undulated country towards the south and south-east in the direction of some spurs of the Sierra Nevada. One of the most picturesque chains of this province is the Sierra de Cordova at some distance from, but along, the right bank of the Guadalquivir, that runs from east-north-east to west-south-west. It waters the richest districts of Cordova, and has many tributaries, one of the most important being El Guadal- mellato. The Guadiato and Bombezar are next in importance, and in the northern part of the province are several streams that are tributaries of the Guadiana. The climate is much varied. Snow is to be found for months on the highest peaks of the mountains, mild temperature in the plains except in the few torrid summer months, when rain seldom falls. The latest returns showed that out of 78,204 children of both sexes between the ages of 4 and 14, 36,357 only were on the school registers, and 27,940 attended classes. There are 266 miles of railways, some good first-class state roads, few good provincial and many fair munic- ipal roads. Cordova is one of the provinces of S^ain that pays most for the industrial a.nd commercial taxes, though its principal resources and products are agricultural, and its mining interests anything but suf- ficiently developed. The mines, however, are important. Three lead, 11 argentiferous lead, and 25 coal mines were worked in 1898. Ten

silver lead mines at work in 1898 produced 9059 metric tons, valued at £82,123, as compared with 6529 tons, valued at £61,945, in 1897. Three silver lead mines also produced 7439 tons, valued at £18,279, in 1898. The total value at pit's mouth of the output of the mines in 1898 was £257,269, against £193,656 in 1897. The coal ipines are almost entirely in the hands of two important companies, Andaluces and Southern of Spain. The Belmez coal-field had in 1898 an output of 383,969 metric tons, valued £156,866, against 316,024 tons, val- ued £113,772, in 1897. This province also produced in 1898, 29,565 tons of coke, 20,105 of anthracite, 47 metric tons of silver. The most important group of silver lead mines belongs to Anglo-Bilbao companies, and the English lead works smelted 8573-|- English tons of lead ore from their Linares mines, producing therefrom 6258 English tons of pig lead. The live stock in the province consists of 11,149 horses, 14,584 mules, 12,923 asses,

25,857 cattle, 214,908 sheep, 61,703 goats, and 54,668 pigs. About 365,000 acres are covered with wheat crops, 228,- 200 with barley, 50,820 with rye, 62,810 with oats, 36,357 with chick peas, 12,635 with vines, 482,495 with olives.

Cordova, the capital of the above province, had a population of 55,615 in 1887, and 65,506 in 1897. The township includes a very extensive territory outside the city proper; in fact, 310,000 acres of area, studded with factories of alcohol, hats, woollen stuffs, and silversmiths' works. The famous leather manufactures have decayed, though some good imitations of the old style are to be met with. Within the area of the town there are lovely gardens, plantations, orange, olive, and lemon groves, and pastures where popular and famed breeds of bulls for the national sport are reared, Cordova being celebrated for its school of bull-fighters. There are many modern public buildings and useful institutions, secondary and primary schools, a school founded in 1590 by the Bishop Pacheco of Cordova for girls, who take the same degrees as the other sex, a school of veterinaries, an academy of sciences, fine arts, and letters, polytechnic school,- and an athenaeum.

Corea. See Korea.

Corfu. See Geeece {Ionian Islands).

Cori nth . — The modern town of New Corinth, capital of an arrondissement in the province of Argolis and Corinth, Greece, is situated on the isthmus of Corinth, near the bay of Lepanto, Greece, about 3^ miles from the site of the ancient city, at the junction of two railway lines, 57 miles west of Athens and 87 east-south-east of Patras, with which there is also frequent communication by steamer. With the opening of the Corinthian Ship Canal in 1893 its prosperity has somewhat revived. The chief exports are raisins, corn, oil, and silk. Population,

4100.

Corinth, after passing through its various stages called Greek, Roman, Byzantine, and Turkish, survived until 1858 as one of the most considerable towns of Greece, when it was, with the exception of a few houses, levelled to the ground by an earthquake, and New Corinth, a city with broad streets but no old traditions, was . founded. A mere handful of the old population re- mained on the old site, which was marked out for continuous occupation by flowing water and fertile fields. At present a picturesque but poverty-stricken village of somewhat over 1000 inhabitants, mostly of Albanian descent, holds its place among the ruins of former days, and bears the name of Old Corinth. Its most picturesque features are its one gigantic plane tree nourished by the water of Pirene, shading nearly all of the public square, its venerable temple ruin, and Acro- Corinth rising above the village to a height of nearly two thousand feet. The view even from the village, over the Corinthian Gulf, of Parnassus with its giant neigh- bours on the north, of Cyllene and its neighbours on the west, and of Geraneia on the east, is very fine ; but from Acro-Corinth the view is still finer, and is perhaps unsur- passed by any in Greece.

Such were the attractions and the features of Corinth known to those who visited it before 1896. The ex- cavations begun in that year by the American School of Classical Studies at Athens, under the direction of Mr Eufus B. Eichardson, have in each succeeding year brought to light

important monupients of the ^A»o- ancient city, both of Roman and of Greek" logical dis- times. The outlook at the outset was not hope- cowries. fui_ In the first place, the long and continu- ous occupation made it appear probable that the slow and remorseless ^wear of ages had done much more than

the destruction of Mummius to obliterate the traces of the ancient monuments ; secondly, although there was one landmark of the old Greek city, namely, the old temple ruin, there was no certainty what one of the temples mentioned by Pausanias this was. In fact, by a perverse error, which one topographer after another had handed along, the wrong name of Athena Chalinitis was quite commonly applied to it. The current topo- graphy of Corinth was simply a web of conjecture, which gained nothing from the fact that one great name after another was added to the list of its vouchers. The great object to be attained by excavations was the locating of the agora; first, because Pausanias says that most of the important monuments of the city were in and near the agora; and secondly, because he could only thus be used as a guide and authority. As he mentions the monuments in order along the streets radiating from the agora, when the starting-point was once gained, one could hope to identify any foundations found along their various lines. One unsuccessful attempt to locate the agora by excavation had already been made.

In the first year's work of the American School twenty- one trial trenches from 10 to 20 feet deep, of varying lengths and scattered over a wide area, were dug, in the hope of finding, if not the agora itself, something which would give a clue that might lead up to the agora. The work was successful. Near the close of the cam- paign, somewhat less than a quarter of a mile to the north-west of the temple ruin, on the edge of a terrace, the theatre was found. This discovery laid the corner- stone of the topography of Corinth ; for the theatre was, according to Pausanias, on the street leading from the agora towards Sicyon, and so to the west of the agora. Another trench, dug across the valley to the east of the temple, revealed a broad pavement of white limestone, extending from the north up the valley towards Acro- Corinth. This was clearly one of the great thoroughfares of the city, and so probably the street mentioned by Pausanias as leading from Lechaeum up to the agora. It was already as

good as certain that, by following up this pavement until it was intersected by a line coming frqm Sicyon past the theatre, one would find oneself in the agora. Even before the agora was found, the temple seemed to take its place as the temple of Apollo, mentioned by Pausanias as "the first monument on your right as you go out of the agora on the street leading towards Sicyon." The limestone pavement yielded in the follow- ing year all that it had promised. It was soon seen to end in a flight of thirty-seven marble steps, in their present form of a late date, which lead up to the propy- laea of the agora, the buttresses of which are well pre- served and agree with the form of a Roman triumphal arch, a form given to the propylaea on the coins of imperial times from Domitian to Commodus. To the east of the staircase and close up against the agora itself, only at a much lower level, was found, buried under 35 feet of earth, the famous fountain, Pirene, tallying exactly with the description of Pausanias, as " a series of chambers resembling grottoes, and bearing a faqade of white marble." This two-storey faqade of porous stone, with arches opening into the chambers, belonged to the Roman city; and before the time of Pausanias, had received a facing of marble, which has now fallen off but has left traces of itself in the holes by which it was attached and in cartloads of chips which lay in front of the facade. This was not, however, the first form of Pirene. It was built up in front of a more simple Greek facade, which consisted of seven cross walls supporting a conglomerate stratum, and forming six chambers, whose only ornamentation was antae at the front end of the cross walls, and on

a parapet at the rear single slender Ionic columns between two antae supporting an entablature. The chambers were really reservoirs. The water flowed along their backs, poured into them, and then out into a large basin in the open air, enclosed by a large quadrangle with apses on three sides and the faqade of the fountain on the other. The whole quadrangle was faced with marble. During the Byzantine period a pretentious but very rough addition was made to this faqade by setting five marble columns about four feet in front of the older faqade, with

heavy architrave blocks running from them back into the faqade, which was roughly cut into for the purpose, the object probably being to form a sort of balcony. The columus, the Coriuthian capitals, and the bases are all of varying sizes, and, like the architrave blocks, were surely taken from earlier buildings.

To the west of the temple of Apollo was a cube of rock protruding some 10 feet from the ground. This, on being ”

excavated, proved to be the fountain Glauce, an impressive structure entirely cut out of native rock, consistiag of four chambers, with a porch of three pillars between two antae, approached by a flight of five steps. This falls in line, as it should, between the temple of Apollo and the theatre.

To the north of the propylaea and Pirene, the brick ruins in the middle of the village were explored, and appeared to be the baths of Eurycles, which should lie here on the street to Lechaeum. Some other monuments were identified with more or less probability. But enough has been located with absolute certainty to allow us to speak of a topography of Corinth, not as based on mere conjecture, but on facts; and for the first time a map of the central portion of the ancient city can be drawn.

This is perhaps the greatest result of the excavations, but much more has been accomplished. Vases and fragments of vases have been found, of all periods except the Mycenaean, a gap which will presumably be filled later. On the north side of the hillock on which stands the village schoolhouse there were found several rock-cut vertical shafts, which led into lateral passages used for burial. These contained unpainted vases in con- siderable quantity, of most varied forms, some of them with incised ornamentation, corresponding closely to the prehistoric pottery of Thera and Hissarlik. A deep digging near the foot of the staircase leading to the propylaea yielded fifteen vases with geometric decoration. , In a well about 30 feet below the surface of the road leading westward out of the village square was found a large celebe of old Corinthian style in forty-six fragments, with pieces of several similar vases. A good many so-called Proto- Corinthian vases may be added to the list.

The statuary yielded by the excavations is mostly of Roman times. A head of Dionysus crowned with a wreath of ivy, and a round base with a relief of dancing Maenads, surpass in value the many headless statues which have been constantly turning up. But the most important sculptures of this period are a group of colossal statues supporting an entablature, a great part of which has been found. One of these figures, appar-

ently a young barbarian captive like those found on Roman triumphal arches, is practically entire; and another, its counterpart, is preserved down to the thighs. These figures are not quite like Caryatids and Atlantes, which bear the entablature on their heads. They, seem rather to prop up the Corinthian capitals, which rest upon pilasters that form a part of their backs. Two of these stood at each end of a re-entrant curve of the entablature. Two female heads of like proportions belonged to figures with the same architectural functions, bearing straight lines of entablature, and were placed probably to the right and left of the first pair. The building to which they belonged was probably a porch which abutted upon the propylaea on the west, and had a faqade like the Septizonium at Rome on a small scale. The foundations of the porch were of a core of opus incertum.

BAmsorEURYCUS

PLAN OF CORINTH SHOWING SITES OF EXCAVATIONS.

In 1900 was found an ancient Greek fountain in the agora, 25 feet below the present surface of the soil. It is approached through an opening in an enclosure made of metopes and triglyphs, with the painted patterns on them almost as fresh as if they had been painted a year ago. Through the opening a flight of seven steps leads down to a quadrangular room, in the west wall of which are two bronze Uon's heads, through the open mouths of which water was once discharged. The whole adjustment and its greater depth than the Roman surroundings prove its great antiquity. It is the only case of an intact Gre^k foun- tain, and so of the highest interest in itself, and perhaps stDl more interesting as an earnest of ancient things still to be discovered when the requisite level is reached.

Among the inscriptions, which are mostly of Roman

date, was one -which deserves mention. It is cut in rather rough Greek letters upon a highly ornamented marble block, -which in its second use served as the lintel of a Je-wish synagogue. The block -was broken at both ends, but in the middle appears AmrHEBP, i.e., oMvaywyi] "EiSpaiW. Under this lintel without doubt passed and repassed the great Apostle to the GentUes.

A full account of the various discoveries is given in the volumes of the American Journal of Archmology for 1896-1901.

(r. b. e.)

Corinth, Isthmus of.— An isthmus of Greece, dividing the Gulf of Corinth from the Saronic Gulf. In 1893 a ship canal -was opened through it, -with its -western entrance about 1^ miles north-east of the little to-wn of New Corinth. It ~~was begun in 1881 by a French com~~ pany, -which ceased operations in 1889, a Greek company completing the undertaking. The canal is 100 feet broad, 3^ miles long, and 26. feet deep. It shortens the journey from the Adriatic to the Piraeus by 202 miles, but foreign steamships -will not use it, as the narrowness of the canal and the strength of the current at times render the passage dangerous. About 1 mile from its -western end it is crossed by the iron bridge of the Athens and Corinth rail-way.

Corinth, capital of Alcorn county, Mississippi, U.S.A., situated in the north-eastern part of the state, on the Mobile and Ohio and the Southern railways, at an altitude of 436 feet. During the Civil War, on October 3 and 4, 1862, it -was the scene of a severe battle between the Confederates, under Van Dorn, and the Union forces, under Eosecrans,-when the former -were defeated -withheavy loss. Population (1880), 2275 ; (1890), 2111 ; (1900) , 3661.

Corinto, a town in Nicaragua, on the Pacific, the chief port of the republic. Its harbour is one of the best protected on the coast of Central

America, and is part of the ancient port of Realejo. Corinto is the terminus of the railway from Lake Managua, and is regularly visited by the various lines of steamers. It is estimated that it does 59 per cent, of the export and 62 per cent, of the import trade of Nicaragua. Population about 1500.

Coric, a maritime county of Ireland, province of Munster.

Population. — The area of the administrative county in 1900 was 1,838,921 acres, of which 415,766 were tillage, 971,221 pasture, 1608 fallow, 29,099 plantation, 24,996 turf-bog, 68,997 marsh, 213,- 688 barren mountain, and 83,546 water, roads, fences, &c. The new administrative county is identical in area with the old judicial county. The population in 1881 was 495,607, and in 1891, 438,432, of whom 219,988 were males and 218,444 females, divided as follows among the different religions : — Roman Catholics, 396,174 ; Prot- estant Episcopalians, 35,407 ; Presbyterians, 2130 ; Methodists, 3293 ; and other denominations, 1428. The decrease of population between 1881 and 1891 was 11-54 per cent. The average number of persons to an acre was '24. Of the total population, 310,851 inhabited the rural districts, being an average of 129 persons to each square mile under crops and pasture. The population in 1901 was 404,813 (Roman Catholics, 366,085 ; Protestant Episcopalians, 31,411 ; Presbyterians, 1780 ; Methodists, 2946 ; others, 2591), being a decrease of 5-7 per cent, in the East Riding, and of 11-6 percent, in the West Riding. The following table gives the degree of educa- tion in 1891 (excluding the city of Cork) : —

Males.

Females.

Total.

Percentage. |

E.G.

Pr. Epis.

Presb.

Read and write Bead only niiterate

121,978 11,940 32,576

113,651 12,018 35,682

285,629 23,958 68,208

69-9

7-7 22-4

91-9 8-4

4-7

95-7 2-2 2-1

In 1881 the percentage of illiterates among Roman Catholics was 32-5. Excluding the city of Cork, in 1891 there were 31 superior schools -with 1439 pupils (Roman Catholics 1023, and Protestants 416), and 776 primary schools with 62,093 pupils (Roman Catholics 58,215, and Protestants 3878). The number of pupils on the rolls

of the national schools on 30th September 1899 was 74,408, of whom 69,325 were Roman Catholics and 5083 Protestants.

The following table gives the number of births, deaths, and marriages in various years : —

Tear.

Births.

Deaths.

Marriages.

1881 1891

1899

12,253 9,713 9,220

8736 8047 7030

1988 1759 1926

In 1899 the birth-rate per 1000 was 21 -0, and the death-rate 16-0 ; the rate of illegitimacy was 1-8 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1899 was 491,932, of whom 255,162 were males and 236,770 females. The following are the chief towns in the county, with their populations in 1891 :^Cork, 75,345 (in 1901, 76,978) ; Queenstown, 9082 ; Fermoy, 6469 ; Kinsale, 4605 ; Youghal, 4317 ; Mallow, 4366 ; Baudon, 3488.

Administration. — The county is divided into seven parliamentary divisions, East, Middle, North, North-East, South, South-East, and "West, the number of registered electors in 1900 being respec- tively 6990, 7822, 7463, 7393, 6611, 8339, and 6683. The rateable value in 1900 was £1,095,885. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury and (to a less extent) of other bodies were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises 7 urban and 18 rural sanitary districts. Under the same Act the city of Cork consti- tutes a separate county.

Agriculture. — The following tables give the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900 :—

Wheat.

Oats.

Barley, Beans, Eye, &c.

Po- tatoes.

Tur- nips.

Other Green Crops.

Meadow

and Clover.

Total.

1881 1891 1895 1900

24,597

10,853

4,770

6,840

101,933 98,698 99,805 95,572

22,280 17,848 19,587 18,689

68,709 56,986 58,798 48,109

88,784 81,984 84,510 82,569

14,914 17,839 20,809 25,113

164,807 169,726 184,167 188,900

481,445 398,334 416,946 415,766

There were also a few acres under flax and rape during these years. For 1899 the total value of the cereal and other crops was estimated by the

registrar-general at £2,753,756. The number of acres under pasture in 1881 was 973,567 ; in 1891, 988,369 ; and in

1900, 971,221.

Horses

and Mules.

Asses.

Cattle.

Sheep.

Pigs.

Goats.

Poultry.

1881 1891 1895 1900

64,435 57,987 62,785 57,167

11,194 18,062 16,802 18,713

386,205 417,581 420,837 444,668

264,165 416,428 811,620 320,361

144,856 147,489 155,478 182,658

22,766 24,651 26,261 28,119

1,115,668 1,125,956 1,279,991 1,451,516

The number of milch cows in 1891 was 174,760, and in 1900, 186,- 785. It is estimated that the total value of cattle, sheep, and pigs in 1899 was

£6,538,272. In 1900 the number of holdings not ex- ceeding 1 acre was 7089 ; between 1 and 5, 2493 ; between 5 and 15, 4760 ; between 15 and 30, 6436 ; between 30 and 50, 6632 ; between 50 and 100, 7992 ; between 100 and 200, 3342 ; between 200 and 500, 757 ; and above 500, 67— total, 39,458. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1900, was 2603, amounting to £1,516,880. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, between 1882 and 1900, was 2559, and the amount issued £189,748, the largest amount in any county of Ireland. The total amount issued on loan for aU classes of works under the Land Improvement Acts, from the commence- ment of operations to 31st March 1900, was £451,533.

Fisheries. — There are four deep-sea and coast fishing districts in the county — Youghal, Kinsale, Queenstown, and Castletown Bere — in which, in 1899, 748 vessels were registered, employing 3304 men and boys, and four salmon fishing districts — Cork, Bandon, Skibbereen, and Bantry— in which 777 persons were employed in the same year. ‘ (■^. h. po.)

Coric, a maritime city, county and parliamentary borough (returning t-wo members), on the Kiver Lee, 138 miles south-west of Dublin. It is the centre of an extensive railway system, which includes the Great Southern and Western, the Cork, Bandon, and South Coast, the Cork and Macroom Direct, and the Cork, Blackrock, and Passage railways. The new Protestant

cathedral was completed in 1879. The central tower is 240 feet high. The Parnell bridge over the south channel of the river was opened in 1882. The Crawford Science and Art Schools were opened in 1885, and stand on the site of the old Custom House. A new Protestant church, St Luke’s,

was erected in 1888. The principal manu- factures are distilling, brewing, tanning, chemical man- ures, tweeds, and friezes, and there is an extensive trade in grain, provisions, and especially butter, the Cork butter market being the chief centre of the trade in Ireland. The port is the most important on the south coast of Ireland, the quays extending for over 4 miles, of which more than 2^ are available for shipping. In all 2368 vessels of 662,086 tons entered in 1899, and 1629 of 402,196 tons cleared. The registered shipping totalled 115 vessels of 21,193 tons. The total foreign and colo- nial imports for the same year, which included 1,138,870 cwts. of wheat and 2,207,700 of maize, amounted to £1,240,304. There are valuable salmon fisheries on the Lee, in which 370 persons were employed iu 1899. In 1898 Cork was constituted one of the six county boroughs which have separate county councils. Population (1881), 80,124; (1891), 75,345, of whom 35,427 were males and 39,918 females, divided as follows among the different religions : — Roman Catholics, 64,561 ; Protestant Epis- copalians, 8620 ; Presbyterians, 749 ; Methodists, 867 ; and others, 548. The population in 1901 was 75,978. In 1891 there were 22 superior schools, with 1771 pupils (1346 Roman Catholics and 425 Protestants), and 58 primary schools, with 11,115 pupils (9597 Roman Catholics and 1518 Protestants). The percentage of illiterates among Roman Catholics was 18-0; among Protestant Episcopalians, 3-2 ; among Presbyterians, 2-8 ; and among Methodists, 2-7. The population of the parliamentary borough in 1891 was 97,281 and in 1901, 99,693, and the registered number of electors in 1900, 13,153. The ratable value of the city in 1900 was £173,656. (w. H. po.)

Cornelius, Carl August Peter (1824- 1874), German musician and poet, son of an actor at Weisbaden, grandson of the well-known engraver Ignaz Cornelius, and nephew of Cornelius the painter, was born at Mainz, 24th December 1824. In his childhood's days his bent was towards languages, though his musical gifts were carefully cultivated by Scharrer the singer, Panny the Hungarian violinist, and Heinrich Esser. Cornelius the elder, anxious for his son to become an actor, himself taught the boy the elements which can be learnt. These theatrical studies, however, were inter- rupted early by a visit paid by Peter Cornelius to England as second violin in the Mainz orchestra. On returning home young Cornelius made his stage debut as John Cook in Kean. But after two more appearances,

as the lover in the comedy Das War Ich and as Perin in Moreto's Donna Diana, he practically abandoned the stage for music, his idea being to become a comic opera composer. In 1843 his father died. Hitherto Cornelius's musical studies had been unsystematic. Now opportunity served to remedy this, for his relative, Cornelius the painter, summoned him in 1844 to Berlin, and enabled him. a year later to become a pupil of Dehn, counterpoint and theory generally being worked at laboriously. After leaving Dehn, Cornelius proved his independence by writing a trio in [A minor, a quartet in C, as well as two comic opera texts. In 1847 he returned to Dehn and immediately composed an enormous mass of mnsic, including a second trio, 30 vocal canons, several sonatas, a Mass, a Stabat Mater ; he also wrote a number of translations of old French poems, which are classics of their kind. In 1852 he first came in touch with Liszt,

through his uncle's instrumentality. At Weimar, whither he went iu 1852, he heard Berlioz's delightful Benvenuto Cellini, a work which ultimately exercised great influence over him. Eor the time, however, he devoted himself, on Liszt's advice, to further Church compositions, the in- fluence of the Church on him at that time being so great that he applied, but vainly, for a place in a Jesuit college. Still his mind was bent on the production of a comic opera, but the composition was long delayed by the work of translating the prefaces for Liszt's symphonic poems and the texts of works by Berlioz and Rubinstein. Between October 1855 and September in the following year, Cornelius wrote the book of the Barhier von Bagdad, and on December 15, 1868, the opera was produced at Weimar under Liszt, and hissed off the stage. There- upon Liszt resigned his post, and shortly afterwards Cornelius went to Vienna and Munich, and stiU later came very much under Wagner's influence. Cornelius's Cid was completed and produced at Weimar in 1866. Eor the last nine years of his life (1865-1874) Cornelius was occupied with his opera Gunlod and other composi- tions, besides writing ably and abundantly on Wagner's music-dramas. In 1867 he became teacher of rhetoric and harmony at the Musik-Schule, Munich, and married Berthe Jung. He died 26th October 1874. Not the least of Cornelius's many claims to fame was his remark- able versatility. Many of his original poems, as well as his translations from the Erench, rank high. Among his songs, the lovely "

Weihnachtslieder ” are conspicuous ; many of the best are unknown in England, but a^great impression has been made in recent years by his ” Vatergruft,” an unaccompanied vocal work for baritone solo and choir. (b. h. l.)

Cornell University, Ithaca, New York, was founded by Ezra Cornell, and opened in 1868. Beside the founder’s endowment, it received 990,000 acres of public land, and subsequently gifts from private benefac- tors. In 1890 its invested funds amounted to $6,766,370, and its total income to $722,210. Its buildings and equipment are valued at $3,242,716, exclusive of the Medical College in New York, valued at $1,000,000. Its library contained, in 1)900, 238,376 volumes and 38,400 pamphlets ; its average annual growth is 13,000 volumes. The book funds amount to $300,000. The instructing staff numbers 266, including 32 non-resident lecturers, beside 94 in the Medical College in New York City. The total attendance in 1900-1901 (including 83 students iu the winter school in Agriculture, and 446 in the sum- mer session of 1899) numbers 3005. Of these, 192 were in the Graduate Department, 744 in the Academic Department, 176 in the College of Law, 336 in the Medical College, 179 in the College of Civil Engineer- ing, 654 in the College of Mechanical Engineering, and 204 in the Colleges of Architecture, Agriculture, Veteri- nary Medicine, and Forestry. Somewhat more than half of the students come from New York State. Free tuition is annually given to 512 state students, and there are 36 university scholarships of $200, each for two years, awarded by competition to freshmen. Seven- teen graduate scholarships of $200 each, 21 fellowships of $500 each, and 2 of $600 are annually granted to graduate students. (See also the articles IJnivebtities and Education.) (j. g. s.)*

Corneto Tarquinia, an Italian town in the province of Rome, 13 miles north from Civitavecchia by rail. The church of Santa Maria, in the citadel of the Countess Matilda of Tuscany, has recently been restored. New buildings are the tgwn-hall and municipal museum particularly rich in archaeological treasures, many of them

taken since 1881 out of the cave tombs of the ancient Etruscan town of Tarquinii. There is another collection of Etruscan antiquities in the Bruschi palace. Popular tion (1901), 7219.

Corning, a city of Steuben county, New York, U.S.A., situated in 42° 08′ N. lat. and 77° 03′ W. long., in the southern part of the state, on Chemung river, at an altitude of 942 feet. It has three railways, the Delaware, Lackawanna, and Western, the Erie, and the New York Central and Hudson River. The surrounding country produces much tobacco. Population (1880), 4802 ; (1890), 8550 ; (1900), 11,061. ‘ v ^’

■ Cornu, Marie Alfred (1841-1902), Erench physi- cist, was born on 6th March 1841, and after being edu- cated at the Ecole Polytechnique and the ficole des Mines, became in 1867 professor of experimental physics in the former institution, where he remained throughout his life. Although he made various excursions into other branches of physical science, undertaking, for example, with Bailie about 1870 a repetition of Cavendish’s experi- ment for determining the mean density of the earth, his original work was mainly concerned with optics and spectroscopy. In particular he was known for his re- determination of the velocity of light by Eizeau’s method, which he improved in various ways, adding greatly to the accuracy of the results. Among the honours which this achievement won for him were membership of the Academy of Sciences in France and the Eumford medal of the Eoyal Society in England (both in 1878). In 1899, at the jubilee commemoration of Sir George Stokes, he was Rede lecturer at Cambridge, his subject being the undulatory theory of light and its influence on modern physics; and on that occasion the honorary degree of D.Sc. was conferred on him by the University. He died on 11th April 1902.

Cornwall, a peninsular county of England, at the extreme south-west of Great Britain, surrounded on all sides by the sea except on the east and north-east, where it marches with Devon, and the boundary line is formed mainly by the river Tamar.

Area and Population. — The area of the ancient and administra- tive county was given in the census returns of 1891 as 868,208 acres, or 1357 square miles, with a population in 1881 of 330,686, and in 1891 of

822,571, of whom 149,259 were males, and 173,312 females, the number of persons per square mile being 238, and of acres to a person 2 ‘69. In 1901 the population was 322,857. The area of tlie registration county is 886,372 acres, with a population in 1891 of 318,583, of whom 113,538 were urban, and 205,045 rural.

The following table gives the marriage-, birth-, and death-rates per 1000 persons living, with the percentages of illegitimate births, for a series of years : —

>

18TO-79.

1880.

1880-89.

1890.

1889-98.

1899.

Marriage-rate .

Birth-rate

Death-rate

Percentage of illegitimacy

12-9

80 -4

20-4

6-3

12-1

29-0

21-4

6-8

13-2

28-7

19-1

61

13-4 26-6 19-6

■ *5-7*

13-4

27-1

18-2

5-4

13-8

25-5

18-1

4-9

The birth-rate was considerably below the average for England, but the death-rate only a very little below it, while the percentage of illegitimate births was rather high.

Constitution and Cfovernment.— The ancient county is divided into 6 parliamentary divisions, and it also includes the parliament- ary burgh of Penryn and Falmouth, returning one member. The administrative county contains 11 municipal boroughs : Bodmin (5151), Falmouth (12,791), Helston (3198), Launceston (4345), Liskeard (3984), Lostwithiel (1379), Penryn (3256), Penzance (12,482), St Ives (6094), Saltash (2745), and Truro. (11,131). The following are urban districts: Camborne (14,700), Hayle (1172), Looe (2454), Ludgvan (23.34), Madron (2761), New Quay (1891), Padstow (1546), Paul (5977), Phillack (3979), Redruth (10,824), St Austell (3477), St Just (6119), and Wadebridge (1868). The county is in the western circuit, and assizes are held at Bodmin.

The boroughs of Bodmin, Falmouth, Helston, Launceston, Lis- keard, Penryn, Penzance, St Ives, and Ti-uro have separate commissions of the peace, and the borough of Penzance has in addition a separate court of quarter sessions. In matters relating to mines the county is under the jurisdiction of the Duchy of Cornwall, of which the Heir Apparent is hereditary duke. The executory court of the duchy is called the Stannary court, its jurisdiction also including West Devon. The ancient county, which is in the diocese of Truro, contains 227 entire ecclesiastical parishes and parts of one other.

Education. — There is a residential training college for school- masters (Exeter Diocesan) at Truro. The number of elementary schools on 31st August 1899 was 339, of which 179 were board, and 160 voluntary schools, the latter including 136 National Church, of England schools, 17 Wesleyan, 2 Roman Catholic, and 5 "British and other." The average attendance at board schools was 26,506, and at voluntary schools 18,517.

Agriculture. — Within recent years the area under cultivation has considerably increased, but it is still less than three-fourths of the total acreage. Of the cultivated area only about one-fifth is under corn crops, and nearly two-fifths under permanent pasture, in addition to which there are nearly 55,000 acres of hill pasture, over 31,000 acres under woods, and about 5000 acres under orchards. The acreage under wheat has greatly diminished, oats now occupying about one-half the total acreage under corn crops, and wheat and barley each about one-fourth. Nearly

three-fourths of the acreage under green crops is occupied by turnips, swedes, and mangold, and in addition cabbage occupies about one-fifth, while less than one-eighth is occupied by potatoes. The following table gives the main divisions of the cultivated area in 1880 and 1900 : —

Year.

Total Acre- age under Cultiva- tion.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1880 1900

551,224 606,139

137,297 125,115

56,399 47,349

154,566 189,313

182,633 238,806

20,329 3,933

The principal live-stock in 1880 and 1899 were as follows :—

Tear.

Total Horses.

Total Cattle.

Cows or Heifers

in Milk or in

Calf.

Sheep.

Pigs.

1880 1899

31,527 31,096

163,604 203,983

55,145 69,500

426,550 399,756

60,193 88,559

Industries and Trade. — ^According to the annual report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 10,923. The number of persons employed in mines and quarries in 1899 was 11,410. In 1899 the amount of igneous rocks raised was 222,614 tons valued at £97,008, and of slate 31,923 tons. The more valuable minerals in 1890 and 1899 were as follows : —

Tear.

Arsenic.

China Clay.

Copper.

Tin.

Tons.

Value.

Tons.

Value.

Tons.

Value.

Tons.

Value.

1890 1889

814.3 1361

£26,508

18,295

893,509 506,228

£268,900

290,620

.5211 6172

£15,801

21,487

14,867 6,889

£780,017

440,299

Large quantities of herring are obtained on the Cornwall coasts, along which there are numerous fishing stations. The valuable pilchard fisheries also retain their importance. The total quan- tity of fish landed at all "stations in 1899 was over 400,000 cwts., valued at over £200,000 ; but much fish from Cornwall is landed at Plymouth in Devon.

Authorities. — Among later works are Bannistek. Glossary of Cornish Names. London, 1878. — Hartino. Birds of Corn- wall. London, 1880. — Ddnkin. Monumental Brasses of Cornwall. London, 1882. — Symojts. Sketches of the Geology of Cornwall. London, 1884. — Cotjetnet. Parliamentary Bepresentation of Cornwall to 183^. London, 1889. — Boase. Collectanea Cornu- biensia. Truro, 1890. — ^Boelase. Early Christianity in Corn- wall. London, 1893; and QniLLEE-ConcH (M. and L. M.). Ancient Wells of Cornwall. (x. r. H.)

Cornwall, the capital of the united counties of Stor- mont, Dundas, and Glengarry, Ontario, Canada, 65 miles south-west of Montreal, on the left bank of the river St Lawrence. It is an important station on the Grand Trunk and the Ottawa and New York railways, and is a port of call for all steamers plying between Montreal and Lake

Ontario ports. The surplus water from the Cornwall Canal furnishes excellent water privileges for its large factories, which include cotton and woollen mills and grist and saw mills. Population (1881), 4468; (1901), 6500.

Corot, Jean-Baptiste Camille (1796-1876), French landscape painter, was born in Paris, in a house on the Quai by the Eue du Bac, now demolished, on 26th July 1796. His family were well-to-do bourgeois people, and whatever may have been the experience of some of his artistic

colleagues, he never, throughout his life, felt the want of money. He was apprenticed to a draper, but hated commercial life and despised what he called its "business tricks," yet he faithfully remained in it until he was twenty-six, when his father at last consented to his adopting the profession of art. Corot visited Italy on three occasions : two of his Eoman studies are now in the Louvre. He was a regular contributor to the Salon during his lifetime, and in 1846 was " decorated" with the knighthood of the Legion of Honour. He was promoted to be Of&cer in 1867. His many friends considered nevertheless that he was officially neglected, and in 1874, only a short time before his death, they presented him with a personal medal. He died in Paris in 1875 and was buried at P^re Lachaise. Of the painters classed in the Barbizon School it is probable that Corot will live the longest, and will continue to occupy the highest position. His art is more individual than Eousseau's, whose works are more strictly traditional ; more poetic than that of Daubigny, who is, however, Corot's greatest contem- porary rival; and in every sense more beautiful than J. P. Millet, who thought more of stern truth than of aesthetic feeling.

Corot's works are somewhat arbitrarily divided into periods, but the point of division is never certain, as he often completed a picture years after it had been begun. In his first style he painted traditionally and " tight " — that is to say, with minute exactness, clear outlines, and with absolute definition of objects throughout. After his fiftieth year his methods changed to breadth of tone and an approach to poetic power, and about twenty years later, say from 1865 onwards, his manner of painting became full of " mystery " and poetry. In the last ten years of his work he became the Pere Corot of the artistic circles of Paris, in which he was regarded with personal affection, and he was acknowledged as one of the five or six greatest landscape painters the world has ever seen, along with Hobbema, Claude, Turner, and Constable. During the last few years of his life he earned large sums by his pictures, which became greatly sought after. In 1871 he gave £2000 for the poor of Paris (where he remained during the siege), and his continued charity was long the subject of remark. Corot's works are spread over Europe and America. The Louvre possesses several important pictures by him, and there are examples in Lille, Bordeaux, Eovien, Eheims, Toulouse, and other centres. In

England the ” Macbeth ” in the Wallace Collection is the only one in a public museum, but it is not characteristic of his best period; and in Scotland there is the splendid ” Souvenir d’ltalie ” in the Glasgow Gallery. Besides landscapes, of which he painted several hundred, Corot produced a number of figure pictures which are now much prized. These were mostly studio pieces, executed, probably with a view to keep his hand in with severe drawing rather than with the intention of producing pictures. Yet many of them are fine in com- position, and in all cases the colour is remarkable for its strength and purity. Corot also executed a few etchings and pencil sketches. In his landscape pictures Corot was more traditional in his method of work than is usually

believed. If even his latest tree-painting and arrange- ment are compared with such a Claude as that which hangs in the Bridgewater Gallery, it will be observed how similar is Corot’s method and also how masterly are his results.

The works of Corot are scattered over France and the Netherlands, Great Britain, and America, and it would be impossible except in a very extended list to name them. The following may be considered as the first half-dozen : — TJne Matinie (1850), now in the Louvre ; Macbeth (1859), in the Wallace Collection; Le Lac (1861); L’Arbre Brise (1865) ; Pastorale — Souvenir d’ltalie (1873), in the Glasgow Corporation Art Gallery ; Biblis (1875). Corot had a number of followers who called themselves his pupils. The best known are Boudin, Lepine, Chintreuil, Franqais, and Le Eoux.

AnTHOKiTiBS.-7-H. DuMESNii,. Souvenirs Intimes. Paris, 1876. — RoGEK-MiLi;8. Les Artistes Celebres : Corot. Paris, 1891. — RoGER-MiLis. Album Classique des Chefs-d’ ceuvres de Corot. Paris, 1895. — J. Rousseau. Bibliotheque d^art moderne : Camille Corot. Paris, 1884. — J. Clakbtie. Peintres et Sculpteurs Contemporains : Corot. Paris, 1884.— Ch. Bigot. Peintres Franqais Contemporains : Corot. Paris, 1888.— Geo. Moore. Ingres and Corot in Modern Painting. London, 1893. — David Croal Thomson. Corot. 4to. London, 1892. — Mrs Schuyler van Rbnssalaek, ” Corot,” Century Magazine (June 1889).— Corot. The

Portfolio, 1870 (p. 60), 1875 (p. 146).— R. A. M. Stevenson. ” Corot as an Example of Style in Painting,” Scottish Art Beview, Aug. 1888. (d. c. t.)

Corpus Christi, capital of Nueces county, Texas, U.S.A. It is a seaport, with a fine harbour, and is situated in the southern part of the state, on Corpus Christi Bay. Two railways, the Mexican National and the San Antonio and Aransas Pass, enter it. Population (1880), 3257;

(1890), 4387 ; (1900), 4703.

Correggio, a town of Emilia, Italy (province Eeggio), on a canal connecting the Secchia and the Po, 11 miles by rail north-east from Eeggio. It has an old castle, and a fine monument (1880) to the painter Antonio Allegri, better known as Correggio, who was bom here in 1494 and died here in 1534. Cheese and hats are manufactured. Population of commune (1881), 12,687 ;

(1901), 14,437.

Correnti, Cesare (1815-1888), Italian revolu- tionist and politician, was bom, 3rd June 1816, at Milan. While_ employed in the Public Debt administration he flooded Lombardy with revolutionary pamphlets designed to excite hatred against the Austrians, and in 1848 proposed the general abstention of the Milanese from smoking, which gave rise to the insurrection known as the Five Days. During the revolt he took part in the council of war and directed the operations of the insurgents. Until the fall of Milan he was Secretary- General of the Provisional Government, but after the restoration of Austrian rule he fled to Piedmont, whence he again distributed his revolutionary pamphlets through- out Lombardy. Elected deputy in 1849, he worked strenuously for the national cause, supporting the Crimea expedition and organizing a new revolt in Milan, which, however, was forestalled by the victory of Magenta. After the annexation of Lombardy he was made com- missioner for the liquidation of the Lombardo-Venetian debt, and in 1860 was appointed Councillor of State. In 1867, and again in 1869, he held the portfolio of Public Instruction, taking considerable part in the events consequent upon the occupation of Eome, and helping to draft the Law of Guarantees. As Minister he suppressed the theological faculties in the Italian

Universities, but eventually resigned office and allied himself with the Left on account of Conservative opposition to his reforms. His defection from the Eight

ultimately assured the adveut of the Left to power; and while declining office, he remained chief adviser of De- pretis until the latter's death. On several occasions— notably m connexion with the redemption of the Italian railways, and of the Paris Exhibition of 1878— he acted as representative of the Government. In 1877 he was given by Depretis the lucrative sinecure of the Secretaryship of the Order of Saints Maurice and Lazarus, and in 1886 was created Senator. He died at Eome on 4th October

1888.

Correze, a department in the interior of Prance, traversed by the ramifications of the central plateau, and watered by the Dordogne, the Vezfere, and the Corrfeze.

Area, 2273 square miles, with 29 cantons and 287 communes. Ihe population decreased from 326,494 in 1886 to 304,718 in 1901 Births in 1899, 7395, of which 299 illegitimate ; deaths' 6263 : mar- riages, 2451. . In 1896 there were 761 schools, with 51,000 pupils and 8 per cent, of the population was illiterate. The area under cultivation in 1896 amounted to 1,030,466 acres, 425,036 acres of which were plough-land, 276,767 acres natural pastures and grass lands, and 296,536 acres forests. The wheat return is low (£240,700), but in 1898 the rye crop yielded a value of £524,270, and the natural grass lands produced the value of £617,120. Chest- nuts and walnuts are also an important crop, yielding in 1899 the value of £240,000. The live-stock amounted in 1899 to 990,200, of which 579,570 were sheep. There is not much working in metals, the department having but few mineral beds. Other industries are also little developed. Tulle, the capital, had a population of 17,000 in 1896.

Corrientes, a province of the Argentine Republic, south of Paraguay and west of the territory of Chaco. The official area at the census of 1895 was

32,579 square miles. The population in 1895 was 239,618. The province is divided into twenty-five departments. The capital, Corrientes, on the Parang, 844 miles from Buenos Aires, had a population of 16,129 in 1895. In 1895 there were 13,632 farms and 136,119 acres planted in cereals, 424,483 head of horses, and 2,893,256 head of cattle.

Corrigan, Michael Augustine (1839-1902), third archbishop of the Roman Catholic archdiocese of New York, in the United States, was born in Newark, N. J., on 17th August 1839. In 1859 he began his studies for the priesthood as one of the twelve students with whom the American College at Rome was opened. On 19th Sep- tember 1863, a year before the close of his theological studies, he was ordained priest, and in 1864 obtained the degree of D.D. Returning to America, he was appointed Professor of Dogmatic Theology and Sacred Scripture, and Director of the ecclesiastical seminary of Seton Hall College; soon after he was made vice-president of the institution; and in 1868, although hardly twenty-eight years of age, was appointed president of the college, one of the foremost of the Catholic educational institutions in the United States. When Archbishop Bayley was transferred to the see of Baltimore in 1873, Pius IX. ap- pointed Pather Corrigan bishop of Newark. In 1880 Bishop Corrigan was made coadjutor, with the right of succession, to Cardinal M'Closkey, archbishop of New York, under the title of Archbishop of Petra ; and there- after nearly all the practical work of the archdiocese fell to his hands. He was at the time the youngest archbishop in the Catholic Church in America. On the death of Cardinal M'Closkey in 1885 Archbishop Corrigan became metropolitan of the diocese of New York. He died May 5, 1902.

Corry, a city of Erie county, Pennsylvania, U.S.A., situated in the north-western part of the state, on the Western New York and Pennsylvania, the Erie, and the Pennsylvania railways, at an altitude of 1434 feet. It is within the limits of the great, oil-fields of Western Pennsylvania and Southern New York, and it is to petroleum that it owes its existence and whatever measure of prosperity it enjoys. It was a place of much

importance during the oil excitement between 1860 and 1870, and in the latter year had a population of 6809. As the excitement abated, however, its population dimin- ished, so that in 1880 it numbered but 5277, in 1890 it was 5677, and in 1900, 5369.

Corsica, an island in the Mediterranean, forming a department of France ; area, 3368 square miles, occupied by high mountains, and distributed among 62 cantons and 364 communes. The population in 1896 numbered 290,168, as compared with 278,501 in 1886. Births in 1899, 6947, of which 504 illegitimate ; deaths, 5582 ; mar- riages, 1625. In 1896 the schools numbered 1170, with 46,000 ,pupils, and 15 per cent, of the population was illiterate. The total area under cultivation in 1896 amounted to 1,693,886 acres, of which 919,265 acres were arable land. In 1899 the wheat crop returned a value of only £57,800, while the produce of rye and oats together hardly exceeded £21,000 ; but the vine, which is making progress in the island, yielded a value of £278,000. In 1899 the crop of chestnuts was of the value of £154,000 ; oranges, £2820; citrons, £1640 ; cedrates, £22,000. The production of silkworm cocoons amounted in 1899 to 5813 cwt. The live-stock in 1899 included 10,730 horses, 9130 mules, 8730 asses, 157,990 cattle, 408,650 sheep, 74,300 pigs, and 215,920 goats. Corsica has no coal-pits, but some copper and lead mines, yielding 1100 metric tons in 1898, and some salt-pans, producing, in 1898, 520 metric tons of salt. The industries are in a backward state. The railway, of recent construction, goes from Bastia to Ajaccio, sending off a branch line to Calvi. The line had in 1899 a length of 182 miles.

Corsicana, capital of Navarro . county, Texas, U.S.A., situated towards the north-eastern part of the state, at an altitude of 426 feet, on the Houston and Texas Central and the St Louis South-Western railways. It is in a region largely devoted to the cultivation of cotton, for which staple it serves as a compressing- and shipping-point. Population (1880), 3373 ; (1890), 6285; (1900), 9313. ‘ V ^’

Corti, Lodovico, Count (1823-1888), Italian diplomatist, born at Gambarano 28th October 1823. Early involved with Cairoli in anti-Austrian conspira- cies, he was exiled to Turin, where he entered the Foreign Office. After serving as artillery officer through the campaign of

1848, he was in 1850 appointed Sec- retary of Legation to London, whence, with the rank of Minister, he passed to Stockholm, Madrid, The Hague, Washington, and, in 1875, as Ambassador to Constanti- nople. Called by Cairoli to the direction of Foreign affairs in 1878, he took part both in the preliminary negotiations to the Congress of Berlin and in the Con- gress itself, but unwisely declined Lord Derby's offer for an Anglo-Italian agreement in defence of common in- terests. At Berlin he sustained the cause of Greek inde- pendence, but in all other respects remained isolated. While other Powers secured extensions of territory, he declined the German suggestion for an Italian' occupation of Tunis, and excited the wrath of his countrymen by returning to Italy with "clean hands." For a time he withdrew from public life, but in 1881 was again sent to Constantinople by Cairoli, where he presided over the futile Conference of Ambassadors upon the Egyptian question. In 1886 he was transferred to the London Embassy, but was recalled by Crispi in the following year through a misunderstanding. He died at Rome on 9th April 1888.

Cortland, a village of New York, U.S.A., and capital of Cortland county, situated in the central part of the state, on Tioughnioga river, at the junction of its

east and west branches, at an altitude of 1122 feet. It has three railways, the Delaware, Lackawanna, and Western, the Erie and Central New York, and the Lehigh Valley. Population (1880), 4050 ; (1890), 8590 ; (1900),

yoii.

Cortona, a town and episcopal see of Tuscany, Italy (province Arezzo), 30 miles north-west from Perugia by rail. The church of St Domenic, buUt about 1250, should be mentioned because of its fine paratings by Luca Signorelli, Pra Angelico, and others. Here is a technical school. Silk is manufactured. Population (1901), 29,343.

Corunna, a maritime province in the extreme north- west of Spain. The coast, which is very daagerous to navigation, is a succession of bays and estuaries, which are very picturesque, and often in close proximity to more rugged parts that are in reality the last spurs of the Cantabric chain. The proviace is very well watered by a great many small rivers and streams. Hills and mountain-sides are covered with forests and pastures. The climate is mild, with comparatively no extremes of cold or heat. The rains are quite as abundant as in the rest of Galicia, and even more so than in Asturias and the Basque provinces. It has an area of 3078 square miles, divided into 14 administrative districts and 97 parishes. The population was 596,436 in 1877, and 631,419 in 1897.

In very few provinces of the kingdom is the birth-rate so high, nor the proportion of illegitimates so great ; the slow progress of the population, the death-rate beiag moderate, is attributed to the fact that emigration carries off on an average 3250 per annum. Education is in a backward condition, as in 1897, out of 129,976 children of both sexes, ranging from 4 to 14 years of age, only 46,603 were enrolled on the school registers, and only 29,487 ever attended the classes.

The railway lines actually open are only 45 miles. Other lines are being constructed. There were 63 unpro- ductive mines in 1897, and 5 mines that were being worked. The latter were — ^1 arsenic pyrites, 2 iron, and 2 that showed traces of gold. The live stock in 1897 included 25,565 horses, 3863 mules, 3250 asses, 104,147 sheep, 10,364 goats, 92,006 pigs, and 169,480 cattle. The rearing of cattle, formerly one of the most important industries of the province, has declined with the decrease of exportation, in particular to England ; even to France and the interior of Spain it is not what it used to be. The yield of the principal crops in 1898 was — ^wheat, 2,087,395 bushels; rye, 1,091,086; beans, 54,596; chick peas, 1,177,650; maize, 2,190,444, the latter showing a falling off of over 2,500,000 bushels. Only about 1890 acres are covered with vines, that produce strongly alcoholic wine (491,392 gallons in 1898). The wheat crop covers 270,000 acres ; rye, 170,000 ; maize, 70,000. As in the rest of Spain, the cultivation of beetroot has been started in the province for the sugar factories and to feed cattle. (a. e. h.)

Corunna, a seaport and the capital of the above proviace. The population was 37,240 in 1887, and 38,927 in 1897. The trade and commerce of Corunna depended so much on the Spanish colonies, especially Cuba and Porto Eico, that the loss of these seriously affected the exports and imports. The total value of the articles exported in 1898 amounted to £86,316 as against £185,061 in 1897, while the imports decreased to £205,602 from £352,323. The chief exports were flour, potatoes, beans, bacon and hams, tinned provisions, chocolate, wine, eggs; the imports were chiefly coals from England, and drugs, hides, metals, machinery, timber, cotton, maize, sugar, coffee, petroleum. The return

of shipping during 1898 showed a total of 1157 vessels, and 983,121 aggregate tonnage. The harbour has been considerably improved. The new quay wall has been completed, and dredgers have been used successfully to deepen the anchorage. The depth of water is now 19 feet 6 inches at the quay walls at low tide, and powerful cranes have been erected on the wall to imload vessels. A lighthouse has been established at Cape Torinana. Corunna is the head of the railway line direct between Galicia and Madrid, and will soon be the terminus of lines in different directions in North-West Spain and Portugal.

Corvey, an abbey of Germany. See Hoxtek.

Cos, or Kos (Italian, Stanchio ; Turkish, Istan-keni, from h rdv kG), an island separated from Cape Krio, near the south-west corner of Asia Minor, by a narrow strait. Under the name of Lungo it became part of the maritime state founded by the knights of Rhodes. In 1523, after the fall of Rhodes, it was annexed to the Osmanli Empire. The estimated population is 10,000: Moslems, 500; Greeks, 9500.

Cosenz, Enrico (1812-1898), Italian soldier, was born at Gaeta, 12th January 1812. As captain of artillery in the Neapolitan army he took part in the expedition sent by Ferdinand II. against the Austrians in 1848; but after the Coup d'Etat at Naples he followed General Pepe in disobeying Ferdinand's order for the withdrawal of the troops, and proceeded to Venice to aid in defendr ing that city. As commandant of the fort of Marghera, Cosenz displayed distinguished valour, and after the fall of the fort assumed the defence of the Piazzale, where he was twice wounded.

Upon the fall of Venice he fled to Piedmont, where he remained until, in 1859, he assumed the command of a Garibaldian regiment. In 1860 he conducted the third Garibaldian expedition to Sicily, defeated two Neapolitan brigades at Piale (August 23), and marched victoriously upon Naples, where he was appointed Minister of War, and took part in organiz- ing the pUbiscite. During the war of 1866 his division saw but little active service. After the war he repeatedly declined the portfolio of War. In 1881, however, he be- came chief of the general staff, and held that position until a short time before his death at Rome on 7th August 1898.

Cosenza, a town and episcopal see of Calabria, Italy, capital of the province Cosenza, 43 miles by rail south- south-west from Sibari, a junction on the railway along the east coast. It consists of the old town, with steep, narrow streets, and a better built new town, and is sur- rounded by villas of the provincial landowners. The town suffered severely from earthquakes in 1638, 1783, 1854, and 1870. Population (1881), 16,686 ; (1901), 21,420.

Coshocton, capital of Coshocton county, Ohio, U.S.A., on the Muskingum riverj at the mouth of Tus- carawas river, and on the Ohio Canal. Three railways intersect at this place. Population (1890), 3672 ; (1900),

6473.

Cosne, chief town of arrondissement, department of Nievre, France, 33 miles north-north-west of Nevers, on railway from Paris to Lyon. Its potteries are now im- portant, and there is wool-spinning, and the preparation of phosphate is carried on in the vicinity ; with commerce in wine, hemp, wood, iron, wool, and leather. Population

(1881), 5241; (1891), 5737; (1901), 8580.

Cossa, Pletro (1830-1880), Italian dramatist, was born at Rome in 1830, and claimed descent from the family of Pope John XXIIL, deposeid by the council of Constance. He manifested an independent spirit

COSSACKS

from Ms youth, and was expelled from a Jesuit school on the double' charge of indoeility and patriotism. After fighting for the Eoman republic in 1849, he emi- grated to South America, but failing to establish himself, returned to Italy, and lived precariously as a literary man until 1870, when his reputation was established by the unexpected success of his first acted tragedy, Nero. From this time to his death in 1880 Cossa continued to produce a play a year, usually upon some classical sub- ject. Cleopatra, Messalina, Julian, enjoyed great popu- la,rity, and his dramas on subjects derived from Italian history, Rienzi and The Borgias, were also successful. Plautus, a comedy, was preferred by the author himself, and is more original. Cossa had neither the divination which would have enabled him to reconstruct the ancient world, nor the imagination which would have enabled him to idealize it. But he was an energetic writer, never tame or languid, and at the same time able to command the attention of an audience without recourse to melodramatic artifice ; while his sonorous verse, if scarcely able to support the ordeal of the closet, is suffi- ciently near to poetry for the purposes of the stage.

(k. g.)

Cossacks (Russian, KazaTc ; plural, Kazaki), the name given to considerable portions of the population of the Russian Empire, endowed with certain special privi- leges, and bound in return to give military service, all at a certain age, under special conditions. They constitute ten separate Yoiskos, settled along the frontiers : Don, Kuban, Terek, Astrakhan, Ural, Orenburg, Siberian, Semi- ryechensk, Amur, and Usuri. The primary unit of this organization is the stanitsa, or village, which holds its land as a commune, and may allow persons who are not Cossacks (excepting Jews) to settle on this land for pay- ment of a certain rent. The assembly of all householders in villages of less than 30 households, and of 30 elected men in villages having from 30 to 300 households (one from each ten households in the more populous ones), con- stitutes the village assembly, similar to the mir, but having wider attributes, which assesses the taxes, divides the land, takes measures for the opening and support of schools, village grain-stores, communal

cultivation, and so on, and elects its ataman (elder) and its judges, who settle all disputes up to £10 (or above that sum with the con- sent of both sides). Military service is obligatory for all men, for 20 years, beginning with the age of 18. The first 3 years are passed in the preliminary division, the next 12 in active service, and the last 5 years in the reserve. Every Cossack is bound to procure his own uniform, equipment, and horse (if mounted) — the Government supplying only the arms. Those on active service are divided into three equal parts according to age, and the first third only is in real service, while the two others stay at home, but are bound to march out as soon as an order is given. The officers are supplied in the usual way by the military schools, in which all Cossack Voiskos have their own vacancies, or are non-commissioned Cos- sack officers, with officers' grades. In return for this service the Cossacks have received from the State consid- erable grants of land, for each Voisko separately.

The total Cossack population in 1893 was 2,648,049 (1,331,470 women), and they owned nearly 146,500,000 acres of land, of which 105,000,000 acres were arable and 9,400,000 under forests. This land was recently divided between the stanitsas, at the rate of 81 acres per each soul, with special grants to officers (personal to some of them, in lieu of pensions), and leaving about one-third of the land as a reserve for the future. The income which the Cossack Voiskos receive from the lands which they rent to different persons, also from various sources (trade

patents, rents of shops, fisheries, permits of gold-digging, &c.), as also from the subsidies they receive from the Government (about 712,600 1. in 1893), is used to cover all the expenses of State and local administration. They have besides a special reserve capital of about 2,600,000 1. The expenditure of the village administration is covered by village taxes. The general administration is kept separately for each Voisko, and differs with the different Voiskos. The central administration, at the Ministry of War, is composed of representatives of each Voisko, who discuss the proposals of all new laws affecting the Cos- sacks. In time of war the ten Cossack Voiskos are bound to supply 890 mounted sotnias or squadrons (of 126 men each), 108 infantry sotnias or companies (same number), and 236 guns, representing 4267 officers and 177,100 men, with 170,695 horses. In time of peace they keep 314 squadrons, 54 infantry sotnias, and 20

batteries containing 108 guns (2574 officers, 60,632 men, 50,064 horses). Altogether, the Cossacks have 328,705 men ready to take arms in case of need. As a rule, popular education amongst the Cossacks stands at a higher level than in the remainder of Russia. They have more schools and a greater proportion of their children go to school. In ad- dition to agriculture, which (with the exception of the Usuri Cossacks) is sufficient to supply their needs and usually to leave a certain surplus, they carry on extensive cattle and horse breeding, vine culture in Caucasia, fishing on the Don, the Ural, and the Caspian, hunting, bee- culture, &c. The extraction of , coal, gold, and other minerals which are found on their territories is mostly rented to strangers, who also own most factories.

The numerical forces and the territories of each Voisko, as also their war-footing, in 1894 (only slightly increased since) were as follows : —

Voiflko.

Territory- Acres.

Cossack Popula- tion.

War-rooUng.

Amur, 1858 .

0. 2,760,000

19,700

6 squadrons, 3 com- panies infantry (33 off., 1629 men, 1070 horses).

Astrakhan

2,080,000

26,627

18 squadrons 1(48 off., 2167 men, 2322

horses).

Don .

29,696,000

966,869

854 sq., 28 batt., 16 detachments (1627 off., 64,069 men, 65,793 horses, 140 guns).

Kuban

18,000,000

702,482

186 sq., 14 batt., 7 inf. detachm., 1 compy. militia (47,617 men, 37,895 horses, 80 guns).

Orenburg, 1TB6

28,000,000

850,614

110 sq., 7 batt., 3 Inf. det. (429 off., 20,639 men, 22,717 horses, 40 guns).

Semiryechensk, 1867

•>. 1,500,000

25,869

12 sq. (45 off., 1965' men, 2106 horses).

Siberian, xvii. o.

c. 15,000,000

118,546

54 sq. (189 off., 8901

(narrow strip from Orenburg to Irtysh

men, 9477 horses).

and Bukbtarma ;

also in Kirghiz

Steppe)

Terek

8,400,000

162,156

70 sq., 2 inf. det., 2 batt. (342 off., 12,372 men, 13,548 horses, 12 guns).

Transbaikalia, 1822,

0. 8,150,000

181,474

18sq.,80compy.,8batt.

1851

(231 off., 9319 men, 4050 horses, 12 guns).

Ural ....

110,986

88 sq., 2 inf. det. (198 off, 8724 men, 9229 horses).

5 sq. (12 off., 588 men,

Usuri, 1858

Undetermined

7,040

Total, . . .

624 horses).

Over 120,000,000

2,666,818

816 sq., 70 inf. coy. and

inf. det., 49 batt.

(8157 off., 177,885

men, 236 guns).

256

COST A — C 0 S T A E I C A

A military organization similar to that of the Cossacks has lately been introduced into certain districts, which supply a number of mounted infantry sotnias. Their peace-footing is as follows : — Daghestan, 6 regular squadrons and 3 of militia ; Kuban Circas- sians, 1 sotnia ; Terek, 8 sotnias ; Kars, 3 sotnias ; Batum, 2 infan- try and 1 mounted sotnia; Turkomanes, 3 sotnias; total, 25 squadrons and 2 companies. (p. a. k.)

Costa, Sir Michael (properly iVIichele) (1810- 1884), musical conductor and composer, son of Cav. Pasquale Costa, a Spaniard, was born at Naples, on 4th February 1810. He early became a free scholar of the Eoyal Music School at Naples, and at sixteen he wrote his first opera, II

Delttto punito, at seventeen H Sospetto funesto, a mass, and an oratorio. In 1828-29 he further composed II Carcere d'Hdegonda and Mcdvina for the Teatro Nuovo and San Carlo, and in this latter year he visited Birmingham to conduct Zingarelli's " Cantata Sapra," a setting of some verses from the book of Isaiah. Instead, however, of conducting, he sang the tenor part. From that time he settled in England, and became naturalized, receiving the honour of knighthood in 1869. He conducted the opera at Her Majesty's from 1832 till 1846, when he seceded to the Italian Opera at Covent Garden ; he was conductor of the Philharmonic Society from 1846 to 1854, of the Sacred Harmonic Society from 1848, and of the Birmingham Festival from 1849. In 1855 Costa wrote Eli, and in 1864 Naaman, both for Birmingham. Meanwhile he had conducted the Bradford (1853) and Handel Festivals (1857-1880), and the Leeds Festivals from 1874 to 1880. On 28th April 1884, he died at Brighton. Costa's compositions have passed into oblivion, with the exception of the least admirable of them — his arrangement of the National Anthem. He was a man of restricted musical and human sympathies (witness his animosity against Sterndale Bennett) ; but he was a great conductor within well-defined limits.

(e. h. L.)

Costa Rica, a country of Central America, lying between 8° and 11° 16′ N. lat. and 80° 35′ and 85° 40′ W. long. The boundary dispute with Nicaragua, alluded to in the 9th edition article, was referred to the arbitration of the President of the United States, who, by his award in 1888, gave the whole of Lake Nicaragua and the upper waters of the San Juan river to Nicaragua, and the lower San Juan, down to the Atlantic and the Bay of Salinas, on the Pacific, to Costa Eica. Disputes respecting the demarcation of this boundary have been settled under treaty of 1896, and the delimitation is now nearly com- plete. The line of frontier towards Colombia was re- ferred for arbitration to the President of the French Republic, who gave his award on 16th September 1900. The boundary begins at Cape Mona on the Atlantic, and, generally following lines of watershed, touches the Pacific at Burica Point (see Colombia).

The climate of Costa Rica is tempered By the proximity of the country to two great oceans, the average tempera- ture at San Jose being about 68° F. The hottest' months are usually May and June, and the coldest usually Janu- ary, but, according to observations extending over the year 1896 at San Jos^, the maximum of 90° F. was reached in March, and the minimum of 50° F. in Feb- ruary. The rainfall at San Jose from May to November averages about 12 inches a month, and during the year from 70 to 80 inches. Port Limon is said to have an annual rainfall of 89 inches, and Colon 120 inches.

Area and Population. — According to the most recent official estimate, Costa Rica has an area of 23,000 square miles ; but, ac- cording to planimetric calculations at Gotha, the area is 20,900 square nules. The population in 1892, according to the census, numbered 243,205, of whom 122,480 were male and 120,725 female. Allowance being made for probable omissions, the total number of

inhabitants was 262,700, or about 11 to the square mile. The population in 1899 was estimated at 310,000. The census popula- tion in 1892 was distributed over the five provinces and two comarcas (or territories) as follows : — San Jos6, 76,718 ; Alajuela, 57,203 ; Cartago, 37,973 ; Heredia, 31,611 ; Guanacaste, 20,049 ; Puntarenas (comarca), 12,167 ; Limon (comarca), 7484. The pre- dominant element in the population consists of whites, many of them of pure blood, descended from Galician Spaniards. They live mostly in the capital and other towns in the highlands, and in the commercial ports. The coast regions are occupied by negroes and a mixed population, while in the interior there are uncivilized Indians, estimated at about 3500, living by themselves. The for- eign poptilation at the date of the census numbered 6289, of whom 831 were Spanish, 622 Italian, 342 German, 246 British, and 204 from the United States. There were also 634 British subjects (coloured) from the West Indies. The total births recorded in

1897 numbered 13,012 ; deaths, 9925 ; marriages, 1763. The prin- cipal towns are San Jos6, the capital of the Republic, with about 25,000 inhabitants, and the provincial capitals of like names with the provinces. Limon, the principal! port, has about 4000 inhabitants.

Constitution. — According to the Constitution, which received its most recent modification in 1882, the legislative power resides in a Congress of one house, consisting of deputies (1 for every 8000 of population) , chosen for four years, half the number retiring every two years. They are chosen in electoral assemblies returned by the votes of all citizens who are able to support themselves. The President is similarly elected, and holds office for four years. For the administration of justice there are a Supreme Court and subordinate tribunals.

Beligion and Education. — In 1892 the Protestants numbered 2245. The Jesuits were expelled in 1884. Elementary education is compulsory, and is provided at the cost of the Government. In

1898 there were 383 primary schools with 917 teachers and 23,134 enrolled pupils. Higher education is given in a liceo with 206 students, a college for ladies with 228 students, and three other institutions. There are also schools of medicine and of law. The Government encourages higher education by maintaining ten Costa Rican youths at European universities, and steps are being taken towards the formation of a National University. The expenditure of Government on public instruction in the year 1899-1900 amounted to 679,843 pesos (£54,387).

Defence. — All citizens from 18 to 50 years of age are liable to military service. Those under 40 are comprised in the ” active ser- vice,” the remainder in the ” reserve. ‘ ‘ The national guard consists of all citizens outside of these age limits, but capable of bearing arms. On war footing, the military force would exceed 34,000 men. The Republic has a gunboat and a torpedo boat.

Finance. — Of the revenue of Costa Rica about 47 per cent, is derived from customs, 25 per cent, from spirit monopoly, 8 per cent, from the tobacco tax, and smaller proportions from stamps, the post office, railways, and other sources. The most important spending departments are those of Internal Development, Instruc- tion, and Government. Outside of these, large amounts are devoted to the national debt. The revenue and expenditure for six years ending March 31 (at 12J pesos=£l) were : —

Tears.

Eevenno.

Expenditure.

Years.

BeTenne.

Expenditure.

1895

1896 1897

£489,910

502,320 594,850

£489,720

495,030 635,790

1898 1899 1900

£673,930

673,060 658,010

£665,080

644,850 696,600

The external debt, according to arrangements made in 1886 and 1897, consists of a New Consolidated Debt of £2,000,000, at 2J and 3 per cent. ; but there are now, in addition, arrears of interest amounting to £85,000. The service of this debt costs about £58,200 annually. The internal debt amounts to about 1,116,800 pesos, or about £89,340, and costs 252,127 pesos, or £20,170 annually.

Production and Industry. — ^The principal industries are agricul- tural. To a large extent the soil is owned and occupied by small landowners, industrious and peaceable, who form the backbone of the population. In the interior cofiee-growing is prosperous, the produce being of excellent quality and commanding a high price in the market. The annual yield has increased from 20,246,000 lb in 1883 to 25,172,400 lb in 1893, 30,040,900 lb in 1897, 42,869,500 lb in 1898, 33,806,680 lb in 1899. Next to coffee the most important culture is that of bananas, which are grown on the Atlantic coast region, the crop in 1898 amounting to 2,962,770 bunches, and in 1899 to 3,594,700. Sugar, tobacco (formerly a Govern- ment monopoly), rice, beans, potatoes, and other crops are grown for local consumption, and there are some cocoa plantations. In the forests the natural timber and dye-woods are cut, and rubber

13 collected for exportation. The working of the gold and silver mines has been largely discontinued. The minor industries within the Republic comprise a foundry and national workshop, at San Jos6, where machinery, farming implements, tools, &c. , are manu- factured, and a silk and cotton factory, and a few other establish- ments. The live-stock in

1892 consisted of 346,665 cattle, 77,043 horses, 2765 sheep, and 62,328 swine.

Commerce. — The imports into Costa Rica are mainly textiles, provisions, iron goods, and live animals ; while coffee, bananas, wood, hides, and (recently) rubber are exported. The following have been the values of the imports and exports (the gold peso being taken at 4s.) : —

Tears.

Imports.

Exports.

1896 .

1897 .

1898 .

1899 .

£950,000

1,092,000

906,000

827,000

£1,120,000

1,095,000

1,182,000

986,000

In 1899 the coffee exports amounted to the value of £598,000 ; .bananas, £236,000; timber and dye-woods, £68,000; hides, £21,000 ; rubber, £21,000. Of the imports in the same year, ■54 per cent, in value were from the United States, 20 per cent, from Great Britain, 15 per cent, from Germany ; of the exports of coffee, 55 per cent, went to Great Britain, 26 per cent, to the United States, and 15 per cent, to Germany. All the banana exports were to the United States.

Shipping and CommunicatiQns. — The trade of the Republic passes through the ports of Limon on the Atlantic, and Puntarenas on the Pacific. Limon is visited monthly by 26 steamers, providing communication with Europe, the United States, and the West Indies, while from 8 to 10 steamers plying on the Pacific coast call monthly at Puntarenas. In 1898, 449 vessels entered the two ports. In some districts within the Republic there are fairly good cart roads maintained by the Government, which in the year 1896-97 spent more than £15,500 on roads and bridges. The railway from Limon to San Jos6 and Alajuela, belonging partly to the Government but mainly to an English company, has, with its branches, a length of 138 miles, and carried in 1898, 601,198 pas- sengers and 160,000 tons of goods. The Pacific railway from San Jos6 to Tivives, which is being constructed for the Government, is completed to the length of 12 miles and partially constructed for 40 miles, 19 miles being not yet begun. Within the Republic there are 83 post offices, through which, in 1898, 4,226,000 pieces of mail passed. The telegraph line in 1897 had a length of 917 miles, and was served by 43 telegraph offices. About 203 miles of tele- phone wire connect San Sos6 with other localities. The nearest telegraph cable station is at San Juan del Sur, on the Pacific in Nicaragua.

Money and Credit. — Within the Republic there are 2 important banks, the Anglo-Costa Rioan Bank and the Bank of Costa Rica, with capital of 1,200,000 and 2,000,000 pesos respectively. On April 25, 1900, a new law was enacted for the regulation of the constitution, capital, note emission, and metallic reserves of banks. On October 24, 1896, an Act was passed for the adoption of a gold coinage, and the execution of this Act was decreed on April 17, 1900. The monetary unit is the gold colon weighing -778 grammes, •900 fine, and thus worth about 23d. It will be legally

equivalent to the silver peso, which will continue in circulation. The metallic currency, as stated in the President's message, consists of 5,000,000 ^old colons and 1,000,000 in silver money, while the circulating notes of the Bank of Costa Rica, exchangeable for gold, amount to ■3,000,000 colons. The gold coins of the United States, Great Britain, France, and Germany are legally current.

The metric system of weights and measures was introduced by law in 1884, but the old Spanish system is still in use.

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Cote-d'Or, a department in the east of France, traversed by the hills of Cote-d'Or, and divided between the basins of the Seine and of the Sa6ne.

Area, 3392 square miles. The population, 381,574 in 1886, numbered only 361,626 in 1901. Births in 1899, 6362, of which 524 were illegitimate ;

deaths, 7279 ; marriages, 2389. Dijon, the capital, had, in 1896, 67,000 inhabitants. In 1896 the schools num- bered 1170, with 52,000 pupils, and 1 per cent, of the population was illiterate. Agriculture forms the principal wealth of C6te-d‘0r. The area under cultivation in 1896 comprised 2,001,625 acres, 1,057,628 acres of which were plough-land and 59,306 acres vine- yards. The wheat produce in 1898 amounted to the value of £1,847,000; rye, £86,520; barley, £197,920; oats, £700,300. Potatoes returned a value of £446,795, and mangold – wurzel £173,500. The grass lands of all kinds, including the lands grow- ing trefoil, lucern, and sainfoin, yielded the value of £809,000, while the produce of beetroot amounted to the value of £38,500. The vineyards returned a value in 1898 of £1,385,200. The live- stock in 1899 included 47,200 horses, 157,420 cattle, 288,480 sheep, and 63,810 pigs. The department mines a small quantity of coal, and much limestone and marble. The metallurgy registered, in 1898, 4800 metric tons of iron and 11,300 tons of steel, which, with the other industries, amounted to the value of £137,000. The distillation of alcohol in 1898 amounted to 352,000 gallons.

Cote -du-Nord,a department in the west of Prance, bordering on the English Channel.

Area, 2787 square miles, with 48 cantons and 390 communes. The population decreased from 628,256 in 1886 to 609,349 in 1901. Births in 1899, 16,780, of which 642 were illegitimate; deaths, 13,571 ; marriages, 4527. There were, in 1896, 982 schools, with 96,000 pupils. The illiterate, who are strongly represented in this department, amounted to between 9 and 10 per cent. St Brieuo, the capital, had in 1896 a population of 21,000 ; the sub-prefectures are Dinan, Guingamp, Lannion, and Loud^ac. The total area under cultivation in 1896 comprised 1,386,311 acres, of which 1,109,542 acres were plough-land. The vine has no place in the statistical returns. The wheat crop yielded in 1899 the value of £1,183,000; rye, £211,000; barley, £183,000; buckwheat, £315,400 ; oats, £713,800. The potato crop of 1899 was of the value of £613,000, and the natural pastures gave a return of £908,000. C6te-du-Nord produced fiax to the value, including both harl and seed, of £73,000, thus taking the first rank in 1899 among the departments of France in the culture of flax. Cider-apples in 1899 produced 206,120 cwts. of the value of £50,000. The live-

stock comprised 92,800 horses, 317,000 cattle, 76,300 sheep, and 148,300 pigs. The department is famed for its horses. The value of milk products, in 1899, was £2,040,000. The mining industry produced, in 1898, 613 metric tons of iron, and the working in metals 8700, of the value of a little less than £30,000.

Cotrone, a fortified town and seaport and bishop's see of Calabria, Italy' (province Catanzaro), on the east coast, 148 miles north-east from Eeggio by rail. There is a small but good harbour, protected by two moles, with a coasting trade (360 vessels of 74,319 tons cleared in 1897) in wine, olive oil, fruits, and liquorice. Population

(1881), 7689 ; (1900), 9610.

Cottbus, or KoTTBUS, a town of Prussia, on the Spree, 72 miles south-south-east of Berlin by rail. It has four Protestant churches, a Catholic church, and a synagogue, a gymnasium, a higher grade, a technical, and other special schools. Population (1890), 34,900; (1900), 39,327.

Cotton Printing. — Recent progress in cotton printing has been mainly in the direction of expedition. This applies to printed cretonne, chintz, velvet, linen, or whatever the fabric which has in turn come into fashion. To a great extent machine printing has taken the place of hand work ; the readier process of " steaming," as it is called, has been adopted in place of first printing in mordants and then dyeing; and the natural vegetable dyes have been superseded by artificial products of the

laboratory, rrom the point of view of commerce this is all to the good. From the artistic standpoint it is not so. It led, indeed, to a condition of things which went far to justify the contention that all this "im-provement" amounted in effect to the degradation of handicraft to the level of trade. When it was boasted by the manufacturer that a machine

printed with more pre- cision than a hand block, the artist pointed out that the result was mechanical ; when it was claimed that the ” steaming ” process was cheap, it was answered that it was proportionately nasty ; when it was urged that aniline gave brighter colours than vegetable dyes, it was com- plained that they were crude. And there was truth in these retorts : the precision of machine printing is not altogether an artistic gain ; the rough and ready process of mixing dye and mordant into one printing paste, and allowing them, as it were, to fight it out between them in the steam-box, does not result in the purest of prints ; and the possibility of getting out of coal-tar unmitigated shades of colour led to the shocking abuse of garish greens, j)urples, &c. Moreover, the method (at first adopted) of attaching the pigments to the cloth by means of albumen did not make them fast ; and, in fading, they did not simply mellow or sadden like the fugitive tints of old tapestry, but grew sickly, and passed through vari- ous unwholesome shades of difference to decay. AU this naturally aroused artistic animosity, and there was some- thing like a crusade against artificial dyestuffs. William Morris, who was at the head of this movement, went further than mere protest against the new methods, and himself set to work at printing according to the old, and more or less obsolete, practice ; and his cottons found ready acceptance at the hands of artists and others better qualified to admire the beauty and originality of his de- sign than to form any just opinion as to the relative value of the method of dyeing it pleased him to adopt. They took it too readily for granted that all pleasant colour was produced from vegetable dyes, and that all artificial dyes, therefore, were ugly.

The truth is that the ancient art of dyeing with vege- table stains had in the course of ages been perfected. The more fugitive and otherwise untrustworthy sub- stances had been found out, the really serviceable had been tested, and a dyer knew what he had to depend upon, and for what he could depend upon it. On the other hand, when new dyestuffs came every day to be produced in the laboratory, all use of them was experi- mental; and it is only after many failures that sat- isfactory results begin to be achieved. The failures in aniline dyeing were obvious. Arsenite of alumina proved a more efficient fixative than albumen, but was open to the objection of the poisonous nature of arsenic — an ob- jection not applicable to tannic acid, which is now mixed with the colour, and when

treated (after steaming) with tartrate of antimony forms a quite insoluble dye. With the introduction of alizarine and of what is known as the " direct " series of colours (which have such affinity with cotton as to require no mordant), printing in artificial dyestuffs entered upon a stage of success already marked enough to show that the falling back upon old-world methods was a counsel of despair, not warranted by the actual condition of things. An artist's sympathy with his material leads him, rightly, to work on the lines determined by it; and the palette offered by vegetable dyes is in a sense sufficient for him ; but dye printing is not simply an art: it is an industry, supported by folks who neither know nor care about the limitations of vegetable tinctures ; and, now that chemistry comes with its promise of so much wider scope in colour, it would show little enterprise on the part of the printer were he content to accept limitations no longer bind-

ing on him. As a matter of fact, the ideal of a range of colours, practically unlimited, all from one base, all to be printed at one operation, all to be de- veloped and fixed by one process, seems on the way to no very distant realization. The last word of science is to the effect that alizarine colours are more perma- nent than vegetable dyes. At the very end of the 19th century these have produced artificially an indigo prac- tically indistinguishable from the natural product. It does not, however, appear that modern methods can ever do quite what was done by the old. By the lei- surely process of block-printing, in vegetable dyes, the printer gets a purity of delicate tint not as yet ap- proached by rapid roller-printing in artificial dyestuffs — and there are obvious reasons, mechanical and chemi- cal, why this should be so. To get the old effects it is necessary (and perhaps always will be) to adopt the old methods. But these effects are not the only ones that are beautiful. And, though they are proper to the old way of printing, there are other effects, beautiful also, quite as proper to the new. It is these which the astute printer seeks, knowing that so long as he aims at what has been done, and better done than his means allow, he puts him- self at a disadvantage. The artistic development of cot- ton printing on the scale of a great industry must depend upon a full appreciation of what new and scientific methods can and cannot do, and upon the production of designs not only conceived in the spirit of art but schemed with the practical purpose of making much of the capac- ities of

the industry under the conditions, commercial and other, which it is bound to obey. Probably the most considerable development of dye-printing in recent years has been in the extended use of "discharge" — dyeing rich grounds, discharging the pattern, and printing it in colours — all but impossible to the printer except in col- laboration with the designer. Considerable improvement in the design of cotton prints has followed upon the revived interest in applied art characteristic of the latter part of the 19th century; even up-to-date extravagance may pass for evidence of vitality; but the aim is more often mere novelty than beauty. Moreover, too great a readiness on the part of the printer to meet demands made in ignorance of the conditions governing good work has led of late years to a departure from the ways of technique, which are indeed also the ways of art in so far as art is possible in cotton printing. (l. f. d.)

Cotton, and Cotton-seed. See Agbictxlttjre (United States).

Couillet, a town of Belgium, in the province of Hainaut, 24 miles south-south-east of Mons, with a sta- tion on the railway between Charleroi and Namur. It has forges and furnaces and important ironworks. Pop- ulation (1880), 7142; (1897), 9339.

Council Bluffs, capital of Pottawattamie county, Iowa, U.S.A., situated in 41° 16′ N. lat. and 95° 61′ W. long., in the western part of the state, in the bottom land at the foot of the bluffs, on the east side of Missouri river, at an altitude of nearly 1000 feet. It is the second largest and most important city of western Iowa, and a railway centre of the first importance, being the converging- point of five great systems from the east. These are the Chicago, Burlington, and Quincy, the Chicago, Milwaukee, and St Paul, the Chicago, Rock Island, and Pacific, the Illinois Central, and the Chicago and North- Western ; while the Union Pacific comes from the west. The point of junction of these lines is at Transfer Station, just outside the city, on the bank of the Missouri. It is connected with Omaha, on the opposite bank of the river, by two iron bridges and by steam and electric cars. It is a railway,

rather than a manufacturing, city. In 1890 its capital invested in manufactures was $1,292,283, and the value of its products was $2,527,388. Population (1880), 18,063; (1900), 25,802, including 240 negroes.

Coupon, a certificate entitling its owner to some payment, share, or other benefit ; more specifically, one of a series of interest certificates or dividend warrants attached to a bond running for a number of years. The word coupon (a piece cut off) possesses an etymological meaning so comprehensive that, while on the Stock Exchange it is only used to denote such an interest certificate or a cer- tificate of stock of a joint-stock company, it may be as suitably, and elsewhere is perhaps more frequently, applied to tickets sold by tourist agencies and others. The cou- pons by means of which the interest on a bond or de- benture is collected are generally printed at the side or foot of that document, to be cut off and presented for pay- ment at the bank or agency named on them as they be- come due. They pass by delivery, and are as a rule exempt from stamp duty. Coupons for the payment of dividends are also attached to the share warrants to bearer issued by some joint-stock companies. The coupons on the bonds of most of the principal foreign loans are pay- able in London in sterling as well as abroad, (s. n. h.)

Courbet, Custave (1819-1877), French painter, was born at Ornans (Doubs) on the 10th June 1819. He went to Paris in 1839, and worked at the studio of Steu- ben and Hesse ; but his independent spirit did not allow him to remain there long, as he preferred to work out his own way by the study of Spanish, Flemish, and French painters. His first works, an "Odalisque," suggested by Victor Hugo, and a "L^lia," illustrating George Sand, were literary subjects ; but these he soon abandoned for the study of real life. Among other works he painted his own portrait with his dog, ^nd " The Man with a Pipe," both of which were rejected by the jury of the Sialon ; but the younger school of critics, the neo-romantics and realists, loudly sang the praises of Courbet, who by 1849 began to be famous, producing such pictures as " After Dinner at Ornans " and " The Valley of the Loire." The Salon of 1850 found him triumphant with the

“Burial at Ornans,” the “Stone-Breakers,” and the “Peasants of Flazey.” His style still gained in indi- viduality, as in “Village Damsels” (1852), the “Wres- tlers,” “Bathers,” and ” AGirl Spinning” (1852). Though Courbet’s realistic work is not devoid of importance, it is as a landscape and sea painter that he will be most hon- oured by posterity. Sometimes, it must be owned, his real- ism is rather coarse and brutal, .but when he paints the forests of Franche-Comte, the « Stag-Fight,” “The Wave,” or the ” Haunt of the Does,” he is inimitable. When Cour- bet had made a name as an artist he grewambitious of other glory ; he tried to promote democratic and social science, and under the Empire he wrote essays and dissertations. His refusal of the Cross of the Legion of Honour, offered to him by Napoleon III., made him immensely popular, and in 1871 he was elected, under the Commune, to the Chamber. Thus it happened that he was responsible for the destruction of the VendSme column. A council of war, before which he was tried, condemned him to pay the cost of restoring the column, 300,000 francs (£1200). To es- cape the necessity of working to the end of his days at the orders of the State in order to pay this sum, Courbet went to Switzerland in 1873, and died at La Tour du Peilz, 31st December 1877, of a disease of the liver aggravated by intemperance. An exhibition of his works was held in 1882 at the i^cole des Beaux-Arts.

See/CHAMPFtBUKT. Les grandes figures d’hier et WmjourWhui. Paris 1861.— Mantz. ” G. ConiX^t” Gas. det Beaux-Arts. Paris,

1878. — Zola. Mes Haines. Paris, 1879. — C. Lemonniek. Les Peintres de la Vie. Paris, 1888. (h. fb.)

Courbevoie, a town in the arrondissement of St Denis, department of Seine, France, 5 miles west-north- west of Paris, on railway to Versailles. It is a residential suburb of Paris, and has a fine avenue opening on the Neuilly Bridge, and forming with it a continuation of the Champs Elys^es. It has manufactures of waggons and awnings. Port traflBc, 1899, amounted to 88,074 tons. Population (1881), 13,094; (1901), 25,330.

Courcelles, a town of Belgium, in the province of Hainaut, 21 miles east of Mons by rail. It has a coal- mining industry, and manufactures linen

and articles of iron. Population (1880), 11,190; (1890), 12,654 ; (1897),

14,494.

Courland, one of the Baltic provinces of Eussia, boutided by the Baltic on the W., the Gulf of Riga and the Western Diina (Livonia and Vitebsk) on the N.E., and Kovno on the S. The Mitau Plain divides it into two parts, of which the western is fertile and thickly inhabited^ excepting in the north, where there is another patch of low- lands, while the eastern is much less so. It is undulating elsewhere, and covered with spurs of the plateau of Lithuania, a hilly and picturesque tract of land which separates the Diina from the Aa, and is known as Upper Courland. Another range of heights stretches along the Windau. Neither exceeds 600 feet in altitude. The province consists mainly of Devonian rocks, besides Jurassic as far as Windau, both thickly covered with glacial deposits. Large parts are occupied by marshes, often clothed with forests, and there are sandy tracts and downs on the seashore. The marshes are drained, and the sands covered with plantations of trees. Nearly one- third of the surface is still forest, watered by nearly a hundred rivers, of which only the Diina, the Aa below Mitau, and the Windau are navigable. They all flow north-westwards and enter the Baltic Sea. The sea- coast is poor in harbours, and the only ports are Libau, Windau, and Polangen, there being non^ on the Courland coast of the Gulf of Eiga. Population (1897), 672,634 (345,756 women), of whom, according to Eittich, 8 per cent, only are Germans, the remainder being Letts (49 per cent.), Coures (30 per cent.), Jews (6 per cent.), Eussians (2 per cent.), Poles, Lithuanians, and Lives. Urban population, 148,134.

The land laws in the Baltic provinces being different from those of Russia, the land is mostly in private ownership, and 2,616,740 acres belong to 636 landlords, mostly nobles, two-fifths of whom own estates of more than 2700 acres each ; 2,366,800 acres are owned or held by the peasants ; and 1,364,660 acres belong to the Crown. In 1863 special laws were issued in order to enable the Letts to acquire the farms which they held, and special banks were founded. With their aid nearly 12,000 farms were bought by the peasants settled on landlords' estates, bat it is estimated that nearly 300,000 Letts remain landless, and are hired

labourers (^hnechts) on the farms and estates, occupying a very low position in the social scale. Agriculture reaches a high degree of perfection on the landlords' estates, and although the wet climate of Courland prevents droughts, artificial irrigation from artesian wells (about 200) is resorted to. 1,660,000 acres are arable land, of these 918,000 being under com crops, 351,000 under flax, 67,500 under potatoes ; and 2,078,000 under meadows and pasturages. CatUe-breeding is on a small scale, but excellent breeds of homed cattle, sheep, and swine are kept ; also 141,100 horses. The fac- tories numbered 315 in 1893, employing 6000 persons, and yield- ing returns of about £1,300,000, Libau and Mitau being the main industrial centres. There are also ironworks, agricultural machinery, tanneries, glass and soap works. Flax spinning is yet in the stage of a domestic industry. Navigation on the Diina and Aa is important for export, and still more the traffic on the railways which lead from Central Russia to Biga and Libau, the latter being one of the chief Russian ports. The Government is well provided with schools, and education is obligatory. The chief towns of the ten districts are:— Mitau

(Boblenskly district), capital of the Government (35,011 inh.) ; Bauske (6843); Friedrichstadt (6800) ; Goldingen (9733) ; Grobin (1489) ; Hasenpoth (3338) ; lUuxt (2340) ; Talsen (1485) ; Tuckum (7542) ; Windau (7132). (p. a. k.)

Courtney, Leonard Henry (1832-), English

politician and man of letters, eldest son of Mr T. S. Courtney, a banker at Penzance, was born at Penzance on 6th July 1832. At Cambridge he was Second Wrangler and First Smith's Prizeman, and was elected a Fellow of his College, St John's. He was called to the Bar at Lincoln's Inn in 1858, was Professor of Political Economy at University College from 1872 to 1875, and in December 1876, after a previous unsuc- cessful attempt, was elected to Parliament for Liskeard in the Liberal interest. He continued to represent the borough, and the district into which it was

merged by the Eeform Act of 1885, until 1900, when his difPerences with the majority of his constituents on the South African question — on which he was one of the foremost ■of the so-called ” Pro-Boer ” party — compelled his retire- ment. Until 1885 he was a devoted adherent of Mr ‘Gladstone, particularly in finance and foreign affairs. In 1880 he was Under Secretary of State for the Home Department, in 1881 for the Colonies, and in 1882 Secre- tary to the Treasury ; but Mr Courtney has always been a stubborn fighter for principle, and upon finding that the Government’s Eeform Bill in 1884 contained no recognition of the scheme for proportional representation, to which he was deeply committed, he resigned office. Mr Courtney manifested the same fidelity to his con- victions by refusing to support Mr Gladstone’s Home Rule BiU in 1885, and was one of those Liberal Unionists who chiefly contributed to its rejection, and whose reputa- tion for unbending integrity and intellectual eminence gave solidity to the section of Liberals who followed Lord Hartington. In 1886 Mr Courtney was elected Chairman of Committees in the House of Commons, and his efficiency in this arduous office seemed to many to mark him. out for the Speakership when a vacancy occurred in 1895. A Liberal Unionist, however, could only be elected by Con- servative votes, and he had made himseK objectionable to a large section of the party by his independent attitude on various questions, on which his Liberalism outweighed his party loyalty. He would in any case have been incapaci- tated by an affection of the eyesight, which for a while threatened to withdraw him. from public life altogether. After 1895 Mr Courtney’s divergences from the Unionist party on questions other than Irish politics became gradu- ally more marked. He became known in the House of Commons principally for his candid criticism of the meas- ures introduced by his nominal leaders, and he was rather to be ranked among the Opposition than as a Minis- terialist ; and when the crisis with the Transvaal came in 1899, Mr Courtney’s views, which remained substantially what they were when he supported the settlement after Majuba in 1881, had plainly become incompatible with his position even as a nominal follower of Lord Salisbury and Mr Chamberlain. Besides numerous essays in the principal reviews, Mr Courtney was the author of the article on ” Banking ” in the 9th edition of the Encydo- pcedia Britannicm, and of the survey of recent British

finance in Mr T. H. Ward's Beign of Queen Victoria (1887). In his earlier years he was a regular contributor to The Times.

Courtrai, a town of Belgium, in the province of West Flanders, 27 miles south of Bruges by rail. The foremost industry of the town is the manufacture of linen, but the trade in oil is increasing in importance. Flax is extensively grown in the district. All the large Ulster spinners send delegates to Courtrai, to visit the farmers

and attend the marts where raw flax is to be bought in its various qualities, in order to ship it off to their mills under the most advantageous conditions. Population

(1880), 26,943; (1890), 30,383 ; (1897), 32,949.

Cousins, Samuel (1801-1887), English mezzo- tint engraver, was born at Exeter on 9th May 1801. He was pre-eminently the interpreter of Sir Thomas Lawrence, his contemporary. During his apprentice- ship to S. W. Reynolds he engraved many of the best amongst the three hundred little mezzotints illustrating the works of Sir Joshua Reynolds which his master issued in his own name. In the finest of his numerous transcripts of Lawrence, such as " Lady Acland and her Sons," "Pope Pius VII.," and "Master Lambton," the distinguishing characteristics of the engraver's work, the brilliancy and force of effect in a high key, corresponded exactly with similar qualities in the painter. After the introduction of steel for engraving purposes in 1823, Cousins and his contemporaries were compelled to work on it, because the soft copper previously used for mezzo- tint plates did not yield a sufficient number of fine impressions to enable the method to compete commercially against line engraving, from which much larger editions were obtainable. The painter-like quality which dis- tinguished the 18th century mezzotints on copper was wanting in his later works, because the hardness of the steel on which they were engraved impaired freedom of execution and richness of tone, and so enhanced the labour of scraping that he accelerated the work by stipple, etching the details instead of scraping them out of the " ground " in the manner of his predecessors. To this "mixed style," previously used by Richard Earlom jon copper, Cousins added heavy roulette and rocking-tool textures, tending to fortify the darks, when he

found that the “burr” even on steel failed to yield enough fine impressions to meet the demand. The effect of his prints in this method after Reynolds and Millais was mechanical and out of harmony with the picturesque technique of these painters, but the phenomenal popularity which Cousins gained for his works at least kept alive and in favour a form of mezzotint engraving during a critical phase of its history. Raimbach, the line engraver, dated the decline of his own art in England from the appearance in 1837 of Cousins’s print (in the “mixed style “) after Landseer’s ” Bolton Abbey.” Such plates as “Miss Peel” after Lawrence (published in 1832); ” A Midsummer Night’s Dream,” after Landseer (1857) ; “The Order of Release” and “The First Minuet,” after Millais (1854 and 1865); “The Strawberry Girl” and ” Lavinia, Countess Spencer,” after Reynolds ; and ” Miss Rich,” after Hogarth (1873-1877), represent various stages of Cousins’s mixed method. It reached its final development in the plates after Millais’s ” Cherry Ripe ” and “Pomona,” published in 1881 and 1882, when the invention of coating copper-plates with a film of steel to make them yield larger editions led to the revival of pure mezzotint on copper, which has since rendered obsolete the steel plate and the mixed style which it fostered. The fine draughtsmanship of Cousins was as apparent in his prints as in his original lead-pencil portraits exhibited in London in 1882. In 1855 he was elected a full member of the Royal Academy, to which institution he later gave in trust £16,000 to provide annuities for superannuated artists who had not been so successful as himself. One of the most important figures in the history of British engraving, he died in London, unmarried, on 7th May 1887.

See George Pycroft, M.R.C.S.E. Memoir of Samuel Cousins, B.A., Member of the Legion of Honour. Published for private circulation by E. E. Leggatt, London, 1899. — Algebnon Geaves.

Catalogue of the Works of Samuel Cousins, B.A. Published by H. Graves and Co., London, 1888. (g. p. e.)

Couza, Alexander John (1820-1873), Pbince OF Rumania, was born 20th March 1820 at Husch, and was educated in Paris, Pavia, and Bologna. He entered the diplomatic service of his country, and became Stadt- holder of Galatz, and head of a department in the Minis- try of the Interior. By his marriage with a daughter of the Boyar Rosetti he became allied to the higher nobility of the country, and in 1848 he joined the patriotic party. On the entry of the Russians he was imprisoned, but managed to escape on an Austrian steamer to Vienna. After their departure he entered the army, and again rose with great rapidity. Elected in 1868 to the Assembly of Moldavia, he became in the same year Minister of War of the united principalities. In the debates upon the Constitution he was chief speaker on the Unionist side, and in 1859 he assumed the government under the title of Prince Alexander John I. He was not recognized by the Porte until 23rd December 1861, on which day the union of the two principalities under the name of Rumania was proclaimed. The Prince made every effort to secure unity and relieve taxation. He suppressed the corvie, introduced the Code Napoleon, and caused the adoption of a system of free education and the foundation of the uni- versities of Jassy and Bucarest. His zeal for reforms and for absolute centralization led to incessant conflict and discontent ; financial distress supervened ; a military conspiracy forced him to abdicate on 23rd February 1866, and led to the election of Prince Carol I. After his abdi- cation. Prince Alexander John spent the remainder of his life chiefly in Paris, Vienna, and Wiesbaden. He died at Heidelberg on 15th May 1873. (g. f. b.)

Coventry, a municipal, county, and parliamentary borough of Warwickshire, England, on the Sherbourne, an affluent of the Avon, 94 miles by rail north-north-west of London. A canal communicates with the Trent and Mersey and Birmingham Canal. The derivation of the name from a convent of 1043 seems no longer tenable. A county of itself till 1843, the city in 1888 became a county borough. The corporation consists of a mayor, 10 aldermen, 30 councillors, a treasurer, town clerk, and other officers. In 1885 the parliamentary representation was reduced to one. In 1894 a suffragan bishop, under the See of Worcester, was appointed with the title of bishop of Coventry. Among recent erections are a Bap- tist, a Congregational, a Primitive Methodist, and a Catholic

chapel. A statue (1883) of Sir Thomas White, Lord Mayor of London 1532-33, founder of St John's College, &c., an opera house, and baths. The cemetery, planned by Sir Joseph Paxton, was extended in 1887. The present buildings of the Eree Grammar School were opened in 1885. A technical school (1887) was enlarged in 1894. Besides Swanswell (1883) and Spencer Park (1883), there is a recreation ground (1880) of twelve acres. A daily paper is issued. Area of municipal bor- ough, 3093 acres. Population (1881), 44,831; (1891),

62,724; (1901), 69,877.

Coventry, a town of Kent county, Rhode Island, U.S.A., with an area of 17 square miles of hill country, interspersed with ponds. It contains a few small villages, but the population is mainly rural. It is traversed by the New England railway. Population (1900), 5279.

Coviiha, a town of Portugal, district Castello Branco, on the east versant of the Serra da Estrella, near the river Zezere, 30 miles north from Castello Branco. Some 4O0O operatives are employed in manufacturing cloth. Population (1900), 15,527.

Covington, a city of Kenton county, Kentucky, U.S.A. It is situated in 39° 05′ N. lat. and 84° 36′ W. long., on the south bank of the Ohio river, opposite Cincinnati, with which it is connected by three bridges and by ferries. Two railways, the Chesapeake and Ohio and the Louisville and Nashville, pass through it. In 1890 the capital invested in manufactures was $6,900,000, the number of hands employed was 7600, and the output was valued at $16,000,000. In 1899 the assessed valua- tion of all property, real and personal, was $21,468,444, the tax rate $30.26 per $1000, and the net debt $2,195,544. To its proximity to Cincinnati, of which it is practically a suburb, it owes its rapid growth. Population (1880), 29,720; (1890), 37,371; (1900), 42,938, including 2487 negroes. The death-rate in 1900 was 20-2.

Cowasjee Jehanghier Readymoney, Sib

(1812-1878), "the Peabody of Bombay." Early in the 18tli century three Parsee brothers moved from Nowsaree, near Surat, in Gujarat, to

Bombay, and became the pioneers of a lucrative trade with China. They gained the sobriquet of ” Readymoney,” which they adopted as a surname. Only Heerjee Jewanjee Readymoney left issue, two daughters, the elder of whom married a Ban- ajee, and the younger a Dady Sett. The son of the former, Jehanghier Heerjee, married Meerbae, the daugh- ter of the latter, and was made the heir not only of his grandfather but of his two grand-uncles. The younger of their two sons was Cowasjee Jehanghier. His only English education was at the then well-known school kept by Serjeant Sykes in the Fort of Bombay. At the age of 15 he entered the firm of Duncan, Gibb, & Co. as ” godown keeper,” or warehouse clerk. In 1837 he was promoted to the highly responsible and lucrative appoint- ment of ” guarantee broker ” to two of the leading Euro- pean firms of Bombay. In 1846 he was able to begin trading on his own account. He was made a J.P. for the town and island of Bombay, and a member of the Board of Conservancy; and in 1866 was appointed a Commissioner of Income Tax, his tactful management being largely responsible for the fact that this tax, then new to Bombay and most unpopular, was levied with unexpected financial success. He was made C.S.I, in 1871 ; and in 1872 he was created a Knight Bachelor of the United Kingdom, and his statue, by T. Woolner, R.A., was erected in the town-hall. His donations to the institutions of Bombay amounted to close on £200,000. His health broke down in 1871, and he died in 1878, being succeeded by his son. Sir J. Cowasjee Jehanghier [Readymoney], who was himself created a Knight Bachelor in 1895. (m. m. bh.)

Cowdenbeath, a mining town and police burgh of Eifeshire, Scotland, situated near the Cowdenbeath sta- tion of the North British railway, 5 miles east-north-east of Dunfermline. The town is mainly occupied by miners. It possesses a public hall. The Police Act was adopted in 1890. Population (1891), 4249; (1901), 7466.

Cowen, Frederic Hymen (1852), English

musical composer, was born at Kingston, Jamaica, on 29th January 1852. At four years old he was brought to England, where his father became treasurer to the opera at Her Majesty’s Theatre, and private secretary to the earl of Dudley. His first teacher was Henry Russell, and his first

published composition appeared when he was but six years old. He studied the piano with Benedict, and com- position with Goss; in 1865 he was at Leipzig under Hauptmann, Moscheles, Reinecke, and Plaidy. Returning home on the outbreak of the Austro-Prussian War, he appeared as a composer for the orchestra in an overture played at the Promenade Concerts at Covent Garden in

September 1866. In the following autumn he went to Berlin, where he was under Kiel, at Stern's conservato- rium. A symphony and a piano concerto were given in St James's Hall in 1869, and from that time Cowen has been recognized as primarily a composer, his talents as a pianist being subordinate, although his public appearances were numerous for some time afterwards. His cantata, The Rose Maiden, was given in London in 1870, his second symphony by the Liverpool Philharmonic Society in 1872, and his first festival work. The Corsair, in 1876 at Birming- ham. In that year his opera, Pauline, was given by the Carl Bosa Company with moderate success. In 1884 he conducted five concerts of the Philharmonic Society, and in 1888, on the resignation of Sullivan, became the regu- lar conductor of the society, resigning the post in 1892. In the year of his appointment, 1888, he went to Mel- bourne as the conductor of the daily concerts given in connexion with the Exhibition there. In 1896 Cowen was appointed conductor of the Liverpool Philharmonic Society and of the Manchester orchestra, in succession to Sir Charles Halle. In 1899 he was reappointed conductor of the Philharmonic Society. His works include: — Operettas : Garibaldi (1860) and One Too Many (1874) ; operas : Pauline (1876), Tliorgrim (1890), Signa (Milan, 1893), and Harold (1895) ; oratorios : Tlie Deluge (1878), St Ursula (1881), Ruth (1887), Song of TJianksgiving (1888), The Transfiguration (1895) ; cantatas :' The Rose Maiden (1870), The Corsair (1876), The Sleeping Beauty (1885), St John's Eve (1889), Tlie Water Lily (1893), Ode to the Passions (1898), besides a large number of short cantatas for female voices ; an enormous number of songs, ranging from the popular "ballad" to really artistic lyrics, anthems, part-songs,

duets, &c. ; six sym- phonies among which No. 3, the " Scandinavian," has had the greatest success ; four overtures ; suites. The Lan- guage of Flowers (1880), In the Olden Times (1883), In Fairyland (1896) ; four English dances (1896) ; a con- certo for piano and orchestra, and a fantasia for the same played by M. Paderewski (1900) ; a quartet in C minor, and a trio in A minor, both early works ; pianoforte pieces, &c. Cowen is never so happy as when treating of fantastic or fairy subjects ; and whether in his cantatas for female voices, his charming Sleeping Beauty, his Water Lily, or his pretty overture, The Butterfly's Ball (1901), he succeeds wonderfully in finding graceful expression for the poetical idea. His dance music, such as is to be found in various orchestral suites, is refined, original, and admirably instrumented ; and if he is seldom as successful in portraying the graver aspects of emotion, the vogue of his semi-sacred songs is a thing that caniiot be ignored. That none of his operas has been permanently successful is a mischance which they share with most of the serious dramatic music of Great Britain ; but even in more favourable conditions their lack of the great qualities, of the sincere emotion that comes from the heart and goes to the heart, would seriously impede their popular- ity. Charmingly melodious as he always is in his lighter moods, Cowen often contents himself with musi- cal ideas that are less than beautiful in writing for the stage.

Cowen, Joseph (1831-1900), Eng:lish politician, son of Sir 'Joseph Cowen, a prominent citizen and mine- owner of Newcastle-on-Tyne, was born in 1831, and was educated at Edinburgh University. In 1874 he was elected member of Parliament for the borough on the death of his father, who had held the seat as a Liberal since 1865. Joseph Cowen was at that time a strong Radical on domestic questions, an advocate of co-opera- tion, an admirer of Garibaldi, Mazzini, and Kossuth, a sympathizer with Irish Nationalism, and one who in

speech, dress, and manner identified himself with the North-country mining class. Short in stature and uncouth in appearance, his individuality first shocked and then by its earnestness impressed the House of Commons ; and his sturdy independence of party ties, combined with a gift of rough but genuine eloquence (of which his speech on the Eoyal Title BUI of 1878 was an example), rapidly made him one of the

best known public men in the country. He was, moreover, an Imperialist and a Colonial Pederationist at a time when Liberalism was tied and bound to the Manchester traditions ; and, to the consternation of the official wire-pullers, he vigorously supported Disraeli's foreign policy, and in 1881 opposed the Gladstonian settlement with the Boers. His independ- ence (which his detractors attributed in some degree to his alleged susceptibility to Tory compliments) brought him into collision both with the Liberal caucus and with the party organization in Newcastle itself, but Cowen's personal popularity and his remarkable powers as an ora- tor triumphed in his own birthplace, and he was again elected in 1885 in spite of Liberal opposition. Shortly afterwards, however, he retired both from Parliament and from public life, professing his disgust at the party in- trigues of politics, and devoted himself to conducting his newspaper, the Newcastle Daily Chronicle, andto his private business as a mine-owner. In this capacity he exercised a wide influence on local opinion, and the revolt of the Newcastle electorate in later years against doctrinaire Radicalism was largely due to his constant preaching of a broader outlook on national affairs. He continued behind the scenes to play a powerful part in forming North-country opinion until his death on 17th February 1900. (h. CH.)

Cowes, or West Cowes, a town, railway station, and seaport in the Isle of Wight parliamentary division of ' Hampshire, England, on the north coast of the island, west side of the Medina estuary, 11^ miles south-south-east of Southampton, and in daily communication with the main-land. A new esplanade has been formed, and a new public pier constructed. At East Cowes on the opposite side of the Medina, a recreation ground has been opened, and a home for aged seamen provided. Each town forms a par- ish under an Urban District Council (1894). Area of West Cowes, 576 acres. Population (1891), 7690 ; (1901), 8654. Area of East Cowes, 510 acres. Population (1891), 2934 ; (1901), 3180. The harbour between the two towns is now subject to an elective body of com- missioners. The registered shipping at the end of 1899 amounted to 258 vessels of 11,284 tons. In 1899, 25,984 vessels of 2,483,969 tons entered, and 25,929 of 2,480,093 tons cleared.

Cowpens, a village of Spartanburg county, South Carolina, U.S.A., situated in the northern part of the state. It was here, in 1781, during the Revolution, that General Morgan defeated the British under Colonel Tarleton, when the latter lost 800 men in killed, wounded, and prisoners, and the Americans 72.

Cox, Rev. Sir George William, 14th Baet. (1827-1902), English historian, son of Mr G. H. Cox, and nephew of the thii-teenth baronet, was born 10th January 1827 at Benares, India, and was educated at Rugby and Trinity College, Oxford. In 1850 he was ordained, and worked as a curate till 1860, when he took a mastership at Cheltenham College, which he only held for a year. He had already contributed to the Edinburgh Review, and had published (1850) Poems, Legendary and Historical (with Edward A. Freeman), and (1853) a Life of St Boni- face. In 1861 he became literary adviser to Messrs Long-

man, and devoted himself to literary work, connected chiefly with history and comparative mythology. His published books include (1861) Tales from Greek Mythology, (1867) A Manual of Mythology, (1870) Latin ■and Teutonic Christendom, and The Mythology of Aryan JSTations, (1874) Histoi-y of Greece, 2 vols., (1876) The Athenian Empire, (1876) General History of Greece, (1881) History of British Rule in India, and Introduc- tion to Comparative Mythology, (1886) Lives of Greek ■Statesmen, (1887) Concise Histm-y of England. Of these works, some of them avowedly written for popular pur- poses and successful in that object, the most important was the larger History of Greece, begun in 1874, which, though showing the inspiration of Grote, was at the same time a conscientious rehandling of the materials as they then existed. Similarly his studies in mythology were inspired by Max MllUer, but his treatment of the sub- jects was his own. Sir George Cox (who succeeded to the baronetcy in 1877) was a Broad Churchman, and became known as a prominent supporter of Bishop Colenso in 1863-65 ; and five years after Colenso's death he published (1888) his Life of the Bishop. In 1881 Sir G. Cox was made vicar of Scrayingham, York, but resigned the living in

1897. In 1896 he was given a Civil List Pension. He died at Walmer on 9th February 1902.

Coxe, Henry Octavius (1811-1881), Bodley's librarian at Oxford, was born at Buoklebury, in Berkshire, 20th September 1811, and was educated at Westminster iScho'ol and Worcester College, Oxford. Immediately on "taking his degree in 1833 he began work in the Manuscript Department of the British Museum, became in 1838 sub-librarian of the Bodleian, and in 1860 succeeded Dr Bandinel as head librarian, an office he held until his death in 1881. Having proved himself an able palseo- rgrapher, he was sent out by the British Government in 1857 to inspect the libraries in the monasteries of the Levant, and his investigations determined the character of the existing remains in the districts he visited. One valuable result of his travels was the detection of the forgery attempted by M. Simonides. He was the author •of various catalogues, and under his direction that of the Bodleian, in more than 720 volumes, was completed. He published Bogeri de Wendover Chronica, 5 vols. (1841-44) ; "the Black Prince, an historical poem written in French by Chandos Herald (1842) ; and Report on the Cheek Manu- scripts yet remaining in the Libraries of the Levant (1858). He was not only an accurate librarian but an active and hard-working clergyman, and was for the last twenty-five years of his life in charge of the parish of Wytham, near Oxford. He was likewise honorary fellow of Worcester .and Corpus Christi Colleges. He died on 8th July 1881.

Cracow (Polish, Krakdw; German, Krakau), the second city of the Austrian crownland of Galicia. Popula- tion in 1890, 74,593; in 1900, 91,310, chiefly Polish and Roman Catholic (estimated to have 7 per cent. German and 15 per cent. Czech ; 28 per cent. Jewish, 1 per ■cent. Greek Catholic, and 1 per cent. Protestant). It is •one of the strongest Austrian fortresses (of which there are two in Galicia, the second being Przemysl), with a garrison of 6000 men. In 1889 the Catholic bishop was raised to the rank of prince. Cracow now contains, in addition to its 39 churches and numerous chapels, 7 synagogues and 25 religious communities. Many of the old buildings have been restored, such as the Church of St Mary, de- corated by the celebrated Polish artist Matejko, and the Tuchhaus, which now contains a collection of pictures by Polish painters

; while important new structures have been •erected. The latter comprise the new university (1881-87), an imposing Gothic edifice which accommodates the Polish

Academy of Science (founded in 1872), a library, and archaeological and other collections ; together with a new theatre (1891-93) in the late Renaissance style. The university, in which the Polish language has been in exclusive use since 1870, has a staff of 157 professors and lecturers, and is attended by 1300 students. The other educational institutions include a theological seminary, 2 training colleges, 3 gymnasia, a realschule, 3 technical and special schools, and an academy of fine art, which was under the control of the painter Matejko up to the time of his death. Industry, which has undergone little change, now comprises the manufacture of machinery, wax candles, matches, and oil, together with brewing and corn-milling, in addition to its staples, cloth and leather. Its commerce is of greater importance, and includes corn, timber, salt and wine, pigs and textiles, eggs and butter, together with a considerable transitandcommission trade withHungary, Silesia, and other parts of Galicia. The Jewish popular tionhas an exceptionally large share in the high proportion of illegitimacy, 44 per cent. While the illegitimate births among the Catholics were less than one-third, they formed over two-thirds of the whole among the Jews. On the other hand, the Jewish death-rate (20-87 per thousand) is comparatively low as compared with that of the entire Christian population (24-82). {^. o'n.)

Cradock, a town of Cape Colony, in the upper valley of the Great Pish River, nearly due north of Port Elizabeth, and about midway between that place and Colesberg, with both of which it is connected by rail. It is one of the chief centres of the wool trade, and in 1891 had a population of 4390. In the neighbouring district still survive a few herds of quaggas, which are now pro- tected by the game laws.

Craik, Dinah Maria (1826-1887), English novelist, better known by her maiden name of Mulock, and still better as " the author of John Halifax, Gentleman," was the daughter of Thomas Mulock, an eccentric religious enthusiast of Irish extraction, and was born on 20th April 1826 at Stoke-upon-Trent, in Staffordshire, where her father was the minister of a small

congregation. She settled in London about 1846, determined to obtain a livelihood by her pen, and, beginning with fiction for children, advanced steadily until John Halifax, Gentleman (1857), placed her in the front rank of the female novelists of her day. A Life for a Life (1859), though inferior, maintained a high position, but she afterwards wrote little of importance except some very charming tales for children. Her most remarkable novels, after those mentioned above, were The Ogilvies (1849), Olive (1850), The Head of the Family (1851), Agatha's Husband (1853) . There is much passion and power in these early works, and all that Mrs Craik wrote was characterized by high-mindedness, principle, and deep, warm feeling. Some of the short stories in Avillion, and other Tales also exhibit a fine imagination. She also published poems distinguished by genuine lyrical spirit, narratives of tours in Ireland and Cornwall, and A Woman's Thoughts about Women. She married Mv G. L. Craik, publisher, in 1864, and died at Shortlands, near Bromley, 12th October 1887.

Craiova or Krajova, a town in Rumania, the ancient capital of Little Wallachia, now seat of the prefect of the district of Dolj. It is of considerable commercial importance, the province of which it is the capital being very rich in _ grain, pasturage, and vegetable products, besides containing extensive forests. Near Craiova is a large military tannery (penitentiary), besides rope and carriage factories. There are 27 Orthodox churches, 1 Roman Catholic, 1 Protestant church, and 6 synagogues. Craiova is also the seat of a Court of Appeal, a Court of

First Instance, and a Chamber of Commerce, as well as the headquarters of the first Army Corps. The ancient bans of Craiova had the right of striking their coins with their own effigies, whence the designation " bani " (cen- times) given to the copper coinage of Eumania. The mon- etary unit " leu " (leo, lion) also comes from this district. The principal exports are cereals and fish, linen, pottery, and leather. The principal trade carried on consists of agricultural products and cattle. Population (1895), 41,000; (1900), 45,438, of whom about 3000 are Jews.

Cranbrook, Cathorne Cathorne- Hardy,

1st Earl of (1814), British statesman born at

Bradford, in Yorkshire, 1st October 1814, was the son of John Hardy, for many years one of the members for the borough. This circumstance seemed to give him a claim upon the suffrages of the electorate, and upon entering upon active political life in 1847, eleven years after" his graduation at Oxford, and nine years after his call to the Bar, he offered himself as a candidate, but was unsuccessful. In 1856 he was returned for Leomin- ster, and in 1865 defeated Mr Gladstone at Oxford. In 1866 he became President of the Poor Law Board in Lord Derby's new administration. When in 1867 Mr Walpole resigned, from dissatisfaction with Mr Disraeli's Eeform Bill, Mr Gathorne-Hardy succeeded him at the Home Office. In 1874 he was Secretary for War; and when in 1878 Lord Salisbury took the Foreign Office upon the resignation of Lord Derby, Viscount Cranbrook (as Mr Hardy became within a month afterwards) suc- ceeded him at the India Office. In Lord Salisbury's administrations of 1885 and 1886 Lord Cranbrook was President of the CouncU, and upon his retirement from public life concurrently with the resignation of the Cabinet in 1892 he was raised to an earldom.

Cranston, a town of Providence county, Ehode Island, U.S.A., with an area of 30 square miles. It con- tains several villages, among them Cranston, Pontiac, and Natick. It is traversed by branches of the New York, New Haven, and Hartford railway. Population (1880),

5940; (1890), 8099; (1900), 13,343.

Crawford, Francis Marion (1854), Amer- ican author, was born at Lucca, Italy, on 2nd August 1854, being the son of the American sculptor Thomas Crawford (long a resident of Italy), and the nephew of Julia Ward Howe, the American poet. He studied suc- cessively at St Paul's School, Concord, New Hampshire ; Cambridge University ; Heidelberg ; and Eome. In 1879 he west to India, where he edited the Allahabad Indian Herald, meanwhile noting the effect of Indian life upon British subjects. Eetuming to America, he studied Sanscrit and Zend at Harvard University for a year, contributed to various periodicals, and in 1882 pro-

duced— at the suggestion of his uncle Samuel Ward, a New York club-man and raconteur — his first novel, Mr Isaacs, a Tale of Modern India, in which he mingled character sketches of two races, romanticism, supernatu- ralism, and plain realism in a manner which gave the story an immediate place in contemporary fiction. After a brief residence in New York and Boston, Crawford, in 1884, returned to Italy, where he made his permanent home, thenceforward producing volume after volume in rapid succession. An American Politician (1884) may be taken as representative of his tales of American life ; A Roman Singer (1884), Saracinesca (1887), and its sequel Sant' llario (1889), and A Cigarette-Maker's Romance (1890), being examples of his dealing with Italian sub- jects ; while of books not fiction the most conspicuous is Ave Roma Immortalis (1898), a survey of the history, archi- tecture, and characteristics of Eome — ^bird's-eye views

to which Crawford brought sympathy and knowledge, writing at once as a Eoman Catholic and a cosmopolitan.

Crawfordsville, capital of Montgomery county, Indiana, U.S.A., situated on Sugar Creek, in the western part of the state, at an altitude of 780 feet. It is on three great railway lines, the Vandalia, the Cleveland, Cincin- nati, Chicago, and St Louis, and the Chicago, Indianapolis, and Louisville. Wabash College, a non-sectarian institu- tion, founded here in 1832, had in 1899 a faculty of 21 professors and an attendance of 189. Population (1880),

5251; (1900), 6649.

Creatianism and Traducianism. — Traducian- ism is the doctrine about the origin of the soul which was taught by Tertullian in his De Anima — ^that souls are generated from souls in the same way and at the same time as bodies from bodies : Creatianism is the doctrine that God creates a soul for each body that is generated. The Pelagians taunted the upholders of original sin with holding TertuUian's opinion, and called them Traduciani (from tradux : vid. Du Gauge s.vv.), a name which was perhaps suggested by a metaphor in De An. 19, where the soul is described " velut surculus quidam ex matrice Adam in propaginem deducta." Hence we have formed " tra- ducianist," "traducianism," and

by analogy "creatianist," " creatianism." St Augustine denied that Traducianism was necessarily connected with the doctrine of original sin, and to the end of his life was unable to decide for or against it. St Jerome condemned it, and said that the other was the opinion of the Church, though he admitted that most of the Western Christians held Tra- ducianism. The question has never been decided, but Creatianism, which had always prevailed in the East, became the general opinion of the mediaeval theologians, and Peter Lombard's ereando infundit animal Deus et infundendo creat was an accepted formula. Luther, like St Augustine, was undecided, but Lutherans have as a rule been Traducianists. Calvin favoured Creatianism.

Peter Lombard's phrase perhaps shows that even in his time it was felt that some union of the two opinions was needed, and St Augustine's toleration pointed in the same direction, for the Traducianism he thought possible was one iu which God operatur institutas administrando non novas instituendo naturas {Ep. 166. 5.11). Modern psychologists teach that while "personality" can be discerned in its "becoming," nothing is Imown of its origin. Lotze, however, who may be taken as representing the believers in the immanence of the divine Being, puts forth — but as a " dim conjecture " — something very like Creatianism {Miero- cosmus, bk. iii. chap. v. ad Jin.). It is still, as in the days of St Augustine, a question whether a more exact division of man into body, soul, and spirit may help to throw light on this subject. See indices to Augristine, vol. xi., and Jerome, vol. xi., in Migne's Fatrologia, s.v. " Anima "; Delitzsch, Biblical Psychology, ii. § 7 ; sections on "Tertullian and Felagianism " in Neander's Hist. Ch. Liddon, Elements of Beligion, Leot. iii.; Mason, Faith of the Gospel, iv. §§ 3, 4, 9, 10. (;a.. n.)*

Crediton, a market-town in the South Molton par- liamentary division of Devonshire, England, on the Greedy, 8 miles north-west of Exeter by rail. The ancient church has been restored, and in 1897 Crediton became the head of a suffragan bishopric. Eecent structures are a temper- ance hall, the town-hall (rebuilt), and water-works. Tan- ning and the making of confectionery and cider have been introduced. Area of urban district, 947 acres. Popula- tion (1881), 4165 ; (1901), 3974.

Creede, capital of Mineral county, Colorado, U.S.A., situated in a narrow canon tributary to the Eio Grande, in the San Juan Mountains, in the south-western part of the state. It owes its existence to rich silver mines devel- oped in 1891 in its vicinity. Within two years it had ac- quired a population of several thousands, and a branch of

the Denver and Rio Grande railway had been extended to it. In 1892 most of the business portion was de- stroyed by fire. Soon afterwards the reduction in the price of silver caused the closing down of most of the mines, and in 1900 the place had a population of only 938.

Creeds. — I. The Apostles' Creed. — Recent researches Tiave confirmed the importance of Ussher's discovery that the creed presented by Marcellus, bishop of Ancyra, to Julius, bishop of Rome, in 341, was the Old Roman €reed (cited as R), which Rufinus some fifty years later compared with the creed of the Church of Aquileia. R is the archetype of all Western forms. It preserves the sim- plicity of the catechetical teaching given in the early years of the 2nd century, to which it can be traced back in quotations by Novatian, Dionysius, G^ertuUian. Even the heretic Marcion may be called as a witness to the fact that the words " holy Church " were found in this the creed of his baptism (before 145). The relation of R to Eastern creeds is disputed. Some writers (Kattenbusch, Harnack) maintain that it is the sole archetype, having been brought to Antioch in the 3rd century and spread by the influence of the school of Lucian the Martyr. Others (Zahn, Sanday) find traces of an Eastern archetype in Justin Martyr and Irenaeus, to be traced with R to a common origin in "a baptismal confession which had already assumed a more or less stereotyped form in early apostolic times." The question is complicated by the dis- covery of new materials (e.g., creeds of Marcus, hermit of Ancyra, and Serapion, bishop of Thmuis in Egypt), which are said to confirm the theory that local creeds existed in the 3rd century which were independent of R. Increas- ing value is set on the baptismal formula (Matt, xxviii. 19) as the seed-thought of later creeds, though there is reason to believe that the Eunuch's creed, interpolated in the text

of Acts viii. 37 : "I believe that Jesus is the Son of God," was the creed of the apostles (cp. Rom. x. 9 ; 1. Cor. xii. 3 ; 1 John iv. 15, v. 5 ; Heb. iv. 14). It was known to Irenseus (iii. 12. 8), and represents the form of baptismal confession used in the Church of Asia Minor, from which he drew his tradition. The history of the received text of the Apostles' Creed is still obscure. The additional phrases, which distinguish it from R, are found in Galilean creeds of the 5th century, with one exception, " maker of heaven and earth." This had found a place in the Dacian Creed of Niceta, bishop of Remesi- ana (c. 400). The received text is found in a group of documents containing liturgical pieces and sermons of mixed Roman and Galilean origin (so-called Galilean Missal and Galilean Sacramentary), then in the treatise of the Benedictine monk Pirminius (c. 730). The usual opin- ion is that it was brought under the influence of a Frank- ish emperor from Gaul to Rome, where (as some suppose) the Nicene Creed (Constantinopolitan form) had been sub- stituted for R. But the evidence of a Psalter attributed to Pope Gregory III. (c. 731), indications that Pirminius used the Roman service of Baptism, and some evidence that R had not been given up, have led to the suggestion that R was enlarged by the Roman Church (Burn).

II. The Nicene Creed of the Liturgies is the old Bap- tismal Creed of Jerusalem as taught in the Catechetical Lectures o^ Cyril (c. 345), revised after 360 by the inser- tion of phrases from the Creed of the Nicene Council of 325. It was quoted by Epiphanius in his Ancoratus (374), and in 381 found a place in the minutes of the Council of Constantinople, from which it was quoted at Chalcedon as " the exposition of the 150 Fathers," being regarded as an improved recension of the first Nicene Creed. It was brought before the Council of 381, either to vindicate the orthodoxy of Cyril, its author (Hort), or as the Baptismal Confession of Nektarius, who (though

unbaptized) was elected president after the death of Meletius (Kunze). The question is still undecided, but there is reason to believe that it was used as the Bap- tismal Creed of Constantinople after 383, and was ac- cepted as such by the Monophy sites, who rejected the Definition of the Council of Chalcedon. At Chalcedon it was approved by the Pope's legates, probably as containing in the words " incarnate by the Holy Ghost and

the Virgin Mary ” a parallel to the teaching of R, on which Leo laid stress in his letter to Flavian. If the Stowe Missal repre- sents the Roman Liturgy of the 5th century (Probst), the creed was introduced into that Liturgy much earlier than is usually supposed.

III. The Athanasian Creed. — A MS. has lately been found in the library of the Marist Fathers at Lyons, which was given by Bishop Leidrad (t814) to the Altar of St Stephen, with an autograph inscription. It contains this creed in a collection which he apparently used on his journey into Spain to confute the Adoptionists. This one MS. disproves the argument (Swainson, Lumby) that the creed in its present form was not known to theologians during the 8th century. Some eight other MSS. may be assigned to the 8th century. Behind these MSS. are early commentaries which quote the text, the earliest (Fortu- natus) probably of the 6th century. The more important quotations from both parts of the creed by the Council of Toledo in 633, Csesarius of Aries (1543), Avitus of Vienne (t523), enable us to trace it back in its present form to the 5th century. A new theory of growth from an un- polished sermon like that in the Treves fragment (Loofs), is based on the doubtful supposition that it was unknown to Isidore, who presided over the Council of Toledo in 633, but assumes the original unity of the document. The authorship is unknown, but the names of Vincentius (Ommanney) and Honoratus, founder of the monastery of Lerins (Burn), have been suggested. Internal evidence shows that it was written as an Instruction on the Faith, probably before the condemnation of Nestorius in 431. It was not introduced into Psalters as a canticle till c. 800.

The history of later confessions of faith is not disputed.

AuTHORiTES. — ^I. F. Kattenbusch. Das apostolische Symbol. Leipzig, 1900. — A. Harnack. Art. ” Apostolisches Symbolism ” in’Saaca’s Bealencyclopadie. Leipzig, 1896 f. — T. Zahn. Apostles’ Creed (Eng. trans.). London, 1899. — W. Sandat. Art., Journal Theol. Studies, Jan. 1900. — A. E. Burn. Introduction to the Creeds. London, 1899. — Also B. Dorholt. Das Taufsymbolum der alten, Kirche, vol. i. Paderborn, 1898. — L. Hahn. ^Bibliothek der Symbole. Breslau, 1897. — H. B. Swete. The

Apostles' Creed. Cambridge, 1899. — F. Weieigand. Die Stellung des ap. Symbols. Leipzig, 1899.

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III. G. D. W. Ommanney. Early Commentaries. London, 1880. — A Critical Dissertation. Oxford, 1897. — F. Loofs. Art. " Atbanasianum " in Hauck's Mealencyclopadie. — A. E. Burn. The Athanasian Creed. Cambridge, 1895. — On the growing sense of the value of creeds, see Harvey Goodwin. Foundatipns of the Creed. London, 1889.— S. G. Green. The Christian Creed and the Creeds of Christendom. London, 1898. (^^ j;_ ^

Crefeld, a town of Prussia, in the Rhine province, 34 miles by rail north-north-west from Cologne and 4 miles west from the Rhine. It is the chief centre in Germany for the manufacture of velvets and silks ; in addition to which there are dyeworks, stuff printing and stamping works, engineering and machine shops, chemical, sugar, and other factories, distilleries, tanneries, &c. The town-hall has been decorated with frescoes by P. Janssen, and the royal weaving school with mural paintings by A. Baur illus- trating the development of the, silk industry. The Emperor William Museum was opened in 1897. There are monuments to Moltke, Bismarck, K. Wilhelm (com-

poser of Die WcuM am Rhdn) and the war of 1870-71. The places of - worship include a Mennonite church and a synagogue. Population (1885), 90,236; (1900),

106,887.

Creighton, Mandell (1843-1901), English his- torian and Bishop of London, was born at Carlisle on 6th July 1843, being the eldest son of Robert Creighton, a merchant of that city. He was educated at Durham Grammar School and at Merton College, Oxford, where he was elected to a postmastership in 1862. He obtained a first class in classical moderations in 1864, followed by a first in literae humaniores and a second in law and modem history in 1866. In the same year he was elected fellow of Merton, becoming tutor immediately afterwards. He was ordained deacon, on his fellowship, in 1870, and priest in 1873 ; in 1872 he had married Louise, daughter of Robert von Glehn, a London merchant (herself a writer of several successful books of history), the marriage being a very happy one. Meanwhile he had rapidly come to the fore in the university as a profound student of men and things, a brilliant teacher, and a wise and trustworthy friend ; and before he left Oxford he had attained to a position and an influence which was "exceptional and even pre-eminent." He had already published several smaller historical works, but his crowded life left little room for writing; and in 1875, with rare wisdom and self-restraint, he left Oxford to become vicar of Embleton, a parish on the coast of Northumberland, near Dunstan- burgh, and within reach of the fine library in Bamburgh Keep, with an ancient and beautiful church and a fortified parsonage house. Here he remained for nearly ten years, devoting himself to his parish and acquiring that intimate knowledge of parochial work which afterwards stood him in such good stead, taking private pupils, studying and writ- ing, as well as taking an active part in diocesan business. Amongst his parishioners was Sir George Grey of Fallo- den, Home Secretary at the time of the Chartist riots ; he and Creighton became close friends, and on his death the vicar wrote a beautiful memoir of him which was privately printed. Here too he planned and wrote the first two volumes of his chief historical work, the History of the Papacy; and it was in part this which led to his being elected in 1884 to the newly founded Dixie Professor- ship of Ecclesiastical History at Cambridge. Creighton visited Cambridge in the Michaelmas term of 1884, but did not come into residence till early in 1885. He found in his new university, as he said, not a noverca but an alma mater, and one perhaps in some ways more con- genial than Oxford. His influence at once made itself felt. To him more than to any other was due the reor- ganization of the historical school at Cambridge, which was

at first far too narrowly political, on broader and more truly historical lines. His lectures and conversation classes were extraordinarily good, and no man could have been more generous in helping students, men and women, than he was. He was a born teacher, and unlike some other great teachers, he had the gift of imparting truth and kindling enthusiasm without in any way curbing the individuality of those who came under his influence. In 1886 he combined with other leading historians to found the English Historical Review, which during his five years of editorship acquired the high standard of excellence which it has since maintained. In 1886, too, he represented Emmanuel College at the centenary of its offshoot. Harvard College in Massachusetts. Mean- while, the vacations were spent at Worcester, where he had been nominated a Canon Residentiary in 1885, and where his sermons and courses of historical lectures were greatly valued. In 1891 he was made Canon of Windsor ; but he never went into residence, for in the same year,

with great searchings of heart and after anxious consul- tation of friends, he accepted the see of Peterborough. He threw himself eagerly into his new work, visiting and preaching in every part of his diocese, lecturing in great towns and conferring with working men (he became an Oddfellow that he might be in fuller sympathy with them), using his influence with churchmen and dissentera alike, and in social work of all kinds. Nor did the diocese absorb his energies : he found time to preach and lecture elsewhere, and to deliver remarkable speeches at social functions ; he worked hard with Archbishop Benson on the Parish Councils Bill (1894); he became the first president of the Church Historical Society (1894), and continued in that ofB.ce till his death ; he took part in the Laud Commemoration (1895) ; he represented the English Church at the coronation of the Tsar (1896). He even found time for academical work, delivering the Hul- sean Lectures (1893-94) and the Rede Lecture (1894) at Cambridge, and the Romanes Lecture at Oxfori

(1896).

On the translation of Dr Temple to Canterbury, Bishop Creighton was, in accordance with general expectation,, called to London; and his election was confirmed on January 15, 1897. In accepting the see he fully realized

the immensity of a burden which circumstances had made exceptionally great. During Dr Temple's bishopric ritual divergencies of all kinds had grown up, which left a very difficult task to his successor. More especially was this, the case in view of the public clamour on the subject, partly political and partly fanatical, which was just then, arising. Of all this agitation Creighton naturally bor& the brunt. He set himself to work without undue haste,, investigating and experimenting, studying the facts and endeavouring to grasp their real significance, and mean- while dealing with particular points as they arose. He knew how to suffer fools gladly : he knew how to enter into a point of view that was not his own. As was only natural, his studied fairness and moderation did not satisfy partisans on either side ; and his efforts towards concili- ation, marked by an unusual appreciation of the aims of both parties, laid him open to much misunderstanding. His administration has been subjected to hostile criticism from various and contradictory points of view; but it- did much, in a period of almost unexampled difficulty, to preserve peace and foster the spirit of loyalty. He is credited with having suggested the reference to the- Archbishops of the questions of Reservation and the- use of Incense ; and it was his express direction, when the hearing took place, that those who appeared on his. behalf should do everything possible to elucidate the truth. He strained every nerve to induce his clergy to- accept his ruling in accordance with the Archbishops' opinion ; but when, during his last illness, a prosecutor brought proceedings against the clergy of five recalcitrant churches, the Bishop, on full consideration, and on the advice of his archdeacons, interposed his veto. One other effort on behalf of peace may be mentioned. In accord- ance with a vote of the Diocesan Conference, the Bishop arranged a " Round Table Conference " between representative members of various parties, to be held, at Fulham in October 1900, on "the doctrine of the Holy Eucharist and its expression in Ritual," and a. report of its proceedings was published with a preface by him.

No mistake could be greater, however, than to regard, things of this kind as the chief events of his episcopate. What concerned him most in them was not the fact of agitation against particular usages, but the fact that prin- ciples of true liberalism seemed to have prevailed so little, and that

people were' so anxious to withhold from others the very liberty which they claimed for themselves. The

true work of his episcopate was positive, not negative ; and the gifts which made him a good historian made him also a great bishop. He knew how to rule, and he ruled in stately fashion, wearing cope and mitre on great occa- sions. AH who came to consult him found him a tender- hearted and sympathetic counsellor, whose fatherly wis- dom was only the more conspicuous for its unassuming simplicity and its sound common sense. His chairman- ship turned the London Church Congress of 1899, which had been regarded as a doubtful experiment, into an unqualified success. He realized as few did the ofSce and message of the English Church in Christendom, and its witness on behalf of something greater than either sectarianism or undenominationalism. He was never tired of reiterating the essential truths to which the English Church bears witness, of directing attention to the great principles which underlie details of practice. Here too , his position lay open to obvious misunderstanding, as being a mere glorification of insular Anglicanism. But his discernment of the truths which the English Church aims at presenting never blinded him to the faults of the presentation, and no man was less insular than he. There was yet another side to his work which was wider still. His interests and his sympathies extended to every side of human life ; and from the first he took a foremost part in almost every good work that went on in his diocese, social or educational, political or religious. To describe this in detail would be impossible ; but it went on con- tinuously, and through it his influence with thinking men and women increased steadily. No period could well have been fuller of fruitful work than the four years of his episcopate, and certainly nothing could have been fuller of promise for the future. But the promise was not destined to be fulfilled. By degrees the work, and espe- cially the routine work, began to tell on him. He fell seriously ill in the late summer of 1900, and the illness developed into ulceration of the stomach. At length, on 14th January 1901, he passed away, and was buried in St Paul's Cathedral on January 17.

Bishop Creighton's publications are too numerous to be spoken of in detail ; they range in size from an excel- lent little primer of Koman History to his History of the Papacy, a work of great and enduring value. He was a notable preacher: a Greek ecclesiastic who heard him frequently, knowing then little English, said that there were two words which recurred constantly in his sermons, sympathy and character; and the implied description is a true one. He was a man of striking presence, with a resonant voice, and clear-cut delicate features, recalling those of the great Englishmen of Tudor days. He was a man of such unusual brilliance (people used to call him " the Admirable Crichton ") that many failed to see all that lay beneath it. His irrepressible and often daring humour, his frank distaste for much conventional religious phraseology, and his readiness to accept people at their own standard and make the best of them, caused him to be little appreciated by some good people. But beneath it all there was profound wisdom and piety, extraordi- narily wide sympathy, and a holy love of truth. He grew visibly with each new call upon him, and few niodern bishops have made so wide and so deep an impression on their age as he did. (w. e. co.)

Creil, a town of France, arrondissement of Senlis, in the department of Oise, on the river Oise, 22 miles in direct line south-east of Beauvais, and an important junction on the railway from that place to Paris. The manufacture of machinery, heavy iron goods, and nails, and copper and iron founding, are important industries ; earthenware is also manufactured. The church is a mediaeval structure, the earlier parts of which date from

the 12th century, and there are ruins of a collegiate church of St Everemont on an island in the river, and some traces of a castle built by Charles V. The port traffic in 1899 amounted to 41,185 tons. Population (1881), 7099 ;

(1901), 9123.

Cremation. — A brief but interesting summary of the ancient usages among different nations in relation to the disposal of the body after death, and ~~particularly to that by cremation, is given in the ninth edition of this work ; and a few particulars are added of its introduction into the United~~

~~*Kingdom at an early period. It is the design of the present writer to continue the narrative to the present date. As there stated, Sir Henry Thompson was the first to introduce the practice, and to perform it experimentally on animals ; advocating the procedure in an article which appeared in the Contemporary Review of January 1874, which excited considerable notice at home and abroad. He had seen Brunetti's results at the Vienna Exhibition in 1873, and his own were obtained in the manner described. At a very early date steps were taken to form an English Society to promote the practice of cremation. A declaration of its objects was drawn up and signed on 13th January 1874 by the following per*~~ *sons : — Shirley Brooks, William Eassie, Ernest Hart, the Eev. H. R. Haweis, G. H. Hawkins, John Cordy JeafPre- son, E. Lehmann, C. F. Lord, W. Shaen, A. Strahan, Henry Thompson, Major Vaughan, Eev. C. Voysey, and T. Spencer Wells ; and they frequently met to consider the necessary steps in order to attain their object. The laws and regulations having been thoroughly discussed, the membership of the Society was constituted by an annual contribution for expenses, and a subscription to the following declaration : —*

"We disapprove the present custom of burying the dead, and desire to substitute some mode which shall rapidly resolve the body into its component elements by a process which cannot offend the living, and shall render the remains absolutely innocuous. Until some better method is devised, we desire to adopt that usually known as cremation."

*Finally, on 29th April a meeting was held, a Council, was formed. Sir H. Thompson was elected President and Chairman, an office he still held in 1901. Mr Eassie was at the same time elected secretary.^*

In 1875 the following were added : — Mrs Hose Craw- shay, Mr Higford Burr, Rev. J. Long, Mr W. Robinson, and the Rev. Brooke Lambert. Subsequently, and in order of date of appointment, followed the Rt. Hon. Lord Bramwell ; Sir Chas. Cameron, M.P. ; Dr Farquharson, M.P. ; Sir Douglas Galton ; Rt. Hon. Lord Playfair ; Mr Martin Ridley Smith; Mr James A. Budgett; Mr Edmund Yates; Mr J. S. Fletcher; Mr J. C. Swinburne-Hanham ; His Grace the Duke of Westminster (on Lord Bramwell's death) ; and Sir Arthur Arnold, L.C.C.

On account of difficulties and prejudices which cannot be further referred to here,^the Council was unable to purchase a freehold until 1878, when an acre was obtained at Woking, not far distant from the Cemetery. At this time the furnace employed by Professor Gorini of Lodi, Italy, appeared to be the best for working with on a small scale; and he was invited to visit this country to superintend its erection. This was completed in 1879, and the body of a horse was cremated rapidly and com- pletely without any smoke or effiuvia from the chimney. No sooner was this successful step taken than the President

1 This was the first society formed in Europe for the promotion of cremation.

2 For a full account of these, see Modern Cremation : Its History and Practice to the Present Date. By Sir H. Thompson, Bart., F.R.C.S., &;c. Fourth edition. Smith & Elder, Waterloo Place, 1901.

received a communication from the Home Office, which resulted in a personal interview with the Home Secretary ; the issue of which was that if the Society desired to avoid direct hostile action, an assurance must be given that no cremation should be attempted without leave first obtained from the Minister. This of course was given, no further building took place, and the Society's labours were con- fined to employing means to diffuse information on the subject. Sir Spencer Wells brought it before the annual meeting of the British Medical Association in 1880, when a petition to the Home Secretary for permission to adopt cremation was largely signed by the leading men in town and country, but without any immediate result. The next important development was an application to the CouncU in 1882, by Captain Hanham in Dorsetshire, to undertake the cremation of two deceased relatives who had left express instructions to that effect. The Home Secretary was applied to, and refused. The bodies were preserved, and Captain Hanham erected a crematorium on his estate, and the cremation took place there. He himself, dying a year later, was cremated also ; in both cases the result was attained under the

supervision of Mr J. C. Swinburne-Hanham, who succeeded Mr Eassie in 1888 as Secretary to the Society. The Government took no notice. But in 1883 a cremation was performed in Wales by a man on the body of his child, and legal proceedings were taken against him. Mr Justice Stephen, in February 1884, delivered his well-known judgment at the Assizes there, declaring cremation to be a legal pro- cedure, provided no nuisance were caused thereby to others. The Council of the Society at once declared themselves absolved from their promise to the Home Office, and publicly offered to perform cremation, laying down strict rules for careful inquiry into the cause of death in every case. They stated that they were fully aware that the chief practical objection to cremation was that it removed traces of poison or violence which might have caused death. Declining to trust the very imperfect statement generally made respecting the cause of death in the ordinary death certificate (unless a coroner's in- quest had been held), they adopted a system of very stringent inquiry, the result of which in each case was to be submitted to the President, to be investigated and approved by him before cremation could take place, with the right to decline or order an inquest if he thought proper ; and this course has been followed ever since the first cremation.

It was on 26th March 1885 that the first cremation took place, the subject being a lady.^ In 1888 it became necessary, nearly 100 bodies having been by this date cremated, to build a large hall for religious service, as well as waiting-rooms, in connexion with the crematorium. The dukes of Bedford and Westminster headed the appeal for funds, each with £105. The former especially took great interest in the progress of the Society, and offered to furnish further donations to any extent necessary. During the next two years he generously defrayed costs to the amount of £3500, and built a smaller crematorium adjacent for himself and family. The latter building was first used on 18th January 1891, a few days after the death of His Grace (the ninth duke of Bedford). The number of cremations slowly increased year by year, and the total at the end of 1900 was 1824. Many of these were persons of distinction — ^by rank, or by attainments in art, literature, and science, or in public life.

The Council next turned their attention to the need for a national system of death certification, to be enforced by law as an essential and much

needed reform in connexion -with cremation. On 6th January 1893 the duke of

1 Times, 27tli March 1885.

*Westminster introduced a deputation to the Secretary of State for the Home Department, Mr Asquith, and the President of the Cremation Society opened the case, show- ing that no less than 7 per cent, of the burials in England took place without any certificate, while in some districts it was far greater. In consequence of this the Home Secretary appointed a Select Committee of the House of Commons, which was presided over by Sir Walter Foster, of the Local Government Board, "to inquire into the sufficiency of the existing law as to the disposal of the dead . . . and especially for detecting the causes of death due to poison, violence, and criminal neglect." After a prolonged inquiry and careful consideration of the evidence, a full report and conclusions drawn there- from were unanimously agreed to, and published as a blue-book in the autumn of 1893.^*

The following conclusions are quoted from this volume : — Page iii. " So far as affording a record of the true cause of death and the detection of it in cases where death may have been due to violence, poison, or where criminal neglect is concerned, the class of certified deaths leaves much to be desired." Page iv. Certifi- cation is extremely Important as a deterrent of crime, and numer- ous proofs are given at length in support of the statement. . . . "Contrast this class with that of uncertified deaths, when the result is such as to force upon yoilr Committee the conviction that vastly more deaths occur annually from foul play and criminal neglect than the law recognizes." Page viii. Great uncertainty in resorting to the coroner's court, and want of system in connexion with the practice of iti, are affirmed to exist. Page x. It is stated that the opportunity for perpetrating crime is great in the con- siderable class of uncertified cases. ... "In short, the existing procedure plays into the hands of the criminal classes." "Your Committee are much impressed with the serious possibilities im- plied in a system which permits death and burial to talte place without the production of satisfactory medical evidence of the cause of death." Page xii. "Your Committee have arrived at the conclusion that

the appointment of medical officials, who should investigate all cases of death which are not certified by a medical practitioner in attendance, is a proposal which deserves their support."

In considering cremation, the Committee reported as follows : — Page xxii. " Your Committee are of opinion that there is only one question in connexion with this method of disposing of a dead body to which it is necessary for them to refer. That ques- tion is the supposed danger to the community arising from the fact that with the destruction of the body the possibility of obtain- ing evidence of the cause of death by post-mortem examination also disappears." The mode of proceeding adopted by the Crema- tion Society of England having been described, "your Committee are of opinion that with the precautions adopted in connexion with cremation, as carried out by the Cremation Society, there is little probability that cases of crime would escape detection, but inasmuch as these precautions are purely voluntary, your Committee consider that in the interests of public safety such regulations should be enforced by law."

After- this, it could only be a question of time before the admitted demands for official inquiry were enforced by law in every case of death ; when that is done, the general employment of cremation may safely follow. In August 1894 the President of the Society laid the results of the Select Committee before the British Medical Asso- ciation at Bristol, and a unanimous vote was obtained in favour of the suggestions made by it. In November a second deputation waited on Mr Asquith, in which the President of the Society begged him to carry out the sys- tem recommended. The Home Secretary replied that the business belonged to the Department of the Local Govern- ment Board, and that it was already dealing with the question and bringing it to a satisfactory solution. Soon afterwards, however, the Government changed, other questions became pressing, and further consideration of – the subject was postponed.

It is most desirable to put in force by Act of Parliament the recommendations of the Select Committee before mentioned. The

2 Reports on Death Certification, 1893. don (373,472).

Eyre & Spottiswoode, Lon-

chief provisions have been carefully considered by the Council of the Society, and the regulations necessary for registration of death and the disposal of the dead may be outlined as follows : —

1. That no body should be buried, cremated, or otherwise disposed of without a medical certificate of death signed, after personal knowledge and observation, or by information obtained after investi- gation made by a qualified medical officer appointed for the purpose.

2. A qualified medical man should be appointed as official certifier in every , parish, or district of neighbouring parishes, his duty being to inquire into all cases of death and report the cause in writing, together with such other details as may be deemed neces- sary. This would naturally fall within the duties of the medical officer of health for the district, and registration should be made at his office. 3. If the circumstances of death obviously demand a coroner's inquest, the case should be transferred to his court and the cause determined, with or without autopsy. If there appears to be no ground for holding an inquest, and autopsy be necessary to the furnishing of a certificate, the official certifier should make it, and state the result in his report. 4. No person or company should be henceforth permitted to construct or use an apparatus for cremating human bodies without license from the Local Government Board or other authority. 5. No crematory should be so employed unless the site, construction, and system of management have been approved after survey by an officer appointed by Government for the purpose. But the license to construct or use a crematory should not be withheld if guarantees are given that the conditions required are or will be complied with. All such crematories to be subject at all times to inspection by an officer appointed by the Government. 6. The burning of a human body, otherwise than in an officially recognized crematory, should be illegal, and punishable by penalty. 7. No human body should be cremated unless the official examiner added the words " Crema- tion permitted." This he should be bound to do if, after due inquiry, he can certify that the

deceased has died from natural causes, and not from ill-treatment, poison, or violence.

I Undoubtedly in populous communities and in crowded districts the burial of dead bodies is liable to be a source of danger to the living. As early as 1840 a Commission had been appointed, including some of the earliest author- ities on sanitary science, — ^namely, Drs Southwood Smith, Chadwick, Milroy, Sutherland, Waller Lewis, and others, — to conduct a searching inquiry into the state of the burial- grounds of London and large provincial towns. By the report the existence of such a danger was strikingly demonstrated, and intramural interments were in con- sequence made illegal. The advocates of burial then declared that interment in certain light soils would safely and eificiently decompose the putrefying elements which begin to be developed the moment death takes place, and which rapidly become dangerous to the living, still more so in the case of deaths from contagious disease. But these light dry soils and elevated spots are precisely those best adapted for human habitation; to say nothing of their value for food-production. Granted the efficiency of such burial, it only effects in the course of a few years what exposure to a high temperature accomplishes with absolute safety in an hour. In a densely popula-ted coun- try the struggle between the claims of the dead and the liv- ing to occupy the choicest sites becomes a serious matter. All decaying animal remains give off effluvia — gases — which are transferred through the medium of the atmo- sphere to become converted into vegetable growth of some kind — ^trees, crops, garden "produce, grass, &c. Every plant absorbs these gases by its leaves, each one of which is provided with hundreds of stomata — open mouths — by which they fix or utilize the carbon to form woody fibre, and give off free oxygen to the atmosphere. Thus it is that the air we breathe is kept pure by the constant interaction between the animal and vegetable kingdoms. It may be taken as certain that the gaseous products arising from a cremated body — amounting, although in- visible, to no less than 97 per cent, of its weight, 3 per cent, only remaining as solids, in the form of a pure*

1 A Special Inquiry into the Practice of Interment in Towns, by Edwin Chadwick (London, 1843), is replete with evidence, and should be read by those who desire to pursue the inquiry further.

white ash — become in the course of a few hours integral and active elements in some form of vegetable life. The result of this reasoning has been that, by slow degrees, crematoria have been constructed at many of the populous cities in Great Britain and abroad. In Manchester a large one was opened in 1892, in Glasgow in 1894, in Liverpool in 1896, in Hull in 1899. In Birmingham another is in progress of formation.

The subject of employing cremation for the bodies of those who die of contagious disease is a most important one. Sir H. Thompson advocated this course in a paper read before the International Congress of Hygiene held in London in 1891 ; and a resolution strongly approving the practice was carried unanimously at a large meeting of experts and medical officers of health. Such diseases are small-pox, scarlet fever, diphtheria, consumption, ma- lignant cholera, enteric, relapsing, and puerperal fevers, the annual number of deaths from which in the United. Kingdom is upwards of 80,000. Complete disinfection takes place by means of the high temperature to which the body is exposed. Heated air suffices, and the chamber of a Siemens regenerative gas-furnace, where no flame enters, is the most perfect form for accomplishing the process. It will probably, at no distant period, supersede the furnaces now employed. At the present day it is compulsory to report any case in the foregoing list, when- ever it occurs, to the medical officer of health for the district ; and it is customary to disinfect the rooms them- selves, as well as the clothes and furniture used by the patient if the case be fatal ; but the body, which is the source and origin of the evil, and is itself loaded with the germs of a specific poison, is left to the chances which attach to its preservation in that condition, when buried in a fit or unfit soil or situation.

The process of preparing a body for cremation requires a brief notice. The plan generally adopted is to place it (in the usual shroud), in a light pine shell, discarding all heavy oak or other coffin, and to introduce it into the furnace in that manner. Eor the purpose of transit such a| shell is convenient and appropriate ; but it is best to discard the linen shroud — the combustion of which, together with the shell, produces a quantity of black charcoal, which has subsequently to be separated, not without some trouble, from the white ashes of the body — ^in favour of one of a stout woollen material ; this, being an animal product, is destroyed and

dissipated by cremation, and is so made that the body may be easily cremated without the shell. A sheet of flannel is provided, say 10 feet by 5 or 6 feet for an adult of average size, in which the body is placed ; the sides of the sheet are then to be folded across the body, one overlapping the other, so as to cover it entirely. Thus the folded ends'of the sheet will extend some 2 feet or so above and below the head and feet of the body respectively. Above each of these points a piece of stout wide strong tape or web should be firmly tied round the folded sheet, and in at least two places round the covered body also, so as to maintain the sheet in situ. These ends are then turned over when the body has been placed in the shell, before the lid is adjusted for removal. Immediately before the act of cremation commences, the shell should be opened, the body be carefully and reverently lifted out by a bearer at each end of the sheet, a third supporting the centre, and be placed on the frame which enters the crematorium.

The following statistics show the history of modem cremation and its progress at home and abroad to the present date : —

Foreign Countries. — ^The first experiment in Italy was made by Brunetti in 1869, his second and third in 1870. Gorini and Polli published their first cases in 1872. Brunetti exhibited his at Vienna in 1873. All were performed in the open air. The next in Europe was a single case at Breslau in 1874. Soon after, an English lady was cremated in a closed apparatus (Siemens) at Dresden. The next cremation in a closed receptacle took place at Milan in 1876. In the same year a Cremation Society was formed, a handsome building was erected, and two Gorini furnaces were at work in 1880. In 1899 the total number of cremations was 1355. Other crematoria were subsequently erected at Lodi, Cremona, Brescia, Bologna, Varese, Fadua, and Venice. At Bologna the total

cremations numbered 155 up to December 31, 1900. At Veiiice the total cremations numbered 45 in May 1899. One crematorium began in Rome

in 1883, and the cremations numbered 800 up to May 1899. At the present time 28 crematoria exist in Italy.

In Grermany ihe first crematorium was erected at Gotha ; it began in 1879, and the total cremations to December 31, 1900, num- bered 2468. At Ohlsdorf, Hamburg, the crematorium began in Ifovember 1892, and the total cremations up to December 31, 1900, numbered 646. At Heidelberg the crematorium started in 1891, and the total cremations up to November 28, 1900, numbered 895. A crematorium started working at Offenbach on December 13, 1899, and at the end of its first year (December 13, 1900) had cremated 113 bodies. Tliroughout the German Empire there are forty societies for promoting cremation, numbering about 40,000 members.

Other societies now exist in Denmark, Holland, Belgium, Sweden, Norway, and Switzerland. At the crematorium recently constructed at Copenhagen 28 bodies were cremated in 1899, the same in 1900 ; the total being 56. The Stockholm crematorium began in October 1887, and the total cremations up to May 1899 numbered 495. The Gothenburg crematorium (also in Sweden) began in January 1890, and the total cremations up to May 1899 was 120.

In Paris a Cremation Society was founded in 1880, and in 1886-87 a large crematorium was constructed by the Municipal Council at P6re Lachaise, containing three Gorini furnaces. It was first used in October 1887 for two men who died of small-pox. The demand became large; an improved furnace was soon devised, the un- claimed bodies at the hospitals and the remains at the dissecting rooms being cremated there, besides a large number of embryos. In 1890 the total number, including the last-named class, exceeded 3000 ; in 1895, 4000 ; numbering 4554 at the end of 1899 ; and the number for the year 1900 was rather larger. The total number of incinerations in private life exceeds the previous record, being, up to December 31, 1900, 197 ; but the employment of cremation for the purposes named has deterred a resort to it by many. Had a separate establishment been organized for the public, its success would have been greater ; the error is now obvious and may be rectified soon, for a magnificent edifice is in course of construction by the municipality

of Paris for the conservation of the ashes, &c., which will form ailarger and mor&imposing columbarium than has yet been seen. Lastly, the construction of crematoria in all the great provincial centres of France — Lyons, LUle, Rheims, Nice, Marseilles, Toulouse, and Bordeaux — is being completed or is com- mencing. At Bouen it is already in operation with good results, the low damp soil there being unfit for burial. ^

In Buenos Ayres, since 1844, the bodies of all persons dying of contagious disease are cremated, and there is also a separate establishment for the use of the public.

At Tokio in Japan no less than twenty-two crematoria exist, and about an equal number of cremations and burials in earth take place.

United Kingdom. — The followdng is the report from the crema torium at Woking for each year, commencing with the first in 1885 and concluding with that ending December 31, 1900.

Cremations at Woking.

Tear.

Number.

Tear.

1885 ... 3

1894

1886

10

1895

1887

13

1896

1888

28

1897

1889

46

1898

1890

54

1899

1891

99

1900

1892

104

1893

101

Total .

1824

The Manchester crematorium began in 1892, and the total crema- tions to December 31, 1900, numbered 475. The Glasgow crema- torium began in

1895, and the total cremations up to December 31, 1900, numbered 75. The Liverpool crematorium began in 1896, and the total cremations up to December 31, 1900, numbered 102. The Hull crematorium was opened on January 2, 1901. It is the first crematorium erected in England under municipal authority. Seven cremations took place within a month of its opening. The Birmingham crematorium is not yet in operation. The capital is subscribed, but a proper site has not yet been met with.

1 The writer is indebted for the history of cremation in France and its departments to the Bulletin de la Soc. pour la Propagation de I' Incineration, Paris, by M. Georges Salomon, secretary from its foundation in 1880 up to the end of 1900 ; and also for the reports from South America and Japan. The present writer has visited Pfere Lachaise several times, and the above report is partly based on his personal observation.

The Cremation Society of England has been long endeavouring to obtain a site on which to establish a crematorium within con- venient driving distance of Central London; and in December 1899 a company was formed for the purpose, its title being "The London Cremation Company Ltd."

The only crematorium at present available to the inhabitants of London is that at Woking, the property of, and managed by, the Cremation Society of England ; but a freehold site, 12 acres in extent, has been purchased about 5 miles distant, from the Marble Arch, surrounded by open country, and on one of the best main roads north of London, and here it' is Intended to erect crematoria on the newest and the most approved principle, with a chapel, waiting-rooms, and attendants' lodges, together with private and public columbaria for the reception of cinerary urns. The land not so occupied will be laid out as a garden, with lawns, trees, and shrubs, becoming a place of increasing interest and beauty from year to year : where ample space will be afforded for the erection of monuments, and provision made for the interment of ashes for those who prefer it.

United States. — There are twenty-five crematoria in the United States. At Fresh Pond, New York, the first crematorium was erected in 1885, and the

total number of cremations to December 31, 1900, was 3903. At Buffalo, N.Y., the first cremation took place in 1885, and the total number up to December 31, 1900, was 484. At Troy (Earl Crematorium), N.Y., the first cremation took place in 1890, and the total number up to December 31, 1900, was 146. At Swinburne Island, N.Y., cremations commenced in 1890, total to 1898 being 106. At Waterville, N.Y., cremations commenced in 1893, total to December 31, 1900, being 38. At St Louis, Missouri, cremations commenced in 1888, total to December 31, 1900, being 1054. At Philadelphia, Penn., cremations com- menced in 1888, total to December 31, 1900, being 914. At San Francisco, Cal. ("Odd Fellows"), commenced in 1895, total to December 31, 1900, being 1535. At San Francisco, Cal. (" Cypress Lawn"), commenced in 1893, total to December 31, 1900, being 632. At Los Angeles, Cal., commenced in 1888, total to 1898 being 352. At Boston, Mass., commenced in 1893, total to Decem- ber 31, 1900, being 1057. At Cincinnati, Ohio, commenced in 1887, total to December 31, 1900, being 647. At Chicago, commenced in 1893, total to December 31, 1900, being 695. At Detroit, Michi- gan, commenced in 1887, total to December 31, 1900, being 371. At Pittsburg, Penn., commenced in 1886, total to December 31, 1900, being 216. At Baltimore, commenced in 1889, total to December 31, 1900, being 180. At Lancaster, Penn., commenced in 1884, total to December 31, 1900, being 95. At Davenport, Iowa, commenced in 1891, total to December 31, 1900, being 134. At Milwaukee, commenced in 1896, total to October 1900 being 170. At Washington, commenced in 1897, total to December 31, 1900, being 109. The Le Moyne (Washington) Crematory, the first in the United States, was erected by Dr F. Julius Le Moyne in 1876 for private use. The first cremation was that of the Baron de Palin of New York, December 6, 1876. Dr F. Julius Le Moyne died October 1879, and his remains were cremated in his own crematory. Total number cremations since, to February 1901, being 42. At Pasadena, Cal., commenced in 1895, total to end of 1898 being 55. At St Paul, Minn., commenced in 1897, total to December 31, 1900, being 56. At Fort Wayne, Ind., commenced in 1897, total to December 31, 1900, being 14. From the reinain- ing crematorium at Middletown, Conn., statistics have not been received.

The sum total of the above incinerations at the twenty-five crematoria in America amoimts to 13,004 up to December 31, 1900- (h. Th.)

Cremer, Jakobus Jan (1837-1880), Dutch novel- ist, born at Amhem, September 1837, started life as a painter, but soon exchanged the brush for the pen. The great success of his first novelettes (Betuwsche Novellen

and Overbetuwsche Novellen), published about 1855

reprinted many times since, and translated into German and French — showed Cremer the wisdom of his new departure. These short stories of Dutch provincial life are written in the quaint dialect of the Betuwe, the large flat Gelderland island, formed by the Rhine, the name recalling the presumed earliest inhabitants, the Batavi. Cremer is strongest in his delineation of character. His picturesque humour, coming out, perhaps, most forcibly in his numerous readings of the Betuwe novelettes, soon procured him the name of the " Dutch Fritz Eeuter." In his later novels Cremer abandons both the language and the slight love-stories of the Betuwe, depicting the Dutch life of other centres in the national tongue. The

principal are : Anna Booze (1867), Dokter Helmond en zijn Vrouw (Dr H. and his Wife, 1870). Banna de Freule (The Honourable Miss Hannah, 1873), Daniel Sils, &e. Cremer was less successful as a playwright, and his two comedies. Peasant and Nobleman and Emma Bertholt, did not enhance his fame ; nor did a volume of poems, pub- lished in 1873. He died at The Hague in June 1880. His collected novels have appeared at Leyden. An English novel, founded by Albert Vandam upon Anna Booze, considered by many his best work, was published in London (1877, 3 vols.) under the title of An Everyday Heroine. (h. ti.)

Cremona, a fortified town and episcopal see of Lombardy, Italy, capital of the province Cremona, on the left bank of the Po, 51 miles by rail south-east from Milan, an important railway junction in the middle of North

Italy. Amongst the public buildings should be particu- larly mentioned the Renaissance churches of St Sigismund (begun in 1463) and St Peter (1549), the baptistery {circa 900, but rebuilt in 1167), the Palace of the Jurisconsults (1292), and the Ala-Ponzone Museum, containing works of the native school of painters, and arohseological collections. There are also statues to Garibaldi, Victor Emmanuel, and the musician Ponchielli (1893). Cremona has two technical schools and a school of singing. Its manufactures embrace the rearing of silkworms and silk-throwiiig, -with ironworks and foundries. Population (1881), 31,930:

(1901), 37,661.

Cremona, Luigi (1830), Italian mathema- tician, was born at Pavia 7th December 1830. In 1848, when Milan and Venice rose against Austria, Cremona, then only a lad of seventeen, joined the ranks of the Italian volunteers, and remained with them, fighting on behalf of his country's freedom, till, in 1849, the capitulation of Venice put an end to the hopeless campaign. He then returned to Pavia, where he pursued his studies at the university under the distinguished mathema- tician Brioschi, and determined to seek a career as teacher of mathematics. His first appointment was as elementary mathematical master at the Gym- nasium and Lyceum of Cremona, and he afterwards obtained a similar post at Milan. In 1860 he was ap- pointed to the professorship of Higher Geometry at the University of Bologna, and in 1866 to that of Higher Geometry and Graphical Statics at the Higher Technical College of Milan. In this same year he competed for the Steiner Prize of the Berlin Academy, with a treatise en- titled "Memoria sulle superficie di terzo ordine," and shared the award with Professor Sturm. Two years later the same prize was conferred on him without competition. In 1873 he was called to Eome to organize the College of Engineering, and was also appointed Professor of Higher Mathematics at the university. Cremona's reputation had now become European, and in 1879 he was elected a corre- sponding member of the Eoyal Society. In the same year he was made a senator of the Kingdom of Italy. As early as 1856 Cremona had begun to contribute to the Annali di Scienze matematiche e Jisiche, and to the Annali di Matematica, of which he became afterwards joint editor. Papers by him have appeared in the mathematical journals of Italy,

France, Germany, and England, and he has published several important works, many of which have been translated into other languages. His manual on Cfraphical Statics and his Elements of Projective Geometry have been published in English by the Clarendon Press. His life has been devoted to the study of higher geometry and reforming the more advanced mathematical teaching of Italy. He is a follower of Steiner, preferring synthetic to analytic methods. In his Introduction to a Geometrical Theory of Plane Curves he develops by a uniform method

many new results, and proves synthetically all important results hitherto reached by analysis. The theory of the transformation of curves, and of the correspondence of points on curves, was extended by him to three dimen- sions. He has devoted special attention to ruled surfaces, surfaces of the second order, space-curves of the third order, and the general theory of surfaces.

Creston, capital of Union county, Iowa, U.S.A., on the high prairie (whence its name), at an altitude of 1312 feet. It is at the intersection of two branches of the Chicago, Burlington, and Quincy railways. Popula- tion (1880), 5081 ; (1900), 7762.

Creswick, a borough of Victoria, Australia, in the county of Talbot, on the Tullaroop Creek, 85^ miles by rail north-west of Melbourne, and 11 miles north of Ballarat. Much of the surrounding district is fertile and well timbered. The quartz and alluvial gold mines of the district are important, employing about 1300 persons. Population (1881), 3731 ; (1900), about 4700.

Crete. — During the past half-century the affairs of Crete have repeatedly occupied the attention of Europe. Owing to the existence of a strong Mussulman minority among its inhabitants, the warlike character of the natives, and the mountainous configuration of the coun- try, which enabled a portion of the Christian population . to maintain itself in a state of partial independence, the island has constantly been the scene of prolonged and sanguinary struggles in which the numerical superiority of the Christians was counterbalanced by the aid ren- dered to the Moslems by. the Ottoman troops. This unhappy state of affairs was aggravated and perpetu- ated by the ■ intrigues set on foot at Constantinople against

successive governors of the island, the con- flicts between the Palace and the Porte, the duplicity of the Turkish authorities, the dissensions of the representatives of the Great Powers, the machinations of Greek agitators, the rivalry of Cretan politicians, and prolonged financial mismanagement. A long series of insurrections— those of 1821, 1833, 1841, 1858, 1866- 1868, 1878, 1889, and 1896 may be especially mentioned— culminated in the general rebellion of 1897, which led to the interference of Greece, the intervention of the Great Powers, the expulsion of the Turkish authorities, and the establishment of an autonomous Cretan government under the suzerainty of the sultan. According to the new au- tonomous constitution, the supreme power is vested in Prince George of Greece, acting as high commissioner of the protecting Powers. The authority thus conferred is confided exclusively to the present high commissioner, and is liable to modification by law in the case of his successor. The prince is irresponsible, but his decrees, except in certain specified cases, must be countersigned by a member of his Council. He convokes, prorogues, and dissolves the Chamber, sanctions laws, exercises the right of pardon in case of political offences, represents the island in its foreign relations, and is chief of its military forces. The Chamber (/SovAif), which is elected in the proportion of one deputy to every 6000 inhabitants, meets for a session of two months every two years. Ten of its members are nominated by the prince. A new election is held before each session, and when the Chamber assembles a budget for a period of two years is submitted. The Chamber exercises a complete financial control, and no taxes can be imposed without its consent. The prince is aided in the administration by a Cabinet of five members, styled "councillors" (tru/xySouXot), who super- intend respectively the departments of justice, finance, education, public security, and the interior. The council- lors, who are nominated and dismissed by the prince, are

responsible to the Chamber, which may impeach them before a special tribunal for any illegal act or neglect of duty. Large exceptional legislative

and administrative powers ~~were accorded to the prince at the opening of his rule. In general the Cretan constitution is charac~~ terized by a conservative spirit, and contrasts with the ultra-democratic systems established in Greece and the Balkan States. A further point of difference is the more liberal payment of public functionaries in Crete. For administrative purposes the departmental divisions exist- ing under the Turkish Government have been retained. There are 5 nomoi or prefectures (formerly sanjaks) each under a prefect (vo/xopxijs), and 23 eparchies (formerly kazas) each under a sub-prefect (iirapxoi). All these functionaries are nominated by the priace. The prefects are assisted by departmental councils. The system of municipal and communal government remains practically unchanged. The island is divided into 86 communes, each with a mayor, an assistant-mayor, and a communal council. The mayors and their assistants were formerly elected; they are now appointed by the high com- missioner, who also for the present nominates the members of the communal councils. The councils assess within certain limits the communal taxes, maintain roads, bridges, &c., and generally superintend local affairs. Public order is maintained by a force of gen- darmery (j(topovXaKr]) organized and at present com- manded by 110 Italian oflS.cers,.who in course of time will be succeeded by natives. The proposed strength was 1400 men, but this number has been reduced to 1246. ■ The expenditure for the maintenance of this force forms the heaviest item in the budget. The constitution authorizes the formation of a militia (iro\iTovXaK-q) to be enrolled by conscription, but in existing circumstances the embodiment of this force seems unnecessary. The administration of justice is on the French model. A su- preme court of appeal, which also discharges the functions of a court of cassation, sits at Canea. There are two assize courts at Canea and Candia respectively with juris- diction in regard to serious offences (KaKovpyrjfmTa). Minor offences (Tr\r]iJ.ixe-qiMiTa) and civil causes are tried by courts of first instance in each of the five departments. There are 26 justices of peace, to whose decision are referred slight contraventions of the law (vraia-iuiTa) and civil causes in which the amount claimed is below 600 francs. These functionaries also hold monthly ses- sions in the various communes. The judges are chosen without regard to religious belief, and precau- tions have been taken to render them independent of political parties. They are appointed,

promoted, trans- ferred, or removed by order of the council of justice, a body composed of the five highest judicial digni- taries, sitting at Canea. An order for the removal of a judge must be based upon a conviction for some specified offence before a court of law. The jury system has not been introduced. The Greek penal code has been adopted with sortie modifications. The Otto- man civil code is maintained for the present, but it is pro- posed to establish a code recently drawn up by Greek jurists which is mainly based on Italian and Saxon law. The Mussulman cadis retain their jurisdiction in regard to religious affairs, marriage, divorce, the wardship of minors, and inheritance.

Finance. — The budget estimates for the year 1900, the first which had been made up for a complete year under the new autonomous government, were as given below. In addition to the regular revenues inscribed in the budget, a sum estimated at 3,700,000 dr. approximately remained available, derived from the issue of a new coin- age and other exceptional sources. The four protecting Powers further advanced 1,000,000 fr. each to defray the

initial expenses of the High Commissioner's Government. It was proposed to expend considerable sums on roadmak-

MeceiptS. Drachmffi. El^enditure. Drachms.

Direct taxatton . . . 1,624,820 Indirect taxation (stamps,

dues, &c.) 662,787

Monopolies .... 124,000 State domains, and other

property 132,688

Export dues (1 percent.) . 98,144 Import dues (8 per cent.) and

taxes on consumption . 1,812,894

Other sources . , . 282,444

4,082,177

High Commissioner

200,000

Financial administration

694,000'

Interior

485,000

Gendarmery

1,686,00»

Education .

882,000'

Justice

677,000'

4,874,000

ing and public works. The Cretans are at present more lightly taxed than any people in Europe. The tithe ha been replaced by an export tax on agricultural produce levied at the custom-houses, and the smaller peasant proprietors and shepherds of the mountainous districts- are practically exempt from any contribution to the State. The communal tax does not exceed on the average 2 fr. annually for each family. The poorer communes are aided by a State subvention. Notwithstanding the havoc wrought during repeated insurrections, the impoverish- ment of the peasants, the desolation of the districts for- merly inhabited by the Moslem agricultural population, and the drain of gold resulting from the sale of Moslem lands and emigration of the former proprietors, the finan- cial prospects of the island were favo'irable, and a rapid recovery of prosperity was anticipated.*

Production and Industries. — Owing to the volcanic nature of its soil, Crete is probably rich in minerals. Recent experiments lead to the conclusion that iron, lead, manganese, lignite, and sulphur exist inconsiderable abundance. Copper and zinc have also been found. A large number of applications for mining: concessions have been received since the establishment of the autonomous government. The principal wealth of the island is: derived from its olive groves ; notwithstanding the destruction of many thousands of trees during each successive insurrection, the production is apparently undiminished, and will probably increase very considerably owing to the planting of young trees and the iipproved methods of cultivation which the . Government is endeavouring to promote. The orange and lemon groves have also sufiered consideral^ly, but new varieties of the orange ti-ee are now being introduced, and an impulse will be given to the export trade in this fruit by the removal of the restriction on its importa- tion into Greece. Agriculture is still in a primitive condition ; notwithstanding the fertility of the arable land the supply of cereals is far below the requirements of the population. A great portion of the central plain of Monofatsi, the principal grain- producing district, is lying fallow owing to the exodus of the Moslem peasantry. The cultivation of silk cocoons, formerly a flourishing industry, has greatly declined in recent years, but. efforts are now being made to revive it. There are few manu- factures. Soap is produced at fifteen factories in the principal towns, and there are two distilleries of cognac at Candia.

Commerce. — ^The commerce of the island was expected to de- velop rapidly under the new system of government. The total value of the exports for the year 1899 was 8,040,912 drachmae. The principal exports were olive oil, value 4,361,029 dr. ; soap,, value 320,806 ; and hides, value 208,170 dr. Oranges, lemons, almonds, and valonia are exported in considerable quantities. The countries which accept the largest share of Cretan produce are Turkey, England, Egypt, Austria, and Russia, in the order named.

The total value of imports in 1899 was 15,842,743 dr. Im- ports from Turkey are valued at 6,865,350 dr., from Greece at 5,147,193 dr., from Austria at 2,030,826 dr., from Roumania. at 1,061,146 dr., from Egypt at

656,548 dr., from Italy at. 463,833 dr., from France at 180,397 dr., from England at 149,986 dr., from Bulgaria at 107,603 dr. Cereals are imported from the Black Sea and Danubian ports, ready-made clothing from Austria and Germany, articles of luxury from Austria and- France, and cotton textiles from England. Imports are charged 8 per cent., exports 1 per cent, ad valorem duty. According to a law published in 1899, Turkish merchandise is subjected to the same rates as that of foreign nations.

Population. — According to the census taken in 1881, the com- plete publication of which was interdicted by the Turkish authorities, the population of the island was 279,165, or 35-78' to the square kilometre. Of this total, 141,602 were males, 137,563 females; 33,173 were literate, 242,114 illiterate; 205,010 were orthodox Christians, 73,234 Moslems, and 921 of other

Archaeo- logical research i early Cretan elvlllza- tloa.

religious persuasions. The Moslem element predominated in the principal towns, of which the population was— Candia, 21,368; Canea, 13,812 ; Retimo, 9274. According to the census taken in June 1900, the population of the island was 301,273, the Christians having increased to 267,266, while the Moslems had diminished to 33,281. The population of Candia was 22,501 ; of Canea, 20,972 ; of Retimo, 9311. ‘ . > .

I

Lying midway between three continents, Crete became a natural stepping-stone for the passage of early culture from the east and south to the west and north. Under the myths of Minos and Dadalos the Greeks proclaimed their indebtedness to Cretan sources in the domains of law and art. Ke- cent researches have illustrated the truth of these traditions in many interesting ways. The ancient remains which abound throughout the island show conclusively that the days of its greatest civilization lie behind

the prehistoric period. Even the remotest nooks are studded with the ruins of Cyclopean strongholds and tower-houses, and here and there, as at Goulas in the east and Hyrtakina in the west, a com- plete acropolis is found. Goulas especially, rising in a succession of huge terraces, presents a mass of prehistoric masonry hardly paralleled elsewhere. The ancient stone vases and engraved seals found on these sites supply definite traces of a contact with Egypt going back to the period of the 12th dynasty, and dating from at least the latter half of the third millennium b.c. An intermediate period follows, characterized by the appearance of painted clay vases of an indigenous kind, first discovered in a votive cave at Kam^res, on the southern slopes of Mount Ida, and subsequently in greater abundance at Knossds. But the most brilliant period of prehistoric Cretan civilization corresponds with the great age of Mycenae (the 14th and 15th centuries B.C.), and the contents of a palace of this epoch, recently excavated on the 'acropolis of Knossds by Mr A. J. Evans, show that in sculpture and fresco-painting the artists of Minoan Crete equalled, if they did not surpass, those of the con- temporary Peloponnesos. Of all the evidences of this early civilization now brought to light the most remark- able is the discovery of an elaborate system of writing. A series of signs, both of the linear and more pictographic class, had already been observed on early seal-stones, and other objects. In the palace at Knossds, however, have been found a large number of clay tablets, analogous in many respects to the cuneiform tablets of Babylonia, but inscribed with the indigenous Cretan character. They are apparently palace archives and lists of horses, chari- ots, and stores in the royal stables and arsenal. To this brilliant Mycenaean age succeeds the period of the Dorian emigration, characterized by the "geometric" type of art. The decline of civilization is marked by a falling off in artistic production, but to a less extent than on the Greek mainland, a certain continuity of ancient tradi- tions being maintained. By about the 8th century b.c. there is a manifest artistic revival, best illustrated by some of the reliefs on the bronze shields discovered in the great cave of Zeus on Mount Ida, in which the native Cretan handiwork more than holds its own beside im- ported Cypro-Phoenician examples. During the so-called archaic period of Greek art, Crete, the ancient home of letters, shows itself especially rich in epigraphic mate- rials. The great inscription of Gortyna, discovered by Halbherr and Eabricius, is the most important monument of early law

hitherto brought to light in any part of the Greek world. A very interesting inscription found at Prsesos in eastern Crete shows that the language of the pre-Hellenic population, the Eteocretes of Homer, survived in that region till at least the beginning of the 5th cen- tury B.C. Of early Greek buildings in Crete, the most re-

markable yet discovered is the Pythion at Gortyna. Ex- ploration in progress at Axos, where important bronze reliefs have been found, and elsewhere, promises to add to our knowledge of classical art in Crete : meanwhile it is best represented by a very interesting series of coin-types, which show a certain marked originality and picturesque- ness of design, but at the same time give evidence of repeated lapses into barbarism, resulting from the inter- necine feuds of the various cities and their isolation from the rest of the Greek world. (See also Mycenaean Civilization.)

Eecent History. — Cretan constitutional history may be said to date from 1868, when, after the suppression of an insurrection which had extended over three years, the Turkish Government consented to grant a certain measure of autonomy to the island. The privileges now accorded were embodied in what is known as the Organic Statute, an instrument which eventually obtained a somewhat wider importance, being proposed by Article XXIII. of the Berlin Treaty as a basis of reforms to be introduced in other parts of the Otto- man empire. Various privileges already acquired by the Christian population were confirmed; a General Council, or representative body, was brought into exist- ence, composed of deputies from every district in the island; mixed tribunals were introduced, together with a highly elaborate administrative system, under which all the more important functionaries, Christian and Mus- sulman, were provided with an assessor of the opposite creed. The new constitution, however, proved costly and unworkable, and failed to satisfy either section of the population. The Christians were ready for another outbreak, when, in 1878, the Greek Government, finding Hellenic aspirations ignored by the Treaty of San Stef- ano, gave the signal for agitation in the island. During the insurrection which followed the usual barbarities were committed on both sides; the Christians betook them- selves to the mountains and the Mussulman peasants crowded into the fortified towns.

Eventually the Cre- tan chiefs invoked the mediation of England, which Turkey, exhausted by her struggle with Kus- sia, was ready to accept, and the convention h'^cm. known as the Pact of Halepa was drawn up in 1878 under the auspices of Mr Sandwith, the British Consul, and Adossides Pasha, both of whom enjoyed the confidence of the Cretan population. The privileges conferred by the Organic Statute were confirmed; the cumbersome and extravagant judicial and administrative systems were maintained; the judges were declared independent of the executive, and an Assembly composed of forty-nine Christian and thirty-one Mussulman deputies took the place of the former General Council. A parliamentary regime was thus inaugurated, and party warfare for a time took the place of the old religious antagonism, the Moslems attaching themselves to one or other of the political factions which now made their appearance among the Christians. The material interests of the island were neg- lected in the scramble for place and power ; the finances fell into disorder, and the party which came off worst in the struggle systematically intrigued against the Gov- ernor-General of the day and conspired with his enemies at Constantinople. A crisis came about in 1889, when the " Conservative " leaders, finding themselves in a minority in the Chamber, took up arms and withdrew to the mountains. Though the outbreak was unconnected with the religious feud, the latent fanaticism of both creeds was soon aroused, and the island once more became a scene of pillage and devastation. Unlike the two preced- ing movements, the insurrection of 1889 resulted unfavour- ably for the Christians. The Porte, having induced the

Greek Government to persuade the insurgents not to oppose the occupation of several strategic posts, des- j)atched a military governor to the island, proclaimed martial law, and issued a firman abrogating many impor- tant provisions of the Halepa Pact. The mode of election to the Assembly was altered, the number of its members xeduced, and the customs revenue, which had hitherto been shared with the island, was

appropriated by the Turkish Treasury. The firman was undoubtedly illegal, as it violated a convention possessing a quasi-international sanction, but the Christians were unable to resist, and the Powers abstained from intervention. The elections held ■under the new system proved a failure, the Christians refusing to go to the polls, and for the next five years Crete was governed absolutely by a succession of Mahom- medan Valis. The situation went from bad to worse, the -deficit in the budget increased, the gendarmery, which ~~*received no pay, became insubordinate, and crime multi*~~ *plied. In 1894 the Porte, at the instance of the Powers, nominated a Christian, Karatheodory Pasha, to the gov- ernorship, and the Christians, mollified by the concession, •agreed to take part in the Assembly which soon after- wards was convoked ; no steps, however, were taken to remedy the financial situation, which became the immedi- ate cause of the disorders that followed. The refusal -of the Porte to refund considerable sums which had been illegally diverted from the Cretan treasury or even to sanction a loan to meet immediate requirements caused no little exasperation in the island, which was increased by the recall of Karatheodory (March 1895). Before that ■event an Epitrop^, or " Committee of Reform," had Appeared in lie mountains^-the harbinger of theprolonged .*

struggle which ended in the emancipation of ^{ona}*^T." '^^^- The Epitrope was at first nothing more*

than a handful of discontented politicians who had failed to find places in the administration, but some slight reverses which it succeeded in inflicting ■on the Turkish troops brought thousands of armed Christians to its side, and in April 1896 it found itself strong enough to invest the important garrison town of Vamos. The Moslem peasantry now flocked to the fortified towns and civil war began. Serious dis- turbances broke out at Canea on 24th May, and were ■only quelled by the arrival of foreign warships. The foreign consuls intervened in the hope of bringing about a peaceful settlement, but the Sultan resolved ■on the employment of force, and an expedition des- patched to Vamos effected the relief of that town with a loss of 200 men. The advance of a Turkish •detachment through the western districts, where other garrisons were besieged, was marked by pillage and devastation, and 5000 Christian peasants took refuge ■on the

desolate promontory of Spada, where they suf- fered extreme privations. These events, which pro- duced much excitement in Greece, quickened the ener- gies of the Powers. An international blockade of the island was proposed by Austria but rejected by England. The ambassadors at Constantinople urged peaceful counsels on the Porte, and the Sultan, alarmed at this juncture by an Armenian outbreak, began to display a conciliatory disposition. The Pact of Halepa was restored, the troops were withdrawn from the inte- rior, financial aid was promised to the island, a Chris- tian Governor-General was appointed, the Assembly was summoned, and an Imperial Commissioner was despatched to negotiate an arrangement. The Christian leaders pre- pared a moderate scheme of reforms, based on the Halepa Pact, which, with a few exceptions, were approved by the Powers and eventually sanctioned by the Sultan. On 4th September 1896 the Assembly formally accepted the new Constitution and declared its gratitude to the Powers

for their intervention. The Moslem leaders acquiesced in the arrangement, which the Powers undertook to guarantee, and, notwithstanding some symptoms of dis- content at Candia, there was every reason to hope that the island was now entering upon a period of tranquillity. It soon became evident, however, that the Porte was endeavouring to obstruct the execution of the new reforms. Several months passed without any step being taken in this direction ; difficulties were raised with regard to the composition of the international commissions charged with the reorganization of the gendarmery and judicial system ; intrigues were set on foot against the Christian Governor-General ; and the presence of a special Imperial Commissioner, who had no place under the constitution, proved so injurious to the restoration of tranquillity that the Powers demanded his immediate recall. The indig- nation of the Christians increased, a state of insecurity prevailed, and the Moslem peasants refused to return to their homes. A new factor now became apparent in Cretan politics. Since the outbreak in May 1896 the Greek Government had loyally co-operated with the Powers in their efforts for the pacification of the island, but towards the close of the year a secret society known as the Ethnike Hetaeria began to arrogate to itself the direction of Greek foreign policy. The aim of the society was a war with Turkey with a view to the acquisition of Macedonia, and it found

a ready instrument for its designs in the grovnng discontent of the Cretan Chris- tians. Emissaries of the society now appeared in Crete, large consignments of arms were landed, and at the beginning of 1897 the island was practically in a state of insurrection. On 21st January the P^* Greek fleet was mobilized. Affairs weretirought . oa. to a climax by a series of conflicts which took place at Canea on 4th February; the Turkish troops fired on the Christians, a conflagration broke out in the town, and many thousands of Christians took refuge on the foreign warships in the bay. The Greek Govern- ment now despatched an ironclad and a cruiser to Canea, which were followed a few days later by a torpedo flotilla commanded by Prince George. The prince soon retired to Melos, but on the night of 14th February a Greek expeditionary force under Colonel Vassos landed at Kolym- bari, near Canea, and its commander issued a proclama- tion announcing the occupation of the island in the name of King George. On the same day Georgi Pasha, the Christian Governor-General, took refuge on board a Eussian ironclad, and, on the next, naval detachments from the warships of the Powers occupied Canea. This step paralysed the movements of Colonel Vassos, who after a few slight engagements with the Turks remained practically inactive in the interior. The insurgents, how- ever, continued to threaten the town, and their position was bombarded by the international fleet (21st Febru- ary). The intervention of Greece caused immense ex- citement among the Christian population, and terrible massacres of Moslem peasants took place in the eastern and western districts. The forces of the Powers shortly afterwards occupied Candia and the other maritime towns, while the international fleet blockaded the Cretan coast. These measures were followed by the pre- sentation of collective notes to the Greek and of›»» Turkish Governments (2nd March) announcing Powers. the decision of the Powers that (1) Crete could in no case in present circumstances be annexed to Greece ; (2) in view of the delays caused by Turkey in the applica- tion of the reforms Crete should now be endowed with an effective autonomous administration, intended to secure to itaseparate government, underthe suzerainty of the Sultan. Greece was at the same time summoned to remove its army and fleet from the island, while the Turkish troops*

were to be concentrated in the fortresses and eventually withdrawn. The Cabinet of Athens, however, declined to recall the expeditionary force,

which remained in the interior till 9th May, when, after the Greek reverses in Thessaly and Epirus, an order was given for its return. Meantime Cretan autonomy had been proclaimed (20th March). After the departure of the Greek troops the Cretan leaders, who had hitherto demanded annexation to Greece, readily acquiesced in the decision of the Powers, and the insurgent Assembly, under its president Dr Sphakianakis, a man of good sense and moderation, co-operated with the international commanders in the maintenance of order. The pacification of the island, however, was delayed by the presence of the Turkish troops and the inability of the Powers to agree in the choice of a new Governor-General. The prospect of a final settlement was improved by the withdrawal of Germany and Austria, which had favoured Turkish pretensions, from the European concert (April 1898) ; the remaining Powers divided the island into four depart- ments which they severally undertook to administer. An attack made by the Moslems of Candia on the British garrison of that town, with the connivance of the Turkish authorities, brought home to the Powers the necessity of removing the Ottoman troops, and the last Turkish soldiers quitted the island on 14th November 1898. On the 26th of that month the nomination of Prince George of Greece as high commissioner of the Powers in Crete for a period of three years (renewed in 1901) was formally announced, and on 21st December the prince landed at .Suda and made his public entry into Canea amid enthusiastic demonstrations. After his arrival com- plete tranquillity prevailed in the island. On 27th April 1899 the new autonomous constitution was voted by a constituent assembly, and in the following June the local administration was handed over to Cretan officials by the international authorities.

Among the more recent works on Crete are i-^Eattlin. Descrip- tion physique de l' He de Crete, 3 vols, and Atlas, Paris, 1869. — Stillman. The Cretan Insurrection of 1866-68. New York, 1874. — Edwardbs. Letters from Crete. London, 1887. — Stavkakis. SraTuTTiKii rov irXijduo-^oC rijt KpijTijs. Athens, 1890. — J. H. Fkeese. A Short Popular History of Crete. London, 1897.— Bickford- Smith. Cretan Sketches. London, 1897. — Labochb. La Crete uncienne et moderne. Paris, 1898. — Victor Berard. Les Affaires de Crete. Paris, 1898. See also Mrs Walker. Eastern Life and Scenery. London, 1886; and Old Tracks and New Landmarks. London, 1897.— H. F. Tozer. The Islands of the

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(j. D. B.)

Cretinism. See Pathology (metabolic diseases).

C re use, a department in the central plateau of France, watered by the Creuse.

Area, 2164 square miles, distributed among 25 cantons and 266 communes. The population decreased from 284,942 in 1886 to 259,138 in 1901; births in 1899, 5176, of which 321 illegitimate; deaths, 4624 ; marriages, 2040. There were in 1896, 594 schools, with 43,000 pupils, and five per cent, of the population was illiterate. None of the towns has a large population. The returns for 1896 gave the total area under cultivation at 1,093,210 acres, of which 674,310 acres were plough-land and 316,160 acres grass land. In 1899 the wheat crop returned a value of £258,000, or less than half that of rye, £562,000. Potatoes yielded a crop valued at £490,000, and the natural pastures and grass lands £814,000. Hemp, which is largely cultivated, gave a return of the total value (in harl and in seed) of £400,000. Chestnut is also an important culture. The live stock of 1899 included 228,250 cattle, 645,690 sheep, 120,540 pigs, and 14,620 goats. 195,000 metric tons of coal were mined in 1898, but metallurgy is in a backward state.

Creusot, Le, or Creuzot, a town and railway centre of France, department of SSone-et-Loire, in the

arrondissement of Autun, 34 miles in direct line north- west of Macon. The importance of its coal and iron mines, and vast engineering works of every description, has very much increased. The total number of persons employed in the coal mines exceeds 10,000, and about 9000 are engaged in the metallurgical departments. A network of railways with a total

length of about 37 miles connects aU branches of the works, which now occupy about 1000 acres. The output of the coal-field (Creusot and Blanzy) amounted in 1899 to 1,647,594 tons. Special attention is paid to the welfare of the workers, and ex- cellent schools have been established. Population (1881), 15,740 ; (1896), 19,713, (comm.) 31,589 ; (1901), 30,175.

Crevillente, a town of Spain in the province of Alicante. Population in 1897, 9846. It is built on rising ground, its flat-roofed houses standing picturesquely amidst rock, nopals, cactus, dwarf palms, and orange trees. In its neighbourhood are two sources not far from each other, the waters of which differ 25° Fahr. in tem- perature, and are used for irrigation. The rugged territory around produces wine, olives, wheat, spart grass, and famed melons. The local industries are manufactures of warse stuffs, spart carpets, oils, and flour. There are a mediaeval castle, two fine churches, and a town hall.

Crewe, a municipal borough (incorporated 1877, enlarged 1892) in the Crewe parliamentary division of Cheshire, England, 158 miles north-north-west of London, on the main line of the London and North-Western rail- way. It is a railway junction where lines converge from Manchester, North Wales and Holyhead, Liverpool, North Stafford, and Hereford. It is inhabited principally by persons in the employment of the London and North- Western Railway Company. Crewe is not only one of the busiest railway stations in the world, but , is the locomotive metropolis of the London and North-Western Railway Company, who have centred here enormous workshops for the manufacture of the material and plant used in their railways. In 1901 the 4000th locomotive was turned out of the works. Recently the station has been extended, both north and south, and a series of subterranean ways extending many miles have been constructed to enable merchandise traf&c to pass through without interfering with passenger trains on the surface railways. The Railway Company have erected one of the finest electric stations in the world, and electrical apparatus for the working of train signals has been brought into operation. The station is fitted with an extensive suite of offices for the interchange of postal traffic, the chief mails to and from Ireland and Scotland being stopped here and arranged for various distributing

centres. Its enormous railway facilities and its geo- graphical situation as the junction of the great trunk lines running north and south, tapping also the Stafford- shire potteries on the one side and the great mineral districts of Wales on the other, constitute it one of the most important links of railway and postal communicar tion in the kingdom. The town owes its growth and importance to the London and North-Western Railway Company, who built its principal schools, provided it with a mechanics' institute, containing library, science and art classes, reading rooms, assembly rooms, &c., and also with baths. Victoria Park, also the gift of the Company, was, opened in 1888. There are five Established churches, a Roman Catholic church, and many Noncon- formist chapels. Two cattle-markets and a theatre have been erected. The corporation have just completed a technical institute and school of art. The area of the borough is 2193 acres. Population (1881), 24,385 ; (1891), 28,671; (1891) (on the area as afterwards extended),

32,783; (1901), 42,075.

CKICKET.

THE era of the modern development of cricket may be definitely dated from the visit of the first Austra- lian team to England in 1878. The previous twenty years had been devoted to the gradual improvement of the game throughout the country. But whilst the value of the work of the touring organizations had been enor- mous, interest in their encounters with local twenty-twos had steadily abated. The splendid prowess of the family of Grace set a new standard of ability, and the real value of county cricket began to be appreciated after the enactment that no cricketer could play for two counties in the same season. Many had previously played indiscriminately either for that of birth or residence, whilst one player, Southerton, represented four counties in the same season.

The development and modification of modern cricket have considerably altered the game. The improvement in the ground has caused the abolition of long-stop, once the most important place in the field, that position not having been filled in first-class cricket since 1877. Over- arm

action in bowling is now universal, though occasionally lobs judiciously pitched and supported by unusually brill- iant fielding have proved effective. The tendency of the modem attack is to bowl for catches rather than on the wicket ; consequently the positions of the field have been much aitered, three slips being quite common, and four having been at times required by very fast bowlers. Cover-point, whilst still an important post, is no longer so brilliant a situation as in the days when the Rev. V. K. Koyle became famous ; and leg hitting has so entirely departed — the last great exponent having been William Oscroft — ^that for some bowlers not a single man is placed on the on-side. At the same time the conviction must grow upon every careful observer that, whilst the increased precision of modern batting continually augments the disadvantages under which the bowler labours, this is not only due to the admirable condition of the turf, but also to a deterioration in fielding. Whether first-class cricketers participate in more matches than they are physically capable of playing at the top of their skill in all depart- ments, or whether this additional handicap to the bowler is due to lack of unison between members of a side, the fact remains that the evil of giant scoring can be best remedied by improvement in fielding, which is largely a matter of personal effort, and without which the multi- plication of matches is spoiling the perfection of the game.

The accessories of cricket are now very different from those in former days. Large pavilions with admirable accommodation for refreshment and dressing have replaced the old tents or " booths," whilst the general public now finds spacious covered stands and thousands of free seats on every county ground. The improved telegraph boards, giving the runs as scored and the numbers opposite the names of both batsmen and bowlers on the printed card, are even now inferior to those employed in Australia, where the entire score and bowling analysis is often dis- played. The increasing amount of space devoted to the game in every daily paper, and the publication of the averages weekly during the season, indicate the enormous attention given by the press io the game, whilst signed articles by the most noted amateurs have become pro- minent in many popular journals, and the latest scores are a feature of each edition of the evening papers. The legislative power over the game is still vested m the Com- mittee of Marylebone Cricket Club, consisting of sixteen members, four

retiring annually. Their places are filled by general vote at the annual meeting of the club, when

all the suggestions for. legislation have to be ratified by a majority of those present. The new president of the club is annually nominated by the outgoing president at the dinner held on the same evening ; but as this is badly patronized, it is now usual to mention the successor when, responding to the customary vote of thanks at the meeting.

The line of demarcation between the professional and the pseudo-amateur has often given rise to much bitter- ness. It is of course the rule that any amateur, who desires it, may receive the money for which he is out of pocket in hotel and travelling expenses. But it has been asserted that a number of prominent amateurs derived large incomes under the guise of expenses. Until Dr W. G. Grace retired from Gloucestershire to take the direction of the London County Cricket Club at the Crystal Palace for five years at a salary of a thousand a. year, the question of his expenses was continually cropping up. Lord Alverstone as chairman of the Surrey County Cricket Club also stated, on the retirement of Mr W W. Bead, that his case had been peculiar and would never become a precedent. Prowess at cricket has undoubtedly helped amateurs to get comfortable billets not only as schoolmasters, but in breweries, ofB.ces, and on the execu- tive of county cricket clubs. A professional in first-class cricket obtains five pounds for each county match he plays, and his hotel bill and third-class railway fares in out-matches. It is the custom of many committees to- give a sovereign to every professional who scores fifty runs, and money to those who perform the hat trick (i.e., take three wickets with consecutive balls) or make a ” century.” Yorkshire, however, leaves the donation of ” talent money ” to the captain, whilst the M.C.C. give a bat to every amateur or professional who scores a century for them. Professionals have always received ten pounds when play- ing for Players v. Gentlemen at Lord’s, and a like sum was invariably paid in ” test matches ” (i.e., between represen- tative elevens of England and Australia) up to August 1896, when the five professionals selected demanded twenty pounds for their services. The affair created a. great sensation, and eventually three of the five, having^ withdrawn their request, were included on the side. In all the test matches of 1899 twenty

pounds was given to> each professional employed. Every county professional of proved ability has the prospect of a benefit towards the end of his career, and the proceeds of the Whit Monday match at Lord's is annually devoted to the recompense of one of the professionals on the ground staff of the Maryle- bone Cricket Club. In December 1899, on Lord Hawke'^ instigation, it was resolved at a meeting of the county secretaries that " the counties should reserve direct control over the investment and disposal of all cricket moneys."" The largest amounts have been recorded at Peel's benefit at Sheffield and Mold's at Manchester, when the subscrip- tion lists and the gate money in each case exceeded £2500. Many counties now give winter pay to their professionals at about fifty shillings a week, Yorkshire having been the first to set the .example. Professionals in advanced years also derive benefit from the Cricketers' Fund, and obtain billets as coaches and groundmen. Umpires receive a, pound a day, and each gets a cricket ball as a perquisite. The list of county umpires was first submitted by the counties to the Committee of M.C.C. in December 1882 to prevent any one standing when his own county was playing. Latterly the county captains have selected twenty umpires to act in the county matches of the following year.

The present rules differ in many respects from those in use in the middle of the last century. The trend of cricket iMvs. legislation has been in three directions : (1) to put county qualification on a more equitable basis ; (2) to enforce fair bowling ; and (3) to increase the chances of bringing matches definitely to a conclusion. (1) The question of county qualification has been a mat- ter of constant friction. The importations of Mr J. J. Ferris to Gloucestershire, and of Albert Trott and Eoche to Middlesex, are examples of men qualifying from Australia. Mr P. R. Spofforth, of New South Wales, has played for Derbyshire, for which county the West Indian Mr C. A. Olivierre has qualified, whilst Mr G. C. B. Llewellyn and Mr C. 0. H. Sewell, of the Ca,pe, have played respectively for Hants and Gloucester- shire. Some wealthy counties practically purchased skilled professionals born outside their boundaries,

and county teams have been seen in which only two members on the side were actually qualified by birth. The rules had, however, stood unchanged since 1873, except for the addition in 1888 that a man can play for his old county during the two years that he is qualifying for another, until the new code came into operation in 1900. (2) Unfair bowling has been prevented so far as possible, but the umpires have often failed to agree in penalizing bowlers who were widely accused of throwing. The chief discussion arose over the delivery of Crossland, and after Lord Harris had openly made himself the spokesman of the malcontents an unfortunate difference arose between Notts and Lancashire. Just as the question of Crossland's action threatened to cause a serious schism, it was discovered that he had lost his residential qualification, so the matter terminated through a side issue, and Crossland was never no-balled by any umpire. There are six prominent instances of no-balling for throwing in first-class matches, the most sensational being those of Mr E. Jones in Australia, Mr C. B. Fry, Mold, and Tyler, the umpire in each case being James Phillips; in the two last-named cases even when the bowler was not at his end and he was standing at square- leg. Hopkins of Warwickshire was no-balled by Titch- marsh in 1898, and Captain Bradford of Hampshire by three umpires in 1899. The delivery of several great bowlers has been impeached, and Mr F. E. Spofforth in a letter to a sporting paper in January 1897 stigmatized both Mr T. R. M'Kibbin and Peel. The action of Mr M. A. Noble in the Australian team of 1899, of Mr W. C. Hedley, Mr W. F. Forbes, and Watson, all aroused marked difference of opinion. (3) The alteration of the follow-on rule and the legislation of the right of declaring an innings closed were made in consequence of two remarkable exhibitions in the university matches of 1893 and 1895, whilst in other cases batsmen had obviously knocked down their wickets. The result in minor matches has not been conducive to the popu- larity of the game, for instances have often been given of cricketers not getting an innings in several succes- sive games ; but in first-class fixtures Dr W. G. Grace is the only captain who has yet applied the closure and lost the game. The enormously increasing percentage of drawn games, now annually over 63 per cent., is attributed to the excellence of cricket pitches ; and sug- gestions for heightening and broadening the wicket, re- ducing the size of the bat, deciding unfinished fixtures on the first innings, and giving the losers of the toss the option to

bat first in the return match, have been widely discussed and thus far negatived. The Committee of M.C.C., in May 1900, tried the experiment of the aboli- tion of boundaries by the erection of a netting round the ground. Several alterations were effected in the compli- cated system of scoring thus introduced, but the entire

attempt was pronounced a complete failure and soon abandoned. The law of leg-bef ore-wicket has also been much discussed, owing to the general objection to the growing habit of deliberately putting the body or legs in front of a breaking ball instead of playing it with the bat. To Gunn and Shrewsbury belongs the reputation of first regularly practising and perfecting a form of legitimate cricket absolutely at variance with the spirit of the game, and their example has been widely followed, to the detri- ment of the attractiveness of batting. In 1884 Lord Harris proposed that the side losing the toss in the first match should have the option of choice of innings in the return engagement; but this was never tried. In the previous year he had commented on the prevalence of illegal-sized bats, and in 1884 nearly all the prominent cricketers appeared with bats which had been shaven down to the proper width.

Lord Harris, 7th December 1886, proposed the estab- lishment of a cricket council, which was organized 12th June 1887, a date practically coinciding with the centenary of the M.C.C. It was expressly couacii. stated that the new body should have no power over the laws of the game, but be competent to amend the rules of county cricket qualification, whilst at the meeting in December 1887 a discussion was raised on the leg-before-wicket question and on the reduction of scoring. In December 1889 Lord Cobham became chair- man, on the appointment of Lord Harris to be governor of Bombay. On 11th August 1890, at the Oval, with Mr J. Shuter in the chair, the council received the report of the committee appointed to drawup a classification of counties. The scheme advocated that the shires should be divided into three sections, with the suggestion that the lowest county in the first and the highest in the second should, in the following season, play home-and-home matches, the winner to be qualified for inclusion in the premier body. On 25th October the representatives of the second-class counties held a meeting protesting against the proposed new legislation, Dr Eussell Bencraft being in the

chair. At the meeting of the cricket council on 8th Decem- ber 1890, with Mr M. J. Ellison presiding, on the motion that the whole question of classification be discussed, Mr A. J. Webbe proposed as an amendment that the meeting be suspended sine die, which was carried by the chairman's casting vote, thus putting an abrupt and unexpected termination to the existence of this abortive assembly.

*The classification of counties was introduced by Mr Ellison at the meeting of the county secretaries December 1893, for the express purpose " of doing away with that very invidious distinction which had Co'"'*y existed for some years and abolishing that "ship." ° hated word ' championship,' which the whole cricket world would be glad to get rid of." This opinion was proved to be erroneous. A special meeting was called for 1st May 1894, when an amendment was carried requesting the Committee of M.C.C. to consider and advise on the whole subject. The captains of the then first-class counties — Lord Hawke (Yorkshire), Dr W. G. Grace (Gloucestershire), Messrs J. Shuter (Surrey), S. M. J. Woods (Somersetshire), J. A. Dixon (Notts), F. Marchant (Kent), A. J. Webbe (Middlesex), W. L. Murdoch (Sussex), and A. N. Hornby (Lancashire) — sent in a resolution that the fixtures of Derbyshire, Essex, Leicestershire, and Warwickshire be regarded as first-class. This was ratified by the Committee of the M.C.C, who also included Hampshire in the following year. The con- solidation of county cricket has since caused the line of demarcation to be very marked, but Worcestershire was elevated in 1899. The earliest mention of a county championship had been in 1870. For a long time con-*

servative folk and many prominent cricketers vigorously opposed what was to a great extent a creation of the sporting press. Popular opinion could not, however, be withstood, and it became presently evident that the inter- est of the public was most keenly aroused over the cham- pionship, although the notion of atrophy incommemoration of the annual achievement was universally scouted. Finally the recognition of the county championship was forced upon the Committee of the M.C.C., who

laid down the rule that ” one point shall be reckoned for each win ; one deducted for each loss. Unfinished games shall not be reckoned. The county which, during the season, shall have, in finished matches, obtained the greatest proportionate number of points shall be reckoned the champion county.” The old way, prior to this enactment, had been simply to regard the county which lost fewest matches as cham- pions, taking no account of proportion. The actual result has been to concentrate not only popular attention but the best efforts of the foremost cricketers on county fix- tures. Therefore, the interest in the first-class fixtures of the M.C.C. as well as other scratch teams has enor- mously diminished. Indeed, so important had county cricket become that it was thought necessary at the meet- ing of the secretaries in December 1895 to propose a motion pledging the first-class counties to give up any players required to represent England in the test matches. The list of champion counties is : —

Played.

Won.

Lost.

Drawn

*1873 / °^*

\ Gloucestershire

7 6

5 4

1 0

1 2

1874 Derbyshire

4

3

0

1

1875 Notts

10

6

1

3

1876 Gloucestershire

8

5

0

3

1877 Gloucesteishire

8

7

0

1

1878 Middlesex

6

3

0

3

,«-q /Notts ”’\LancaBhire*

12 10

5 5

1

1

6 4

1880 Notts

10

6

1

3

1881 Notts

13

10

0

3

^^^’^ \ *Lancashire*

12 14

8 10

1 1

3 3

1883 Notts

12

4

1

7

1884 Notts

10

9

0

1

1885 Notts

12

6

1

6

1886 Notts

14

7

0

7

1887 Surrey

16

12

2

2

1888 Suney

14

12

1

1

(■ Surrey

14

10

3

1

1889-^ Lancashire

14

10

a

1

(.Notts

14

9

2

3

1890 Surrey

14

9

3

2

1891 Surrey

16

12

2

2

1892 Surrey

16

13

2

1

1893 Yorkshire

16

12

3

1

1894 Surrey

16

18

2

A tie

1895 Surrey

26

17

4

5

1896 Yorkshire

26

16

3

7

1897 Lancashire

26

16

3

7

1898 Yorkshire

26

16

3

7

1899 Surrey

26

10

2

14

1900 Yorkshire

28

16

0

12

1901 Yorkshire

27

20

1

6

We now come to the performance of the counties. Notts has a great record. Daft and Oscroft with the bat, and Shaw and Morley, perhaps unrivalled as a pair of bowlers, left ‘”/“trf traditions well supported by Gunn and Shrewsbury, two crc eL exceptionally able batsmen. With them was associated Scotton, most patient of ” stonewaUers,” whilst Barnes, Flowers, and Attewell did splendid service (the last-named being a remark- ably steady bowler, keeping a good length, which gave him an ab- normal number of “maidens”), and Sherwin was an excellent successor to Plumb and Wild at the wicket. Latterly Mr J. A. Dixon, for many years a vigilant captain, has seen a considerable decline in the fortunes of the county, the slow play of the home side alienating popular support at Trent Bridge until the advent of a dashing batsman in Mr A. O. Jones. With Shrewsbury, the latter scored 391 v. Gloucestershire in 1899, that being a ” record ” for first wicket. From 1873 to 1902 Notts won 155 matches, lost 90, and drew 109.

Gloucestershire, founded in 1871, and so long known as the county of the Graces, at the outset played an entirely amateur team. Apart from the prowess of the three famous brothers — E. M., W. G., and G. F. Grace —

many flue cricketers have appeared on the side, such as in the earlier days Messrs F. Townsend, W. R. Gilbert, and J. A. Bush, a notable stumper ; in the middle period, Midwinter, Mr J. Cranston, Mr 0. G. RadcliSe, and Woof ; more recently the colo- nial importations, Messrs J.J. Ferris and C. O. H..Sewell, and latterly that tremendous " slogger," Mr G. L. Jessop, and Mr C. L. Town- send, a remarkable left-handed batsman. From 1871 to 1902, Gloucestershire won 115 matches, lost 164, and drew 114. This county can boast the only cricketers who have scored 2000 runs and taken 100 wickets in the same season, namely, Dr W. G. Grace (1873), Mr C. L. Townsend (1899), and Mr G. L. Jessop (1900).

Lancashire, founded in 1864, has been directed by one of the hardest of hitters and best of captains, Mr A. N. Hornby. With his name wUl always be associated ithat of the patient Barlow. The bowling of Crossland, Nash, and Watson aroused discussion and evoked legislation on the nature of a fair delivery. The four brothers Steel did noble service when able to play, Mr A. G. Steel especially uniting marvellous skill with consummate theoretical knowledge. Briggs proved a clever left-handed bat, who gradually became one of the principal bowlers in England. Sugg, who mi- grated from Yorkshire and Derbyshire, was a great aggressive bat, and Pilling was the finest English wicket-keeper. A great profes- sional bat of the defensive type is Albert Ward, and the present captain is the famous Harrovian, Mr A. C. MacLaren, who played in such magnificent form as to be chosen to occupy that post for England in the four last test matches with the Australians in 1899. He made the highest individual score in a first-class match, 424 against Somerset at Taunton in 1895. The success of Mold as a fast bowler, the excellent cricket of Cuttell, and the batting of Baker and Tyldesley, have alike proved invaluable. From 1873 to 1902 Lancashire won 228 matches, lost 106, and drew 105.

Yorkshire, whose county club was founded in 1861, was at one time a team of professionals, but of late years Lord Hawke has been the captain. Its team, always good, has played the best and most attractive cricket, culminating in the highest honours in 1900, when the side went through a programme of twenty-eight fixtures with- out sustaining a reverse. In the earlier period Ulyett, Hall, and Lockwood were the most notable bats, Bates and Emmett valuable all-round men, with Freeman and Hill as

straight fast bowlers. As wicket-keeper. Binder was succeeded in turn by the capable brothers Hunter. In recent cricket Brown and Tunnioliffe have become famous for their partnerships. In 1898 v. Derbyshire, at Chesterfield, their stand of 554 runs is a world record, whilst v. Surrey in 1897 they scored 328 for the first wicket. Tunnioliffe has also caught out more batsmen than any other fieldsman. Hirst and Wain Wright have been efficient all-round men, of value to any side ; Haigh is an excellent fast bowler, and Mr Ernest Smith a useful bat. Wilfrid Khodes has also made a great name with the ball very early in his career, and in 1900, in county matches alone, he took 206 wickets for 12 runs apiece. The admirable all-round cricket of Mr F. S. Jackson has been of immense value, and Denton has done creditable work both with the bat and in the field. In earlier times Mr Sellars, Lee, and Preston were all successfuVand Edmund Peate in his prime was never surpassed as a bowler. The county record to 1902 was 257 victories against 114 defeats and 131 draws.

Middlesex was founded in 1868 on the initiative of the renowned family of the Walkers, seven brothers, the record of whose prowess has been latterly written by Mr W. A. Bettesworth. The county team was subsequently controlled by Mr A. J. Webbe, a notable old Oxonian. Pre-eminent in a team relying much on amateur talent was Mr A. E. Stoddart, one of the grandest bats of any period and a shrewd judge of the game, whose retirement from county matches was universally lamented. Sir Timothy O'Brien in his prime was also very sound, and his performance with Mr G.

F. Vernon against Yorkshire in 1895 will live in the annals of the game. The triumvirate of Studds — Messrs J. E. K., G. B., and C. T. — did fine work in the 'eighties, and a number of other univer- sity cricketers have assisted the metropolitan county : Messrs J.

G. Walker, P. F. Warner, M. E. Jardine, E. A. Mepean, E. H. Buckland, F. J. N. Thesiger, B. J. T. Bosanquet, F. H. E. Cun- liffe, F. G. J. Ford, W. J. Ford, A. F. J. Ford, J. Douglas, E. Lyttelton, R. N. Douglas, C. M. Wells, P. J. de Paravicini, P. J. T. Henery, C. I. Thornton, W. H. Hadow, and A. W. Ridley, may all be cited. Nor must the work of Messrs T. S. Pearson, S.

W. Scott, E. M. Hadow, and J. Robertson be forgotten, and the lengthy services of Mr A. J. Webbe will be memorable in county annals. After the retirement of Mr Alfred Lyttelton, no stumper of ability could be found until the appearance of Mr Gregor Mac- Gregor, the finest amateur wicket-keeper and a good captain. The attack — led by J. T. Hearne, most willing of good-length bowlers, and the spirited Australian, A. E. Trott, with such useful changes as Rawlin and Roche — is formidable. Trott both in 1899 and 1900 performed the hitherto unprecedented feat of scoring over

1000 runs and taking 200 wickets. From 1873 to 1902 Middlesex won 131 matches, losing 117, with 96 unfinished.

Surrey, one of the oldest counties, passed through vicissitudes when Jupp, Pooley, Southerton and Humphrey grew old. Under the energetic direction of Mr J. Shuter they again came to the front, and for several years the excitement over the Bank Holi- day match with Notts was intense, 63,763 people witnessing the game in 1892. So remarkable a cricketer as George Lohmann would alone have made a side famous, and he received admirable support from Beaumont and Bowley. In those days Mr W. W. Read was performing marvels with the bat, and Abel showed ex- traordinary ability, being the finest cricketer of his inches in the world. His biggest score was 357 not out v. Somerset in 1899. Maurice Read, a dashing hitter, Mr W. E. Roller, and the late Mr M. P. Bowden also did yeoman service. Mr K. J. Key then be- came captain ; and Brockwell, a valuable and hard-working all- round player, sprang into prominence. With Abel he scored 379 V. Hants, 1897, the largest of many notable stands. Sharpe had a brief and sensational success with the ball, and Lockwood became almost as deadly as Lohmann. Yet more famous has been Tom Richardson, who from 1893 to 1898 was absolutely a terror to all Surrey's opponents, taking 1340 wickets for 20,000 runs. Hay- ward, nephew of the famous Cambridgeshire professional, gained fame as a wonderfully judicious bat ; and his superb play in the test matches o£ 1899, when he averaged 65, may be considered the highest standard

attained by any salaried cricketer. Mr D. L. A. Jephson, advancing on his university reputation, developed dogged defiance combined with great punishing power, and became the only modern lob bowler of calibre. Surrey up to 1902 had won 242 victories against 138 defeats and 109 drawn games.

Sussex has always been hampered by lack of effective bowling and by the run-getting capability of the county ground at Brighton. In the 'eighties the performances were of the feeblest, but better days came when the Australian, Mr W. L. Murdoch, qualified. Of more value was the inclusion of Kumar Shri Ranjitsinhji, the Indian cricketer, whose dexterity and grace as a batsman have never been surpassed. He actually scored 2780 runs in 1896, averaging 57, while in county matches in 1899 he amassed 2555, averaging 75, and in 1900 his average of 83 was obtained for an aggregate of 2563 runs. Mr C. B. Fry is a brilliant bat ; Mr P. H. Latham has scored largely ; and Mr W. Newham, with Mr G. Brann, bore the brunt of the batting for.fifteen years. The bowling, in spite of the brothers Hide, has always been weak, though the lobs of Walter Humphreys were sometimes puzzling, and Alfred Shaw emerged successfully from his retirement in 1894. Sussex from 1873 to 1902 could claim only 80 victories against 195 defeats, with 104 undecided fixtures.

Kent (the modern county club, dating from 1870) has varied considerably, and has played more cricketers in its team in the past twenty-five years than any other county. The . incalculable value of Lord Harris as "batsman aiid captain was terminated by his appointment as governor of Madras. In the earlier period Messrs Frank Penn and Ivo Bligh were the greatest batters, with Mr E. F. S. Tylecote as wicket-keeper. Then came Mr W. H. Patterson, a remarkably sound bat, and Rev. W. Rashleigh, with Mr M. C. Kemp behind the stumps, Mr Stanley Christopherson as bowler, and that hard hitter Mr F. Marchant. In 1898 the latter handed over the reins of office to the Wykehamist, Mr J. R. Mason, an admirable all-round cricketer, who has been assisted by the fast bowler Mr W. M. Bradley and by Mr C. J. Burnup, an obstinate bat difficult to dislodge. The family of the Hearnes have done ad- mirable service for Kent, and the bowling of Martin and Wright has proved effective, whilst Blythe is

useful with left-handed deliveries. From 1873 to 1902 Kent won 119 matches, lost 165, and drew 95.

Derbyshire, founded in 1870, fared so poorly after the decline of their two fast bowlers. Hay and Mycroft, that conspicuous failures in 1886 and 1887 caused the county to be dropped from first-class fixtures until 1895. The re-inclusion was due to the excellent all- round play of Davidson, the steady batting of Chatterton, and the fine cricket of Storer, a great wicket-keeper, who could bat and on occasion bowl. Hulme bowled well when health permitted. The achievements of the county, whilst reckoned first-class, up to 1902 were only 36 successes against 123 defeats, with 53 unfinished fixtures.

Somersetshire only came into the first rank in 1891, and has since played an attractive though not always a successful game. The retirement of the captain, Mr H. T. Hewett, a brilliant left- handed hitter, was an incalculable loss, though his successor, Mr S. M. J. Woods, has worked with untiring courage and ability. Mr L. C. H. Palairet, the best bat in the county, with Mr H. T. Hewett, scored 346 in partnership v. Yorkshire 1892. Messrs R. C. N. Palairet, V. T. Hill, and W. N. Roe have been valued batsmen. Rev. A. P. Wickham and Mr A. E. Newton excellent stumpers, and Tyler a successful slow bowler. Up to 1892, 36 victories were scored against 89 defeats, with 39 unconcluded games.

Essex, a comparatively new county, owes its elevation in 1895 originally to the exertions of Mr C. E. Green. The eleven

possesses a quartette of bowlers with notably diversified styles : Messrs C. J. Kortright, F. G. Bull, Mead, and Young. The batting of Messrs P. Perrin, C. M'Gahey, and A. J. Turner, with Carpenter, has been wonderfully good. No small part of the success is due to the presence of that fine player, Mr A. P. Lucas,, who took part in the first test match in 1880, and twenty years later still averaged over 27. To 1902 the county had 41 gains to 36 losses and 50 undecided fixtures.

Warwickshire has played steady but unattractive cricket. Mr H. W. Bainbridge has proved valuable as captain and bat, the brothers Quaife have scored heavily though slowly. Diver has often made long innings,

and Lilley has been pre-eminently the modern English wicket-keeper. The achievement from 1895 to 1902 was 28 victories against 35 defeats and 62 draws.

Leicestershire has been least successful of all. Apart from Pougher, Mr C. E. de Trafford has had no player of rank under his captaincy, though Woodcock is a straight fast bowler. From 1895 to 1902 only 16 wins, 67 losses, and 36 draws make a poor chronicle, and the batting collapses have been frequent.

Worcestershire, only promoted in 1899, owes its advance mainly to the capital cricket of the Foster family.

Largely relying on military assistance, the form of Hampshire has been uncertain. The batting of Major Poore in 1899 has never been approached. In two months he scored 1399, with an average of 116. Grand batting capacity has also been displayed by Captain Wynyard. These two scored 411 v. Somerset in 1899 before they were separated. From 1895 to 1902, 24 wins, 62 losses, and 39' drawn games form the record of what is the oldest cricket county in England.

In December 1894 Mr P. H. Foley announced that the majority of the eighteen counties outside the important shires had agreed to> the institution of a championship among the second-class counties. This met with complete success, though it was unfortunate at the outset that Cheshire, who had not lost a game in 1894, could not enter the competition. In 1895 Worcestershire was bracketed champion with Norfolk and Durham, though third according to the ruling of M.C.C. In 1896 Worcestershire came out easily first, with only one defeat inflicted by Northamptonshire, whilst in 1897 and 1898 they possessed an unbeaten record, which caused their elevation to the front rank. In 1899 Northamptonshire and Bucks obtained the highest percentage of points, though the record of Glamorganshire, who only lost one game to the Surrey- Second Eleven, was infinitely superior. In 1900 Glamorganshire and Northamptonshire alike came through their list of fixtures- without sustaining any defeat. It must be pointed out that the level of play in minor county cricket is of a standard distinctly lower than that of even the less successful first-class counties. la 1899 and 1900 the following minor

counties played eight games apiece : — Northamptonshire (Mr T. Horton, captain), Bucks (Mr P. J. de Paravicini), Glamorganshire (Mr J. H. Brain), Nor- folk (Mr L. C. V. Bathurst)V Hertfordshire, Durham (Mr J. F. Whitwell), Northumberland (Mr'F. G. Clayton), Wiltshire (Mr A. M. Miller), Berkshire (Mr A. C. M. Croome),and Cambridgeshire. Oxfordshire (Mr C.C.Bradford), Bedfordshire (MrL. C. R.Thring), Devonshire, Cornwall, Monmouthshire, Rutlandshire, Cumberland, and Lincolnshire have also put elevens of varying ability in the field within the last few seasons. The popularity of cricket does not seem to progress much in either Scotland or Ireland, though the Dublin University crack, Mr Lucius Gwynne, twice played for Gentlemen v. Players, and proved himself a steady left-handed bat.

*The Marylebone Cricket Club has always remained the domina- ting authority on the game. Apart from its legislative powers, it has played an unparalleled number of matches. Be- tween 1878 and 1899 no less than 3151 fixtures have "'«"'• taken place, of which the premier club won 1730, losing ***}' w_ 607, with two ties and the remainder drawn. First- ""<' ^ class fixtures between 1878 and 1902 numbered 289, of which 135 were successful, 105 ended in defeat, and 50 were unfinished. With increased interest m county fixtures, the engagements of M.C.C. with counties have latterly deteriorated into trial matches for promising colts, the best amateurs of the county often declining to encounter the weak and unsatisfactory elevens put into the field by the club even at headquarters. As an example of the increase in county fixtures, it may be mentioned that the match-list for the following season was first published in Lillywhite's Annual for 1882, and occupied two pages, whilst in the issue for 1899 th& forthcoming matches filled nine pages. Mr Henry Perkins, as secretary to M.C.C, was in 1898 succeeded by Mr F. E. Lacey,. who used to play for Hants, and represented Cambridge in 1882. The M.C.C. celebrated its centenary in 1887 by a banquet at which the president of the year, Mr E. Chandos Leigh, took the chair,, the matches for the commemorative week being England v. M.C.C, and Ground and Gentlemen of M.C.C. v. Eighteen Veterans. In 1895 I Zingari celebrated their jubilee by playing the Gentlemen of England at Lord's. The historic wandering club is still para^ mount at the Canterbury Week, though county fixtures are now*

the rule. Scarborough and Hastings also have important cricket festivals at the conclusion of each season.

The University match yearly sustains its importance and interest. Up to 1901, 66 matches had been played, of which Cambridge have ■won 32, Oxford 30, and 5 have been left drawn ; 503 by Oxford in 1900, 388 by Cambridge in 1872 and 1892, and 365 by Oxford in 1892 are the highest totals. Mr R. E. Foster's 171 in 1900, Mr K. J. Key's 143 in 1886, and Mr M. R. Jardine's 140 in 1892, are the largest individual scores, whilst Mr K. J. Key and Mr C. E. M. WiLson have the best batting averages for the match. Eton has played Harrow 76 times, losing 32 and winning 28. The chief scores are Mr E. Bayley's 152 in 1841, and Mr T. G. 0. Cole's 142 in 1897, the highest total being Harrow's 388 in 1900. Cricket is ■enthusiastically played at all the public schools.

Gentlemen v. Players at Lord's always forms the crowning tussle of the year. In addition to the companion but less represen- tative fixture at the Oval, matches under this title have been played at Prince's, Scarborough, Brighton, and Hastings. Dr W. G. Grace has made fifteen three-figure innings — 217 at Brighton, 215 at Oval, 174 at Scarborough, 169 at Lord's — all these being at the time re- cords in the match on the ground. At Hastings he has scored 131, and at Prince's 110 ; but Gunn scored 169 at Hastings, and G. P. Grace 134 at Prince's. Abel made 247 at the Oval, whilst Mr R. E. Foster made 102 not out, and 136 in the same match at Lord's, Barnes 130, Brown 163. Altogether there have been 144 en- ■counters, of which the amateurs have secured 51, and the profes- sionals 70 matches, 22 being unfinished and 1 resulting in a tie. In 14 of these the aggregate exceeded 1000 ; in 1899, 1258 was scored at the Oval for 30 wickets, and in 1900, 1274 for 38 wickets, the Players going in to make 508 on fourth hands and winning by 2 wickets. North v. South has lapsed from its former position of im- portance, and M.C.C. v. England and Over Thirty v. Under Thirty have been dropped. Gentlemen no longer play I Zingari at Scar- borough, nor does East oppose West. Smokers v. Non-Smokers proved interesting at Lord's in 1884, Notts played England

in 1886, SuiTey opposed England in 1895 (the testimonial match to Mr W. W. Read), Surrey and Sussex confronted England in 1898 and 1900, and the Home Counties played the Rest of England in 1899. Lord Sheffield's team, Daft's team, and both Mr A. E. Stoddart's teams played the Rest of England on their return from Australian tours, "the last two defeating formidable opponents.

The visits of the Australian teams to England have aroused unparalleled interest and acted as an immense incentive to the game. The greatest sensation was caused when the y"g first team on 27th May 1878 defeated a powerful

watches. M.C.C. eleven in a single day, disposing of them for 33 and 19, Mr Spofforth taking 6 wickets for 4 runs, and Mr Boyle 5 for 3, whilst the Australians fielded superbly. Their prowess was well maintained when, in September 1880, Australia for the first time met the whole strength of England, for though the Old Country won by 5 wickets the honours were fairly divided, especially as Mr Spofforth could not play. Dr "W. G. Grace with a magnificent score of 152 headed the total of 420, but even finer was Mr W. L. Murdoch's imperturbable display, when he carried lis bat for a superb 158. Prom 1882 onwards the Colonials, with two exceptions, at Blackpool and Skegness, only played eleven-a- side matches. Such bowlers as Messrs Spofforth, Boyle, Palmer, G-arrett, and Gifien became household names. Nor was the batting less admirable, for Mr Murdoch was supported by Messrs Massie, M'Donnell, Bannerman, Horan, Bonnor, and Jones, whilst the wicket-keeper was the unrivalled Mr M'Carthy Blackham. This "visiting side in 1882 was the greatest team of all; 23 matches were won, only 4 lost, and England was defeated at the Oval by 7 runs. In 1884 English cricket had improved, and the visiting record was hardly so good. The stupendous match against Eng- land at the Oval will never be forgotten. The Colonials scored •551 (Mr Murdoch 211, Mr M'DonneU 103, Mr Scott 102), and England responded with 346, Scotton and Mr W. W. Bead adding 151 for the ninth wicket. Mr Scott's team in 1886 proved less successful, for all three test matches were lost, and eight defeats had to be set against nine victories, but Giffen covered himself with distinction. This was the first tour under the auspices of the Melbourne Club. M'Donnell's team in 1888 was rendered remark- able

by the appearance of Messrs Turner and Ferris. The former took 814 wickets for 11 runs each, and the latter 220 for 14 apiece. To all appearance they redeemed a poor tour, 19 matches being won and 14 lost. The 1890 tour, though Mr Murdoch reappeared, proved disappointing, both the test matches being lost and defeats for the first time exceeding victories, though the two bowlers again performed marvellously well. After an interval of three years, Mr Blackham captained the seventh team, which was moderately fortunate. Messrs Graham and Gregory batted admirably, and the magnificent 149 of Mr J. J. Lyons, v. M.C.C, electrified spectators, and was perhaps the finest display of punishing cricket ever recorded. In 1896, though they did not win the rubber of test matches, the Colonials were most successful, 19 matches being

victories and only 6 lost. Messrs Gregory, Darling, Iredale, Giffen, Hill, and G. H. S. Trott were the best bats, and the last-named made an admirable skipper. Mr H. Trumble kept an excellent length, and whilst the wickets lasted Mr E. Jones was deadly. Finally, the Australian representatives in 1899 demonstrated that they were the best since 1882, 16 successes and only 3 defeats (v. Essex, Surrey, and Kent) being emphasized by a victory over England at Lord's by the handsome margin of 10 wickets, the only one of the five test matches brought to a conclusion. The steady batting proved untiring, Messrs Noble and Trumper, both new- comers, being superb. The latter, v. Sussex, made 300, the largest individual score ever made by an Australian in England, the previous best having been 286 by Mr Murdoch in the corresponding match in 1882. Mr H. Trumble scored 1183 runs and took 142 wickets for 18 runs apiece, and Mr Darling not only made a judi- cious captain, but scored the biggest aggregate, 1941, ever obtained by any batsman touring with a Colonial eleven in England. On the home side, Hay ward did sound service as a batter, and his stand with Mr F. S. Jackson in the fifth test match yielded 185 runs for the first wicket. In England the ten Australian teams have played 320 eleven-a-side matches, winning 149, losing 74, and leaving 97 un- finished. Their highest innings was 843 v. Past and Present of Ox- ford and Cambridge at Portsmouth 1893, and the highest against them 576 for England at Oval 1899. Their lowest was 18, v. M.C.C. in 1896, when Pougher took 5 wickets in 15 balls for no runs,

and the lowest against them 19 by M.C.C. in 1878. Of the 24 test matches England has won 12 and the Australians 8.

The first team to visit Australia was organized in 1862. George Parr took out the next in 1864, Dr E. M. Grace being the only amateur. In 1873 the Melbourne Club invited Dr W. G. Grace to take out an eleven, and three years later James Lillywhite con- ducted a band of professionals. On this tour for the first time Colonials contended on equal terms, one match v. Australia being won by 4 wickets and the other lost by 45 runs. Lord Harris in the autumn of 1878 took a team of amateurs assisted by Ulyett and Emmett, winning 2 and losing 3 eleven-a-side encounters, Emmett's 137 wickets averaging 8 runs each. Shaw, Shrewsbury, and Lillywhite jointly organized the expedition of 1881, when Australia won the second test match by 5 wickets. Mr Ivo Bligh in 1882 took a fine team, which was crippled owing to the injury sustained by Morley that eventually proved fatal. Four victories could be set against three defeats ; Australia winning the only test match, owing to the batting of Mr Blackham. Shaw's second tour in 1884 showed Barnes heading both batting and bowling averages, while six victories counterbalanced two defeats. In the third tour Shrewsbury became captain, but the English for the first time encountered the bowling of Mr C. T. B. Turner, who took 27 wickets for 113 runs in two matches. Australia was twice defeated, the English captain batting in fine form. On this tour was played the Smokers v. Non-Smokers, when the latter scored 803 for 9 wickets (Shrewsbury 236, Mr "W. Bruce 131, Gunn 150), against the bowling of Briggs, Boyle, Lohmann, Mr Palmer, and Flowers. The winter of 1887 saw two English teams in Australia, one under Lord Hawke and Mr G. F. Vernon, the other under Shrewsbury and Lillywhite. Both teams played well, the batting being headed by Mr W. W. Read with an average of 65, and Shrewsbury with 58. The ill-success of Lord Sheffield's team in two out of three test matches did not disprove the great merits of his eleven. Dr W. G. Grace headed, the averages with 44, and received the best support from Abel and Mr A. E. Stoddart, whilst Attewell, Briggs, and Lohmann all possessed fine bowling figures. Mr A. E. Stoddart's first team (in 1894) achieved immense success and was the best of all. In the first test match they went in against 586 runs and ultimately won by 10 runs. Ward making 75 and 117. Mr Stoddart himself averaged 51, scoring 173 in the

second test match, and Mr A. C. MaoLaren, who made 228 v. Victoria, Brown, and Ward all averaged over 40. The last tour conducted by Mr A. E. Stoddart proved less satisfactory, four of the five test matches being lost, and some friction being caused by various incidents. K. S. Ranjitsinhji, who averaged 60 and made 175 in a test match and 189 v. South Australia, and Mr A. C. MacLaren, who scored five hundreds and averaged 54, were prominent, Hayward also doing good work ; but the bowling broke down badly. Altogether, in Australia, the English teams have played 87 eleven-a-side matches, winning 52 and losing 27. Of the 26 test matches, 12 have been won and 13 lost.

With regard to cricket in other parts of the world, many pleasant tours have been organized. The Philadelphians visited England in 1884, 1889, and 1897, when they won 2 and lost 9 games. Messrs G. S. Patterson, F. H. Other Bohlen, J. A. Lester, J. B. King, and R. S. NewhaU '^',",'1° have been the best amateurs. Teams of Canadian y'sits. Gentlemen came in 1880 and 1887, whilst Haverford College enjoyed an instructive tour in 1897. Parsees arrived in 1884 and 1888, and one member of the side, M. E. Pavri, once played for Middlesex. Gentlemen of Holland made a modest pilgrimage in 1894. The

Cape team of 1894 won 12 matches and lost 7, Mr C. O. H. Sewell, •who subsequently played for Gloucestershire, heading the batting, and Mr Rowe proving an excellent bowler, who captured 136 wickets for 12 runs apiece. A representative side from the West Indies were comparatively unsuccessful in 1900, though two coloured bowlers. Woods and Mignon, had fair averages, and Mr Olivierre, who headed the batting, remained to qualify for Derby- shire. Many visits have been paid to the United States. Irish amateurs toured in 1878 and 1892 ; and English teams were taken by Mr E. J. Sanders in 1885 and 1886, Lord Hawke in 1891 and 1895, Mr F. Mitchell in 1896, Mr P. E. Warner in 1897 and 1898, and K. S. Ranjitsinhji in 1899. Mr R. S. Lucas took a team to the West Indies in 1896, and both Lord Hawke and Mr A. Priestley had elevens touring in the islands in 1898. Mr A. E. Stoddart scored 1079, with an average of 53,

making six hundreds, and capturing 104 wickets for 7 rtins each. Mr P. F. Warner scored 984, with an average of 51, making four centuries. In April 1898 an English eleven visited Oporto under Mr Westray. India was visited by Mr G. F. Vernon's team in 1889 and by Lord Hawke's in 1892. All the above were strictly amateur combinations. Four tours have been made in South Africa— under Mr C. A. Smith in 1888, Mr W. W. Read in 1891 (when Mr Ferris took 235 wickets for 5 runs each), under Lord Hawke in 1896 (when Lohmann captured 157 wickets for 6 runs apiece), and in 1899 (when Haigh took 107 for 8 runs, and Trott 168 for 9 runs each). A very large proportion of the engagements of all these sides resulted in English victories, and the lavish hospitality left the pleasantest memories.

Beeords other than those already cited may be added for reference : — A schoolboy named A. E. J. Collins, at Clifton College, 1899, excited some interest by scoring 628 not out in a boys' match, being about seven hours at the wicket. Mr A. E. Stoddart made 485 for Hampstead v. Stoics in 1886. Melbourne University scored 1094 against Essendon in March 1898, this being the highest authenticated total on record. M.C.C. and Ground made 785 v. Wiltshire in 1888, the highest total at Lord's. In the match between Mr A. E. Stoddart's team and New South Wales at Sydney 1898, 1739 runs were scored, an aggregate unparalleled in first-class cricket. The lowest total in a first-class match is 12 by Oxford University v. M.C.C. and Ground at Oxford in 1877. The record for first wicket is 472 by Messrs S. Colman and P. Coles at Eastbourne in 1892. The longest partnership is 628 by Captain Gates and Fitz- gerald at the Curragh in 1895. The best stand for the last wicket in a first-class match is 230 by Mr R. W. Nicholls and Roche for Middlesex v. Kent at Lord's in 1899.

The best averages for both batting and bowling in different seasons are appended : —

BATTING.

Inns.

Times not out.

Buns.

Most in an Inns.

Average.

1878

Dr W. G. Grace .

40

2

1116

116

23-13

Ulyett .

49

3

1847

109

29-13

1879

Dr W. G. Grace .

28

3

880

123

36-6

1880

Dr W. G. Grace .

27

3

951

162

89-16

1881

Mr A. N. Hornby

37

0

1531

188

41-14

1882

Mr C. T. Studd .

43

5

1249

126

32-33

Lord Harris .

24

0

987

176

32-19

1883

Mr W. W. Read .

39

6

1573

168

47-22

Mr C. T. Studd .

36

6

1193

176

41-4

1884

Mr A. G. Steel .

28

3

967

148

38-17

Lord Harris .

47

5

1417

112

33-81

1886

Mr W. W. Read .

42

0

1880

163

44-32

Shrewsbury .

24

4

1130

224

66-10

1886

Mr W. W. Read .

46

3

1825

120

42-19

Shrewsbury .

38

5

1404

227

42-18

1887

Shrewsbury .

28

2

1653

267

78-16

Dr W. G. Grace .

46

8

2062

183

54-10

1888

Mr W. W. Read .

41

2

1414

338

36-10

Dr W. G. Grace .

69

1

1886

215

32-30

1889

Gunn .

38

4

1299

118

38-7

1890

Shrewsbury .

43

6

1568

267

41-26

Gunn .

63

6

1621

228

34-48

1891

Shrewsbury .

25

3

1071

178

48-68

1892

Shrewsbury .

34

4

1260

212

42

1893

Gunn .

61

3

2057

156

42-86

Mr A. E. Stoddart

50

1

2072

195

42-28

1894

Brookwell

46

6

1491

128

38-09

1895

Dr W. G. Grace .

48

2

2346

238

51

A. C. MacLaren .

24

• 0

1229

424

51-20

1896

K. S. Ranjitsinhji .

56

7

2780

171

57-44

1897

K. S. Ranjitsinhji . Abel

48 60

5 3

1940 2099

260 250

45-6 44-31

1898

W. G. Quaife

28

8

1219

167

60-96

Abel .

45

3

2058

219

48-88

Mr C. B. Fry ~

37

4

1788

179

64-18

1899

Major R. M. Poore

21

4

1551

304

91-28

BATTING— Continued.

Inns.

Times not out.

Buns.

Most in an Inns.

Average.

1899

K. S. Ranjitsinhji .

58

8

3169

197

63-18

11

Hayward

49

4

2647

273

58-82

Abel .

53

3

2685

357

53-70

1901

K.S. Ranjitsinhji.

40

6

3065

275

87-57

Mr C. B. Fry

41

3

2325

229

61-18

Abel .

49

3

2592

221

56-34

»»

Hayward

57

7

2693

193

53-86

1902

Mr C. B. Fry

43

3

3147

244

78-67

»)

K. S. Ranjitsinhji .

40

6

2468

285

70-51

BOWLEG.

Overs.

Maidens.

Buns,

Witts.

Average.

1878

Mr A. G. Steel .

1228

447

1542

161

9-66

1879

Shaw .

1576

924

1259

134

9-53

1880

Shaw .

1994

1231

1525

177

8-109

1881

Peate .

1688

781

2088

162

12-144

1882

Peate .

1858

868

2466

214

11-112

1883

Harrison

786

328

1326

100

13-26

1884

Emmett

1031

557

1250

107

11-73

1885

Lohmann

1264

692

2030

142

14-42

1886

Emmett

1339

677

1676

1.82

12-91

1887

Lohmann

1684

737

2404

154

15-94

1888

Lohmann

1649

783

2280

209

10-190

Briggs .

USO

763

1679

160

10-79

Peel .

1648

880

2091

171

12-89

1889

Attewell

1314

654

1555

140

11-15

Briggs .

1040

447

1646

140

11-106

Lohmann

1614

646

2714

202

13-88

1890

Briggs .

1113

456

1950

158

12-34

Attewell

1581

820

1874

151

12-41

Lohmann

1759

787

2998

220

13-62

1891

J. T. Heame

791

301

1449

129

11-28

Lohmann

1189

445

2066

177

11-66

1892

Lockwood

890

292

2052

151

13-58

1893

Peel .

1060

431

1622

121

14-23

1894

Richardson

936

293

2024

196

10-64

1895

Richardson

1690

463

4170

290

14-37

1896

J. T. Heame

2003

818

3670

257

14-72

Richardson

1656

526

4015

246

16-79

1897

Richardson

1603

495

3945

273

14-128

1898

J. T. Heame

1802

781

3120

222

14-05

Rhodes

1240

482

2249

164

14-61

1899

A. E. Trott

1772

587

4080

2.39

17-09

Rhodes

1518

548

3062

179

17-10

1900

Rhodes

1553

455

3606

261

13-81

11

Haigh

958

269

2416

163

14-82

”

, ,

The following figures give a summary of some of the greatest performances with bat and ball during the entire career of each cricketer up to the conclusion of the season of 1901 : —

BATTING.

Inns.

Times not out.

Buns.

Most in an Inns.

Average.

K. S. Ranjitsinhji

347

42

17,170

286

56-90

C. B. Fry .

307

14

12,932

244

44-40

F. S. Jackson .

376

26

11,694

160

42

Haywalrd .

420

44

15,509

315

41-98

Dr W. G. Grace

1362

98

51,406

344

40-846

Abel.

848

60

29,358

357

37-202

Shrewsbury

762

81

24,569

267

36-413

A. C. MacLaren

346

21

11,511

424

35-136

Gunn

761

64

23,347

273

83-346

A. E. Stoddart .

613

16

16,081

221

32-177

W. W. Read .

739

53

22,919

328

82-167

BOWLING.

Overs.

Maidens.

Buns.

Wlvts.

Average.

Shaw

22,880

12,803

21,887

1916

11-811

Mr F. R. SpofEorth .

5,342

2,168

8,773

682

12-509

Mr C. T. B. Turner .

5,388

2,396

8,419

649

12-631

Rhodes

5,871

1,985

11,808

846

13-823

Emmett

14,672

6,870

20,811

1628

13-1012

Lohmann .

15,196

6,508

23,958

1784

13-1416

Morley

12,610

6,239

15,938

1213

13-169

Peate ....

11,669

5,593

14,299

1061

13-606

Attewell .

22,461

11,408

28,671

1874

15-561

Briggs

20,300

8,275

34,411

2161

15-1996

Richardson

12,631

3,466

32,341

1847

17-942

Dr W. G. Grace

27,745

10,680

48,201

2658

18-447

S. III. — 36

282

C K I E F F — C EIMINAL LAW

No exhaustive summary on cricket could be complete without a tribute to the grand cricket of the Graces. Dr E. M. Grace has altogether taken 10,006 wickets, scored 72,482 runs and been the most daring field at point ever seen. Far greater has been the record of Dr W. G. Grace, who has made over a hundred centuries in first-class matches and has in four

seasons scored three successive centuries. In 1871 his aggregate was 2739, and in 1895 he reached his thousand runs in May; he has always been a very crafty bowler, whose leg ball has dimissed scores of unwary colts. K. S. Ranjitsinhji, who in 1899 scored .3159 runs, and in 1900, 3065 runs, has even surpassed Dr W. G. Grace's performances vrith the bat. The feat of three consecutive hundreds has been scored, in addition to these two great batsmen, by Messrs C. B. Fry (who in 1901 made six in succession, besides scoring over .3000 runs altogether), E. G. Wynyard, A. C. MacLaren, W. L. Foster, R. E. Foster, Major Poore, Tyldesley, Abel, Hayward, Hirst, and Storer. But it must always be remembered that the batsmen of recent years have a great advantage in the improved grounds, as compared with Dr W. G. Grace's achievements twenty years before. To ensure some estimate of the comparative ability of the finest cricketers, an eminent judge selected, for the present article, the following as forming the three best modern elevens, it being calculated that each man is

chosen on his form when in the prime of his career : — First World Eleven: Dr W. G. Grace, Dr E. M. Grace, K. S. Ranjitsinhji, Messrs A. E. Stoddart, A. 6. Steel, J. M'C. Blackham, C. T. B. Turner, F. R. Spofforth, with Shrewsbury, Lohmann, and Peate. Second World Eleven : Messrs W. W. Read, G. Giflen, W. L. Murdoch, with Abel, Hayward, Gunn, Shaw, Peel, Pilling, Richardson, and A. E. Trott. Third World Eleven : Messrs P. S. M'Dormell, H. F. Boyle, F. S. Jackson, A. C. MacLaren, C. B. Fry, with Barnes, Briggs, Rhodes, Ulyett, Lockwood and Lilley or Mr G. E. M'Gregor. Messrs S. M. J. Woods, G. E. Palmer, C.T. Studd, and J. T. Heame would be the reserves, (h. S. c. m. g.)

CriefF, a police burgh of Perthshire, Scotland, 18 miles west of Perth by rail. New Established and Free churches were erected in 1881, and a new United Presby- terian church in 1891. The academy was remodelled in 1878. The town grows in favour as a summer resort. Population of the police burgh (1881), 4469; (1891),

4902; (1901), 5706.

Crimea. See Taukida.

CRIMINAL LAW

THE article on Criminal Law in the ninth edition of the Encyclopaedia Sritqnnica deals with general prLaciples, and it is not necessary to reproduce them save in the briefest fashion. A crime is an act which,

*by violating the law, affects injuriously not of crime." "^^^ *^® ^^^^^ rights belonging to an individual*

but also the public rights and duties due to the whole community. The sovereign is taken to be the person injured by the crime, as he represents the whole community, and he is nominally the prosecutor of ■crime. Criminal law includes the rules as to the pre- vention of crime, the investigation of crime, the prosecu- tion of crime, the punishment of crime. It lays down what constitutes a criminal offence, what proof is nec- essary to establish the fact of a criminal offence and the culpability of the offender, what excuse or justifica- tion for the act can be legally admitted, what procedure should be followed in a criminal court, what degrees and kinds of punishment should be imposed on the various offences which come up for trial. Einally, it regulates the constitution of the tribunals established for the trial of offences according to the gravity of the in- fraction of law, and deals with the organization of the police and the proper management of prisons, and main- tenance of prison discipline. (See Evidence, Peison Discipline, and Police.)

Criminal and civil law, however, overlap, and in all ■offences where an individual has suffered loss, he can ■claim damages in a civil court from the wrong-doer. Again, there are many minor offences established by statute which cannot be said to have a strictly criminal ■character, although the case is tried by a magistrate with ■criminal powers, and the result of the case is in a sense penal because it consists solely in a fine or penalty, or sometimes a short term of imprisonment is also imposed. Any statutory nuisance, such as improper emission of smoke from a chimney, or the failure to repair a highway, or the carrying on of certain trades in close proximity to inhabited houses, are all tried as criminal offences, although they cannot be described as crimes. Crimes — the word is here intended to include all breaches of the criminal law — may be divided into (a) crimes which affect public order, abuses and obstructions of public authority, offences which are injurious to the public at large; (6)

offences against the person, offences against parental and conjugal rights ; (c) offences against property, ij way either of force or fraud.

There are three classes of crimes — treason, felony, and misdemeanour — in addition to a large numi)er of petty

infractions of law known as summary offences. The distinction between felony and misdemeanour, though still maintained in the English system, has xreason no longer any logical basis. Formerly all Many, ‘ felonies, including treason, involved forfeiture «”” “”’«• of goods and property, whilst misdemeanours ’”’”””^’ were not treated as felonies and did not involve for- feiture. Forfeiture is no longer a legal punishment, and whenever English criminal law is codified the dis- tinction will no doubt disappear and a new classification be introduced.

Treason in England is a crime of a special character. The ofience of treason is the attempt by overt acts either to upset the Govern- ment of the country or to kill or personally injure the sovereign or his family. The offence at common law was never concisely de- fined, and depended too much on the discretion of the king and his judges. It was limited by legislation so long ago as 1352 by what is caUed the Statute of Treason. The punishment for treason was beheading, with other brutal accompaniments. The barbarous features of the punishment were abolished in 1799. The severity of the punishment, i.e., death, led in 1848 to the constitution of Treason Felonies, which are, like treason proper, of a special character, but are now tried as ordinary felonies. Whilst the compassing of the death of the sovereign or his deposition, or levying war upon him, remain punishable with death, lesser treasonable acts are punishable with penal servitude. The procedure for treason was formerly of a very oppressive character, and was made more reasonable in 1695. The offence is now tried on indictment and by a jury at the Court of Assize in the same manner as ordinary felonies. Persons indicted for treason (1) can have a copy of indictment five days before trial; (2) can have counsel ; (3) can produce witnesses, who will be heard on oath. On charges of treason, bail may not be granted except by order of the Secretary of State or of the High Court.

The distiuetions between felonies, misdemeanours, and summary offences are of considerable importance. Thus a person guilty of felony can be arrested by any person without a warrant ; a person guilty of misdemeanour cannot, unless by a constable in special circumstances, be arrested without a warrant. Further, a person charged with a misdemeanour or summary offence is entitled to be released on bail, i.e., on the obtaiuing of sureties, who are bound under the penalty of paying a sum of money to produce the prisoner charged for his trial on the day and at a place named. The sureties mus^ be sufficient in the opinion of the court, and as a rule only householders are accepted. Bail is obligatory in all misdemeanours, with the exception of misdemeanours where the costs of the prosecution are payable out of the county or borough rate or fund. It is obligatory in all summary cases. But a person charged with felony is not entitled as of right to be released on bail, but may be so released at the discretion

of the]udge or justice dealing with the case. In the procedure for the trial of felonies and misdemeanours there are several differences as regards : (a) the right of challenge, that is to say, the right of either party to challenge jurors, which is equivalent to an exception for one or more of the jurors, who have appeared individually, and who in consequence of the challenge are set aside. In the case of felonies the defendant may challenge peremptorily twenty jurymen; in the case of misde- meanour he has no right to peremptory challenge, but has to show justification for his challenge.

(6) The withdrawal of the jury from communicating with the outside world during the pendency of the case.

(c) The obligatory presence of the person charged. In the case of misdemeanour the court may permit his absence. Formerly, on conviction of the offence of felony, forfeiture of lands and goods ensued. But forfeiture resulting on a conviction of felony was abolished in 1870, and

the distinction of felony and misdemeanour with regard to forfeiture, as already stated, now only exists in the unusual case of outlawry.

Whether a crime is a felony, misdemeanour, or a summary offence depends chiefly on the heinousness of the offence. But a few misdemeanours, created by statutes of Victoria's reign for punishing frauds of modern origin, are punishable more severely than some felonies. However, as a rule all the more serious offences are felonies, and the most trivial offences are summary offences, whilst misdemeanours come between the two categories. Many summary offences are what some writers call mala prohibita, as distinguished from mala in se; that is to say, they do not involve any breach of ordinary morality, except such breach as is involved in any violation of positive law.

The chief common l&w felonies are : homicide, rape, larceny, i.e., in ordinary language, theft, robbery, i.e., theft with violence, burglary, and kindred offences ; counterfeiting the coin has been made a felony instead of being treason ; and forgery of most docu- ments has been made felony instead of being, as it was at common law, a misdemeanour.

Among the chief misdemeanours the following may be men- tioned:—

1. Assaults on the Sovereign.

2. Unlawful assemblies.

3. Riots and seditious offences.

4. Forcible entries.

5. Perjury.

6. Blasphemy.

7. Extortion.

8. Bribery.

9. Minor bodily injuries.

10. Assaults.

11. Common nuisances.

12. Libel.

13. Conspiracy to defraud, &c.

Perjury was, until the year 1563, punished solely by the ecclesi- astical courts, but since that year it has been punished, like any other misdemeanour, by a civil court.

Examples of summary offences are as follows : —

1. Offences by children (under twelve years).

2. Offences by young persons (twelve to sixteen years).

3. Offences by adults (above sixteen years), in oases of larceny and embezzlement.

4. Common assaults.

5. Certain larcenies not indiotate.

6. Small wilful injuries to property.

7. Offences relating to game.

*The criminal law applies in England to all persons alike, with the sole exception of a peer or peeress charged with felony, who has the right to be tried by Trial of a ^Yiq Housc of Lords. An Earl Marshal is ”**”■ appointed. He presides over the House of*

Lords to try the indictment. When the trial is over, the staff, which is the sign of his office, is broken, and the Earl Marshal ceases to exist as the president of this special court.

There are in England no courts of a special character, such as exist in some foreign countries, for the de- termination of disputes between the governing classes themselves or with the governed classes, whether of a civil or criminal character. Special tribunals do indeed exist for trying naval or military ^^^nais. offences committed by members of the navy and army, but those members are not exempt from being tried by the ordinary tribunals for civil offences, as though they were civilians.

*TkQ punishment for crimes by English law was formerly most brutal, but this brutality was tempered partly by the law of Benefit of Clergy, partly by the rigid adherence to singular technicalities, as, for instance, acquitting a criminal because the person whom he was charged with killing had two Christian names, whereas one only was mentioned in the indictment, or because the name of the person killed was wrongly spelt in the indictment. Benefit of clergy began with the claim of the ecclesi- astical authorities that they alone should punish *" "' a clerk. The term clerk always included a large number of persons in what were called minor orders, and after a time the test of being a clerk was ability to read, and thus everybody who could read obtained exemption from punishment for his crime, as the ecclesiastical author- ities practically enacted no punishment. This practice led to Parliament declaring certain offences to be felonies without benefit of clergy, in order to ensure punishment in all cases of offence against life or property.*

Bentham pointed out at the beginning of the 19th century that certainty of punishment was more effective than severity, that severe punishments induced juries to acquit criminals, and thus the certainty of punishment was diminished. But his arguments and the eloquence of Sir Samuel Eomilly produced no effect until after the reform of Parliament in 1832, shortly after which Acts were passed abolishing the death sentence for all felonies where benefit of clergy existed. Benefit of clergy was finally abolished in 1827 (7 & 8 Geo. IV. c. 28). At present no offences are capital except treason, murder, piracy accompanied by violence, setting fire to the royal dockyards, and inciting to mutiny. The severity of the capital sentences had already been modified by the par- doning power of the Crown, which directed the convict to be transported to convict settlements in the Colonies instead of being hanged. For some years this

was only done by the consent of the convict, who agreed to be transported if his death sentence was remitted, but in 1824, when a convict refused to give this consent, Parlia- ment authorized the Crown to substitute transportation for a death sentence.

About the middle of the 19th century the Colonies objected to receive any more convicts. Transportation was prohibited in 1857, and penal servitude within the United Kingdom was substituted for ment' transportation; whilst for many felonies im- prisonment with hard labour for a term not exceeding two years may now be substituted for penal servitude. By the Penal Servitude Act, 1864, the shortest period of penal servitude for an offence committed after the passing of the Act is five years, and where any previous Act had fixed a maximum of less than five years, the period of five years is to be substituted for such shorter term. The distinction between penal servitude and imprisonment with hard labour is rather one of prison management and discipline than one of any principle. The punishment for misdemeanour at common law has always been fine or imprisonment, or both, at the discretion of the court before which the prisoner was convicted. To this simple imprisonment hard labour has been added by statute for various offences, but the term for imprisonment with hard*

labour is limited to two years. The punishment for summary offences is imprisonment with or without hard labour, or a fine, or both, subject to limitations which as a rule do not allow imprisonment exceeding six months. When the punishment may exceed three months' im- prisonment, the accused has a right to demand that the offence shall be tried by a jury as a misdemeanour and not summarily.

In the case of treason and murder the court has no discretion as to the punishment awarded, and in most other cases some limitation is imposed by statute on the length of penal servitude or imprisonment with hard labour which may be imposed. But the maximum in every case is so high that, save in treason and murder, the court has a very large discretion as

to the punish- ment to be imposed, and is not as a general rule limited, outside the offences of treason and murder, in its dis- cretion as regards the minimum of punishment which it can award. Together with the mitigation of punish- ment since 1832, laws have been passed for getting rid of the technicalities which formerly led to the improper acquittal of criminals. Indeed the looseness of pleading in criminal cases is carried almost too far; for while there is no danger in such looseness when times are quiet and when law is administered by the judges of the High Court in England, yet when crimes of a certain character are committed in times of great political excitement and the law is administered by an inferior judiciary, there may be some danger of in- justice if the strictness of pleading and procedure is too much relaxed.

The punishments which may be imposed summarily are as follows : —

(a) In the case of adults pleading guilty to offences involving property worth over 40s., imprisonment not exceeding six months, without the option of a fine.

(&) In the case of adults where the offence affects pro- perty not worth over 40s., imprisonment not over 3 months, or fine not exceeding £20.

(c) In the case of young persons, imprisonment not over 3 months, or fine not exceeding £10.

(d) In the case of children, imprisonment not over 1 month, or fine not exceeding 40s.

If the offence is trifling, the accused may be discharged without punishment, and under the First Offenders Act (1887) the justices have a discretionary power to forego punishment. The justices have also the power, under the Reformatory Schools Act and the Industrial Schools Act, to commit youthful offenders to one or other of these institutions, — in the case of a previous conviction, the Industrial School; in the case of a first offence, the Keformatory (see Industkiai Schools).

Crime is in England treated locally ; the responsibility for the suppression of it is local. Formerly each town- ship was responsible for the

suppression of crime "v/etf of ~~vnthin its own boundaries. The " view of frank pledge." pledge " which gave effect to this has long since disappeared, but the system of each township having a headborough or constable still survives in a few places. In each county the sheriff was, and in law still is, responsible for the peace of the county, and he had control of the county jail, in which he lodged the prisoners he arrested as suspected of crime. In ancient times the free~~ holders of the county sat, with the sheriff presiding, to inquire into and punish the crime in the county. The Sheriff's Criminal Court, being superseded by the Assizes and Quarter Sessions, was long ago abolished, but the tribunal at the Assizes for the trial of crimes is still fur- nished by the freeholders of the county, acting as jurymen under the direction of the judge. The jury must come from the vicinage or neighbourhood. The judges, who

used to be sent on a commission of jail delivery and " oyer and terminer" from Westminster, are now from the Royal Courts of Justice, and not from Westminster. In olden days, and even now in theory, the Grand Jury inquire of their own knowledge, by the oath of good and lawful men of the neighbourhood, into the crime of the county, but in practice the charges against the accused persons are always submitted to an officer known as the Clerk of the Crown. The Grand Jury is "^°"""" first instructed as to their inquisition by a charge from the judge, as regards the indictment concerning which they are called upon to examine, whether there is a primd facie case to send for trial to the ordiaary jury. The Grand Jury must consist of not less than twelve, not more than twenty-three, good and lawful men of the county. But any person who prefers an indictment is entitled to put it forward, provided he submits to be bound over to prosecute and to be liable to costs in case his prosecution fails. Such cases are very rare. As a rule, in the big towns a solicitor is specially appointed to direct criminal prosecutions ; in the rural districts it may be the person injured, it may be the magistrates' clerk, it may be a policeman who is bound over to prosecute.

The Clerk of the Crown puts the charges into proper shape, and lays them before the Grand Jury. The charges are then called Bills, and if the Grand Jury considers that there is no primd facie case, the foreman endorses the Bill with the words "no true case," and then presents it to the

judge. The jury are then said to have ignored the BUI, and if the person charged is in custody he is released, yet liable to be tried on better evidence.

When an indictment is found by the Grand Jury (twelve at least must concur), the person charged is brought before the court, the indictment is read to him, he is asked whether he is guilty or not guilty ; if he pleads guilty, he is then sentenced by the court; if he pleads not guilty, a petty jury of twelve is formed out of the number of jurors who have been summoned by the sheriff to attend the court. He is tried by these jurors in open court ; he can, if he choose, have counsel Prmedure to defend him, by cross-examining the witnesses, p^^ y„,y, by calling witnesses of his own, and by address- ing the jury. The judge then sums up the case to the jury, and they acquit or convict him. If he is acquitted, he is discharged from custody; if convicted, the judge awards the sentence. From such acquittal or conviction, properly speaking there is no appeal in criminal trials. The verdict of the jury is final. Any considerable defect or informality in the procedure may be taken before the King's Bench by Writ of Error, but such cases are not now of frequent occurrence. And if any question of law arises at the trial, the judge may reserve it for the opinion of the court for the consideration of Crown Cases Reserved, by whom the conviction may be either quashed or confirmed.

The question of criminal appeal has been, and still is, a matter of great controversy. On the Continent of Europe, and even in India, appeal is allowed in criminal cases on the facts as well as on the law of the case. In England an appeal on questions of law arising at the trial is allowed, as stated above, but the procedure is intricate and tech- nical, whilst no provision whatever is made for questioning the decision of the jury on matters appeal" of fact. The verdict of a jury, however unsatis- factory, cannot be reversed, and the only remedy is founded on the prerogative of pardon inherent in the Crown, which, is exercised, as a matter of fact, by the Home Secretary. Various proposals have been made, the most practical being that a new trial shall be granted (1) when the verdict is obviously against the evidence, (2) when new

facts have arisen after tlie trial, proving the verdict con- clusively wrong. The exercise of the power of pardon in the prerogative of the Crown does not satisfy the justice of the case — it only accords mercy where there may be no criminal guilt. Moreover, as it is given on the advice of the Secretary of State, and his inquiry must necessarily be informal and without publicity, cases might arise where a pardon would not satisfy public opinion. At the same time, celerity of punishment is absolutely necessary for the repression of crime, and so far no system of criminal appeal has duly satisfied that requirement. The Court of Crown Cases Reserved con- sists of a number of judges of the High Court — not less than five — and from their decision there is no appeal.

The indictment must say that it is found by a jury of a particular county, and the offence charged must appear to have been committed in that county ; this is known as the venue, and in former days, at any rate, was a great protection against the oppression of the subject on the ^^ part of the Crown. It prevented the Crown in

T/re venae, ti t j? • j , p

the days ot its great power from removing a person whom it wished to get rid of from among his neighbours, and placing him on trial in a strange place where the influence of the Crown was greater. This is still true to a certain extent, as great injustice may be caused to a man by removing him from his neighbours and trying him at a distance from his friends and from the witnesses whom he might call for his defence. In Ireland, for instance, the greatest injustice might be done by removing an Orangeman from Belfast and trying him in a Eoman Catholic ■county. But it has its evils where the area from which the jurors are drawn is a small one, such as a town of a few thousand inhabitants. In that case a man charged, say, with fraud, may be protected by his friends from "being properly punished for that fraud. In 1856 power was given for the first time to remove a prisoner for trial from any part of England to the Central Criminal Court. This was originally done in favour of a prisoner against whom there was great local animosity, but so long as the law is

administered in quiet times by judges of the High Court there is no danger of injustice to any accused person.

It has been mentioned above that in theory an indict- ment is the spontaneous act of the Grand Jury, but that in practice a Bill for that indictment is always presented by some individual to the Grand Jury. In theory the prosecution is on the part of the Crown ; and this is so far true in fact that the Attorney-General, on behalf of the Crown, can in any case intervene, and either take the •conduct of the prosecution out of the hands of the private person or enter what is called a Tiolle prosequi, which has the effect of stopping any further prosecution; but in practice such a course is never taken.

It is obviously necessary that criminals should be arrested as soon as possible after the crime is committed, and that the arrest should not wait until an indictment has been found. Hence a practice has grown up, which

has been largely extended of recent years, of Prelim- having a preliminary inquiry of the crime before

justices, the effect being that if there is no

primd facie case a man is at once discharged, instead of being kept in custody until the Assizes are held, and the Grand Jury can inquire into the case. This procedure before justices was regulated by an Act of 1848, known as Jarvis's Act, and is now almost uni- versal. This procedure before justices is entirely different from the procedure for summary offences. It may be, though usually it is not, held in private ; it is an inquiry and not a trial ; the justices have to consider not whether the man is guilty, but whether there is such, a primd facie

Inary Inquiry-

Coroner's courts.

case against him that he ought to be tried. If they think that there is, they commit him to prison to wait his trial, or require him to give security, with

sureties, to the amount named by them for appearing to take his trial.

If a coroner's jury, on inquiring into any sudden death, finds that murder or manslaughter has been committed, that finding has the same effect as an indictment by a grand jury, and the man charged may be tried by the petty jury accordingly. The law and procedure of the Coroner's Courts are now regulated by the Cor- oner's Act, 1887 (50 & 51 Vict. c. 71). When there is a dead body of a person lying within the area of his jurisdiction, and there is reasonable cause to suspect that such person died a violent or unnatural death, or a sudden death of which the cause is unknown, or has died in prison, the coroner's decision to hold an inquisition cannot be challenged. The verdict of guilty is followed by trial in the ordinary manner.

For many years the costs of the prosecution of felonies, and also of many misdemeanours, were paid out of the public funds, raised in each county. After 1852 an annual sum was voted by Parliament for the reimburse- ment of half, and then of all, these costs to the counties, or rather localities, which paid them, and thus the cost of these prosecutions fell upon the Imperial Exchequer. In 1888 the proceeds of certain taxes were handed over to the local authorities, and they again became liable to pay these costs.

With the organization of the police forces, which began about the year 1827 in London, and in 1834 in the United Kingdom generally, the police became the prosecutors in many cases. In 1879 an Act was passed (42 & 43 Vict. c. 22, amended by 47 & 48 Vict. c. 68) providing g,,.^^. . for the payment of a director of public prose- pubuc cutions, who was to act under the Attorney-Gen- prosecu- eral in such cases and under such conditions as ”’”’• might be settled by rules laid before Parliament, and in 1884 a further Act developed the system of the Act of 1884. The office of director is now held by the officer who, for the time being, is solicitor to the Treasury. He is sub- ject to the direction of the Attorney-General; and in the cases provided for by the rules, which may be roughly taken to be the cases of the most serious crimes, or of crimes which require long and careful investigation, under- takes, always with the approbation of the Attorney- General, the prosecution in place of the private indi- vidual.*

The Attorney-General has always represented the Crown in criminal matters, and in State prosecutions appears in person on behalf of the Crown, and when he so appears has certain privileges as respects the reply to the prisoner's defence and the mode of trial. ■ The Attorney-General has a right on behalf of the Crown to institute in the High Court, by information, a prosecution for any misdemeanour, but he cannot so institute a prosecution for felony ; any such information is tried by a jury in like manner as if it were an indictment. Preliminary jurisdiction in criminal cases is possessed by the Justices of the Peace, who may also under special Acts convict in a summary manner for offences of minor importance. The procedure for punish- ing summary offences is before two justices, or in the case of a stipendiary magistrate, one justice. This pro- ceeding must not be confused with the preliminary procedure already mentioned before justices for an indict- able offence, nor with the procedure before justices in relation to civil matters, such as the recovery of small sums of money. The proceeding begins either by the issue of a warrant for the arrest of the person charged, in which case a sworn information must be filed, or by a summons directing the person charged to appear on a certain day to answer the complaint made by the prosecutor. The jus-

tices hear the case in open court ; the person charged can make his defence either in person or by his solicitor or Procedure Counsel, he can cross-examine the witnesses, for for the prosecution, call his own witnesses, and

summary address the justices in his defence. The jus- tices, after hearing the case, either acquit or convict him, and in case of conviction award the sentence. If the sentence is a fine and the fine is not paid, the person convicted is liable to be imprisoned for the term fixed by the justices, not exceeding a scale fixed by an Act of 1879, the maximum of which is one month. The imprisonment may be with or without hard labour.

Of late years this summary jurisdiction of the justices has received very large extensions, and many offences which were formerly prosecuted as serious offences by an indictment before 1;he Court of Assize, or Quarter Sessions have, where the offence was a trivial one, been made punishable, on summary proceedings before justices, by a small fine or a short term of imprisonment.

The extension of the jurisdiction of the justices is open to the observation that it deprives a person charged of the protection of a jury, and also that it throws upon him, if convicted, and upon the prosecution if there is no convic- tion, the cost of the proceedings. The former objection is much mitigated by the enactment made in 1879, that a person if liable on conviction to be sentenced to imprison- ment for more than three months, or to a fine exceeding £100, can claim to be tried by a jury. But the objection as to the costs remains, and the payment of costs is often a very serious addition to the trivial fine; and it is anomalous that a person convicted of a trifling offence should bear the cost of the prosecution, while if he is convicted before a superior tribunal of the most serious offence he does not pay the cost.

The Criminal Evidence Act, 1898, is explained in the article on Evidencb ; but as it goes to the root of the English system of criminal trials, this article requires a brief reference to it. Bentham wrote that amongst the singularities of the English common law ~~the most remark~~ able is the rule that does not allow any questions to be put to the accused which might lead to the proof of p .. his guilt. Sir James Stephen rather defended

the rule, because it stimulated independent inquiry. Other writers maintained that any interrogation of the prisoner would be contrary to the principle " nemo tenetur se ipsum accusare." On the Continent of Europe the prisoner can be interrogated; and the Criminal Evidence Act, 1898, now enables every person, and the wife or husband of such person, to be a competent but not compellable witness for the defence at every stage of the procedure. No comment is allowed by the prose- cution on the abstention of the accused or the accused's wife or husband from giving evidence. Cross-examination is allowed, but previous convictions and bad antece- dents are not allowed to influence the court, which is bound to

judge according to the facts presented to it. The Indian procedure does not go so far as this English reform. The court is empowered to ask the accused questions generally on the case after the witnesses for the prosecution have been examined and before he is called for his defence. His answers are taken into consideration, and the court and the jury may draw such inference from the answers as appears just. The accused does not render himself liable to punish- ment by refusing to answer or by giving false answers. Theoretical objections often do not stand the test of practice, and the Criminal Evidence Act, 1898, has given satisfaction. In England, as already pointed out, although the prosecution is in the name of the Crown, and although a public prosecutor has been appointed, still criminal charges are conducted, with few exceptions, by

the person injured, with the assistance of the police. In the Prosecution of Offences Acts of 1879 and 1884 there is to be found the nucleus of the system of the public action such as obtains in other countries in case of crime. Under these Acts the Solicitor to the Treasury acts as Director of Public Prosecutions under the Attorney-General. But both these high officials have many other duties, and the outcome of the present system, worked as it is now, is small. The annual average of cases by jury on indictment for the five years ending 1897 was 11,633; if the indictable cases disposed of summarily were included, the annual average would be 55,174. Yet in 1897 only 414 cases were prosecuted by the Public Prosecutor. In Ireland the system is nominally the same as in England, but in practice almost all prosecutions are instituted and conducted under the direction of the Attorney-General for Ireland, who is a member of the Government of the day, and so responsible to Parliament, as in the case of the Lord Advocate. In Ireland, owing to the police being a centralized force, under the management of Commissioners residing in Dublin, any prosecution which in England might be conducted by the local police, would in Ireland be conducted under the direction of the chief of the police in Dublin, who is necessarily in close communica- tion with the Attorney-General.

In Ireland the law relating to crimes is nearly the same as in England, but in Scotland iardly any crimes are con- stituted by statute law, the common law being to the: effect that if a judge will direct any act to be a crime, and

a jury will convict, that act is a crime. This great elasticity of the common law to include every sort of new crime which may arise is obviously one very dangerous to political liberty, as it greatly enlarges the power of the Crown to oppress political opponents, but in modern days it has its convenience in facilitating the punishment of persons committing crimes for the punishment of which in England a new Act of Parliament may be necessary. The localization in England of crime, and the procedure for punishing it, differ largely from the view taken in France and most European countries. The French theory is that, a Frenchman owes allegiance to the French State, and commits a breach of that allegiance whenever he commits a crime against French law, even although he is not at the time within French territory. Arid in modem days this theory has been extended so as to allow the French courts to punish Frenchmen for crimes committed in foreign countries.

The principle of the French law, though not expressly- recognized in England, must be invoked to justify two- departures from the English principle — (1) as regard offences on the high seas, and (2) as regards certain limited offences committed outside the otteaces United Kingdom. In early days offences com- bijbseas. mitted by Englishmen on the high seas were pimished by the Lord High Admiral, and he encroached! so much on the ordinary courts as to render it necessary to pass an Act in Eichard II.'s reign (15 Rich. II. st. 2,, c. 3) to restrain him.*

*In the time of Henry VIII. (28 Hen. VIII. c. 15) an Act was passed stating that as the admiral tried persons- according to the course of the civil law, they could not be convicted unless either they confessed or they or the- witnesses were submitted to torture, and that therefore it. was expedient to try the offences according to the course of the common law. Under that Act a special commission of Oyer and Terminer was issued to try these offences at the Old Bailey, and English law was satisfiedby permitting the indictment to state that the offence was committed on board a ship on the high seas, to wit in the county of Middlesex. Since 1861 these special commissions have^*

been rendered unnecessary by the provision that all offences committed on the high seas may be tried as

*OHences ^^ ^^^^ ^^^ ^^^'^ Committed in England. As committed regards offences on land, it was found necessary on land as early as the reign of Henry VIII. to provide "B^hild. "" *^^ *^^^^ ^^ England of treasons and murders*

committed on land outside England; this was largely due to the constant presence in Eranee of the king and many of his nobles and knights. The latest legislation on the subject wq,s in 1861 (24 & 25 Vict. c. 100, s. 9), and any murder or manslaughter committed on land out of the United Kingdom, whether within the King's dominions or without, and whether the person killed were a subject of His Majesty or not, may be dealt ■ with in all respects as if it were com- mitted in England. The jurisdiction has been extended to a few other cases such as slave trade, bigamy, perjury committed with reference to an English court, and offences connected with explosives. But these offences must be committed on land and not on board a foreign ship, because if a man takes service on board a foreign ship he is treated for the time as being a member of the foreign State to which that ship belongs. The prin- ciple has been also extended to misdemeanours (but

*not felonies) committed by public officers in ™1™.„ colonies and elsewhere, whether within or with- committed out the British dominions. Thus a Governor by public or an Inferior Officer of a colony, if appointed "mloaus." 'y *^ British Government, may be prosecuted*

for any misdemeanour committed by him by virtue of his office in the colony ; and cases have happened where governors have been so prosecuted, such, for instance, as the case of General Picton at the beginning of the 19th century, and of Governor Eyre of Jamaica in 1865.
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There are a few exceptional courts with criminal juris- diction. The Court of Chivalry, which used to punish offences committed within military lines outside the king- dom, has long disappeared. The Military Courts for trying members of the navy and army for offences com- mitted against

naval and military law have been already referred to. The naval courts can only try members in actual service on board a ship. The military courts can only try persons who are actually members of the army at the time, and their authority is annually renewed by Parliament, in consequence of the jealousy still felt against the trial of any man except by the ordinary courts of law. These courts can try in any part of the world, and whenever the forces are in active service can try followers of the camp as if they were actual members of the forces. (See articles on Military Law and Martial Law.)

The Ecclesiastical Courts, which were formerly very powerful in England, and punished persons for various

offences, such as perjury, swearing, and sexual Ecciesias- offences, have now almost fallen into desuetude. ^Courts. Their authority over Protestant dissenters from

the Established Church was taken away by statute ; their authority over lay members of the Church of England has disappeared by disuse. Occasionally suits are instituted in them against the clergy for offences either against morality or against doctrine or ritual. In these cases their sentences are enforced by penalties, such as suspended deprivation of their benefice, or by impris- onment, which has replaced the old punishment of ex- communication.

Eeference has been made in various places to the crim- inal law which prevails on the Continent. The English system prevails in most of the States which form the United States 'of America. It prevails also, with a few exceptions, in the Colonies of the British Empire ; but the manner in which it has been adapted to the requirements

of a backward country is best exemplified in the system of law which obtains in India, the greatest dependency of the Empire. In the first place both the substantive and the adjective criminal law have been codified. The Indian Penal Code came into force in 1860, 'Sf'f and the Indian Code of Criminal Procedure, co. enacted in 1882, has been somewhat modified by an amending Act of 1898. As regards all criminal law as administered throughout British India, they have taken the place of an older criminal

system, which was based partly on Mahommedan law, partly on usage and custom, partly on principles imported from England. Great delays and considerable injustice were formerly caused by the want of unity in judicial organization. Now, one set of courts has been established throughout the country, composed of well-paid, well-educated judges, most of the higher judicial appointments being held by Englishmen ; all those who hold subordinate judicial posts at the same time are subjected to a combined system of appeal and revision. The arrangement of the Indian Penal Code is natural as well as logical ; its basis is the law of England freed from technicalities, whilst certain modifications are introduced to meet the exigencies of a country such as British India. It opens with a chapter of general explanations, and interpretations of the terms used throughout the Code. It then describes the various punishments to which offenders are liable ; follows with a list of the exceptions regarding criminal responsibility under which a person who otherwise would be liable to punishment is exempted from the penal consequences of his act, such as offences committed by children, by accident or misfortune without any criminal intention, offences committed by lunatics, offences committed in the exercise of the right of private defence. It may be worth while to add, as an innovation on English law, that an act which results in harm so slight that no person of ordinary sense and temper would complain of such harm is not considered an offence under the Code. Then follows a chapter on Abetment, in other words, the instigation of a person to do a wrongful act. The next chapters deal with offences against the public, including the State, the army and navy, public tranquillity, public servants, contempts of the lawful authority of public servants, perjury; offences relating to coin and Govern- ment stamps, to weights and measures ; offences affecting the public health, safety, convenience, decency, and morals ; offences relating to religion; and offences relating to the human body, from murder down to the infliction of any hurt. The Code then passes on to offences against property; offences relating to forgery, including trade marks, criminal breach of contracts for service ; offences relating to marriage, defamation, criminal intimidation, insult, and annoyance. Under this last head is included an attempt to cause a person to do anything which that person is not legally bound to do, by inducing him to believe that he would otherwise become subject to Divine displeasure. The last chapter

deals with attempts to commit offences punishable by the Code with transpor- tation or imprisonment, and the punishment is limited to one-half of the longest term provided for the offence had it been carried out.

One peculiarity of the Penal Code which has proved eminently successful and been imitated by other Codes, lies in the system of illustration of the offence declared in every section by a brief state- ment of some concrete case. For instance, as illustration of the offence of an attempt to commit an oflence the following examples are given : —

I. "A. makes an attempt to steal some jewels by breaking open a box, and finds on opening the box there is no jewel in it. He has done an act towards the commission of theft, and therefore is guilty under this section.

II. "A. makes an attempt to pick the pocket of Z. by thrusting his hand into Z.'s pocket. A. fails in the attempt in consequence

of Z. haying nothing in his pocket. A. is guUty under this section."

Passing on to the system of criminal procedure ~~*which, is set forth in detail in the Code of Criminal Procedure Jadian* ^^ *amended in 1898, it is no doubt modelled on Code of the English system, but with considerable mod*~~ *Crimiaai ifications. The principal steps are — (1) arrest race ure.* ^^ ^^ *police and inquiries by the police ; (2) the issue of summons or warrant by the magistrate ; (3) the mode of procedure before the magistrate, who may either try the accused himself or commit him to the Ses- sions or the High Court, accordiag to the importance of the case ; (4) procedure before the Court of Session ; (5) appeals, reference and revision by the High Court.*

Elaborate provision is made for the prevention of of- fences, as regards security for keeping the peace and for good behaviour, the dispersion of unlawful assemblies, the suppression of nuisances, disputes as to

immovable property^, which in all Oriental countries constitute one of the most frequent causes of a breach of the peace.

Ample provision is thus made for the prevention of offences, and the Code next deals with the mode of prose- cution of offences actually committed.

As a general rule, every offence is inquired into and tried by the court within the local limits of whose juris- diction it was committed. Differing from the practice of Continental countries, all offences, even attempts, may be prosecuted after any lapse of time. As in England, there is no statutory limitation to a criminal offence.

A simple procedure is provided for what are called summons cases, as distinguished from warrant cases — the first being offences for which a police officer may ar- rest without warrant, the second being offences where he must have a warrant, or, in other words, minor offences and important offences. In summons cases no formal charge need be framed. The magistrate tells the accused the particulars of the offence charged : if he admits his guilt, he is convicted ; if he does not, evidence is taken, and a finding is given in accordance with the facts as proved. When the complaint is frivolous or vexatious, the magistrate has the power to fine the complainant. The Code gives power of criminal appeal which goes much farther than the system in England.

In cases tried by a jury, no appeal lies as. to matters of fact, but it is allowed as to matters of law; in other cases, criminal appeal is admitted on matters of law and fact.

In addition to the system of appeal, the superior courts are entrusted with a power of revision, which is maintained automatically by the periodical transmission to the High Courts of calendars and statements of all cases tried by the inferior courts ; and at the same time, whenever the High Court thinks fit, it can call for the record of any trial and pass such orders as it deems right. All sentences of death must be confirmed by the High Court. No appeal lies against an acquittal in any criminal case. This system of appeal, superintendence, and revision would be totally inapplicable to England, but it has proved eminently successful as applied to the present social condition of the inhabitants of India. The appeals

keep the judges up to their work, revision corrects all grave mistakes, superintendence is necessary as a kind of discipline over the conduct of judges, who are not subjected, as in England, to the criticism of en- lightened public opinion.

The French Penal Code and Code of Criminal Proced- ure are still substantially the model of all systems of Continental criminal law. They were promulgated in 1811 by Napoleon I., and although he called in the aid of the greatest Ereuch jurists, he guided, and occasion- ally even revised, their labours. The French Codes have

been amended by later Continental Codes, and more es- pecially the Italian Penal Codes. All Codes have an opening chapter where the general principles of criminal law in its practical application are enunciated, such as, for instance, the rules that — (1) no person is liable to punishment for any act not expressly declared to be an offence ; (2) no person can be punished for an ^^^^^ act which by virtue of a subsequent law is de- British clared not to be an offence ; (3) whoever com- criminal mits an offence within the kingdom is tried p”^^””- and punished according to the criminal law of the king- dom, and by the tribunals created for the administration of justice, to the exclusion of special tribunals created for temporary purposes. This rule really lays down that no citizen can be deprived of his own judges when he is accused of a criminal offence. (4) A citizen, although he may have been tried in a foreign country for an of- fence committed within the kingdom, can be retried ac- cording to the law of the kingdom ; (5) extradition only applies to foreigners, not to citizens. The preliminary chapter is followed by the classification of offences ac- cording to the importance of the punishments the law assigns to them. The lowest degree of offence is denomi- nated ” contravention.” It applies mainly to the petti- est offences, or to infractions of police regulations, and can be punished by fine or by imprisonment under a week, or by both fine and imprisonment, limited to a week. Next comes the “delit,” which includes all of- fences punished by imprisonment over a week and under five years. Then, finally, we arrive at the ” crime,” the highest form of offence in French Criminal Law. It in- cludes all offences subject to a more severe sentence than the punishment assigned to a delit. All cases are held to be crimes

where death, life-imprisonment with or with- out hard labour, deportation out of the kingdom, deten- tion or seclusion in a fortress or other expressly assigned place, are the punishments mentioned by the law. A certain number of explanatory definitions follow, of which the most important concern attempts to commit offences, and in ” crimes ” they are punishable if the exe- cution of the attempt was only prevented by circum- stances beyond the will of the offender, whilst in “dilits” an attempt is not punishable as an offence unless the law specially provides that it should be punished. As regards ” contraventions,” attempts not carried out are not held to be offences at all. Accomplices are generally subject to the same punishment as the principal. Old offenders (ricidivistes) are subject to severer punishments. The usual exceptions as regards responsibility for crime, such as madness and extreme youth and force majeure, are to be found in all Codes. The excuse of youth extends to all offenders under the age of sixteen, when the tribunal decides whether the offender has acted without ” discern- ment,” and acquits where the discernment is not found, whilst one-half of the usual punishment is inflicted where discernment is found. Foreign Codes differ from the English law in allowing the injured party to claim dam- ages in the criminal suit, appearing as partie civile. On another question there is a wide divergence on the Conti- nent from English law. According to the law of England there is no prescription in criminal law. An offender is al- ways liable to punishment whatever time may have elapsed since the committal of the offence. On the Continent the limitation of a judgment and sentence for a crime is twenty years ; five years for a dMit, and for a contraven- tion two years. No proceedings can be taken as regards a crime after a lapse of ten years, whilst as regards a d4lit the limit is three years, and two years for a contraven- tion. There are three main differences between English criminal procedure and Continental criminal procedure. 1. A criminal prosecution directed on Continental

criminal procedure at once passes into the hands of the State as an infringement of law which must be repressed, on the ground that the

whole community bases its security on obedience to law. In England the repression of all minor crime is left to the injured party.

2. In England every criminal proceeding from begin- ning to end is, and has always been, public, whilst on the Continent, with rare exceptions, all preliminary proceedings in a criminal charge are secret. The public system is called accusatory, the secret system is called inquisitorial.

Outside English-speaking countries this secret inves- tigation continues more or less. But of the two systems, accusatory or inquisitorial — the first meaning the right of the accused to defend himself, the second meaning the right of the State to examine any legal offence in private in order to ensure the safety of society, — the accusatory is gaining ground in every country. In English-speaking countries it is an established law that an accused person should have the right of publicity of the proceedings and the right to defend himself by counsel and by witnesses. On the Continent the inquisitorial system is gradually being abandoned. Perhaps the best Code of Criminal Procedure in Europe is that promulgated in Austria in 1873. It followed a fundamental law of the Empire which laid down inter alia that all legal proceedings, civil or criminal, should be oral and public, and that the accusatory system in criming,l cases should be adopted. Germany followed this example. Italy, Holland, Switzer- land, and Spain have followed Austria and Germany as regards the preliminary investigation ; Italy and Belgium have surrounded the accused with guarantees against arbitrary confinement before trial ; Holland has conferred upon the accused the right of seeing the adverse testimony and of being confronted with the witnesses, and, further, has formally insisted that no insidious questions, such as questions assuming a fact as true which is not known to be true, should be allowed. Other countries still remain on the old lines. But everywhere, whether reform has actually been accomplished or not, there is a demand for even-handed justice, and a growing conviction that the accused should have all his rights, now that society is no longer in danger from undiscovered criminals and un- punished crime. Even in Erance, the champion of the inquisitorial system, a change is rapidly being made. Up to 1897 secrecy was imposed invariably in the preliminary investigation of crime, and was held necessary for the dis- covery and punishment of the

offender. The " Loi de I'Instruction Contradictoire," December 8, 1897, however, was a long step towards complete justice in the treatment of the accused in the preliminary inquiry. The main reform is that the accused, after he had once appeared before the judge and a formal charge has been made against him, is entitled to the assistance of counsel, either chosen by himself or assigned to him if he is poor. If he is in prison, he is allowed to communicate freely with his counsel, who is entitled to see all the proceedings, and in every appearance before the judge his counsel accompanies him. There are, however, certain limitations. The counsel cannot address the judge without leave, which may be refused, nor can he insist on any proceeding he thinks necessary in his client's interest. He can only solicit. He has no right to be present at the examination of witnesses, who continue to be interrogated by the judge alone and not in the presence of the accused; but he must receive twenty-four hours' notice of every appearance of the accused, and he is entitled to be present whenever his client, after the first formal appearance, comes before the judge. In England, as already pointed out, although the prosecution is in the name of the Crown, and although a public prosecutor has been appointed, still as a rule it is

conducted by the person injured as the person injured, or by the police.

3. In England the single-judge system is universal, save in appeal ; on the Continent plurality of judges is insisted upon, save in the most trivial cases, where the punishment is insignificant. The Public Prosecutor's Department is yet in embryo in England, whilst in most countries of the Continent the whole machinery for the prevention, investigation, and punishment of crime, is conducted by what is called the Parquet, which represents society as a collective unit and not the individual injured. The head of the whole Parquet in France is the Pro- cureur-Giniral, who holds equal rank with the mem- bers of the Supreme Court. Under him there are Pro- cureurs-Gen^raux attached to each of the Courts of Appeal, of which in France there are twenty-six, and under each of these subordinate Procureurs there are Procureurs (prosecutors) of a lesser degree. The next stage to the Parquet is the Juge d'Instruction, who corresponds to the English magistrate, and is the most formidable personage in the whole system of French criminal law. He can detain and

accuse a person in prison, can send for him at any time and ask him such questions as he pleases. •

After the first examination the prisoner is entitled, in most Continental countries, to the assistance of counsel, but the powers of counsel are so limited that the Juge d'Instruction has a complete discretionary power regard- ing the investigation of the case. The natural conse- quence of this procedure is that the preliminary investi- gation really decides the ultimate result, and the final trial becomes more or less a solemn form.

The single-judge system, applied to important matters, prevails only in English-speaking countries, or where English influence is dominant. On the Continent a plurality of judges is deemed essential to the administra^ tion of sound justice. This rule was probably made at a time when judges could never be allowed to sit alone for fear of the influence of the rich and powerful, the possi- bility of corruption, and the danger that a judge sitting alone would decide questions sometimes according to his convenience. Experience has shown in England and in all Greater Britain that the concentration of responsi- bility, which is the basis of the single-judge system, is preferable to a multiplicity of judges, none of whom feel the same duty to the case before them. Financial consider- ations also com-e into the question. It is of paramount importance that a judge should be sufliciently well paid to ensure his absolute independence from every point of view. The following comparative tables of judicial sala- ries in England and France speak for themselves : —

England —

Lord Chancellor £10,000

Lord Chief Justice of England . . . 8,000

(4) Lords of Appeal, each .... 6,000 Master of the Rolls 6,000

(5) Lord Justices, each 5,000

(23) Judges of the High Court, each . . 5,000

Eecorder of London 4,000

Common Serjeant 3,000

Assistant Judges, each 1,500

Judge (City of London Court) . . . 2,400

(56) County Court Judges, each . . . 1,500

(11) Metropolitan County Court Judges, each . 1,500

Other Metropolitan Police Magistrates, each 1,500

Bow Street Police Magistrate . . 1,800

France —

President of the Court of Cassation . . 1,200 (3) Presidents of Chambers of the Court of

Cassation, each 1,000

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CKIMMITSCHA U — C R I S P I

(45) Judges of the Court of Cassation, each . £720

(1) President (at Paris) of the Court of Appeal 1,000

(25) Presidents of other Courts of Appeal, each 720 (59) Presidents of Chambers of Courts of Appeal —

(9) at Paris, each 560

(50) in Provinces, each . . . 400 (359) Presidents of Tribunals of 1st Instance —

(1) at Paris 800

(15) 1st Class, each 400

(76) 2nd Class „ .... 280 (267) 3rd Class „ 200

(633) Judges—

(48) Paris, each 320

(77) 1st Class, each .... 240 (175) 2nd Class „ . . . . 160 (335) 3rd Class „ 120

Tribunals of the Juge de Paix.

Judges number 2872 —

20 receive, each 320

43 „ „ 200

754 „ „ salaries varying from 140 to 84

2055 „„...!. 72

Ministire Puhlique (Public Prosecutor's Department).

Chief Public Prosecutor .... 1,200 His Advocate-General in Cour de Cassation 720

(26) Public Prosecutors in Court of Appeal —

(1) Paris 1,000

(25) In Provinces, each . . . 720

Adthokities. — Stephen. History of Criminal Law. — Esmbin. Histoire de la Procedure Criminelle en France ; Codes Franqais et les Codes des autres pays d' Europe. — Livingstoit. On the Criminal Legislation of Louisiana. — Whitley Stokes. The Anglo-Indian Codes. (h. je. ; Jno. S.)

Crimmitschau, a town of Germany, on the Pleisse, 8 miles north-north-west of the town and in the circle of Zwickau, kingdom of Saxony; on the Leipzig-Hof rail- way. There are real, commercial, and technical schools, and over 100 spinning mills and woollen cloth factories, employing between 5000 and 6000 workmen. Population

(1890), 23,068; (1900), 22,840.

Cripple Creek, a mining city of El Paso county, Colorado, U.S.A., situated near the centre of the state, in 38° 45' N. lat. and 105° 11' W. long., in the mountains west of Pike's Peak, at an altitude of 9500 feet. It has two railways, the Florence and Cripple Creek, making connexion with Pueblo, and the Midland Terminal, a branch of the Colorado Midland, connecting with Colorado Springs. It is the richest gold mining camp in the United States. Gold was first discovered in 1891, and in 1897 the production exceeded $10,000,000. The sources of the gold are placers, veins, and the country rock. The ores consist of free gold, not only in placers but in veins and country rock, and tellurides and auriferous iron pyrites. They differ greatly in value, ranging from $20 up to several thousand dollars per ton. Population

(1900), 10,147.

Crispi, Francesco (1819-1901), Italian states- man, was born at Eibera in Sicily, October 4, 1819. In 1846 he established himself as advocate at Naples. On the outbreak of the Sicilian Eevolution at Palermo (Janu- ary 12, 1848) he hastened to the island and took an active part in guiding the insurrection. Upon the restora^ tion of the Bourbon Government (May 16, 1849) he was excluded from the amnesty and compelled to flee to Pied- mont. Here he unsuccessfully applied for a situation as communal secretary of Verolengo, and eked out a penurious existence by journalism. Implicated in the Mazzinian

conspiracy at Milan (February 6, 1853), he was expelled from Piedmont, and obliged to take refuge at Malta, whence he fled to Paris. Expelled from Prance, he joined Mazzini in London, and continued to conspire for the redemption of Italy. On June 15, 1859, he returned to Italy after publishing a letter repudiating the aggrandize- ment of Piedmont, and proclaiming himself a Eepublican and a partisan of national unity. Twice in that year he went the round of the Sicilian cities in disguise, and pre- pared the insurrectionary movement of 1860. Upon his return to Genoa he organized, with Bertani, Bixio, Medici, and Garibaldi, the expedition of the Thousand, and overcoming by a stratagem the hesitation of Garibaldi, secured the departure of the expedition on May 6, 1860. Disembarking at Marsala on the 11th, Crispi on the 13th, at Salemi, drew up the proclamation whereby Garibaldi assumed the Dictatorship of Sicily, with the programme : " Italy and Victor Emmanuel." After the fall of Palermo, Crispi was appointed Minister of the Interior and of Finance in the Sicilian provisional government, but was shortly afterwards obliged to resign on account of the struggle between Garibaldi and the emissaries of Cavour with regard to the question of immediate annexation. Appointed secretary to Garibaldi, Crispi secured the resignation of Depretis, whom Garibaldi had appointed Pro-Dictator, and would have continued his fierce opposition to Cavour at Naples, where he had been placed by Garibaldi in the Foreign Office, had not the advent of the Italian regular troops and the annexation of the Two Sicilies to Italy brought about Garibaldi's withdrawal to Caprera, and Crispi's own resignation. Entering Parliament in 1861 as deputy of the Extreme Left for Castelvetrano, Crispi acquired the reputation of being the most aggressive and most im- petuous member of the Eepublican party. In 1864, how- ever, he made at the Chamber a Monarchical profession of faith, in the famous phrase afterwards repeated in his letter to Mazzini: "The Monarchy unites us; the Ee- public would divide us." In 1866 he refused to enter the Eicasoli Cabinet ; in 1867 he worked to impede the Garibaldian invasion of the Papal States, foreseeing the French occupation of Eome and the disaster of Mentana. By methods of the same character as those subsequently employed against himself by Cavallotti, he carried on the violent agitation known as the Lobbia affair, in which sundry Conservative deputies were, on insufficient grounds, accused of corruption. On the outbreak of the Franco-German War he worked

energetically to impede the projected alliance with France, and to drive the Lanza Cabinet to Eome. The death of Eatazzi in 1873 induced Crispi's friends to put forward his candidature to the leadership of the Left; but Crispi, anxious to reassure the Crown, secured the election of Depretis. After the advent of the Left he was elected (November 1876) President of the Chamber. During the autumn of 1877 he went to London, Paris, and Berlin on a confidential mission, establishing cordial personal relationships with Gladstone, Granville, and other English statesmen, and with Bismarck.

In December 1877 he replaced Nicotera as Minister of the Interior in the Depretis Cabinet, his short term of office (70 days) being signalized by a series of important events. On January 9, 1878, the death of Victor Emmanuel and the accession of King Humbert enabled Crispi to secure the formal establishment of a unitary Monarchy, the new monarch taking the title of Humbert I., instead of Hum- bert IV. of Savoy. The remains of Victor Emmanuel were interred in the Pantheon, instead of being transported to the Savoy Mausoleum at Superga. On February 9, 1879, the death of Pius IX. necessitated the first Conclave held after the unification of Italy. Crispi, helped by Mancin?

and Cardinal Pecci (afterwards Leo XIII.), persuaded the Sacred College to hold the Conclave in Rome, and prorogued the Chamber lest any untoward manifes- tation should mar the solemnity of the event. The statesmanlike qualities displayed on this occasion were unavailing to avert the storm of indignation conjured up by Crispi's opponents in connexion with a charge of bigamy incapable of legal proof. Crispi was compelled to resign office, although the judicial authorities upheld the invalidity of his early marriage, contracted at Malta in 1853, and ratified his subsequent union with Signora Barbagallo. For nine years Crispi remained politically under a cloud, but in 1887 returned to office as Minister of the Interior in the Depretis Cabinet, succeed- ing to the Premiership upon the death of Depretis (July 29, 1887). i' V J

One of his first acts as Premier was a visit to Bismarck,
whom he desired to consult upon the working of the Triple
Alliance. Basing his foreign policy upon the alliance, as
supplemented by the naval
entente with Great Britain
negotiated by his predecessor,
Count Kobilant, Crispi as- sumed a resolute attitude
towards France, breaking off
the prolonged and unfruitful
negotiations for a new Pranco-
Italian commercial treaty, and
refusing the French invitation
to organize an Italian section
at the Paris Exhibition of
1889. At home Crispi secured
the adoption of the Sanitary
and Commercial Codes, and
reformed the administration
of justice. Forsaken by his
Radical friends, Crispi gov- erned with the help of the

Right, until, on January 31,

1891, an intemperate allusion

to the former policy of the

Conservative party led to his

overthrow. In December

1893 the impotence of the

Giolitti Cabinet to restore

public order, then menaced

by disturbances in Sicily and in Lunigiana, gave rise to a general demand that Crispi should return to power. Upon resuming oflSce he vigorously suppressed the disorders, and lent sturdy support to the energetic remedies adopted by Sonnino, Minister of Finance, to save Italian credit, which had been severely shaken by the bank and financial crises of 1892-1893. Crispi's uncompromis- ing suppression of disorder, and his refusal to abandon either the Triple Alliance or the Eritrean Colony, or to forsake his colleague Sonnino, caused a breach between him and the Radical leader Cavallotti. Cavallotti then began against him a pitiless campaign of defamation. An unsuccessful attempt upon Crispi's life by the anarchist Lega brought a momentary truce, but Cavallotti's attacks were soon renewed more fiercely than ever. They produced so little effect that the general election of 1895 gave Crispi a huge majority, but, a year later, the defeat of the Italian army at Adowa in Abyssinia brought about his resignation. The ensuing Rudini Cabinet lent itself to Cavallotti's campaign, and at the end of 1897 the judicial authorities applied to the Chamber for per- mission to prosecute Crispi for embezzlement. A parliamentary Commission, appointed to inquire into the

FEANCESCO CEISPI. {Ft'otn a Photograph hy Oiacomo Brogi, Florence.)

charges against him, discovered only that Crispi, on assuming office in 1893, had found the Secret Service coffers empty, and had borrowed from a State bank the sum of £12,000 for Secret Service, repaying it with the monthly instalments granted in regular course by the Treasury. The Commission, considering this proceeding irregular, proposed, and the Chamber adopted, a vote of censure, but refused to authorize a prosecution. Crispi resigned his seat in Parliament, but was re-elected by an overwhelming majority in April 1898 by his Palermo constituents. For some time he took little part in active politics, chiefly on account of his growing blindness. A successful operation for cataract restored his eyesight in June 1900, and notwithstanding his 81 years he resumed to some extent his former political activity. Soon afterwards, however, his health began to give way permanently, and he died at Naples on the 12th of August 1901.

The importance of Crispi in Italian public life depended less upon the many reforms accomplished under his ad- ministrations than upon his intense patriotism, remarkable fibre, and capacity for admin- istering to his fellow-country- men the political tonic of which they stood in constant need. In regard to foreign politics he greatly contributed to raise Italian prestige and to dispel the reputation for untrustworthiness and vacilla- tion acquired by many of his predecessors. (h. w. s.)

Croatia- Slavonia

(Horvat – Szlavonorszag), an autonomous province (Border- land) of Hungary. Area, 16,417 square miles, with 2,416,304 inhabitants in 1900. At the head of the Government stands the Banus, appointed by the king, with counter-signature of the Hungarian Prime Minister. The provincial Diet (Croatia- Slavonian-DalmatianNational Assembly) consists (a) of elected deputies, (&) of personal voters, whose number, however, cannot exceed half of that of the elected deputies. The National Assembly delegates out of its midst 40 deputies to the House of Commons and 3 deputies to the House of Magnates of the Hungarian Parliament, who participate in the discussion of the affairs which are common to Hungary and Croatia^Slavonia. The Croatian Minister, without portfolio, is a member of the Plungarian Government, who countersigns every act of

importance of the provincial Government of Croatia- Slavonia. In the eastern part of the land, especially on the plain extending between the Danube, Drava. and Szava, agriculture is largely carried on. The chief pro- ducts of 1900 were 3-0 millions metric centners of wheat, 3-6 mill. metr. cent, of potatoes, and 4-7 mill. metr. cent, of maize. The mountainous portion of the country is wooded, and on the plains are extensive forests. Above one-third (1,511,779 hectares=35-74 per cent.) of the cultivable ter- ritory is coveredby forests, whereof the public treasury pos- sesses 300-280 hectares, of a value of 58-9 million crowns. Of the grain produced, wheat, potatoes, and maize are

■the most important. Excepting Zagrab (Agram), the «ipidly rising capital of Croatia-Slavonia, and its sur- roundings, the greatest traf&c is in the regions near the Danube and the frontier passes towards Bosnia.

Croix, or Croix Wasequehal, a town of France, in the department of Nord, arrondissement of Lille, 5 miles north-east of Lille and 2 miles south-west of Roubaix, with station on railway to Courtrai. The town is situated near the Marcq, an affluent of the Deule, and is practically a suburb of Eoubaix. Port traffic (1899), 71,145 tons. Population (1881), 3260 ; (1896), 13,895 ;

(1901), 15,933.

Croll, James (1821-1890), Scottish man of science, was born of a peasant family at Little Whitefield, in Perthshire, 2nd January 1821. He was regarded as an unpromising boy, but a trifling circumstance aroused a passion for reading, and he made great progress in self- education. Debarred by ill-health from manual labour, he became successively a shopkeeper and an insurance agent, and in 1859 was made keeper of the Andersonian Museum at Glasgow, a humble appointment, which, however, gave him what he most required. In 1857, being deeply im- pressed by the metaphysics of Jonathan Edwards, he had .-^jublished an anonymous volume entitled Tlie Philosophy of Theism; but his connexion

with the Museum induced him to take up physical science, and in 1864 he wrote his celebrated essay " On the Physical Causes of the Changes of Climate during the G-lacial Epoch." This led to his receiving an appointment on the Scottish Geological Sur- vey in 1867. In 1875 he summed up his researches upon the ancient condition of the earth in his Climate and Time, in which he contends that terrestrial revolutions are due in a measure to cosmical causes. This theory excited warm controversy. Croll's replies to his opponents are collected in his Climate and Cosmology (1885). He had been compelled by ill-health to withdraw from the public service in 1881 ; yet, working under the greatest difScul- ties, and harassed by the miserable inadequacy of his retiring pension, he managed to produce Stellar Evolution, discussing, among other things, the age of the sun, in 1.889 ; and Tlie Philosophical Basis of Evolution, partly a critique of Herbert Spencer's philosophy, in 1890. He died on 15th December 1890. The soundness of Croll's theories remains a subject of controversy, but his char- acter as a scientific worker under the greatest discourage- ments was nothing less than heroic. His life, prefaced by an unfinished autobiography, was written by Mr J. C. Irons in 1896. (r. g.)

Cromarty. See Koss.

Cromer, a parish and fashionable watering-place in the northern parliamentary division of Norfolk, England, 22 miles north of Norwich by rail. Standing on clifPs of considerable elevation, the town has repeatedly suffered from ravages of the sea. In 1894 a wall and esplanade were built at the bottom of the East Cliffs, and these are being extended to the west. A pier, 183 yards long, is to be constructed at a cost of £11,000. A water reservoir to hold 600,000 gallons was finished in 1896. There are a town-hall, a cottage hospital, and a lecture hall. On a site of three acres stands the Convalescent Home of the Norfolk and Norwich Hospital. There is an excellent golf course. There are herring, cod, lobster, and crab fisheries. Area of urban district, 938 acres. Population (1881), 1597 ;

(1901), 3776.

Cromer, Evelyn Baring, 1st Earl (1841),

British statesman and diplomatist, was born on the 26th February 1841, the ninth son of Henry Baring, M.P., by Cecilia Anne, eldest daughter of Admiral Windham of

Felbrigge ilall, Norfolk. Having joined the Royal Artillery in 1858, he was appointed in 1861 A.D.C. to Sir Henry Storks, High Commissioner of the Ionian Islands, and acted as secretary to the same chief during the inquiry into the Jamaica outbreak in 1865. Gazetted captain in 1870, he went in 1872 as private secretary to his cousin Lord Northbrook, Viceroy of India, where he remained until 1876, when he became major, received the C.S.I., and was appointed British Commissioner of the Egyptian Public Debt Office. Up to this period Major Baring had given no unusual signs of promise, and the appointment of a comparatively untried major of artillery as the British representative on a Financial Board com- posed of representatives of all the Great Powers was considered a bold one. Within a very short time it was recognized that the Englishman, though keeping himself carefully in the background, was unmistakably the pre-dominant factor on the Board. He was mainly responsible for the searching report of the Commission of Inquiry that had been instituted into the financial methods of the Khedive Ismail ; and when that able and unscrupulous Oriental had to submit to an enforced abdication, it was Major Baring who became the British Controller-General and practical director of the Dual Control. Had he re- mained in Egypt, the whole course of Egyptian history might have been altered, but his services were deemed more necessary in India, and under Lord Eipon he became Financial Member of Council in June 1880. He remained there till 1883, leaving an unmistakable mark on the Indian financial system, and then, having been rewarded by the K.C.S.I., he was appointed British Agent and Con- sul-General in Egypt and a Minister Plenipotentiary in the Diplomatic Service.

Sir Evelyn Baring was at that time only a man of forty- two, who had gained a reputation for considerable finan- cial ability, combined with an abruptness of manner and a certain autocracy of demeanour which, it was feared, would impede his success in a position which required considerable tact and diplomacy. It was a friendly colleague who wrote —

The virtues of Patience are known, But I think that, when put to the toiich,

The people of Egypt will own, with a groan. There's an EvU in Baring too much.

When he arrived in Cairo in 1883 he found the adminis- tration of the country almost non-existent. Ismail had ruled with all the vices, but also with all the advantages, of autocracy. Disorder in the finances, brutality towards the people, had been combined with public tranquillity and the outer semblance of civilization. Order, at least, reigned from the Equator to the Mediterranean, and such trivial military disturbances as had occurred had been of Ismail's own devising and for his own purposes. Tewfik, who had succeeded him, had neither the inclination nor character to be a despot. Within three years his govern- ment had been all but overthrown, and he was only Khedive by the grace of British bayonets. Government by bayonets was not in accord with the views of the House of Commons, yet Ismail's government by the kourbash could not be restored. The British Govern- ment, under Mr Gladstone, desired to establish in Egypt a sort of Constitutional Government ; and as there existed no single element of a constitution, they had sent out Lord Dufferin to frame one. That gifted nobleman, in the delightful lucidity of his picturesque report, left nothing to be desired except the material necessary to convert the flowing periods into political entities. In the absence of that, the constitution was still-born, and Sir Evelyn Baring arrived to find, not indeed a clean slate, but a worn-out papyrus, disfigured by the efforts of centuries to describe in hieroglyph a method of rule for a docile people.

From that date the history of Sir Evelyn Baring, who became Baron Cromer in 1892, G.C.B. in 1895, Viscount in 1897, and Earl in 1901, is the history of Egypt, and requires the barest mention of its salient points here. From the outset he realized that the task he had to per- form could only be effected piecemeal and in detail, and his very first measure was one which, though severely criticized at the time, has been justified by

events, and which in any case showed that he shirked no responsi- bility and was capable of adopting heroic methods. He temporarily abandoned that portion of the territory over which Egypt held only a nominal sway, already challenged by the Mahdi, and set himself to work to reorganize the remainder. That portion, too, he attacked in detail. The very first essential was to regulate the financial situation ; and in Egypt, where the entire revenue is based on the production of the soil, irrigation was of the first importance. With the assistance of Sir Colin Scott Moncrieff, in the Public Works Department, and Sir Edgar Vincent, as Financial Adviser, these two great departments were practically put in order before he gave more than superficial attention to the rest. The Ministry of Justice was the next department seriously taken in hand, with the assistance of Sir John Scott, while the army had been reformed under Sir Evelyn Wood, who was succeeded by Sir Francis Grenfell. Education, the Ministry of the Interior, and gradually every other de- partment, came to be reorganized, or, more correctly speaking, formed, under Lord Cromer's carefully per- sistent direction, until it may be said to-day that the Egyptian administration can safely challenge comparison with that of any other state. In the meantime the rule of the Mahdi and his successor, AbduUa Khalifa, in the temporarily abandoned provinces of the Sudan, had been weakened by internal dissensions; the Italians from Massawa, the Belgians from the Congo State, and the French from their West African possessions, had gradu- ally approached nearer to the valley of the Nile ; and the moment had arrived at which Egypt must decide either to recover her position at Khartum or allow that im- portant centre to fall into hands hostile to Great Britain and her position in Egypt. Lord Cromer was as quick to recognize the moment for action and to act as he had fifteen years earlier been prompt to recognize the necessity of abstention. In March-September 1896 the first ad- vance was made to Dongola under the Sirdar, Sir H. (now Lord) Kitchener ; between July 1897 and April 1898 the advance was pushed forward to the Atbara; and on September 2, 1898, the battle of Omdurman finally crushed the power of the Khalifa and restored the Sudan to the rule of Egypt and Great Britain. To have effected this in the face of the greatest difB.culties, — political, national, and international, — and at the same time to have raised the credit of the country from a condition of bankruptcy to an equality with that of the first European Powers, entitles Lord Cromer to a very high place among

the greatest administrators that the British Empire has pro- duced. Lord Cromer married in 1876 Ethel Stanley, daughter of Sir Rowland Stanley Errington, eleventh baronet, but was left a widower with two sons in 1898 ; and in 1901 he married Lady Katherine Thynne, daughter of the fourth Marquess of Bath.

Crompton, a township in the Prestwich division of Lancashire, England, 2^ miles north of Oldham. Since 1894 it has been governed by an urban district council. At Shaw, a large village included within it, is a station on the Lancashire and Yorkshire railway. Population

(1891), 12,901 ; (1901), 13,427.

Crookes, Sir William (1832), English

chemist and physicist, was born in London on 17th June

1832, and studied chemistry under Hofmann at the Royal College of Chemistry. In 1861, while conducting a spectroscopic examination of the residue left in the manufacture of sulphuric acid, he observed a bright green line which had not been noticed previously, and by following up the indication thus given he succeeded in isolating a new metal, thallium, a specimen of which was shown in public for the first time at the Exhibition of 1861. During the next eight years he carried out a minute investigation of this substance and its properties. While determining its atomic weight, he thought it desirable, for the sake of accuracy, to weigh it in a vacuum, and even in these circumstances he found that the balance behaved in an anomalous manner, the metal appearing to be heavier when cold than when hot. This phenomenon he explained as a ” repulsion from radiation,” and he expressed his discovery in the statement that in a vessel exhausted of air a body tends to move away from another body hotter than itself. Utilizing this principle he constructed the radiometer (see Ency. Brit. vol. xix. p. 249 and Supp. Radiometbe), which he was at first disposed to regard as a machine that directly transformed light into motion, but which was afterwards perceived to depend on thermal action. Thence he was led to his famous researches on the discharge of electricity through highly rarefied gases and on radiant matter, and to the development of his theory of a “fourth state of matter.” In 1883 he began

an inquiry into the nature and constitution of the rare earths. By repeated chemical fractionations he was able to divide yttrium into distinct portions which gave different spectra when exposed in a high vacuum to the spark from an induction coU. This result he considered to be due, not to any removal of impurities, but to an actual splitting-up of the yttrium molecule into its constituents, and he ventured to draw the provisional conclusion that the so-called simple bodies are in reality compound molecules, at the same time suggesting that all the elements have been produced by a process of evolution from one primordial stuff or "protyle." A later result of this method of investigar tion was the discovery of a new member of the rare earths, monium or victorium, the spectrum of which is characterized by an isolated group of lines, only to be detected photographically, high up in the ultrarviolet end; the existence of this body was announced in his presidential address to the British Association at Bristol in 1898. In the same address he called attention to the conditions of the world's food supply, urging that with the low yield at present realized per acre wheat cannot long retain its position among the food-stuffs by which mankind is nourished, and that since nitrogenous manures are essential for an increase in the yield, the hope of averting starvation depends on the ability of the chemist to find an artificial method for fixing the nitrogen of the air. In addition to many other researches besides those here mentioned. Sir William Crookes has edited various books on chemistry and chemical technology, and has also given up a certain amount of time to the investigation of psychic phenomena, en- deavouring to effect some measure of correlation between them and ordinary physical laws. He was knighted in 1897, and has received the Royal and Davy medals of the Royal Society, besides having filled the offices of Presi- dent of the Chemical Society and of the Institution of Electrical Engineers.

Croolcston, capital of Polk county, Minnesota, U.S.A., on the Red Lake River in the edge of Red River valley, on the Great Northern and the Northern Pacific railways lines. Population {1890), 3457 ; (1900), 6369.

Croos River. See Nigeria.

CROQUET

Croquet. — The line of demarcation between the old game and "New Croquet," as it is called, is not very difficult to draw, for croquet has had an experience quite vmexampled in the history of games. The pastime eulo- gized by Lord Beaconsfield and illustrated by John Leech spread very rapidly. In some half dozen years after the appearance of the game, a croquet groimd in a country house was deemed as important an adjunct as a con- servatory. And then, almost in a night, the game disappeared. More than one reason has been assigned for this. It was pushed forward too quickly by experts and made too difficult; and then the croquet grounds were foimd admirably adapted for lawn tennis which in its early development could be played by man, woman, and child. The dimensions of the croquet ground have been altered since the days when Mr Henry Jones wrote his article in the ninth edition of the JEncyclopcedia Britannica (vol. vi.). A ground for match play must measure 35 yards in length by 28 yards in width, and the boundary must be marked with a white line. A little flag must be placed in each corner, and a spot of white near the flag, this spot being 3 feet from each boundary. Six hoops are used in the game, and two pegs. The hoop must be made of half-inch iron, and must stand up 12 inches above the ground. The hoop now used at all tournaments is the " Davidson," which develops into an inverted cone some 4 or 5 inches long under the soil, the broadest part at the top being a little broader than the iron above the surface. These hoops are very rigid, and if they get loose a tap with the mallet makes them tight again. The hoop must measure 4 inches across, inner measurement, and be square at the top. The pegs are of wood. They must bell inch in diameter and stand two feet out of the ground. One peg, the winning peg, is painted with four rings of colour, namely, blue, red, black, and yellow ; the other peg is painted white. This distinction was made to indicate the top end and the bottom end of the ground, which was confusing sometimes at tournaments. Little cross bars should be on the top of the pegs to hold the clips. The balls are of boxwood, and weigh between 14^ and 16^ ozs. They are 3|- inches in diameter. There must be a blue ball, a red ball, a black ball, and a yellow ball, and this sequence of the colours must be preserved. Thus if a player having the choice of balls and lead elects to play with yellow, blue must follow. Clips of the colour of the balls must be

used. The clip indicates the next point in order of the player. The laws about mallets have changed since the old days of croquet when there was ” no restriction as to the number, weight, size, shape, or material of the mallets.” If you have india- rubber at one striking end you must not use it. Also your mallet must have the two striking ends perfectly vertical. The accompanying plan will show why a multiple of 5 and 4 have been selected for the dimensions of the ground. Up the central line the hoops are 7 yards apart, each peg 7 yards from the nearest outer hoop, 7 yards from each side hoop, 7 yards from the boundary. This is the setting, and the game con- sists in driving both balls through these hoops, in the order indi- cated by the numbers, up to the turning peg, and then returning to the winning peg, in a similar manner. At starting each player places his ball one foot away from hoop No. 1, placing it not If he runs the hoop he

1

i

7

3

2

•

1

i

12

6

1

i

1.3

5

11

9

p

4

1

14

1

i

10

— indicates 7 yds. slantingly, but in the exact centre,

plays again, and his turn can be prolonged by the follow- ing incidents : — 1. Making a fresh point (hoop or peg) in order. 2. Hitting a ball that he has not hit since making a point. This hit is called a roquet, and after a roquet a player is compelled to take croquet. To take croquet you must place your ball in undeniable contact with the ball you have hit, and you may in your stroke glance away 20 yards (or other distance) after moving it half an inch, or you may roll it along with your own ball all that dis- tance, or you may effect what is called a stop shot, and drive the croqueted ball a considerable distance while arresting the progress of your own ball almost com- pletely. The croquet is an important stroke, and you must get from it all the advantage you can. But it is checked by certain minute regulations : — 1. If the balls are not quite touching when you take croquet the ad- versary may have them put back and make you play the stroke over again. 2. If you fail to move both balls your turn ceases, and the adversary once more can have the balls put back. 3. If the croqueted

ball reaches the boundary of the ground your turn ceases. 4. If your own ball reaches the boundary of the ground, unless in- termediately it makes a roquet, your turn ceases. This, called the dead boundary law, was in existence when Mr Henry Jones wrote, but it has since been modified.

The laws of croquet may here be briefly sketched. There are thirteen strokes called ” foul.” No point can be scored off any of them, the turn is lost, and the adver- sary, if he likes, can have the ball replaced after the stroke : — 1. To strike the ball twice distinctly in playing it. 2. To push a ball without an audible knock. 3. To strike another ball besides one’s own in playing, or taking aim. 4. To touch a rolling ball. 5. To allow a ball to rebound on the player’s person or mallet. 6. To press a ball round a wire. 7. To play a ball after a roquet with- out taking croquet. 8. To fail to move the croqueted ball in the croquet stroke. 9. To take croquet from a ball with- out having first roqueted it. 10. To knock a hoop out of the ground with the mallet when making a stroke. 11. To use any part of the mallet, except the striking ends of the head, to propel a ball. 12. To use an indiarubber- tipped mallet. 13. To touch a ball improperly with hand, foot, or mallet. Besides these “foul strokes” there are six minor offences ; it is a blemish in the laws that no defined penalties are attached to them, and players are advised to settle beforehand that the stroke must be played again if the adversary wishes it : — 1. To play a stroke with a second mallet without having damaged the first. 2. To take croquet off a ball which you have sent not off but nearer than 3 feet to the boundary, without bringing it in three full feet before you play. 3. To lay down a mark to help your aim. 4. To play the first stroke at less than a foot from the first hoop, and not from a central spot. 6. To play with the wrong ball at starting. 6. To move a ball at rest accidentally. There are a few other laws. Only a rover can peg out a rover. A hoop is considered run when it cannot be touched with a straight edge from the playing side. On the other hand, a ball driven partly through a hoop from the non-playing side cannot run the hoop next stroke if it can be touched by a straight edge from the non-playing side. If the player play with a wrong ball, blue and black must be placed in one corner and red and yellow in the other corner, behind hoops 1 and 10, and the adversary may go on with either ball of his side.

A considerable advance has been made in the use of the mallet since 1877. Players are now divided into two groups, those who use side-play and those who use front- play. The distinction can be best understood if we imagine a player shooting at an object due north. The side player will face due east and strike with his mallet across the

■ *body, the front-player will face due north and look along the head of his mallet in taking aim. When Mr Henry Jones wrote his article side-play was the only play. In- deed a law in the code called ” The Field” Laws absolutely forbids the use of front-play at all. The side-player usually stoops down and slopes his mallet, and delivers a stroke rather like a hockey stroke ; he drives the ball, often very accurately, by a pure and unadulterated blow. But this stroke is uncertain. It depends entirely on eye and hand, and one bad stroke in a game may lose a match. The advantages of front-play are twofold. It allows the player to ” look along the barrel,” to use a phrase which fairly conveys the right idea. This is a great advantage, especially in strokes that require much accu- racy, as with a hoop played at from a slanting direction. The second advantage of front-play is that the pendulum stroke can be used. The player must have his mallet perfectly upright, his eye, his two hands, the line along the mallet head, the line through the centre of his ball, and the line through the centre of the ball aimed at must all be in the same vertical plane. His left hand will act as a pivot, the centre of the curve described by the mallet head in the stroke. The right hand will guide this mallet head, and it is essential to accuracy that it should be drawn up rather than back to preserve as much as possible the pendulum’s curve. Much depends on the left hand, which clutches the mallet handle and acts as a pivot. The great dif&culty of all is keeping this pivot during the stroke rigidly in the same vertical plane as the moving head.*

The tactics of croquet have undergone a change since the days of Mr Henry Jones. The hoops for match play then were very difficult. They were of ^-inoh steel, and 3J-inch span, and were fixed in a block of solid oak under the soil. This block was about the size and shape of a volume of

the Encyclopedia Britannica. The diameter of a ball was only | of an inch less than the span of the hoop, and when the ball touched the steel upright it was at once arrested. From this resulted very timid and cautious play. A tricky stroke was invented to put on what billiard players call " follow " in running a hoop. A player was afraid to attempt such a feat if any but a friendly ball was near. There was a great deal of what is called finesse, which means shooting into a corner to prevent your ball from helping the antagonist. Games were excessively long. Moderate players, and experts, who were not able to practise with the socketed hoops, soon gave up the game altogether. New croquet, by reverting to the 4-inch hoop and encouraging large handicaps, is giving to the scientific game a rapid and vast extension quite out of all precedent in the past. Excellent players are springing up everywhere, and with them a stronger and bolder game. A brief statement will show all that this means. Croquet is a unique game. If it is to be compared to any other it may be said that from the point of view of accurate striking and nice judgment of strength it approaches billiards, and from the intellectual side it approaches whist. Four balls, blue, red, black, and yellow, roll along the ground, and each of these balls affects the others at every stage of the game as much as the units of the little armies of spades and diamonds in whist. Red, we will say, hits blue. From that moment red dominates not only his own balls but those of his adversary, often for a considerable time. This is at once the weakness of croquet, and also its ex- ceptional fascination. This command of the balls is called the attack, and the crucial strategy of the game is centred on two problems, namely, how to win when you have the attack, and liow to get it when it is in the hands of the adversary. The object of the game being to pass both balls through the prescribed circuit of hoops, the player who possesses the attack will try to do this as fast as he can, passing not one hoop alone, but several, if practicable, in a turn. This sequence of hoops is called a break, and if it is effected with the aid of all the balls it is called a four-ball break, but if only three are available it is a three-ball break. The four- ball break is naturally the easiest. The principle of all breaks is to arrange to have a ball at your hoop the next m order as you come up to it, and another ball always at your next hoop but one in order. Thus if you are going up to hoop 5 (see plan)you should have a ball there to help you, and another at hoop 6. Let us say that with the aid of the first you run hoop 5 ; at once you send the ball that has assisted you on the turning peg

itself, and you stop yaur ball in the croquet stroke close to the ball at hoop 6. Ihe difficult feature of the setting is the four corner hoops, but these

are run by the aid of what is called a centre ball, i.e., you leave one of the balls in the centre of the ground as you run up to the stick. As you do so, you split the ball that has helped you to run hoop 6 away to hoop 8 and make the peg with the ball sent there to help you. Now comes in the work of the centre ball. You drive the ball that has helped you at the stick to the distant comer, hoop 9, and stop by the centre ball. You then hit it and take off to the ball left at hoop 8. In this way the centre ball will help you to do the four corner hoops 8, 9, 10, 11. Plainly the main object of the adversary must be to keep this fourth ball from you. His chief chance is coming in with a long shot, but he must send this as much as possible out of your game. (a. li.)

Cross, Mary Ann (or, as she usually signed her- self, Marian) (1819-1880), the famous English writer who is more generally known as George Eliot, was born at Arbury Farm, in Warwickshire, on 22nd November 1819. Her father, Eobert Evans, was the agent of Mr Erancis Newdigate, and the first twenty-one years of the great novelist's life were spent on the Arbury estate. She received an ordinary education at respectable schools till the age of seventeen, when her mother's death, and the marriage of her elder sister, called her home in the character of housekeeper. This, though it must have sharpened her sense, already too acute, of responsibility, was an immense advantage to her mind, and, later, to her career, for, delivered from the tiresome routine of lessons and class-work, she was able to work without pedantic interruptions at German, Italian, and music, and to follow her unusually good taste in reading. The life, in-asmnch as she was a girl still in her teens, was no doubt monotonous, even unhappy. Just as Cardinal Newman felt, with such different results, the sadness and chain of evangelical influences from his boyhood till the end of his days, so Marian Evans was subdued all through her youth by a severe religious training which, while it pinched her mind and crushed her spirit, attracted her idealism by the very hardness of its perfect counsels. It is not surprising to find, therefore, that when Mr Evans moved to Coventry in 1841, and so enlarged the circle of their acquaintance, she became much interested in some new friends, Mr and

Mrs Charles Bray and Mr Charles Hennell. Mr Bray had literary taste and wrote works on the Education of the Feelings, the Philosophy of Necessity, and the like. Mr Hennell had publishe'd An Enquiry concerning the Origin of Christianity. Miss Evans, then twenty-two, absorbed immediately these unexpected, and, at that time, daring habits of thought. So compelling was the atmosphere that it. led to a complete change in her opinions. Kind in her affection, she was relentless in argument. She refused to goto church(for sometime, at least), wrote painful letters to a former governess, — the pious Miss Lewis, — and barely avoided an irremediable quarrel with her father, a churchman of the old school. Here was rebellion indeed. But rebels come, for the most part, from the provinces where petty tyranny, exercised by small souls, show the scheme of the universe on the meanest possible scale. George Eliot was never orthodox again : she abandoned, with fierce determination, every creed, and although she passed, later, through various phases, she remained incessantly a rationalist in matters of faith and in all other matters. It is nevertheless true that she wrote admirably about religion and religious persons. She had learnt the evangelical point of view : she knew — none better — ^the strength of religious motives: vulgar doubts of this fact were as distasteful to her as they were to another eminent writer, to whom she refers in one of her letters (dated 1853) as " a Mr Huxley, who was the centre of interest" at' some "agreeable evening." Her books abound in tributes to Christian virtue, and one of her own favourite characters was Dinah, the Quakeress, in Adam Bede.

She undertook, about the beginning of 1844, the trans- lation of Strauss's Leben Jesu. This work, published in

29(3

CROSS

1846, was considered scholarly, but it met, in the nature o_f things, with no popular success. On the death of]\Ir Evans in 1849, she went abroad for some time, and we hear of no more literar}' ventures till 1851, when she accepted the assistant-editorship of the Westminster Review. For a while she had lodgings at the offices of that pub- lication in the Strand, London. She wrote several nota- ble papers, and became acquainted with

many distinguished authors of that period — among them Herbert Spencer, Carlyle, Harriet Martineau, Francis Newman, and George Henry Lewes. Her friendship with the last named led to a closer relationship, which she regarded as a marriage. Among the many criticisms passed upon this step (in view of the fact, among other considerations, that Lewes had a wife living at the time), no one has denied her courage in defying the law, or questioned the ciualit)^ of her tact in a singularly false position. That she felt the deepest affection for Mr Lewes is evident ; that we owe the development of her genius to his influence andconstant sym- pathy is all but certain. Yet it is also sure that what she gained from his intimate com- panionship was heavily paid for in the unceasing conscious- ness that most people thouglit her guilty of a grave mistake, and found her written words, Avith their endorsement of tra- ditional morality, wholly at variance with the circum- stances of her private life. Doubts of her suffering in this respect will be at once dis- missed after a study of her journal and letters. Stilted and unnatural as these are to a tragic degree, one can read well enough between the lines, and also in the elaborate dedi- cation of each manuscript to " my husband " (in terms of the strongest love), that self- repression, coupled with audacity, does not make for peace. Her sensitiveness to criticism was extreme : a flip- fiant paragraph or an illiterate review with regard to her work actually affected her for d^.vs. The whole history of

GEORGE {From a photo.hy the Lo

her union with Lewes

is a complete illustration of the force of sheer will — in that case partly her own and not inconsiderably his — over a nature essentially unfitted for a bold stand against attacks. At first she and the man whom she had described "as a sort of miniature Mirabeau in appear- ance," went abroad, but they returned to England the same year and settled, after several moves, in lodgings at East Sheen.

In 1854 she published Tlie Essence of Cliristianity, a translation from Feuerbach, a philosopher to whom she had been introduced by Mr Bray. During 1855 she trans- lated Spinoza's Ethics, wrote articles for the Leader, the Westminster Reviev:,&n

and altliough the author received much encouragement from private sources, the few real critics were mostly non- committal, and it was not until the publication of Adam Bede in 1859 that enthusiasm was attracted to the quality of the earlier production. Adam Bede, in many judg- ments George Eliot's masterpiece, met with a success (to use her own words) "triumphantly beyond anything she had dreamed of." In 1860 appeared TJie Mill on the Floss. After the sensational good fortune of Adam Bede, the criticism applied to the new novel seems to have been disappointing. \e find Miss Evans telling her publisher that " she does not wish to see any newspaper articles." But the book made its way, and prepared an ever-growing army of readers for Silas Marner (1861), Romola (1862-63), and Felix Holt (1866). The Spanish Gypsy (1868), a drama in blank verse, received more public response than most compositions of the kind executed by those connected

with the drama or with poetry only ; and she published in 1874 another volume of verses, Tlie Legend of Jubal and other Poems.

Any depression which the author may have felt with regard to the faults found with some of the last named books was completely cured by the praise bestowed on Middle- march (1873). This profound study of certain types of English character was supreme at the time of its writing, and it remains supreme, of its school, in European literature. Thackeray is brilliant ; Tolstoi is vivid to a point where life, not art, seems the question at issue ; Balzac created a whole world ; George Eliot did not create, but her exposition of the upper and middle class minds of her day is a masterpiece of scientific psj'chology. Daniel Deronda (1876), a production on the same lines, was less satisfactory. It exhibited the same human insight, the pas- sionate earne.stness,the insinu- ated special pleading for hard cases, the same intellectual strength, but the subject was unwieldy, almost forbidding, and, as a result, the novel, in spite of its distinction, has never been thoroughly liked. The death of !Mr Lewes in 1878 was also the deathblow to her artistic vitality. She corrected the proofs of Tlieo- pihrastus Such (a collection of essays), but she wrote no more. About two years later, however, she married]\Ir J. W. Cross, a gentleman whose friendship was especially congenial to a temperament so abnormally dependent on affectionate understanding as George Eliot's.

But she never really recovered from her shock at the loss of George Lewes, and died at 4 Cheyne Walk, Chelsea, on the 22nd of December 1880.

No right estimate of her, whether as a woman, an artist, or a philosopher, can be formed without a steady recollec- tion of her infinite capacity for mental suffering, and her need of human support. The statement that there is no sex in genius is, on the face of it, absurd. George Sand certainly the most independent and dazzling of all women authors, neither felt, nor wrote, nor thought as a man. Saint Teresa, another great writer on a totally different

plane, was pre-eminently feminine in every ~~*word and idea. George Eliot, less reckless, less romantic than the Freuchwoman, less spiritual than the Spanish saint, was more masculine in style than either, but her outlook was not, for a moment, the man's outlook ; her sincerity, with its odd reserves, was not quite the same as a man's sin*~~ *cerity, nor was her humour that genial, broad, unequivo- cal humour which is peculiarly virile. Hers approximated, curiously enough, to the satire of Jane Austen, both for its irony and its application to little everyday affairs. Men's humour, under all its headings, is on the heroic rather than the average scale. It is for the uncommon situa- tions, not the daily tea-table. Again, George Eliot was a little scornful to those of both sexes who had neither special missions nor the consciousness of this deprivation. Men are seldom in favour of missions in any field. She demanded, too strenuously from the very beginning, an aim, more or less altruistic, from every individual, and as she advanced in life this claim became the more impera- tive, till at last it overpowered her art, and transformed a great delineator of humanity into an eloquent observer with far too many personal prejudices. But she was altogether free from cynicism, bitterness, or the least tendency to pride of intellect. She suffered from bodily weakness the greater part of her life, and but for an extras*

ordinary mental health — ^inherited from the fine yeoman stock from which she sprang — it is impossible that she could have retained, at all times, so sane a view of human conduct, or been the least sentimental among women writers of the first rank — the one wholly without morbidity in any disguise. The accumulation of mere book knowledge, as opposed to the friction of a life spent among all sorts and conditions of men, drove George Eliot at last to write as a specialist for specialists : joy was lost in the consuming desire for strict accuracy : her genius became more and more speculative, less and less emotional. The highly trained brain suppressed the im- pulsiveheart, — the heart described with such candour and pathos as Maggie Tulliver's in The Mill on the Floss. For this reason — chiefly because philosophy is popularly asso- ciated with inactive depression, whereas human nature is held to be eternally exhilarating — her later works have not received so much praise as her earlier productions. But one has only to compare Romola or Daniel Deronda with the compositions of any author except herself to realize the greatness of her designs, and the astonishing gifts brought to their final accomplishment.

Life of George Eliot. Edited by J. W. Ckoss. 3 vols. 1885- 87. (p. M. T. 0.)

Crosse n, a town of Prussia, at the influx of the Bober into the Oder, 31 miles south-east of Frankfurt by rail, capital of the circle of Crossen, Government district of Frankfurt. It has two Protestant and one Catholic church, a real, a mechanics', a horticultural, and other schools, and a brisk shipping trade. Population (1890), 6657; (1895), 79il; (1900), 7369.

Crowe, Sir Joseph Archer (1828-1896), Eng- lish consular ofiicial and art critic, was born in London on 25th October 1828. At an early age he showed con- siderable aptitude for painting, and entered the studio of Paul Delaroche in Paris, where his father then resided as correspondent of the Morning Chronicle, but he never achieved any great distinction with the brush. During the Crimean War he was the correspondent of the Illus- trated London News, and during the Austro-Italian War represented the Times in Vienna. He was British consul- general in Leipzig from 1860 to 1872, and in Dlisseldorf from 1872 to 1880, when he

was appointed commercial attache in Berlin, being transferred in a like capacity to

Paris in 1882. In 1883 he was secretary to the Danube Conference in London ; in 1889 plenipotentiary at the Samoa Conference in Berlin ; and in 1890 British envoy at the Telegraph Congress in Paris, in which year he was made K.C.M.G. During a sojourn in Italy, 1846-1847, he cemented a lifelong friendship with the Italian painter Cavalcaselle, and the two friends engaged in works of artistic research. Notable among these are Early Flemish Painters (London, 1857) ; A New History of Painting in Italy from the Second to the Sixteenth Century (Lon- don, 1864-66, 3 vols.). The latest work from his own pen was Reminiscences of Thirty-five Years of My Life. He died at Schloss Gamburg in Bavaria on 6th Septem- ber 1896.

Crowther, Samuel Adjai (18 ? -1891), African missionary-bishop, was born in Yoruba, and was sold into slavery in 1821. Next year he was rescued, with many other captives, by H.M. ship Myrmidon, and was landed at Sierra Leone. Educated there in one of the Church Missionary Society's schools, he was baptized on 11th December 1825. In the course of time he became a teacher at Fousah Bay, and afterwards an energetic missionary on the Niger. Summoned to Eng- land in 1842, he entered the Church Missionary Col- lege at Islington. On 11th June in the following year he was ordained by Bishop Blomfield. Keturning to his native land, he laboured with great success amongst his own people, and afterwards at Abeokuta. Here he devoted himself to the preparation of school-books, and the trans- lation of the Bible and Prayer-Book into, Yoruba and other dialects. He also established a trade in cotton, and improved the native agriculture. In 1857 he commenced the third expedition up the Niger, and after labouring with varied success, and encountering great danger from a pow- erful native chieftain, returned to England and was conse- crated, on St Peter's Day 1864, first Bishop of the Niger Territories, and was warmly welcomed in his native land. Before long a commencement was made of the missions to the Delta of the Niger, and between 1866 and 1884 con- gregations of Christians were formed at Bonny, Brass, and New Calabar, but the progress made was slow and subject to many impediments. In 1872, during a violent perse- cution, two converts*

suffered martyrdom. In 1888 the tide turned, and several chiefs embraced Christianity, and on Bishop Crowther's return from another visit to England, the large iron church known as " St Stephen's Cathedral " was opened, and all the objects of superstitious worship were given up. For three years more the bishop laboured, and then died of paralysis at the end of October 1891, having displayed as a missionary for many years untiring industry, great practical wisdom, and deep piety.

(g. f. M.)*

Croydon, a parish and county borough, 10 miles south of London by rail, in the north-east of Surrey. It was once supposed to mark the site of the Roman station Noviomagus, but this opinion is now rejected, and Hol-wood Hill, Keston, is believed to be the true site of that station. It was formed into a municipal borough in 1883, a parliamentary borough in 1885, and a county borough in 1888. The population of the registration district was in 1881, 101,241 ; in 1891, 151,771 ; and in 1901, 194,425. The population of the county borough in 1891 was 102,695, and in 1901, 133,885. The parish church of St John the Baptist appears to have been built in the 14th and 15th centuries, but to have contained remains of an older building. The church was restored or rebuilt in the 16th century, and again restored by Sir Gilbert G. Scott in 1857-59. It was destroyed by fire, with the exception of the tower, on 5th January 1867, and

was at once rebuilt by Scott on the old lines. Adding- tou Park, 3^ miles from Croydon, was purchased for the residence, in 1807, of the archbishop of Canterbury, but was sold in consequence of Archbishop Temple's decision to reside at the Palace, Canterbury. Whitgift's Hospital (1596) was restored in 1860, and the Whitgift Grammar School was built in 1871. Tew towns have developed the modern spirit so thoroughly as Croydon has. It makes full use of electric lighting, and has one of the lowest death-rates in the United Kingdom.

Crozet Islands, an uninhabited insular group in the Indian Ocean, 46°-47° S. and 50° E. They are mountainous, with summits from 4000 to 5000 feet high, and are disposed in two divisions — Penguin or Inaccessible, Hog, Possession, East; and the Twelve Apostles. Like Kerguelen, Heard, Prince Edward, Marion, and the other clusters in these southern waters, they appear to be of igneous formation; but owing to the bleak climate and their inaccessible character they are seldom visited, and have never been explored since their discovery by Marion in 1771. Possession, the highest, has a snowy peak said to exceed 5000 feet. Hog takes its name from the animals which were here let loose by an English captain many years ago, but have since disappeared. Babbits burrow in the heaps of scoria on the slopes of the mountains.

Cruikshank, George (1792-1878), English artist, caricaturist, and illustrator, was born in London on the 27th September 1792. By natural disposition and col- lateral circumstances he may be accepted as the type of the born humoristic artist predestined for this special form of art. His grandfather had taken up the arts, and his father, Isaac Cruikshank, followed the painter's pro- fession. Amidst these surroundings the children were born and brought up, their first playthings the materials of the arts their father practised. George followed the family traditions with amazing facility, easily surpassing his compeers as an etcher. When the father died, about 1811, George, still in his " teens," was already a success- ful and popular artist. All his acquisitions were native gifts, and of home-growth; outside training, or the serious apprenticeship to art, were dispensed with, under the necessity of working for immediate profit. This lack of academic training the artist at times found cause to regret, and at some intervals he made exertions to cultivate the knowledge obtainable by studying from the antique and drawing from life at the schools. From boyhood he was accustomed to turn his artistic talents to ready account, disposing of designs and etchings to the printsellers, and helping his father in forwarding his plates. Before he was twenty his spirited style and talent had secured popular recognition ; the contemporary of Gillray, Eowlandson, Aiken, Heath, Dighton, and the established caricaturists of that generation, he developed great proficiency as an etcher. Gillray's matured and trained skill had some influence upon his executive pow- ers, and when the older caricaturist

passed away in 1815, George Cruikshank had already taken his place as a satirist. Prolific and dexterous beyond his competitors, for a generation he delineated Tories, Whigs, and Radi- cals with fine impartiality. Satirical capital came to him from every public event, — wars abroad, the enemies of England (for he was always fervidly patriotic), the camp, the Court, the Senate, the Church ; low life, high life ; the humours of the people, the follies of the great. In this wonderful gallery the student may grasp the popular side of most questions which for the time being engaged public attention.

A vast number of Craikshank's spirited cartoons were published as separate caricatures, all coloured by hand ; others formed series, or were contributed to satirical magazines, the Satirist, Town

Talk, The Scourge (1811-16), and the like ephemeral publications. In conjunction with William Hone's scathing tracts, G. Cruikshank produced political satires to illustrate the series of facetiae and miscellanies, like The Political Bouse that Jack Built (1819).

Of a more genially humoristic order are his well-known book illustrations, now so deservedly esteemed for their inimitable fun and frolic, among other qualities, such as the weird and terrible, in which he excelled. Early in this series came The Humorist (1819-21) and Life in Paris (1822) . The well-known series of Life in London, conjointly produced by the brothers I. K. and G. Cruik- shank, has enjoyed a prolonged reputation, and is still sought after by collectors. Grimm's Collection of German Popular Stories (1824-26), in two series, with 22 inimitable etchings, are in them- selvis sufficient to account for G. Craikshank's reputation. To the first fourteen volumes (1837-43) of Bentley"s Miscellany, Cruikshank contributed 126 of his best plates, etched on steel, including the famous illustrations to Oliver Twist, Jack Sheppard, Ouy Fawkes, and The Ingoldshy Legends. For W. Harrison Ainsworth, Cruikshank illustrated Pookwood (1836), and The Tower of London (1840); the first six volumes of Ainsworth's Magazine (1842-44) were illustrated by him with several of his finest suites of etchings. For C. Lever's Arthur O'Leary he supplied 10 full-page etchings (1844), and 20 spirited graphic etchings for Maxwell's lurid History of the Irish

Bebellion in 1798 (1845). Of his own speculations, mention must be made of Geonie Cruikshank'' s Omnibus (1841) and George Cruikshank's Table Book (1845), as well as his Comic Almanack (1835-53). The Life of Sir John Falstaff contained 20 full-page etchings (1857-58). These are a few leading items amongst the thousands of illus- trations emanating from that fertile imagination. As an enthusi- astic teetotal advocate, G. Cruikshank produced a long series of pictures and illustrations, pictorial pamphlets, and tracts ; the best known of these are The Bottle, 8 plates (1847), with its sequel. The Drunkard's Children, 8 plates (1848), with the ambitious work. The Worship of Bacchus, published by subscription after the artist's oil painting, now in the National Gallery, London, to which it was presented by his numerous admirers.

Regarding manual dexterity, George Cruikshank's technical and manipulative skill as an.«toher was such that Ruskin and the best judges have placed his productions in the foremost rank ; in this respect his works have been compared favourably with the master- pieces of etching. George Cruikshank died at 263 Hampstead Road on 1st February 1878, aged 86 years. His remains rest in St Paul's Cathedral. (j. go.)*

Crustacea. — Carcinology, as the science of Crustacea is now called, begins with Aristotle, and, making no sub- stantial advance in the days of Pliny, Aelian, Oppian, recommences in the 16th century with the writings of Rondelet, Belon, and Gesner. After several authors of various calibre, such as Friderich Martens, Eay, Swam- merdam, Fritsch, had made more or less useful contribu- tions to it, the science in the middle of the 18th century entered upon its modem phase under the auspices of Linnaeus, though without much assistance from that great naturalist in person. His voluminous contemporaries Seba and Gronovius were still somewhat mediaeval, while Pallas of the same date in time was a modern in spirit. But car- cinology at large first took shape and definiteness in the last quarter of the 18th century through the writings of J. C. Fabricius, beginning with his Systema Entomologice in 1775. Important aid was rendered also by the works of 0. F. Milller and J. F. Herbst. During the first quarter of the next century a great advance was made by the numerous writings of Latreille and Leach. From 1828 to 1855 the dominant writers were Henri Milne-Edwards, Henrik Kroyer, and J. D.

Dana, the first producing his still valuable Histoire naturelle des Crustac&s, the second his long series of important papers in the Danish Natur- liistorisk Tidsskrift, and the third, after many preliminary essays, his vast report on the Crustacea of the U.S. Explor- ing Expedition under Wilkes. During the same period other notable expeditions collected Crustacea, and other eminent observers wrote about them, among well-known names being those of Giierin-M^neville, Vaughan Thomp- son, Lucas, Zaddach, Rathke, the two Costas, Harry Goodsir, Adam White, and Dr Baird. During the next ten or twelve years, with the older authors for the most part still writing, we find prominent the additional names of

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I^eydig Lilljeborg, Stimpson, Westwood, Bate, Kinahan, inoreii, and the incipient merit of Alphonse Milne- Ji^awards, C. Glaus, and G. 0. Sars. Thenceforward down to me present day the bibliography of Crustacea exhibits a nost ot writers and a flood of records. From every zone, irom water fresh, brackish, or saline, exposed or sub- terranean, from the surface of sea or lake down to almost every a,ccessible depth, and from the surface of the land up to almost every accessible height, Crustacea have been obtained, captured by new devices, examined by new metiiods, studied with a new zeal, and revealing new forms and relations m a previously unsuspected and still un- ceasing and increasing variety. From the axils of a plant to the nostrils of a fish or the intestines of an annelid, crustaceans can accommodate themselves to every kincj of strange habitation, and the descriptions of them are often equally fugacious, since they may have to be tracked through an indefinite number of serials in nine or ten different languages. For an effective grasp of knowledge

already acquired, and the adjustment of future acquisi- tions, it is clear that the mind of the naturalist is always yearning for classification; — in the Crustacea the basis for this has been sought in many directions, — in the general shape, the eyes, the locomotive appendages, the mouth-organs, the breathing apparatus, the structure of the stomach, the genital organs, the circulatory and nervous systems, the development of the young, and the phylogeny. Unfortunately the last, which would be most decisive for a natural system, is likely always to remain the most speculative. On the other hand, parts of the organism which might seem ieast adapted for system- atic purposes may be of service, since a high authority has stated that in the Copepoda the number and dis- tribution of the hairs on the swimming-feet are capable of affording valuable characters for general, or even for sub-families.

As might be expected, in the great expansion of the class, with so much attention concentrated on its arrangement, numerous classificatory changes have been proposed, and many of them have been established on apparently satisfactory grounds, during recent years. But these alterations leave us at liberty to maintain the three leading divisions, the Malacostraca, Ento- mostraca, and Thyrostraca, while keeping apart the small group of the Leptostraca, established by Glaus for the Nebaliidse, as a connecting link between the first division and the second. Briefly, all the four may be distinguished as follows : —

Malacosteaca are those Crustacea in which, apart from an ocular segment and telson, the assignable seg- ments are nineteen in number. The first antennae often have more than one branch.

Leptostkaca have more than nineteen segments, and a second branch on their first antennae.

In the rest of the Crustacea the assignable segments are more or fewer than nineteen, and the first antennae never have more than one branch. These, form two divi- sions : —

Entomosteaca, in which the antennae of normal adults are unconcealed ; and

Thveosteaoa, more commonly called Gieeipedia, in which the antennae of adults are concealed.

Another division, named Gigantostraca, including the extinct Merostomata and Trilobita, and the still existing Xiphosura, represented by Limulus, the so-called king- crab, is by some eminent authorities altogether banished from the class of Crustacea. By others the affinity of trilobitas and king-crabs with Apus and other phyllopod entomostracans is strictly maintained.

In regard to the Leptostraca it is worthy of note that G. H. Parker, in the Mittheilungen aus der zoologischen

Station zu Neapel for 1895, endorses the opinion of Glaus on the optic ganglia of the Nebaliidse, both authors hold- ing that these belong rather to the Malacostracan than to the Entomostracan type. On the other hand, the trunk limbs in this family are strikingly phyllopodan in char- acter.

The unity of the whole crustacean class often receives unexpected illustrations. Thus it is a notable character- istic of the Malacosteaca that the seven pairs of limbs of the middle body are seven-jointed, although through subdivision or coalescence this peculiarity may be ob- scured in some of these limbs. But that the number of seven joints should be normal also for the maxillipeds, which immediately precede the median appendages above mentioned, is interesting less as a distinctive character of the Malacostraca, than for the opposite reason, as con- necting them

with the Entomostraca, inasmuch as the same number of joints is found to recur in what are now understood to be the homologous maxillipeds of the Gope- poda.

An exposition of the present state of science in regard to each of the divisions above distinguished will be given under its own name, except that the linking Leptostraca will, for convenience, be grouped with their allies (nearer or more remote), the Entomostracan Phyllopoda.

(t. e. e. s.)

Csaba (Bekes), a market-town of Gentral Hun- gary, nearly 50 miles south-west of Grosswardein. There are many industrial establishments (including 8 steam mills), a Lutheran gymnasium, and a theatre. Population

(1891), 34,243; (1900), 37,547.

Csengery, Anton (1822-1880), Hungarian pub- licist, and a historical writer of great influence on his time, was born at Nagyvarad on the 2nd of June 1822. He took, at an early date, a very active part in the literary and political movements immediately preceding the Hun- garian Revolution of 1848. He and Baron Sigismund Kemeny may be considered as the two founders of high- class Magyar journalism. After 1867 the greatest of modern Hungarian statesmen, Francis DeSik, attached Gsengery to his personal service, and many of the momentous state documents inspired or suggested by Deak were drawn up by Gsengery. In that manner his in- fluence, as represented by the text of many a statute regulating the relations between Austria and Hungary, is one of an abiding character. As a historical writer he excelled chiefly in brilliant and thoughtful essays on the leading political personalities of his time, such as Paul Nagy, Bertalan, Szemere, and others. He also com- menced a translation of Macaulay's Histoi-y. He died at Budapest on the 13th of July 1880.

Csiky, Cregor (1842-1891), one of the foremost dramatists of modern Hungary, was born on the 8th of December 1842 at Pankota, in the county of Arad. He studied Roman Gatholic theology at Pest and Vienna,

and was Professor in the Priests' College at Temesvar from 1870-78. In the latter year, however, he joined the Evangelical Ghurch, and took up literature. Beginning with novels and works on ecclesiastical history, which met with some recognition, he ultimately devoted himself to writing for the stage. Here his career was one of almost instantaneous success. Already in his Az ellendllhatatlan (" L'Irresistible "), which obtained a prize from the Hungarian Academy, he showed the distinctive features of his talent — directness, freshness, realistic vigour, and highly individual style. In rapid succession he enriched Magyar literature with realistic giewre-pictures, such as A Proletdrok (" Proletariate "), Buborckok (« Bubbles "), Kit szerelem (" Two Loves "), A szigyenlos (" The Bashful "),

Athalia, &c., in all of which he seized on one or another feature or type of modern life, dramatizing it with unusual intensity, qualified at the same time by chaste and well-balanced diction. Of the latter, his classical studies may, no doubt, be taken as the inspiration, and his translation of Sophocles and Plautus will long rank with the most successful of Magyar translations of the ancient classics. Among the best known of his novels are Arnold, Az Atlasz csaldd (" The Atlas Family"). He died at Budapest on the 19th November 1891.

Csongrad, a large market-town of Hungary, at the confluence of the Tisza and Koros. It has a population (1900) of 22,619,— all Hungarians,— chiefly engaged in agriculture, for which the fine soil of the district (57,623 acres) is specially adapted.

Csorba, Lake of, a tourist centre in the county of Lipto, North Hungary, situated in the T^tra Mts., 4432 feet above sea-level. The lake, which is called the "Pearl of the T^tra," is of inconsiderable size, but its picturesque position at the foot of the highest snow- covered peaks, bordered by dense pine-forests, has given it a great vogue, and since 1895 it has been connected by a mountain railway with the chief line from Kassa to Oderberg.

Ctenophora were briefly described by Professor Huxley in 1875 (see Actinozoa, Ency. Brit. vol. i.) as united with what we now term Anthozoa to form the group Actinozoa ; but little was known of the intimate structure of those remarkable and beautiful forms till the appearance in 1880 of Chun's Monograph of the CStenophora occurring in the Bay of Naples. They may be defined as Ccelentera which exhibit both a radial and bilateral symmetry of organs ; with a storaodaeum ; with a mesenchyma which is partly gelat- inous but partly cellular ; with eight meridianal rows of vibratile paddles formed of long fused or matted cilia; lacking nematocysts (except in one genus). An example common on the British coasts is furnished by Hormiphora. In outward form this is an egg-shaped ball of clear jelly, having a mouth at the pointed (oral) pole, and a sense-organ at the broader (aboral) pole. It possesses eight meridians (costse) of iridescent paddles in constant vibration, which run from near one pole towards the other; it has also two pendent feathery tentacles of considerable length, which can be re- tracted into pouches. The mouth leads into an ectoder- mal stomodaeum (" stomach "), and the latter into an endo- dermal funnel (infundibulum) ; these two are compressed in planes at right angles to one another, the sectional long axis of the stomodaeum lying in the so-called sagittal (stomodseal or gastric) plane, that of the funnel in the transverse (tentacular or funnel) plane. From the funnel, canals are given off in three directions : (a) a pair of paragastric (stomachal, or stomodaeal) canals run orally, parallel to the stomodaeum, and end. blindly near the mouth ; (&) a pair of perradial canals run in the transverse plane towards the equator of the animal ; each of these becomes divided into two short canals at the base of the tentacle sheath which they supply, but has previously given off a pair of short interradial canals, which again bifurcate into two adradial canals ; all these branches lie in the equatorial plane of the animal, but the eight adradial canals then open into eight meridianal canals which run orally and aborally under the costae ; (c) a pair of aboral vessels which run towards the sense-organ, each of which bifurcates; of the four vessels thus formed, two only open at the sides of the sense-organ, forming the so-called excretory apertures. These three sets of structures, with the funnel from which they rise, make up the endodermal

ccelenteron, or gastro-vascular system. The generative organs are endodermal by origin, borne at the sides of the meridianal canals as indicated by the signs ^ ? . There exists a subepithelial plexus with nerve cells and fibres, similar to that of jelly-

fishes. The sense-organ of the aboral pole is complex, and lies under a dome of fused cilia shaped like an inverted bell-jar; it consists of an otolith, formed of numerous calcareous spheroids, which is sup- ported on four plates of fused cUia termed balancers, but is other- wise free. The ciliated ectoderm below the organ is markedly thickened, and perhaps functionally represents a nerve-ganglion : from it eight ciliated furrows radiate outwards, two passing under each bal- ancer as through an archway, and diverge each to the head of a meridianal costa. These ciliated furrows stain deeply with osmic acid, and nervous im- pulses are certainly transmitted along them. Locomotion is effected by strokes of the paddles in an aboral direction, driving the animal mouth forwards through the water : each paddle or comb (hence Ctenophora) con- sists of a plate of fused or matted cilia set transversely to the costa. The myoepi- thelial cells (= neuro- muscular cells of Ency. Brit. vol. xii. p. 549), characteristic of other Ccelentera, are not to be found in this group. On the other hand there are well-marked muscle fibres in definite layers, de- rived from special mesoblastic cells in the embyro, which are embedded in a jelly ; these in their origin and arrange- ment are quite comparable to the mesoderm of Triplo- blastica, and, al- though the muscle- cells o f some jelly-fish exhibit a

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Fre, 1. — Schematic drawing of a cydippid from the side. (After Chun.) A, adradial canals ; ^^ infiinaibnlum ; /, interradial canal; Jf, meridianal canal lying under a costa ; , ciliated furrow from sense pole to costa ; Pg paragastric canal ; SO^ sense-organ ; St, Btomodsenm ; Suba, sub- sagittal costa ; Sabt, subtentacular costa ; T, tentacle ; TSf boundaries of tentacle-sheath.

Sail

Fio. 2.— Schematic drawing of a cydippid from the aboral pole. (After Ohiim,.) T (centrally), tentacular canal, and (distally) tentacle ; d, position of testes ; 9 1 position of ovaries ; other letters as in Fig. 1. The stomodeeum lies in the sagittal plane, the funnel and tentacles in the transverse or tentacular plane.

somewhat similar condition, nothing so highly specialized as the mesenchyme of Ctenophora occurs in any other Coelenterate. The nematocysts being nearly absent from their group, their chief function is carried out by adhe- sive lasso-cells.

The Ctenophora are classified as follows : —

Subclass i. Tentaculata, Order 1. Ctdippidea, Sormiphora. „ 2. LoBATA, Deiopea. „ 3. Cestoidea, Cestus. „ ii. Nuda, „ Beroe.

The Tentaculata, as the name implies, may be recognized by the presence of tentacles of some sort. The Ctdippidea are generally spherical or ovoid, with two long retrusible pinnate ten- tacles : the meridianal and paragastric canals end blindly. An example of these has already been briefly described. The Lobata are of the same general type as the first Order, except for the pres- ence of four circumoral auricles (processes of the subtransverse costae) and of a pair of sagittal outgrowths or lobes, on to which the subsagittal costae are continued. Small accessory tentacles He in grooves, but there is no tentacular pouch ; the meridianal ves- sels anastomose in the lobes. In the Cestoidea the body is com- pressed in the transverse plane, elongated in the sagittal plane, so as to become riband-like : the subtransverse costae are greatly re-

Fio. S. — Schematic drawing of ccBtuB. (After Chti/n.) Suba^ subsagitl^l costse ; Subtt much reduced subtentacular costse ; Subi ‘, branch of the bud- teiitacular canal which runs along the centre of the riband ; Pg, continu- ation of the paragastric canal at right angles to its

original direction along the lower edge of the riband. At the right hand end the last two are seen to unite with the subsagittal canal.

duced, the subsagittal costae extend along the aboral edge of the riband. The subsagittal canals lie immediately below their costse aborally, but continuations of the subtransverse canals round down the middle of the riband, and at its end unite, not only with the subsagittal, but also with the paragastric canals which run along the oral edge of the riband. The tentacular bases and pouches are present, but there is no main tentacle as in Cydippidea ; fine accessory tentacles lie in four grooves along the oral edge. The sub- class Nuda have no tentacles of any kind ; they are conical or ovoid, with a capacious stomodaeum like the cavity of a thimble. There is a coelenterio network formed by anastomoses of the meridianal and para- gastric canals all over the body.

The embryology of Callianira has been worked out by Metschnlkoff. Segmenta- tion is complete and unequal, producing macromeres and micromeres marked by differences in the size and in yolk-contents. The micromeres give rise to the ectoderm ; each of the sixteen macromeres, after bud- ding oft a small mesoblast cell, passes on as endoderm. A gastrula is established by a mixed process of embole and epibole. The mesoblast cells travel to the aboral pole of the embryo, and there form a cross-shaped mass, the arms of which lie in the sagittal and transverse planes (perradii).

There can be but little question of the propriety of including Ctenophora among the Coelentera. The undi-

FlG. 4.— Schematic draw- ing of beroe, (After Chun.)

vided ccelenteron (gastro-vascular system) which consti- tutes the sole cavity of the body, the largely radial symmetry, the presence of endodermal generative organs on the ccelenteric canals, the subepithelial nerve-plexus, the mesoglcea-like matrix of the body — all these features indicate affinity to other Ccelentera, but, as has been stated in the article under that title, the relation is by no means close. In the ninth edition of this work (see Hydkozoa) some stress was laid on Haeckel's discovery of Ctenaria as a possible link-form between Hydrome- dusse and

Ctenophora, but this view has now been gener- ally abandoned. At what period the Ctenophora branched off from the line of descent, which culminated in the Hydromedusse and Scyphozoa of to-day, is not clear, but it is practically certain that they did so before the point of divergence of these two groups from one another. The peculiar sense-organ, the specialization of the cilia into paddles with the corresponding modifications of the ccelen- teron, the anatomy and position of the tentacles, and, above all, the character and mode of formation of the mesenchyme, separate them widely from other Coelentera. The last-named character, however, combined with the discovery of two remarkable organisms, Coeloplana and Ctenoplana, has suggested afSnity to the flat-worms termed Turbellaria. Ctenoplana, the best known of these, has recently been redescribed by Willey (Quart. Journ. Micr. Sci. xxxix., 1896). It is flattened along the axis which unites sense-organ and mouth, so as to give it a dorsal (aboral) surface, and a ventral (oral) surface on which it frequently creeps. Its costse are very short, and retrusible ; its two tentacles are pinnate and are also re- trusible. Two crescentic rows of ciliated papillae lie in the transverse plane on each side of the sense-organ. The ccelenteron exhibits six lobes, two of which Willey identifies with the stomodaeum of other Ctenophora ; the other four give rise to a system di anastomosing canals such as are found in Beroe and Polyclad Turbellaria. An aboral vessel embraces the sense-organ, but has no external opening. Ctenoplana is obviously a Ctenophoran flattened, and of a creeping habit. Coeloplana is of simi- lar form and habit, with two Ctenophoran tentacles : it has no costae, but is uniformly ciliated. These two forms at least indicate a possible stepping-stone from Cteno- phora to Turbellaria, that is to say, from Diploblastic to Triploblastic Metazoa. By themselves they would pre- sent no very weighty argument for this line of descent from two-layered to three-layered forms, but the coinci- dences which occur in the development of Ctenophora and Turbellaria, — the methods of segmentation and gas- trulation, of the separation of the mesoblast cells, and of mesenchyme formation, — together with the marked similarity of the adult mesenchyme in the two groups, have led many to accept this pedigree. In his Mono- graph on the Polyclad Turbellaria of the Bay of Naples^ Lang regards a Turbellarian, so to say, as a Ctenophora, in which the sensory pole has rotated forwards in the sagittal plane through 90° as regards the original oral-, aboral axis,

a rotation which actually occurs in the development of Thysanozoon (Mtiller's larva) ; and he sees, in the eight lappets of the preoral ciliated ring of such a larva, the rudiments of the costal plates. According to his view, a simple early Turbellarian larva, such as that of Stylochus, most nearly represents for us to-day that ancestor from which Ctenophora and Turbellaria are alike derived. Tor details of this brilliant theory, the reader is referred to the original monograph.

A list of the chief works relating to the group may be found at the end of Bourne's chapter on Ctenophora, in part ii. of Lankes- ter's Treatise on Zoology (1900).

(g. H. Fo.)

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CUBA.

I. Geography and Statistics.

CUBA is the largest and most populous of the West India islands. It lies directly south of Florida, the south- easternmost of the United States, being separated from it by the Strait of Florida, 100 miles in width. It is included between the meridians of 74° and 85° W. of Greenwich, arid the parallels of 19° 40′ and 23° 33′ N. latitude. Its length from Cape Maisi on the east to Cape San Antonio on the west is 730 miles, while its breadth from north to south ranges from 25 miles in the neighbourhood of Havana to 100 miles in the eastern part of the island. Its area, including the Isle of Pines, which is under its jurisdiction, is 44,000 square miles. In its relief the island presents little appearance of unity of plan. West of Havana it is traversed, in a direction parallel to its length, by a mountain range, the Sierra de los Organos, whose summits rise to altitudes of 2000 to 2500 feet,

culminating in Pan de Guagaibon, with the latter alti- tude. To the north and south of the crest of this range the land slopes to the coast, the southern slopes, known as Vuelta de Abajo, being the most celebrated tobacco lands of the island. The middle portion of the island consists

mainly of low rolling plains, with shallow stream-valleys, rising in a few places into plateaux, which have been deeply dissected by erosion. The eastern portion of the island is mountainous, consisting in great part of a plateau, 2000 to 3000 feet high, deeply cut by streams, while closely bordering the southern coast from Santiago westward to Cape Cruz is Sierra Maestra, rising to an average altitude of 5000 feet, and culminating in Pico Turquino, said to be 8320 feet high. The rivers of Cuba are short, and except for the estuaries at their mouths, are not navigable. The only exception is the Eio Cauto, the largest river of the island, which drains a broad and fertile valley lying north of Sierra Maestra. This river has

CUBA.

Vialkei & Cockerel! sc.

a length of 150 miles, one-third of which is navigable for light-draught vessels. Much of the south coast of the island is bordered by swamps, which in the longitude of Matanzas expand to a great breadth, 75 by 30 miles, forming the Zapata Swamp. Much of the north coast, especially along the middle part of the island, is fringed by low mangrove-covered islets, which are in the main uninhabited. The harbours are numerous and excellent. Most of them are pouch-shaped, with narrow, often sinuous, entrances, expanding in the interior into broad lakes, com pletely sheltered. Of this type are the harbours of Havana, Santiago, Cienfuegos, Guantanamo, and many others.

Climate. — The climate may be characterized as tropic and insular. At Havana, on the north coast, the mean annual temperature is 77° F., with a range of but 11° between the mean temperature of the warmest and the coldest months. Inland and upon the south coast the temperature is probably somewhat greater, the climate of the north coast being tempered by the north-east trades, the prevailing winds. The mean annual rainfall at Havana is

52 inches, while inland it is probably greater, and upon the south coast less. About two-thirds of this precipita- tion falls between May and

October, in what is known as the rainy season. The mean relative humidity at Havana is 75 per cent.

Minerals. — The mineral resources, so far as developed, are not of great importance. Iron ore of excellent quality is mined at several points between Santiago and Guanta- namo, at the south base of Sierra Maestra. The ore, though abundant, is apparently float ore, mainly haematite, containing about 62 per cent, of iron. Most of the product has been shipped to the United States. A copper deposit in the neighbourhood of El Cobre, said to be of enormous value, was f ormerlyextensively worked, but since 1868 min- ing upon it has ceased. Asphaltum has been found in sev- eral localities, and has for some time been used in the production of illuminating gas for the city of Santa Clara. Gold and silver were mined on a small scale in past times, but none is produced at present. There, is, how- ever, every probability that thorough prospecting will discover great mineral wealth.

Forests. — The forests are extensive and comprise many valuable species, among which are mahogany, ebony, cedar, -walnut, lignum-vitse, oak, and many species of palm. The prevailing tree is the Cuban pine, which forms excellent lumber. It is estimated that half the area of the island is forested. Little use is at present made of the forest wealth, and its economic development awaits the construction of adequate means of transporta- tion.

Government. — For administrative purposes Cuba is divided into six provinces, which, named from the west eastwards, are Pinar del Rio, Havana, Matanzas, Santa Clara, Puerto Principe, and Santiago. These are divided into municipal districts, or terminos, of which there were 132 at the time of the census of 1899. These, in turn, are subdivided into barrios, or wards, of which there were between 1100 and 1200. There are no chartered cities, and the population of cities here given has been

obtained from that of the barrios, which are closely built. On May 20, 1902, the military occupation by the United States, which had been the form of government since the war with Spain, formally ceased, and a Cuban Eepublic was inaugurated under American protection ; the local administration was already then in Cuban hands.

Population. — The population in 1899, according to the census, was 1,572,797. In 1887 it was 1,631,687, and in 1877, 1,509,291. In the twelve years preceding the latest census there was an actual diminution of population of 58,890, a result of the civil war which opened in 1895. This measures, however, only a part of the loss consequent upon the war, since the population doubtless increased up to 1895. Allowing for this increase, the loss was probably about 200,000. The average number of inhabitants to a square mile was 36. The following table gives the popula- tion and its density by provinces : —

Population.

per Square Mile

Havana

424,804

153

Matanzas

202,214

55

Pinar del Kio

173,064

35

Puerto Principe .

88,234

8

Santa Clara .

356,536

37

Santiago

327,715

26

The proportion of urban population was very high, when it is considered that nearly all the industries and products relate to agriculture. Including all places of 8000 inhabitants or more, the urban population numbered 507,831, or 32-3 per cent, of all the inhabitants, a proportion very close to that of the United States. The proportion of urban inhabitants of the several provinces differed greatly: —

Per cent. Urban.

Havana

65-4

Matanzas

28-8

Pinar del Eio

5-1

Puerto Principe .

28-4

Santa Clara .

22-5

Santiago

17-5

principal cities, with their p

opulation in 1899, a

follows: — Havana, the capital of Cuba and of Havana province, population 235,981 ; Santiago, on the south coast, the capital of Santiago province, population 43,090 ; Matanzas, on the north coast, the capital of Matanzas province, population 36,374 ; Cienfuegos, in Santa Clara province, on the south coast, population 30,038 ; Puerto Principe, situated in the interior, the capital of the province of the same name, population 25,102 ; Cardenas, on the north coast in Matanzas province, population 21,940; Manzanillo, on the south coast, in Santiago

province, population 14,464; Guanabacoa, in Havana province, population 13,965; Santa Clara, in the interior, the capital of Santa Clara province, population 13,763 ; Sagua la Grande, on the north coast, in Santa Clara province, population 12,728; Sancti Spiritus, in Santa Clara province, population 12,696 ; Eegla, a suburb of Havana, population 11,363 ; and Trinidad, on the north coast in Santa Clara province, population 11,120. As to sex, the population was divided in the

proportions of 51-8 per cent, males and 48-2 per cent, females, the dispropor- tion being due to immigration.

As to race, the whites constituted nearly 68 per cent., or more than two-thirds, and the coloured, including negroes, persons of mixed blood, and Chinese, 32 per cent. The following table gives the proportions of the races in the several provinces : —

Per cent. Per cent. White. Coloured.

Havana .

74

26

Matanzas

60

40

Pinar del Eio

73

27

Puerto Principe

80

20

Santa Clara .

70

30

Santiago

65

45

The proportion of coloured has been diminishing since 1841, when it was 58-5 per cent. The proportion of persons of alien birth was 9 per cent, of the population, and three-fourths of these were from Spain, China and Africa contributing largely to the remainder. As in other countries, the foreign-born were proportionately more numerous in the cities than in the country, nearly one-third of this element being found in the city of Havana. During the last six months of 1900 there were 15,810 immigrants, of whom 12,676 came from Spain, 979 from the United States, and 923 from Mexico. The conjugal condition of the people was in certain respects peculiar. Of the total population in 1899 only 15-7 per cent, were lawfully married. Besides these, 8-4 per cent, of the population were living together by mutual consent, in more or less permanent unions. The proportion of married, even with the addition of those in these con- sensual unions, was much smaller than in Europe. Consensual unions were much more common among the coloured than among the whites.

*Of the population over ten years of age, 57 per cent, were unable to read, the proportions of illiterates in the two races being, whites 49*2 per cent., and coloured 72 per cent. The public school system, which under Spanish regime existed mainly on paper, has been put into effective operation under American administration. In 1899 the census reported that only 15-7 per cent, of the children of school age attended school, the propor- tion of whites being somewhat greater than that of coloured. The number of schools was 1510, the number of public and private schools being about equal. The number of teachers was 2665. In 1901 there were 3567 public schools, 3608 teachers, and 172,273 enrolled scholars.*

Of the population over ten years of age, 51-2 per cent, were engaged in gainful occupations. The wage-earners were distributed as follows among the great groups of occupations : —

Per cent, of all Wage-Earners. Agriculture, fishing, and mining . . . 48-1
Domestic and personal service . . . 22-8

Manufactures 14-9

Trade and transportation Professions ....

12-8 1-4

Practically the only religious sect represented in Cuba is the Roman Catholic, of which nearly all the people are, nominally at least, adherents.

There are no statistics of manufactures available, but it is well known that, aside from sugar mills and cigar factories, this branch of industry is of little importance.

Agriculture. — In 1899 there were 60,711 farms and plantations, pomprising an area of 8,761,600 acres. Of this, 901,100 acres were under cultivation, or only 3-2 per cent, of the area of Cuba. The average size of farm was 144 acres, a little larger than in the United States ; and the average area cultivated per farm was 15 acres. Of the cultivated area 43-5 per cent, was owned by the occupants, and 56-5 per cent, rented or worked on shares. Again, 84-9 per cent, was occupied by whites, and only 15‘1 per cent, by coloured, or in mixed occupancy of white and coloured.

The following table shows the proportion of the cultivated area which was planted in each of the principal crops, this being the only measure of products which the census furnishes : —

Sugar cane . Sweet potatoes Tobacco Bananas Indian com . Malangas Yucca . Cofeee . Cocoanuts . Cocoa .

Per cent, of Cultivated Area

47-3 11-3

9-3

8-6

7-3

3-4

3-2

1-6

1-4

1-4

Sugar, which is by far the most important crop, was produced in all parts of the island, but chiefly in Santa Clara and Matanzas provinces. Tobacco also was widely distributed over the island, but nearly three-fourths of the area devoted to it was in Pinar del Rio. Live stock on farms is summarized as follows : —

Horses

Mules and asses

Cattle

Hogs

Sheep and goats

Fowls

88,001

20,316

753,300

358,868

28,546

1,517,892

The sugar mills of Cuba numbered 207, with a total capacity of 8,754,192 arrobas of cane, and a daUy output of 61,407 bags of 200 pounds each of sugar. In connexion with these mills were 85 stills, with a daily capacity of 161,751 gallons of rum.

Bail and Boad. — Means- of transportation ai-e scanty. Outside of the three smallest western provinces and the neighbourhood of large cities there is not a good road in Cuba, and many of the good roads are impassable in wet weather. There are about 1100 miles of railway, most of which are in Havana, Matanzas, and the western part of Santa Clara provinces. These railways are for the most part poorly constructed and scantily equipped.

Commerce. — The following figures epitomize the commerce of the island in 1899 and 1900:—

Total exports . (1899)$46,301,929 ; (1900)$49,014,962 Total imports . (1899) 66,783,111 ; (1900) 66,658,589

Leading Articles of Export.

Sugar ....

Tobacco

Fruit and nuts

Wood (unmanufactured)

Countries. United States United Kingdom Spain . Germany . France

(1899)fl9,876,749 ; (1900)$16,886,693

(1899) 21,084,750; (1900) 26,087,968 (1899) 355,579; (1900) 729,719 (1899) 166,313; (1900) 1,050,322

Exports.

533,356,889 5,427,749 830,349 5,545,827 1,267,241

Imports.

$29,176,002 10,463,325 9,756,693 2,982,779 3,267,570

During the year 1900, 12,350 vessels, with a net tonnage of 4,928,814, entered the ports of Cuba, and 11,954 vessels, with a net tonnage of 4,367,246, cleared.

(h. g.)*

II. Recent Histoet.

The insurrection in Cuba from 1868 to 1878 was only the prelude to the stronger movement vsrhich began in 1895, and which was destined eventually to involve the United States in war with Spain, with the result of bring-

*ing to an end Spanish sovereignty in the island. In 1878 a policy of conciliation towards the insurgents was deter- mined upon by the Spanish Government, and General Martinez Campos was despatched to Cuba to carry this new policy into effect. Martinez s^mxs' Campos commanded general respect, and found leading up little difficulty in opening negotiations with the *° ^fjF' insurgents. Eeforms in the administration and a free pardon for all who had taken part in the revolt were among the stipulations agreed upon, and the abolition of slavery was decreed, although this measure only took full effect in 1886. In the autumn of 1878 General Campos met the leaders of the insurrection at Zanjon ; a treaty was signed embodying the various prom- ises and conditions. It was the non-fulfilment of the terms of this convention (commonly called "El*

Pacto de Zanjon") which paved the way for the insurrection organized by Jose Marti in 1895. For all practical purposes there was no reform in administrative methods after the Convention of Zanjon. The island continued, as formerly, to be a rich field reserved for Spanish official- dom. Corruption became more pronounced. Cubans, unless entirely pro- Spanish, were given no share in the Government, although their standard of intelligence was quite equal to, if not higher than, that of the majority of Spaniards in similar conditions of life. In these circum- stances the natives bitterly resented the attitude of the Spaniards, and the estrangement between the two peoples became more marked as time went on. In 1886 a number of young students were accused of writing some derogatory verses on the tombstone of a high Spanish official. The supposed ringleaders were arrested, and three of them were condemned to death and shot. It is difficult to find any excuse for this act, and it served to deepen into hatred and fear the hostility of a large section of the population to Spanish authority. Attempts at revolt were occasionally made, but without success, owing to prompt and drastic measures taken by the Government and to the lack of organization on the part of the Cubans. Meanwhile the economic condition of the island was undergoing great changes. The crisis in the sugar trade in 1883, and the fall in prices in consequence of over- production, seriously threatened the main industry. The situation was further complicated by the abolition of slavery, which involved severe pecuniary losses to the slave-owners. The energy shown by the people of Cuba at this crisis in their affairs is deserving of the highest praise. The old factories were abandoned and great central sugar-houses erected where the process of convert- ing the cane juice into sugar could be more cheaply effected. The newest machinery was imported, and immense areas of new cane fields were planted. The estates were mortgaged to obtain the money for these changes, and so by hard work and intelligent application the principal source of wealth was saved from annihilation and brought round to a comparatively flourishing condi- tion. During this critical period the Spanish Government gave no helping hand. Heavy duties were levied upon Cuban products, although Spanish goods entering the island were allowed important reductions as compared with merchandise from other countries. Cuba was saddled with a gold debt of $162,849,625 for bonds issued in Spain to defray military expenses and other charges from which

the island derived no benefit. The population of 1,500,000 souls was called upon to find a revenue of £5,240,000 sterling to meet the service of the bonds issued in Spain and to cover the expense of the Spanish adminis- tration of the island. In reality they paid much more than this amount, on account of the extortions systematically practised by the officials. The Cubans bitterly resented the attitude of Spain, but their protests were un-

"Decent histoet]

heeded. Between the years 1889 and 1893 the sugar in- dustry increased rapidly. A treaty with the United States allowing considerable advantages to sugars of Cuban origin was a substantial aid to the situation, and in the season 1893-94 the output amounted to 1,023,719 tons. Prices during this period of expansion had been fairly remunerative. In 1895, however, a change came for the worse. The treaty with the United States was denounced, and Cuban sugars entered only on the same terms as those from other foreign countries. The value of sugar all over the world fell steadily until it reached a price which left little, if any, profit to the producer. The factory owners, who had not had time to recoup themselves for the money which they had laid out in improvements, began to feel the strain severely, and numbers of the cane-grower's abandoned their fields. As the economic crisis developed, real misery and hardship began to be felt in nearly every district.

The Government of Spain so far recogflized the danger of the situation as to consider seriously the acceptance of some measure of reform. Seflor Maura brought forward in the Cortes a project for restricted home rule for Cuba, but after long discussion it was rejected. A scheme of modified local government was then introduced by Senor Abarzuza and accepted ; but this acceptance did not entail its immediate application to Cuba and Porto Rico, as the general public was induced to believe would be the case. Indeed, the measure was never applied to the Spanish West Indian colonies, being delayed on one excuse or another until the condition of

Cuba had become such that the concessions proposed were inadequate. When concili- atory measures were tried in the island, a different law of constitution was promulgated. The opinion generally ex- pressed in Cuba was that if Senor Abarzuza's proposals had been immediately put in force, the insurrection would not have broken out in 1895, or in any case would not have received the widespread sympathy which was ac- corded to it. Meanwhile a powerful factor was at work, the strength of which was too lightly estimated by the Spaniards. This was in the person of Jqs6 Marti, a clever and intelligent man with a gift of oratory to aid him in his work. Love of Cuba, hatred of Spain, and a desire to see the island freed from Spanish domination led him to devote his whole life to pleading for the Cuban cause, and he ended by dying for the country he loved so well, shot down soon after the insurrection broke out. Marti began his work of organization after the Zanjon Convention had been signed. Meetings were held from time to time at Key West, Tampa, and all other places where Cuban colonies were established, and funds were col- lected for the purchase of arms and ammunitiouii Ul- timately Marti decided to strike before the proposed Abarzuza reforms could be promulgated and the hostility of the Cubans towards Spain be in any degree modified by the concessions granted.

Jose Marti had made plans for a simultaneous rising in the provinces of Santiago and Matanzas. In the

rt_,at former province 400 persons assembled in of the the neighbourhood of Yara, and on February

lasurrec- 23, 1895, took up arms under the leadership tioa. q£ Jesus Eabi. The movement in Matanzas

was attempted on the same day, but was mismanaged at the start and suppressed for the moment. The Government from the first underestimated the sym- pathy of the public with the outbreak, and declared that it was nothing more than an attempt by a few bandits to commit robbery and outrage under the guise of patriotism. How fallacious was this reasoning soon became apparent from the eagerness shown by people of all classes in watching the progress of events in Santiago. Perhaps the most significant fact in connexion with the

revolt was that it was not a pronundamiento of any par- ticular leaders, but the spontaneous uprising of people belonging to the lower classes, without distinction of colour. At the outset the whites were in the minority, hence the mistaken opinion was almost invariably held outside Cuba that the trouble was one of negroes against white men. At the beginning of 1895 Spain had in Cuba a garrison of some 17,000 men, a force amply sufiieient to have crushed the revolutionary movement had it been ener- getically handled. The officials, however, made hardly any effort to disperse the rebels, whose ranks were rapidly increasing, and before the end of March 1895 it was evi- dent that serious trouble was in store for Spain. The Madrid Government raised the garrison of Cuba to a strength of 30,000, and appointed General Martinez Cam- pos as Captain-General of the island. After his arrival in Cuba in April, General Campos found that his hands were tied by the many restrictions imposed from home, and that he would not be permitted to declare in force the Abarzuza reforms until the insurrection was sup- pressed. The Spanish troops were in a demoralized condition, and the character of the eastern portion of Cuba made military operations difficult.

On April 21, Antonio Maceo, who afterwards played so important a part in the revolt, landed at Duabi, and shortly afterwards was followed by Maximo Gomez, ac- companied by Marti. Maceo was a mulatto, and his pre- sence in Cuba at once drew many additional recruits to the insurgent ranks from the coloured population. Maximo Gomez was a native of San Domingo, and had served in the Spanish army during the campaign in that island. Both Gomez and Maceo had taken part in the insurrection of 1868-78, and won for themselves a considerable amount of prestige. To Gomez was confided the post of Com- mander-in-Chief of the rebel forces, while Maceo was appointed next to him in rank. Marti prepared to return to New York to procure further supplies of arms and ammunition, but on his way to the seacoast he was killed in a skirmish with Spanish troops. His death was a severe blow to the Cuban cause, but the progress of the rebellion continued unchecked. In every town in Cuba secret committees were formed to aid the revolt, and by the month of August Gomez and Maceo had under their orders some 4000 men, and the area of the movement had ex- tended over the whole of the province of Santiago and the greater part of Puerto Principe. Realizing the gravity of

the situation, the Captain-General explained to the home Government that it would be necessary to occupy every province of the island and vigorously attack the insur- gents in the field. In response to his demand for rein- forcements, troops were poured into the island, but they consisted mainly of young and raw recruits, and sickness set in among them to an alarming extent. The wet season, furthermore, rendered any active operations almost im- possible. At the close of 1895 the Spanish army in Cuba, including the volunteers and irregular cavalry under arms, numbered 100,000 men. The rebel forces had also steadily increased, and amounted to 10,000, but they were very imperfectly supplied with arms and ammiinition.

The condition of the Spanish army was far from satis- factory. The men were obedient and cheerful, but were young, inexperienced, unacclimatized, poorly fed, and badly looked after. No attempt was made to instruct officers or men in their duties, or to improve the musketry practice. The officers were generally ignorant of the topo- graphy of the island, and took no trouble to make proper reconnaissances. Such maps as were compiled by order of the Government were so inaccurate as to be of small practical value. In these circumstances it is no wonder that the insurgents were able to elude pursuit and con- stantly to lead the Spanish troops into carefully prepared

ambushes. The organization of the insurrection developed rapidly. A provisional Government was formed, and the Marquez de Cisneros was named President of the Cuban Republic. The island was divided into districts, and a civilian appointed prefect of each one. Certain taxes were levied by these rebel authorities, non-pay me at being pun- ished by destruction of the plantation buildings or crops of standing cane and the seizure of cattle and other live stock. Meanwhile the Cuban Junta in New

York continued to collect subscriptions and arrange for further supplies of arms.

In January 1896 the insurgent leaders determined to carry the war into the districts in the immediate vicinity of Havana, and so paralyze the industrial life of the island. The Spaniards gave little heed to the rumours concerning the movement, and failed to perceive that the majority of the population sympathized with the rebels. As the insurgents advanced, they burned all the cane-fields and destroyed valuable property, on the ground that as long as industry continued to flourish in Cuba, the Spanish Government could find the money to maintain a large army to operate against the Cubans, but that once the industrial life was stopped, Spain would be unable to bear the burden and would then withdraw her troops. Accordingly, a vast sheet of flame from the burning cane-fields marked the advance of the insurgents. Near Coliseo, in the province of Matanzas, General Campos made his last effort to stem the onward movement with 10,000 men, but the insurgents eluded him and invaded the rich Western Provinces. The town of Havana was thrown into a state of excitement, and Marshal Campos was relieved of his command.

At the opening of 1896 there were still many Cubans in sympathy with, or actively engaged in, the insurrection who

would have been satisfied with a liberal meas- oeaerai ^^g pf home rule, and this aspect of the case was seat out duly impressed upon the Spanish Government,

but to no purpose. Meanwhile in the United States the drift of feeling was distinctly in favour of the insurgents, and this had the effect of making Spain more determined than ever to crush the revolt by force of arms, and the task was entrusted to General Weyler, who had a great reputation for energy and relentless severity. Large reinforcements were sent to the island from Spain, and in a few months the army of occupation amounted to 185,000 regular troops, 20,000 guerillas, and 30,000 volunteers. Antonio Maceo, with some 4000 insurgents, had taken up his position in the mountains of Pinar del Rio, and con- tinually harried the Spanish garrisons. In order to prevent him from recrossing towards the eastern provinces and again joining hands with Gomez, a cordon of troops was

stationed from north to south of the island between Mariel and Majana, trenches were thrown up, entanglements laid down, and blockhouses erected at short intervals. A •corps of 20,000 men was stationed on this trocha or military cordon, and 10,000 troops were despatched to Pinar del Rio to march through the province and force a :fight with the followers of Maceo whenever possible. These measures did not give the results expected. The rainy season brought sickness among the troops on the trocha, and many thousands died of fever, dysentery, and exposure. The columns sent out in Pinar del Rio were exhausted by long marches, and invariably found "the mountain passes difficult of approach and strongly guarded by the rebels. Foiled in his attempt to bring about a general engagement. General Weyler issued an order for the "concentration" of the whole rural population in the fortified towns, with a view to prevent the insurgents from obtaining supplies from the country people with them. Some 600,000 people, chiefly women and children, were thus driven from their homes and

collected in the towns, where they had no means of gaining a living, and where no due provision had been made for their subsistence. With very few exceptions the men joined the insurrection, and the women and children suffered great privations.

*In June 1896 a vessel called the Competitor was sur- prised and captured on the north coast of Pinar del Rio just after landing a cargo of arms and ammuni- _4„j^,„„ tion for Maceo. The crew, with one exception, grievances were United States citizens. They were tried by against a military tribunal and sentenced to be shot. **"'"■ Under the treaties existing between Spain and the United States it was specially provided that unless American citizens were captured with arms in their hands against the Spanish authority, they could only be arraigned before the ordinary tribunals. The United States Government insisted that these men were not captured with arms in their hands within the meaning of the treaty, and that the summary triftl accorded them was illegal. The Spanish authorities maintained that they had right on their side, but at the last moment gave way and ordered a fresh trial by ordinary process. The men were in prison for a long period, but were finally released and sent out of the island. Here the affair nominally ended, but bad blood was created*

between the two nations. One of the most difficult political questions with which General Weyler was confronted was the treatment of United States citizens in Cuba. Of persons born in the United States there were only a limited number in the island, but of Cubans who had become naturalized citizens of the United States there were some 20,000, and it was this latter class who occasioned friction. It was a common practice for Cubans to reside a sufficient length of time in the United States to obtain naturalization papers, then to return to Cuba and, whenever in trouble, to call upon the United States authorities for assistance. Many of these naturalized citizens who were directly or indirectly implicated in the revolt only owed their immunity from imprisonment to the fact that their arrest would have entailed diplomatic complications with the United States. Occasionally a man was arrested who claimed to be an American citizen; he could talk no language but Spanish, was born in Cuba, and had not been near his adopted country for twenty years ; nevertheless he was entitled to and received the active intervention of the United States Consul-General in Havana. Time after time the Spanish authorities were forced to give way to the protests sent from Wash- ington, and each succeeding incident increased the bitterly hostile feeling of the Spaniards towards the United States.

In July 1896 Jose Maceo, who commanded the rebels in the eastern part of the island, was killed in a skirmish. This loss to the cause was more than compensated for by the landing of Calixto Garcia, a veteran of the former revolt, who became one of the most prominent of the rebel leaders. Garcia had studied military tactics and understood the weak points of the Spanish character. Many members of families of good social standing who had hesitated to serve under Gomez or Maceo, joined Garcia in the field, and the movement in Santiago and Puerto Principe was further strengthened .by the landing of arms and ammunition sent by the Cuban Junta in New York. In the month of August an attempt was made to dislodge Antonio Maceo from the mountain heights near Cacarajicara, in the province of Pinar del Rio. The officer commanding the Spanish troops. General Echague, was severely wounded, and the Spanish loss was heavy. After hard fighting, the insurgents were forced to retire farther into the mountain fastnesses. In November the strength of the

insurrection in Pinar del Rio and the centre of the island showed no sign of exhaustion, and General Weyler

himself took the field with 60,000 men. Shortly before he left on this expedition he repeated his proclamation that a free pardon would be extended to all insurgents who presented themselves to the Spanish authorities. The rebels did not, however, take advantage of this con- cession, except in the case of sickness, and in that event left the revolt with the advice and consent of their ^ comrades. An order was issued from the seter%r' military headquarters to the effect that troops when marching through the country would destroy all buildings or crops capable of sheltering or assisting the insurgents in any way, and that all persons encountered who had failed to obey the order to con- centrate in the fortified towns were to be treated as rebels. This roused the indignation of the people of the United States, for it showed clearly that the policy Weyler intended to pursue was one of absolute extermination of the recalcitrant sections of the population. The horrors of the march through the provinces of Havana and Pinar del Eio cannot be overestimated. The country people were mercilessly shot down, the animals that could not be made use of were hamstrung, and the smiling country was left a grim mass of smoking ruins. Constant skirm- ishes occurred with groups of insurgents, but no advantage of importance was gained.

Suddenly it was discovered that Antonio Maceo was not in Pinar del Eio, but had slipped through the trocha and was in the province of Havana, in the rear of Weyler. Maceo had crossed the Bay of Mariel in a boat with the object of organizing a demonstration and threatening the city of Havana as an offset to the operations of Weyler in Pinar del Rio. This intention was never put into practice for the reason that on December 6 Maceo was killed in a skirmish. His death was a very severe blow to the in- surrection, and the Spaniards thought for a time that they would have

small further dif&culty with the rebels. But here, again, the authorities underestimated the strength and bitterness of feeling on the part of the Cubans. After a few weeks Eius Rivera, who had served throughout the former revolt, landed in Pinar del Rio to take command of the rebels, but in March 1897 he was wounded in a skirmish near San Cristobal, and subsequently captured and deported. About the same time, Layas, another prominent Cuban leader, was killed in the province of Havana, but these two additional difficulties did not cause the insurgents to waver.

General Weyler returned to Havana after the death of Maceo, leaving General Arolas and General Bernal to continue operations against the rebels in Pinar del Rio. Other factors arose to complicate the situation. The authorities declared that the owners of sugar plantations were making regular payments to the rebel leaders in order to protect their property. No doubt it was a fact that such payments were made, but no other course was open to the planters unless they were prepared to abandon "their properties. General Weyler issued a decree pro- hibiting the manufacture of sugar until such time as the different districts might be declared pacified, and stating that work would only be permitted as this pacification progressed. This order affected Spaniards as well as •Cubans, and brought upon Weyler a storm of abuse, so much so that he was obliged to rescind the decree. Large numbers of persons suspected of sympathizing with the rebels were arrested and shipped without trial to the .Spanish penal settlements of Fernando Po and Ceuta, in Africa, and executions after summary trial took place almost daily.

The Spanish Commander-in-Chief decided to build a second trocha across the island for the purpose of isolating the central provinces from the eastern section of Puerto Principe and Santiago, drawing the line from Moron on

the north coast to Jucaro on the southern seaboard. Preparatory to initiating this work, General Weyler determined to march through the centre of the island in order to drive the insurgents towards the east, and with this object left Havana early in February 1897 at the head of a large body of troops. The route taken was through Havana and Matanzas to Santa Clara and Cienfuegos. The system followed was similar to the

former one through Pinar del Rio. The insurgents made no attempt to oppose the troops,, and their inactivity apparently deceived General Weyler, for on his return to Havana he declared officially that the western and central sections of the island might be considered pacified. This statement was no sooner made public than the rebels again began to make their presence known by attacks on Spanish posts and the destruction of a number of plantations where the owners had failed to comply with their demands.

The arrest of an American citizen named Rius served to increase the tension between the United States and Spain. Rius was a Cuban who had obtained naturalization after residing for some years in Philadelphia. The United States Consul-General demanded that he should be immediately tried and released if no offence could be proved against him. While the question was pending, Rius was reported to have died suddenly. The United States Consul-General insisted upon a medical examina- tion of the body, and it was found that Rius had died from the effects of a blow on the back of his head. On the woodwork of a chair in his cell was discovered a statement, scratched with a nail, to the effect that the prison authorities intended to murder him. General Lee, the United States Consul-General in Havana, reported the facts of the case to Washington, and President Cleveland caused instructions to be sent to him to demand a full investigation, promising all necessary support. Ulti- mately the Spanish authorities appointed a commission of inquiry, but no clear proof was adduced that Rius had been deliberately murdered. The incident then dropped, but it brought one step nearer the intervention of the United States.

Meanwhile the country-people of Pinar del Rio, Matanzas, and Havana, concentrated in the fortified towns, were dying of starvation. In the village of Consolacion del Sur the deaths exceeded 10,000, and in the city of Matanzas the total was still larger. As the true situation became understood in the United States, the opinion that intervention should take place, or in any case the recog- nition of Cuban independence, every day found expression in emphatic terms in Congress. The number of lives sacrificed in the campaign had reached nearly 50,000 without bringing the end of the trouble in sight, while the cost of the operations in Cuba

was calculated at £2,000,000 sterling monthly. In view of the general situation, the United States Government ^^/g/' approached the Madrid authorities with sug- gestions for a very liberal measure of local self-government for Cuba. This pressure from Washington, combined with a change of Ministry in Spain, brought about the recall of General Weyler in October 1897, and the appointment of General Blanco as his successor. The Sagasta Adminis- tration determined on a radical change of policy in Cuba and Porto Rico. The Abarzuza reforms were abandoned, and a form of Constitution was drawn up for both islands based on that of Canada, but with certain restrictions as regards financial legislation. General Blanco was in- structed to use every endeavour to conciliate the Cubans, but the new policy came too late. The Cubans were convinced that it was only a question of maintaining the insurrection for another year to force Spain to evacuate the island, unless American intervention brought about*

this result at an earlier date, and the principal rebel leaders declined to accept the terms offered.

General Blanco arrived in Cuba in November 1897, and immediately annulled the concentration order ; but

the permission for the people to return to their %at^m's ^°™®s was of little avail to them owing to their policy. weak condition and the ruin of their homes.

To the insurgents in the field the abrogation of the concentration decree was, however, an immense boon. They were now able through their friends in the cities to obtain the medicines, clothing, and other neces- saries of which they stood sorely in want. General Blanco's next act was to proclaim an amnesty for all rebels who presented themselves to the authorities. A few surrendered, but no leaders of importance. No further executions of captured rebels took place, and arrests for political purposes

were rarely effected. The Press, also, was allowed a far greater degree of liberty, although all news concerning the revolt continued to be strictly censured. On January 1, 1898, the new Consti- tution was proclaimed in force and a Colonial Government appointed, of which Senor Galvin was the nominal leader. The new Administration had, however, very little power, the question in Cuba being a military one as long as the insurrection continued. Finding that the insurgents did not intend to lay down their arms. General Blanco ordered military operations to be energetically carried out ; but, as in former years, no decided advantage over the rebels was gained.

A riot, in which many military officers and Spanish volunteers were concerned, occurred in Havana in January, and with a view to the protection of citizens of the United States in the event of any further outbreak the American

warship Maine, commanded by Captain Sigsbee, "^Maine " ^^^ Ordered to Havana. Under the direction

of the port authorities she was moored in the section of the harbour specially reserved for men-of-war. No discourtesy was shown to the officers and crew of the vessel, and several receptions were held on board by the captain and officers in order to return in some measure the hospitality extended to them by the residents of Havana. On February 16 a large number of guests visited the cruiser. At 9.30 on the evening of that day the in- habitants of Havana were startled by a terrific explosion, and the Maine was seen to be in flames and in a sinking condition. Subsequent explosions of ammunition occurred, and the wreck settled dovni. The boats of the Spanish cruiser the Alfonso XII. were promptly lowered, and helped to save the survivors. The complement of the Maine in officers and crew was 347 all told. Two officers were absent on leave ashore when the explosion occurred. Of those on board, two officers and 267 men lost their lives. The great loss of life among the crew was due to the fact that the men had turned in, and the explosion took place under their quarters in the forward part of the vessel. Everything that was possible was done by the Spanish authorities to aid the wounded survivors, seven of whom afterwards died. A public funeral was accorded

to the victims, and was attended by the principal Spanish officials. In spite of this show of sympathy, it was recognized in Havana that the critical moment had arrived, and that unless the explosion could be satisfac- torily accounted for, war between Spain and the United States was inevitable.

Shortly before the disaster two events had occurred rendering the relations between the two countries ex- tremely strained. The first was a letter written by Sefior Dupuy de Lome, the Spanish Minister in Washington, to his friend Senor Canalejas, then on a visit to Cuba. It was not intended for publication, but was stolen in Havana and disposed of to a New York newspaper. In this letter

the Minister expressed emphatic doubts as to the good faith of the United States Government in dealing with the Cuban question, and made some insulting remarks in reference to President M'Kinley. The result of the publication of this letter was that Senor Dupuy &e Lome was forced to resign his post. The second event was a request from Madrid for the recall of General Fitzhugh Lee from his position as Consul-General of the United States in Havana, on the ground of his being a persona non grata to the Spanish authorities.

The advice of Captain Sigsbee to his Government and the people of the United States was contained in a tele- gram sent to Washington a little before mid- night on the evening of the disaster, — " Suspend T!'j,j„g „ judgment pending result of official investigar inquiry tiou." A court of inquiry was named, composed "»' "» of Captain (afterwards Admiral) W. T. Sampson, '"eaces. Captain F. C. Chad wick, Lieutenant-Commander W. P. Potter, and Lieutenant-Commander A. Marix. The court assembled on board the United States steamer Mangrove in Havana harbour a few days after the dis- aster occurred, and sat continuously until March 21. The huU of the Maine was examined by divers, and a search- ing investigation of all facts bearing on the case was made. It was not until early in April that the report of the court was handed to Congress. The finding was : —

" That the loss of the Maine was not In any respect due to fault or negligence on the part of any of the officers or members of her crew; that

the ship was destroyed by the explosion of a sub- marine mine, which caused the partial explosion of two or more of her forward magazines ; and that no evidence has been obtainable fixing the responsibility for the destruction of the Maine upon any person or persons. ”

The position of the vessel after the explosion vras evidence of the correctness of this finding, the keel being bent upwards from the centre and remaining above the level of the main deck. The Spanish authorities held an inquiry, and after a few days drew up a report to the effect that the explosion was due to internal causes. They also stated officially that no submarine mines existed in the harbour of Havana, and that the Government pos- sessed no materials for their construction. This state- ment was afterwards conclusively proved to be incorrect.

On April 8, 1898, General Lee received orders to leave Cuba and hand over the charge of United States interests to the British Consul-General. The following day General Lee, with the remainder of the United States citizens still in Havana, embarked on board a United States gun- boat and proceeded to Florida, and on Monday, April 11, President M’Kinley sent to Congress ”^f^f^,”.^ his Message on the situation. On April 13 the message. Foreign Affairs Committees of both Houses reported joint resolutions, and on April 18 a conference between the two Committees resulted in the adoption of the following joint resolution by 42 votes to 36 in the Senate, and by 311 votes to 6 in the House of Repre- sentatives : —*

” Whereas the abhorrent conditions which have existed for more than three years in the island of Cuba, so near our own borders, have shocked the moral sense of the people of the United States, have been a disgrace to Christian civilization, culminating as they have in the destruction of a United States battleship with 266 of its officers and crew, while on a friendly visit in the harbour of Havana, and cannot longer be endured, as has been set forth by the President of the United States in his message to Congress of April 11, 1898, upon which the action of Congress was invited ; therefore,

” Resolved by the Senate and House of Representatives of the United States of America in Congress assembled —

” First. That the people of the island of Cuba are, and of right ought to be, free and independent.

” Second. That it is the duty of the United States to demand, and the Government of the United States does hereby demand, that

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the Government of Spain at once relinquish its authority and government in the island of Cuba and withdraw its land and naval forces from Cuba and Cuban waters.

” Third. That the President be, and hereby is, directed and em- powered to use the entire land and naval forces of the United States, and to call into the actual service of the United States the militia of the several States, to such an extent as may be necessary to carry these resolutions into effect.

‘ ‘ Fourth. That the United States hereby disclaims any disposition to exercise sovereignty, jurisdiction, or control over the said island, except for the pacification thereof, and asserts its determination when that is completed to leave the government and control of the island to its people.”

This resolution was signed by President M’Kinley on April 20, and a copy served upon the Spanish Minister, Senor Polo y Bernabe, who immediately asked for his pass- ports and left Washington. On April 24 the Spanish Government formally recognized the existence of war between Spain and the United States, and on April 25 the United States Congress passed the following Bill without a division : —

” Be it enacted by the Senate and House of Representatives of the United States in Congress assembled, First — That war be, and the same is hereby declared to exist, and that war has existed since the 21st day of April a. d. 1898 including the said day, between the United States of America and the kingdom of Spain. Second — That the President of the

United States be, and he hereby is, directed and empowered to use the entire land and naval forces of the United States, and to call into the actual service of the United States the militia of the several States, to such extent as may be necessary to carry this act into efiect."

On April 21 the President of the United States pro- claimed the blockade of the Cuban coast from Cienfuegos on the south of the island, thence westwards to Cape San Antonio and thence to the east, passing Havana, to Cardenas on the northern seaboard. From the date of the destruction of the Maine, the bulk of the United States navy had been quietly concentrating at Key West, off the coast of Florida, and within eight hours of the pro- clamation of the blockade the fleet was patrolling Cuban waters. The dominion of Spain in Cuba virtually ceased from this time.

Meanwhile General Blanco decided to make a bold bid for peace with the insurgents, and for their co-operation with the Spanish troops in defending the island against American aggression. On April 10, 1898, he ordered a cessation of hostilities against the rebels, and sent a deputation to their leaders to ascertain what terms they demanded as the price of laying down their arms. The insurgents accepted the armistice offered pending any decided action on the part of the United States, but made no compact with the Spanish authorities not to resume hostilities on the declaration of war, and meanwhile remained in their camps awaiting the development of events. General Blanco withdrew the majority of the garrisons in the interior of the island in order to strengthen the coast defence against any attack by the Americans, and the country districts were left at the mercy of the insurgents. When the declaration of war was made public on April 23, the insurgents immediately resumed their aggressive tactics and harassed the Spanish troops when opportunity offered. Considerable supplies of arms, ammunition, and provisions were despatched by the United States Government to enable the insurgents to carry on operations until the time arrived for the landing of American troops. With a few exceptions, there was at this time no industrial life in the island ; it had been reduced to a desert, and on all sides were signs of suffer- ing and distress.

The United States army for the invasion of Cuba was concentrated at Tampa, in Florida, in May 1898. It had been intended to land a force of 5000 men, under the command of Major-General Shafter, near Tunas, on the

south coast, and, in conjunction with the insurgents, gradually push the Spaniards to the westward, but the arrival of a Spanish squadron under Admiral Cervera at Santiago de Cuba, and the blockade deciara- of that port by Admiral Sampson, made imperar tioaof tive the landing of an army to attack the city, ”’””• and so render the harbour untenable for the Spanish ships. On June 14 the Fifth Army Corps, consisting of 815 ofBcers and 16,072 men, sailed from Tampa. Shortly before this the transport Florida had landed a contingent of 500 Cubans on the north coast of the island. On June 20 the fleet of transports conveying the American troops arrived off Daiquiri, some 15 miles to the east of the city of Santiago, and by the evening of the 24th the entire force had been landed. On the following day, under an arrangement effected by Major-General Shafter, some 6000 Cubans, commanded by Calixto Garcia, were also brought to the scene of operations. No attempt was made by the Spaniards to resist the landing, although the country lent itself admirably to defensive purposes. The garrisons at Daiquiri and Siboney retired in the direction of Santiago, where General Linares was in command of some 7000 men. At Guantanamo, a few miles to the eastward of Daiquiri, a force of some 1400 American marines had been landed a couple of weeks earlier, and held possession of the villages at the entrances to the harbour.

Until June 30, Major-General Shafter was engaged in moving his troops towards Santiago, and preparing for a general attack on the outer lines of defence at San Juan and El Caney. The Cubans were usefully employed as scouts and skirmishers. On July 1 the division com- manded by General Lawton attacked El Caney. The Spaniards made an obstinate resistance, but their positions were captured. General Vara del Key, commanding the Spanish forces, and most of his ofBcers were killed. At the same time the divisions under Generals Wheeler and Kent drove the Spaniards from the hill of San Juan, which formed part of the outer line of defence of Santiago. During the night the Spanish General Escario

reached Santiago with reinforcements of 3600 men, having made forced marches from Manzanilla. The fighting was con- tinued on the following day, the American lines being drawn closer towards Santiago. On the morning of July 3 (an unsuccessful, but plucky, attempt having been previously made by Lieutenant Hobson to block the channel by sinking the Merrimac across it) the Spanish squadron under Admiral Cervera left the harbour and attempted to force the blockade. In > half an hour this important section of Spain's navy was destroyed, with a loss of 600 killed and 2000 captured, and the fate of Santiago was sealed. At noon General Shafter de- manded the unconditional surrender of the city. General Linares had been wounded on July 2, and had temporarily handed over the command to General Toral, who conducted the negotiations with General Shafter. After a delay of fourteen days and a partial bombardment of the city on July 12, the Spaniards agreed to the terms proposed, namely, the surrender of the city and province of Santiago de Cuba and the entire garrison of the province, this con- sisting of nearly 23,000 officers and men. The losses of the United States troops in the fighting on July 1, 2, and 3 were officially returned as 22 ofBcers and 208 men killed, and 81 oflBcers and 1203 men wounded, while 79 men were reported missing. The Spanish loss was stated to be, approximately, 1500 officers and men killed and wounded.

General Shafter took formal possession of Santiago on July 17. By some oversight, ho official invitation to be present at the ceremony of surrender was extended to Calixto Garcia as representative of the Cubans. This fact, and the order of General Shafter prohibiting the Cubans

from entering the city, were taken as an insult by Garcia, and he withdrew with all his forces to the interior of the island in the direction of Holguin, where he remained until hostilities were suspended.

The sufferings of the non-combatants in Santiago were very great. The foreign Consuls, of whom the British Consul, Mr Ramsden, was the doyen, visited the American lines on July 3 and presented a joint petition to General Shafter to the effect that the women, children, and other non-combatants should be allowed to leave the town before further offensive operations were undertaken. This request was granted, and El Ganey was designated as the most convenient place to which these people might proceed. Some 22,000 persons took advantage of the permission. The Spanish authorities placed no obstructions in the way, but only allowed the fugitives to take with them such food and worldly goods as they could carry individually, and would permit no wheeled vehicles to leave the city. In the course of a couple of days the food supplies at El Ganey were exhausted, and it became necessary for General Shafter to issue rations. These were necessarily limited, and many families were reduced to dire straits. Mr Kamsden died shortly afterwards from the effects of the privations he suffered at this period.

Some further skirmishing took place towards the end of July, and the Spanish gunboats in the harbour of Manzanilla were captured or destroyed by United States men-of-war. The fall of Santiago, however, practically ended the war. On July 26 the French Ambassador in Washington approached the United States Government with peace proposals. A protocol was signed on August 12, and all hostilities were suspei^ded. Under the terms of this agreement Spain was obliged to evacuate Cuba within a reasonable time, as is seen by the following copy of the ofl8.cial document signed by Mr W. R. Day, the Secretary of State, and M. Jules Cambon, the French Ambassador, acting on behalf of the Spanish Govern- ment : —

" Protocol of agreement between the United States and Spain, embodying the terms of a basis for the establishment of peace between the two coilntries.

" William R. Day, Secretary of State of the United States, and his Excellency Jales Cambon, Ambassador Extraordinary and Plenipotentiary of the Republic of France at Washington, respect- ively possessing for this purpose full authority from the Govern- ment of the

United States and the Government of Spain, have concluded and signed the following articles embodying the terms on which the two Governments have agreed in respect to the matters hereinafter set forth, having in view the establishment of peace between the two countries, that is to say : —

“Article I. Spain will relinquish all claim of sovereignty over, and title to, Cuba.

“Article II. Spain will cede to the United States the island of Porto Rico and other islands now under Spanish sovereignty in the West Indies, and also an island in the Ladrones, to be selected by the United States.

‘ ‘ Article III. The United States will occupy and hold the city, bay, and harbour of Manila pending the conclusion of the treaty of peace, which shall determine the control, disposition, and gov- ernment of the Philippines.

” Article IV. Spain shall immediately evacuate Cuba, Porto Rico, and other islands under Spanish sovereignty in the West Indies ; and to this end each Government will, within ten days after the signing of this protocol, appoint Commissioners, and the Commissioners appointed shall, within thirty days after the signing of this protocol, meet at Havana for the purpose of arranging and carrying out the details of the aforesaid evacuation of Cuba and the adjacent Spanish islands ; and each Government will, within ten days of the signing of this protocol, appoint other Commissioners, who shall, within thirty days after the signing of this protocol, meet at San Juan, in Porto Rico, for the purpose of arranging and carrying out the details of the aforesaid evacuation of Porto Rico and other islands now under Spanish sovereignty in the West Indies.

“Article V. The United States and Spain will each appoint not more than five Commissioners to treat of peace, and the Commis- sioners so appointed shall meet in Paris not later than October 1,

1898, and proceed to the negotiation and conclusion of a treaty of peace, which treaty shall be subject to ratification according to the respective constitutional forms of the two countries.

“Article VI. Upon the conclusion and signing of this protocol, hostilities between the two conntries shall be suspended, and notice to that effect shall be given as soon as possible by each Government to the commanders of its naval and military forces.

” Done at Washington, in duplicate in English and in French, by the undersigned, who have hereunto set their hands and seals, the 12th day of August 1898.

(Seal) William R. Day. (Seal) Jules Cambon.”

The treaty of peace agreed upon in Paris was finally signed on December 10, 1898, and Spanish dominion ceased after having been in force since 1492, a period of 406 years.

It is worthy of note that throughout the insurrection the Church took no part in the political troubles ; this was in marked contrast to the ^attitude of the Clerical authorities in the Philippines and in Spain.

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By the terms of the Spanish surrender of Santiago province, July 1898, that province temporarily became American territory. The remainder of Cuba was still in a state of insurrection, and under Spanish cessation control. The Porto Rico campaign after the of Spanish- fall of Santiago lasted until the signing of the “Jjj” protocol on 12th August 1898. The status of the Cuban insurgents, who were still in ai-ms against Spain, west of Santiago province, remained indefinite. Inasmuch as by the terms of the protocol Spain re- linquished all claims to sovereignty and title to Cuba, and promised to evacuate the island as soon as a Commission to be appointed should arrange details of the evacuation, the insurgents themselves, exhausted by the conflict, nat- urally ceased hostilities, awaiting future action. Within a month of the surrender of Santiago all the Spanish and American forces, with the exception of a small guard of the latter, had returned to their homes. Brigadier-General Leonard Wood was appointed Military Governor of the stricken province. He at once began an enlightened policy of sanitation and public improvements, and gave the Cuban element every official and political recognition. The

undertaking of the United States to retain control only until a form of government could be evolved from the chaotic and stricken condition existing upon the island at the end of hostilities was conscientiously maintained. No discrimination was allowed in favour of goods shipped to Cuba from the United States, and the products of aU nations were admitted to Cuba on same terms as America. The acts of the temporary American occupation were : (1) the relief of immediate suffering ; (2) the successful conducting of an orderly evacuation of the island by Spain without the attending evil of anarchy ; (3) the disbandment of the Cuban army ; (4) the restoration and betterment of the social, hygienic, and economic condition; and (5) the preparation of the island for independent government.

The condition of the island upon the cessation of hostilities was bad beyond description. The people were impoverished by revolution and starvation, transportation and communication were palsied, agi-iculture prostrated, brigandage rampant, and commerce dead. Human misery had apparently attained the maximum of possibility. The debris of war and attending disease existed everywhere. Oflftcial and private charity immediately hastened to the relief of the starving inhabitants, and was practised upon a scale of munificence never before exhibited in the world. Money, food, medicine, raiment, shelter, and employment were quickly bestowed, all deoendanta weie properly cared

for by the public treasury, and the hordes of maimed beggars which hitherto had infested the streets of Cuban cities were properly dealt with. The relinquish- ment of Spanish sovereignty was accomplished in an orderly manner and without disturbance on January 1, 1899. By previous arrangement the flag of Spain was lowered and that of the United States temporarily hoisted. The Spanish officials withdrew from the island and the American authorities took up the reins of government. A tragic incident of the evacuation of Cuba, the last colony of Spain in America,

was the solemn removal of the supposed remains of Christopher Columbus, the discoverer of America and founder of the first Spanish-American colony, from their tomb in the Cathedral at Havana, and transportation to Spain.

Another serious problem which confronted the American authorities upon the acquirement of Cuba was the dis- bandment of the Cuban army. It was unfortunate that the tidings of peace in Cuba should have been followed by distrust between the Cubans and Americans, and a mutual misunderstanding followed which for some time proved awkward. This was brought about (see p. 309) by the refusal of the American commander at the battle of Santiago to permit the representatives of the Cuban army under General Calixto Garcia to participate in the investment of that city. The Cubans were hurt and insulted, feeling that there had merely been a change of masters. General Garcia, wounded by the incident, retired with his troops into the interior of Santiago pro- vince. In October 1898 the Provisional Cuban (Insurgent) Government, which had existed since 1895, called a meeting of delegates from all sections of the insurgent forces to decide upon a line of policy for the immediate future. This Congress sat at Santa Cruz del Sur for some three weeks. It was finally resolved to dissolve the Provisional Government and nominate a Commission to represent the armed forces which had fought against the Spaniards, leaving the question of the constitution of a Government to be determined at a later period, when the intentions of the United States Administration in the matter of Cuba were more clearly defined. This Comm ission, the President of which was Calixto Garcia, went to Washington in December 1898 and laid before the United States authorities a carefully prepared statement of the situation of Cuba and the Cubans. The Commission arranged that the Insurgent army be disbanded, with certificates of service to be presented to the future permanent Government of Cuba for pay. General Garcia, at the head of the Commission, declared that the Cubans accepted gratefully the aid of the United States, and trusted implicitly in its promise that a free and independent Government should sooner or later be established in Cuba. This general, who for forty years had laboured and fought for the freedom of Cuba, died in Washington, December 1898, while upon this mission of peace. The American Government sent his remains to Cuba

upon a man-of-war, and accorded them full military honours. After the death of Garcia, the details of disbanding the Cuban army became temporarily serious, and resulted in many conferences between the military authorities and the insurgent leaders in Cuba, rinally, through the aid of General Maximo Gomez, all the various elements came to agreement, rosters were made of the insurgent armies, and each soldier was given a sum of money sufficient for his temporary needs, and the arms turned over to the American authorities. In all $3,000,000 was distributed to 48,000 men and 6000 commissioned

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By the Treaty of Peace signed December 17, 1898, Cuba's status became that of a foreign Power in the mili- tary occupation of the United States, pending the estab-

lishment of an orderly Government. By the same treaty Spanish subjects were given twelve months in which to determine whether they were to retain or relinquish their allegiance to Spain. Until the end of that period it was impossible to know who might rightly participate in the work of reconstruction, and therefore the withdrawal of the United States and the establishment of a Cuban Government necessarily became a gradual process requir- ing much toil and firmness. The War Department issued a formal order in December 1898 making Cuba a military division, with Havana for headquarters. For the purposes of military administration the island was at first divided into military departments, each under a commanding officer carefully chosen from men with broad experiences in civil as well as military administration. The United States assumed entire control of Cuba January 1, 1899. Presi- dent M'Kinley issued immediate proclamation defining government and organization and establishing custom rates. The supreme authority upon the island was vested in a Commanding-General, whose functions were very similar to those of the Captain-General under the Spanish regime. The first American Military Governor to be ap- pointed upon the retirement of Spanish sovereignty was Major-General John E. Brooke, who entered upon his duties January 1, 1899. The Military Governor preserved and restored the Spanish forms of administration so far as they were compatible with good

government. He established an advisory and administrative Cabinet composed of Secretaries, in whom were vested the administrar tion of civil government. The departments and Ministers were known as those of state and government, finance, justice and public instruction, agriculture, commerce, in- dustries, and public works. The military commanders there were instructed to restore local government as soon as possible. In carrying out this order the communal or municipal organization of the Spanish system was retained in spirit as well as form, and the people were permitted as far as possible to manage their local affairs. There are about two hundred municipalities in Cuba, and the alcaldes temporarily appointed were selected with great care.

The chief problems confronting the newly installed American authority were those of relief, police, sanita- tion, and reform of the judiciary. The last was especially needed. The civil and criminal code which was in existence prior to the relinquishment of Spanish sovereignty was retained in force, with such modifications and changes as might from time to time be found necessary in the interest of good government.

By decree of January 1, 1900, the department of Jus- tice and Public Instruction was divided. The judiciary system of the Spanish regime early received the attention of the American Military Governor, and was so modified as to result in more speedy attainment for the ends of justice, although retaining the forms of procedure and organization which previously existed. Upon the withdrawal of Spain, General Brooke organized a Supreme Court to hear cases and appeals, which under Spanish rule were sent to Spain for decision. This court, with its seat at Havana, was composed of a president, of a chief justice, six associate justices, one fiscal or prosecuting attorney, two assistant fiscals, one secretary, two deputy clerks, and other sub- ordinate officials. Another court established was the Municipal or Correctional Court of Havana, the powers of which had hitherto been exercised by the mayors, and this system of police courts was afterwards applied to the whole island. A great obstacle to the administration of justice was the absence of remedial writs in the Spanish law of procedure. It was proposed, however, to institute the Habeas Corpus and other procedures for the protection of personal liberty as soon as expedient.

[recent histobt

Census

1899.

President M'Kinley, on August 17, 1899, ordered the taking of a census of the people of Cuba by disinterested

citizens of Cuba as enumerators and supervisors.

The proclamation of the President ordering the

census was declared to be a preliminary step in the establishment of an effective sy stem of self-government. The census was limited to inquiries concerning population, agriculture, and education as the three subjects of most importance. No previous census of Cuba as one had been taken since 1878. This work was accomplished with great thoroughness under the direction of Brigadier-General Sanger. The results of this census were beneficial in removing popular prejudices against the Cubans in the United States, demonstrating that a majority of the Cubans were of the white race and were generally more literate than the people of Spain and Porto Eico. The census also showed that the mortality due to the insurrec- tion and the reconcentration had been less than had been ascribed. (For the details of the census results, see p. 303 above.)

On January 1, 1900, Brigadier-General Leonard A. Wood succeeded General Brooke as Military Governor of

the island. General Wood had shown great Wood's success as governor of the province of Santiago, appoint- and his appointment was considered eminently ""'• appropriate and satisfactory both to the Cubans*

and the Americans. One of the early acts of his adminis- tration was to show his trust in the Cuban people by giving them most of the executive

offices. To him fell the difficult task of conducting the elections, and serving as an intermediary between the administration at Wash- ington and the Cuban people. On July 25, 1900, the President directed that a call be issued for an election in Cuba for members of a constitutional Convention to frame a Constitution as a basis for a stable and independent Government in the island. In pursuance thereof Military-Governor Wood issued a proclamation again citing the fact that the United States disclaimed any disposition or intention to exercise sovereignty, jurisdiction, or control over the island except for the pacification thereof, and asserting its determination, when that was accomplished, to leave the government and control of the island to its people. Therefore he ordered a general election to be held on the third Saturday of September in the year 1900, to elect delegates to a Convention to meet in the city of Havana on the 1st Monday of November of the same year to frame and adopt a Constitution for the people of Cuba, and as a part thereof to provide for and agree with the Government of the United States upon the relations to exist between that Government and the Government of Cuba, and to provide for the election by the people of officers under such Constitution, and the transfer of govern- ment to the officers so elected. The election was held on the 15th of September, and the Convention assembled on the 5th of November 1900. Military-Governor Wood in opening the Convention said : " It will be your duty, first of all, to frame and adopt a Constitution for Cuba, and when that has been done, to formulate what in your opinion ought to be the relations between Cuba and the United States. The Constitution must be adequate to secure stable, orderly, and free government. When you have formulated the relations which, in your opinion, ought to exist between Cuba and the United States, the Government of the United States will doubtless take such action on its part as shall lead to final and authoritative agreement between the people of the two countries to the promotion of their common interests." The Convention expressed appreciation and gratitude to the United States Government and to General Wood for aid given to the Cuban people in advancing self- government.

By the end of January 1901 the Cuban Constitutional Convention had so far completed the instrument that its character and general features were evident. It was an able and well-written document, follow- CuAanajirf ing

in a general way the essential features of relations. the Constitution of the United States. In one essential feature it was lacking, however — it did not men- tion the relations which were to exist between Cuba and the United States. In the Constitution as framed there " was no recognition of the United States, no expression of gratitude or even friendliness," and no provision was made for the relations to exist between Cuba and the United States, as stipulated in the call for the Convention. On March 2, 1901, Congress, appreciating the fact that the Cuban Constitution ignored the relations to exist between the future Cuban Eepublic and the United States, and in order to enable the President to withdraw the military forces from Cuba, through an amendment to the Military Appropriation Bill framed the articles known as the Piatt Amendment. The Piatt Amendment contained eight articles, specifically defining what the relations were to be between the future Cuban Eepublic and the United States. These articles, in essence, were as follows : —

1. Prohibiting Cuba from entering into treaties with foreign Powers tending to impair Cuban independence, or prohibiting them to obtain lodgment or control over any portion of the island.

2. Regulating Cuba's power to incur debts beyond the capacity of the island's ability to pay.

3. Providing that the United States shall have the right of intervention for the preservation of Cuban independence, the maintenance of an orderly Government, and for discharging the obligations of the United States relative to Cuba stipulated in the Treaty of Paris.

4. Eatification on validation of all acts of the United States while in temporary military occupation.

5. Requiring Cuba to execute and extend the plans for the sani- tation of the island.

6. Demanding that the Isle of Pines be omitted from the con- stitutional boundaries of Cuba, and that its future status be fixed by treaty.

7. Demanding that Cuba sell or lease to the United States suit- able sites for coaltug or naval stations.

8. Demanding that the foregoing stipulations be embodied in the form of a permanent treaty.

The Eadical element in Cuba bitterly advocated the rej ection of any dictation from the United States. Finally it was determined in April 1901 that a Commission from the Cuban Constitutional Convention should visit Wash- ington for the purpose of ascertaining the exact intent and meaning of the language of the Piatt Amendment. This Commission consisted of Juan Gualberto Gomez, the Eadical independent leader; Domingo Capote, the presiding officer of the Convention; Dr Berriel, a noted constitutional lawyer; Judge Florente, an asso- ciate justice of the Cuban Supreme Court; Eafael Portuondo, an extreme Eadical ; Diego Tamayo, and a Nationalist and member of Governor Wood's cabinet. The Cuban Commission reached Washington April 24, 1901, and was given every attention and consideration. After many interviews with the President and Secretary of War, the members were informed that the United States would insist upon its position. President Capote, of the Commission, asked the President to do something for the Cubans upon an economic line, especially in the matter of reciprocal trade relations. He said that it was especially desirable that something of this kind be done before the next crop was harvested, in order that the Cubans might thus realize the advantages of closer political and economic relations with the United States. To this inquiry the reply was made that Congress alone had the power to regulate commerce. It was supposed after the visit of the Commission to Washington that the

Constitutional Convention would appreciate that the United States had no ulterior motives in attempting to establish and protect the Cubans in an independent Gov- ernment. Upon the return of the Commission the Con- vention decided to accept the Piatt Amendment, and the incident was supposed to be closed. It was subsequently- ascertained, however, that the

acceptance was accom- panied by a Cuban interpretation, whereupon (June 1901) the President issued his dictum that until the Cuban Convention accepted the Piatt Amendment in its entirety, the troops of the United States would be retained upon the island. On June 18th, 1901, the Convention, seeing that further dallying was useless, accepted the amend- ment m its entirety, and a Cuban Eepublic was inaugu- rated on May 20, 1902, with Senor Palma as first presi- dent.

It is impossible to set forth here what the Americans have done for the social and industrial improvement of the ^island. Brigandage and mendicity were AmeliLn' eliminated. . The establishment of a thorough action. public school System was accomplished, super- intendents and teachers being imported. As a result, 150,000 Cuban children were obtaining free educa- tion in 1900, while only 27,000 children had hitherto found instruction. In 1900, 1400 Cuban teachers were given free transportation to, and instruction at, Harvard University. Cuban prisons were in bad sanitary condition, and the time of detention was long. In Havana twenty- two Americans were found imprisoned over five months with no hearing. Over 1500 people were found in the jails in Cuba who had never been tried. The sanitary cleansingof the cities was undertaken on a gigantic scale. The sanitation of Havana — a plague-spot which had long menaced the United States — was thoroughly studied and the city changed into one of the cleanest in the world. Colonel George E. Waring, America's ablest sanitary en- gineer, personally studied the sanitary conditions of Cuba, and died of yellow fever contracted in this work. Not only were matters of public hygiene carefully attended to, but the Surgeon-General of the army established in Havana a corps of medical investigators, who attacked the problem of the causes and dissemination of yellow fever with great energy. In the summer of 1901 they demonstrated by experimentation that the cause of the dissemination of the disease was the mosquito. The death-rate of Havana decreased nearly one-half as a result of the sanitary measures which were taken, and yellow fever, for the first time in the history of Havana, was not epidemic in 1901. It had already become ap- parent that the army surgeons, through their sanitation and researches, had obliterated the conditions which once made Havana the focus and distributing centre of this disease in the New World. Postal and telegraphic com- munication was greatly

improved and placed upon a systematic basis. The peculations of a few postal author- ities, who were duly arrested and punished, was the only blot upon the American administration. The rehabilita- tion of the fields and plantations has been encouraged. Seeds and animals were at first furnished, but by 1901 all agricultural industries were self-sustaining, and the sugar and tobacco industries had recovered the full de- velopment which they possessed before the insurrection in 1895, In 1901 Cuba might be described as better off socially and economically than at any period since 1840. From a political standpoint the acts of the United States have been even more munificent. The United States spent millions of money and many lives in a war with Spain for the sake of Cuba ; sent aid to its starving popu- lation; paid three million dollars to the insurgent soldiers; and assumed payment of all damages which American citizens sustained during the revolution. (b. t. h.)

Cuddalore, a town of British India, in the South Arcot district of Madras ; on the seacoast, 125 miles south of Madras. In 1881 it had a population of 43,545 ; in 1891, of 47,355 ; and in 1901, of 51,880, showing an in- crease of 10 per cent. The municipal income in 1897-98 was Rs.51,710. The mouth of the river GaddUam having silted up, the anchorage is an open roadstead. In 1897-98 the total sea-borne trade amounted to Es.61,46,419, of which nearly half was with foreign countries. The prin- cipal exports are sugar, oil-seeds, and indigo. There are two colleges, two high schools with 861 pupils, two printing-presses, and a club.

Cuddapah, a town and district of British India, in the Madras Presidency. The town is 6 miles from the right bank of the river Pennar, and 161 miles by rail from Madras. Population, about 18,000. The municipal income in 1897-98 was Es.47,830. It is now a poor place, but has some trade in cotton and indigo, and manu- factures of cotton cloth. There are a high school, two printing-presses, and a literary association.

The DISTRICT OF Cuddapah has an area of 8722 square mijes. Population (1891), 1,272,072; (1901), 1,291,903. The land revenue and rates were Es.22,51,654, the inci- dence of assessment being E.1-8 per acre ; the number of police was 1002. In 1897-98, out of a total culti- vated area of 1,586,665 acres, 282,702 were irrigated. The principal crops

are millet, rice, other food-grains, pulse, oil-seeds, cotton, and indigo. The two last are largely exported. There are two steam factories for pressing cotton; and 570 indigo vats, employing 8417 persons, with an out-turn valued at Rs.6,37,000. In 1896-97 the number of schools was 846, attended by 18,652 pupils. The registered death-rate in 1897 was 25-9 per thousand. The district is served by two lines of railway.

Cuenca, a province of Central Spain, with a population of 236,253 in 1877, 242,024 in 1887, and 241,566 in 1897. In 1896, of 47,764 children of both sexes, ranging from 4 to 14 years of age, 28,146 were on the school registers, though only 19,779 attended. The province is divided into 8 administrative districts and 288 parishes, covering an area of 6726 square miles. It is the least thickly peopled province in Spain, and has only 68 miles of railway, but a new line is under construction. The roads are in such a backward condition that they cripple not only the mining interests but also the exports of timber, which is generally floated down the Tagus and other streams. Thereare but few manufacturing interests. In 1897 the province contained 3 salt mines in working order. An English company bought the principal cop- per mines near Garabella and Talayuelim in 1898. The province, chiefly owing to its hilly pasture grounds, had a goodly show of live-stock in 1897 — ^291,205 sheep, 51,266 goats, 20,191 pigs, 3232 horses, 25,503 mules, 21,315 asses, 4149 cattle. 225,600 acres were devoted to the culture of wheat, 48,402 to that of barley, 39,157 to rye, 16,250 to oats, 62,207 to vines, 30,320 to olives. CuENCA, the capital, has much decayed in importance. The wool trade has been in part replaced by manufactures of soap, paper, chocolate, matches, and leather. There are many saw mills, worked by steam. The population has grown from 9745 in 1887 to 10,332 in 1897. Cuenca attracted notice by its gallant and prolonged resistance against the Carlists in 1874.

Cuenca, a" town of Ecuador, and capital of the pro- vince of Azuay, about 80 miles south-east of Guayaquil. It is the second town of the interior in importance, and the third in rank of the republic. Population, about

25,000.

Cuesmes, a town of Belgium, in the province of Hainaut, 2 miles south-west of Mons, with which it is united by rail. It has a coal-mining industry and railway workshops. Population (1880), 7079 ; (1897), 8626.

Cuevas de Vera, a town of Spain in the province of Almeria, near the Mediterranean, in a plain fringed by the river Almanzora. Population (1897), 20,366. It has two fine squares, de la Constitucion and del Castillo, the latter deriving its name from the residence of the Marquesses of Villafranca, one of whose towers is said to be a Roman structure. The parish church. La Encarnar cion, dates from 1758 and is of Doric style. The town is essentially a mart for the products of mines in the Sierra Almaguera, and for tlje products of the rich agricultural districts around.

Cull era, a seaport of Spain, in the province of Valencia, 24 miles south-south-east of Valencia, on the Mediterranean at the mouth of the Jucar. In 1898 the principal imports were sulphate of ammonia, valued at £23,070, and artificial manure, valued at £2600. The return of shipping in 1898 showed that 42 vessels entered with 24,199 tons of cargoes, and 27 in ballast with 8490 tons ; 7 English vessels with 4173 tons entered. Twenty- seven Spanish vessels cleared with 8490 tons of cargoes, and 42 vessels in ballast with 24,199 tons cleared, 7 being English.

Cumberland, a north-western county of England on the Scottish border, bounded on the S.W. and W. by the Irish Sea, on the N.W. by the Solway Eirth, Dum- fries, and Roxburgh, on the N.E. by Northumberland, on the E. fcy Durham, and on the S.E. by Westmoreland and Lancashire.

Area and Population. — The area of the ancient, administrative, and registration county is given in the census returns as 970,161 acres or 1516 square miles, with a population in 1881 of 250,647, in 1891 of 266,549 (of whom 132,100 were males and 134,449 females, the number of persons per square mile being 176, and of acres to a person 3-64), and in 1901 of 266,921. The urban population (1891) numbered 150,168, and the rural 116,881. Be- tween 1881 and 1891 the percentage of increase was 6-34.

The excess of births over deaths between 1881 and 1891 was 38,597, but the actual increase of resident population was only 15,902. The following table gives the number of marriages, births, and deaths, with the number of illegitimate births for 1880, 1890, and 1898 :—

Tear.

Marriages.

Births.

Deaths.

Illegitimate Births.

Males.

Females.

1880 1890 1898

1721 1941 2017

8504 8441 7543

5153 4928 4680

347 842 281

843 396

228

In 1899 the number of marriages was 1978, of births 7660, and of deaths 4307.

The following table gives the marriage-, birth-, and death-rates per 1000 persons living, with the percentage of illegitimate births for a series of years : —

1870-79.

1880.

1880-89.

1890.

1888-97.

1898.

Marriage-rate .

Birth-rate

Death-rate

Percentage of illegitimacy

15-5

361

21-6

8-9

18-8

34-2

20-7.

8-1

13-8

33 -6

19-5

7-6

14-6

81-8

19-0

7-6

13-4

30-2

17-2

7-2

14-5

27-2

16-9

6-7

In 1891 there were in the county 11,826 natives of Scotland, 9628 natives of Ireland, and 404 foreigners.

Constitution and Government. — The county is divided into four parliamentary divisions, and it also includes the parliamentary boroughs of Carlisle and Whitehaven. It contains three municipal boroughs— Carlisle (39,176), Whitehaven (18,879), and Workington (23,490). The following are urban districts: — Arlecdon and Frizington (5697), Aspatria (2714), Cleator Moor (9464), Cocker- mouth (5464), Egremont (6258), Harrington (8535), Holme Cultram (4602), Keswick (4500), Mary port (12,536), Millom (8895), Penrith (8981), and Wigton (8965). The

county is in the northern circuit, and assizes are held at Carlisle. The borough of Carlisle has a sepa-

rate court of quarter sessions and separate commissions of the peace. The ancient county constitutes part of the archdeaconry and diocese of Carlisle, and contains 162 entire ecclesiastical parishes.

Education. — At Carlisle is a school of science and art. At St Bees there is an ancient grammar school. The Theological College of St Bees was closed in 1897. The number of elementary schools on 31st August 1899 was 286, of which 105 were board and 181 voluntary schools, the latter including 153 National Church of England schools, 1 Wesleyan, 14 Roman Catholic, and 13 "British and other." The average attendance at board schools was 22,635, and at voluntary schools 22,389. The total school board receipts for the year ending 29th September 1899 were over £85,695. The income under the Agricultural Kates Act was over £32,645.

Agriculture. — The county being mountainous, the acreage under cultivation is much below the average — only about three-fifths of the whole ; while nearly three-fifths of this acreage is in permanent pasturage. In addition, over 261,000 acres are in hill pasture and over 35,000 acres under woods. Sheep are largely kept and many cattle are reared. Of the com crops about nine-tenths are under oats, while about three-fourths of the green crop area is occupied by turnips and swedes. The following table gives particulars at intervals of five years from 1880 : —

Tear.

Total Area under Cultiva- tion.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1880 1885 1890 1895 1900

574,665 679,069 593,991 579,404 582,036

94,422 92,923 89,978 85,880 78,728

47,291 46,598 47,391 46,200 42,515

105,182 107,270 114,805 115,654 115,582

322,780 329,237 339,510 380,105 844,428

4989 8089 2129 1211 561

The following table gives the numbers of the principal live-stock for the same years : —

Tear.

Total Horses.

Total Cattle.

Cows or Heifers

in Milk or in

Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1900

20,654 20,288 20,442 22,542 21,557

132,082 189,.329 138,086 141,937 148,839

41,429 45,579 46,398 45,941 48,145

517,410 494,553 562,252 518,276 580,618

20,574 24,104 31,717 23,708 18,816

Industries and Trade.— According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 19,871 as com- pared with 19,598 in 1896. Of these 2212 were employed in textile factories. Non-textile factories employed 14,958 persons, there being between 1895 and 1896 an increase of 15-5 per cent. ; but between 1896 and 1897 a decrease of 2*5 per cent. Of these 4088 were employed in the founding and conversion, and 2087 in the extraction, of metals, the other principal industries being the manufacture of machines, appliances, conveyances, tools, &c., em- ploying 2185 persons, and food employing 1642. There is some iron shipbuilding. Of the 2201 persons employed in workshops, 1625 were employed in clothing industries. The total number of persons employed in mines and quarries in 1899 was 14,560. Within recent years the mining industries of the county have made rapid progress. Of granite 103,923 tons were raised in 1899, of limestone 524,417 tons, of clays 75,427 tons, and of sandstone 52,352 tons. There is a large production of pig iron, 687,874 tons in 1885, 832,614 tons in 1890, 648,740 tons in 1895 and 954,637 tons in 1899. The seats of the industry are Whitehaven, Work- ington, Cleator Moor, Maryport, and Millom. The following table gives particulars regarding the output of the more Important minerals in 1890 and 1899 :—

Tear.

Coal.

Gypsum.

Iron Ore.

Lead.

Zinc.

Tons.

Value.

Tons.

Value.

Tons.

Value.

Tons.

Value.

Tons.

Value.

1890 1899

1,740,418 2,100,418

£

668,094 710,991

20,864 48,868

£

5218

8772

1,480,159 1,187,760

£

894,474 838,879

2272 825

£

18,005 7,691

4869 7184

£

15,569 86,958

On account of the number of lakes, rivers, and streams, the fresh- water fisheries are of considerable importance, and include besides trout and salmon, char, pike, perch, lamprey, and eels. At White- haven, Maryport, and Morecambe the amount of fish landed in 1899 was 7766 cwt., valued at £14,241.

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Cumberland, capital of Alleghany county, Mary- land, U.S.A., situated in the mountainous western portion of the state, at an altitude of 626 feet, on the main western line of the Baltimore and Ohio railway, and on four other lines. It is on the border of the Cumberland coal-field, and through these railways, and the Chesapeake and Ohio Canal, of which it is the western terminus, it has a large trade in coal. It has rolling-mills, and other iron and steel works, glass and railway works. Population (1880), 10,693; (1900), 17,128. (t. f. h.)

Cumberland, a town of Providence county, Rhode Island, U.S.A., with an area of 27-5 square miles of hilly country. It is bordered on the west by Blackstone river, on which are several small villages, the remainder of the population being rural. Population (1880), 6445 ;

(1900), 8925.

Cumberland River, a large southern branch of Ohio river, U.S.A., rising in the highest portion of the Cumberland plateau, in eastern Kentucky. From its source it flows westwards, then south into Tennessee, thence again westwards, passing Nashville, and finally north-westwards across the western part’of Kentucky, to its mouth at Smithfield, a few miles above the mouth of Tennessee river. Its entire length is about 700 miles, of which much the greater part is navigable. Its drainage basin comprises 18,573 square miles. During the Civil War Fort Donelson was erected on the Cumberland and Fort Henry on the Tennessee by the Confederates, about 40 miles above their mouths, to prevent navigation by Federal vessels. These forts were captured by General Grant in February 1862,

with 14,000 prisoners, and the rivers were thus opened up to Federal gunboats.

Cumnock, a police burgh of Ayrshire, Scotland, 33| miles south of Glasgow by road. There is a town- hall, an athenaeum, a public library, and a monument to " Prophet " Peden, the Covenanter. Coal and ironstone are extensively mined in the neighbourhood, and there are several woollen and tweed mills in the town. The churches are Established, United Free, Congregational Union, Baptist, and Roman Catholic. The public school had an average attendance of 522 in 1898-99, and a Roman Catholic school 102. Population (1881), 3345;

(1901), 3087.

Cundinamarca, a department of the republic of Colombia, bounded on the IST. by Venezuela and the de- partments of Boyaca and Santander, on the W. by Antio- quia and Tolima, on the S. by Cauca, and on the E. by Venezuela. Area, 79,691 square miles. Population, 500,000, of whom one-fourth are whites, the rest Indians and half-breeds. The capital, Bogota, which is also the capital of the republic, has about 100,000 inhabitants. Principal towns: Zipaquird:, Facatativa, Caqueza, Fdmeque, Choconta.

Cuneo, a town, episcopal see, and capital of the province of Cuneo, Piedmont, Italy, 54 miles by rail south-south-west from Turin, on a rocky platform above

a tributary of the Tanaro, at the northern foot of the Maritime Alps. Apart from the broad arcaded main street, the streets are narrow and crooked. The chief buildings are the (restored) cathedral, the 12th-century Franciscan church, the town-hall, theatre, and military hospital. The former town walls have been converted into promenades. A monument to Barbaroux was erected in 1879. Silk-spinning, raising of cocoons, and printing are the principal industries. There is a school of the in- dustrial arts and handicrafts. Population of town, about 17,000 ; of commune, about 29,000.

Cupar Fife, a royal, parliamentary (St Andrews group), and police burgh, and the county town of Fifeshire, Scotland, on the river Eden, 45 miles

north of Edinburgh by the Forth Bridge and 16 south-west of Dundee by rail. The business of the town chiefly depends on its import- ance as an agricultural and legal centre. A handsome new Free church was erected in 1877-78. The Madras Academy having received a supplementary endowment from alegacy of Sir David Baxter is now known as the Bell-Baxter school, and is one of the five recognized higher-class schools of the county. The county buildings were en- larged in 1892-93. Population of the parliamentary and police burgh (1881), 5010; (1891), 4729; (1901), 4511; and of the royal burgh (1881), 4964; (1891),

4693.

Cura^oa or Curacao, an island in the Caribbean Sea ofE Venezuela, and the name of a government com- prising that island and its dependencies, the other Dutch West Indies — Oruba (Aruba) and Buen Aire (Bonaire), near the coast of Venezuela ; Saba, St Eustatius, and the half of St Mai'tin, in the Lesser Antilles. Total area, 630 square miles. The islands near the coast of South America consist of slate, cretaceous formations, and erup- tive rocks (diorite and diabase), forming ridges 650 to 1300 feet high, and plateaux or hills 200 to 500 feet. The islands of the Lesser Antilles are of volcanic (Saba, St Eustatius) or Tertiary (St Martin) rocks. The principal occupations are the rearing of cattle, the cultivation of fruit trees (palms), aloe, and divi-divi, and the working of salt and phosphate. The island of CuraQoa is the only one with a good port, Willemstad (population about 8000), with a total trafllc valued at £160,240 in 1899, while that for the rest of the islands amounted only to £21,300. The total population in 1898 was 51,693, of whom only 425 were born in the Netherlands. (Curaqoa, 30,119; Bonaire, 4926; Aruba, 9591; St Martin (Dutch part), 3485 ; St Eustatius, 1383 ; Saba, 2189.)

Wynmalen. " Les colonies neerlandaises dans les Antilles," Revue Colon. Internal. 1887, ii. p. 391. — K. Martin. West-Indische Skizzen. Leiden, 1887. — De Veer. La colonic de Curaqoa. Les Pays Bas, 1898. — Molengraaff. De geologic van het eiland St Eustatius. Leiden, 1886. Also several articles on all the islands in Tijdschriftv./h. Ned. Aardr. Genootschap (1888-86).

Curci, Carlo Maria (1809-1891), Italian theolo- gian, was born at Naples on the 4th of September 1809. He became a- novice of the Order of Jesuits in 1826, and was ordained priest in 1837. For some years he was stationed at the Church of the Gesii at Naples, was made rector of the schools, and also devoted himself to work among the poor and in the prisons. Here he came into close relations with Gioberti, Rosmini, and other advo- cates for reform in the Italian Church. Curci wrote a preface to Q-ioberti's PWmato, published in 1843, but he pro- tested against Gioberti's Prolegomena, and wrote against his later books in favour of reform. After the fall of the Papal Government in 1870 Curci delivered discourses on Christian Philosophy at Florence. In 1874 he published

an introduction to his Exegetical Lessons on the Gospels. In 1879 and 1880 appeared his edition of the New Testa^ ment, in the preface to which he made some severe re- marks on the neglect of the study of the Scriptures among the Italian clergy. In the meantime he had commenced the campaign against the Vatican which has made him famous. In his H Moderno Dissidio tra la Chiesa e V Italia (1878) he advocated an understanding between Church and State. In his La Nuova Italia ed i Vecchi Zelanti (1881) he inveighed against the condition of the Vatican at that period. In 1883 he published his Vaticano Regio, in which he accuses the Church of making mer- chandise of the holiest things, and declares that her worldliness was due to the false principles she had embraced. He still kept up his sympathy with the working class, and expressed it in a striking treatise on Christian Socialism, in which he invoked State inter- ference to check the inequality with which profits were shared between employer and employed. Excommuni- cated and deprived, he was reduced to beggary, and in 1884 he retracted " all that he had said contrary to the faith, morals, and discipline of the Church." He passed the remainder of his life in retirement, and died at Villa Careggi, near Florence, on 8th June 1891. (j. j. l.)*

Curico, a city of Chile, capital of the province and department of the same name, 114 miles from Santiago by rail, situated in 34° 58′ S. lat. and 71°

19′ W. long. Population, 15,000.

Curitiba, a city of Brazil, and capital of the state of Parana. The population is 20,000, of whom over 12,000 are foreign-born (4000 Germans, 4000 Italians, 2000 Poles, and from 2000 to 3000 Portuguese, Spaniards, &c.). Nearly all the wholesale trade is in the hands of Germans. In the vicinity of Curitiba are prosperous colonies of Italians, Germans, Poles, &c.

Curling, Thomas Blizard (1811-1888), British surgeon, was born in London in 1811. Through his uncle, Sir William Blizard, he became assistant-surgeon to London Hospital in 1833, becoming full surgeon in 1849. After filling other important posts in the College of Surgeons, he was appointed President in 1873. In 1843 he won the Jacksonian prize for his investigations on tetanus ; and he became famous for his skill in treat-ing diseases of the testes and rectum, his published works on which went through many editions. He died on 4th March 1888.

Curtea d'Argesh, a town in Rumania, on the southern slopes of the Carpathians (population in 1900, 4210), north-west of Pitesti, connected by railway with Bucharest. It derives its name from Courtea (the Court), having been the residence of Radu Negru early in the 13th century. It contains two interesting churches, one of which was constructed by Radu himself. About 1^ miles north of the town is the cathedral, a magnificent and unique specimen of Byzantine art. There are myths connected with its foundation, which have been put into beautiful and pathetic verse by the Rumaniau poet, B. Alexandri, but as a matter of fact it was constructed by the Prince Nagul Bassaraba, who governed Wallachia from 1512 to 1622, and who studied architecture while a hostage at Constantinople at the court of the Sultan Selim. Aided by another architect, Manoli, he erected this cathedral, which was completely reconstructed with great taste and success at the expense of the Rumanian Government between 1875 and 1885, under the direction of a French architect, M. Lecomte de Nouy. It was recon- secrated with great pomp in the presence of the king on 12th October 1886.

Curtis, Ceorge Ticitnor (1812-1894), American legal writer and constitutional historian, was born in Watertown, Massachusetts, 28th

November 1812. He graduated at Harvard University in 1832, became a lawyer, and practised his profession in Boston, New York, and Washington. He was the nephew and close friend of George Ticknor, the historian of Spanish literature, and his association with his uncle was influential in developing his scholarly tastes ; while his other personal friendships with eminent Bostonians during the period of conservative Whig ascendancy in Massachusetts polities were of direct influence upon his political opinions and published estimates. After preparing a number of law- books, one of which — on the Rights and Duties of Merchant Seamen — elicited the hearty praise of Mr Justice Story, he issued in 1855-58 the first of the two works upon which his place in literature depends: A Histoi-y of the Origin, Formation, and Adoption of the Constitution of the United States, with Notices of its principal Framers. "This history, which had been watched in its earlier progress by Daniel Webster, may be said to present the old federalist or " Webster- Whig " view of the formation and powers of the constitution ; and it was natural that Mr Curtis should follow it with a voluminous Life of Daniel Webster (2 vols., 1870). Both these works were characterized by solidity and comprehensiveness rather than by rhetorical attract- iveness or literary perspective. In his later years Mr Curtis, like so many of the followers of Webster, turned towards the Democratic party ; and he wrote, among other works of miaor importance, an exculpatory life of President James Buchanan (2 vols., 1883) and two vindications of General George B. M'Clellan's career (1886 and 1887). He died in New York, 28th March

1894.

Curtis, Ceorge William (1824-1892), American man of letters, was born in Providence, R.I., 24th February 1824. He came of old New England stock, and at the time of his birth the New England community was at its best. His mother died when he was two years old. At six he was sent with his elder brother to school in Jamaica Plain, Mass., where he remained for five years. Then, his father having again married happily, the boys were brought home to Providence, where they stayed till, in 1839, their father removed to New York. Three years later, Curtis, being allowed to determine for himself his course of life, and being in sympathy with the spirit of the so-called Transcendental movement, became a boarder at the

community of Brook Farm. He was accompanied by his brother, whose in- fluence upon him was strong and helpful. He remained there for two years, brought into stimulating and service- able relations with many interesting men and women. Then came two years, passed partly in New York, partly in Concord, in order mainly to be in the friendly neigh- bourhood of Emerson, and then followed four years spent in Europe, Egypt, and Syria. Curtis returned from Europe in 1850, handsome, attractive, accomplished, am- bitious of literary distinction. He instantly plunged into the whirl of life in New York, obtained a place on the staff of the Tribune, entered the field as a popular lecturer, set himself to work on a volume published in the spring of 1851, under the title of Nile Notes of a Howadji, and became a favourite in society. He wrote much for Put- nam^ s Magazine, of which he was associate editor ; and a number of volumes, composed of essays written for that journal and for Harper's Monthly, came in rapid succession from his pen. The chief of these were the Potiphar Papers, a satire on the fashionable society of the day ; and Prue and I, a pleasantly sentimental, fancifully tender and humorous study of life. In 1855 he married Miss

Anna Shaw. Not long after his marriage he became, through no fault of his own, deeply involved in ~~*debt owing to the failure of Putnam's Magazine; and his high sense of honour compelled him to devote the greater part of his earnings for many years to the discharge of obliga*~~ *tions for which he had become only by accident re- sponsible, and from which he might have freed himself by legal process. In the period just preceding the Civil War other interests became subordinate to those of national concern. Curtis made his first important speech on the questions of the day at Wesleyan University in 1856 ; he engaged actively in the Presidential campaign of that year, and was soon recognized not only as an effective public speaker, but also as one of the ablest, most high- minded, and most trustworthy leaders of public opinion. In 1863 he became the political editor of Harper's Weekly, and no other journal exercised during the war and after it a more important part in shaping*

public opinion. His writing was always clear, direct, forcible ; his fairness of mind and sweetness of temper were invincible. He never became a mere partisan, and never failed to apply the test of moral principle to political measures. From month to nionth he contributed to Harper's Monthly, under the title of " The Easy Chair," brief essays on topics of social and literary interest, charming in style, touched with delicate humour, and instinct with generous spirit. His service to the Republican party was such, that more than once he was offered nominations to office of high distinc- tion, and might have been sent as Minister to England ; but he refused all offers of the kind, feeling that he could render more essential service to the country as editor and public speaker. In 1871 he was appointed by President Orant chairman of the Commission to report on the reform of the Civil Service. The report which he wrote was the foundation of every effort since made for the purification and regulation of the Service and for the destruction of political patronage. From that time till his death Mr Curtis was the leader in this reform, and to his sound judgment, his vigorous presentation of the evils of the corrupt prevailing system, and his untiring efforts, the progress of the reform is mainly due. He was the Presi- dent of the National Civil Service Reform League and of the New York Civil Service Reform Association. In 1884 he refused to support the nomination of Mr Blaine as candidate for the Presidency, and thus broke with the Republican party, of which he had been one of the founders and leaders. From that time he stood as the typical independent in politics. In April 1892 he de- livered at Baltimore his eleventh annual address as President of the National Civil Service Reform League, and in May he appeared for the last time in public, to repeat in New York an admirable address on James Russell Lowell, which he had first delivered in Brooklyn on the 22nd of the preceding February, the anniversary of Lowell's birth. On the 31st of the following August he died. He was a man of consistent virtue, whose face and figure corresponded with the traits and stature of his soul. The grace and charm of his manner were the ex- pression of his nature. Of the Americans of his time few were more widely beloved, and the respect in which he was held was universal.

See -.—George William Curtis, by Edward Gary, in the series of Lives of American Men of Letters (Boston, 1894) ; an excellent biography.— " An

Epistle to George William Curtis," by James RcssELL Lowell, 1874-87. In Lowell's Poems.— George William Curtis, a Commemorative Address delivered before The Cen- tury Association, 17th December 1892, by Pakke Godwin. New York, 1S93.— Orations and Addresses by George William Curtis, edited by Charles Eliot Norton, 3 vols., 8vo. New YoKk, 1894.

' (C. E. N.)

Curtius, Ernst (1814-1896), German archaeologist and historian, was born at Liibeck on 2nd September 1814. On completing his university studies he was chosen by Professor Brandis to accompany him on a journey to Greece for the prosecution of archaeological researches. Curtius then became Otfried Mtlller's companion in his exploration of the Peloponnesus, and on MuUer's death in 1840 returned to Germany. In 1844 he became an extraordinary professor at the University of Berlin, and in the same year was appointed tutor to Prince Frederick William (afterwards Emperor Frederick III.) — a post which he held till 1850. After holding a professorship at Gottingen and undertaking a further journey to Greece in 1862, Curtius was appointed in 1863 ordinary professor at Berlin. At the same time he became Secretary of the Royal Academy of Science, of which he had been a member since 1853. In 1874 he was sent to Athens by the German Government, and concluded an agreement by which the excavations at Olympia were entrusted exclu- sively to Germany. Among the results of these excava- tions was the discovery of Praxiteles' famous statue of Hermes. He died at Berlin on 11th July 1896. Curtius' best-known work is his History of Greece (1857-67 ; English translation by A. W. Ward, 1868-73). It pre- sented to the public in an attractive style the latest results of scholarly research, but was criticized as wanting in erudition. His other writings are chiefly archaeological. The most important are : Die Akropolisvon Athen (1844) ; Naxos (1846) ; Peloponnesos, eine historisch-geographische Beschreibung der Halbinsel (1851) ; Olympia (1852) ; Die lonier vor der ionischen Wanderung (1855) ; Attische Studien (1862-65) ; Gottinger Festreden (1864) ; Sieben Karten zur Topographie von Athen nebst einem erldu- temden Text (1868) ; Ephesos (1874) ; Die Ausgrahungen zu Olympia (1877, etc.) ; Olympia. und Umgegend (edited by Curtius and

Friedrich Adler, 1882) ; Olympia, Die Ergebnisse der von dem Deutschen Begierung veranstalteten Ausgrabung (also with F. Adler, 1890-98) ; Die Stadt- geschickte von Athen (1891). His collected speeches and lectures were published in 2 vols, under the title of Altertum und Gegenwart (1875 and 1882), to which a third volume was added under the title of Unter drei Kaisern (1889).

His brother, Geoeg (1820-1885), philologist, was born at Lubeck on 16th April 1820. After an education at Bonn and Berlin he was for three years a schoolmaster in Dresden, until (in 1845) he returned to Berlin University as privat-docent. In 1849 he was placed in charge of the Philological Seminary at Prague, and two years later was appointed Professor of Classical Philology in Prague University. In 1854 he removed from Prague to a similar appointment at Kiel, and again in 1862 from Kiel to Leipzig. His philological theories had a widespread influence upon the study of that science. The more important of his publications are : Sprachvergleichung in ihrem Verhdltniss zur classischen Philologie (1845), Sprachvergleichende Beitrdge zur griechischen und latein- ischen Gframmatik (1846), Grundziige der griechischen Etymologie (1858-62), Das Verbum der griechischen Sprache (1873). From 1868 to 1878 he was general editor of Studien zur griechischen und lateinischen Cham/- matik, and, from 1878 till his death, of a similar publica- tion entitled Leipziger Studien zur classischen Philologie. His Greek Grammar for Schools, first published in 1855, passed through a number of editions, and has been edited in English. He died at Hermsdorf on 12th August

1885.

Curzola, chief town of the Adriatic island of the same name in the Austrian province of Dalmatia. The

principal resources of the population are boat-building, fishing, and seafaring, the cultivation of the vine, corn, and oil, and breeding of mules. Population of island, 18,749 ; of town, 6486.

Gushing, Caleb (1800-1879), American statesman, ■was born in Salisbury, Mass., on the 17th of January 1800. He was graduated from Harvard in 1817, and began the practice of law in Newburyport. After serving in each house of the State legislature he was a representa- tive in Congress from 1835 to 1843. Originally a Whig, he supported President Tyler, and gradually became associated with the Democrats. As Commissioner to China he negotiated the first treaty between that coun- try and the "United States. He raised a regiment for the Mexican war, and rose to the rank of brigadier- general. During the administration of President Pierce he was Attorney-General of the United States. In 1860 he associated himself with the Breckinridge wing of the Democratic party. In 1866 he was appointed one of the three commissioners to revise and codify the laws of Congress. In 1868 he was sent on a diplomatic mission to Bogota. At the Geneva Conference for the settlement of the Alabama claims he was one of the counsel for the United States. In 1873 he was nominated Chief Justice of the United States, but the nomination was not con- firmed. From 1874 to 1877 he was United States minis- ter to Spain. He died at Newburyport, Mass., on the 2nd of January 1879.

Cushman, Charlotte Saunders (1816-1876), the famous American actress, was born of New England stock in Boston, Mass., 23rd of July 1816. She went on the opera stage in 1834 in consequence of her father's financial failure and death, successfully appearing as the Countess Almaviva in The Marriage of Figaro. Her voice failing for purposes of singing, she took to the dramatic stage, playing Lady Macbeth (1835) with dis- tinction. Convinced that she had not served a proper apprenticeship, she engaged herself as a stock actress, but was soon given the leading parts, among them high comedy impersonations. In 1844 she accompanied Macready on an American tour, winning great reputa^ tion in a series of tragedy parts. In 1844 and in 1853 she played successful engagements in London. She was a keen student, and acquired a large range of classic rdles. Her best parts were perhaps Lady Macbeth and Queen Catherine, her most popular being Meg Merrilies. Her figure was commanding and her face expressive, and she was animated by a temperament full of vigour and fire. These qualities enabled her to play with success such male parts as Eomeo and Cardinal Wolsey. She died at Boston on the 18th February 1876.

See also Charlotte GusJ^man, her Letters and Memories of her Life. Edited by Emma Stebbins. Boston, 1878.

Cusset, a town in the arrondissement of Lapalisse, department of Allier, France, 31 miles south by east of Moulins, with station (2 miles distant) on railway to Vichy. It is situated at the confluence of the Sichon and Jolan, two small affluents of the Allier, and 2 miles north-east of Vichy, with which it is connected by a beautiful avenue. Its mineral waters are renowned, and its industries include paper, linen, oil, and basket-work. The town grew up around a convent founded in 886, and afterwards, in the 13th century, converted into an abbey of St Benoit. Louis XI. improved and fortified the town. A relic of that period is the Grosse Tour, now used as a prison. The fortifications have been replaced by boulevards, but many of the older houses exhibit the architectural features of the 15th and 16th centuries. Population (1881), 4955; (1901), 6444.

Custer, George Armstrong (1839-1876),

American soldier, was born in New Rumley, Ohio, on 5tli December 1839. After graduating at the U.S. Militaiy Academy in June 1861, he entered at once the Union service early in the Civil War. As a young cavalry offi- cer he impressed General M'Clellan, who in May 1862 appointed him an aide-de-camp with the rank of captain. Under General Pleasanton and General Sheridan he sub- sequently rose rapidly, both in volunteer and regular rank, while the Virginia operations lasted. He partici- pated in all but one of the battles of the Army of the Potomac, led the cavalry division in pursuit of Lee's army, 1865, received its first flag of truce, and was pre- sent at the surrender at Appomattox Court House. At the age of twenty- five he was major-general of volun- teers. After the war he engaged in service on the Western frontier. In an expedition against the Indians he and his entire command were massacred, after a des- perate struggle, on 25th June 1876, by an overwhelming hostile force. Both Custer and his wife wrote interest- ing books descriptive of Indian frontier life.

Giistrin, a town of Prussia, at the confluence of the Oder and the Warthe, 18 miles north by east of Frank- furt ; three railway stations. It has three Protestant churches, a Catholic church, a gymnasium, a higher grade

and a burgher school, a school for mechanics, four ma^ chinery works, and other manufactures. Population

(1890), 16,672 ; (1900), 16,463.

Cutch (Kachh), a native state of India, within the Gujarat division of Bombay, with an area of 6500 square miles. In 1881 it had a population of 512,084, and in 1891 of 558,415, giving an average density of 86 persons per square mile. In 1901 the population was 487,384, showing a decrease of 13 per cent., due to the famine of 1899-1900, compared with an increase of 9 per cent, in the previous decade. The estimated gross revenue is Ils.25,21,670 ; the tribute for a subsidiary force amounts to Es.2,00,000. There are special manufactures of silver filigree-work and embroidery. The maritime population supplies the best sailors in India. In 1897-98 the im- ports by sea were valued at Es.66,69,273, and the exports at Es.21,35,605 ; the customs duties amounted to Rs.8,17,000. There are ten cotton presses and two gin- ning factories. The number of police was 826; the num- ber of schools was 134, with 7142 pupils, being 2-23 per cent, of the population. The chief institutions are a high school and a school of art, both at Bhuj, the capital. There are seven libraries in the state, with 7246 books. Cutch suffered severely from the recent plague.

Cuttack, a town and district of British India, in the Orissa division of Bengal. The town is situated at the head of the delta of the Mahanadi. Population (1881), 42,676; (1891), 47,186. It is the centre of the Oris:=a canal system, and now an important railway station on the East Coast line from Madras to Calcutta. It con- tains the Government college, called after Mr Raven- shaw, a former Commissioner ; a high school, with 265 pupils ; a training school ; a survey school ; a medical school, with 112 students, of whom 5 were women ; a law school; six printing-presses; three vernacular periodi- cals ; a Baptist mission ; and a Roman Catholic convent.

The DISTRICT OF OuTTAOK lies in the centre of Orissa, occupying the deltas of the Mahanadi and Brahmani, to- gether with a hilly tract inland. Its area is 3633 square miles. The population in 1881 was 1,795,065 ; in 1891 it was 1,937,681, giving an average density of 533 persons per square mile. Classified according to religion, Hindus numbered 1,881,913

; Mahommedans, 52,895 ; Christians, 2733, of whom 128 were Europeans ; " others," 140 In 1901 the population was 2,059,719, showing an increase

of 6 per cent. The land revenue and rates were Es.10,32,983 ; the number of police was 671 ; the num- ber of boys at school in 1896-97 was 55,351, being 39-2 per cent, of the male population of school-going age ; the registered death-rate in 1897 was 33-39 per thousand. The Orissa canal system, which lies mainly within Cuttack district, irrigated in 1897-98 an area of 200,943 acres, and carried 646,766 tons of cargo. The gross receipts amounted to Es.5,51,924, showing a net profit of Es.12,005. The railway across the district towards Calcutta was opened in 1899. Considerable trade is carried on at the mouth of the rivers along the coast, the principal port being near the lighthouse at False Point. In 1897-98 the value of the exports (mostly rice) was Es.26,76,728 for foreign and Rs.1,50,452 for coasting trade. The imports are insignificant.

Cuttle-fish. — The Cuttle-fish, whose general anat- omy has already been described in the 9th edition of the Ency. Brit., are classed in the sub-kingdom Mollusca on account of their bilaterally symmetrical, unsegmented bodies, their possession of a fleshy integument, or " mantle," and of a muscular " foot," and the ar- rangement of their nervous centres in three pairs of ganglia. They are placed in the cephalous division on account of their having a distinct head, and a buccal cavity lined in almost all cases by a toothed lin- gual ribbon or " odontophore." Within this division they are sharply marked off as an anciently developed distinct class by the following characters. In the earliest stage of their growth a part only of the germinal substance of the ovum is seg- mented, instead of the whole, as is com- monly the case in other molluscs. They are provided with strong parrot-like horny jaws surrounded in the Octopods by eight, and in the Decapods by ten, sucker-bearing arms ; their brain is encased in cartilage ; their eyes are enormous ; and on their ven- tral side is an ejecting siphon or funnel, at the base of which lies the ink-bag. These characters combine to make

them the most active, intelligent, and predaceous of all the marine invertebrates.

The class Cephalopoda, of which the gen- eral characters are thus indicated, includes as a distinct group the members of the Pearly Nautilus Order, which differ only in the living animals by minor peculiarities, as follows: — They are protected by an external camerated shell ; their jaws are calcareous and of different form ; their arms are in lobes, with clinging tentacles in place of suckers ; their siphon is not a complete tube, and there is no ink-bag ; their eyes have no lens, but only a pin-hole aperture ; and they have four branchiae instead of two, each of which is provided with a sense-organ or osphradium, but there are no branchial hearts. These characters indicate a less active and intelligent animal, and one less removed by development from the primitive type of the class. The number of the branchise has been used for the purpose of nomenclature, so that while the Nautilus Order belongs to the Tetrabranchiata, the Cuttle-fish Order belongs to the Dibranchiata. Besides these two orders there is an immense number of fossil forms, of whose branchiae nothing is ever likely to be known, and they have accordingly been sometimes classed as Tetrabranchiates and sometimes as Dibranchiates, but they ought rather to be called Ignoto- branchiates. Much discussion has taken place as to the true homo-

logy of the arms and their relation to the head of the Cuttle-fish. The majority of naturalists consider the arms to be part of the ” foot,” which has grown up so as to surround the mouth, because they originate at the same part of the embryo as does the foot of a snail, and are innervated from a ganglion corresponding in its connex- ions with the pedal ganglion. In this view the siphon and its appendages form the remainder of the foot, and the animal is represented, for comparison, as standing with its head downwards and its body obliquely upwards. Others consider the siphon to represent the whole of the foot, and the arms to be organs special to the class. The origin of the arms in the development of the embryo is certainly very distinct at first from that of the siphon.

The number of distinct forms now included amongst existing Cuttle-fish is very large, the latest census giving 464 species. These may be described

as cluster- ing principally round certain well-known types, as the Octopus or Poulpe, the Sepia or Squid, and the LoUgo or Calamary, with a few specially isolated and interesting forms. Of these latter may be enumerated the CirroteutJiis and the OpisthoteutJus, which are finned Octopods in which no odontophore has been found, while

Recent forms.

‘■■P,l

Fib. 1.— The Argonaut in life. (After Lacase-Duthiera.) Tr, float ; £r.a, anterior arms ; £r.p, posterior arms ; V, the expanded portion of them, once called the sails ; £, the C, the shell ; JS!n, the funnel.

their arms are webbed together like an umbrella ; and the latter has its siphon directed backwards. These are prob- ably retrograde forms. Others are the Argonauta and the Spirula, on which of late years fresh light has been thrown. Of the Argonaut many fables have been told as to its position in the shell, and its mode of progression, but in 1892 Lacaze-Duthiers had an opportunity of watch- ing the living animal for a fortnight (Fig. 1). It forsakes its shell in adverse circumstances, but enters it again under favourable conditions. The front edge of the shell is then kept nearly vertical, and the early part of the coil encloses air which serves as a float. The funnel projects in front below, and the beak above, the eye. The broad pair of arms embrace only the hinder part of the shell, leaving the front part uncovered, and the other arms in swimming are tucked inside the shell between it and the body.

A well-preserved specimen of the animal of the Spirula, as obtained by the Challenger Expedition, has been described by Pelseneer. The shell is naked and exposed both on the front and back of the animal, and coils towards the ventral side, on which the siphuncle lies. The mantle sac at first

Nautilus.

CLASSIFICATION OF CUTTLE-FISH AND THEIR

Spirula. Sepia. Onychoteuthis. Lollgo.

OigopsidsB. Myopsidse.

§ 1

. TETRABRANCHIATA.

DIBRANCHIATA.

^= I Aturia.

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Spirulirostra. Sepia.

Belosepia.

Cretaceous.

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Belemnitella.

Actinocamax.

Belemnites. Conoteuthis.

Plesioteuthifl.

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Belemnoteuthi

Xiphiteuthis.

Belemnitids.

Coccoteuthis.

Plesioteuthis.

Jurassic.

Sepiophoba.

3.

Acanthoteuthis.

Geoteuthia. Teuthldae.

Chondeophoea.

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Ortho

jeraa.

Aulacoceras. Ftiragmoteuthis. Pheagmopuoea.

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DECAPODA.

BELEMNOIDEA.

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Discites.

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Poterioceras.

Actinoceras.

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^ ***Gyroceras.***

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Bactrites.

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LIPOPROTOCONCHIA.

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L Naati

Gyroceras. Piu-agmoceras. ^ ^ Ascoceras. 1 idse. Gompboceratidse. |

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Trochoceraa.

Cyrtocera

^ Lltuites.

Orthoceratidse.

Actinoceratidae.

PUoceras. Endoceratidie.

HAPL09IPH0NIDA.

META8IPH0NIDA.

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Cyrtocera

i.

Orthoceras.

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NAUTILOIDEA.

Note.— This cbArt is to be read as if placed on a cylinder,

only covers the chamber adjacent to it, but afterwards grows over the sides and coalesces below. At the base is a flat depressed disc, which is not a sucker, but may be a pad, to prevent shocks in swimming backwards. At the sides hang two fins which are parallel to each other, in the direction from back to front and not in one transverse line behind. The ovary lies against the right-hand side of the coil of the shell and the oviduct against the left, and the last chamber is occupied by part of the liver. The eyes are on peduncles sunk below the level of the head, but are not covered, as in higher groups. The Spirula thus represents an early stage in the development of the Order. The shells of the Cuttle-fish Order,on which we principally depend for our knowledge of their relations to fossil forms, are not in great variety at the present day, but the Spirulorshell itself sufiices to connect them on the one hand with the Pearly Nautilus, and on the other with an infinite series of extinct allies. The

Extinct forms.

Spirula, like the Nautilus, has its shell in the form of a conical tube, coiled in one plane and divided by cross parti- tions— the ” septa ” — into chambers connected by an inner tube — ^the ” siphuncle.” Fossils showing these same general characters can be traced back to the earliest fossiliferous or Cambrian strata. Withthese, as the primitive ancestors, the history of the Cuttle-fish commences. These earliest forms of shell are, as might be expected, very simple. The tube is oval or round, the coiling is slight {Gyrtoceras), or absent {Orthoceras), the s^pta mere shallow basins, the siphuncle a simple narrow tube with no fixed position, and the ornam ents no more than lines of growth. In the later history we find one after another of the several elements becoming a centre of variation, till fixity is reached, or the element, or even the shell itself, is dispensed with. The first element to vary was the siphuncle, the complexity of which gave rise to such early genera as Eridoceras, Piloceras, and Actinoceras, forming a separate group, IVIetasiphonida, the remainder

C U T T L E-F I S H

ALLIES DURING SUCCESSIVE EPOCHS.

Octopodidee. Argonauta,

(inc. Leioglosba).

Argonauta.

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Paleeoctopus.

OCTOPODA.

T Baculites. I Hamites. HopUtes.

Acanthoceras. Paohydiseus, Schloenbachia. Fhylloceras.

Neolobites. FlacentleeraB. TisBotia.

Hoplites,

Aspidoceras,

Lytoceras.

Crloceras. Cardioceras. PeriBphinctes.

CoBmoceras. Hecticoceras. Ochetoceras. Stephanoceras.

Harpoceratidse. Amaltheidae. FhylloceraB.

Bchlotheimia. Arietids. iBgoceras.

Lttooebatida. Cosmocebatida.

Arietida.

^OOOEBATIDA. PhYLLOOEBATIDA.

ANGU8TISELLATI.

Trachyceratidse. Balatonitidffi.

Geratitidee.

Monophyllites. Arcestidae. Finacoceras. Sageceras.

TEACHT08TEACA.

LEIOSTEACA.

DlnarlteB.

TIrolites.

Proleoanltas.

‘ ‘ Goniatitidffi. ‘ ‘ Perioyolus.

Popanoceras.

Cyclolobus.

Medlioottia. -]

DATISELLATI. ‘

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Prolecanltes.

Anaroestes. ‘

Beloceras.

Clymenia. ■

AMMONOIDE.

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SOSIPROTOCONCHIA.

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like a map of the World on Mercator's projection.

being Haplosiphonida. This condition of things con- tinued to the Carboniferous period, after which no complex siphuncles are known ; the organ then became insignifi- cant, and is finally lost in all the recent Cuttle-fish except the Spirula. The position of the siphuncle was variable at first, and in those forms which are the special ancestors of the Nautilus it continued to be so. But in Devonian times a cleavage of the class took place, and a new group was developed, in which the siph- uncle is permanently pushed to the ventral side in the adult, where it is also now found in the archaic Spirula. This group is also characterized by having a thin and fragile shell, and by the peculiarities of the initial chamber or protoconch, which is of globular form, has a restricted neck, and contains the commencement of the siphuncle at its centre, as seen in Spirula. We thus obtain two great subdivisions of the Class: on the one hand the Nautiloidea, presumably tetrabranchiate and

certainly less progressive; on the other, the remaining Cephalopoda then existing. The only collective name yet suggested for this new group, unless we assume them all to have belonged to the Dibranchiata, is the Sosipboto- CONCHIA of Bather, who calls the JTautiloids at the same time LiPOPEOTOooNCHiA. As the Cuttle-fish proper must have descended from these Sosiprotoconchia, we need follow the Nautiloids no more.

Within- the Sosiprotoconchia there was soon a new and fundamental cleavage dependent on the variation of the coiling. On the one side are the Belemnoids, which have practically no coiling at all, and whose fragile shells are protected, if at all, by a massive external guard, while their septa remain simple; on the other side are the Ammonoids, 'whose, globular protoconch is closely enveloped by the later coils, which often overlap each other and whose septa become complex, their surface being partially convex forwards, and their edges or " sutures" folded or wrinkled.

Both, these modifications seem adapted to give greater strength in relation to a more active life.

The modern Decapod Cuttle-fish are undoubtedly the descendants of the Belemnoids. The earliest of these be- long to Triassic times where they are known as Aulacoceras, Atractites, and Phragmoteuthis. It is very probable that there were earlier, as yet undiscovered, representatives, and that a cleavage had already taken place, for in the succeeding, Liassic, period a new group is well established. In this group, the ChondropJiora, all signs of the original septate shell are lost, and the protecting pen, now horny, alone is left. The genera, known as Tetidopsis, Beloteuthis, GeoteutMs, &c., differ in little beyond their broader pens from the modern Calamaries, so that they rapidly attained their acme of development, and then remained stationary. The other group, the Phragmophora, developed the Belemnites proper. These retain throughout their whole developmWt the original thin shell — or " proostracum," its internal septa and siphuncle forming together the " phragmocone." It is the guard that changes, either in form or markings. It is very feeble in Belemnoteiithis and said to be absent in Conoteuthis ; it commences to be absorbed in Belemnitella, and is caducous in Actinocamax. So far we are on safe ground, for the Belemnites were certainly Cuttles, since their guard is known to have been internal, by its

earlier layers being enveloped by the later ones ; and further, they are found with the guard in position at the extremity of a perfectly outlined body with characteristic fins, ten arms with hooks, ink-bag, and eyes.

The history of the divergence from the general Belemnoid type into the two branches represented respectively by the Spirula, with phragmocone and no mucro (or modified guard), and the Sepia, with mucro and no phragmocone (unless the cancellous tissue represent it) , is obscure. For the only possible suggestion for an ancestor of the former would be the doubtful Conoteuthis, and the latter is said to have a near ally in Coccoteuthis of the Solenhofen limestone. Both of these are anterior to the disappearance of Belemnites, so that it is not certain whether the latter have been modified into, or superseded by, the representatives of the modem Cuttles. Nor is it clear whether the peculiar cancellous substance in the Sepia represents a series of modified septa, or of special shell layers. Each lamella is supported by sinuous partitions rising vertically from the one below, and these appear to spread out horizontally at intervals and coalesce to form tiie new lamella, the whole being calcified in horizontal layers. The spaces bounded by the calcified partitions and the lamellae are occupied in the very fresh shell by a number of thin walled, apparently empty, cells in two or more horizontal layers, whose adpressed walls give the appearance of free membranes, but these are without regularity. It is probable that these secrete some gas, so that the lamellae coincide in function, if not in origin, with the septa of a phragmocone.

The history of the Ammonoids, including their probable modern representatives, the Octopods, is more complex. In this group the first element to form a centre of varia- tion was the septum, and its outline the suture. This variation in the early stages of growth has been made the basis of Branco's classification into the Asellati, Latisellati, and Angustisellati ; in the later or adult stages it gives the principal generic characters of the Goniatite and Ceratite groups, and of those remarkable forms of the Trias in which it reaches its acme of complexity, as in Sageceras, Pinacoceras, and the Arcestidoe. After this, the Ammonoids settle down into a "normal" type of suture, which, though showing abundant differences of detail, can all be described, without straining, as

modifi- cations of a definite arrangement of ” lobes ” and ” saddles.” The centre of variation next passes to the build and ornament of the external shell. Whilst the sutures were the principal seat of variation the shells remained smooth — Leiostraca; now they became ornamented or rough — Trachyostraca ; doubtless this, on the principle of cor- rugated iron, made them stronger and less dependent on their septa. From these latter the majority of the later

Ammonoids have descended, the genera depending prin- cipally upon the build and ornaments, so called, of the shell; till in Cretaceous times their abnormal forms, Hamites, Baculites, &c., indicate their decadence and presage their disappearance. Other abnormal forms have, however, appeared at various epochs of Ammonite history.

What became of the Ammonites ? and whence are the Octopods derived? are two correlated questions on which more light is desirable. The wide distribution of Ammonites in all latitudes and in all varieties of strata, shows that neither change of tem- perature nor of circumstance can have caused their extinction. The forward convexity of their septa suggests the secretion of gas at great depths which expanded as they rose to the surface before the last septum was fully formed. In this case they must have been pelagic animals, and therefore have been superseded by other pelagic animals performing their function more eflSciently — such as more highly developed members of the same class.

It is now known that Octopods were actually in existence in the Cretaceous period, thus overlapping the

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Fig. 2. — PalcBoeiopue K&uiboldi^ the oldest Octopod known. From the Cretaceous rocks of Lebanon. {After H, Woodward.)

Ammonoids in time, since a member of that group, the PalcBoctopus (Fig. 2), has left an impression of its body, head, arms, and two fins, as in the Pinnoctopus, on rocks of that age in the Lebanon. This was naked, so

that in part of the group the shell was already dispensed with. On the other hand we have in the living Argonaut an Octopod whose shell has a great external resemblance to

that of an Ammonite, particularly to such an early type as the Trachyceras, or late type as the Hoplites.

It has usually been considered, but not without yarious protests, that this resemblance is superficial only, since there are no septa, and the shell has been supposed to be the product of the arms which partially embrace it. That such is not the case has been shown by Steinmann, and can be easily verified on the shell itself. The most solid part is a transverse bar, projecting from either side of the apex and spreading out in a double fold over its surface. It is actually inaccessible to the arms, and cannot be produced by them. This bar passes insensibly into the remainder of the shell, which consequently has the same origin. This is composed of two principal layers. The inner layer is a comparatively thin basement membrane, irregularly folded and thickened by calcareous matter in irregular lines running parallel to the margin of the shell, and in no way interrupted in passing from one side to the other of the median line. The outer layer, which has a tendency to split into two parts, consists of very fine vertical rods, arranged as in a pile carpet, which readily coalesce and are calcified into the solid shell. It is these two layers that are produced by the mantle. Besides these there is a thin amorphous periostracum, often coloured with a brownish tint and rough on the surface from the sporadic deposit of calcareous particles. This is found only on the outside of the shell where it is covered by the arms, that is, it is wanting near the margin and for some distance oni either side of the median line.

The relation of this shell to the animal is similar to that of the Nautilus, and thus presumably of the Ammonite also, and different from that of the Sepia, inasmuch as the outer part of it lies on the siphonal or ventral side of the mouth ; while in the Sepia it lies on the antisiphonal or dorsal side. Such is the evidence at present available for the view that Octopods are

descended from Ammonites which have dispensed with their septa, or with their entire shell. On the other hand is the fact that no ink-bag has ever been found in association with an Ammonite.

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(j. F. BL.)

Cuxhaven, a seaport town of Germany, belonging to the state of Hamburg, and situated at the extremity of the west side of the mouth of the Elbe, 71 miles by rail north-west from Hamburg. A new harbour was made in 1891-96, having an area of 71,800 square yards and a depth of 26J feet, with a fore port 1000 feet long by 800 feet wide ; and it is now the place of departure and arrival of the mail steamers of the Hamburg-American Steamship Company, who in 1901 transferred here a part of their permanent staff. The port is free, i.e., out- side the Customs Union {Zollverein), and in 1899 was entered by 331 vessels of 73,090 tons ; the imports being principally coals, bricks, and timber, and the exports fish. There is a fishing fieet, for which a new harbour was opened in 1892. Population (1900), 6898.

CuzcO| the largest department of Peru, with an area of 156,270 square miles and a population of 438,646. It contains twelve provinces — Convencidn, Urubamba, Talca, Puacartamba, Anta, Cuzco, Quispicanchi, Paruro, Acomayo, Chumbivilicas, Canas, and Canchis. The capital, Cuzco, has a population of 30,000.

Cyciades. See Greece {Ionian Islands).

Cycling. — The history of the pastime, the sport, and the trade of cycling really begins with the year 1885. The method of self-propulsion upon two, three, or four wheels —bicycles, tricycles, or multicycles — has been practised.

with more or less perseverance, for at least a hundred years. But before 1885 its votaries were either athletes, or persons carried away by a temporary craze ; either venture- some pioneers, balancing and propelling themselves, with varying degrees of speed and uncertainty, upon " bone- shakers" and "ordinaries," tall bicycles, or the timid, sometimes the comfort-loving, who rode tricycles, veloci- pedes, or multicycles. Had it not been for the practical and commercial introduction of the safety bicycle, brought out by J. K. Starley, of Starley and Sutton, in 1885, cycling would never have gained its popularity or become

Fio. 1.— Gentleman's Hobby Horse, 1816-80.

a universally recognized method of locomotion. The invention of the safety bicycle is claimed by numberless inventors. From 1818, the year of the craze for the Draisnene of Baron Drais de Saverbrun of Mannheim, who propelled his bicycle by half-sitting, half-standing upon a bar fitted with a saddle, connecting two equal-sized wheels, with a handle in front for steering and also for rest, and by pushing with his toes which just touched the ground, until 1840 and 1846, when Kirkpatrick Macmillan, a blacksmith of Dumfriesshire, and Gavin Dalziel, a cooper of Lanarkshire, fitted cranks and pedals to these Draisnene or similar vehicles, there is no authentic historical record. It has also been asserted that similar machines were used in Paris in 1816, one by M. Niepiee in the Luxembourg Gardens. There was also a machine shown in the

Pig. 2.— Lady's Hobby Horse.

historical collection in Class 30 at the Paris Exhibition of 1900, which was stated to have been made in 1799, but there is no authentic proof of the correctness of any date before 1818. Maemillan's and Dalziel's machines had pedals, which moved levers backwards and forwards, connected with the rear axle, and thus drove them. Credit, therefore, for

the invention of balancing and rear driving seems to belong to Macmillan ; for direct steer- ing to Baron Drais. By 1856 cranks and pedals had been affixed to the front wheel, which was driven, and in 1866 came Michaux with his velocipede, a heavy lumbering

affair of steel, iron, and wood. The rider sat upon a ■wooden or iron frame, or along steel spring connecttag the wheels, and he propelled and steered the cycle, known as a bone-shaker, by the front wheel. In 1866 also, Pierre Lallemant took out in the United States a patent for a wheel driven by a crank and pedals ; this patent was upheld for many years, and later it had much to do with the development, or want of development, of the American cycle industry. A similar patent was granted to E. Gillman in England a few months earlier. Lallemant's machine was shown by Michaux in the Paris Exhibition of 1867. In the same year the first modern machine with a large wheel in front is said to have been made in England, but the maker's name is unknown. Crank-action, how- ever, had been applied to velocipedes with three or

Fio. 8.— The Bone-shaker, 1868.

four wheels many years before. In 1868 the bone-shaker was imported into England from Paris by Mr Turner. And in 1869 Michaux is reputed to have produced in France the first bicycle with a big front wheel, the " ordinary." These two statements seem contradictory, but it would be impossible to prove, or disprove their truth at the present time — that is, to prove whether the bicycle with the large front wheel was first made in Eng- land or in Prance. There is no doubt, however, that the tall bicycle was at first used more generally in England. There was unquestionable delight and pleasure in riding this machine, and very long tours and very fast times on the road and path were made on it. H. L. Cortis covered 20 miles 300 yards in the hour, ia 1882. In 1884 Thomas Stevens started from San Erancisco to ride round the

Fis. 4.— Ancient Wood Tricycle, 1850-65.

world, a feat of most surprising pluck, energy, and endur- ance, which he accomplished in three years. Endless attempts were made to produce dwarf or safety bicycles which should combine the safety of the tricycle with the speed of the ordinary. Among the most popular were the " Extraordinary Challenge," the "EacUe," the " Kangaroo," the "American Star," but, though they possessed scarcely greater safety than the ordiaary, they were very compli-

cated, and have all disappeared. Starley's "Eover," how- ever, was safe, and was a success from the start. He re- turned to the form of the "Draisnene," but the "Eover " was driven by a chain carried on a gear wheel, so that the

Fig. 5.— The " Phantom," 1869.

rider by one revolution of the pedals propelled his cycle as far as or farther than the rider of the tall ordinary. This chain travelled from a crank axle, fitted between the two wheels, to the hub of the back wheel, and the machine was steered by the front wheel. Save in structural details the safety is the same to-day as in 1885.

About 1870, or possibly before — the exact date is un- known— steel suspension wheels had been substituted for wooden spokes, and solid rubber for iron tyres. But even with rubber tyres (by 1887 to 1888 large cushion tyres had been fitted to the wheels and powerful springs to deaden vibration added to the frame) the progress of the cyclist along the road was anything but pleasant. The vibration on the tall bicycle, produced by the small back wheel, often only from 14 to 18 inches in diameter, though the front wheel had grown from 50 to 60 inches, was most trying, and the jolting on the safeties, with their tiny tyres, was almost equally bad, producing not only nervous exhaustion and. fatigue, but, with most people, ultimate

Fig. 6.— Groat's Tension, 1871.

distaste for the pastime. Sir Benjamin Ward Richardson was the first to draw serious attention to the mental and physical danger of vibration. But no satisfactory solution was to be found. The safety not inf requetitly was

totally unmanageable. The frames had no uniformity. They were either made in a series of curves, or with two crossed tubes like an open pair of scissors stayed by wires. The diamond frame, now universal, was faintly suggested by imaginary lines, and the diagonal one was unthought of.

In 1888 a veterinary surgeon of Belfast, J. B. Dunlop, substituted for the solid, or cushion tyre, — the latter a much enlarged rubber tyre with a hollow core, both of them cemented to the rim, — a bandage composed of a rubber tube, about two inches in diameter, vulcanized or solutioned to a canvas cover, which encircled the whole rim and was then inflated by an air pump. The idea was not new ; in 1846 Mr William Thompson had taken out a patent for a pneumatic tyre, for carriages, little used at the time and afterwards completely forgotten. Upon a machine fitted with the Dunlop tyre, races were won by Messrs Ducros in Ireland in the spring of 1888, and also at an autumn meet- ing of the Surrey Bicycle Club at the Kennington Oval in the same year, while a few tourists made experiments with the new tyre on the road. It was at once seen that

Fio. 7.— Humber‘8 ” Spider,” 1872.

not only had vibration been greatly lessened, but speed wonderfully increased, and this invention of the veterinary surgeon, who did not even ride a bicycle, when applied to the safety, gave cycling its universal popularity. Within a few years the ordinary or tall front-driven bicycle and the tricycle almost disappeared. The former has gone almost entirely save as a dwarf, and the latter only sur- vives as the carrier, though a certain number are still manufactured of the Humber Cripper type. The safety also solved the problem of women cycling without being compelled to adopt male attire. There was an attempt to change woman’s costume, and for safety and ease such a radical change might be an improvement. But the general feeling, warranted by the general result, when the experi- ment was made, was against it. Women had for years ridden the tricycle. But tricycles weighed ordinarily

Fia. 8.— The “FacDe,” 1879-84.

from 60 to 100 ft or more, and were therefore unsuitable for them, unless in the form of tandems and sociables, on which the greater part of the work was usually done by a male rider. Still, as far back as 1883 or 1884 the whole

of Europe had been covered by women on tricycles. Bicyles for women were introduced about 1887 or 1888 by Starley Brothers, the makers of the ” Psycho,” and by 1890 or 1891 they had been generally adopted. The first machine of this sort is said to have been made by J. M’Cammon of Belfast in 1884. Tandem bicycles first became practical about 1889 or 1890, and in a few years

Fio. 9.— otto Dioycle, 1879.

they virtually superseded the tandem tricycle. Save that they are strengthened and simplified in construction there is little change in them. Certain makers of cycles deserve to be remembered. A few names will always stand out prominently. Among them are D. Rudge, Thomas Humber, James Starley, for his balance gear, W. Bown, the inventor of ball-bearings, and J. K. Starley — men who more than any others impressed their inventive genius on the industry and the trade, though the present mechanical position of the cycle industry is the result of the untiring labour of multitudes of inventors everywhere. J. K. Starley, practically and commercially, made the safety bicycle in 1885. But nine years before this, in 1876, Messrs Henry Bate and George Shergold were working at the safety idea. Bate by gearing up, Shergold by means of a small front wheel. In the same year, too, Mr H. J. Lawson patented a lever-driven safety, but the rear wheel was from 60 to 84 inches, and, in 1879, he produced Lawson’s bicyclette. This, however, was, in many details, very like the bone-shaker of a few years before, though it had a small back wheel which was geared up and chain-driven.

Fig. 10 — The ” Lawson Bicyclette,” 1879.

By 1895 so universal had become the popularity of cycling that the makers were unable to cope with the demand. New factories were started,

small shops grew into large companies, and where the capital invested in them before had been reckoned by hundreds it speedily became millions. Nor was the new activity confined to cycles alone or to Great Britain. Tyres, component parts, lamps, saddles, every sort of accessory, acquired enormous financial importance. The Dunlop Co., started in 1889 with a capital of £26,000, was floated in 1894 for £5,000,000.

The makers who by their mechanical genius had brought? the manufacture of cycles well on the way towards perfection, each one striving to improve his own detail, were now swallowed up by company pro- moters and adventurers, bent simply upon lining their own pockets, at any cost, by supplying a world which had suddenly gone cycle-mad. The result was that energy was mainly turned to the payment of dividends by the grossly over-capitalized companies. Machines, instead of being built by mechanics proud of their work, in many cases were simply put together in the shortest possible time, and turned out in the greatest possible numbers in one or more standard patterns. For these the world clamoured, and for a year the makers could

Fig. 11.— Stager's '"Xtxa," 1879.

not produce them fast enough. In another year the demand decreased. The inventive spirit had become dormant, the British market was over-stocked, and, as the British manufacturers refused to consider the wants of foreign customers, their store rooms remained crowded with unsold machines, dividends were unpaid, and aU but the strongest firms went to the wall. Although cycling remained as popular as ever, the trade became dis- organized, through seeking, frequently by cheapness and the resurrection of antiquated ideas, to bolster itself up, rather than by individual excellence to regain its lost position. The only attempt to meet individual require- ments was to be found among a few makers who buUt cycles to fit their riders, as was done at the very beginning of the industry. A similar state of affairs, more or less, exists in almost all other countries. . In America a huge trust was organized, by which it was hoped that the

wants of the manufacturers, rather than the desires of pur- chasers, would be promoted. But ever since Lallemant's patent was purchased by one company, and sustained, it has been the effort of the American cycle makers to compel riders to purchase machines made in the fashion which was most profitable for them. Hence dropped steel f orgings, wood rims, and single tube tyres were for a time all but universal in America. As American cycles are made by the most perfect automatic machinery, and as the parts can be duplicated, the whole of Europe, as well as America, for a year or two, was all but monopolized by the manufacturers of the United States. They, however, paid little more attention than the English makers to European wants, so that they, too, began to lose their hold. With the 20th century, however, the outlook became more hopeful.

Although cycle tours were taken and cycle clubs estab- lished almost as soon as the cycle appeared (the Pickwick Bicycle Club of London was founded in 1870, and is the oldest bicycle club in the world), and although the Cyclists' Touring Club, then known as the Bicycle Touring Club, was organized in 1878, it was not until 1895 that this organization assumed its present importance. To-day it

numbers about 56,000 members, scattered throughout Europe and America and even the East. It is the only international organization of the kind, though almost every other country possesses a national club. The League of American Wheelmen, started in 1880 in a very small way, was able, after a period, to claim a membership of over 100,000, a degree of prosperity which it could not maintain, for by 1900 its members had dwindled to 28,000. The Touring Club de France, founded 1895, at the present time is numerically the strongest, with 72,000 members, but cycling is only one, if the chief, of its objects. An International Tour- ing League has been formed by the national clubs, and it numbers a quarter of a million members. The aim of these associations is the promotion of cycle touring. They publish road-books, maps, and journals; they recommend hotels in their own and other countries with fixed tariffs; they appoint representatives to aid their members when touring; and they have succeeded in inducing most governments to allow their members to travel freely across frontiers without paying duty on their cycles. Another important branch of the work of these clubs, either directly or indirectly,

is the im- provement of the roads. This is accomplished either, as in Belgium, where all the roads are paved, by the taxBr tion of cycles and the consequent demand on the part of riders for side-paths; or by grants of money, as in France, to aid the State ; or, as in Great Britain, by the publication, through a body known as the Roads Improvement Associar tion, of good-roads literature, and by watching, promoting, or suppressing, when possible, various parliamentary and local government and railway bills affecting cyclists. In the United States also the League of American Wheelmen is devoting itself more Jind more to the good-roads question with satisfactory results, laws for improved road legislation having been passed in many states. The dubs have in aU countries erected a system of warning-boards upon dangerous hUls. In France even the best route is suggested by a sign-post, while cyclists who come to grief in lonely places find a repair outfit for their free use. The large touring organizations have therefore, to a great extent, superseded the old clubs. If these stUl exist in a quiet way — a few possessing well-appointed club-houses— ^they have lost their usefulness, now that all the world cycles, and survive merely as social organizations. The Stanley is an exception. It continues to promote the large annual show of cycles, held almost regularly since 1877, the makers of England and other countries having borrowed the idea, until the big yearly exhibition of machines has become an institution everywhere.

Fig. 12.— The "EoTer," 1885.

Each country also possesses an organization for the gov- ernment of cycle racing ; and although these unions, one object of which — ^usually the main one — is the encourage- ment of cycle racing and cycle legislation, boast an enor- mous membership, their membership is often composed of clubs and not individuals. Among the most important are the National Cyclists' Union of England and the Union

V^locip^dique of Prance. These bodies are also bound together by the International Cyclists' Association, which is devoted mainly to the

promotion of racing and legisla- tion connected with it all over the world. The National Cyclists' Union, originally the Bicycle Union, which was the parent body of all, formed in February 1878, was the first to put up danger-boards, and also was early instru- mental, alone and with the C.T.C., in framing or suggest- ing laws for the proper government and regulation of cycle traffic, notably in establishing its position as a vehicle in securing universal rights, in endeavouring, again in conjunction with the C.T.C., but unfortunately with little success, to increase facilities for the carriage of cycles on the railways, in securing the opening of parks, and in promoting many other equallypraiseworthy objects. For a number of years, however, it has been more prominent as the ruling race-governing body. But cycle racing has fallen upon

Fig. 18.— The Humber Pattern Safety, 1888.

the same evil days as cycle making. As in all other forms of sport, racing apparently occupies a great deal of public attention, and at one time a cycle race drew a large number of spectators, but now it has lost the public favour, or rather it is ignored by the public. The reason is that cycle racing has been mainly an advertisement for cycle makers. The presence of the man, directly or indirectly, in the employ of, or aided by a maker, and the consequent mixing up of trade and sport, have lowered racing not only in the public estimation, but in that of all genuine amateurs. There have always been a few amateurs who have raced for the love of the sport, but the greater number of promihent racing men have raced for the benefit of a firm, so much so that, a few years ago, an entire section of racing men were classed as " makers' amateurs." They did not confine themselves to the race track, but appro- priated the public roads until they became a danger and a nuisance, and road-racing finally was abolished, though record rides, as they ai'C called, are still indulged in, being winked at by the police and by the cycling authorities. The makers' amateurs at least rode to win and to make the best time possible. But the scandal was so great that a system of licensing riders was adopted by the N.C.U., and if this did not effectively kill the sport, the introduc- tion of waiting races did. There probably is considerable skill in riding two-thirds of a race as slowly as possible, and only hurrying the last part of the last lap, but it does not amuse the public, who want to see a fast race as well

as a close finish. This also accounts for the fact that some of the early records have not yet been beaten. The intro- duction of pacing by multicycles and motors next took from cycle racing what interest was left. A motor race, in which the machines are run at top speed, is more exciting than the spectacle of a motor being driven at a rate which the cyclist can follow with the protection of a wind-shield. In America this system of proving what cyclists can do with racing machines, has been carried so far that in 1899

a board track was laid down on the Long Island railway for about two miles between the metals, and a cyclist named Murphy, following a train, and protected by enormous wind-shields, succeeded in covering a mile in less than a minute in the autumn of 1900. W. Stinson covered forty miles in an hour on a safety, thus doubling Cortis's record on the tall machine. Other cyclists have devoted them- selves, at the instigation of makers, to the riding of a hundred miles a day every day for a year. It would be difficult to say what advantage there is in these trials and contests. They are not convincing records, and only prove that some people are willing to take great personal risks for the benefit of their employers. E. Hale during 1899-1900 covered 32,496 miles in 313 days. For many years also long-distance races, mostly of six days' dura- tion, have been promoted on covered tracks. Though condemned by all cycling organizations, they find a great deal of pecuniary support. Racing is probably at the present day in the most flourishing condition in France, where more money is offered in prizes on the track, the city of Paris granting funds for the purpose, and where also, on certain occasions, as in the race from Bordeaux to Paris, held annually in May, the high roads are given up unreservedly for twenty-four hours to a carnival of recklessness.

The cycle has also been taken up as a war machine. For this idea the army is indebted to Colonel A. E. Savile, who in 1887 organized the first series of cycle manoeuvres in England. Since then military cycling has been continued and somewhat encouraged by the organi- zation of cycling sections among volunteers and a special corps, the 26th Middlesex, and to a less extent in the regular army. On the Continent cyclists are attached to many army corps, if not in every regiment, as

scouts, messengers, and despatch-bearers, in which capacity they may at times be of great use.

Cycling has produced a literature of its own, both of the pastime and of the trade. Owing to the enormous profits which, for several years, were obtained by cycle makers, a trade press appeared which simply lived by, and out of, its advertisers ; and though each country has one or more genuine trade journals, the large proportion of these sheets have been worth, in a business aspect, as little practically, as from a literary standpoint. On the

Fie. 14.— Kudge Eaoing Ordinary, 1887.

other hand a vast mass of material and unpractical, scientific and medical, historical and touring treatises and records have appeared, but even this literature is mostly of a rather ephemeral character.

The history of cycling on the continent of Europe and in America is virtually a repetition of the happenings in Great Britain. Though the invention of the modem cycle is probably due to Michaux, a Frenchman, cycle- making reaches its greatest perfection in England. Im- provements in many ways have been made in France and America, but English cycles of the best makes are still regarded as the most trustworthy. France, however, has done more for the cyclist than any other country, owing to the fact that she possesses the best roads, kept up to a certain extent by the cycle tax, thus giving the cyclist a certain ofELcial position and right; moreover, cycles are conveyed free on railways, and State aid is given to the sport and the pastime, with the result that trade for some yearshas been in avery flourishing condition. In Germany, Italy, Switzerland, and Holland much the same state of

Fig. 15.— Safety, 1901.

affairs exists, though in a lesser degree. In Belgium the cycle has worked a veritable revolution in the national life. The surface of the greater part of the country is loose and sandy, and the roads therefore have been all paved, and are impossible for light traffic, because the paving is so bad. The cycle tax consequently has been devoted, first, to the construction of cycle-paths, on which wheelmen have equal rights with pedestrians, and secondly, to the replacing of the paving by macadam. In this way alone cycling has proved of inestimable benefit to Belgium and Luxem- bourg. In the United States also, though it has not yet been possible to procure uniform legislation', good-roads and side-path Bills have been introduced in various states, mainly at the instigation of wheelmen, while state aid has been obtained by law for the free carriage of cycles.

World's Records in 1900.

The following are the world's records to the end of 1900, which have been accepted by the Union Cycliste Internationale : —

MUes.

Time.

Holder and Place.

Date.

flying

20"

Major Taylor at Chicago

Nov. 9, 1899

standing

27S"

41"

Green at liOndon .

Aug. 2, 1899

flying

Major Taylor at Chicago

Nov. 10, 1899

1 standing

51i”

Green at London .

Aug. 2, 1899

1 flying

l’:0«

Chase at London .

July 26, 1900

1 standing

l’:15

Green at London .

Aug. 2, 1899

1 standing

l’:22f

Major Taylor at Chicago Chase at London .

Aug. 8, 1899

l’:88i

July 26, 1900

2 „

2′ : Sl§

StiQson at Brockton

Oct. 24, 1900

8 „

4;: 18

Elkes at Brockton

Nov. 8, 1900

4 „

T’inl

Elkes at Brockton

Nov. 8, 1900

6 „

Elkes at Brockton

Nov. 8, 1900

10 „

14’:22§

Bauge at Paris

Aug. 28, 1900

20 „

29’: 88

Elkes at Brockton

Oct. 27, 1900

25 „

8T’ : 02i

Elkes at Brockton

Oct. 27, 1900

30 „

44' :49

Elkes at Brockton

Oct. 27, 1900

40 „

69’:43|

Stinson at Brockton

Oct. 25, 1900

60 „

li’:U:o6|

Bauge at Paris

Nov. 4, 1900

100 .,

2i>:88:40|

Bauge at Paris

Nov. 4, 1900

200 „

eh : 3T : 43

Walters at Paris

Sept. 16-16, 1900

300 „

10k:12:45i

Walters at Paris .

Sept. 15-16, 1900

400 „

14k : M : 24

Walters at Paris

Sept. 15-16, 1900

500 „

IS”: 19:191

Walters at Paris

Sept. 15-16, 1900 July 8-9, 1899

600 „

2211 : 40 : D5t

Walters at Paris .

(J. p.)*

Cyprus, an island situated in the easternmost basin of the Mediterranean, in size only inferior to Sicily and Sar- dinia. It is nearly equally distant from the coast of Asia

Minor to the north and from that of Syria to the east, lying between 34° 33′ and 35° 41′ N. lat., and 32° 20′ and 34° 35′ E. long. Its greatest length from west-south- west to east-north-east is about 140 miles, and its greatest breadth from north to south about 60 miles. The mean temperature is about 69° Fahr. ; mean maximum, 78° Fahr. ; mean minimum, 57° Fahr. ; average rainfall for the last ten years, 1946 inches. Where there are marshes there is malarial fever, but this is rarely of a severe type.

Area and Population. — In 1885 a trigonometrical sur- vey and a map on the scale of 1 : 63360 were executed by Captain (now Lord) Kitchener, E.E., who made the area 3584 square miles. The population in 1881 was 186,173 ; in 1891, 209,286. The island is divided into six districts, which contain, besides their chief towns, 687 villages and 58 monasteries. Limasol (Gr. Lemessos), on the south coast, is the chief seat of the wine and carob trade. Ktrenia (Gr. Kyreneia), on the north coast, has a small harbour recently improved, and carries on some trade with the Cazamanian coast, which is plainly visible. Its castle, a virgin fortress, for it has never been captured, was built in the earliest years of the 13th century. For Nicosia, Famagusta, Laenaca, and Paphos, see under those heads.

Constitution and Government. — Under a convention signed at Constantinople, 4th June 1878, Great Britain engaged to join the Sultan of Turkey in defending his Asiatic possessions (in certain contingencies) against Russia, and the Sultan, " in order to enable England to make necessary provision for executing her engagements," consented to assign the island of Cyprus to be occupied and administered by England. The British flag was hoisted on 12th Jime, and the conditions of the occupa- tion were explained in an annex to the convention, dated 1st July. An Order in Council of 14th September, modi- fied so far as related to legislation by another of 30th November, regulated the government of the island. The administration was placed in the hands of a High Com- missioner with the usual powers of a Colonial Governor. Executive and Legislative Councils were established; and in each of the six districts into which, for admin- istrative and legal purposes, the island was divided, a commissioner was appointed to represent the Gov- ernment. The Executive Council consists of the High Commissioner, the Chief Secretary, the King's Advo- cate, the senior officer in charge of the troops, and the Eeceiver-General, with, as "additional" members, two Christians and one Mussulman. The Legislative Council consists of six non-elected members, being office-holders, and twelve elected members, three being chosen by the Moslems and nine by the non-Moslem inhabitants. British subjects and foreigners, who have resided five years in Cyprus, can exercise the franchise as weU as Ottoman subjects. The qualification otherwise is the payment of any of the taxes classed as Vergi Taxes (see below). The courts in existence at the time of the occupation were superseded by the following, con- stituted by an Order in Council dated 30th November 1882: — (1) a supreme court of criminal and civil appeal ; (2) six assize courts ; (3) six district courts ; (4) six magistrates' courts; and (6) village courts, at present ten in number. Actions are divided, according to the nationality of the defendant, into " Ottoman " and " Foreign " ; in the latter, the president of the court alone exercises jurisdiction as a rule, so also in criminal cases against foreigners. The law administered is that con- tained in the Ottoman codes, modified by 337 ordinances passed by the Legislative Council.

Religion. — In 1891, 47,296 of the inhabitants were Moslems ; nearly aU the remaining 161,990 were Chris-

tians of the Orthodox Greek Church. The Mussulman religious courts, presided over by Cadis, are strictly eon- fined to jurisdiction in religious cases affecting the Mar hommedan population.

Instruction. — A general system of grants in aid of ele- mentary schools was established in 1882. There are some 200 connected with the Greek Orthodox Church, re- ceiving about £2730; about £660 is granted to some 70 elementary Moslem schools. Aid is also given to Arme- nian schools at Nicosia, a Maronite school at Kormakiti, a Moslem high school (maintained entirely by Govern- ment at a cost of about £200 a year), and a training col- lege at Nicosia for teachers in the Orthodox Church schools, to which also £200 is granted annually. There are Greek high schools at Larnaca and Limasol. By a law of 1895 separate Boards of Education for Moslem and Greek Christian schools have been established, and in each district there are separate committees, presided over by the commissioner. The total enrolment is about 17,900— 4400.Moslems and 13,500 Christians.

One hundred and twenty lepers are treated in a farm specially assigned to them. Eight weekly newspapers in Greek, and one in Turkish, are published in the island.

Finance. — The principal sources of revenue are : —

(1) Vergi taxes, or taxes on house and land property, and trade profits and incomes (not including salaries) ; (2) Military exemption tax, now payable by Moslems and Christians alike, but not by foreigners, of 2s. 6d. a head on males between 18 and 60 years of age ; (3) Tithes. All tithes have been abolished, except those on cereals, car- obs, silk cocoons, and, in the form of 10 per cent, ad valorem export duties, those on cotton, linseed, aniseed, and raisins (all other export duties and a fishing tax have been abol- ished) ; (4) Sheep, goat, and pig tax ; (5) An excise on wine, spirits, and tobacco ; (6) Import duties ; (7) Stamps, court fees, royalties, licenses, &c. ; (8) Salt monopoly.

There is a temporary tax of \ per cent, on tithes and certain incomes to provide means for the destruction of the locusts. Foreigners are now liable to all the above taxes except the military exemption tax. The annual sum of £92,800, payable to Turkey as the average excess (ac- cording to the years 1873-78) of revenue over expendi- ture, but really appropriated to the interest on the British guaranteed loan of 1855, is a heavy burden. But if not lightened, taxation has at least been- better apportioned.

Production and Industry. — Eock crystal and asbestos are still found in the district of Paphos. Gypsum is exported unburnt from the Carpas, and as plaster of Paris from Limasol and Larnaca. Statuary marble has been found on the slopes of Buffavento in the northern range. Excellent building stone exists throughout the island. The salt lakes of Larnaca and Limasol are practically in- exhaustible. The most important species of the few trees that still remain in the island are the Aleppo pine, the Pinus laricio, Cypress, Cedar, Carob, Olive, and Quercus alnif olia. Eecent additions are the Eucalyptus, Casuarina, Pinus pinea, and Ailanthus. Since 1878 some protection has been afforded to existing plantations, and some attempt made to extend their area ; but the budget of the Forest Department is starved, and the progress made is slow. The soil is extremely fertile, and with a fair rainfall, say 13 inches, between November and April, yields mag- nificent crops, but the improvements in agriculture are scarcely satisfactory. The methods and appliances used are extremely primitive, and inveterate prejudice debars the average peasant from the use of new implements, of fresh seed, of manure; he cares nothing for the rotation of crops, or for the cleanliness of his land. A director of agriculture was appointed in 1896, and leaflets are issued pointing out improvements within the means of the villager.

and how to deal with plant diseases and insect pests. The rehabilitation of the French vineyards has contributed almost fatally to the depreciation of the native wines, which are pure and strong, but not always palatable. The experiments made to improve the quality and to secure a European market have not, so far, proved remunerative. Very large sums have been expended on the destruction of locusts ; they are now practically harmless, but live locusts and locusts' eggs are diligently collected every year. A committee exists " for the improvement of the breeds of Cyprus

stock ” ; stallions of Arab blood have been im- ported, and prizes are offered for the best donkeys. Cattle, sheep, mules, and donkeys are sent in large numbers to Egypt. Cyprus mules have found favour in war in the Crimea, India, Uganda, Eritrea, and Egypt. Out of the £314,000 advanced under the Colonial Loans Act, 1899, £60,000 has been allotted for irrigation; and under the superintendence of an officer lent by the Government of ■Madras, two great works are in process of construction. The smaller includes a reservoir at Syncrasi (Famagusta D.), with a catchment of 27 square miles and a capacity of 70 million cubic feet. Itreclaims360 acres,and should irrigate 4320. The larger scheme includes three large reservoirs in the Mesaoria to hold up and temporarily store the flood waters of the Pedias and Yalias rivers. It is estimated that, at a cost of £50,000, 42,000 acres will be irrigated and 10,000 reclaimed. The net return is calculated at 5 per cent, on the cost of both schemes. Manufactures are unimportant.

Commerce. — During 1887-98 the annual value of imports and exports, as calculated for the financial year ending 31st March, fluctuated considerably. In 1887-88 the total imports were £356,375, and in 1887-89 the total exports averaged £205,781 (specie neglected). In 1899 the imports were — of goods, £289,962, and of specie, £27,799, a total of £317,761 ; and the exports were — of goods, £264,851, and of specie, £43,398, a total of £308,249. The most important items of imports in 1899 were manufactured cotton, £29,545 ; raw cotton, £18,498 ; tobacco, £21,961 ; wool- lens, £18,902 ; timber, £14,618 ; leather, £13,632 ; com, &c. (mainly flour), £12,784 ; and of exports, carobs, £68,213 ; corn, &c. (mainly barley and wheat), £38,105 ; wine, £32,064 ; animals, £20,340; fruit (chiefly raisins), £19,829; silk cocoons, £14,708. The export of sponges reached 140 cwts.

Shipping. — In 1899, in the coasting trade, 2297 vessels (2080 sailing) of 146,465 tons entered, and 2358 (2141 sailing) of 145,- 462 tons cleared the ports ; in the foreign trade 1149 vessels (932 sailing) of 258,454 tons entered, and 1144 (927 sailing) of 260,046, cleared.

Internal Communications. — (i.) Roads: 488 miles of roads classed as ” good ” or fair ” carriage roads ” have been constructed between 1878-99,

at a cost of £139,720. (ii.) Posts and Tele- graphs : There are 23 post oflfices, 18 rural mail sections, and 7 money order offices. In 1898-99, 268,670 internal letters were dealt with, 212,200 external, and 148,000 newspapers. The total cost of the postal service was £3094, leaving a surplus of £240. There are 9 telegraph offices. The Imperial Ottoman Telegraph Com- pany has 67 miles of line, and a cable connecting the Carpas with Syria ; the Eastern Telegraph Company has 170 miles of line, and a cable connecting Larnaca with Alexandria. In 1898-99 the former despatched 2650 messages, and the latter 17,750.

Banking and Currency. — The Imperial Ottoman Bank has branches at Larnaca, Nicosia, and Limasol. In 1882 the following coins were decreed legal currency : gold — sovereign, half-sovereign, Turkish lira, and French 20-franc piece ; silver — florin, shilling, sixpence, and threepenny piece ; limit of tender, £3 ; bronze — piastre (9=ls.), half-piastre, and quarter-piastre : limit of tender, 27 piastres. A law relating to weights and measures was passed in 1890. Those in use are the Turkish standards. The oke = 2-8 lb avoirdupois, and the donum = about J acre.

Authorities. — An Attempt at a Bibliography of Cyprus by C. D. CoBHAM (4th ed., Nicosia, 1900) registers over 700 works which deal with Cyprus. No one full and comprehensive account of the island exists, though such is being compiled by Dr Eugen Obbhhcmmer, of Munich. The most interesting travels may be found under the names of Felix Faber. Evagatorium. Stutt- gart, 1843. — De Villamont. Voyages. Arras, 1598. — Van KooTWTCK. Cotovici Itinerarium. Antwerp, 1619. — R. Pococke. Description of the Hast. London, 1743. — A. Drummond. Travels. London, 1754.— E. D. Clarke. Travels. London, 1812.— Sir S. ‘Baker. Cyprus in 1879. London, 1879. — W. H. Mallock.

In an Enchanted Island. London, 1879. — The geology of the island has been well handled by A. Gaudrt. Geologie de Vile de Chypre. Paris, 1862. Its natural history by F. Unger and T. Kotscht. Die Insel Cypem. Wien, 1865. Numis- matics by the duc de Luthes. NumismaXigue et Inscriptions Cypriotes. Paris, 1852. — R. H. Lang. Numism. Chronicle, \o.xi. 1871.^r. P. Six. Bev. Num. pp. 249-374. Paris, 1883 ; and E. Baeelon. Monnaies Greoques. Paris, 1893. The coins of mediaeval date have been described by P. Lambkos. Monnaies inedites. Athens, 1876 ; and G. Schlumbergek. Num. de I'orient latin. Paris, 1878. Inscriptions in the Cypriot character have been collected by M. Schmidt. Sammlung. Jena, 1876 ; and W. Deecke. Die Qriechisch Kyprischen Inschriften. Gottingen, 1883; in Phoenician in the C. I. P. Paris, 1881.— J. Meursius, Cyprus, Amsterdam, 1675, marshals the classical authorities ; and W. Bngel, Kypros, Berlin, 1841, gives a good summary of the ancient history of the island. For the Phoenician element, see F. Movers, Die Ph'onizier. Bonn and Berlin, 1841-56. — Jj. Comte de Mas Latkie published between 1852-61 one volume of History (1191-1291), and two of most precious documents in illustration of the reigns of the Lusignan kings. — ^Fra Stepano LtrsiGNANo, Chorograffia di Cipro, Bologna, 1573, and Bp. Stubbs, Two Lectures, Oxford, 1878, are useful for the same period ; and perhaps a score of contemporary pamphlets — the best of them by N. Martinengo, Relatione di tutto il successo di Famagosta, Venezia, 1572, and A. Calepio (in Lusignan's Chorograffia) — ^preserve the details of the famous sieges of Nicosia and Famagosta. — G. Mabiti, Viaggi, Lucca, 1769, and Ctpri- ANOs, History, Venice, 1768, are the best authorities of Cyprus under Turkish rule. Mediaeval tombs and their inscriptions are recorded and illustrated in T. J. Chameeblatne, Lacrimae Nicossienses, Paris, 1894 ; and C. Enlart's charming and valuable volumes, VArt Qothique et la Benaissance en Chypre, Paris, 1899, deal with mediaeval architecture. — J. Hackbtt treats exhaustively The Church of Cyprus, London, 1900. (c. d. C.)

Ctpeiote Aech^ologt.

At the time when the article Cyprus was written for the ninth edition of this Encyclopaedia, little was known of the archseological history of the island. A few chance finds of vases, inscriptions, and coins; of a hoard of

*silver bowls at Dali (anc. Idalium) ^ in 1851 ; and of a bronze tablet with Phoenician and Cypriote bilingual inscriptions," also at Dali, and about the same time, had raised questions of great interest as to the art and the language of the ancient inhabitants ; Mr T. B. Sandwith, British Consul 1865-69, had laid the foundations of a sound knowledge of Cypriote pottery ; ' his successor Mr E. H. Lang (1870-72) had excavated a sanctuary of Aphrodite at Dali ; * and at the time of writing * General Louis P. di Cesnola, American Consul 1872-76, was already exploring ancient sites, and opening tombs, in all parts of the island, though his results were not published till 1877.° But though his vast collection, now in the Metropolitan Museum of New York, remains the largest series of Cypriote antiquities in the world, the accounts which have been given of its origin are so inadequate, and have provoked so much controversy,' that its scientific value is small, and a large part of subsequent excavation has necessarily been directed to solve the problems sug- gested by its practically isolated specimens. From 1876 to 1878 Major Alexander P. di Cesnola continued his brother's work, but the large collection which he exhib- ited in London in 1880 was dispersed soon afterwards.**

On the British occupation of Cyprus in 1878, the Ottoman Law of 1874 in regard to antiquities was retained in force. Excavation is permitted under Govern- ment supervision, and the finds are apportioned in thirds.

1 De LongpSrier, AthensBum fran^ais, 1853, pp. 413 ff. ; Musie NapoUon, pi. x. xi.

2 De Luynes, Numismatique et Inscriptions Chypriotes, 1852. » Archxologia, xlv. (1877), pp. 127-142.

- *Trans. Roy. Soc. Literature, 2nd ser. xi. (1878), pp. 30 ff. i Ency. Brit., 9th edition, "Cyprus" ad fin. 6 Cyprus : its Cities, Tombs, and Temples, London, 1877. ' See Cobham, An Attempt at a Bibliography of Cyprus, Nicosia, 4th edition, 1900, Appendix, " Cesnola Controversy," p. 54.*

8 The Lawrence-Cesnola Collection, London, 1881 ; Salaminia, id. 1882.

between the excavator, the landowner (who is usually bought out by the former), and the Government. The Government thirds lie neglected in a " Cyprus Museum " maintained at Nicosia by voluntary subscription. There is no staff, and no efifective supervision of ancient sites or monuments. A catalogue of the collections was published by the Oxford University Press in 1899.' Since 1878 more than seventy distinct excavations have been made in Cyprus, of which the following are the most important.

In 1879 the British Government used the acropolis of Citium (Larnaca) to fill up the ancient harbour; and from the destruction a few Phoenician inscriptions, and a proto-Ionic capital, were saved. In 1882 tombs were opened by Mr G. Hake at Salamis and Curium for the South Kensington Museum, but no scientific record was made. In 1883 the Cyprus Museum was founded by private enterprise, and on its behalf Mr Max Ohnefalsch-Eichter, who had already made trial diggings for Sir Charles Newton and the British Museum, excavated sanctuaries at V6ni and Kythrea (Chytri), and opened tombs on some other sites.^"

*In 1885 Dr E. Diimmler opened tombs at Dali, Aldmbra, and elsewhere, and laid the foundations of knowledge of the Bronze Age and Early Iron Age ; " and Mr Eichter, on behalf of officials and private individuals, excavated parts of Erangissa (Tainassus), Episkopi, and Dali.^*

In the same year 1885, and in 1886, a syndicate opened many tombs at P61i-tis-Khrysochou {Marium, Arsinoe), and sold the contents by auction in Paris. From Mr Eichter's notes of this excavation, Dr P. Herrmann com-

B. V.Darbakiri Sf OJ. R.H

CTPEUS (excavation SITES).

Oxford,' igoi

piled the first scientific account of Grseco-Phoenician and Hellenistic Cyprus.^ In 1886 also, M. le Vicomte E. de Cas'tillon de St Victor opened rich Grseco-Phcenician tombs at Episkopi, the contents of which are in the Louvre."

The successes of 1885-86 led to the foundation of the Cyprus Exploration Eund, on behalf of which (1) in 1888 the sanctuary of Aphrodite at Paplios (Kouklia) was excavated by Messrs E. Gardner, M. R. James, D. G. Hogarth, and E. Elsey Smith ;i= (2) in 1889-90 more tombs were opened at Poli by Messrs J. A. E. Munro and H. A.~ Tubbs ; ^' (3) in 1890-91 extensive trials were

8 Myres and Ohnefalseh-Richter, A Catalogue of the Cyprus Museum, with a Chronicle of Excavations since the British Occupation, and Introductory Notes on Cypriote ArchsBology, Oxford, 1899.

w Mitt. d. Arch. Inst. (Athens), ii. (1881).

u Mitt. d. Arch. Inst. (Athens), vi. (1886). Bemerkungen z. alt. Kunsthandwerk, &c., ii. "Der Kypr. G«ometrische Stil," Halle, 1888.

12 Summarized in Cyprus, the Bible, and Homer, London and Berlin,

1893.

18 Das GrSberfeld von Marion, Berlin, 1888.

11 Archives des Missions Sdentiflques, xvii., Paris, 1891.

16 Journal of Hellenic Studies, ix., London, 1888.

i6 7d. xi.,1890; xii., 1891.

archeology]

CYPRUS

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made at Salamis, by the same ; ^ (4) minor sites were exam- ined at Leondari Voun6 (1888)/Amargetti (1888),' and Limniti (1889) ; ♦ (5) in 1888 Mr Hogarth made a surface- survey of the Karpass promontory ; « and finally, (6) in 1894, the balance was expended by Mr J. L. Myres m a series of trials, to settle special points, at Agia Paraskevi, Kalopsida, and

Larnaca.' In 1894 also, Dr Eichter excavated round Idalium and Tamasms for the Prussian Government: the results, unpublished up to 1902, are in the Berlin Museum/ Finally, a legacy from Miss Emma T. Turner enabled the British Museum to open numerous tombs, by contract, of the Grseco-Phoenician Age, in 1894, at Pal8e6-Lemess6 (Amathus) ; and of the Mycenaean Age, in 1894-95 at Episkopi, m 1895-96 at Enkomi (near Salamis), and in 1897-99 on small sites between Larnaca and Limasol.' Many important sites remain still unexplored, and many problems unsolved; but the outline of Cypriote archseology which follows may give some idea of the conclusions established hitherto.

The Stone Age has left but few traces in Cyprus ; no sites have been found, and even single implements are very rare. The " megalithio " monuments of Agia Phaneromfei and Halat Sultan Tekfi, near Larnaca, may perhaps be dolmens of the Palestinian type ; the vaulted chamber of Agia Katrina, near Enkomi, may be Mycenaean or later ; the perforated monoliths at Ktima belong to oil-presses of uncertain date.

The Bronze Age, on the other hand, is of peculiar importance in an area which, like Cyprus, was one of the chief early sources of copper. It has been carefully studied both on settlement sites at Leondiri Voun6 and Kalopsida, and in tombs in more than thirty places, notably at Agia Paraskevi, Psemmatism&o, Aldmbra, Episkopi, and Enkomi. Cypriote Bronze Age culture falls into three stages. In the first, the implements are rather of copper than of bronze, tin being absent or in small quantities (2 to 3 per cent.) ; the pottery, of gourd-like and often fantastic forms, is all hand-made, with a red burnished surface, with simple geometrical ornaments incised. Zoomorphic art is very rare, and imported objects are unknown. In the second stage, implements of true bronze (9 to 10 per cent, tin) become common ; painted pottery appears alongside the red-ware, and foreign imports occur, such as Egyptian blue-glazed beads (xii.-xiii. dynasty: 2500-2000 b.c.) and Asiatic cylindrical seals (one of Sargon I. ~~. In the third stage, intercourse with Palestine and Egypt, following the conquests of Thothmes III. (c. 1500 b.c), brought over new fabrics of pottery, which were freely copied ; and JEgean colonists introduced the Mycenaean culture and art, which rapidly dominated the primitive native industries : new types of weapons, and wheel~~ made pottery appear ; gold

and ivory become abundant, and glass and enamels are known. The magnificent tombs from Enkomi and Episkopi (In the British Museum) illustrate the wealth and advancement of Cyprus at this time.'

The early Iron Age which succeeds is a period of obscurity and relapse. Iron, which occurs rarely, and for ornaments, in some of the tombs at Enkomi suddenly superseded bronze for tools and weapons, and its introduction was accompanied, as in the ^gean, by economic, and probably by political changes, which broke up the high civilization of the Mycenaean colonies, and brought about a return to poverty, isolation, and comparative barbarism. Gold, and even silver, become rare ; foreign imports almost cease ; en- graved cylinders are replaced by conical or pyramidal seals like those of Asia Minor, and dress-pins by brooches (fibulm) like those of Greece ; representative art languishes (except a few childish attempts to model in clay), and the decorative art becomes once more purely geometrical in character.

But while Mycenaean traditions lingered in Cyprus after their extinction in the ^gean, new Oriental influences from the Syrian coast were felt there earlier than farther west. Two lines of foreign tradition may be distinguished, originating in Egypt and Assyria respectively. Of these, the former predominates somewhat earlier than the latter, a historical date for which is given by the Assyrian conquest of Cyprus in 704 b.c. The effects are best seen in sculp- ture and in metal-work, though it remains doubtful whether the best examples of the latter were made in Cyprus or on the main- land. Among the great series of engraved silver bowls, some exam-

1 Journal of Hellenic Studies, xli., 1891. 2 Id. Ix., 1888.

s/d. ix., 1888. 4 Jc?. xi., 1890.

s Devia Cypna, Oxford, 1889. « J. H. S. xvii., 1897.

' Summarized in Cyprus Mttseum Catalogue, Oxford, 1899.

8 Excavations in Cyprus, London, 1900.

9 The official publication stands alone in referring these tombs to the Hellenic period (800-600 B.C.).

pies show almost unmixed imitation of Egyptian types ; in others, Assyrian types are introduced among the Egyptian in senseless confusion; while in others both classes are merged in a mixed art which betrays a return to naturalism, and a new sense of style, and from Its intermediate position between the art of Phoenicia and its colonies, and the earliest art of Hellenic Greece, has been called Ormco-Phxnioian. The same succession of styles is represented in sculpture by the votive statues from the sanctuaries of Aphrodite at Dali and of Apollo at V<5ni and Eringissa ; by the elaborately painted terra^cottas from the "Toumba" site at Salamis ; and by magnificent examples in the Cesnola collection. Gem-engraving and pottery-painting follow very similar lines ; the latter, however; with greater nalvetfi of treatment, and closer adherence to Mycenaean traditions.

Meanwhile, .iEgean influences, which had been predominant in the Mycenaean Age, and had never wholly ceased, grew stronger as Hellenic culture matured, and slowly repelled Phoenician Orient- alism. Imported vases of "Dipylon," "Proto-Corinthian," and "Rhodian" fabric (though not of orientalizing "Corinthian") occur rarely, and were imitated by the native potters, and early in the 6th century the influence of Ionia, and still more of Naucratis, becomes perceptible in imports, in ceramic, and in sculpture. Finally, from the later 6th century, and the period of "black-figured" vases onwards, a rapidly increasing mass of Attic imports (chiefly vases) brings Cyprus at last into full contact with Hellen- ism. Unable, however, to rival, or fully to acquire, this higher culture, native art and industry languished and became extinct even before the Ptolemaic conquest (295 e.g.), except, perhaps, in Citium, the headquarters of Phoenician influence in the island. A rare and beautiful class of terra-cottas like those of Myrina and Tanagra may be of Cypriote fabric, but their style is wholly of the JEgean. The Greek colonists in Cyprus traced their origin, at Curium, from Argos ; ^^ at Lapathus from Laconia ; i' at Paphos from Arcadia ; ^ at Salamis from the Attic Salamis ; i' and at Soli also from Attica. The settlements at Paphos and Salamis, and probably also at Curium, were believed to date from the period of the Trojan "War ; the name of Teucer, the legendary*

founder of Salamis, probably represents a memory of the piratical Tikkara who harried the Egyptian coast under Rameses III. ; and the dis- covery of Mycenaeam settlements at Curium and Salamis, and of traces of sub-Mycenaean occupation at Paphos aad Lapathus, goes far to confirm the belief that the legends have a historical basis. The Greek dialect of Cyprus points in the same direction ; it shows marked resemblances to that of Arcadia, i and forms with it a " South Achaean " or "South .Slolic" group related to the north- em .ablic of Thessaly and other parts of north and central Greece. No Greek alphabet was used in Cyprus, except by visitors, ^^ nntil the 4th century, and the numerous inscriptions of earlier date than this are written in a peculiar and elaborate syllabary " which can be traced in use in late Mycenaean times,^^ and is apparently related to the linear and pictographic scripts of Crete and the South gean.^ In the Phoenician centres, Citium and Idalium, a Semitic dialect and the Phoenician alphabet were in use from the 8th cen- tury at least ^ ; and a cuneiform inscription recording the conquest of the island by Sargon II. has been found at Larnaca. ^i

The coins of the Greek dynasts and autonomous tovms are struck on a variable standard, with a stater of 170-180 grs.^"

For Ptolemaic (Hellenistic) Cyprus the evidence is most inade- quate. Excavation in the grea^ sanctuaries at Paphos and Idalium, and in the public buildings of Salamis, which were all wholly remodelled during this period, have produced but few works of art; and the sculpture from local shrines at V(5ni and Vitsada, and the frescoed tombstones from Amathus, only show how inadequately the Cypriote copied debased HeBenistio models.

Eor the Roman period there is abundant evidence from the sites of Salamis and Paphos, and from tombs everywhere ; but little that

10 Hdt. 5. 117 ; Strabo, 683. n Strabo, 682.

12 Id. 683. 18 Id. 682. " Id. 683.

isMoriz Schmidt, Z. f. Yergl. Sprachw., 1860; H. W. Smith, Tr. Am. Philol. Ass., 1887; K. Meister, Zum Eleischen, Arkadischen u. Kyprischen

Dialekte, 1890; Otto Hoffmann, Die Griechischen Dialekte, vol. i., 1891. Full bibliography in Cobham (see above).

w E.g., Ionic inscriptions of early 5th century from Amathus. Excavations in Cyprus (Brit. Mus.) , 1900, p. 95.

"George Smith, Tr. Soc. Bibl. Arch. i. (1872); Moriz Schmidt, Sammlung Kyprischer Inschriften, 1876 ; Deecke, Ursprung der Kypr. Sylbenschrift, 1877, cf. Deecke in CoUitz, Samml. d. Gr. Dialekt- inschriften, i., 1883; Meister, Gr. Dialekte, ii.; Ber. d. K. Sachs. Oes. d. Wiss., 1894; Indo-Germ. Forsch. iv. 175 ff. (cf. Cobham, Z.O.).

18 Excavations in Cyprus, 1900, p. 27.

19 Evans, Joum. Hell. Stud. xiv. (1894), xvii. (1897).

20 Corpus Inscr. Semit. ii. ri881), cf. Cobham, (.c.

21 Sehrader, Die Sargon-stele des Berliner Museums, 1882.

22 De Luynes, Numismatique Chypriote, 1852 ; De Vogue, Melanges d'Archiologie Orientate, 1869; Six, Revue Numismatique, 3rd Ser., i. (1883) ; Pecz, Num. Zeitschr. xvi. (1884) ; Babelon, Catalogue dfis Monnaies Grecques de la Bibl. Nationals, 1893.

is chaxacteristlo or noteworthy ; little attention has been paid to the sequence of style.

Of the Byzantine period little remains but the ruins of the castles of St Hilarion, Bufflavento, and Kant&ra,i a magnificent series of gold ornaments 2 and some silver plate,' found near Kerynia in 1883 and 1897 respectively. Christian tombs usually contain nothing of value.

The Frank conquest is represented by the "Crusaders' tower" at Kolossi, and the church of St Nicholas at Nicosia ; and, later, by masterpieces of a

French Gothic style, such as the church (mosque) of St Sophia, and other churches at Nicosia ; the cathe- dral (mosque) and others at Famagusta, and the monastery of Bella Pais; as well as by domestic architecture at Nicosia and elsewhere, and by a rich series of inscribed tombstones in the churches. The elaborate wood-carvings of the church at Aschelia belong to the 15th century, and the "miraculous" picture at the monastery of Kykkou apparently to the 16th. The architecture of the Renaissance is illustrated by fortifications and remains of public buildings (now being quarried away) at Famagusta, by walls, gates, and domestic buildings at Nicosia, and by forts at Kerynia, Limasol, and elsewhere.*

The Turks and English have added little, and destroyed much, converting churches into mosques and grain-stores, and quarrying the buildings and walls of Famagusta. There is an iron bridge over the Pedias river, and a harbour at Famagusta has been proposed. (j. l. m.)

Cyprus, Church of.— The Church of Cyprus is in communion and in doctrinal agreement with the other Orthodox Churches of the East (see Orthodox Eastern Church), but is independent (avTOK€aXos) and subject to no patriarch. This position it has always claimed (see, however, W. Bright, Notes on the Canons, on Ephesus 8). At any rate, its independence " by ancient custom " was recognized, as against the claims of the patriarch of Antioch, by the Council of Ephesus, a.d. 431, by an edict of the Emperor Zeno (to whom the church had sent a cogent argument on its own behalf, the alleged body of its reputed founder St Barnabas, then just discovered at Salamis), and by the Trullan CouncU in 692. Attempts have been made subsequently by the patriarchs of Antioch to claim authority over it, the last as recently as 1600 ; but they came to nothing. And excepting for the period during which Cyprus was in the hands of the Lusignans and the Venetian Eepublic (1193-1571), the Church has never lost its independence. It receives the holy ointment (jivpov) from without, till 1860 from Antioch and subse- quently from Constantinople, but this is a matter of courtesy and not of right. Of old there were some twenty sees in the island. The bishop of the capital, Salamis or Constantia, was constituted metropolitan by Zeno, with the title " archbishop of all Cyprus," enlarged sub- sequently into "archbishop of Justiniana Nova and of all Cyprus," after an enforced

expatriation to Justiniano- polis in 688. Zeno also gave him the unique privileges of wearing and signing his name in the imperial purple, &c., which are still preserved. A Latin hierarchy was set up in 1196 (an archbishop at Nicosia with suffragans at Limasol, Paphos, and Famagusta), and the Greek bishops were made to minister to their flocks in subjec- tion to it. The sees were forcibly reduced to four, the archbishopric was ostensibly abolished, and the bishops were compelled to do homage and swear fealty to the Latin Church. This bondage ceased at the conquest of the island by the Turks : the Latin hierarchy disappeared (the cathedral at Nicosia is now used as a mosque), and the native church emerged into comparative freedom. In 1821, it is true, all the bishops and many of their flock were put to death by way of discouraging sympathies with the Greeks ; but successors were soon consecrated, by bishops sent from Antioch at the request of the

1 Cf. Handbook to Cyprus, 1901, p. 7.

2 Cyprus Museum ; cf. Myres, Reliquary, &c., March 1898. s British Museum ; cf . Dalton, Archosologia, Ivii. p. 159.

- *Hogarth, Devia Cypria, pp. 42-4. For a full list cf . Handbook to Cyprus, 1901, pp. 7-8.*

patriarch of Constantinople, and on the whole the Church has prospered. The bishops-elect required the berat of the Sultan ; but having received this, they enjoyed no little eivU importance. Since 1878 the berat has not been given, and the bishops are less influential. The suppressed sees have never been restored, but the four which survive (now khown as Nicosia, Paphos, Kition, and Kyrenia) are of metropolitan rank, so that the arch-bishop, whose headquarters, first at Salamis, then at Famagusta, are now at Nicosia, is a primate amongst metropolitans. There are several monasteries dating from the 11th century and onwards ; also an archiepiscopal school at Nicosia, founded in 1812 and raised to the status of a ” gymnasion ” in 1893 ; and a high school for girls. But there is no theological seminary, and the ignorance of the clergy is great. Still, there are signs of progress, especially since the island passed into British hands ; and if the great revenues of the Church can be redistributed and better administered, excellent results will doubtless follow.

Authorities. — Ph. Gbokgiou. EiSiJo-eis ‘laropiKal vepl ri}! ‘EicKXijirias Tjjt Kiwpov. Athens, 1875. — K. Koukiokuhineos (Archbishop of Cyprus). ‘IffropLa xpo”<''^<'7"f').'''5s v^ffou Kiirpov. Venice, 1788. — de Mas Latkib. Histoire de Vile de Chypre sous les Princes de la Maison de Lusignan. Paris, 1852 f. — H. T. F. Duckworth. The Church of Cyprus. London, 1900. — J. Hackbtt. History of the Orthodox Church of Cyprus. 1901.

(w. E. Co.)

Cytology (Vegetable). — Remarkable progress has been made of late years in our knowledge of minute cell structure, or Cytology, around which so much of the biological research of the present time revolves, and upon which the ultimate solution of important problems in physiology depends. This has been due largely to the application of the ribbon section-cutting microtome to histological research, to more refined methods of fixing, staining, and mounting, and to the immense im- provements made in optical instruments. Among the more important subjects in which progress has been made are the minute structure of protoplasm; the phenomena of nuclear division ; the structure and de- velopment of the sexual cells and germ-nuclei ; the phe- nomena of fertilization ; the structure and development of the cell-wall, starch-grains, and plastids; the proto- plasmic connexions between the cells ; and the structure and development of sieve-tubes and laticiferous tissue. But although much has been accomplished, we are still far from a complete understanding of minute cell-structure, and, unfortunately, the brilliant results which have been obtained by the investigation of dead stained tissues have so dominated the attention of students during this period that the living cell has been neglected, and doubt has, in consequence, been cast upon some of the results obtained. It is probable, therefore, that in the future any substantial advance in our knowledge will come, not from the exclu- sive study either of dead or living cells, but from a judicious correlation of observations upon both.

The contents of a living cell are collectively termed protoplasm. This consists of a semi-fluid granular substance, called the cytoplasm, one or more nuclei, and sometimes centrospheres or centrosomes, and plastids.

Cells from different parts of a plant differ very much in their cell-contents. Young cells are often full of cyto- plasm; old cells generally contain a large vacuole or vacuoles, and may have only a thin, almost invisible, layer of cytoplasm on their walls. Others contain chloro- phyll-grains or chromatophores, starch-grains, or oil- globules. Very little is known of the finer structure of the cytoplasm of a vegetable cell. When observed under the microscope it is usually seen to consist of a homo-geneous substance containing numerous granules of various sizes, and vacuoles, which are probably full of a watery

sap. It is sometimes differentiated into a clearer outer layer, of hyaloplasm, commonly called the ectoplasm, and an inner granular endoplasm. In some cases it shows, when submitted to a careful examination under the high- est powers of the microscope, and especially when treated with reagents of various kinds, traces of a more or less definite structure which is sometimes very com- plicated. This exhibits itself in the form of a mesh- work which consists of a clear homogeneous substance containing numerous minute bodies known as microsomes, the spaces being filled by a more fluid ground-substance. This structure, which is visible both in living cells and in cells treated by reagents, has been interpreted by many observers as representing a network of threads em- bedded in a homogeneous ground-substance. Blltschli, on the other hand, interprets it as an extremely finely vacu- olated foam-structure or emulsion, comparable to that which is observed when small drops of a mixture of finely powdered potash and oil are placed in water, the vacuoles or alveoli being spaces filled with liquid, the inore solid portion representing the mesh- work in which the microsomes are placed. According to Strasburger, the cytoplasm consists of trophoplasm, or nutritive plasm, and kinoplasm, which is concerned in the division of the cell. The former is of alveolar, the latter of fibrillar, nature. The structure of the protoplasm as revealed by the action of reagents is regarded with scepticism by many observers, and it has been shown, by Fischer espe-cially, that some of the appearances observed in dead cells can be

produced artificially by treating albumen and other substances of a similar nature with various reagents. But whilst due weight must be attached to such observations, it would not be wise to push them too far. The objects which are actually visible in the living cell are reproduced with striking fidelity in the fixed and hardened cell, and one might expect that their finer structure would also be to some extent preserved.

Living protoplasm is alkaline or neutral, and, so far as is known at present, is a mixture of complicated chem- ical compounds. By the gross analysis of simple or- ganisms which consist mainly of protoplasm, it has been found that there are two main groups of compounds, in one of which phosphorus is present, in the other not. The phosphorus is especially abundant in the nucleus, where it enters into the composition of that important substance known as nvxilein. It may also be present in smaller quantities in other parts of the cell. By means of a simple micro-chemical test Macallum finds that it occurs in the chromatin of all nuclei, in nucleoli, and in pyrenoids ; and that it is present in small quantities in cytoplasm and chromatophores, in the central body (nucleus ?) of the Cyanophycese and in Yeast, where it is sometimes located in a definite organ of the cell which is commonly regarded as of a nuclear nature.

The chromatophores or plastids are protoplasmic struc- tures, denser than the cytoplasm, and easUy distinguish- able from it by their colour or greater refrac- pA^f ’”” ti”^® power. They are spherical, oval, fusiform, or rod-like, and are always found in the cyto- plasm, never in the cell-sap. They appear to be perma- nent organs of the cell, and are transmitted from one cell to another by division. In young cells the chromato- phores are small, colourless, Hghly refractive bodies, principally located around the nucleus. As the cell grows they may become converted into leucoplasts (starch-formers), cMoroplasts (chlorophyll-bodies), or chromoplasts (colour-bodies). And all three structures may be converted one into the other (Schimper). The chloroplasts are generally distinguished by their green colour, which is due to the presence of chlorophyll ; but in many Algse this is masked by another colouring

matter — Phycoerythrin in the Florideae, Phycophoein in the Phseophyceee, and Phycocyanin in the Cyanophyceee. These substances

can, however, be dissolved out in water, and the green colouring matter of the chloroplast then becomes visible. Its structure is difflcult to make out, but the views put forward by various observers lead to the conclusion that the chloroplast consists of two parts, a colourless ground substance, and a green colour- ing matter, which is contained either in the form of fibrils, or in more or less regular spherical masses, in the colourless ground-mass. The chloroplasts increase in number by division, which takes place in higher plants when they have attained a certain size, independent of the division of the cell. In Spirogyra and allied forms the chloroplast grows as the cell grows, and only divides when this divides. The division in all cases takes place by constriction, or by a simultaneous splitting along an equatorial plane. In the chromatophores' of many Algse and in the Liverwort Anthocetos there are present homogeneous, highly refractive, crystal-like bodies, called pyrenoids or starch-centres, which are composed of pro- teid substances and surrounded by an envelope of starch-grains. In Spirogyra the pyrenoids are dis- tinctly connected by cytoplasmic strands to the cen- tral mass of cytoplasm, which surrounds the nucleus, and according to some observers, they increase exclu- sively by division, followed by a splitting of the cyto- plasmic strands. Those chromatophores which remain colourless, and serve simply as starch-formers in parts of the plant not exposed to the light, are called leu-coplasts or amyloplasts. They are composed of a homogeneous proteid substance, and often contain albu- minoid or proteid crystals of the same kind as those which form the pyrenoid. If exposed to light they may become converted into chloroplasts. The forma- tion of starch may take place in any part of the leu- coplast. When formed inside it, the starch-grains exhibit a concentric stratification; when formed ex- ternally in the outer layers, the stratification is excen- tric, and the hilum occurs on that side farthest removed from the leucoplast. As the starch-grains grow, the leucoplasts gradually disappear. Chromoplasts are the yellow, orange, or red colour-bodies found in some flowers and fruits. They arise either from the leuco- plasts or chloroplasts. The fundamental substance or stroma is colourless and homogeneous. The colour is due to the presence of xanthophyll, or carotin, or both. The colouring matters are not dissolved in the stroma of the chromoplast, but exist as amorphous granules, with or without the presence of a protein crystal, or in the form of fine crystalline needles, frequently curved and sometimes present in

large numbers, which are grouped together in various ways in bundles, and give the plastids their fusiform or triangular crystal- line shape. Such crystalline plastids occur in many fruits and flowers (e.g., Tamus communis, Asparagus, Lonicera, berries of Solanese, flowers of Cacdlia coccinea, Tropceolum, bracts of Strelitzia, &c.), and in the root of the carrot. In some cases the plastid disappears and the crystalline pigment only is left. In the red variety of Cucurbita pepo these crystals may consist of rods, thin plates, flat ribbons, or spirals. Starch-grains may often be seen in contact with the pigment crystals. The crystal- line form appears to be due entirely to the carotin, which can be artificially crystallized from an alcohol or ether so- lution. In addition to the plastids, there are found in some plant-cells, e.g., in the epidermal cells of the leaf of species of Vanilla (Wakker), and in the epidermis pf different parts of the flower of Funkia, Omithogalum, &c. (Zimmer- mann), highly refractive bodies of globular form, elaio- plasts, which consist of a granular protein ground-

substance containing drops of oU. They are stained deep red in dilute solution of alkannin. There appears to be one in each cell, and in Orithogalum umhellatum it occurs at one of the poles of the elongated nucleus. An oily substance in the form of drops may also occur La chromato- phores, and, in the Hepaticse, oil-bodies are found which may have some relation to elaioplasts. Although no special oil-forming plastid has been observed, it appears from these observations that oil may sometimes be formed by special structures, or may accumulate in them (PfEefEerV The eye-spot -which is found in motile cells of the Algae, Protococcus Euglena, &c., may also have something in common -with the elaioplast. In Euglena it consists of a protoplasmic substance, in which are embedded numerous spherical or irregular drops of a red oUy substance. The red colouring matter turns blue in concentrated sulphuric acid, and is probably related to the red colouring matter of chromoplasts. The eye-spot appears to be concerned in some way with the response to the light-stimulus which is exhibited by cells con- taining it.

It is highly probable that starch is only produced as the result of the activity of chromatophores, either in connexion with chromoplasts, chloroplasts, or leucoplasts. Starch exists, in the majority of cases, in the form of grains, which are composed of stratified layers arranged around a nucleus or hilum. The stratification, wMeh may be concentric or excentric, appears to be due to a difference in density of the various layers. The outer layers are denser than the inner, the density decreasing more or less uniformly from the outside layers to the centre or hilum. The outermost, newly-formed layer is composed of a more homogeneous, denser substance than the inner one, and can be distinguished in all starch-grains that are- in process of development. The separate layers of the starch-grain are deposited on it by the activity of the chromatophore, and according to Meyer the grain is always surrounded by a thin layer of the chromatophore which completely separates it from the cytoplasm. The layers appear to be made up of elements which are arranged radially. These are, according to Meyer, acicular crystals, which he calls trichites. The starch grain may thus be regarded as a crystalline structure of the nature of a sphere-crystal, as has been suggested by many observers.

The nucleus appears to be an essential constituent of the cell. Its presence has been demonstrated in all plants with the exception of the Cyanophyceae and Bacteria, and even here structures have been observed which resemble nuclei La some of their char- acteristics, and are thought to be such by some observers. The nucleus is generally regarded as a controlling centre of cell-activity, upon which the growth and development of the cell in large measure depends, and as the agent by which the transmission of specific qualities from one generation to another is brought about. If it is absent, the cell loses its power of assimilation and growth, and soon dies. Haberlandt has shown that in plant cells, when any new formation of membrane is to take place in a given spot, the nucleus is found in its immediate vicinity ; and Klebs found that only that portion of the protoplasm of a cell which contains the nucleus is capable of forming a cell- wall ; whilst Townsend has further shown that if the non- nucleated mass is connected by strands of protoplasm to the nucleated mass, either of the same cell or of a neighbouring cell, it retains the power of forming a cell- membrane.

The nucleus consists of an irregular network of threads surrounded by a nuclear membrane, which separates itf rom the cytoplasm. The nuclear cavity in which the network is placed contains a more or less fluid nuclear sap, and in the

majority of plant-nuclei, but not in all, one or more spheri- cal or slightly irregular bodies, the nucleoli. In the living condition the nucleus appears granular, and the thread structure is in most cases invisible, but the nucleolus is sometimes distinguishable by its more refractive appear- ance. The structure of the nuclear thread can only be made out by the use of reagents. It consists of a ground- substance called Linin, which is only slightly stained by the ordinary nuclear stains, and, embedded in it, numerous grains of a substance called Chromatin, having a strong affinity for stains. These chromatin-granules are looked upon by some observers as independent morphological units, the ids of Weismann. The staining reactions of the various parts of the nucleus depend to some extent upon their chemical constitution, especially with regard to the amount of phosphorus they contain. The chromatin is practically identical with nuclein, a complex albuminoid compound containing about 3 per cent, of phosphorus. This has a strong attraction for basic aniline dyes, and can usually be distinguished from those parts of the cell which are more easily coloured by acid anilines. But the staining reactions of nuclei may vary at different stages of their development ; and it is probable that there is no method of staining which differentiates with certainty the various morphological constituents of the nucleus.

The formation of new cells by division is, in the case of uninucleate cells, preceded by or accompanied by the division of the nucleus. In multinucleate cells the division of the nucleus is independent of the division of the cell. Nuclear division may be indirect or direct, that is to say it may either be accompanied by a series of complicated changes in the nuclear structures called mitosis or karyo- kinesis, or it may take place by simple direct division, amitosis, or fragmentation. Direct division is a much less common phenomenon than was formerly supposed to be the case. It occurs most frequently in old cells, or in cells which are placed under abnormal conditions. It may also take place where rapid proliferation of the cell is going on, as in the budding of the Yeast plant. It

takes place in the internodal cells of Characese; in the old internodal cells of Tradescantia ; and in various other cells which have lost their power of division. It has been shown that, in cells of Spirogyra placed under special conditions, amitotic division can be induced, and that normal mitosis is resumed when they are placed again under normal conditions. Amitosis is probably connected by a series of intermediate gradations with karyokinesis.

In indirect nuclear division the nucleus undergoes a series of complicated changes, which result in an equal division of the chromatic substance between the two daughter nuclei. Four stages can be recognized. (1) Prophase. — The nucleus increases in size ; the network disappears and a much convoluted thread takes its place (Fig. 1, B). The chromatin substance increases in amount ; the thread stains more deeply, and in most cases presents a homogeneous appearance. This is commonly called the spirem-figure. The chromatin thread next becomes shorter and thicker, the nucleoli begin to disappear, and the thread breaks up into a number of segments — chromosomes — which vary in number in different species, but are fairly constant in the same species (Fig. 1, C, D). Coincident with these changes the nuclear membrane disappears and a spindle-shaped or barrel-shaped group of threads makes its appearance in the midst of the chromosomes, the longitudinal axis of which is at right angles to the plane of the division (Fig. 1, F). At each pole of this spindle figure there often occur fibres radiating in all directions into the cytoplasm, and some- times a minute granular body, the centrosome, is also found there. (2^ Metaphase. — ^The chromosomes pass to the equator or the spindle and become attached to the spindle- fibres in such a way that they form a radiating star-shaped

figure — Aster — when seen from the pole of the spindle. This is called the nuclear plate (Fig. 1, E, P, G-, H). As they pass into this position they undergo a longitudinal splitting by which the chromatin in each chromosome be- comes divided into equal halves. (3) Anaphase. — The longitudinal division of the chromosomes is completed by the time they

have taken up their position in the nuclear plate, and the halves of the chromosomes then begin to move along the spindle-fibres to opposite poles of the spindle (Fig. 1, 1, J). Many observers hold the view that the chromosomes are pulled apart by the contraction of the fibres to which they are attached. (4) Telophase. — ^When they reach the poles the chromosomes group themselves again in the form of stars — Diaster — with spindle-fibres extending between them (Fig. 1, K). The chromosomes then fuse together again to form a single thread (Fig. 1, L), a nucleolus appears, a nuclear membrane is formed, and daughter nuclei are thus constituted which possess the same structure and staining reactions as the mother nucleus. When this nuclear division is followed by cell- division, a cell-wall is formed between the two daughter nuclei. The spindle-fibres which extend between the daughter nuclei increase in number and extend laterally until they touch the cell-walls. They then thicken in the middle, and form a layer of granules across the cell — the ■cell-plate. These then disappear and the new cell-wall appears in their place. In the lower plants the new cell- wall may be formed as an outgrowth on the old one {Spirogyra, &c.), or it may be formed directly in the ■cytoplasm.

The spindle figure is probably the expression of forces which are set up in the cell for the purpose of causing the separation of the daughter chromosomes. It arises partly from the cytoplasm, partly from the nucleus, or it may be •derived entirely from the nucleus — intranuclear spindle — as occurs in many of the lower plants (Fungi, &c.). The formation of the spindle begins in the prophases of division. A layer of delicate filamentous cytoplasm — kinoplasm — may collect around the nucleus, or at its poles, out of which the spindle is formed. As division proceeds, the filamen- tous nature of this cytoplasm becomes more prominent, and the threads begin either to converge towards the poles •of the nucleus, to form a bipolar spindle, or may converge towards, or radiate from, several different points, to form .a multipolar spindle. The wall of the nucleus breaks down, and the cytoplasmic spindle-fibres become mixed with those derived from the nuclear network. The formation •of the spindle differs in details in different plants.

The longitudinal splitting of the chromosomes appears to take place in order to ensure that one-half of each chromatin unit — id — shall be

distributed to each daughter nucleus. The longitudinal division of the linin thread is in fact probably initiated by the division of these chromar tin granules, which are arranged in a single row along the thread. In many cases the granular nature of the chromo- some is masked by the shortening of the thread and the absorption of additional chromatin substances during the various stages of the prophase, so that the chromosome appears to be a homogeneojis structure. In other cases the longitudinal splitting takes place before the chromo- some stage, in which case two rows of granules are visible on the linin thread at an early stage, and the shortening and thickening do not take place until the daughter ■chromosomes have become visible as separate threads. This phenomenon is especially prominent in the nuclear divisions which lead to the formation of the sexual cells. Here certain other features also present themselves which are not observed in the vegetative nuclei, the most im- portant being the reduction in the number of chromosomes —to one-half. This takes place in the spore mother- ■cells of all those Vascular Cryptogams and Phanero-

gams which have been investigated, and is probably of general occurrence. We know very little of the pheno- menon as it takes place in the lower plants, but in Fucus it occurs in the oogonial stage, so that the cells of the vegetative plant have the full number. Inasmuch as the essential feature of fertilization is the fusion of two nuclei, it is evident that unless this reduction took place the number of chromosomes would be doubled at each generation. In the higher plants this reduced number is found in all the cells of the gametophyte, the full

Fig. 1. — Various stages in the nuclear division of the pollen mother-cella of Lilium. {Aft&r Grigoire.)

number in those of the sporophyte. The reduction is brought about simply by the segmentation of the spirem thread into half the number of segments instead of the normal number ; but there is no diminution in the actual amount of nuclear substance. During the second division, however, it has been stated that a qualitative reduction is brought about by the transverse division of the chromo- somes, and that different chromatin granules, or ids, are thus distributed to the daughter nuclei. This has an

important bearing upon the supposed function of the ids as the bearers of hereditary qualities in fertilization ; but the most recent investigations seem to show that, so far as

plants are concerned, such transverse divisions do not take place. In the process of division of a spore mother-cell the spirem thread is divided longitudinally before the segmentation occurs (Fig. 1, B), and this is preceded by a peculiar contraction of the thread around the nucleolus which has been termed synapsis (Fig. 1, A). It has been suggested that this may be connected with the early splitting of the thread, but some observers regard it as a contraction due to reagents. The segments of each chromosome are usually twisted upon each other and may be much contorted (Fig. 1, C, D). Soon after the segmentation the chromosomes begin to shorten and thicken, and another peculiar phenomenon is then observed — each longitudinal half of the chromosome exhibits a double row of dots instead of a single row, probably due to a second division of the chromatin granules. This is not, however, accompanied by a longi- tudinal fission of the linin segment, and the granules are soon obscured by the continued shortening and thicken- ing of the chromosome, which finally becomes homogene- ous (Fig. 1, E). The longitudinal segments of the chromosome become more or less fused together, espe- cially at the ends, by which variously shaped figures are produced of greater or less regularity (Fig. 1, E). The chromosomes now become attached to the spindle-fibres (Fig. 1, F, Gr), and as the daughter chromosomes become pulled asunder they often appear more or less V-shaped, so that each pair appears as a closed ring of irregular shape, the ends of the V's being in contact thus — o (Fig. 1, H, I, J, K). This V has been variously inter- preted. Some observers consider that it is due to bending, others to the early longitudinal splitting, of the daughter chromosomes, the segments of which remaining connected together at one end, produce a V-shaped figure. From the recent observations of Strasburger it appears probable that the latter interpretation is the correct one in most cases, and that the former only occurs exceptionally. The form of division which is thus

characterized by the early longitudinal fission of the chromosomes and the formation of more or less regular rings is called the heterotype division. In the one case, therefore, this ring is formed by a single longitudinal fission and subsequent bending of the two halves of the chromosome ; in the other, by two longitudinal fissions at right angles to one another. In either case the first division of the germ-nucleus in which the reduced number of chromosomes appears, results in an equal division of the chromatin granules or ids to each daughter nucleus, just as in the vegetative nuclei. But now comes the important question. Is the division which next takes place in the daughter nuclei of this nature, or is it effected in such a manner as to produce a qualitative separation of the chromatin ? In other words, is the divi- sion of the chromosomes of the daughter nuclei longitudi- nal or transverse ? Some observers contend that where the V-shape is produced by a bending of the chromosome, the division is accomplished by a separation of the V's at the apex, and that in this way we get a true transverse or qual- itative division. But from the observations of Farmer, Sargant, Gregoire, Strasburger, and others, it appears that in all such cases the division takes place by a longi- tudinal splitting of the V, and not by its separation at the apex ; and where the V's are produced, not by bending, but by the early longitudinal splitting of the chromosomes, it is evident that their separation at the apex is simply the completion of this longitudinal fission, and not a trans- verse division at all (Fig. 1, L to P).

In the majority of plant-nuclei, both in the higher and

lower plants, there is found, in addition to the chromatin

network, a deeply stained spherical or slightly

Nucleolus, jjjggijar body (sometimes more than one) called

the nucleolus (Fig. 1, A to D). It is often vacuolar, some-

times granular, and in other cases it is a homogeneous body with no visible structure or differentiation. The special function of this organ has been a source of con- troversy during the past few years, and much uncertainty still exists as to its true nature. There does not appear to be

any staining reaction which absolutely separates it from other structures in the cell. In resting nuclei it often stains more deeply than any other of the nuclear constituents. In nuclei in a dividing stage it tends to dis- appear or break up into granules, and always stains less intensely than in the resting stage. So far as we know at present, there are two distinct types of nucleoli in plants, one of which stains exactly like chromatin in the chromo- some stage, the other more like the cytoplasm. Many observers are inclined to the view that true nucleoli do not contain chromatin, but our knowledge of their behaviour towards the various reagents which are stated to differen- tiate chromatin is not sufB.ciently definite to allow that view to pass uncriticized. Nor is our knowledge of the morphological behaviour of the nucleolus suflBlcient to enable us to draw a definite distinction between "true nucleoli " and nucleolus-like bodies. It may be that all these structures should be regarded as true nucleoli of a different chemical nature (Montgomery). The nucleolus is most commonly considered to be a store of reserve material for the use of the nucleus during division, serv- ing also in part to nourish the chromosomes. This view, which was formerly held by Strasburger, is supported by the behaviour of the nucleolus during division. In the resting condition it stains more deeply than the chromatin networ]£, but as the chromosomes are formed it loses its capacity for stains to a large extent, and the staining capacity of the chromosomes at the same time increases ; in some cases the nucleolus breaks up, and particles of nucleolar substance are often found attached to the chro- mosomes, other particles being at the same time found in the cytoplasm. According to Strasburger's more recent explanation, the nucleolus is concerned mainly in the formation of the nuclear spindle. As it dissolves, it is taken up by the kinoplasm, which is thereby stimulated to form the spindle-figure, and the maximum development of the spindle fibres coincides with the complete or partial disappearance of the nucleolus. Another explanation given, which is probably the best, is that the nucleolus is a store of reserve material both for the chromosomes and for the production of the spindle.

The centrosome is a minute homogeneous granule found in the cytoplasm of some cells in the neighbourhood of the nucleus. It is generally surrounded by a clear space, which is in turn surrounded by a granular or radiating cytoplasmic substance, the whole being known as the

centrosphere or aMraction-sphere. According to the researches of Van Beneden, Boveri,' and others, it is an important special organ of the animal cell, and has been regarded as a regular constituent of it, like the nucleus. It is not so common in plant cells, and its presence has only been certainly demonstrated in the Thallophytes and Bryophytes. In the higher plants the structures which have been often described as centrosomes are too indefinite in their constitution to allow of this interpretation being placed upon them. Even in the lower plants, while the centrospheres may be very apparent, the granules found in them are not sufficiently uniform either in number or general character to allow of their being regarded as centrosomes (Farmer), and many of the centro- somes described are probably nothing more than granules of the fragmented nucleolus, or possibly extra-nuclear nucleoli. They do not appear to be permanent organs of the cell. They are prominent during cell-division, but may disappear in the resting stage. They are more easily seen , when the nucleus is about to undergo mitosis, at the ends

Ceatro- some.

of the spindle, where they form the centres towards which the radiating fibres in the cytoplasm converge. The centrosome or centrosphere is usually regarded as the dynamic centre of the cell and a special organ of divi- sion; but its absence in many groups of plants does not lend support to this view so far as plant-cells are concerned. '

The membrane which surrounds the protoplasts in the majority of plants is typically composed of cellulose, Cell- together with a number of other substances

membrane. ^^^^ are known as pectic compounds. Some of these have a neutral reaction, others react as feeble acids. They can be distinguished by their insolu- bility in cuprammonia, which dissolves cellulose, and by their behaviour towards stains, some of which stain pectic substances but not cellulose. Cellulose has an affinity for acid stains, pectic substances

for basic stains. The cell- membrane may become modified by the process of lignifi- cation, suberization, cuticularization, or gelatinization. In the Fungi it is usually composed of a modified form of cellulose known as Fungus cellulose, which, according to Mangin, consists of callose in combination either with cellulose or pectic compounds. It is formed by the proto- plasm, either by the direct conversion of the outer cyto- plasmic layer into the cell-wall, or by the excretion of the substances which form the cell-wall. In the formation of the new transverse walls which are produced in cell- division, the cell-plate or protoplasmic membrane pro- duced in the equatorial plane of the spindle-fibres appears to be transformed directly into the primary cell-wall. According to Gardiner's recent researches, the nodes of the spindle-fibres persist as the connecting threads of the protoplasts, and are not, as was formerly supposed, merged in the substance of the cell- wall. It is probable, therefore, that the cell-plate is not, as is usually stated, formed by the fusion of the thickened connecting fibres, but that it is formed out of plasmatic substances conducted to and deposited in the cell-plate region by them. According to Strasburger, the cell-plate splits into two, and the new cell-wall is formed as a secretion product between them. Thick cell-walls exhibit a dis- tinct stratification, and the separate layers are composed of thin lamellae. The primary cell-wall persists as the middle lamella, which appears to be of different chemical composition from the rest of the wall, and to be composed of pectic acid, or a salt of it. By the solution of this middle lamella the cells can be separated from each other. This may take place even in young cells with thin cell- walls. The substance contained in the intercellular spaces, which are formed in some cases between the cells, is probably related to the pectic substances. In many cells there is a distinct striation visible in the cell-wall in addition to the lamination and stratification. These striae run obliquely and across each other, but the two systems do not occur in the same lamella. We know very little of the minute structure of the cell-wall beyond its lamina- tion and striation. Nageli considered it to be composed of minute particles of cellulose — Micellce — each surrounded by water. Wiesner suggests that it consists of minute particles or dermatosomes connected together by a delicate protoplasmic network ; and there is a certain amount of evidence to show that it is composed of radiating elements somewhat similar to those which are supposed to occur in starch grains. The growth of the cell-wall takes

place by the addition of new layers to those already formed. These layers are secreted by the protoplasm by the direct apposition of substances on those already in existence ; and they may go on increasing in thickness, both by apposition and by the intussusception of particles probably carried in through the protoplasmic fibres, which penetrate the cell-wall as long as the cell lives. The growth of the

cell-wall is very rarely uniform. It is thickened more in some places than in others, and thus are formed the spiral, annular, and other markings, as well as the pits which occur on various cells and vessels. Besides the internal or centripetal growth, some cell-walls are thickened on the outside, such as pollen grains, oospores of Fungi, cells of Peridinese, &c. This centrifugal growth must apparently take place by the activity of protoplasm ex- ternal to the cell. The outer protective walls of the oospores of some Fungi are formed out of protoplasm containing numerous nuclei, which is at an early stage separated from the protoplasm of the oospore. In the Peridinese, Diatoms, and Desmids, according to recent researches, the thickenings on the outer walls of the cells are due to the passage of protoplasm from the interior of the cell to the outside, through pores which are found perforating the wall on all sides.

Cell-walls may become modified by the impregnation of various substances. Woody or lignified cell-walls appear to contain substances called coniferin and vanillin, in addition to various other compounds which are imperfectly known. Lignified tissues are coloured yellow by aniline sulphate or aniline chloride, violet with phloroglucin and hydrochloric acid, and characteristic reactions are also given by mixtures containing phenol, indol, skatol, thallin sulphate, &c. (see Zimmerm an's Microtechnique) . Staining reagents can also be used to differentiate lignified cell- walls. Cuticularized or suberized cell-walls occur espe- cially in those cells which perform a protective function. They are impervious to water and gases. Both cuticular- ized and suberized membranes are insoluble in cupram- monia, and are coloured yellow or brown in a solution of chlor-iodide of zinc. It is probable that the corky or suberized cells do not contain any cellulose (Gilson, Wisse- lingh) ; whilst cuticularized cells are only modified in their outer layers, cellulose inner

layers being still recognizable. The suberized and cuticularized cell-walls appear to con- tain a fatty body called suberin, and such cell-walls can be stained red by a solution of alcannin, the lignified and cellulose membranes remaining unstained.

Except in the unicellular plants the cell is not an inde- pendent unit. Apart from their dependence in various ways upon neighbouring cells, the protoplasts of all plants are probably connected together by fine P”>to- strands of protoplasm which pass through the ^t^aity. cell-wall (Tangl, Russow, Gardiner, Kienitz- Gerloff, and others) (Fig. 2). In Pinus the presence of connecting threads has recently been demonstrated throughout all the tissues of the plant. These protoplasmic strands are, except in the case of sieve tubes, so delicate that special methods have to be employed to make them visible. The basis of these methods consists in causing a swelling of the cell-wall by means of sulphuric acid or zinc chloride, and subsequent staining with Hoffmann’s blue or other anil- ine dyes. Fresh tissue may be used, or tissue killed and hardened in dilute solution of iodine, or in osmic acid — ^uran- ium-nitrate mixture. Alcohol is not suitable. The results so far obtained show that the con- necting threads may be either ” pit-threads ” which traverse the closing membrane of the pits in the cell-walls (Fig. 2, B), or ” wall-threads ” which are present in the wall of the cell (Fig. 2, A). Both pit-

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Fig. 3. — Continuity of protoplasm of cells of Tamus communia (A) and endosperm of Liliitm Ma7’- tagon (B). {After Gardiner.)

threads and ■wall-threads may occur in the same cell, but more often the threads are limited to the pits. The pit- threads are larger and stain more readily than the wall-threads. The threads vary in size in different plants. They are very thick in Viscum album, and are well seen in Phaseolus muUiflorus and Lilium Martagon. In epidermal cells (Tamus communis, Lilium Martagon) the external walls are penetrated by threads which ex-

tend to the cuticle. In dead cells the threads appear to be converted into mucilage. These connecting threads probably consist of ectoplasm. They are present from the beginning of the development of the cell- wall, and arise from the spindle fibres, all of which may be con- tinued as connecting threads (Endosperm of Tamus comr munis), or part of them may be overlaid by cellulose lamellae (Endosperm of Lilium Martagon), or they may be all overlaid as in pollen mother-cells and poUen grains of Helleborus fcetidus. The presence of these threads between all the cells of the plant shows that the plant body must be regarded as a connected whole ; the threads themselves probably play an important part in the growth of the cell-wall, the conduction of food and water, the process of secretion, and the transmission of impulses. In certaia cells of the root-apices of plants, however, there exist, according to N6mec, longitudiual protoplasmic fibrils which are especially concerned in the conduction of stimuli.

The component parts of the tissues of which plants are composed may consist of but slightly modified cells with copious protoplasmic contents, or of cells which have been modified in various ways to perform their several func- tions. In some the protoplasmic contents may persist, in others they disappear. The formation of the conducting tubes or secretory sacs which occur in all parts of the higher plants is due either to the elongation of single cells, or to the fusion of cells together in rows by the ab- sorption of the cell-walls separating them. Such cell- fusions may be partial or complete. Cases of complete fusion occur in the formation of laticiferous vessels, and in the spiral, annular, and reticulate vessels of the xylem. Incomplete fusion occurs in sieve tubes. Tubes formed by the elongation of single cells are found in bast fibres, tracheides, and especially in laticiferous cells.

The laticiferous tissue consists of a network of branching or anastomosing tubes which contain a coagulable fluid known as latex. These tubes penetrate to all ous'ttesue P^J^ts of the plant and occur in all parts of the root, stem, and leaves. A protoplasmic lining is found on their walls which contains nuclei. The walls are pitted, and protoplasmic connexions between the latici- ferous tubes and neighbouring parenchyma-cells have been seen. The fluid sap contains various

substances, either in solution or suspended in the form of minute globules, such as sugar, tannin, malic acid in combination with lime, starch-grains, and small globules composed of caoutchouc or resin, which give to the fluid its milky appearance. There are two types of laticiferous tissue — non-articulate and articulate. The non-articulate tissue which occurs in Euphorbiaceae, Apocynese, Urticaceee, Asclepiadese, con- sists of long tubes, equivalent to single multinucleate cells, which ramify in all directions throughout the plant. The development of laticiferous cells takes place quite early in the embryo, from a group or groups of cells which form a single layer in the pericycle around the central cylinder of the embryo at the cotyledonary node. The number of these initial cells appears to be constant for each species. In some cases a second layer is found just external to the central cylinder, in the cortex, from which a separate corti- cal system is developed. In other cases the single layer of initial cells gives off branches which penetrate the cortex, central cylinder, and pith (Chauveaud). Laticiferous

vessels arise by the coalescence of originally distinct cells. The cells not only fuse together in longitudinal and transverse rows, but put out transverse projections, which fuse with others of a similar nature, and thus form an anastomosing network of tubes which extends to all parts of the plant. They are found in the Compositae (Cichoriacece), Campanulacese, Papaveraceae, Lobellaceae, Papayacese, m some Aroideae and Musaceae, and in Euphor- biaceae (Manihot, Hevea). The nuclei of the orignal cells persist in the protoplasmic membrane. Kny has shown that in the Cichoriacese hairs containing latex are com- monly present, connected to the laticiferous network by means of a narrow opening at the base. The rows of cells from which the laticiferous vessels are formed can be distinguished in many cases in the young embryo while still in the dry seed (Scott), but the latex vessels in process of formation are more easily seen when germina- tion has begun. In the process of cell-fusion the cell- wall swells slightly and then begins to dissolve gradually at some one point. The opening, which is at first very small, increases in size, and before the cross-wall has entirely disappeared, the contents of the two cells become continuous (Scott). The absorption of the cell-walls takes place very early in the germinating seedling.

The sieve tubes consist of partially fused rows of cells, the tranverse or lateral walls being perforated by minute openings, through which the contents of the cells are connected with each other, and which after of tubes. a certaia time become closed by the formation of callus on the sieve plates. The sieve tubes contain a thin lining layer of protoplasm on their walls, but no nuclei, and the cell sap contains albuminous substances which are coagulable by heat. Starch grains are some- times present. In close contact with the segments of the sieve tubes are companion cells which communicate with the sieve tubes by delicate protoplasmic strands ; they can be distinguished from ordinary parenchymatous cells by their small size and dense protoplasm. Companion cells are not found in the Pteridophyta and Gymnosperms. In the latter their place is taken by certain cells of the medullary rays and bast parenchyma. The com- panion cells are cut off from the same cells as those which unite to form the sieve tube. The mode of forma- tion of the sieve plate is not certainly known ; but from the fact that delicate connecting threads of protoplasm are present between the cells from their first develop- ment, it is probable that it is a special case of the normal protoplasmic continuity, the sieve pores being produced by a secondary enlargement of the minute openings, through which these delicate strands pass. According to Lecomte, the young wall consists partly of cellulose and partly of a substance which is not cellu- lose, the latter existing in the form of slight depressions, which mark the position of the future pores. As the sieve plate grows, these non-cellulose regions swell and gradually become converted into the same kind of mucous substance as that contained in the tube; the two cells are thus placed in open communication. If this is correct, it is easy to see that the changes which take place may be initiated by the original delicate protoplasmic strands which pass through the cell-wall. (For further informar tion regarding tissues, see Anatomy of Plants.)

The formation of the zygote or egg-cell takes place usually by the fusion of the contents of two cells, and always includes, as an essential feature, the fusion of two germ nuclei. In many of the lower f^^'"^' plants the fusing cells — gametes — are precisely similar so far as size and general appearance are concerned; and the whole contents of the two cellg fuse

together, cytoplasm with cytoplasm, nucleus with nucleus, nucleolus with nucleolus, and plastid with plastid. The gametes

may be motile (some Algae) or non-motile, as in Spirogyra, Mucor, Basidiobolus, &c. In many of the lower plants and in all higher plants there is a difference in size in the fusing cells, the male cell being the smaller. The reduction in size is due to the absence of cytoplasm, which is in some cases so small in amount that the cell consists mainly of a nucleus. In all cases of complete sexual differentiation the egg-cell is quiescent, but the male cell may be motile or non-motile. In many of the Fungi the non-motile male cell or nucleus is carried by means of a fertilizing tube actu- ally into the interior yfc,^—” of the egg-cell, and is extruded through the apex in close proxim- ity to the egg nucleus. In the rioridеae, Lichens, and Laboul- beniacese the male cell is a non-motile sper- matium, which is car- ried to the female organ by movements in the water. In Monohlepkaris, one of the lower Fungi, in some Algae, in the Vas- cular Cryptogams, ia Cycads (Zamia and Cycas), and in Ginkgo, an isolated genus of Gymnosperms, the male cell is a motile spermatozoid with two or more cilia. In the Algae such as Fucus, Vblvox, Oedogonium, Bulbochcete, and in the Fungus Monoblephor ris, the spermatozoid is a small oval or elongate cell containing nucleus, cytoplasm, and sometimes plastids. In the Characeae, the Vascular Cryptogams, in Zamia and Cycas, and in Ginkgo, the spermatozoids are more or less highly modified cells with two or more cilia, and resemble in many respects, both in their structure and mode of formation, the spermatozoids of animals. In Characese and Muscineae they are of elongate spiral form, and consist of an elongate dense nucleus and a small quantity of cytoplasm. At the anterior end are attached two cilia or flagella. In the Vascular Cryptogams the structure is much the same, but a more or less spherical mass of cytoplasm remains attached to the posterior spirals, and a large number of cilia are grouped along the cytoplasmic anterior portion of the spiral. In Zamia (Fig. 4, A), Cycas, and Ginkgo they consist of large spherical or oval cells with a coiled band of cilia at one end, and a large*

nucleus which nearly fills the cell. They are carried by the pollen tube to the apex of the prothallus, where they are extruded, and by means of their cilia swim through a small quantity of liquid, contained in a slight depression to the oosphere. In the other phanerogams the male cell, which is non- motile, is carried to the oosphere by means of a pollen tube. In the spermatozoids of Chara, Vascular Cryp- togams, and in those of Cycas, Zamia, and Ginkgo, the cilia arise from a centrosome-like body which is found on one side of the nucleus of the spermatozoid mother-cell. This body has been called a blepharoplast, and in the Pteridophytes, Cycads, and Ginkgo it gives rise- to the spiral band on which the cilia are formed. Belajeff regards it as a true centrosome; but this is

Fio. 8.— Fertilization In the. Lily. (IVom Wilson^ after GhUgnard and Mottier.) A, Two vermiform nuclei in the embryo sac ; one approaching the egg-nucleus, the other uniting . with the upper polar nucleus, B, Union of the vermiform nuclei with the egg- nucleus and the two polar nuclei. G, Fusion of the germ nuclei in the egg-cell ; a, anti- podal cells ; p, polar nuclei ; pt^ pollen tube.

doubtful, for while in some cases it appears to be con- nected with the division of the cell, m others it is independent of it. The egg-cell or oosphere is a large cell containing a single large nucleus, and in the green plants the rudiments of plastids. In plants with multi- nucleate cells, such as Cystopus, Peronospora, and Vaucheria, it is usually a uninucleate cell differentiated by separation of the nuclei from a multinucleate cell, but in Cystopus Bliti it is multiaucleate, and in Sphceroplea it may contain more than one nucleus. In some cases the region where the penetration of the male organ takes place is indicated on the oosphere by a hya- line receptive spot {CEdogonium, Vau- cheria, &c.), or by a receptive papUla consistiQg of hyaline cytoplasm (Peronos- poreae^. Fertilization is effected by the union of two nuclei only in all those cases which have been care- fully investigated. Even in the multi- nucleate oosphere of Cystopus Bliti the nuclei fuse in pairs; and in the oospheres of Sphceroplea, which may contain more than one nucleus, the egg nucleus is formed by the fusion of one only of these with the spermatozoid nu- cleus (Klebahn). In the higher Fungi nuclear fusions take place in Basidia or Asci which involve the union of two and sometimes more

nuclei, which may be regarded as physiologically equivalent to a sexual fusion. The union of the germ nuclei has now been observed in all the main groups of Angiosperms, Gymnosperms, Ferns, Mosses, Algae, and Fungi, and presents a striking resemblance in all. In nearly all cases the nuclei appear to fuse in the resting stage (Fig. 3, C). In many Gymnosperms the male nucleus penetrates the female nucleus before fusing with it (Blackman, Ikeno). In other cases the two nuclei place themselves side by side, the nuclear membrane between them disappears, and the contents fuse together — nuclear thread with nuclear thread, and nucleolus with nucleolus — so completely that the separate constituents of the nuclei are not visible. It was at one time thought that the centrosomes played an important part in. the fertil- ization of plants, but recent researches seem to indicate that this is not so. Even in those cases where the cilia band, which is the product of the centrosome-like body or blepharoplast, enters the ovum, as in Zamia (c in Fig. 4, B, C, D), it appears to take no part in the fertilization phenomena, nor in the subsequent division of the nucleus. During the process of fertilization in the Angiosperms it has been shown by the researches of Nawaschin and Guignaid that in Lilium and Fritillaria both generative nuclei enter the embryo sac, one fusing with the oosphere nucleus, the other with the polar nuclei (Fig. .3, A, B). A double fertilization thus takes place. Both nuclei are elon- gated vermiform structures, and as they enter the embryo

Fia. 4. — Spermatozoid and fertilization In Zamia. {After Webier.')

sac present a twisted appearance like a spermatozoid with- out cilia (Fig. 3, A, B). It has since been shown by other observers that this double fertilization occurs in many- other Angiosperms, both Dicotyledons and Monocotyle- dons, so that it is probably of general occurrence through- out the group (see Angiosperms).

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(h. w.)*

Czaslau or Caslau, chief town of the govem- ment district of the same name in Bohemia, Austria. Population (1890), 8396, almost exclusively Czech and Catholic (655 Protestants and 247 Jews) ; (1900), 9145. There is a garrison of 623 men. A monument was erected in 1880 to the

celebrated Hussite leader, Ziska, who was buried in the church. There are a sugar refinery, a brewery, and a distillery.

Czech Literature (see Bohemia and Slats, Ency. Brit. 9th edition). — The later years of the 19th century saw a continued forward movement in the re- vived literature of Bohemia; but this progress may be briefly indicated, since its interest is still mainly local, except in so far as the work of Czech writers has helped to vindicate the Bohemian national movement by the re- assertion of the Bohemian language as a literary vehicle. Between 1820 and 1848 anew "national school" of writers arose, led by Joseph Jungmann (1773-1847), and includ- ing the poets Jan Koll£ir (1793-1852), J. Kamaryt, Langer, Rubes, and Borovsky (1821-56), the dramatists Turnisk;^ and Klicpera, and the novelists Jan Marek and Joseph Tyl. Jungmann introduced new models by his translations of British, French, aild German literature; the new Czech drama was largely influenced by Shakespeare, and the novel by Sir Walter Scott. This " national school " gradually acquired a Panslavist character, Jungmann himself, the phijologist V. Hanka (1791-1861), and the historians P. Safarik (1795-1861), Franz Palacky (1798-1876), and Tomek (who, born in 1818, was still working at his great History of Prague at the end of the century) being the most prominent representatives of this tendency. After 1848 the narrower traditions of the national school gave way before a spirit of cosmopolitanism, introduced by H. Mdcha (1810-76), but much encouraged by the in- fluence of Byron ; the poets H. H^lek (1835-74) and Jan Nenida (1834^91) being the leading names in this con- nexion. The national and cosmopolitan schools then became blended in writers of a more eclectic type, like the poets Svatopluk Cech and " Jaroslav Vrchlicky (pseudo- nym for Emil Frida), the latter of whom (6. 1853) published some twenty volumes of poems, translations, dramas, and essays between 1893 and 1900. His epic poem Bar- Kochba, describing the last struggle of the Jews against Rome, is his masterpiece. Between 1890 and 1900 there was a great increase of literary production of all sorts. Julius Zeyer (6. 1841), besides writing poetry, has published many romantic prose stories ; and Madame "Carolina Svjetla" (pseudonym for Johanna Muz^k, 6. 1830) is a novelist whose tales portray the life of the people. Among recent Czech dramatists must be men- tioned Stroup^znicky, the brothers Mrstik, Vaclav Vi8ek, and Vaclav Fri6

(pseudonym ” Brodsky,” b. 1829), while Adolph Heyduk (6. 1831), has made a name as a poet, and Anton Gindely (1829-92) as a historian.

Czernowitz (Rumanian, Cernduz), the capital of the Austrian duchy of Bukovina. Population, with suburbs (1869), 33,884; (1890), 54,171; (1900), 69,619. There is a garrison of 2965 men. There are several rather imposing modern buildings, including the Episcopal Palace in the Byzantine style, the Greek Orthodox cathedral, the Jesuit church, and a Hebrew temple in the Moorish style. The Francis Joseph University, opened in October 1875, has three faculties: theology (Greek Orthodox), law and politics, and philosophy. The language of instruction is German. In 1897 there were 41 professors and lecturers and 390 students. The industry (corn-milling and brew- ing) is unimportant. The trade, which is in the hands of the Jews and Armenians, is chiefly in corn, timber, cattle, hides, wool, and potash.

Dacca, a city of British India, giving its name to a district and division of Bengal. The city is 150 miles north-east by east of Calcutta, on an old channel of the Ganges. Eailway station, 10 miles from the terminus of the river steamers at Narayanganj. Its area is about 8 square miles. The population in 1881 was 79,076, in 1891 it was 82,321, and in 1901 it was 90,679. It still shows some signs of its former magnificence. The famous manu- facture of fine muslins is almost extinct, but the carving of shells, carried on from ancient times, is an important industry in the city. The Government college had 318 students in 1896, and the collegiate school 556. There is also an unaided Hindu college, with 222 students. There are 20 printing-presses, issuing 3 English and 3 vernacu- lar newspapers. There is a large settlement of mixed Portuguese descent, known as Firinghis. Many of the public buildings, including the College, suffered severely from the earthquake of 12th June 1897.

The DISTRICT comprises an area of 2797 square miles. In 1881 it had a population of 2,113,005, and in 1891 of 2,420,656, giving an average density of 865 persons per square mile. Classified according to religion,

Hindus numbered 934,063; Mahommedans, 1,450,250; Chris- tians, 10,476, of whom 223 were Europeans ; " others," 813. In 1901 the population was 2,660,631, showing an increase of 11 per cent. The land revenue and rates were Rs.6,08,761 ; the number of police was 697 ; the number of boys at school in 1896-97 was 75,836, being 42-4 per cent, of the male population of school-going age; the registered death-rate in 1897 was 27-97 per thousand. The district is now traversed by a line of the Eastern Bengal railway, and it is further proposed to connect it by branches with the Assam-Bengal railway ; but most of the traffic is still conducted by water. It is a centre of the jute trade. There are 21 steam presses, em- ploying 8000 hands, with an out-turn of 1,427,000 bales ; and 10 hand-presses, with a capital of Es.24,00,000, em- ploying 1130 hands, with an out-turn of 130,000 bales.

The DIVISION OF Dacca occupies the delta of the Brah- maputra, where it joins the main stream of the Ganges. It consists of the four districts of Dacca, Mymensingh, Faridpur, and Backergunge. Its area is 15,045 square miles. Its population in 1881 was 8,705,916, and in 1891 it was 9,844,127, — by far the highest rate of increase in Bengal, — with an average density of 654 persons per square mile.

Daghestan, a province of Eussia, Transcaucasia. It occupies the triangular space between the Andi ridge, the south-east portion of the main Caucasus Eange, and the Caspian Sea, and has Terek in N., Tiflis in S.W., Baku in S.E., and Caspian Sea in E. With the exception of a narrow strip of land along the seacoast and a small area in north, it is entirely covered with mountains, and presents one of the most hilly parts of the world. Area, 11,492 square miles. The snow-clad Andi ridge, belong- ing to the system of the south-west to north-east up- heavals which cross the Caucasus, branches off the latter at Barbalo Peak (10,807 feet), and reaches its highest altitudes in Tebulos-mta (14,781 feet). Great Kachu (14,027 feet), and Donos-mta (13,736 feet). It is encirr cled on the north by a lower outer ridge, the Black Mountains, pierced by the rivers, and thickly clothed with woods, composed chiefly of beech (Ichkeria). The Bozdakh and another ridge run in the same direction be- tween the four Koisu rivers (Avarian, Andian, Kazy- kumukh, and Kara Koisu), all flowing north-east to make the Sulak, a tributary of the Caspian. The

main feature of the country is, however, according to Abich, the succession of folds of Jurassic cretaceous limestones and slates, all nearly parallel to the Caucasus, forming high

and barren plateaux. Many peaks rise above 12,000 feet, and the passes are at altitudes of 11,000 feet in the inte- rior of the country and 9000 feet in the east, towards the Caspian. The country is altogether difficult of access, and only one military route leads from Grozny! on the Terek to the military town of Botlikh on the Andi Koisu, while the eleven passes known across the Caucasus are mere bridle-paths. The climate is severe on the plateaux, hot towards the Caspian, and dry everywhere. The average temperatures are : year 61°, January 26°, July 73° at Temir-khan-shura (42° 49′ IST., alt. 475 feet). The yearly rainfall varies from 21 to 17 inches.

The population of Daghestan was 590,336 in 1897, out of whom there were only 5000 Russians. It consists chiefly of mountaineers, known under the general name of Lezghians, in the west, and of a mixture of the same with Tatars and Georgians in the Caspian coast region. For a long time the highlands of Daghestan were the stronghold of the Caucasians against the Russians, especially under the leadership of Shamil. The difficulties of communication between the valleys have resulted in the formation of a great num- ber of dialects, or even languages, which have been divided by Baron Uslar into several groups. The Avarian is a sort of inter- tribal tongue, while the Lakh or Kazy-kumukh language, the Kyurin, the Dargo-kaitakh, the Andi, and the Tabasaran are as many separate languages of common origin, subdivided in their turn into a number of dialects.

The mountaineers breed some cattle, and cultivate with great difficulty their small fields on the slopes of the mountains. In the littoral regions excellent crops are obtained with the aid of irriga- tion. The mountaineers excel also in a variety of petty trades.

A railway line of grefct importance, connecting the North Cau- casian line, Rostov to Petrovsk, with the Transcaucasian line, Batum to Baku, has been built of late. It runs along the seacoast from Petrovsk, through the Derbent ” Gate,” to Baku.

The province is divided into nine districts : Temir-khan-shura, Avarian, Andian, Gunib, Dargo, Kazy-kumukh, Kastago-Taba- saran, Kyurinsk, and Samur. The only towns are : Temir-khan- shura, capital of the province (9210 Inh.), Derbent on the Caspian (14,821), and Petrovsk, a seaport of some importance (9810). The chief towns of the districts are mere military villages or forts, of which the fort of Gunib, the last stronghold of Shamil, has only 825 inhabitants. (p. a. k.)

Dagupan, the most important commercial centre in the province of Pangasinan, Luzon, Philippine Islands, and the northern terminus of the only railway in the islands. It is situated near the mouth of one of the branches of the Agno, but can be approached only by vessels of very small draught, because of a narrow bar at the river's mouth. It has a healthful climate, and is the chief point of exportation for a very rich province, which produces rice, sugar, indigo, Indian corn, and copra in abundance. It has a shipyard in which small sailing vessels and steam launches are constructed. The principal language is Pangasinan. Population, 16,000.

Dahomey. — An old West African kingdom, now a French colony, bounded on the S. by the Gulf of Guinea, on the E. by Lagos, on the N. and N.W. by the military territories of the French Sudan, and the W. by Togoland. With a coast-line of only 76 miles, the area after the decree of October 1899 (see below) was estimated at about 69,000 square miles, and the population at about 450,000, but nothing is as yet known with any degree of accuracy on these points. The coast is very low, sandy, and obstructed by a bar. Behind the immediate coast-line is a line of lagoons, where small steamers can ply : that of Porto Novo, on the east, that of Whidah, the longest (26 miles), and that of Grand Popo. The Ofe, the only important river (240 miles), drains the colony from the Bariba country to Porto Novo. The Zu is an affluent. The climate is very hot and moist. Four seasons are well marked: the long dry season, from December 1 to March 15 ; the season of the great rains, from March 16 to July 15; the short dry season, from July 15 to September 15 ; and the little rains, from September 15 to December 1. The negroes, of whom the population

entirely consists, belong to the Mina, Ewe, Fou, Mahi, Nago, and Bariba races. Cultivation is primitive and nine-tenths of the lands are waste. Maize, manioc, yams, and potatoes grow along the coast ; millet in the interior. The forests contain the baobab, the cocoanut palm, and the oil-palm. Cattle are rare, and a few years ago the ox was entirely un- known. An experimental farm is carried on at Porto Novo.

France first established factories in 1851 at Whidah, after the signature of a treaty with the king. In 1868 a similar power was granted at Kotonu, and in 1878 France received authority to collect the customs at this locality. In the meantime, in 1863, the kingdom of Porto Novo had accepted the French protectorate, and the Anglo-French agreement of 1864 had fixed its boundaries. This protectorate was soon afterwards abandoned by Napoleon III., but was re-established in 1882 ; in 1885 a Franco-German convention assigned GrandPopo to France and Little Popo, to the west of the coast of Dahomey, to Germany. In 1890, Glegle, king of Dahomey, claimed the right to collect the customs at Kotonu, ceded to France in 1878, and to depose the king of Porto Novo, while he also interfered with the French and with the population protected by France. The dispute ended with a treaty which secured to France her rights and to the king of Dahomey an annual pension of £800. In 1892 the attitude of King Behanzin rendered a new war necessary ; Abomey, his capital, was taken by General Dodds, his states were annexed, and he himself was sent a prisoner to the Antilles. In 1894 the colony was separated from France's other West African possessions and became a separate administrative unit. Anglo-French conventions of 1889 and 1898 fixed the eastern frontier, and a Franco- German convention of 1897 settled the boundary on the west. The limits northwards were Gxed on the disin- tegration of the French Sudan in 1899, when some of the cantons of Kwala, or Nebba, and the territory of Say, on the Niger, were added to the colony's possessions.

The colony is administered by a governor (himself under the Governor-General of French West Africa), assisted by a council composed of three official and three civil members. It has a paymaster-general and a justice of peace. It is one of the three French West African colonies which have been allowed to manage their own finances, with the result that it is

entirely self-supporting. In 1899 the receipts amounted to £110,634, or £34,634 more than was antici-

pated in the budget. The budget for 1901 anticipated £89,000, of which the native tax was expected to produce £14,800. The principal items of expenditure provided for, apart from £31,000 for the administrative service, were : public works, &c., £21,500; the occupation of Upper Dahomey, £19,000; native troops and police, £9000. The chief towns are Por^o Novo (50,000), the seat of government ; Grand Popo (2000), a port ; Kotonu (1000), a port ; Whidah, a port ; and in the interior, Abomey (15,000), the capital of Dahomey, 75 miles from the sea, AUada (10,000), and Agony (20,000).

The following table gives the value of the principal articles of im- port and export for 1898 and 1899, with the totals for those years :

Tear.

Imports.

Exports.

TextUes.

Intoxi- cants.

Total.

Palm Kernels.

Palm Oil.

Total.

1898 1899

£83,000

77,000

£155,000

182,000

£400,000

494,000

£170,000

£109,000

£801,500

509,000

In 1898 Great Britain sent nearly all the textiles, Germany nearly aU the intoxicants. The exports of kernels to Lagos was more than half the total, while France and Germany divided the remainder about equally. Lagos and France each received nearly half the oil export. France's total share of the imports in 1898 amounted to only £135,000 ; of the exports to only £118,300.

France can only slowly increase her sales, the convention of 1898 having guaranteed absolute equality in respect of customs. There are few roads, but a telegraph line connects Kotonu with Abomey, Gurma on the Niger, and Senegal • A railway is projected between Kohonou and the Niger. With Europe there is telegraphic communication (at Kotonu) over an English submarine cable, and steamship communication by lines from Bordeaux and Marseilles and Liverpool and Hamburg. In 1898, of 433 steamers which visited Dahomey, 111 were French, 133 British, and 156 German. French, English, and American coins circulate, and also cowrie shells. The difficvdty of firmly establish- ing French money as the basis of exchange is one of the problems of the colony.

Authorities. — Beetin. Benseignements sur Porto Novo et le Dahomey. Paris, 1890. — Adblet. La Chierre du Dahomey. Paris, 1894. — Leb.

French Colonies. Foreign Office Eeport, 1900. — L^Annee Coloniale. Paris, 1900. (p. l.)

Daiquiri, a village 15 miles east of Santiago de Cuba. An expensive iron pier, built by the American shippers of Cuban ores, was used for the landing of the American army in the advance on Santiago in 1898. Population (1899), 1380.

DAIRY-FARMINa.

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MoDEBN Changes.

“VFO branch of agriculture underwent greater changes _lN during the closing quarter of the 19th century than dairy-farming ; within the period named, indeed, the dairy- ing industry may be said to have been revolutionized. The two great factors in this modification were the intro- duction about the year 1880 of the centrifugal cream- separator, whereby the old slow system of raising cream in pans was dispensed with, and the invention some ten years later of a quick and easy method of ascertaining the fat content of samples of milk without having to resort to the tedious processes of chemical analysis. About the

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year 1875 the agriculturists of the United Kingdom, influenced by various economic causes, began to turn their thoughts more intently in the direction of dairy-farming, and to the increased production of milk and cream, butter and cheese. On 24th October 1876 was held the first London Dairy Show, under the auspices of a committee of agriculturists, and it has been followed by a similar show in every subsequent year. The official report of the pioneer show stated that " there was a much larger attend- ance and a greater amount of enthusiasm in the movement than even the most sanguine of its promoters anti- cipated." On the day named Professor J. Prince Sheldon read at the show a paper on the dairying industry, and

proposed the formation of a society to be called the British Dairy Farmers' Association. This was unanimously agreed to, and thus was founded an organization which has since been closely identified with the development of the dairying industry of the United Kingdom. In its earlier publications the Association was wont to reprdduce from Household Words the following tribute to the cow: —

" If civilized people were ever to lapse into tlie worship of animals, the Cow would certainly be their chief goddess. What a fountain of blessings is the Cow 1 She is the mother of beef, the source of butter, the original

cause of cheese, to say nothing of shoe-homs, hair-combs, and upper leather. A gentle, amiable, ever-yielding creature, who has no joy in her family affairs which she does not share with man. We rob her of her children that we may rob her of her milk, and we only care for her when the robbing may be perpetrated."

The Association has, directly or indirectly, brought about many valuable reforms and improvements in dairy- ing. Its London shows have provided, year after year, a variety of object-lessons in cheese, in butter, and in dairy equipment. In order to demonstrate to producers what is the ideal to aim at, there is nothing more effective than a competitive exhibition of products, and the approach to uniform excellence of character in cheese and butter of whatever kinds is most obvious to those who remember what these products were like at the first two or three dairy shows. Simultaneously there has been a no less marked advance in the mechanical aids to dairying, in- cluding, in particular, the centrifugal cream-separator, the crude germ of which was first brought before the public at the International Dairy Show held at Hamburg in the spring of 1877. The Association in good time set the ex- ample, now beneficially followed in many parts of Great , Britain, of providing means for technical instruction in the making of cheese and butter, by the establishment of a dairy school in the Vale of Aylesbury, subsequently re- moving it to new and excellent premises at Eeading, where it is known as the British Dairy Institute. The initiation of butter-making contests at the annual dairy shows stim- ulated the competitive instinct of dairy workers, and afforded the public useful object-lessons ; in more recent years milking competitions have been added. Milking trials and butter tests of cows conducted at the dairy shows have afforded results of much practical value. Many of the larger agricultural societies have found it expedient to include in their annual shows a working dairy, wherein butter-making contests are held and public demonstrations are given.

What are regarded as the dairy breeds of cattle is illus- trated by the prize schedule of the annual London Dairy- Show, in which sections are provided for cows and heifers of the Shorthorn, Jersey, Guernsey, Eed Polled, Ayrshire, Kerry, and Dexter breeds, the characteristics of which are set forth in the article Ageioultuke. A miscellaneous class is also

provided, the entries in which are mostly cross-breeds. There are likewise classes for Shorthorn bulls, Jersey bulls, and bulls of any other pure breed, but it is stipulated that all bulls must be of proved descent from dams that have won prizes ia the milking trials or butter tests of the British Dairy Farmers' Association or other high-class agricultural society. The importance of securing dairy characters in the sire is thus recognized, and it is notified that, as the object of the bull classes is to encourage the breeding of bulls for dairy purposes, the prizes are to be given solely to animals exhibited in good stock-getting condition.

Milk and BtrTTBB Tests.

The award of prizes in connexion with milking trials

cannot be determined simply by the quantity of milk

yielded in a given period, say twenty-four hours. Other

matters must obviously be taken into consideration, such

as the quality of the milk and the time that has elapsed since the birth of the last calf. With regard to the former point, for example, it is quite possible for one cow to give more milk than another, but for the milk of the second cow to include the larger quantity of butter-fat. The awards are therefore determined by the total number of points obtained according to the following scheme : —

One point for every ten days since calving (deducting the first forty days), with a maximum of fourteen points.

One point for every pound of milk, taking the average of two days' yield. Twenty points for every pound of butter-fat produced. Four points for every pound of "solids other than fat." Seductions. — Ten points each time the fat is below 3 per cent. Ten points each time the solids other than fat fall below 8-5 per cent.

This method of award is at present the best that can be devised, but it is possible that, as experience accumulates, some rearrangement of the

points may be found to be desirable. Omitting many of the details. Table I. shows some of the results in the case of the Shorthorn and Jersey cows to which prizes were awarded in 1900. The days " in milk " denote in each case the number of days that have elapsed since calving ; and if the one day's yield of

Table I. Prize Shorthorn and Jersey Gows in the Milking Trials, London Dairy Show, 1900.

Cow.

Age.

In

Milk.

Milk Day.

Fat.

other SoUds.

Total Points.

Tears.

Days.

lb

Per

cent.

Per

cent.

No.

Shoethoknb eligible

for Herd-Book—

Heroine III.

6

61

52-4

3-7

8-3

91-5

Musical

7

16

45-2

3-2

9-3

90-8

Lady Eosedale .

8

48

47-8

3-5

9 0

88-7

Shorthorns not

eligible for Herd-

Book—

>

Granny

9

33

70-2

3-5

8-9

144-1

Cherry

9

103

55-5

4-0

8-9

127-1

Chance

6

23

60-0

3-6

8-9

124-6

Jersets —

Sultane 14th

12

256

41-7

4-9

9-4

112

Queen Bess

n

136

39-4

4-8

9-0

101

Gloaming IV.

7

156

30-5

6-7

9-5

94-9

milk is desired in gallons, it can be obtained approxi- mately ^ by dividing the weight in pounds by 10 : thus, the Shorthorn cow Heroine III. gave 52-4 lb, or 5-24 gallons, of milk per day. The table is incidentally of interest as showing how superior as milch kine are the unregistered or non-pedigree Shorthorns — which are typi- cal of the great majority of dairy cows in the United Kingdom — as compared with the pedigree animals en- tered, or eligible for entry, in Coates's Herd-Book. The evening's milk, it should be added, is nearly always richer in fat than the morning's, but the percentages in the table relate to the entire day's milk.

The milking trials are based upon a chemical test, as it is necessary to determine the percentage of fat and of solids other than fat in each sample of milk. The butter test, on the other hand, is a churn test, as the cream has to be separated from the milk and churned. The following is the scale of points used at the London Dairy Show in making awards in butter tests : —

One point for every ounce of butter ; one point for every com- pleted ten days since calving, deducting the first forty days. Maximum allowance for period of lactation, 12 points.

1 A gallon of milk weighs 10-3 lb, so that very little error is in- volved in converting pounds to gallons by dividmg the number of pounds by 10.

[milk and buttek tests

Fractions of ounces of butter, and incomplete periods of less than ten days, to be worked out in decimals and added to the total points.

In the case of cows obtaining the same number of points, the prize to be awarded to the cow that has been the longest time in milk. No prize or certificate to be given in the case of : —

(a) Cows under five years old failing to obtain 28 points. (6) Cows five years old and over failing fo obtain 32 points.

The manner in which butter tests are decided will be rendered clear by a study of Table^ II. It is seen that whilst the much larger Shorthorn cows — ^having a bigger frame to maintain and consuming more food — gave both

Table II. Prize Shorthorn and Jersey Cows in the Butter Tests, London Dairy Show, 1900.

Milk

Milk to

Points

Points

for Lacta- tion.

Cows.

Age.

MUk.

^i;.

Batter.

lib

Butter.

for Butter.

Total Points.

Tears.

Days.

lb oz.

Hi oz.

H)

No.

No.

No.

Ist

9

104

55 2

2 5J

28-67

87-25

6-40

48-65

2nd

9

84

72 7

2 lOJ

27-11

42-75

42-75

8rd .

7

83

58 5

2 7i

23-47

89-75

89-75

Ist ■ .

7

157

29 10

2 21

18-88

84-25

11-70

45-95

2nd

4

108

33 10

2 8

15-87

85-00

6-80

41-30

8rd .

12

257

40 18

1 12

28-32

28-00

12-00

40-00

more milk and more butter in the day of twenty-four hours, the Jersey milk was much the richer in fat. In the case of the first-prize Jersey the "butter ratio," as it is termed, was excellent, as only 13-83 lb of mUk were required to yield 1 lb of butter; in the case of the second-prize Shorthorn, practically t-wice this quantity (or 27-11 lb) was needed. Moreover, if the days in milk are taken into account, the difference in favour of the Jersey is seen to be 123 days.

The butter-yielding capacity of the choicest class of butter cows, the Jerseys, is amply illustrated in the results of the butter tests conducted by the English Jersey Cattle Society over the period of fourteen years 1886 to 1899 inclusive. These tests have been carried out year after year at half a dozen different shows, and the results are classified in Table III. accordiag to the age of the animals. The average time in milk is measured by the number of days since calving, and the milk and butter yields are

Table III. Summary of the English Jersey Cattle Society^s Butter Tests, Fourteen Years, 1886 to 1899.

Cows Tested.

Average

Average

Average

Quantity Milk to

Cows' Ages.

Time in Milk.

MUk Tield.

Butter Tield.

IH) Butter.

Tears.

No.

Days.

lb oz.

lb oz.

lb

Ito 2

2

34

15 2

0 13

18-48

2 „ 3

57

73

24 15J

1 5i

18-74

3 „ 4

108

77

29 14

1 10

18-42

4 „ 5

165

72

32 5

1 Hi

19-01

5 „ 6

188

80

32 15

1 12

18-76

6 „ 7

189

89

34 7

1 18

18-92

7 „ 8

189

84

83 11;

1 13J

18-40

8 „ 9

71

82

33 64

1 12

19-08

9 „10

42

92

32 6

1 11

18-95

10 „11

31

88

35 4

1 14J

18-60

11 „12

15

89

37 1

1 13

19-96

12 „13

18

95

34 li

1 10,

20-56

13 „14

3

64

42 li

2 li

19-85

those for the day of twenty-four hours. The last column shows the ” butter ratio.” This number is lower in the case of the Jerseys than in that of the general run of dairy cows. The average results from the total of 1023 cows of the various ages are : — One day’s milk, 32 ft 2\ oz., equal to about 3 gallons, or 12 quarts ; one day’s

butter, 1 ft lOf oz.; butter ratio, 19-13, or about 16 pints of milk to 1 ft of butter. Individual yields are sometimes extraordinarily high. Thus at the Tring show in 1899 the three leading Jersey cows gave the following results : —

Cow.

Age.

Live- Weight.

In MUk.

Butter.

Butter Eatio.

Sundew 4th Madeira 5th Em . . .

Tears.

8

7 7

lb

929

1060 864

Days.

77

107

44

lb oz. 3 6|

2 15^

3 4|

lb

15-10 16-14 13-32

The eight prize-winning Jerseys on this occasion, with an average weight of 916 ft and an average of 117 days in milk, yielded an average of 2 ft 9 oz. of butter per cow in the twenty-four hours, the butter ratio working out at 16-69. At the Tring show of 1900 a Shorthorn cow Cherry gave as much as 4 ft 4§- oz. of butter in twenty- four hours ; she had been in milk 41 days, and her butter ratio worked out at 15-79, which is unusually good for a big cow.

In the six years 1895 to 1900 inclusive 285 cows of the Shorthorn, Jersey, Guernsey, and Red Polled breeds were subjected to butter tests at the London Dairy Show, and the general results are summarized in Table IV.

Table IV. Average Butter Yields and Butter Matios at the London Dairy Show, Six Years, 1895 to 1900.

Breed.

No. of Cows.

In Milk.

Butter.

Milk to lib Butter.

Shorthorn Jersey Guernsey Ked Polled .

106

126

23

30

Days.

50 99

72 60

lb oz.

1 11 1 101

1 9i 1 4J

lb

28-81 19-15 21-86 30-29

Although cows in the showyard may perhaps be some- what upset by their unusual surroundings, and thus not yield so well as at home, yet the average results of these butter-test trials over a number of years are borne out by the private trials that have taken place in various herds. The trials have, moreover, brought into prominence the peculiarities of different breeds, such as: (a) that the Short- horns, Eed Polls, and Kerries, being cattle whose milk contains small fat globules, are better for milk than the Jerseys and Guernseys, whose milk is richer, containing larger-sized fat globules, and is therefore more profitable for converting into butter ; (6) that the weights of the animals, and consequently the proportionate food, must be taken into account in estimating the cost of the dairy produce ; (c) that the influence of the stage reached in the period of lactation is much more marked in some breeds than in others.

An instructive example of the milk-yielding capacity of Jersey cows is afforded in the carefully kept records of Lord Rothschild's herd at Tring Park, Herts. The fol- io-wing are the figures, the gallons being calculated at the rate of 10 ft of milk to the gallon : —

In 1897, 30 cows averaged 6896 lb, or 640 gallons per cow.

In 1898, 29 „ „ 6209 „ 621

In 1899, 87 „ „ 6430 „ 648

In 1900, 39 „ „ 6136 „ 614 „

The average over the four years works out at about 630 gallons per cow per annum.

Cows of larger type will give more milk than the Jerseys, but it is less rich in fat. The milk record for the year 1900 of the herd of Red Polled cattle belonging to Mr Garrett Taylor, Whitlingham, Norfolk, affords a good example. The cows in the herd, which had before

1900 produced one or more calves, and in 1900 added another to the list, being in full profit the greater part of the year, numbered 82. Their total yield was 521,950 tb of milk, or an average of 6365 lb— equivalent to about 636 gallons— per cow. In 1899 the average yield of 96 cows was 6283 lb, or 628 gallons ; in 1898 the average yield of 75 cows was 6473 lb, or 647 gallons. Of cows which dropped a first calf in the autumn of 1899, one of them — Lemon — milked continuously for 462 days, yield- ing a total of 7166 lb of milk, being still in milk when the herd year closed on 27th December. Similar cases were those of Nora, which gave 9066 lb of milk in 455 days ; Doris, 8138 lb in 462 days ; Brisk, 9248 lb in 469 days ; Delia, 8806 lb in 434 days, drying 28 days before the _ year ended; and Lottie, 6327 lb in 394 days, also drying 28 days before the year ended; these were all cows with their first calf. Eight cows in the herd gave milk on every day of the 52 weeks, and 30 others had their milk recorded on 300 days or more. Three heifers which produced a first calf before 11th April 1900, aver- aged in the year 4569 ib of milk, or about 456 gallons. In 1900 three cows, Eyke Jessie, Kathleen, and Doss, each gave over 10,000 ft, or 1000 gallons of milk ; four cows gave from 9000 lb to 10,000 lb, two from 8000 ft to 9000 ft, 17 from 7000 ft to 8000 ft, 19 from 6000 ft to 7000 ft, 30 from 5000 ft to 6000 ft, and 16 from 4000 ft to 5000 ft. The practice, long followed at Whitlingham, of developing the milk-yielding habit by milking a young cow so long as she gives even a small quantity of milk daily, is well supported by the figures denoting the results.

Though milking trials and butter tests are not usually available to the ordinary dairy farmer in the management of his herd, it is, on the other hand, a simple matter for him to keep what is known as a milk register. By a milk register is meant a record of the quantity of milk yielded by a cow. In other words, it is a quantitative estimation of the milk the cow gives. It affords no in- formation as to the quality of the milk, or as to its butter-yielding or cheese-yielding capacity. Nevertheless, by its aid the milk-producing capacity of a cow can be ascertained exactly, and her character in this respect can be expressed by means of figures about which there need be no equivocation. A greater or less degree of exactness can be secured, according to the greater or less frequency with which the register is taken. Even a weekly register would give a fair idea as to the milk yields of a cow, and would be extremely valuable as compared with no register at all.

The practice of taking the milk register, as followed in a well-known dairy, may be briefly described. The cows are always milked in the stalls, and during summer they are brought in twice a day for this purpose. After each cow is milked, the pail containing the whole of her milk is hung on a string balance suspended in a convenient position, and from the gross weight indicated there is deducted the already known weight of the pail.^ The difference, which represents the weight of milk, is recorded in a book suitably ruled. This book when open presents a view of one week's records. In the left-hand column are the names of the cows; on the right of this are fourteen columns, two of which receive the morning and evening record of each cow. In a final column on the right appears the week's total yield for each cow ; and space is also allowed for any remarks. Fractions of a pound are not entered, but 18 ft 12 oz. would be recorded

1 A portable milk-weighing appliance is made in which the -weight of the pail is included, and an indicator shows on a dial the exact weight in pounds and ounces, and likewise the volume in gallons and pints, of the milk in the pail. When the pail is empty the indicator of course points to zero.

as 19 ft, whereas 21 ft 5 oz. would appear as 21 ft, so that a fraction of over half a pound is considered as a whole pound, and a fraction of under half a pound is ignored. By dividing the pounds by 10 the yield in gallons is readily ascertained.

Every dairy farmer has some idea as to each of his cows, whether she is a good, a bad, or an indifferent milker, but such knowledge is at best only vague. By the simple means indicated the character of each cow as a milk-producer is slowly but surely recorded in a manner which is at once exact and definite. Such a record is particularly valuable to the farmer, in that it shows to him the relative milk-yielding capacities of his cows, and thus enables him gradually to weed out the naturally poor milkers and replace them by better ones. It also guides him in regulating the supply of food according to the yield of milk. The register will, in fact, indicate un-erringly which are the best milk-yielding cows in the dairy, and which therefore are, with the milking capacity in view, the best to breed from.

The simplicity and inexpensiveness of the milk register must not be overlooked. These are features which should commend it especially to the notice of small dairy farmers, for with a moderate number of cows it is particularly easy to introduce the register. But even with a large dairy it will be found that, as soon as the system has got fairly established, the additional time and trouble involved will sink into insignificance when compared with the benefits which accrue.

The importance of ascertaining not only the quantity but also the quality of milk is aptly illustrated in the case of two cows at the Tring show, 1900. The one cow gave in 24 hours 4^ gallons of milk, which at 7d. per gallon would work out at about 2s. 7d. ; she made 2 ft 12 oz. of butter, which at Is. 4d. per ft would bring in 3s. 8d. ; consequently by selling the milk the owner lost about Is. Id. per day. The second cow gave 5^ gallons of milk, which would work out at 3s. Id. ; she made 1 ft 12 oz. of butter, which would only be worth 2s. 4d., so that by converting the milk into butter the owner lost 9d. per day.

The colour of milk is to some extent an indication of its quality — ^the deeper the colour the better the quality. The colour depends upon the size of the fat globules, a deep yellowish colour indicating large globules of

fat. When the globules are of large size the milk will churn more readily, and the butter is better both in quality and in colour.

The following fifty dairy rules relating to the milking and general management of cows, and to the care of milk and dairy utensils, were drawn up on behalf of, and published by, the United States Department of Agricul- ture at Washington. They are given here with a few merely verbal alterations : —

THE OWNEK AND HIS HBLPEBS.

1. Eead current dairy literature and keep posted on new ideas.

2. Observe and enforce the utmost cleanliness about the cattle,

their attendants, the cow house, the dairy, and all utensils.

3. A person suffering from any disease, or who has been exposed

to a contagious disease, must remain away from the cows and the milk.

THE cow HOUSE.

4. Keep dairy cattle in a shed or building by themselves. It

is preferable to have no cellar below and no storage loft above.

5. Cow houses should be well ventilated, lighted, and drained ;

should have tight floors and walls, and be plainly constructed.

6. Never use musty or dirty litter.

7. Allow no strong-smelling material in the cow house for any

length of time. Store the manure under cover outside the cow house, and remove it to a distance as often as practic- able.

8. Whitewash the cow house once or twice a year ; use gypsum in the manure gutters daily.

9. Use no dry, dusty feed just previous to milking ; if fodder is dusty, sprinkle it before it is fed.

10. Clean and thoroughly air the cow houie before milking ; in hot weather sprinkle the floor.

11. Keep the cow house and dairy room in good condition, and then insist that the dairy, factory, or place where the milk goes be kept equally well.

THE cows.

12. Have the herd examined at least tvyice a year by a skilled veterinarian.

13. Promptly remove from the herd any animal suspected of being in bad health, and reject her milk. Never add an animal to the herd until it is ascertained to be free from disease, especially tuberculosis.

14. Do not move cows faster than a comfortable walk while on the way to the place of milking or feeding.

15. Never allow the cows to be excited by hard driving, abuse,

loud talking, or unnecessary disturbance ; do not expose them to cold or storms.

16. Do not change the feed suddenly.

17. Feed liberally, and use only fresh, palatable feed-stuffs ; in no case should decomposed or mouldy material be used.

18. Provide water in abundance, easy of access, and always pure ; fresh, but not too cold.

19. Salt should always be accessible to the cows.

20. Do not allow any strong-flavoured food, like garlic, cabbages, and turnips, to be eaten, except immediately after mUking.

21. Clean the entire skin of the cow daily. If hair in the region of the udder is not easily kept clean, it should be clipped.

22. Do not use the milk within twenty days before calving, nor for three to five days afterwards.

23. The milker should be clean in all respects ; he should not use tobacco while milking ; he should wash and dry his hands just before milking.

24. The milker should wear a clean outer garment, used only when milking and kept in a clean place at other times.

25. Brush the udder and surrounding parts just before milking, and vripe them vrith a clean damp cloth or sponge.

26. Milk quietly, quickly, cleanly, and thoroughly. Cows do not

like unnecessary noise or delay. Commence milking at exactly the same hour every morning and evening, and milk the cows in the same order.

27. Throw away (but not on the floor — better in the gutter) the

first two or three streams from each teat ; this milk is very watery and of little value, but it may injure the rest.

28. If in any milking a part of the milk-is bloody or stringy or

unnatural in appearance, the whole should be rejected.

29. Milk with dry hands ; never let the hands come in contact

with the milk.

30. Do not allow dogs, cats, or loafers to be around at milking

time.

31. If any accident occurs by which a pail, full or partly fuU, of

milk becomes dirty, do not try to remedy this by straining, but reject all this milk and rinse the pail.

32. Weigh and record the milk given by each cow, and take a

sample morning and night, at least once a week, for testing by the fat test.

CAKE OF MILK.

38. Eemove the milk of every cow at once from the cow house to a clean dry room, where the air is pure and sweet. Do not allow cans to remain in the cow house while they are being filled with mUk.

34. Straiu the milk through a metal gauze and a flannel cloth or

layer of cotton as soon as it is drawn.

35. Cool the milk as soon as strained — ^to 45° F. if the milk is

for shipment, or to 60° if for home use or delivery to a factory.

36. Never close a can containing warm mUk.

37. If the cover is left off the can, a piece of cloth or mosquito

netting should be used to keep out insects.

38. If mUk is stored, it should be kept in tanks of fresh cold water

(renewed as often as the temperature increases to any material extent), in a clean, dry, cold room. Unless it is desired to remove cream, it should be stirred with a tin stirrer often enough to prevent the forming of a thick cream layer.

39. Keep the night milk imder shelter so that rain cannot get into

the cans. In warm weather keep it in a tank of fresh cold water.

40. Never mix fresh warm milk with that which has been cooled.

41. Do not allow the milk to freeze.

42. In no circumstances should anything be added to milk to

prevent its souring. Cleanliness and cold are the only preventives needed.

43. All milk should be in good condition when delivered at a

creamery or a cheesery. This may make it necessary to deliver twice a day during the hottest weather.

44. When cans are hauled far they should be full, and carried in a

spring waggon.

45. In hot weather cover the cans, when moved in a waggon, with

a clean wet blanket or canvas.

THE UTENSILS.

46. Milk utensils for farm use should be made of metal and have

all joints smoothly soldered. Never allow them to become rusty or rough inside.

47. Do not haul waste products back to the farm in the cans used

for delivering milk. When this is unavoidable, insist that the skim milk or whey tank be kept clean.

48. Cans used for the return of skim mUk or whey should be

emptied, scalded, and cleaned as soon as they arrive at the farm.

49. Clean all dairy utensils by first thoroughly rinsing them in

warm water ; next clean inside and out with a brush and hot water in which a cleaning material is dissolved ; then rinse and, lastly, sterilize by boiling water or steam. Use pure water only.

50. After cleaning, keep utensils inverted in pure air, and sun if

possible, until wanted for use.

Pood and Milk Production.

In their compreiiensive paper relating to the feeding of animals, published in 1895, Lawes and Gilbert discussed amongst other questions that of milk production, and directed attention to the great difference in the demands made on the food — on the one hand for the production of meat (that is, of animal increase), and on the other for the production of milk. Not only, however, do cows of different breeds yield different quantities of milk, and milk of characteristically different composition,

but in- dividual animals of the same breed have very different milk-yielding capacity ; and whatever the capacity of a cow may be, she has a maximum yield at one period of her lactation, which is followed by a gradual decline. Hence, in comparing the amounts of constituents stored up in the fattening increase of an ox with the amounts of the same constituents removed in the milk of a cow, it is necessary to assume a wide range of difference in the yield of milk. Accordingly, Table V. shows the amounts of nitrogenous substance, of fat, of non-nitrogenous substance not fat, of mineral matter, and of total solid matter, carried off in the weekly yield of milk of a cow, on the alternative assumptions of a production of 4, 6, 8, 10, 12, 14, 16, 18, or 20 quarts per head per day. For comparison, there is given at the foot of the table the amounts of nitrogenous substance, of fat, of mineral matter, and of total solid matter, in the weekly increase in live-weight of a fatten- ing ox of an average weight of 1000 ft — first, on the assumption of a weekly increase of 10 ft, and, secondly, of 15 ft. The estimates of the amounts of constituents in the milk are based on the assumption that it will con- tain 12-5 per cent, of total solids — consisting of 3-65 albuminoids, 3-50 butter-fat, 4-60 sugar, and 0-75 of mineral matter. The estimates of the constituents in the fattening increase of oxen are founded on determinations made at Rothamsted.

With regard to the very wide range of yield of milk per head per day which the figures in the following table assume, it may be remarked that it is by no means impos- sible that the same animal might yield the largest amount, namely, 20 quarts, or 6 gallons, per day near the beginning, and only 4 quarts, or 1 gallon, or even less, towards the end of her period of lactation. At the same time, an entire herd of, for example. Shorthorns or Ayrshires, of fairly average quality, well fed, and including animals at various periods

of lactation, should not yield an average of less than 8 quarts, or 2 gallons, and would seldom exceed 10 quarts, or 2^ gallons, per head per day the year round.

Table V. Comparison of the Gonstituents of Food carried off in Milk and in the Fattening Increase of Oxen.

Non-

Nitro-

Nitro-

[1 QaUon=10-8S Hi.]

genous Snb-

Fat.

genous Sub-

Mineral

Total Solid

Btanoe.

stance not Fat (Sugar).

Matter.

-

In Milk per Week.

If:—

H)

lb

B)

B)

lb

4 quarts per head per day

2-64

2-53

3-33

0-54

9-04

6 M ., „

3-96

3-80

4-99

0-81

13-56

8 „

5-28

5-06

6-66

1-08

18-08

10 „

6-60

6-33

8-32

1-35

22-60

la „

7-92

7-59

9-99

1-62

27-12

14 „

9-24

8-86

11-65

1-89

31-64

16 „

10-56

10-12

13-32

2-16

36-16

18 „

11-88

11-39

14-98

2-43

40-68

20 „

13-20

12-65

16-65

2-70

45-20

In Increase in Live-Weight per W

eek. — C

)xen.

If 10 R) increase

0-75

6-35

0-15

7-25

If 15 R) increase

1-13

9-53

0-22

10-88

For the sake of illustration, an average yield of milk of 10 quarts, equal 2^ gallons, or between 25 and 26 lb per head per day, may be assumed, and the amount of con- stituents in the weekly yield at this rate may be compared with that in the weekly increase of the fattening ox at the higher rate assumed in the table, namely, 15 ft per 1000 ft live-weight, or 1-5 per cent, per week. It is seen that whilst of the nitrogenous substance of the food the amount stored up in the fattening increase of an ox would be only 1-13 ft, the amount carried off as such in the milk would be 6-6 ft, or nearly six times as much. Of mineral matter, again, whilst the fattening increase would only require about 0-22 ft, milk would carry off 1-35 ft, or again ‘ about six times as much. . Of fat, however, whilst the fattening increase would contain 9-53 ft, the milk would contain only 6-33 ft, or only about two-thirds as much. On the other hand, whilst the fattening in- crease contains no other non-nitrogenous substance than fat, the milk would carry off 8-32 ft in the form of milk- sugar. This amount of milk- sugar, reckoned as fat, would correspond approximately to the difference between the fat in the milk and that in the fattening increase.

It is evident, then, that the drain upon the food is very much greater for the production of milk than for that of meat. This is especially the case in the important item of nitrogenous substance ; and if, as is frequently assumed, the butter-fat of the milk is at any rate largely derived from the

nitrogenous substance of the food, so far as it is so at least about two parts of such substance would be required to produce one of fat. On such an assumption, therefore, the drain upon the nitrogenous substance of the food would be very much greater than that indicated in the table as existing as nitrogenous substance in the milk. To this point further reference will be made presently.

Attention may next be directed to the amounts of food, and of certain of its constituents, consumed for the pro- duction of a given amount of milk. This point is illus- trated in Table VI., which shows the constituents con- sumed per 1000 ft live-weight per day in the case of the Eothamsted herd of 30 cows in the spring of 1884. On

the left hand are shown the actual amounts of the different foods- consumed per 1000 ft live-weight per day ; and in the respective columns are recorded — first the amounts of total dry substance which the foods contained, and then the amounts of digestible nitrogenous, digestible non- nitrogenous (reckoned as starch), and digestible total organic substance which the different foods would supply; these being calculated according to Lawes and Gilbert's own estimates of the percentage composition of the foods, and to Wolff's estimates of the proportion of the several constituents which would be digestible.

The first column shows that the amount of total dry substance of food actually consumed by the herd, per 1000 ft live-weight per day, was scarcely 20 ft, whilst Wolff's^ estimated requirement, as stated at the foot of the table, is 24 ft. But his ration would doubtless con- sist to a greater extent of hay and straw-chaff, containing a larger proportion of indigestible and effete woody fibre. The figures show, indeed, that the Rothamsted ration supplied, though nearly the same, even a somewhat less amount of total digestible constituents than Wolff's.

Table VI. Constituents consumed per 1000 R) Live -Weight per Day, for Sustenance and for Milk-Production. The Eotham- sted Herd of 30 Cows, Spring 1884.

Total Dry Sub- stance.

Digestible.

Nitro- genous Sub- stance.

Non-Nitro- gen ouB Substance (as Starch).

Total Nitro- genous and Non- Nitro- genous Substance.

3-1 H) Cotton cake 2-7 R) Bran . 2-8 R) Hay-chafE . 5-6 R) Oat-straw-chafl . 62-8 R) Mangel

Total Required for stistenance

Available for milk In 23-3 R) milk

Excess in food

ft

2-76 2-33 2-34 4-64 7-85

ft

1-07 0-33 0-15 0-08 1-01

ft

1-50 1-09 1-18 2-21 5-73

ft

2-57 1-42 1-33 2-29 6-74

19-92

2-64 0-57*

11-71 7-40*

14-35 7-97

...

2-07 0-85

4-31 3-02

6-38 3-87

...

1-22

1-29

2-51

Per 1000 la' Live-Weight.

Wolfl ....

lb

24

ft

2-5

ft 12-5 t

ft

15-4

- ***Albuminoid ratio, 1-4-4.***

t Exclusive of 0-4 fet ; albuminoid ratio, 1-5-4.

Of digestible nitrogen substance, the food supplied 2-64 ft per day, whilst the amount estimated to be re- quired for sustenance merely is 0-57 ft;

leaving, therefore, 2-07 ft available for milk production. The 23-3 ft of milk yielded per 1000 ft live-weight per day would, how- ever, contain only 0-85 ft ; and there would thus remain an apparent excess of 1-22 ft of digestible nitrogenous substance in the food supplied. But against the amount of 2-64 ft actually consumed, Wolff's estimate of the amount required for sustenance and for milk-production is 2-5 ft, or but little less than the amount actually con- sumed at Eothamsted. On the assumption that the expenditure of nitrogenous substance in the production of milk is only in the formation of the nitrogenous substances of the milk, there would appear to have been a consider- able excess given in the food. But Wolff's estimate assumes no excess of supply, and that the whole is utilized; the fact being that he supposes the butter-fat of

1 Landw. FUtterungslehre, 5'" Aufl., 1888, p. 249.

the milk to have been derived largely, if not wholly, from the albuminoids of the food.

It has been shown that although it is possible that some of the fat of a fattening animal may be produced from the abuminoids of the food, certainly the greater part of it, if not the whole, is derived from the carbo- hydrates. But the physiological conditions of the pro- duction of milk are so difEerent from those for the production of fattening increase, that it is not admissible to judge of the sources of the fat of the one from what may be established in regard to the other. It has been assumed, however, by those who maintain that the fat of the fattening animal is formed from albuminoids, that the fat of milk must be formed in the same way. Disallowing the legitimacy of such a deduction, there do, nevertheless, seem to be reasons for supposing that the fat of milk may, at any rate in large proportion, be derived from albuminoids.

Thus, as compared with fattening increase, which may in a sense be said to be little more than an accumulation of reserve material from excess of food, milk is a special product, of a special gland, for a special normal

exigency of the animal. Further, whilst common experience shows that the herbivorous animal becomes the more fat the more, within certain limits, its food is rich in carbo- hydrates, it points to the conclusion that both the yield of milk and its richness in butter are more connected with a liberal supply of the nitrogenous constituents in the food. Obviously, so far as this is the case, it may be only that thereby more active change in the system, and therefore greater activity of the special function, is main- tained. The evidence at command is, at any rate, not inconsistent with the supposition that a good deal of the fat of milk may have its source in the breaking up of albuminoids, but direct evidence on the point is still wanting ; and supposing such breaking up to take place in the gland, the question arises — What becomes of the by-products ? Assuming, however, that such change does take place, the amount of nitrogenous substance supplied to the Eothamsted cows would be less in excess of the direct requirement for milk-production than the figures in the table would indicate — if, indeed, in excess at all.

The figures in the column of Table VI. relating to the estimated amount of digestible non-nitrogenous substance reckoned as starch show that the quantity actually con- sumed was 11-71 lb, whilst the amount estimated by Wolff to be required was 12-5 lb, besides 0.4 lb of fat. The figures further show that, deducting 7-4 lb for sus- tenance from the quantity actually consumed, there would remain 4-31 lb available for milk-production, whilst only about 3-02 lb would be required supposing that both the fat of the milk and the sugar had been derived from the carbohydrates of the food ; and according to this calcula- tion, there would still be an excess in the daily food of 1-29 lb. It is to be borne in mind, however, that estimates of the requirement for mere sustenance are mainly founded on the results of experiments in which the animals are allowed only such a limited amount of food as will main- tain them without either loss or gain when at rest. But physiological considerations point to the conclusion that the expenditure, independently of loss or gain, will be the greater the more liberal the ration ; and hence it is prob- able that the real excess, if any, over that required for sustenance and milk-production would be less than that indicated in the table, which is calculated on the assump- tion of a fixed requirement for sustenance for a given live-weight of the animal. Supposing that there really was any material excess of either the

nitrogenous or the non-nitrogenous constituents supplied over the require- ment for sustenance and milk-production, the question

arises — Whether, or to what extent, it conduced to in- crease in live-weight of the animals, or whether it was in part, or wholly, voided, and so wasted ?

As regards the influence of the period of the year, with its characteristic changes of food, on the quantity and composition of the milk, the first column of the second division of Table VII. shows the average yield of milk per head per day of the Eothamsted herd, averaging about 42 cows, almost exclusively Shorthorns, in each month of the year, over six years, 1884 to 1889 inclusive; and the succeeding columns show the amounts of butter-fat, of solids not fat, and of total solids in the average yield per head per day in each, month of the year, calculated, not according to direct analytical determinations made at Eothamsted, but according to the results of more than 14,000 analyses made, under the superintendence of Dr Vieth, in the laboratory of the Aylesbury Dairy Company in 1884 ; ^ the samples analysed representing the milk from a great many difEerent farms in each month.

Table VII. Percentage Composition of Milk each Month of the Tear; also Average Yield of Milk, and of Constituents, per Head per Day each Month, according to Mothamsted Dairy Becords.

Average Composition of Milk

Eothamsted Dairy. |

each Month, 18M

(Dr Vieth— 14,285 analyses).

Estimated Quantity of Constituents in

Average Yield

Per cenl

MUk per Head per

of Milk

Day each Month.

Specific

per Head

j

Gravity.

Butter-

not

Fat.

Total

per Day, 6 Tears.

HnllHs

Fat.

Solids.

Butter- Fat.

not Fat.

Total Sohds.

Per

cent.

Per

cent.

Per

cent.

ft

ft

ft

ft

January .

1-0325

3-55

9-34

12-89

20-31*

0-72

1-90

2-62

February

1-0325

3-53

9-24

12-77

22-81

0-80

2-11

2-91

Maroh .

1-0323

3-50

9-22

12-72

24-19

0-85

2-23

3-08

April .

1-0323

3-43

9-22

12-65

26-50

0-91

2-44

3-35

May

1-0324

3-34

9-30

12-64

31-31

1-05

2-91

3-96

June

1-0323

3-31

9-19

12-50

30-81

1-02

2-83

3-85

July

1-0319

3-47

9-13

12-60

28-00

0-97

2-56

3-53

Aiigust .

1-0318

3-87

9-08

12-95

2ff-00

0-97

2-27

3-24

September

1-0321

4-11

9-17

13-28

22-94

0-94

211

3-05

October .

1-0324

4-26

9-27

13-53

21-00

0-89

1-95

2-84

November

10324

4-36

9-29

13-65

19-19

0-84

1-78

2-62

December Mean .

1-0326

4-10

9-29

13-39

19-31

0-79

1-79

2-58

1-0323

3-74

9-22

12-96

24-28

0-90

2-24

3-14

- *Average over five years only, as the records did not commence until February 1884.*

It should be stated that the Eothamsted cows had cake throughout the year ; at first 4 lb per head per day, but afterwards graduated according to the yield of milk, on the basis of 4 lb for a yield of 28 lb of milk, the result being that then the amount given averaged more per head per day during the grazing period, but less earlier and later in the year. Bran, hay and straw-chaff, and roots (generally mangel) were also given when the animals were not turned out to grass. The general plan was, therefore, to give cake alone in addition when the cows were turned out to grass, but some other dry food, and roots, when entirely in the shed during the winter and early spring months.

EeferrLng to the column showing the average yield of milk per head per day each month over the six years, it will be seen that during the six months — January, February, September, October, November, and December — the average yield was sometimes below 20 lb, and on the average only about 21 lb of milk per head per day ; whilst over the other six months it averaged 27-63 lb, and over May and June more than 31 lb, per head

1 The Analyst, April 1885, vol. x. p. 67.

per day. That is to say, the quantity of milk yielded was considerably greater during the grazing period than when the animals had more dry

food, and roots instead of grass.

Next, referring to the particulars of composition, accord- ing to Dr Vieth's results, which may well be considered as typical for the different periods of the year, it is seen that the specific gravity of the milk was only average, or lower than average, during the grazing period, but rather higher in the earlier and later months of the year. The percentage of total solids was rather lower than the average at the beginning of the year, lowest during the chief grazing months, but considerably higher in the later months of the year, when the animals were kept in the shed and received more dry food. The percentage of butter-fat follows very closely that of the total solids, being the lowest during the best grazing months, but considerably higher than the average during the last four or five months of the year, when more dry food w^as given. The percentage of solids not fat was considerably the lowest during the later months of the grazing period, but average, or higher than average, during the earlier and later months of the year. It may be observed that, according to the average percentages giveh in the table, a gallon of milk will contain more of both total solids and of butter-fat in the later months of the year; that is, when there is less grass and more dry food given.

Turning to the last three columns of the table, it is seen that although, as has been shown, the percentage of the several constituents in the milk is lower during the grazing months, the actual amounts contained in the quantity of milk yielded per head are distinctly greater during those months. Thus, the amount of butter-fat yielded per head per day is above the average of the year from April to September inclusive ; the amounts of solids not fat are over average from April to August inclusive; and the amounts of total solids yielded are average, or ov;er average, from April to August inclusive.

From the foregoing results it is evident that the quantity of milk yielded per head is very much thq greater during the grazing months of the year, but that the percentage composition of the milk is lower during that period of higher yield, and considerably higher during the months of more exclusively dry-food feeding. Never- theless, owing to the much greater quantity of milk yielded during the grazing months, the actual

quantity of constituents yielded per cow is greater during those months than during the months of higher percentage composition but lower yield of milk per head. It may be added that a careful consideration of the number of newly-calved cows brought into the herd each month shows that the results as above stated were perfectly dis- tinct, independently of any influence. of the period of lactation of the different individuals of the herd.

The few results which have been brought forward in' relation to milk-production are admittedly quite insufficient adequately to illustrate the influence of variation in the quantity and composition of the food on the quantity and composition of the milk yielded. Indeed, owing to the intrinsic difficulties of experimenting on such a subject, involving so many elements of variation, any results ob- tained have to be interpreted with much care and reserva- tion. Kevertheless, it may be taken as clearly indicated that, within certain limits, high feeding, and especially high nitrogenous feeding, does increase both the yield and the richness of the milk.^ But it is evident that when

I The evidence on this point taken by the Committee on Milk and Cream Regulations in 1900 is somewhat conflicting. The report states that an impression commonly prevails that the quality of milk is more or less determined by the nature and composition of the food which the cow receives. One witness said that farmers who produce

high feeding is pushed beyond a comparatively limited range, the tendency is to increase the weight of the animal — that is, to favour the development of the in- dividual, rather than to enhance the activity of the func- tions connected with the reproductive system. This is, of course, a disadvantage when the object is to main- tain the milk-yielding condition of the animal; but when a cow is to be fattened off it will be otherwise.

It has been stated that, early in the period of six years in which the Eothamsted results that have been quoted were obtained, the amount of oil-cake given was graduated according to the yield of milk of each individual cow ; as it seemed unreasonable that an animal yielding, say, only four quarts per day, should receive, beside the home foods, as much cake as one yielding several times the quantity. The obvious inference is,

that any excess of food beyond that required for sustenance and milk-production would tend to increase the weight of the animal, which, accord- ing to the circumstances, may or may not be desirable.

It may be observed that direct experiments at Eotham- sted confirm the view, arrived at by common experience, that roots, and especially mangel, have a favourable effect on the flow of milk. Further, the Eothamsted experi- ments have shown that a higher percentage of butter-fat, of other solids, and of total solids, was obtained with mangel than with silage as the succulent food. The yield of milk was, however, in a much greater degree increased by grazing than by any other change in the food ; and at Eothamsted the influence of roots comes next in order to that of grass, though far behind it, in this respect. But with grazing, as has been shown, the percentage composi- tion of the milk is considerably reduced ; though, owing to the greatly increased quantity yielded, the amount of soil-constituents removed in the railk when the cows are grazing may nevertheless be greater per head per day than under any other conditions. Lastly, it has been clearly illustrated how very much greater is the demand upon the food, especially for nitrogenous and for mineral constituents, in the production of milk than in that of fattening increase.

Manueial Value of Food consumed in the Pboduotion of Milk.

In any attempt to estimate the average value of the manure derived from the consumption of food for the production of milk, the difficulty arising from the very wide variation in the amount of milk yielded by different cows, or by the same cow at different periods of her lactation, is increased by the inadequate character of information concerning the difference in the amount of the food actually consumed by the animal' coincidently with the production of such different amounts of milk. But although information is lacking for correlating, with numerical accuracy, the great differences in milk-yield of

milk for sale feed differently from what they do if they are producing for butter. Another stated that most of the statistics which go to show that food has no effect on milk fail, because the experiments are not carried far enough to counterbalance that peculiarity of the animal first to utilize the food for itself before utilizing it for the milk. A witness who kept a

herd of 100 milking cows expressed the opinion that improvement in the quality of milk can be effected by feeding, though not to any large extent. On the other hand, it was maintained that the fat percentage in the milk of a cow cannot be raised by any manner or method of feeding. It is possible that in the case of cows very poorly fed the addition of rich food would alter the composition of their milk, but if the cows are well-fed to begin with, this would not be so. The proprietor of a herd of 500 milking cows did not think that feeding affected the quality of milk from ordinarily well-kept animals. An experimenter found that the result of resort- ing to rather poor feeding was that the first effect was produced upon the weight of the cow and not upon the milk ; the animal began to get thin, losing its weight, though there was not very much effect upon the quality of the milk.

individual cows with the coincident differences in con- sumption to produce it, it may be considered as satis- factorily established that more food is consumed by a herd of cows to produce a fair yield of mUk, of say 10 or 12 quarts per head per day, than by an equal live- weight of oxen fed to produce fattening increase. In the cases supposed it may, for practical purposes, be assumed that the cows would consume about one-fourth more food than the oxen. Accordingly, in the Eothamsted estimates of the value of the manure obtained on the consumption of food for the production of milk, it is assumed that one- fourth more will be consumed by 1000 lb live-weight of cows than by the same weight of oxen ; but the estimates of the amounts of the constituents of the food removed in

the milk, or remaining for manure, are nevertheless reckoned per ton of each kind of food consumed, as in the case of those relating to feeding for the production of fattening increase. It may be added that the calculations of the amounts of the constituents in the mUk are based on the same average composition of milk as is adopted in the construction of Table V. Thus the nitrogen is taken at 0-579 (=3-65 nitrogenous substance) per

cent., the phosphoric acid at 0-2175 per cent., and the potash at 0-1876 per cent, in the milk.

Table VIII. shows in detail the estimate of the amount of nitrogen in one ton of each food, and in the mUk pro- duced from its consumption, on the assumption of an average yield of 10 quarts per head per day; also the

Table VIII. Estimates of the Total or Original Manure-Value of Cattle Foods after Consumption by Cows for the Production of Milk. Valuations on the assumption of an average production by a herd of 10 quarts of milk per head per day.

NiTBOGBN.

?H08POEio Acid.

Potash.

Total or Original Manure-

[n Manure.

In Manure.

In Manure.

Nos,

Description of Food.

In MUk from ITon

of Pood.

In Milk

from 1 Ton of

Food.

In Milk

from 1 Ton of Food.

Value per Ton of

Food con- sumed.

In 1 Ton of Food.

Total re- maining for

Nitrogen equal Am-

Value of

Ammonia

at 4a.

In 1 Ton of Food.

Total remain- ing for

Value at 2d. per ft.

In 1 Ton of Food.

Total remain- ing for

Value atlW. per ft.

Manure.

monia.

per ft.

Manure.

Manure.

ft

H)

ft

ft

£ s. d.

ft

ft

ft

8. d.

ft

ft

ft

B. d.

£ s. d.

1

Linseed

80-64

25 04

55-60

67-52

12 6

34-50

9-34

25-16

4 2

80-69

8-02

22-67

2 10

19 6

2

Linseed cake

106-40

20-86

85-54

103-87

114 7

44-80

7-79

87-01

6 2

31-36

6-71

24-65

3 1

2 8 10

3

Decorticated

cotton cake .

147-84

19-27

128-57

156-13

2 12 1

69-44

7-18

62-26

10 5

44-80

6-22

38.58

4 10

3 7 4

4

Palm-nut cake .

56-00

17-86

38-14

46-31

0 15 5

26-88

6-68

20-20

8 4

11-20

5-73

5-47

0 8

019 5

5

Undecortlcated

cotton cake .

84-00

15-66

68-34

82-99

17 8

44-80

5-85

38-95

6 6

44-80

5-07

39-73

5 0

119 2

6

Cocoa-nut cake .

76-16

15-66

60-50

73-47

14 6

31-36

5-85

25-51

4 8

44-80

5-07

39-78

5 0

113 9

7 8

Kape cake Peas .

109-76

12-50

97-26

118-11

119 4

56 00

4-69

51-31

8 7

33-60

4-09

29-51

3 8

2 11 7

80-64

17-86

62-78

76-24

15 5

19-04

6-68

12-36

2 1

21-50

5-73

15-77

2 0

1 9 6

9

Beans

89-60

17-86

71-74

87-12

19 0

24-64

6-68

17-96

3 0

29-12

5-73

23-39

2 11

114 11

10

Lentils

94-08

17-86

76-22

92-56

110 10

16-80

6-68

10-12

1 8

15-68

5-78

9-95

1 3

113 9

11 12

Tares (seed) Maize

94.08

17-86

76-22

92-56

110 10

17-92

6-68

11-24

110

17-92

5-78

12-19

1 6

114 2

38-08

17-38

20-70

25-14

0 8 5

13-44

6-50

6-94

1 2

8-29

5-56

2-73

0 4

0 9 11

13

Wheat

40-32

17-38

22-94

27-86

0 9 3

19-04

6-50

12-54

2 1

11-87

5-56

6-81

0 9

0 12 1

14

Malt .

38-08

17-86

20-22

24-55

0 8 2

17-92

6-68

11-24

110

11-20

5-73

5-47

0 8

0 10 8

15

Barley

36-96

17-38

19-58

23-78

0 7 11

16-80

6-50

10-30

1 9

12-32

5-56

6-76

0 10

0 10 6

16

Oats .

44-80

16-68

28-12

34-15

Oil 5

18-44

6-24

7-20

1 2

11-20

5-40

5-80

0 9

0 13 4

17

Rice meal .

42-56

16-68

25-88

81-43

0 10 6

(13-44)

6-24

7-20

1 2

(8-29)

5-40

2-89

0 4

0 12 0

18 19

Locust beans Malt coombs

26-88

13-90

12-98

15-76

0 5 3

…

5-19

…

4-42

…

87-36

15-66

71-70

87-07

19 0

44-80

5-85

38-95

6 6

44-80

5-07

89-73

5 0

2 0 6

20

Pine pollard

54-88

16-68

38-20

46-39

0 15 6

64-96

6-24

58-72

9 9

32-70

5-40

27-30

3 5

18 8

21

Coarse pollard .

56-00

15-66

40-34

48-99

0 16 4

78-40

5-85

72-55

12 1

33-60

5-07

28-58

8 7

112 0

22 23

Bran . Clover hay .

56-00

13-90

42-10

51-12

0 17 0

80-64

5-19

75-45

12 7

32-48

4-42

28-06

3 6 8 10

118 1

53-76

8-94

44-82

54-43

0 18 2

12-77

3-35

9-42

1 7

33-60

2-94

30-66

13 7

24

25

Meadow hay Pea straw .

33-60

8-36

25-24

30-65

0 10 3

8-96

3-10

5-86

1 0

85-84

2-62

38-22

4 2

0 15 5

22-40

7-83

14-57

17-69

0 511

7-84

2-91

4-93

0 10

22-40

2-46

19-94

2 6

0 9 3

26

Oat straw .

11-20

6-95

4-25

5-16

0 19

5-88

2-60

2-78

0 6

22-40

2-29

20-11

2 6

0 4 9

27

Wheat straw

10-08

5-98

4-10

4-98

0 18

5-38

2-23

3-15

0 6

17-92

1-96

15-96

2 0

0 4 2

28

Barley straw

8-96

5-46

3-50

4-25

0 15

4-03

2-04

1-99

0 4

22-40

1-80

20-60

2 7

0 4 4

29 30

Bean straw Potatoes .

20-16

5-68

14-48

17-58

0 510

6-72

2-14

4-58

0 9

22-40

1-80

20-60

2 7

0 9 2

5-60

2-07

3-53

4-29

0 1 5

8-36

0-78

2-58

0 5

12-32

0-66

11-66

1 5

0 3 3

31

Carrots

4-48

1-46

3-02

3-67

0 13

2-02

0-54

1-48

0 3

6-27

0-49

5-78

0 9

0 2 3

82

Parsnips .

4-93

1-67

3-26

3-96

0 14

4-26

0-63

3-63

0 7

8-06

0-49

7-57

0 11

0 210

33

Mangel wurzels .

4-93

1-32

3-61

4-38

0 16

1-57

0-49

1-08

0 2

8-96

0-49

8-47

1 1

0 2 9

34

Swedish turnips.

5-60

1-14

4-46

5-42

0 110

1-34

0-44

0-90

0 2

4-93

0-33

4-60

0 7

0 2 7

35

Yellow turnips .

4-48

0-93

8-55

4-31

0 1 5

(1-84)

0-84

1-00

0 2

(4-93)

0-33

(4-60)

0 7

0 2 2

36

White turnips .

4 03

0-84

3-19

3-87

0 13

1-12

0-31

0-81

0 2

6-72

0-33

6-39

0 10

0 2 3

amount remaining for manure, the amount of ammonia corresponding to the nitrogen, and the value of the ammonia at 4d. per ft> . Similar particulars are also given in relation to the phosphoric acid and the potash con- sumed in the food, removed in the mUk, and remaining for

manure, &c. This table will serve as a sufficient illustration of the mode of estimating the total or original

value of the manure, derived from the consumption of the different foods for the production of milk in the case supposed; that is, assuming an average yield of a herd of 10 quarts per head per day.

In Table IX. are given the results of similar detailed calculations of the total or original manure-value (as in Table VIII. for 10 quarts), on the alternative assumptions

of a yield of 6, 8, 12, and 14 quarts per head per day. For comparison there is also given, in the first column, the estimate of the total or original manure-value when the foods are consumed for the production of fattening increase.

So much for the plan and results of the estimations of total or original manure-value of the different foods, that is, deducting only the constituents removed in the milk, and reckoning the remainder at the prices at which they can be purchased in artificial manures. With a view to direct application to practice, however, it is necessary to estimate the unexhausted manure-value of the different foods, or what may be called their compensation-value, after they have been used for a series of years by the outgoing tenant and he has realized a certain portion of

Table IX. Comparison of the Estimates of Total or Original Manure-Value, when Foods are consumed for the Production of Fattening Increase, with those when the Food is consumed by Cows giving different Yields of Milk.

Total or Original Manure- Value per

Ton of Food con-

sumed— that is, only deducting the GonstituentB la |

1

Description of Food

Fattening Increase or in Milk.

For the

For the Production of Milk, supposing the

^^* Mi W^Aa

Produc-

Yield per Head per Day to be as under —

tion of Fatten-

–

~1

ing In- crease.

6quarts.

8 quarts.

10 quarts.

12quarts.

14quart3.

£ s. d.

£ s.d.

£ s. d.

£ s. d.

£ s.

d.

£ B. d.

1

Linseed . .

1 19 2

114 7

112 0

1 9 6

1 7

1

14 5

2

Linseed cake

2 1111

2 8 1

2 6 0

2 8 10

2 1

9

1 19 8

8

Decorticated

cotton cake

8 14 9

311 2

8 9 2

8 7 4

3 5

4

3 3 4

4

Palm-nut cake .

16 4

18 2

114

0 19 5

0 17

9

0 15 11

5

Undecorticated

cotton cake

2 5 3

2 2 4

2 0 8

1 19 2

1 17

6

1 15 11

6

Cocoa-nut cake .

1 19 10

11611

1 15 8

1 18 9

1 12

8

1 10 6

7

8

Eape cake . Peas

2 18 5

214 2

2 12 11

2 11 7

2 10

4

2 9 1

1 16 S

lis 1

1 11 2

19 6

1 7

8

15 9

9

Beans

2 1 11

118 7

1 16 10 ■

1 14 11

1 18

1

1 11 4

10

Lentils.

2 0 8

117 5

1 16 7

1 18 9

1 12

2

1 10 1

11 12

Tares (seed) Maize .

2 11

11711

116 0

1 14 2

1 12

6

1 10 7

0 16 7

018 4

0 11 7

0 9 11

0 8

1

0 6 5

18

Wheat .

0 18 11

015 8

0 13 11

0 12 1

0 10

5

0 8 8

14

Malt .

0 17 7

014 5

0 12 7

0 10 8

0 9

0

0 7 1

15

Barley .

0 17 2

014 0

0 12 8

0 10 6

0 8

8

0 6 11

16

Oats .

0 19 9

016 8

0 16 0

0 18 4

0 11

7

0 9 10

IT

Bice meal .

(0 18 6)

015 5

0 18 9

0 12 0

0 10

5

0 8 7

18 19

Locust beans Malt coombs

...

2 6 7

2 3 9

2 2 0

2 0 6

1 18 11

1 17 4

20

Fine poUard

1 15 2

112 0

110 5

18 8

1 6 11

15 3

21

Coarse pollard .

118 1

115 2

1 18 6

1 12 0

1 10

5

18 9

22 23

Bran Clover hay .

1 18 6

11511

1 14 6

1 18 1

1 11

8

1 10 8

17 0

15 6

14 5

13 7

1 2

8

118

24 26

Meadow hay Pea straw .

0 18 7

017 0

0 16 3

0 15 5

0 14

5

0 13 7

0 12 2

010 9

0 10 0

0 9 8

0 8

6

0 7 8

26

Oat straw .

0 7 5

0 6 2

0 5 5

0 4 9

0 4

0

0 8 8

27

Wheat straw

0 6 6

0 5 5

0 4 10

0 4 2

0 8

6

0 3 0

28

Barley straw

0 6 5

0 6 6

0 4 10

0 4 4

0 3

9

0 3 2

29 80

Bean straw . Potatoes

Oil 5

010 4

0 9 9

0 9 2

0 8

7

0 8 0

0 4 1

0 8 9

0 8 6

0 3 8

0 8

1

0 2 11

81

Carrots

0 2 9

0 2 6

0 2 4

0 2 8

0 2

1

0 1 11

32

Parsnips Mangel wurzels .

0 8 6

0 8 8

0 8 1

0 2 10

0 2

8

0 2 7

33

0 3 2

0 8 0

0 2 10

0 2 9

0 2

7

0 2 5

84

Swedish turnips .

0 2 11

0 2 9

0 2 8

0 2 7

0 2

5

0 2 8

35

Yellow turnips .

(0 2 6)

0 2 4

0 2 8

0 2 2

0 2

1

0 2 0

86

White turnips .

0 2 7

0 2 6

0 2 4

0 2 8

0 2

2

0 2 0

the manure-value in his increased crops. In the calcula- tions for this purpose the rule is to deduct one-half of the original manure-value of the food used the last year, and one-third of the remainder each year to the eighth, in the case of all the more concentrated foods and of the roots — in fact, of all the foods in the list excepting the hays and the straws. For these, which contain larger amounts of indigestible matter, and the constituents of which will be more slowly available to crops, two-thirds of the original manure^alue is deducted for the last year, and only one- fifth from year to year to the eighth year back. The results of the estimates of compensationyvalue so made are given for the five yields of 6, 8, 10, 12, and 14 quarts of

milk per head per day respectively in Lawes and Gilbert's paper ^ on the valuation of the manures obtained by the consumption of foods for the production of milk, which may be consulted for fuller details. It must, however, be borne in mind that when cows are fed in sheds or yards the manure is generally liable to greater losses than is the case with fattening oxen. The manure of the cow contains much more water in proportion to solid matter than that of the ox. Water will, besides, fre- quently be used for washing, and it may be that a good deal of the manure is washed into drains and lost. In the event, therefore, of a claim for compensation, the management and disposal of the manure requires the attention of the valuer. Indeed, the varying circum- stances that will arise in practice must be carefully con- sidered. Bearing these in mind, the estimates may be accepted as at any rate the best approximation to the truth that existing knowledge provides ; and they should be found sufB.cient for the requirements of practical use. Obviously they will be more directly applicable to the case of cows feeding entirely on the foods enumerated in the list, and not depending largely on grass; but, even when the animals are partially grass-fed, the value of the manure derived from the additional dry food, or roots, may be estimated according to the scale given. The whole question is more fully dealt with under Agkicultuke.

Cheese and Cheese-jVTaking.

For generations, perhaps for centuries, the question has been discussed as to why there should be so large a pro- portion of bad and inferior cheese and so small a propor- tion of really good cheese made in farmhouses throughout the land. That the result is not wholly due to skill and care, or to the absence of these qualities, on the part of the dairymaid may now be taken for granted. Instances might be quoted in which the most painstaking of dairy- maids, in the cleanest of dairies, have failed to produce cheese of even second-rate quality and character, and yet others in which excellent cheese has been made under commonplace conditions as to skill and equipment, and with not much regard to cleanliness in the dairy. The explanation of what was so long a mystery has been found in the domain of ferments. It is now known that whilst various micro-organisms, which in many dairies have free access to the milk, have ruined an incalculable quantity of cheese — and of butter also — neither

cheese nor butter of first-rate quality can be made without the aid of lactic acid bacilli. As an illustrative case, mention may be made of that of two most painstaking dairymaids who had tried in vain to make good cheese from the freshest of milk in the cleanest of dairies in North Lancashire. Advice to resort to the use of the ferment was acted upon, and the result was a revelation and a transformation, excellent prize-winning cheese being made from that time forward. By the addition of a " starter," in the form of a small quantity of sour milk, whey, or buttermilk, in an advanced stage of fermentation, the development of acidity in the main body of milk is accelerated. It has been ascertained that the starter is practically a culture of bacteria, which, if desired, may be obtained as a pure culture. Professor J. E. Campbell, as the result of recent experiments on pure cultures for Cheddar cheese-making, states that (1) first-class Cheddar cheese can be made by using pure cultures of a lactic organism ; (2) this organism abounds in all samples of sour milk and sour whey; (3) the use of a whey starter is attended with results equal in every respect to those obtained from a milk-starter. It is well within

1 Joum. Roy. Agric. Soc, 1898.

2 Trans. Sight, and Agric. Soc. Scot., 1899.

the power of any dairyman to prepare what is practically a pure culture of the same bacterium as is supplied from the laboratory. Moreover, the sour-whey starter used by some of the successful cheese-makers before the introduc- tion of the American system is in effect a pure culture, from which it follows that these men had, by empirical methods, attained the same end as that to which bacteriological research subsequently led. Wherever a starter is necessary, the use of a culture practically pure is imperative, whether such culture be obtained from the laboratory or prepared by what may be called the "home-made starter." Pure cul- tures may be bought for a few shillings in the open market. The factory-made cheese of Canada, the United States, and Australasia, which is so largely imported into the United Kingdom, is all of the Cheddar type. The factory

system has made no headway in the original home of the Cheddar cheese in the West of England. The system was thus described in the Journal of the British Dairy Farmers' Association in 1889 by Mr E. J. Drummond : —

" In the year 1885 I was engaged as cheese instructor by the Ayrshire Dairy Association, to teach the Canadian system of Cheddar cheese-making. I commenced operations under many diffi- culties, being a total stranger to both the people and the country, and with this, the quantities of milk were very much less than I had been in the habit of handling. Instead of having the mUk from 500 to 1000 cows, we had to operate with the milk from 25 to not over 60 cows.

" The system of cheese-making commonly practised in the county of Ayr at that time was what is commonly known as the Joseph Harding or English Cheddar system, which differs from the Canadian system in many details, and in one particular is essentially different, namely, the manner in which the necessary acidity in the milk is produced. In the old method a certain quantity of sour whey was added to the milk each day before adding the rennet, and I have no doubt in my own mind that this whey was often added when the milk was already acid enough, and the consequence was a spoiled cheese.

"Another objection to this system of adding sour whey was, should the stuff be out of condition one day, the same trouble was inoculated with the milk from day to day, and the result was sure to be great unevenness in the quality of the cheese. The utensils commonly in use were very different to anything I had ever seen before ; instead of the oblong cheese vat with double casings, as is used by all the best makers at the present time, a tub, sometimes of tin and sometimes of wood, from 4 to 7 feet in diameter by about 30 inches deep, was universally in use. Instead of being able to heat the mUk with warm water or steam, as is commonly done now, a large can of a capacity of from 20 to 30 gallons was filled with cold milk and placed in a common hot-water boiler, and heated sufficiently to bring the whole body of milk in the tub to the desired temperature for adding the rennet. I found that many mistakes were made in the quantity of rennet used, as scarcely any two makers used the same

quantity to a given quantity of milk. Instead of having a graduated measure for measuring the rennet, a common tear-cup was used for this purpose, and I have found in some dairies as low as 3 oz. of rennet was used to 100 gallons of milk, where in others as high as 6J oz. was used to the same quantity. This of itself would cause a difference in the quality of the cheese.

" Coagulation and breaking completed, the second heating was effected by dipping the whey from the curd into the can already mentioned, and heated to a temperature of 140° P., and returned to the curd, and thus the process was carried on till the desired temperature was reached. This mode of heating I considered very laborious and at the same time very unsatisfactory, as it is im- possible to distribute the heat as evenly through the curd in this way as by heating either with hot water or steam. The other general features of the method do not differ from our own very materially, with the exception that in the old method the curd was allowed to mature in the bottom of the tub, where at the same stage we remove the curd from the vat to what we call a curd- cooler made with a sparred bottom, so as to allow the whey to separate from the curd during the maturing or ripening process. In regard to the quality of cheese on the one method compared with the other, I think that there was some cheese just as fine made in the old way as anything we can possibly make in the new, with one exception, and that is, that the cheese made according to the old method will not toast — instead of the casein melting down with the butter-fat, the two become separated, which is very much objected to by the consumer — and, with this, want of uniformity through the whole dairy. This is a very short and imperfect description of how the cheese was made at the time I came into

Ayrshire ; and I will now give a short description of the system that has been taught by myself for the past four years, and has been the means of bringing this county so prominently to the front as one of the best cheese-making counties in Britain.

"Our duty in this system of cheese-making begins the night before, in having the milk properly set and cooled according to the temperature of the atmosphere, so as to arrive at a given heat the next morning. Our

object in this is to secure, at the time we wish to begin work in the morning, that degree of acidity or ripe- ness essential to the success of the whole operation. We cannot give any definite guide to makers how, or in what quantities, to set their milk, as the whole thing depends on the good judgment of the operator. If he finds that his milk works best at a temperature of 68° F. in the morning, his study the night before should tend toward such a result, and he will soon learn by experience how best to manage the milk in his own individual dairy. I have found in some dairies that the milk worked quite fast enough at a tempera- ture of 64° in the morning, where in others the milk set in the same way would be very much out of condition by being too sweet, causing hours of delay before matured enough to add the rennet. Great care should be taken at this point, making sure that the milk is properly matured before the rennet is added, as impatience at this stage often causes hours of delay in the making of a cheese. I advise taking about six hours, from the time the rennet is added till the curd is ready for salting, which means a six-hours process ; if much longer than this, I have found by experience that it is im- possible to obtain the best results. The cream should always be removed from the night's mUk in the morning and heated to a temperature of about 84° before returning it to the vat. To do this properly and with safety, the cream should be heated by adding about two-thirds of warm milk as it comes from the cow to one- third of cream, and passed through the ordinary mUk-strainers. If colouring matter is used, it should' be added fifteen to twenty minutes before the rennet, so as to become thoroughly mingled with the mUk before coagulation takes place.

" We use from 4 to 4 J oz. of Hansen's rennet extract to each 100 gallons of milk, at a temperature of 86° in spring and 84° in summer, or sufficient to coagulate milk firm enough to cut in about forty minutes when in a proper condition. In cutting, great care should be taken not to bruise the curd. I cut lengthwise, then across with perpendicular knife, then with horizontal knife the same way as the perpendicular, leaving the curd in small cubes about the size of ordinary peas. Stirring with the hands should begin immediately after cutting, and continue for ten to fifteen minutes prior to the application of heat. At this stage we use a rake instead of the hands for stirring the curd during the heating process, which lasts about one hour from time of beginning until the desired

temperature of 100° or 102° is reached. After heating, the curd should be stirred another twenty minutes, so as to become properly firm before allow- ing it to settle. We like the curd to lie in the whey fully one hour after allowing it to settle before it is ready for drawing the whey, which is regulated altogether by the condition of the milk at the time the rennet is added. At the first indication of acid, the whey should be removed as quickly as possible. I think at this point lies the greatest secret of cheese-making — ^to know when to draw the whey.

" I depend entirely on the hot-iron test at this stage, as I con- sider it the most accurate and reliable guide known to determine when the proper acidity has been developed. To apply this test, take a piece of steel bar about 18 inches long by an inch vride and \ inch thick, and heat to a black heat ; if the iron is too hot, it will bum the curd ; if too cold, it vrill not stick ; consequently it is a very simple matter to determine the proper heat. Take a small quantity of the curd from the vat and compress it tightly in the hand, so as to expel all the whey ; press the curd against the iron, and when acid enough it will draw fine silky threads J inch long. At this stage the ciird should be removed to the curd-cooler as quickly as possible, and stirred till dry enough to allow it to mat, which generally takes from five to eight minutes. The curd is now allowed to stand in one end of the cooler for thirty minutes, when it is cut into pieces from 6 to 8 inches square and turned, and so on every half ~~hour until it is fit for milUng. After removing the whey, a new acid makes its appearance in the body of the curd which seems to depend for its development upon the action of the air, and the presence of which experience has shown to be an essential element in the making of a cheese. This acid should be allowed to develop properly before the addition of salt. To de~~ termine when the curd is ready for salting, the hotr-iron test is again resorted to ; and when the curd will draw fine silky threads IJ inch long, and at the same time have a soft velvety feel when pressed in the hand, the butter-fat will not separate with the whey from the curd. I generally advise using 1 lb of salt to 50 lb of curd, more or less, according to the condition of the curd. After salting, we let the curd lie fifteen minutes, so as to allow the salt to be thoroughly dissolved before pressing.

” In the pressing, care should be taken not to press the curd too severely at first, as you are apt to lose some of ttie butter-fat, and

with this I do not thinlc that the whey will come away so freely by heavy pressing at first. We advise three days’ pressing before cheese is taken to the curing-room. All cheese should have a bath in water at a temperature of 120° next morning after being made, so as to form a good skin to prevent cracking or chipping. The temperature of the curing-room should be kept as near 60° as possible at all seasons of the year, and I think it a good plan to ventilate while heating.”

With regard to the hot-iron test for acidity, Mr F. J. Lloyd, in describing his investigations on behalf of the Bath and West of England Society, states that cheese- makers have long known that in both the manufacture and the ripening of cheese the acidity produced — known to the chemist as “lactic acid” — materially influences the results obtained, and that amongst other drawbacks to the test referred to is the uncertainty of the tempera- ture of the iron itself. He gives an account,^ however, of a chemical method involving the use of a standard so- lution of an alkali (soda), and of a substance termed an ” indicator ” (phenolphtnalein), which changes colour ac- cording to whether a solution is acid or alkaline. The apparatus used with these reagents is called the acidi- meter. The two stages in the manufacture of a Cheddar cheese most difficult to determine empirically are (1) when to stop stirring and to draw the whey, and (2) when to grind the curd. The introduction of the acidimeter has done away with these difficulties ; and though the use of this apparatus is not actually a condition essential to the manufacture of a good cheese, it is to many makers a ne- cessity and to all an advantage. By its use the cheese- maker can determine the acidity of the whey, and so de- cide when to draw the latter off, and will thus secure not only the proper development of acidity in the subsequent changes of cheese-making, but also materially diminish the time which the cheese takes to

*make. Furthermore, it has been proved that the acidity of the whey which drains from the curd when in the cooler is a suffi- ciently accurate guide to the condition of the curd before grinding; and by securing uniformity in this acidity the maker will also ensure uniformity in the quality and ripening properties of the cheese. Speaking generally, the acidity of the liquid from the press should never fall below 0-80 per cent, nor rise above 1-20 per cent., and the nearer it can be kept to 1-00 per cent, the better. Simultaneously, of course, strict attention must be paid to temperature, time, and every other factor which can be accurately determined. Analyses of large numbers of Cheddar cheeses manufactured in every month of the cheese-making season show the average composition of ripe specimens to be — water, 35*58 per cent.; fat, 31 "33; casein, 29'12; mineral matter or ash, 3-97. It has been maintained that in the ripening of Cheddar cheese fat is formed out of the curd, but a com- parison of analyses of ripe cheeses with analyses of the curd from which the cheeses were made affords no evidence that this is the case.*

The quantity of milk required to make 1 lb of Cheddar oheese may be learnt from Table X., which shows the results obtained at the cheese school of the Bath and West of England Society in the two seasons of 1899 and 1900. The cheese was sold at an average age of ten to twelve weeks. In 1899 a total of 21,220 gallons of milk yielded 20,537 lb of saleable cheese, and in 1900, 31,808 gallons yielded 29,631 ft. In the two years together 53,028 gallons yielded 50,168 ft, which is equivalent to 1-05 gallon of milk to 1 ft of cheese. For practical pur- poses it may be taken that one gallon, or slightly over 10 ft, of milk yields 1 ft of pressed cheese. The prices obtained are added as a matter of interest.

Cheshire cheese is largely made in the county from

1 Report on Cheddar Cheese-Making, Loudon, 1899.

which it takes its name, and in adjoining districts. It is extensively consumed in Manchester and Liverpool, and other parts of the densely populated county of Lancaster.

Table X. Quantities of Milk employed and of Cheese produced in the Manufacture of Cheddar Cheese.

When Made.

MUk.

Green Cheese.

Saleable Cheese,

Shrinkage,

Price,

1899.

galls.

lb

lb

per cwt.

April .

3077

3100

2924

6 per cent.

60s.

May

4462

4502

4257

6J K) per cwt.

63s,

June

4316

4434

4141

7 ft) 6 oz. per cwt.

70s,

July .

3699

3785

3545

7 R) 2 oz. per cwt.

74s.

August .

2495

2539

2353

8 lb 3 oz. per cwt.

74s.

Sept. and Oct.

3171

3583

3317

8 R) 5 oz. per cwt.

74s.

1900.

April .

3651

3505

3292

6 per cent.

63s.

May

6027

6048

5577

7J per cent.

64s.

June

5960

5889

5466

7J per cent.

68s.

July and Aug.

7227

7177

6630

Tl per cent.

66s.

Sept. and Oct.

8943

9635

8666

10 per cent.

66s.

The following is a description of the making of Cheshire cheese : —

The evening's milk is set apart until the following morning, when the cream is skimmed off. The latter is poured into a pan which has been

heated by being placed in the boiling water of a boiler. The new milk obtained early in the morning is poured into the vessel containing the previous evening's milk with the warmed cream, and the temperature of the mixture is brought to about 75° F. Into the vessel is introduced a piece of rennet, which has been kept in warm water since the preceding evening, and in which a little Spanish annatto (a quarter of an ounce is enough for a cheese of 60 lb) is dissolved. (Marigolds, boiled in milk, ai-e oc- casionally used for colouring cheese, to which they likewise impart a pleasant flavour. In winter, carrots scraped and boiled in milk, and afterwards strained, will produce a richer colour ; but they should be used with moderation on account of their taste,) The whole is now stirred together, and covered up warm for about an hour, or until it becomes curdled ; it is then turned over with a bowl and broken very smaU. After standing a little time, the whey is drawn from it, and as soon as the curd becomes somewhat more solid it is cut into slices and turned over repeatedly, the better to press out the whey.

The curd is then removed from the tub, broken by hand or cut by a curd-breaker into small pieces, and put into a cheese vat, where it is strongly pressed both by hand and with weights, in order to extract the remaining whey. After this it is transferred to another vat, or into the same if it has in the meantime been well scalded, where a similar process of breaking and expressing is repeated, until all the whey is forced from it. The cheese is now turned into a third vat, previously warmed, with a cloth beneath it, and a thin hoop or binder put round the upper edge of the cheese and within the sides of the vat, the cheese itself being previously enclosed in a clean cloth, and its edges placed within the vat, before transfer to the cheese-oven. These various pro- cesses occupy about six hours, and eight more are requisite for pressing the cheese under a weight of 14 or 15 cwt. The cheese during that time should be twice turned in the vat. Holes are bored in the vat which contains the cheese, and also in the cover of it, to facilitate the extraction of every drop of whey. The pressure being continued, the cheese is at length taken from the vat as a firm and solid mass.

On the following morning and evening it must be again turned and pressed ; and also on the third day, about the middle of which it should be

removed to the salting chamber, where the outside is well rubbed with salt, and a cloth binder passed round it which is not turned over the upper surface. The cheese is then placed in brine extending half-way up in a salting-tub, and the upper surface is thickly covered with salt. Here it remains for nearly a week, being turned twice in the day. It is then left to dry for two or three days, during which period it is turned once — being well salted at each turning — and cleaned every day. When taken from the brine it is put on the salting benches, with a wooden girth round it of nearly the thickness of the cheese, where it stands a few days, during which time it is again salted and turned every day. It is next washed and dried ; and after re- maining on the drying benches about seven days, it is once more washed in warm water with a brush, and wiped dry. In a couple of hours after this it is rubbed all over with sweet whey butter, which operation is afterwards frequently repeated ; and, lastly, it

is deposited in the cheese- or store-room — wliich should be moder- ately warm and sheltered from the access of air, lest the cheese should crack — and turned every day, until it has hecome suffi- ciently hard and firm. These cheeses require to be kept a considerable time.

As a matter of fact, there are three different modes of cheese- making followed in Cheshire, known as the early ripening, the medium ripening, and the late ripening processes. There is also a method which produces a cheese that is permeated with " green mould" when ripe, called "Stilton Cheshire" ; this, however, is confined to limited districts in the county. The early ripening method is generally followed in the spring of the year, until the middle or end of April ; the medium process, from that time until late autumn, or until early in June, when the late ripening process is adopted and followed until the end of September, changing again to the medium process as the season advances. The late ripening process is not

found to be suitable for spring or late autumn make. There is a decided difference between these several methods of making. In the early ripening system a larger quan- tity of rennet is used, more acidity is developed, and less pressure employed than in the other processes. In the medium ripening process a moderate amount of acidity is developed, to cause the natural drainage of the whey from the curd vfhen under press, ^n the late ripening system, on the other hand, the development of acidity is prevented as far as possible, and the whey is got out of the curd by breaking down finer, using more heat, and skewering vrhen under press. In the Stilton Cheshire process a larger quan- tity of rennet is used, and less pressure is employed, than in the medium or late ripening systems.

It is hardly possible to enunciate any general rules for the making of Stilton cheese, "which differs from Cheddar and Cheshire in that it is not subjected to pressure. Mr J. Marshall Dugdale, in 1899, made a visit of inspection to the chief Leicestershire dairies where this cheese is produced, but in his report ^ he stated that every Stilton cheese-maker worked on his own lines, and that at no two dairies did he find the details all carried out in the same manner. There is a fair degree of uniformity up to the point when the curd is ladled into the straining-cloths, but at this stage, and in the treatment of the curd before salting, diversity sets in, several different methods being in successful use. Most of the cheese is made from two curds, the highly acid curd from the morning's milk being mixed with the coinparatively sweet curd from the evening's milk. Opinion varies widely as to the degree of tightening of the straining-cloths. No test for acidity appears to be used, the amount of acidity being judged by the taste, feel, and smell of the curd. When the desired degree of acidity has developed, the curd is broken by hand to pieces the size of small walnuts, and salt is added at the rate of about 1 oz. to 4 lb of dry curd, or 1 oz. to 3J lb of wet curd, care being taken not to get the curd pasty. If a maker has learnt how to rennet the milk properly, and how to secure the right amount of acidity at the time of hooping — that is, when the broken and salted curd is put into the wooden hoops which give the cheese its shape — ^he has acquired pro- bably two of the most important details necessary to success. It was formerly the custom to add cream to the milk used for making Stilton cheese, but the more general practice

now is to employ new milk alone, which yields a product apparently as excellent and mellow as that from enriched milk.

As a cheese matures or becomes fit for consumption, not only is there produced the characteristic flavour peculiar to the type of cheese concerned, but with all varieties, independently of the quality of flavours developed, a profound physical transformation of the casein occurs. In the course of this change the firm elastic curd " breaks down " — that is, becomes plastic, whilst chemi- cally the insoluble casein is converted into various soluble decomposition products. These ripening pheno-

1 "The Practice of Stilton Cheese-Making," Joum. Boy. Agric. Soc, 1899.

mena — the production of flavour and the breaking down of the casein (that is, the formation of proper texture) — ^used to be regarded as diiferent phases of the same process. As subsequently shown, however, these changes are not necessarily so closely correlated. The theories formerly advanced as explanatory of the ripening changes in cheese were suggestive rather than based upon experimental data, and it is only since 1896 that careful scientific studies of the problem have been made. Of the two existing theories, the one, which is essentially European, ascribes the ripening changes wholly to the action of living organisms — the bacteria present in the cheese. The other, which had its origin in the United States, asserts that there are digestive enzymes — that is, unorganized or soluble ferments — inherent in the milk itself that render the casein soluble. The supporters of the bacterial theory are ranged in two classes. The one, led by Duclaux, regards the breaking down of the casein as due to the action of liquefying bacteria (Tyrothrix forms). On the other hand, Von Freudenreich has ascribed these changes to the lactic-acid type of bacteria, which develop so luxuriantly in hard cheese like Cheddar.

With regard to the American theory, and in view of the important practical results obtained by Babcock and Russell at the Wisconsin experiment station, the follow- ing account^ of their work is of interest, especially as the subject is of high practical importance. In 1897 they announced the discovery of an inherent enzyme in milk, which they named galactase, and which has the power of digesting the casein of milk and producing chemical de- composition products similar to those that

normally occur in ripened cheese. The theory has been advanced by them that this enzyme is an important factor in the ripening changes ; and as in their experiments bacterial action was excluded by the use of anaesthetic agents, they conclude that, so far as the breaking down of the casein is concerned, bacteria are not essential to this process. In formulating a theory of cheese-ripening, they have further pointed out the necessity of consider- ing the action of rennet extract as a factor concerned in the curing changes. They have shown that the addition of increased quantities of rennet extract materially hastens the rate of ripening, and that this is due to the pepsin which is present in all commercial rennet extracts. They find it easily possible to differentiate between the pro- teolytic action — that is, the decomposing of proteids — of pepsin and galactase, in that the first-named enzyme is incapable of producing decomposition products lower than the peptones precipitated by tannin. They have shown that the increased solubility — the ripening changes — of the casein in cheese made with rennet is attributable solely to the products peculiar to peptic digestion. The addition of rennet extract or pepsin to fresh mUk does not produce this change, unless the acidity of the milk is allowed to develop to a point which experience has shown to be the best adapted to the making of Cheddar cheese. The rationale of the empirical process of ripening the milk before the addition of the rennet is thus explained. In studying the properties of galactase it was further/ found that this enzyme, as well as those present in rennet extract, is operative at very low temperatures, even below freezing-point. When cheese made in the normal manner was kept at temperatures ranging from 26° to 45° P. for periods averaging from 8 to 18 months, it was found that the texture of the product simulated that of a perfectly ripened cheese, but that such cheese developed a very mild flavour in comparison with the normally-cured product. Subsequent storage at

2 Experiment Station Becorcf, zdi. 9. Washington, 1901.

somewliat higher temperatures gives to such cheese a flavour the intensity of which is determined by the dura- tion of storage. This indicates that the

breakiag down of the casein and the production of the flavour peculiar to cheese are in a way independent of each other and may be independently controlled — a point of great econ- omic importance in commercial practice. Although it is generally believed that cheese ripened at low temperatures is apt to develop a more or less bitter flavour, the flavours in the cases described were found to be practically perfect. Under these conditions of curing, bacterial activity is in- operative, and these experiments are held to furnish an independent proof of the enzyme theory.

Not only are these investigations of interest from the scientific standpoint, as throwing light on the obscure processes of cheese-curing, but from a practical point of view they open up a new field for commercial exploita- tion. The iuability to control the temperature in the ordinary factory curiag-room results in serious losses, on account of the poor and uneven quality of the product, and the consumption of cheese has been greatly lessened thereby. These conditions may all be avoided by this low- temperature curing process, and it is not improbable that the cheese industry may undergo important changes in methods of treatment. With the introduction of cold- storage curing, and the necessity of constructing cen- tralized plant for this purpose, the cheese industry may perhaps come to be differentiated into the manufacture of the product in factories of relatively cheap construction, and the curing or ripening of the cheese in central curing stations. In this way not only would the losses which occur under present practices be obviated, but the improve- ment in the quality of the cured product would be more than sufficient to cover the cost of cold-storage curing.

The characteristics of typical specimens of the different kinds of English cheese may be briefly described. Cheddar cheese possesses the aroma and flavour of a nut — the so-called ” nutty ” flavour. It should melt in the mouth, and taste neither sweet nor acid. It is of flaky texture, neither hard nor crumbly, and is firm to the touch. It is early-ripening and, if not too much acid is developed in the makiag, long-keeping. Before all others it is a cosmopolitan cheese. Some cheeses are ” plain,” that is, they possess the natural paleness of the curd, but many are coloured with annatto — a practice that might be dis- pensed with. The average weight of a Cheddar

cheese is about 70 Bb . Stilton cheese is popularly but erroneously supposed to be commonly made from morning's whole milk with evening's cream added, and to be a " double- cream " cheese. The texture is waxy, and a blue-green mould permeates the mass if well ripened ; the flavour is suggestive of decay. The average weight of a Stilton is 15 ft. Cheshire cheese has a fairly firm and uniform texture, neither flaky on the one hand nor waxy on the other ; is of somewhat sharp and piquant, flavour when fully ripe ; and is often — at eighteen months old, when a well-made Cheshire cheese is at its best — permeated with a blue-green mould, which, as in the case of Stilton cheese, contributes a characteristic flavour which is much appreciated. Cheshire cheese is, like Cheddar, some- times highly-coloured, but the practice is quite unneces- sary; the weight is about 55 lb. Gloucester cheese has a firm, somewhat soapy, texture and sweet flavour. Double Gloucester differs from single Gloucester only in size, the former usually weighing 26 to 30 lb, and the latter 13 to 15 lb. Leicester cheese is somewhat loose in texture, and mellow and moist when nicely ripened. Its flavour is " clean," sweet, and mild, and its aroma pleasant. To those who prefer a mild flavour in cheese, a perfect Leicester is perhaps the most attractive of all the so-called " hard " cheese ; the average weight of

such a cheese is about 35 lb. Derby cheese in its best forms is much like Leicester, being " clean " in flavour and mellow. It is sometimes rather flaky in texture, and is slow-ripening and long-keeping if made on the old lines; the average weight is 25 ft. Lancashire cheese, when well made and ripe, is loose in texture and is mellow ; it has a piquant flavour. As a rule it ripens early and does not keep long. Dorset cheese — sometimes called " blue vinny " (or veiny) — is of firm texture, blue- moulded, and rather sharp-flavoured when fully ripe; it has a local popularity, and the best makes are rather like Stilton. Wensleydale cheese, a local product in North Yorkshire, is of fairly firm texture and mild flavour, and may almost be spread with a knife when ripe ; the finest makes are equal to the best Stilton. Cotherstone cheese, also a Yorkshire product, is very much like Stilton, and commonly preferable to it. The blue-green mould develops, and the cheese is fairly mellow and moist, whereas many Stiltons are hard and dry. Wiltshire cheese, in the form of " Wilts truckles," may be described as small Cheddars, the weight being usually

about 16 ft. Caerphilly cheese is a thin, flat product, having the appearance of an undersized single Gloucester and weighing about 8 ft ; it has no very marked characteristics, but enters largely into local con- sumption amongst the mining population of Glamorgan- shire and Monmouthshire. Soft cheese of various kinds is made in many localities, beyond which its reputation scarcely extends. One of the oldest and best, somewhat resembling Camembert when well ripened, is the little " Slipcote," made on a small scale in the county of Rut- land; it is a soft, mellow, moist cheese, its coat slipping off readily when the cheese is at its best for eating — hence the name. Cream cheese is likewise made in many dis- tricts, but nowhere to a great extent. A good cream cheese is fairly firm but mellow, with a slightly acid yet very attractive flavour. It is the simplest of all cheese to make — cream poured into a perforated box lined with loose muslin practically makes itself into cheese iu a few days' time, and is usually ripe in a week.

In France the pressed varieties of cheese with hard rinds include Gruy^re, Cantal, Eoquefort, and Port Salut. The first-named, a pale yellow cheese full of holes of varying size, is made in Switzerland and in the Jura Mountains district in the east of France ; whilst Cantal cheese, which is of lower quality, is a product of the mid- land districts, and is made barrel-shape. Eoquefort eheese is made from the milk of ewes, which are kept chiefly as dairy animals in the department of Aveyron, and the cheese is cured in the natural mountain caves at the vil- lage of Eoquefort. It is a small, rather soft, white cheese, abundantly veined with a greenish-blue mould, and weighs between 4 and 5 ft. The Port Salut is quite a modem cheese, which originated in the abbey of that name in Mayenne ; it is a thin, flat cheese, of characteristic and not unattractive odour and flavour. The best known of the soft impressed cheeses are Brie, Camembert, and Coulommiers, whilst Pont I'Evgque, Livarot, and other varieties are also made. After being shaped in moulds of various forms, these cheeses are laid on straw mats to cure, and when fit to eat they possess about the same consistency as butter. The Neuf chatel, Gervais, and Bondon cheeses are soft vari- eties intended to be eaten quite fresh, like cream cheese.

Of the varieties of cheese made in Switzerland, the best known is the Emmenthaler, which is about the size of a cart-wheel, and has a weight varying from 150 to 300 ft. It is fuU of small holes of almost uniform size and very regularly distributed. In colour and flavour it is the same as Gruy^re. The Edam and Gouda are the common cheeses of Holland. The Edam is spherical in shape, weighs from 3 to 4 ft, and is usually dyed crimson on

the outside. The Gouda is a flat cheese with convex edges, and is of any weight up to 20 ft. Of the two, the Edam has the finer flavour. Limburger is the leading German cheese, whilst other varieties are the Backstein and Munster ; all are strong-smelling. Parmesan cheese is an Italian product, round and flat, about 5 inches thick, weighing from 60 to 80 ft, and possessed of fine flavour. Gorgonzola cheese, so called from the Italian town of that name near Milan, is made in the Cheddar shape, and weighs from 20 to 40 ft. When ripe it is permeated by a blue mould, and resembles in flavour, appearance, and consistency a rich old Stilton.

BUTTBK AND BuTTBK-MaKING.

As with cheese, so with butter, large quantities of the latter have been inferior not because the cream was poor in quality, but because the wrong kinds of bacteria had taken possession of the atmosphere in hundreds of dairies. The greatest if not the latest novelty in dairying in the last decade of the 19th century was the isolation of lactic acid bacilli, their cultivation in a suitable medium, and their employment in cream preparatory to churning. Used thus in butter-making, an excellent product results, pro- vided cleanliness be scrupulously maintained. The cul- ture repeats itself in the buttermilk, which in turn may be used again with marked success. Much fine butter, indeed, was made long before the bearing of bacteriological science upon the practice of dairying was recognized — made by using acid buttermilk from a previous churning.

In Denmark, which is, for its size, the greatest butter- producing country in the world, most of the butter is made with the aid of "starters," or artificial cultures which are employed in ripening the cream. Though the butter made by such cultures shows little if any superiority over a good sample made from cream ripened in the ordinary way, — that is, by keeping the cream at a fairly high temperature until it is ready for churning, when it must be cooled — it is claimed that the use of these cultures enables the butter-makers of Denmark to secure a much greater uniformity in the quality of their produce than would be possible if they depended upon the ripening of the cream through the influence of bacteria taken up in the usual way from the air.

Butter-making is an altogether simpler process than cheese-making, but success demands strict attention to sound principles, the observance of thorough cleanliness in every stage of the work, and the intelligent use of the thermometer. The following rules for butter-making, issued by the Eoyal Agricultural Society, sufficiently in- dicate the nature of the operation : —

Prepare churn, butter-worker, wooden hands, and sieve as fol- lows : — (1) Kinse with cold water. (2) Scald with boiling water. (3) Rub thoroughly with salt. (4) Rinse with cold water.

Always use a correct thermometer.

The cream, when in the churn, to be at a temperature of 56° to 58 r. in summer and 60° to 62° F. in winter. The churn should never be more than half full. Churn at number of revolutions sug- gested by maker of churn. If none are given, churn at 40 to 45 revolutions per minute. Always churn slowly at first.*

Ventilate the chum freely and frequently during churning, until no air rushes out when the vent is opened.

Stop churning immediately the butter comes. This can be ascer- tained by the sound ; if in doubt, loolc.

The butter should now be like grains of mustard seed. Pour in a small quantity of cold water (1 pint of water to 2 quarts of cream) to harden the grains, and give a few more turns to the chum gently.

Draw off the buttermilk, giving plenty of time for draining. Use a straining-cloth placed over a hair-sieve, so as to prevent any loss, and wash the butter in the churn with plenty of cold water ; then draw off the water, and repeat the process until the water comes off quite clear.

To brine butter, make a strong brine, 2 to 3 lb of salt to 1 gallon of water. Place straining-cloth over mouth of churn, pour in brine,

put lid on churn, turn sharply half a dozen times, and leave for 10 to 15 minutes. Then lift the butter out of churn into sieve, turn butter out on worker, leave it a few minutes to drain, and work gently till all superfluous moisture is pressed out.

To drysalt butter, place butter on worker, let it drain 10 to 15 minutes, then work gently till all the butter comes together. Place it on the scales and weigh ; then weigh salt, for slight salt- ing, J oz. ; medium, J oz. ; heavy salting, | oz. to the lb of but- ter. Roll butter out on worker and carefully sprinkle salt over the surface, a little at a time ; roll up and repeat tiU all the salt is used.

Never touch the butter with your hands.

Well-made butter is firm and not greasy. It possesses a characteristic texture or "grain," in virtue of which it cuts clean with a knife and breaks with a granular frac- ture, like that of cast-iron. Theoretically, butter should consist of little else than fat, but in practice this degree of perfection is never attained. Usually the fat ranges from 83 to 88 per cent., whilst water is present to the extent of from 10 to 16 per cent.^ There will also be from 0-2 to 0-8 per cent, of milk-sugar, and from 0-6 to 0-8 per cent, of casein. It is the casein which is the objectionable ingredient, and the presence of which is usually the cause of rancidity. In badly washed or badly worked butter, from which the buttermilk has not been properly removed, the proportion of casein, or curd, left in the product may be considerable, and such butter has only inferior keeping

qualities. At the same time, the mistake may be made of overworking or of overwashing the butter, thereby de- priving it of the delicacy of flavour which is one of its chief attractions as an article of consumption if eaten fresh. The object of washing with brine is that the small quan- tity of salt thus introduced shall act as a preservative and develop the flavour. Streaky butter may be due either to curd left in by imperfect washing, or to an uneven dis- tribution of the salt.

Equipment of the Daiky.

The improved form of milking-pail shown in Eig. 1 has rests or brackets, which the milker when seated on

Fio. 3.— Bectangolar Cheese Vat.

his stool places on his knees ; he thus bears the weight on his thighs, and is entirely relieved of the strain involved

1 Market butter is sometimes deliberately over-weighted with water, and a fraudulent profit is obtained by selling this extra moisture at the price of butter. In July 1901, therefore, a departmental committee was appointed to inquire into the matter {vide infra) ,

Fig. 4.— Cheese Tub.

Fig. 5.— Curd Kniyes.

Fig. 6.— Curd MiU.

Fig. 7.— Hoop for Flat Cheese.

Fig. 10.— Cheese Mould (Pont l'ET6que).

Pig. U.— Milk Pan.

Fig. 15.— Butter Scoop.

Fig. 14.— Churn.

in gripping the can between the knees. The milk sieve or strainer (Fig. 2) is used to remove cow-hairs and any other mechanical impurity that may have fallen into the milk. A double straining surface is provided, the second being of very fine gauze placed vertically, so that the pressure of the mUk does not force the dirt through ; the strainer is easily washed. The cheese tub or vat receives the milk for cheese-making. The rectangular form shown in Fig. 3 is a Cheshire cheese-vat, for steam. The inner vat is of tinned steel, and the outer is of iron and is fitted with pipes for steam supply. Eound cheese-tubs (Fig. 4) are made of strong sheets of steel, double tinned to render them lasting. They are fitted with a strong bottom hoop and bands round the sides, and can be double-jacketed for steam-heating if required. Curd-knives (Fig. 5) are used for cutting the coagulated mass into cubes in order to liberate the whey. They are made of fine steel, with sharp edges; there are also wire curd-breakers. The object of the curd-mill (Fig. 6) is to grind consolidated curd into small pieces, preparatory to salting and vatting ; two spiked rollers work up to spiked breasts. Hoops, into which the curd is placed in order to acquire the shape of the cheese, are of wood or steel, the former being made of well-seasoned oak with iron bands (Fig. 7), the latter of tinned steel. The cheese is more easHv removed

Fio. 16.— Butter-worker.

from the steel hoops, and they are readily cleaned. The cheese-press (Fig. 8) is used only for hard or ” pressed ” cheese, such as Cheddar. The arrangement is such that the pressure is continuous ; in the case of soft cheese the curd is merely placed in moulds (Figs. 9 and 10) of the required shape, and then taken out to ripen, no pressure being applied.

The cheese-room is fitted with easily-turned shelves, on which newly-made ” pressed ” cheeses are laid to ripen.

In the butter dairy, when the centrifugal separator is not used, milk is ” set ” for cream-raising in the milk-pan (Fig. 11), a shallow vessel of white porcelain, tinned steel, or enamelled iron. The skimming-dish or skimmer (Fig. 12), made of tin, is for collecting the cream from the surface of the milk, whence it is transferred to the cream- crock (Fig. 13), in which vessel the cream remains from one to three days, tUl it is required for churning. Many different kinds of churns are in use, and vary much in size, shape, and fittings ; the one illustrated in Fig. 14 is a very good type of diaphragm churn. The butter-scoop (Fig. 15) is of wood, and is sometimes perforated ; it is used for taking^ the butter out of the churn. The butter- worker (Fig. 16) is employed for consolidating newly-churned butter, pressing out superfluous water, and mixing in salt. More extended use, however, is now being made

Fia. IT.— Scotoli Hands.

of the ” Delaiteuse ” butter-dryer, a centrifugal machine that rapidly extracts the moisture from the butter, and renders the butter-worker unneces- sary, whilst the butter produced has a better grain. Scotch hands (Fig. 17), made of boxwood, are used for the lifting, moulding, and pressing of butter.

In the centrifugal cream-separator the new milk is allowed to flow into a bowl, which is caused to rotate on its own axis several thousand times per minute. The heavier por- tion which makes up the watery part of the milk flies to the outer circumference of the bowl, whUst the lighter particles of butter-fat are forced to travel in an inner zone. By a simple mechanical arrangement the separated milk is forced out at one tube and the cream at another, and they are collected in distinct vessels. Separators are made of all sizes, from small machines dealing with 10 or 20 up to 100 gallons an hour, and worked by hand (Fig. 18), to large machines separating 150 to 440 gallons an hour, and worked by horse, steam, or other power (Fig. 19). Separation is found to be most effective at temperatures ranging in different machines from 80° to 98° F., though as high a temperature as 150° is sometimes employed. The most efficient separators remove nearly

the whole of the butter- fat, the quantity of fat left in the separated milk falling in some cases to as low as 0-1 per cent. When cream is raised by the deep-setting method, from 0-2 to 0-4 per cent, of fat is left in the skim-milk ; by the shallow-settiag method from 0-3 to 0-5 per cent, of the fat is left behind. As a rule, therefore, ” separated ” milk is much poorer in fat than ordinary ” skim ” milk left by the cream-raising method in deep or shallow vessels.

The first continuous working separator was the inven- tion of Dr de Laval. The more recent invention by Baron von Bechtolsheim of what are known as the Alfei discs, which are placed along the centre of the bowl of the separator, has much increased the separating capacity of the machines without adding to the power required. This has been of great assistance to dairy farmers by lessening the cost of the manu- facture of butter, and thus enabling a large additional number of factories to be estab- lished in different parts of the world, particularly in Ireland, where these disc machines are very extensively used.

The pasteurizer — so named after the French chemist Pasteur — affords a means whereby at the outset the milk is maintained at a tempera- ture of 170° to 180° F. for a period of eight or ten minutes. The object of this is to destroy the tubercle bacillus, if it should happen to exist in the milk, whilst incidentally the bacilli asso- ciated with several other dis- eases communicable through the medium of milk woidd also be kUled if they were present. Discordant results have been recorded by experimenters who have attempted to kill tubercle bacilli in milk by heating the latter in open vessels, thereby permitting the formation of a scum

Fia. 18.— Hand Separator.

or “scalded layer” capable of protecting the tubercle bacilli, and enabling them to resist a higher temperature

Fio. 19.— Power Separator.

*than otherwise would be fatal to them. At a tempera- ture not much above 150° F. milk begins to acquire the cooked flavour which is objectionable to many palates, whilst its ” body ” is so modified as to lessen its suitability for creaming purposes. Three factors really enter into effective pasteurization of milk, namely, (1) the tempera- ture to which the milk is raised, (2) the length of time it is kept at that temperature, (3) the maintenance of a con- dition of mechanical agitation to prevent the formation of *’ scalded layer.” Within limits, what a higher tempera- ture will accomplish if maintained for a very short time may be effected by a lower temperature continued over a longer period. The investigation of the problem forms the subject of a paper ^ in the llth Annual Report of the Wisconsin Agricultural Experiment Station, 1900. The following are the results of the experiments : —*

1. An exposure of tuberculous milk in a tightly closed com- mercial pasteurizer for a period of ten minutes destroyed in every case the tubercle bacillus, as determined by the inoculation of such heated milk into susceptible animals like guinea-pigs.

2. Where milk is exposed under conditions that would enable a pellicle or membrane to form on the surface, the tubercle organism is able to resist the action of heat at 140° F. (60° C.) for con- siderably longer periods of time.

8. EJBcient pasteurization can be more readily accomplished in a closed receptacle such as is most frequently used in the commercial treatment of milk, than where the milk is heated in open bottles or open vats.

1 “Thermal Death-Point of Tubercle Bacilli, and Belation of same to ‘Commercial Pasteurization of Milk.” By H. L. Eussell and E. G. Hastings.

4. It is recommended, in order thoroughly to pasteurize milk so as to destroy any tubercle bacilli which it may contain, without in any way injuring its creaming properties or consistency, to heat the same in closed pasteurizers for a period of not less than twenty minutes at 140° F.

Under these conditions one may be certain that disease bacteria such as the tubercle bacillus will be destroyed without the milk or cream being . injured in any way. For over a year this new standard has been in constant use in the Wisconsin University Creamery, and the results, from a purely practical point of view, reported a year earlier by Farrington and Russell,^ have been abundantly confirmed.

Dairy engineers have solved the problem as to how large bodies of milk may be pasteurized, the difficulty of raising many hundreds or thousands of gallons of milk up to the required temperature, and maintaining it at that heat for a period of twenty minutes, having been successfully dealt with. The plant usually employed pro- vides for the thorough filtration of the milk as it comes in from the farms, its rapid heating in a closed receiver and under mechanical agitation up to the desired temper- ature, its maintenance thereat for the requisite time, and finally its sudden reduction to the temperature of cold water through the agency of a refrigerator, to be next noticed.

Eefrigerators are used for reducing the temperature of milk to that of cold water, whereby its keeping properties

Fid. 20.— Be&igerator and Can.

are enhanced. The milk flows down the outside of the metal refrigerator (Fig. 20), which is corrugated in order to provide a larger cool- ing surface, whilst cold water circulates through the interior of the refrigerator. The conical vessel into which the milk is represented as flowing from the refrigerator in Fig. 20 is absurdly called a ” milk-churn,” whereas milk-can is a much more appropri- ate name. For very large quantities of milk, such as flow from a pasteurizing plant, cylindrical refrigerators

Fio. 21.— Cylindrical Cooler or EeHgerator.

(Fig. 21), made of tinned copper, are available; the cold water circulates inside, and the milk, flowing down the outside in a very thin sheet, is rapidly cooled from a temperature of

” Vath Sept. Wis. Agric. Expt. Station, 1899, p. 129.

[dairy factories

Fio. 22.— Butyrometer.

140° F. or higher to 1° above the temperature of the water.

The fat test for milk was originally devised by Dr S. M. Babcock, of the Wisconsin Experiment Station, U.S.A. It combines the principle of centrifugal force with simple chemical action. Besides the machine itself and its graduated glass vessels, the only requirements are sulphuric acid of standard strength and warm water. The machines — of- ten termed butyro- meters — are com- monly made to hold from two up to two dozen tes- ters. After the tubes or testers have been charged, they are put in the apparatus, which is rapidly rotated as shown (Fig. 22); in a few minutes the test is complete, and with properly graduated vessels the percentage of fat can be read off at a glance. The butyrometer is extremely useful, alike for measuring periodically the fat-producing capacity of individual cows in a herd, for rapidly ascertaining the percentage of fat in milk delivered to factories and paying for such milk on the basis of quality, and for determining the richness in fat of milk supplied for the urban milk trade. Any intelligent person can Soon learn to work the apparatus, but its efficiency is of course dependent upon the accu- racy of the measuring vessels. To ensure this the Board of Agriculture have made arrangements with the National Physical Laboratory, Old Deer Park, Richmond, Surrey, to verify at a small fee the pipettes, measuring-glasses, and test-bottles used in connexion with the centrifugal butyrometer, which in recent years has been improved by Dr N. Gerber of Zurich.

Dairy Pactokies.

In connexion with co-operative cheese-making the merit of having founded the first “cheesery” or cheese factory is generally credited to

Jesse Williams, who lived near Rome, in Oneida county. New York State. The system, therefore, was of American origin. Williams was a skilled cheese-maker, and the produce of his dairy sold so freely, at prices over the average, that he increased his output of cheese by adding to his own supply of milk other quantities which he obtained from his neigh- bours. His example was so widely followed that by the year 1866 there had been established close upon 500 cheese factories in New York State alone. In 1870 two co-operative cheeseries were at work in England, one in the town of Derby and one at Longford in the same county. There are now thousands of cheeseries in the United States and Canada, and also many "cream- eries," or butter factories, for the making of high-class butter.

The first creamery was that of Alanson Slaughter, and it was built near Wallkill, Orange county. New York State, in 1861, or ten years later than the first cheese factory; it dealt daily with the milk of 375 cows. Cheeseries and creameries would almost certainly have become more numerous than they are in England but for the rapidly-expanding urban trade in country milk. The development of each, indeed, has been contempo-

raneous since 1871, and they are found to work well in conjunction one with the other — that is to say, a factory is useful for converting surplus mUk into cheese or butter when the milk trade is overstocked, whilst the trade affords a convenient avenue for the sale of milk whenever this may happen to be preferable to the making of cheese or butter. Extensive dealers in milk arrange for its conversion into cheese or butter, as the'case may be, at such times as the milk market needs relief, and in this way a cheesery serves as a sort of economic safety- valve to the milk trade. The same cannot always be said of creameries, because the machine-skimmed milk of some of these establishments has been far too much used to the prejudice of the legitimate milk trade in urban dis- tricts. Be this as it may, the operations of cheeseries and creameries in conjunction with the milk trade have led to the diminution of home dairying. A rapidly-increasing population has maintained, and probably increased, its consumption of milk, which has obviously diminished the farmhouse production of cheese, and also of butter. The foreign competitor has been less successful with cheese than with butter, for he is unable to produce

an article qualified to compete with the best that is made in Great Britain. In the case of butter, on the other hand, the imported article, though not ever surpassing the best home- made, is on the average much better, especially as regards uniformity of quality. Colonial and foreign producers, however, send into the British markets as a rule only the best of their butter, as they are aware that their inferior grades would but injure the reputation their products have acquired.

There are no official statistics concerning dairy factories in Great Britain, and such figures relating to Ireland were issued for the first time in 1901. The number of dairy factories in Ireland in 1900 was returned at 506, compris- ing 333 in Munster, 92 in Ulster, 62 in Leinster, and 29 in Connaught. Of the total number of factories, 495 received milk only, 9 milk and cream, and 2 cream only. As to ownership, 219 were joint-stock concerns, 190 were maintained by co-operative farmers, and 97 were proprie- tary. In the year ended 30th September 1900 these fac- tories used up nearly 121 million gallons of milk, namely, 94 in Munster, 14 in Ulster, 7 in Leinster, and 6 in Con- naught. The number of centrifugal cream-separators in the factories was 985, of which 889 were worked by steam, 79 by water, 9 by horse-power, and 8 by hand-power. The number of hands permanently employed was 3653, made up of 2976 in Munster, 279 in Leinster, 278 in Ulster, and 120 in Connaught. The year's output was returned at 401,490 cwt. of butter, 439 cwt. of cheese (made from whole milk), and 46,253 gallons of cream. In most cases the skim-milk is returned to the farmers. A return of the number of separators used in private establishments gave a total of 899, comprising 693 in Munster, 157 in Leinster, 39 in Ulster, and 10 in Connaught. In factories and private establishments together as many as 1884 sep- arators were thus accounted for. Much of the factory butter would be sent into the markets of Great Britain, though some would no doubt be retained for local con- sumption. A great improvement in the quality of Irish butter has recently been noticeable in the exhibits entered at the London Dairy Show.

Adulteration of Dairy Produce.

The Sale of Food and Drugs Act, 1899, which came into operation on January 1, 1900, contains several sec- tions relating to the trade in dairy

produce in the United Kingdom. , Section 1 imposes penalties in the case of the importation of produce insufficiently marked, such as (a) margarine or margarine-cheese, except in packages con- spicuously marked ” Margarine ” or ” Margarine-cheese ” j

adulteration]

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(6) adulterated or impoverislied butter (other than mar- garine) or adulterated or impoverished milk or cream, except in packages or cans conspicuously marked with a name or description indicating that the butter or milk or cream has been so treated; (c) condensed separated or skimmed milk, except in tins or other receptacles which bear a label whereon the words ” Machine-skimmed Milk ” or ” Skimmed Milk ” are printed in large and legible type. For the purposes of this section an article of food is deemed to be adulterated or impoverished if it has been mixed with any other substance, or if any part of it has been abstracted, so as in either case to affect injuriously its quality, substance, or nature ; provided that an article of food shall not be deemed to be adulterated by reason only of the addition of any preserv- ative or colouring matter of such a nature and in such quantity as not to render the article injurious to health. Section 7 provides that every occupier of a manufactory of margarine or margarine-cheese, and every wholesale dealer in such substances, shall keep a register showing the quantity and destination of each consignment of such substances sent out from his manufactory or place of business, and this register shall be open to the inspection of any officer of the Board of Agri- culture. Any such officer shall have power to enter at all reasonable times any such manufactory, and to inspect any process of manufacture therein, and to take samples for analysis. Section 8 is of much practical importance, as it limits the quantity of butter-fat which may be contained in margarine; it states that it shall be unlawful to manufacture, sell, expose for sale, or import any margarine the fat of which contains more than 10 per cent, of butter-fat, and every person who manufactures, sells, exposes for sale, or imports any margarine which contains more than that percentage shall be guilty of an offence under

the Margarine Act, 1887. For the purposes of the Act margarine-cheese is defined as ” any substance, whether compound or other- wise, which is prepared in imitation of cheese, and which contains fat not derived from milk”; whilst cheese is defined as ” the substance usually known as cheese, containing no fat derived otherwise than from milk.” The so-called ” filled ” cheese of American origin, in which the butter-fat of the milk is partially or wholly replaced by some other fat, would come under the head of ” margarine-cheese.” In making such cheese a cheap form of fat, usually of animal origin, but sometimes vegetable, is added to and incorporated with the skim-milk, and thus takes the place previously occu- pied by the genuine butter-fat. The Act is regarded by- some as defective in that it does not prohibit the arti- ficial colouring of margarine to imitate butter.

In connexion with this Act a departmental committee was appointed in 1900 ” to inquire and report as to what regulations, if any, may with advantage be made by the Board of Agriculture under section 4 of the Sale of Food and Drugs Act, 1899, for determining what deficiency in any of the normal constituents of genuine milk or cream, or what addition of extraneous matter or propor- tion of water, in any sample of milk (including condensed milk) or cream, shall for the purposes of the Sale of Food and Drug Acts, 1875 to 1899, raise a presumption, until the contrary is proved, that the milk or cream is not genuine.” Much evidence of the highest interest to dairy farmers was taken, and subsequently published as a Blue-Book (Cd. 484). The report of the committee (Cd. 491) included the following “recommendations,” which were signed by all the members excepting one : — •

I. That regulations under section 4 of the Food and Drugs Act, 1899, be made by the Board of Agriculture with respect to milk (including condensed niilk) and cream.

II. (a) That in the case of any milk (other than skimmed, separated, or condensed milk) the total milk-solids in which on being dried at 100° C. do not amount to 12 per cent, a presumption shall be raised, until the contrary is proved, that the milk is deficient in the normal constit- uents of genuine milk. (6) That any milk (other than skimmed, separated, or

con- densed milk) the total milk-solids in which are less than 12 per cent. , and in which the amount of milk-fat is less than 3-25 percent., shall be deemed to be so deficient in milk-fat as to raise a presumption, until the contrary is proved, that it has been mixed with separated milk or water, or that some portion of its normal content of milk- fat has been removed. In calculating the percentage amount of deficiency of fat the analyst shall have regard to the above-named limit of 3‘25 per cent, of milk-fat. (c) That any milk (other than skimmed, separated, or con- densed m&k) the total milk-solids in which are less than 12 per cent. , and in which the amount of non-fatty milk- solids is less than 8-5 per cent., shall be deemed to be so deficient in normal constituents as to raise a presumption, until the contrary is proved, that it has been mixed with water. In calculating the percentage amount of admixed water the analyst shall have regard to the above-named limit of 8 ‘5 per cent, of non-fatty milk-solids, and shall further take into account the extent to which the milk- fat may exceed 3-25 per cent.

III. That the artificial thickening of cream by any addition of

gelatin or other substance shall raise a presumption that the cream is not genuine.

IV. That any skimmed of separated milk in which the total

milk-solids are less than 9 per cent, shall be deemed to be so deficient in normal constituents as to raise a presump- tion, until the contrary is proved, that it has been mixed with water. V. That any condensed milk (other than that labelled ” machine- skimmed milk” or “skimmed milk,” in conformity with section 11 of the Food and Drugs Act, 1899) in which either the amount of milk- fat is less than 10 per cent. , or the amount of non-fatty milk-solids is less than 25 per cent., shall be deemed to be so deficient in some of the normal constituents of milk as to raise a presumption, until the contrary is proved, that it is not genuine.

The committee further submitted the following expres- sions of opinion on points raised before them in evidence : —

(a) That it is desirable to call the attention of those engaged in the administration of the Food and Drugs Acts to the necessity of adopting effective measures to prevent any addition of water, separated or condensed milk, or other extraneous matter, for the purpose of reducing the quality of genuine milk to any limits fixed by regulation of the Board of Agriculture.

(6) That it is desirable that steps should be taken with the view of identifying or "ear-marking" separated milk by the addition of some suitable and innocuous substance, and by the adoption of procedure similar to that provided by section 7 of the Food and Drugs Act, 1899, in regard to margarine.

(c) That it is desirable that, so far as may be found practicable,

the procedure adopted in collecting, forwarding, and re- taining pending examination, samples of milk (including condensed milk) and cream under the Food and Drugs Acts should be uniform.

(d) That it is desirable that, so far as may be found practicable,

the methods of analysis used in the examination of samples of milk (including condensed milk) or cream taken under the Food and Drugs Acts should be uniform.

(e) That it is desirable in the case of condensed milk (other than

that labelled "machine-skimmed milk" or "skimmed milk," in conformity with section 11 of the Food and Drugs Act, 1899) that the label should state the amount of dilution required to make the proportion of milk-fat equal to that found in uncondensed milk containing not less than 3'25 per cent, of milk-fat:

(/) That it is desirable in the case of condensed whole milk to limit, and in the case of condensed machine-skimmed milk to exclude, the addition of sugar.

(gr) That the oflficial standardizing of the measuring vessels commercially used in the testing of milk is desirable.

In the minority report, signed by Mr Geo. Barham, the most important clauses are the following : —

(a) That in the case of any milk (other than skimmed, separ- ated, or condensed milk) the total milk-solids in which are less

than 11-75 per cent, and in which, during the months of July to Febraary inclusive, the amount of milk-fat is less than 3 per cent., and in the case of any milk which during the months of March to June inclusive shall fall helow the above-named limit for total solids, and at the same time shall contain less than 2-75 per cent, of fat, it shall be deemed that such milk is so deiicient in its normal constituent of fat as to raise a presumption, for the purposes of the Sale of Food and Drugs Acts, 1875 to 1899, until the contrary is proved, that the milk is not genuine.

(6J That any milk (other than skimmed, separated, or condensed milk) the total milk-solids in which are less than 11-75 per cent. , and in which the amount of non-fatty solids is less than 8-5 per cent., shall be deemed to be so deficient in its normal constituents as to raise a presumption, for the purposes of the Sale of Food and Drugs Acts, 1875 to 1899, until the contrary is proved, that the milk is not genuine. In calculating the amount of the deficiency the analyst shall take into account the extent to which the milk-fat exceeds the limits above named.

(c) That any skimmed or separated milk in which the total milk-solids are less than 8-75 per cent, shall be deemed to be so deficient in its normal constituents as to raise a presumption, for the purpose of tiie Sale of Food

and Drugs Acts, 1875 to 1899, until the contrary is proved, that the milk is not genuine.

Much controversy arose out of the publication of these reports, the opinion most freely expressed being that the standard recommended in the majority report was too high. The difficulty of the problem is illustrated by, for example, the diverse legal standards for milk that prevail in the United States, where the prescribed percentage of fat in fresh cows' milk ranges from 2-5 in Rhode Island to 3-5 in Georgia and Minnesota, and 3-7 (in the winter months) in Massachusetts, and the prescribed total solids range from 12 in several states (11-5 in Ohio during May and June) up to 13 in others. Standards are recognized in 21 of the states, but the remaining states have no laws prescribing standards for dairy products. That the public discussion of the reports of the committee was effective is shown by the following regulations which appeared in the London Gazette on 6th August 1901, and fixed the limit of fat at 3 per cent.: —

The Board of Agriculture, in exercise of the powers conferred on them by section 4 of the Sale of Food and Drugs Act, 1899, do hereby make the following regulations : —

1. Where a sample of milk (not being milk sold as skimmed, or separated, or condensed mUk) contains less than 3 per cent, of milk-fat, it shall be presumed for the purposes of the Sale of Food and Drugs Acts, 1875 to 1899, until the contrary is proved, that the milk is not genuine, by reason of the abstraction therefrom of milk- fat, or the addition thereto of water.

2. Where a sample of milk (not being milk sold as skimmed, or separated, or condensed milk) contains less than 8-5 per cent, of milk-solids other than milk-fat, it shall be presumed for the pur- poses of the Sale of Food and Drugs Acts, 1875 to 1899, until the contrary is proved, that the milk is not genuine, by reason of the abstraction therefrom of milk-solids other than milk-fat, or the addition thereto of water.

3. Where a sample of skimmed or separated milk (not being condensed milk) contains less than 9 per cent, of milk-solids, it shall be presumed for the purposes of the Sale of Food and Drugs Acts, 1875 to 1899, until the

contrary is proved, that the milk is not genuine, by reason of the abstraction therefrom of milk-solids other than milk-fat, or the addition thereto of water.

4. These regulations shall extend to Great Britain.

5. These regulations shall come into operation on 1st September

1901.

6. These regulations may be cited as the Sale of Milk Begula- tions, 1901.

In July 1901 another departmental committee was appointed by the Board of Agriculture to inquire and report as to what regulations, if any, may with advantage be made under section 4 of the Sale of Pood and Drugs Act, 1899, for determining what deficiency in any of the normal constituents of butter, or what addition of extrane- ous matter, or proportion of water in any sample of butter shall, for the purpose of the Sale of Food and Drugs Acts, raise a presumption, until the contrary is proved, that the butter is not genuine. As bearing upon this point

reference may be made to a report of the Dairy Division of the United States Department of Agriculture on experi- mental exports of butter, in the appendix to which are recorded the results of the analyses of many samples of butter of varied origin. First, as to American butters, 19 samples were analysed in Wisconsin, 17 in Iowa, 5 in Minnesota, and 2 in Vermont, at the respective experiment stations of the states named. The amount of moisture throughout was low, and the quantity of fat correspondingly high. In no case was there more than 15 per cent, of water, and only 4 samples contained more than 14 per cent. On the other hand, 11 samples had less than 10 per cent., the lowest being a pasteurized butter from Ames, Iowa, with only 6-72 per cent, of water. The average amount of water in the total 43 samples was 11-24 per cent. The fat varies almost inversely as the water, small quantities of curd and ash having to be allowed for. The largest quantity of fat was 91-23 per cent, in the sample containing only 6-72 per cent, of water. The lowest proportion of fat was 80-18 per cent., whilst the average of all the samples shows 85-9 per cent., which is regarded as a good market standard. The

curd varied from 0-55 to 1-7 per cent., with an average of 0-98. This small amount indicates superior keeping qualities. Theoretically there should be no curd present, but this degree of perfection is never attained in practice. It was desired to have the butter contain about 2^ per cent, of salt, but the quantity of ash in the 43 samples ranged from 0-83 to 4-79 per cent., the average being 1-88. Analyses made at Washington of butters other than American showed a general average of 13-22 per cent, of water, over 28 samples representing 14 countries. The lowest were 10-25 per cent, in a Canadian butter and 10-38 in an Australian sample. The highest was 19-1 per cent, in an Irish butter, which also contained the remarkably large quantity of 8-28 per cent, of salt. Three samples of Danish butter contained 12-65, 14-27, and 15-14 per cent, respectively of water. French and Italian unsalted butter included, the former 15-46 and the latter 14-41 per cent, of water, and yet appeared to be unusually dry. In 7 samples of Irish butters the percentages of water ranged from 11-48 to 19-1. Of the 28 foreign butters 15 were found to contain preserva- tives. All 5 samples from Australia, the 2 from France, the single ones from Italy, New Zealand, Argentina, and England, and 4 out of the 7 from Ireland, contained borie acid.

The Milk Tbade.

The term ” milk trade ” has come to signify the great traffic in country milk for the supply of dwellers in urban districts. Prior to 1860 this traffic was comparatively small, or in its infancy. Thirty years earlier it could not have been brought into existence, for it is an outcome of the great network of railways which was spread over the face of the country in the latter half of the 19th century. It affords an instructive illustration of the process of com- mercial evolution which has been fostered by the vast in-, crease of urban population within the period indicated. It is a tribute to the spirit of sanitary reform which — as an example in one special direction — has brought about the disestablishment of urban cow sheds and the consequent demand for milk produced in the shires. London, in fact, is now being regularly supplied with fresh milk from places anywhere within 150 miles, and the milk traffic on the railways, not only to London but to other great centres, is an important item. A factor in the development of the milk trade mtist no doubt be sought in the outbreak of

cattle plague in 1865, for it was then that the dairymen of the metropolis were compelled to seek milk all over England, and the capillary refrigerator being invented

soon after, the production of milk has remained ever since in the hands of dairymen living mainly at a distance from the towns supplied.

This great change in country dairying, involving the continuous export of enormous quantities of milk from the farms, has been accompanied by subsidiary changes in the management of dairy farms, and has necessitated the extensive purchase of feeding-stuffs for the produc- tion of milk, especially in winter time. It is probable that, in this way, a gradual improvement of the soil on such farms has been effected, and the corn-growing soils of distant countries are adding to the store of fertility of soils in the British Isles. Country roads, exposed to the wear and tear of a comparatively new traffic, are lively at morn and eve with the rattle of vehicles conveying fresh milk from the farms to the railway stations. Most of these changes were brought about within the limits of the last third of the 19th century.

In the case of London, the daily supply of a perish- able article such as milk, which must be delivered to the consumer within a few hours of its production, to a population of five millions, is an undertaking of very great magnitude, especially when it is considered that only a comparatively minute proportion of the supply is produced in the metropolitan area itself. To meet the demand of the London consumer some 6000 dairies proper exist, as well as a large number of businesses where milk is sold in conjimction with other commod- ities. It has been computed that some 12,000 traders are engaged in the business of milk-selling in the metrop- olis, and the number of persons employed in its distribution, &c., cannot be fewer than 25,000. The amount of capital involved is very great, and it may be mentioned that the paid-up capital of six of the principal distributing and retail dairy companies amounts to upwards of one million sterling. The most significant feature in connexion with the milk supply of the metropolis at the beginning of the 20th century is the gradual extinction of the town ” cowkeeper ” — the

retailer who produces the milk he sells. The facilities afforded by the railway com- panies, the favourable rates which have been secured for the transport of milk, and the more enlightened methods of its treatment after production, have made it possible for milk produced under more favourable con- ditions to be brought from considerable distances and delivered to the retailer at a price lower than that at which it has been possible to produce it in the metrop- olis itself. As a result, the number of milk cows in the county of London diminished from 10,000 in 1889 to 6144 in 1900, the latter, on an estimated production of 700 gallons per cow — the average production of stall- fed town cows — representing a yearly milk yield of 3,600,000 gallons. How small a proportion this is of the total supply will be gathered from the fact that the an- nual quantity of milk delivered in London on the Great Western line amounts to some 11,000,000 gallons, whilst the London and North-Western railway delivers 9,000,000, and the Midland railway at St Pancras 5,000,000, and at others of its London stations about 1,000,000, mak- ing 6,000,000 in all. The London and South-West- ern railway brings upwards of 8,000,000 gallons to London, a quantity of 7,500,000 gallons is carried by the Great Northern railway, and the Great Eastern railway is responsible for 7,000,000. The London, Brighton, and South Coast railway delivers 1,000,000 gallons, and the South-Eastern and Chatham and the London and Tilbury railways carry approximately 1,000,000 gallons between them. A large quantity of milk is also carried in by local lines from farms in the vicinity of London and delivered at the local stations, and some is now brought by the Great Central railway, which

has recently obtained an entry into London. In addi- tion to this, milk is taken into London by carts from farms in the neighbourhood of the metropolis. A com- putation of the total milk supply of the metropolis re- veals a quantity approximating to 60,000,000 gallons per annum, or rather more than a million gallons per week, which, taking 600 gallons as the average yearly produc- tion of the cows contributing to this supply, represents the yield of at least 120,000 cows. The growth of the supply of

country milk to London is seen from the figures given by Mr George Barham, chairman of the Express Dairy Co. Limited, in an article on " The MUk Trade " contributed to Professor Sheldon's work on The Farm and Dairy. The quantities carried by the respective rail- ways in 1889 are therein stated in gallons as : — Great Western, 9,000,000 ; London and North-Western, 7,000,- 000; Midland, 7,000,000; London and South-Western, 6,000,000; Great Northern, 3,000,000; Great Eastern, 3,000,000; the southern lines, 2,000,000. The increase, therefore, during the past twelve years on these liiies amounts to no less than 13,600,000 gallons per "an- num, or 36 per cent. The diminished production in the metropolis itself amounts approximately to only 3,000,000 gallons, and it follows, therefore, that the consumption has largely increased. ,

Previous to 1864 it was only possible to bring milk into London from short distances, but the introduction of the refrigerator has enabled milk to be brought from places as far removed from the metropolis as North Staffordshire, and it has even been received from Scotland. Practically the whole of the milk supplied to the metropolis is pro- duced in England. Attempts have been made to introduce foreign milk during recent years, and in 1898 a company was formed to promote the sale of fresh milk from ' Nor- mandy, but the enterprise did not succeed. The trade has shown signs of reviving since, owing probably to the increased cost of the home produced article, and during the winter season of 1900-1901 the largest quantity received into the kingdom in one week amounted to 10,000 gallons. Of recent years a large demand has sprung up for sterilized milk in bottles, and a considerable trade is also done in humanized milk, which is a milk preparation approximating in its chemical composition to human milk.

Estimating the average yield of milk of each country cow at 600 gallons per annum, and assuming an average of 28 cows to each farm, as many as 4300 farmers are engaged in supplying London with milk ; allotting ten cows to each milker, it needs 12 battalions of 1000 men each for this work alone. Some 3600 horses are required to convey the milk from the farms to the country railway stations. The chief sources of supply are in the counties of Derby, Stafford, Leicester, Northampton, Notts, War- wick, Bucks, Oxford, Gloucester, Berks, Wilts, Hants, Dorset, Essex, and

Cambridge. It is not entirely owing to the railways that London's enormous supply of milk has been rendered possible, for the milk must still have been produced in the immediate neighbourhood of the metropolis had not the method of reducing the temperature of the product by means of the refrigerator been devised. There are probably 6700 horses engaged in the delivery of milk in London, and more people are employed in this work than in milking the cows. One of the great diffi- culties the London dairyman has to contend with, and a cause of frequent anxiety to him, is associated with the rise and fall of the thermometer, for a movement to the extent of ten degrees one way or the other may diminish or in- crease the supply in an inverse ratio to the deman d. Thus, at periods of extreme cold, the cows shrink in their yield of milk, while from the same cause the Londoner is de- manding more, in an extra cup of coffee, &c. Again, at periods of extreme heat, which has the same effect on the

cow's production as extreme cold, the customer also demands an increased quantity of milk. Ten degrees' fall of temperature in the summer will result in a lessened demand and an enlarged supply — to such an extent, indeed, that a single firm has been known to have had returned by its carriers some 600 gallons in one day. In such cases the cream separator is capable of rendering invaluable assistance. To make cheese in London in large quantities and at uncertain intervals has been found to be impracticable, whilst to set for cream a great bulk of milk is almost equally so. But now a considerable portion of what would otherwise be lost is saved by passing the milk through separators, and churning the cream into butter.

Previous to the enormous development of the urban trade in country milk, dairy farms were in the main self- sustaining in the matter of manures and feeding-stuffs, and the cropping of arable land was governed by routine. To-day, on the contrary, many dairy farms are run at high

pressure by the help of purchased materials, — corn, cake, and manure, — and the land is cropped regardless of routine and independent of courses. Such crops, moreover, are grown — white straw crops, green crops, root crops — as are deemed likely to be most needed at the time when they are ready. Green crops, — "soiling" crops, as they are termed in North America, — consisting largely of vetches or tares (held up by stalks of oat plants grown amongst them), cabbages, and in some districts green maize, are used to supplement the failing grass-lands at the fall of the year, and root crops, especially mangel, are advantage- ously grown for the same purpose. For winter feeding the farm is made to yield what it will in the shape of meadow and clover hay, and of course root crops of the several kinds. This provision is supplemented by the purchase of, for example, brewers' grains as a bulky fopd, and of oil cake and corn of many sorts as concen- trated food.

Home Output, Imports, and Exports of Daiet Peoducb.

Whilst the quantity of imported butter and cheese consumed in the United Kingdom from year to year can be arrived at with a tolerable degree of accuracy, it is more difB^cult to form an estimate of the amounts of these articles annually produced at home. Various attempts have, however, from time to time been made by competent authorities to arrive approximately at the annual output of milk, butter, and cheese in the United Kingdom, and the results have been brought down to date by Messrs W. Weddel & Co. in their annual Dairy Produce Review (1899-1900), from which Table XI. is quoted. It shows the estimates for each of the ten years 1890 to 1899, the numbers in the second column of " cows and heifers in milk or in calf " being identical with those officially recorded in the agricultural returns. In thus estimating the quan- tity of milk, butter, and cheese produced within the United Kingdom, the " average milking life " of a cow is taken to be four years, from which it follows that on the average one-fourth of the total herd has to be renewed every year by heifers with their first calf. This leaves 75 per cent, of the total herd giving milk throughout the year. Each cow of this 75 per cent, is estimated as yielding 49 cwt., or 531 gallons of milk annually. It is assumed that 15 per cent, of the total milk yield is used for the calf, 32 per cent, utilized for butter-making, 20 per cent, for cheese- making, and the remaining 33 per cent,

consumed in the household as fresh milk. A ton of milk is estimated to produce 80 lb of butter or 220 ft of cheese. A gallon of milk weighs 10-33 lb (10^ ft). The probable effects of each season upon the production have been taken into consideration in making these estimates, and it will be

noticed that owing to the terrible drought of 1893 a reduction of 9 per cent, is made from the average. Accept-

Table XI. Estimated Annual Production of Milk, Butter, and Cheese in the United Kingdom for the Ten Tears ended 31st December 1899.

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Estimated Total Quantity of

Milk produced in the 52

Weeks by T5 per cent, of the

Total Herd, at 49 Cwt. or 531

Gallons per Cow.

Estimated Total Quantity of

Butter produced in the 52 Weeks, takinB 82 per cent, of the Total Milk to yield 80 lb of Butter per Ton of Milk.

Estimated Total Quantity of

Cheese produced in the 52

Weeks, taking 20 per cent, of

the Total Milk to yield 220 lb

of Cheese per Ton of Milk.

No.

No.

No.

Per cent.

Tons.

Tons.

Tons.

1890

3,956,220

105-5

2,967,165

+3-0

7,487,640

85,572

147,078

1891

4,117,707

108-9

8,088,281

Average.

7,566,288

86,472

148,624

1892

4,120,451

108-1

8,090,839

-6-6

7,147,837

81,684

140,894

1893

4,014,055

104-4

8,010,542

-9-0

6,712,004

76,709

131,848

1894

3,925,486

101-2

2,944,115

+6-3

7,667,505

87,628

150,611

1896

3,937,590

100-5

2,953,193

-3-5

6,982,087

79,652

187,148

1896

3,958,762

100-0

2,969,887

-4-0

6,983,999

79,817

180,000

1897

8,984,167

99-7

2,988,126

+3-1

7,547,856

86,261

148,260

1898

4,085,501

100-0

8,025,526

+3-2

7,645,105

87,372

160,171

1899

10 Teart' Average

4,133,249

101-9

8,099,937

-3-5

7,329,027

83,760

180,020

4,018,318

108-0

3,018,660

-0-7

7,906,874

83,992

141,412

ing these estimates with due reservation,^ it is seen that the annual production of milk varied in the decade to the extent of nearly a million tons, the exact difference be- tween the maximum of 7,667,505 tons in 1895 and the minimum of 6,712,004 tons in 1894 being 955,501 tons. The decennial averages are 7,906,874 tons of milk, 83,992 tons of butter, and 141,412 tons of cheese.

Table XII. furnishes an estimate of the total con- sumption of butter in the United Kingdom in each of the

Table XII. Estimated Some Production and Imports of Butter into the United Kingdom for the Ten Tears ended 30th June

1900.

Tear ended 30th June.

Home Production, esiimated.

Imported Colonial.

Imported Foreign.

Total.

Tons.

Tons.

Tons.

Tons.

1891 .

84,961

2,883

99,598

187,442

1892

86,022

6,323

101,796

194,141

1893

84,078

9,408

105,712

199,198

1894

79,196

15,550

107,534

202,280

1895

82,168

17,807

116,730

216,705

1896

83,640

12,949

133,249

229,838

1897

79,734

18,111

138,800

236,645

1898

83,039

17,732

141,426

242,197

1899

87,326

22,443

142,193

251,962

1900

83,760

37,534

133,957

255,251

10 Tears

‘ Av(

rage

83,392

16,074

122,099

221,565

*years 1891 to 1900. Whilst the estimated home produc- tion did not vary greatly from year to year, the imports from colonial and foreign sources underwent almost continuous increase. The ten years' average indicates 37-6 per cent, home-made, 7-3 per cent, imported colonial, and 55*1 per cent, imported foreign butter. But whereas at the begin- ning of the decade the proportions were 45.4 per cent, home-made, 1-5 per cent, colonial, and 63-2 per cent, foreign, at the end the percentages were 32-8, 14-7, and 52-5 respectively. It thus appears that whilst the United Kingdom was able in 1891 to furnish nearly half of its requirements (45-4 per cent.), by 1900 it was unable to supply more than one-third (32-8 per cent.).*

The rapid headway which colonial butter is making in

1 A special committee appointed by the council of the Royal Statistical Society commenced in 1901 an Inquiry into the home pro- duction of milk and meat in the United Kingdom.

HOME OtTTPUT]

D A I E Y-F ARMING

365

Britisli markets is shown by the fact that for the five years ended 30th June 1900 the import had grown from 12,949 tons to 37,534 tons per annum, or an increase of 24,585 tons. It is during the mid-winter months that the colonial butter from Australasia arrives on the British markets, while that from Canada begins to arrive in July, and vir- tually ceases in the following January. The bulk of the Canadian butter reaches British markets during August, September, and October ; the bulk of the Australasian in December, January, and February.

It appears to be demonstrated by the experience of the last decade of the 19th century that the United Kingdom is quite unable to turn out sufficient dairy produce to supply its own population. In the year ended 30th June 1891 the total import of butter was 102,500 tons, and for the year ended 30th June 1900 it was 170,700 tons, which shows an annual average increase in the decade of 6800 tons. This growth was on the whole very uniform, any disturbance in its regularity being attributable more to the deficient seasons in the colonies and foreign countries than to the bountiful seasons at home. Twice in the decade the import of butter from colonial sources fell off slightly from the previous year, namely, in 1896 and 1898, while only once was there any decrease in the foreign supply, and this occurred in 1900. In 1896 the colonial supply fell off by 6000 tons, princi- pally owing to drought in Australia, but from foreign countries this deficiency was more than made good, as the increased import from these sources exceeded 16,500 tons. In 1900 the position was reversed, for while the foreign import fell away to the extent of over 8000 tons, the supply from the colonies exceeded that of 1899 by 15,000 tons, thus leaving a gain in the quantity of im- ported butter of nearly 7000 tons on the year. Table XII. shows that over the ten years 1891 to 1900 the im- port of colonial butter was augmented by 34,600 tons, and that of foreign by 33,600 tons, so that the increased import is fairly divided between colonial and foreign sources. If, however, the last five years of the period be taken, it will be seen that the increases in the arrivals of colonial butter have far exceeded those from foreign countries. Between 1891 and 1900 the Australasian colonies increased their quota by 13,400 tons, and Canada by 11,100 tons. Of foreign countries, Denmark showed the greatest development in the supply of imported but- ter, which increased in the ten years by 28,678 tons. Next came Eussia and Holland, with increases respec- tively of 7207 tons and 6589 tons. Sweden, which made steady progress from 1891 to 1896, subsequently declined, and in 1900 sent 1400 tons less than in 1891. France and Germany are rapidly falling away, and the latter country will soon cease its supply altogether. Up to 1896 it was 6000 tons annually; by 1900 it had fallen to 1850 tons. France, which in 1892 sent to the United Kingdom 29,000 tons, regularly declined, and in 1900 sent only 16,800. Among the countries sending the smaller quantities, Argentina, Belgium, and Norway are all gradually increasing their supplies ; but their totals are comparatively insignificant,

as they together con- tributed in 1900 only 6400 tons out of a total foreign supply of 134,000 tons. The United States was erratic in its supplies duiing the decade, and up to 1900 ha,d not made butter specially for export to the United King- dom, as all the other foreign countries had done. Conse- quently it is only when supplies from elsewhere fail that American butter is sought for by British buyers. The large amount of salt in this butter, although suitable for the American palate, prevents its becoming popular in the United Kingdom.

The sources whence the United Kingdom receives but- ter from abroad are sufiaciently indicated in Table XIII.,

which shows the absolute quantities and the relative proportions sent by the chief contributory countries in each of the four years 1897 to 1900, the order of pre- cedence of the several countries being in accord with the figures for 1900. Denmark, as a result of the efforts made by that little kingdom to supply a sound product of uniform quality, possesses over 40 per cent, of the trade, and in the year 1900 received from the United Kingdom upwards of eight million pounds sterling for butter and over three million pounds sterling for bacon, the raising of pigs for the consumption of separated milk being an important adjunct of the dairying industry in Denmark, where butter factories are extensively main- tained on the co-operative principle. It is worthy of note that some at least of the butter received in the United Kingdom from Russia is made in Siberia, whence it is sent at the outset on a long land journey in refriger- ated railway cars for shipment at a Baltic port, usually Riga. The countries not specifically enumerated in Tar ble XIII. from which butter is sent to the United King-

Table XIII.

Annual Imports of Butter into the United Kingdonif 1897 to 1900.

From

189T.

1898.

1899.

1900.

Denmark .

Australasia .

France

Holland

Russia 1

Sweden

Canada

United States .

Germany .

Other countries .

Total .

Denmark . Australasia . France Holland . Russia 1 Sweden Canada

United States . Germany . Other countries .

Total .

Cwt.

1,334,726

269,432

448,128

278,631

299,‘214 109,402 154,196 51,761 272,312

Cwt.

1,465,030 228,563 416,821 269,324

294i962

166,865

66,712

41,231

269,645

Cwt.

1,430,052 366,944 353,942 284,810

245’,599 250,083 159,137 36,953 262,331

Cwt.

1,486,342

509,910

322,048

282,806

209,738

196,041

138,313

56,046

36,042

141,231

3,217,802

3,209,153

3,389,851

3,378,516

Per cent.

41-5

8-4

13-9

8-7

‘9‘3 3-4

4-8 1-6 8-4

Per cent.

46-6

7-1

13 0

8-4

9‘2 4-9 2 1 1-3 8-4

Per cent.

42-2

10-8

10-5

8-4

7-2 7-4 4-7 11

7-7

Per cent.

44-0 15-1 9-5 8-4 6-2 5-8 4-1 1-6 11 4-2

100-0

100-0

100-0

100-0

^ Not shown separately in the Trade and Navigation Beturns prior to 1900.

dom are Argentina, Belgium, Norway, and Spain — these are included in " other countries."

In Table XIV., relating to the estimated home produc- tion of cheese and the imports of that article, the ten years' average indicates a home-made supply at 65-3 per cent., imports of colonial cheese 24-2 per cent., and im- ports of foreign cheese 20-5 per cent. Comparing, how- ever, the first with the last year of the period 1891 to 1900, it appears that in 1891 the proportions were 68-6 per cent, home-made, 17-2 per cent, colonial, and 24-2 per cent, foreign, whereas in 1900 the percentages were 50-3, 28-9,

and 20-8 respectively. Hence the colonial contribu- tion (chiefly Canadian) has gained ground at the expense both of the home-made and of the foreign. Again, com- paring 1891 with 1900, the import of cheese into the United Kingdom increased to the extent of only 24,600 tons, so that it shows no expansion comparable with that of butter, which increased by about 70,000 tons. Simul- taneously the estimated home production diminished by 17,000 tons.

[home output

In imported colonial cheese Canada virtually has the field to itself, for the only other colonial cheese which

Table XIV. Estimated Home Production and Imports of Cheese into the United Kingdom for the Ten Years ended ZOth June

1900.

Te«r ended

Home Pro-

Imported Colonial.

Imported

80th June.

duction, esiimaied.

Foreign.

Tons.

Tons.

Tons.

Tons.

1891 .

147,078

43,228

60,816

251,122

1892

148,624

45,781

59,452

253,857

1893

140,394

55,549

56,767

252,710

1894

131,843

57,322

52,498

241,663

1895

150,611

61,622

52,570

264,803

1896

187,148

62,478

44,569

244,195

1897

130,000

67,028

46,317

243,345

1898

148,260

77,620

49,114

274,994

1899

150,000

73,752

46,985

270,737

1900 .

130,000

74,702

53,903

258,605

10 Tears' .

Averc

ige

141,396

61,908

52,299

255,603

finds its way into the United Kingdom is from New Zealand, but the amount of this kind is comparatively insignificant, having been in 1900

only 4000 tons out of a total import of 128,600 tons. Australia, in several seasons since 1891, sent small quantities, but they are not worth quoting.

From foreign countries the decline in the export of cheese is mainly in the case of the United States, which shipped to British ports 10,000 tons less in 1900 than in 1891. France also is losing its cheese trade in British markets, and is being supplanted by Belgium. In 1891 France supplied over 3000 tons, in 1900 the import was below 2000 tons. Belgium in 1891 supplied less than 1000 tons, but in 1900 contributed 2600 tons. The import trade in Dutch cheese remains almost stationary. In 1891 it amounted to 15,300 tons, in 1899 it was 16,600 tons, whilst in 1900, owing to exceptionally high prices, which stimulated the manufacture, it reached 17,000 tons.

Over 80 per cent, of the cheese imported into the United Kingdom is derived from North America, but the bulk of the trade belongs to Canada, which supplies nearly 60 per cent, of the entire import. The value of the

Tablb XV. Annual Imports of Cheese into the United Kingdom, 1897 to 1900.

Frem

189T.

1898.

1899.

1900.

Cwt.

/ Owt.

Ovrt.

Owt.

Canada

1,526,664

1,432,181

1,337,198

1,511,872

United States .

631,616

485,995

590,787

680,583

Holland .

297,604

292,925

328,541

327,817

Australasia .

68,615

44,608

32,294

86,513

France

36,358

33,086

34,307

35,110

Other countTies . Total .

42,321

50,657

60,992

69,910

2,603,178

2,339,452

2,384,069

2,711,805

Per cent.

Per cent.

Per cent.

Per cent.

Canada

58-6

61-2

56-1

55-8

United States .

24-3

20-8

24-8

25-1

Holland .

11-4

12-5

13-8

12-0

Australasia .

2-7

1-9

1-3

8-2

France

1-4

1-4

1-4

1-3

Other countries . Total .

1-6

2-2

2-6

2-6

100-0

1000

100-0

100-0

cheese exported from Canada to the United Kingdom in the calendar year 1900 was close upon £3,800,000. As is shown in Table XV. above, Holland, Australasia,and France

participate in this trade, whilst amongst the ” other coun- tries ” are Germany, Italy, and Kussia. The cheese sent from North America and Australasia is mostly of the sub- stantial Cheddar type, whereas soft or ” fancy ” cheese is the dominant feature of the French shipments. Thus, in the calendar year 1900 the average price of the cheese imported into the United Kingdom from France was 61s. per cwt., whilst the average value of the cheese from all other sources was 50s. per cwt., there being a difference of lis. in favour of the ” soft ” cheese of France.

The imports of butter and margarine into the United Kingdom were not separately distinguished before the year 1886. Previous to that date they amounted, at five year intervals, to the following aggregate quantities : —

Cwt.

1870. 1875. 1880. 1885. 1,159,210 1,467,870 2,326,305 2,401,373

For the same years the imports of cheese registered the subjoined totals : —

Cwt.

18T0. 1875.

1,041,281 1,627,748

1880.

1,775,997

1885.

1,833,832

The imports of butter and margarine, both separately and together, and also the imports of cheese in each year from 1886 to 1900 inclusive, are set out in Table XVI., the most significant feature of which is the rapid expansion it shows in the imports of butter. In the space of nine

Table XVI. Imports of Butter, Margarine, and Cheese into the United Kingdom, 1886-1900.

Tear.

Butter.

Margarine.

Total Butter and Margarine.

Ctieese.

Cwt.

Cwt.

Owt.

Cwt.

1886 .

1,543,566

887,974

2,431,540

1,734,890

1887

1,513,134

1,276,140

2,789,274

1,836,789

1888

1,671,433

1,139,743

2,811,176

1,917,616

1889

1,927,842

1,241,690

8,169,582

1,907,999

1890

2,027,717

1,079,856

3,107,578

2,144,074

1891

2,135,607

1,285,430

3,871,087

2,041,325

1892

2,188,009

1,305,350

3,488,359

2,232,817

1893

2,327,474

1,299,970

3,627,444

2,077,462

1894

2,574,885

1,109,325

3,684,160

2,266,145

1895

2,825,662

940,168

3,765,830

2,183,819

1896

8,037,718

925,984

3,963,652

2,244,525

1897

3,217,802

936,543

4,154,345

2,603,178

1898

3,209,163

900,615

4,109,768

2,339,452

1899

8,889,851

958,175

4,343,026

2,384,069

1900

3,378,516

920,416

4,298,932

2,711,805

years, between 1887 and 1896, the quantity was- doubled. On the other hand, the general tendency of the imports of margarine, which have been much more uniform than those of butter, has been in the direction of decline since 1892. It is necessary, however, to point out that there has been an increase in the number of margarine factories in the United Kingdom, and in the quantity of margarine manufactured in them, during the last few years. Taking the imports of butter and margarine together, the aggregate in 1899 and also in 1900 was practically three times as large as a quarter of a century earlier, in 1875. The im- ports of cheese have increased at a less rapid rate than those of butter, and the quantity imported in 1900, which was a maximum, fell considerably short of twice the quan- tity in 1875. In 1886, 1887, 1888, 1890, and 1892 the imports of cheese exceeded those of butter, but since the last-named year those of butter have always been the larger, and in 1899 were fully a million cwt. more than the cheese imports. The cheapness of imported fresh meat has probably had the effect of checking the growth of the demand for cheese amongst the industrial classes. The imports of condensed milk into the United Kingdom

AMERICAN dairying]

D A I E T-F A E M I N G

were not separately distinguished before 1888. In that year they amounted to 352,332 cwt. The quantities im- ported in subsequent years were the following ; —

Year.

Cwt.

Year.

Cwt.

Year.

Cwt.

1889 .

1890 . 1891 . 1892 .

339,892 407,426 444,666 481,374

1893 . .

1894 . .

1895 . .

1896 . .

501,005 529,465 546,394 611,335

1897 – .

1898 . .

1899 . .

1900 . .

756,243 817,274 824,599 986,741

The quantity thus increased continuously in each year after 1889, with the result that in 1900 the imports had grown to nearly three times the amount of those in 1889. Simultaneously over the period 1889-1900 the annual value of the imports steadily advanced from £704,849 to £1,405,033. Thus, while the imports of condensed milk trebled in quantity, they doubled in value. A fair pro- portion is, however, exported, as is shown in the follow- ing statement of exports of imported condensed milk for the four years 1897 to 1900 :—

1897. 1898. 1899. 1900.

Quantity, . cwt. 143,932 133,596 118,394 164,602 Value . . £274,578 £256,525 £228,446 £309,460

There is also an export trade in condensed milk made in the United Kingdom. Thus, in 1892 the exports of home-made condensed milk amounted to 61,442 cwt., valued at £133,556. By 1896 the quantity had, almost doubled, and reached 111,959 cwt., of the value of £224,831. In subsequent years the exports were : —

1897. 1898. 1899. 1900.

Quantity, . cwt. 154,901 178,055 185,749 209,447 Value . . £302,748 £343,070 £353,819 £390,559

Milk and cream (fresh or preserved other than con- densed) received no separate classification in the import^ until 1894, in which year the quantity imported was 161,633 gallons, followed by 126,995 gallons in 1895, and 22,776 gallons in 1896. The quantities have .since been returned by weight— 10,006 cwt. in 1897, 10,691 cwt. in 1898, 7869 cwt. in 1899, and 15,638 cwt. in 1900. The values of these imports in the successive years 1894 to 1900 were £21,371, £19,991, £5489, £9848, £11,293, £16,068, and £26,837.

The total values of the imports of dairy produce of all kinds — butter, margarine, cheese, &c. — into the United Kingdom were, at five-year intervals between 1875 and 1890, the following :—

1875. 1880. 1885. 1890.

Value . £13,211,592 £17,232,548 £15,632,852 £19,505,798

The values in each year of the closing decade of the 19th century are set forth in Table XVII., where the totals in the last column include small sums for

Table XVII. Values of Dairy Products imported into the United Kingdom from 1891 to 1900, in Thousands of Founds Sterling.

Year.

Butter.

Margarine.

Cheese.

Condensed MUk.

Total.

£1000.

£1000.

£1000.

£1000.

£1000.

1891 .

11,591

3558

4813

900

20,863

1892 .

11,965

3713

5417

930

22,025

1893 .

12,754

3655

5161

1010

22,580

1894 .

13,457

3046

5475

1079

23,077

1895 . ■ *.*

14,245

2557

4675

1084

22,581

1896 .

15,344

2498

4900

1170

23,920

1897 .

15,917

2485

5886

1398

25,715

1898 .

15,962

2384

4970

1436

24,779

1899 .

17,214

2549

5503

1455

26,747

1900 .

17,450

2465

6838

1743

28,544

margarine-cheese and, since 1893, for fresh milk and cream. The aggregate value more than doubled during the last quarter of the century.

*The earliest year for which the value of imported butter is separately avail- able is 1886, when it amounted to £8,141,438. Thirteen years later this sum had more then doubled, and it is an impressive fact that in the closing year of the century the United Kingdom should have expended on imported butter alone a sum closely approximating to 17^ million pounds sterling, equivalent to about three- fourths of the total amount disbursed on imported wheat grain.^*

The imports of margarine — that is, of margarine specifically declared to be such — into the United King- dom are derived almost entirely from Holland. Out of a total of 920,416 cwt. imported in 1900 Holland sup- plied 862,154 cwt., and out of £2,464,839 expended on imported margarine in the same year Holland re- ceived £2,295,174. To the imports in the year named Holland contributed 93-7 per cent.; France, 2-9; Nor- way, 0-9 ; all other countries, 2-5 ; so that Holland pos- sesses almost a monopoly of this trade. The quantities of imported butter, margarine, and cheese that are again exported from the United Kingdom are trivial when compared with the imports, as will be seen from the fol- lowing quantities and values in the three years 1898 to 1900:—

1898.

1899.

1900.

1898.

1899.

1900.

Butter . Margarine Cheese .

Cwt.

63,491 10,023 56,694

Cwt.

50,453 13,139 56,390

Cwt.

51,583 11,326 55,982

£

319,806

24,721

159,210

£

257,999

33,319

163,991

258,931

27,882

168,369

There is also a very small export trade in butter and cheese made in the United Kingdom, but its insignificant character is evident from the subjoined details as to quantities and values for the years named : —

1898.

1899.

i90o;

1898.

1899.

1900.

Butter . . Cheese . .

Cwt.

11,359 10,126

Cwt.

9936 9768

Cwt.

10,127

9,356

£

59,731 36,803

£

53,195 35,890

£

53,701 36,691

American Dairying.

The development of the dairying industry in the vast region of the United States of America has been described in the ofi&cial Tear-Book by Major Henry E. Alvord, chief of the dairy division of the Bureau of Animal Industry in the Department of Agriculture at Washington. The beginning of the 20th century found the industry upon an altogether higher level

than seemed possible a few decades earlier. The milch cow herself, upon which the whole business rests, has become almost as much a machine as a natural product, and a very different creature from the average animal of bygone days. The few homely and inconvenient implements for use in the laborious duties of the dairy have been replaced by perfected appliances, skil- fully devised to accomplish their object and to lighten labour. Long rows of shining metal pans no longer adorn rural dooryards. The factory system of co-operative or concentrated manufacture has so far taken the place of home dairying that in entire states the cheese vat or press is as rare as the handloom, and in many counties it

1 In 1901 the United Kingdom imported 3,702,810 cwt. of butter, valued at £19,297,005, both totals being the largest on record.

is as difB-Cult to find a farm churn as a spinning-wheel. An illustration of the nature of the changes is afforded in the butter-making district of Northern Vermont, at St Albans, the business centre of Franklin county. In 1880 the first creamery was built in this county ; ten years later there were 15. Now a creamery company at St Albans has upwards of 50 skimming or separating sta- tions distributed through Franklin and adjoining coun- ties. To these is carried the milk from more than 30,000 cows. Farmers who possess separators at home may deliver cream which, after being inspected and tested, is accepted and credited at its actual butter value, just as other raw material is sold to mills and factories. The separated cream is conveyed by rail and waggon to the central factory, where in one room from 10 to 12 tons of butter are made every working day — a single churning place for a whole county ! The butter is all of standard quality, "extra creamery," and is sold on its reputa- tion upon orders received in advance of its manufacture. The price is relatively higher than the average for the product of the same farms fifty years

earlier. This is mainly due to better average quality and greater uniformity — two important advantages of the creamery system.

In one important detail dairy labour is the same as a century ago. Cows still have to be milked by hand. Although many attempts have been made, and patent after patent has been issued, no mechanical contrivance has yet proved a practical success as a substitute for the human hand in milking. Consequently, twice (or thrice) daily every day in the year, the dairy cows must be milked by manual labour. This is one of the main items of labour in dairying, and is a delicate and important duty. Assuming 10 cows per hour to a milker, which implies quick work, it requires the continuous service of an army of 300,000 men, working 10 or 12 hours a day throughout the year, to milk the cows kept in the United States.

The business of producing milk for urban consumption, with the accompanying agencies for transportation and distribution, has grown to immense proportions. In many places the milk trade is regulated and supervised by excellent municipal ordinances, which have done much to prevent adulteration and to improve the average quality of the supply. Quite as much is, however, being done by private enterprise through large milk companies, well organized and equipped, and establishments which make a speciality of serv- ing milk and cream of fixed quality and exceptional purity. Such efforts to furnish "certified" and "guaranteed" milk, together with general competition for the best class of trade, are doing more to raise the standard of quality and improve the service than all the legal measures. The buildings and equipment of some of these modem dairies are beyond precedent. This branch of dairy- ing is advancing fast, upon the safe basis of care, cleanliness, and better sanitary conditions.

Cheese-making has been transferred bodily from the domain of domestic arts to that of manufactures. In the middle of the 19th century about 100,000,000 lb of cheese was made yearly in the United States, and all of it in farm dairies. At the beginning of the 20th century the annual production is about 300,000,000 lb, and 96 or 97 per cent, of this is made in factories. Of these there are nearly 3000, but they vary greatly in

capacity, and some are very small. New York and Wisconsin possess a thousand each, but the former state makes nearly twice as much cheese as the latter, whilst the two together produce three-fourths of the entire output of the country. A change is taking place in the direction of bringing a number of factories previously independent into a "combination" or under the same management. This tends to improve the quality and secure greater uniformity in the product, and often reduces cost of manufacture. More than nine-tenths of all the cheese made is of the familiar standard type, copied after the English Cheddar, but new kinds and imitations of foreign varieties are increasing. The annual export of cheese from the United States ranges between 30,000,000 and 50,000,000 lb. The consumption jjer capita does not exceed 3 J lb per annum, which is much less than in most European countries.

Butter differs from cheese in that it is still made much more largely on farms in the United States than in creameries. Cream-

ery butter controls all the large markets, but this represents little more than one-third of the entire business. Estimating the annual butter product of the entire country at 1,400,000,000 lb, not much over 500,000,000 lb of this is made at the 7500 or 8000 creameries in operation. Iowa is the greatest butter-producing state, and the one in which the gi-eater proportion is made on the factory plan. The total output of butter in this state is one-tenth of all made in the Union. The average quality of butter has materially improved since the introduction of the creamery system and the use of modern appliances. Nevertheless, a vast quantity of poor butter is made — enough to afford a large and profitable business in col- lecting it at country stores at grease prices or a little more,. and then rendering or renovating it by patent processes. This reno- vated butter has been fraudulently sold to a considerable extent as the true creamery article, of which it is a fair imitation while fresh, and several states have made laws for the identification of the product and to prevent buyers from being imposed upon. No butter is imported, and the quantity exported is insignificant, although there is beginning to be a foreign demand for American butter. The home consumption is estimated at the yearly rate of 20 lb per person, which, if correct, would indicate Americans to be the greatest butter-eating people in the world. The people

of the United States also consume millions of pounds every year of butter substitutes and imitations, such as oleomargarine and butterine. Most of this is believed to be butter by those who use it, and the State Dairy Commissioners are busily employed in carrying out the laws intended to protect purchasers from these butter frauds.

The by-products of dairying have, within recent years, been put to economical uses, in an increasing degree. For every pound of butter made there are 15 to 20 lb of skim-milk and about 3 lb of butter-milk, and for every pound of cheese nearly 9 lb of whey. Up to 1889 or 1890 enormous quantities of skim-milk and butter- milk from the creameries and of whey from the cheese factories were entirely wasted. At farm dairies these by-products are generally used to advantage in feeding animals, but at the factories — especially at the seasons of greatest milk supply — this most desirable method of utilization is to a great extent impracticable. In many places new branches have been instituted for the making of sugar-of-milk and other commercial products from whey, and for the utilization of skim-milk in various ways. The albumin of the latter is extracted for use with food products and in the arts. The casein is desiccated and prepared as a substitute for eggs in baking, as the basis of an enamel paint, and as a substitute for glue in paper-sizing. It has also been proposed to solidify it to make buttons, combs, brush-backs, electrical insulators, and similar articles.

No census of cows in the United States was taken until the year 1840, but they have been enumerated in each subsequent decennial censiis. From 23 to 27 cows to every 100 of the population were required to keep the country supplied with milk, butter, and cheese, and provide for the export of dairy products. The export trade, though it has fluctuated considerably, has never exceeded the produce of 500,000 cows. At the close of the 19th century it was estimated that there was one milch cow in the United States for every four persons, making the number of cows about 17,500,000. They are, however, very unevenly distributed, being largely concentrated in the great dairy states, Iowa leading with 1,500,000 cows, and being followed closely by New York. In the middle and eastern states the milk product goes yery largely to the supply of the numerous large towns and

cities. In the central, west, and north-west butter is the leading dairy product.

Table XVIII. shows approximately the quantity and value of the dairy products of the United States in 1899, the grand total repre-

Table XVIII. Estimated Number of Cows and Quantity and Value of Dairy Products in the United States in 1899.

COWB.

11,000,000 1,000,000 6,500,000

Product.

Butter Cheese HUfc

Rate of Product per Cow.

180 ft 800 ft 880 gals.

Total Product.

1,480,000,000 ft 800,000,000 ft 2,090,000,000 gals.

Rate of Value.

Cents.

18

9

8

Total Value.

Dollars.

287,400,000

27,000,000 167,200,000

senting a value of 1451,600,000. Adding to this the skim-milk, butter-milk, and whey, at their proper feeding value, and the calves dropped yearly, the annual aggregate value of the produce of the dairy cows exceeds $500,000,000, or is more than one hundred million pounds sterling. Accepting these estimates as- conservative, they show that the commercial importance of the dairy industry of the United States is such as to justify all reason- able provisions for guarding its interests.

(w. FK.)

DALAGUET E — D A L M A T I A

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Dalaguete, a town on the east coast of the island of Cebii, Philippine Islands, in 9° 62′ N. It has a hot but healthful climate. The growing of Indian corn, sibu- cao, cacao, copra, and sugar, and the weaving of rough fabrics, are the sole occupations of its inhabitants. The language is Cebii-Visayan. Population, 21,000.

Dalbeattie, a police burgh of south-east Kirkcud- brightshire, Scotland, 14^ miles south-west of Dumfries by rail. There are important quarries in the neighbour- hood, and steam granite-polishing works in the town. There is a prospect of ironstone being worked. There is a town-hall, a mechanics' institute, and a church hall. Population (1891), 3149 ; (1901), 3462.

Dale, Robert William (1829-1895), Congregar tionalist divine, was born in London, 1st December 1829, and was educated for the Congregational ministry. In 1853 he became eo-pastor of Carr's Lane Chapel, Birming-ham, with the veteran John Angell James. At first the liberality of his theology occasioned much suspicion and offence, over which, partly owing to the support of the senior minister, he so completely triumphed as to become sole pastor on the latter's death in 1859. He was for many

years one of the most influential personalities in Birmingham, and took the most active part in the re- markable municipal development of that city. He was especially conspicuous in the controversies arising out of the Education Act of 1870, which, so far as Birmingham was concerned, were terminated in 1879 by a compromise, of which Dale disapproved. His adherence to Mr Cham- berlain on the Irish Home Rule question did not diminish his influence. His sympathies were broad, and he had many warm friends in the Church of England. He died on 13th March 1895.

Dalecarlia, in Swedish Dalarne ("the Dales"), in popular usage the name of a very characteristic region in the middle of Sweden, characteristic in respect of its productions, but even more so in respect of its people. It is virtually the same as the county of Kopparberg, of which Falun is the chief town. The Dalecarlians or Dalesmen speak their own peculiar dialect (see a paper by A. Noreen in De Svenska Landsmdlen, vol. iv., 1881), wear their own peculiar costumes, and are famed for their brave spirit and sturdy love of independence. More than once they have played a decisive rdle in the his- tory of Sweden. In 1434, led by Engelbrecht, the miner, they rose against the oppressive tyranny of the officers of Erik XIV. of Denmark, and in 1519-23 it was amongst them that Gustavus Vasa found his staunchest supporters in his patriotic task of freeing Sweden from the yoke of the Danes. The districts around Lakes Eunn and Siljan (" the Eye of the Dales "), the principal sheets of water in the valleys of the Dal rivers, are consequently classic ground. The people are for the most part small peasant proprietors. In 1894, out of 27,848 estates, no less than 27,287 were under 50 acres in extent. They eke out their scanty returns from tilling the soil by a variety of home industries, such as making scythes, saws, bells, wooden wares, hair goods, and so forth. The larger portion of the area is, however, covered with forest (75-4 per cent, in 1897), only 7-1 per cent, being under cultivation. Besides the wealth of the forests, the Dales contain some of the largest and most prolific iron mines in Sweden, especiallj^ Grangesberg. In 1898 the iron mines of Dalecarlia yielded 751,038 tons of iron ore, or 32-6 per cent, of the entire output of the kingdom. Nor is iron the only mineral. In Dalecarlia, too, are the far- famed copper mines of Falun, as well as mines of silver and lead, zinc and sulphur. In consequence of this the district has numerous smelting furnaces, blasting and

rolling mills, iron and metallurgical works, as well as sawmills, wood-pulp factories, chemical works, and so forth.

See G. H. Mellin, Skildringar af den Skandinamska N'orden» Folklif og Natur, vol. iii. (1865), and Feederika Bkemeb, I Dalarne (1845), of which there is an English translation by Wm. and Mary Howitt (1852).

Dallas, a town of Spain in the province of Almeria,. 8 miles from the Mediterranean. Population in 1897, 6341. In its neighbourhood are the ruins of an older town, walls, tombs, aqueducts. Between Dallas and the sea are small lagoons and an old castle turned into a guardhouse for the carabiniers. The streets are narrow and irregular, and there is no public building worth men- tioning, except a parish church and the town-hall, both comparatively modern. An earthquake on 26th August. 1804 destroyed most of the houses and churches, and 162 inhabitants were killed. The trade of Dallas consists of wheat, wine, oil, oranges, esparto-grass, and fruit.

Dalkeith, a police burgh and market-town in the county of Edinburgh, situated between the North and South. Esk, 6| miles south-east from Edinburgh P.O. and about 5 miles from the city boundary. In 1899 the parish con- tained 7704 inhabitants (W. parish, 4323; E. parish, 3381), and in 1901 the police burgh had 6763. The rental of lands in the parish for 1899-1900 amounted to £40,166> In recent years Eskbank (within the parish and burgh) has been made a handsome residential quarter. The only changes of note in the industries of the town are the closing of the iron-foundry and the opening of a colliery near Eskbank. A pipe supply of water has been intro- duced from the Edinburgh district works, and has been supplemented by a local water scheme.

Dallas, capital of Dallas county, Texas, U.S.A., in 32° 45′ N. lat. and 96° 46′ W. long., on the eastern bank of Trinity river, which here is not navigable. It is at an altitude of 422 feet. It has a level site, a fairly regular plan, is sewered, and has a good water supply. It is the third city in population and the most important railway centre in Texas, being entered by five railways, four of which are trunk lines. It is in a rich agricultural region, which produces cotton, wheat, and Indian corn, and it has large trade and extensive manufactures. In 1890 its. manufacturing capital was

$6,260,000, employing 4082 hands, and the products were worth over $9,000,000> Prominent among these were flour and leather goods. In 1900 the assessed valuation of real and personal property, on a basis of about one-half of the full value, was. $23,016,600, the net debt 1 1,769,468, and the tax rate from $24.02 to $24.60 per $1000. Dallas was founded in 1841, but most of its growth has come in recent years. Population (1880), 10,368 ; (1890), 38,067 ; (1900), 42,638, of whom 9035 were negroes.

Dal mat I a (German, Dalmatien; Serbo-Croatian, DaZ- macijd), a crownland and kingdom of the Cisleithan part of the Austro-Hungarian monarchy. It is separated from the rest of Austria by Croatia, which belongs to the Hungarian half of the monarchy. Ethnographically and geographically it is part of the lands of the Hungarian crown, and is still included in the official title of the King- dom of Croatia. Its reincorporation is one of the objects aimed at by a considerable section of the Croatian people. Population in 1869, 466,961 ; in 1880, 476,101 ; in 1890, including garrison of 5400 men, 627,426, the equivalent of 106-83 inhabitants per square mile ; in 1900, 591,597. Proportion of females to males (1890), 993 to 1000. The Serbo-Croatians constitute 96-2 per cent, and the Italians 3 per cent, of the population, the former increas- ing, the latter declining. The remainder is made up of

Germans, Czechs, Slovenes, &c. 83-3 percent, are of the Roman Catholic and 16-5 per cent, of the Greek Orthodox faith. There are 329 Jews. In 1896 the marriage-rate was 7-34, the birth-rate 40‘01, or, excluding still-births, 39-65, and the death-rate 29 per thousand. Of the births, 3‘84 per cent, were illegitimate, with the exception of Gorz and Gradisca the lowest proportion in Austria. Dalmatia sends 11 members to the Eeichsrath. In the provincial Diet there are 28 Croatians, 9 Servians, and 6 Italians. The distinction drawn between Croatians and Servians in Dalmatia, as also in Croatia and Slavo- nia, is political and religious, and not one of race. The

Croatians and Servians of those parts speak the same language, but the former are Roman Catholic and use the Latin characters in writing, and the latter are Orthodox and employ the Cyrillic characters. Notwithstanding the progress during the period 1860-1900, Dalmatia remained the most backward of the Austrian crownlands in the matter of education. In 1890, 82-8 per cent, of the popu- lation were returned as illiterate, that proportion being an improvement of 4 per cent, on the census of 1880. It possessed, in 1893, 6 intermediate and 337 elementary schools, attended by 88-4 per cent, of the children, 6 theo- logical seminaries, 6 gymnasia, and some 40 technical and continuation schools. Of the 28 periodicals, 21 are in the Serbo-Croatian language, 5 in Italian, 1 in Latin, and 1 in polyglot. But a small proportion of the population (4-58 per cent.) is engaged in industry and mining, and 4-8 per cent, in trade and transport. Viticulture, which has latterly made great progress, cattle-breeding, and the cul- tivation of the olive-tree, vegetables, and fruit are among the principal resources, a large number of the inhabitants also finding employment as sailors and in sea-fishing. A small quantity of searsalt is recovered by evaporation. Other industries are ship-building (which is of consider- able importance), the manufacture of liqueurs (Maras- chino), spirits, soap, oil, &c. Its commerce consists mainly of a lucrative transit trade with Bosnia and Her- zegovina, Montenegro, Turkey, and the ports of the Adriatic and the Mediterranean. In 1890 the Dalmatian mercantile marine numbered 8 steamers and nearly 6000 sailing vessels of all sizes. Communications are in a backward state. In 1897 there were 125 kilometres of railway, 2857 kilometres of roads, and 55 kilometres of navigable waterway. There were 151 post and 98 tele-graph ofl&ces.

See T. G. Jackson, Dalmatia, the Quarnero, and Istria (Oxford, 1887) ; and works by Goracucchi, Scliatzinayer, Ruthner, Cons, Nolhac, Schwelger-Lerchenfeld, Eitelberger, and Pismi.

{m. o'n.)

Dalny, a new Russian free port, opened to foreign trade in 1901, situated on the Central Manchurian rail- way, and thus one of the Pacific termini of the Trans- Siberian railway. It stands at the head of Talien-wan Bay,

on the east side of Liao-tung peninsula, in Man- churia, about 20 miles north-east from Port Arthur and twenty-one days' journey by rail from St Petersburg. The harbour is roomy, easy of entrance, and free from ice all the year round. Population (1901), 50,000, of whom about one-half were workmen, mostly Chinese.

Dairy, a mining and manufacturing town of Ayrshire, Scotland, on the river Garnoek, 17^ miles north by west of Ayr. There is a public hall, library, and a public park (1893). Ironstone is extensively worked, and the town contains woollen factories and a large worsted spinning mill. The other industries embrace cabinet-making, coke- making, brick-making, machine-knitting, box-making, currying, and the manufacture of aerated waters. The churches are two Established, two United Free, Episco- pal, and Roman Catholic, and there are two memorial

mission halls. Three public schools had an average at- tendance of 698 in 1898-99, a female industrial school 184, and a church school 129. Population (1881), 6010;

(1891), 4572; (1901), 6314.

Dalton-in-Furness, a market-town and railway station in the North Lonsdale parliamentary division of Lancashire, England, 4 miles north-east by north of Barrow-in-Furness. The ruins of Furness Abbey are near, and Dalton Castle stands on an eminence in the town. There are Established, Roman Catholic, and various Nonconformist churches. There are numerous iron-ore mines in the parish, and ironworks at Askam, in the northern part of the district. Area (an urban district), 7223 acres. Population (1881), 13,339 ; (1901), 13,020.

Damanhur, a town and important railway station of Lower Egypt, 10 miles from Alexandria, capital of the richly cultivated province of Behera. The town stands on the site of the ancient Egyptian PorTahoth, the Her- mopolis Parva of the Romans. A much frequented fair is held here three times a year, and there are several cotton manufactories. Population (1900), 19,600.

Damao or Damaun, a town of Portuguese India, capital of district Damao, is situated on the east side of the entrance of , the Bay of Cambay. Area of district, 148 sq. miles. Population (1894), 64,248. Salt is pro- duced by 600 to 600 men to the extent of nearly 3000 tons annually. The cajuri palm is cultivated.

Damaraland. See South-West Apkica, Gebman.

Damascus (Hebrew Z)a»n.mesefc, ot DarmeseJc ; Egyp- tian, Timasku; Assyrian, DimasM; Arabic, Dimishk esh- Shdm, or simply eshrShdm), the largest town in Syria, and the capital of the esh-Sh^m (Syria) vilayet, situated near the northern edge of the Ghiita, a fertile plain at the foot of Anti-Lebanon, at an altitude of 2260 ft. above the sea. It is the seat of the governor-general, of the Mushir commanding the 6th Army Corps, and of British and other consuls, and is connected by rail with its port, Beirut, and with el-Mezeirfb in the Haur^n. The Ghiita is irrigated by the Barad^ (see Abanah) and the 'Awaj, which flow eastward in several channels, and lose them- selves, about 18 miles from the city, in small marshes at the edge of the Syrian desert. The plain is covered nearly everywhere with luxuriant vegetation, out of which, where the foliage is densest and most beautiful, rise the minarets and domes of the " white smokeless city." The delicious verdure and the all-pervading presence of running water constitute an abiding charm, which is heightened by the barren hills that almost surround the great oasis. Damascus stands on both banks of the main stream of the Barada, about two miles from the mouth of the gorge through which the river runs to the plain. Most of the city, including the oldest portion, which was enclosed by a wall, lies on the right bank, and from it a long suburb, el-Meid£in, stretches southwards for more than a mile along the Haj road to Mecca. On the left bank is a large suburb, el-'Am^ra, of later date, and north of this, at the foot of the hills, lies the beautiful suburb es-Salihiyeh. The old wall, Arab and Turkish, on' Roman or perhaps earlier foundations, was pierced by several gates, and the city was traversed from east to west by a colonnaded street, " the street which was called Straight," still named Derb el-Mustakim. In the north-west comer, near the Barada, which filled its moat, is the castle built, a.d. 1219, by el- Melik el-Ashraf. It stands on the site of an earlier build- ing, possibly a palace, which was connected with a

temple to the east, now represented by the Great Mosque of the Omeiyads. This mosque, destroyed by fire on the 14th of October 1893, and now being rebuilt, was a reconstruction, by the Khalif el-Walid (705-715), of the Church of St

John, built by Arcadius (395-408), on a site previously- occupied by Eoman, Greek, and earlier temples. Traces of the church and of the two later temples are still visible, and recent research has shown that they, and their courts, stood near the centre of a great enclosure measuriag 1300 feet from east to west and 1000 feet from north to south. The streets are still narrow, crooked, and in great part unpaved. The best is the Derb el-Mustakim, which sepa^ xates the Christian and Jewish quarters. The water of the Baradd; is led through every quarter ; but the supply is not well regulated, and in autumn the water is often unwholesome. In the gardens which surround the city grow walnut, apricot, pomegranate, almond, &c. ; and beyond them are fields of wheat, barley, and maize. The climate is good : in winter there is often hard frost and much snow, and even in summer, with a day temperature of 100° r., the nights are always cool. Fever, dysentery, and ophthalmia, chiefly due to exposure to heavy dews and cold nights, are prevalent.

In 1894-95 the Damascus-Mezeirfb and Damascus-Beirtit rail- ways were opened, and they are now worked at a loss by a French company. Damascus appears to haveTjeen an important manu- facturing, agricultural, and commercial centre from an early time. Its position in a fertile oasis on the edge of the desert, with roads leading to Northern Syria, the Euphrates and Persian Gulf, Arabia, Egypt, and Acre, its natural port, enabled it to recover after every disaster, and until the opening of the Suez Canal it retained its importance. It is still the market of the nomads, but the surer and cheaper sea route has almost destroyed the transit trade to which it owed its wealth, and has even diminished the importance of the annual pilgrim caravan (Haj) to Mecca. The Damascene, however, still retains his skill as a craftsman and tiller of the soil. The furniture of mosaic wood-work, the iron, copper, and brass

work, and the woven goods in cotton, silk, and wool, show great artistic taste. The principal exports are silk and cotton fabrics, wool, apricot paste, wooden and brass goods, starch, rope, &c. ; and the imports are cloths, prints, muslins, raw silk, sugar, rice, &c.

The value of exports and imports in certain specified years is shown in the following table : —

1890.

1894.

1898.

Exports . Imports .

£325,660

525,710

£400,830

614,490

£302,050

675,080

The estimates of population vary from 154,000 (including Christians and Jews, 55,000) to 225,000 (including Christians and Jews, 35,000). Most of the Christians belong to the Orthodox and Roman Catholic (United) Greek Churches ; and there are also communities of Melchites, Jacobites, Maronites, Nestorians, Armenians, and Protestants. There are British and American Missions, and a British hospital.

AuTHOEiTiES. — LoKTET. La Syiie cfaujourd'hui, p. 567 f. Paris, 1884. — Von Oppenheim. Vom mittelmeer sum Persischen Golf, i. 49 f. Berlin, 1899. — G. A. Smith. Historical Geography of the Holy Land. Encyclopaedia Biblica, art. "Damascus." Consular Beports. — Baedeker-

Socin. Handbook to Syria and Palestine. — For the Great Mosque see Dickie, Spiers, and Wilson in Palestine JExploration Fund Quarterly Statement, October 1897.

(c. W. W.)

Damghan, a town in the province of Samndln va Damgh^n of Persia, situated 216 miles from Teheran, on the high-road thence to Khorasan, at an elevation of 3770 feet, and in 36° 10′ N. lat. and 54° 20′ E. long. It has a population of less than 10,000. There are post and telegraph offices, and a great export trade is done in pistachios and almonds. The Damghan almonds of the kind called ” Kaghazi ” (papery), with very thin shells, are famous throughout the country. Damghdin was an im- portant city in the Middle Ages, but only a ruined mosque, with a number of columns and some fine wood-carvings, and two minarets remain of that period. Near the city, a few miles south and south-west, are the remains of Hecatompylos, extending from Fr^t, 16 miles south of Damgh£in, to near Gusheh, 20 miles west.

Damien [properly Veustee, Joseph de] (1840- 1889), Belgian missionary, was born at Tremeloo, near Lou- vain, on 3rd January 1840. He was educated for a busi- ness career, but in his eighteenth year entered the Church, joining the Society of the Sacred Heart of Jesus and Mary (also known as the Picpus Congregation), and taking Damien as his name in religion. In October 1863, while he was still in minor orders, he went out as a missionary to the Pacific Islands, taking the place of his brother, who had been prevented by an illness. Reaching Honolulu in March 1864 he was ordained priest in Whitsuntide of that year, and took up his duties as a missionary. Having observed the ravages of leprosy among the natives, and the painful scenes attending the departure of the lepers, whom it was the practice of the Hawaiian Government to deport to the island of Molokai, he conceived an earnest desire to mitigate their lot, and in 1873 volunteered to take spiritual charge of the settlement at Molokai. Here he remained for the rest of his life, with occasional visits to Honolulu, until he became stricken with leprosy in 1885. Besides attending to the spiritual needs of the lepers, he managed, by the labour of his own hands and by appeals to the Hawaiian Government, to improve materially the water-

supply, the dwellings, and the victualling of the settle- ment. For five years he worked alone ; subsequently other resident priests from time to time assisted him. He succumbed to leprosy on 15th April 1889. Some ill-considered imputations upon Father Damien by a Protes- tant clergyman produced a memorable tract by Robert Louis Stevenson, which has made Damien's self-sacrifice famous throughout the world. (j. m'f.)

Damietta, a town of Lower Egypt, near the mouth of the eastern branch of the Delta, terminus of the railway from Cairo, from which it is distant 125 miles by the Tanta route. The population in 1900 was 43,000, show- ing an increase of 9000 since 1882. Damietta gives its name to dimity, a kind of striped cloth, for which the place was at one time famous. Now it is chiefly im- portant for its rice and fisheries, with which it does a brisk trade with the interior.

Damoh, a town and district of British India, in the Jubbulpore division of the Central Provinces. The town is a railway station, 48 miles east of Sanger. The popu- lation in 1881 was 8665 ; in 1891 it was 11,753.

The DISTRICT OF Damoh has an area of 2831 square miles. The population in 1881 was 312,957, and in 1891 was 325,613, giving an average density of 115 persons per square mile. In 1901 the population was 285,138, showing a decrease of 12 per cent., due to famine. The land revenue was Es.3,85,000, the incidence of assess- ment being E.0-5-3 per acre; the cultivated area in 1897-98 was 433,283 acres, of which 1858 were irrigated ; the number of police was 326 ; the boys at school num- bered 3394, being 13-6 per cent, of the male population of school-going age ; the registered death-rate in 1897 was 60-84 per thousand. A branch of the Indian Midland railway was opened throughout from Saugor to Katni (104 miles) in January 1899. Damoh suffered severely from the famine of 1896-97. Fortunately the famine of 1900 was little felt.

Dana, Charles Anderson (1819-1897), American journalist, was born in Hinsdale, New Hampshire, 8th August 1819 ; studied at Harvard University, and became a member of the Brook Farm literary, philosoph- ical, socialistic, and agricultural community, near West Eoxbury, Massachusetts, in 1842, where he had among his associates Hawthorne,

George W. Curtis, George Eipley, and Margaret Fuller, the three last named being after- wards, like himself, editors in New York. As a young

man he entered ardently into the hopes of the founders of this famous enterprise, lecturing on " Friendship," &c., and remaining at Brook Farm until its abandonment in 1844; but in his later years, in the words of the his- torian of the community, " he departed farthest from its aspirations." After some newspaper work in Boston, Dana joined the editorial staff of Horace G-reeley's New York Tribune, becoming its managing editor, and actively promoting the anti-slavery cause, but he left the paper in 1862, because of a sharp disagreement with Greeley regarding the conduct of the war by President Lincoln's administration. As Dana himself said : " Greeley was for peace and I was for war." Having served as a special investigating agent of the war department at the front, — informing Secretary Stanton of the capacity and methods of various generals in the field, — Dana became assistant- secretary of war in 1863, so remaining until the close of the conflict. After a brief editorial connexion in Chi- cago, in 1868 he became editor and chief owner of the New York Sun, and remained in control until his death, giving to it a flavour and character of its own, in accord- ance with his personal preferences and aversions. The Sun, under the same editorial control, was at one time a spokesman of Tammany Hall, the local Democratic organization in New York City ; and at another of the Republican party and its managers in city and state. In his later years, after his abandonment of the Demo- cratic party at the time of the nomination of William J. Bryan for the Presidency, Dana was the principal advo- cate, in the New York press, of an aggressively " Ameri- can" or national policy. Dana was also a connoisseur in art, and edited a Household Book of Poetry (1857) and (with George Ripley) the New American Cyclopaedia, 15 vols. (1857-63). His reminiscences of the war, having been published in a monthly magazine, were issued in a volume in 1898. Dana died at his home at Glen Cove, Long Island, near New York, 18th October 1897.

Dana, James Dwight (1813-1895), American geologist, was born in Utica, New York, 12th February 1813. He early displayed a taste for science, and entered Yale College that he might study under the elder Benja- min Silliman. Graduating in 1833, for the next two years he was teacher of mathematics to midshipmen in the navy, and sailed to the Mediterranean while engaged in his duties. From 1835 to 1837 he was assistant to Professor Silliman at Yale, and then, for five years, acted as mineralogist and geologist of a United States exploring expedition, com- manded by Commodore Wilkes, in the Southern and Pacific oceans. His labours in preparing the reports of such ex- plorations as he had shared, occupied parts of thirteen years after his return to America in 1842. In 1844 he again became a resident of New Haven, married Professor Silliman's daughter, and on the resignation of Silliman was appointed Silliman Professor of Natural History and Geology in Yale College, a position which he only re- signed in 1892. He was for many years, and until his death, editor of the American Journal of Science and Arts (founded in 1819 by Benjamin Silliman), to which he was a constant contributor, principally or articles on geology and mineralogy. A bibliographical list of his writings shows 214 titles of books and papers, beginning in 1835 with a paper on the conditions of Vesuvius in 1834, and ending with the fourth revised edition (finished in February 1895) of his Manual of Geology. His reports on Zoophytes, on the Geology of the Pacific, and on Crustacea, summarizing his work on the Wilkes expedition, appeared in 1846, 1849, and 1852-54, in quarto volumes, with copiously illustrated atlases; but as these were issued in small numbers, his general reputation more

largely rests upon his System of Mineralogy (1837), Man- ual of Geology (1862), and Corals and Coral Islands (1872), the first two having repeatedly been revised in successive editions, and widely used as text-books in American col- leges, in 1887 Dana visited the Hawaiian Islands to study volcanoes. He died in New Haven, 14th April 1895.

Danao, a town on the east coast of the island of Cebii, Philippine Islands, in 10° 28′ N. It has a com- paratively cool and healthful climate, and is the centre of a rich agricultural region producing rice, Indian corn,

sugar, copra, and cacao. The language is Cebii-Visayan. Population, 16,000.

Danbury, capital of Fairfield county, Connecticut, U.S.A., in 41° 24′ N. lat. and 73° 26′ W. long., at an alti- tude of 371 feet. It is entered by the New England and the New York, New Haven, and Hartford railways. It has for a century been known for its manufacture of hats, which is still its principal industry. Besides these, it makes boots and shoes, shirts, and other articles of clothing. Population of the town (1880), 11,666; (1890), 19,473; (1900), 19,474; population of the city (1890), 16,552 j

(1900), 16,537.

Dancing is the universal human expression, by movements of the limbs and body, of a sense of rhythm which is implanted among the primitive instincts of the animal world. The rhythmic principle of motion extends throughout the universe, governing the lapse of waves, the flow of tides, the reverberations of light and sound, and the movements of celestial bodies ; and in the human organism it manifests itself in the automatic pulses and flexions of the blood and tissues. Dancing is merely the voluntary application of the rhythmic principle, when excitement has induced an abnormally rapid oxidation of brain tissue, to the physical exertion by which the over- charged brain is relieved. This is primitive dancing ; and it embraces all movements of the limbs and body expres- sive of joy or grief, all pantomimic representations of incidents in the lives of the dancers, all performances in which movements of the body are employed to excite the passions of hatred or love, pity or revenge, or to arouse the warlike instincts, and all ceremonies in which such movements express homage or worship, or are used as religious exercises. Although music is not an essential part of dancing, it almost invariably accompanies it, even in the crudest form of a rhythm beaten out on a drum. For an account of savage dances and of such customs of savage or civilized peoples as are included in this descrip- tion of dancing the reader is referred to the article on Dancing in the ninth edition of this work. The present article is confined to a discussion of Modern Dancing, by which is meant dancing employed as an entertainment either for the dancers or for spectators — this being the direction in which dancing has been

developed as an art in civilized countries. In its evolution, its direct application to arouse emotion or religious feeling tends to be obscured, and, although attempts are occasionally made to revive it, finally dropped out ; and it is in the sense of an art or pastime that the term dancing is used in this article.

Italy, in the 15th century, saw the renaissance of dan- cing, and France may be said to have been the nursery of the modem art, though comparatively few modern dances are really French in origin. The national dances of other countries were brought to France, studied systematically, and made perfect there. An English or a Bohemian dance, practised only amongst peasants, would be taken to France, polished and perfected, and would at last fiiid its way back to its own country, no more recognizable than a piece of elegant cloth when it returns from the printer to the place from which as ” grey ” material it was

sent. The fact that the terminology of dancing is almost entirely French is a sufficient indication of the origin of the rules that govern it. The earliest dances that bear any relation to the modern art are probably the danses basses and danses hautes of the 16th century. The daiise basse was the dance of the court of Charles IX. and of good society, the steps being very grave and dignified, not to say solemn, and the accompaniment a psalm tune. The danses hautes, or baladines, had a skipping step, and were practised only by clowns and country people. More lively dances, such as the Gaillarde and Volta were intro- duced into France from Italy by Catherine de’ Medici, but even in these the interest was chiefly spectacular. Other dances of the same period were the Branle (after- wards corrupted to Braule, and known in England as the Brawle) — a kind of generic dance which was capable of an almost infinite amount of variety. Thus there were imitative dances — Branles mimis, such as the Branles des Ermites, Branles des flambeaux, and the Branles des lavandiires. The Branle in its original form had steps like the Allemande. Perhaps the most famous and stately dance of this period was the Pavane (of Spanish origin), which is very fully described in Tabouret’s

OrcMsographie, the earliest work in which a dance is found minutely described. The Pavane, which was really more a procession than a dance, must have been a very gorgeous and noble sight, and it was per- fectly suited to the dress of the period, the stifE brocades of the ladies and the swords and heavily plumed hats of the gentlemen being displayed in its simple and dignified measures to great advantage. The dancers in the time of Henry III. of France usually sang, while performing the Pavane, a chanson, of which this is one of the verses :

" Approche done, ma belle,

Approche — ^toi, mon blen ; Ne me sois plus rebelle,

Puisque mon cceur est tien ; Pour mon S,me apaiser, Donne-moi un baiser."

In the Pavane and Branle, and in nearly all the dances of the 17th and 18th centuries, the practice of kissing formed a not unimportant part, and seems to have added greatly to the popularity of the pastime. Another ex- tremely popular dance was the Saraband, which, how- ever, died out after the 17th century. It was originally a Spanish dance, but enjoyed an enormous success for a time in France. Every dance at that time had its own tune or tunes, which were called by its own name, and of the Saraband the Chevalier de Grammont wrote that " it either charmed or annoyed everyone, for all the guitarists of the court began to learn it, and God only knows the universal twanging that followed." Vanquelin des Yveteaux in his eightieth year desired to die to the tune of the Saraband, " so that his soul might pass away sweetly." After the Pavane came the Courante, a court dance performed on tiptoe with slightly jumping steps and many bows and curtseys. The Courante is one of the most important of the strictly modern dances. The Minuet and the Waltz were both in some degree derived from it, and it had much in common with the famous Seguidilla of Spain. It was a favourite dance of Louis XIV., who was an adept in the art, and it was regarded in his time as of such importance that a nobleman's education could hardly have been said to be begun until he had mastered the Courante.

The dance which the French brought to the greatest perfection — which many, indeed, regard as the fine flower of the art — was the Minuet. Its origin, as a rustic dance, is not less antique than that of the other dances from which the modern art has been evolved. It was originally

a branle of Poitou, derived from the Courante. It came to Paris in 1650, and was first set to music by Lully. It was at first a gay and lively dance, but on being brought to court it soon lost its sportive character and became grave and dignified. It is mentioned by Beauchamps, the father of dancing-masters, who flourished in Louis XIV.'s reign, and also by Blondy, his pupil ; but it was Pecour who really gave the Minuet its popularity, and although it was improved and made perfect by Dauberval, Gardel, Marcel, and Gaetan Vestris, it was in Louis XV.'s reign that it saw its golden age. It was then a dance for two in moderate triple time, and was gen- erally followed by the Gavotte. Afterwards the Minuet was considerably developed, and with the Gavotte became chiefly a stage dance and a means of display; but it should be remembered that the minuets which are now danced on the stage are generally highly elaborated with a view to their spectacular effect, and have imported into them steps and figures which do not belong to the Minuet at all, but are borrowed from all kinds of other dances. The original Court Minuet was a grave and simple dance, although it did not retain its simplicity for long. But when it became elaborated it was glorified and moulded into a perfect expression of an age in which deportment was most sedulously cultivated and most brilliantly polished. The " languishing eye and smiling mouth " had their due effect in the minuet ; it was a school for chivalry, courtesy, and ceremony ; the hundred slow graceful movements and courtesies, the pauses which had to be filled by neatly turned compliments, the beauty and bravery of attire — all were eloquent of graces and outward refinements which we cannot boast now. The fact that the measure of the Minuet has become incorporated in the structure of the Symphony shows how important was its place in the polite world. The Gavotte, which was often danced as a pendant to the Minuet, was also originally a peasant's dance, a danse des Oavots, and consisted chiefly of kissing and capering. It also became stiff and artificial, and in the later and more prudish half of the 18th century the ladies received bouquets instead of kisses in dancing the Gavotte. It rapidly became a stage dance, and it has never

been restored to the ballroom. Gretry attempted to revive it, but his arrangement never became popular. Other dances which were naturalized in France were the Ecossaise, popular in 1760 ; the Cotillon, fashionable under Charles X., derived from the peasant branles and danced by ladies in short skirts ; the Qalop, imported from Germany; the Lancers, invented by Laborde in 1836 ; the Polka, ■ brought by a dancing-master from Prague in 1840; the Schottisch, also Bohemian, first introduced in 1844 ; the Bourie, or French clog-dance ; the Quadrille, known in the 18th century as the Contre- danse; and the Waltz, which was danced as a volte by Henry III. of France, but only became popular in the beginning of the 19th century. We shall return to the history of some of these later dances in discussing the dances at present in usei

If France has been the nursery and school of the art of dancing, Spain is its true home. There it is part of the national life, the inevitable expression of the gay, contented, irresponsible, sunburnt nature of the people. The form of Spanish dances has hardly changed ; some of them are of great antiquity, and may be traced back with hardly a break to the performances in ancient Kome of the famous dancing-girls of Cadiz. The connexion is lost during the period of the Arab invasion, but the art was not neglected, and Jovellanos suggests that it took refuge in the Asturias. At any rate, dances of the 10th and 12th centuries have been preserved uncorrupted. The earliest dances known were the Turdion, the Gibidana,

the Pii-de-gibao, and (later) the Madama Orleans, the Alemana, and the Pavana. Under Philip IV. theatrical dancing was in high popularity, and ballets were organ- ized with extraordinary magnificence of decoration and costume. They supplanted the national dances, and the Zarabanda and Chacona were practically extinct in the 18th century. It is at this period that the famous modern Spanish dances the Bolero, Seguidilla, and the Fandango first appear. Of these the Fandango is the most important. It is danced by two people in 6-8 time, beginning slowly and tenderly, the rhythm marked by the click of castanets, the snapping of the fingers, and the stamping of feet, and the speed gradually increasing until

a whirl of exaltation is reached. A feature of the Fandango and also of the Seguidilla is a sudden pause of the music towards the end of each measure, upon which the dancers stand rigid in the attitudes in which the stopping of the music found them, and only move again when the music is resumed. M. Vuillier, in his History of Dancing, gives the following description of the Fan- dango:— "Like an electric shock, the notes of the Fandango animate all hearts. Men and women, young and old, acknowledge the power of this air over the ears and soul of every Spaniard. The young men spring to their places, rattling castanets, or imitating their sound by snapping their fiigers. The girls are remarkable for the willowy languor and lightness of their movements, the voluptuousness of their attitudes — beating the exact- est time with tapping heels. Partners tease and entreat and pursue each other by turns. Suddenly the music stops, and each dancer shows his skill by remaining absolutely motionless, bounding again into the full life of the Fan- dango as the orchestra strikes up. The sound of the guitar, the violin, the rapid tic-tac of heels (taconeos), the crack of fingers and castanets, the supple swaying of the dancers, fill the spectator with ecstasy. The measure whirls along in a rapid triple time. Spangles glitter; the gharp clank of ivory and ebony castanets beats out the cadence of strange, throbbing, deepening notes — assonances unknown to music, but curiously character- istic, effective, and intoxicating. Amidst the rustle of silks, smiles gleam over white teeth, dark eyes sparkle and droop, and flash up again in flame. All is flutter and glitter, grace and animation — quivering, sonorous, passionate, seductive."

The Bolero is a comparatively modern dance, having been invented by Sebastian Cerezo, a celebrated dancer of the, time of King Charles III. It is remarkable for the free use made in it of the arms, and is said to be de- rived from the ancient ZaraAanda, a violent and licentious dance, which has entirely disappeared, and with which the later Saraband has practically nothing in common. The step of the Bolero is low and gliding, but well marked. It is danced by one or more couples. The Seguidilla is hardly less ancient than the Fandango, which it resembles. Every province in Spain has its own Seguidilla, and the dance is accompanied by coplas, or verses, which are sung either to traditional melodies or to the tunes of local composers ; indeed, the national music of Spain

consists largely of these coplas. Baron Davillier, among several specimens of SeguidUlas, gives this one

“Mi corazon volando Se fu6 & tu peCho ; Le cortaste las alas,

Y qa^do dentro.’

Por atrevido Se quedarfl por siempre

En elmetido.”!

J My heart flew to thy breast. Thou didst cut its wings, so that it lemained there. And now it has wazed daring, and will stay with thee for evermore.”

M. Vuillier quotes a copla which he heard at Polenza, in the Balearic Islands. This verse is formed on the rhythm of the Malaguefla :

” Una estrella se ha pardida En el ciel y no pareoe ; En tu cara se ha metido ; Y en tu f rente resplandece.” ^

The Jota is the national dance of Aragon, a lively and splendid, but withal dignified and reticent, dance derived from the 16th century Passacaille. It is still used as a religious dance. The Cachuca is a light and graceful dance in triple time. It is performed by a single dancer of either sex. The head and shoulders play an important part in the movements of this dance. Other provincial dances now in existence are the Jaleo de Jerez, a whirling measure performed by gipsies, the PaloUa, the Polo, the Oallegada, the Muyneria, the Hahas Verdes, the Zapa- teado, the Zorongo, the Vito, the Tirana, and the Tripola Trapola. Most of these dances are named either after the places where they are danced or after the composers who have invented tunes for them. Many of them are but slight variations from the Fandango and Seguidilla.

The history of court dancing in Great Britain is prac- tically the same as that of France, and need not occupy much of our attention here. But there are strictly national dances still in existence which are quite peculiar to the country, and may be traced back to the dances and games of the Saxon gleemen. The Egg dance and the Carole were both Saxon

dances, the Carole being a Yule-tide festivity, of which the present-day Christmas carol is a remnant. The oldest dances which remain unchanged in England are the Morris dances, which were introduced in the time of Edward III. The name Morris or Moorish refers to the origin of these dances, which are said to have been brought back by John of Gaunt from his travels in Spain. The Morris dances are associated with May-day, and are danced round a Maypole to a lively and capering step, some of the performers having bells fastened to their knees in the Moorish manner. They are dressed as characters of old English tradition, such as Robin Hood, Maid Marian, Friar Tuck, Little John, and Tom the Piper. All the true country dances of Great Britain are of an active and lively measure ; they may all, indeed, be said to be founded on the jig ; and the hornpipe, which is a kind of jig, is the national dance of England. Captain Cook on his voyages made his sailors dance hornpipes in calm weather to keep them in good health. A character- istic of English dances was that they partook to a great extent of the nature of games ; there was little variety in the steps, which were nearly all those of the jig or horn-pipe, but these were incorporated into various games or plays, of which the Morris dances were the most elaborate. Richard Baxter wrote that " sometimes the Morris dancers would come into the church in all their linen and scarves and antic dresses, with Morris bells jingling at their legs ; and as soon as Common Prayer was read, did haste and presently to their play again." May-day has always been celebrated in England with rustic dances and festivities. Before the Reformation there were no really national dances in use at court ; but in the reign of Elizabeth the homely, domestic style of dancing reached the height of its popularity. Remnants of many of these dances remain to-day in the games played by children and country people; "Hunt the Slipper," "Kiss in the Ring," "Here we go round the Mulberry Bush," are examples. All the Tudor dances were kissing dances, and must have been the occasion of a great deal of merriment. Mrs Groves

" A star is lost and appears not in the sky; in thy face it has set If: on thv brow it shines."

itself ; on thy brow it shines

gives the following description of the Cushion Dance : — ” The dance is begun by a single person, man or woman, who, taking a cushion in hand, dances about the room, and at the end of a short time stops and sings: ‘This dance it will no farther go,’ to which the musician answers: ‘I pray you, good sir, why say so?’ ‘Because Joan Sanderson will not come to.’ ‘ She must come to whether she will or no,’ returns the musician, and then the dancer lays the cushion before a woman ; she kneels and he kisses her, singing ‘ Welcome, Joan Sanderson.’ Then she rises, takes up the cushion, and both dance and sing. ‘ Prinkum prankum is a fine dance, and shall we go dance it over again ? ‘ Afterwards the woman takes the cushion and does as the man did.” Other popular dances — generally adapted to the tunes of popular songs, the nature of some of which may be guessed from their titles — were the Trenchmore, Omnium-gatherum, ToUy-poUy, Hoite cum toite, Dull Sir John, Faine I would, Sillinger, All in a Garden Green, An Old Man’s a Bed Full of Bones, If All the World were Paper, John, Come Kiss Me Now, Cuck- holds All Awry, Green Sleeves and Pudding Pies, Lumps of Pudding, Under and Over, Up Tails All, The Slaughter House, Rub her Down with Straw, Have at thy Coat Old Woman, The Happy Marriage, Dissembling Love, Sweet Kate, Once I Loved a Maiden Fair. Dancing practically disappeared during the Puritan rigime, but with the Restoration it again became popular. It underwent no considerable developments, however, until the reign of Queen Anne, when the glories of Bath were revived in the beginning of the 18th century, and Beau Nash drew up his famous codes of rules for the regulation of dress and manners, and founded the balls in which the polite French dances completely eclipsed the simpler English ones. An account of a dancing lesson witnessed by a fond parent at this time is worth quoting, as it shows how far the writer (but not his daughter) had departed from the jolly, romptag traditions of the old English dances: — ” As the best institutions are liable to corruption, so, sir, I must acquaint you that very great abuses are crept into this entertaininent. I was amazed to see my girl handed by and handing young fellows with so much familiarity, and I could not have thought it had been my child. They very

often made use of a most impudent and lascivious step called setting to partners, which I know not how to describe to you but by telling you that it is the very reverse of back to back. At last an impudent young dog bid the fiddlers play a dance called Moll Patley, and, after having made two or three capers, ran to his partner, locked his arms in hers, and whisked her round cleverly above ground in such a manner that I, who sat upon one of the lowest benches, saw farther above her shoe than I can think fit to acquaint you with. I could no longer endure these enormities, wherefore, just as my girl was going to be made a whirligig, I ran in, seized my child, and carried her home." What we may call polite dancing, when it became fashionable, soon invaded Lon- don, its first home being Madame Cornely's famous Carlisle House in Soho Square. Eanelagh and Vauxhall and Almack's were all extensively patronized, and the rage for magnificent entertainment and dancing culmi- nated in the erection of the palatial Pantheon in Oxford Street — a place so universally patronized that even Dr Johnson was to be found there. White's and Boodle's were also famous assembly rooms, but the most exclusive of all these establishments was Almack's, the original of Brooks's Club.

The only true national dances of Scotland are reels, strathspeys, and flings, while in Ireland there is but one dance— the jig, which is there, however, found in many varieties and expressive of many shades of emotion, from the maddest gaiety to the wildest lament. Curiously

enough, although the Welsh dance often, they have no strictly national dances.

Dancing in present-day society is a comparatively simple affair, as five-sixths of almost all ball programmes consists of Waltzes. The origin of the Waltz is a much- debated subject, the French, Italians, and Bavarians each claiming for their respective countries the honour of having given birth to it. As a matter of fact the Waltz, as it is now danced, comes from Germany ; but it is equally true that its real origin is French, since it is a development of the Volte, which in its turn came from the Lavolta of Provence, one of the most ancient of French dances. The Lavolta was fashionable in the 16th cen- tury, and was the delight of the Valois court. The Volte danced by Henry III. was really a Valse d. deux pas; and Castil-

Blaze says that ” the waltz which we took again from the Germans in 1795 had been a French dance for four hundred years.” The change, it is true, came upon it during its visit to Germany, hence the theory of its German origin. The first German waltz tune is dated 1770 — ” Ach ! du lieber Augustin.” It was first danced at the Paris opera in 1793, in Gardel’s ballet La Danso- manie. It was introduced to English ballrooms in 1812, when it roused a storm of ridicule and opposition, but it became popular when danced at Almack’s by the Emperor Alexander in 1816. The Waltz d, trois temps has a sliding step in which the movements of the knees play an im- portant part. The tempo is moderate, so as to allow three distinct movements on the three beats of each bar; and the Waltz is written in 3-4 time and in eight bar sentences. Walking up and down the room and occasionally break- ing into the step of the dance is not true waltzing, and the habit of pushing one’s partner backwards along the room is an entirely English one. But the dancer must be able to waltz equally well in ~~all directions, pivoting and crossing the feet when necessary in the reverse turn. It need hardly be said that the feet should never leave the floor in the true Waltz. Gungl, Waldteufel, and the Strauss family may be said to have moulded the modern Waltz to its present form by their rhythmical and agree~~ able compositions. There are variations — chiefly Ameri- can— ^which include hopping and lurching steps; these are degradations, and foreign to the spirit of the true Walti.

The QuADKiLLE is a Contredanse of some antiquity. The Contredanse was first brought to England from. Normandy by William the Conqueror, and was common all over Europe in the 16th and 17th centuries. The term Quadrille means a kind of card game, and the dance is supposed to be in some way connected with the game. A species of Quadrille appeared in a French ballet in 1745, and since that time the dance has gone by that name. Like many other dances, it came from Paris to Almack’s in 1815, and in its modern form was danced in England for the first time by Lady Jersey, Lady Harriet Butler, Lady Susan Ryder, and Miss Montgomery, with Count Aldegarde, Mr Montgomery, Mr Harley, and Mr Montague. It immediately became popiilar. It then consisted of very elaborate steps, which in England have been simplified until the degenerate practice has become common of walking through the dance. It can hardly be said to be popular in England to-day. This is a pity, for the Quadrille, properly

danced, has many of the graces of the Minuet. It is often stated that the Contredanse, or square dance, is of modern French origin. This is in- correct, and probably arises from a mistaken identification of the terms Quadrille and square dance. “Dull Sir John ” and ” Faine I would ” were square dances popular in England three hundred years ago. ” Country dance ” is a corrupt Anglicization of contredanse, and not, as is so often asserted, the true original name of the dance.

The Lancers ■were invented by Laborde in Paris in 1836. They were brought over to England in 1850, and ■were made fashionable by Madame Sacre at her classes in Hanover Square Rooms. The first four ladies to dance the Lancers in England ■were Lady Georgina Lygon, Lady Jane Eielding, Mdlle Olga de Lechner, and Miss Berke- ley.

The Polka, the chief of the Bohemian national dances, ■was adopted by Society in 1835 at Prague. Josef Neruda had seen a peasant girl dancing and singing the Polka, and had noted down the tune and the steps. Prom Pragne it rapidly spread to Vienna, and was introduced to Paris by •Cellarius, a dancing-master, who gave it at the Odeon in 1840. It took the public by storm, and spread like an infection through England and America. Everything was named after the Polka, from public-houses to articles of dress. Mr Punch exerted his ■wit on the subject weekly, and even Tlie Times complained that its French corre- spondence was interrupted, since the Polka had taken the place of politics in Paris. The true Polka has three slightly jumping steps, danced on the first three beats of a four-quaver bar, the last beat of which is employed as a rest while the toe of the unemployed foot is dra^wn up against the heel of the other. The Polka has recently fallen into disuse in England because of the craze for waltzing to every possible and impossible measure.

The Galop is strictly speaking a Hungarian dance, which became popular in Paris in 1830. But some kind of a dance corresponding to the Galop was always in- dulged in after Voltes and Contredanses, as a relief from their grave and constrained measures.

The Washington Post, Pas de Quatee, and several varieties of Baen Dance are of American origin, and have recently become fashionable. The general tendency of American dances is to be of a lively and romping measure, in which kicking and hopping and waving of the arms take the place of symmetrical figures and rhythmically de- signed steps.

The Polka-Mazueka is extremely popular in Vienna and Budapest, aind is a favourite theme with Hungarian composers. The six movements of this dance occupy two bars of 3-4 time, and consists of a mazurka step joined to the polka. It is of Polish origin.

The Polonaise and Mazueka are both Polish dances, and are still fashionable in Russia and Poland. Every State ball ia Russia is opened with, the ceremonious Polonaise.

The Schottische, a kind of modified Polka, was ■" created " by Markowski, who was the proprietor of a famous dancing academy in 1850. The Highland Schottische is a fling. The Eling and Reel are Celtic ■dances, and form the national dances of Scotland and Denmark. They are complicated measures of a studied and classical order in which free use is made of the arms and of cries and stampings. The Steathspet is a slow and grandiose modification of the Reel.

SiE RoGEE DE CovEELET is the only one of the old English social dances which has survived to the present ■day, and it is frequently danced at the conclusion of the less formal sort of balls. It is a merry and lively game in which all the company take part, men and women fac- ing each other in two long rows. The dancers are con- stantly changing places in such a way that if the dance is carried to its conclusion everyone ■will have danced with everyone else. The music was first printed in 1685, and is sometimes written in 2-^ time, sometimes in 6-8 time, and sometimes in 3-9 time.

The Cotillon is a modern development of the French dance of the same name referred to above. It is an extremely elaborate dance, in which a great many toys and accessories are employed ; hundreds of figures may be

contrived for it, of which the chief are La Conversation, Le Mouchoir, La Trompeuse, Les Dames CacMes, Le Huit entre deux chaises, Les Quatre Coins, Le Fandango, L'Artichaut, La Finale. There are also several figures in which presents, toys, lighted tapers, biscuits, air-balloons, and hurdles are used. Some of these are Pile ou Face, La Parapluie, La PSche A la Ligne, La Loterie, Le Chevalier de la Triste Figure, Les Ballons, Steeplechase, Le Chasse d, Courre, and Le Postilion.

The Ballet is a performance in which dancing, music, and pantomime play equally important parts. The origin of the modern ballet is identical with the revival of dancing, the earliest on record being that given by Bergonzio di Botta at Tortona to celebrate the marriage of the Duke of Milan in 1489. The ballet, like other forms of dancing, was developed and perfected in France ; it is closely associated with the history of the opera ; but in England it came much later than the opera, for it was not introduced until the 18th century, and in the first Italian operas given in London there was no ballet. During the regency of Lord Middlesex a ballet-master was appointed and a corps of dancers formed. The ballet has had three distinct stages in its development. For a long time it was to be foimd only at the court, when princely entertainments were given to celebrate great occasions. At that time ladies of the highest rank performed in the ballet, and spent much time in practising and perfecting themselves for it. Catherine de' Medici iutroduced these entertainments into France, and spent large sums of money on devising performances to distract her son's attention from the affairs of the State. Baltasarini, otherwise known as Beaujoyeulx, was the composer of a famous entertainment given by Catherine in 1551 called the " Ballet Comique de la Reyne." This marks an era in the history of the opera and ballet, for we find here for the first time dance and music arranged for the display of coherent dramatic ideas. Henry IV., Louis XIII. andXIV., were all lovers of the ballet and performed various characters in them, and Richelieu used the ballet as an instrument for the expression of political purposes. Lully was the first to make an art of the composition of ballet music, and he was the first to insist on the admission of women as ballet dancers, feminine characters having hitherto been assumed by men dressed as women. When Louis XIV. became too fat to dance, the ballet at court became unpopular, and thus was ended the first stage of its development.

It then was adopted in the colleges at prize distributions and other occasions, when the ballets of Lully and Quinault were commonly performed. The third period in the history of the ballet was marked by its appearance on the stage, where it has remained ever since. It should be added that up till the third period dramatic poems had accompanied the ballet, and the dramatic meaning was helped out with speech and song; but with the advent of the third period speech disappeared, and the purely pantomime performance, or Ballet d'Action, was instituted. The father of ballet dancing as we know it at the present day was Jean George Noverre, who appeared in 1749. He has left voluminous writings ; they are remarkable for a refined literary style, and in them he sets forth at length his theories and practices as an artist of dancing. The Ballet d'Action was really invented by him ; in fact, the ballet has never advanced beyond the stage to which he brought it ; it has rather gone back. Noverre held the opinion that words only served to weaken the action and partly destroy its effects. He held that a pantomime which, in order to be understood, had to borrow the help of a verbal explanation, was imperfect. " When dancers shall feel, and, Proteus-like, transform themselves into various shapes," he says, "to express to the life the

conflict of passions ; when their features, their very looks, shall speak their inward feelings ; when, extending their arms beyond the narrow circle prescribed by the rigid rules of pedantry, and with equal grace and judgment giving them a fuller scope, they shall by proper situa- tions describe the gradual and successive progress of the passions; when, in fine, they call good sense and genius to the assistance of their art; then they may expect to distinguish themselves : explanatory speeches "will become useless; a mute but powerful eloquence will be substituted to much better effect; each motion will be a sentence ; every attitude will portray a situar tion; each gesture convey a thought, and each glance a new sentiment: every part will please, because the whole will be a true and faithful imitation of nature." The essence of Noverre's theory was that mere dis- play was not enough to ensure interest and life for the

ballet ; and the late Sir Augustus Harris expressed a similar opinion when he was asked wherein lay the reason of the decadence of the modern ballet. Noverre brought to a high degree of perfection the art of pre- senting a story by means of pantomime, and he never allowed dancing which was not the direct expression of a particular attitude of mind. Since Noverre's time the greatest ballet-master was undoubtedly the famous Gaetano Apolline Baltasare Vestris, who modestly called himself "le dieu de la danse," and was accustomed to say that his century had produced only three great men — himself, Frederic II., and Voltaire. He was, indeed, the finest male dancer that Europe ever produced, and was a great man in his time. Gluek composed Iphigenia in Aulis in conjunction with Vestris. In 1760 the two greatest dancers of the day performed together in Paris in a ballet-opera called Liandre et Hi.ro; the dancers were Vestris and Madame Camargo, who introduced short skirts on the stage. The word " balette " was first used in the English language by Dryden in 1667, and the first descriptive ballet seen in London was TM Tavern Bilkers, which was played at Drury Lane in 1702. Since then the ballet in England has been purely exotic and has merely followed on the lines of French developments. The palmy days of the ballet in England are said to have been in the first half of the 19th century, when there was a royal revenue spent on the maintenance of this fashionable attraction. Some famous dancers of this period were Carlotta Grisi, Mdlle Taglioni (who is said to have turned the heads of an entire generation), Fanny Elssler, Mdlle Cerito, Miss P. Horton, Miss Lucile Grahn, and Mdlle Carolina Eosati. Miss Kate Vaughan is probably the greatest dancer whom England has produced, and, in Sir Augustus Harris's opinion, she did much to ele- vate the modern art. She was the first to qiake skirt-dancing popular, although that achievement will not be regarded as an unmixed benefit by every student of the art. Skirt-dancing, in itself a beautiful exhibition, is a depar- ture from true dancing in the sense that the steps are of lit- tle importance in it ; and in the present day we have seen its development extend to a mere exhibition of whirling draperies under many coloured lime-lights. The best known of Miss Vaughan's disciples and imitators (each of whom has contributed something to the art on her own account) have been Miss Sylvia Grey, Miss Letty Lind, Miss St Cyr, Miss Mabel Love, and Miss Topsy Sinden. But ballet-dancing, affected by a tendency in modern entertainment to make less and

less demands on the intelligence and intellectual appreciation of the public, and m^jre and more demands on the eye, — ^the sense most easily affected, — has gradually developed into a spectacle, the chief interest of which is quite independent of dancing. Thousands of pounds are spent on dressing a small army of women who do little but march about the stage and group themselves

in accordance with some design of colour and mass ; and no more is asked of the intelligence than to believe that a ballet dressed, for example, in military uniform is a. compliment to or glorification of the army. Only a few out of hundreds of members of the corps de ballet are really dancers, and they perform against a background of colour afforded by the majority. It seems unlikely that we shall see any revival of the best period and styles of dancing until a higher standard of grace and manners becomes fashionable in Society. Withtheconstantlyincreasingabolitionof cere- mony, courtliness of manner is bound to diminish ; and only in an atmosphere of ceremony, courtesy, and chivalry caa the dance maintain itself in perfection. (a. b. f. y.)

Danube. — The river Danube and its tributaries; have been described at length in the ninth edition of the Encyclopedia Britannica. It is proposed in this article to describe briefly the recent engineering works for the- improvement of its navigation, more especially those- that have been carried out under international agreement: as decided on under the Treaties of Paris, Berlin, and London.

The European Commission in 1866 had its powers pro- longed for five years, and by the Treaty of London of 1871 it was granted another twelve years' lease of life. At the Congress of Berlin in 1878 its ^^"f""' jurisdiction was extended from Isakcha upwards mission. to Galatz, a distance of 25 nautical miles, and it was decided that Eumania should henceforward be- represented by a delegate. By the Treaty of London of 1883 the jurisdiction of the Commission was extended from Galatz to Braila — 10 miles farther up the river; and its powers were prolonged for twenty-one years (i.e.,. till the 24th of April 1904), at the expiration of which period its existence is to continue by tacit prolongation for successive terms of three years, unless one of the- High Contracting*

Powers should propose any modifica- tion in its constitution or attributes. It was also decided to withdraw the Kilia or Northern branch of the mouths- of the Danube from the immediate jurisdiction of the European Commission, but Russia and Rumania were to superintend the application of the regulations in force in the Sulina branch in that part of the Kilia branch, lying between those countries. Russia was given com- plete control over that portion of the river which flows, exclusively through her own territory, and was authorized to levy tolls intended to cover the expenses of any works of improvement that might be undertaken by her. Article VII. of the same Treaty declared that the regulations for navigation, river police, and superintendence drawn up- on the 2nd of June 1882 by the European Commission,, assisted by the delegates of Servia and Bulgaria, should be made applicable to that part of the Danube situated between the Iron Gates and Braila. In consequence of Rumania's opposition, the Commission Mixte was never formed, and these regulations have never been put in force. As regards the extension of the Powers of the European Commission to Braila, 10 miles above Galatz, and at the head of the Maritime Navigation, a tacit understanding has been arrived at, under which questions- concerning navigation proper come under the jurisdiction of the Commission, while the police of the ports remains in the hands of the Rumanian authorities.

The British delegates on the Commission have been, successively : — Sir John Stokes, E.E., K.C.B., whose in- valuable services extended over a period of fifteen years, from 1866 to 1871; General C. G. Gordon, R.E. (of Khartum), from 1871 to 1873; Major-General H. T. Siborne, R.E., from 1873 to 1881 ; Sir Percy Sanderson, K.C.M.G., 1882 to 1894; and Lieutenant-Colonel Henry Trotter, R.E., C.B., since October 1894.

In the ninth edition of the Encyclopaedia Britannica it was stated, as regards the work effected by the European Commission .0^ ^^^ Danube, that between 1858 and 1871 the depth mea^^"' ° water at the entrance*

of the Sulina Port had been increased from 9 to 19 feet. In 1876 the south jetty ■was prolonged, so as to bring its end exactly opposite the light-house on the north pier. This resulted in an increase of the depth to 20^ feet, and for fifteen years, from 1879 to 1895, this depth remained constant without the aid of dredging. In 1894, owing to the constantly increasing size of vessels frequenting the Danube, it was found necessary to deepen the entrance still farther, and to construct two parallel piers between the main jetties, reducing the breadth of the river to 500 feet, and thereby increasing the scour. There is now a continuous channel 5200 feet in length and 24 feet in depth, 300 feet in width between the piers and 600 feet in width outside the extremities of the piers, until deep water is reached in the open sea.

In addition to the successful treatment of the main Danube 11 miles below Isakcha, the engineers of the Commission have been equally successful in dealing with the Sulina branch of the river. Its original length of 45 miles from St George's Chatal to the sea was impeded at the commencement of the improvement works by eleven bends, each with a radius of less than 1000 feet, besides numerous others of somewhat larger radius, and its bed was encumbered by ten shifting shoals, varying from 8 to 13 feet in depth at low water. By means of a series of train- ing walls, by groynes thrown out from the banks, by revetments of the banks, and by dredging, all done with the view of narrowing and limiting the breadth of the river, a minimum depth of 11 feet was attained in 1865, and 13 feet in 1871. In 1880 the needs of commerce and the increased size of steamers frequenting the river necessitated the construction of a new entrance from the St George's branch. This work, designed in 1857, but unexecuted during a quarter of a century, owing to insufficiency of funds, was completed in 1882 ; and in 1886, after other comparatively short cuttings had been made to get rid of difficult bends and further to deepen the channel without having to resort to dredgers, the desired minimum depth of 15 feet was attained. Since that date a series of new cuttings have been made, the last commenced in 1898, and estimated to be completed in 1902. These new cuttings, when the last is completed, will have shortened the length of the Sulina canal by 11 nautical miles, eliminated all the difficult bepds and shoals, and provided an almost straight waterway 34

miles in length from Sulina to the St George's Chatal, with a minimum depth of 18 feet when the river is at its lowest.

Two names are indissolubly connected with the eminently satis- factory results obtained both in the river and at its mouth. The English engineer Sir Charles Hartley designed all the works and improvements referred to, and personally superintended their execution from 1856 until 1872, after which time he occupied the post of consulting engineer, while the execution of the worlds after 1872 devolved on the Danish engineer, Mr Charles Klihl.

The Commission has an average annual income of about £80,000, derived from taxes paid"' by ships when leaving the river. The normal annual expenditure amounts to about £56,000, Fmaace. ^rhile £24,000 is generally allotted to extraordinary works, such as new cuttings, &c. This large expenditure has, however, been attended with a more than corresponding benefit to commerce. The depth of water over the bar of the Sulina mouth has been increased from 9 feet (in 1856) to the minimum of 24 feet (in 1900). The minimum depth of water in the Sulina branch with the river at its lowest has been increased during the same period from 8 feet to 17 feet. Freights from Galatz and Braila to North Sea ports have fallen from 50s. to about 12s. 6d. per ton. Sailing ships of a maximum of 200 tons register have given way to steamers up to 2600 tons register carrying a dead weight of 5500 tons ; and last, but not least, good order has suc- ceeded chaos.

As illustrating the great value, especially to British maritime trade, of the improvements that have been effected by the Danube Commission in the navigable channel of the river from Braila to the sea, it may be mentioned that whilst from 1857 to 1867 the average annual registered tonnage entered was but 450,000 tons, of which only one-third was British, the total tonnage in 1896 had increased to 1,800,000, of which three-fifths was British. Thus in thirty years the whole annual Danubian trade of all European nations increased fourfold, while the tonnage of British ships increased eightfold.

In 1861 the average size of the 3084 vessels visiting the river was 146 tons register only, whereas in 1899-1900 the average size exceeded one

thousand tons register.

Many of the treaties previously alluded to also dealt with the question of the regularization of that part of the Danube lying between Old Moldova (in Hungary) and Tum-Severin Iron Dates. (Rumania). Article VI. of the Treaty of London (1871) authorizes the Powers which possess the shores of that part of the Danube where the cataracts and the Iron Gates offer

impediments to navigation, to come to an understanding with the view of removing these impediments, and to have the right of levying a provisional tax on vessels of every flag which may henceforth benefit thereby until the extinction of the debt con- tracted for the execution of the works. As the riverain Powers could not come to an agreement on the subject, the Great Powers at the Congress of Berlin (1878) intrusted to Austria- Hungary the execution of the works in question. Austria-Hungary subsequently conferred its rights on Hungary, by whom the works were carried out at the cost of about 1^ millions sterling.

Eor the construction of the works and the formation of a sinking fund by which the capital expenditure will be repaid in ninety- nine years, the Hungarian Government raised a loan of 22 J millions of florins ; the interest on this sum, together with the annual expenditure in repairs, maintenance, pilotage, &c., is estimated to amount to 900,000 florins, and the Hungarians claim that the difference between this sum and the estimated revenue, i.e., 500,000 florins, is a generous contribution paid by Hungary for the Ijeneflt of navigation in general. The engineering works in the neighbourhood of the Iron Gates are of great interest. The principal obstructions between Old Moldova and Tum-Severin are the Stenka Rapids, the Kozla Dojke Eapids, the Greben section, and the Iron Gates. At the first named there was a bank of rocks, some of them dry at low water, extending almost across the river (985 yards wide). The fall of the river-bed is small, but the length of the rapid 1100 yards. The Kozla Dojke, 9 miles below the Stenka Rapids, extend also for 1100 yards, with a fall of 1 in 1000, and are caused by the two banks of rocks which cause a sudden alteration in the direction of the current. The river is here only 170 to 330 yards in width ; six miles below them Is the Greben section, the most difficult part of the works of improve- ment. A spur of the Greben

mountains runs out below two shoals into the river, which suddenly narrows to about 300 yards at low water, although it shortly widens to 1^ mUes. Seven miles lower down are the Juez Rapids, where the river-bed has a fall of 1 in 433. At the so-called Iron Gates, between Orsova and Tum- Severin, and 34 mUes below the Greben, the Prigrada rocky bank nearly blocked the river at the point where it widens out after leaving the stupendous Kazan defile.

During the 19th century many schemes were worked out for the improvement of this portion of the river, but it was not till 1883 that a practical start was made, and the Hungarian engineers, Messrs Vfisirhalyi and Wallandt, prepared the design? which have since been executed. The general object of these works was to give a navigable depth of water at all seasons of 2 metres (6J feet) on that portion of the river above Orsova, and a depth of 3 metres below that town. To effect this at Stenka, Kozla Dokje, Izlas, and Gachtalia, channels 66 yards wide had to be cut in the solid rock to a depth of 6 feet 6 inches below low water. The point of the Greben spur had to be entirely removed for a distance of 167 yards back from its original face (in the execution of which work in 1894 no less than 2,100,000 cubic feet of rock were thrown down by a single charge of 12 tons of dynamite). Below the Greben point a training wall 7 to 9 feet high, 10 feet at top, and nearly four mUes in length, has been built along the Servian shore in order to confine the river in a narrow channel. At Juez another similar, channel had to be cut and a training wall built. At the Iron Gates a channel 80 yards wide and nearly 2000 yards in length (1720 metres) had to be cut on the Servian side of the river, traversing the Prigrada Bank to a depth of 9 feet 9 inches below high-water level. Training walls have been built on either side of the channel to confine the water so as to raise its level ; that on the right bank having a width of 19 feet 6 inches at top, and serving as a tow-path ; that on the left being 13 feet in width. These training walls are built of stone with flat revetments to protect them against ice.

These formidable and expensive works have not altogether realized the expectations that had been formed of them. One most important result, however, has been attained, i. e., vessels can now navigate the Iron Gates at all seasons of the year when the river is not closed by ice, whereas

formerly at extreme low water, lasting generally for about three months in the late summer and autumn, through navigation was always at a standstill, and goods had to be landed and transported considerable distances by land. The canal was opened for traffic on the 1st October 1898, and during the last three months of that year 180,000 tons of merchandise was carried through the canal out of a total traffic during the year of 500,000 tons. On the other hand, the canal was designed of sufficient width, as was supposed, for the simultaneous passage of boats in opposite directions ; but on account of the great velocity of the current, this has been found to be dangerous and impracticable. Oeneral The slope of the stream at the upper entrance results. of the canal is from 1 in 200 to 1 in 300, according to the height of the water, producing a velocity varying from 16 to 19^ feet per second, and so lowering the surface of the water that when the river is at its lowest the depth of water in the canal

Taries from 7J to 8 feet only. Similar and other causes, such as the discovery of fresh banks at the island of Ada Kaleh, have pro- duced similar effects higher up the river. Between the Iron Gates and Orsova, at extreme low water, i.e., when the gauge at Orsova reads zero, there is only 3 feet 6 inches of available depth, i.e., at ■certain seasons 9 inches less than before the works of improvement were commenced. Again, between Orsova and Old Moldova, at •extreme low water there is a navigable depth of only 3 feet instead of the anticipated 6 feet 6 inches. It was calculated, however, that ■with three more years' work and a further expenditure of £240,000, the wished-for depth of 6 feet 6 inches would be obtained through- out the whole distance from Old Moldova to the Iron Gates.

In addition to the works already described, executed under in- ternational arrangements, the riverain Powers— Bavaria, Austria, and Hungary — have spent large sums of money in improving the navigation of the Upper Danube. At "Vienna the principal channel of the Danube was brought IJ miles nearer the town by the con- struction of a new channel 10 miles in length and 330 yards in breadth, with a depth at low water of from 10 to

11 feet. This work, projected in 1866, involved the removal of 12 million cubic metres of sand and gravel, and with its subsidiary works, bridges, quays, &c., cost about 3J millions of pounds sterling. It has proved an immense success, not only protecting Vienna from disastrous inun- dations, the principal object in view, but also in improving the rail- way communication and the navigability of the river.

Very extensive engineering operations have also been carried out at Budapest, where the Seroksar branch of the Danube, which in time of flood carried away one-third of its entire volume of water, has been completely closed, the water passing into the main Pro- montor channel.

The result of all the combined works for the rectification of the Danube is that from Sulina up to Braila the river is navigable for seagoing vessels of 2500 tons register. From Braila to Turn-Severin it is open for seagoing vessels up to 600 tons, and for flat barges of from 1500 to 2000 tons capacity. From Turn-Severin to Orsova navigation is confined to river steamers, tugs, and barges drawing 6 feet of water. Thence to Vienna the draught is limited to 5 feet, and from there to Ratisbon to a somewhat lower figure. Barges of 600 tons register can be towed from the Lower Danube to Katisbon, at which place petroleum tanks have been constructed for the stor- age of Rumanian petroleum, the first consignment of which in 1898, conveyed in tank- boats, took six weeks on the voyage up from Giurgevo. The principal navigation company on the Upper Danube is the Soci6t6 Imp^riale et Eoyale Autriohienne of Vienna, which started operations in 1830 with three small steamers, but now pos- sesses a fleet of 151 paddle steamers, 23 screw steamers, 5 powerful tugs, and 850 large barges, besides grain elevators, dredgers, steam launches, &c. &c. In 1896 they carried 579,000 passengers for long distances, 2,220,000 for short distances, 1,113,871 tons of miscella- neous cargo, 978,000 tons of cereals, and 148,609 tons of coal. Their gross receipts during the same year were 14J million florins. The company transports goods and passengers between Galatz and Batisbon.

A less important society is the Rumanian State Navigation Company, possessing a large flotilla of tugs and barges, which run to Budapest, where they have established a combined service with the South Danube

German Company for the transport of goods from Pesth to Ratisbon. A Hungarian Navigation Com- pany, subsidized by the State, has recently been formed, and the Hungarian railways, the Servian Government, and private owners own between them about 70 tugs and 420 barges of about 380,000 tons burden.

The merchandise carried in 1896 between Sulina and the Iron Gates and intermediate ports amounted to 3,529,575 tons, of which 2,700,000 tons was composed of cereals and the remainder miscel- laneous merchandise. Three-fourths of this amount were earned down stream, and one-fourth up.

The following tables show the total amount of tonnage (regis- tered) of ships leaving the Danube and clearing for foreign ports at quinquennial intervals from 1871 to 1896, and for each year from 1889 to 1900 :—

Quinquennial Returns.

Tear.

Total Tonnage.

British Tonnage.

Proportion of

Britisli to

whole.

1871 . 1876 . 1881 . 1886 . 1891 . 1896 .

549,720 748,363 793,454 950,567 1,512,030 1,794,934

178,858

452,414 498,994 623,479 990,935 1,097,689

Per cent.

32-54 60-45 62-88 65-59 65-53 62-00

Annual Meturns.

Total

Number

Tear.

Number of Vessels.

Total Tonnage.

of British Vessels.

Tonnage.

Per cent.

1889

1870

1,473,345

842

1,000,773

67-93

1890

1828

1,539,445

778

983,862

63-91

1891

1723

1,512,030

773

990,935

65-53

1892

1532

1,427,087

638

866,758

60-73

1893

1801

1,893,506

905

1,287,762

68 00

1894

1716

1,619,703

733

1,034,097

63 •84

1895

1619

1,554,698

604

906,043

58-27

1896

1713

1,794,934

699

1,097,737

61-15

1897

1324

1,397,917

540

855,477

61-19

1898

1419

1,476,119

446

694,773

47-06

1899

1056

**1, 070,367*

277

446,170

41-68

1900

1101

1,252,509

260

458,921

36-64

- *This diminution was due to failure of the harvest in Kumania and Bulgaria.*

(h. TR.)

Danvers, a town of Essex county, Massachusetts, U.S.A. It includes an area of 14 square miles of level country diversified by glacial hills, with a village bearing the same name, and a large rural population. It is traversed by a branch of the Boston and Maine rail- way. The village is irregular in plan, contains a State Insane Asylum and a public library, and has manu- factures of boots and shoes, leather, &c. Population

(1880), 6598; (1890), 7454; (1900), 8542.

Danville, capital of Vermilion county, Illinois, U.S.A., on the Vermilion river, at an altitude of 598 feet. Its site is a level prairie, and its street plan is regular. It is entered by three railways, the Chicago and Eastern Illinois, the Cleveland, Cincinnati, Chicago, and St Louis, and the Wabash. Situated in a coal-mining region, it handles and ships large quantities of that com- modity. It contains also car shops and iron works. Population (1880), 7733; (1890), 11,491 ; (1900), 16,354.

Danville, capital of Boyle county, Kentucky, U.S.A., on the Queen and Crescent railwaj", at an altitude of 955 feet. It is the seat of Centre College, opened in 1821, and of Caldwell College for women, both Presby- terian institutions, and of the State Deaf and Dumb Institute. Population (1880), 3074; (1890), 3766; (1900),

4285.

Danville, capital of Montour county, Pennsylvania, U.S.A., in 40° 68′ 3S". lat. and 76° 37′ W. long., on the north branch of the Susquehanna, at an altitude of 471 feet. The borough is irregular in plan, though situated on a level plain. It is on the Delaware, Lackawanna, and

Western, and the Philadelphia and Reading railways. It is of importance because of its iron manufactures. Population (1880), 8346 ; (1890), 7998 ; (1900), 8042.

Danville, a city of Virginia, U.S.A. Though within the limits of Pittsylvania county, it is not subject to county organization. It is on the Danville river, at the falls, near the southern boundary of the state, at an alti- tude of 413 feet, ai;d is traversed by the Southern and the Danville and Western railways. It is the seat of Roan- oke Eemale College. The city has long been prominent in the tobacco trade, and in the manufacture of smoking and chewing tobacco. It is also becoming important in the manufacture of cotton. Population, including the annexed town of North Danville (1880), 8726; (1890),

14,104; (1900), 16,520.

Danzig, a strong maritime fortress and seaport town of Prussia, capital of the province of West Prussia, head- quarters of the 17th German Army Corps, standing on the Vistula, 3 miles south of its entrance into the Baltic. The

old fortifications, which, with their twenty-two bast- ions, surrounded the inner town, were taken down on the west and north sides in 1895-96. The trenches have been filled in, and the area thus freed has been laid out on a spacious plan. One portion, acquired by the corpor- ation, has been turned into promenades and gardens, the New Steffens Park, 50 acres in extent, outside the Olivner Thor, occupying the north-western corner. The remainder of the area remains in the hands of the military authori- ties. A cordon of detached forts has lately been built for the defence of the harbour, which is now strongly protected against attack from the sea. The natural his- tory and archaeological collections of the West Prussian Museum are preserved in the Green Gate ; the provincial industrial museum and the municipal picture gallery in a former Franciscan monastery. The most recent public buildings are the extensive slaughter-

houses, the market- hall, the imperial post office, a new railway station, and a new Evangelical church. The educational and similar institutions embrace a military school, an art and a tech- nical school, a school of navigation, a commercial academy, and a couple of observatories; whilst a technical high school was built in 1900-01. Danzig owed its commercial importance to the fact that it was the shipping port for the corn grown in Poland, and the adjacent regions of Russia and Prussia; but for some few years past this trade has been slipping away from her. On the other hand, her trade in timber and sugar has grown propor- tionally. Nevertheless energetic efforts are being made to check any loss of importance — first, in 1898, by a determined attempt to make Danzig an industrial centre, manufacturing on a large scale; and secondly, by the construction, and opening in 1899, of a free harbour at the mouth of the Vistula. The industries which it has been principally aimed to establish are shipbuilding (naval and marine), steel foundries and rolling mills, sugar refineries, flour and oil mills, and distilleries. The free port at Neufahrwasser, at the mouth of the Vistula, has a total area of 39^ acres. Vessels drawing 16^ feet can, however, get up to the wharves of Danzig itself, the approach being kept open in winter by ice-breakers. The port is cleared by an average of 1433 vessels of 481,000 tons annually (1712 vessels of 651,821 tons in 1899), a decrease as compared with 1805 vessels of 796,065 tons cleared in 1884. The exports reach an average of £4,972,150 annually (£3,230,000 in 1884) ; whilst the imports, chiefly coal, average £4,219,700 annually (£2,960,000 in 1884). The mercantile fleet of Danzig numbered, in 1900, 49 seagoing vessels of some 26,956 tons. Population (1885), 114,805; (1895), 125,605;

(1900), 140,539.

Darbhanga, a town and district of British India, in the Patna division of Bengal. The town is on the left bank of the Little Baghmati river, and has a rail- way station. The population in 1881 was 65,955; in 1891 it was 73,561 ; and in 1901 it was 65,990. The town is really a collection of villages that have grown up round the residence of the Raja, who ranks as the first nobleman of Behar. This is now a magnificent pal- ace, with gardens, a managerie, and a good library. There are a first-class hospital,

with a Lady Dufferin hospital attached ; a handsome market-place ; an Anglo- vernacular school ; and four printing-presses.

The DISTRICT OF Dakbhanga lies in North Behar, ex- tending from the Nepal frontier to the Ganges. It was constituted in 1875 out of the unwieldy district of Tirhut. Its area is 3335 square miles. The population in 1881 was 2,630,496; in 1891 it was 2,801,955, giving an average density of 840 persons per square mile. Classified according to religion, Hindus numbered

2,462,308; Mahommedans, 338,667; Christians, 380, of whom 200 were Europeans; "others," 600. In 1901 the population was 2,914,577 ; showing an increase of 4 per cent. The land revenue and rates were Rs.10,51,273 ; the number of police was 471 ; the number of boys' at school in 1896-97 was 31,410, being 15-2 per cent, of the male population of school-going age; the registered death-rate in 1897 was 27-36 per thousand. There are 30 indigo factories, with a capital of Rs.61,36,000, em- ploying 26,000 hands, and producing an out-turn valued at Rs.15,00,000 ; 54 saltpetre refineries ; and a tobacco factory, producing cigars valued at Rs.37,000. The dis- trict is traversed by the main line and branches of the Tirhut State railway, originally begun as a famine relief work in 1874.

Dardanelles (Town) [_Sultanieh Kalehsi, or Chanak Kalehsi, of the Turks], the chief town and seat of govern- ment of the lesser Turkish province of Bigha, Asia Minor. It is situated at the mouth of the Rhodius, and at the narrowest part of the Strait of the Dardanelles, where its span is but a mile across between the continents of Europe and Asia. Its recent growth has been rapid, and it possesses a lyceum, a military hospital, a public garden, a theatre, quays, and water-works, besides many private houses and a suburb. Exclusive of the garrison, the population is esti- mated at 13,000, of whom one-half are Turkish, and the remainder Greek, Jewish, Armenian, and European. The town contains many mosques ; Greek, Armenian, and Catholic churches ; and a synagogue. There is a resident Greek bishop. Strategically the Dardanelles is a point of great importance, since it commands the approach to Con- stantinople from the Mediterranean. The civil governor, and the military

commandants of the numerous fortresses on each side of the Strait, are stationed here. Many im- portant works have been added to the defences. Armed with modern artillery and protected by torpedoes, the forcing of the passage would be a difficult operation. The Ottoman Fleet is stationed not far from the town, at Aby dos, now called Nagara. The average annual number of mer- chant vessels passing the Strait is 12,000, and the reg- ular commercial vessels calling at the port of Dardanelles are represented by numerous foreign agencies. Besides the Turkish telegraph service, the Eastern Telegraph Company has a station at Dardanelles, and there are Turkish, Austrian, French, and Russian post offices. The import trade consists of manufactures, sugar, flour, coffee, rice, leather, and iron. The export trade consists of valonia (largely produced in the province), wheat, barley, beans, chick-peas, canary seed, liquorice root, pine and oak timber, wine, and pottery. Excepting in the items of wine and pottery, the export trade shows steady increase. Immigration brings a larger area of land under cultiva- tion year by year, and every year adds to the number of mature {i.e., fruit-bearing) valonia trees. Vine-growers are discouraged by heavy fiscal charges, and by the low price of wine. Many are uprooting their vineyards. The pottery trade is affected by change of fashion, and the old potteries of Ohanak Kalehsi are losing their importance. The lower quarters of the town were heavily damaged in the winter of 1900-01 by repeated inundations caused by the overflow of the Rhodius. (e. w.)*

Dar el Baida (in English, White House; in Spanish, Casa Blanco), a growing grain port of Central Morocco, with numerous foreign merchants, Franciscan and Protes- tant missions, and a consular corps. Exports: 1896, £197,131 ; 1897, £212,824 ; 1898, £281,247. Imports : 1896, £175,788 ; 1897, £176,713 ; 1898, £211,461. Ship- ping: 1897, 155,315 tons; 1898, 150,048 tons. Population, probably about 20,000.

Darial, a widely renowned gorge in the Caucasus, through which the Terek pierces, for a distance of 8 miles, between vertical walls, the Side Eange of the Caucasus. It is fortified at its northern entrance. It was

known to Pliny and to Procopius, and mentioned in the Georgian annals under the names of Ral-ani, Dargani, Darialani, – &c., of which the root is the Persian dar or der, meaning " door." The Persians and the Arabs knew it as the Gate of the Alans. Being the only available passage across the Caucasus, it was fortified since a remote antiquity, at least in 150 B.C. In Russian poetry it has been immortal- ized by LermontofE. The present Russian fort, Darial, is at the northern issue of the gorge, at an altitude of 4122 ft.

Darjiling, a hill station arid district of British India, in the Rajshahi division of Bengal. The sanitary station is situated 367 miles by rail north of Calcutta. In 1881 it had a population of 7018, and in 1891 of 14,146. It is now the summer quarters of the Bengal Government. There are several schools of considerable size for European boys and girls, and the Government boarding-school at Kurseong can accommodate 200 boys. Three breweries have an out-turn of 80,000 gallons. The buildings and the roads suffered severely from the earthquake of June 12, 1897. But a more terrible disaster occurred in October 1899, when a series of landslips carried away houses and broke up the hill railway. The total value of the property destroyed was returned at Rs.26,00,000.

The DISTRICT comprises an area of 1164 square miles. The population in 1881 was 165,645, and in 1891 was 223,314, giving an average density of 192 persons per square mile. Classified according to religion, Hindus numbered 171,171 ; Mahommedans, 10,011 ; Buddhists, 40,600 ; Christians, 1602, of whom 1049 were Europeans ; "others," 30. In 1901 the population was 249,232, showing an increase of 12 per cent., compared with an increase of 43 per cent, in the previous decade. The land, revenue and rates were Rs. 1,66,806; the number of police was 396 ; the number of boys at school in 1896-97 was 2938, being 15-9 per cent, of the male population of school-going age ; the registered death-rate in 1897 was 42-16 per thousand. The cultivation of tea was intro- duced in 1866. In 1897 there were 186 gardens, with 55,822 acres under tea, employing 32,897 persons perman- ently and 14,108 persons temporarily, and producing nearly 12 million fb. Cinchona cultivation was introduced by the Government in 1862, and has since been taken up by private enterprise. In 1896-97 the number of plants in the Government

plantations was nearly 2^ millions ; and the amount of dry bark produced was 318,716 lb. In- cluding bark bought from private plantations, the out- turn of the Government factory was 10,149 lb of sulphate of quinine, and 4075 lb of cinchona febrifuge ; the gross receipts were Rs.1,76,798, and the net profits Rs.9767. The three forest divisions of Darjiling yielded in that year a gross revenue of Rs. 1,36,068. There is a coal-mine at Daling, employing 260 persons, with an output of 2000 tons. The Darjiling Himalayan Railway, of 2 feet gauge, opened in 1880, runs for 50 miles from Siliguri in the plains on the Eastern Bengal line.

See G. S. Bomwetsch. A Handbook to Darjiling and its Bail- way. Calcutta, 1899.

Darlington, amunicipal and parliamentary borough (one member) and market-town of Durham, England, on the Skerne, 1 mile from its confluence with the Tees, 18 miles south of Durham city by rail. There are now, in all, seven Established churches, two Roman Catholic churches and a school chapel, and twelve Nonconformist churches or chapels. The training-school for school-

mistresses has been enlarged and a school for children added. Recent erections are a cattle market, a corn exchange, hospital, library, and new theatre. A technical school has been formed, the public park enlarged to an area of 44 acres, and the baths twice extended. The worsted spinning mills of Pease & Company have up- wards of 18,000 spindles, and employ between 600 and 600 hands. The Pease Partners Company (Limited) employ at their collieries, ironstone mines, quarries, brick- works, &c., over 6000 workmen, and raise about 3,000,000 tons of minerals per annum. Darlington possesses im- portant works for the manufacture of iron and steel bars, and the specialties required for engineering, bridge-building, ship-building, locomotive engine work, railway waggon building, collieries, &c. At the Rise Carr Roll- ing Mills (belonging to Sir Theodore Fry & Company, Limited) about 700 men are employed, and in 1899 the output of finished iron and steel work amounted to 25,840 tons. The Darlington Forge Company (Limited), with premises of 100 acres in area, of which about 40 acres were in 1901 occupied by their rapidly extending works, employ from 1000 to 1200 men, and, besides turning out

steel castings and steel and iron forgings for engineering purposes, manufacture gun work, shells, &c., for British and foreign shipyards and arsenals ; the annual output, of all descriptions, being from 10,000 to 12,000 tons, rep- resenting a value of about £250,000.

Extended municipal area, 3945 acres. Population on this in 1881, 36,104; in 1891, 38,060; in 1901, 44,496. Parliamentary area since 1886, 3602 acres. Population on this in 1881, 34,831 ; in 1891, 38,033 ; in 1901, 44,496. Rateable value of municipal borough in 1900, £183,726.

Darmesteter, James (1849-1894), author and antiquarian, was born of Jewish parents on 28th March 1849. He was educated at Paris, where, under the guid- ance of M. Michel Breal, he imbibed a love for Oriental studies, to which for a time he entirely devoted himself. In 1876 he published a thesis on the mythology of the Zendavesta, and in 1877 became university professor of Zend. He followed up his researches with his Etudes Iraniennes (1883), and ten years later published a com- plete translation of the Avesta, with commentary, in the Musee Chdmet. An interesting episode in his life was his journey to India in 1886, undertaken for the purpose of collecting the popular songs of the Afghans, a trans- lation of which, with a valuable essay on the Afghan language and literature, he published on his return. His impressions of English dominion in India were conveyed in Lettres sur VInde (1888). England interested him deeply; his attachment for a gifted English poetess, whom he eventually married, led him to translate the poems of Mary Robinson ; and two years after his death a collection of excellent essays on English subjects was published in English. He also wrote Le Mahdi, Origine de la Poesie Persane, PropMtes d' Israel, and other books on topics connected with the East, and from 1883 onwards drew up the annual reports of the Societe Asiatique. He had just become connected with the Revue de Paris, a new undertaking of great importance, when his delicate con- stitution succumbed to a slight attack of illness on 19th October 1894. (r. g.)

Darmstadt, a town of Germany, capital of grand- duchy of Hesse-Darmstadt, 21 miles by rail south-east from Mainz and 17 miles south from Frankfort-on-Main. Here are a technical high school, possessing

(since 1900) power to confer the degrees of doctor of engineering (doctor of the technical sciences in Prussia), a school of agriculture, an artisans' school, and a botanical garden. The chemist von Liebig was born in Darmstadt in 1803. Principal industries : the production of machinery, carpets, playing

cards, chemicals, tobacco, hats, wine, and beer. In 1888 Bessungen was incorporated with Darmstadt. Population (1885), 50,609; (1895), 63,745; (1900), 72,019 (pro- visional census results).

Darrang, a disti-ict of British India, in the Brah- maputra Valley division of Assam. It lies betweep the Bhutan and Dafla Hills and the Brahmaputra, including many islands in the river. The administrative head- quarters are at Tezpur. Its area is 3418 square miles. The population in 1881 was 273,333; in 1891 it was 307,761, giving an average density of 90 persons per square mile. Classified according to religion, Hindus numbered 196,037; Mahommedans, 18,454; hill tribes, 91,870 ; Christians, 849, of whom 183 were Europeans ; "others," 551. In 1901 the population was 337,724, showing an increase of 10 per cent. The land revenue was Es.7,15,656, the incidence of assessment being Es.2-10-2 per acre ; the number of police was 195 ; the number of boys at school in 1896-97 was 4114, being 17 per cent, of the male population of school-going age ; the registered death-rate in 1897 was 45-68 per thousand. In 1897 the number of tea gardens was 89, with 33,984 acres under tea, employing 71,535 persons, of whom 23,424 were children, and producing an out-turn of over 11 million ft, or at the rate of 407 ft per acre. There is a timber mill, producing 25,000 tearchests, valued at Es.20,000. Almost the only means of communication is by river. A steam tramway of 2^ feet gauge has been opened from Tezpur to Balipara, a distance of 20 miles. A similar tramway is proposed at Mangaldai, with a length of 35 miles.

Dartford, a market-town in the Dartford parlia- mentary division of Kent, England, on the Darenth, 16 miles east-south-east of London by rail. Recent erections are a Martyrs' Memorial Hall and a cottage hospital. On

Dartford Heath is the lunatic asylum of the London County Council, and, at Long Reach, the infectious dis- eases hospital of the Metropolitan Asylums Board. Iron, chemical, and cement works have been introduced. Area of parish (an urban district), 4251 acres. Population (1881), 10,163; (1891), 11,962; (1901), 18,615; of parliamentary division (1891), 79,853.

Dartmouth, a municipal borough, seaport, and market-town in the Torquay parliamentary division of Devonshire, England, on the west side of the estuary of the Dart, 28 miles east of Plymouth. The town is con- nected with the Great "Western Railway by a steam ferry to Kingswear on the opposite side of the Dart. There is an embankment 600 yards long, constructed by the Dartmouth Harbour Commissioners. A cottage hospital has been erected. Yacht and boat building are carried on ; there is a large paint factory. The port is used as a coaling station for yachts and ocean steamers. Area, 1924 acres. Population (1881), 5725; (1901), 6037.

Dartmouth, a town in Halifax County, Nova Scotia, on the eastern side of Halifax harbour, connected with Halifax by a steam ferry. It contains four churches, large sugar refinery, foundries, machine shops, three saw mills, several factories, and a bank. Population, about 6500.

Darwen, a municipal borough in the Darwen par- liamentary division of Lancashire, England, 4 miles south of Blackburn by rail. It is a centre of the cotton trade, and has also blast furnaces, and paper-making, paper-staining, and fire-clay works. New sewerage filtration works have been completed at a cost of £30,000. Recent erections are new buildings for the free library and a technical school. Area, 5962 acres. Population (1881), 29,744; (1891), 34,192 ; (1901), 38,311; of parliamentary

division (1881), 61,092; (1891), 70,475; (1901), 78,793. The parish of Ovbr-Darwen, which, together with various hamlets, and portions of Eccleshill and Lower Darwen, makes up the municipal borough, has an area of 5134 acres. Population (1881), 27,626 ; (1891), 31,680.

Darwin, Charles Robert (1809-1882),the famous. English naturalist, author of the Origin of Species, was born at Shrewsbury on 12th February 1809. He was the younger of the two sons and the fourth child

of Dr Robert Waring Darwin (1766-1848), a successful medical practitioner at Shrewsbury. His mother, a daughter of Josiah Wedgwood, died when Charles Darwin was eight years old. His grandfather was the great genius Dr Erasmus Darwin (1731-1802), who made suggestions upon the origin of species in many respects similar to those which were later more completely elaborated by Lamarct Charles Darwin's elder brother, Erasmus Alvey (1804— 1881), was interested in literature and art rather than science : on the subject of the wide difference between the brothers Charles wrote that he was "inclined to> agree with Francis Galton in believing that education, and environment produce only a small effect on the mind of anyone, and that most of our qualities are innate"" {Life and Letters, London, 1887, p. 22). Darwin con- sidered that his own success was chiefly due to "the love of science, unbounded patience in long reflecting over any subject, industry in observing and collecting facts,, and a fair share of invention as well as of common sense " (Z.c, p. 107). He also says : " I have steadily endeavoured to keep my mind free so as to give up any hypothesis, however much beloved (and I cannot- resist forming one on every subject), as soon as facts are shown to be opposed to it " (I.e., p. 103). The essen- tial causes of his success are to be found in this latter sentence, the creative genius ever inspired by existing- knowledge to build hypotheses by whose aid further know- ledge could be won, the calm unbiassed mind, the trans- parent honesty and love of truth which enabled him to abaiidon or to modify his own creations when they ceased to be supported by observation. The even balance between these powers was as important as their remarkable de- velopment. The great naturalist appeared in the ripeness- of time, when the world was ready for his splendid generalizations. Indeed naturalists were already every- where considering and discussing the problem of evolu- tion, although Alfred Russel Wallace was the only one who, independently of Darwin, saw his way clearly to the- solution. It is true that hypotheses essentially the same- as natural selection were suggested much earlier by W. C. Wells {Phil. Trans., 1813) and Patrick Matthew {Naval'. Timber and Arboriculture, 1831), but their views were lost sight of and produced no effect upon the great body of naturalists. In the preparation for Darwin Sir Charles. Lyell's Principles of Geology played an important part, accustoming men's minds to the vast changes brought about by natural processes, and leading them, by its lucid and temperate discussion of Lamarck's and

other views,, to reflect upon evolution. Darwin's early education was- conducted at Shrewsbury, first for a year at a day-school,, then for seven years at Dr Butler's. He gained but little- from the narrow system which was then universal. In. 1825 he went to Edinburgh to prepare for the medical profession, for which he was unfitted by nature. After- two sessions his father realized this, and in 1828 sent him to Cambridge with the idea that he should become a- clergy man. He matriculated at Christ's College, and took . his degree in 1831, tenth in the list of those who do not seek honours, Up to this time he had been keenly interested in sport, and in entomology, especially the- collecting of beetles. Both at Edinburgh, where in 1826-

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he^ read his first scientific paper, and at Cambridge he gained the friendship of much older scientific men — Grant and Macgillivray at the former, Henslow and Sedgwick at the latter. He had two terms' residence to keep after passing his last examination, and studied geology with Sedgwick. Returning from their geological excursion together in North Wales (August 1831), he found a letter from Henslow urging him to apply for the position of naturalist on the Beagle, about to start on a surveying expedition. His father at first dis- liked the idea, but his uncle, Josiah Wedgwood, pleaded with success, and Darwin started on December 27, 1831, the voyage lasting until October 2, 1836. It is practically certain that he never left Great Britain after this latter date. After visiting the Cape de Verde and other Atlantic Oceanic islands, they surveyed on the South American coasts and adjacent islands (including the Galapagos), afterwards visiting Tahiti, New Zealand, Australia, Tasmania, Keeling Island, Maldives, Mauritius, St Helena, Ascension ; and Brazil, de Verdes, and Azores on the way home. His work on the geology of the countries visited, and that on coral islands, became the subject of volumes which he pub- lished after his return, as well as his Journal of a Naturalist, and his other con- tributions to the official nar- rative. The voyage must be regarded as the real prepar- ation for his life-work. His observations on the relation between animals in islands and those of the

nearest con- tinental areas, near akin and yet not the same, and between living animals and those most recently extinct and found fossil in the same country, here again related but not the same, led him even then to reflect deeply upon the modi- fication of species. He had also been much impressed by ” the manner in which closely allied animals replace one another in proceeding south- wards ” in South America. On his return home Darwin worked at his collections, first

: care of his wife. For eight years (184(i to was chiefly engaged upon four monographs

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OHAELES EOBEET DAEWIN. {From a photograph by Elliott & Fry^ London.)

at Cambridge for three months and then in London. His pocket-book for 1837 contains the words : ” In July opened first notebook on Transmutation of Species. Had been greatly struck from about the month of previous March [while still on the voyage and just over twenty-eight years old] on character of South American fossils, and species on Galapagos Archipelago. These facts (especially latter) origin of all my views.” From 1838 to 1841 he was secretary of the Geological Society, and saw a great deal of Sir Charles Lyell, to whom he dedicated the second edition of his Journal. On January 29, 1839, he married his cousin, Emma Wedgwood, the daughter of Josiah Wedgwood of Maer.

Theylived in London until September 1842, when they moved to Down, which was Darwin's home for the rest of his life. His health broke down many times in London, and remained precarious during the whole of his life. The immense amount of work which he got through was only made possible by

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on the recent and fossil Cirripede Crustacea (Ray Soc, 1851 and 1854 ; Palaontograph. Soc, 1851 and 1854). Towards the close of this work Darwin became very wearied of it, especially of the synonymy. For a time he hox^ed to start a movement which should discourage the habit of appending the name of the describer to the name of the species, a custom which he thought led to bad and superficial work. From this time he was engaged upon the numerous lines of inquiry which led to the great work of his life, the Origin of Species, published in November 1869.

Soon after opening his notebook in July 1837, he began to collect facts bearing upon the formation of the breeds of domestic animals and plants, and quickly saw " that selection was the keystone of man's success. But how selection could be applied to organisms living in a state

of nature remained for some time a mystery to me." Vari- ous ideas as to the causes of evolution occurred to him, only to be successively aban- doned. He had the idea of " laws of change " which affected species and finally led to their extinction, to some extent analogous to the causes which bring about the de- velopment, maturity, and finally death of an individual. He also had the conception that species must give rise to other species or else die out, just as an individual dies unrepresented if it bears no offspring. These and other ideas, of which traces exist in his Diary, arose in his mind, together with perhaps some general concej)tion of natural selection, during the fifteen months after the opening of his notebook. In October 1838 he read Maltlms on Population, and his observa- tions having long since con- vinced him of the struggle for existence, it at once struck him " that under these cir- cumstances favourable varia- tions would tend to be preserved, and unfavourable ones to be destroyed. The result of this would be the formation of new species. Here, then, I had a theory by which to work." In June 1842 he

wrote out a sketch, which two years later he expanded to an essay occupying 231 pages folio. The idea of progressive divergence as an advantage in itself, because the competition is most severe between organisms most closely related, did not occur to him until long after he had come to Down. During the growth of the Origin Sir Joseph Hooker was his most intimate friend, and on January 11, 1844, he wrote : " at last gleams of light have come, and I am almost convinced (quite contrary to the opinion I started with) that species are not (it is like confessing a murder) immutable " (^.c, ii. 23). In 1855 he began a correspondence wm the great American botanist Asa Gray, and in 1857 explained his views in a letter which afterwards became classical. In 1856

urged by Lyell, he began the preparation of a third and far more expanded treatise, and had completed

about half of it ~~*when, on June 18, 1858, he received a manuscript essay from A. E. Wallace, who was then at Ternate in the Moluccas. Wallace wanted Darwin's opinion on the essay, which he asked should be forwarded ■to Lyell. Darwin was much startled to find in the essay a complete abstract of his own theory of natural selec*~~ *tion. He forwarded it the same day, writing to Lyell, ■" your words have come true with a vengeance — that I should be forestalled." He placed himself in the hands of Lyell and Hooker, who decided to send Wallace's •essay to the Linnean Society, together with an abstract •of Darwin's work, which they asked him to prepare, the joint essay being accompanied by a preface in the form of an explanatory letter written by them to the secretary. The title of the joint communication was " On the Ten- ■dency of Species to Form Varieties ; and on the Per- petuation of Varieties and Species by Natural Means of Selection." It was read on July 1, 1858, and appears in the Linn. Soc. Journal (Zoology) for that year. In this statement of the Theory of Natural Selection, Darwin's part consisted of two sections, the first being extracts from his 1844 essay, including a brief account of sexual selection ; the second consisting of an abstract of his letter to Asa Gray dated September 5, 1857. This latter, probably his first attempt to expound*

natural selection, cannot be surpassed as a clear statement of the theory. Darwin explained at the outset, what he insisted on elsewhere, that the facts of adaptation or contrivance in nature are the real difficulty to be explained by a theory of evolution, the stumbling-block of every pre- vious suggestion. Until he could explain "the mistletoe, with its pollen carried by insects, and seed by birds — the woodpecker, with its feet and tail, beak and tongue, to climb the tree and secure insects " — ^he was " scien- tifically orthodox." Nevertheless he was led to believe in evolution, apart from any possible motive-cause, by " general facts in the affinities, embryology, rudimentary organs, geological history, and geographical distribution of organic beings." He then proceeds to describe the manner in which he met the difficulty of adaptation by " his notions on the means by which Nature makes her species." The essentials of the statement are as fol- lows : — I. Man has made his domestic breeds of animals and plants by selection, conscious or unconscious, of very slight or greater variations. II. The material for selection exists in nature, namely, slight variations of all parts of the organism. III. The " unerring power " which sifts these variations is Natural Selection . . . which selects exclusively for the good of each organic being." The rate of increase is such that only a few in each generation can live : hence the never sufficiently appreciated struggle for life. " What a trifling difference must ofteu determine which shall survive and which perish ! " The remaining heads explain the complex nature of the struggle, the reasons for deficient direct evidence, the advantage of divergence, &c. In the Joint Essay the phrases "Natural Selection " and " Sexual Selection " were first made public by Darwin, the " struggle for existence " by Wallace. Darwin and Wallace had only met once before the depart- ure of the latter for the East. Their rivalry in the dis- covery of the great principle of Natural Selection was the beginning of a lifelong friendship. Wallace was lying ill with intermittent fever at Ternate in February 1858, when he began to think of Malthus's Essay, read several years before : suddenly the idea of the survival of the fittest flashed upon him. In two hours he had "thought out almost the whole of the theory," and in three evenings had finished his essay. Darwin, also inspired after reading Malthus, in October 1838, did not publish until nearly twenty years had elapsed, and then only when Wallace sent him his essay. Canon Tristram was the first to apply

the new theory, explaining by its aid the colours of desert birds, &c. {Ibis, October 1859).

Acting under the advice of Lyell and Hooker, Darwin then began to prepare what was to become the great work of his life. It appeared November 24, 1859, with the full title. On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life. The whole edition of 1250 copies was exhausted on the day of issue. The first four chapters explain the operation of artificial selection by man and of natural selection in consequence of the struggle for exist- ence. The fifth chapter deals with the laws of variation and causes of modification other than natural selection. The five succeeding chapters consider difficulties in the way of a belief in evolution generally as well as in natural selection. The three remaining chapters (omitting the recapitulation which occupies the last) deal with the evi- dence for evolution. The theory which suggested a cause of evolution is thus given the foremost place, and the evidence for the existence of evolution considered last of all. This method of presentation was no doubt adopted because it was just the want of a reasonable motive-cause which more than anything else prevented the acceptance of evolution. But the other side of the book must'not be eclipsed by the brilliant theory of Darwin and Wallace. The evidence for evolution itself had never before been thought out and marshalled in a manner which bears any comparison with that of Darwin in the Origin, and the work would have been in the highest degree epoch-making had it consisted of the later chapters alone. In the fifth chapter Darwin incorporated a certain proportion of the doctrines of Buffon, — modifications due to the direct in- fluence of environment ;• and of Lamarck, — ^the hereditary effects of use and disuse. Lyell for a long time hesitated to accept the new teaching, and Darwin carried on a long correspondence with him. His public confession of faith was made at the Anniversary Dinner of the Koyal Society in 1864. A storm of controversy arose over the book, reaching its height at the meeting of the British Associa- tion at Oxford in 1860, when the celebrated duel between Huxley and the Bishop of Oxford took place. Through- out these struggles Huxley was the foremost champion for evolution and for fair play to natural selection, al- though he never entirely accepted the latter theory, holding that until man by his selection had made his domestic

breed sterile inter se, there was no sufficient evidence that selection accounts for natural species which are thus separated by the barrier of sterility. The theory of natural selection was at first greatly misunderstood. Thus some writers thought it implied conscious choice in the animals themselves, others that it was the personi- fication of some active power. By many it was thought to be practically the same idea as Lamarck's. Herbert Spencer's alternative phrase, " the survival of the fittest," probably helped to spread a clear appreciation of Darwin's meaning.

The history of opinion since 1859 may be summed up as follows. Evolution soon gained general acceptance, except among a certain number of those of middle or more advanced age at the time when the Origin appeared. Although natural selection had been an essential force in producing this conviction, there gradually grew up a tendency to minimize its importance in relation to the causes originally suggested by Buffon and Lamarck, which were ably presented and further elaborated by Herbert Spencer. In America a school of Neo-Lamarckians ap- peared, and for a time flourished under the inspiration of the vigorous personality of E. D. Cope. The writings of August Weismann next raised a controversy over the scope of heredity, assailingthe very foundation of the hypotheses of Buffon, Lamarck, and Herbert Spencer, by demanding

evidence that the " acquired characters " upon which they rest are capable of hereditary transmission. The quanti- tative determination of heredity has been the subject of much patient investigation under the leadersitiip of Francis Galton. The question of isolation as a factor in species-formation has been greatly discussed, G. J. Romanes proposing, in his hypothesis of " Physiological Selection," that the barrier of sterility may arise sponta- neously by variation between two sets of individuals as the beginning instead of the climax of specific distinc- tion. Others have fixed their attention upon the varia- tions, which provided the material for natural selection, and have advocated the view that evolution proceeds by immense strides instead of the minute steps in which Darwin and Wallace

believed; Others, again, have found significance in the artificial production of ” mon- strosities” or huge modifications during individual development. All through the period a varying pro- portion of naturalists, probably larger now than at any other time, has followed the founders of the theory, and has sought the motive-cause of evolution in ” the accumu- lative power of natural selection,” which Darwin, as his first public statement indicates, looked upon ” as by far the most important element in the production of new forms.” They hold, with Darwin and Wallace, that although variar , tion provides the essential material, natural selection, from its accumulative power, is of such paramount importance that it may be said to create new species as truly as a man may be said to make a building out of the material pro- vided by stones of various shapes, a metaphor suggested and elaborated by Darwin, and forming the concluding sen- tences of J%e Variation of Animals and Plants under Do- mestication. This, probably the second in importance of all his works, was published in 1868, and may be looked upon as a complete account of the material of which he had given a very condensed abstract in the first chapter of the Origin, together with the conclusions suggested by it. He finally brought together an immense number of appar- ently disconnected sets of observations under his ” provi- sional hypothesis of pangenesis,” which assumes that every cell in the body, at every stage of growth and in maturity, is represented in each germ-cell by a gemmule. The germ-cell is only the meeting-place of gemmules, and the true reproductive power lies in the whole of the body- cells which despatch their representatives, hence “pah- genesis.” There are reasons for believing that this infi- nitely complex conception, in which, as his letters show, he had great confidence, was forced upon Darwin in order to explain the hereditary transmission of acquired charac- ters involved in the small proportion of Lamarckian doc- trine which he incorporated. If such transmission does not occur, a far simpler hypothesis based on the lines of Weismann’s ” continuity of the germ-plasm ” is suf&cient to account for the facts.

The Descent of Man, and Selection in Relation to Sex, was published in 1871 ; as the title implies, it really con- sists of two distinct works. The first, and by far the shorter, was the full justification of his statement in the Origin that ” light would be thrown on the origin of man and his history.” In the second part he brought together a large mass of evidence

in support of his hypothesis of sexual selection which he had briefly described in the 1858 essay. This hypothesis explains the development of colours and structures peculiar to one sex and dis- played by it in courtship, by the preferences of the other sex. The majority of naturalists probably agree with Darwin in believing that the explanation is real, but relar tively unimportant. It is interesting to note that only in this subject and those treated of in the Variation under Domesticaticm had Darwin exhausted the whole of the material which he had collected. The Expression of the

Emotions, published in 1872, offered a natural explanar tion of phenomena which appeared to be a difl&culty in the way of the acceptance of evolution. In 1876 Darwin brought out his two previously published geological works on Volcanic Islands and South America as a single volume. The widely read Formation of Vegetable Mould through the Action of Worms appeared in 1881. He also published the following volumes on Botanical subjects. The Fertiliza- tion of Orchids appeared in 1862. The subject of cross- fertilization of flowers was in Darwin's mind, as shown by his notebook in 1837. In 1841 Robert Brown directed his attention to Sprengel's work (Berlin, 1793), which con- firmed his determiaation to pursue this line of research. TJie Effects of Cross- and S elf-Fertilization in the Vegetable Kingdom (1876) contained the direct evidence that the offspring of cross-fertilized individuals are more vigorous, as well as more numerous, than those produced by a self- fertilized parent. Different Forms of Flowers on Plants of the Same Species appeared in 1877. It is here shown that the different forms, although each possesses both kinds of sexual organs, is specially adapted to be fertilized by the pollen of ajiother form, and that when artificially fertil- ized by its own pollen less vigorous offspring, bearing some resemblance to hybrids, are produced. He says, " no little discovery of mine ever gave me so much pleasure as the making out the meaning of heterostyled flowers " (Autobiography). Climbing Plants was published in 1875, although it had, in large part, been communicated to the Linnean Society,' in whose publications much of the material of several of his other works ' appeared. This inquiry into the nature of the movements of twining plants was suggested to him in a paper by Asa Gray. ~~Tlie Power of Movement in Plants (1880) was produced by him in conjunction with~~

~~his son Francis. It was an in~~ quiry into the minute power of movement possessed, he believed, by plants generally, out of which the larger movements of climbing plants of many different groups had been evolved. The work included an investigation of other kinds of plant movement due to light, gravity, &c., all of which he regarded as modifications of the one fundamental movement (circummutation), which exists in a highly specialized form in climbing plants. Insectivorous Plants (1875) is principally concerned with the descrip- tion of experiments on the Sun-dew (Drosera), although other insect-catching plants, such as Dioncea, are also investigated.

■ Charles Darwin's long life of patient, continuous work, the most fruitful, the most inspiring, in the annals of modern science, came to an end on April 19, 1882. He was buried in Westminster Abbey on April 26. It is of much interest to attempt to set forth some of the main characteristics of the man who did so much for modern science, and in so large a measure moulded the form of modern thought. Although his ill-health prevented Dar- win, except on rare occasions, from attending scientific and social meetings, and thus from meeting and knowing the great body of scientific and intellectual workers of his time, probably no man has ever inspired a wider and deeper personal interest and affection. This was in part due to the intimate personal friends who represented him in the circles he was unable jfrequently to enter, but chiefly to the kindly, generous, and courteous nature which was revealed in his large correspondence and published writings, and especially in his treatment of opponents.

In a deeply interesting chapter of the Life and Letters Francis Darwin has given us his reminiscences of his father's everyday life. Rising early, he took a short walk before breakfasting alone at 7.45, and then at once set to work, " considering the 1^ hours between 8.0 and 9.30 one of his best working times.' ' He then read his letters and listened to reading aloud, returning to work at about

10.30. At 12 or 12.15 “he considered his day’s work over,” and went for a walk, whether wet or fine. For a time he rode, but after accidents had occurred twice, was advised to give it up. After lunch he read the newspaper and wrote his letters or the MS. of his books. At about 3.0 he rested and smoked for an hour while being read to, often going to sleep. He then went for a short walk, and returning about 4.30, worked for an hour. After this he rested and smoked, and listened to reading until tea at 7.30, a meal which he came to prefer to late dinner. He then played two games of backgammon, read to himself, and listened to music and to reading aloud. He went to bed, generally very much tired, at 10.30, and was often much troubled by wakefulness and the activity of his thoughts.

It is thus apparent that the number of hours devoted to work in each day was comparatively few. The im- mense amount he achieved was due to concentration during these hours, also to the unfailing and, because of his health, the necessary regularity of his life.

The appearance of Charles Darwin has been made well known in numerous portraits and statues. He was tall and thin, being about 6 feet high, but looked less because of a stoop, which increased towards the end of his life. As a young man he had been active, with considerable powers of endurance, and possessed in a marked degree those qualities of eye and hand which make the success- ful sportsman. ‘

Charles Darwin was, as a young man, a believer in Christianity, and was sent to Cambridge with the idea that he would take Holy Orders. It is probable, however, that he had merely yielded to the influences of his home, without thinking much on the subject of religion. He first began to reflect deeply on the subject during the two years and a quarter which intervened between his return from the Beagle (October 2, 1836) and his marriage (Jan- uary 29, 1839). His own words are, ” disbelief crept over me at a very slow rate, but was at last complete. The rate was so slow that I felt no distress.”

His Mtitude was that of the tolerant unaggressive agnostic, sympathizing with and helping in the social and charitable influences of the English

Church in his parish. He was evidently most unwilling that his opinions on religious matters should influence others, holding, as his son, !Francis Darwin, says, "that a man ought not to publish on a subject to which he has not given special and continuous thought "(I. c, i. p. 306).

In addition to the personal qualities and powers of Charles Darwin, there were other contributing causes without which the world could never have reaped the benefit of his genius. It is evident that Darwin's health could barely have endured the strain of working for a living, and that nothing would have been left over for his researches. A deep debt of gratitude is owing to his father, Dr Darwin, who placed him in a position in which all his energy could be devoted to scientific work and thought. But his iU-health was such that this important and essential condition would have been insuf&cient with- out another even more essential. Francis Darwin, in the Life and Letters (i. pp. 159-160), writes these eloquent and pathetic words : — " No one indeed, except my mother, knows the full amount of suffering he endured, or the full amount of his wonderful patience. For all the latter years of his life she never left him for a night ; and her days were sc^ planned that all his resting hours might be shared with her. She shielded him from every avoidable annoyance, and omitted nothing that might save him trouble, or prevent him becoming over-tired, or that might alleviate the many discomforts of his ill-health. I hesitate to speak thus freely of a thing so sacred as the lifelong devotion which prompted all this constant and tender care.

But it is, I repeat, a principal feature of his life, that for nearly forty years he never knew one day of the health of ordinary men, and that thus his life was one long struggle against the weariness and the strain of sickness. And this cannot be told without speaking of the one condition which enabled him to bear the strain and fight out the struggle to the end."

Charles Darwia was honoured by the chief societies of the civilized world. He was made a Knight of the Prussian Order, "Tour le M^rite " in 1867, a Corresponding Member of the Berlin Academy of Sciences in 1863, a Fellow in

1878, and later in the same year a Corresponding Member of the French Institute in the Botanical Section. He received the Bressa Prize of the Royal Academy of Turin, and the Baly Medal of the Eoyal College of Physicians in

1879, the Wollaston Medal of the Geological Society in 1859, a Eoyal Medal of the Royal Society in 1853, and the Copley Medal in 1864. His health prevented him from accepting the Honorary Degree which Oxford Uni- versity wished to confer on him, but his own University had stronger claims, and he became an Honorary LL.D. Cantab, in 1877.

7%e Life and Letters of Charles Darwin, including an autobio- graphical chapter. Edited by his son Pkancis Dakwin. 3 vols. London, 1887. — Charles Darwin: hislife told in an autobiographical chapter, and in a selected series of his published letters. Edited by his son Francis Daewin. London, 1892. — Charles Darwin and the Theory of Natural Selection. By E. B. Potjltoit. London, 1896. — Life and Letters of Thomas JBenry Huxley. By his son Leonakd Huxley. 2 vols. London, 1900. (e. b. p.)

Datia, a native state of India, in the Bundelkhand agency. It lies in the extreme north-west of Bimdelkhand, near Gwalior. Area, 837 square miles. Population, (1881), 182,598 ; (1891), 186,440, showing an increase of 2 per cent.; average density, 223 persons per square mile. Estimated gross revenue, Es.10,00,000 ; tribute to Sindhia paid through the British Government, Rs.15,000. The chief, whose title is Maharaja, is a Rajput of the Bundela clan, being descended from a younger son of a former chief of Orchha. The present Maharaja was appointed K.C.S.I. in 1898. The state suffered from famine in 1896-97, and again to a less extent in 1899-1900. It is traversed by the branch of the Indian Midland railway from Jhansi to Gwalior. The Town of Datia is situated in 25° 40′ N. lat. and 78° 30′ E. long. ; railway station, 16 miles from Jhansi. Population (1881), 28,346 ; (1891), 27,566. It is surrounded by a stone wall, enclos- ing handsome palaces, with gardens.

Daubigny, Charles- Frangois (1817-1878), French landscape painter, allied in several ways with th4 Barbizon School. He was born in Paris, 15th. February 1817, but spent much time as a child at Valmondois, a village on the Oise to the north-west of Paris. Daubigny was the son of an

artist, and most of his family were painters. He began to paint very early in life, and at the age of seventeen he took a studio of his own. Within twelve months he had saved enough to go Italy, where he studied and painted for nearly two years; he then returned to Paris, not to leave it again until, in 1860, he took a house at Auvers on the Oise. By 1837 Daubigny had become famous as a river and landscape painter, although he had been devoting himself as well to drawing in black-and-white, to etching, wood engraving, and lith- ography. In 1855 his picture, " Lock at Optevoz," now in the Louvre, was purchased by the State ; four years later Daubigny was created Knight of the Legion of Honour, and in 1874 he was promoted to be an Ofllcer. In 1866, at the invitation of Lord, then Mr, Leighton and others, he visited London, where, however, he was hurt by

ni!q° famous "Moonlight" being badly hung in the Uid Koyal Academy. But the personal encouragement of his admirers in England made up for the disappointment, and the sale of his picture to a Eoyal Academician greatly pleased him. In 1870-71 he again visited London, and subsequently Holland, where he painted a number of river scenes with windmills. In 1874, having returned to Paris, he fell ill, and from that time until he died (on 19th Feb- ruary 1878) his work won less distinction than before. ' Daubigny's finest pictures were painted between 1864 and 1874, and these for the most part consist of carefuUy com- pleted landscapes with trees, river, and a few ducks. It has curiously, been said, yet with some appearance of truth, that when Daubigny liked his pictures himself he added another duck or two, so that the number of ducks often indicates greater or less artistic quality in his pic- tures. One of his sayings was, " The best pictures do not sell," as he frequently found his finest achievements little understood. Yet although during the latter part of his life he was considered a highly successful painter, the money value of his pictures since his death has increased nearly tenfold. Daubigny is chiefly preferred in his riverside pictures, of which he painted a great number, but although there are two large landscapes by

Daubigny in the Louvre, neither is a river view. They are for that reason not so typical as many of his smaller Oise and Seine pictures. None of his paintings can be seen in pub- lic galleries in Great Britain, although they frequently appear in loan exhibitions both in London and in Scot- land.

The works of Daubigny are, like Corot's, to be found in many modern collections. His most ambitious canvases are : " Spring-time " (1857), in the Louvre ; " Borde de la Cure, Morvan " (1864) ; « Villerville sur Mer " (1864) ; "Moonlight" (1865); "Andresy sur Oise" (1868); and "Eeturn of the Flock— Moonlight " (1878).

His followers and pupils were his son Karl (who some- times painted so well that his works are occasionally mistaken for those of his father, though in few cases do they equal his father's mastery), Oudinot, Delpy, and Damoye.

Feed Henribt. C. Daubigny et son (Euvre. Paris, 1878. — D. Cboal Thomson. The Barbizon School of Painters. London, 1890. — J. W. MoLLETT. Daubigny. London, 1890. — J. Claketie. Peintres et Sculpteurs Oontemporains : Daubigny. Paris, 1882. — Albert Wolff. La Capitale de VArt : Ch. Franqois Daubigny. Paris, 1881. (d. c. t.)

Daudet, Alphonse (1840-1897), French novelist, was born at Nimes on the 13th May 1840. His family, on both sides, belonged to the bourgeoisie. The father, Vincent Daudet, was a silk manufacturer — a man dogged through life by misfortune and failure. The lad, amid much truancy, had but a depressing boyhood. In 1856 he left Lyons, where his schooldays had been mainly spent, and began life as an usher at Alais, in the south. The position proved to be intolerable. As Dickens declared that all through his prosperous career he was haunted in dreams by the miseries of his apprenticeship to the blacking business, so Daudet says that for months after leaving Alais he would wake with horror thinking he was still among his unruly pupils. On the 1st No- vember 1857 he abandoned teaching, and took refuge with his brother Ernest, only some three years his senior, who was trying, " and thereto soberly," to make a living as a journalist in Paris. Alphonse betook himself to his pen likewise, — wrote poems, shortly collected into a small volume Les Amoureuses (1858), which met with a fair reception, — obtained employment on the Figaro,

then under Villemessent's energetic editorship, wrote two or three plays, and began to be recognized, among those interested in literature, as possessing individuality

and promise. Morny, the emperor's all-powerful minis- ter, appointed him to be one of his secretaries, — a post which he held till Morny's death in 1866, — and showed him no small kindness. He had put his foot on the road to fortune. The first of his longer books, Le Petit Chose (1868), did not, however, produce any very popular sen- sation. It is, in its main feature, the story of his own earlier years told with much grace and pathos. But the next book, Froment jeune et Risler aini (1874), at once took the world by storm. It struck a note, not new certainly in English literature, but comparatively new in French. Here was a writer who possessed the gift of laughter and tears, a writer not only sensible to pathos and sorrow, but also to moral beauty. He could create too. His characters were real and also typical ; the ratis, the men who in life's battle had flashed in the pan, were touched with a master hand. The book was alive. It gave the illusion of a real world. Jaclc, the story of an illegitimate ehilc a martyr to his mother's selflshness, which followed in 1876, served only to deepen the same impression. Henceforward his career was that of a very successful man of letters, — publishing novel on novel, Le Nabob (1877), Les Bois en Exil (1879), Numa Roumestan (1880), Sapho, L'Immortel, — and writing for the stage at frequent intervals, — giving to the world his reminiscences in Trente ans de Paris and Souvenirs d'un homme de lettres. These, with the three Tartarins, — Tartarin the mighty hunter, Tartarin the mountaineer, Tartarin the colonist, — and the admir- able short stories, written for the most part before he had acquired fame and fortune, constitute his life work. Though Daudet defended himself from the charge of imitating Dickens, it is difficult altogether to believe that so many similarities of spirit and manner were quite unsought. What, however, was purely his own was his style. It is a style that may rightly be called "impressionist," full of light and colour, not descriptive after the old fashion, but by a masterly juxtaposition .of words that are like pigments flashing its intended effect. Nor does it convey, like the style of the Gon- courts, for example, a constant feeling of effort. It is full of felicity and charm, — un charmeur M. Zola has called him. An intimate friend of Edmond de Goncourt (who died in his house), of Flaubert, of M. Zola, Daudet belonged essentially to the naturalist school of fiction. His own experiences, his surroundings, the men with whom he had been

brought into contact, various persons who had played a part, more or less public, in Paris life — all passed into his art. But he vivified the material supplied by his memory. His world has the great gift of life. L'Immortel is a bitter attack on the French Acad- emy, to which august body Daudet never belonged. His married life — he married in 1867 — seems to have been singularly happy. There was perfect intellectual har- mony, and Madame Daudet possesses much of his literary gift. In his later years came insomnia, failure of health, and chloral. He died in Paris on the 17th December 1897. The story of Daudet's earlier years is told in his brother Ernest Daudet's Mbn fr&re et moi. There is a good deal of autobiographical detail in Daudet's Trente ans de Paris and Souvenirs d'un homme de lettres, and also scattered in his other books. The references to him in the Journal des Ooncourts are numerous.

(f. t. m.)

Dauphin6, one of the old provinces (the name is still in current use in the country) of pre-Eevolutionary France, in the south-east portion of France, between Provence and Savoy. After the death of the last king of Burgundy, Rudolf III., in 1032, Dauphine (as part of his realm) reverted to the far-distant emperor. Much confusion fol-

lowed, out of which the counts of Albon (between Valence and Vienne) gradually came to the front. The first dy- nasty ended in 1162 with Guigue V., whose daughter and heiress, Beatrice, carried the possessions of her house to her husband, Hugh III., duke of Burgundy. Their son, Andr^, continued the race, this second dynasty making many territorial acquisitions, among them (by marriage) the Embrunais and the Gapenqais in 1232. In 1282 the second dynasty ended in another heiress, Anna, who carried all to her husband, Humbert, lord of La Tour du Pin (between Lyons and Grenoble). The title of the chief of the house was Count (later Dauphin) of the Viennois, not of Dauphine.

The origin of the title “Dauphin” (borne also by the allied house ol Auvergne) is very obscure. Guigue IV. (1132-1142) seems to have adopted the rare name ” Delphinus ” as a second Christian name, and so did his son, Guigue V. (1142-1162). The latter’s daughter, Beatrice, the heiress, gave it to her son Andr6, to recall his descent from the ancient house of the counts of Albon. Two princes of the second dynasty, namely, Guigue VI. and John I., use the form ” Dalphini ” (genitive case) as a sort of patronymic. But even under Guigue VI. (1237-1270) the term “Delphinus” is used (especially by foreigners) as a title of dignity, and is so borne regularly by the third dynasty. The ” canting arms ” of a dolphin were borrowed from the Counts of Clermont (Dauphins of Auvergne), and appear first in 1237 on a seal of Guigue VI., son of Andr^ Dauphin (1192-1237). Humbert II. (1338-1349), grandson of the heiress Anna, was the last independent Dauphin, selling his dominions in 1349 to Charles of Valois, and stipulating that every one who inherited this province should bear the name of Dauphin, and quarter the arms of Dauphin^ with those of France. As a matter of fact, the title was borne by all succeeding eldest sons of the kings of France. In 1422 the Diois and the Valentinois by the will of the last count passed Ip the eldest son of Charles VI. , and in 1424 were annexed to the Dauphinfi. Louis (1440-1461), later Louis XI. of France, was the last Dauphin who occupied a semi- independent position. The suzerainty of the emperor gradually died out. In the 16th century the names of Farel and of the duke of Lesdiguiferes are prominent in Dauphin^ history. The ” States ” of Dauphinfi (dating from about the middle of the 14th century) were suspended by Louis XIII. in 1630. (w. A. B. c.)

Davenport, capital of Scott county, Iowa, U.S.A., in 41° 30′ N. lat. and 90° 39′ W. long., on the west bank of the Mississippi, at the foot of Eock Island Eapids, at an altitude on the river bank of 590 feet. It is laid out on a regular plan, is supplied with water from the Missis- sippi by the Holly pumping system, is well sewered and well paved with brick and macadam, and contains six wards. It is entered by three great railway systems, and enjoys a large trade. In 1890 it contained 475 manu- facturing establishments, with a capital of $8,732,122, and employing 5136 hands; the value of the manufac- tured goods was $10,357,232. The principal articles of manufacture were lumber and flour. The assessed valu- ation

of real and personal property in 1900, on a basis of about one-half of the full value, was $14,396,685, the debt of the municipality was $441,112, and the total rate of taxation was $51.75 per $1000. The death-rate in 1900 was 15-9. Population (1880), 21,831; (1890), 26,872; (1900), 35,254, of whom 8479 were foreign-born and 488 negroes.

Daventry, a municipal borough of Northampton- shire, England, 12 miles west by north of Northampton. There are Established, Eoman Catholic, Congregational, and Mbthodist churches; an endowed grammar school, and a grammar school for girls. A public recreation ground was opened in 1890. The principal industry is the manufacture of boots and shoes. Area, 3427 acres. Population (1881), 3859; (1901), 3780.

Davey of Fernhurst, Horace Davey, Baeon

(1833), English judge, son of Peter Davey, of Hor-

ton, Bucks, was born 30th August 1833, and educated at Eugby and University College, Oxford. He took a double first-class in classics and mathematics, was senior mathematical scholar and Eldon law scholar, and was

elected a fellow of his college. In 1861 he was called to the Bar at Lincoln's Inn, and read in the chambers of Mr (afterwards Vice-Chancellor) Wickens. Devoting himself to the Chancery side, he soon acquired a large practice, and in 1875 became a Q.C. In 1880 he was returned to Parliament as a Liberal for Christchurch, Hants, but lost his seat in 1885. On Mr Gladstone's return to power in 1886 he was appointed Solicitor-General and was knighted, but had no seat in the House; from 1888 to 1892 he sat for Stockton-on-Tees. As an equity lawyer Sir Horace Davey ranks among the finest intellects and the most subtle pleaders ever known at the English Bar. He was standing counsel to the University of Oxford, and senior counsel to the Charity Commissioners, and was engaged in all the important Chancery suits of his time. Among the chief leading cases in which he took a prominent part were those of The Mogul Steamship Company, Boswell v. Cokes, Erlanger v. New Phosphate Co., and the Ooregum Gold Mines Co. ; he was counsel for the promoters in the trial of the Bishop of Lincoln, and

leading counsel in the Berkeley Peerage case. In 1862 he married Miss Louisa Donkin. In 1893 he was raised to the Bench as a Lord Justice of Appeal, and in the next year was made a Lord of Appeal in Ordinary and a life-peer.

David, Felicien (1810-1876), French composer, was born on 13th April 1810 at Cadenet. After having studied for a while at the Paris Conservatoire, he joined the sect of Saint Simonians, and travelled in the East in order to preach the new doctrine. After three years' absence, during which he visited Constantinople, Smyrna, and spent some time in Egypt, he returned to Prance and published a collection of Oriental melodies. For several years he worked in retirement, and wrote two symphonies, some chamber music, and songs. On the 8th of December 1844 he suddenly leapt into fame through the extraordi- nary success obtained by his symphonic ode entitled Le Disert, produced at the Conservatoire. In this work David had struck out a new line. He had attempted in simple strains to evoke the majestic stillness of the desert. Notwithstanding its title of " symphonic ode," Le Disert has little in common with the symphonic style. What distinguishes it is a certain ndiveti of expression and an effective Oriental colouring. In this last respect David may be looked upon as the precursor of a whole army of com- posers. His succeeding works, Mdise au Sinai (1846), Christophe Oolomb (1847), L'Eden (1848), scarcely bore out the promise shown in Le D6sert, although the second of these compositions was successful at the time of its production. David now turned his attention to the the- atre, and produced the following operas in succession : La Perle du BrSsil (1851), Herculanum (1859), Lalla- BouJch (1862), Le Saphir (1865). Of these, Lalla-RouMi is the one which has obtained the greatest success. It is still played in France. He died at Saint-Germain-en- Laye on the 29th of August 1876. If David can scarcely be placed in the first rank of French composers, he nev- ertheless deserves the consideration due to a sincere artist, one who was undoubtedly inspired by lofty ideals. At a time when the works of Berlioz were caviare to the general, David succeeded in making the public take in- terest in music of a picturesque and descriptive kind. Thus he may be considered as one of the pioneers of mod- ern French musical art. (a. hb.)

Davis, Jefferson (1808-1889), American soldier and statesman. President of the Confederate States in the American War of Secession, was born on 3rd June 1808 in Christian (now Todd) county, Kentucky. His father, Samuel Davis, was of Welsh, his mother, Jane Cook, of Scotch-Irish, descent. Jefferson Davis was edu-

cated at Transylvania College and West Point Academy. From the latter he graduated in July 1828, with the rank of second lieutenant of infantry. He was assigned for duty to Jefferson Barracks at St Louis, and later to Fort Crawford, now Prairie du Chien, Wisconsin. Here he met Sarah Knox, the daughter of the commanding officer, whom he married two years later. Daring the Black Hawk war he was under General Winfield Scott at Fort Snelling, and was sent to Dixon, Illinois, to muster into service some volunteers from that State. Their captain was Abraham Lincoln, and Lieutenant Davis is said to have administered to him his first oath of allegiance. After his marriage, he resigned from the army and settled in Mississippi, where Mrs Davis died of fever, and Jefferson Davis afterwards married Miss Varina Howell of Mississippi. In 1843 Mr Davis entered the field of politics as a Democrat, and exhibited great power as a public speaker. In 1814 he was chosen as Presidential Elector, and in 1845 was elected to Congress. From the beginning of his political career he advocated a strict construction of the United States Constitution. He was an ardent admirer of John C. Calhoun and his political opinions. In his speeches in Congress, which were few, he clearly defined his position in regard to State Rights, which he consistently held ever afterwards. Dur-ing his first session, war with Mexico was declared, and he left his seat to take command of the First Regiment of Mis- sissippi Volunteers. He was greatly distinguished for gal- lantry and soldierly conduct at Monterey and Buena Vista. In this last battle he was severely wounded early in the engagement, but continued in command until victory crowned the American arms.

Upon his return to his home, he was made a United States Senator. After a ser- vice of nearly six years, he resigned his seat to accept the

nomination for Governor of his State, but was defeated. In 1853 he accepted the position of Secretary of War in the Cabinet of President Pierce, and for four years performed the duties of the office with great distinction and with lasting benefit to the nation. He organized the engineer companies which explored and reported on the several proposed routes for a railway connecting the Mississippi Valley with the Pacific Ocean. He effected the enlargement of the army, and made material changes in its equipment of arms and ammunition, utilizing the latest improvements. He made his appointments of subordinates on their merits, regardless of party considerations. He revised the system of tactics, perfected the signal corps service, and enlarged the coast and frontier defences of the country. At the end of his service in the Cabinet, he was returned to the Senate, and continued as a member until the secession of his State in 1861. As a senator he stood in the front rank in a body distinguished for its ability ; and his purity of character and courteous manner, together

with his intellectual gifts, won him the esteem of all parties. While believing in Secession as a last resort, he earnestly sought to avoid the necessity, and when his State passed the ordinance he resigned his seat with the saddest forebodings of the impending conflict. His part- ing speech was a clear and able statement of the position taken by his State, and a most pathetic expression of his feelings in saying farewell to his associates.

On 25th January 1861 Mr Davis was commissioned Major-General of the forces Mississippi was raising in view of the threatened conflict. On the 9th of Febiuary he received the unanimous vote of the Congress of the seceded States as President of the ” Confederate States of America.” This office he had not sought, preferring ser- vice in the field.’ His brilliant career, both as a civilian and a soldier, drew all eyes to him as best fitted to guide the fortunes of the new Confederacy, and with a deep

sense of the responsibility he obeyed the call. He heartily apjproved of the ” Peace Con- ference,” which attempted to draw up a plan of reconcilia- tion between the two sections, but whose failure made war inevitable. The disparity be- tween the hostile sections was very great. In white popula-

tion the North had four times that of the South, and her manufacturing resources were nearly five hundred times' as great ; she had vminterrupted commerce with the outside world, and out of her popula- tion and the great stream of immigrants she had an un- limited supply of soldiery. She had the army and navy, with the munitions of war be- longing to the Federal Gov- ernment. On the other hand, the South had to create every- thing needed for war. Never having been a manufacturing people, and having her ports soon blockaded, she was greatly at a disadvantage. It was, indeed, astonishing that she was able to maintain the un- equal contest for four years. Montgomery, Alabama, was the first Confederate capital, but after Virginia joined her sister States, the seat of government was removed to Richmond. How Mr Davis — of whom Mr Gladstone, in the early days of English sympathy with the South, said that he had " made a nation " — bore himself in his most respon- sible position during the gigantic conflict which ensued, cannot here be related in detail. It is sufficient to say that it was with great ability and an unblemished character. In a wonderfully short time he organized and put into the field one of the finest bodies of soldiers of which history has record. Factories sprung up in the South in a few months, supplying the army with arms and munitions of war, and the energy of the President was everywhere apparent. That he com- mitted serious errors, his warmest admirers will hardly deny. Unfortunately his firmness developed into obsti- nacy, and exhibited itself in continued confidence in offi- cers who had proved to be failures, and in dislike of some of his ablest generals. He committed the great mistake, too,

.lEFFEESON n.WIS, (From a photograph hy Sarony, New York.)

of directing the movements of distant armies from the., seat of government, though, those armies were under able generals. This naturally caused great dissatisfaction, and more than once resulted in irreparable disaster.

Only two instances need be cited. In the winter of 1861-62 General Thomas J. (" Stonewall ") Jackson was in command of the Valley forces. He planned and executed a brilliant winter attack on Romney in Hampshire county, occupied by the TederalSj.and during his march destroyed a dam on the Chesapeake and Ohio Canal, an important feeder to Washington. The position gained was very im- portant in the defence of the Valley of Virginia. General Loring, with a part of the command, was left at Eomney to hold the advantages gained. But he communicated with the War Department, and requested to be allowed to retire, on the plea that he might be cut off, although Jackson was within supporting distance. Thereupon, the administration, without consultation with General Jackson, ordered Loring's withdrawal, which resulted in a serious disadvantage in the defence of the Valley. General Jackson at once tendered, his resignation, and it was with the greatest difficulty that the Governor of Virginia, with something like an apology from the War Department, was able to retain for the Confederacy the services of this great military genius. In 1864 General Joseph E. Johnston, in command of the army of Tennessee, was faced by General Sherman with nearly double his force. Johnston eluded Sherman's efforts to outflank him, and in a series of en- gagements, inflicting great loss, drew him some hundreds .of miles from his base. He then urged Mr Davis to send a strong body of cavalry to the rear of Sherman and destroy his line of supplies. This Mr Davis declinea to do, but instead insisted on Johnston's stopping the advance of his opponent. General Sherman commanded the best of the Federal troops, and Johnston, having reached Atlanta and having prepared to defend it on his own chosen ground, declined to say what his future movements mi^ht be, as they were dependent on the fortunes of war. Whereupon Mr Davis relieved him and placed in command General J. B. Hood, a greatly inferior soldier, who, in a series of wild assaults on Sherman, soon shattered the magnificent army which Johnston had led with such ability.

The defeats of Hood hastened the fate of the Confeder- acy. During the winter of 1864-65 the resources of the Government showed such exhaustion that it was apparent that the end would come with the opening of the Spring campaign. This was clearly stated in the reports of the Heads of Departments and of General Lee. President Davis, however,

acted as if he was assured of ultimate suc- cess. He sent Duncan F. Kenner as special commissioner to the courts of England and France to obtain recognition of the Confederacy on condition of the abolition of slavery. When a conference was held in Hampton Eoads on 3rd February 1865 between President Lincoln and Secretary Seward on the one side, and A. H. Stevens, R. M. T. Hunter, and Judge James A. Campbell, representing President Davis, on the other, he instructed his representa- tives to insist on the recognition of the Confederacy as a condition to any arrangement for the termination of the war. This defeated the object of the conference, and deprived the South of terms which would have been more beneficial than those imposed by the conqueror when the end came a few weeks later. The last days of the Con- federate Congress were spent in recriminations between that body and President Davis, and the popularity with which he commenced his administration had almost entirely vanished.

After the surrender of the armies of Lee and Johnston in April 1865, President Davis attempted to make his way through Georgia across the Mississippi, in the vain hope

of continuing the war with the forces of Generals Smith and Magruder. He was taken prisoner by Federal troops before he reached the river, and was brought back to Old Point, Virginia, that he might be confined in prison at Fortress Monroe. His prison was a casemate under a damp parapet, in which a light was kept constantly burning, and sentinels paced backwards and forwards continually. He was heavily chained, and his coarse food was served in filthy vessels. He entered the prison a feeble man, and . such treatment soon brought him to death's door. Dr Craven, the Federal surgeon who attended him, by earnest pleas had his treatment changed and saved his life. Per- sistent efforts were made to connect him with the assassin- ation of President Lincoln and with the harsh treatment of prisoners at Anderson ville, but without avail. Two indict- ments were found against him for treason, and for several years he was denied trial or bail. Such cruel treatment aroused the sympathy of the Southern people, who regarded him as a martyr to their cause, and in a great measure restored him to that place in their esteem which by his blunders he had lost. It also aroused a general feeling in the North, and when

finally he was admitted to bail, Horace Greeley, Cornelius Vanderbilt, Gerrit Smith, and others in that section who had been his political opponents, became his sureties. Charles O'Conor, a leader of the New York Bar, volunteered to act as his counsel. With him was associated Robert Ould of Richmond, a lawyer of great ability. They moved to quash the indictment on which he was brought to trial. Chief Justice Chase and Judge Underwood constituted the court, which was divided, the Chief Justice voting to sustain the motion and Underwood to overrule it. The matter was thereupon certified to the Supreme Court of the United States, and no decision of which there is record was ever announced by that high tribunal. Meanwhile the administration dismissed the prosecution and discharged the accused. The health of Mr Davis was greatly injured by the harsh treatment inflicted on him while at Fortress Monroe, a harrowing ac- count of which is given by the Federal surgeon Dr Craven in his Prison Life of Jefferson Davis. It was some years before he was sufficiently recovered to write his Rise aiid Fall of the Confederate States of America. In this volume he attempted to vindicate his administration, and in so doing he attacked the records of those generals he disliked. He died on 6th December 1889 at New Orleans, leaving a widow and two daughters — Margaret, who married J. A. Hayes, and Varina, better known as "Winnie" Davis, the "daughter of the Confederacy," who died unmarried in 1899.

The life of Jefferson Davis has been written several times. The most prominent of these publications are those by J. WiUiam Jones, D.D., and by Mrs "Varina Davis, his widow. But his life is so prominently identified with the struggle between the States, that every history of that great contest must present him in the foreground. (w. W. H.)*

Dawlish, a seaside resort in the Ashburton parlia- mentary division of Devonshire, England, 11 miles south by east of Exeter by rail. A masonic hall was built in 1890. A dispensary was established in 1885j and an infirmary in 1896. The cottage hospital, founded in 1871, was removed to other premises in 1880. The area of the civil parish is 5370 acres. The population in 1881 was 4595, and in 1891 it was 4925. The area of the urban district is 1500 acres. The population in 1881 was 3977; in 1901, 4003.

Dawson, Sir John William (1820-1899), Canadian man of science, was born at Pictou, Nova Scotia, on 30th October 1820. Of Scottish descent, he went to Edinburgh to complete his education, and graduated at

that university in 1842. Eeturning to Canada he carried out some geological explorations under the direction of Sir Charles Lyell, and was afterwards appointed superin- tendent of education for Nova Scotia, a position in which he was responsible for important reforms in the educational arrangements of the province. From 1866 to 1893 he was principal of M'Gill University, which prospered under his fostering care and attained a reputation that was a good deal more than local. When the Royal Society of Canada was constituted he was the first to occupy the presidential chair, and he also acted as president of the British Association at its meeting at Birmingham in 1866, and of the American Association for the Advancement of Science. Sir William Dawson's name is especially associated with the Eozoon Oanadense, which in 1866 he described ,as an organism existing in a fossil state in the Laurentian rocks, but his views on the subject were far from commanding general assent. Besides many memoirs published in the Transactions of various learned societies, he was the author of numerous popular books on geological subjects. In these he maintained a distinctly theological attitude, declining to admit the descent or evolution of man from brute ancestors, and holding that the human species only made its appearance on this earth within quite recent times. He died on 20th November 1899. His son, Geokgb Meecbe Dawson (1849-1901), was born at Pictou on 1st August 1849, and received his education at M'Gill University and the Eoyal School of Mines, Lon

Dax, chief town of arrondissement, in the department of Landes, France, 36 miles west-south-west of Mont- de-Marsan, with station on railway from Bordeaux to Bayonne. It is an important market for resinous sub- stances, cattle, mules, and horses, and has considerable mercantile interchange with Spain. In the middle of the town there is a hot sulphur spring of a temperature of 140° Fahr. ; and the place is consequently

frequented by visitors for the sake of the baths. An important new bathing establishment, beautifully situated on the site of the old castle and near the Adour, was opened by the President of the Eepublic in 1891. In the same year a monument to the engineer Borda (d. 1799) was unveiled. Population (1881), 8369; (1891), 8403; (1896), 8307, (comm.)9836; (1901), 10,329.

Dayton, a city of Campbell county, Kentucky, U.S.A., on the south bank of the Ohio river, opposite Cincinnati, and adjoining Bellevue and Newport, Ky., in the northern part of the state. Population (1890), 4264 ; (1900), 6104, of whom 655 were foreign-born and 63 negroes.

Dayton, capital of Montgomery county, Ohio, U.S.A., in 39° 44′ N. lat. and 84° 08′ W. long., on the Great Miami river, which here is not navigable, at an alti- tude of 737 feet. The site is level, and the streets

broad, with a fairly regular plan, and paved with gravel. It is supplied with water by the Holly pumping system, the works being owned by the city. Dayton is a com- mercial city of importance, being on the Miami and Erie Canal, and on ten lines of railway, belonging to five rail- way companies, and radiating in all directions. Its manu- factures are large and varied. In 1890 the invested capital was $13,470,000, employing over 12,000 hands. The product was valued at $22,446,672. The more promi- nent of the products were agricultural implements, flour, and iron and steel goods. The assessed valuation of real and personal property, on a basis of about 55 per cent, of the full value, was, in 1889, $42,565,200, the net debt of the municipality, $3,562,943, and the rate of taxation, $25.60 per $1000. The city had a slow growth between 1870 and 1880, but from then until 1900 it increased rap- idly, owing to the development of manufactures and trade. Population (1880), 38,678 ; (1890), 61,220 ; (1900), 85,333, of whom 10,053 were foreign-born and 3387 negroes. The death-rate in 1900 was 16‘5.

Deacon. — The germ of the Christian diaconate may be seen in the choosing of the Seven (Acts vi.), whose primary function was ” to serve tables ” ; but its definite and permanent shape comes from the Greek churches founded by St Paul. The ministers of these formed two distinct classes, ” those who rule ” and ” those who serve,” with the designations

eirto-Koirot and Sta/covot ; and St Paul enumerates their qualifications in 1 Tim. iii. 8-13, ~~&c. With the development of the episcopate (in the later sense), the deacons became the immediate ministers of the bishop for disciplinary purposes ; and their primary function was extended to include supervising church property, visiting the sick, distributing alms, &c. By degrees these became subsidiary to another function, that of ministering in the church, especially in Baptism and the Eucharist, and later on that of teaching too. And thus the duties of the deacon came to be summed up as follows in the Eoman Pontifical : diaconus oportet minis~~ trare ad altare, baptizare et prcBdicare. (In the English Ordinal both functions, ministering in temporal matters and ministering in the congregation, are kept in view.) But the fundamental character of his oflce remained : on the one hand he was sftiarply distinguished, as being in " holy orders " like the bishop and presbyter, from the various lower orders in the ancient Church ; on the other hand, he " ministered " to those of higher degree. And although in their absence fresh functions devolved upon him (varying with times and regions), he could never per- form strictly "sacerdotal" functions, such as consecrat- ing the Eucharist. The ofiice frequently led in ancient days to the higher orders ; but it was frequently held for life, and in great cities, where the number of deacons was long restricted to seven, it became one of high honour and em olument. In modern days both tendencies are repre- sented : in the West the office is usually a stepping-stone to the priesthood, whereas in the East it is often held for life, and some high offices are reserved to deacons. The ancient canonical age for the diaconate was twenty-five ; it is nOw twenty-three. In the Lutheran Churches the Diakonat is merely a title of certain assistant clergy, not a separate order ; in most other non-Episcopal Churches it is practically a lay office.

Thomassinus. Vetus ac Nova BiscipUna, pars i. lib. i. c. 51 f. and lib. ii. c. 29 f. Lugdunum, 1706. — J. N. Seidl. Der Diakonat in der katholischen Kirche. Regensburg, 1884. — R. Sohm. Kir- chenrecht, i. 121-137. Leipzig, 1892. — Smith and Cheetham. Dic- tionary of Christian Antiquities, a.it. "Deacon." (w. B. Co.)

Deaconess. — The office of deaconess has a special importance at the present day, in view of the movement for its revival. It may now be

considered certain that (a)

there was a true diaconate of women in the churches founded by St Paul. Bishop Lightfoot held that Phoebe, SiaKoi/os of the church at Cenchrese (Rom. xvi. 1), ” is as much a deacon as Stephen or Philip is a deacon ” ; and even if the word be used loosely here, it is clear that 1 Tim. iii. 11 means “Women (-deacons) in like manner,” &c. (b) Nor must they be confused with the ” widows ” of the ancient Church, to whom certain functions were sometimes intrusted; they were ordained (excepting apparently for a time in Egypt) and had a definite position ” about the altar,” i.e., in the ranks of the clergy. Their ‘ work was to visit and instruct the women, to have charge of them during service, and to anoint women and children for baptism ; sometimes also to cleanse the sanctuary and even administer the chalice to women. At first they ranked with, but below, the men-deacons ; in course, of time, however, the former rose in the scale and the latter fell, ranking below the sub-deacons; and indeed the author of the Testamentum Domini (q.v.) places over them an entirely new officer, the “canonical widow,” ” presbytera,” or ” vidua Jiabens prcecedentiam sedendo,” of whom there are only faint traces elsewhere. Although the order appears to have existed from the first in the East, where women were much secluded (the two ministroe tortured by Pliny, Ep. xcvi, may well have been deaconesses), it only spread elsewhere by degrees. It is not mentioned in Egypt till well on in the 3rd century, and does not appear in the West till about 400 a.d., — first in Gaul and then in Italy. Even then it does not seem to have been a thriving institution. Some deacon- esses are known to us of a strictly ministerial kind, but more frequently they are of a monastic or g’wasi-monastic character ; and the institution died away by about the 11th century. In the East they throve better : they are well known to us in the writings of St Chrysostom and other fathers, synods made regulations respecting them, and their position before the law is clearly laid down in the Civil Law. Nevertheless, here also they passed away by degrees ; first the office came to be held by the heads of communities of women, then the name came to be given to

abbesses in general, and by about the 13th century deaconesses were practically extinct. Several mediaeval and Protestant sects, however, possessed a ministry of dea,conesses, amongst whom may be mentioned the Cathari, Mennonites, United Brethren, and the early Independents. Moreover, the enlarged scope of women's work at the present day has led to the foundation of " deaconess insti- tutions " of an entirely new kind. Such an institution was inaugurated at Kaiserwerth in 1833 by the Lutheran Dr Pleidner ; others of the same kindf oUowed, both abroad and in England (e.g., at Tottenham and Mildmay Park) ; and they are now to be found in most parts of Europe. The members of these institutions, however, do not really represent the deaconesses of early days : they are not ministers of their churches in any real sense, but rather members of voluntary societies for common work. In fact they are Protestant sisters of charity rather than deacon- esses. In recent days, however, there has been a move- ment in the churches of the Anglican communion for the revival of the order of deaconess on ancient lines. In 1861 Bishop Tait of London set apart Miss E. Eerard as a deaconess by laying on of hands, and she became the first head of the London Deaconess Institution. Similar insti- tutions have since been founded at home and abroad, some on a " regular " and some on a " secular " basis ; i.e., in some cases the members are professed sisters, in others not. By degrees, too, they have received further recog- nition. In 1871 a body of " Principles and Eules " for deaconesses received the signature of the two English archbishops and eighteen bishops ; in 1891 eight " Eeso- lutions " on the subject were passed in the Convocation |

of Canterbury ; and the Lambeth Conference of 1897 ' " recognizes with thankfulness the revival of the office of deaconess." Nevertheless, the revival cannot yet be con- sidered complete : the deaconess is not yet more than a diocesan officer, who " may be released from her obliga^ tions by the bishop, if he thinks fit, upon cause shown " ; her special functions are undetermined, and her status is still in many ways indefinite. No doubt, however, further development is only a question of time.

Deaconess Cecilia Robinson. The Ministry of Deaconesses. London, 1898. — Church Quarterly Review, vol. xlvii. p. 302 f., art. "On the Early History and Modern Revival of Deaconesses." London, 1899; and the

works there referred to. — D. Latas. XpumaviK'^ ' Apxaiokoyla, vol. i. pp. 163-171. Athens, 1883. — Testamentum Domini, ed. Rahmani. Mainz, 1899.

(w. E. Co.)

Dead Sea, a lake in Palestine, so called from the absence of animal life in its waters. It lies nearly north and south, in the deepest part of the Jordan-' Araba de- pression. It has no outlet, and its surface is from 1289 to 1300 feet below that of the Mediterranean. At its northern end is the broad valley down which the Jordan flows ; and beyond the marshy plain at its other ex- tremity, the floor of the 'Araba rises southward to the watershed between the Dead and Red Seas (65^ miles from the Dead and 46|- miles from the Red Sea ; altitude 660 feet). From the eastern shore the ground rises abruptly in terraces to the Moabite plateau (3100 feet) ; and from the western with almost equal abruptness to the hill country of Judah (3300 feet). The slopes on either side are deeply seamed by watercourses, through which winter torrents and, in some cases, perennial streams flow to the lake. The Dead Sea is about 47^ miles long, and its greatest width is 9^ miles ; its area is about 340 square miles. It is divided into two unequal parts by a peninsula, el-Lisan, which breaks off on the west in a cliff about 300 feet high, and is connected with the Moabite shore by a narrow strip of marshy land. The peninsula is composed of white calcareous marl with beds of salt and gypsum, and, like Jebel Usdum, which it resembles in character and composition, it formed part of the bed of the lake when its waters stood at a higher level. North of the peninsula the lake has a maximum depth of 1278 feet. South of it the depth is only 3 to 12 feet, and some years ago it was fordable opposite el- Lis^n. The marshy plain, es-Sebkha, at the south end is liable to inundation, and strewn with driftwood encrusted with salt; it extends southwards to a terrace 500 feet high, which marks the commencement of the 'Araba. At the south-west end of the lake is Jebel or Khashm Usdum, about 600 feet high, and 7 miles long, of which the lower part is formed of solid rock-salt. The principal affluents, including winter torrents, are, on the north, the Jordan and 'Ain es-Sueimeh; on the east, Wadies Ghuweir, Zerka Ma'in, in which lie the hot sulphur springs of Callirrhoe, Mdjib (Arnon), ed-Dera'a or el- Kerak, en-N'meirah, and el-Hesi or es-Sd;fieh,

which passes to the lake through the reed-thickets of es-Sebkha ; on the south, Wadies et-Taf ileh, el- Jeib, and el-Pikreh ; and on the west, Wadies Muhauw^t and Sey^l, 'Ain Jidi, W. el-Merabba or ed-Derajeh, 'Ain Ghuweir, W. en-N^r, and 'Ain Peshkha. It is estimated that these affluents pour more than six million tons of water into the Dead Sea daily, all of which passes off by evaporation.

The surface level of the lake varies with the season. In March 1865 it was 1292 feet below sea-level (Wilson) : it is highest in February or March. The boiling-point of ■ the water is 221° F. The density increases from north to south, and with the depth— rapidly to a certain point, after which it is more uniform. Its density at 300 m&tres is 1-253, average 1-166. The solid matter at a depth of

300 m. is 27-8 per cent, of the weight, and consists of chlorides of calcium, magnesia, sodium, and potassium, and in smaller proportions of bromides and sulphates of the same substances. The richness in bromine is held to indicate greatly prolonged concentration. Eggs float in the water. Curative properties were attributed to it in Eoman times; and according to Mukaddasi, a.d. 985, people assembled to drink it on a feast day in August. A bath in the lake is wholesome and refreshing. The oily sensation after bathing is due to the chloride of calcium, and the noisome, acrid taste to the chloride of magnesia. The chloride and bromide of magnesia are fatal to all animal life excepting certain microbes found in the mud by Ehrenberg and Lortet. Fish carried down by the Jordan, and small fish from brackish pools and streams near the shore, die at once in the water of the lake. The water strongly affects the eyes, and evaporation leaves a thick deposit of salt. The water is limpid and trans- parent, and under varying conditions is deep blue or ■green in colour. Its surface, far from being motionless, as some writers have supposed, is constantly rippled by breezes, or raised into waves by the strong northerly winds, and is sometimes veiled by light bluish clouds or haze produced by the evaporation. Molyneux, in 1847, and others since that date, have noticed a streak of white foam which sometimes stretches from the north-west end

of the lake towards el-Lisdln, following nearly the axis of the lake. From this Blanckenhorn concludes that there is a sub-lacustrine fissure which he considers to be thermal and asphaltic ; but the phenomenon is possibly due to the current of the Jordan, which does not expend its force completely until it reaches el-Lisin. A recent traveller, Rev. P. Cady, writes of a strong current setting towards the north along the east coast; of oil floating on the water near the mouth of the Zerka Main ; and of disturb- ances of level that appear, like those to which the Lake of Geneva is subject, to be due to differences of barometric pressure at different points on the lake. The origin of these and other phenomena can only be ascertained by a thorough scientific examination of the lake and its basin. The shores are sterile and desolate from the absence of fresh water, and from the smallness of the rainfall, and not, as formerly supposed, from the poisonous ~~*nature of the air. The springs near the lake give life to thickets of willow, tamarisk, and acacia, which are frequented by birds ; and wherever, as at Engedi, there is running water the vegetation is almost tropical in its luxuriance. The plain of Jericho is very fertile, and south of the lake the Arabs raise crops of wheat, dura, cotton, and tobacco. The climate in summer and autumn is very hot and unhealthy ; but in winter it is good, with hot days and cool nights. The unhealthiness is due partly to the intense heat, and partly to the miasma from the swamps and lagoons at the southern end. The scenery is remark*~~ *able for the brilliancy of the colouring, and the varying effects of light and shade. The abrupt slopes on either side, the deep ravines on the eastern shore, and the intense colouring of the water combine to form a scene of grandeur and beauty which has been compared, not inaptly, with the aspect of some portions of the Lake of Geneva. Boats were employed on the lake in Roman, and possibly in much earlier, times (Tacitus, Hist. V. 6; Josephus, Ant. ix. 1, § 2; B. J.iv. 7, § 6) ; they are represented on it in the mosaic map at Medeba; and under the Latin Kingdom of Jerusalem the navigation dues formed part of the revenue of the Lords of Kerak. The use of boats died out when the Turks abandoned the country east of the Jordan to the Bedawin. During the 19th century boats have oc- casionally been used for exploration, and since the occupation of Moab and Edom by the Turks an at-*

tempt has been made to place small steamers on the lake.

Name, — In the Old Testament the Dead Sea is called “the feea,” the “salt sea,” the ” sea of the Arabah,” and “the eastern sea.” The name “Dead Sea” appears in the Vulgate (Jos. iii. 16), and is used by Pausanias, Galen, Justin, and Eusebius. Diodorus Sionlus, Pliny, and Josephus call it the ” Asphaltic Lake,” and others the “Sodomitish sea.” It is now known to the Arabs as Bahr Mt, ” the sea of Lot.’;

Ckology. — The Jordan-Araba depression, in which the Dead Sea lies, was produced by subsidence along a line of faults or fractures during the terrestrial movements that accompanied the gradual elevation of the region out of the sea after the close of the Eocene period. As a result of the faulting, the formations on the opposite sides of the lake do not correspond. Whilst the hills on the western side are formed entirely of Cretaceous limestones, the abrupt face of the Moabite plateau is composed of a base of ancient volcanic rocks, upon which rest, in ascending order, red sand- stones and conglomerates of the Carboniferous age, Carboniferous limestone, variegated sandstones (Nubian sandstone) of Lower Cretaceous age, and Cretaceous limestones. The deeply cut ravines of the Moabite plateau owe their origin to the same sub- sidence, but their features, and those of the hills east and west of the lake, were greatly modified by the heavy rainfall in the Pliocene and Pleistocene periods. Terraces of lacustrine deposits at diflerent levels indicate that in Pleistocene times the Jordan valley was occupied by a lake 200 miles long, which had the same surface level as the Mediterranean ; and that the water gradually subsided until, long before the dawn of history, the evaporation equalled the supply, and the lake assumed approximately its present level. The surface is liable to frequent fluctuations of level, which, though confined to narrow vertical limits, are suffi- cient to alter considerably the form and superficial extent of the lake. Such fluctuations are due to a succession of exceptionally dry or rainy seasons, to the greater or lesser activity of subaqueous springs, to landslips, to changes in the drainage, to the gradual silting up of the basin, and, possibly, to slight earth movements which escape detection. The annual rise and fall is estimated at from 6 to 10 feet, but there seem to be also prolonged periods of high and low level. The lines of Driftwood and the marks on the rocks show the limits of rise which might occur under existing conditions, and a fall of 15 feet is quite possible after

exoep- tioijal periods of dryness. Such a fall would dry up almost the whole of the lagoon south of el-Lis&n, and effect great changes in the appearance of the lake. During the forty years 1860-1900 there was a gradual rise in the level of the surface, apparently coinciding in part with a succession of wet seasons, but accurate observations are wanting. A small island near the north end of the lake, which in 1858 was from 10 to 12 feet above the surface, and con- nected with the shore by a causeway, has been entirely submerged since 1892 ; and the track between Jebel Usdum and the lake has for several years been covered^with water. Monthly measurements of the rise and fall of the lake, taken for the Palestine Exploration Fund during an exceptionally dry year, October 1900 to October 1901, showed a rise of 1 foot 3 inches up to 30th March 1901, and then a fall of 1 foot 9 inches to October. Thus the level of the lake was lowered 6 inches during the year. The asphalt or bitumeii, so highly prized in ancient times, is supposed to be derived from subaqueous strata of bituminous limestone or marl, and to collect at the bottom of the lake until it is loosened by an earthquake and rises to the surface. The Arabs collect the bitumen which reaches the shore, and the salt of Jebel Usdum and of the Dead Sea has been carried to Jerusalem from the earliest times. But no systematic attempt has been made yet to turn the mineral wealth of the Dead Sea and its basin to account.

The following analysis of water taken from the north end of the lake, not near the Jordan, in March 1885, when the level was high, was made by Dr Bemays : —

Sp. gr. 1-1528 at 15-5 C.

Calcium carbonate . Calcium sulphate Magnesium nitrate . Potassium chloride . Sodium chloride Calcium chloride Magnesium chloride . Magnesium bromide . Iron and aluminium oxides

Organic matter, water of”! crystallization and loss j

Grr.

70-00

163-39

175-01

1089-06

5106-00

594-46

7388-21

345-80

10-50

14,942-43 317-57

15,260-00 1 S^^'"^'«,f"'i® _J I. per gallon.

S. Ill — 50

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D E A D W 0 0 D — D E B A R Y

This is not the place to discuss the theories respecting the de- struction of the Cities of the Plain (Gen. xix.). The catastrophe was in no way connected with the formation of the Dead Sea. Some^authorities place the cities at the south end of the lake ; but it is clear from the statements in the Bible that they were situated in the Jordan valley to the north of the lake.

Atjthomties. — Doc de Luynes. Voyage d' Exploration a la Mer Morte, tome 3, Oeologie par Louis Laktet, Paris, 1875. — Fraas. Aus dem Orient. — Wilson, in Ordnance Survey of Jeru- salem, Notes (for levels), and in P. E. F. Qy. Stat., 1900. — Hull. Memoir On the Geology and Geography of Arabia Petroea, Palestine, &c., P. E. Fund, 1889; Mount Seir, 1889.— G. A. Smith. His- torical Geography of the Holy Land, 1894.

— Lobtet, in Zeitschrift des Beutschen Paldstina Vereins, xvii. 142. — Blanckenhorn, in Z.D.F. V. xix. 157.— Gautiee, Autour de la Mer Morte, 1901. — De Lapparent. Mtude Geologique sur la Mer Morte in Bevue Biblique, vol. V. (1896).— Gray Hill and Putnam Cadt in P. E. F. Qy. Stats., 1900, 1901. (c. W. W.)

Dead wood, capital of Lawrence county, South Dakota, U.S.A., in the northern part of the Black Hills, in 44° 23′ N. lat. and 103° 44′ W. long., in the caiion of Whitewood Creek, at an altitude of 4632 feet. Its site is hilly, and its street plan irregular. It has two railways, the Burlington and Missouri Eiver and the Premont, Elkhorn, and Missouri Valley. It is the commercial and mining centre of the Black Hills. About it are several gold- mines, characterized by the low grade of their ores, which range from f 3 to f 4 per ton, by their vast quantity, and by the ease of mining and of extracting the metal. The ore contains free gold, which is extracted by the simple process of stamping and amalgamation. Several hundred tons of ore are treated thus in Deadwood and its environs daily, and its stamp mills are exceeded in size only by those of the Treadwell Mine in south-eastern Alaska. The annual gold product of this region is about $4,000,000. Population (1880), 3777; (1890), 2366; (1900), 3498, of whom 707 were foreign-born.

Deal, a municipal b6rough and bathing resort in the St Augustine's parliamentary division (since 1885) of Kent, England, 8 miles north-east by north of Dover by rail. The asphalted promenade is now nearly 4 miles long; the pier has been provided with a pavilion and enlarged. There are well-known golf links. Area, 1124 acres. Population (1881), 8600 ; (1901), 10,427. There is a parish of Deal.

De Amicis, Edmondo (1846), Italian

writer, was born at Oneglia, 21st October 1846. After some schooling at ,Cuneo and Turin, he was sent to the Military School at Modena, from which he was appointed to a lieutenancy in the 3rd Regiment of the line in 1866. He fought at the battle of Custozza in 1866. In 1867 he became Director of the Itcdia Militare, Florence. In the following year he published his first book. La Vita Mill- tare, which consisted of sketches of military life, and attained wide popularity. After the overthrow of the

Pope's temporal power in 1870, De Amicis retired from the army and devoted himself to literature, making his headquarters at Turin. Always a traveller by inclination, he found opportunity for this in his new leisure, and some of his most popular books have been the product of his wanderings. Several of these have been translated into English and the other principal languages of Europe. The most important of these are his descriptions of Spain (1873), Holland (1874), Constantinople (1877), and Morocco (1879). These have gained him reputation as a brilliant depicter of scenery and the external aspects of life; solid information is not within their sphere; and much of their success is owing to the opportunities they afford for spirited illustration. Of late years De Amicis has greatly extended his fame as a novelist, especially by II Romanzo d' un Maestro (1890). His poems consist principally of sonnets.*

De Bary, Anton (1831-1888), German botanist.

was of Belgian extraction, but his family had long been settled in Germany. He was born, January 26, 1831, at Frankfort-on-Main. From 1849 to 1853 he studied medicine at Heidelberg, Marburg, and Berlin. In 1853 he settled at Frankfort as a surgeon. In 1854 he became privat-docent for botany in Tubingen, and afterwards Pro- fessor of Botany at Freiberg (1859). In 1867 he migrated to Halle, and in 1872 to Strassburg, where he was the first rector of the newly constituted university. He died there January 19, 1888. In his earlier years he came under the influence of Mohl, Fresenius, A. Braun, Ehrenberg, and Johannes Miiller, but his startling origin- ality and ability soon brought him into prominence, and he became one of Germany's most distinguished biologists, remarkable for his broad and firm grip of the botanical problems of his day, and for the clear insight he brought to bear on investigations.

Although one of his largest and most important works was on the Comparative Anatomy of Fei-ns and Phan- erogams, in which he produced an account of the tissues of vascular plants which has never been entirely super- seded, his treatment of the epidermal system being especially good, and notwithstanding his admirable ac- quaintance with systematic and field botany generally, De Bary will always be remembered as the founder of modern Mycology. This branch of botany he completely

revolutionized in 1866 by the publication of his celebrated Morphologie und Physiologie d. Pilze, &c., a classic which he rewrote in 1884, and which has had a world-wide influence on Biology. His clear appreciation of the real significance of Symbiosis and the dual nature of Lichens stands out as one of his masterpieces, and in many ways he showed powers of generalizing in regard to the evolu- tion of organisms which would alone have made him a distinguished man. It was as an investigator of the then mysterious I^ingi, however, that De Bary stands out first and foremost among the biologists of the 19th century. He not only laid bare the complex facts of the life-history of many forms, — e.g., the TJstilagineae, Peronosporeae, Uredinese, and many Ascomycetes,— rtreating them from the developmental point of view, in opposition to the then prevailing anatomical method of the Tulasnes, but he insisted on the necessity of tracing the evolution of each organism from spore to spore, and by his methods of culture and accurate observation brought to light numerous facts hitherto undreamt of. These his keen perception and insight continually employed as the basis for hypotheses, which he in turn tested with an experimental skill and critical faculty rarely equalled and probably never surpassed. One of his most fruitful discoveries was the true meaning of infection as a morphological and physiological process. He traced this step by step in Phytophthora, Cystopus, Puccinia, and other Fungi, and so placed before the world in a clear light the significance of parasitism. He then showed by numerous examples wherein lay the essential differences between a parasite and a saprophyte, a theme by no means clear in 1860-70, but which he himself had recognized as early as 1853, as is shown by his work. Die Brandpilze.

These researches led to the explanation of epidemic diseases, and De Bary's contributions to this subject were fundamental, as witness his classical work on the Potato Disease in 1861. They also led to his striking discovery of heteroecism (or metoecism) in the Uredinese, the truth of which he demonstrated in Wheat Rust experimentally, and so clearly that his classical example (1863) has never iDcen other than confirmed by subsequent observers, though we now know much more as to details. It is difficult to estimate the relative importance of De Bary's astoundingly accurate work on the sexuality of the Fungi. He not only described the phenomena of sexuality in Peronosporese

and Ascomycetes, — Eurotium, Erysiphe, Peziza, Sec, — but also established the existence of Parthenogenesis and Apo- gamy on so firm a basis that it is doubtful if all the combined workers who have succeeded- him, and who have brought forward contending hypotheses in oppo- sition to hi views, have succeeded in shaking the doctrine he established before modern cytological methods existed. In one case, at least {Pyronema confluens), the most recent and skilful investigations, with every modern appliance, have shown that De Bary described the sexual organs and process ac- curately.

It is impossible here to mention all the discoveries made by De Bary. He did much work on the Chytridieae, Ustilaginese, Exoasceae, and Phalloideae, as well as on that remarkable group the Myxomycetes, or, as he himself termed them, Mycetozoa, almost every step of which was of permanent value, and started lines of investigation which have proved fruitful in the hands of his pupils. Nor must we overlook the important contributions to Algology contained in his earlier monograph on the Con- jugatse (1858), and investigations on Nostocaceae (1863), Chara (1871), Acetabularia (1869), &c. De Bary seems to have held aloof from the Bacteria for many years, but it was characteristic of the man that, after working at them in order to include an account of the group in the second edition of his book in 1884, he found opportunity to bring the whole subject of Bacteriology under the influence of his genius, the outcome being his brilliant Lectures on Bacteria in 1886. De Bary's personal influence was immense. Every one of his numerous pupils was en- thusiastic in admiration of his kind nature and genial criticism, his humorous sarcasm, and his prof ound insight, knowledge, and originality.

Memoirs of De Bary's life will be found in Bot. Centralbl. 1888, vol. xxxiv. p. 93, by Wilhelm; Ser. d. d. bot. Ges. vol. vi., 1888, p. viii., by Reess, each with a list of his works ; Bot. Zeitung, 1889, vol. xlvii., No. 3, by Graf zu Sohms-Laubach. (h. m. w.)

Debentures and Debenture Stock. — An ad- vantage incident in Great Britain to incorporation under the Companies Acts is found in the facilities which it affords a trading concern for borrowing on debentures or debenture stock. More than four hundred millions of money are now invested in these forms of security. Borrow- ing is not specifically dealt with by the Companies Acts at all, but that it was contemplated by the Legislature is evident from the provision in sect. 43 of the Act of 1862 for a company keeping a register of mortgages and charges. The policy of the Legislature in this, as in other matters connected with trading companies, was apparently to leave the company to determine whether borrowing should or should not be one of the objects defined expressly or by implication in the memorandum of association. A company cannot borrow unless it is expressly or impliedly authorized to do so by its memorandum. In the case of a trading company borrowing is impliedly authorized as a necessary incident of carrying on the company's business. ' Thus a company established for the conveyance of passen- gers and luggage by omnibuses, a company formed to buy and run vessels between England and Australia, and a company whose objects included discounting approved commercial bills, have all been held to be trading companies with an in- cidental power of borrowing as such to a reasonable amount. A building society, on, the other hand, has no inherent power of borrowing, though a limited statutory power was conferred on such societies by the Building Societies Act, 1874 ; nor has a society formed not for gain but to promote art, science, religion, charity, or any other useful object. Public companies again, formed to carry out some undertaking of public utility, such as docks,

water-works, or gas-works, and governed by the Companies Clauses Acts, have only limited powers of borrowing.

The indefiniteness of an implied power of borrowing, even when it attaches, has led to a general power of borrowing being usually inserted in a company's memo- randum of association. It is left to the articles to define the amount to be borrowed, the nature of the security, and the conditions, if any, such as the sanction of a general meeting of shareholders, on which the power is to be exercised. Under the Companies Act, 1900, i a company cannot exercise any borrowing power

until it has fulfilled the conditions prescribed by the Act en- titling it to commence business. A person who is pro- posing to lend money to a company must be careful to acquaint himself with any regulations of this kind, and to see (1) that the memorandum and articles of association authorize borrowing, and (2) that the borrowing limit is not being exceeded, for if "it should turn out that the borrowing was in excess of the company's powers and ultra vires, the company cannot be bound, and the borrower's only remedy is against the directors for breach of warranty of authority, or to be surrogated to the rights of creditors paid out of the borrowed moneys. A company proposing t)o borrow usually issues a prospectus, similar to the ordinary share prospectus, stating the amount of the issue, the dates for payment, the particulars of the property to be comprised in the security, the terms as to redemption, and so on, and inviting the public to sub- scribe. Underwriting is also resorted to, as in the case of shares, to insure that the issue is taken up. There is no objection to a company issuing debentures or de- benture stock at a discount, as there is to its issuing its shares at a discount. It must borrow on the best terms it can get. A prospectus inviting subscriptions for deben- tures or debenture stock comes within the terms of the Directors Liability Act, 1890, and persons who are parties to it have the onus cast upon them, should the prospectus contain any misstatements, of showing that, at the time when they issued the prospectus, they had reasonable grounds to believe, and did in fact believe, that the state- ments in question were true ; otherwise they will be liable to pay compensation to any person injured by the mis- statements.

The usual mode of borrowing by a company is either on debentures or debenture stock. Etymologically, debenture is merely the Latin word " debentur," — the first word in a document in common use by the Crown in early times admitting indebtedness to its servants or soldiers. This was the germ of a security which has now, with the ex- pansion of joint-stock company enterprise, grown into an instrument of considerable complexity.

The Floating Debenture. — The form of debenture chiefly in use at the present day is that known as the floating debenture. By it the company covenants to pay to the holder thereof the sum ^secured by the debenture

on a specified day (usually ten or fifteen years after the date of issue), or at such earlier date as the principal moneys be- come due under the provisions of the security, and in the meantime to pay interest until repayment, or until the security becomes enforceable under the conditions ; and the company further charges its undertaking and all its property and assets, including its uncalled capital, with the payment of the amount secured by the debentures. The word "property" by itself will not cover uncalled capital. This is the body of the instrument; on its back is endorsed a series of conditions, constituting the terms on which the debenture is issued. Thus the debenture- holders are to rank pari passu with one another against the security; the debenture is to be transferable free from equities between the company and the original holder ; the charge is to be a floating charge, and is to be enforce-

able in certain events : for instance, if the interest is in arrear for three months, or if a winding up order is made against the company, or a resolution for winding up is passed. Other events are sometimes added accele- rating payment. The conditions also provided for the mode and form of transfer of the debentures, the death or bankruptcy of the holder, the place of payment, &c. The term " floating charge " is used to distinguish it from one that is fixed. The charge attaches as soon as the debenture is issued, but it attaches to the assets for' the time being only, i.e., it leaves the company free (or, to put it otherwise, gives it a licence) to sell, mortgage, lease, and otherwise deal with such assets as if no charge existed. This licence is involved in the fact that the debenture-holders' charge is on the company's undertak- ing, which implies that the undertaking is to remain a going concern. The licence extends, however, only to dealings in the ordinary course of business; it does not entitle a company to sell the whole of its undertaking and assets. Payment by a company of its just debts is always in the ordinary course of business, but satisfac- tion by execution levied in invitum, is not.

Every debenture must now, under the Companies Act, 1900, bear the registrar's certificate of registration. This floating form of security is

found very convenient both to the borrowing company and to the lender. The com- pany is not embarrassed by the charge, while the lender has a security covering the whole assets for the time being, and can intervene at any moment by obtaining a receiver if his security is imperilled, even thoughJnone of the events in which the principal moneys are made payable have happened. If any of them has happened, e.g., default in payment of interest, or a resolution by the company to wind up, the payment of the principal moneys is accelerated, and a debenture-holder can at once commence an action to obtain payment and to realize his security. At times a proviso is inserted in the con- ditions endorsed on the debenture, that the company is not to create any mortgage or charge ranking in priority to or pari passu with that contained in the debentures without the consent of the debenture-holders.

Trust Deeds. — When the amount borrowed by a com- pany is large, and it is not meant that it should be soon paid off, it is very common for the company to execute a Trust Deed by way of further security. The object of such a trust deed is twofold : (1) it conveys specific pro- perty to the trustees of the deed by way of legal mort- gage^(the charge contained in the debentures is only an equitable security), and charges all the remaining assets in favour of the debenture-holders, with appropriate pro- visions for enabling them in certain events similar to those expressed in the debenture conditions, to enforce the security, and for that purpose to enter into possession and carry on the business, or to sell it and distribute the pro- fits ; (2) it organizes the debenture-holders, and consti- tutes in the trustees of the deed a set of experienced and business-like men who can watch over the interests of the debenture-holders and take steps for their protection if necessary. In particular it provides machinery for the calling of meetings of debenture-holders by the trustees, and empowers a majority of (say) two-thirds or three- fourths in number and value at such meeting to bind the rest to any compromise or arrangement with the com- pany which such majorities may deem beneficial. This is foimd a very useful power, and may save recourse to a scheme of arrangement under the machinery of the Joint-Stock Companies Arrangement Act, 1870.

Registration of Mortgages and Charges. — A company is bound, under the Companies Act, 1862, to keep a register of mortgages and charges, open for the inspection of

creditors. It is also bound now, under the Companies Act, 1900, to register with the registrar of joint-stock companies at Somerset House all mortgages and charges of certain specified kinds made by the company, other- wise the security will be void.

Debentures Registered and to Bearer. — Debentures are usually of two kinds — (1) registered debentures, and (2) debentures to bearer. Eegistered debentures are trans- ferable only in the books of the company. Debentures to bearer are negotiable instruments, and pass by de- livery. Coupons are attached for interest. Sometimes debentures to bearer are made exchangeable for regis- tered debentures, and vice versd.

Redemption. — A company generally likes to reserve to itself a right of redeeming the security before the date fixed by the debenture for repayment ; and accordingly a power for that purpose is generally inserted in the con- ditions. But as debenture-holders, who have got a satis- factory security, do not wish to be paid off, the right of redemption is usually qualified so as not to arise till (say) five years after issue, and a premium of 5 per cent, is made payable by way of bonus to the redeemed deben- ture-holder. The number of debentures to be redeemed each year is also limited. The selection is usually made by drawings held in the presence of the directors. A sinking fund is a convenient means often resorted to for redemption of a debenture debt. Such a fund is formed by the company setting apart a certain sum each year out of the profits of the company after payment of inter- est on the debentures.

Debenture Stock. — Debenture stock bears the same re- lation to debentures that stock does to shares. "Deben- ture stock," as Lord Lindley states (Companies, 6th ed. 195), " is merely borrowed capital consolidated into one mass for the sake of convenience. Instead of each lender having a separate bond or mortgage, he has a certificate entitling him to a certain sum, being a portion of one large loan." This sum is not uniform, as in the case of debentures, but variable. One debenture-stockholder, for instance, may hold £20 of the debenture stock, another £20,000. It is this

divisibility of stock in fact, whether debenture or ordinary stock, into quantities of any amount, which constitutes its peculiar character- istic, and its convenience from a business point of view. It facilitates dealing with the stock, and also enables investors with only a small amount to invest to become stockholders. The property comprised. in this security is generally the same as in the case of deben- tures. Debenture stock created by trading companies differs in various particulars from debenture stock created by public companies governed by the Companies Clauses Act. The debenture stock of trading companies is created by a contract made between the company and trustees for the debenture-stockholders, known as a debenture-stockholders' trust deed, analogous in its pro- visions to the trust deed above described as used to secure debentures. By this deed the company acknow- ledges its indebtedness to the trustees as representing the debenture-stockholders to the amount of the sum ad- vanced, covenants to pay it, and conveys the subject- matter by way of security to the trustees with all the requisite powers and provisions for enabling them to enforce the security on default in payment of interest by the company or the happening of certain specified events evidencing insolvency. The company further in pursu- ance of the contract enters the names of the subsisting stockholders in a register, and issues certificates for the amount of their respective holdings. A deed securing debenture stock requires an ad valorem stamp.

Remedies. — When debenture-holders' security becomes

enforceable there are a variety of remedies open to them. These fall into two classes — (1) remedies available with- out the aid of the Court ; (2) remedies available only with the aid of the Court.

(1^ If there is a trust deed, the trustees may appoint a receiver of the property comprised in the security, and they may also sell under the powers contained in the deed, or under § 25 of the Conveyancing Act, 1881. Sometimes similar powers — to appoint a receiver and to sell — are inserted in the conditions endorsed on the debenture.

(2) The remedies with the aid of the Court are — (a) an action by one or more debenture-holders on behalf of all for a receiver and to realize the security; (6) an originating summons for sale or other relief, under Eule^ of Supreme Court, 1883, 0. 55, E. 5a ; (c) an action for foreclosure wher^ the security is deficient, — all the deben- ture-holders must be parties to this proceeding; (tZ) a winding-up petition. Of these modes of proceeding, the first is by far the most common and most convenient. The company is generally consenting, and the action comes on for judgment on agreed minutes, when the Court directs accounts and inquiries as to who are the holders of the debentures, what is due to them, what property is com- prised in the security, and gives leave to any of the parties to apply in chambers for a sale. If the company has gone into liquidation, leave must be obtained to commence or continue the action, but such leave in the case of debenture-holders is ex debitojustitice. The administration of a company's assets in such actions by debenture-holders (debenture-holders' liquidations, as they are called) has of late encroached very much on the ordinary administration of winding up. The chief sufferers from the floating security, when it comes to be enforced on winding up, are the company's unsecured creditors, who find that everything belonging to the "company, uncalled capital included, has been pledged to the debenture-holders. The conventional answer is that such creditors might and ought to have inspected the company's register of mortgages and charges.

Beconstruction. — *When a company reconstructs, as it often does in these days, the fights of debenture-holders have to be provided for. Keconstructions are mainly of two kinds* ***(l) by arrangement, under the Joint-Stock Companies Arrangement Act, 1870, and (2) by sale and transfer of assets, either under § 161 of the Companies Act, 1862, or under a power in the company's memoran- dum of association. Under the Joint-Stock Companies Act a petition for the sanction of the Court to a scheme is presented, and the Court thereupon directs meetings of creditors, including debenture-holders, to be held. A three-fourths majority in value of debenture-holders present at the meeting in person or by proxy binds the rest. Debenture-holders claiming to vote must produce their debentures at or before the meeting. Under the other mode of reconstruction — sale and transfer of assets — there is usually a novation, and the debenture-holders accept the security of the new company in the shape of debentures of equivalent value or — occasionally — of fully paid preference shares.***

A point in this connexion, which involves some hard- ship to debenture-holders, may here be adverted to. It is a not uncommon practice for a solvent company to pass a resolution to wind up voluntarily for the purpose of reconstructing. The effect of this is to accelerate pay- ment of the security, and the debenture-holders have to accept their principal and interest only, parting with a good security and perhaps a premium which would have accrued to them in a year or two. The company is thus enabled by its own act to redeem the reluctant deben- ture-holder on terms most advantageous to itself. To

obviate this hardship, it is now a usual thing in a debenture-holders' trust deed to provide — the committee of the London Stock Exchange indeed require it — that a premium shall be paid to the debenture-holders in the event of the security becoming enforceable by a voluntary winding up with a view to reconstruction.

Public Companies. — ^Public companies, i.e., companies incorporated by special Act of Parliament for carrying on undertakings of public utility, form a class distinct from trading companies. The borrowing powers of these companies, the form of their debenture or debenture stock, and the

rights of the debenture-holders or deben- ture-stockholders, depend on the conjoint operation of the companies' own special Act and the Companies Clauses Acts, 1845, 1863, and 1869. The provisions of these Acts as to borrowing, being express, exclude any implied power of borrowing. The first two of the above Acts relate to mortgages and bonds, the last to debenture stock. The policy of the Legislature in all these Acts is the same, namely, to give the greatest facilities for borrowing, and at the same time to take care that under- takings of public utility which have received its sanction shall not be broken up or- destroyed, as they would be if the mortgagees or debenture-holders were allowed the ordinary rights of mortgagees for realizing their security by seizure and sale. Hence the Legislature has given them only " the fruit of the tree," as Lord Cairns expressed it. The debenture-holders or the debenture- stockholders may take the earnings of the company's undertaking by obtaining the appointment of a receiver, but that is all they can do. Theyi cannot sell the under- taking or disorganize it ' by levying execution, so long as the company is a going concern; but this protecting principle of public policy will not be a bar to a debenture- holder, in his character of creditor, presenting a petition to wind up the company, if it is no longer able to fulfil its statutory objects. Railway companies are af- fected by further special legislation, which wiU he found in the Railway Companies Powers Act, 1864, the Rail- ways Construction Facilities Act, 1864, and the Railway Securities Act, 1866.

Municipal Corporations and County Councils. — These bodies are authorized to borrow for their proper purposes on debentures and debenture stock with the sanction of the Local Government Board. See the Municipal Corpo- rations Act, 1882, the Local Authorities Loans Act, 1876, and the Local Government (England and Wales) Act, 1888.

United States. — In the United States there are two meanings of debenture — (1) a bond not secured by mortgage ; (2) a certificate that the United States is indebted to a certain person or his assigns in a certain sum on an audited account, or that it will refund a certain suni paid for duties on imported goods, in case they are subsequently exported.

BiBLioGKAPHT. — Manson. Debentures and Debenture Stock. London, 1894. — Simonson. Debentures and Debenture Stock. London, 1898. — Palmek. Company Precedents, 7th ed. (^De- bentures). London, 1900. (b. ma.)

‘ Debreczen, a municipal town of Hungary, 114 miles east of Budapest, with (1900) 75,006 inhabitants. The country belonging to the town forms a vast plain 370 square miles in extent, on which are few dwelling-places,- but where roam hundreds of thousands of cattle, horses, sheep, and pigs.

Debu Lake. See ISTigeb.

Decatur, capital of Macon county, Illinois, U.S.A., near the Sangamon river, at an altitude of 668 feet. Its site is level, its street plan regular, and it has a good water supply and well-paved streets. Five railways meet here, making it a commercial point of much importance. Among its manufacturing establishments are flour-mills and car shops, and in its vicinity are coal-mines. Popula-

tion (1880), 9547; (1890), 16,841; (1900), 20,754, of “whom 1939 were foreign-born and 620 negroes.

Decazeville, a town and railway station in the arrondissement of Villefranche, department of Aveyron, Jrance, 22 miles in direct line north-west of Eodez. Coal and iron are .worked in the vicinity, and supply the raw material for very important ironworks, first established in the year 1827 by the Due Decazes, which have since grown to such magnitude that the town ranks as the chief centre of the coal and iron industry in the south-west of Prance. ¥iee schools and various benevolent institutions for the workpeople are in operation. A statue com- memorates the founder. Population (1881), 6793 ; (1896), 7434, (comm.) 9634; (1901), 11,536.

Decimal System. See Weights and Measuees.

Dedeagatch, a seaport of Turkey, capital of the province of the same name, about 10 miles north-west of the mouth of the Maritza. Till 1871 it was a mere cluster of fishermen's huts. A new town then began to spring up, settlers being attracted by the prospect of opening up a trade in the products of a vast forest of Valonia oaks which grew near. In 1873 it was made the chief town of a Kama, to which it gave its name, and a Kaimdkam was appointed to it. In 1884 it was raised in administrative rank from a Kaza ts, a Sandjak, and the governor became a Mutessarif. In 1889 the Greek Archbishopric of Enos was transferred to Dddeagatch. On the opening, early in 1896, of the Constantinople-Salonica railway, which has a station here, a large proportion of the extensive transit trade which Enos, situated at the mouth of the Maritza, had acquired was immediately diverted to Dedeagatch, and an era of unprecedented prosperity began ; but when the railway connecting Burgas on the Black Sea with the interior was opened, in 1898, it lost all it had won from Enos. The Valonia trade, however, has steadily developed, and is supplemented by the export of a certain amount of timber and some almonds. But untU the open roadstead is converted into a well- sheltered harbour it wUl be impossible for this place to become the entrepSt which its position otherwise emi- nently qualifies it to be. It has no manufacturing industry of any kind. Its population numbers about 4000 souls, of whom 2500 are Greeks. Austria-Hungary, Erance, Great Britain, Greece, and Eussia have consular representatives at Dedeagatch, and Bulgaria has an agent there. In digging out the foundations of their houses, the settlers found many ancient tombs. Probably these are relics, not of the necropolis of the ancient Zone,, but of a TM of Dervishes, of the D^de sect, which was established shortly after the conquest, and whose occu- pants gave to the place its name — ^Dedeagatch.

Dedham, capital of Norfolk county, Massachusetts, U.S.A., with an area of 23 square miles of quite level country. There are three villages in the town, known as Dedham, East Dedham, and Oakdale. The town is traversed by the New York, New Haven, and Hartford raUway. The chief industry is the manufacture of woollen goods. Population (1880), 6233 ; (1890), 7123 ; (1900), 7457, of whom 2186 were foreign-born and 65 negroes.

Deer. — The classification of the family Cervidse has been much altered since the article in Ency. Brit. vol. vii. was written. Deer are now arranged as follows : — ^First, the Reindeer {Bangifer tarandus), with several local races, distinguished from all other forms by the presence of antlers in both sexes. Second, the Elks (Alces), in which the antlers diverge at right angles to the middle line of the skull. Third, the typical Deer (Cervvs) , characterized by the antlers diverging obliquely to the middle line of the

skull, and having a brow-tine. They include the typical, or Bed Deer group, containing the Red Deer (C. elaphus), Hangul (C. cashmirianus), Shou (C affinis), Duke of Bedford's Deer (C. xanthopygus), and the Wapiti (C canadensis), of which a variety is found in Central Asia. Also the Sika group (sub-genus Pseudaxis)^ a,s represented by the Japanese Deer (C. sica) and Pekin Deer (C. hortulorum). The Fallow Deer (C. da-ma) represents a group by itself. This is followed by the Oriental Rusine group {Busa), with 3-tuied antlers, as represented by the numerous races of the Sambar (C unicolor), the Rusa (C7. hippelaphus), the Chital (C axis), and many smaller forms. The Swamp-Deer (C duvaiccel^ and Thamin (C eldi) are weU-known members of the last, or Rucervine group, which is likewise Oriental. , The five species of Muntjac constitute the fourth genus (Cervulus) of the family ; while the fifth is formed by the Tufted Deer (Elaphodus) of North China and Tibet. Then follows the hornless Chinese Water-Deer (Hydrelaphus), which is succeeded by the Roes {Gapreolus). These latter have no brow-tine, and the same is the case with the much larger Pere David's Deer (Elaphurus davidianus), now known only in cap- tivity. Allied to the last are the numerous species of American Deer (Mazama),oi. which the common species (Jf. americana) represents one group (Odocoileics), the Marsh-Deei (M. dichotomd) a second (Blastoceros), the Guemals (M. bisulca and M. antisiensis) a third (Xenela- phus), and the Brockets a fourth. Lastly, we have the diminutive American Pudus (Pudva), and the Musk- Deer {Moschus), which forms a subfamily apart.*

Dees or Des, a corporate town of Eastern Hungary, 48 miles north-north-east of Kolozvdr, on the river Szamos. Population (1900), 9888. Among

several ancient buildings the most noteworthy is the Gothic Calvinist church, con- structed in 1450. There is a large distillery in the town.

Defiance, capital of Defiance county, Ohio, U.S.A., on the Maumee river, at the mouth of the Auglaize, at an altitude of 695 feet. It has two railways, the Baltimore and Ohio, and the Wabash, and it is the seat of Defiance College. Population (1880), 5907; (1890), 7694 ; (1900), 7579, of whom 960 were foreign-bom and 39 negroes.

Degas, Hilaire Germain Edgard (1834- •), French painter, was born in Paris, 19th July 1834.

Entering in 1855 the ificole des Beaux Arts, he early developed independence of artistic outlook, studying under Lamothe. He first exhibited in the Salon of 1865, contributing a ” War in the Middle Ages,” a work executed in pastel. To this medium he was ever faithful, using it for some of his best work. In 1866 his ” Steeplechase ” revealed him as a painter of the racecourse and of ~~all the most modern aspects of life and of Parisian society, treated in an extremely original manner. He subsequently exhib~~ ited in 1867 ” Family Portraits,” and in 1868 a portrait of a dancer in the ” Ballet of La Source.” In 1869 and 1870 he restricted himself to portraits ; but thenceforward he abandoned the Salons and attached himself to the Im- pressionists. With Manet and Monet be took the lead of the new school at its first exhibition in 1874, and repeatedly contributed to these exhibitions (in 1876, 1878, 1879, and 1880). In 1868 he had shown his first study of a dancer, and in numerous pastels he proclaimed himself the painter of the ballet, representing its figurantes in every attitude with more constant aim at truth than grace. Several of his works maybe seen atthe Luxembourg Gallery, to which they were bequeathed, among a collection of impressionist pictures, by M. Caillebotte. In 1880 Degas showed his powers of observation in a set of “Portraits of Criminals,” and he attempted modelling in a

■ *Dansel’si; sur la Sckn’e.” By Degas.*

{Ill tlie I.ii.i-pi,ilii,iirii:

” Dancer,” in wax. He afterwards returned to his studies of the sporting world, exhibiting in December 1884 at the Petit Gallery two views of ” Races ” which had a great success, proving the increasing vogue of the artist among collectors. He is ranked with Manet as the leader of the ” impressionist school.” At the eighth Impressionist Exhibition, in 1886, Degas continued his realistic studies of modern life, showing drawings of the nude, of work- women, and of jockeys. Besides his pastels and his paintings of genre and portraits — among these, several likenesses of Manet — Degas also handled his favourite subjects in etching and in aquatint ; and executed several lithographs of “Singers at Cafes-concert,” of “Ballet- girls,” and indeed of every possible subject of night-life and incidents behind the scenes. Degas is reputed not to have striven for official recognition; but his work is to be seen not only at the Luxembourg but in many of the great private collections in Paris, as in those of M. Camondo and M. Manzi, in England and America. In the Centenary Exhibition of 1900 he exhibited ” The Inte- rior of a Cotton-Broker’s Office at New Orleans ” (belong- ing to the Museum at Pau) and ” The Eehearsal.”

See also G. Mooke. “Degas, the Painter of Modem Life,” Magazine of Art, 1890. — J. K. Hutsmans. Certains. Paris, 1889. — G. Geffkot. La vie Artistique. (3« Serie.) Paris, 1894.

Dehra, a town of- British India, headquarters of the Dehra Dun district. In 1881 the population was 18,959 ; in 1891 it was 26,684 ; the municipal income in 1897-98 was Es.27,618 ; the death-rate in 1897 was 27-15 per thousand. It is the headquarters of Trigonometrical Survey, and of the Forest Department, besides being a cantonment for a Gurkha regiment ; it has an American Presbyterian mission.

Dehra DuiY, a district of British India, in the Meerut division of the North-West Provinces. Its area is 1193 square miles. The population in 1881 was 144,070 ; in 1891 it was 168,135, giving an average density of 141 persons per square mile. In 1901 the population was 177,646, showing an increase of 6 per cent. The land revenue and rates were Rs. 1,12,666, the incidence of assessment beiag E. 0-5-9 per acre; the

cultivated area in 1896-97 was 87,912 acres, of which 23,441 were irrigated ; the number of police was 372 ; there were 22 vernacular schools, with 705 pupils ; the death-rate in 1897 was 24-25 per thousand. A railway to Dehra from Har- dwar, on the Oudh and Rohilkhand line (32 miles), was completed in 1900. Up to 1897-98 the capital outlay on the Dun canals was Es.7,15,311 ; the net receipts in that year were Es.68,161, showing a profit of 9-5 per cent. There are four printing-presses, issuing two English and one vernacular newspapers; and three breweries. Tea gardens cover an area of nearly 5000 acres.

Deir, or Deir ez-Zor, a town of Asiatic Turkey, on the right bank of the Euphrates, at an altitude of 806 feet. It is the capital of ithe Zor sanjak, which was formed in 1857, and includes Eas el-"Ain to the east, and Palmyra to the west of the river. The town is connected by a bridge with an island, whence there is a ferry to the left bank. The climate is healthy, but hot. Large num- bers of sheep and camels are bred in the sanjak, and cereals are grown. ' Eoads lead to Aleppo and Damascus, and, by Sinjar, to Mosul. The population of the sanjak is 100,000, chiefly nomads ; of the town, 7000, including a few Christians and Jews.

Dekalb, a city of Dekalb county, Illinois, U.S.A., in the northern part of the state, at the intersection of two railways. Population (1890), 2579; (1900), 5904, of whom 1520 were foreign-born.

Dekker, Edward Douwes (1820-1887), the Dutch writer, commonly known as Multatuli was born at Amsterdam on the 2nd of March 1820. His father, a ship's captain, intended his son for trade, but this humdrum prospect disgusted him, and in 1838 he went out to Java, and obtained a post in the Inland Eevenue. He rose from one position to another, until, in 1851, he found himself assistant-resident at Amboyna, in the Moluccas. In 1857 he was transferred to Lebak, in the Bantam residency of Java. By this time, however, all the secrets of Dutch administration were kno-^oi to him, and he had begun to protest against the abuses of the colonial system. In consequence he was threatened with dismissal from his office for his openness of speech, and, throwing up his appointment, he returned to Holland in a state of fierce indignation. He determined to expose in detail the scandals he had witnessed, and he

began to do so in newspaper articles and pamphlets. Little notice, however, was taken of his protestations, until, in 1860, he published, under the pseudonym of "Multatuli," his ro- mance entitled Max Havelaar. An attempt was made to ignore this brilliant and irregular book, but in vain ; it was read all over Europe. The exposure of the abuse of free labour in the Dutch Indies was complete, although there were not wanting apologists who accused Dekker's terrible picture of being over-coloured. He was now fairly launched on literature, and he lost no time in publishing Love Letters (1861), which, in spite of their mild title, proved to be mordant satires of the most rancorous and unsparing kind. The literary merit of Multatuli's work was much contested; he received an unexpected and most valuable ally in Vos- maer. He continued to write much, and to faggot his miscellanies in uniform volumes called Ideas, of which seven appeared between 1862 and 1877. Douwes Dek- ker quitted Holland, shaking off her dust from his feet, and went to live at Wiesbaden. He now made several attempts to gain the stage, and one of his pieces. The School for Princes, 1875 (published in the fourth volume of Ideas), pleased himself so. highly that he is said to have styled it the greatest drama ever written. It is a fine poem, written in blank verse, like an English tragedy, and not in Dutch Alexandrines; but it is undramatic, and has not held the boards. Douwes Dekker moved his residence to Nieder Ingle- heim, on the Ehine, and there he died on the 19th of February 1887. Towards the end of his career he was the centre of a crowd of disciples and imitators, who did his reputation no service ; he is now, again, in danger of being read too little. To understand his fame, it is neces- sary to remember the sensational way in which he broke into the dulness of Dutch literature forty years ago, like a flame out of the Far East. He was ardent, provocative, perhaps a little hysterical, but he made himself heard all over Europe. He brought an exceedingly severe indict- ment against the egotism and brutality of the administra^ tors of Dutch India, and he framed it in aliterary f orm which was brilliantly original. Not satisfied with this, he attacked, in a fury that was sometimes blind, everything that seemed to him falsely conventional in Dutch religion, government, society, and morals. He respected nothing, he left no institution untouched. Now that it is possible to look back upon Multatuli without passion, we see in him, not what Dutch enthusiasm saw, — " the second writer of Europe in the nineteenth century " (Victor Hugo being

presumably the first), — but a great man who was a power- ful and glowing author, yet hardly an artist, a reckless enthusiast, who was inspired by indignation and a burning sense of justice, who cared little for his means if only he could produce his effect. He is seen to his best and worst in Max Havelaar; his Ideas, hard, fantastic, and sardonic,

seldom offer any solid satisfaction to the foreign reader. But Multatuli deserves remembrance, if only on account of the unequalled effect his writing had in rousing Holland from the intellectual and moral lethargy in which she lay half a century ago. (e. g.)

Delane, John Thaddeus (1817-1879), editor of Tlie Times, was born 11th October 1817, in London, being the second son of Mr W. F. A. Delane, a barrister who was employed by Mr Walter in Tlie Times ofB.ce. While still a boy he attracted Mr Walter's attention, and it was always intended that he should find work on the paper. He received a good general education at private schools and King's College, London, and also at Magdalen Hall, Oxford; and after taking his degree in 1839, he read for the Bar, being called in 1847. MeanwhUe he had already begun work for The Times as a reporter ; and in 1841, on the death of Mr Barnes, he succeeded him as editor, a post which he occupied for thirty-six years. He was not himself a writer, but he was the greatest newspaper editor of his time, and perhaps of any time. Though he went into society and had a position there such as no journalist had pre- viously enjoyed, using his opportunities with a sure intuition for the way in which events would move, he had no likiag for personal publicity, but was careful to preserve his impersonality as an editor, and to merge himself in the newspaper which he represented. His triumph was the triumph of The Tim,es, which under his regime attained an influence which has never been surpassed. He was a man of many interests and great judgment; capable of long application and concentrated attention, with power to seize always on the main point at issue, and rapidly master the essential facts in the most complicated affair. His general policy was to keep the paper a national organ of opinion above party, but with a tendency to sympathize with the

Liberal movements of the day. He admired Palmerston and respected Lord Aberdeen, and was of considerable use to both; and it was Lord Aberdeen himself who, in 1845, told him of the impending repeal of the Com Laws, an incident round which many incorrect stories have gathered. The history, however, of the events during the thirteen administrations, between 1841 and 1877, in which Tim Times, and therefore Delane, played an im- portant part cannot here be recapitulated. In 1877 his health gave way, and he retired from the editorship ; and on 22nd November 1879. he died at Ascot. (h. ch.)

De la Rue, Warren (1815-1889), British astron- omer and chemist, son of Thomas de la Eue, the founder of the large firm of stationers of that name in London, was born in Guernsey on 18th January 1815. Having completed his education in Paris, he entered his father's business, but in his leisure hours he devoted himself with success to chemical and electrical researches, and between 1836 and 1848 published several papers on these subjects. Towards the end of this period he was attracted to astronomy, and with the aid of a 13-inch refiecting telescope, the optical parts of which were made entirely by himself, he executed many drawings of the celestial bodies of singular beauty and fidelity. His name, how- ever, will be chiefly remembered as one of the earliest and most successful pioneers in the application of the art of photography to astronomical research. In the year 1851 his attention was drawn to a daguerreotype of the moon by G. P. Bond, which was exhibited at the Great Exhibition of that year. Encouraged by this first attempt, and employing the more rapid wet-collodion process, he succeeded before long in obtaining exquisitely defined automatic pictures of the moon, which remained imsur- passed until the appearance of the Eutherf urd photographs

in 1865. In 1854 he turned his attention to solar physics, and for the purpose of obtaining a daily photographic representation of the state of the solar su|^face he devised the photoheliograph. This instrument is described in his report to the British Association, " On Celestial Photo- graphy in England " (1859), and in his Bakerian Lecture {Phil. Trans. Roy. Soc. vol. clii. pp. 333-416). Eegular work with this instrument was inaugurated at Kew by De la Eue in 1858, and was carried on there for

fourteen years; since 1872 it has been continued at the Eoyal Observatory, Greenwich. The results obtained in the years 1862-1866 are discussed in two memoirs published by De la Eue, in conjunction with Professor Balfour Stewart and Mr B. Loewy, in the Phil. Trans, (vol. clix. pp. 1-110, and vol. clx. pp. 389-496), entitled "Ee- searches on Solar Physics." In the year 1860 De la Eue took the photoheliograph to Spain for the purpose of photographing the total eclipse of the sun, which occurred on July the 18th of that year. This expedition formed the subject of the Bakerian Lecture already referred to. The photographs obtained on, that occasion proved beyond doubt the solar character of the prominences, or red flames, seen around the limb of the moon during a solar eclipse. In 1873 De la Eue gave up active work in astronomy, and presented most of his astronomical instruments to the University Observatory, Oxford. Subsequently, in the year 1887, he provided the same observatory with a 13-inch refractor to enable it to take part in the International Photographic Survey of the Heavens. In conjunction with Dr Hugo Mtiller, he published several papers of a chemical character between the years 1856 and 1862. He was twice President of the Chemical Society, and also of the Eoyal Astro- nomical Society (1864-1866). In 1862 he received the gold medal of the latter society, and in 1864 a Eoyal medal from the Eoyal Society, for his observations on the total eclipse of the sun in 1860, and for his improve- ments in astronomical photography. He died on 19th April 1889. ^ (a. a. e.)*

Delaware. — One of the Middle Atlantic States of the American Union, and next to Ehode Island the smallest in extent, Delaware is situated on the Atlantic seaboard, and forms part of the peninsula between the Chesapeake and Delaware Bays. Its total land surface is approximately 1960 square miles. The -population in 1870 was 125,015, of whom 102,221 were white and 22,794 coloured; in 1880 it was 146,608, of whom 120,160 were white, 26,442 coloured, 5 civilized Indians, and 1 Chinese. In 1890 it was 168,493, of whom 140,066 were white, 28,386 coloured, 37 Chinese, and 4 civilized Indians. In 1900 the population was 184,735, of whom 153,997 were white, 30,677 negroes, 61 Chinese, 1 Japanese, and 9 Indians. Out of 54,018 males 21 years of age and over, 7538 were illiterate (unable to write), of whom 3945 were white and 3593 coloured. Of the total population 94,158 (51 per cent.) were males, and 90,657 (49

per cent.) females; 170,925 (92-6 per cent.) were native-born, and 13,810 (7-5 per cent.) foreign-born. The increase in population from 1890 to 1900 was 9-6 per cent., and the number of inhabitants per square mile in 1900 was 94-2. There were 35 incorporated cities and towns. The largest city was Wilmington, with 76,508 inhabitants. The city next in size, Newcastle, had a population of but 3380, while the largest town, Dover, the State capital, had 3329. In Indian Eiver Hundred, Sussex county, there lives a race of persons, nearly white, called " Indians " or " Moors," whose origin is unknown, although local tradition says they are the descendants of some Moorish sailors who were cast ashore years ago in a shipwreck. They do not associate with

persons of negro descent; and they maintain separate churches and schools, the latter receiving State aid. Delaware is an agricultural and manufacturing State. Much of it is in a high state of cultivation. Besides wheat, maize, and other grain, peaches are grown in immense quantities and sent over the country. Straw- berries, raspberries, and other small fruits are raised for transportation. Increased attention has lately been given to dairy products. The canning of fruits, vegetables, meats, and poultry is carried on extensively. The kaolin mines were among those first worked in the United States, the product in 1899 being 10,500 tons, valued at $91,500. The forests, which afforded excellent timber, including white oak for the building of ships, have been greatly reduced by constant cutting. In the northern part of the- State there are numerous and important manufactories. Wilmington and its suburbs have large machine shops, whose products, including marine engines and boilers and paper and pulp machines, are justly renowned ; cotton, cotton-finishing, paper, morocco, patent leather, vulcanized fibre, car-wheel, carriage, and silk factories ; rolling-mills aiid bridge works. Cars, for steam and street railways, are manufactured on a large scale. Upwards of 400 iron steamships have been built in Wilmington, exceeding in number and in aggregate tonnage those constructed in any other American city. The flour-mills on the Brandywine, founded in 1762, are famous, and the

Dupont Gunpowder Works, 6 miles from Wilmington, are the oldest and largest in the country. There is a petroleum refinery at Marcus Hook.

According to the census of 1900, the number of manu- facturing establishments in the State (excluding 169 having an annual product of less than $500 each) was 1417, in which was invested a total capital (including land, buildings, machinery, tools, &c., but not including capital stock) of $41,203,239. There were 1327 ^salaried employees receiving salaries amounting to $1,422,831, and an average number of 22,203. wage-earners receiving $9,263,661 in wages. The cost of materials used, in- cluding mill supplies, freight, fuel, &c., was $26,652,601, and the miscellaneous expenses (including rent, taxeSj &c., but not including interest on capital invested) $2,158,350. The added values of the products in the different establishments amounted to $45,387,630. If from this gross value be deducted, in order to avoid duplication, the value ($15,849,388) of materials pur- chased in a partly manufactured form — where the finished product of one industry is used later as the raw material for another — the net value is foUnd to be $29,638,242. If the steel and rolling-mills, car shops, foundry and machine shops, and ship-building be grouped as the iron and steel industry, there were in ttiis industry fifty-three establishments having a capital of'#14,929,935, employing 8536 wage-earners, paying $4,265,670 as wages, and having a gross product of $13,953,379. The leather industry ranks next in importance, with twenty establishments, a capital of $5,178,804, 2457 wage-earners receiving $1,044,903, and gross product of $9,400,504.

The Delaware and .Chesapeake Canal connects the Delaware and Chesapeake bays, and affords water transit for produce between Philadelphia and Baltimore. The Philadelphia, Wilmington, and Baltimore railroad and the Baltimore and Philadelphia railroad run through the northern part of the State; the Wilmington and Northern railroad communicates with the Pennsylvania coal region ; the Delaware railroad runs through the whole length of the State below Wilmington, connecting with various railways that reach either the Atlantic Ocean or the Chesapeake Bay; while another line, running directly

across the lower part of the State, connects, at Queens- town, Maryland, with steamers for Baltimore.

The financial condition of the State is excellent, the assets, in bonds, railway mortgages, and bank stocks, exceeding the liabilities. Besides the income from assets, the State revenues are derived from taxes on licences, on commissions to public officers, on railway and banking companies, and to a slight extent from taxes on collateral inheritances, and on investments, as bonds, mortgages, notes and stocks, the Investment tax yielding in 1899 only $1,311.35. There are county taxes, on land and live-stock, for tlie care of the roads and the poor ; local taxes, levied on the rental value of land and on live-stock, towards the support of the public schools ; town taxes, and, in some places, ditch taxes.

The vital statistics of the State are of little value, not having been systematically kept. A State Board of Health was organized in 1879, and there are now local boards in various towns. There is in each county a jail and an almshouse. Under recent legislation there is to be established in Newcastle county a workhouse, where persons under sentence must labour for eight hours each secular day, pay being allowed for overwork, and credit given, by reduction of sentence, for good behaviour. There is a State hospital for the insane. A certain number of persons are main-tained out of the State School fund at outside institutions, such as the Pennsylvania Institution for the Deaf and Dumb, and the Pennsyl- vania Training School for Feeble-Minded Children. There are various private charities, particularly in the city of Wilmington.

Education exhibits progress. Delaware College, at Newark, with the support of Federal grants, steadily increases in efSoiency. The maintenance of a system of public schools is rendered com- pulsory by the State Constitution. The State School fund, ranging from about $130,000 to $140,000 a year is apportioned among the school districts, and is used exclusively for teachers' salaries and free text-books. In the apportionment no discrimina- tion is allowed on account of race or colour ; but separate schools for white and coloured children must be provided, and there is a State college for coloured students. Besides the State Board of Education, there is in each county a School Commission and a

Superintendent of Public Schools, and in each district a School Committee chosen by the voters of the district, with power to levy taxes. At school elections women as well as men may be qualified to vote.

The Constitution now in force was framed in 1897, superseding the Constitution of 1831. Following the precedent recently set elsewhere, it was published and put into operation by authority of a resolution of the Constitutional Convention, without submission to the people. In the General Assembly the number of Repre- sentatives is raised from 21 to 35, and of Senators from 9 to 17, equal county representation being done away with.

The State is divided into 35 representative districts, Newcastle county having 15, and Kent and Sussex each 10 ; and 17 senatorial districts, Newcastle having 7, and Kent and Sussex each 5. Of the 15 Newcastle Eepresentatives, Wilmington has 5 ; of the 7 Senators, 2. The sessions of the General/Assembly, held at Dover, the State capital, are still biennial. The members receive an allowance for each day of the session not exceeding sixty, after which they get no compensation. At a special session the daily allowance is limited to thirty days. Legislative divorces are prohibited. The Governor's appointments to office must, except in certain cases, be confirmed by the Senate. He has a suspensory veto on legislation. Certain State officers, including the Attorney- General, and various county officers, formerly appointed by the Governor, are now elected. The judges are still appointed, but only for terms of twelve years. All persons coming of age, or becoming citizens of the United States, after 1st January 1900, must, in order to vote, be able to read the State Constitution in English and write their names. The payment of a poll-tax as a prerequisite to voting is abolished, and all eligible persons are registered on payment of a fee of one dollar. Persons charged with bribery at elections are triable by the court on information and without a jury. A Board of Pardons, consisting of the Chancellor and certain administrative officers, is created, and no reprieve for more than six months, or commutation of sentence, or pardon, can be granted by the Governor unless on the written recom- mendation of a majority of this Board. There is also established a State Board of Agriculture.

The Judicial power of the State is vested in a Supreme Court, a Superior Court, a Court of Chancery, an Orphans' Court, a Court of Oyer and Terminer, a Register's Court, and Justices of the Peace. There are six State judges, namely, a Chancellor, a Chief Justice, and four Associate judges. The Chancellor, Chief Justice, and one of the Associates may be appointed from and reside in any part of the State; the other three Associates may be appointed from any part of the State, but must reside one in each county. The five law judges compose the Superior Court, Court of General Sessions, and Court of Oyer and Terminer, but not

more than three of them can sit together in any one of those courts, though three must do so whenever practicable. Two constitute a quorum, save in the Court of Oyer and Terminer, where three are required. The Supreme Court consists, on error or appeal from a law court, of a Chancellor, who presides, and such of the five law judges as did not sit below ; on appeal from the Court of Chancery, of the five law judges, three of whom consti- tute a quorum.

In politics, since the close of the Civil War in 1865, the State has generally been Democratic. But, in 1889, a Republican was elected to the United States Senate ; and candidates of the same party were, in 1894, 1898, and 1900, chosen to the National House of Representatives, and, in 1894 and 1900, to the Governorship. In 1895, 1899, and 1901, the Legislature, being then Republican, was, because of a division in the party as to candidates, unable to elect a United States Senator, so that the State had, from 4th March 1895 till 1897, and from 4th March 1899 till 4th March 1901, only one United States Senator, and none at the special session of the Senate in March 1900. In 1896 and 1900, Mr M'Kinley, the Repub- lican candidate for the Presidency, partly because of the attitude of the Gold Democrats, carried the State by large majorities. General Graait obtained, as the Republican candidate in 1872, a small majority. (j. b. M.)*

Delaware, capital of Delaware county, Ohio, U.S.A., on the Olentangy river, at an altitude of 902 feet. It has three railways, the Cleveland, Cincinnati, Chicago, and St Louis, the Columbus, Sandusky and Hocking, and the Hocking Valley. The Ohio Wesleyan University, located here, had, in 1899, 53 professors and instructors, and 1055 students, one-third of whom were women. Its property was valued at over $1,300,000, and its income was 1 62,000. Population (1880), 6894 ; (1890), 8224; (1900), 7^40, of whom 572 were foreign- born and 432 negroes.

Delaware River, a river of the eastern United States, rises in the Catskill Mountains, in south-eastern New York, and flows south-west to the north-east corner of Pennsylvania ; thence, with a south-east course, it forms the boundary between New York and Pennsylvania, and farther down, with a course alternating between south-east and south-west, it forms the boundary between New Jersey on the east and Pennsylvania and Delaware on the west. It has no well-defined mouth, but gradually wijdens into Delaware Bay. It is navigable to Trenton, where are falls, a distance from the capes of the Delaware of 128 miles. Its entire length from its head to the capes at the entrance to Delaware Bay is upwards of 400 miles, and its drainage basin comprises 12,012 square miles. In its upper course, after leaving the Catskills, it flows alter- nately through the valleys between the Appalachian ridges and across these ridges through water-gaps. The most picturesque and best known of these is Delaware Water- Gap. The falls at Trenton, which have been utilised for power, are produced by the passage of the river over a fault-line from hard granite rocks to soft Tertiary beds.

DelbriJck, Martin Friedrich Rudolf, Prus- sian statesman (1817), was born at Berlin on 16th

April 1817. On completing his legal studies he entered the service of the State in 1837 ; and after holding a series of minor posts, was transferred in 1844 to the Ministry of Commerce, which was to be the sphere of his real life's work. Both Germany and Austi-ia had realized the influence of commercial upon political union. Delbrtick in 1851 induced Hanover, Oldenburg, and Schaumburg- Lippe to j oin the ZoUverein ; and the southern States, which had agreed to admit Austria to the union, found

themselves forced in 1853 to renew the old union, from which (Austria was excluded. Delbriick now began, with the support of Bismarck, to apply the principles of Pree Trade to Prussian fiscal policy. In 1862 he concluded an im- portant commercial treaty with Trance, which he succeeded in inducing the southern States to accept. After the Prussian victories of 1866, a Zollbundesrath or Federal

Council was constituted, in which Delbriick, who became the first President of the Bundeskanzleramt or Federal Chancellery (1867), represented Bismarck in political as well as commercial questions. In 1868 he became a Prussian Minister without portfolio. In October 1870, when the political union of Germany under Prussian headship became a practical question, Delbriick was chosen to go on a mission to the South German States, and con- tributed greatly to the agreements concluded at Versailles in November. In 1871 he became President of the newly constituted Reichskanzleramt. Delbriick now, however, began to feel himself uneasy under Bismarck's leanings towards Protection and State control. On the introduc- tion of Bismarck's plan for the acquisition of the railways by the State, Delbriick resigned ofiSce, nominally on the ground of ill health (1st June 1876). In 1879 he opposed in the Eeichstag the new protectionist tariff, and on the failure of his efforts retired definitely from public life.

Delcasse, Theophile (1852), French states- man, was born at Pamiers, in the' department of Ariege, on 1st March 1852. He wrote articles on foreign affairs for the Bipublique Frangaise and Paris, and in 1888 was elected Conseiller G&eral of his native department, standing as " un disciple fidele de Gambetta." In the following year he entered the Chamber as deputy for Foix. He was appointed Under Secretary for the Colonies in the second Eibot Cabinet (January to April 1893), and retained his post in the Dupuy Cabinet- till its fall in December 1893. It was largely owing to his efforts that the French Colonial OfB.ce was made a separate depart- ment with a minister at its head, and to this office he was appointed in the second Dupuy Cabinet (May 1894 to Jan- uary 1895). He gave a great impetus to French colonial enterprise, especially in West Africa, where he organized the newly acquired colony of Dahomey, and despatched the Liotard mission to the Upper Ubangi.

While in oppo- sition, he devoted special attention to naval affairs, and in speeches that attracted much notice declared that the func- tion of the French navy was to secure and develop colonial enterprise, deprecated all attempts to rival the British fleet, and advocated the construction of commerce-destroyers as France's best reply to England. On the formation of the second Brisson Cabinet in June 1898 he succeeded M. Hanotaux at the Foreign Office, and retained that post under the subsequent premierships of MM. Dupuy and Waldeck-Eousseau. In 1898 he had to deal with the delicate situation caused byOaptain Marchand's occupation of Fashoda, for which, as he admitted in a speech in the Chamber on 23rd January 1899, he accepted full responsi- bility, since it arose directly out of the Liotard expedition, which he had himself organized while Minister for the Colonies ; and in March 1899 he concluded an agreement with Great Britain by which the difficulty was finally adjusted, and France consolidated her Vast colonial empire in North- West Africa. In the same year he acted as mediator between the United States and Spain, and brought the peace negotiations to a successful conclusion. He introduced greater cordiality into the relations of France with Italy : at the same time he adhered firmly to the alliance with Russia, and in August 1899 made a visit to St Petersburg, which he repeated in April 1901. In June 1900 he concluded an important agreement with Spain, fixing the long-disputed boundaries of the French and Spanish possessions in West Africa.

Delft, a tovTn in the province of South Holland, Nether- lands, 10 miles north-west of Rotterdam by rail. For- merly it rivalled Rotterdam in the importance of its shipping and commerce, but is now only the market for the butter and cheese of the fertile district around. There is

still considerable industry in earthenware (" New Delft "), gun-construction, distilling, and the manufacture of salad oil and oil-cakes. The "Phoenix," or old clubhouse of the students, which was burned down in 1872, has been replaced by a handsome erection in Renaissance style.

A bronze statue of Hugo Grotius was raised in 1886. The population in 1900 was 31,582.

Delhi, or DiLLi, a city of British India, the former capital of the Mughal Empire, now giving its name to a district and a division in the Punjab. It is situated on the right bank of the river Jumna, 954 miles from Calcutta by rail. In 1881 it had a population of 173,393, and in 1891 of 192,579. In 1901 the population was 208,385, showing a continuous increase. The municipal income in 1897-98 was Rs.4,57,182 ; the death-rate in 1897 was 34 per thousand. Delhi, as the centre of the railway system of Northern India, is now regaining much of the importance it lost at the time of the Mutiny. It is the terminus of three mainlines — the East Indian,.the North-Western, and the Eajputana ; while the Delhi-IJmballa-Kalka and the Northern Punjab companies also have stations here. The principal manufactures are gold and silver filigree-work and embroidery, jewellery, muslins, shawls, glazed pottery, and wood-carving. Since 1890 three cotton mills have been established, with 351 looms and 47,000 spindles, employing 1800 hands. There are also three flour-mills, several iron foundries, and a brush factory. A filtered water supply and sewerage works have been provided by the municipality out of a loan of Es.8,00,000, and a further loan of Es.1,80,000 for improving the water sup- ply is proposed. The institutions include St Stephen's /College, which teaches up to the M.A. degree ; five high schools ; Government normal school ; native school of medicine subsidized by the municipality; S.P.G., Ro- man Catholic, and Baptist missions ; sixty-four printing- presses, issuing twenty-one newspapers and periodicals ; institute and reading room ; Mahommedan and Hindu religious associations.

The DiSTEiCT OF Delhi has an area of 1290 square miles. The population in 1881 was 643,516 and in 1891 was 638,689, being the only case in the Punjab of a decrease ; the average density was 495 persons per square mile. In 1901 the population was 688,979, showing an increase of 8 per cent. The land reveniie and rates were Es. 8,90,644, the incidence of assessment being E.1-0-8 per acre ; the cultivated area was 432,209 acres, of which 178,782 were irrigated, including 68,072 from Government canals ; the number of police was 1031 ; the number of schools in 1897-98 was 237, attended by 8192 boys, being 13-8 per cent,

of the boys of school-going age ; the death-rate in 1897 was 33-34 per thousand. There are four factories for ginning and pressing cotton. Its northern portion is traversed by the Delhi-UmballarKalka railway, and crossed by the Eajputana and Southern Punjab lines; total length, 74 miles. A new line, on the East Indian system, is now (1891) being constructed from Delhi south- ward to Agra through Muttra. ,

The DIVISION OP Delhi stretches from Simla to Eaj- putana, and' is much broken up by native states. It comprises the seven districts of Hissar, Eohtak, Gurgaon, Delhi, Karnal, TJmballa, and Simla. Its total area is 15,530 square miles, and in 1891 the population was

3,435,886.

Delibes, Clement Philibert Leo (1836-1891), French composer, was born at Saint Germain du Val on February 21, 1836. He studied at the Paris Con- servatoire under Adolphe Adam, through whose influence he became accompanist at the Theatre Lyrique. Towards the same period he began writing for the theatre, and during several years he produced a number of operettas. I

Alger, a cantata from his pen, was heard at the Opera in 1865. Having become second chorus-master at the Grand Opera, he wrote the music of a ballet entitled La Source for this theatre, in collaboration with Minkous, a Eussian composer. La Source was produced with great success in 1866. The composer returned to the operetta style with Malhrouk s'en vaA-en guerre, — written in col- laboration with Georges Bizet, Emile Jonas, and Le- gouix, and given at the The§,tre de I'Athenee in 1867. Two years later came L'Ecossais de Chatou, a one-act piece, and La Cour du Boi Pitaud, a three-act opera- bouffe. The ballet CoppMia was produced at the Grand Opera on 25th May 1870 with enormous success. De- libes's first important dramatic work was Le Roi I'a dit, a charming "opera Comique," heard for the first time on 24th May 1873 at the Opera Comique Theatre. Three years later, on 14th June 1876, Sylvia, a ballet in three acts, one of the composer's most delightful works, was produced at the Grand Opera. This was followed by Jean de Nivelle, a three-act opera brought out at the Opera Comique on 8th March 1880, and LakmA, in three acts produced at the same theatre on 14th April 1883, which has

remained his most popular opera. The com- poser died in Paris on the 17th January 1891, leaving Kassya, a four-act opera, in an unfinished state. This work was completed and scored by Massenet, and produced at the Op^ra Comique Theatre on 24th March 1893. Leo Delibes was a typically French composer. His music is light, graceful, and refined. He excelled in ballet music, and Sylvia may well be considered a masterpiece of the genre. His operas are constructed on a conventional pattern. The harmonic texture, how- ever, is modern, and the melodic invention abundant, while the orchestral treatment is invariably excellent.

(a. he.)

Del isle, Leopold Victor (1826), French

historian and head of the Bibliotheque Nationale at Paris, was born at Valognes (Manche) on 24th October 1826. In 1847 he became a student at the ificole des Chartes, where his career was remarkably brilliant. In 1832 he was appointed an assistant in the Manuscript Depart- ment-of the Bibliotheque Nationale, and after being for some time conservator of that department, succeeded M. Taschereau as head of the entire establishment in 1874. He produced many valuable oflSeial reports, and a still greater amount of memoirs and monographs on points connected with palaeography, and the study of history and archaeology. Among his services ■fras the acquisition for France of a portion of the Ashburnham manuscripts, including many that, before M. Delisle's time, had been purloined from the Bibliotheque Nationale. In 1897 he commenced the publication of what is intended to be a nearly complete printed catalogue of the books in the Bibliotheque — a great enterprise destined to occupy many years in its completion.

Delius, Nicolaus (1813-1888), German philolo- gist and Shakespearean scholar, was bom at Bremen on 19th October 1813. He was educated at Bonn and Berlin, and took his Doctor's degree in 1838.

dreizehnten Jahrhunderts (1868), and Abhandlungen zu Shakspere (2 series, 1878 and 1888). As a critic of Shakespeare's text he stands in the first rank. (r. f. s.)

Delmenhorst, a town of Germany, grand duchy of Oldenburg, 8 miles by rail west from Bremen, on the river Delme, was protected by a strong castle from 1247 to 1679, when it was destroyed by the French. Carries on cork-cutting, jute-spinning and weaving, brewing, iron- founding, and making of boxes. Population (1885), 3842 ;

(1900), 16,569.

De Long, George W. (1844-1881), American ex- plorer, was born in New York City on 22nd August 1844. He graduated at the U.S.' Naval Academy in 1865, and spent the next fourteen years in the service in various parts of the world. In 1873 he sailed on the Juniata expedition in search of the Arctic exploring steamer Polaris, and was detailed to the command of the launch which was sent out by the Juniata from Upernivik, Greenland. On his return to New York the same year he proposed to Mr James Gordon Bennett, of the New York Herald, that the latter should fit out a Polar ejtpedition, but it was not until 1879 that final arrangements were made. The Pandora, a private yacht which had been previously used in a number of Arctic expeditions, was purchased and rechristened the Jeanette, and strengthened and fitted out for the voyage. By Act of Congress the expedition was placed under the authority of the Secretary of the U.S. Navy, although all the expenses were borne by Mr Bennett. On 8th July 1879 the Jeanette, with 33 men on board, set sail from San Francisco for Siberian waters. On 5th September 1879 the vessel was enclosed in the ice-pack, and after a long drift was finally crushed by the ice on the 12th of June 1881 in 77° 15′ N. lat. and 165° E. long. The members of the expedition journeyed by sledge and boat 150 miles to the New Siberian Islands, and thence set out by . boat in three parties for the mainland. The crew of one boat was lost in a gale ; that of another, under the command of Chief- Engineer George W. Melville, reached a village on the Lena. The third party, under the command of De Long, succeeded in landing at the mouth of the Lena, and pushed forward up the river by land. All of De Long's party perished except two

who had been sent forward to seek relief. The dead bodies and the records of the expedition were found in the following March by Melville, only 25 miles distant from a Siberian settlement. De Long was the last survivor. His journal, in which he made regular entries up to the day on which he died, has been edited by his wife and published under the title Voyage of the " Jeanette." An account of the search for De Long and his comrades was also published by G. W. Melville in his book entitled In the Lena Delta.

Delos. — Excavations have been made by the French School at Athens upon the island of Delos since 1877, chiefly by M. Th. Homolle. They have proceeded slowly but systematically, and the method adopted, though scientific and economical, has left the site in some apparent confusion, the debris being heaped up into piles or thrown into alreMy excavated portions, instead of being removed bodily as at Olympia and at Delphi. The complete plan of the sacred precinct of Apollo has been recovered, as well as those of a considerable portion of the commercial quarter of Hellenistic and Eoman times, of the theatre, of the temples of the foreign gods, of the temples on the top of Mount Cynthus, and of several very interesting private houses. Numerous works of sculpture of all periods have been found, and also a very extensive series of inscriptions, some of them throwing much light upon the subject of temple admin- istration in Greece.

The most convenient place for landing is protected by an ancient mole ; it faces the channel between Delos and Eheneia, and is about opposite the most northerly of the two little islands now called 'Fev/mndpi. From this side the sacred precinct of Apollo is approached by an avenue flanked by porticoes, that upon the seaside bearing the name of Philip V. of Macedon, who dedicated it about 200 B.C. This avenue must have formed the usual approach for sacred embassies and processions ; but it is probable that the space to the south was not convenient for marshalling them, since Nicias, on the occasion of his famous embassy, built a bridge from the island of Hecate (the Greater Khevmatiari) to Delos, in order that the imposing Athenian procession might not miss its full effect. Facing the avenue were the propylsea that formed the chief entrance of the precinct of Apollo. They con- sisted of a gate faced on the outside with

a projecting portico of four columns, on the inside with two columns in antis. Through this one entered a large open space; filled with votive. offerings and containing a large exedra. The sacred road continued its course from the north-east corner of this open space, with the precinct of Artemis on its west side, and, on its east side, a terrace on which stood three temples. The southernmost of these was the temple of Apollo, but only its back was visible from this side. Though there is no evidence to show to whom the other two were dedicated, the fact that they faced west seems to imply that they were either dedicated to heroes or minor deities, or that they were treasuries. Beyond them a road branches to the right, sweeping round in a broad curve to the space in front of the temple of Apollo. The outer side of this curve is bounded by a row of treasuries, similar to those found at Delos and Olympia, and serving to house the more costly offerings of various islands or cities. The space to the east and south of the temple of Apollo could also be approached directly from the propylaea of entrance, by turning to the right through a passage-like building with a porch at either end. Just to the north of this may be seen the basis of the colossal statue of Apollo dedicated by the Naxians, with its well-known archaic inscription ; two large fragments of the statue itself may still be seen a little farther to the north.

The temple of Apollo forms the centre of the whole precinct, which it dominates by the height of its steps as well as of the terrace already mentioned ; its position must have been more commanding in ancient times than it is now that heaps of earth and debris cover so much of the level. The temple was of Doric style, with six columns at the front and back and thirteen at the sides ; it was built early in the 4th century b.c. ; little if any traces have been found of the earlier building which it superseded. Its sculptural decoration appears to have been but scanty; the metopes were plain. The groups which ornamented, as acroteria, the two gables of the temple have been in part recovered, and may now be seen in the National Museum at Athens ; at the one end was Boreas carrying off Orithyia, at the other Eos and Cephalus, the centre in each case being occupied by the winged figure that stood out against the sky — a variation on the winged Victories that often occupy the same position on temples.

To the east of the space in front of the temple was an oblong building of two chambers, with a colonnade on each side but not in front ; this may have been the Prytaneiim or some other official building; beyond it is the most interesting and characteristic of all the monuments of Delphi. This is a long narrow hall, running from north to south, and entered by a portico at its south end. At the north end was the famous altar, built out of the horns of the victims, which was reckoned among the seven wonders of the world. The rest of the room is

Walker Cockerell sc*

PRECINCT OP APOLLO AT DELPHI.

Scale of Metres

Scale of Yards P 5 ip y 3P

By permission from plans in Uuilctin de Correspondence HellenLque 1897. XVI, XVII.

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DELPHI

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taken up by a paved space, surrounded by a narrow gang- way ; and on this it is supposed that the famous yepavos or stork-dance took place. The most remarkable archi- tectural feature of the building is the partition that separated the altar from this long gallery ; it consists of two columns between antae, with capitals of a very pecul- iar form, consisting of the fore parts of bulls set back to back ; from these the whole building is sometimes called the sanctuary of the bulls. Beyond it, on the east, was a sacred wood filling the space up to the wall of the pre- cinct; and at the south end of this was a small open space with the altar of Zeus Polieus.

At the north of the precinct was a broad road, flanked with votive offerings and exedrae, and along the boundary were porticoes and

chambers intended for the recep- tion of the Oeaipiai or sacred embassies; there are two entrances on this side, each of them through extensive propylaea.

At the north-west corner of the precinct is a building of limestone, the iriipivtK oocos often mentioned in the inventories of the treasures of the Delian shrine. South of it is the precinct of Artemis, containing within it the old temple of the goddess ; her more recent temple was to the south of her precinct, opening not into it but into the open space entered through the southern propylsea of the precinct of Apollo. The older temple is mentioned in some of the inventories as " the temple in which were the seven statues " ; and close beside it was found a series of archaic draped female statues, which was the most im- portant of its kind until the discovery of the finer and better preserved set from the Athenian Acropolis.

Within the precinct there were found many statues and other works of art, and a very large number of inscriptions, some of them giving inventories of the votive offerings and accounts of the administration of the temple and its property. The latter are of considerable interest, and give full information as to the sources of the revenue and its financial administration.

Outside the precinct of Apollo, on the south, was an open place; between this and the precinct was a house for the priests, and within it, in a kind of court, a set of small structures that may perhaps be identified as the tombs of the Hyperborean maidens. Just to the east was the temple of Dionysus, which is of peculiar plan, and faces the open place ; on the other side of it is a large rectangular court, surrounded by colonnades and chambers which served as offices, the whole forming a sort of commercial exchange ; in the middle of it was a temple dedicated to Aphrodite and Hermes.

To the north of the precinct of Apollo, between it and the sacred lake, there are very extensive ruins of the commercial town of Delos ; these have been only partially cleared, but have yielded a good many inscriptions and other antiquities. The most extensive building is a very large court surrounded by chambers, a sort of club or exchange. Beyond

this, on the way to the east coast, are the remains of the new and the old palsestra, also partially excavated.

The shore of the channel facing Rhenea is lined with docks^ and warehouses, and behind them, as well as elsewhere in the island, there have been found several private houses of the 2ud or 3rd century B.C. Each of these consists of a single court surrounded by columns and often paved with mosaic ; various chambers open out of the court, including usually one of large proportions, the avSpmv or dining-room for guests.

The theatre, which is set in the lower slope of Mount Cynthus, has the wings of the auditorium supported by massive substructures. The most interesting feature is the scena, which is unique in plan ; it consisted of an oblong building of two storeys, surrounded on all sides by a low

portico or terrace reaching to the level of the first floor. This was supported by pillars, set closer together along the front than at the sides and back. An inscription found in the theatre showed that this portico, or at least the front portion of it, was called the proscenium or logeum, two terms of which the identity was previously disputed. On the summit of Mount Cynthus, above the primitive cave-temple which has always been visible, there have been found the remains of a small precinct dedicated to Zeus Cynthius and Athena Cynthia. Some way down the slope of the hill, between the cave-temple and the ravine of the Inopus, is a terrace with the temples of the foreign gods, ,Isis and Serapis, and a small odeum.

Numerous articles in the Bulletin de Correspondence Hellenique record the various discoveries at Delos as they were made. See also Th. HomoUe, Les archives de Vintendance sacrie a Delos (with plan). The best consecutive account is given in the Guide Joanne, Grece, vol. ii. p. 443-464. For works of art found at Delos see Archeology.

See also Geeece, Ionian Islands. (b. Ge.)

Delphi. — The site of Delphi was bought by the French Government in 1891t, and the peasant proprietors expropriated and transferred to ^he new village of Castri, a little farther to the west. Work began in the spring of 1892, and the site was rapidly cleared of earth by means of a light

railway. The plan of the precinct is now easily traced, and with the help of Pausanias many of the build- ings have been identified.

The ancient wall running east and west, commonly known as the Hellenico, has been found extant in its whole length, and the two .boundary walls running up the hill at each end of it, traced. In the eastern of these was the main entrance by which Pausanias went in along the Sacred Way. This paved road is easily recognized as it zigzags up the hill, with treasuries and the bases of various offerings facing it on both sides. It mounts first westwards to an open space, then turns eastwards till it reaches the eastern end of the terrace wall that supports the temple, and then turns again and curves up north and then west/ towards the temple. Above this, approached by a stair, are the Lesche and the theatre, occupying respectively the north-east and north-west corner of the precinct. On a higher level still, a little to the west, is the stadium. There are several narrow paths and stairs that cut off the zigzags of the Sacred Way.

In describing the monuments discovered by the French excavators, the simplest plan is to follow the route of Pausanias. Outside the entrance is a large paved court of Roman date, flanked by a colonnade. On the north side of the Sacred Way, close to the main entrance, stood the offering dedicated by the La- cedaemonians after the battle of .^Egospotami. It was a large quadrangular building of conglomerate, with a back wall faced with stucco, and stood open to the road. On a stepped pedestal facing the open stood the statues of the gods and the admirals, perhaps in rows above one another.

The statues of the Epigoni stood on a semicircular basis on the south side of the way. Opposite them stood another semicircular basis which carried the statues of the Argive kings, whose names are cut on the pedestal in archaistic characters, reading from right to left. Farther west was the Sicyonian treasury on the south of the way. It was in the form of a distyle Doric temple in antis, and had its entrance on the east. The present foundations are built of architectural fragments, probably from an earlier building of circular form on the same site. The sculptures from this treasury are in the museum, as are' the other sculptures found on the site.

These sculptures, which are in rough limestone, most likely belong to the earlier building, as their surface is in a better state of

preservation than could be possible if they had been long exposed to the air. The earlier treasury was probably destroyed either by earthquake or by the percolation of water through the terracing.

The Cnidian treasury stands on the south side of the way farther west. This building was originally surmised by the excavators to be the Siphnian treasury, but further evidence led them to change their opinion. The treasury was raised on a quadrangular structure, supported on its south side by the Hellenico, and built of tufa. The lower courses ai-e left rough and were most likely hidden. A small distyle Ionic temple of marble stood on this substrueture. The sculpture from this treasury, which ornamented its frieze and pediment, is of great interest in the history of the development of the art, and the fragments of architectural mouldings are of great delicacy and beauty. The whole work is perhaps the most perfect example we possess of the tran- sitional style of the early 5th century. Standing back somewhat from the path just as it bends round up the hill is the Theban treasury. Farther north, wHere the path turns again, is the Jlthenian treasury. This struc- ture, which was in the form of a small Doric temple in antis, appears to have suffered from the building above it having been shaken down by an earthquake. There can be no doubt about the identity of the building, for the basis on which it stands bears the remains of the dedicatory inscription, stating that it was erected from tlie spoils of Marathon. Almost all the sculptured meto- pes are in the museum, and are of the highest interest to the student of archaic art. The famous inscriptions with hymns to Apollo accompanied by musical notation were found on stones belonging to this treasury.

Above the Athenian treasury is /an open space, in which is a rock which has been identified as the Sibyl's rock. It has steps hewn in it, and has a cleft. The ground round it has been left rough like the space on the Acropolis at Athens identified as the ancient altar of Athena. Here too

was placed the curious column, with many flutes and an Ionic capital, on which stood the colossal sphinx, dedicated by the Naxians, that has been pieced together and placed in the museum.

A little farther on, but below the Sacred Way, is another open space, of circular form, which is perhaps the oX^sor sacred threshing-floor on which the drama of the slay- ing of the Python by Apollo was periodically per- formed. Opposite this space, and backed against the beautifully jointed polygonal wall which has for some time been known, and which supports the terrace on which the temple stands, is the colonnade of the Athenians. A dedicatory inscription runs along the face of the top step, and has been the subject of much dispute. Both the forms of the letters and the style of the architecture show that the colonnade cannot date, as Pausanias says, from the time of the Peloponnesian War ; M. HomoUe now assigns it to the end of the 6th century. The polygonal terrace wall at the back, on being cleared, proves to be covered with inscriptions, most of them concerning the manumission of slaves.

After rounding the east end of the terrace wall, the Sacred Way turns northward, leaving the G-reat Altar, dedicated by the Chians, on the left. After passing the altar, it turns to the left again at right angles, and so enters the space in front of the temple. Remains of offerings found in this region include those dedicated by the Cyrenians and by the Corinthians. The site of the temple itself carries the remains of successive structures. Of that built by the Alcmseonids in the 6th century b.c. considerable remains have been found, some in the f oundar tions of the later temple and some lying where they were thrown by the earthquake. The sculptures found have

been assigned to this building, probably to the gables, as they are archaic in character, and show a remarkable resemblance to the sculptures from the pediment of the early temple of Athena at Athens. The existing founda- tions are« these of the temple built in the 4th century. They give no certain information as to the sacred cleft and other matters relating ‘to the oracle. Though there are great hollow spaces in the structure of the founda- tions, these appear merely to have been intended to save material, and not to have been put to any religious or other use. Up in the north-

eastern corner of the pre- cinct, standing at the foot of the cliffs, are the remains of the interesting Cnidian Lesche or Clubhouse. It was a long narrow building accessible only from the south, and the famous paintings were probably disposed around the walls so as to meet in the middle of the north side. Some scanty fragments of the lower part of the frescoed walls have survived ; but they are not enough to give any information as to the work of Polygnotus.

At the north-western comer of the precinct is the theatre, one of the best preserved in Greece. The foundations of the stage are extant, as well as the orches- tra, and the wall and seats of the auditorium. There are thirty-three tiers of seats in seven sets, and a paved diazoma. The sculptures from the stage front, now in the museum, have the labours of Heracles as their sub- ject. The date of the theatre is probably early 2nd century b.c.

The stadium lies, as Pausanias says, in the highest part of the city to the north-west. It stands on a narrow plateau of ground supported on the south-east by a terrace wall. The seats have been cleared, and are in a state of extraordinary preservation. A few of those at the east end are hewn in the rock. No trace of the marble seats mentioned by Pausanias has been found, but they have probably been carried off for lime or building, as they could easily be removed. An immense number of inscrip- tions have been found in the excavations, and many works of art, including a bronze charioteer, which is one of the most admirable statues preserved from ancient times.

Provisional accounts of the excavations have appeared during the excavations in the Bulletin de Correspondence Hellenique. A summary is given in Frazer, Pausanias, vol. v. For the works of art discovered see Aeoh^ologt. (e. Gr.)

Delyannis, Theodore (1826), Greek

statesman, was born at Kalavrytra, Peloponnesus, in 1826. He studied law at Athens, and in 1843 entered the Ministry of the Interior. In 1862 he began to take an important part in politics after the deposition of King Otho. In 1867 he was Minister at Paris. On his return to Athens he became a member of successive cabinets in various capacities, and rapidly

collected a party round him consisting of those who opposed his great rival, Tricoupis. In the so-called ” CEcumenical Ministry ” of 1877 he voted for war with Turkey, and on its fall he entered the cabinet of Koumoundoros as Minister for Foreign Affairs. He was a representative of Greece at the Berlin Congress in 1878. Prom this time forward, and particularly after 1882, when Tricoupis again came into power at the head of a strong party, the duel between these two statesmen was the leading,featureof Greek politics (see Greece, History). Delyannis first formed a cabinet in 1885, and his warlike policy resulted in the intervention of the Powers, who eventually blockaded the Piraeus and other ports, and this brought about his downfall. He returned to power in 1890, with a radical programme, but his failure to deal with the financial crisis produced a conflict between him and the king, and his disrespectful attitude resulted in his sum- mary dismissal in 1892. Delyannis, by his demagogic behaviour, evidently expected the public to side with him ; but at the elections he was badly beaten. In 1895, how-

ever, he again became Prime Minister, and was at the head of affairs during the Cretan crisis and the opening of the war with Turkey in 1897. The humiliating de- feat which ensued— though Delyannis himself had been led into the disastrous war policy to some extent against his will — caused his fall in April 1897, the king again dismissing him from of&ce when he declined to resign. Delyannis kept his own seat at the election of 1899, but his following dwindled to small dimensions.

Demotica, a town of Turkey in Europe, in the san- jak and province of Adrianople, situated on the right bank of the Kizil-deli, near its junction with the Maritza, and on the Maritza Valley or Ded^ahgatch-Kuleli-Bourgas railway, about 35 miles south of Adrianople. It is, of some industrial importance, the chief exports being pot- tery, for which it has some repute, linen, silk, cocoons, and grain. The population is about 12,000.

Denbigh, a maritime county of North Wales, is bounded N. by the Irish Sea, N.E. by Flint and Cheshire, S.E. by Flint and Shropshire, S. by Montgomery and Merioneth, and W. by Carnarvon.

Area and, Population. — The area of the ancient county is 423,477 acres or 662 square miles. The population in 1881 was 111,957, and 117,872 in 1891, of whom 59,569 were males and 58,303 females ; the number of persons per square mile being 178, and of acres to a person 3‘59. In 1901 the population was 129,935. The area of the administrative county, as given in the census re- turns of 1891, was 424,435 acres, with a population of 118,843, but since then certain alterations have been made in the administrative area. In 1897 the part of the parish of Nanerch in Denbigh was transferred to Flint, and the part of the parish of Llanarmon yn Vale in Flint, and part of the parish of Erbistock were transferred from Flint to Denbigh. The area of the registration county is 386,416 acres, with a population in 1891 of 116,698. Within this area the increase of population between 1881 and 1891 was 3-29 per cent. The excess of births over deaths between 1871 and 1881 was 11,172, and the actual increase of population was 5716. The following table gives the numbers of marriages, births, and deaths, with the number and percentage of illegitimate births, for 1880, 1890, and 1898 :—

Tear.

Marriages.

Births.

Deatlis.

Illegitimate Births.

No.

Per cent.

1880 1890 1898

738 871 881

3535 3262 3572

2394 2313 2369

239 173 184

6-7 6-3 4-9 ‘

In 1891 there were in the county 554 natives of Scotland, 819 natives of Ireland, and 171 foreigners ; while 38,310 persons could speak English, 37,195 Welsh, and 35,030 English and Welsh.

Constitution and Government. — ^The ancient county is divided into two parliamentary divisions, and it also includes the Denbigh district of parliamentary boroughs, consisting of Denbigh, Holt, Euthin, and Wrexham. There are three municipal boroughs, Denbigh, Ruthin, and Wrexham. The following are urban dis- tricts— Abergele and Pensarn, Colwyn Bay and Colwyn, Llangol- len and Llanrwst. Denbighshire is in the North Wales Circuit, and assizes are held at Ruthin. The boroughs of Denbigh and Wrexham have separate commissions of the peace, but no separate court of quarter sessions. The ancient county, which is in the diocese of St Asaph’s, contains 75 entire ecclesiastical parishes and districts, and part of one other.

Education. — The number of elementary schools on 31st August 1899 was 122, of which 48 were board and 74 voluntary schools, the latter including 70 National Church of England schools, 2 Roman Catholic, and 3 ” British and other.” The average attend- ance at board schools was 9288 and at voluntary schools 8258. The total school board receipts for the year ended 29th September 1899 were over £38,495. The income under the Technical In- struction Act was £69 ; that under the Agricultural Rates Act was over £1384.

Agriculture. — More than three-fifths of the total area of the county is under cultivation, and of this nearly three-fifths is in permanent pasture. There are also over 80,000 acres of mountain pasture grazed by sheep,

and over 18,000 acres under woods. Only about 220 acres are under orchards. The acreage under corn crops has considerably decreased, the decrease being chiefly in the acreage under wheat, which now occupies about one-seventh of the

corn crop acreage, barley occupying about two-sevenths, and oats nearly four-sevenths. Nearly three-fourths of the green crop area are occupied by turnips, and nearly one-fourth by potatoes.

Industries and Trade.— According to the annual report for 1898 of the chief inspector of factories (1900), the number of persons employed in factories and workshops in 1897 was 4690, as compared with 5359 in 1896. Non-textile factories employed 3379 persons, workshops 1150, the majority being engaged in the clothing in- dustries. The total number of persons employed in connexion with mines and quarries in 1899 was 11,138. Coal-mining is the most important industry. Of the less valuable minerals there were raised (in 1899) 264,982 tons of clay, 204,599 tons of lime- stone, 23,042 tons of sandstone, and 28,840 tons of igneous rocks. Iron ore has almost ceased to be raised. The following table gives the productions of coal, lead, and zinc in 1890 and 1899 : — ^

Year.

Coal,

Lead.

ZiQc.

Tons.

Value,

Tons.

Value.

Tons.

Value.

1890 1899

2,221,497 2,512,104

£916,367

973,440

1416

1983

£12,821

20,150

6593 3273

£41,104

26,976

See Williams and Undeewood. The Village Churches of Denbighshire, illustrated hy geometrical, perspective, and detail drawings. Denbigh, 1872.^ (t. f. h.)

Denbigh, a municipal and contributory parlia- mentary borough (uniting with Holt, Euthin, and Wrexham), market-town, and county town of Denbigh- shire, Wales, 25 miles west of Chester. There are three Established, Eoman Catholic, Baptist, Presbyterian, Methodist, and Congregationalist churches ; also a new county school under the Welsh Intermediate Education Act, a Blue Coat school (both of old foundation), a school for 50 orphan girls maintained from funds left to the Drapers' Company, and, in the neighbourhood, the North Wales Asylum. The chief industries are tanning, boot- making, and slate-quarrying. Area of borough, 8868 acres. Population (1901), 6439.

Denia, a Mediterranean seaport of Spain, in the province, and 45 miles north-east of the town, of Alicante. Population (1897), 11,401. There are manufactures of woollen and linen cloths and esparto grass rugs. The export trade in fruit is considerable, the figures for raisins in 1898 being : to Great Britain, 13,000 tons ; elsewhere, 12,000 tons ; 150,000 barrels of grapes were also exported, exclusively to English ports. Of pnions, 81,400 crates were despatched, practically all to North America. A breakwater, 1485 yards long, is in course of construction. 426 vessels of 165,246 tons entered in 1898, and 427 of 166,511 tons cleared. About half of these were small vessels engaged in the coasting trade, carrying agricultural produce. ‘ The chief imports were timber from the Baltic and coal from England.

Denison, George Anthony (1805-1896), Eng- lish Churchman, brother of Mr Speaker Denison (Lord Ossington : 1800-1873), was born at Ossington, Notts, 11th December 1805, and educated at Eton and Christ Church, Oxford. In 1828 he was elected fellow of Oriel ; and after a few years there as tutor, during which he was ordained and acted as curate at Cuddesdon, he became rector of Broadwindsor, Dorset, and married (1838) the daughter of Mr Henley, M.P. In 1843 he was preferred by his brother, the Bishop of Salisbury, to the valuable living of East Brent, Somerset, and in 1861, was made Archdeacon of Taunton. For many years Archdeacon Denison repre- sented the extreme High Tory party not only in politics but in the Church, regarding all ” progressive ” movements in education or theology as abomination, and vehemently repudiating the ” higher criticism ” from the days of Essays and Eeviews (1860) to those of Lux Mundi (1890). In 1853 his views on the doctrine of the Eeal Presence subjected him to a suit for heresy on the complaint of a neighbouring parson, and after various complications he was condenined by the Archbishops’ Court at Bath ; but

on appeal the Court of Arches and the Privy Council quashed this judgment on a technical plea. The result was to make Archdeacon Denison a keen champion of the Eitualistic school. Until the end of his

life he remained a protagonist in theological controversy and a keen fighter against latitudinarianism and liberalism ; but the sharpest religious or political differences never broke his personal friendships and his Christian charity. Among other things for which he will be' remembered was his origination of Harvest Homes. He died 21st March 1896.

Denison, a city of Grayson county, Texas, U.S.A., on the south bank of the Eed river, at an altitude of 723 feet. It is regularly laid out on a level site, and has four wards. It has three railways, the Houston and Texas Central, the Missouri, Kansas, and Texas, and the Texas and f Pacific, and is an important point in the collection

and shipment of cotton. Population (1880), 3975 ; (1890), 10,958 ; (1900), 11,807, of whom 604 were foreign-born and 2261 negroes.

Denizli, chief town of a sanjak of the Aidin vildyet of Asia Minor, altitude 1167 ft. It is beautifully situated at the foot of Baba Dagh (Mt Salbakus), on a tributary of the Churuk Szz (Lycus), and is connected by a branch line with the Smyrna^Dineir railway. It took the' place of Laodicea when that town was deserted during the wars between the Byzantines and Seljiik Turks, probably between 1158 and 1174. It had become a large and fine Moslem city in the 14th century, and was then called Ladik. The delightful gardens of Denizli have obtained for it the name of the Damascus of Anatolia. Population, 17,000 (Moslems, 14,500; Christians, 2600).

See Ramsat. Cities and Bishoprics of Phrygia, vol. i. Oxford, 1895. — Murray. Asia Minor Handbook. 1895.

DEJN^MARK.

DENMAEK, in the strictest geographical sense, com- prises the northern portion of the Cimbric Penin- sula called Jutland (Jylland) and the Danish Islands, which are situated mostly to the south-east of Jutland, between the southern part of the Cimbric Peninsula and the southern part of Sweden. Jutland lies between lat. 55° 16′ and lat. 67° 45', whilst the islands are situated between lat. 64° 33′ and lat. 66° 8'. The westernmost

point of Jutland is in long. 8° 4′ 54”, the easternmost point of the islands (apart from Bornholm) is in long. 12° 47′ 26”- The last-named island is situated in the Baltic, 76 miles east of the rest of Denmark, but in the same latitude as the southernmost of the other islands. According to the latest measurements, the total area of Denmark proper is 14,829 square miles, of which 9763 square miles fall to the share of Jutland, including the small islands belonging to it. The islands together cover 5076 square miles, and may be divided into four groups : the westernmost group, of which Pyen’^ is the largest, covers 1324 square miles ; whilst Sealand^ (Sjselland), with some adjacent smaller islands, occupies 2866 square miles ; Lolland and Falster, which are to the south of Sealand, and separated from each other only by a very narrow channel, cover 671 square miles ; Bornholm, finally, has an area of-226 square miles. Denmark is almost entirely surrounded by the sea, as it is connected with the Continent only at the southern frontier of Jutland, in which place the width of the peninsula is only about 37 miles. The west and north-west coasts of Jutland, from Blaavandshuk to the Scaw, are destitute of harbours, and girt by sandbanks very dangerous to shipping. In many places the sea has encroached very considerably ; even in the 19th century entire villages were destroyed, but during the last twenty years of the century systematic efforts were made to secure the coast by groynes and embankments. A belt of sand dunes, from 500 yards to 7 miles wide, stretches along the whole of this coast for about 200 miles. The east coast of Jutland is of quite a different description, a series of long fjords entering deep into the country from the Cattegat. The longest of these is the Limf jord, which reaches the western coast of Jutland, and since 1825 has been in communication with the North Sea, so that the northern portion of Jutland is really an island ; but the waters of the Limf jord, particularly in the western part, are so shallow that it offers no facility for

1 ” Fiihnen ” is German, not Danish.

2 Tliis spelling of tfie English name is nearer to the Danish and less liable to misunderstanding than that of Zealand, which is properly the name of a well-known island in Holland.

navigation except to small craft. The Cattegat itself is full of sandbanks and difficult of navigation ; in the winter it is often obstructed by drifting ice. From the Cattegat three passages lead to the Baltic, of which they form the outlet, namely, the Little Belt, the Great Belt, and the Sound (see Baltic Sea). South of Copenhagen the passage is narrowed by the islands of Amager and Saltholm ; and the channels on both sides of these islands have in their shallowest parts only 23 feet of water, besides being difficult to navigate. On the west coast of Jutland the ordinary tides of the North Sea are experienced, but in the Cattegat the difference between high and low water gradually diminishes towards the south. In the Belts and in the Sound the changes become almost imperceptible, and are obscured by the effects of winds and currents. In the Baltic there are no tides. No hill in Denmark exceeds 550 feet in height. Gudenaa in Jutland, the largest river in Denmark, has a course of 80 miles. Small lakes abound, but there are none of considerable size.

The surface in Denmark is almost everywhere formed by the so-called" Boulder Clay and what the Danish geologists call the Boulder Sand. The former, as is well known, owes its origin to the action of ice on the mountains of Norway P^y^l'^l in the Glacial period. It is unstratified ; but by the ™™'*''' action of water on Jt, stratified deposits have been * "* formed, some of clay, containing remains of arctic animals, some, and very extensive ones, of sand and gravel. This boulder sand forms almost everywhere the highest hiUs, and besides, in the central part of Jutland, a wide expanse of heath and moorland apparently level, but really sloping gently towards the west. The deposits of the boulder formation rest generally on limestone of the Cretaceous period, which in many places comes near the sxirface and forms cliffs on the seacoast, of which the most interest- ing is the " Klint," on the island of Moen. But in the south-western parts a succession of strata, described as the Brown Coal or Lignite formations, intervenes between the chalk and the boulder clay ; its name is derived from the deposits of lignite which occur in it. It is only on the island of Bornholm that older formations come to light. This island agrees in geological structure with the southern part of Sweden, and forms, in fact, the southernmost portion of the Scandinavian system. There the boulder clay lies immediately on the primitive rock, except in the south-western corner of the island, where a series of strata appear*

belonging to the Cambrian, Silurian, Jurassic, and Cretaceous formations, the true Coal formation, &c. , being absent. Some parts of Denmark are sup- posed to have Iseen finally raised out of the sea towards the close of the Cretaceous period ; but as a whole the country did not appear above the water till about the close of the Glacial period. The upheaval of the country, a movement common to a large part of the Scandinavian peninsula, still continues, though slowly, north- east of a line drawn in a south-easterly direction from Nissum- fjord on the west coast of Jutland, across the island of Fyen, a little south of the town of Nyborg. Ancient seabeaches, marked by accumulations of seaweed, rolled stones, &c., have been noticed

as much as 20 feet above the present level. But the upheaval does not seem to affect all parts equally. Even in historic times it has vastly changed the aspect and configuration of the country. It will easily be understood from the foregoing that the mineral pro- ducts of Denmark are Insignificant. Coal is found in Bornholm, several seams cropping out amongst the strata belonging to the Jurassic system. But the Bornholm coal is too hygroscopic to bear transport, and Its heating power falls far short of that of English coal. The mines which have at different times been opened have proved failures, and their produce is only used for domestic purposes on the island itself. There is in Bornholm a deposit of kaolin of good quality, from which the Copenhagen porcelain factories take their supply. The Flora and Fauna of Denmark offer no peculiarities worthy of notice here. In ancient times extensive pine and fir forests existed, of which abundant re- mains are found in the peat bogs ; but they have disappeared long ago, and at the present time firs and pines occur in Denmark only in plantations. The forests of Denmark consist of oak and beech, of which the latter is gradually getting the upper hand. The elm is comparatively rare in Denmark. The peat bogs are numerous, and supply a large proportion of the fuel used in the country. The sea fisheries are of importance, and a not inconsiderable quantity of fresh fish is exported to the interior of the Continent. Oysters are still found in some places, but

have disappeared from many localities, where their abundance in ancient times is proved by the shell mounds on the coast. Such mounds occur in other countries too, but it was in Denmark that they were first recog- nized as being but the accumulated remains of the meals of the ancient population, which largely fed on oysters. Gudenaa is the only salmon river in Denmark. The climate of Denmark does not differ materially from that of Great Britain in the same latitude ; but whilst the summer is a little warmer, the winter is colder, so' that most of the evergreens which adorn an English garden in the winter cannot be grown in the open in Denmark. During 30 years the annual mean temperature varied from 43-88° to 46-22° in different years and different localities, the mean average for the whole country being 45-14°. The islands have, upon the whole, a somewhat warmer climate than Jutland. The mean temperature of the four coldest months, December to March, is 33-26°, 31-64°, 31-82°, and 33-98° respectively, or for the whole winter 32-7°; that of the summer, June to August, 59-2°, but considerable irregulari- ties occur. Frost occurs on an average on 20 days in each of the four winter months, but only on a couple of days in either October or May. A fringe of ice generally lines the greater part of the Danish coasts on the eastern side for some time during the winter, and both the Sound and the Great Belt are at times impassable on account of ice. In some winters the latter is suflBciently firm and level to admit of sledges passing between Copenhagen and MalmS. The annual rainfall varies between 21-58" and 27-87" in different years and different localities. It is highest on the west coast of Jutland ; the small island of Anholt in the Cattegat has an annual rainfall of only 15-78". More than half the rainfall occurs from July to November, the wettest month being September, with nn average of 2-95" ; the driest month is April, with an average of 1-14". Thunderstorms are frequent in the summer. South- westerly winds prevail from January to March, and from Septem- ber to the end of the year. In April the east wind, which is par- ticularly searching, is predominant, while westerly winds prevail from May to August.

According to the census taken on 1st February 1901, the total population of Denmark was 2,449,540, as com- pared with 929,001 on the same date in 1801, showing an increase during the century in the proportion of 100 : 263. As compared with the total in 1890, namely, 2,172,380, the returns

for 1901 are 12-76 per cent, higher, corresponding to an average annual increase of 1-09 per cent, during the ten years. The first four years of th'e decade were, however, far from favourable, owing to a great increase of mortality and at the same time of emigration, which latter cause reduced the increase which should have followed from the excess of births over deaths by nearly one-half. The actual annual increase during these years varied only from 0"54 per cent, to 0-68 per cent. In 1901 the average density of the population of Denmark was at the rate of 165-2 to the square mile, but varied much in the different parts. Jutland, which represents three-fifths of the total area of Denmark, and in 1901 had a population of 1,063,792, showed an average of only 1,09 inhabitants per square mile, whilst on the isla,nds, which had a total population of 1,385,537, the average stood at 272-95,*

Popula- tion.

owing, on the one hand, to the fact that large tracts in the interior of Jutland are almost uninhabited, and on the other to the fact that the capital of the country, with its proportionately large population, is situated on the island of Sealand. The latter had a population of 960,053, or 336-2 inhabitants to the square mile including Copenhagen (with the suburbs of Fredriksberg and Sundby), but without the capital only 169-2. Not reckon- ing Sealand, the density of the population on the islands was at the rate of 191-7 to the square mile. In 1901, 936,565 persons were living in towns in Denmark, i.e., 38-24 per cent, of the total population, whilst 1,612,975, or 61-77 per cent., were living in purely rural districts. In 1890 the town population amounted to 735,554, or 33-86 per cent, of the total, leaving but 1,436,826, or 66-14 per cent., for the rural districts. The movement of the population to the towns which is indicated by these figures commenced about the middle of the 19th century, and increased until very iiear its end. It has been stronger on the islands, where the rural population has increased by 5-3 per cent, only in eleven years, whereas in Jutland the increase of the rural population between 1890 and 1901 amounted to 12-0 per cent. (But for some of the causes of this increase see Jutland.) During the same years the population of Copenhagen increased by 24-94 per cent., namely, to 476,876 (491,340 with the en- virons) ; and the population of the provincial towns above

10,000 inhabitants by 43-6 per cent. ; but in the smaller towns the augmentation only amounted to 20-5 per cent.

According to the census of 1890, the population of Denmark was divided as follows according to occupation, the figures including dependants : —

Per

Per

Occupation.

Num- ber.

cent, of Popu- lation.

Occupation.

Num- ber.

cent, of Popu- lation.

Agriculture .

882,336

40-6

Professions

185,790

6-1

Trades .

534,428

24-6

Capitalists .

84,974

1-6

Commerce . General labour .

172,929

7-9

Pensioners .

17,728

0-8

162,928

7-6

Annuitants .

40,276

1-8

Fisheries

82,912

1-5

No certain livelihood .

44,667

2-0

Navigation .

26,092

1-29

Paupers

89,014

1-79

Transport, posts,

Prisoners .

1,822

telegraphs, Ac.

42,780

1-9

Insane

8,758

...

In 1901, 1,193,448, or 48-72 per cent., of the population of Den- mark were males ; 1,256,092, or 51-28 per cent, were females. The number of marriages has increased, with little oscillation, from 14,975 in 1891 to 18,499 in 1900, that is, in a considerably greater ratio than the population. The number of divorces in 1900 w^ 391. The birth-rate appears to have oscillated during the period in question between 29-3 and 38-8 per thousand, the highest number of children born alive being 72,141 in 1900. On an average, 51-3 per cent, of the children born annually are boys, and the male sex remains in excess until about the

20th year, from which age the female sex preponderates in increasing ratio with advancing age. Of all children born annually an average of 9-6 per cent, are illegitimate. In some rural districts the ratio is as low as 3-5 per cent., but in Copenhagen it reaches 20-2 per cent. 12 per cent, of the illegitimate children born alive had mothers who were under 20 years of age. The still-born numbered, in 1899, 2-47 per cent, of all births, but amongst them 12-8 per cent, were illegitimate. Between the middle and the end of the 19th century the rate of mortality decreased most markedly for all ages. The annual death-rate per thousand may be taken to have varied during 1890-1900 between 19-5 in 1891 and 15-1 in. 1898 (17-4 in 1900). The annual number of suicides, which used to average 555, declined towards the close of the 19th century, and was 523 for the period 1896-1900.

Emigration, which for some time seriously affected the popula- tion of Denmark, diminished in the 'nineties. In 1892 the number of emigrants to Transatlantic places rose to 10,422, but in 1900 it was only 3570. The great bulk of them go to the United States ; next in favour is Canada. In 1890 there were 70,900 persons, foreigners, living in Denmark, of whom 33,802 were born in Sweden, 20,824 were Schleswigers, 10,823 were natives of other parts of Germany, and 3385 were Norwegians. From 1891 to 1900 2525 foreigners were naturalized.

Govern- ment

The Danish Parliament, called the " Eigsdag," consists of two chambers, the Folkething and the Landsthing, but the constitution contains no indication of any difference in their attributes. The Landsthing, however, is evidently intended to form the con- servative element in the constitutional machinery. Whilst the 114 members of the Folkething are elected in the usual way by universal suffrage, 12 out of the 66 members of the Landsthing are life members nominated by the Crown. The

remaining 54 members of the Landsthing are returned according to a method of proportionate representation by a body of deputy electors. Of these latter one-half are elected in the same way as members of the Folkething, without any property qualification for the voters ; the other half of the deputy electors are chosen in the towns by those who during the last preceding year were assessed on a certain minimum of income, or paid at least a certain amount in rates and taxes. In the rural districts the deputy electors returned by election are supplemented by an equal number of those who have, paid the highest amounts in taxes and county rates together. In this manner a representation is secured for fairly large mi- norities, and what is considered a fair share of influence on public affairs given to those who contribute the most to the needs of the State. The Faroes, which form an integral part of the kingdom of Denmark in the wider sense, are represented in the Danish Parliament, but not the other dependencies of the Danish Crown. For administrative purposes the country is divided into 18 so-called " Amts," or counties. The principal civil of&cer in each of them is the " Amtmand." Local affairs are managed by "Amtsraad " and " Sogneraad," corresponding to the English county council and parish council. These institutions date from 1841, but they have undergone several modifications since. The members of these councils are elected on a system similar to that applied to the elections for the Landsthing. The same is the case with the provincial town councils. That of Copen- hagen is elected by those who are rated on an income of at least 400 crowns (£22). The burgomasters are appointed by the Crown, except in Copenhagen, where they are elected by the town council, subject to royal approbation.

For the administration of justice Denmark is divided into " Herreds " or Hundreds; as, however, they are mostly of small ex- , . tent,several are generally served by one judge, "Herreds-

*" **■ foged" ; the townships are likewise separate jurisdic- tions, each with a "Byfoged." There are 126 such local judges, each of whom deals with all kinds of cases arising inhis'district, and is also at the head of the police. There are two intermediary Courts of Appeal, one in Copenhagen, another in Viborg ; the Supreme Court of Appeal sits at Copenhagen. In the capital the different functions are more divided. There is also a Court*

of Com- merce and Navigation, on which leading members of the trading community serve as assessors. In the country, Land Commissions similarly constituted deal with many questions affecting agricul- tural holdings. A peculiarity of the Danish system is that, with few exceptions, no civil cause can be brought before a court until an attempt has been made at effecting an amicable settlement. This is mostly done by so-called Committees of Conciliation, but in some cases by the court itself before commencing formal judicial proceedings. In this manner three- fifths of all the causes are settled, and many which remain unsettled are abandoned by the plaintiffs. In 1897 the courts disposed of about 30,000 civil cases ; 3689 persons (2838 males and 851 females) were convicted of various crimes ; 3573 were punished for police offences ; whilst 33,005, police cases were disposed of without formal judgment, on the defendant agreeing to pay a fine. Sanitary matters are under the control of a Board of Health. The whole country is divided into districts, in each of which a medical man is appointed with a salary, who is under the obligation to attend to poor sick and assist the authori- ties in medical matters, inquests, &c. The relief of the poor is well organized, mostly on the system of out-door relief. Many work- houses have been established for indigent persons capable of work. There are many almshouses and similar institutions. The National or State Church of Denmark is officially styled

"Evangelically Eeformed," but is popularly described as Lutheran. In 1890 its members numbered 2,186,329, or 98-44 per cent, of the total population. 10,624 belonged to free extra- peHgioa parochial congregations of Lutherans. The members of other Christian communities numbered 14,502, of which 1252 were Calvinists, 137 Anglicans, 2301 Methodists, 4656 Baptists, 2609 Irvingites, and 3647 Roman Catholics. There were 4080 Jews, mostly in Copenhagen. 941 were returned as Mormons, and 2560 as not professing any positive religion. There are seven dioceses, the Primate being the Bishop of Sealand, who resides at Copen- hagen, but his cathedral is at Roeskilde. There are 72 rural dean- eries, and 988 pastorates, of which the greater part comprise more than one parish; the number of parish churches is 1721. The benefices are almost without exception provided with good resi- dences and glebes, and the tithes, &c., generally afford a comfort- able

income. The bishops have fixed salaries in lieu of tithes appropriated by the State.

Every child is bound to attend the parish school at least from the 7th to the 13th year, unless the parents can prove that it receives suitable instruction in other ways. The schools are ^ucatloa. under the immediate control of school boards appointed by the parish councils, but of which the incumbent of the parish is ex-officio member ; superior control is exercised by the Amtmand, the rural dean, and the bishop, under the Minister for Church and Education. The instruction in primary schools is gratuitous. Secondary public schools are provided in towns, in which moderate school fees are paid. There are 13 public grammar schools. Nearly all schools are day-schools. There are only two public schools which, though on a much smaller scale, resemble the great English schools, namely, those of Soro and Herlufsholm, both founded by private munificence. Private schools are mostly more or less under public control. The nuiiiber of children in Danish schools was, in 1898, 364,091, of whom 307,633 were in municipal schools, 6838 in grammar schools, and 49,620 in other schools, including infant schools, &c. The University, Copenhagen, which was founded in 1479, has 53 professors, besides a varying number of lecturers. Connected with it are an observatory, museums of natural history, a botanical garden, various collections and laboratories, as well as a good library. The matriculations average 350 a year. Amongst the numerous other institutions for the furtherance of science and training of various kinds may be mentioned the large polytechnic schools ; the High School for Agriculture and Veterinary Art, with 22 professors, besides lecturers ; the Royal Library (500,000 vols., 20,000 MSS.); the "Royal Society of Sciences; the Museum of Northern Antiquities ; the Society of Northern Antiquaries, &c. The art mu.seums of Denmark are not considerable, except the Museum of Thorvaldsen, but much is done to provide first-rate training in the fine arts and their application to industry. The Royal Academy of Arts has seven professors, besides assistant teachers, and its schools are frequented by about 200 students annually. Finally, it may be mentioned that comparatively much money is available from public funds and regular parliamentary grants for furthering science and arts by temporary subventions to students,

authors, artists, and others of insufficient means, in order to enable them to carry out particular works, to profit by foreign travel, &c.

The following is a summary of the items of expendi- ture in the Danish Budget for 1900-01 : —

Finance.

Civil List ....

Appanages to the' Royal Family

Parliament (payment of mem- ters, &c.) .

Council of State (pay of Minis- ters, &c.) .

Interest on Public Debt

Reduction of Debt

Pensions

Army ....

Navy ....

Civil Service .

Iceland, annual grant .

Public Works (new railways, &c.) ....

Loans and Advances .

Kr.1,000,000 or £55,555 203,200 „ 11,289

200,000

119,016

7,059,000

1,802,731

3,349,540

11,022,419

7,787,310

26,957,512

76,564

10,370,907 2,229,950

11,111

6,612 392,183 100,152 186,086 612,357 432,629 . 1,497,639

4,254

576,161 123,886

Kr.72,178,449 £4,009,914

The items of estimated actual revenue for 1900-01 were as follows : —

or

Customs . Excise and Beer Tax Land and House Tax Stamps .

Kr.33, 176,000

9,170,000

10,577,600

3,550,000

Carryforward Kr.66,473,500

£1,843,111

509,444 687,639 197,222

£3,137,416

DEN MA K K

411

Brought forward

Death duties .

Tax on Transfers of Pro- perty ….

LegalFees(Patents,&c.)

State Railways . ,

Post and Telegraphs

State Lottery

Crown Lands (Forests, &c.) . . .

Interest on Reserve

Interest on Debts to the State

Sundry receipts .

Kr.56,473,500 or £3,137,416 1,400,000 „ 77,778

916,000 2,555,100 2,958,916

222,581 1,090,000

893,424 643,000

841,127 1,221,517

50,889

141,950

164,384

12,366

60,556

49,635 35,722

46,729 07,862

Kr.69,215,165 £3,845,287

The amount of the internal debt on 1st April 1900 is estimated at Kr.77,708,810 or £4,317,156, bearing interest of SJ per cent, (excepting some small amounts on which 3, 4, 4J, or 5 per cent, are paid), whilst that of the foreign debt is placed atKr.138,512,250 or £7,695,125, bearing 3 per cent, interest, with the exception of a very small amount on which 4 per cent, is paid. The revenue and expenditure of the Faroes are included in the budget for Denmark proper, but Iceland and the West Indies have their separate bud- gets. The Danish Treasury receives nothing from these posses- sions ; on the contrary, Iceland receives an annual grant, and the West Indian Islands have been heavily subsidized by the Danish finances to assist the sugar industry. The administration of Green- land entails an annual loss of Kr.156,273 or £8682, which is posted on the budget of the Ministry of Finance. The financial position of the municipalities in Denmark is generally good. The ordinary budget of Copenhagen amounts to about £1,100,000 a year.

The main source of wealth in Denmark is agriculture. No infor- mation is available as to the average size of agricultural holdings in Industry Denmark, but there are statistics from which their value ^' may be

estimated. Rates and taxes on land are mostly levied according to a uniform system of assessment, the unit of which is called a ” TSnde Hartkom. ‘ ‘ The Td. Htk. , as it is usually abbreviated, has further subdivision, and is intended to correspond to the same value of land throughout the country. The Danish measure for land is a ” Tonde Land” (Td. L.), which is equal to 1-363 statute acres. Of the best ploughing land a little over 6 Td. L. , or about 8 acres, go to a Td. Htk. , but of unprofitable land a Td. Htk. may represent 300 acres or more. On the islands and in the more fertile part of Jutland the average is about 10 Td. L., or 13J acres. Woodland, tithes, &c., are also assessed to Td. Htk. for fiscal purposes, but the total assessment of agricultural land in Denmark is 369,161 Td. Htk., exclusive of the island of Bomholm, where the assessment is somewhat different, though the general state of agricultural holdings is the same as in other parts. The selling value of land has lately been declining, on account of the agricultural depression which has affected Denmark as well as Eng- land, but according to an o£5cial calculation based on the actual open sales which had taken place, it was, in 1895, Kr.5155 or £286 per Td. Htk. A homestead with land assessed less than 1 Td. Htk. is legally called a ” Huus ” or ” Sted,” i.e., cottage, whilst a farm assessed at 1 Td. Htk. or more is called ‘,’ Gaard,” i.e., farm. Most of the land in Deninark is freehold and cultivated by the owner himself, and comparatively little land is let on lease except very large holdings and glebe farms. Farms of between 1 and 12 Td. Hartkorn are called ” Bondergaarde,” or peasant faams, and are subject to the restricflon that such a holding cannot lavrfully be joined to or entirely merged into another. They may be subdivided, and portions may be added to another holding, but the homestead, with a certain amount of land, must be preserved as a separate holding for ever. According to the return of 1895, there were in Denmark (apart from ‘the island of Bomholm) 73,889 ” gaarde,” of which 2031 were assessed at 12 Td. Htk. or more (not a few exceeding 100 Td. Htk.), their total assessment being 56,822 Td. Htk., or 15”4 per cent, of the total assessment of the country. Only 30 of these gaarde were not freehold. This class, of course, includes the ” Herregaarde,” or seats of the nobility and landed gentry. 12,858 holdings were ” Bondergaarde,” or peasant farms, and as the total assessment of this class of holdings amounts to 267,302 Td. Htk., it will be seen that the peasants in Denmark hold 72-9 per cent, of all the land according to its

value. As regards their size, 44,557, or 30 per cent., were assessed at from 1 to4Td. Htk. ; 23,638, or 32-9 per cent., were assessed at 4 to 8 Td. Htk. ; the remainder at about 8 Td. Htk. In the rural districts there are, besides, 169,147 " Huse," or cottages with land, assessed at less than 1 Td. Htk., of which 141,439, or 89'1 per cent., were freehold and occupied by the ovraers. There were, besides, 32,946 cottages without land, of which 20,271, or 61-5 per cent, were freehold and occupied by the owners. Of late years an annual sum has been voted by the Eigsdag, out of which loans are granted to cottagers who desire to purchase small freehold plots. The total

area of Denmark is 6,892,110 Td. Ld., or 9,393,945 statute acres, of which 5,097,357 Td. Ld., or 6,957,697 acres— that is, fully 74 per cent. — are agricultural land. Only 563,059 acres of this total are meadow land. In 1896 the ploughed land, 6,384,637 acres, was utilized as follows : — ^2,876,124 acres were sown with cereals; ng^ely, wheat 85,001 acres, rye 718,228 acres, barley 691,181 acres, oats 1,085,847 acres, and mixed cereals 295,867 acres ; 533,221 acres were sown with green fodder, potatoes, roots, and other minor crops ; whilst 2,333,869 acres were under grass in rotation, and 621,423 acres were in fallow. The quantity of grain harvested in 1896 is stated to have been, in English quarters, 446,875 of wheat, 2,432,875 of rye, 2,574,500 of barley, 4,667,125 of oats, and 1,301,138 of mixed grain. There is, of course, a good deal of variation from year to year, but the above figures are near the average. During the last fdrty years of the 19th century dairy- farming was greatly developed in Denmark, and brought to a high degree of perfection by the application of scientific methods and the best machinery, as well as by the establishment of joint dairies. The Danish Government has assisted this development by granting money for experiments, and by a rigorous system of inspection for the prevention of adulteration. According to the latest returns (1898), 449,264 horses, 1,743,440 head of cattle, 1,178,514 swine, 1,074,413 sheep, were kept in Denmark, but only 31,803 goats and 139 donkeys. Rabbits, which are not found wild in Denmark, are bred for export, their number being given as 81,475. The garden land in Denmark amounted, in 1896, to 81,152 acres. The woods cover 665,584 acres, or fully 7 per cent, of the area, and their pre- servation is considered of so much importance that private owners are under strict control as regards

cutting of timber. The woods consist mostly of beech, which is principally used for fuel, but pines were extensively planted during the 19th century. Efforts are being made to plant the extensive heaths in Jutland with pine trees (see Jutland). Peat bogs occupy 188,650 acres ; heaths, moors, and other essentially waste lands, 909,795 acres.

The fishery along the coasts of Denmark is of some importance, both on account of the supply of food obtained thereby for the population of the country, and on account of the export ; but the good fishing grounds, not far from the Danish coast, particularly 'in the North Sea, are mostly worked by the fishing vessels of other nations, which are so numerous that the Danish Government is obliged to keep gunboats stationed there in ordet to prevent en- croachments on territorial waters.

The factories of Denmark supply mainly local needs. The Copen- hagen china has a good reputation. In 1897 there were only 165 establishments employing each more than 100 hands ; the largest are those engaged in the construction of engines and iron ships, of which there are 4, employing together about 3000 persons. Trade- unionism flourishes in Denmark, and strikes are of frequent occurrence.

The total value of Danish commerce has risen from £22,433,000 in 1874 to £51,132,000 in 1900,. in which year the exports were val- ued at £21,865,000, the imports at £29,267,000. The commerce of Denmark is mainly based on home produc- ''''''««*■ tion and home consumption, but a certain quantity of goods is im- ported with a view to re-exportation, for which the free port and bonded warehouses at Copenhagen give facilities. The value of goods exported in 1900 and declared to be of foreign origin was £6,203,000. The main features of the trade of Denmark will be seen from the subjoined table for 1899, in which the different articles are classed as follows: — I. Live animals. II. Articles of animal food. HI.*

Import.

Export.

Balance.

Foreign

Goods

Exported.

I. Live animals . II. Animal food . ni. Breadstuffs . rv. Colonial pro- duce . V. Alcoholic drinks . VI. Textiles, &c. . VIL Timber . VIII. Raw materials, vegetable and animal . IX. Minerals and metal goods . X. Other goods .

£

123,800 3,145,700 6,205,100

2,214,000

413,700 3,659,800 1,408,000

2,913,400

5,385,000 1,869,200

1,080,500

13,145,300

1,158,400

711,500

206,800 848,600 117,000

1,454,400

1,070,100 458,400

£

- 956,700 -9,999,600 + 5,046,700

+ 1,502,500

+ 206,900 + 2,811,200 + 1,291,000

+ 1,459,000

+4,314,900 + 1,410,800

£

200 1,457,900 553,400

660,600

165,300

684,400

85,000

815,200

701,800 119,400

27,337,700

20,251,000

+ 7,086,700

5,243,200

Breadstuffs and foods for animafe. IV. Colonial produce, conserves, &c. V. Alcoholic drinks. VI. Materials for spinning and weaving, woven fabrics and garments. VII. Timber and

\

wooden goods. VIII. Otlier raw materials of vegetable or animal ori- gin, including all kinds of manures and oils. IX. Raw materials of mineral nature, and goods manufactured from them. X. All other goods. In the third column — indicates excess of export, + excess of im- port ; the fourth column indicates the value of the foreign goods re-ex- ported, which is included in the general figure for imports and exports.

In the first of the classes under which the articles have been summarized the most important is homed cattle, of which 37,736 head were exported in 1899, all home-bred ; only 1130 head were imported. The trade in live sheep and swine, which was formerly important, has now mostly been converted into a dead-meat trade. In the second class, butter is the principal article, the export in 1899 amounting to 158,303,300 B) avoir., valued for export at £7,708,600, or 38-6 per cent, of the total value of Danish exports. Of this quantity 134,898,700 lb, valued at £6,611,900, was home produce, whilst the remaining 23,404,600 lb (value £1,096,700) had been imported chiefly from Russia (also Siberia) and Sweden and re-exported as of foreign origin. In 1899 there was a further importation of butter for home consumption of 14,183,000 lb. The production of margarine amounted in the year 1899-1900 to 35,849,064 lb, besides which 5,622,290 ft were impbrted, but only 384,889 lb were exported, margarine being largely consumed in Denmark instead of the butter which is exported. Next to butter the most important article of Danish export is bacon, of which 164,667,953 ft, valued at £3,083,620, were exported in 1899, all home produce excepting 5,782,349 ft, which had been previously imparted, together with 2,721,240 ft for home con- sumption. Eggs were exported in 1899 to the number of 302,994,800. The first two classes of articles, living animals and articles of food of animal origin, are the only ones of which the exportation exceeds the importation ; with regard to all other goods, the reverse is the case ; at the same time, from about 26 per cent, to 92 per cent, of the export in each of these classes consisted of foreign goods re-exported. Denmark had formerly a considerable net export of grain, but this is not the case now, owing partly to the increase of the population in wealth and number, and consequently to the greater consumption of bread- stuffs, partly to the great

development of dairy-farming and cattle-feeding. The proportionally large importation of timber is caused by the scarcity of native timber suitable for building purposes, the plantations of firs and pines being as yet insuffi- cient to produce the quantity required, and the quality of the wood being inferior beyond' the age of about 40 years. The large importation of minerals and metals and goods made from them is, of course, likewise caused by the natural poverty of the country in these respects. Coals were imported to the value of £1,953,700. Among the unclassified articles may be noted vessels built abroad, which in the statistics for 1899 figure with a value of £654,100 on the import side against £175,400 on the export side.

The value of the trade (1899) of Denmark with particular countries wiU be seen from the following table : —

Countries.

Total.

Import.

Export.

Balance.

Great Britain Germany Sweden . United States Russia . Norway France . Other countries

£

17,607,400

11,718,000

4,804,500

4,722,100

2,943,800

1,042,000

697,300

4,053,600

£

5,584,400 8,014,000 2,868,000 4,341,400 2,043,300 416,200 619,300 3,451,100

£

12.023,000

3,704,000

1,936,500

380,700

900,500

625,800

78,000

602,500

£

-6,438,600 +4,310,000 + 931,500 +3,960,700 +1,142,800 – 209,600 + 541,300 +2,848,600

+ 7,086,700

Total

47,588,700

27,387,700

20,251,000

The value of the trade of Denmark proper with the other parts of the Danish State, which is included in the category of ” Other countries,” was as follows in 1899 : —

Faroes Iceland Greenland . Danish West Indies

Total

Imports, £19,400;

133,500 35,000 4,200

exports, £35,800

147,800

„ 18,000

5,200

£192,100

£206,800

The commercial fleet of Denmark comprised at the end of 1900, exclusive of small craft under 4 tons, 3017 sailing vessels, with a Shlpplaz collective tonnage of 146,900 tons. > Of these, 395 (tonnage in all, 98,799) each exceeded 100 tons register. The steamers numbered 483, with a total tonnage of 247,353, of which 312, with a collective tonnage of 242,770, each exceeded 100 tons. The total number of clearances to or from foreign ports in 1899 was 63,774, of which 82,889 were Danish vessels, 80,885

foreign vessels, but with this difierence, that whilst the clearances of Danish steamers numbered 21,783, and those of Danish sailing vessels amounted only to 11,092, the reverse proportion held good for foreign vessels, of which 11,013 were steamers and 19,872 sailing ves- sels, chiefly Swedish. A large proportion of Danish vessels are engaged in the carrying trade between foreign ports ; in 1899, 4703 clearances of Danish vessels so employed occurred in Great Britain, lesser num- ber in other countries.

Denmark has long possessed a very complete set of excellent roads. The length of the railways, which for the most part are State property, was at the close of 1900, 1810 miles. In the course of 1900 about 20,000,000 of passengers <-ommunl- were carried, travelling 687,500,000 miles; besides ""“^ luggage, about 3,571,000 tons of goods were carried. ‘

There were in 1899, 274 post offices, 583 sub-offices, and 10,115 letter-boxes; 90,382,094 ordinary letters and 915,328 letters con- taining money were carried, of which respectively 17,228,427 and 69,157 for or from places abroad. 3,260,627 parcels were carried, of which 641,191 to or from places abroad. 83,499,502 newspapers and periodicals were carried, of which 2,789,143 to or from abroad. 2,628,616 postal orders passed through the post, of which 328,754 to or from abroad ; finally, 983,457 different sums were collected for senders of parcels, of which 85,927 were in respect of parcels to or from places abroad. The telegraph service is carried on by the General Post Office. There were 480 stations ; the length of the lines was 3850 miles. 2,056,613 telegrams were carried, of which 595,483 passed between Danish stations, 842,886 between Danish and foreign stations, whilst 618,294 passed through the Danish system

between foreign stations. Of the second class, 257,562 were exchanged with Germany, 231,651 with Great Britain, 103,704 with Sweden, 83,404 with Norway, 53,026 with Russia, and 30,338 with America. There are 171 telephone stations in connexion with the State telegraph.

The principal bank of Denmark is the National Bank at Copen- hagen, which is the only one authorized to issue notes. The total amount of these is £5,333,834 ; the notes are of the value of 10 kr. (1 krone = Is. IJd.), 50, 100, and 500 kr. Next in importance are the Danske Landmands Bank, the Handels Bank, and the Private Bank, all at Copenhagen. The provincial banks are very numerous; many of them are at the same time savings banks. This latter class niunbered at the close of 1899, 532. The total of their deposits was £37,410,820, their rate of interest, with few exceptions, 3^ to 4 per cent. There exists, besides, in Denmark 15 mutual loan associations (Kreditf oreninger) , whose business is the granting of loans on mortgage. The total of the money lent by these institutions was £46,121,780. Registration of mortgages is compulsory in Denmark, and the system is extremely simple, a fact which has been of the greatest importance for the improvement of the country. There are comparatively large institutions for in- surance of all kinds in Denmark. The largest office for life insurance is a State institution. By law of 9th April 1891 a system of old-age pensions has been established for the benefit of persons over 60 years of age. The total nuiiber of those who in 1898 were in receipt of per- manent and direct assistance was 40,759, of whom 27,629 were with- out encumbrance, whilst 13,130 were heads of families having in all 16,897 persons depending on them. Those assisted were fully 17 per cent, of all persons in Denmark above 60 years of age, but the number will of course increase. 69-15 per cent, lived in the rural districts.

The unit of the Danish monetary system is the krone (crown), equal to Is. IJd., which is divided into 100 ore ; consequently 7J ore are equal to o^e penny. Since 1878 gold has been the standard, and gold pieces of 20 and 10 kroner are coined, but not often met with, as the public prefers bank-notes.

As regards the dependencies and colonies of Denioark, see articles on Faroes, Gkeenland, Iceland, and St Thomas. Their areas and population

are as follows : —

Far5es (1900) . . . Area, 511 sq. m. Iceland (1890) . . . „ 40,426 „ Danish West Indies (1900) „ 138 „ Greenland (1890) . about 43,000 „

population, 15,230 „ 70,927

„ 30,504

„ 10,576

Recent History.

Totalarea(withoutGreenland), 41,075 sq. m. Total . 127,237

The recent political history of Denmark oflers very little of general interest. The country has not been engaged in the political struggles of Europe, and has been left in peace. As long as Napoleon III. was on the throne, Denmark could still hope one day to recover the lost province of North Schleswig, and when war broke out in 1870 between France and Germany, public opinion inclined to an active sympathy with France. The rapid course of that campaign, however, compelled Denmark to observe neutrality. Aft«r its close any rapproche- ment to the new German Empire was distasteful to the people. In the circumstances, Austria and Germany agreed, in October 1878, to the abolition of clause 6 of the Treaty of Prague, which, to the great surprise of the Danes, was carried out at the very time the Danish Court was preparing to give expression to its anti-German

sentiments on the marriage of the Princess Thyra to the Duke of Cumberland. The most noticeable feature in the internal history of Denmark is the constitutional struggle which has been going on for many years between successive Governments and the Left party, which

commands an overwhelming majority in the Folkething. No practical questions of great importance have been at the bottom of this disagreement save that of the fortification of Copenhagen. The Government considered this necessary, because without it the capital was exposed to a coup de main at any time, while the Left opposed it as a piece of aggressive militarism, which would be unnecessary if Denmark only proclaimed her neutrality in any war that might arise. For this reason the majority of the Polkething refused to sanction the outlay, but the Government, considering that the danger was real, and that the neutrality of a State cannot be secured by her own declaration but depends on the good-will of her neighbours, which cannot be guaranteed, nevertheless carried out the work by means of a huge accumulated surplus. In the course of this conflict the majority in the Folkething even went the length of refusing supplies altogether ; but under the Premier- ship of M. Estrup the Government collected the revenue neverthe- less, and sought its justification in the approval of the Landsthing, whose political power according to the Charter is in every respect equal to that of the Folkething. This procedure met with no seri- ous resistance in the country. The election in the spring of 1901 resulted in the return to the Folkething of 76 members of the Reform party of .the Left, 16 members of the Moderate Left,~~14 Social Democrats, and only 8 members of the Right, the party which had held the r^ins of power for so many years. Professor Deuntzer, one of the law professors in the University of Copen~~ hagen, became the head of a Government composed of prominent men drawn from the different sections of his own side of the Folke- thing, and including amongst the number a simple peasant as Min- ister of Agriculture. The most prominent articles in the policy of the new Government were a reform of the customs, a readjustment of the system of taxation, a reform of the judicial procedure, a reform of primary education, and a reduction in the expenditure for military purposes.

Danish literature is dealt with below. As regards the intel- lectual life of the Danish nation in other respects during the last quarter of the 19th century, there is not much that calls for notice. During the earlier part of the century not a few men could be mentioned who enjoyed an exceptional reputation in various departments of science, but they have gradually died away, and their places have not been filled. Danish

scientists, nevertheless, continue to contribute their full share to the advancement of knowledge, and a full account of what has been published would occupy considerable space. The Society of Sciences, that of Northern Antiquaries, the Natural History and the Botanical Societies, &c., still publish their transactions and proceedings, but the NaUirhistorisk Tidsskrift, of which 14 volumes with 259 plates were published 1861-84, and which really was in the foremost rank in its department, ceased with the death in 1884 of the editor, the distinguished zoologist, L C. Schiodte. Another extremely valuable publication of wide general interest, the Meddelelser om Gron- land which is published, by the Commission for the Exploraiion of Greenland, and of which 23 volumes, richly illustrated with maps, &o., have appeared, is still being continued. Amongst the works on the history of Denmark which have appeared, the most important is the History of Denmark and Norway since 1720, by E. Holm.

What may be called the modern "art" current, with its virtues and vices, is as strong in Denmark as in England (see Schools or Painting). In architecture the prevailing fashion is a return to the style of the first half of the 17th century, called the Christian IV. Style.

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Danish Liteeatuke.

The development of imaginative literature in Denmark became very closely defined during the latter half of the 19th century. The romantic movement culminated in several poets of great eminence, whose deaths prepared the way for a new school. In 1874 Bodtcher passed away, in

1875 Hans Christian Andersen {q.v.), in the last week of 1876 Winther {q.v.), and the greatest of all, Erederik

Paludan-Milller {q.v.) . The field was, therefore, left open to the successors of those idealists, and in 1877 the reaction began to be felt. The eminent critic, Dr G-eorg Brandes {q.v.), had long foreseen the decline of pure romanticism, and had advocated a more objective and more exact treat- ment of literary phenomena. Accordingly, as soon as all the great planets had disappeared a new constellation was perceived to have risen, and all the stars in it had been lighted by the enthusiasm of Brandes. The new writers were what he called'Natuialists, and their sympathies were with the latest forms of exotic, but particularly of French literature. Among these fresh forces three immediately took place as leaders — Jacobsen, Drachmann, and Schan- dorph. In J. P. Jacobsen (1847-1886) {q.v.) Denmark was now taught to welcome the greatest artist in prose which she had ever possessed ; his romance of Marie Qruhhe led off the new school with a production of unex- ampled beauty. But Jacobsen died young, and the work was really carried out by his two companions. Holger Drachmann (6. 1846) {q.v.) began life as a marine painter ; and a first little volume of poems, which he published in 1872, attracted slight attention. In 1877 he came forward again with one volume of verse, another of fiction, a third of travel ; in each he displayed great vigour and freshness of touch, and he rose at one leap to the highest position among men of promise. He has known how, through many vicissitudes, to retain his place, and Drachmann is to-day, without rival, the leading imaginative writef in Denmark. For many years he made the aspects of life at sea his particular theme, and he contrived to rouse the patriotic enthusiasm of the Danish public as it had never been roused before. His various and unceasing productiveness, his freshness and vigour, and the inexhaustible richness of his lyric versatility, early brought Drachmann to the front and kept him there. Meanwhile prose imaginative literature was ably supported by Sophus Sehandorph (1836-1901), who had been entirely out of sympathy with the idealists, and had taken no step while that school was in the ascendant. In 1876, in his fortieth year, he was encouraged by the change in taste to publish a volume of realistic stories. Country Life, and in 1878 a novel, Witlwut a Centre. He has some relation with Guy de Maupassant as a close analyst

of modern types of character, but he has more humour. He has been compared with such Dutch painters of low life as Teniers. His talent reached its height in the novel called Little Folk, 1880,- a most admirable study of lower middle-class life in Copenhagen. He was for a while, without doubt, the leading living novelist, and he went on producing works of great force, in which, however, a certain monotony is apparent. The three leaders had meanwhile been joined by certain younger men who took a prominent position. Among these Karl Gjellerup and Erik Skram were the earliest. Gjellerup (&. 1857), whose first works of importance date from 1878, was long uncertain as to the direction of his powers ; he was poet, novelist, mor- alist, and biologist in one ; at length he settled down into line with the new realistic school, and produced in 1882 a satirical novel of manners which had a great success, The Disciple of the Teutons. Erik Skram (6. 1847) had in 1879 written a solitary novel, Gertrude Coldhjornsen, which created a sensation, and was hailed by Brandes as exactly representing the "naturalism" which he desired to see encouraged'; but Skram has written little else of importance. Other writers of reputation in the naturalistic school were Edvard Brandes (6. 1847) and Herman Bang (6. 1858). Peter Nansen (6. 1861) has come into wide notoriety as the author, in particularly beautiful Danish, of a series of stories of a pronouncedly sexual type, among which Maria (1894) has been the most successful. Meanwhile, several of the elder generation.

unaffected by the movement of realism, continued to please the public. Three lyrical poets, H. V. Kaalund (1818- 1885), Carl Ploug (1813-1894), and Christian Eichardt (1831-1892), of very great talent, were not yet silent, and among the veteran novelists were still active H. F. Ewald (6. 1821) and Thomas Lange (&. 1829). During the whole of this period the most popular writer of Denmark was J. C. C. BrosboU (1816-1900), who wrote, under the pseu- donym Carit Etlar, a vast number of tales. The admirable prose-writer Meier Goldschmidt survived until 1887. So- phus Bauditz (b. 1850) has persevered in composing novels which attain a wide general popularity. Mention must be made also of the dramatist Christian

Molbech (1821-1888) and of the miscellaneous writer Erik Bogh (1822-1899).

Between 1885 and 1892 there was a transitional period in Danish literature. Up to that time all the leaders had been united in accepting the naturalistic formula, Tv^hich was combined with an individualistic and a Eadical tendency. In 1885, however, Drachmann, already the recognized first poet of the country, threw off his allegiance to Brandes, denounced the exotic tradition, declared him- self a conservative, and took up a national and patriotic attitude. He was joined a little later by G-jellerup, while Schandorph remained staunchly by the side of Brandes. The camp was thus divided. New writers began to make their appearance, and, while some of these were staunch to Brandes, others were inclined to hold rather with Drachmann. Of the authors who came forward during this period of transition, the strongest has proved to be Henrik Pontoppidan (6. 1857), in 1902 perhaps the first living novelist of Denmark. In some of his books he reminds the reader of Tourgenieff. Pontoppidan pub- lished in 1898 the first volume of a great novel entitled Lykke-Per, the biography of a typical Jutlander named Per Sidenius, a work to be completed in eight volumes, of which four had appeared by 1901. Since 1893 no great features of a fresh kind have revealed themselves. The Danish public, grown tired of realism, and satiated with pathological phenomena, have returned to a study of their own national characteristics. The cultivation of verse, which was greatly discouraged in the 'eighties, has re- turned. Drachmann, who is really a talent of immense force, has persisted, and he is now supported by excellent younger poets of his school. J. J. Jorgensen (&. 1866), a Catholic decadent, is one of these who have been very prolific. Otto C. Fonss (b. 1853) has published seven little volumes of graceful lyrical poems in praise of gardens and of farm-life. Andreas Dolleris (6. 1850), of Vejle, published the same number of books between 1879 and 1901, and is an occasional poet of considerable merit. Alfred Ipsen (6. 1852) should also be mentioned as a poet and critic. Valdemar Eordam, whose Tlie Danish Tongue was the lyrical success of 1901, must also be named. Some attempts have been made to transplant the theories of the symbolists to Denmark, but without signal success. On the other hand, something of a revival of naturalism is to be observed in the

powerful studies of low life admirably written by Karl Larsen (6. 1860), of which At Sixteen was published in 1901.

The drama has long flourished in Denmark, and it has not ceased to do so within the last quarter of a century. The principal theatres are liberally open to fresh dramatic talent of every kind, and the great fondness of the Danes for this form of entertainment gives unusual s^pe for experiinents in halls or private theatres ; nothing is too eccentric to hope to obtain somewhere a fair hearing. Drachmann has produced with great success several romantic dramas founded on the national legends. Most of the novelists and poets already mentioned have essayed the stage, and to those names should be added these of Ernst von der Eecke (b. 1818) and Gustav Wied (6. 1858).

In theology Denmark has not approached the preceding generation, in which such writers as Clausen (1793-1877), and still more Martensen (1808-84), lifted the prestige of Danish divinity to a high point. But in history the Danes have been very active. Jens Peter Trap (1810-1885) concluded his great statistical account of Denmark in 1879. The 16th century has been made the object of the investigations of Troels Lund (q.v.). About 1880 several of the younger historians formed the plan of combining to investigate and publish the sources of Danish history; in this the indefatigable Johannes Steenstrup (b. 1844) was prominent. The domestic history of the country began, about 1885, to occupy the attention of Holm, 0. Nielsen, and the veteran Frederik Barfod (1811-1896). The naval histories of G. Liitken attracted much notice. Besides the names already mentioned, A. D. Jorgensen (1840-1897), Eridericia, and Mollerup have all distin- guished themselves in the excellent school of Danish historians. Since 1896 a composite history of Denmark, on a very large scale, has been undertaken by some leading historians. In philosophy nothing has been published of the highest value. Martensen's Jakob Bohme (1881) really belongs to an earlier period. H. Hoffding (6. 1843) has been the most prominent contributor to- psychology, and an enthusiastic disciple of Mr Herbert Spencer. Alfred Lehmann (b. 1858) has, since 1896, attracted a good deal of attention by his sceptical investigation of psychical phenomena. P. Eonning has written on the history of thought in Denmark. In the criticism of art, Julius Lange

(1838-1896)., and later Karl Madsen, have done excellent service. In literary criticism that eminent master of thought and language Dr Georg Brandes (b. 1842) has been active and predominant throughout the whole of this period. His influence on his age has been greater than that of any other Dane. Thor Lange (6. 1851) has been an excellent critic and a useful trans- lator, (e. g.)

Denny and Dunipace, a police burgh (1876) of Stir- lingshire, Scotland, formed of two towns on opposite sides of the river Carron, 25J miles north-east of Glasgow by rail. The industries are iron-founding, paper-making, engineering, chemical manufacture, brick-making, and coal-mining. There is a cottage hospital and a public hall and library. The churches are Established, three United Free, and Eoman Catholic. The Denny public school had an average attendance of 802 in 1898-99, Dunipace public school 176, and Denny Eoman Catholic school 178. Population (1881), 4081 ; (1901), 5158.

Dentistry. — Dentistry is a special department of medical science, embracing the structure, function, and therapeutics of the mouth and its contained organs, together with their surgical and pros- ^^^f’”” thetic treatment. As a distinct vocation it is first alluded to by Herodotus (500 b.c). There are evidences that at an earlier date the Egyptians and Hin- dus attempted to replace lost teeth by attaching wood or ivory substitutes to adjacent sound teeth by means of threads or wires, but the gold fillings reputed to have been found in the teeth of Egyptian mummies have upon investigation been shown to be superficial applications of gold leaf for ornamental purposes. The impetus given to medical study in the Grecian schools by the followers of ^sculapius and especially Hippocrates (500 to 400 b.c.) developed among the practitioners of medicine and surgery considerable knowledge of dentistry. Galen (a.d. 131) taught that the teeth were true bones existing before birth”, and to him is credited the belief that the upper canine teeth receive branches from the nerve which supplies the eye, and hence should be called ” eye-teeth.” Albucasis (a.d. 1006 ?) describes the operation by which artificial

crowns are attached to adjacent sound teeth. Vesalins (1514), Ambroise Par^, Scaliger, Kerckring, Malpighi, and lesser anatomists of the same period contributed disser- tations which threw some small amount of light upon the structure and functions of the teeth. The operation of transplanting teeth is usually attributed to John Hunter (1728-1793), who practised it extensively, and gave to it additional prominence by transplanting a human tooth to the comb of a cock, but the operation was alluded to by Ambroise'Pare (1509-1590), and there is evidence to show that it was practised even earlier. Leeuwenhoek in 1678 described with much accuracy the tubular structure of the dentine, thus making the most important contribu- tion to the subject which had appeared, up to that time.- Until the latter part of the 18th century extraction was practically the only operation for the cure of toothache. The early contributions of France exerted a controUuig influence upon the development of dental practice. Urbain H^mard, surgeon to the Cardinal G-eorges of Armagnac, whom Dr Blake (1801) calls an ingenious surgeon and a great man, published in 1682 his Researches upon the Anatomy of the Teeth, their Nature and Properties. Of H^mard, M. Fauchard says : " This surgeon had read Greek and Latinauthors, whose writings he has judiciously incorporated in his own works." In 1728 jFauchard, who has been called the ~~*Father of Modern Dentistry, pub*~~ *lished his celebrated work, entitled Le Chirurgien Den- tiste ou Traits des dents. The preface contains the following Statement as to the existing status of dental art and science in France, which might have been applied with equal truth to any other European coun- try : — " The most celebrated surgeons having abandoned this branch of surgery, or having but little cultivated it, their negligence gave rise to a class of persons who, without theoretic knowledge or experience, and without being qualified, practised it at hazard, having neither principles nor system. It was only since the year 1700 that the intelligent in Paris opened their eyes to these abuses, when it was provided that those who intended practising dental surgery should submit to an examination by men learned in all the branches of medical science, who should decide upon t^heir merits." After the publication of Fauehard's work the practice of dentistry became more specialized and distinctly separated from medical practice, the best exponents of the art being trained as apprentices by practitioners of ability, who had acquired their training in the same way from their^ predecessors. Fau chard sug-*

gested porcelain as an improvement upon bone and ivory for the- manufacture of artificial teeth, a suggestion which he obtained from Reaumur, the French savant and phys- icist, who was a contributor to the Royal Porcelain Man- ufactory at Sevres. Later, Duchateau, an apothecary of St Germain, made porcelain teeth, and communicated his discovery to the Academy of Surgery in 1776, but kept the process secret. Du Bois Chemant carried the art to England, and the process was finally made public by M. Du Bois Foucou. M. Fonzi improved the art to such an extent that the Athenaeum of Arts in Paris awarded him a medal and crown, 14th March 1808.

In Great Britain the 19th century brought the dawn- ing of dental science. The work of Dr Blake in 1801 on the Anatomy of the" Teeth was distinctly in advance of anything previously written on the subject. Joseph Fox was one of the first members of the medical pro- fession to devote himself exclusively to dentistry, and his work is a repository of the best practice of his time. The processes described, though comparatively crude, involve principles in use at the present time. Thomas Bell, the successor of Fox as lecturer on the Structure and Disease of the Teeth at Guy's Hospital, published his well- known work in 1829. About this period numerous

publications on dentistry made their appearance, not- ably those of Koecker, Johnson, and Waite, followed somewhat later by the admirable work of Alexander Nasmyth (1839). By this time Cuvier, Serres, Rous- seau, Bertin, Herissant, and others in France had added to the knowledge of human and comparative dental anat- omy, while Retzius, of Sweden, and Weber, Rosenmiiller, Schreger, Purkinje, Fraenkel, and Mliller in Germany were carrying forward the same lines of research. The sympathetic nervous relationships of the teeth with other parts of the body, and the interaction of diseases of the teeth with general pathological conditions, were clearly established. Thus a scientific foundation was laid, and dentistry came to be practised as a specialty of medicine. Certain minor operations, however, such as the extraction of teeth and the stopping of caries in an imperfect way, were still practised by barbers, and the empirical practice of dentistry, especially of those operations which were almost wholly mechanical, had developed a considerable body of dental artisans who, though without medical education in many cases,

possessed a high degree of manipulative skill. Thus there came to be two classes of practitioners, the first regarding dentistry as a specialty of medicine, the latter as a distinct and separate calling.

In America representatives of both classes of dentists began to arrive from England and France about the time of the Revolution. Among these were John Woffendale (1766), a student of Robert Berdmore of Liverpool, surgeon-dentist to H.M. George III. ; James Gardette (1778), a French physician and surgeon ; and Joseph Lemaire (1781), a French dentist who went out with the army of Count Rochambeau. During the winter of 1781-82, while the Continental army was in winter quarters at Providence, R.I., Lemaire found time and opportunity to practise his calling, and also to instruct one or two persons, notably Josiah Flagg, probably the first American dentist. Dental practice was thus estab- lished upon American soil, where it has produced such fertile results.

Until well into the 19th century apprenticeship afforded the only means of acquiring a knowledge of dentistry. The profits derived from the apprenticeship system fos- tered secrecy and quackery among many of the early practitioners ; but the more liberal minded and better educated of the craft developed an increasing opposition to these narrow feethods. In 1837 a local association of dentists was formed in New York, and in 1840 a national association, " The American Society ^"afnhuf of ' Dental Surgeons," the object of which was "to advance the science by free communication and interchange of ' sentiments." The first dental periodical in the world, the American Journal of Dental Science, was issued in June 1839, and in November 1840 was established the Baltimore College of Dental Surgery, the first college in the world for the sys- tematic education of dentists. Thus the year 1839-40 Inarks the birth of the three factors essential to professional growth in dentistry. All this, combined with the refusal of the medical schools to furnish the desired facilities for dental instruction, placed dentistry for the time being upon a footing entirely separate from general medicine. Since then the curriculum of study preparatory to dental practice has been systematically increased both as to its content and length, until in all fundamental principles it is practically equal to that required for the training' of medical specialists, and in addition includes the technical subjects

peculiar to dentistry. In England, and to some extent upon the Continent, the old apprenticeship system is retained as an adjunct to the college course, but it is rapidly dying out, as it has already done in America. Owing to the regula-

tion by law of tlie educational requirements, the increase of institutions devoted to the professional training of dentists has been rapid in all civilized countries, and during the past twenty years especially so in the United States. Great Britain possesses upwards of twelve insti- tutions for dental instruction, Trance two, G-ermany and Switzerland six, all being based upon the conception that dentistry is a department of general medicine. In the United States there were in 1878 twelve dental schools, with about 700 students; in 1899 there were fifty-six schools, with 7633 students. Of these fifty-six schools, thirty-six are departments of universities or of medical institutions, and there is a growing tendency to regard dentistry from its educational aspect as a special depart- ment of the general medical and surgical practice.

Recent studies have shown that besides being an im- portant part of the digestive system, the mouth sustains intimate relationship with the general nervous system, and is important as the portal of entrance for the majority of the bacteria that cause specific diseases. This fact has rendered more intimate the relations between dentis- try and the general practice of medicine, and has given a powerful impetus to scientific studies in dentistry. Through the researches of Tomes, Mummery, Research, jjopewell Smith, Williams, and others in England, Hertwig, Weil, and Eose in Germany, Andrews, Sudduth, and Black in America, the minute anatomy and embryology of the dental tissues have been worked out with great fulness and precision. In particular, it has been demonstrated that certain general systemic diseases have a distinct oral expression. Through their extensive nervous connexions with the largest of the cranial nerves and with the sympathetic nervous system, the teeth frequently cause irritation resulting in profound reflex nervous phenomena, which are curable only by removal of the local tooth

disorder. Gout, lithsemia, scurvy, rickets, lead and mercurial poisoning, and certain forms of chronic nephritis, produce dental and oral lesions which are either pathognomonic or strongly indicative of their several constitutional causes, and are thus of great importance in diagnosis. The most important dental research of modern times is that which was carried out by Professor W. D. Miller of Berlin (1884) upon the cause of caries of the teeth, a disease said to affect the human race more extensively th^n any other. MUler demonstrated that, as previous observets had suspected, caries is of bacterial origin, and that acids play an important r61e in the process. The disease is brought about by a group of bacteria which develop in the mouth, growing naturally upon the debris of starchy or carbohy- drate food, producing fermentation of the mass, with lactic acid as the end product. The lactic acid dissolves the mineral constituent of the tooth structure, calcium phosphate, leaving the organic matrix of the tooth exposed. Another class of germs, the peptonising and putrefactive bacterid, then convert the organic matter into liquid or gaseous end products. The accuracy of the conclusions obtained from his analytic research was synthetically proved, after the manner of Koch, by pro- ducing the disease artificially. Caries of the teeth has been shown to bear highly important relation to more remote or systemic diseases. Exposure and death of the dental pulp furnishes an avenue of entrance for disease- producing bacteria, by which invasion of the deeper tissues may readily take place, causing necrosis, tuberculosis, ac- tinomycosis, phlegnion, and other destructive inflamma- tions, certain of which, affecting the various sinuses of the head, have been found to cause meningitis, chronic empyema, metastatic abscesses in remote parts of the body, paralysis, epilepsy, and insanity.

Operative Dentistry. — The art of dentistry is usually

divided arbitrarily into operative dentistry, the purpose of which is to preserve as far as possible the teeth and associated tissues, and prosthetic dentistry, the purpose of which is to supply the loss of teeth by artificial substi- tutes. The filling of carious cavities was prob- ably first performed with lead, suggested ap- s^“pf„g’ parently by an operation recorded by Celsus (100 B.C.), who recommended that frail or decayed teeth be stuffed with lead previous to extraction, in order that they might not break under

the forceps. The use of lead as a filling was sufficiently prevalent in France during the 17th century to bring into use the word plombage, which is still occasionally applied in that country to the operation of filling. Gold as afilling material came into general use about the beginning of the 19th century.' The earlier preparations of gold were so impure as to be virtually without cohesion, so that they were of use only in cavities which had sound walls for its retention. In the form of rolls or tape it was forced into the previously cleaned and prepared cavity, condensed with instruments under heavy hand pressure, smoothed with files, and finally burnished. Tin foil was also used to a limited extent and by the same method. Improvements in the refining of gold for dental use brought the product to a fair degree of purity, and, about 1855, led to the in- vention by Df Robert Arthur of Baltimore of a method by which it could be welded firmly within the cavity. The cohesive properties of the foil were developed by passing- it through an alcohol flame, which dispelled its surface contaminations. The gold was then welded piece by piece into a homogeneous mass by plugging instru- ments with serrated points. In this process of cold- welding, the mallet, hitherto in only limited use, was found more efficient than hand pressure, and was rapidly developed. The primitive mallet of wood, ivory, lead, or steel, was supplanted by a mallet in which a hammer was released automatically by a spring condensed by pressure of the operator's hand. Then followed mallets operated by pneumatic pressure, by the dental engine, and finally by the electro-magnet, as utilized in 1867 by Bonwill. These devices greatly facilitated the operation, and made possible a partial or entire restoration of the tooth-crown in conformity with anatomical lines.

The dental engine in its several forms is the outgrowth of the simple drill worked by the hand of the operator. It is uspd in removing decayed structure and for shaping the cavity for inserting the filling. From time to time its usefulness has been extended, so that it is now used for finishing fillings and polishing them, for polishing the teeth, removing deposits from them and changing their shapes. Its latest development, the dento-surgical engine, is of heavier construction and is adapted to operations upon all of the bones, a recent addition to its equipment being the spiral osteotome of Cryer, by which, with a minimum shock to the patient, fenestra of any size or shape in the brain-case may be made, from a

simple trepanning operation to the more extensive openings required in intra-cranial operations. The rotary power may be supplied by the foot of the operator, or by hydraulic or electric motors. The rubber dam invented by S. C. Barnum of New York (1864) provided a means for protecting the field of operations tiojca. the oral fluids, and extended the scope of operations even to the entire restoration of tooth-crowns with cohesive gold foil. Its value has been found to be even greater than was at first anticipated. In all operations involving the exposed dental pulp or the pulp-chamber and root-canals, it is the

1 The filling of teeth with gold foil is recorded in the oldest known book on dentistry, Artzney Buchlein, published anonymously in 1530, in which the operation is quoted from Mesne (a.d. 857) , physician to the Caliph Haroun al-Raschid.

only efficient method of mechanically protecting the field of operation from invasion by disease-producing bacteria.

The difficulty and annoyance attending the insertion of gold, its high thermal conductivity, and its objectionable colour have led to an increasing use of amalgam, gutta- percha, and cements of zinc oxide mixed with zinc chloride or phosphoric acid. Eecently much attention has been devoted to restorations with porcelain. A piece of platinum foil of ~~001 inch thickness is burnished and pressed into the cavity, so that a matrix is produced exactly fitting the cavity. Into this matrix is placed a mixture of powdered porcelain and water or alcohol, of the colour to match the tooth. The mass is carefully dried and then fused until homogeneous. Shrinkage is counteracted by additions of porcelain powder, which are repeatedly fused untilthewholeexactlyfillsthematrix. After cooling,the matrix is stripped away and the porcelain is cemented into the cavity. When the cement has hardened, the sur~~ face of the porcelain is ground and polished to proper con- tour. If successfully

made, porcelain fillings are scarcely noticeable. Their durability remains to be tested.

Until recent times the exposure of the dental pulp inevitably led to its death and disintegration, and, by in- vasion of bacteria vid the pulp canal, set up an inflamma- tory process which eventually caused the loss of the entire tooth. A rational system of thera- peutics, in conjunction with proper antiseptic measures, has made possible both the conserva- tive treatment of the dental pulp when exposed, and the successful treatment of pulp-canals when the pulp has been devitalized either by design or disease. The conservation of the exposed pulp is affected by the operation of capping. In capping a pulp, irritation is allayed by antiseptic and sedative treatment, and a metallic cap, lined with a non- irritant sedative paste, is applied under aseptic conditions immediately over the point of pulp exposure. A filling of cement is superimposed, and this, after it has hardened, is covered with a metallic or other suitable filling. The utility of arsenious acid for devitalizing the dental pulp was discovered by J. K. Spooner of Montreal, and first published in 1836 by his brother Shearjashub in his Guide to Sound Teeth. The painful action of arsenic upon the pulp was avoided by the addition of various sedative drugs, — morphia, atropia, iodoform, &c., — and its use soon became universal. Of late years it is being gradually supplanted by immediate surgical extirpation under the benumbing effect of cocaine salts. By the use of cocaine also the pain incident to excavating and. shaping of cavities in tooth structure may be controlled, especially when the cocaine is driven into the dentine by means of an electric current. To fill the pulp-chamber and canals of teeth after loss of the pulp, all organic remains of pulp tissue should be removed by sterilization, and then, in order to prevent the entrance of bacteria, and consequent infection, the canals should be perfectly filled. Upon the exclusion of infection depends the future integrity and comfort of the tooth. Numberless methods have been invented for the operation. Pulpless teeth are thus preserved through long periods of usefulness, and even those remains of teeth in which the crowns have been lost are rendered comfortable and useful as supports for artificial crowns, and as abutments for assemblages of crowns, known as bridge-work.

The discoloration of the pulpless tooth through putrefactive changes in its organic matter were first over- come by bleaching it with chlorine. Small quantities of calcium hypochlorite are packed into the pulp-chamber and moistened with dilute acetic acid ; the decomposition of the calcium salt liberates chlorine in situ, which restores the tooth to normal colour in a short time. The cavity is

Extrac- tion.

afterwards washed out, carefully dried, lined with a light- coloured cement, and filled. More efiicient bleaching agents of recent introduction are hydrogen dioxide in a 25 per cent, solution or a saturated solution of sodium dioxide; they are less irritating and much more convenient in application. Unlike chlorine, these do not form soluble metallic salts which may subsequently discolour the tooth. Hydrogen dioxide may be carried into the tooth structure by the electric current, in which case a current of not less than forty volts controlled by a suitable graduated resistance is applied with the patient in cir- cuit, the anode being a platinum-pointed electrode in con- tact with the dioxide solution in the tooth cavity, and the cathode a sponge or plate electrode in contact with the hand or arm of the patient. The current is gradually turned on until two or three milliamperes are indicated by a suitable ammeter. The operation requires usually twenty to thirty minutes.

Malposed teeth are not only unsightly but prone to disease, and may be the cause of disease in other teeth, or of the associated tissues. The impairment of func- tion which their abnormal position causes has been found to be the primary cause of disturbances of the general bodily health; for example, enlarged tonsils, chronic pharyngitis and nasal catarrh, indigestion, and malnutri- tion. By the use of springs, screws, vulcanized caout- chouc bands, elastic ligatures, &c., as the case may require, practically all forms of dental irregularity may be cor- rected, even such protrusions and retrusions of the front teeth as cause great disfigurement of the facial contour.

The extraction of teeth, an operation which until quite recent times was one of the crudest procedures in minor surgery, has been reduced to exactitude by improved instruments, designed with refer- ence to the

anatomical relations of the teeth and their alveoli, and therefore adapted to the several classes of teeth. The operation has been rendered painless by the use of anaesthetics. The anaesthetic generally employed is nitrous oxide, or laughing-gas, the use of which was discovered in 1844 by Horace Wells, a dentist of Hartford, Conn., U.S.A. Chloroform and ether, as well as other general anaesthetics, have been employed in extensive operations because of their more prolonged effect ; but chloroform, especially, is dangerous, owing to its effect upon the heart, which in many in- stances has suddenly failed during the operation. Ether, while less manageable than nitrous oxide, has been found to be practically devoid of danger. The local injection of solutions of cocaine and allied anaesthe- tics into the gum-tissue is extensively practised ; but it is attended with danger, from the toxic effects of an overdose upon the heart, and the local poisonous effect upon the tissues, which lead in numerous cases to necrosis and extensive sloughing.

Dental Prosthesis. — The fastening of natural teeth or carved substitutes to adjoining sound teeth by means of thread or wire preceded their attachment to base-plates of carved wood, bone, or ivory, which latter method was practised until the intr odu ction of swaged metallic plates. Where the crown only of a tooth or those of several teeth were lost, the restoration was effected by engrafting upon the prepared root a suitable crown by means of a wooden or metallic pivot. When possible, the new crown was that of a corresponding sound tooth taken from the mouth of another individual ; otherwise an artificial crown carved from bone or ivory, or sometimes from the tooth of an ox, "was used. To replace entire dentures a base-plate of carved hippopotamus ivory was constructed, upon which were mounted the crowns of natural teeth, or later those of porcelain. The manufacture of a denture of this character was tedious and uncertain,

and required much skill. The denture was kept in place by spiral springs attached to the buccal sides of the appliance above and below, which caused pressure upon both jaws, necessitating a constant effort upon the part of the unfortunate wearer to keep it in place. Metallic swaged plates were introduced in the latter part of the 18th century. An impression of the gums was taken in wax, from which a cast was made in plaster of Paris. With this as a model, a metallic die of brass or zinc was prepared, upon which the plate of gold or silver was formed, and then swaged into contact with the die by means of a female die or counter-die of lead. The pro- cess is essentially the same to-day, with the addition of numerous improvements, in detail, which have brought it to a high degree of perfection. The discovery, by Gardette of Philadelphia in 1800, of the utility of atmospheric pressure in keeping artificial dentures in place led to the abandonment of spiral springs. A later device for en- hancing the stability is the vacuum chamber, a central depression in the upper surface of the plate, which when exhausted of air by the wearer, materially increases the adhesion. The metallic base-plate is used also for sup- porting one or more artificial teeth, being kept in place by metallic clasps fitting to, and partially surrounding, adjacent sound natural teeth, the plate merely covering the edentulous portion of the alveolar ridge. It may also be kept in place by atmospheric adhesion, in which case the palatal vault is included, and the vacuum chamber is utilized in the palatal portion to increase the adhesion.

In the construction usually practised, porcelain teeth are attached to a gold base-plate by means of stay-pieces of gold, perforated to receive the platinum pins baked in the body of the tooth. The stay-pieces or backings are then soldered to the pins and to the plate by means of high-fusing gold solder. The teeth used may be single or in sections, and may be with or without an extension designed in form and colour to imitate the gum of the alveolar border. Even when skilfully executed, the process is imperfect in that the jointing of the teeth to each other, and their adaptation to the base-plate, leaves crevices and recesses, in which food debris and oral secretions accumulate. To obviate these defects the enamelled platinum denture was devised. Porcelain teeth are first attached to a swaged base-plate of pure platinum by a stay-piece of the same metal soldered with pure gold, after which the interstices between the teeth are filled, and the

entire surface of the plate, excepting that in contact with the palate and alveolar border, is covered with a porcelain paste called the body, which is modelled to the normal contour of the gums, and baked in a muffle furnace until vitrified. It is then enamelled with a vitreous enamel coloured in imitation of the colour of the natural gum, which is applied and fired as before, the result being the most artistic and hygienic denture known. This is commonly known as the continuous gum method. Originating in France in the early part of the 19th century, and variously improved by several experi- menters, it was brought to its present perfection by Dr John Allen of New York about 1846-47. Dentures supported upon cast bases of metallic alloys and of aluminium have been employed as substitutes for the more expensive dentures of gold and platinum, but have had only a limited use, and are less satisfac- tory.

Metallic bases were used exclusively as supports for artificial dentures until in 1855-56 Charles Goodyear, jun., patented in England a process for constructing a denture upon vulcanized caoutchouc as a base. Several modifica- tions followed, each the subject of patented improvements. Though the cheapness and simplicity of the vulcanite base has led to its abuse in incompetent hands, it has on the

whole been productive of much benefit. It has been used with great success as a means of attaching porcelain teeth to metallic bases of gold, silver, and aluminium. It is extensively used also in correcting irregular positions of the teeth, and for making interdental splints in the treatment of fractures of the jaws. For the mechanical correction of palatal defects causing imperfection of deglutition and speech, which comes distinctly within the province of the prosthetic dentist, the vulcanite base produces the best-known apparatus. Two classes of palatal mechanism are recognized — the obturator, a palatal plate, the function of which is to close periorar tions or clefts in the hard palate, and the artificial velum, a movable attachment to the obturator or palatal plate, which closes the opening in the divided natural velum and, moving with it, enables the wearer to close off the nasopharynx; from the oral cavity in the pro- duction of the guttural sounds. Vulcanite is also used for extensive restorations of the jaws after surgical operations or loss by disease, and in the majority of instances wholly corrects the deformity.

For a time vulcanite almost supplanted gold and silver as a base for artificial denture, and developed a genera- tion of practitioners deficient in that high degree of skill necessary to the construction of dentures upon metallic bases. The recent development of crown-and- bridge work has brought about a renaissance, ^”^g. so that a thorough training is more than ever necessary to successful practice in mechanical dentistry. The simplest crown is of porcelain, and is engrafted upon a sound natural tooth-root by means of a metallic pin of gold or platinum, extending into the previously enlarged root-canal and cemented in place. In another type of crown the point between the root-end and the abutting crown-surface is encircled with a metallic collar or band, which gives additional security to the attachment and protects the joints from fluids or bacteria. Crowns of this character are constructed with a porcelain facing attached by a stay-piece or backing of gold to a plate and collar, which has been previously fitted to the root- end like a ferule, and soldered to a pin which projects through the ferule into the root-canal. The contour of the lingual surface of the crown is made of gold, which is shaped to conform to the anatomical lines of the tooth. The shell-crown consists of a reproduction of the crown entirely of gold plate, filled with cement, and driven over the root-end, which it closely encircles. The two latter kinds of crowns may be used as abutments for the support, of intervening crowns in constructing bridge-work. When artificial crowns are supported not by natural tooth-roots but by soldering them to abutments, they are termed dummies. The number of dummies which may be sup- ported upon a given number of roots depends upon the position and character of the abutments, the character of the alveolar tissues, the age, sex, and health of the patient, the character of the occlusion or bite, and the force- exerted in mastication. In some cases a root will not properly support more than one additional crown ; in. others an entire bridge denture has been successfully supported upon four well-placed roots. Two general, classes of bridge-work are recognized, namely, the fixed and the removable. Removable bridge-work, though more- difficult to construct, is preferable, as it can be more thoroughly and easily cleansed. When properly made and applied to judiciously selected cases, the bridge den- ture is the most artistic and functionally perfect restora- tion of prosthetic dentistry.*

The entire development of modern dentistry is com- prised within the last century, and mainly within its latter half. Beginning with a few practitioners and no organized professional basis, educational system, or literature, its.

practitioners are to be found in all civilized communities, those in Great Britain numbering about 5000; in the United States, 27,000 ; Trance, 1600, of whom 376 are graduates ; German Empire, qualified practitioners (Zahn- arzte), 1400 ; practitioners without official qualification, 4100. Its educational institutions are numerous and well equipped. It possesses a large periodical and standard literature in all languages. Its practice is regulated by- legislative enactment in all countries the same as is med- ical practice. The business of manufacturing and selling dentists' supplies represents an enormous industry, in which millions of capital are invested.

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Denton, a township in the Gorton division of Lan- cashire, England, 1^ miles north-east from Stockport, with a station on a branch of the London and North- Western railway. The township of Haughton was added to it in 1894, and it has since been governed by an urban district council. Public buildings include, besides churches and chapels, the free library, installed in new and spacious premises in 1898, and the Conservative and the

Liberal club houses. In the township are reservoirs for the water supply of Manchester, with a capacity of 1860 millions of gallons. The manufacture of felt hats is the leading industry. Coal is extensively mined in the district. The ponulation of the urban district in 1891 was 13,993; in 1901, 14,934.

Denver, the capital of the state of Colorado, U.S.A., and county seat of Arapahoe county, situated in lat. 39° 45′ N. and long. 105° W. It comprises an area of 49 square miles on the South Platte river, 15 miles east of the foot of the Eocky Mountains, at a mean elevation of 5280 feet above sea-level. The population in 1890 was 106,713, and in 1900 it was 133,859, of whom 25,301 were foreign-born and 3923 were negroes. Out of 42,712 males of voting age (21 years and over), only 716 were reported by the U.S. census enumerators in 1900 as illit- erate (unable to write) ; of these 548 were foreign-born. The death-rate in 1890 was 23-0 ; in 1900 it was 18-6. The city is the junction of the Burlington and Mis- souri Eiver, the Chicago Eock Island and Pacific, the Kansas Pacific, the Missouri Pacific, the Union Pacific, the Atchison, Topeka, and Santa Ee, the Denver and Eio Grande, the Colorado Midland, and the Colorado and Southern railway systems. The street railways are owned by a private corporation using electrical motive-power. The public education is provided by 3 high schools, a manual training school, and 44 public schools, the total public school property being valued at $2,700,000. Ac- cording to the census of 1900, the number of persons of school age (5 to 20 years inclusive) was 37,423. The University of Denver, Gross Medical College, and the College of the Sacred Heart are influential institutions. A public library, with 75,000 volumes, is supported by a tax of one-half of one mill upon the assessed valuation of the city, which, for 1900, was $69,550,115 on a basis of about one-third actual value. The city has 12 parks, with a total area of 550 acres. The water supply is derived from mountain streams and carried to the city by gravity. Its daily capacity is 60,000,000 . gallons. The factories in 1900 employed an average number of

10,926 wage-earners, with total wages amounting to $6,824,003, the total value of the manufactured products being $41,368,698. The city has four national banks, three savings banks, three State banks, and a branch of

the United States mint. In 1858 placer gold was discovered at the junction of Cherry Creek with the South Platte river at 39° 47′ N. lat. and 105° Wv long., which led to a small settlement called Auraria. In 1859 Denver (named after General James Denver, then Governor of Kansas Territory) was laid out on the east side of Cherry Creek, and shortly afterwards the two settlements were united. The city is the centre of the wealth and influence of the increasing mineral, agricultural, and stock-raising interests of the Eocky Mountain region. (j. h. pe.)

Deogarh, a town of British India, in the Sonthal Parganas district of Bengal. Situated in 24° 29′ N. lat. and 86° 44′ E. long. Population, about 8000. It is famous for a group of twenty-two temples dedicated to Siva, the resort of numerous pilgrims. It is connected with the East Indian railway by a steam tramway, 5 miles in length. In 1897 the net earnings were Rs.19,168, yielding a profit of 3-9 per cent, on a capital outlay of Es.2,87,942.

Depretis, Agostino (1813-1887), Italian states- man, was born at Mezzana Corte, in the province of Stra- della, 31st January 1813. Before 1848 he conspired with Mazzini, and was nearly captured by the Austrians while smuggling arms into Milan. Elected deputy in – 1848, he joined the Left and founded the journal II Diritto, but held no ofiicial position imtil appointed Governor of Brescia in 1859. In 1860 he went to Sicily on a mission to reconcile the policy of Cavour (who desired the immediate incorporation of the island in the kingdom of Italy) with that of Garibaldi, who' wished to postpone the Sicilian pUMscite until after the liberation of Naples and Eome. Though appointed pro-dictator of Sicily by Garibaldi, he failed in his attempt. Accepting the portfolio of Public Works in the Eattazzi Cabinet in 1862, he served as inter- mediary in arranging with Garibaldi the expedition which ended disastrously at Aspromonte. Eour years later he entered the Eicasoli Cabinet as Minister of Marine, and, by maintaining Admiral Persano in command of the fleet, con- tributed to the defeat of Lissa. Upon the death of Eattazzi in 1873, Depretis became leader of the Left, prepared the advent of his party to power, and was called upon to form, the first Cabinet of the Left in 1876. Overthrown by Cairoli in March 1878 on the grist-tax question, he succeeded, in the following December, in defeating Cairoli, became again Premier, but on

3rd July 1879 was once more overturned by Cairoli. In November 1879 he, however, entered the Cairoli Cabinet as Minister of the Interior, and in May 1881 succeeded to the Premiership, retaining that ofEce until his death on 29th July 1887. During the long in- terval he recomposed his Cabinet four times, first throwing out Zanardelli and Baccarini in order to please the Eight, and subsequently bestowing portfolios upon Eicotti, Eo- bilant, and other Conservatives, so as to complete the political process known as " trasformismo." A few weeks before his death he repented of his transformist policy, and again included Crispi and Zanardelli in his Cabinet. During his long term of ofiBlce he abolished the grist tax, extended the suffrage, completed therailway system, aided Mancini in forming the Triple Alliance, and initiated colonial policy ,by the occupation of Massawa ; but, at the same time, he vastly increased indirect taxation, cor- rupted and destroyed the fibre of parliamentary parties, and, by extravagance in public works, impaired the stability of Italian finance. Shrewdness and unscrupulous political

ability assured him a long lease of power, but Ms influ- ence upon Italian public life has been permanently dele- terious, (h. w. s.)

Deptford, a town of England, in the county of Lon- don, partly in Kent and partly in Surrey, at the junc- tion of the Eavensbourne with the Thames, 3^ miles east of London Bridge, 5 miles from Charing Cross by rail. The parish of Deptford St Paul has been formed into the new metropolitan borough of Deptford. There are two open spaces, namely, Deptford Park, consisting of the site of the gardens of old Sayes Court (11 acres), and Tele- graph Hill (9^ acres). The Trinity House was founded at Deptford, and the old hall was pulled down in 1787. A new building was erected, which was used by the cor- poration until the Trinity House on Tower Hill was ready for occupation, and occasionally for many years afterwards. The population of Deptford St Nicholas (now included in the metropolitan borough of Greenwich) was (1881), 7901; (1896), 7722; of Deptford St Paul

(1881), 76,752 ; (1901), 110,513.

Dera Chazi Khan, a town and district of British India, in the Derajat division of the Punjab. In 1881 the town had a population of 22,309, and in 1891 of 27,886; the municipal income in 1897-98 was Es.1,57,532. There are several handsome mosques in the native quarter. The cantonment accommodates one cavalry and two infantry regiments of the Punjab Prontier Force. There is an efficient high school.

The DisTKiCT OF Deea Ghazi Khan contains an area of 6606 square miles. The population in 1891 was 404,- 031, being 72 persons per square mile, an increase since 1881 of 11 per cent. Classified according to religion, Mahommedans numbered 349,587, largely Baluchis ; Hin- dus, 52,903 ; Sikhs, 1424 ; Christians, 117, of whom 73 were Europeans. In 1901 the poptdation was 445,163, showing a further increase of 10 per cent. The total amount of land revenue and rates was returned as Ks.6,83,807, the incidence of assessment being 3 annas per acre ; the number of police was 514. In 1896-97, out of a total cultivated area of 443,749 acres, 230,074 were irrigated, mostly from Government canals and wells. The exports are wheat and indigo. The only manufac- tures are for domestic use. There is no railway in the district, and only 25 miles of metalled road. The Indus, which is nowhere bridged, is navigable by native boats throughout its course of 239 miles. Education is making some progress. There are three Mahommedan institu- tions and one Hindu for religious instruction. In 1896-97 there were altogether 233 schools, with 5784 pupils, the proportion of boys at school to those of school-going age being 11-9 per cent. The registered death-rate in 1897 was 36 per thousand; the rainfall in 1897 was 5-41 inches.

Dera Ismail Khan, a town and district of Brit- ish India, in the Derajat division of the Punjab. The town is situated near the right bank of the Indus, here crossed by a bridge of boats during half the year. In 1881 it had a population of 22,164, and in 1891 of 26,884 ; the municipal income in 1897-98 was Ils.54,889. It takes its name from Ismail Khan, a Beluchi chief who settled here towards the end of the 15th century, and whose descendants ruled for 300 years. The old town was swept away by a flood in 1823, and the present town stands 4 miles back from the permanent

channel of the river. The native quarters are well laid out, with a large bazaar for Afghan traders. It is the residence of many Mahomme- dan gentry. The cantonment accommodates a force of all arms. There are several efficient schools, one missionary. A vernacular newspaper is issued. There is consider- able through trade with Afghanistan by the Gomal Pass,

and there are manufactures of scarves and inlaid wood- work. Here is the tomb of Sir Henry Durand, Lieuten- ant-Governor of the Punjab.

The DISTRICT OF Deea Ismail Khan contains an area of 9440 square miles. The population in 1891 was 486,- 201, being 52 persons per square mile — much the lowest density in the province. Since 1881 the increase had been at the rate of 10 per cent. According to religion, Mahommedans numbered 420,189; Hindus, 62,961 ; Sikhs, 2840; Christians, 204, including 108 Europeans; "others," 7. In 1901 the population was 627,705, showing a further increase of 9 per cent. The total amount of land revenue and rates was returned as Es.6,02,437, the incidence of assessment being about 1^ annas per assessed acre, but nearly 15 annas per cultivated acre ; the number of police was 627. In 1896-97, out of a total cultivated area of 588,413 acres, 159,849 were irrigated from private canals and wells. Wheat and wool are exported. There are manufactures of cotton cloth. The North-Western rail- way runs through the Cis-Indus portion of the district for 93 miles. In the other portion there are 108 miles of metalled roads for military purposes. The Indus is navigable by native boats throughout its course of 120 miles within the district. Education is making fair pro- gress, particularly in the English-teaching schools at the towns. In 1896-97 there were altogether 441 schools, attended by 7714 boys. The proportion of boys at recog- nized schools was 13-5 per cent, of those of school-going age. The death-rate in 1897 was 50 per thousand ; the rainfall in 1897 was 9-77 inches.

Derajat, the name of a division or commissioner- ship of British India, in the west of the Punjab, con- sisting of the four districts of Dera Ismail Khan, Dera Ghazi Khan, Bannu, and Muzaffargarh, the last having been recently transferred to it. It contains a total area of 22,315 square miles, and a population (1891) of 1,643,- 703, being 74 persons per square mile.

Derbent. See Daghestan.

Derby, the county town and a municipal (extended 1877), parliamentary, and county borough of Derbyshire, England, on the Derwent, 15f miles west by south of Nottingham, and 127 miles north-west by north of London. It is the central station of the Midland railway system. The enlarged parliamentary borough was in 1885 identified with the municipal borough, which was created a county borough in 1888, and is governed by a mayor, 16 aldermen, and 48 councillors. In 1898 the civil parishes within the borough were constituted one parish, though still ecclesiastically distinct. The water- works of the town, costing over £350,000, became in 1880 the property of the corporation. Electric works, lighting the principal streets, were erected in 1893. There are 17 churches, 2 Eoman Catholic churches, and over 30 dissenting chapels. Derby school was in 1879 reconstituted as a first grade school. Among recent erec- tions are a free library and museum, an art gallery, a mechanics' institute, a Midland railway institute, a grand theatre, an infirmary, and an infectious hospital. The Midland railway storehouses, workshops, and engine and carriage factory employ altogether over 10,000 men. In Little Chester are chemical and steam boiler works. In 1891 there were 3375 engaged in iron and steel manu- factures, 1031 in the manufacture of silk, 963 in the mak- ing of carriages, and 290 in the manufacture of china and porcelain. There are two daily newspapers. Area, 3450 acres. Population (1881), 81,168; (1891), 94,146 ;

(1901), 105,785.

Derby, a city of New Haven county, Connecticut, U.S.A., on the eastern bank of the Housatonic, at the

mouth of the Nai^gatuck river. It is on the New York, New Haven, and Hartford railway, and was chartered in 1894. Population (1890), 5969; (1900), 7930 (2635 foreign-born and 159 negroes).

Derby, Edward Henry Stanley, 15th Eakl OP (1826-1893), was the eldest son of the fourteenth earl, the ” Eupert of Debate.” He was educated at Rugby and Trinity College, Cambridge, where he took a high degree and became a member of the society known as ” The Apostles.” In March 1848 he unsuccessfully con- tested the borough of Lancaster, and then made a long tour in the West Indies, Canada, and the United States. During his absence he was elected member for King’s Lynn, which he represented till October 1869, when he succeeded to the peerage. No one ever prepared himself more assiduously or with a stronger sense of duty for the great position to which his birth had called him. When he took his seat in the House of Commons he wrote to a Eugby friend (the Rev. W. Philpot) to say, half proudly, half in sorrow, that he had put on the armour which he would never be able to take off again until he died ; and he kept his word. He took his place, as a matter of course, among the Conservatives, and delivered his maiden speech in May 1850 on the Sugar Duties. Just before, he had made a very brief tour in Jamaica and South America. In 1852 he went to India, and while travelling in that country he was appointed Under-Secretary for Foreign Affairs in his father’s first Administration. From the outset of his career he was known to be a most Liberal Conservative, and in 1855 Lord Palmerston offered him the post of Colonial Secretary. He was much tempted by the proposal, and hurried down to Knowsley to consult his father, who called out when he entered the room, ” Hallo, Stanley ! what brings you here ? — Has Dizzy cut his throat, or are you going to be married ? ” When the object of his sudden appearance had been explained, the Conservative chief received the courteous suggestion of the Prime Minister with anything but favour, and the offer was declined. In his father’s second Administration Lord Stanley held, at first, the office of Secretary for the Colonies,- but became President of the Board of Control on the resignation of Lord Ellenborough. He had the charge of the India Bill of 1858 in the House of Commons, became the first Secretary of State for India, and left behind him in the India Office an excellent reputation as a man of business. After the revolution in Greece and the disappearance of King Otho, the people most earnestly desired to have Queen Victoria’s second son. Prince Alfred, for their king. He declined the honour, and they then took up the idea that the next best thing they could do would be to elect some great and wealthy English noble, not concealing the hope that although they

might have to offer him a Civil List he would decline to receive it. Lord Stanley was the prime favourite as an occupant of this bed of thorns, and it has been said that he was actually offered the crown. That, however, is not true ; the offer was never formally made. After the fall of the Russell Government in 1866 he became Foreign Secretary in his father's third Administration. He com- pared his conduct in that great post to that of a man floating down a river and fending off from his vessel, as well as he could, the various obstacles it encountered. He thought that that should be the normal attitude of an English Foreign Minister, and probably under the circumstances of the years (1866-68) it was the right one. He arranged the Collective Guarantee of the Neutrality of Luxemburg in 1867, negotiated a convention about the Alabama, which, however, was not ratified, and most wisely refused to take any part in the Cretan troubles. In 1874 he again became Foreign Secretary in Mr Disraeli's Government. He acqui-

esced in the purchase of the Suez Canal shares, a measure then considered dangerous by many people, but ultimately most successful ; he accepted the Andrassy Note, but de- clined to accede to the Berlin Memorandum. His part in the latter phases of the Russo-Turkish struggle has never been fully explained, for with equal wisdom and gener- osity he declined to gratify public curiosity at the cost of some of his colleagues. A later generation will know better than his contemporaries what were the precise developments of policy which obliged him to resign. He kept himself ready to explain in the House of Lords the course he had taken if those whom he had left challenged him to do so, but from that course they consistently re- frained. Already in October 1879 it was clear enough that he had thrown in his lot with the Liberal party, but it was not till March 1880 that he publicly announced this change of allegiance. He did not at first take office in the second Gladstone Government, but became Secretary for the Colonies in December 1882, holding this position tUl the fall of that Government in the summer of 1885. In 1886 the old Liberal party was run on the rocks and went to pieces. Lord Derby became a Liberal Unionist,, and took an active part in the general management of that party, leading it in the House of Lords till 1891, when Lord Hartington became Duke of Devonshire. In 1892 he presided over the Labour Commission, but his health never recovered an attack of

infiuenza which he had in 1891, and he died at Knowsley on 21st April 1893.

During a great part of Lord Derby's life he was deflected from his natural course by the accident of his position as the son of the leading Conservative statesman of the day. From first to last he was at heart a moderate Liberal. After making allowance, however, for this deflecting agency, it must be admitted that in the highest quality of the states- man, " aptness to be right," he was surpassed by none of his contemporaries, or — if by anybody — by Sir George Cornewall Lewis alone. He would have been more at home in a state of things which did not demand from its leading statesman great popular power ; he had none of those "isms" and "prisms of fancy" which stood in such good stead some of his rivals. Byron in a famous passage speaks of those

" Madmen who have made men mad By their contagion, conquerors and kings, Sophists, hards, statesmen, all unquiet things Which stir too strongly the soul's secret springs And are themselves the fools to those they fool ! "

Lord Derby was emphatically not the kind of statesman mentioned in that passage. He had another defect besides the want of popular power. He was so anxious to arrive at right conclusions that he sometimes turned and turned and turned a subject over till the time for action had passed. One of his best lieutenants said of him in a moment of impatience : " Lordy Derby is like the God of Hegel : ' Er setzt sich, er verneint sich, er verneint seine Negation.' " Like many Englishmen, he loved business for its own sake, and more than he knew. That fact must be borne in mind when we remember the answer he gave to a friend who expressed his surprise at his serving so much as chairman of Private Bill Committees. " I do it," he said, " because I come in that way across the great interests of the country better than I otherwise could." His know- ledge, acquired both from books and by the ear, was immense, and he took every opportunity of increasing it. He retained his old university habit of taking long walks with a congenial companion, even in London, and although he cared but little for what is commonly known as society — the society of

crowded rooms and fragments of sentences — he very much liked conversation. During the many

years in which he was a member of ” The Club ” he was one of its most assiduous frequenters, and his loss was acknowledged by a formal resolution. His talk was gener- ally grave, but every now and then was lit up by dry humour. The late Lord Arthur Eussell once said to him, after he had been buying some property in Southern England: “So you stUl believe in land, Lord Derby.” ” Hang it,” he replied, ” a fellow must believe in some- thing ! ” It was to the same companion that he said, when, looking one evening for a book at Knowsley and passing his candle along the shelves, he came to the poems of William Morris : ” If I had known that he was going to turn Socialist I wouldn’t have gone to the expense of binding him in red miorocco ! ” He did an immense deal of work outside politics. He was Lord Eector of the University of Glasgow from 1868 to 1871, and later held the same office in that of Edinburgh. From 1875 to 1893 he was President of the Eoyal Literary Eund, and attended most closely to his duties then. He succeeded Lord Granville as Chancellor of the University of London in 1791, and remained in that position till his death. He lived much in Lancashire, managed his enormous estates with great skill, and did a great amount of work as a local magnate. He married in 1870 Maria Catharine, daughter of the fifth Earl De la Warr, and widow of the second marquess of Salisbury. The best account of Lord Derby which exists is that which was prefixed by Mr Lecky, who knew him very intimately, to the edition of his speeches outside Parliament, which was published in 1894. Mr Lecky brings out extremely well what almost every page of these two volumes confirms, that he was most strongly attracted by all questions which related to the condition of the mass of the people. He once wrote to Lord Shaftesbury : ” We are both public men deeply interested in the condition of the working class, and for my own part I would rather look back on services such as you have performed for that class than receive the highest honours in the employment of the State.” (m. g. d.)

Derbyshire, a north midland county of England, bounded W. by Stafford and Cheshire, N.W. by Cheshire, N. by York, E. by Nottingham, and S.E. and E. by Leicester.

Area and Population. — The area of the ancient and administra- tive county (including the county borough of Derby), as given in the census returns, is 658,876 acres or 1029 square miles. The population in 1881 was 461,746, and in 1891 was 528,033, of whom 266,011 were males and 262,022 females, the number of persons per square mQe being 513, and of acres to a person 1-25. In 1901 the population was 620,196. Since 1891 the administra^ tive area has undergone various alterations. In 1895 the part of the parish of Pinzton in Nottingham, and a part of the parish of Kirkby-in-Ashfield in the same county, were transferred to Derby, and two parts of the parish of Pinxton were transferred from Derby to Nottingham ; in the same year part of the parish of Croxall in Derby was transferred to Stafford ; and in 1897 the parishes of Nether Seal and Over Seal, part of the parish of Ashby Woulds, and part of the township of Blackfordby were transferred from Leicester to Derby ; while the parishes of Appleby, Oakthorp, and Donisthorpe and Willesley, and the townships of Chilcote, Measham, and Shetton-en-le-Fields, were transferred from Derby to Leicester. The area of the registration county is 557,768 acres, with a population in 1891 of 432,414, of which 252,931 were urban and 179,483 rural. Within this area the increase of population between 1881 and 1891 was 11-87 per cent. Between 1881 and 1891 the excess of births over deaths was 63-103, and the increase in resi- dent population 45,878.

The following table gives the number of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 :—

Tear.

Marriages.

Births.

Deaths.

Illegitimate Births.

Males.

Females.

1880 1890 1898

2672 3229 3725

13,965 13,261 14,802

7250 7831

7987

340 286 352

364 294 348

The number of marriages in 1899 was 3885, of births 14,663, and of deaths 7921. , , ^ ... ,

The following table shows the marriage, birth, and death rates per 1000 of the population, with the percentage of illegitimate births, for a series of years : —

1870-79.

1880.

1880-89.

1890.

1888-97.

1898.

Marriage-rate .

16-0

13-7

13-2

13-4

15-2

15-9

Birth-rate .

37-8

36-5

33-9

30-8

32-1

31-7

Death-rate .

21-0

18-9

17-9

18-3

17-6

17-1

Percentage of ille-

gitimate births

5-4

5 0

4-8

4-4

4-4

4-7

The birth-rate is above the average, but the death-rate rather under it.

The number of Scots in the county in 1891 was 1872, of Irish 4234, and of foreigners 684.

Constitution and Government.— The ancient county is divided into seven parliamentary divisions, and it also includes the parlia- mentary borough of Derby, returning two members. The adminis- trative county includes the municipal boroughs of Chesterfield (27,185), Derby (105,785), Glossop (21,526), and Ilkeston (25,283). Derby is a comity borough. The following are urban districts :— Alfreton (17,505), Alvaston andBonlton (4526), Ashbourne (4039), Bakewell (2850), Baslowand Bubnell (797), Belper (10,934), Bol- sover (6844), Bonsall (1360), Brampton and Walton (2698), Buxton (10,181), Claycross (8348), Dronfield(3809), Fairfield (2969), Heage (2889), Heanor (16,249), Long Eaton (13,045), Matlock (5980), Matlock Bath (1816), Newbold and Dunston (5986), Newmills (7773), North Darley (2756), Ripley (10,111), South Darley (788), Swadlincote (18,014), Whittington (9416), and Wirksworth (3807). Derbyshire is in the midland circuit, and assizes are held at Derby. The boroughs of Derby, Chesterfield, and Glossop have separate com- missions of the peace, and Derby has also a separate court of quarter sessions. The ancient county, which is partly in the dioceses of Lichfield,

Peterborough, and Southwell, contains 240 ecclesiastical parishes and districts, and parts of eleven others.

Education. — There is a residential coUege (Lichfield diocesan) for schoolmistresses at Derby, which also takes day students. At Derby there is also a royal institution for the deaf and dumb. The number of elementary schools in the county on 31st August 1899 was 422, of which 117 were board and 305 voluntary schools, the latter includ- ing 246 National Church of England schools, 12 Wesleyan, 16 Roman Catholic, and 31 " British and other. " The average attendance at board schools was 41,358, and at voluntary schools 53,833. The total school board receipts for the year ended 29th September 1899 were £159,815. The income under the Technical Instruction Act was over £1689 ; that under the Agricultural Rates Act was over £2943.

Agriculture. — ^About three-fourths of the total area of the county is under cultivation, and of this area as much as four-fifths is under permanent pasture, cattle rearing and dairy farming, in- cluding the manufacture of cheese, occupying the chief attention of the farmer. Less than 39,000 acres are in hUl pasture, and nearly 26,000 acres are under woods. Wheat and oats are the principal corn crops, and their acreage has within recent years greatly diminished. Turnips occupy more than half the area under green crops. The following table gives the larger main divisions of the cultivated area at intervals of five years from 1880 : —

Tear.

Total Area

under

Cnltiva-

tion.

Com Crops.

Green Crops.

Clover.

Permanent Pasture.

FaUow.

1880 1885 1890 1895 1900

512,368 514,660 514,573 503,185 494,716

63,135 56,293 53,297 48,498 46,923

21,026 22,081 20,144 19,714 18,169

28,774 24,889 25,947 25,093 24,697

388,966 405,680 410,320 406,487 401,830

10,453 5,717 4,460 2,822 2,541

The following table gives particulars regarding the principal Uve stock for the same years : —

Year.

Total Horses.

Total Cattle.

Cows or Heifers

in Milk or in

Calf.

Sheep,

Pigs.

1880 1885 1890 1895 1900

21,847 21,631 22,357 27,105 26,722

134,786 155,308 143,232 136,111 143,609

64,324 73,888 71,186 68,806 70,723

228,445 204,925 202,897 176,998 171,364

29,704 35,143 36,190 40,919 34,108

Manufactures and Minerals. — According to the report for 1898 of the chief inspector of factories (issued 1900) the total number of persons employed in factories and workshops in 1897 was 67,848, as compared with 68,774 in 1896. Of these nearly a third (20,324)

were employed in textfle factories, there being an increase between 1895 and 1896 of 10-4 per cent., but a decrease between 1896 and 1897 of 8-4 per cent. About one-half (10,701) were employed in the cotton industry, while lace employed 4667, hosiery (chiefly cotton and silk) 2530, and silk 1092. Non-textUe factories employed 43,630 persons, there being an increase between 1895 and 1896 of 13-9 per cent., and between 1896 and 1897 of 2-9 per cent. Those employed in the manufacture of machines, appliances, con- veyances, and tools numbered 13,990; the founding and conversion of metals employed 10,027 ; the making of earthenware, etc., 3884 ; print(calico), bleach, and dye works, 3813; andpapermaking, print- ing, &o. , 3186. In workshops only 3894 persons were employed, the majority (2263) in the clothing industries. The total number of persons employed in mining in 1899 was 48,578. In its limestone production the county stands next to Durham, the amount raised in 1899 being 1,761,270 tons. In the same year 519,208 tons of clay were raised, including 71,244 tons of fireclay valued at £21,373 (the total value of the clays being £43,648), 165,366 tons of sand- stone, and 30,218 tons of gravel and sand. But the principal mineral is coal. Ironstone is not extensively wrought, but on account of the abundant supply of coal, large quantities are

imported for smelting purposes. The amount of pig-iron produced in 1885 was 368,863 tons, in 1890, 387,760 tons, in 1895, 413,454 tons, and in 1899 (including Nottingham, the production in which county is, however, small) 611,994 tons. The furnaces are situated in Alfreton, Chesterfield, Derby, and Ilkeston. Zinc is mined to a small extent. The following table gives particulars regarding the production of coal, gypsum, iron ore, and lead in 1890 and 1899 :—

Tear.

Coal.

Gypsum.

Iron Ore.

Lead. .

Tons.

Value.

Tons.

Value.

Tons.

Value.

Tons.

Value.

1890 1899

10,445,974 14,594,424

£

4,705,188 5,047,238

67,571 11,557

£

80,407

6,778

28,732 8,626

£

8806 1534

4026 4266

£

30,195 31,995

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Dereham (East), a market tovni and railway station in the Mid parliamentary division of Norfolk, Eng- land, 15 miles west by north of Norwich. The ancient church of St Nicholas contains interesting memorials, and the Congregational chapel stands on the site of the house where the poet Cowper spent his last days. Dereham is an important agricultural centre with works for agricul- tural implements. Area of civil

parish (an urban district), 5313 acres ; population (1881), 6640 ; (1901), 5545.

Deroulede, Paul (1846), French author

and politician, was born in Paris on 2nd September 1846. He made his first appearance as a poet in the pages of the Revue nationale, under the pseudonym of Jean Eebel, and in 1869 produced at the Theatre Fran^ais a one-act drama in verse entitled Juan Strenner. On the outbreak of the Franco-German war he enlisted as a private, was wounded and taken prisoner at Sedan, and sent to Breslau, but effected his escape. He then served under Chanzy and Bourbaki, took part in the latter's disastrous retreat to Switzerland, and fought against the Commune in Paris. After attaining the rank of lieutenant, he was forced by an accident to retire from the army. He now published a number of patriotic poems {Chants du soldat), which enjoyed unbounded popularity. In 1877 he produced a drama in verse called L'Hetman, which derived a passing success from the patriotic fervour of its sentiments. For the Exhibition of 1878 he wrote a hymn, Vive la France, which was set to music by Gounod. In 1879 his drama in verse. La Moabite, which had been accepted by the Theatre Fran^ais was forbidden by the censor on religious grounds. In 1882 M. Deroulede founded the Ligue des

Patriotes, with the object of furthering France's " revanche " against Germany. He was one of the first advocates of a Franco- Russian alliance, and as early as 1883 undertook a journey to Russia for the furtherance of that object. On the rise of General Boulanger, M. Deroulede attempted to use the Ligue des Patriotes, hitherto a non-political organization, to assist his cause, but was deserted by a great part of the League and forced to resign his presidency. Nevertheless he used the section of the League that re- mained faithful to him with such effect that the Govern- ment found it necessary in 1889 to decree its suppression. In the same year he was elected to the Chamber as member for AngoulSme. He did not stand at the elections of 1893, but was re-elected in 1898, and distinguished himself by his violence as a Nationalist and anti- Dreyfusard. After the funeral of President Faure, on 23r(i February 1899, he endeavoured to persuade General Eoget to lead his

troops upon the Elysee. For this he was arrested, but on being tried for treason was acquitted (31st May). On 12th August he was again arrested and accused, together with Andre Buffet, Jules Guerin, and others, of conspiracy against the Republic. After a long trial before the High Court, he was sentenced, on 4th Janu- ary 1900, to ten years' banishment from France, and retired to San Sebastian. In 1901 he was again brought prominently before the public by a quarrel with his Royalist allies, which resulted in an abortive attempt to arrange a duel with M. Buffet in Switzerland. Besides the works already mentioned, he has published Le Sergent, iu the " Theatre de campagne " (1880) ; De I'education nationale (1882) ; Monsieur le Uhlan et les trois couleurs (1884) ; Le premier grenadier de France, La Tour d'Auvergne (1886) ; Refrains militaires (1889) ; Histoire d' amour (1890); a pamphlet entitled Desarmementf (1891) ; Poisies militaires and Messire du Guesdin, Drame en vers (1896) ; La Mort de Hoche. Cinq actes en prose (1897) ; La plus belle 'JUle du monde, conte dialogue en vers libres (1898).

Des Moines, capital and largest city of Iowa, U.S.A., and capital of Polk county, in 41° 36′ N. lat. and 93° 38′ W. long., on Des Moines river, at an altitude of 800 feet. It has a regular street plan, is supplied with water from the Raccoon river, a branch of the Des Moines, by the Holly pumping system, its streets are partly paved with brick, and it is divided into seven wards. Among the fine buildings are the new State Capitol, erected at a cost of $3,000,000, the United States Post Office, the City Hall, and the Grand Opera House. There are two public libraries, the larger of which, the State Library, contains 46,000 volumes. There are two institutions for higher education, Drake University and Des Moines College. The former under the Christian denomination had, in 1899, 54 instructors and 722 students ; the latter, 10 instructors and 157 students. Des Moines is an important railway centre. It is the meeting-point of five great systems, the Chicago, Burlington, and Quincy, the Chicago and North- western, the Chicago Great Western, the Chicago, Rock Island, and Pacific, and the Wabash, which give it a large commerce. In 1900 there were 494 manufacturing estab- lishments, with a capital of $7,911,764, with 4557 hands, and a product valued at $10,488,189. The assessed valuation of property, real and personal, was, in 1900, $13,871,430 ; the net debt (exclusive of school debt) was $727,777, and the tax rate (exclusive of school tax) $42.40 per $1000. The basis of assessment is very low (about

one-fourth of full value). Population (1890), 50,093; (1900), 62,139, of whom 7946 were foreign-born and 1675 negroes.

Desoto, a city of Jefferson county, Missouri, U.S.A.,

on the St Louis, Iron Mountain, and Southern railway. Population (1890), 3960; (1900), 5611, of whom 332 were foreign-born and 364 negroes.

Dessau, a town of Germany, capital of duchy of Anhalt, 2 miles south of the Elbe and 38 miles by rail south- east from Magdeburg. A new town hall was built in 1899- 1900. Other new buildings are St Paul's church (1890-92), a Roman Catholic church, the " magistrates' house"(1872-1874) , containing a library and drawings by Durer, Holbein, Cranach, and State law courts ; there are monuments to Moses Mendelssohn (1890), the Emperor William I. (1892), W. Mtiller (1891), who was a native of Dessau, and a war monument (1874). There are a small ducal library, a geological collection, the Leopold home for impoverished men (1750), and a picture gallery in the Amelia Institute. The various industries produce sugar, cloth, machinery, woollen yarn, carpets, blinds ; iron- founding and gardening are also carried on; an import- ant corn market. Population (1885), 27,766; (1895),

42,375 ; (1900), 50,677.

Desterro. See Ploeianopolis.

Destructors. — The name destructors is applied by English municipal engineers to furnaces, or combinations of furnaces, constructed for the purpose of disposing by burning of town refuse, which is a heterogeneous mass of material, including, besides general household and ash-bin refuse, small quantities of garden refuse, trade refuse, market refuse, and often street sweepings. The mere disposal of this material is not, however, by any means the only consideration in dealing with it upon the

destructor system. For many years past scientifie experts, municipal engineers, and public authorities have been directing careful attention to the utilization of refuse as fuel for steam production, and such progress in this direction has been made of late that in many towns its calorific value is now being utilized daily in operating machinery. On the other hand, that proper degree of caution which is obtained only by actual experience must be exercised in the applicar tion of refuse fuel to steam-raising purposes. When its value as a low-class fuel was fi^rst recognized, the idea was disseminated that the refuse of a given population was of itself sufB.cient to develop the necessary steam-power for supplying that population with the electric light. The economical importance of a combined destructor and electric • undertaking of this character naturally presented a some- what fascinating stimulus to public authorities, and possibly has had much to do with the recent development both of the adoption of the principle of dealing with refuse by fire, and also of lighting towns by electricity. However true this phase of the question may be as the statement of a theoretical scientific fact, experience so far does not show it to be a basis upon which engineers may venture to calculate, although, as will be seen later, under certain circumstances of equalized load, which must be considered upon their merits in each case, a well-designed destructor plant can be made to perform valuable commercial service to an electric or other power-using undertaking. Further, when a system, thermal or otherwise, for the storage of energy can be introduced and applied in a trustworthy and economical manner, the degree of advantage to be derived from the utilization of the waste heat from destructors will be materially enhanced.

The composition of house refuse, which must obviously afiect its calorific value, varies considerably in different localities, accord- ing to the condition, habits, and pursuits of the people. ComposI- jYom analyses it is found that average London ash-bin Ivhise refuse contains the constituents in the average propor-

tions given in the following table. In the northern towns, where the privy and ash-pit system is in use, excrementitious matter also occurs in the refuse.

Average London Ash-bin Eefuse.

Manchester Eefuse.

Constituents.

Percentaf^es by Weight.

Constituents.

Percentages by Weight.

Breeze (cinder and

Ashes and excreta

ashes) Fine dust

63-69

in pails

64-50

19-51

Dust and cinders .

84-55

Vegetable, animal.

Fish and bones

•15

and various min-

Animal refuse, as

eral matters

4-61

dogs, cats, hens,

Waste paper .

4-28

rabbits, &c.

•05

Straw, fibrous ma-

Boots, hats, rags,

terial, and rags .

3-61

paper, &c. .

•05

Bottles, crockery.

Vegetable refuse .

-05

and broken glass

1-98

Glass, pottery,

Coal and coke

•84

bricks, &c.

•60

Tins and iron

1-00

Old iron and tin

Bones

■48

ware .

•05

Total .

100-00

Total .

100 00

In London the quantity of house refuse amounts approximately to \ million tons per annum, which is equivalent to from 4 cwt. to 5 cwt. per head per annum, or to from 200 to 250 tons per 1000 of the population per annum. Statistics, however, vary widely in different districts. In the vicinity of the metropolis the amount varies from 2-5 cwt. per head per annum at Leyton to 3-5 cwt. at Hornsey, and to as much as 7 cwt. at Ealing:. In the north of England the total house refuse collected, exclusive of street sweep- ings, amounts on the average to 8 cwt. per head per annum. Speaking generally, throughout the country an amount of from 5 cwt. to 10 cvrt. per head per annum should be allowed for. A cubic yard of ordinary house refuse weighs from 12J to 15 cwt. Shop refuse is

lighter, frequently containing a large proportion of paper, straw, and other light wastes. It sometimes weighs as little as 't\ cwt. per cubic yard. A load, by which refuse Is often estimated, varies in weight from 15 cwt. to IJ tons.

The question how a town's refuse shall be disposed of must be considered both from a commercial and a sanitary point of view. Various methods have been practised. Sometimes the Disposal household ashes, &c., are mixed with pail excreta, or with sludge from a sewage farm, or with lime, and disposed of for agricultural purposes, and sometimes they are conveyed in carts or by canal to outlying and country districts, where they are shot on waste ground or used to fill up hollows and raise the level of marsh land. Such plans are economical when suitable outlets are available. To take the refuse out to sea in hopper barges and sink it in deep water, as Is done, for example, at Liverpool and New York, is usually expensive and frequently unsatisfactory. At Bermondsey, for instance, the cost of barging is about 2s. 9d. a ton, while the material may be destroyed by fire at a cost of from lOd. to Is. a ton, exclusive of interest and sinking fund on the cost of the works. In other cases, as at Chelsea and various dust contractors' yards, the refuse is sorted and its ingredients are sold : the fine dust may be utilized in connexion with manure manufactories, the pots and pans employed in forming the foundations of roads, and the cinders and vegetable refuse burnt to generate steam. In the Arnold system, carried out in Philadelphia and other American towns, the refuse is sterilized by steam under pressure, the grease and fertiliz- ing substances being extracted at the same time ; while in other systems, such as those of Weil and Porno, and of Defosse, distillation in closed vessels Is practised. But the destructor system, in which the refuse is burnt to an innocuous clinker in specially constructed furnaces, is that which must finally be resorted to, especially in districts which have become well built up and thickly populated. Various types of furnaces and apparatus have from time to time been designed, and the subject has been one of much experiment and many failures. The principal towns in England which took the lead in the adoption of the refuse destructor system were Manchester, Birmingham, Leeds, Heckmondwike, Destruc- Warrington, Blackburn. Bradford, Bury, Bolton, Hull, "'

Nottingham, Salford, Ealing, and London. Ordinary furnaces, built mostly by dust contractors, were in use in London and in the north of England some forty years ago, but they were not scientifi- cally adapted to the purpose, and necessitated the admixture of coal or other fuel with the refuse to insure its cremation. The Manchester Corporation erected a furnace of this description about the year 1873, and Messrs Mead and Co. made an unsatisfactory attempt in 1870 to burn house refuse in closed furnaces at Padding- ton. In 1876 Mr Fryer erected his destructor at Manchester, and several other towns adopted this furnace shortly afterwards. Other furnaces were from time to time brought before the public, among which may be mentioned those of Pearce and Lupton, Pickard,

Healey, Thwaite, Young, Wilkinson, Burton, Hardie, Jacobs and Ogden. In addition to these the "Beehive" and the "Nelson" destructors became well known. The former was introduced by Stafford and Pearson of Burnley, and one was erected in 1884 in the parish yard at Richmond, Surrey, but the results being unsatis- factory, it was closed during the following year. The " Nelson " furnace, patented in 1885 by Messrs Richmond and Birtwistle, was erected at Nelson-in-Marsden, Lancashire, but being very costly in working, was abandoned. The principal types of destructors now in use are those of Fryer, Whiley, Horsfall, Warner, Meldrum, and Beaman and Deas.

The general arrangement of the destructor patented i by Mr Alfred Fryer in 1876 is illustrated in Pig. 1. An installation upon Fryer's "' principle consists of a number of furnaces or cells,

^ ■ *usually arranged in pairs back to back, and enclosed in a rectangular block of brickwork having a flat top, upon which the house refuse is tipped from the carts. Each cell measures internally*

Fig. 1. — Fryer's Destruetoi.*

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about 9 feet by 5 feet, and is covered by a firebrick arch 3 feet 6 inches high above the grates. The furnaces have cast-iron furnace mouths, with doors 5 feet wide hinged at the top to open outwards with balance weights. The furnace bottom has an inclination of 1 in 3, from front to back, the rearmost portion, for a width of 4 feet, forming a firebrick hearth or dead plate, and the lower part, having a width of 5 feet, consisting of fire-bars. A wall at the back end of the cells divides each furnace into halves. On one side is a passage forming an opening into the main flue for the escape of the products of combustion, whilst on the other the upper end of the slope is carried up with a steeper inclination to a "feeding hole " for the admission of refuse from the platform above. A large mam flue, which also forms the dust chamber, is placed underneath the furnace hearths. The Fryer furnace ordinarily burns from 4 to 6 tons of refuse per celt per 24 hours. It will be observed that the outlets for the products of combustion are placed at the back near the refuse feed opening, an ari'angement which is imperfect in design, inasmuch as while a charge of refuse is burning upon the furnace bars the charge which is to follow lies on the dead hearth near the outlet flue. Here it undergoes drying and partial decomposition, giving off ofEensive empyreumatic vapours which pass into the flue without being exposed to sufficient heat to render them entirely inoffensive. The serious nuisances thus pro- duced in some instances led to the introduction of a second furnace, or "cremator," patented by Mr C. Jones of Ealing in 1885, which was placed in the main flue leading to the chimney-shaft, for the purpose of resolving the organic matters present in the vapour, but the greatly increased cost of burning due to this device led to its abandonment in many cases. This type of cell was largely used during the early period of the history of destructors, but of recent years has to a considerable extent given place to furnaces of more modern design.

A furnace patented ^ in 1891, by Mr Henry Whiley, superin- tendent of the scavenging department of the Manchester Corpora- tion, is automatic in its action and has been designed Wblley's. primarily with a view to saving labour — ^the cells being fed, stoked, and clinkered automatically. There is no drying hearth, and the refuse carts tip direct into a shoot or

hopper at the back which conducts the material directly on to movable eccentric grate bars. These automatically traverse the material forward into the furnace, and finally push it against a flap-door which opens and

1 Patent No. 3125 (1876).

2 Patent No. 8271 (1891).

allows it to fall out. This apparatus is adapted for dealing with screened rather than unscreened refuse, since it suffers from the objection that the motion of the bars tends to allow fine particles to drop through unburnt. Some difficulty has been experienced from the refuse sticking in the hopper, and exception may also be taken to the continual flapping of the door when the clinker passes out, as cold air is thereby admitted into the furnace. As in the Fryer cell, the outlet for the products of combustion into the main flue is close to the point where the crude refuse is fed into the furnace, and the escape of unburnt vapours is thus facilitated. Forced draught is applied by means of a Root's blower. The Manchester Corporation has 28 cells of this type in use, and the approximate amount of refuse burnt per cell per 24 hours is from 6 to 8 tons at a cost per ton for labour of 3-47 pence.

*Horsfall's destructor ^ (Fig. 2) is a high-temperature furnace of modern type which has been adopted largely in Great Britain and on the continent of Europe. In it some of the general features of the Fryer cell are retained, but the details "•"'**'" *• differ considerably from those of the furnaces already described. Im- portant points in the design are the arrangement of the flues and*

Feeding Hole

Feadir.q rj'.^ai'

flue outlets for the products of combustion, and the introduction of a blast duct through which air is forced into a closed ash-pit. The feeding-hole is situated at the back of and above the furnace, while the flue opening for the emission of the gaseous products is placed at the front of the furnace over the dead plate ; thus the gases distilled from the raw refuse are

caused to pass on their way to the main flue over the hottest part of the furnace and through the flue opening ia the red-hot reverberatory arch. The steam jet, which plays an important part in the Horsfall furnace, forces air into the closed ash-pit at a pressure of about f to 1 inch of water, and in this way a temperature varying from 1500° to 1900° F. , as tested by a thermoelectric pyrometer, is maintained in the main flue. In a battery of cells the gases from each are delivered into one main flue, so that a uniform temperature is maintained therein sufficiently high to prevent noxious vapours from reaching the chimney. The cells being charged and clinkered in rotation, when the flre in one is green, in the others it is at its hottest, and the products of combustion do not reach the boiler surfaces until after they have been mixed in the main flue. The cast-iron boxes which are provided at the sides of the furnaces, and through which the blast air is conveyed on its way to the grate, prevent the adhesion of clinker to the side walls of the cells, and very materially preserve the brickwork, which otherwise becomes damaged by the tools used to remove the clinker. The wide clinkering doors are suspended by counterbalance weights and open vertically. The rate of working of these cells varies from 8 tons per cell per 24 hours at Oldham to 10 tons per cell at Bradford, where the fur- naces are of the latest type. The cost of labour in stdking and clinkering is about 6d. per ton of the refuse treated at Bradford, and 9d. per ton at Oldham, where the rate of wages is higher. Well-constructed and properly-worked plants of this type should give rise to no nuisance, and may be located in populous neigh- bourhoods without danger to the public health or comfort.

Warner's destructor, known as the "Perfectus," is, in general arrangement, similar to Fryer's, but differs in being provided with special charging hoppers, dampers in flues, dust-catch- ing arrangements, rocking grate bars and other im- ^^i'"'"- provements. The refuse is tipped into feeding-hoppers, consisting of rectangular cast-iron boxes over which plates are placed to prevent the escape of smoke and fumes. At the lower portion of the feeding-hopper is a flap-door working on an axis and con- trolled by an iron lever from the tipping platform. When re- fuse is to be fed into the furnace the lever is thrown over, the contents of the hopper drop on to the sloping firebrick hearth beneath, and the door is at once closed again. The door should*

*8 Patent No. 8999 (1887) ; No. 14,709 (1888) ; No. 22,531 (1891). * Patent No. 18,719 (1888) .*

be kept open as short a time as possible In order to prevent the admission of cold air into the furnace at the back end, since this leads to the lowering of the temperature of the cells and main flue, and also to paper and other light refuse being carried into the flues and chimney. The flues of each furnace are provided with dampers, which are closed during the process of clinkering in order to keep up the heat. The cells are each 5 feet wide and 11 feet deep, the rearmost portion consisting of a fire-brick drying hearth, and the front of rocking grate bars upon which the com- bustion takes place. The crown of each cell is formed of a rever- beratory firebrick arch having openings for the emission of the products of combustion. The flap dampers which are fitted to these openings are operated by horizontal spindles passing through the brickwork to the front of the cell, where they are provided with levers or handles ; thus each cell can be worked independently of the others. With the view of increasing the steam-raising capa- bilities of the furnace, forced draught is sometimes applied and a tubular boiler is placed close to the cells. The amount of refuse consumed varies from 5 tons to 8 tons per cell per 24 hours. At Hornsey, where 12 cells of this type are in use, the cost of labour for burning the refuse is 9Jd. per ton.

The Meldrum ” Simplex” destructor (Fig. 3), a modern type of furnace which yields good steam-raising results, is in successful , operation at Kochdale, Hereford, and Darwen, at each Meldrum s. ʿ i^jijch towns the production of steam is an import- ant consideration. Cells have also been laid down at Burton, Hunstanton, Blackburn, and Shipley. In general arrangement the

destructor differs considerably from those previously described. The grates are placed side by side without separation except by dead plates,

but, in order to localize the forced draught, the ash-pit is divided into parts corresponding with the different grate areas. Each ash-pit is closed air-tight by a cast-iron plate, and is provided with an air-tight door for removing the fine ash. Two patent Meldrum steam-jet blowers are provided for each fur- nace, supplying any required pressure of blast up to 6 inches' water column, though that usually employed does not exceed IJ inches. The furnaces are designed for hand-feeding from the front, but hopper-feeding can be applied if desirable. The products of com- bustion either pass away from the back of each fire-grate into a common flue leading to boilers and the chimney-shaft, or are conveyed sideways over the various grates and a common fire- bridge to the boilers or chimney. The heat in the gases, after passing the boUers, is still further utilized to heat the air supplied to the furnaces, the gases being passed through an air heater or continuous regenerator consisting of a number of cast-iron pipes from which the air is delivered through the Meldrum "blowers" at a temperature of about 300° F. That a high percentage (15 to 18 per cent.) of CO^ is obtained in the furnaces proves a small excess of free oxygen, and no doubt explains the high fuel efficiency ob- tained by this type of destructor. High-pressure boilers of ample capacity are provided for the accumulation during periods of light load of a reserve of steam, the storage being obtained by utilizing the difference between the highest and lowest water-levels and the difference between the maximum and working steam-pressure.

Tipping plat Form

^Steam Boiler

Refuse is shovelled from openinq into furnace-

Fig. 8. — Meldrum's Destructor at Darwen.

*Patent locking fire-bars, to prevent lifting when clinkering, are used in the furnace and have a good life. At Eochdale the Meldrum furnaces consume from 53 to 66 lbs. of refuse per square foot of grate area per hour, as compared with 22*4 lb per square foot in a low-temperature destructor burning 6 tons per cell per 24 hours with a grate area of 25 square feet. The evaporative effi- ciency of the Bochdale furnaces varies*

from 1-39 lb to 1 ~~87 ib of water (actual) per 1 lb of refuse burned, and an average steam~~ pressure of about 114 K) per square inch is maintained. The cost of labour and supervision amounts to lOd. per ton of refuse dealt with. A Lancashire boiler (22 feet by 6 feet 6 inches) at the Sewage Outfall Works, Hereford, evaporates with refuse fuel 2980 K) of water per hour, equal to 149 Indicated horse-power. About 54 lb of refuse are burnt per square foot of grate area per hour with an evaporation of 1-82 lb of water per pound of refuse. At Darwen a Meldrum furnace of 104-5 square feet grate area runs the present electric plant consistlag of two 150 kilowatt steam dynamos (225 horse-power each), one only being in use at a time. As the dynamos run only 9J hours per day, whfle the refuse is burned throughout the 24 hours, there is a large surplus of heat running to waste. This it is proposed to employ for electric tram- ways and then the available power will be utilized to its full extent. The Beaman and Deas destructor i (Fig. 4) has attracted much attention from public authorities, and successful installations are Beaman '^^ operation at Warrington, Dewsbury, Leyton, Canter- and Deas. ^^^' Llandudno, Colne, Streatham, Eotherhithe, and Wimbledon. Its essential features include a level fire-grate with ordinary type bars, a high-temperature combustion chamber at the back of the cells, a closed ash-pit with forced draught, provision for the admission of a secondary air-supply at the fire-bridge, and a firebrick hearth sloping at

1 Patents No. 15,598 (1893) and 23,712 (1893) ; Deas Sludge Furnace, patent No. 13,029 (1894).

also Beaman and

an angle of about 52°. From the refuse storage platform the material is fed into a hopper mouth about 18 inches square, and slides down the firebrick hearth, supported by T-irons, to the grate bars, over which it is raked and spread with the assist-

PiQ. 4.— Beaman and Deas Destraotor at Leyton.

ance of long rods manipulated through clinkering doors placed at the sides of the cells. A secondary door in the rear of the cell facilitates the operation. The fire-bars, spaced only j inch apart, are of the ordinary stationary type.

Vertically, under the fire-bridge, is an air-conduit, from the top of which lead air blast pipes 12 inches in diameter discharging into a her- metically closed ash-pit under the grate area. The air is supplied from fans (Schiele's patent) at a pressure of from 1 to 2 inches of water, and is controlled by means of baffle valves worked by handles on either side of the furnace, conveniently placed for the attendant. The forced draught tends to keep the bars cool and lessen wear and tear. The fumes from the charge

drying on the hearth pass through the fire and over the red-hot fire-bridge, which is perforated longitudinally with air-passages connected with a small flue leading from a grated opening on the face of the brickwork outside ; in this way an auxiliary supply of heated oxygen is fed into the combustion chamber. This chamber, in which a temperature approaching 2000° F. is attained, is fitted with large iron doors, sliding with balance weights, which allow the introduction of infected articles, bad meat, etc. , and also give access for the periodical removal of fine ash from the flues. The high temperatures attained are utilized by in- stalling one boiler, preferably of the Babcook and Wilcox water- tube type, for each pair of cells, so that the gases, on their way from the combustion chamber to the main flue, pass three times between the boiler tubes. A secondary furnace is provided under the boiler for raising steam by coal, if required, when the cells are out of use. The grate area of each cell is 25 square feet, and the consumption varies from 16 up to 20 tons of refuse per cell per 24 hours. In a 24-hours' test made by the superintendent of the cleansing department, Leeds, at the Warrington installation, the quantity of water evaporated per pound of refuse was 1-14 ib.

the average temperature in the combustion chamber 2000° r. by copper-wire test, and the average air pressure with forced draught, 2 J inches (water gauge). At Leyton, which has a population of over 100,000, an eight-cell plant of this type is successfully dealing with house refuse and filter press cakes of sewage sludge from the Sewage Disposal Works adjoining, and even with material of this low calorific value the total

steam-power pro- duced is considerable. Each cell bums about 16 tons of the mixture in 24 hours and develops about 35 indicated horse-power continuously, at an average steam-pressure in the boilers of 105 R). The cost of labour at Leyton for burning the mixed refuse is about Is. 7d. per ton ; at Llandudno, where four cells were laid down in connexion with the electric-light station in 1898, it is Is. 3Jd., and at Warrington, 9Jd. per ton of refuse consumed. Combustion is complete, and the destructor may be safely installed in populous districts without nuisance to the inhabitants. Further patents (Wilkie's improvements) have been obtained by Meldrum Brothers (Manchester) in connexion with this destructor. In addition to the above-described destructors, other modem

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Fig. 5. — Leyton Destructor — Block Plan, showing general arrangement of tlie works.

forms have been introduced from time to time, but adopted to a less degree; amongst these may be mentioned Hanson's Utilizer, Mason's Gasifler, the "Bennett-Phythian," Cracknell's (Mel- bourne, Victoria), Coltman's (Loughborough), Willoughby's, and Healey's improved destructors. On the continent of Europe, systems for the treatment of refuse have also been devised. Among these may be mentioned those of M. Defosse and M. Helouis. The former has endeavoured to burn the refuse in large quantities by using a forced draught and only washing the smoke. 1 Helouis has extended the operation by using the heat from the combustion of the refuse for drying and distilling the material which is brought gradually on to the grate.

Boulnois and Brodie's improved charging tank is a labour- saving apparatus consisting of a vTrought-iron truck, 5 ft. wide by~3 ft. deep, and of sufficient length to hold not less than 12 hours' supply for the two cells which it serves. The truck, which moves along a pair of rails laid across the top of the destructor, may be worked by It is divided into compartments holding a charge of refuse in each, and is provided with a pair of doors in the bottom, opening downwards, which are supported by a series of small wheels running on a central rail. A special feeding opening in

1 Compte Rendu des Travaux de la Sodeti des Ingenieurs Civile de France, folio 775 (June 1897).

Destructor

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one man.

the reverberatory arch of the cell of the width of the truck, situated over the drying hearth, is formed by a firebrick arch fitted into a frame capable of being moved backwards and forwards by means of a lever. The charging truck, when empty, is brought under the tipping platform, and the carts tip (Srectly into it. When one of the cells has to be fed, the truck is moved along, so that one of the divisions is immediately over the feeding opening, and the wheel holding up the bottom doors rests upon the central rail, which is continued over the movable covering arch. Then the movable arch is rolled back, the doors are released, and the contents are discharged into the cell, so that no handling of the refuse is required from tipping to feeding. This apparatus is in operation at Liverpool, Shoreditch, Cambridge, and else- where.

Various forms of patent movable fire-bars have been employed in destructor furnaces. Among these may be mentioned Settle's," Vicar's," Riddle's rocking bars,^ Horsfall's self-feeding appa- ratus,^ and Healey's movable bars;' but complicated movable arrangements are not to be recommended, and experience greatly favours the use of a simple stationary type of fire-bar.

2 Patent No. 15,482 (1885).

« Patents No. 1955 (1867) and No. 378 (1879).

- *Patent No. 4896 (1891). 6 Patent No. 20,207 (1892).*

6 Patents No. 18,398 (1892) and No. 12,990 (1892).

A dust-catching apparatus has been designed and erected at Edinburgh, by the Horsfall Furnace Syndicate, in order to over- come difficulties in regard to the escape of flue dust, &c., from the destructor chimney.

Externally, it appears a large circular block of brickwork, 18 ft. in diameter and 13 ft. 7 in. high, connected with the main, flue, and situated between the destructor cells and the boiler. Internally it consists of a spiral flue traversing the entire circumference and winding upwards to the top of the cham- ber. There is an interior well or chamber 6 ft. diameter by 12 ft. high, having a domed top, and communicating with the outer spiral flue by four ports at the top of the chamber. Dust traps, baffle walls, and cleaning doors are also provided for the retention and subsequent weekly removal of the flue dust. The apparatus forms a large reservoir of heat maintained at a steady temperature of from 1.500° to 1800° F. , and is useful in keeping up steam in the boiler at an equable pressure for a long period. It requires no attention, and has proved successful for it purpose.*

Travelling cranes for transporting refuse and feeding cells are sometimes employed at destructor stations, as, for example, at Hamburg. Here the transportation of the refuse is effected by means of specially constructed water-tight iron waggons, con- taining detachable boxes provided with two double-flap doors at the top for loading, and one flap-door at the back for unloading. There are thirty-six furnaces of the HorsfaU type placed in two ranks, each arranged in three blocks of six in the large furnace hall. An electric crane running above each rank lifts the boxes ofE the waggons and carries them to the feeding-hole of each cell. Here the box is tipped up by an electric pulley and emptied on to the furnace platform. Where the travelling crane is used, the carts (four-wheeled) bringing the refuse may be constructed so that the body of the carriage can be taken ofE the wheels, lifted up and tipped direct over the furnace as required, and returned again to its frame. The adoption of the travelling crane admits of the reduction in size of the main building, as less platform space for unloading refuse carts is required ; the inclined roadway may also be dispensed with. Where a destructor site will not admit of an inclined roadway and platform, the refuse may be discharged from the collecting carts into a lift, and thence elevated into the feeding-bins.

The general arrangement of a battery of refuse cells at a destructor station is illustrated by Fig. 5. The cells

are arranged either side by side, with a common Working main flue in the rear, or back to back with the structors. main flue placed in the centre and leading to a

tall chimney-shaft. The heated gases on leaving the cells pass through the combustion chamber into the main flue, and thence go forward to the boilers, where their heat is absorbed and utilized. Forced draught is supplied from fans through a conduit commanding the whole of the cells. An inclined roadway of as easy gradient as circumstances will admit, is provided for the conveyance of the refuse to the tipping platform, from which it is fed through feed-holes into the furnaces. In the installation of a destructor, the choice of suitable plant and the general design of the works must be largely de- pendent upon local requirements, and should be entrusted to an engineer experienced in these matters. The following primary considerations, however, may be enumerated as materially affecting the design of such works : —

(a) The plant must be simple, easily worked without stoppages, and without mechanical complications upon which stokers may lay the blame for bad results. (6) It must be strong, must with- stand variations of temperature, must not be liable to get out of order, and should admit of being readily repaired, (c) It must be such as can be easily understood by stokers or firemen of average intelligence, so that the continuous working of the plant may not be disorganized by change of workmen, (d) A sufficiently high temperature must be attained in the cells to reduce the refuse to an entirely innocuous clinker, and all fumes or gases should pass either through an adjoining red-hot cell or through a chamber whose temperature is maintained by the ordinary working of the destructor itself at a degree sufficient to exclude the possibility of the escape of any unconsumed gases, vapours, or particles. The temperature may vary between 1500° and 2000°. (e) The plant must be so worked that while some of the cells are being recharged, others are at a glowing red heat, in order that a high temperature may be uniformly maintained. (/) The design of the furnaces must admit of clinkering and recharging being easOy and quickly performed, the furnace doors being open for a minimum of time so as to obviate the inrush of cold air to lower the

temperature in main flues, &c. {g) The chimney draught must be assisted with forced draught from fans or steam jet to a pressure of IJ inches to 2 inches under grates by water-gauge. (A) Where a destructor is required to work without risk of nuisance to the neigh- bouring inhabitants, its efficiency as a refuse destructor plant must be primarily kept in view in designing the works, steam-raising being regarded as a secondary consideration. Boilers should not be placed immediately over a furnace so as to present a large cooling surface, whereby the temperature of the gases is reduced before the organic matter has been thoroughly burned, (i) Where steam- power and a high fuel efficiency are desired a large percentage of CO2 should be sought in the furnaces with as little excess of air as possible, and the flue gases should be utilized in heating the air-supply to the grates, and the feed-water to the boilers. (j) Ample boiler capacity and hot- water storage feed-tanks should be included in the design where steam-power is required.

As to the initial cost of the erection of refuse destructors, few trustworthy data can be given. The outlay necessarily depends, amongst other things, upon the difficulty of preparing ^^^

the site, upon the nature of the foundations required, the height of the chimney-shaft, the length of the inclined or approach roadway, and the varying prices of labour and materials in different localities. As an example may be mentioned the case of Bristol, where, in 1892, the total cost of constructing a 16-cell Fryer destructor was £11,418, of which £2909 was expended on foundations, and £1689 on the chimney-shaft ; the cost of the destructor proper, buildings, and approach road was therefore £6820, or about £426 per cell. The cost per ton of burning refuse in destructors depends mainly upon — (a) The price of labour in the locality, and the number of "shifts" or changes of work- men per day ; (6) the type of furnace adopted ; (c) the nature of the material to be consumed ; (d) the interest on and repayment of capital outlay. The cost of burning, ton for ton consumed, in high-temperature furnaces, including labour and repairs, is not greater than in slow-combustion destructors. The average cost of burning refuse at twenty-four different towns throughout England, exclusive of interest on the cost of the works, is Is. IJd. per ton burned ; the minimum cost is 6d. per ton at Bradford,

and the maximum cost 2s. lOd. per ton at Battersea. At Shoreditch the cost per ton for the year ending 25th March 1899, including labour, supervision, stores, repairs, &c. (but exclusive of interest on cost of works), was 2s. 6-9d. The quantity of refuse burned per cell per day of 24 hours varies from about 4 tons up to 20 tons. The ordinary low-temperature destructor, with 25 square feet grate area, bums about 20 lb of refuse per square foot of grate area per hour, or between 5 and 6 tons per cell per 24 hours. The Meldrum destructor furnaces at Rochdale burn as much as 66 lb per square foot of grate area per hour, and the Beaman and Deas destructor at Llandudno 71‘7 lb per square foot per hour. The amount, however, always depends materially on the care observed in stoking, the nature of the material, the frequency of removal of clinker, and on the question whether the whole of the refuse passed into the furnace is thoroughly cremated.

*The amount of residue in the shape of clinker and fine ash varies from 22 to 37 per cent, of the bulk dealt with. From 25 to 30 per cent, is a very usual amount. At Shoreditch, where the refuse consists of about 8 per cent, of straw, *””””• paper, shavings, &c. , the residue contains about 29 per cent, clinker, 2-7 per cent, fine ash, -5 per cent, flue dust, and -6 per cent, old tins, making a total residue of 32-8 per cent. As the residuum amounts_ to from | to J of the total bulk of the refuse dealt vfith, it is a question of the utmost importance that some pro- fitable, or at least inexpensive, means should be devised for its regular disposal. Among other purposes, it has been used for bottoming for macadamized roads, for the manufacture of con- crete, for making paving slabs, for forming suburban footpaths or cinder footwalks, and for the manufacture of mortar. The last is a very general, and in many places, profitable, mode of disposal.*

Through defects in the design and management of many of the early destructors complaints of nuisance frequently arose, and these have, to some extent, brought destructor installations into disrepute. Although some of the older furnaces were decided offenders in this respect, that is by no means the case with the modern improved type of high-temperature furnace ; and often, were it not for the great prominence in the landscape of a tall chimney-shaft, the existence of a refuse destructor in a

neighbourhood would not be generally known to the inhabitants. A modern furnace, properly designed and worked, will give rise to no nuisance, and may be safely erected in the midst of a popu- lous neighbourhood. To ensure the perfect cremation of the refuse and of the gases given off, forced draught is essential. This is supplied either as air draught delivered from a rapidly revolving fan, or as steam blast, as in the Porced Horsfall steam jet or the Meldrum blower. With a ”™”^”«- forced blast less air is required to obtain complete combustion than by chimney draught. The forced draught grate requires

little more than the quantity theoretically necessary, while with chimney draught more than double the theoretical amount of air must be supplied. With forced draught, too, a much higher tem- perature is attained, and if it is properly worked, little or no cold air will enter the furnaces during stoking operations. As far as possible a balance of pressure in the cells during clinkering should be maintained just sufficient to prevent an inrush of cold air through the flues. The forced draught pressure should not exceed 2 inches’ water-gauge. The efficiency of the combustion in the furnaces is conveniently measured by the ” Econometer,” which registers con- tinuously and automatically the proportion of COj passing away in the waste gases ; the higher the percentage of CO2 the more efficient the furnace, provided there is no formation of CO, the presence of which would indicate incomplete combustion. The theoretical maximum of CO2 for refuse burning is about 20 per cent. ; and, by maintaining an even clean fire, by admitting secondary air over the fire, and by regulating the dampers or the air-pressure in the ash- pit, an amount approximating to this percentage may be attained in a well-designed furnace if properly worked. If the proportion of free oxygen {i.e., excess of air) is large, more air is passed through the furnace than is required for complete combustion, and the heat- ing of this excess is clearly a waste of heat. The position of the econometer in testing should be as near the furnace as possible, as there may.be considerable air leakage through the brickwork of the flues.

The modern high-temperature destructor, to render the refuse and gases perfectly innocuous and harmless, is worked at a tem- perature varying from 1250° to 2000° F., and the main- tenance of such temperatures has very naturally suggested the possibility of utilizing this heat-energy for the pro- duction of steam-power. Successful steam-raising destructor stations have been in operation during recent years in England, and experi- ence shows that a considerable amount of energy may be derived therefrom, amply justifying a reasonable increase of expenditure on plant and labour. The actual calorific value of the refuse material jiecessarily varies, but, as a general average, experience shows that, with suitably-designed and properly-managed plant, an evaporation of 1 ft) of water per pound of refuse burned is a result which may be readily attained, and affords a basis of calculation which engi- neers may safely adopt in practice. Many destructor steam-raising plants, however, give considerably higher results, as will be seen from the following table : —

Calorific value.

Town.

Type of Furnaces.

Water eva- porated per lb of Refuse Actual.

Water eva- porated per IbofEe- fuse, ftom and at 212° Fahr.

Average Steam- pressure per square inch.

Total Indicated Horse-power developed per hour (based on 20 ft of steam perl.H.P. per hour).

Rochdale .

Hereford .

Darwen .

Oldham . Canterbury

Meldrum

Bros. (4 cells) Meldrum

Bros. (4 cells) Meldrum

Bros. (4 cells) Horsfall (10 cells) Beaman & Deas (2 cells)

1-64 lb

1-51 „

1-48 „

1-11 „ 1-41 „

1-97 R)

1-82 „

1-65 „

1-33 „ 1-59 „

113 ft 70-92 „

183 „

128 „

132„

350

236

275

200 236

Prom actual experience it may be accepted, therefore, that the calorific value of unscreened house refuse varies from 1 to 2 lb of water evaporated per pound of refuse burned, the exact proportion depending upon the quality and condition of the material dealt with. Taking the evaporative power of coal at 10 lb of water per pound of coal, this gives for domestic house refuse a value of from I'iy to J that of coal ; or, with coal at 20s. per ton, refuse has a commercial value of from 2s. to 4s. per ton. In London the quantity of house refuse amounts to about IJ million tons per annum, which is equivalent to from 4 cwt. to 5 cwt. per head per annum. If it be burned in furnaces giving an evaporation of 1 lb of water per pound of refuse, it would yield a total power annually of about 138 million brake horse-power hours, and equiva- lent cost of coal at 20s. per ton for this amount of power, even when calculated upon the very low estimate of 2 lb i of coal per brake horse-power hour, works out at over £123,000. On the same basis, the refuse of a medium-sized town, with, say, a population of 70,000 yielding refuse at the rate of 5 cwt. per head per annum, would afford 112 indicated horse-power per

1 With medium-sized steam plant, a consumption of 4 ft of coal per brake horse-power per hour is a very usual performance.

ton burned, and the total indicated horse-power hours per annum would be

70,000 X 6 cwt.

20

X 112 = 1,960,000 I.H.P. hours annually.

If this were applied to the production of electric energy, the elec- trical horse-power hours would be (with a dynamo efficiency of 90 per cent.)

1,960,000 X 90 ^ j_7Q4 oQo j, jj p ^^^^ ^^^ ^^^^^ .

and the watt-hours per annum at the central station would be

1,764,000 X 746 = 1,315,944,000. Allowing for a loss of 10 per cent, in distribution, this would give 1,184,349,600 watt-hours available in lamps, or with 8 candle-power lamps taking 30 watts of currenfper lamp, we should have

1,184,349,600 watt- hours

that is,

30 watts

39,478,320

70,000 population

: = 39,478,320

8-c.p. lamp – hours annum ;

per

= 563 8-c.p. lamp-hours per annum per head of population.

Taking the loss due to the storage which would be necessary at 20 per cent, on three-quarters of the total or 15 per cent, upon the whole, there would be 478 8-c.p. lamp-hours per annum per head of the population ; i.e., if the power developed from the refuse were fully utilized, it would supply electric light at the rate of one 8-c.p. lamp per head of the population for about 1^ hours for every night of the year.

In actual practice, when the electric energy is for the purposes of lighting only, difficulty has been experienced in fully utilizing the thermal energy from a destructor plant owing to the want of adequate means of storage either of the ”” ^’ thermal or of the electric energy. A destructor station usually yields a fairly definite amount of thermal energy uniformly throughout the twenty-four hours, while the consumption of electric-lighting current is extremely irregular, the maximum demand being about four times the mean demand. The period during which the demand exceeds the mean is comparatively short, and does not exceed about six*

hours out of the twenty-four, while for a portion of the time the demand may not exceed ^ of the maximum. This difficulty, at first regarded as somewhat grave, is now substantially minimized by the provision of ample boiler capacity, or by the introduction of feed thermal storage vessels in which hot feed-water may be stored during the hours of light load (say eighteen out of the twenty-four), so that at the time of maximum load the boilers may be filled directly from these vessels, which work at the same pressure and temperature as the boiler. Further, the difficulty above mentioned will dis- appear entirely at stations where there is a fair day load which practically ceases at about the hour when the illuminating load comes on, thus equalizing the demand upon both destructor and electric plant throughout the twenty-four hours. This arises in cases where current is consumed during the day for motors, fans,' lifts, electric tramways, and other like purposes, and, as the em- ployment of electric energy for these services is rapidly becoming general, no difficulty need be anticipated in the successful working of combined destructor and electric plants where these conditions prevail. The more uniform the electrical demand becomes, the more fully may the power from a destructor station be utilized. In the case above cited of a town of 70,000 population, the horse- power to be derived from the refuse, calculated upon the basis of 2 R) of coal per brake horse-power hour, which is the utmost efficiency practicable even for very good steam-engines, will cost £1760 per annum for fuel with coal at 20s. per ton, and, in prac- tice, the actual cost would doubtless be nearly double. At Shore- ditch during the year ending March 1899, a total of 1,031,348 Board of Trade units of electric energy was supplied to consumers ; of this about seven-tenths were generated from the' refuse of the district, and on many occasions a load of • 400 kilowatts (i.e.,

400 kilo. X 1000 100 „„ , X u T, • ., „

■ X gjr = 596 horse – power) has been earned by

746 90

refuse fuel only. Some 200 municipalities in England have laid down destructor plants, but although the great majority are utilizing some of the surplus heat generated by the furnaces, at comparatively few stations is

the full thermal energy of the refuse turned to commercial utility owing to the fact that the plants were installed before the value of refuse for steam-raising was properly understood. During recent years, however, new and improved plant has been introduced, and in the laying down of all new installations this phase of the question has been kept most prominently in view.

For further information on the subject, reference should be made to William H. Maxwell, Assoc. M. Inst. C. E., on the Bemoval and Disposal of Town Refuse, loith an exhaustive treat-

ment of Refuse Destructor Plants, London, 1899, which is a compre-Jiensive work of reference dealing fully with details of construction and results of practical experience. See also the Proceedings of the Incorporated Association of Municipal and County Engineers, vols. xiii. p. 216, xxii. p. 211, xxiv. p. 214, and xxv. p. 138 ; also the Proceedings of the Institution of Civil Engineers, vols, cxxii. p. 443, cxxiv. p. 469, cxxxi. p. 413, cxxxviii. p. 508, cxxix. p. 434, cxxx. pp. 213 and 347, cxxiii. pp. 369 and 498, cxxviii. p. 293, and cxxxv. p. 300. (w. H. MA.)

De Tabley, John Byrne Leicester Warren,

3rd Baron (1836-1895), English poet, was born at Tabley House, Cheshire, 26th April 1835. He was educated at Eton and Christ Church, where he took his degree in 1856 with second classes in Classics and in Law and Modern History. In the autumn of 1858 he went to Turkey as unpaid attach^ to Lord Stratford de RedclifEe, and two years later was called to the bar. He became an ofB.cer in the Cheshire Yeomanry, and unsuccessfully contested Mid-Cheshire in 1868 as a Liberal. After his father's second marriage in 1871 he removed to London, where he became a close friend of Tennyson for several years. From 1877 till his succession to the title in 1887 he was lost to his friends, assuming the life of a recluse. It was not till 1892 that he returned to London life, and enjoyed a sort of reilaissance of reputation and friendship. During the

later years of his life Lord De Tabley made many new friends, besides reopeniag old associations, and he almost seemed to be gathering around him a small literary company when his health broke, and he died 22nd November 1895 at Eyde, in his sixty- first year. He was buried at Little Peover in Cheshire. Although his reputation will live almost exclusively as that of a poet, De Tabley was a man of many studious tastes. He was at one time an authority on numis- matics ; he wrote two novels ; published A Guide to the Study of Book Plates (1889) ; and the fruit of his careful researches in botany was printed posthumously in his elaborate Flora of Cheshire (1899). Poetry, however, was his first and last passion, and to that he devoted the best energies of his life. De Tabley's first impulse towards poetry came from his friend George Portescue, with whom he shared a close companionship during his Oxford days, and whom he lost, as Tennyson lost Hallam, within a few years of their taking their degrees. Portescue was killed by falling from the mast of Lord Drogheda's yacht in November 1859, and this gloomy event plunged De Tabley into deep depression. Between 1859 and 1862 De Tabley issued four little volumes of pseudonymous verse (by G-. P. Preston), in the production of which he had been greatly stimulated by the sympathy of Portescue. Once more he assumed a pseudonym — his Praeterita (1863) bearing the name of William Lancaster. In the next year he published Eclogues and Monodramas, followed in 1865 by Studies in Verse. These volumes all displayed technical grace and much natural beauty ; but it was not till the publication of Philoctetes in 1867 that De Tabley met with any wide recognition. Philoctetes bore the initials " M. A.," which, to the author's dismay, were interpreted as meaning Matthew Arnold. He at once disclosed his identity, and received the congratu- lations of his friends, among whom were Tennyson, Browning, and Gladstone. In 1868 he published Orestes, in 1870 Rehearsals, and in 1873 Searching the Net. These last two bore his own name, John Leicester Warren. He was somewhat disappointed by their luke- warm reception, and when in 1876 Tlie Soldier of Fortune, a drama on which he had bestowed much careful labour, proved a complete failure, he retired altogether from the literary arena. It was not until 1893 that he was persuaded to return, and the immediate success in that year of his Poems, Dramatic and Lyrical, encouraged him to publish a second series in 1895, the year of his death.

The genuine interest with which these volumes were welcomed did much to lighten the last years of a somewhat sombre and solitary life. His posthumous poems were collected in 1902. The characteristics of De Tabley's poetry are pre-eminently magnificence of style, derived from close study of Milton, sonority, dignity, weight, and colour. His passion for detail was both a strength and a weakness: it lent a loving fidelity to his description of natural objects, but it sometimes involved him in a loss of simple effect from over-elaboration of treatment. He was always a student of the classic poets, and drew much of his inspiration directly from them. He was a true and a whole-hearted artist, who, as a brother-poet well said, "still climbed the clear cold altitudes of song." His ambition was always for the heights, a region naturally ice-bound at periods, but always a country of clear atmosphere and bright, vivid outlines. (a. wa.)

Detaille, Jean Baptiste Edouard (1848-

), Prench painter, was born in Paris, 5th October

1848. After working as a pupil of Meissonier's,. he first exhibited, in the Salon of 1867, a picture repre- senting "A Corner of Meissonier's Studio.'^ Military- life was from the first a principal attraction to the young painter, and he gained his reputation by de- picting the scenes of a soldier's life with every detail truthfully rendered. He exhibited "A Halt" (1868); " Soldiers at Rest, during the Manoeuvres at the Camp of Saint Maur " (1869) ; " Engagement between Cossacks and the Imperial Guard, 1814" (1870). The war of 1870-71 furnished him with a series of subjects which gained him repeated successes. Among his more im- portant pictures may be named " The Conquerors" (1872); "The Retreat" (1873); "The Charge of the 9th Regi- ment of Cuirassiers m the Village of Morsbronn, 6th August 1870" (1874); "The Marching Regiment, Paris, December 1874" (1875); "A Reconnaissance" (1876); "Hail to the Wounded!" (1877); "Bonaparte in Egypt" (1878); the "Inauguration of the New Opera House" — a water-colour; the "Defence of Champigny by Paron's Division" (1879). He also worked with Alphonse de Neuville on the Panorama of Rezonville. In 1884 he exhibited at the Salon the "Evening at Rezonville," a panoramic study, and " The Dream " (1888),

now in the Luxemburg Gallery (see Plate). Detaille has recorded other events in the military histoty of his country : the " Sortie of the Garrison of Huningue," the " Vincendon Brigade," and "Bizerte," reminiscences of the expedition to Tunis. After a visit to Russia, Detaille exhibited "The Cossacks of the Ataman" and "The Hereditary Grand Duke at the Head of the Hussars of the Guard." Other important works are: "Victims to Duty," "The Prince of Wales and the Duke of Connaught," and "Pasteur's Puneral." In his picture of "CMlons, 9th October 1896," exhibited in the Salon, 1898, DetaiUe has painted the Emperor and Empress of Russia at a review, with M. Pelix Faure. Detaille has been a member of the French Institute since 1898, and has been awarded many medals and other honours.

See Marius Vachon. Detaille. Paris, 1898. — ^FiiiiDtEic Masson. Edouard Detaille and his Work. Paris and London, 1891 — J. Claretie. Peintres et sculpteurs contemporaires. Paris, 1876. — G. Goetsoht. Les jeunes Peintres Militaires. Paris, 1878.

Detmold, a town of Germany, capital of the princi- pality of Lippe Detmold, beautifully situated on the east slope of the Teutoburger Wald, 25 miles south of Minden, on the Herford Altenbeken line of the Prussian state railways. The residential castle of the princes of Lippe Detmold (1550), in the Renaissance style, is an imposing building, lying with its pretty gardens nearly in

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the centre of the town ; whilst at the entrance to the large park on the south is the New Palace (1708-18), enlarged m 1860, used as the dower-house. Detmold possesses a natural history museum, theatre, high school, library, the house m which the poet Preiligrath (1810-76) was born, and that in which the dramatist Grabbe (1801-36), also a native, died. Population (1885), 8916; (1900),

Detroit, a city of the United States, the county seat of Wayne county, and metropolis of the state of Michigan, is situated on the Detroit river in lat. 42° 20′ N. and long. 83° 3′ W. It is generally level, and has an extent along the river of 7 miles and a depth of 3 miles, except that at the centre of the city it extends towards the north more than 5 miles. Its area is 29^ square miles. The streets are very wide, and are kept scrupu- lously clean. There are three lines of electric street railways, aggregating 160 miles of track, and ten lines of suburban electric cars, carrying both passengers and freight. Sixteen lines of railways connect the city with all parts of the United States and Canada. Ferries con- nect the city with Windsor and Walkerville in Canada, directly opposite, and with the island park and the various summer resorts along the river front. The foot of each street reaching to the river is converted into a public wharf. There are 28 parks and parkways, aggregating ■912 acres, besides the Grand Boulevard, which is a drive 11 miles long, around the city. The largest park is Belle Isle, an island within the city limits, at its eastern extremity, and

connected with the mainland by a bridge over the American channel of the Detroit river.

The population in 1890 was 205,876, and in 1900 it had increased to 285,704, of whom 96,603 were foreign- "born and 4111 negroes. Out of 78,855 males 21 years •of age and over, 3587 (of whom 3262 were foreign- born) were illiterate (unable to write). The birth-rate per thousand averages 14. The death-rate in 1900 was 17-1 ; in 1890 it was 18-7. There are 69 public schools (3 of which are high schools) and 69 private and parochial schools, employing 1187 teachers. In 1900 there were 91,777 persons of school age (5 to 20 years inclusive). There is one literary college (Jesuit), three colleges of medicine, one of dentistry, and one of law. The State University at Ann Arbor is within easy reach (37 miles). There are four public libraries, the largest of which contains 157,934 volumes. Branches of this library are established in the public schools. The Museum of Art is supported in part by taxation. The building cost f 127,000, and the contents, paintings and articles of vertu are valued at $150,000. There are 80 newspapers and periodicals published in the city, of which 7 are dailies. There are 30 asylums, hospitals, and charitable homes. There are 183 churches, of which 30 are Eoman Catholic, 28 Methodist, 25 Lutheran, 24 Episcopal, 17 Baptist.*

The basis of the government is the city charter, granted by the State Legislature. The mayor is elected every two years by popular vote; and the council is composed of two members from each of the 17 wards of the city, one from each being elected every year. The waterworks are owned by the city, and are main- tained by water rates and an annual tax of $75,000. The supply is taken from Lake St Clair, immediately above the city. The public lighting is entirely electric, and the plant is owned by the city. Much of the lighting is by arc lights on towers 100 to 150 feet high.

Detroit river is so deep at the foot of the streets that any vessel can approach the wharf. It is never so affected by storms that vessels are in danger, and the most severe rains never perceptibly raise its waters.

The main commerce of the Great Lakes passes through it. How much this amounts to it is impossible to ascertain, but certainly twice as much as passes the famous Sault Ste Marie Canal, 25,255,810 tons. The shipments

of grain from Detroit for 1899 were as fol- lows:—Wheat 1,567,132 bushels, corn 2,304,105 bushels, oats 266,133 bushels, rye 261,869 bushels, and flour 137,000 barrels. There are 23 banks, with an aggregate capital of $7,850,000, deposits amounting to $67,744,956, and total resources of $91,020,716. The bank clearances for the year 1899 were $415,073,499. The assessed valuation of the city, on a basis estimated at 70 per cent, of full value, is $237,799,250, and the entire tax- levy for general purposes about 2 per cent. The total public debt, exclusive of water bonds, is $3,617,166. There is also a debt of the county, for the new county building, of about $1,500,000. The property belonging to the city is valued at $20,430,985. (c. m. b.)

Deus, Joao de (1830-1896), the greatest Portuguese poet of his generation, and perhaps of the 19th century, was born at San Bartholomeu de Messines in the province of Algarbe on 8th March 1830. Matriculating in the faculty of law at the university of Coimbra, he did not proceed to his degree but settled in the city, dedicating himself wholly to the composition of verses, which circulated among professors and undergraduates in manuscript copies. In the volume of his art, as in the conduct of life, he practised a rigorous self-control. Though it is by no means uncommon for Portuguese poets to publish books of verse before they are of age, and though Joao de Deus was the idol of an academic circle from a very early date, he printed nothing previous to 1865, and the first of his poems to appear in a separate form was La Lata, which was issued in 1860. In 1862 he left Coimbra for Beja, where he was appointed editor of 0 Bejense, the chief newspaper in the province of Alemtejo, and four years later he edited the Folha do Sul. As the pungent satirical verses entitled Eleigoes prove, he was not an ardent politician, and, though he was returned as Liberal deputy for the constituency of Silves in 1869, he acted independently of all political parties and promptly resigned his mandate. The renunciation implied in the act, which cut him off from all advancement, is in accord with nearly all that is known of his lofty character. In the year of his election as deputy, his friend, Jose Antonio Garcia Blanco, collected from local journals the series of poems. Flares do Campo, which is supplemented by the Jtamo de Flares (1869). This is Joao de Deus's masterpiece. Fires de Mdrmalada (1869) is an improvisation of no great merit. The four theatrical pieces — Amemas a

nosso proximo, Ser apresentado, Ensaia de Casamento, and A Vi-Ava incon- solavel — are prose translations from Mery, cleverly done but not worth the doing. Horacio e Lydia (1872), a translation from Ponsard, is a good example of artifice in manipulating that dangerously monotonous measure, the Portuguese couplet. As an indication of a strong spiritual reaction three prose fragments (1873) — Anna, MUe de Maria, A Virgem Maria and A Mulher do Levita de Ephrain — translated from Darboy's Femmes de la Bible, are full of significance. The Folhas soltas (1876) is a collec- tion of verse in the manner of Flores do Campo, brilliantly effective and exquisitely refined. Within the next few years the writer turned his attention to educational prob- lems, and in his Cartilha maternal (1876) first expressed the conclusions to which his study of Pestalozzi and Probel had led him. This patriotic, pedagogical apostolate was a misfortune for Portuguese literature ; his educational mission absorbed Joao de Deus completely, and is respon- sible for numerous controversial letters, for a translation

of Theodore-Henri Barrau's treatise, Des devoirs des enfants envers leurs parents, for a prosodic dictionary, and for many otlier publications of no literary value. A copy of verses in Antonio Vieira's Orinalda de Maria (1877), the Loas d Virgem (1878), and the Proverbios de SalomSo, are evidence of a complete return to orthodoxy during the poet's last years. By a lamentable error of judgment some worthless pornographic verses entitled Cryptinas have been inserted in the completest edition of Joao de Deus's poems— Oampo de Flores (Lisbon, 1893). He died at Lisbon on 11th January 1896, was accorded a public f \ineral, and was buried next to the traditional grave of Camoens in the Jeromite church. His scattered minor prose writings and correspondence have been posthu- mously published by Dr Theophilo Braga (Lisbon, 1898). His last resting-place corresponds to his position in the history of- Portuguese literature. Next to Camoens, no Portuguese poet has been more widely read, more pro- foundly admired than Joao de Deus ; yet no poet in any country has been more indifferent to public opinion and more deliberately careless of

personal fame. He is not responsible for any single edition of his poems, which were put together by pious but ill-informed enthusiasts, who ascribed to him verses that he had not written ; he kept no copies of his compositions, seldom troubled to write them himself, and was content for the most part to dictate them to others. He has no great intellectual force, no philosophic doctrine, is limited in theme as in outlook, is curiously uncertain in his touch, often marring a fine poem with a slovenly rhyme or with a misplaced accent; and, on the only occasion when he was induced to revise a set of proofs, his alterations were nearly all for the worse. And yet, though he never appealed to the patriotic spirit, though he wrote nothing at all comparable in force or majesty to the restrained splendour of Os Lusiadas, the popular instinct which links his name with that of his great predecessor is eminently just. For Camoens was his model; not the Camoens of the epic, bat the Camoens of the lyrics and the sonnets, where the passion of tenderness finds its supreme utterance. Braga has noted five stages of development in Joao de Deus's artistic life — the imitative, the idyllic, the lyric, the pessimistic, and the devout phases. Under each of these divisions is included much that is of extreme interest, especially to contemporaries who have passed through the same succession of emotional experience, and it is highly probable that Gaturras and Gaspar, pieces as witty as anything in Bocage but free from Bocage's coarse impiety, will always interest literary students. But it is as the singer of love that Joao de Deus will delight pos- terity as he delighted his own generation. The elegiac music of Bachel and of Marina, the melancholy of Adeus and of Remoinho, the tenderness and sincerity of Men casto lirio, of Lagrima celeste, of Descalga, and a score more songs are distinguished by the large, vital simplicity which withstands time. It is precisely in the quality of unstudied simplicity that Joao de Deus is incomparably strong. The temptations to a display of virtuosity are almost irresistible for a Portuguese poet; he has the tradition of virtuosity in his blood, he has before him the example of all contemporaries, and he has at hand an instrument of wonderful sonority and compass. Yet not once is Joao de Deus clamorous or rhetorical, not once does he indulge in idle ornament. His prevailing note is that of exquisite sweetness and of reverent purity; yet with all his caressing softness he is never sentimental, and, though he has not the strength for a long flight, emotion has seldom been set to more delicate music. Had he included among his other gifts

the gift of selection, had he continued the poetic discipline of his youth instead of dedicating his powers to a task which, well as he per-

formed it, might have been done no less well by a much lesser man, there is scarcely any height to which he might not have risen. (j- f.-k.)

Deutsch-Brod (Czech, Nemecky ^rotZ), the chief town of a government district of the same name in Eastern Bohemia, on the Sazawa river, north-west of the Iglau German enclave. It was the scene of a victory by Ziska in 1422 over the Emperor Sigismund, when it was destroyed by the Hussites, and in the preceding century had been a flourishing mining town. It was found im- possible, however, to restore the old mines. Deutsch- Brod is now a manufacturing town, producing starch, cloth, glass, spodium, flour, beer, and it has a number of saw-mills. Population, almost exclusively Czech (1890),

5735; (1900), 6526.

Deutz, a town of Prussia, incorporated with Cologne {q.v.) in 1888.

Deva, a corporate town of South-East Hungary, near the river Maros, 82 miles east by north of Temesv^ ; capital of the county of Hunyad. It existed in the time of the Eomans, but its oldest edifice is the Calvinist church, dating from the epoch of the Hunyadis (15th century). The neighbourhood was the scene of important events in the War of Independence, 1848-49, and the iniins of the fortress, which was then destroyed, are still very imposing. Population (1891), 4657; (1900), 7089.

Deventer, an old Hanse town in the province of Overyssel, Netherlands, on the river Yssel, 25 miles north of Arnheim. The rise of Amsterdam and the shallowing of the Yssel contributed to its decline, but it remains a commercial centre of some importance, trading with the eastern parts of Guelderland and Overyssel. Connexion with Borculo by steam tram has been established ; also an institution to carry out agricultural experiments. A new theatre was built in 1875. Population (1900), 26,212.

De Vere, Aubrey Thomas (1814-1902), Irish poet and critic, was born at Curragh Chase, county Limerick, on 10th January 1814, being the third

son of Sir Aubrey de Vere Hunt. In 1832 his father dropped the final name by royal license. Aubrey de Vere was educated at Trinity CoUege, Dublin, and in his twenty- eighth year began his literary career with The Waldenses, which he followed up in the next year by The Search after Proserpine. Thenceforward he was continually engaged, till his death on 20th January 1902, in the production of poetry and criticism, devoting a long and industrious life to his enthusiasm for literature. His best known works are : in verse. The Sisters, 1861 ; The Infant Bridal, 1864 ; Irish Odes, 1869 ; Legends of St Patrick, 1872 ; Sbud Legends of the Saxon Saints, 1879 ; and in prose, Essays chiefly on Poetry, 1887 ; and Essays chiefly Literary and Ethical, 1889. He also wrote a picturesque volume of travel- sketches, and two dramas in verse, Alexander the Great, 1874 ; and St Thomas of Canterbury, 1876 ; both of which, though they contain fine passages, suffer from diffuseness and a lack of dramatic spirit. The characteristics of Aubrey de Vere's poetry are "high seriousness" and a fine religious enthusiasm. His research in questions of faith led him to the Roman Church ; and in many of his poems, notably in the volume of sonnets called St Peter's Chains, 1888, he made rich additions to devotioual verse. He was a disciple of Wordsworth, whose calm meditative serenity he often echoed with great felicity ; and his affection for Greek poetry, truly felt and understood, gave dignity and weight to his own versions of mythological idylls. But per- haps he will be chiefly remembered for the impulse which he gave to the study of Celtic legend and literature. In this direction he has had many followers, who have sometimes assumed the appearance of pioneers ; but after Matthew

Arnold's fine lecture on "Celtic Literature," nothing per- haps has had more influence upon the return to Celtic interests than Aubrey de Vere's tender insight into the Irish character, and his stirring reproductions of the early Irish epic poetry. (a. wa.)

Devizes, a municipal borough and market town in the Devizes parliamentary division (since 1886) of Wiltshire, England, 23 miles north-north-west of Salisbury by rail. A cottage hospital has been erected. The

scanty remains of the ancient castle are mostly incorporated in a modern residence. There are large engineering works and manu- factures of agricultural implements ; edso a large tobacco and snuff factory. Area, 907 acres ; population (1881), 6649; (1901), 6532. The Devizes Union District, ex- cluding the borough of Devizes, had a population of

(1891) 13,318; (1901), 13,070.

Devon port, a municipal (extended 1898), county (1888), and parliamentary borough, naval arsenal, royal dockyard, and garrison town of England, on the Hamoaze or estuary of the Tamar, 1 mile west-north-west of Ply- mouth, 248 miles by rail west-south-west of London. The borough is divided into 15 wards under a council of 60 members. Among recent institutions are a free library (1882) ; the Naval Engineering College (1880), enlarged in 1896 by the addition of a new wing costing £30,000, the only establishment of the kind in the United Kingdom (Portsmouth College having been abolished), with 200 students resident in the college ; the municipal technical schools, opened in 1899, 80 per cent, of the students be- ing connected with the dockyard ; and the new naval bar- racks (1885). There is a public park (35 acres). No. 3 dock of Devonport dockyard (72 acres) has been recently enlarged to accommodate the biggest ships, and the ad- joining dock southwards now admits all but the largest cruisers. One of the building slips, still roofed, measures over 6000 square yards. In a " shed," converted into an open slip, was built the " Ocean," launched in 1898 — Devonport's first battle-ship. A new slip suitable for battle-ships or cruisers of the largest type was begun in 1900. Over 7000 workmen are employed in the dockyard. A ropery, producing half the hempen ropes used in the navy, employs 100 women. Keyham steamyard (72 acres), to the north of Devonport, opened in 1853, com- prises 3 large docks and 2 basins, the Queen's Dock being 418 feet long. To the north of the docks, the factory, quadrangular in shape, includes an engineer students' shop, a torpedo shop, machinery shops, engine smithery, erecting shop and turnery, iron and brass foundries, pat- tern and millwrights' shops, flanging works, &c. The Keyham extension works, begun in 1896, includes the reclamation of nearly 100 acres of land to the north of Keyham and of the Naval Engineering College. The scheme provides a closed basin 1550 feet long,

1000 feet wide, and 55 feet deep, communicating with the Hamoaze by a spacious lock as well as a caisson entrance ; another tidal basin (10 acres) ; and 3 graving docks. On the completion, some six or seven years hence, of the exten- sion, the port will command 5 basins and 10 docks, and rank as by far the most capacious arsenal of the world, disposing of a continuous sea frontage, extending nearly three miles, of docks and arsenal. Area of municipal and county borough before extension, 1760 acres ; population (1881), 48,939; (1891), 54,803. The extended area is 3160 acres ; population (1891), 55,981 ; (1901), 69,674.

Devonshire, a south-western maritime county of England, bounded N.W. by the Bristol Channel, N.E. and E. by Somerset and Dorset, S. by the English Chan- nel, and W. by Cornwall.

Area and Population. — The area of the ancient county, as given in the census returns, is 1,667,097 acres, or 2605 square miles.

The population in 1881 was 603,654, and in 1891 was 631,808, of whom 297,898 were males and 333,910 females, the number of persons per square mile being 243, and of acres to a person 2-6^. In 1901 the population was 660,444. The area of the administra- tive county, exclusive of the county boroughs, was 1,661,914 acres, with a population of 455,353, and including the county boroughs its area was identical with that of the ancient county, but since 1891 certain changes have been made. In 1896 the parishes of Chardstock and Hawkchurch were transferred from Dorset to Devon ; in the same year the boundaries of the county borough of Plymouth were extended ; and in 1898 the county borough of Ply- mouth was again extended. The area of the registration county is 1,660,705 acres, with a population in 1891 of 636,225, of which 336,936 were urban and 299,289 rural. Within this area the in- crease of population between 1881 and 1891 was 4-60 per cent. The excess of births over deaths between 1881 and 1891 was 63,001, and the increase of resident population was 27,969.

The following table gives the number of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 :—

Year.

Marriages.

Births.

Deaths.

Illegitimate Births. 1

Males.

Females.

1880 1890 1898

4521 4851 5038

18,218 16,893 16,222

12,167 11,903 10,844

436 351 350

380 388 305

The number of marriages in 1899 was 6245, of births 16,294, and of deaths 11,562.

The following table shows the marriage, birth, and death rates per 1000 of the population, with the percentage of illegitimate births, for a series of years : —

1870-79.

1880.

1880-89.

1890.

1888-97.

1898.

Marriage-rate .

15-3

14-8

14-9

15-3

15-1

15-4

Birth-rate

29-9

29-8

28-8

26-6

26-4

24-8

Death-rate

19-8

19-9

18-4

18-8

17-5

15-7

Percentage of ille-

gitimate births

5-2

4-5

4-6

4-4

4-2

4:0

The number of Scots in the county in 1891 was 3316, of Irish 6537, and of foreigners 1789.

Constitution and Government. — The ancient county is divided into eight parliamentary divisions, and it also inpludes the parlia- mentary boroughs of Devonport and Plymouth returning two members, and the borough of Exeter returning one. The adminis- trative county includes thirteen municipal boroughs: Barnstaple (14,137), Bideford (8754), Dartmouth (6579), Devonport (69,674), Exeter (46,940), Honiton (3271), Okehampton (2568), Plymouth (107,509), South Molton (2848), Tiverton (10,382), Torquay (33,626), Great Torrington (3241), and Totnes (4034). Of these, Devonport, Exeter, and Plymouth are county boroughs. The fol- lowing are urban districts: Ashburton (2628), Bampton (1667), Brixham (8090), Buckfastleigh (2520), Budleigh Salterton (1883), Crediton (3974), Dawlish (4003), East Stonehouse (16,111), Ex- mouth (10,487), Heavitree (7529), Ilfracombe (8567), Ivybridge (1575), Kingsbridge (3025), Lynton (1641), Newton Abbot (12,618), Northam (5357), Ottery St Mary (3495),

Paignton (8385), St Mary Church (6849), St Thomas the Apostle (8245), Salcombe (1710), Seaton (1825), Sidmouth (4201), Tavistock (4728), and Teignmouth (8636). Devonshire is in the western circuit, and assizes are held at Exeter. The boroughs of Barnstaple, Bideford, Dartmouth, Devonport, Exeter, Plymouth, South Molton, and Tiverton have separate courts of quarter sessions. The ancient county, which is almost entirely in the diocese of Exeter, contains 506 entire ecclesiastical parishes, and parts of five others.

Education. — There is a residential training college (diocesan) for schoolmasters at Exeter. At Exeter are also the West of England Institution for the deaf and the West of England Institution for the blind, while at Plymouth are the South Devon and Cornwall Institution for the blind and a school board deaf school. The number of elementary schools on 31st August 1899 was 643, of which 239 were board and 404 voluntary schools, the latter includ- ing 349 National Church of England schools, 6 Wesleyan, 13 Roman Catholic, and 36 "British and other." The average attendance at board schools was 43,261, and at voluntary schools 50,162. The total school board receipts for the year ended 29th September 1898 were over £144,335. The income under the Tech- nical Instruction Act was over £602, and that under the Agricul- tural Rates Act over £6114.

Agriculture. — About three-fourths of the total area of the county is under cultivation, and of this more than a half is in permanent pasture, a large number of cattle and sheep being raised. The Devon breed of cattle are well adapted both for fattening and dairy purposes. For sheep there are, in addition to the permanent

pasture of the cultivated area, about 158,000 acres in hill pasturage. Over 86,000 acres are under woods and about 27,000 acres under orchards, chiefly of apple trees, nearly every farm having a large orchard for the manufacture of cider. Of the acreage under com crops, more than one-

half is under oats, and less than a third under wheat, the acreage of which has diminished since 1880 about a third. The bulk of the acreage under green crops is occupied by turnips, mangold, and cabbage, potatoes occupying only about a tenth of the whole acreage. The following table gives the larger main divisions of the cultivated area at intervals of five years from 1880 :—

Tear.

Total Area under Culti- vation.

Corn Crops.

Green Crops.

Clover.

Perman- ent Past- ure.

Fallow.

1880 1885 1890 1895 1900

1,150,888 1,193,108 1,208,467 1,213,913 1,210,034

278,413 252,244 242,864 222,896 225,203

138,735 140,822 132,485 127,905 122,769

190,197 196,743 201,326 218,965 219,091

609,694 582,203 615,230 633,055 634,427

33,833

21,063

15,532

9,596

7,179

The following table gives “particulars regarding the principal live-stock for the same years : —

Tear.

Total Horses.

Total

Cattle.

Cows or Heifers

in Milk or in

Calf.

Sheep.

Hgs.

1880 1885 1890 1895 1900

53,944 54,579 55,280 69,916 54,526

229,471 253,421 259,876 263,506 279,728

80,280 90,937 95,960 94,685

91,872

773,916 874,606 913,562 874,408 846,324

84,815

99,513

123,227

123,937

95,944

Industries and Trade. — According to the annual report for 1898 of the chief inspector of factories (issued 1900), the total number of persons employed in factories and workshops in 1897 was 36,887, as compared with 34,608 in 1896. Textile factories employed only 2356, of whom 1197 were employed in the manufacture of woollen goods, lace employing 879. Honiton lace is made in other parts of the county as well as in Honiton. In non-textile factories 24,002 persons were employed, there being an increase between 1895 and 1896 of 10-4 per cent., and between 1896 and 1897 of 7-6 per cent. In the manufacture of machines, appliances, conveyances, and tools, 8-534 persons were employed, chiefly in the Government establishments at Devonport and Keyham ; in the clothing in- dustry 2800, there being a considerable trade in costumes and outfitting ; in the manufacture of paper 2756 ; in the clay and stone industry (including articles in pottery and terra-cotta at Bovey Tracy, Watcombe, &c.), 1047. Of the 10,529 persons employed in workshops as many as 6342 were employed in the clothing industry, and 1576 in the manufacture of machines, ap- pliances, conveyances, and tools. Por mineral purposes Devon is included in the duchy of Cornwall. The total number of persons employed in mining in 1899 was 3085. Increasing quantities of marble, granite, and other building stones, as well as limestone and roofing slates, are being dug. In 1899 as many as 527,026 tons of limestone were raised,- 290,991 tons of clay (value £82,244), 48,651 tons of granite, 71,487 tons of sandstone, and 13,901 tons of slate. Manganese and tin are mined in only very small quantities. The following table gives particulars regarding the production of arsenic, china clay, and copper in 1890 and 1899 : —

Tear.

Arsenic.

China Clay.

Copper.

Tons.

Value.

Tons.

Value.

Tons.

Value.

1890 1899

4133 2468

£34,224 £40,941

60,346 62,198

£80,173 £30,187

6038 990

£9197

£2292

Much of the fishing is carried on within the three mile limit. Pilchard, cod, sprats, brill, plaice, soles, turbot, shrimps, lobster, oyster, and mussels, are met with, besides herrings and mackerel, which are rather plentiful. The principal fishing stations are Brixham and Plymouth, but there are small ones in all the bays and river outlets. The total amount of fish landed at Brixham in 1899 was 62,337 cwt., valued at £70,685 ; and at Plymouth 138,972 cwt., valued at £89,003. The annual average for all stations is about 280,000 cwt., valued at £180,000. Much of the fish landed at Plymouth is from Cornwall.

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history series). London, 1886, new edition 1895 ^D'Urban and

*Mathew. Birds of Devon. London, 1896; and Wokthy's Devonshire Wills. London, 1896. / ^ p „ *

Devonshire, Spencer Compton Cavendish,

8th Duke of (1833), was born on 23rd July

1833. He was the son of the seventh duke of Devon- shire- (who died in 1891 at the age of 83), a man who, without playing a prominent part in public affairs, exercised great influence not only by his position but also by his abilities. In 1854 the marquis of Hartington, as he then was, took his degree at Trinity College, Cambridge, and in 1857 was returned to Par- liament for North Lancashire. At the opening of the new Parliament of 1859 he moved the amendment to the address which overthrew the Government of Lord Derby. In 1863 he was Under Secretary for War, and on the formation of the Eussell-Gladstone administration at the death of Lord Palmerston he entered it as "War Secretary. He retired with his colleagues in July 1866 ; but upon Mr Gladstone's return to power in 1868 he became Postmaster-General, which office he exchanged in 1871 for that of Secretary for Ireland. When Mr Glad- stone, after his electoral defeat and consequent resignation in 1874, temporarily withdrew from the leadership of his party in January 1875, Lord Hartington was chosen his successor. Mr W. E. Forster, who had taken a much more prominent part in public life, was the only other possible nominee, but he declined to stand. Lord Harting- ton's rank no doubt told in his favour, and Mr Forster's Education Bill had offended the Nonconformist members, who would probably have withheld their support. Lord Hartington's prudent management in difficult circum- stances laid his followers under great obligations, since not only was the opposite party in the ascendant, but his own former chief was indulging in the freedom of inde- pendence. After

the complete defeat of the Conservatives in the general election of 1880, a large proportion of the party would have rejoiced if Lord Hartington could have taken the Premiership instead of Mr Gladstone, and the Queen, in strict conformity with constitutional usage, sent for him as leader of the Opposition. Mr Gladstone, however, was clearly master of the situation : no Cabinet could be formed without him, nor could he reasonably be expected to accept a subordinate post. Lord Hartington, therefore, gracefully abdicated the leadership which he had temporarily assumed, and be- came Secretary of State for India, from which office, in December 1882, he passed to the War Office. His adminis- tration was memorable for the expeditions of General Gordon and Lord Wolseley to Khartum. In June 1885 he resigned along with his colleagues, and in December was elected for the Eosendale Division of Lancashire, created by the new Eeform Bill. Immediately afterwards the great political opportunity of Lord Hartington's life came to him in Mr Gladstone's conversion to Home Eule. Lord Hartington's refusal to follow his leader in this course inevitably made him the chief of the new Liberal Unionist party, composed of a large and influential section of the old Liberals. In this capacity he moved the first resolution at the famous public meeting at the Opera House, and also, in the House of Commons, moved the rejection of Mr Gladstone's Bill on the second reading. During the memorable electoral con- test which followed, no election excited more interest than Lord Hartington's for the Eosendale Division, where he was returned by a majority of nearly 1500 votes. In the new Parliament he held a position much resembling that which Sir Robert Peel had occupied after his fall from power, the leader of a small, compact party, the standing and ability of whose members were out of all proportion to their numbers, generally esteemed and trusted beyond any other man in the country, yet in his own opinion forbidden to think of office. Lord Salisbury's overtures, at all events, were declined, and Lord Hartington con-

tinued to discharge the delicate duties of the leader of a middle party with no less judgment than he had shown when leading the Liberals during the interregnum of 1875-80. It was not until 1895, when the differences between Conservatives and Liberal Unionists had become almost obliterated by changed circumstances and the habit of acting together, that the duke of Devonshire, as he had become by the death of his father in 1891, consented to enter Lord Salisbury's third Ministry as President of the Council. The duke thus was the nominal representative of education in the Cabinet at a time when educational questions were rapidly becoming of great importance ; and the duke's own technical knowledge of this difficult and intricate question being admittedly superficial, a good deal of criticism from time to time resulted. His great contribution to public life, however, has been the weight of character which procured for him universal respect and confidence, and exempted him from bitter attack, even from his most determined political opponents. No man ever doubted the duke of Devonshire's patriotism, or felt entirely secure in differing from his judgment. Wealth and rank combined with character to place him in a measure above party : and he remained a luminous example of the benefit which a democratic community may derive from the existence within it of an aristocratic class and the participation of its members in public affairs. The duke succeeded his father as Chancellor of the University of Cambridge in 1892, and is a Knight of the Garter.

Dewar, James (1842), British chemist and

physicist, was born at Kincardine-on-Forth, Scotland, on 20th September 1842. He was educated at Dollar Acad- emy and Edinburgh University, being at the latter first a pupil, and afterwards the assistant, of the late Lord Play- fair, then professor of chemistry ; he also studied under Kekule at Ghent. In 1875 he was elected Jacksonian pro- fessor of natural experimental philosophy at Cambridge, becoming a fellow of Peterhouse, and in 1877 he succeeded Dr J. H. Gladstone as Pullerian professor of chemistry in the Eoyal Institution, London. He has been president of the Chemical Society and of the Society of Chemical Industry, served on the Balfour Commission on London Water Supply (1893-94), and as a member of the Com- mittee on Explosives (1888-91) invented cordite jointly with Sir Frederick Abel. His scientific work covers

a wide field. Of his earlier papers, some deal with questions of organic chemistry, others with Graham's hydrogenium and its physical constants, others with high temperatures, e.g., the temperature of the sun and of the electric spark, others again with electro-photometry and the chemistry of the electric arc. With Professor M'Kendrick, of Glasgow, he investigated the physiological action of light, and examined the changes which take place in the elec- trical condition of the retina under its influence. With Professor G. D. Liveing, one of his colleagues at Cam- bridge, he began in 1878 a long series of spectroscopic observations, the most recent of which have been devoted to the spectroscopic examination of various gaseous con- stituents separated from atmospheric air by the aid of low temperatures. Since the time that liquid air and liquid oxygen have been available in considerable quantities,' he has been joined by Professor J. A. Fleming, of University College, London, in the investigation of the electrical behaviour of substances cooled to very low tempera- tures. His name is most widely known in connexion with his work on the liquefaction of the so-called permar nent gases and his researches at temperatures approaching' the zero of absolute temperature. His interest in this branch of inquiry dates back at least as far as 1874, when he discussed the "Latent Heat of Liquid

Gases" before the British Association. In 1878 he devoted a Friday evening lecture at the Eoyal Institution to the then recent work of Cailletet and Pictet, and exhibited for the first time in Great Britain the working of the Cailletet apparatus. Six years later, in the same place, he described the researches of Wroblewski and Olszewski, and illustrated for the first time in public the liquefaction of oxygen and air, by means of apparatus specially designed for optical projection so that the actions taking place might be visible to the audience. Soon afterwards he constructed a machine from which the liquefied gas could be drawn off through a valve for use as a cooling agent, and he showed its employment for this purpose in connexion with some researches on meteorites ; about the same time he also obtained oxygen in the solid state. By 1891 he had designed and erected at 'the Eoyal Institution an apparatus which yielded liquid oxygen by the pint, and towards the end of that year he showed that both liquid oxygen and liquid ozone are strongly attracted by a magnet. About 1892 the idea occurred to him of using vacuum-jacketed vessels for

the storage of liquid gases, and so efficient did this device prove in preventing the influx of external heat that it is found possible not only to preserve the liquids for comparatively long periods, but also to keep them so free from ebullition that examination of their optical pro- perties becomes possible. He next experimented with a high-pressure hydrogen jet by which low temperatures were realized through the Thomson-Joule effect, and the successful results thus obtained led him to build the large refrigerating machine by which in 1898 hydrogen was for the first time collected in the liquid state, its solidification following in 1899 (see Liquid Gases). The Eoyal Society in 1894 bestowed the Eumford Medal upon Professor Dewar for his work in the pro- duction of low temperatures, and in 1899 he became the first recipient of the Hodgkins Gold Medal of the Smithsonian Institution, Washington, for his contributions to our knowledge of the nature and properties of atmos- pheric air.

Dewas, a native state of India, in the Indore agency. For more than a century the state has been divided, almost equally, between the descendants of a former chief, known as the senior and junior branches, or as Baba and Dada Saheb. Both live in the town of Dewas, but exer- cise exclusive jurisdiction over their several shares. Total area, 289 square miles. Population (1881), 142,162 ; (1891), 152,073, showing an increase of 7 per cent., which has been almost confined to the share of the senior branch ; average density, 526 persons per square mile. The chiefs are Eajputs of the Puar clan, of the same family as the Eaja of Dhar. The two chiefs ruling in 1901 were named Krishnaji Eao and Mulhar Eao, these names showing Maratha influence.

The town of Dewas is situated in 22° 58′ N. lat. and 76° 6′ E. long., about 20 miles north-east of Indore. Population, 11,921. It has a high school and a hospital.

Dewey, George (1837), American naval com- mander, was born in Montpelier, Vt., on 26th December 1837, and graduated at the U.S. Naval Academy in 1868. In the Civil War he served as lieutenant on the steam sloop Mississippi, during Farragut's passage of the forts below New Orleans in April 1862, and at Port Hudson in March 1863. After the war he performed various routine duties, rising in grade to commodore

(February 1896). On 30th November 1897 he was assigned, at his own request, to sea service, and sent to Asiatic waters. Being notified by telegraph in April 1898, while with his fleet at Hong-Kong, that war had been declared with

Spain, and ordered to ” capture or destroy the Spanish fleet ” at the Philippines, he departed for Manila with his squadron, after procuring coal and provisions for the expedition. Steaming into Manila harbour, his fleet advanced on 1st May at early dawn against the Spanish vessels sighted at the other end of the bay. His flagship, the Olympia, led in a fight at close range which lasted, with slight intermission, until the afternoon, when the last Spanish flag was hauled down. The surrender of the city of Manila followed later. After remaining in the Philippines under orders from his G-overnment to maintain control, Dewey returned home, October 1899, re- ceiving great ovations. He was advanced to rear-admiral, with the thanks of Congress, soon after his victory, and was promoted to admiral on 2nd March 1899.

Dewsbury, a municipal and parliamentary borough and market-town of Yorkshire, England, on the Calder, 7 miles east-north-east of Huddersfield by rail. The old church of All Saints has been enlarged ; besides^ there are five Established, a Roman Catholic, and several IToncon- formist churches, grammar and technical schools, an infirmary, and, of recent erection, a town-hall, a free library, and public baths. The hall and library in the buildings of an industrial co-operative society also deserve mention. A public park was opened in 1893. There are iron foundries and works for machinery. Area of municipal borough, 1468 acres. Population (1881), 29,637 ;

(1901), 28,050.

Dhar, a native state of India, in the Bhopawar agency. Central India, includes many Eajput and Bhil feudatories, and has an area of 1740 square miles. In 1881 it had a population of 151,877, and in 1891 of

169,474, showing an average density of 98 persons per square mile. The revenue in 1897-98 was Es.8,57,909 ; the police force numbered 1015 men. The state includes the ruins of Mandu, or Mandogarh, the Mahommedan capital of Malwa.

The town of Dhab is 33 miles west of Mhow, 908 feet above the sea. Population, about 15,000. It is a centre of the opium trade, and has a high school and hospital.

Dharampur, a native state of India, in the Gujarat division of Bombay, with an area of 794 square miles. The population in 1881 was 101,289; in 1891 it was 120,498; the estimated gross revenue was Es.4,12,712, of which Es.88,000 was expended in public works in 1897-98; the tribute is Es.9000. The state has been surveyed for land revenue on the Bombay system. The number of police was 170; the number of schools was 20, with 940 pupHs in 1897-98. The population of Dharampur town in 1891 was 4775.

Dharwar, a town and district of British India, in the Carnatic or Canarese-speaking division of Bombay, with a railway station. The population in 1881 was 27,191; in 1891 it was 32,841. It has two ginning factories and a cotton-mill with 10,000 spindles, employing 200 hands ; two high schools, one maintained by the Government and the other by the Basel German Mission, with 466 pupils in 1896-97 ; training schools for masters and for mistresses; fourteen printing-presses, eleven of which issue periodicals in Canarese and Mahratti.

The DISTRICT OF Dharwar has an area of 4603 square miles. In 1881 it had a population of 893,687, and in 1891 of 1,051,314, giving an average density of 228 persons per square mile. In 1901 the population was 1,113,426, showing an increase of 6 per cent. The land revenue and rates were Es.33,01,157, the incidence of assessment being E.1-3-5 per acre ; the cultivated area in 1897-98 was 2,076,808 acres, of which 94,323 were irrigated from tanks, &c., including 4381 acres from

Government canals ; the number of police was 945 ; the children at school in 1897-98 numbered 34,298, being 3-4 per cent, of the total population ; the death-rate in 1897 was 37-57 per thousand. The principal

crops are millets, pulse, and cotton. The centres of the cotton trade are Hubli and Gadak, junctions on the Southern Mahratta railway, which now traverses the district in several directions.

Dholpur, a native state of India, in the Rajputana agency, with an area of 1156 square miles. The popula- tion in 1881 was 249,657 ; in 1891 it was 279,980, giving an average density of 242 persons per square mile. In 1901 the population was 271,496, showing a decrease of 3 per cent. The estimated revenue is Es.12,50,000. There were six schools, with 366 pupils, in 1897-98 ; and four dispensaries, attended by 25,843 patients. The state is crossed by the Indian Midland railway from Jhansi to Agra. In recent years it has suffered severely from drought. In 1896-97 the expenditure on famine relief amounted to Es.1,22,859.

The town of Dholpur is 34 miles south of Agra by rail. Population, about 16,000.

Dhrangadra, a native state of India, in the Gujarat division of Bombay, situated in the north of the peninsula of Kathiawar. Its area is 1156 square miles. The population in 1881 was 99,686, and in 1891 was 103,754 ; the estimated gross revenue is Es.5,75,110, of which Es.25,790 was expended on public works in 1897-98; the tribute is Es.44,677. A railway on the metre gauge from Wadhwan to the town of Dhrangadra (21 miles) was opened for trafiic in 1898.

The town of Dhrangadra is situated in 22° 59′ N. lat. and 71° 31′ E. long. There is a printing-press, issuing an ofacial gazette. Population (1891), 15,209.

Dhuleep Singh (1837-1893), Maharajah of Lahore, was born in February 1837, and was proclaimed Maharajah on 18th September 1843, under the regency of his mother the Eanee Jinda, a woman of great capacity and strong will, but extremely inimical to the British. He was acknowledged by Eunjeet Singh and recognized by the British Government. After six years of peace the Sikhs invaded British territory in 1845, but were defeated in four battles, and terms were imposed upon them at Lahore, the capital of the Punjab. Dhuleep Singh retained his territory, but it was administered to a great extent by the British Government in his name. This

arrangement increased the Regent's dislike of the British, and a fresh outbreak occurred in 1848-49. In spite of the valour of the Sikhs, they were utterly routed at Gujarat, and in March 1849 Dhuleep Singh was deposed, a pension of £40,000 a year being granted to him and his dependants. He became a Christian and elected to live in England. On coming of age he made an arrangement with the Government by which his income was reduced to £25,000 in consideration of advances for the purchase of an estate, and he finally settled at Elvedon in Suffolk. While passing through Alexandria in 1864 he met Miss Bamba MuUer, the daughter of a German merchant who married an Abyssinian. The Maharajah had been interested in mission work by Sir John Login, and he met Miss Muller at one of the missionary schools where she was teaching. She became his wife on 7th June 1864, and six children were the issue of the marriage. In the year after her death in 1890 the Maharajah married at Paris, as his second wife, an English lady. Miss Ada Douglas Wetherill, who survived him. The Maharajah was passionately fond of sport, and his shooting parties were celebrated, while he himself became a persona grata in English society. The result, however, was financial dif&culty, and in 1882 he appealed to the Government for

assistance, making various claims based upon the alleged possession of private estates in the Punjab, and upon the surrender of the Kohinoor diamond to the English Crown. His demand was rejected, whereupon he started for India, after drawing up a proclamation to his former subjects. But as it was deemed inadvisable to allow him to visit the Punjab, he remained for some time as a guest at the residency at Aden, and was allowed to receive some of his relatives to witness his abjuration of Christianity, which actually took place within the resi- dency itself. As the climate began to affect his health, the Maharajah at length left Aden and returned to Europe. He stayed for some time in Russia, hoping that his claim against England would be taken up by the Russians ; but when that expectation proved futile he proceeded to Paris, where he lived for the rest

of his life on the pension allowed him by the Indian Government. His death from an attack of apoplexy took place at Paris, 22nd October 1893. (g. f. b.)

Dhulia, a town of British India, administrative headquarters of Khandesh district in Bombay, on the right bank of the Panjhra river. The population in 1881 was 18,449 ; in 1891 it was 21,880. It has canton- ments for the Bhil Corps and a detachment of the Poona Horse. Considerable trade is done in cotton and oil- seeds, and weaving of cotton. It contains the Garud High School, with 348 pupils in 1896-97, and five print- ing-presses, each issuing a vernacular newspaper. A railway to connect Dhulia with Chalisgaon, on the main line of the Great Indian Peninsula (37 miles), was com- menced in 1900.

Diabetes. See Pathology {Metabolic Diseases).

Diamantina, a town of Brazil, in the state of Minas Geraes, with a population of 13,000, is the centre of the diamond mine district, and yields the larger part of the production of diamonds in Brazil, which is estimated at 40,000 carats a year.

Diarbekr. — I. A viMyet of Asiatic Turkey through which the western arm of the Tigris flows. It extends southwards from Palu, on the Euphrates, to Mardin and Nisibin, and is divided into three sanjaks — Arghana, Diarbekr, and Mardin. Cereals, cotton, tobacco, rice, and silk are produced ; but most of the fertile lands have been abandoned to the nomads and semi-nomads, who raise large quantities of live-stock. Copper, galena, mineral oil, and silicious sand are found. The popular tion is about 480,000 (Moslems, including nomad and • semi-nomad Kiirds, 336,000 ; Yezidis and Gypsies, 4000 ; Christians, chiefly Armenians and Syrians, 139,000 ; Jews, 1000). II. The chief town of the vilayet and of a sanjak of the same name (the Ancient Amida), seat of a Governor-General, headquarters of a military district, situated at an altitude of 1950 feet, on a high mass of basalt rock on the right bank of the Tigris, which is here crossed by a stone bridge and is f ordable in several places in winter. Its position at the head of raft navigation on the Tigris, and with easy roads to Alexandretta on the Mediterranean, Samsun on the Black Sea, Erzerum, Bitlis, and Mosul, has always been

one of commercial and strategic importance. Old walls, pierced by four gates, and standing above cliffs from 20 to 40 feet high, sur- round the town, and beneath them, on the river side, are irrigated gardens. At the north-east angle, on the highest ground, are the ruins of a citadel, in which is the Serai or Government House. The streets are narrow, badly paved, and filthy. The houses are low, and built partly of black basalt — ^whence the ancient name of the town, Kara (black) Amid — and partly of dark coloured sun-dried bricks. In the great mosque, Ulu Jami' and its court are the facades

of two Sassanian palaces, apparently built with materials from an older palace, perhaps that of Tigranes II. The churches of SS. Cosmas and Damian (Jacobite) and St James (Greek) are also of interest. The climate in winter is good ; snow often lies, and there is sufficient ice for storage for summer use. In summer it is very hot and unhealthy. Epidemics of typhus are frequent, and ophthalmia and the " Aleppo button " are common. Scorpions, noted for the virulence of their poison, abound. There are a few small industries, silver fili- gree work, morocco leather, cotton, and silk. Eruit is grown near the town, but little of the adjoining land is cultivated. The principal exports are wool, mohair, copper ore, &c. ; and the imports, cotton and woollen goods, indigo, coffee, sugar, petroleum, &c. The popu- lation is 26,000 (Turks, Kurds, and Arabs, 13,000; Armenians, Jacobites, Greeks, Protestants, and Jews, 12,000). During the massacres of 1895 the Christians successfully defended themselves against the Moslems.

(c. w. w.)

Diaz, Narcisse Virgilio (1808-1876), Erench painter, was born in Bordeaux of Spanish parents, 25th August 1808. At first a figure-painter who indulged in strong colour, in his later life Diaz became a painter of the forest and a " tone artist " of the first order. He spent much time at Barbizon ; and although he is the least exalted of the half-dozen great artists who are usually grouped round that name, he sometimes produced works of the highest quality. At the age of ten Diaz became an orphan, and misfortune dogged his earlier years. His foot was bitten by a reptile in Meudon wood, near Sevres, where he had been taken to live with some

friends of his mother. The bite was badly dressed, and ultimately it cost him his leg. Afterwards his wooden stump became famous. At fifteen he entered the studios at Sevres, where the decoration of porcelain occupied him ; but tiring of the restraint of fixed hours, he took to painting Eastern figures dressed in richly coloured garments. Turks and Oriental scenes attracted him, and many brilliant gems remain of this period. About 1831 Diaz encountered Theodore Eousseau, for whom he entertained a great veneration, although Rousseau was four yearshis junior ; but it was not until ten years later that the remarkable incident took place of Rousseau teaching Diaz to paint trees. At Eontainebleau Diaz found Rousseau painting his wonderful forest pictures, and determined to paint in the same way if possible. Rousseau, then in poor health, worried at home, and embittered against the world, was difficult to approach. Diaz followed him surrepti- tiously to the forest, — wooden leg not hindering, — and he dodged round after the painter, trying to observe his method of work. After a time Diaz found a way to become friendly with Rousseau, and revealed his anxiety to understand his painting. Eousseau was touched with the passionate words of admiration, and finally taught Diaz all he knew. Diaz exhibited many pictures at the Paris Salon, and was decorated in 1851. During the war, twenty years later, he went to Brussels. After 1871 he became fashionable, his works gradually rose in the estimation of collectors, and he worked constantly and successfully. In 1876 he caught cold at his son's grave, and on 18th November of that year he died at Mentone, whither he had gone to recruit his health. Diaz's finest pictures are his forest scenes and storms, and it is on these, and not on his pretty figures, that his fame is likely to rest. There are several fairly good examples of the master in the Louvre, and three small figure pic- tures in the Wallace Collection, Hertford House. Perhaps the most notable of Diaz's works are " La Fee aux Perles " (1857), in the Louvre ; " Sunset in the Forest " (1868) ;

" The Storm," and « The Forest of Fontainebleau "(1870) at Leeds. Diaz had no well-known pupils, but Leon Eichet followed markedly his

methods of tree-painting, and J. ~F. Millet (q.v.) at one period painted small figures in avowed imitation of Diaz's then popular subjects.

Authorities. — A. Hustin. Les Artistes Celebres: Diaz. Paris. — D. Croal Thomson. The Barhizon School of Painters. London, 1890.— J. W. Mollett. Diaz. London, 1890.— J. Claretie. Peintres et Sculpteurs Contemporains : Diaz. Paris, 1882. — Albert Wolff. La Capitale de VArt: Narcisse Diaz. Paris, 1886. — Ph. Burtt. Maitres et Petit-Maitres : N. Diaz. Paris, 1877. (d. c. t.)

Diaz, Porfirio (1830-

~~), President of the Ee~~

public of Mexico, was born at Oaxaca 16th September 1830. He was educated for the Church, but upon becoming his own master decided to follow the profession of the law ; and, about 1856, the disturbed condition of the country, in revolt against Santa Anna, made him a soldier. He took a prominent part in the resistance to the French invasion in 1863, and so greatly distinguished himself as to have become by 1867 commander of the army of the east, to which the capital surrendered after the execution of the Emperor Maximilian. He then retired into private life, but in 1870-72 was in arms against President Juarez, and in 1875 placed himself at the head of an insurrection against the Government of President Lerdo de Tejada. After many desperate struggles and hairbreadth escapes he entered the city of Mexico in November 1876, and was elected President in 1877. His repudiation of all the promises he had made in the programme he had put forward at the beginning of the civil war caused his term of oiBce to be exeedingly stormy, but he suppressed all opposition, and in 1880 peacefully transmitted his power to General Gonzalez, his Secretary of War. In 1884 he was elected for a second term, and, the pro- vision of the Constitution which forbade the re-election of a President having been repealed, he continued to be regularly re-elected; and no disquieting event has since occurred, except an abortive attempt to assassi- nate him in 1897. Under his vigorous rule the most anarchical of Spanish American states has become the most orderly; military revolts have disappeared; the laws are executed without opposition ; industry has been stimulated, to the great increase of national wealth ; roads and

railways have been multiplied ; foreign capital has been invested and rendered secure ; and the financial credit of the country, which had sunk to the lowest ebb, has been entirely re-established. All these benefits are owing to General Diaz's force of character and administrative ability, and he has ineontestably earned the title of the regenerator of Mexico.

Dibrugarh, a town of British India, in the Lakhimpur district of Assam, of which it is the head- quarters, situated on the Dibru river about 4 miles above its confluence with the Brahmaputra. In 1881 it had a population of 7153, and in 1891 of 9876. It is the terminus of steamer navigation on the Brahma^ putra, and also of a railway running to important coal-mines and petroleum wells, which will ultimately be connected with the Assam-Bengal system. Large quantities of coal and tea are exported. There are a mil- itary cantonment, with 280 men in 1898 ; the headquar-ters of the volunteer corps known as the Assam Valley Light Horse ; a Government high school, with 292 pupils in 1896-97 ; a training school for masters ; and an aided school for girls. In 1900 a medical school for the province was established, out of a bequest of Es.60,000 left by the late Brigade-Surgeon J. Berry- White, which will be maintained by the Government, to train hospital assist-

ants for the tea gardens. The Williamson Artisan School is entirely supported by an endowment. There are three printing-presses.

Dictionary. — A dictionary is a book in which the words of a language, or words of a special class, are arranged, generally in alphabetical order, and their mean- ing and idiomatic use are explained in the same or in a different language. Most modern dictionaries give also the pronunciation of the words defined and an account of their derivation or etymology, and some add information of various kinds about the things or processes which certain words designate. If the latter variety are general (not limited to a special class of words) they are commonly called encyclopoedic. A general dictionary in which the information given relates only to the meaning, idiomatic use, pronunciation, orthography, derivation, and history of words (or to some of these things) is literary, pedagogical, or philological. Special dictionaries are classed as techni-cal when they include only the terms of one or more of the sciences, arts,

or trades. The name is also given to certain works, such as a "rhyming dictionary," a "diction- ary of biography," a " dictionary of quotations," and the like, which are not of a strictly lexicographic character, and to encyclopaedias. For a detailed description of dictionaries of various kinds, and for a list of the more important of them, the reader is referred to the article in the ninth edition of this work, vol. vii. (pp. 179-193). Here only the more noteworthy recent work in general lexicography will be considered.

At no time has progress in the making of general dictionaries been so rapid as during the second half of the 19th century. It is to be seen in three things : in the perfecting of the theory of what a general dictionary should be ; in the elaboration of methods of collecting and editing lexicographic materials ; and in the mag- nitude and improved quality of the work which has been accomplished or planned. Each of these can best be illustrated from English lexicography, in which the process of development has in all directions been carried farthest. The advance that has been made in theory began with a radical change of opinion with regard to the chief end of the general dictionary of a language. The older view of the matter was that the lexicographer should furnish a standard of usage — should register only those words which are, or at some period of the language have been, "good" from a literary point of view, with their " proper " senses and uses, or should at least furnish the means of determining what these are. In other words, his chief duty was conceived to be to sift and refiine, to ' decide authoritatively questions with regard to good usage, and thus to fix the language as completely as might be possible within the limits determined by the literary taste of his time. Thus the Accademia della Crusca, founded near the close of the 16th centiiry, was established for the purpose of purifying in this way the Italian tongue, and in 1612 the Vocabolario degli Accademici della Crusca, long the standard of that language, was published. The Acad^mie Fran^aise, the first edition of whose dictionary appeared in 1694, had a similar origin. In England the idea of constructing a dictionary upon this principle arose during the second quarter of the 18th century. It was imagined by men of letters — among them Alexander Pope — ^that the English language had then attained such perfection that further improvement was hardly possible, and it was feared that if it were not

fixed by lexicographic authority deterioration would soon begin. Since there was no English "Academy," it was necessary that the task should fall to some one whose judgment would command respect, and the man who undertook it was Samuel John- son. His dictionary, the first edition of which, in two

folio volumes, appeared in 1755, was in many respects admirable, but it was inadequate even as a standard of the then existing literary usage. Johnson himself did not long entertain the belief that the natural development of a language can be arrested in that or in any other way. His work was, however, generally accepted as a final authority, and the ideas iipon which it was founded dominated English lexicography for more than a century. The first effective protest, in England, against the supremacy of this literary view was made by Dean (later Archbishop) Trench, in a paper on " Some Deficien- cies in Existing English Dictionaries " read before the Philological Society in 1857. " A dictionary," he said, " according to that idea of it which seems to me alone capable of being logically maintained, is an inventory of the language; much more, but this primarily. . . . It is no task of the maker of it to select the good words of the language. . . . The business which he has under- taken is to collect and arrange all words, whether good or bad, whether they commend themselves to his judgment or otherwise. . . . He is an historian of [the language], not a critic." That is, for the literary view of the chief end of the general dictionary should be substituted the philological or scientific. In Germany this substitution had already been effected by Jacob and Wilhelm Grimm in their dictionary of the German language, the first volume of which appeared in 1854. In brief, then, the modern view is that the general dictionary of a language should be a record of all the words — current or obsolete — of that language, with all their meanings and uses, but should not attempt to be, except secondarily, or indirectly, a guide to " good " usage. A " standard " dictionary has, in fact, been recognized to be an impossibility, if not an absurdity.

This theoretical requirement must, of course, be modi- fied considerably in practice. The date at which a modern language is to be regarded by the lexicographer as ” be- ginning ” must, as a rule, be somewhat arbitrarily chosen ; while considerable portions of its earlier vocabulary cannot be recovered because of the incompleteness of the literary record. Moreover, not even the most complete dictionary can include all the words which the records — earlier and later — actually contain. Many words, that is to say, which are found in the literature of a language cannot be regarded as, for lexicographic purposes, belonging to that language; while many more may or may not be held to belong to it, according to the judgment — ^almost the whim — of the individual lexicographer. This is especially true of the English tongue. “That vast aggregate of words and phrases which constitutes the vocabulary of English-speaking men presents, to the mind that endeav- ours to grasp it as a definite whole, the aspect of one of those nebulous masses familiar to the astronomer, in which a clear and unmistakable nucleus shades off on all sides, through zones of decreasing brightness, to a dim marginal film that seems to end nowhere, but to lose itself imper- ceptibly in the surrounding darkness ” (Dr J. A. H. Murray, Oxford Diet., General Explanations, p. xvii.). This “marginal film” of wbrds with more or less doubtful claims to recognition includes thousands of the terms of the natural sciences (the New-Latin classificatory names of zoology and botany, names of chemical compounds and of minerals, and the like) ; half -naturalized foreign words ; dialectal words ; slang terms ; trade names (many of which have passed or are passing into common use) ; proper names and many more. Many of these even the most complete dictionary should exclude ; others it should include ; but where the line shall be drawn will always remain a vexed question.

Another importantprincipleuponwhichTrenchinsisted, and which also expresses a requirement of modern scientific

philology, is that the dictionary shall be not merely a record, but also an historical record of words and their uses. From the literary point of view the most im- portant thing is present usage. To that alone the idea of a “standard” has any application. Dictionaries of the older type, therefore, usually make the common, or ” proper,” or ” root ” meaning of a word

the starting- point of its definition, and arrange its other senses in a logical or accidental order, commonly ignoring the his- torical order in which the various meanings arose. Still less do they attempt to give data from which the vocab- ulary of the language at any previous period may be determined. The philologist, however, for whom the growth, or progressive alteration, of a language is a fact of central importance, regards no record of a language as complete which does not exhibit this growth in its succes- sive stages. He desires to know when and where each word, and each form and sense of it, are first found in the language ; if the word or sense is obsolete, when it died ; and any other fact that throws light upon its history. He requires, accordingly, of the lexicographer that, having ascertained these data, he shall make them the foundation of his exposition — ^in particular, of the division and ar- rangement of his definitions, that sense being placed first which appeared first in order of time. In other words, each article in the dictionary should furnish an orderly biography of the word of which it treats, each word and sense being so dated that the exact time of its appearance and the duration of its use may as nearly as possible be determined. This, in principle, is the method of the new lexicography. In practice it is subject to limitations similar to those of the vocabulary mentioned above. In- completeness of the early record is here an even greater obstacle ; and there are many words whose history is, for one reason or another, so unimportant that to treat it elaborately would be a waste of labour and space.

The adoption of the historical principle involves a further noteworthy modification of older methods, namely, an impcjrtant extension of the use of quotations. To Dr Johnson belongs the credit of showing how useful, when properly chosen, they may be, not only in corroborating the lexicographer's statements, but also in revealing special shades of meaning or variations of use which his defini- tions cannot well express. No part of Johnson's work is more valuable than this. This idea was more fully devel- oped and applied by Dr Charles Richardson, whose Neiv Dictionary of the English Language . . . Illustrated by Quotations from the Best Authors (1835-36), still remains a most valuable collection of literary illustrations. Lexi- cographers, however, have, with few exceptions, imtil a recent date, employed quotations chiefly for the ends just mentioned — as instances of use or as illustrations of cor- rect usage

— ^with scarcely any recognition of their value as historical evidence ; and they have taken them almost exclusively from the works of the ” best ” authors. But since all the data upon which conclusions with regard to the history of a word can be based must be collected from the literature of the language, it is evident that, in so far as the lexicographer is required to furnish evidence for an historical inference, a quotation is the best form in which he can give it. In fact, extracts, properly selected and grouped, are generally sufficient to show the entire mean- ing and biography of a word without the aid of elaborate definitions. The latter simply save the reader the trouble of drawing the proper conclusions for himself. A further rule of the new lexicography, accordingly, is that quota- tions should be used, primarily, as historical evidence, and that the history of words and meanings should be exhibited by means of them. The earliest instance of use that can be found, and (if the word or sense is obsolete) the latest,- are as a rule to be given ; while in the case of an important

word or sense, instances taken from successive periods of its currency also should be cited. Moreover, a quotation which contains an important bit of historical evidence must- be used, whether its source is ” good,” from the literary point of view, or not — whether it is a classic of the languageorfrom a daily newspaper; though where choice is possible, preference should, of course, be given to quotation s extracted from the works of the best writers. This rule does not do away with the illustrative use of quotations, which is still recognized as highly important, but it sub- ordinates it to their historical use. It is necessary to add that it implies that the extracts must be given exactly and in the original spelling and capitalization, accurately dated, and furnished with a precise reference to author, book, volume, page, and edition; for insistence upon these requirements — which are obviously important, whatever the use of the quotation may be — is one of the most note- worthy of modern innovations. Johnson usually gave simply the author’s name, and often

quoted from memory and inaccurately ; and many of his successors to this day have followed — altogether or to some extent — his example.

The chief difficulty in the way of this use of quotations — after the difficulty of collection — is that of finding space for them in a dictionary of reasonable size. Preference must be given to those which are essential, the number of those which are cited merely on methodical grounds being made as small as possible. It is hardly necessary to add that the negative evidence furnished by quotations is generally of little value ; one can seldom, that is, be certain that the lexicographer has actually found the earliest or the latest use, or that the word or sense has not been current during some intermediate period from which he has no quotations.

Lastly, a much more important place in the scheme of the ideal dictionary is now assigned to the etymology of words. This may be attributed, in part, to the recent rapid development of etymology as a science, and to the greater abundance of trustworthy data ; but it is chiefly due to the fact that from the historical point of view the connexion between that section of the biography of a word which lies within the language — subsequent, that is, to the time when the language may, for lexicographical purposes, be assumed to have begun, or to the time when the word was adopted or invented — and its antecedent history has become more vital and interesting. Etymology, in other words, is essentially the history of the form of a word up to the time when it became a part of the language, and is, in a measure, an extension of the history of the development of the word in the language. Moreover, it is the only means by which the exact relations of allied words can be ascertained, and the separation of words of the same form but of diverse origin (homonyms) can be effected, and is thus, for the dictionary, the foundation of all family history and correct genealogy. In fact, the attention that has been paid to these two points in the best recent lexicography is one of its distinguishing and most important characteristics. Related to the etymology of words are the changes in their form which may have occurred while they have been in use as parts of the lan- guage— modifications of their pronunciation, corruptions by popular etymology or false associations, and the like. The facts with regard to these things which the wide research necessitated by

the historical method furnishes abundantly to the modern lexicographer are often among the most novel and interesting of his acquisitions.

It should be added that even approximate conformity to the theoretical requirements of modern lexicography as above outlined is possible only under conditions similar to those under which the Oxford English Dictionary was under- taken (see below). The labour demanded is too vast, and

the necessary bulk of the dictionary too great. When, however, a language is recorded in one such dictionary, those of smaller size and more modest pretensions can rest upon it as an authority and conform to it as a model so far as their special limitations permit.

The ideal thus developed is primarily that of the general dictionary of the purely philological type, but it applies also to the encyclopaedic dictionary. In so far as the latter is strictly lexicographic — deals with words as words, and not with the things they denote — it should be made after the model of the former, and is defective to the extent in which it deviates from it. The addition of encyclopaedic matter to the philological in no way affects the general principles involved. It may, however, for practical reasons, modify their application in various ways. For example, the number of obsolete and dialectal words included may be much diminished and the number of scientific terms (for instance, New-Latin botanical and zoological hames) be increased ; and the relative amount of space devoted to etymologies and quotations may be lessened. In general, since books of this kind are designed to serve more or less as works of general reference, the making of them must be governed by considerations of practical utility which the compilers of a purely philo- logical dictionary are not obliged to regard. The ency- clopaedic type itself, although it has often been criticized as hybrid — as a mixture of two things which should be kept distinct — is entirely defensible. Between the diction- ary and the encyclopaedia the dividing-line cannot sharply be drawn. There are words the meaning of which cannot be explained fully without some description of things, and, on the other hand, the description of things and processes often involves the definition of names. To the combination of the two objection cannot justly be made, so long as

it is effected in a way — with a selection of material — that leaves the dictionary essentially a dictionary and not an encyclopaedia. Moreover, the large vocabulary of the general dictionary makes it possible to present certain kinds of encyclopaedic matter with a degree of fulness and a convenience of arrange- ment which are possible in no single work of any other class. In fact, it may be said that if the encyclopaedic dictionary did not exist it would have to be invented ; that its justification is its indispensableness. Not the least of its advantages is that it makes legitimate the use of diagrams and pictorial illustrations, which, if properly selected and executed, are often valuable aids to definition.

On its practical side the advance in lexicography has consisted in the elaboration of methods long in use rather than in the invention of new ones. The only way to collect the data upon which the vocabulary, the defini- tions, and the history are to be based is, of course, to search for them in the written monuments of the language, as all lexicographers who have not merely bor- p ~~,, i rowed from their predecessors have done. But methods of the wider scope and special aims of the new modem lexicography demand that the investigation shall '^""“'Z~~ be vastly more comprehensive, systematic, and precise. It is necessary, in brief, that, as far as may be possible, the literature (of all kinds) of every period of the language shall beexaminedsystematically, in order that all the words, and senses and forms of words, which have existed during any period may be found, and that enough excerpts (carefully verified, credited, and dated) to cover all the essential facts shall be made. The books, pamphlets, journals, newspapers, and so on which must thus be searched will be numbered by thousands, and the quotar tions selected may (as in the case of the Oxford Dictionary) be counted by millions. This task is beyond the powers of any one man, even though he be a Johnson, or a Littre,

or a Grimm, and it is now assigned to a corps of readers whose number is limited only by the ability of the editor to obtain such assistance. The modern method of editing the material thus accumulated — the actual work of

com- pilation—also is characterized by the application of the principle of the division of labour. Johnson boasted that his dictionary was written with but little assistance from the learned, and the same was in large measure true of that of Littr. Such attempts on the part of one man to write practically the whole of a general dictionary are no longer possible, not merely because of the vast labour and philological research necessitated by modern aims, but more especially because the immense development of the vocabulary of the special sciences renders indispens- able the assistance, in the work of definition, of persons who are expert in those sciences. The tendency, accord- ingly, has been to enlarge greatly the editorial staff of the dictionary, scores of sub-editors and contributors being now employed where a dozen or fewer were formerly deemed sufiicient. In other words, the making of a " complete " dictionary has become a co-operative enter- prise, to the success of which workers in all the fields of literature and science contribute.

The most complete exemplification of these principles and methods is the Oxford English Dictionary. It origi- nated in the suggestion of Trench that an attempt should be made, under the direction of the Philological Society, to complete the vocabulary of existing diction- aries and to supply the historical information which they lacked. The suggestion was adopted, considerable material was collected, and Mr Herbert Coleridge was appointed general editor. He died in 1861, and was suc- ceeded by Mr F. J. Furnivall. Little, however, was done, beyond the collection of quotations — about two millions of which were gathered — until in 1878 the expense of printing and publishing the proposed dictionary was assumed by the Delegates of the Clarendon Press, and the editorship was entrusted to Dr J. A. H. Murray. From that time the work has been carried on with vigour and increasing rapidity, and it will probably be completed about 1912. As the historical point of beginning, the middle of the 12th century was selected, all words that were obsolete at that date being excluded, though the his- tory of words that were current both before and after that date is given in its entirety ; and it was decided that the search for quotations — which, according to the origi- nal design, was to cover the entire literature down to the beginning of the 16th century and as much of the sub- sequent literature (especially the works of the more im- portant writers and works on special subjects) as might be possible — should be made more thorough. More than 800 readers, in all

parts of the world, offered their aid ; and when the preface to the first volume appeared in 1888, the editor was able to announce that the readers had increased to 1300, and that-three and one-half millions of quotations, taken from the writings of more than five thousand authors, had been a;massed : numbers which must now be very greatly enlarged. The first part was issued in 1884, and up to April 1901 somewhat less, probably, than one-half of the work had appeared (to the word Lap, with the exception of the letter K; in five volumes and the first part of the sixth). The number of "main words," " subordinate words," and " special combinations " (the last term including a very large number of ordinary com- pounds, loose compounds, and phrases) defined in these published portions is given as 148,413, a figure which indi- cates a total for the whole dictionary of considerably more than 300,000. When this is compared with the 40,000 words (about) registered by Johnson, the progress made in the direction of completeness will be evident. Completeness, however, is less important than quality of

work, and for this the dictionary is equally notable. The historical method of exposition, particularly by quo- tations, is applied, if not in all cases with entire success, yet, on the whole, with a regularity and a precision which leave little to be desired. A minor fault is that excerpts from second or third rate authors have occasionally been used where better ones from writers of the first class either must have been at hand or could have been found. As was said above, the literary quality of the quotation is highly important even in historical lexicography, and should not be neglected unnecessarily. Other, special features of the book are the completeness with which variations of pronunciation and orthography (with dates) are given ; the fulness and scientific excellence of the etymologies, which abound in new information and cor- rections of old errors ; the phonetic precision with which the present (British) pronunciation is indicated; and the elaborate subdivision of meanings. The definitions as a whole are marked by a high degree of accuracy. Work of such magnitude and quality is possible, prac- tically, only when the editor of the dictionary can com- mand not merely the aid of a very large number of scholars and men of science, but their gratuitous aid. In this the Oxford Dictionary has been singularly fortu- nate. The conditions under which it originated, and its aim, have interested scholars everywhere, and led them to contribute to

the perfecting of it their knowledge and time. The long list of names of such helpers in Dr Murray's preface is in curious contrast with their absence from Dr Johnson's and the few which are given in that of Littre. Of the dictionary as a whole it may be said that it is one of the greatest achievements, whether in literature or science, of the Victorian Age.

The Oxford Dictionary furnishes for the first time data from which the extent of the English word-store at any given period, and the direction and rapidity of Its growth, can fairly be estimated. Por this purpose the materials furnished by the older dictionaries are quite insufficient, on account of their incomplete- ness and unhistorical character. For example, one hundred pages of the Oxford Dictionary (from the letter H) contain 1002 words, of which, as the dated quotations show, 685 were current in 1750 (though some, of course, were very rare, some dialectal, and so on), 191 were obsolete at that date, and 226 have since come into use. But of the more than 700 words — current or obsolete-=-which Johnson might thus have recorded, he actually did record only about 300. Later dictionaries give more of them, but they in no way show their status at the date in question. It Is worth noting that the figures given seem to indicate that not very many more words have been added to the vocabulary of the language during the past one hundred and fifty years than had been lost by 1750. The pages selected, however, contain comparatively few recent scientific terms. A broader comparison would probably show that the gain has been more than twice as great as the loss.

In the Deutsches Worterbuch of Jacob and Wilhelm Grimm the scientific spirit, as was said above, first found expression in general lexicography. The desirability of a complete inventory and investigation of German words was recognized by Leibnitz and by various 18th-cen- tury scholars, but the plan and methods of the Grimms were the direct product of the then new scientific philology. Their design, in brief, was to give an exhaustive account of the words of the literary language (New High German) from about the end of the 15th century, including their earlier etymological and later history, with references to important dialectal words and forms ; and to illustrate their use and history abundantly by quotations. The first volume appeared in 1854. At the present time seven others have been completed, and one has nearly been finished, while parts

of the remaining three (there are to be twelve in all) have been issued. Jacob Grimm (died 1863) edited the first, second (with his brother, who died in 1869), third, and a part of the fourth volumes ; the others have been edited by various distinguished scholars. The scope and methods of this dictionary have been

broadened somewhat as the work has advanced. In general it may be said that it differs from the Oxford Dictionary chiefly in its omission of pronunciations and other pedagogic matter ; its irregular treatment of dates ; its much less systematic and less lucid statement of ety- mologies; its less systematic and less fruitful use of quotations ; and its less convenient and less intelligible arrangement of material and typography.

These general principles lie also at the foundation of the scholarly Dictionnaire de la langue frangaise of E. Littre, though they are there carried out less systematically and less completely. In the arrangement of the defini- tions the first place is given to the most primitive mean- ing of the word instead of to the most common one, as in the dictionary of the Academy ; but the other meanings follow in an order that is often logical rather than his- torical. Quotations also are frequently used merely as literary illustrations, or are entirely omitted ; in the special paragraphs on the history of words before the 16th century, however, they are put to a strictly historical use. This dictionary — perhaps the greatest ever compUed by one man — ^was published 1863-72. (Supplement,

1878.)

The Thesaurus Linguae Latinae, prepared under the auspices of the German Academies of Berlin, Gottingen, Leipzig, Munich, and Vienna, is a notable application of the principles and practical co-operative method of modern lexicography to the classical tongues. The plan of the work is to collect quotations which shall register, with its full context, every word

(except the most famUiar particles) in the text of each Latin author down to the middle of the 2nd century a.d., and to extract all important passages from all writers of the following centuries down to the 7th; and upon these materials to found a com- plete historical dictionary of the Latin language. The work of collecting quotations was begun in 1894, and the first part of the first volume has been published.

In the making of all of these great dictionaries (except, of course, the last) the needs of the general public as well as those of scholars have been kept in view. But the type to which the general dictionary designed for popular use has tended more and more to conform is the encyclo- pcedic. This combination of lexicon and encyclopaedia is exhibited in an extreme — and theoretically objectionable — form in the Gfrand dictionnaire universel du XIX' si&cle of Pierre Larousse. Besides common words and their definitions, it contains a great many proper names, with a correspondingly large number of biographical, geograph- ical, historical, and other articles, the connexion of which with the strictly lexicographical part is purely mechan- ical. Its utility, which — notwithstanding its many defects — is very great, makes it, however, a model which will be copied in the future. Fifteen volumes were pub- lished 1866-76, and a much improved new edition {Noy^ veau Larousse IllustrS) was being published during 1901-2.

The most notable work of this class, in English, is The Century Dictionary, edited by Professor W. D. Whitney, and published 1889-91 in six volumes, containing 7046 pages (large quarto). It conforms to the philological model in giving with great fulness the older as well as the present vocabulary of the language, and in the com- pleteness of its etymologies ; but it does not attempt to give the full history of every word within the language. Among its other more noteworthy characteristics are the inclusion of a great number of modern scientific and technical words, and the abundance of its quotations. The quotations are for the most part provided with refer- ences, but they are not dated. In the application of the encyclopaedic method this dictionary is conservative, ex- cluding, with a few exceptions, proper names, and re- stricting, for the most part, the encyclopaedic matter to

descriptive and other details which may legitimately be added to the definitions. Its pictorial illustrations are very numerous and well executed. In the manner of its compilation it is a good example of modern co-operative dictionary-making', being the joint product of a large number of specialists. Next to the Oxford Dictionary it is the most complete and scholarly of English lexicons.

Among the more important dictionaries of European lan- guages that have appeared since the list given in the 9th ed. of the Ency. Brit. vol. vii. (pp. 183-193) was written are the following :—

Annandalb. The Imperial Dictionary of the English Language, by John Ogilvie, LL.D. ; new edition by Charles Annandale, M.A., London, 1882 ; 4 volumes. An encyclopaedic dictionary, which served in a manner as the foundation of the Century Dictionary. — Stormonth and W. Batne. A Dictionary of the English Language. 1885.— Mueeay and Bradley. TTie Oxford English Dictionary : A New English Dictionary on Historical Principles ; founded mainly on the materials collected by the Philological Society. Oxford, 1888 [1884].— Whitney. 7%e Century Dic- tionary: An Encyclopedic Lexicon of the English Language. New York, 1889-91. See above. — Porter. Webster^s Inter- national Dictionary of the English Language. Springfield, Mass., 1890.— Funk. A Standard Dictionary of the English Language. New York, 1894.— Hunter. The Encyclopedic Dictionary. Lon- don and New York, 1879-88. — Fennell. The /Stanford Diction- ary of Anglicized Words and Phrases. Cambridge, 1892.— Tol- ler. An Anglo-Saxon Dictionary based on Manuscript Collec- tions of the late Joseph Bosworth, D.D. Oxford, 1882-98.— Skeat. An Etymological Dictionary of the English Language. Oxford, 1881. — Weight. The English Dialect Dictionary. Lon- don. Vol. 1, A-C, 1898 ; vol. 2, D-G, 1900.— Bradley. A Mid- dle-English Dictionary by Francis Henry Stratman; a new edition by Henry Bradley. Oxford, 1891. — Matzner and Bieling, Altenglische Sprachpj-oben, nebst einem Worterbuch. Berlin, 1878 — . This dictionary had been advanced as far as Misteleven in 1900. — Bescherblle. Nouveau dictionnaire national, ou dic- tionnaire universel de la langue frangaise. Paris, 1887. — Gode- FKOY. Dictionnaire de Vancienne langue frangaise et de tous ses dialectes du /X« au XV' siecle. Paris, 1881-95 ; Complement, 1895 — . — Hatzfbld,

Darmesteter, and Thomas. Dictionnaire general de la langue frangaise. Paris, 1890-1900. — Larive et Flehry. Dictiortnaire frangais illustri des mots et des choses. Paris, 1884-91. — Pbteocchi. Novo dizionario universale della lingua italiana. Milan, 1884-91. — Ccerto. Diccionario de con- struccion y regimen de la lengua castellana. A-B (1886) : C-D (1894). — MoNLAu. Diccionario etimol6gico de la lengua castel- lana. Madrid, 1881. — Zerola, Toko y Gomes, and Isaza. Dic- cionario enciclopedico da la lengua castellana. Paris, 1895. — Ser- rano. Diccionario universal de la lengua castellana, ciencias, y artes: enciclopedia de los conocimientos humanos. Madrid, 1876-81. — Barcia. Primer diccionario general etimolSgico de la lengua espanola. Madrid, 1881-83. — Sanders. Erganzungs- Worterbuch der deutschen Sprache. Berlin, 1885. — Kluge. Ety- mologisches Worterbuch der deutschen Sprache. Strassburg, 1883. — Heynb. Deutsches Worterbuch. Leipzig, 1890-95. — Diefen- BACH and WtTLCHER. Hoch-und niederdeutsches Worterbuch der mittleren und neueren Zeit. In Ergdnzung der vorhandenen Wor- terbucher, insbesondere das der Bruder Gfrimm. Basel, 1885. — Weigand. Deutsches Worterbuch. Giessen, 1878. — Schade. Altdeutsches Worterbuch. Halle, 1872-82. — Kalkak. Ordbog til det mldre Danske Sprog. Copenhagen. (Incomplete.) — Dale. Croot Woordenboek der Nederlandsche taal. s'Gravenhage, 1898 (4th ed.). — Vries and Winkel. Woordenboek der Nederlandsche taal. s'Gravenhage, 1882 — . — Verwijs and "Veedam. Middel- nederlandsch Woordenboek. s'Gravenhage, 1885-99 (A-N). — Franck. Etymologische Woordenboek der Nederlandsche taal. 1884-92. — Evans. Dictionary of the Welsh Language. Carmar- then, 1887. (Incomplete.) — Clbasby-Vigflsson. An Icelandic- English Dictionary based on the MS. Collections of the late Eichard Cleasby, enlarged and completed by Gudbrand Vigfusson, M.A. Oxford, 1874. — Miklosich. Etymologisches Worterbuch der Slavischen Sprachen. Wien, 1886. — Balg. A Comparative Glos- sary of the Gothic Language. Mayville, Wisconsin, 1887-89. — Thesaurus Linguae Latinae. Leipzig, 1900. (b. e. S.)

Didon, Henri (1840-1900), French Dominican priest, was born at Touvet, Isere, on 17th March 1840. In his early life he was brought into relations with Lacordaire. In consequence, probably, of this he became a Dominican monk in 1862. He completed his theological studies at the

Minerva Convent at Rome, and became a great admirer of the theology of Aquinas. The influence of Lacordaire was further shown in the zeal displayed by the young

preacher in favour of a reconciliation between philosophy and science. In 1871 his fame had so much grown that he was chosen to deliver the funeral oration over the murdered archbishop of Paris, Monseigneur Darboy. After this he delivered some discourses at the Church of St Jean de Beauvais in Paris on the relations between science and religion ; but his utterances, especially on the question of divorce, were deemed suspicious by those in authority, and his intimacy with Claude Bernard the physiologist was disapproved. He was interdicted from preaching and sent into retirement at the Convent of Corbara in Corsica. After eighteen months he emerged, and travelled in Germany, publishing an interesting work upon that country, entitled Les Allemands, on his return to Prance. In 1890 he produced his best-known work, a Life of Jesus (Jisus-OIirist) , for which he had qualified himself by travel in the Holy Land. In the same year he became director of the College Albert-le-Grand (Albertus Magnus) at Arcueil, and himself founded three auxiliary institu- tions, Ecole Lacordaire, !ficole Laplace, and iScole St Dominique. He wrote, in addition, several works on educational questions, and augmented his fame as an eloquent preacher by discourses preached duriug Lent and Advent. He died in 1900. (j. j. l.)*

Diedenhofen (in French, Thionville), a fortified town of Germany, in Alsace-Lorraine, dist. Lorraine, on the Moselle, 22 miles north from Metz by rail, a railway junction of some consequence, with cultivation of wine, fruit, and vegetables, brewing, tanning, &c. It is an an- cient Frank town (TheudoneviUa, Totonisvilla), in which imperial diets were held in the 8th century ; was captured by Cond^ in 1643 and fortified by Vauban; capitulated to the Prussians in 1870. Population (1885), 8111 ; (1900),

10,062.

Dieppe, chief town of arrondissement, departmentof Seine Inf^rieure, France, 36 miles north of Eouen, with terminal station on railway from Paris. The Palais de Justice is a recent erection. Lace, woollen goods, and ceramic wares are now important manufactures. The ivory carving has greatly declined in recent years, and instead of 300 in 1866 only about 40 workmen were employed in it in 1898. Efforts are being made, however, to give a fresh impetus to this industry. In 1900, 1894 vessels of 497,446 tons entered and cleared, of which Great Britain's share was 340,082 tons. Imports were valued (1899) at £5,248,000; exports at £6,732,000. The principal imports were textiles (chiefly silk), forming 60 per cent. The principal exports were textiles (silk, cotton, and woollen), amounting to 40 per cent., and hides and skins. During the summer months large quantities of fruit are sent to England. The total port traffic on the Canal de Bourgoyne amounted to 94,774 tons in 1899. The number of vessels engaged in the fisheries in 1898 was 95, with 471 men. A school of fisheries, similar to that which has already rendered good service at Sables d'Olonne, has been established at Dieppe. A new harbour railway station and a landing stage were opened in 1900, and an esplanade f mile in length is in course of construc- tion. The passenger traffic with England was represented in 1900 by 130,985 arrivals from and 139,143 departures to that country. The harbour, to which an improved approach is projected, comprises an outer and an inner port, with a total length of quayage 3772 feet. Depth at high tide in the outer port (ordinary spring) varies in different parts from 29 to 36 feet. There are four floating docks and a dry dock. The entrance channel, cut in the bed of the Arques, is 1950 feet long and 246 feet wide. Population (1881), 20,408; (1901), 21,798.

Dietetics. — The term dietetics is frequently applied to the science of the food and nutrition of man in health and disease. This article deals mainly with that part of the subject which has to do with the composition and nutritive values of foods and their adaptation to the use of people in health. The principal topics are : — 1. Food and its functions. 2. Metabolism of matter and energy. 3. Digestibility and availability of food materials. 4. Fuel-value of food. 5. Composition of food materials. 6. Food consumption — studies of dietaries. 7. Hygienic econ- omy of food. 8. Quantities of nutrients needed. 9. Pecuniary economy of food.

1. Food and its Functions. — Food is that which, taken into the body, builds tissue or yields energy. More specific- ally, food supplies the wants of the body in several ways : — (1) it forms the tissues and fluids of the body; (2) it re- pairs the waste of tissues ; (3) it is stored in the body for future consumption; (4) it is consumed as fuel, its po- tential energy being transformed into heat or muscular energy or other forms of energy required by the body ; and (5) in being consumed, it protects tissue or other food from consumption. The most healthful food is that which is best fitted to the needs of the user. To be adapted to his needs, the food must supply the different nutritive ingre- dients, or nutrients, in the kinds and proportions required by the body for building and repair and for supplying energy. It should also be in forms which the person can easily digest and which will " agree " with him. The cheap- est food is that which furnishes the most nutriment at the least cost. The most economical food is that which is most healthful and cheapest. Ordinary food materials, such as meat, fish, eggs, potatoes, wheat, &c., consist of — refuse, e.g., the bones of meat and fish, shells of shell- fish, skin of potatoes, bran of wheat, &c. ; edible portion, e.g., the flesh of meat and fish, the white and yolk of eggs, wheat flour, &c. The edible portion consists of water and nutritive iugredients or nutrients.

The principal kinds of nutritive ingredients axe protein, fats, carbohydrates, and mineral matters. The water, refuse (and salt of salted meat and fish), are here regarded as non-nutrients and, in comparing the values of different food materials for nourishment, are left out of account. The following are familiar examples of compounds of each of the four principal classes of nutrients : —

*Protein. — The term protein is here used to include the nitrogenous nutrients of foods except the nitrogenous fat, namely, the proteids, e.g., albumen (white of egg), casein (curd) of milk, myosin of muscle (lean meat), gluten of wheat, &c. ; and the non-proteids, including the so-called extractives (e.g'., creatin) of meats and the amides (e.g., as- paragin), and allied compounds of vegetables and fruits.^*

Fats. — ^Fat of meat ; fat (butter) of milk, olive oil, oil of corn, wheat, &c. (Here are included the nitrogenized fats, as lecithin.)

Carbohydrates. — Sugars, starches, cellulose (woody fibre), &c.

Mineral Matters. — Phosphates, sulphates, and chlorides of potassium, sodium, calcium, &c.

Protein forms tissue (muscle, tendon, &c.) and fat, and serves as fuel. Fats form fatty tissue (not muscle, &c.) and serve as fuel. Carbohydrates are transformed into fat and serve as fuel. All these nutrients yield energy in the form of heat and muscular power. In being themselves burned to yield energy, the nutrients protect each other from being consumed. The protein and fats of body tissue

1 UDfortunately the terms applied by different writers to these nitrogenous compounds are very conflicting. In accordance with a common usage, preference is here given to the word protein to cover all the nitrogenous compounds except the nitrogenous fats, though the word proteid is sometimes used in this signification.

are used like those of food. An important use of the carbohydrates and fats is to protect body tissue (muscle, &c.) from consumption. What compounds are especially concerned in the production of intellectual or nervous energy is not known. The idea that fish is especially rich in phosphorus and valuable as brain food has no foundation in observed fact.

Heat and muscular work represent forms of energy. The energy is developed as the food is consumed in the body, and is measured in the laboratory by means of an apparatus called the calorimeter. The unit commonly used is the calorie, the amount of heat which would raise the temperature of a kilogram of water 1 degree centigrade, or approximately 1 pound of water 4 degrees Fahrenheit. By heat of combustion is meant the amount of heat which a given substance yields upon combustion with oxygen out- side the body. Thus a gram of cane-sugar yields 3‘96 calories, and a gram of proteid, in the form of white of egg, 5‘69 calories. By fuel-

value is here meant the total energy which a given substance can yield the body ; in other words, it is the heat of combustion of that part of the food which is capable of oxidation within the body.

2. Metabolism of Matter and Energy. — In so far as its material phenomena are concerned,lifeconsistsof transfor- mations of matter and energy, to which the term metabolism is applied. The processes of metabolism are thus of two definite and closely alliedkinds — the metabolism of matter, in which the changes are chemical, and that of energy, in which the changes are physical. To say that the chemical transformations in the body obey the law of the conserva tion of matter is simply to say that the body can neither create nor destroy matter — a principle long since demon- strated and universally accepted. It would seem that the metabolism of energy must in like manner obey the law of the conservation of energy, but owing to the great experi- mental difiiculties the actual demonstration of this principle has been long delayed. For this demonstration it is necessary to prove that the income and expenditure of energy are equal. The body receives energy in the com- pounds of the food and drink. In the processes of nutrition the potential energy of these compounds is metabolized, and appears as kinetic energy in the heat given off from the body, and in the external muscular work performed, although a small amount remains unchanged, mostly in theunoxidized materials excreted by the kidneys, intestines, and otherwise. The minute quantities given off as electricity or light by some animals are here neglected. The apparatus andmethods of experimentinglately devised make it possible to measure the energy of income in food and drink on the one hand, and that of expenditure in body heat, external work, and unoxidized excretory products on the other. The potential energy of income and expendi- ture is measured by the heat of combustion of food and excretory products as determined by burning with oxygen in the bomb calorimeter. The kinetic energy, which is f oiind only in the expenditure, is measured by the respira- tion calorimeter — an apparatus in which the subject of the experiment (a man, for instance) remains for a number of days and nights under conditions which permit of comparison between the matter and energy taken in and given off. This involves weighings, measure- ments, and analyses of the food and drink, and of respiratory and other excretory products, and measure- ments of the heat given off by the body, and of the external mechanical work,

allowance being made for the energy of the body material gaiued or lost during the experiment.

Partial measurements of income and expenditure of energy were published by Rubner i in 1894. The experiments were made with

1 Ztschr. Biol. 30, 73.

dogs without external muscular work. The income of energy was computed from the excretory products, while the outgoings in the form of heat (since no external muscular work was done) were measured directly. In the average of 8 experiments, which continued during 45 days, the two quantities agreed within 0-47 per cent., thus demonstrating, what the author desired to prove, that the heat given off from the body came solely from the oxidation of food within it. Results in accord with these were reported by Studenski ^ and by Laulanie in 1898. ^ Results of experiments with men have been lately published by Atwater, Rosa, and Benedict and associates, who used a respiration calorimeter as above men- tioned, and made detailed analyses and determinations of heats of combustion of food, drink, and excretory products, and measure- ments of heat given off by the body and the heat equivalent of the external muscular work done. In all, 30 experiments had been reported by November 1901, occupying from 2 to 4 days each, or a total of 93 days of experimenting. In some of these experiments the subject was at rest ; in others he rode a stationary bicycle belted to a dynamo, so that the gxtemal muscular work was used to generate an electric current which was measured and afterwards transformed into heat within the calorimeter by passage through a resistance, the heat being measured with that given off by the body. The diet was generally not far from sufiBcient to maintain nitrogen and carbon equilibrium. In these experiments the energy actually measured, in the form of heat given off from the body and that from the external muscular work done in work experiments, accord on the average very closely with the estimated potential energy of the material oxidized in the body. It is to be observed, however, that the variations for individual days, and in the averages for the indi- vidual experiments as well, were considerable, sometimes amounting to 6 per cent., or even more. This is perhaps not strange in view of the*

physiological conditions of the experiments. In the average of all the experiments the measured energy of expenditure was 99-8 per cent, of the estimated energy of income ; in other words, they agreed within two parts in one thousand. While these results do not absolutely prove the application of the law of the conservation of energy in the human body, they certainly approximate very closely to such demonstration. It is,, of course, possible that energy may have been given off from the body In other forms than heat and external muscular work. Thus it is conceivable that in- tellectual activity may involve a transformation of physical energy, and that this energy may be eliminated in some form now unknown. But if the body did give off energy which was not measured in these experiments, the quantity must have been ex- tremely small. It seems fair to infer from these results that the metabolism of energy in the body occurred in conformity with the law of the conservation of energy.

3. Digestibility and Availability of Food. — The value of a food for nutriment depends not only upon the kinds and amounts of nutrients which it contains, but also upon the proportions of these nutrients which the body can digest and make available, and upon the ease and convenience with which the materials are utilized. By digestion in the narrower sense is understood the changes, chiefly chemical, but partly physical, which the food undergoes in the alimentary canal in order to prepare it for absorption. By digestibility of food, as the term is popularly understood, several things are, or may be, meant. Some of these (as the ease with which a given food material is digested, the time required for the process, the influence of different methods of preparation, including cooking, and the influence of condiments) are so difficult of measurement, and others (as bodily conditions, and the question as to whether a given food agrees or disagrees with a given person) are so dependent upon the peculiarities of different individuals, as to make it impossible to lay down hard and fast rules. The term digestibility is also applied to the proportion of the several kinds of nutrients which the body can digest from different kinds of food materials. These proportions are best found by actual experiment in which

2 In Russian. Cited in Bulletin No. 45 of the Office of Experiment Stations, U.S. Department of Agriculture : " A Digest of Metabolism

Experiments," by W.O. Atwater and C. F. Langworthy.

8 Archiv. de biol. norm, et path., 1898, 4.

- *Office of Experiment Stations) U.S. Department of Agriculture, Bulletin No. 63, " Description of a New Respiration Calorimeter," by W. O. Atwater and E. B. Rosa; and Bulletin No. 69, " Experiments on the Metabolism of Matter and Energy in the Human Bodv " bv W. O. Atwater and E.G. Benedict.*

people of different classes eat known amounts of different food materials, and the amounts iligested are determined by weighings and analyses of the food and excreta. Suppose the diet to consist of bread and milk. The larger part of the nutrients will be digested, absorbed, taken into the circulation, and utilized, A small pro- portion, however, will pass through the intestines un- digested, and along with this undigested residue there will also be excreted a certain amount of residuum, mainly from the digestive juices. That is to say, these two forms of residues, the undigested portions of the food and the meta- bolic products, are not oxidized, but are excreted together. To find what proportion of the diet is actually available to the body for the two great purposes of building of tissue and yielding of energy, we must take the total quantity of nutrients, and subtract the amounts given off unconsumed. Thus the handling of the bread and milk- within the body, and getting it into condition to be metabolized in the system, involves the rejection by the intestines of a certain amount of material unavailable for the general purposes of nutrition. This brings out the difference between digestibility and availability. The former ap- plies to the amounts actually digested in the alimentary canal, the latter to the amounts actually available for use. The difference is practically, the amount used to digest the food and make it available.

This subject is comparatively new, and although experimental inquiries have been actively pushed since 1880, and especially since 1890, the results are still insufficient for exact statements regard- ing the

availability of different kinds of food material. The following estimates! are based upon the results of nearly 300 experiments, made in Europe and in the United States, with per- sons, chiefly men, living upon different diets. The figures are subject to revision as data accumulate. While they are not to be taken as exact measures of the availability of every kind of food of each given class, they probably represent fairly well the average availability of these classes of food materials under ordinary circumstances.

Coefficients of Availability and Fuel- Value of Nutrients.

Coefficients of

Fuel- Value per gram

ATailabillty.

of Total Nutrients.

Kind of food.

■

n

a

il

5

iS

iS

*“^^*

fi

^*:s*

Per c.

Per 0.

Per c.

Cals.

Cals.

Cals.

Meats and fish

97

95

98

4-25

9-00

3-80

Eggs .

97

95

98

4-35

9-00

3-80

Dairy products

97

95

98

4-25

8-80

3-80

Anima . food (of

mixed diet)

97

95

98

4-25

8-95

3-80

Cereals .

85

90

98

3-70

8-35

4-10

Legumes (dried) .

78

90

97

3-20

8-35

4-05

Sugars .

—

—

98

—

—

3-85

Starches

—

—

98

—

—

4-10

Vegetables .

83

90

95

2-90

8-35

4-00

Fruits .

85

90

90

3-15

8-35

,3-60

Vegetable food (of

mixed diet)

85

90

97

3-55

8-35

4-00

Total food (of mixed

diet) .

92

95

97

4-00

8-90

4-00

4. Puel-Valite of Food. — The fuel-value of a particular food material depends on the proportions of available nutri- ents which can be oxidized in the body. It is commonly assumed that the available fats and carbohydrates are completely oxidized. Their fuel-value is the same as the heats of combustion of the available nutrients. The oxida- tion of the nitrogenous compounds, — proteids and non-pro- teids, — however, is not complete, considerable portions of

I Atwater and Bryant, Connecticut, Agricultural Experiment Station,

1899.

the nitrogen being excreted in the kidneys in urea, creatinin, and other organic compounds. In determining the quantities of energy derived from the oxidation of the nitrogenous material in the body, therefore, allowance must be made for the energy lost to the body in these latter compounds. It will be seen that the term fuel-value is here used to represent the potential energy of the material actually oxidized, or capable of being oxidized, in the body. It thus represents the actually available energy, and might be called the physical fuel-value in distinction from the physiological fuel-value, which de- pends upon the ways the energy, made kinetic, is used by the body. This distinction corresponds to the one above made between the amounts of available nutrients and the extent to which they are actually utilized by the body.

The estimates of Rubner ^ commonly quoted for the fuel- value of the nutrients of mixed diet are as follows : — protein, 4-1; fats, 9-3; and carbohydrates, 4-1 calories per gram. These factors were, however, originally, intended to represent the average heat of com- bustion of the different nutrients in the ordinary mixed diet, allow- ance being made for the energy lost in the incomplete oxidation of the nitrogenous compounds of the urine. Later estimates have been made by Atwater and associates,' using data much more extensive than were available to Rubner, and including results of a considerable amount of experimenting in the United States. The factors for the different nutrients represent in each case the amount of energy which the body is capable of obtaining from one gram of the particular nutrient as it exists in the food as eaten in ordinary mixed diet.

Estimates of Heats of Combustion and Fuel-Value of Nutrients in Ordinary Mixed Diet.

Nutrients.

Heat of Combustion.

Fuel-Value.

One gram of protein .

One gram of fats

One gram of carbohydrates

Calories.

5‘65 9-40 4-10

Calories.

4-0 8-9 4-0

Thus, averaging together the fats in ordinary mixed diet, one gram burned in the calorimeter would yield 9-40 calories of energy in the form of heat. , Of this gram 95 per cent, is reckoned as available for oxidation in the body, and the part so oxidized would yield energy, in the form of heat, muscular work, &c., equivalent to (9-40 X -95 =) 8-9 calories. In like manner the heat of combus- tion of average protein is estimated at 5-65 calories per gram. Of this, 92 per cent, is estimated as available, and its potential energy would be (5-75 x -92 =) 5-2 calories. But part of this escapes oxidation, and is excreted by the kidneys. Allowing 1-2 calories for the potential energy of this portion, that actually oxidized will yield (5-2 — 1-2=) 4-0 calories, which is taken as the fuel ~~value of the protein. Similarly, 97 per cent, of the total energy of carbo~~ hydrates is assumed to be available for use in the body. Nutrients of the same class, but from different food materials, vary both in availability and in heat of combustion, and hence in fuel-value. The above estimates seem to represent the best averages available (1900), but are subject to revision.

5. Composition of Food Materials. — Different food materials vary widely in their proportions of nutrients, water, and refuse. In general, the animal foods have the most protein and fats, while the vegetable foods are rich in the carbohydrates — starch and sugar. The chief nutrient of lean meats and fish is protein. Cheese has a large quantity of protein because it contains the most of the proteids of the milk. Among the vegetable foods, beans and peas have a high proportion of protein. The propor- tion in oatmeal is also large. In wheat it is moderate, and in maize meal and rice it is rather small. The materials with the highest fuel-value are those with

the most fat, because the fuel-value of the fat is, weight for weight, two and one-fourth times as great as that of either sugar, starch, or protein. Hence fat pork and butter lead the other materials in fuel-value. The fat meats in general

2 Ztschr. Biol., 21, 1885, p. 377.

stand high in this respect. So also do the grains, flour, and meal, as they have very little water and large quan-

Kind of Food Material.

rf a

Available

Nutrientfl.

Fuel-Value.

$

M

a

‘3

1

i

ll

i

Per

Per

JS

Pound

Kilo.

Per

Per

Per

Per

Per

Per

Calo-

Calo-

Beefi—

Leaner cuts*

Cent.

Cent.

Cent.

Cent

Cent.

Cent.

ries.

riea.

64-4

1-6

18-9

14-7

0-7

1010

2220

Medium fat cuts’

61-5

1-8

17-9

18-5

0-7

1155

2646

Fatter cuts*

86-4

2-0

16‘5

24-9

0-7

1400

3090

Kound

65-5

1-6

19-7

12-9

0-8

960

2090

Loin .

60-6

1-8

17-9

19-2

0-8

1185

2610

Side ....

59-T

1-8

17-6

20-9

0-7

1250

2760

Canned, corned

51-8

2-7

25-5

17-8

8-0

1275

2806

Dried, smoked .

64-8

3-5

29-1

6-2

68

850

1870

Veal-

Leff

70-0

1-3

196

8-6

0-9

760

1680

Loin .

69 0

1-3

19-8

10-8

0-8

830

1825

Side .

Tl-3

1-2

19-6

7-7

0-8

725

1595

Mutton —

Leg

62-8

1-7

17-9

17-1

0-8

1095

2410

Loin

50-2

2-4

15-6

81-4

0-6

1660

3665

Side .

58-6

2-2

16-7

28-3

0-6

1536

8880

Pork-

Loin .

52-0

2-2

16-1

28:6

0-8

1555

8425

Ham, smoked

40-3

8-8

15-8

86-9

3-4

1905

4200

Fat, salt .

7-9

5-4

1-8

81-9

2-9

3665

7860

Bacon .

18-8

4-8

9-6

64-0

8-8

2950

6500

Lard

4-8

4-8

2-1

89-3

0-1

3890

8675

Chicken

68-7

1-6

18-7

15-5

0-8

1040

2295

Turkey .

55-8

1-9

20-5

21-8

0-8

1860

2975

Bggs .

73-7

1-1

14-4

10-0

0-8

725

1600

Cod,» ft-esli

82-6

0-8

160

0-4

•. >

0-9

885

740

Cod, salt

58-5

6-8

20-9

0-8

18-5

430

950

Mackerel,^ fresh .

78-4

1-3

18-1

6-7

0-9

650

1480

Salmon, tinned .

63-5

1-9

2M

11-5

2-0

916

2020

Oysters .

88-8

0-6

5-8

1-2

3-3

0-8

225

500

Butter

11-0

4-8

1-0

80-8

0-2

3410

7515

Cheese .

34-2

8-4

25-1

82-0

2”4

2-9

1880

4146

Milk (whole)

87-0

0-5

3-2

8-8

5-0

0-5

810

665

Milk (skimmed) .

90-5

0-3

3-8

0-3

6-1

0-5

170

870

Maize (Indian corn)

meal

12-5

3-2

7-5

1-7

74-3

0-8

1685

8620

Oatmeal

7-8

4-9

18-2

6-5

65-9

1-4

1800

3970

Rice

12-8

2-9

6-5

0-3

77-7

0-3

1615

8660

Rye flour

12-9

8-0

5-8

0-8

77-5

0-5

1615

3570

Buckwheat flour

18-6

2-8

6-2

1-1

76-6

0-7

1650

3640

Graham flour

11-8

3-9

10-3

2-0

71-1

1-4

1650

8640

Entire wheat flour

11-4

3-8

10-7

1-7

71-6

0-S

1655

8660

Fine wheat flour

12-0

8-3

8-8

0-9

74-6

0-4

1685

8605

Wheat breakfast foods

9-6

3-7

9-4

1-6

74-8

1-0

1680

8706

Wheat bread, white

85-8

2-8

7-1

1-2

52-8

0-8

1200

2645

Rye bread .

85-7

2-8

7-0

0-5

52-9

1-1

1170

2686

Biscuit (crackers)

.6-8

4-3

8-3

7-9

71 -8

1-4

1766

8890

Sugar ....

98-0

1760

8870

Starch .

...

98-0

1860

4126

Beans, dried .

12-6

7-9

17-5

1-6

57-8

2-6

1495

8290

Beets' ....

87-5

11

1-2

0-1

9-3

0-8

200

446

Cabbage'

91-5

1-0

1-8

0-3

5-1

0-8

180

290

Squash ....

88-3

1-8

11

0-5

8-2

0-6

195

480

Potatoes

78-3

1-5

1-6

0-1

17-7

0-8

370

816

Sweet potatoes

69-0

2-2

1-8

0-6

26-1

0-8

545

1200

Tomatoes .

94-3

0-6

0-7

0-4

3-6

0-4

100

215

Apples’

84-6

1-6

0-8

0-5

12-8

0-2

260

670

Bananas

75-3

2-7

1-0

0-5

19-9

0-6

400

885

Grapes

77-4

2-4

1-0

1-4

17-4

0-4

890

865

Oranges

86-9

1-4

0-6

02

10-5

0-4

210

465

StrawborriesW

90-4

1-0

0-8

0-5

6-6

0-5

156

346

titles of carbohydrates. Potatoes are quite low in the list in respect to fuel-value as well as protein, principally because they are three-fourths water. For the same reason,

1 Meats, eggs, fish, and some vegetables and fruits contain more or less refuse in the form of bone, shell, skins, &c. Thus, on the average, the food materials enumerated above would contain about the following percentages of refuse : beef round 7, loin 13, side 17 ; veal leg 14 loin 17, side 23 ; mutton leg, loin, and side 16 to 19 ; pork loin 20 ■' ham 14; chicken 26; turkey 23; eggs 11; fresh cod (bone, skin, &c.) 53; salt cod 25 ; and fresh mackerel 45 per cent. The proportion of refuse in vegetables and fruit may vary from 10 to 50 per cent., according to the way they are prepared for the table.

2 Such as round, shoulder, rump, and shank. 8 Such as rib, loin, and chuck.

- *Such as brisket, plate, and flank.*

6 Typical of lean fish, such as haddock, bluefish, flounder, weakfish, bass, perch. 6 Typical of fat fish, such as salmon, halibut, shad, &c. '

Typical of roots, such as parsnips, carrots, &c.

8 Typical of leafy vegetables, such as cauliflower, lettuce, spinach, &c.

9 Typical of such fruits as the pear, peach, apricot, &c. 10 Typical of berries, such as raspberries, &c.

milk, which is seven-eighths water, ranks low in respect to both protein and fuel-value.

Like food materials differ considerably in percentage composition. This is especially true of meats. Thus the leaner portions of beef from a fat animal may be nearly as fat as the fatter portions from a lean animal. From the analyses now available it would appear that American meats, especially beef and pork, are generally fatter 'than those produced upon the continent of Europe. English meat products seem to resemble .Ajnerican rather than continental European products in respect to fatness, although the published analyses are insufficient for definite comparison.

The foregoing table shows the average percentage composition of some of the more common food materials. The analyses are mostly of American products, since there are but few available analyses of English food materials, and these probably differ but little from the average of similar materials produced in the United States. The comparatively few available analyses of meats produced on the continent of Europe imply that^ they contain, as a rule, considerably less fat and more water, and often more protein, than .American meats. The fuel- values per pound would consequently be smaller. The values for the leaner meats in the table would very likely represent more nearly the medium fat meats of the Continent, while values for medium fat meats in the table would probably represent fat meats of continental Europe. The figures for leaner parts of beef in the table are for such cuts or joints as the loin, shoulder, rump, and shank. The medium fat meats would include such portions as the rib, loin, and chuck, while the brisket, plate, and navel represent the fatter portions. The proportion of bone in meat as ordinarily purchased will vary from almost nothing in " shoulder clod " and " round " to as much

as 40 or 60 per cent, in the shank. The com- position of the materials in the table is shown for the edible portion free from refuse.

6. Food Consumption — Studies of Dietaries. — The actual food consumption of persons of different age, sex, and occupation is found by means of dietary studies. The general plan of such a study includes the determination of the amounts and composition of the food consumed by a given number of persons during a certain number of days, and the deduction of the quantities per person or per man per day. In dietary studies of families the number of meals for one man to which the total number of actual meals taken is equivalent is frequently estimated upon the basis of the potential energy of the relative amounts of food assumed to be eaten by men and women with different occupations, and by children of different ages, as compared with an adult man at moderately hard manual labour. These energy equivalents are somewhat arbitrary, and will require revision from time to time as data accumulate. Those used in the American dietary studies referred to below are" : A man at moderately active manual labour, 10 ; a man with sedentary occupation, or a woman with moderate work, or a boy between 14 and 16 years of age, 8 ; a girl between 14 and 16 years, 7 ; children between 10 and 13 years, 6 ; between 6 and 9 years, 5 ; between 2 and 5 years, 4 ; and under 2 years, 3. Until the last two decades comparatively few exact studies of actual food consumption of people of different age, sex, and occupation had been reported. More of these were from Germany than from any other country, although valuable work had been done in England, France, and elsewhere. Of late the activity of this kind of experimenting in Europe has increased, especially in Eussia, Italy, and Sweden. Outside of Europe there has

11 Later experience has led to slight changes in the estimates for boys and girls, making: boys at 12, 7; 13-14, 8; 15-16, 9; and girls at 13-14, 7; 15-16, 8. ^

been considerable investigation in some Asiatic countries, notably Japan, but the most active inquiry during the past few years has been in the United States.

Not all the studies of dietaries are made with sufB.cient completeness to furnish accurate data. Those which are being made at the present time are probably more trust- worthy than most of the older ones. The total number of studies of dietaries which have been reported is diflcult to determine. The number which are sufftciently accurate to be included in st^itistical averages may perhaps be roughly estimated at 700 to 800, of which over 300 have been made within the past ten years in the United States, and more are rapidly accumulating. The number of persons in the individual studies has varied from 1 to 100 or more. The data thus accumulated may be regarded as the beginning of the study of the comparative nutrition of mankind, but are not yet suflcient to warrant the definite generalizations which are to be desired. The figures of the following table will serve as illustrations : —

Quantities of Available Nutrients and Energy in Actual Daily Food Consumption of Persons in Different Circumstances.

{Quaniities per Man per Day unless oilierwiae stated.)

II

o .

B

%

<6

S3

»

1

fa

■3

s fa

QramB.

Onuna.

Gnuna.

Calories,

Persons wUli active work.

English Eoval Engineers

1

496

132

79

612

3835

Prussian maqliinists, Krupp gun

works

1

SOO

129

107

657

42KJ

American college athletes Swedish mechanics

9 5

100 5

157 174

205 105

468 693

4540 4695

American machinist's family, Boa-

ton, Mass

1

2

167

241

598

.5450

Bavarian lumbermen

8

8

120

277

702

6010

Persons with ordinary work.

Bavarian mechanics

11

112

82

553

3060

Kussian peasants ....

119

81

571

3155

Bavarian farm labourers .

“s

126

62

526

3200

Prussian prisoners ....

1

117

28

620

3320

Swedish mechanics ....

6

“e

128

75

507

3325

American mechanics’ families

14

74

95

143

390

8360

American farmers' lUmiliea .

10

66

89

124

453

3415

Professional men.

Japanese professional man . German physicians .

1

1

113

20

404

2340

2

2

120

91

317

2685

Swedish medical students

S

5

117

108

291

2725

Danish physician ....

1

1

124

183

242

2790

American professional men’s

families

14

68

96

119

410

3220

Japanese students ....

1

180

106

29

616

3266

American college students

16

874

96

141

445

3580

Persons with little or no exercise.

Men (German) iu respiration arppa-

ratua

6

2

115

78

261

2310

old men and women ^ in house ‘of

refuge

1

477

94

48

377

2410

Men (American) in respiration cal-

orimeter

11

8

98

75

319

2445

Prussian prisoners without work .

100

82

457

3025

Persons in destitute circumstances.

German factory girls 3 . . .

1

2

52

43

222

1600

German labourer’s family

1

3

48

SO

278

1635

Italian mechanics ....

6

5

70

36

884

2220

American day-labourers' families, Pittsburg, Pa. . . – .

2

17

74

90

299

2400

Prussian farm labourers

1

3

76

16

556

2765

Miscellaneous.

Inhabitants of Java village. World's

Fair, Chicago .... Bohemians in Chicago .

1 8

5 46

61 106

IS

96

246 849

1446 2800

Italians in Chicago ....

3

12

96

105

379

2960

Russian Jews in Chicago

10

51

128

93

405

3135

American Negroes .... Mexican families, New Mexico

89 4

114

IS

78 36

138 – 67

427 595

ml

German army ration, peace footing

105

37

466

2720

German army ration, war footing .

123

65

474

3000

German army ration, extraordinary war ration ....

...

144

271

321

4495

Italian army ration, peace footing .

...

105

13

574

2935

United States army ration, peace footing

110

188

440

.’!725

> Quantities per person per day.

7. Hygienic Economy of Food. — For people in good health and with good digestion there are two important rules to be observed in the regulation of the diet. The first is to choose the things which ” agree ” with them, and to avoid those which they cannot digest and assimilate without harm. The second is to use such kinds and amounts of food as will supply the nutrients the body needs, and at the same time to avoid burdening it with superfluous material, to be disposed of at the cost of health and strength. There are people who, because of some peculi- arity of the alimentary system, are debarred from using foods which for people in general are most wholesome and nutritious. Somepersonscannot endure eggs, others suffer if they take milk, others have to avoid certain kinds of meat, and others experience great discomfort if they eat frilits. But these cases are exceptions. In the processes of cleavage which the compounds of the food undergo in the body, substances are often formed which may be in one way or another injurious. In this sense it is literally true that “what is one man’s meat is another man’s poison.” But for the great majority of people in health proper combinations of the ordinary standard wholesome foods make a healthful diet. On the other hand, some foods have at times a great value over and above their use for nourishment. Pruits and garden vegetables often benefit people greatly, not as nutriment merely, for they may have very little of actual nutrients, but because of the vegetable acids or other substances which they contain, and which_ sometimes serve a most useful purpose.

8. Quantities of Nutrients Needed. — Various standards have been proposed by physiological chemists to represent the amounts of nutrients

needed by people of different age, sex, and occupation for daily sustenance. The problem is this. How much protein, fats, and carbohydrates, or, more simply, what amounts of protein and energy, are required, under varying circumstances, to build and repair muscular and other nitrogenous materials, tissues, &c., and to supply the demand for internal and external muscular work, heat, or other forms of kinetic energy ? Unfortunately, experi- mental data are still insufficient for entirely trustworthy averages. Two classes of data are employed for the estimates — dietary studies with considerable numbers of people, and metabolism experiments with individuals in which the income and expenditure of the body are studied by quantitative methods. The standards herewith are not to be considered as exact and final, but merely as tentative estimates of the amounts of nutrients and energy required. As the chief function of the fats and carbo- hydrates is to serve as fuel, their exact proportion in the diet is of less account than their total fuel-value. In the standards proposed by the present writer, therefore, no proportions of fats and carbohydrates are indicated, the

Standards for Dietaries. Available Nutrients and Energy.

Protein.

Fal.

Carbo- hydrates.

ruel- Value.

Man at hard work (Voit) ....

Man at moderate work (Voit)

Man with very hard muscular work (At- water) ».

Man witji hard muscular work (Atwater) .

Man with moderately active muscular woft: (Atwater)

Man with light muscular work (Atwater) .

Man at ” sedentary ” or woman with moder- ately active work (Atwater)

Woman with light muscular work or man without muscular exercise (Atwater)

GraiDs.s

133 109

161 138

115 103

92

83

Grams.

95 58-

3 3

S

3

S

8

Grams.

437 435

3

S

3 3

3

3

Calories.

8270 2966

5500 4150

8400 3050

2700

2450

‘ One ounce equals 28‘55 grams.

‘ Fats and carbohydrates sufficient, with the protein, to furnish the requh-ed energy.

U8 DIE Z— D IFFEEENTIAL EQUATIONS

requirement being that the amounts of the two shall suflB.ce, with the protein, to bring up the fuel-value of the food to the indicated amount. It is specially to be noted that the amounts are in terms of available rather than total nutrients and energy.

9. Pecuniary Economy of Food. — Statistics of income and cost of living in Great Britain, Germany, and the United

Amounts of Nutrients and Energy furnished for One Shilling in Food Materials at Ordinary Prices.

Food Materials ai purchaBed

Price!

per Pound,

One Shilling will buy

Total

Food Ma.

terials.

Available Nutrients.

Fuel-‘ Value.

Protein.

Fat.

Carbo- hydrate!.

Beef, round .

B.

0 0 0

d.

10

Founds.

1-20 1-41 2-40

Founds.

-22 -26 -44

Pounds.

■14 ■17 ■29

Founds.

Calories.

1,155 1,285 2,105

Beef, sirloin .

0 0 0 0

10 9 8 5

1-20 1-38 1-60 2-40

•19 ■21

■20 ■22

•••

1,225 1,360

Beef, rib.

0 0 0

9

If

1-33 1-60 2-67

-19

■19

1,200

Mutton, leg ,

0 0

9 5

i-ss”

2-40

-20 -37

■20 ■35

1,245 2,246

Pork, spare-rib

0 0

9

1

1-83

1-71

-17 -22

■81 ■89

1,645 2,110

Pork, salt, fat

0 0

r

6

1-71 2-40

-08 -04

1^40 1^97

6,025 8,460

Pork, smoked ham

0 0

8

1-50 2-67

-20

•36

•48 •85

2,485 4,330

Fresh cod

0 0

i

3

8-00 400

-84 -46

■01 •01

:::

710 945

Salt cod .

0 0

8J

10

3-48

1-20

•54

-07

■07 ■01

•04

1,370 275

Milk, whole, 4d. a qt. . 3d. a qt. . 2d. a qt. .

0 0

fl

2

6-00

S-00

12-00

-19 -26 -38

■23 ■30 ■46

•30 •40 •60

1,916 2,550 8,825

Milk, skimmed, 2d. a qt.

0

1

12-00

•40

■08

•61

2,085

Butter .

1

1 1

6 3 0

-67

•80

1-00

■01 ■01 •01

■54 ■64 •81

2,820 2,770 3,460

Margarine

0

4

800

237

...

10,080

Eggs, 2s. a dozen . „ lis. a dozen ,, Is. a dozen .

1

1

0

4 0

8

■75

1-00 1-60

•10 ■18 ■19

•07 •09 •18

476 685 950

Cheese ....

0 0 0

8 7 5

1-60 1-71 2-40

■88 ■48 ■60

•48 •55 •77

•04 ■04 ■06

2,865 8,265 4,586

Wheat bread .

0

n

10-67

■76

•18

6^57

12,421

Wheat flour .

0 0

1 1

7-64 8-16

■67 •72

•07 •07

5-68 6-01

12,110 12,986

Oatmeal ....

0 0

11

8-39 8-16

1^11 1^08

•64 •53

5^S4

5-89

14,885 14,430

Rice ....

0

n

6-86

■45

■02

5^27

10,795

Potatoes

0 0

SI

18-00 24-00

■25 ■34

■02 ■02

2^70

8-60

5,606 7,470

Beans ....

0

2

6-00

1-05

■10

3-47

8,960

Sugar ....

0

n

6-86

6-86

12,760

States (Massachusetts) ‘ show that from 50 to 60 per cent, or more of the income of wage-workers and other people in moderate circumstances is expended for food. This relatively large cost of food, and the important influence of diet upon health and strength, make a more widespread understanding of the subject very desirable. The maxim that ” the best is the cheapest ” does not apply to food. The best food, in the sense of that which is the finest in

1 Report of Mass. Bureau of Labour, 1884.

appearance and flavour, and which is sold at the highest price, is not generally the cheapest, nor is it always the most healthful or economical. The price of food is not regulated solely by its value for nutriment. Its agreeable- ness to the palate or to the buyer’s fancy is a large factor in determining the current demand and market price. There is no more nutriment in an ounce of protein or fat from the tenderloin of beef than from the round or shoul- der. The protein of animal food has, however, an advan- tage over that of vegetable foods. Animal foods, such as meats, fish, milk, and the like, gratify the palate as most vegetable foods do not, and, what is perhaps of still greater weight in regulating the demand and market price, they satisfy a real need by supplying protein and fats, which vegetable foods lack. In general, animal proteids are more easily and

completely digested than vegetable. There is doubtless good ground for paying somewhat more for the same quantity of nutritive material in the animal food. For persons in good health the foods in which the nutrients are most expensive are like costly articles of adornment — people who can well afford them may be justified in buying them, but they are not economical.

The variations in the cost of the actual nutriment in different food materials may be illustrated by comparison of the amounts of nutrients obtained for a given sum in the materials as bought at ordinary market prices. This is done in the foregoing table, which shows the amounts of available nutrients, which one shilling would pay for, in different food materials at prices common in England.

Adthorities. — Composition of Foods: — Konig. Chemie der menschlichenNahrungs-undOenussmittel. — Atwateb and Bryant. " Composition of American Food Materials," Bui. 28, Office of Experiment Stations, U.S. Department of Agriculture. — Nutri- tion AND Dietetics : — Burney Yeo. Food in Health and Dis- ease.— McNK and Uffblmann. Die Ernahrung des gesunden und kranken Menschen. — Von Leyden. Frndhrungstherapie und Diatetik. — Ddjardin-Beadmetz. Hygiene Alimentaire. — Hutchi- son. Food and the Principles of Dietetics. — Atwater. " Chem- istry and Economy of Food," Bui. 21, Office of Experiment Stations, U.S. Department of Agriculture. See also other Bulletins of the same office on composition of food, results of dietary studies, metabolism experiments, &c., in the United States. — General Metabolism: — Voit. Physiologie des allgemeinen Stoffwechsels und der Ernahrung.— Resmi^ss. Handbuch der Physiologie, Bd. vi. — Von Noorden. Pathologie des Stoffwechsels. — Schafer. Text-Book of Physiology. Vol. i. — Atwater and Langworthy. " Digest of Metabolism Experiments," Bui. 45, Office of Experi- ment Stations, U.S. Department of Agriculture. (yf, o. A.)

Dier, a town of Prussia, province of Hesse-Nassau, on the Lahn, 30 miles by rail east from Coblenz. It is over- looked by a former castle of the counts of Nassau-Dillen- burg, now a prison. Near by is the cadet school

of Castle Oranienstein, formerly a nunnery, -with its beautiful gardens. It has saw-mills and tanneries and corn-mills. Population (1900), 4303.

Differential Equations Differential equations

a,rise in the expression of the relations between quan- tities by the elimination of details, either unkno-wn or regarded as unessential to the formulation of the re- lations in question. They give rise, therefore, to the t-wo closely connected problems of determining what arrangement of details is consistent with them, and of developing, apart from these details, the general properties expressed by them. Very roughly, two methods of study can be distinguished, with the names Transformation-theories, Function-theories ; the former concerned to re- duce the algebraical relations to the fewest and simplest forms, eventually with the hope of obtaining explicit expressions of the dependent variables in terms of the independent variables ; the latter concerned to determine what general descriptive relations among the quantities are involved by the differential equations, with as little

use of algebraical calculations as may be possible. Under the former heading we may, with the assumption of a few theorems belonging to the latter, arrange the theory of partial differential equations and Pfaff's problem, with their geometrical interpretations, as at present developed, and the applications of Lie's theory of transformation- groups to partial and to ordinary equations; under the latter, the study of linear differential equations in the manner initiated by Riemann, the applications of discon-tinuous groups, the theory of the singularities of integrals, and the study of potential equations with existence theor- ems arising therefrom. In order to be clear we shall enter into some detail in regard to partial differential equations of the first order, both those which are hnear in any number of variables and those not linear in two independent variables, and also in regard to the function- theory of linear differential equations of the second order. Space renders impossible anything further than the briefest account of many other matters ; in particular,,,the theories of

partial equations of higher than the first order, the function-theory of the singularities of ordinary equations not linear and the applications to differential geometry, are taken account of only in the bibliography. It is believed that on the whole the article will be more useful to the reader than if explanations of method had been further curtailed to include more facts.

When we speak of a function without qualification, it is to be understood that in the immediate neighbourhood of a particular set Xo, yo, • • oi values of the independent variables x, y, • • ■ oi the function, at whatever point of the range of values for x, y, • • • under consideration Xo, yo, • • may be chosen, the function can be expressed as a series of positive integral powers of the differences x — Xo, y—y<» • • ', convergent when these are sufficiently small (see Function, Analytic). Without this con- dition, which we express by saying that the fimction is developable about Xq, yo,- ~~; many results provisionally stated in the transformation theories would be unmeaning or incorrect. If, then, we have a set of k functions, /^ • / of n independent variables x~~^ • • Xn, we say that they are independent when ri^h and not every determinant of Ic rows and columns vanishes of the matrix of k rows and n columns whose r-th row has the constituents dfr/dx^ ■ ■ dfr/dxn ; the justification being in the theorem, which we assume, that if the determinant involving, for instance, the first k columns be not zero for x^ = Xj° • ■ Xn=x^, and the functions be developable about this point, then from the equations /i=Ci • •fk = <'k ^^ •'i express x-_ ■ Xk by convergent power series in the differences 374+1 — xjc'- • • Xn – Xn", and so regard x-^^- • xjc as functions of the remain- ing variables. This we often express by saying that the equations fi = c^- ~~fk^Ck can be solved for x~~^^ ■ Xk. The explanation is given as a type of explanation often under- stood in what follows.*

We may conveniently begin by stating the theorem : If each of the n functions 0i • • » of the (»-t- 1) variables x • • xj, be devel- opable about the values x-^ ■ • x^H", the n differential Ordinary er[uations of tHe form dXi/dt =

"" and the only functions satisfying the equations and

order. reducing respectively to x{‘ • ■ x„’ when 1=^, are

those determined by continuation of these series. If the result of solving these n equations for x-° ■ ■ Xn° be written in- the form Wi(Xi • ■ x4)=x{‘ ■ • ?“f “« *t values {Xi’ ■ • XnH”) and reduce respectively to ajj • • a^ of the first ^^^^ t—t°. And in fact it has no other integrals so order. reducing. Thus this equation also possesses an unique*

integral reducing when <=<" to an arbitrary function ^J^C^Ti ■ ■ a:„), this integral being y^C^i ■ ■ "n). Conversely, the existence of these

Proof of the existence of Inte- grals.

principal integrals Uj • • a!„ of the partial equation establishes the existence of the specifiid solutions of the ordinary equations dxijdt=^i. The following sketoli of the proof of tlie existence of these principal integrals fur tlie case 7i = 2 will show the oliaracter of more general inves ligations. Put x for a; ~~a;”, &c., and consider the equation a(xyt)dfjdx + }>{xyt)d/jdy:= dfjdt, wherein the functions a, b are develo|iabie about a;=0, y=0, t = 0 ; say a(xyt)=a„ + lai + t“aj2l+~~; b{xyt) = b„ + ibi + fib^2l+- ; so that adldx + bdjdy= ii, + lS^ + it^S.^+ ■ •, where Sr=a,djdx + hrdjdy. In order that/= Po + tpi + t’p^l’M+ • ; wherein ^0,[1] are power series in X, y, shoukl satisfy the equation, it is necessary, as we find by equating like terms, fh&t Pi=S„p„ p2=S„p + S^Po, ko., and in general Jj,+i = 5„;),+ai5]p,_i + i252^,_jj + • ■+S,p„ where Sr=(s\)l{rl){s-r’,). Now compare with the given equation another equation A{xyt)di’ldx + ^[xyt)d¥jdy = d¥jdt, wherein each coefficient in the expansion of either A or B is real and positive, and not less than the absolute value of the corresponding coefficient in the expansion of a or b. In the secoud equatiou let us substitute a series F = Po ~~+~~ iPj + i^Pj/ ‘l\+ ■ •, whereiu the coefficients in P, are real and positive, and eaoh not less than the absolute value of the corresponding coeffi- cient in Pa ; then putting A, = krdjdx + Brdjdy, we obtain necessary eiiuations of the same form as before, namely, Pj = A»P„, P2=A„Pi + AiP„, ■ ■ ■ and in general P,+i=AoP, + s,AiP,_i-(- ■ • ~~, specifying functions A, B with real positive coefficients, each in absolute value not less than the corresponding coefficient in a, i ; (2) proving that the equation AdFjdx + RdFjdy = (iF/(i< possesses an integral P„ + (Pi + fiF^I2[+ ■ ■ in which the co~~ efficients in P„ are real and

positive, and each not less than the absolute value of the corresponding coefficient in p,^ If a, b be developable for x, y both in absolute value less than r and for t less in absolute value than B, and for such values a, b be both less in absolute value than the real positive constant M, it is not difficult

to verify that we may take A = B = m(1 \ (1 ~ e) , and

and that this solves the problem w^hen x, y, t are sufficiently small for the two ca,set p„=x, po=y. One obvious application of the general theorem is fio the proof of the existence of an integral of an ordinary linear differential equation given by the n equations dyldx=yi, dyildx=y^ ■ ~~, dy„_~~ ^fdx=p ~~p^y^.^~~ ■ ■ -p„y ; but in fact any simultaneous system of ordinary equations is reducible to a system of the form dxijdt=

Suppose we have k homogeneous linear partial equations of the first order in n independent variables, the general equation being a,idfldXi + • ■+ a^dfldxn = 0, where a=- ~~k, and that we desire to know whether the equations have common Slmultane~~ solutions, and if so, how many. It is to be understood "usUnear that the equations are linearly independent, which P'"""} implies that hzn and not every determinant of k rows l"'''''- and columns is identically zero in the matrix in which the i-th element of the ir-th row is a^i=l ■ ■ n, a=\ ■ • k). Denoting the left side of the Z'S.idfjdxi~0 where Hj=Ppa^- P^^i, and if it be not already contained among the given equations, or be linearly deducible from them, it may be added to them, as not introducing any additional limitation of the possibility of their having common solutions. Proceeding thus with every pair of the original equations, and then with every pair of the possibly augmented system po obtanied, and so on continually, we shall arrive at a system of equations, linearly independent of each other and therefore not more than n in number, such that the combination, in the way described, of every pair of tliom, leads to an equation which is linearly deducible from them. If the number of this so-called complete system is n, the equations give d/ldxi = 0 ■ ■ df/dx„=0, leading to the nugatory result /=a constant. Suppose, then, the number of this system to be r-

obtain ¥=r-{r-x-

a determinant of r rows and columns not vanishing identically is that formed by the coefficients of the differential coefficients of / in regard to k^ ■ • a;,; also that the coefficients are all Complete developable about the values x-y=x-^ • • a;„=a;„ ”, and ^^/i™* that for these values the determinant just spoken of is “—fj^f^ not zero. Then the main theorem is that the complete eaaatlons [7]^^™ °f *” equations, and therefore the originally given ‘ set of k equations, have in common n — r solutions, say Wr+i • • u„, which reduce respectively to x^+i ■ ■ x„ when in them for x^ • ■ x^ are respectively put x^” • ■ Xr° ; so that also the equations have in common a solution reducing wLeu Xi=Xj° • ■ Xr=Xr° to an arbitrary function \j/{Xr+i • • a;„) which is developable about Xr°+i • ■ x„ ’, namely, this common solution is - It is seen at once that this result is a generalization of the theorem forr=l, and its proof is conveuiontly given by induction from that case. It can be verified without difficulty (1) that if from the r equations of the complete system we form r independent linear aggregates, with coefficients not necessarily constants, the new system is also a complete system ; (2) that if in place of the independent variables x- • • x,i we introduce any other variables which are independent functions of the former, the new equations also form a complete system. It is convenient, then, from the complete system of r equations to form r new equations by solving separately for dfjdx-^, • ; ~~dfjdxr ; suppose the general equation of the new system to be Q„f=dfjdx,+c„r+idfjdxr+i+~~ ■+e^dfldx„ = 0(a-=l • • r). Then it is easily obvious that the equation Q^Q,/ -Qo-Qp/=0 contains only the differential coefficients of/ in regard to Xr+1 • • x„; as it is at most a linear function of Qj/, • •, Q^f, it must be identically zero. So reduced the system is called a Jam- hian system. Of this system Qi/= 0 has re – 1 principal Jacoblan gojutions reducing respectively to a;™ • • x„ when a-j = systems. ^^„^ ^^^ j^^ f^^,^ shows that of these the first r- 1 are exactly x^ • • Xr. Let these a-1 functions together with Xj be introduced as n new independent variables in all the r equations. Since the first equation is satisfied by n – 1 of the newindependent variables, it will contain no differential coefficients in regard to them, and will reduce therefore simply to dfldxi=0, expressing that*

any common solution of the r equations is a function only of the m-1 remaining variables. Thereby the investigation of the common solutions is reduced to the same problem for r-1 eauations in « – 1 variables. Proceeding thus, we reach at length one equation in n-r + 1 variables, from which, by retracing the analysis, the proposition stated is seen to follow.

The analogy with the case of one equation is, however, still closer. With the coefficients Cr,) of the equations Q,/=0 in transposed array (j,^ them we may be able to regard 2;,+] • • a:„ as equations, f^^^^ig,^^ of Ki • • Xr, these being regarded as independ- ent variables, it is clearly necessary that when we differentiate Crj in regard to x on this hypothesis the result should be the same as when we differentiate Cp in regard to x^ on this hypothesis. The differential coefficient of a function f o{ x^ • ■ x„ on this hypothesis, in regard to x^,, is, however, dfldx^ + c^,r+idfldxr+i + ■ • + Cpndfjdx„, namely, is Q^/. Thus the consistence of the n-r total equations requires the conditions Q c^j-Q,c^=0, which are, how- ever, verified in virtue of QMc/)-QMp^)= *’- And it can in fact be easily verified that if Wr+i • •(/=0, reducing respectively to a;r+i ■ ■ x„ when a;x=a;i° • • Xr=Xr°, and the equations Wr+j = a;/+i • • u„=x„ ’> be solved for a’r+j • • a;„ to give Xj = \pj(x-i • • Xr, a;r°+i • • x„°), these values solve the total equations and reduce respectively to Xr’+i ■ ■ Xn” when Xi=Xj° ■ ■ Xr=Xr”. And the total equations have no other solutions with these initial values. Conversely, the existence of these solutions of the total equations can be deduced d, priori and the theory of the Jacobian system based upon them. The theory of such total equations, in general, finds its natural place under the heading Pfaffian ExpressioTis, below.*

A practical method of reducing the solution of the r equations of a Jacobian system to that of a single equation in re-r + 1 variables may be explained in connexion with a geo- Oeometrl- *etjigaj interpretation which will perhaps be clearer in / “«’ ”” Particular case, sayre=3, r=2. There is then only and” ”” °°® °^ equation, say dz=adx + bdy ; if wo do not solution *^^® account of the condition of integrability, which is here dajdy + Maldz=dildx + adhldz, this equation may be regarded as delining through an arbitrary point x„y^„ of three-dimensioned space (about wliich a, h arc developable) a plane, namely, z-z„=a„{x-Xc) + bo{y-y„), and therefore, through this arbitrary point oo^ directions, namely, all those in the plane. If now there be a surface z=\j/(xy), satisfying dz=adx + bdy and passing through x„y^„ this plane will touih the surface, and the operations of passing along the surface from (x„y^o) to {x„ + dXo, y„, z„ + dZo) and then to {Xo+dxo, Vo + dy^, Zo +*

d^z^), ought to lead to the same value of dh„ as do the operations of passing along the surface from {x^yji^ to {x,,, y„ + dy„, Zo + &„), and then to (.r<,+

dx„, y„ + dy„ z„ + 5'u„), namely, 5's„ ought to be equal to

+ dx^y,

/db db

\dx„ °d:o /'

and so at once reach the condition of inte-

grability. If now we put x=x„ + t, y=y„ + mt, and regard m as constant, we shall in fact be considering the section of the surface by a fixed plane y-i/ „=m(a;-a;<,) ; along this section dz=dl(a + bm) ; if we then integrate the equation dxldt = a + bm, where a, b are expressed as functions of ?» and t, with m kept constant, finding the solution which reduces to s„ for<=0, and in the result again replace m by {y-yo)l{'x-x„), we shall have the surface in question. In the general case the equations dXj=CjjdXi+- • + ^.„„,. CrjdXr similarly determine through an arbitrary point „gfi,o^„f Xi" ■ ■ x,," a. planar manifold of r dimensions in space y^^^g.,^. of n dimensions, and when the conditions of Integra- j/^^ bility are satisfied, every direction in this manifold through this point is tangent to the manifold of r dimensions, e.'ipressed by Ur+i=a;r°+i • • <«'».= a:».°, which satisfies the equations and passes through this point. If we put Xj - Xj° =t,x^- x^ = m^, ■ -, Xr-Xr"=irb,t, and regard TOj • • m^ as fixed, the {n — r) total equations take the form dxjjdt=(^j + m,c«j+ ■ ■ +mrC, and their integration is equivalent to that of the single partial equation d/jdt +

n

S {Cjj + m^+- • +mrCrj)dfldxj=0 in the n-r+l variables t,

Xr+i ■ ■ x„. Determining the solutions O^+i • • fin which reduce to respectively x^-n • • n when < = 0, and putting therein i = arj - ri", m=[x^-x^')j{x-i-a°), ■ -, mr=(xr-Xr°)li.Xi-xi'), vie obtain the solutions of the original

system of partial equations previously denoted by Wr+i • • Un- It is to be remarked, however, that the presence of the fixed parameters m^- • rrir in the single integration may frequently render it more difficult than if they were assigned numerical quantities.

*We have above considered the integration of an equation dz= adx + bdy on the hypothesis that the condition da/dy + bda/dz=^ dbjdx + adb/dz. It is natural to inquire what relations ptaftiaa among x, y, 2, if any, are implied by, or are consistent Bxores- with, a differential relation a^K-f Ml/ 4-c(i«=o, when a, siwis b, c are unrestricted "functions of a-, y, z. This problem leads to the consideration of the so-called Pfaffian Emiression adx + bdy + cdz; it can be shown (1) if each of the quantities £^5/^2 – dc/dy, dcjdx – dajdz, da/dy – db/dx, which we shall denote respectively by u^, 1*31, «i2, be identically zero, the expression is the differential of a function of x, y, z, equal to dt say ; (2) that if the quantity au^ + bxi,^ + cu^^ is identically zero, the expression is of the form udt, that is can be made a perfect differential by*

multiplication by the factor – ; (3) that in general the expression

is of the form dt + Uidtj. Consider the matrix of four rows and three columns, in which the elements of the first row are a, b, c, and the elements of the {r-l-l)-th row, for r=l, 2, 3, are the quantities «r], «r2, «r3, where %tyi=u^=u^=0. Then it is easily seen that the cases (1), (2), (3) above coiTospond respectively to the cases when (1) every determinant of this matrix of two rows and columns is zero, (2) every determinant of three rows and columns is zero, (3) when no condition is assumed. This result can be generalized as follows: if % • ■ a„beany functions of a;; • • x„, the so-called Pfaffian expression Oidx^ + • ■ + andx„ can be reduced to one or other of the two forms u^dti + • ■+ Ujjdtt, dt + u^dt^ -!-•• + u^-idtt-i, wherein t,u^,—,ti,- ■ are independent functions of a;, • • a-,, and k is such that in these two cases respectively 2k or 2i – 1 is the rank of a certain matrix of re -fl rows and n columns, that is, the greatest number of rows and columns in a non-vanishing determin- ant of the matrix ; the matrix is that whose first row is consti- tuted by the quantities Oj • • a„, whose s-th element in the (r -H) -th row is the quantity dar/dx, – dajdxr. The proof of such a reduced form can be obtained from the two results : (1) li.t be any

given function of the 1m independent variables u^ • ■ u^t^ • • t„, the expression dt + ii,jdt^+ • ■ u„dtm can be put into the form u\dt'i • • +Urnd(m- (2) If the quantities v^ ■ ■ u^ti • • C ' e connected by a relation, the expression u^dti + • •+ Umdim can be put into the form di + u\dt\ + • ■ + u'm-idt'm-i ; and if the relation connecting itj ■ • «„ <; • • t,„ be homogeneous in % ■ ■ «„, then t' can be taken to be zero. These two results are deductions from the theory of contact transformations (see below), and their demonstra- tion requires, beside elementary algebraical considerations, only the theory of complete systems of linear homogeneous partial differen- tial equations of the first order. When the existence of the reduced form of the Pfaffian expression containing only independent quan- tities is thus once assured, the identification of the number k with that defined by the specified matrix may, with some difficulty, be made d posteriori.

In all cases of a single Pfaffian equation we are thus led to consider what is implied by a relation dt-Uidt^— ■ ~~^ly„dt„ =0, in which t,Ui ■ ■ Umti • • tm are, except for this equation, independ~~ent var'ables. This is to be satisfied in virtue of one or several relations connecting the variables ; these must involve relations con-

necting t, t^- • «„ only, and In one of these at least t must actually enter. Wecan then suppose that in one actual system of n-lations

in virtue of which the PfaiBan equation is satisiied, all the relations connecting t,t-^- ■ i„ only are given by i=

*' t,= f,Us+i • ■ *m) ; so*

Single

*IVaWaa "S'+i ', ' '"■" *i = 'i"i('m " ■'"')•*

*equation. “” ™^ equation d^-u^di’i— ■-u,du,+idt,+i • • ~~‘Umdtm=0 is identically true in regard to ii^~~ • u^ *«+i • ■ tm’, equating to zero the coefficients of the differentials of these variables, we thus obtain m-s relations of the form df/dtj ~~iijd^Jdtj~~- ■-ujsl^,jdtj-Uj=a; these m-s relations, with the previous s + \ relations, constitute a set of m + 1 relations connecting the 2m + 1 variables in virtue of which the Pfaffian equation is satisfied independently of the form of tlie functions f, i’l ■ ■ ,. There is clearly such a set for each of the values s = 0, s=l, • •, « = OT-1, TO. And for any value of s there may exist relations additional to the specified m + 1 relations, provided they do not involve any relation connecting t, t*

■ • tm only, and are consistent with the m-s relations connecting u^ • ■ Um- It is now evident

that, essentially, the integration of a Pfaffian equation ajdxi + – • -- andx„=0, wherein a^ • • a„ are functions of a;, • • x„, is efieoted by the processes necessary to bring it to its reduced form, involving only independent variables. And it is easy to see that if we suppose this reduction to be carried out in all possible ways, there is no need to distinguish the classes of integrals corresponding to 4.U. — : 1 — .!• _ J.QJ, jj. j,^^ ^jg verified without difficulty

the various values of s ;

that by putting t’=t- u^t-y – ■ . – u^„ <'i = Mi, •

equation becomes changed to dt’ – u\dt\ – • general relations changed to t’ = \p{t’,+i ■

iim=‘Umt the reduced -ti’^t’m=0, and the

<'m) – i'lfl(t',+i • • t'm)

t’,^i{t’t+i ■ ■ t’„),=ip, say, together with u\=d^ldt\,

which contain only one relation connecting the vari- ables i’ t’l • ■ t’m only.

This method for a single Pfaffian equation can, strictly speaking,

be generalized to a simultaneous system of («-r) Pfaffian equations

dxj=CjjdXi + ■ —i- Cpdxr only in the case already treated,

ta^eoas ‘^’^ this system is satisfied by regarding a;,+j • . a:„ as

Ptattlan ‘‘t^^ls functions of the independent variables x-^ ■ ■ Xri

equations.

in that case the integral manifolds are of r dimensions.

When these are non existent, there may be integral manifolds of higher dimensions; for if dit>=tl>idx^-i— ■■‘rrdxr + r+\i.Bv+idxi-^— ■+Crr^-xdXr) + satisfies the r partial di fferential equations previously associated with the total equations ; when these are not a complete system, but included in a complete systfm oi r--ix equations, having therefore n — r — n independent integrals, the total equations are satisfied over a manifold of r-l-/ dimensions. See E. v. Weber, Math. Arnnal. Iv. (1901), p. 386.*

It seems desirable to add here certain results, largely of algebraic character, which naturally arise in coimexion with the theory of contact transformations. Foranytwofunctionsoftlie2» Contact independent variables x, • • XnPi • -Pn we denote by (t/xJ/) traasform. . dd>d^ d

atlons. the sum of the n terms such as / / – ~~/del>~~ ~~. For~~

dpi dxi dpi dXi

two functions of the (2?i-f-l) independent variables zx-^ • • x„pi ■ -p^ we denote by [0i/’] the sum of the n terms such as -^| ~~li + pi~~^ \ –

ttPi\(iX^ UZ /

-Z-f ^ + p.z$.. It can at once be verified that for any three dpAdxi dz /

fu notions [/[0,t]] + Wi^/]] ~~1~~ i-E/] = |[0it] -^ ^ [^^/] -^ g [/0],

which when /, (p, ^ do not contain z becomes the identity (/”(0\^)) + (‘W/)) + W/’))=O- Then if Xj • • X„Pi • • P„ be such functions of x^- • x„pj • • pn that PjCiXi ~~f • • H~~ P„(iX„ is identically equal to Pidx-^ -V • ■ -i-pndx„, it can be shown by elementary algebra, after equating coefficients of independent differentials, (1) that the functions Xj ■ • • • P„ are independent functions of the 2re vari- ables Xi- • ■ ~~pru so that the equations a;’(=X<, yj=P«can be solved for a;j • • a;„^i ■ ■ Pm and represent therefore a transformation, which we call a homogeneous contact transformation ; (2) that the Xj~~ • X„ are homogeneous functions of p^- -pn of zero dimensions, the Pj. . Pn are homogeneous functions of j • ~~pn of dimension one, and the Jra(»i~~ 1) relations (XjX)=0 are verified. So also are the »2 relations (PiXj) = 1, (PiX^) =0, (P.P^) =0. Conversely, if Xj ■ • X„ be independent functions, each homogeneous of zero dimension in Pi • -pn, satisfying the J«()i-1) relations (XiX^) = 0, then Pj • • P„ can be uniquely detennined, by solving linear algebraic equations, such thatPi(iXi-t— ■-¥‘P^^=PTdx^-\— ■+pndx„. If now we put m ~~I~~ 1 for n, put z for »„+,, Z for X„+i, Q< for - Pi/Pn-n, for i= 1 • ■ m, put qt roi- pilp„+i and Pn f”” Qi ■ ■ Q”?! ■ ■ ?»’ ”^ obtain the following re sults : If ZXi • ■ X„P, • • P„ be functions of zx^ ■ ■ x„pi • • Vn, such

that the expression dZ – Pi^iXj P„rfX„ is identically equal to

cridz-pidxi p„dx„), and cr not zero, then (1) the functions

ZXj ■ ■ X„Pi • • Pn are independent functions of zx^ ■ ■ x„pi • -pn, so that the equations z’=Z, a:’{=Xh y<=P< can be solved for zx, • ■ x„pi ' • Pm and determine a transformation which we call a |

(non-homogeneous) contact transformation ; (2) the ZX^ • ■ Xn verify the u(n-¥Vj identities [ZX4]=0, [XiX = 0. And the further identities [P

0- ‘^^ ~~o~~“, [Xiff]=

versely, if ZXj • ■ Xn be independent functions satisfying the iden- tities [ZXi] = 0, [XiX^] = 0, then (t, other than zero, and Pj • • P„ can be uniquely determined, by solution of algebraic equations, such

that dZ- Pip^dx^ PndXn). Finally,

there is a particular case of great importance arising when a=\, which gives the results : (1) If UXj ■ • X„Pi ■ ■ P„ be 2ji + l func- tions of the 2» independent variables Xi • • x„pi ■ ~~p^, satisfying the identity dU 4~~ PifiXj ~~1~~ • • ~~I~~ YJXn=P\dx-y -f • • -Vpndxn, then the 2™ functions Pj • • P„Xi ■ ■ X„ are independent, and we have

(X,x^)=o, (XiU)=aX(, (P

Pi=5Pfe where 5 denotes the operator _pi(i/d!jOi ~~I~~ • ■+pnd\dpn; (2) If Xj • • X„ be independent functions of a;i • ■ XnPx ■ • Pn, such that (XiX^) = 0, then U can be found by a quadrature, such that (XiU) = SX{ ; and when Xj • • X„, U satisfy these im(»-l-l) conditions, then Pi • • Pn can be found, by solution of linear algebraic equations, to

render true tlieidentity dU + FjdXi H 1- F„dX„=pidx-i + • ■ +p„dx„;

(3) Functions Xj • ■ XnPi • ■ Pn can be found to satisfy this differ- ential identity when U is an arbitrary given luuction of Xi ■ ■ x„pi ■ ~~pn', but this requires integrations. In order to see' what integrations, it is only necessary to verify the statement that if U be an arbitrary given function ofx^~~ ■ XnPi • ~~pn, and, for r=l • • »•, then the »• -1-1 homogeneous linear partial dilferential equations of the first order (Ufy+S/=0, (X^/) = 0, form a complete system. It will be seen that the assump- tions above made far the reduction of Pfaffian expressions follow from the results here enunciated for contact transformations.~~

We pass on now to consider the solution of any partial differential equation of the first order; we attempt to explain certain ideas relatively to a single equa- „ ^, , • tion with any number of independent variables jfffe^„. (in particular, an ordinary equation of the first tlalequa- order witli one independent variable) by speaking ***ion ot the of a single equation with two independent van- ”' ables X, y, and one dependent variable z. It will be seen that we are naturally led to consider systems of such simultaneous equations, of which we give some account below. The central discovery of the transformation theory of the solution of an equation F(a;, y, z, dzjdx, dz/dy) = 0 is that its solution can be reduced to the solution of partial equations which are linear. For this, however, we must regard dzjdx, dz/dy, during the process of integration, not as the differential coefficients***

of a function z in regard to X and y, but as variables independent of x, y, z, the too great indefiniteness that might thus appear to be intro-‘ duced being provided for in another way. We notice, in fact, tJiat if z = il’{x,y) be a solution of the differential equa- tion, then dz=dzd\l//dx-hdydf/dy; thus if we denote the equation by ¥{xyzpq)=^0, and prescribe the condition dz=pdx-hqdy for every solution, any solution such as z = \j/{x, y) will necessarily be associated with the equations p = dzjdx, q = dzjdy, and z will satisfy the equation in its original form. We have previously seen (under Pfaffian Expressions) that if five variables xyzpq, otherwise in-dependent, be subject to dz—pdx — qdy = 0, they must in fact be subject to at least three mutual relations. If we associate with a point xyz the plane Z-z=p(K — x) + q{Y-y) passing through it, where X, Y, Z are current co-ordinates, and call this association a surface-element; and if two consecutive elements of which the point {x -‘rdx,y + dy, z ± dz) of one lies on the plane of the other, for which, that is, the condition dz =pdx -f qdy is satisfied, be said to be connected, and an infinity of connected elements following one another continuously be called a connectivity, then our statement is that a connectivity consists of not more than oo ^ elements, the whole number of elements {xyzpq) that are possible being called oo ^ The solution of an equation F(a;, y, z, dzjdx, dzjdy) = 0 is then to be understood to mean finding in all possible ways, ‘ from the oo *elements (xyzpq) which satisfy ‘F{xyzpq) = Q.*

a set of 00 ‘ elements forming a connectivity ; or, more analytically, finding in all possible ways two relations G = 0, H = 0 connecting x, y, z, p, q and independent of F = 0, so that the three relations together may involve dz =pdx + qdy. Such a set of three relations may, for example, be of the form z = tj/{x, y), p^dij/jdx, q^df/dy ; but it may also, as another case, involve two relations z = \l/{y), X = il/i{y) connecting x, y, z, the third relation being i/f’(y) = P^‘iiv) + ffj tli6 connectivity consisting in that case, geo-metrically, of a curve in space taken with oo i of its tangent planes ; or, finally, a connectivity is constituted by a fixed point and all the planes passing through that point. This generalized view of the meaning of a

solution of F = 0 is of advantage, moreover, in view of anomalies otherwise Meaning ^^rising from special forms of the equation itself. of a sola- For instance, we may include the case, some- tlonottbe times arising when the equation to be solved equation, jg obtained by transformation from another equation, in which F does not contain either p or q. Then the equation has oo ^ solutions, each consisting of an arbitrary point of the surface F = 0 and all the 00 2 planes passing through this point ; it also has oo ^ solutions, each consisting of a curve drawn on the sur- face F = 0 and all the tangent planes of this curve, "the whole consisting of oo ^ elements ; finally, it has alao an isolated (or singular) solution consisting of the Joints of the surface, each associated vrith the tangent plane of the surface thereat, also oo ^ elements in aU. Or again, a linear equation F = Pp ÷ Qj – R = 0, wherein P, Q, R are functions of x, y, z only, has oo 2 solutions, each consisting of one of the curves defined by dxj'P = dy/(i=dz/'R taken with all the tangent planes of this curve ; and the same equation has oo ^ solutions, each consisting of the points of a surface containing oo ^ of these curves and the tangent planes of this surface. And for the case of n variables there is similarly the possibility oi n+1 kinds of solution of an equation F(a:j • • x„^p-^ ■ ■ pn) = 0 ; these can, however, by a simple contact transformation be reduced to one kind, in ■Which there is only one relation z' = ^{x\ ■ • x'n) connecting the new variables x\ • • x'.„?' (see under Pfaffian Expresswns) ; just as in the case of the solution z = i/'(y), x — yfrfy), \y)=P\{y) + g. of the equation Pp-l-Qg' = R the transformation z' = z-px, x'=p,p'= -x, y' — y, q' = q gives the solution z =ij/(y')+x'tj/^(y'), p' = dz'/dx', q' = diljdy of the transformed equation. These explanations take no account of the possibility of p and q being infinite ; this can be dealt with by writing p= -m/w, q= —vjw, and considering homogeneous equations in u, v, w, with vdx+vdy + wdz = 0 as the differential relation necessary for a connectivity ; in practice we use the ideas associated with such a procedure more often without the appropriate notation.

In utiliging these general notions we shall first con- sider the theory of characteristic chains, initiated by Cauchy, which shows well the nature of the Oeldeas relations implied by the given differential equa- tion ; the alternative ways of carrying out the necessary integrations are suggested by considering the method of Jacobi and Mayer, while a good summary is obtained by the fqrmulation in terms of a Pfaffian ex- pression.

Consider a solution of F=0 expressed by the three independent equations F=0, G=0, H=0. If it bo a solution in which there is more than one relation connecting x, y, z, let new yarial/les Cbarac- ^V^Pi ^^ introduced, as before explained under Pfaffian terlstic Expressions, in which z is of the form s'=z- pjarj- cbalna ' " "/> ^« (=1 or 2), so that the solution becomes of a form z =\j/[x'y'), p'=d\)/ldx', q'=d*

Passing in this direction on the surface z' =

whose vertex is x'y'z, the consecutive point {x' + dx, y' + dz', z + dz')

dV dV I

of the generator of contact being such that rfa;' — j=dy' I — T=dz

dp dg I

/ ,dt ,dl'

ij/ixy') the tangent plane of the surfaie at this consecutive point is (p' + djj, q' + dq), where, since F'(x', y, f, d^jdx, d

dq' l(^—q'—-,~~\ are satisfied along a connectivity of oo • ele~~

l\dy dz I

ments consisting of a curve on z =\l/{x'y') and the tangent planes of the surface along this curve. The equation F' = 0, when_;)', q are fixed, represents a curve in the plane Z – z'=p'{X – x) + q(Y – y') passing through x'y'z ; if (x ~~t~~ Sx, y + Sy, z + Sz') be a consecutive

point of this curve, we find at once Sx'(~~—, + p'~~-p-\ + Sy'(—-yi-

j'-— – 1 = 0 ; thus the equations above give Sx'dp' + dy'dq'=0, or the

dz / tangent line of the plane curve, is, on the surface z' = ^{x'y'), in a direction conjugate to that of the generator of the cone. Putting each of the fractions in the characteristic equations equal to dt, the equations enable us, starting from an arbitrary element x' „y' ji' „p' jq „ about which all the

quantities F', dF'jdp, etc., occurring in the denominators, are developable, to define, from the differential equation F'=0 alone, a connectivity of oo • elements, v liich we call a characteristic chain ; and it is remarkable that when we transform again to the original variables {xyzj,q), the form of the differential equations for the chain is unaltered, so that they can be written down at once from the equation F=0. Thus we have proved that the characteristic chain starting from any ordinary element of any integral of this equation F = 0 consists only of elements belonging to this integral. For instance, if the equation do not contain p, q, the characteristic chain, starting from an arbitrary plane through an arbitrary point of the surface F = 0, consists of a pencil of planes whose axis is a tangent line of the surface F=0. Or if F = 0 be of the form 'Pp+Q,q='B,, the chain consists of a curve satisfying dxlF=dylQ.=dzl'B, and a single infinity of tangent planes of this curve, determined by the tangent plane chosen at the initial point. In all cases there are oo ' characteristic chains, whose Aggregate may therefore be expected to exhaust the oo ♦ elements satisfying F=0.

Consider, in fact, a single infinity of connected elements each satisfying F = 0, say a chain connectivity T, consisting of elements specified by x„y^„p„q„ which we suppose expressed as functions of a parameter M, sothatlI„=d«„/d«-7>„rfa!„/dM Complete – iiAVoldu is everywhere zero on this chain ; further, '"'W^ suppose that each of F, dYjdp, ■ ■ •, dFldx + pdEjdzis """" developable about each element of this chain T, and ***'JT^'"*** *that T is rwt a characteristic chain. Then consider "/ the aggregate of the characteristic chains issuing from y""'"' all the elements of T. The oo" elements, consisting J*'. of the aggregate of these characteristic chains, " ' "" satisfy F=0, provided the chain connectivity T consists of elements satisfying F=0; for each characteristic chain satisfies rfF = 0. It can be shown that these chains are connected ; in other words, that if xyyag be any element of one of these characteristic chains, not only is dzldt-pdxldt-qdyldt=0, as we know, but also '[5=dzjdv,-pdxjdu-qdyjdu is also zero. For*

dt dt\du '^du ^dul du\dt ^ dt ^dt)~dudt

+

pdx dy_ d_(dz dx_ dy\ '^du ^dul dv,\dt ^ dt ^dt)'

*dqdy d^dy^ wl^‘oh is equal to ^<^I + ^^ (^^ +p^*

dudp^du \dx ‘^dzj

da d¥ , dy /dF d¥\ d¥ yj . dF . j , , ,

— 3- +T^ (^ + ?T-|=- Tr—U- As — IS a developable dq du \dy dz / dz dz

dpdx .J dt du du dt

du

function of t, this, giving U = Uo exp(– j j-^t\, shows that

to

*U is everywhere zero. Thus integrals of F=0 are obtainable by considering the aggregate of characteristic chains issuing from arbitrary chain connectivities T satisfying F=0 ; and such connectivities T are, it is seen at once, determinable without integration. Conversely, as such a chain connectivity T can be taken out from the elements of any given integral all possible integrals are obtainable in this way. For instance, an arbitrary curve in space, given by x„=e{u), y<,=0(M),2„=^i'(it), determines by the two equations F{x„y^^^„) = 0, tl/{u)=p„0'(u) + q„^'{u), such a chain connectivity T, through which there passes a perfectly definite integral of the equation F=0. By taking oo * initial chain connectivities T, as for instance by taking the curves x„ = $, yo = , z„=^ to be the oo’ curves upon an arbitrary surface, we thus obtain oo” integrals, and so oo* elements*

satisfying F = 0. In general, if functions G, H, independent of F, be obtained, such that the equations F = 0, G=b, H = c represent an integral for all values of the constants b, c, these equations are said to constitute a complete integral. Then oo elements satisfying F = 0 are known, and in fact every other form of integral can be obtained without further integrations.*

In the foregoing discussion of the differential equations of a

characteristic chain, the denominators — , ■ – may be supposed to

dp be modified in form by means of F=0 in any way conducive to a simple integration. In the immediately following explanation of ideas, however, we oonsfder indifferently all equations F= constant ; when a function of xyzpq is said to be zero, it is meant that this is so identically, not in virtue of F = 0 ; in other words, we consider the integration of F=a, where a is an arbitrary constant. In the theory of linear partial equations we have seen that the integration _ of the equations of the charaoteristio chains, from which,

*Uperatlons ^^ has just been seen, that of the equation F=a follows necessaiy ^^ once, would be involved in completely integrating latem- *^® single linear homogeneous partial differential Hon at ‘ equation of the first order [F/j = 0, where the notation p_ is that explained above under Ccmtact Transformations,*

One obvious integral is /= F. Putting F= a, where a is arbitrary, and eliminating one of the independent variables, we can reduce this equation [F/‘J=0 to one in four variables ; and so on. Calling, then, the determination of a single integral of a single homogeneous partial differential equation of the first order in n independent variables, an operation of order n-1, the character- istic chains, and therefore the most general integral of F=a, can be obtained by successive operations of orders 3, 2, 1. If, however, an integral of F=a be represented by F=a, Gr=d, H=c, where b and c are arbitrary constants, the expression of the fact that a characteristic chain of F = a satislies dG=0, gives [F6]=0 ; similarly, [FH]=0 and [GH]=0, these three relations being identically true. Conversely, suppose that an Integral G, Independent of F, has been obtained of the equation [F/] = 0, which is an operation of order three. Then it follows from the identity

[/[0\(‘]strong lang=“f/”>].[\(‘l/0]]=f[v(‘0] + \y]+[/ hefore re-

marked, by putting 0=F, i/=G, and then [Fy]=AC/”), [G/)=B(/),

that AB(/)-BA(/=^B(/)-^ACO, so that the two linear dz dz

equations [F/]=0, [G/]=0 form a complete system; as two integrals F, G are known, they have a common integral H, inde- pendent of F, G, determinable by an operation of order one only. The three functions F, G, H thus iJenticaUy satisfy the relations [FG]=[GH]=[FH]=0. The oo^ elements satisfying F = a, G=b, a.=c, wherein a, b, c are assigned constants, can then be seen to constitute an integral of F=a. For the conditions tliat a characteristic chain t>f G=ft .issuing from^.an element satisfying F=a, G=J, H = c shouM consist only of elements satisfying these three equations are simply [FG] = 0 [GHJ =0. Thus, starting from . an arbitrary element of (F=a, G=b, H=c), we can single out a connectivity of elements of (F=a, G=6, II=c) forming a character- istic chain of G = 6 ; then the aggregate of the characteristic chains of F=a issuing from the elements of this characteristic chain of G = 6 will be a connectivity consisting only of elements of (F= a, G=6, H = e), and will therefore constitute an integral of F=a; further, it will include all elements of (F=a, G=b, H=c). This result follows also from a theorem given under Contact Transform- ations, which shows, moreover, that though the characteristic chains of F=a are not determined by the three equations F=fl, G = b, H = c, no further integration is now necessary to find them. By this theorem, since identically [FG] = [uII] = [FII] = 0, we can find, by the solution of linear algebraic equations only, a non-vanisliing function -^ and two functions A, C, such that dG – AdF – Ci^H =

When we consider the particular equation F=0, neglecting the case when neither p nor q enters, and supposing p to enter, we may express^ from F = 0 in tornis of xysq, and then eliminate it from all other equations. Then instead of the equation [I/] = 0, we

have, if F=0 give j?=^(a!3/zy), the equation 0/= – f^ ± f-/')

\dx dz/

d±{df df_rd± df\df ^ moreover obtainable by omit- dqKdy^dz) \dy^^dz)dq

tine the term in -/ in [p – f , /] = 0. Let XoyjiJi„ be values about

° *dp*

which the coefficients in this equation are developable, and let f, 1), (0 he the principal solutions reducing respectively to z, y and q when x=x^ Then the equations ^=f, f=2„, v=yo, “=2o

represent a characteristic chain issuing from the element Xayjia\j/^i, ; we have seen that the aggregate of such chains issuing from the elements, of an arbitrary cliain satisfying &„ -^odao – ■pi, , ,

equation

q„dy„=0 constitute an integral of the equation =,

Let this arbitrary chain be taken so that a;„ is constant ; __„ .

then the condition for initial values is only dz„ – q^yo= pf„ffifm

0, and the elements of the integral constituted by fg„„ujg.

*the characteristic chains issuing therefrom satisfy df- (jg„^*

itidv = 0. Hence this equation involves dz – \pdx – qdy = 0,

or we have dz-^l/dx — qdy = ff{df—udr]), where ir is not zero.

Conversely, the integration oip=\j/ is, essentially, the problem of

writing the expression dz-^dx-qdy in tlie form (!{dl – udi)), as

must be possible (from what was said under Pfaffian Expressions).

To integrate a system of simultaneous equations of the first order Xi=ai • • • X,=Or inn independent variables Ki • • a;„ and one dependent variable z, we write i for dzjda, &c., g ^^^ ^ and attempt to find n + l-r further functions Z, Xr+i gg„gf]„^ ■ ■ X„, such that the equations Z= a, X|=a.i(i=l ■ • n) „ffi,g first mvolse dz-p-^dxi- • • ~~pndx„=0. By an argument ^^g^_ already given, the common integral, if existent, must be satisfied by the equations of the characteristic chains of any one equation Xj=aj ; thus each of the~~

~~expressions [XjX/] must vanish in virtue of the equations expressing the integral, and we may without loss of generality assume that each of the corresponding Jr(r~~ 1) expressions formed from the r given differential equations vanishes in virtue of these equations. The determination of the remaining n + l-r functions may, as before, be made to depend on characteristic chains, which in this case, however, are manifolds of r dimensions obtained by integrating the equations [X,/] = 0 • ■ • [X,/]=0 ; or having obtained one integral of this system other thanXi • • X„ say X,+i, we may consider the system [Xi/]=0 • • [X,+i/]=0, for which, asain, we have a choice ; and at any stage we may use Mayer's method and reduce the simultaneous linear equa- tions to one equation involving parameters ; while if at any stage of the process we find some but not all of the integrals of the simultaneous system, they can be used to simplify the remaining work ; this can only be clearly explained in connexion with the theory of so – caUed function groups for which we have no space. One result arising is that the simultaneous system Pi=4>i, • • , pr=i, P>-0;]=O, has a solution z=\l/{x^ • • a;„), pi=drl/ldxj • ■, p„=d^jdx„, reducing to an arbitrary function, of Xr+i • • ■ a!„only, when Xi=Xi° ■ • av =av° under certain conditions as to developability ; a generalization of the theorem for linear equations. The problem of integration of this system is, as before, to put dz — (p^dxi — •• — 4>rdXr—pr+Tdxr+f – • • -^„ (ia:„ into the form a[di – ur+id^r+\— • •- "ndfn) ; and here f, f,+i • • fn "r+i • • • w„ may be taken, as before, to be principal integrals of a certain complete system of linear equations ; those, -namely, determining the characteristic chains.

If L be a foiiction oft and of the 2?i -quantities a^ • • x^i ■ ■ i„,

where ij denotes dxijdt, ~~&c., and if in the n equations — (^t~~ J=

dt\dxi/

x„ in terms of i, ari •

— we put »<=-=—, and so express f, ■ dxi dxi

aJnPi • • Pn, assuming that the determinant of the quantities -= — = .

dxidxj

*is not zero ; if, further, H denote the function of t, x^ • • x„pi • • p„, numerically equal to p^i^ + • • +p„.i„ – L, it is ea^y to prove that dpjdt = – dlljdxi, dxtjdt = dnjdp,. These equations so-called canonical equations form part of those for the ° namlca. characteristic chains of the single partial equation *”’ i dzjdt + ‘B.(tXi ■ • x„, da/do^ • ■ • , dzldxn) = 0, to which then the solution of the oriainal equations for x^ ■ ■ x„ can be reduced. It may be shown (1) that if «=^«Xi • • x„Ci • ■ c„)-l-c be a, complete integral of this equation, then pi=d-^jdxi, d\j/jdci=ei are 2» equations giving the solution of tlie canonical equations referred to, where c^ • • Cn and ej ■ • e„ are arbitrary constants ; (2) that if a;i=X((*

0=/ udt. where, after integration, 0 is to be expressed as »

function of <, Xi ■ ■ XnXi' • • Xn", then 2=0 ɨ 2° is a complete integral of the partial equation.

A . system of differential equations is said to allo-w a certain continuous group of transformations (see Geottps) when the introduction for the variables in the differential equations of the new variables arising in the general finite equations of the group leads, for all values of the parameters of the group, to the same differential equations in the new variables. It would be interesting

to verify in examples that this is the case in at least the majority of the differential equations which are known to

*be integrable in liiiite terms. As space forbids tim f’ *^^ attempt, we give a theorem of very general theory ot application for the case of a simultaneous coBtiBu- complete system of linear partial homogeneous °”® ■”’”” differential equations of the first order, to the tfieortes. solution of which the various differential*

equations discussed have been reduced. It wiU be enough to consider whether the given differential equa- tions allow the infinitesimal

transformations of the group.

It can be shown easily that sufBcient conditions in order that a complete system 11]/= 0 ■ • IIi/=0, iu n independent variables, should allow the infinitesimal transformation Vf= 0 are expressed by k equations IIjP/- PIIj/= \jill]/+ • ■ + Xallj:/. Suppose now a complete system oi n-r equations in n variables to allow a group of T infinitesimal transformations (Pi/, • ■ , ^rf) which has an invariant subgroup of r – 1 parameters (Pj/, ■ ■ , Fr-if), it being supposed that the n quantities IIi/, ■ • , lln-r/, Pi/, ■ • , P,/ are not connected by an identical linear equation (with coefficients even depending on the independent variables). Then it can be shown that one solution of the complete system is determinable by a quadrature. For each of HiP^f-FJlif is a linear function of IIi/, ■ • , II„_,/ and the simultaneous system of independent equations ni/=0 • • n„_,/= 0, Pi/= 0 • • P,_,/=0 is therefore a complete system, allowing the infinitesimal trans- formation Pr/. This complete system of « – 1 equations has therefore one common solution oi, and Pr(w) is a function of a. By choosing a suitably, we can then make Pr(a)) = l. From this equation and the » – 1 equations njU=0, P^u=0, we can determine w by a quadrature only. Hence can be deduced a much more general result, that if the group of r parameters be integrable, the complete system can be entirely solved by quadratures ; it is only necessary to introduce the solution found by the first quadrature as an independent variable, whereby we obtain a complete system of n-r equations in » – 1 variables, subject to an integrable group of r-1 parameters, and to continue this process. We give some examples of the application of the theorem. (1) If an equation of the first order y'=ij/{x, y) allow the infinitesimal transformation (dfjdx + ridfldy, the integral curves a{x, y)=y", wherein u(x, y) is

the solution of ■^+

ihterohanged among themselves by the infinitesimal transformation, or u (a;, y) can be chosen to make ^dinjdx + rjdoijdy = 1 ; this, with duldx+^duildy=0, determines u as the integral of the complete differential {dy – ^dx)j{Ti – ^|). This result itself shows that eveiy ordinary differential equation of the first order is subject to an Infinite number of infinitesimal transformations. But every infinit- esimal transformation dfjdx+ridfjdy can by

change of variables (after integration) be bi-ought to the form dfjdy, and all differential equations oF the first order allowing this group can then be reduced to the form F(a;, dyjdx) = 0. (2) In the ease of an ordinaiy equation of the second order y”=\j/\oeyi/), equivalent to dy/dx=yi, dy-ijdx=\j/{xfyy-, if H,Hi be the solutions for y and y^ chosen to reduce to y° and y-^” when x=3fl, and the equations ‘R=y, Hi=yi be equivalent to a=y°, Ui=j/i°, then w, Wi are the principal solu- tions of II/= dfjdx + y^dfjdy + ^<^fldyi = 0. If the original equation allow an infinitesimal transformation whose first exteruled form (see art. Grottps) is 'Pf=(df/dx + ridf/dy + riidf/dyi, where 5;,5< is the in- crement of dyjdx when St, riSt are the increments of as, y, and is to be expressed in terms of x, y, y, then each of Pw and Pui must be functions of w and W], or the partial difierential equation 11/ must allow the group Vf. Thus by our general theorem, if the differential equation allow a group of two parameters (and such a group is always integrable), it can be solved by quadratures, our explanation sufficing, however, only provided the form 11/ and the two infinitesimal transformations are not linearly connected. It can be shoTra, from the fact that i/i is a quadratic polynomial in j/j, that no difierential equation of the second order can allow more than 8 really independent infinitesimal transformations, and that every homogeneous linear differential equation of the second order allows just 8, being in fact reducible to d^yjdx^ = 0. Since every group of more than two parameters has subgroups of two parameters, a differential equation of the second order allowing a group of more than two parameters can, as a rule, be solved by quadratures. By transforming the group we see that if a diflferential equation of the second order allows a single infinitesimal transformation, it can be transformed to the form ¥{x,dy/dx, d^/dx^) ; this is not the case for every differential equation of the second order. (3) For an ordinary differential equation of the third order, allowing an integrable group of three parameters whose infinitesimal trans- formations are not linearly connected with the partial equation to which the solution of the given ordinary equation is reducible, the

similar result follows that it can be integrated by quadratures. But if the group of three parameters be simple, this result must be replaced by the statement that the integration is reducible to quadratures and that of a so-called Riccati equation of the first order, of the form dy/dx=A + By + Cy^, where A,B,C are functions of X. (4) Similarly for the integration by quadratures of an ordinary equation ya=‘l’{xyyi ■ ■ yn-i) oi any order.

Moreover, the group allowed by the equation may quite well consist of extended contact traLsformations. An important application is to the case where the difierential equation is the resolvent equation defining the group of transformations or rationality group of another difiTerential equation (see below) ; in particular, when the rationality group of an ordinary linear differential equation is integrable, the equation can be solved by quadratures.

Following the practical and provisional division of theories of differential equations, to which we alluded at starting, into transformation theories and func- tion theories, we pass now to give some account f^on o/'" of the latter. These are both a necessary logical function complement of the former, and the only remain- theories of ing resource when the expedients of the former '/feren. have been exhausted. While in the former gq„at,ons. investigations we have dealt only with values of the independent variables about which the functions are developable, the leading idea now becomes, a was long ago remarked by G. Green, the consideration of the neighbourhood of the values of the variables for which this developable character ceases. Beginning, as before, with existence theorems applicable for ordinary values of the variables, we are to consider the cases of failure of such theorems.

When in a given set of differential equations the number of equations is greater than the number of dependent variables, the equations cannot be expected to have common solutions unless certain conditions of com- patibility, obtainable by equating different forms of the same differential coefficients deducible from the equations, are satisfied. We have had examples in systems of linear equations, and in the case of a set of equations p-^ — <^j, • ■, jtj,. = y. For the case when the number of equations is the same as that of dependent variables, the following is a general theorem which should be referred to : Let there be r equations in r dependent variables Zj • • Zr and n indejwndent variables a;j ■ • a;„ ; let the differ- ential coefficient of z of highest order which ■A^?"'' enters be of order h^ and suppose d^rz^jdx-^" theorem. to enter, so that the equations can be written d'^rzJdx^K = ^^, where in the general differential co- efficient of Zp w^hich enters in ^^, say c?!"" • • ""■^nz^/

dx^h ■ ■ dxj^, we have k^< hf and k^-\ 1- kn'

a^ • • anby ■ • br and ¥ki ■ • ^ be a set of values of x-^- ■ a;„Zj • • Zr and of the differential coefficients entering in 4>^ about which all the functions 4>^ • ■ O^ are developable. Corresponding to each dependent variable z^ we take now a set of Ag. functions of x^- • x^, say ^^, ft>J^\ • ■ •, <^^' "'j arbitrary save that they must be developable about a^ ■ ■ an, and such that for these values of x^- • Xn, the func- tion (l>f reduces to b^,, and the differential coefficient rf*!"*" • • +*«c^^*i'/c?a;2*2 ■ ■ '^^n^" reduces to biji' ■ • j„. Then the theorem is that there exists one, and only one, set of functions z-^- ■ Zr of x^- ■ Xn developable about a-^- ~~an satisfying the given differential equations, and such that for x~~^ = a, we have z^ = <^^, dzjdx.^ = J^' ■ ■ ■ d'"r~'Zg./d'—* r=^JK-'^\ And, moreover, if the arbitrary functions 't'ff^J^* ■ ■ ■ contain a certain number of arbitrary variables *j ■ •*

The proof of this theorem may be given by showing that if ordinary power series in K] – a, • ■ a;„ – a„ «i – ii" • • <„ - i^" be sub- stituted in the equations wherein in z, the coefficients of (a^ - (»i)"', K] - Oi, • • •, (a^ - ai)V~' are the arbitrary functions ,0,W ■ • 0j.(~',*

*divided respectively by 1, 1!, 2!, &c., then the differential equations aetermine uniquely all tlie other coefficients, and that the resulting series are convergent. We rely, in fact, upon the theory of monogenic analytical functions (see art. Functions, Analytic), a function being determined entirely by its development in the neighbourhood of one set of values of the independent variables, from which all its other values arise by continuation ; it being of course understood that the coefficients in the differential equations are to be continued at the same time. But it is to be remarked that there is no ground for believing, if this method of continuation be utilized, that the function is single-valued ; we may quite well return to the same Singular '^^^^^ °f the independent variables with a, different points ot ^^1"^ °f *li8 function, belonging, as we say, to a solutions, different branch of the function ; and there is even no reason for assuming that the number of branches is finite, or that different branches have the same singular points and regions of existence. Moreover, and this is the most difficult*

consideration of all, all these circumstances may be dependent upon the values supposed given to the arbitrary constants of the integral ; in other words, the singular points may be either fixed, being determined by the differential equations themselves, or they may be movable with the variation of the arbitrary constants of integration. Such difficulties arise even in establishing the rever- sion of an elliptic integral, in solving the equation (-pY={x-ai)

(x-a^)(x-as){x-a^); about an ordinary value the right side is developable; if we put a!~~ai= able about~~

These remarks will show the place of the theory now to be sketched of a particular class of ordinary linear homogeneous .. differential e(iuations whose importance arises from

*dltf^ . ^^ completeness and generality with which they can tiateaua ^ discussed. We have seen that if in the; equations tlonawltb <*2'M'"=2'i> dy-iidx^y^, ■ ■ ■ ,dy„_,ldx=yn_-i,dy„_Jdx= rational co-'y' "^-^y^t ' ' +"i2'"~~i' "^^l^srein a^, a,, ■ ■ ■, a„ are efficients. ''"^ *" ^^ t^ikeu to be rational functions of x, the value a; =2?" bo one for which no one of these rational func~~ tions is infinite, and y°, y^", • • • , y°„-i be quite arbitrary finite values, then the equations are satisfied by y=y°u + yj°Ui + – ■ + y°n-iUf„-.i, wherein m, Mj, • • •, Un-i are functions of x, independent oty ■ . 2/° „_i, developable about x=xf ; this value ofy is such that for x=x^ the functions y, y-i- ■ yn-i reduce respectively to y°y-^ • • y°n-\ ; it can be proved that the region of existence of these series extends within a circle centre xf and radius equal to the distance from of of the nearest point at which one of osj ■ • o„ be- comes infinite. Now consider a region enclosing k», and only one of the places, say S, at which one of a; • • »„ becomes infinite. When X is made to describe a closed curve in this region, includ- ing this point S in its interior, it may well happen that the continuations of the functions it, ttj, ■ • ■, «„_i give, when we have returned to the point x, values v, v^, • ■, i'„_i, so that the integral under consideration becomes changed to y°v+yj°Vi + – ■+y%_jy„^i. At ,xf let this branch and the corresponding values of 2/1 • • J/n-i be ■rfrj'i ■ • tfn-x ; then, as there is only one series satisfying the equation and reducing to [rfrf^ • ■ 7;»„-i) for*

x=x’, and the coeffici- ents in the differential equation are single-valued functions, wo

must have i7”M-l-7;i“iti-l i-v“r,-i«‘n-i=y°v + y\Vi + – ■+y°n-ii’n-t;

as this holds for arbitrary values of y° • • y’n-i, upon which u • -Un-i and v ■ • v„_i do not depend, it follows that each of ■t) ■ • Vn-i is a linear function o(u ■ ■ m„_i with constant coefficients, sa.jV(=AtjU+ ■ ■ -fAj„m„_i. Theny“v + – • -l-2/”„_it’„-i = (SjAiij/s”) M. + – ■ ~ (SjAj,!3/°j)K„_i ; this is equal to /i(y’u+ ■ ■ +2/°„_i«„_i) if 2{i.iry“i=fjt.y’r-i ; eliminating y ■ ■ y’n-i from these linear equa- tions, we have a determinantal equation of order n for /j, ; let yuj be one of its roots ; determining the ratios of y’y-^” • • y°n~\ to satisfy the linear equations, we have thus proved that there exists an integral, H, of the equation, which when continued round the point S and back to the starting-point, becomes changed to Hi=,itiH. Let now | be the value of x at S, and rj one of the

1

values of s— • log ft ; consider the function (a:-|) ‘iH ; when x

makes a circuit round a!=f, this becomes changed to exp{-iTir-^ (x – |)~“iftH, that is, is unchanged ; thus we may put H = (a; – ?)‘“i0i, ^] being a function single-valued for paths in the region con- sidered described about S, and therefore, by Laurent’s Theorem (see art. Functions, Analytic), capable of expression in the annular region about this point by a series of positive and negative integral powers of K-f, which in general may con- tain an infinite number of negative powers; there is, however, DO reason to suppose rj to be an integer, or even real.

Thus, if all the roots of the determinantal equation in 11, are different, we obtain n integrals of the forms (a5-f)“i0i, ■ • •, (x – D’n^n. In general we obtain as many inl egrals of this form as there are really different roots ; and the problem arises to discover, in case a root be k times repeated, k~i equations of as simple a form as possible to replace the k-i equations of the form y’>v+ ■ ■ y-iv„_i=fji,{y’u ■ ■ +y\^jU„^j} which would have existed had the roois been different. The most natural method of obtaining a suggestion lies probably in remarking that if r^ = r-^ + %, there is an

integral [{a; – |)“i”” “02 – (a; – Y\l’h, wherein the coefficients in (j) are the same functions of r + h a.s are the coefficients in i of r- ; when A vanishes, this integral takes

the form (x – f)“i[^^ t 0i log (a; – f) J or say {x-ifi[-^\og,

(s-f)] ; denoting this by 27riftK, and (»- D’l^i by H, a circuit

of the point | changes K into K’ = i- [e’^‘iCa; – f)“n«‘i (e^*^”-!

{x – J)“i0i(27ri I log (x – 1))] = ftK -f H. A similar artifice suggests

itself when three of the roots of the determinantal equation are the same, and so on. We are thus led to the result, which is justified by an examination of the algebraic conditions, that whatever may be the circumstances as to the roots of the determinantal equation, n integrals exist, breaking up into batches, the values of the con- stituents Hi, Hj, ■ ■ • of a batch after circuit about x=^ being Hi’=/iiHi, H2’=yaiH2 + Hi, ‘E.ii^ + ‘S^, and so on. And this is found to lead to the forms [x – ^Yi^i, (x – ifA’pi + i log (x – 1)], (x – iy^lxi + X2 log (x-^) + ^ (log {x – f))”], and so on. Here each of (pifiXiXi • • is a series of positive and negative integral powers of a; – 1 in which the number of negative powers may be infinite.

It appears natural enough now to inquire whether, under proper conditions for the forms of the rational functions Oj • • a„, it may be possible to ensure that in each of the series ^i^iXi- • „ the number of negative powers shall be finite. Herein ‘f^S”’^” lies, in fact, the limitation which experience has shown ‘’”” ””■ to be justified by the completeness of the results obtained. As- suming n integrals in which in each of j, xi • • the number of negative powers is finite, there is a definite homogeneous Uneai- differential equation having these integrals ; this is found by forming it to have the form y”={x-^)-”biy’/del> ”-) + (x-i)·V> ”” ”^ + ■ • • + (x-i) “b„y, where by -Jnare finite for a!=|. Conversely, assume the equation to have this form. Then on substituting a series of the form (x — Yil + A{x — f) -H A2(a! — ?)^ + • •] and- equating the coefficients of like powers of a; — f , it is found that r must be a root of an algebraic equation of order n ; this equation, which we shall call the index equation, can be obtained at once by sub’ stituting for y only (x- ^Y and replacing each of ftj • ■ b„ by their values at !K=J ; arrange the*

roots r^, r^, ■ • of this equation so that the real part of r; is equal to, or greater than, the real part of ri^.j, and take r equal to rj ; it is found that the coefficients Aj, A^ • • are uniquely determinate, and that the series converges within a circle about x=i which includes no other of the points at which the rational functions Oj • • a„ become infinite. We have thus a solution Hi=(a;f)“i0i of the differential equation. If we now substitute in the equation y =‘H.^/’>idx, it is found to reduce to an equation of order to — 1 for 1; of the form ?;’(”” ^) = (x-)~\ri’(-’) + • ■ ■ + {x-iY~’^c„_iTi, wherein Cj ■ • c„_i are not infinite at a!=f. To this equation precisely similar reasoning can then be applied-; its index equation has in fact the roots T2-ri-l, ■ ■ -, r„-ri-l; if rj — Ti be zero, the integral {x — f)~’i of the ij equation will give an integral of the original equation containing log (a; — 1) ; if r — r^ be an integer, and therefore a negative integer, the same will be true, unless in ^^ the term in (a; — D’l-‘a be absent ; if neither of these arise, the original equation will have an integral (aj-D’a^^- The 71 equation can now, by means of the one integral of it belong- ing to the index r^-r-^-l, be similarly reduced to one of order n-2, and so on. The result will be that stated above. We shall say that an equation of the form in question is regular about a;=^. We may examine in this way the behaviour of the integrals at all the points at which any one of the rational functions Oj • • a„ becomes infinite ; in general we must expect that „ beside these the value a;=:oowill be a singular point for ‘^”” ”j” the solutions of the differential equation. To test this 9”””«”’- we put x=”-lt throughout, and examine as before at t=0. For instance, the ordinary linear equation with constant coefficients has no singular point for finite values of a; ; at a; =00 it has a singular point and is not regular ; or again, Bessel’s equation x\j” + xy’ + ix^-n”)y=Oia regular about a; =0, but not about a!= on. An equation regular at all the finite singularities and also at x=a> is called a Fuchsian equation. We proceed to examine particularly the case of an equation of the second order y” + ay’ +

by=0.

Putting x=-, it becomes dh)jdt^ + {^2t-‘at)dyldt +

bt~^y=0, which is not regular about t=0 unless 2-at~^ and bf-

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*that is, unless ax and hx' are finite at a; = ■» ; which we thus assume ; putting y = t"{l + Ait+ ■ ■), we find for the index equation at a;=oo the equation r(r- l) + r (2-aa;)o+(6a:")<,=0. fth '"' ^^ there be finite singular points at fj • ■ f™, where we " nrf assume m>l, the cases m = 0, m = l being easily *^°j. dealt with, and if 0(a;) = (a;~~(j) • • ■ (a;~~?m), we must*

have a ■ 4>(x) and 6 • If, however, we make a change in the dependent

variable, puttingi/=(a;~~fi)«i~~ ■ (a!-|m)»™i7, it is easy to see that the equation changes into one having the same singular points about each of which it is regular, and that the indices at a;=fj become 0 and ft – a,-, which we shall denote by Xj, for {x – ij)<^S can be developed in positive integral powers of x — ii about a!=|j ; by this transformation the indices at a; =00 are changed \o a. + ij^+ ■ ■ + om, /3 + ft + ■ ■ +Pm which we shall denote by X, /t. If we suppose this change to have been introduced, and still denote the independ- ent variable by y, the equation has the form y" +y"2{\-'Ki)l (x-ii)+y(x,V)m-il

*Thus we see that (beside the cases m =: 0, m= 1) the " Fuchsian equation" of the second order with two finite singular points is distinguished by the &ct that it has a definite form yP^*"' when the singular points and the indices are assigned. 7auatlon ° * '®' P""ing (a; – |,)/(a; – Ij) = «/(< - 1), the sin- gular points are transformed to 0, 1, 00 , and, as is clear, without change of indices. Still denoting the independent variable by x, tlie equation then has the form a:(l -a02/"-t-s/'[l-X]-a! (iH-X-f/t)] — X/iiy=0, which is the ordinary hypergeome trie equa- tion. Provided none of X, Xj, X — /t be zero or integral, it has the solutions F(X, /i, 1-Xj, x), x*'iF(X + Xi, ii + \, H-Xj, x) about a;=0 ; about x=\ it has the solutions F(X, /»,l-X2,l-x), (l-a!)*a F(X-fX2, n + 'S^,l + \,-x), where X-l-yit-hXj-(~~X2=l ; about a:=oo it has the solutions a!~~^F(X, X-l-X,, X-;i-l-l, a;~~'), a;~~"F(/i, /iH-Xj, /t-X-(-l,a!~'), where F(o^7a;) is the series l + apx/'f +*

^ — ^ — — , which converges when |a;| < 1, whatever

tt, ft7 may be, converges for all values of x for which |a:| = l provided the real part of7-a-/3>0 algebraically, and converges for all these values except a;= 1 provided the real part of 7-0-/8 > — 1 algebraically. In

accordance with our general theory, logarithms are to be expected in the solution when one of X],X2, X — M is zero or integral. Indeed when Xj is a negative integer, not zero, the second solution about a;=0 would contain vanishing factors in the denominators of its coefficients ; in case X or /i be one of the positive integers 1, 2,- ~~, vanishing factors occur also in the numerators ; and then, in fact, the second solution about a;=0 becomes a:H times an integral polynomial of degree (— Xj) — X or of degree (— X]) — /i. But when Xj is a negative in~~ teger including zero, and neither X nor n is one of the positive integers 1, 2 • ■ (-X,), the second solution about x=0 involves a term having the factor log x. When X, is a positive integer, not zero, the second solution about x=0 persists as a solution, in accordance with the order of arrangement of the roots of the index equation in our theory ; the first solution is then replaced by an integral polynomial of degree – X or -/i, when X or /i is ono of the negative integers 0, – 1, -2, • ■ •, 1 ~~\, but otherwise con~~ tains a logarithm. Similarly for the solutions about x=l or x= 00 ; it mil be seen below how the results are deducible from those for x=0.

Denote now the solutions about a;= 0 by ■Mi,M2 > those about a;= 1 by tij, «2 ; and those about a!=oo by «>i, w^ ; in the region (S„Si) March common to the circles S„, Sj of radius 1 whose centres f f]jg are the points a;=0, a;=l, all the first four are valid, Intezn l "'^ there exist equations v^^Av^ + ᵛ, v^=Cv-^+l>V2 where A, B, C, D are constants ; in the region (SjS) lying inside the circle Sj and outside the circle S„, those that are valid are ViV^w^w^, and there exist equations », = PW] ~~+~~ Q Wj, ■»2 = ""'1 + Tw, where P, Q, E, T are constants ; thus considering any integral whose expression within the circle S„ is aiv^ + bu^, where a, 6 are constants, the same integral will be represented within the circle

Sj by (aA + hC)vi + {aQ + b'D)v^, and outside these circles wiU be represented by [(aA-f6C)P-KaB-l-ftD)R]«)i + [((iA-)-6C)Q-t-(oB-f 6D)T]m'2. a single-valued branch of sucb integral can be obtained by making a barrier in the plane joining 00 to 0 and 1 to <» ; for instance, by excluding the consideration of real negative values of X and of real positive values greater than 1, and defining the phase of X and a; – 1 for real values between 0 and 1 as respectively 0 and T. '

We can form the Fuchsian equation of the second order with three arbitrary singular points li, i^t h' and no singular point at a; =00, and with respective indices aij8ia2;82a3j33 such _ . that oi-t- ft -l-a2-h ft + 03 1/33 = 1. This equation can j™"™" then be transformed into the hypergeometric equation ^^^ eaua- in 24 ways ; for out of f j, J2, f 3 we can in six ways choose j^ j^^^ two, say li, I2. which are to be transformed respectively nggif^ intoOandl,by(a;-y/(a!-4) = <(«-l); andthenthere are four possible transformations of the dependent variable which will reduce one of the indices at i = 0 to zero and one of the indices at t=l also to zero, namely, we may reduce either oj or ftat (=0, and simultaneously either 02 or p^aX < = 1. Thus the hypergeo- metric equation itself can be transformed into itself in 24 ways, and from the expression F(X, /*. 1 – ^1. "!) which satisfies it follow 23 other forms of solution ; they involve four series in each of the argu-*

1 1 x~\ X

ments,a!,a;-l, -, , , . Five of the 23 solutions agree

X -X X x-

with the fundamental solutions already described about a;=0, x=^, a;=oo ; and from the principles by which these were obtained it is immediately clear that the 24 forms are, in value, equal in fours. The quarter periods K, K' of Jacobi's theory of elliptic functions.

of which

K=/'(l-

h sin '0)~id$, and K' is the same function of

1 – A, can easily be proved to be the solutions of a hypergeometric equation of which h is the independent ^^I^, "'' variable. When K, K' are regarded as defined in terms t^^t^'n of h by the differential equation, the ratio E'/K is an infinitely many valued function of h. But it is remarkable that Jacobi's own theory of theta functions leads to an expression for h in terms of K'/K [see art. Functions, Analytic] in terms of single- valued functions. We may

then attempt to investigate, in general, in what cases the independent variable a; of a hypergeometiic equa- tion is a single-valued function of the ratio i of two independent integrals of the equation. The same inquiry is suggested by the problem of siscertaining in what cases the hypergeometric series F(a/37x) is the expansion of an algebraic (irrational) function of x. In order to explain the meaning of the question, suppH qd , and, supposing logarithms not to enter about a!=0, choose two quite definite integrals y^jVi of the equation, say y^ = F(X/il – \x\ y, = a^iF(X -^ Xj, ai ~~f Xj, 1 4~~ Xj, x), with the condition that the phase of x is zero when x is real and be- tween 0 and 1. Then the value of %=V3 is definite for all values

of a; in the divided plane, i being a single-valued monogenic branch of an analytical function existing and without singularities all over this region. If, now, the values of i that so arise be plotted on to another plane, «. value ^ + ij of s being repre- sented by a point (p, 5) of this s-plane, and the value of x from which it arose being mentally associated with this point of the s-plane, these points will fill a connected region therein, with a continuous boundary formed of four portions corresponding to the two sides of the two barriers of the a;-plane. The question is then, firstly, whether the same value of s can arise for two different values of x, that is, whether the same point (p, q) of the s-plane can arise twice, or in other words, whether the region of the s-plane overlaps itself or not. Supposing this is not so, a second part of the question presents itself. If in the a;~~plane the barrier join~~ ing -00 to 0 be momentarily removed, and a; describe a small circle with centre at a:=0 starting from a point x= -h-ik, where h, k are small, real, and positive and coming back to this point, the original value s at this point will be changed to a value a, which in the original case did not arise for this value of x, and possibly not at all. If, now, after restoring the barrier, the values arising by continuation from

lU + ?-?!!l=4(A-Aj-A2)a;->

boundary of the s-region corresponding to the two sides of the barrier (– oo, 0) meet (at s = 0 if the real part of Xj be positive) at -an angle 2jrLi,

wbere Lj is the absolute value of the real part of Aj ; tlie same is true for the cr-region representing the branch a. The condition that the s-region shall not overlap itself requires,

then, Li<;l. But, further, we may form an infinite number of

branches o-=se’”^, <7i = (re^\ • • . in the same way, and the corre-sponding regions in the plane upon wliich y-Jyi is represented will have a common point and each have an angle 27rLi ; if neither ■overlaps the preceding, it will happen, if Lj is not zero, that at length one is reached overlapping the first, unless for some positive integer o we have 2irahi = iir, in other words Li = l/o. If this be so, the branch 'r^_^ = se'^'H will be represented by a region having the angle at the common point common with the region for the ' branch s ; but not altogether coinciding with this last region iinless Xi be real, and therefore =+l/a ; then there is oiily a finite number, «,, of branches obtainable in this way by crossing the barrier (- oo , 0). In precisely the same way, if we had begun by taking the quotient $' = (x-l)^i'S{\ + \, ii. + \,\ + \, l~x)l ^(\ M, 1 - Xa, 1 - x) of the two solutions about a;= 1, we should have found that x is not a single-valued function of s' unless \ is the in- verse of an integer, or is zero ; us s' is of the form (As + B)/(Cs + 1)), A, B, C, D constants, the same is true in our case ; equally, by considering the integrals about x= we find, as a third condition necessary in order that x may be a single-valued function of s, that X-li must be the inverse of an integer or be zero. These*

three differences of the indices, namely, Xj, \, X – /i, are the quantities which enter in the differential equation satisfied by as as a function

■of s, which is easily found to be ‘s ‘ o

{x-\r^ + \x~’ +lih{x-Vf\ where Xi=dxlds, etc.; and h^- 1 – V> 2 = 1 – V> ‘%=l-(_ A’)”- Into the converse question ■whether the three conditions are sufficient to ensure (1) that the s region coiTesponding to any branch does not overlaj) itself, (2) that no two such regions overlap, we have no space to enter. The second question clearly requires the inquiry whether the ^roup (that is, the monodromy group) of the differential equation is properly discontinuous. (See art. Groups.)

The foregbing brief account will give an idea of the mature of the function theories of differential equations ; it appears essential not to exclude some explanation of a theory intimately related both to such theories and to transformation theories, which is a generalization of Galois's theory of algebraic equations. We deal only with the application to homogeneous linear differential equations.

In general a function of variables a^, ajj. • • • is said to be rational -when it can be formed from them and the integers 1, 2, 3 • • • by a „ „ finite number of additions, subtractions, multiplications,

^ "'■f'^a.jid divisions. We generalize this definition. Assume ^U^ar ^'''' ^^ 3:^ assigned a fundamental series of quantities ^aaatloa ^^^ functions of x, in which x itself is included, such that all quantities formed by a finite number of addi- tions, subtractions, multiplications, divisions, and differentiations in regard to x, of the terms of this series, are themselves members ■of this series. Then the quantities of this series, and only these, are called rational. And by a rational function of quantities P, q, r • ■ • ia meant a function formed from them and any of the fundamental rational quantities by a finite number of the five fundamental operations. Thus it is a function which would be ■called, simply, rational if the fundamental series were widened by the addition to it of the quantities p, q, r ■ • ■ and those derivable from them by the five fundamental operations. A rational ordinary differential equation, with x as independent and ■y as dependent variable, is then one which equates to zero a rational function of y, the order k of the differential equation being that of the highest differential coefficient s/'‘ **which enters ; •only such equations are here discussed. And such an equation P=0 is called irreducible when, firstly, being arranged as an in- f J I tegral polynomial in 2/()**, *this polynomial is not the hlHt"/ product of other polynomials in yW also of rational tl^aal *<"■"> ; *"d, secondly the equation has no solution satis- •eauatlon fy^°S *^®° * rational equation of lower order. From this it follows that if an irreducible equation P=0 have one solution satisfying another rational equation Q = 0 of the same or higher order, then all the solutions of P = 0 also satisfy Q = 0. For from the equation P=0 we can by differentiation express (s-l-i) y(-^**2) ... in terms of x, y, y^\ • • -, y'‘**, and so put the function Q rationally in terms of these*

quantities only. It is sufficient, then, to prove the result when the equation Q = 0 is of the same order as F=:0. Let both the equations be arranged as

integral polynomials in 2/'' ; their algebraic eliminant in regard to 2/W must then vanish identically, lor they are known to have one common solution not satisfying an equation of lower order ; thus the equation P=0 involves Q = 0 for all solutions of P=0.*

*Now let j/W^osij/l"~~H~~)!-. ■+a„y be a given rational homogeneous linear differential equation ; let Jji • ■ 2/„ be » particular functions of X, unconnected by any equation with constant coefficients of the form Cjyi + – ■ + c„y n = 0, all satisfying the differ- '"** ential equation ; let i)i • • ijn be linear functions of*

y„, say 'rii=Aiiyi + – •+Ai„y„, where the constant

variant function tor a

coefficients Ay have a non- vanishing determinant ; ,, write {n) = A.{y), these being the equations of a general eolation linear homogeneous group whose transformations may be denoted by A, B, • • •. We desire to form a rational function 0(1;), or say {A.{y)), of i/j ■ ■ ■);„, in which the n' constants A^ shall all be essential, and not reduce effectively to a fewer number, as they would, for instance, if the 1/1 . . y„ were connected by a linear equation with constant coefficients. Such a function is in fact given, if the solutions y-^- -yn be developable in positive integral powers about a = a, by 0(7;) = 771 -f (a – as)");3 ~~I~~ • ■ • ~~I~~ (a; – a)("~"")7„. Such a function, V, we call a variant.

Then differentiating V in regard to x, and replacing t^jI"' by its value ajijl"""') ~~f~~ • •■'ranT], we can ai-range dVldx, and similarly each o(d'\/dx^ • ■ d^Yldx", where N=w^, as a linear func- tion of the N quantities tji' ' Vn- ■ J/i'""" • • W""')) and

The re- solvent

thence by elimination obtain a linear differential equa- ,.

tion for V of order N with rational coefficients. This ’” ” • we denote by F = 0. Further, each of % • • i)„ is expressible as a linear function of V, dVjdx ■ ■ • d^~^‘Vjd3^~^, with rational co- efficients not involving any of the Tfi coefficients A,j, since other- wise V would satisfy a linear equation of order less than N, which is impossible, as it involves (linearly) the m^ arbitrary coefficients A^;, which would not enter into the coefficients of the supposed equation. In particular, y-i ■ • yn are expressible rationally as Hnear functions of u, dwjdx, • • • d”wjdx”, where oi is the particular function 0(2/).

Any solution W of the equation F=0 is derivable from functions fi • ■ fn, which are linear functions of j/j • ■ y^, just as V was derived from i/i • • »;» ; but it does not follow that these functions fi •• fn are obtained from yi • • 2/n by a transformation of the linear group A, B, • • ; for it may happen that the determin- ant rf(fi • • fn)ld(yi ■ • y„) is zero. In that case fi • • f„ may be called a singular set, and W a singular solution ; it satisfies an equation of lower than the N-th order. But every solution V, W, ordinary or singular, of the equation F = 0, is expressible rationally in terms of w, du/dx, ■ ■ ■ ■ d”,ajdx” ’ ; we shall write, simply, V=r(u). Consider now the rational

irreducible equation of lowest order, not necessarily a linear equation, which is satisfied by u ; as t/j • • y„ are particular functions, it may quite well be of order less than N ; we call it the resolvent equation, suppose it of order p, and denote it by 7(11). Upon it the whole theory turns. In the first place, as 7(u) = 0 is satisfied by the solution w of F = 0, all the solutions of y{v) are solutions F = 0, and are therefore rationally expressible by u ; any one may then be denoted by r{a). If this solution of F=0 be not singular, it corresponds to a transformation A of the linear group (A, B, • ■), effected upon y-^ ■ ■ y„. The co- efficients A^ of this transformation follow from the expressions before mentioned for rii- ■ rin in terms of V, dVjdx, d’YjdaP, • ■ by substituting V=r(w) ; thus they depend on the p arbitrary para- meters wliich enter into the general expression for the integral of the equation 7(1;) =0. Without going into further details, it is then clear enough that the resolvent equation, being irreducible and such that any solution is expressible rationally, with p parameters, in terms of the solution w, enables us to define a linear homogeneous group of transformations of j/i • ■ y„ depending on p parameters ; and every operation of this (continuous) group corresponds to a rational transformation of the solution of the resolvent equation. This is the group called the rationality group, or the group of transformatioTis of the original homogeneous linear differential equation.

The group must not be confounded with a subgroup of itself, the monodromy group of the equation, often called simply the group of the equation, which is a set of transformations, not depending on arbitrary variable parameters, arising for one particular funda- mental set of solutions of the linear equation (see art. Geottps).

The importance of the rationality group consists in three propo- sitions. (1) Any rational function of t^j • • y^ which is unaltered in value by the transformations of the group can be written in rational form. (2) Ifany rational function be changed The tun- in form, becoming a rational function of y^- ■ y„, a ^"nentat transformation of the group applied to its new form will ^^'orem leave its value unaltered. (3) Any homogeneous linear '" '"^ transformation leaving unaltered the value of every ™ '■°® rational function of 2/1 • • 2/n which has a rational value, ™ff'"" belongs to the group. It follows from these that any "'■^ group of linear homogeneous transformations having ^ "" the properties (1) (2) is identical with the group in question. It is clear that with these properties the group must be of the greatest*

importance in attempting to discover what functions of x must be regarded as rational in order that the values of i/i • • 2/n may be expressed. And this is the problem of solving the equation from another point of view.

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Diffraction Gratings. — The grating is an optical instrument for the production of the spectrum ; it now generally replaces the prism in a spectroscope where large dispersion is needed, or when the ultra-violet portion of the spectrum is to be examined, or when the spectrum is to be photographed. The transparent grating consists of a plate of glass covered with lampblack, gold leaf, opaque collodion or gelatine, the coating being scratched through in parallel lines ruled as nearly equi- distant as possible. When the lines are to be ruled very close together, a diamond ruling directly on glass is used. Other transparent materials, such as fluor-spar, are some- times substituted for glass. For certain researches on long waves the grating is made by winding a very fine wire, 1-lOOOth inch in diameter, in the threads of two fine screws placed parallel to each other, soldering the wire to the screws and then cutting it away on one side of the screws. As the value of a grating is dependent upon the number of lines ruled, it is very desirable to have their num- ber great. Glass is so hard that the diamond employed for

the ruling wears away rapidly.; and hence the modem grating is generally a reflecting grating, which is made by ruling on a speculum metal surface finely ground and polished. On such a surface it is possible to rule 100,000 lines without damaging the diamond, although its point even then often wears away or breaks down. The lines are generally so close together as 15,000 or 20,000 to the inch, although it is feasible to rule them even closer — say 40,000 to 50,000 to the inch There is little advantage, however, in the higher number, and many disadvantages.

The grating produces a variety of spectra from a single source of light, and these are designated as spectra of the first, second, &c., order, the numbering commencing from the central or reflected image and proceeding in either direction from it. The dispersion depends upon the number of lines ruled in a unit of length, upon the order of the spectrum, and upon the angle at which the grating is held to the source of light. The defining power depends upon its width and the angles made by the incident and difiracted rays, and is independent of the number of lines per unit of length ruled on the grating. If this number is too small, however, the difierent order of the spectra will be too much mixed up with each other for easy vision. A convenient number is 15,000 to 20,000 lines to the inch, or from 6000 to 8000 to the centimetre. The defining power is defined as the ratio of the wave-length to the distance apart of the two spectral lines which can be just seen separate in the instrument. Thus the sodium or D lines have wave-lengths which differ from each other by '597 fjLfj., and their average wave-length is 589'3 /i/i. A spfectroscope to divide them would thus require a defining power of 988. The most powerful gratings have defining powers from 100,000 to 200,000. Lord Eayleigh's formula for the defining power is

D=]Sr7i, where D is the defining power, N is the order of the spectrum, and n is the total number of lines ruled on the grating. As the defining power increases with N, and since we can observe in a higher order as the number of lines ruled in a unit of length decreases, it is best to express the defining power in terms of the width of the grat- ing, w. In this case we have for the maximum defining power D'=20,000 w for smaU gratings, or D' = 15,000 w for extra fine large gratings, w being the width of the gratings in centimetres. It is seldom that very large gratings are perfect enough to have a defining power of more than 10,000 w, owing to imperfection of surface or ruling. The relative brightness of the different orders of

OM.

Fio. 1.— Method of using Flat Grating. A, source of light; B, slit; C, C, two telescopes, movable or fixed ; D, grating, movable about its centre ; E, ej'e-piece.

spectra depend upon the shape of the groove as ruled by the diamond. No two gratings are ever alike in this respect, but exhibit an infinite variety of

distributions of brightness. Copies of glass gratings can be made by

photography, contact prints being taken on collodio- chloride of silver or other dry plates. Eeflecting gratings can be copied by pouring collodion or gelatine over the grating and stripping off the films thus formed. The latter warp, however, and destroy the definition to a great extent. The grating always produces a brighter spectrum in the violet than a prism. In the green the reflecting speculum metal grating may be brighter than a prism spectroscope of five prisms, and for higher dispersion it surpasses the prism spectroscope both in definition and brightness in all portions of the spectrum.

To produce the pure spectrum from flat gratings, two telescopes are generall;^ used, as in Fig. 1.

The telescopes are fixed, and the grating is turned on its axis to pass to different portions of the spectrum. As the glass of the telescopes absorbs the ultra-violet hght, this portion of the spectrum is cut off entirely, unless quartz lenses are used. The concave grating avoids this trouble, and produces a spectrum without the aid of lenses, the lines being ruled on a cOncave surface instead of on a flat one. Such a grating, properly mounted, produces what has been called a normal spectrum, and is specially adapted to photographic purposes (Fig. 2).

A special form of grating of great defining power has

*t Source dF iigh^*

Pig. 2.— Method of using Concave Grating. A, source of light; B, slit ; D, grating mounted in beam C, movable along the ways Bj E ; Ft camera-box or eye-piece.

been invented by Professor Michelson of the University of Chicago, called the " echelon " spectroscope (see Spectroscopy). It is, however, of very

limited applica- tion.

See an article on "Gratings in Theory and Practice" in Astronomy and Astro-Physios, 1893, xii. p. 129. (h. A. E.)

Diffusion of Gases. — When two gases are con- tained in different parts of the same vessel, at the same pressure and temperature without any currents being set up between them, a gradual mixing takes place which is called diffusion. Diffusion may also occur if the gases are separated by a thin membrane ; it is then usually called osmosis or transpiration, and may give rise to differences of pressure on the two sides of the membrane. In the diffusion now considered such differences would cause the gas as a whole to move from the region of higher to that of lower pressure, hence the pressure of the mixture must be the same everywhere. By Dalton's law, the pressure of a mixture of two gases is the sum of the partial pressures of the comgonents, or, in other words, the sum of the pressures which each would exert separately. The sum of the partial pressures of the two gases is thus uniform. If then one gas is moving by diffusion in one direction, say from A to B, its partial pressure will be decreasing at A and increasing at B. Hence the partial pressure of the second gas must be increasing at A and

decreasing at B, — that is, it must be moving from B to A. Thus diffusion may be regarded as consisting of two streams of gas flowing in opposite directions.

Now it is natural to assume (at any rate as an approxi- mation) that the rate of flow of either gas is proportional to the rate at which its partial pressure decreases in the direction of flow, or, as engineers term it, to the " pressure gradient " in this direction. This again is proportional to the rate of decrease of the density of the component in the same direction. We may define the coefficient of diffusion as the ratio of the total mass of either com- ponent which flows across a unit surface per unit time to the rate at which the density of that component decreases in a direction perpendicular to the said unit surface.

The equations of diffusion given in Clerk Maxwell's article DiF- rusiON (Ency. Brit. 9th ed., vii. 216) need not be repeated here. According, however, to Meyer, Tait, and others, the coefficient of diffusion depends in

general on the proportion of the two compon- ents contained in the mixture, and thus varies from point to point. The diffusion equation then becomes dVi/dt—{d/dx){DdViJdx), an integral of which has been found by Boltsimann. The equation of diffusion when gravity is taken into account has been integrated by Des Coudres.

Natanson has reduced diffusion and other irreversible pheno- mena to particular eases of a general principle which he calls the " thermokiuetic principle," and which includes as ,a particular case the principle of least action of reversible dynamics. Tlie " dissipation function," or expression for the rate at which heat is dissipated by diffusion is calculated, and from it are deduced equations similar to those in Maxwell's article.

The discovery by Lord Eayleigh of an unpublished memoir " On the Physics of Media that are composed of free and perfectly elastic Molecules in a State of Motion," which paper had been deposited in '"^'^ the archives of the Eoyal Society, shows that much of the kinetic theory of gases, including the view that the temperature of a gas is proportional to the square of the molecular velocity, was first established by J. J. Waterston in 1845. The kinetic theory, in its general aspect, is supported by modern experi- ments in high vacua. In many of Dewar's experiments with liquid air a glass bulb placed in a mercury vacuum becomes coated with mercury in a surpris- ingly short time. The rate of deposition agrees fairly well with the formula for the total mass of molecules falling on a unit of area per unit time, viz., ^pq where /D = density, 5 = mean molecular velocity. Sir William Crookes's observation, that if two unequally exhausted vacuum tubes are connected by a fine capillary tube, equalization of pressure takes place very slowly, accords with what we should naturally expect in a rarefied gas consisting of molecules moving in straight lines, and rebounding from the sides of the vessels with but rare collisions with each other ; for the molecules would rarely chance to strike on the opening of the tube. The cathode rays have been attributed to a stream of molecules or particles projected by the cathode, and the fact that they only exist in high vacua accords with the view that at ordinary pressures the molecules of gas would collide with and obstruct them. In 1899 J. J. Thomson demonstrated the existence of such particles ("corpuscles" or "electrons") having masses much smaller than

those of atoms ; a similar conclusion was arrived at in connexion with the Becquerel rays by M. and Mme. Curie.

The presence of certain gases in the atmospheres of some planets and their absence from others admits in some cases of a ready explanation according to the kinetic theory, to which may be attributed in particular the absence of atmosphere from the moon. Those molecules which are moving away from a planet with velocity greater than that due to the planet's attraction tend to escape from the planet's atmosphere. Hence we should expect

the smaller planets to retain only the denser gases whose molecular velocity at a given temperature is least. Yet the present writer's calculations indicate that the molecular velocities assigned by the kinetic theory are insufficient in themselves to remove helium from our atmosphere, a point discussed by Stoney in 1897 and 1900. Very similar in principle is the explanation of dissociation. If we assume the molecules of a compound gas to be made up of atoms which are bound together by their mutual attraction, and adopt Boltzmann's hypothesis that the heat-energy of a molecule is due partly to translation and partly to rotation, it is evident that with increase of temperature there will be an increasing number of molecules, in which the "centrifugal force" due to rotation exceeds the force of attraction between the atoms, causing these atoms to break asunder. The kinetic theory of dissociation is treated at some length in Boltzmann's book.

The distribution of velocity among the molecules of a gas, worked out by Watson and Burbury in their article Boltemann- ^oi-ECtrLE (Ency. Brit., 9th ed., xvi. 612), is Maxwell called the Boltzmann-Maxwell distribution, and disttiba- when it exists the gas is said by Tait to be tiott. jjj ^jjg "special state." There is abundant

evidence that this distribution holds good in any gas in which (a) the actions between the molecules resemble the collisions of elastic bodies ; (6) the sum of the volumes of the individual molecules is very small compared with the volume of the gas.

Much doubt still exists as to how far the distribution is applic- able to gases whose molecules are of appreciable volume, or repel one another with finite forces which are functions of the distances between them. Burbury is of opinion that in such cases the motions of the molecules tend to become correlated, by which he means that two neighbouring molecules are more likely to move in the same than in opposite directions. For monatomic molecules ^material particles or smooth spheres), he finds that the probability of the velocity components {Ui,Vi,Wi), (MjjDjjWj)... lying within the limits of the multiple differential dtiidv^dwi. du^v^w^. . . is pro- portional to «—'"", where

6]2 being a negative function of the distance between the two molecules designated by the suffixes 1, 2, which is inappreciable except when this distance is small. The motion changes its character when Q ceases to be essentially positive, and this change may possibly be the condition for liquefaction. If the 6,2 coefficients vanish we have the Boltzmann-Maxwell distribution.

The special case of the Boltzmann-MaxweU distribution for molecules regarded as non-spherical, elastic, rigid bodies, and capable of having angular velocities lUj, Wj, Wj about their principal axis of inertia, besides translatory velocities v, v, w of their centre of gravity, is interesting. The kinetic energy is given by

T = |m(«2 ± 1;2) M.2) -f ^(Ao).2 + Bco^s + CogS), and the distribution being given by the expression

e' du dv dw dw-ydw^dm^, it follows that the mean values of Jmw', mv, Jmw^, A(i)j2, JBcoj, G are each equal to 1/A. This is a particular case of a statement known as Maxwell's Law of Partition of Energy, according to which in certain cases, " if the kinetic energy of a system be expressed as a sum of squares, the mean values of these squares are equal." The applicability of this law to dynamical systems in general, and indeed to any systems other than groups of molecules arranged according to the Boltzmann-Maxwell distribution, has for many years been a source of controversy, and was discussed in 1900 by Lord Eayleigh. When C = 0, or the molecule consists of a distribution of masses along a straight line, the energy is equally divided between the five remaining components ; this gives a specific heat ratio of 1'4 approximating to that of most gases, while the specific heat ratio, on the hypothesis that the energy

is wholly translational, is 1§, or nearly that of argon. The tendency of the molecules of a gas to assume the Boltzmann-Maxwell distribution, if their velocities are initially distributed in any other manner, has been investigated by Boltzmann and Watson in a theorem known as Boltzmann's Minimum Theorem.

Let fdv denote the probability that the co-ordinates and momenta of a molecule shall lie within the limits of the multiple differential dv{, = dpi,...dqn of Watson and Burbury's article Molecule). Let H denote the integral // log fdv, or for a mixture of gases letH=S/'/log/(iw, the sumujation extending over the several components. Then it is proved in the Minimum Theorem that, as the result of intermolecular collisions or encounters, H tends to decrease until the ' ' special state " is reached, when it becomes a minimum. This proposition is furthenshown by Boltzmann to admit of both mathematical and physical interpretations.

(1) According to the theory of probability, Boltzmann finds that if W is proportional to the probability that the distribution of co-ordinates and momenta may be defined by the function /, then log W is proportional to -H. Hence, as H decreases, W increases ; in other words (a) the molecular motions tend to pass from less probable to more probable distributions, and (6) the Boltzmann-Maxwell distribution is the most probable of all distributions.

(2) The entropy of the gas is proportional to — H-f- a constant, and the tendency of H to decrease to a minimum thus represents the physical property that the entropy of a system tends to in- crease to a maximum.

When the molecules of a gas are thoroughly mixed (as assumed in the Minimum Theorem), it appears, from the calculations of Tait and Watson, that a very small fraction of a second is sufficient, in ordinary cases, to restore the molecules to the Boltzmann-Maxwell distribution. We now have to consider difiusion and allied phenomena in which the distribution, instead of being uni- form, varies at different points of the gas. In such cases the process of equalization, which is comparatively slow, depends on the free paths of the molecules between collisions. We proceed to investigate the general problem by a method based on the work of Boltzmann and used subsequently by Burbury.

If a molecule A moving with velocity w impinge nonually on a stratum of gas of thickness x containing n molecules per unit volume, whose velocities are distributed about a mean velocity q, it is easy to see that, if nx is small, the probability of its encountering another molecule in traversing the layer is propor- tional to nirs'x, where a is the sum of the radii of the impinging and interfering molecules when these are spherical, and s is deter- mined by the linear dimensions of the molecules in other cases. Since, moreover, the probability is evidently unaltered by in- creasing the velocities of the impinging and interfering molecules in the same ratio it may be written mr^!nj/(wjq), where

=L..{^-^Ki)}'=

e =e I

Here I is the constant defined in the article Molbcitle (Ency. Brit. vol. xvi. p. 616). The mean free path may be found as in that article. Tait, on the other hand, defines the mean free path as the mean value of I, when the molecule A is replaced by a number of molecules in the "special state," and the value he finds for a simple gas is 0 ■677/mxs'-'.

*Now let G be any physical quantity (e.g., mass, charge of electricity, momentum, energy, &c.) which may be carried by a molecule. Let the quantity of G per unit volume vary uni- formly in the direction of the axis of z, and be denoted by G(z) ; also let f{w)dw denote the proportion of molecules whose trans- lational speeds are between lo and «» -^ dw. It is required to find the rate at which G is being carried across the plane z=z^*

Now the total number of molecules crossing the plane Zf, in unit of time, and having their velocities between w and w + dw, in directions at inclinations to the axis of «

The number of those that have travelled a distance between X and X ɨ rf\ since their last encounter is found by multiplying this

number bye" d\jl. These molecules must have collided between the planes z^z^ + X cos 6 and z=z^ + {\ + d\) cos B, and they are assumed to cany their average share of the quantity G between

these two planes, i.e., G{Za + \ cos 0). Hence tlie total quantity of O carried across the plane z = 2q in the negative direction is r, where

/» fir rx p-l^/l

dw\ d9 d\ wf{w) J sine cos9 %— G^z. + \ cosS), 0 J Q J 0 I

the integration between 9=0 and 6=\Tr representing the part due to molecules coming from the positive side and between B=\Tr and d = -K, that due to molecules coming from the negative side. Making the assumption that G varies uniformly, or neglecting differeutiaf coefficients above the first, we obtain

therefore

G(2o + X cosS) = G(2o) + X cos9 1 dG

r=;

3 dz

f{wyuildw=-wi

0 6

dG dz' dG

For the diffusion of two gase's, A and B, in a mixture containing N» and Nj molecules per unit volume of the two components, we put G=N,i and G=Ki in succession, and obtain

^»=3«"" -dT

l—rdNi

If wla and wh are unequal, Ta and Tj will be unequal. The formula gives more molecules flowing in one direction than in the other, and the pressure (which is proportional to N„ + Nj) would on this hypothesis soon cease to be uniform. Meyer assumes, therefore, that there is a counter current Fj-r^, and, as in the article Molecule, the coefficient of diffusion becomes

1 ‘SgWlg + ‘S^Oli

3 Na + Nj •

If, however, we assume that the diffusion of the gas A is unaffected by its collisions with molecules of the same gas, and only depends on collisions with the B molecules, and similarly for the gas B, we get for the coefficient of diffusion

1 wlg + wh

a 2 ■

The last formula has been used by Stefan, but is objected to by Meyer. Both formulae have been tested experimentally, but practical difficulties give rise to discrepancies in the observed results quite as great as the differences given by the formulae. Where the gases are mixed in equal proportions tlie two formulas become identical ; and to decide between them it is necessary to examine diffusionin mixtures where one gas |ireponderates largely over the other. Such oases are, however, difficult of observation.

When the molecules are of the same size, shape, and mass wla = wh, and the coefficient of diffusion is \wl on either hypothesis. It is therefore everywhere constant.

Taking unequal spherical molecules, Tait, by evaluating the integrals depending on his form of I, arrives at the

following conclusions : — (1) For molecules of Tart’s cott- equal mass, a difiference of size, the mean of the

diameters being unchanged, favours diffusion. (2) Diffusion is, however, but little affected by even a con- siderable disparity in size of the molecules, but depends mainly on the mean of the diameters. (3) Taking molecules of masses in the ratio 16:1, and of diameters in the ratios 3:1, 1:1, and 1 : 3, it is found that if the sum of the diameters is kept constant, difftision is most rapid when the molecules of greater mass have the greater diameter. (4) A gas diffuses more quickly into one of different than into one of the same specific gravity. (5) If the diameters of the more massive molecules are decreased and of the lighter ones increased, keeping their sum constant, the rate of diffusion decreases to a minimum at first and then increases before the more massive molecules become infini- tesimal compared with the others. (6) Owing to the smallness of the variations of the diffusion-coefficient, ex- periments on diffusion are not well suited for determining the relative size of the molecules of different gases.

Next taking G to represent translational velocity in a plane

perpendicular to the axis of z and assuming it to be proportional

to 2, if the density be p, then pV will represent the

momentum carried across the plane z=Zq per unit

time, i.e., the shearing force, and the coefficient of

dGjdz in pV will be the coefficient of viscosity, whiih

therefore =^pwl.

In conduction of heat the mean translational energy T or ^{mw}

is a function of z. If /{w)dw denote the proportion of molecules

Viscosity and thermal conduB- tlrlty.

with speeds between w and w + dwaXa, point where this mean energy ia ‘)^^,f{w)dw will at oilier points denote the proportion of molecules witli speeds between w J^IlJTii) and {w + dw) ^{T/1’q). We assume these

molecules to carry with them translational energy imw^T/Tn, and rotational energy i^muf' T/T, where p = 2/(3A – 3) – 1, and k is the specific heat ratio. In calculating the true thermal conduc- tivity we have to separate the transference of heat-energy due to conduction proper from that due to motion of the medium. By a method resembling Boltzmann's we find

r = 5t^ -§rjh»{w" + Pw^)u;l dw

*M^^BwlV^*

3T liz^J ""- "^^"^ '""• """~3 1^+^"'}- Putting 5j = ^nniwl we see that the thermal conductivity of a gas is proportional to its coefficient of viscosity i/. The above, and other f ormulee based on alternative assumptions, give in general for the conductivity an expression of the form

Cv being the specific heat at constant volume and A, B, con stants. Meyer finds A = 0'795, B = 0'205, giving for air at 0° C, K = 406.10-" centigrade C.G.S. units. Boltz- mann finds A = |f, B= – ^f, giving K = 536.10-1 The values observed for air by Stefan and Winkelmann are 558.10"' and 525.10"' respectively. The thermal con- ductivity of gases is treated at considerable length by Verdet-Ruhlmann.

In the equation T = wl dGjdz the coefficient of dGjdz, viz. \wl, varies as the mean velocity w and as the mean free path I. Now from the expression mrs in the de- nominator of Tait's formula, or otherwise, we infer that for the same gas or mixture of gases I varies inversely as n, and therefore directly as the volume. Hence on the hypothesis that the molecules are elastic bodies the co- efficients of diffusion, viscosity, and conductivity vary as the volume and the square root of the absolute tempera- ture. If the pressure p and temperature T be taken as variables they will vary inversely as p and directly as Ti Now it appears from Maxwell's experiments that the co- efficient of viscosity at constant density is proportional to T instead of T and from Loschmidt's experiments it is not improbable that the coefficient of diffusion at constant pressure is proportional to T^ instead of Tl These con- siderations led Maxwell to consider a kinetic theory based on the hypothesis that the molecules of a gas repel one another with finite forces which are functions of the distance between them, and in particular to consider the case when the force varies*

inversely as the fifth power of the distance, in whigh case the viscosity varies as T. The phenomena of diffusion, viscosity, and conductivity and fluid motions, have been worked out on this hypothesis very fully by Boltzmann and others. The relation of the coefficient of diffusion to the temperature appears, how- ever, difficult to determine experimentally. A "pressure balance" for this purpose has been described by M. Toepler.

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Dignano (Slavonic, Vodnjan), a town in the government district of Pola, Istria (Austria), about 8 miles north of Pola, on the railway from Trieste. It is situated on a gentle slope overlooking the Gulf of Venice, a few miles from the shore. The principal resource of the inhabitants (in 1890, 9151 ; in 1900, 9684 — mostly Italian) is the cultivation of the vine, olive, fruit, and the silkworm, together with a con- siderable trade in timber. The so-called rose-vine, one of the best of the Istrian varieties, is grown in the vicinity.

Dijon, chief town of department Cote-d'Or, France, 196 miles south-east of Paris, on railway from Paris to Lyon. It is the seat of a court of appeal for the depart- ments of Cote d'Or, Haute Marne, and Seine-et-Loire, and has schools of medicine and pharmacy. Since the Franco-Prussian "War it has been strongly fortified, and it is now protected by eight forts. The bathing

establish- ment or casino was rebuilt in ornate style in 1886. The manufacture of heavy iron goods and machinery has become extensive, and there are large soap works, while black-currant liqueur ("cassis de Dijon") is a speciality; cotton-spinning is still carried on, but textile industries are no longer of any account. Population (1881), 46,344 ;

(1891), 66,673; (1901), 70,428.

Dillmann, Christian Friedrich August

(1823-1894), German theologian and Orientalist, was born at Illingen, Wiirtemberg, 26th April 1823. He commenced the study of theology at Tubingen, where he was a favourite pupil of Ewald, who en- couraged him to pursue the study of the Oriental languages, of which, after having for some years been a Privat-docent, he became extraordinary professor in 1863. In 1854 he removed to Kiel, where he was made regular professor in 1860. Having, however, signalized himself as a divine as well as an Oriental scholar, he was in 1864 invited to fill the post of professor of biblical exegesis at Giessen, and in 1869 succeeded the celebrated Heng- stenberg as exegetical professor at Berlin. His lectures were much esteemed, but his principal distinction was

gained by his researches in the Ethiopic language and literature, upon which he was regarded as the highest living authority. Between 1846 and 1848, and before his first appointment at Tiibingen, he visited France and England as a student, and while in England pre- pared the seventh volume of the Bodleian catalogue of manuscripts, comprising the Ethiopic. This catalogue was published in 1848. Dillmann also catalogued the Ethiopic MSS. in the British Museum. In 1861 he edited the apocryphal Book of Enoch in the Ethiopic version, the only one in which it is extant, and published an annotated translation of it in 1863. In the same year he translated the Ethiopic Book of Adam, and in 1865 edited the ancient Ethiopic translation of the Old Testament. He was also the author of an Ethiopic grammar (1867) and lexicon (1862-66), standard works in their department of philology. Among his Ethiopic labours may also be reckoned two works on the history of the kingdom of Axum, published in 1879 and 1880. His principal theological writings are On the Origin of the Religion of the Old Testament (1865) and On the Political Activity of the Old

Testament Prophets (1868). His investigations are characterized by a prevailing spirit of moderation and sobriety. He died at Berlin, 4th July 1894, leaving the reputation not merely of a great Ethiopic scholar, but of the re- viver of a branch of Oriental study which had fallen into neglect. (r. g.)

Diloio, Lalce. See Congo.

Dimensions of Units. — Measurable entities of different kinds cannot be directly compared. Each one must be specified in terms of a unit of its own kind ; a single number attached to this unit forms its measure. Thus if the unit of length be taken to be L centimetres, a line whose length is I centimetres will be represented in relation to this unit by the number Z/L ; while if the unit is increased times, that is [L][T]'" times: this expression thus repre- sents the dimensions (1 in length and — 2 in time) of the derived entity acceleration in terms of its fundamental elements length and time. In the science of dynamics all entities are derived from the three fundamental ones, length, time, and mass ; for example, the dimensions of force (P) are those of mass and acceleration jointly, so that in algebraic form [P] = [M] [L] [T]-^. This restriction of the fundamental units to three is therefore applicable to

all departments of physical science that are reducible to pure dynamics.

The mode of transformation of a derived entity, as regards its numerical value, from one set of fundar mental units of reference to another set, is exhibited in the simple illustrations above given. When the numerical values of the new units, expressed in terms of the former ones, are substituted for the symbols, in the expression for the dimensions of the entity under consideration, the number which results is the numer- ical value of the new unit of that entity in terms of the former unit: thus all numerical values of entities of this kind must be divided by this number, in order to transfer them from the former to the latter system of fundamental units.

As above stated, physical science reduces the pheno- mena of which it treats to the common denomination of the positions and movements of masses. Before the time of Gauss it was customary to use a statical measure of force, alongside the kinetic measure depending on the accelera- tion of motion that the force can produce in a given mass. Such a statical measure could be conveniently applied by the extension of a spring, which, however, has to be cor- rected for temperature, or by weighing against standard weights, which has to be corrected for locality. On the other hand, the kinetic measure is independent of local conditions, if only we have absolute scales of length and time at our disposal. It has been foimd to be indispens- able, for simplicity and precision in physical science, to express the measure of force in one way ; and statical forces are therefore now generally referred in theoretical discussions to the kinetic unit of measurement. In me- chanical engineering the static unit has largely survived ; but the increasing importance of electrical applications is introducing imiformity there also. In the science of electricity two different systems of units, the electrostatic and the electrodynamic, still to a large extent persist. The electrostatic system arose because in the development of the subject statics came before kinetics ; but in the complete synthesis it is even now found convenient to express the various quantities in terms of the electro- kinetic system alone.

The system of measurement now adopted as fundamen- tal in physics takes the centimetre as unit of length, the gramme as unit of mass, and the second as unit of time. The choice of these units was in the iirst instance arbi- trary

and dictated by convenience; for some purposes subsidiary systems based on multiples of these units by certain powers of ten are found convenient. There are certain absolute entities in nature, such as the constant of gravitation, the velocity of light in free space, and the constants occurring in the expression giving the constitu- tion of the radiation in an enclosure that corresponds to each temperature, which are the same for all kinds of matter ; these might be utilized, if known with sufficient accuracy, to establish a system of units of an absolute or cosmical kind. The wave-length of a given spectral line might be utilized in the same manner, but that depends on recovering the kind of matter which produces the line.

In physical science the uniformities in the course of phenomena are elucidated by the discovery of permanent or intrinsic relations between the measurable properties of material systems. Each such relation is expressible as an equation connecting the numerical values of entities be- longing to the system. Such an equation, representing as it does a relation between actual things, must remain true when the measurements are referred to a new set of fundamental units- Thus, for example, the kinematical equation v^=nfl, if n is purely numerical, contradicts the necessary relations involved in the definitions of the entities velocity, acceleration, and length which occur in

it. For on changing to a new set of units as above the equation should still hold; it, however, then becomes tf/\Y]'=n ~~*f/l^y ■ Z/[L]. Hence on division there re*~~ *mains a dimensional relation [V^[L], which is in disagreement with the dimensions above determined of the derived units that are involved in it. The inference follows either that an equation such as that from which we started is a formal impossibility, or else that the factor n which it contains is not a mere number, but represents n times the unit of some derived quantity which ought to be specified in order to render the equation a complete statement of a physical relation. On the latter hypothesis the dimensions [lif] of this quantity are deter- mined by the dimensional equation [V]=[]Sr][F[L] where, in terms of the fundamental units of length and time, [V] = [L] [T*~~*S [F] = [L] [T]"*~~ *; whence by substitu tion it appears that [N] = [L]"^[T]l Thus, instead of being merely numerical, n must represent in the above formula the measure of some physical entity, which may be classified by the statement that it has the conjoint dimensions of time directly and of velocity inversely.*

It often happens that simple comparison of the dimen- sions of the quantities which determine a physical system- will lead to important knowledge as to the necessary rela- tions that subsist between them. Thus in the case of a simple pendulum the period of oscillation t can depend only on the angular amplitude a of the swing, the mass m of the bob considered as a point, and the length I of the suspending fibre considered as without mass, and on the value of g the acceleration due to gravity, which is the active force; that is, T=f(a,m,l,g). The dimensions must be the same on botii sides of this formula, for, when they are expressed in terms of the three independent dynamical quantities mass, length, and time, there must be complete identity between its two sides. Now the dimensions of g are [Ij] [T]"" ; and when the unit of length is altered, the numerical value of the period is unaltered, hence its expression must be restricted to the form /(a, m, l/g). Moreover, as the period does not depend on the unit of mass, the form is further reduced to /(a, l/g) ; and as it is of the dimensions ~~f~~ 1 in time, it must be a multiple of Q/gY, and therefore of the form ^{a)-sj(l/g). Thus the period of oscillation has been determined by these considerations except as regards the manner in which it depends on the amplitude a of the swing. When a process of this kind leads to a definite result, it will be one which makes the unknown quantity jointly proportional to various powers of the other quantities in- volved ; it will therefore shorten the process if we assume such an expression for it in advance, and find whether it is possible to determine the exponents definitely and uniquely so as to obtain the correct dimensions. In the present example, assuming in this way the relation T=AaPm"l'g', where A is a pure numeric, we are led to the dimensional equation [T] = [aJ'[M]«[L]'~~', show~~ ing that the law assumed would not persist when the fundamental units of length, mass, and time are altered, unless 9=0, s= —\, r=\ ; as an angle has no dimensions, being determined by its numerical ratio to the invariable angle forming four right angles, p remains undetermined. This leads to the same result, T=(a)l+^g-^, as before.

As illustrating the power and also the limitations of this method of dimensions, we may apply it (after Lord Eayleigh, Hoy. Soc. Proc. , March 1900) to the laws of viscosity in gases. The dimen- sions of viscosity (/i) are (force/area) h- (velocity/length), giving [ML'iT"'^] in terms of the fundamental units. Now, on the dynam- ical theory of gases viscosity must

he a function of the mass m of a molecule, the number n of molecules per unit volume, their velocity of mean square n, and their effective radius a ; it can depend on nothing else. The equation of dimensions cannot supply more than three relations connecting these four possibilities of

variation, and so cannot here lead to a definite result without further knowledge of the physical circumstances. And we remark conversely, in passing, that wherever in a problem of physical dynamics we know that the quantity sought can depend on only three other quantities whose dynamical dimensions are known, it must vary as a simple power of each. The additional knowledge required, in order to enable us to proceed in a case like the present, must be of the form of such an equation of simple variation. In the present case it is involved in the new fact that in an actual gas the mean free path is very great compared with the effective molecular radius. On this account the mean free path Is inversely as the number of molecules per unit volume ; and therefore the coeificient of viscosity, being proportional to these two quantities jointly, is independent of either, so long as the other quantities defining the system remain unchanged. If the molecules are taken to be spheres which exert mutual action only during collision, we therefore assume

which requires that the equation of dimensions

[ML-iT-i] = [M]'[LTJJi'[L]'

must be satisfied. This gives z=l, y=l, z=—2. As the tem- perature is proportional to mlP, it follows that the viscosity is proportional to the square root of the mass of the molecule and the square root of the absolute temperature, and inversely proportional to the square of the effective molecular radius, being, as already seen, uninfluenced by change of density. If the atoms are taken to be Boscovichian points exerting mutual attractions, the effective diameter a is not definite ; but we can still proceed in cases where the law of mutual attraction is expressed by a simple formula of variation — that is, provided it is of type knfir' where r is the

dis- tance between the two molecules. Then, noting that, as this is a force, the dimensions of k must be [M-^L'+'T-], we can assume*

provided [ML-'T-i] = [MJ'CLT-iJJ'CM-iL'+iT-"]", which demands and is satisfied by

X— 10=1, y+2w=l, y+{s+V)w= — l,

so that

2 s+3 s-3

s— 1 «— 1 s— 1

Thus, on this supposition,

***-9 2 rt**+3*

where 8 represents absolute temperature. (See Dippubion of Gases.)

In electrical science two essentially distinct systems of measurement were arrived at according as the develop- ment began with the phenomena of electrostatics or those of electrokinetics. An electric charge appears as an entity having different dimensions in terms of the funda- mental dynamical units, in the two cases : the ratio of these dimensions proves to be the dimensions of a velocity. It was found, first by W. Weber, by measuring the same charge by its static and its kinetic effects, that the ratio of the two units is a velocity sensibly identical with the velocity of light, so far as regards experiments conducted in space devoid of dense matter. The emergence of a definite absolute velocity such as this, out of a comparison of two diiferent ways of approaching the same quantity, entitles us to assert that the two ways can be consolidated into a single dynamical theory only by some development in which this velocity comes to play an actual part. Thus the hypothesis of the mere existence of some complete dynamical theory was enough to show, in the stage which electrical science had reached under Gauss and Weber, that there is a definite physical velocity involved in and underlying electric phenomena, which it would have been hardly possible to imagine as other than a velocity of propagation of

electrical effects of some kind. The time was thus ripe for the reconstruction of electric theory by Faraday and Maxwell.

The power of the method of dimensions in thus reveal- ing general relations has its source in the hypothesis that, however complicated in appearance, the phenomena are really restricted within the narrow range of dependence on the three fundamental entities. The proposition is also therein involved, that if a changing physical system

be compared with another system in which the scale is altered in different ratios as regards corresponding lengths, masses, and times, then if all quantities affecting the second system are altered from the corresponding quan- tities affecting the first in the ratios determined by their physical dimensions, the stage of progress of the second system will always correspond to that of the first ; under this form the application of the principle, to determine the correlations of the dynamics of similar systems, originated with Newton (Frincipia, lib. ii. prop. 32). For example, in comparing the behaviour of an animal with that of another animal of the same build but on a smaller scale, we may take the mass per unit volume and the muscular force per unit sectional area to be the same for both ; thus [L], [M], . . . being now ratios of corre- sponding quantities, we have [ML”^] = 1 and [ML-‘T-”]=1, giving [L] = [T] ; thus the larger animal effects move- ments of his limbs more slowly in simple proportion to his linear dimensions, while the velocity of movement is the same for both. But this is only on the hypothesis that the extraneous force of gravity does not intervene, for that force does not vary in the same manner as the muscular forces. The result has thus application only to a case like that of fishes in which gravity is equilibrated by the buoyancy of the water. The limbs of a land animal have mainly to support his weight, which varies as the cube of his linear dimensions, while the sectional areas of his muscles and bones vary only as the square thereof. Thus the diameters of his limbs should increase in a greater ratio than that of his body, — theoretically in the latter ratio raised to the power f , if other things were the same. An application of this principle, which has become indispensable in modern naval architecture, permits the prediction of the behaviour of a large ship from that of a small-scale model. The principle is also • of very wide utility in unravelling the fundamental relations in definite physical problems of such

complexity that complete treatment is beyond the present powers of mathematical analysis ; it has been applied, for example, to the motions of systems involving viscous fluids, in elucidation of wind and waves, by Helmholtz (^ad. Berlin, 1873 and 1889), and in the electrodynamics of material atomic systems in motion by Lorentz and by Larmor. (j. l.)*

Dinajpur, a town (with a population in 1891 of 12,204) and district of British India, in the Eajshahi division of Northern Bengal. The earthquake of 12th June 1897 caused serious damage to most of the public buildings of the town. There is a railway station; a Government high school, with 284 pupils in 1896-97; and five printing-presses, with one vernacular periodical. The district comprises an area of 4118 square miles. Its population in 1881 was 1,514,346, and in 1891 was 1,555,835, giving an average density of 378 persons per square mile, being the lowest in the plains of the province. Classified according to religion, Hindus numbered 740,442 ; Mahommedans, 802,597; aborigines, 10,694; Christians, 611, of whom 30 were Europeans ; " others," 1291. In 1901 the population was 1,569,133, showing an increase of 6 per cent. The land revenue and rates were Rs.16,26,711 ; the number of police was 423 ; the number of boys at school in 1896-97 was 22,489, being 18-4 per cent, of the male population of school-going age; the registered death-rate in 1897 was 34-72 per thousand. The district is partly traversed by the main line of the Eastern Bengal railway and by two branch lines.

Dinan, chief town of arrondissement, department of Cotes-du-Nord, France, 35 miles east by south of St Brieuc, on railway from that town to St Malo. In a suburb of the town are many English residents. The new lyc^e (1892)

is installed in a fine building, and the public library now contains about 90,000 volumes. The principal manu- factures now are farming implements and earthen ware. During the bathing season steamboats ply regularly be- tween Dinan and St Malo. The old cemetery of the church of St Sauveur has been converted into a public garden. Population (1881), 7893 : (1896), 7828, (comm.)

8462 ; (1901), 10,634.

Dinapur, a town of British India, in the Patna district of Bengal, on the right bank of the Ganges, 12 miles west of Patna city by rail. In 1881 it had a population of 37,893, and in 1891 of 44,419. It is the largest military cantonment in Bengal, with accommodation for two batteries of artillery, a European and a native infantry regiment.

Dindigul, a town of British India, in the Madura district of Madras, 880 feet above the sea, 40 miles from Madura by rail. In 1881 it had a population of 14,182, and in 1891 of 20,115 ; the municipal income in 1897-98 was Rs.32,070. Dindigul has risen into importance as the centre of a trade in tobacco and manufacture of cigars, which are exported to England. There are now two large European cigar factories here. It has manufactures of silk, muslin, and blankets, and an export trade in hides and cardamoms ; and there is a large native Christian popula- tion, with two churches. It also has a municipal high school and two printing-presses.

Dindorf, Wilhelm (1802-1883), German classical scholar, was born at Leipzig, 2nd January 1802, and was the son of the university professor of Oriental languages. From his earliest years he showed a strong partiality for classical studies, and after completing Invernizzi's edi- tion of Aristophanes at an early age, and editing several grammarians and rhetoricians, was in 1828 appointed professor of literary history in his native city. Einding, however, that the d^ity of lecturing interfered too much with his philosophical pursuits, he resigned this office in 1833, and devoted himself entirely to Hellenic studies. His attention was at first chiefly given to Athenaeus, whom he edited in 1827, and to the Greek dramatists, all of whom he edited separately and combined in his Poetae Scenwi Ghraed (1830). He also wrote a work on the metres of the dramatic poets, and compiled special lexicons to ^schylus and Sophocles. He edited Procopius and other historians for Niebuhr's great Corpus of the Byzantine writers, and between 1846 and 1851 brought out at Oxford a highly important edition of Demosthenes; he also edited Lucian and Josephus for the Didot Classics. His last important editorial labour was his EuseUus of Ccesarea (1867-71). Much of his attention was occupied by the great republication of Stephanus's Thesaurus (Paris, 1832-65), chiefly executed by him and his

brother Ludwig, a work of prodigious labour and utility. His reputation suffered somewhat through the imposture practised upon him by the Greek Constantino Simonides, who succeeded in deceiving him by a fabricated fragment of the Greek historian Uranius. The book was printed, and a few copies had been circu- lated, when the forgery was discovered, just in time to prevent its being given to the world under the auspices of the University of Oxford. Dindorf died on 1st August 1883. — His brother Ludwig (1805-1871) was born at Leipzig on 3rd January 1805, and died there on 6th September 1871. Like Wilhelm, he declined academ- ical office, and he secluded himself so entirely for study that many doubted his existence, and affirmed that he was a mere pseudonym . The important share which he took in the edition of Stephanus's Thesaurus is neverthe- less authenticated by his own signature to his contribu-

tions, and he published valuable editions of Polybius, Dion Cassius, and other Greek historians. (e. g.)

D'Indy, Paul – Marie – Theodore – Vincent

(1851), French musical composer, was born in

Paris, 27th March 1851. He studied composition under Cesar Franck, the organ at the Paris Conservatoire, and obtained the Grand Prize offered by the city of Paris in 1885 with Le Chant de la Cloche, a dramatic legend after Schiller. His principal works, beside the above, are the symphonic trilogy Wallenstein, the symphonic works entitled Sauge fleuri, La For&t enchanUe, Istar, Sym- phonie sur un air montagnard fran^is; overture to Anthony and Cleopatra; Ste Marie Magdeleine, a can- tata ; Attendez moi sous Vorme, a one-act opera ; Fervaal, a musical drama in three acts. Vincent d'Indy is per- haps the most prominent among the disciples of Cesar Franck. Imbued with very high aims, he has always, been guided by a lofty ideal, and very few musicians have attained so complete a mastery over the art of instru- mentation. His music, however, lacks simplicity, and can never become popular in the widest sense. His opera Fervaal, which is styled " action musicale," is con- structed upon the system of Lett motifs. Its legendary subject recalls both Parsifal and Tristan, and the music is also suggestive of Wagnerian influence. D'Indy can scarcely be considered so typical a representative of modern French music as his juniors Alfred

Bruneau, the composer of Le Rive, L'Attaque du Moulin, Messidor^ or Gustavo Charpentier, the author of Louise, who have chosen subjects of modem life for their operatic works. He nevertheless occupies a distinguished position as one of the most gifted among the musicians of his country.

Dineir, a small town in Asia Minor, built amidst the ruins of Celaenae-Apamea, near the sources of the Mseander (Mendere), is the terminus of the Smyrna- Aidin-Dineir railway. The population numbers 1400. (See Apamea.)

Dingelstedt, Franz von, Bakon (1814-1881),. German poet and dramaturgist) was born at Halsdorf, in Hesse Cassel, 30th June 1814. In 1836 he became a teacher at the Government school at Cassel, from which, having given offence to the authorities, he was transferred to Fulda in 1838. Despairing of being reinstated, he resolved to abandon his profession for literature, and in 1841 obtained an appointment on the staff of the Augshurger Allgemeine Zeitung. He had previously, in 1839 and 1840 respectively, produced a novel, Unter der Erde, which obtained considerable success, and a play,, Gespenst der Ehre (" The Phantom of Honour "), which, proved an utter failure. In 1841 appeared the book by which he is likely to be best remembered, the Lieder eines kosmopolitischen Nachtwachters, a most effective contribu- tion to the political poetry of the day, animated with a spirit of bitter opposition to the prevalent despotism and distinguished by great sarcastic power. Extreme, there- fore, was the surprise when, in 1844, the satirist of German princes accepted the appointment of private librarian to the King of Wurtemberg, and he was unanimously de- nounced as a renegade. In reality, his political convictions had never been very deep, and his hostile attitude towards the rulers was chiefly inspired by a spirit of scepticism and irony, to which the Liberals were as obnoxious as their opponents. His marriage in 1843 with the celebrated actress Jenny Lutzer probably had much influence on his. decision. In 1845 he published a volume of poems, some of which, treating of modern life, possessed great literary rather than strictly poetical merit. A subsequent collection, published in 1852, attracted little attention. In 1850 a tragedy on the House of Barneveldt obtained

great success, and it still ranks as one of the best German plays of the period. In the following year he accepted an invitation to undertake the direction of the Royal Theatre at Munich. He proved one of the ablest managers that Germany had ever seen, but incurred the animosity of the Jesuit clique about the court, and in 1856 was suddenly dismissed on the most frivolous charges. A similar engagement was soon offered to him at Weimar through the influence of Liszt, and, although not altogether easy in his situation, he remained there until 1867. His administration was most successful, and he especially distinguished himself by putting all Shakespeare's historical plays upon the stage. In 1867 he removed to Vienna, and directed the Imperial Theatre there until his death in 1881. Among his other works may be noticed an autobiographical sketch of his Munich career, entitled Munchener Bilderbogen (1879), Die Ama- zone, an art novel of considerable merit (1869), translations of several of Shakespeare's comedies, and a treatise on the theatrical administration which he understood so well. His life, founded on his posthumous papers, was written by Julius Eodenberg in 1890. He was ennobled by the Emperor of Austria. Dingelstedt possessed few qualifications for the higher walks of poetry, but his style both in prose and verse was admirable, and he might have been the poet of modern social life. It is probable that the imputation of political apostasy under which he laboured impeded the full exercise of his abilities. (e. g.)

Dingwall, a market-town, royal and parliamentarj' burgh (Wick group), railway station, and county town of Ross-shire, Scotland, on the north-west shore of the Cromarty Firth, 13^ miles north-west of Inverness. A small harbour opens on to the Peffer river. There are county buUdings, militia barracks, public hall, a cottage hospital, and a public park. There is an academy. Population (1891), 2300 ; (1901), 2519.

Dinkar Rao, Sir, Raja (1819-1896), Indian states- man, was born in Ratnagiri on 20th December 1819, being a Maratha Brahnian. At fifteen he

entered the service of the Gwalior state, in which his ancestors had served. Rapidly promoted to the responsible charge of a •division, he displayed unusual talents in reorganizing the police and revenue departments, and in reducing chaos to order. In 1852 Dinkar Rao became Dewan. The events which led to the British victories of Maharajpur and Pan- niar in 1844 had filled the state with mutinous soldiery, ruined the finances, and weakened authority. With a strong hand the Dewan suppressed disorder, abolished ruinous imposts, executed public works, and by a reduction of salaries, including his own, turned a deficit into a sur- plus. When the contingent mutinied, he never wavered in loyalty; and although the state troops also mutinied in June 1858 on the approach of Tantia Topi, he adhered to the British cause, retiring with the Maharaja Sindhia to the Agra fort. After the restoration of order he remained minister until December 1859, when he resigned. In 1873 he was appointed guardian to the minor Rana of Dholpur, but soon afterwards he resigned, ow'ing to ill- health. In 1875 the Viceroy selected him as a Commis- sioner, with the Maharajas Sindhia and Jaipur, and three British colleagues, to try the Gaekwar of Baroda on a charge of attempting to poison the British Resident. No higher honour could have been conferred on a British subject. He served in the Legislative Council of India, and was frequently consulted by Viceroys on difScult questions. An estate was conferred upon him, and the hereditary title of Raja, for his eminent services, and he also received the decoration of K.C.S.I. He died on 9th January 1896. No Indian statesman of the 19th century

gained a higher reputation, yet he possessed none of the qualifications which entitled Salar Jung, Madava Rao, Eanga Charlu, or Sheshadri Aiyar to fame. He only commenced the study of English at the age of forty, and was never able to converse fluently in it ; his orthodoxy resented social reforms ; he kept aloof from the Congress, and he had received no training in British administration. Finally he resigned the service in Gwalior and Dholpur just when his work seemed likely to bear most fruit. But the verdict of posterity has endorsed the favourable opin- ion entertained by his contemporaries. (w. l.-w.)

DiognetUS, Epistle to. — The one manuscript which contained this letter perished by fire at Strasburg in 1870, but happily it had been accurately collated by Reuss nine years before. It formed part of a collection of works

supposed to be by Justin Martyr, and to this mistaken attribution its preservation is no doubt due. The end of it is lost, but there followed in the codex the end of a homily, which was attached without a break to the epistle : this points to the loss in some earlier codex of pages containing the end of the letter and the beginning of the homily.

Diognetus has expressed a desire to know what Chris- tianity really means — " What is this new race " of men who are neither pagans nor Jews ? " What is this new interest which has entered into men's lives now and not before?" The answer begins with a refutation of the folly of worshipping idols, fashioned by human hands and needing to be guarded if of precious material. The re- pulsive smell of animal sacrifices is enough to show their monstrous absurdity. Next Judaism is attacked. Jews abstain from idolatry and worship one God, but they fall into the same error of repulsive sacrifice, and have absurd superstitions about meats and sabbaths, circum- cision and new moons. So far the task is easy ; but the mystery of the Christian religion "think not to learn from man." A passage of great eloquence follows, show- ing that Christians have no obvious peculiarities that mark them off as a separate race. In spite of blameless lives they are hated. Their home is in heaven, while they live on earth. " In a word, what the soul is in a body, this the Christians are in the world. . . . The soul is enclosed in the body, and yet itself holdeth the body together: so Christians are kept in the world as in a prison-house, and yet they themselves hold the world together." This strange life is inspired in them by the almighty and invisible God, who sent no angel or subor- dinate messenger to teach them, but His own Son by whom He created the universe. No man could have known God, had He not thus declared Himself. " If thou too wouldst have this faith, learn first the knowledge of the Father. For God loved men, for whose sake He made the world . . . Knowing Him, thou wilt love Him and imitate His goodness ; and marvel not if a man can imitate God: he can, if God will." By kindness to the needy, by giving them what God has given to him, a man can become " a god of them that receive, an imitator of God." " Then shalt thou on earth behold God's life in heaven ; then shalt thou begin to speak the mysteries of God." A few lines after this the letter suddenly breaks off.

Even this rapid summary may show that the writer was a man of no ordinary power. Both his thought and his language mark him off entirely from Justin Martyr. Bishop Lightfoot, who speaks of the letter as " one of the noblest and most impressive of early Christian apologies," places it c. 150 a.d., and inclines to identify Diognetus with the tutor of M. Aurelius. Harnack would place it later, perhaps in the 3rd century. There are some strik- ing parallels in method and language to the Apology of Aristides, and also to the early " Preaching of Peter,"

of which Aristides also has made considerable use (see Aeistides, Apology of).

The Epistle may be read in Lightfoot's Apostolic Fathers (ed. min.), where there is also a translation into English.

(j. a! k.)

Diomedes, The. — Two small islands situated in the middle of Bering Strait, about a mile apart, between which passes the boundary line between the possessions of Russia and the United States. They are granite domes without a harbour, and are occupied by a small tribe of Eskimo (85 in 1890), who have plied the trade of middle- men between Asia and America from prehistoric times. They are situated in N. lat. 65° 46' ; the western is called by the natives Nundlrbook, and the eastern, Ignalook. They were discovered by Deshneff in 1648.

Diosgydr, a market-town of Northern Hungary, Si- miles west of Miskolcz. Population (1891), 6537 ; (1900), 11,526. The state has here some of the largest iron and steel works in the country, employing regularly, in company with the mines, 6000 men. To accommodate these, two large barracks have been erected, besides numerous houses ; also schools, hospitals, and other in- stitutions. A large paper-mill likewise deserves mention. The Hungarian kings in old times used often to visit the now dismantled fortress.

Diphtheria. — Great attention has been paid to diphtheria in recent years, with some striking results. Its cause and nature have been definitely ascertained, the con- ditions which influence its prevalence have been elucidated, and a specific " cure " has been found. In the last respect it occupies a unique position at the present time. In the case of several other zymotic diseases much has been done by way of prevention, little or nothing for treatment ; in the case of diphtheria prevention has failed, but treatment has been revolutionized by the introduction of antitoxin, which constitutes the most important contribution to practical medicine as yet made by bacteriology.

The exciting cause of diphtheria is a micro-organism, identified by Klebs and Loffler in 1883. A description of it will be found under the heading of Pathology Causation, (ᵖ^f^ging Diseases). It has been shown by experiment that the symptoms of diphtheria, including the after-effects, are produced by a toxin derived from the micro-organisms which lodge in the air-passages and multiply in a susceptible subject. The natural history of the organism outside the body is not well understood, but there is some reason to believe that it lives in a dormant condition in suitable soils. Eecent research does not favour the theory that it is derived from defective drains or " sewer gas," but these things, like damp and want of sunlight, probably promote its spread, by lowering the health of persons exposed to them, and particularly by causing an unhealthy condition of the throat, rendering it susceptible to the contagion. Defective drainage, or want of drainage, may also act, by polluting the ground, and so providing a favourable soil for the germ, though it is to be noted that " the steady increase in the diphtheria mortality has coincided, in point of time, with steady improvement in regard of such sanitary circumstances as water supply, sewerage, and drainage " (Thome Thome). Cats and cows are susceptible to the diphtheretic bacillus, and fowls, turkeys, and other birds have been kno.wn to suffer from a disease like diphtheria, but other domestic animals appear to be more or less resistant or immune. In human beings the mere presence of the germ is not sufficient to cause disease ; there must also be susceptibility, but it is not known in what that consists. Individuals exhibit all degrees of resistance up to complete immunity. Children are far more susceptible than adults, but even children may

have the Klebs-LofBler bacillus in their throats without showing any symptoms of illness. Altogether there are many obscure points about this micro-organism, which is apt to assume a puzzling variety of forms. Nevertheless its identification has greatly facilitated the diagnosis of the disease, which was previously a very difficult matter, often determined in an arbitrary fashion on no particular principles. Diphtheria, as at present understood, may be defined as sore throat in which the bacillus is found ; if it cannot be found, the illness is regarded as something else, unless the clinical symptoms are quite unmistakable. One result of this is a large transference of registered mor- tality from other throat affections, and particularly from croup, to diphtheria. Croup, which never had a well-defined application, and is not recognized by the College of Physicians as a synonym for diphtheria, appears to be dying out from the medical vocabulary in Great Britain. In France the distinction has never been recognized.

Diphtheria is endemic in all European and American countries, and is apparently increasing, but the incidence varies greatly. It is far more prevalent on the Continent than in England, and still more so in the United States and Canada. The following table, compiled from figures collected by Dr Newsholme, shows how London compares with some foreign cities. The figures give the mean death-rate from diphtheria and croup for the term of years during which records have been kept. The period varies in different eases, and therefore the com- parison is only a rough one.

Mean Death-Bates from Diphtheria and Croup per Million living.

Preva- lence.

New York

. ICIO

Munich

. 990

Chicago .

. 1400

Milan .

. 990

Buenos Aires

. 1360

Florence .

. 830

Trieste

. 1300

Vienna

. 770

Dresden .

. 1290

Stockholm .

. 720

Berlin

. 1190

St Petersburg

. 650

Boston

. 1160

Moscow

. 640

Marseilles

. 1130

Paris .

. 630

Christiania

. 1090

Hamburg .

. 490

Budapest .

. 1880

London^ .

. 386

There is comparatively little diphtheria in India and Japan, but in Egypt, the Cape, and Australasia it prevails very extensively among the urban populations. The mor- tality varies greatly from year to year in all countries and cities. In Berlin, for instance, it has oscillated between a maximum of 2420 in 1883 and a minimum of 340 in 1896; in New York between 2760 in 1877 and 680 in 1868 ; in Christiania between 3290 in 1887 and 170 in 1871. In some American cities still higher maxima have been recorded. In other words, diphtheria, though always endemic, exhibits at times a great increase of activity, and becomes epidemic or even pandemic. The following

table shows fairly well the periodical rise and fall in England and Wales. Diphtheria and croup are given both separately and together, showing the increasing transference from one to the other of late years. Diphtheria was first entered separately in the year 1859, with which the table begins.

Deaths from Diphtheria and Croup per Million living in England and Wales.

Tears.

Diphtheria.

Croup.

Diphtheria and Croup.

1859

517

286

803

1860 .

261

220

481

1861-70

185

246

431

1871-80

121

168

289

1881-90

/

163

144

307

1891-95

254

70

324

1896-97

269

43

312

1898 .

244

27

271

1899 .

293

32

325

■*468*

DIPHTHEEIA

Several facts are roughly indicated by this table. It begins with an extremely severe epidemic, which has not been approached since. Then follows a fall extending over twenty years. On the whole this diminution was progressive, though not in reality so steady as the decennial grouping makes it appear, being interrupted by smaller oscillations in single years and groups of years. Still the main fact holds good. After 1880 an opposite movement began, likewise interrupted by minor oscillations, but on the whole progressive, and culminat- ing in the year 1893 with a death-rate of 389, the highest recorded since 1865. After 1896 a marked fall again took place. This is partly accounted for by the use of antitoxin, ~~which only began on a considerable scale in 1895, and did not bexjome general until a year or two later at least. Probably its effects are only now, being fully felt, and they undoubtedly affect the Eegistrar~~ General's return, which record mortality, not prevalence — that is to say, the number of deaths, not of cases. The factor, therefore, must not be forgotten, but it can hardly account for the whole of the diminution.

On the whole, we get clear evidence of an epidemic rise and fall, which may serve to dispose of some erroneous conceptions. The belief, held until recently, that diphtheria is steadily increasing in Great Britain was obviously pre- mature ; it did rise over a series of years, but has now ebbed again. Moreover, the general prevalence during the last thirty years has been notably less than in the previous twelve years. Yet it is during years since 1870 that compulsory education has been in existence and main

drainage chiefly carried out. It follows that neither school attendance nor sewer gas exercises such an important influence over the epidemicity of diphtheria as some other conditions. What are those conditions ? Dr Newsholme has advanced the theory, based on an elaborate examinar tion of statistics in various countries, that the activity of diphtheria is connected with the rainfall, and he lays down the following general induction from the facts: " Diphtheria only becomes epidemic in years in which the rainfall is deficient, and the epidemics are on the largest scale when three or more years of deficient rainfall follow each other." He points out that the comparative rarity of diphtheria in tropical climates, which are characterized by excessive rainfall, and its greater prevalence in continental than in insular countries, confirm his theory. His observations seem quite contrary to the view laid down by various authorities, and hitherto generally accepted, that wet weather favours diphtheria. The two^ however, are not irreconcilable. The key to the problem — and possiblyto many other epidemiological problems — may perhaps be found in the movements of the subsoil water. It has been suggested by different observers, and particularly by Mr M. A. Adams, who has for some yetos made a study of the subsoil water at Maidstone, that there is a definite connexion between it and diphtheria. In England the underground water normally reaches its lowest level at the end of the summer ; then it gradually rises, fed by percolation from the winter rains, reaching a maximum level about the end of March, after which it gradually sinks. This maximum level Mr Adams calls the annual spring cleaning of the soil, and his observations go to show that when the normal movement is arrested or disturbed, diphtheria becomes active. Now that is what happens in periods of drought. The underground water does not rise to its usual level, and there is no spring cleaning. The hypothesis, then, is this: The diphtheria bacillus lives in the soil, but is "drowned out " in wet periods by the subsoil water. In droughty ones it lives and flourishes in the warm, dry soil ; then when rain comes, it is driven out with the ground air into the houses. This process will continue for some time, so

that epidemic outbreaks may well seem to be associated with wet. But they begin in drought, and are stopped by long-continued periods of copious rainfall. This is quite in keeping with the observed fact that diphtheria is a seasonal disease, always most prevalent in the last quarter of the year. The

summer develops the poison in the soil, the autumnal rains bring it out. The fact that the same cause does not produce the same effect in tropical countries may perhaps be explained by the extreme violence of the alternations, which are too great to suit this particular micro-organism, or possibly the regularity of the rainfall prevents its development.

The foregoing hypothesis is supported by a good deal of evidence, and notably by the concurrence of the great epidemic or pandemic prevalence in Great Britain, culmin- ating in 1859, with a prolonged period of exceptionally deficient rainfall. Again, the highest death-rate registered since 1865 was in 1893, a year of similarly exceptional drought. But it is no more than an hypothesis, and the fate of former theories is a warning against drawing con- clusions from statistics and records extending over too short a period of time. The warning is particularly neces- sary in connexion with meteorological conditions, which are apt to upset all calculations. As it happens, a period of deficient rainfall even greater than that of 1854-58 has recently been experienced. Itbegan inl893andculminated in the extraordinary season of 1899. The dry years were 1893, 1895, 1896, 1898, and 1899, and the deficiency of rainfall was not made good by any considerable excess in 1894 and 1897. It surpassed all records at Greenwich; streams and wells ran dry all over the country, and the flow of the Thames and Lea was reduced to the lowest point ever recorded. There should be, according to the theory, at least a very large increase in the prevalence of diphtheria. To a certain extent it has held good. There was a marked rise in 1893-96 over the preceding period, though not so large as might have been expected, but it w^as followed by a decided fall in 1897-98. The experience of 1898 contradicts, that of 1899 supports, the theory. Further light is therefore required ; but perhaps the failure of the recent drought to produce results at all comparable with the epidemic of the 'fifties may be due to variations in the resistance of the disease, which differs widely in different years. It may also be due in part to improved sanitation, to the notification of infectious diseases, the use of isolar tion hospitals, which have greatly developed in quite recent years, and, lastly, to the beneficial effects of antitoxin. If these be the real explanations, then scientific and adminis- trative work has not been thrown away after &,11' in com- bating this very painful and fatal enemy of the young.

The conditions governing the general prevalence of diphtheria, and its epidemic rise and fall, which have just been discussed, do not touch the question of actual dissemination. The contagion is spread by [a]^'. means which are in constant operation, whether the general amount of disease is great or small. Water, so important in some epidemic diseases, is believed not to 1 e one of them, though a negative proof based on absence of evidence cannot be accepted as conclusive. On the other hand, milkis undoubtedly ameans of dissemination. Several outbreaks of an almost explosive character, besides minor extensions of disease from one place to another, have been traced to this cause. Milk may be contaminated in various ways, — at the dairy, for instance, or on the way to customers, — but several cases, investigated by the officers of the Local Government Board and others, have been thought to point to infection from cows suffering from adiphtheritic affection of the udder. The part played by aerial convection is undetermined, but there is no reason to suppose that the infecting material is conveyed any distance by wind or air currents. Instances which seem to point to the contiary

may be explained in other ways, and particularly by the iact, now fully demonstrated, that persons suffering from minor sore throat, not recognized as diphtheria, may carry the disease about and introduce it into other localities. Human intercourse is the most important means of dis- semination, the contagion passing from person to person €ith€r by actual contact, as in kissing, or by the use of the same utensils and articles, or by mere proximity. In the last case the germs must be supposed to be air^borne for short distances, and to enter with the breath. Eooms appear liable to become infected by the presence of diph- theritic cases, and so spread the disease among other persons using them. At a small outbreak which occurred at Darenth Asylum in 1898 the infection clung obsti- nately to a particular ward, in spite of the prompt removal of all cases, and fresh ones continued to occur until it had been thoroughly disinfected, after which there were no more. The part played by human inter- course in fostering the spread of the disease suggests that it would naturally be more prevalent in

urban communi- ties, where people congregate together more, than in rural ones. This is at variance with the conclusion laid down by some authorities, that in this country diphtheria used to affect chiefly the sparsely populated districts, and though tending to become more urban, is still rather a rural disease. That view is based upon an analysis of the distribution by counties in England and Wales from 1855 to 1880, and it has been generally accepted and Tepeated until it has become a sort of axiom. Of course the facts of distribution are facts, but the general infer- ence drawn from them, that diphtheria peculiarly affects the country and is changing its habitat, may be erroneous. Dr Newsholme, by taking a wider basis of experience, has arrived at the opposite conclusion, and finds that diphtheria does not, in fact, flourish more in sparsely peopled districts. " When a sufficiently long series of years is taken," he says, " it appears clear that there is more diphtheria in urban than in rural communities." The rate for London has always been in excess of that for the whole of England and Wales. Its distribution at any given time is determined by a number of circum- stances, and by their incidental co-operation, not by any property or predilection for town or country inherent in the disease. There are the epidemic conditions of soil and rainfall, previously discussed, which vary widely in different localities at different times ; there is the steady influence of regular intercourse, and the accidental ele- ment of special distribution by various means. These things may combine to alter the incidence. In short, accident plays too great a p,art to permit any general con- clusion to be drawn from distribution, except from a very wide basis of experience. The variations are very great and sometimes very sudden. For instance, the county of London has for years headed the list, having a far higher death-rate than any other. In 1898 it dropped to the fifth place, and was surpassed by Rutland, a purely rural county, which had the lowest mortality of all in the pre- vious year and very nearly the lowest for the previous ten years. Again, South Wales, which had a low mortality for some years, has recently and rapidly become a diph- theria district, and in 1898 had the highest death-rate in the whole country. Staffordshire and Bedfordshire show a similar rise, the one an urban, the other a rural, county. All the northern counties, both rural and urban, — namely, Northumberland, Durham, Cumberland, Westmorland, Lancashire, Yorkshire, Cheshire, and Lincolnshire, — had a very high rate in 1861-70, and a low one in 1896-98. It is obviously unsafe to draw general conclusions from distribution data on a small scale.

Diphtheria appears to creep about very slowly, as a rule, from place to place, and from one part of a large town to another ; it forsakes

one district and appears in another ; occasionally it at- tacks a fresh locality with great energy, presumably because the local conditions are exceptionally favourable, which may be due to the soil or, possibly, to the suscep- tibility of the inhabitants, who are, so to speak, virgin ground., But through it all personal infection is the chief means of spread.

The acceptance of this doctrine has directed great atten- tion to the practical question of school influence. There is no doubt whatever that it plays a very considerable part in spreading diphtheria. The incidence of the dis- ease is chiefly on children, and nothing so often and reg- ularly brings large numbers together in close contact under the same roof as school attendance. Nothing, in fact, furnishes such constant and extensive opportunities for personal infection. Many outbreaks have definitely been traced to schools. In London the subject has been very fully investigated by Dr Shirley Murphy, the Medical Oflicer of Health to the County Council, and by Dr W. E. Smith, who fills the same post for the London School Board. Dr Murphy has shown that a special incidence on children of school age began to manifest itself after the adoption of compulsory education, and that the summer holidays are marked by a distinct diminution of cases, which is succeeded by an increase on their return to school. Dr W. E. Smith's observations are directed rather to minimizing the effect of school influence, and to showing that it is less important than other factors ; which is doubtless true, as has been already remarked. It ap- pears that the heaviest incidence falls upon infants under school age, and that liability diminishes progressively after school age is reached. But this by no means disposes of the importance of school influence, as the younger children at home may be infected by older ones, who have picked up the contagion at school, but, being less susceptible, are less severely affected and exhibit no worse symptoms than a sore throat. From a practical point of view the problem is a difficult one to deal with, as it is virtually impossible to ensure the exclusion of all infection, on account of the deceptively mild forms it may assume; but considering how very often out- breaks of diphtheria necessitate the closing of schools, it would probably be to the advantage of the authorities to discourage, rather than to compel, the attendance of

children with sore throats. A fact of some interest revealed by statistics is that in the earliest years of life the incidence of diphtheria is greater upon male than upon female children, but from three years onwards the position is reversed, and with every succeeding year the relative female liability becomes greater. This is probably due to the habit of kissing maintained among females, but more and more abandoned by boys from babyhood onwards. It emphasizes the part played by personal infection.

All these considerations suggest the importance of segregating the sick in isolation hospitals. Of late years this preventive measure has been carried out with increas- ing efficiency, owing to the better provision of such hos- pitals and the greater willingness of the public to make use of them ; and probably the improvement so effected has had some share in keeping down the prevalence of the disease to comparatively moderate proportions. Unfortunately, the complete segregation of infected persons is hardly possible, because of the mild symptoms, and even absence of symptoms, exhibited by some indi- viduals. A further difficulty arises with reference to the discharge of patients. It has been proved that the bacillus may persist almost indefinitely in the air-passages in ceitain cases, and in a considerable proportion it does persist for several weeks after convalesence. On return- ing home such cases may, and often do, infect others.

Treatment

Since antitoxin was introduced in 1894 it has over- shadowed all other methods of treatment. We owe this drug originally to the Berlin school of bacteri- ologists, and particularly to Dr Behring. The idea of making use of serum arose about 1890, out of researches made in connexion with Metschnikoff's theory of phagocytosis, by which is meant the action of the phagocytes or white corpuscles of the blood in destroying the bacteria of disease. It was shown by the German bacteriologists that the serum or liquid part of the blood plays an equally or more important part in resisting disease, and the idea of combating the toxins produced by pathogenic

bacteria with resistant serum injected into the blood presented itself to several workers. The idea was followed up and worked out independently in France and Germany, so successfully that by the year 1894 the serum treatment had been tried on a considerable scale with most encouraging results. Some of these were published in Germany in the earlier part of that year, and at the Inter- national Hygienic Congress, held in Budapest a little later, Dr Eoux, of the Institut Pasteur, whose experience was somewhat more extensive than that of his German col- leagues, read a paper giving the result of several hundred cases treated in Paris. When all allowance for errors had been made, they showed a remarkable and even astonishing reduction of mortality, fully confirming the conclusions drawn from the German experiments. This consensus of independent opinion proved a great stimulus to further trial, and before long one cUnique after another told the same tale. The evidence was so favourable that Pro- fessor Virchow — the last man to be carried away by a novelty — declared it " the imperative duty of medical men to use the new remedy" (TJie Times, 19th October 1894). Since then an enormous mass of facts has accumulated from all quarters of the globe, all testifying to the value of antitoxin in the treatment of diphtheria. The experi- ence of the hospitals of the London Metropolitan Asy- lums Board for five years may be given as a particularly instructive illustration, because it represents a prolonged experiment on an immense scale, and because the mor- tality was already comparatively low in those hospitals before the use of antitoxin. '

Annual Case Mortality in Metropolitan Asylums Board's Hospitals.

Before Antitoxin.

Aftek Antitoxin.

Year.

Mortality

Tear Mortality

per cent.

°’‘- percent.

1890 .

. 33-55

1895 . . . 22-85

1891 .

. 30-61

1896 . . . 21-20

1892 .

. 29-51

1897 . . . 17-79

1893 .

. 30-42

1898 . . . 15-37

1894 .

.. 29-29

1899 . . . 13-95

The number of cases dealt with in the five antitoxin years was 32,835, or an average of 6567 a year, and the broad result is a reduction of mortality by more than one- half. It is a fair inference that the treatment saves the lives of about 1000 children every year in London alone. This refers to all cases. Those which occur in the hospitals as a sequel to scarlet fever, and consequently come under treatment from the commencement, show very much more striking results. The case mortality, which was 46-8 per cent, in

1892 and 58-8 per cent, in 1893, has been reduced to 3-6 per cent, since the introduction of antitoxin. But the evidence is not from statistics alone. The beneficial eifect of the treatment is equally attested by clinical observation. Dr Eoux's original account has been con- firmed by a cloud of witnesses year after year. " One may say," he wrote, "that the appearance of most of the patients is totally different from what it used to be. The pale and leaden faces are scarcely seen in the wards ; the expression of the children is brighter and more lively."

Adult patients have described the relief afforded by inoculation; it acts like a charm, and lifts the deadly feeling of oppression off like a §loud in the course of a few hours. Finally, the counteracting effect of antitoxin in preventing the disintegrating action of the diphtheritic toxin on the nervous tissues has been demonstrated pathologically. There are some who still affect scepti- cism as to the value of this drug. They cannot be acquainted with the evidence, for if the efficacy of anti- toxin in the treatment of diphtheria has not been proved, then neither can the efficacy of any treatment for any- thing be said to be proved. Prophylactic properties are also claimed for the serum ; but protection is necessarily more difficult to demonstrate than cure, and though there is some evidence to support the claim, it has not been fully made out.

AuTHOKiTiES. — Adams. Public Health, vol. vii. — Thokne Thokne. Milroy Lectures, 1891. — Newsholme. Epidemic Diphtheria.— W . R. Smith. Harben Lectures, 1899. — Muephy. Seport to London County Council, 1894. — Sims Woodheaju. Report to Metropolitan Asylums Board, 1901. (a. sl.)

Dirschau, a town of Prussia, province of West Prussia, on the left bank of the Vistula, 20 miles south from Danzig and at the junction of important lines of railway. The river is here crossed by two fine iron bridges. The older structure dating from the year 1857, originally used for the railway, is now given up to road traffic, and the railway carried by a new bridge com- pleted in 1891. Dirschau has railway workshops and manufactories of sugar, agricultural implements, and cement. During the war with Poland, Gustavus Adol- phus made it his headquarters for many months after its capture in 1626. Population (1885), 11,146; (1900),

12,808.

Distribution. See Zoological Distribution.

District of Columbia.

capital of the United States.

See Washington, the

Dittersbach, a village of Prussia, prov. Silesia, 3 miles by rail south-east from Waldenburg and 50 miles south-west from Breslau. It has coal-mines, bleachfields, and match factories. Population (1900), 9371.

Diu, an island and town of India, belonging to Portu- gal, and situated at the south extremity of the peninsula of Kathiawar. Area of district, 20 square miles. Popu- lation, 13,206. Many of the inhabitants are the well-known Banyan merchants of the East Coast of Africa and Arabia. Native spirits are distilled from the palm, salt is made, and fish caught.

Dividend , the net profit periodically divisible among the proprietors of a joint-stock company in proportion to their respective holdings of its capital. Dividend is not interest, although the word dividend is frequently applied to payments of interest; and a failure to pay dividends to shareholders does not, like a failure to pay interest on borrowed money, lay a company open to being declared bankrupt. In bankruptcy a dividend is the proportionate share of the proceeds of the debtor's estate received by a creditor. The Companies Act, 1862, pro- vides that no dividend shall be payable except out of the profits arising from the business of the company, but, in the case of companies incorporated by special Act of Parliament for the construction of railways and other public works which cannot be completed for a considerable time, it is sometimes provided that interest may during construction be paid to the subscribers for shares out of capital. All dividends are payable in cash, while the divi-

dends ou tlie shares of a few American railroad companies are occasionally made payable either in cash or in new shares of the company at the proprietor's option. Most companies divide their capital into at least two classes, called " preference " shares and " ordinary " shares, of which the former are entitled out of the profits of the com- pany to a preferential dividend at a fixed rate, and the latter to whatever remains after payment of the prefer- ential dividend and any fixed charges. Before, however, a dividend is paid, a part of the profits is often carried to a " reserve fund." The dividend on preference shares is either " cumulative " or contingent on the profits of each separate year or half-year. When cumulative, if the profits of any one year are insufficient to pay it in full, the deficiency has to be made good out of subsequent profits. A cumulative preferential dividend is sometimes said to be " guaranteed," and preferential dividends pay- able by all companies registered under the Companies Acts, 1862 to 1900, are cumulative unless stipulated to be otherwise. Certain public companies are forbidden by Parliament to pay dividends in excess of a prescribed maximum rate, but this restriction has been happily mod- ified in some instances, notably in the case of gas com- panies, by the institution of a sliding scale, under which a gas company may so regulate the price of gas to be charged to consumers that any reduction of an authorized standard price entitles the company to make a propor- tionate increase of the authorized dividend, and any in- crease above the standard price involves a proportionate decrease of dividend. Dividends are usually declared yearly or half-yearly ; and before any dividend can be paid it is, as a rule, necessary for the directors to submit to the shareholders, at a general meeting called for the pur- pose, the accounts of the company, with a report by the directors on its position and their recommendation as to

the rate of the proposed dividend. The articles of asso- ciation of a company usually provide that the sharehold- ers may accept the directors' recommendation as to dividend or may declare a lower one, but may not declare a higher one than the directors recommend. Directors frequently have power to pay on account of the dividend for the year, without consulting the shareholders, an " in- terim dividend," which on ordinary shares is generally at a much lower rate than the final or regular dividend. An exceptionally high dividend is often distributed in the shape of a dividend at the usual rate supplemented by an additional dividend or

“bonus.” Payment of dividends is made by means of cheques sent by post, called “divi- dend warrants.” All dividends are subject to income-tax, and by most companies dividends are paid “less income- tax,” in which case the tax is deducted from the amount of dividend payable to each proprietor. When paid without such deduction a dividend is said to be ” tree of income-tax.” In the latter case, however, the company has to make provision for payment of the tax before declar- ing the dividend, and the amount of its divisible profits and the rate of dividend which it is able to declare are consequently to that extent reduced. In respect of con- sols and certain other securities, holders of amounts of less than £1000 may instruct the Bank of England or Bank of Ireland to receive and invest their dividends. With few exceptions, the prices of securities dealt in on the Stock Exchange include any accruing dividend not paid up to the date of purchase. As soon as a price ceases to include any accruing dividend, it is marked ” ex dividend ” or ” x.d.” The expression ” cum dividend ” is used to signify that the price of the security dealt in includes a dividend which, in the absence of any stipu- lation, might be supposed to belong to the seller of the security. (s. d. h.)

DIYOROE.

DIVORCE is the dissolution, in whole or in part, of the tie of marriage. It includes both the complete abrogation of the marriage relation known as a divorce a vinculo matrimonii, which carries with it a power on the part of both parties to the marriage to remarry other persons or each other, and also that incomplete severance not involv- ing powers to remarry, which was formerly known as divorce a mensd et tlioro, and has in England been termed ” judicial separation.” Less strictly, divorce is commonly understood to include judicial declarations of nullity of marriage, which, while practically terminating the marriage relation, proceed in law on the basis of the marriage never having been legally established. The conditions under which, in different communities, divorce has at different times been permitted, vary with the aspects in which the relation of marriage has been regarded. When marriage has been deemed to be the acquisition by the husband of property in the wife, or when it has been regarded as a mere agreement between persons capable both to form and to dissolve that contract, we find that marriage has been dissoluble at the will of the

husband, or by agreement of the husband and wife. Yet even in these cases the interest of the whole community in the purity of marriage relations, in the pecuniary bearings of this particular contract, and the condition of children, has led to the imposition of restrictions on, and the attachment of conditions to, the termination of the obligations consequent on a marriage legally contracted. But the main restrictions on liberty of divorce have arisen from the conception of marriage entertained by religions, and especially by one religion. Christianity has had no greater practical effect on the life

of mankind than in its belief that marriage is no mere civil contract, but a vow in the sight of God binding the parties by obligations of conscience above and beyond those of civil law. Translating this conception into practice, Christianity not only profoundly modified the legal con- ditions of divorce as formulated in the Roman civil law, but in its own canon law defined its own rule of divorce, going so far as in the Western (at least in its unreformed condition), though not the Eastern, branch of Christendom to forbid all complete divorces, that is to say, all dissolu- tions of marriage carrying with them the right to remarry. The Roman Law of Divorce before Justinian. — The history of divorce, therefore, practically begins with the law of Rome. It took its earliest colour from that con- ception of the patria potestas, or the power of the head of the family over its members, which enters so deeply into the jurisprudence of ancient Rome. The wife was transferred at marriage to the authority of her husband, in manus, and consequently became so far subject to him that he could, at his will, renounce his rule over her, and terminate his companionship, subject at least to an, adjust- ment of the pecuniary rights which were disturbed by such action. So clearly was the power of the husband derived from that of the father, that for a long period a father, in the exercise of his potestas, could take his daughter from her husband against the wishes of both. It may be pre- sumed that this power, anomalous as it appears, was not unexercised, as we find that a constitution of Antoninus Pius prohibited a father from disturbing a harmonious union, and Marcus Aurelius afterwards limited this pro- hibition by allowing the interference of a father for strong

and just cause. Magnd et justd causd interveniente. Ex- cept ia so far as it was restrained by special legislation, the authority of a husband in the matter of divorce was absolute. As early indeed, however, as the time of Eomulus, it is said that the State asserted its interest in the permanence of marriage by forbidding the repudia- tion of wives unless they were guilty of adultery or of drinking wine, on pain of forfeiture of the whole of an offender's property, one-half of which went to the wife, the other to Ceres. But the law of the XII. Tables, in turn, allowed freedom of divorce. It would appear, however, that the sense of the community was so far shocked by the inhumanity of treating a wife as mere property, or the risk of regarding marriage as a mere terminable contract, that, with- out crystallizing into positive enactment, it operated to prevent the exercise of so harsh and dangerous a power. It is said that for 500 years no husband took advantage of his power, and it was then only by an order of a Censor, however obtained, that Spurius Carvilius Euga repudiated his wife for barrenness. We may, however, be permitted to doubt the genuineness of this Censorial order, or at least to conjecture the influence under which the Censor was induced to intervene, when we find that in another instance, that of L. Antonius, a Censor pun- ished an unjust divorce by expulsion from the Senate, and that the exercise of their power by husbands increased to a great and alarming extent. Probably few of the admirers of the greatest of Roman orators have not re- gretted his summary and wholly informal repudiation of Terentia. At last the lex Julia de adulteriis, while recog- nizing a power of divorce both in the husband and in the wife, imposed on it, in the public interest, serious restrictions and consequences. It required a written bill of divorce (libellus repudii) to be given in the presence of seven witnesses, who must be Eoman citizens of age, and the divorce must be publicly registered. The act was, however, purely an act of the party performing it, and no idea of judicial interference or contract seems to have been entertained. It was not necessary for either husband or wife giving the bill to acquaint the other with it before its execution, though it was considered proper to deliver the bill, when made, to the other party. In this way a wife could divorce a lunatic husband, or the paterfamilias of a lunatic wife could divorce her from her husband. But the lex Juliawas also the first of a series of enactments by which pecuniary consequences were

imposed on divorce both by husbands and wives, whether the intention was to restrain divorce by penalties of this nature, or to readjust pecuniary relations settled on the basis of marriage and disturbed by its rupture. It was provided that if the wife was guilty of adultery, her husband in divorcing her could retain one-sixth of her dos, but if she had committed a less serious offence, one-eighth. If the husband was guilty of adultery, he had to make immediate restitution of her dowry, or if it consisted of land, the annual proceeds for three years ; if he was guilty of a less serious offence, he had six months within which to restore the dos. If both parties were in fault, no penalty fell on either. The lex Julia was followed by a series of acts of legislation ex- tending and modifying its provisions. The legislation of Constantine, a.d. 331, specified certain causes for which alone a divorce could take place without the imposition of pecuniary penalties. There were three causes for which a wife could divorce her husband with impunity : (1) murder, (2) preparation of poisons, (3) violation of tombs ; but if she divorced him for any other cause, such as drunkenness, or gambling, or immoral society, she forfeited her dowry and incurred the further penalty of deportation. There were also three causes for which a husband could divorce his wife without incurring any penalty : (1) adultery, (2)

preparation of poisons, (3) acting as a procuress. If he divorced her for any other cause, he forfeited all interest in her dowry; and if he married again, the first wife could take the dowry of the second.

In A.D. 421 the emperors Honorius and Theodosius enacted a law of divorce which introduced limitations on the power of remarriage as an additional penalty in certain cases. As regards a wife : (1) if she divorced her husband for grave reasons or crime, she retained her dowry and could remarry after five years; (2) if she divorced him for criminal conduct or moderate faults, she forfeited her dowry, became incapable of remarriage, and liable to deportation, nor could the emperor's prerogative of pardon be exerted in her favour. As regards a husband: if he divorced his wife (1) for serious crime, he retained the dowry, and could remarry immediately ; (2) for criminal conduct, he did not retain the dowry, but could remarry ; (3) for mere dislike, he forfeited the property brought into the marriage, and could not remarry.

In A.D. 449 the law of divorce was rendered simpler and certainly more facile by Theodosius and Valentinian. It was provided that a wife could divorce her husband without incurring any penalty if he was convicted of any one of twelve offences: (1) treason, (2) adultery, (3) homicide, (4) poisoning, (6) forgery, (6) violating tombs, (7) stealing from a church, (8) robbery, (9) cattle-stealing, (10) attempting his wife's life, (11) beating his wife, (12) introducing immoral women to his house. If the wife divorced her husband for any other cause, she forfeited her dowry, and could not marry again for five years. A husband could divorce his wife without incurring a penalty for any of these reasons except the last, and also for the following reasons : (1) going to dine with men other than her relations without the knowledge or against the wish of her husband; (2) going from home at night against his wish without reasonable cause ; (3) frequenting the circus, theatre, or amphitheatre after being forbidden by her husband. If a husband divorced his wife for any other reason, he forfeited all interest in his wife's dowry, and also any property he brought into the marriage.

The above sketch of the legislation prior to the time of Justinian, while it indicates a desire to place the husband and wife on something like terms of equality as regards divorce, indicates also, by its forbidding remarriage and by its pecuniary provisions in certain cases, a sense in the community of the importance in the public interest of restraining the violation of the contract of marriage. But to the Roman marriage was primarily a contract, and therefore side by side with this legislation there always existed a power of divorce by mutual consent. We must now turn to those principles of the Christian religion which, in combination with the legislation above described, produced the law formulated by Justinian.

The Christian View of Divorce. — The Christian law of divorce as enunciated by its Founder was expressed in a few words, but these, unfortunately, by no means of agreed interpretation. To appreciate them it is necessary to consider the enactment of the Mosaic law, which also was expressed in few words, but of a meaning involved in much doubt. The phrase in Deut. xxiv. 1-4, which is translated in the Authorized Version " some uncleanness," but in the Revised Version " some unseemly thing," and which is the only cause stated to justify the giving of a "bill of divorcement," was limited by the school of Shanmai to moral delinquency,

but was extended by the rival school of Hillel to causes of trifling importance, or even to motives of caprice. The wider interpretation would seem to be supported by the words of Christ (Matt. V. 31), who, in indicating His own doctrine in contradistino-

tion to the law of Moses, said, " Whosoever shall put away his wife, saving for the cause of fornication (iropvetas), causeth her to commit adultery; and whosoever shall marry her that is divorced committeth adultery." The meaning of these words of Christ Himself have been in- volved in controversy, which perhaps was nowhere carried on with greater acuteness or under more critical conditions than within the walls of the British Parliament during the passage of the Divorce Act of 1857. That they justify divorce of a complete kind for moral delinquency of some nature is supported by the opinion probably of every competent scholar. But scholars of eminence have sought to restrict the meaning of the X^os n-opveias to antenuptial incontinence concealed from the husband, and to exclude adultery. The effect of this view commends itself to the adherents of the Church of Eome, because it places the right to separation between husband and wife, not on a cause supervening after a marriage, which that Church seeks to regard as absolutely indissoluble, but on invalid- ity in the contract of marriage itself, and which may therefore render the marriage liable to be declared void without impugning its indissoluble character when rightly contracted. The narrower view of the meaning of iro/}ma« has been maintained by, among others, Dr Bol- linger {First Ages of the Church, ii. 226) ; but those who will consider the arguments of Professor Conington in reply to Dr Dollinger (Contemp. Review, May 1869) will probably assign the palm to the English scholar. A more general view points in the same direction. It is quite true that under the Mosaic law antenuptial incon- tinence was, as was also adultery, punishable with death. But when we consider the effect of adultery not only as a moral fault, but as violating the solemn contract of marriage and vitiating its objects, it is inconceivable that Christ, in employing a term of general import, intended to limit it to one kind, and that the less serious, of incontinence.

Effect of Christianity on the Law of Rome. — The modi- fication in the- civil law of Rome effected by Justinian under the joint anfluence of the jurevious law of Eome and that of €!Bristia.nity was remarkable. Gibbon has summed up the change effected in the law of Rome with characteristic accuracy : " The Christian princes were the first who specified the just causes of a private divorce ; their institutions from Constantino to Justinian appear to fluctuate between the customs of the empire and the wishes of the Church ; and the author of the Novels too frequently reforms the jurisprudence of the Code and Pandects." Divorce by mutual consent, hitherto, as we have seen, absolutely free, was prohibited (Nov. 117) except in three cases : (1) when the husband was im- potent ; (2) when either husband or wife desired to enter a monastery ; and (3) when either of them was in cap- tivity for a certain length of time. It is obvious that the two first of these exceptions might well commend themselves to the mind of the Church, the former as being rather a matter of nullity of marriage than of divorce, the latter as admitting j;he paramount claims of the Church on its adherents, and not inconsistent with the spirit of the words of St Paul himself, who clearly contemplated a separation between husband and wife as allowable in case either of them did not hold the Christian faith (1 Cor. vii. 12). At a later period Jus- tinian placed a further restriction or even prohibition on divorce by consent by enacting that spouses dissolving a marriage by mutual consent should forfeit all their pro- perty, and be confined for life in a monastery, which was to receive one-third of the forfeited property, the re- maining two-thirds going to the children of the mar- riage. The cause stated for this remarkable alteration of the law, and the abandonment of the conception of

marriage as a civil contract ut nan Dei judicium con- temnatur (Nov. 134), indicates the influence of the Christian idea of marriage. That influence, however, did not long continue in its full force. The prohibitions of Justinian on divorce by consent were repealed by Justin (Nov. 140), his successor. " He yielded," says Gibbon, "to the prayers of his unhappy subjects, and restored the liberty of divorce by mutual consent ; the civilians were unanimous, the theologians were divided,, and the ambiguous word which contains the precept of Christ is flexible to any interpretation that the wisdom of a legislature can demand." It was difficult, the enactment stated,

” to reconcile those who once <.'ame to hate each other, and who, if compelled to live together, frequently attempted each other's lives."

Justinian further re-enacted, with some modifications, the power of divorce by a husband or wife against the will of the other. Divorce by a wife was allowed in five cases (Nov. 117) : (1) the husband being party or privy to conspiracy against the State; (2) attempting his- wife’s life, or failing to disclose to her plots against it ;.

(3) attempting to induce his wife to commit adultery;,

(4) accusing his wife falsely of adultery ; (5) taking a woman to live in the house with his wife, or, after warning, frequenting a house in the same town with any woman other than his wife. If a wife divorced her hus- band for one of these reasons she recovered her dowry and any property brought into the marriage by her hus- band for life with reversion to her children, or if there were no children, absolutely. But if she divorced him for any other reason, the provisions of the enactment of Theodosius and Valentinian were to apply. A husband was allowed to divorce his wife for any one of seven reasons: (1) failure to disclose to her husband plots against the Stat^; (2) adultery; (3) attempting or fail- ing to disclose plots against her husband’s life ; (4) fre- quenting dinners or balls with other men against her husband’s wishes ; (5) remaining from home against the wishes of her husband, except with her parents ; (6) going to the circus, theatre, or amphitheatre without the knowledge or contrary to thesprohibitionof ~~her husband ; (7) procuring abortion. If the husband divorced his wife for any one of these, reasons he retained the dowry absolutely, or if there were children, with reversion to them. If he divorced her for any other reason, the enactments of Theodosius and Valentinian applied. In any case of a divorce, if the father or mother of either spouse had advanced the dowry and it would be for~~ feited by an unreasonable divorce, the consent of the father or mother was necessary to render the divorce valid.

Effect of Divorce on Children in the Law of Rome. — The custody of the children of divorced parents was dealt with by the Roman law in a liberal manner. A consti- tution of Diocletian and Maximian left it to the judge to determine in his discretion to which of the parents the children should go. Justinian enacted that divorce should not impair the rights of children

either as to inheritance or maintenance. If a wife divorced her hus- band for good cause, and she remained unmarried, the children were to be in her custody, but to be maintained by the father ; but if the mother was in fault, the father obtained the custody. If he was unable, from want of means, to support them, but she was able to do so, she was obliged to take them and support them. It is inter- esting to compare these provisions as to children with the practice at present under English law, which in this respect reflects so closely the spirit of the law of Rome.

The Canon Law of Divorce. — The canon law of Rome was based on two main principles : (1) That there could be no divorce a vinculo matrimonii, but only a mensd et thoro. The rule was stated in the most absolute terms :

" Quamdiu vivit vir licet adulter sit, licet sodomita, licet flagitiis omnibus coopertus, et ab uxors propter hcec scelera derelictus, maritus ejus reputatur, cui cdterum vivum accipere non licet" (Caus. 32, Qusest. 7, c. 7). (2) That no divorce could be had at the will of the parties, but only by the sentence of a competent, that is to say, an ecclesiastical, court. In this negation of a right to divorce a vinculo matrimonii lies the broad difference be- tween the doctrines of the Eastern and Western Churches of Christendom. The Greek Church, understanding the words of Christ in the broader sense above mentioned, has always allowed complete divorce with a right to remarry for the cause of adultery. And it is said that the form at least of an anathema of the Council of Trent was modified out of respect to difference on the part of the Greek Church (see Pothier 5. 6. 21). The papal canon law allowed a divorce a mensd et thoro for six causes : (1) adultery or unnatural off ences ; (2) impotency ; (3) cruelty; (4) infidelity ; (5) entering into religion ; (6) consan- guinity. The Church, however, always assumed to itself the right to grant licenses for an absolute divorce ; and further, by claiming the power to declare marriages null and void, though professedly this could be done only in cases where the original contract could be said to be void, it was, and is to this day, undoubtedly extended in

practice to cases in which it is impossible to suppose the original contract really void, but in which a complete divorce is on other grounds desirable.

Divorce in England.

In England the law of divorce, originally based on the canon law of Eome, underwent some, though little, permanent change at the Reformation, but was pro- foundly modified by the exercise of the power of the State through legislation. From the canon law was derived the principle that divorce could legally take place only by sentence of the court, and never at the will of the parties. Complete divorce has never been governed by any other principle than this; and in so far as an incomplete divorce has become practicable at the will of the parties, it has been by the intervention , of civil tribunals and contrary to the law of the eccle- siastical courts. Those courts adopted as ground for divorce a mensd et thoro the main grounds allowed by Eoman canon law, adultery and cruelty (Ayliffe, 22; Co. Lit. 102; 1 Salk. 162; Godolphin Abridg. 496). The causes of heresy and of entering with religion, if ever they were recognized in England, ceased to exist at the Reformation.

The principles upon which the English ecclesiastical courts proceeded in divorce a mensd et thoro are those which are still in force, and which (with some modifica- tion by statutory enactment) have been administered by judicial tribunals down to the present day. The courts by which the ecclesiastical law, and therefore the law of divorce, was administered were, until 1857, the courts of the various dioceses, including that of the Archbishop of Canterbury, known as the Arches Court, and that of the Archbishop of York, known as the Consistory Court of York ; but by statute a suitor was prevented from taking proceedings in any court except that determined by the residence of the person against whom proceedings were taken (23 Hen. VIII. c. 9). From these courts an appeal lay to delegates appointed in each case by the Crown, until the establishment of the Judicial Committee of the Privy Council in 1836, when the appeal was given to the Crown as advised by that body.

The proof of adultery (to which Isydon in his Book of Etymologies gives the fanciful derivation of "ad alterius thorum") was not by the canon law as received in

England restricted by the operation of arbitrary rules. It was never, for example, required, as by the law of Ma- homet; that the act should have been actually seen by competent witnesses, nor even that the case should be based on any particular kind of proof. It was recognized that the nature of the offence almost inevitably precluded direct evidence. One rule, however, appears to have commended itself to the framers of the canon law as too general in its application not to be regarded as a princi- ple. The mere confession of the parties was not regarded as a safe ground of conviction ; and this rule was formu- lated by a decretal epistle of Pope Celestine III., and, following it, by the 105th of the Canons of 1604. This rule has now been abrogated ; and no doubt it is wiser not to fetter the discretion of the tribunal charged with the responsibility of deciding particular cases, but experience of divorce proceedings tends to confirm the belief that this rule of the canon law was founded on an accurate appreciation of human nature.

Although, therefore, with the above exception, no strict rules of the evidence necessary to establish adultery have ever been established in the English courts, experience has indicated, and in former days judges of the ecclesias- tical courts often expressed, the lines upon which such proof may be expected to proceed. It is necessary and sufBcient, in general, to prove two things — first the guilty affection towards each other of the persons accused, and, secondly, an opportunity or opportunities on which, if so minded, their passion may have been gratified. It is obvi- ous that any strong proof on either of these points ren- ders strict proof on the other less needful; but when proof on both is afforded, the common sense of a tribunal, acting with a knowledge of human nature, may be trusted to draw the inevitable conclusion.

The definition of cruelty accepted by the ecclesiastical courts as that of the canon law is the same as that which prevails at the present time ; and the view of the law taken by the House of Lords in a recent case, by which the subject is now governed {Russell v. Russell, 1897 App. Cas. 395), was expressly based on the view of cruelty taken by the authorities of the ecclesiastical law. The best definition by our older writers is probably to be found in Clarke's Praxis (p. 144) : " Si maritus fuerit erga uxorem crudelis et ferax ac mortem comminatus et machinatus fuerit, vel earn inhumaniter

verbis et verberibus tractaverit, et aliquando venenum loco potus paraverit vel aliquod simile commiserit, propter quod sine periculo vitae cum marito cohabitare aut obsequia conjugalia impendere nonaudeat . . . consimili etiam causS,competit viro contra mulierem." Lord Stowell, probably the greatest master of the civil and canon law who ever sat in an English court of justice, has in one of his most famous judgments (Evans v. Evans, 1 Hagg. Consist. 35) echoed the above language in words often quoted, which have constituted the standard exposition of the law to the present day. " In the older cases," he said, " of this sort which I have had the oppor- tunity of looking into, I have observed that the danger of life, limb, or health is usually insisted as the ground upon which the court has proceeded to a separation. This doc- trine has been repeatedly applied by the court in the cases which have been cited. The court has nev^r been driven off this ground. It has always been jealous of the incon- venience of departing from it, and I have heard no one case cited in which the court has granted a divorce without proof given of a reasonable apprehension of bodily hurt. I say an apprehension, because assuredly the court is not to wait till the hurt is actually done ; but the ■apprehension must be reasonable: it must not be an apprehension arising from an exquisite and diseased sensibility of mind. Petty vexations applied to such a constitution of mind may certainly in time wear out the animal machine, but still

they are not cases of legal relief ; people must relieve themselves as well as they can by prudent resistance, by calling in the succours of religion and the consolation of friends ; but the aid of courts is not to be resorted to in such cases with any effect." The risk of personal danger in cohabitation constituted, therefore, the foundar tion of legal cruelty. But this does not exclude such conduct as a course of persistent ill-treatment, though not amounting to personal violence, especially if such ill- treatment has in fact caused injury to health. But the person complaining must not be the author of his or her oym wrong. If, accordingly, one of the spouses by his or her conduct is really the cause of the conduct complained of, recourse to the

court would be had in vain, the true remedy lying in a reformation of the real cause of the disagreement.

In addition to a denial of. the charge or charges, the canon law allowed three grounds of answer: (1) Com- pensatio criminis, a set-off of equal guilt or recrimination. This principle is no doubt derived from the Eoman law, and it had the effect of refusing to one guilty spouse the remedy of divorce against the other although equally guilty. It was always accepted in England, although not in other countries, such as France and Scotland, which also followed the canon or civil law. In strictness, recrimination applied to a similar offence having been com- mitted by the party charging that offence. But a recent decision of the English courts shows that a wife who had committed adultery could not bring a suit against her hus- band for cruelty {Otway v. Otway,lZ'P. D. 141). (2) Con- donation. If the complaining spouse has, in fact, forgiven the olfence complained of, that constitutes a conditional bar to any proceedings. The main and usual evidence of such forgiveness is constituted by a renewal of marital intercourse, and it is difficult — ^perhaps impossible — to imagine any case in which such intercourse would not be held to establish condonation. But condonation may be proved by other acts, or by words, having regard to the circumstances of each case. Condonation is, however, always presumed to be conditional on future good be- haviour, ancj misconduct even of a diiferent kind revives the former offence. (3) Connivance constitutes a com- plete answer to any charge. Nor need the husband be the active agent of the misconduct of the wife. Indiffer- ence or neglect imputable to a corrupt intention are sufiB.- cient. , It will be seen presently that modern statute law has gone further in this direction. It is to be added that the connivance need not be. of the very act com- plained of, but may be of an act of a similar kind. A learned judge, recalling the classical anecdote of Msecehas and G- alba, said, " A husband is not permitted to say non omnibus domiio." The ecclesiastical courts- also considered themselves bound to refuse relief if there was shown to be collusion between the parties. In its primary and most general sense collusion was understood to be an agreement between the parties for the purpose of deceiving the court by false or fictitious evidence; for example, an agreement to commit, or appear to commit, an act of adultery. Collusion, however, is not limited to the imposing of other than genuine evidence on the court. It extends to an agreement to withhold

any material evidence; and indeed is carried farther, and held to extend to any agreement which may have the effect of concealing the real and complete truth from the court (see Churchward v. Churchward, 1894, P. 161). This doctrine was of considerable importance even in the days when only divorces a mensd et thoro were granted, because at that time the parties were not permitted to separate by consent. At the present day it has become, with regard to divorce a vinculo matrimonii, a rule of greater and of more far-reaching importance.

The canon law as accepted in England, while allowing divorces of the nature and for the causes above mentioned, actively interfered to prevent separation between husband and wife in any other manner. A suit known as a suit for restitution of conjugal rights could be brought to compel cohabitation ; and on evidence of the desertion of either spouse, the court ordered a return to the matri- monial home, though it carried no further its authority as to the matrimonial relations within the home. To this suit an agreement between the parties constituted no answer. But an answer was afforded by any conduct which would have supported a decree of divorce a mensd et thoro. It is a question whether, indeed, the ecclesi- astical courts would not have gone farther, and refused a decree of restitution of conjugal rights on grounds which might appear adequate to justify such refusal, though not sufficient on which to ground a decree of divorce. Recently the view of the Court of Appeal and the House of Lords has given some colour to this opinion, and certainly the Court of Appeal has held, although perhaps somewhat hastily, that the effect of a modern statute has been to allow the court to refuse restitution of conjugal rights for causes falling short of what would constitute ground for divorce (Russell v. Russell, 1896, p. 315).

The ecclesiastical courts provided for the pecuniary rights of the wife by granting to her alimony during the progress of the suit, and a proper allowance after its termination in cases in which she was successful. Such payments 'were dependent on the pecuniary means, or faculties, as they were termed, of the husband, and were subject to subsequent increase or diminution in proper cases. But the ecclesiastical courts did not deal with the custody of the children of the marriage, it being probably considered

that that matter could be determined by the common law rights of the father, or by the intervention of the Court of Chancery.

The canon law fixed no period of limitation, either in respect of a suit for divorce or for restitution of conjugal rights ; but, as regards at least suits for divorce, any sub- stantial delay might lead to the imputation of acquies- cence or even condonation. To that extent, at least, the maxim vigilantihus non dormientibus jura subvenivint applied.

It is remarkable that desertion by either party to a marriage, except as giving rise to a suit for restitution, was not treated as an offence by canon law in England. It formed no ground for a suit for divorce, and constituted no answer to such a suit by way of recrimination. It might indeed deprive a husband of his remedy if it amounted to connivance, or perhaps even if it amounted only to culpable neglect.

The canon law, as administered in England, has kept clear the logical distinction which exists between dissolv- ing a marriage and declaring it null and void. The result has been that, in England at least, the two proceedings have never been allowed to pass into one another, and a complete divorce has not been granted on pretence of a cause really one for declaring the marriage void ab initio. But for certain causes the courts were prepared to declare a marriage null and void on the suit of either party. There is, indeed, a distinction to be drawn between a marriage void or only voidable, though in both cases it became the subject of a similar declaration. It was void in the cases of incapacity of the parties to contract it, arising from want of proper age, or consanguinity, or from a previous mar- riage, or from absence of consent, a state of things which would arise if the marriage were compelled by force or induced by fraud as to the nature of the contract entered into or the personality of the parties. It is to be re- marked that, in England at least, the idea of fraud as

connected with the solemnization of marriage has been kept within these narrow limits. Fraud of a different kind, such as deception as to the

property or position of the husband or wife, or antecedent impurity of the wife, even if resulting in a concealed pregnancy, has not in England (though the last-mentioned cause has in other countries) been held a ground for the vitiation of a mar- riage contract. A marriage was voidable, and could be declared void, on the ground of physical incapacity of either spouse, the absence of intercourse between the parties after a sufficient period of opportunity being almost, if not quite, conclusive on this subject.

With regard to one cause of nullity the legislation in- terfered from consideration, it is said, of a case of special hardship. Before an Act of 1835 (5 & 6 Will. IV. c. 54) marriages within the prohibited degrees of consanguinity and affinity were only voidable by a decree of the court, and remained valid unless challenged during the lifetime of both the parties. But this Act, while pro- viding that no previous marriage between persons within the prohibited degrees should be annulled by a decree of the ecclesiastical court pronounced in a suit depending at the time of the passing of the Act, went on to render all such marriages thereafter contracted in England " absolutely null and void to all interests and purposes whatever."

Another suit was allowed by the ecclesiastical courts which should be mentioned, although its bearing on divorce is indirect. This was the suit for jactitation of marriage, which in the case of any person falsely asserting his or her marriage to another, allowed such person to be put to perpetual silence by an order of the court. This suit, which has been of rare occurrence, although an instance of it has recently been known, does not appear to have been used for the purpose of determining the validity of a marriage. The legislature has, however, in the Legitimacy Declaration Act of 1858, provided a ready means by which the validity of marriages and the legitimacy of children can be determined, and the pro- cedure provided has repeatedly been utilized.

It should. be.added,.as. a matter closely akin to the pro- ceedings in the ecclesiastical courts, that the common law took cognizance of one phase of matrimonial relations by allowing an action by the husband against a paramour, known as an action for criminal conversation. In such an action a husband could recover damages estimated according to the loss he was

supposed to have sustained by the seduction and loss of his wife, the punishment of the seducer not being altogether excluded from consideration. Although this action was not unfrequently (and indeed, for the purposes of a divorce, necessarily^ brought, it was one which naturally was regarded with disfavour.

Effect of the Reformation. — Great as was the indirect effect of the Reformation upon the law of divorce in England, the direct effect was small. It might, indeed, have been supposed that the disappearance of the sacramental idea of marriage entertained by the Roman Church would have ushered in the greater freedom of divorce which had been associated with marriage regarded as a civil contract. And to some extent this was the case. It was for some time supposed that the sentences of divorce pronounced by the ecclesiastical courts ac- quired the effect of allowing remarriage, and such divorces were in some cases granted. In Lord Northampton's case in the reign of Edward VI. the delegates pronounced in favour of a second marriage after a divorce a mensd et thoro. It was, however, finally decided in Foljambe's case, in the 44th year of Elizabeth, that a marriage validly contracted could not be dissolved for any cause. But the growing sense of the right to a complete divorce for ade-

quate cause, when no longer any religious law to the contrary could be validly asserted, in time compelled the discovery of a remedy. The commission appointed by Henry VIII. and Edward VI. to reform the ecclesiastical law drew up the elaborate report known as the Reformatio> Legum, and in this they recommended that divorces a mensd et thoro should be abolished, and in their place, complete divorce allowed for the causes of adultery, desertion, and cruelty. These proposals, however, never became law. In 1669 a private Act of Parliament was granted in the case of Lord de Roos, and this was followed by another in the case of the Duke of Norfolk in 1692. Such Acts were, however, rare until the accession of the House of Hanover, only five Acts passing before that period. Afterwards their number considerably increased. Between 1715 and 1776 there were sixty such Acts, in the next twenty-five years there were seventy-four, and between 1800 and 1850 there were ninety. In 1829 alone there were seven, and in 1830 nine.

The jurisdiction thus assumed by Parliament to grant absolute divorces was exercised Avith great care. The case was fully investigated before a committee of the House of Lords, and not only was the substance of justice so secured, but the House of Lords further required that application to Parliament should be preceded by a success- ful suit in the ecclesiastical courts resulting in a decree of divorce a mensd et thoro, and in the case of a husband being the applicant, a successful action at common law and the recovery of damages against the paramour. In this way, and also, if needful, on its own initiative, the House of Lords provided that there should be no con- nivance or collusion. Care was also taken that a proper allowance was secured to the wife in cases in which she was not the offending party. This procedure is still pur- sued in the case of Irish divorces.

It is obvious, however, that the necessity for costly pro- ceedings before the Houses of Parliament imposed great hardship on the mass of the population, and there can be little doubt that this hardship was deeply felt. Repeated proposals were made to Parliament with a view to reform of the law, and more than one commission reported on the subject. It is said" that the final impetus was given by an address to a prisoner by Mr Justice Maule. The prisoner's wife had deserted him with her paramour, and he married again during her lifetime. He was indicted for bigamy, and convicted, and Mr Justice Maule sentenced him in the following words : — " Prisoner at the bar : You have been convicted of the offence of bigamy, that is to say, of marrying a woman while you had a wife still alive, though it is true she has deserted you and is living in adultery with another man. You have, therefore, com- mitted a crime against the laws of your country, and you have also acted under a very serious misapprehension of the course which you ought to have pursued. You should have gone to the ecclesiastical court and there obtained against your wife a decree o m^nsd et thoro. You should then have brought an action in the courts of common law and recovered, as no doubt you would have recovered, damages against your wife's paramour. Armed with these decrees, you should have approached the legislature and obtained an Act of Parliament which would have rendered you free and legally competent to marry the person whom you have taken on yourself to marry with no such sanction. It is quite true that these proceedings would have cost you many hundreds of pounds, whereas you probably have not as many pence. But the law knows no

distinction between rich and poor. The sentence of the court upon you, therefore, is that you be imprisoned for one day, which period has already been exceeded, as you have been in custody since the commencement of the assizes." The grave irony of the learned judge was felt to

represent truly a state of things -well-nigh intolerable, and a reform in the law of divorce was felt to be inevitable. The hour and the man came in 1857, the man in the person of Sir Richard Bethell, then Attorney- Oeneral.

Tlie Act of 1857. — Probably few measures have been conceived with such consummate skill and knowledge, and few conducted through Parliament with such dexterity and determination. The leading opponent of the measure was Mr Gladstone, backed by the zeal of the High Church party and inspired by his own matchless subtlety and resource. But the contest proved to be unequal, and after debates in which every line, almost every word, of the measure was hotly contested, especially in the House of Commons, the measure emerged substantially as it had been introduced. Not the least part of the merit and success of the Act of 1857 is due to the skill which while effecting a great social change, did so with the smallest possible amount of innovation. The Act embodied two main principles : 1. The constitution of a lay court for the administration of all matters connected with divorce. 2. The transfer to that court, with as little change as possible, of the powers exercised in matrimonial matters by (a) the House of Lords, (&) the ecclesiastical courts, (c) the courts of common law.

The Constitution of the Court. — The new court, termed " The Court for Divorce and Matrimonial Causes," was constituted by the Lord Chancellor, the chiefs and the senior puisne judges of the three courts of common law, and the judge of the Court of Probate (which was also established in 1857), but the functions of the court were practically entrusted to the judge of the Court of Pro- bate, termed the " Judge Ordinary," who thus in matters of probate and divorce became the representative of the former ecclesiastical jurisdiction. The Judge Ordinary was empowered either to sit alone or with one or more of the other judges to constitute a full court. The parties to a

suit obtained the right of trial by jury of all dis- puted questions of fact ; and the rules of evidence of the common law courts were made to apply. An appeal to the full court was given in all matters, which the Judge Ordinary was enabled to hear sitting alone.

1. To this court was transferred all the powers of the ecclesiastical courts with regard to suits for divorce a mensd et thoro, to which the name was given of suits for "judicial separation," nullity, restitution of conjugal rights, and jactitation of marriage, and in all such pro- ceedings it was expressly enacted (sec. 22) that the court should act on principles and rules as nearly as possible conformable to the principles and rules of the ecclesias- tical courts. Judicial separation could be obtained by either husband or wife for adultery, or cruelty, or deser- tion continued for two or more years.

2. There were also transferred to the court powers equivalent to those exercised by the legislature in grant- ing absolute divorce. The husband could obtain a divorce for adultery, the wife could obtain a divorce for adultery coupled with cruelty or desertion for two or more years, and also for incestuous or bigamous adultery, or rape, or unnatural offences. The same conditions as had been required by the legislature were insisted on. A petition for dissolution (sec. 30) was to be dismissed in case of connivance, condonation, or collusion; and further, the court had power, though it was not compelled, to dismiss such petition if the petitioner had been guilty of adul- tery, or if there had been unreasonable delay in pre- senting or prosecuting the petition, or if the petitioner had been guilty of cruelty or desertion without reason- able excuse, or of wilful neglect or misconduct conducing to the adultery. The exercise of these discretionary powers of the court, just and valuable as they undoubt-

edly are, has been attended with some difficulty. But the view of the legislature has on the whole been under- stood to be that the adultery of a petitioner should not constitute a bar to his or her proceeding, if it has been caused by the misconduct of the respondent, and that cruelty' should not constitute such a bar unless it has caused or contributed to the misconduct of the respond- ent. But the court, while regarding its powers as these of a

judicial and not an arbitrary discretion, has declined to fetter itself by any fixed rule of interpretation or practice.

It is to be observed that this Act assigned a new force to desertion. The ecclesiastical law regarded it only as suggestive of connivance or culpable neglect. But the Act of 1857 made it (1) a ground of judicial separation if continued for two years, (2) a ground in part of disso- lution of marriage if continued for the same period, (3) a bar, in the discretion of the Court, to a petition for dis- solution, though it was not made in a similar way any bar to a suit for judicial separation. It is also to be observed that the Act was confined to causes of divorce recognized by the ecclesiastical law as • administered in England. It did not either extend the causes of a suit for nullity by adding such grounds as antenuptial incon- tinence, even if accompanied with pregnancy, nor did it borrow from the civil law of Rome either lunacy or crime as grounds for divorce.

Much comment has been made on tl .■'. different grounds on which divorce is allowed to a husband and to a wife, — it being necessary to prove infidelity in both cases, but a wife being compelled to show either an aggravation of that offence or an addition to it. Opinions probably will alway s differ whether the two sexes should be placed on an equality in this respect, abstract justice being invoked, and the idea of marriage as a mere contract pointing in one direction, and social considerations in the other. But the reason of the legislature for making the distinction is clear. It is that the wife is entitled to an absolute divorce only if her reconciliation with her husband is neither to be expected nor desired. This was no doubt the view taken by the House of Lords. In 1801 a Mrs Addison claimed an absolute divorce on the ground of her husband's incest with her sister. The matter was long debated, but Lord Thurlow, who appeared in the House of Lords for the last time in order to support the Bill, turned the scale by arguing that it was improper that the wife should under such circumstances return to her hus- band (see Campbell, Lives of the Chancellors, vii. 145). " Why do you," he said, " grant to the husband a divorce for the adultery of the wife ? Because he ought not to forgive her, and separation is inevitable. Where the wife cannot forgive, and separation is inevitable by reason of the crime of the husband, the wife is entitled to the like remedy."

The Act (sec. 32) provided, in case of dissolution, for maintenance of the wife by the husband on principles similar to those recognized by the ecclesiastical courts, and (sec. 45) for the settlement of the property of a guilty wife on her husband or children ; but this enactment was im- perfect, as provision was made only for a settlement and not for payment of an allowance, and none was made for altering settlements made in view or in consequence of a marriage. The Act (sec. 35) provides also in all divorce proceedings, and also in those of nullity, for provision for the custody, maintenance, and education of children by the court : provisions of great value, which were unfortunately for some time limited by an erroneous view of the court that the age of the children to which such provisions applied should be considered limited to sixteen. The Act of 1857 also transferred to the new court the powers exercised by the common law courts in the action for

criminal conversation. It was made obligatory to join an alleged adulterer in the suit, and damages (see. 33) might be claimed against him, and he might be ordered to pay the costs of the proceedings (sec. 34). The latter pro- vision, however, has been considerably curtailed by a recent decision of the Court of Appeal.

The Act of 1857 in one respect went beyond a transfer of the powers exercised by the ecclesiastical courts or the legislature. It provided (sec. 21) that a wife deserted by her husband might apply to a magistrate in petty sessions and obtain an order which had the effect of protecting her earnings and property, and during the currency of such order of protection a wife was to be in the same position as if she had obtained an order for judicial separation. The effect of this section appears to have been small ; but further legislation in 1895 has afforded a cheap and speedy remedy to all classes of the community.

The framers of the Act of 1857 were careful to avoid offending the scruples of clergymen who disapproved of the complete dissolution of marriage by a lay court. It was provided (sees. 57 and 68) that no clergyman should be

compelled to solemnize the marriage of any person whose former marriage had been dissolved on the ground of his or her adultery, but should permit any other clergyman to solemnize the marriage in any church or chapel in which the parties were entitled to be married. It is to be feared that this concession, ample as it appears, has not allayed conscientious objections,, which are per- haps from their nature insuperable. The Act made no pro- vision as to the name to be borne by a wife after a divorce ; and this omission has led to litigation in the case of a peer's wife.

Modifications of the Act of 1857. — Subsequent legislation has made good many of the defects of the Act of 1857. In 1859 power was given to the court, after a decree of dissolution or of nullity of marriage, to inquire into the existence of ante- and post-nuptial settlements, and to make orders with respect to the property settled either for the benefit of children of the marriage or their parents ; and a subsequent Act (41 & 42 Vict. c. 19, s. 3) removed a doubt which was entertained whether these powers could be exercised if there were no children of the marriage. In 1860 a very important change was made, having for its object a practical mode of preventing divorces in cases of connivance and collusion or of misconduct of the petitioner. It was provided that a claim of dissolution (a provision afterwards extended to decrees of nullity) should in the first instance be a decree nisi, which should not be made absolute until the expiration of a period then fixed at not less than three, but by subsequent legislation enlarged to not less than six, months. During the interval which elapsed between the decree nisi and such decree being made absolute, power was given to any person to intervene in the suit and show cause why the decree should not be made absolute, by reason of the same hav- ing been obtained by collusion, or by reason of material facts not brought before the court ; and it was also pro- vided that, at any time before the decree was made absolute, the Queen's Proctor, if led to suspect that the parties were acting in collusion for the purpose of obtain- ing a divorce contrary to the justice of the case, might under the direction of the Attorney-General intervene and allege such case of collusion. This enactment (extended in the year 1873 to suits for nullity) was ill drawn and unskilfully conceived. The power given to any person whomsoever to intervene is no doubt too wide, and practically has had little or no useful effect as employed by friends or

enemies of parties to a suit. The limitation in terms of the express power of the Queen's Proctor to intervene to cases of collusion was undoubtedly

too narrow. But the Queen's Proctor, or the official by whom that officer was afterwards represented, has in practice availed himself of the general authority given to any person to show cause why a decree nisi should not be made absolute, and has thus been enabled to render such important service to the administration of justice that it is difficult to imagine the due execution of the law of divorce by a court without such assistance. In 1866 power was given to the court to order an allowance to be paid by a guilty husband to a wife on a dissolution of marriage. This Act also can hardly be considered to have been drawn with sufficient care, inasmuch as while it provides that if the husband's means diminish, the allow- ance may be diminished or suspended, it makes no corre- sponding provision for increase of the allowance if the husband's means increase ; nor, apparently, does it per- mit of an allowance in addition to, but only in substitution for, a settlement. The Act makes no provision for allow- ance to a guilty wife, and it certainly is a serious defect that the power to grant an allowance does not extend to cases of nullity. In 1868 an appeal to the House of Lords was given in cases of decree for dissolution or nullity of marriage.

The great changes effected by the Judicature Acts included the Court for Divorce and Matrimonial Causes. Under their operation a division of the High Court of Justice was constituted, under the designation of the Probate Division and Admiralty Division, to which was assigned that class of legal administration governed mainly by the principles and practice of the canon and civil law. The division consists of a President, and a Justice of the High Court, with registrars representing each branch of the jurisdiction. Appeals lie to the Court of Appeal, and thence to the House of Lords.

In 1884 the legislature interfered to prevent imprison- ment being the result of disobedience to an order for restitution of conjugal rights. That mode of enforcing the order of the court was abolished, and the matter was left to a proper adjustment of the pecuniary relations of the husband and wife ; and a respondent disobeying such an order was held to be guilty of desertion without reasonable cause, such desertion having further given to it a similar effect to that assigned to desertion for two years or upwards. The

effect of this provision has been that the suit for restitution of conjugal rights is most frequently brought for the purpose of shortening the time within which a wife can obtain a decree for dissolu- tion of marriage.

Proceedings in the Divorce Court have shown the improvement in the law of evidence which has been effected with regard to other legal proceedings. The Act of 1857 made an inroad on the former law, which pro- hibited evidence being given by parties interested in the proceedings, by allowing a petitioner (sec. 43) to be called and examined by order of the court, absolving such petitioner, however, from the necessity of answering any question tending to show that he or she had been guilty of adultery. In the next year power was given to the court to dismiss any person, with whom a party to the suit was alleged to have committed adultery, from the suit if there should not appear to be sufficient evi- dence against him or her, the object being to allow such person to give evidence; and in 1859 it was provided that, on a petition by a wife for a divorce on the grounds of cruelty or desertion with adultery, the husband and wife were rendered competent and compellable witnesses as to the cruelty or desertion. A few years later, however, in 1869, the subject was finally dealt with by repealing all previous rules which limited the powers to give evi- dence on questions of adultery, with the safeguard that no witness in any proceeding can be asked or bound to

answer any question tending to show that he or she has been guilty of adultery, unless in the same proceeding such witness shall have given evidence in disproof of his or her alleged adultery. It has been held that the prin- ciples of these enactments apply to interrogatories as well as to evidence given in court.

It is a most remarkable omission in the Act of 1857, especially when we remember the high legal authority from whom it proceeded, that the Act nowhere defines the class of persons with regard to whom the jurisdiction of the court should be exercised. This omission has given rise to a misapprehension of the law which, though now set at rest, prevailed for a

considerable period, and has undoubtedly led to the granting of divorce in several cases in which it could not legally be given. It was supposed that the court could grant a dissolution of marriage to all persons who had anything more than a casual and fleeting residence within the jurisdiction of the court; and this view, although its correctness was doubted by Lord Penzance, the judge of the Divorce Court, was upheld by a majority of the judges of the Court of Ap- peal in the case of Nihoyet v. Niboyet (4 P. D. 1). It was supposed that such residence gave what was termed a matrimonial domicile. But this view was undoubtedly erroneous as regards dissolution of marriage, although probably correct as regards judicial separation, and the true view is no doubt that indicated with great learning and ability by Lord Watson in a judgment given by him in the Privy Council in the case of Le Mesurier v. Le Mesurier (1895, App. Cas. 517), that the only true test of jurisdiction for a decree of divorce altering the status of the parties to a marriage is to be found in the domicile of the spouses — that is to say, of the husband, as the domicile of a wife follows that of her husband — at the time of the divorce. The legal definition of dom- icile is the subject of elaborate rules. It is sufficient to say here that domicile means a person's permanent home, the place at which he resides, with no intention of making his home elsewhere, and if he leaves it, with the inten- tion of returning to it.

It is now also clearly recognized as the law of England that the English courts will not recognize a divorce pur- porting to be made by a foreign tribunal with regard to persons domiciled in England. For a considerable time doubt appears to have clouded the law on this subject. In a famous case known as Lolley's case, decided in 1812, the judges of England (the point arose in con- nexion with a criminal charge) unanimously held " that no sentence or act of any foreign country or any state could dissolve an English marriage a vinculo matrimonii for grounds on which it was not liable to be dissolved a vinculo matrimonii in England." This case has been frequently understood as deciding that a mar- riage celebrated in England cannot be dissolved else- where, and on this point the courts of Scotland differ from the view supposed to be taken by the English judges. But the matter has been fully explained in one of the most masterly of Lord Hannen's judgments (Harvey v. Faimie, 5 P. D. 154"), afterwards upheld by the House of Lords in 1882 (8 App. Cas. 43) ; and it is now clear that while the parties are domiciled in this country no decree of any foreign court dis-

solving their marriage will be recognized here, unless it proceed on the grounds on which a divorce may be obtained in this country, and even the exception just mentioned appears to rest rather on reasoning and principle than on the authority of any decided case. This principle has received the highest sanction in a re- cent prosecution of Earl Eussell for bigamy before the

House of Lords. , , . ,

Summary Proceedings for Separation.— Ta.B legislature

has sought to extend the relief afforded by the courts in matrimonial causes by a procedure fairly to be con- sidered withia the reach of all classes. In 1896 an Act was passed which re-enacted in an improved form the provisions of an Act of 1878 of similar effect. By the Act of 1895 power was given to a married woman whose husband (1) has been guilty of an aggravated assault upon her within the Offences against the Person Act, 1861, or (2) convicted on indictment of an assault on her and sentenced to pay a fine of more than £5 or to im- prisonment for more than two months, or (3) shall have deserted her, or (4) been guilty of persistent cruelty to her or wilful neglect to maintain her or her infant chil- dren, and by such cruelty or neglect shall have caused her to leave and live apart from him, to apply to a court of summary jurisdiction and to obtain an order containing all or any of the following provisions : (1) that the applicant be not forced to cohabit with her husband, (2) that the applicant have the custody of any children under sixteen years of age, (3) that the husband pay to her an allowance not exceeding £2 a week. The Act- provides that no married woman guilty of adultery should be granted relief, but with the very important proviso, altering as it does the rule of the common law, that the husband has not conduced or connived at, or by wilful neglect or misconduct conduced to, such adultery. The provisions of this Act have been largely put in force, and no doubt to the great advantage of the poorer classes of the community. It will be observed that the Act is unilateral, and affords no relief to a husband against a wife ; and the complaint is often heard that no misconduct of the wife, except adultery, relieves the husband from the necessity of maintaining her and al- lowing her to share his home, unless he can obtain access to the High Court.

Separation Deeds. — Although nothing in the develop- ment of the law of divorce has tended to give to married persons the right absolutely to dissolve their marriage by consent, and, on the contrary, any such agreement would be held to be strong evidence of collusion, the view of the Church expressed in the ecclesiastical law has been entirely departed from as regards agreements for separation. Such agreements were embodied in deeds, and usually contained mutual covenants not to sue in the ecclesiastical courts for restitution of conjugal rights. The ecclesiastical courts, however, wholly disregarded such agreements, and considered them as affording no answer to a suit for restitution of conjugal rights. Por a considerable period the Court of Chancery refused to enforce the covenant in such deeds by restraining the parties from proceeding to the ecclesiastical courts. But at last a memorable judgment of Lord Westbury asserted the right {Hunt V. Hunt, 4 De G. P. & J. 221 ; see also Marshall v. Marshall, 5 P. D. 19) of the Court of Chancery to main- tain the claim of good faith in this as in other cases, and restrained a petitioner from suing in the ecclesiastical court contrary to his covenant. Thereafter these deeds became common, and no doubt often afford a solution of matrimonial difB.culties of very great value. When the courts of the country became united under the Judicature Acts, it became practicable to set up in the Divorce Division a separation deed in answer to a suit for resti- tution of conjugal rights without the necessity of recourse to any other tribunal.

Statistics. — The statistics of divorce in England have for some years been regularly published in the volumes of judicial statistics published annually by the Home Ofiice — that published in 1901 bringing the figures down to

1899.

The number of petitions for divorce (including in the term both divorce a mensd et thoro and divorce a

vinculo) for the as follows : —

years from 1858 to 1899 inclusive are

1858 1859 1860 1861 1862 1863 1864 1865 1866 1867 1868 1869 1870 1871

. 326

1872 .

374

1886

. 291

1873 .

416

1887

. 272

1874 .

469

1888

. 236

1875 .

451

1889

. 248

1876 .

536

1890

. 298

1877 .

551

1891

297

1878 .

632

1892

. 284

1879 .

555

1893

. 279

1880 .

615

1894

. 294

1881 .

589

1895

. 303

1882 .

481

1896

. 351

1883 .

561

1897

. 351

1884 .

647

1898

. 384

1885 .

541

1899

708 662 680 054 644 632 629 645 652 683 772 781 750 727

It is probably impossible to account for the variations ivhich the above table discloses. It was no doubt natural that the year immediately

succeeding the passing of the Act which originated facilities for divorces a vinmdo should exhibit a larger number of divorces than its successors for a considerable period. But there does not appear to be any adequate cause for the comparative increase which seems to have prevailed in the decade ibetween 1878 and 1888, unless it be found in the increase •of marriages which culminated in 1873 and 1883, falling .after each of those years. The number of marriages again ;rose high in 1891 and 1892, and this may account for the increased number of divorces in 1896 and the following jears. But it may certainly be said with confidence that as compared with the growth of population the number of divorces in England, especially in recent years, shows no alarming increase.

The total number of petitions in matrimonial causes presented by husbands exceed those presented by wives, but in no marked degree. This excess would seem to be due to the fact that the larger number of petitions for dissolution presented by husbands, owing no doubt to the difference in the law affecting the two sexes, is not entirely •counterbalanced by the much larger number of petitions for judicial separation presented by wives. The following figures for the years 1895 to 1899 inclusive may be taken as typical.

1396.

1896.

189T.

1898.

1399.

Petitions for Dissolution- Presented by husbands . Presented by wives .

Petitions for Judicial Separation — Presented by husbands . Presented by wives ,

Total : Presented by husbands Presented by wives .

353 220

4 106

357 326

393 280

3 96

396 376

414 269

2 96

416 365

401 243'

4 102

405 345

383 262

4

78

387 340

Speaking generally, it may be said that about 70 per ■cent, of the petitions presented are successful and result in decrees. This percentage has tended to rise in recent years. Attempts have been made to ascertain the classes which supply the petitioners for divorce, but this cannot be done with such certainty as to warrant any but the most general conclusions. It may, however, safely be said that while all classes, professions, and occupations are repre- ;sented, it is certainly not those highest in the scale that are the

largest contributors. The principles of the Act of 1857 have beyond question been justified by the relief required by and afforded to the poorer members of the community.

Other European Couisttries.

We may now turn to the law of divorce as administered in the other countries of the modern world. On the main qnpstion whether marriage is to be considered indissoluble

they -will be found to range themselves on one side or the other according to the influence upon them of the Church of Eome and its canon'law.

In Scotland it has long been the law that marriage can be dissolved at the instance of either party by judi- cial sentence on the grounds of adultery or of desertion, termed non-adherence, and the spouses could in such case remarry, except with the person with whom the adultery was committed. A divorce a mensd et thoro could also be granted for cruelty. By an Act of Parliament (11 Geo. IV. and 1 Will. IV. c. 69) the jurisdiction in divorce was transferred from a body of commissaries to the Court of Session.

By the law of Holland complete divorce could be granted by judicial sentence on the grounds of adultery or of wilful and malicious desertion, to which were added unnatural offences and imprisonment for life, and such divorce gave the power of remarriage, except with the person with whom adultery was proved to have been committed, but there would seem to be a doubt whether this power extended to the guilty party (Voet, de Divortiis, lit. 24 tit. 2). Divorce a mensd et thoro could be granted on the grounds allowed by the canon law.

The Code of Prussia of 1794 contained elaborate pro- visions which gave great facility of divorce. A complete divorce could be obtained by judicial sentence for the following causes : (1) Adultery or unnatural offences ; and adultery by a husband formed no bar to his obtain- ing a divorce against his wife for adultery ; and even an illicit intimacy, from which a presumption of adultery might arise, was held sufficient for a divorce. (2) Wilful desertion. (3) Obstinate refusal of the rights of rnar- riage, which was considered as equivalent to desertion. (4) Incapacity to perform the

duties of marriage, even if arising subsequent to the marriagej and the same effect was assigned to other incurable bodily defects that excited disgust and horror. (5) Lunacy, if after a year there was no reasonable hope of recovery. (6) An attempt on the life of one spouse by the other, or gross and unlawful attack on the honour or personal liberty.

(7) Incompatibility of temper and quarrelsome disposi- tion, if rising to the height of endangering life or health.

(8) Opprobrious crime for which either spouse has suf- fered imprisonment, or a knowingly false accusation of such crime by one spouse of the other. (9) If either spouse by unlawful transactions endangers the life, honour, office, or trade of the other, or commences an ignominious employment. (10) Change of religion. In addition to these causes, marriages, when there were no children, could be dissolved by mutual consent if there be no reason to suspect levity, precipitation, or compul- sion; and a judge had also power to dissolve a marriage in cases in which a strongly-rooted dislike appeared to him to exist. In all cases of divorce, but sometimes sub- ject to the necessity of obtaining a license, remarriage was permissible (see Burge, Commentaries on Colonial and Foreign Law, vol. i. 649).

By the law of Denmark, according to the Code of King Christian the Fifth, complete divorce could be obtained for incest; for leprosy, whether contracted before or after marriage; for transportation for crime or flight from justice, after three years, though not for crime itself ; and for exile not arising from crime, after seven years.

In Sweden complete divorce is granted by judicial sentence for adultery, and in Bussia for that cause and also for incompatibility of temper (Ayliffe, Par. 49). On the other hand, in Spain marriage is indissoluble, and the ecclesiastical courts have retained their exclusive cogniz- ance of matrimonial causes. In Italji certain articles of the Civil Code deal with separation, voluntary and judicial, but divorce is not allowed in any form.

In France the law of divorce has had a chequered history. Before the Revolution the Roman canon law prevailed, marriage was considered indissoluble, and only divorce a mensd et thorn, known as la separation d'habitation, was permitted ; though it would appear that in the earliest age of the monarchy divorce a vinculo matrimonii was allowed. La separation d'habitation was granted at the instance of a wife for cruelty by her husband or false accusation of a capital crime, or for habitual treatment with contempt before the inmates of the house ; but a wife could not obtain

a separation for adultery by her husband, although he had his remedy in case of adultery by his wife. In every case the sentence of a judicial tribunal, which took precautions against collusion, was necessary. But the Revolution may be said to have swept away marriage among the institutions which it overwhelmed, and by the law of 20th September 1792 so great facility was given for divorce a vinculo mairimonii as practically to terminate the obligations of marriage. A reaction came with the Code NapolSon, yet even under that system of law divorce remained comparatively easy. Mutual consent, expressed in the manner and continued for a period specified by the law, was cause for a divorce (the principle of the Roman law being adopted on this point), but such consent could not take place unless the husband was twenty-five years of age and the wife twenty-one, unless they had been married for two years, nor after twenty years of marriage, nor after the wife had completed her forty-fifth year; and further, the approval of the parents of both parties was required. In case of divorce by consent, the law required that a proper agreement should be made for the maintenance of the wife and the custody of the children. A husband could obtain a divorce a vinculo matrimonii for adultery, but the wife had no such power unless the husband had brought his mistress to the home. Both husband and wife could claim divorce on the ground of outrage, or grievous bodily injury, or condemnation for an infamous crime. If the divorce was for adultery, the erring party could not marry the partner of his or her guilt. A divorce a mensd et thoro could be obtained on the same grounds as a divorce a vinculo, but not by mutual consent ; and if the divorce a m^nsd et thoro continued in force for three years, the defendant party could claim a divorce a vinculo. On the restoration of royalty, in 1816 divorce a vinculo was abolished, and pending suits for di- vorce a vinculo were converted into suits for separation only.

Divorce in France, after the repeal of the provisions respecting it in the Code Napoleon in 1816, was re-enacted by a law of 27th July 1884, the provisions of which were simplified by a further law of April 20, 1886. But a wide departure was made by these laws from the terms of the Code Napoleon. Divorce by consent disappeared, and the following became the causes for which divorce was allowed : (1) Adultery by either party to the marriage at the suit of the other, without, in the case of adultery by the husband, the aggravation of introduction of the con- cubine into the home

required by the Code ; (2) violence {excis) or cruelty (sevices) ; (3) injures graves; and (4) peine afflictive et infamante. Excis is defined by Locie as " a generic expression comprising all acts tending to compromise the safety of the person, without distinction as to their object or motive, premeditation as well as furious anger, attempts upon life as well as serious wound- ings." SMces are acts of ill-treatment less grave in character, which, while not endangering life, render existence in common intolerable (Kelly's French Law of Marriage, p. 122) . Injures graves, as to which the courts have considered themselves entitled to exercise a wide discretion, have been defined as acts, writings, or words which reflect upon the honour or the reputation of the

*party against whom they are directed. The courts have held that retraction at the trial does not relieve the party from the consequences of an injure grave, and that publicity is an aggravating but not a necessary element. A letter from one spouse to the other may constitute an injure, and the courts have further held themselves at liberty to consider letters written after divorce proceedings have been commenced. Injures graves have also been con- sidered to include material injuries, and among these have been classed habitual and groundless refusal of matrimonial rights, communication of disease, and refusal to consent to a religious ceremony of marriage. Habitual but not occa- sional drunkenness has also been held to fall within the definition of an injure grave. Peine afflictive et infamante signifies a legal punishment involving corporal confinement and moral degradation.^*

In addition to its recognition of full divorce, the French law recognizes s^aration of two kinds, one separation de Mens and the other separation de corps. The effect of separation de Mens is merely to put an end to the community of goods between the spouses. It neces- sarily follows, but may be decreed independently of separation de corps. The grounds of separation de corps are the same as those for a divorce ; and if a separation de corps has existed for three years, it may be turned into a divorce upon the application of either party to the court.

Until 1893 a wife separee de corps obtained only the capacity attaching to a concomitant separation de Mens; that is to say, she recovered the

enjoyment and manage- ment of her separate property, but could not deal with real property, nor take legal proceedings, without the sanction of her husband or of the court. But by a law of 6th Febru- ary 1893 a wife separee de corps obtains " the full exercise of her civil capacity, so that she shall not need to resort to the authority of her husband or of the court." In case of reconciliation, the wife returns to the limited capacity of a wife separee de Mens, and after the prescribed notifica- tion of such change of status it becomes binding on third persons.

The provisions of French law with regard to the custody of the children of a dissolved marriage, and with regard to property, do not differ materially from those prescribed by the English Acts. The custody of children is given to the party who has obtained the divorce, unless the court, on the application of the family, or the ministlre public, consider it better, in the interests of the children, that custody should be given to the other party or a third person ; but in evety case the right of both father and mother to supervise the maintenance and education of the children, and their liability to contribute to their support, are continued.

The law in France as to property on a divorce has been accurately stated as follows : —

" Divorce in France effects a dissolution of the matrimonial regime of property as well as of the marriage itself. The decree appoints a notary, who is charged with the settlement of the pecuniary interests of the parties. By a stereotyped form of procedure the appointment is made invariably for the purpose of liquidating la communaute ayant existe entre les epoux, irrespective of whether the regime really was that of community or another. In the case of aliens, therefore, married under the rule of separate property, it is necessary care- fully to set this out in the notarial deed of liquidation, in order to

1 It is interesting to observe how, according to the latest decision of the House of Lords above referred to, cruelty, according to English law, includes some but not others of the forms of injury for which, under the term of injvres graves, the French law affords a remedy. It may well be doubted whether the view taken by the minority of the peers, which would have included in the definition of cruelty all, or nearly all, of that which the

French law deems either siviees or injures graves, would not have better satisfied both the principles of English juris- prudence and the feelings of modern life.

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defeat the presumption which might he raised hy the wording of the decree that a community really did exist The party against whom the divorce has been pronounced loses the benefit of all settlements made upon him or her by the other party, either by the marriage contract or since the marriage. On the other hand, the party in whose favour the divorce has been pronounced preserves the benefit of all settlements made in his or her favour by the un- successful party. If no such settlements were made, or if those made appear inadequate to ensure the subsistence of the successful party, the court may grant him or her permanent alimony out of the property of the other party, not to exceed one-third of the income, and revocable in case it ceases to be necessary" (Kelly, p. 130).

On a divorce' both parties are at liberty to remarry, the husband at once, the wife after an interval of ten months. A divorced husband may remarry his divorced ■wife, but if he does so, he cannot be again divorced, except on the ground of a sentence to a peine afflictive et infamante passed on one of them since their remarriage. There is, however, this limitation on ^the power of re- marriage of divorced persons, that the party to the marriage against whom the decree has been pronounced is not allowed to marry the person with whom his or her guilt has been established. Such person, however, has no such rights as are recognized in him or her according to English law, and cannot take any part in the proceed- ings. But his or her name is referred to in the proceed- ings only by an initial ; and French law goes even further in the avoidance of publicity, inasmuch as the publication of divorce proceedings in the press is forbidden, under heavy penalties.

By a law of 6th February 1893 French jurisprudence, more complete at least, and perhaps wiser, than English, dealt vrith a matter previously in

controversy, and decided that after a divorce the wife shall resume her maiden name, and may not continue to use the name of her divorced husband ; nor may the husband, for business or other purposes, continue to use the name of his wife.

*By the law of 1886 the special procedure in divorce previously in force under the Code and under the law of 1884 was abolished, and it was provided that matrimonial causes should be tried according to the ordinary rules of procedure. The action therefore, when brought, follows the methods of procedure common to other civil proceed- ings. But there still remain certain necessary prelimina- ries to an action of divorce. A petition must be presented by a petitioner in person to the President of the court sitting in chambers, with the object of a reconciliation being effected. This is known as the premiere comparor tion. If the petitioner still determines to proceed, there follows the seconde comparation, on which occasion both parties appear before the President. If the President fails to effect a reconciliation, he makes an order permit- ting the petitioner to proceed, and deals with the matters necessary to be dealt with pe7idente lite, such matters being (1) separate residence, (2) alimony, (3) possession of personal effects, (4) custody of children. As regards residence, the wife is compelled to adhere during the proceedings to the residence assigned to *her, but no similar restriction is placed on the husband. Alimony pendente lite is in the discretion of the court, having regard to the means of the parties, and includes a proper provi- sion for costs. As regards the custody of children, the Code and the law of 1884 gave it to the husband, unless the court otherwise orders, but the law of 1886 leaves the matter wholly in the discretion of the court.*

There are certain technical rules of evidence on the trial of a divorce action. It is a general principle of the French law of evidence that documentary evidence is the best evidence, and oral testimony only secondary, In divorce cases adultery flagrante delicto can be proved by the official certificate of the commissary of police. Letters between the husband and wife are admissible in

evidence. As to letters between the parties and third persons, the law, which has been doubtful, now appears to be that the wife may produce only such

letters from third parties to her husband as have come into her possession accidentally, and without any ruse or artifice on her part; but the husband may put in evidence any letters written to or by his wife which he has obtained by any, short of criminal, means. If the documents put in evidence are not sufficient to satisfy the court, there follows an investigation by means of witnesses, termed an enquite. A schedule of allegations is drawn up, and a judge, termed a juge-commissaire, is specially appointed to conduct the inquiry. Relatives and servants, though not competent witnesses in ordinary civil actions, are so in divorce proceedings. Cross petitions may be entered ; the substantiation of a cross petition, however, does not have the effect, in some cases given to it by English law, of barring a divorce, but a divorce may be, and often is, granted in favour of and against both parties pour torts reciproques. When a case comes on for trial, it is in the power of the court to order an adjournment for a period not exceeding six months, which is termed a temps d'epreuve, in order to afford an opportunity for reconcilia^ tion. It is said, however, that this power is seldom exercised. An appeal maybe brought against a decree of divorce within two months ; and a decree made on appeal is subject to revision by the Court of Cassation within two months. Both references to the Court of Appeal and the Court of Cassation operate as a stay of execution. A decree 'must, by the law of 1886, be transcribed on the register of marriages within two months from its date, and failing this transcription, the decree is void. The transcription must be made at the place of celebration of the marriage, or, if the parties are married abroad, at the place where the parties were last domiciled in France. If the parties, after having married abroad, return to France, it has been provided, by a circular of the Pro- cureur de la Ripublique in 1887, that the transcription may be made at the place of their actual domicile at the time of action brought, a rule which has been held to apply to the divorce of aliens in France. The effect of transcrip- tion does not relate back to the date of the decree.

Opinions may differ as to the relative merits of the English and French law relating to divorce. But it cannot be denied that the French law presents a singularly complete and well-considered system, and one which, obviously with the English system in view, has endeavoured to graft on it provisions supplementing its omissions, and modifying certain of its terms in accordance with the light afforded by experience and the changed feelings

of the modern world. The effect of the laws of 1884 and 1886 in France has been great. During the five years from 1884 to 1888 the courts granted divorces in 21,064 cases, rejecting applications for divorce in 1524. In addition, there were 12,242 applications for judicial separ ration, of which 10,739 were granted. A distinguished French writer, the author of a work of singular complete- ness and accuracy on the judicial system of Great Britain, has compared these figures with the corresponding result of the English Act of 1857. His conclusion is expressed in these words : " On voit qu'en cinq annees nos tribunaux ont prononce trois fois plus de divorces que la haute Cour d'Angleterre n'en a prononc^ en trente ans. Je n'insiste pas sur les conclusions morales a tirer de ce rapprochement " (Comte de Franqueville, Le Systkne Judiciare de la Grande Bretagne, ii. p. 171). It is, how- ever, practically impossible to compare the number of divorces in France and in England with exact justice, because, as will have been seen above, the causes of divorce in France materially exceed those recognized by English law ; and the absence in France of any official performing

the functions assigned to the King's Proctor by the Eng- lish Act cannot but have great influence on the number of applications for divorce, as well as on their results.

(f. h. j.)

United States.

Divorce is the termination by proper legal authority, sometimes legislatively but usually judicially, of a mar- riage which up to the time of the decree was legal and binding. It is to be distinguished from a decree of nullity of marriage, which is simply a legal determinar tion that no legal marriage has ever existed between the two parties. It is also to be distinguished from a decree of separation, which permits or commands the parties to live apart, but does not completely and for all purposes sever the marriage tie. Upon the subject of divorce in the United States, and, to some extent, in for- eign countries, a careful investigation has been made by the American

Department of Labour, and its report, covering the years 1867 to 1886, is the main source of information. There is no reason to suspect that if the returns for the following ten or fifteen years were known they would discredit the main conclusions of the report. The number of divorces granted in the United States was in 1886 over 25,000, and unless the rate of increase has materially slackened, which is improbable, it is now 30,000. This is about equal to the number reported from all the rest of the Christian world. As divorce pre- supposes a legal marriage, the amount of divorce, or the divorce-rate, is best stated as the ratio between the number of divorces decreed during a year and the num- ber of subsisting marriages or married couples. The usual basis is 100,000 married couples. In 1886 the divorce-rate in the United States was 250 to 100,000 married couples. This is equivalent to more than one divorce annually to each 2500 people. The several states differ in divorce-rate, from South Carolina (q.v.), with no provision for legal divorce, to some of the Eocky Mountain states, where the rate is from three to four times the average for the country. In general the rate is greater in the North than in the South, and in the West than in the East ; but to this rule the New England states, Louisiana, New Mexico, and Arizona are excep- tions. The New England states have a far higher rate than their geograpiiical position would lead one to expect in accordance with the preceding statement; and the other three, owing doubtless, in part at least, to the influ- ence of the Roman Catholic Church, have a lower rate than the states about them. The several state groups had the following divorce-rates in 1886 : South Atlantic, 106; North Atlantic, 149; South Central, 296; North Central, 334; Western, 527. The divorce-rate in the United States has increased rapidly and steadily in twenty years from 173 in 1867 to 250 in 1886. But dis- tinct tendencies are traceable in different regions. In the North Atlantic group the rate fell in twenty years ; in all other groups it rose — in the North Central by 21 per cent., in the Western by 54 per cent., in the South Atlantic by 100 per cent., and in the South Central by over 200 per cent. The great increase in the South was mainly due to the spread of divorce among the eman- cipated negroes.

The ground pleaded for a divorce is seldom an index to the motives which caused the suit to be brought. This is determined by the character of the law rather than by the state of mind of the parties ; and so far as the indi- viduals are concerned, the ground alleged is thus a cloak rather than a clue

or revelation. Still those causes which have been enacted into law by the various state legis- latures do indicate the pleas which have been endorsed by the social judgment of the respective communities.

In the United States there are fifty-two different juris- dictions in the matter of divorce. Six out of every seven allow divorce for desertion, adultery, or cruelty ; and of the divorces reported with their causes during the twenty years, of which there were 315,547 in the United States, nearly 78 per cent, were granted for some one of these three causes, viz., 40 per cent, for desertion, 21 per cent, for adultery, and 16 per cent, for cruelty. Probably nearly 10 per cent, more were for some combination of these causes. Three other grounds for divorce are ad- mitted as legal in many or most American states, viz., imprisonment' in 39, habitual drunkenness in 38, and neglect to provide in 22. About 98 per cent, of American divorces are granted on some one or more of these six grounds. In general the legislation on the subject of the causes allowed for divorce is most restrictive in the states on the Atlantic coast, from New York to South Carolina inclusive, and is least so in the Western states. The slight expense of obtaining a divorce in many of the states, and the lack of publicity which is given to the suit, are also important reasons for the great number of decrees issued. The importance of the former consider- ation is reflected in the fact that the divorce-rate for the United States as a whole shows clearly, in its fluctua- tions, the influences of good and bad times. When times are good and the income of the working and industrial classes likely to be assured, the divorce-rate rises. In periods of industrial depression it falls, fluctuating thus in the same way and probably for the same reason that the marriage-rate in industrial communities fluctuates. In two-thirds of the divorce suits the wife is the plaintiff, and the proportion increased in the twenty years. In the Northern states the percentage issued to wives is 69, while in the Southern states it is only 55. But where both parties desire 'a decree, and each has a legal ground to urge, a jury will usually listen more favourably to a woman's suit.

Divorce is probably especially frequent among the native population of the United States, and among these probably more common in the city than in the country. This statement cannot be established absolutely, since statistics afford no means of distinguishing the native from the foreign-born applicants. It is, however, the most obvious reason for explaining the fact

that, while in Europe the city divorce-rate is from three to five times as great as that of the surrounding country, the difference in the United States between the two regions is very much less. In other words, the great number of foreigners in American cities tend to obscure by their low divorce- rate the high rate of the native population. Divorce is certainly more common in the New England states than in any others on the Atlantic coast north of Florida, and it is not unlikely that wherever the New England families have gone divorce is more frequent than elsewhere. Eor example, it is much more common in the northern coun- ties of Ohio than in the southern counties settled from the Middle Atlantic states.

There are two statements frequently made regarding divorce in the United States which do not find warrant in the statistics on the subject. The first is, that the real motive for divorce with one or both parties is the desire for marriage to a third person. The second is, that a very large proportion of divorces are granted to persons who move from one jurisdiction to another in order to avail themselves of lax divorce laws. On the first point the American statistics are practically silent, since, in issuing a marriage license to parties one or both of whom have been previously divorced, no record is generally made of the fact. In Connecticut, however, for a number of years this information was required ; and, if the statements were trustworthy, the number of persons remarrying each

year was about one-third the total number of persons divorcing, which is probably a rate not widely different from that of widows and widowers of the same age. Foreign figures for Switzerland, Holland, and Berlin indicate that in those regions the proportion of the divorced who remarry speedily is about the same as that o£ widows and widowers. What evidence there is on the subject therefore tends to discredit this popular opinion. The evidence on the second point is more conclusive, and has gone far towards decreasing the demand for a con- stitutional amendment allowing a federal marriage and divorce law. About four-fifths of all the divorces granted in the United States were issued to parties who were married in the state in which the decree was later made ; and when from the remaining one-fifth

are deducted those in which the parties migrated for other reasons than a desire to obtain an easy divorce, the remainder would constitute a very small, almost a negligible, fraction of the total number.

It is difficult, perhaps impossible, to say how far the frequency of divorce in the United States has been or is a social injury ; how far it has weakened or undermined the ideal of marriage as a lifelong union between man and woman. In this respect the question is very like that of illegitimacy ; and as the most careful students of the latter subject agree that almost no trustworthy inference regarding the moral condition of a community can be derived from the proportion of illegitimate children born, so one may say regarding the prevalence of divorce that from this fact almost no inferences are warranted regarding the moral or social condition of the population. It is by no means impossible, for example, that the spread of divorce among the negro population in the South marks a step in advance from the condition of largely unregulated and illegal unions characteristic of the race immediately after the war. The prevalence of divorce in the United States among the native popula- tion, in urban communities, among the New England element, in the middle classes of society, and among those of the Protestant faith, indicates how closely this social phenomenon is interlaced with much that is char- acteristic and valuable in American civilization. In this respect, too, the United States perhaps represent the out- come of a tendency which has been at work in Europe at least since the Reformation. Certainly the divorce-rate is increasing in nearly every civilized country. Decrees of nullity of marriage and decrees of separation not abso- lutely terminating the marriage relation are relatively far less prevalent than they were in the mediaeval and early modern period, and many persons who under former con- ditions would have obtained relief from unsatisfactory unions through one or the other of these avenues now re- sort to divorce. The increasing proportion of the com- munity who have an income suf&cient to pay the requisite legal fees is also a factor of great importance. The belief in the family as an institution ordained of God, decreed to continue "till death us do part," and in its relations typifying and perpetuating many holy religious ideas, probably became weakened in the United States during the 19th century, along with a weakening of other religious conceptions ; and it is yet to be determined whether a substitute for these ideas can be developed un- der the guidance of the motive of

social utility or indi- vidual desire. In this respect the United States is, as Mr Gladstone once wrote, a tribus prcerogativa, but one who knows anything of the family and home life of America will not readily despond of the outcome.

BiBnoGEAPHT. — ^The only important source of statistical infor- mation is the govenmiental report of over 1000 octavo pages, A Report on Marriage and Divorce in the United States, 1867 to 1886, including an Appendix, relating to Marriage and Divorce in

Certain Countries of Europe, by Caekoli, D. Wkight, Commis- sioner of Labour. The student may perhaps obtain a copy by apply- ing to the Commissioner of Labour. The statistics contained in this volume have been analysed and interpreted in W. F. Willcox's The Divorce Problem : A Study in Statistics, published by Columbia University, New York City, in 1891 and again in 1897. Further interpretations are contained in an article in the Political Science Quarterly for March 1893, entitled " A Study in Vital Statistics." The best legal treatise is probably Bishop on Marriage, Divorce, and Judicial Separation. (w. F. w.)

Dix, John Adams (1798-1879), American soldier and politician, was born at Boscawen, N.H., and died in New York City 21st April, 1879. His early training was military, and as a boy he participated in the war of 1812. Afterwards he studied law and was admitted to the Bar. In 1830 he became adjutant-general of New York, and was soon one of the Democratic managers of the State. From 1845 to 1849 he was a United States senator of New York. In May 1860 he became postmaster of New York City, and from 10th January until 6th March 1861 he was Secretary of the Treasury of the United States. He rendered important services in hurrying for- ward troops in 1861, and was appointed major-general of volunteers. In 1872 he was elected governor of New York as a Eepublican by a large majority, but was de- feated for re-election. He had great energy and adminis- trative ability, and became president of the Mississippi and Missouri railway in 1853, and was first president of the Union Pacific railway, 1863-1868.

Dixon, capital of Lee county, Illinois, U.S.A., on the Eock river, at an altitude of 725 feet. Its site is level and its street plan regular. It is at the intersection of branches of the Chicago and North- Western and the Illinois

Central railways. Population (1880), 3658 ; (1890), 5161 ; (1900), 7917, of whom 879 were foreign-born and 59 negroes.

Dixon, Richard Watson (1833-1900), English poet and divine, son of Dr James Dixon, z well-known Wesleyan minister, was born 5th May 1833. He was educated at King Edward's School, Birmingham, and on proceeding to Pembroke College, Oxford, became one of the famous "Birmingham group" there, who shared with William Morris and Burne-Jones in the Pre-Eaphaelite movement. He only took a second class in Moderations in 1854, and a third in lAteroe Humaniores in 1856 ; but in 1858 he won the Arnold Prize for an historical essay, and in 1863 the English Sacred Poem Prize. He was ordained in 1858, was second master of Carlisle High School, 1863- 1868, and successively vicar of Hayton, Cumberland, and Warkworth, Northumberland. He became Honorary Canon of Carlisle in 1874, and died at Warkworth, 23rd January 1900. Canon Dixon's first two volumes of verse, Christ's Company and Historical Odes, were published in 1861 and 1863 respectively ; but it was not until 1883 that he attracted conspicuous notice with Mano, an historical poem in terza rima, which was enthusiastically praised by Mr Swinburne. This success he followed up by three privately printed volumes. Odes and Eclogues, 1884, Lyricai Poems, 1886, and The Story of Eudocia, 1888. Dixon's poems were during the last fifteen years of his life recognized as scholarly and refined exercises, touched with both dignity and a certain severe beauty, but he never attained any general popularity as a pcet. The appeal of his poetry is addressed directly to the scholar and the man of erudition. A great student of history, his studies in that direction colour much of his poetry. He is at his best in poetic narrative, where he combines fancy and fact with much skill and grace. The romantic atmosphere is remark- ably preserved in Mano, which is also a highly successful metrical exercise in the difficult terza rima. His typical

poems have charm and melody, without introducing any- new note or variety of rhythm. A strong love of nature, with much felicity in interpreting natural beauty, informs all his descriptive passages. He is contemplative,

sober, and finished in literary workmanship, a very typical ex- ample of the Oxford school. Pleasant as his poetry is, however, he will probably be longest remembered by the work to which he gave the best years of his life, his History of the Church of England from the Abolition of Roman Jurisdiction, of which at the time of his death four volumes had appeared, covering the period from 1529 to 1588. This fine work is not only built upon elaborate research, but also presents a trustworthy and unpreju- diced survey of a subject in the treatment of which free- dom from bias is exceedingly rare and difficult.

(a. wa.) Dobein, a town of Germany, on the Mulde, 42 miles south-east by rail of the town and in the circle of Leip- zig, kingdom of Saxony. There are an agricultural and a commercial school. The industries include wool-spin- ning, iron-founding, carriage, agricultural implement, and metal printing and stamping works. Population (1890),

13,892; (1895), 15,760.

Dobsina (German, Dobschau), a corporate town of Northern Hungary, 42 miles west by north of Kassa. The most remarkable feature in connexion with it is a large cavern some 3f miles to the north-west, in which is an ice- field nearly 2 acres in extent containing forma- tions which are at once most curious and strikingly beau- tiful. Population, (1900), 5115.

Dobson, Henry Austin (1840), English

poet and man of letters, was born at Plymouth 18th Jan- uary 1840, being the eldest son of George Clarisse Dob- son, a civil engineer, and on his grandmother's side of French descent. When Mr Austin Dobson was about eight years old the family moved to Holyhead, and his first school was at Beaumaris, in the Isle of Angldsea. He was afterwards educated at Coventry, and the Gym- nase, Strasburg, whence he returned at the age of sixteen with the intention of becoming a civil engineer. He had a taste for art, and in his earlier years at the office continued to study it at South Kensington, at his leisure, but without definite ambition. In December 1856 he entered the Board of Trade, gradually rising to a princi- palship in the Harbour Department, from which he with- drew in the autumn of 1901. He married in 1868 Frances Mary, daughter of Nathaniel Beardmore of

Broxboume, Herts, and settled at Ealing. His official career was in- dustrious though uneventful, but as poet and biographer he stands among the most distinguished of his time. The student of Mr Austin Dobson's work will be struck at once by the fact that it contains nothing immature : there are no juvenilia to criticize or excuse. It was about 1864 that Mr Dobson first turned his attention to compo- sition in prose and verse, and some of his earliest known pieces remain among his best. It was not until 1868 that the appearance of St Paul's, a magazine edited by Anthony Trollope, afforded Mr Dobson an opportunity and an audience ; and during the next six years he con- tributed to its pages some of his favourite poems, includ- ing "Tu Quoque," "A Gentleman of the Old School," " A Dialogue from Plato," and " Une Marquise." Many of his poems in their original form were illustrated — some, indeed, actually written to support illustrations. By the autumn of 1873 Mr Dobson had produced suffi- cient verse for a volume, and put forth his Vignettes in Rhyme, which quickly passed through three editions. During the period of their appearance in the magazine the poems had received unusual attention, George Eliot, among others, extending generous encouragement to the

anonymous author. The little book at once introduced him to a larger public. The period was an interesting one for a first appearance, since the air was full of met- rical experiment. Mr Swinburne's bold and dithyrambic excursions into classical metre had given the clue for an e?dargement of the borders of English prosody; and, since it was hopeless to follow him in his own line with- out necessary loss of vigour, the poets of the day were looking about for fresh forms and variations. It was early in 1876 that a small body of English poets lit upon the French forms of Theodore de Banville, Marot, and Villon, and determined to introduce them into English verse. Mr Austin Dobson, who had already made successful use of the triolet, was at the head of this movement, and in May 1876 he published va..,The Prodigals the first original ballade written in English. This he followed by English versions of the rondel, rondeau, and villanelle. An article in the Comhill Magazine by Mr Edmund Gosse, "A Plea for Certain Exotic Forms of Verse," appearing in July 1877, simul- taneously with Mr Dobson's second volume. Proverbs in Porcelain, drew the general eye to the possibilities and achievements of the movement. The experiment was extremely fortunate in its introduction. Mr Dobson is above all things

natural, spontaneous, and unaffected in poetic method ; and in his hands a sheaf of metrical forms, essentially artificial and laborious, was made to assume the colour and bright profusion of a natural pro- duct. An air of pensive charm, of delicate sensibility, pervades the whole of these fresh revivals; and it is perhaps this personal touch of humanity which has given something like stability to one side of a movement other- wise transitory in influence. The fashion has faded, but the flowers of Mr Dobson's French garden remain bright and scented.

In 1883 Mr Dobson published Old-World IdyUs, a volume which contains some of his most characteristic work. By this time his taste was gradually settling upon the period with which it has since become almost ex- clusively associated; and the spirit of the 18th cen- tury is revived in " The Ballad of Beau Brocade " and in " The Story of Eosina," as nowhere else in modem English poetry. In " Beau Brocade," indeed, the picto- rial quality of his work, the dainty economy of eloquent touches, is at its very best : every couplet has its picture, and every picture is true and vivacious. The touch has often been likened to that of Eandolph Caldecott, with which it has much in common ; but Mr Dobson's humour is not so "rollicking," his portraiture not so broad, as that of the illustrator of "John Gilpin." The appeal is rather to the intellect, and the touches of subdued pathos in the "Gentleman" and " Gentlewoman of the Old School" are addressed directly to the heart. We are in the 18th century, but see it through the glasses of to-day; and the soft intercepting sense of change which hangs like a haze between ourselves and the subject is altogether due to the poet's sympathy and sensibility. At the Sign of the Lyre (1885) was the next of Mr Dobson's sep- arate volumes of verse, although he has added to the body of his work in a volume of Collected Poems (1897). At the Sign of the Lyre contains examples of all his various moods. The admirably fresh and breezy "Ladies of St James's" has precisely the qualities we have traced in his other 18th-century poems ; there are ballades and rondeaus, with all the earlier charm ; and in " A Eevolutionary Eelic," as in " The Child Musician " of the Old- World Idylls, the poet reaches a depth of true pathos which he does not often attempt, but in which, when he seeks it, he never fails. At the pole opposite to these are the light occasional verses, not untouched by the influence of Praed, but also quite individual, buoyant, and

happy. But the chief novelty in At the Sign of the Lyre was the series of " Fables of Literature and Art," founded in manner upon Gay, and exquisitely finished in scholar- ship, taste, and criticism. It is in these perhaps, more than in any other of his poems, that we see with how much felicity Mr Dobson interpenetrates the literature of fancy with the literature of judgment. Since 1885 Mr Dobson has been engaged principally upon critical and biographical prose, by which he has added very greatly to the general knowledge of his favourite 18th century. His biographies of- Fielding (1883), Bewick (1884), Steele (1886), Goldsmith (1888), Walpole (1890), and Hogarth (1879-98) are studies marked alike by assiduous research, sympathetic presentation, and sound criticism. It is par- ticularly noticeable that Mr Dobson in his prose has al- ways added something, and often a great deal, to our pos- itive knowledge of the subject in question; his work as a critic has never been solely aesthetic. In Four French- women (1890), in the three series of Eighteenth-Cen- tury Vignettes (1892-94-96), and in The Paladin of Phi- lanthropy (1899), which contain unquestionably his most delicate prose work, the accurate detail of each study is relieved by a charm of expression which could only be attained by a poet. In 1901 he collected his hitherto un- published poems in a volume entitled Carmina Votiva. Possessing an exquisite talent of defined range, Mr Austin Dobson has, in his own words, " held his pen in trust to Art " with a service sincere and distinguished.

Docks. — The development within recent years of vessels of enormous carrying capacity and great speed has rendered necessary various improvements in the facilities for dealing with the traffic at different ports, including the enlargement of old docks and the construction of new ones. In tidal docks, where the shipping can be accommodated at open quays, the improvements generally consist of deepening the approaches by dredging, providing deeper water alongside the quays, and extending and enlarging the quay space. This has been the case to a large extent at such ports as Southampton, Glasgow, Dublin, and Bel- fast. In closed docks the chief improvements are the en- largement of old basins and the construction of

entirely new ones with deeper sills and improved entrances, as at Liverpool, London, Hull, the Tyne, and various ports in South Wales and other parts of the coast.

The position, shape, and general arrangement of docks are determined by local features and the nature of the traffic carried on. At Liverpool, for instance, there are certain local Liverpool features which account for the dock arrangements difier- ■ ing from those at many other large ports. The channel

forming the approach from the sea used to be blocked at the sea end by a bar of sand on which there was a depth of water of only 10 feet at low water of spring tides, though at high water there was 40 feet ; the time, therefore, during which ships could cross was limited to a few hours at high water. This, together with the great accumulation of sand in front of the docks, was apparently the reason why untU the year 1873 their sills (with the exception of a few on the Birkenhead side) were not formed deeper than the level of low water of spring tides. The consequence was that the largest steamers could not enter the docks at neap tides untU some of their cargo had been discharged, and vessels loading in the docks had to move iijto the river to complete their loading from barges. Within the last few years the bar of the Mersey has been improved by dredging, and the depth increased to 28 feet at low water of spring tides. The improvements in the docks themselves were necessary to enable the port to reap the full benefit of the deepening of the bar and to compete successfully with other places. These improvements have been chiefly at the north end, where there was most room for extension and where new large basins have been constructed. Some of the old docks have been grouped together to form large basins, new entrances and locks have been provided to suit the new arrangements of docks inside, and the siUs of entrances have been lowered, the deepest being now 12 feet below low water. New and extensive graving docks have also been constructed. The Alexandra Dock, 44 acres in extent, is one of the latest and largest basins, and was designed to accom-

modate the biggest steamers, having special features to meet their requirements. It forms one of a line of basins opening into each other and having one common entrance from the river. Its shape is that which is found

generally the most convenient for traffic, being practically rectangular, with piers projecting from one side into the

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Alexandra Dock

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water area, leaving sufficient open space near the entrance for vessels to turn. This arrangement largely increases the length of quayage (Fig. 1) . In the ordinary course of trade, goods landed at the docks have to be warehoused in Liverpool, and it is found that cargoes on being discharged can be most conveniently and expeditiously dealt with by sorting them under sheds on the quays and removing them by carts to their various destinations. Hence many of the quays differ from those at most docks in not being provided with railways.

Compared with the docks on the Mersey, those on the Thames are larger in extent. They are not in one continuous line as at Liverpool, but are situated at various points on the river. The individual docks or basins are also larger than those at Liverpool. The trade at London is greater than at Liverpool taken altogether, for though the export trade is less, the import is much greater. The range of tide in the Thames is smaller than in the Mersey, and there is a deep and uninterrupted waterway from the docks to the sea. In these different circumstances the arrangements of the docks are some- what different. The sills of the chief entrance basins are generally fixed at such a

depth that ships can enter and leave them at any state' of the tide, and the quays are well provided with storehouses and railways, so that cargoes can be loaded direct into railway trucks. Amongst the latest additions to the London docks are those at Tilbury, which consist of a tidal basin of 21 acres with a wide trumpet-shaped entrance to the river, having a depth of 26 feet at low water. A lock connects this basin with the main dock, which is rectangular, with a water space of about 50 acres and a depth of 38 feet at high water. From the side opposite the lock project three piers, each 350 feet wide ; one is provided with a double row of store- houses, railways, &c. Parallel with the lock are two graving docks, each opening into the tidal basin and the main dock, and divided into unequal lengths by a caisson ; these can be used either as four short docks, or two long docks, or two locks.

Docks situated in the neighbourhood of the large coal-fields in Scotland, the North of England, and South Wales, which provide almost entirely for the loading of coals, require arrange- ments different from those which deal with the ordinary Docks tor trade of such ports as London and Liverpool. Barry ""^ ft docks may be mentioned as an illustration. Entirely ■'"' constructed within the last few years, and devoted almost ex- clusively to the export of coal, they are fitted with all the latest improvements for the accommodation of ships and for rapidly load- ing them with coal. In selecting the site, every natural advantage has been considered and made use of, not only for the docks them- selves, but also for the approach and entrance. The latter is 80 feet wide, with a single pair of wrought-iron gates, and gives access to a basin 500 feet wide and 600 feet long. Between this basin and the main dock is a passage 80 feet wide, with a pair of gates, so that the basin is used as a large lock. The main dock is 3400 feet long by 1100 feet wide, and is divided longitudinally at one end by a wide projecting pier. Another large wet dock and two graving docks have been added, also a deep lock alongside the entrance basin. In South Wales coal is conveyed from the collieries in waggons containing about 10 tons, with a door at one end ; the full waggons on arrival at the dock are shunted into sidings, and then taken one by one over a weigh-bridge to the coal-tips, which are erected on masonry towers, or on the quay walls, at intervals along the sides of the dock. At the tip the waggon enters an iron cradle or platform, which is raised or lowered and tilted as required by hydraulic

power, and the coal is discharged from the end of the waggon along a shoot to the hatchway of the vessel. The empty

waggon on leaving the cradle runs down an incline to a second weigh-bridge, and thence to the sidings provided for empty waggons. A similar expeditious system is adopted at other Soath Wales ports and at Hull, variations in the details of the tips being introduced to meet local requirements. A somewhat different method is practised on the Tyne and at other north-country ports, where there are no hoists, but the waggons, which carry about 4 tons and discliarge through a door at the bottom, are brought on to the tipping staiths at a level high enough to suit any vessel. Each staith is provided with two or three spouts so as to load at two or three hatchways of a vessel simultaneously, the spouts being arranged to swing to the extent of about 16 feet on either side of their centres. Modifications of these systems are adopted at most of the various coal-ports. The speed of the coaling depends greatly upon the rapidity with which the loaded and empty waggons can be brought to and from the staiths or tips, and also upon the trimming of coal in the hold of the vessel. For loading and dis- charging ordinary cargoes steam or hydraulic travelling cranes are provided by some dock companies ; at other docks the cargoes are worked by steam winches and derricks on the ships themselves ; while at others, again, the quays are leased to various steam ship- ping companies, who provide their own cranes or other gear for working their cargoes.

Dock walls may be considered as generally partaking of the nature of retaining walls. Theoretically the lateral pressure exerted by a bank of earth or other material of the Dock walls. ^^™® height as the wall is that due to the wedge- ‘ shaped mass, abo (Fig. 2), included between the vertical back of the wall ab and a line bo bisecting the angle between the vertical ab and bd, the slope of repose of

the material. This, however, cannot always be entirely relied on in practice, especially in some ground, such as clay, of which the slope of repose is

found to vary considerably in different circumstances. An important point in the design of dock and quay walls is the nature of the foundation, as is shown by the instances of failure which could be attributed to its defects. If the foundations are in- secure, a wall is liable either to slide bodily forward at the base when the pressure of the filling is applied at the back, or the yielding of the ground under the front toe of the wall causes the top to fall forward. Conditions of the subsoil, which it is diflBlcult, if not impossible, to foresee, have sometimes caused the failure of walls which theo- retically were of more than sufficient .strength. The ex- perience of some engineers is that a dock wall should be constructed of sufficient strength to support a head of water equal to its height when the dock is empty, but it would appear that such a wall is only required in excep- tional cases, and even then would fail if the foundation were not secure. In ordinary dock walls a margin of strength should always be provided to meet any weight which may be placed on the quays at the back, and this, if the f oundar tion is good, should be sufficient for any pressure due to backing. Docks are usually constructed in estuaries and rivers where the circumstances are rarely favourable ; the engineer must therefore be g^iided by practical experience and his own judgment, rather than rely on the ordinary calculations which might be set forth as generally appli- cable to retaining walls.

As regards the foundations of walls in soft ground, if the depth of mud or silt is not excessive, and a firm foundation can be obtained beneath it, the wall Pounda- should be carried down well into the solid ground. The usual course is to enclose the site of the works by a cofferdam so as to exclude the tide, and enable the foundations and other work to be con- structed dry, any leakage being kept down by pumping. Where the head of water is not great and the space not limited, effectual dams can be made by embankments. |

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When, however, a considerable head of water has to be dealt with, it becomes necessary to use timber piles driven either in a single continuous row with the joints caulked, or in a double row, with clay puddle between, and well secured by struts at the back. Timber cofferdams admit of much variety of design to suit local circumstances and to meet the varying strains

to which they may be sub- jected. In some instances the cofferdam is partly or wholly formed by a permanent embankment or sea-wall reclaiming ground from the foreshore and enclosing the site of the works; such a method has been adopted at Leith. If the nature of the ground will not admit of a trench beihg excavated deep enough to afford a firm footing for the wall, this must be obtained by some other method, and the expedient most frequently adopted is to drive timber piles to carry the weight of the wall. The timber chiefly used for this purpose is pitch-pine from the states bordering the Gulf of Mexico ; in comparison with the Baltic timbers it is stronger, quite as cheap, and can be obtained in longer lengths. Elm is very tough and durable; so also is beech, which has been largely used, especially when always under water or embedded in the ground. The durability of timber piles depends greatly on their situation ; those which are alternately wet and dry do not last so well as those which are wholly in the ground or under water, while some soils have a more injurious effect on timber than others. Many piles have been found in good condition after being as long as 600 years in the ground. If practicable, it is advisable to drive piles rmtil they reach hard ground. Failing this the only satisfactory way of arriving at an approximation of what they will carry is to test the ground by driving one or two piles to what is considered a sufficient depth and loading them with dead weight, from which may be determined the final set for the remainder. It has been conclusively proved that a light hammer with a high fall causes more injury, with less effective work, than a heavy hammer with a short fall. In driving piles in sand a water jet under pressure, in a pipe sunk down so that it delivers the water just below the point of the pile, loosens the sand and greatly facilitates the operation.

Cylinders constructed of brickwork have for a long time been used in India and elsewhere for foundations. At Glasgow, where they formed the foundation of part of the quay walls, they were 12 feet external and 7 ft. 4 in. internal diameter, and were tongued and grooved together (Fig. 3). The ground in which they were sunk consisted chiefly of sand and water-bearing gravel. They were 35 feet in length, and were sunk until their tops were about 2 feet above low-water level ; they were then filled with concrete, and upon this foundation the upper wall was constructed. Concrete cylinders were after- wards adopted, built into groups of three, and placed as shown in plan (Fig. 4). They were made in rings 2 ft. 6 in.

deep formed alternately of three and four segments so as to break bond when built together, the inside diameters being 5 ft. 9J in. and the out- side 9 ft. 7 J in. Under the bottom ring a cast- iron shoe was secured of the same external size and shape as the ring. This was made in six parts bolted together, and shaped to form a cutting edge. As the rings were built up, the sand and gravel were removed from within the cylinders by means of grabs or excavators. The total height of these cylinders was 28 feet, and when sunk their tops were about 3 feet below the level of low water ; the average rate of sinking was about 12 inches an hour,

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and cast-iron weights amounting to 300 or 400 tons were generally required to force them down.

At Brest, where the range of spring tides is 20 feet, the founda- tions of the quay walls were constructed in the deep water without a cofferdam. A bank of rubble was formed up to a level of 15 feet below low water ; on this large artificial blocks were placed in two courses reaching to low-water level, the part of the wall above low water being constructed in the ordinary manner by tide work. The blocks, about 100 tons in weight, and constructed of rubble masonry, were built on platforms on a slipway, and when ready for setting were lowered down the slipway sufficiently far to admit of a barge being floated over them ; each was then suspended under a barge, and, as the tide rose, was lifted up and taken to the position where it was required to be set, and deposited in its place as the tide fell. In favourable circumstances this method answers well, and with slight modifications has been adopted at other ports.

At Quebec, where the time for constructing harbour works was limited to the summer months, the quay walls were formed of cribwork fill with concrete. The cribs were constructed during the winter, and in the spring

were floated into position, where they rested on a foundation of bearing piles ; they were then filled with concrete deposited under water. The cribs were in lengths of 40 feet, being 27 feet high, 33 feet wide at base, and 23 feet wide at top.

During the improvements and extensions executed at the port of Antwerp, it was found necessary to build on one side of the river an entirely new line of quay walls in advance of the old line, so as to secure a depth of 26 feet of water at low water and prevent the silting up caused by the irregular and broken line of the old wall. The new quay wall, which was constructed by a special system of movable cofferdams, was built of brickwork faced with stone, and was carried out in lengths of 82 feet. First an iron caisson for compressed air was provided, which was 82 feet long and 29J feet wide, and which varied in height from 8J feet to 16J feet according to the depth required below the bed of the river, the footings of the wall being always 26J feet below low water. This caisson, after serving for the removal of the soil, was filled with concrete and became an integral part of the founda^ tion. A movable iron cofferdam 40 feet high was fixed by bolts on the top of the caisson and well strutted inside ; within this the wall from the top of the foundation to low-water level could be built in the dry and in the open air, the struts being removed and replaced in the ordinary way as the work advanced. Iron tubes provided with air-locks were fixed to the top of the caisson, the wall being built round these tubes so that they could be removed when the caisson had reached the bottom and was filled in. The cofferdam was suspended complete by chains from an iron framework carried on two iron barges, and was raised or lowered by hoisting-gear. The site for the caisson was first prepared by dredging. The caisson with cofferdam attached was then fixed in place by means of the fioating barges, and sunk by the weight of the work being carried on above and within it. The narrow spaces between the lengths of wall thus built were filled in afterwards by an arrangement which effectually tied together the whole wall.

Dock walls are usually now constructed of Portland cement concrete, mixed in proportions varying from 6 to 8 parts of shingle and sand to 1 part of Walls. cement, the sand being in the proportion of from 1^ to 2^ parts to 1 part of cement according to the quality required. The interstices of ordinary

shingle without sand form about 33 per cent, of its bulk, and they should be completely filled by the cement and sand when mixed. To ensure good work the cement must be of the highest quality, and the other materials must be perfectly clean. Broken stone is sometimes substituted for shingle, and some engineers use large fragments of stone bedded in the mass of the concrete. Care should be taken to make the concrete as compact and solid as possible, in order to prevent the percolation of water, since concrete is liable to damage from sea-water in course of time if this precaution is not observed. The upper por- tion of the wall, where it is exposed to the rubbing of ships and boats lying alongside, should be faced with masonry or timber fendering. Some quay walls are constructed entirely of timber, the filling at the back being retained by sheet piling up to about low water, and above that level by a paved slope. A slight batter or slope— from 1 in 8 to 1 in 12 is that usually given— to the face of a

wall adds to its strength and appearance. Where the range 'of tide is great, the walls should be vertical or with a very slight batter, since the fall of the tide will other- wise cause the side of the ship to be an inconvenient distance away from the line of the coping.

Later improvements in the design of graving docks consist chiefly in the increased dimensions, the facilities for moving the gates and caissons at their entrances, and the arrange^ients for pumping ™" out the water. With the increasing size of vessels, it has become necessary to provide larger dry docks in which repairs to such ships may be carried out. In aU the most important ports new and extensive graving docks have been constructed. The following are the lengths of some of the largest: Liverpool, 1000 feet; Southampton, 760 feet; Glasgow, 880 feet; Belfast, 850 feet ; Barry, 740 feet ; Tilbury, 876 feet. Some of the longest graving docks are provided with a caisson or gates, dividing them into two lengths, so that for a short vessel only a part of the dock need be used. The con- struction of a graving dock requires great care, especially if the ground is of a soft or treacherous nature. If soft ground, such as sand or silt, extends to some depth below the bottom of the dock, and the depth to hard ground is so great as to render the removal of the soft material impracticable, it will be necessary to enclose the site by sheet piling to prevent any movement of the subsoil through scour. This should be done in addition to any piling that may be required to*

carry the floor and side walls, and is necessary under the entrances of both wet and graving docks; for if water finds its way under the entrance with the pressure due to the head of water on either side of the gates, it will cause a scour, and sooner or later the destruction of the entrance will follow. When the site has been excavated and prepared, and suitable drains have been provided for drawing off any water that may be met with, the foundations for the floor and side walls have to be constructed. For this class of work Portland cement concrete has almost entirely superseded brickwork where suitat|le materials for concrete can be obtained. The floor of a graving deck is in principle an inverted arch, which has to resist the upward pressure of any water that may penetrate to the under-side, and as such water will also be equally at the back of the walls, they will be subjected to a similar pressure in addition to the lateral pressure due to the filling. This fact should be regarded in putting in the concrete, which should be constructed in sections to the full depth of the floor, with the longitudinal vertical joints radiating as if the surface of the invert were

curved (Mg. 6). When the concrete is in contact with rock, the joint should be broken by trenches cut into the surface of the rock, to which the concrete is thus firmly keyed; this is of especial importance if the roc^ is of a water-bearing nature. The surface of the floor is generally formed of granite masonry bedded on the concrete, deeper stones being placed along the centre to carry the blocks, while the sides are some- times paved with granite setts, or blue bricks, or, as in the case of a dock at Halifax, N.S., with pitch-pine planking fixed to longitudinals bedded in the concrete. Usually the centre of the floor is kept a few inches higher than the sides, to allow the water to draw off. The blocks on which the keel of the vessel rests when in dock are fixed along the centre of the floor, and are constructed of hard wood, or of cast-iron and wood combined, the parts of

each, block being formed wedge-shaped so as to be easily adjusted to any required height. There is considerable variety in the shape and arrangement of the side walls of graving docks, but they must be strong enough to bear any pressure that may be applied to them as training walls. The faces are

constructed in steps, or altars as they are termed (Fig. 5), on which rest the shores which support a vessel in the dock. Steps are constructed in suitable positions for access to the bottom, also slides down which timber and other materials can be lowered. These side walls are usually of concrete faced with stone; in some docks the facing is formed of concrete of extra quality, and in others of blue bricks with copings of stone. The entrances are constructed with side walls and sills to suit the method adopted for closing the dock, gates requiring a different arrangement from that provided for a caisson. Culverts fitted with penstocks are built in the side walls near the entrances, for filling the dock with water. For emptying, centrifugal pumps seem on the whole the inost convenient and the least liable to be affected by the passage of small chips of wood, which cannot always be avoided even with the greatest care. When arrangements have to be provided for keeping the entrance clear of mud occasional dredg- ing is generally resorted to. At Liverpool an extensive system of sluicing is adopted, the head of water retained in the dock or closed basin as the tide falls being utilized to produce a strong current which carries off the mud. At Tilbury jets of water under pressure, combined with an arrangement of harrows, are applied at ebb tide to the bottom of the dock and entrance, from an apparatus attached to a floating craft which can be moved to any part required ; the mud stirred up by the harrows is set in motion by the jets, and carried away by the ebb tide.

Hitherto most of the dry docks for the United States Government have been constructed of timber, those C|f masonry having been considered too expensive. doc^”^ In the navy yards of Charlestown, Brooklyn, and Norfolk there are masonry docks, the sills of which are 25 feet below high-water spring tides ; in the timber docks at the various yards the sills are from 15 to 22 feet below high water. A report on the relative value of timber and masonry for dry docks by Commodore Endicott, U.S. Navy, chief of the Bureau of Yards and Docks, states that timber docks are temporary structures, and that the wood of which, they are built requires exten- sive renewal at the end of 25 years, practically amounting in some instances to rebuilding; also that accidents have occurred from the partial collapse and bursting of the floor and sides of some of the timber docks. He con- siders that, in view of the increased depth required in new docks to accommodate vessels of large draught, the risk to their stability will be largely increased,

as they will be subjected to more unfavourable conditions, in particular to a much greater hydrostatic pressure, and that freedom from such risk can only be obtained from a masonry structure designed to resist by its own weight the dangerous force to which it is subjected. He recom- mends that any new docks should be constructed, not of timber, but of masonry and concrete combined ; and that instead of being constructed by day labour and by Govern- ment employees, they should be carried out by contract, which would be the means of greatly reducing their cost. Dock gates are constructed of timber or iron. The two doors are exactly similar, each being rather longer than half the width of the entrance, so that when Dockgates. ^^^^ meet in closing their faces form two sides of a triangle whose base is the straight line drawn from one heel post to the other (Fig. 6). The distance from the apex or meeting-point to the base, which is termed the

rise of the gates, is a matter of considerable importance, as affecting the strains on the gates themselves and on the masonry, to which the strains are transmitted at the heel posts ; in practice it varies from one-sixth to one-fourth of the width of entrance. The heel post is vertical, and shaped to form a tight joint with the closing face of the

hollow quoin; at the bottom is fixed a cast-iron socket which rests upon a cast-iron pivot firmly secured to the masonry of the gate platform, the top being held by an iron strap passing round it and securely anchored to the masonry of the side walls. The main beams of each gate are built into and secured to the heel post at one end and to the mitre post at the other end ; the two mitre posts constitute the meeting face of the pair of gates, and should form a tight and even joint from top to bottom. The timber generally used for gates is greenheart, which is durable and not liable in Britain to the attacks of sea- worms. When gates are made of iron the closing faces at siUs, mitre posts, and heel posts are formed of timber to ensure close-fitting joints. The gates when open fit back into recesses formed in the side walls. Timber gates are less liable to injury or twisting, and are more easily fitted together than iron gates ; on the other hand, the latter can be easily rendered buoyant by the introduction of air chambers, which reduce the strain on the hinges and the weight on the rollers supporting the outer end. These rollers are fixed so that they can be adjusted as required to support the gate, and work on a circular iron way attached to the masonry of the

gate platform ; they are not necessary for gates where the entrance is less than 60 feet wide. The pressure on a gate is due to the difference in level of water on the inside and outside surfaces ; this has to be withstood and conveyed to the side walls by the structure of the gates. The strains in any gate are those of an arch with the load applied in radial lines and equally distributed (Fig. 6). A pair of gates should 'form part of a circular dam, and should be so designed that the line of pressure approximates to a line forming the arc of a circle passing through the centres of the heel posts and the centre of the meeting face of the mitre posts, to ensure that the gates are subject to compressive stress only. For convenience a pair of gates are usually shaped so that their outside faces when closed form a continuous curve, with the inside faces straight. The subject of strains in dock gates has been most fully dealt with in a paper by Mr A. F. Blandy {Proc. Inst. C. E. vol. Iviii.), and by Mr J. M. Moncrieff (ih. vol. cxvii.), to which the reader is referred for information. For moving dock gates an opening and a closing chain is attached to the outer and inner faces respectively of each gate as low down as can be arranged. The chains are conducted to the back of the side walls through openings, and are worked mostly by hydraulic power. At Barry, Leith, and other ports a more rapid and simple arrangement has been introduced by attaching the piston of a hydraulic engine direct to the back of each gate (Fig. 7). The gate thus closed is held up firm against any undulation of the water outside, and the chains are done away with, together with the necessary guiding sheaves. Instead of gates caissons

are frequently used, and are of two types — floating and sliding. The former, when the entrance is opened, is floated out of its position, while the latter is drawn end- ways into a chamber constructed at the side of the entrance, being moved over ways with plane sliding surfaces,

or on rollers fixed either to the ma- sonry or to the bot- tom of the caisson. The advantages of caissons are that they save room by shortening the length of the entrance, they dis- pense with hollow quoins, they facil- itate maintenance and repairs, and, by being capable of carrying a road or railway along their top, they do away with the cost and inconvenience of a swing bridge across the entrance. The deck forming the roadway on top of the sliding caisson can be so arranged that it falls auto-, matically as the caisson is drawn into the chamber, and

rises again when it is moved out. Caissons are raised and lowered by the aid of air and water chambers, the water being ejected or admitted by pumps. Sliding cais- sons are constructed of rectangular section, and are drawn backwards and forwards by hauling gear fixed at the inner end of the caisson chamber and worked by steam, com- pressed air, or hydraulic power, the weight of the caisson on the sliding ways or rollers being adjusted by the amount of water admitted to the water chambers. Float- ing caissons are in shape somewhat similar to theihull of a ship, with a width at the top varying according to the nature of the road or footway required along it.

Floating and pontoon docks are constructed in various forms, but their function is in every case to lift a vessel out of the water and support it by means of their buoyancy. They can only be used in completely sheltered positions. Circumstances, such as a bad foundation, which might render the construction of a solid dock almost if not quite impracticable, would favour the adoption of a fioating dock, but each case must be judged on its own merits.

Eeference may be made to Proc. List. C. E. — C. Colson. Notes on Docks and Dock Construction. — L. F. Vernon-Haecourt. Har- bours and Docks. — William Shield. Principles and Practice of Harbour Construction. (w. E.)

DOCKYARDS.

JL. i>3ITISH.

Recent Structural Developments. — The extensions of H.M. dockyards at Portsmouth and Chatham, described in the ninth edition article on

Docktaeds, marked the most important stage in the history of dockyard construction which had been reached up to the date of their completion and prior to the year 1880. It is proposed to describe briefly in the present article the extent to which H.M. dockyards have developed since that date, with special r. "erence to the great works which were sanctioned by the Naval Works Acts of 1895 and subsequent years.

The works proposed under these Acts are classified under three heads, viz., (a) the enclosure and defence of harbours against torpedo attack; (6) adapting naval ports to the present needs of the fleet ; (c) naval barracks and hospitals. Under the first heading are included the defensive harbours at Portland, Dover, and Gibraltar ; under head- Under jj^g (jf^ ^re included the deepening of harbours li^slation. and approaches, the dockyard extensions at Gibraltar, Keyham, Simons Bay, and Hong- Kong, with sundry other items. Under heading (c) are included the naval barracks at Chatham, Portsmouth, and Keyham; the naval hosr)itals at Chatham, Haslar, and Haulbowline ; the colleges at Keyham and Dartmouth, with other items. The total estimated cost of these works, as stated in the Act of 1899, amounts to upwards of twenty- three and a half millions sterling, and they will form, when completed, the most important additions yet made at any one period to the dockyard and harbour works required to meet the necessities of the fleet. These works will now be briefly described under the headings of their various localities, together with the principal additions to other dockyards carried out between 1880 and 1901.

(a) Enclosure and Defence of Harbours against Torpedo Attack.

Portland. — The existing harbour of refuge at this station was commenced in 1847 under the direction of the Ad- miralty, and completed about fifteen years later in the form and extent in which it remained up to the date of

the commencement of the additional works now being carried out. The original design consisted of the partial enclosure of an extensive area of water bounded on the south and west by the island of Portland and the adjacent coast, and sheltered thereby from winds from those quar- ters, and on the east by a breakwater of large dimensions starting from the north-east corner of Portland island. This breakwater consisted of a rubble mound of btone quarried by convict labour at the summit of the island, lowered by a

wire-rope incline to the sea-level, and de- posited by means of staging in its position in the mound. The breakwater consisted of two portions, an inner arm terminating in a masonry head and fort, and an outer or detached breakwater terminating in a circular fort at its northern extremity, an entrance for shipping being left between the two. The enclosure thus formed afforded a magnificent sheltered roadstead of great extent, with a depth of water of not less than thirty feet over a large proportion of the area.

The developments of naval strategy and the necessity of greater protection from torpedo attack have, however, led to additional works. It will have been observed from the foregoing remarks that the harbour, while protected on the west, south, and east sides, was still open on the north to Weymouth bay and the Channel. It is therefore to the further and complete enclosure of the roadstead on this northern side that the additional works have been directed (Pig. 1). The distance from the circular fort at the extremity of the eastern breakwater above described to the Bincleaves rocks on the western shore of the har- bour is about two miles. This opening is now closed by two additional breakwaters, one portion being detached and about 4465 feet in length, the other starting from the Bincleaves shore and about 4642 feet in length. Each breakwater consists of a rubble mound of stone, quarried as before on the summit of the island, lowered by wire-rope incline, shipped into specially designed hopper barges, towed out and depositad on the site of the breakwaters, which have thus been brought up from the sea bottom to above the water-line in depths of water ranging from 30 to 60 feet. Each section of breakwater

is terminated by a masonry head ~~*with beacon light, and two entrances, each 700 feet in width, serve for the navigation of shipping in entrance and exit. The defen*~~ *sive harbour thus completely enclosed, partly by natural means, partly by the great artificial works now carried out, covers an area of 2200 acres to the one-fathom line, of which 1500 acres have a depth of not less than 30 feet at low water, and is probably one of the finest artificial*

harbours in the world. There is no dockyard at Portland, but the water- ing and coaling appliances for the supply of the fleet are of consider- able importance and extent, the latter having lately been greatly improved by the construction of a coaling jetty and camber for the storage of both sea-borne and land- borne coal and its handling by modern hydraulic appliances.

Dover. — The Admiralty pier at Dover, so familiar to passengers by this route to or from the Continent, was the first instalment of the scheme for a large harbour of refuge recommended by the Eoyal Commissions of 1844-45. This pier was commenced in 1847, and practically completed in 1871, hav- ing a total length of about 2000 feet. As an engineering structure it has proved successful, as, with the exception of the destruction of the parapet in 1877, no material damage has been caused by the heavy seas to which it has con- stantly been exposed. The re- mainder of the scheme was not, however, completed. The Eoyal Commission of 1881 on the em- ployment of convicts again recom- mended the construction of a large harbour at Dover, but beyond the erection of a convict prison nothing further was done for some years. In the meanwhile the Dover Harbour Board, with a view to improving the existing condition of the port, com- menced the scheme indicated on the plan and entitled the " commercial harbour," consisting of an east pier, which runs parallel to the general direction of the Admiralty pier, and will ultimately enclose in conjunction with the latter a sheltered water area of some 75 acres. This work was commenced in 1893, and is now approaching completion. The en- closed harbour for the accommoda- tion of H.M. navy, for which funds were voted by Parlia- ment in 1895 and subsequent years, is indicated on the plan. It will be seen that the water area enclosed amounts to 610 acres, exclusive of the commercial harbour, of which 322 acres have a depth of not less than 30 feet at low water. The enclosing breakwaters are three in number, the most westerly one being an extension in a south-easterly direction of the existing Admiralty pier for a length of 2000 feet ; the southern breakwater is isolated, and is 4200 feet in length, curving round shore- wards at its eastern end to accord with the direction of the third breakwater, which forms the eastern boundary of the harbour ; the last starts from the shore at a point

somewhat east of the convict prison, and runs southerly for a length of 3320 feet.

These three breakwaters, with a united length of rather more than If miles, are each built of massive concrete blocks in the form of a practically vertical wall, founded upon the solid chalk and rising to a quay level of 10 feet above high water. Two entrances, one 800 feet and the other 600 feet in width, are provided in the positions

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/ PafftLAND HARBOUR.

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NEW BREAKWATERS.

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Fig. 1.

shown on the plan. The foreshore at the foot of the cliffs between the Castle jetty and the root of the eastern break- water is in process of reclamation by means of a mas- sive sear wall founded upon the chalk. These great works were begun in 1897 (Fig. 2).

Gibraltar. — The details of the defensive harbour here are closely connected with the general scheme of dockyard extension, and will be found described under the reference to Gibraltar which follows. The en- closed water area at Gibraltar is less than that at Dover in the proportion of about 440 to 610 acres, but neither harbour is comparable with Portland in area.

— Admiralty Harbourt—

— Plan of Proposed Works —

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Fig. 2.

Fig. 3.

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DOCKTAEDS

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(&) Adapting Naval Ports to the Present Needs of the Fleet. Gibraltar. — The history of British naval dockyards is in general one of continuous development, extending over considerable periods of time, and reflecting in the various stages of that history the naval requirements, the engineer- ing skill, and the mechanical resources and appliances of the day. As these have developed and increased, so the older and more obsolete portions and appliances of the yards have been from time to time renewed and readapted to meet modern exigencies ; and the result exhibits the constantly increasing effort to meet the demands which modern naval architecture and strategy are as constantly renewing. In the case, however, of the great works at Gibraltar we have the somewhat unique example of thq creation of a modem dockyard of the first class, as it were, at a stroke, as the small existing yard will have be- come entirely absorbed in the new extension works. The absence of any dry dock at Gibraltar had been for some time the occasion of considerable public discussion, and a commission was appointed in 1890 to consider the ques- tion. But the recommendations of this commission be- came greatly amplified in the scheme finally approved by the Admiralty, for which funds were provided in the Naval Works Loan Act of 1895 and subsequent years. This scheme may be said to consist of two principal parts : the construction of a dockyard with ample dry dock accommodation, with the necessary workshops, stores, and offices ; and the construction of a great defensive harbour of sufficient extent to shelter a

powerful fleet, and yielding largely increased coaling and wharfage accommodation. Combined with the defensive harbour, and forming an integral part thereof, is the new commer- cial mole, a portion of the cost of which is borne by the colony (Fig. 3).

The necessary space for dockyard purposes is exceedingly limited at the Rock of Gibraltar, and thus, with the exception of the small area of the old yard, the area required has been obtained by artificially reclaiming the land over a considerable sea-space, of which the soundings range from low-water mark to 40 feet In depth. The total area thus created for dockyard purposes is about 64 acres. The material required for this reclamation is obtained chiefly from quarries on the eastern side of the Rock by means of a tunnel pierced for that purpose. The graving docks are three in number, alike in cross section and in depth over the sill, but of unequal lengths, to accommodate battleships and cruisers. Dock No. 1 is 850 feet in length, 95 feet in width at entrance, and has a depth of 35J feet over the sill at low-water springs. It is divided into two portions by an intermediate slid- ing caisson, and is capable of docking two ships simultaneously. Dock No. 2 is 550 feet, and Dock No. 3, 450 feet in length, and of similar dimensions in vridtli of entrance and depth over sill. All the docks will have their entrances closed by steel sliding caissons, and are lined throughout with granite and lime- stone. The most important dockyard buildings are the pumping- engine house, the workshops of the chief constructor's and chief engineer's departments, the naval stores, and offices. The pump- ing-engine house will contain the steam machinery for the emptying of the dry docks, which will be capable of pumping out the contents of the largest dock, amounting at high water to 105,000 tons, and discharging into the sea in five hours. The workshop for the chief constructor's department is an extensive building, 407 feet in length and 322 feet in width. The shops of the chief engineer's department are comprised within a building of similar dimensions. The staff captain's department and other stores are comprised within buildings having a total floor-space of about 300,000 superficial feet. At the northern end of the yard are the administrative oflices and a series of slipways for hauling up destroyers, together with a slip for small craft, a wharf for ordnance purposes, and an auxiliary boat camber. The reclaimed area of the dockyard is faced seawards by a wharf wall constructed of interlocked concrete blocks, upon a new system, built in the

sea without the aid of a dam, and having an unbroken line for wharfage purposes of about 1600 feet lineal, with a depth of water alongside of 33 feet at low water. Upon this wharf are erected powerful shears and cranes for the use of vessels alongside. The older appellation of "harbour of refuge" has, from the point of view of the naval strategist, acquired a new and extended

meaning, and while the modem defensive harbour may still serve as shelter from bad weather, it further fulfils the not less import- ant function of protection from torpedo attack. The defensive harbour now in course of construction at Gibraltar is formed by the enclosure of a water area of about 440 acres, of which some 250 acres will have a minimum depth of 30 feet at low water. This enclosure is formed by three several works of considerable magnitude : the Neio Mole Extension forming the southerly bound- ary, the Commercial Mole on the north side, and the Detached Mole forming the westerly boundary, while two entrances, each 200 yards wide, form the approaches to the harbour from the sea. The New Mole, so called in distinction from the Old Mole or Devil's Tongue at the northern end of the town, is supposed to have been commenced during the Spanish occupation in the year 1620. Both New and Old Moles are frequently referred to in Drinkwater's History of the Siege of Gibraltar, and the successful assault upon the former by the officers and men of the British fleet forms a leading incident in the capture of Gibraltar by Admiral Sir George Rooke in 1704. Additions to the length of this mole were made at various times, and in 1895 the total length of the artificial mound was about 1400 feet. The extension now in progress will add 2700 feet to this length.

This mole is formed of a rubble mound, with a top width of 102 feet, the stone being obtained from adjacent quarries and deposited in the sea by barges. The harbour side is faced by a continuous wharf wall, having 30 to 35 feet depth of water alongside, and the total length of wharfage available for ships of war for coaling or other purposes will be 3500 feet. The Detached Mole, forming the westerly boundary of the harbour, is of a different type of construction. It is a vertical wall formed of massive concrete blocks, the greater number of which are of 32 tons in weight, arranged upon what is known as the sloping block system, and founded upon a rubble mound of stone de- posited from barges and levelled for the

reception of the blocks by divers. As this breakwater stands isolated, some half a mile from the nearest point on shore, in from 45 to 65 feet depth of water, and has at no time during its construction been connected with the land by any temporary staging, a brief description of the method employed for commencing its construction will not be without interest. A box-shaped steel caisson, 38 feet wide, 74 feet in length on the top, 101 feet in length at the bottom, and 48J feet high, fitted with compartments and with ends sloped to the angle of the blockwork, was constructed in this country, shipped to Gibraltar, re-erected, launched, towed to its correct position, and sunk, by the admission of water, on the rubble mound before mentioned. Concrete was then filled in as rapidly as possible until the entire mass, weighing about 9000 tons, had formed, so to speak, an artificial rock or island in the sea, being, in fact, a completed section of the breakwater Itself. Upon this foundation were erected two block-setting Titans (see Titan Cranes), capable of setting 36-ton blocks at a radius of 75 feet, by which means this mole has been rapidly extended north and south to its full length of 2720 feet. The blocks, having been transported from the block-yard by rail and then shipped ia barges to the site of the mole, are laid in their sloping position by means of special apparatus designed and patented by the writer.

The Commercial Mole, forming the northerly boundary of the harbour, is intended to serve the commercial requirements of the colony, while at the same time it forms an integral portion of the defensive scheme. This mole starts from the neighbourhood of the Waterport wharf, alongside the Old Mole or " Devil's Tongue," an appellation given to this portion of the defences of the fortress during the siege of Gibraltar in 1779-83, on account of the annoyance to the besiegers caused by its flanking fire. The mole consists of a rubble mound projecting in a westerly direction, furnished with five jetties, lying north and south, and terminating in a western arm lying parallel to the jetties. Each jetty and the western arm is faced with a concrete wharf wall, and the total length of wharfage available for mercantile coaling or other purposes amounts to 7000 feet lineal, with a depth of water alongside ranging from 20 to 30 feet. Extensive coal and bonded stores are provided, and an open viaduct is constructed in the connecting arm, leaving a waterway for the' purpose of giving circulation

to the enclosed waters of the harbour, which is being dredged to secure the depths already referred to.

Devonport and Keyham. — ^Prior to the period dealt with in this article, the works at Keyham described in the ninth edition article on Docktakds had been completed ; rail- way communication with the Cornwall line was established, and a tunnel formed a connexion between the two yards. Keyham yard in 1880 consisted substantially of two basins, the north basin of 9 acres and the south basin of 7 acres in extent; three docks, having floor-lengths of

295, 347, and 413 feet respectively, and extensive dock- yard buildings. The most important addition to Devon- port yard at this period was the construction of Dock No. 3, having a floor-length of 415 feet, with 34' 9" over the sill at high-water springs, and this, with certain dock- yard buildings, constitute the principal features in the development of Devonport yard up to the year 1901. Seamen's barracks of considerable architectural import- ance, with accommodation for 1000 men, together with officers' quarters, drill shed, commandant's residence, &c., were completed on a site to the north of Keyham yard and overlooking the Hamoaze. Such in brief was the extent to which H.M. dockyards at Devonport and Key- ham had been developed up to the time when the scheme sanctioned by Parliament under the Naval Works Loan Act of 1895 was first commenced, and the mud flats to the northward of Keyham yard, and immediately in front of the seaman's barracks above referred to, became the active scene of the new works.

These works present three leading features : a tidal basin with entrance from the Hamoaze ; a group of three graving docks and entrance lock ; and a large enclosed basin, with a coaling depot at the northern end. The tidal basin is in the Immediate neighbourhood of the old Keyham north basin, and is 740 feet in length by 590 feet in mean width, with an area of 10 acres

and a depth of 32 feet at low water of spring tides. This basin affords access to two graving docks of large dimensions, each dock serving also (when not occupied) as a lock for entrance into the closed basin. One of these docks has a length of 745 feet on floor, with 20J feet over the sill at low-water springs. The other is 741 feet on floor, with 32 feet over the sill at low-water springs. Each of these docks can be subdivided by means of an inter- mediate caisson. A third dock, opening out of the dosed basin, is 480 feet in length, with 32J feet over the sill at high water of neap tides, and provision is made for an increase of length when required. An entrance lock, 730 feet in length between caissons, with .32 feet over the sill at low water of spring tides, gives direct access from the Hamoaze to the closed basin, which is 1550 feet in length, 1000 feet in width, and covers an area of 35J acres, with a depth of 32J feet at low-water springs. An addi- tional entrance, closed by caissons, but without a lock, com- municates with the Hamoaze. A wharf wall forming the eastern boundary of the closed basin wUl aSord a length of wharfage of 800 yards, with 30 feet alongside at low-water springs. The site of these worlis is an expanse of mud overlying rook at varying depths, which in some places reach 100 feet or more below the level of coping. As the walls of docks, lock, and basins are in every case carried down to the rock, it follows that the process of constructing foundations at such great depths involves engineering operations of considerable magnitude and difficulty.

The docks and basins above described are remarkable for the depths at which their floors and entrances are laid, and this, combined with the tidal rise of 15i feet, causes the problem of closing and opening the dock and lock entrances to be attended with somewhat more than ordinary difficulty. It is therefore not out of place to describe very briefly the practice in this respect customary in H.M. dockyards. The ordinary lock gate usually found in private docks (though some of the finest modern docks use caissons) is too familiar to need description, but this form of closing an entrance does not afford facilities for carrying a railway line across the dock or lock, and where this is required a swing bridge must be constructed. In the case of H.M. dock- yards it frequently happens that railway lines cross the dock entrances, and the weight to be transported by their means, such as heavy guns, boilers, machinery, and the like, would require a swing bridge of great strength and considerable span. It has consequently been found

convenient and economical to construct the apparatus for keeping the water out of the dry dock in such a form as to combine the functions of a movable dam and a swing bridge, and this is done by the employment of so-called "caissons." The great majority of dock entrances In H.M. dockyards are closed by caissons, and these are, broadly, of two principal types — the floating or ship caisson and the sliding caisson. The former is sunk into its place in a groove prepared in the dock walls for its reception by means of water supplied by hose into a ballast tank, and raised again by letting the water out. The latter type consists of a rectangular steel or iron box- shaped dam, which is drawn across the entrance by machinery, or withdrawn into a recess provided in the side of the dock entrance when access is required into the dock. Both types can be designed to carry a railway across their upper deck capable

of sustaining the heaviest loads ever required. When the caisson is in its place across the entrance and the dock is dry, it has of course to sustain the maximum water pressure which can come upon it at the highest tides. Owing to the causes above men- tioned, the caissons at Keyham are of exceptional dimensions, and the mechanical problems to be dealt with in their design are of no ordinary kind. They are, as a rule, sliding caissons, constructed of riveted mild steel, and capable of withstanding a hydraulic pressure amounting in some cases to 3700 tons.

Simons Bay (Cape of Good Hope). — The existing naval yard at this station covers an area of about 13 acres, exclusive of the victualling establishment and naval hospital, and is provided with a small camber, slipways for torpedo-boats and small vessels, together with various dockyard buildings, storehouses, coal stores, &c., but has no dry dock or deep-water wharf. The new works pro- posed under the Naval Works Loan Act of 1899, at an estimated cost of two and a half millions sterling, are situated near Blockhouse Point, to the east of the present naval yard. These works consist of a tidal basin of 28 acres in extent, and with a depth of 30 feet at low-water spring tides, enclosed by a breakwater on the eastern and northern sides and a similar projecting arm or pier on the west. The entrance to the basin faces north-westerly, and is 300 feet in width. South of the basin is a large reclaimed area forming the site of the new dockyard. Opening from

the basin is a dry dock, 760 feet in length on blocks, with an entrance 95 feet wide and having 30 feet over the sill at low-water spring tides.

This dock can be subdivided by an intermediate caisson in such a manner as to form two docks, respectively 400 feet and 320 feet in length, or 470 feet and 260 feet in length on blocks, as may be required, or the full length of 750 feet can be made available when necessary. The dockyard buildings include extensive shops for the chief engineer's and chief constructor's departments, the pump- ing-engine house, working sheds, &c., while ample space is reserved for additional docks and buildings. Berthing accommodation is provided in the basin alongside the wharf walls which surround it. The walls available for this purpose have a total length of 2585 feet lineal, are constructed of interlocked concrete block work, with an available depth of water of 30 feet at low water, and are furnished with powerful shear-legs and cranes for the use of vessels alongside. Extensive sheds for the storage of coal are provided. The whole of the dockyard area, together with that of the enclosing breakwater and pier, will be formed by reclamation from the sea; and as the total space thus created amounts to 35 acres, the entire extent of the proposed works, including the tidal basin, will amount to 63 acres in area. The works thus briefly described will, in combination with the existing yard, form an important naval station for the requirements of the fleet in South African waters.

Hong-Kong. — The naval yard at this important station consisted of an area of some 4f acres in extent, but unprovided either with basins, dry docks, or any wharfage suitable for large vessels. The widening range of political aifairs in the East, and the increasing requirements of the navy in Chinese waters, had, however, made it obvious that the existing resources of the naval yard were inadequate. The result was an Admiralty scheme of enlargement. The principal features of this scheme are as follows : A tidal basin of 9^ acres in extent is provided, having a depth of 30 feet at low-water springs, and enclosed by wharf walls, giving a total length of wharfage of 2900 feet lineal. A dry dock, opening direct into the roadstead, 550 feet in length on blocks, 95 feet wide at entrance, and with 30 feet over the sill at low-water springs, will accommodate the largest vessel in H.M. navy. Extensive workshops for the chief constructor's and chief engineer's departments, shears, cranes, pumping-engine house, and slipway for

small craft, will also be provided. The site of the exten- sion will be formed by reclamation, and the additional area thus formed, including the basin, will equal 34^ acres. The present yard will thus be increased from 4| acres to 39^ acres in area, and the extension will mark an important stage in the development of the accommoda- tion required to meet the necessities of the fleet in the East. The existing establishment at Kowloon will be augmented by the construction of coaling jetties, &c.

(c) Naval Barracks, Hospitals, &c.

The works in progress under this heading are in- cluded in the following general remarks on the shore establishments of the navy, which include barracks for the seamen, royal marines, and royal marine artillery, training schools, hospitals, and victualling stores. The policy in recent years with regard to naval barracks has been to provide buildings on shore in place of berthing the men in hulks moored alongside the dockyards; and in pur- suance of this policy naval barracks have been provided, or are under construction, in the vicinity of the three great dockyards — Portsmouth, Devonport, and Chatham. At Portsmouth new barracks on the site of the old Angle- sey barracks have been commenced, and when completed will provide quarters for 4609 officers and men. At Dev- onport, as before described, the naval barracks adjacent to the extension works at Keyham were erected to accom- modate 1000 officers and men, and the buildings are now being extended so that the numbers may be increased to 2313 officers and men. At Chatham the site of the old convict prison is being utilized for constructing quarters for 3731 officers and men. The royal marines have barracks at Forton,near Gosport ; at Stonehouse, near Plymouth; and at Chatham, with a depot at Walmer recently enlarged. The barracks and training establish- ment of the royal marine artillery are at Eastney, near Portsmouth, and provide accommodation for 1800 officers and men. The above-mentioned buildings include all necessary accessories, such as canteens, drill sheds, sick quarters, and the various buildings

required for the accom- modation and training of seamen and marines. The training schools on shore include the gunnery establish- ment at Whale Island in Portsmouth harbour, where an area of 73 acres has been formed by the deposit of ex- cavated material from the dockyard extension works, and a gunnery school, provided for 1100 officers and men, with parade ground, gun drill battery, sick quarters, rifle range, &c. The establishment is about to be enlarged to accommodate an additional number of officers and men under instruction. At Dartmouth H.M.S. Britannia has hitherto been used as the training school for naval cadets, but a new naval college is now being erected on the high ground overlooking the site where the Britannia is moored. Greenwich Hospital, formerly appropriated to naval pensioners, is now used as a college for the instruction of naval officers in the more advanced branches of their profession, while at Keyham there is a college for engineer students. The largest naval hospital and medical school is at Haslar, near Gosport, covering an area of 88 acres, with beds for 1084 patients. Stonehouse Naval Hospital has 700 beds for the use of seamen and marines of the Devonport district. At Chatham the existing hospital accommodates nearly 250 patients, and a new hospital for 600 beds is under construction. Hospitals or sick quarters are also provided at Great Yarmouth, Dart- mouth, Haulbowline, Portland, and South Queensferry. The chief victualling establishments are Deptf ord for the Thames, Chatham, and Sheerness ; the Clarence Yard at Portsmouth; and the Eoyal William Victualling Yard at Plymouth and Haulbowline. Magazines for warlike

and ”””••“y •”■””^ navy votes.

stores are established close to the principal dockyards and within easy access by rail or water. At foreign stations Malta has a hospital and victualling yard, Gibraltar has a hospital, and the other chief naval stations in different parts of the world have a shore establishment on a scale adapted to meet their probable requirements.

The chief features in the extensions of H.M. voder dockyards carried out between 1880 1901 under the ordinary navy votes, and not already referred to, may now be briefly described. Portsmouth. — The extension works at this dockyard, described in the ninth edition article Dockyards, and

completed prior to 1880, formed an important stage in the history of this station, and, together with the works at Chatham carried on at about the same period, marked an epoch of advancement in H.M. yards, following as they did the transformation which had already taken place iu naval construction in the substitution of iron for timber and of steam in lieu of sail propulsion. This extension, commenced in 1867, was designed to meet the naval requirements of the day, and no works of equal magnitude have since been carried out at this port. The developments of naval architecture and the increasing length of modern cruisers necessitated, however, additional dry dock accommodation, and in 1896 Docks Nos. 14 and 15 were completed, having a floor length of 557 feet, with 33 ft. 10 in. over the sill at high-water springs. These were the longest docks in the service, with the exception of a double dock at Portsmouth. Other important works carried out since the completion of the extension may be summarized as follows : — The renewal and extension of the jetties on the west front, and, in late years, the construction of jetties at the entrance to the tidal basin and at the north wall ; a torpedo range in the harbour ; the establishment of a coaling wharf at coaling-point, with hydraulic appliances ; the widening of the entrance between Basins 4 and 5 ; the erection of various buildings, such as torpedo and gun-mounting stores, electrical shops, and the like, with numerous subsidiary works of more or less importance. Extensive dredging of the harbour is in progress for the purpose of increasing the berthing accommodation for the fleet.

Chatham dockyard covers an area of 516 acres, including the extensive works described in the ninth edition article on Dockyards and completed prior to 1880. No works of equal magnitude or importance have been carried out since that date at this yard, but among the principal additions or improvements which have been made from time to time may be mentioned extensive dredging opera- tions in the Medway for the deepening of the navigable channel and approach to the basins and docks, the pro- vision of a 160-ton crane, the lengthening of Dock No. 6, and the erection of various yard buildings. Additional dry dock accommodation is provided for under the Naval Works Act.

Pembroke dockyard has an area of some 79 acres, and is furnished with one dry dock 387 ft. 8 in. in length on blocks, numerous building slips of various

lengths, and the usual shops, stores, and other dockyard buildings. The Carr Eocks jetty now under construction will form, when completed, a valuable addition to the resources of the yard in the fitting out and completion of vessels.

Haulbowline dockyard was practically completed about the year 1889, and covers an area of 33 acres, while the adjoining victualling yard of 22 acres makes the total area of this naval station 55 acres. The yard includes a closed basin of 9 acres in extent, with entrance from Queenstown harbour, and with 32 ft. 8 in. over the sill at high-water springs. A dry dock at the south end of the basin has a length of 408 feet on blocks, and is

94 feet wide at entrance. The basin is enclosed by wharf walls with a total length of 1700 feet, and furnished with 60-ton shears, cranes, &c. A slipway is provided at the south end of the basin, and the dockyard buildings comprise a pumping-engine house, constructors' shops, furnace house, worksheds, &c.

Malta dockyard was but briefly referred to in the ninth edition article, and some further notice is desir- able here. The dock and victualling yards occupy to- gether an area of some 100 acres, spread over the shores on both sides of those arms of the grand harbour known as "Dockyard" and "French" creeks, the dock- yard being located partly on the former, but principally on the latter creek. In 1880 the graving dock accom- modation consisted of one double dock at the extremity of Dockyard creek, known as No. 1 and 2 Docks, with a total length of about 525 feet, and with 25 feet over the sill at average water level, the tidal range at Malta being but slight; and opening into French creek a dry dock of more modern construction, known as No. 3, or the Somerset Dock, 427 feet long on floor, and with 34 feet over the sill. Subsequently to this period the fine range of buildings known as the iron ship repairing shop was erected close to the Somerset Dock, and added greatly to the repairing resources of the yard.

Dock No. 4, or the Hamilton Dock, was completed in 1891, having a length on floor of 520 feet, a width of entrance of 94 feet, and with 35 ft. 5 in. depth over the sill at average water level. Associated with this dock was the construction of adjacent deep- water wharf walls, together with the great 160-ton crane. New gun-mounting stores, boiler shop, boat sheds, canteen, coal stores, &c., are among the more recent additions to the yard, and preparations are being made for additional dry dock accommodation.

Halifax naval yard has an area (including the hospital ground) of about 18 acres. The yard is provided with slipways for small craft, shops, stores, &c., but does not possess a dry dock. A private dock in the immediate vicinity completed in 1889, under a Government subsidy, has a floor length of 560 feet, a width of entrance of 89^ feet, with 30 feet over the sill at high-water springs.

Bermuda naval yard is provided with a camber or small enclosed harbour protected with a breakwater. Within the camber is moored an iron floating dock having an inside length of 330 feet. Additional dock accom- modation is contemplated.

Jamaica naval yard covers an area of about 13 acres, but there is no graving dock.

Sydney. — The naval yard at this port is situated on Garden Island, Wooloomooloo Bay, and is provided with a deep-water wharf with shears, an engineer's shop, naval and victualling stores, coal stores and coaling wharf, boat slip, &c. Accommodation for docking H.M. ships is found in the Fitzroy and Sutherland Docks at Cockatoo Island, the former having a length of 474 feet on blocks, with an entrance of 59 feet in width; and the latter a length of 602 feet on blocks, with an 84-feet entrance, having 32 feet over the sill at high-water spring tides.

In addition to the above are naval stations at Ascen- sion, Bombay, Calcutta, Trincomalee, and Esquimalt, together with works in contemplation at Wei-Hai-Wei.

The literature on the subject of H.M. dockyards is not ex- tensive, but the following papers and works may be consulted with advantage: — Bernays.

“Chatham Dockyard Extension Works,” R. E. Lectures. Chatham, 1879. — Colson and Meteb. “Portsmouth Dockyard Extension Works,” Proe. Inst. C. E., 1881. — CoLsoN. “Hamilton Graving Dock, Malta,” Proc. Inst. C. E., 1894.— “The Two New Docks at Portsmouth,” Engineer, vol. Ixxxi. — CooDE, Son, and Matthews. “Dover Harbour Works,” jBn’f. Assoc. Mechanical Science Section. London, 1899.

See also Vernon-Harcourt. Harbours and Docks. London. 1885. — C. CoLSON. Notes on Docks and Dock Construction, London, 1894. (H. f.)

Dockyard Administration. — To a great maritime power like Great Britain the importance of possessing adequate dockyards fitted with every requirement for a fleet is sufficiently obvious. In the dockyard are brought together all the materials of every class and kind re- quired in the construction of ships ; and here is provided the labour required for the building of them. In the dockyard the ships receive their provision for offence and defence and their means for navigation, and are fltted in every detail for their service. Depending as the British empire does on the efficiency of its navy to safe- guard it from attack and to protect its commerce, it is essential to remember that the navy could not carry on its work successfully if there did not exist an efficient civil service such as is found in British dock- yards. In speaking of these establishments, it may be necessary to note that, in addition to the work in the yards of the State, much of that which has been alluded to is carried on in private yards, though the ships built in these last are equipped and brought to completion in the Government establishments. A dockyard may be defined as an enclosure in which are sufficient basins, building slips, dry and wet docks, ammunition, store and coal magazines, coaling wharfs and appliances, and all other things necessary for the life of the ships. It may “be noted that a wet dock is a receptacle for a ship which is open to the tide, and a dry dock one specially constructed to receive ships for the repair of the under-water portions of their hulls in the most advantageous conditions.

An ordinary observer, looking at the great mass and variety of stores arriving alongside a ship, and seeing hundreds of men busily engaged in every part of her, may not at once recognize the existence of a system. But closer observation will show that there is a thorough organization, that

every man knows his duties, and that every separate party bringing stores or requirements is informed as to exactly what is required to be done with them. The operations go on with celerity, regularity, and order, and it is a matter of astonishment to those who know the vast and varied character of the work how quietly it proceeds and how soon order is evolved from apparent chaos. The dockyards at home and abroad lie within the province of the controller of the navy (the third lord of the Board of Admiralty); and the director of dockyards, whose office, replacing that of sur- veyor of dockyards, was created in December 1886, is responsible to the controller for the building of ships, boats, &c., in dockyards, and for the maintenance and repair of ships and boats, and of all steam machinery in ships, boats, dockyards, and factories. The director of naval constraction, who is also deputy-controller, is re- sponsible, not only for the design of ships, but for their construction, in the sense that he approves great numbers of working drawings of structural parts prepared at the dockyards. But the director of dockyards is the Admir- alty official under whose instructions the work goes on, involving the employment and supervision of an army of artisans and labourers. Instructions, therefore, emanate froni the Admiralty, but the details lie with the dockyard officials, and in practice there is a considerable decen- tralization of duties.

The superintendent of a British dockyard is a rear- admiral in tlie case of Portsmouth, Devonport, and Chatham, and abroad of Malta, but a captain is the super- intendent of smaller yards, Sheerness and Pembroke at home, and Gibraltar, Bermuda, Jamaica, Hong-Kong, Sydney, and Ascension abroad; and there are smaller establishments at Halifax, N.S., the Cape of Good Hope,

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Trinoomalee, and Vancouver ; while the Indian Govern- ment has dockyards at Bombay and Calcutta.

The chief function of a dockyard is the building and mainta,ining of ships in ef&ciency. The constructive work is carried out under the care of the chief con- structor of the yard, in accordance with plans sent down from the Admiralty. The calculations for displacement, involving the draught of water forward and aft, have al- ready been made, and, in order to ensure accuracy in the carrying out of the design, an admirable system has beeii devised for weighing everything that is built into the new ships or that goes on board ; and it is astonishing how very closely the actual displacement approximates to that which was intended, particularly when the tendency of weights to increase, in perfecting a ship for commis- sion, is considered. The late Mr Froude, who carried out experiments for many years at Gosport as to the best form for the hulls of ships, was amazed at the great magnitude of the calculations involved in the design of modern vessels. The ship being built to her launching weight, the duty of putting her into the water devolves upon the chief constructor of the yard, and failures in this matter are so extremely rare that it may almost be said they do not occur. As soon as the ship is water- borne the responsibility falls upon the King's harbour mas- ter, who has charge of her ailoat and of moving ships into the fitting basins. When the ship has been brought along- side the wharf, the responsibility of the chief construc- tor of the yard is resumed, and the ship is carried forward to completion by the affixing of armour plating, the mount- ing of guns, often the instalment of engines, boilers, and electrical and hydraulic gear, and the fitting of cabins for ofiicers, mess places for men, and storerooms, and a vast volume of other work unnecessary to be specified. In regard to the complicated details of guns and torpe- does, the captains of the gunnery and torpedo schools have a function of supervision. The captain of the fieet reserve also closely watches the work, because, when the heads of all departments have reported the ship to be ready, she has to be inspected by the commander-in- chief at the port and then passed into the fleet reserve as ready for sea, and there the captain of the fleet re- serve is responsible for her efficiency. Other important officers of a dockyard are the chief engineer ; the super- intendent civil engineer, who has charge of the work in- volved in keeping all buildings, docks, basins, caissons, roads, &c., in repair; the naval store officer, who has charge of most of the stores in the dockyard; and the cashier of the yard, whose name sufficiently expresses his duties.

The system of conducting business at the dockyards is analogous to that which prevails at the Admiralty. There is personal communication between the officers respon- sible for the work, and, as at Whitehall, facilities are af- forded for coming to rapid decisions upon matters that are in hand, and the operations are conducted with an ease which contributes much to efficiency. It is the custom for all the principal officers of the dockyard to meet at the superintendent's office at 9.30 a.m. every day, in order that they may be made acquainted with the orders from the Admiralty and may discuss the work of the day, settling the necessary details as they affect the several departments. It thus follows that there is a complete understanding among the principal officers as to the work to be done, and a full recognition of the part which each is to play in its execution. The result is that time is gained by the avoidance of the necessity of passing minutes from department to depart- ment— a system which would act prejudicially in many cases. An efficient police service is a necessity in a dockyard.

The force necessary is supplied from the Metropolitan police, and is under the orders of the superintendent of the yard for duties connected with it, and under the commissioner of police for the discipline and dis- position of the force. The charges are, of course, paid by the Admiralty, and the system answers well.

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2. United States.

The shore stations under control of the Navy Depart- ment (see AdmibaltY Administration), and collectively known as naval stations, are under different names ac- cording to their nature. Of those called Navy YardSy and intended for the general purpose of sources of supply and for repairs of ships, there are within the United States twelve in number. Two of them are on the Pacific coast, situated on Puget Sound, at Bremerton, Washington; and at Mare Island, near San Prancisco. The other ten are on the Atlantic coast, and are situated at Kittery, Maine Boston, Mass. ; New London, Conn. ; Brooklyn, N.Y. Philadelphia, Pa. ; Washington, D.C. ; Portsmouth, Va. Port Eoyal, S.C. ; Pensacola, Pla. ; and Key West, Pla. There are also such naval stations at Havana, Cuba ; San Juan, Porto Eico ; Honolulu, H.I. ; Cavite, P.I. ; and Island of Guam, in the Ladrones Islands. A floating

dock with a lifting capacity of 15,000 tons is being built for Government use at Algiers, La., near New Orleans.

Besides these, there are important naval stations es- tablished for special purposes, but which in some cases are also available for ports of supply and for repairs. These are : the Naval Academy, Annapolis, Md., for the instruction of naval cadets ; the training stations at New- port, E.I., and Yerba Buena Island, Cal., for the instruc- tion of apprentices ; the proving ground at Indian Jlead, Md., on the Potomac river, where all Government-built ordnance is tested ; the War College at Newport, E.I., for the instruction of officers; the torpedo station at. Newport for the instruction of officers and men in torpedoes, electricity, and submarine diving ; the naval observatory at Washington ; and the marine post at Sitka, Alaska. Coaling depots have been established at Hono- lulu, Pago Pago, Samoan Islands, and at Manila, P.I. Numerous others are to be established soon, both at home and abroad.

Naval hospitals are located at the Portsmouth, Boston, New York, Philadelphia, Washington, Norfolk, and Mare Island yards ; at Newport, E. I. ; Cavite, P.I. ; and Yoko- hama, Japan.

Information regarding the dry docks is given in the table on the following page.

The commandant of a navy yard and station, who is. usually a rear-admiral, is its commander-in-chief. His- official assistants are called heads of departments. The captain of the yard, who is next in succession to com- mand, has general charge of the water front and the ships moored there, and of the police of the navy yard ; it is his duty to keep the commandant informed as to the nature and efficiency of all work in progress. The equip- ment officer has charge of anchors, chains, rigging, sails, and the electric generating plant. The other heads of departments are the ordnance officer, the naval con- structor, the engineering officer, the general storekeeper, the paymaster of the yard, the surgeon, and the civil engineer. The clerks and draughtsmen employed by these officers are appointed under civil service rules, and their employment is continuous so long as funds are available. The foremen are selected by competitive examination, and their number is fixed. In the employment of mechanics and labourers, veterans are given

preference, after which follow persons previously employed who have displayed especial efficiency and good conduct. The rates of wages,

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are determined semi-annually by a board of oflcers, who ascertain the wages paid by private establishments in the vicinity of the navy yai-d. Eight hours constitute the legal work day. “When emergencies necessitate longer hours the workmen are paid at the ordinary rate plus 50 per cent.

The nature and extent of work to be performed upon naval vessels is determined by the Secretary of the Navy ; the commandant th^n issues the necessary orders. The material required is obtained by a system of requisitions, which provide for the purchase from the lowest bidder after open competition. Heads of departments initiate the purchase of materials which are peculiar to their own work ; ordinary commercial articles, however, are usually carried in a special stock called the ” Naval Supply Fund,” which may be drawn upon by any head of department. All materials are inspected, both as to quantity and quality, by a board of inspectors consisting of three ofl&cers. (w. t. s.)

3. Other Dookyaeds.

France. — The French coast is divided into five naval arrondisseinents, which have their headquarters at the five naval ports, of which Cherbourg, Brest, and Toulon are the most important, Lorient and Kochefort being of lesser degree. All are building and fitting-out yards. Each arrondissement is divided into sous-arrondissements, having their centres in the great commercial ports, but this arrangement is purely for the embodiment of the men of the Inscription Maritime, and has nothing to do with the dockyards as naval arsenals. In each arron- dissement the vice-admiral, who is naval prefect, is the immediate representative of the Minister of Marine, and has full direction and command of the arsenal, which is his headquarters. He is thus commander-in-chief, as also governor-designate for time of war, but his authority does not extend to ships belonging to organized squadrons or divisions. The naval prefect is assisted by a rear-admiral as chief of the staff (except at Lorient and Eochefort, where the office is filled by a captain), and a certain num- ber of officers, the special functions of the chief of the staff having relation principally to the efficiency and per- sonnel of the fleet,

while the "major-general," who is usu- ally a rear-admiral, is concerned chiefly with the matiriel. There are also directors of stores, of naval construction, of the medical service, and of the submarine defences (which are concerned with torpedoes, mines, and torpedo- boats), as well as of naval ordnance and works. The pre- fect directs the operations of the arsenal, and is respon- sible for its efficiency and for that of the ships which are there in reserve. In regard to the constitution and maintenance of the naval forces, the administration of the arsenals is divided into three principal departments, the first concerned with naval construction, the second with ordnance, including gun-mountings and small-arms, and the third with the soKsalled submarine defences, dealing with all torpedo matiriel.

Cherbourg, at the head of the Cotentin Peninsula, is a dockyard and harbour chosen on geographical grounds and possessing no natural advantages. It owes its existence in the first place to Louis XIV., and Vauban as the engineer, but the construction of the great breakwater, which encloses the harbour on the north, was a work of very great diflSculty ; it, after being damaged and washed away several times, was recommenced in 1832 and completed. It is over 4000 yards long, is well protected by forts, and has two entrances, the eastern passage having been narrowel to 500 yards by a second breakwater carried out from the Batterie des Grgves to the He Pel^e, while the western entrance is about 1000 yards wide, and lies between the main breakwater and a mole run out from the Fort de Querqueville. The arsenal covers an area of about 54 acres. It consists of an entrance port and of two large basins, all cut out of the solid rook, and there are eight dry docks, of which the principal are capable of admitting the largest vessels.

The arsenal is very completely fitted, and there are extensive stores, magazines, barracks, and engineering shops. The small battleship Henri IV. has been built there, with several modern armoured cruisers, and Cherbourg has become the principal arsenal for the building of submarine boats.

The harbour and arsenal of Brest are approached through the Goulet, which is divided into two deep channels by the Fillettes and the Mengam

Reef, beyond which a great expanse of water is reached, stretching eastward to Landevenec and having the arsenal of Brest on the north. The arsenal lies in a rooky valley open to the harbour, into which the little river Penfeld flows, the two sides of the channel being united by a splendid revolving bridge, which gives a headway at high tides of 72 feet. The water space has an average width of 110 yards in the port, with a maximum of about 170 yards and a minimum of 75 yards. Near the entrance is the great basin excavated in 1683 and, enlarged in 1864. Beyond are the stores and magazines, the old prison, the rope-works, the saw- yard, and the building slips, while on the Kecouvrance or western side, beyond the bridge, are the gun-shops, the salle d'armes, machine-shops, basins and slips, as well as coaling and other estab- lishments. The arsenal possesses a dry dock for destroyers and gunboats, two for cruisers and small battleships, and two for the largest classes of ships. A reconstruction has been begun which will give two additional large docks, of which one can be used for two vessels owing to the provision of a dividing dock-gate. Another dock of large size is to be constructed in the commercial port. At the entrance to the arsenal, and actually in the harbour of Brest, a jetty has been constructed, forming what is called the rade-abri. The works there are to be extended, and magazines and engineer- ing shops are to be built on land won from the harbour. In regard to building facilities, it may be said that Brest has five slips for the construction of vessels ranging from 150 tons to 13,000 tons. The sinuosities of the valley in which the arsenal lies render it some- what incommodious, but the protective harbour mentioned above will considerably increase the facilities. The arsenal and the har- bour, as well as its approaches, are protected by a great number of forts and batteries furnished with modern heavy and quick-firing guns.

The harbour of Lorient is formed by the junction of the Blavet and Scorff, and is SJ miles long, the naval arsenal being on the Scorff, and chiefiy on its right bank. Lorient is a port of construc- tion, but large ships built there are usually fitted at Brest. The largest battleships, such as the Bouvet, Brennus, and St Louis, as well as first-class armoured cruisers, have been constructed at the port. There are two dry docks, and the port is well equipped, but the harbour is shallow, and will not accommodate a large squadron, the usual anchorage being to the north of the He Groix.

Bochefort, the head of the fourth arrondissement, dates from the time of Louis XIV., and is formed by the river Charente, the waters of which are being deepened to facilitate the approach for larger vessels. The largest ships built at the port do not exceed 8000 tons. There are two dry docks, three building slips, and a torpedo basin.

Toulon is the most important of the French dockyards, and is the headquarters of the Mediterranean fleet. The arsenal, which was created by Louis XIV., Vauban being the engineer of the works, lies on the north side of the Petite Bade. This is approached from the Grande Bade by passages at the north and south ends of a long breakwater which extends from the direction of Le Mouril- lon towards the Cfipet Peninsula. The arsenal has been greatly enlarged, and at the present time the water space within the moles amounts to about 150 acres, while the quays approach 4 miles in length. Outside in the Petite Bade is a splendid protected anchor- age for a great fleet, the whole being commanded by many forts and batteries. There are four great basins approached from the Petite Bade — the Vieille Darse, to the east, on the side of Le Mourillon ; the Darse Vauban, next to it ; and the Darse de Cas- tigneau and the Darse Missiessy, farther to the west. In the Darse Vauban are three dry docks, two of them 246 feet long, with a depth of water on the sill of about 20 feet ; while the third is 283 feet long, with a depth of over 24 feet. Three other dry docks are in the Darse de Castigneau, of which one is in two sections. The largest of the docks is 385 feet long, and the depth of water on the sill in all these docks averages 30 feet. In the Darse Missiessy are two dry docks, 426 feet long, with a depth on the sill of over 32 feet. There are several building slips, and the yard is supplied with a gun foundry and wharf, fitting shops, boiler works, victual- ling and other establishments, rolling mills, magazines, and everything that can be required to make it the eflficient base of a great fieet. Le Mourillon is a subsidiary yard at Toulon, de- voted chiefly to shipbuilding, and possessing large facilities, includ- ing five covered slips.

Corsica, which has naval harbours at Ajaccio and other places, is a dependency of the arsenal at Toulon. Porto Vecchio is intended to be made a centre of the mobile defence of the island, with every facility for the repairing of torpedo-boats ; Bonifacio to be

improved as a secondary station ; Bastla to te provided with a floating dock ; and minor establishments to be formed at Calvi and the lie Kousse.

Docking facilities are being increased in Algeria, and the naval station is being united with that of Tunis. Bizerta, the Tunisian port, has been made a naval base by the deepening and fortifying of the canal which is the approach to the inner lake, upon which naval establishments are being constructed for the refitting, coal- ing, and provisioning of the fleet. There are arsenals also at Saigon and Hai-phong, and an establishment at Diego Suarez, which is being extended.

The subsidiary establishments in France are the gun foundry at Buelle ; the steel and iron works at Guerigny, where anchors, chains, and armour-plate are made ; and the worl^ at Indret, on an island in the lower Loire, where machinery is constructed. There are many private shipbuilding establishments in the country, the most important being the Forges' et Chantiers de la M6diterran6e at La Seyne, on the lesser roadstead at Toulon, where very many French and foreign warships of the largest classes have been built. The same company has a building yard at Qraville, near Havre. Other establishments are the Ateliers et Chantiers de la Loire, at Saint Nazaire ; the Normand Yard, at Havre ; and the Chantiers de la Gironde, near Bordeaux.

Germany. — With the expansion of the German navy considerable additions have been made to the two prin- cipal dockyards. These are Wilhelmshaven, the naval headquarters on the North Sea, and Kiel, the headquarters on the Baltic, Danzig being an establishment of lesser importance, and Kiao-ehow an undeveloped base in the Shan-tung peninsula, China. The chief official at each home dockyard is the superintendent (Oberwerftdirektor), who is a rear-admiral or senior captain directly responsible to the Naval Secretary of State. Under the superin- tendent's orders are the chief of the " Ausrtistung " depart- ment, or captain of the fleet reserve, the directors of

ordnance, torpedoes, navigation, naval construction, en- gineering, and harbour works, with some other officers. The chiefs of the constructive and engineering departments are responsible for the building of ships and machinery, and for the maintenance of the hulls and machinery of existing vessels ; while the works department has charge of all work on the quays, docks, &c., in the dockyard and port. A great advance had been made in increasing the efficiency and capabilities of the imperial dockyards by introducing a system of continuous work in the building of new ships and effecting alterations in others, and German material is exclusively used.

Wilhelmshaven, on the Jade, is an artificial port, and has been constructed entirely since the year 1857, when extensive works were undertaken to protect the port from the inroads of the North Sea. The old port is on the western side, where, communicating with the sea by the fitting basin, is a building harbour with three dry docks and two building slips. Here two other large dry docks are now being constructed at a total cost of 12 million marks, partly contributed by the North German Lloyd in consideration of the navy forgoing the right to precedence over all vessels of the mercantile marine in regard to the use of the company's dock at Bremerhaven. This renunciation only applies to times of peace. The new docks will admit the largest men-of-war, even if lying deep in the water through the flooding of compartments, and will be provided with very powerful pumping apparatus which will empty them in 2^ hours. After the war with France a second building period was entered upon at "Wilhelmshaven, and works, including another harbour entrance, were continued until 1886. A new mole is now being built on the east side, where a third entrance to the harbour is projected, as well as the construction of a great basin and other works. There are at the present time two large building slips at the yard, a floating dock, and the five dry docks, built and building, alluded to above. The machine-shops, ordnance, and other stores and magazines are very extensive.

The North Sea station is now in direct communication with the arsenal at Kiel, on the Baltic, by way of the Kaiser Wilhelm Canal from Brunsbuttel, on the Elbe, to Holtenau, on Kiel Bay. Kiel is an extremely important naval station on the eastern side of the Sohleswig-Holstein neck and on one of the finest harbours in the world, and possesses a fully equipped arsenal equal

to all the requirements of the Baltic command. Kiel itself has greatly grown since the war of 1864 gave it to the Prussians. The arsenal is provided with a complete establishment for the building, fitting, and provisioning of a great fleet ; and the docking facilities

are being increased by the building of two great dry docks analogous to those at Wilhelmshaven. There are at the present time four building and patent slips, four dry docks, and two floating docks. A new harbour for torpedo craft is being constructed in Wick Bay, south of the mouth of the Kaiser Wilhelm Canal. No account of Kiel would be complete without a reference to the Germania Yard, which is now an establishment of the Krupp firm, and is capable of constructing vessels of the largest class. There are ten building slips in this yard, ready or projected, four having lately been built and roofed in, so that work can go on in all weathers. The Howaldt works at Kiel are also of great importance, and have large building facilities, which are being added to, with a floating dock for ships of 11,000 tons.

Danzig is a yard of lesser importance, but very completely equipped for the building of small armour-clads and cruisers. Here are two building slips and one dry dock. The Schichau Ship, building Works at Elbing (where torpedo craft are built) have also an important establishment at Danzig, and vessels of the largest class have been built there. The Vulkan Yard at Bredow, near Stettin, the Weser Company at Bremen, and the establishment of Blohm & Voss at Hamburg, are other important private estab- lishments which have built many vessels for the German navy as well as for foreign states.

Russia. — In Russia the naval ports are of two classes. The most important are Cronstadt, St Petersburg, and Nicolaieff. Of lesser importance are Reval, Sveaborg, Sebastopol, Batum, Baku, and Vladivostok. The last-named portdoes notlose importance through the acquisition of Port Arthur, which, however, is rapidly becoming the chief Russian naval base in the Pacific. The administration of the larger ports, except St Petersburg, which is imder special regulations, is in the hands of vice-admirals, who are commanders-in-chief, while the smaller ports are under the direction of rear-admirals. All are directly under the Minister of Marine, except that the

Black Sea ports and Astrabad, on the Caspian, are subordinate to the commander- in-chief at Nicolaieff. Latterly Sebastopol has grown ia importance, and will ultimately become a purely naval harbour, the commercial harbour being removed to Feo- dosia. The Russian Government proposes al so to remodel the harbour works at St Petersburg and Cronstadt, and it is stated that the latter will become a naval port only. The Emperor Alexander III. Port at Libau, on the Baltic, in a region less liable to be icebound in the winter, is approaching completion. Considerable progress has been made in building ice-breaking vessels, by which it is hoped to maintain open passages to the ports during the winter months. A small port is being formed on the White Sea, which may ultimately be connected with the Gulf of Fin- land by a canal through the lake region.

There are two Government dockyards in the city of St Peters- burg, both under the supervision of the port admiral. The most important of these ^ the new Admiralty Yard in the centre of the city, where both building and repairing work goes forward. There are three building slips in the yard, of which two, for the construction of the largest battleships, are new and of stone. The slips are housed in, so that the building work can go on in all weathers. At this yard there is also a very large experimental basin, some 400 feet in length, for trials with models of vessels. The yard is well provided with appliances, and there are two large machine-shops. The Galerny Island Yard is a little lower down the river, and Is an important building establishment entirely devoted to construction. There are two building slips for large vessels, besides numerous workshops, storehouses, and other build- ings, and a very fine moulding loft about 500 feet long and nearly 100 feet broad. The battleships Alexander II., Gangvt, Poltava, Petropavlovsk, Sevastopol, and Orel have been built at the Galerny Yard.

The Baltic Yard is near the mouth of the Neva, and was originally known as the Baltic Shipbuilding and Engineering Works, but it was taken over by the Ministry of Marine, which owned most of the shares, in 1894. Since that time the establish- ment has been enlarged, and a new stone building slip, 520 in length, completely housed in, has been finished, and numerous buildings have been erected. Here the Burik, Bossia, Oromohoi, and other powerful cruisers were built. The Baltic works are now- directed by a

constructor of the imperial navy, but the work is not entirely confined to warship building.

The dockyard at Cronstadt is the principal arsenal for supplying

the Baltic fleet ~~with stores and ammunition, and is largely used for repairs, there being four dry docks— the Alexandrovsky, 584 feet long and 85 feet wide j the Constantinovsky, 490 feet long and 73 feet wide ; the Nikolaievsky ; and the Petrovsky. There are numerous workshops, storehouses, magazines, and steam factories, with a depSt for torpedoes and a torpedo workshop. The work~~ men employed at St Petersburg number about 3500, at the Baltic Yard about 7250, and at Cronstadt about 3830. There are no strictly private yards for the building of large vessels in Russia, with the exception of the Black Sea Company at Nicolaieff. Messrs Creighton build torpedo-boats at Abo in Finland, and the Admiralty has steel works at Ijora, where some torpedo-boats have been built ; and other ordnance and steel works are at Obukhoff and PutilofE. The new port at Libau includes an outer port, a naval port, and a commercial harbour. In the first named is a large basin for ships completing, surrounded by storehouses, work- shops, and other buildings, as well as another large basin with dry docks and workshops for repair, the two being connected by a canal. The works in the naval port were approaching completion in 1901.

At Vladixiostok a fine new dry dock has been opened, which is 650 feet long and 90 feet wide. The facilities of Port Arthur are being considerably developed, and the completion of the railway adds greatly to the importance of the port.

Italy. — The principal Italian state dockyards are Spezia, Naples, and Venice, the first named being by far the most important. It covers an area, including the water spaces, of 629 acres, and there are five dry docks, three of them being 433 feet long and 105 feet wide, and two of them 361 feet long and 98 feet 6 inches wide. The dockyard is very completely equipped with machinery of the best British, German, and Italian makes. At Spezia

several of the finest Italian ships have been built. The number of hands employed in the yard averages 4000. Spezia has two building slips, and for smaller vessels there are two in the neighbouring establishment of San Bartolommeo (which is the headquarters for submarine mining), and one at San Vito, where is a Government gun factory.

The dockyard at Naples covers an area of about 18 acres, but at Castellammare the establishment is a little larger. There are four building slips at the last-named establishment, and a fine dry dock is at Naples.

At Venice are two fine dry docks, 361 feet long, and two build- ing slips, and the yard is well equipped for turning out iron and steel f orgings. A large dry dock has been built at Taranto. There is a small naval establishment at Maddalena Island on the Strait of Bonifacio. The Italian Government has no gun or torpedo facto- ries, nearly all the ordnance coming from the Armstrong factory at Pozzuoli, near Naples, and the torpedoes from the Schwarzkopf factory at Venice, while armour-plates are produced at the im- portant works at Terni. Machinery is supplied by the firms of Ansaldo, Odero, Orlando, Guppy & Hawthorn, and Pattison. The three establishments first named have important shipbuilding yards, and have constructed vessels for the Italian and foreign navies. The Orlando Yard at Leghorn is Government property, but is leased by the firm, and possesses five building slips.

AdstriOrHungary. — The naval arsenal is on the well- protected harbour of Pola, in Istria, which is the head- quarters of the national navy, and includes establishments of all kinds for the maintenance of the fleet. There are large building and docking facilities, and a number of war- ships have been built there. There is a construction yard also at Trieste. A new coaling and torpedo station is at Teodo, large magazines and stores are at Vallelunga, and the mining establishment is at Ficella. The shipbuilding branch of the navy is under the direction of a chief con- structor (Oberster-Ingenieur), assisted by seven construc- tors, of whom two are of the first class. The engineering and ordnance branches are similarly organized.

Spain. — The Spanish dockyards are of considerable antiquity, but of diminishing importance. There is an establishment at Ferrol, another at Cartagena, and a third at Cadiz. They are well equipped in all necessary

respects, but are not provided with continuous work. A recent ar- rangement is the specialization of the yards, Ferrol being designed for larger, and Cartagena for smaller, building work. The ordnance establishment is at Carraca.

Japan. — The principal Japanese dockyard, which was established by the Shogunate in 1866, is Yokosuka. French naval constructors and engineers were employed, and several wooden ships were built there. The Japanese took the administration into their own hands in 1876, and have built a number of vessels of small displacement in the yard. The limit of size has been about 5000 tons, but it is intended to enlarge the establishment so that vessels of the first class may ultimately be built there. There is a first class modern dry dock which will take the largest bat- tleship. About 4000 hands are employed. Shipbuilding would be undertaken to a larger extent but for the fact that nearly all material has to come from abroad. All the im- portant vessels of the Japanese navy have been built in Great Britain, France, Germany, and the United States. Japan has dockyards of lesser importance at Kure and Sassebo, and a fourth is being established at Maisuru, on the north-west coast of the main island. (j. ld.)

Dodgson, Charles Lutwidge ("Lewis Cak- KOLL ") (1832-1898), English mathematician and author. — The literary life of " Lewis Carroll " is familiar to every one, but the private life of Charles Lutwidge Dodgson was retired and practically uneventful. The son of the Kev. Charles Dodgson, vicar of Daresbury, he was born in that village on 27th January 1832. After four years' schooling at Eugby, he matriculated at Christ Church, Ox- ford, in May 1850; and from 1852 till 1870 held a studentship there. He took his degree in 1854, and the fol- lowing year was appointed mathematical lecturer at Christ Church, a post he continued to fill till 1881. In 1861 he was ordained. His earliest publications, beginning with A Syllabus of Plane Algebraical Geometry (1860) and The Formulae of Plane Trigonometry (1861) were exclusively mathematical ; but late in the year 1865 he published, under the pseudonym of " Lewis Carroll," Alice's Adven- tures in Wonderland, a work that was the outcome of his keen sympathy with the imagination of children and their sense of fun. Its success was immediate, and the name of " Lewis Carroll " has ever since been a household word. It was followed (in the "Lewis Carroll" series) by Phantasmagoria in 1869 ;

Through the Looking-Glass, in 1871 ; The Hunting of the Snark, 1876 ; Rhyme and Reason, 1883 ; A Tangled Tale, 1885 ; and Sylme and Bruno, in two parts, 1889 and 1893. A number of anony- mous skits on Oxford topics, that appeared between 1865 and 1874, were due to his pen. While " Lewis Car- roll " was delighting children of all ages, C. L. Dodgson periodically published mathematical works, such as An Elementary Treatise on Determinants (1867), Euclid, Book v., proved Algebraically (1874), Curiosa Mathematica (1888) ; and throughout this dual existence Mr Dodg- son pertinaciously refused to acquiesce in being publicly identified with " Lewis Carroll." Though the fact of his authorship of the "Alice " books was an open secret, he invariably stated, when occasion called for such a pronouncement, that " Mr Dodgson neither claimed nor acknowledged any connexion with the books not published under his name." He died at Guildford, 14th January 1898. (b. f. s.)

Dodona. — The ruins at Dramisos, near Tsacharo- vista, ia Epirus, consisting of a theatre, the walls of a town, and some other buildings, had been conjectured to be those of Dodona by Wordsworth in 1832, but the conjecture was changed into ascertained fact by the exca- vations of M. Carapanos. In 1875 he made some pre- liminary investigations ; soon after, an extensive discovery of antiquities was made by peasants, digging without authority ; and after this M. Carapanos made a systematic excavation of the whole site. The topographical and

architectural results are disappointing, and show either that the site always retained its primitive simplicity, or else that whatever buildings once existed have been very completely destroyed. As M. Carapanos states that he has turned over the whole surface to a considerable depth, he can hardly have failed to bring to light what- ever is left.

To the south of the hill, on which are the walls of the town, and to the east of the theatre, is a plateau about 200 yards long and 50 yards wide. Towards the eastern end of this terrace are the scanty remains of a building which can hardly be anything but the temple of Zeus ; it appears to have

consisted of pronaos, naos or cella, and opisthodomus, and some of the lower drums of the internal columns of the cella were still resting on their foundations. No trace of any external colonnade was found. The temple was about 130 feet by 80 feet. It had been converted into a Christian church, and hardly anything of its architecture seems to have survived. In it and around it were found the most interesting products of excavation — statuettes and decorative bronzes, many of them bearing dedications to Zeus Naios and Dione, and inscriptions, including many small tablets of lead which contained the questions put to the oracle. Farther to the west, on the same terrace,- were two rectangular buildings, which M. Carapanos conjectures to have been connected with the oracle, but which show no distinguish- ing features.

Below the terrace was a precinct, surrounded by walls and flanked with porticoes and other buildings ; it is over 100 yards in length and breadth, and of irregular shape. One of the buildings on the south-western side contained a pedestal or altar, and is identified by M. Carapanos as a temple of Aphrodite, on the insufficient evidence of a single dedicated object; it does not seem to have any of the characteristics of a temple. In front of the porticoes are rows of pedestals, which once bore statues and other dedications. At the southern corner of the precinct is a kind of gate or propylaeum, flanked with two towers, between which are placed two coarse limestone drums. If these are in situ and belong to the original gateway, it must have been of a very rough character ; it is very improbable that they carried, as M. Carapanos suggests, the statuette and bronze bowl by which divinations were carried on.

The chief interest . of the excavation centres in the smaller antiquities discovered, which are now placed in M. Carapanos's collection in Athens. Among the dedica- tions, the most interesting historically are a set of weapons dedicated by King Pyrrhus from the spoils of the Eomans, including characteristic specimens of the pilum. The leaden tablets of the oracle contain no certain example of a response, though there are many questions, varying from matters of public policy or private enterprise to inquiries after stolen goods.

See Dodone et ses Buines, par Constantin Carapanos. Paris, 1878. For the oracle inscriptions, see E. S. Roberts in Journal of Hellenic Studies, vol. i. p. 228. (e. Ge.)

Dolby. See Sainton.

Dolgeliey, a market town, railway station, and county town of Merionethshire, Wales, 68 miles south-east by south of Holyhead. There are a parish church and various chapels. There is a free grammar school (1665). The old " Parliament House " has been demolished. Area of urban district, 176 acres. Population (1881), 2455; (1901), 2437. Area of civil parish, 25,375 acres. Popula- tion (1881), 3962; (1891), 3785.

Dollinger, Johann Joseph Ignaz von

(1799-1891), German theologian and Church historian, was born at Bamberg, Bavaria, on 28th February

1799. He came of an intellectual stock, his grandfather and father having both been physicians of eminence and professors of one or other of the branches of medical science. His father was also a man of general literary culture, and celebrated for his power of imparting instruc- tion, though he is said to have been somewhat rough and overbearing in character. The mother of the young Dollinger, too, was a member of a family not undis- tinguished in intellectual power. The early education of their son was carried out under his father's super- vision ; and though the stories which have become widely current about the proficiency of Dollinger at an early age in Greek and Latin were denied by the celebrated theologian himself, we may be sure that he was not permitted to be backward in his studies. The elder Dollinger, shortly after his son's birth, was removed to a professorship at Wtirzburg. There he came into'friendly relations with the well-known philosopher Schelling, a circumstance which doubtless left its stamp for life upon his son.

Young Dollinger mastered the French language very early, and soon conceived an enthusiastic admiration for Napoleon, which lasted until, at about seventeen years of age, he fell in with an account of the treatment of Pope Pius VII. by that great conqueror. At this period he left the gymnasium

at Wurzburg, to which he had early been sent, and began to study natural philosophy at the university in that city. In 1817 he commenced the study of mental philosophy and philology. He thus laid a basis of sound general knowledge before he pursued the study to which he ultimately devoted himself. This study was theology, which he decided to take up in 1818, because he believed it to lie be- neath every other science which could be named. The teaching of theology in Eoman Catholic Germany was then passing through a transition stage. But at that moment ecclesiastical history continued to be very ill taught, and young Dollinger resolved to carry on the study of it independently — a resolution which in all probability materially affected his career.

In 1820 he became acquainted with Huber, another fact which, as will be seen, largely influenced his own life as well as that of his friend. On 6th April 1822 he was ordained priest, after studying awhile at Bamberg, and in 1823 — at a very early ag» — he became professor of Ecclesiastical History and Canon Law at Aschaffenburg. Here began his career as author. He then took his doctor's degree, and in 1826 became professor of Theology at Munich, where he spent the rest of his life. About this time Dollinger brought upon himself the animadversion of Heine, who was then editor of a Munich paper. He described the professor's face as the "gloomiest" in the whole procession of ecclesiastics which took place on Good Friday. All shades of Christianity, it is to be remembered, came under the lash of that unspar- ing satirist. It has sometimes been stated that in his earlier years Dollinger was a pronounced Ultramontane. This does not appear to have been altogether the case; for, very early in his professorial career at Munich, the Jesuits attacked his teaching of ecclesiastical history, and the celebrated Mohler, who afterwards became his friend, on being appealed to, pronounced on the whole in his favour. He also entered into relations with the well- known French Liberal Catholic Lamennais, whose views on the reconciliation of the Eoman Catholic Church with the principles of modern society had aroused much suspicion in Ultramontane circles. In 1832 Lamennais, with his friends Lacordaire and Montalembert, visited Germany, and obtained considerable sympathy in their attempts to bring about a modification of the Eoman

Catholic attitude to mo “iprn problems. Dollinger seems to have regarded favourably the removal, by the Bavarian Government, in 1841, of Professor Kaiser from his chair, because he had taught the infallibility of the Pope. On the other hand, he published a treatise in 1838 against mixed marriages, and in 184.3 wrote strongly in favour of requiring Protestant soldiers to kneel at the consecration of the Host when compelled officially to 1)6 present at Mass. Moreover, in his work on the ” Reform- ation ” (184(j-1848) he is very severe on the Protestant leaders, and he also accepts, in his earlier works, tlie Ultramontane view then current on the practical condition of the (Jhurch of England, a view which in later days he found reason to change. Mean- while he had visited England, where he was well received ; and he afterwards travelled in Holland, Belgium, and France, acquainting Limself with the condition and prospects of the Roman Catholic Church in those countries. In 1842 he entered into correspondence with the leaders of the Tractarian move- ment in England, and some in- teresting letters have been preserved which were exchanged between him and Dr Pusey, Mr Gladstone, and Mr Scott (after- wards Mr Hope Scott). When the last-named joined the Church of Rome he was warmly congratulated by Dollinger on the step he had taken. He, however, much regretted the gradual and very natural trend of his new English allies to- wards extreme Ultramontane views, of which Ar’hdeacou, afterwards Cardinal, Manning ultimately became an enthusi- astic advocate. In 1845 Dol- linger was made representative of his University in the Second Chamber of the Bavarian

Legislature. In 1847, in consequence of the fall from power in Bavaria of the Abel Ministry, with which he had been in close relations, he was removed from his professor- ship at Munich, but in 1849 he was invited to occupy the chair of Ecclesiastical History. In 1848, when nearly every throne in Europe was shaken lay the spread of revolutionary sentiments throughout the European continent, he was elected delegate to the National German Assembly at Frankfort, — a sufficient proof that at this time he was regarded as no mere narrow and technical theologian, but as a man of wide and independent views. It has been said that his change of relations to the Papacy dated from the Italian war in 1859, but no sufficient reason has

been given for this statement. It is far more pro- bable that, like Grosseteste, he had imbibed in early youth an enthusiastic sentiment of attachment to the Papacy as the only centre of authority, and the only guarantee for public order in the Church, but that his experience of the actual working of the Papal system had to a certain extent convinced him how little correspond- ence there was between his ideal and the reality. He may also have been unfavourably impressed with the promulgation by Pius IX. in 1854 of the dogma of the Immaculate Conception of the Blessed Virgin. But, whatever may have been his reasons, he ultimately became

JOIIANISr JOSEPH IGNAZ VON" nOLLINGEE. {From a photograph by F. Bruckmann, Munich.')

the leader of those who were energetically opposed to any addition to, or more stringent definition of, the powers the Papacy had possessed for centuries. By the year 1863 his position had evidently undergone a change. In that year he invited a number of theologians, amounting to one hundred, to discuss the question which Lamennais and Lacordaire had previously and prematurely raised in Prance, namely, the attitude that should be assumed by the Roman Catholic Church towards modern ideas. His The Church and the Churches (Munich, 1861) dealt to a certain extent with the same question. But his address to the assembled divines in 1863 was, as

Professor Woker says (Inter- natioiiale Theologische Zeitsclir/ft, July 1899, p. 459), "practi- cally adeclaration of war against the Ultramontane party." He had spoken boldly in favour of freedom for the Church in the Frankfort National Assembly in 1848, but he had found the authorities of his Church claiming a freedom of a very different kind from that for which he had con- tended. The freedom he claimed for the Church was freedom to manage her affairs without the interference of the State ; the adherents of the Papacy desired freedom in order to put a stoj) to the dissemin- ation of modern ideas. The famous Syllabus, recently put forth by Pius IX., had de- clared war against modern science and progress, and had reproduced the mediteval claims of the Church in a most uncom- promising form. The addresses delivered in the Assembly of Divines in 1863 were a declara- tion in the opposite direction. The Pope for a moment seemed to hesitate, but there could be little doubt what course he would ultimately pursue, and

after four days' debate the As- sembly was closed at his command. It was in connexion with this question that Dollinger published his Past and Present of Catholic Theology and his Universities Past and Present (Munich, 1867).

We now approach the critical period of DoUinger's life. It was about this time that some of the leading theologians of the Roman Catholic Church, conceiving that the best way of meeting present perils was to emphasize, as well as to define more clearly, the authority of the Pope, advised him to make his personal infallibility a dogma of the Church, and urged strenuously on him the necessity of calling a Council for that purpose. There was considerable opposi- tion in various quarters. Many bishops and divines con- sidered the proposed definition a false one. Others, though accepting it as the truth, declared its promulgation to be inopportune. But the headquarters of the opposition was Germany, and its leader was Dollinger, whose high reputation and vast stores of learning placed him far above any other member of the band of theological experts who now gathered around him. Among them were his intimate friends Priedrich and Huber, in Bavaria. In the rest of Germany he found many supporters, chiefly professors in the Catholic faculty of theology at Bonn : among these were the famous canonist von Schulte, the

learned Eeusch, the afterwards celebrated ecclesiastical historian Langen, as well as Reiakens, afterwards bishop of the Old Catholic Church in Germany, Knoodt, and other distinguished scholars. In Switzerland, Professor Herzog, who became Old (or, as it is sometimes called, Christ-) Catholic Bishop in Switzerland, and other learned men supported the movement. Early in 1869 the famous Letters of Janus (which were at once trans- lated into English) began to appear. They were written by DoUinger in conjunction with Huber and Friedrich, afterwards professors at Munich. In these the tendency of the Syllabus towards obscurantism and Papal despot- ism, and its incompatibility with modern thought, were clearly pointed out; and the evidence against Papal Infallibility resting, as the " Letters " asserted, on the Forged Decretals, and accepted without controversy in an age of ignorance, was ably marshalled for the guid- ance

of the Council. When, on 8th December 1869, it had actually assembled, the world was kept informed of what was going on in the Letters of Quirinus, writ- ten by DoUinger and Huber while the debates of the Council were proceeding. Some of these letters ap- peared in the German newspapers. An English trans- lation was published by Eivington. Augustin Theiner, the librarian at the Vatican, then in disgrace with the Pope for his outspoken Liberalism, kept his German friends well informed of the course of the discussions. The proceedings of the Council were frequently very stormy, and the opponents of the dogma of Infallibility complained that they were not unfrequently interrupted, and that endeavours were made to put them down by clamour. The dogma was at length carried by a con- siderable majority of the bishops present, and the rest one by one submitted. Bishops Hefele, of Eottenburg, and Strossmayer, from Croatia, being the last who held out. DoUinger, however, was not to be silenced. He headed a protest by forty-four professors in the University of Munich, and gathered together a Congress at Nuremberg, which met in August 1870 and issued a declaration adverse to the Vatican decrees. An immense ferment took place. In Bavaria, where DoUinger's influence was greatest, the strongest determination to resist the resolutions of the Council prevailed. But the authority of the Council was held by the Archbishop of Munich to be paramount, and he called upon DoUinger to submit. Instead of submitting, DoUinger, on 28th March 1871, addressed a memorable letter to the arch- bishop, refusing to subscribe the decrees. They were, he said, opposed to Holy Scripture, to the traditions of the Church for the first thousand years, to historical evidence, to the decrfes of the General Councils, and to the existing relations of the Eoman Catholic Church to the State in every country in the world. " As a Christian, as a theologian, as an historian, and as a citizen," he added; " I cannot accept this doctrine." The reply of the Arch- bishop of Munich was the proclamation of an excommuni- cation against the disobedient professor. This roused opposition afresh. He was almost unanimously elected rector-magnificus of the University of Munich, and Oxford, Edinburgh, and Marburg universities conferred upon him the honorary degree of doctor of laws, and Vienna that of philosophy. The Bavarian clergy invited Bishop Loos, the bishop of a Church in Holland which for more than 150 years had existed independent of the Papacy, and had adopted the name of " Old Catholic," to hold confirmations in Bavaria. The offer was accepted, and the bishop was received with

triumphal arches and other demonstrations of joy. The three Dutch Old Catholic bishops declared themselves ready to consecrate a bishop, if it were desired. The momentous question was discussed at a meeting of the opponents of the Vatican

decrees, and it was resolved to elect a bishop and ask the Dutch bishops to consecrate him. DoUinger, however, voted against the proposition, and withdrew from any further steps towards the promotion of the movement. This was the critical moment in the history of the re- sistance to the decrees. Had DoUinger, with his im- mense reputation as a scholar, as a divine, and as a man, allowed himself to be consecrated bishop of the Anti- Vaticanist Church, it is impossible to say how wide the schism would have been. But he declined to initiate a schism. His refusal lost Bavaria to the movement ; and the number of Bavarian sympathizers was still further reduced when the seceders, in 1878, allowed their priests to marry, a decision which DoUinger, as was known, sincerely regretted. The Old Catholic Communion, how- ever, was formaUy constituted, with Eeinkens at its head as bishop, and it still continues to exist. DoUinger's atti- tude to the new community was not very clearly defined, nor indeed very consistent. He did not refuse to meet the Old Catholic leaders in the various Conferences ' which were held between 1871 and 1875, and was al- ways ready to give his advice, when asked, to the infant community. He remained on the most friendly terms with its members. His addresses on the Eeunion of the Churches, delivered at the Bonn Conference of 1872, show that he was by no means hostile to the newly formed communion, in whose interests these Conferences were held. It may be difficult to reconcile the two de- clarations made by him at different times : " I do not wish to join a schismatic society ; I am isolated," and " As for myself, I consider that I belong by conviction to the Old Catholic community." The latter declaration was made some years after the former, in a letter to Pastor Widmann. The nearest approach to a reconciliation of the two statements would appear to be that while, at his advanced age, he did not wish to assume the responsibility of being head of a new denomination, formed in circum- stances of exceptional difficulty, he was unwilling to con- demn those who were ready to hazard the new departure. " By conviction " he belonged to the Old Catholics, but practically he took no active part in their proceedings. Yet at least he was ready to meet the leaders of the Old

Catholic Church, to address them, and to discuss difficult problems with them. In 1874, and again in 1875, he presided over the Eeunion Conferences held at Bonn and attended by leading ecclesiastics from the British Isles and from the Oriental Church, among whom were Bishop ChristopherWordsworthof Lincoln; BishopHarold Browne of Ely ; Lord Plunket, archbishop of Dublin ; Lycurgus, archbishop of Syros and Tenos ; Canon Liddon ; Professor Ossinine of St Petersburg, and other eminent divines. At the latter of these two Conferences, when DoUinger was seventy-six years of age, he delivered a series of marvellous addresses in German and English, in which he discussed the state of theology ou' the Continent, the Eeunion question, and the religious condition of the various countries of Europe in which the Eoman Catholic Church held sway. Not the least of his achievements on this occasion was the successful attempt, made with extraordinary tact, ability, knowledge, and perseverance, to induce the Orientals, Anglicans, and Old Catholics present to accept a formula of concord, drawn from the writings of the leading theologians of the Greek Church, on the long-vexed question of the Procession of the Holy Spirit. This result having been attained, he passed the rest of his days in retirement, emerging some- times from his retreat to give addresses on theological questions, and also writing, in conjunction with his friend Eeusch, his last book, GescMcMe der Moratstreitigkeiten in der Romisch-Katholischen Kirche seit dem sechzehnten Jahrhundert, mit Beitrdgen zur OescJiichte und Charah

teristik des Jesuitenordens (Nordlingen, 1889), in which he deals with the moral theology of St Alphonso de Liguori. He died in Munich, on the 14th January 1890, at the age of ninety-one. In his latest moments he refused the sacraments at the,hands of a Roman Catholic priest, and the last offices were performed by his faithful and attached friend Professor Friedrich.

In addition to the works referred to in the foregoing sketch, we may mention The Eucharist in the First Tliree Centuries (Mainz, 1826), a Church History (Ratisbon, 1836-1838), Hippolytus and Callistus (Katisbon, 1854), First Age of Christianity (1860). His Lectures on the Beunion of the Churches

and on TJie Vatican Decrees have also been published. Both these last have been translated into English. (j. j. l.)*

*Dol nja-TuzIa, capital of the district of Tuzla in the province of Bosnia, Austria-Hungary, beautifully situated in a mountainous district on the right bank of the Julia, at the terminus of a branch railway line fromDoboj, from which it is 38^ miles south-east. From a very ancient date it has had an important connexion with the salt industry, being known by the Eomans as Ad Salinas, while in the Middle Ages it was known as Sou or Sow, the capital of the salt district. It is the seat of an Orthodox bishop. A high school (phergymnasium) was opened in 1898. Of late, attempts have been made to develop the salt industry. There are coal-mines in the neighbourhood, and there is also a trade in corn, cattle, swine, and horses. An am- monia soda factory has been opened near the town. The population is 10,227, all Mahommedans, including a per- manent colony of gypsies^*

Dominica, the largest island in the colony of the Leeward Islands, of which its forms one of the five presidencies. The temperature ranges from 78° to 86° in the hot season (from August to October), and from 72° to 84° during the cooler months. In spite of the heavy rain- fall (varying in different parts of the island from 50 to 162 inches per annum) the atmosphere is dry, the rain sinking into the porous soil very rapidly. The climate, though hot on the low ground, is decidedly healthy for the tropics, and no case of yellow fever has occurred since 1850. In 1871 the census return gave 27,178 in- habitants; that of 1891 gave 26,841 (335 white, 6806 coloured, and 19,700 black). In 1900 the population was estimated at 30,000. The value of the imports for 1874 was £56,714 ; for 1899, £66,433 ; while for 1874 exports were £67,720; and for 1899, £64,070. The principal exports in 1899 were limes and lime-juice, cacao, and sugar. Other products are coffee, cocoanuts, nutmegs, cloves, cinnamon, and other spices, oranges, bananas, pine- apples, and almost all tropical fruits. The tonnage of the vessels entered and cleared during 1898 was (steam, 447,324; sailing, 9674) 456,998, of which 451,136 was British and 6862 foreign. The revenue for 1874 was £15,022 ; for 1898, £24,670. The expenditure for 1874 was £17,456 ; for 1898, £24,648. The manufactures of the island include sugar, lime-juice, and bay-oil ; there are many peasant proprietors and metayers. In religion, Roman Catholics predominate. Education in the primary

schools is free and by law compulsory. The Cambridge Local Examinations are held in the colony. The French patois, a result of French occupation from time to time, is the predominant language of the peasant class, but English is understood by many, and its general use is in- creasing. In 1898 the local legislature, in consideration of pecuniary assistance from Great Britain, passed an Act abrogating the semi-elective cbnstitution and providing for a Legislative Council of 12 members, — 6 official and 6 unofficial, — all nominated by the Governor.

Don, Province of the (Russian, Donskaya Oblast), a province of S.E. Russia. The governments of

Voronezh, Kharkoff, and Ekaterinoslav lie to the west, the Sea of Azov to the south-west, the Caucasian provinces Kuban and Stavropol to the south, Astrakhan and Saratov to the east. Area, 63,532 square miles. Population (1897), 2,575,818. It almost entirely belongs to the domain of the South Russian prairies, having the character of higher, ravinated plains in the north (Donetskiy Kryazh), west, and south-west, while in the south-east, towards the Manych, they belong to the type of the dry Aral-Caspian steppes (Zadonsk Steppe), dotted with salt lakes. The geological formation consists of Carboniferous sandstones, clay slates and limestones containing anthracite and coal ; Cretaceous marls,, chalk, sandstone, and green sands — chalk cliffs accompanying the Don for 200 miles of its course ; and Miocene limestones and clays. Coal is extracted in the south-west, also some chalk, slate, limestone, and salt. The surface, especially west of the Don, is fertile black earth, interrupted here and there, and especially in the Zadonsk Steppe, with clay impregnated with salt. The province is watered by the Don and its tributaries, of which the Donets, Chir, and Mius are on the left bank, Khoper and Medvyeditsa on the right. The Don is navigable for more than 660 miles below Voronezh, attaining, after its junction with the Sosna, a width of 250 to 300 yards, and 600 yards in its lower course. Before entering the Sea of Azov it sends it a long navigable branch, the Aksai, and in its delta it divides into some thirty minor branches (ghirla). The Don is a very important artery of navigation for S.E. Russia ; and as it approaches very near to the Volga at Kalach, which is connected by a 40-miles railway with Tsaritsyn on the Volga, goods shipped down or up the latter (corn, naphtha, timber, &c., 450,000 tons every year) are trans-

ported to the Don in order to be shipped to Rostov and Taganrog for export or to be sent up the river to Central Russia ; at the same time goods imported to the last-named ports are brought to Kalach and transported to the Volga to be sent up this river. Moreover, in its upper parts the Don is connected by a canal with the Oka, tributary of the Volga. Nearly 550,000 tons of various goods are shipped every year in the basin of the Don, the chief ports being Rostov, Taganrog on the Sea of Azov, Kalach, and Uryu-pina. The climate is continental and dry, the average temperatures being : — ^year 43° Fahr., January 13°, July 72°, at Uryupina (50° 48' N. ; alt. 92 ft.) ; and year 48° Fahr., January 21°, July 73°, at Taganrog. The yearly amount of rain is only 13-4 and 17-6 inches respectively. Forests cover only 2 per cent, of the area.

Nearly one-half of the population (966,869, of whom 483,174 were men and 483,695 women, out of a total population which was 2,078,878 in 1891) belong to the Cossacks. The great bulk of the population belong to the Greek Orthodox Church ; there were, moreover, in 1891, 123,039 Nonconforfcists, 43,714 other Chris- tians, 15,154 Jews, 2478 Mussulmans, and 29,550 Lamaite Kalmyks, who also belonged to the Cossack Voisko. The Cossacks own 23,485,640 acres of land and have a reserve of 6,210,000 acres, more than half of which is rented. Provincial self-government was introduced in 1879, but withdrawn three years later. The province is well provided with schools, especially on the Cossack territory.

Agriculture is the main occupation, but the crops vary very much from year to year on account of want of rain (from 3,524,000 to 8,420,000 quarters). Vine-growing on a large scale and tobacco culture are carried on in the south. Cattle-breeding is important, there being 532,688 horses (some very fine breeds), 1,889,600 horned cattle, and 3,093,600 sheep. Rich fisheries at the mouth of the Don. Nearly 13,000 persons are engaged in coal-mining, 580,000 tons of anthracite and 700,000 tons of coal being extracted yearly. The yearly production of all factories attains £2,261,000, the chief of them being ironworks, and tobacco factories. The exports are considerable, consisting chiefly of corn, cattle, horses, sheep, wine, fish, and hides.

The province is under the Ministry of War, and is divided into nine districts : Donets (chief town Kamenskaya, 23,576 inh.), First Don (Konstantinovskaya, 8808 inh.), Second Don (Nizhne- Chirskaya, 15,196 inh.), Rostov (chief town Rostov-on-the-Don,

119,889 inh.), Salsky (Velikoknyazheskaya village), Taganrog (chief town same name, 51,965 inh.), Ust-Medvyeditsa (chief town same name, 14,520 inh.), Khoper (Uryupinskaya, 9612 inh.), Cherkassky (chief town Novocherkassk, capital of province, 52,005 inh.). Many of the Cossack villages {stanitsas) are very populous.

(p. A. K.)

Don Benito, a town of Spain in the province of Badajoz, 62 miles east of Badajoz by rail. Population in 1897, 15,863. It is a prosperous, busy place, with an active trade in wheat, wine, oil, and fruit. There are brandy distilleries, flour-mills, and soap, linen, jute, and cloth factories. Public buildings include a theatre and two casinos.

Doncaster, amunicipal and quarter sessions borough and market-town in the Doncaster parliamentary division of Yorkshire, England, on the Don, 156 miles north- east of London by rail. Besides a Wesleyan school, there have been erected Primitive Methodist, Presbyterian, Baptist, Congregational, and Wesleyan chapels; also Roman Catholic and other churches. A free library and school of science and art, publicbaths, gas-works, electricity works, corn exchange, markets, slaughter-houses, and cold .stores have been built ; and the water-works constructed at Thrybergh in 1880 (£170,000) have been augmented to more than twice their capacity of supply by a joint scheme undertaken in partnership with Sheffield and Eotherham ; electric trams running from the borough into adjoining suburbs are in course of construction ; the old opera-house has been taken down and a new one erected near the railway station, and the Yorkshire

institution for deaf mutes enlarged. The racecourse a6commodation has been extended by the formation of the Sandall mile course and the erection of additional permanent stands. The Great Northern Eailway Company's locomotive and carriage works employ between 5000 and 6000 hands. Area, 1695 acres. Population (1881), 21,139 ; (1901), 28,928.

Donchery, an ancient town and railway station, in the arrondissement of Sedan, department of Ardennes, Prance, 3 miles west of Sedan, on the Meuse. A sanguinary battle between the French and Bavarians was fought here on the left bank of the Meuse, 31st August 1870, and two days later, at the Ch§,teau de Bellevue, Napoleon surrendered his sword to the king of Prussia ; and terms of capitulation for Sedan were agreed on. Population

(1901), 1915.

Donegal, a maritime county of Ireland, province of

Ulster.

Area and Population. — The area of the administrative county in 1900 was 1,190,268 acres, of which 220,864 were tillage, 422,862 pasture, 995 fallow, 5890 plantation, 102,465 turf-bog, 28,614 marsh, 346,289 barren mountain, and 62,289 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, is identical with the old judicial county. The population in 1881 was 206,035, and in 1891, 185,635, of whom 91,478 were males and 94,157 females, divided as follows among the different religions : — ^Roman Catholics, 154,893 ; Protestant Epis- copalians, 21,884 ; Presbyterians, 18,055 ; Methodists, 2006 ; and other denominations, 797. The decrease of population between 1881 and 1891 was 9 90 per cent. The average number of persons to an acre was -16. Of the total population, 180,844 inhabited the rural districts, being an average of 181 persons to each square mile under crops and pasture. The population in 1901 was 173,625 (Roman Catholics, 134,999 ; Protestant Episcopalians, 19,907; Presbyterians, 16,221; Methodists, 1795; others, 703), being a decrease of 6-5 per cent. The following table gives the degree of education in 1891 : —

Males.

Females.

Total.

Percentage. 1

E.G.

Pr.Ep.

Presb.

Read and write Read only Illiterate

47,464 10,486 24,175

45,304 11,981 27,838

92,768 22,467 52,013

48-8 13-9 37-3

73-6 12-8 13-6

81-3 11-0

7-7

In 1881 the percentage of illiterates among Roman Catholics was 47-8. In 1891 there were 7 superior schools with 154 pupils (27 Roman Catholics and 127 Protestants), and 424 primary schools with 20,747 pupils (14,648 Roman Catholics and 6099 Protestants). The number of pupils on the rolls of the national schools on 30th September 1899 was 30,016, of whom 23,183 were Roman Catholics and 6833 Protestants. The following table gives the number of births, deaths, and marriages in various years : —

Tear.

Births.

Deaths.

Marriages.

1881 1891 1899

4519 3900 3785

2802 2982 2512

682 674 712

In 1899 the birth-rate per 1000 was 20-4, and the death-rate]3‘5 ; the rate of illegitimacy was l-^per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1899 was 121,429, of whom 64,848 were males and 56,581 females. The chief towns in the county are Ballyshannon, Letterkenny, and Donegal.

Administration. — The county is divided into four parliament- ary divisions, north, south, east, and west, the number of regis- tered electors in 1900 being respectively 8095, 8370. 7950, and 9475. The ratable value in 1900 was £304,121. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury and (to a less extent) of other bodies were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises 2 urban and 10 rural sanitary districts.

Agriculture. — The following tables give the acreage under crops, including meadow and clover, and the amount of live-stock in 1881, 1891, 1895, and 1900 :—

“S

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3

§

1881 1891 1895 1900

671 468 219 288

98,989 90,627 87,725 82,568

8189 2820 2460 1721

48,666 48,840 42,446 89,725

14,797 18,778 19,267 18,562

4348 4875 4223 4071

11,844 5,098 7,645 6 816

58,989 66,066 68,360 67,128

281,486 281,666 282,235 220,864

In 1899 the total value of the cereal and other crops was estimated by the Registrar-General at £1,569,253. The number of acres under pasture in 1881 was 380,510 ; in 1891, 410,259 ; and in

1900, 422,862.

Tear.

Horses

and .Mules.

Asses.

Cattle.

Sheep.

Pigs.

Goats.

Poultry.

1881 1891 1896 1900

23,762 28,224 23,939 22,611

2500 2265 2116 3096

178.286 164:844 180,964 186,824

202,885 147,894 183,212 194,707

36,968 22,886 84,514 27,471

8702 3118 2855 2916

706,797 675,700 762,662 867,492

The number of milch cows in 1891 was 65,264, and in 1900, 66,335. It is estimated that the total value of cattle, sheep, and pigs in 1899 was £2,709,468. In 1900 the number of holdings not exceeding 1 acre was 1573 ; between 1 and 5, 2882 ; between 5 and 15, 10,399 ; between 15 and 30, 8432 : between 30 and 50, 4037; between 50 and 100, 3161; between 100 and 200, 1026; between 200 and 500, 344; above 500, 97— total, 31,951. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1900, was 1207, amounting to £334,948. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, between 1882 and 1900, was 280, and the amount issued was

£17,943. The total amount issued on loan for all classes of works under the Land Improvement Acts, from tlie commencement of operations in 1847 to 31st March 1900, was £190,129.

Fisheries. — In the deep-sea and coast fishery districts of Killybegs, Gweedore, and RathmuUen the number of vessels regis- tered in 1899 was 678, employing 2929 men and boys. The number of persons employed in the salmon-fishery districts of Ballyshannon and Letterkenny in the same year was 988.

(w. H. PO.)

Doobaunt, a river of Mackenzie and Keewatin districts, Canada. It rises in Wholdiah Lake, in 104° 20' W. long, and 60° 15' N. lat., and flows northward to its confluence with the Thelew river, and thence eastward to Chesterfield Inlet, an arm of Hudson Bay. It passes I through several lake-expansions, including Doobaunt Lake,

Illustrations for JJante's I.'fEK.\ij. By Gustave IJore.

DOKCHESTE R — D OESETSHIEE

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with an area of 1700 square miles and an altitude of 500 feet above the sea; Aberdeen, altitude, 130 feet; and Baker, 30 feet above the sea. Discovered in 1770 by Samuel Hearne, the Doobaunt was explored by J. B. Tyrrell in 1893, and the Thelew by David Hanbury in

1899.

Dorchester, a municipal borough, market-town, and county town in the southern parliamentary division (since 1885) of Dorsetshire, England, on the Frome, 120 miles south-west by west from London by rail. Eecent erections are the Dorset County Museum, an isolation hospital, and a statue to the Dorsetshire poet, William Barnes (1889). The borough gardens were bought and laid out by the corporation in 1896. Area, 1653 acres. Population (1881), 7567 ; (1901), 9458.

Dordogne, a department in the south-west of France, watered by the Dordogne.

Area, 3561 square miles, distributed among 47 cantons and 585 communes. From 492,205 in 1886 the population decreased to 448,- 545 in 1901. Births in 1899, 9377, of which 361 illegitimate ; deaths, 9831 ; marriages, 3777. There were, in 1896, 1220 schools, with 62,000 pupils, and 15 per cent, of the population was illiterate. The area under cultivation in 1896 comprised 1,887,952 acres, of which 1,104,600 acres are arable land, 494,229 acres are woodland, and 54,365 acres vineyards. The wheat crop of 1899 amounted to the value of £1,980,300 ; maize returned £173,800 ; potatoes, £630,500 ; mangold-wurzel, £155,000 ; the natural pastures, £604,- 000. Hemp, yielding in 1899 altogether a value of £3940, and tobacco £85,800, are also cultivated with success. The produce of the vines in 1899 amounted to the value of ii680,000 ; of chestnuts, £92,000 ; of walnuts, £83,000. The live-stock in 1898 comprised 16,290 horses, 21,650 asses, 201,900 cattle, 399,000 sheep, 175,750 pigs, and 9150 goats. The mining industry turned out in 1898 2500 metric tons of lignite, 1200 tons of peat, and 1300 tons of iron. Building stone is quarried in abundance, and the metal- lurgic industry yielded in 1896 £32,000 worth of iron. With the exception of paper manufacture, the other industries are in a backward state. The capital town, P^rigueux, has a population of 31,400.

Dordrecht or Dordt, one of the oldest towns in the province of South Holland, Netherlands, 10 miles south- east of Rotterdam, on the main line between that town and Antwerp, at the junction of the Old and New Maas (Noord), the Merwede, and the waterway to Zeeland. (As Tiel was deprived of a portion of its trade by Dordrecht, so the trade of Dordrecht has in part been diverted to Rotterdam. • The shipping trade of the town, however, still remains very considerable, 2600 ships passing weekly. The trade is mainly in wood (imported from Germany, Scandinavia, and America), salt, oil-seeds, wine, grain, and petroleum. The town has numerous engineering works, sawmills, distille- ries, stained-glass works, and shipbuilding y^rds. The Gothic Greek church was successfully restored in 1882, the theatre of the Musis Sacrum enlarged in 1885, and a new theatre erected in 1889. Population (1900), 34,386.

Dore, Louis Auguste Custave (18321883), French artist, the son of a civil engineer, was born at Strassburg on 6th January 1832. In 1848 he came to Paris and secured a three years' engagement on the Journal pour Eire. His facility as a draughtsman was extraor- dinary, and among the books he illustrated in rapid suc- cession were Balzac's Contes Drolatiques (1855), Dante's Inferno (1861), Don Quixote (1863), The Bible (1866\ Paradise Lost (1866), and the works of Eabelais (1873). He painted also many large and ambitious compositions of a religious or historical character, and made some success as a sculptor, his statue of Alexandre Dumas in Paris being perhaps his best-known work in this line. He died 26th January 1883.

Dorking, a market-town in the Eeigate parliar mentary division of Surrej', England, on the Mole, 26

miles south of London by rail. Eecent erections are the Eoman Catholic church (rebuilt), a drill hall, and a literary institute. Area of urban district, 1347 acres. Population (1881), 6328 ; (1901), 7670. Area of old civil parish, now comprising both Dorking and Dorking Eural, 10,028 acres. Population (1881), 9577 ; (1901), 11,410.

Dornbirn, a township in the district of Feldkirch, Vorarlberg (Austria), on the Vorarlberglineof the Austrian State railway. A busy industrial centre, the regulated Dornbirner Ach furnishing motive -power for several factories. The industries include the manufacture of machinery, hardware and metal goods, jewellery, cotton spinning, weaving, and printing, and a model dairy farm. Population (1890), 10,678 ; (1900), 13,052.

Dorner, Isaac August (1809-1884), German Lutheran theologian, was born at Neuhausen-ob-Eck, in Wtlrtemberg, 20th June 1809. He studied at Tiibingen, and then returned to his native village and assisted his father in the pastorate of the parish. He afterwards visited Holland and England, in order to investigate the condition of Protestantism in those countries. He was made professor of Theology at Tiibingen in 1838, at Kiel in 1839, at Konigsberg in 1840, of the Protestant Faculty of Theo- logy at Bonn in 1847. Thence he removed to Berlin. Though a student at Tiibingen, he did not embrace the well-known views on theology and early Church history which originated at that university. In his famous History of the Doctrine of the Person of Christ, in which he investigated with remarkable skill and

clearness the teaching of the leading divines of the first five centuries, he has left an indelible record of his ability and research. He was a voluminous writer, and among his most im- portant works are a History of Protestant Theology (1867), and his System of Christian Doctrine (1879-81), and System of Christian Morals (1888). He also contributed to Herzog's well-known Encyclopddie filr Protestantische Theologie. For many years he assisted in editing the Jahrbucher fur Deutsche Theologie. He died at Wies-baden, 8tli July 1884. (j. j. l.*)

Dornoch, a royal and parliamentary burgh (Wick group) and the county town of Sutherlandshire, Scotland, on the Dornoch Firth, 7 miles south-south-east of the Mound station on the Highland railway. A light railway between the Mound and Dornoch is being constructed. The tower of the cathedral, built by Bishop Gilbert de Moravia (1222-45), remains ; the main body was rebiiilt in 1837, and is used as the parish church. On the site of the Bishop's Palace, of which the tower is still standing, are the county buildings. There are well-known golf links and a public library. Population (1881), 497 ;

(1901), 624.

Dorohoi, a town in Eumania, and chief town of the district bearing the same name, about 80 miles north-west of Jassy, on the river Shiska, tributary of the Pruth. It has an extensive transit trade in the products of Northern Europe. The Church of St Nicholas, built by Stephen the Great in the 15th century, is remarkable. The annual fair held on 12th June is important. Population, of which between 60 and 60 per cent, are Jews (1900),

12,701.

Dorpat. See Yueiev.

Dorsetshire, a south-eastern county of England, bounded S. and S.W. by the English Channel, W. by Devon, N.W. by Somerset, N.E. by Wilts, and E. by Hampshire.

Area and Population. — The area of the ancient and administra-

tive county, as given in the census returns, is 632,272 acres, or 988 square miles. The population in 1881 was 190,969, and in 1891 was 194,517, of whom 94,735 were males and 99,782 females, the number of persons per square mile being 197, and of acres to a person 3-25. Since 1891 the area of the administrative county has undergone certain changes. In 1895 the parishes of Goathill, Poyntington, Sandford-Orcas, Seaborough, and Trent were trans- ferred from Somerset to Dorset, and the parish of Wambrook from Dorset to Somerset, and in 1896 the parishes of Chardstock and Hawkchurch were transferred from Dorset to Devon. The area of the registration county is 616,403 acres, with a population in 1891 of 188,995, of whom 69,216 were urban, and 119,779 rural. Within this area the increase of population between 1881 and 1891 was 2-17 per cent. Between 1881 and 1891 the excess of births over deaths was 22,388, but the increase in resident population was only 4023. In 1901 the population was 202,962. The follow- ing table gives the numbers of marriages, births, and deaths, with the number of illegitimate births, in 1880, 1890, and 1898 : —

Year.

Marriages.

Births.

Deaths.

Illegitimate Births.

Males.

Females.

1880 1890 1898

1214 1332 1371

5508 4786 4852

3122 2970 2973

134 100 101

128

107

89

The number of marriages in 1899 was 1319, of births 4807, and of deaths 3144.

The following table shows the marriage, birth, and death rates per 1000 of the population, with the percentage of illegitimate births, for a series of years : —

18T0-79.

1880.

1880-S9.

1890.

1888-97.

1898.

Marriage-rate Birth-rate Death-rate . Percentage of ille- gitimacy

13-7 29-5 17-8

5-2

13-1 29-6 16-8

4-8

13-4 28-1 16-3

4-8

14-1 25-4 15-7

4-3

13-9 26-4 15-7

4-5

14-3 25-4 15-5

3-9

Both the birth-rate and the death-rate are much below the average for England. In 1891 there were in the county 771 natives of Scotland, 1240 natives of Ireland, and 396 foreigners.

Constitution and Government. — The ancient county is divided into four parliamentary divisions, but has no parliamentary borough. The administrative county contains thirteen towns and urban districts: Blandford Forum (3649), Branksome (8095), Bridport (5710), Dorchester (9458), Lyme Regis (2095), Poole (19,461), Portland (15,262), Shaftesbury (2027), Sherborne (5753), Swanage (3384), Wareham (2003), Weymouth and Melcombe Regis (19,831), Wimborne Minster (3696). Dorsetshire is in the western circuit, and assizes are held at Dorchester. The boroughs of Bridport, Dorchester, Lyme Regis, Poole, and Weymouth and Melcombe Regis have separate commissions of the peace, and the borough of Poole has in addition a separate court of quarter sessions. The ancient county, which is almost entirely in the diocese of Salisbury, contains 254 entire ecclesiastical parishes or districts and parts of iive others.

Education. — The number of elementary schools in the county on 31st August 1899 was 278, of which only 25 were board, and 253 were voluntary schools, the latter including 234 National Church of England schools, 3

Wesleyan, 7 Roman Catholic, and 9 “British and other.” The average attendance at board schools was 3301, and at voluntary schools 24,855. The total school board receipts for the year ended 29th September 1899 were over £10,035. The income under the Agricultural Rates Act was over £632. Agriculture. — About three-fourths of the area of the county is ^ under cultivation, and of this nearly flve-eighths is in permanent pasture, while there is, in addition, about 26,000 acres in hill pasturage. Nearly 38,000 acres are under woods. Of the green crops, wheat, barley, and oats occupy an almost equal acreage ; but turnips are grown on nearly three-fourths of the acreage under green crops. The following table gives the main divisions of the cultivated area at intervals of five years from 1880 : —

Tear.

Total Area under Cul- tivation.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

FaUow.

1880 1885 1890 1895 1900

485,857 491,123 493,321 487,296 481,430

105,113

97,206 91,851 82,299 83,137

58,054 59,104 53,889

50,728 49,227

52,239 52,157 51,556 49,711 48,933

262,427 277,503 291,818 299,600 299,312

7766 5026 3903 4503 2678

The following table gives particulars regarding the principal Uve-stock during the same years : —

Tear.

Total Horses.

Total Cattle.

Cows or Heifers

in Milk or in

Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1900

16,192 15,794 15,970 16,425 15,588

76,049 91,202 89,017 83,071 87,904

47,791

54,675 53,834 52,192 53,620

463,864 460,371 418,945 370,947 360,491

37,857 47,790 63,556 66,211 50,930

Industries and TVatJe.— According to the annual report for 1898 of the chief inspector of factories and workshops (1900), the total number of

persons employed in factories and workshops in 1897 was 7994, as compared with 7950 in 1896. Non-textile factories employed 3820, of whom 1080 were employed in the manufacture of machines, appliances, conveyances, or tools. Paper is manufactured, and ships and yachts are built at Poole. Of the 3347 persons employed in workshops, 1182 were employed in the clothing industries. The number of persons employed in mines and quarries in 1899 was 2038. Limestone and potter's and other clay are dug in Increasing quantities, and the famous Purbeck marble and Portland freestone are more and more in demand. The amount of limestone dug in 1898 was 519,214 tons, and of clay 148,184 tons. There are no returns regarding the Portland stone.

There are numerous fishing stations along the coast. The fish- ing is generally prosecuted within three miles of the shore. There are some oyster beds near Poole. The total fish landed in 1899 amounted to 11,305 cwt., valued at £8143.

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Dortmund, a town of Prussia, province of West- phalia, 50 miles east by north from Dtisseldorf . Since the abolition of the walls in 1872 and the conversion of their site into promenades, the town has rapidly assumed a mod- em appearance. The 13th-century town-hall, with the ad- jacent Bread House, was thoroughly restored in 1899 ; the basement of the former contains the municipal antiqua- rian museum. The post office (1895), synagogue (1898), Eoman Catholic church of Our Lady, the provincial law courts, the municipal infirmary, the monuments of the war of 1870-71 (1881) and Bismarck (1899), and the Emperor William Park, with a bronze statue of the Emperor Will- iam I. (1894) by Schilling, and a bronze statue

of the Em- peror Frederick III. (1898), deserve mention. But the real interest of Dortmund centres in her industries— iron, coal, beer, and bricks. Whereas in 1860 the output of the Dortmund coal-field was under 4 million tons (valued at £1,362,300), in 1870 it had increased to over 11^ millions £3,353,460), in 1880 to close upon 22|. million tons (£5,147,700), in 1890 to approximately 35i million tons (£14,122,100), and in 1897 to 48| million tons.' During the same period, i.e., from 1860 to 1897, the number of workmen employed in the coal-mines increased from 28,460 to 185,640. The chief products of the iron furnaces, forges, foundries, and other works are mining plant, wire ropes, implements and machinery, safes, and sewing machines. One firm alone employs nearly 8000 workmen. In addition to the above there are several flour and saw mills. In connexion with the Dortmund- Ems Canal a space of 360 acres has been set apart at Dortmund for docks, and in 1899 four basins, each 43 acres in area and 8 feet minimum depth, were already constructed. Population (1885), 78,435 : (1890), 89,663 ;

(1895), 111,232; (1900), 142,418.

1 See Coal Industry of the EhenishWestphalian Provinces, by T. E. Mulvany (1898), Dipl. and Cons. Reps., Misc. Series, No. 454.

Dost Mahommed Khan (1793-1863), founder of the dynasty of the Barakzai in Afghanistan, was born in 1793. His elder brother, the chief of the Barakzai, Fati Khan, took an important part in raising Mahmud to the sovereignty of Afghanistan in 1800 and in restor- ing him to the throne in 1809. That ruler repaid his services by causing him to be assassinated in 1818, and thus incurred the enmity of his tribe. After a bloody conflict Mahmud was deprived of all his possessions but Herat, the rest of his dominions being divided among Fati Khan's brothers. Of these Dost Mahommed received for his share Ghazni, to which in 1826 he added Kabul, the richest of the Afghan provinces. From the commence- ment of his reign he found himself involved in disputes with Eanjit Singh, the Sikh ruler, who used the dethroned Saduzai prince, Shuja-ul-Mulk, as his instrument. In 1834 Shuja made a last attempt to recover his kingdom. He was defeated by Dost Mahommed under the walls of Kandahar, but Eanjit Singh seized

the opportunity to annex Peshawar. The recovery of this fortress became the Afghan Amir's great concern. Rejecting overtures from Russia, he endeavoured to form an alli- ance with England, and welcomed Alexander Burnes to Kabul in 1837. Burnes, however, was unable to prevail on the Governor-General, Lord Auckland, to respond to the Amir's advances. Dost Mahommed was enjoined to abandon the attempt to recover Peshawar, and to place his foreign policy under British guidance. In return he was only promised protection from Eanjit Singh, of whom he had no fear. He replied by renewing his relations with Eussia, and in 1838 Lord Auckland set the British troops in motion against him. In March 1839 the British force under Sir Willoughby Cotton advanced through the Bolan Pass, and on the 26th April it reached Kandahar. Shah Shuja was proclaimed Amir, and entered Kabul on 7th August, while Dost Mahommed sought refuge in the wilds of the Hindu Kush. Closely followed by the British, Dost was driven to extremities, and . on 4th November 1840 surrendered as a prisoner. He remained in captivity during the British occupation, during the disastrous retreat of the army of occupation in January 1842, and until the recapture of Kabul in the autumn of 1842. He was then set at liberty, in consequence of the resolve of the British Government to abandon the attempt to intervene in the internal politics of Afghanistan. On his return from Hindustan Dost Mahommed was received in triumph at Kabul, and set himself to re-establish his authority on a firm basis. From 1846 he renewed his policy of hostility to the British and allied himself with the Sikhs ; but after the defeat of his allies at Gujarat on 21st February 1849 he abandoned his designs and led his troops back into Afghanistan. In 1850 he conquered Balkh, and in 1854 he acquired control over the southern Afghan tribes by the capture of Kandahar. On 30th March 1855 Dost Mahommed reversed his former policy by concluding an offensive and defensive alliance with the British Government. In 1857 he declared war on Persia in conjunction with the British, and in July a treaty was concluded by which the province of Herat was placed under a Barakzai prince. During the Indian Mutiny Dost Mahommed punctiliously refrained from assisting the insurgents. His later years were dis- turbed by troubles at Herat and in Bokhara. These he composed for a time, but in 1862 a Persian army, acting in concert with Ahmed Khan, advanced against Kandahar. The old Amir called the British to his aid, and, putting himself at the head of his warriors, drove the enemy

from his frontiers. On 26th May 1863 he captured Herat, but on 9th June he died suddenly in the midst of victory, after playing a great role in the history

of Central Asia for forty, years. He named as his suc- cessor his son. Shir Ali Khan. (e. i. c.)

Dostoievsky, Feodor Mikhailovitch (1821- 1881), Eussian author, born at Moscow, 30th October 1821, was the second son of a retired military surgeon of a decayed noble family. He was educated at Moscow and at the military engineering academy at St Peters- burg, which he left in 1843 with the grade of sub-lieu- tenant. Next year his father died, and he resigned his commission in order to devote himself to literature — thus commencing a long struggle with ill-health and penury. In addition to the old Eussian masters Gogol and Pushkin, Balzac and George Sand supplied him with literary ideals. He knew little of Dickens, but his first story is thoroughly Dickensian in character. The hero is a Eussian " Tom Pinch," who entertains a pathetic, humble adoration for a fair young girl, a solitary waif like himself. Characteristically, the Eussian story ends in "tender gloom." The girl marries a middle-aged man of property ; the hero dies of a broken heart, and his funeral is described in lamentable detail. The germ of all Dostoievsky's imaginative work may be discovered here. The story was submitted in manuscript to the Eussian critic, Bielinski, and excited his astonishment by its power over the emotions. It appeared in the course of 1846 in the Becueil de Saint-Petersbourg, under the title of " Poor People." An English version. Poor Folk, with an introduction by Mr George Moore, appeared in 1894. The successful author became a regular con- tributor of short tales to the Annals of the Country, a monthly periodical conducted by Kraevsky ; but he was wretchedly paid, and his work, though revealing extraordinary power and intensity, commonly lacks both finish and proportion. Poverty and physical suffering robbed him of the joy of life and filled him with bitter thoughts and morbid imaginings. During 1847 he became an enthusiastic member of the revolutionary reunions of the political agitator, Petrachevski. Many of the students and younger members did little more than discuss the theories of Fourier and other economists at these gatherings. Exaggerated reports were eventually carried to the police, and on 23rd April 1849 Dostoievsky and his brother, with thirty other suspected personages, were arrested. After a short examination by the

secret police they were lodged in the fortress of St Peter and St Paul at St Petersburg, in which confinement Feodor wrote his story A Little Hero. On 22nd December 1849 the accused were all condemned to death and con- veyed in vans to a large scaffold in the Simonovsky Place. As the soldiers were preparing to carry out the sentence, the prisoners were informed that their penalty was commuted to exile in Siberia. The novelist's sentence was four years in Siberia and enforced military service in the ranks for life. On Christmas Eve 1849 he commenced the long journey to Omsk, and remained in Siberia, " like a man buried alive, nailed down in his cof&n," for four terrible years. His Siberian experi- ences are graphically narrated in a volume to which he gave the name of Recollections of a DeadrHouse (1858). It was known in an English translation as Buried Alive in Siberia (1881; another version, 1888). His release only subjected him to fresh indignities as a common soldier at Semipalatnisk ; but in 1858, through the intercession of an old schoolfellow. General Todleben, he was made an under-officer ; and in 1859, upon the accession of Alex- ander II., he was finally recalled from exile. In 1858 he had married a widow, Madame Isaieff, but she died at St Petersburg in 1867 after a somewhat stormy married life.

After herding for years with the worst criminals,

Dostoievsky obtained an exceptional insight into the dark and seamy side of Eussian life. He formed new conceptions of human life, of the balance of good and evil in man, and of the Eussian character. Psychological studies have seldom, if ever, found a more intense form of expression than that embodied by Dostoievsky in his novel called Crime and PunisJiment. The hero Easkol- nikoff is a poor student, who is led on to commit a murder partly by self-conceit, partly by the contemplation of the abject misery around him. Unsurpassed in poignancy in the whole of modern literature is the sensation of com- passion evoked by the scene between the self-tormented Easkolnikoff and the humble street-walker, Sonia, whom he loves, and from whom, having confessed his crime, he derives the idea of expiation. Easkolnikoff finally gives himself up to the police and is exiled to

Siberia, whither Sonia follows him. The book gave currency to a number of ideas, not in any sense new, but specially characteristic of Dostoievsky : the theory, for instance, that in every life, however fallen and degraded, there are ecstatic moments of self-devotion; the doctrine of purification by suffering, and by suffering alone; and the ideal of a Eussian people forming a social state at some future period bound together by no obligation save mutual love and the magic of kindness. In this visionary prospect, as well as in his objection to the use of physical force, Dostoievsky anticipated in a remarkable manner some of the conspicuous tenets of his great successor Tolstoi. The book electrified the reading public in Eussia upon its appearance in 1866, and its fame was confirmed when it appeared in Paris in 1867. To his remarkable faculty of awakening reverberations of melancholy and com- passion, as shown in his early work, Dostoievsky had added, by the admission of all, a rare mastery over the emotions of terror and pity. But such mastery was not long to remain unimpaired. Crime and Punishment was written when he was at the zenith of his power. His remaining works exhibit frequently a marvellous tragic and analytic power, but they are unequal, and deficient in measure and in balance. The chief of them are : The Injured and the Insulted, The Demons (1867), The Idiot (1869), TJie Adult (1875), The Brotliers Kdramzov (1881).

From 1865, when he settled in St Petersburg, Dostoiev- sky was absorbed in a succession of journalistic enter- prises, in the Slavophil interest, and suffered severe pecuniary losses. He had to leave Eussia, in order to escape his creditors, and to seek refuge in Germany and Italy. He was further harassed by troubles with his wife, and his work was interrupted by epileptic fits and other physical ailments. It was under such conditions as these that his most enduring works were created. He managed finally to return to Eussia early in the 'seventies, and was for some time director of the Russian World. From 1876 he published a kind of review, entitled Garnet d'un Ecrivain, to the pages of which he committed many strange autobiographical facts and reflections. The last eight years of his life were spent in comparative prosperity at St Petersburg, where he died on 9th February 1881.

His life had been irremediably seared by his Siberian experiences. He looked prematurely old ; his face bore an expression of accumulated sorrow

; in disposition he had become distrustful, taciturn, contemptuous — his favourite theme the superiority of the Eussian peasant over every other class ; as an artist, though uncultured, he had ever been subtle and sympathetic, but latterly he was tortured by tragic visions and morbidly preoccupied by exceptional and perverted types. M. de Vogue, in his admirable Ecrivains Busses, has worked out with some success a parallel between the later years of Dostoievsky and those of Jean Jacques Eousseau. Siberia effectually convinced

the novelist of the impotence of Nihilism in such a country as Eussia ; but though he was assailed by ardent Liberals for the reactionary trend of his later writings, Dostoievsky became, towards the end of his life, an extremely popular figure, and his funeral, on 12th February 1881, was the occasion of one of the most remarkable demonstrations of public feeling ever witnessed in the Eussian capital. The death of the Eussian novelist was not mentioned in the London press; it is only since 1885, when Crime and Punishment first appeared in English, that his name has become at all familiar in England, mainly through French translations. A complete edition of his novels was issued at St Petersburg in fourteen volumes, 1882-83. Two critical studies by Tchij and Zelinsky appeared at Moscow in 1885, and a German life by Hoffmann at Vienna in 1899. (t. se.)

Douai, chief town of arrondissement, department of Nord, France, 20 miles south of Lille, junction on railway from Paris to Lille. The manufacture of glass, oil, sugar, and paper, wool- spinning, leather-currying, and bell-founding, have all become important industries. The town library now contains 80,000 volumes and 1800 manuscripts. — Dorignies, 1^ mile north of the town, is an important industrial suburb; Sin-le-Noble, Dechy, and Sambres, though distinct municipalities, are practically suburban. The port traf&c of Douai and Dorignies in 1898 amounted to 427,677 tons. Population (1881),

20,608; (1901), 33,918.

Doubs, a department in the east of France, bordering on Switzerland. It is traversed by the Jura mountains and watered by the Doubs.

Area, 2052 square miles. The population decreased from 310,963 in 1886 to 296,957 in 1901. Births in 1899, 7222, of which 590 were illegitimate ; deaths, 6706 ; marriages, 2186. There were in 1896 1024 schools, with 51,000 pupils ; 1 per cent, of the popula- tion was illiterate. The area under cultivation in 1896 comprised 1,097,186 acres, of which only 360,785 acres were arable and 12,355 acres in vines. Forest, on the other hand, covers an extensive area, occupying with the natural grass lands nearly 741,000 acres. The wheat crop yielded in 1899 a value of only £420,000, but the produce of the green crop and grass lands amounted in 1899 to the value of £902,000, the natural pastures alone yielding the value of £603,000. The live-stock in 1899 in- cluded 19,990 horses, 121,330 cattle, 47,750 sheep, 45,580 pigs, and 6700 goats. Doubs has no coal, but it turned out, in 1896, 6200 metric tons of iron and 20,000 tons of rock-salt. It produced, in 1898, 19,000 metric tons of wrought-iron and steel, of the value of £170,000. Among the other industries watch-making takes the first rank, having its centres at Besan^on and MontbSliard, while distillation holds the second place, producing a yearly average of 687,800 gallons. Besanjon, the capital, has 55,250 inhabitants.

Douglas, a town and railway station on the east coast of the Isle of Man, England, 75 miles by steamer north-west of Liverpool. The steamship communication with this popular watering-place has been greatly improved during the last twenty-five years, in particular the service connecting it with Liverpool, Barrow, Fleetwood, Dublin, and the Clyde. Many improvements have also been made in the town itself, which has displaced Castletown as the legal capital of the island. A magnificent parade sweeps around the bay; new wide streets have been cleared in the old town and constructed in the new; municipal buildings, a free library, a second theatre, and three music-halls with capacious dancing saloons have been erected ; an electric tramway has been laid down to all parts of the island ; cable and horse trams encircle the town ; and a sporting summer golf course has been con- structed at Howstrake, in addition to the winter course behind the town. Many of the public undertakings, such as the water-works, abattoirs, markets, and cemetery, are under municipal control. Douglas is in the parish of Onchan, and in 1881 had a population of 15,725; in

1901, 19,126, Witt a suburban population iust outside the borough of 3100.

Douglass, Frederick (1817-1895), American orator, was born in Tuckahoe, Talbot county, Md., and died in Anacostia, D.C., 20th February 1895. His mother was a slave and his father a white man. He learned to read and write, and was allowed to hire his own time and work in a shipyard. In 1838 he escaped from slavery, and soon settled in New Bedford, Mass. A speech m ade by him in 1841 resulted in his being offered the agency of the Massachusetts Anti-Slavery Society. From that time his oratorical powers rapidly developed, and he aroused much interest in the cause of emancipation. In 1845 he made a lecturing tour through the British Isles, where he re- mained until 1847. For many years after 1847 he con- ducted an anti-slavery weekly journal at Rochester, N.Y. He encouraged, but did not actually participate in, John Brown's invasion of Harper's Ferry. In 1870 he became editor of the New National Era in Washington, D.C. When, in 1871, President Grant appointed a commission to report on the question of annexing Santo Domingo to the United States, Douglass became its assistant-secre- tary. In 1872 he was presidential elector at large for the State of New York. From 1876 to 1881 he was marshal of the District of Columbia, after which time he was its recorder of deeds for five years. From 1889 to 1891 he was United States minister to Hayti. The experiences of his life were described in an autobiography.

Doukhobors, The. — "Doukhobors" is a name given by the Russian Orthodox clergy to a community of nonconformist peasants. The word etymologically signi- fies "spirit-fighters," being originally intended by the priesthood to convey that they fight against the Spirit of God ; but the Doukhobors themselves accepted the term as signifying that they fight, not against, but for and with the Spirit. Of late, however, they have decided to give up this name aud call themselves " Christians of the Universal Brotherhood." This religious community was first heard of in the middle of the 18th century. By the end of that century or the beginning of the 19th their doctrine had become so clearly defined, and the number of their members had so greatly increased, that the Rus- sian Government and Church, considering this sect to be peculiarly obnoxious, started an

energetic campaign against it. The foundation of the Doukhobors' teaching consists in the belief that the Spirit of God is present in the soul of man, and directs him by its word within him. They understand the coming of Christ in the flesh, his works, teaching, and sufferings, in a spiritual sense. The object of the sufferings of Christ, in their view, was to give an example of suffering for truth. Christ continues to suffer in us even now when we do not live in accordance with the behests and spirit of his teaching. The whole teaching of the Doukhobors is penetrated with the Gospel spirit of love. Worshipping God in the spirit, they affirm that the outward Church and all that is performed in it and concerns it' has no importance for them. The Church is where two or three are gathered together, i.e., united in the name of Christ. They pray inwardly at all times ; on fixed days they assemble for prayer-meetings, at which they greet each other fraternally with low bows, thereby acknow- ledging every man as a bearer of the Divine Spirit. Their teaching is founded on tradition, which is called among them the " Book of Life," because it lives in their memory and hearts. It consists of sacred songs or chants, partly composed independently,, partly formed out of the contents of the Bible, which, however, has evidently been gathered by them orally, as until quite lately they were

almost entirely illiterate and did not possess any written book. They found alike their mutual relations and their relations to other people — and not only to people, but to all living creatures — exclusively on love, and therefore they hold all people equal and brethren. They extend this idea of equality also to the Government authorities, obedience to whom they do not consider binding upon them in those cases when the demands of these authori- ties are in conflict with their conscience; while in all that does not infringe what they regard as the will of God they willingly fulfil the desire of the authorities. They consider killing, violence, and in general all rela- tions to living beings not based on love as opposed to their conscience and to the will of God. They are indus- trious and abstemious in their lives, and when living up to the standard of their faith they present one of the nearest approaches to the realization of the Christian ideal which has ever been attained.

Such, in their most general character, are the beliefs for which the Doukhobors have long endured cruel persecution. Under Nicholas I., in the

years 1840 and 1860, the Doukhobors, who on religious grounds refused to participate in military service, were all banished from the government of Tauris — whither they had been previously transported from various parts of Russia by Alexander I. — to Transcaucasia, near the Turkish fron- tier. But neither the severe climate nor the neighbour- hood of wild and warlike hillmen shook their faith, and in the course of half a century, in one of the most unhealthy and unfertile localities in the Caucasus, they transformed this wilderness into flourishing colonies, and continued to live a Christian and laborious life, making friends instead of fighting with the hillmen. But the wealth to which they attained in the Caucasus weakened for a time their moral fervour, and little by little they began to depart somewhat from the re- quirements of their belief. As soon, however, as events happened among them which disturbed their outward tranquillity, the religious spirit which had guided their fathers immediately revived within them. In 1887, in the reign of the Tsar Alexander III., universal mili- tary service was introduced in the Caucasus; and even those for whom, as in the case of the Doukhobors, it had formerly been replaced with banishment, were called upon to serve. This measure took the Doukhobors unawares, and at first they outwardly submitted to it. About the same time, by the decision of certain Government ofRcials, the right to the possession of the public property of the Doukhobors (valued at about £50,000) passed from the community to one of their members, who had formed out of the more demoralized Doukhobors a group of his own per- sonal adherents, which was henceforth called the " Small Party." Soon afterwards several of the most respected representatives of the community were banished to the government of Archangel. This series of calamities was accepted by the Doukhobors as a punishment from God, and a spiritual awakening of a most energetic character ensued. The majority (about 12,000 in number) resolved to revive in practice the traditions left them by their fathers, which they had departed from during the period of opulence. They again renounced tobacco, wine, meat, and every kind of excess, many of them dividing up all their property in order to supply the needs of those who were in want, and they collected a new public fund. They also renounced all participation in acts of violence, and therefore refused military service. In confirmation of their sincerity, in the summer of 1895 the Doukhobors of the " Great Party," as they were called in distinction from the " Small Party," burnt all the arms which they, like other inhabitants of the

Caucasus, had taken up for their protection from wild animals, and those who were in

the army refused to continue service. At the commence- ment of the reign of the Tsar Nicholas II., in 1895, the Doukhobors became the victims of a series of persecu- tions, Cossack soldiers plundering, insulting, beating, and maltreating both men and women in every way. More than four hundred families of Doukhobors who were living in the province of Tiflis were ruined and banished to Georgian villages. Of 4000 thus exiled, more than 1000 died in the course of the first two years from ex- haustion and disease ; and more would have perished had not information reached Count Leo Tolstoy and his friends, and through them the Society of Friends in England. Funds were immediately raised by sympathizers for al- leviating the sufferings of the starving victims. At the same time an appeal, written by Tolstoy and some of his friends, requesting the help of public opinion in favour of the oppressed Doukhobors, was circulated in St Peters- burg and sent to the Emperor and higher Government oflBcials. The Doukhobors themselves asked for per- mission to leave Russia, and the Society of Friends peti- tioned the Emperor to the same effect. In March 1898 the desired permission was granted, and the first party of Doukhobors, 1126 in number, were able in the summer of 1898 to sail from Batum for Cyprus, which was origi- nally chosen for their settlement because at that time funds were not sufficient for transferring them to any other British territory. But as contributions accumulated, it was found possible to send a number of Doukhobor emigrants to Canada, whither they arrived in two parties, numbering above 4000, in January 1899. They were j oined in the spring of the same year by the Cyprus party, and another party of about 2000 arrived from the Caucasus. In all about 7600 Doukhobor immigrants arrived in Canada. The Canadian Government did their best to facilitate the immigration, and allotted land to the Doukhobors in the provinces of Assiniboia near Yorkton and of Saskatch- ewan near Thunder Hill and Prince Albert. They were very cordially received by the population of the Canadian port towns. In April 1901, in the Canadian House of Commons,

the Minister of Justice made a statement about them in which he said that " not a single offence had been committed by the Doukhobors; they were law-abiding, and if good conduct was a recommendation, they were good immigrants. . . . The large tracts of land de- manded population, and if they were not given to crime, the conclusion was that they would make good citizens." About eighteen months after they arrived in Canada the Doukhobors sent the Society of Friends a collective letter in which they sincerely thanked the English and American Friends for all the generous help of every kind they had received at their hands, but begged the Quakers to cease sending them any more pecuniary support, as they were now able to stand on their own feet, and therefore felt it right that any further help should be directed to others who were more in need of it.

See also Christian Martyrdom in Russia, by V. Tchertkoff. The Free Age Press, Christchurcli, Hants. (v. T.)

Doulton, Sir Henry (1820-1897), English inventor and manufacturer of pottery, born in Vauxhall 25th July 1820, was from the age of fifteen actively employed in the pottery works of his father, John Doulton, at Lambeth. One of the first results of his many experi- ments was the production of good enamel glazes. In 1846 he initiated in Lambeth the pipe works, in which he superintended the manufacture of the drainage and sanitary appliances which have helped to make the firm of Doulton famous. In 1870 the manufacture of " Art pottery " was begun at Lambeth, and in 1877 works were opened at Burslem, where almost every variety of china and porcelain, as well as artistic earthenware, has been

produced. Works have since been opened at Eowley Regis, Smethwick, St Helens, Paisley, and Paris. After the Paris Exhibition of 1878, Henry Doulton was made a Chevalier of the Legion of Honour. In 1872 the " Art department " was instituted in the Doulton works, giving employment to both male and female artists, amongst whom such workers as George Tinworth and the Misses Barlow have obtained a reputation outside their immediate sphere. In 1887 Mr Doulton received the honour of knighthood, and a few years later was awarded the Albert Medal by the Society of Arts. He married in 1849 the daughter of Mr J. L. Kennaby; she died in 1888. Sir

Henry Doulton took an active interest, as Almoner, in St Thomas's Hospital. He died in London 18th November 1897. (k. f. s.)

Douro (in Spanish, Duero ; Portuguese, Douro), a river of the Iberian peninsula. It rises in the Sierra d'Urbion (between the Sierra de la Demanda and the Sierra de Moncayo), describes a wide curve eastwards past Soria, then flows on the whole west right across the Spanish tableland, passing on the way Valladolid and Zamora; then from Paradela to Barca d'Alva it flows south-west and forms the frontier between Spain and Portugal. It crosses Portugal in an east to west direction in a narrow and tortuous bed, and enters the Atlantic 3 mUes below Oporto. In Spain it receives from the right the rivers Pisuerga, Valderaduey, and Esla, and from the left several small streams which drain the Sierra Guadarrama; and in Portugal the Agueda, CSa, and Paiva from the left, and the Sabor, Tiia, and Tamega from the right. The lower stream is beset with numerous rapids, called pontos, and is subject to swift and violent inundations. On this account navigation is attended with difficulties and risks between its mouth and Barca d'Alva ; but a railway, running for the most part along the right bank, traverses the Portuguese portion of the river. The mouth of the river is partly blocked by a rocky bar, but has recently been improved. Its total length is about 420 miles, of which 140 are in Portugal. Its waters abound in fish, especially trout, shad, and lampreys.

Douro, a former province of Portugal, corresponding to the present districts of Oporto, Aveiro, and Coimbra (qq.vv.). Area, 3606 square miles. Population (1900), 1,237,374, giving 353 inhabitants to the square mile.

Douwes-Dekker, Edward. See Dekkeb, Ed- ward DOUWES.

Dover, the principal Cinque Port, municipal and par- liamentary borough of Kent, England, terminal station of the South-Eastern and^ Chatham and Dover railway, 76 miles by rail east-south-east of London. The municipal borough, till 1895 coextensive with the parliamentary, was then extended to include parts of parishes previously in the rural district of Dover. In 1885 the parliamentary repre- sentation was reduced to one member. In 1888 the gates of Wellington dock were widened 10 feet to admit the new Channel steamers ; new coal stores were erected on the Northampton quay ; the shipway was lengthened 40 feet, and widened for the reception of vessels up

to 800 tons. In 1891 it was resolved to construct a new com- mercial harbour, estimated to cost about £700,000 and to be finished by the end of 1901. Begun in 1893, the worl^ include (1) an open iron viaduct, 1260 feet long, joining the east pier ; (2) the extension of the east pier, of solid masonry, to a length of 1920 feet ; (3) two jetties, 1100 and 500 feet long respectively ; (4) reclamation of 5 acres of land, between the Admiralty pier and the mouth of the present harbour, as a water station ; (5) an extension of the Admiralty pier. The harbour thus formed will have a

water area of 76 acres, with a depth within the mouth of over 40 feet at low water. A great national harbour, estimated to occupy ten years in building and to cost £3,500,000, commenced in 1899, will comprise (1) an ex- tension of the Admiralty pier east-south-east for a dis- tance of 2000 feet, over 90 feet from base of wall to top of parapet; (2) an east arm, projecting 3300 feet into the sea ; (3) a sea-wall, 3850 feet long, from the Castle jetty to the base of the east arm; (4) reclamation of the foreshore between the back of the wall and the base of the cliff ; (6) a breakwater 4300 feet long, | mile from the shore, from the south extremity of the east arm, south-west and west by south to a point 800 feet from the Admiralty pier extension, with entrance at each end of about 7 fathoms at low water. The Admiralty har- bour will cover at low water an area of 610 acres, accom- modating twenty of the largest ships and any number of armed cruisers, torpedo and dispatch boats, at any time needing its shelter. Coaling berths will extend 1800 feet along the inner side of the east arm. To strengthen its defences, the construction of three powerful forts was begun in 1899. Three pits have been sunk to work the coal discovered by boring. The water-works, which are the property of the corporation, are situated on Castle Hill, and have given a constant supply since 1870. The rainfall at this point, 200 feet above sea-level, was 24-34 inches in 1899 and 31-34 inches in 1900. The sewage outfall, constructed in 1885 at a cost of £7500, dis- charges into the sea, to the west of the Admiralty pier, at a distance of 1225 feet from the shore. There is a prom- enade pier (1893), costing £24,000; electric lighting, be- gun in 1894 ; electric tramways, with a length of 3i miles ; and

a public park (1883), of 22|- acres. Besides the mail and packet service, Dover does a trade in shipbuilding, timber, rope and sail making, and ships' stores. Ship- ping at port in 1888, 46 vessels of 3478 tons ; in 1898, 66 of 5066 tons. Entered in 1888, 2923 vessels of 720,337 tons ; cleared, 2895 of 716,544 tons. Entered in 1898, 3718 vessels of 1,015,609 tons; cleared, 3675 of 1,006,951 tons. Imports of foreign and colonial merchandise in 1888, valued £6,333,468 ; exports of produce of the United Kingdom, £1,128,104. In 1898, imports valued £9,451,- 780; exports, £1,564,225. Area of parliamentary bor- ough, 1317 acres. Population (1881), 30,270; (1901), 33,300. Area of municipal borough as now extended 1779^ acres. Population (1891), 33,503 ; (1901), 41,782.

Dover, capital of the state and of Kent county, Delaware, U.S.A., on the Philadelphia, Wilmington, and Baltimore railroad, at an altitude of 40 feet. It is the site of the state college for coloured students, opened in 1892. Population (1880), 2811; (1890), 3061; (1900), 3329, of whom 123 were foreign-born and 772 negroes.

Dover, capital of Strafford county, New Hampshire, U.S.A., in 43° 14' N. lat. and 70° 54' W. long., on Cocheco river, 12 miles from its mouth, at the lower falls, and at the head of navigation. Its street plan is irregular, few of the streets are paved, and its water supply, de- rived from Cocheco river, is obtained by gravity. It is at the intersection of two branches of the Boston and Maine railway, and these, with the river, give it consid- erable commerce. Its manufactures consist mainly of cot- ton and woollen goods. Population (1880), 11,687 ; (1890), 12,790; (1900), 13,207, of whom 3298 were foreign-born.

Dover, a town of Morris county. New Jersey, U.S.A., on the Eockaway river, at an altitude of 570 feet. It is on the Morris Canal, and on the Central of New Jersey and the Delaware, Lackawanna, and Western railways. It contains iron furnaces, rolling mills, and steel works. Population (1880), 2968; (1900), 5938, of whom 947 were foreign-born and 53 negroes.

Dower, or the life interest of the widow in a third part of her husband's lands, is governed in the United Kingdom, so far as women married after 1st January 1834 are concerned, by the Dower Act, 1834, and under it only attaches on the husband's death to the lands which he actually possessed

for an estate of inheritance at the time of his death. The wife is now entitled to dower out of equitable estates, but joint estates are still exempt. By the Act the wife's dower is placed completely under her husband's control. It does not attach to any land actually disposed of by him in his lifetime or by his will, nor to ,any land from which he has declared by deed his wife shall not be entitled to dower. He may also defeat her right, either as to any particular land or to all his lands, by a declaration in his will ; while it is subject to all the deceased husband's debts and con- tracts, and to any partial estates which he may have created during his life or by his will. A widow tenant in dower may make leases for twenty-one years under the Settled Estates Act, 1878. Free-bench is an analo- gous right in regard to copyhold land ; it does not fall within the Dower Act, 1834, and varies with the custom of each manor. At common law, and prior to the Act of 1834, dower was of a very different nature. The wife's right attached, while the husband was still living, to any land whereof he was solely seised in possession (exclud- ing equitable and joint estates) for an estate of inheri- tance at any time during the continuance of the marriage, provided that any child the wife might have had could have been heir to the same, even though no child was actually born. When once this right had attached, it ad- hered to the lands, notwithstanding any sale or devise the husband might make ; nor was it liable for his debts. In this way dower proved an obstacle to the free alienation of land, for it was necessary for a husband wishing to make a valid conveyance to obtain the consent of his wife releasing her right to dower. This release was only effected by a fine, the wife being separately examined. Often, by reason of the expense involved, the wife's con- currence was not obtained, and thus the title of the pur- chaser was defective during the wife's lifetime. The acceptance of a jointure by the wife before marriage was, however, destructive of dower; if after marriage, she was put to her election between it and dower. By the ingenuity of the old conveyancers, devices, known as " uses to bar dower " (the effect of which was that the purchaser never had at any time an estate of inheritance in possession), were found to prevent dower attaching to newly purchased lands, and so to enable the owner to give a clear title, without the need of the wife's concur- rence, in the event of his wishing, in his turn, to convey the land. All this has, however, been swept away by the Dower Act, 1834, and a purchaser of land need not now trouble himself to

inquire whether the dower of the wife of the vendor has been barred, or to insist on her concur- rence in a fine. (h. s. s.)

Down, a maritime county of Ireland, province of Ulster, bounded on the N. by Belfast Lough and Antrim, on the E. and S. by the Irish Sea, and on the W. by Armagh. The area of the judicial county in 1900 was 612,093 acres, of which 265,745 were tillage, 262,237 pasture, 763 fallow, 13,673 plantation, 1688 turf bog, 4129 marsh, 41,495 barren mountain, and 32,463 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, includes the portion of the town of Newry formerly situated in Armagh, but does not include the portion of Lisburn and the portion of Belfast formerly situated in Down. The population in 1881 was 272,107 ; in 1891, 267,069, of whom 126,268 were males and 140,791 females, divided

as follows among the different religions : — Presbyterians, 106,346; Roman Catholics, 73,410; Protestant Episco- palians, 65,239 ; Methodists, 7742 ; and other denomina^ tions, 14,322. The population in 1901 was 289,335 (Eoman Catholics, 76,535; Protestant Episcopalians, 71,568; Presbyterians, 114,182; Methodists, 10,543; others, 16,507), being an increase of 7-3 per cent. ; but these figures include part of the county borough of Belfast.

The following table gives the number of births, deaths, and marriages in various years : —

Tear.

Births.

Deaths.

Marriages.

1881 1891 1899

5671 7005 7752

4257 5419 5366

1062 1376 1464

The chief towns in the county are Newtownards, Banbridge, Downpatrick, and Holywood.

Education. — The foUowing table gives the degree of education in 1891 :—

Males.

Females.

Total.

Percentage. 1

E. 0.

Pr.Ep.

Presb.

Read and write Bead only Illiterate

72,239 10,750 10,650

77,570 17,442 12,487

149,809 28,192 23,137

62-6 15-8 21-6

73-4 16-0 10-6

82-3

12-1

5-6

The percentage of illiterates among Roman Catholics in 1881 was 26-5. In 1891 there were 15 superior schools with 621 pupils (Roman Catholics 191 and Protestants 430), and 460 primary schools with 32,461 pupils (Roman Catholics 8690 and Protestants 23,771). The number of pupils on the rolls of the national schools on 30th September 1899 was 50,220, of whom 11,595 were Roman Catholics and 38,626 Protestants.

Administration. — The county is divided into four parliamentary divisions, north, south, east, west, the number of registered electors in 1900 being respectively 9886, 8944, 8489, and 8815. The borough of Newry returns one member. The ratable value in 1900 was £794,836. By the Local Government (Ireland) Act 1898, the fiscal and administrative duties of the grand jury and (to a less extent) of other bodies were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises 7 urban and- 8 rural sanitary districts.

Agriculture. — The following tables show the acreage under crops, including meadow and clover, and the amount of live- stock in 1881, 1891, 1895, and 1900. The figures for 1900 are for the new administrative comity.

Tear.

1

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pq «,

i

1

III

i

^1

is

Total.

1881

22,365

106,094

1715

51,668

16,818

4754

28,089

70,035

801,533

1891

18,277

101,060

967

48,805

17,957

4666

12,968

78,367

272,567

1895

7,225

100,090

851

46,053

20,017

3885

16,634

78,957

273,662

1900

9,531

95,218

1872

43,014

20,101

4114

7,738

74,895

255,745

For 1899 the total value of the cereal and other crops was estimated by the Registrar-General at £1,755,140. The number of acres under pasture in 1881 was 217,543 ; in 1891, 242,700, and in 1900, 262,237.

Tear.

Horses and Mules.

Asses.

Cattle.

Sheep.

Pigs.

Goats.

Poultry.

1881 1891 1895 1900

81,465 82,171 85,142 83,700

1882 1302 1859 1454

129,447 150,481 151,261 159,746

56,745 101,931

92,791 122,166

84,272 51,708 45,651 42,153

10,911 13,791 12,638 11,186

636,802

719,682

822,123

1,049,378

The number of milch cows in 1891 was 53,743, and in 1900 54,087. It is estimated that the total value of cattle, sheep, and pigs in 1899 was £2,242,131. In 1900 the number of holdings not exceeding 1 acre was 6.306, between 1 and 5, 3775, between 5 and 15, 8904, between 15 and 30, 6505, between 30 and 50, 3181, between 50 and 100, 1756, between 100 and 200, 333, between 200 and 500, 87, and above 500, 2S— total, 30,870. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1886, 1891, and 1896, up to 31st March 1900, was 1314, amounting to £497,045. The number of loans sanctioned for agricultural improvements under sect. 31 of the Land Act, 1881, between 1882 and 1900 was 102,

and the amount issued £8887. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations to 31st March 1900 was £99,765. Fisheries. — In 1899, 375 vessels, employing 1120 hands, were registered in the deep sea and coast fishery districts of Donaghadee, Strangford, and Newcastle. In the same year 15,619 cwt. of herring were caught in the Ardglass fisheries. (w. h. Po.)

Downpatrick, a market-town and county town of Down, Ireland, on Strangford Lough, 18 miles south- east of Belfast by rail. It ceased to be a parliamentary borough in 1886. It is governed by town commissioners, but under the powers conferred by the Local Government (Ireland) Act, 1898,

can apply to be constituted an urban sanitary district. The County Dovm railway connects the town with Belfast and (among other places) with New-townards and Newcastle, a favourite watering-place. In 1883 an assembly hall was erected at the expense of Lord Dunleath, and a new lunatic asylum has been opened near the town. Population (1881), 3901 ; (1901), 2992.

Doyle, Sir Francis Hastings Charles, Babt.

(1810-1888), English man of letters, was born at Nunappleton, Yorkshire, 22nd August 1810, and was educated at Eton and Oxford, where he took a first-class in classics in 1831, and became a Fellow of All Souls' He read for the Bar, but was chiefly interested in liter ature and society. Among his intimate friends was Mr Gladstone, whose " best man " he was ; but in later life their political opinions widely differed. In 1841 he pub- lished Miscellaneous Verses, (1844) Two Destinies, (1852) Tlie Duke's Funeral, (1866) Return of the Guards and other Poems; and from 1867 to 1877 he was professor of poetry at Oxford. In 1869 some of the lectures he de- livered were published in book form. In 1886 he published his Reminiscences, full of records of the interestiiig people he had known. Sir Francis Doyle succeeded his father (Chairman of the Board of Excise) as second baronet in 1839, and married in 1844. From 1846 he held various- important offices in the Customs. He died 8th June 1888. A cultivated and agreeable man and writer, Doyle's poetry is memorable for certain isolated and spirited pieces,, which became popular because of their thoroughly English celebration of manly deeds. The best known are his ballads on the "Birkenhead" disaster and on "The Private of the Buffs."

Doyle, Richard (1824-1883), English artist, son of John Doyle, the caricaturist known as " H. B." (1797-1868), was born in London in 1824. His father's " Political Sketches " took the town by storm in. the days of Lord Grey and Lord Melbourne. The son was an extremely precocious artist, and in his " Home for the Holidays," done when he was twelve, and his " Comic English Histories," drawn four years later, he showed extraordinary gifts of humour and fancy. He had no art training outside his father's studio. In 1843 he joined the staff of Punch, drawing cartoons and a vast number of illustrations, but he retired in 1850, in con- sequence of the attitude adopted by that paper towards what was known as " the papal*

aggression," and especially towards the pope himself. In 1854 he published his " Continental Tour of Brown, Jones, and Eobinson." His illustrations to three of the Christmas Books of Charles Dickens, and to The Newcomes by Thackeray, are reckoned among his principal achievements ; and his fanciful pictures of elves and fairies have always been general favourites. He died on 11th December 1883. His most popular drawing is his cover of Punch.

Dozy, Reinhart Pieter Anne (1820-1883),^ Dutch Arabic scholar of French (Huguenot) origin, was born at Leyden in February 1820. The Dozys, like so

many other contemporary French families, emigrated to the Low Countries after the revocation of the Edict of Nantes, but some of the former appear to have settled in Holland as early as 1647. Dozy studied at the UniTer- sity of Leyden, obtained the degree of doctor in 1844, was appointed an extraordinary professor of history in 1860, and professor in 1857. The first results of his extensive studies in Oriental literature, Arabic language, and history manifested themselves in 1847, when he published Al- Marrakushi's History of the Almohades (Leyden, 2nd ed., 1881), which, together with his Scriptorum Arabum loci de Abhaditis (Leyden, 1846-63, 3 vols.), his editions of Ibn-Adhari's History of Africa and Spain (Leyden, 1848-52, 3 vols.), of Ibn-Badrun's Historical Commentary on the Poem of Ibn-Abdun (Leyden, 1848), and his Dic- tionnaire detailli des noms des vitements chez les Arabes (Amsterdam, 1845) — a work crowned by the Dutch Institute — stamped Dozy as one of the most learned and critical Arabic scholars of his day. But his real fame as a historian mainly rests on his great work Histoire des Mussulmans d'JSIspagne,jusqu'd, la Conquite de VAndalousie par les Almoravides, 711-1110 (Leyden, 1861 ; 2nd ed., ibid., 1881) ; a graphically written account of Moorish dominion in Spain, which shed new light on many ob- scure points, and has remained the standard work on the subject. Dozy's Becherches sur V Histoire et la Littirature de VEspagne pendant le Moyen Age (Leyden, 2 vols., 1849 ; 2nd and 3rd ed., completely recast, 1860 and 1881) form a needful and wonderfully trenchant supplement to his

Histoire des Mussulmans, in which he mercilessly exposes the many tricks and falsehoods of the monks in their chronicles, and effectively demolishes a good part of the Cid legends. As an Arabic scholar Dozy stands well- nigh unsurpassed in his Supplement aux Dictionnaires Arabes (Leyden, 1877-81, 2 vols.), a work full of re- search and learning, a storehouse of Arabic lore. To the same class belongs his Glossaire des mots espagnols et portugais, dirivis de VArahe, edited with Dr W. H. Engelmann of Leipzig (Leyden, 1866; 2nd ed., 1868), and a similar list of Dutch words derived from the Arabic. Dozy also edited Al-Makkari's Ancdectes sur V Histoire et la Littirature des Arabes d'Espagne (Leyden, 1855-61, 2 vols.), and, ia conjunction with his friend and worthy successor, Professor De G-oeje, at Leyden, Edrisi's Description de VAfrique et de VEspagne (1866), also the Calendrier de Cordoue de I'annAe 961 ; texte arabe et ancienne traduction latine (Leyden, 1874). Het Islamisme (Islamism ; Haarlem, 1863; 2nd ed., 1880; French translation) is a popular exposition of Mahom- medanism, of a more controversial character ; and He Israelieten te Mekka (The Israelites at Mecca, Haarlem, 1864) became the subject of a rather heated discussion in Jewish circles. Dozy died at Leyden, May 1883.

(h. ti.)

Drachmann, Holger (1846), Danish poet

and dramatist, the son of a well-known physician of Copenhagen, Dr A. G. Drachmann, whose family was of German extraction, was bom in Copenhagen on the 9th October 1846. Owing to the early death of his mother, who was a Dane, the child was left much to his own devices. He soon developed a fondness for semi-poetical performances, and loved to organize among his com- panions heroic games, in which he himself took such parts as those of Tordenskjold and Niels Juul. His studies were belated, and he did not enter the university until 1865, leaving it in 1866 to become a student in the Academy of Fine Arts. From 1866 to 1870 he was learning, under Professor Sorensen, to become a marine painter, and not without success. But about the latter date he came under the influence of Georg Brandes, and,

without abandoning art, he began to give himself more and more to literary ideas. He travelled very extensively iu England, Scotland, France, Spain,

and Italy, and his literary career began by his sending letters about his journeys to the Danish newspapers. After returning homg, he settled for some time in the island of Born- holm, painting seascapes. He now issued his earliest volume of Poems, 1872, and joined the group of young Radical writers who gathered under the banner of Brandes. Drachmann was unsettled, and still doubted whether his real strength lay in the pencil or in the pen. By this time he had enjoyed a surprising experience of life, especially among sailors, fishermen, students, and artists, and the issues of the Franco-German War and the ■ French Commune had persuaded him that a new and glorious era was at hand. His volume of lyrics. Muffled Melodies, 1875, proved that Drachmann was a poet with a real vocation, and he began to produce books in prose and verse with great rapidity. Young Blood, 1876, is his solitary attempt at a realistic novel of to-day. But in 1877 he returned to his true field in his magnificent Songs of the Sea, and he won the passionate admiration of his countrymen by his prose work, with interludes in verse, called Over the Fi-ontier There, a series of impres-sions made on Drachmann by a visit to the scenes of the war with Germany. During the succeeding years he was a great traveller, visiting most of the principal countries of the world, but particularly familiarizing himself, by protracted voyages, with the sea and with the life of man in maritime places. In 1879 he published Tendrils and Roses, amatory lyrics of a very high order of melody, in which he showed a great advance in technical art. To the same period belongs On the Faith and Honour of a Sailor, a volume of short stories in prose. It was about this time that Drachmann broke with Brandes and the Eadicals, and set himself at the head of a sort of " Nationalist " or popular-Conservative party in Denmark. He continued to celebrate the life of the fishermen and sailors in books, whether in prose or verse, which were the most popular of their day. Paul and Virginia and Lars Kruse (both 1879) ; East of the Sun and Moon, 1880; Chrysalis and Butterfly, 1882 ; and Strandby Folk, 1883, were among these. In 1882 Drachmann published his fine translation, or paraphrase, of !^rron's Don Juan. He now gave his attention to dramatic composition, and in 1885 his romantic play called Once upon a Time enjoyed an enormous success on the boards of the Eoyal Theatre, Copenhagen. He pursued this profitable course, and his tragedies of Volund Smed and Brav-Karl have made him the most popular playwright of Denmark. He published a volume of exquisitely fantastic Melo- dramas in rhymed verse, a collection which contains some

of Drachmann's most perfect work. It is im- possible to give the titles of all the poet's publications, which are extremely numerous. In 1899 he enjoyed a great success through Scandinavia by his romantic play called Gurre, and in 1900 he brought out a prose story called Dcedalus and a brilliant lyrical drama, Hallfred Vandraadeskjald. In the winter of 1900 Drachmann visited England, and was entertained at dinner by fifty English authors. A man of lofty stature and command- ing appearance, he looks like a poet and a Viking. He is unquestionably the greatest writer that Denmark pro- duced in the last quarter of the 19th century.

Dragasani, atown in Eumania, of 4398 inhabitants, on the right bank of the river Olt. It was the scene in 1821 of a bloody battle between the Turks and the troops of Ypsilanti, in which the latter were completely defeated. The vines of the neighbouring hills produce the best white wines in the country.

Drama. — The last quarter of the 19th century wit- nessed a very distinct progress in the theatrical life of the world at large. It is at present too early to unify this movement by tracing it to any one cause or set of causes, political, economic, or psychological. Yet the fact is clear that the new theatrical literature of En^and, France, Germany, and even of Italy and America, repre- sents a break with tradition rather than a continuance of it.

In England the whole mechanism of theatrical life had undergone a radical change in the middle decades of the century. At the root of this change lay the immense growth of population and the enormously increased facili- ties of communication between London and the provinces. Similar causes came into operation, of course, in Trance, Germany, and Austria, but were much less dis- Orama'! tinctly felt, because the numerous and important subventioned theatres of these countries re- mained more or less unaffected by economic influences. Eree trade in theatricals (subject only to certain licensing regulations and to a court censorship of new plays) was established in England by an Act of 1843, which abolished the long moribund monopoly of the " legitimate drama" claimed by the " Patent Theatres " of Drury Lane and Covent Garden. The drama was thus

formally subjected to the operation of the law of supply and demand, like any other article of commerce, and managers were left, unaided and unhampered by any subvention or privilege, to cater to the tastes of a huge and growing community. Theatres very soon multiplied, competition grew ever keener, and the long run, with its accompaniments of ostentatious decoration and lavish advertisement, became the one object of managerial effort. This process of evolution may be said to have begun in the second quarter of the 19th century and completed itself in the 3rd. The system which obtains to-day, almost unforeseen in 1825, was in full operation in 1875. The repertory theatre, with its constant changes of programme, maintained on the Continent partly by subventions, partly by the mere force of artistic tradition, had become in England a faint and far-off memory. There was not a single theatre in London at which plays, old and new, were not selected and mounted solely with a view to their continuous per-formance for as many nights as possible, anything short of fifty nights constituting an ignominious and probably ruinous failure. It was found, too, that those theatres were most successful which were devoted exclusively to exploiting the talent of an individual actor. Thus when the fourth quarter of the century opened the long " run " and the actor-manager were in firm possession of the field.

The outlook was in many ways far from encouraging. It was not quite so black, indeed, as it had been in the late 'fifties and early 'sixties, when the " legitimate " enterprises of Phelps at Sadler's Wells and Charles Kean at the Princess's had failed to hold their ground, and when modern comedy and drama were represented almost exclusively by adaptations from the French. There had been a slight stirring of originality in the series of come- dies produced by T. W. Eobertson (1829-1871) at the Prince of Wales's Theatre, Tottenham Street, where, under the management of Mr and Mrs Bancroft,[1] a new school of mounting and acting, minutely faithful (in theory at any rate) to everyday reality, had come into existence. But

1 Sir Squire Bancroft, who was knighted in 1897, was born on Uth May 1841, and made his dfl)ut at Birmingham in 1861. In 1865 he joined the company with which Miss Marie Wilton (whom he after- wards married) opened the Prince of Wales's Theatre, in Tottenham Court Boad, London; and he became co-manager with his wife in 1868. They moved to the

Haymarket in 1880, and formally retired from the stage in 1885, but at rare intervals afterwards occasionally reappeared.

the hopes of a revival of English comedy seemed to have died with Kobertson's death. One of his followers, James Albery (1832-1889), possessed both imagination and wit, but had not the strength of character to do justice to his talent, and sank into a mere adaptor. In the plays of another disciple, H. J. Byron (1836-1884), the Koberfc- sonian or " cup-and-saucer " school declined upon sheer inanity. Of the numerous plays signed by Tom Taylor (1817-1880) some were original in substance, but all were cast in the machine-made French mould. Wilkie Collins (1824-1889), in dramatizing some of his novels, produced somewhat crude anticipations of the modern " problem play." The literary talent of Mr W. S. Gilbert (6. 1836) displayed itself in a group of comedies both in verse and prose ; but Mr Gilbert saw life" from too pecul- iar an angle to represent it otherwise than fantastically. The Robertsonian impulse seemed to have died utterly away, leaving behind it only five or six very insubstantial comedies and a subdued, unrhetorical method in acting. This method the Bancrofts proceeded to apply, during the 'seventies, to revivals of stage classics, such as Hie School for Scandal, Money, and Masks and Faces, and to adaptations from the French of Sardou.

While the modern drama appeared to have relapsed into a comatose condition, poetic and romantic drama was giv- ing some signs of life. At the Lyceum in 1871 Henry Irving (b. 1838) had leapt into fame by means of his performance of Mathias in The BeUs, an adaptation from the French of Erckmann-Chatrian. He followed this up by an admirably picturesque performance of Charles I. in a play of that name by W. G. Wills (1828-1893), a writer of some talent, which ran to waste for lack of an adequate sense of either dramatic or literary form. In the autumn of 1874 the great success of Mr Irving's Hamlet was hailed as the prelude to a revival of tragic acting. As a matter of fact, it was the prelude to a long series of re-markable achievements in romantic drama and melodrama. Mr Irving's lack of physical and vocal resources prevented him from scaling the heights of tragedy, and his Othello, Macbeth, and Lear could not be ranked among his suc- cesses ; but he was admirable in such parts as Richard III., Shylock, lago, and Wolsey, while in melodramatic parts, such as Louis XI.

and the hero and villain of The Lyons Mail, he was unsurpassed. Mephistopheles in a version of FatCst (1885), perhaps the greatest popular success of his career, added nothing to his reputation for artistic intelligence ; but on the other hand his Becket in Tenny- son's play of that name (1893) was one of his most masterly, efforts. His management of the Lyceum (1878-1899) did so much to raise the status of the actor and to restore the prestige of poetic drama, that the knighthood conferred upon him in 1895 was felt to be no more than an appropriate recognition of his services. But unfortunately his managerial career had scarcely any significance for the living English drama. He seldom experimented with a new play, and, of the few which he did produce, only Tlie Gup and Becket by Lord Tennyson have the remotest chance of being remembered.

To trace the history of the English drama, then, we must go back to the Prince of Wales's Theatre. Even while it seemed that French comedy of the school of Scribe was resuming its baneful predominance, the seeds of a new order of things were slowly germinating. Diplomacy, an adaptation of Sardou's Dora, produced in 1878, brought together on the Prince of Wales's stage Mr and Mrs Bancroft, Mr and Mrs Kendal, Mr John Clayton, and Mr Arthur Cecil — in other words, the future managers of the Haymarket, the St James's, and the Court Theatres, which were destined to see the first real stirrings of a literary revival. Mr and Mrs Kendal, who, in conjunction with Mr John Hare, managed the St James's Theatre

from 1879 to 1888, produced Mr A. W. Pinero's first play of any consequence, The Money-Spinner (1881), and af- terwards The Squire (1882) and The Hobby Horse (1887). Mr and Mrs Bancroft, who, after entirely rebuilding the Haymarket Theatre, managed it from 1880 till their re- tirement in 1885, produced in 1883 Mr Pinero's Lords and Commons; and Messrs Clayton and Cecil produced at the Court Theatre between 1885 and 1887 his three brilliant farces The Magistrate, The Schoolmistress, and Dandy Dick, which, with the sentimental comedy, Sweet Lavender, produced at Terry's Theatre in 1888, assured his position as an original and fertile dramatic humorist of no small literary power. It is to be noted, however,

that Mr Pi- nero was almost the only original playwright represented under the Bancroft, Hare-Kehdal, and Clayton-Cecil man- agements, which relied for the rest upon adaptations and revivals. Adaptations of French vaudevilles were the staple productions of Mr Charles Wyndham's management at the Criterion from its beginning in 1876 until 1893, when he first produced an original play of any importance. When Mr Beerbohm Tree went into management at the Haymarket in 1887, he still relied largely on plays of foreign origin. Mr George Alexander's first managerial ventures (Avenue Theatre, 1890) were two adaptations from the Trench. Until well on in the 'eighties, indeed, adaptation from thePrenchwas held the normal occupation of the British playwright, and original composition a mere episode. Eobertson, Byron, Albery, Gilbert, Tom Taylor, Charles Eeade, Herman Merivale, G. W. Godfrey, all pro- duced numerous adaptations ; Mr Sydney Grundy was for twenty years occupied almost exclusively in this class of work; Mr Pinero himself has adapted more than one Prench play. To this day the managers have not quite unlearnt the habit of regarding Paris as the natural , fountainhea'd of English drama. The 'eighties, then, may on the whole be regarded as showing a very gradual decline in the predominance of Prance on the English stage, and an equally slow revival of originality, so far as comedy and drama were concerned, manifesting itself mainly in the plays of Mr Pinero.

The reaction against Prench influence, however, was no less apparent in the domain of melodrama and operetta than in that of comedy and drama. Until well on in the 'seventies, D'Ennery and his disciples, adopted and imitated by Boucicault and others, ruled the melodramatic stage. The reaction asserted itself in two quarters — in the East End at the Grecian Theatre, and in the West End at the Princess's. In The World, produced at Drury Lane in 1880, Paul Meritt {d. 1895) and Henry Pettitt (d. 1893) brought to the West End the " Grecian " type of popular drama ; and at Drury Lane it has survived in the elabo- rately spectacular form imparted to it by Sir Augustus Harris, who managed that theatre from 1879 till his death in 1896. The production of Mr G. B.. Sims's Lights o' London at the Princess's in 1881, under Mr Wilson Bar- rett's management, also marked a new departure; and the two streams of melodrama flowed together in a long series of popular plays at the Adelphi Theatre, from about 1882 to almost the end of the century. The "Adelphi" as opposed to the "Drury Lane" type

of drama has recently died out in the West End, apparently because a host of suburban theatres drew away its audiences. Of all these English melodramas, only one. The Silver King, by Mr H. A. Jones (Princess's, 1882) could for a moment compare in invention or technical skill with the French dramas they supplanted. The fact remains, however, that even on this lowest level of dramatic art the current of the time set decisively towards home-made pictures of English life, however crude and puerile.

For twenty-five years, from 1865 to 1890, the English

stage was overrun with French operettas of the school of Offenbach. Hastily adapted by slovenly hacks, their librettos (often witty in the original) became incredible farragos of metreless doggrel and punning ineptitude. The great majority of them are now so utterly forgotten that one scarcely realizes, until one looks into the records, how in their heyday they swarmed on every hand. The reaction began in 1875 with the performance at the Royalty Theatre of Trial by Jury, by Mr W. S. Gilbert and Mr (afterwards Sir) Arthur Sullivan (1842-1900). This was the prelude to that brilliant series of witty and melodious extravaganzas which began with The Sorcerer at the Opera Comique Theatre in 1877, but has been mainly associated with the Savoy Theatre, opened by Mr D'Oyly Carte (d. 1901) in 1881. Little by little the Gilbert and Sullivan operettas (of which the most famous, perhaps, were H.M.S. Pinafore, 1878, Patience, 1881, and The Mikado, 1885) undermined the popularity of the French operarbouffes, and at the same time that of the indigenous "burlesques" which, graceful enough in the hands of their inventor J. E. Planche (1796-1880), had become mere incoherent jumbles of buffoonery, devoid alike of dramatic ingenuity and of literary form. When, early in the 'nineties, the collaboration between Mr Gilbert and Sir Arthur Sullivan became intermittent, and the vogue of the Savoy somewhat declined, a new class of extravaganza arose, under the designation of "musi- cal comedy " or " musical farce." It first took form in a piece called In Town, by Messrs "Adrian Eoss" and Osmond Carr (Prince of Wales's Theatre, 1892), and rapidly became very popular. In these plays the scene and costumes are almost always modern, though sometimes exotic, and the prose dialogue, setting forth an attenuated and entirely negligible plot, is frequently interrupted by musical numbers. The lyrics are often very clever pieces of rhyming, totally different from the

iuane doggrel of the old opefa-bouffes and bur- lesques. In other respects there is little to be said for the literary or intellectual quality of "musical farce"; but being an entirely English (or Anglo- American) product, it falls into line with the other indications we have noted of the general decline — one might almost say extinction — of French influence on the English stage.

To what causes are we to trace this gradual disuse of adaptation ? In the domain of modern comedy and drama, to two causes acting simultaneously : the decline in France of the method of Scribe, which produced " well-made," exportable plays, more or less suited to any climate and environment ; and the rise in England of a generation of playwrights more original, thoughtful, and able than their predecessors. It is not at all to be taken for granted that the falling off in the supply of exportable' plays meant a decline in the absolute merit of French drama. That point is discussed in the section French Drama below. The historian of the future may very possibly regard the movement in France, no less than the movement in England, as a step in advance, and may even see in the two movements co-ordinate manifestations of one tendency. Be this as it may, the fact is certain that as the playwrights of the Second Empire gradually died off and were succeeded by the authors of the ' new comedy," plays which would bear transplantation became ever fewer and farther between. It is worthy of note that (a few mere buffooneries apart) most of the adaptations produced since 1890 have been from comedies and novels of a very much older date — works of Labiche and of Dumas phre and flls. Attempts to acclimatize the poetical drama of the, present generation — Pour la Oouronne, Le Chemi- neau, Cyrano de Bergerac — ^have all been more or less unsuccessful.

Having noted the decline of adaptation, we may now trace a stage farther the development of the English drama. The first stage, already surveyed, ends with the production of Sweet Lavender in 1888. Up to this point its author, Mr Pinero (6. 1855), stood practically alone, and had won his chief successes as a humorist. Mr Henry Arthur Jones (6. 1861) was known as little more than an able melodramatist, though in one play. Saints and

Sinners (1884), he had made some attempt at a serious study of provincial life. Mr B,. C. Carton (&. 1866) had written, in collaboration, one or two plays of slight account. Mr Sydney Grundy (&. 1848) had produced scarcely any original work. Kone of the other drama- tists of to-day had as yet appeared on the horizon. The second stage may be taken as extending from 1889 to 1893. On 24th April 1889 Mr John Hare opened the new Garrick Theatre with The Profligate, by Mr Pinero — an unripe and superficial piece of work in many ways, but still a great advance, both in ambition and achieve- ment, upon any original work the stage had seen for many a year. With all its faults, this play notably enlarged at one stroke the domain open to the English dramatist. And it did not stand alone. The same year saw the production of two plays by Mr Jones, Wealth and The Middleman, in which a distinct effort towards a seri- ous criticism of life was observable, and of two plays by Mr Grundy, A Fool's Paradise and A White Lie, which, though very French in method, were at least original in substance. Mr Jones during the next two years made a steady advance with Judah (1890), his first really mature production, and The Dancing Oirl and The Crusaders (1891), in the latter of which he made his first attempt to work the vein of social satire. Mr Pinero in these years was putting forth less than his whole strength in The Cabinet Minister (1890), Lady Bountiful and The Times (1891), and The Amazons (March 1893). But meanwhile new talents were coming forward. The man- agement of Mr George Alexander, which opened at the Avenue Theatre in 1890, but was transferred in the fol- lowing year to the St James's, brought prominently to the front Mr Carton, Mr Haddon Chambers, and Mr Oscar Wilde. Mr Carton's two sentimental comedies, Sunlight and Shadow (1890) and Liberty MaU (1892), showed excellent literary workmanship, but did not yet reveal his true originality as a humorist. Mr Haddon Chambers's work (notably The Idler, 1891) was as yet sufiiciently commonplace ; but in Lady Wirvdemiere^s Fan (1892) Mr Oscar Wilde showed himself at his first attempt a brilliant and accomplished dramatist. Mr Wilde's sub- sequent plays, A Woman of No Importance (1893) and An Ideal Husband and The Importance of being Earnest (1896), though marred by mannerism and insincerity, did much to promote the movement we are here tracing, and his painful downfall gave it a distinct, though temporary, check.

As the production of The Profligate marked the open- ing of the second period in the revival of English drama, so the production of the same author's The Second Mrs Tanqueray is very clearly the startiag-point of the third period — of the phase of development stUl in progress. Before attempting to trace its course, however, we may do well to glance at certain conditions which probably influenced it.

In the first place, economic conditions. The Bancroft- Robertson movement at the old Prince of Wales's, be- tween 1865 and 1870, was of even more importance from an economic than from a literary point of view. By making their little theatre a luxurious place of resort, and faithfully imitating in their productions the accent, costume, and furniture of upper and upper-middle class life, the Bancrofts had initiated a recon-

ciliation between Society and the Stage. Throughout the middle decades of the century it was the constant complaint of the managers that the world of wealth and fashion was by no means to be tempted to the theatre. The Bancroft management changed all that. It was at the Prince of Wales's that half-guinea stalls were first introduced; and these stalls were always filled. As other theatres adopted the same policy of upholstery, both on and off the stage, fashion extended its complai- sance to them as well. In yet another way the reconcilia- tion was promoted — by the ever-increasing tendency of young men and women of good birth and education to seek a career upon the stage. Eor the past fifteen years, then, the theatre has been one of the favourite amusements of fashionable (though not necessarily of intellectual) Society. It is often contended that the influence of the sensual and cynical stall audience is a pernicious one. In some ways, no doubt, it is detri-mental ; but there is another side to the case. Even the cynicism of Society marks an intellectual advance upon the sheer rusticity which prevailed during the middle years of the 19th century and accepted without a mur-mur plays (original and adapted) which bore no sort of relation to life. In a celebrated essay published in 1879, Matthew Arnold dwelt on the sufficiently obvious fact that the result of giving English names and costumes to French characters was to make their sayings and do- ings utterly unreal and "fantastic." During the years of French ascendancy, audiences had quite forgotten that it was possible for the stage to be other than "fantastic" in this sense. They no longer thought of comparing the

mimic world with the real world, but were content with what may be called abstract humour and pathos, often of the crudest quality. The cultivation of external realism, coinciding with, and in part occasioning, the return of Society to the playhouse, gradually led to a demand for some approach to plausi- bility in character and action as well as in costume and decoration. The stage ceased to be entirely " fantastic," and began to essay, however imperfectly, the representa^ tion, the criticism, of life. It cannot be denied that the influence of Society tends to narrow the outlook of Eng- lish dramatists and to trivialize their tone of thought. But this is, in all likelihood, a passing phase of develop- ment ; and cleverly trivial representations of reality are, after all, to be preferred to brainless concoctions of sheer emptiness.

Quite as important, from the economic point of view, as the reconciliation of Society to the stage, was the reorganization of the mechanism of theatrical life in the provinces which took place between 1865 and 1876. From the Eestoration to the middle of the 19th century the system of " stock companies " had been universal. Every great town in the three kingdoms had its established theatre with a resident company, playing the " legitimate " repertory, and competing, often by illegitimate means, for the possession of new London successes. The smaller towns, and even villages, were grouped into local " circuits," each served by one manager with his troupe of strollers. The " circuits " supplied actors to the resident stock com- panies, and the stock companies served as nurseries to the patent theatres in London. Metropolitan " stars " travelled from one country theatre to another, generally alone, sometimes with one or two subordinates in their train, and were " supported," as the phrase went, by the stock company of each theatre. Under this system, scen- ery, costumes, and appointments were often grotesquely inadequate, and performances almost always rough and unfinished. On the other hand, the constant practice in a great number and variety of characters afforded valuable training for actors, and developed many remarkable talents.

As a source of revenue to authors, the provinces were practically negligible. Stageright was unprotected by law ; and even if it had been protected, it is doubtful whether authors could have got any considerable fees out of country managers, whose precarious ventures usually left them a small enough margin of profit.

The spread of railways throughout the country gradu- ally put an end to this system. The " circuits " disap- peared early in the 'fifties, the stock companies survived until about the middle of the 'seventies. As soon as it was found easy to transport whole companies, and even great quantities of scenery, from theatre to theatre throughout the length and breadth of Great Britain, it became apparent that the rough makeshifts of the stock company system were doomed. Here again we can trace to the old Prince of Wales's Theatre the first distinct impulse towards the new order of things. Eobertson's comedies not only encouraged but absolutely required a style of art, in mounting, stage-management, and acting, not to be found in the country theatres. To entrust them to the stock companies was well-nigh impossible. On the other hand, to quote Sir Squire Bancroft, "per- haps no play was ever better suited than Caste to a trav- elling company; the parts being few, the scenery and dresses quite simple, and consequently the expenses very much reduced." In 1867, then, a company was organized and rehearsed in London to carry round the provincial theatres as exact a reproduction as possible of the Lon- don performance of Caste and Robertson's other comedies. The smoothness of the representation, the delicacy of the interplay among the characters, were new to provin- cial audiences, and the success was remarkable. About the same time the whole Haymarket company, under Buckstone's management, began to make frequent rounds of the country theatres; and other "touring combinar tions" were soon organized. It is manifest that the "combination" system and the stock company system cannot long coexist, for a manager cannot afiord to keep a stock company idle while a London combination is occupying his theatre. The stock companies, therefore, soon dwindled away, and were probably quite extinct be- fore the end of the 'seventies. Under the present system, no sooner is a play an established success in London than it is reproduced in one, two, or three exact copies and sent round the provincial theatres (and the numerous suburban theatres which have sprung up since 1895), Company A serving first-class towns. Company B the

second-class towns, and so forth. The process is very like that of taking plaster casts of a statue, and the pro- vincial companies often stand to their London originals very much in the relation of plaster to marble. Even the London scenery is faithfully reproduced in material of extra strength, to stand the wear-and-tear of constant removal. The result is that, instead of the square pegs in round holes of the old stock company system, provincial audiences now see pegs carefully adjusted to the particular holes they occupy, and often incapable of fitting any other. Instead of the rough performances of old, they are now accustomed to performances of a mechanical and soulless smoothness. In some ways the gain is undeniable, in other ways the loss is great. The provinces are no longer, in any effective sense, a nursery of fresh talents for the London theatres, for the art acquired in touring combinar tions is that of mimicry rather than of acting. Moreover, provincial playgoers have lost all personal interest and pride in their local theatres, which have no longer any in- dividuality of their own, but serve as a mere frame for the presentation of a series of ready-made London pic- tures. Christmas pantomime is the only theatrical pro- duct that has any local flavour in it, and even it is very often only a second-hand London production, touched up

with a few topical allusions. Again, the railways which bring London productions to the country take country playgoers by the thousand to London. The wealthier classes, in the Lancashire, Yorkshire, and Midland towns at any rate, do almost all their theatre-going in London, or during the autumn months when the leading London com- panies go on tour. Thus the better class of comedy and drama has a hard fight to maintain itself in the provinces, and the companies devoted to melodrama and musical farce enjoy an ominous preponderance of popularity.

On the whole, however — and this is the main point to be observed with regard to the literary development of the drama — the economic movement of the five-and- twenty years between 1865 and 1890 was enormously to the advantage of the dramatic author. A London success meant a long series of full houses at high prices, on which he took a handsome percentage. The provinces, in which a popular playwright would often have three or four plays going the rounds simultaneously, became a steady source of income. And, finally, it was found pos- sible, even before international copyright

came into force, to protect stageright in the United States, so that about the beginning of the 'eighties large receipts began to pour in from America. Thus successful dramatists, in- stead of living from hand to mouth, like their prede- cessors of the previous -generation, found themselves in comfortable and even opulent circumstances. They had leisiu-e for reading, thought, and careful composition, and they could afford to gratify their ambition with an occasional artistic experiment. Failure might mean a momentary loss of prestige, but it would not spell ruin. A distinctly progressive spirit, then, began to animate the leading English dramatists — a spirit which found intelligent sympathy in such managers as Mr John Hare, Mr George Alexander, Mr Beerbohm Tree, and finally Mr Charles Wyndham. Nor must it be forgotten that, though the laws of literary property, internal and inter- national, are still far from perfect, it has been found possible during the past ten years to print and publish plays without incurring loss of stageright either at home or in America. The playwrights of the present generation have accordingly a motive for giving literary form and polish to their work which was quite inoperative with their predecessors, whose productions were either kept jealously in manuscript or printed only in miserable and totally unreadable stage editions. It is no small stimu- lus to ambition to know that even if a play prove to be in advance of the public to which it is originally pre- sented, it will not perish utterly, but will, if it have any inherent vitality, continue to live as literature.

Having now summed up the economic conditions which made for progress, let us glance at certain intellectual influences which tended in the same direction. The es- tablishment of the Theatre Libre in Paris, towards the close of 1887, unquestionably marked the beginning of a period of restless experiment throughout the theatrical world of Europe. M. Antoiue and his supporters were in open rebellion against the artificial methods of Scribe and the Second Empire playrights. influence Their effort was to transfer to the stage the ar^^f" realism, the so-called " naturalism," which had been dominant in French fiction since 1870 or earlier ; and this naturalism was doubtless, in its turn, the out- come of the scientific movement of the century. New methods (or ideals) of observation, and new views as to the history and destiny of the race, could not fail to produce a profound effect upon art; and though the modern theatre is a cumbrous contrivance, slow to adjust its orientation to the winds of the spirit, even it at last began to

revolve, like a rusty windmill, so as to fill its sails in the main current of the intellectual atmosphere.

Under the section French Drama (below), the history of the Theatre Libre is outlined. Within three or four years of its inception M. Antoine's experiment had been imitated in Germany, England, and America. The Freie Biihne of Berlin came into existence in 1889,' the Inde- pendent Theatre of London in 1891. Similar enterprises were set on foot in Munich and other cities. In America several less formal experiments of a like nature were attempted, chiefly in Boston and New York. Nor must it be forgotten that in Paris itself the Theatre Libre did not stand alone. Many other thedtres-d, cdtS sprang up, under such titles as " Theatre d'Art," " Theatre Moderne," " Theatre de I'ATenir Dramatique." The most important and least ephemeral was the " Theatre de I'CEuvre," founded in 1893 by M. Lugne-Poe, which represented mainly, though not exclusively, the symbolist reaction against naturalism.

The impulse which led to the establishment of the Theatre Libre was, in the first instance, entirely French. If any foreign influence helped to shape its course, it was that of the great Eussian novelists. Tolstoi's Puissance des Tin^hres was the only " exotic " play announced in M. Antoine's opening manifesto. But the whole move- ment, in France and elsewhere, was soon to receive a potent stimulus from a somewhat unlikely quarter. Born in 1828, the Norwegian poet Henrik Ibsen was already an old man before his fame became European. His youth and middle life had been devoted to romantic tragedy and satiric drama in verse. Not till 1877 did he finally restrict himself to prose and to the modern world. In the series of plays which then followed he antici- pated the process of evolution which was to lead, both in France and Germany, through prosaic realism to an intensely imaginative treatment of everyday life, touched here and there with symbolism. As a matter of fact, the author of Brand and Peer Gfynt was above all things a poet. In essaying a literal and photographic transcript of reality, he was merely, as it were, trying a new set of tools. He is least himself in his most prosaic play, Pillars of Society. In its successors the poet gradually but

decisively reasserts himself, and shakes off the tram- mels of the theoretic realist. Still, there was a sufB^cient element of realism, narrowly so called, in A Doll's House, Ghosts, An Enemy of the People, and The Wild DucTc to awaken the enthusiasm of the realist party, just as the symbolists afterwards hailed with delight The Lady from the Sea, The Master Builder, and Little Eyolf.

Ibsen's early romantic plays had been known in Ger- many since 1875. In 1878 Pillars of Society, and in 1880 A Doll's House, achieved wide popularity, and held the German stage side by side with A Bankruptcy, by Bjornstjerne Bjornson (6. 1832). But these plays had little influence on the German drama. Their methods were, indeed, not essentially different from those of the French school of the Second Empire, which were then dominant in Germany as well as everywhere else. It was Ghosts (acted in Augsburg and Meiningen 1886, in Berlin 1887) that gave the impulse which, coalescing with the kindred impulse from the French Theatre Libre, was destined in the course of a few years to create a new dramatic literature in Germany. During the mid- dle decades of the century Germany had produced some dramatists of solid and even remarkable talent, such as Friedrich Hebbel (1813-1865), Heinrich Laube (1806- 1884), Karl Gutzkow (1811-1878), and Gustav Freytag (1816-1895). Even the generation which held the stage after 1870, Paul Heyse (&. 1830), Paul Lindau (p. 1839), and Adolf Wilbrandt (6. 1837), with numerous writers of light comedy and farce, such as Wichert, Blumenthal, Von Moser, L'Arronge, and Schonthan, had produced a good many works of some merit. But, in the main.

French artificiality and frivolity predominated on the German stage. In point of native talent and originality, the Austrian popular playwright Ludwig Anzengruber (1839-1889) was probably well ahead of his North Ger- man contemporaries. It was in 1889, with the estab- lishment of the Berlin Freie Biihne, that the reaction definitely set in. In Berlin, as afterwards in London, Ghosts was the first play produced on the outpost stage, but it was followed in .Berlin by a very rapid develop- ment of native talent. Less than a month after the per- formance of Ibsen's play, Gerhart Hauptmann (6. 1862) came to the front with Vbr Sonnenaufgang, an immature piece of almost unrelieved Zolaism, which he soon followed up,

however, with much more important works. In Das Friedensfest (1890) and Einsame Menschen (1891) he had transferred his allegiance from Zola to Ibsen. His true originality first manifested itself in Die Weber (1892); and since that time he has produced nine or ten plays in several different styles, but all bearing the stamp of a potent individuality. His most popular productions have been the dramatic poems Hannele and Die Ver- sunkene Glocke, the low-life comedy Der Biberpelz, and the low-life tragedy Fuhrmann Henschel. Other remark- able playwrights belonging to the Freie Biihne group are Max Halbe (&. 1866), author of Jugend and Mutter Erde, and Otto Erich Hartleben (b. 1864), author of Hanna Jagert and Rosenmontag. These yoimg men, however, so quickly gained the ear of the general public, that the need for a special " free stage " was no longer felt, and the Freie Biihne, having done its work, ceased to exist. Unlike the French Theatre Libre and the English Independent Theatre, it had been supported from the outset by the most influential critics, and had won the day almost without a battle. The productions of the new school soon made their way even into some of the subventioned theatres ; but it was the unsubven- tioned Deutsches Theater of IBerlin that most vigorously continued the tradition of the Freie Buhne. One or two playwrights of the new generation, however, did not actually belong to the Freie Biihne group. Hermann Sudermann (6. 1857) produced his first play, Die Ehre, in 1888, the year before the Freie Biihne came into exist- ence, and his most famous work, Heimat, in 1892. In him the influence of Ibsen is very clearly perceptible; while Arthur Schnitzler of Vienna, author of Liebelei, may rather be said to derive his inspiration from the Parisian " new comedy."

The promoters of the Theatre Libre had probably never heard of Ibsen when they established that institu- tion, but three years later his fame had reached France, and Les Bevenants was produced by the Theatre Libre, 29th May 1890. Within the next two or three years almost all his modern plays were acted in Paris, most of them either by the Theatre Libre or by L'CEuvre. Close upon the heels of the Ibsen influence followed another, less potent, but by no means negligible. The exquisite tragic symbolism of Maurice Maeterlinck (6. 1862) began to find numerous admirers about 1890. In 1891 his one-act play L'lntruse was acted; in 1893, PelUas et Milisande. By this time, too, the reverber- ation of the impulse which the Theatre Libre had given to the Freie Biihne began to be felt in France. In 1893

Hauptmann's Di.e Weber was acted in Paris, and, being frequently repeated, made a deep and lasting impression.

The English Theatre Libre, the Independent Theatre, opened its first season, 13th March 1891, with a perform- ance of Ghosts. This was not, however, the first introduc- tion of Ibsen to the English stage. On 7th June 1889 (six weeks after the production of TTie Profligate), A Doll's House was acted at the Novelty Theatre, and ran for three

weeks, amid a storm of critical controversy. In the same year Pillars of Society was presented in London. In 1891 and 1892 A Doll's House was frequently acted ; Rosmersholm was produced in 1891, and again in 1893 ; in May and June 1891 Hedda Oabler had a run of several weeks; and early in 1893 TJie Master Builder enjoyed a similar passing vogue. During these years, then, Ibsen was very much " in the air " in England, as well as in France and Germany. The Independent Theatre, in the meantime, under the management of Mr J. T. Grein, found but scanty material to deal with. It presented translations of Zola's Ther&se Baquin, and of A Visit, by the Danish dramatist Edward Brandes; but it brought to the front only one English author of any note, in the person of Mr George Bernard Shaw (6. 1856^, whose "didactic realistic play," Widower^ Houses, it produced in December 1892. In Erance and Germany the Eree Theatres were like artesian wells, tapping rich subterranean reservoirs which only awaited an outlet. In England it must be owned that the most industrious boring (ominous word!) produced only a meagre trickle. It appeared that all the available talent was already at the surface.

None the less is it true that the ferment of fresh energy, which between 1887 and 1893 had created a new dramatic literature both in Erance and in Germany, was distinctly felt in England as well. England did not take at all kindly to it. Eumours (some of them too well founded) of the excesses of cynical crudity perpetrated in the French tMdtres d, c6t6 established a very general prejudice against the whole movement. Nor did the productions of Ibsen's plays tend to soothe the alarmed susceptibilities of the critics and

the public. They were received with an outcry of horror and reprobation, the echoes of which have not yet died away. A great part of this clamour was due to sheer misunderstanding, but some of it, no doubt, arose from genuine and deep-seated distaste, which even perfect comprehension would have left unaltered. As for the dramatists of recognized standing, they one and all, both from policy and from conviction, adopted a hostile attitude towards Ibsen, expressing at most a theoretical respect overborne by practical dislike. To represent that they imitated him would be to misrepresent them grossly. Consciously and voluntarily they did nothing of the sort. Yet his in- fluence permeated the atmosphere. He had revealed possibilities of technical stagecraft and psychological delineation that, once realized, were not to be banished from the mind of the thoughtful playwright. They haunted him in spite of himself. Still subtler was the influence exerted over the critics and the more intelligent public. Deeply and genuinely as many of them disliked Ibsen's works, they found, when they returned to the old- fashioned play, the adapted frivolity or the home- grown sentimentalism, that this they disliked still more. On every side, then, there was an instinctive or deliberate reaching forward towards something new; and once again it was Mr Pinero who ventured the deci- sive step.

*On 27th May 1893 27*6 Second Mrs Tanqueray was pro- duced at the St James's Theatre. This is not the place for a detailed criticism of the play, or an attempt to fore- cast its ultimate status in English literature. Whether it will be acted flfty years hence is a question which the future may safely be left to answer. What here concerns us is the historical fact — questioned only by critics who have been denied a sense of proportion — that with The Second 3frs Tanqueray the English acted drama ceased to , be a merely insular product, and took rank in the literature of Europe. Here was a play which, whatever its faults, was obviously comparable with the plays of Dumas, of*

Sudermann, of Bjornson, of Echegaray. It might be better than some of these plays, worse than others ; but it stood on the same artistic level. The fact that such a play could not only be produced, but could brilliantly succeed, on the London stage gave a potent stimulus to progress. . It encouraged ambition in authors, enterprise in managers. What Hemani was to the romantic move- ment of the 'thirties, and La Dame aux CamMias to

the realistic movement of the 'flfties. The Second Mrs Tan- queray has been to the movement of the 'nineties towards the serious stage-portraiture of English social life. All the forces which we have been tracing — Eobertsonian realism of externals, the leisure for thought and experi- ment involved in vastly improved financial conditions, the substitution in Erance of a simpler, subtler technique for the outworn artifices of the Scribe school, and the electric thrill communicated to the whole theatrical life of Europe by contact with the genius of Ibsen — all these slowly converging forces coalesced to produce, in The Second Mrs Tanqueray, an epoch-marking play.

Even the critics, few but insistent, who deny all merit to The Second Mrs Tanqueray, cannot fail to be struck by what, on their theory, must seem an extraordinary coincidence : the fact that the English plays produced since 1893 have been, on an average, incomparably better than those produced before that date. Mr Pinero himself has given us five plays — The Notorious Mrs Ehhsmith, The Benefit of the Doubt, The Princess and the Butterfly, Trelawny of the " Wells," and Hie Gay Lord Quex — any one of which it would be absurd to compare with the very best of his earlier productions. Though more unequal in workmanship than The Second Mrs Tanqueray, they all show a marked advance even upon that play in originality of conception and intellectual force. In January 1893 Mr Charles Wyndham initiated a new policy at the Criterion Theatre, and produced an original play. The Bauble-Shop, by Mr Henry Arthur Jones. Though not quite without merit, it belonged very distinctly to the pre-Tanqueray order of things ; whereas in The Case of Rebellious Susan, produced in the following year at the same theatre, Mr Jones showed an almost startlingly sudden access of talent. Erom this level he has never seriously declined, and in some plays, notably in Michael and his Lost Angel (1896), in that admirable comedy The Liars (1897), and in Mrs Dane's Defence (1900), he has risen well above it. Mr Sydney Grundy has produced since 1893 by far his most important original works, I%e Gheatest of These (1896) and The Debt of Honour (1900). Mr R. C. Carton, breaking away from the somewhat laboured sentimentalism of his earlier manner, has given us since 1898 three light comedies of thoroughly original humour and of excellent literary workmanship — Lord and Lady Algy, WJieels within Wheels, and Lady Huntworth's Ex- periment. Mr Haddon Chambers, in The Tyranny of Tears

(1899) and The Awakening (1901), has produced two pl^s of a merit scarcely even foreshadowed in his earlier efforts. Moreover, a new generation of playwrights has come to the front which, if it has not as yet produced any quite masterly work, has time before it in which to fulfil its high promise. Its most notable representatives are Mr J. M. Barrie, whose Wedding Quest (1900), amid many crudities, showed real power ; Mrs Craigie (" John Oliver Hobbes "), who has produced in The Ambassador (1898) a comedy of fine accomplishment ; and Mr H. V. Esmond, who has passed from light comedy in One Summer's Day (1897) to sentimental tragedy in Gfrierson's Way (1899), and back to social comedy in The Wilderness (1901). The indubitable though too self-sufficient talent of Mr George Bernard Shaw defies classification. Passing, often in one and the same play, from serious drama to the most whimsical extravaganza, it entirely subordinates the

portrayal to the criticism of life, or in other words, to the expression of Mr Shaw's very peculiar individuality. Two of his comedies, however. Arms and the Man (1894) and The Devil's Disciple (1898), have had some success on the American stage ; and occasional performances have proved that the wit of Candida and You Never Can Tell is at least as effective in the theatre as in the pages of Plays, Pleasant and Unpleasant (1898).

It is not, of course, suggested that The Second Mrs Tanqueray was the cause of that enlargement in the aims and methods of drama which has marked the years since its production. It was rather the decisive symptom of a pre-existent tendency. Mr Pinero demonstrated to authors, managers, and the public the unreality of that superstition which declared the modern English stage foredoomed to intellectual impotence. Other playwrights have succeeded, not by imitating him, but simply by availing themselves of the extension of frontier which, at two strides, as it were, marked by The Profligate and Mrs Tanqueray, he had vindicated for his craft. These two plays constituted an " effective occupation " of ter- ritory hitherto supposed

inaccessible to the British dramatist — territory which now belongs to the public domain. To the unprejudiced observer it is manifest that the English drama of to-day stands on a totally different plane from that which it occupied twenty-five, or even fifteen, years ago. Yet it is still far from taking the place it ought to take in the intellectual life of the country. For one thing, it has still to struggle against unfortunate financial conditions, of which the most hampering is the necessity of appealing to an enormous public on pain of finding none at all. There is no middle course between a continuous run of at least three months and absolute failure. If only as offering a loophole of escape from the pressure of the long-run system, the endowed Repertory Theatre for which Professor Ward sighed in concluding, in 1877, his article Dkama in the ninth edition of this work, is as much as ever to be desiderated. Some of the limitations of the modern English drama, however, are to be traced, not to external conditions, but to a certain narrowness of outlook on the part of the authors them- selves, combined with a deficiency in what may be called, in the largest sense of the term, philosophic grasp 9f life. Most of the leading playwrights of Great Britain have served their apprenticeship either as actors or as adapters and melodramatists. They have begun at the bottom of the ladder, and have in their early years acquired techni- cal skill (some of which they have afterwards had to un- learn) to the comparative exclusion of intellectual culture. Only a few have approached the special work of the dramatist from the side of general literary accomplish- ment. Chief among the latter class stands Mr Stephen Phillips (6. 1866), who had won distinction as a poet before his Paolo and Francesca (published 1899) gave proof of his power as a dramatist. The success of his tragedy of Herod (1900) has awakened hopes of a revival of poetic drama, which have been strengthened by the almost simultaneous revival in the younger generation of actors of the power of speaking verse with smoothness and sonority.

*The American drama has during the past decade shown a progressive tendency as marked, if not quite as vigorous, as that which we have been tracing in England. Down to about 1890 the influence of France had been even more predominant in America than in England. The only American dramatist of eminence, Mr Bronson Howard (p. 1842), was a disciple, though a very able 'st^. °^^' /strong> *^* **French school. A certain stirring of native originality manifested itself during the 'eighties, when a series of***

semi-improvised farces, associ- ated with the names of two actor-managers, Harrigan and

Hart, depicted low life in New York with real observation, though in a crude and formless manner. About the same time a native style of popular melodrama began to make its appearance — a play of eonventioifal and negligible plot, which attracted by reason of one or more faithfully observed character-types, generally taken from country life. The Old Homestead, written and acted by Denman Thompson, was the most popular play of this class. Rude as it was, it distinctly fore- shadowed the subsequent course of development. The drama, indeed, has simply followed in the track of fiction. Almost every district and every city in the Union has its novelist-interpreter who faithfully studies, with more or less ability, local character-types and their environment ; and it is in similarly attaching itself to definite localities that the American drama has done its best work. Ibsen has had little or no influence in America, but the stimulus of the Theatre Libre has been felt to some extent in various experimental enterprises. It was at a sort of Free Theatre in Boston that Mr James A. Heme (d. 1901) produced in 1891 his realistic drama of modem life, Margaret Fleming, which did a great deal to awaken the interest of literary America in the theatrical movement. Mr Heme, an actor and a most accomplished stage- manager, next produced a drama of rural life in New England, Shore Acres (1892), which made an immense popular success. It was a play of the Old Homestead type, but very much more coherent and artistic. His next play, Griffith Davenport (1898), founded on a novel, was a drama of life in Virginia during the Civil War, admirable in its strength and quiet sincerity ; while in his last work, Sag Harbour (1900), Mr Heme returned to the study of rustic character, this time in Long Island. Mr Heme showed human nature in its more obvious and straightfor- ward aspects, making no attempt at psychological subtlety ; but within his own limits he was an admirable craftsman. The same preoccupation with local colour is manifest in the plays of Mr Augustus M. Thomas, a writer of genuine humour and originality. His localism announces itself in the very titles of his most popular plays — Alabama, In Mizzoura, Arizona. Mr Clyde Fitch, a young playwright of indubitable ability, has made experiments in several directions, notably in that of quasi-historical drama {Nathan Hale, Barbara Frietchie), but his

chief bent seems to be in the direction of social drama on the French model. Mr William Gillette, a very popular actor, has written several melodramas of such marked originality and power as almost to raise them to the rank of litera- ture. It must be said, however, that the financial con- ditions of the American stage are even more hostile to original drama than those which we have noted in England, while the fact that American managers have not only the French but the English stage to draw upon, tends to restrict the field open to native endeavour.

It remains to say a few words of the English literary drama, as opposed to the acted drama. The two classes are not nearly so distinct as they once were ; but plays continue to be produced from time to time which are wholly unfitted for the theatre, and others which, though they may be experimentally placed on the stage, make their appeal rather to the reading public. Concluding in 1877 his survey of the English drama, Dr Ward remarked, " The latest English dramatic poet is Tennyson." The late Poet Laureate had in his old age attempted an art which is scarcely to be mastered after the energy of youth has passed away. He continued to the last to occupy himself more or less with drama, and all his plays, except Harold, found their way to the stage. Tlie Cup and Becket, as we have seen, met with a certain success, but Tlie Promise of May (1882),

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an essay m contemporary drama, was a disastrous failure, while 2%e Falcon (1879) and The Foresters (acted by an American company in 1893) made little impression. Lord Tennyson was certainly not lacking in dramatic faculty, but he worked in an outworn form which he had no longer the strength to renovate. Mr Swinburne has continued now and then to east his creations in the dramatic mould, but it cannot be said that his dramas have attained either the vitality or the popu- larity of his lyrical poems. Mary Stuart (1881) brought his Marian trilogy to a close. In Locrine he produced a tragedy • in heroic couplets— a thing probably unat- tempted since the age of Dryden. Tlie Sisters is a tragedy of modem

date (1816), with a mediseval drama inserted by way of interlude. Rosamund, Queen of the Lombards (1899), perhaps approached more nearly than any of his former works to the concentration essential to drama. It may be doubted, however, whether his copious and ebullient style could ever really subject itself to the trammels of dramatic form. Of other dramas on the Elizabethan model, the most notable, perhaps, have been the works of two ladies who adopt the pseudonym of "Michael Field." They have writ- ten Callirrhoe (1884), Brutus UUor (1887), and many other dramas, all of which show considerable power of imagination and expression, but are burdened by a de- liberate archaism both of technique and style. Mr Alfred Austin has put forth several volumes in dror matic form, such as Savonarola (1881), Prince Lucifer (1887), and England's Barling (1896). They are laud- I able in intention and fluent m utterance. Notable ad- ditions to the purely literary drama were made by Mr Eobert Bridges in his Prometheus (1883), Nero (1885), The Feast of Bacchus (1889), and other solid plays in verse, full of science and skill, but less charming than his lyrical poems. Sir Lewis Morris made a dramatic experiment in Gycia, but has not been en- couraged to repeat it.

Poets of a younger generation have contributed some noteworthy works to the literary drama. Mr John David- son's volume of Plays contains more poetry, perhaps, than drama properly so called, but is by no means a negligible production. In his earlier efforts, such as An Unhistorical Pastoral, Mr Davidson gave himself up to luxuriant imitation of Shakespeare in his most luxuriant mood; but there is strong writing in Smith: a Tragedy (1886), and genuinely dramatic vigour in Bruce : a Chroni- cle Play (1884). Scaramouch on Naxos (1888) is a some- what too fantastic fantasy. Mr W. B. Yeats has written two plays on subjects borrowed from Irish folk-lore: Tlie Gountess Kathleen (1892) and The Land of Hearfs Desire (1894). They are tender and exquisite poems, with a real element of drama in them, and both have met with some acceptance on the stage. "John Oliver Hobbes" (Mrs Craigie) has produced in Osbem and Ursyne (1899) a tragedy of considerable merit, marred by obscurities of style. Mention has already been made of the plays of Mr Stephen Phillips, which belong no less to theatrical than to literary drama. Prom the point of view of literary history, Mr Phillips may be regarded as a rebel against the supremacy of the Elizabethan tradition in

English poetic drama. While choosing romantic subjects, he seeks to give them classic dignity, repose, and compression. He has shown a gift of dra^ matic story-telling unequalled among the poets of our time, while in his diction he has avoided at once the obscurity arising from over-conciseness and the tedium involved in redundant verbiage.

The collaboration of Eobert Louis Stevenson with Mr William Ernest Henley produced a short series of inter- esting experiments in drama, two of which. Beau Austin

(1883) and Admiral Guinea (1884), have more than a merely experimental value. The former is an emotional comedy, treating with rare distinction of touch a difficult, almost an impossible, subject; the latter is a nautical melodrama, raised by force of imagination and diction into the region of literature. It is much to be regretted that, in the later years of Stevenson's life, his health, and the absence from England which it entailed, should have kept the collaborators so much apart as to prevent the continuance of the series.

The most prolific and, it would seem, the ablest of the literary contingent---of those, that is to say, who do not approach the drama primarily through the stage-door — is Mr George Bernard Shaw, whose three volumes. Plays, Pleasant and Unpleasant, and Plays for Puritans, contain some very remarkable writing. After some insignificant and needlessly disagreeable 'prentice-pieces, Mr Shaw produced, in Mrs Warren's Profession, a drama of remarkable, though crude, power, and in Arms and the Man a brilliant comedy-extrava- ganza. The same description applies to You Never Can Tell and Captain Brassbound's Conversion; while TTie Devil's Disciple is a satiric melodrama, and Caesar and Cleo-patra a curious compound of historic drama with topical burlesque. Mr George Moore has made two experiments in drama — The Strike at Arlingford and The Bending of the Bough. The latter, with its some- what ill-digested symbolism, is a characteristic out- come of the Irish Literary Movement, to which we also owe Mr Edward Martyn's sombre but able drama, The Heather Field, and his tragic fantasy entitled Maeve. Other published plays of interest are Mr Alfred Sutro's Cave of Illusion, and Mr Gilbert Murray's Carlyon Sahib and Andromache, the latter a noteworthy

attempt to go to the very sources of Greek inspiration and treat a saga-theme in the saga spirit. (w. a.)

French Drama (since 1875). — The last twenty-five years of the 19th century witnessed an important change in the constructive methods, as well as in the moral tend- encies, of the French playwrights. The old favourites dis- appeared; new men came to the front. Various influences, some proceeding from foreign quar- arama ters, some closely connected with the evolution of national thought and manners, have been working, not very harmoniously, together, often in totally opposite directions. It would be rash, and indeed almost impossi- ble, to offer a general opinion on the French drama of this period, as no identity of moral purpose, and hardly any artistic relationship, can be traced between the leading writers; but it may be profitable to note the different experiments which have been tried, more or less success- fully, during the last quarter of a century, and the crisis through which the French theatre has been slowly and laboriously working its way towards an unknown future. Of the two leading dramatists who reigned supreme over the haute comidie in 1875, one, Emile Augier, had almost ended his career ; but the other, Alexandre Dumas, was to maintain his ascendancy for many years longer. Sardou's fertility of invention, and extraordinary clever- ness at manipulating a complicated intrigue, were also greatly admired, and much was expected from Edouard Pailleron's brilliant and — as it seemed — ^inexhaustible wit in satirizing the whims and weaknesses of high-born and highly culturedsociety. Alexandre Dumas had created and still monopolized the problem play, of which Le Demi- Monde, Le Fils Naturel, La Question d' Argent, Les Idi.es de Madame Aubray, La^emme de Claude, Monsieur Alphonse, La Visite de Noces, L'Etrang&re, Francillon, andZ)emsemay be mentioned as the most characteristic specimens. The problem play is the presentation of a particular case, with a view to a general conclusion on some important question

of human conduct. This afforded the author, who was, in his way, a moralist and a reformer, excellent opportunities for humorous discussions

and the display of that familiar eloquence which was his greatest gift and most effective faculty. Among other subjects, the social position of women had an all-powerful attraction for his mind, and many of his later plays were written with the object of placing in strong relief the remarkable inequality of the sexes, both as regards freedom of action and responsi- bility, in modem marriage. Like all the dramatists of his time, he adhered to Scribe's mode of play-writing — a mixture of the drame bourgeois, as initiated by Diderot, and the comedy of character and manners, long in vogue — from the days of Molifere, Eegnard, Destouches, and Marivaux, down to the beginning of the 19th century. In his prefaces Dumas often undertook the defence of the system which, in his estimation, was best calculated to serve the purpose of the artist, the humorist, and the moralist — a dramatist being, as he conceived, a combina- tion of the three.

Though the majority of French playgoers continued to side with him, and to cling to the time-honoured theat- rical beliefs, a few young men were beginning to murmur against the too elaborate mechanism and artificial logic. Scribe and his successors, whose plays were a combination of comedy and drama, were wont to devote the first act to a brilliant and witty presentation of personages, then to crowd the following scenes with incidents, until the action was brought to a climax about the end of the fourth act, invariably concluding, in the fifth, with an optimistic denouement, just before midnight, the time appointed by police regulations for the closing of playhouses. At the same time a more serious and far-reaching criticism was levelled at the very principles on which the conception of human life was then dependent. A new philosophy, based on scientific research, had been gradually gaining ground and penetrating the French mind. A host of bold writers had been trying, with considerable firmness and continuity of purpose, to start a new kind of fiction, writing in perfect accordance with the determinist theories of Auguste Comte, Darwin, and Taine. The long-disputed success of the Naturalistic School carried everything before it dur- ing the years 1875-1885, and its triumphant leaders were tempted to make the best of their advantage by annexing a new province and establishing a footing on the stage. In this they failed signally, either when they were assisted by professional dramatists or when left to their own re- sources. It becajne

evident that Naturalism, to be made acceptable on the stage, would have to undergo a special process of transformation and be handled in a peculiar way. M. Henry Becque succeeded in embodying the new theories in two plays, which at first met with very indif- ferent success, but were revived at a later period, and finally obtained permanent recognition in the French theatre — even with the acquiescence of the most learned critics, when they discovered, or fancied they discovered, that M. Becque's comedies agreed, in the main, with Moli^re's conception of dramatic art. In Les Corbeaux and La Parisienne the plot is very simple ; the episodes are incidents taken from ordinary life. No extraneous character is introduced to discuss moral and social theo- ries, or to acquaint us with the psychology of the real dramatis personce, or to suggest humorous observations about the progress of the dramatic action. The characters are left to tell their own tale in their own words, which are sometimes very comical, sometimes very repulsive, but purport to be always true to nature. Human will, which was the soul and mainspring of French tragedy in the 17th century, and played such a paramount part in the drame bourgeois and the haute comidie of the 19th, appears in M. Becque's plays to have fallen from its

former exalted position and to have ceased to be a free agent. It is a mere passive instrument to our inner de- sires and instincts and appetites, which, in their turn, obey natural laws. Thus, in M. Becque's comedies, as in the old Greek drama, Destiny, not man, is the chief actor, the real but unseen protagonist.

M. Becque was not a prolific writer, and when he died, in 1899, it was remarked that he had spent the last ten years of his life in comparative inactivity. But during these years his young and ardent disciples had spared no effort in putting their master's theories to the test. It had occurred to a gifted and enterprising actor-manager, named Antoine, that the time had come for trying dra- matic experiments in a continued and methodical manner. For this purpose he gathered around him a number of young authors, and produced their plays before a select audience of subscribers, who had paid in advance for their season-tickets. The entertainment was a strictly private one. In this way M. Antoine made himself independent of the censors, and at the same time was no longer

obliged to consider the requirements of the average playgoer, as is the case with ordinary managers, anxious, above all things, to secure long runs. At the Theatre Libre the most successful play was not to be performed for more than three nights.

The reform attempted was to consist in the elimination of what was contrary to nature in Dumas's and Augier's comedies : of the intrigue parallUe or underplot, of the over-numerous and improbable incidents which followed the first act and taxed the spectator's memory to the verge of fatigue ; and, lastly, of the conventional dinouement for which there was no justification. A true study of character was to take the place of Sardou's complicated fabrications and Dumas's problem plays. The authors would present the spectator with a fragment of life, but would force no conclusion upon him at the termination of the play. The reformation in histrionic art was to proceed apace. The actors and actresses of the preceding period had striven to give full effect to certain witty utterances of the author, or to preserve and to develop their own personal peculiarities or oddities. M. Antoine and his fellow-artists did their best to make the public realize, in every word and every gesture, the characteristic features and ruling passions of the men and women they were supposed to represent.

It was in the early autumn of 1887 ' that the Theatre Libre opened its doors for the first time. It struggled on for eight years amidst unfailing curiosity, but not without encountering some adverse, or even derisive, criticism from a considerable portion of the public and the press. The Theatre Libre brought under public notice such men as Courteline and George Ancey, who gave respectively, in Bonbouroche and La Dupe, specimens of a comic vein called the " comique cruel." M. Fabre, in L' Argent, approached if not surpassed his master, Henry Becque. M. Brieux, in Blanchette, gave promise of talent, which he has since in a great measure justified. In Les Fossiles and L'Envers d'une Sainte, by M. Franqois de Curel, were found evidences of dramatic vigour and concentrated energy, allied with a remarkable gift for the minute analysis of feeling. M. Antoine's activity was not exclusively confined to the efforts of the French Naturalistic School ; he included the Norwegian drama in his programme, and successively pro- duced several of Ibsen's plays. They

received a large amount of attention from the critics, the views then ex- pressed ranging from the wildest enthusiasm to the bitterest irony. Francisque Sarcey was decidedly hostile, and M. Jules Lemaitre, who ranked next to him in authority, ventured to suggest that Ibsen's ideas were nothing better than long-discarded social and literary paradoxes, borrowed from Pierre Leroux through George Sand, and returned to

the French market as novelties. It was only quite re- cently that John Gabriel BmxTcmann received a warm tribute of admiration from M. Emile Faguet, the talented successor of M. Jules Lemaitre on the Journal des Dibats. "Without entering into a close consideration of the subject, it may be affirmed that up to the year 1902 Ibsen had not yet been understood by the French pub- lic at large, though his influence could be clearly traced on thoughtful men like M. Paul Hervieu and M. Francois de Curel.

The authors of the Theatre Libre were sadly wanting in tact and patience. They went at once to extremes, and, while trying to free themselves from an obsolete form of drama, fell into a state of anarchy. If a too elaborate plot is a fault, no plot at all is an absurdity. The old school had been severely taken to task for devot- ing the first act to the delineation of character, and the delineation of character was now found to have extended over the whole play; and worse still, most of these young men seemed to find pleasure in importing a low vocabulary on to the stage; they made it their special object to place before the spectator revolting pictures of the grossest immorality. In this they were supported by a knot of noisy and unwise admirers, whose misplaced approval largely contributed towards bringing an other- wise useful and interesting undertaking into disrepute. The result was that, after the lapse of eight years, the little group collected round M. Antoine had lost in cohe- sion and spirit, that it was both less hopeful and less compact than it had been at the outset of the campaign. But some authors who had kept aloof from the movement were not slow in reaping the moral and intellectual profit of these tentative experiments. Among them must be cited M. George de

Porto-Eiche, M. Henri Lave- dan, M. Paul Hervieu, M. Maurice Donnay, and M. Jules Lemaitre. The first-named is a veteran writer, but in Amoureuse he revealed qualities unsuspected by those who witnessed his first literary efforts. M. Henri Lave- •dan, who has succeeded Henri Meilhac at the French Academy, has also inherited some of that writer's brilliant faculty for light comedy and the portrayal of the gay Parisian world of pleasure and fashion. There is no wit, no humour, in M. Paul Hervieu, nothing bright pr re- freshing in his manner. In two successive plays, Les Tenailles and La Loi de V Homme, he has made evident to all but prejudiced minds the inadequacy and injustice of the marriage laws now existing in France. It is ad- mitted by fastidious judges that the third act of Les Tenailles is a model of masterly simplicity and dramatic concentration. M. Donnay, in his play entitled Amants, has presented a fascinating love-story, which goes through all its natural phases without the addition of a single in- cident borrowed from old scenic traditions. In his more recent works he has won only partial applause. He is still a master of light, easy-going dialogue, but his style and treatment become conventional^ and constrained when he attempts drama. M. Jules Lemaitre, in his double capacity of critic and playwright, seems to have over- looked the salutary example set him by Maitre Jacques, who was both cook and coachman in the household of Har- pagon. He should have been warned against letting his two callings clash. His dramatic works may be described as successful and clever efforts in all branches of the art, from tragedy down to farce, but he has achieved no deci- sive triumph in any particular field, perhaps because his freedom of invention has been, to some extent, hampered by his critical faculties, or diverted towards the imitation of too many different lines. Alone among the authors of the Theatre Libre, M. Brieux has come to the front and secured an assured position on the regular stage. Instead of attacking the vices and follies of his times, he

has made a name by satirizing the weak points or the wrong application of certain fundamental principles by which modern institutions are supported. He mocked at universal suffrage in L' Engrenage, at art in Minages d' Artistes, at popular instruction in Blanchette, at charity in Les Bienfaiteurs, at science in L' Evasion, and, finally, at law in La Robe Rouge. Of Les Trois Filles de M. Pupont, one is an old maid with a strong

bent towards mysticism, another is a star in the demi-monde, and the third is married. Neither religion, nor free love, nor' marriage has made one of the three happy. The strange fact about M. Brieux is that he propounds his uncomfortable ideas with an incredible amount of dash and spirit.

All the plays written by the above-mentioned authors, and by those who follow in their steps, have been said to constitute the " new comedy." But one may question the advisability of applying the same name to literary works which present so little, if any, family likeness. It was tacitly agreed to remove the intricacies of the plot and the forced dinouement. But no one will trace in those plays the uniformity of moral purpose which would justify us in comprising them under the same head, as products of the same school. Then, before the Natural- istic, or half-Naturalistic, School had attained to a practi- cal result or taken a definite shape, a wave of Eomanti- cism swept over the French public, and in a measure brought back the old artistic and literary dogmas pro- pounded by Victor Hugo and the generation of 1830. Signs of- an approaching revival in French dramatic poetry have not been lacking during the last few years. The success of La Fille de Roland, by the Vicomte de Bornier, was restricted to the more cultivated classes, but the vogue of M. Jean Eichepin's Chemineau was at once general and lasting. Cyrano de Bergerac, produced in the last days of 1897, brought a worldwide reputation to its young author, M. Edmond Eostand. This play combines sparkling wit and brilliancy of imagination with delightful touches of pathos and delicate tenderness. It was assumed that M. Edmond Eostand was endowed to an extraordinary degree both with theatrical genius and the poetic faculty. L'Aiglon fell short of this too favourable judgment. It is more a dramatic poem than a real drama, and the author handles history with the same childish incompetence and inaccu- racy as Hugo did in Cromwell, in Ruy Bias, and Hernani. The persistent approbation of the public seems, however, to indicate a growing taste for poetry, even when un- supported by dramatic interest — a curious sympton among the least poetical of modern European races.

To sum up, the French, as regards the present condition of their drama, are confronted with two alternative move- ments. Naturalism, furthered

by science and philosophy, is contending , against traditions three centuries old, and seems unable to crystallize into masterly works ; while romantic drama, founded on vague and exploded theories, has become embodied in productions of real artistic beauty, which have been warmly welcomed by the general play- goer. It should nevertheless be noted that in Cyrano and L'Aiglon human will, which was the mainspring of Corneille's tragedy and Hugo's drama, tries to reassert itself, but is bafled by circumstance, and has to submit to inexorable laws. This shows that the victorious school will have to reckon with the doctrines of the defeated party, and suggests that a determinist theatre may be the ultimate outcome of a compromise. (a. fi.)

Dram men, a seaport town of Norway, partly in co. Buskerud, partly in co. Jarlsberg and Laurvik, 33 miles by rail south-west from Christiania. In 1899 it owned a mercantile fleet of somel40vessels of 88,700 tons aggregate, and its total foreign trade was valued at over one million sterling (exports, £704,100; imports, £373,750), as

against £530,000 iu 1887. The exports consist princi- pally of timber (7,000,000 cubic feet in 1898) and wood- pulp (136,250 tons), with paper, ice, and a little cobalt and nickel ore. Of these 58 per cent, of the timber and 64 per cent, of the wood-pulp go to Great Britain. The imports consist chiefly of coal (127,000 tons in 1898) from Great Britain and machinery from Germany. Population

(1876), 18,643; (1900), 23,091.

Draughts. — The last decade of the 19th century witnessed a remarkable increase in the popularity of the game of draughts (known also in the United States as "checkers"). This was the result of several causes, chief among which were the establishment of champion- ship tournaments, the institution of leagues similar to the football leagues, the insertion of " draughts columns " in several weekly newspapers, and the publication of the late James Lees's Guide to the Game of Draughts, a hand- book at

once accurate, fairly well arranged, and cheap. To these causes, and to the correspondence tournaments conducted by the editors of draughts columns, is also to be attributed the improvement which took place in the standard of play of the average player, an improvement which manifested itself both in the variety of openings played and in more accujate mid-game play.

*In January 1893 the first of the annual tournaments for the championship of Scotland was held. These tour- neys deservedly rank first among the events of ships!”””” *^® draughts year, on account of the number and ability of Scottish players and the high standard of play which they have maintained throughout the competitions. The following is a list of the winners since the competition was instituted : —*

1893. W. Bryden, Glasgow.

1894. R. Stewart, Blairadam.

1895. R. Stewart, Blairadam.

1896. R. Jordan, Edinburgh.

1897. J. Ferrie, Coatdyke.

1898. H. Freedman, Glasgow.

1899. H. Freedman, Glasgow.

1900. R. Stewart, Blairadam.

1901. R. Stewart, Blairadam.

1902. R. Stewart, Blairadam.

The series of tournaments for the championship of England commenced in 1885. The English Draughts Association now holds these competitions biennially. The following is a list of winners : —

1885. J. Smith, Spennymoor.

1891. H. Christie, Sunderland.

1892. A. Jordan, London.

1898. W. Gardner, Leeds. 1900. A. Hynd, Manchester.

Similar tournaments are held in the Australian col- onies and in New Zealand, but not in America, though the game has obtained a firm hold both in Canada and in the United States. In these countries the championship is decided by matches.

In 1894 James Eerrie of Coatdyke challenged James WyUie, the famous " Herd Laddie," for the title of Champion Draughts Player of the World, an honour which the latter had held since 1877. Eerrie won easily by thirteen games to six, but no doubt the severity of the defeat was in part due to Wyllie's advancing years. Eerrie, however, did not long retain his honours. In the Scottish tournament held in January 1896 he met Richard Jordan and was defeated by him. In conse- quence a match was arranged between them for Eerrie's title of Champion of the World, and the result was a win for Jordan by four games to three. In 1897 Jordan suc- cessfully defended his recently won title against K. Stewart, who had made a name for himself in the Scot- tish championship tournaments. The match, which was played at Edinburgh, resulted in a victory for Jordan by four wins to two. In 1900 the champion visited Boston, U.S.A., in response to a challenge from C. E. Barker, the American chainpion. The result of the contest which

ensued was a draw of two wins each, Jordan thus retain- ing his title.

In 1884 the first international match between Scotland and England took place. It resulted in so decisive a victory for the north-countrymen that the contest was not renewed until ten years later. The matches played in 1894 and 1899 also went strongly in favour of the Scotsmen, but the disparity between the teams was not so marked as in the first match, a result which may be attributed rather to improvement in the skill of the English players than to any falling off on the part of their opponents. The following are the scores in the three matches : —

1884. Scotland won by 36 games to 7. 1894. Scotland won by 29 games to 15. 1899. Scotland won Ijy 42 games to 25.

*An objection frequently urged against draughts, and especially as compared with chess, is that the game lacks scope for variety. The charge is easily dis- proved by a rough computation of the varia^ ^o o/**' tions possible at draughts. We see that the draughts first player has seven different ways in which varia- he may make his first move, and that to each ""*■ of these seven moves his opponent has seven possible replies, making in all 49 "openings." Two of these openings, however (9-14, 21-17, and 10-14, 21-17), are unsound, since white loses a piece without any compen- sating gain in position, thus reducing the number of recognized " openings " to 47. Taking the Jordan-Eerrie and Jordan-Barker match-games as the standard, the average number of moves in a game is over 60 — say 62 for convenience of calculation, — and, as may be proved by an examination of the specimen games given below, it is within the mark to say that there are, on an average, four possible variations at each point in the game after the opening is formed. In computing the latter average, moves which would obviously result in the loss of a piece without any corresponding gain in position have been neglected. To ascertain, therefore, the total number of possible moves, the number of openings must be multi- plied by 4™. The logarithm of 47 x 4" shows the expres- sion to represent a number of thirty-one digits, a number so large that the imagination utterly fails to grasp its significance.*

Players have been accustomed to consider the unlim- ited scope for variety which the game possesses as an unmixed benefit, the reason being that it tends to foster original play. There is, however, another side to the question. Suppose a player to hold such a position that he has the choice of four moves, and that his opponent may reply to each of these in four different ways. Six- teen possible positions may thus be formed, and if, as is probable, they each permit of as many continuations as the first-mentioned position, we see that the first player must examine 256 moves in order to make sure of his ground four moves ahead. The best chess and draughts players agree that, to play well, one should look ten moves ahead. Obviously, then, a player cannot possibly examine all continuations open to him, nor indeed can he do more than select a few of

the most likely, relying on his judgment of position to aid him in his choice. The drawback undoubtedly exists in both chess and draughts, but of course it applies, in theory at least, with greater force to the former game, from the fact that an average chess position will give more possible continuations than a similar position at draughts.

Draughts-players claim, among minor considerations, that their game possesses, for the busy man, an advantage over chess in that a good game — say one worthy of publication — occupies less time than a similar game at

chess. This is probably the case ; but on the other hand, it must be pointed out that chess is the more picturesque in appearance ; and this is a fact the value of which should not be underestimated in considering the game's claim, to popular favour or its desirability as a pastime.

Both games, played in moderation, undoubtedly assist the mind towards a habit of concentrated and consecutive thought, coupled with carefulness in matters of detail | both games allow almost unlimited scope for brilliant and critical combinations. It is worthy of note, perhaps, that while so far the bulk of draughts-players have been members of the working and lower middle classes, the majority of chess-players have been drawn from the middle and upper classes.

The calculations given aboTO as to the variation possible at draughts will convince most inquirers that no player, however expert at the game, could claim to know the replies to every possible move. Were further proof necessary, one might find it in the fact that more than one-third of the games played in the Scottish Champion- ship Tournament of 1901 resulted in wins; and this proportion is not affected even if the games of the first round, in which less able players were more likely to be engaged, be omitted.

In different districts and at different times the greatest diversity of opinion has existed regarding the relative strength of the various openings. It used to he generally held that for the black side 11-15 was considerably superior to any other opening move. Towards the end of the 19th century this view became much modified, and though 11-15 still remained the favourite, It was recognized that 10-15, 9-14, and 11-16 were little. If at all, inferior ; 10-14 and 12-16 were rightly rated as somewhat weaker than the four moves named above, whilst 9-13, the favourite of the "unscientific" player, was found to be weakest of all.

The white replies to 11-15 have gone through many vicissitudes. The seven possible moves have each at different times figured as the gen- eral favourite. Thus 24-19, which

more thorough analysis proved to be the weakest of the seven, was at one period described by the title of " Wyllle's Invincible." In course of time it came to be regarded as decidedly weak, and doubts began to be entertained as to whether the opening even admitted of a draw for white, its name being, in consequence, dropped for the less pretentious title of " Second Double Comer." In the Scottish Tournament of 1894 the opening was played between Eerrie and Stewart, and the latter won the game with white. The new play then introduced has stood the test of analysis, and the opening now ranks as but little Inferior to those formed by the other possible replies, its main drawback consisting in the lack of scope for varla^ tions favourable to the player of the white pieces. The 21-17 reply to 11-15 was introduced by "Wyllie, who was so successful with it that it became known as the " Switcher." The opening is perhaps lacking in the solid strength of some of the others, but it so abounds in traps as to be well worthy of Its name. The other five replies to 11-15, namely, 24-20, 23-19, 23-18, 22-18, and 22-17, are productive of games which are generally held to give equal chances to both sides.

The favourite replies to 10-15 are 23-18, 22-18, and 21-17, but they do not appear to be appreciably stronger than the others, with the possible exception of 24-20.

In response to 11-16, 23-18 Is held to give white a trifling advantage, but it is more apparent than real. With the exception of 23-19, which is weak,

the other replies are of equal strength, and are only slightly, if at all, inferior to the more popular 23-18. Against 10-14 the most popular move is 22-17, which gives white an advantage. .Next in strength come 22-18 and 24-19. 23-18 is weak.

The strongest reply to 12-16 is 24-20. The others, except 23-19, which is weak, give no initial advantage to either side.

As already mentioned, 9-13 is black's weakest opening move, both 22-18 and 24-19 giving, white a distinct advantage. Never- theless 9-13 is a favourite d^but with certain expert players, especially when playing with inferior opponents.

The three following games are typical examples of the play arising from three of the most frequently played openings : — Game No.l — " Ayrshire Lassie " Opening. a 11-15 25-18 10-15 22-17 6 15-18 24.- 6 a 24-20 3- 8 23-19 13-22 24-20 2- 9

8-11 26-22 6-10 26-17 18-27 17-10

28-24 5- 9 ^} 27-23 11-16 31-24 8-11

9-13 30-26 9-14 20-11 16-23 Drawn. 22-18 1-5 18-9 7-16 20-16 E. Jordan.

15-22 32-28 5-14 29-25 12-19

a. 11-15, 24-20 forms the "Ayrshire Lassie" opening, so named by Wyllie. It is generally held to admit of unvisual scope for the display of critical and brilliant combinations.

6. 16-20, 25-22, 20-27, 31-24, 8-11, 17-13, 2-6, 21-17, 14-21,

22-17, 21-25, 17-14, 10-17, 19-1. Drawn. R. Jordan.

(c)

26-23 28-19 20-16 7-11 14-10 15-10

9-14 2- 6 6-10 19-24 26-23 23-18

18- 9 20-11 16-11 11-18 10- 7 10-15

5-14 8-24 10-15 24^27 4- 8 20-16

29-25 27-20 11- 7 18-15 7- 3 15-22

11-16 10-15 14-18 27-31 8-12 16- 7

20-11 31-26 7- 3 22-18 3- 7 Drawn.

7-16 15-19 18-23 31-27 27-24 A. B. Scott

24-20 23-16 3- 7 18-14 7-11 v.

15-24 12-19 23-30 30-26 24.-20 R. Jordan.

Cd)

19-16

7-10

23-19

11-15

16-11

25-30

12-19

6- 1

15-24

27-24

18-25

20-16

22-17

9-14

28-19

22-25

17-14

Drawn.

15-22

26-23

8-11

29-22

10-17

R. Jordan

24- 6

11-15

19-16

14r-18

21-14

Game No. 2. — ” Kelso-Cross ” Opening.

a 10-15 8-12 13-22 5- 9 14^18 22-25

0 23-18 25-21 26-17 20-16 17-14 29-22

12-16 1- 6 d 19-26 2- 7 10-17 17-26

21-17 32-27 30-23 24-19 21-14 5- 1

9-13 12-16 15-22 15-24 6-10 26-30

17-14 27-23 24-19 23-19 14- 9 1-6

16-19 7-10 9-14 24-27 10-14 30-26

24-20 14- 7 19-12 31-24 19-15 5- 9

6- 9 3-10 11-15 9-13 14-17 26-23

6 27-24 c 22-17 28-24 24^20 9- 5 Drawn.

R. Jordan. a. These two moves form the ” Kelso-Cross ” opening. 6. 27-23 is also a strong line for white to adopt.

c. 30-25, 4-8, 18-14, 9-27, 22-18, 15-22, 24-15, 11-18, 20-4, 27-32, 26-17, 13-22, 4-8, 22-26, and black appears to have a winning advantage. R. Jordan.

d. Taking the piece on 18 first seems to lose, thus : — 15-22 e 9-13 13-17 6- 9 5-14

24- 8 17-14 23-18 14-10 10- 7 wTbite

4-11 10-17 17-21 9-14 2- 6 wins.

31-27 21-14 28-24 18- 9 7-2 Dallas.

e. 2-7, 27-24, 22-26, 23-18, 26-31, 18-15, 11-18, 20-2, 9-13, 2-9, 5-14, 24^19, 13-22, 30-26. White wins.

Game No. 3. — ” Dundee ” Opening.

12-16 11-15 c 8-12 4- 8 9-14 1-26

24-20 20-11 17-13 18-15 26-22 31-22

8-12 7-16 5-9 2-7 14-17 19-23

28-24 24-20 22-18 30-26 21-14 13- 9

9-14 6 16-19 15-22 10-14 18-23 12-19

22-17 23-16 25-18 29-25 27-18 9- 6

3- 8 12-19 14^23 14-18 6-10 7-11

a 26-22 20-16 27-18 32-27 15- 6 Drawn.

R. Jordan.

a. This move is the favourite at this point on account of its

" trappiness," but 25-22 is probably stronger, thus : 25-22, 16-19,

24-15, 11-25, 29-22, 8-11, 17-13, 11-16, 20-11, 7-16, and white

can with advantage continue by 27-24, 22-17, 23-19, or 22-18.

&. 15-19, 20-11, 8-15, 23-16, 12-19, 17-13, 5-9, 30-26, 4-8, 27-23, 8-12, 23-16, 12-19, 31-27, 1-5, 27-23, 19-24, 32-27, 24-31,

22-17. White wins. C. F. Barker,

c. 8-11

27-18

15-18

14-10

24-27

7-10

16- 7

15-22

14-10

19-24

31-24

27-31

2-11

25-18

6-15

10- 7

16-20

10-26

22-18

10-15

17-14

18-23

3- 7

31-22

14^23

18-14

11-16

7- 3

20-27

30-25

Drawn. R. Stewart v. R. Jordan. The problem diagrammed on next page is the simplest form of that known to draughts-players as the " Eirst Position." It is of more frequent occurrence in actual play than any other end-game,

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D R A V A — D E E D G I N G

and is, besides, typical of a class of draughts problems which may be described as analytical, in contradistinction to "strokes."

Problem No. 1, by Wm. Payne.

BLACK.

m.

WHITE.

White to move and win

.

Solution :-

—

27-32

18-15

15-11

11-15

28-32

19-24

28-24

2-28-24

12-16

19-24

27-31

“White

23-18

32-28

28-32

32-28

15-19

wins.

3-0-24-28

1-24-20

16-19

24-27

31-26

a. 12-16 same as Var.

I. at 5th move.

Var

I.

24-27

18-15

19-16

28-32

8-12

15-11

15-18

6 16-20

18-23

8-12

23-18

White

12-16

15-18

16-11

32-27

12- 8

wins.

28-32

24-19

23-19

12- 8

18-15

27-24

.32-28

11- 8

27-23

8-12

6. 24-28 same as Var. II. at 1st move.

Var. II. 12-16, 15-11, 16-19, 32-27, 28-32, 27-31, 32-28, 11-16, 19-23, 16-19. White wins.

Var. ni. 24-19, 32-28, c 19-16, 28-24, 16-11, 24-20, 11-8, 18-15. White wins.

c. 12-16, 28-32, 19-24 or 16-20, same as Var. II. at 5th or 9th moves respectively. White wins.

Problem No. 2.

BLACK.

^:;,» e*

>>ss».rT.,«»s'.Tr !^iSS „.ss>

*o»o^*

l®l

te^Hr

WHITE.

White to move and win.

The above position is a fine example of another class of problems, namely, "strokes." It is formed from the "Paisley" opening, thus : —

11-16 22-17 11-16 26-19 9-13 15-10

24-19 9-13 25-21 4- 8 25-22 a 2- 7

8-11 17-14 6- 9 29-26 7-11

28-24 10-17 23-18 13-17 19-15

16-20 21-14 16-23 31-26 12-16

a. This forms the position on the diagram. The solution is as follows : —

27-23 7-14 18- 9 14-23 26- 3

20-27 9- 6 5-14 21- 7 27-31

14- 9 1-10 23-18 3-10 3- 7

White wins. Jacques and Campbell. Becent Books on Draughts.— The most important recent works on the game are Lees's Guide to the Game of Draughts, Hill's Manual (for beginners), Kear's reprint of Sturges' and Drummond's works on the game, and Gould's Problem Book. The Encyclo- pedia of Draughts bids fair to be a most useful compilation of the best published play on each opening. The principal maga- zines devoted to the game are the Draughts World, the North American Checker Board, both monthly publications, and the Draughts Players^ Quarterly Review. (j. m. m. d.; k. j.)

Drava or Drave, one of the right-bank afluents of the Danube, 668 kilometres long. Its sources are in Tirol

*under the mountain of Eohrwald, at a height of 1670 metres, whence, after passing across Carinthia and Styria, it penetrates into Hungary, where it forms the frontier-line between the mother country and Croatisr Slavonia. From Villach it is navigable by rafts, but by steamers only from Bares downwards, to a distance of 155 kilometres. Of its confiu^ts only the Mura is con- siderable, but it receives the excess of many alpestrine ponds. The Dr^va flows into the Danube close under the town of Eszek ; at this spot it has already a breadth of 325 metres, and a depth of 6*5 metres. Because of its tortuousness from Bares downwards it is defended by strong dams ; its length is 601 kilometres, with a water- region of 47,191 square kilometres. In the escutcheon of the Kingdom of Hungary the Dr^va is represented, with the Danube, the Tisza, and the Sz£iva, as one of the largest rivers of the country.*

Dredging. — The use of dredging plant and the selection of special appliances to be used in different localities and under varying circumstances requires the exercise of sound judgment on the part of the engineer. In rivers and estuaries where the bottom is composed of light soils, and where the scour of the tide can be so guided, by training walls

or other works constructed at reasonable expense, as to keep the channel clear with- out dredging, it is manifest that dredging machinery, with its great cost for annual upkeep, should be as far as possible avoided. On the other hand, where the bottom consists of clay, rock, or other hard material, dredging must, in the first instance at any rate, be employed to deepen or widen the channel. In other instances, as in the Mississippi, a deep channel has for twenty years been maintained by jetties, with occasional resort to dredging to preserve the required channel section and to hasten its enlargement. The bar of the Mersey is 11 miles from the land, and the cost of training works would be so great as to render them impracticable ; but by a capital expendi- ture of £120,000, and an annual expense of £20,000 for three years, the depth of water over the bar at low water has been increased by dredging from 11 ft. to 27 ft., the channel being 1500 ft. wide.

The effects of dredging operations upon the trade and prosperity of a port are nowhere more forcibly shown than in the case of Glasgow. In 1755 only small vessels with a draught of 3 ft. or less could reach Glasgow at high water of spring tides. Now vessel's drawing 27 ft. come up on an ordinary tide. Formerly some of the river streets of Glasgow were often flooded; now, consequent upon the straightening, deepening, and widening of the river, flooding never occurs. In 1755 the rise of tide was only about 2 ft. 5 in. The extreme range of tide in Glasgow harbour is now 22 ft. These remarkable results have been due to the dredging carried on in the river Clyde. Between 1844 and 1897 the quantity of material dredged from the river and deposited outside its mouth was 50,721,710 cubic yards. The tonnage of goods imported and exported has risen from 1,023,216 tons in 1861 to 6,673,152 tons in 1897. Similar results have been obtained in the rivers Tyne and Tees. In the Tyne dredging amounting to 96,362,136 tons was done between 1860 and 1896, at a cost of £1,766,639 ; the average rate was 4-4 pence per ton, which, however, does not include interest upon the first cost of the dredging plant. The registered tonnage of ships clearing the port has risen from 3,120,265 tons in 1860 to 6,752,252 tons in 1896. At Eotterdam, Antwerp, Calais, Dunkirk, and Ostend equally satisfactory results have followed the dredging operations undertaken, and similar results have been obtained

by the dredging works at the Sulina mouth of the Danube. It will be seen, there- fore, that dredging operations form a most important de-

partment of civil engineering. It is proposed in this article to describe the improvements which have been made in dredgers and in dredging operations since the publication of the article in the ninth edition of this work (vol. vii., published in 1877), and to give the cost of dredging operations in various instances.

Bucket-Ladder Dredgers. — Barge-loading dredgers used form erly to be provided with two ladders, one on each side of the vessel or contained in wells formed in the vessel near each side. Two ladders were adopted, partly to permit the dredger to excavate material close to a quay or wall, and partly to enable one ladder to work while the other was being repaired. Of late years, however, bucket-ladder dredgers have generally been constructed with one central ladder working in a well, and this is the type now generally followed. Such dredgers are frequently made with the bucket ladder projecting either at the head or stern of the vessel, to enable it to cut its own way through a shoal or a bank, a construction which has been found very useful. In one modification of this method the bucket ladder is supported upon a traversing frame which slides along the fixed framing of the dredger and moves the bucket ladder forward as soon as it has been sufficiently lowered to clear the end of the well. In places where a large quantity of dredging has to be done, a stationary dredger with three or four large hopper barges proves generally to be the most economical kind of plant. It has, however, the dis- advantage of requiring large capital expenditure, while the dredger and its attendant barges take up an amount of space which is sometimes inconvenient where traffic is large and the navigable width narrow. The principal im- provements made in barge-loading dredgers have been the increase in the size of the buckets, in the strength of the dredging gear, in the application of more economical en- gines for working the machinery, and in the use of fric- tional gearing for driving the ladder-hoisting gear. It is very important that the main drive be fitted with friction blocks or clutches which shall

slip and prevent breakage in the machinery when hidden obstacles causing unusual strain come in the path of the buckets.

Up to the year 1877 dredgers were seldom made with buckets of a capacity exceeding 9 cubic ft., but since that time they have been gradually increased to 14, 16, and 18 cubic ft. capacity, while in the dredger Melbourne, constructed by Messrs William Simons & Co. to the design and specification of Messrs Coode, Son, & Matthews about the year 1886, the buckets had a capacity of 22 cubic ft., the dredger being capable of making 37 feet of water. The driving power consisted of two pairs of compound surface condensing engines, each of 250 I.H.P., having cylinders 20 in. and 40 in. in diameter respectively, with a 30-in. stroke, the boiler pressure being 90 lb per square inch. The vessel was 200 ft. long by 36 ft. wide and 11 ft. 6 in. deep, and was driven by twin-screw propellers. The gearing was arranged so that either pair of engines could be employed for dredging. The speed under steam was 7 knots, and in free-getting material 800 tons per hour could be dredged with ease. On one occasion the dredger loaded 400 tons in 20 minutes. The speed of the bucket chain was 83 lineal ft. per min- ute. The draught of the dredger in working trim was 7 ft. forward and 9 ft. aft. The efficiency of the machine, or the net work done in raising materials compared with the power exerted in the cylinders, was about 25 per cent. The dredged material was delivered into barges moored alongside. Contrasting favourably with former expe- rience, the Melbourne worked for the first six months without a single breakage. She was fitted with very powerful mooring winches, a detail which is of great importance to ensure efficiency in working.

The St Austell (Fig. 1), another powerful barge-loading dredger, 195 ft. long by 35 ft. 6 in. beam by 13 ft. deep, fitted with twin- screw compound surface-condensing propelling engines of 1000 I.H.P., either set of engines being available for dredging, was con- structed for H.M. Dockyard, Devonport, by Messrs William Simons & Co. in 1896. This dredger loaded thirty-five 500-ton hopper barges in the week ended 2nd April 1898, dredging 17,500 tons of material in the working time of 29 hours 5 minutes.

An instance of a stUl larger and more powerful dredger is the Devolant, constructed by Messrs William Simons & Co. for Nico- laieff, South Russia. She is a bow well, barge-loading, bucket- ladder dredger. Length 186 ft., breadth, moulded, 36 ft., depth,

moulded, 13 ft. The bucket ladder is of suflSclent length to dredge 36 ft. below the water-level. The buckets are exceptionally large, each having a capacity of 36 cubic ft., or fully two tons weight of material, giving a lifting capacity of 1890 tons per hour. At the dredging trials 2000 tons of spoil were lifted in one hour with an expenditure of 250 I.H.P. The propelling power is supplied by one pair of compound surface-condensing marine engines of 850 I.H.P. , having two cylindrical boilers constructed for a working pressure of 120 R) per square inch. Each boiler is capable of supplying steam to either the propelling or the dredging machinery, thus al- lowing the vessel always to have a boiler in reserve. On the trials a speed of 8 J knots was obtained. The bucket ladder, which weighs over 100 tons, exclusive of dredgings, is raised and lowered by a set of independent engines. Por manoeuvring, powerful winches driven by independent engines are placed at the bow and stern. The vessel is fitted throughout with electric light, arc lamps being provided above the deck to enable dredging to be carried on at night. Steam steering gear, a repairing shop, a 3-ton crane, and all the latest appliances are installed on board.

The Majestic, constructed by Messrs Lobnitz & Co., is a good example of a dredger fitted with their patent rock cutters, as used on the Suez Canal. These rock cutters consist of stamps passing down through the bottom of the dredger, slightly in advance of the bucket chain, and are employed for breaking up rock in front of the bucket ladder so that it may afterwards be raised by the buckets.

In regard to the depth of water which can be made by dredging, it is interesting to note that the dredger Diver, constructed by Messrs Hunter & English for Mr Samuel Williams of London, is capable of working in 60 ft. of water. In this vessel au ingen- ious arrangement was devised by Mr Williams, by which part of the weight of the dredger was balanced while the ladder itself could be drawn up through the bucket well and placed upon the deck, enabling a long ladder to be used with a

comparatively short vessel. The Tilbury dredger, constructed by the same firm, is able to dredge to a depth of 45 ft. below the surface of the water.

Hopper Dredgers. — In places, where barge – loading dredgers are inconvenient, owing to confined space and interference with the navigation, and where it is further necessary to curtail capital expenditure, hopper dredgers are convenient and economical. The vessel for this type of dredger is made of sufficient length and floating capacity to contain its own dredgings, which it carries out to the depositing ground as soon as its hopper is full. Consider- able time is of course occupied in slipping and recovering moorings and in conveying material to the depositing ground, but these disadvantages are in many instances counterbalanced by the fact that less capital is required for plant and that less room is taken up by the dredger. If the depositing ground is far away, the time available for dredging is much curtailed, but the four-screw hopper dredger constructed by Messrs W. Simons & Co. for Bristol has done good work at the cost of 6d. per ton, including wages, repairs, coals, grease, sundries, and interest on the first cost of the plant, notwithstanding that the material has to be taken 10 miles from the Bristol docks. It can lift 400 tons of stifE clay per hour from a depth of 36 ft. below the water-line, and the power required varies from 120 I.H.P. to 150 I.H.P., according to the nature of the material. The speed is 9 knots, and four propellers were provided, two at the head and two at the stern, to enable the vessel to steam equally well either way, as the river Avon is too narrow to permit her to be turned round.

The largest bucket hopper dredger in the world is La Puissante (Fig. 2), constructed by Messrs William Simons & Co. Ltd. for the Suez Canal Company, for the improvement of Port Said" roads. It is 275 ft. long by 47 ft. beam by 19 ft. deep. The hopper capacity is 2000 tons, and the draught loaded 16 ft. 5 ins. The maximum dredging depth is 40 ft. and the minimum dredging depth is only limited by the vessel's draught, it being able to cut its own way. The bucket ladder working through the well in the stem weighs, with buckets, 120 tons. The buckets each have a capacity of 30 cubic ft., and raised on trial 1600 tons per hour. The dredger is propelled by two sets of independent triple-expansion surface- condensing engines of a combined indicated horse-power of 1800, working with steam

at 160 K) pressure, supplied by two mild steel multitubular boilers. Each set of engines is capable of driving the buckets independently at speeds of sixteen and twenty buckets per minute. The bucket ladder is fitted with buffer springs at its upper end to lessen the shock when working in a sea-way. The

dredger can deliver the dredged material either into its own hopper or into barges lying on either side. The vessel attained a speed of 9 J knots per hour on trial. The coal consumption during six hours steaming trial was 1-66 tb per I.H.P. per hour.

Dredgers fitted with Long Shoot or Shore Delivering Apparatus. — The first instance of dredgers being fitted with long shoots was in the Suez Canal. The soil in the lakes was very variable, the surface being generally loose mud which lay in some places on sand, but frequently on more or less hard clay. Mr Lavalley employed shoots 230 ft. long, supported on pontoons connected with the hull of the dredger. The sand flowed away with a moderate supply of water to the shoots when they were fixed at an inclination of about 1 in 20, but when the sand was mixed ■with shells, these formed a coating which prevented the stream of water from washing out the shoot, and even with an inclination of 1 in 10 the material could not be delivered. A pair of endless chains working down the long shoot overcame the difficulty, and also enabled hard clay in lumps to be dealt with. One dredger turned out about 2000 cubic yards of thick clay in 15 hours, and when the clay was not hard it could deliver 150,000 cubic yards in a month for several consecutive months.

A dredger (Fig. 3) constructed by Messrs Hunter & English for reclamation works on Lake Copais in Greece was fitted with delivery belts running on rollers in steel lattice frames on each side of the vessel, supported by masts and ropes. It could deliver 100 cubic metres per hour at 85 ft. from the centre of the dredger, at a cost of 1 •82d. per cubic metre

for working expenses, with coal at 45s. per ton, including 0-66d. per cubic metre for renewal of belts, upon which the wear and tear was heavy.

Another instance of the successful application of shore-delivery apparatus is that of a dredger for Lake Titicaca, Peru, which was fiitted with long shoots on both sides, conveying the dredged material about 100 ft. fropa the centre of the dredger upon either side. The shoots were supported by shear-legs and ropes, and were supplied with water from a centrifugal pump in the engine-room. This dredger could excavate and deliver 120 cubic yards per hour at a cost of l-725d. per cubic yard with coal costing 40s. per ton. If coal had been available at the ordinary rate in England of 20s. per ton, the cost of the dredging and delivery would have been 0-826d. per cubic yard for wages, coal, oil, &c., but not including the salary of the superintendent.

An interesting example of a shore-delivering dredger is a light- draught dredger for the Lakes of Alberpera at the mouth of the Ebro in Spain. The conditions laid down for this dredger were that it should float in 18 in. of water and deliver the dredged material at 90 ft. from the centre of its own hull. In order to meet the latter requirement, the vessel was made of steel plates \ in. thick, and longitudinal girders ran from end to end of the vessel, the upward strain of flotation being conveyed to them from the skin plating by tranverse bulkheads at short intervals. The dredger was 94 ft. long, 25 ft. wide, and 3 ft. deep, and the height of the top tumbler above the water was 25 ft. When completed it drew 17 in. of water. The dredgings were delivered by the buckets upon an endless belt, driven from the main compound surface con- densing engine, which ran over pulleys supported upon a steel lattice girder, the outer end of which rested upon an independent pontoon. This belt delivered the dredgings at 90 ft. from the centre of the dredger round an arc of 180 degrees. The dredger delivered 125 cubic yards per hour of compact clay at a cost of l-16d. per cubic yard or 0-86d. per ton for wages, coal, and stores.

Another method of delivering dredgings is that of pneumatic delivery, introduced by Mr F. E. Duckham, of the Millwall Dock Company, by which the dredgings are delivered into cylindrical tanks in the dredger, closed by air-tight doors, and are expelled by compressed air either into

the sea or through long pipes on to the land. The Millwall Dock dredger is 113 ft. long, with a beam of 17 ft. and a depth of 12 ft. The draught loaded is 8 ft. It con- tains two cylindrical tanks, having a combined capacity of 240 cubic yds. , and is fitted with compound engines of about 200 1. H. P., with a 20-in. air-compressing cylinder. The discharge pipe is 15 in. diameter by 150 yds. long. , The nozzles of the air-injection pipes must not be too small, otherwise the compressed air, instead of driving out the material, simply pierces holes through it and escapes through the discharging pipe, carrying with it all the liquid and thin material in the tanks. The cost of working the Millwall Dock dredger is given by Mr Duckham at l-75d. per cubic yard of mud lifted, conveyed, and deposited on land 450 ft. from the water- side, for working expenses only. This dredger is believed to be the first one constructed with a traversing ladder, as suggested by the late Captain Gibson when dock-master of the Millbank Docks.

Sand-Pump Dredgers. — Perhaps the most important de- velopment which has taken place in dredging during recent years has been the employment of sand-pump dredgers, which are very useful for removing sandy bars where the particular object is to remove quickly a large quantity of sand or other soft material. They are, however, apt to make large holes, and are therefore not fitted for positions where it is necessary to finish off the dredging work to a uniform flat bottom, for which purpose bucket dredgers are better adapted. Pump dredgers are, however, admir- able and economical machines for carrying out the work for which they are specially suited.

In a discussion upon Mr J. J. Webster's paper upon "Dredg- ing Appliances " at the Institution of Civil Engineers in 1886, Sir John Coode stated that he had first seen sand-pump dredgers at the mouth of the Maas in Holland. The centrfiugal pump was placed against the bulkheads in the after part of the vessel, and the sand and water were delivered into a horizontal breeches-piece leading into two pipes running along the full length of the hopper. The difficulty in preventing the sand from running overboard was en- tirely obviated by its being propelled by the pump through these pipes, the bottoms of which were perforated by a series of holes. In addition, there were a few small flap-doors fixed at intervals, by

means of which the men were able to regulate the discharge. On being tested, the craft pumped into this hopper 400 tons of sand in 22 minutes. The coamings round the well of the hoppers were constructed with a dip, and when the hopper was full the water ran over in a steady stream on either side. The proportion of sand delivered into the hopper was about 20 per cent, of the total capacity of the pump. The dredger was constructed by Messrs Smit of Kinderdijk, near Rotterdam.

In the same discussion Mr A. A. Langley, then engineer to the Great Eastern Railway Company, gave particulars of a sand pump upon the Bazin system, which had been used successfully at Lowestoft. The boat was 60 ft. long by 20 ft. wide, and the pump was 2 ft. in diameter, with a two-bladed disc. The dis- charge pipe was 12 in. in diameter. The pump raised 400 tons of sand, gravel, and stones per hour as a maximum quantity, the average quantity being about 200 tons per hour. The depth dredged was from 7 ft. to 25 ft. The pump was driven by a double-cylinder engine, having cylinders of 9 in. diameter by 10 in. stroke, and making 120 revolutions per minute. An important addition was introduced by Mr Ball in fitting the working faces of the pump with indiarubber, which was very successful and largely reduced the wear and tear. The cost of the dredging at Lowestoft was given by Mr Langley at 2d. per ton, including delivery two miles out at sea. The quantity dredged was about 200,000 tons per annum.

One of the earliest applications of pumps for dredging, made by Mr Woodford, consisted of a horizontal disc with two or more arms working in a case somewhat similar to the ordinary centrifugal pump. The disc was keyed to a vertical shaft which was driven from above by means of belts or other gear coupled to an ordinary portable engine. The pump within rested on the ground ; the suction pipe was so arranged that water was drawn in with the sand or mud, the proportions being regulated to suit the quality of the material. The discharge pipe was rectangular and carried a vertical shaft, the whole apparatus being adjustable to suit different depths of water. This arrangement was very effective, and has been used on many works. Burt and Freeman's sand pump, a modification of the Woodford pump, was used in the construction of the Amsterdam Ship Canal, for which it was designed. The excavations from

the canal had to be deposited on the banks some distance away from the dredgers, and after being raised by the ordinary bucket dredger, instead of being discharged into barges, they were led into a vertical chamber on the top side of the pump, suitable arrangements being made for regulating the delivery. The pump was 3J ft. in diameter, and made about 230 revolutions per minute. It drew up the water on the bottom side which mixed with the descending mud on the top side, and the two were discharged into a pipe 15 in. in diameter. The dis- charge pipe was a special feature of this work, and consisted of a series of wooden pipes jointed together with leathern hinges and floated on buoys from the dredger to the bank. In some cases this pipe was 300 yds. long, and discharged the material 8 ft. above the water-level. Each dredger and pump was capable of discharging an average of 1500 cubic yds. per day of 12 hours. Schmidt's sand pump is claimed to be an improvement on the Burt and Freeman pump. It consists of a revolving wheel 6 ft. in diameter, with cutters revolving under a hood which just allows the water to pass underneath. To the top side of the hood a 20- in. suction pipe of an ordinary centrifugal pump is attached. The pump is driven by two 16-in. by 20-in. cylinders, at 134 revo- lutions per minute, and the cutter by two 12-in. by 12-in. cylinders, working at 120 revolutions per minute, the boiler pres-

FiK. 1.

Fi- 2.

Fig. 3. DREDGING.

Fi-. 4,

Fi- 5.

DREDGING

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sure being 95 ib per square in. This apparatus is capable of excavating sticky blue clayey mud, and will deliver the material at 500 to 650 yds.

distance. The best results are obtained when the mixture of mud and water is as 1 to 6-5. The average quantity excavated per diem by the apparatus is 1300 cubic yds., the maximum quantity being 2500 cubic yds.

Kennard's sand pump is entirely different from the pumps already described, and is a direct application of the ordinary lift pump. A vrrought-iron box has a suction pipe fitted at the bottom rising about half-way up the inside of the box ; on the top of the box is fitted the actual pump and the flat valves. The apparatus was lowerered by chains, and the pump worked from above. As soon as the box was filled with sand it was raised, the catches holding up the bottom were released, and the contents discharged into a pimt.

Sand-pump dredgers, designed and arranged by Mr Damton Hatton, were extensively used on the Amsterdam Ship Canal. A centrifugal pump with a fan 4 ft. in diameter was employed, the suction and delivery pipes, each 18 in. in diameter, being at- tached to an open v?Tought-iron framework. The machine was suspended between guides fixed to the end of the vessel, which was fitted with tackle for raising, lowering, and adjusting the machine. The vessel was fitted with a steam-engine and boiler for working and manipulating the pumps and the heavy side chains for the guidance of the dredger. The engine was 70 horse- power, and the total cost of one dredger was £8000. The number of hands required for working this sand-pump dredger was one captain, one engineer, one stoker, and four sailors. Each machine was capable of raising about 1300 tons of material per day, the engines working at 60 and the piimp at 180 revolutions per minute. The sand was delivered into barges alongside the dredger. The cost of raising the material and depositing it in barges was about Id. per ton when the sand pumps were working, but upon the year's work the cost was 2'4d. per cubic yd. for working expenses and repairs, and l-24d. per cubic yd. for interest and depreciation at 10 per cent, upon the cost of the plant, making a total cost for dredging of 3-64d. per cubic yd. The cost for transport was 3-588d. per cubic yd., making a total cost for dredging and transport of 7 •234d. per cubic yd. Dredging and transport on the same works by an ordinary bucket dredger and barges cost 8-328d.percubicyd.

Two of the largest and most successful instances of sand-pump dredgers are the Branker and the (?. B. Crow, belonging to the Mersey Dock and Harbour Board. Mr A. 6. Lyster gave par- ticulars of the work done by these dredgers in a paper read before the Engineering Congress in 1899. They are each 320 ft. long, 47 ft. wide, and 20-5 ft. deep, the draught loaded being 16 ft. They are fitted with 2 centrifugal pumps, each 6 ft. in diameter, with 36 in. suction and delivery pipes, united into a 45-in. diameter pipe, hung by a ball and socket joint in a trunnion, so as to work safely in a sea-way when the waves are 10 ft. high. The suction pipe is 76 ft. long, and will dredge in 53 ft. of water. The 8 hoppers hold 3000 tons, equivalent when solid to 2000 cubic yds. ; they can be filled in three-quarters of an hour and discharged in five minutes. Mr Lyster stated that up to May 1899 the quantity removed from bar and main-channel shoals amounted to 41,240,360 tons, giving a width of channel of 1500 ft. through the bar, with a minimum depth of 27 ft. The cost of dredging on the bar by the (?. B. Crow during 1898, when 4,309,350 tons of material were removed, was 0-61d. per ton for wages, supplies, and repairs. These figures include all direct . working costs and a proportion of the charge for actual superin- tendence, but no allowance for interest on capital cost or for depreci- ation. On an average, 20 per cent, of the sand and mud that are raised escapes over the side of the vessel. Mr Lyster has, however, to a considerable extent overcome this difficulty by a special arrange- ment added to the hoppers. (See Proc. Inst. C. E. vol. oxxxviii.)

Another powerful and successful sand-pump dredger is the twin-screw dredger Kate (see Fig. 4), built in 1897 by Messrs William Simons & Co. Limited for the East London Harbour Board, South Africa. Its dimensions are: length 200 ft., breadth 39 ft., depth 14 ft. 6 in., hopper capacity 1000 tons. The pumping arrangements for filling the hopper with sand or discharging overboard consist of two centrifugal pumps, each driven from one of the propelling engines. The suction pipes are each 27 in. in diameter, and are so arranged that they may be used for pumping either forward or aft, as the state of the weather may require. Four steam cranes are provided for manipu- lating the suction pipes. Owing to the exceptional weather with which the vessel has to contend, special precautions were taken in designing the attachments of the suction pipes to the vessel. The attachment is above deck, and consists of a series of

joints, which give a perfectly free and universal movement to the upper ends of the pipes. The joints, on each side of the vessel, are attached to a carriage, which is traversed laterally by hydraulic gear. By this means the pipes are pushed out well clear of the vessel's sides when pumping, and brought inboard when not at work. Hydraulic cushioning cylinders are provided to give any required resistance

to the fore and aft movements of the pipes. When the vessel arrived at East London on the 18th July 1897 there was a depth of 14 ft. on the bar at high water. On 10th October, scarcely three months afterwards, there was a depth of 20 ft. on the bar at low water. Working 22 days in rough weather during the month of November 1898, the Kate raised and deposited 2J miles at sea 60,000 tons of dredgings. Her best day's work (12 hours) was on the 7th November, when she dredged and deposited 6440 tons.

A large quantity of sand-pump dredging has been carried out at Boulogne and Calais by steam hopper pump dredgers, workable when the head waves are not more than 3 ft. high and the cross waves not more than IJ ft. high. The dredgings are taken 2 miles to sea, and the price for dredging and depositing from 800,000 to 900,000 cubic metres in 5 or 6 years was 7-25d. per cubic yard. The contractor offered to do the work at 4-625d. per cubic yard on condition of being allowed to work either at Calais or Boulogne, as the weather might permit. Sand-pump dredging has also been extensively carried out at the mouth of the ports of Amsterdam, Rotterdam, and on the north coast of France by sand dredgers constructed by Messrs L. Smit & Son and G. & K. Smit. The largest dredger, the Amsterdam, is 141 ft. by 27 ft. by 10 ft. 8 in., and has engines of 190 LH.P. The hopper capacity is 10,600 cubic ft., and the vessel can carry 600 tons of dredgings. The pump fan is 6 ft. 3 in. in diameter by 10 in. wide, the plates being of wrought-iron, and makes 130 revolutions a minute. The pump can raise 230 cubic ft. a minute from a depth of 33 ft., which, taking the proportion of 1 of sand to 7 of water, gives a delivery of 29 cubic ft. of sand per minute. The hopper, containing 10,600 cubic ft., was under favourable circumstances filled in 40 minutes. The vessels are excellent sea boats.

Combined Bucket-Ladder and Sand-Pump Dredgers. — Eecently bucket ladders and sand pumps have both been fitted to the same dredger. A successful example of this practice is furnished by the hopper dredger Percy Sanderson (see Fig. 5), constructed under the direction of Sir Charles L. Hartley, engineer of the Danube Com- mission for the deepening of the river Danube and the Sulina bar. This dredger is 220 ft. by 40 ft. by 17 ft. 2 in., and has a hopper capacity for 1260 tons of dredgings. The buckets have each a capacity of 25 cubic ft., and are able to raise 1000 tons of ordinary material per hour. The suction pump, which is driven by an independent set of triple-expansion engines, is caipable of raising 700 tons of sand per hour, and of dredging to a depth of 35 ft. below the water-line. The lower end of the suction pipe is con- trolled by special steam appliances by which the pipe can be brought entirely inboard. The Percy Sanderson raises and deposits on an average 5000 tons of material per day.

Hopper Barges.— ^Wheie dredging operations on a large scale are being carried out, steam hopper barges are generally employed. Good examples of these vessels are the two steam hopper barges built for the Conservators of the river Thames in 1898. Their dimensions are : length 190 ft., breadth 30 ft., depth 15 ft. 3 in., hopper capacity 900 tons. They are propelled by a set of triple- expansion engines of 1200 1.H.P., with two return tubular boilers having a working pressure of 160 ft. Special appliances are provided to work the hopper doors by steam power from independent engines placed at the forward end of the hopper. A steam windlass is provided forward and a steam capstan aft. The vessels are fitted with cabins for the officers and crew. On their trial trip, the hoppers having their full load, a speed of 11 knots was attained, the coal consumption being 1-44 ft per I.H.P.

Oralis. — Various kinds of apparatus have been designed in the shape of grabs or buckets for dredging purposes. These are usually worked by a steam crane, which lets the open grab down to the surface of the ground to be excavated and then closes it by a chain which forces the tines into the ground ; the grab is then raised by the crane, which deposits the contents either into the hopper of the vessel upon which the crane is fixed or into another barge.

The Priestman grab has perhaps been more extensively used than any other apparatus of this sort. It is very useful for excavating mud, gravel, and soft sand, but is less effective with hard sand or stiff clay, which is a general defect in this class of dredger. It is

also capable of lifting large loose pieces of rock weighing from one to two tons. A dredger of this type, with grab holding one ton of mud, dredged during six days, in 19 ft. of water, an average of 52J tons and a maximum of 68J tons per hour, and during 12 days, in 16 ft. of water, an average of 48 tons and a maximum of 58 tons per hour, at a cost of l-63d. per ton, excluding interest on the capital and depreciation. The largest dredger to which this apparatus has been applied is the grab bucket hopper dredger Miles K. Burton (see Pig. 6), belonging to the Mersey Docks and Harbour Board. It is equipped with five grabs on Morgan's patent system, which is a modification of Priestman's, the grabs being worked by five hydraulic cranes. It raised and deposited, 12 to 15 miles out at sea, 11 loads of about 1450 tons each with a double shift of hands, at a cost of about l-5d. per cubic yard of spoil, including the working expenses for wages of crew, fuel, and stores. Mr Marillier of Hull has stated that "the efficiency of these grabs is not at all dependent upon the force of the blow in falling for the penetration and grip in the material, as they do their work very satisfactorily even when lowered quite gently on to the material to be cut out, the jaws being so framed as to draw down and penetrate the material as soon as the upward strain is put on the lifting chain. Even in hard material the jaws penetrate so thoroughly as to cause the bucket to be well filled. The grab is found to work successfully in excavating hard clay from its natural bed on dry land." It is claimed on behalf of grabs that they lift a smaller proportion of water than any other class of dredger.

Wild's single chain half-tine grab works entirely with a single chain, and has been found very useful in excavating the cylinders in Castries harbour. Upon experimenting with an ordinary grab a rather curious condition of things was observed with respect to sinking. On penetrating the soil to a certain depth the ground was found, as it were, nested, and

nothing would induce the grab to sink lower. Mr Matthews suggested that an additional set of external tines might possibly get over this difficulty. A new grab having been made with this modification, and also with a large increase of weight — all the parts being steel — it descended to any required depth with ease, the outside tines loosening the ground effectually, whilst the inside bucket or tines picked up the material.

Miscellaneous Appliances. — Under this head may be classed several machines or appliances ■which perhaps can hardly be called dredgers, although they are used for cleansing and deepening rivers and harbours.

Kingsf oot's dredger, used for cleansing the river Stour, consisted of a boat with a broad rake fitted to the bow, capable of adjust- ment to different depths. At the sides of the boat were hinged two wings of the same depth as the rake and in a line with it. When the rake was dropped to the bottom of the river and the wings extended to the side, they formed a sort of temporary dam, and the water began to rise gradually. As soon as a sufficient head was raised, varying from 6 to 12 in., the whole machine was driven forward by the pressure, and the rake carried the mud along with it. A progress of about 3 miles an hour was made in this manner, and to prevent the accumulation of the dredgings, operations were begun at the mouth of the river and carried on backwards. The apparatus was very effective and the river was cleansed thoroughly, but the distance travelled by the dredger must have been great.

In 1876 J. J. Rietschoten designed a " propeller dredger " for removing the shoals of the river Maas. It consisted of an old gun- boat fitted with a pair of trussed beams — one at each side — each of which carried a steel shaft and was capable of being lowered or raised by means of a crab. An ordinary propeller 3 ft. 6 in. in diameter was fixed to the lower end of each shaft, and driven by bevel-gear from a cross shaft which derived its motion by belting from the fly-wheel of a 12 H.P. portable engine. The propellers were lowered until they nearly reached the shoals, and were then worked at 150 revolutions per minute. This operation scoured away the shoal effectively, for in about 40 minutes it had been lowered about 3 ft. for a space 150 yards long by 8 yards wide.

Mr Lavalley in 1877 designed an arrangement for the harbour of Dunkirk to overcome the difficulty of working an ordinary bucket- ladder dredger when there is even a small swell. A pump injects water into the sand down a pipe terminating in three nozzles to stir up the sand, and another centrifugal pump draws up the mixed sand and water and discharges it into a hopper, the pumps and all machinery being on board the hopper. To allow for the rising and falling of the vessel — either by the action of the tide or by the swell — the ends of the pipes are made flexible. The hopper has a capacity of 190 cubic yards, and is propelled and the pumps worked by an engine of 150 I. H.P. From 50 to 80 cubic yards per hour can be raised by this dredger.

The " Aquamotrice," designed by Mr Popie and used on the Garonne at Agen, appears to be a modification of the old bag and spoon arrangement. A fiat-bottomed boat 51 J ft. long by 6 J ft. wide was fitted at the bow with paddles, which were actuated by the tide. Connected with the paddles was a long chain, passing

over a pulley' on uprights and under a roller, and a beam was attached to the chain 14 ft. 8 in. long, passing through a hole in the deck. At the end of the beam was an iron scoop 2 ft. wide and 2 ft. 6 in. deep. When the tide was strong enough it drew the scoop along by means of the paddles and chains, and the scoop when filled was discharged by means of a lever opening it. About 65 cubic yards of gravel can be raised by the apparatus in 12 hours. When the tide failed, the apparatus was worked by men.

The Danube Steam Navigation Co. removed the shingle in the shallow parts of the river by means of a triangular rake with wrought-iron sides 18 ft. long, and fitted with 34 teeth of chilled cast-iron 12 in. deep. This rake was hung from the bow of a steamer 180 ft. long by 21 ft. beam, and dragged across the shallows, increasing the depth of water in one instance from 5 ft. 6 in. to 9 ft., after passing over the bank 365 times.

A combination of a harrow and high-pressure water jets, arranged by Mr Tydeman, was found very efficacious in removing a large quantity of mud which accumulated in the Tilbury Dock basin, which has an area of about 17 acres, with a depth of 26 ft. at low- water spring tides. In the first instance chain harrows merely were used, but the addition of the water

jets added materially to the success of the operation. The system accomplished in six tides more than was done in twelve tides without their aid. The water jets worked at about 80 lb pressure per square in., attaining an effective pressure of about 60 lb per square in. at the bottom of the dock.

Ives's excavator consists of a long weighted spear, with a sort of large spade at the end of it. The spade is hinged at the top, and is capable of being turned at right angles to the spear by a chain attached to the end of the spear. The spade is driven into the ground and, after releasing the catch which holds it in position during its descent, it is drawn up at right angles to the spear by the chain, carrying the material along with it. Milroy's excavator is similar, but instead of having only one spade it generally has eight, united to the periphery of an octagonal iron frame fixed to a central vertical rod. When these eight spades are drawn up by means of chains, they form one flat table or tray at right angles to the central rod. In operation the spades hang vertically, and are dropped into the material to be excavated ; the chains are then drawij up, and the table thus formed holds the material on the top, which is lifted and discharged by releasing the spade. This apparatus has been extensively used both in this country and in India for excavating in bridge cylinders.

The clam-shell dredger consists of two hinged buckets, which, when closed, form one semi-cylindrical bucket. The buckets are held open by chains attached to the top of a crosshead, and the machine is dropped on to the top of the material to be dredged. The chains holding the buckets open are then released, whUe the spears are held firmly in position, the buckets being closed by another chain. Bull's dredger, Gatmell's excavator, and Fouracres's dredger are modifications with improvements of the clam-shell dredger, and have all been used successfully upon various works.

Bruce and Bathe's dredger, when closed, is of hemispherical form, the bucket being composed of three or four blades. It can be worked either by a single chain or by means of a spear, the latter being generally used for stiff material. The advantage of this form of dredger bucket is that the steel points of the blades are well adapted for penetrating hard material.

Messrs Bruce and Batho have also designed a novel dredger consisting of one of these buckets, but worked entirely by hydraulic power. This was made for working on the Tyne. The excavator or dredger is fixed to the end of a beam which is actuated by two hydraulic cylinders, one being used for raising the bucket and the other for lowering it ; the hydraulic power is supplied by the pumps in the engine- room. The novelty m the design is the ingenious way in which the lever in ascending draws the shoot under the bucket to receive its contents, and draws it away again as the bucket descends. The hydraulic cylinder at the end of the beam is carried on gimballs to allow for the irregularities of the surface being dredged. The hydraulic pressure is 700 lb per square in., and the pumps are used in connexion with a steam accumulator.

An unloading apparatus was designed by Mr A. Manning for the East and West India Dock Company for unloading the dredged materials out of barges and delivering it on the marsh at the back of the bank of the river Thames at Crossness, Kent. A stage constructed of wooden piles commanded a series of barge beds, the unloading dredger running from end to end of the stage, lifting and delivering the materials on to the marsh behind the river wall at the cost of Id. per cubic yard.

Dredging combined with Blasting. — In the Encyclopaedia Britannica, vol. vii. p. 466, a description was given of blasting and dredging upon the river Tees. This may profitably be supplemented by an account of similar operar tions in Blyth harbour (cp. Proc' Inst. C E. vol. Ixxxi. p. 302). Here it became necessary to provide extensive deep-water berths, and the site determined upon was on

the south side of Blyth, about a mile from the harbour entrance. The bottom of the river at this place was formed of a large patch of rock, which had long been a serious obstruction to dredging operations, and which it was necessary to remove in order to provide the required depth. The rock was 700 ft. long by 139 ft. 6 in. at its widest part, a width of 86 ft. being dry at low water of spring tides. The material consisted of yellow

sand- stone, rocky shale, and clay, lying in horizontal beds ; there was also a considerable proportion of very hard quartzite in the form of large boulders and irregular beds. The shoal was of very irregular character and the clay layers were the worst feature, as they rendered effective blasting difficult.

The means employed were, first, boring and blasting ; secondly, dredging. The boring was effected by hand labour, from rafts 25 ft. by 13 ft., made of yellow pine logs decked over with plank- ing. The bore-holes were 2J in. diameter. The drills were chisel- pointed, 2J 'in. broad, the shanks being IJ in. diameter. Boring tubes 3 in. diameter were firmly driven into the ground after the raft was moored, and drills were worked within them. The tubes prevented the sand from getting into the bore-holes, and enabled cartridges to be rammed home without the aid of a diver. Four men were required at each drill. The average speed of boring was about 3 lin. ft. per hour, and the cost for labour was Is. per lin. ft. At first the work was carried on as tide-work, but after- wards by day-work irrespective of the tide, which was found to be cheaper. It was originally intended to do the operation in one lift, but the dredger was not powerful enough, so the operation was effected in two lifts, the first 9 ft. deep and the second to the finished depth of 15 ft. below water at spring tides.

The bore-holes were arranged in diagonal squares of 6 ft. 3 in., the upper series being bored to 9 ft. 10 in. and the lower to 15 ft. 6 in. below low water. The blasting charges were contained in water-tight tin oases 2 in. diameter, closed at the top with wood plugs 2 in. deep. Bickford's double-coated gutta-percha fuzes and Nobel's detonators were used, and there were few misfires, except in frosty weather, when the dynamite was liable to burn. No tamping material was employed. After blasting, the material was removed by dredging, the greater portion being loaded into hopper barges and deposited about three miles from the site of the works. The dredger employed belonged to the harbour authorities, and was 100 ft. long by 25 ft. beam by 10 ft. deep. Thirty-two buckets and claws, capable of dredging 90 tons per hour of soft sand and mud from a depth of 23 ft., excavated only 6 tons of rock per hour. The buckets had a capacity of 2-82 ft. and weighed 6 cwt. The hoppers were each of 120 tons capacity. The Priest- man grab was occasionally used, and was found effective for

lifting large loose pieces of rook up to 2 tons in weight. When the blocks exceeded this weight, they were lifted by a floating steam crane in conjunction with a diver. Dredging was carried on both by day and night, two crews working alternately in twelve-hour shifts. Small ridges and patches about 12 in. high, missed by the dredger, were removed by a diver with pick and bar. In this way 24,500 cubic yds. of rock, with a large quantity of mud and sand, were removed ; 4500 2J in. holes were fired ; and after deducting the gunpowder which was not eflcacious, 11,820 lb of explosives, principally nitro-glycerine compounds, were used, being 0-482 Tb of explosives per cubic yard. The cost of the explosives per cubic yard was Is. 4d., of boring Is. 9d. per cubic yard, and of dredging 3s. per cubic yard, including repairs, but nothing for the use of plant. The whole cost worked out to 6s. Id. per cubic yard on the average.

Dredging in the River Scheldt below Antwerp. — This dredging took place at Krankeloon and the Belgian Sluis under the direction of Mr L. Van Gansberghe. At Melsele there is a pronounced bend in the river, causing a bar at the Pass of Port Philip, and just below the Pass of Lillo there is a cross-over in the current, making a neutral point and forming a shoal. After dredging to 8 metres (26-24 ft.) below low tide, in clay containing stone and ferruginous matter, a sandstone formation was encoun- tered, which was very compact and very difficult to raise. A suction dredger being unsuited to the work, a bucket- ladder dredger was employed. The dredging was com- menced at Krankeloon in September 1894 and continued to the end of 1897. A depth of six metres (19-68 ft.) was excavated at first, but was afterwards increased to eight metres (26-24 ft.). The place of deposit was at first on lands acquired by the State, 2-17 miles above Kran-

keloon, and placed at the disposal of the contractor. The dredgings excavated by the bucket-ladder dredger were deposited in scows, which were towed to the front of the deposit ground and discharged by a suction pump fixed in a special boat, moored close to the bank of the river. The material brought by the suction dredger in its own hull was discharged by a plant fixed upon the dredger itself. In both instances the material was deposited at a distance of 1640 ft. from the river, the spoil bank vary- ing in depth from 6-66 ft. to 22-96 ft. The wat^er thrown out behind the dyke

with the excavated material returned to the river, after settlement, by a special discharge lock built under the dyke. Since 1896 the material was deliv- ered into an abandoned pass by means of barges with bottom hopper doors or by the suction dredger. One suction dredger and three bucket-ladder dredgers were employed upon the work, and a vessel called Scheldt I. used for discharging the material from the scows. Pour tug-boats and twenty scows were also employed.

The largest dredger, Scheldt III., was 147-63 ft. long by 22-96 ft. wide by 10-98 ft. deep, and had buckets of 21-18 cubic ft. capacity. The output per hour was 10,594 cubic ft. This dredger had also a complete installation as a suction dredger, the suction pipe being 2 ft. diameter. The fan of the centrifugal pump was 5-25 ft. diam- eter, and was driven by the motor of the bucket ladder.' The three bucket dredgers worked with head to the ebb tide. They could also work with head to the flood tide, but it took so long a time to turn them about that it was impracticable. The work was for from 13 to 14 hours a day on the ebb tide. The effective daily excavation averaged 4839 cubic yds. Each dredger was fitted with six anchors. The excavated out was 164 ft. wide by 6-56 ft. deep.. Scheldt III. was capable of lifting a mass 9-84 ft. thick. The suction dredger Scheldt II. was of the multiple type, and is stated to be unique in construction. It can discharge material from a scow alongside, fill its own hopper with excavations, discharge its own load upon the bank or into a scow by different pipes provided for the purpose, and discharge its own load through hopper doors. The machinery is driven by a triple-expansion engine of 300 I.H.P. working the propeller by a clutch. Owing to the rise and fall in the tide of 23 ft., the suction pipe is fitted with spherical joints and a telescopic arrangement. The vessel is 157-5 ft. by 28-2 ft. by 12-8 ft. The diameter of the pump is 5-25 ft. The wings of the pump are curved, the surface being in the form of a cylinder parallel to the axis of rotation, the directrix of which is an arc of a circle of 2-62 ft. radius with the straight part beyond. The suction and discharge pipes are 2 ft. diameter. A centrifugal pump is provided for throwing water into the scows to liquefy the mate- rial during discharge. The dredger, which is fitted with electric lights, for work at night, is held by two anchors, to prevent lurch- ing backwards and forwards ; it can work on the fiood as well as on the ebb tide, and can excavate to a depth of 42-65 ft., the output depending upon the nature of

the material. With good material it can fill its tanks in thirty minutes. To empty the tanks by suction and discharge upon the bank over the dyke takes about fifty minutes, depending upon the height and distance to which the material requires to be delivered. The daily work has aver- aged eighteen hours, ten trips being made when the distance from the dredging ground to the point of delivery is about one mile. When the dredged material is discharged into the Scheldt, a quantity of 5886 cubic yards has been raised and deposited in a day, the mean quantity being 4700 cubic yards. When the dis- tance of transportation is increased to 2J miles, six voyages were made in a day, and the day's work amounted to 3530 cubic yards. The work was let to the contractor at the following prices : —

For excavation, transportation, and

deposit 2-17 miles in Polder of

Borgerwoort .... 4-5d. per cubic yd. For excavation, transportation, and

discharge in disused parts of the

Scheldt 2-Od. „ „

For excavation and leading into a scow l-2d. „ „

the transportation by water per

kilometre being .... -15d. „ „

For discharge of scows in the Scheldt •55d. „ „

For dredging into scows and delivering

on to the embankments in Polder

of Borgerwoort .... 2-Od. „ „

The extra price for dredging heaps of

stone found in the bed of the river

was l-75d. ,, „

The output and cost of dredging and delivering were as follows from the different dredgers : —

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DRESDEN

Geisendam — For excavating and trans- porting 6-2 miles and discharging into the Scheldt, requiring a tug and 5 scows. The work done was 1765 cubic yds. per diem . . 5-2d. per cubic yd.

Elizabeth — ^For transporting 1-55 miles and discharging into Scheldt with tug and 3 scows, 3793 cubic yds. per diem ..... 2‘4d. ,, „

Scheldt III. — Transporting 2-17 miles and discharging upon lands of Polder 1312 ft. behind the dyke, 1 tug and 5 scows, and using a suction boat for discharging over the dyke, 4839 cubic yds. per diem 4-8d. ,, „

Scheldt II. — This suction dredger exca- vated, transported 2-48 miles, and delivered upon the Polder 2943 cubic yds. per diem . . . 4-8d. „ „

The above prices are those paid to the contractor. It is esti- mated that the cost was about 2-5d. delivered on the bank and •18d. delivered into the Scheldt.

Biver Garonne.— Th& cost of dredging upon this river was given in a paper by M. H. Desprez of Paris. The mean cost of dredging, transporting, and placing upon the bank 14,271 cubic ft. was 4-626d. per cubic yd., made up as under : —

Dredging l-425d.

Transportation l-68d.

Placing on bank .... l‘3d.

Management, &o 0-22d.

Total

4-625d.

Biver Loire.— In 1897 the dredging of 1,233,670 cubic yds. with three bucket-ladder dredgers cost 2-5d. and 3.7Sd. per cubic yd. , made up as follows :—

Dredging l‘25d. per cubic yd.

Transporting for a short distance and

discharging from hoppers . . l-25d. „ „

2-5d. „ „ If discharged upon bank with floating elevator, including tow-boats, ele- vators, and barges . . . 3-75d. „ „ Transport and discharge, transporting

21J miles ■ 4-65d. „ „

With suction dredger and transportation not exceeding 21| miles, the cost was 2-25d. per cubic yard. (w. h.)*

Dresden (the name is derived from the old Slav -word Drezga^imest; Drezgajan = ioT:est-dwelleis), the capital city of the kingdom of Saxony, headquarters of the 12th German Army Corps, and the fifth largest town in the German Empire. It lies in a broad valley on both banks of the Elbe, 111 miles south from Berlin. Its delightful situation, no less than the richness of its art treasures and the educational advantages it offers, has ever made it a favourite resort of strangers, and during the last few years the numbers of foreigners who have made it their home have largely increased. Particularly is this the case with the so-called Russian, British, and American ” colonies.” Within two decades (1880-1900) Dresden almost at a bound advanced into the front ranks of German commercial and industrial towns ; but whUst gaining in prosperity, it has lost much of its picturesque mediaeval aspect. Old buildings in the heart of the Alt-stadt have been swept away, and their place occupied by modern business houses and new streets. Konig Johann- strasse has opened up the

Altmarkt to the eastern suburbs, while the Schloss-strasse has been widened, an operation involving the demolition of the famous Georgenthor. The city, in its expansion in all directions, is gradually assimilating the more distant suburbs, which through a well-arranged tramway system are now brought into easy connexion with its centre. The prospect of the Elbe and of the undulating and pine-clad hills beyond, as formerly enjoyed from the Brilhlsche Terrasse, has become some- what marred, owing to the extension of the town up the river and to the two new bridges (both east of the old

Augustus-briicke)— the Queen Carolarbriicke, 1070 ft. long, resting on a couple of pillars in the stream, built in 1892-95, and the Konig Albert-brlicke, 1037 ft. long, with four arches, each 102 ft. span, built in 1876-77. But ia spite of its having become to a certain extent modernized, it cannot be denied that, architecturally, Dresden has gained in general embellishment by the new buildings which have lately been erected. In the old town the most striking of the new edifices is the Maler-akademie. It consists of a complex of buildings, constructed from designs by Lipsius, in the Italian Eenaissance style, in the years 1890-94, and is profusely decorated with busts and medallions of famous artists, poets, and illustrious men. It contains not only the academy proper, but also the permanent exhibition of the Kunst-verein. The Albertinum, formerly the arsenal, built m 1659-63, was rebuilt in 1884-89, and fitted up as a museum of Oriental and classical antiquities, and as the depository of the state archives. There are also a bronze statue of Semper by Schilling (1891), a statue of Ludwig Eichter by Kircheisen (1898), and the Moritz monument (removed here in 1896). The royal palace has undergone a radical restoration since 1890. The Briihl Palace is about to be reconstructed; the central portion of it is destined to form part of a new Parliament House for the kingdom. An elaborate equestrian monu- ment of Konig Johann, by Schilling, unveiled in 1889, faces the Hof theater. The latter is a magnificent creation, rebuilt after the designs of Semper on the site of the theatre burnt down in 1869, and was completed by his son Manfred in 1878. The exterior and interior are sumptuously decorated. In the old town there are further the Saxon industrial art museum, ;.with a school, collection of drawings, and library attached ; the Kreuz- kirche, rebuilt after destruction by fire in 1897; the municipal museum

(antiquities, archives, coins, pictures, &c.) ; the Reformierte Kirche (1894) ; the Holy Trinity church; the Renaissance Victoria-Haus (1891-92); the Luther monument (1886), a copy of the Eietschel model at Worms; and the Dresdner Bank. In the suburbs which encircle the old town on west, south, and east there are to be noted the central railway station (1893-98), occupying the site of the old Bohmischer BaJinhof; a new station in the Neustadt, comprising the Leipziger and Schlesischer Bahnhofe, is in course of construction ; the vast premises of the municipal infirmary ; the graves of Friedrich von Schleggl and von Weber (the musician) in the Roman Catholic cemetery; the bronze statue of Korner (1871), and a bust of Gutzkow (1887) ; ia the Grosser Garten is the botanical garden, laid out in 1891, and a large exhibition building : the imposing law courts ; the Johannes Kirche, richly sculptured in the interior ; the Schilling Museum; and two ornamental fountains (Gerechtigkeit und Gansedieb). On the right bank of the Elbe stands the fine ministry of finance (1896), the war ministry, the ministry of justice, the Korner Museum, and the Japanese Palace, this last containing the roval library of 400,000 vols., 6000 MSS., and 20,000 maps. Albert-platz is adorned with two fine fountains by Diez. In this same quarter are also the Luther church (1887) and the architects' school. On the Bismarck-platz is the technical high school, which since 1870 has enjoyed the privilege of conferring the degrees of doctor of engineering, doctor of technical sciences, &c. Beyond the Neustadt, and extending for more than a mile at half height on the range of hills which form its background, lies the Albertstadt, the military quarter, consisting of an imposing line of barracks and other military build- ings, reference to which has been made in the article Barracks. Behind these stretches away the romantic pine forest — the so-called Dresdener Heide. Dresden is

the seat of very various industries, its famous breweries occupying a prominent place. Population (1885),

246,086; (1890), 276,622; (1895), 336,440; (1900),

Dreux, chief town of arrondissement, department of Eure-et-Loir, Trance, 20 milesnorth-north-west of Chartres, on railway from Paris to Granville. The manufacture of hardware and heavy iron goods has become important, as now are nurseries. There is considerable commerce in grain, fowls, and boots and shoes. The remains of Louis Philippe and his queen were brought from Wey- bridge, England, their first resting-place, in 1876, and interred in the chapel of St Louis. Population (1881),

6867 ; (1901), 9697.

Drewenz, a river of Germany. It rises south-east of Osterode in East Prussia, passes through the lake of Drewenz (7 miles long), and after a south-west course of 148 miles enters the Vistula from the right a little above Thorn. It is navigable only for rafts. Lake Drewenz is connected with Elbing (and so with the Baltic) by the navigable Elbing-Oberland Canal.

Driffield, Great, a market-town and railway sta- tion in the Buckrose parliamentary division of Yorkshire, England, 13 miles north of Beverley. All Saints’ Church has been restored, and a Eoman Catholic church, a Wes- leyan Methodist chapel, and a new court-house have been erected. There are oil-cake works. Area of township (an urban district), 4998 acres. Population (1881), 6939 ; (1901), 5765. Area of ecclesiastical parish, 7699 acres. Population (1881), 6323 ; (1901), 6036.

Drogheda, a seaport in the county of Louth, Ireland, on the river Boyne and the Great Northern railway, 31^ miles north of Dublin. It ceased to be a parliamentary borough in 1885, and a separate county in 1898, but it retains its mayor and corporation, which, however, has now practically the status of an urban district council. Steamers maintain almost daily com- munication with Liverpool, carrying chiefly agricultural produce of various kinds. In 1899, 454 vessels of 99,441 tons entered and 346 of 105,658 tons cleared. There are valuable salmon fisheries on the Boyne, which in 1899 gave employment to 711 persons. Population (1881), 12,297; (1901), 12,765. The area of the borough was extended in 1896, increasing the population by about

1500.

Drohobycz, a town in Galicia, Austria. Popular tion (1890), 17,916 (6200 German, 4500 Euthenians, the remainder Poles ; the Jews number 8700) ; in 1900, 19,146. The principal industries are the production of salt (from the local brine wells), naphtha, and oil. Also con- siderable trade in cattle, corn, earthenware, and petroleum.

Droitwich, a municipal borough and market-town in the. Droitwich parliamentary division (since 1885) of Worcestershire, England, 20^ miles south-west by south of Birmingham by rail. There are three parish churches. Eecent erections are a Wesleyan chapel (rebuilt), new hospital, private bath hospital, St Andrew's Baths, and a large Salters' Hall. There are a town-hall and Eoyal Brine Baths. Owing to the pumping of the brine for the salt works there is a continual subsidence of the ground detrimental to the buildings, and the houses are now mostly built in the suburbs. Area, 1856 acres. Popu- lation (1881), 3761 ; (1901), 4163.

Drome, a department in the south-east of France, traversed by the Alps of Vercors and watered by the Ehone, the Isere, and the Dr6me.

Area, 2533 square miles. The population, numbering 314,615 in 1886, decreased to 294,704 in 1901. Births in 1899, 5802, of

which 259 were illegitimate ; deaths, 6405 ; marriages, 2126. There were, in 1896, 908 schools with 44,000 pupils ; the illiterate form 3 to 4 per cent, of the population. The area under cultivation in 1896 amounted to 1,242,985 acres ; 644,968 acres arable, and 858,314 acres forest. The wheat crop in 1899 yielded a value of £1,110,000; mangel-wurzel, £103,000; potatoes, £420,000; grass lands, £190,000; olive, £21,000; mulberry, £61,000. The pro- duction of silkworm cocoons is one of the largest among those of the departments of France, amounting in 1899 to 25,320 cwts. avoir. The live-stock in 1899 included 17,290 horses, 13,850 asses, 421,000 sheep, 120,540 pigs, and 96,750 goats. Mining and metallurgy are in a backward state. The textile industry is more advanced. Valence, the capital, has 25,000 inhabitants.

Droylsden, a township and parish in the Prestwich parliamentary division of Lancashire, England, formed in 1844, in the civil parish of Manchester, 4 miles east of Manchester by rail. There are an educational institute, and a Moravian theological college. The industries comprise cotton spinning, chemical and dye works, brick- making, and iron-founding. Area of urban district, 1014 acres. Population (1881), 8687 ; (1901), 11,087.

Droysen, Johann Custav (1808-1884), Ger- man historian, was born 6th July 1808 at Treptow, Pomerania. His father was a pastor who held several cures in Pomerania, and was chaplain to a regiment of cuii-assiers, in which capacity he was present at the cele- brated siege of Kolberg in 1806-7. The young Droysen, as a child, was also witness of some of the military operar- tions during the War of Liberation, for his father was pastor of Greifenhagen, in the immediate neighbourhood of Stettin, which was held by the French during the greater part of 1813. The impressions of these early years laid the foundation of the ardent attachment to Prussia which dis- tinguished him, as so many other historians of his genera- tion. He was educated at the gymnasium of Stettin and at the University of Berlin ; in 1829 he became a master at the Graue Kloster (or Grey Friars), one of the oldest schools in Berlin ; besides his work there he gave lectures at the university, from 1833 as privat-docent, and from 1835 as Professor, without a salary. During these years he was occupied with classical antiquity ; he published a translation of ^schylus and a paraphrase of Aristophanes, but the work by which he made himself known as an his- torian was his Life of Alexander the Gfreat, published in 1832, a book which still remains probably the best work on the subject. It was in some ways the herald of anew school of German historical thought, for it shows that idealization of power and success which he had learnt from the teaching of Hegel. It was followed by other volumes dealing with the successors of Alexander, published under the title of TJie History of Hellenism. A new and revised edition of the whole work was published ta 1885 ; it has been translated into French, but not into English. In 1840 Droysen was appointed Professor of History at Kiel. He was at once attracted into the political movement for the defence of the rights of the Elbe Duchies, of which Kiel was the centre. Like his predecessor Dahlmann, he placed his historical learning

at the service of the Estates, and composed the address of 1844, ia which the Estates protested against the claim of the king of Denmark to alter the law of succession in the Duchies. In 1848 he was elected a member of the Frankfort Parliament, and acted as secretary to the committee for drawing up the Constitution. He was a determined supporter of Prussian ascendancy, and was one of the first members to retire after the king of Prussia refused the crown in 1849. During the next two years he continued to support the cause of the Duchies, and in 1850, with Carl Samwer, he published a history of the dealings of Denmark with Schleswig- Holstein, Die Herzogthumer Schleswig-Holstein und das Konigreich Ddnemark seit dem Jahre 1806, Hamburg, 1850. A translation was published in London in the same

year under the title Tlie Policy of Denmark towards the Duchies of Schleswig-Holstein. The work was one of great political importance, and had much to do with the formation of public opinion on the rights of the Duchies in their struggle with Denmark. After 1851 it was im- possible for him to remain at Kiel, and he was appointed to a professorship at Jena ; in 1869 he was called to Berlin, where he remained till his death in 1884. In his later years he was almost entirelyoccupied with Prussian history. In 1851 he brought out a life of Count Yorck v. Warten- berg, one of the best biographies in the German language, and then began his great work on the History of Prussian Policy, Berlin, 1855-86. Seven volumes were published, the last not till after his death. It forms a complete history of the growth of the Prussian monarchy down to the year 1756. This, like all Droysen's work shows a strongly marked individuality, and a great power of trac- ing the manner in which important dynamic forces worked themselves out in history. This quality also gave him great influence as a teacher. Droysen was twice married; his eldest son, Gustav, is the author of several well- known historical works ; namely, Life of Oustavus Adolphus (Leipzig, 1869-70) ; Life of Bemhard of Saxe- Weimar, London, 1886; a History of the Tliirty Tears' War in Oncken's Universal History ;

and an admirable Histori- cal Atlas. Another son, Hans Droysen, is the author of some works on Greek history and antiquities, (j. w. he.)

Drummond, Henry (1851-1897), Scottish evangeli- cal writer and lecturer, was born in Stirling on 17th August 1861. He was educated at Edinburgh University, where he displayed a strong inclination for physical and mathematical science. The religious element was an even more powerful factor in his nature, and disposed him to enter the Free Church of Scotland. While preparing for the ministry, he was for a time carried away by the evangelizing mission of Messrs Moody and Sankey, in which he actively co-operated for two years. In 1875 he became Lecturer on Natural Science in the Free Church College, which enabled him to combine all the pursuits for which he felt a vocation. His studies re- sulted in a book whose title expressed the mediating position he was called upon to occupy. Natural Law in the Spiritual World. As it was about to issue from the press (1883), a sudden invitation from the African Lakes Company drew him away to Central Africa. Upon his return in the following year he found himself famous. Large bodies of serious readers, alike among the religious and the scientific classes, discovered in Natural Law the common standing-ground which they needed ; and the uni- versality of the demand proved, if nothing more, the seasonableness of its publication. Drummond continued to be actively interested in missionary and other move- ments among the Free Church students. In 1888 he published Tropical Africa, a valuable digest of informa- tion. In 1890 he travelled in Australia, and in 1893 delivered the Lowell Lectures at Boston. It had been his intention to reserve them for mature revision, but an at- tempted piracy compelled him to hasten their publication, and they appeared in 1894 under the title of The Ascent of Man. Their object was to vindicate for altruism or the disinterested care and compassion of animals for each other, an important part in effecting "the survival of the fittest," a thesis previously maintained by Professor Fiske. Drummond's health failed shortly afterwards, and he died on 11th March, 1897. His character was full of charm. His writings are too nicely adapted to the needs of his own day to justify the expectation that they will long survive it, but few men have exer- cised more influence upon certain circles in their own generation. (b. g.)

Dublin, a maritime county of Ireland, province of Leinster, bounded on the N. by Meath, on the E. by the Irish Sea, on the W. by Kildare and Meath, and on the S. by Wicklow. The area of the administrative county in 1900 was 226,686 acres, of which 68,913 were tillage, 122,373 pasture, 502 fallow, 3986 plantation, 1194 marsh, 55 turf bog, 13,305 barren mountain, and 16,358 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, does not include the portion of the township of Bray formerly situated in Dublin. The population in 1881 was 418,910, and in 1891, 419,216, of whom 197,409 were males and 221,807 females, divided as follows among the different religions : Roman Catholics, 322,822 ; Protestant Episcopalians, 77,896 ; Presbyterians, 7724 ; Methodists, 4129 ; and other de- nominations, 6645. The increase of population between 1881 and 1891 was -07. The average number of persons to an acre (including the city of Dublin) was 1-85, being by far the largest number of any county in Ireland. Of the total population, 66,675 persons inhabited the rural districts, being an average of 241 persons to each square mile under crops and pasture. The population in 1901 was 447,266 (Roman Catholics, 348,701 ; Protestant Epis- copalians, 78,921 ; Presbyterians, 7638 ; Methodists, 4464 ; others, 7642), being an increase of 7-3 per cent. The following table gives the number of births, deaths, and marriages in various years : —

Tear.

Births.

Deaths.

Marriages.

1881 1891 1899

12,047 11,496 12,055

10,839 10,322 11,806

2987 2943 3178

In 1899 the birth-rate per 1000 was 28-9, and the death- rate 28-3 ; the rate of illegitimacy was 2-7 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1899 was 110,832, of whom 61,751 were males and 49,081 females. The county contains the following townships, which are all practically suburbs of Dublin : Rathminesand Rathgar (27,706), Pembroke (24,269), Blackrock (8401), Kilmainham (6510), Drumcondra, Clonliffe, and Glasnevin f7621), and Clontarf (5104), and the town of Kingstown (17,352), the populations given in each case being those of 1891. In 1901 the population of the urban districts of Rathmines and Rathgar, Pembroke, Blackrock, and Kings- town was respectively 32,472, 25,524, 8719, and 17,356.

Education. — The following table gives the degree of education (excluding the city of Dublin) in 1891 : —

Males.

Females.

Total.

Percentage. |

B.C.

Pr. Ep.

Pi-esb.

Read and write . Bead only . Illiterate

58,710 4,653 8,130

72,458 5,853 7,836

131,168 10,506 15,966

78-1

8-7

13-2

94-7 •

2-1 3-2

95-1 1-9 30

*The percentage of illiterates among Roman Catholics in 1881 was 17*1. Excluding the city of Dublin the number of superior schools in 1891 was 80, with 5838 pupils (Roman Catholics 2392 and Protestants 2946), and 284 primary schools with 23,891 pupils (Roman Catholics 19,478 and Protestants 4513). The number of pupils on the rolls of the national schools on 30th September 1899 was 55,405, of whom 46,256 were Roman Catholics and 9149 Protestants.*

Administration. — The county is divided into two parliamentary divisions, north and south, the number of registered electors in 1900 being respectively 12,429 and 10,762. The ratable value in 1900 (excluding the county borough of Dublin) was £859,044. By the Local Government (Ireland) Act, 1898, the fiscal and adminis- trative duties of the grand jury and (to a less extent) of other bodies were transferred to a County Council, urban and rural dis- trict councils were established, and under that Act the county now comprises 9 urban and 5 rural sanitary districts. The city of Dublin constitutes a separate county.

DUBLIN

537

Agriculture. — The following tables show the acreage under crops, including meadow and clover, and the amount of live- stoolt in 1881, 1891, 1895, and 1900. The figures for 1900 are for the new administrative county : —

i

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1

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(2

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I'd" 1^1

1

1881

6599

14,212

2282

9881

2045

8846

50,909

88,724

1891

4028

11,915

2436

8053

2816

8701

41,048

78,491

1896

2B92

12,825

2687

7459

2407

8159

44,668

74,882

1900

8056

9,887

1995

6666

2868

8705

41,241

89,113

For 1899 the total value of the cereal and other crops was esti- mated by the Registrar-General at £470,899. The number of acres under pasture in 1881 was 103,698 ; in 1891, 118,355 ; and in 1900,

122,373.

Tear.

Horses and Mules.

Asses.

Cattle.

Sheep.

Pigs.

Qoats.

Poultry,

1881 1891 1896 1900

22,600 22,502 24,560 22,492

1881 1862 1941 2056

67,688 68,516 61,684 70,865

7^443

67,365 69,578

13,460

12,794

11,096

8,988

5827 6766 4718 8619

286,018 250,093 266,801 249,147

The number of milch cows in 1891 was 17,322, and 1900, 17,748. It is estimated that the total value of cattle, sheep, and pigs in 1899 was £1,140,644. In 1900 the number of holdings not exceeding 1 acre was 2997, between 1 and 5, 1651, between 5 and 15, 1628, between 16 and 30, 911, between 30 and 50, 585, between 50 and 100, 628, between 100 and 200, 387, between 200 and 500, 138, and above 500, 13 — ^total 8938. The number of loans issued (the num- ber of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1900, was 148, amounting to £170,350. The number of loans sanctioned for agricultural improvements under sect. 31 of the Land Act, 1881, between 1882 and 1900 was 202, and the amount issued was £25,030. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations in 1847 to 31st March 1900, was £98,770.

Fisheries. — In 1899, 134 vessels, employing 546 hands, were registered in the deep sea and coast fishing district of Kingstown. In the same year 175 persons were employed in the salmon fishery district of Dublin. (w. H. Po.)

Dublin, a maritime city, county and parliamentary borough, metropolis of Ireland, on the river Liffey, 292 miles vrest-north-v^est of London. The

population in 1881 was 249,602 ; in 1891, 245,001, of whom 117,503 were males and 127,498 females, divided as follows among the different religions: Roman Catholics, 201,418; Protestant Episcopalians, 35,125; Presbyterians, 3492; Methodists, 1708 ; and other denominations, 3258. The population in 1901 was 289,108, the increase being due to the extension of the municipal area in 1900. Between 1891 and 1901 the population of the chief suburbs also increased, as will be seen from the following figures : — Eathmines and Rathgar (1891), 27,796; (1901), 32,472; Pembroke (1891), 23,992; (1901), 25,524; Blackrock (1891), 8401; (1901), 8719; Kingstovm (1891), 17,183; (1901), 17,356. Of recent years blocks of artisans' dwell- ings have been erected, some from a fund provided by the munificence of Lord Iveagh in 1889. The following table shows the standard of general education attained in 1891 : —

Males.

Females.

Total.

Percentage.

Boman Oath.

Protes. Epis.

Presby- terians.

Metho- dists.

Eead and write Bead only . . Illiterate . .

83,294

6,890

18,520

85,897 10,020 17,996

169,191 16,910 81,516

74-6

8-8

16-6

92-2 8-1 4-7

94-5 2-6 2-9

96-3 2-0 2-7

In 1881 the percentage of illiterates among Roman Catholics was 184, among Protestant Episcopalians 5-2, among Presbyterians 3-5, and among Methodists 3‘5. In 1891 there were 40 superior schools with 4024 pupils (Roman Catholics 2238, and Protestants 1786), and 197 primary schools with 26,513 pupils (Roman Catholics 21,117, and Protestants 5296). The yearly average of

births registered in the registration district (population in 1891, 349,594) between 1890 and 1899, both inclusive, was, males 5200, and females 4962, and of deaths regis- tered, males 4711, and females 4859. The number of persons proceeded against in the metropolitan police district in 1899 for indictable offences was 1256, of whom 933 were convicted or committed for trial ; for non-indictable offences, 36,195, of whom 27,752 were fined and 2785 otherwise punished. Though the number of public-houses within the same limits fell from 897 in 1896 to 888 in 1899, the charges of drunkenness (includ- ing cases where some other offence was charged) rose from 7677 in 1896 to 9277 in 1899.

Something has been done since 1880 to improve the condition of the poorer parts of the city, but only a few important changes have been effected in the outward aspect of the city. The restoration of Christchurch Cathedral was completed , in 1878. What was then known as Carlisle Bridge was rebuilt in 1880, and now under its name of O’Connell Bridge forms one of the finest structures of its kind in the United Kingdom. The

Royal University, established in 1880, is housed in the permanent building of the International Exhibition of 1865, to which many additions have been made. It possesses a fine hall, much used for concerts. In the same year St Stephen's Green, converted into a public park at the expense of Lord Ardilaun, was opened to the public ; a statue of its donor has been erected in it. Statues have also been erected of Eather Mathew, the temperance reformer, in Sackville Street, and of Surgeon- Major Parke and Sir R. P. Stewart of Leinster Lawn, Merrion Square. The most noteworthy new building is the museum and library of the Royal Dublin Society, erected at a cost of about £150,000, and opened in 1890. To it were transferred the collection of Irish antiquities belonging to the Royal Irish Academy and the old library from Leinster House. Considerable attention has been paid of late years to providing facilities for the travelling public. A loop line now connects the various railway systems, thus facilitating the transit of passen- gers and goods between the various parts of Ireland and between England and Ireland. Steam tramways are in operation between Parkgate Street and Lucan and be- tween Terenure and Blessington, and electric trams con- nect all the important suburban districts with the city.

Administration. — Dublin was formerly represented by two members of Parliament, but in 1885 the parliamentary borough, the population of which in 1901 was 286,328, was divided into four divisions. College Green, Harbour, St Stephen's Green, and St Patrick's, each returning one member. The number of registered electors in 1900 was 38,361. Dublin University, with a constituency of over 4000, returns two members. In 1898 Dublin was con- stituted a county borough, but the position and duties of its corporation were otherwise left practically unaltered. The ratable value in 1900 was £742,413, and the total receipts of the corporation in 1898 were £565,448. A new body was created in 1898 for governing the port and harbour, comprising the Lord Mayor, six members of the corporation, twelve traders' members, and nine shipping members. A scheme is on foot for reviving the ship- building industry in Dublin.

Commerce and Shipping. — By continual dredging a greater depth of water is now available in the harbour than ever before. The Custom House Docks, which cover an area of about 8 acres, have 16 feet of water

and can accommodate 40,000 tons of shipping. A basin con- structed by the Port and Docks Board was named the Alexandra Basin by the Prince and Princess of Wales in April 1885. The lighting of the harbour has also been much improved, and a fog siren placed at Poolbeg light-

house. Dublin continues to produce little for exportation except whisky and porter. Since 1895 whisky has been exported in the following quantities : —

Tears.

Butts and Punclieons.

Hogsheads.

Casks.

Quarter Casks.

1895 1896 1897 1898 1899

4521 5192 4947 4762 5092

15,519 14,696 13,398 15,401 13,955

2765 2636 3509 2621 2159

8989 9231 8181 9156 8985

The number of hogsheads of porter exported in 1895 was 379,131; in 1896, 376,199; in 1897, 377,247; in 1898, 368,628; and in 1899, 409,415. The number of horses exported to Great Britain in 1899 was 13,814; of cattle, 304,187 ; of sheep and lambs, 406,709 ; and of pigs, 327,980. The

value of British and Irish produce exported direct to foreign countries has considerably declined of late years. In 1893 it was £155,243 ; in 1896, £68,809 ; and in 1899 , £63,385. The total value of the foreign and colonial imports in 1899, which included 89,157 tons of wheat, 100,476 tons of maize, 739,549 sacks and bags of flour, and 51,653 quarters of barley, was £2,565,817. The total amount of customs duties collected at the port in the same year was £615,566, as compared with £804,214 in 1894 and £817,391 in 1890. In 1899 the harbour receipts derived from tonnage and quay wall dues on shipping amounted to £58,727. The following table shows the number of vessels in the foreign and coasting trades that entered and cleared with cargoes from the port, and the number of vessels registered from 1895 to 1899 :—

Tears.

Entered.

Cleared.

Registered. 1

Vessels.

Tonnage.

Vessels.

Tonnage.

Vessels.

Tonnage.

1896 1896 1897 1898 1899

7171 7047 7085 7174 7247

1,745,409 1,769,065 1,800,564 1,764,223 1,804,175

4484 4526 4499 4612 4549

1,170,948 1,215,806 1,213,444 1,226,111 1,220,700

329 327 822 318 317

58,657 59,877 63,456 60,916 61,667

(W. H. PO.)

Dubois, a borough of Clearfield county, Pennsyl- vania, U.S.A., at the intersection of three railways, the Allegheny Valley, the Buffalo, Rochester, and Pittsburg, and the Pennsylvania. It is in the midst of a coal-min- ing region, and its industries consist largely in handling coal. Population (1880), 2718; (1890), 6149; (1900), 9375, of whom 1655 were foreign-bom.

Dubois, Clement Francois Theodore (1837- -), Prench musical composer and director of the Paris

Conservatoire, was born at Rosnay on 24th August 1837. He studied at the Conservatoire under Ambroise Thomas, and won the Grand Prix de Rome in 1861 with a cantata entitled Atala. After the customary sojourn in Rome, Dubois returned to Paris and devoted himself to teaching. He was appointed ” maitre de Chapelle ” at the Church of Ste Clotilde, where C^sar Pranck was organist, in 1863, and remained at this post for five years, during which time he composed a quantity of sacred music, notably Les Sept Paroles du Christ (1867), a work which has become well known in Prance. In 1868 he became ” maitre de Char pelle ” at the Church of the Madeleine, and nine years later succeeded Camille Saint-Saens there as organist. He became Professor of Harmony at the Conservatoire in 1871, and was appointed Professor of Composition in suc- cession to Leo Delibes in 1891. At the death of Ambroise Thomas in 1896, he became director of the Conservatoire. Dubois is an extremely prolific composer, and has written in a variety of forms. His sacred works include four

masses, a requiem, Les Sept Paroles du Christ, a large number of motets and pieces for organ. For the theatre he has composed La Quzla de

I'^mir, an opera comique in one act, played at the Theatre Lyrique de I'Ath^nee in 1873; Le Pain Bis, an opera comique in one act, given at the Op^ra Comique in 1879 ; La Farandole, a ballet in three acts, produced at the Grand Op^ra in 1883; Abeiirllamet, a four-act opera, heard at the Theatre Italien in 1884 ; Xavi^re, a dramatic idyll in three acts, played at the Opera Comique in 1895. His orchestral works include two concert overtures, the overture to Frithioff (1880), several suites, Marche H&ro'ique de Jeanne d'Arc (1888), &c. He is also the author of Le Paradis Perdu, an orar torio which gained for him the prize offered by the City of Paris in 1878 ; L' Enlevement de Proserpine (1879), a seine lyrique ; DMivrance (1887), a cantata ; Hylas (1890), a sc^ne lyrique for soli, chorus, and orchestra. In addition, he has composed much for the piano and voice. If his musical personality is not a very marked one, M. Dubois is nevertheless a musician of lofty aims and undoubted abUity.

Dubois, Paul (1829), French sculptor and

painter, was born at Nogent-sur-Seine, 18th July 1829. He studied law to please his family and art to please himself, and finally abandoned the former in favour of the latter, and placed himself under Toussaint. For a short while a student at the ificole des Beaux Arts, M. Dubois sojourned in Rome, and by the study there of the great masters of sculptiu'e developed his eye and his feeling for form so that he well-nigh equalled the greatest in knowledge and refinement. His first contributions to the Salon (I860) were busts of "The Countess de B." and "A Child. ^' For his first statues, " St John the Baptist " and " Nar- cissus at the Bath" (1863), Dubois was awarded a medal of the second class. The statue of " The Infant St John," which had been modelled in Florence in 1860, was exhibited in Paris in bronze, and was acquired by the Luxembourg Museum. "A Florentine Singer of the Fifteenth Century," to this day one of the most popular statuettes " published " in Europe, was shown in 1865, and at once attracted great attention. " The Virgin and Child" appeared in the Paris Universal Exhibition in 1867 ; " The Birth of Eve " was produced in 1873, and was followed by striking busts of Henner, Dr Parrot, Paul Baudry, Dr Pasteur, Gounod, and Bonnat, remarkable alike for life, vivacity, likeness, refinement, and subtle handling. His chief work was " The Tomb of General Larmoriciere," a brilliant masterpiece,

conceived in the Renaissance spirit, with allegorical figures and groups representing Warlike Courage, Charity, Faith, and Medi- tation, as well as bas-reliefs and enrichments ; the two first-named works were separately exhibited in the Salon of 1877. The medallions represent Wisdom, Hope, Jus- tice, Force, Rhetoric, Prudence, and Religion. The statue of the " Constable Anne de Montmorency " was executed for Chantilly, and that of "Joan of Arc" (1889) for the town of Rheims. The Italian influence which characterizes Dubois's earlier work disappears as his own individuality became clearly asserted. As a painter M. Dubois has restricted himself mainly to portraiture, " My Children " (1876) being probably the most noteworthy. His work in painting is of a high order, admirable alike in colour, drawing, and taste. His drawings and copies after the Old Masters are also of peculiar excellence : they include "The Dead Christ" (after Sebastian del Piombo) and "Adam and Eve" (after Raphael). In 1873 M. Dubois was appointed Keeper of the Luxembourg Museum, which contains the " Infant St John " and several other works fi-om his hand. He succeeded M. Guillaume as Director of the ;^eole des Beaux Arts, 1878, and Perraud as member of the Acaddmie des Beaux Arts. Twice at the Salon he

obtained the Medal of Honour (1866 and 1876), and once at the Universal Exhibition (1878). He also won numerous other distinctions, and was appointed Grand Cross of the Legion of Honour. He is a member of several European orders, and in 1895 received the rare distinction of election as Honorary Foreign Academician of the Eoyal Academy of London.

Du Bois-Reymond, Emil (1818-1896), German physiologist, was born in Berlin on 7th November 1818. The Prussian capital was the place both of his birth and of his life's work, and he will always be counted among Germany's great scientific men, yet he was not of German blood. His father belonged to Neufchatel, his mother was of Huguenot descent, and he has spoken of himself as "being of pure Celtic blood." Educated first at the French College in Berlin, then at Neufchatel, whither his father

had returned, he entered in 1836 the University of Berlin. He seems to have been uncertain at first as to the bent of his studies, for he sat at the feet of the great ecclesiastical historian iNeander, and dallied with geology ; but eventually he threw himself into the study of medicine, with such zeal and success as to attract the notice of the great teacher of anatomy and physiology, who was then making Berlin famous as a school for the sciences ancillary to medicine. Johannes Miiller may be regarded as the central figure in the history of modern physiology, the physiology of the 19th century. Mtlller's earlier studies had been distinctly physiological; but his inclination, no less than his position as Professor of Anatomy as well as of Physiology in the University of Berlin, led him later on into wide studies of comparative anatomy, and these, aided by the natural bent of his mind towards problems of general philosophy, gave his views of physiology a breadth and a depth which profoundly in- fluenced the progress of that science in his day. He had, about the time when the young Du Bois-Eeymond came to his lectures, published his great Elements of Physiology, the dominant note of which may be said to be this : — "Though there appears to be something in the phenomena of living beings which cannot be explained by ordinary mechanical, physical, or chemical laws, much may be so explained, and we may without fear push these explana^ tions as far as we can, so long as we keep to the solid ground of observation and experiment." Mtiller recognized in the Neufchatel lad a mind fitted to carry on physical researches into the phenomena of living things in a legi- timate way. He made him in 1840 his assistant in physiology, and as a starting-point for an inquiry put into his hands the essay which the Italian Matteucci had just published on the electric phenomena of animals. This determined the work of Du Bois-Eeymond's life. He chose as the subject of his graduation thesis "Electric Fishes," and so commenced a long series of investigations on. animal electricity, by which he enriched science and made for himself a name. The results of these inquiries were made known partly in papers communicated to scientific journals, but also and chiefly in his work Researches on Animal Electricity, the first part of which appeared in 1848, the last in 1884.

This great work may be regarded under two aspects. On the one hand it is a record of the exact determination and approximative analysis of the

electric phenomena presented by living beings. Vie wed from this standpoint, it represents a remarkable advance of our knowledge. Du Bois-Eeymond, beginning with the imperfect observa- tions of Matteucci, buUt up, it may be said, this branch of science. He did so by inventing or improving methods, by devising new instruments of observation or by adapting old ones. The debt which science owes to him on this

score is a large one indeed. On the other hand, the volumes in question contain an exposition of a theory. In them Du Bois-Eeymond put forward a general conception by the help of which he strove to explain the phenomena which he had observed. He developed the view that a living tissue, such as muscle, might be regarded as com- posed of a number of electric molecules, of molecules having certain electric properties, and that the electric behaviour of the muscle as a whole under varying circum- stances was the outcome of the behaviour of these native electric molecules. It may perhaps be said that this theory has not stood the test of time so well as have Du Bois-Eeymond's other more simple deductions from observed facts. It was early attacked by Ludimar Her- mann, who maintained that a living untouched tissue, such as a muscle, is not the subject of electric currents so long as it is at rest, is isoelectric in substance, and therefore need not be supposed to be made up of electric molecules, all the electric phenomena which it manifests being due to internal molecular changes associated with activity or injury. Although most subsequent observers have ranged themselves on Hermann's side, it must never- theless be admitted thatDu Bois-Eeymond's theory was of great value if only as a working hypothesis, and that as such it has greatly helped in the advance of science.

Du Bois-Eeymond's work lay chiefly in the direction of animal electricity, yet he carried his inquiries — such as could be studied by physical methods — into other parts of physiology, more especially into the phenomena of diffusion, though he published little or nothing con- cerning the results at which he arrived. For many years, too, he exerted a great influence as a teacher. In 1858, upon the death of Johannes Miiller, the chair of Anatomy and Physiology, which that great man had held, was divided into a chair of Human and Comparative Anatomy, which was given to Eeichert, and a chair of Physiology, whichnaturally fell to

DuBois-Eeymond. This he held to his death, carrying out his researches for many years under the unfavourable circumstances of inadequate accommodation. In 1877, through his influence, the Government provided the University with a proper physiological laboratory. In 1851 he was admitted into the Academy of Sciences of Berlin, and in 1867 became its Perpetual Secretary. For many years he and his friend Helmholtz, who like him had been a pupil of Johannes Miiller, were prominent men in the German capital. Acceptable at Court, they both used their position and their influence for the advancement of science. Both, from time to time as opportunity offered, stepped out of the narrow limits of the professorial chair and gave the world their thoughts concerning things on which they could not well dwell in the lecture-room. Du Bois-Eeymond, as has been said, had in his earlier years wandered into fields other than those of physiology and medicine, and ia his later years he went back to some of these. His occasional discourses, dealing with general topics and various problems of philosophy, show that to the end he possessed the historic spirit which had led him as a lad to listen to Keander ; they are marked not only by a charm of style, but by a breadth of view such as might be expected from Johannes Miiller' s pupil and friend. He died in the city of his birth and adoption on 26th November 1896. (m. f.)

Dubuque, capital of Dubuque county, Iowa, U.S.A., and in 1900 the second city in size in the state, in 42° 30′ N. lat. and 90° 40′ W. long., on the western bank of the Mississippi, at an altitude on the river bank of 611 feet. The business part stands in the level bottom land at the foot of the bluffs, while the residence portion climbs the

bluffs, 200 feet or more, and spreads over the Mgh prairie above. The city is divided into five wards, is well paved with brick, macadam, and gravel, and is connected with the other side of the Mississippi by two bridges. It is entered by four great railway systems, the Chicago, Burlington, and Quincy, the Chicago Great Western, the Chicago, Mil- waukee, and St Paul, and the Illinois Central. These, with steamboat lines on the river, give the city a large commerce. Its manufactures had, in 1900, an invested

capital of $8,117,358, an average number of 6503 wage- earners receiving $2,012,163 in wages, and a product valued at $10,952,204. The chief articles of manufacture were lumber, men's clothing, carriages and waggons, and malt liquors. The assessed valuation of real and personal property was, in 1900, $23,907,583, the net debt $ 1,617,020, and the rate of taxation $37 per $1000. The lead and zinc mines of the adjacent region, which first induced the settlement of Dubuque, are at present producing but little. Population (1880), 22,254 ; (1890), 30,311 ; (1900), 36,297, of whom 6965 were foreign-born and 115 negroes. The death-rate in 1900 was about 12.

Ducamp, Maxime (1822-1894), French writer, the son of a successful surgeon, was born in Paris, 8th February 1822. He had a strong taste for travel, which his father's means enabled him to indulge as soon as his college days were over. Between' 1844 and 1845, and again between 1849 and 1851, he travelled in Europe and the East, and made excellent use of his experiences in books published after his. return. In 1851 he was one of the founders of the Revue de Paris, to which he contributed for some six or seven years. In 1853 he was made an ofH.- cer of the Legion of Honour. In 1870 he was nominated for the Senate, but his election was frustrated by the downfall of the Empire. He was elected a member of the French Academy in 1880, mainly, it is said, on account of his history of the Commune, published under the title of Les Convulsions de Paris (1878-80). His writings include Paris (6 vols., 1869-75), and the entertaining Souvenirs Littiraires (1882). The latter book contains much infor- mation respecting Flaubert, of whom Ducamp was an early and intimate friend. He died on 9th February 1894. Ducamp was one of the earliest amateur photographers, and his books of travel were among the first to be illus- trated by means of what was then a new art. (b. f. s.)

Du Chaillu, Paul Belloni (1835), traveller

and anthropologist, was born at New Orleans on 31st July 1835, and in his youth accompanied his father, an African trader, to the West Coast of Africa. From 1855 to 1859 he regularly explored the regions bordering upon the equator, and his travels resulted in the rediscovery of the great anthropoid ape called the gorilla, mentioned by Carthaginian navigators,

and not entirely unknown to modern science, but practically forgotten. A subsequent expedition, from 1863 to 1866, enabled him to confirm the accounts given by the ancients of a pigmy people in- habiting the African forests. Narratives of both expedi- tions were published in 1861 and 1867 respectively : the former excited a warm controversy. After writing several books for the young, founded upon his African adventures, M. Du Chaillu turned his attention to Northern Europe, and published in 1881 The Land of the Midnight Sun, and in 1889 TJie Viking Age.

Dudley, a municipal, county (1888), and parliamen- tary borough, and market-town of England, 8 miles west- north-west of Birmingham, 122 miles north-west of London, in a portion of the county of Worcester enclaved in Staffordshire. It has a joint station of the Great Western and the London and North- Western railways, and is on the Birmingham and Stourbridge canals. The

parish church of St Thomas has been restored. .The gram- mar school has been reorganized, and a new building with chemical laboratory was opened in 1899. Of recent erec- tion are a technical school, free library and school of art, public baths, and an hospital for infectious diseases. Area of municipal and county borough, 3604 acres. Population (1891), 45,724; (1901), 48,809. Area of parliamentary borough, 7794 acres, of which 3615 are in Worcestershire and 4179 in Staffordshire. Included in the parliamentary borough, and 2^ miles by rail to the south-west of Dudley, stands Brieblet Hill, a market-town on the river Stour and the Stourbridge and Birmingham canals. There is a town-hall and a free library. The industries are similar to those of Dudley — coal and iron mining, iron manufac- ture, engineering, &c. Area of urban district, 1023 acres ; population (1881), 11,603; (1901), 12,005.

Dudweiler, a village of Prussia, in the Rhine pro- vince, 4 miles by rail north-east from Saarbriicken, with coal mines, ironworks, and production of fire-proof bricks- Population (1885), 11,550; (1900), 16,323.

Duehring, Eugen Karl (1833), German

philosopher and political economist, was born on 12th Janu- ary 1833 in Berlin. After a legal education he practised at Berlin as a lawyer till 1869.

A weakness of the eyes, ending in total blindness, occasioned his taking up the studies with which his name is now connected. In 1864 he became docent of the University of Berlin, but, in con- sequence of a quarrel with the professoriate, was deprived of his license to teach in 1874. Among his works are Kapital und Arbeit (186^ ; Der Wert des Lehens (1865) ; NatUrliche Dialektik (1865) ; Kritische Geschichte der Philosophie (1869) ; Kritische Geschichte der aUegemeinen Principien der Mechanik (1872) — one of his most success- ful works; Kursus der National- und Sozialokonomie (1873) ; Kursus der Philosophie (1875), entitled in a later edition Wirklichkeitsphilosophie ; Logik und Wissen^ schaftstheorie (1878); Der Ersatz der Religion durch Vollkommeneres (1883). He published his autobiography in 1882 under the title Sache, Leben und Feinde; the mention of ” Feinde ” (enemies) is characteristic. Dueh- ring's philosophy claims to be emphatically the philosophy of reality. He is passionate in his denunciation of every- thing which, like mysticism, tries to veil reality. He is almost Lucretian in his anger against religion which would withdraw^ the secret of the universe from our direct gaze. His ” substitute for religion ” is a doctrine in many points akin to Comte and Feuerbach, the former of whom he resembles in his sentimentalism. Duehring's opinions have changed considerably since his first appearance as a writer. His earlier work, Naturliche Dialektik, in form and matter not the worst of his writings, is entirely in the spirit of the Critical Philosophy. Later, in his move- ment towards Positivism, he strongly repudiates Kant's separation of phenomenon from noumenon, and affirms, that our intellect is capable of grasping the whole reality. This adequacy of thought to things is due to the fact that the universe contains but one reality, i.e., matter. It is to matter that we must look for the explanation both of conscious and of physical states. But matter is not, in his system, to be understood with the common meaning, but with a deeper sense as the substratum of all consciouii and physical existence ; and thus the laws of being ari- identified with the laws of thought. In this materialistic or quasi-materialistic system Duehring finds room for teleology ; the end of Nature, he holds, is the production of a race of conscious beings. From his belief in teleology he is not deterred by the enigma of pain ; he is a deter- mined optimist. Pain exists to throw pleasure into conscious relief. In ethics Duehring follows Comte in

making sympathy the foundation of morality. In political philosophy he teaches an ethical communism, and attacks the Darwinian principle of struggle for existence. In economics he is best known by his vindication of the American writer H. C. Carey, who attracts him both by his theory of value, which suggests an ultimate harmony of the interests of capitalist and labourer, and also by his doctrine of " national " political economy, which advocates protection on the ground that the morals and culture of a people are promoted by having its whole system of indus- try complete within its own borders. His patriotism is fervent, but narrow and exclusive. He idolizes Frederick the Great, and denounces Jews, Greeks, and the cosmo- politan Goethe. Duehring's clear, incisive writing is disfigured by arrogance and ill-temper, failings which may be extenuated on the ground of his physical afdiction.

Duelling.— While in England the law against duel- ling has, supported by public opinion, sufB.ced to condemn the practice and entirely to suppress it, a recrudescence of the custom in foreign countries, and especially in France and Germany, was observable towards the close of the 19th century. Although most penal codes make duelling an offence punishable by pains and penalties of more or less severity, no country has as yet gone so far in this direction as England, where the slayer in a duel is held to be guilty' of the capital offence, and the principals and accessories, even where no fatal issue supervenes, of a misdemeanour. This survival of the trial by battle flourishes, as would be expected, in countries in which militarism reigns supreme, and where, as a corollary, the civil tribunals are supposed to furnish but inadequate guarantees for personal liberty in cases where the delicate sense of honour of the military caste is concerned. The antagonism subsisting between the combatant class and the civil population is further intensified in the " nations in arms," and notably in Germany, by the fact that an officer on retiring from the army still preserves in civil life his character as officer, and cannot seek satisfaction for personal affronts before the civil tribunals without for- feiting his position as a " man of honour." The

spirit of mediaevalism, which still in tradition is strong enough to support an anomaly which sober public opinion has been unable to abolish, is further fostered by the prerogative of pardon, which, except in very flagrant cases, is almost always exercised by the ruling powers in favour of the offenders.

Although French writers on the subject, notably Chateauvillard, claim for the duel a French origin, there appears to be little doubt that it was in Germany that, about the middle of the 16th century, it became estab- lished as an institution. No other country has clung to the duel with such tenacity. Academically it has found many staunch advocates among jurists in that country, and recent attempts to deal with the evil have been rather in the nature of palliatives than of measures directed towards eradicating it. Since 1896, when a tragic duel between two officers of the reserve, von Schrader and von Kotze, at Potsdam, resulting in the death of the former, more than ordinarily aroused public opinion, attempts have on various occasions been made to enlist the sympathies of the Reichstag with a view to fresh legislative enactment on the subject — ^but unsuccess- fully. The German Emperor, in a Cabinet Order of 1897, confirmed in 1901, issued directions to the military courts of honour, insisting upon the causes of the alleged affront being in each case properly sifted, the blame brought home to the .proper party, the illegality of the duel pointed out to the parties by the president of the court, and every attempt made to effect a reconciliation. It is only fair to say that where these instructions have been

disregarded, rigorous punishment has not failed to be meted out to the responsible persons. The German penal code (Reichsstrafgesetzbuch pars. 101-110) only punishes a duel when it is fought with lethal weapons ; and much controversy has raged round the question of the Mensuren or students' duels {vide infra), which, as being conducted with sharpened rapiers, have, despite the precautions taken, in the way of bandaging the vital parts of the body which a cut could reachj to reduce the risk of a fatal issue to a minimum, been declared by the Supreme Court of the Empire to fall under the head of duels, and as such to be punishable. The so-called Ameri- can duel, where the two parties draw lots, and the loser is under a moral obligation to kill himself within a speci- fied time, is not

recognized as a duel (not being a battle) by any foreign code except that of Austria (Strafgesetzent- wurf, 1889), which makes it a penal offence " where pre- determined chance shall determine which of two persons shall kill himself." The French claim for their writer Chateauvillard that he first formulated the rules of affairs of honour, and his treatise is, in effect, the accepted authority in all civilized countries. The recognized weapons are pistol, fleuret, and broadgword; and it seems to be an established rule that a civilian may, though a military man may not, refuse to fight with the sword. In July 1889 M. Freycinet (French Minister for War), in an order addressed to the Generals commanding Army Corps, after stating that his attention had been drawn to the risk to life resulting from the use of the fleuret in military duels, communicated his decision that in the rare cases where an armed encounter was not per- haps prescribed, but authorized, by the chief of the corps, the combatants should make use, not of the fleuret, but of service swords. The German Emperor William I. also declared in favour of the broadsword ; but the pistol is in Germany almost always the weapon selected. In France, unlike Germany, in which latter country military duels largely preponderate, it is parliamentarians and pressmen who mostly seek satisfaction in affaires d'hon- neur, which are often merely nominal ; the weapon em- ployed is generally the fleuret.

The Roman Catholic Church does not admit any reason justifying the duel ; and it is generally understood that both Roman Catholics and Jews may, without detriment to their social position, refuse one, as being expressly prohibited by the canons of their religion. Moreover, the practice is visited by ecclesiastical censures, by excom- munication, denial of the last rites of sacrament, and, in the Protestant Church also, of burial by the Church.

The Mensuren (German students' duels) above referred to are frequently misunderstood. They bear little re- semblance, save in form, to the duel d, outrance, and should rather be considered in the light of athletic games, in which the overflow of high animal spirits in young Germany finds its outlet. These combats are indulged in principally by picked representatives of the " corps " (recognized clubs), and according to the position and value of the Schmisse (cuts which have landed) points are awarded to either side. Formerly these so-called duels could be openly

indulged in at most universities without let or hindrance. Gradually, however, the academic authorities took cognizance of the illegality of the practice, and in many cases infiicted punishment for the offence. Nowadays, owing to the decision of the Supreme Court reserving to the common law tribunals the power to deal with such cases, the governing bodies at the universities have only a disciplinary control, which is exercised at the various seats of learning in various de- grees : in some the practice is silently tolerated, or at most visited by reprimand ; in others, again, by relegation or career — with the result that the students of one university

frequently visit another, in order to be able to fight out their battles under less rigorous surveillance, (p. a. a.)

Dufaure, Jules Armand Stanislas (1798- 1881), French statesman, was bom at Saujon (Charente- Inferieure) on 4th December 1798. He was called to the Bar at Bordeaux, where he won a great reputation by his oratorical gifts, but soon abandoned law for politics, and in 1834 was elected deputy. Two years later he was made Gonseiller d'etat by Thiers, but did not hold his ofiEice long. In 1839 he became Minister of Public Works in the Soult Ministry, and succeeded in freeing railway construction in France from the obstacles which tUl then had hampered it. Losing office in 1840, Dufaure became one of the leaders of the Opposition, and on the outbreak of the Revolution of 1848 frankly accepted the B.epublic, of which he remained throughout his life a foremost champion. On 13th October he became Minister of the Interior under Cavaignac, but retired on the latter's defeat in the Presidential election. During the Second Empire, Dufaure abstained from public life, and practised at the Paris bar with such success that he was elected bdtonnier in 1862. In 1863 he succeeded to Pasquier's seat in the French Academy. In 1871 he became a member of the Assembly, and it was on his motion that Thiers was elected President of the Eepublic. Dufaure received the Ministry of Justice, his tenure of which was distinguished by the passage of the jury-law. In 1873 he fell from office with Thiers, but in

1875 resumed his former post under Buffet, whom he succeeded on 9th March 1876 as President of the Council. In the same year he was elected a life senator. On 12th December he was defeated on the ques- tion of an amnesty for the Communists, but returned to power on 24th December 1877. Early in 1879 Dufaure took part in compelling the resignation of Marshal Mao- Mahon, but immediately afterwards (1st February), worn out by factious opposition, himself laid down 'office. He died in Paris on 28th June 1881. (e. g.)

Dufferin and Ava, Frederick Temple Hamilton-Temple-Blackwood, 1st Marquis OF (1826-1902), British diplomatist, son of the 4th Baron Dufferin, whom he succeeded in 1841, was bom 21st June 1826, his mother, Helen Selina, being a granddaughter of Eichard Brinsley Sheridan. He was educated at Eton and Oxford, and then devoted himself to his Irish estates at Clandeboye, near Belfast. He assisted in combating the Irish famine of 1846-47, and published an account of his experiences. As an Irish landlord he was generous and sympathetic, and in 1865 already advocated compensation for disturbance and for tenants' improvements ; but while advocating reform, he insisted upon qualifying it by considerations of justice to the landowners. He quickly became a persona grata in Society and at Court ; was a lord-in-waiting in 1849-50 (being created a peer of the United Kingdom in the latter year), and again in 1854-55, and was attached in 1855 to Lord John Russell's special mission to Vienna. In 1856 he made a voyage to Iceland, which he described with much humour and graphic power in his successful book, Letters from High Latitudes, a volume which made his reputation as a writer, though his only other purely literary publication was his memorial edition (1894) of his mother's Poems and Verses. Lord John Russell showed his recognition of Lord Dufferin's talents as a diplomatist by sending him in 1860 as British special commissioner in the Lebanon (Syria), wherethemassacres of Christians by the Mussulmans and Druses had precipitated a serious situar tion, which was complicated by the possibility of a French occupation. He did his work so successfully in carrying a scheme of reform that the trouble was permanently

removed, and he was made a K.C.B. In 1862 he married Hariott, daughter of Captain Rowan Hamilton, of Killy- leagh Castle, Down. In 1863 he

was made a K.P. ; and after holding the under-secretaryships for India (1864) and of war (1866), and the office of Chancellor of the Duchy of Lancaster (1868-1872), he was in 1872 appointed Governor-General of Canada. In 1871 he had been created Earl of Dufferin. In Canada his tact and personal charm were invaluable. He had already become known as a powerful and graceful speaker, and this quality was brilliantly displayed in dealing with the different Canadian nationalities, while his strictly constitutional methods enabled him to settle satisfactorily many of the problems of the new Federation. On his return he became successively ambassador at St Petersburg (1879) and at Constantinople (1881). From October 1882 to April 1883 he was employed as special British commissioner in Egypt, to clear matters up after Arabi's rebellion; but his Report, though its ability as a State paper was unimpeachable, hardly grasped the real problems of the subsequent recon- struction. In 1884 he was appointed Viceroy of India, and spent there four busy years, largely employed in restoring the equilibrium which had been upset by Lord Ripon's zeal for reform. The chief event of his administration was the annexation of Burma, which procured him the title of Marquis of Dufferin and Ava (1888) ; but Lady Dufferin's work on behalf of the better medical treatment of native women must also be mentioned. In 1888 he was sent as ambassador to Rome, and in 1891 to Paris, where he re- mained till 1896. He then retired from the public service to his Irish home. Lord Dufferin was one of the most admired men of his time. A man of well-nigh universal accomplishments, his special gift was a genius for diplo- macy, his courteous and winning manner and great felicity in verbal expression being exceptionally marked. His last years were shadowed by the death of his eldest son. Lord Ava, at Ladysmith in 1899, and by financial troubles. He had become chairman of the " London and Globe Finance Corporation," which was entirely in the hands of the managing director, Mr Whitaker Wright ; and when, after several warnings, the methods employed led to financial collapse, it was a matter of deep regret that Lord Dufferin should have been connected with such a business. He died on 12th February 1902, while the affairs of the company were still under investigation. (h. ch.)

DufFy, Sir Charles Cavan (1816—

), Irish

and colonial politician, was born in Monaghan, Ireland, on 12th April 1816. At an early age he became con- nected with the press, and was one of the founders of the Dublin Nation in 1842. The new journal was remarkable for its talent, for its seditious tendencies, and for the fire and spirit of its political poetry. In 1844 Duffy was in- cluded in the same indictment with O'Connell, and shared his conviction in Dublin and his acquittal by the House of Lords upon a point of law. His ideas, nevertheless, were too revolutionary for O'Connell; a schism took place in 1846, and Duffy united himself to the " Young Ireland" party. He was tried for treason-felony in 1848, but the jury were unable to agree. Duffy continued to agitate in the press and in Parliament, to which he was elected in 1852, but his failure to bring about an alliance between Catho- lics and Protestants upon the land question determined him in 1856 to emigrate to Victoria. There he became in 1857 Minister of Public Works, and after an active political career, in the course of which he was Prime Minister from 1871 to 1873, when he was knighted, he was elected Speaker of the House of Assembly in 1877, being made K.C.M.G. in the same year. In 1880 he resigned and re- turned to Europe, residing mostly in the south of France. He has published The Bailad Poetry of Ireland (1845),

several works on Irisli history, Cmiversations with Garlyle (1892), Memoirs (1898), &c. In 1891 he became first President of the Irish Literary Society. He was married three times, his third wife dying in 1889.

Duisburg, a town of Prussia, 15 miles by rail north from Dttsseldorf, on the Euhr-Rhine Canal and between these two rivers. The concert hall, law courts, Mercator fountain (1878), and war memorial are new. There are iniportant iron industries, chemical works, saw-milling, shipbuilding, tobacco, cotton, sugar, soap, and other manufactures. There is also (in conjunction with Hoch- feld) an extensive trade in coal. The harbour was,

in 1898, entered and cleared by an aggregate of 2,745,400 tons. Population (1885), 47,519 ; (1900), 92,729.

Dulcigno (Servian, JJldnj; Turkish, Olgun), an ancient town formerly belonging to Turkish Albania, but since 1880 Montenegrin. The old walled quarter, with the strong castle, occupies a bold promontory on the Adriatic, 18 miles west-south-west of Scutari; the new town occupies a small narrow valley, and the little harbour is stopped with sand. There are about 5000 inhabitants. Dulcigno was the scene of a naval demon- stration made by the British, Russian, French, and Italian fleets in August 1880, by which Turkey was com- pelled to hand the place over to Montenegro according to the Berlin Treaty.

Dill ken, a town of Prussia, in the Rhine province, 11 miles by rail west-south-west from Crefeld, with manu- factures of linen, cotton, silk, and velvet, &c., ironworks and foundries. It has a (Roman Catholic) Gothic parish church. Population (1900), 9517.

Duluth, capital of St Louis county, Minnesota, U.S.A., the third city in the state iu population, in 46° 47′ N. lat. and 92° 06′ W. long., on the north shore of Lake Superior. The city is situated mainly on the slope of steep bluffs, which rise 600 feet above the lake level. It is regular in plan, one set of streets running directly up the bluffs, the others along their face, parallel with the lake shore; and it is well paved and sewered. A gravel spit, known as Minnesota Point, stretches nearly across Lake Superior, forming behind it a fine harbour, with a narrow entrance. Duluth is the terminus of no less than nine railways, making it, with its large lake com- merce, a commercial city of the first magnitude. It handles large quantities of wheat from Red River Valley and Manitoba, estimated at 90,000,000 bushels annually, great amounts of lumber from the adjacent pine forests, and of iron ore from the Vermilion and Mesabi Ranges to the north. About 2000 vessels enter and clear annually. In 1890, its manufactures had an invested capital of $5,332,447, employed 3752 hands, and had a product valued at f 8,811,723. The assessed valuation of real and personal property in 1900, on a basis of about one-half of the full value, was $24,600,333 ; the net debt of the city was $5,876,732; and the rate of taxation was $30 per $1000. Population (1880), 838 ; (1890),

33,115 ; (1900), 52,969, of whom 20,983 were foreign-born and 357 negroes. The death-rate in 1900 was 13-2. The village of West Duluth was included in the corporate limits in 1894.

Dulwich, a parish of the county of London, in the metropolitan borough of Camberwell, Surrey, five miles from London Bridge, with three railway stations. The upper school, or Dulwich College, maintains its position in the front rank of English public schools. The lower, or AUeyne's school, is situated about a mile from the college, and in close proximity to it are the James Allen's school for girls and the Dulwich Presbyterian Church. There is a high -school for girls within half a mile of West Dulwich station. Population (1881), 5590; (1901), 10,246.

Dumas, Alexandre (JUs) (1824-1895), French dramatist and novelist, was born in Paris on the 28th July 1824. His parentage was irregular, and his father at that date still a humble clerk and not much more than a boy. " Happily," writes the son, " my mother was a good woman, and worked hard to bring me up " ; while of his father he says, " by a most lucky chance he happened to be well natured," and " as soon as his first successes as a dramatist " enabled him to do so, " recog- nized me and gave me his name." Nevertheless the lad's earlier school-life was made bitter by his illegiti- macy. The cruel taunts and malevolence of his com- panions rankled through life (see preface to La Femme de Claude and L' Affaire Climenceau), and left indelible marks on his character and thoughts. Nor was his paternity, however distinguished, without peril. Alex- andre the younger and elder saw life together very thoroughly, and Paris can have had few mysteries for them. Suddenly the son, who had been led to regard his prodigal father's resources as inexhaustible, was rudely undeceived. Coffers were empty, and he had accumulated debts to the amount of two thousand pounds. Thereupon he pulled himself together. To a son of Dumas the use of the pen came naturally. Like most clever young writers — and report speaks of him as specially brilliant at that time — he opened with a book of verse, PicMs de Jeunesse (1847). It was succeeded in 1848 by a novel. La Dame aux Camelias, a sort of reflec- tion of the world in which he had been living. The book had considerable success, and was followed, in fairly quick succession, by Le Roman d'une Femme (1848) and Diane de Lys (1851). All this, however,

did not deliver him from the load of debt, which, as he teUs us, remained odious. In 1849 he had dramatized La Dame aux Ca- milias, but for various reasons, the rigour of the censorship being the most important, it was not till the 2nd Febniary 1852, and then only by the intervention of Napoleon's all-powerful minister, Morny, that the play could be pro- duced, at the Vaudeville. It succeeded then, and has held the stage ever since, less perhaps from inherent superiority to other plays which have foundered, than to the great opportunities it affords to any actress of genius. Thence- forward Dumas's career was that of a brilliant and pros- perous dramatist. Diane de Lys (1853), Le Demi-Monde (1855), La question d'argent (1857), Leflls naturel (1868), Le P&re prodigue (1859), followed rapidly. Debts became a thing of the past, and Dumas a wealthy man. The didactic habit was always strong upon him. " Alexandre loves preaching overmuch," wrote his father ; and in most of his plays he assumes the attitude of a rigid and un- compromising moralist commissioned to impart to a heedless world lessons of deep import. The lessons them- selves are mostly concerned with the " eternal feminine," by which Dumas was haunted, and differ in ethical value. Thus in Les Idies de Madame Auhray he inculcates the duty of the seducer to marry the woman he has seduced ; but in La Femme de Claude he argues the right of the husband to take the law into his own hand and kill the wife who is unfaithful and worthless, — a thesis again defended in his novel, L' Affaire Climenceau, and in his pamphlet, L' Homme-femme ; while in Diane de Lys he had taught that the betrayed husband was entitled to kill — ^not in a duel, but summarily — the man who had taken his honour ; and in L'Etrangdre the bad husband is the victim. Nor did he preach only in his plays. He preached in voluminous introductions, and pamphlets not a few. And when, in 1870 and 1872, Prance was going through bitter hours of humiliation, he called her to re- pentance and amendment in a Ifouvelle Lettre de Junius and two Lettres sur les choses du jour. As a moralist he took himself very seriously indeed. As a dramatist.

didacticism apart, he had great gifts. He knew his business thoroughly, possessed the art of situation, inter- est, crisis — could create characters that were real and alive. His dialogue also is admirable, the repartee rapier-like, the wit most keen. He was singularly happy, too, in his dramatic interpreters. The cast of L'Mranglre, for instance, comprised Sarah Bernhardt, Croizette, Made- leine Brohan, in the female characters; and Coquelin, Got, Mounet-SuUy, and Febvre in the male characters ; and Desclee, whom he discovered, gave her genius to the creation of the parts of the heroine in Une Visite de Noces, the Princesse Georges, and La Femme de Claude. His wit has been mentioned. He possessed it in abundance, of a singularly trenchant kind. It shows itself less in his novels, which, however, do not contain his best work; but in his introductions, whether to hi own books or those of his friends, and what may be called his "occar sional " writings, there is an admirable brightness. At work of this kind he showed the highest literary skill. His style is that of the best French traditions. Towards his father Dumas acted a kind of brother's part, and while keeping strangely free from his literary influence, both loved and admired him. The father never belonged to the French Academy. The son was elected into that august assembly on the 30th January 1874. He died on the 27th November 1895. (f. t. m.)

Dumas, Jean Baptiste Andre (1800-1884), French chemist, was born at Alais (Gard) on 14th July 1800. Disappointed in his early hope of entering the navy, he became apprentice to an apothecary in his native town ; but seeing little prospect of advancement in that calling, he soon moved to Geneva (in 1816). There he attended the lectures of such men as Pictet in physics, De la Eive in chemistry, and De Candolle in botany, and before he had reached his majority he was engaged with Provost in original work on problems of physiological chemistry, ^and even of embryology. In 1823, acting on the advice of Humboldt, he left Geneva for Paris, which he made his home for the rest of his life. There he gained the acquaintance of many of the foremost scientific men of the day, and quickly made a name for himself both as a teacher and an investigator, attaining within ten years the honour of membership of the Academy of Sciences. When approaching his fiftieth year he entered political life, and became a mem- ber of the National Legislative Assembly. He acted as Minister of Agriculture and Commerce for a few months in 1850-51, and subsequently became a Senator, Presi- dent of the Municipal Council of

Paris, and Master of the French Mint; but his ofl&cial career came to a sudden end with the fall of the Second Empire. He died at Cannes on 11th April 1884. Dumas is one of the most prominent figures in the chemical history of the middle part of the 19th century. He was one of the first to criticize the electro-chemical doctrines of Berzelius, which at the time' his work began were widely accepted as the true theory of the constitution of compound bodies, and opposed a unitary view to the dualistic conception of the Swedish chemist. In a paper on the atomic theory, pub- lished so early as 1826, he anticipated to a remarkable extent some ideas which are frequently supposed to belong to a later period ; and the continuation of these studies led him to the ideas about substitution (" metalepsy ") which were developed about 1839 into the theory (" Older Type Theory ") that in organic chemistry there are certain types which remain unchanged even when their hydrogen is replaced by an equivalent of a haloid element. Many of his well-known researches were carried out in support of these views, one of the most important being that on the action of chlorine on acetic acid to form trichloracetic

acid — a derivative of essentially the same character as the acetic acid itself. In the 1826 paper he described his famous method for ascertaining vapour densities, and the redeterminations which he undertook by its aid of the atomic weights of carbon and oxygen proved the fore- runners of a long series which included some thirty of the elements, the results being mostly published in 1858-60. He also devised a method of great value in the quantitative analysis of organic substances for the estimation of nitrogen, while the classification of organic compounds into homologous series was advanced as one consequence of his researches into the acids generated by the oxidation of the alcohols. Dumas was a prolific writer, and his numerous books, essays, memorial ad- dresses, &c., show him to have been gifted with a clear and graceful style. His earliest large work was a treatise on applied chemistry in eight volumes, the first of which was published in 1828 and the last twenty years after- wards. In the Essai de Statique Chimique des JEtres Organisis, written jointly with Boussingault (1841), he treated the chemistry of life, both plant and animal; this book brought him into conflict with Liebig, who con- ceived that some of his prior work had been appropriated without due acknowledgment. In 1824, in conjunction with his friends Audouin and

Adolphe Brongniart, he founded the Annales des Sciences Naturelles, and from 1840 he was one of the editors of the Awiales de Chimie et de Physique. As a teacher Dumas was much sought after for his lectures, at the Sorbonne and other institu- tions, both on pure and applied science ; and he was one of the first men in France to realize the importance of experimental laboratory teaching. (h. m. e.)

Du Maurier, George Louis Palmella Bus- son (1834-1896), British artist and. writer, was born in Paris. His father, a naturalized British subject, was the son of emigres who had left France during the Reign of Terror and settled in London. In Peter Ihhetson, the first of the three books which won George du Maurier late in life a reputation as novelist almost as great as he had enjoyed as artist and humorist for more than a generation, the author tells in the form of fiction the story of his singularly happy childhood. He was brought to London, indeed, when three or four years old, and spent in Devonshire Terrace and elsewhere two colourless years ; but vaguememoriesof this period were suddenly exchanged one beautiful day in June — " the first day of his conscious existence " — for the charming realities of a French garden and " an old yellow house with green shutters and mansard roofs of slate." Here, at Passy, with his " gay and jovial father" and his young English mother, the boy spent " seven years of sweet priceless home-life — seven times four changing seasons of simple genial prse-Imperial French- ness." The second chapter of Du Maiirier's life had for scene a Paris school, very much in the style of that " Institution F. Brossard " which he describes, at once so vividly and so sympathetically, in The Martian; and like " Barty Josselin's " schoolfellow and biographer, he left it (in 1851) to study chemistry at University College, London, actually setting up as an analytical chemist after- wards in BucklersbUry. But this was clearly not to be his mitier, and the year 1856 found him once more in Paris, in the Quartier Latin this time, in the core of that art-world of which in Trilby, forty years later, he was to produce with pen and pencil so idealistic and fascinat- ing a picture. Then, like " Barty Josselin " himself, he spent some years in Belgium and the Netherlands, ex- periencing at Antwerp in 1857, when he was working in the studio of Van Lerius, the one great misfortune of his life — the gradual loss of sight in his left eye, accompanied by alarming symptoms in his right. It was a period of

CONFUSION OF CAUSE AND EFFECT.

Miir/r/ie. “Oh, T

AID OF CiiL\li;oR.\z

FOND AND FOOLISH.

[i>V; G/‘j^ijc ‘hi Mat/rier.]

Edwin (sndihnhj, aftpr 11 Ion;/ pause) “Dakling!” Aiir/eliiw. “Yes, Darling’?”

[Murci, 17, iBss.ra. ;i4, ;. vi:.] Edwiii. “Nothing, Darling. Ohi^y Barlixo, Darling!” ‘ [BiliDitx Ohl Gentleman feels quite sick.

ILLUSTRATIONS BY GEORGE DU MAUEIER.

{Bt/ permission of the Proprietors of ^^ Punch. ^^)

tragic anxiety, for it seemed possible that the right eye might also become affected ; but this did not happen, and the dismal cloud was soon to show its silver lining, for, about Christmas time 1868, there came to the forlorn invalid a copy of Punch's Almanac, and with it the dawn of a new era in his career.

There can be little doubt that the study of this Almanac, and especially of Leech's drawings in it, fired him with the ambition of making his name as a graphic humorist ; and it was not long after his return to London in 1860 that he sent in his first contribution (very much in Leech's manner) to Punch. Mark Lemon, then editor, appreciated his talent, and on Leech's death in 1865 appointed him his successor, counselling him with wise discrimination not to try to be "too funny," but "to un- dertake the light and graceful business" and be the "romantic tenor" in Mr Punch's little company, while Keene, as Du Maurier puts it, " with his magnificent highly trained basso, sang the comic songs." These respective rdles the two artists continued to play until the end, seldom trespassing on each other's province ; the " comic songs" finding their inspiration principally in the life of the homely middle and lower middle classes, while the "light and graceful business" enacted itself almost ex- clusively in " good Society." To a great extent, also, Du Maurier had to leave outdoor life to Keene, his weak sight making it difficult for him to study and sketch in the open air and sunshine, thus cutting him off, as he records regretfully, from "so much that is so popular, delightful, and exhilarating in English country life" — hunting and shooting and fishing and the like. He contrived, however, to give due attention to milder forms of outdoor recreation, and turned to good account his familiarity with Hampstead Heath and Rotten Row, and his holidays with his family at Whitby and Scarborough, Boulogne and Dieppe.

Of Du Maurier's life during the thirty-six years of his connexion with Ptaich there is not, apart from his work as an artist, much to record. In the early 'sixties he lived at 85 Newman Street in lodgings, which he shared with his friend Lionel Henley, afterwards E..B.A., working hard at his Punch sketches and his more serious contribu- tions to Once a Week and the Cornhill Magazine. After his marriage with Miss Emma Wightwick in 1862 he took a spacious and pleasant house near Hampstead Heath, in surroundings made familiar in his drawings. Shortly be- fore he died he moved to a house in Oxford Square. About 1866 he struck out a new line in his admirable illustrations to Jerrold's Story of a Feather. In 1869 he realized a long-cherished aspiration, the illustrating of Thackeray's Esmond, and in 1879 he drew twelve additional vignettes for it, in the same year providing several illustrations for the Ballads. Erom time to time he sent pretty and graceful pictures to the exhibitions of the Royal Society of Painters in Water-Colour, to which he was elected in 1881. In 1886 the first exhibition of his works at the Pine Art Society took place. Thus occupied in the prac- tice of his art, spending his leisure in social intercourse with his many friends and at home with his growing family, hearing all the new singers and musicians, seeing all the new plays, he lived the happiest of lives. He died somewhat suddenly on 8th October 1896, and was buried in the Hampstead Cemetery.

It is impossible, in considering'Du Maurier's work, to avoid comparing it with that of Leech and Keene, the more so that in his little book on Social Pictorial Satire he himself has set forth or suggested the points both of resemblance and of difference. Like Keene, though Keene's marvellous technique was his despair, Du Maurier was a much more finished draughtsman than John Leech, but in other respects he had less in common with the

younger than with the older humorist. He shows him- self, in the best sense, a man of feeling in all his work. He is clearly himself in love with " his pretty woman," as he calls her — every pen-stroke in his presentment of her is a caress. How affectionate, too, are his renderings of his fond young mothers and their big, handsome, simple-minded husbands; his comely children and neat nurserymaids; even his dogs — ^his elongated

dachshunds and magnificent St Bernards ! And how he scorns the snobs and philistines — Sir Gorgius Midas and Sir Pompey Bedell, Grigsby and Cadby, Soaplej"- and Toadson ! How merciless is his ridicule of the aesthetes of the 'eighties — Maudle andPostlethwaite and Mrs Cimabue Brown ! Even to Mrs Ponsonby de Tomkyns, his most conspicuous creation, his satire is scarcely tempered, despite her pret- tiness. He shows up unsparingly all her unscrupiilous little ways, all her cynical, cunning little wiles. Like Leech, he revelled in the lighter aspects of life — the humours of the nursery, the drawing-room, the club, the gaieties of the country house and the seaside — without being blind to the tragic and dramatic. Just as Leech could rise to the height of the famous cartoon " General F^vrier turned Traitor," so it was Du Maurier who inspired Tenniel in that impressive drawing on the eve of the Franco-Prus- sian War, in which the shade of the great Napoleon is seen warning back the infatuated Emperor from his ill- omened enterprise. In his tender drawings in Once a Week, also, and in his occasional excursions into the grotesque in Punch, such as his picture of " Old Nickotin stealing away the brains of his devotees," he has given ample proof of his faculty for moving and impressive art. The technique of Du Maurier's work in the 'eighties and the 'nineties, though to the average man it seems a marvel of finish and dexterity, is considered by artists a falling off from what was displayed in some of his earlier Punch drawings, and especially in his contributions to the Corn- hill Magazine and Owce a Week. His later work is un- doubtedly more mannered, more "finicking," less simple, less broadly effective. But it is to his fellow-craftsmen only and to experts that this is noticeable.

A quaint tribute has been paid to the literary talent shown in Du Maurier's inscriptions to his drawings, by Mr F. Anstey, his colleague on the staff of Punch. " In these lines of letterpress," says Mr Anstey, " he has brought the art of precis-writing to perfection." They are indeed singularly concise and to the point. It is the more curious, therefore, to note that in his novels, and even in his critical essays, Du Maurier reveals very different qualities : the precis-writer has become an improvisatore, pouring out his stories and ideas in full flood, his style changing with every mood — by turn humorous, eloquent, tender, gay, sometimes merely "skittish," sometimes quite solemn, but never for long ; sometimes, again,

breaking into grace- ful and haunting verse. He writes with apparent artless- ness ; but, in his novels at least, on closer examination, it is found that he has in fact exerted all his ingenuity to give them — what such flagrantly untrue tales most require — verisimilitude. It is hard to say which of the three stories is the more impossible: that of Trilby, the tone-deaf artist's model who becomes a prima donna, that of Barty Josselin and his guardian angel from Mars, or that of the dream-existence of Peter Ibbetson and the Duchess of Towers. They are all equally preposterous, and yet plausible. The drawings are cunningly made to serve the purpose of evidence, circumstantial and direct. These books cannot be criticized by the ordinary canons of the art of fiction. They are a genre by themselves, a blend of unfettered day-dream and rose-coloured rem- iniscence.

For the dramatic version of Trilby by Mr Paul Potter Du Maurier would accept no credit. The play was pro-

duced in 1895 by Mr Beerbohm Tree, at the Haymarket, with, immense popular success.

Some striking examples of Du Maurier's work for Once a Week and the Cornhill Magazine are included in Gleeson White's English Illustrators of the Sixties. The following is a list of the chief works which he illustrated : Foxe's Book of Martyrs, 1865 ; Mrs Gaskell's Wives and Daughters, 1866 ; Jerrold's Story of a Feather, 1867; Owen Meredith's Lucile, 1868; The Book of Drawing-room Plays, by H. Dalton, 1868 ; Sooner or Later, by C. A. G. Brooke, 1868 ; Thackeray's Esmond, 1869 and 1879, and Ballads, 1879; Misunderstood, by Florence Montgomery, 1874 ; Bound about the Islands, by C. W. Scott, 1874 ; Hurlock Chase, by G. E. Sargent, 1876 ; Songs of Many Seasons, by J. Browne (in collaboration), 1876 ; Pegasus Be-saddled, by H. C. Pennell, 1877; Ingoldsby Legends (in collaboration), by R. Barham, 1877 ; Prudence, by

L. C. Lillie, 1882 ; As in a Looking- glass, by F. C. Phillips, 1889 ; Luke Ashleigh, by A. Elwes, 1891 ; and his own three novels, which appeared serially in Harper^s Magazine: Peter Ibbetson, 1892; Trilby, 1894; The Martian, 1897, and published after his death. In 1897 also there was published, under the title English Society, with an introduction by W. D. Howells, a collection of full-page drawings which he had contributed regularly to Harper's Magazine.

Some of his Punch drawings have been reproduced also in The Collections of Mr Punch, 1880 ; Society Pictures from Punch, 1890 ; A Legend of Gamelot, 1890. To his Social Pictorial Satire (1890) reference has been made. He contributed two essays upon book illustration to the Magazine of Art, 1890. See also the Magazine of Art for 1892, for an article upon his work by W. Delaplaine Scull, with illustrations. Other volumes containing information about his life and work are : The History of Punch, by M. H. Spielmann ; In Bohemia with Du Maiirier, by Felix Mosoheles ; Henry James's "Du Maurier and London Society," Century Magazine, 1883 ; and " Du Maurier," Harper" s Magazine, September 1897, June 1899. See also Ruskin's Art of England, Lecture 5, Pennell's Pen^Drawing and Pen-Draughtsmen, and Muther's Modern Painting, vol. ii. (f. w. w.)

Dumbarton, a seaport, royal and parliamentary burgh (Kilmarnock group), and the county town of Dum- bartonshire, on the river Leven near its confiiuence with the Clyde, 16 miles west by north of Glasgow by rail. A large park, Levengrove, was presented in 1885, and there is a public common and recreation ground. The burgh hall and academy were restored after a fire in 1883. There are two cottage hospitals and a philosophical and literary institute, whilst recent erections are a Congregational church, a Denny Memorial Institute, new county build- ings, new municipal buildings, and a combination hospital for infectious diseases. There are two large shipbuilding yards, and numerous industries connected with ship- building. The output was 37,734 tons in 1889, and 52,- 623 tons in 1899 ; and in the latter year a marine engineering work turned out 16 sets of marine engines, aggregating 35,700 i.h.p. Only a few married artillery- men now occupy the ancient

castle. There is an academy under the School Board. Population of parliamentary burgh (1881), 13,782; (1901), 19,864.

Dumbartonshire, a western county of Scotland, bounded S. by the Clyde river and firth, E. by Stirling- shire and Lanarkshire, N. by Perthshire, and W. by Loch Long and Argyllshire.

Area and Population. — The Stirling part of the parish of New Kilpatrick, including the town of Milngavie, was trans- ferred to Dumbartonshire in 1891. According to the latest official estimate, the area of the county (foreshore excluded) is 170,762 acres, or 267 square miles. The population was in 1881, 75,.333 ; in 1891, 94,495 ; in 1891, on the above area, 98,014, of whom 46,683 were males and 49,331 females ; in 1901, 113,870. On the old area, taking land only (154,542 acres, or 241 -5 square miles), the number of persons to the square mile in 1891 was 383, and the number of acres to the person 1 -6. In the registration county the population increased between 1881 and 1891 by 25-4 per cent. Between 1881 and 1891 the excess of births over deaths was 13,252, and the increase of the resident population 19,832. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 :—

Tear.

Deaths.

Marriages.

Births.

Percentage of Illegitimate.

1880 1890 1899

1500 ,

1883

1872

475 583 676

2513 3065 3511

5-0

4-50

3-4

The birth-rate is above, the death-rate and marriage-rate are both below, the rates for Scotland. The following table gives the birth-rate, deathirate, and marriage-rate per thousand of the popu- lation for a series of years : —

1880.

1881-90.

1890.

1891-98.

1899.

Birth-rate . Death-rate . Marriage-rate

32-73

19-54

6-19

33-02

17-98

5-91

31-79

19-53

6-04

30-93

17-29

5-46

29-84

15-90

5-74

At the census of 1891 there were 3618 persons in Dumbarton- shire who spoke Gaelic, and of these 37 spoke Gaelic only ; and there were 74 foreigners. Valuation in 1889-90, £459,141 ; in 1899-1900, £685,389.

Administration. — The county returns a member to Parliament. Dumbarton (19,864), the county town, is the only royal burgh, and belongs to the Kilmarnock group of parliamentary burghs. The county contains among its police burghs Helensburgh (8554), Kirkintilloch (10,502), and Clydebank (18,654), and considerable manufacturing towns are Alexandria (8392) and Renton (5227). There are 12 civil parishes, most of which belong to the Dumbarton combination, with a poorhouse at the county town. The number of paupers and dependants in September 1899 was 2155. Dumbarton forms a sheriffdom with Stirling and Clackmannan, and there is a resident sheriff-substitute at Dumbarton, who sits also at Kirkin- tilloch.

Education. — Fourteen school boards manage 47 schools, which had an average attendance of 16,100 in 1899-1900; while 9 volun- tary schools, of which 7 are Roman Catholic and 1 Episcopal, had 2956. The whole of the county "residue" grant and a trifling proportion of that accruing to the burghs is spent in subsidizing science, art, and technical classes

(including building and mechani- cal construction), in supporting a^icultural lectures, and in paying the fees and travelling expenses of county students at the Glasgow Technical College.

Agriculture. — ^The percentage of cultivated area in 1898 was 30-2. Li 1895 there were 8772 acres under wood. Of the 667 holdings in 1895, the date of the latest return, the average .size was 76 acres. The percentage under 5 acres was 15-89, between 5 and 50 acres 35-08, and over 50 acres 49-03. The number of farms between 50 and 100 acres was 117 ; between 100 and 300, 198 ; and there were only 12 over 300. The proximity of the county to Glasgow encourages high farming. Dairying is carried on on a considerable scale. Highland cattle are bred on the upland farms. The following table gives the principal acreages at intervals of five years from 1880 : —

Tear.

Area under Crops.

Com Crops.

Green Crops.

Clover.

Perma- nent Pasture.

Fallow.

1880 1885 1890 1895 1899

46,432 47,305 48,367 50,813 51,426

10,037 9,313 8,226 8,221

8,284

5000 4249 3994 4050 4164

13,010 15,482 18,341 14,822 16,416

18,269 18,113 17,632 23,522 22,4.32

98

148

114

127

67

The following table gives particulars of the live stock during the same years : —

Tear.

Total Horses.

Total Cattle.

Cows or

Heifers in

Milk or Calf.

Sheep.

Pigs.

1880 1885

1890 1895 1899

1865 1730 1745 2072 1845

12,538 14,112 14,990 14,676 15,384

6676 7491 7601 8203 8660

73,596 70,735 73,946 75,0.32 76,287

697

953

1083

1837

1339

In 1891, 2491 men and 398 women were returned as being engaged in agriculture.

Industries and Trade. — Turkey-red dyeing is now the most dis- tinctive industry ; indeed, the vale of Leven is the headquarters of this industry in Scotland. Clydebank (g.c.) has become an important shipbuilding and engineering centre. Among other in- dustries of the county now of importance, noticed under Dum- barton, Kirkintilloch, Alexandria, Duntocher, &c., are distilling, the manufacture of chemicals, paper-making, and muslin-weaving. 339,559 tons of coal were raised in 1890, valued at £135,824 ; 511,199 tons, valued at £208,740, in 1899. Of ironstone, 107,767

tons, valued at £58,272, were obtained in 1890 ; 38,722 tons, valued at £20,329, in 1899. In 1899 were also obtained 29,585 tons of fireclay, 30,355 tons of sandstone, and 11,398 tons of limestone.

In 1891 the number of persons in the county engaged in indus- trial pursuits was 23,258 men and 7030 women, of whom 2967 men were concerned with machines and implements, 2746 men with ships, 3305 men and 2030 women with textiles, and 5782 men with minerals. Fishing

is carried on on a small scale at Helensburgh and along the Gareloch, and salmon iishing at Dumbarton. About 42 miles have been added to the railway mileage during the past twenty-five years, the largest contributor being the West Highland railway (1894).

AuTHOHiTiEs. — J. Irvikg. Sistory of Dumbartonshire. Dum- barton, I860.— /dew. Book of Dumbartonshire. Edinburgh, 1879.— Sir W. Frasek. Chiefs of Colquhoun. Edinburgh, 18Q9.— Mem. The Lennox. Edinburgh, 1874. — D. Macleod. Castle and Town of Dumbarton. Dumbarton, 1877. — Idem. Dumbarton. Dumbarton, 1884. — Idem. Dumbarton : Ancient and Modern. Glasgow, 1893. — Idem. Ancient Records of Dumbarton. Dumbarton, 1896. — J. Glen. History of Dumbarton. Dumbarton, 1876. Nif, wa.)

Dumfries, a royal and parliamentary burgh (Dum- fries group), railway station, and county town of Dum- friesshire, Scotland, on the left bank of the river Nith. The town is half industrial, half residential. The station has been largely rebuilt, and recent erections are a new post oflce, St George's Hall, a volunteer drill hall, a contagious diseases hpspital, a new academy (£20,000), and a Crichton Institution chapel (£3Q,000). The cor- poration purchased the gas works in 1878, and has rebuilt and enlarged them. Public baths and wash-houses were presented to the town in 1898, and a marble statue of Burns was unveiled in 1882. A free library is under con- struction. The School Boardcontrols anendowed academy. A novitiate has lately been added to the Commercial College of the Marist Brotherhood. Population of royal burgh (1881), 15,759; (1891), 16,675; of parliamentary burgh (1891), 18,049; (1901), 17,081. Maxv^lltown, on the other side of the river, and in Kirkcudbrightshire, but included in the parliamentary burgh of Dumfries, is a burgh of barony and a police burgh. The new bridge connecting the towns has been widened. There are in Maxwelltown 2 tweed mills, 3 hosiery factories, and dye- works. Kecent erections are a Roman Catholic church and convent, an Episcopal mission church, a court house, and a new prison for Dumfries. Population (1891),

4975; (1901), 5789.

Dumfriesshire, a border county of Scotland, bounded S. by the Solway Firth, N. by Lanark, Peebles, and Selkirk, W. by Ayr and Kirkcudbright, and S. by Cumberland.

Area and Population.— In 1891 the Lanark parts of the parishes of Moffat and Kirkjjatrick-Juxta were transferred to Dumfries- shire. The area of the county, according to the latest official estimate, is 688,057 acres, or 1068-8 square miles. The popula- tion was in 1881, 74,808; in 1891, 74,221 ; in 1891, on the above area, 72,245, of whom 34,898 were males and 39,347 females ; in 1901, 72,669. On the old area, taking land only (680,217 acres or 1062-8 square miles), the number of persons to the square mile in 1891 was 70, and the number of acres to the person 9-2. In the registration county the population decreased 2-6 per cent, between 1881 and 1891. Between 1881 and 1891 the excess of births over deaths was 7053, and the decrease of the resident population 1922. The following table gives particulars of births, deaths, and mar- riages in 1880, 1890, and 1899 :—

Tear.

Deaths.

Marriages.

tBirths.

Percentage of Illegitimate.

1880 1890 1899

1417 1469 1255

469 486 482

2252 1962 1835

14-4

13-46

10-8

The following table gives the birth-rate, death-rate, and marriage-rate per thousand of the population for a series of years : —

1880.

1881-90.

1890.

1691-98.

1899.

Birth-rate . Death-rate . Marriage-rate

29-60

18-63

6-17

20-51

19-13

614

26-37

19-74

6-53

26-16

19-22

6-32

25-33

17-32

6-65

In 1891 there were 201 Gaelic-speaking persons in the county, and 75 foreigners. Valuation in 1889-90, £623,427 ; 1899-1900, £629,765.

Administration. — The county returns a member to Parliament. Koyal burghs are Dumfries (17,081), Annan (5804), Lochmaben (1328), and Sanquhar (1379), which all belong to the Dumfries group of parliamentary burghs. Langholm (8142) is the largest police burgh. There are 43 civil parishes, and 2 poorhouses, be- sides the one at Dumfries ; the number of paupers and depend- ants in September 1899 was 1547. Dumfries forms a sheriffdom with Kirkcudbright and Wigtownshire, and there is a resident sheriff-substitute at Dumfries, who sits also at Annan, Langholm, and Lockerbie.

Education. — Forty-five school boards manage 92 schools, which had an average attendance of 10,418 in 1898-99, while 13 volun- tary schools (2 Roman Catholic and 1 Episcopal) bad an attend- ance of 1624. There are academies at Dumfries, Closeburii, Annan, Langholm, and Moffat, and Dryfesdale public school ami others earned grants in 1898-99 for giving higher education. Tlie county council and most of the burgh councils hand over the bulk of the "residue" grant to the County Committee on Secondaiy Education, which expended in 1899 £1076 of parliamentary gram, and £1356 thus contributed on building grants, apparatus, sub- sidies to higher schools, bursaries, and science and technical classes, embracing agriculture, dairying (at Kilmarnock Dairy School), and practical chemistry.

Agriculture. — The percentage of cultivated area was 37-6 in 1898 ; 31,531 acres were under wood in 1895, 1311 having been planted Since 1881. Wheat is a steadily diminishing crop, and the oats acreage, which was 48,292 in 1871, was 43,937 in 1898. The following table- gives the principal acreages at intervals of five years from 1880 : —

Tear.

Area under Crops.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow,

1880 1885 1890 1895 1899

231,447 238,158 249,168 259,082 259,764

50,406 49,708 48,567 46,495 44,414

25,783 25,331 25,978 24,996 23,651

71,450 69,294 76,306 82,797 80,838

83,221

93,535

98,145

104,374

110,790

587

290 130 344 106

The following table gives particulars of the live stock during the same years :^—

Tear.

Total Horses.

Total Cattle.

Cows or

Heifers in

MUkorCalf.

Sheep.

Pigs.

1880 1885 1890 1895 1899

7414 7240 7409 7990 7484

55,676 57,119 58,211 58,067 62,016

16,266 18,677 18,420 19,489 20,339

517,288 490,641 527,319 525,301 566,490

10,286 12,154 14,034 11,531 ,10,915

Pig-feeding has fallen off steadily since the value of the pork product reached £100,000 in 1867. Arable farms range from 100 to 300 acres, and pastoral from 300 to 3000. At the date of the last return, 1895, the average size of the 2785 holdings was 93 acres; 21-83 were under 5 acres, 30-41 between 5 and 50, and 47-76 over 50 acres. The number of farms between 50 and 100 acres was 384 ; between 100 and 300, 763 ; between 300 and 600, 147 ; between 500 and 1000, 34 ; and there were 2 over 1000 acres. The fortunes of agriculture of recent years have not tended to deprive the county of its general pastoral appearance. At the census of 1891 there were 7122 men and 1089 women engaged in agriculture.

Industries and Trade. — The following table shows the output of minerals for 1890 and 1899 ; the figures for coal represent the output of Dumfries and Argyll shires conjointly : —

Tear.

Coal.

Lead Ore.

Sandstone. |

Tons.

Value.

Tons.

Value.

Tons.

Value.

1890 1899

106,128 154,786

£38,471 £58,690

1863 1848

£12,973 £14,500

245^912

£83,039

The number of persons engaged in industrial pursuits in 1891 was 9754 men and 3535 women, of whom 2047 men were con- nected with minerals, and 1192 men and 1308 women with tex- tiles. Dumfries and Annan (gf.v.) are the ports. Only 2 miles have been added to the railway mileage during the past twenty-

five years, but a light railway (16 miles) from Dumfries to Moniaive has been sanctioned.

Authorities. — W. M'Dowell. History of the Burgh of Dum- fries. Edinburgh, 1887. — Idem. Memorials of St MichaeVs Churchyard. Edinburgh, 1876. — Idem. Chronicles of Lincluden. Edinburgh, 1866. — Sir Herbert Maxwell. Dumfries and Oalloway. Edinburgh and London, 1897. — W. Dickie. Dumfries and Round About. Dumfries, 1898. — Transactions of the Dum- friesshire and Galloway Natural History and Antiquarian Society. — J. Macdonald and J. Barbour. Bin-ens and its Antiquities. Dumfries, 1897.— R. W. Weir. History of the Scottish Borderers Militia. Dumfries, 1877. — Historical MSS. Commission.— J . Gillespie. Report on the Agriculture of Dumfriesshire. Edin- burgh, 1869. — Sir William Fraser. The Book of Carlaverock. Edinburgh, 1873.— /(Jem. The Douglas Book. Edinburgh, 1885.— Idem. The Annandale Book. Edinburgh, 1894.— G. Neilson. Annandale under the Bruces. Annan, 1887. — 6. F. Scott- Elliot. The Flora of Dumfriesshire. Dumfries, 1896.— C. T. Kamage. Drumlanrig Castle and the Douglases. Dumfries, 1876.

(w. WA.)

Diinaburg. See Dvinsk.

Dunbar, a royal burgh and seaport of Haddington- shire, Scotland, near the mouth of the Firth of Forth, 28 miles east of Edinburgh by rail. It is a sub-port of Leith, but owing to the advent of steam the shipping is now extinct. The Victoria Harbour (£20,000) is a refuge for vessels between

Leith Eoads and the Tyne. The fishing industry has declined. Shipbuilding and paper- making are no longer carried on, but the manufacture of agricultural implements is considerable, and there is a considerable export trade in potatoes. The town is a rising watering-place. Episcopal and Roman Catholic churches have been built. Dunbar was formerly one of the Haddington group of burghs, but its constituency was merged in that of the county in 1885. Population (1881),

3545 ; (1901), 3581.

Dunblane, a market town and police burgh of Perthshire, Scotland, on the river Allan, 5 miles north-west of Stirling by rail. A masonic hall was erected in 1886 and a town hall in 1887. The mineral springs at Cromlix are included within the beautiful grounds — 18 acres in extent^of the hydropathic establishment, which cost over £60,000. The cathedral underwent restoration, 1892-95, at a cost of £26,000. Population of police burgh

(1881), 2186 ; (1901), 2516.

Duncker, Maximilian Wolfgang (1811- 1886), German historian and politician, eldest son of the publisher Karl Duncker, was born at Berlin on 15th October 1811. He studied at the Universities of Bonn and Berlin till 1834, was then accused of participation in the students' societies, which the Government was endeavour- ing to suppress, and was condemned to six years' imprison- ment, afterwards reduced to six months. He had already begun his labours as a historian, but after serving his sen- tence in 1837, found himself debarred till 1839 from com- pleting his course at Halle, where in 1842 he obtained a pro- fessorship. Elected to the National Assembly at Frankfort in 1848, he joined the Right Centre party, and was chosen reporter of the projected constitution. He sat in the Erfurt Assembly of 1850, and in the second Prussian Chamber from 1849 to 1852. During the crisis in Schleswig and Holstein in 1850 he endeavoured in person to aid the Duchies in their struggles. An outspoken opponent of the policy of Manteuffel, he was refused promotion by the Prussian Government, and in 1857 accepted the professor- ship of history at TillDingen. In 1859, however, he was recalled to Berlin as assistant in the Ministry of State in the Auerswald Cabinet,

and in 1861 was appointed Coun- cillor to the Crown Prince. In 1867 he became Director of the Prussian Archives, with which it was his task to incorpo- rate those of Hanover, Hesse, and Nassau. He retired on 1st January 1875, and died at Ansbach on 21st July 1886. Duncker's eminent position among German historians rests

mainly on his Geschichte des Altertlmms (1st ed., 1852-57 ; 5th ed., in 9 vols., 1878-86; English translation by Evelyn Abbott, 1877-82). He edited, with J. G. Droysen, Preussische Staatsschriften, FoUHsche Correspondenz Friedrichs des Grossen, and Urkunden und Actenstiicke zur Geschichte des Kurfilrsten Friedrich Wilhelm von Brandenburg. To the period of his political activity belong, Zur Geschichte der deutschen Reichsversammlung in Frankfurt (1849) ; Heinrich von Gagern (1850), in the series of Mdmver der Gegenwart; and the anonymous Vier Monate ausivdrtiger Politik (1851). His other works include Origines Germanics (1840) ; the lectures Die Krisis der Reformation (1845) and Fudalitdt und Aristokratie (1858) ; Aus der Zeit Friedrichs des Grossen und FriedrichWilhelms III. Abhandlungen zur preussischen Geschichte (1876) ; followed after his death by Abhand- lungen aus der griechischen Geschichte and Abhandlungen aus, der neueren Geschichte (1887). (h. sy.)

Dundalk, a seaport, urban sanitary district, and formerly (until 1885) a parliamentary borough in the county of Louth, Ireland, on Dundalk Bay, 60 miles north of Dublin. It is a large railway centre, being in communication with Belfast, Dublin, Londonderry, and vid Clones with the western counties. There are also branch lines to Ardee and Greenore, from which there is a service of steam packets to Holyhead. Steamers leave for Liver- pool several times a week, carrying large quantities of farm produce and live stock. In all, 833 vessels of 111,374 tons entered in 1899, and 426 of 72,684 tons cleared. The number of vessels registered in the fishery district in 1899 was 191, employing 689 men and boys. Population

(1881), 11,913 ; (1901), 13,067.

Dundee, a seaport, royal and parliamentary burgh (returning two members), and county of a city (1894), Forfarshire, Scotland, on the

north bank of the Firth of Tay, 69 miles north-north-east of Edinburgh by rail. Its area is 4201 acres. Jute has displaced linen as the principal manufacture of the city, and gives employment to 30,000 hands, flax employing about 10,000. The total annual value of the product of jute goods is estimated at £3,800,000, and of linen goods at £450,000. The following table shows the imports of raw materials and the exports of manufactured articles for 1890, 1896, and 1899 :—

Tear.

Imports.

Flax.

Tow and Cod ilia.

Hemp.

Jute.

1890 1895 1899

1890

1895 1899

Tons.

29,896 24,673 15,753

Tons.

4776 5175 6485

Tons.

1053 2147 1826

Tons.

206,759 277,314 198,718

Exports.

Linen and Jute Cloth.

Bags and

Sacks.

Sea.

Tarn. Sea.

To

72,

Eail.

ns.

371

Sea.

Tons.

16,900

16,448 17,910

Tons.

21,189

24,531 33,808

Tons.

72,401 81,107

Tons.

97,057 81,500

The Arctic seal and whale fishing employed 6 vessels in 1898. The total expenditur^on the harbour, with its 36\ acres of wet docks and tidal basin, was £1,088,620 up to 1898, and the debt was then £386,883, including £20,000 for the Tay ferries, which were taken over by the Harbour Trust in 1890, and on which £58,465 has since been ex- pended. In 1891 the revenue of the harbour was £62,829, and in 1898 £60,636. In 1888, 1244 vessels of 520,363

tons entered the port, and 774 vessels of 341,192 tons cleared ; in 1898, 1497 vessels of 661,264 tons entered, and 1417 of 729,067 tons cleared. The registered shipping at the port at the close of 1898 was 140 vessels of 109,073 tons. In 1889, 14 vessels of 18,311 tons were launched from the shipbuilding yards ; and in 1899, 19 vessels of 17,908 tons. Recent erections are the Victoria Art Gal- leries, the Victoria Hospital for Incurables, the Maternity- Hospital and Nurses' Home, infectious diseases hospital, small-pox hospital, royal lunatic asylum, and bronze statues of Queen Victoria (1899^ and Burns (1880). Lochee Park (25 acres) and Fairmuir (12 acres) were presented to the town in 1883 and 1890. Dundee Law has been acquired by the corporation, and the Barrack Park was bought in 1893 for £40,000. The esplanade on the river frontage was extended in 1893 to a total length of 21 miles ; and about 130 acres of additional recreation ground are about to be reclaimed from the river, as a result of which the esplanade will be extended another half mile. A large part of the town has been reconstructed of late years, under an Improvement Act, at a total cost of about half a million sterling; and another scheme of reconstruction is in progress, which will cost a further sum of £350,000. There are 18 Established churches, 32 United Free, 8 Congregational, 5 Scottish Epis- copal, 5 Roman Catholic, 2 Wesleyan,

and 6 belonging to other denominations. Dundee University College was founded in 1881 by Dr and Miss Baxter, and has now endowments amounting to £224,027. The college has, after much litigation, been incorporated with the Univer- sity of St Andrews, and has a staff of principal, 13 profes- sors, and numerous lecturers in arts, science, medicine, and law. Evening classes form an important part of the teaching scheme, and a training college for teachers has just been inaugurated. There are also a technical insti- tute, two endowed high schools — one for boys and the other for girls — and 35 elementary schools. The two academies and 21 of the elementary schools are managed by the School Board, and have an average attendance of 17,653 ; while the other 14 schools, of which 6 are Roman Catholic and 4 Episcopal, have an average attendance of 5176. On board a training-ship, which lies in the Tay, there are about 400 boys, one-fourth of whom belong to Dundee. Valu- ation in 1889-90, £640,225; 1899-1900, £829,388. Pop- ulation (1881),- 140,794; (1891), 154,118; (1901),

160,871.

Authorities. — David Barrie. The City of Dundee Illus- trated. Dundee, 1890. — J. M. Beatts. The Municipal History of Dundee. Dundee, 1878. — Charles S. Lawson. Guide-Book to Dundee. — Alexander Maxwell. Old Dundee. Dundee, 1891. — Idem. History of Old Dundee. Dundee, 1884. — Dundee Tear-Booh, 1878-99.— A. C. Lamb. Dundee: its Quaint and Historic Buildings. Dundee, 1895. — A. H. Millar. Boll of Eminent Burgesses of Dundee. Dundee, 1887. (w. wa.)

Dunedin, the third largest city of New Zealand, with (1901) 53,294 inhabitants, not including 2205 persons in the borough of Port Chalmers, eight miles distant, on the same harbour. The former prosperity of Dunedin has lately revived, owing in part to gold- dredging in the Otago rivers. The University College includes a School of Medicine and Medical Museum, and a School of Mines. ‘ The University library contains 5000 works of reference, well selected. The primary and secondary schools of the town are excellent. Pour hundred and two pupils attend the School of Art, and there is a small training college for state teachers. Dunedin is well built and well administered. The total import and export trade was

£2,721,677 in 1893 ; £4,423,442 in 1899 ; and £3,636,248 in 1900. The headquarters of the Union Steamship Company of New Zealand are in Dunedin.

Dunfermline, a royal, parliamentary (Stirling and Dunfermline group), and police burgh and city of

Fif eshire, Scotland, 5^ miles north of the Forth Bridge by rail. The new corporation buildings were completed in 1879 and cost £26,000 ; other erections have been a public hall, a Carnegie free library, and new buildings for the high school. Population of the royal and police burgh (1881), 19,916; (1901), 26,250.

Dungannon, an inland town and urban sanitary district in the county of Tyrone, Ireland, 94^ miles north- north-west of Dublin by rail. It ceased to be a par- liamentary borough in 1886. Population (1881), 4084 ;

(1901), 3693.

Dungarpur, a native state of India in the Rajputana Agency, in the extreme south of Rajputana. A large portion is hilly, and inhabited by Bhils. Its area is 1440 square miles. The population in 1881 was 86,429; in 1891 it was 165,400, including 66,952 Bhils, who were not enumerated in 1881, giving an average density of 115 persons per square mile. In 1901 the total population was 100,018, showing an apparent decrease of 40 per cent., due to the famine of 1899- 1900. The revenue in 1896-97 was Rs.2,21,297, and the tribute was Rs.34,147. An annual fair is held at Banes- war, where goods are sold to the value of Rs. 2,50,000, chiefly cloth. Kherwara is the headquarters of the Meywar Bhil corps.

Dungarvan, a maritime town and urban sanitary district in the county of Waterford, Ireland, 125 miles south-west of Dublin by rail. It ceased^ to be a parliar mentary borough in 1885. The exports are chiefly agri- cultural. Population (1881), 6306 ; (1901), 4850.

Dunkirk, or Dunkerque, a seaport and chief town of arrondissement, department of Nord, France, 63 miles north-west of Lille by rail. It has a chamber of commerce, a library, two hospitals, a college, and schools of

design, painting, architecture, and music. An important wool depot and market has been established here under the auspices of the Chamber of Commeifll (1900). The spinning of flax, hemp, and jute, and the manufacture of artiflcial manures, soap, and esparto bathing shoes, have become important industries. A shipbuilding yard cover- ing an area of 27 acres and fitted with the newest appli- ances has been recently established. The first ships were laid down in 1901. Direct steamship service has been arranged with Cochin China and with South America (La Plata river). The number of vessels entered and cleared „ in 1900 was respectively 2698, tonnage 1,613,774, and 2622, tonnage 1,613,188 ; of which British vessels entered numbered 1107 of 600,672 tons, and cleared 1099 of 687,412 tons. Large quantities of produce are im- ported from Australia, India, and North and South America. The principal imports in 1900 were grain, coal, iron ore, nitrate of soda, wool, oil-seeds, wood, raw fibres, petroleum, pitch, metals ; and the principal exports sugar, coal, iron and steel, phosphates, forage, bricks, cement. The Iceland cod-fishery, employing 83 vessels manned by 1436 men, yielded 4569 tons of fish and 280 tons of oil. The harbour accommodation has been greatly in- creased since 1876, and now comprises seven basins, while still further extensions are projected. The entrance canal from the sea to the outer harbour has a length of 3113 feet, width between jetties 229 feet (to be increased to , 425 feet), depth ordinary spring tide 27 feet. The total length of quayage is nearly 6 miles. A canal connects the docks with the inland canals. Three lighthouses now mark the approach to the port, of which one at an altitude of 193 feet is visible 42 miles. Population (1881) , 34,769 ;

(1901), 40,329.

Dunkirk, a city of Chautauqua county. New York, U.S.A., in 42° 29′ N. lat. and 79° 20′ W. long., on the

south shore of Lake Erie. It is regularly laid out, has a good harbour, with a fair share of the lake commerce, and is entered by no fewer than five

railways, which give it a large inland trade. It is a manufacturing city, and contains locomotive works. Population (1880), 7248 ; (1890), 9416; (1900), 11,616, of whom 3338 were foreign- born.

Dun more, a borough of Lackawanna county, Penn- sylvania, U.S.A., in the anthracite coal region, at an altitude of 939 feet. It is on the Erie and Wyoming Valley railway. The mining and handling of anthracite coal constitute its principal, almost its sole, industry. Population (1880), 5151; (1890), 8315; (1900), 12,683, of whom 3103 were foreign-born.

Dun mow, a town in the Epping parliamentary division of Essex, England, 12 miles north-west by north of Chelmsford by rail. It ceased to be a corporate town in 1886, and the town hall (1578) has been purchased by a company. Area of parish, 6795 acres ; population,

(1881), 3005; (1901), 2704.

Dunoon, a watering-place and police burgh (1868) of Argyllshire (including Dunoon, Kirn, and Hunter's Quay), on the west shore of the Pirth of Clyde, nearly opposite Greenock. Recent constructions are a combina- tion hospital, a new pier at Dunoon, and a court house. An esplanade has been laid out, and Dunoon Castle and grounds made into a place of recreation. A statue of Burns's "Highland Mary" was erected in 1898. One of the public schools is a grammar school. Population

(1881), 4692; (1901), 6772.

Duns, a burgh of barony, police burgh, and railway station of Berwickshire, Scotland, 44 miles east-south-east of Edinburgh by road. There are a town hall, county buildings, a corn exchange, a mechanics' institute, and a public library. Duns has become the virtual county town of Berwickshire, and the county buildings are being en- larged with a view to its being legally constituted as such. Population (1881), 2438 ; (1901), 2206.

Dunstable, a municipal borough and market town in the Luton parliamentary division of Bedfordshire, England, 37 miles north by west of London by rail. A grammar school has been founded out of the funds

of the Ashton charity, and an endowed school built. Extensive printing works have been established. Area, 453 acres ; population (1881), 4627; (1901), 5147.

Dupanloup, Felix Antoine Philibert, Prench ecclesiastic (1802-1878), was born in Savoy on 3rd January 1802. In his earliest years he was confided to the care of his brother, a priest in the diocese of Chambery. In 1810 he was sent to a pensionnat eccUsiastique at Paris. Thence he went to the seminary of St Nicolas de Chardonnel in 1813, and was transferred to the seminary of St Sulpice at Paris in 1820. In 1825 he was ordained priest. In the same year he became vicar of the Madeleine at Paris. He became the founder of the celebrated Academy at St Hyacinthe, and received a letter from Gregory XVI. eulogizing his work there, and calling him Apostolibs juventuti.i. His imposing height, his noble features, his brilliant eloquence, as well as his renown for zeal and charity, made him a prominent feature in French, life for many years. Crowds of persons attended his addresses, on whom his energy, command of language, powerful voice, and impassioned gestures made a profound impression. When made bishop of Orleans in 1848, he pronounced a fervid panegyric on Joan of Arc, which attracted attention in England as well as France. Before this he had been sent by Archbishop Affre to Eome, and had been appointed Roman Prelate and Protonotary Apostolic. For thirty years he remained a notable figure in

France. He instituted the celebrated catechetical method of St Sulpice, and, with Mgr Darboy, took a prominent part in opposing the proclamation of papal infallibility in 1870. He died on 11th October 1878. (j. j. l.)*

Diippel, a village of Prussia, province of Schleswig- Holstein, opposite the little town of Sonderburg (on the island of Alsen), the scene of bloody contests between the Germans and the Danes. Here in 1848 the former were repelled by the latter. The Danes then constructed strong earthworks at this spot, the key of Alsen, which, however, were stormed by the Germans in the following year. At the outbreak of the war between Denmark and Austria-Prussia in 1864 the Danes had established themselves in this same position behind a dozen lines of earthworks, but

their defences were stormed by the Prussians on the 18th April of the year named. After being still ,f urther strengthened and linked with similar defences at Sonderburg, the Diippel entrenchments were abandoned in 1881 in favour of the project of fortifying Kiel.

Dupuy, Charles Alexandre (1851),

French statesman, was born at Le Puy, 5th November 1851, his father being a local official. After beiiig a professor of philosophy in the provinces, he was appointed a school inspector, and thus obtained a practical acquaint- ance with the needs of French education. In 1885 he was elected to the Chamber as an Opportunist Repub- lican. After acting as " reporter " of the budget for public instruction, he became minister for the department, in M. Ribot's cabinet, in 1892. In April 1893 he formed a ministry himself, taking as his office that of minister of the interior, but resigned at the end of November, and on 5th December was elected president of the Chamber. During his first week of office an anarchist, Vaillant, who had- managed to gain admission to the Chamber, threw a bomb at the president, and M. Dupuy's collected bearing and conduct on this occasion gained him much credit. In May 1894 he again became premier and minister of the interior; and he was by President Carnot's side when the latter was stabbed to death at Lyons in June. He then became a candidate for the presidency, but was defeated, and his cabinet remained in office till January 1895 ; it was under it that Captain Dreyfus was arrested and condemned (23rd December 1894). The progress of Vaffaire then cast its shadow upon M. Dupuy, along with other French " ministrables," but in November 1898, after M. Brisson had at last remitted the case to the judgment of the Cour de Cassation, he formed a cabinet of Republican concentration. In view of the apparent likelihood that the judges of the criminal division of the Cour de Cassation — who formed the ordinary tribunal for such an appeal — would decide in favour of Dreyfus, it was thought that M. Dupuy's new cabinet would be strong enough to reconcile public opinion to such a result ; but, to the surprise of out- side observers, it was no sooner discovered how the judges were likely to decide than M. Dupuy proposed a law in the Chamber transferring the decision to a full court of all the divisions of the Cour de Cassation. This arbitrary act, though adopted by

the Chamber, was at once con- strued as a fresh attempt to maintain the judgment of the first court-martial ; but in the interval President Faure (an anti-Dreyf usard) died, and the accession of M. Loubet doubtless had some effect in quieting public feeling. At all events, the whole Cour de Cassation decided that there must be a new court-martial, and M. Dupuy at once resigned (June»1899).

Dupuy de Lome, Stanislas Charles Henri Laurent (1816-1855), French naval architect, the son of a retired naval officer, was born at Ploemeur, near

Lorient, on 15tli October 1816. He entered the ;^cole Polytechnique in 1835, and in 1842 was sent to England to study and report on iron shipbuilding. Acting on his report, -which was published in 1844, the Government built their first iron vessels under his supervision. He planned and built the steam line-of-battle ship Napoleon (1848-62), and devised the method of altering sailing ships of the line into steamers, which was afterwards extensively practised in both France and England. He also showed the practicability pf armouring the sides of a ship, and the frigate Gloire gave a very clear demon- stration of his views. It was the beginning of the great change in the construction of ships of war which has been going on ever since. In 1857 Dupuy de Lome was appointed " chef de la direction du materiel," at Paris ; and in 1861 "inspecteur general du materiel de la ma- rine." In 1866 he was elected a member of the Acade- mie des Sciences. At the beginning of the war with Germany in 1870 he was appointed a member of the Committee of Defence, and during the siege of Paris occupied himself with planning a steerable balloon, for carrying out which he was given a credit of 40,000 fr. ; but the balloon was not ready till a few days before the capitulation. The experiments that were afterwards made with it did not prove entirely satisfactory. In 1876 he was busy over a scheme for embarking a railway train at Calais, and exhibited plans of the improved harbour and models of the " bateaux porte-trains " to the Acade- mic des Sciences in July. In 1877 he was elected a sen- ator for life. He received the cross of the

Legion of Honour in 1846, was made a commander in 1858, and grand officer in December 1863. He died at Paris on 1st February 1885. (j. k. l.)

Duquesne, a borough of Allegheny county, Penn., U.S.A., on the Monongahela river, and on a line of the Pennsylvania railway, a few miles south-east of Pitts- burg. It is an iron-manufacturing place of recent growth. Population (1900), 9036, of whom 3461 were foreign- born and 192 negroes.

Durance (ancient Druentia or DUrentia, from Celtic "dour," water), a river of South-East France, tributary to the Ehone. It rises in the department of Hautes Alpes, near the Italian frontier, at the foot of the Gon- dran Pass, 3 or 4 miles in direct line east of Brianqon. Here, in a valley open to the north and dominated by lofty mountains, are deep ponds apparently with no outlet, but really drained by a subterranean channel which issues 2 miles to the north. The stream then flows south-west, passing Mont Gen^vre, and at the ham- let of Alberts is joined by the Clairee, a mountain tor- rent from the north. The Durance passes BrianQon through a defile between that town and the fortress of Trois-T8tes, and about 6 miles lower bends to the south and flows for 1^ miles through the deep gorge of Bessie or Baissde. Between Savine and Sisteron, in Basses Alpes, the river forms a wide western bend, separating the departments of Hautes and Basses Alpes. At Sis- teron it is joined by an important tributary, the Bench, aiid a little below Volonnes is joined on the left bank by the BleSne. It borders for 2^ miles the department of Var, where it is joined by its most important tribu- tary, the Verdon. It then flows west and north-west between the^ departments of Vaucluse and Bouches du EhSne, and falls into the Rhone 3 miles below Avignon. Its length is 217 miles, and the area of its basin 5800 square miles. The breadth is extremely variable — sometimes vei:y small, sometimes spreading to nearly li miles. At its outfall in the Ehone the breadth is only about 130 yards. The Durance preserves through- out its whole course the character of a torrent, and it

is consequently quite useless for navigation, but for ir- rigation purposes it is of the highest importance. For- merly reckoned one of the three great scourges of Provence, it is now a source of immense benefit. In the

departments of Vaucluse and Bouches du EhSne it irri- gates nearly 100,000 acres, and tracts in the Crau for- merly sterile and almost worthless are now amongst the best lands in France. Its virtue as a fertilizing agent is largely due to the immense quantity of rich mud which it brings down, containing, according to M. Herv^Mi- gnon, as quoted by Joanne, " as much assimilable nitro- gen as 100,000 tons of excellent guano, and as much carbon as would be supplied by a forest of 121,000 acres." Amongst the principal irrigation canals which the Durance supplies are those of PeyroUes, Marseille, Crapannes Cabddan Neuf, Alpines, Chateau-renard and Eyragues, and Rognonas. Barrage reservoirs in the de- tile of the Upper Durance and of the Verdon augment and regulate the supply of water to the canals. The Durance is classed as floatable from the bridge of St Clement (Hautes Alpes) to the Ehone, a length of 169 miles, but the amount of trafilc is small. It is believed that in a former geologic period the Durance flowed as an independent river through the valley now traversed by the Canal des Alpines to the Gulf of Fos, though probably having a subsidiary connection with the Ehone by one or more arms.

Durango, a state of Mexico, bounded on the N. by that of Chihuahua, on the E. and S.E. by the state of Coahuila ; Zacatecas and the Territory of Tepic on the S., and Sinaloa on the W. It has an area of 38,020 square miles. The population in 1879 was 190,846, and in 1900 was 371,274. It is one of the richest states of the Eepublic as to agriculture, mining, and stock-raising, and is divided into 13 partidos and 49 municipalities. The capital, Durango, 574 miles from the city of Mexico, has a population of 26,426, and contains many fine build- ings, notably the cathedral, one of the handsomest in the Eepublic, besides a mint, city and suburban railways, electric lights, cotton and woollen mills, foundries, flour and sugar mills. Amongst other cities are Villa Lerdo, Guanacevi (6869), San Juan de Guadalupe, Nombre de Dios, San Dimas, and El Oro.

Durazzo, a Turkish seaport on the Adriatic, and the chief town of the sanjak of Durazzo, in Albania. The chief exports are olive oil — largely manufactured in the district — wheat, oats, barley, pottery, and skins. The population is about 6000.

Durban, seaport town of Natal, South Africa. It has a population within the township of 39,245 (1898), namely, 17,706 Europeans, 10,924 natives, and 10,616 Indians. It is well laid out, has many good public buildings, including a very fine town hall, central railway station, and public baths. It has an extensive system of electric lighting and an efficient drainage scheme. A tram service con- nects the Point, the town proper, and the Berea, which is the residential suburb. The rateable value of the borough in 1899 was £5,626,696. The harbour, which used to be impeded by a bar, has been much improved of late years, and this change, besides leading to a large increase of shipping business, was of material service in connexion with the Boer war.

Duren, a town of Prussia, in the Ehine province, on the river Eoer, 19 miles by rail east from Aix-la-Chapelle. It is the seat of cloth, paper, carpet, flax-spinning, artificial wool, sugar, iron-wares, and other manufactures. Here are several new buildings and monuments — the former em- bracing the provincial lunatic asylum and the church of St Joachim; the latter, monuments to the Emperors William I. and II., Bismarck, and the war of 1870-71.

The town hall contains a selection of antiquities. There are also a synagogue, technical school, library, and hospital. Population (1885), 19,802 ; (1901), 27,171.

Durham, a north-eastern county of England, bounded S.E. and S. by Yorkshire, W. by Westmoreland and Cumberland, N.W. and N. by Northumberland, and E. by the North Sea.

Area and Population. — The area of the ancient and administra- tive county, as given in the census tables of 1891, was 647,281 acres or 1011 square miles, with a population in 1881 of 867,576 and in 1891 of 1,016,559, of whom 517,942 were males and 498,617 females, the number of persons per square mile being 1005, and of acres to a person 0-64. In 1895 the area of the administrative county was slightly enlarged, by the

transference from the North Riding of Yorkshire of the area which, prior to the passing of the Local Government Act, 1894, constituted the part of the township of Linthorpe in the borough of Stockton. The area of the registra- tion county is 764,788 acres, with a population in 1891 of 1,024,369, of whom 668,782 were urban and 355,587 rural. Within the regis- tration area the population between 1881 and 1891 increased 26-28 per cent. The excess of births over deaths between 1881 and 1891 was 169,257, and the actual increase of the resident population was 148,885. In 1901 the population was 1,187,.S24.

The following table gives the number of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 :—

Tear.

Marriage B.

Births.

Deaths.

Illegitimate Births.

Males.

Females.

1880 1890 1898

6419 8534 9977

33,197 36,955 40,240

19,796 20,767 22,169

704 668 718

681 663 723

The number of marriages in 1899 was 10,101 ; of births, 40,991 ; and of deaths, 22,530.

The following table shows the marriage-, birth-, and death-rates per 1000 of the population, with the percentage of illegitimate births, for a series of years : —

1870-79.

ISSO.

1889.

1S8S-97.

1898.

Marriage-rate . . . » .

Birth-rate

Death-rate

Percentage of illegitimate births .

17-3

44-3

24-0

4-2

14-9

38-5

22-9

4-2

16-9

36-5

20-5

3-6

15-7

36 0

19-3

3-8

17-5

35-2

19-4

3-6

The birth-rate is much above the average, and the death-rate is also above it, but the percentage of illegitimate births is consider- ably below it.

In 1891 the number of Scots in the county was 26,857,. of Irish 27,663, and of foreigners 5366.

Constitution and Gfovernment. — The county is divided into eight parliamentary divisions, and it also includes the parliamentary borough of Sunderland, returning two members ; and the boroughs of Darlington, Durham, Gateshead, Hartlepool, South Shields, and Stockton-on-Tees, each returning one member. There are nine muni- cipal boroughs: Darlington (44,496 in 1901), Durham (14,641), Gateshead (109,887), Hartlepool (22,737), Jarrow (34,294), South Shields (97,267), Stockton-

on-Tees (51,476), Sunderland (146,565), and West Hartlepool (62,614) ; Gateshead, South Shields, and Sunderland are county boroughs. The following are urban districts : Hebbum (20,901), Hetton (13,673), Houghton-le-Spring (7858), Leadgate (4658), Ryton (8448), Seaham Harbour (10,163), Shildon and East Thickley (11,759), Southwiok (12,643), Spennymoor (16,661), Stanhope (1964), Stanley (13,553), Tanfield (8178), Tow Law (4371), Whickham (12,851), and Willington , (7887).

Durham is in the north-eastern circuit, and assizes are held at Durham. The boroughs of Darlington, Durham, Gateshead, Hartle- pool, Jarrow, South Shields, Stockton-on-Tees, and Sunderland have separate commissions of the peace. The ancient county, which is in the diocese of Durham, contains 238 ecclesiastical parishes, and parts of two others.

Mducation. — The city of Durham (q.v.^is the seat of a university, and it has also a residential training college (diocesan) for school- masters and schoolmistresses. At Ushaw, near Durham, there is a Roman Catholic college. The number of elementary schools on 31st August 1899 was 519, of which 187 were board and 332 voluntary ; the latter including 218 National Church of England schools, 19 Wesleyan, 54 Roman Catholic, and 51 "British and other." At South Shields there is a board school for blind children ; there is another at Sunderland ; Darlington and Stockton-on-Tees have each a board school for deaf children. The average attendance at

board schools in 1899 was 93,095, and at voluntary schools 91,713. The total school board receipts for the year ended 29th September 1899 were over £356,360. The income under the Technical Instruc- tion Act was over £1289 ; that under the Agricultural Rates Act was over £2343.

Agriculture. — Nearly two-thirds of the total area of the county are under cultivation, but nearly two-thirds of this are in permanent pas- ture. Th^re are also about 49,000 acres of hill-pasture, and 29,000 acres under woods. Of the area under corn crops, which has greatly diminished, oats occupy about one-half, and wheat and barley each about a fourth. Nearly two-thirds of the acreage under green crops are occupied by turnips, many cattle being raised. The following table gives the acreages of the

larger main divisions of the culti- vated area at intervals of five years from 1880 : —

Tear.

Total Area under Cultiva- tion.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1880 1885 1890 1895 1900

415,626 423,421 435,084 439,144 438,713

90,771 81,645 7.3,065 65,038 65,726

34,835 35,267 32,285 33,023 33,488

44,582 48,265 56,518 53,907 51,780

226,867

241,900 260,064 277,355 280,190

19,155

16,332

12,886

9,425

7,186

r

The following table gives particulars regarding the live stock for the same years : —

Tear.

Horses.

Total Cattle.

Cows or

Heifers in

Milk or in

Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1900

16,839 16,586 17,925 20,425 20,167

62,395 69,427 69,037 71,968 78,183

21,124 25,202 26,004 26,190 28,822

214,427 198,471 224,504 226,041 258,257

7,732 11,913 14,758 12,894 10,024

Industries and Trade. — According to the annual report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 99,219, as compared with 95,115 in 1896. Only 1760 were employed in textile factories. As many as 90,039

were employed in non-textile factories, there being an increase between 1895 and 1896 of 7-3 per cent. ,and between 1896andl897of4-lpercent. Morethanhalf (46,376) wereemployed in the manufacture of machines, appliances, conveyances, tools, &c. This includes those employed in the iron and steel shipbuilding yards of the Tyne, Stockton-on-Tees, and the Hartlepools. TheTyne ship- building industry is second only to that of the Clyde, and the greater portion of it is carried on within the Durham boundaries. The total number of ships built in the Tyne ports and at the Hartle- pools, Stockton, and Sunderland in 1895 was 174, with a tonnage of 229,868 ; in 1898 it was 224, with a tonnage of 319,705. Next to shipbuilding the most important industry is the founding and con- version of metal, which in 1897 employed 17,980 persons, the extraction of metal employing 3148. Other industries are the manu- facture of paper, &c., employing 3211 persons ; of chemicals (chiefly on the Tyne), employing 3289; and of glass (at Gateshead and Sunder- land), employing 3264; and of clay, stone, &c. (chiefly earthenware at Gateshead and Sunderland), 3195. In workshops, 7240 persons were employed — 4403 in clothing industries. The total number of persons employed in mines and quarries in 1899 was 111,720. Of limestone 1,944,207 tons were raised in 1899, the largest amount of any county in the United Kingdom, of clays 744,453 tons, of which 498,011 were mainly fireclay, of sandstone 82,048 tons, of igneous rocks 73,644 tons, and of gravel and sand 20,471 tons. But the most important mineral is coal. The coalfield of Durham is at present by far the most productive in England ; and although the county's output of iron is inconsiderable, its proximity to the great Cleveland iron region of North Yorkshire enables it now to produce over 1,000,000 tons of pig iron annually. There is also a very large pro- duction of salt from brine. The following /table gives particulars regarding the more valuable minerals in 1890 and 1899 : —

Tear.

Coal.

Ironstone.

Lead.

Salt.

Tons.

Value.

Tons.

Value.

Tons.

Value.

Tons.

Value.

1890 1899

80,265,241 34,870,675

£11,084,202

12,065,153

11,488 16,960

£8591

6360

9781 8361

£81,422

82,958

119,971 197,610

£64,990

98,868

The only fishing stations mentioned in the annual return relating to the sea fisheries of the United Kingdom are Sunderland and East Hartlepool, the total quantity of fish landed in 1898 being 118j884 cwt., valued at £95,826.

AtiTHORiTiES. — Hutchinson. History and Antiquities of the County Palatine of Durham, 3 vols. Newcastle, 1785-^94. —

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SuBTEES. History and Antiquities of the County Palatine of Durham, 4 vols. London, 1816-40.— Raine. History and Anti- quities of North Durham. London, 1852.— D. M. A. A Collection of Bhymes, Proverbs, and Sayings. C. W. Dunelm, 1859.— Pekrt and Herman. Illustrations of the Mediaeval Antiquities of the County of Durham. Oxford, 1867.— Lebohe. Outlines of the Geology of Durham. Newcastle, 1886. See also the Surtees Society's Publications and Transactions of the Architectural So- ciety of Durham and Northumberland.

Durham, a city, municipal and parliamentary bor- ough (since 1885 returning only one member), and county town of Durham, England, on the Wear, 256 miles from London by rail. The cathedral has undergone extensive repairs and the chapter-house been restored. The grammar school, the diocesan training colleges for schoolmasters and schoolmistresses, and the County Hospital have been en- larged. A mission church, a high school for girls, and the Shire Hall and County Buildings have been erected. Manufactures of hosiery and iron-works have been intro- duced. Area of municipal borough, 880 acres ; population (1881), 14,932 ; (1901), 14,641. (See Univbesitibs.)

Durham, capital of Durham county, North Carolina, U.S.A., on the Southern, the Norfolk and Western, and the Seaboard Air Line railways,

at an altitude of 392 feet. It is the seat of Trinity College, a Methodist Epis- copal institution. The surrender of General J. E. John- ston, at the close of the Civil War, took place in this neighbourhood on 25th April 1865. The growth and prosperity which have come to the city since the Civil War are due to the development of its tobacco manufac- tures. Population (1880), 2041 ; (1890), 6485 ; (190Q), 6679, of whom 108 were foreign-born and 2241 negroes.

(t. f. h.)

Durlach, a town of Germany, grand-duchy of Baden, 2|- miles by rail east from Carlsruhe. A funicular railway runs to the top of the Turmberg. Gardening, iron-founding, and the manufacture of sewing and other machines, starch, chicory, and pottery are carried on. Population (1885), 7656; (1901), 11,353.

Duruy, Jean Victor (1811-1894), French histo- rian and statesman, was born in Paris on 11th September 1811. The son of an artisan, he was at first intended for his father's trade, but succeeded in passing brilliantly through the Ecole Normale Superieure, and then held a suc- cession of professorships and educational inspectorships. He assisted Napoleon III. in his life of Julius Csesar, and his abilities being thus brought under the emperor's notice, he was in 1863 appointed Minister of Education. In this position he displayed incessant activity, and a desire for broad and liberal reform which aroused the bitter hostility of the clerical party. Among his measures may be cited his organization of higher education (" enseignement special"), his foundation of the "conferences publiques," which have now become universal throughout France, and of a course of secondary education for girls by lay teach- ers, and his introduction of modern history and modern languages into the curriculum both of the lycies and of the colleges. He greatly improved the state of primary education in France, and proposed to make it compulsory and gratuitous, but was not supported in this project by the emperor. In the new cabinet that followed the elections of 1869, Duruy was replaced by Bourbeau, and was made a senator. After the fall of the Empire he took no part in politics, except for an unsuccessful candidature for the Senate in 1876. From 1881 to 1886 he served as a member of the Conseil Superieur de

I'lnstruction Pub- lique. In 1884 he was elected to the Academic Franqaise in succession to Mignet. He died in Paris on 26th Nov- ember 1894. Duruy's fame as a historian rests mainly on the revised edition of his Eoman history. First pub-

lished in 2 vols, under the title of Histoire des Bomains et des peuples sounds d leur domination (1843-44), it ap- peared in a greatly enlarged form in 7 vols, under the title of Histoire des Bomains depuis les temps les plus reculisjusqu'd, la mort de Thiodose (1876-85) ; a magnifi- cent illustrated edition was published from 1879 to 1886 (English translation by W. J. Clarke, in 6 vols., 1883-86). His Histoire des Orecs, similarly illustrated, appeared in 3 vols, from 1887 to 1889 (English translation in 4 vols., 1892). He was the editor, from its commencement in 1846, of the Histoire universelle, publiie par une sociki de professeurs et de savants, for which he himself wrote a "Histoire sainte d'apres la Bible," "Histoire grecque," " Histoire romaine," " Histoire du moyen age," " Histoire des temps modernes," and "Abrege de I'histoire de France." His other works include Atlas liistorique de la France accompagni d'un volume de texte (1849) ; Histoire de France de IJ^S h 181& (1856), of which an expanded and illustrated edition appeared as Histoire de France depuis I'invasion des barbares dans la Oa%de romaine jusqu'd, nos jours (1892) ; Histoire populaire de la France (1862-63) ; Histoire popvlaire contemporaine de la France (1864-66) ; Causeries de voyage (1864) ; and Introduction gin6i-ale d, I'histoire de France (1865). A memoir by Ernest Lavisse appeared in 1895 under the title of Un Ministre : Victor Duruy. (h. sy.)

Dusseldorf, a town of Prussia, in the Ehine pro- vince, on the right bank of the Ehine, 24 miles by rail north by west from Cologne. Dusseldorf is one of the handsomest cities of Western Germany. Its situation on the great mid-European waterway and as the junction of several main lines of railway has largely favoured its rapid growth and industrial development. It is the principal banking centre of the Westphalian coal and iron trade, and the favourite residence of the leading merchants of the lower Ehine. Of late the city has been much ex- tended and improved. New quays, with a magnificent har- bour, affording accommodation for vessels of deep draught, have been built, and the trade with the Dutch ports, and with

London {hereby greatly enhanced. On the south side the town has been of late completely metamor- phosed by the removal of Koln-Mindner and Bergisch Maerkisch stations to a new central station lying to the east. The site gained has been converted into new boule- vards, while the railway to Neuss and Aix-larChapelle has been diverted through the suburb of Bilk and thence across the Ehine by a new iron bridge. A new road bridge (completed 1898, 2087 feet long), replacing the old bridge of boats, carries the electric tram-line to Crefeld. Dusseldorf ranks as one of the art centres of Europe, and is especially famous for its school of painting, which is largely attended. Many handsome modern build- ings have been recently erected. The west wing of the town hall was rebuilt in 1885. The building of the academy of art, in the Eenaissance style, was erected in 1879-81. The art exhibition (1881), with a mosaic faqade, contains the municipal picture gallery and a permanent exhibition of pictures. In front of it stands a bronze statue of ^Bismarck (1899). In the old town there are, further, the industrial art museum (1896), the historical museum, and the industrial art school (1882). In the quarters which lie east and north of the old town the most note- worthy of the newer buildings are the Johannes (1876-81), St Eochus, and the Heil Empfangniss Kirchen (1896) ; the law courts ; the Eoman Catholic hospital of St Mary ; the state archives; the bronze statue of Cornelius, by Donndorf (1879) ; the bronze equestrian statue of the Emperor William I. (1896) ; and the war memorial in the botanical gardens. To the south of the old town lie the assembly hall of the Ehenish provincial diet, an Italian

Renaissance edifice (1879), and in front of it a large bronze group representing the river Rhine and its chief tributaries, by Tushaus and C. Janssen (1897) ; Petri Kirehe ; and the house in which the poet Freiligrath (1810-76) lived. Tarther south, in the suburb of Bilk, there are the Flora Garten and the Volks Garten, the as- tronomical observatory (51° 12′ 25″ N. lat., 6° 46′ 13″ E. long.), and the harbour. Towards the extreme north-east lie the zoological gardens. Within quite recent years

Diisseldorf has made remarkable progress as an indus- trial centre. The first place is occupied by the iron in- dustries, embracing foundries, furnaces, engineering and machine shops, &c. Next come cotton spinning and weaving, calico printing, yarn-spinning, dyeing, and similar textile branches, besides a variety of other indus- tries. Population (1885), 115,190; (1890), 144,642;

(1895), 175,985; (1900), 212,949.

Dutch East Indies. See Malay Archipelago.

Dux (Czech, Duchovcov), a town in the government district of the same name m Bohemia, Austria; the cen- tre of an extensive lignite or brown coal deposit, which is worked in sixteen different pits. It has also a steam corn-mill and a sugar refinery, and manufactures glass, porcelain, earthenware, and hosiery. There are numerous memorials of Wallenstein in the chateau of Count Wald- stein, which also contains a collection of arms and ar- mour, a picture gallery, and a library of about 24,000 volumes. Population in 1890, 10,141; in 1900, 11,921, the majority German and Catholic (Czechs, estimated at 29 per cent. ; Protestants and Jews, 1 per cent. each).

Dvinsk, the official name (since 1893) of Dunabueg, a fortress of Western Russia, and district town of the government, 183 miles by rail north-west of Vitebsk, on the right bank of the Dilna, and at the crossing of two main lines — Riga^Smolensk and Wilno-St Peters- burg. It is the chief strategic position for the defence of the Dtlna. The population of Dvinsk rapidly increased from 25,764 in 1860, to 72,230 in 1897. It consists chiefly of Jews (about 30,000), Lithuanians, and Letts.

Dvorak, Anton (1841), Bohemian musical

composer, born at Nelahozeves (otherwise Miihlhausen) in Bohemia on 8th September 1841, was the son of Frantisek Dvorak, a small publican and village butcher. At the door of his father's inn Dvorak first imbibed the " concord of sweet sounds " uttered by peripatetic musi- cians, and there he first appeared as a practical musician, taking his place among the fiddlers who scraped out their " furiants " and other wild dances for

the benefit of the holiday-making local beaux and belles. At the village school he learnt from Josef Spitz both to sing and to play the violin with so much effect that soon he was able to assist in the parish church services. But the seriousness of life came home soon to the youth, who at twelve years old was sent by his father to Zlonic, near Schlan, to an uncle, with whom he lived while passing through the higher-grade classes at school. Here, too, he was fortunate enough to find a valuable friend in A. Liehmann, organ- ist and chief musician of the little town, a competent musician, who instructed the boy in elementary theory, organ and pianoforte playing. The theory studies, how- ever, could not long be continued, since Liehmann soon acknowledged in his own dialect that " Aus Tonda, dem Sappermentsbuben 'mal 'was werden konnte," at the same time realizing that he could not do much to assist. But DvoMk soon left Zlonic for Bohmisch-Kamnitz, where he learnt German and advanced his musical stud- ies under Hancke. A year later he was summoned to re- turn to Zlonic to assist his father, who had set up in business there. But his craving for a musical career was

not to be denied, and after considerable trouble with Dvorak senior, consent was obtained to his settling in Prague in order to devote himself entirely to music. In October 1857 DvoMk entered the organ-schoql of the "Gesellschaft der Kirchenmusik," where he worked for three years. The small financial aid his father was at first able to lend soon ceased, and after being in Prague but a few months Dvorak found himself practically thrown on his own resources to obtain a livelihood. This he obtained precariously by playing the viola in a private orchestra and by making music in various inns of the town. On the opening in 1862 of the Bohemian Inte- rimstheater, DvoMk, with part of this band, formed the nucleus of the theatrical orchestra, and remained con- nected with it for eleven years, when he became organist of the church of St Adalbert. At this time his small stipend was augmented slightly by the fees of a few

ANTON DVORAK. (From aphotogra/ph by Draycott, London.)

pupils, though the privations suffered by him and his wife — whom he had recently married — must have been great. But in spite of financial worry and of the amount of time he had to devote to his professional

duties and private pupils, Dvorak found leisure not only for his own studies of the classics, but also to compose. His work, like his daily life, was beset with difficulties, for he had not the means to provide himself with sufficient music- paper, much less to hire a pianoforte ; and it is possible that several of his important early works would never have been written had it not been for the generosity of Karel Bendl, the distinguished composer, who helped him in many ways.

DvofSik himself has said since that he retained no re- collection of much that he then composed. In and about 1864 two symphonies, a host of songs, some chamber- music, and an entire opera, Alfred, lay unheard in his. desk. The libretto of this opera was made up from.

materials found in an old almanack. Most of these works were burnt long ago. In 1873 he made his first bid for popularity by his patriotic hymn Die Erhen des weissen Berges (published many years later as Op. 30). Its reception was enthusiastic, and Dvorak's subsequent works were eagerly awaited and warmly received on pro- duction. In 1874 his opera Konig und Kohler resulted in a fiasco at Prague, owing to its mixture of styles. Nothing daunted, Dvorak recomposed the whole work in three months. In 1875 he obtained a stipend from the Kultus-Ministerium at Vienna on the recommenda- tion of Brahms and Hanslick, which freed him from care and enabled him to indulge in composition to his heart's content. Following on this success came a com- mission in 1877 from Simrock in Berlin for a series of Slavic dances, which took the public by storm. Immedi- ately compositions, old and new, began to pour from the publisher. English sympathy was entirely won by the Stabat Mater in 1883, and increased by the symphonies in D, D mi., and F, G-, and E mi. (The American), and the cantata 77ie Spectre's Bride, but somewhat chilled by the oratorio St Ludmila, a comparatively feeble work written "to suit English taste" for the Leeds Festival of 1886. The three overtures 0pp. 91, 92, 93, failed to hold their place, but the pseudo-American symphony has become one of Dvorak's most popular works, and much of his chamber-music, of which there is abundance, seems quite permanent

in its place in concert programmes. In 1892, after having frequently visited England, Dvorak took up the duties of head of the principal American school of ‘ music in New York. There he remained till 1895, when he returned to Prague.

Dvotak’s music is characteristically national, though less purely so than that of Smetana. His industry is monumental f but in spite of his dramatic talent, none of his operas has been really successful. A past master of the orchestra and a composer of real individuality, he has earned and deserved his place among the elect, not only by his great gifts, but by his abnormal energy in their development.

Dyeing. — Dyeing is the art of colouring textile and other materials in such a manner that the colours will not be readily removed by those influences to which they are likely to be submitted — e.g., washing, rubbing, light, &c. The materials usually dyed are those made from ske^h’‘—^ textile fibres, silk, wool, cotton, &c., and in- tended for clothing or decoration ; but in addition to these may be mentioned straw, fur, leather, paper, &c. The art of dyeing dates from prehistoric times, and its practice probably began with the first dawn of civilization. Although we cannot trace the successive stages of its development from \the beginning, we may suppose they were somewhat similar to those witnessed among certain uncivilized tribes to-day — e.g., the Maoris of New Zealand. At first the dyes were probably mere fugitive stains obtained by means of the juices of fruits, and the decoctions of flowers, leaves, barks, and roots; but in course of time methods were discovered, with the aid of certain kinds of earth and mud containing alumina or iron, whereby the stains could be rendered permanent, and then it was that the true art of dyeing began. There is no doubt that dyeing was, in the early period of its his- tory, a home industry practised by the women of the household, along with the sister arts of spinning and weaving, for the purpose of embellishing the materials manufactured for clothing.*

Historical evidence shows that already at a remote period a high state of civilization existed in Persia, India, and China, and the belief is well founded that the arts of

dyeing and printing have been practised in these coun- tries during a long succession of ages. In early times the products and manufactures of India were highly prized throughout Southern Asia, and in due course they were introduced by Arabian merchants to Phoenicia and Egypt, with which countries commercial intercourse, by way of the Persian and Arabian Gulfs, seems to have ‘ existed from time immemorial. Eventually the Egyp- tians themselves began to practise the arts of dyeing and printing, utilizing no doubt both the knowledge and the materials derived from India. Pliny the histo- rian has left us a brief record of the methods em- ployed in Egypt during the first century, as well as of the Tyrian purple dye celebrated already 1000 b.c, while the chemical examination of mummy cloths by Thomson and Schunck testifies to the use by the Egyptian dyers of indigo and madder. The thcenician and Alexandrian merchants imported drugs and dyestufEs into Greece, but we know little or nothing of the methods of dyeing pur- sued by the Greeks and Romans, and such knowledge as they possessed seems to have been almost entirely lost during the stormy period of barbarism reigning in Europe during the 5th and succeeding centuries. In Italy, however, some remnants of the art fortunately survived these troublous times, and the importation of Oriental products by the Venetian merchants about the beginning of the 13th century helped to revive the industry. From this time rapid progress was made, and the dyers formed important guilds in Florence, Venice, and other cities. It was about this time, too, that a Florentine named Rucellai rediscovered the method of making the purple dye orchil from certain lichens of Asia Minor. In 1429 there was published at Venice, under the title of Marie- gola dell’ Arte de Tentori, the first European book on dye- ing, which contained a collection of the various processes in use at the time. From Italy a knowledge of dyeing gradually extended to Germany, France, and Flanders, and it was from the latter country that the English king Edward III. procured dyers for England, a Dyers’ Company being incorporated in 1472 in the City of London. A new^ impetus was given to the industry of dyeing by the discovery of America in 1492, as well as by the opening up of the way to the East Indies round the Cape of Good Hope in 1498 by Vasco de Gama. A number of new dyestuff s were now introduced, and the dyewood trade was transferred from Italy to Spain and Portugal, for the East Indian products now came direct to Europe round the Cape instead of by the old trade routes through Persia

and Asia Minor. Eastern art- fabrics were introduced in increasing quantity, and with them came also information as to the methods of their production. In Europe itself the cultivation of dye-plants gradually received more and more attention, and both woad and madder began to be cultivated, about 1507, in France, Germany, and Holland. Under the influence of Spain the Dutch largely developed their industries and made considerable progress in dyeing. The Spaniards, on their first arrival in Mexico (1518), noticed the employ- ment of the red dyestuff cochineal hj the natives, and at once imported it to Europe, where an increasing demand for the new colouring matter gradually developed in the course of the century. A further impetus was given to the trade by the Dutch chemist Drebbel's accidental dis- covery, in 1630, of the method of dyeing' a brilliant scarlet on wool by means of cochineal and tin solutions. The secret was soon communicated to other dyers, and the new scarlet was dyed as a speciality at the Gobelin dye- works in Paris, and some time later (1643) at a dyeworks in Bow, near London. In 1662 the Royal Society of London gave some attention to the art of dyeing, and in order to inform and assist practical dyers, caused the

publication of the first original account, in tie English language, of the methods employed in dyeing, entitled " An apparatus to the history of the common practices of Dyeing." Ten years later the French Minister Colbert sought to improve as well as control the operations of dyeing, by publishing a code of instructions for the use of the woollen dyers and manufacturers in France. From this time, too, a succession of eminent chemists were ap- pointed by the French Government to devote some of their attention to the study of the industrial arts, includ- ing dyeing, with a view to their progress and improvement. Dafay, Hellot, Macquer, Berthollet, Board, and Chevreul (1700-1825) all rendered excellent service to the. art, by investigating the chemical principles of dyeing, by pub- lishing accounts of the various processes in vogue, by ex- amining the nature and properties of the dyestuffs employed, and by explaining the cause of the several phenomena connected with dyeing. With the advent

of the 18th century, certain old prejudices against the use of foreign dyewoods gradually disappeared, and very rapid progress was made owing to the birth of the modern chem- istry and the discovery of several useful chemical pro- ducts and processes — e.g., Prussian Blue (1710), Saxony Blue or Indigo Extract (1740), sulphuric acid (1774), ‘ Murexide (1776), picric acid (1788), carbonate of soda (1793), bleaching powder (1798). Experiments on the practical side of bleaching and dyeing were made during this period, in England by Thomas Henry, Home, and Ban- croft, and in France by Dambourney, Gonfreville, and others, each of whom has left interesting records of his work. Down to the middle of the 19th century natural dye- stuffs alone, with but few exceptions, were at the com- mand of the dyer. But already in the year 1834 the German chemist Eunge noticed that one of the products obtained by distilling coal-tar, namely, aniline, gave a bright blue coloration under the influence of bleaching powder. No useful colouring matter, however, was ob- tained from this product, and it was reserved for the English chemist Perkin to prepare the first aniline dj’e- stuff, namely, the purple colouring matter Mauve (1856). The discovery of other brilliant aniline dyestuffs followed in rapid succession, and the dyer was in the course of a few years furnished with Magenta, Aniline Blue, Hof- mann’s Violet, Iodine Green, Bismarck Brown, Aniline Black, &c. Investigation has shown that the products of the distillation of coal-tar are very numerous, and some of them are found to be specially suitable for the prepara- tion of colouring matters. Such, for example, are ben- zene, naphthalene, and anthracene, from each of which distinct series of colouring matters are derived. In 1869 the German chemists Graebe and Liebermann succeeded in preparing Alizarin, the colouring matter of the mad- der-root, from the coal-tar product anthracene, a discovery which is of the greatest historical interest, since it is the first instance of the artificial production of a vegetable dyestuff. Another notable discovery is that of artificial Indigo by Baeyer in 1878. Since 1856, indeed, an ever- increasing number of chemists has been busily engaged in pursuing scientific investigations \vith the view of pre- paring new colouring matters from coal-tar products, and of these a few typical colours, with the dates of their dis- covery, may be mentioned: Cachou de Laval (1873) ; Eosin (1874) ; Alizarin Blue (1877) ; Xylidine Scarlet (1878); Biebrich Scarlet (1879); Congo Bed (1884); Primuline Red (1887) ; Ehodamine (1887) ;

Paranitrani- line Red (1889); Alizarin Bordeaux (1890); Alizarin Green (1895). At the present time (1901) it may truly be said that the dyer is furnished with quite an embar- rassing number of coal-tar dyestuffs which are capable of producing every variety of colour possessing the most diverse properties. Many of the dyes produced are fugi-

tive, but a considerable number are permanent and with- stand various influences, so that the general result for some years has been the gradual displacement of the older dyewoods by the newer coal-tar colours.

During this period of discovery on the part of the chemist, the mechanician has been actively engaged in de- vising machines suitable for carrying out, with a minimum of manual labour, all the various operations con- nected with dyeing— e.g-., washing, squeezing, -^/f ‘ dyeing, drying, &c. At the present time the a,eats. several textile fabrics may be dyed in each stage of their manufacture, e.g., as loose unspun fibres, slubbing, tops, yarn, cops, and cloth, each requiring special forms of machine. Loose wool, which was formerly stirred about in the dye solution, is now enclosed in perforated cylinders, &c., and remains stationary, while the dye-liquor is circu- lated through the material by means of a pump. “Wool tops and cotton cops are dyed in a similar manner. Yarn is still suspended on wooden rods and turned in the dye-liquor by hand, or the rods of yam are suspended on re- volving reels. Cloth is dyed by circulating it as an end- less band over a reel placed above the dye-vessel and through the dye solution. This introduction of machinery into the dyeing trade has resulted in the production of better work, it has effected considerable economy, and may be regarded as an important feature in modem dyeing.

The art of dyeing is a branch of applied chemistry in which the dyer is continually making use of chemical and physical principles in order to bring about a permanent union between the material to be dyed and the colouring matter applied. If cotton or wool is boiled in water containing finely powdered charcoal, or p^fadpies. other insoluble coloured powder, the material is not dyed, but merely soiled or stained. This staining is entirely due to the entanglement of the coloured powder by the rough surface of the fibre, and a vigorous washing and rubbing sufSces to

remove all but mere traces of the colour. True dyeing can only result when the colouring matter is presented to the fibre in a soluble condition, and is then, by some means or other, rendered insoluble while it is absorbed by, or is in direct contact with, the fibre. There must always be some marked physical or chemical af&nity existing between fibre and colouring matter, and this depends upon the physical and chemi- cal properties of both. It is well known that the typi- cal fibres, wool, silk, and cotton, behave very differently towards the solution of any given colouring matter, and that the method of dyeing employed varies with each fibre. As a general rule wool has the greatest attraction for colouring matters, and dyes most readily^ cotton has the least attraction, while silk occupies in this respect an intermediate position. These differences are no doubt partly due to differences of physical structure in the fibres, but they are also in great measure owing to their different chemical composition.

On the other hand, a given fibre, e.g., cotton, behaves quite differently in dyeing towards various colouring matters. Some of these are not at all attracted by it, and are incapable of being used as dyestuffs for cotton. For others cotton exhibits a marked attraction, so that it is readily dyed by mere steeping in a hot solution of the colouring matter. Again, for other colouring matters cotton has little or no attraction, and cannot be dyed with them until it has been previously impregnated or prepared with a metallic salt, tannic acid, or some other agent, which is capable of combining with the colouring matter, and precipitating it as an insoluble coloured com- pound within or upon the fibre. Such differences of be- haviour are to be ascribed to differences in the chemical constitution or atomic arrangement of the various colour- ing matters.

In the case of the coal-tar colours we are, for the most part, well acquainted with their chemical constitution, ciassifica- “^ ^? accordance with this knowledge the tioo of chemist has arranged them in the following colouring groups : — 1. Nitro Colours. 2. Azo Colours, in- matters. eluding Amido-azo, Oxy-azo, Tetrazo, and Poly- azo Colours. 3.

Hydrazone Colours. 4. Oxy-quinone Colours, including Qdnone-oxirae Colours. 6. Diphenyl- methane and Tripheny Imethane Colours, including Eosani- line, Rosolic acid, and Phthaleine Colours. 6. Quinone-imide Colours, including Indamine, Indophenol, Thiazime, Thiazone, Oxazime, Oxazone, Azine, Induline, Qainoxa- line, and Tluorindine Colours. 7. Aniline Black. 8. Quinoline and Acridine Colours. 9. Thiazol Colours. 10. Oxy-ketone, Xanthone, Flavone, and Cumarine Colours. 11. Indigo.. 12. Colours of unknown constitution.

This arrangement of the colouring matters in natural chemical groups is well suited for the requirements of the chemist, but another classification is that based on the mode of their application in dyeing. This is much simpler than the previous one, and being better adapted for the practical purposes of the dyer, as well as for explaining the yarious methods of dyeing, it is preferred for this article. According to this arrangement colouring matters are classified under the following groups : — 1. Acid Colours. 2. Basic Colours. 3. Direct Colours. 4. De- veloped Colours. 5. Mordant Colours. 6. Miscellaneous Colours. 7. Mineral Colours. It is well to state that there is no sharp line of division between some of these groups, for many colours are applicable by more than one method, and might quite well be placed in two, or even three, of the above gropps. This may be due either to the kind of fibre to which the colouring matter is to be applied, or to certain details in the chemical constitution of the latter which give it a twofold character.

Acid Colours. — These dyestuffs are so called because they dye the animal fibres wool and silk in an acid bath ; they do not dye cotton. From a chemical point of view the colouring matters themselves are of an acid character, this being due to the pres- ence in the molecule of nitro (NO2) orsulphonic acid (HSO3) groups. According to their origin and constitution they may be distin- guisUed as nitro compounds, sulphonated azo compounds, and sul- phonated basic colours. The Acid Colours are usually sold in the form of their alkali salts, as variously coloured powders soluble in water. For the alkali salts in neutral or alkaline solution wool and silk have little or no affinity, but dyeing rapidly occurs if the solu- tion is acidified with sulphuric acid whereby the colour-acid is lib- erated. This addition of acid, however, is necessary not only to set free

the colour-acid of the dyestuff, but also to alter partially the chemical composition of the fibre, and thus render it capable of uniting more readily with the free colour-acid. It has been shown, namely, that if wool is boiled with dilute sulphuric acid, and then thoroughly washed with boiling water till free from acid, it acquires the property of being dyed with Acid Colours even in neutral solu- tion. By this treatment a portion of the wool substance is con- verted into so-called lanuginic acid, which has a strong attraction for the colour-acid of the dyestuff, with which it forms an insolu- ble coloured compound. For dyeing wool, tlie general rule is to charge the dyeljath with the amount of dyestuff necessary to give the required colour, say from ^ to 2 or 6 per cent, on the weight of wool employed, along with 10 per cent, sodium sulphate (Glauber's salt) and 4 per cent, sulphuric acid (1-84° sp. gr.). The woollen material is then introduced and continually handled or moved about in the solution, while the temperature of the latter is padually raised to the boiling-point in the course of f to 1 hour ; after boil- ing for ^ to I hour longer, the operation is complete, and the material is washed and dried.

In practice, modifications of this normal process may be intro- duced, in order to ensure the dyeing of an even colour, i.e. , free from such irregularities as cloudiness, streaks, &c., which may be due to the quality of the material or to the special properties of the Acid Colour employed. Materials of a firm, close texture, also the existence of a strong affinity between fibre and colouring mat- ter, are not conducive to the dyeing of even colours, or to a satis- factory penetration of the material. Some Acid Colours dye even colours without any difficulty ; others, however, do not. The addition of sodium sulphate to the dyebath acts beneficially by causing less sulphuric acid to be attracted by the wool, so that its

action is moderated ; the dyeing therefore proceeds more slowly and regularly, and a more equal distribution and better absorption of the colouring matter takes place. Other devices to obtain even colours are : the use of old dye-liquors, a diminished amount of acid, the employment of weaker acids, e.g., acetic acid or ammon- ium acetate, and the entering of the material at a low temperature.

In the application of so-called Alkali Blue the process of dyeing in an acid bath is impossible, owing to the insolubility of the colour-acid in an acid solution. Wool and silk, however, possess an affinity for the alkali salt of the colouring matter in neutral or alkaline solution, hence these fibres are dyed with the addition of about 5 per cent, borax ; the material acquires only a pale colour, that of the alkali salt, in this dyebath, but by passing the washed material into a cold or tepid dilute solution of sulphuric acid a full bright blue colour is developed, due to the liberation of the colour- acid within the fibre. In the case of other Acid Colours, e.g., Chromotrope, Chrome Brown, Chromogen, Alizarin Yellow, &c., the dyeing in an acid bath is followed by a treatment with a boil- ing solution of bichromate of potash, alum, or chromium fluoride, whereby the colouring matter on the fibre is changed into insoluble oxidation products or colour-lakes. This operation of developing or fixing the colour is effected either in the same bath at the end of the dyeing operation, or in a separate bath. See' also Artificial Mordant Colours.

When dyeing with certain Acid Colours, e.g., Eosine, Phloxine, and other allied bright pink colouring matters derived from resor- cinol, the use of sulphuric acid as an assistant must be avoided, since the colours would thereby be rendered paler and duller, and only acetic acid must be employed.

The properties of the dyes obtained with the Acid Colours are extremely varied. Many are fugitive to light ; on the other hand, many are satisfactorily fast, some even being very fast in this respect. As a rule, they do not withstand the operations of milling and scouring very well, hence Acid Colours are generally unsuit- able for tweed yarns, or for loose wool. They are largely em- ployed, however, in dyeing other varieties of woollen yarn, silk yarn, union fabrics, dress materials, leather, &c. Previous to the discovery of the coal-tar colours, very few Acid Colours were known, the most important one being Indigo Extract. Prussian Blue as applied to wool may also be regarded as belonging to this class, also the purple dyestuff known as Orchil or Cudbear.

The following list includes some of the more important Acid Colours now in use, arranged according to the colour they yield in dyeing :—

Bed. — Wool Scarlet, Brilliant Scarlet, Erythrine, Brilliant Crooein, Violamine G, Scarlet 3 R, Crystal Scarlet, New Coccine, Chromotrope 2 B, Azo Acid Magenta, Victoria Scarlet, Xylidine Scarlet, Palatine Scarlet, Biebrich Scarlet, Pyrotine, Orchil Red, Milling Red, Azo Carmine, Acid Magenta, Fast Acid Violet A 2 R, Naphthylamine Red, Fast Red, Claret Red, Eosine, Erythrosine, Rose Bengal, Phloxine, Cyanosine.

Orange. — Diphenylamine Orange, Methyl Orange, Napthol Orange, Crocein Orange, Brilliant Orange, Orange G, Orange N, Mandarin G R.

Yellow. — Picric acid, Napthol Yellow S, Fast Yellow, Brilliant Yellow S, Azoflavine, Metanil Yellow, Resorcine Yellow, Tartra- zine, Quinoline Yellow, Milling Yellow,, Azo Yellow, Victoria Yel- low, Brilliant Yellow S.

Green. — Acid Green, Guinea Green, Fast Green, Patent Green.

Blue. — Alkali Blue, Soluble Blue, Opal Blup, Hoechst New Blue, Patent Blue, Ketone Blue, Cyanine, Thiocarmine, Fast Blue, Indu- line, Violamine 3 B, Azo Acid Blue, Wool Blue, Indigo Extract.

Violet. — Acid Violet, Red Violet, Regina Violet, Formyl Violet, Violamine B, Fast Violet.

Brown. — Fast Brown, Naphthylamine Brown, Acid Brown, Resorcine Brown, Azo Brown, Chrome Brown, Chroinogen.

Black. — Naphthol Black, Azo Black, Wool Black, Naphthyl- amine Black, Jet Black, Anthracite Black, Victoria Black, Azo Acid Black, Brilliant Black. ^

Basic Colours. — These colouring matters are the salts of organic colour-bases, their name being derived from the fact that their dyeing power entirely resides in the basic part of the salt. In the free state the bases are colourless and insoluble, but in combination with acids they form salts which are coloured and for the most part soluble in water. They are usually sold in the form of powder or crystals, the latter exhibiting frequently a beautiful metallic lustre. Wool and silk are dyed in a neutral bath, i.e., without any addition, the material not requiring any previous

prepara- tion. During the dyeing operation the animal fibres appear to play the part of an acid, for they decompose the colouring mat- ter and unite with the colour-base to form an insoluble coloured salt or lake, while the acid of the colouring matter is liberated and remains in solution. Although, as a rule, a neutral dyebath is employed in dyeing wool, a slight addition (2 per cent.) of soap is sometimes made in order to give a brighter colour, while in other cases, e.g., with Victoria Blue the dyebath must of necessity be

made distinctly acid with acetic or sulphuric acid. Silk is usually dyed in a bath containing "boiled-off liquor" (i.e., the spent soap- liquor from the operation of scouring) neutralized or slightly acidified with acetic or tartaric acid. For a full colour use 2 or 3 per cent, colouring matter, enter the wool at a low temperature, heat gradually to near the boiling-point in the course of f hour, and continue dyeing for J hour. Owing to the slight solubility of many Basic Colours, it is important to take the precaution of filter- ing the colour solution into the dyebath through a fiannel filter, also to neutralize the alkalinity of calcareous water with a little acetic acid, to prevent decomposition of the colouring matter and precipitation of the colour-base.

Unlike the animal fibres, cotton has little or no alfinity for the Basic Colours ; hence the cotton dyer makes use of the fact that cotton has a natural attraction for tannic acid, and that the latter f >)rms insoluble lakes with the bases of Basic Colours. Previous to dyeing, the cotton is prepared with tannic acid by steeping in a cold solution of the latter for one or two hours ; it is then worked for half to one hour in a cold solution of tartar-emetic or stannic chloride, so that the tannic acid absorbed by the fibre may be fixed upon it as insoluble tannate of antimony or tin. Although the tannic acid is thus united with metallic oxide, it still has the power of attracting the base of the colouring matter, and there is fixed upon the fibre an insoluble colour-lake, namely, a tannate of antimony and colour-base, which constitutes the dye. In this process the tannic acid is called the mordant, the tartar-emetic acts as the fixing-agent for the*

tannic acid, and the cotton as finally prepared for dyeing is said to ~~be mordanted. The proportions employed, reckoned on the weight of cotton, may vary from 2 to 10 per cent, tannic acid, or the equivalent in a decoction of sumach, myrabolams, or other tannin matter, and ^ to 3 per cent, tartar~~ emetio. After mordanting and fixing of the mordant, the cotton is well washed and dyed in the cold or at 60° C. for J to 1 hour with the necessary colouring matter. Applied in this manner, Basic Colours are moderately fast to soap, but not to the action of light.

Another method of mordanting cotton for dyeing with the Basic Colours is to impregnate the fibre for a few minutes with a warm solution of soap, or of so-called sulphated-oil (1 lb per gallon), then dry and work for J hour in a cold solution of aluminium acetate (f'jj gallon at 1-045° sp. gr. to 20 gallons water), and finally rinse in water. The cotton is thus mordanted or prepared with a substance analogous to oleate of alumina, in which the oleic acid acts as the real mbrdant and combines with the base of the colouring matter subsequently applied, while the alumina acts as the fixing-agent for the oleic acid. The ultimate compound fixed upon the dyed fibre is an oleate of alumina and colour-base. The dyes thus obtained are brighter than the colours dyed on tannin mordant, but they are not so fast to soap, and are also fugitive to light.

Linen is dyed in the same manner as cotton. Jute is dyed without any previous preparation, since it behaves like a tannin- mordanted fibre, attracting the Basic Colours direct.

The Basic Colours, to which class most of the earlier coal-tar colours belonged, are remarkable for their great colouring power, and in most cases for the brilliancy of the colours they yield. With the exception of certain dark colours, they are fugitive to light. It is interesting to note that only one vegetable colouring matter is at present recognized as belonging to this class, namely, the yellow dyestuff Barberry bark and root (Berberis vulgaris), which con- tains the organic base berberine.*

The following is a list of the more important Basic Colours derived from coal-tar : —

Red. — Magenta, Safranine, Khodamine, Pyronine Red, Magdala Red.

Orange. — Chrysoidine, Phosphine, Acridine Orange, Tannin Orange.

Yellow. — Auramine, Benzoflavine, Thioflavine T.

Green. — Malachite Green, Emerald Green, Imperial Green, China Green, Brilliant Green, Victoria Green, Diamond Green, Methylene Green, Azine Green.

Blue. — Methylene Blue, Toluidine Blue, Thionine Blue, Inda- mine Blue, Victoria Blue, Night Blue, Nile Blue, Turquoise Blue, Marine Blue, Indoine Blue, Induline, Nigrosine, Meldola Blue, Metamine Blue, Muscarine, Capri Blue, Basle Blue, Indazine, Metaphenylene Blue, Paraphenylene Blue, Toluylene Blue, Indi- gene, Indol Blue, Diphene Blue.

Violet.— Methyl Violet, Crystal Violet, Ethyl Purple, Methylene Violet, Mauve, Paraphenylene Violet, Rhoduline Violet.

Brown. — Bismarck Brown.

Black. — Fast Black.

Orey. — Methylene Grey, Nigrisiue, New Grey.

Direct Colours. — The characteristic feature of the dyestuffs belonging to this class is that they dye cotton "direct" — i.e., without the aid of mordants. Three distinct series of colouring matters of this group may be distinguished — namely. Benzidine Colours, Janus Colours, and Sulphide Colours.

(a) Benzidine Colours. — The colours of this class are frequently called the Substantive Cotton Colours, Direct Cotton Colours,

Benzo Colours, Diamine Colours, Congo Colours. Considered from the chemical point of view, they are alkali salts of sulphonated tetrazo colours obtained by azotizing certain diamido compounds, e.g., benzidine, diamido-stilbene, &c., and uniting the product thus obtained with various amines or phenols. The first colouring matter of this <;lass was the so-

called Congo Red, discovered in 1884, and since that time a very great number have been intro- duced which yield almost every variety of colour. The method of dyeing cotton consists in merely boiling the material in a suitably concentrated solution of the dyestuff, when the cotton absorbs and retains the colouring matter by reason of a special natural afiSnity. The addition of 1 to 3 oz. sodium sulphate and ^ to i oz. car- bonate of soda per gallon gives deeper, colours, since it diminishes the solubility of the colouring matter in the water and increases the affinity of the cotton for the colouring matter. An excess of sodium sulphate is to be avoided, otherwise precipitation of the colouring matter and imperfect dyeing result. With many dye- stuffs it is preferable to use ^ to -J oz. soap instead of soda. On cotton the dyed colours are usually not very fast to light, and some are sensitive to alkali or to acid, but their most serious defect is that they are not fast to washing, the colour tending to run and stain neighbouring fibres. Their fastness to light and washing is, however, greatly improved by a short (^ hour) after-treatment with a boiling solution of copper sulphate (3 per cent.), with or without the addition of bichromate of potash (1 per cent.). Wool and silk are dyed with the Direct Colours in the same manner as cotton, or as with the Acid Colours, adding acetic acid to the dyebath. On these fibres the dyed colours are usually faster than on cotton to washing, milling, and light ; some are very fast even to light — e.g., Diamine Fast Red, Chrysophenine, Hessian Yellow, &c. Many of the Direct Colours are very useful for dyeing plain shades on union fabrics composed of wool and cotton, silk and cotton, or wool and silk. Owing to the facility of their application,, they are also very suitable for use as household dyes.

A few vegetable dyestuffs belong to this class, notably Turmeric, Saffron, Annatto, and SafBower, but they all yield colours which are fugitive to light, and they are now of little importance. Tur- meric is the underground stem or tuber of Curcuma tinctoria, a plant growing abundantly in the East Indies. It dyes cotton, wool, and silk in a bath acidified with acetic acid or alum, yielding a bright yellow colour which is turned brown by alkalis. Saffron consists of the stigmata of the flovyer of Crocus sativus, which is grown in Austria, France, and Spain. It dyes a bright orange- yellow colour. Annatto is the pulpy mass surrounding the seeds of Bixa orellanaj a plant which grows in South America — e.g.,

Brazil, Cayenne, &c. It dyes cotton and silk in an alkaline or soap bath an orange colour, which is turned red by acids. Safflower consists of the dried florets of Carthamus tinctorius, which is grown in the East Indies, Egypt, and Southern Europe. Cotton is dyed a brilliant pink colour by working it in a cold alkaline (sodium carbonate) extract of the colouring matter, while gradually acidi- fying the solution with citric acid (lime-juice).

The Direct Colours which are derived from coal-tar products are very numerous indeed ; they are largely employed, and occupy a very important position among dyestuffs. The following list in- cludes the principal coal-tar colours of this group : —

Red. — Congo Red, Brilliant Congo, Benzopurpurine, Brilliant Purpurine, Deltapurpurine, Diamine Scarlet, Diamine Fast Red, Rosazurine, Salmon Red, Erica, Titan Pink, St Denis Red, Colum,bia Red, Naphthylene Red, Congo Rubine, Geranine, Brilliant Geranine.

Orange. — Congo Orange, Benzo Orange, Toluylene Orange, Mi- kado Orange, Brilliant Orange, Columbia Orange, Diamine Orange.

Yellow. — Chrysamine, Cresotin Yellow, Diamine Yellow, Car- bazol Yellow, Chrysophenine, Hessian Yellow, Curcumine Yellow, Thiazol Yellow, Thioflavine S,"Oriol, Mimosa Yellow, Columbia Yellow, Cotton Yellow, Chloramine Yellow, Direct Yellow, Dia- mine Fast Yellow, Diamine Gold.

Green. — Benzo Olive, Columbia Green, Benzo Green, Diamine Green.

Blue. — Azo Blue, Benzoazurine, Brilliant Azurine, Sulphon- azurine, Diamine Blue, Benzo Indigo Blue, Benzo Black Blue, Chicago Blue, Columbia Blue, Erie Blue, Zambesi Blue, Benzo Cyanine, Congo Blue, Diamine Sky Blue, Brilliant Benzo Blue, Benzo Chrome Black Blue.

Violet.— Hessian Purple, Congo Corinth, Heliotrope, Congo Violet, Diamine Violet, Hessian Violet, Azo Violet, Benzo Violet, Violet Black, Diamine Bordeaux.

Brown. — Benzo Brown, Congo Brown, Toluylene Brown, Dia^ mine Brown, Cotton Brown, Hessian Brown, Terra Cotta, Mikado Brovra, Catechu Brown, Wool Brown, Columbia Brown, Zambesi Brown, Benzo Chrome Brown, Direct Fast Brown, Direct Bronze Brown, Chloramine Brown.

Black.— Biamme Black, Columbia Black, Nyanza Black, Tabora Black, Zambesi Black, Chromanil Black, Benzo Black, Benzo Fast Black, Direct Blue Black, Pluto Black, Oxy Diamine Black, Diamine Jet Black.

Grey.— Benzo Grey, Benzo Black, Azo Mauve, Diaminogene, Neutral Grey.

(6) Janus Colours. — These comprise a small series 'of azo colours of a strongly basic character, which possess the unusual property of dyeing cotton in an acid bath. Since they also dye wool and silk under the same conditions, they may be employed for dyeing plain shades on wool, silk, and cotton union fabrics. The material is entered into the dyebath at a low temperature, which is gradually raised to the boiling-point. The necessary additions to the dyebath are 1 to 3 per cent, colouring matter, 2 per cent, sulphuric acid, and 5 to 20 per cent, sodium sulphate. The colours include Janus Red, Janus Yellow, Janus Green, Janus Blue, Janus Brown, Janus Bordeaux, Janus Grey, and Janus Black.

(c) Sulphide Colours. — These dyestuffs, which are also called Sulphine Colours and Thiosulphate Colours, are only suitable for dyeing the vegetable fibres. The dyestuff Caohou de Laval, dis- covered in 1873, was the first member of this group, and was obtained by melting a mixture of sodium sulphide and various organic substances — e.g., bran sawdust, &o. In recent years several other dyestuffs have been added to the list, namely, grey, blue, green, brown, and especially black colours, by submitting certain definite amido compounds to a similar treatment with sodium sulphide or sodium thiosulphate, and subsequent oxidation. The mode of dyeing with these colours is based on the fact that they are

soluble in an alkaline reducing agent, and if the cotton is impregnated with the' solution, subsequent oxidation develops the colour and fixes it upon the fibre in an insoluble condition. The material is boiled for about one hour in a solution of the colour (10 to 15 per cent.), with the addition of sodium carbonate (1 to 10 per cent.), common salt (10 to 20 per cent.), and sodium sulphide (2 to 20 per cent.) ; it is then washed quickly in water, and developed for half an hour in a boiling bath containing 2 to 5 per cent, of some metallic salt — e.g., bichromate of potash, copper sulphate, chrome alum, &o. A final washing with water containing a, little caustic soda to remove acidity is important. The sulphide colours are remarkable for their fastness to light, alkalis, acids, a,nd washing, but unless proper care is exercised the cotton is apt to be tendered.

The following list includes most of the colours of this class : —

Green. — Pyrogene Green, Italian Green.

Brown. — Pyrogene Brown, Pyrogene Yellow, Cachou de Laval, Thiocatechine, Katigene Black Brown.

Ghrey and Black. — Pyrogene Grey, Vidal Black, Immedial Black, Katigene Black, Anthraquinone Black, St Denis Black, Amidazol Black, Cross Dye Black, Clayton Fast Black, Eclipse Black, Carbide Black, Thiogene Black, Sulphaniline Black, Sulfogene Black, Pyrogene Black.

At the present time (1902) this class of colours is continually increasing in number, and for certain purposes in cotton dyeing the group is already becoming important.

Developed Colours. — This group includes certain azo colours which are developed or produced upon the fibre itself (usually cotton) by the successive application of their constituent elements. It may be conveniently divided into the following sub-groups : — Insoluble Azo Colours, Primuline Colours, Developed Direct Colours, Benzo Nitrol Colours.

(a) The Insoluble Azo Colouks are produced as insoluble coloured precipitates by adding a solution of a so-called diazo com- pound to an

alkaline solution of a phenol, or to an acid solution of an amido compound. The necessary diazo compound is prepared by allowing a solution containing nitrous acid to act upon a solution of an amido-base — e.g. , aniline. It is desirable to keep the solutions cool with ice, owing to the very unstable nature of the diazo com- pounds produced. The colour obtained varies according to the particular diazo compound, as well as the amine or phenol employed, beta-naphthol being the most useful among the latter. The same coloured precipitates are produced upon the cotton fibre if the material is first impregnated with an alkaline solution of the phenol, then dried and passed into a cold solution of the diazo solution. Three operations are therefore necessary when dyeing with these colours: (1) diazotizing of the base ; (2) impregnation of the cotton with the phenol solution ; (3) developing. As an example, the method of dyeing an orange-yellow colour derived from aniUne and beta- naphthol is here given. — Diazotizing. Aniline (93 pares) is dissolved in hydrochloric acid (sp.gr. M4) (390 parts) and water (200 parts). The solution is cooled with the addition of ice, and a solution of sodium of nitrite (75 parts) in water (500 parts) is slowly added with continual stirring. Each base requires a slightly different treatment to ensure the best results. — Impregnation. A stock solution of beta- naphthol is prepared by dissolving 14 parts by weight of this substance in 4 parts caustic soda and 50 parts water. This solution is diluted 6 to 10 times with water, according to the depth of colour required, and 1 part soda^ash (sodium carbonate) is then dissolved in 15 to 30 parts of the dilute solution ; in order to give a brighter colour, a small amount of sulphated oil is sometimes added. The cotton is well impregnated with this solution, then wrung out and

dried quickly. — Developing. The naphthol-prepared cotton should be passed as soon as possible into the diazo or developing solution, in order to prevent the cotton from acquiring a brownish hue through oxidation. The orange-yellow colour desired is developed almost im- mediately, but it is well to continue working the cotton about in the solution for a few minutes. The dyed cotton is squeezed, washed, soaped slightly, and finally rinsed in water and dried. The colours obtained by this method vary according to the particular diazo compound employed. If the aniline used in the foregoing process is replaced by metar-nitraniline, a yellowish-orange colour is obtained ; with para-nitraniline, a bright red ; with

alpha^naphthylamine, a claret-red ; with amido-azo-toluene, a brownish red ; with benzidine, a dark chocolate ; with dianisidine, a dark blue ; and so on. The dyed colours are fast to washing and are much used in practice, particu- larly the Para-nitraniline Red, which serves as a substitute for Turkey-red, although it is not so fast to light as the latter.

(6) The Primuline Colours are derived from the yellow dye- stuff known as Primuline, which dyes cotton in the same manner as the Direct Colours. The Primuline yellow is fugitive to light and of no practical value, but since the colouring matter is an amido base, the dyed fibre can be diazotized and then developed in solu- tions of phenols or amines, whereby azo dyes of various hues may be obtained, according to the developer employed ; e.g., beta- naphthol develops a bright red colour (Primuline Red), resorcinol develops an orange, phenol a yellow, naphthylamine a brown, &c. The dyeing of the Primuline yellow is effected by boiling the cotton for one hour in a solution of Primuline (6 per cent.) and common salt (10 to 20 per cent.). The diazotizing operation consists in passing the dyed and rinsed cotton for 5 to 10 minutes into a cold solution of nitrous acid — i. e. , a solution of J oz. sodium nitrite per gallon of water, slightly acidified with sulphuric acid. The diazotized material should not be exposed to light, but at once washed in cold water and passed into the developer. The developing process con- sists in working the diazotized material for 5 to 10 minutes in a cold solution of the necessary phenol or amine, and finally washing with water. If the developer employed is an amido compound, the dyed colour will contain a free amido group, and hence the operations of diazotizing and developing may be repeated again and again with the object of obtaining darker shades. The Primuline colours are best adapted for cotton dyeing, and the colours obtained are fast to washing and to moderate soaping, but they are not very fast to light.

(c) Developed Direct Colours. If cotton is dyed with such Direct Colours as contain free amido groups, the colour can be diazotized on the dyed fibre exactly in the same manner as in the case of Primuline-dyed cotton, and then developed by passing into the solution of an amine or phenol, or by treating it with a warm solution of sodium carbonate. In this manner a new azo dye is produced upon the fibre, which differs from the original

one not only in colour, but also by being faster to washing and other influences. A treatment with copper sulphate solution after development is frequently bene- ficial in rendering the colour faster to light. Some Direct Colours, indeed, are of little value, owing, for example, to their sensibility to acids, until they have been diazotized and developed, the usual devel- opers being beta naphthol,resorcinol, phenol,andphenylene-diamine.

The following Direct Colours, after being applied to cotton, may be submitted to the above treatment, the colours produced being chiefly blue, brown, and black : —

Blue. — Diazurine, Diazo Blue, Diamine Blue, Diaminogene.

Brown. — Diazo Brown, Diamine Cutch, Diamine Brown, Cotton Brown.

Grey and Black. — Benzo Blue, Diazo Blue Black, Diazo Black, Diamine Black, Diazo Brilliant Black.

(d) Benzo Nitrol Colours. — These are certain Direct Colours dyed on cotton in the ordinary manner, which are then developed by passing into a diazo solution — e.g,, diazotized para-nitraniline, &c. The dyed colour here plays the part of a phenol or amine, and reacts with the diazo compound to produce a new colour. The process is similar to the production of the Insoluble Azo Colours, the beta-naphthol which is there applied to the fibre being here replaced by a Direct Colour. The colour of the latter is rendered much deeper by the process, and also faster to wash- ing and to the action of acids. The dyestuffs recommended for application in the manner described are : Benzo Nitrol Brown, Toluylene Brown, Direct East Brown, Pluto Black, Direct Blue Black.

Mordant Colours. — The colouring matters of this class include some of the most important dyestuffs employed, since they furnish many colours remarkable for their fastness to light, washing, and other influences. Employed by themselves. Mordant Colours are usually of little or no value as dyestuffs, because, with some excep- tions, either they are not attracted by the fibre, particularly in the case of cotton, or they only yield a more or less fugitive stain. Their importance and value as dyestuffs are

due to the fact that they act like weak acids and have the property of combining with metallic oxides to form insoluble coloured compounds termed

" lakes," which vary in colour according to the metallic oxide or salt employed. The most stable lakes are those in which the colour- ing matter is combined with two metallic oxides, a sesquioxide and a monoxide — e.g., alumina and lime. In applying colouring matters of this class the object of the dyer is to precipitate and fix these coloured lakes upon and within the fibre, for which purpose two operations are necessary, namely, mordanting and dyeing.

The mordanting operation aims at fixing upon the fibre the necessary metallic oxide or insoluble basic salt, which is called the mordant, although the term is also applied to the original metallic salt employed. In the subsequent dyeing operation the mordanted material is boiled with a solution of the colouring matter, during which the metallic oxide attracts and chemically combines with the colouring matter, producing the coloured lake in situ on the fibre, which thus becomes dyed. The mode of applying the mordants varies according' to the nature of the fibre and the metallic salt em- ployed, the chief mordants at present in use being salts of chromium, aluminium, tin, copper, andiron. The method of mordanting wooi depends upon its property of decomposing metallic salts, and fixing upon itself an insoluble metallic compound, when boiled in their solutions. This decomposition is facilitated by the heating and by the dilution of the solution, but it is chiefly due to the action of the fibre itself. The exact nature of the substance fixed upon the fibre has not in all cases been determined ; probably it is a compound of the metallic oxide with the wool-substance itself, which has the character of an amido-aoid. The mordant most largely employed for wool is bichromate of potash, since, besides being simply applied, and leaving the wool with a soft feel, it yields with the various mordant-dyestuffs a large variety of fast colours. The wool is boiled for 1 to 1 J hour in a solution containing 2 to 3 per cent, bichromate of potash on the weight of the wool employed. During

this operation the wool at first attracts chromic acid, which is gradually reduced to chromium chromate, so that the mordanted fibre has finally a pale olive-yellow tint. In the dyebath, under the influence of a portion of the dyestuff , further complete reduction to chromic hydrate occurs before it combines with the colouring mat- ter. Not unfrequently certain so-called "assistants" are employed in small amount along with the bichromate of potash — e.g., sul- phuric acid, cream of tartar, tartaric acid, lactic acid, &c. The use of the organic acids here mentioned ensures the complete reduction of the chromic acid on the wool to chromic hydrate already in the mordant bath, and the pale greenish mordanted wool is better adapted for dyeing with colours which are susceptible to oxidation — e.g.. Alizarin Blue. For special purposes chromium fluoride, chrome , alum, &o., are employed. Alum or aluminium sulphate (8 per cent.), along with acid potassium tartrate (cream of tartar) (7 per cent.), is used for brighter colours — e.g., reds, yellows, &c. . The object of the tartar is to retard the mordanting process and ensure the penetration of the wool by the mordant, by preventing superficial precipitation through the action of ammonia liberated from the wool ; it ensures the ultimate production of clear, bright, full colours. For still brighter colours, notably yellow and red, stannous chloride was at one time largely employed, — now it is used less frequently ; and the same may be said of copper and ferrous sulphate, which were used for dark colours. Silk may be often mordanted in the same manner as wool, but as a rule it is treated like cotton. The silk is steeped for several hours in cold neutral or basic solutions of chromium chloride, alum, ferric sulphate, &c., then rinsed in water slightly, and passed into a cold dilute solution of silicate of soda, in order to fix the mor- dants on the fibre as insoluble silicates. Cotton does not, like wool and silk, possess the property of decomposing metallic salts, hence the methods of mordanting this fibre are more complex, and vary according to the metallic salts and colouring matters employed, as well as the particular effects to be obtained. One method is to impregnate the cotton with a solution of so-called " sulphated oil " or " Turkey-red oil " ; the oil-prepared material is then dried and passed into a cold solution of some metallic salt — e.g., aluminium acetate, basic chromium chloride, &c. The mordant is thus fixed on the fibre as a metallic oleate, and after a passage through water containing a little chalk or silicate of soda to remove acidity, and a final rinsing, the cotton is ready for dyeing. Another

method of mordanting cotton is to fix the metallic salt on the fibre as a tannate instead of an oleate. This is effected by first steeping the cotton in a cold solution of tannic acid or in a cold de- coction of some tannin matter, e.g., sumach, in which operation the cotton attracts a considerable amount of tannic acid ; after squeezing, the material is steeped for an hour or more in a solution of the metallic salt, and finally washed. The mordants employed in this case are various — e.g., basic aluminium or ferric sulphate, basic chromium chloride, stannic chloride (cotton spirits) , &c. There are other methods of mordanting cotton besides those mentioned, but the main object in all cases is to fix an insoluble metallic compound on the fibre. It is interesting to note that whether the metallic oxide is united with the substance of the fibre, as in the case of wool and silk, or precipitated as a tannate, oleate.

silicate, &c., as in the case of cotton or silk, it still has the power of combining with the colouring matter in the dyebath to fonn the coloured "lake " or dye on the material.

The (iyein^ operation consists in working the mordanted material in a solution of the necessary colouring matter, the dyebath being gradually raised to the boiling-point. With many colouring matters, e.g., with Alizarin, it is necessary to add a small percentage of calcium acetate to the dyebath, and also acetic add if wool is being dyed. In wool-dyeing, also, the mordanting operation may follow that of dyeing instead of preceding it, in which case the boiling of the wool with dyestuff is termed " stuffing," and the subsequent developing of the colour by applying the mordant is termed "sad- dening," because this method has in the past been usually carried out with iron and copper mordants, which give dull or sad coIoih's. The method of "stuffing and saddening" may, however, be carried out with other mordants, even for the production of bright colours, and it is now frequently employed with certain alizarin dyestuffs for the production of pale shades which require to be very even and regular in colour. There is still another method of applying Mordant Colours in wool-dyeing, in which the dyestuff and the mordant are applied simultaneously from the beginning ; it is known as the " single-bath method." It is only successful, however, in the case of certain

colouring matters and mordants, to some of which reference will be made in the following paragraphs.

The Natukal Mordant Colours. — It is interesting to note that nearly all the natural or vegetable dyestuffs employed belong to the class of Mordant Colours, the most important of these being included in the following list : — Madder, Cochineal, Peach- wood, Sapanwood, Limawood, Camwood, Garwood, Sanderswood, Old Fustic, Toung Fustic, Quercitron Bark, Persian Berries, Weld, Logwood.

Madder consists of the dried ground roots of Bubia tinctorum, a plant of Indian origin. Formerly cultivated largely in France and Holland, it was long one of the most important dyestuffs employed, chiefiy in the production of Turkey-red and in calico— printing, also in wool-dyeing. With the different mordants it yields very distinct colours, all fast to light and soap ; namely, red with aluminium, orange with tin, reddish brown with chromium, purple and black with iron. Madder contains two closely allied colouring matters ; namely, purpurin and alizarin. The latter, which is by far the most important, is now prepared artificially from the coal-tar product anthracene, and has almost entirely superseded madder.

Cochineal is the dried scale-insect Coccus-cacti, which lives on certain of the cactus plants of Mexico and elsewhere. The rearing of cochineal was once a large and important industry, and although still pursued, it has seriously declined, in consequence of the dis- covery of the Azo Scarlets derived from coal-tar. The colouring matter of cochineal, carminic acid, is believed by chemists to be a derivative of naphthalene, but its artificial production has not yet been accomplished. Cochineal dyes a purple colour with chromium mordant, crimson with aluminium, scarlet with tin, and grey or slate with iron. Its chief employment is for the purpose of dyeing crimson, and more especially scarlet, on wool. Crimson is dyed by mordanting the wool with alum and tartar and dyeing in a separate bath with ground cochineal. Scarlet on wool is obtained by the single-bath method, namely, by dying the wool with a mixture of stannous chloride (or nitrate of tin), oxalic acid, and cochineal. It is usual to add also a small amount of the yellow dyestuff Flavine in order to obtain a yellower

shade of scarlet. The cochineal colours are very fast to light, but somewhat susceptible to the action of alkalis.

Peachwood, Sapanwood, and Limawood are usually referred to as the " soluble red-woods," because of the solubility in water of the colouring principle they contain. They consist of the ground wood of various species of Caesalpinia found in Central America, the East Indies, and Peru. They all yield more or less similar colours with the different mordants — claret-brown with chromium, red with aluminium, bright red with tin, dark slate with iron. Owing to the fugitive character of all the colours to light, these dyewoods are now comparatively little employed in dyeing, being replaced by the Alizarin Colours. All these dyewoods seem to contain the same colouring principle, namely, brazilin, which, either before or during its union with the mordant, is converted by oxidation into the colouring matter brazilein. The chemical constitution of this substance Jias recently been definitely estab- lished, and it appears to be a member of the 7-pyrone group of colouring matters, to which several of the natural yellow dyestuffs also belong.

Camwood, Bakwood, and Sanderswood represent the so- called "insoluble red-woods," their colouring principles being sparingly soluble even in boiling water. They are obtained from certain species of Pterocarpus and Baphia, large trees growing in the interior of West Africa. Their general dyeing properties are similar, a claret-brown being obtained with chromium mordant, a brownish red with aluminium, a brighter red with tin, and

purplish hrown with iron. Their chief employment is in wool- dyeing, for the production of various shades of brown, being best applied by the "stuffing and saddening '? method above described ; but since the colours are fugitive to light, they are now very largely replaced by Alizarin. A brown on wool is obtained by first boiling for one to two hours in a decoction of the ground wood (50 per cent.), and then boiling in a separate bath in solution of bichromate of potash (2 per cent.) for half an

hour. These dye- woods are also employed by the indigo-dyer, in order to give a brownish ground colour to the wool previous to dyeing in the indigo vat, and thus obtain a deeper, fuller blue. The colouring matters contained in these dyewoods have not been exhaustively examined.

Old Fustic is a yellow dyestuff, and consists of the wood of the dyer's mulberry tree. Morns tinctoria, which grows in Cuba, Jamaica, &c. It is still an important and largely used dyestuff, being cheap, and the colours obtained from it being satisfactorily fast to light and other influencesj With chromium mordant it yields an olive-yellow or "old-gold" shade; with alumin- ium, yellow ; with tin, a brighter yellow ; with iron, an olive-green. It is chiefly employed in wool-dyeing along with other dyestuffs, and furnishes the yellow in compound shades. Two colouring principles exist in Old Fustic, namely, morin and mac- lurin, the former being the most important, and generally regarded as the true colouring matter.

YoDNG Fustic consists of the wood of the sumach tree, Bhus cotinus, which grows in Italy and Southern Europe. Its general dyeing properties are similar to those of Old Fustic, although the various mordants give somewhat different colours, notably the tin mordant, which gives a brilliant orange-yellow. All the colours obtained are very fugitive to light, hence this dyestuff is now of little importance. The colouring matter of Young Fustic is called fisetin.

Quercitron Bark consists of the inner bark of an oak-tree, Quercus tinctoria, which grows in the North American States. It dyes somewhat like Old Fustic, but gives with aluminium and tin mordants brighter yellows, for which colours it is chiefly used. The colouring principle of Quercitron Bark is called quercitrin, which by the action of boiling mineral acid solutions is decomposed, with the production of the true colouring matter termed quercetin.

So-called Flavine is a commercial preparation of Quercitron Bark consisting of quercitrin or of quercetin ; it is much used by wool-dyers for the production of bright yellow and orange colours. Wool is dyed in single bath by boiling with a mixture of Flavine (8 per cent.), stannous chloride (4 per cent.), and oxalic acid (2 per cent.). Flavine is used in small quantity along with cochineal for dyeing scarlet on wool.

Persian Berries are the dried unripe fruit of various species of Bhamnus growing in the Levant. The general dyeing properties are similar to those of Quercitron Bark, the orange colour given with tin mordant being particularly brilliant. The high price of this dyestufi causes its employment to be somewhat limited. The colouring matter of Persian Berries is called xanthorhamnin, which by the action of fermentation and acids yields the true dyestufi rhamnetin.

Weld is the dried plant Beseda luteola, a species of wild migno- nette, formerly largely cultivated in Europe. Its dyeing proper- ties resemble those of Quercitron Bark, but the yellows with alumin- ium and tin mordants are much brighter and purer, and also faster to light It is still used to a limited extent for dyeing a bright yellow on woollen cloth and braid for the decoration of military uniforms. Quite recently the colouring matter of Weld, namely, luteolin, has been prepared artificially, but the process is too ex- pensive to be of practical use.

Logwood is the heart-wood of Bmmatoxylon campechianum, a tree growing in Central America. It is the most important natural dyewood at present employed, being largely used for dyeing dark blues and black on silk, wool, and cotton. With chromium and aluminium mordants logwood dyes a dark blue, and even black ; with tin, a, dark purple ; and with iron, black. The colours are only moderately fast to light. On wool the mordant is bichromate of potash, on cotton and silk an iron mordant is employed. Before use by the dyer the logwood is ground and aged or oxidized, by allowing moistened heaps of the ground wood to ferment slightly, and by frequently turning it over to expose it freely to the air. By this means the colouring principle hsematoxylin which logwood contains is changed into the true colouring matter hsematein. The constitution of this colouring matter has been re- cently discovered ; it is very closely allied to the brazilin of Peach- wood", Sapanwood, and Limawood, and is also a .member of the 7-pyrone group of colouring matters.

The importance of the above-mentioned natural dyestufis is gradually diminishing in favour of mordant dyestuffs and others derived from coal-tar. Old Fustic and Logwood are perhaps the most largely used, and may

continue to be employed for many years, owing to their comparatively low price.

The Artificial Mordant Colours are well represented J)y Alizarin, the colouring matter of the Madder root, which was the first natural dyestufi prepared artificially in 1868 from the coal-tar product anthracene. For this reason many of these colours are fre- quently referred to as the Alizarin Colours. Atthepresenttime, how- ever, there are numerous Mordant Colours which are prepared from other initial materials than anthracene ; they are not chemically related to Alizarin, and for these the term Alizarin Colours is therefore inappropriate. The property, which Mordant Colours possess in common, of combining with metals and producing lakes, which readily adhere to the fibre, depends upon their chemical con- stitution, more particularly upon the general and relative position in the molecule of certain side atomic groups. In Alizarin there are, for example, two characteristic hydroxyl groups (OH) occupy- ing a special (ortho) position in the molecule — i.e., they are next to each other, and also next to one of the so-called ketone groups (C : 0). In other Mordant Colours there are oarboxyl (COOH) as well as hydroxyl groups, which are all-important in this respect. In addition to this, the general dyeing property is influenced by the constitution of the molecule itself, and by the presence of other side-groups, e.g., NH2, HSO3, &c., which modify the colour as to solubility or hue. Hence it is that the members of this group, while possessing the mordant-dyeing property in common, differ materially in other points. Some, like Alizarin, are not in them- selves to be regarded as colouring matters, but rather as colouring principles, because they only yield useful dyes in combination with metallic oxides. According to their constitution , these may yield one or many colours with the various metallic oxides employed, and they are used for cotton as well as for wool and silk. Other Mor- dant Colours, e.g., many of the Direct Colours and others, are cap- able of dyeing either the vegetable or animal fibres without the aid of a mordant ; they are fully developed colouring matters in themselves, and possess the mordant dyeing property as an addi- tional feature, in consequence of the details of their chemical con- stitution, to which reference has been made in the foregoing para- graphs. As a rule these yield, at most, various shades of

one colour with the different oxides, and are only suitable for the ani- mal fibres, particularly wool.

In the following list, the most important artificial Mordant Colours are arranged according to the colour they give in conjunc- tion with the aluminium mordant, unless otherwise indicated. Those which dye the animal fibres, even without tnordants, are given in italics ; some are Direct Colours possessing mordant-dye- ing properties, others are sulphonic acid derivatives of Alizarin Colours, suitable for wool but not for cotton. Bed. — Alizarin, Anthrapurpurin, Flavopurpurin, Purpurin, Alizarin Bordeaux, Alizarin Garnet R, Alizarin Maroon, Alizarin S, Cloth Bed, Diamine Fast Bed, Anthracene Bed. Orange and Yellow. — Alizarin Orange, Alizarin Orange G, Ali- zarin Yellow paste. Alizarin Yellow A, Alizarin Yellow C, Anthracene Yellow, Galloflavin, Fustin, Alizarin Yellow GO, Alizarin Yellow B, Diamond Flavin Q, Chrome Yel- low D, Crumpsall Yellow, Fast Yelloio, Diamond Yellow, Bemo Orange B, Cloth Orange, Carbazol Yellow, Chrysa- mine. Green. — Coerulein, Coerulein S, Alizarin Green S, Fast Green (Fe), Naphthol Green (Fe), Dioxin (Fe), Gambine (Fe), Azo Green, Gallanil Green, Alizarin Green G and B, Acid Alizarin Green, Alizarin Cyanine Green, Diamond Green. Blue. — Alizarin Blue, Alizarin Blue S, Alizarin Cyanine, Anthracene Blue, Brilliant Alizarin IBlue, Alizarin Indigo Blue S, Acid Alizarin Blue, Brilliant Alizarin Cyanine, Alizarin Saphirole, Gallanilide Blue, Delphine Blue, Gal- lamine Blue, Celestine Blue, Chrome Blue, Gallazine A, Phenocyanine, Coreine. Purple and Violet. — Galle'in, Gallocyanine, Chrome Violet. Brown. — Anthracene Brown, Chromogen, Cloth Brown, Diamond

Brown, Alizarin Brown, Fast Brown. Black. — Alizarin Black, Diamond Black, Alizarin Blue Black, Alizarin Cyanine Black, Alizarin Fast Grey, Chromotrope. A brief description of the application of a few of the more im- portant of the above colouring matters will suffice.

Alizarin, Anthrapurpurin, and Flavopurpurin give some- what similar shades with the different mordants, namely, brown with chromium, red with aluminium, orange with tin, and purple with iron mordant.

In wool-dyeing they are applied along with other Mordant Colours on chromium mordant for the production of a large variety of compound shades, browns, drabs, greys, &c., the presence of acetic acid in the dyebath being advantageous. When alum and tartar mordant is employed, for the production of reds, it is neces- sary to add a small amount (4 per cenfr.) of calcium acetate to the dyebath, in order to neutralize the strong acidity of the mordanted wool, and to furnish the calcium of the colour-lake fixed upon the fibre, which is regarded as an aluminium-calcium compound of the colouring matter.

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DYEING

In coMon-dyeing the above colouring matters are chiefly used for the production of so-called Turkey-red, a colour remarkable for its brilliancy and its fastness to light and soap. These properties are due to the preparation of the cotton with oil, in addition to the ordinary mordanting and dyeing, whereby there is fixed on the fibre a permanent and stable lake, in which aluminium and calcium are combined with Alizarin and some form of oxy-fatty acid. In the older processes employed, the preparation of the cotton with oil was effected by passing the material several times through emulsions of olive-oil and potassium carbonate solution ; at a later date, and even now in the case of cloth, the cotton is first impregnated with hot oil (Steiner's process), then passed through solutions of alkali carbonate. After the preparation with oil or oil-emulsions, the cotton is "stoved," i.e., heated for several hours in special cham- bers or stoves to a temperature of about 70° C, during which operation the oil is decomposed and oxidized and becomes indelibly attached to the fibre. The oil-prepared cotton is steeped in cold solutions of basic aluminium sulphate or acetate, washed, dyed with Alizarin, and finally boiled for several hours with soap solution under pressure in order to brighten the colour. In the more recent and much more expeditious "sulp hated-oil process," castor-oil is employed instead of olive-oil, and before use it is submitted to a treatment with sulphuric acid, the sulphated oil thus obtained being finally more or less neutralized with alkali. The

cotton is im- pregnated with this sulphated-oil solution, dried, mordanted with aluminium acetate, dyed, dried, steamed, and soaped. The opera- tion of steaming plays an important part in brightening and fixing the colour-lake on the fibre. In these and all other Turkey-red processes, the oil, probably in the form of an oxy-fatty acid, acts as a fixing agent for the aluminium and enters into the composition of the red lake, imparting to it both brilliancy and'permanency.

Alizarin S is a sulphonic acid derivative of Alizarin, and since it is much more soluble, it readily yields level colours. Silk is dyed in a similar manner to wool, the fibre being mordanted by the ordinary methods and then dyed in a separate bath.

Diamine Fast Red is applied to cotton as a Direct Colour, with the addition of soda or soap to the dyebath. By treating the dyed colour with a solution of fluoride of chromium, its fastness to washing is materially increased. Wool is dyed in a similar manner, sodium sulphate being added to the dyebath, and the dyed colour treated with fluoride of chromium or bichromate of potash. The colour is so extremely fast to light and to milling on wool that it may well serve as a substitute for Alizarin.

Alizakin Orange is employed in the same manner as Alizarin. In wool-dyeing it is usually applied on chromium mordant for browns and a variety of compound shades in combination with other Alizarin Colours and dyewood extracts, less frequently on aluminium mordant.

Galloflavin is used in wool and silk dyeing on chromium mordant as a substitute for Fustic and other yellow dyewoods, to furnish the yellow part of compound shades.

The Alizarin YeUows, R and GG, Anthracene Yellow, Diar- mond Flavine, Chrome Yellow, Diamond Yellow, Carbazol Yellow, Chrysamine, &c., are Direct Colours with mordant-dyeing pro- perties. They also serve as substitutes for Fustic in wool or silk dyeing, and are dyed either on a chromium mordant, or first in an acid bath and afterwards saddened with bichromate of potash.

CcEBULEiN is employed in dyeing wool, silk, or cotton with aluminium or chromium mordants, either as a self-colour or for compound shades. With aluminium mordant the colour is a moderately bright green, more particularly on silk ; with chromium mordant, an olive-green. Coeralein S is the more soluble bisulphite compound of the ordinary Coerulein. It is applied in the same manner, care being taken, however, to dye for some time (one hour) at a temperature not exceeding 60° C. until the bath is nearly exhausted, and then only raising the temperature to the boiling-point. Without this precaution Coerulein S is decomposed, and the ordinary insoluble Ccerulein is precipitated. The colours obtained are very fast to light.

Fast Green, Dioxine, and Gambine are chiefly of use in calico- printing and in wool-dyeing. With iron mordant they yield olive-greens, which on wool are extremely fast to light. Cotton is impregnated with ferrous acetate, dried, aged, and fixed with silicate of soda, then dyed in a neutral bath. Wool is mordanted with ferrous sulphate and tartar (3 per cent, of each) and dyed in a neutral bath.

Acid Alizarin Green, Alizarin Ctanine Green, and Dia- mond Green, all dye wool direct in a, bath acidified with acetic or sulphuric acid, and the dyed colour may be afterwards fixed or saddened with bichromate of potash, or they may be dyed on chromium-mordanted wool. The first method is very useful for pale shades, since the colours are very level or regular.

Alizarin Blue is a dark blue dyestuff which, owing to .the fastness of the colours It yields, has for many years been regarded as a worthy substitute for Indigo in wool-dyeing. It is applied in the same manner as Alizarin, the chromium mordant being alone

employed. Alizarin Blue S is the soluble sodium bisulphite com- pound of Alizarin Blue ; it corresponds, therefore, to the above- mentioned Coerulein S, and in its application the same precautions as to the temperature of the dyebath are necessary. The fastness of the dyed colours to light, milling, and acid satisfy the highest requirements.

Alizarin Cyanine, Anthracene Blue, and Brilliant Alizarin Blue were discovered later than the above-mentioned Alizarin Blues, and, owing to their greater solubility and other advantages, they have largely replaced them as substitutes for Indigo. They are dyed on chromium-mordanted wool, silk, or cotton, and yield dark purplish or greenish blues, according to the particular brand employed. The fastness of the dyed colours to light, and general durability, are very satisfactory, but in fastness to milling and acids they are to some extent inferior to Alizarin Blue.

Celestine Blue and Chrome Blue dye purplish blue and bright blue respectively, and are dyed in the ordinary way upon a chromium mordant. The colours they yield are inferior to the Alizarin Colours in fastness to light, but on account of their clear shades they are often used for brightening other colours.

Brilliant Alizarin Cyanine and Alizarin Saphirole are true Alizarin Colours, and possess the same fastness to light as other colours of this class. Unlike most of the Alizarin Colour?, they are capable of dyeing wool satisfactorily without the aid of a metallic mordant — namely, with the addition of sulphuric acid to the dyebath, in the same manner as the Acid Colours. If neces- sary, the dyed colours may be treated with bichromate of potash. The colours thus produced are very fast to light and very level, hence these dyestuffs are valuable in the production of the most delicate compound shades, such as drabs, slates, greys, &c., which are desired to be fast to light. Alizarin Saphirole dyes clear blue, the colour produced being much more brilliant even than those of Brilliant Alizarin Cyanine.

Gallein, Gallocyanine, and especially Chrome Violet dye somewhat bright purple shades, and are hence frequently employed for brightening other colours, but they are only moderately fast to light. They are applied in the usual manner on a chromium mordant.

Anthracene Brown is largely employed in the production of compound shades. It dyes a dark, somewhat reddish, brown on chromium mordant, the colour being very even and extremely fast to light.

Chromogen is a greyish white powder, readily soluble in water, with a pale brown colour. It is attracted and absorbed by wool in a boiling acid bath ; at this stage the wool remains colourless, but by subsequently boiling it with a little bichromate of potash in the same or in a separate bath the absorbed chromogen is oxidized and the brown colour is developed.

Alizarin Black is dyed on chromium mordant in the same manner as Alizarin, and is used as a self-colour or in combination with other Alizarin Colours.

Diamond Black and the following three colours mentioned in the list are very useful for dyeing good blacks on wool, fast to light and acids. The wool is first dyed with the addition of acetic and finally sulphuric acid. When the dyebath is exhausted, bichromate of potash (2 per cent.) is added, and boiling is continued for half an hour longer.

Chkomotrope, of which there are several brands, is an Acid Colour which ^is applied to wool in an acid bath in the usual manner. The red or purple colours thus obtained are saddened in the same bath with bichromate of potash and changed into black, the colouring matter being oxidized and simultaneously combined with chromium.

Miscellaneous Colours. — Under this head there may be arranged a few dyestuffs which, although capable of inclusion under one or other of the foregoing groups, it is more convenient to treat of separately. Indigo, Aniline Black, and Catechu, for example, might be placed in the class of Developed Colours, since they are all developed on the fibre, and indeed by the same method — namely, by oxidation.

Indigo is one of our most important blue dyestufis, which has been employed from the earliest times. It may be obtained from various plants, the chief of which are the European woad- plant Isatis tinctoria, the Chinese and Japanese indigo-plant Polygonum tinctorium, and the indigo-plant of India, IrS,igofera tinctoria, &c., but the chief supply is obtained from the last- mentioned plant, which is largely cultivated in India. Curiously enough, the living plant contains no indigo, but an indigo-yielding substance called indican, which is converted into indigo

during the process of extraction by the joint influence of fermentation and oxidation, there being simultaneously separated a sugar product called Indiglucine. In India the fresh plants are steeped in large tanks containing water; fermentation soon begins, and lasts for about fifteen hours, when It subsides ; at this stage a clear yellow liquor is drawn off into shallow tanks, and there agitated in contact with the air, whereby the indigo is produced and precipitated as

a dark blue powder. After drawing off the supernatant liquid, the sediment of indigo is boiled with water to prevent further destruc- tive fermentation, and then collected on filtering frames, the drained pasty indigo being finally pressed ; the press-cakes are cut into the form of cubes, which are finally dried in open-air sheds. In 1878 Professor Baeyer succeeded in preparing indigo by artifi- cial means from the coal-tar product toluene. Two years later he devised another method, the initial substance being cinnamic acid. This process, known as the " propiolic-acid " method, was for a brief period carried out on a commercial scale, the product " pro- piolic acid " being employed by calico-printers-and only converted by them into indigo-blue during the process of application. Since then, chemists have found it possible to prepare artificial indigo by various methods, but few of these have given any great promise of commercial success. In 1890, however, Heumann astonished the chemical world by preparing indigo from such simple materials as aniline, acetic acid, chlorine, and alkali, the immediate mother- substance, prepared from the first three, being so-called phenyl- glycocoU, which requires simply to be melted with alkali and dissolved in water to yield the indigo. DifBoulties as to the yield of indigo obtained soon caused this process to be abandoned in favour of one closely akin to it, in which the carboxylic acid derivative of phenyl-glycocoU is similarly melted with alkali. This substance is derived by successive stages from anthranilic acid, phthalimide, phthalic acid, and finally naphthalene. This last-mentioned substance, which has now therefore become the initial material, is obtained in large quantity by the direct dis- tillation of coal-tar. Since

1897 the manufacture of indigo from naphthalene on a commercial scale has been carried on by one of the large German colour-manufacturing firms (Badische Anilin and Soda Fabrik) with every appearance of success, so much so that the indigo-planters of India have been compelled to adopt improved methods in order to reduce the cost of production. At the present time natural and synthetic indigo are entering upon a period of commercial competition with each other, and time alone can show which can be produced at the lowest price and be ulti- mately successful in the confiict. It is well to emphasize the fact that the colouring matter indigotin is identical in both the artificial and natural products, but in the latter it is accompanied by other substances, notably indigo-red (indirubin), indigo-brown, and indigo-gluten. The first is a dyestuft similar in general properties to indigo-blue, but yielding purple shades instead of blue ; the rest may be regarded as impurities. An exaggerated importance has been attached by some dyers to the presence of these accompany- ing substances in natural indigo, as giving fulness and depth to the dyed colour, but these effects may also be obtained with arti- ficial indigo by employing suitable means ; and in the case of indigo-red, this, too, can be made artificially if required.

As to the methods of application in dyeing, they are the same with both dyestuffs, and these may be now briefly described. In- digo, being insoluble in water, would be of no use in dyeing if it were not capable of being rendered soluble. This is effected in two ways, corresponding to which there are two methods of dyeing with indigo. One method consists in dissolving the indigo in very strong sulphuric acid, whereby it is converted into indigotin- disulphonio acid (Indigo Extract), which is really soluble in water. This substance belongs to the group of Acid Colours ; hence it is applied to the animal fibres, wool and silk, by boiling in a solution of the colouring matter slightly acidified with sulphuric acid. The second and most important method is based on the fact that under the influence of reducing agents (i.e., substances capable of yielding nascent hydrogen) indigo-blue is changed into indigo- white, which is soluble in alkali, the solution thus obtained being called a "vat." If textile materials are steeped in a clear yellow solution of the reduced indigo and then exposed to air, the indigo- white absorbed by the fibre is oxidized and reconverted into indigo- blue within and upon the fibre, which thus

becomes dyed blue ; this is the so-called " indigo-vat " method of dyeing. Comparing the two methods, the "indigo-extract method" is only applicable to the animal fibres, and although it gives brighter colours, they are fugitive to light and are decolorized by washing with alkaline solutions ; the " vat method" is applicable to all fibres, and gives somewhat dull blues, which are very fast to light, washing, &c.

Cotton is dyed by means of the "■lime and copperas vat,"" the ^^ zinc powder vat," or the ^^ hydrosulphite vat." In the first- mentioned vat the ingredients are quicklime, ferrous sulphate, and indio-o ; the lime decomposes the ferrous sulphate and precipitates ferrous' hydrate ; this quickly absorbs oxygen from the water present, with the liberation of hydrogen, which at once conibines with the indigo to form indigo-white, this in turn dissolving in the ■excess of lime present. The ingredients of the zinc powder vat are zinc powder, lime, and indigo ; in the presence of the lime and indigo the zinc takes up oxygen from the water, liberating the hy- drogen necessary to reduce the indigo,. as in the previous vat. The constituents of the hydrosulphite vat are hydrosulphite, or more correctly hyposulphite of soda, lime, and indigo. The requisite

hyposulphite of soda is prepared by allowing zinc powder (13 lb) to act upon a cold concentrated solution of bisulphite of soda (17 gallons of sp. gr. 1-225), taking care to avoid, as much as possible, access of air and any heating of the mixture, to prevent decompo- sition. The solution thus obtained is thoroughly neutralized by the addition of lime ; and after settling, the clear liquor is used for the vat, along with indigo and lime. Here again the hypo- sulphite takes up oxygen from the water and liberates the necessary hydrogen. It is found convenient to prepare, in the first instance, a very concentrated standard of reduced indigo, and to add as much of this to the dye-vat as may be required, along with lime and a little hyposulphite of soda. The advantages of this vat are that it is easily prepared and that there is very little sediment ; moreover, it can be employed in dyeing wool as well as cotton, and it is now very generally in use. The vat usually employed for dyeing wool is the so-called " woad vat," which differs from the foregoing in that the hydrogen necessary to reduce the indigo and bring it into solution is furnished, not by the action of chemical agents, but by means of fermentation. The ingredients of the

woad- vat are indigo, woad, bran, madder, and lime. The woad here employed is pre- pared by grinding the leaves of the woad plant (Isatis tinctoria) to a paste, which is allowed to ferment and then partially dried. It serves as the ferment to excite lactic and butyric fermentation with the aid of the bran and madder, the necessary hydrogen being thus evolved. Excessive fermentation is avoided by making timely ad- ditions of lime ; sluggish fermentation is accelerated by additions of brau and slightly raising the temperature. When the reduction and complete solution of the indigo is effected, the vat is allowed to settle, and the woollen material is immersed and moved about in the clear liquor for half an hour to two hours, according to the shade required, then squeezed and exposed to the air in order to develop the blue colour on the fibre.

Aniline Black differs from other dyes in that it is not sold as a ready-made dyestuff, but is produced in situ upon the fibre by the oxidation of aniline. It is chiefly used for cotton, also for silk and cotton-silk union fabrics, but seldom or not at all for wool. Prop- erly applied, this colour is one of the most permanent to light and other influences with which we are acquainted. One method of dyeing cotton is to work the material for about two hours in a cold solution containing aniline (10 parts), hydrochloric acid (20 parts), bichromate of potash (20 parts), sulphuric acid (20 parts), and ferrous sulphate (10 parts). The ferrous sulphate here employed is oxidized by the chromic acid to a ferric salt, which serves as a carrier of oxygen to the aniline. This method of dyeing is easily carried out, and it gives a good black ; but since much of the col- ouring matter is precipitated on the fibre superficially as well as in the bath itself, the colour has the defect of rubbing off. Another method is to impregnate the cotton with a solution containing ani- line hydrochlorate (35 parts), neutralized with addition of a little aniline oil, sodium chlorate (10 parts), ammonium chloride (10 parts). Another mixture is 1-8 part aniline salt, 12 parts potassium ferrocyanide, water (200 parts) , (8‘5) potassium chlorate dissolved in water. After squeezing, the material is passed through a special oxidation chamber, the air of which is heated to about 50° C. and also supplied with moisture. Tljis oxidizing or ageing is continu- ous, the material passing into the chamber at one end in a colourless condition, and after about 20 minutes passing out again with the black fully developed, a final treatment with hot chromic acid solution

and soaping being necessary to complete the process. In this method, employing the first-mentioned solution, chlorate of copper is formed, and this being a very unstable compound, readily decomposes, and the aniline is oxidized by the liberated chlor- oxygen compounds. The presence in the mixture of a metallic salt is very important in aiding the development of the black, and for this purpose salts of vanadium, cerium, and copper have proved to be specially useful. The chemistry of aniline black is still incom- plete, but it would appear that there are several oxidation products of aniline. The first product is so-called emeraldine, a dark green sub- stance of the nature of a salt, which by treatment with alkali yields a dark blue base called azurine. The further oxidation of emerald- ine yields nlgraniline, also a dark green salt, but the free base of which has a violet black colour. The latter becomes greenish under the infiuence of acids, especially sulphuric acid, and explains the defect known as "greening" which is developed in ordinary aniline blacks during exposure to air. By a supplementary oxida- tion with chromic acid such a black is rendered ungreenable, the nigraniline being probably changed into the more stable chromate of nigraniline.

Catechu is a valuable brovm dyestuff, obtained from various species of Acacia, Areca, and Uncaria growing in India. The wood, leaves, and fruit of these plants are extracted with boiling water ; the decoction is then evaporated to dryness or to a pasty consistency. Catechu is largely used by the cotton dyer for the production of brown, drab, and similar colours. It is seldom employed for wool. Cotton is usually dyed by boiling it for about one hour in a decoction of catechu (100 per cent.) containing

copper sulphate (5 per cent.)- After squeezing, the material is boiled for about fitteeu minutes in a solution of bichromate of potash (J oz. per gal.), then washed and dried. By repeating the opera- tions two or three times, deeper shades are obtained. During the boiling with catechu the cotton attracts the active principles cateohin and cateohu-tannic acid, but it thus acquires only a pale brown colour ; in the bichromate of potash, however, these are oxidized to form insoluble japonic acid, which

permeates the fibre, and a deep brown colour is thus developed. Catechu browns are fast to a variety of influences, e.g., washing, alkalis, acids, &c., but less so to light. Catechu has been recently much employed, in conjunction with copper sulphate, for dyeing the so-called khaki- brown on woollen material for military clothing. On silk, catechu is much used for weighting purposes in dyeing black.

Mineral Colours.^These include Chrome Yellow, Iron Buff, Prussian Blue, and Manganese Brown.

Chkome Yellow is only useful in cotton-dyeing as a self-colour, or for conversion into Chrome Orange, or, in conjunction with Indigo, for the production of fast green colours. The cotton is first impregnated with a solution of lead acetate or nitrate, squeezed, and then passed through a solution of sodium sulphate or lime water to fix the lead on the fibre, as sulphate or oxide of lead. The material is then passed through a solution of bichromate of potash. The colour is changed to a rich orange by a short, rapid passage through boiling milk of lime, and at once washing with water, a basic chromate of lead being thus produced. The colour is fast to light, but has the defect of being blackened by sulphuretted hydrogen.

Iron Boff is produced by impregnating the cotton with a solution of ferrous sulphate, squeezing, passing into sodium hydrate or carbonate solution, and finally exposing to air, or passing through a dilute solution of bleaching powder. The colour obtained, which is virtually oxide of iron, or iron-rust, is fast to light, but readily removed by acids.

Prussian Blue is applicable to wool, cotton, and silk, but since the introduction of coal-tar blues its employment has been very restricted. The colour is readily obtained on cotton by first dyeing an iron-buff, according to the method just described, and then passing the dyed cotton into an acidified solution of potassium ferrocyanide, when the blue is at once developed. A similar method is employed for silk. Wool is dyed by heating it in a solution containing potassium ferricyanide and sulphuric acid. The colour is developed gradually as the temperature rises ; it may be rendered brighter by the addition of stannous chloride. On wool and

silk, Prussian blue is very fast to light, but alkalis turn it brown (ferric oxide).

Manganese Brown is applied in wool, silk, and cotton dyeing. The animal fibres are readily dyed by boiling with a solution of potassium permanganate, which, being at first absorbed by the fibre, is readily reduced to insoluble brown manganic hydrate. Imitation furs are dyed in this manner on wool-plush, the tips or other parts of the fibres being bleached by the application of sulphurous acid. Cotton is dyed by first impregnating it with a solution of manganous chloride, then dyeing and pajssing into a hot solution of caustic soda. There is thus precipitated on the fibre manganous hydrate, which by a short passage into a cold dilute solution of bleaching powder is oxidized and converted into the brown manganic hydrate. This manganese bronze or brown colour is very susceptible to, and readily bleached by, teducing agents ; hence by the application of these, in conjunction with various dyestuffs, the calico-printer is able to produce a pleasing variety of so-called coloured' discharge patterns.

With respect to the question of colour, we meet with two kinds of substances in nature, — those which possess

colour and those which do not. Why this differ- dKe/ne' "' -'^^ " ^^® physicist says the former are bodies

which reflect all the coloured rays of the spec- trum composing white light — if opaque, they appear white; if transparent, they are colourless. The latter are bodies which absorb some of the spectrum rays only, reflecting the remainder, and these together produce the impression of colour. A black substance is one which absorbs all the spectrum rays. The fundamental reason, however, of this diif erence of action on the part of substances towards light remains still unknown. All substances whichpossess colour are not necessarily dyestuffs, and the question may be again asked, Why ? It is a remarkable circumstance that most of the dyestuffs at present employed occur among the so-called aromatic or benzene compounds derived from coal-tar, and a careful study of these has furnished a

general explanation of the point in question, which briefly is, that the dyeing property of a substance depends upon its chemical constitution. Speaking generally, those colouring matters which have the simplest constitution are yellow, and as the molecular weight increases, their colour passes into orange, red, violet, and blue. In recent years chemists have begun to regard the constitution of nearly all dyestuffs as similar to that of Quinone, and some even believe that all coloured organic compounds have a quinonoid structure. According to 0. N. Witt, a colour-less hydrocarbon, e.g., benzene, becomes coloured by the introduction of one or more special groups of atoms, which he terms the colour-bearing or chromopliorous groups — e.g., NO2, – N : N – , &c. Benzene, for example, is colourless, whereas nitro-benzene and azo-benzene are yellow. Such compounds containing chromophorous groups are termed chromogens, because, although not dyestuffs themselves, they are capable of generating such by the further intro- duction of salt-forming atomic , groups — e.g., OH, NHj. These Witt terms auxochromous groups. In this way the chromogen tri-nitro-benzene CeH3(N02)3 becomes the dye- stuff, tri-nitro-phenol (picric acid) CsH2(N02)3(OH), and the chromogen azo-benzene CeHj • N : N ■ CeHj is changed into the dyestuff amido-azo-benzene (Fast Yellow) CgHs . N : N • C6H4. These two dyestuffs are typical of a large number which possess either an acid or a basic character according as they contain an hydroxyl (OH) or an amido (NHo) group, and correspond to the Acid Colours and Basic Colours to which reference has already been made. Other important atomic groups which frequently occur, in addition to the above, are the carboxyl (COOH) and the sulphonic acid (HSO3) groups ; these either increase the solubility of the colouring matter or assist in causing it to be attracted by the fibre, &c. In many cases the free colour-acid or free colour-base has little colour, this being only developed in the salt. The free base rosaniline, for example, is colourless, whereas the salt magenta (rosaniline hydrochloride) has a deep crimson colour in solution. The free-acid Alizarine is orange, while its alumina-salt is bright red. It may be here stated that the scientific classification of colouring matters into Nitro-colours, Azo-colours, &c., already alluded to, is based on their chemical constitution, or the chromo- phorous groups they contain, whereas the classification according to their mode of application is dependent upon the character and arrangement of the auxochromous groups. The

question of the mordant-dyeing property of certain colouring matters containing (OH) and (COOH) groups has already been explained under the head of Artificial Mordant Colours.

The peculiar property characteristic of dyestuffs, as distinguished from mere colouring matters, namely, that of being readily attracted by the textile fibres, notably the animal fibres, appears then to be due to their more or less marked acid or basic character. Intimately connected with this is the fact that these fibres also exhibit partly basic and partly acid characters, due to the presence of carboxyl and araido groups. The behaviour of magenta is, typical of the Basic Colours. As already indicated, rosaniline, the base of magenta, is colourless, and only becomes coloured by its union with an acid, and yet wool and silk can be as readily dyed with the colourless rosaniline (base) as with the magenta (salt). The explanation is that the base rosaniline has united with the fibre, which here plays the part of an acid, to form a coloured salt. It has also been proved that in dyeing the animal fibres with magenta, (rosaniline hydrochloride), the fibre unites with the ros- aniline only, and liberates the hydrochloric acid. Further, in dyeing cotton with magenta it is necessary to prepare the cotton previously with the mordant tannic acid, with which the base rosaniline unites to form an insoluble salt.

In dyeing -wool it is the fibre itself -which acts as the mordant. In the case of the Acid Colours the explanation is similar. In many of these the free colour-acid has quite a different colour (purple) from that of the alkali-salt (yellow), and yet on dyeing -wool or silk -with the free colour-acid, the fibre exhibits the colour of the alkali-salt and not of the colour-acid. In this case the fibre evi- dently plays the part of a base. Another, fact in favour of the vie-w that the union between fibre and colouring matter is of a chemical nature, is that by altering the chemica.1 constitution of the fibre its dyeing properties are also altered ; oxycellulose and nitrocellulose, for example, have a greater attraction for Basic Colours than cellulose. Such facts and considerations as these have helped to establish the vie-w that in the case of dyeing animal fibres with many

colouring matters the operation is a chemical process, and not merely a mechanical absorption of the dyestuff. A similar explanation does not suffice, ho-wever, in the case of dyeing cotton -with the Direct Colours ; also in some cases of dyeing -wool and silk — e.g., -with Orchil. These are attracted by cotton from their solutions as alkali salts, apparently - without decomposition. The affinity existing between the fibre and colouring matter is some-what feeble, for the latter can readily be removed from the dyed fibre by merely boiling -with vs^ater. The depth of colour obtained in dyeing varies -with the concentration of the colour solution, or ~~with, the amount of some neutral salt — e.g., sodium chloride, added as an assistant to the dyebath ; moreover, the dyebath is never completely exhausted. The colouring matter is submitted to the action of two forces, the solvent power of the water and the affinity of the fibre, and divides itself between the fibre and the water. After dyeing for some time, a state of equilibrium is attained in which the colouring matter is divided between the fibre and the water in a given ratio, and prolonged dyeing does not intensify the dyed colour. An interesting fact bearing on this question is that some basic colouring matters are capable of dyeing — amorphous sulphur, gelatin, silicic acid, infuso~~ rial earth, &c.

These and other similar facts have led to the adoption by various investigators of the view that in some cases the fibres exert a purely physical attraction towards col- ouring matters, and that the latter are held in an un- changed state by the fibre. The phenomenon is regarded as one of purely mechanical surface-attraction, very similar to that exercised by animal charcoal when em- ployed in decolourizing a solution of some colouring matter. Some consider such direct dyeing as mere diffu- sion of the colouring matter into the fibre, and others that the colouring matter is in a state of " solid solution" in the fibre, similar to the solution of a metallic oxide in coloured glass. According to this latter view, the cause of the dyeing of textile fibres is similar to the attraction of solvent action exerted by ether when it withdraws colouring matter from an aqueous solution by agitation.

In the case of colours which are dyed on mordants, the question is merely transferred to the nature of the attraction which exists between the fibre and the mordant, for it has been conclusively established that the union

between the colouring matter and the mordant is essen- tially chemical in character.

From our present knowledge it will be seen that we are unable to give a final answer to the question of whether the dyeing process is to be regarded as a chemical or a mechanical process. There are arguments and facts which favour both views ; but in the case of wool and silk dye- ing, the prevailing opinion in most cases is in favour of the chemical theory, whereas in cotton-dyeing the me- chanical theory is widely accepted. Probably no single theory can explain satisfactorily the fundamental cause

Con- clusloa.

of attraction in all cases of dyeing, and further investi- gation is needed to answer fully this very difficult and abstruse question.

The poisonous nature or otherwise of the coal-tar dyes has been frequently discussed, and the popular opinion, no doubt dating from the time when magenta and its derivatives were contaminated with arsenic, seems to be that they are for the most part really poisonous, and ought to be avoided for colour- ing materials worn next the skin, for articles of food, &c. It is satisfactory to know that most of the colours are not poisonous, but some few are — namely, Picric acid, Victoria Orange, Aurantia, Coralline, Metanil Yellow, Orange II., and Safranine. Many coal-tar colours have, indeed, been recommended as antiseptics or as medicinal remedies, e.g.. Methyl Violet, Auramine, and Methylene Blue, because of their special physiological action. In histology and bacteriology many coal-tar colours have rendered excellent service in staining microscopic prepa- rations, and have enabled the investigator to detect differences of structure, &c., previously unsuspected. In photography many of the more fugitive colouring mat- ters, e.g'., Cyanine, Eosine, Quinoline Eed, &c., are employed in the manufacture of ortho-chromatic plates, by means of which the colours of natural objects can be photographed in the same degrees of light and shade as they appear to the eye — ^blue, for example, appearing a darker grey, yellow a lighter grey, in the printed photograph.

Since the year 1856, in which the first coal-tar colour, mauve, was discovered, the art of dyeing has made enor- mous advances, mainly in consequence of the continued introduction of coal-tar colours having the most varied properties and suitable for nearly every requirement. The old idea that the vegetable dyestuffs are superior in fastness to light is gradually being given up, and, if one may judge from the past, it seems evident that in the future there will come a time when all our dyestuffs will be prepared by artificial meansi

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Dynamics, Analytical. — The fundamental principles of Dynamics, and their application to special problems, are explained under Mechanics {Ency. Brit. vol. XV.), where brief indications are also given of the more general methods of investigating the properties of a dynamical system, independently of the accidents of its particular constitution, which were inaugurated by Lagrange. These methods, in addition to the unity and breadth which they have introduced into the treatment of pure dynamics, have a peculiar interest in relation to modern physical speculation, which finds itself confronted in various directions with the problem of explaining on dynamical principles the properties of systems whose ultimate mechanism can at present only be vaguely con- jectured. This article is devoted to an outline of such portions of general dynamical theory as seem to be most important from this latter point of view.

General Equations of Impulsive Motion. § 1. The systems contemplated by Lagrange are composed of discrete particles, or of rigid bodies, in finite number, connected (it may be) in various ways by invariable geometrical relations, the fundamental postulate being that the position of every particle of the system at any time can be completely specified by means of the instantaneous values of a finite number of independent variables jj, q

a! =yi?i, ?»■•■?«). 2/=&o-. 2=&o., . . (1) where the functions / differ (of course) from particle to particle. In modern language, the variables ?„ Js, ... q„ are generalized co- ordinates serving to specify the configuration of the system ; their derivatives with respect to the time are denoted by ji, jji ■ • • jm and are called the generalized components of velocity. The continuous sequence of configurations assumed by the system in any actual or imagined motion (subject to the given connexions) is called the path.

For the purposes of a connected outline of the whole subject it is convenient to deviate somewhat from the historical order of development,

and to begin with the consideration of Impulsive impulsive motion. Whatever the actual motion of the motion. system at any instant, we may conceive it to be generated instantaneously from rest by the application of proper impulses. On this view we have, if x, y, z be the rectangular co-ordinates of any particle m,

mx=X', m^=Y', mz=Z', . . (2)

where X', Y', Z' are the components of the impulse on m. Now let dx, Sy, Sz be any infinitesimal variations of a;, y, z which are con- sistent with the connexions of the system, and let us lorm the equation

Sm(a;^a!j'5/25)=S(X'Bx-^Y'a1/-^-Z'^^), . (3)

where the sign Z indicates (as throughout this article) a summation

extending over all the particles of the system. To transform (3) into an equation involving the variations Sq^, Sq^, ... of the generalized co-ordinates, we have

~ ^

(4)

and therefore

"=&'&+-''=-'*°-*

where

*2m{xdx H- ySy H- iSz) = (An^i ł Ajj^a ł . . .)*7i + (Ajiji ł A22J2 t . . .)S?2 + ■ • •*

*^^(dx dx dy dy dz^dz^*

(5)

(6)

(7)

If we form the expression for the kinetic energy T of the system, we find

2T=Sm(!c2^-^2-l-z2)=Au^l■■'-l-A2J2/-^...-2AJ2,2-... (8)

The coefficients A,i, A^, ... A^, ... are by an obvious analogy called the coefficienis of inertia of the system ; they are in general func- tions of the co-ordinates jj, q^ The equation (6) may now be

written

2m(a:x-^5y-^a^^) = aT-S^l + 5^5^2+ (9)

0?1 0?2

This may be regarded as the cardinal formula in Lagrange's method. For the right-hand side of (3) we may write

where

S(X'«a! + Y'Sy + Z'5z) = Q'i5?i Ł Q'aSja H

Q'r

<^t.

oqr aqr,

(10)

(11)

The quantities Qj, Qj, ••• are called the generalized components of impulse. Comparing (9) and (10), we have, since the variations Sqi, Sjj,... are independent,

*1 = *^'-|=«' (^2)*

These are the general equations of impulsive motion. It is now usual to write

The quantities pi, p^... represent the effects of the several com- ponent impulses on the system, and are therefore called the generalized components of momentum. In terms of them we have

y^{xSx+SSy--!iSz)=PiSgi-i-p^dq^-- ... . (14)

Also, since T is a homogeneous quadratic function of the velocities Si! 32. -“i

2T=Mi+M2+ (15)

This follows independently from (14), assuming the special varia- tions Sx=xdt, &o., and therefore 5g’i=jidi, Sq^=q.fit,... .

Again, if the values of the velocities and the momenta in any other motion of the system through the same con- figuration be distinguished by aqcents, we have the ^” proca identity

M\+PA’i+-=P’ii\+p“A-i+ (16)

each side being equal to the symmetrical expression

A„M’l + ~~M2^2+~~+Al2(5’lj‘2 + ^l?2)+ (17)

*The theorem (16) leads to some important reciprocal relations. Thus, let us suppose that the momenta p-^, p^,... all vanish with the exception oi p^, and similarly that the momenta ^‘j, ‘j,... all vanish except p’. We have then Piq\ =p‘2^2> °^*

i2’Pi=i’i-p’i ■ ■ ■ . (18)

The interpretation is simplest when the co-ordinates g^, q-i are both of the same kind, e.g,, both lines, or both angles. We may then conveniently put ft =^‘2, and assert that the velocity of the first type due to an impulse of the second type is equal to the velocity of the second type due to an equal impulse of the first type. As an example, suppose we have a chain of

straight links hinged each to the next, extended in a straight line, and free to move. A blow at right angles to the chain, at any point P, wUl produce a certain velocity at any other point Q"; the theorem asserts that an equal velocity will be produced at P by an equal blow at Q. Again, an impulsive conple acting on any link A will produce a certain angular velocity in any other link B ; an equal couple applied to B will produce an equal angular velocity in A. Also if an impulse F applied at P produce an angular velocity u in tt link A, a couple Fo applied to A will produce a linear velocity ua at P. Historically, we may note that reciprocal relations in

*dynamics were first recognized by Helmholtz in the domain of acoustics ; their use has been greatly extended by Lord Kayleigh. The equations (13) determine the momenta p,, pi,... as linear functions of the velocities ^j, ^„... . Solving these, we can express Velocities ^^' ^^'y "^ I'l^ear functions of^j, pj,... . The resulting In terms ot 1"**'°°s give us the velocities produced by any given momenta. ®y*∗^°i "^ *impulses. Further, by substitution in (8), we can express the kinetic energy as a homogeneous*

quadratic function of the momenta pi, p^ The kinetic energy,

aa 30 expressed, will be denoted by T ; thus*

2r = A>i2 + AV22+... + 2A>2+... . (19) where A\], A'jj, . . . A^, ... are certain coefficients depending on the configuration. They have been called by Maxwell the coefficients of mobility of the system. When the form (19) is given, the values of the velocities in terms of the momenta can be expressed in a re markable form due to Hamilton. The formula (15) may be written

Piii+P^^+-. = 'r + T, . . . (20) where T is supposed expressed as in (8), and T' as in (19). Hence if, for the moment, we denote by 5 a variation affecting the velocities, and therefore the momenta, but not the configuration, we have

*PMi + iiSp +Piiii^ + ^2Sp2 + . . . = «T + ST**

In virtue of (13) this reduces to

*dpi '^ 8pj -^^*

3T

(21)

(22)

Since Sp^, Sp^, . . . may be taken to be independent, we infer that

. . (23)

In the very remarkable exposition of the matter given by Maxwell in his Electricity and Magnetism, the Hamiltonian expressions (23) for the velocities in terms of the impulses are obtained directly from first principles, and the formulae (13) are then deduced by an inversion of the above argument.

An important modification of the above process has been intro- duced in recent times by Routh and Thomson and Tait. Instead of expressing the kinetic energy in terms of the veloci- ties alone, or in terms of the momenta alone, we may express it in terms of the velocities corresponding to some of the co-ordinates, say jj, jj, ... q^ and of the momenta corresponding to the remaining co-ordinates, which (for the sake of distinction) we may denote by Xi x'l x"> ■ ■ • ■ Thus, T being expressed as a homogeneous quadratic function of ji, jj, • •• ?m. X) x" x")---. the momenta corresponding to the co-ordinates X, x', x".— may be written

Roatb's modltica Hon.

8T

k"=

3T

(24)

3T

““Sx’ ““Bx” “‘ax’

These equations, when written out in full, determine x, %’, x”,.—

*as linear functions of jj, jaj— J™ *i “> ”” ^^ ””^ consider*

the function

e = T-KX-K’x’~~K”r~~..., . . (25) supposed expressed, by means of the above relations, in terms of yi, 52,... jm, 1^, k’, k”,... . Performing the operation 5 on both sides of (25), we have

-kSx-xSk-..., . . (26)

where, for brevity, only one term of each type has been exhibited. Omitting the terms which cancel in virtue of ‘24), we have

3k 3?i

. + g.Sx + ..

dqi ^^ OK

Since the variations dq-^, dq be independent, we have 3T

3T

^^ Ji + ...~~xSk~~ (27)

5k, 5k’, Sk”,... may be taken to

^’=dT

3e

*3*i'*

3T 39

and

(28) (29)

39 ., 39 „ 39

>^=~Tk' ^~~dK" ^ " 8k"

An important property of the present transformation is that, when expressed in terms of the new variables, the kinetic energy is the sum of two homogeneous quadratic functions, thus

T =

where © involves the velocities ^j, ^j,...^™ alone, and K the momenta k, k', k",.— alone. For in virtue of (29) we have, from

™ ^ /■ 89 . /99 , j»39 , \ ■i

T=e (Kg^+K'9;.+K"g ,+ ...j,. . (31)

and it is evident that the terms in 9 which are bilinear in respect of the two sets of variables jj, q^,... ^„ and k, k', k",... will dis- appear from tlie right hand side.

it may be noted that the formula (30) gives immediate proof of two important theorems due to Bertrand and to Lord Kelvin respectively. Let us suppose, in the first place, that m 1 m the system is started by given impulses of certain "^ "" types, but is otherwise free. Bertrand's theorem is to g,i„i„„„„ the elfect that the kinetic energy is greater than if by „„g.jy impulses of the remaining types the system were con- strained to take any other course. We may suppose the co- ordinates to be so chosen that the constraint is expressed by the vanishing of the velocities ji, 52, ...^„,

~~whilst the given impulses are k, k', k", ... Hence the energy in the actual motion is greater than in the constrained motion by the amount ©.~~

~~Again, suppose that the system is started with prescribed velocity components jj, ^j, ... j„, by means of proper impulses of the corresponding types, but is otherwise free, so that in the motion actually generated we have K=0, k' = 0, k"=0,... and there- fore K = 0. The kinetic energy is therefore less than in any other motion consistent with the prescribed velocity-conditions by the value which K assumes when k, k', k", . . . represent the impulses due to the constraints.~~

~~Simple illustrations of these theorems are afforded by the chain of straight links already employed. Thus if a point of the chain be held fixed, or if one or more of the joints be made rigid, the energy generated by any given impulses is less than if the chain had possessed its former freedom.~~

~~CoTiiinvAms Motion of a System. § 2. We may proceed to the continuous motion of a system. The equations of motion of any particle of the system are of the form~~

~~mJc=X, mp=Y, mz = Z. . . (1)~~

~~Now let x+Sx, y + Sy, z + Sz be the co-ordinates of m in any~~

~~arbitrary motion of the system differing infinitely i .„•..„«.«>-~~

~~little from the actual motion, and let n* form the .„, __^„_„ ' equations.~~

~~equation~~

~~^m(xSx + y5y + zSz) = '2.{XSx + i:Sy + ZSz). . (2)~~

~~Lagrange's investigation consists in the transformation of (2) into an equation involving the independent variations Sqi, Sq^,... Sq„.~~

~~It is important to notice that the symbols 5 and djdt are com- mutative, since~~

~~Hence~~

- ~~. d , . . dx d ^ „ ,„.~~

~~Sx = rXx + Sx) w = :rM> ^f’ - • ■ (3) dt dt dt ‘~~

~~^m(xSx + ySy + ‘idz) = j^Sm [xSx+ySy + iSz) — ‘Zm(i.Sx + ySy + zII) =j^(piSqi+piSqi+...) ST,. . . (4)~~

~~by § 1 (14). The last member may be written~~

~~PlSqi+PiSqi+Pidq^+P2Sq2+ ■■■~~

~~dT,. dT, oT,, 3T,~~

~~Hence, omitting the terms which cancel in virtue of § 1 (13), we find~~

~~7im(xSx + ydy + zSz)=(pj,)sq(p^:^jdq2... . (6)~~

~~For the right-hand side of (2) we have~~

~~■2(XSx + YSy + ZSz) = (iidqi + Q^5q^+..., . (7)~~

~~‘^-i^t-^h’B ■ ■ “~~

~~r 3?r 3?r~~

~~The quantities Qi, Qj, ... are called the generalized components of force acting on the system. Comparing (6) and (7) we find~~

~~Ar|=Q^- ^2 |=Q.~~

~~. (9)~~

~~(l) |,=«. ID lr’. “»>~~

~~or, restoring the values of j,p,..., d dt~~

~~These are Lagrange’s general equations of motion. Their number is of course equal to that of the co-ordinates q^, qi,... to be deter- mined.~~

Analytically, the above proof is that given by Lagrange, but the terminology employed is of much more recent date, having been first introduced by Thomson and Tait ; it has greatly pro- moted the physical application of the subject. Another proof of the equations (10), by direct transformation of co-ordinates, has

been given by Hamilton and other writers, but the variational method of Lagrange is that which stands in closest relation to the subsequent developments of the subject. The chapter of Maxwell, already referred to, is a most instructive commentary ou the sub- ject from the physical point of view, although the proof there attempted of the equations (10) is iallaoious.

In a " conservative system " the work which would have to be done by extraneous forces to bring the system from rest in some standard configuration to rest in the configuration {q^, q^,... q„) is independent of the path, and may therefore be regarded as a definite function of ?i, Ja. • • • ?>■• Denoting this function (the potential energy) by V, we have, if there be no extraneous force on the system, /

^iXdx + Ydy + Zdz)=-5V, . . (11)

and therefore

Q2=-

av

(12)

Hence the typical Lagrange's equation may be now written in the form

dt\dqr) dir dqr

or, again,

~~A=-~~

~~3?r~~

~~(V-T).~~

~~(13)~~

~~(14)~~

~~It has been proposed by Helmholtz to give the name kinetic potential to the combination V-T.~~

~~To calculate the rate at which the kinetic energy varies in the actual motion we have~~

~~„iir d, .~~

~~) =Mi + PiSi +M2 + Pais + . •~~

~~=(l^^Mi.^^>~~

~~92+-~~

~~3T .. 3T'.. 02i (^ii~~

~~by (9). This may be written~~

~~„rfT dT^^ . ^. dt=dt+^^^ + ^~~

~~dT~~

~~dt~~

~~Ql*l+Q2J2+.~~

~~(15)~~

~~(16) (17)~~

~~This expresses that the kinetic energy is increasing at a rate equal to that at which work is being done by the forces. In the case of a conservative system free from extraneous force, we have, sub- stituting the values of Qj, Qj, ... from (12),~~

~~|(T + V) = 0~~

~~or T + V= const.,~~

~~(18)~~

~~Applica- tion to tlie top.~~

~~■which is the equation of energy.~~

A classical example of the application of Lagrange's equations is to the motion of a top. A rigid body, symmetrical about an axis, is supposed free to turn about a fixed point 0 in this axis, at a distance h (say) from the centre of mass. Let B be the angle which 06 makes with the vertical OZ, ^ the azimuth of the plane ZOG relative to a fixed vertical plane ZOX, and 1^ the angle which a meridian plane fixed in the solid makes with the plane ZOG, the notation being in fa':t that of MECHANICS, § 81. Denoting the principal moments of inertia by A, A,0, we have

2T=A(uJ + <.^) + Cu2

= kid" + sm'e^jP■) + C{^ + ^jy 0.03 ef… . (19)

If \, fi, V be the corresponding components of momentum, we have

.3T

aT

i3■=A II=^.=ksmHi}/ + G{^+xj/coae)cos e,\

d6

■'=§1=0(^-1-^2' cos 9)..

09

k20)

The geometrical meaning of these quantities is recognized at once from the expression for the virtual moment of the impulses,

\Se+iidil/ + i>S

viz., \ is the angular momentum about an axis normal to the plane of 0, /i is the angular momentum about the vertical, and v that about the axis OG. If M be the total mass, the potential energy is

v=:

~~Igh cos ff. Hence the equations (10) become~~

~~A9-A sin 0 cos9\p" + C{4> + 'l' cos c)~~

~~+ >pcos $) cos c} = 0.~~

~~dt~~

~~C{4>+i"^3 c)=o,~~

~~(22)~~

~~(23)~~

~~of which the last two express the constancy of the momenta ju, v.~~

~~Hence~~

~~A^ — A sin 9 cos B^'^ + v sin B\l/ = Mgh sin 9, \ Asia'B\// + ycoae=iJi, f~~

~~or, eliminating \p,~~

~~(cosg)(Atcosfl.) g~~

~~A sin^fl~~

~~(24) (25)~~

~~An immediate application of (24) is to find the condition for a steady precessional motion, i.e., one in which the axis of the top describes a right circular cone about the vertical. Putting 9=0, 9 = 0., in (24), we obtain~~

~~Acosa~~

~~For given values of v and a we have two possible values of \p, pro- vided V exceed a certain limit. "With very rapid rotation, or more precisely, with v large in comparison with iJ{iAMghcoaa], one value of 4' is small and the other large, viz., the two values are MgrA/;» and p/A cos a, approximately. To find the small small oscillation about the steady motion~~

we put S=o-l-x i" oscllla- (26), and neglect terms of the second order in x-
The (jons. " usual method leads to an equation of the type

X+p^ = Q. . . . (27)

where

„ i/i-v cos a)^ + 2(fi — V cos o)(/ii cos a — >>) cos a I (/i cos a — vf P = J7^^ — (28)

When p is large we find that for the slow precession ^p^k/A, whilst for the rapid precession p=v/Aaoaa = ^, approximately. Further, on examining the small variation in ^p, it appears that in a slightly disturbed slow precession the motion of any point of the axis consists of a rapid circular motion superposed ou the slow precession, so that the resultant path has a trochoidal character. This is a type of motion commonly observed in a top spun in the ordinary way, although the successive undulations of the trochoids may be too small to be directly observed. In a slightly disturbed rapid precession the added vibration is elliptic-harmonic, with a period equal to that of the precession itself. The ratio of the axes of the ellipse is sec a, the major axis being in the plane of $. The result is that the axis describes a circular cone about a fixed line making a small angle with the vertical. Another view of the matter is appropriate when we study the small oscillations abont the vertical position a = 0. The motion of any point of the axis may then be described as an elliptic-harmonic motion superposed on a uniform rotation with angular velocity i'/2A about the vertical OZ. The period of revolution in the ellipse is 2ir/p, where

P^^'^^l^ . . . (29)

This would indicate that the upright position of a top (with the centre of gravity above the pivot) is stable if, and only if, v" > iAMgh. See, however, § 6.

Constrained Systems.

~~• § 3. It has so far been 2tssumed that the geometrical relations, if any, which exist between the various parts of the system — are of the type § 1 (1), and so do not contain t ex- ”»«« ” plicitly. The extension of Lagrange’s equations to the ^‘p’jps case of ” varying relations ” of the type reiatioas.~~

~~x=f(,t, q^, q^... q„), y=&o.,z = &c. . . (1) was made by Vieille. We now have~~

~~3a; . dx , . dx. , , , ,~~

~~(3)~~

~~so that the expression § 1 (8) for the kinetic energy is to be replaced by~~

~~2T = ai, + 2ai^i + 2a^^+... + Ai^qi’ + A^^^+... + Ai^iq2+..., (4) where~~

~~— {(©■III)‘III)’}.1~~

~~u -Sm f— .dydydz dz\ ”’- “‘Xdtdqr^dtdqr^didiJ’~~

~~(5)~~

~~and the forms of A„.. Ar, are as given by § 1 (7). It is to be remembered that the coefficients ao, oj, Oj, ... A„, A^, ... Aj,... will in general involve t explicitly as well as implicitly through the co-ordinates ji, g’j Again, we find~~

~~2m{xSx -^ JS^ + zSz) = («! I All ji (A]2^2 -^ . . .)S?i~~

~~+ (a2-h A21J1 + A22^j (- ...)Sj2+ ...~~

~~3T. , 3T, ,~~

~~=PiSqi+PiSq2+..., . . (6)~~

~~where jj, ia defined as in § 1 (13). The derivation of Lagringe’a~~

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ln?„Tfi: ^ ‘V-‘ °? °°’ *« * ‘■“l« no - hold. The proof in- If t^e vetrsTr. ^ ‘^ ‘ ^- ogeneous quadraticUtiou

hmLhf „^.T r”*^”^ out by Hayward that ViciUe’s case can be r,UnKf .J Lagrange’s by introducing a new co-ordinate (0) in have th °* *^^^”” *“Pl’“i*ly i° t’^« relations (1). We

(7)

The equations of motion wiU be as in § 2 (10), with the additional

d 8T 3T dt d6 de~·^’

(8)

where 6 is the force corresponding to the co-ordinate 6. We may suppose e to be adjusted so as to make 0, and in the remaining equations nothing is altered if we write t for $ before, instead of alter, the differentiations. The reason why the equation § 2 (17) no longer holds is that we should require to add a term 9 on the right-hand side ; this represents the rate at which work is being done by the constraining forces required to keep 6 constant.

As an example, let a, y, z be the co-ordinates of a particle relative to axes fixed in a solid which is free to rotate about the axis of z. I.J ^^ *h® angular co-ordinate of the solid, we find without difficulty

2’r=m{a^ + $^ + z’) + 26mix -yx)+{l + m{si? + y^)}^’, . (9)

where I is the moment of inertia of the solid. The equations of motion, viz.,

ar 5i7 ‘^> (10)

d BT dtdx

3T rf 3T 3T dx ‘ dfdy dy- ‘

and become

~~(Z 3T 3T –~~

~~diWde-^~~

~~m{x-26s-~~

~~- x&^ — y9) = X,m,{y + 26x-y~~

~~ddV~~

~~dt-dz~~

~~dz~~

~~.(“)~~

~~and~~

~~d~~

~~2-ra;^) = Y, ms = Z).(12)~~

~~[.{(I-H m{x + y2)} 6 + m(xi — yxj] = 9.~~

~~dt’~~

~~(13)~~

~~If we suppose 9 adjusted so as to maintain 6>’=0, or (again) if we suppose the moment of inertia I to be infinitely great, we obtain the familiar equations of motion relative to moving axes, viz.,~~

~~‘m(x-2~~

~~where u has been written for 6. These are the equations which we should have obtained by applying Lagrange’s rule at once to the formula~~

~~2’r=mix^ + y’^ + z”) + 2ma(xy-yx) + mofi{x^ + y’^), . (15)~~

which gives the kinetic energy of the particle referred to axes rotating with the constant angular velocity to.

More generally, we might apply Lagrange's method to find the

Potatlnir equations of motion of a system whose configuration

relative to axes rotating with constant angular velocity

(oi) is defined by means of generalized co-ordinates

?i, ?2, ■•■?«, wi-iting

2T = Sjn(2 - 2>2 -H s) 1 2ul,m(xy — yx) + b?'m[+ y') = 2< sup=" ">-2/a:)H-2To (16)

say. This problem is interesting on account of its bearing on the kinetic theory of the tides. The details of the work would occupy too much space, but the result may be stated. Assuming that the Cartesian co-ordinates x, y, z of any particle relative to the moving axes are functions of jj, q

d 9

where

+ ('•, l)2i + (r, 2)?2 + . . . I ir,s)q, + ...

3To

dqr

d[q„ qr) It is to be noticed that

(r, r) = 0, (r, s)= (s, r). The conditions of relative equilibrium are

3T„

= Qr, (17)

(18)

Q,= –

3?r’

(19)

(20)

or, in case the forces Q, depend only on the co-ordinates jj, q^,. and are conservative,

gf;V-T„) = 0,

(21)

i.e., the value of V-To must be stationary.

If we multiply (17) by ?„ and sum the result for r=l, 2, 3,...n, we find, taking account of (19),

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(22)

or, in the case of conservative forces,

This may be called the equation of relative energy. It may, of course, be easily established from first principles without the use of generalized co-ordinates.

We have still to notice the modifications which Lagrange’s

equations undergo when the co-ordinates jj, ?2, ...jn ^

are not all independently variable. In the first place, ,“1

we may suppose them connected by a number m (”’’”*”

of relations of the type systems.

■A-tt ?i, ?2---?n) = 0, B(!!, 2-1, g‘2,...g’„) = 0, &c., (24) These may be interpreted as introducing partial constraints into a previously free system. The variations Sq-^, Sq2,...Sq„ in the ex- pressions (6) and (7) oC § 2 which are to be equated are no longer independent, but are subject to the relations

3A, 3A,

SB,

^^Sq, + ^^Sq,+ ... = 0, ^.

0?2

2-f... = 0, &0. (25)

Introducing indeterminate multipliers X, /n, ..., one for each of these equations, we obtain in the usual manner n equations of the type

ddT 3T ^, ^3A 3B

dtWr-W=^’ “W^— ■■ ” in place of § 2 (10). These equations, together with (24), serve to determine the n co-ordinates q^, q^t-.-in and the m multipliers \ n, ...

Again, it may happen that although there are no prescribed relations between the co-ordinates jj, q^...q.n, yet from the cir- cumstances of the problem certain geometrical conditions are im- posed on their variations, thus

■A.i5(?i-l-A2J?2+... = 0, Bi«?j-fB25g‘2-|-... = 0, &c., (27)

where the coefficients are functions of q^, g‘2, •■•?« and (possibly) of t. It is assumed that these equations are not integrable as regards the variables ji, q^,... .q„; otherwise, we fall back on the previous conditions. Cases of the present type arise, for instance, in ordinary dynamics when we have a solid rolling on a (fixed or moving) surface. The six co-ordinates which serve to specify the position of the solid at any instant are not subject to any necessary relation, but the conditions to be satisfied at the point of contact

impose three conditions of the iorm (27). The general equations of motion are obtained, as before, by the method of indeterminate multipliers, thus

(Z 3T 3T „ _ , .

5i3^-3^=Q' + ^^'^2' (28)

The co-ordinates q^, q^,...g„, and the indeterminate multipliers X, /i, . . . are determined by these equations and by the velocity- conditions corresponding to (27). When t does not appear ex- plicitly in the coefficients, these velocity -conditions take the forms

AiJi-fA2?2+-. = 0, Bi2i-l-B2J2+... =0,

&c.

(29)

Hamiltonian Equations of Motion.

% 4. In the Hamiltonian form of the equations of motion of a conservative system with unvarying relations, the kinetic energy is supposed expressed in terms of the momenta p^, p^,... and the co-ordinates jj, q^,..., as in § 1 (19). Since the symbol S now denotes a variation extending to the co-ordinates as well as to the momenta, we must add to the last member of § 1 (21) terms of the types

3T^ dT\

9i;'?^+3^«?i+ (1)

Since the variations Sp^, Sp^,... dq„ dq^,... may be taken to be independent, we infer the equations § 1 (23) as before, together with

3T 3r 3T 3r

3?i· 3}i' 3j2· 3?2' '"" ■■ ^^' Hence the Lagrangian equations § 2 (14) transform into

‘=-375+” —372^^+^) (3).

If we write

H = r + V, ... (4).

so that H denotes the total energy of the system, supposed ex- pressed in terms of the new variables, we get

3H . 3H

^^=_^’ _^^= “3^’ (^).

If to these we join the equations

. 8H . 3H

*^=^’ ^^=3S ‘^^

■ S. III. — 72

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which follow at once from § 1 (23), since V does not involve ^,^2,..., we obtain a complete system of ditferential equations of the first order for the determination of the motion.

The equation of energy is verified immediately by (5) and (6), since these make

dt ~a^-^i + 5r?

,+ ... + 2— g, + -5— 02+.

. = 0.

(7).

~~the case of~~

~~The Hamiltonian transformation is extended to varying relations as follows. Instead of (4) we write~~

~~H=Mi+M2+—T + V, . . . (8)~~

~~and imagine H to be expressed in terms of the momenta ^1,^2,..., the co-ordinates j], jj, ..., and the time. The internal forces of the system are assumed to be conservative, with the potential energy V. Performing the variation 5 on both sides, we find~~

~~SH=j,5p,+ ...-g^Sj, + gsj+ (9)~~

~~terms which cancel in virtue of the definition of j)-^, p^,--- being omitted. Since dp^, Sp^,..., Sq^, Sg^... may be taken to be in- dependent, we infer~~

~~— . 3H~~

~~and~~

~~9H ‘dpi~~

~~1(T-V)=-^.~~

~~8?!~~

~~(T-V)=-~~

~~3H~~

~~It follows from (11) that~~

~~8H~~

~~^’=-W,’ ^=~~

~~3H~~

(10)

(“)

(12)

The equations (10) and (12) have the same form as above, but H is no longer equal to the energy of the system.

Cyclic Systems.

§ 5. A cyclic or gyrostatic system is characterized by the following properties. In the first place, the kinetic energy is not affected if we alter the absolute values of certain of the co-ordinates, which we will denote by %, x’, x”j---> provided the remaining co-ordinates ?i> ?2> ■ • • ?»• ^iid the velocities, including 6f course the velocities X, id, x”, ■••, are unaltered. Secondly, there are no forces acting

on the system of the types Xi x’. x”i This case arises, for

example, when the system includes gyrostats which are free to rotate about their axes, the co-ordinates Xi x’l x”> ”- then being the angular co-ordinates of the gyrostats relatively to their frames. Again, in theoretical hydrodynamics we have the problem of moving solids in a frictionless liquid ; the ignored co-ordinates X, x’l x’l— then refer to the fluid, and are infinite in number. The same question presents itself in various physical specula-tions where certain phenomena are ascribed to the existence of latent motions in the ultimate constituents of matter. The general theory of such systems has been treated by Eouth, Lord Kelvin, and Helmholtz.

If we suppose the kinetic energy T to be expressed, as in

*„ .. , Lagrange’s method, in terms of the co-ordinates and^*

., the velocities, the equations of motion oonesponding

to the forms

whence

to Xi x'. x"v reduce, in virtue of the above hypotheses,

d gT

dtdx!

7=0,

^?I=0

(1)

= «",

(2)

3T 3T , ar^

die"" ' die'"' 3x" where k, k', k",.. are the constant momenta corresponding to the cyclic co-ordinates x, x', x"--- • These equations are linear in X, x'l x'l--- ; solving them with respect to these quantities and substituting in the remaining Lagrangiau equations, we obtain m, differential equations to determine the remaining co-ordinates ?ii ?2, • — • 9m- The object of tlie present investigation is to ascertain the general form of the resulting equations. The retained co- ordinates q-i, q^,... gm may be called (for distinction) the palpable co-ordinates of the system ; in many practical questions they are the only co-ordinates directly in evidence. If, as in § 1 (25), we write

e=T-,cx-c"x'-i ... (3) and imagine 9 to be expressed by means of (2) as a quadratic func- tion of jj, ^2,... ,,,, q^... q^, then, performing the operation 5 on both sides, we find

30,. 30,

dii ^' OK

3T,.

36, 3T,.

3T,

3?i

-KSx-icSx- Omitting the terms which cancel by (2), we find

W

X=

3T 3ji' 3T

39

"3/c'

36

39

■3?i'

x'=-

3T 39

3J2 Sja'

3T^3e

892 3?2' '■■ '

36 .„ 06

(5) (6) (7)

^?=Q.

(8)

Substituting in § 2 (10), we have rf 3936^- rf 36 dt 3^1 3^1 dt dq2

These are Routh's forms of the modified Lagrangian equations. Equivalent forms were obtained independently by Helmholtz at a later date.

The function 0 is made up of three parts, thus

6=62,oH-6],i-f9o,2,. . . . (9)

where 92,o is a homogeneous quadratic function of jj, ?2---, ?m, 9o,2is a homogeneous quadratic function of k, k', k",..., whilst „ . . , 9],i consists of products of the velocities q^, q^... q^ «™.«„1- into the momenta k, k', k"....
Hence from (3) and (7) *'"" ' ""*• we have

T=e-((c'

36 , ,36 , ,,36

■ + '^'S? + "'3?'+-)

- 60,0 — 9(1,

'210 "0,2' ....

If, as in § 1 (30), we write this in the form T=

6 = ©-K-t-/3i^i-t-|82^2-)-

where ft, /Sj,.— *i'6 linear functions of ic, k', k",... say

|3,=(i,jc-faVK'-)-a'VK"l

the coefficients a„ a'„ a",,. . . being in general functions of the co-ordinates ji, 321 ■•■ ?!»• Evidently /S,. denotes that part of the momentum-component 36/3jr which is due to the cyclic motions. Now

d 36 dt

(10) (11) (12) (13)

3e_d/3iS _rf3iS^3ft^ 3^ Zqr-dt\dir ^7 ~* ^ ‘ “*” 3” ”^ •■■•

(14)

3j, 3g, 3jr dqr^^ dq^^

(15)

Hence, substituting in (8), we obtain the typical equation of motion of a gyrostatic system in the form

It f f + (‘.l)?i + (‘.2fe+... + (‘,). + ... + f =0,, (16) where

This form is due to Lord Kelvin. When ?i, g^,... qm have been determined, as functions of the time, the velocities corresponding to the cyclic co-ordinates can be found, if required, from ihe relations (7), which may be written

. 3K

., 3K , . X=gp-a,ft

(18)

&c., &c, It is to be particularly noticed that

(r,r) = 0, (r,s)=-(s,r). . . . (19) Hence, if in (16) we put r=l, 2, 3,... m, and multiply by ^1, jj,--- 2m respectively, and add, we find d.

dl^’

i + K) = Qiqj + Q^^+...

(20)

or, in the case of a conservative system

iS-t-V-HK=const. . . . (21) which is the equation of energy.

The equations (16) include § 3 (17) as a particular case, the eliminated co-ordinate being the angular co-ordinate of a rotating solid having an infinite moment of inertia.

In the particular case where the cyclic momenta k, k', k", . . . are all zero, (16) reduces to

d 3S 3© ^

di Wr'Wr

(22)

The form is the same as in § 2, and the system now behaves, as regards the co-ordinates g^, g^... ?,,, exactly like the acyclic type there contemplated. These co-ordinates do not, however,

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now fix the position of every particle of the system. For example, if by suitable forces the system be brought back to its initial con- figuration (so far as this is defined by q^, jj, ... y^), after performing any evolutions, the ignored oo-ordinates Xt x': x") "Will not in general return to their original values.

If in Lagrange's equations § 2 (10) we reverse the sign of the time- element dt, the equations are unaltered. The motion is therefore reversible ; that is to say, if as the system is passing through any configuration its velocities Ji, ^j,... q,, be all reversed, it will (if the forces be the same in the same configuration) r«trace its former path. But it is important to observe that the statement does not in general hold of a gyrostatic system ; the terms of (16), which are linear in $i, J,,... j,,,, change sign with dt, whilst the others do not. Hence the motion of a gyrostatic system is not reversible, unless

indeed we reverse the cyclic motions as well as tho velocities ji, jj, ... ^„. For instance, the precessional motion of a top cannot be reversed unless we reverse the spin.

The cojiditians of equilibrium of a system with latent cyclic KIneta ™°^’”’^ ” obtained by putting ji=0, 2‘2=0,... jm=0 atatlcs. ^” ^^^^ ‘ ^^^•’ *^®y *”®*

3K 3K

(23)

These may of course be obtained independently. Thus if the system bo guided from (apparent) rest in the configuration [q^, q^... qm) to rest in the configuration (q-i + Sq^, q^+Sq.^,... qm + Sqm), the work done by the forces must be equal to the increment of the kinetic energy. HIence

Qi5g’i4-Q2«?2-I-...=«K, . . . (24)

which is equivalent to (23). The conditions are the same as for the equilibrium of a system without latent motion, but endowed with potential energy K. This is important from a physical point of view, as showing how energy which is apparently potential may in its ultimate essence be kinetic.

By means of the formulie (18), which now reduce to

3K ., 3K .„ 3K

X=l

X =

3(c”

X — a„«

3k’”

(25)

E may also be expressed as a homogeneous quadratic function of the cyclic velocities x, x't x't ■•■ ■ Denoting it in this form by To, we have

S{T„ + K) = 2SK = S{Kx + K'x'-^r<"x"+■■.). . (26) Performing the variations, and omitting the terms which cancel by (2) and (2S), we find

3T„.

3K

'822'

—^ 3K 3To so that the formulae (23) beoomCj.

A simple example is furnished by the top (§ 2). co-ordinates being tp, 0, we find

2

. (27).

. (28).

The cyclic

A sm ^9 0

(30).

2T„ = A sin'erj/" I C(.^ + ^i- cos 0f, . . (29).

whence we may verify that 3To/3fl= -dKjdS in accordance with (27). And the condition of equilibrium

3K — 3V

de de ' ' '

gives the condition of steady precession, § 2 (26).

~~Stability of Equilihrium and of Steady Motion. % 6. The theory of the small oscillations of a conservative system about a configuration of equilibrium, originated by Lagrange, has been greatly developed by Thomson and Tait, Routh, ^thim ^^^ ^^^ Rayleigh. The details of the matter belong stability, properly to acoustics, but some reference may be made to the important but rather difficult question of stability^. If we neglect small quantities of the second order in the velocities and the displacements, Lagrange's equations assume a linear form, and the deviation of any co-ordinate from its equilibrium value~~

~~is expressed by a series of terms of the type Ce , the admissible values of X'^ being given by an algebraic equation of degree n. In order that the expressions for the deviations may not admit of indefinite increase, the values of X must be purely imaginary (i.e., of the form tV), so that the exponentials become replaced by circular functions of t. It is found that this will.be the case if, and only if, the potential energy.V is a minimum in the configura- tion of equilibrium. Accordingly, it is usual to say that the neces.sary and sufficient condition for stability is that the equili- brium-value of V should be a minimum.~~

~~The validity of this inference has in recent times been contested. It is pointed out that since Lagrange's approximate equations~~

~~become less and less accurate as the deviation from the equilibrium configuration increases, it is a matter for examination how far rigorous couclusions as to the ultimate extent of the deviation can be based upon them. Some researches in this direction have been instituted by Liapounotf, Poincar^, and others, but the question cannot yet be regarded as completely resolved.~~

~~That the occurrence of a minimum value of V is a sufficient con- dition of stability was shown independently by Diriohlet. In the motion consequent on any slight disturbance the total energy T -II V is constant, and since T is essentially positive, it follpws that V can never exceed its equilibrium value by more than a slight amount depending on the energy of the disturbance. This implies, on the present hypothesis, that there is an upper limit to the deviation of each co-ordinate from its equilibrium value ; moreover, this limit diminishes indefinitely with the energy of the original disturbance. No~~

such simple proof is available to show without qualification that the above condition is necessary. If, however, we recognize the existence of dissipative forces called into play by any motion of the system, the conclusion can be drawn as follows. HOwever slight these forces may be, the total energy T -H V must coiitinually diminish so long as the velocities ^11 ?2i • ■ • in differ from zero. Hence, if the system be started from rest in a configuration for which V is less than in the equilibrium configuration, this expression must still further decrease (since T cannot be negative), and it is evident that either the system will finally come to rest in some new equilibrium configuration, or V will in the long run diminish indefinitely. This argument is due to 'Thomson and Tait.

A little consideration will show that a good deal of the obscurity which attaches to the question arises from the want of a sufliciently precise definition of what is meant by " stability." „. .. The same difiiculty is encountered, in an aggravated stablllty form, when we pass to the question of stability of motion. The various definitions of stability which have been pro- pounded by different writers are examined critically by Klein. and Sommerfeld in their book on the theory of the top. Rejecting previous definitions, they base their criterion of stability on the character of the changes produced in the path of the system by small arbitrary disturbing impulses. If the undisturbed path be the limiting form of the disturbed path when the impulses are indefinitely diminished, it is said to be stable, but not otherwise. For instance, the vertical fall of a particle under gravity is reckoned as stable, although for a given impulsive disturbance, however small, the deviation of the particle's position at any time t from the position which it would have occupied in the original motion increases indefinitely with t. Even this criterion, as the writers quoted themselves recognize, is not free from ambiguity unless the phrase "limiting form," as applied to a path, be strictly defined. It appears, moreover, that a definition which is analytically precise may not in all cases be easy to reconcile with geometrical prepossessions.

A special form of the problem, of great interest, presents itself in the steady motion of a gyrostatic system, when the non-eliminated co-ordinates ^{j,q},... qm all vanish (see § 5). This has been dis- cussed by Routh, 'Thomson and Tait, and Poincard. These writers treat the question, by an extension of

~~Lagrange's method, as a problem of small oscillations. Whether we adopt the notion of stability which this implies, or take up the position of Klein and Sommerfeld, there is no difficulty in showing that stability is ensured if V) K be a minimum as regards variations of jj, q^, . . .qm- The proof is the same as that of Dirichlet for the case of statical stability. It is easily seen that, in the notation of § 5, an equivalent condition is that V — Tq should be a minimum for the same variations.~~

~~We can illustrate this condition from the case of the top, where, in our previous notation,~~

~~i/i — v cos S)' "^~~

~~V -H K = M^A COS fl I ^~~

~~+ ^~~

~~2Asin2e 2C~~

~~(1)~~

~~To examine whether the steady motion with the centre of gravity vertically above the pivot is stable, we must put ii=v. We then find without difficulty that V-(-K is a minimum provided r^ ^ iAMgh. The method of small oscillations gave us the condition v"> iAM.gh, and indicated instability in the cases v^^iAMgh. The present criterion can also be applied to show that the steady precessional motions in which the axis has a constant inclination to the vertical are stable.~~

~~The question remains, as before, whether it is essential for stability that V-f K should be a minimum. It appears that from the point of view of the theory of small oscillations it is not essential, and that there may even be stability when T-fK is a maximum. The precise conditions, which are of a. somewhat elaborate character, have been formulated by Routh. An important distinction has, however, been established by Thomson and Tait, and by Poincar^, between what we may call ordinary or accidental stability (which is stability in the above sense) and permanent or secular stability, which means stability when regard is had to possible dissipative~~

forces called into play whenever the co-ordinates y,, ffj,...?™ vary. Since the total energy of the system at any instant is given (in the notation of § 6) by an expression of the form © + V + K, where © cannot be negative, the argument of Thomson and Tait, given above for the statical question, shows that it is a necessary as well as a sufficient condition for secular stability that V + K should be a minimum.

Principle of Least Action.

§ 7. The preceding theories give us statements applicable to the system at any one instant of its motion. We now come to a series of theorems relating to the whole motion Stationary ^f ^^^ system between any two coufigurations through ^* ■ which it passes, viz., we consider the actual motion and compare it with other imaginable motions, differing infinitely little from it, between the same two configurations. We use the symbol d to denote the transition from the actual to any one of tue hypothetical motions.

The best-known theorem of this class is that of Least Action, originated by Maupertnis, but first put in a definite form by Lagrange. The "action" of a single particle in passing from one position to another is the space-integral of the momentum, or the time-integral of the vis viva. The action of a dynamical system is the sum of the actions of its constituent particles, and is accordingly given by the formula

;• (1)

L = S fmvds = S fwv'dt = 2 \ldl.

The theorem referred to asserts that the free motion of a conserva- tive system between any two given configurations is characterized by the property

SA = 0, (2)

provided the total energy have the same constant value in the varied motion as in the actual motion. The proof, from first prin- ciples, has been given under Mechanics (Uncy. Brit. vol. xv. pp. 723-26), where it is also shown how the equation (2), expressed in terms of generalized co-ordinates, leads to Lagrange's equations. -The equation (2), it is to be noticed, merely expresses that the variation of A vanishes to the first order ; the phrase stationary action has therefore been suggested as indicatipg more accurately what has been proved. The action in the free path between two given configurations is in fact not invariably a minimum, and even when a minimum it need not be the least possible subject to the given conditions. Simple illustrations are furnished by the case of a single particle. A particle moving on a smooth surface, and free from extraneous force, will have its velocity constant ; hence the theorem in this case resolves itself into

Sfd

1=0,

(3)

i.e., the path must be a geodesic line. Now a geodesic is not neces- sarily the shortest path between two given points on it ; for ex- ample, on the sphere a great-circle arc ceases to be the shortest path between its extremities when it exceeds 180°. More gener- ally, taking any surface, let a point P, starting from 0, move along a geodesic ; this geodesic will be a minimum path from 0 to P until P passes through a point 0' (if such exist), which is the intersection with a consecutive geodesic through 0. After this point the minimum property ceases. On an anticlastio surface two geodesies cannot intersect more than once, and each geodesic is therefore a minimum path between any two of its points. These illustrations are due to Jacobi, who has also formulated the general criterion, applicable to all dynamical systems, as follows : — Let 0 and P denote any two configurations on a natural path of the system. If this be the sole free path from 0 to P with the pre- scribed amount of energy, the action from 0 to P is a minimum. But if there be several distinct paths, let P vary from coincidence with 0 along the first-named path ; the action will then cease to be a minimum when a configuration 0' is reached such that two of the possible paths from 0 to 0' coincide. For instance, if 0 and P be positions on the parabolic path of »

projectile under gravity, there will be a second path (with the same energy and therefore the same velocity of projection from 0), these fwo paths coinciding when P is at the other extremity (0', say) of the focal chord through 0. The action from 0 to P will therefore be a minimum for all positions of P short of 0'. Two configurations such as 0 and 0' in the general statement are called conjugate kinetic foci. Cf. Variation of an Integral, § 6.

Before leaving this topic the connexion of the principle of stationary action with — well-known theorem of optics may be noticed. For the motion of a particle in a conservative field of force the principle takes the form

(4).

5/rais=0

On the corpuscular theory of light v is proportional to the refrac- 'uive index /i of the medium, whence

q,

a//«fe=o.

(5).

For the further development of this result see Optics (HIn^. Brit. vol. xvil) and Wave Theory (Ency. Brit. vol. xxiv.).

In the formula (2) the energy in the hypothetical motion is prescribed, whilst the time of transit from the initial to the final configuration is variable. In another theorem, due to h- ii Hamilton, the time of transit is prescribed to be the f „/ ^" same as in the actual motion, whilst the energy may be princlnle different and need not (indeed) be constant. Under these conditions we have

5f"(T-V)dt=0,

(6).

where t, t' are the prescribed times of passing through the given, initial and final configurations. The proof of (6) is simple ; we have

sf"{T-\)dt= f"{ST-SY)dt = f" {SmJ{xSx+ySy + zSi)-S'V}dt = Xmixdx + ySy + zdz) I

-/:

- / {'Zm{xSx + ySy+z5si) + SY}dt.

(7)

The integrated terms vanish at both limits, since by hypothesis the configurations at these instants are fixed ; and the terms under the iutegral sign vanish by D'Alembert's principle.

The fact that in (6) the variation does not aB"ect the time of transit renders the formula easy of application in any system of co-ordinates. Thus, to deduce Lagi'ange's equations, we have

/> -w)«./;'{|ii.|s„...g !„...}<«

PiSq+PiSqi +

■1

oT 8V^,

8?i 9?i,

1 +

/. 3T 3V^^■»

dt (8)

The integrated terms vanish at both limits ; and in order that the remainder of the right-hand member may vanish it is necessary that the coefficients of dqi Sg^, . . . under the integral sign should vanish for all values of t, since

the variations in question are independent, and subject only to the condition of vanishing at the limits of integration. We are thus led to Lagrange's equation of motion for a conservative system. It appears that the formula (6) is a convenient as well as a compact embodiment of the whole of ordinary Dynamics.

*The modification of the Hamiltonian principle appropriate to the case of cyclic systems has been given by Larmor. Extension If we write, as in § 1 (25), ^„ ^y^„^*

B = T- KX- k'x' k"x"—.-, . . (9) systems.

we shall have

•/:

s (e-V)=o,*

(10)

provided that the variation does not affect the cyclic momenta K, k', k",...; and that the configurations at times t and t' arfe un- altered, so far as they depend on the palpable co-ordinates Ji, q.,, ■■■ q-m- The initial and final values of the ignored co- ordinates vnll in general he affected. To prove (10) we have, on the above imderstandings,

5 r'(e — Y)dt = r'(ST ~Khx-...- SY)dt

i + —

- S'\dt,

where terms have been cancelled in virtue of § 5 (2). member of (11) represents a variation of the integral

• (11) The last

/:

~~{T-Y)dt~~

~~on the supposition that 5x = 0, 8x' = 0, 5x"=0, ... throughout, whilst S^j, Sj2, Sq„ vanish at times t and t' ; i.e., it is a variation in which the initial and final configurations are absolutely un- altered. It therefore vanishes as a consequence of the Hamiltonian principle in its original form.~~

~~Larmor has also given the corresponding form of the principle of least action. He shows that if we write~~

~~then~~

~~.j(2T-Kx-K'x'K"x".-)dt,~~

~~. (12)~~

~~. (13)~~

~~provided the varied motion takes place with the same constant value of the energy, and with the same constant cyclic momenta,~~

~~SA = 0,~~

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~~between the same two configurations, these being regarded as 4elined by the palpable co-oidinates alone.~~

~~Hamilton's Principal and Characteristic Functions,~~

~~% 8. In the investigations next to be described a more extended meaning ia given to the symbol 3. We will, in the first instance, Pill denote by it an infinitesimal variation of the most Hrmcipai gg^gp^^j kjnj^ affecting not merely the values of the co- ordinates at any instant, but also the initial and final configurations and the times of passing through them. If we put~~

~~S=f"{T-Y)dt,~~

we have, then,

SS = (T — Y’)5t’ — (T — Y)St + [”(ST — dV)dt

(1)

= (T’ — Y’)dt’ — (T — Y)dt + r^mixSx + i/Sy + zSz)\ .

(2)

Let us now denote by x’ + Sx’, y’ + dy’, z’ + Sz’, the final co-ordinates {i.e., at time t’ + St’) of a particle m. In the terms in (2) which relate to the upper limit we must therefore write Sx’-x’St’, Sy’ — y’St’, Sz’ — z’W for Sx, Sy, Sz. “With a similar modification at the lower limit, we obtain

SS = — HSt + Xm(x’Sxf + fSy’ + i’SJ)

-JirtJ^iSx + ySy + iSz), ., . (3)

■where H(=T-|-V) is the constant value of the energy in the free motion of tilie system, and r {_= t’ -t) is the time of transit. In generalized co-ordinates this takes the form

5S = — H5r +p\Sq\ +p\Sq\ + ...

-PiSq^-PiSq^- (4)

Now if we select any two arbitrary configurations as initial and final, it is evident that we can in general (by suitable initial velocities or impulses) start the system so that it will of itself pass from the first to the second in any prescribed time t. On this view of the matter, S will be a function of the initial and final co-ordinates (?i, g^,... and q\, q‘2, ■■■) and the time t, as independent variables. And we obtain at once from (4)

, as , as

Pl

as

~~Vi =~~

~~¥~~

~~Pi~~

~~- ~ di,'~~

~~Pi.~~

~~'iq.i~~

~~and~~

~~H =~~

~~3r~~

~~(5)~~

~~(6)~~

~~S is called by Hamilton the principal function ; if its general form for any system can be found, the preceding equations suffice to ■determine the motion resulting from any given conditions. If we substitute the values oipy, jOj, ... and H from (5) and (6) in the ex- pression for the kinetic energy in the form T' (see § 1), the equation~~

~~r-l-V=H . . . . (7)~~

~~becomps a partial differential equation to be satisfied by S. It has been shown by Jacobi that the dynamical problem resolves itself into obtaining a "complete " solution of this equation, involving m I 1 arbitrary constants. This aspect of the subject, as a problem in partial difl'erential equations, has received great attention at the hands of mathematicians, but must be passed over here. There is a similar theory for the function~~

~~A = 2/'~~

~~Tf«<=S-I-Ht~~

~~(8)~~

~~Character- istic tanctlott. It follows from (4) that~~

~~aA =t5H -f/i Vi +^“2 V2 + ■ • •~~

~~-PiHi-v-ihi- (9)~~

~~Selecting, as before, any two arbitrary configurations, it is in general possible to start the system from one of these, with a prescribed value of the total energy H, so that it shall pass through the other. Hence, regarding A as a function of the initial and final co-ordinates and the energy, we find~~

~~, 3A , aA~~

~~Pl = -‘^’~~

~~.and~~

~~aA M~~

~~-aA. aH’~~

~~(10)~~

~~(11)~~

~~A ia called by Hamilton the characteristic function ; it represents, ■of course, the “action” of the system in the free motion (with prescribed energy) between the two configurations. Like S, it satisfies a partial differential equation, obtained by ^bstitution |~~

~~from (10) in (7). Some illustrations of the theory, for the case of a single particle, are given under Mechanics {Ency. Brit. vol. xv. pp. 724-25).~~

~~The preceding theorems are easily adapted to the case of cyclic systems. We have only to write~~

~~in place of (1), and~~

~~A:~~

~~Y)dt=[‘\i:-~~

~~=/(2T-~~

~~KX-K’x’---^)dt . (12)~~

~~KX-K^ic—)dt,~~

~~(13)~~

~~in place of (8) ; cf. § 7 ad fin. It is understood, of course, that in (12) S is regarded as a function of the initial and final values of the palpable co-ordinates jj, q^ ...qm, and of the time of transit t, the cyclic momenta being invariable. Similarly in (13), A is regarded as a function of the initial and final values of Ji, ?2, ... ff™, and of the total energy H, with the cyclic momenta invariable. It will be found that the forms of (4) and (9) will be conserved, provided the variations Sy,, Sg^,... be understood to refer to the^palpable co- ordinates alone. It follows that the equations (5), (6), and (10), (11) will still hold under the new meanings of the symbols.~~

~~Reciprocal Properties of Direct and Reversed Motions.~~

~~§ 9. We may employ Hamilton’s principal function to prove a very remarkable formula connecting any two slightly . ,~~

~~disturbed natural motions of the system. If we use f„Z-„i? the symbols S and A to denote the corresponding varia- tions, the theorem is~~

~~d.~~

~~d(~~

~~Z{Spr.Aqr-i^Pr-Sq,) = 0 ; .~~

~~(1)~~

~~or, integrating from t to t',~~

~~^iSp'r.Aq'r-^p'r.Sq'r) = 'S{Spr.Aqr-Apr-Sqr)- ■ (2) If for shortness we write~~

~~a^s~~

~~(r, «) =~~

~~dqrdq,'~~

~~(r, s') =~~

~~dqrdq",'~~

~~we have~~

~~Spr= S.(r, s)Sq.-S,,{r, s')Sq',~~

~~(3)~~

~~(4),~~

~~with a similar expression for Ap,. Hence the right-hand side of (2) becomes~~

~~S,{S,(», s)Sq, + ^,{r, «')5?',}Ag',-(S,{2,(?, s)Aq, + X,{r, s')Aj'.}Sj, = 2;r2.,~~
~~{r,s')(5qr.Aq'.-Aqr.Sq',} . (5)~~

~~The same value is obtained in like manner for the expression on the left hand of (2) ; hence the theorem, which, in the form (1), is due to Lagrange, and was employed by him as the basis of his method of treating the dynamical theory of Variation of Arbitrary Constants.~~

~~Theformula(2)leadsatoncetosome remarkable reciprocal relations which were first expressed, in their complete form, by Helmholtz. Consider any natural motion of a conservative system ,, between two configurations 0 and 0' through which it t^.f J passes at times t and t' respectively, and lett' - t=T. " * * As the system is passing through 0 let a small impulse ^VLf"" " Spr be given to it, and let the consequent alteration in the co-ordinate q, after the time t be Sq',. Next consider the reversed motion of the system, in~~

which it would, if undisturbed, pass from 0' to 0 in the same time t. Let a small impulse Sp', be applied as the system is passing through 0', and let the conse- quent change in the co-ordinate g, after a time t be Sq,. Helm-holtz's first theorem is to the effect that

Sqr:Sp', = Sq'.:Spr. . . . (6)

To prove this, suppose, in (2), that all the Sq vanish, and likewise all the 5p with the exception of Sp,. Further, suppose all the Aq' to vanish, and likewise all the A^ except Ap',, the formula then gives

Spr.Aqr=-Ap',.Sq'., . . . (7)

which is equivalent to Helmholtz's result, since we may suppose the symbol A to refer to the reversed motion, provided we change the signs of the Ap. For example, in the most general motion of a top (§ 2), suppose that a small impulsive couple about the vertical produces after a time t a change S9 in the inclination of the axis, the theorem asserts that in the reversed motion an equal im- pulsive couple in the plane of ff will produce after a time t a change S^, in the azimuth of the axis, which is equal to S8. It is under-stood, of course, that the couples have no components (in the generalized sense) except of the types indicated ; for instanc, they may consist in each case of a force applied to the top at a point of the axis, and of the accompanying reaction at the pivot. Again, in the corpuscular theory of light let 0, 0' be any two points on the axis of a symmetrical optical combination, and let V, V be the correspond- ing velocities of light. At 0 let a small impulse be applied perpen-

dicular to the axis so as to produce an angular deflection S8, and let p' be the corresponding lateral deviation at 0'. In like manner, in the reversed motion, let a small deflection S6' at 0' produce a lateral deviation /3 at O. The theorem (6) asserts that

.... (8)

or, in optical language, the " apparent distance " of 0 from 0' is to that of 0' from O in the ratio of the refractive indices at 0' and O respectively. In the second reciprocal theorem of Helmholtz the configuration O is slightly varied by a change Sqr in one of the Helm- co-ordinates, the momenta being all unaltered, and Sp',

holtz's is the consequent variation in one of the momenta secoad re- after time t. Similarly in the reversed motion a change thfn^ «5', produces after time r a change of momentum dpr.

theorem.

The theorem asserts that

Sp',:Sqr=dpr:Sq' (9)

This foUovrs at once from (2) if we imagine all the Sp to vanish, and likewise all the Sq save dq^, and if (further) we imagine all the Ap' to vanish, and all the Aq' save Aq's. Reverting to the optical illustration, if F, F', be principal foci, we can infer that the con- vergence at F' of a parallel beam from F is to the convergence at F of a parallel beam from F' in the inverse ratio of the refractive indices at F' and F. This is equivalent to Gauss's relation between the two principal focal len'gths of an optical instrument. It may be obtained otherwise as a particular case of (8).

We have by no means exhausted the inferences to be drawn from Lagrange's formula. It may be noted that (6) includes as par- ticular cases various important reciprocal relations in Optics and Acoustics formulated by Clausius, Helmholtz, Thomson and Tait, and Lord Rayleigh. In applying the theorem care must be taken that in the reversed motion the reversal is complete, and extends to every velocity in the system ; in particular, in a cyclic system the cyclic motions must be imagined to be reversed with the rest. Conspicuous instances of the failure of the theorem through incom- plete reversal are afforded by the propagation of sound in a wind and the propagation of light in a magnetic medium.

It may be worth while to point out, however, that there is no such limitation to the use of Lagrange's formula (1). In applying it to cyclic systems, it is

~~convenient to introduce conditions already laid down, viz., that the co-ordinates g, are the palpable co-ordi- nates, and that the cyclic momenta are invariable. Special inferences can then be drawn as before, but the interpretation cannot be ex- pressed so neatly owing to the non-reversibility of the motion.~~

~~Authorities. — The most important and most accessible early authorities are Lagrange, Mecanique Analytique,. 1st ed., Paris, 1788, 2nded., Paris, 1811 ; Hamilton, "On a General Method in Dynamics," Phil. TVans., 1834 and 1835 ; Jacobi, Vorlesungen iiber Dynamik, Berlin, 1866, reprinted in Werke, Supp.Bd., Berlin, 1884. An account of the extensive literature on the differential equations of dynamics and on the theory of variation of parameters is given by Caylet, " Report on Theoretical Dynamics," Srit. Assn. Bep., ISbl, Mathematical Papers, vol. iii., Cambridge, 1890. For the modern developments reference may be made to Thomson and Tait, Natural Philosophy, 1st ed., Oxford, 1867, 2nd ed., Cam bridge, 1879 ; Lord Rayleigh, Theory of Sound, vol. i., 1st ed., London, 1877, 2nd ed., London, 1894 ; Routh, Stability of Motion, London, 1877, and Bigid Dynamics, 4th ed., London, 1884 ; Helm- holtz, " Ueber die physikalische Bedeutung des Princips der kleinsten Action," Crelle, vol. c, 1886, reprinted (with other cog- nate papers) in Wiss. Abh. vol. iii., Leipzig, 1895 ; Lakmor, " On Least Action," Proc. Lond. Math. Soc. vol. xv. 1884. As to the question of stability, reference may be made to Poincare, " Sur I'^quilibre d'une masse fluide animfe d'un mouvement de rotation,' ' Acta Math. vol. vii., 1885 ; Klein and Sommerfeld, Theorie des Kreisels, pts. 1, 2, Leipzig, 1897-98 ; LiouPANorF and Hadamard, Liouville, 5me s6rie, vol. iii., 1897. A remarkable interpretation of various dynamical principles is given by Hertz in his post- humous work, Die Prinzipien der Meehanik, Leipzig, 1894, of wtdch an English translation appeared in 1900. (h. lb.)~~

~~Dynamo. — Invented by Faraday in 1831, the dynamo ranks with the telegraph and telephone among the most striking achievements of science, and the ma- terial progress that marked the later years of the 19th century was in no small measure due to the practical ap- plication of these three electrical inventions. Since 1830 the simple model constructed by Paraday has been gradually developed into the dynamos of 5000 horse- power or more, which are constructed to meet the needs of large cities for electric~~

~~lighting and power, and the machines in use are to be numbered, not by hundreds~~

~~or thousands, but by hundreds of thousands. Yet the fundamental theory of the dynamo, as a machine for generating electromotive force, remains but little changed, and the advance since Faraday's time may, by com- parison with his results, be regarded as a progressive improvement of the mechanical and electrical design leading to a fuller realization of the idea which was al- ready present in his mind. His experiments on the in- duction of currents in a coil of wire during the approach or recession of a magnet led naturally to the explanation of induced electromotive force as caused by the linking or unlinking of magnetic lines of flux with an electric cir- cuit. For the more definite case of the dynamo, however, we may, with Faraday, make the transition from line- linkage to the precisely equivalent conception of " line- cutting " as the source of E.M.F.— in other words, to the ■ idea of electric conductors "cutting" or intersecting * the lines of flux in virtue of relative motion of the magnetic field and electric circuit. On 28th October 1831 Faraday mounted a copper disc so that it could be rotated edge- wise between the poles of a permanent horse-shoe magnet. When so rotated, it cut the lines of flux which passed transversely through its upper half, and by means of two rubbing contacts, one on its periphery and the other on its spindle or axis, the circuit was closed through a gal- vanometer, which indicated the passage of a continuous current so long as the disc was ro- tated (Fig. 1). Thus by the in- vention of the first dynamo Faraday proved his idea that the E.M.F. induced through the inter- action of a magnetic field and an electric circuit was due to the pas- sage of a portion of the electric circuit across the lines of flux, or vice versd, and so could be maintained if the cutting of the lines were made continuous.*~~

~~A dynamo, then, is a machine in which, by means of continuous relative motion, an electrical conductor or system of conductors forming part of a circuit is caused to cut the lines of a magnetic field or fields ; the cutting of the magnetic flux induces an electromotive force in the conductors, and when the circuit is closed a current flows, whereby mechanical energy is converted into elec- trical energy.~~

Little practical use could be made of electrical energy so long as its only known sources were frictional machines and voltaic batteries. The cost of the materials for producing electrical cur- rents on a large scale by chemical action was prohibitive, while the frictional machine only yielded very small cun-ents at extremely high potentials. In the dynamo, on the other hand, electrical energy in a convenient form could be cheaply and easily obtainei" by mechanical means, and with its invention the application of elec- tricity to a wide range of commercial purposes became economi- cally possible. As a converter of energy from one form to another it is only surpassed in efficiency by another electrical appliance, namely, the transformer (see Transformers). In this there is merely conversion of electrical energy at a high potential into electrical energy at a low potential, or vice versd., but in the dynamo the mechanical energy which must be applied to maintain the relative movement of magnetic field and conductor is absorbed, and reappears in an electrical form. A true transformation takes place, and the jiroportion which the ratfe of delivery of electrical energy bears to the power absorbed, or in other words the efficiency, is the more remarkable. The useful return or "output" at the terminals of a large machine may amount to as much as 95 per cent, of the mechanical energy which forms the " input." Since it needs some prime mover to drive it, the dynamo has not made any direct addition to our sources of energy, and does not therefore rank with' the primary battery or oil engine, or even the steam engine, all of which draw their energy more immediately from

1 Experimental Researches in JBlectricity, series ii. § 6, pars. 256, 259-60, and series xxvili. § 34.

2 Ibid., series i. § 4, pars. 84-90.

nature. Yet by the aid of the dynamo the power to he derived from waterfalls can be economically and conveniently converted into an electrical form and brought to the neighbouring factory or distant town, to be there reconverted by motors into mechanical power. Over any but very short distances energy

is most easily transmitted when it is in an electrical form, and turbine-driven dynamos are very largely and successfully employed for such transmission. Thus by conducing to the utilization of water-power which may previously have had but little value owing to its disadvantageous situation, the dynamo may almost be said to have added another to our available natural resources.

*The two essential parts of the dynamo, as required by its definition, may be illustrated by the original disc machine of Faraday. They are (1) the iron magnet, between the poles of which a magnetic field exists, and (2) the electrical conductors represented by the rotating copper disc. The sector of the disc ' cutting the lines of the field forms part of a closed electric circuit, and has an E.M.r. induced in it, by reason of which it is no longer simply a conductor, but may be called an " inductor." In its more highly developed form the simple copper disc becomes a system of many inductors so inter-connected as to add up their several E.M.F.'s. Since these inductors are very commonly mounted on an iron structure, which may be likened to the keeper or "armature" of a magnet rotating between its poles, the term " armature " has been extended to cover not only the iron core, but also the wires on it, and is often applied to the copper conductors them- selves even when there is no iron core. In the dynamo of Faraday it is the "armature" which is rotated, and such is usually the case ; sometimes, however, the magnet, or a portion of it, is rotated. It is in fact immaterial to the action whether the one or the other is moved, or both, so long as their relative motion causes the armature induc- tors to cut the magnetic flux. As to the ultimate reason why an E.M.F. should be thereby induced, physical science cannot as yet yield any surer knowledge than in the days of Faraday.^ For the engineer, the simple fact is sufficient that the E.M.F. of the dynamo is due to the cutting of the magnetic flux by the inductors, and, fur- ther, is proportional to the rate at which the lines are cut.**

The equation of the electromotive force which is required in order to render this statement quantitative must contain three factors, namely, the density of the flux in

*the air-gap through which the in- ^. ^^*

ductors move, the length of the i"\ i^'"'"'—..

inductors, and the speed of their I "T j movement. For given values of the i I j first and third factors and a single j i =

straight inductor moved parallel to t.--- -4 -i,^^

itself through a uniform field, the

maximum rate of cutting is evidently

obtained when the three directions pj g.

of the lines, the armature inductor,

and the relative motion are respectively at right angles

to each other, as shown by the three co-ordinate axes of

Fig. 2. Under these circumstances the E.M.F. of the

inductor is

E=B,LVx 10-8 volts, ... (I.)

where B, is the density* of the lines of flux per square centimetre in the air-gap, L is the active length of the inductor within the field in centimetres, and V is the velocity of movement in centimetres per second. Further, the direction in which the E.M.F. has the above maximum value is along the length of the inductor, its " sense "

Movement of inductor

1 See Electricity, Ency. Brit. vol. vlli. p. 78.

a "On the Physical Lines of Magnetic Force," Phil. JKoff., June

s^Faraday, Exp. Res., series xxviii. § 34, pars. 3104, 3114-15. ■• See ElbctromAGNBT, New Volumes, Ency. Brit.

being determined by the relative directions of the field and movement.'

~~The second fundamental equation of the dynamo brings to light its mechanical side, aud rests on Oerstedt's discovery of the interaction of a magnetic field and an electric current. If a straight electric conductor carrying a current be so placed in a magnetic field that its length is not parallel to the direction of the lines of flux, it is acted on by a force which, if not balanced by an equal and opposite force, will cause the conductor to move in a definite direction; or if the conductor is fixed and the magnet be unconstrained, the latter will itself move in the opposite direction. JNow in the dynamo the inductors are placed so that their length may be as nearly as possible at right a-ngles to the field ; hence when they are rotated and an electric current begins to flow under the E.M.F. which they induce, a mutual force at once arises between the copper conductors and the magnet, and the direction of this force must by Lenz's law' be opposed to the direction of the movement. Thus as soon as the disc of Fig. 1 is rotated and its circuit is closed, it experiences a mechanical pull or drag, which must be overcome by the force applied to rotate it. While the magnet must be firmly held so as to remain stationary, the mechanical construction of the armature must be such that its inductors can be forcibly driven through the magnetic field against the mutual pull. The law of electrodynamic action requires its equation of mechanical force, just as the law of electromagnetic induction requires the equation of electromotive force, and it may be expressed in analogous terms. If a conductor of length L cm., carrying a current C amperes, is immersed in a field of uniform density B,, and the length of the conductor is at right angles to the direction of the lines, it is acted on by a force~~

~~F=B,LCx 10-1 dynes,~~

~~(II.)~~

~~and the direction of this force is at right angles to the conductor and to the field. The rate at which electrical energy is developed, when this force is overcome by moving the inductor as a dynamo through the field, is EC= BjjLVC X 10"* watts, whence the equality of the mechanical power absorbed and the electrical power developed (as required by the law of the conservation of energy) is easily established. The whole of this power is not, however, available at the terminals of the machine; if E.^ be the resistance~~

of the armature in ohms, the passage of the current €„ through the armature inductors causes a loss of pressure of C.Il„ volts, and a corresponding loss of energy in the armature at the rate of C/R„ watts. As the resist- ance of the external circuit K^ is lowered, the current

E G=^— ^is increased, but at the same time the external

lie + l^o

voltage at the terminals of the machine is decreased, until a maximum output is reached, when the loss of volts over the internal resistance is equal to the loss of volts over the external resistance. The increase of the current is, how- ever, accompanied by a progressive increase in the loss of energy over the armature, and as this is expended in heating the armature conductors, their temperature may rise so much as to destroy the insulating materials with which they are covered. Hence the temperature which the machine may be permitted to attain in its working is of great importance in determining its output, the current which forms one factor therein being primarily limited by the heating of the armature wires. The lower the resist- ance of the armature, the less the rise of its temperature for a given current flowing through it ; and the reason for

6 Faraday, Exp. Res., series 1. § 4, pars. 114^-119. 6 Electricity, Ency. Brit. vol. viii. pp. 11 and 76.

the almost universal adoption of copper as the material for the armature inductors is now seen to lie in its high conductivity. ^

Since the voltage of the dynamo is the second factor to which its output is proportional, the conditions which render the induced E.M.F. a maximum must evidently be reproduced as far as possible in practice, if the best use is to be made of a given mass of iron and copper. The first problem, therefore, in the construction of the dynamo is the disposition of the inductors and field in such a manner that the three directions of field, inductors, and

~~*movement are at right angles to one another, and so that the relative motion is continuous. Reciprocating motion, such as would be obtained by direct attachment of the inductors to the piston of a steam-engine, has been successfully employed only in the special case of an " oscillator " producing a small current very rapidly changing in direction. Rotary motion is therefore universally adopted, and with this two distinct cases arise. Eithfer (A) the length of the inductor is parallel to the axis of rotation, or (B) it is at right angles to it. A single inductor can- not, however, be made to give more than a few volts, and hence it is necessary to use several inductors, and to add up their E.M.F.'s by connecting them in series. Two methods of effecting this may be distinguished, and as each may be applied both to case (A) and to case (B), four types of armatures result therefrom.*~~

~~*(A). If an inductor is rotated in a rectangular gap formed in a horse-shoe magnet by two pole-pieces having plane faces opposed to each other, as in Fig. 3, not only is the density of the flux in the gap between the poles small, but the direction of movement is not al- ways at right angles to the di- rection of the lines. Starting from the position of the inductor when it is mid- way between the pole-tips, its rate of line-cutting will increase to a maximum as it passes under the centre of a pole-face, and will then decrease to zero. As it crosses a line drawn symmetrically through the gaps between the poles, the direction of the E.M.F. along its length is reversed, since its motion relatively to the direction of the field is reversed. If the ends of the inductor are electrically con- nected to two collecting rings fixed on, but insulated from, the shaft, two stationary brushes 6 b can be pressed so as to make rubbing contact with the rings, and an ex- ternal circuit may be connected to the brushes, which then form the " terminals " of the machine; the alternat- ing E.M.F. set up in the inductor will cause an alternating current to flow through the external circuit, and the sim- plest form of alternator is obtained. If the field cut by the inductor is of uniform density, and all the lines pass straight across from one pole to the other (both of which assumptions are approximately correct), a curve connect- ing the instantaneous values of the E.M.F., as ordinates, with time or degrees of revolution, as abscissae (as shown at the foot of Fig. 3), will be sinusoidal when the speed of rotation is uniform. If, however, the inductor is*~~

1 Faraday, Exp. Res., series ii. § 6, pars. 211, 213 ; series xxviii. § 34, par. 3152.

2 Invented by Nikola Tesla (Elec. Eng. vol. xiii. p. 83. Cp. Brit. Pat., Spec. Nos. 2801 and 2812, 1894). Several early inventors, e.g., Dal Negro in 18.32 (Phil. Mag., third series, vol. i. p. 45), adopted reciprocating or oscillatory motion, and this was again tried by Edison in 1878.

Fig. 8.

+ Y \ 3B

lo iao\ /

g. 4-

fig. 5.

mounted on an iron cylinder (Fig. 4),' a sufficient margin being allowed for mechanical clearance between the inductor and the poles, not only will the reluctance of the magnetic ^ circuit be reduced, and the total flux and its density in the air-gap B, be thereby increased, but the path of the lines will become nearly radial, except at the " fringe " near the edges of the pole-tips, and hence the relative directions of the movement and lines will be con- tinuously at right angles. The shape of the E.M.F. curve will then be as shown in Fig. 4 — flat- topped, with rounded corners rapidly sloping down to the zero line.

With the addition of a number of similar inductors arranged along the length of the armature core parallel to the first, the question arises of their connexion, in order to add their E.M.F.'s. Since the E.M.F.'s generated by the inductors under the one pole-piece are opposite in direction to those induced under the other pole-piece as viewed from one end of the armature (Fig. 5, where the dotted and crossed wires indicate E.M.F.'s directed towards and away from the observer), two distinct methods are possible by which two or more inductors can be joined in series.

~~(1) The first, or ring winding, was invented by Dr Antonio Pacinotti of Florence * in 1860, and was subsequently and independently reintroduced in 1870* by the Belgian electrician, Zenobe TheophUe Gramm e, whence it is also frequently called the " Gramme " wind- ing. By this method the farther end of inductor 1 (Fig. 5) is joined to the near end of inductor 2 ; this latter lies next to it on the surface of the core or immediately above it, so that both are simultaneously under the same pele- piece. For this connexion to be possible, the armature core must be a hollow cylinder, supported JErom the shaft on an open non-magnetic spider or hub, between the arms of which there is room for the internal wire completing the loop (Fig. 6). The end of one complete loop or turn embracing one side of the armature core thus forms the starting-point for another loop, and the process can be continued if required to form a coil of two or more turns. In the ring armature the iron core serves the double purpose of con- ducting the lines across from one pole to the other, and also of shielding from the magnetic flux~~

~~the hollow interior through which the connecting wires pass. Any lines which leak across the central space are cut by the internal wires, and the direction of cutting is such that the E.M.F. caused thereby opposes the E.M.F. due to the inductors proper on the external surface. If, however, the section of iron in the core~~

~~8 The advantage to be obtained by making the poles closely embrace the armature core was first realized by Dr Werner von Siemens of Berlin in his " shuttle-wound " armature (Brit. Pat., No. 2107, 1856).~~

~~^Nuovo Cimento, 19, p. 378, 1865. Elias of Amsterdam is by some credited with having used ring winding on a motor even earlier than~~

~~1860.~~

~~5 Brit. Pat., No. 16S8, 1870. Comptes Rendus, 73, p. 175, 1871.~~

~~Fig. 6.~~

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Fig. 7.

be correctly proportioned, the number of lines which cross the interior will bear but a small ratio to those which pass entirely through the iron, and the counter E.M.F. of the internal wires will become very small; they may then be regarded simply as connectors for joining the ex- ternal inductors in series.

(2) The second or drum method was used in the original " shuttle-wound " armatures invented by Dr Werner von Siemens in 1856, and is still known as the " Siemens " winding. The farther end of inductor 1 (Fig. 5) is joined by a connecting wire to the farther end of another inductor 2' situated nearly diametrically opposite on the other side of the core and under the opposite pole-piece. The near end of the complete loop or turn is then brought across the end of the core, and can be used as the starting-point for another loop beginning with inductor 2, which is situated by the side of the first inductor. The iron core may now be solid from the surface to the shaft, since no connecting wires are brought through the centre, and each loop embraces the entire armature core (Fig. 7). By the for- mation of two loops in the ring armature and of the single loop in the drum armature, two inductors are placed in series ; the curve of instantaneous E.M.F. is therefore similar in shape to that of the single inductor (Fig. 4), but with its ordinates raised throughout to double their former height, as shown at the foot of Fig. 6.

Next, if the free ends of either the ring or drum loops, instead of being connected to two collecting rings, are attached to the two l^lves of a split-ring insulated from the shaft (as shown in Fig. 7 in connexion with a drum armature), and the stationary brushes are so set relatively to the loops that thiey pass over from the one half of the split-ring to the other half at the moment when the loops are passing the centre of the interpolar gap, and so are giving little or no E.M.F., each brush will, always remain either positive

or negative. The current in the external circuit attached to the brushes will then have a constant direction, although the E.M.F. in the inductors still remains alternating ; the curve of E.M.F. obtained at the brushes is thus (as in Fig. 7) entirely above the zero line. The first dynamo of Pixii," which immediately followed Faraday's discovery, gave an alternating current, but in 1832 " the alternator was converted into a machine giving a unidirected current by the substitution of a rudimentary '^commutator" in place of mercury col- lecting cups.

On passing to case (B) we are at once reminded of the original dynamo of Faraday, yet though the disc of Fig. 1 is in reality a single inductor whose plane of move- ment is at right angles to its axis of rotation, it has the peculiarity that the E.M.F. generated is always in the same direction along the inductor's length ; it thus repre-

1 Ann. Chim. Phys. vol. 1. p. 322.

^ Ann. Chim. Phys. vol. li. p. 76. Since in Pixli's machine the armature was stationary, while hoth magnet and commutator rotated, four brushes were used, and the arrangement was not so simple as the split-ring described above, although the result was the same. Saxton's machine (1833) and Clarke's machine (1835, see Sturgeon's Annals of Electricity, vol. i. p. 146) were similar to one another in that a unidirected current was obtained by utilizing every alternate half- wave of E.M.F., but the former still employed mercury collecting cups, while the latter employed metal brushes. Sturgeon in 1835 followed Pixii in utilizing the entire ware of E.M.F., and abandoned the mercury cups in favour of metal brushes pressing on four semi- circular disca {Sdentiflc Researches, p. 2.52). The simple split-ring is described by Wheatstone and Cooke in their Patent No. 8345, 1840.

Fig. 8.

sents a class of machines which are distinguished by the somewhat misleading name of "unipolar" dynamos. In this special form the (B) principle of arrangement is seldom employed, since it is dif&cult to add other inductors in order to increase the E.M.F. If, however, the mag- netic circuit be interrupted by another air-gap (Fig. 8), a single inductor can be arranged to cut the flux twice in each revolution in difiEerent directions as

it passes through the two air- gaps. The E.M.ywhich is now produced in the in- ductor will be first radially outwards, and then inwards towards the centre, i.e., it alternates in direction just as in case (A). It then be- comes possible to employ a number of inductors (Fig. 9), and to add together their E.M.F.'s in series by methods which are analogous to the ring and drum winding already discussed under case (A), and which yield the third and fourth types of armature.

(3) By the discoidal or flat-ring method (Fig. 10) an inductor 1 is joined to its next neighbour 2, and for this to be possible it is again necessary that there should be an iron core (as A in Fig. 9) to convey the lines from one pole to the other, and at the same time to shield the con- nepting wires, so that they may not themselves cut the field. A second magnet M' (shown dotted in Fig. 10) can now be ar- ranged on the op- posite side of the armature core to the first magnet M, with poles of the same sign facing each other. The greater portion of the length of the wires which previ- ously served merely as conductors can then also be rendered usefully inductive, the inactive connectors being simply the wires joining the two sides of each loop.^ The armature thus takes the form of a flat ring (Fig. 10),

Fig. 10.

and is analogous to a ring armature in which a second pair of poles is introduced into the centre of the core, each of the same sign as the external pole which it faces.

(4) The fourth or disc winding was in principle em-

8 The advantage originally claimed for the discoidal-ring machine, namely, that the rim of the armature could also be utilized by joining the opposite poles, and that so the inactive length of the wire was con- siderably reduced as compared with the longitudinally-wound ring (Schuckert, Brit. Pat., No. 4464, 1877), has proved somewhat illusory, owing to the difficulty of avoiding eddy-currents in the core when the flux enters it in two directions at right angles to each other, from the sides and from the overarching pole-piece respectively.

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ployed in many of the earliest machines, and especially in alternators, but has not met with much favour for continuous-current dynamos. In this method the outer end of inductor 1 is joined, by a connecting wire passing round J;he periphery, to the outer end of another inductor 2' situated nearly diametrically opposite under the other pole (Fig. 9). No iron core is now required; the two opposite poles can be brought close together, leaving but a short path for the lines in the air-gap, and any mechan- ical support on which the wires are wound may be non- magnetic. By bringing the inner end of inductor 2' along the inside periphery (Fig. 11), a loop is formed, which may be again repeated. If the ends of the loops

Fig. 11.

thus formed by either method (3) or (4) are connected to a pair of collecting rings, a simple discoidal-ring or disc alternator is obtained, while if they are connected to a split-ring the current may be commuted, and the dy- namo gives an unidirected E.M.F. and current in the external circuit. It is therefore true to say that in almost all dynamos which are used in practice, whether they supply an alternating or a continuous current to the external circuit, the E.M.F. and curl-ent in the inductors themselves are alternating.

The addition of new loops leads to a coil of many turns, and thence to a number of coils. If the several new loops are wound over each other in the ring, drum, and discoidal-ring armatures, or by the side of each other in the disc, the depth of the wires in the air-gap would necessitate such a long distance between the pole-piece and the armature core, or between the opposing poles of the disc, that it would be difficult to obtain a suffi- ciently strong magnetic field. The additional loops must be wound side by side in the first three cases, or on the top of each other in the disc armature. The coil thus has a certain width along the face of the poles, and the effect of such width must be considered in its relation to the width of the poles. The pitch-line being defined as a circle drawn through the middle of the length of the inductors, or, in other words, as the mean path traversed by them in their rotation, it is convenient to refer the widths of pole, interpolar gap,

and coil to the ■pitch, or the distance measured along the pitch-line from the centre of one pole to the centre of a neighbouring pole of opposite sign. In the ring armature, if the E.M.F.'s induced by the turns in any one coil are to be added in series, they must be in the same direction along the inductors. A ring core entirely overwound with one coil in a continuous helix would give no E.M.F. at the ends ; but when the coil is divided into two halves, these may, by means of appropriate connexions, be placed either in series or in parallel, and each half will at any instant give the same E.M.F. The ring armature must therefore be divided into at least two coils, and it is then evident that if the width of each coil exceeds the width of the interpolar gap, the loops will for some por- tion of one revolution be moving at the same time under two poles of opposite sign, and consequently differintial action will be set up, by which one part of the coil will be

Fig. 12.

inducing an E.M.F. opposed in direction to that of the rest. If this disadvantageous action is to be avoided, either the width of the coil or the width of the pole, or both, "must be reduced until the coil is no wider than the interpolar gap. If the coil be wide, the poles must be narrow, so that with a given density the number of lines in a field will be very small ; while, on the other hand, if the coil be narrow and the pole wide, the flux of one field may be large, but the number of inductors in the coil must be small.

If the poles of tlie alternator are arranged in two separate circles (as in Fig. 43), all the N poles forming one crown and all the S

poles another crown, the width of "

the poles may be equal to the pitch ; ' '

but if they occur alternately, first a N pole and: then a S pole round the ^ same circle, their width must be less • than equal to the pitch in order to avoid an excessive amount of mag- netic leakage between the adjacent pole-edges. Considerations of the inductance of the armature and of its heating in turn limit the feasible width of Tending in the armature coils. A compromise has therefore to be made, and experiehce shows that in practice the best combined use of an armature core and field-magnet of

given size is made if the width of the poles of alternate sign is ap-proximately half the pitch, and the width of the ring coil is equal to the width of a pole. The two-pole machine will then have two coils, and the armature core will be only half covered with winding (Fig.

12 i.). The same considerations govern the best width of a drum coil. If the core be entirely overwound (as in Fig. 12 ii., if the blank portions of the core were covered with loops of continually diminishing size), the arrangement is the equivalent of the ring ar- mature with two coils in series, each of width equal to the pitch. The single coil of the bipolar drum may equally well be divided into two coUs, the largest loop of each half having a width equal to the pitch ; and the two coils so formed may be connected either in series or in parallel. Again, however, if there is to be no differ- ential action, opposite sides of one coil must never be moving under the same pole, and the innermost or smallest loop must not be less in width than the pole-face. The best proportions are obtained if the width of the inner loop and the width of the field are each ap- proximately equal to half the pitch (Fig. 12 ii.). The same rea^ soning can easily be applied to the discoidal ring and disc machines, and will lead to like results.

If the bipolar armatures of Fig. i2 are imagined to be cut through to the centre from any point X and opened out, it is evident that any number of pairs of coils similarly spaced to the original pair may be inserted without in any way affecting the action, save to increase the periodicity of the alternating E.M.F.;, an equal numbei' of pairs of poles may then also be added, with a corresponding increase in the total E.M.F., and the multipolar alternators ^ of Fig. 13 are obtairied. As the wires of a coil pass gradually into or out of action, the total E.M.F. of the coil, being the sum of the E.M.F.'s in the separate inductors, rises or falls- gradually, the maximum value being reached when the coil is immediately under a pole in the ring armature, or when the side of a coil is under a pole in the drum and disc machines. When the coil enters under the next pole of opposite sign, the gradual rise and fall are again repeated, but the E.M.F. is in the opposite direction. Thus the passage of a coil through two magnetic fields of opposite direction yields a complete wave of E.M.F. such as. is shown in Fig. 6, and the time in seconds taken by the E.M.F. or current to pass through such a complete cycle is the "period i' of the alternator. The

number of complete periods through which the E.M.F. or current passes per second is called ihe periodicity OT frequency, and in the bipolar alternator is equal to the number of revolutions per second. In the multipolar alternators of Fig.

13 the coils may be arranged either in series or in parallel, since their phases are all alike ; the periodicity of the multipolar alter- nator is with either arrangement equal to the number of pairs of fields through which a coil passes in one second, so that in general

the periodicity= — xp, where N=the number of revolutions per

60

1 The first use of a number of pairs of coils and an equal number of pairs of poles was due to Stohrer of Leipzig, Pogg. Ann. Ixi. 417, 1844.

minute, andp=thenumberof pairs of fields. In the ring and drum alternators, p is also the number of pairs of poles, but in the dis- ooidal ring and the disc types the pairs of poles must be reckoned on one side only, since each pair of poles facing each other on oppo- site sides of the armature only corresponds to a single field.

The above reasoning has, so far, led us in all cases to as many coils a£ there are fields and an armature core only half covered with winding, and such is the form taken by the single-phase alter- nator. But since only one-half of the armature core is utilized, an entirely distinct but similar set of coils may be wound to form a second armature circuit between the coils of the first circuit. The phase of this second circuit will differ by a quarter of a period from that of the first, and it may either be used to feed an entirely separate external circuit, possibly at a different pressure, or, if it be composed of the same number of inductors and therefore gives the same pressure, it may be inter-connected with the first circuit to form a quarter-phase alternator. By

~~an extension of the same process, if the width of winding in each ring coil be reduced to one-~~

~~Fig. 18.~~

~~third of the pitch, or the width of each side of the drum coil be reduced to one-sixth of the pitch, three armature circuits can be wound on the same core, and a three-phase alternator is obtained, giving waves of E.M.F. differing in phase by 120°.~~

~~Eeverting to the simple dynamo of Fig. 7, we have stni to consider the effect of the addition of more armature loops in dynamos of this typ^, which give a unidirected current in virtue of their split-rings. If the loops form a single coil, wider than the interjJolar gap and connected to a single split-ring, they will, just as in the alterilator, act differentially against one another during part of a revolution. Hence the coil must be more or less concen-trated into a narrow band. Such an arrangement in the case of drum winding gives the H-form " shuttle" arma- ture invented by Dr Werner von Siemens. Although its E.M.F. has a much higher maximum value than that of the curve of Fig. 7, it still periodically varies during each revolution, and so gives a pulsating current. To avoid the pulsation, recourse must be had to a new principle pecu- liar to the closed-coil continuous-current machine, which is by far the most largely used of all dynamos. Since a second coil placed at right angles to the original coil will yield a wave of E.M.F. of which the crests will coincide with. the hollows of the first wave, the E.M.F.'s of the two coils when in series will supplement each other, and~~

~~the fluctuations of the resultant curve will be greatly re- duced, although its maximum may be no higher. Instead, therefore, of concentrating the new loops into a narrow coil, as in the case of the alternator, the opposite course must be pursued, and the loops be divided be- tween several coils equally spaced round the armature. Given two coils at right angles and with their split- rings displaced through a corresponding angle of 90°, they may be connected in series by joining one brush to the opposite brush of the second coil, the external circuit being applied to the two remaining brushes.^ The same arrangement may again be repeated with another pair of coils in parallel with the first, and we thus obtain Fig. 14 with four split-rings, their connex-~~

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fv

^^^N^

y.

A^

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— w

2^ ^r=j.|

*v^ ‘ * 1 y.

M

g^/

\ 1 * /^

f^

ff.

ii. Drum

VolU

1

-

i. Ring

Curve of E M.F.

m

Hg. 14.

ions to the loops being marked by corresponding nu- merals ; the four coils will give the same E.M.F. as the two, but they will be jointly capable of carrying twice the current, owing to their division into two parallel circuits. Now, since the effect of joining brush 2 across to brush 3 is virtually to connect the end of coil A with the beginning of coil B, and so on until they are closed upon themselves in a continuous helix, the four split-rings may be replaced by the simpler arrangement of Fig. 15, consisting of four segmental portions of a cylinder, insulated from one another and from the shaft, and requiring only two brushes, which form the terminals of the external circuit. Each sector replaces a pair of halves of adjacent split-rings, in the order of sequence, 2 and 3, 4 and 5, 6 and 7, 8 and 1. The function of this structure^ being not merely to collect the current, but to com- mute its direction in any coil as it passes through the interpolar gap, it is known as the commutator. Each coil is successively short-circuited, as a brush bridges over the insulation between the two sectors which terminate it ; and the brushes must be so set that the period of short- circuit takes place when the coil is generating little or no E.M.F., i.e., when it is moving through the zone between the pole-tips. The effect of the four coils in reducing the percentage fluctuation of the E.M.F. is very marked, as shown at the foot of Fig. 14 (where the upper curve is the resultant obtained by adding together the separate curves of coils A and B), and the levelling process may evidently be carried still further by the insertion of more coils and more corresponding sectors in the commutator, until the whole armature is covered with winding. For example. Fig. 16 shows a ring and a drum armature, each with eight coils and eight commutator sectors ; their resultant curve, on the assumption that a single inductor

Fig. 15.

1 Such was the arrangement of Wheatstone's machine (Brit. Pat., No. 9022) of 1841, which was the first to give a more nearly conimaoMS current, the number of sections and split-rings being five.

2 Its development from the split-ring was due to Pacinotti and Gramme (Brit. Pat., No. 1668, 1870) in connexion with their ring armatures.

gives the flat-topped curve of Fig. 4, will be the upper wavy line of E.M.F. obtained by adding together two of the resultant curves of Fig. 14, with a relative dis- placement of 45°. The amount of fluctuation for a given number of commutator sectors depends upon the shape of the curve of E.M.F. yielded by the separate small sections of the armature winding; the greater the polar arc, the less the fluctuation. In practice, with a polar arc equal to about 0'75 of the pitch, any number of sectors over 32 yields an E.M.F. which is sensibly constant throughout one or any number of revolutions. If the armatures of Fig. 16 be imagined to be cut across to the centre from any point such as X and opened out, as was also done in the case of alter- nators, any number of pairs of poles, with a correspond- " ing incre'ase in the number

Voltt

"mm

Fig. 16b.

of inductors, may be added, and multipolar continuous- current dynamos are obtained. But whereas in the alter- nator there may in each phase be only one circuit through the armature, in the continuous-current closed-coil armature there can never be less than two parallel circuits, while if there are more than two, there must be as many as there are poles. ^ The two

conditions coincide in the simple bipolar armature, since it has two parallel paths through the armature, or as many as there are poles.

The fundamental electromotive force equation can now be given a more definite form, suitable for both the continuous-current dynamo and the alternator. Let Za=the number of C.G.S. lines or the total flux, which issuing from any one pole flows through the armature core, to leave it by another pole of opposite sign. Since each inductor cuts these lines, first, as they enter into the armature core from one pole, and then as they emerge from it to enter another pole, the total number of lines cut in one revolution by any one inductor is 2pZa. The time in seconds taken to per- form one complete revolution is „, where N is the number of

revolutions per minute. The average E.M.F. induced in each in- ductor in one revolution, being proportional to the total number of lines which it cuts, divided by the time taken to put them, is

therefore 2p

N

60"

Za X 10" ‘ volts. Let T be the total number of

inductors on the surface of the armature, whether ring- or drum- wound, and let q be the number of parallel circuits into which the armature winding of a continuous-current dynamo is divided,

whence the number of inductors in series is -. The average E. M. F.

induced in the armature is then Ea=2.^.. ZaX 10”* volts, and

60 q in the continuous-current machine, with a sufiicient number of inductors and commutator sectors, this is the same as the instan- taneous E.M.F. ; for the sum total of the several E.M.F.‘s set up in the different inductors of one circuit, spread uniformly over the armature core, will at any moment be equal to the average E.M.F. set up in one inductor

multiplied by the number of inductors in series, i. e., it is independent of the distribution of the flux in the air-gap. It should be observed that Za, or the number of lines flowing through the armature, is taken, since in the ring machine this will difl'er from the number that crrss the air-gap or Zg by the small percentage which leak across the int^ior of the ring, and so are cut in the opposite sense by the internal connecting wires.

' Except in the special case of multiple-circuit windings, which will "be referred to later.

The case of the discoidal armature may best be treated by reducing it to the analogous simple ring ; each pair of opposing poles, since they are of the same sign, forms in eflect a single divided pole, whence a total number of lines Za pass into the armature core ; t must then be reckoned as equal to the number of loops in the ring, or the number of inductors on one only of its two faces. The equation of E.M.F. thus becomes exactly the same as that of the simple ring machine. The disc winding is analogous to the drum, so that in all cases the E.M.F. of the continuous-current closed-coil armature is

Ea = |-|^.T.Za.X 10- volts, . . . (Lffi)

where q must be an even number, and can never be less than 2.

In the continuous-current dynamo the instantaneous and average values of the E.M.F. from the armature as a whole are the same ; but when we pass to the alternator, its " effective " E.M.F. is equal to the square root of the mean square of the instaiitaneous values of the E.M.F., since this is the value of the equivalent unidireoted and unvarying E.M.F., which, when applied to a given resistance or to a glow lampj would give the same amount of heat or of light as the alternating E.M.F. produces (see Electricity, iii. Electric Current). The shape of the curve of instantaneous E.M.F. therefore becomes a matter of the greatest importance, for upon it will depend the effective voltage of the alternator, even though its average E.M.F. may be the same with some different shape of E.M.F. cm-ve. Assuming, as we may, that the density of the lines is the same along the length of an inductor for any given position of it during rota- tion, its instantaneous E.M.F., =Bi,LV x 10 "* volts, will vary as By varies,

~~according to the position of the inductor imder or between the poles. Hence the addition of more inductors in series may not give a proportionate addition of E.M.F., and in fact will not do so, unless they are so close beside each other that their difference of spacial position or of phase can be neglected ; the nearest practical approach to this will be in the case of a toothed or tunnel armature, when the inductors of a coil are wound in the same slot or hole. Differential action, which has been already discussed, is indeed only an aggravated case of the same effect as must take place when a coil is gradually coming into or out of action, and is not entirely under a pole. Further, it is evident that the curve of E.M.F. ■ f the coil may be given any shape that we please, by so shaping the pole-piece as to give the required variation in density of the lines in the air-gap. Thus the length of gap between pole-face and armature core might be so varied as to give a curve of E.M.F. varying after a sine law (cp. Fig. 3 — for the case of a single in- ductor), and the ratio of the effective E.M.F. to the average E.M.F.~~

~~would then have the particular value of ^ =1‘11. Two points~~

~~2 j^2 have, then, to be considered in an alternator, namely, what is the ratio of the square root of the mean square to the average value of its E.M.F., and what is the ratio which either the instantaneous or the average E.M.F. of a coil bears to the instantaneous or average E.M.F. of a single inductor. Both^depend on the ratio of the width of coil and pole, and on the law which governs the variation in den.sity of the field. If et=the effective E.M. F. of one coil, and ibe total number of coils in one phase, i.e., 2p, be divided into q~~

~~parallels, the effective E.M.F. of the phase is Eoe=— .ee. Let~~

~~q i’=the ratio of the square root of the mean square to the average~~

~~value of the E.M.F. of the coil, or:~~

~~T~~

~~2p~~

~~then the effective~~

value of the E.M.F. of the phase is -t . fc'. «^ where T is the

time of a period and eai>=the net average value of the E.M.F. of a coil. . Let A"=the ratio which the net average E.M.F. of the coil bears to the gross average E.M.F. on the supposition that there is no differential action, and let «=the average E.M.F. of a single inductor ; then if t be the number of inductors in a coil, the reduc- tion rf the E.M.F. of a coil as a whole may be taken into account by multiplying the product te by a breadth coefiBcient k", which must be less than unity if the coil have any width. The effective

E.M.F. per phase is therefo;-e .^.!c'.k".te. If m=thenumberof

separate phases into which the armature winding is divided,

t= T-— ; further, the average E.M.F. of the single inductor e

m . 2p

is 2 . ^^ . Za X 10' volts ; whence the effective E. M.F. of erne phase

60

of the alternator is

■c '^ 7J lit r 2p.N „ ,„ , l.ld.ld' pN „ ,. ,

Ea«=^.F.fc". — -. ^i; — .ZoXlO-8= .- .tZoX 10"'

q TO . "gp 60 TO . ?. 60

volts. The two factors V and V may be united into one constant

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K, and the equation then takes its final form of 2.K

Ea«='— ---^. T . Za X 10-8 volts

~~(1.6)~~

~~mq 60~~

~~In contrast to the continuous-current dynamo, q may be nnit^. The analogy of this equation to that of the continuous-current machine is at once apparent ; the process by which it is arrived at really consists in stating the E.M.F. of the alternator as that of a similarly wound continuous-current dynamo multiplied by a certain constant, and only because this is the most convenient method of expressing it are we interested in its average E.M.F. The second~~

~~term "' in both equations gives the periodicity of the alternating~~

~~E. M. F. in the inductors ; and even though the current be commuted, as in the continuous-current machine, it is of importance as deter- mining the loss by hysteresis in the core, and by eddy currents in the armature as a whole.~~

~~The fundamental equation of the electromotive force of the dynamo in its fully-developed forms (I.a) and (I.J) may be compared with its previous simple statement (I.). The three variable terms still find their equivalents, but are differently expressed, the density Bj being replaced by the total flux of one field Za, the- length L of the single inductor by the total number of inductors t, and the velocity of movement V by the number of revolutions per second. Even when the speed is fixed, an endless number of changes may be rung by altering the relative values of the remaining two factors ; and in successful practice these may be varied between fairly wide limits without detriment to the working or economy of the machine. While it may be said that the equation of the E. M. F. was implicitly known from Faraday's time onwards, the diflSculty under which designers laboured in early days "was the problem of choosing the correct relation of Za and t for the required output ; this, again, was due chiefly to the difficulty of predetermining the total flux before the machine was constructed.^ The general error lay in employing too weak a field and too many inductors, and credit must here be given to the American inventors, Weston and Edison, for their early appreciation of the superiority in practical working,~~

~~of the drum armature, with comparatively few inductors rotating in a strong field.~~

~~The equation of mechomicaZ force now requires to be given, in its turn, a more fully developed form correlative to that of the electro- motive force. Let the inductors of a continuous-current dynamo be carrying a current of c amperes ; then each, so long as it is moving under a pole-face, is subjected to a mechanical drag of 'BgLc X 10"' dynes, or if the length and force fje expressed in English units of inches and pounds, of 57 "RgVc x lO"* pounds. This force is gradually removed and re-established 2p times in each revolution as the inductor passes the interpolar gaps, but its direction is always tangential to the path of rotation, and opposed to it, so that the torque resisting the movement of a single in- ductor is BjLc. rx 10"' dyne-centimetres, where r is the radius in cm. of the mean path of the inductor. The total torque acting on the armature is due to the combined effect of the several in- ductors with which it is wound ; and since the number of inductors~~

~~within one polar face is t . $-, where 0 is the angle subtended by~~

~~the polar arc in radians, the total torque of the armature due to the ip fields is T=p . r. 2 . Bj . L . c . r x 10 ' dyne-centimetres.~~

~~that the mechanical horse-power absorbed is equal to~~

~~Since Bj=~~

~~ ?2L Lr^'~~

~~T^^JLlLi — : — ?xlO^ dyne-centimetres, or~~

~~p.T. C.Zg~~

~~4.26~~

~~xlO"' pound-feet~~

~~(Il.a).~~

In the above statement the lines are treated as if confined ^strictly to the area of the pole-face — an assumption which is not strictly true, since the fringe surrounding the pole-edges has been neglected. The correction for this slightly decreases , the value of Bj for a given value of Za, but correspondingly increases the number of inductors which are subjected to the torque, so that the final form of the equation is strictly true for the continuous-current armature as a whole. This may be proved if the torque be multiplied by the angular velocity in radians per sec. , and the rate of absorption of mechanical energy as thus obtained in ergs per sec. or foot-pounds per sec. be equated to the rate of development of electrical energy. The latter is equal to E C watts, or since 0 = qe, the electrical horse-power is

c.T.ZaX 1.33×10-“.

2 p^ r.Zg.lO-s 2;)N-

^‘60 ■ 746 ^ 60 ■ On the other hand, the angular velocity in radians per sec. is equal to the number of revolutions per sec. multiplied by 2ir, so

‘ Cp. Kapp, Jov/m. Sac. Tel. Eng. vol. xv. p. 5901,

f=

.e.Za

4-26

xlO

,2rff.

60

1 2pN

550 ~ 60 ‘

c.T-.ZaXl‘33xlO-“.

Since the expression for the drag on any single inductor involves the term B^, it is evident that it is dependent on the distribution of the flux in the air-gap, i.e., on the shape of the curve of B,,, and if the average value of Bj, is alone considered, the equation (Il.a), although giving the average pud on the inductor, does not express its instantaneous values. As will be explained subsequently, the value of the actual B^ in the continuous-current dynamo when at work is not uniform even under the pole-face. Hence the instantaneous pull on any inductor varies on either side of the average value, and in practice its maximum value at full load may be as much as 20 per cent, greater than the average value.

Lastly, in the alternator the current n varies as well as the density B^, so that the problem becomes much more complicated and no simple equation can express it. If the current in the armature were in phase witb the induced E.M.F. , and so with the flux,-density which causes it, the maxima values of Bj, and c would occur simultaneously. The maximum drag thereby produced will be far greater than the average value, and may considerably exceed the force acting on the equivalent continuous-current dynamo. But, more than this, if there be inductance in the circuit, the current in the armature will lag in phase behind the induced E.M.F. and behind the B^ curve. The pull on the inductors now becomes zero not only when Bj is zero, but also when c is zero, and, further, its direction relatively to the rotation changes each time that either the one or the other passes through zero. Thus the alternator is subjected to a racking action which is much more trying than the simple torque of the con- tinuous-current machine. The armature is alternately dragged back when the directions of field and current coincide, and driven forward as a, motor when they are opposed, the backward drags being more powerful and lasting longer than the forward pushes, so that on the whole the machine absorbs mechanical energy and acts as a generator.

If the inductors, instead' of being .wound on the surface of a smooth armature core, are sunk into slots or passed through holes close to the edges of the core-discs, the force which would otherwise be ex- pended on them is largely transferred to the iron teeth which project between the slots or tunnels. The lines of the field, after passing through the air-gap proper, divide between the teeth and the slots in proportion to their relative permeances. Hence at any moment the inductorl are situated in a weak

field, and for a given armature current the force on them is only proportional to this yveak field.^ This surprising result is connected with the fact that when the armature is giving current the distribution of the lines over the face of each tooth is distorted, so that they become denser on the "trailing" side than on the "leading " ^ side (Fig. 17) ; the lines tend to straighten and shorten themselves, and the result of the unsymmetrical distribution acting on all the teeth is to produce h magnetic drag on the armature core proportional to the current taken out of the inductors, so that the total resisting force remains the same as if the armature had a smooth core. The amount by which the stress on the inductors is reduced entirely depends upon the degree to which the teeth are saturated, but since the relative permeabilities of iron even at a flux density of 20,000 lines per square centimetre is to that of air as 33 : 1, the embedded inductors are very largely relieved of the driving stress.

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On passing to the separate consideration of continuous- current dynamos, the winding of the armature may first be taken in greater detail, and certain results drawn from

2 Electrician, vol. xxxiv. p. 757 (Sayers), and vol. xh. p. 108 (Du Bois) ; Swinburne, Industries and Iron, February 2, 1894 ; Mordey, Joum. Inst. Elec. Eng. vol. xxvi. p. 564 ; Houston and Kennelly, Elec. Eng. vol. xviii. p. 208.

^ By the "leading" side is to be understood that side which first enters under a pole after passing through the gap between the poles, and the edge of the pole under which it enters is here termed the "leading" edge, as opposed to the "trailing" edge or comer from under which a tooth or coil emerges into the interpolar gap ; cp. Fig. 30, where the leading and trailing edges are marked II and tt.

Fig. 17.

the ring and drum armatures of Fig. J 6, which are equally true for the discoidal and disc forms.

The simple ring winding consisting of a continuous helix is in itself unailected by the number of poles ; by the mere placing of 2p, sets of brushes on the surface of the commutator at equal distances apart, the winding is at once divided into as many „, equal and symmetrical paths through the armature,

windim °^ i—’^Pr Hence if 2pj is made equal to 2p or the number of poles, a tnultvpolar parallel-wouTid ring is obtairied, having as many parallel circuits and as many points of collection of the current as there are poles. The E.M.F. of the

N

N

armature is then :fL.r.Za*: 10-8=— . t . Zo x 10- volts,

2p, 60 60

whether it be bipolar or multipolar, and the current in any one

inductor is —-. All the sets of brushes which are of the same sign 2p

must be connected together in order to collect the total current C. The potential rises gradually in the armature wires as we pass from a negative to a positive brush, or falls as we proceed onwards from a positive to a negative brush. The difference of potential between adjacent wires is only that due to the added voltage of one in- ductor if the winding be in one layer, or to one section if there be several layers ; and as this is but a few volts even in machines giving as much as 3000 volts at the terminals, the insulation of the wires from one another presents no difficulty. On this score the ring winding contrasts favourably with the drum, and it is there- fore more especially suited to very high potential machines. If the increased number of brush-sets in the multipolar parallel- wound armature is regarded as a disadvantage, they may again be

reduced to two by cross-connexion of sectors situated

360°

apart ;

Fig 18.

but the commutator must then be lengthened p times in order to provide sufficient brush- contact surface to collect the total current C, and, further, the number ol sections must be an even number.

It is, however, often required to add together the inductive effect of sections of the winding situated under two or more poles, especially in high voltage machines. This may be done by connecting together in series a set of coils sym- metrically situated in fields of like polarity, as diagrammatically shown in Fig. 18 ; the current in the armature is then only divided be- tween two parallel paths, and there are only two sets of brushes, or P/ = i and q=2pj= 2. Hence the E. M. F. of the series-wound muUi-

polar armaiure is E« =p t . Zo x 10-^ volts.

The development of the modern drum lomding from the shuttle- wound Siemens armature is chiefly due to von Hefner Alteneck of Dram Berlin (1871). From Fig. 16b it will be seen that,

wlndlnz ^^ order to avoid differential action, the width of each loop must exceed the width of a pole-face and may be equal to the pitch of the poles, i.e., the loop may be wound diametrically across the bipolar armature core. If, however, the number of commutator sectors be even and the winding be dis- posed in one layer, a symmetrical winding cannot be obtained unless the width of the loop falls short of the above maximum width by at least the width of one inductor, i.e., the "pitch" of the loop at the "back" end of the armature farthest from the commutator, or the number of inductors passed through in joining

one inductor to another, must not exceed "s — !• Since — is with an

even number of sectors itself also an even number, the pitch at the back end of the armature must then be an uneven number. Even if the armature winding be disposed in two layers, or the commutator sectors be an uneven number, it is not advisable for the loops to be wound diametrically across the armature core ; hence it may be said in general that the pitch of the winding at the back end of the armature must be an uneven number les-s than t/2, so that the loop spans a chord less than the diameter, and is in effect wound on one side of the core (cp. Fig. 16b). In completing the loop and joining it to the next loop, two possible cases present themselves. By the first, or lap winding (Fig. 16), the end of the loop is taken to a commutator sector, and thence

starts off again to a third inductor on the same side of the core as the first loop, and lying within its two sides, i.e., the next loop starts with the inductor next but one to the first inductor. The pitch of the front end is therefore less than the pitch of the back end, and differs from it by two. Thus the winding works con- tinually forwards and backwards, until it passes right round the armature and finally closes on itself. The development on a flat surface shows that the completed winding takes the form of a number of partially overlapping loops, whence its name originates. One of these loops is marked in heavy Unes in Fig. 19 i., where the firm-line portion gives the development of Fig. 16b, if cut through at the point marked X. The multipolar parallel-wound drum is precisely similar, as shown by the dotted additions in Fig. 19 i., which convert it from a two-pole to a four-pole armature ; the only difference is that the pitch at the back end must in all cases be an odd number less than, but not far different from, rjip. The maximum difference of potential in the drum armature exists between neighbouring wires as they successively pass the neutral points corresponding to the position of the brushes, and is here equal to the full E.M.F. of the machine. These wires lie side by side in the smooth-core armature with one layer, or one on the top of the other if there are two layers, as is usually the case in slotted

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n. Wave-winding Fig. 19.

armatures ; so that good insulation must be provided between the adjacent sides of the vrires in the former case, and between the two layers in the latter case.

By the second, or wave, method of drum winding, the end of the first loop in the bipolar armature is taken to a commutator sector on the opposite side of the diametric line to the first loop, and thence the second loop starts with an in- J^^, ductor lying outside the first loop and next but one ‘”’’”””^• to the original inductor. The method may be extended to multipolar machines, and then gives the series-wound multipolar armature ; when the completed winding is developed on a flat surface (Fig. 19 ii.), it is seen to work

continuously forwards in a zigzag wave round the armature, one inductor under each pole being successively joined up until the winding closes on itself,

T-)-2 The average of the front and back pitches must be -S^, so that,

e.g., in a four-pole machine, the possible number of inductors goes up by steps of four.

The equations of the E.M.F. of parallel-wound and series-wound drum armatures are the same as those" for the parallel-wound and series- wound rings, the latter in each case being p times the former. Thus the chief advantage of the series-wound armature, whether ring or drum, is that for a given voltage the number of inductors and the space lost in insulation of the wires is only \j'p of the number of inductors and the space lost in the parallel-wound armature. A further advantage is that the two circuits from brush to brush consist of inductors influenced by all the poles in the drum, or by aU the poles of like sign in the ring ; hence

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if for any reason, such as eccentricity of the armature in the bore of the pole-pieces, the inductive effect of one field is not equal to that of any other, the equality of voltage produced by the two halves of the winding is not affected thereby. In the parallel- wound armature inequality of the voltage of the various parallels may be avoided by a combination of the series and parallel methods. For large currents, multiple circuits are possiblQ.both with series and parallel winding, and q=2pi xx, where a; = the number of separate armatures which are virtually wound on the same core.

When the core of the armature is constructed of iron or other metal, the passage of it through the lines of the field

sets up in its mass E.M.F.'s which are in opposite core? "™ directions under poles of opposite sign, and are

greatest at the surface where the rate of line- cutting is greatest. Hence if the core were a solid mass, a current-sheet would flow along its surface under each pole, and complete its circuit by passing through the inner parts of the core or by returning in a sheet under a pole of opposite sign. The result would be a considerable re- duction in the efficiency of the machine, since the power absorbed by these so-called eddy-cwrrents would be entirely dissipated in heating the core. The production of the E.M.F. cannot be prevented, but the paths of the eddy- currents can be broken up, so that they meet with a comparatively high resistance and are reduced in amount. In the first place, the metal core must be divided into laminations whose planes are at right angles to the length of the inductors proper, since these are arranged to secure the maximum E.M.F. The laminae must be slightly in- sulated from one another ; and if the insulation be main- tained right up to their edges, the E.M.E.'s which still act across their thickness will not be added up along the length of the core, but will only produce very small currents, which circulate through the interior of the separate lamina^ tions. This remedy is practically realized in ring and drum armatures by building up their cores of thin iron plates or discs, strung on the shaft or on a supporting hub, so that their edges are presented to the lines of the field. Each disc is either coated with an insulating varnish or has one of its sides covered with a sheet of very thin paper; or in some cases no special insulating material is employed, and reliance is placed on the thin film of oxide which forms on the disc in the process of manufac- ture, and which is a poor electrical conductor. The thickness of the discs is usually about one-fortieth of an inchj and if this be not exceeded, the eddy-currents set up in the mass of the core are reduced to an almost negligible amount. The discs are in the ring machine notched with three or more key-ways, and are then passed over agun-metal hub with three or more arms running parallel to the shaft, which fit into the corresponding slots on the inner peri- phery of the discs (cp. Fig. 6 and the sections of Fig. 13). In the case of small bipolar drums the discs are often keyed directly to the shaft, but in larger multipolar machines the required radial depth of iron is small, and the discs are then mounted on a hub similar to that of the ring armature, save that it may now be made of cast-iron. If the armature is more than 4 feet in diameter, the discs become too large to be conveniently made in one piece, and are therefore divided into segments, which are built up so that they alternately break joint. In all cases the stout eud-plates between which the discs are

clamped together must be kept well out of the influence of the field, since otherwise the lines which curve round into the ends of the core from the edges of the poles may cause eddy-currents in their mass. Hence the axial length of the core is often made slightly greater than the corre- sponding dimension of the poles. In discoidal-ring arma- tures the laminations must be concentric with the axis of rotation, and a thin ribbon of iron is wound on the sup-

porting wheel, which may be of cast-iron (cp. Figs. 10 and 13 ii.).

When the armature core has been built up and all rough edges smoothed off, it is covered with some material of good insulation, resistance, and durability, such as oiled linen, varnished paper, or micanite sheeting, so that all edges and sur- ;"^j„™ faces on which the winding rests are thoroughly pro- ^ " • tected. In the ring wire-wound armature a length of wire suffi- cient for one section of the armature is cut off, treated with shellac, and dried ; one end is passed through the interior of the ring, and the required number of loops are wound tightly round the core. The next section is then similarly wound, until finally the whole core is covered, and the beginnings and ends of contiguous sections are united at the commutator to form a continuous helix. If the size of the solid wire becomes too large to he conveniently bent, two or more wires may be wound in parallel, with, however, some neces- sary loss of space owing to the subdivision. The small drum arma- ture may he similarly hand-wound, the loops of wire overlapping at the ends of the armature core ; but the method is accompanied by the disadvantage that if one section has to be repaired, the whole armature njay have to be taken to pieces and rewound. Hence various methods have been devised for winding drums with coils formed on shapers previously to fixing them in place. The former- wound coils have the advantage that they are perfectly symmetri- cal and interchangeable, can be thoroughly insulated before they are placed on the core, and, further, are economical in cost of Ig- bour. If, however, the current in each inductor is large, the drum arma- ture must be bar-wound. The inductors are then large and heavy bars of rectanglar section,. which are laid on the core and joined up in regular sequence by soldering to the end-connectors. These latter are strips of copper from one to two inches wide, which are bent in a double evolute curve so that they span the correct pitch and unite the short end of one bar to the long end of another bar situated at the proper distance apart round the circumference of the core. Por multipolar armatures with two or more layers of induc- tors, "surface" or "ftaj-j-eZ" winding is now extensively used, in which no

~~separate end-connectors are employed ; at each end the inductors project beyond the core and are bent through an angle corresponding nearly to half the pitch of the poles, the upper layer being bent in the opposite direction to the lower ; the ends of the two layers are then soldered together to form loops lying entirely on the surface of the cylindrical armature.~~

~~Since any inductor must have a certain width "in the direction of rotation, one edge enters or leaves the field sooner than the other edge. Hence when a solid bar is moving through the fringe of lines between the pole-tips, where the density varies considerably, the E.M.F. set up along the one edge is different from that set up along the other, and an eddy -current will flow round the bar, passing down one side and up the other, due to the difference between the E.M.F.'s of the two edges. Thus in a rotating armature an eddy-current will be set up in each and every solid bar as it passes between the pole-tips. To prevent the reduction in efficiency that results therefrom, and the consequent heating of the bar, it is necessary to make use of a stranded bar in which the separate strands, lightly insulated from each other, are twisted so that they pass from one side to the other, at least once midway along the length of the bar. The E.M.F. induced in each strand is then practically the same, since it is the average of the E.M.F.'s of the two sides, and the eddy-current loss is very largely avoided.~~

~~In every dynamo with rotating armature the driving force has to be transmitted from the shaft or coupling to the hub, thence to the discs, and finally to the inductors. The discs must therefore be securely keyed to the hub, and in the Driving~~

~~the inductors.~~

~~smooth-surface armature any slip between the core and the inductors is opposed by the friction between the two. The bands of binding wire, which are placed at intervals along the length of the armature in order to resist the stress of cen- trifugal force, further increase the friction. In the wire-wound ring the loops themselves grip the core tightly, and are also held in place by passing through the interior of the ring between the arms of the hub. But in the smooth-core drum the firm attach- ment of the inductors to the core presents greater difficulties, and in order to ensure the positive driving of the bars through the magnetic field against the mechanical drag, it is usual~~

to groove a number of longitudinal slots in the periphery of the core at equal distances apart of some four inches, and to drive tightly into these hard-wood driving strips, which project from the core to a height equal to that of the inductors. TIius the inductors are split up into groups, and the combined drag due to a group is taken up by a corresponding strip. A still more perfect method of driving is found in the toothed or slotted core. This was the original type of armature invented by Pacinotti, but after some considerable use it was largely discarded in favour of the smooth core ; of recent years, however, it has again been reintro- duced, with a fuller understanding of the special precautions

required in its design, and it has met with great success in the construction of traction dynamos, in which the stresses set up by the varying load are very great. Not only are the bars securely driven by the teeth, but, as previously mentioned, they are largely relieved of the driving stress. A further advantage is due to the fact that the lines snap across the inductors from tooth to tooth with a velocity far in excess of the speed of rotation. The product of the weaker density in the slots and the increased velocity of the relative movement gives the same E.M.F. as in the equivalent smooth-core armature, but owing to the comparatively uniform density of the lines within any one slot, and tlje extremely rapid rate at which they cut the inductors, solid bats of much greater width may be used in the toothed armature than on a smooth core without trouble from eddy-currents.i One disadvantage of the slotted core remains to be mentioned. If the top of the slot be open, and its width of opening be considerably greater than the length of the single air-gap from the iron of the pole-piece to the surface of the core, the lines become unequally distributed not only at the surface of the teeth, but also at the bored face of the pole-pieces ; and this massing of the lines into bands causes the density at the pole-face to be rhythmically varied as the teeth pass under it. No such variation can take place in a solid mass of metal without the production of eddy-currents within it ; hence if the proportion ^ of the width of slpt/opening to the length of air-gap is equal to or exceeds 2:1, it becomes advisable to laminate the pole-pieces to avoid eddy-currents

~~in them. This precaution is less necessary with half-closed slots, and is entirely unnecessary with tunnel armatures, in which the inductors are threaded through holes pierced close to the surface of the core ; but we are then met with the difficulty that such closed, or nearly closed, slots greatly increase the inductance of the loops, and are therefore disadvan- tageous to the commutation and sparkless collection of the current.~~

~~On passing to the second fundamental part of the dynamo, namely, the field-magnet, its functions may be briefly recalled as follows : — It has to supply the magnetic flux ; to provide for it an iron path as nearly closed as possible upon the armature, save for the air-gaps which must exist between the pole-system and the armature corq, the one stationary and the other rotating ; and, lastly, it has to give the lines such direbtion and intensity within the air-gaps that they may be cut by the armature in- ductors to the best advantage. Roughly corresponding to the three functions above summarized are the «"/]?'* "' three portions which are more or less differen- mag'net tiated in the complete structure. These are : (1) the magnet " cores " or " limbs," carrying the exciting coils whereby the inert iron is converted into an electro-magnet; (2) the yoke, which joins the limbs together and conducts the flux between them ; and (3) the pole-pieces, which face the armature and transmit the lines from the limbs through the air-gap to, the armature core, or vice-versd.~~

~~Of the countless shapes which the field-magnet may take, it may be said, without much exaggeration, that almost all have been tried; yet those which have proved economical and successful, and hence have met with gen- eral adoption, may be classed under a compar- atively small number of types. For bipolar machines the single horse-shoe (Fig. 20) , which is the lineal successor of the permanent magnet employed in the first magneto-electric machines, has been very largely used, and for all outputs up to 150 kilowatts remains one of the simplest, most economical, and most compact types. It takes two principal forms, according as the pole-pieces and armature are above or beneath the magnet limbs and yoke. Tlie " over-type " form is best suited to small belt-driven dynamos, while the "under-type" is admirably adapted to be directly driven by the steam engine, the armature shaft being immediately coupled to the crank-shaft of the engine, and the axis of rotation being thus kept low. In the latter case the magnet~~

must be mounted on non-magnetic supports of gun-metal or zinc, so as to hold it at some distance away from the iron bed-plate which carries both engine and dynamo ; otherwise a large propor- tion of the flux which passes through the magnet limbs would leak

1 Elihu Thomson, JElec. Eng. vol. iil. p. 499.

2 Cp. Esson, Elec. Review, vol. xvii., 188S, and Journ. Inst. Elec. Eng. vol. xxvi. p. 596 ; Sayers, Journ. Inst. Elec. Eng. vol. xxii. p. 393.

Fig. 21.

through the bed-plate across from pole to pole without passing through the armature core, and so would not be cut by the armature inductors. The field-system is thus — to use a somewhat inaccurate expression — "magnetically insulated" from the bed-plate, the in- tervening distance being some eight to ten tiroes the length of the single air-gap.

Ns?;t may be placed the "Manchester " field (Fig. 21) — the type of a divided magnetic circuit in which the flux forming one field or pole is divided between two magnets. An exciting coil is placed on each half of the double horse-shoe magnet, the pair being so wound that conse- quent poles are formed above and be'low the armature. Each magnet thus carries one-half of the total flux, the lines of the two halves uniting to form a common field where they issue forth into or leave th6 air-gaps. Or the coils may be divided and placed on the limbs of each horse-shoe, as in Fig. 22, instead of on the yoke, as in Fig. 21. The pole-pieces in both cases ma- be lighter than in the single horse-shoe type, and the field is much more symmetrical, whence it is well suited to ring armatures of large diameter. Yet these advantages are greatly discounted by the excessive magnetic leakage, and by the increased weight of copper in the exciting coils. Even if the greater per- centage which the leakage lines bear to the useful flux is neglected, and the cross sectional area of each mag- net core is but half that of the equivalent single horse- shoe, the weight of wire in the double magnet for the same rise of temperature in the coils must be some 40 per cent, more than in the single horse-shoe, and the rate at which energy is expended in heating the coils will exceed that of the single horse-shoe in the same proportion.

A somewhat similar form of two-pole fleld is required by the discoidal machine, but the poles now face the sides of the flat-ring armature (cp. Fig. 13 ii.) ; opposite poles of similar sign may be joined together by an overarching pole-piece, but owing to the

Fig.

rig. 23a.

Fig. 2Sb.

difficulty of avoiding eddy-currents in the core it is more usual for the magnetic circuits to be entirely divided.

Fourthly comes the two-pole ironclad type, so called from the exciting coil being more or less encased by the iron yoke ; th4s latter is divided into two halves, which pass on either side of the armature. Unless the yoke be kept well away from the polar edges and armature, the leakage across the air into the yoke becomes considerable, especially if only one exciting coil is used, as in Fig. 23a ; it is better, therefore, to divide the excitation Ijetween two coils, as in Fig. 23b, when the field also becomes symmetrical.

From this form is easily derived the multipolar type ^ of Fig. 24, which is by far the most usual for any number of poles from four upwards ; its leakage co- efficient is but small, and it is economical in weight both of iron and copper. The multipolar discoidal mag- net takes the shape shown in the four-pole machine of Fig. 25, with which may be compared Fig. 13 ii. Another four-pole type (Fig. 26) ■ may also be derived from Fig. 23b, if we suppose the

8 For the advantages of multipolar machines, vide Esson, " Notes on the Design of Multipolar Dynamos," Journ. Inst. Elec. Eng. vol. xx. p. 265.

Fig. 24.

yoke on either side of the armature to be pushed inwards until it nearly meets the armature on a horizontal diameter, and the direction of winding of one coft to be changed. Two salient poles and two consequent poles are thus obtained, and the machine is like that of Fig. 24, but with only two poles wound. The leakage across from pole to pole is great in a four-pole magnet of this type.

^&y

Fig. 25.

Fig. 26.

but in alternators where a large number of poles are required it may be convenient to wind only half their number, owing to their close proximity to one another. The multipolar equivalent of Fig. 21 is shown in Fig. 27, and again the weight of copper on the divided magnetic circuits must be greater than in the preced- ing multipolar magnets. Fig. 28, which is best suited to four

Fig. 27.

Fig. 28.

poles, may be obtained from Fig. 22 by dividing the pole-pieces and reversing the direction of winding on one side. The two single horse-shoe magnets thus formed have the peculiarity that half of the flux passing from one pole returns at once through the armature core to the opposite pole of the same magnet, while half passes onwards to a pole of the second magnet. Lastly, the multi- polar magnet of Fig. 29, in which there is only one magnetizing coil enclosed between overarching claws form- ing the poles, those of one sign projecting into the gaps between the others of opposite sign, is economical in the weight of copper in its single coil, but the leakage between the sides of adjacent poles is considerable.

As regards the materials of which magnets are made, generally speaking there is little (J difference in the permeability of wrought- iron or mild-steel forgings and good Materials cast-steel ; typical (B,H) curves ot magnets,

connecting the magnetizing force required with different flux-densities for these materials are given under Elec- TKOMAGNET. Ou the Other hand, there is a marked infer'iority in the case of cast-iron.

Fig. 29.

which for a flux-density of B=8000 requires practically the same number of ampere-turns per centimetre length as steel requires for B=16,000. "Whatever the material, if the flux-density be pressed to a high value the ampere- turns are very 'largely increased owing to its approaching saturation, and this implies either a large amount of copper in the field coils or an undue expenditure of electrical energy in their excitation. HIence there is a limit imposed by practical considerations to the density at which the magnet should be worked, and this limit may be placed at about ,B=16,000 for wrought-iron or steel, and at half this value for cast-iron. For a given flux, therefore, the cast-iron magnet must have twice the sectional area and be twice as heavy, although this disadvantage is partly compensated by its greater cheapness. If, however, cast- iron be used for the portion of the magnetic circuit which is covered with the exciting coils, the further disadvantage must be added that the weight of copper on the field-magnet is much increased, so that it is usual to employ forgings or cast-steel for the magnet cores on which the coils are wound. If weight is not a disadvantage, a cast-iron yoke may be combined with the wrought-iron or cast- steel" magnet cores. An absence of joints in the magnetic circuit is only desirable from the point of view of economy of expepse in machining the component parts during manufacture ; when the. surfaces which abut against each other are drawn firmly together

by screws, the want of homogeneity at the joint, which virtually amounts to the presence of a very thin film of air, produces little or no effect on the total reluctance by comparison with the very much longer air-gaps surrounding the armature. In order to re- duce the eddy-currents in the pole-pieces, due to the use of toothed armatures with relatively wide slots, the pole -pieces must be laminated in the same direction as the armature core is laminated ; the poles are then built up of thin sheets of charcoal iron or mild steel, and these are sometimes fixed by casting them into the outer yoke-ring.

However it be built up, the mechanical strength of the magnet system must be carefully considered. Any two surfaces between which there exists a field of density B, experience a force tending to draw them together proportional to the square of the density,

B ^ and having a value of -i 7qc ^ ins ^ P®"^ square inch of surface,

over which the density may be regarded as having the uniform value Bj. Hence, quite apart from the torque with which the stationary part of the dynamo tends to turn with the rotating part as soon as current is taken out of the armature, there exists a force tending to make the pole-pieces close on the armature as soon as the field is excited. Since both armature and magnet must be capable of resisting this force, they require to be rigidly held ; although the one or the other must be capable of rotation, there should otherwise be no possibility of one part of the magnetic circuit shifting relatively to any other part. An important con- clusion may be drawn from this circumstance. If the armature be placed exactly concentric within the bore of the poles, and the two or more magnetic fields be symmetrical about a line joining their centres, there is no tendency for the arma- ture core to be drawn in one direction more than in another ; but if there is any difference between the densities of the several fields, it will cause an unbalanced stress on the armature and its shaft, under which it will bend, and as this bending is con- tinually reversed relatively to the fibres of the shaft, they will eventually become weakened and give way. Especially is this likely to take place in dynamos with short air-gaps, wherein any difference in the lengths of the air-gaps produces a much greater percentage difference in the flux-density than in dynamos with long air-gaps. In toothed armatures with short air-gaps the shaft must on this account be of great stiffness ; even when the shaft is suf&ciently strong to withstand the stress without appreciable bend- ing, any unbalanced pull on the armature as a whole should be avoided, since it may produce greater friction in the bearings and cause them to develop an undue amount of heat.

Reference has already been made to the importance in dynamo design of the predetermination of the flux due to a given number of ampere-turns wound on the field-magnet, or, conversely, of the number of ™ ampere-turns which must be furnished by the Ttnuit " •exciting coils in order that a*

certain flux corre- sponding to one field may flow through the armature core from each pole. An equally important problem is the correct proportioning of the field-magnet, so that the use- ful flux Za may be obtained with the greatest economy in materials and exciting energy. The key to the two problems is to be found in the concept of a magnetic circuit as originated by Eowland and Bosanquet ; ^ and the full solution of both may be especially connected with the name of the late Dr J. Hopkinson, from his practical application of the concept in his design of the Edison-Hopkinson machine, and in his paper on " Dynamo- Electric Machinery." ' The publication of this paper ,in 1886 begins the second era in the history of the dynamo ; it at once raised its design from the' level of empirical rules-of thumb to a science, and is thus worthy to be ranked as the necessary supplement of the original dis coveries of Faraday. The process of predetermining the necessary ampere-turns is described in a simple case under Electeomagnbt. In its extension to the complete dynamo, it consists merely in the division of the magnetic

1 And extended by Kapp, "On Modern Continuous — Current Dynamo-Electric Machines," Proc. Inst. C.E. vol. Ixxxiii. p. 136.

2Drs J. and E. Hopkinson, "Dynamo-Electric Machinery," Phil. Trans., May 6, 1886; this was further expanded in a second paper on "Dynamo-Electric Machinery," Proc. Roy. Soc, Feb. 15, 1892, and both are reprinted in Original Papers on Dynamo-Machinery and Allied Subjects.

circuit into such portions as have the same sectional area and permeability and carry approximately the same total flux ; the difference of magnetic potential that must exist between the ends of each section of the magnet in order that the flux may pass through it, is then calculated seriatim for the several portions into which the magnetic circuit is divided, and the separate items are summed up' into one magnetomotive force that must be furnished<*by the exciting coils.

The cliief sections of the magnetic circuit are (1) the air-gaps, (2) the armature core, and (3) tiie iron magnet.

The air-gap of a dynamo is partly filled with copper and partly ■with the cotton, mica, or other materials used to insulate the core and inductors ; all these substances are, however, sensibly non- magnetic, so that the whole interferrio gap between the iron of the pole-pieces and the iron of the armature may be treated as an air- space, of which the permeability is constant for all values of the flux-density, and in the C.G.S. system is unity. Hence in the simple bipolar machine with single horse-shoe magnet, if Ig and Ag be the length and area of the single air-gap in cm. and sq[.cm.,

the reluctance of the double air-gap is t-^i and the difference of

- ^ magnetic potential required to pass Zg lines over this reluctance is

Zg . j^=Bg.2lg; or, 'siucB one ampere-turn gives 1'2.57 C.G.S.

" . ...

units of magnetomotive force, the exciting power m ampere-turns

B 21 required over the two air-gap is Xg= ^',J=0'8 Bg. ilg. In

the determination of the area A.g a. small allowance must be made for the fringe of lines which extend beyond the actual polar face ; and in the ring machine, as already mentioned, Zg is a few per cent, more than Za, owing to the leakage across the interior of the core.

In the armature core the length of path continually shortens as we pass from the middle of the pole towards the centre line of symmetry. On the other hand, as the lines gradually accumulate in the core, their density increases from zero midway under the poles until it reaches a maximum on the line of symmetry. The two effects partially counteract cftie another, and tend to equalize the difference of magnetic potential required over the paths of varying lengths ; but since the reluctivity of the iron increases more rapidly than the density of the lines, we may ap- proximately take for the length of path (la) the minimum peri- pheral distance between the edges of adjacent

polo-faces, and then assume the maximum value of the density of the lines as holding throughout this entire path. In ring and drum machines the flux issuing from one pole divides into two halves in the armature core, so that the maximum density of lines in the armature is

Z

Bii=— %, where a = the radial depth of the discs in centimetres tab

and J=the net length of iron core parallel to the axis of rotation. A distinction must be made between the gross length of the core and the net length of iron, owing to the waste of space through the insulating varnish or paper between the discs, and the presence of ventilating air-ducts, which are sometimes introduced at inter- vals along the length of the core, especially in multipolar arma- tures of large diameter. The former deduction may be said to average about 7 to 10 per cent, of the gross length. Reference has now to be made to a (B H) or flux-density curve, from which may be found the number of ampere-tm-ns required per centimetre length of path. This may be expressed as a function of the assumed density Bo. and the total exciting power required between the pole-pieces is therefore, at no load, Xp^'Kg + 'S.a, where X(,= f(Ba) .la', in order, however, to allow for the effect of the armature current, which increases with the load, a further term Xs must be added.

In the continuous-current dynamo it may be, and usually is, necessary to move the brushes forward from the interpolar line of symmetry tlu'ough a small angle in tlie direction of rotation, in order to avoid spiirking between the brushes and the commutator (vide infra). "When the dynamo is giving current, the inductors on either side of theiiiameter of commutation form a current-sheet flowing along the surface of the armature fi-om end to end, and whatever the actual end-connexions of the wires, the inductors may be imagined to be joined together into a system such that the two sides of each loop are carrying current in opposite directions. Thus a, number of ai-mature ampere-turns are formed, and their effect on the entire system of magnet and armature must be taken into account. So long as the diameter of commutation coincides with the line of symmetry, the armature may be regarded as a cylindrical electromagnet producing a flux of lines, as shown

in Fig. 30. The direction of the sflf-induced flux in the air-gaps is the same as that of the lines of the external field in one

quadrant on one side of DC, but opposed to it in the other quadrant on the same side of DCj.l^noe in the resultant field due to the combined action of the field-magnet and armature ampere-turnsjhe flux is as much strengthened over the one half of each polar face as it is weak- ened over the other, and the total number of lines is un- affected, although their distri- bution is altered. The armature ampere-turns are then called cross — turns, since they pro- duce a cross-field, which, when combined with the symmetrical field, causes the leading pole-corners II to be weakened and the trailing pole-corners tt to be strengthened, the neutral line of zero field being thus twisted forwards in the direction of rotation. But when the brushes and diameter of commutation are shifted for- ward, as shown in Fig. 31, it will be seen that a number of ampere-turns, forming a zone between the lines Un and mC, are in effect wound im- mediately on the magnetic circuit proper, and this belt of ampere-tums is in direct opposition to the ampere- turns of the field, as shown by the dotted and crossed wii-es on the pole-pieces. The

Fig. 31.

armature ampere-turns are then divisible into the two bands, the back-turns, included within twice the angle of h-ad X, weakening the field, and the cross-turns, bounded by the lines Dm, nC, again producing distortion of the weakened sym- metrical field. If, therefore, a certain flux is to be passed through the armature core in opposition to the demagnetizing turns, the difference of magnetic potential between the pole-faces must include not only Xa and Xg, but also an item X;,, in order to balance the "back" ampere-turns of the armature. The amount by which the brushes must be shifted forward increases with the armature current, and in corresponding proportion the back ampere-turns are

2\ also increased, their value being c.t. -^^ci where c=the current

earned by each of the t inductors. Thus the term Xj takes into account the effect of the armature reaction on the total flux ; it varies as the armature current and angle of lead required Jo avoid sparking are increased ; and

the reason for its introduction in the third place (Xp=Xg-i-Xa-i-Xt), is that it increases the magnetic difference of potential which must exist between the poles of the dynamo, and to which the greater part of the leakage is due. The leakage paths which arc in parallel with the armature across the poles must now be estimated, and so a new value be derived for the flux at the commencement of the iron-magTiet path. If P = their joint permeance, the leakage flux due to the difference of potential at the poles is 2, = 1 '257 Xp x P, and this must be added to the useful flux Zg, or Zji = Zg--z,. There are also certain leakage paths in parallel with the magnet cores, and upon the permeance of these a varying number of ampere-turns is acting as we proceed along the magnet coil^ ; the magnet flux therefore increases by the ad- dition of leakage along the length of the limb.s, and finally reaches a maximum near the yoke. Either, then, the density in the magnet

7 ^

Bm= r^ will vary if the same sectional area be retained throughout,

Am

or the sectional area of the magnet must itself be progi'essively increased. In general, suflicient accuracy will be obtained by assuming a certain number of additional leakage lines z„ as travers- ing the entire length of magnet limbs and yoke (=lm), so that the

density in the magnet has the uniform value Bm=

Zp+z„.

The

leakage flux added on actually within ttie length of the magnet core or z„ will be approximately equal to naif the total M.M.F. of the coils multiplied by the permeance of the leakage paths around one coil. The corresponding value of H can then be obtained from the (B H) curve of the material of which the magnet is com- posed, and the ampere-turns thus determined mast be added to Xp, or X = Xp-fXm, where Xm=f (Bm) . Im- The final

equation for the exciting power required on the magnetic circuit as a whole will therefore take the foi-m

X=AT = 0-8B^. 2^, /del>/(B„) . la + X + f(Bm). Im

(III.)

Since no substance is impermeable to the passage of magnetic flux, the only form of magnetic circuit free from leakage is one uniformly wound with ampere-turns-over its whole length. The reduction of the magnetic leakage to a minimum in any given tyj>e is there- fore primarily a question of distributing the winding as far as

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Fig. 82.

possible uniformly upon the circuit, and as the winding must be more or leas concentrated into coils, it resolves itself into the Maeaetlc "^"^ssity of introducing as long air-paths as possible be- leakage. t^een any surfaces which are at different magnetic potentials. No iron should be brought near the machine which does not form part of the magnetic circuit proper, and especially no iron should be brought near the poles, between which the difference of magnetic potential practically teaches its maxi- mum value. In default of a machine of the same size or similar type on which to experiment, the probable direction of the leakage flux must be assumed from the drawing, and the air surrounding the machine must be mapped out into areas, between which the permeances are calculated as closely as possible by means of such approximate formulas as those devised by Professor Forbes.i

In the earliest "magneto-electric" machines permanent steel magnets, either simple or compound, were employed,

and for many years these were retained in certain ^fti"u'°" s-lt^rnators, some of which are still in use for arc magaet lighting in lighthouses. But

since the field

they furnish is very weak, a great advance was made when they were re-placed by soft-iron electro- magnets, which could be made to yield a much more intense flux. As early as 1831 Faraday" experimented with electro-magnets, and after 1860 they gradually superseded the permanent magnet. When the total ampere- turns required to excite the electromagnet have been determined, it re-^ mains to decide how the' excitation shall be obtained ; and, according to the method adopted, continuous-current machines may be divided into four well-defined classes.

)

The simplest method, and that which was first used, is separate excitation from some other source of direct current, which may be either a primary or a secondary battery or another dynamo (Fig. 32). But since the armature yields a continuous current, it was early suggested (by Brett in 1848 and Sinsteden in 1851) that this current might be utilized to increase the flux ; combinations of permanent and electromagnets were therefore next employed, acting either on the main armature or on separate armatures, until in 1867 Dr Werner von Siemens and Sir C. Wheatstone almost simul-taneously discovered that the dynamo could be made self-exciting through the residual magnetism retained in the soft-iron cores of the electromagnet.^ The former proposed to take the whole of the current round the magnet coils which were in series with the armature and external circuit, while the latter proposed to utilize only a portion derived by a shunt from the main circuit ; we thus arrive at the second and third classes, namely, series and shunt machines. The starting of the process of excitation in either case is the same ; when the brushes are touching the commutator and the armature is rotated, the small amount of flux left in the

1 Soc. Tel. Eng. vol. xv. p. 555, 1886. Cp. also Ives, "Magnetic Leakage in Dynamos and Motors," Elec. Rev., Jan. 22 and 29, 1892, and Puffer, Elec. Rev., April 15, 1892.

^iSxp. iJes., seriesi. § 4, par. 111. In 1845 Wheatstone and Cooke patented the use of " voltaic " magnets in place of permanent magnets (No. 10,655).
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8 In Pat. No. 3006, 1863, Wilde described the use of a small magneto-machine as exciter of a large dynamo with electromagnets ; cp. also his paper read before t)ie iBoyal Society, April 1866. In 1866 C. and S. A. Varley provisionally protected a machine having electromagnets onlyv excited initially by the application of a direct current for a short time (No. 3394, 1866) ; this appeared again in the complete Patent No. 1755, 1867 ; but meantime the same device had been patented by Sir C. W. Siemens, Jan. 31, 1867, No. 261. Dr Werner von Siemens's paper was submitted to ' the Berlin Academy of Sciences, Jan. 1867 {Fogg. Ann., Feb. 1867), and his results were communicated to the Royal Society in London by Sir William Siemens in a paper " On the Conversion of Dynamical into Electrical Force without the Aid of Permanent Magietism," which was read on Feb. 14, 1867. On the same day Sir C. Wheatstone's paper "On the Augmentation of the Power of a Magnet by the Reaction thereon of Currents induced by the Magnet itself" was read before the Royal Society.

magnet is cut by the inductors, and a very small current begins to flow round the closed circuit ; this increases the flux, which in turn further increases the E.M.F. and current, until, finally, the cumulative effect stops through the increasing saturation of the iron cores. Pig. 33, illustrating the series machine, shows the winding of the exciting coils to be composed of a few turns of thick wire. Since the current is undivided throughout the whole circuit, the resistance of both the armature and field-magnet winding must be low as compared with that of the external circuit, if the useful power available at the terminals of the machine is to form a large percentage of the total electrical power — in other words, if the efficiency is to be high. Fig. 34 shows the third

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Fig. 33.

Fig. 84.

~~method, in which the winding of the field-magnets is a shunt or fine-wire circuit of many turns applied to the terminals of the machine; in this case the resistance of the shunt must be high * as compared with that of the external circuit, in>, order that only a small proportion of the total energy may be absorbed in the field.~~

~~Since the whole of the armature current passes round the field- magnet of the series machine, any alteration in the resistance of the external circuit will affect the excitation and also the voltage. A curve connecting together corresponding values of external current and terminal voltage for a given speed of rotation is known as the external-characteristic of the machine ; in its main features it has the same appearance as a curve of magnetic fiux, but when the current exceeds a certain amount, it begins to bend downwards and the voltage decreases. The reason for this will be found in the armature reaction at large loads, which gradually produces a more and more powerful demagnetizing effect, as the brushes are shifted foiTwards to avoid sparking ; eventually the back ampere- turns overpower any addition to the field that would otherwise be due to the increased current fiowing round the magnet. The "external characteristic" for a shunt machine has an entirely different shape. The field-magnet circuit being connected in parallel with the external circuit, the exciting current, it the applied voltage remains the same, is in no way affected by altera- tions in the resistance of the latter. As, however, an increase in the external current causes a greater loss of volts in the armature and a greater armature reaction, the ter- minal voltage, which is also the ex- citing voltage, is highest at no load and then diminishes. The fall Is at first gradual, but after a certain critical value of the armature cur- rent is reached, the machine is rapidly demagnetized and loses its voltage entirely.~~

~~The last method pf excitation, namely, compound-winding (Fig. ~35), is a combination of the two pre- ceding, and was first used by S. A. Varley 5 and by Brush. If a machine is in the first instance shunt-wound, and a certain number of serie5.-turns~~

~~are added, the latter, since they carry the external current, can be made to counteract the effect which the increased external current would have in lowering the voltage of the simple shunt machine. The ampere-turns of the~~

series winding must be such that they not only balance the increase of the demagnetizing back ampere-turns on

Fig. 85.

4 Sir William Siemens, Phil. Trans., part ill., 1880, " On the Dynamo-Electric Current, and on Certain Means to Improve its Steadi- ness," and Brit. Pat., No. 4534, 1879.

6 In Brit. Pat., No. 4905, 1876, he describes a machine with its field-magnet wound with two coils of different resistance ; and Brush (Brit. Pat., No. 2003, 1878) employed a shunt circuit to maintain the ma^etism of a series-wound machine. But the fuU advantages of compound-winding were not realized until the patent of Crompton and Kapp (No. 4810, 1882).

the armature, but further increase the useful flux, and compensate for the loss of volts over their own resistance and that of the arma- ture. The machine will then give for a constant speed a nearly constant voltage at its teiminals, and the curve of the external characteristic becomes a straight line for all loads within its capacity. Since with most prime movers an increase of the load is accompanied by a drop in speed, this eifect may also be counter- acted ; while, lastly, if the series-turns are still further increased, the voltage may be made to rise with an increasing load, and the machine is "over-compounded."

The question of the commutation ' of the current in a section of the armature winding during the time when it is short-circuited * '^y ^^^ brush resting simultaneously on both the trail- Comwuta- ^^^ ^^^ leading sectors, turns primarily on the varying tionaaa contact-resistance between the brush tip and the oom- sparKiag. j^^g^^^. gegtors.'^ If the brushes are of the same width as the sectors, and T = the total time of the short-circuit depend- ing on the speed of rotation, the area of contact between the brush and the leading sector at any time t (reckoned from the commence-

T -t ment of short-circuit) is ot -7p— , while that between the brush

and the trailing sector is ocTp; hence as the brush slides over

from the leading to the trailing sector (Fig. 36), the contact-resist- ance of the leading sector gradually increases from E, to oo , and

at any time t within the period of short-circuit is E/‘s^— ;. while

the contact-resistance of the trailing sector gradually diminishes

T from 00 to E„ and at any time is R,— . If Cj and c^ be the in- stantaneous values of the current in the leading and trailing sectors

CiT respectively, the current densities s^ and Sj are —

T-i

and

t

If R=the resistance of the coU and its commutator con-

nexions, and/ (≤) be the E.M.F. induced in the coil by its rotation through the external field, either positive or negative according as it is moving on the trailing or leading side of the neutral line of zero field, the direction of the old current in the coil being reckoned as positive, the complete ecjuation to the short circuit is by Kirchhoffs laws — ■

-L^-h/(0-E<;-

\T~r t)

ET = 0.

Fig. 36.

Now when there is no induced E.M.F., or /{t) = 0 — in other words, if the short-circuited section is moving in zero field — the current persists in the section by reason of its inductance; and does not fall in propor- tion to the amount by which the brush passes over on to the trailing sector ; hence the current density of Cj in the leading sector is greater than the density of c^ in the trailing sector. There is thus a difference in the two values in the bracket, and Sj being greater than %, there is a greater fall of potential between sector 1 and the brush than between sector 2 and the rest of the brush. Further, Cj is negative, and the brush tip being necessarily throughout at the same potential, there re- sults a potential difference acting round the circuit in the direc- tion 1 — coU — 2, i. e. , against the positive decaying current of the^ coil, and assisting the current which is growing up in the trailing sector. Some part, therefore, of the self-induced E.M.F. is spent in overcoming this negative E.M.F. until equality is reached, and then the current becomes negative simply in virtue of the E.M.F. set up by the unequal current densities. If the equation as above expressed holds good unconditionally, and no secondary effects come into play, it will be found that the current in the short-circuited coil will be reversed to the exact value that is required in the new direction, or be automatically commuted at the end of the period of short-circuit by the mere action of the brush-contact resistance ; and further, that this wiU be the case wherever the brush be placed, and whatever the direction

‘ Cp. Swinburne, “The Theory of Armature Reactions in Dynamos and Motors,” and Esson, “Some Points in Dynamo and Motor Design,” Joum. Inst. Elec. Ung. vol. xix., Feb. 13, 1890 ; Esson,^’ Notes on the Design of Multipolar Dynamos,” Joum. Inst. Elec. Eng. vol. xx. p. 265 ; J. Fischer-Hionen, E.T.Z., No. 5, 1893, p. 53 ; Sayers, Joum. Inst. Elec. En

^ Honsman, Joum. Inst. Elec. Eng. vol. xxii. p. 399 • Thorbum Eeid, Ainerican Iinsi. E.E., Dec. 15, 1897, voL xv. p. 33.

of the field in which the short-circuited coil is moving. If, however, it be moving in the old field, or f{t) is positive, the current-density under the leading brush edge will be enormously great, in order to counterbalance both the E.M.F. of self-induction and that impressed by the field. There is, however, an important secondary effect, which comes into play when the

current-density becomes very high, and which causes sparking at the brushes when the position of the brushes is not correctly adjusted. When a circuit is broken by an ordinary switch, the area of contact is diminished more or less rapidly, and when the current-density over the decreasing contact-surface rises beyond a certain limit, the local development of heat is so great that some portion of the metal forming the contact becomes incandescent and eventually is volatilized, and an arc results. In exactly the same way, under a very high current-density, the trailing edige of the leading sector or the leading edge of the brush becomes fused so that as the brush tip leaves the leading sector the current still finds an outlet for a short time through the heated vapour, and a series of small arcs are started every time that a sector passes from under the brush.

Now, in the dynamo, if the brushes are kept fixed on the line of symmetry, and current be taken out of the armature, the dis- tribution of the field is so distorted by the action of Brushes the cross ampere-turns of the armature that the neutral line of zero field, where the lines just dip into the armature core and immediately leave it again, is displaced ahead of the line of symmetry. As the coil is now moving in the trail- ing field, the E.M.F. set up by it is in the old direction and tends to keep up the old current, hence the excessive current- density is magnified, and the more so as the current is increased. The higher the brush contact-resiiftance, however, the less the abnormal density, and the less the difficulty of commutation. One remedy, then, is to employ a brush of high contact-resistance, and for this purpose the only suitable material that has been dis- covered is carbon moiflded into hard blocks. Even if some little sparking doe^ take place with carbon brushes, the damage done thereby to the commutator surface is very much less than would be the case with metal brushes. The only objection to their use is that in virtue of their high resistance they necessarily increase the normal loss (jf volts between the armature winding and the external terminals. If brushes of copper wire or gauze are used, it is not possible to maintain them on the line of symmetry, when the current reaches any great amount, without excessive sparking, and the only remedy is to shift the brushes forward in the direc- tion of rotation through an angle of lead, which increases roughly as the armature cuiTent is increased. By the shifting of the brushes the armature ampere-turns become divisible into the two groups of back- and cross-turns, as shown in Fig. 31. The latter are

progressively reduced, so that though the total flux may not be so large as at no load, the distortion becomes less ; and if the shift- ing is carried far enough, the diameter of commutation eventually overtakes the neutral line, and finally the short-circuited coil is moving in a reversing field, or f(f) is negative. The reversing E.M.F. then rapidly causes the old current to decay, starts a reversed current, and if the adjustment is correct, the strength to which the new current is raised at the end of short-circuit is pre- cisely that of the armature current in the portion of the winding which it is to join, so that on opening the short-circuit there is no sparking.

From the moment that a dynamo begins to run with excited field, heat is continuously generated by the passage of the current through the windings of the field-magnet coils and „ the armature, as weU as by the action of hysteresis "f^"Og and eddy-currents in the armature and pole-pieces. * **^ ** Whether the source of the heat be in the field-magnet or in the armature, the mass in which it originates will continue to rise in temperature until such a difference of temperature is established between itself and the surrounding air that the rate at which the heat is carried off by radiation, convection, and con- duction is equal to the rate at which it is being generated. Evidently, then, the temperature which any part of the machine attains after a prolonged run mu.st depend on the extent and effectiveness of the cooling surface from which radiation takes place, upon the presence or absence of any currents of air set up by the rotation of itself or surrounding parts, and upon the pre- sence of neighbouring masses of metal to carry away the heat by conduction. In the field-magnet coils the rate at which heat is being generated is easily determined, since it is equal to the square of the current passing through them multiplied by their resistance. Further," the magnet is usually stationary, and only indirectly affected by draughts of air due to the rotating armature. Hence for machines of a given type and of similar proportions, it is not difficult to decide upon some method of reckoning the cool- ing surface of the magnet coils Sc, such that the rise of tempera- ture above that of the surrounding air may be predicted from an i.W

equation of the form <° = –

where W = the rate in watts at

■which heat is generated in the coils, and h is some constant depending upon the exact method of reckoning their cooling surface. As a general rule the cooling surface of a field-coil is reckoned as equal to the exposed outer surface of its wire, the influence of the 'end flanges being neglected, or only taken into account in the case of very short bobbins wound with a considerable depth of wire. In the case of the rotating armature a similar formula must be constructed, but with the addition of a factor to allow for the increase in the effectiveness of any given cooling surface due to the rotation causing convection currents in the surrounding air. Only experiment can determine the exact effect of this, and even with a given type of armature it is dependent on the number of poles, each of which helps to break up the air- currents, and so to dissipate the heat. For example, in two-pole machines with drum bar-armatures, if the cooling surface be reckoned as equal to the cylindrical exterior plus the area of the two ends, the heating coefficient for a peripheral speed of 1500 feet per minute is less than half o^ that for the same armature when at rest. A further difficulty still meets the designer in the correct predetermination of the total loss of watts in an armature before the machine has been tested. It is made up of three separate items, namely, the copper loss in the armature winding, the loss by hysteresis in the iron, and the loss by eddy-currents, which again may be divided into tliose in the armature bars and end-connexions, and those in the core and its end-plates. The two latter items are both dependent upon the speed of the machine; but whereas the hysteresis loss is proportional to the speed for a given density of flijx in the armature, the eddy-current loss is proportional to the square of the speed, and owing to this difference, the one loss can be separated from the other by testing an armature at varying speeds. Thus for a given rise of temperature, the question of the amount of current which can be taken out of an armature at different speeds depends upon the proportion which the hysteresis and eddy watts bear to the copper loss, and the ratio in which the effectiveness of the cooling surface is altered by the alteration in speed. Experimental data, again, can alone decide upon the amount of eddy -currents that may be expected in given armatures, and caution is required in applying the results of one machine to

another in which any of the conditions, such as the width of the inductors, the number of poles, or the extent of lamination of the core, are altered.

It remains to add, that the rise of temperature which may be permitted in any part of a dynamo after a prolonged run is very generally placed at about 70° Pahr. above the surrounding air. Such a limit in ordinary conditions of working leads to a final temperature of about 170° Fahr., beyond which the durability of the insulation of the wires is liable to be injuriously affected. Upon some such basis the output of a dynamo in continuous work- ing is rated, although for short periods of, say, two hours the normal full-load current of a large machine may be exceeded by some 25 per cent, without unduly heating the armature.

For the electro-deposition of metals or the electrolytic treatment of ores a continuous current is a necessity.; but, apart from such use, the purposes for which contiau- the continuous-current dynamo is well adapted ous-curreat are SO numerous that they cover nearly the dynamos, ^jiole field of electrical engineering, with one important exception. To meet these various uses, the pressures for which the machine is designed are of equally wide range ; for the transmission of power over long distances they may be as high as 3000 volts, and for electrolytic work as low as five. Each electrolytic bath, with its leads, requires on an average only some four or five volts, so that even when several are worked in series the voltage of the dynamo seldom exceeds 60. On the other hand, the current is large and may amount to as much as from 1000 to 14,000 amperes, necessitating the use of two commutators, one at either end of the armature, in order to collect the enormous current without excessive heating of the sectors and brushes. The field-magnets are invariably shunt-wound, in order to avoid reversal of the current through polarization at the electrodes of the bath. For incandescent lighting by glow lamps, the requirements of small isolated installations and of central stations for the distributidn of electrical energy over large areas must be distinguished. For the lighting of a private house or large factory, the dynamo giving from 5 to 100 kilowatts of output is commonly wound for a voltage of 100, and is driven by pulley and belt from a gas, oil, or steam

engine; or, if approaching the higher limit above men- tioned, it is often directly coupled to the crank-shaft of the steam engine. If used in

conjunction with an accumulator of secondary cells, it is shunt-wound, and must give the higher voltage necessary to charge the battery; otherwise it is compound-wound, in order to maintain the pressure on the lamps constant under all loads within its capacity. The compound-wound dynamo is likewise the most usual for the lighting of steamships, and is then directly coupled to its steam engine ; its output seldom exceeds 60 kilowatts, at a voltage ranging from 60 to 100. For central-station work, economy in the distributing mains dictates a higher voltage, especially in connexion with a three-wire system; the larger dynamos may then give 500 volts, and be connected directly across the two outer wires. A pair of smaller machines coupled together, and each capable of giving 260 volts, are often placed in series across the system, with their common junction connected to the middle wire ; the one which at any time is on the side carrying the smaller current will act as a motor and drive the other as a dynamo, so as to balance the system. The directly coupled steam dynamo may be said to have prac tically displaced the belt- or rope-driven sets which were formerly common in central stations. Though in Great Britain the bipolar machine has been generally retained for outputs up to 160 kilowatts, or even more, the tendency is towards the multipolar machine, which is largely used on the Continent and in the United States, even for com- paratively small outputs. The generating units of the central station are arranged in progressive sizes, rising from, it may be, 260 or 600 horse-power up to 750 or 1000, or in large towns to as much as 5000 horse-power. They are usually shunt-wound, the regulation of the voltage, to keep the pressure constant on the distributing system under the gradual changes of load, being effected by variable resistances in the shunt circuit of the field-magnets. ‘ ^

Generators used for supplying current to electric tram- ways are commonly wound for 600 volts at no load and are over-compounded, so that the voltage rises to 550 volts at the maximum load, and thus compensates for the loss of volts over the transmitting lines. Since the changes of load are very rapid, it would not be possible to shift copper gauze brushes so that they should always be at the exact position to avoid sparking ; hence carbon brushes are employed. For are lighting it was formerly usual to employ a class of dynamo which, from the nature of its construction, was called an ” open-coil ” machine, and which gave an unidirected but

pulsating current. Of such machines the Brush and Thomson-Houston types were very widely used; their E.M.F. ranged from 2000 to 3000 volts for working a large number of arcs in series, and by means of special regulators their current was main- tained constant over a wide range of voltage. But as their e£fi.ciency was low and they could not be applied to any other purpose, they have been largely superseded in central stations by closed-coil dynamos or alternators, which can also be used for incandescent lighting. In cases where the central station is situated at some distance from the district to which the electric energy is to be supplied, voltages from 1000 to 2000 are employed, and these are transformed down at certain distributing centres by con- tinuous-current transformers (see Teansfokmees and Electeicitt Supply). These latter machines are in reality motor-driven dynamos, and hence are also called "motor-generators" ; the armatures of the motor and dynamo are often wound on the same core, with a com- mutator at either end, the one to receive the high-pressure motor current, and the other to collect the low-pressure current furnished by the dynamo.

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In all large central stations it is necessary that the dynamos should be capable of being run in parallel, so that their outputs imay be combined on the same "omnibus bars," and thence dis- tributed to the network of feeders. With simple shunt-wound machines this is easily effected by coupling together terminals of like sign when the voltage of flie two or more machines are closely equal. With compound-wound dynamos not only must the external terminals of like sign be coupled together, but the junctions of the brush leads with the series winding must be con- nected by an " equalizing " lead of low resistance; otherwise, should the E.M.F. of one machine for any reason fall below the voltage of the omnibus bars, there is a danger of its polarity being reversed by a back current from the others with which it is in parallel.

~~Owing to the necessary presence in the continuous-current dynamo of the commutator, with its attendant liability to spark- ing at the brushes, and further, owing to the difficulty of insulating the rotating armature wires, a pressure of 3000 volts has seldom been exceeded in any one continuous-cufrent machine, and has been given above as the limiting voltage of the class. If, therefore, it is required to work with higher pressures in order to secure economy in the transmitting lines, two machines must be coupled in series by connecting together two terminals which are of unlike sign. The stress of the total voltage may still fall on the insulation of the winding from the body of the machine ; hence for high-voltage transmission of power over very long dis- tances, the continuous-current dynamo must yield in convenience to the alternator. In this there is no commutator, the armature coils may be stationary and can be more thoroughly insulated, while farther, if it be thought undesirable to design the machine for the full transmitting voltage, it is easy to wind the armature for a low pressure ; this can be subsequently transformed up to a high pressure by means of the alternating-current transformer, which has stationary windings and so high an efficiency that but little loss arises from its use. With these remarks, the transition may be made to the fuller discussion of the alternator.~~

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~~The value of tlie factor K in the electromotive-force equation of the alternator (I. 6) depends on the ratio of~~

~~the pole-width to the pitch, and upon the distri- JaB^/n'F^ bution of the inductors of the coil; in the latter, equation. t"wo cases may be distinguished as "grouped"~~

~~and "uniform" distribution. Bythe first, the coil is split up into two or more groups, each of these groups Being itself so closely wound that its inductors may be regarded as in phase, although the several groups which are in series differ in phase.^ By the second, the coil is uniformly wound over a certain portion of the peri- phery of the armature, as in Fig. 13. Thus the distinction of the two cases lies in the fact that with grouped distri- bution a small number of widely distinct phases are compounded together, while with uniform distribution a large number of phases differing very little from each other are united. In either case the result must be the same, namely, a~~

*reduction, in the effective E.M.F. as compared with the same winding concentrated in a single line, since the several components are more or less out of, phase. Yet the advantages are gained of a smaller inductance and a better ventilation of the armature conductors on the surface, and still more at the ends of the core. Further, the reduction in the E.M.F. only takes place in its full force at no load ; when the armature is giving current its reaction on the field tends to crowd the lines towards one or other edge of each pole, and so to narrow the effective width of the pole-face. In actual machines the value of K usually falls between the limits of 1 and 1-25.^*

*The first experimental determination of the shape of the *£.]«.?. curve of an alternator was made by Joubert in 1880. A revolving contact-maker charged a condenser with the E.M.F. produced by the armature at a particular instant during each period. The condenser was discharged through a ballistic galvanometer, and*

1 Such is the case of an armature having slots or holes evenly dis- tributed round its periphery, each side of a drum coil or each com- plete ring coil being divided between two or more slots.

2 Knapp, " Alternate-Current Machinery," Proc. Inst. C. E. vol xcvii part iii., 1888-89, and Ellhu Thomson's remarks, p. 101 • Parshall Engineering, vol. Ixv. p. 388; Fischer-Hinnen, Elec. Eng. vol xx' p. 597; Brousson, Electrical World, 1895, vol. xxvi. p. 236.

from the measured throw the instantaneous E.M.E. could be deduced. The contact-maker was then shifted through a small angle, and the instantaneous E.M.F. at the new position cor- responding to a different moment in the period was measured; this process was repeated until the E.M.F. dS'%" curve for a complete period could be traced. Various carve ' modifications of the same principle have since been used, and recently a form of "oscillograph" has been perfected which is well adapted for the purpose of tracing the curves both of E.M.F. and of current (see Measuring Ihstrumbnts, Eleoteic). The machine on which Joubert carried out his experiments was a Siemens jJisc alternator having no iron in its armature, and it was found that the curve of E.M.F. was practically identical with a sine curve. The same law has also been found-to hold tnie for a smooth-core ring or drum armature, but the presence of the iron core enables the

armature current to produce greater distorting effect, so that the curves under load may vary considerably from their shape at no load. In toothed armatures, the broken surface of the core, and the still greater reaction from the armature current, may produce wide variations from the sine law, the general tend- ency being to give the E.M.F. curve a more peaked form. The great convenience of the assumption that the E.M.F. obeys the sine law has led to its being very commonly used as the basis for the mathematical' analysis of alternator problems; but any deductions made from this premiss require to be applied with caution if they are Ukely to be modified by a different shape of the curve. Further, the same alternator will give widely different curves even of E.M.F., and still more so of current, according to the nature of the external circuit to which it is connected. As will be explained later, the phase of the current relatively to the E.M.F. depends not only on the inductance of the alternator itself, but also upon the inductance and capacity of the external circuit, so that the same current will produce different effects according to the amount by which it lags or leads. The question as to the relative advantages of differently shaped E.M.F. curves has led to much discussion, but can only be answered by reference to the nature of the work that the alternator has to do — i.e. , whether it be arc light- ing, motor driving, or incandescent lighting through transformers. The shape^ of the E.M.F. curve is, however, of great importance in one respect, since upon it depends the ratio of the maximum instantaneous E.M.F. to the effective value, and the insulation of the entire circuit, both external and internal, must be capable of withstanding the maximum E.M.F. WhUe the maximum value of the sine curve isv^ or 1-414 times the effective value, the maxi- mum value of a A curve is 1-732 times the effective value, so that for the same effective E.M.F. the armature wires must not only be more heavily insulated than in the continuous-current dynamo, but also the more peaked the curve, the better must be the insulation.

The frequency employed in alternating-current systems for distributing ppwer and light varies between such wide limits as 40 and 135 ; yet in recent times the „ tendency has been towards common standards ”’”’”^' of 50 .and 60 or 100 as a maximum. HIgh frequencies involve more copper in the magnet coils, owing to the greater number of poles, and a greater loss of power in their excitation, but the alternator as a whole is somewhat lighter, and the transformers are cheaper. On the other hand,

high frequency may cause prejudicial effects, due to the inductance and capacity of the distributing lines ; and in asynchronous motors used on polyphase systems the increased number of poles necessary to obtain reasonable speeds reduces their efficiency, and is otherwise disadvan tageous, especially for small horse-powers. A frequency lower than 40 is, however, not permissible where arc light- ing is to form any considerable portion of the work and is to be effected by the alternating current without rectifica- tion, since below this value the eye can detect the periodic alteration in the light as the carbons alternately cool and become heated. Thus for combined lighting and power 50 or 60 are the most usual frequencies ; but if the system is designed solely or chiefly for the distribution of power, a still lower frequency is preferable, and on this account 25 was selected by the engineers for the Niagara Falls power transmission, *after careful consideration of the problem.*

Each of the four methods of forming coils of many turns, namely, the ring, drum, discoidal ring, and disc, have already been shown to be applicable to alternators. Bing

8 See Forbes, Journ. List. Elec. Eng. vol. xxii. p. 493.

alternators]

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*winding (Fig. 13 i.) was early employed in the machines of Gramme and Wilde, and later of De Meritens. Owing winding *° “^ excellent grip of the wires on the core, the ring coils are well adapted to withstand centrifugal force, and high peripheral speeds become permissible. The discoidal form of ring winding, with its appropriate -form of field-magnet, may be easily de- rived from Figs. 13 ii. and 25. Drum winding in some of its numerous varieties is, however, more usual at the present time in alternators, as in continuous-current machines, and for the same reasons, namely, that it requires less wire and has less in- ductance. As in the continuous- current dynamo, the coils may be hand,- wound, f or- mer-wound, or composed of*

bars united by end-con- nectors. If the armature core is smooth and the section of wire is small, the drum coil ^‘s- *”■

may be former-wound, and with a large number of poles the curvature required to fit it to the circumference of the armature coil is so slight that it becomes almost flat ; the open space within the inside turn is usually filled with a wood centre, flush with the sides. The complete coils may be placed either on the outside or inside of the armature core (Fig. 13 iii.), according as the poles are external or internal. A single coil per pair of poles may be used, as shown in Fig. 37, but the advantages of its division into two halves, as in Fig. 13 iii., naniely, the better utilization of the space at the ends of the core and the gain in ef fective cooling sur- face, have already been mentioned. A pair of outside ends of adjacent coils and a pair of inside ends are then alternately con- nected together, and the maximum difference of poten- tial between any two adjacent wires is equal to twice ^’

the voltage of one coil. But if the coils are all connected in series right round the armature, one of the groups, consisting of the adjacent halves of the first and last coils, is subjected to the strain of the total voltage; hence for high pressures it may be advantageous to insert one dummy coil to separate the first and last coUs. Another plan is to divide the armature winding into two halves and to connect these in parallel, as in Fig. 38. Either circuit then carries half the current, but must give the total voltage of the mSkchine, sO that twice the number of inductors of half the section are required; there is thus a greater amount of space lost in insulation, and, as with all cases of parallel circuits, it is very neces- sary to secure close equality of the E.M.F.‘s of the two branches at every instant, since otherwise the load will

not divide equally between them, and a loss of efficiency, with greater heating, will result. As compared with ring winding, the drum coils on a rotating smooth core are not so easily held in place against centrifugal force and the alternating stresses due to the magnetic pull on them ; the wood filling-pieces, being screwed to the core, serve as drivers, but with high peripheral speeds the surface must be covered at frequent intervals by bands of binding wire. It is iiherefore even more common to employ a toothed armature core, although the embedded wires have more inductance

*and more reaction on the field ; the alternator then requires more alteration of its excitation if the voltage is to be kept constant under varying loads. When the slots of the armature have parallel sides, or the teeth do not close entirely over the opening at the top, the coils may stUl be wound on a former in the lathe, and afterwards pressed into the slot, which is well lined with micanite,*press-spahn, or other highly-insulating material. But if the armature has holes pierced close to the periphery of the discs, hand-winding must be resorted to, and the wires are threaded through the holes in tubes of micanite or paper. The wires themselves must be well insulated, but do not need to be very tight in the holes, as by far the largest part of the mechanical pull is transferred to the iron core.*

Disc winding (Fig. 13 iv.) has been very successfully used for alternators, as in the large magneto-machines invented by NoUet, and afterwards constructed and improved by the Alliance Co. (1860), and also in the alternators of Wilde (li866) and Siemens (1878). The connexions of the coils can be followed from Figs. 37 and 38, which are as applicable to disc as to drum winding. It is usual for the armature to revolve, and no iron is employed in the core ; there is therefore no loss from hysteresis, but a somewhat large exciting-current loss is involved by th^ length of the air-gap between the oppos- ing poles of opposite sign. An undulatory winding which was adopted in some early alternators has since been dis- carded in favour of coils, as in Fig. 38. In the modern Ferranti alternator, the centres on -which the coils are wound are made up of strips of brass soldered together at their inner ends and lightly insulated, to separate the teeth of the comb; eddy-currents in the core are thus largely prevented, and the advantage of a metal centre is retained. The thin copper strip employed in winding the coils is corrugated along its centre line, to retain it in its place and to prevent it shifting sideways. The very high ^peripheral speed which is used in this type of machine tends to keep the composite structure of the armature rigid in the plane of rotation.

The general idea of the polyphase alternator giving two or more E.M.F.'s of the same frequency, but displaced in phase, has been already described. The several phases may be entirely independent, and such was the case with the early poly- Quarter- phase machines of Gramme, who used four independent "f circuits, and also in the large two-phase alternators aatoirs designed by Gordon

in 1883. If the phases are thus entirely separate, each requires two collector rings and two wires to its external circuit, i.e., four in all for two-phase, and I six for three-phase, machines. The only advantage of tjie polyphase ma chine as thus used is that the whole of the surface of the armature core may be eflficiently covered with winding, and the output of the alternator for a given size be thereby increased. It is, however, also possible so to interlink the several circuits of the armature that the necessary number of transmitting lines to the external cir- cuits may be reduced, and also the weight of copper in them for a given loss in the transmission .^ The condition which obviously must be fulfilled, for such interlinking of the phases to be possible, is that in the lines meeting at any common junction the algebraic sum of the instantaneous currents, reckoned as positive if away from such junction and as negative if towards it, must be zero. Thus if the phases be diagrammatically represented by the relative angular position of the coils in Fig. 39, the current in the coils

1 As in the historical transmission of energy from Lauffen to Frank- fort (1891).

A and B differs in phase from the current in the coils C and D by a quarter of a period, or 90° ; hence if the two wires 6 and d be replaced by the single wire bd, this third wire will serve as a common path for the currents of the two phases either outwards or on their return. At any instant the value of the current in the third wire must be the vector sum of the two currents in the other wires, and if the shape of the curves of instantaneous E.M.F. and current are identical, and are assumed to be sinusoidal,the effect- ive value of the current in the third wire will be the vector sum of the eflective \values of the currents in. the other wires ; in other words,

Fig. 39.

if the system is balanced, the effectiyfe current in the third wire is V‘2, or 1-414 times the current in either of the two outer wires. Since the currents of the two phases do not reach their maximum values at the same time, the sectional area of the third wire need not be twice that of the others ; in

order to secure maximum effi- ciency by employing the same current density in all three wires, it need only be 40 per cent, greater than that of either of the outer wires. The effective voltage between the external leads may in the same way be calculated by a vector diagram, and with the above star connexion the voltage between the outer pair of wires a and c is V2, or 1-414 times the voltage between either of the outer wires and the common wire bd. Next, ■if the four coils are joined up into a contin- uous helix, just as in the winding of a con- tinuous-current machine, four wires may be attached to equi- distant points at the opposite ends of the two diameters at right angles to each other (Fig. 40) . Such a method is known as the mesh connexion, and gives a perfectly symmetrical Jour-phase system of distribution. Four collecting rings are neces^ry if the armature rotates, and there is no saving in copper in the transmitting lines ; but the importance of the arrangement lies in its use in connexion with rotary converters, in which it is necessary that the winding of the armature should form a closed circuit. If e =the effective

Fig. 40.

A

Three: phase

Fig. 41.

voltage of one phase A, the voltage between any pair of adjacent lines in the diagram is e, and between m and o or n and p is y/2 . e. The current in any line is the resultant of the currents in the two phases connected to it, and its effective value is V2 . c, where c is the current of one phase.

When we pass to machines giving three phases differing by 120°, the same methods of star and mesh connexion find their analogies. If the current in coil A (Fig. 41) is flowing away from the centre, and has its maximum value, the alter- currents in coils B and C are flowing towards the centre,

*nators. ”” - ” ^^’^^ °^ ^^^^ *’^^ magnitude of the current in A ;*

the algebraic sum of the currents is therefore zero, and this will also be the case for all other instants. Hence the three coils can be united together at the centre, and three external wires are alone required. In this star or " Y " connexion, if e be the effective voltage of each phase, or the voltage between any one of the three collecting rings and the common connexion, the volts between any pair of transmjaing lines will be E= VS . e (Fig. 41) ; ifthe load be balanced, the effective current C in each of the three hnes will be equal, and the total output in watts will be

■W=3Ce =t?5I = i.732 EC, or 1-732 times the product of the

effective voltage between the hnes and the current in any single line. Next, if the three coils are closed upon themselves in a mesh or delta fashion (Fig. 42), the three transmitting wires may be con-

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neoted to the junctions of the coils (by means of collecting rings if the armature rotates). The voltage B between any pair of wires is evidently that generated by one phase, and the current in a line wire is the resultant of that in two adjacent phases ; or in a balanced system, if c be the current in each phase, the current in the line wire beyond a collecting ring is C = V3. c,

hence the watts are W=3cE=5^=l-732 EC,

VE as before. Thus any three-phase winding may be changed over from the star to the delta con- nexion, and will then give 1-732 times as much current, but only 1/1-732 times the voltage, so that the output remains the same. Any of the alternator windings shown in previous diagrams are equally avail- able for polyphase machines, if the width of the coils be altered to suit the number of phases.

The field-magnet systems of alternators differ from those of con- tinuous-current multipolar machines only in the employment of a larger number of pairs of poles ; ^ hence the alternator usually has somewhat more copper in its exciting coils, „a "^^ and a slightly greater loss of watts in the excitation. Four of the most common types of field are shown in Fig. 13,

and may be compared with Figs. 24 and 25. In Fig. 13 i. the armature rotates and is internal to the poles, while in Fig. 13 iii. it is station- ary and external to the rotating poles ; and it may be said that while in continuous-current dynamos it is most usual for the armature to rotate, in alternators it is more common for the magnet to rotate. The coils of the stationary armature, which for high voltages must be heavily insulated, are then not subjected to the additional stresses due to centrifugal force ; and further, the col- lecting rings, which must be attached to the revolving portion, need only be employed to transmit the exciting current at a low voltage. The multipolar form of field-magnet with single exciting coil, shown in Fig. 29, has been very largely used for alternators, since its introduction by Mordey, with disc armature, and by the Oerlikon Co. of Switzerland in connexion with drum armatures ; but although advantageous for particular frequencies and speeds, it requires careful designing to avoid a somewhat large armature reaction. A further step brings us to the so-called inductor alter- nator, in which both the armature and the field-magnet coils are stationary, and the E.M.F. is set up in the armature coils by causing the fiux through them to be periodically varied by the rota- tion of iron ‘ ‘ induct- ors.” It will be seen that in Fig. 29 it is not really necessary for the field-magnet coil to revolve, and by such a modifica- tion as shown in Fig. 43 it can be held sta- tionary, while the iron mass which com- pletes the magnetic system is alone ro- tated. It is very im- portant in such a machine to keep the ‘- ^■

reluctance of the magnetic circuit constant, so as to ensure as far as possible an equal fiux in the magnet for all positions of the inductor ; otherwise eddy-currents are set up in its mass. Even when the total flux alters but little, the pole-tips are usually lam- inated, owing to the variations in its distribution over their faces.

Since an alternating current cannot be used for exciting the field-magnet, recourse must be had to some source of a direct current. This is usually obtained from a small auxiliary contin- uous-current dynamo, called an exciter, which may be an entirely separate machine, separately driven and used for exciting several alternators, or may be driven from the alternator itself ; in the latter case the armature of the exciter is often coupled directly to the rotating shaft of the alternator, while its field-magnet is attached to

the bed-plate. Although separate excitation is the more usual method, the alternator can also be made self-exciting if a part or the whole of the alternating current is "rectified,"

'For experiments on high-frequen(w currents, Nikola Tesla con- structed an alternator havinj* 384 poles and giving ^a frequency of about 10,000 {Journ. Inst. Elec. Eng. vol. xxi. p. 82, 1892). The opposite extreme is found in alternators directly coupled to the Parsons steam turbine, in which, owing to its high speed of 3000 revs, per min., only four poles are required to give a frequency of 100. By a combi- nation of a Parsons steam-turbine running at 12,000 revs, per min. with an alternator of 140 poles a frequency of 14,000 has been obtained {Engineering, Aug. 25, 1899).

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and thus converted into a direct current. Or both methods may be employed simultaneously.

The reaction of the armature-current upon the field in an alternator is in many ways different from that of the contiiluous- Armaiare '^^^^^"^\ dynamo, and requires detailed consideration. reaction ^^^^ single-phase alternator be running on open circuit and giving a sine curve of E.M.F., and let a non- inductive resistance be applied to its terminals. At the instant of closing the circuit, a current arises, and in its growth causes a cor- responding self-induced flux to arise, which as it cuts the armature coils generates an E.M.F. of self-inductance; this E.M.F. delays the rise of the current, so that'its instantaneous value is not in step with the instantaneous value of the impressed E.M.F., although they gradually become more and more alike in phase. The first few waves of current are therefore distorted, their exact shape de- pending upon the moment in the period when the circuit is closed, and it is only after some little time that the current curve reaches its final shape and phase relatively to the impressed E.M.F. Since the impressed E.M.F. is always changing in value and never be- comes steady, the current-phase can never overtake that of the E.M.F., but must

continue to lag behind it by some angle of lag depending on the armature inductance. If the ms^netio circuit presented to the armature coils had a constant inductance and no hysteresis, the self-induced flux would vary simultaneously with, and in proportion to, the current ; both would be sinusoidal, and so also would be the E.M.F. of self -inductance, which would be in quadrature with either the flux or the current. The phase of the current with reference to the impressed E.M!.F. would then be given by a simple vector diagram ; since the armature current lags, the E.M.F. of self-inductance will be more than 90° behind the im- pressed E.M.F., andv therefore will partially oppose it, so that the terminal E.M.F. will' be less than the impressed B.M.F. minus the loss of volts over the armature resistance. The matter admits, however, of further analysis. The paths of the magnetic circuit presented to the armature coils vary according to the position of the coils relatively to the poles, and hence the reluctance to the self-induced flux is not constant, but varies. When the centre of a ring coil or the side of a drum coil is directly under a pole, all the ampere-turns of the coil act round a cross-circuit, or are cross ampere-turns, displacing the maximum density of the resultant field towards the trailing edges;. As the coil moves forward, the self-induced flux divides, and some lines pass through a pair of field- magnet coils instead of across them. More strictly speaking, the ampere-turns are divisible now into cross and back ampere-turns, of which the latter directly reduce the strength of the symmetrical field, while the former simply distort the weakenfed symmetrical field. The proportion of back to cross turns gradually increases until th'e inductors of the coil are exactly mid-way between the poles ; later, as the coil passes under the next pole, and as soon as the current has reversed its direction, the armature turns become divisible into cross and forward ampere-turns. The latter increase the strength of the field, and their proportion relatively to the cross turns is continually increasing. Thus the effect of either the direct or the cross ampere-turns during a whole period can only be calculated by taking into account both the instantaneous values of the current and the magnetizing effect which a , constant current would have for the different positions of the coil at cor- responding instants. H-g., if there were' no difference of phase between current and impressed E.M.F., the dotted curve mm (Fig. 44) may be taken to represent the direct mag-netizing effect of the coil in various positions for some constant value of current, say one ampere ; the current curve being that marked cc, the

~~product of simultaneous ordinates of the two curves may be plotted as mc, and will show the varying M.M.F. due to the direct ampere-turns, back ampere-turns being plotted below, and forward ampere-turns above, the base line. It is seen that in this case the periodic weakening~~

~~and strengthening of the sym- liiis'JjiS ;#?; ;i:';;?.^; ;tls&Si%~~

~~metrical field balances during a complete period, and the average flux is unaffected. Since, how- ever, in our first case of an arma- ture with self-inductance there must be some lag of current be- hind impressed E.M.F., Fig. 45 shows that the weakening effect, lasts longer and is greater than the strengthening effect, so that the terminal E.M.F. for the same exciting current must decrease. Similarly, the cross flux will be found periodically to vary, or, in other words, the lines wiU be periodically crowded up into one or~~

~~Fig. u.~~

~~Fig. 45.~~

~~other pole-edge, and then resume their symmetrical distribution when either the current in the coil or its cross effect is zero. If there be lag of the current, the displacement towards the leading pole-edge will be less marked than that towards the trailing edge.~~

~~If the direct M.M.F. of the armature be taken into account in calculating the resultant flux, the smaller value of the self-induced E.M.F. which is then left simply measures the time-rate of change of the distortion, and has nothing to do with the strengthening and weakening of the field due to the lag or lead of the current. The importance of thus differentiating the armature reaction into the cross and direct magnetizing effect lies in the fact that, for a given terminal voltage under load, the actual density of lines in the magnot cores, for which allowance must be made in their sectional area, will be only that of the resultant flux due to the combined M.M.F. of the magnet winding and the direct ampere- turns. Since, however, both divisions of the armature reaction produce the same class of effect, they may be combined by assign- ing to the armature a certain inductance, which causes an E.M.F. of self-induction in quadrature with the current. It~~

must' then be remembered that the value of the flux corresponding to the im- pressed E.M.F. is really that which would be due to the same ex- citation if there were no armature current, and never really exists except at no load. If the external circuit also has self-inductance, the lag of the current is increased and the terminal voltage is further lowered. If, on the other hand, the external circuit has sufficient condenser capacity, the current may be brought back into phase with ttie E.M.F., or may even be in advance of it ; in this case, the above effects are reversed, and the field and terminal E.M.F. are increased for the same exciting current.

Evidently, therefore, the characteristic curve-connecting armature current and terminal volts will with a constant exciting current depend on the nature of the load, whether inductive or non- inductive, and upon the amount of inductance already possessed by the armature itself. With an inductive load it will fall more rapidly from its initial maximum value, or, conversely, if the initial voltage is to be maintained under an increasing load, the exciting current will have to be increased more than if the load were non- inductive. In practical working many disadvantages result from a rapid drop of the terminal E.M.F. under increasing load, so that between no load and full load the variation in terminal voltage with constant excitation should not exceed 16 per cent. Thus the output of an alternator is limited either by its heating or by its armature reaction, just as is the output of a continuous-current dynamo ; in the case of the alternator, however, the limit set by armature reaction is not due to any sparking at the brushes, but to the drop in terminal voltage as the current is increased, and the consequent difficulty in maintaining a constant potential on the external circuit.

The joint operation of several alternators so that their outputs may be delivered into the same external circuit, is sharply dis- tinguished from the corresponding problem in con- tinuous-current dynamos by the necessary condition ^^ that they must be in synchronism — i.e., not only ^"f/S? must they be so driven that their frequency is the nators. ' same, but their E.M.F.'s must be in phase or, as it is also expressed, the machine's must be in step. Although in practice it is impossible to run two alternators in series unless they are rigidly coupled together — ^whioh virtually reduces them to one machine — two or more machines can be run in parallel, as was first described by Wilde m 1868, and subsequently redemonstrated by Hopkinson

and Adams in 1884. Their E.M.F.'s should be as nearly as possible in synchronism, but as contrasted with series connexion, parallel coupling gives them a certain power of re- covery if they fall out of step, or are not in exact synchronism when thrown into parallel. Under such circumstances a syn- chronizing current passes between the two machines, due to the difference in their instantaneous pressures ; and as this current agrees in phase more nearly with the leading than. with the lagging machine, the former machine does work as a generator on the latter as a motor. Hence the lagging machine is accelerated and the leading machine is retarded, until their frequencies and phase are again the same. '

The chief use of the alternator has already been alluded to. Since it can be employed to produce very high pressures either directly or through the medium of transformers, it is specially adapted to the Vses at electrical transmission of energy over long dis- tances.' In the early days of electric lighting, the alternate-current system was adopted for a great number of central stations, the machines, designed to

1 In the pioneer three-phase transmission between Lauffen and Frank- fort (Electrician, vol. xxvi. p. 637, and xxvii. p. 548), the three-phase current was transformed up from about 55 to 8500 volts, the distance

give a pressure of 2000 volts, supplied transformers which Tvere situated at considerable distances and spread over large areas, without an undue amount of copper in the transmitting lines. While there was later a tendency to return to the continuous current for central stations, owing to the introduction of better means for economizing the weight of copper in the mains, the alternating current is again coming into favour in special cases, as rendering it possible to place the central station in some convenient site far away from the district which it is to serve. The pioneer central station in

this direction was the Deptford station of the London Electric Supply Corporation, which furnished current to the heart of London from a distance of 7 miles. In this case, however, the alternators were single-phase and gave the high pressure of 10,000 volts immediately, while more recently the tendency has been to employ step-up transformers and a polyphase system.^ The advantage of the latter is that the current, after reach- ing the distant sub-stations, can be dealt with by rotary converters, through which it is transformed into a con- tinuous current. The alternator is also used for welding, smelting in. electric furnaces, and other metallurgical pro- cesses where heating effects are alone required ; the large currents needed therein can be produced without the dis- advantage of the commutator, and, if necessary, trans- formers can be interposed to lower the voltage and stUl further increase the current. The alternating system can thus meet very various needs, and its great recommendation may be said to lie in the flexibility with which it can supply electrical energy through transformers at any potential, or through rotary converters in continuous-current form.

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(c. C. H.)

being 110 miles. Between Eichdorf and Griinberg, energy developed at 225 Tolts is transmitted after transformation np to 10,000 volts (Electrician, voL xxxviii. p. 469, 1897) ; while in the transmission from Pademo to Milan the three-phase ciurent is generated directly at 13,500 volts (Elettricitd, vol. xvii. p. 133, 1898). At Kootenay- Eossland the three-phase current is transformed up from 1100 to 20,000 volts.

1 As at Chicago, Electrician, voL xliv. p. 177.

DynamometerSa — If P represent the average value of the component of a force in the direction of the displacement, s, of its point of application, the product Ps measures the work done during the displacement. When the force acts on a body free to turn about a fixed axis only, 'it is convenient to express the work done by the transformed product T^, where T is the average turning moment or torque acting to produce the displacement 6 radians. A dynamometer is used in the process of measuring work to measure the force P, or the torque T. The factors s or ^ are observed independently. Apparatus is added to some dynamometers by means of which a curve showing the variations of P on a distance base is drawn automatically, the area of the diagram represent- ing the work done ; with others, integrating apparatus is combined, from which the work done during a given interval may be read off dii-ectly. It is convenient to distinguish between absorption and transmission dyna- mometers. In the

first kind the work done is converted into heat ; in the second it is transmitted, after measure- ment, for use.

Absorption Dynamometers. — Prony's dynamometer {Ann. Chim. Phya. vol. xix".,, Paris, 1821), which has been modified in various ways, consists in its original form of two symmetric- ally-shaped timber beams clamped to the engine-shaft. When these are^ held from turning, their frictional resistance may be adjusted by means of nuts on the screwed bolts which hold them together until the shaft revolves at a given speed. To promote smoothness of action, the rubbing surfaces are lubricated, A weight is moved along the arm of one of the beams nntil it just keeps the brake steady, midway between the stops which must be provided to hold it when the weight fails to do so. The general theory of this kind of brake is as follows : — Let F be the whole frictional resistance, r the common radius of the rubbing surfaces, W the force which holds the brake from turning and whose line of action is at a perpendicular distance E from the axis of the shaft, N the revolutions of the shaft per minute, a its angular velocity in radians per second ; then, assuming that the a(5ustments are made so that the engine runs steadily at a uniform speed, and that the brake is helld still, clear of the stops, and without oscillation, by W, the torque T exerted by the engine is equal to the frictional torque Fr acting at the brake surfaces, and this is measured by the statical moment of the weight W about the axis of revolution ; that is —

T=Fr=WR . . . . (1) Hence WR measures the torque T.

If more than one force be applied to hold the brake from turning, Fr, and therefore T, are measured by the algebraical sum of their individual moments with respect to the axis. If the brake is not balanced, its moment about the axis must be included. Therefore, quite generally,

T=SWR (2)

The factor B of the product T9 is found by means of a revolution

counter. The power of a

motor is measured by the

rate at which it works,

and this is expressed

,-„ T2xN . „.

by Tw= — go — m foot-

per second, or 33;000 ^ horsepower units. The latter is com-

pounds T27rN

monly referred to as the brake horse-poWer. The maintenance of the con-
ditions of steadiness im- plied in equation (1) depends upon the con- stancy
of F, and there- fore of the coefficient of friction /» between the rubbing
surfaces. The heating at the surfaces, the variations in their smoothness,
and the variations of the lubrication make ft, continuously variable, and
necessitate frequent adjustment of W or of the nuts. Ponoelet invented a
form of Prony brake which automatically adjusted its grip as /t changed,
thereby maintaining F constant.

The principle of the Appold compensating brake is shown in Fig. 1. A
flexible steel band, lined with wood blocks, ia

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gripped on the motor fly-wheel or pulley by a screw A, which, to- gether
with W, is adjusted to hold the brake steadily. Compensa- tion is efiected by
the lever L mserted at B. This has a slotted

end, engaged by a pin P fixed to the fram- ing, and it wUl be seen that its
action is to slacken the band if the load tend to rise and to tighten it in the
contrary case. The external forces holding the brake from turning are W,
distant R from the axis, and the reac- tion, Wi say, of the lever against the
fixed pin P, distant Ej from the axis. The moment of Wi may be positive or
negative. The torque T at any instant of steady running is there- fore {WE,
=^WiRi}.

Lord Kelvin patented a brake in 1858 (Fig. 2) consisting of a rope or cord wrapped round the circumference of a rotating wheel, to one end of which is applied a regulated force, the other end being fixed to a spring balance. The ropes are spaced laterally by the blocks B, B, B, B, which also serve to prevent them from slipping side- ways. When the wheel is turning in the direc- tion indicated, the forces holding the band stilt are W, and p, the observed pull on the spring balance. Both these forces usually act at the same radius E, the distance from the axis to the centre line of the rope, in which case the torque T is (W — p)E, and consequently the brake horse-power is

(W- j))Rx27rN -^yrhen ft changes the weight W rises or falls

33,000 f* 5 5

against the action of the spring balance until a stable condition

W of running is obtained. The ratio — is given by ei^^, where

P 6=2-718 : ft is the coefficient of friction and 6 the angle, measured in radians, subtended by the arc of contact between the rope and the wheel. In Fig. 2 e=:27r. This ratio increases very rapidly as fl is increased, and therefore by making e sufficiently large, p may con- veniently be made a small fraction of W, thereby render- ing errors of observation of the spring balance negligible. Thus this kind of brake, though cheap to make, is, when 6 is large enough, an exceedingly accurate measure- ing instrument, readily ap- plied and easily controlled. It has come into very general use in recent years, and has practically superseded the older forms of block brakes.

It is sometimes necessary to use water to keep the brake wheel cool. Engines specially de- signed for testing are usually provided with a brake wheel having a trough-shaped rim. Water trickles continuously into the trough, and the centrifugal action holds it as an inside lining against the rim, where it slowly evapora,te3.

Fig. 3 shows a band-brake invented by Professor James Thom- son, suitable for testing motors exerting a constant torque (see

~~Fig. 2.~~

~~Engineering, 22nd October 1880).. To maintain ei^^ constant, compensation for variation of /n is made by inversely varying 6.' A and B are fast and loose pulleys, and the brake band is placed partly over the one and partly over the other. Weights W and w are adjusted to the torque. The band turns with the fast pulley if /i morease, thereby slightly turning the loose pulley, otherwise at rest, until $ is adjusted to the new value of /it. This form of brake was also invented independently by Carpentier, and the principle~~

~~Fig. 4.~~

~~has been used in the Raffard brake. A self compensating brake of another kind, by Marcel Deprez, was described with Carpefitier's in 1880 (Bulletin de la Societe d' Encouragement, Paris). Ayrton and Perry have used a band or rope brake in which compensation is ef fected by the pulley drawing in or letting out a part of the band or rope which has been roughened or in which a knot has been tied.~~

~~In an effective water-brake invented by W. Froude (see Proc. Inst. M. E., 1877), two similar castings, A and B, each consisting of a boss and circumferen- tial annular channel, are —■ ** placed face to face on a shaft, to which B is keyed, A being free (Fig. 4). A ring tube of elliptical sec- tion is thus formed. Each channel is divided into a series of pockets by equally spaced vanes inclined at 45°. When A is held still and B rotated, centrifugal action sets up vortex currents in the water in the pockets ; thus a con- tinuous circulation is caused between B and A, and the consequent~~

~~of momentum~~

~~to oblique re-~~

~~The moments~~

~~components of and re- plane to~~

~~changes give rise actions, of the these actions actions in a~~

which the axis of rota^ tion is at right angles are the two aspects of the torque acting, and therefore the torque act- ing on B through the shaft is measured by the torque required to hold A still. Froude con- structed a brake to take up 2000 H.P. at 90 revs, per min. by du- plicating this apparatus. This replaced the propeller of the ship whose engines were to be tested, and the outer-casing was held from turning by a suitable arrangement of levers carried to weigh- ing apparatus conveniently disposed on the wharf. The torque corresponding to 2000 H.P. at 90 revs, per min. is 116,772 foot- pounds, and a brake 5 feet in diameter gave this resistance. Thin metal sluices were arranged to slide between the wheel and casing, and by their means the range of action could be varied from 300 H.P. at 120 revs, per min. to the maximum.

Professor Osborne Reynolds in 1887 patented a water-brake (see Proc. Inst. C. E. vol. xcix. p. 167), using Fronde's turbine to obtain the highly resisting spiral vortices, and arranging passages in the casing for the entry of water at the hub of the wheel and its exit at the circumference. Water enters at E (Fig. 5), and finds its way into the interior of the wheel, A, driving the air in front of it through the air-passages K, K. Then following into the pocketed chambers Vj, Vj, it is caught Into the vortex, and finally escapes at the circumference, flowing away at F. The air- ways k, k, in the fixed vanes, es- tablish communication between the cores of the vortices and the atmo- sphere. From ^ to 30 H.P. may be measured at 100 revs, per min. by a brake-wheel of this kind 18 inches in diameter. For other

, . ■ ■ — • 1-1 I speeds the power varies as the cube

11 i !.. J of the speed. The casing is held

T~T — 1^'"!^ ■ ^^1 ^^°^ turning by weights hanging

III . ^ 11 O on an attached arm. The cocks

regulating the water are connected tb the casing, so that any tilting automatically regulates the flow, and therefore the thickness of the fllm in the vortex. In this way the brake may be arranged to main- tain a constant torque, notwith- standing variation of the speed. In Alden's brake (see Trans. Amer. Soc. Eng. vol. xi.) the resistance is obtained by turning a cast- iron disc against the frictional resistance of two thin copper plates, which are held in a casing free to turn upon the shaft, and are so arranged that the pressure between the rubbing surfaces is controlled, and the heat developed by friction carried away, by the regulated flow of water through the casing. The torque required to hold the casing still against the action of the disc measures the torque exerted by the shaft to which the disc is keyed.

Transmission Dynamometers. — The essential part of many transmission dynamometers is a spring whose deformation indi- rectly measures the magnitude of the force transmitted through it. For many kinds of spring the change of form is practically proportional to the force, but the relation should always be deter- mined experimentally. Morin (see Notice sur divers appareils dynamometriques, /Paris, 1841), in his classical experiments on traction, arranged his apparatus so that the change in form of the spring was continuously recorded on a sheet of paper drawn under a style. For longer ex- periments he used a "Compteur" or me- chanical integrator, sug- gested by Poncelet, from which the work done during a given displacement could be read off directly. This device consists of a roller of radius r, pressed into contact with a disc. The two' are carried on a common frame, so ar- ranged that a change in form of the spring causes a relative dis- placement of the disc and roller, the point of contact moving radially from or towards the centre of the disc. The radial distance x is at any instant proportional to the force acting through the spring. The angular displacement, 0, of the disc is made proportional to the displacement, s, of the point of application of the force by suitable driving gear. If dji is the angular displacement of the roller corresponding to displacements, d0 of the disc, and ds of the

point of application of P, a, and C constants, then d0 = — =

*a /•« *"*

Pds=C.7ds, and therefore =C\ 'Ms; that is, the angular dis placement of the roller measures the work done during the displace- ment from si to 82. The shaft carrying the roller is connected to a counter so that 0 may be observed. The angular velocity of the shaft is proportional to the rate of working. Morin's dyna- mometer is shown in Fig. 6. The transmitting spring is made up of two flat bars linked at their ends. Their centres si, Sj, are held respectively by the pieces A, B, which together form a

Fig. 7.

sliding pair. The block A carries the disc D, B carries the roller R and counting gear. The pulley E is driven from an axle of the carriage. In a dynamometer used by Mr F. W. "Webb to measure the tractive resistance of trains on the London and North-Western railway, a tractive pull or push compresses two spiral springs by a definite amount, which is recorded to scale by a pencil on a sheet of paper, drawn continuously from a storage drum at the rate of three inches per mile, by a roller driven from one of the carriage axles. Thus the diagram shows the tractive force at any instant. A second pencil electrically connected to a clock traces a time line on the diagram with a kick at every thirty seconds. A third pencil traces an observation line in which a kick can be made at will by pressing any one of the electrical pushes placed about the car, and a fourth draws a datum line. The spring of the dyna- mometer car used by Mr Dean on the Great Western railway is made up of thirty flat plates, 7ft. 6 in. long, 5 in. x | in. at the centre, spaced by distance pieces nibbed into the plates at the centre and by rollers at the ends. The drawbar is connected to the buckle, which is carried on rollers, the endsiof the spring resting on plates fixed to the under-frame. The gear operating the paper roll is driven from the axle of an independent wheel which is let down into contact with the rail when required. This wheel serves also to measure the distance travelled. A Morin disc and roller inte- grator is connected with the apparatus, so that the work done during a journey may be read off. Five lines are traced on the diagram. In spring dynamometers designed to measure a transmitted

Fig. 8.

torque, the mechanical problem of ascertaining the change of form of the spring is complicated by the fact that the spring and the whole apparatus

are rotating together. In the Ayrton and Perry transmission dynamometer or spring coupling of this type, the relative angular displacement is proportional to the radius of the circle described by the end of a light lever operated by mechanism between the spring-connected parts. Prof. Dalby (see Proe. Inst. C. E. vol. cxxxii., 1897-98) uses a device shown in Fig. 7, by means of which the change in form of the spring is shown on a fixed indicator, which may be placed in any con- venient position. Two equal sprocket wheels Qi, Q2, are fastened, the one to the spring pulley, the other to the shaft. An endless band is placed over them to form two loops, which during rota- tion remain at the same distance apart, unless relative angular displacement occurs between Qi and Qj, due to a change in form of the spring. The change in the distance d is proportional to the change in the torque transmitted from the shaft to the pulley. To measure this, guide pulleys are placed in the loops guided by a geometric slide, the one pulley carrying a scale, and the other an index. A recording drum or integrating appa- ratus may be arranged on the pulley frames. A quick variation, or a periodic variation of the magnitude of the force or torque transmitted through the springs, tends to set up oscillations, and this tendency increases the nearer the periodic time of the force variation approaches a periodic time of the spring. Such vibrations may be damped out to a considerable extent by the use of a dash-pot, or may be practically prevented by using a relatively stiH spring.

Every part of a machine transmitting force suffers elastic defor- mation, and the force may be measured indirectly by measuring the deformation. The relation between the two should in all cases be found experimentally. Him (see Les Pandynamometres, Paris, 1876) employed this principle to measure the torque trans- mitted by a shaft. Signer RoSio used a telephonic method to effect the same end, and more recently mechanical, optical, and telephonic devices have been utilized by the Rev. F. J. Jervis- Smith. (See Phil. Mag., Feb. 1898.)

When a belt in which the maximum and minimum tensions are respectively P and p lb, drives a pulley,, the torque exerted is (P—p)r lb ft., r being the radius of the pulley plus half the thickness of the belt. P and p may be measured directly by leading the belt round two freely hanging guide pulleys,

one in the tight, the other in the slack part of the belt, and adjust- ing loads on them until a stable condition of running is obtained. In W. Froude's belt dynamometer (see Proc. Inst. M.E., 1858) (Fig. 8) the guide pulleys Gi, 62 are carried upon an arm free to turn about the axis O. H is a pulley to guide the approaching and receding parts of the belt to and from the beam in parallel directions.

ri9. 9.

Neglecting friction, the unbalanced torque acting on the beam

is 4r {P— i?} R) ft. If a force Q acting at R maintains equilibrium,

OR

2 = (P— p)r=T. Q is supplied by a spring, the extensions of

which are recorded on a drum driven proportionally to the angular displacement of the driving pulley ; thus a work diagram is obtained. Farcot has designed a form in v^hioh the guide pulleys are attached to separate weighing levers placed horizontally below the appa- ratus. In a belt dynamometer built for the Franklin Institute from the designs of Mr Tatham, the weighing levers are separate and arranged horizontally at the top of the apparatus. The weigh- ing beam in the Hefner-Alteneck dynamometer is placed trans- versely to the belt (see Electrotechnischen Zeitschrift, Heft 7, 1881). The force Q, usually measured by a spring, required to maintain

the beam in its central position is proportional to (P-p). If the angle 91=92=120°, Q=(P-i3) neglecting friction.

When a shaft is driven by means of gearing the driving torque is measured by the product of the resultant pressure P acting between the wheel teeth and the radius of the pitch circle of the wheel fixed to the shaft. Fig. 9,

which has been reproduced from J. White's A New Century of Inventions (Manchester, 1822), illustrates possibly the earliest application of this principle to dynamometry. The wheel D, keyed to the shaft overcoitiing the resistance to be meas- ured, is driven from wheel N by two bevel wheels L, L, carried in a loose pulley K. The two shafts, though in a line, are independent. A torque applied to the shaft A can be transmitted to D, neglect- ing friction, without change only if the central pulley K is held from turning ; the torque required to do this is twice the torque transmitted.

The torque acting on the armature of an electric motor is necessarily accompanied by an equal and opposite torque acting on the frame. If, therefore, the motor is mounted on a cradle free to turn about knife-edges, the reacting torque is the only torque tending to turn the cradle when it is in a vertical posi- tion, and may therefore be measured by adjusting weights to hold the cradle in a vertical position. The rate at which the motor

is transmitting work is then , . H.P., where n is the revolutions

per second of the armature.

See Dredge. Electric Illumination, 'vol. ii. London, 1885. — Beatjmont, W. W. " Dynamometers and Friction Brakes," Proc. Inst. C.E. vol. xcv. London, 1889. — Bkauer, E. " Ueber Bremsdynamometer und verwandte Kraftmesser," Zeitschrift des Vereins deutscher Ingenieure.' Berlin, 1888.: — ^Flather, J. J. Dynamometers and the Measurement of Power. New York, 1893.

(w. E. D.)

Dzungaria or Jungaria, the name tliat may con- veniently be given to the broad trench leading from the Mongolian plateau to the lowlands round Lake Balkhash, and limited by the Eastern Altai in the north and the Eastern Tian-shan in the south. It was formerly an in- dependent state, and has played an important part in the history of Mongolia and the great migrations of Mongolian stems westward. Now its territory belongs partly to the Chinese Empire (East Turkestan- and North-Western Mongolia) and partly to Russian Turkestan (provinces of Semiryechensk and Semipalatinsk). See Mongolia and East Turkestan.

Eads, James Buchanan (1820-1887), Ameri- can engineer, was born at Lawrenceburg, Indiana, on 23rd May 1820. His first engineering work of any importance was in raising sunken steamers. In 1845 he established glass works in St Louis. During the Civil War he con- structed ironclad steamers and mortar boats for the Federal Grovernment. His next important engineering achieve- ment was the construction of the great steel arch bridge across the Mississippi at St Louis (see Encyclopcedia Britannica, vOl. xxi. p. 185), upon which he was engaged from 1867 till 1874. The work, however, upon which his reputation principally rests was his deepening and fixing the channel at the mouths of the Mississippi by means of jetties, whereby the narrowed stream was made to scour out its own channel and carry the sediment out to sea. (See vol. xx. pp. 680, 581.) Shortly before his death he projected a scheme for a ship railway across the Isthmus of Tehauntepec, in lieu of an isthmian canal. He died at Nassau, in the Bahamas, on 8th March 1887.

Eaglehawk, a borough of Victoria, Australia, in the county of Bendigo, 4 miles north-north-west of Bendigo city, with which it is connected by steam tramway. It has a fine park, with lake, of 40 acres. There are valuable gold mines in the district. Altitude, 733 feet. Population

(1881), 7362 ; (1901), 8130.

Ealing, a suburb of London, England, in the Ealing parliamentary division of Middlesex, 9 miles west of St Paul's with two railway stations. There are seven Estab- lished churphes (in St Mary's, 1770, are buried Oldmixon, the historian, and Home Tooke). Other buildings are public ofB.ces, with libl- ary and science and art schools, a high school for girls, a training college for teachers of the deaf, an isolation hospital, and a cottage hos- pital and dispensary. There is a common and a public park. Among former distinguished residents of Ealing were Henry Fielding, the no'^relist, and John, first duke of Marlborough. Area of urban district, 2928 acres. Population (1881), 16,769 ; (1891), 23,979 ; (1901),

33,040.

Ear. See Pathology and Physiology {special senses).

Early, Jubal Anderson (1816-1894), Ameri- can soldier and lawyer, was born in Franklin county, Va., on 3rd November 1816, and graduated at the U.S. military academy in 1837i After a brief service he resigned in July 1838, to psactise law in Virginia, but as major in a regiment of state volunteers took part in the Mexican War. In 1861 'he entered the Confederate service as a colonel, fought at Bull Run (July 1861), received a wound at Williamsburg (May

EARTH, FIGURE OF THE

1862), and was advanced to brigadier- and major-general. HIs division held the lines at Fredericksburg during the battle of Chancellorsville (May 1863), and he fought in July at Gettysburg. As lieutenant-general in 1864, Early crossed the Potomac in July, and part of his force ad- vanced as far north as Chambersburg, Pa. HIe threatened Washington with his main force, but was compelled to retreat upon the arrival of the 6th corps, despatched by Grant from the front. In the ensuing autumn he won a partial success in the Shenandoah valley, but General Sheridan checked him in September at Opequan and Fisher's HIll, and on 19th October he suffered a decisive defeat at Cedar Creek. Wholly routed in March 1865, Early was relieved of command, and took no further active part in the war. After the peace he visited Europe, and 'later resumed the practice of law, managing for a time with Beauregard the Louisiana lottery. HIe died at Lynchburg, Va., on 2nd March 1894.

Earth, Figure of the. — To complete, to link together into one great network of triangles, the geodetic surveys accomplished in various countries, notably in Prance, England, Eussia, and India, is the actual endeav- our of astronomers, in order to reach an exact knowledge of the shape and size of the earth. From this common desideratum the International Geodetic Association was born, which has promoted researches directly or indi- rectly relating to Geodesy. Planned as early as 1861, the I. G. Association grew slowly, and was definitely con- stituted by the Conventions of 1886 and 1895. The As- sociation meets at least every third year, with the Central Bureau in Potsdam, and its president is Professor HIelmert, Director of the

Royal Geodetic Institute, founded in 1868, the resources of which are at the disposal of the Associa^ tion.

The general meeting of the I. G. Association at Paris in September 1900 gave the delegates an opportunity of knowing the state oi the surveys in progress and pro- jected.^ Among these undertakings may first be quoted the measurement of an arc of 66 degrees of amplitude which crosses Africa from the Delta of the Nile to Cape Town ; then the measuring of an arc in Spitzbergen, and the remeasurement of the arc of Peru.

The AfricEin arc will be surveyed along the meridian of 30° E. Sir David Gill, director of the Cape Observatory, has already given a report of the operations undertaken in South Africa, which will form a good basis for the realization of his adnlirable project. The Geodetic Survey of South Africa has established an important chain of tri- angles between the 20th and 30th meridians ; it will not be long before this reaches from Cape Agulhas to the Zambezi, embracing thus more than 20° of latitude. Major Laffan and Lieutenant Wettstein, English and Ger- man commissioners, have recently measured, under the direction of Sir D. Gill, a chain of triangles along the 20th meridian, which divides Bechuanaland from German South- west Africa, between Rietfontein and the parallel of 22° south latitude. Mr Alston has united, by a chain along they 28th parallel, through Bechuanaland, those already established along the 20th and 24th meridians. The Chartered Company had a triangulation along the 30th meridian undertaken in Rhodesia, and the Geodetic Survey of Rhodesia achieved, amid great difficulties, the observations between Mangwe and the parallel of -19°, and reconnoitred the northern part of the chain up to the Zambezi, when the war in South Africa caused the interruption of these works. As soon as circumstances permit, the chain of Rhodesia will pass through the Transvaal and be linked with that which the Geodetic

1 See the valuable reports of Lieut. Perrier and Professor Helmert.

Survey of South Africa has already measured in Cape Colony and Natal, along the south-eastern shore of Africa, from Cape Agulhas to Vaal river. It is therefore to be expected that the triangulation will before long extend from the Cape to the Zambezi. From this river to the Bahr-el-Gazal, the 30th meridian passes through the terri- tories of the Congo Free State, of

~~German East Africa, and of British East Africa, which it reaches near Albert Edward Nyanza, crossing Lake Tanganyika, which is surrounded by hills Visible from onS shore to the other, this being a favourable circumstance to facilitate the work. The northern extremity of the African arc is in Egypt, and a triangulation performed along the Medit- terranean shore would afterwards avail to link the African arc to the Rumanian and to the Russian arc, so as to form a continuous chain, ranging over 105° from Cape Agulhas to North Cape.~~

~~The question of the measurement of an arc in Spitz- bergen had already been raised by General Sabine. After the exploration of that archipelago by Nordenskjold and some others, it was resumed by Professor Ros^n, who prepared a scheme of triangulation, and the solution of the problem was deemed possible, on account of the im- provements of the base-apparatus of Taderin, whose nickel-steel wire makes the measuring of an extended base-line much easier than by previous processes.~~

~~During the summer of 1898 a private Swedish expedi- tion, conducted by Taderin, began the reconnaissance of a meridian chain between the parallels of South Cape and Ross Island, thus embracing about 4° 6' of latitude, between 76° and 81°. The summits of the triangles were to be marked by signals on the shores of the Storf jord, of the Strait of Hinlopen, and of the Seven Isles ; the expe- dition succeeded in placing the signals from Ross Island to the Storf jord. The continuation of the work was then entrusted to two official commissions named by the Swed- ish and Russian Governments, who proceeded to compose two missions. Towards the end of June 1899 the Russo- Swedish expedition, on five steamships, went from Tromso to Spitzbergen. The work was postponed till July, be- cause of the ice and the time lost in erecting the cabins, and was then pursued till September. The Russian mission took charge of the installation of the signals in the Storf jord. This was a very heavy task, .on account of the elevation of the mountains around the gulf, and of its width, the two shores being seldom at the same moment free from fogs; the consequence being that the sides of many triangles exceed 100 kilometres in length. It was also possible to do some astronomical and geodeti- cal work for two of the most difficult summits, namely, those of Cape Lee and of Whole Point, where a base-line has to be measured. At the north the condition of ice did not~~

permit reaching the Seven Isles; the Swedish mission has been employed in measuring a base-line at Hekla Hook and determining some summits. In Sep- tember both missions settled in winter, stations; the Russians at Hornsund, on the south-western coast of Spitzbergen, in 77° N., the Swedish in the Treurenberg Bay, towards 80°. They remained there, isolated from the outer world, during nine months, occupied in astro- nomical and meteorological observations. When the spring of 1900 came, the geodetical work was resumed and pursued till September, amidst very unfavourable cir- cumstances. They succeeded with much ado in building up on Mount Chydenius (alt. 1500 metres) a signal des- tined to join the chain of the Storf jord to that of Hinlo- pen Strait.

The revision of the arc of Peru, the opportunity for which had already been pointed to by Mr Davidson, the delegate of the United States to the I. G. Association in 1889, and later by Mr Preston in 1898, has been undertaken,

the French Government having been authorized by the Chambers to appropriate to that work a sum of 600,000 francs. The operation was entrusted to the members of the Geographical Service of the Army, under the direction of General Bassot. The Government of the Eepublic of Ecuador (on whose territory the arc of Bouguer is now comprised) having shown a disposition to favour the enterprise, two French officers, Captains Maurain and Lacombe, of the Geographical Service, were sent in 1899 to reconnoitre the country. They left Bordeaux at the end of May, and returned in January 1900, after having surveyed, in less than five months (July to November), an arc of 6°, between the Cerro de Pasto (1° 10' N. lat., Colombian territory) and the Cerro Ereo (4° 55' S. lat., Peruvian territory), thus lengthening by 1° towards the north and 2° southwardly the arc of Bouguer. In the southern part of the arc they could retain the old stations of the French academicians ; in the northern part they had to rise above the former stations, found defective. The obstacles w^e formidable, for there the twin Cordilleras rise to peaks — some of them volcanoes^-of fr(jm 5000 to 6000 metres in altitude, namely, Pichincha, Chimborazo, Cotopaxi, &c. MM. Maurain and Lacombe, with a zeal and persistence above all praise,

traversed 3600 kilometres and effected about thirty ascents in one of the most difficult countries, investigated the sites of two new base-lines, and determined fifteen geodetical stations ; they brought back topographical sketches and plans which give a clear idea of the work to be accom- plished. In Julj 1900 an official report, presented by M. Poinear^ in the name of the Academy of Sciences, drew out the lines of the projected revision of the arc of Quito. The system implies a series of 57 triangles and is sup- ported by three base-lines, each of about 8600 metres. The principal base will be situated towards the middle of the arc, near Biobamba, in 1° 30' S. lat., and 2600 metres above the searlevel ; two bases of verification are to be established at both extremities : the one near Cumbal, in Colombia, the other between Quiroz and SuUana (Peru). For measuring the angles, 52 stations (28 from the old chain of Bouguer and La Condamine) will be established along both Cordilleras, their altitude being often of 4000 metres ; the sides of the triangles will be of 30 to 40 kilom^res. The mission will be divided into two parties, who will proceed in parallel lines, the one along the western range, the other along the eastern. As it would be hazardous to build up sig- nals, always liable to be destroyed by the Indians, optic telegraphy will be resorted to, by means of heliostats, in order to njaintain communication between the successive stations.

The difference of longitude of the extremities will be a little less than 3°. In the southern part of the Gulf of Guayaquil the hills are near enough to the coast to make it possible to push on the triangulation to the sea, by connecting it with a point where an old lighthouse stands, and also, perhaps, with a point of Puna Island. The altitude of the principal base (Kiobamba) will be obtained by a spirit-levelling, which will follow the line of the future Guayaquil-Quito railroad. The searlevel will be obtained by means of a " medimarem^tre " placed at Playas, on the Pacific coast, distant about 70 kilometres from Guayaquil. The line of levelling from Playas to Eiobamba will attain a development of 280 kilometres and rise to 2600 metres. For the other bases a geodetic levelling by zenith distances may suffice. The astronomical stations for the observa- tion of the fundamental elements (latitude, longitude, azimuth) will be multiplied as much as possible, and likewise the stations for pendulum observations. The principal station will be at Quito, where a perfectly fitted observatory already stands, the direction of which has

~~been entrusted to a French astronomer, M. Gonnessiat. The differences of longitude between Quito, Guayaquil, and several other astronomical stations will be determined with the help of the telegraph.~~

~~It is estimated that this programme can be executed within four years by a party of five officers, namely. Commandant Bourgeois, head of the mission, Captains Lacombe, Maurain, Lallemand, and Lieutenant Perrier ; the other members are a military physician, a mechani- cian, and sixteen corporals and privates. A vanguard mission, consisting of Captains Maurain and Lallemand, sailed in December 1900, and reached Guayaquil in Jan- uary 1901. The rest of the personnel followed in April with the instruments.~~

~~It is right to recall here that geodetical studies have recovered, in France, their former expansion under the vigorous impulse of Colonel (afterwards General) Perrier. When occupied with the triangulation of Algeria, Colonel Perrier had conceived the possibility of the geodetic junction of Algeria to Spain, over the Mediterranean; therefore the French meridian line, which was already connected with England, and was thus produced to the 60th parallel, could further be linked to the Spanish triangulation, cross thence into Algeria and extend to the Sahara, so as to form an arc of about 30° in length. But it became, then, urgent to proceed to a new measure- ment of the French arc, between Dunkirk and Perpignan. In 1869 Perrier was authorized by Marechal Niel to undertake that revision. He devoted himself to that work till the end of his career, closed by premature death in February 1888, at the very moment when the Depot de la Guerre had just been transformed into the Geo- graphical Service of the Army, of which General Perrier was the first director. His work was continued by his assistant Colonel (afterwards General) Bassot. The operations concerning the revision of the French arc (triangulation, remeasurement of the Perpignan base, measurement of a new base near Melun, which may replace the former, &c.) were completed only in 1896. Meanwhile the French geodesists had accomplished the junction of Algeria to Spain, with the help of the geode- sists of the Madrid Institute under General Ibanez (1879), and measured the meridian line between Algiers and El Aghouat (1881). They have since been busy in prolong- ing the meridians of El Aghouat and Biskra, so as to converge towards Wargla, through Gardaia and Tuggurt. A careful study of the deflections of the vertical has been~~

commenced in the hills of the Algerian Sahel. In France the Geographical Service of the Army has been entrusted with the triangulations of the first, second, and third orders, to serve as a basis for the new map of France.[1] The Geographical Service has thus been led to, undertake the revision of the whole triangulation of France, wjth methods and instruments of high precision. The parallel of Paris has been connected with the German net by the co-operation of German and French geodesists. The fundamental co-ordinates of the Pantheon have also been obtained anew by connecting the Pantheon and the Paris Observatory with the five stations of Bry-sur-Marne, Morlu, Mont Valerien, Chatillon, and Montsouris, where the observations of latitude and azimuth have been. effected.

The triangulation of Italy is finished and in connexion with the French net on north and south, where it is linked to Tunis. The geodetic junction of Malta to Sicily was executed in 1900 by M. Guarducci. The observations were made by night, by means of light signals. The distances of many of the stations reach to 200 kilometres. The probable error in closing the triangfes does not exceed

1 See the work entitled La Carte de France, 1750-1898 ; &ude historique, par le Colonel Berthaut, 2 vols. 4to, 1898-99.

two seconds. The connexion of Corsica with the continent by new measures is also contemplated.

Rumania, which since 1895 has had a G-eographical In- stitute of the Army, has not remained backward." Three base-lines have been measured with Brunner's apparatus : the western base, at Garla Mare (6200 metres) ; the central base, in Bucarest (9420 metres) ; and the northern base, at Roman (7400 metres). The astronomical observations have been commenced for the measurement of an arc of parallel, supported by three bases (the westprn, central, and an eastern one, at Slobozia), which will produce to the Black Sea the mean parallel, already measured from the Atlantic. On the other hand, the meridian arc, de- pending upon three bases

(eastern, northern, and a Rus- sian base near the Dniester), will help to join the Russian arc of Struve with the African arc of Gill, in long! 30° E. For their levellings the Rumanian geodesists have adopted the methods employed in the Nwellertient gdniral de la France, under the direction of M. Lallemand. It has already been reported that there does, not exist any dif- ference of mean level between the Black Sea and the Adriatic, contrary to what has hitherto been generally believed.

Greece, also, is now in possession of a valuable survey, which has been effected under Colonel Hartl.

~~*In Russia the Topographical Section of the General Staff has begun great calculations, for the sake of unifica- tion of the various triangulations, executed at very dif- ferent epochs. As spheroid of reference, the Besselian ellipsoid was made use of, which seems to suit better with the surface of the Russian Empire than that of Clarke, which had been utilized several times since 1880. In fact, General Bonsdorfif, by a new calculation of the arc of Struve (long. 30° E.), found the ellipticity 1/298-6, scarcely different from Bessel (1/299). On the other hand. Professor Shdanov, by the arcs of the parallels of 52° and 47°, combined with three meridian arcs which run across, found nearly the same result (1/299-7). The , Clarke ellipsoid has, on the contrary, a much stronger ellipticity (1/293-5), which results from the influence of the Indian arc.*~~

~~*In the new mathematical treatment of the Russian triangulations, only the geometrical conditions of the system and the astronomical azimuths have been taken into account, leaving aside astronomical longitudes and latitudes, too much influenced by local attractions. It was therefore decided to compute the geodetical co-ordin- ates of the stations, starting from Dorpat (Yurief) as a point of reference. Besides the three fundamental chains (meridian arc of Struve, arcs of the parallels of 47° and 52°), four polygonal systems were at hand, formed by these chains, and meridian or parallel arcs, measured in the zone comprised between Warsaw and Saratof. The vastness of these systems prevented the application of a uniform method of simultaneous adjustment, and made it necessary to resort to partial adjustments before the final. connexion of the several parts of the network.*~~

~~*The results of the computations relative to the parallel of Central Europe (lat. 52°), that ranges over 69° of longitude, with a linear development of 4730 kilometres, from Valentia (Ireland) to the Ural, are now known. The radius of curvature of this parallel is smaller than that corresponding to the Clarke ellipsoid ; it belongs to another ellipsoid ; according to Helmert, this might be an ellipsoid with the equatorial radius found by Clarke (which is confirmed by the computation of the meridian arc of Struve), but with a much smaller ellipticity, smaller even than Bessel's, i.e., 1/308. It is true that the parallel*~~

1 See Report of General Bratiano.

2 See Oeodesy, by Colonel A. R. Clarke.

Oxford, 1880.

of 52° presents a very sensible irregularity : the eastern, or Russian, half would agree well enough with Clarke's ellipsoid, but the western half concords better with Bessel's, its average curvature being greater than that of the eastern half. There lies a strong indication of the attraction of continents ; this seems to be confirmed by the curvature of the Anglo-French meridian arc, which proves a little greater than that of the l^ussian arc of Struve, and by the fact that the polar semi-axes of the ellipses of these two arcs do not coincide ; they separate by 4"-5, in such a manner that Russian latitudes are too large by 4"-5, or the others too small by the same amount.

The United States Coast and Geodetic Survey has published an account of the transcontinental triangulation and measurement of an arc of the parallel of 39°, which extends from Cape May (l^ew Jersey), on the Atlantic coast, to Point Arena (California), on the Pacific coast, and embraces 48° 46' of longitude, with a linear develop- ment of about 4225 kilometres (2625 st. miles). The triangulation depends upon ten base-ljnes, with an aggre- gate length of 86 kilometres, the longest exceeding 17 kilometres in length, which have been measured with the utmost care. "A characteristic of the triangulation is its rigidity, imparted to it by quadrilaterals and other polygons. Iji crossing the Rocky Mountains, many of its sides exceed one hundred miles in length, and there is one side reaching to a length of 294 kilometres, or 183 St. miles ; the altitude of many of the stations is also considerable, reaching to 4300 metres, or 14,108 feet, in the case of Pike's Peak, and to 14,421 feet at Mount Elbert. All geometrical conditions subsisting in the triangulation are satisfied by adjustment, inclusive of the required accord of the base-lines, so that the same length for any given line is found, no matter from what line one may start." ^

Over or near the are were distributed 109 latitude stations, "occupied with zenith telescopes ; 73 azimuth stations ; and, 29 telegraphically determined longitudes. It has thus been possible to study in a very complete manner the

deviations of the vertical, which in the moun- tainous regions sometimes amount to 25 seconds, and even to 29 seconds. According to Mr Schott, the average curvature of the surface of the geoid, along the parallel of 39°, approaches closely to that of the Clarke spheroid in the eastern part of the arc, which extends from the Atlantic to the Rocky Mountains, and to that of the Besselian spheroid in the western part, on the Pacific side, which represents f of the arc. Thus in North America as well as in Europe the curvature increases from east to west. Some preliminary combinations of this arc with other .American arcs lead to spheroids approaching that of Clatke.

The computations relative to another arc, the " eastern oblique arc of the United States," are also available. It extends from Calais (Maine) in the north-east, to the Gulf of Mexico, and terminates at New Orleans (Louisiana), in the south. Its length is 2612 kilometres (1623 st. miles), the difference of latitude 15° V, and of longitude 22° 47'. In the main, the triangulation follows the Appalachian chain of mountains, bifurcating once, so as to leave an oval space between the two branches. It includes among its stations Mount Washington (1920 metres) and Mount Mitchell (2038 metres). It depends upon six base'-lines, and the adjustment is effected in the same manner as for the arc of the parallfel. The astronomical data have been afforded by 71 latitude stations, 17 longitude stations, and 56 azimuth stations, distributed over the whole extent of the arc. For various reasons a selection had, however.

' U.S. Coast and Geodetic Survey; H. S. Prltchett, superintendent. The Transcontinental Triangulation and the American Arc of the Parallel. By C. A. Schott, assistant C. and G. S. Washington, 1900.

to be made among these data, a part of which only was admitted into the final equations for the determination of the best spheroid (84 data out of 144). The resulting dimensions of an osculating spheroid were found to be

Equatorial radius . Compression (elliptioity)

6,378,157 ±90 metres. l/304-5±l-9.

The equatorial radius differs but little from Clarke's value of 1866, whereas the compression is very different, and comes more nearly to Bessel's value.

The measurement of a great meridian arc, in long. 98° W., has also begun ; it has a range of latitude of 23°, and will extend over 50° when produced southwards and northwards by Mexico and Canada. It may afterwards be connected with the new arc of Quito. Geodetical sur- veys of some extent have also been undertaken in New South Wales and in Queensland.

Differences of longitude were measured along the cir- cuit Green wich-Pulkowa- Vladivostok-Shanghai-Madras -Tehran-Potsdam-Greenwich.

-% We transcribe from Mr Schott a comparative table of the dimensions of several spheroids which of late have been often quoted : —

' EUipsoid of

Equatorial BadiuB a.

Polar Semi- Axis b.

Compression (a-i)/a.

Bessel, 1841. From ten meri-

m.

m.

dional arcs, total amplitude

90° -6

6,377,397

6,356,079

1/299-15

Clarke, 1858. Special spher-

oid for surface of Great

Britain and Ireland ; range

of lat.- 12°, the same in

long. ; 75 astron. stations .

ff,378,494

6,355,746

1/280-4

Clarke, 1866. From five

merid. arcs, total ampli-

V

tude 76° -6 . . ” .

6,378,206

6,356,584

1/295-0

Clarke, 1880. From five

merid. arcs and longitud-

inal measures, total ampli-

tude 89° -0 .

~~6,378,249~~

~~6,356,515~~

~~1/293-5~~

~~U.S. Coast and Geod. Sur-~~

~~vey, 1900. Eastern oblique~~

~~'arc ; total length 23° -6 ; 84~~

~~astronomic stations .~~

~~6,378,157~~

~~6,357,210~~

~~1/304-5~~

~~Bonsdorff, 1899. Russian~~

~~merid. arc, amplitude 25° -3~~

~~6,378,344~~

~~6,356,983~~

~~1/298-6~~

~~Shdanov,1899. Russian par-~~

~~allels of 47° and 52°, and~~

~~three merid. arcs~~

~~6,377,717~~

~~6,356,437~~

1/299-T

Harkness, 1891. Erom a

variety of sources (Solar

Parallax, Washington,

1891)

6,377,972

6,356,727

1/300-2

It is thus evident that great efforts are now being made by all civilized nations to complete the network of tri- angles that will ere long, cover the whole surface of the continents. In due course we shall be in possession of the results of some of the most important undertakings, now in process of execution. Meantime it may be ad- mitted as highly probable that the dimensions of the geoid are nearly those adopted by Clarke (a > 6,378,000 metres), with an ellipticity approaching to Bessel's value (1/299). The ellipsoid of three unequal axes has been abandoned, mainly for theoretical reasons * that lead us to prefer an ellipsoid of revolution as a reference spheroid, in relation to which may be stated the prominences and depressions of the true geoid. In Europe, according to Helmert, the deviations of level are scarcely over 100 metres.

1 F R. Helmert, Die mathematischen und physiMlUchen Theorieen der h'sheren Geodasie, 2 vols., 1880-1884. See t. ii. p. 135.

But it is necessary to agree precisely on the definition of the geoid. This word is generally understood to mean a level surface coinciding with the mathematical surface of the sea, produced below the continents, which it is imagined to percolate by canals or open cuttings. In that case the reduction of gravity to the sea-level ought to be

done simply by the correction for height [+2g:^\ just as.

if the superposed strata were condensed upon the surface of the geoid. A somewhat different geoid would be ob- tained by supposing the surface of the oceans continued below the continents by means of tunnels, or by a levelling in mine galleries, for then the attraction of the upper strata dimmislies the gravity at the sitrface of the geoid, and the latter will be a little below the surface of the former geoid ; it has discontinuities of curvature where it enters the continents. If now, according to what is often done, we add to the reduction of gravity Bouguer's correc- tion (— g — — J, which goes to subtract the attraction of

the continent, 8 being the density of the grotind, and A the mean density of the earth, we thereby suppose the upper layers erased ; but the process is inadmissible, since we know that mountain masses are generally compensated ' by a deficiency of matter in the underlying strata. In Europe the compensation is often found to be incomplete, whereas in the Himalaya' r^ige the attracting masses are sometimes over-compensated.

Professor Helmert, who has devoted much labour and time to the calculations of measures of gravity by means of pendidum observations, has proposed another mode of reduction, which is known by the name of " condensation method." He imagines the upper strata condensed upon the surface of a geoid situated at a depth of 21 kilometres (its- equatorial radius being, therefore, equal to the polar semi-axis of the earth). Thi^ process, conceived with a view to facilitate the development of the potential, presents the inconvenience of introducing many very uncertain data, and may seem somewhat artificial. Professor Helmert has found that it brings into fair agreement the numerous measures of gravity already obtained. The number of stations is about 1400, out of which more than 50 have been connected with the central bureau in Potsdam. A thorough examination of the deflections of the vertical, or local attractions, observed in all parts of Europe has also been undertaken by the central bureau.

According to Helmert, the ellipticity of the earth, as derived from pendulum observations, is 1/299-3 (in his^ latest paper the corrected result is 1/298-3), and from the lunar theory 1/297-8 ; Hansen's value is 1/296-2. Lastly, M. Eadau has shovn^ that by the introduction of the

variable r]= , where c, e are the mean radius and ellip-

edc ticity of a spheroid, it becomes possible to integrate ap- proximately the equations of Clairaut, and to establish a relation which affords the means for an independent evaluation of the ellipticity of the earth. The subject is very fully gone into in two important memoirs, one by M. Callandreau,' the other by Professor l)arwin, whose results point to an ellipticity between 1/296 and 1/298. Professor Darwin further concludes that the level surface of the earth is depressed below the true ellipsoid by 3 metres in latitude 45°. It is highly probable that a value*

2 Comptes Rendus, t. c, 1885. See also Tisserand, Traits de Mecan- ique celeste, ii. p. 221.

8 O. Callandreau, " Memoire sur la Theorie de la figure des planfetes," Annates Obs. Paris, vol. xix., 1889. See also Bullet. Astron., 1897.

- *G. H. Darwin, The Theory of the Figure of the Earth, carried to the Second Order of Small Quantities. (Monthly Notices R.A.S., vol. be., December 1899.)*

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differing but little from'^Bessers (1/299) will be finally adopted. It must, of course, be borne in mind that the spheroid here considered is a spheroid of reference, and that the true geoid may present many irregularities.

A question which has much absorbed the attention of geodesists of late years, but which need only be briefly mentioned here, is that of the variation of latitudes, re- sulting from a periodical shift of the axis of rotation on the surface of the earth. Suspected by Bessel (1817), the variability of latitudes was proved by the researches of Peters (1844) and Nyrea (1873), founded on the observations of Pulkowa; but these astronomers had found only a very slight amplitude (0"-10) in adopting the ten-months' period, which seemed 'pointed to by Enter's theory. The researches of Clerk Maxwell (1857), Fergola (1872), Downing (1880),

Kiistner (1888), having once more attracted attention to this subject, in the year 1889 the observatories of Berlin, Potsdam, Prague, and Strasburg concerted a plan for regular determinations of latitude by Talcott's method; and variations of from 0"-3 to 0"5 were brought to light. Since then many other observatories have taken part in the work, and a special expedition was sent to Honolulu in 1891. Pro fessor Albrecht every year brings together the results of the gathered observations. Prom his detailed reports it follows that, since 1890, the pole of rotation of the earth has described an irregular spiral, of variable amplitude, around a mean position from which it does not deviate by more than 0"3. On the other hand, Mr S. C. Chan dler, by a careful discussion of observations from 1825 to 1893, arrived at the conclusion that the latitude variation is composed of two terms, one haying a period of 14 months (429 days), the other a mean period of a year, with amplitudes varying from 0"-10 to 0"20; he thinks the annual component may be elliptical. As to the theo retical question of the causes of these variations. Lord Kelvin has already stated that meteorological influences might be the cause of annual variations so great as 0"5. M. Kadau has further shown ^ that the combination of an annual period with another period, such as the Euler ian one, could result in great amplification of the effects. Finally, Professor Newcomb has explained the existence of the fourteen-months' period by the influence of the elasticity of the earth. It was for the sake of an exhaus- tive study of these questions that an "International Service of Latitudes " was organized in 1899 by the Geodetic Association in six observatories distributed along the parallel of 39°. (e. ra.)

Earthquakes. — Strange as it may appear, the advances that have been made in the study of earth- Attenuion l^^'^^^s, and the world-wide interest shown now given in their phenomena, were initiated in work toseismo- commenced in Japan. When the Japanese ""■ Government, desiring to adopt Western know-*

ledge, invited to its shores bodies of men to act as its instructors, the attention of the newcomers was naturally attracted to the frequent shakings of the ground. Inter- est in these phenomena increased more rapidly than their frequency, and at length it was felt that something should be done for their systematic study. At midnight on 22nd February 1880 movements

more violent than usual occurred ; chimneys were shattered or rotated, tiles slid down from roofs, and in the morning it was seen that Yokohama had the appearance of a city that had suffered a bombardment. The excitement was intense, and before the ruins had been removed a meeting was convened and the Seism ological Society of Japan estab- lished. The twenty volumes of original papers published

1 Comtes Sendus, t. cxi., 1890.

by this body summarize to a large extent the results of the later study of Seismology.

The attention of the students of earthquakes in Japan was at first directed almost entirely to seismometry or earthquake measurement. Forms of apparatus which then existed, as for example the seismographs, seismome- ters, and seismoscopes of Mallet, Palmieri, and others, were subjected to trial ; but inasmuch as they did little more than indicate that an earthquake had taken place — the more elaborate forms recording also the time of its occurrence — they were rapidly discarded, and instru- ments were constructed to measure earthquake motion. To describe the varieties of apparatus devised in Japan and their purposes would require a special volume on Seismometry. Slightly modified types of the new instru- ments were adopted throughout the Italian peninsula, and it is fair to say that the seismometry developed in Japan revolutionized the seismometry of the world. The records obtained from the new instruments increased our knowledge of the character of earthquake motion, and the engineer and the architect were placed in a position to construct so that the effects of known movements could be minimized. It was no doubt the marked success, both practical and scientific, attending these investigar tions that led the Japanese Government to establish a chair of Seismology at its University, to organize a system of nearly 1000 observing stations throughout the country, and in 1893 to appoint a committee of scientific and practical men to carry out investigations which may palliate the effects of seismic disturbances. In the first year this committee received a grant of £5000, and as liberal sums for the same purpose appear from time to time in the parliamentary estimates, it may be assumed that the work has been fraught with good results. In their publications we find records not only of

experiences and experiments in Japan, but descriptions and com- ments upon earthquake effects in other countries. In two of the volumes there are long and extremely well- illustrated accounts of the earthquake which on 12th June 1897 devastated Assam, to which country two members of the above-mentioned committee were de- spatched to gather such information as might be of value to the architect and builder in earthquake-shaken districts.

A great impetus to seismological investigation in Eu- rope and America was no doubt given by the realization of the fact that a large earthquake originating in any one part of the world may be recorded seismo in almost any other. Italy for many years past research. has had its observatories for recording earth- quakes which can be felt, and which are of local origin, but at the present time at all its fiftefen first-class star tions we find instruments to record the unfelt movements due to earthquakes originating at great distances, and as much attention is now paid to the large earthquakes of the world as to the smaller ones originating within Italian territory. The Kaiserliche Akademie der Wissen- schaften of Vienna has established earthquake observato- ries in Austria, and the Central Observatorium of St Petersburg has carried out similar work in Russia. Germany, at a cost of £3500 and with an annual allowance of £295, has attached a seismological obser- vatory to its university at Strasburg, whilst provision has been made for a professorship of Earth Physics at Gottingen. In accordance with the recommendation of the British Association of Great Britain, seismographs of a similar character have been installed at the following places : — ^Isle of Wight, Kew, Paisley, To- ronto, Victoria (B.C.), Philadelphia, Mexico, Trinidad, Arequipa, Cordova in Argentina, New Zealand, Ha- waii, Japan, Java, Calcutta, Madras, Bombay, Mauritius,

the Cape of Good Hope, Cairo, Beyrout, San Fernando in Spain. The principal objects of this extended and still extending system of stations are to determine the velocity with which motion is propagated over the surface aiid through the interior of the earth, to locate the posi- tions of sub-

oceanic earthquake origins, and generally to extend our knowledge respecting the physical nature of the planet on which we HIve.

We now know that earthquakes are many times more frequent than was previously supposed. In Japan, for example, between 1885 and 1892 no fewer than f^IX*^ 8331 were recorded— that is to say, on the quakes. average there were during that time more than 1000 disturbances per year, y Although many of these did not cause a sensible shaking over areas exceeding a few hundred square miles, many of them were sufiiciently intense to propagate vibrations round and through the globe. If we pick out the well-marked earth- quake districts of the world, and give to each of them a seismicity or earthquake frequency per unit area one-third of that in Japan, the conclusion arrived at is that con- siderable areas of our planet are on the average shaken every half-hour.

The knowledge which we now possess respecting the localities where earthquakes are frequent and the forms of ' the foci from which they have spread, enables

aadeara- ^^ *° Speak definitely respecting the originat- quakes. iug causes of many of these phenomena. It is found, for example, that although in many countries there may be displays of volcanic and seismic activity taking place almost side by side, it is only rarely that there is direct relationship betw^n the*two. Now and then, however, before a volcano breaks into eruption there may be a few ineffectual efforts to form a vent, each of which is accompanied by no more than a slight local shaking of the ground. This is true even for the largest and most violent eruptions, when mountains have with practically a single effort blown off their heads and shoulders. Thus the earthquake which accompanied the eruption of Bandaisan, in Central Japan, in 1888 was felt only over a radius of 25 miles. The analyses of the seismic registers of Japan clearly indicate that comparatively few shakings originate near to the vol- canoes of the country, the majority of them, like those of many other countries, coming from regions where volcanic rocks are absent. The greatest number spread inland from the Pacific sea-board, the movement becoming more and more feeble as it approaches the backbone of the coiintry, which is drilled with numerous

volcanic vents. What is true for Japan is generally true for the western coasts of North and South America.

Speaking broadly, earthquakes are most frequent along the steeper fiexures in the earth's surface, and in those regions where there is geological evidence to Origin of show that slow secular movements in the earth's q^takes. crust are possibly yet in progress. With a unit distance of 2 degrees, or 120 geographical mil^s, we find' that the slopes running eastwards from the highlands of Japan and westwards from the Andean ridges down into the Pacific vary from 1 in 20 to 1 in 30, and it is on the faces or near to the bottom of these slopes that seismic efforts are frequent. The 'slopes running from Australia, Eastern America, and Western Europe into the neighbouring oceans vary between 1 in 70 and 1 in 250, and in these regions earthquakes are of rare occurrence. The seismic activity met with in the HImalayas and the Alps finds its best explana- tion in the fact that these mountains are geologically recent, and there are no reasons to doubt that the forces which brought their folds into existence are yet in action.

This peculiar association of earthquakes with pronounced topographical configuration and certain geological con- ditions evidently indicates that the origin of many of them is connected with rock folding. Inasmuch as certain large earthquakes have been accompanied by rock fracture, as for example in 1891, when in Central Japan a fault some 50 miles in length was created, whilst the origins of others have been distinctly traced to the line of an exist- ing fault or its continuation, we may conclude that the majority of earthquakes are spasmodic accelerations in the secular movements which are creating (and in some in- stances possibly obliterating) the more prominent features of the earth's surface. These secular movements, which include upheavals, subsidences, horizontal displacements, all of which are explained on the assumption of a crust seeking support on a nucleus gradually contracting by loss of heat, are collectively referred to as bradyseismical (/SpaSu's = slow) movements. To these may be added movements directly attributable to the influence of gravity. Sub-9ceanic districts in a state of seismic strain may be so far loaded by the accumulation of sediments that gentle bending may be accompanied by sudden yieldings. This possibly accounts for the frequency of earthquakes off the mouth of the Tonegawa on the eastern side of Japan.

The distortions so frequently observed in fossils and pebbles, the varying thickness of contorted strata, and the " creep " in coal mines, together with other phenomena, indicate that rocks may flow. Obseryar tions of this nature lead to the supposition that high plateau-like regions may be gradually subsiding under the influence of their o,wn weight, and that the process of settlement may from time to time be spasmodic in its character. Whether the earthquakes which originate round the submerged basal frontiers of the continents bounding the Pacific are ever attributable to such ac- tivities, it is impossible to say. All that we know with certainty is that they are sometimes accompanied by such a vast displacement of material that the ocean has been set into a state of oscillation for periods of 24 hours, that in some instances there have been marked changes in depth, and that enormous sub-oceanic landslips have occurred. These phenomena are, however, equally well explained on the assumption of sudden faulting accom- panied by violent shaking, which would dislodge steeply- inclined beds of material beneath the ocean as it does upon the land.

Although the proximate cause of earthquake motion is traced to sudden yieldings in the crust of the earth brought about by some form of bradyseismical , action, the existence of at least two distinct oteartb-^ types of seismic motion indicates that the quake mechanical conditions accompanying the frac- '""""""'• turing of rocks are not always identical. Ninety or ninety- five per cent, of -the earthquakes which can be recorded consist of elastic or quasi-elastic vibrations. The re- mainder, including the large earthquakes, not only exhibit the elastic movements, but are accompanied by surface undulations which are propagated most certainly for some hundreds of miles round their origin, and then as hori- zontal movements sweep over the whole surface of the globe. The former of these may accompany the formation of a new fault or the sudden renewal of movement along an old one ; they are cracking or rending effects, with- out any great displacement. The latter are probably fracturings accompanied by vertical and horizontal dis- placements of masses of the earth's crust sufiiciently great to set up the observed surface undulations. These shocks are so frequently followed a few minutes later by dis- turbances, which from their similarity to the movements whichhave preceded them may be called earthquake echoes, that we are led to the speculation that we are here dealing*

with the caving-in of ill-supported portions of the earth's CTOst, the waves from which are radiated to boundaries and then returned to their origin to coalescc and give rise to a second impulse not unlike the primary. Succeeding the first repetition of motion recorded by the seismo- graph there is often a rhythmical repetition of similar wave groups, suggesting the existence within our earth of phenomena akin to multiple echoes.

Before considering in greater detail the nature of eartliquake motion, sometliing may be said respecting tlie instruments by wliich our knowledge of the subject has been gained. Selsmo- Popularly it is supposed that earthquake recorders ™* •"■ are instruments so sensitive to slight vibrations that

great care is necessary in selecting a site for their installation. Although this supposition is correct for a certain class of ap- paratus, as for example that which will record rapid elastic vibrations produced by the movement of a train a mile distant, it is far from being so for the ordinary apparatus employed by the seismologist. "What he usually aims at is either to record the more or less rapid movements of the ground which we can feel, or the slow but large disturbances which do not appeal to our unaided senses. Generally speaking, the instruments used for these purposes are not disturbed by the vibrations resulting from ordinary traffic. In almost every household something may be found which will respond to a gentle shaking of the ground. Sometimes it is a loosely-fitting shutter or window-frame, a hang- ing drawer-handle, or a lamp-shade which will rattle ; the tim- bers in a roof may creak, or a group of wine-glasses with their rims in contact may chatter. Any of these sounds may call attention to movements which otherwise would pass unnoticed. Specially arranged contrivances which tell us that the ground has been shaken are called seismoscopes or earthquake indicators. A small column, as for example a lead pencil standing on end, or a row of pins propped up against suitable supports, or other bodies which are easily overturned, may be used as seismoscopes. Experience, however, has shown that contrivances of this order

are wanting in sensi- bility, and often re- main standing dur- ing movements that are distinctly per- ceptible. A more satisfactory arrange- ment is one where the body to be overturned is placed upon a plat- form which exagger- ates the movements of the ground. For example, the platform h (see Fig. 1) may be on the top of a smfiU rod r, fixed at its lower end by plaster of Paris in a watch-glass w, and carrying a disc or sphere of lead at I. When the stand on which w rests is shaken, a multiplied place at h, and any

Fig. 1.

representation of this movement

small body resting on that point, as for example a small screw s standing on its head, may be caused to topple over. If the loaded rod is elastic its lower end may be fixed in a stand, and the spherically curved base w is no longer required. In this case the motion at h is that of elastic switching. Apparatus of this kind may be employed for several purposes beyond merely indicating that an earthquake has taken place. For example, if the falling body s is attached by a thread to the pendu- lum of a timepiece, it may be used to stop it and indicate the approximate time at which the tremor occurred. In its most sensitive form r is a steel wire, the upper end of wliich passes freely through a small hole in a metal plate. By the movement of the wire or the movement of the plate, especially it the latter projects from the top of a second and similar piece of apparatus, an electrical contact can be established by means of which an electromagnet may ring a bell, stop a clock, or set free machinery connected with a cylinder or other surface upon which an earthquake machine may record the movement of the ground.

The next class of instruments to be considered are seismometers or earthquake measurers, and seismographs, or instruments which give diagrams of earthquake motion. Although a seismograph may be designed that will not only respond to fairly rapid elastic vibrations, but will also record very slow and slight undulatory movements of the groimd, experience has shown that the most

Fig. 2.

satisfactory results are obtained when special instruments are employed for special purposes.

First we will consider the types of apparatus which are used to record the rapid back-and-forth movements of earthquakes which can be distinctly felt and at times are even destructive. The essential feature in these seismographs is a fairly heavy mass of metal, so suspended that although its supports are moved, some point in the mass remains practically at rest. For small earth- quakes, in which the move- ment is rapid, the bob of a very* long and heavy pendu- lum wUl practically comply with these conditions. If a style projecting from this pendulum rests upon say the smoked surface of a glass plate fixed to the ground, the vibra^- tory motion of the ground will be recorded on the glass plate as a set of superimposed vibrations. To obtain an open diagram of these move- ments the plate must be moved, say by clockwork.

Experience, however, has shown that even when the movements of the ground are alarming the actual range of motion is so small that a satisfactory record can be obtained only by some mechanical (or optical) method of multiplication. This is usually accomplished

as shown in Fig. 2. 6 is the bob of a pendulum, with its style s passing through a slot in the short arm of a light lever, sop, pivoted at o, and with its outer end resting upon a revolving cylinder covered with smoked paper. As shown in the figure, it is ^ident that the motion of o in the line sop would not be recorded, and to obtain a complete record of horizontal move- ments it is necessary to have two levers at right angles to each other. A complete arrangement of this kind is shown in the plan of Fig. 2. Here the style s of the pendulum rests in slots in the short arms of two writing levers pivoted at o and o'. Motion of the ground in the direction as actuates only the lever so'p', motion in the direction o's actuates only sop, whilst motion in intermediate directions actuates both. The length of the short arms of the levers is usually J or ^ of the long arms.

Although this type of apparatus is still largely employed in the Italian observatories, it has been replaced jn Japan by what are called duplex pendulum seismo- graphs. The change was made^"'"** because it frequently happened that '"""""""*• in consequence of the movement of

the ground agreeing with the period of the pendulum, the latter no longer acted as a steady point, but was caused to swing, and the record became little better than that given by a seismo- scope. Very long pendulums (30 to 40 feet) are less subject to this disadvantage, but on the other hand their installation is a matter of some difficulty. A duplex pendulum (Fig. 3) consists of an ordinary pendulum diagram- matically represented by ab, connected by a universal joint to an inverted pendulimi dc. The latter, which is a rod pointed at its lower end and loaded at c, would be unstable if it were not connected with 6. Now imagine this system to be suddenly displaced so that a moves to a' and d moves to d'. In the new position 6 would tend to follow the direction of its point of support, whilst c would tend to fall in the opposite direction, and the bob of one pendulum would exercise a restraint upon the motion of the other. If, as in practice, the moment of 6 is made slightly greater than that of c, the system will come slowly to a vertical position beneath a'd'? In this way, by coup- ling together an ordinary pendulum about 3 feet in length with an inverted pendulum 2 ft. 6 in. long, it is easy to obtain the equivalent of a slowly moving very long pendulum which is too sluggish to foUow the back-and-forth movements of its supports. To complete an instrument of this description (see Fig. 4) a point in the steady mass & is used as the fulcrum for the short arm of a light-writing index. This has a ball joint at s, a universal joint at 0, and a writing point 3.tp, resting upon a piece of smoked glass. Attention was first directed to the possibility of render- ing ordinary pendulums more ti-uly astatic by Professor Thomas

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imssswS

Fig. 3.

EAETHQUAKiES

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Gray, who suggested methods by which this might be accomplished. The method shown in Fig. 4 is that devised by Professor J. A. Ewing. Records obtained from instruments of this description give information respecting the range and principal direction of motion, and show us that in a given earthqualje the ground may move in many azimuths.

For obtaining an open diagram of an earthquake the best type of appa- ratus consists of a pair of horizontal pendulums writing their movements upon a moving surface. A simple „ , . , form of horizontal pendu- -“™il”..f «?owninFig 5, consists of a rod, op, free to swing like a gate round a vertical or nearly vertical axis, eo’, and loaded at some point 6. In practice the weight h is pivoted on the rod whilst its outer end, bp, which writes on a smoked surface, is made extremely light. When the frame of this arrangement is rapidly displaced through a small horizontal range to the right and left of the direction in which tile rod points, the weight 6 by its inertia tends to remain at rest, and the motion of the frame, which is that of the earth, is magnified in ‘the ratio op to bp. This apparatus, of which there are many types, was first introduced into seismometry by Pro fessor Ewing.

To obtain a complete record of horizontal motion, two of these pendu- lums are placed at right angles ; and by cranking one of the writing levers, o’p’, as shovm in the plan of Fig. 5, two rectangular components ot the earth’s movements are written side by side. Since the movements of the ground are frequently accompanied by a slight tilting, which would cause 6 or 6' to swing or wander away from its normal position, a sufficient stability is given to the weights by inclining the axis of the instrument at cc’ slightly forwards. Although by compounding oorrespondiUg’TJortions of the diagrams given by instruments of this type, it is possible to determine the range and direction of the movement of which they are the resolved parts, their

Fig. 4.

Fig. 5. chief value is that they enable us to measure with ease the extent of any vibration, half of which is called its amplitude, and the time taken to make any complete back-and-forth movement, or its period. Now if a be the amplitude expressed in millimetres, and t the period expressed in seconds, then the maximum velocity of an earth particle as it vibrates to and fro equals ^va/t, whilst the maximum acceleration equals iwH/fi. The former quantity determines the distance to which a body, as for example the cap- ping of a pillar, may be projected, whilst the latter measures the

efiort exerted by an earthquake to overturn or shatter various bodies. If after a heavy earthquake we find bodies that have been projected or overturned, then by observing the distance of projection, and the height through which they have fallen, or their dimensioijs, we can by means of simple formulae calcu- late quantities closely agreeing with those obtained from the seismogram. For example, if a body, say a coping-stone, has been thrown horizon- tally through a distance a, and fallen from a height 6, the maximum horizontal velocity with which it was projected

equals

V26-

or if the

Fig. 6.

seismo- graph.

height of the centre of gravity of a column like a gravestone above the base on which it rests is y, and x is the hori- zontal distance of this centre from the edge over which it has turned, then the accel- eration or suddenness of motion which caused its overthrow is measured, as pointed out

by Mr C. D. West, with fair accuracy by the quantity g-.

To measure vertical motion, which with the greater number of earthquakes is not appreciable, a fairly steady mass to which a multiplying light-writing index can be attached is ;

*obtained from a weight carried on a lever held by any '^ **

form of spring in a horizontal position. Such an arrangement, for which seismologists are indebted to Professor T. Gray, is shown in Fig. 6, in which B is the mass used as the steady point. This, when supported as shown, can be arranged to have an extremely slow period of vertical motion, and in this respect be equivalent to a weight attached to a very long spring, an alternative which is, however, impracticable. The value of these records, as is the case with other forms of seismo- graphs, is impaired by pronounced tiltings of the ground.

We next tutn to types of instruments employed to record earthquakes which have radiated from their origins, where they may have been violent, to such distances that their movements are no longer perceptible. In these instru- lostni- ments the same principles are followed as in the con- ™"^f .° struction of horizontal pendulums, the chief difference tant earth- being that the so-called steady mass is arranged to have quakes. ,a much longer period than that required when record- ing perceptible earthquakes. Instruments largely employed for*

this purpose in Italy are ordinary pendulum seismo- graphs as in Fig. 2. The largest of these is one at Ca/- tania. It consists of a weight of 300 kilos suspended by a wire 25 metres in length, the movements of which by means of writing indexes are multiplied 12-5 times. With pen- dulums of shorter length, say 2 me- tres, it is necessary to have a multipli- cation 80 to 100 fold by a doubjle system of very light levers, in or- der to render the extremely slight tilting of their sup- port perceptible. This arrangement, as devised by Professor Vicentini, will yield excellent diagrams of the gentle undulations of earthquakes which have originated at great distances, but for local disturbances, even if the bob of the pendulum acts as a steady point, the displacements are usually too great to be recorded on ordinary record-receiving surfaces when so largely multiplied.

In Japan, Germany, Austria, England, and Russia horizontal pendulums of the von Rebeur-Paschwitz type are employed, which by means of levelling screws are usually adjusted to have a natural

Fig. 7.

period or double swing of from 15 to 30 seconds. These pendu- lums are usually small. The swinging arm or boom is from 4 to 8 inches long horizontally, and carries at its extremity a weight of a few ounces. A simple form, which is sometimes referred to as a conical pendulum, may be constructed with a large sewing needle carrying a galvanometer mirror, suspended by means of a silk or quartz fibre as shown in Pig. 7. To avoid the possibOity of displacements due to magnetic influences, the needle may be re- placed by a brass or glass rod. The adjustment of the instrument is effected by means of screws in the bed-plate, by turning which the axis o'o" may be brought into a position nearly vertical. As this position is approached the period of swing becomes greater and greater, and sensibility to slight tilting at right angles to the plane of o'o"m is increased. The movements of the apparatus, which when complete should consist of two similar pendulums in planes at right angles to each other, are recorded by means of a beam of light, which, after reflexion from the mirror or mirrors, passes through a cylindrical lens and is focussed upon a moving surface of photographic paper. The more distant this is from the pendulum the greater is the magnification of the angular movements of the mirror. With a period of 18 seconds, and the record-receiv- ing paper at a distance of about 15 feet, a deflection of oiie milli- metre of the light spot may indicate a tilting of j Jj part of a second of arc, or 1 inch in 326 miles. Although this high degree of sensi- bility, and even a sensibility still higher, may be required in con- nexion with investigations respecting changes in the vertical, it is not necessary in ordinary seismometry.

A type of instrument which has sufficient sensibility to record the various phases of unfelt earthquake motion, and which, at the suggestion of a committee of the British Association, has been adopted at many

observatories throughout the world, is shown in rig. 8. With an adjustment to give a 15-second period, a deflexion of 1 mm. at the outer end of the boom corresponds to a tilting of the bed-plate of 0”-5, or 1 inch in 6-4 miles. The record is obtained by the light from a small lamp reflected down-wards by a mirror so as to pass through a slit in a small plate at- tached to the outer end of the boom. The short streak of light thus obtained moves with the movement of the boom over a second slit perpendicular to the first and made in the lid of a box con- taining clock-work driving a band of bromide paper. With this arrangement of crossed slits a spot of light impinges^ on the photographic surface and, when the boom is steady, gives a sharp fine line. The passage of the long hand of a watch across the end of the slit every hour cuts off the light, and gives hour

Fig. 9.

Mirror

\|Aa

Table

Walch

Sland

Boom

Fig. 8.

marks enabling the observer to learn the time at which a disturb- ance has taken place. The chief function of the instrument is to measure slow displacements due to distant earthquakes. For local earthquakes it will move relatively to the pivoted balance weight like an ordinary bracket seismograph, and for very rapid motion it gives seismoscopic indications of slight tremors due to the switching of the outer end of the boom, which is necessarily somewhat flexible. If we wish to obtain mechanical registrar tion from a horizontal pendulum of the above type, we may

minimize the effect of the friction of the writing index say

a glass fibre touching the smoked surface of moderately smooth paper— by using a considerable weight and placing it near to the

outer end of the boom. In the Isle of Wight there is a pair of pendulums arranged as in Fig. 5. The stand is 3 feet in height. Weights of 10 fi each are carried at a distance of 10 inches from the pivots of booms which have a total length of 34 inches. With these, or even with booms half the above length, actuating indices arranged as shown in Fig. 2, but multi- plying the motion six or seven times, good results may be obtained. At Kocca di Papa near Rome there is a pair of horizontal pendulums with booms 8 feet 9 inches in length, 17 feet in vertical height, which carry near their outer ends weights exceeding half a hundredweight. Although such apparatus is far too cumbersome to be used by ordinary observers, it yields valuable results.

An apparatus of great value in measuring slight changes in the vertical which have a bearing upon seismometrical observation is the Darwin bifllar pendulum. This consists of a mirror about half an inch in diameter, which, when it is suspended as shown in Fig. 9, rotates by tilting at right angles to the paper. By this rotation a beam of light reflected from the surface suffers displacement. It is possible to adjust the apparatus so that a tilt of jA^ sec. of arc, or a change of slope of 1 inch in 1000 miles, can be detected.

The introduction of these new methods into seismo- metry quickly revolutionized our ideas respectiag the character of earthquake motion. Although an earthquake may be strongly felt within a ofeartb- distance of 50 miles from its origin, and al- ,9uake thoijgh the movements in the upper storeys of ’””””> ”• buildings within the shaken area may be large, the actual range of the horizontal motion of the ground is usually less than ^ij of an inch. With such earthquakes ordinary seismographs for recording vertical motion do not show any disturbance. When the movement reaches ^ inch it becomes dangerous, and a back-and-f orth movement of an inch is usually accompanied by destructive effects. In this latter case the amplitude of the vertical record which indicates the existence of surface waves will vary between ^ and j^ of an inch. In the earthquake which devas- tated*

Central Japan on 26th October 1891, nearly every building within the epifocal district fell, the ground was fissured, forests slipped dowpa from mountain sides to dam up valleys, whilst the valleys themselves were permanently compressed. The hori- zontal movements seem to have reached 9 inches or a foot, and the surface undu- lations were visible to the eye.

The rapidity with which the movements are performed vai-ies throughout a disturb- ance. A typical earthquake usually commences with minute Period elastic vibrations, the periods of aatation which vary between ^ and ^ of a second. These are recorded by seismo graphs, and are noticed by certain of the lower animals like pheasants, which before the occurrence of movement perceptible to human beings scream as if alarmed. When an earthquake is preceded by a sound we have evidence of preliminary tremors even more rapid than those recorded by seismo- graphs. Following these precursors there is a shock or 'shocks, the period of which will bs 1 or 2 seconds. Prom this climax the movements, although irregular in character, become slower and smaller until finally they are imperceptible. The dura- tion of a small earthquake usually varies from a few seconds to a minute, but large earthquakes, which are accompanied by surface undulations, may be felt for 2 or 3 ' minutes, whilst an ordinary seismograph indicates a dura- tion of from 6 to 12 minutes. A free horizontal pendulum tells us that with severe earthquakes the ground comes

to rest by a series of more or less rhythmical surgings contiQuing over 1 or 2 hours. Although the maximum displacement has a definite direction, the successive vibrar tions are frequently performed in many different azimuths. The predominating direction at a given station in certain instances is apparently at right angles to the strike of the neighbouring strata, this being the direction of easiest yielding.

Earthquake motion as recorded at stations several thou- sands of miles distant from its origin exhibits characteris- tics strikingly different from those just described. The precursors now show periods of from 1 to 6 seconds, whilst the largest movements corresponding to the shocks may

have periods of from 20 to 40 seconds. The interval of Velocity. ^^^^ ^y which the first tremors have outraced the maximum movement has also become greater. Within a few hundreds of miles from an origin this interval increases steadily, the velocity of propagation of the first movements being about 2 km. per second, whilst that of the latter may be taken at about 1-6 km. per second. Beyond this distance the velocity of transmission of the first movements rapidly increases, and for great distances, as for example from Japan to England, it is higher than we should expect for waves of compression passing through steel or glass. This observation precludes the idea that these preliminary tremors have travelled through the heterogeneous crust of the earth, and since the average velocity of their transmission increases with the length of the path along which they have travelled, and we but rarely obtain certain evidence that a seismograph has been disturbed by waves which have reached it by travelling in opposite direc- tions round the world, we are led to the conclusion that earthquake precursors pass through our earth and not round its surface. The following table relating to earthquakes which originated off the coast of Borneo on 20th and '27th September 1897, is illustrative of the velocities here considered: —

Localities.

Distance

from

origin

in degrees.

Velocity

in kms.

per sec. if

on chord.

~~/Average .-» /depth of t\ chord in~~

~~kms.~~

~~NioolaiefE .... Potsdam .... Catania, Isohia, Rocoa di~~

~~Papa, Rome Isle of Wight~~

~~1~~

~~81°~~

~~96° 103°~~

~~8-1 8-4~~

~~9-0 9-8~~

~~S-0~~

~~91~~

~~9-5 10-2~~

~~The chords referred to here are those joining the earth- quake origins and distant observing stations, and it will be noted that one-quarter of the square root of the average depths at which these run closely corresponds to observed average velocities if wave paths followed chords. This increase of velocity with average depth shows that the paths followed through the earth must be curved with their convexity towards the centre of the earth. These observations do not directly tell us to what extent a true wave path is deflected from the dire*ction of a chord, but they suggest as an extremely plausible assumption that the square of the speed is a linear function of the depth below the surface of the earth. With this assumption Dr C. G-. Knott shows that the square of the speed (v^ can be expressed linearly in terms of the average depth of the chord d, thus: v^ = 2-9 + -026 d, the units being miles and seconds. The formula applies with fair accuracy to moderate and high values of d, but it gives too high a value for short chords. It follows that the square of th& speed increases 0-9 per cent, per mile of descent in~~

the earth. The conclusion we arrive at is that the preliminary tremors which pass through the earth do so in the vicinity

of their origin at the rate of almost 2-3 km. per second. •This velocity increases as the wave path plunges down- wards, attaining in the central regions a velocity of 16 to 17 kms., whilst the highest average velocity which is across a diameter lies between 10 and 12 kms. per second

The large surface waves radiating from an origin to a distant place have velocities lying between 1-6 and 4 kms. per second, and it has been observed that when the higher velocity has been noted this refers to an observation at a station very remote from the origin. Oiie explanation of this is the assumption that only very large waves indicat- ing a large initial disturbance are capable of travelling to great distances, and, as pointed out by Mr R. D. Oldham, large waves under the influence of gravity will travel faster than small waves. These waves (which may be gravitational or distortional) are recorded as slow tiltings of the ground measured by angles of 0-5 to 10 or 15 sec- onds of arc, or as horizontal displacements of 0-5 or sev- eral millimetres. Their calculated lengths have reached 50 kms.'XSl miles).

In the section of this article relating to the cause of earthquakes a little has been said about their frequency or the number of times these phenomena are re- peated during a given interval of time. It has luency. been shown that all countries are very often moved by earthquakes which have originated at great distances. Great Britain, for example, is crossed about 100 times a year by earthquake waves having durations of from 3 minutes to 3 hours, whilst the vibratory motions which originate in that country are not only small but of rare occurrence. In the earlier stages of the world's history, because the contraction of its nucleus was more^rapid than it is at present, it is commonly inferred that phenomena accompanying brady^ismical activity must have been more pronounced and have shown themselves upon a grander scale than they do at the present time. Now, although the records of our rocks only carry us back over a certain portion of this history, they certainly represent an interval of time sufBciently long to furnish some evi- dence of such enf eeblement if it ever existed. So far from this being the case,, however, we meet with distinct evi- dences in the

later chapters of geological history of plutonic awakenings much more violent than those recorded at its commencement. During Palaeozoic times many mountain ranges were formed, and accompanying these erogenic processes there was marked volcanic activity. In the suc- ceeding Secondary period plutonic forces were quiescent, but during, the formation of the early Tertiaries, when some of the largest mountain ranges were created, they awoke with a vigour greater than had ever been previously exhibited. At this period it is not improbable that Scot- land was as remarkable for its volcanoes and its earth- quakes as Japan is at the present day. If the statement relating to the general decrease in bradyseismical changes referred merely to their frequency, and omitted reference to their magnitude, the views of the geologist and physicist might harmonize. One explanation for this divergence of opinion may rest on the fact that too little attention has been directed to all the conditions which accompany the adaptation of the earth's crust to its sl^rinking nucleus. As the latter grows smaller the puckerings and foldings of the former should grow larger. Each succeeding geological epoch should be characterized by mountain formations more stupendous than those which preceded them, whilst the fracturing, ' dislocation, caving-in of ill-supported regions, and creation of lines of freedom for the exhibi- tion of volcanic activity which would accompany these changes, would grow in magnitude. The written records of many countries reflect but on a smaller scale the crystal- lized records in their hills. In 1844, at Comrie, in Perth- shire, as many as twelve earthquakes were recorded in a

single month, -whilst now there are but one or two per year. Eartiiquake frequency varies with time. A district under the influence of hypogenic activities reaches a condition of seismic strain which usually is relieved rapidly at first, but subsequently more slowly.

The small shocks which follow an initial large disturb- ance are known as after-shocks. The first shock which in 1891 devastated Central Japan was accompanied by the formation of a large fault, and the 3364 small shocks which succeeded this during the following two years are regarded as due to

intermittent settlements of disjointed material. The decreasing frequency with which after- shocks occur may be represented by a curve. Dr F. Omori points out that the continuation of such a curve gives the means of determining the length of time which will probably elapse before the region to which it refers will return to the same seismic quiescence that it had prior to the initial disturbance.

The positive results that we have respecting the period- icity of earthquakes are but few. Generally fc/6?”’” earthquakes are somewhat more frequent during winter than during summer, and this applies to both the northern and southern hemispheres. This annual periodicity, which, however, does not show itself if only destructive earthquakes are considered, finds an explanation, according to Dr Knott, in the annual period- icity of long-continued stresses, as for example those due to the accumulation of snow and to barometric gradients. For certain earthquake regions there appears to be a dis- tinct semi-annual period for which no satisfactory ex- planation has yet been adduced. Although the elaborate registers of Japan, which have enabled us to group earth- quakes according to their respective origins and varying intensities, and to separate after-shocks from initial dis- turbances, have been subjected by Dr Knott to most careful analysis, with the object of discovering periodicities connected with the ebb and flow of the tides, the lunar day or lunar months, nothing of marked character has been found. Certainly there is slight evidence of a periodicity connected with the times of conjunction and oppositiop of the sun and moon, and a maximum frequency near the time of perigee, but the effect of lunar stresses is comparatively insignificant. Ordinary earthquakes, and especially after-shocks, show a diurnal period, ‘but we cannot say that there are more earthquakes during the night than during the day.

Many experiments and investigations have been made to determine a possible relationship between earthquakes and electrical phenomena, but beyond drawing attention to the fact that luminous appearances may accompany the friction of moving masses of rock, and that a temporary current may be established in a line by the Magnetic disturbance of an earth plate, these inquiries meal’ “^ yielded but little of importance. The inquiries respecting a possible relationship between adjustments so frequently taking place within and beneath that region called the crust of

the earth and magnetic phenomena are, however, of a more promis- ing nature. We have seen that at or near the origin of earthquakes which for several hours disturb conti- nents, and occasionally cause oceans to oscillate for longer periods, we sometimes have direct evidence of the bodily displacement of many cubic miles of material. When this material is volcanic it is almost invariably magnetic, and we perceive in its sudden rearrangement causes which should produce magnetic effects within an epifocal district. In Japan, where attention is being directed to phenomena of this description, not only have such effects been observed, but unusual magnetic disturbances have been noted prior to the occurrence of large earthquakes. These may, of

course, be regarded as mere coincidences, but when we consider volcanic and seismic activities as evidences of physical and chemical changes, together with mechanical displacements of a magnetic magma, it is reasonable to suppose that they should have at least a local influence upon magnetic needles. Another form of disturbance to which magnetic needles are subjected is that which accompanies the passage of large earth-waves beneath certain observatories situated at great distances from earthquake origins. At Utrecht, Potsdam, and Wilhelms- haven the magnetographs are frequently disturbed by seismic waves, whilst at many other European observar-tories such effects are absent or only barely appreciable. To explain these marked differences in the behaviour of magnetic needles at different stations we are at present only in a position to formulate hypotheses. They may be due to the fact that different needles have different periodic times of oscillation; it is possible that at one observatory the mechanical movements of the ground are much greater than at others ; we may speculate on the existence of materials beneath and around various observatories which are different in their magnetic characters ; and, lastly, we may picture a crust of vary- ing thickness, which from time to time is caused to rise and fall upon a magnetic magma, the places nearest to this being the most disturbed.

A subject to which but little attention has hitherto been directed is the effect which displays of seismic and volcanic activities have had f?^”” upon the human mind. The effects are dis- mind!”””’ tinctly dual and opposite in character. In countries like England, where earthquakes are seldom

experienced, the prevailing idea is that they are asso- ciated with all that is baneful. For certain earthquakes, which fortunately are less than 1 per cent, of those which are anndally recorded, this is partially true. A disastrous shock may unnerve a whole community. Many become hysterical, and all are seized with terror, behaving for a time as if they have lost their reason. While the shakings continue, the " Ora pro nobis," or its equivalent, will be heard on many sides. Effects of this nature, how- ever, differ in a marked mann er with different nationalities. After the shock of 1891, when Japan lost 9960 of its inhabitants, amongst the wounded indications of mental excitement were shown in spinal and other trouble. The cases of tetanus which were found may be attributed to contamination of open sores. Those who had escaped unhurt and were living in ruined buildings, on hearing the sounds which preceded very many hundreds of after- shocks, and realizing the possibility of a repetition of what had gone before, simply rushed for the open, to return a minute or so later laughing and joking at the continued recurrence of so many false alarms. Notwithstanding the lightheartedness of this particular nation, it is difficult to imagine that the long series of seismic effects chronicled in Japanese history, which culminated in 1896 in the loss of 29,000 lives by sea-waves, has been without some effect upon its mental and moral character. Several earth- quakes are annually commemorated by special services at temples. In bygone times governments have recognized earthquakes as visitations of an angry deity, whom they have endeavoured to appease by repealing stringent laws and taxes. In other countries the sermons which have been preached to show that the tremblings of the world were visitations consequent on impiety, and the prayers which have been formulated to ward off disasters in the future, far exceed in number the earthquakes which gave rise to them. In 1755 many of the English clergy held the view that Lisbon was destroyed because its inhabit- ants were Catholics, whilst the survivors from that disaster attributed their misfortune to the fact that they

had tolerated a few Protestant heretics in their midst. To avoid a recurrence of disaster certain of these were baptized by force. In the myths relating to

underground monsters and personages that are said to be the cause of earthquakes we see the direct effects which exhibitions of seismic and volcanic activity have produced upon the imagination. The beliefs, or more properly, perhaps, the poetical fancies thus engendered have exhibited themselves in various forms. Beneath Japan there is said to be a catfish, which in other countries is replaced by a mole, a hog, an elephant, or other living creature, which when it is restless shakes the globe. The Kamchadales picture a subterranean deity called Tuil, who in Scandinavian mythology is represented by the evil genius Loki. To come still nearer home, we have only to think of the reference in the Decalogue forbidding the making of graven images of that which is in the earth beneath, to see in early Biblical history evidence of a subterranean mythology. It cannot be positively stated how this arose, but it seems probable that the same causes which led to the creation of Pluto, Vulcan, and Poseidon gave rise to practices condemned by Moses. The marked effect which these imaginary deities and creatures have had upon the literature and the pictorial and other arts of many nations hardly requires comment. The mental effects which accompany and follow small earthquakes may be compared to those we pay for when we ride upon a switchback. When an earthquake commences there is perhaps a little anxiety as to what may happen next, but when it is over the imagination is excited as to its cause, and there is a feeling of satisfaction that a new sensation has been experienced. Small earth-shiver- ings have often thawed the formalities of a dinner-party, and made strangers in hotels acquainted with each other.*

Perhaps the greatest practical benefits derived during the last few years from seismological investigations re- late to important changes and new principles ivftftstend" which have been introduced into the arts of earth- the engineer and builder when constructing quakes. ^^ earthquake countries. The new rules and formulae, rather than being theoretical deductions from hypotheses, are the outcome of observation and experi ment. True measures of earthquake motion have been given to us by modern seismometers, with the result that seismic destructivity can be accurately expressed in mechanical units. From observation we now know the greatest acceleration and maximum velocity of an earth particle likely to be encountered ; and these are measures of the destructivity. The engineer is therefore dealing with known forces, and he has to bear in mind that these are chiefly applied

in a horizontal direction. A formula connecting the acceleration requisite to overturn bodies of different dimensions has been given. The acceleration which will fracture or shatter a column firmly fixed at its foundation to the moving earth may be expressed as

follows : —

IggAB

“~6 fw ‘ where

a = the acceleration per sec. per sec. F = the force of cohesion, or force per unit surface, which when gradually applied produces frac- ture. A = area of base fractured. B = thickness of the column. / = height of centre of gravity of column above the

fractured base. w = the weight of the portion broken off. With this formula and its derivatives we are enabled to state the height to which a wall, for example, may

be built capable of resisting any assumed acceleration. Experience has shown that yielding first shows itself at the base of a pier, a wall, or a building, and it is therefore clear that the lower portion of such structures should be of greater dimensions or stronger than that above. Piers having these increased dimensions below, and tapering upwards in a proper manner, so that every horizontal section is sufficiently strong to resist the effects of the inertia of its superstructure, are employed to carry rail- ways in Japan. In that country cast-iron piers are things of the past, whilst piers of masonry, together with their foundations, no longer follow the rules of ordinary engineering practice.

After flood, fire, earthquake, or when opportunity presents itself, changes are introduced in the construc- tion of ordinary buildings. In a so-called earthquake- proof house, although externally it is similar to other dwellings, we find rafters running from the ridge pole to the floor sills, an exceedingly light roof, iron straps and sockets replacing mortices and tenons, and many other departures from ordinary rules. Masonry arches for bridges or arched openings in walls (unless protected by lintels), heavy

gables, ornamental copings, cappings for chimneys, have by their repeated failure shown that they are undesirable features for construction in earth-quake coimtries. As sites for buildings it is well to avoid soft ground, on which the movement is always greater than on hard ground. Excessive movement also takes place along the face of unsupported openings, and for this reason the edges of scarps, bluffs, cuttings, and river banks are localities to be avoided. In short, the rnles and precautions which have to be recognized so as to avoid or mitigate the effects of earthquake move-ment are so numerous that students of engineering and architecture in Japan receive a special course of lectures on this subject. When it is remembered that a large earthquake may entail a loss of life greater than that which takes place in many wars, and that for the re- construction of ordinary buUdings, factories, and public works an expenditure of several million pounds sterling is required, the importance of these studies cannot be overrated. Severe earthquakes are fortunately unknown in the British Isles, but we have simply to turn our eyes to earthquake-shaken colonies and lands in close com- mercial touch with Great Britain to realize the import- ance of mitigating such disasters as much as possible, and any endeavour to obviate the wholesale destruction of life should appeal to the civilized communities of the world.

An unexpected application of sejsmometry has been to record the vibration of railway trains, bridges, and steam- ships. An instrument of suitable construction will give records of the more or less violent uoas'of jolting and vibratory movements of a train seismo- and so localize irregularities due to changes "'e'O'. in the character of ballast and sleepers, to variation in gauge, &c. An instrument placed on a locomotive throws considerable light upon the effects due to the methods of balancing the wheels, and by alterations in this respect a saving of fuel of from 1 to 5 lb of coal per mile per locomotive has sometimes been effected.

By mapping the centres from which earthquakes originate off the coast of Japan, we have not only deter- mined districts where geological activity is pronounced, but have placed before the cable engineer well-defined localities which it is advisable to avoid ; and in the rec- ords of unfelt earthquakes which originate far from land similar information is being collected for the deeper parts of the oceans. Occasionally these records

have almost immediately made clear the cause of a cable failure. From lack of such information in 1888, when three cables

connecting Australia with the outer world were simul- taneously broken, the sudden isolation was regarded as a possible operation of war, and the colonists called out their naval and military reserves. Records of earthquakes originating at great distances have also frequently enabled us to anticipate, to correct, to extend, or to disprove tele- graphic accounts of the disasters. Whatever information a seismogram may give is certain, whilst the information gathered from telegrams may in the process of transit become exaggerated or minimized. Otherwise unaccount- able disturbances in records from magnetographs, baro- graphs, and other instruments employed in observatories, are frequently explained by reference to the traces yielded by seismometers. Perhaps the greatest triumph in seis- mological investigation has been the determination of the varying rates at which motion is propagated through the world. These measurements have already thrown new light upon its effective rigidity, and if we assume that the density of the earth increases uniformly from its surface towards its centre, so that its mean density is 5‘5, then, according to Knott, the coefficient of elasticity which governs the transmission of preliminary tremors of an earthquake increases at a rate of nearly 1-2 per cent, per mile of descent. These, then, are a few of the results which seismologists have attained, and considering how much has been accomplished during the last few years, we may surely claim for the study of the changes in progress within the planet on which we live as much attention as is devoted to the study of the ocean, the atmosphere, and the stars.

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East Africa, British. — British East Africa, in its widest sense, includes all the territory placed under British influence on the eastern side of the continent between the latitudes, roughly speaking, of 6° S. and 10° N. It is bounded on the S. by German East Africa, on the W. by the Congo State, and on the N., where its limits are stUl in part undefined, by the Egyptian Sudan, Abyssinia, and Italian Somaliland. The total area is estimated at about 670,000 square miles. Administratively it comprises the protectorates of Zanzibar (consisting of the islands of Zanzibar and Pemba), British East Africa, and Uganda. Apart from a narrow belt of lowlands along the coast, the mainland area, which extends from the Umba river in the south to the Juba in the north, belongs almost entirely to the great lake plateau of East Africa, rarely falling below an elevation of 2000 feet, while exten- sive sections rise to a height of 6000-8000 feet. The primary surface features run generally in zones from north to south. From the coast lowlands a series of steps with intervening plateaux leads to a broad zone of high ground remarkable for the abundant traces of volcanic action. This broad upland is furrowed by the great East African "rift-valley," formed by the subsidence of its floor, and occupied in parts by lakes without outlet. Towards the west a basin of lower elevation is partially occupied by Victoria Nyanza, drained north to the Nile, while still farther inland the ground again rises to a second volcanic belt, culminating in Mount Euwenzori (18,000 feet), and traversed by a line of depression occupied by Lakes Albert Edward and Albert, the Western Nile reservoirs. The western boundary of British East Africa is mainly formed, beyond the western rift-valley, by the crest of the water-shed between the Nile and Congo basins.

Coast Zone and Eastern Plateaux. — The first of the parallel zones — the coast plain or "Temborari " — is gener- ally of insignificant width, varying from 2 to 10 miles, except in the valleys of the main rivers. It consists largely of coral rock partially covered with deposits of alluvium or sand, the latter forming ridges sometimes 400 feet high. The shore line is broken by bays and branching creeks, often cutting off islands from the mainland. Such are Mvita or Mombasa in 4° 5' S., and the larger islands of Lamu, Manda, and Patta, between 20° 20' and 2°. Farther north the coast

becomes straighter, with the one indentation of Port Durnford in 1° 10' S., but skirted seawards by a row of small islands. The northern interior east of the rift-valley is still little known, and a detailed description must therefore be confined to the more southern parts. Beyond the coast plain the country rises in a generally well-defined step or steps to an altitude of some 800 feet, forming the wide level plain of the " Nyika " (uplands), largely composed of quartz. In the south this zone has a width of some 80 miles, but it widens out northwards, and seems to occupy a large part of the northern interior. The next stage in the ascent is marked by an intermittent line of mountains — gneissose or schistose — running gener- ally north-north-west, sometimes in parallel chains, and representing the primitive axis of the continent. Their height varies from 5000 to 8000 feet. The principal units are the Bura Mountains in 3° to 3° S., the Julu or Dyulu range between 2J° and 2f° S., the Iveti Mountains in 1° S., and various ranges in the districts of Kikuyu and Ukamba. East of the latter the plateau itself seems to consist of a wide extent of grass. Farther inland wide uplands, largely grass-covered, and known to the inhabitants as Eangatan, extend to the eastern edge of the rift-valley, though varied with cultivated ground and forest, the former especially in Kikuyu, the latter between 0° and 0° 40' S. The most extensive grassy plains are those of Kapte or Kapote and Athi, between 1° and 2° S. The general altitude of these uplands, the surface of which is largely composed of lava, varies from 5000 to 8000 feet, the highest portion occurring on or near the equator, beyond which the high Laikipia plateau falls gradually to the north. This zone contains the highest elevations in British East Africa, including the volcanic pile of Kenya (17,200 feet), Settima (13,400' feet), and Nandarua (12,900 feet). To the west the fall to the rift-valley is marked by a line of cliffs, of which the best defined portions are the Kikuyu escarp- ment (800 feet), just south of 1° S. ; the Kinangop escai-p- ment, a little north of the same parallel ; the Laikipia escarpment, on the equator ; and the cliffs of Morongop, a little south of 1° N. In the intervals the descent is. often much more gradual.

Rivers of the East Coast. — One of the main watersheds of East Africa runs in close proximity to this eastern wall of the rift-valley, separating the basins of inland drainage from the rivers of the east coast, of which the two largest, wholly within British East Africa, are the Sabaki and Tana. The Sabaki rises (as the Athi) in 1° 42' S., and after flowing north-east for 70

miles across the Kapote and Athi plains, turns south-south-east under the wooded slopes of the Yatta ridge, which shuts in its basin on the east. In 3° S. it turns east, and in its lower course (known as the Sabaki) traverses the sterile quartz-land of the outer plateau. The actual valley is in parts low and flat, covered with forest and scrub, and containing small lakes and backwaters con- nected with the river in the rains. At this season the stream is deep and strong, and of a turbid yellow colour, but navigation is interrupted by the Lugard falls, about 100 miles from its mouth. Its total length is about 400 miles, but, apart from the numerous small feeders of the upper river, almost the only tributary is the Tzavo, from the=

east side of Kilimanjaro, which enters in about 3° S. The Tana is both longer and larger than the Sabaki. One series of its numerous headstreams traverses the Kikuyu plateau north of the Athi, while others flow down the southern and eastern slopes of Kenya, uniting with the former to form the Kiloluma, a rapid stream traversing a broken rocky country, with many falls. Beyond 39° E. no tributary of any importance is known to join the main stream, which flows in a wide curve east and south, its course being very tortuous, the current rapid, and the channel m,uch obstructed by snags. Its width varies, as a general rule, between 100 and 200 yards. The banks are generally low, in part forested and inundated at high water, but away from the river the country appears to consist of dry plains covered with mimosa scrub. Adjoining the Lower Tana are many backwaters, which seem to show that the course has been subject to great changes. In 2° 20' S. the river again turns east, but during the last 10 miles it flows south-west, parallel to the coast, finally entering the sea across a dangerous bar. Some 20 miles from the mouth the narrow Belasoni canal connects the Tana with the Ozi, the intervening country being deltaic in character, and at high water a discharge takes place in this direction. Observations made at Golbanti by the Eev. W. Ormerod show that the Tana rises twice in the year, being high in June and July and again in November and December, these periods coinciding with the rainy seasons in the Kenya region.

The Eastern Eift- Valley. — Coming next to the rift- valley, this, though with a generally level floor, is divided by transverse ridges into a series of basins, each con- taining a lake without outlet. The southernmost section within British East Africa is formed by the arid Dogilani plains, drained south towards G-erman Territory. At their north end rise the extinct volcanoes of Suswa (7800 feet) and Longonot (8700), the latter on the ridge dividing off the next basin — that of Lake Naivasha. This is a small fresh-water lake, 6312 feet above the sea, measuring some 13 miles each way. Its basin is closed to the north by the ridge of Mount Burn, beyond which is the basin of the still smaller Lakes Nakuro (5845 feet) and Elmenteita (5860 feet), followed in turn by that of Baringo. This lake (15 miles long by 8 broad, altitude 3300 feet) lies at the north end of the basin, the southern parts being drained north by the Nyuki river, which, however, is lost in a swamp just before reaching Baringo. At the foot of the eastern escarpment, and separated from the Baringo basin by subsidiary ridges, are Lakes Kibibi (4820 feet) and Losuguta (3050 feet). Beyond Baringo the valley is again drained north into Lake Sugota, in 2° N., some 35 miles long, while north of this lies the much larger Lake Rudolf, the valley becoming here somewhat less defined.

The Western Escarpments and Plateaux. — On the west of the rift-valley the wall of cliffs is best marked between the equator and 1° S., where it is known as the Mau escarpment, and about 1° N., where the Elgeyo escarpment falls to a longitudinal valley separated from Lake Bariago by the ridge of Kamasia. Opposite Lake ISTaivasha the total height of the Mau escarpment is some 3000 feet. At the top occurs a vast forest, in great part unexplored. To the south the woods become more open, and the plateau falls towards an open country drained towards the Dogilani plains. On the west the cultivated districts of Sotik and Lumbwa, broken by wooded heights, fall towards Victoria N'yanza. The Mau plateau reaches a height of 9000 feet on the equator, north of which is the somewhat lower Nandi country, well watered and partly forested. In th^ treeless "red-plain" of GuashNgishu, abreast of Elgeyo, it again rises to a height of over 8000 feet, and to the west of this is the great mountain mass of Elgon. All these

plateaux west of the rift-valley are included in the Uganda Protectorate.

Climate, Fauna, Flora. — In its climate and vegetation British East Africa again shows an arrangement of zones parallel to the coast. Close to the sea, where the rainfall is fairly plentiful, the low plain is covered with thick bush. The outer plateaux, especially the "Nyika," have a scanty rainfall, and form arid steppes with a. sparse scrub vegetation. The uplands beyond are generally fertile, clothed with rich pastures alternating with cultivated ground and forest, the latter covering a large part of the Mau plateau. Farther west the rainfall increases, and in Uganda and neighbour- ing countries cultivated land and pasture are varied with luxuriant groves of bananas, which form a chief item in the food of the in- habitants. The higher mountains have a distinct flora, representing the remnants of the flora of a cooler period. Large mammals are plentiful, especially on the drier steppes. They include the elephant (more and more restricted to unfrequented districts), rhinoceros, many kinds of antelope, girafie, hippopotamus, lion and other camivora. In many parts the rhinoceros is particularly abundant and dangerous.

Natives. — The inhabitants include representatives of various stocks, as the country forms a borderland between the Negro and Hamitic races, and contains many tribes of mixed or doubtful affin- ities. The Bantu division of the former is represented chiefly in the south, the principal tribes being the Wakamba, Wakikuyu, Wa-6iriama, Wapokomo, Waboni, &c. In the west the Bantu peoples (Waganda, Wanyoro, &c.) have been subject to intruders of Galla stock (Wahuma), who are cattle-rearers, while the subject population practise agriculture. In the north-west — on the Upper Nile — the tiibes are more nearly related to the true Negroes, though sometimes placed in a distinct group as "Nilotic." Of Hamitic race are the Masai, a race of cattle-rearers speaking a Nilotic language, who in decreasing numbers occupy the uplands bordering on the eastern rift-valley. Farther north they are represented by the Turkana and other tribes dwelling between Lake Eudolf and the Nile. A section of the Masai, which has adopted the settled life of agriculturists, is known as the Wakwafi. The Galla section of the Hamites is represented, among others, by the Borans of the plains east of Lake Rudolf, while Somalis occur in tlie coast-lands between the Tana and Juba rivers. Primitive hunting tribes are the Wandorobo in Masailand and scattered tribes of small stature in various parts. The immediate coast-land contains a mixed population of Arab and Hindu immigrants, with representatives of

numberless interior tribes. Missions have been at work for many years, both on the coast and in the Uganda region, and increasing numbers of native children are being educated in mission schools.

Annexation and Administration. — The Portuguese held posts on the coast during the 16th and 17th centuries, but finally aban- doned Mombasa in 1729. The interior was first made known in the middle of the 19th century by the journeys of Krapf, Reb- mann. Von der Decken, and others, followed a little later by the great expedition of Speke and Grant to the Upper Nile region. The countries east of Victoria Nyanza (Masailand, &c.) were, however, first traversed throughout their whole extent by Joseph Thomson in 1883-84.1 When, almost immediately afterwards, Germany secured a footing on the coast opposite Zanzibar, a British claim, ratified by an agreement with Germany in 1886, was made to the districts behind Mombasa, the administration of the coast towns being ceded by the sultan of Zanzibar. In 1888 the British Bast Africa Company obtained a charter placing the government of the territory in its hands, but, after doing much to open up the country, and securing Uganda for Great Britain, was forced by lack of resources to make over its rights to the British Government (1895). Uganda was then declared a British protectorate, and in 1896 the districts between the latter and the coast were formally taken over by the Foreign OfBce as the British East Africa Protec- torate. The islands of Zanzibar and Pemba had been taken over in 1890 by agreement with Germany.

British East Africa Protectorate. — The British East Africa Pro- tectorate, which, roughly speaking, extends to the rift-valley, has been divided into the four provinces of Seyyidieh (the coast province, capital Mombasa), Ukamba (capital Nairobi), Tanaland (capital Lamu), and Jubaland (capital Kismayu), each being in turn divided into districts and subdistriots. These are — ^in Sfeyyidieh, districts : Vanga, Mombasa, and Melindi ; subdistriots, Rabai and Takaungu. In Ukamba, districts : Teita, Kitui, Masailand, Ulu, and Kenya ; subdistriots, Kikumbului and Taveta. In Tanaland, districts: Lamu, Port Durnford, and Tana river. In Jubaland, districts : Upper and Lower Jubaland. The area (apart from the northward extension not yet organized or under control) is esti- mated at 80,000

square miles, and population 2,500,000, including 25,000 Asiatics and 460 Europeans and Eurasians. The revenue

1 For further details on exploration, see Africa.

for 1897-98 amounted to £43,481 ; for 1898-99, to £69,400 ; and for 1899-1900 was estimated at from £75,000 to £80,000. The capital of the protectorate is Mombasa, which is also the largest town (population, 27,000). It has two excellent harbours, one on each side of the island of Mvita or Mombasa, on the eastern side of which the town is placed. The harbour on the south-west side is known as Port Kilindini, and here, on the west side of the island, is the terminus of the Uganda railway, with a pier and other works. On the mainland, nearly opposite Mombasa town, is the settlement of freed slaves called Freretown, after Sir Bartle Frere. The second largest town is Lamu, on the island of the same name, besides which the most important are Melindi, Patta, Kipini, Port Durn- ford, and Kismayu. Much has been done to open up the country by means of roads, including a trunk road from Mombasa by Kib- wezi in the upper Sabaki basin and Lake Naivasha to Berkeley Bay on "Victoria Nyanza. But the most important work taken in hand is the construction of a railway from Mombasa to that lake, for which a survey was executed in 1892, and on which work was commenced in 1896. The line chosen roughly coincides with that of the road just mentioned, until the equator is reached, after which it will strike by a more direct route across the Mau plateau to Lake Victoria, which it will reach at Port Florence on Kavirondo Bay ; total length, 582 miles. The most serious difficulty has been the descent of the escarpment of Kikuyu to the rift-valley, which has necessitated the most skilful engineering. The total length of the line constructed up to April 1901 was 488 miles.

Besources and Commerce. — The resources of British East Africa are still little developed. The coast-lands, however, contain much fertile soil suitable for the cultivation of cotton, jute, the oocoanut, oil-seeds, fibres, &c., while the jungle products include rubber, copal, orchilla, &c. The grassy uplands

of the interior are emi- nently suited for cattle-rearing, and at the higher elevations Euro- pean crops might be grown with success. The comparative healthiness of these plateaux might possibly allow of their settle- ment by white men. The imports, which in 1897-98 reached a total of about 4J million rupees, and in 1898-99 about 7 millions, were valued at 6,642,000 rupees in 1899-1900 ; the exports, which in the former two years were little over 1 million rupees, in 1899-1900 rose to 1,825,000. The chief articles imported are piece and trade goods, rice, grain, and flour, while the exports consist principally of ivory (which showed a large increase in 1899-1900), rubber, hides and horns, and grains. Shipping entered, in 1897-98, to the extent of 196,630 tons ; in 1898-99, 321,440 tons ; in 1899-1900, 332,882 tons.

See also Uganda Zanzibar.

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(e. h. e.)

East Africa, German, occupying the east centre of the African continent, was acquired for Germany by treaties which Dr Peters, Graf Pfeil, and Dr Jlihlke con- cluded with a number of chiefs in November and Decem- ber 1887. An imperial charter was granted on the 27th of February 1885, and on the 28th of October 1890 the sul- tan of Zanzibar ceded his suzerainty

over the coast and the island of Mafia to the German emperor. The protecto- rate extends from 1° S. lat. to 11° S. lat. and 30° to 40° E. long. On the E. it is bounded by the Indian Ocean, on the N.E. and N. by British East Africa. The boundary line runs from the mouth of the Umbe river to Lake Jipe and Mount Kilimanjaro, including both in the protecto- rate, and thence to Victoria Nyanza, crossing it on 1° S. lat., which parallel it follows till it reaches 30° E. long. On the 1st of July 1890 it was stipulated that this line should be subject to an alteration in case it included Mount Mf umbiro, which was to fall into the British sphere

of influence. In the west it is separated from the Congo Free State as follows, according to the agreement of 1st to 25th August 1885. From the point of intersection of 1° S. lat. and 30° E. long., nearly straight to the north end of Lake Tanganyika, along the middle line of the lake to where this is intersected by the south boundary line of the Congo Free State in about 8° 30' S. lat. In November 1900 a disputed boundary on Lake Kivu was decided by the Kiag of the Belgians in favour of Ger- many. The agreement of 30th July 1890 arranged the boundary between Lakes Tanganyika and Nyasa as fol- lows. From Tanganyika along the river Kilamba to the junction of its two arms ; thence in a line which is not fixed with absolute precision to the point where 35° E. long, intersects the river Songwe, which it follows to the lake. Round the northern end it follows the shore of the lake, which it leaves on that degree of S. lat. on which the river Msinge enters the Rovuma; joining these two points, it follows the latter river to the Indian Ocean, according to the agreement between Portugal and and Germany of 30th December 1886. These boundar ries include an area of about 386,000 square miles, with a population roughly estimated at 3,000,000 to 8,000,000. Physical Features. — The coast of German East Africa is chiefly composed of coral, and is generally low, partly sandy, partly covered with bush or mangroves. Only where the Arabs have established settlements the cocoa- palm and mango tree introduced by them give char- acter to the vegetation. The coast, though little indented, has several good harbours, amongst them Tanga (6000), Dar-es-Salaam (13,000), Kilwa (10,000), Kisiwani, Lindi, Mikindani, Bagamoyo (13,000). The littoral plain is from 10 to 30 miles wide and 620 miles long ; it is bor- dered on the west by the precipitous eastern side of the interior plateau of Central Africa. As a whole this plateau, considerably tilted from its

horizontal position, attains its highest elevation north of Lake Nyasa, where several peaks rise to 8000 feet, one to 9000, while its mean altitude is about 3000 to 4000 feet. From this re- gion the country slopes gently towards the north-west, and is not distinguished by any considerable mountain ranges. A deep narrow gorge, the so-called " rift-valley," traverses the middle of the plateau in a meridional direc- tion. In the northern part of the country it spreads into several side valleys, from one of which rises the extinct volcano Mount Kilimanjaro (19,200 feet), the highest mountain in all Africa. Its glacier sends down a thou- sand rills which combine to form the Pangani river. East of Mount Kilimanjaro are the Pare Mountains, sep- arated from the coast only by a comparatively narrow strip of plain. The Pangani is navigable for 12 to 18 miles, the Rufiji for more than 60 mUes from the coast, and its tributary, the Ulanga, for a much greater distance. The Wami and Kingani spring from the plateau border and the mountains fringing it ; only the latter river has been ascended by a steam launch. The Rovuma, though broader than the other rivers, is very shallow, so that all attempts at navigation have proved failures. West of the rift-valley the plateau sends its water through the Malar garazi to Lake Tanganyika and thence to the Atlantic, through the Kagera and other smaller rivers to Lake Victoria and the Nile. Lake Nyasa in the southern part of the country and Lake Tanganyika fill the deepest part of the Central African rift-valley. Several smaller lakes occur in parts of the eastern rift. Lake Rikwa is pre- sumably only the remnant of a huge swamp, the extent of which varies with the rainfall of each year. Lake Victoria, the largest of all African lakes, is the reser- voir which gives rise to the Nile.

Meteorology. — The climate derives its chief characteristic from the monsoons. On the coast the south-east monsoon sets in in April,

and the north-east monsoon in November. In the interior April brings south-east winds, which continue until about the beginning of October. During the rest of the year changing winds prevail. These winds are charged with moisture, which they part with on ascending the precipitous side of the plateau. The heat, though scarcely greater here than In the interior, is

sometimes oppressive. Rain comes with the south-east monsoon, and on the northern part of the coast the rainy season is divided into two parts, the great and the little Masika : the former falls In the months of September, October, November ; the latter In February and March. In the interior the climate has a more, continental character, and is subject to considerable changes of temperature ; the rainy season sets In a little earlier the farther west and north we proceed, and is well marked, the rain beginning in November and ending in April ; the rest of the year is dry. On the highest parts of the plateau the climate is almost European, the nights being sometimes exceedingly cold. Kilimanjaro has a climate of its own ; the west and south sides of the mountain receive the greatest rainfall, while the east and north sides are dry nearly all the year. On a mountain of such height all degrees of temperature are to be met with. Malarial diseases are rather frequent, more so on the coast than farther inland. The Kilimanjaro region Is said to enjoy immunity. Small- pox is frequent on the coast, but Is diminishing before vaccination ; cases of other epidemic diseases are extremely rare.

Flora and Fauna. — The character of the vegetation varies with and depends on moisture, temperature, and soil. On the low littoral zone theicoast produces a rich tropical bush, in which the mangrove is very; prominent. Cocoa-palms and mango trees have been planted in great numbers, and also many varieties of bananas. The bush Is grouped in copses on meadows, which produce a coarse tall grass. The river banks are lined with belts of dense forest, in which useful timber occurs. The Syphcena palm Is frequent, as well as various kinds of gum-producing mimosas. The slopes of the plateau which face the rain-bringing monsoon are in some places covered with primeval forest, in which timber is plentiful. The silk-cotton tree \Bomhax ceibd), miomba, tamarisk, copal tree {Hymenma courbaril) are frequent, besides sycamores, banian trees (^Ficus indica), and the deleb palm {Borassus aethiopum). It is here we find the Landolphia florida, which yields the best rubber. The plateau is partly grass land without bush and forest, partly steppe covered with mimosa bush, which sometimes is almost impenetrable. Mount Kilimanjaro exhibits on a vertical scale the various forms of vegetation which characterize East Africa (see Kilimanjaro). East Africa is rich in all kinds of antelope, and the elephant, rhinoceros, and hippopotamus are still plentiful in parts.

Character- istic are the giraffe, the chimpanzee, and ostrich. Buffaloes and zebras occur in two or three varieties. Lions and leopards some- times stray down to the coast. Crocodiles are found in all the larger rivers. Snakes, many vetiomous, are frequent. Of birds there are comparatively few on the steppe, but rivers, lakes, and swamps abound with them. Locusts have often been observed in late years, and ants of various kinds are often a plague. The tsetse fly (Glossina morsitans) infests several districts ; the sand-flea has been imported by labourers returning from' the west coast. Land and water turtKs are frequent.

Ethnography. — On the coast we find Arab and Indian immigrants, who are agriculturists and merchants. The Waswaheli are a tribe sprung from a mixture of these immigrants with Bantu natives. They are Islamites. In the interior can be dis tinguished two classes of Bantu negroes; one with a migratory tendency towards the north and an ad- dition of Zulu immigrants, the other with a similar tendency towards southward expansion and an admixture of Hamitic and Nilotic ele- ments. The older groupsof Bantu are chieflyagriculturists and live in conical houses,while the others comprise thecattle-raisingtribes,who live in square mud-plastered houses called tembe, which can be easily fortified and defended. The agriculturists are good labourers, and wil- lingly take service with the whites ; they form the great caravans. The cattle-raising tribes are less sociably inclined, and often very war- like. In 1891 the rinderpest brought to the verge of ruin those who, like the Masai, would not adopt agriculture as a means of livelihood.

Oovernment. — The coast is divided into six districts (Bezirks- aemter), Tanga, Pangani, Bagamoyo, Dar-es-Salaam, Kilwa, Mik- indani. In the interior there are ten stations {Stationsbezirke), Victoria Nyanza, Kilimanjaro, Tabora, Kilimatinde, Mpwapwa, Kilossa, Tanganyika, Langenburg, Ulanga, and Lindi. Each station has a chief, who Is subordinate to the oflBcial of his dictrict, these in their turn being under the governor, who resides in Dar-es-Salaam. ^The lieutenant-governor is also commander of the colonial force, consisting (1901) of 1635 regular and 168 irregular coloured soldiers, with 44 commissioned, 110 non-commissioned white ofacers, 12 coloured non-commissioned officers, and 18 medical officers. There are 61 field-guns. The stations have to maintain

communication with the native chiefs, and peace in the interior • they have to introduce as far as possible cultivation of valuable' products, and to establish and maintain roads. The district chiefs on the coast administer their districts in the ordinary

way, with the assistance of a police force and a regular stafl of officials. They have to keep an eye on the suppression of slavery and on the regulation of the supply of labour. They are entrusted with the functions of judges in all cases of litigation between coloured people ; in cases involving amounts exceeding 1000 rupees, appeal to the governor is admissible. There are two ordinary judges and one chief justice in the colony ; the latter conjointly with the governor presides over a court of appeal.

Finance. — ^The revenue is raised by taxes on imports and exports, on consumption and from licences for the sale of spirituous liquors, and wood-cutting, harbour and other dues, and the natives have to pay a hut tax. Receipts for the sale of lands are also beginning to swell the revenue. The expenditure is for civil and military administration, the small fleet of steamers maintained by the colonial government, and the caravans, which keep up communica- tion with the stations in the interior and supply them with European necessaries. In the budget for 1899-1900 the revenue (including Imperial contribution of 5,985,000 marks) and expenditure balanced at 8,495,000 marks. The Imperial contribution for 1900-1901 was 6,830,000 marks.

Missions. — There are ten missionary societies — six German, one French, three English. Three of the ten are Roman Catholic. One of the latter, the Mission du Sacre Coeur in Bagamoyo, the oldest mission, has been very successful in training young negroes to be useful mechanics. There are several schools, and the number of young people who can read and vyrite is increasing rapidly. On the coast the inhabitants profess to be Moslems.

Communications. — The German East Africa line of Hamburg runs a fleet of first-class steamers to East Africa, which touch at Tanga, Dar-es-Salaam, and Zanzibar. Two steamers go to Bombay once in three weeks ; and of other lines, the Messageries Maritimes and British East India Steam Navigation Company call once a month at Zanzibar. Proper roads only exist where constant traffic keeps them open. A railway has been laid from Tanga

~~to Korogwe. Regular postal communication is maintained with the stations in the interior, through native runners, twice a month. There is a submarine cable from Dar-es-Salaam to Zanzibar, and an overland line connecting all the coast stations.~~

~~Production. — The country is rich in natural products which are found in the forest or cultivated by the natives. The former are chiefly rubber, copal, bark, various kinds of fibres, orseille, timber, pepper, honey ; the latter cocoanuts, tobacco, sugar-cane, cotton, vanilla, sorghum, panicillaria, eleusine, arachis, sesame, maize, rice, beans, peas, bananas, batatas and yams, manioc and hemp. Animal products are ivory, hides, tortoiseshell, and pearls. On the plateau in the interior large herds of cattle are reared by the natives, who in the lowlands are chiefiy agriculturists. The people have many small native smithies. Useful minerals exist, but are not yet exploited. Coal, iron, graphite, and salt have been found, and gold too, though not in paying quantities.~~

~~The imports and exports have been as follows, in marks : —~~

~~1838.~~

~~1895.~~

~~1898.~~

~~Imports . . Exports . .~~

~~2,485,163 4,270,653~~

~~7,629,000 8,257,584~~

~~16,401,705 5,995,930~~

~~The chief exports were ivory, rubber, sesame, and gum.~~

~~No sooner was German East Africa annexed than companies were formed for the purpose of exploiting the country by trading, planting, and mining. The first was the Deutsch Oestafricanische Gesellschaft, founded in 1885, which now owns large capital, has trading stations in each seaport, and~~

seven flourishing plantations in various parts of the country. It is the owner of vast tracts of land, which in time are expected to become extremely valuable. No fewer than forty trading companies have been established since then, and all are in a more or less thriving condition ; a compara- tively large number of private individuals have laid out plantations, from which they are beginning to derive a considerable return. Coffee and tobacco are the chief products, and thrive so well in the northern parts of the littoral zone of the protectorate, that Usambara and Par6 have become favourite districts for agricul- tural enterprise.

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EAST AFRICA, PORTUGUESE

East Africa, Portuguese, or Mozambique,

a province of the East Coast of Africa, belonging to Portugal, stretching 1430 miles along the Indian Ocean, between 10° 40' and 26° 62' S. lat.

Boundaries and Physical Geography. — By treaties with Germany in 1886 and in 1894, and with Great Britain in 1891, the boimdaries are as follows : — On the N. by 10° 40' S. lat. to the B.ovuma, and this river as far as the confluence of the M'Singe, and thence due W. to the E. shore of LakeNyasa; on the W. along the E. shore of the lake southwards as far as 13° 30' S. lat., thence S.E. to the E. shore of Lake Shiuta, along this lake and in a straight line from its S. extremity to the E. side of Lake Shire, down its E. side to the

S. end, and straight on to the most E. afiiuent (M'losa) of the river Ruo, which stream it then follows as far as its confluence with the Shir^. Erom that point it coincides with the Shire as far as a point a little below Shiwanga, thence due W. until it intersects the watershed between the Shire and the Zambezi ; then it follows this watershed, and the watershed between the Zambezi and Lake Nyasa, as far as 14° S. ; after that it turns S.W. and goes to the point where the river Arwangua is cut by 15° S. lat., and thence follows this river to its confluence with the Zambezi. On the S. of the Zambezi the Portuguese boundary strikes from a point opposite the mouth of the Arwangua and goes due S. to 16° S. lat., which it follows as far as 31° E. long., thence E. to the outer section of the river Mazoe and 33° E. long., continues along this meridian to 18° 30' S. lat., then follows southwards along the upper edge of the Manica plateau as far as the river Save, and follows the course of this river to its confluence with the Lunde. Erom that point it makes for the N.E. corner of the Transvaal Colony, then goes S. over the Lebombos and Swaziland frontier to the river Maputo, follows this river to the confluence of the Pongolo, and finally runs thence due E. to the Indian Ocean near Oro Point. Portugal at one time claimed ' almost unlimited areas in the interior of the continent, but by the extension of British enterprise in the south and west, and German enterprise in the north, the limits of the territory have been defined as above.

Orographically the backbone of the province south of the Zambezi is formed by the Lebombo Mountains, which, however, nowhere exceed 2070 ft. in height ; the Manica plateau, where Mount Doe rises to 7875 ft. and Mount Panga to 7610 ft. ; and the Gorongosa plateau, with Mount Miranga (6560 ft.), Enhatete (6050 ft.), and Gogogo (5900 ft.). The chief mountain range, however, lies north of the Zambezi, namely, the Namuli Mountains, in which hamuli Peak rises to 8860 ft., and Molisani, Mruli, and Mresi attain to altitudes of 6500 to 8000 ft. These mountains are covered with vegetation and have a temperate and healthy climate, a decided contrast to the unhealthy, malaria-haunted lowlands along the coast. At Tete, on the Lower Zambezi, the annual mean temperature is 77°-9 Eahr. ; the hottest month being November, 83°-3, and the coldest July, 72°-5. At Quilimane, on the coast, the mean temperature is 85°-l, maximum 106°-7, and mini- mum 49°-l. The rainy season lasts from December to March and the dry season from May to September. During the monsbons the districts bordering on the

Mozambique Channel enjoy a tolerably even mean tem- perature of 76°-l, maximum mean 88°‘7, and minimum mean 65°-3. Besides the Zambezi, the principal rivers that water the territory are the Limpopo, Save, Pungwe, Lurio, Eovuma, Shire, and Luia. In 1891 the colony, which used to be known as Mozambique, was designated the state of East Africa, and was divided into a north- ern and southern province, Mozambique and Lourenqo Marques ; and further, instead of that division, into the

districts of Mozambique, Zambezia, Gaza, and Inham- bane, Lourengo Marques forming one province. There is a governor-general, appointed for three years, residing at Lourenqo Marques, now the capital. There is a force of 3180 regular troops. The Manica and Sofala regions are administered by the Mozambique Company, which has a royal charter granting sovereign rights for fifty years from 1891. Another company administers the region on the east of Lake Nyasa, and the Companhia da Zambezia holds a concession in the Quilimane, Tete, and Zumbo regions. For 1900-1901 the estimated revenue was 2,838,000 milreis, and expenditure 2,993,000 milreis.

Products and Trade. — The chief vegetable products of the low coast region are the cocoanut and various other palms, ironwood (Casuarina), indigo, orchil, tobacco, coffee, and several oleaginous plants. The higher zone above the coast-lands abounds in timber trees, as the mutembate and the morepa, which yield timber similar to teak ; outch and cedra serve as supports for the climbing m’hungo {Landolphia florida) and calumba {Jateorhiza palmata). The natives devote their attention chiefly to the cultivation of oleagin- ous crops, e.g., almonds, sesamum, cocoanuts, copra, cashewnuts, and carapa. At Mopeia and other places the sugar-cane is culti- vated. In the north of the province, on the Zambezi, and at In-hambane, rice, millet, and beans are grown, also coffee in the two districts last named ; indiarubber in Quilimane. Wheat and other cereals grow in the delta of the Zambezi and in the valley of the Busi. Coal exists chiefly in Tete and between the Rovuma, Lujenda, and M’Salu, in Medo, and alongside the Umbelusi ; iron is abundant in the Serra Shinga, and is extracted by the Makwas ; gold exists in Medo, Mashinga, Missale, and Manica. In Manica the gold-mining country has been taken up mainly by British subjects. iFish are plentiful along the coast, and pearls are fished in the Bazaruto Isles.

Spirits, sugar and pottery are the only commodities manufactured. The imports in 1898 were valued at £19,894,000, exports at £402,400, besides a transit trade, mainly by Beira and Lourenfo Marques, of about £2,500,000. The total trade in 1899 was £29,662,500. Lourengo Marques, Beira, and Chinde are the chief ports. The chief exports are oil, seeds, indiarubber, wax, gums, orchil, coffee, tobacco, Indian hemp, manioc, ivory. The imports (£108,670 from Portugal In 1895, £466,000 in 1897) consist principally of wine, with cottons, wooUens, linen, silk, preserved foods, flour, ironmongery. Trade is carried on chiefly with Bombay, Marseilles, England, Zanzibar, and Lis- bon. The province possesses only two railways, one running from Lourenjo Marques to the Transvaal frontier, 57 mUes (Eessano Garcia) ; and so on to Pretoria, and the other from Beira to the frontier of Rhodesia, 222 miles, and to Salisbury. Beira is con- nected by telegraph with Salisbury, and Louren^o Marques with the Transvaal system, and there are 2661 miles of line.

Population, &c. — The area is estimated at 301,000 square miles, and the population at 3,120,000. Of the native races the most im- portant in the north are the Makwas and the Ajaus, both belong- ing to the Bantu stock. The dominant race between the Zambezi and the Mazoe are the Tavalas, other tribes in the same region being the Maraves, Sengas, Muzimbas, and Muzuzuros. On, the south of the Zambezi the ruling race are the Zulu tribe of the Vatwa in Gasa ; all other tribes of different stock being known as Tongas. The province forms a bishopric (Mozambique), belonging to the ecclesiastical province of Goa.

The principal towns are as follow : — ^Mozambique, the old capital, on an island off the coast to the north of the Zambezi ; population about 8000. In 1898 it was visited by 416 vessels, of 188,665 tons. Quilimane or Kelimane, at the mouth of a supposed former branch of the Zambezi, which is silting up. Chinee, a new port at the mouth of the Chinde branch of the Zambezi, in which Great Britain has a lease of land for a bonded warehouse ; it is con- nected by telegraph with Blantyre in British Central Africa ; population (1898), 1675. Beira, at the mouth of the Pungwe, south of the Zambezi, connected by rail and telegraph with Salisbury in Mashonaland, and an import- ant port for transit trade with the interior ; in 1898, 270 vessels, of 434,684 tons, visited the port; population (1898), 4223. Lourengo Marques,

on Delago'a Bay, of importance as the terminus of the railway to the Trans-vaal, with good harbour and excellent anchorage in the bay ; in 1898, 506 vessels, of 1,032,543 tons, visited the port j population, 5130. Towns on the Zambezi of little importance are Zumbo, Tete, and Sena.

EASTBOUEN E — E B B W VALE

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Eastbourne, a municipal borough (1883) and flourishing watering-place in the Eastbourne parliamen- tary division of Sussex, England, 66 miles south-south- east of London by rail. The ancient church of St Mary has been restored, and with that there are now eight parish churches, a Roman Catholic and various Nonconformist churches. Eecent erections otherwise are the town-hall and municipal buildings, the Princess Alice Memorial Hospital, the children's branch of All Saints' Convalescent Hospital, and a free library. There are also public baths and many high-class schools. The pier has been provided with a handsome pavilion and a new landing stage. Devonshire Park (13 acres) contains a large pavilion and a theatre. Area, 5410 acres. Population (1881), 22,014 ;

(1901), 43,357.

Easthampton, a town of Hampshire county, Mass., U.S.A., in the Connecticut valley. It is entered by two railways, and is the seat of Williston Academy. Population (1890), 4395; (1900), 5603, of whom 1731 were foreign-born and 42 negroes.

Ecl^t Hartford, a town of Hartford county, Con- necticut, U.S.A., on the Connecticut opposite Hartford, and entered by two railways. Population (1890), 4455 ; (1900), 6406, of whom 1191 were foreign-born and 78 negroes.

East Liverpool, acityof Columbiana county, Ohio, U.S.A., on the Ohio river and on the Pennsylvania rail- road, at an altitude of 692 feet. Pottery is the chief manufacture. Population (1880), 5568 ; (1890), 10,966 ; (1900), 16,485, of whom 2112 were foreign-born and 219 negroes.

East London, a town and seaport of Cape Colony, at the mouth of the Buffalo river, between the £eiskamma and Great Kei estuaries, with a population of about 7000. The harbour is one of the most dangerous on the south coast, and is still often inaccessible for days together, despite the breakwaters and otter extensive works that have been constructed to improve the ap- proaches. The bar, which formerly shifted with every storm and freshet, is now fixed, but has seldom more than a depth of 9 or 10 feet at the flow, whereas before the works were carried out it could be crossed by vessels drawing 20 feet of water. Nevertheless East London, being the natural outlet for the rich pasturages of the eastern districts, is the second port in the colony for the shipment of wool. It is the seaward terminus of the railway which runs through Queenstown and Molteno north to the Orange Eiver Colony. The imports, chiefly textiles, hardware, and provisions, were valued at £3,456,000 in 1896, £3,121,000 in 1897, and £3,620,000 in 1898 ; and the exports (wool, angora hair, hides, and skins) at £861,000, £817,000, and £9^5,000 for the same years.

Easton, capital of Northampton county, Pennsyl- vania, U.S.A., in 40° 43' N. lat. and 75° 16' W. long., at an altitude of 215 feet, at the junction of the Lehigh and Delaware rivers. It is a railway centre of importance, since it is entered by five lines, the Bangor and Portland, the New Jersey Central, the Delaware, Lackawanna, and Western, the Lehigh and Hudson Rivers, and the Lehigh Valley. It is divided into twelve wards. It is the seat of Lafayette College, a Presbyterian institution which in 1899 had a faculty of 28, and was attended by 309

students ; its property was valued at nearly $1,000,000, and its income for the year was $40,315. Population (1880), 11,924 ; (1890), 14,481 ; (1900), 25,238, of whom 2135 were foreign-born and 326 negroes. The death-rate in 1900 was 16-7.

East Orange, a township of Essex county. New Jersey, U.S.A., on branches of the Delaware, Lackawanna, and Western and the Erie railways, by which

it is con- nected with New York, 12 miles distant. It is a sub- urban residential town for New York business men. Population (1880), 8349 ; (1890), 13,282 ; (1900), 21,506, of whom 3950 were foreign-born and 1420 negroes.

Eastport, a city and port of entry of Washington county, Maine, U.S.A., the most easterly point of the United States, on Moose Island, in Passamaquoddy Bay. It has a good harbour, although the rise and fall of the tide is great, 26 feet, and it is connected in summer with Boston and Portland by daily steamers. It has consider- able industry in the canning of so-called sardines. Certain ,of the neighbouring islands in Passamaquoddy Bay are well-known summer resorts, among which are Campo Bello and Grand Manan, on the Canadian side of the boundary. Population (1880), 4006 ; (1890), 4908 ; (1900), 5311, of whom 1564 were foreign-born.

East Portland, formerly a city of Multnomah county, Oregon, U.S.A., annexed to Portland in 1891, on the east bank of the Willamette river. Population (1880),

2934; (1890), 10,532.

East Providence, a town of Providence county, Rhode Island, U.S.A., on the east side of the Providence river, opposite Providence. Within its area of 12^ square miles are several villages, the largest of which bears the same name as the town. A branch of the New York, New Haven, and Hartford railroad crosses the town. Population (1880), 5056; (1890), 8422; (1900), 12,138, of whom 2067 were foreign-born and 369 negroes.

East St Louis, a city of St Clair county, Illinois, U.S.A., in 38° 38' N. lat. and 90° 10' W. long., on the east bank of the Mississippi, at an altitude of 418 feet. Its site is in the American Bottom, little above the high- water mark of the river. This bottom stretches a long distance up and down the river, with a breadth of 10 or 12 miles. It is intersected by many sloughs and crescent-shaped lakes, which indicate former courses of the river. East St Louis is one of the great railway centres of the country. Into it enter from the east fourteen lines of railway, which cross to St Louis by the celebrated steel arch bridge, designed and built by J. B. Eads, and by the Merchants' Bridge. It has also extensive dockyards. Population (1880), 9185 ; (1890),

15,169 ; (1900), 29,656, of whom 3920 were foreign-born and 1799 negroes.

Eaii Claire, capital of Eau Claire county, Wisconsin, U.S.A., in 44° 51' N. lat. and 91° 30' W. long., at the junction of the Eau Claire and Chippewa rivers, at the head of navigation on the latter, at an altitude of f 89 feet. It is on branches of the Chicago, Milwaukee, and St Paul, the Chicago, St Paul, Minneapolis, and Omaha, and the Wisconsin Central railways. It is an important city in the lumber trade, and has many saw and planing mills. Population (1880), 10,119 ; (1890), 17,415 ; (1900), 17,517. ‘ V ^’

Ebbw Vale, an urban district in the Western par- liamentary division of Monmouthshire, England, 9 miles west-south-west of Abergavenny by rail. There is a library and scientific institute. The district contains large collieries and important iron and steel works. Area of urban district, 6817 acres. Population (1881), 14,700 ; (1901), 20,993. V y» > ,

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E B E R S — E CCLESIASTiuuS

Ebers, Ceorg (1837-1898), German Egyptologist and novelist, was born in Berlin on the 1st of March 1837. He was a posthumous child, and was chiefly educated by his mother. The rupture of a blood-vessel, occasioned by a chill caught in returning lightly clad from a ball in the depth of winter, led him to turn his thoughts seriously to study. At Gottingen he studied jurisprudence, and at Berlin Oriental languages and archaeology. By the advice of Brugsch and Lepsius he devoted himself mainly to Egyptology. In 1865 he be- came decent in Egyptian language and antiquities at Jena, and in 1870 he was appointed professor in these subjects at Leipzig. He had made two scientific journeys to Egypt, and his first great work, Egypt and the Books of Mos^s, appeared in 1867-68. Having discovered the celebrated medical papyrus which bears’ his name, he edited it in 1874, and a translation was published in 1890 by H. Joachim. At an early period of his career Ebers conceived the idea of popularizing Egyptian lore through the medium of historical romances. An Egyptian Princess was published in 1864, and obtained great success. Ebers’s subsequent experiments in the same style — Uarda (1877), The Sisters (1880), Serapis (1886), Homo Sum

(1887)— were also well received, and deservedly so, for, although not belonging to a very exalted class of literature, they did much to render the discoveries of Egyptologists com- mon property throughout Europe. When this vein was exhausted Ebers turned to ordinary historical fiction, and many of his novels were translated into English and obtained considerable popularity ; but his efforts in this department, though not inferior in talent, lacked the special recommendation of his Egyptian romances. He also wrote the life of his old preceptor Lepsius, and an autobiography. The state of his health led him in 1889 to retire on a pension from his chair at Leipzig, without, however, interrupting his literary activity. He died in August 1898.

Eberswalde, till 1877 named Nefstadt-Ebebs- WALDE, a town of Prussia, 28 miles north-east of Berlin by rail ; on the Finow Canal. The town has, besides the school of forestry, a gymnasium, a higher-grade girls' school, and two schools of domestic economy. Population

(1890), 16,114; (1900), 21,654.

Eccies, a municipal borough (1892) in the Eccles parliamentary division of Lancashire, England, 4 miles west of Manchester by rail. The Manchester Ship Canal passes the town. The chief additions comprise a town- hall, magistrates' court-house, sewage disposal works, town's yard, electric light works, theatre, two recreation grounds (1892), and several open spaces ; three Established churches, one Eoman Catholic church ; and the Wesleyan, Congregational, and Unitarian bodies possess handsome edifices. Eccles wakes, abolished in 1881, are held on private ground. Silk-throwing and the manufacture of fustians and ginghams are among the industries, and there are also large engine works. Area, 2008 acres. Population (1881), 21,850 ; (1901), 34,369.

Ecclesfield, a township in the Hallamshire parlia- mentary division of Yorkshire, England, 5 miles north of Shefiield by rail. There are remains of a Benedictine priory. The parish church (about 1470) has been re- stored. ; Cutlery and tools are largely manufactured, and there are coal-mines, paper mills, and iron and fire-clay works. Area of township, 10,893 acres. Population

(1881), 21,156 ; (1901), 34,153.

Ecclesiasticus, or Ben Siea (Hebrew Fragments). — That the book called in Latin Ecclesiasticus, in Greek SnpaX) ^^d by Jerome Jesu filii Sirach liber, was com-

posed in Hebrew was known to Jerome (d. a.d. 420), who testified "Hebraicum repperi." Saadiah Gaon {Jl. circ. A.D. 930) of the Fayyum in the Sepher haggalui refers to Ben Sira's work as written in pointed and accented Hebrew. After this all trace of a Hebrew Ecclesiasticus disappeared until Dr S. Schechter identified a loose leaf from Palestine, and published it in the Expositor for July 1896. More leaves were soon discovered at Oxford and at Cambridge, in the British Museum, and at Paris. Probably all these leaves came from the cellar (genizah) of the old synagogue at Cairo. The beginning of the book is still missing, but three colophons are preserved. The most ancient of these was attached to chap. 1., before the supplementary chap. li. was added to the original book. It runs : The Instruction of Understanding and the Proverbs fitly spoken of Simeon son of Jeshua son of Eleazar son of Sira. . . . Happy is the man who meditateth on these ; and he that layeth them to heart shall be wise : for the fear of Jehovah is life. From this colophon (and from the Sepher haggalui) we learn that the author's name was Simeon son of Jeshua (Jesus), though the LXX and Syriac seem to call him JesMS. (The writer of the Greek prologue may be wrong in attributing the book he "found" in Egypt to his ancestor Jesus, and not to Simeon, perhaps his uncle.) This ancient colophon also tells us (in agreement with Jerome) that the title of the book was " Proverbs." In Talmudic and Rabbinic litera- ture it is called simply the Book of Ben Sira. G. Bickell, Israel L^vi, and D. S. Margoliouth have argued that the Hebrew is only a retranslation from a Version. Most Hebrew scholars, however, believe that though the text has suffered much, especially by the addition of glosses, the fragments as a whole are a survival from the Hebrew original. The following portions have been published in Hebrew : Chaps, iii. 6-xvi. 26 a ; [gap] ; xxv. 8-xxvi. 2 (text abbreviated) ; [gap] ; xxx. 11-xxxiii. 3 ; [gap] ; XXXV. 9-xxxviii. 27 a; [gap]; xxxix. 15 h-adfin. These fragments were published by S. Schechter and C. Taylor (Cambridge, 1899) ; E. N. Adler, J.Q.E., April 1900; S. Schechter {ibid.); G. Margoliouth, J.Q.R., October 1899; and by A. E. Cowley and A. Neubauer

(Oxford, 1897). In addition to these, Isr. Levi published (E.E.J, tom. xl. No. 79) chaps, xxxvi. 24-xxxviii. 1 from a MS. which shows some variations from the text previously published. At the present time four different MSS. are known, of which the largest (called "B" by Schechter-Taylor) con- tains (with some gaps) chaps, xxx. ll-ad.;[n. A complete edition in collotype facsimile of all the above-mentioned fragments was published jointly by the two University Presses (Oxford and Cambridge, 1901). The Hebrew con- tains interpolations, but it also preserves original passages missing from the Versions. One of these is a Psalm of 15 verses found between verses 12 and 13 of chap. li. (This passage is doubtless pre-Maccabean, for it gives honourable mention to the priestly House of Zadok, which fell into disrepute during the Maccabean struggle.) The Hebrew often agrees strikingly with the Syriac ; when it agrees with the Greek, it is more often with a cursive MS. (H. and P. No. 248)] than with the uncials. The English E.V., following the uncials, often disagrees with the Hebrew. ".The language is classical Hebrew," wrote Cowley and Neubauer in 1897, " though the vocabulary has an admixture of late or Aramaic words or expressions " (preface, xiii). But the discovery of further fragments made a qualification of this verdict necessary. In 1899 Dr Schechter wrote, " Strained as [Ben Sira's] efforts were in imitating [the Scriptures], he failed in the end " ; a tell-

^ Ecclesiasticus is published from tliis MS. by tlie Cambridge Uni- versity Press, under tiie editorship of Mr J. H. A. Hart, St John's College.

ing list of Eabbinic expressions which follows justifies this judgment (Schechter and Taylor, pp. 33, 34). Ben Sira's book is an echo of books greater than itself, (w. b. b.)

Echegaray y Eizaguirre, Jose (1833),

Spanish mathematician, statesman, and dramatist, was born at Madrid in March 1833, and was educated at the grammar school of Murcia, whence he proceeded to the Escuela de Caminos at the capital. His exemplary dili- gence and unusual mathematical capacity were soon no- ticed. In 1853 he passed out at the head of the list of engineers, and, after a brief practical

experience at Almeria and Granada, was appointed professor of pure and applied mathematics in the school where he had lately been a pupil. HIs Problemas de geometrla analitica (1865) and Teorias modernas de la fisica unidad de las fuerzas ma- teriales (1867) are said to be esteemed by competent judges. HIe became a member of the Society of Political Economy, helped to found La Bevista, and took a promi- nent part in propagating Free Trade doctrines in the press and on the platform. HIe was clearly marked out for office, and when the popular movement of 1868 over- threw the monarchy, he resigned his post for a place in the revolutionary cabinet. Between 1867 and 1874 he acted as Minister of Education and of Finance ; upon the restoration of the Bourbon dynasty he withdrew from politics, and won a new reputation as a dramatist. ' As early as 1867 he wrote La hija natural, which was re- jected, and remained unknown till 1877, when it appeared with the title of Para ial culpa tal pena. Another play. La liUima noche, also written in 1867, was produced in 1875 ; but in the latter year Echegaray was already ac- cepted as the successful author of M Libra talonario, played at the Teatro de Apolo on 18th February 1874, under the transparent pseudonym of Jorge HayaseCa. Later in the same year Echegaray won a popular triumph with La Esposa del vengador, in which the good and bad qualities — the clever stagecraft and unbridled extravar gance — of his later work are clearly noticeable. From 1874 onwards he has written, with varying success, a pro- digious number of plays. Among the most favourable specimens of his talent may be mentioned En elpuflo de la espada (1875) ; 6 locura 6 santidad (1877), which has been translated into Swedish and Italian; En el seno de la micerte (1879), of which there exists an admirable German version by Fastenrath. El gran Galeoto (1881), perhaps the best of Echegaray's plays in conception and execution, has been translated into several languages, and still holds the stage. The humorous proverb, i Piensa mal y acer- tards ? exemplifies the author's limitations, but the at- tempt is interesting as an instance of ambitious versatility. HIs susceptibility to new ideas is illustrated in such pieces as El Mjo de Don Juan (1892) and El loco Dies (1900) : both of these plainly ;^rove a close reading of Ibsen, and El loco Dios more especially might be "taken for an unintentional parody of Ibsen's symbolism. Confirma- tory signs of a new departure are noticeable in Mariana (1892), in Mancha que limpia (1895), and in many other productions. Echegaray has succeeded to the literary inheritance of Ldpez

de Ayala and of Tamayo y Baus ; and though he possesses neither the poetic imagination of the first nor the instinctive tact of the second, it is impossible to deny that he has reached a larger audience than either. Not merely in Spain, but in every land where Spanish is spoken, and in cities as remote from Madrid as Munich and Stockholm, he has met with an appreciation incomparably beyond that accorded to any other Spanish dramatist of the 19th century. But it would be more than usually rash to prophesy that this exceptional popularity will endure. There have been signs of a reaction in Spain itself. Echegaray applies his mathe-

matics to the drama : no writer excels him in artful con- struction, in the arrangement of dramatic scenes, in mere theatrical technique, in the focussing of attention on his chief personages. These are valuable gifts in their way, and it is just to say that Echegaray has a singularly pow- erful, gloomy imagination, which is momentarily impres- sive. In the drawing of character, in the invention of felicitous phrase, in the contrivance of verbal music, he is deficient. He alternates between the use of verse and prose ; and this hesitancy in choosing a medium of ex- pression is amply justified, for the writer's prose is not more distinguished than his verse. These serious short- comings may explain the diminution of his vogue in Spain ; they will certainly tell against him in the estimate of posterity.

Echinodermata. — Since the article on Echino- derms in the 9th edition of the Encyclopaedia Britannica was published, our knowledge of this phylum of the animal kingdom has greatly increased, and our views on many important points have correspondingly changed. In 1877 the researches of Johannes Mllller formed the groundwork of scientific conceptions of the group, and they had thus far been confirmed rather than added to. The distinction of Echinoderms from such radiate animals as jelly-fish and corals (see Ccelenteka), by their pos- session of a body-cavity ("coelom") distinct from the gut, was fully realized ; while their severance from the worms (especially Gephyrea), with which some Echino- derms were long confused, had been necessitated by the recognition in all of a radial symmetry, impressed on the original bilateral symmetry of the larva through the growth of a special division of the coelom, known as the "hydroccel," and giving rise to a set of water-bearing canals — the water-vascular or ambulacral system. There was also sufficient comprehension of the

differences be- tween the main classes of Echinoderms — the sea-urchins or Echinoidea, the starfish or Asteroidea, the brittle-stars and their allies known as Ophiuroidea, the worm-like Holothurians, the feather-stars and sea-lilies called Cri- noidea, with their extinct relatives the sac-like Cystidea, the bud-formed Blastoidea, and the flattened Edrioaster- oidea — while within the larger of these classes, such as Echinoidea and Crinoidea, fair-working classifications had been established. But the study that should eluci- date the fundamental similarities or homologies between the several classes, and should suggest the relations of the Echinodermata to other phyla, had scarcely begun. Indeed, the time was not ripe for such discussions, stUl less for the tracing of lines of descent and their embodi- ment in a genealogical classification. Since then explor- ing expeditions have made known a host of new genera, often exhibiting unfamiliar types of structure.

Among these the abyssal starfish and holothurians described by Sladen and Th^el respectively, in the Report of the "Challenger" Expedition, are most notable. The sea-urchins, ophiuroids, and crinoids also have yielded many important novelties to A. Agassiz (Ohallenger,Blake, and Albatross Expeditions), Lyman (Challen- ger), Sladen (" Astrophiura," Ann. Mag. Nat. Mist., 1879), Bell (numerous papers in^nm. Mag. Nat. Hist., and in Proc. Zool.Soc), B. Perrier (Travailleur and Talisman, Cape Horn, and Monaco Expeditions), P. H. Carpenter (Challenger Reports) and others. The anatomical researches of these authors, as well as those of Lov6n (" On Pourtalesia " and "Echinologica," published by the Swedish Academy of Science), Ludwig (Morphologische Studien, Leipzig, 1877-1882), Hamannffi'stoiofifie der Bchinodermen, Jena, 1883-1889), Cu^not (" Etudes morphologiques," Arch. Biol, 1891, and papers therein referred to), Duncan (" Revision of the Echinoidea," Journ. Linn. Soc, 1890), Prouho (" Siir Dorooidaris," Arch. Zool. Exper., 1888), and many more, need only be mentioned to recall the great advance that has been made. In physiology may be instanced W. B. Cai^enter's proof of the nervous nature of the chambered organ and axial cords of crinoids (Proc. Boy. Soc, 1884), the researches of Durham (Quart. Journ. Micr. Sci., 1891), and others into the wander- ing cells of the body-cavity, and the study of the deposition of the

skeletal substance (“stereom “) by Thfiel (in Festskrift for Lillje- borg, 1896). Knowledge of the development has been enormously extended by numerous embryologists, e.g., Ludwig (op. cit.), MaoBride (“Asterina gibbosa,” Quart. Journ. Micr. Set, 1896), Bury (Quart. Journ. Micr. Sci., 1889, 1895), Seeliger (on “Ante- don,” Zool. Jahrb., 1893), Goto (” Asterias pallida,” Journ. Coll. Sci. Japan, 1896), Grave (” Ophiura,” ilfeHj. Jtihns Hopkins Univ., 18!)9), Thgel (” Echinocyamus,” JVbu. Act. Soc. Sci. Vpsala, 1892), Semon (” Synapta,” Jena. Zeitschr., 1888), and Love’n (opp. citt.) ; and though the theories based thereon may have been fantastic and contradictory, we are now near the time when the results can be co- ordinated and some agreement reached. But the scattered details of comparative anatomy are capable of manifold arrangement, while the palimpsest of individual development is not merely fragmentary, but often has the fragments misplaced. The morphologist may propose classifications, and the embryologist may erect genealogical trees, but all schemes which do not agree with the direct evidence of fossils must be abandoned ; and it is this evidence, above all, that gained enormously in volume and in value during the last quarter of the 19th century. The Silurian crinoids and cystids of Sweden have been illustrated in Angelin’s Iconographia Crinoideorum, 1878 ; the Palaeozoic crinoids and cystids of Bohemia are dealt with in Barrande’s Systeme Silurien, 1887 and 1899 ; P. H. Carpenter published important papers on fossil crinoids in the Journal of the Geological Society, on Cystidea in that of the Linnean Society, 1891, and, together with R. Etheridge, jun., compiled the large Catalogue of Blastoidea in the British Museum, 1886 ; O. Jaekal, in addition to valuable studies on crinoids and cystids appearing in the Zeitschrift of the German Geological Society, has published the first volume of Die Stammesgeschichte der Pelmatozoen (Berlin, 1899) , a richly suggestive work ; the Mesozoic Echinoderms of France, Switzerland, and Portugal have been made known by P. de Loriol, G. H. Cotteau, J. Lambert, V. Gauthier, and others (see Faleontologie Franqaise, Mem. Soc. Paleontol. de la Suisse, Trabalhos Comm. Geol. Portugal, &c.) ; a beautiful and interesting Devonian fauna from Bundenbach has been described by

EoUmaun, Jaekel, and especially Sttirtz (see Verh^ndl. nat. Verein preuss. Mheinlande, Pal< Abhandl. and="" palceonto-="" graphica ="" ="" while="" the="" multitude="" of="" north="" american="" palaeozoic="" crinoids="" has="" been="" attacked="" by="" waohsmuth="" andspringer="" in="" theproceedings="" ofthe="" philadelphia="" academy="" andthe="" memoirs="" of ="" theharvard="" museum="" 1897 .="" ="" p=">

The vast mass of material made known by these and many other distinguished writers has to' be included in our classification, and that classification itself must be controlled by the story it reveals. Thus it is that a change, characteristic of modern systematic zoology, is affecting the subdivisions of the classes. It is not long since the main lines of division corresponded roughly to gaps in geological history : the orders were Palseocrinoidea and Neocrinoidea, Palechinoidea and Euechinoidea, Pala&^ asteroidea and Euasteroidea, and so forth. Or divisions were based upon certain modifications of structure which, as we now see, affected assemblages of diverse affinity : thus both Blastoidea and Euechinoidea were divided into Eegularia and Irregularia ; the Holothuroidea into Pneu mophora and Apneumona ; and Crinoids were discussed under the heads " stalked " and " unstalked." The barriers between these groups may be regarded as horizontal planes cutting across the branches of the ascending tree of life at levels determined chiefly by our ignorance ; as know- ledge increases, and as the conception of a genealogical classification gains acceptance, they are being replaced by vertical partitions which separate branch from branch. The changes may be appreciated by comparing the sys- tematic synopses in the Treatise on Zoology, edited by Ray Lankester, with the classification adopted in the article in Ency. Brit., 9th ed., vol. vii., or in any zoological text-book contemporary therewith. In the present stage of our know- ledge these minor divisions are the really important ones. For, whereas to one brilliant suggestion of far-reaching homology another can always be opposed, by the detailed comparison of individual growth-stages in carefully selected series of fossils, and by the minute application to these of the principle that individual history repeats race history, it actually is possible to unfold lines of descent that do not admit of doubt. The gradual linking up of these will manifest the true genealogy of each class, and

reconstruct its ancestral forms by proof instead of conjec- ture. The problem of the interrelations of the classes will thus be reduced to its simplest terms, and even ques- tions as to the nature of the primitive Echinoderm and its affinity to the ancestors of other phyla may become more than exercises for the ingenuity of youth. Work has been and is being done by the laborious methods here alluded to, and though the diversity of opinion as to the broader groupings of classification is still restricted only by the number of writers, we can point to an ever-increas- ing body of assured knowledge on which all are agreed. Unfortunately such allusion to these disconnected cer- tainties as alone might be introduced here would be too brief for comprehension, and we are forced to select a few of the broader hypotheses for a treatment that may seem dogmatic and prejudiced.

Calycinal Theory. — The theory which liad most influence on the conceptions of Echinoderms in the two concluding decades of the 19th century was that of Lovfin, elaborated by P. H. Carpenter, Sladen, and others. This, which may be called the calycinal theory, will be appreciated by comparing the structure of a simple crinoid with that of some other types. A crinoid reduced to its simplest elements consists of three principal portions — (i.) a theca or test enclosing the viscera ; (ii.) five arms stretching upwards or outwards from the theca, sometimes single, sometimes branching; (iii.) a stem stretching downwards from the theca and attaching it to the sea-floor (see Fig. 1). That p^rt of the theca below the origins of

CAeca.

Stem..

root.

oral.

ooo

Fio. 1.— Diagram of a simple form of Crinoid, vrtth five arms, each forking once ; the one nearest the observer is removed to expose the tegmen of five orals. This crinoid has only two circlets of plates in the cup, but the cup

analysed in the adjoining diagram has in addition infrabasals and a centrale O.

the free arms is called the "dorsal cup" ; the ventral part above the origins of the arms, serving as cover to the cup, is known as the " tegmen." All these parts are supported by plates or ossicles of crystalline carbonate of lime. The cup, in its simplest form, con- sists of two circlets of five plates. Each plate of the upper circlet sup- ports an arm, and is called a " radial "; the plates of the lower circlet, the " basals, ' ' rest on the stem and alternate with those of the upper circlet, i.e., are interradial in position. Some crinoids have yet another circlet below these, the constituent plates of which are called 'I infrabasals," and are situated radially. The tegmen in most primi- tive forms, as well as in the embryonic stages of the living Antedon (Fig. 2), consists of five large triangular plates, alternating with the radials, and called " orals," because they roof over the mouth. In addition to these three or four circlets of plates, two other elements were once supposed essential to the ideal crinoid : the dorso-central and the oro-central. The former term was applied to a flattened plate observed in the embryonic stage of a single genus (Antedon) at that end of the stem attached to the sea-floor, and comparable to

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the foot of a wine-glass (Fig. 2). In some crinoids which have no trace of a stem {e.g., Marsupites) a pentagonal plate is found at the bottom of the cup, where the stem would naturally have arisen (" centrale " in Fig. 1) ; and since it was believed that the stem always grew by addition of ossicles immediately below the infra- basals, it was inferred that this pen- tagonal plate was the centro-dorsal in its primitive position, as though the wine-glass had been evolved from a tumbler by pulling the bottom out to form the foot. The oro-central was, it must be admitted, a theoretical concep- tion due to a desire for symmetry, and was not confirmed by anything better than some erroneous observations on certain fossils, which were supposed to ^'"•2— An early stage to the show a plate at the oral pole between the

t^r^^S^Ztoifl^foi nve orals ; but this plate, so far as it exists "dorso-
oentral"/^ at the at all, is now known to be nothing but an oral shifted in
position. The theory was that all the plates just described, and more
particularly those of the cup, which were termed " the calycinal sys- tem,"
could be traced, not merely in all crinoids, but in all Echinoderms,- whether
fixed forms such as cystids and blastoids, or free forms such as ophiuroids
and echinoids, even — with the eye of faith — in holo- thurians. It was
admitted that these elements might atrophy, or be displaced, or be
otherwise obscured ; but their complete and symmetrical disposition was
regarded as typical and original. Thus the genera exhibiting it were
regarded as primitive, and those orders and classes in which it was least
obscured were supposed to approach most nearly the ancestral
Echinoderm. Everyone knows that an " apical system," composed of two
circlets known as " genitals " or basals and " oculars " or radials, occurs
around the aboral pole of echinoids (Fig. 3, A), and that a few genera
(^e.g., Salenia,

end of the stem col. Some of the thecal plates, infra- basals IB, basals B,.
and orals 0 are forming around the body-cavities r.pe and l.pc ; p is the
water-pore. [2ft6r SeeUger.) (x 83 diam.)

Tio. 8.— -Supposed calyolnal systems of free-moving Echinoderms. A,
regular sea-urchin {(MdariB) : B, sea-urchin with a sur-anal plate
(Salenia) ; 0, developing ophiurid {AmpMwra) ; D, young starfish
\Zoroa8ter),

Fig. 3, B) possess a sub-central plate (the "sur-anal"), which might be
identified with the centro-dorsal. It is also the case that many asterids (Fig.
3, D) and ophiuridS (Fig. 3, C) have a similar arrangement of plates on the
dorsal (i.e. , aboral) surface of the disc. Accepting the homology of these
apical systems with the calycinal system, the theory, would regard the
aboral pole of a sea-urchin or starfish as corresponding in everything,
except its relations to the sea-fioor, with the aboral pole of a fixed
echinoderm.

The theory has been vigorously opposed, notably by Semon (pp. cit.), who
saw in the holothurians a nearer approach to the

ancestral form than was furnished by any calyculate echinoderm, and by the Sarasins, who derived the echinoids from the holo- thurians through forms with flexible tests (Echinothuridse, which, however, are now known to be specialized in this respect). The support that appeared to be given to the theory by the presence of supposed calycinal plates in the embryo of echinoids and asteroids has been, in the opinion of many, undermined by MacBride (op. cit.), who has insisted that in the fixed stage of the developing starfish, Asterina, the relations of these plates to the stem are quite different to those which they bear in the developing and adult crinoid. But, however correct the observations and the homologies of MacBride may be, they do not, as Bury (pp. cit) has well pointed out, afford sufficient grounds for his inference that the abactinal (i. e. , aboral) poles of starfish and crinoids are not comparable with one another, and that all conclusions based on the supposed homology of the dorso-central of echinoids and asteroids with that of crinoids are incorrect. Bury himself, however, has infiicted a severe blow on the theory by his proof that the so-called oculars of Echinoidea, which were supposed to represent the radials, are homologous with the "terminals" (i.e., the plates at the tips of the rays) in Asteroidea and Ophiuroidea, and therefore not homo- logous with the radially disposed plates often seen around the aboral pole of those animals. For, if these radial constituents of the supposed apical system in an ophiurid have really some other origin, why can we not say the same of the supposed basals ? Indeed, Bury is constrained to admit that the view of Semon and others may be correct, and that these so-called calycinal systems may not be heirlooms from a calyculate ancestor, but may have been independently developed in the various classes owing to the action of similar causes. That this view must be correct is urged by students of fossils. Palseontology lends no support to the idea that the dorso-central is a primitive element ; it exists in none of the early echinoids, but its origin from the minor plates around the anus is seen in the Saleniidse. There is no reason to suppose that the central apical plate of certain free-swimming crinoids has any more to do with the distal foot-plate of the larval Antedon stem than has the so-called centro-dorsal of Antedon itself, which is nothing but the compressed proximal end of the stem. As for the supposed basals of Echinoidea, Asteroidea, and Ophiuroidea, they are scarcely to be distinguished among the ten or more small plates that surround the anus of Bothriocidaris, which is the oldest and probably the most ancestral of fossil

sea-urchins (Fig. 5). Acalycinal system may be quite apparent in the later Ophiuroidea and in a few Asteroidea, but there is no trace of it in the older Palseozoid types, unless we are to transfer the appellation to the terminals. Those plates are perhaps constant throughout sea-urchins and starfish (though it would puzzle any one to detect them in certain Silurian echinoids) and they may be traced in some of the fixed echinoderms ; but there is no proof that they represent the radials of a simple crinoid, and there are certainly many cystids in which no such plates existed. Lovfo and M. Neumayr adduced the Triassic sea- urchin Tiarechinus, in which the apical system forms half of the test, as an argument for the origin of Echinoidea from an ancestor in which the apical system was of great importance ; but a genus appearing so late in time, in an isolated sea, under conditions that dwarfed the other echinoid dwellers therein, cannot seriously be thought to elucidate the origin of pre-Silurian Echinoidea, and the recent discovery of an' intermediate form suggests that we have here nothing but degenerate descendants of a well-known Palaeozoic family (Lepidocentridse) . But to pursue the tale of isolated in- stances would be wearisome. The calycinal theory is not merely an assertion of certain homologies, a few of which might be disputed without affecting the rest : it governs our whole conception of the echinoderms, because it implies their descent from a calyculate an- cestor— not a " crinoid-phantom " that bogey of the Sarasins, but a form with definite plates subject to a quinqueradiate arrangement, with which its internal organs must likewise have been correlated. To this ingenious and plausible theory the revelations of the rocks are more and more believed to be opposed.

Fentactma Theory. — In opposition to the calycinal theory has been the Pentactasa theory of Semon. There have always been many zoologists prepared to ascribe an ancestral character to the holothurians. The absence of an apical system of plates ; the fact that radial symmetry has not affected the generative organs, as it has in all other recent classes ; the well-developed muscles of the body-wall, supposed to be directly inherited from some worm-like ancestor ; the presence on the inner walls of the body in the family Synaptidae of ciliated funnels, which have been rashly compared to the excretory organs (nephridia) of many worms ; the outgrowth from the rectum in other genera of caeca (Cuvierian organs and respiratory trees), which recall the anal glands of the Gephyrean worms ; the absence of podia

(tube-feet) in many genera, and even of the radial water-vessels in Synaptldae ; the absence of that peculiar structure known in other echinoderms by the names "axial organ," "ovoid gland," &c. ; the simpler form of the larva — all these features have, for good reason or bad, been

Fig. 4. — The P&ntaciula Btage in the develop- ment of Synapia. T, the five interradial ten- tacles; M, the water- pore, leading by the stone-canal ate to the water-ring, from which hangs a Folian vesicle ph ; oc^ supposed octo-cysts ; m, longitudinal muscles ; ak, calcareous spicules ; 6i, stomach. (After Sermm.) (x 24 diameters.)

regarded as primitive. Some of the more striking of these features are confined to Synaptidse ; in that family too the absence of the radial water-vessels from the adult is corre- lated vrith continuity of the circular muscle-layer, while the gut runs almost straight from the anterior mouth to the posterior anus. Early in the life-history of Synapta occurs a stage with five tentacles around the mouth, and into these pass canals from the water-ring, the radial canals to the bpdy- wall making a subsequent, and only tem-porary, appearance (Fig. 4). Semon called this stage the Pentactula, and supposed that, in its early history, the class had passed through a similar stage, which he called the Pentactma, and regarded as the ancestor of all Echinoderms. It has since been proved that the five tentacles with their canals are interradial, so that one can scarcely look on the Pentactula as a primitive stage, while the apparent simplicity of the Synap- tidae, at least as compared with other holo- thurians, is now believed to be the result of re-gressive changes. The PentactcBO, at all events as it sprang from the brain of Semon, must pass to the limbo of mythological ancestors.

Pelmatozoic Theory. — The rejection of the calycinal and Pen- tactcea theories need not scatter our conceptions of Echinoderm structure back into the chaos from which they seemed to have emerged. The idea of a calyculate ancestor, though by no means connoting fixation, turned men's minds in the direction of the fixed forms, simply because in them the calyx was best developed. The PentactcBa again suggested a search for some

primitive type in which quinqueradiate symmetry was exhibited in circumoral ap- pendages, but had not affected the nervous, water-vascular, mus- cular, or skeletal systems to any great extent, and the generative organs not at all. Study of the earliest larval stages has always led to the conclusion that the Echinoderms must have descended from some freely-moving form with a bilateral symmetry, and, con- necting this with the ideas just mentioned, we reach the conception that this supposed bilateral ancestor (or Dipleurula) may have be- come fixed, and may have gradually acquired a radial symmetry in consequence of its sedentary mode of life. The different extent of quinqueradiate symmetry in the different classes would thus de- pend on the period at which they diverged from the sedentary stock. The tracing of this history, and the explanation of the gen- eral characters of Echinoderms and of the differentiating features of the classes in accordance therewith, Constitutes the Pelmatozoic theory.

The word "Pelmatozoa" literally means "stalked animals," but the name is now used to denote all Cystidea, Blastoidea, Crinoidea, and Edrioasteroidea, as opposed to the other classes, which may be called Eleutherozoa. Many Pelmatozoa have, it is true, no stalk, while some are freely-moving, but all agree in the possession of certain characters obviously connected with a fixed mode of life. Thus, the mouth is central and turned away from the sea-floor ; the animal does not seize its food by tentacles, limbs, or jaws, neither does it move in search of it, but a series of ciliated grooves which radiate from the mouth sweep along currents of water, in the eddies of which minute food-particles are caught up and carried down into the gullet; the undigested food is driven out through an anus which is on the upper or oral side of the theoa, but as far distant as practicable from the mouth and ciliated grooves. Such characters are found in any primitive, sedentary group. More peculiarly Echinoderm features, in which the Pelma- tozoan nature is manifest, are the enclosing of the viscera in a calcified and plated theca, for protection against those enemies from which a fixed animal cannot flee ; the development, at the aboral pole of this theca, of a motor nerve-centre giving off branches to the stroma connecting the various plates of the theca and of its brachial, anal, and columnar extensions, and thus co-ordinating the movements of the whole skeleton ; the absence of suckers from the podia, which, when present, are respiratory, not locomotor, in function. There are other features of most, if

not all, Pelmatozoa that appear to be due to a fixed existence, but those are also found in the Eleutherozoa. The Pelmatozoic theory thus regards the Pelmatozoa as the more ancestral forms, and the Pelmatozoan stage as one that must have been passed through by all Echino- derms during their evolution from the Dipleurula. It might be possible to prove the origin of all classes from Pelmatozoa, without thereby explaining the origin of such fundamental features as radial symmetry, the developmental metamorphosis, and the torsion that affects both gut and body-cavities during that process ; but the acceptance of a Dipleurula as the common ancestor necessitates an explanation of these features. Such explanation is an integral part of the Pelmatozoic theory, but is provided by no other.

The evidence for the Pelmatozoic theory is supplied by palaeon- tology, embriology, the comparative anatomy of the classes, and a consideration of other phyla. Palaeontology, so far as it goes, is a sure guide, but some of the oldest fossiliferous rocks yield remains of distinctly differentiated crinoids, asteroids, and echinoids, so that the problem is not solved merely by collecting fossils. Two lines of argument appear fruitful. First, a comparison of the relative numbers of the representatives of the various classes at different epochs ; according to this they may be placed in the following order, with the oldest first : Cystidea, Crinoidea, Blastoidea, Asteroide'a, Ophiuroidea, Echinoidea. As for Holo- thuroidea, the fossil evidence allows us to say no more than that the class existed in early Carboniferous times, if not before. The second method is to work out by slow and sure steps the lines of descent of the different families, orders, and classes, and so either to arrive at the ancestral form of each class, or to plot out the curve of evolution, which may then legitimately be projected into "the dark backward and abysm of time." In this way the many highly modified orders of Cystidea may be traced back to a simple, many-plated ancestor with little or no radiate symmetry (see below). All the complicated structures of Blastoidea are evolved from a fairly simple type, which in its turn is linked on to one of the cystid orders. That the crinoids are all deducible from some such simple form as that above described under the head "calycinal theory," is now generally admitted. Although, in the extreme correlation of the radial food-grooves, nerves, water- vessels, and so forth, with a radiate symmetry of the theca, such a type differs from the Cystidea, while in the possession of jointed processes from the radial plates,

bearing the grooves and the^various body-systems outwards from the theca, it differs from all other Echinoderms, nevertheless ancient forms are known which, if they are not themselves the actual links, suggest how the crinoid type may have been evolved from some of the more regular cystids. The fourth class of Pelmatozoa — the Edrioasteroidea — differs from the others in the structure of its ambulacra. As in all Pelmatozoa, these seem to have borne ciliated food-grooves protected by movable covering-plates (Fig. 11). Beneath each food-groove was a radial water-vessel and probably a nerve and blood-vessel, all which structures passed either between certain regularly arranged thecal plates, or along a furrow floored by those plates, which were then in two alternating series. The important and distinctive feature is the presence of pores between the flooring-plates, on either side of the groove ; and these, we cannot doubt, served for the passage of podia. Thus in a highly developed edrioasteroid, such as Edrioaster itself (Fig. 11), there was a true ambulacrum, apparently constructed like that of a starfish, but differing in the possession of a ciliated food-groove protected by covering-plates. The simpler forms of Edrioasteroidea, with their more sac-like body and undifferentiated plates, may well have been derived from early Cystidea of yet simpler structure, and there seems no reason to follow Jaekel in regarding the class as itself the more primitive. Turning to fossil Asteroidea, we find the earlier ophiurids scarcely distinguishable from the asterids, while in the alternation of the ambulacrals, which undoubtedly correspond to the flooring-plates of Edrioaster, both groups approach the Pelmatozoan type. These facts have been expressed by Sttirtz in his names Encrinasterise and Ophio-encrinasterisB. There is no difBculty in deducing the highly differentiated asterids and ophiurids of a later day from these simpler types. The evolution of the modem Echinoidea from their Palaeozoic ancestors is also well understood, but in this case the ancestral form to which the palaeontologist is led does not at first sight present many resemblances to the Pelmatozoa. It is, however, characterized by simplicity of structure, and a short description of it will serve to clear the problem from unnecessary difificulties. Bothriocidaris (Fig. 5), a small echinoid from the

termint amlfuiacrt

Fio. f>.—Bo11wiocidaris gldbulwt. A, from the side ; B, the plates around the aboral pole. (After Jaekel.) The short spines which were attached to the tubercles are not drawn.

Ordovician rocks of Esthonia, is in essential structure just the form demanded by comparative palaeontology to make a starting- point. It is spheroidal, with the mouth and anus at opposite

poles ; there are five ambulacra, and the ambulacral plates are large, simple, and alternating, each being pierced by two podial pores which lie in a small oval depression ; the ambulacrals next the mouth form a closed ring of ten plates ; the interambulacrals lie in single columns between the ambulacra, and are separated from the mouth-area by the proximal ambulacrals just mentioned, and sometimes by the second set of ambulacrals also ; the ambulacra end in the five oculars or terminals, which meet in a ring around the anal area and have no podial pores, but one of them serves as a madreporite ; within this ring is a star-shaped area filled with minute irregular plates, none of which can safely be selected as the homologues of the so-called basals or genitals of later forms ; within the ring of ambulacrals around the mouth are five somewhat pointed plates, which Jaekel regards as teeth, but which can scarcely be homologous with the interradially placed teeth of later echinoids, since they are radial in position ; small spines are present, especially around the podial pores. The position of the pores near the centre of the ambulacrals in Bothriocidaris need not be regarded as primitive, since other early Falseozoic genera, not to mention the young of living forms, show that the podia originally passed out between the plates, and were only gradually surrounded by their substance ; thus the originfil structure of the echinoid ambulacra differed from that of the early asteroid in the position of the radial vessels and nerves, which here lie beneath the plates instead of outside them. To this point we shall recur ; palssontology, though it suggests a clue, does not furnish an actual link either between echinoidea and asteroidea, or between those classes and Pelmatozoa.

The argument from embryology leads farther back. First, as already mentioned, it outlines the general features of the Dipleurula; secondly, it indicates the way in which this free- moving form became fixed, and how its internal organs were modified in consequence ; but when we seek, thirdly, for light on the relations of the classes, we find the features of the adult coming in so rapidly that such intermediate stages as may have existed are either squeezed out or profoundly modified. The difficulty of rearing the larvse in an aquarium towards the close of the metamorphosis may account for the slight information available concerning the stages that immediately follow the embryonic. Another difficulty is due to the fact that the types studied, and especially the crinoid Antedon, are highly specialized, so that some of the embryonic features are not really primitive as regards the class, but only as regards that particular genus. Thus inferences from embryonic development need to be checked by palaeontology, and supplemented by comparison of the anatomy of other living genera.

Minute anatomical research has also aided to establish the Pelmatozoic theory by the gradual recognition in other classes of features formerly supposed to be confined to Pelmatozoa. Thus the elements of the Pelmatozoan ventral groove are now detected in so different a structure as the echinoid ambulacrum, while an aboral ner- vous system, the diminished representative of that in crinoids, has been traced in all Eleutherozoa except Holothurians. The broader theories of modern zoology might seem to have little bearing on the Bchinoderma, for it is not long since the study of these animals was compared to a landlocked sea undisturbed by such storms as rage round the origin of the Vertebrata. This, however, is no more the case. The conception of the Dipleurula derives its chief weight from the fact that it is comparable to the early larval forms of other primitive coelomate animals, such as Balanoglossus, Phoronis, Chsetognatha, Brachiopoda, and Bryozoa. So too the explanation of radial symmetry and torsion of organs as due to a Pelmatozoic mode of life finds confirmation in many other phyla. Instead of discussing all these questions separately, with the de- tails necessary for an adequate presentation of the argument, we shall now sketch the history of the Echinoderms in accordance with the Pelmatozoic theory. Such a sketch must pass lightly over debatable ground, and must consist largely of suggestions still in need of confirmation ; but if it serves as a frame into which more precise and more detailed statements

~~may be fitted as they come to the ken of the reader, its object will be attained.~~

~~Evolution, of the Echinoderms. — It is reasonable to suppose that the Coelomata — animals in which the body- cavity is divided into a gut passing from mouth to anus and a hollow (coelom) surrounding it — were derived from the simpler Coelentera, in which the primitive body-cavity (archenteron) is not so divided, and has only one aperture serving as both mouth and anus. We may, with Sedg- wick, suppose the coelum to have originated by the en- largement and separation of pouches that pressed outwards from the archenteron into the thickened body-wall (such structures as the genital pouches of some Coelentera, not yet shut off from the rest of the cavity), and they would probably have been four in number and radially disposed~~

~~about the central cavity. The evolution of this cavity into a gut is foreshadowed in some Coelentera by the elliptical shape of the aperture and by the development at its ends of a ciliated channel along which food is swept ; we have only to suppose the approximation of the sides of the ellipse and their eventual fusion, to complete the transformation of the radially symmetrical Ccelente- rate into a bilaterally symmetrical Coelomate with mouth and anus at opposite ends of the long axis. We further suppose that of the four coelomic pouches one was in front of the mouth, one behind the, anus, and one on each side. Such an animal, if it ever existed, probably lived near the surface of the sea, and even here it may have changed its medusoid mode of locomotion for one in the direction of its mouth. Thus the bilateral symmetry would have been accentuated, and the organism shaped more definitely into three segments, namely, (1) a preoral segment or lobe, containing the anterior coelomic cavity ; (2) a middle segment, containing the gut, and the two middle coelomic cavities; (3) a posterior segment, con- taining the posterior coelomic cavity, which, however, owing to the backward prolongation of the anus, became divided into two — a right and left posterior coelom. Each of these cavities presumably excreted waste products to the exterior by a pore. There was probably a nervous area, with a tuft of cilia, at the anterior end ; while, at all events in forms that remained pelagic, the ciliated nervous tracts of the rest of the body may be supposed to have become arranged in bands around the body-segments.~~

Such a form as this is roughly represented to-day by the ‘ Actinotrocha larva of Phoronis, the importance of which has been brought out by Masterman. But only slight modifications are required to produce the Tornaria larva of the Enteropneusta and other larvse, including the special type that is inferred from the Dipleurula larval stages of recent forms to have characterized the ancestor of the Echinoderms. We cannot enter here into all the details of comparison between these larval forms ; amid much that is hypothetical a few homologies are widely accepted, and the preceding account will show the kind of relation that the Echinoderms bear to other animals, including what are now usually regarded as the ancestors of the Chordata (to which back-boned animals belong), as well as the nature of the evidence that their study has been, or may be, made to yield. How the hypothet- ical Dipleurula became an Echinoderm, and how the primitive Echinoderms diverged in structure so as to form the various classes, are questions to which an an- swer is attempted in the following paragraphs : —

Confining our attention to that form of Dipleurula (Fig. 6) which, it is supposed, gave rise to the Echinoderma, we infer

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ff’.postr

arUerio/’ CQelom. mouCh. H.pos^r. coelom.

Fig. 6.— Diagrammatic reconstruction of Dipleurula. The creature is repre- sented crawling on the sea-iloor, but it may equally well have been a float- ing animal. The ciliated bands are not drawn.

from embryological data that its special features were as fol- low : — The anterior coelomic cavity was wholly or partially divided, and from each half a duct led to the exterior, open- ing at a pore near the middle line of the back. The middle cavities were smaller, and the ducts from them came to unite with those from the anterior cavities, and no longer opened directly to the exterior ; whether these cavities were already specialized as water-sacs

cannot be asserted, but they certainly had become so at a slightly later stage. The posterior cavities were the largest, but what had become of their original opening to the exterior

is uncertain. The genital products were derived from the lining of the coelomic cavities, but it would not be safe to say that any particular region was as yet specialized for generation. The epithelium of the outer surface was probably ciliated, and a portion of it in the peroral lobe differentiated as a sense-organ, with longer cilia and underlying nerve-centre, from which two nerves ran back below the ventral surface. Into the space between the walls of the coelom and the outer body-wall, originally filled with jelly, definite cells now wandered, chiefly derived from the coelomic walls. Some of these cells produced muscles and connective tissue ; others absorbed and removed waste products, iron salts, calcium carbonate, and the like, and so were ready to be utilized for the deposition of pigment or of skeletal substance. In some of these respects the Dipleurula may have diverged from the ancestor of Enteropneusta and of other animals, but it could not as yet have been recognized as echinodermal by a zoologist, for it presented none of the structural peculiarities of the modem adult echinoderm.

Now ensued the great event that originated the phylum — ^the discovery of the sear-floor. This being apprehended by the sen- sory anterior end, it was by that end that the Dipleurula attached itself ; not, however, by the pole, since that would have interfered at once with the censory organ, but a little to one side, the right side being the one chosen for a reason we cannot now fathom ; it may be that fixation was facilitated by the presence of the pore on that side, and by the utilization of the excretion from it as a cement. The first result was that which is always seen to foUow in such cases — ^the passage of the mouti towards the upper surface (Fig. 7). As it passed up along the left side, the gut caught hold of the left water-sac and pulled it upwards, curving it in the pro- cess ; this being attached to the left duct from the anterior body- cavity, this structure with its water-pore was also pulled up, and

meath.

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left, poatenicr

/>as{er6oi' coelom.

pre-oral remains o^ nerve gtzagh

J'iG. 7.— Diagrammatic reconstruction of primitive Pelmatozoon, seen from the side. The plates of the test are not drawn ; their probable appearance may be gathered from Pig. 8.

the pore came to lie between mouth and anus. The forward portion of die anterior coelom shared in the constriction and elongation of the preoral lobe ; but its hinder portion was dragged up along with the water-pore and formed a canal Ijing along the outer wall (the parietal canal). As the gut coiled, It pressed inwards the middle of the left posterior coelom of the Dipleurula, and drew the whole towards the mouth, while the corresponding cavity on the right was pressed down by

the stomach towards the rnouiA. — —^ry->^-a/are/-/?ore. fixed end of the animal ^f^Pj^^^p^^gre/ueaefiore

and became involved in the elongation of that region. These changes, which may still be traced in the development of Antedon, resulted in the primitive Pelmatozoon (Fig. 7), represented in the rocks by such a genus as Aristocystis (Fig. 8). The pear-shaped body is encased in a theca formed by a number of poly- gonal plates, and is attached by its narrow end. On the broad upper surface are four openings, Fio- 8.—Aristocygtie iohemicuB ; side-view of that nearest the centre *^?^'5f5*i The internal structure may be being the mouth, which e«««"d from Kg. T. (xjdmn.)

is slit-like, and that nearest the periphery being the anus. The two other openings are minute, and placed between those

Fig. 9.— Fumgocystis raris^ma^ one of the Diploporita, in which the thecal plates bordering the food- grooves are not yet regularly ar- ranged.

~~The brachioles are not drawn.~~

~~two ; one close to the mouth is almost certainly the water- pore, while that nearer the anus is regarded as a genital aperture. Which of the coelomic cavities this last is connected with is un- certain, for there is considerable doubt as to the origin of the genital glands in the embryonic development of recent echinoderms. It seems clear, however, that there was but a single duct and a single bunch of reproductive cells, as in the holothurians, though perhaps bifurcate, as in some of those animals. The line between mouth and anus, along which these openings are situate, corre- sponds with the plane of union between the two horns of the curved left posterior coelom, the united walls of which form the " dorsal mesentery. " Since this must have, on our theory, enclosed the parietal canal from the anterior coelom, it is possible that the genital products were developed from the lining cells of that cavity, and that the genital pore was nothing but its original pore not yet united with that from the water-sac. The concrescence of these pores can be traced in other cystids ; but as the genital organs became affected by radial symmetry the original function of the duct was lost, and the reproductive elements escaped to the exterior in another way. Ari$tocystis may have had ciliated food-grooves leading to its mouth, but these have left no traces on the structure of the test. Traces, however, are perceptible in genera believed to be descended from such a simple type, and the majority may be grouped under two heads. One group includes those in which the grooves wander out- wards from the mouth over the thecal plates, which gradually become arranged regularly on either side of the grooves, while further extensions ascend from the grooves on small jointed processes called "brachioles" (Fig. 9). In the other group the grooves do not tend so much to stretch over the theca as to be raised away from it on relatively larger brachioles, arising close around the mouth (Fig. 10).~~

~~These two types are, in the main, correlated with two gradual difierentations in the minute structure of the thecal plates. Origin- ally the calcareous substance of the plates (stereom) was pierced by irregular canals, more or less vertical, and containing strands of the soft tissue (stroma) that deposited the stereom, as well as spaces filled with fluid. In the former group (Fig. 9) these canals became connected in pairs (diplopores) still perpendic- ular to the surface, and this structure,~~

combined with that of the grooves, characterizes the order — Diploporita. In the latter group (Fig. 10) the canals, that is to say, the stroma- strands, came to lie parallel to the sur- face and to cross the sutures between the plates, which were thus more flexibly and more strongly united ; since the canals crossing each suture naturally occupy a rhombic area, the order is called Rhombifera. At first the grooves were three, one proceeding from each end of the mouth-slit, and the third in a direction opposed to the anus ; with reference to the Pel- matozoan structure, the anal side may be termed posterior, and this groove anterior. Eventually

each lateral groove forked, so that there were five grooves. These gradually impressed

themselves on the theca and influenced the ar- rangement of the internal organs : it is fairly safe to assume that

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Flo. 10. — ChiroarimM»-

nerves, blood-vessels, and branches from the water-sac stretched

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out along with these grooves, each system starting from a ring around the gullet. At last a quinqueradiate symmetry influenced the plates of the theca, partly through the development of a plate at the end of each groove (terminal), partly through plates at the aboral pole of the theca (hasals and infrabaaals) arising in response to mechanical pressure, but soon intimately connected with the cords of an aboral nervous system. Before the latter plates arose, the stem had developed by tHk elongation and constriction of

~~the fixedjnd of the theca, the gradual regularization of the plates in- volved, and their coalescence into rings. The crinoid type was differentiated by the extension of the food-grooves and associated organs along radial outgrowths from the theca itself. These con- stituted the arms (brachia) ; and five definite radial plates of the theca were specialized for their support. These radials may be homologous with the terminals already mentioned, but this is neither necessary nor certain. In this development of brachial extensions of the theca the genital organs were involved, and their ripe products formed at the ends of the brachia or in the branches therefrom. The remains of the original genital gland within the theca became the " axial organ " surrounded by the "axial sinus " derived from the anterior coelom, and this again by structures derived from the right posterior coelom, which, as explained above, had been depressed to the aboral pole. These last structures formed a nervous sheath around the axial sinus with its blood- vessels, and became divided into five lobes correlated with the five basals (the "chambered organ") and forming the aboral nerve- centre. Before these changes were complete the Holothurioidea must have diverged, by the assumption of a crawling existence. Thus in them the mouth and anus reverted to opposite poles, and only the torsion of the gut and ccelom, and the radial extensions of the nervous, water- vascular, and blood-vascular systems, testified to their Pelmatozoan ancestry. The ciliated grooves, no longer needed for the collection of food, closed over, and are still traceable as ciliated canals overlying the radial nerves. At the same time the thecal plates degenerated into spicules. The Edrioasteroidea followed a different line to that of the cystids above mentioned and their descendants. The theca became sessile, and in its later devel- opments much flattened (Fig. 11). Mouth, water-pore, and anus**

~~covering plates~~

~~flooring plates.~~

~~trUeram~~

~~bulAfTc~~

~~plates~~

lobes offlejc- iile integ- ument

anus

mwth

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B

Fig. W.—EiA-ioaater. A, upper or oral surface of H. Bigebyt, with the coveriDg-plateB on the anterior and left posterior food-grooves, but re-moved from the others, which show only the flooring-plates, between which are pores ; B, under surface of E. SuchianUB, with covering-plat^ on right posterior and right anterior food-grooves (left hand in the draw- ing). The : (c denotes the position of the anal interradius.

remained as in Aristocystis, but the five ciliated grooves radiated from the mouth between the thecal plates rather than over them, and were, as usual, protected by covering-plates. The important feature was the extension of radial canals from the water-sac along these grooves, with branches passing between the flooring-plates of the grooves (Fig. 12, A). The resemblance of the flooring-plates to the ambulacral ossicles of a starfish is so exact that one can ex- plain it only by supposing similar relations of the water-canals and their branches (podia). On the thinly -plated under surface of well-preserved specimens of Edrioaster are seen five interradial swellings (Fig. 11, B). These are likely to have been produced by the ripe genital glands, which may have extruded their products directly through the membranous integument of the under side. No other way out for them is apparent, and it is clear that Edrio- aster was not permanently and solidly fixed to the sea-floor.

Now comes a great change, unfortunately diflicult to follow whether in the fossils or in the modern embryos. We suppose some such form as Edrioaster, which appears to have lived near the shore, to have been repeatedly overturned by waves. Those that were able to accommodate themselves to this topsy-turvy existence, by taking food in directly through the mouth, survived, and their podia gradually specialized as sucking feet.

~~Such a form as this, when once its covering-plates had atrophied, would be a starfish without more ado (Fig. 12, B) ; but the sear-urchins present a more~~

~~difficult problem. We may suppose that the radial water-canals sank beneath the flooring-plates of the grooves, and that the cover- ing-plates disappeared, in which case the plates that in the echinoid are pierced by podia would be homologous with the ambulacral ossicles of an asteroid and the flooring-plates of Edrioaster. Or we may suppose the canals and other organs to have remained as they were, the covering-plates to have closed permanently over them, merely leaving slits for the podia between them, and the flooring-plates to have disappeared. In either case we have to admit a closure of the integument over the ciliated groove (Fig. 12, D, e) just as in holothurians, since this is necessitated by anatomi-~~

~~/It~~

~~plate. cteepe>-/iei~~

~~uvUer vessel'.~~

~~coelom,.~~

~~A. Edrioasteroid.~~

~~, nerve." wafer vessel!~~

~~coelom B. Asteroid.~~

~~covereny plate.~~

~~u/a,ter v&ssel. ,~~

~~rroetom.~~

~~C. Crinoid. D. Echinoid.~~

~~Fig. 13. — Diagrammatic sections across the ambulacra of A, C, Pelmatozoa, and B, D, Elbutheeozoa, placed in the same position for~~

~~comparison. S^ blood-spaces, of which the homology is still uncertain.~~

~~cal evidence. The genital organs in both Asteroidea and Echinoi- dea would retain the interradial position they first assumed in Edrioaster ; and in Eohinoidea their primitive temporary openings to the exterior were converted into definite pores, correlated with five interradially placed plates at the aboral pole. The anus also naturally moved to this superior and aboral position. In the Eohi- noidea the water-canals and associated structures, ending in the terminal plates, stretched right up to these genital plates ; but in the Asteroidea they never reached the aboral surface, so that the terminals have always been separated from the aboral pole by a number of plates.~~

~~Analysis of Echinoderm Oharacters. — To follow the further evolution of the several classes would require a series of independent articles ; reference must perforce be made to works (vide infra) in which this has recently been attempted. Regarding the Echinoderms as a whole in the light of the foregoing account, we may give the following analytic summary of the characters that dis- tinguish them from other coelomate animals : —~~

~~They live in salt or brackish water ; a primitive bilateral sym- metry is still manifest in the right and left divisions of the ccelom ; the middle coelomic cavities are primitively transformed into two hydrocoels communicating with the exterior indirectly through a duct or ducts of the anterior coelom ; stereom, composed of crystal- line carbonate of lime, is, with few exceptions, deposited by special amoebocytes in the meshes of a mesodermal stroma, chiefly in the integument ; reproductive cells are derived from the endothelium, apparently of the anterior coelom ; total segmentation of the ovum produces a coeloblastula and gastrula by invagination ; mesenchyme is formed in the segmentation cavity by migration of cells, chiefly from the hypoblast. Known Echinoderms show the following features, imagined to be due to an ancestral pelmatozoio stage : — Increase in the coelomic cavities of the left side, and atrophy of those on the right ; the dextral coil of the gut, recognizable in all classes, though often obscured ; an incomplete secondary bilateral- ism about the plane including the main axis and the water-pore or its successor, the madreporite, often obscured by one or other of various tertiary~~

~~bilateralisms ; the development of the hydrocoel into a circumoral, arcuate, or ring canal ; development through a free-swimming, bilaterally symmetrical, ciliated larva, of which in~~

~~Q24.~~

~~ECHIUROIDEA~~

~~many cases only a portion Is transformed into the adult Echinoderm (where care of the brood has secondarily arisen, this larva is not developed). All living, and most extinct, Echinoderms show tlie following features, almost certainly due to an ancestral Pelmatozoic stage :— An incomplete radial symmetry, of which five is usually the dominant number, is superimposed on the secondary bilateral- ism, owing to the outgrowth from the mouth region of one un- paired and two paired ciliated grooves ; these have a floor of nervous epithelium, and are accompanied by subjacent radial canals from the water-ring, giving off lateral podia and thus forming ambulacra, and by a perihsemal system of canals apparently growing out from coelomic cavities. All living Echinoderms have a lacunar, hsemal system of diverse origin ; this, the ambulacral system, and the cce- lomic cavities contain a fluid holding albumen in solution and carrying numerous amoebocytes, which are developed in special lymph-glands and are capable of wandering through all tissues. The Echinoderms may be divided into seven classes, whose prob- able relations are thus indicated : —~~

~~' Cystidea Edrioasteroidea.~~

~~Holothurioidea~~

~~PELMATOZOA -(~~

~~Blastoidea Crinoidea~~

~~ELEUTHEROZOA~~

~~Asteroidea (and Ophiuroidea) Echinoidea ^~~

~~Authorities. — In addition to the works referred to in the open- ing paragraph, the following deal with the general subject : — Bather, Gbegoky, and Goodrich. " Echinoderma," in Lankes- ter's Treatise on Zoology. London, 1900. — Bell. Catalogue of the British Echinoderms in the British Museum. London, 1892. — P. H. CARPEfTTER. " Notcs ou Echiuoderm MoTphology," Quart. Journ. MicT: Sci., 1878-1887. — Lang. Text-Book of Comparative Anatomy, transl., part ii. London, 1896. — Ludwig and Hamann. "Echinodermen," in Bronn's Klassen und Ordnungen des Thier- reichs. Leipzig, 1889 — in progress. — ^NEnMAYR. Die Stdmme des Thierreiches. Wien, 1889.— P. B. and C. F. Sarasin. "tJeber die Anatomie der Echinothuriden und die Phylogenie der Echino- dermen," Ergehnisse naturw. Forseh. auf Ceylon, Bd. i. Heft 3. Wiesbaden, 1888. — Semon. " Die Homologien innerhalb des Echinodermenstammes," Morph. Jahrb., 1899. — Sladen. " Homo- logies of the Primary Larval Plates in the Test of Brachiate Echi- noderms," Quart. Journ. Micr. Sci., 1884. — Zittel. Handbuch der . . . Palceozoologie, i. pp. 308-560. Miinchen, 1879 ; also Orundzuge, translated and revised by Eastman as Text-^pook of Falxontology. New York and London, 1899. A complete ana- lytical index to the annual literature of the Echinoderma has for many years been published in the Zoological Record, London.~~

~~(f. a. b.)~~

~~Echiuroidea. — The EcMuroidea form a small group of marine animals which show in their larval life- history a certain degree of segmentation, and are there- fore grouped by some authorities as Annelids. Formerly, together with the Sipunculoidea and Priapuloidea, they made up the class Gephyrea, but on the ground that they retain in the adult a large preoral lobe (the proboscis), that they have anal vesicles, that their anus is terminal, that setae are found, and finally that they are segmented in the larval stage, they have been removed from the group, which by the proposed further separation of the Priapuloidea on account of their unique renal and repro- ductive organs, has practically ceased to exist.~~

~~Echiuroids are animals of moderate size, varying roughly from one to six or seven centimetres in length, exclusive of the proboscis. This organ is capable of very considerable extension, and may attain a length in Bonellia~~

viridis of about a metre and a half (Rg. 1). It is grooved ventrally and ciliated. At its attachment to the body the groove sinks into the mouth. In Bonellia the proboscis is forked at its free end, but in the other genera it is short and un- forked. The body is somewhat sausage-shaped, with the anus at the posterior extremity, surrounded in Echiurus by a single or double ring of setae. The skin is usually wrinkled, and in B. viridis TJialassema lankesteri, Tli. ha- ronii, Hamingia arctica, and in the larva of many species, is of a lively green colour. A pair of curved bristles, formed in true setal sacs as in Chsetopoda, project from the body a short distance behind the mouth, and are moved by special

muscles ; they are of use in helping the animal to move slowly about, and they take a large share in the burrow-

Fio. 1. — A, Bonellia vi^'idis Eol., $; B, .5. fuliginosa. Both natural size, a, grooved proboscis ; 6, mouth ; c, ventral hook ; d, anus.

ing movements (C. B. Wilson, Biol. Bull., 1900), for some species tunnel in the mud and sand and form more or less permanent burrows, the walls of which are strengthened by mucus secreted from the skin. The openings of the burrows become silted up, leaving, however, a small aper- ture through which theproboscis is extruded. This organ carefully searches the neighbourhood for particles of food. When these are found the grooved proboscis folds its walls inwards, and the cilia pass the particles down the tube thus formed to the mouth. Echiuroids also move by extending the proboscis, which takes hold of some fixed object, and then contracting, draws the body forwards. Recently it has been shown that Echiurus swims freely at night-time, using for locomotion both the proboscis and the contrac- tion of the muscles of its body-wall. The motion is de- scribed as " gyratory," and the anterior end is always carried foremost. Those species which do not burrow usually conceal themselves in crevices of the rocks or under stones, or at times in empty Mollusc or Echinid shells. They are occasionally used by fishermen as bait. Anatomy (Fig. 2).-^A thin cuticle covers the epidermis, which contains mucus-secreting glands. Beneath the epi- dermis is a layer of circular muscles, then a layer of longitudinal, and finally in some cases a layer of oblique muscle-fibres. The inner face of this muscular skin is lined by a layer of epithelium. The coelomic body-cavity is

spacious. It does not extend into the proboscis, which is a solid organ traversed by the nervous and vascular rings, but otherwise largely buUt up of muscle-fibres and connective-tissue. Many sense-cells lie in the epi-dermis. The ciliated ventral groove of the proboscis leads at its base into the simple mouth, which gives access to the thin-walled alimentary canal. This is longer than the body, and to tuck it away it is looped from side to side. The loops are supported by strands of connective-tissue, which in some species are united so as to form a dorsal mesentery, whilst traces of a ven- tral mesentery are met with anteriorly and posteriorly

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(H. L. Jameson, Zool. Jahrb. Anat., 1899). The alimen- tary canal is divisible into fore-gut, mid-gut, and hind-gut, and the first-named can be further divided into pharynx, oesophagus, gizzard, and crop, mainly on histological grounds. The mid-gut is characterized by the presence of a ciliated groove, from which arises the collateral intes- tine or siphon, a second tube which rejoins the alimentary canal lower down. Similar collateral intestines are familiar in the Echinids and certain Polychsets (Capitel- lidse). The rectum receives the openings of a pair of very characteristic organs, the anal vesicles. Each con- sists of a branching tube, the tips of whose twigs termin- ate in minute ciliated funnels. The anal vesicles are thought to be excretory ; whether this be so or not, they

Fio. 2. — Female BonelUa viridis, Kol. Opened along the left side, x 2. a, proboscis out short: 6, bristle passing through the mouth into the pharynx ; o, coiled intestine ; d, anal tufts or vesicles ; «, ventral nerve oord ; /, ovary borne on ventral vessel running parallel with e ; g, position of anus ; A, position of external opening of nephridium ; i, nephridium — ^the line points towards, but does not reach, tne internal opening.

undoubtedly have some influence on the amount of fluid found in the ccelom. The ccelomic fluid contains as a rule both amoeboid and rounded corpuscles, and, when ripe, the products of the gonads. A closed system of vessels, usually called the vascular system, is present. There are, however, no capillaries connected with this, and it is confined to certain portions of

the body. It can possess few of the functions usually associated with a vascular system, and its main use is probably to assist in the ex- pansion of the proboscis. The system consists of the following parts : — A dorsal vessel applied to the ali^ mentary canal is continued anteriorly into a median vessel, which traverses the proboscis to its tip. Here the vessel splits, and each half returns along the lateral edge of the proboscis ; they reunite around the oesophagus and

form a single ventral vessel, which lies above the ventral nerve-cord. The ventral vessel, which ends solidly be- hind, sends off a branch which forms a ring around the intestine and opens into the posterior extremity of the dorsal vessel. In Echiurus and Thalassema the same vessel forms a ring round a stout muscle, which connects the basis of the two ventral setse before passing to sur- round the intestine. Amoeboid corpuscles float in the fluid contents. The nephridia vary in number from a single one in SoneZZia to three pairs in manyspecies of Thalassema. Their external openings are ventral, and on the same level as the ciliated funnel-shaped nephrostomes. The posterior wall of the organ is produced into a long bliad sac, which is lined by secretory cells. The nervous system is a single ventral cord, which starts from a circum-oesophageal ring. This ring is involved in the growth of the proboscis, and is drawn out with it. Thus there is a lateral nerve near each edge of the proboscis which unites with its fel- low dorsally above the oesophagus at the tip of the pro- boscis, and ventrally beneath the oesophagus, where they fuse to form the ventral nerve-cord. There are no special- ized ganglia, but ganglion-cells are scattered uniformly along the nerve-cords. The ventral cord gives off rings, which run in the skin at regular intervals. The repro-. ductive cells are modified coelomic cells, which lie on the ventral vessel. They escape into the coelomic fluid and there develop. When mature they leave the body through the nephridia. BonelUa and Hamingia are very interesting examples of sexual dimorphism. The female has the normal Echiuroid structure, but the male is re- duced to a minute, flattened, planarian-like organism, which passes its life usually in the company of two or three others in a special recess of the nephridia of the female. Its structure may be gathered by a refer- ence to Fig. 3.

Larva. — The larva is a typical trochosphere, which, although of a temporary character, shows' a distinct seg- mentation of the mesoblast, of the nervous system, and of the ciliated and pigmented structures in the skin, resembling that of Chaetopods. The preoral lobe persists as the proboscis. The sexes of the larvae are not deter- minable in the early stages, but when a certain growth has been reached in Bonellia the males seek the proboscis of the adult females, and passing into the mouth undergo there the transformation into the planarian-like parasite which is the fully formed male. This now creeps along the body of the female and takes up its home in her nephridia.

Classification and Distribution. — The ,Echiuroidea con- sists of the following genera : — (1) Bonellia (Eol.), with four species, widely distributed, but inhabiting the tem- perate and warmer waters of each hemisphere. (2) Echi- urus (Guerin-Meneville), with four species. This genus reaches from the Arctic waters of both hemispheres into the cooler temperate regions. (3) Hamingia (Kor. and Dan.), with one species, which has been taken in the Arctic Sea and the Hardanger Ejord. (4) Saccosoma (Kor. and Dan.) was described from a single specimen dredged about half-way between Iceland and Norway. (6) Thalassema (Gaertner, Lamarck), with twenty-one species. This genus is in the main a denizen of the warmer waters of the globe. Sixteen species are found only in tropical or subtropical seas, three species are Mediter- ranean {Mt. Stat. Neapel, 1899), whilst three species are from the eastern Atlantic, where the temperature is modi- fied by the Gulf Stream (Shipley ; see Willey's Zoological Results, part iii., 1899 ; Proc. Zool. Soc. Lond., 1898, 1899 ; and Cambridge Natural History, ii.). The following are found in the British area : — E. paUasii (Guerin-Mene- ville), Th. neptuni (Gaertner), and Th. lanJcesteri (Herd- man, Q.J.M.S., 1898).

Affinities. — The occurrence of trochosphere larva and the temporary segmentation of the body have led to the belief that the Echiuroids are more

nearly allied to the Annelids than to any other phylum. This view is strengthened by certain anatomical and histological re-

FiG. 8. — Adult male, BonelUa mridia, Eol. The original was 1*6 mm. long. The nervous system is not shown. (After Sel&nha.') a, generative pore with spermatozoa coming out ; &, anterior blind end of intestine attached to the parenchymatous tissue by muscular strands ; c, green wandering cells containing chlorophyll ; d, parenchy- matous connective-tissue ; fi, epidermis ; i, intestine ; j, vas deferens ; Z, internal opening of vas deferens ; wi, the left anal vesicle ; n, sper- matozoa in the body-cavity.

semblances to the genus Stemaspis, which in one species, S. spinosa, is said to carry a bifid proboscis resembling that of the Echiuroids. The relationship with the Sipunculoidea and the Priapuloidea are discussed in the article Sipunculoidea. (a. e. s.)

Echuca, a borough of Victoria, Australia, in the county of Kodney, on the river Murray, across which it is connected by bridge with Moama, which has railway connexion with Deniliquin, New South Wales. The town is the terminus of the Murray River railway and the entrepot of the overland intercolonial trade, and has large wool stores. The district, a rich agricultural one, is noted for its vineyards. Altitude, 314 feet. Mean temperature for the year, 68°-6 E. ; for January, 71°-6 ;" for July, 44°-7. Population (1881), 4789 ; (1901), 4083.

Eckernfdrde, a town of Prussia, province of Schleswig-Holstein, on a bay of the Baltic, 20 miles by rail north-west from Kiel. It has a good harbour, fish- ing, trade in agricultural products, and production of tobacco, salt, and iron goods. There are an architects' school and a teachers' seminary. The place suffered from a searflood in 1872. Population (1885), 5604;

(1900), 6719.

Eclipse. — The general subject of eclipses, and the conditions under which they may occur, were fully treated in the article Asthonomy (Ency. Brit. vol. ii.). To that article nothing need be added on the subject of eclipses of the moon, and the present article is therefore confined to eclipses of the sun, especially those which are total.

The complete computation of the circumstances of an eclipse ab initio requires three distinct processes. The geocbntric position of the sun and moon f/^fip^g^^ have first to be computed from the tables of the motions of those bodies. The second step is to compute certain elements of the eclipse from these geocentric positions. The third step is from these elements to com- pute the circumstances of the eclipse for the earth generally, or for any given place on its surface. The national Astronomical Ephemerides, or "Nautical Almanacs," give in full the geocentric positions of the sun and moon from at least the early part of the 19th century to an epoch three years in advance of the date of publication. It is therefore unnecessary to undertake the first part of the computation except for dates outside the limits of the published ephemerides, and for many years to come even this computation will be unnecessary, be- cause tables giving the elements of eclipses from the earliest historic periods up to the 22nd century have been published by Oppolzer and Newcomb. We shall there- fore confine ourselves to a statement of the eclipse pro- blem and of the principles on which such tables rest.

Two systems of eclipse elements are now adopted in the ephemerides and tables; the one, that of Bessel,is used in the English, American, and French ephemerides, the other — Hansen's — in the German and in the eclipse tables of Oppolzer. The two have in common certain fundamental geometric constructions. A fundamental axis of reference in both systems is the line passing through the centres of the sun and moon ; this is the common axis of the shadow cones, which envelop simultaneously the sun and moon (see Eig. 37, Uncy. Brit. vol. ii. p. 803). The surface of one of these cones, that of the umbra, is tangent to both bodies externally. This cone comes to a point at a distance from the moon nearly equal to that of the earth. Within it the sun is wholly hidden by the moon. Outside the umbral cone is that of the penumbra, within which the sun is partially hidden by the moon. The condition that the two bodies shall appear in contact, or that the eclipse shall begin or end at a certain moment, is that the surface of one of these cones shall pass through the place of the observer at that moment. Let a plane, which we call the fundamental plane, pass through the centre of the earth perpendicular to the shadow axis. On this plane the centre of the earth is taken as an origin of rectangular co-ordi- nates. The axis of Z is perpendicular to the plane, and therefore parallel to the shadow axis ; that

of Y and Z lie in the plane. In these fundamental constructions the two methods coincide. They differ in the direction of the axis of Y and Z in the fundamental plane. In Bessel's method, which we shall first describe, the intersection of the plane of the earth's equatorwith the fundamental plane is taken as the axis of X. The axis of Y is perpendicular to it, the positive direction being towards the north. The Besselian elements of an eclipse are then: — x, y, the co- ordinates of the shadow axis on the fundamental plane; d, the declination of that point in which the shadow axis intersects the celestial sphere; jti, the Greenwich hour angle of this point ; I, the radius of the circle in which the penumbral or outer cone intersects the fundamental plane; and V, the radius of the circle in which the inner or umbral cone intersects this plane, taken positively when the vertex of the cone does not reach the plane, so that the axis must be produced, and negatively when the vertex is beyond the

plane. It will be noticed that, in the first case, the eclipse appears annular to an observer at the point where the shadow axis intersects the fundamental plane, and in the second case total. But since an observer on the sur- face of the earth is nearer to the moon than the funda- mental plane is, it may happen that an eclipse which is annular on the plane will be total to the observer on the earth's surface.

Hansen's method differs from that of Bessel in that the ecliptic is taken as the fundamental plane instead of the equator. The axis of X on the fundamental plane is parallel to the plane of the ecliptic; that of Y perpen- dicular to it. The other elements are nearly the same in the two theories. As to their relative advantages, it may be remarked that Hansen's co-ordinates follow most simply from the data of the tables, and are necessarily used in eclipse tables, but that the subsequent computation is simpler by Bessel's method. Its use, in case Hansen's form is used at first, requires merely the transformation of co-ordinates from the ' ecliptic to the equator. The eclipse tables of Oppolzer and Newcomb give the data for computing the ecliptic Y-co-ordinate at the moment T of true conjunction of the sun and moon in longitude. This co-ordinate is called B by Oppolzer and y°2 by Newcomb,

~~and is expressed by Oppolzer in the form B=p sin P. The tables also give, for the moment T, the value of v^^ or AL, the hourly motion of the X-co-ordinate. Oppolzer gives separately data for AB, the hourly motion of B, while Newcomb determines the motion of the shadow-axis from a;\ and the angle, assumed constant, which the path makes with the X-axis. An approximate value of the sun's longitude (L or O) and of the angle between the shadow- axis and the equator (S [Delta] or S) is also found. Oppolzer uses these elements in the subsequent com- putation, while Newcomb transforms x^ and y^ into asj and ^1, the Besselian co-ordinates, which are to be used in the subsequent , work.~~

~~Several problems are involved in the complete com- putation of an eclipse from the elements. First, from the values of the latter at a given moment to determine the point, if any, at which the shadow-axis intersects the surface of the earth, and the respective outlines of the umbra and penumbra on that surface. Within the umbral curve the eclipse is annular or total, outside of it and within the penumbral curve the eclipse wUl be partial at the given moment. The penunibral line is marked from hour to hour on the maps given annually in the American Ephemeris. Second, a series of positions of the central point through the course of an eclipse gives us the path of the central point along the surface of the earth, and the envelopes of the penumbral and umbral curves just de- scribed are boundaries within which a total, annular, or partial eclipse will be visible. In particular, we have a certain definite point on the earth's surface on which the edge of the shadow first impinges ; this impingement necessarily takes place at sunrise. Then passing from this point, we have a series of points on the surface at which the elements of the shadow-cone are in succession tangent to the earth's'surface. At all these points the eclipse begins at sunrise until a certain limit is reached, after which, following the successive elements, it ends at sunrise. At the limiting point the rim of the moon merely grazes that of the sun at sunrise, so that we may say that the eclipse both begins and ends at that time. Of course the points we have described are also found at the ending of the eclipse. There is a certain moment at which the shadow-axis leaves the earth at a certain point, and a series of moments when, the elements of the penumbral cone being tangent to the earth's surface, the eclipse is ending at sunset. Three cases may arise in studying the passage of the outlines of the shadow over the earth. It may be~~

that all the elements of the penumbral cone intersect the earth. In this case we shall have both a northern and south- ern limit of partial eclipse. In the second case there will be no limit on the one side except that of the eclipse be- ginning or ending at sunrise or sunset. Or it may happen, as the third case, that the shadow-axis does not intersect the earth at all; the eclipse wUl then not be annular or total at any point, but at most only partial.

The third problem is, from the same data, to find the circumstances of an eclipse at a given place — especially the times of beginning and ending, or the relative positions of the sun and moon at a given moment. Eef erence to the formulae for all these problems will be given in the biblio- graphy of the subject.

There are two well-marked periods in which eclipses -recur at nearly the same distance from a node of the moon's orbit, one of 223 lunations, the other of 368. At the end of the latter period the eclipse */™J^'^ recurs at the opposite node, and at the end of two periods, at the same node. The length of this period is 10,571-95 days, or 29 Julian years less 20 '30 days. Hence 18 periods make 521 years, so that at the end of this time the eclipse recurs on the same day of the year. In the mean, the time of recurrenxie is so nearly at the same distance from the node that we find each central eclipse visible at our time to be one of an unbroken series extending from the earliest historic times to the present, at intervals equal to the length of the period. For example, starting from the eclipse of Nineveh, 763 B.C., June 15, recorded on the Assyrian tablets, we find eclipses on May 27, 734 b.c. May 7, 705 b.c, and so on in an unbroken series to 1843, 1872, and 1901, the last being the 93rd of the series. Those at the ends of 18 periods occurred on June 15, O.S., of each of the years 763, 242 B.C., A.D. 280, 801, 1322, and 1843. As the lunar perigee moves through 242°-4 in a period, the eclipses will vary from total to annular, but at the end of 3 periods the peri- gee is only 7°-l in advance of its original position relative to the node. Hence in a series including every third eclipse the eclipses will be of the same character through a thou- sand years or more. Thus the eclipses of 1467, 1554, 1640, 1727, 1814, 1901, 1988, &c., are total.

The length of the other period, called the Saros, is 6585|- days, or 18 years and 11 or 12 days. The fact that eclipses recur at the end of this period has

been known from ancient times. Owing to the fractional excess of J of a day in the period, each recurring eclipse takes place about 120° farther west in longitude than the preceding one of the series, and is therefore not generally visible in the same region. During the course of a Saros there are 223 lunations and 19 returns of the sun to each of the moon's nodes. The clearest idea of the law of re- currence thus arising may be gained by the conception of conjunction-points of the moon and sun in the fol- lowing way :—

Imagine a circle, having the earth in its centre, to be situated in the mean plane of the moon's orbit, and to be fixed to the node of the orbit so as to make one revolution in its plane around its centre in the same period as the revolution of the node (about 18!'-6). Imagine also that, as the sun and moon revolve, we mark on this circle the points in the direction of which the mean conjunctions of the two bodies occur. These conjunction-points will fall at various points of the circle until the end of the Saros. Then after 223 conjunctions the 224th will fall very near the first. The deviation will be somewhat less than half a degree. To make it fall exactly upon the first we have only to give our circle, conceived as, bearing the conjunc- tion-points, a motion equal to this deviation, or, speaking more exactly, a uniform retrograde revolution through 0°-476 in one period. The amount of this motion was

slightly less in former centuries, and will increase a little in the future owing to the acceleration of the moon's motion. When this motion is assigned to the circle eclipses will always take place at one or the other of these 223 points, but will, of course, be confined to those which lie near the moon's node. The latter will now move over the system of points at the rate of 0°-476 per period. This will carry the node from one conjunction-point to the next in about 61 years.

We may classify eclipses according to the conjunction- point at which they occur. As any one such point slowly ap- proaches the node the successive eclipses, separated by an interval of one Saros, which occur at that point,

will fall continually nearer the node until the conjunction-point passes it, near which time they will be central. After passing the node a certain distance the eclipse will cease to be central, and become partial until at length the distance of the point from the node will be such that the series will cease. The entire duration of each series is more than a thousand years. The introduction of the period in Question would have no special significance but for one important circumstance. It happens that the lapse of one Saros brings together not only the sun and moon, but approximately the lunar perigee and the mean anomaly of the sun. The change in the former is less than three degrees, in the latter between ten and eleven degrees. The character of an eclipse, whether annular or total, and, if total, the duration of the total phase, depend on the po- sition of the lunar and solar perigees relatively to the con- junction-point. It follows that each recurring eclipse *will be of the same general character as that which preceded it. If the duration of totality of the latter is remarkably long, the same will be true of the recurring eclipse. This fact enables us, by the aid of suitable tables, to select almost at sight eclipses of long duration in the past or future.

The following is a brief chronological enumeration of those total eclipses of the sun which are of interest, either from their historic celebrity or the nature of the conclusions derived from them. In numbering the years before the Christian era the astro- nomical nomenclature is used, in which the number of the year is one less than that used by the chronologists. The Chinese eclipses are passed over, owing to the generally doubtful character of the records pertaining to them.

762 B.C., June 14; a total eclipse recorded at Nineveh. Com- putation from the modem tables shows that the path of totality passed about 100 miles or more north of Nineveh.

584 B.C., May 28 ; the celebrated eclipse of Thales. An account of this eclipse wiU be found in the article Thalbs (Mncy. Brit. vol. xxiii.).

556 B.C., May 19 ; the eclipse of Larissa. The modern tables show that the eclipse was not total at Larissa.yand the connexion of the classical record with the eclipse is doubtful.

~~430 B.C., August 3 ; eclipse mentioned by Thucydides, but not total by the tables.~~

~~399 B.C. , June 21 ; eclipse of Bnnius. Totality occurred immedi- ately after sunset at Rome. The identity of this eclipse is doubtful.~~

~~309B.C., August 14 ; eclipse of Agathocles. This eclipse would be one of the most valuable for testing the tables of the moou, but for an uncertainty as to the location of Agathocles, who, at the time of the occurrence, was at sea on a voyage from Syracuse to Carthage.~~

~~Ginzel (Spezieller Kanon der Finsternisse) has collected a great number of passages from classical authors supposed to refer to eclipses of the sun or moon, but the difficulty of identifying the phenomenon is frequently such as to justify great doubt as to the conclusions. In a few cases no eclipse corresponding to the description can be found by our modern table to have occurred, and in others the latitude of interpretation and the uncertainty of the date are so wide that the eclipse cannot be identified.~~

~~Of mediaeval eclipses we mention only the dates of those visible in England, referring for details to the works mentioned in the biblio- graphy. The letter C following a date shows that the eclipse is men- tioned In the Anglo-Saxon Chronicles. The dates in question are : —~~

~~Notable eclipses.~~

~~A.D. 538, February 15, C. (partial) . 540, June 12, C. (partial). 594, July 23.~~

~~A.D. 603, August 12. 639, September 3. 664, May 1, C.~~

~~A.D. 733, August 14 (annular). 764, June 4 (annular). 878, October 29, C. 885, June 15. 1023, January 24.~~

~~A.D. 1133, August 1,0. 1140, March 20, C. 1185, May 1, C. 1191, June23,C. (annular), 1330, July 16.~~

Besides these, the tables show that the shadow of the moon passed over some part of the British Islands on 1424, June 26 ; 1433, June 17 ; 1598, March 6 ; 1652, April 8 ; 1715, May 2 ; 1724, May 22. The next dates are 1927, June 29, when a barely total eclipse will be seen soon dfter sunrise in the northern counties near the Scottish Border, and 1999, August 11, when the moon's shadow will graze England at Land's End.

*We give below, in tabular form, a list of the principal total eclipses between 1800 and 1970, omitting a few visible only in the extreme polar regions, and EcUpggg,,f some others of which the duration is very short, tbe I9a The eclipses are classified in the table according aad20ib to their position in the eighteen-years period, **"'''■'**• so that the table shows the successive eclipses occurring at this interval. In this way it is possible for the reader to continue the table, with a considerable degree of ap- proximation, for several periods, while the law of recur- rence and the gradual change in the character of the eclipse are made evident at sight. The first column gives the date of the point on the earth's surface at which the eclipse is central at noon. The next two columns give the position of this point to the nearest degree. As the date in the first column changes at 180° long, from Green- wich, the integer dates are not at equal intervals, and therefore the fourth column shows the Greenwich astro- nomical time of conjunction in longitude. The next column gives the duration of the total phase at the noon- point; this is sometimes 0°>-l less than the greatest duration. The eclipses of each period occur near the same node of the moon, which is indicated at the head of the series. By the central date of the series is meant that date when an eclipse occurred, in the mean, nearest to the node. This is, of course, one of the dates of the series.*

*Total Eclipses of the Sun, 1800 to 1970, classified by the 18- Tears Period.^*

Date at Noon- Point.

Central at Noon.

Lat. Long.

Greenwich

~~*M.T.*~~

~~*of Conj.*~~

~~*In Long.*~~

~~*Dnr.*~~

~~*of*~~

~~*Total*~~

~~*Phase*~~

~~*BegionB swept by Shadow.*~~

~~*Series I. Ascending Node; Central date, 1731, Jan. 8.*~~

~~*1S03,*~~

~~*1821, 1889,*~~

~~*185T,*~~

~~*1876, 1893, 1911, 1929,*~~

~~*194T,*~~

~~*Feb. 21 Mar. 4 Mar. 15 Mar. 25 Apr. 6 Apr. 16 Apr. 28 May 9 May 20*~~

~~*1965, May 20*~~

~~*o*~~

~~*θ*~~

~~*d,. 7i. tjl.*~~

~~*m.*~~

~~11 rt~~

~~186 W~~

~~21 9 20~~

~~4-2~~

~~8 8~~

~~96 E~~

~~8 17 50~~

~~4-8~~

~~6 H~~

~~81 W~~

~~15 2 14~~

~~4-4~~

~~4 B~~

~~155 W~~

~~25 10 80~~

~~4-5~~

~~2 8~~

~~83 E~~

~~5 18 86~~

~~4-7~~

~~1 8~~

~~8TW~~

~~16 2 85~~

~~4-8~~

~~1 8~~

~~155 W~~

~~28 10 26~~

~~5-0~~

~~1 8~~

~~89 E~~

~~8 18 8~~

~~51~~

~~28~~

~~25 W~~

~~20 1 44~~

~~5-2~~

~~4S~~

~~137 W~~

~~80 9 14~~

~~6-8~~

~~*Pacific Ocean, Mexico. Indian and Pacific Oceans. South America, Africa, Egypt. Pacific Ocean, Idexlco. Indian Ocean, Siam, Pacific. Venezuela to West A&ica. Australia, Polynesia. Somatra, Malacca, Philippines. Argentina, Paraguay, Central*~~

~~*Africa. Pacific Ocean.*~~

~~*Seeibs II. Descending Node ; Central date, 2183, March 23.*~~

~~*1804, Aug. 6 1822, Aug. 16 1840, Aug. 27 1858, Sept. 7 1876, Sept. 17 1894, Sept. 29 1912, Oct. 10 1980, Oct. 21 194S, Nov. 1 1966, Nov. 12*~~

~~*88 8*~~

~~*66 W*~~

~~*5 4 6*~~

~~*1-2*~~

~~*86 8*~~

~~*176 W*~~

~~*16 11 22*~~

~~*1-4*~~

~~*84 S*~~

~~*72 E*~~

~~*26 18 45*~~

~~*1-6*~~

~~*83 8*~~

~~*41 W*~~

~~7 2 16~~

~~1-7~~

~~83 8~~

~~156 W~~

~~IT 9 64~~

~~1-8~~

~~84 8~~

~~86 E~~

~~28 17 84~~

~~1-8~~

~~35 8~~

~~33 W~~

~~10 1 41~~

~~1-8~~

~~86 H~~

~~155 W~~

~~21 9 4T~~

~~1-9~~

~~ST H~~

~~82 E~~

~~81 18 3~~

~~1-9~~

~~88 8~~

~~43W~~

~~12 2 2T~~

~~1-9~~

~~Pacific Ocean, Chile, Argentina.~~

~~Australia, Faclfiic Ocean.~~

~~Africa, Indian Ocean.~~

~~Peru, Soutiiern Brazil, Uruguay.~~

~~Pacific Ocean.~~

~~East Africa, Indian Ocean.~~

~~Colombia, Ecuador, Brazil.~~

~~Pacific Ocean, Pati^onia.~~

~~Central Africa, Congo.~~

~~Bolivia, Argentina, Brazil.~~

~~Series III. Descending Node ; Central date, 1626, Feb. 26.~~

~~1806, June 16 1824, June 26 1842, July 8 1860, July 18 18T8, July 29 1896, Aug. 9 1914, Aug. 21 1982, Aug. 81~~

~~42 N~~

~~66 W~~

~~16 4 22~~

~~4-6~~

~~47 N~~

~~175 W~~

~~26 11 43~~

~~4-4~~

~~51 N~~

~~77 E~~

~~7 19 2~~

~~41~~

~~56 N~~

~~81 W~~

~~18 2 21~~

~~8T~~

~~60 N~~

~~189 W~~

~~29 9 40~~

~~8-2~~

~~65 N~~

~~112 E~~

~~*8 17 2*~~

~~*2-T*~~

~~*71 N*~~

~~*2 E*~~

~~*21 0 air*~~

~~*2-1*~~

~~*78 N*~~

~~*105 W*~~

~~*31 7 55*~~

~~*1-5*~~

~~*New England, Atlantic, Spain. Pacific Ocean, Japan, China. Spain, France, Bussla to China. British America, Spain, Egypt. United States.*~~

~~*North Europe, Siberia, Japan, Scandinavia, Russia, Asia Minor. Canada, East United States.*~~

~~*1 In addition to these, a series will commence 1988, May 29, and be continued 1956, June 8, 1974, June 20, &c., with a duration 4 or 6 m., but will be visible only In the Southern Hemisphere.*~~

~~*ECLIPSE*~~

~~*629*~~

~~*Total Eclipses — (continued).*~~

~~*Gteenwioh*~~

~~*H.T. of OODj.*~~

~~*In Longt*~~

~~*Regioiu swept by Sbftdow.*~~

~~*Series IV. Ascending Node*~~

~~*Cen*~~

~~*180T, Not. 29 1826, Dec. 9 1843, Dec. 21*~~

~~*UN 9N 8N*~~

~~*2 E 12T-W 102 E*~~

~~*d. h. rti.*~~

~~*28 28 48*~~

~~*9 S2T*~~

~~*20 IT 10*~~

~~*m.*~~

~~*1‘4 1-5 1-6*~~

~~*1861, Dec. 81 1880, J»n. 11 1898, Jan. 22 1916, Feb. 8*~~

~~*9N ION 18 N 16 N*~~

~~*29 W*~~

~~*160 W*~~

~~*69 E*~~

~~*62 W*~~

~~*81 1 65*~~

~~11 10 40~~

~~21 19 24~~

~~8 4 6~~

~~1-8 2-1 2-8 2-5~~

~~1984, Feb. 14 1952, Feb. 25 19T0, Mar. T~~

~~19 N 22 N 25N~~

~~168 E 89 E~~

~~88 W~~

~~18 12 44~~

~~24 21 IT~~

~~T 548~~

~~2-T~~

~~8-0 8-8~~

~~Central date, 2096, ifay 22.~~

~~Central Africa, Anolia. Pacific Ocean, Mexico. Indian and North Pacific Oceans,~~

~~India. Caribbean Sea to North Africa. Pacific Ocean, California. East Africa, India, China. Pacific Ocean, Venezuela, "West~~

~~Indies. Borneo, Celebes. Nubia, Fersia, Siberia. Mexico, Georgia, South and~~

~~North CaroUna.~~

~~*Series V. Descending Node ; Central date, 1702, Jan. 28.*~~

~~*1810, Apr. 4 1828, Apr. 14 1846, At>r. 25 1364, May 6 1882, May IT 1900, May 28*~~

~~*1919, June 8 1986, June 19 1964, June 30*~~

~~*12 N*~~

~~*154 E*~~

~~*8 18 41*~~

~~*Ann.*~~

~~*18 N*~~

~~*89 E*~~

~~*18 21 18*~~

~~*0-8*~~

~~*25 N*~~

~~*T5'W*~~

~~*25 4 49*~~

~~*0-9*~~

~~*82 N*~~

~~*1T8 E*~~

~~*5 12 14*~~

~~*1-4*~~

~~*89 N*~~

~~68 E~~

~~16 19 84~~

~~1-8~~

~~46 N~~

~~45W~~

~~28 2 50~~

~~2-1~~

~~51 N~~

~~162 -W~~

~~8 10 8~~

~~2-4~~

~~56 N~~

~~101 E~~

~~18 IT 15~~

~~2-6~~

~~62 N~~

~~5-W~~

~~80 1 2T~~

~~2-5~~

~~Pacific Ocean, Borneo. Northern Afirica, India. Mexico, West Indies, Africa. Pacific Ocean. Egypt, Central Asia, China. United States, Spain,~~

~~*North*~~

~~*Africa. British Columbia, United States. Greece to Central Asia. Canada, Scandinavia, Eussia,*~~

~~*Persia.*~~

~~*Series, VI. Descending Node ; Central date, 2009, July 22.*~~

~~*1811, Mar. 24 1829, Apr. 8 184T, Apr. 15 1865, Apr. 25 1888, May 6 1901, May 18 1919, May 29 198T, June 8 1955, June 20*~~

~~*89 S*~~

~~*26 W*~~

~~*24 2 19*~~

~~*3-4*~~

~~*82 S*~~

~~*149 W*~~

~~*8 10 24*~~

~~*4-1*~~

~~*24 8*~~

~~*90 E*~~

~~*14 18 22*~~

~~*4-T*~~

~~*16 S*~~

~~*80 -W*~~

~~26 2 18~~

~~.5-8~~

~~9 S~~

~~UTW~~

~~6 9 58~~

~~6-0~~

~~2 S~~

~~9T E~~

~~IT IT 88~~

~~6-5~~

~~4N~~

~~18 -W~~

~~29 1 12~~

~~6-9~~

~~ION~~

~~181 W~~

~~8 8 48~~

~~T-1~~

~~15 N~~

~~HT E~~

~~19 16 12~~

~~T-2~~

~~South Atlantic to South Afiica. South Pacific Ocean. Indian Ocean, Java. Brazil to Central Africa. Pacific Ocean, Caroline Islands. Sumatra, Borneo. Peru, Brazil, Central Africa. Pacific Ocean, Peru. Ceylon, Slam, Philippines.~~

~~Series VII. Ascending Node ; Central date, 1904, Sept. 9.~~

~~1814, July IT 31 N 84 E 16 18 38 6-6 Africa, Central Asia, China.~~

~~1832, July 2T 24 N 28 "W 2T 2 2 6-8 West Indies to Central Africa.~~

~~1860, Aug. T 18 N 142 W T 9 84 6-8 Pacific Ocean.~~

~~1868, Aug. 18 10 N 108 E IT IT 12 6-8 India to Pacific Ocean.~~

~~1886, Aug. 29 8 N 14 W 29 0 54 6-6 West Indies, Central AMca.~~

~~1904, Sept. 9 6 S 183 TV 9 8 48 6-4 Pacific Ocean.~~

~~1922, Sept. 21 12 S 106 E 20 16 88 6'1 East Africa, Australia.~~

~~1940, Oct. 1 19 S 16 "W 1 0 42 5T Colombia, Brazil, South Aftioa.~~

~~1968, Oct. 12 26 S 189 W 12 8 52 5-2 Chile, Argentina.~~

~~Series VIII. Ascending Node ; Central date, 2212, March 3.~~

~~1815, July 6 1838, July IT 1861, July 28 1869, Aug. T 188T, Aug. 19 1905, Aug. 80 1928, Sept. 10~~

~~1941, Sept. 21~~

~~1959, Oct. 2~~

~~88 N~~

~~1T5-W~~

~~6 11 52~~

~~8-2~~

~~T8N~~

~~T6 E~~

~~16 19 16~~

~~8-5~~

~~TON~~

~~34W~~

~~28 2 41~~

~~8-T~~

~~61 N~~

~~146 W~~

~~T 10 8~~

~~3-8~~

~~68N~~

~~102 E~~

~~18 IT 89~~

~~3-8~~

~~46N~~

~~12 -ff~~.

~~80 1 18~~

~~8-8~~

~~88 N~~

~~128 W~~

~~10 8 68~~

~~3‘6~~

~~80 N~~

~~114 E~~

~~20 16 89~~

~~8-8~~

~~28N~~

~~6W~~

~~2 0 32~~

~~3-0~~

~~Polar Regions, “Western Siberia. North-Eastern Asia. Scandinavia, South-East Europe. United States.~~

~~North Europe, Siberia, Japan, Canada, Spam, North Africa. California, Mexico, Central~~

~~America. Central Asia, China, Pacific~~

~~Ocean. Canaries, Central Afiica.~~

~~*Series IX. Descending Node ; Central date, 1510, May 8.*~~

~~*1816, Nov. 19 1884, Nov. 30*~~

~~*1852, Dec. 11 18T0, Dec. 22*~~

~~*1889, Jan. 1*~~

~~*190T, Jan. 14*~~

~~*1926, Jan. 24*~~

~~*1943, Feb. 4*~~

~~*1961, Feb. 15*~~

~~*4SN 40 N*~~

~~*80 E 101 “W*~~

~~*18 22 9 80 6 48*~~

~~*1-8 1-9*~~

~~*8TN 86 N*~~

~~*12T E 5^*~~

~~*10 15 32 22 0 19 / 19 8*~~

~~*2-0*~~

~~*2-1*~~

~~*8TN*~~

~~*138 -W*~~

~~*2-2*~~

~~89 N 42 N 4TN 53 N~~

~~89 E~~

~~44-W~~

~~1T6W~~

~~63 E~~

~~18 IT 5T~~

~~24 2 46 4 11 81 14 20 11~~

~~2-8 2-4 2-5 2-6~~

~~Eastern Europe, Central Asia. Southern and "Western United~~

~~States. China, Pacific Ocean. Gibraltar, Northern Africa,~~

~~Sicily. California, Oregon, British~~

~~America. Bussia, Central Asia. United States. SiWia, Alaska. Prance, Italy, Austria, Siberia.~~

~~Series X. Descending Node ; Central date, 1817, Nov. 9.~~

~~181T, Nov. 9 1886, Nov. 20 1858, Nov. 80 18T1, Dec. 12~~

~~1889, Dec. 22 1908, Jan. 8 1926, Jan. 14~~

~~1944, Jan. 25 1962, Feb. 6~~

~~T S~~

~~10 S~~

~~11 S~~

~~12 S~~

~~149 E~~

~~20 E~~

~~111-W~~

~~118 E~~

~~8 18 63 19 22 81~~

~~80 T 14~~

~~11 16 2~~

~~4-7 4-6 4-4 4-4~~

~~12 S~~

~~12 8 10 8~~

~~18 “W 146 -W~~

~~82 E~~

~~22 0 52 3 944 18 18 35~~

~~4-2 4-2 4-2~~

~~T S 4 S~~

~~49 W 1T9 E~~

~~25 8 25 4 12 11~~

~~4-3 4-1~~

~~Burma, Pacific Ocean.~~

~~Central Africa, Madagascar. Pacific Ocean and Brazil. Southern India, IN’orthem~~

Australia. "Western Africa. Pacific Ocean. East Africa, Sumatra, Fhillp-

pines. Peru, Brazil, "West Africa. New Guinea.

Series XI. Ascending Node ; Central date, 2270, Jan. 22.

192T, June 29 1945, July 9

1968, July 20 1981, July 81 1999, Aug. 11

T8N TON

84 E 20 W

28 18 82 9 1 36

0-T

1-1

62 N 64N 46 N

126 -W 127 E 18 B

20 8 48 30 15 68 10 28 8

1-6 1-8 2-2

England, Scotland, Scandinavia. United States, British America,

Scandinavia, Bussia. Alaska, Hudson's Bay Territory. Central Asia, Siberia. Cornwall, Southern Europe, and

Asia.

It will be noticed that two of these series, VI. and VII., ' wiU be, or have been, notable for the long duration of totality. Those of 1937 and 1955 fall not more than 20" below the absolute maximum of 7" 30°. But series IV. will increase to a yet greater duration, reaching in 2150, June 25, a duration of

~~about 7”” 16°, and on 2168, July 5, a duration of 7" 28’, the longest in human history. The first of these will pass over-the Pacific Ocean ; the second over the southern part of India, near Madras.~~

~~Physical Phenomena of Recent Total Eclipses.~~

~~As the moon advances on the solar disc, the sharp and rugged edge of the lunar disc is in strong contrast to the soft and uniform outline of the sun’s limb. Some little time before the commencement of the total phase the entire outline of the moon may be distinguished, that part of the sun being seen by its cutting ofE the faint light of the corona. A few seconds before the commencement of the total phase the red light of the chromosphere becomes visible, and will be seen most distinctly as continuations of the solar crescent at its two ends. Owing to the in- equalities of the lunar surface, the diminution of the solar crescent does not go on with perfect uniformity, but, just before the last moment, what remains of it is gener- ally broken up into separate portions of light, which, mag- nified and diffused by the irradiation of the telescope, present the phenomenon long celebrated under the name of ” Baily’s beads.” These were so called because minutely and vividly described by Baily as he observed them during the annular eclipse of May 16, 1836, when he compared them to a string of bright beads, irregular in size and distance from each other. The disappearance of the last bead is commonly taken as the beginning of totality. An arc of the chromosphere will then be visible at the point of disappearance, the length and duration of which will depend on the apparent diameter of the moon as compared with that of the sun, being greater in length and longer seen as the excess of diameter of the moon is less. The red prominences may now generally be seen here and there around the whole disc of the moon, while the effulgence of soft light called the corona surrounds it on all sides. Before the invention of the spectroscope, observers of total eclipses could do little more than describe in detail the varying phenomena presented by the promi- nences and the corona. Drawings of the latter showed it to have the appearance of rays surrounding the dark disc of the moon, quite similar to the glory depicted by the old painters around the head of a saint. The discrepancies between the outlines as thus pictured, not only at differ- ent times, but by different observers at the same time and place, are such as to~~

show that little reliance can be placed on the details represented by hand drawings.

During the eclipse of July 8, 1842, the shadow of the moon passed from Perpignan, France, through Milan and Vienna, over Eussia and Central Asia, to the Pacific Ocean. Very detailed physical observations were made, but none which need be specially mentioned in the present con- nexion. The eclipse of July 28, 1851, was total in Scan- dinavia and Eussia. It was observed in the former region by many astronomers, among them Airy and Dawes. It was especially noteworthy for the first attempt to photo- graph such a phenomenon. A daguerreotype clearly show- ing the protuberances was taken by Berkawski at the Observatory of Konigsberg. An attempt by Majocchi to daguerreotype the corona was a failure. Photographs of the eclipse of July 18, 1860, were taken by Padre Secchi and Mr Warren De La Eue, which showed the prominences well, and proved that they were progressively obscured by the edge of the advancing moon. It was thus shown that they were solar appendages, and did not belong to the moon, as had sometimes been supposed. The corona was

barely visible on De La Eue's plates, but those of Secchi sbowed it, with its rifts and the bases of the tall coronal ■wings, to about 15' from the sun's limb. The sketches taken at this eclipse proved that the corona extended in some regions 1° from the sun's limb. As the sensitiveness of photographic plates has increased, they have gradually been wholly relied upon for information respecting the corona, so that at the present time naked-eye descriptions are regarded as of little or no scientific value. Owing to the great contrast between the brilliancy of the coronal light at its base and its increasing faintness as it extends farther from the sun, no one photograph will bring out all the corona. An exposure of one or two seconds is ample to show the details of the inner corona to the best advan- tage, while longer exposures give greater extent of the brighter portions. The most extended streameirs are very little brighter than the sky, and must be photographed with short exposures.

The first application of the spectroscope to the pheno- menon was made during the total solar eclipse of August 18, 1868, by Janssen and other observers in India. By them was made the capital discovery that the red solar prominences give a spectrum of bright lines, and are therefore immense masses of incandescent gases, chiefly hydrogen and the vapours of calcium and helium. Janssen also found that this bright-line spectrum could be fol- lowed after the eclipse was over, and, in fact, could be observed at any time when the air was sufficiently transparent. By one of those remarkable coincidences which frequently occur in the history of science, this last discovery was made independently by Lockyer in England before the news of Janssen's success had reached him. It was afterwards found that, by giving great dispersing power to the spectroscope, the promi- nences could be observed in a wide slit, in their true form. At this eclipse the spectrum of the corona was also observed, and was supposed to be continuous, while polariscopic observation by Lieutenant Campbell showed it polarized in planes passing through the sun's centre. The conclusion from these two observations was that the light was composed, at least in great part, of reflected sunlight. At the total eclipse of August 7, 1869, it was independently found by Professors Young of Princeton and Harkness of Washington that the continuous spectrum of the corona was crossed by a bright line in the green, which was long supposed to be coincident with 1474 of Kirchhoff' s scale. This coincidence is, however, now found not to be real, and the line cannot be identifled with that of any terres- trial substance. The name " coronium " has therefore been given to the supposed gas which forms it. It is now known that 1474 is a double line, one component of which is produced by iron, while the other is of unknown origin. The wave-length of the principal component is 5317, while that of the coronal line was found at the eclipses of 1896 and 1898 to be 6303.

The eclipse of December 28, 1870, passed over the south-western corner of Spain, Gibraltar, Oran, and Sicily. It is memorable for the discovery by Young of the " re- versing layer " of the solar atmosphere. This term is now applied to a shallow stratum immediately above the photo- sphere, the absorption of which produces the principal dark lines of the solar spectrum, but which, being incan- descent, gives a spectrum of bright lines by its own light when the light of the sun is cut off. This layer is much thinner than the chromosphere, and may be considered to form the base of the latter. Owing

~~to its thinness, the phenomenon of the reversed bright lines is almost in- stantaneous in its nature, and can only be observed for a considerable period near the edge of the shadow-path where the moon advances but little beyond the silar limb. Elsewhere it is a mere flash. Young also at this eclipse~~

~~saw bright hydrogen lines when his spectroscope was directed to the centre of the dark disc of the moon. This can only be attributed to the reflection of the light of the prominences and chromosphere from the atmosphere be- tween us and the moon. The coronal light as observed in the spectroscope may thus be regarded as a mixture of true coronal light with chromospheric light reflected from the air, and it is therefore probable that the H and E (calcium) lines of the coronal spectrum are not true coronal lines, but chromospheric.~~

~~At the eclipse of December 12, 1871, visible in India and Australia, Janssen observed, as he supposed, some of the dark lines of the solar spectrum in the continuous spectrum of the corona, especially D, h, and G. This would show that an important part of the coronal light is due to reflected sunshine. This feature of the spectrum, however, is doubtful in the most recent photographs under the best conditions. At this eclipse the remarkable obser- vation was also made by Herschel and Tennant that the characteristic line of the coronal spectrum is as bright in the dark rifts of the corona as elsewhere. This would show that the gas coronium does not form the streamers of the corona, but is spherical in form and distributed uniformly about the sun. Photographs were also taken on wet plates by a party in Java and by the parties of Lord Lindsay (at Baikul, India) and of Colonel Tennaat (at Dodabetta). The Baikul and Dodabetta photographs were of small size (moon's diameter =j^ inch), but of ex- cellent definition. A searching study was made of them by Messrs Eanyard and Wesley (see Memoirs E.A.S. vol. xli. 1879), and for the first 'time a satisfactory representation of the corona was obtained. The draw- ings in the volume quoted show its polar rays, wings, interlacing filaments, and rifts as they are now known to be, as well as the forms and details of the prominences.~~

~~The eclipse of April 16, 1874, was observed in South Africa by Mr E. J. Stone, Astronomer-Koyal at the Cape, who traced the coronal line about 30'~~

(430,000 miles) from the sun's limb. The visual corona was seen to ex- tend in places some 90' from the limb.

The eclipse of April 6, 1875, was observed in Siam by Sir J. Norman Lockyer and Professor Schuster. Their photographs showed the calcium and hydrogen lines in the prominence spectrum.

The eclipse of July 29, 1878, was thoroughly observed by many astronomers in the United States along a line extending from Wyoming to Texas. A number of the stations were at high altitudes (up to 14,000 feet), and the sky was generally very pure. The visible corona extended on both sides of the s\in along the ecliptic for immense distances — at least twelve lunar diameters, about eleven million miles. Photographs taken by the parties of Professors Hall and Harkness gave the details of the inner corona and of the polar rays, showing -the filamentous character of the corona, especially at its base in the polar regions. A photograph taken by the party of Professor Holden showed the outer corona to a distance of 50' from the moon's limb. The bright-line spectrum of the corona was excessively faint and, as the solar activity (measured by sun-spot frequency) was near a minimum, it was con- cluded that the brilliancy of the coronium line varied in the sun-spot period, a conclusion which subsequent eclipse observations seem to have verified. It is not yet certain that the other coronal spectrum lines vary in the same way.

The eclipse of May 17, 1882, was observed in Egypt. On the photographs of the corona the image of a bright comet was found, the first instance of the sort. (A faint comet was found on the plates of the Lick Observatory eclipse expedition to Chile in 1893.) The slitless spectre-

scope showed the green line (coronium) and Dj (helium) in the coronal spectrum.

The eclipse of May 6, 1883, was observed from a small coral atoll in the South Pacific Ocean by parties from America, England, France, Austria,

~~*and Italy. A thorough search was made by Holden (with a six-inch telescope) for an intrarMercurial planet, without success, during an imusually long totality (S m. 23 s.). Palisa also searched for such a planet. Janssen again reported the presence of dark lines in the coronal spectrum. " White " prominences were seen by Tacchini.*~~

~~*The eclipse of August 29, 1886, was observed in the West Indies. The English photographs of the corona, taken with a slitless spectroscope, show the hydrogen lines as well as K and/. Tacchini devoted his attention to the spectra of the prominences, and showed that their upper portions contained no hydrogen lines, but only the H and K lines of calcium. He also observed a very extensive " white " prominence. It was shown on the photographs of the corona, but could not be seen in the Ha line with the spectroscope. It has been suggested by Professor G. E. Hale that the colour of a " white " prominence may be due to the fact that the H and K lines (calcium) are of their normal intensity, while the less refrangible prominence lines are, from some unknown cause, comparatively faint. It is known that the inten- sity of such lines does, in fact, vary, though it is not yet certain that the " white " prominences are produced in this way. The subject is one demanding further obser- vation. High prominences are generally "white" at their summits, " red " at their bases. The Harvard Col- lege Observatory photographs show the corona out to 90' from the moon's limb, though no detail is visible beyond 60'. Mr W. H. Pickering made a series of photographic photometric measures of the corona, some of which are given below, together with results deduced by Holden from the eclipses of January and December 1889 : —*~~

~~*Auerust*~~

~~*January*~~

~~*December*~~

~~*1886.*~~

~~*1889.*~~

~~*1889.*~~

~~*Intrinsic actinic brilliancy of the*~~

~~*brightest parts of the corona .*~~

~~*0-031*~~

~~*0-079*~~

~~*0-029*~~

~~*Do. of the polar rays*~~

~~*...*~~

~~*0-053*~~

~~*0-016*~~

~~*Do. of the sky near the sun*~~

~~*0-0007*~~

~~*0-0050*~~

~~*0-0009*~~

~~*Ratio of intrinsic brilliancy of*~~

~~*the brightest parts of the co-*~~

~~*rona to that of the sky (actinic)*~~

~~*44tol*~~

~~*letol*~~

~~*32tol*~~

~~*Magnitude of the faintest star*~~

~~shown on the eclipse negatives~~

~~2-8~~

~~The results in the first and third columns are derived from plates taken in a very humid climate, and are not very different.~~

~~The eclipse of August 19, 1887, was total in Japan and Russia, but cloudy weather prevented successful observa- tions except in Siberia and Eastern Eussia.~~

~~The eclipse of January 1, 1889, was observed in Califor- nia and Nevada by many American astronomers. The pho- tographs of the corona, especially those by Charoppin and Barnard, show a wealth of detail. Those of Barnard, of the Lick Observatory party, were studied by Holden, and exhibited the fact that rays, like the " polar-rays," extended all round the sun, instead of being confined to the polar regions only. The outer corona was registered out to 100' from the moon's limb on Charoppin's negatives, to 130' on those of Lowden and Ireland. On other plates the outline of the moon is visible projected on the corona before totality began. The spectrum of the corona showed few bright lines besides those of coronium and hydrogen.~~

~~The eclipse of December 22, 1889, was observed in Cayenne, S.A., by a party from the Lick Observatory~~

~~under rather unfavourable conditions. Expeditions sent to Africa were baffled by cloudy weather. Father Perry observed at Salute Islands, French Guiana, and obtained some photographs of value. The efifort cost him his life, for he died of malarial fever five days after the eclipse.~~

~~The eclipse of April 16, 1893, was observed by British and French parties in Africa and Brazil, and by Professor Schalberle of the Lick Observatory in Chile. The Chile photographs of the corona were taken with a lens of 40 feet focus, and are extremely fine. They show a faint comet near the sun. No great extensions to the corona were shown on any of the negatives, or seen visually, though they were specially looked for by British parties. The neighbourhood of the sun was carefully examined by Bigourdan without~~

finding any planet. The spectrum of the corona was the usual one. The following lines were photographed in slitless spectroscopes, and undoubtedly belong to the corona :— W. L. 3987 ; 4086 ; 4217 ; 4231 ; 4240; 4280; 4486; 5303 (the last number is the wave- length of the green coronium line). All of these have been seen in slit spectroscopes also. It is possible that two lines observed by Young in 1869, namely, W. L. (Ang- strom) 5450 and 5570, should be added to the list of un- doubted coronal lines. It is not likely that helium or hydrogen or calcium vapour forms part of the corona. The wave-lengths of some 700 lines belonging to the chromosphere and prominences were determined by the British parties.

The eclipse of August 9, 1896, was total in Norway and Nova Zembla. The day was very unfavourable, but good photographs of the corona were obtained by Russian parties in Siberia and Lapland. Mr Shackelton, in Nova Zembla, with a prismatic camera obtained a photograph of the reversing-layer at the beginning of totality. This photograph completely confirms Young's discovery, and shows the prominent Fraunhofer lines bright, the bright lines of the chromosphere spectrum being especially con- spicuous.

At the solar eclipse of January 22, 1898, the shadow of the moon traversed India from the western coast to the Himalaya. The duration of totality was about 2 m. The eclipse was very fully observed, more than 100 negar tives of the corona being secured. The equatorial exten- sion of the visible corona was short and faint, and the invisible (spectroscopic) corona was also very faint. The spectrum of- the reversing-layer was successfully photo- graphed ; one set of negatives shows the polarization of one of the longest streamers of the corona, and proves the presence of dust particles reflecting solar light. The bright-line spectrum of hydrogen in the chromosphere was followed to the thirtieth point of the series, and the wave-lengths were shown to agree closely with Balmer's formula (see Specteosoope). The wave-length of coronium was found to be 5303 (not 5317 as previously supposed), and the brightness of the corona was meas- ured. Maunder made the curious observation of coronal matter enveloping a prominence in the form of a hood.

~~Observations of the eclipse of May 28, 1900, were favoured in a remarkable degree by the absence of clouds. The photographs of the corona obtained by Campbell extended four diameters of the sun on the west side. The sun's edge was photographed with an objective-prism spectrograph composed of two 60° prisms in front of a telescope of 2 in. aperture and 60 in. focus. A fine photo- graph, 6 inches long, of the bright- and dark-line spectra of the sun's edge at the end of totality was thus obtained. It shows 600 bright lines sharply in focus besides the dark- line spectrum, to which the bright lines gave way as the sun reappeared. The coronal material radiating the green light was found to be markedly heaped up in the sun-spot -regions. No dark lines were found in the spectrum of the~~

~~inner corona. Hale and Frost also photographed the com- bined bright- and dark-line spectra of the solar cusps at the instants before and after totality. On one photograph showing no dark lines 70 bright lines could be measured between 4070 and 4340. On another were 70 bright lines between H6 and Us. On a third were 266 bright lines be- tween 4026 and 4381, and some dark lines. These lines show a marked dissimilarity from the solar spectrum.~~

~~At this eclipse the " shadow-bands " received special attention. These consist of seeming vague and rapidly moving alternations of light and shade flitting over any white surface illuminated by the sun's- rays just before and after the total phase ; they are probably due to a flickering of the light from the thin crescent produced by the air, in the same way that the twinkling of the stars is produced.~~

~~Beferences. — The richest mine of information respecting eclipses of the sun and moon is Oppolzer's " Kanon der Finsternisse," pub- lished by the Vienna Academy of Sciences in the 52nd volume of its Denkschriften, Vienna, 1887. It contains elements of all eclipses both of the sun and moon, from 1207 b.c. to a.d. 2161, a period of more than thirty centuries. Appended to the tables is a series of charts showing the paths of all central eclipses visible in the northern hemisphere during the period covered by the~~

table. The points of the path at which the eclipse occurs, at sunrise, noon, and sunset, are laid down with precision, but the inter- mediate points are frequently in error by several hundred miles, as they were not calculated, but projected simply by drawing a circle through the three points just mentioned. For this reason we cannot infer from them that an eclipse was total at any given place. The correct path can, hovyever, be readily computed from the tables given in the work. Dr Eduard Mahler's memoir, " Die Centralen Sonnenfinsternisse des XX. Jahrhunderts " (Denk- schriften, Vienna Academy, vol. xUx.), gives more exact paths of the central eclipses of the 20th century, but no maps. General tables for computing eclipses are Oppolzer's " Syzygien-tafeln fiir den Mond" (Publication der Astronomischen GeseUschaft, xvi.), and Newcomb's, in Publications of the American Ephemeris, vol. i, part i. Of these, Oppolzer's are constructed with greater numeri- cal acciiracy and detail, while Newcomb's are founded on more recent astronomical data, and are preferable for computing ancient eclipses. Ginzel's Spezieller Kanon der Sonnen- und Mondjinster- nisse (Berlin, 1899) contains, \)esides the historical researches already mentioned, maps of the paths of central eclipses visible in the lands of classical antiquity from 900 b.c. to a.d. 500, but com- puted with imperfect astronomical data. Maguire, " Monthly Notices," B.A.S., xlv. and xlvi., has mapped the total solar eclipses visible in the British Islands from 878 to 1724. General papers of interest on the same subject have been published by Rev. S. J. Johnson. A r&um6 of all the observations on the physical phenomena of total solar eclipses up to 1878, by A. C. Eanyard, is to be found in Memoirs of the Royal Astronomical Society, vol. xli. A very copious development of the computation of eclipses by Bessel's method is found in Chauvenet's Spherical and Practical Astronomy, vol. i. Hansen's method is developed in the Abhandlungen of the Leipzig Academy of Sciences, vol. vi.

Si:ath.-Phys. Classe, vol. iv.). The formulae of computation by is method are found in the introductions to Oppolzer's two works cited above. (s. n.)

Economic Entomology is the study of insects based on their relation to man, his domestic animals and his crops, and, in the case of those that are injurious, of the practical methods by which they can be prevented from doing harm, or be destroyed when present. In Great Britain little Mtention

is paid to this important branch of agricultural science, but in America and the British Colonies the case is different. Nearly every State in America has its ofiicial Economic Entomologists, and nearly every one of the British Crown Colonies is provided vdth one or more able men who help the agri-cultural community to battle against the insect pests. Most, if not all, of the important knowledge of remedies comes from America, where this subject reaches the highest perfection ; even the life-histories of some of the British pests have been traced out in the United States and British Colonies more completely than at home, from the creatures that have been introduced from Europe.

Some idea of the importance of this subject may be

gained from the following figures. The estimated loss by the Vine Phylloxera in the Gironde alone was £32,000,000 ; for all the French wine districts £100,000,000 would not cover the damage. It has been stated on good evidence that a loss of £7,000,000 per annum was caused by the attack of the Ox Warble Fly on cattle in England alone. In a single season Aberdeenshire suffered nearly £90,000 worth of damage owing to the ravages of the Diamond Back Moth on the root crops ; in New York State the Codling Moth caused a loss of $3,000,000 to apple- growers. Yet these figures are nothing compared to the losses due to Scale Insects, Locusts, and other pests.

The most able exponent of this subject in Great Britain was John Curtis, whose treatise on Farm Insects, published in 1860, is still the standard British work dealing with the insect foes of corn, roots, grass, and stored corn. The most important works dealing with fruit and other pests come from the pens of Saundere, Lintner, Riley, Slingerland, and others in America and Canada, from Taschenberg, Lampa, Renter, and KoUar in Europe, and from French, Froggatt, and Tryon in Australia. It was not until the last quarter of the 19th century that any real advance was made in the study of economic entomology. Among the early writings, besides the book of Curtis, there may also be mentioned a still useful little publication by Pohl and KoUar, entitled Insects Injurious to Gardeners, Foresters, and Farmers, published in 1837, and Taschenberg's Praktische Insecktenkimde. American litera- ture began as far back as 1788, when a report on the

Hessian Fly was issued by Sir Joseph Banks ; in 1817 Say began his vreitings ; while in 1856 Asa Fitch started his report on the " Noxious Insects of New York." Since that date the literature has largely increased. Among the most important reports, &c., may be mentioned those of Riley, published by the U.S. Department of Agriculture, ex- tending from 1878 to his death, in which is embodied an enormous amount of valuable matter. At his death the work fell to Pro- fessor Howard, who constantly issues brochures of equal value in the form of Bulletins of the State Department of Agriculture. The chief writings of Lintner extend from 1882 to 1898, in yearly parts, under the title of Meports on the Injurious Insects of the State of New York. Another author whose writings rank high on this subject is Slingerland, whose investigations are published by Cornell University. Among other Americans who have largely increased the literature and knowledge must be mentioned Webster and Felt. In 1883 appeared a work on fruit pests by William Saunders, which mainly applies to the American continent ; and another small book on the same subject was , published in 1898 by Miss Ormerod, dealing with the British pests. ' In Australia Tryon published a work on the Insect and Fungus Enemies of Queensland in 1889. Many other papers and reports are being issued from Australia, notably by Froggatt in N.S. Wales. At the Cape excellent works and papers are prepared and issued by the Government Entomologist, Dr Lounsbury, under the auspices of the Agricultural Department ; while from India we have Cotes's Notes on Economic Entomology, published by the Indian Museum in 1888, and other works, especially on tea

Injurious insects occur among the following orders : — '■ Coleoptera, Hymenoptera, Lepidoptera, Diptera, Hemiptera (both heteroptera and homoptera), Orthoptera, Neuroptera, and Thysanoptera. The order Aptera also contains a few injurious species.

Among the Coleoptera or Beetles there is a group of world-wide pests, the Elateridce or Click Beetles, the adults of the various "Wireworms." These insects in the larval or wireworm stage attack the roots of plants, eating them away below the ground. The eggs deposited by the beetle in the ground develop into yellowish-brown wire-like grubs with six legs on the first three segments and a ventral prominence on the anal segment. The life of these subterranean pests differs in the various species; some undoubtedly

(Agriotes lineatum) live for three or four years, during the greater part of which time they gnaw away at the roots of plants, carrying wholesale destruction before them. When mature they pass deep into the ground and pupate, appearing after a few months as the click beetles (Fig. 1). Most crops are attacked by them, but they are particularly destructive to wheat and other cereals. With such subterranean pests little can be done beyond

rolling tlie land to keep it firm, and thus preventing them from moving rapidly from plant to plant. A few crops, such as mustard, seem deleterious to them. By growing mustard and ploughing it in green the ground is made obnoxious to the wireworms, and may even be cleared of them. For root feeders, bisulphide of carbon injected

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B

Tig. 1.-

-A, Wireworm ; B, pupa of Click Beetle ; C, adult Click Beetle (Agriotee lineatmn).

into the soil is of particular value. One ouSice injected about two feet from an apple tree on two sides has been found to destroy all the ground form of the Woolly Aphis. In garden cultivation it is most useful for wireworm, used at the rate of 1 ounce to every 4 square yards. It kills all root pests.

In Great Britain the Plea Beetles (Hcdticidoe) are one of the most serious enemies; one of these, tne Turnip Flea (Phyllotreta nemorum), has in some years, notably 1881, caused more than £600,000 loss in England and Scotland alone by eating the young seedling turnips, cabbage, and other Cruciferm. In some years three or four sowings have to be made before a "plant" is produced, enormous loss in labour and cost of seed alone being thus involved. These beetles, characterized by their skipping movements and enlarged hind femora, also attack the hop {H. concinna), the vine in America {Gfraptodera chalyhea, lUig.), and numerous other species of plants, being specially harmful to seedlings and young growth. Soaking the seed in strong-smelling substances, such as paraffin and turpentine, has been found efficacious, and in some districts paraffin sprayed over the seedlings has been practised with decided success. This oil generally acts as an excellent preventive of this and other insect attacks. In all climates fruit and forest trees suffer from Weevils or CuculionidcB. The Plum Cuculio (Conotra- cJielus nenuphar, Herbst) in America causes endless harm in plum orchards ; Cuculios in Australia ravage the vines and fruit trees (OrthorrJiinus Klugii, Schon, and Leptops Hopei, Bohm, &c.) . In Europe a number of " long-snouted " beetles, such as the Easpberry Weevils (Otiorhynchus piGipes),theA^Tp\e'BlossomWeeyil(Anthonomuspomorum), attack frait; others, as the "corn weevils" (Calandra oryzce and 0. granaria), attack stored rice and corn ; while others produce swollen patches on roots (Geutorhynchus suldcol- lis), &c. AH these Cuculionidse are very timid creatures, falling to the ground at the least shock. This habit can be used as a means of killing them, by placing boards or sacks covered with tar below the trees, which are then gently shaken. As many of these beetles are nocturnal, this trapping should take place at night. Larval " weevils " mostly feed on the roots of plants, but some, such as the Nut Weevil (Balaninus nucum), live as larvae inside fruit. Seeds of various plants are- also attacked by weevils of the family Bruchidoe, especially beans and peas. These seed- feeders may be killed in the seeds by subjecting them to the fumes of bisulphide of carbon. The corn weevils

(Ccdandra granaria and 0. oryece) are now found all over -the world, in many cases rendering whole cargoes of corn useless.

The most important Hymenopterous pests are the Saw- flies or TenthredinidcB, which in their larval stage attack almost all vegetation. The larvae of these are usually spoken of as "false caterpillars," on account of their resemblance to the larvae of a moth. They are most ravenous feeders, stripping bushes and trees completely of their foliage, and even fruit. Sawfly larvae can at once be recognized by the curious positions they assume, and by the number of pro-legs, which exceeds ten. The female lays her eggs in a slit made by means of her " saw-like " ovipositor in the leaf or fruit of a tree. The pupae in most of these pests are found in an earthen cocoon beneath the ground, or in some cases above ground {Lophyrus pini). One species, the Slugworm {Eriocampa Umacina), is com- mon to Europe and America ; the larva is a curious slug- like creature, found on the upper surface of the leaves of the pear and cherry, which secretes a slimy coating from its skin. Currant and gooseberry are also attacked by sawfly larvae {Nematus ribesii and JV. ventricosus) both in Europe and America. Other species attack the stalks of grasses and corn (Cephus pygmceus). Forest trees also suffer from their ravages, especially the Conifers (Lophyrus pini). Another group of Hymenoptera occasionally causes much harm in fir plantations, namely, the Siricidce or Wood-Wasps, whose larvae burrow into the trunks of the trees and thus kill them. For all exposed Sawfly larvae hellebore washes are most fatal, but they must not be used over ripe or ripening fruit, as the hellebore is poisonous.

The order Diptera contains a host of serious pests. These two-winged insects attack all kinds of plants, and also animals in their larval stage. Many of the adults are hlooAsvLokeTS (Taba7iidce,Culicidm,&oc.') ; others are parasitic in their larval stage (CE strides, &(y. The best known dipterous pests are the Hessian Fly (Cfeddomyia destructor), the Pear Midge (Diplosis pyrivora), the Fruit Flies (Tephritis Tryoni of Queenland and Halterophora capi- tata or the Mediterranean Fruit Fly), the Onion Fly (Phorbia cepetorum), and numerous corn pests, such as the Gout Fly (Chloropstoeniopus) and the Frit Fly {Oscinis frit). - Animals suffer from the ravages of Bot Flies ((Estridce) and Gad Flies (Tabanidoe) ; while the Tsetse disease is due to the Tsetse Fly (Glossina morsitans), carrying the protozoa that cause the disease from one horse to another. Other flies act as disease-carriers, including the mosquitoes (nopAeZes) which not only carry

malarial germs, but also form a secondary host for these parasites. Hundreds of acres of wheat are lost annually in America

Fio. 2. — A, Ox Bot Ifeggot i B, puparium ; 0, Ox Warble Fly {Sypoderma bovis).

by the ravages of the Hessian Fly ; the Fruit Flies of Australia and South Africa cause much loss to orange

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and citron growers, often making it necessary to cover

the trees in muslin tents for protection. Of animal pests

the Ox Warbles {Hypoderma lineata and H.

bovis) are the most important (see Fig. 2).

The " bots " or larvae of these flies live under

the skin of cattle, producing large swollen

lumps — "warbles" — in which the "bots"

mature (Fig. 2). These parasites damage the

hide, set up inflammation, and cause immense

loss to farmers, herdsmen, and butchers.

The universal attack that has been made

upon this pest has, however, largely decreased

its numbers. In America cattle suffer much

from the Horn Fly (Haematohia serratd).

The dipterous garden pests, such as the Onion

Fly, Carrot Fly, and Celery Fly, can best be

kept in check by the use of paraffin emulsions

and the treatment of the soil with gas-lime

after the crop is lifted. Cereal pests can

only be treated by general cleanliness and

good farming, and of course they are largely

kept down by the rotation of crops.

Lepidopterous enemies are numerous all over the world. Fruit suffers much from the larvae of the Geometrida&, the so-called "Looper-larvae" or "Canker- worms." Of these geometers the Winter Moth. (Cheimatobia brumata) is one of the chief culprits in Europe (Fig. 3). The females in this moth and in others allied to it are wingless. These insects pass the pupal stage in the ground, and reach the boughs to lay their eggs by crawling up the tnmks of the trees. To check them, "grease banding" round the trees has been adopted; but as many other pests eat the leafage, it is best to kill all at once by spraying with arsenical poisons. Among other notable Lepidopterous pests are the " surface larvae " or Cutworms (Agrotis spp.), the caterpillars of various Noctuae; the Codling Moth (CarpocapsapomoneZ^a), which causes the maggot in apples, has now become a universal pest, having spread from Europe to America and to most of the British Colonies. In many years quite half the apple crop is lost in Eng land owing to the larvae destroying the fruit. Sugar canes suffer from the Sugar-cane Borer (DicUioca sacchari) in the West Indies; to-bacco from the larvae of Hawk Moths (Sphingidce) in America; corn and grass from various Lepidopterous pests all over the world. Nor are stored

goods exempt, for much loss annually takes place in corn and flour from the presence of the larvae of the Mediterranean Flour Moth {Ephestia JcunieUd); while furs and clothes are often ruined by the Clothes Moth {Tinea trapezella).

By far the most destructive insects in warm climates belong to the Hemiptera, especially to the Coccidce or Scale Insects. All fruit and forest trees suffer from these curious insects, which in the female sex always remain apterous and apodal and live attached to the bark, leaf, and fruit, hidden beneath variously-formed scale-like coverings. The male scales differ in form from the female; the adult male is winged, and is rarely seen. The female lays her eggs beneath the scaly covering, from which hatch out little active six-legged larvae, which wander about and soon

can,

begin to form a new scale. The Coccidce mainly do, breed asexually (parthenogenetically)

and One

Fig. 8.— Looper-larva of Winter Moth (Cheima- iohia brumaia).

Via. i.-~^B.iiJos() Sciie[Aspidiotvapemiaioma). A, male scale Insect; B, female; C, larva ; D, female scale ; E, male scale.

of the most important is the San Jos6 Scale (Aqridiotus pemiciosus), which in warm climates attacks all fruit and many other trees, which, if unmolested, it will soon kill (Fig. 4). These scales breed very rapidly; Howard states one may give rise to a progeny of 3,216,080,400 in one year. Other scale insects of note are the cosmopolitan Mussel Scale {Mytilaspis pomorum) and the Australian Icerya purchasi. The former attacks apple and pear; the latter, which selects orange and citron, was introduced into America from Australia, and carried ruin before it in some orange districts until its natural enemy, the lady-bird beetle, Adalia cardincUis, was also imported.

After the Coccidce the next most important insects economically are the Plant-Lice or ApMdidce. These breed with great rapidity under favourable conditions : one by the end of the year will be accountable, according to Linnaeus, for the enormous number of a quintillion of its species. Aphides are born, as a rule, alive, and the young soon commence to reproduce again. Their food consists mainly of the sap obtained from the leaves and blossom of plants, but some also live on the roots of plants (Phylloxera vastatrix and Schizoneura lanigera). Aphides often ruin whole crops of fruit, corn, hops, &c., by sucking out the

Fio. 6.—The Hop Aphis (PAorotJow humuU). A, vringed female; B, winged male; 0, ovigerous wingless female ; D, Tlviparous wingless female from plum ; E, pupal stage.

sap, and not only check growth, but may even entail the death of the plant. Reproduction is mainly asexual,

the females producing living young -without the agency of a male. Males in nearly all species appear once a year, when the last female generation, the ovigerous generation, is fertilized, and a few large ova are produced to carry on the continuity of the species over the winter. Some aphides live only on one species of plant, others on two or more plants. An example of the latter is seen in the Hop Aphis (Phorodon fewmMZi), which passes the winter and lives on the sloe and damson in the egg stage until the middle of May or later, and then flies off to the hops, where it causes endless harm all the summer (Fig. 5) ; it flies back to the prunes to lay its eggs when the hops are ripe. Another Aphis of importance is the Woolly Aphis (Schizoneura lanigera) of the apple and pear : it secretes tufts of white flocculent wool often to be seen hanging in patches from old apple trees, where the insects live in the rough bark and form cankered growths both above and below ground. Aphides are provided with a mealy skin, which does not allow water to be attached to it, and thus insecticides for destroying them contain soft soap, which fixes the solution to the skin;

paraffin is added to corrode the skin, and the soft soap blocks up the breathing pores and so produces asphyxiation.

Amongst Orthoptera we find many noxious insects, notably the Locusts, which travel in vast cloud-like armies, clearing the whole country before them of all vegetable life. The most destructive locust is the migratory locust (Locusta migratoria), which causes wholesale destruction in the East. Large pits are dug across the line of advance of these great insect armies to stop them when in the larval or wingless stage, aud even huge bonfires are lighted to cheek their flight when adult. So dense are these " locust clouds " that they sometimes quite darken the air. The commonest and most widely distributed migratory locust is Pachytylus cinerascens. The mole cricket (Gryllotalpa vulgaris) and various cockroaches {BlaMidce) are also amongst the pests found in this order.

Of Neuroptera there are but few injurious species, and many, such as the lace wing flies (Hemerobiidce), are beneficial.

*77*6 Treatment of Insect Pests. — One of the most Im- portant ways of keeping insect pests in check is by *' spraying " or " washing." This method has made great advances in recent years. All the pioneer work has been done in America; in fact, until the South-Eastern Agri- cultural College undertook the elucidation of this subject, little was known of it in England except by a few growers. The results and history of this essential method of treat- ment are embodied in Professor Lodemann's work on the Spraying of Plants, 1896. In this treatment we have to bear in mind what the entomologist teaches us, that is, the nature, habits, and structure of the pest.*

For insects provided witli a biting mouth, which take nourish- ment from the whole leaf, shoot, or fruit, the poisonous washes used are chiefly arsenical. The two most useful arsenical sprays are Paris green and arsenate of lead. To make the former, mix

1 oz. of the Paris green with 15 gallons of soft water, and add

2 oz. of lime and a small quantity of agricultural treacle ; the latter is prepared by dissolving 3 oz. of acetate of lead in a little water, then 1 oz. of

arsenate of soda in water and mixing the two well together, and adding the whole to 16 gallons of soft water ; to this is added a small quantity of coarse treacle. For piercing- mouthed pests like Aphides no wash is of use unless it contains a basis of soft soap. This soft-soap wash kills by contact, and may be prepared in the following way : — Dissolve 6 to 8 lb of the best soft soap in boiling soft water, and while still hot (but of course taken off the Are) add one gallon of paraffin oil and churn well to- gether with a force-pump ; the whole may then be mixed with 100 gallons of soft water. The oil readily separates from the water, and thus a perfect emulsion is not obtained ; this difficulty has been solved by Mr Cousin's paraffin naphthalene wash, which is patented, but can be made for private use. It is prepared as follows :— Soft soap, 6 Xb dissolved in 1 quart of water ; naphthalene, 10 oz. mixed with IJ pint of paraffin ; the whole is mixed together.

When required for use, lib of the compound is dissolved in 5 to 10 gallons of warm water.

These two washes are essential to the well-being of every orchard in all climates. Not only can we now destroy larval and adult insects, but we can also attack them in the egg stage by the use of a caustic alkali wash during the winter ; besides destroying the eggs of such pests as the Fsyllidm, Red Spider, and some Aphides, this also removes the vegetal encumbrances which shelter numerous other insect pests during the cold part of 4ltie year. Caustic alkali wash is prepared by dissolving 1 lb of cnide potash and 1 lb of caustic soda in soft water, mixing the two solutions together, adding to them | lb of soft soap,"and diluting with 10 gallons of soft water when required for use. Another approved insecticide for Scale Insects is resin wash, which acts in two ways : first, corroding the soft scales, and second, fixing the harder scales to stop the egress of the hexapod larvae. .. It is pre-pared as follows : — First crush 8 lb of resin in a sact, and then place the resin in warm water and boil in a cauldron until thor- oughly dissolved ; then melt 10 lb of caustic soda in enough warm water to keep it liquid, and mix with the dissolved resin ; keep stirring until the mixture assumes a clear coffee-colour, and for ten minutes afterwards ; then add enough warm water to bring the whole up to 25 gallons, and well stir. Bottle this off, and when required for use dilute with three times its bulk of warm soft water,

~~and spray over the trees in the early spriug just before the buds burst. For mites {Acari) sulphur is the essential ingredient of a syray. Liver of sulphur has been found to be the best form, especially when mixed with a paraffin emulsion. Bud Mites (Phytoptidce, Fig. 6) are of course not affected. Sulphur wash is~~

~~Fro. 6. — Bud mites (P?i/ytoptidcB), A, currant bud mite {Phytoptus ribia) ; B, nut bud mite (P. avellanoB).~~

~~made by adding* to every 10 gallons of warm paraffin emulsion or paraJBBn-naphthalene-emulsion 7 oz. of liver of sulphur, and stirring until the sulphur is well mixed. This is applied as an ordinary spray. Nursery stock should always be treated, to kUl scale, aphis, and other pests which it may carry, by the gas treat- ment, particularly in the case of stock imported from a foreign climate. This treatment, both out of doors and under glass, is carried out as follows : — Cover the plants in bulk with a light gas- tight cloth, or put them in a special fumigating house, and then place 1 oz. of cyanide of potassium in lumps in a dish with water beneath the coverinig, and then pour 1 oz. of sulphuric acid over it (being careful not to inhale the poisonous fumes) for every 1000 cubic feet of space beneath the cover. The gas generated, hydrocyanic acid should be left to work for at least an hour before the stock is removed, when all forms of animal life will be destroyed.~~

~~For spraying, proper instruments must be used, by means of which the liquid is sent out over the plants in as fine a mist as possible. Numerous pumps and nozzles are now made by which this end is attained. Both horse and hand machines are employed, the former for hops and large orchards, the latter for bush fruit and gardens. In America, where trees in parks as well as orchards and gardens are treated, steam-power is sometimes used. Among the most important sprayers are the Strawson horse sprayers and the smaller Eclair and Notus knapsack pumps, carried on the back (Fig. 7). The nozzles for " mistifying " the wash most in use are known as the Vermorel and Riley's, which can be fitted to any length of tubing, so as to reach any height, and can be turned in any direction. The pumps in the machine keep the insecticide constantly mixed, and at the same time force the wash with great strength through the nozzle, and so to the exterior, as a fine mist ; every part of the plant is thus affected.~~

Beneficial Insects have also to be considered in Economic Entomology. They are of two kinds — (1) those that help to keep down an excess of other insects by acting either

Fig. T.— Knapsack sprayer for liquid InsectlcldeB.

as parasites or by being insectivorous in habit ; and (2) insects of economic value, such as the bee and silkworm. Amongst the most important friends to the farmer and

gardener are the Hymenopterous families of Ichneumon Elies (Ichneumonidce and BraconidcBy, the Dipterous iami- lies Syrphidos an& Tachinidce; the Coleopterous families CoccinellidcB and Garabidoe; and the Neuropte^ous Heme- rdbiidm, or Lace- Wing Flies. Ichneumon Flies lay their eggs either in the larvae or ova of other insects, and the parasites destroy their host. In this way the Hessian Fly is doubtless kept in check in Europe, and the Aphides meet with serious hindrance to their increase. If a num- ber of plant-lice are examined, a few will be found looking like little pearls ; these are the dried skins of those that have been killed by Ichneumonidce. The SyrphidcB, or Hover Flies, are almost exclusively aphis-feeders in their larval stage. Tachina flies attack lepidopterous larvae. One of the most notable examples of the use of insect allies is the case of the Australian Lady Bird, Adalia cardinalis, which, in common with all lady birds, feeds off Aphidoe and Coccidce. The Icerya Scale (icerya purchasi) imported into America ruined the orange groves, but its enemy, the Adalia, was also imported from Australia, and counteracted its abnormal increase with such great re- sults that the crippled orange groves are now once more profitable. (f. v. t.)

EOOJ^OMICS.

IN a former article (ee Political Economy, J5?rw. Brit., 9th edition, vol. xix. pp. 346^01), in which the growth of Economics from the earliest times was described, it was shown that, owing partly to the conditions affect- . . ing

the industrial and commercial organization of recent and the economic policy of different countries, work on partly to the influence on economics of the economics. gj-Q-wth of Other sciences, there were in Europe and America various schools of economists representing somewhat different views as to the aims, the subject- matter, and the method of the science. This state of .things was no doubt a symptom of vitality and progress, but it was associated with much destructive criticism of principles hitherto considered well founded, and diminished for a time both the practical usefulness of the science and the estimation in which it was held by ordinary men. During the last few years there have been no new departures of fundamental importance, such as the application of the historical method to economic in- vestigation; the methods characteristic of the different groups of economists have been seen to be not mutually exclusive, but complementary to each other; and much of the work done has been constructive, in the sense that economic writers have devoted themselves to the solution of particular problems rather than the discussion of the method by which the problems should be attacked. The time has therefore now arrived when we can review the situation and attempt to combine the positive results of a period of active criticism and inquiry. Many years must elapse before we can survey the whole field of economic investigation, if indeed the time ever arrives when we can undertake so great a task. Present ten- dencies scarcely point to the creation of a complete and well-rounded system of economics such as appealed to past generations. Like the world of business and com- merce of which it is the reflex, economic thought resembles a great river. Its sources lie far back in the historic past. Its course has been determined by practical needs which are no longer felt, by ideals to which the present genera- tion does not respond, and by systems of politics and philosophy whose day is over. The titles of an economic bibliography are a brief epitome of general history, and a complete survey of economic thought at the present time

would involve a careful examination of many of the im- portant questions which now occupy the public mind in, at least, Europe and America. It is the spirit and the method of economic science which we may hope will be permanent. The more numerous the points of contact between economic science and the real world of business, the less possible will it be, at any rate for many years, to construct a complete system. In the present state of

economic knowledge, generality can only be obtained by abstraction. But it is possible to describe the character and subject-matter of economics, to indicate its relation to other sciences, to explain the methods by which economists reach their conclusions, to show within what limits a science which we may call General Economics is possible, to apply our reasoning to particular groups of practical questions ; and that is the task we shall attempt in the following pages.

Economics, as we understand it, is the science which investigates the manner in which nations or other larger or smaller communities, and their individual mem- bers, obtain food, clothing, shelter, and whatever * ” ” ”■ else is considered desirable or necessary for the mainten- ance and improvement of the conditions of life. It is thus the study of the life of communities with special reference to one side of their activity. It necessarily involves the scientific examination of the structure and organization of the community or communities in question ; their history, their customs, laws, and institutions ; and the relations between their members, in so far as they affect or are affected by this department of their activity. At the root of all economic investigation lies the conception of the standard of life of the community. By this expression we do not mean an ideal mode of living, but the habits and requirements of life generally current in a com- munity or grade of society at a given period. The stand- ard of life of the ordinary well-to-do middle class in England, for example, includes not only food, clothing, and shelter of a kind different in many respects from that of a similar class in other countries and of other classes in England, but a highly complicated mechanism, both public and private, for ministering to these primary needs, habits of social intercourse, educational and sanitary organization, recreative arrangements, and many other

elements. Many influences operating for a long period of time on the character and the environment of a class go to determine its standard of life. In a modern industrial community it is possible to express this standard fairly accurately for the purposes of economic investigation in terms of

money. But it is doubtful whether the most complete investigation would ever enable us to include all the elements of the standard of life in a money estimate. The character, tastes, and capacity for management of different individuals and groups differ so widely that equal incomes do not neces sarily imply identity of standard. In the investigar tion of past times, the incommensurate elements of well-being are so numerous that merely money estimates are frequently misleading. The conception of the stand- ard of life involves also some estimate of the efforts and sacrifices people are prepared to make to obtain it ; of their ideals and character; of the relative strength of the different motives which usually determine their con- duct. But no carefully devised calculus can take the place of insight, observation, and experience. The econ- omist should be a man of wide sympathies and practical sagacity, in close touch with men of different grades, and, if possible, experienced in affairs.

It is evident that no permanent classification is possible of what is or is not of economic significance. No general

*rules, applicable to all times, can be laid down ot'subiKt- ^^ *° what phenomena must be examined or matter. what may be neglected in economic inquiry.*

The different departments of human activity are organically connected, and all facts relating to the life of a community have a near or remote economic sig- nificance. Por short historical periods, indeed, many phenomena are so remotely connected with the ordinary business of life that we may ignore them. But at any moment special causes may bring into the field of eco- nomic inquiry whole departments of life which have hith- erto been legitimately ignored. In times past, biblical exe- gesis, religious ideals, and ecclesiastical organization, the purely political aims of statesmen, chance combina- tions of party politics and the intrigues of diplomatists, class prejudice, social conventions, apparently sudden changes of economic policy, capricious changes of fashion — all these causes and many others have exerted a direct and immediate influence on the economic life of the community. In our own day we have had many illustrations of the manner in which special circum- stances may at once bring an almost unnoticed series of scientific investigations into direct and vital relation with the business

world. The economist must, there- fore, not only be prepared to take account of the physi- cal features of the world, the general structure and or- ganization of the industry and commerce of different states, the character of fheir administration, and other important causes of economic change. HIe must be in touch with the actual life of the community he is study- ing, and cultivate "that openness and alertness of the mind, that sensitiveness of the judgment, which can rapidly grasp the significance of at first sight unrelated discoveries or events."

Some people are of opinion that the factors to be taken account of in economic investigation are so numerous that progress on these lines is impossible. It would certainly be impossible if we had to begin de novo to construct the whole fabric of economic science. But, as we shall see, it is no more necessary to do this in the world of science than it is in the world of business or politics. There is in existence a vast store of accumulated knowledge, and few, if any, departments of economics have been left quite unUluminated by the researches of former generations. Progress is the result of adaptation rather than recon-

struction. It must be remembered also that economic work in modern times is carried on by consciously or uncon- sciously associated effort, and although it must always require high qualities of judgment, capacity, and energy, many of the difftculties which at first sight appear so insuperable give way when they are attacked. In some ways also the study of highly developed organizations like the modern industrial state is simpler than that of earlier forms of society'.

In the earliest times for which we have abundant ma- terial the economic life of England had already reached in certain directions a high degree of complexity. Even in the rural districts, manorial records reveal the existence of a great variety of classes and groups of persons engaged in the performance of economic functions. The lord of the manor with his officials and retainers, the peasantry bound to him by ties of personal dependence and mutual tights and obligations, constituted a little world, in which we can watch the play of motives and passions not so dissimilar as we are sometimes led to believe from those of the great modern world. In many a country district the gradations of social rank were more con- ^,,c/eii<

tinuous, the opportunities of intercourse more and modern frequent, and the capacity for organization f'p'''''' greater than in modern times. The manorial " agan . accounts were kept with precision and detail, and we are told that a skilled official could estimate to the ut- most farthing the value of the services due from the villein to his lord. The manor was indeed self-suffi- cient and independent in the sense that it could furnish everything required by the majority of the inhabitants, and that over the greater part of rural England pro- duction was not carried on with a view to a distant market. But in the earliest times the manor was sub- jected to external influences of great importance. Vast areas of the country were in fact under the single control of a territorial lord or an ecclesiastical foundation. Every manor composing these great fiefs was likely to be affected by the policy or the character of the administration of the feudal lord, and he, again, by the policy or the difficulties, the strength or the weakness, of the central government. Foreign trade and foreign intercourse were undeveloped, but their influence was in historical times never entirely absent, while the influence of Roman law and the Christian Church constantly tended to modify the manorial organ- ization. In the towns the division of labour had proceeded much further than in the rural districts, and there were in existence organized bodies, such as the Gild Merchant and the crafts, whose functions were primarily economic. But one of the most striking characteristics of town life in the Middle Ages was the manner in which municipal and industrial privileges and responsibilities were interwoven. In modern times the artisan, however well trained, effi- cient, and painstaking he may be, does not, in virtue of these qualities, enjoy any municipal or political privileges. By means of his trade union, co-operative society, or club he may gain some experience in the management of men and business, and in so far as the want of a sufficient income does not constitute an insuperable difficulty, he may share in the' public life of the country. But in his character as artisan he enjoys no municipal or political privileges. In the Middle Ages this differentiation of the industrial, municipal, and political life had not taken place, and in order to understand the working of at first sight purely economic regulations it is necessary to make a close study of the functions of local government. But this, after all, does not carry us very far. From the very nature of the records in which we study the town life of the Middle Ages, it follows that we obtain from them only a one-sided

view. No one knows what proportion of the industrial population was included in the organized guilds,

or how complete was the control exercised by these bodies over their members. Elaborate regulations were in force, but no one knows how elastic they were in practice. Mediaeval Englishmen were particularly apt to put their aspirations into a legal form, and then rest satisfied with their achievement. The number of regulations is scarcely to be regarded as a test of their administrative success. Further, as the country became more consolidated and the central government extended its authority over economic affairs, new regulations came into force, new organs of government appeared, which were sometimes in conflict, sometimes in harmony, with the existing system, and it becomes for a time far more difficult to obtain a clear view of the actual working of economic institutions. Thus the study of the economic life of the Middle Ages is one of the most complicated subjects which can engage the attention of man. It is impossible to carry the pro- cess of isolation very far. The different threads of social activity are so closely interwoven that we cannot follow any one for very long without forming wrong impressions, and it becomes necessary to turn back and study others which seemed at first sight unrelated to the subject of our investigations. Under an apparently uniform and stable system of social regulation there was much variation and movement, the significance of which it is impossible to estimate. Materials for forming such an estimate no doubt exist, but before doing so we have to study in infinite detail a vast number of separate manors, munici- palities, or other separate economic areas. This involves great industry on the part of many scientific workers. Meanwhile we can illustrate the economic life of the Middle Ages, describe its main features, indicate the more important measures of public policy, and draw attention to some of the main lines of development.

It is only as we approach more modern times that the conditions of economic study are realized and economic science, as we understand it, becomes possible. Those conditions are : (i.) the life of the state or other

commu- nity or communities we are studying must be so differ- entiated that we can isolate those functions which are wholly or predominantly economic. The "separation of employments" is not only a condition of Conditions economic efficiency ; it was necessary before

ot economic u -u • ■>•■ \ ttt

science. "^6 could have an economic science, (ii.) We must be in a position so far to understand and estimate the character and motives of different classes and groups in these communities that we can rightly interpret their action. This condition cannot be real- ized without great difficulty, for " economic motives " are very different in different periods, nations, and classes, and even for short periods of time in the same country are modified by the influence of other motives of an entirely different order. In studying the economic history of the 18th century, for example, it is not enough to assume with Defoe that "gain is the design of merchandise." We have to be saturated, as it were, with 18th-century influences, so that we can realize the conditions in which industry and trade were carried on, before we can rightly explain the course of development. In our own day labour disputes, to take another example, can scarcely ever be resolved into a question of merely pecuniary gain or loss. The sig- nificance of the amount of money involved varies greatly for different trades, and can only be under- stood by reference to the character and habits of the people concerned. But questions of sentiment, shop- feeling, and trade customs invariably play an important part, (iii.) Economics can never lead to anything but hypothetical results unless we not only realize that we must " take account of " other than the purely economic factors, but also give due weight and significance to

these factors. No explanation of the industrial situation in Germany, for example, would be intelligible or satis- factory even from the economic point of view which ignored the significance of the political conditions which Germans have to deal with. So, again, it is impossible to make a useful comparative estimate of the advantages and disadvantages of the transport systems of England, the United States, and Germany, unless we keep con- stantly in view the very different geographical, military, and political conditions which these systems have to satisfy, (iv.) Sufficient information must be available to enable us to test the validity of our

hypotheses and con- clusions. Whatever " method " of economic investigation we employ, we must at every stage see how far our rear soning is borne out by the actual experience of life. This obvious condition of scientific inquiry is very far from being completely realized even at the present time. It implies the existence of a well-trained class engaged in the work of collecting information, and much orgauizar tion both by the state and private bodies. These four conditions can be reduced to two. The community wp are studying must have reached such a stage of development that its economic functions and those immediately cognate to them form a well-defined group, and adequate means must be available so that we can, as it were, watch the performance of these functions and test our hypotheses and conclusions by observation and experience.

It is easy to understand, therefore, why we trace the beginnings of economics, so far as England is concerned, in the 16th century, and why the application of strict sci- entific tests in this subject of human study has become possible only in comparatively recent times. Mediaeval economics was little more than a casuistical system of elaborate and somewhat artificial rules of conduct. Prom the close of the Middle Ages until the middle of the 18th century thousands of pamphlets and other works on economic questions were published, but, with the few notable exceptions mentioned in the former article, the vast majority of the writers have little or no scientific importance. Their works frequently contain information given nowhere else, and throw much light on the state of opinion in the age in which they wrote. It is also possi- ble to find in them many anticipations of the views of the economists of later times ; but such statements were as a rule generated merely by the heat of controversy on some measure or event of practical importance, and when the controversy died down were seldom regarded or incorpo- rated in a scientific system. Trade bias, personal im- pressions, and guess-work took the place of scientific method. This was inevitable in the absence of trust- worthy information on an adequate scale, and from the immediately practical aims of the writers. But from the end of the 17th century economics has been definitely recognized as a subject of scientific study.

In modern times the conditions which have made economic science possible have also made it necessary. While it is impossible to give a strictly

economic inter- pretation of the earlier history of nations, economic interests so govern the life and determine the policy of modern states that other forces, like those of religion and politics, seem to play only a subsidiary part, modifying here and there the view which is taken of particular questions, but not changing in any important degree the general course of their development. This may be, in the historical sense, merely a pass- Necessity ing phase of human progress, due to the rapid sci^w?”’” extension of the industrial revolution to all the civilized and many of the uncivilized nations of the world, bringing in its train the consolidation of large areas, a similarity of conditions within them, and amongst peoples and governments a great increase in the strength

of economic motives. When the world has settled down to the new conditions, if it ever does so, we may be confronted with problems similar to those which our forefathers had to solve. But, for the time, if we know the economic interests of nations, classes, and individuals, we can tell with more accu- racy than ever before how in the long run they will act. Public policy therefore requires the closest pos- sible study of the economic forces which are mould- ing the destinies of the great nations of the world. In most civilized countries except England this is recognized, and adequate provision is made for the study of economic science. But the subject is not only of im mediate concern to the state in its corporate and public capacity. The neglect of it in the domain of private business can now only lead to disastrous results. To quote from a recently published work (see National Education : a Symposium, 1901), “the commercial suprem- acy of England was due to a variety of causes, of which superior intelligence, in the ordinary business sense, was not the most important. Her insular position, continuity of political development, and freedom from domestic broils played an important part in bringing about a steady and continuous growth of industry and manufactures for several generations before the modern era. The great wars of the 18th and the beginning of the 19th century, which arrested the growth of con- tinental nations, gave England the control of the markets of the world. When peace was restored, England enj oyed

something in the nature of a monopoly. The com- petition of France ceased for a time to be an important factor. Wbat is now the German Empire was a mere congeries of small states, waging perpetual tariff wars upon each other. In the old Prussian provinces alone there were fifty-three different customs frontiers, and German manufactures could not develop until the growth of the Zollverein brought with it commercial consolidation, internal freedom, and greater homogeneity of economic conditions. The industries of the United States were in their infancy. Thus the productive power of England was unrivalled, and her manufactures and business men, under a regime rapidly approximating to complete freedom of trade, could reap the full advantages to be derived from the possession of great national resources and production by machinery. Commercial supremacy required not so much highly trained intelligence amongst manufacturers and merchants as keen business instinct and a certain rude energy. In the last generation all that has changed, and the change is of a permanent character. The struggle of the future must inevitably be between a number of great nations, more or less equally well equipped, carrying on production by the same general methods, each one trying to strengthen its industrial and commercial position by the adoption of the most highly developed machinery, and all the methods suggested by scientific research, policy, or experience. Under these conditions, it is no longer possible for the individual merchant, or for small groups of merchants, to acquaint themselves, by personal experi- ence alone, with more than a fractional part of the causes which affect the business in which they are engaged. The spread of the modern industrial system has brought with it the modem state, with its millions of consumers, its vast area, its innumerable activities, its complicated code of industrial and commercial law. At the same time, the revolution in the means of transport and communica- tion has destroyed, or is tending to destroy, local markets, and closely interwoven aU the business of the world. Events in the most distant countries, industrial and commercial movements at first sight unrelated to the concerns of the individual merchant, now exert a direct and immediate influence upon his interests. The technical

training of the factory or the office, the experience of business, the discharge of practical duties, necessary as they are, do not infallibly open the mind to the large issues of the modem business world, and can never

confer the detailed acquaintance with facts and principles which lie outside the daily routine of the individual, but are none the .less of vital importance." Economics, therefore, under modern conditions, is not only a sub- ject which may usefully occupy the attention of a leisured class of scientific men. It should form part of the training of educated men of all classes, on grounds of public policy and administrative and busi- ness efficiency.

The relations between economics and other sciences cannot be stated in a very general form. They vary for different periods, and are not the same for all branches of economics. There is no- subject of human study which may not be at sometime or other of economic significance, and anything which affects the character, the ideals, or the environment of man may make it necessary to modify our assumptions and our reasoning with regard to his conduct in economic affairs. But if the ^g^g"^^ economist, while studying one side of man's economics activities, must also cultivate all other branches and other of human learning, it is obvious that no sub- "'<""*• stantial progress can be made. The economist frankly assumes the reality of the existing world and takes men as they are, or as they have been if he is studying past times. HIs assumptions are based upon ordinary observa- tion and experience, and are usually accurate in proportion to his practical shrewdness and sagacity, so that he is not interested in the speculative flights of philosophy, except in so far as they influence or have influenced conduct. In times past, and to a less extent in our own day, philosophical conceptions have formed the basis of great systems of politics and economics. The historical relations between philosophy and economics are of great importance in tracing the development of the latter, and have done much to determine its present form. But the modem conception of society or the state owes more to biology than philosophy, and actual research has destroyed more frequently than it has justified the assumptions of the older philosophical school. Experimental psychology may in course of time have an important bearing on economics, but the older science cannot be said to be of much significance except in its historical aspects. Ethics is in much the, same position. That is, it is possible to conceive of an ethical science which would extend con siderably our knowledge of economic affairs, but no important new principle or original discovery, relevant to economic investigation, has come from that quarter in recent years, and at present

ethics has more to learn from economics than the latter has from ethics. It is in the adaptation of biological conceptions and methods, in the positive contributions of jurisprudence, law, and history, in the rigorous application, where possible, of quantitative tests, that the explanation of the present position of economics is to be found. Mathematics has influenced the form and the terminology of the science, and has some- times been useful in analysis, but mathematical methods of reasoning, in their application to economics, while possessing a certain fascination, are of very doubtful utility.

There is no method of investigation which is peculiarly economic or of which economics has the monopoly. In every age economists have applied the methods ordinarily in use amongst scientific men. There would probably have been no controversy at all on this subject but for the fact that economics was elaborated into systematic form, and made the basis of practical measures of the greatest importance, long before the remarkable development in

the 19th century of historical research, experimental science, and biology. The application of the d. priori Method of ^^i^thod. in economics was an accident, due to its economic association with other subjects and the general investiga- backwardness of other sciences rather than any ”” ”■ exceptional and peculiar character in the subj ect-

matter of the science itself. The methods applied to economics in the 18th and the early part of the 19th century were no more invented with a special view to that subject than the principles of early railway legis- lation, in the domain of practical policy, were devised with a special view to what was then a new means of transport. As a matter of fact, discussions of method and the criticism of hypotheses and assumptions are very rarely found in early economic works. It is only by reference to the prevailing ideas in philosophy and politics that we can discover what was in the minds of their authors. The growth of a science is much like the growth of a constitution. It proceeds by adaptation and precedent. The scientific and historical

movement of the 19th 'century was revolutionary in character. ' When it began to affect economies, many people were afraid that the whole fabric of the science would be destroyed and the practical gains it had achieved jeopardized. These fears were justified, in so far as those who entertained them shut their eyes to everything new and assumed an attitude of no compromise. Where the newer methods were assimi- lated, the position of economics was strengthened and its practical utility increased. General discussion of method, however, is rarely profitable. In all branches of economics, even in what is called the pure theory, the're is an implied reference to certain historical or existing conditions of a more or less definite character ; to the established order of an organized state or other community, at a stage of development which in its main features can be recog- nized. In all economic investigation assumptions must be made, but we must see that they are legitimate in view of the actual life and character of the community or com- munities which are the subject of investigation. In common with other sciences, economics makes use of " abstractions " ; but if for some problems we employ symbolic processes of reasoning, we must keep clearly in view the limits of their significance, and neither endow the symbols with attributes they can never possess, nor lose sight of the realities behind them. Every hypothesis must be tested by an appeal to the facts of life, and modi- fied or abandoned if it will not bear examination, unless we are convinced on genuine evidence that it may for a time be employed as a useful approximation, without prejudice to the later stages of the investigation we are conducting.

We shall best illustrate the character and method of economic reasoning by examples, and for that purpose let A HI tr • ^^ **^® ^^* °"^ ^ ^ purely historical problem, tion of ' namely, the effect on the wage-earners of the economic wages clauscs of the Statute of Apprenticeship method. (1563). It is at once obvious that we are dealing not with an abstract scheme of regulation in a hypothetical world, but with an Act of Parliament nomin- ally in force for two hundred and fiftyyears,and applicable to a great variety of trades whose organization and history can be ascertained. The conclusions we reach may or may not modify any opinions we have formed as to the manner in which wages are determined under modern conditions. For the time being such opinions are irrelevant to the question we are investigating, and the less they are in our minds the better. There is no

reason why we should apply to this' particular Act a different method of inquiry from that we should apply to any other of the numerous Acts, of more or less economic importance, passed in' the same session of Parliament. The first step is to see

whether there is aprimdfacie case for inquiry, for many Acts of Parliament have been passed which have never come into operation at all, or have been administered only for a short time on too limited a scale to have important or lasting results. The justices were authorized to fix wages at the Easter Quarter Sessions. Did they exercise their powers ? To answer this question we must collect the wages assessments sanctioned by the magistrates. This is a perfectly simple and straightforward operation, involving nothing more than familiarity with records and industry in going through them. Without having recourse to any elaborate process of economic reasoning, by con- fining our attention to one simple question, namely, what happened, we can establish conclusions of the . greatest interest to economic historians and, further, de- fine the problem we have to investigate. We can show, for example : (1) that the Statute of Apprenticeship did not stand alone ; it was one of a long series of similar measures, beginning more than two centuries before, which in their turn join on to the municipal and gild regulations of the Middle Ages; one of an important group of statutes, more or less closely interwoven throughout their history, administered by local authorities whose functions had grown largely in connexion with this legislation and the gradual differentiation of the trades and callings to which it related. (2) That wages were regulated with much greater frequency during the reigns of Elizabeth, James I., and Charles I. than at any later period. (3) That they were regulated in some counties and not in others. (4) That in the counties and towns where they were regulated the action of the magistrates was in general spasmodic, and rarely continuous for a long series of years. (6) That the magistrates used their powers sometimes to raise wages, sometimes to force them down. (6) That the local variations of wages and prices were what we should call excessive, so that the standard of comfort in one district was very different .from that of others. (7) That the wages assessments group themselves round cer- tain short periods, coincident in many instances with high prices, increase of poverty, and other causes of excep- tional action. (8) That what we may call, with the above limitations, the effective period of the Act

terminates with the outbreak of the Civil War. (9) That subsequent to that period organic changes in the industries affected, coupled with the incompetence of Parliament to adapt the old legislation to new conditions, and the growing ac- ceptance of the doctrine of laisser faire, brought about a general disuse of the statute, though isolated attempts to enforce it were made and new Acts applicable to certain trades were passed in the 18th century. (10) For more than one hundred years before the repeal of the Act, trade unions and other forms of voluntary association amongst wage-earners, combinations amongst employers, collective agreements, customary regulations, were established in many of the important trades of the country. But these conclusions, after all, suggest more difficulties than they remove, for they show that our inquiry, instead of pre- senting certain well-marked features which can be readily dealt with, has to be split up into a number of highly specialized studies : the investigation of rates of wages, prices, and the standard of comfort in different localities, bye-industries, regularity of employment, the organization of particular trades, the economic functions of local authorities, apprenticeship, and a host of other subjects. Moreover, all these subjects hang together, so that it seems impossible to come to a decision about one of them without knowing all about the others.

It is a comparatively simple thing to state the questions to which we want an answer, but extremely difB.cult to define the exact nature of the evidence which will con- stitute a good answer ; easy enough to say we must try

hypothesis after hypothesis, and test each one by an appeal to the facts, but a man may easily spend his life in this sort of thing and still leave to his descendants nothing more than a legacy of rejected hypotheses. Every volume of records we look through contains a mass of detailed information on the economic life of England in the period we are studying. How much of it is relevant to the subject of inquiry ? What is to be the principle of selection ? How shall we determine the relative weight and importance of different kinds of relevant evidence ? As in modern problems, so in those of past times, a man requires for success qualities quite distinct from those

conferred by merely academic training and the use of scientific methods. A correct sense of proportion and the faculty of seizing upon the dominant factors in an historical problem are the result partly of the possession of certain natural gifts in which many individuals and some nations are conspicuously wanting, partly of general knowledge of the working of the economic and political institutions of the period we are studying, partly of what takes the place of practical experience in relation to modern problems, namely, detailed acquaintance with different kinds of original sources and the historical imagination by which we can realize the life and the ideals of past generations. These qualities are required all the more because, in order to make any further pro- gress with such an inquiry as we have suggested, we have deliberately to make use of abstraction as an instrument of investigation.

Let us see how this will work out. Suppose we have selected one of the numerous subsidiary problems sug- gested by the general inquiry, and obtained The plan ot such full and complete information about one m‘- particular industry that we can tabulate the wages of the workers for a long series of years. We may do the same for other industries, some of them coming under the Statute of Apprenticeship, others not. If all the industries belong to one economic area over which, so far as we can tell from general statistics of wages and prices, and other information, fairly homoge- neous conditions prevailed, we may be able to reach some useful conclusions as to the operation of the Act. But it would be absurd to suppose that we could reach those conclusions by simple reference to the trades them- selves. We cannot assume that the fluctuations in wages were due to the action or inaction of magistrates without the most careful examination of the other influences affecting the trades. In economic affairs the argument post hoc propter hoc never leads to the whole truth, and is frequently quite misleading. We cannot suppose that the policy of the Merchant Adventurers’ Company had noth- ing to do with the woollen industry ; that the export trade in woollen cloth was quite independent of the for- eign exchanges and international trade relations in those times ; that the effect on wages of the state of the currency, the influx of new silver, the character of the harvests, and many other influences can be conveniently ignored. In studying, therefore, such an apparently sim- ple question as the effect of an Act of

Parliament on wages in a small group of trades we want a general the- ory which we can use as a kind of index of the factors we have to consider.

We shall return to this subject later (see p. 646). It is sufficient to say here that all that we require is amply provided by readily-accessible works on eco- nomics. Assuming that we have m our minds this safeguard against loose thinking and neglect of important factors, the investigation of the special problems arising out of the general inquiry resolves itself into a careful definition of each problem we wish to deal with, and the collection, tabulation, and interpretar

due to want ot evidence.

tion of the evidence. In most cases the interpretation of the facts is far from obvious, and we have to try several hypotheses before we reach one which will bear the strain of a critical examination in the light of further evidence. But at this stage in historical investigation it is generally the want of evidence of a sufficiently complete and con- tinuous character, rather than difficulties of method, which forces us to leave the problem unsolved. It is, for instance, practically impossible to obtain reliable evidence as to the regularity of employment in any industry in the 17th century, and the best approximations and devices we can invent are very poor substitutes for what we really want. For this reason guess-work must continue to play an important part in economic history. But every genuine attempt to overcome its difficulties brings us into closer touch with the period we are examining ; and though we may not be able to throw our conclusions into the form of large generalizations, we shall get to know something of the operation of the forces which determined the economic future of England ; understand more clearly than our fore- fathers did, for we have more information than they could command, and a fuller appreciation of the issues, the broad features of English development, and be in a position to judge fairly well of the measures they adopted in their time. By comparing England with other countries we may be able in the distant future to reach conclusions of some generality as to the laws of growth, maturity, and decay of industrial nations. But, like the early statis- ticians of the 17th century, economic historians are the " beginners of an art not yet polished, which time may bring to more perfection."

When we come to exclusively modern questions, there is no reason or necessity for a fundamental change of method. We cannot suppose that there occurred, ^^^ ^^ at or about the commencement of the IQth tigationot century, a breach of historical continuity of such modern a character that institutions, customs, laws, and luestions. social conventions were suddenly swept away, the bonds of society loosened, and the state and people of England dissolved into an aggregate of competing individuals. The adoption of machinery gradually revolutionized the methods of production; but in the first instance only certain industries were affected, and those not at the same time or in the same degree ; old laws grown obsolete were repealed, but other laws affecting wage-earners and employers took their place, more complicated and elabo- rate than the Elizabethan code. Trade unions, so far from disappearing, were legalized, gathered strength from the changes in industrial organization, and nowhere be- came so powerful as in the most progi'essive industries ; while other forms of combination appeared, incomparably stronger, for good or evil, than those of earlier times. But while we recognize these facts, we must not suppose that we have to study the action of men as though they were all enrolled in organized associations or covered by stringent laws which were always obeyed. There has never been in the history of English industry such licence as we find in certain directions in the earlier part of the 19th century.

It is not in the decay of combination and monopoly or in the growth of competition that we must look for the distinctive characteristics of modern problems. A 17th- century monopoly was a very weak and ineffective instru- ment compared with a modern syndicate ; the Statute of Apprenticeship was certainly not so widely enforced as the " common rules " of trade unions ; and many of the regulations of past times, which look so complicated to modern eyes, were conditions of free enterprise rather than restraints upon it. It is due to the influence of the laisser faire doctrine that we regard law and regulation as a restraint on liberty. As a maxim for guidance

in public affairs, laisserfaire was genuinely relevant at the end of the 18th and the beginning of the 19th century, when the Statute Book was cumbered with vexatious and obsolete laws. As an explanation of what has taken place « during the last sixty years, or of the actual

d/stfnctfve economic life of the present day, it is ludicrously features ot inadequate. Competition, in the sense in which modern the word is still used in many economic works, is problems. jj^qj.qIj g, special Case of the struggle for survival, and, from its limitation, does not go far towards explaining the actual working of modern institutions. To buy in the cheapest market and sell in the dearest ; to secure cheap- ness by lowering the expenses of production ; to adopt the less expensive rather than the more expensive method of obtaining a given result — these and other maxims are as old as human society. Competition, in the Darwinian sense, is characteristic not only of modern industrial states, but of all living organisms ; and in the narrower sense of the " higgling of the market " is found on the Stock Exchange, in the markets of old country towns, in mediaeval fairs and Oriental bazaars. In modern countries it takes myriads of forms, from the sweating of parasitic trades to the organization of scientific research. Economic motives, again, are as varied as the forms of 'competition, and their development is coeval with that of human society. They have to be interpreted in every age in relation to the state of society, the other motives or ideals with which they are associated, the kind of action they inspire, and the means through which they operate. Apparently the same economic motives have led in the same age and in the same nation to monopoly and individual enterprise, protection and free trade, law and anarchy. In our own time they have inspired both the formation of trade combinations and attempts to break them up, hostility to all forms of state interference and a belief in collectivism.

The conditions which are peculiar to the modern world are the large numbers we have to deal with, the vast and fairly homogeneous areas in which justice is administered and property secured, and the enormously increased facilities for transport and communication. These condi- tions are of course not independent of each other, and they have brought in their train many consequences, some good and some bad. But they supply the bases for that general theory which, as we have seen, is indispensable in

economic investigation. From the standpoint of general theory economic movements assume an impersonal character, and economic forces operate like the forces of nature. Although economic motives have become more complex, they have just as much and no more to do with general economic reasoning and analysis than the causes of death with the normal expectation of life, or domestic ideals with the birth-rate. So far as we have anything to do with psychology at all, it is the psychology of crowds and not of individuals which we have to consider. If we study the economy of a village, the idiosyncrasies of every individual in it are of importance. If the village is replaced by a large area, inhabited by millions, with modern facilities of communication, it is a matter of observation and ex- perience that for the purposes of general reasoning the idiosyncrasies of individuals may be neglected. Whether such large numbers have the character of the " economic man " of the early economists matters very little. All the assumptions we require are furnished by observation of people in the mass and the larger generalizations of statistics. Thus we can construct a kind of envelope of theory, which, by careful testing as we proceed, can be made to indicate in a general manner the reactions of one part of the activities of the economic world upon the others, and the interdependence of the several parts. From its very nature this general theory can never corre-

spond strictly to the actual life and movement of any given state. It is useful and necessary, and plays somewhat the same part in economic investigation as ton-mile statistics do in the administration of a railway. To express in any language or to illustrate by any images, from a purely objective standpoint, the infinitely compli- cated movements of the actual world, is a task far beyond human capacity.

With the aid of this general theory the methods we have sketched in relation to historical problems apply with greater force to the special problems of modern times, and are rewarded with results more accurate, more fruitful, more relevant to difficulties which all civilized nations have to face, than those of historical research. To many minds the interest and usefulness of economics depend entirely on the application of these methods, for it is the actual working of economic institutions about which the statesman, the publicist, the business man, and the artisan wish to know. Under the conditions we have ^ ^^^ described, many of the most interesting problems

t/JJ ^' of our own time, when they are once defined, modern resolve themselves into statistical inquiries. "«''««'«• But in most cases such an inquiry cannot be successfully carried out by a mere statistician. Definite economic problems can very rarely be dealt with by merely quanti- tative methods. In the tabulation and interpretation of statistical evidence, as in its collection, it is scarcely possible to overrate the importance of wide knowledge and experience. There is another very important instrument of investigation which can be used in our own time, but cannot be employed in historical research. Historical documents, however detailed, rarely show all the factors we have to deal with or fully explain a given situation. Ifo sane person would suppose that the minutes of a modern legislative body explain the steps by which legislation has been passed, or the issues really involved. The ostensible cause of a modern labour dispute is fre- quently not the real or the most important cause. In modem problems we can watch the economic machine actually at work, cross-examine our witnesses, see that delicate interplay of passions and interests which can- not be set down or described in a document, and acquire a certain sense of touch in relation to the questions at issue which manuscripts and records cannot impart. We can therefore substitute sound diagnosis for guess-work more frequently in modern than in historical problems.*

*What then, it may be asked, becomes of the " old Political Economy " ? Of what possible use are the works of the so-called classical writers, except in relation to the history of Economies and the practical influence of theory in past times ? If we take the mere popular view of what is meant by the " old Political Economy," that is, that a generation or so ago economics was comprised in a neatly rounded set of general propositions, universally accepted, which could be set forth in a text-book J** " "" and learnt like the multiplication table, it is Economy." not incumbent on the present generation to define its attitude at all. In this sense of the words, there was no faith delivered to our fathers which we are under any obligation to guard or even explain. If by the " old Political Economy " we mean the methods and conclusions of certain great writers, who stood head and shoulders above their contemporaries and determined the general character of economic science, we are still under no obliga- tion to define the attitude of the present generation with regard to them. The fact that Adam Smith, with the meagre materials of the 18th century at his disposal, saw his way to*

important generalizations which later research has established on a firm basis, may enhance greatly the reputation of Adam Smith, but does not strengthen the

generalizations. They stand or fall by the strength of the evidence for or against them. In the history of economics or the biography of Ricardo it is of interest to show that he anticipated later writers, or that his analysis bears the test of modern criticisms ; but no economist is under any obligation to defend Ricardo's reputation, nor is the fact that a doctrine is included in his works to be taken as a demonstration of its truth. The appeal to authority cannot be permitted in economics any more than in chemistry, physics, or astronomy. But the cases stated above suggest more or less false issues. There has been no revolution in economic science, and is not likeiy to be any. The question we have really to determine is how we can make the best use of the accumulated know- ledge of past generations, and to do that we must look more closely into the economic science of the 19th century.

Any one who has taken the trouble to trace the history of one of the modern schools of economists, or of any branch of economic science, knows how difficult it is to say when it began. "Anticipations" of method and doctrine can generally be found by the diligent investigator in the economic literature of his own or a foreign country. So that cross-sections of the stream of economic thought will reveal the existence, at different times, in varying proportions and at different stages of development, of most of the modern " schools." Again, the classification of an economic bibliography at once shows i how varied has been the character of economic investigation, ranging from the most abstract speculation on the one hand to almost technical studies of particular trades on the other. Of the great army of writers who flourished in the first half of the 19th century some were closely indentified with the utilitarian school, and the majority were influenced in a greater or less degree by the prevailing ideas of that school. Others, however, were hostile to it. In many works, such as those of a statistical or historical character, there are frequently to be found passages which could have been written in no other period, but are only of the nature

~~of ejaculations and do not affect the argument. In stating the position of economics during this time we cannot ignore all writers, except those who belonged to one group, how- ever eminent that group may have been, simply because they did not represent the dominant ideas of the period, and exercised no immediate and direct influence on the inovement of economic thought. We must include the pioneers of the historical school, the economic historians, the socialists, the statisticians, and others whose contri- butions to economics are now appreciated, and without whose labours the science as we know it now would have been impossible. If we take this broadly historical view of the progress of economics, it is obvious that even in England there was no general agreement, during the 19th century, as to the methods most appropriate to economic investigation.~~

~~Suppose, now, we ignore the writers who were inaugurat- ing new methods, investigating special problems or labori- ously collecting facts, and concentrate attention on the dominant school, with its long series of writers from Adam Smith to John Stuart Mill. It is the work of these writers -Which people have in mind when they speak of the " old Political Economy. " There are several quite distinct questions we can ask with regard to them. That they must be studied closely by every one who wishes to follow the history of economics goes without saying. That they must be studied by the economic historian is equally clear, owing to their practical influence and the fact that they furnished the theorejical bases of much of the economic policy of the 19th century. This is true whether their , method is good or bad, whether their conclusions are true~~

~~or false. It is not so easy to determine their relevance and usefulness in relationto distinctively modern problems, or to indicate within what limits their work is of per- manent value, and we can only deal with these questions in their more general aspects.~~

~~It must be clear to every observer that the economists of the classical period, with the one- exception of Adam Smith, will speedily share the fate of nearly all scientific writers. They will be forgotten, and their books will not be read. Adam Smith's Wealth of Nations, if it has ever been, has long ceased to be a scientific text-book. Whether a modern economist accepts his views or not is of no importance. There is probably not a single chapter in~~

the Wealth of Nations which would be thoroughly endorsed by any living economist. But the reputation of the book and its author is quite independent of considerations of this kind. The Wealth of Nations is one of the great books of the world, many of the sayings of which are likely to be more frequently quoted in the future than they have been in the 19th century. Malthus is already an author whose name is probably more widely known than that of any other economist, but whose works are rarely read, and studied only by a small proportion of the few people who write books on the history of economic theory. Of economic students, many are unaware of the fact that he wrote any other book than the Essay on the Principle of Population, and what is of permanent importance in that work is contained in the generalization which it suggested to Darwin. Moreover, modem economists, while accepting in the main the general tenor of Malthus's theory of population, would not agree with his statement of it. Like Malthus, Ricardo owes his reputation very largely to the theory associated with his name, though it has long ceased to be stated precisely in the terms he employed. But there are very few people in the world who have made a careful study of his works ; and although his theory of rent has a wide and increasing application in economics, it is not comparable in general scientific importance with Malthus's theory of population. It is already impossible to take J. S. Mill's Principles of Political Economy as a text-book. Important as it was for thirty or forty years, it will soon be as little read as M'Culloch's Principles. Eor the rest of the economists of this period, it is difficult to see how they can escape oblivion. When the generation whose economic training was based upon Mill has died out, the relevance of the " old Political Economy " is not likely to be a question of any interest to ordinary educated men and women, or even to the great mass of economic students.

The explanation of this decay of interest does not lie upon the surface. It is frequently supposed that the influence of the " old Political Econoihy " has been gradu- ally undermined by the attacks of the historical school. But great as the achievements of this school have been, it has not developed any scientific machinery which can take the place of theory in economic investigation. If our view is correct that, broadly speaking, the two ways of regarding economic questions are complementary rather than mutually exclusive, there does not seem to be any reason why the growth of the

historical school should have been destructive of the " old Political Economy" if it had been well founded. The use of the historical method has, in fact, raised more reputations than it has destroyed, be- cause by keeping carefully in view the conditions in which economic works have been written, it has shown that many theories hastily condemned as unsound by A priori critics had much to be said for them at the time when they were propounded. This observation is true not only of old- world writers like the Mercantilists, but also of Ricardian economics. No one is concerned to prove that the Ricardian

economics applies to the manorial system, and it is generally supposed at any rate that the world has been approximating more and more nearly during the last century to the conditions assumed in most of the reasoning of that school. On the principles we have explained, therefore, the Eicardian economics should supply just that body of general theory which is required in the investigation of modern economic problems, and the reputation of at any rate the leading writers should be as great as ever. It would be of immense advantage from a scientific point of view if this could be taken for granted, if for a time the work of the classical economists could be considered final so far as it goes, and for the purposes of investigation regarded as the theoretical counterpart of the modern industrial sys- tem.' This assumption, however, has been made quite impossible, not by the historical school, but by the criti- cism and analysis of economists in the direct line of the Eicardian succession.

Modern economic criticism and analysis has destroyed the authority of the " old Political Economy " as a scien- tific system. The assumptions, the definitions, the reason- ing, the conclusions of the classical writers have been ruthlessly overhauled. Defects in their arguments have been exposed to view by those who are most concerned to defend their reputation. Writers with none of the pre- judices of the historical school, but with the cold and re- morseless regard for logic of the purely objective critic,have pointed out serious inconsistencies here, the omission of important factors there,until very little of the " oldPolitical Economy " is left unscathed. In fact, there

never was a scientific system at all. What was mistaken for it was fashioned in the heat of controversy by men whose interests were practical rather than scientific, who could not write correct English, and revealed in their reasoning the usual fallacies of the merely practical man. So the " old Political Economy " lies shattered. It is useless to suppose that this destructive criticism from within can be neutralized by generously sprinkling the pages of the classical writers with interpretation clauses. This may serve to show that the ideals of our youth were not without justification ; but the younger generation, which does not care about our ideals, and looks to the future rather than the past, will not read annotated editions of old books, however eminent their authors. If the Eicardian school of economists had been merely philosophers, or even a group like the French physiocrats, this state of things might be regarded with equanimity. We might assume that criticism and analysis had separated the wheat from the chaff in their writings, that everything of permanent value had probably been pre- served and incorporated in the works of later economists. But the character of much of their work makes this as- sumption impossible. It is, in fact, quite true that many of them were more interested in practical aims than in the advancement of economic science. We may u'mita-'^ talk of the assumptions implicitly involved in uoas. Eicardo's works. In reality we do not know

what those assumptions were ; we only know what assumptions we should make in order to reach the same conclusions, and they maybeverydiiIerentfrom"the mind of Eicardo." Eicardo's works, in fact, do not explain a theoretical system, but contain the matured reflexions, more or less closely reasoned, of a man of great mental power looking out on the world as it appeared to a business man experienced in affairs. The conclusions of such a work are of wider significance than the assumptions we attribute to the author would warrant. They are not expressed in terms which satisfy our canons of scientific accuracy. Dissected sentence by sentence, the book may be shown to be a mass of inconsistencies. If it has the misfortune to be systematized by an enthusiastic but dull and incompetent

disciple, it mayj appear even absurd. But after all the misinterpretation of contemporaries and the destructive criticism of later times, the book as a

*whole leaves upon us an impression of peculiar strength and charm, and imparts a sense of the relations of things truer, because less mechanical, than the laboui-ed reasoning of smaller men. Such is the character of much of the work of Eicardo and some of his contemporaries. We think that the decay of interest in these writers involves a real loss, and that students of modern problems may do worse than read Eicardo and his school. Some of the criticism of their works, necessary and useful as it has been, will probably be corrected later on by that breadth * of view and sense of proportion which has enabled us to appreciate justly the achievements of lesser men in more remote times. But rehabilitation in accordance with the canons of historical justice will not restore the lost influence of the Eicardian school. Their achievements in the 19th century will be fully acknow- ledged, but the relevance of their work to the problems of the 20th century will be admitted less than at the present time.*

*In a subject like economics it must always be very dif&cult to decide how far a departure from the traditional form and expression of its main doctrines is Economics necessary or desirable. No one who is really ex- a mnser- perienced in economic investigation cares to vaWve emphasize the originality, still less the revolu- **' *"'*■ tionary character of his own work. It is much more likely than not that some principle which for the moment seems new, some distinction which we may flatter our- selves has not been observed before, has been pointed out over and over again by previous writers, although, owing to special circumstances, it may not have received the notice it deserved. Economics is therefore, on the whole, an intensely conservative science, in which new truths are cautiously admitted or incorporated merely as extensions or qualifications of those enunciated by previous writers. This procedure has its advantages, but it may easily be- come dangerous by destroying the influence of the science it is meant to preserve. It is not unlike the procedure of the canonists and casuists of the Middle Ages with regard to the doctrine of usury, by which the doctrine was to all appearances preserved intact while in reality it was stripped of all its original meaning by innumerable dis- tinctions " over-curious and precise." In the same way the doctrines of the classical economists may be adapted by interpretation clauses and qualifications the exact force of which cannot be tested or explained, so that we do not know whether the original proposition is to be considered substantially correct or not. The*

result will be that while the doctrines are apparently being brought into closer correspondence with the facts of life, they will in reality be made quite useless for practical purposes or economic investigation. It is easier to point out the danger than to suggest how it should be met. The position we have described is no doubt partly due to the unsettlement of economic opinion and the hostile criticism of old-estab- lished doctrines which has characterized the last genera- tion. Or it may be the residt of economic agnosticism, combined with unwillingness to cut adrift from old moor- ings. Whatever the cause, the complete restatement of economic theory, which some heroic persons demand, is clearly impossible, except on conditions not likely to be realized in the immediate future. The span of life is limited; the work requires an extensive knowledge of the economic literature of several countries and the general features of all the important departments of modern economic activity. In general theory special studies by other men cannot play the same part as they do in historical and statistical work. In historical and statis-

economic theory.

tical investigation, or in special studies of particular sub- jects, it is possible, given the pecuniary means, to organize a whole army of skilled assistants, and with ordinary care to combine the results of their separate efforts. In general theory the inverse rule seems to prevail. There the unity of conception and aim, the firm grip of all the different lines of argument and their relation to each other, which are required, can only be given by a single brain. But no one individual can do original work over the whole field. He is lucky if he can throw new light on a few old propositions. For the rest, he can only, with the utmost caution, adopt the suggestions of other minds as qualifications of old doctrines, never feeling quite sure that he is right in doing so. A complete restatement could only be undertaken by a group of men, trained in much the same conditions, accustomed to think and work together, each one engaged on a special department, but all acting under the control of one master-mind. This is largely a question of the organization of economic studies, and it is of the greatest importance

~~that, if possible, such an effort should be made to present in a connected form the best results of modern criticism and analysis.~~

~~Economics is unlike many other sciences in the fact that its claim to recognition must be based upon its prac- tical utility, on its relevance to the actual life n^at ^^ *^® economic world, on its ability to unravel develop- the social and economic difficulties of each gen- mentsot eration, and to contribute to the progress of nations. The very effectiveness of modern criticism and analysis, which has brought great gains in almost all branches of economic theory, has made the science more difficult as a subject of ordinary study. The extensions, the changes or the qualifications, of old doctrines, which at any rate in the works of re- sponsible writers are rarely made without good if not always sufficient reason, have modified very considerably the whole science, and weakened the confidence of ordi- nary educated men in its conclusions. In the case of many subjects this would matter very little, but in that of economics, which touches the ordinary life of the community at so many points, it is of great importance, especially at a time like the present, when economic questions determine the policy of great nations. The " economic man " of the earlier writers, with his aversion from labour and his desire of the present enjoyment of costly indulgences, has been abandoned by their succes- sors, with the result that in the opinion of many good people altruistic sentiment may be allowed to run wild over the whole domain of economics. The "economic man " has, on the other hand, been succeeded by another creation almost as monstrous, if his lineaments are to be supposed to be those of the ordinary individual — a man, that is, who regulates his life in accordance with Gossen's Law of Satiety, and whose main passion is to discover a money measure of his motives. It is ex- tremely important to consider how far the economic con- ceptions based upon this view of the action of men in the ordinary business of life — such, for example, as the doctrine of marginal utility — depend for their truth and relevance on the fact that in ecpnomics we are dealing with large aggregates. The earlier writers generally as- sumed perfect mobility of labour and capital. Ko econo- mist would deliberately make that assumption now unless he were dealing with some purely theoretical problem, for the solution of which it was legitimate at some stage in the reasoning. Many of the questions of the greatest practical importance at the present time, such as the competition between old and~~

~~new methods of manufacturing commodities substantially the same in kind and equally useful to the great body of consumers, arise largely from the immobility of capital or labour.~~

~~or both of them. But it is obvious that if the assump- tion of perfect mobility is invalid, there is scarcely any economic doctriuB identified with the earlier writers which may not require modification, in what degree it is impossible to say without very careful investigation. Much suggestive work on this subjept of a general char- acter is incorporated in recent economic books, but there is room for a whole series of careful monographs on a question of such fundamental importance. The same may be said of another subject, too frequently neglected by earlier writers, to which due significance has been given in the best recent work, namely, time in relation to value. It would perhaps be too much to say that the full consideration of this point has revolutionized the theory of value, but it has certainly created what seems almost a new science in close contact with the actual life of the modern world.~~

~~Some doctrines of the earlier economists, such as the Wages Fund Theory, have practically been abandoned in recent times, though it may be said that they contained a certain amount of truth. Others, which were con- sidered of fundamental importance, owe their position in modern economics and the form in which they are stated to the " tradition of the elders." If they could, by some happy chance, have been left for discovery by modern economists, they would without doubt have received different treatment, to the great advantage of economic science. Such a doctrine is the so-called Law of Dimin- ishing Returns, which MUl considered " the most impor- tant proposition in Political Economy." "Unless this one matter," he says, " be thoroughly understood, it is to no purpose proceeding any further in our inquiry." " Were the law different, nearly all the phenomena of the production and distribution of wealth would be other than they are." On the other hand, Thorold Rogers, not to speak of earlier objectors, described the law as a " dismal and absurd theorem." The opinions of recent economists appear to fluctuate between these two ex- tremes. The law may apparently be " a general rule " or " a tendency " which is liable to be " checked," or a particular case of the law of the conservation of energy. If we go to Mill to discover what it is, we find that " it is not pretended that the law of~~

diminishing return was operative from the beginning of society ; and though some political economists may have believed it to come into operation earlier than it does, it begins quite early enough to support the conclusions they founded on it." "It comes into operation at a certain and not very advanced stage in the progress of agriculture." But this very im- portant stage in the history of a nation is not defined or clearly illustrated. We are told that we can see "the law at work underneath the more superficial agencies on which attention fixes itself" ; it " undergoes temporary suspension," which may last indefinitely ; and " there is another agency, in habitual antagonism " to it, namely, " the progress of civilization," which may include every kind of human improvement. Mill apparently is not content with the confusion between "law" and "agency" or " force," but opposes the one to the other. He is con- stantly speaking in terms which imply the conquering of one law by another, a habit from which his successors have not freed themselves ; and the theory of nati;ral processes which appears to have satisfied him, was that when two forces come into operation there is a partial or complete suspension of one by the other. In modern economics " fertility " has no very definite meaning. It may mean what is ordinarily understood by the word — climate, rainfall, raUway rates, or anything else except "indestructible powers of the soil." To speak of "addi- tional labour and capital " without reference to the kind and quality of the labour and capital, and the manner in

which they are employed, organized, and directed, throws very little light on agriculture. Every improvement involves, from a quantitative point of view, more or less of capital or of labour, so that it is the "antagonizing" influences, which are nearly all qualitative, which appear to be really important. It is therefore extraordinarily difBcult at present to know what happens, or rather what would happen if it were not prevented, when a country reaches " the stage of diminishing returns " ; what pre- cisely it is which comes into operation, for obviously the diminishing returns are the results, not the cause ; or how commodities " obey " a law which is always " suspended." Possibly the next few years of English industrial history will

furnish many illustrations of the law of diminishing returns. We can only say that it requires investigation and restatement.

Closely related to the law of diminishing returns is the Theory of Kent. No economic doctrine so well illus- trates the achievements and the defects of modern eco- nomic analysis. Eicardo's statement of the theory left upon the world an impression, not wholly just, of singu- lar clearness. He employed the theory with wonderful success in unravelling the problems of his time. Its importance has not been seriously, or at any rate successfully, called in question. Treated at first as a doctrine peculiarly applicable to land, with a certain controverted relevance to other natural agents, it has been so extended that there is scarcely any subject of economic study in which we may not expect to find adaptations or analogies, so that Eicardo seemed to have discovered the key of economic knowledge. But it was discovered that there were no " indestructible powers of the soil " ; that the fertility of land in a country like England is almost entirely the result of improvement at some time or other ; that " advantage of situation " in- cludes very much more than the words in their literal sense imply; that both "fertility" and "advantage of situation " include many kinds of differential advantage ; that in some circumstances rent does not enter into 4he price of agricultural and other produce, and that in others it does. Moreover, the study of the theory of rent has had a very great influence on all branches of economics, by destroying the notion that it is possible to draw sharp lines of distinction or deal with economic conceptions as though they were entirely independent categories. That modern economic analysis is incomparably more ac- curate than that of earlier times there can be no ques- tion. But the net result of the development of the doctrine of rent is that all problems in which this factor appears, and they embrace the whole range of economic theory, must apparently be treated on their merits. In its modern form the doctrine is far too general to be serviceable without the closest scrutiny of all the facts relating to the particular case to which it is applied. To deal adequately with the numerous exten- sions or qualifications of these and other doctrines in the hands of modern economists would involve us in an at- tempt to do what we have already said is impossible ex- cept on conditions not at present realized. It is clear that in the interests of general economic theory we require a vast number of special studies before an adequate re- statement can be undertaken.

~~It must be clearly recognized that the functions of economic science in the present requirements of the world cannot possibly be discharged by treatises on eco- nomic theory. The relations between general theory and special studies conducted on the lines we have indicated have completely changed in the last thirty years. Gen- eral theory never has been, and in the nature of things never can be, the actual reflex of the life and movement of the economic world. It never has been, and never can~~

~~be, more than an indication of the kind of thing which might be expected in a purely hypothetical world. When the aim of the man of affairs and the hypothesis of the economist was unrestricted competition, and measures were being adopted to realize it, **^^^* general theory such as the classical economists general provided was perhaps a sufficiently trustworthy economics guide for practical statesmen and men of busi- %^/,^"" ness. If only people can be got to believe in them, a few abstract principles are quite enough to destroy an institution which it has taken centuries to create. But a new institution cannot be made on the same terms. The modern industrial system has brought with it an immense variety of practical problems which nations must solve on pain of industrial and commercial ruin. For these problems we want, nbt a few old-estab- lished general principles which no one seriously calls in question, but genuine constructive and organizing ca- pacity, aided by scientific and detailed knowledge of par- ticular institutions, industries, and classes. Just as the historical school grew up along with the greatest con- structive achievement of the 19th century, namely, the consolidation of Germany, so the application to modern problems of the methods of that school has been called forth by the constructive needs of the present generation. We have already shown how these methods, in their turn,- reqiure the aid of general theory, but not of a general theory which tries to do their work. In fact, every at- tempt to make it do so must inevitably fail. How can such a huge mass of general propositions as are neces- sarily included in a system of economics ever be thor- oughly tested by an appeal to facts ? If they are not so tested, the general theory will remain a general theory, of no practical use in itself, until the end of time. If they are to be tested, an indefinitely large number of special studies must be made, for which the original materials must be collected and examined. That is, original inves- tigation of special problems has to be carried out on a more gigantic scale than any~~

*economist of the historical school ever dreamt of or the world requires, with the cer- tain knowledge that at the end of it all the general theory will not correspond with the facts of life. Eor there is all the difference in the world between using a body of general theory as an indication of the factors to be considered in the study of a special problem, and undertaking special studies with a view to testing the general theory. If the necessary limitations of general economic theory are recognized, most of the dif&culties we have noticed disappear. Now that the "industrial revolution " has extended practically all over the world, So that we have several countries carrying on production by modern methods, it is easily possible to sketch the main features of industrial and commercial organization at the present time, to describe the banking and currency systems of the principal nations, their means of trans- port and communication, their systems of commercial law and finance, and their commercial policy. It is true that at present very little work of this kind has been done in England, but innumerable books, many of them about England, have been written by thoroughly compe- tent economists, in Erench, German, and other languages. So that no great amount of original work is required for a reliable account of those general features of the modern system which should form the introduction to economics. The general theory which we require should be sketched in firm and clear outline, leaving the detailed qualifica- tions of broad principles to special studies, where they can be dealt with if it is necessary or desirable, and ex- amined by statistical and other tests. For such a general theory there is ample material in the economic literature of all civilized countries. It is of the utmost import**

ance that the economic terms, which are also, though in many cases with an entirely different meaning, the terms of business and commerce, should as far as possible be used in their common and ordinary English sense : that they should correspond in meaning with the same words when used in description, in law, accountancy, and or- dinary business. This is no doubt a difficult matter. But some change in this direction is necessary both in the interests of the science itself and of its practical utility. All the materials for

iuYestigation, all the facts and figures from which illustrations are drawn, all methods of keeping accounts in England, assume the ordinary English tongue. There are few if any con- ceptions in economics which cannot be expressed in it without depleting the ordinary vocabulary. At present the language of economics is for the ordinary English- man like a foreign language of exceptional difBculty, because he is constantly meeting with words which sug- gest to his mind a whole world of associations quite dif- ferent from those with which economic theory has clothed them. The refinements of economic analysis, as distin- guished from its broader achievements, should be reserved for special studies, in which a technical scientific termi- nology, specially devised, can be used without danger of misconception. But in a subject like economics obscu- rity and an awkward termiaology are not mark^ of scientific merit.

Economic studies should be as relevant to existing needs as those of engineering and other applied sciences. The scientific study of practical problems and difficulties is far more' advanced in almost every civilized country than it is in England, where the limited scale upon which such work is carried on, the indifference of statesmen, officials, and business men, and the incapacity of the public to understand the close relation between scientific study and practical success, contrast very unfavourably with the state of affairs in Germany or the United States. The backwardness of economic science is an index of the danger which threatens the industrial and commercial supremacy of the United Kingdom. There are at the present time very few questions of public or commercial importance upon which the best and most recent investigations are to be found amongst English works. This would matter very little, perhaps, if Englishmen had a firm belief, estab- lished by actual experience, in the soundness of their policy, the present security of their position, and the sufficiency of their methods to strengthen or maintain it. But this is very far from being the case. If we take, for example, the corner-stone of the British commercial system, namely, the policy of free trade, the present generation does not read the economic works which supplied the theoretical basis of that policy, and problems if it did, would not be convinced by them. The /n Great generation which knew Cobden and Bright is Britain. rapidly dying out. The great men of their period are merely historical figures, not so real to the present generation as the younger Pitt was to their grand- fathers. Long before his death, Bright's

references in public speeches to the achievements of the Anti-Corn Law League were received with respectful impatience, and Peel's famous speech on the repeal of the Corn Laws would not convince the German Reichstag or a modern House of Commons. The result is that free trade has ceased to be an article of faith, or even in any real sense a doctrine of expediency. It is rather an old habit for jvhich the ordinary English manufacturer could give no very reasonable explanation, which is not likely to be given up as long as the generation now over fifty years of age has the predominant influence in commerce and public affairs, but for which a younger generation will care no more than their grandfathers did for the mercantile

system, unless it can win their adhesion as a policy well designed to realize the aims they will have in view. Hence free trade is in serious jeopardy unless it can be restated in terms which have a direct relevance to the present position of England and present conditions of international trade. If the Imperialist tendencies of the present time continue, as no doubt they will, this ques- tion will become one of burning interest. No great scheme of national or Imperial consolidation has ever been carried through without raising and solving ques- tions of commercial policy; and although there is no reason why the consolidation of the British Empire should involve the destruction of the established commer- cial system of the United Kingdom, and every historical and scientific reason for safeguarding the inheritance of the past, we may see a revival of old fallacies in a new form. It should be the work of economic science ruth- lessly to analyse the existing situation, explain the issues involved in the commercial policy of different countries, and point out the alternative methods of dealing with present difficulties, with their probable results.

The commercial policy of a state is merely the reflex of its system of public finance. The absence of conviction in regard to British commercial policy has its counterpart in the attitude of many men to the financial system of the country. It is not often that the eulogies showered upon it in the past are repeated at the present time. The difficulty appears to be caused partly by the great increase in military and naval expenditure, which has been made necessary by the exceptional demands of a state of war and the great development of foreign Powers, partly by the great extension of the

functions of the State duijing the latter part of the 19th century. The former causes are partly permanent, partly temporary ; but those of a permanent character are likely to increase in force, and those of a temporary character will leave a deposit in the shape of an addition to the normal expenditure of the central Government. The extension of Government func- tions is much more likely to continue than to be checked. Normal expenditure is therefore Commerce almost certain to rise. It is almost inconceiv- ""nance. able that it will fall. Meanwhile, in spite of the vast increase in national wealth, it is a matter of in- creasing difficulty to meet a comparatively slight strain without recourse to measures of a highly controversial character ; and it is certain that no important new source of revenue can be suggested which will not raise, in an acute form, questions of commercial policy and the rela- tions between the United Kingdom and the Colonies. Here there is room for a whole series of iijiportant mono- graphs. There is no civilized country in which ques- tions of public finance, ui a concrete form, have received so little attention as in England.

The development of the powers of the central Govern- ment has been less than that of the functions of local governing authorities. This, again, is a movement much more likely to extend than to be checked. Local governing authorities now discharge economic functions of enormous importance and complexity, involving sums of money larger than sufficed to run important states a generation ago. At present we do not know precisely what happens. The scientific study of the economics of local administration is in its infancy. It is of the utmost importance that it should be taken up in^earnest by economists. These questions of commercial policy and local government are closely bound up with the scientific study of the transport system. On this important subject there is at present not a single treatise of first-rate import- ance by an English writer, and there is only one English railway company which records in a suitable form the

data necessary not only for scientific study but for ef&cient administration. So that, although the British Empire contains within itself every known species of railway enterprise, the study of railways and other means of

transport, and their relation to the business, the com- merce, and the social life of the country, is deplorably backward. It is obvious that no inquiry into com- mercial policy, or into such social questions as the housing of the poor, can be effective unless this deficiency is remedied.

The whole social and political fabric of the British Empire depends upon the eflciency of its industrial system. On this subject many monographs and larger works have been published in recent years, but dealing rather with such questions as trade unionism, co-opera- tion, and factory legislation, than the structure and organization of particular industries, or the causes and the results of the formation of the great combinations, peculiarly characteristic of the United States, but not wanting in England, which are amongst the most striking economic phenomena of modern times.

These are some of the questions which might with advantage absorb the energies of the rising generation of economists. It would be possible to add to their number almost indefinitely, but these press for immediate atten- tion. The claim of economics for recognition' as a science and as a subject of study must be based on its relevance to the actual life of the economic world, on its ability to unravel the practical difficulties of each generation, and so contribute to the progress of nations.

~~*It is impossible to give even a select bibliography which is at all adequate of the publications of recent years on Economics. The most important general work published in English is Marshall's Principles of Economics, vol. i., 1st edition, 1890; 4th edition, 1898. J. Shield Nicholson's Principles of Political Economy, 3 vols., which is now completed, not only gives a survey of economic principles since Mill's time, but contains much suggestive and original work. The writer of this article is much indebted to the works of SchmoUer, particularly his Grundriss der Allgemeinen Volksmrtschaftslehre (1900), and Adolph Wagner, particularly his Orundlegung der Politischen Oekonomie. On the history of eco- nomic theory, Canaan's Sistory of the Theories of Production and Distribution (1776-1848) is an admirable criticism, from a purely objective standpoint, of the works of the English classical writers. The most important English works published in recent years on general English economic history are Cunningham's Growth of Industry and Commerce and Ashley's Economic History, while VinogradoH's Villenage in England and Maitland's Domesday Studies are of great importance to the student of early economic institutions. D'Avenel's Mistoire Sconomique de la Propriety, &c. (1200-1800), is a monumental work on the history of prices in France. Some recent books dealing with special subjects are likely to take a very high place in economic literature. We may mention particularly Charles Booth's Labour and Life of London and Sidney and Beatrice Webb's History of Trade Unionism and In- dustrial Democracy. These books are generally regarded as typical of the best English work of recent years in economic investigation. We may also mention Schloss's Methods of Industrial Remunera- tion, a most important contribution to the study of the wages question ; C. E. Bastable's works on International Trade and Public Finance; George Clare on the Money Market and the Foreign Exchanges ; and A. T. Hadley's Economics: An account of the relations between private property and public welfare (1896). Studies of particular questions, both concrete and theo- retical, in foreign languages are too numerous to specify, and much of the best modem work is to be found in economic periodicals.*~~

~~*(w. A. s. H.)*~~

Ecuador, a country of South America extending between Colombia and Peru from 1° 56' N. lat. to about 6° 30' S. lat., and from the Pacific coast to a distance inland not yet determined. The boundary dispute be- tween Colombia, Ecuador, and Peru was, by agreement of 15th December 1894, submitted to the arbitration of the Spanish Crown, but no award had been made up to the beginning of 1902, nor had any definite steps been

taken to execute a survey of the frontier. The climate is on the whole healthy, especially in the inter-CordUleran valley. Intermittent fevers, frequent in the coast region, are unknown in the highlands, where also pulmonary diseases are rare. The average rainfall at Quito is about 39 inches. The death-rate at Quito in 1892 was stated to be 36 per 1000.

Population. — The area has never been ascertained by survey, but is estimated at 118,630 square miles, an estimate which includes a vast territory still in dispute. No census has ever been taken, and the generally ac- cepted estimate of the population is that of Cefvallos, who for 1889 put the total number of inhabitants at 1,272,160. The following table shows the population of the fifteen provinces, the territory of Oriente, and the Galapagos Islands, which in 1885 were made dependent on the province of Guayas : —

Population,

1889.

Population,

1889.

Carchi

Imbabura .

Pinchincha

Leon

Tunguragua

~~Chimborazo~~

~~Cafiar~~

~~Azuay~~

~~Loja~~

~~Bolivar~~

~~36,000~~

~~67,940~~

~~205,000~~

~~109,600~~

~~103,033~~

~~122,. 300~~

~~64,014~~

~~132,400~~

~~66,456~~

~~43,000~~

~~Rios .~~

~~Oro .~~

~~Guayas~~

~~Manabi~~

~~Esmeraldas~~

~~Oriente~~

~~Galapagos Islands~~

~~Total .~~

~~32,800 32,600 98,042 64,123 14,553 80,000 300~~

~~1,272,161~~

~~The population contains approximately 120,000 whites, 450,000 of mixed races, and 702,000 Indians. The isolated position of the inland towns has helped their white in- habitants to preserve the characteristics of the original Spanish settlers. The offspring of the intermixture of whites and Indians are called, in the language of the country, mestizos, and the offspring of mestizos and Indians, cholos. The crossing of white and negro, and of negro or mulatto and Indian, produces the classes named respectively mulattos, zambos, and zambaigos. The colour among these people confers superiority in rank, or at least in self-esteem. The half-breeds, whether those between Spaniards and Indians or Indians and negroes, are indo- lent and unintelligent. The Indians as a rule are sturdily built and have great power of endurance, travelling im- mense distances over mountainous country without undue fatigue. They are extremely docile, except when excited by drink. A few of the tribes near the seaboard in the province of Esmeraldas have a large admixture of negro blood from slaves formerly employed in that district. The foreigners resident in Ecuador number altogether about 6000, some 5000 being natives of South or Central America, 700 Europeans, and 300 Chinese. The popu- lation of Quito is estimated at 65,000 ; of Guayaquil at 45,000; of Cuenca at 25,000; of Riobamba, 12,000; and of Ambato, Loja, and Latacunga about 10,000 each. A fire destroyed half the city of Guayaquil in~~

~~1897.~~

~~Constitution. — The Constitution in force is that of 1884, with modifications introduced in 1887 and 1897. The legislative authority is vested in a Congress of two chambers, the Senate consisting of 30 members (2 for each province), and the Chamber of Deputies with 41 members (1 for every~~

35,000 inhabitants, and 1 more if there are still 15,000 unrepresented) . Senators are elected for four years, and Deputies for two, directly by popular vote, every male citizen who can read and write being an elector. Congress meets every second year at Quito on 10th June for a session of 60 days. The executive authority resides in the

statistics]

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President of the Eepublic, elected for four years by direct vote- of the people, and not re-eligible till the two follow- ing presidential terms have elapsed. The Vice-President is elected' two years after the President, and is therefore a member of two distinct administrations. He succeeds for the remainder of the term in case of the decease or disability of the President, and is, moreover. President of the Council of State. The President is assisted by 4 Secretaries of State, heads of departments, appointed by himself, and by a Council of State consisting of the Vice- President of the Eepublic, the 4 Secretaries, the Fiscal Minister, 2 Senators, 1 Deputy, 3 private citizens, and an ecclesiastical functionary, the last five members being chosen by Congress. This Council must be consulted by the President on every important measure or appoint- ment. The President has the power of veto over meas- ures passed by Congress ; but if these measures are again voted, he has no other alternative than to accept them. The President cannot dissolve Congress or shorten their sittings within the two months established by law, but he can call an extraordinary session for a specified pur- pose. By a decree issued in 1896 the Indian population is exempted from payment of tribute and admitted to rights of citizenship. The provinces are administered by governors, nominated by the supreme Government; the departments by jefes politicos, or political chiefs; and, the municipalities by tenientes politicos, or political lieutenants. The Galapagos Islands are under a jefe ter- ritorial, or territorial chief.

The subdivisions of the provinces, the cantons, and the parishes are administered by subordinate officials, all of whom are appointed by the President.

~~Justice. — The judicial power rests with a Supreme Court, com- posed of six judges and a fiscal judge nominated hy the executive; a Tribunal de Ouentas of four members ; six superior courts ; tribunals of the second and third instance for commercial cases ; and courts of consular judges at Quito, Biobamba, Cuenca, Guaya- quil, and Monte Cristi ; magistrates are appointed in each provincial capital ; municipal alcaldes at the headquarters of each depart- ment; civil magistrates in all parishes. Tribunales de Jurados exist in Ibarra, Quito, Loja, Latacunga, Ambato, Riobamba, Cuenca, and Guayaquil for the trial of such criminal cases as the law brings within their jurisdiction. The judges of the Supreme Court, the six superior courts, and the members of the Tribunal de Ouentas are elected by Congress for a term of six years. The laws of Ecuador are founded on Spanish law, and are all written and codified. There is a civil code, a code of civil procedure, a com- mercial code, a penal code, and a code of procedure in criminal cases. Constant complaints are heard of the inefBciency and dilatory method of procedure in the courts of Ecuador, and appar- ently with much justification.~~

~~Beligion. — According to the Constitution, "the religion of the Republic is the Roman Catholic Apostolic, and all others are excluded," but as a matter of fact official toleration exists for all forms of religion. In 1889 the tithes from which Church revenues had been collected were abolished, and instead a tax of 3 per 1000 on real estate was imposed.~~

~~Education. — Primary education is free and nominally compulsory. No great effort is, however, made by the authorities to compel the attendance of children. Under President Plores, from 1888 to 1892, much attention was paid to the question of public instruction, and many new establishments were opened. The number of primary schools is 1088, and in these 1498 teachers are employed. The number of pupils on the rolls in 1898 was 68,380. The National Government supports 778 schools, 452 for boys and 326 for girls, the remainder being maintained by the municipalities or from pri- vate sources. There are 35 schools for secondary and 9 national colleges for higher education. Colleges for the higher education of women are established at Quito, Guayaquil, Cuenca, Loja, and Latacunga, under the supervision of religious orders. In Quito is a central university with 32 professors and attended by 216 students in 1897. There are also university~~

corporations at Guayaquil and Cuenca. The faculties include philosophy and literature, juris- prudence, medicine and pharmacy, and science. Theology is taught in seminaries for the education of the priesthood, three of these institutions being situated at Quito, and one in each diocese of the Eepublic. Comm^cial and technical schools have also been established at Guayaquil and Quito. There is a national library at

Quito, containing 13,000 volumes, amongst them many old and rare books and manuscripts. The National Government devotes about 600,000 sucres annually to educational purposes.

Defence. — The army consists of 221 officers and 3120 non-com- missioned officers and men. The National Guard nominally contains a total strength of 95,329 men. The navy consists of 1 transport, 1 small gunboat, and 1 torpedo launch, these vessels mounting in the aggregate 9 guns. The ships are manned by 114 sailors.

Finance. — Of the re-senue, about 70 per cent, is derived from import duties, 8 per cent, from export duties, 15 per cent, from taxes on cocoa, real estate, rum, and tobacco, 6 per cent, from the salt and gunpowder monopolies, and the remainder from excise, state property, and the post , office. The chief spending depart- ments are those of Public Works, Einance, War, and Education. From 19th June 1895 to 31st July 1896 the ordinary revenue (the Sucre being taken at 24d.) amounted to £512,860, and the extra- ordinary receipts (mostly loans from banks) to £373,070 ; while the total expenditure amounted to £877,950. For 1897 the re- venue was stated to amount to £676,055, and the expenditure to £569,020. For 1900 the revenue was estimated at £826,810 and the expenditure at £896,780. The external debt originally con- sisted of liabilities taken over by the Republic on its secession from Colombia. In 1865 the debt was fixed at £1,824,000, and arrangements were made for the payment of interest. In 1868 default was made. In 1892 the debt was converted into a New Consolidated Debt of £750,000, but in 1894 payment of interest was suspended. In 1895 a new arrangement was made which was suspended in 1896. In 1897-1900 various contracts were signed whereby the Guayaquil and Quito Railway Company was to pur- chase the bonds of the existing debt, the Government guaranteeing the suin of £2,520,000 mortgage bonds

~~of the company, and recog- nizing the external debt at 35 per cent, of its face value. The internal debt is stated to be about 10,000,000 sucres ; its service is attended to irregularly.~~

~~Industry. — Industrial development has not made any marked progress, owing largely to the absence of transport facilities throughout the interior. Cocoa is the most important product, and is cultivated on the lower lands, especially in the neighbour- hood of the Guayaquil river. In 1895 the receipts of this article at Guayaquil amounted to 16,122 tons ; in 1896 to 15,327 tons ; in 1897 to 14,800 tons ; in 1898 to 19,000 tons ; and in 1899 to 23,200. Though the cultivation of coffee has been considerably extended, low prices have greatly discouraged the planters. In 1897 the amount exported was 1201 tons; and in 1898, 1692 tons. Sugar is grovm and manufactured principally for local consumption. The total export of sugar in 1898 was less than 2500 tons. The collection of indiar rubber from the forests of the interior has increased, the amount shipped abroad in 1898 being 429 tons, as compared with 271 tons in 1897. In the province of Tunguragua some 200 acres are under vines, from which a small quantity of wine is made, but the bulk of the grapes are sold fresh. Tobacco is also produced on a small scale for home use, the centre of this industry being in the province of Esmeraldas. Pastoral industry is confined to breeding cattle to meet the home demand for meat. The export of hides was valued at £27,060 in 1898. Ivory nuts were shipped to the value of £23,080 in 1898. Mining industry is practically confined to the work of gold quartz crushing at 2aruma, in the province of Loja, and to extraction in Esmeraldas from gravel beds by hydraidio process by American companies. Gold washing in the beds of rivers and streams is practised by the Indians. Petroleum exists in different localities, but no serious attempt has been made to work this natural product, nor has any development in mining for copper, iron, lead, or coal taken place, although large deposits of these minerals are stated to be found. Silver is found in consider- able quantities in the province of Cuenca, and quicksilver in that of Loja. Manufacturing industry is represented by factories for soap, chocolate, biscuits, and vermicelli and macaroni ; 4 sawmills ; some small woollen and cotton mills ; and a brewery and ice factory at Guayaquil. The making of straw hats, known as "Panama," is a national industry, the value exported in 1898 being £8900.~~

~~*Commerce. — The foreign trade passes almost exclusively through the port of Guayaquil. The value of the imports and exports for 1890, and for the years from 1894 to 1900, is returned as follows : —*~~

~~*Tears.*~~

~~*Imports.*~~

~~*Exports.*~~

~~*Tears.*~~

~~*Imports.*~~

~~*Exports.*~~

~~*1890 1894 1895 1896*~~

~~*1,001,635*~~

~~*1,200,000*~~

~~*852,000*~~

~~*870,000*~~

~~*£*~~

~~*976,164*~~

~~*1,393,375*~~

~~*1,156,274*~~

~~*1,088,920*~~

~~*1897 1898 18991 1900*~~

~~*£’*~~

930,000 910,000

1,341,688

£

1,217,630 1,257,930 2,142,025 1,541,922

1 The statistics of Imports for 1899 were in great part destroyed by the fire at Gaayaquil on 27th November 1899.

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The imports consist mainly of cotton and woollen fabrics, pro- visions, flour, hardware, wines and spirits, and other articles of consumption or common use. The staple article of export is cocoa, of which there were shipped abroad in 1895, 32,516,000 lb ; in 1896, 33,909,000 lb ; in 1897, 33,123,000 lb ; in 1898, 35,036,000 R) ; inl899, 47,704,550 lb. Of the shipments in 1899, 22,186,190 lb went to France ; 5,535,310 lb to Spain ; 9,781,720 lb to Germany ; 5,493,100 lb to Great Britain ; 3,473,220 lb to the United States ; 1,235,010 lb to other countries. The exports will probably increase, since millions of new plants are planted every year. Other articles of export have been already mentioned. Of the imports, about 33 per cent, in value are from Great Britain, 15 per cent, from Germany, 15 per cent, from the United States, and 14 per cent, from France. The imports from Ecuador into the United Kingdom in 1899 (according to British statistics) amounted to £175,500, of vyhich £154,960 was for cocoa ; vrhile the exports to Ecuador from the United Kingdom amounted to £403,425, of which £253,640 was for cotton goods. According to American statistics, the Ecuadorian imports into the United States in the year 1899-1900 amounted to the value of $1,524,375 (£304,875), and the United States exports to Ecuador to the value of $1,216,005 (£243,201).

Shipping. — Guayaquil, the principal port, is In regular com- munication not only with other Pacific ports, but with New York, Liverpool, and Hamburg. The coasting trade is carried on by small vessels under the Ecuadorian flag. Of vessels in the foreign trade in 1898, 206 of an aggregate tonnage of 298,805 entered and 200 of 290,855 tons cleared at the port of Guayaquil. Of those that entered, 110 of 162,280 tons were British. At the same port there entered also 3600 vessels of 34,989 tons engaged in the coasting trade.

Communications. — Roads are nothing better than mule tracks, over which wheeled vehicles cannot pass. The highway of 115 miles between Guayaquil and Quito is constantly in need of repair, bridges and culverts being frequently vrashed avray. The naviga- tion of the rivers Guayas, Daule, and Vinces is carried on by a fleet of 17 steamers, and by small craft and canoes. The only railway is that — with a gauge of 36 inches — from Duran, near Guaya- quil, to Chimbo, a distance of 58 miles. A concession has been granted to an American syndicate to take over the line and pro- long it to Quito. The total length of telegraph lines open to public service in 1898 was 1242 miles, with 60 offices. The principal cities are connected with Quito, and that city vyith Guayaquil. From Guayaquil there is cable connexion with the rest of the world. The telephone is in use in Guayaquil and the vicinity. The inland postal correspondence is stated to comprise about 850,000 letters annually, and the foreign correspondence about 1,809,000 letters and 6,347,000 newspapers and parcels.

Money, Weights, and Measures. — The monetary unit is the silver Sucre of 100 cents, weighing 25 grammes, and "900 fine. The Sucre derives its name from President Sucrfi, a prominent figure in the War of Independence with Spain. Other silver coins are 50-, 20-, 10-, and 5-cent pieces. There are nickel coins of 5-, 1-, and J-cent pieces, and bronze coins of 2 cents and 1 cent. By an agreement between the banks and the commercial community a rate of exchange equal to 10 sucres to £1 was sustained during 1898, and stUl continues, vrith slight variations. Congress has recently provided for the coinage of gold pieces of the same weight and fineness as the British sovereign ; these will be known as condores, each condor being equal in value to 10 sucres. The British sovereign is also declared by this measure to be legal tender for the same value as the condor.

The principal banks within the republic are the Banco del Ecuador and the Banco Comercial y Agricola. The former has a capital of 2,000,000 sucres, the latter one of 500,000 sucres. Both issue notes, the banking law providing that one-third of the value of the issue must be held in coin, one-half of the reserve being in gold. On December 31, 1898, the note issue of the Banco del Ecuador was 2,138,170 sucres, and that of the Banco Comercial y Agricola 3,522,242 sucres. There are also two mortgage banks, the Banco Hipotecario and the Banco Terri- torial. The rate of interest charged is from 8 to 12 per cent, per annum. By the law of 6th December 1856 the metric system of weights and measures is the legal system of the republic, but the old Spanish weights and measures are almost invariably used.

Recent Political History. — After the assassination of President Moreno at Quito, in August 1875, Dr Borrero was elected to the presidency, but his tenure of povs^er was short. A revolution headed by General Veintemilla, the Radical leader, then military commandant at Guayaquil, broke out in 1876, and on 14th December of that year the Government forces underGeneralAparicio were completely routed at Galte. Veintemilla was proclaimed president, and in 1877 was duly elected by the Cortes. He altered

the constitution in a more Liberal direction, and struck various blows at the Clerical party, among other things abolishing the concordat with Rome. In 1878 Veintemilla caused himself to be declared elected as president for a term of four years. At the expiration of this period the president assumed dictatorial powers and remaiaed in office as chief of the executive. This action on the part of General Veintemilla led to a union between the Clericals and Moderate Liberals, and resulted in a popular rising throughout the republic, ending in his defeat and over- throw. His power was first restricted to Guayaquil and Esmeraldas, and finally General Einaldo Flores drove him from Guayaquil, and Veintemilla fled (July 1883) to Peru. Dr Placido Caamano was then called upon to take charge temporarily, and on 17th February 1884 was definitely elected for the presidential period terminating in 1888. Several revolutionary outbreaks occurred during the Caamano administration, but were successfully suppressed. In 1888 Dr Antonio Flores succeeded Caamano, the four years

following being passed in peaceful conditions. In 1892 Dr Luis Cordero was elected, his administration again plunging the country into an epoch of internal disturbance.

The cause of the troubles under President Cordero was the assistance lent by Ecuador to Chile in the matter of the sale of the cruiser Esmeralda to the Japanese Gov- ernment in 1894, in the middle of the Japanese-Chinese War. The Government of Chile arranged the sale of the Esmeralda, but wished to be free from all danger of international complications in the affair. To this end the transfer of the vessel was made to Ecuador, and she pro- ceeded to Ecuadorian waters. On arriving at the Galapagos Islands the flag of Ecuador was replaced by that of Japan and the vessel handed over to the representatives of that nation sent for the purpose. When the part played by President Cordero in this transaction became known, an outburst of popular indignation occurred. An insurrection, headed by General Eloy Alfaro, followed; and after desultory skirmishing extending over a period of nearly a year the Government forces were finally routed. President Cordero abandoning his office and escaping from the country.

General Alfaro then assumed dictatorial powers as supreme chief of the nation, contimiing in this capacity until 6th February 1897, on which date he was declared to be elected president of the republic. A series of revolu- tionary movements against the administration of President Alfaro occurred in the course of the next few years. Many of these risings were due to the intrigues of the Church party, and in view of these circumstances President Alfaro curtailed the influence of the clergy in several directions. On 31st August 1901 General Alfaro peacefully handed over the presidency to his elected successor. General Plaza.

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amongst the Great Andes of the Equator. London, 1892. — Wolf, T. Qeografia y Geologia del Ecuador. Leipzig, 1892. — Stubel, A. Skizzen aus Ecuador. Berlin, 1886. Die VuVcanherge von Ecuador. Berlin, 1897. — Reports of the Council of Foreign Bondholders. London. — Anuario de Estadistica Comer- cial de la Bepublica del Ecuador. Guayaquil. — British Foreign Office Diplomatic and Consular Reports. London. — United States Consular Reports. Washington. — Handbook of Ecuador. Bureau of the American Republics, Washington, 1892.

(w. W. B. ; c. E. A.)

E D E S S A — E D I N B U R G H

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Edessa, now called Uefa, one of the most import- ant towns of Northern Mesopotamia. It stands at a height of 1700 feet above sea-level, on the right bank of the Scirtus (Syrian, Daizon), a winter torrent which discharges into the Belikh, a tributary of the Euphrates. Urfa is the capital of a sanjak of the same nanie, in the Aleppo viUyet, seat of a governor and of an Armenian bishop, situated on the border of a fertile plain noted for its wheat and fine pasture, on the great caravan road from Aleppo to Mosul, about 46 miles east of Birejik. It stands partly on the plain and partly on two rocky hills, between which runs a small stream. There are remains of the old walls, with their rock-hewn ditch, and of the citadel. The streets are narrow and winding, with well-built stone houses. Beneath the citadel are two springs, which supply tanks — one the Birket Ibra- him, with sacred fish, now under the protection of Abra- ham, as they formerly were under that of Atergatis. About one mile from the town is a spring connected by tradition with the healing of Abgar's leprosy by Thaddeus. The climate is healthy, but not in sum- mer: the "Aleppo button" is common. The principal manufactures are fine cotton stuffs and yellow leather. The population numbers 20,000 (Moslems 8500, Ar- menians 7500, Syrians, Greeks, Protestants, and Jews 4000). On the 28th and 29th December 1895 there was a barbarous massacre, between 3000 and 4000 Gregorian, Roman Catholic, and Protestant Armenians perishing.

Authorities. — Gctschmid. " TTntersuchungen liber die Gesohiohte des Konigrelch Osroene" In Memoires de VAcademie Imperiale. St Petersburg, 1887. — Fitzmaurice. Beport dated March 16th, 1896, in Turkey No. 5, 1896. (c. w. W.)

Edinl^urgh, a city, county, and parliamentary burgh, and the capital of Scotland, situated on the south shore of the Firth of Porth, and surrounded by the county of Midlothian, 396 miles by rail north of London, with which it is connected by the Great Iforthern, Midland, and London and North-Western railways. Its progress since 1880, if not so rapid as that of some other towns more dependent for their prosperity on trade and manufactures, has been steady and great.

Area. — Its area has been enlarged by successive exten- sions of its municipal bound- aries, especially towards the west and south, the directions in ' which growth has been most marked. An important accession of territory was obtained in 1896, when por- tions of the parishes of Liber- ton and Duddingston and the police burgh of Portobello were incorporated in the city. The attempt then made to secure the amalgamation of the contiguous burgh of Leith to the Scottish capital did not prove successful. Under the Edinburgh Corporation Act, 1900, a further addition of nearly 1800 acres was made to the city area. This embraces portions of South Leith parish (landward) and of Duddingston parish, including the village of Restalrig and the ground lying on both sides of the main road from Edinburgh to Portobello;

and" also part of Cramond parish, in which is contained the village and harbour of Granton. The total area of the city is now 10,697^ acres.

Population and Wealth. — The number of inhabitants, set down at 212,729 in 1877, increased to 234,402 in 1881, to 261,225 in 1891, and to 316,479 in 1901. In

1900 the birth-rate was 26-90 per thousand of population, 7-8 per cent, of the births being illegitimate ; the death- rate, 19-40 per thousand of population, and the marriage- rate 10 per thousand. Of the total number of deaths 29 per cent, were those of children under five years, com- pared with 39-8 per cent, in Glasgow. The increase in wealth may best be measured by

the rise in the assessed valuation of the town. The city rental was £1,727,740 in 1880, £2,106,395 in 1890, and £2,807,122 in 1900-

1901.

Municipal Government and Finance. — There have been corresponding growth and change in the munici- pal and political organization of Edinburgh. By the Eedistribution Act of 1885 the number of the city's representatives was doubled, and it was divided, for electoral purposes, into East, West, Central, and South Edinburgh, each returning a single member; the par- liamentary and municipal boundaries have been made almost coterminous. The parliamentary constituency in

1901 numbered 42,376 registered electors, of whom 11,025 were in the East, 8926 in the West, 7630 in the Central, and 14,794 in the South divisions. The municipal constituency is 69,339. The Town Council has been increased to fifty members, and consists of a Lord Provost, 7 bailies, a dean of guild, treasurer, and convener of trades, 7 judges of police, and 32 ordinary councillors. Among the important new public duties and functions undertaken by the Corporation and its de- pendent bodies may be mentioned the acquisition of the

Cranton Harbour

ENVIRONS Of

EDINBURGH.

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gas-works, and of the horse and cable tramways; the electric lighting of the streets ; the bringing in of an addi- tional water supply from the Moorfoots, to be supple- mented by the Talla Water scheme ; and the purchase of

EDINBUEGH

several public parks, including the Braid Hills and Black- ford Hill.

Finance. — ^The debt of the city at 15th May 1900, existing and in immediate prospect, amounted to £3,515,585, made up as fol- lows:—To be metoutoftherates, £1,623,440; tramways, £1,147,817 ; electric lighting, £662,078 ; municipal debt to be met out of Com- • mon Good revenue, £92,250. The estimated net expenditure of the city, under the Municipal and Police Acts, for the year ending 15th May 1901, was £331,365, of which £303,098. was chargeable on the burgh assessment. The rates imposed for 1900-1901 were at 9 Jd. per £ on owners and Is. 8^d. per £ on occupiers, together 2s. 5Jd. per £, being the same as the rates imposed in tlie preceding year. The estimated capital expenditure contemplated on schemes sanctioned by the Council includes the sums of £116,000 on the improvement of the City Chambers, £57,000 for the purchase of the new park at Saughton, £193,000 for the erection of the new City Hospital, and £153,000 for acquiring and demolishing old property and erecting new houses on " Dwelling- House Improve- ment" account.

Industries. — Many new branches of industry have been started ; and the older indiistries, like printing and brewing, for which the town has long been celebrated, have received further develop- ment. But Edinburgh is still, as it was in 1875, and as it has been during its recorded history, a residential rather than a commercial or manufacturing city. City improvements, some of them still in progress, have swept away, as " slum property," numerous build- ings of venerable age and historic associations. Along with this inevitable process of change there has gone, however, an effort not only to preserve ancient and characteristic features of the street architecture of the Old Tovm, but to rescue from degradation, and to restore something of their long-lost social dignity to, the, closes and front " lands " of the Lawnmarket, the High Street, and the Canongate. If the city is no longer, in the same sense as early in the 19th century, the home and centre of literary society, it can still claim to be a place whose main industry is education, which, whether as regards its University and Medical School, its second- ary, technical, and endowed institutions, or its public elementary schools, has undergone immense development since 1875.

~~The Castle. — The Castle, which from its rock has always dom- inated the site and history of Edinburgh, has received a number of improving and restoring touches. The most important of these was due to the late Mr William Nelson, publisher, who, by his re- storation of the Argyll Tower and of the Old Parliament Hall, fur- nished but one of the many instances of local patriotism and private munificence exhibited during their lifetime by citizens on behalf of the amenities and institutions of the town. The Parliament and Banqueting Hall forms a lofty, spacious, and beautiful hall of arms, with a fine collection of Scottish armour and weapons and old regimental colours, and the heraldic bearings of royal and distinguished figures in national history emblazoned on the windows overlooking the Grassmarket. A new hospital, in the Scottish baronial style, has also replaced the former ugly structure.~~

~~Holyrood. — The neglected and dilapidated royal vault in the Chapel Royal has been repaired and put in order. Clockmill House and grounds have been added to the area of the parade ground, and there have been improvements in the Abbey precincts and in the accesses to the King's Park. The privileges of sanctuary came to an end with the abolition of imprisonment for debt in 1881.~~

~~Old Town Improvements. — ^Time and the city improvements have laid heavy hands on the Old Town buildings. Other agencies that have been active in producing change have been railway extension and the necessity for forming new or widening old streets. Much that was ancient and interesting has had to yield place to the requirements of sanitation, social progress, and public convenience. On the other hand, it has been found possible in many cases to increase the amenity of the main thoroughfares and the closes of "Auld Reekie," while preserving, and even enhancing, the picturesque features of its architec- ture. The Canongate quarter has suffered comparatively little alter- ation. New buildings have arisen, however, in the Watergate and Horse Wynd, and in the North and South Back of Canongate. The. Old White Horse Close has been tastefully renovated ; a public board school has taken the place of Milton House, traditionally associated with Cromwell's residence in Edinburgh ; New Street a town improvement of more than a century ago, and the home of eminent men in law and letters of a past generation, has disap- peared in~~

the course of raUway alterations. Much change has taken place In the vicinity of the Netherbow, where formerly the bounds and authority of the city met those of the Canongate. St Mary Street, the former "Rag Fair" outside the town wall, has been almost rebuilt ; it was the first>-fruits of the labours of the Improvement Trust. Jeffrey Street has supplanted what was once Leith Wynd, and is continued westwards in Market Street, which fronts the railway line with many handsome buildings, including

the new Trinity College Church. In the place of the historic Blackfriars Wynd there is a new and prosaic thoroughfare.; and "Beaton's Palace," the old Cunzie House, and other ancient dwell- ings have been removed from the adjoining Cowgate. Much more significant and more important are the changes produced by the rebuilding of the North Bridge. The bridge has been widened and heightened, and at its northern end, opposite the General Post Office, the North British Railway Company have built a magnifi- cent new hotel. To make way for the lofty and handsome block of buildings fronting the new North Bridge Street on the east side, many old houses have been pulled down, including Robert Fergus- son's birthplace in the Cap and Feather Close, and Allan Ramsay's wigmaker's shop, "at the sign of the Mercury, opposite Niddry Wynd." As great a sweep of ancient landmarks has been made on the other side of the thoroughfare, where the new and stately Scotsman buildings occupy the site of the many famous drinking "howfs" of the Fleshmarket Close and Milne's Square. In the part of High Street between the Tron Church and Parliament Square an important city improvement has involved the demolition of a host of noteworthy sites and dwellings in Stevenlaw's, Bur- net's, Covenant, and Assembly Closes, all these narrow and un- wholesome alleys being now opened to the air and light. The extension of the Municipal Buildings in Writers' Court and War- riston Close has caused the destruction of Clerihugh's tavern, the scene of the " high jinks " described in Ouy Mannering ; and the earlier improvement of opening St Giles Street, beside which stands the new Bank of Scotland, caused another great breach in the ranks of the old High Street houses. Opposite, at the comer of High Street and George IV. Bridge, the County Buildings, erected in 1818, will be replaced by a more commo- dious structure. Among the improvements and additions made on the adjoining Parliament House may be mentioned the Library of the Solicitors before the Supreme Courts, which pre- sents to the Cowgate a lofty

elevation in red sandstone. The Sheriff Court Buildings and the new Free Library also rise out of the depths of that hidden thoroughfare, and face each other on the higher level of George IV. Bridge. The latter structure is the gift to the city of Mr Carnegie, and cost £50,000. The Lawnmarket, the West Bow, and the Castle Hill bear many traces, in frontages and recesses, of change tempered by taste. The congeries of alleys on the north side of the Lawnmarket, from Paterson's Close to James Court, have been cleansed and connected ; and here Lord Rosebery has acquired and restored the 17th-century dwelling in which was located the legend of "My Aunt Margaret's Mirror." Another model restoration of a historic Edinburgh close is found across the way in Riddle's Court, converted into a "University Hall." Quaint examples of Lawnmarket and Bow Head tenements have disappeared, partly through the extension of the Free Church Assembly Hall ; a board school has usurped the place of the old Gordon mansion on Castle Hill ; while a new and noteworthy addition has been made to -the architectural features and the social amenities of this part of the Old Town by the development of Allan Ramsay's former residence of Ramsay Lodge into the imposing group of Ramsay Gardens.

The University, &c. — The "youngest of the Scottish universi- ties" has continuously maintained and enhanced its reputation as a seat of learning, and more particularly as a medical school; and it has increased in wealth, in equipment, and in the mun- ber of its students, which in 1899-1900 reached 2789, compared with 2065 in 1875-6. The constitution, administration, and curri- culum of the university have undergone great development, the most recent changes taking place under the Act of 1889. In 1883 it celebrated its tercentenary ; it was one of the first univer- sities to admit women students to its classes and degrees ; and its alumni have been brought into closer bonds of sympathy and action by the formation of a handsomely housed Students' Union. The university buildings have received extension and embellish- ment to meet the needs and tastes of the age. The plan of the structure, designed bj Adam and Playfair, has been com- pleted by a dome and cupola crowning the facade in South Bridge Street ; the opening up of the spacious thoroughfare of Chambers Street, on the site of College Wynd and Brown and Argyll Squares, has cleared the precincts of the old university buildings of unsightly obstructions and unsavory neighbours ; the Museum of Science and Art, structurally united to it, has

been completed and enriched with additional collections illustrative of industry, art, and natural history ; and opposite have arisen other new struc- tures, the Minto House Medical College and the Heriot-Watt Col- lege, which may be regarded as adjuncts of the university. Within, the library hall has received restoration and decoration, largely through the generosity of Sir William Priestley, formerly member for the university ; while munificent additions to the academic funds and resources have been made by the late Earl of Moray, Sir William Fraser, Mr John Usher, and others. The university will benefit also, like the other Scottish universities, from Mr

Carnegie's noble endowment fund. The most splendid evidence of its growth and of the liberal and enlightened spirit in which it is supported is provided by the new Medical School, built in Teviot Eow, adjoining George Square and the Meadows. To this fine and spacious group of buildings the Faculty of Medicine has been re- moved ; and its suite of class-rooms, operating theatres, and labora- tories equip it thoroughly for its work of teaching and healing. The Medical School is in the Renaissance style, from the designs of Dw Rowand Anderson, and when completed by a campanile tower will have cost over £300,000. A magnificently decorated hall, for academic and other public functions, is the gift of Mr William M'Ewan, M.P., to the university and city, and with the grand organ has cost a sum of £115,000. Closely associated with the Medical School, and separated from it by the Middle Meadow Walk, is the Royal Infirmary, removed hither from Infirmary Street. Its wards, in which nearly 10,000 patients receive treatment an- nually, are lodged in a series of turreted pavilions, and cover a large space of ground on the margin of the Meadows, from which, to make room for it, George Watson's College— the most im- portant of the Merchant Company schools — ^has had to shift to a site farther west, while the Sick Children's Hospital has moved to the farther side of the Meadows. The Old Infirmary buildings have served the purposes of a City Fever Hospital, which soon, however, will be accommodated more spaciously and suitably on a site lying on the burgh outskirts at Wester Craiglockhart Hill. Similarly, the Royal

Edinburgh Asylum for the Insane has been crowded from its old ground at Morningside, and has occupied a noble structure set on a commanding position on the caster hill of Craiglockhart ; and the Royal Blind Asylum has moved from its former quarters in Nicholson Street to a new home at Powbum. A Home for In- curables has been erected in Salisbury Place. Among the host of benevolent, charitable, and other public institutions mention may be made of the Central Public Baths in Infirmary Street, and branch establishments in other parts of the town, including the new suburb of Portobello, and the Workmen's Institutes' planted in crowded districts of the city with funds provided by the late Mr Thomas Nelson.

Endowed and Public Schools. — Among buildings more strictly educational in their purposes, notice must be taken of the host of new public schools, for the most part large, handsome buildings, which bear witness to the zeal and activity of the School Board in providing for the elementary and advanced instruction of the young, and fulfilling their other duties under the Act of 1872. A large number of these schools have been erected within the city bounds, and the expenditure of the board on building, including sites, and exclusive of schools now being built, has been £496,000. The estimated expenditure on two new schools which are approach- ing completion, and for additions that are being made to other schools, is over £73,000 ; and plans have been prepared for a new school for the Craiglockhart district, in the south-west of the city, at a probable cost of £30,000. Two of the existing schools have been graded and fitted with apparatus to meet the require- ments of the secondary education grant, and a day industrial school for truant chUdren has been provided. The new Merchant Company colleges have more than fulfilled the expectations of those who devised the scheme by which the buildings and endowments foundajd on the old " hospital " system were devoted to the purpose of estab- lishing highly equipped day schools, which should carry the pupils through all the stages of primary and secondary education. In this way George Watson's College, Stewart's College, and the Queen Street Ladies' College, George Square Ladies' College, and Gillespie School, possessing an aggregate income of £66,000, have taken a high place among the educational institutions of the city and country, and have become important feeders of the university. The Heriot Trust, also, has devoted its funds, now reaching over £30,000 annually, mainly to the encouragement of secondary,- technical, and higher education

; in addition to the support thus provided for the Heriot- Watt College already mentioned, the fine and venerable structure of Heriot's Hospital is occupied as a tech- nical school, and a large part of the revenue is spent on a school and university bursary scheme. The Royal High School — the old and famous burgh school of Edinburgh — has also been reorganized and enlarged to meet modern requirements ; and on the northern outskirts there has risen in Fettes College — an endowed institution on the model of the English public schools — an architectural oma^ ment of the city.

New Town Improvements. — The New Town has spread westwards and northwards in handsome streets, terraces, and crescents, which in both directions have crossed over the valley of the Water of Leith. By the purification of the stream, carried out at the cost of the city, a great addition h^ been made to the amenity of its neighbourhood, which has been further increased by the restoration and embellishment of St Bernard's Well and its surroundings, an improvement of which the whole cost was borne by the late Mr William Nelson. Beyond the Water to the north, between Inver- leith Row and the Fettes College grounds the Arboretum, joined on

one side to the Royal Botanic Gardens, and adjacent on the other to the new luverleith Park, has become a favourite public resort. To the south and west of Haymarket a populous working-class district has sprung up at Dairy. In Atholl Crescent is a possible site of a public hall for musical and other purposes, for which the late Mr Thomas Usher gave the sum of £100,000. Important changes have been made upon the architectural appearance of Princes Street, George Street, St Andrew Square, and the adjoining thoroughfares, through the erection of new hotels, banking and insurance offices, and clubs ; and at the east end of Queen Street a stately struc- ture, designed by Dr Rowand Anderson, to accommodate the National Portrait Gallery and the Antiquarian Museum, has been raised through the liberality of the late Mr J. E. Findlay of Aberlour, who bestowed a sum of nearly £70,000 for the purpose, the Govern- ment providing the site. In Castle Terrace the Synod Hall of the United Presbyterian Church (now joined to the Free Church, under the title of the "United Free Church of Scotland") is flanked on either side by the School Board and Parochial Board offices ; while behind it, in Grindlay Street, is the Lyceum Theatre.

Churches. — The most important addition made in recent years to the churches of Edinburgh is St Mary's Cathedral, belonging to the Scottish Episcopal Cfiurch. It is built on ground and chiefly from funds bequeathed by the late Miss Walker of Coates, and the Cathedral Close contains the early 17th-century mansion of East Coates, now occupied by the organist, and a Song School. The church, designed in the Early Pointed style by Sir Gilbert Scott, is 278 feet in length, and is surmounted by a spire 275 feet in height. A chapter-house has been added by the late Mr Hugh Rollo, and when the two western towers are completed the whole cost of the edifice will be some £140,000. Many other churches, of different denominations, have been built or rebuilt in the city and suburbs, the most noticeable, from an architectural point of view, being perhaps the Catholic Apostolic church at the foot of Broughton Street, one of the features of which is a fine set of mural paintings executed by Mrs Traquair. In all there are now 192 places of worship in the city, of which 46 belong to the Church of Scotland, 75 to the United Free Church and 4 to the other Presbyterian churches, and 26 to the Episcopalian, 7 to the Roman Catholic,and34tootherdenominations.

Bailway Improvements. — Among the most important of the city changes are those that have taken place in the hollow between the Old and New Towns. The increase in the traffic of the North British Railway has rendered necessary successive alterations and enlargements of the Waverley Station, which will become one of the most extensive, as regards platform area and other accommo- dation, in the country. Additional tunnels of access have been formed from Haymarket on the west and Abbeyhill on the east ; and it has been found necessary to appropriate strips of the East and West Princes Street Gardens. The Caledonian rail- way, also, has built a handsome and commodious new station, with hotel attached, at the west end of Princes Street ; and among the additions to the railway mileage of the city and its vicinity are the Caledonian branch lines to Leith and Cramond Bridge, and the suburban and Corstorphine lines of the North British railway.

New Parks and Monuments. — Edinburgh is well provided with "lungs," in the shape of public parks. In addition to the magnificent open spaces previously existing within the city bounds, in the King's Park, the Meadows, the Calton Hill, the Princes Street Gardens, &c., a large area of new ground has been set apart of late years for the health and recreation of the

citizens. Mention may be made of the Blackford Hill, on the shoulder of which the new Royal Observatory has been built and the great Dunecht telescope fitted up. Beyond is another spacious and breezy play- ground, the Braid Hills, mainly devoted to the game of golf. These are on the south side of the city. On the north of the Water of Leith are the Arboretum and Inverleith Park. The Harrison Park provides recreation ground for the dwellers in the crowded district around Fountainbridge ; and another and larger public park for the western district of the city has been purchased by the Town Council at Saughton Hall. The numerous monu- ments of Edinburgh have been reinforced by a statue of the late Duke of Buccleuch in High Street, of Dr Thomas Chalmers in George Street, of Dr Livingstone, Adam Black, and Sir James Young Simpson on the line of Princes Street, of John Knox in the quadrangle of the Free Church College, and Sir William Chambers in Chambers Street. (j. qj..)

Edinburghshire, or Midlothian, a county on the southern shore of the Tirth of Forth, bounded on the W. by Linlithgow, on the E. by Haddington, and on the S.-W. and S. by Lanark, Peebles, Selkirk, Eoxburgh, and Berwick shires. Geographically it embraces the city of Edinburgh (administratively a separate county) and the parliamentary burghs of Leith and Musselburgh.

Area and Population. — With regard to area, so many alterations have been, and are in process of being, made upon it by the exten- sions of Edinburgh city, and by alterations in the boundaries by the Boundary Commissions under the Local Government Act of 1889, that it would be a matter of considerable difficulty to arrive at a correct statement of the present acreage. The geographical area is given as 362 square miles, or 231,724 acres. The county and parish changes of boundary in 1889 were chiefly in the parishes of Cramond and Fala, and involved small transferences of popular tion and acreage from West Lothian and East Lothian \o the county. The population of the registration county, including Edinburgh city, vras 388,811 by the census of 1881, 433,552 in 1891, and 488,647 in 1901. Outside of the parliamentary burgh areas the figures were 75,120 in 1881, 81,033 in 1891, and 83,807 in 1901. The principal centres

~~of population vrithin the bounds of Midlothian are Edinburgh (municipal burgh, including Portobello), 316,479 inhabitants in 1901 ; Leith, 76,667 ; Musselburgh, 11,704 ; Dalkeith, 6753 ; Loanhead, 3011 ; Bonnyrigg, 2926 ; and Penicuik, 2803. According to the latest corrected figures, the percentage of births within the registration area was 2-91 ; of deaths, 1‘67 ; and of marriages, 0-83. Illegitimate births formed 7”43 per cent, of the whole.~~

~~The following table gives particulars of births, deaths, and mar- riages in 1880,1890, and 1899:—~~

~~Tear.~~

~~Deaths.~~

~~Marriages.~~

~~Births.~~

~~Per cent, of Illegitimate Bu-tha.~~

~~1880 1890 1899~~

~~‘, 8558 8909 8901~~

~~3016 3266 4290~~

~~13,255 12,671 13,485~~

~~7-3 7-4 6-3~~

~~The following table gives the birth-rate, death-rate, and marriage- rate per 1000 of population at different periods since 1880 : —~~

~~1880.~~

~~1881-90.~~

~~Average.~~

~~*1890.*~~

~~*1899.*~~

~~*Birth-rate Death-rate Marriage-rate .*~~

~~*34-52*~~

~~*22-29*~~

~~*7-86*~~

~~*31-50 19-53*~~

~~*7-75*~~

~~*29-22*~~

~~*20-70*~~

~~*7-59*~~

~~*28-27*~~

~~*18-66*~~

~~*8-99*~~

~~*Constitution and Gc/vernment. — The county, generally spoken of in this connexion as Midlothian, forms a single parliamentary constituency, exclusive of Edinburgh city and the Leith burghs. The parliamentary constituency in 1900-1 numbered 14,077 ; the valuation (including railways and water-works) was £674,842. Under the Local Government Act of 1889, the county is divided into 38 electoral districts, and these have been by the County Council arranged into 4 county districts for the purposes of the Eoads and Bridges Act, 1878, and the Public Health Acts. The management of special districts formed for water supply, drainage, and other sanitary purposes is committed to sub-committees appointed by the respective district committees. The grant under the Local Taxation (Customs and*~~

~~Excise) Act is administered by the Technical Education Committee appointed by the Council ; and on the same authority, a special committee, called the Secondary Education Committee, looks after the distribution of the grant under the Local Taxation (Scotland) Act.~~

~~Education. — There are in the county, exclusive of Edinburgh and the other burghs, 30 separate school boards, managing 96 schools, the average attendance in these being 16,394 in 1899-1900. The grant for higher education earned in 1899 amounted to £1588 16s. 4d.~~

~~Agriculture. — The depression in agriculture has not affected Midlothian so severely as some other counties ; compensa^ tion for the fall in the price of grain and other agricultural products has been found in the growth of population and the local demand. There have been comparatively few changes in the size of agricultural holdings, either in the shape of cutting up large farms into small ones, or amalgamating small farms in larger. The neighbourhood of Edinburgh has given considerable stimulus to dairy-farming. The area under crops has increased rather than diminished, but the area under corn crops is nearly 6000 acres less than in 1880. Fallow land has practically disappeared.~~

~~Tear.~~

~~Area under Crops.~~

~~Corn Crops.~~

~~Green Crops.~~

~~Clover, &c.~~

~~Perennial Pasture.~~

~~1880 1890 1899~~

~~134,344 139,764 1.32,833~~

~~88,628 84,367 33,038~~

21,365 18,779 19,354

29,390 37,296 32,818

44,708 48,928 47,279

Wheat, notwithstanding the fall in prices, may be said to hold its own among the grain crops ; the area devoted to wheat, some 5000 acres, is rather larger than in 1880, and represents practically

the whole acreage of arable land on which this crop can be pro- fitably grown at present rates. Oats also maintain their ground on the whole ; the great reduction has been in barley. The follow- ing are the figures for live- sfock : —

Tear.

Total Horses.

Total Cattle.

Cows or Heifers

in Milk or in

Calf.

Sheep.

Pigs.

1880 1885

1890 1895 1899

3979 4143 4415 4540 4478

18,907 21,472 22,404 19,451 21,450

10,765 12,308 12,628 11,096 12,537

170,562 168,873 179,565 183,322 191,403

5309 7141 6888 8133 8194

Industries. — There are few changes to note with regard to the staple industries of the county of Edinburgh. The paper-mills, situated chiefly in the valleys of the Esk and the Water of Leith, have increased their production while improving their processes. Near the outskirts of the city a number of new brewing, distilling, and other works have sprung up ; on the other band, some of the Midlothian granaries have been closed through exhaustion. The quantity of coal raised in 1900 was 1,829,495 tons ; and 9160 men were employed at the collieries above and below groimd. The production of oil shale was 637,810 tons. The county output of sandstone was 132,761 tons, and of limestone 177,696 tons. For the year 1900-1, the quantity of white flsh landed in the Leith district was 207,218 cwts., valued at £133,895 ; there were 364,616 barrels of herrings, exported mostly to Germany.

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-), American

Edison, Thomas Alva (1847- inventor, was born 11th February 1847, at Milan, Erie county, Ohio, but his parents moved to Port Huron, Michigan, when he was seven years old. At the age of twelve he became a train news-boy on the railway to Detroit, and managed to gratify his youthful interest in chemistry by performing experiments while travelling. At fifteen he became a telegraph operator, and was employed in many cities in the United States and Canada, but frequently neglected his duties in order to carry on studies and experiments in electrical science. Before he was twenty-one he had constructed an automatic repeater, by means of which a message could be transferred from one wire to another without the aid of an operator ; and he had also directed his attention to the problem of duplex telegraphy, of which he later invented a successful system. In 1869 Edison came to New York City, and soon after- wards became connected with the Gold and Stock Company. He invented an improved printing telegraph for stock quotations, for which he received $40,000. He then established a laboratory and factory in Newark, N. J., for further experiments and for the manufacture of his in- ventions. In 1876 he removed to Menlo Park, and later to West Orange, N. J., where he continued his experiments. Since then his name has been prominently associated with all kinds of novelties in practical electricity. Among his principal inventions are his system of duplex telegraphy, which he later developed into quadruplex and sextuplex transmission ; his carbon telephone transmitter ; the micro- tasimeter, for the detection of small variations in tem- perature ; the phonograph, which records and reproduces

all manner of sounds ; and his method of preparing carbon filaments for the incandescent electric lamp. In 1878 Edison received the degree of Ph.D. from Union College, and in the same year was made a chevalier of the Legion of Hbnour by the Trench Government.

Edmonton, a suburb of London, England, in the Enfield parliamentary division of Middlesex, 9 miles north of the City by rail. There is an ancient church containing interesting brasses and tablets, town-hall, and a free library. Cowper and Keats lived here for a time, as did Charles Lamb, who

~~died and was buried here. In 1881 Southgate was separated from Edmonton parish. Popula- tion of urban district (3890 acres), (1881), 15,174; (1891),~~

~~25,380; (1901), 46,899.~~

~~Edmunds, George Franklin (1828),~~

~~American lawyer and statesman, was born in Eich-~~

~~mond, Vermont, on 1st February 1828. He began the practice of law in 1849. He served in each House of the Vermont legislature at different times between 1854 and 1862, and was elected to the United States Senate in 1866, where he remained until 1891, when he resigned in order to have more time for the practice of his profession. He took an active part in the attempt to impeach President Johnson. He was influential in pro- viding for the electoral commission to decide the dis- puted Presidential election of 1876, and became one of the commissioners. In the Republican conventions of 1880 and 1884 he was a candidate for the Presidential nomination. From 1881 until 1885 he was president pro tempore of the Senate. As senator he was conspicuous on account of his legal attainments, industry, and liberal opinions. He was the author of the so-called Edmunds Act of 22nd March 1882 for the suppression of polygamy in Utah.~~

~~EDUCATIOJSr.~~

~~FORMER articles on the subject of education have appeared successively in the various editions of the Encydopcedia Briiannica, and have well illustrated the very different aspects under which \;he subject of education may be viewed. Mr James Mill's treatise in the Supple- ment of 1824 discussed with fulness and much acute- ness various abstract questions — e.g., the genesis of ideas ; the qualities of mind which it should be the chief business of education to develop ; the instruments of instruction ; the circumstances, whether material or moral, which operate upon and control mental growth ; and the right function of domestic, social, and political training respectively, as distinguished from formal didactic teaching by means of school lessons. Except for a descriptive reference to Jeremy Bentham's famous experiment of a "Chrestomathic" day- school, there is little in Mr Mill's article which deals prac- tically with the provision or~~

organization of schools, or with any proposals for legislative action. The whole of this valuable paper is speculative and philosophical, and is highly characteristic of its author and of the spirit in which the subject of popular instruction was at first approached by the leading thinkers of his day. Dr J. D. Morell, one of the most distinguished of the first group of inspectors, contributed to the edition of 1858 an account of German and Swiss education, and' a description of the tentative efforts which at that date the Government of Great Britain was making in the department of public elementary instruction. He foreshadowed with much ability the probable future of a State system in England on the lines laid down by Sir James Kay Shuttleworth — a system then in an early and experimental stage, and only beginning to attract the serious attention of British statesmen. Mr 0. Browning's article in the ninth edition is mainly con- cerned with the growth of educational ideas and theories. He followed the precedent set by Aristotle, who in book i. of the Metaphysics made a critical survey of the history of Greek philosophy from Thales to Plato, and an estimate of the merits of the chief metaphysical writers. As a descriptive history of the books and speculations which all through the Greek, Roman, and Renaissance periods have in different ways helped to shape opinion and policy on the subject of education, Mr Browning's article is invaluable to the student who desires to take a vue d'ensemble of the several parts of the educational problem, and to know what are the ideals which have from time to time prevailed on this subject, and how far it has been possible to give practical effect to those ideals. Other branches of the general subject will be found treated in

detail in the articles Universities and Technical Educa- tion. In connexion with each of the countries of Europe and of the British colonies and dependencies there will be found facts relating to the educational provision made by their several Governments, and the way in which the law of public instruction is administered. The scope of the present article is thus definitely restricted. Its main purpose will be to trace the gradual growth of what may be called the English system, the forces which have controlled it, and the results it effected during the last quarter of the 19th century.

It should be observed in limhie that England has a unique history so far as public provision for the education of the people is concerned. That

provision is not the product of any theory or plan formulated f^^^sat’”’ beforehand by statesmen or philosophers. It Bagiisb has come into existence through a long course of educa- experiments, compromises, traditions, successes, *^°f^L, failures, and religious controversies. What has been done in this department of public policy is the resultant of many diverse forces, and of slow evolution and growth, rather than of clear purpose and well-defined national aims. It has been effected in different degrees by philanthropy, by private enterprise, by religious zeal, by ancient universities and endowed foundations, by municipal and local effort, and only to a small extent by legislation. The genius, or rather the characteristic mental habit, of the English people, is averse from philosophical system, and is disposed to regard education not as a science, but as a body of practical expedients to be discovered empirically and amended from time to time as occasion may require. The tendency to distrust theorists and to be afraid of legislation has in England been strongly reinforced, and indeed largely justified, by the fact that most of the legal enactments of the past were negative and restrictive only, and were neither calculated nor intended to encourage educational progress. Henry VIII.‘s ordinances respecting grammar schools forbade the use of any other than the authorized primers and Latin books. Elizabeth’s Act of Uniformity severely restricted the liberty of teaching; and the Act of Charles II. in 1662 obliged all school- masters, whether lay or clerical, to accept the declaration of Conformity, and to obtain a licence from the bishop or the ordinary. The Acts generally known as the Clarendon Code were even more stringent in their requirements, and the Occasional Conformity Act (1711) and the Schism Act (1713) put it out of the power of Dissenters to hold office or to keiep any private or public school. Thus the

efforts of later reformers were during many years directed rather to the removal of disabilities and hindrances than to the actual encouragement of education by legal meas- ures. It was not till the year 1779 that the Act was passed rendering it lawful for any person to act as schoolmaster without subscribing the Thirty-nine Arti- cles. The Test and Corporation Acts

survived to the year 1829 ; and subscription to the Articles was enforced as a condition of taking degrees at the Universities until 1871. It has thus happened that the habitual attitude of the English people was for a long period marked by watchful jealousy and dislike of all legislative action. In fact, the evil memories associated with the harsh and intolerant legislation of an older time caused many Eng- lishmen in the beginning of the 19th century to suppose that no influence of the State in the spheres of charity, education, or religion could be otherwise than mischievous. Hence the popular faith in Voluntaryism. Hence, too, the resistance on the part of the Nonconformists during a part of the Victorian reign to the establishment of any system by which the Government proposed to aid and inspect primary schools. Nevertheless time has wrought a remarkable change in public opinion on this subject. Matthew Arnold, who devoted much time and thought to inquiries into the systems of foreign countries, tried in his reports to convince his countrymen that if once an enlightened democracy were animated by a progressive spirit and noble ideals, it would be the part of wisdom to invoke the collective power of the State to give effect to those ideals. Great Britain as a nation has not yet ac- cepted this dictum in all its fulness. But it is not diffi- cult to account for the slowness and hesitation with which English statesmen have approached this subject, and for the lack of symmetry and of scientific completeness in so much of the national system of education as already exists. What there is in that system, both of merit arid of defect, will be better understood by a brief reference to three or four of the leading countries of Europe, in which the people, less hampered than in England by the traditions of the past, have felt free to recognize earlier their national obligations in this respect, and to make more systematic provision for the education of the people.

In France, Turgot in 1775 drew the outlines of an elaborate sys- tem of national education. Talleyrand, even in the midst of the political and social storms of 1793, formulated proposals Prance. ^^^-^ establishment, by authority, of a school for every 1500 inhabitants. The decrees of Napoleon made further provision for academic and higher instruction, for the establishment of a State University, and for the certification of qualified teachers. The whole of the legislation of the Consulate and the First Empire con- templated a system essentially laic, military, and highly organized, under the direct control of the Government. From that time, not-

withstanding frequent aberration of opinion and political change, increasing and generous sacrifices have been made by the French people to complete their edifice of primary, secondary, and supe- rior instruction. Ecclesiastical influence became more pronounced under the Restoration, and in 1816 public subventions were made for the maintenance of schools. Under the reign of Louis Philippe, Guizot, with the advice of Remusat and Cousin, made special efforts to secure the co-operation of the Churches in the business of national education. In a circular addressed to 300 elementary teachers in 1833, they are exhorted to bear in mind that "educa^ tion has never really flourished when the religious sentiment has not been combiued, in those who propagated it, with the taste for enlightenment and instruction." Accordingly, the law of 1833 expressly enacted that the wishes of the parent should always be consulted and followed in what concerned religious teaching, ^his was effected partly by multiplying schools of different confessions and types, forbidding proselytism, and exempting children in mixed schools from teaching which their parents disapproved. The Gov- ernment said in effect to their Churches : " The State cannot make itself denominational, but we invite the denominations to make themselves more national." The response to this appeal was not very cordial ; and when in 1860 Matthew Arnold made his report on Popular Education in France, he foresaw that the compromise was not likely to last. The efforts of Catholics were so far success-

ful that in 1878 official statistics showed that more than a fourth of the primary public schools for boys and nearly two-thirds of those for girls were under "religious" masters and mistresses. But these efforts, in turn, to obtain increasing control over the State schools generated corresponding intolerance on the part of the extreme secularists, such as M. Paul Bert ; and in 1877 a law was passed excluding the bishops from the Supreme Council of Educa^ tion. Further measures in 1880 forbade the Jesuits to take any part in teaching, either in public or in private schools ; and in 1886 it was enacted that none but lay teachers should be recognized in the public schools. The various stages by which the popular edu- cation of France has been gradually and completely secularized are clearly and fully described by Mr Lecky in chapter vi. of his Democracy and Liberty. Notwithstanding the liberal subsidies, both national and departmental, by which the common school sys- tem is now supported, it cannot be said that

~~the system is coexten- sive with the needs of the nation, or that it satisfies the wishes of the people. In a parliamentary paper prepared by the writer of this article it was shown (Memorandum on the Working of the Free School System in America, France, and Belgium, 1891) that the complete secularization of the public school had aroused the hostility of the Roman Church, and had caused a large number of schools and scholars to be detached from the public school system and taught independently in voluntary or confessional schools. The statistics of that year showed that of the 5,545,000 scholars reported as enrolled in primary schools, 1,166,477, or more than one-fifth, were in private or denominational schools ; of these, ,370,772 were boys and 795,705 were girls. In Paris the dispropor- tion was still greater, for while 111,112 scholars of the age from 6 to 13 were in the public schools, 71,850, or nearly two-fifths of the whole, were in schools outside the State system.~~

~~The returns for 1899 show how this tendency has continued, and that the number of the ecoles confessionelles as compared with those aided and regulated by the State continues to increase. There were in that year in public primary schools 95,233 lay teachers and 9929 congriganistes, and in private schools 6994 lay teachers and 38,757 congreganistes. The total number of scholars in private or confessional schools had risen to 1,324,684. Besides these numbers in primary schools proper, the returns show that in ecoles primaires superieures or in cours complementaires there were enrolled 56,051 scholars, and in the ecoles maternelles or infant schools 532,077 younger children.~~

~~The most notable of recent changes in France concerns the higher academic education. At the time of the Revolution there were twenty-one universities governed by local academic bodies independent of each other, and for the most part feeble and inefficient. Napoleon created in their stead one Imperial institu- tion, which was intended, under the name of the University of France, to co-ordinate and control the whole educational organizar tion in the country, under the direction of the Minister of Public Instruction for the time being, who was to be ex officio Grand Master of the University of France and Rector of the Academy of Paris. The local academies had no power to confer University distinctions ; but degrees in Letters and in Science were instituted by the State, and demanded by it as a~~

guarantee for admission to certain professions and public offices. The University of France, thus constituted, continued all through the Restoration, the Gov- ernment of July, the Second Emjpire, and part of the third Republic to dominate the education of the country, notwithstand- ing the efforts of Guizot and others to substitute for the separate faculties and schools a number of independent universities, and to make them centres of intellectual life. The general desire on the part of scholars and men of science for decentralization, and for restoring independence and some power of initiation to the local academies, found expression in the Act of 1896 and in the Decree of July 1897, which practically abolished the State Uni- versity of France, and gave to sixteen institutions, at Paris, Bordeaux, Lille, Lyons, Montpellier, Nancy, Toulouse, ALx, Mar- seilles, Caen, Dijon, Grenoble, Poitiers, Rennes, Besan^on, and Clermont, each comprising several faculties, larger liberty and autonomy — e.g., the power to grant diplomas and certificates apart from the State degrees. The new law also handed over to these universities such fees for enrolment, and for the use of laboratories and other facilities for practical work, as were paid by the students of the faculties. The history and probable educational effect of this great reform are admirably summarized by M. Louis Liard in his article Les Universitis Franqaises in the fourth volume of Special Reports on Educational Subjects issued (1900) by the English Board of Education.

It is interesting to compare with these details the history of the neighbouring country of Belgium, which during the same period has gone through similar educational experiences, « i i but has arrived at different practical conclusions, "eigiam. Though small, it is a highly prosperous country, full of indus- trial enterprise and activity, and it presents in a compact form illiistrations of some of the more important problems concerning

education, especially those which affect the relation of the State to religion and the Church. Its history dates from 1831, when, on its separation from the kingdom of the Netherlands, it received its con- stitution under King Leopold. At that date its population was 2,800,773. In 1897 the numbers

had reached 6,586,593. The rate of annual increase in the population is 14 per thousand, as compared with Germany, 11 ; Holland, 18 ; Austria, 9 ; Great Britain, 8 ; Switzerland, 7 ; Hungary and Sweden, 10 ; Italy and Spain, 4 ; and France, -09. The density of its population is remarkable, there being 224 inhabitants par kilometre carre, as compared with Great Britain, 126 ; Germany, 96 ; France, 71 ; Italy, 109 ; Spain, 36 ; Sweden, 11 ; and Norway, 6. (See article Belgium.)

One of the articles of the Constitution of 1831 asserts definitely the principle of the liberty of instruction. Private or individual enterprise and initiative are therefore not forbidden ; but owing to the completeness of the State provision for primary, secondary, academic, and technical instruction, there is little room for such enterprise, and, except on the part of clerical authorities desirous to secure provision for religious instruction, hardly any private schools can be said to exist. But this exception is important. Its history has shown in Belgium since 1831 successive changes in popular opinion on the relations between Church and State which have from time to time profoundly modified the educa- tional system. At first the law, as it was consolidated in 1842, required every commune to maintain a school or schools for primary instruction, that is to say, for children of ages from 6 to 14. The cost of building was to be defrayed by the com- mune, and the annual maintenance was to be provided partly by a subvention from the State, in addition to a nearly equal sum from the commune, partly and to a much smaller extent — about 3 per cent, of the total revenue — from the fees paid by parents. Practically primary education was gratuitous in all the large towns and in many rural districts ; and provision was made that in all oases the children of indigent parents could claim, either from the local charity bureau or from the commune, the means of exemption from the payment of fees. "The law of 1842 made religious instruction obligatory, and placed it under the direction of the minister of the faith professed by the majority of the pupils in the school, children not belonging to the denomina- tion of that majority being dispensed from attendance at the religious lessons. Supervision of this religious teaching, including inspection of its methods and results and the choice of text-books, was entrusted to the ecclesiastical authorities, who were represented (in a consultative capacity) in the Central Office, and were required to make an annual report to the Minister" (see " Recent Legislation in Belgium," vol. i.

of Special Beports on Educational Subjects, 1897). This compromise lasted thirty-seven years ; but meanwhile there was a steady growth of one section of public opinion hostile to any " association of the State with the action of a favoured Church," on the ground that it violated the spirit of the Belgian Constitution. The law of 1879 accordingly prescribed that religious education should be left wholly to the care of the families and to the clergy of different faiths. The system of religious inspection was abolished, religious instruction ceased to be included in the curriculum of the communal schools, and in its place instructors were enjoined "to give moral precepts and to inculcate sentiments of duty, of love for country, respect for national institutions, and attachment to constitutional liberty." This provision was not found to satisfy the educational requirements of a nation in which the Roman Catholic Church exercises an exceptionally powerful influence. The purely secular, or rather non-religious, character of the State schools was from the first distasteful to the authorities of that Church ; parents were exhorted to withdraw their children from the communal schools, and private and denominational schools were established by the efforts of the congregations and the clergy. These schools received no subventions from the State, yet they attracted year by year a larger number of scholars. In 1883 there were in the public or communal schools 320,709, and in the private or Catholic schools 479,280 scholars. It was computed that in that year there were for every 100 inhabitants in the kingdom 14 children in elementary schools, of whom 8-47, or 59'9 per cent., were taught in icoles confessionelles, and only 5'67, or 40 per cent., in the schools provided by the State. A strong Catholic majority at the general election of 1884 led to the enact- ment of a new law, which, though not relieving the communes from the responsibility of providing schools, gave liberty to place religious and moral instruction at the head of the curriculum, and also to accept as icoles adoptees, and to assist by public funds and recognition, the confessional schools which had since 1879 been maintained by the private efforts of the Church. Provision was further made entitling any twenty parents of children of school age to demand either a school of the normal communal type, or one which gave separate religious instruction in the tenets of the Church. Subsequent legislation in 1895 took a further step in the same direction, gave additional subsidies to private or confessional schools, and made religious instruction obligatory in the first or

last half-hour of each school attendance, children whose parents so desired being excused. It further required that the inspection of religious instruction shall be exercised by the ecclesiastical authorities. The effect of this change has been to cause a large diminution in the number of communal schools and a consider- able increase in the influence of the clergy. There is no immediate prospect of any reversal of the policy which has thus made the Belgian system of public education essentially denominational, although tiie proportion of Catholics has somewhat declined. The general election of 1900 resulted in the return of 85 Catholics, 33 Liberals, and 34 Socialists to the Representative Chamber, and of 47 Catholics and 29 Liberals to the Senate or Upper House.

The returns for 1899 show that a total of 940,370 children, or nearly one-sixth of the population, are in attendance in primary schools. Of these, 475,487 (292,382 boys and 183,105 girls) are in communal schools, 168,397 (57,810 boys and 111,087 girls) in adopted schools, and 120,416 (46,518 boys and 78,903 girls) in private or confessional schools, besides 176,070 infants in ecoles gardiennes. It will be observed that the proportion of girls under direct clerical influence is greater than that of boys. In the staff of teachers the effect of the new law has been very marked. There were in 1894 in the communal schools 9275 lay schoolmasters and 200 members of religious orders, and in the denominational schools now "adopted" 1252 lay schoolmasters and 411 religieuses. Out of the 7418 mistresses, 3419 (of whom 3225 are employed in adopted schools) are religieuses. There are in the whole country 19 training colleges for men and 34 for women, and the aggregate number of normal students is 3585, who furnish an annual supply of certificated teachers (^diplomes) of 915. The total annual cost of primary education is 33,318,328 frs., of which the State con- tributes 13,868,045 frs. ; the communes, 15,402,204 frs. ; the fees of parents, 1,814,410 ; charitable endowments, 226,801 ; and the bureaux de bienfaisance, 334,372.

Some light is thrown on the degree of efBciency attained in primary education by the official returns of the examination of young men drawn annually for military service. These show that the number unable to read and write was in 1870, 29-23 per cent. ; in 1880, 21-66 per cent. ; in 1890, 15-92 per cent. ; and in 1898, 12-83 per cent. In 2116 continuation schools,

held for the most part in the evening and for adults, there were 91,269 scholars. The provision for secondary instruction may be regarded as ample. In the special normal schools for higher or intermediate teachers there were in 1898, 56 men and 92 women students. The HIgh Schools or Athinees Boyales were attended in 1897 by 5657 scholars, the State intermediate schools {&coles moyennes) by 13,923 boys and 5497 girls, and the communal secondary schools by 1518 boys and 1440 girls. Academic education (enseignement superieur) in connexion with the four Universities of Brussels, Ghent, Lifege, and Louvain is provided for a total number of 4951 students, or 75 for every 100,000 of the entire population. Of these, 536 are entered in the Faculty of Arts and Letters, 1028 in that of Science, 921 in Law, 1172 in Medicine, and 54 in Theology. For special instruction in the Fine Arts there are in the kingdom 87 academies and schools of design with 15,958 pupils, and 53 conservatoires or ecoles de musique with 13,063 pupils. Thus the country may be said to possess, in proportion to its population, a very complete equipment of primary, secondary, technical, and academic or university education.

A Dutch law of 1857 established throughout the Netherlands an excellent system of national education. Secular teaching alone was to be endowed with public funds. No schoolmaster huh in the national schools was allowed to give religious "oi'^nd. instruction, or "to say, do, or tolerate anything disrespectful to the religion of any class of pupils." Religious teaching was left wholly to the care of religious bodies, who were permitted to provide it in the schoolrooms, outside the regular school hours. This system was confirmed by the law of 1878. But it proved unsatisfying to the large and earnest minority of religious persons who had set up at their own expense schools for the denominational education of their children. In 1888 no fewer than 480 of these "Bible schools" were found to be maintained by voluntary gifts, with 11,000 teachers and 79,000 pupils (cf. Lecky, Democracy and Liberty, ii. p. 72). The law has since 1889 been so altered as to permit these schools, on fulfilling certain conditions of efficiency, to receive regular subsidies and inspection from the State. The result is in Holland a mixed system which, while leaving the public secular schools undisturbed, recognizes voluntary and religious schools, and offers to aid them with grants of public money.

The following statistics show the latest returns respecting prim ary education in Holland. Further details will be found in the im- portant report of Mr Balfour in the fourth volume of Special Reports issued by the English Board of Education.

In the school year 1898-99, 730,688 pupils were receiving primary education in Holland. This figure includes both girls and boys. The total population on 31st December 1898 was, according to the communal population returns, 6,074,632.

The 730,688 pupUs were distributed among the various classes of schools as follows : —

In Public Primary Schools —

Boys .... 280,152 Girls 223,579

503,731

In Subsidized Private Primary Schools —

Boys 130

Girls 770

In Private Primary Schools not receiving Government Subsidies —

Boys 99,340

Girls 126,717

900

~~226,057~~

~~Total, . . . 730,688~~

~~It is noticeable that whereas the figures for all primary schools amount for the year 1899 to 730,688, and for the year 1898 to 719,415, showing an increase for the attendance of all schools of 11,273, the increase has been mainly confined to the public schools and the unassisted private schools.~~

~~Possibly the explanation of these facts may be found in the conditions attaching to Government grants to private or denomi- national schools.~~

~~Such grants were first instituted by the law of 1889, which estab- lished the compromise by which the long-standing religious diffi- culty seems finally to have been settled. Yet after ten years of operation, the law of 1889 has enabled the Government to make grants to eighteen only out of 1448 private schools. And while the number of schools receiving Government grants has decreased, the tmassisted private schools show a great increase, larger even than that of the public schools.~~

~~The following are some of the conditions that have to be fulfilled by a private school claiming a Government grant under the Act of 1889:—~~

~~1. It must be managed by an association or institution possess- ing the rights called "civil personality" (similar to the English " rights of a corporation ").~~

~~2. Its headmaster must possess the rank of instituteur-en-chef, or " master-in-charge."~~

~~3. The instruction miist comprise all the obligatory subjects of primary education.~~

~~4. Instruction must be given in obligatory subjects during at least eighteen hours per week.~~

~~6. The school must possess a body of rules and regulations which are binding upon it, and must annually receive the signature of the Inspector of~~

~~*the arrondissement, whose duty is to see that the rules are not contrary to school law.*~~

~~*It is, therefore, to the conditions which preclude private schools from applying for Government grants that we should look for an explanation of the figures already given. These negative condi- tions are as follows : —*~~

~~*No school can claim a Government grant*~~

~~*(1) in which there are not more than 25 pupils more than six*~~

~~*years of age ;*~~

~~*(2) in which the school fees exacted reach an average of 80*~~

~~*florins per pupil ;*~~

~~*(3) which has been established or is managed for pecuniary*~~

~~*profit.*~~

~~*It should further be noted that whereas Government grants are made to public schools, in aid of new buildings, repairs, &c. , to the amount of 25 per cent., no such grants are made to any private school.*~~

~~*If the explanation of the small number of private schools receiv- ing Government grants is not to be found in the conditions attached to them by the law of 1889, — and it will be generally agreed that those conditions are in no sense onerous, — then the only explana- tion is that the members of religious and charitable associations who direct the private schools of the country prefer partial freedom from Government control, and will not sacrifice this in order to gain Government assistance.*~~

~~*In Matthew Arnold's report to the Schools Inquiry Commission in 1866, he said, " The school system of Germany, in its complete- ness and carefulness, is such as to excite the foreigner's ertnany. admiration." There is, in fact, no country in Europe in which more skill, statesmanship, and public spirit have been brought to bear on national education. So early as 1649 the General Synod of Wiirtemberg (G. Perry, German Elementary*~~

Schools, p. 24) required that parents should send their children to school. Similar regulations were enforced in Saxony in 1764, in Prussia in 1730, and in Bavaria in 1802. The Prussian Constitu- tion of 1850 declares "that adequate provision for the education of the young is made by means of public schools ; and that parents and their representatives may not leave their children and foster- children without the instruction prescribed for the public elements ary schools. ' ' The laws in the several German states differ slightly

in some details, but generally enforce attendance from the age of six to fourteen, and an additional attendance at a Portbildung- sehule is frequently required in the evenings or on Sundays, e.g., in Saxony, Saxe-Weimar, Saxe-Coburg-Gotha, and Hesse, for either two or three years after attaining that age. In the kingdom of Saxony alone there were 1900 such institutions, with 77,808 boys. Long habit and tradition and the public opinion of the industrial classes have rendered the attendance laws easy of enforcement, and it is computed that the absences from school vary from 3-6 to 7 per cent., and seldom exceed 6. Moderate school fees are exacted in Prussia, Saxony, and Bavaria ; but some muni- cipalities—notably those of Berlin and Dusseldorf — have made the instruction in the communal schools gratuitous. (Arnold, B^ort to Education Department, 1886, p. 4.) On the average of the whole kingdom of Prussia, school fees meet 20 per cent, of the cost of teaching in the popular schools, endowments 12 per cent., the municipalities 55 per cent., and the State 12 per cent. In Bavaria the fee is fixed at a minimum of eighftpence and a maxi- mum of one shilling and fourpence per quarter. In Saxony the minimum fee is three shillings per annum, but a higher charge is made according to the means and social status of the parents. But in all the states provision is made for the gratuitous instruc- tion of the very poor. The general rule in Germany is "a school fee where the scholar can afford to pay it, remitted where he can- not." As to the quality of the school instruction, Arnold, in the same report, describes a fuller programme for the elementary schools than in England : religion, German, English, history, geog- raphy, arithmetic and algebra, geometry, vpriting, drawing, sing- ing, and gymnastics being all included. In the opinion of that acute observer, the methods of teaching in Germany were more gradual, more natural, and more rational than the English ; and the religious teaching, chiefly in the form of Bible history and extracts and

evangelical hymns, appeared to him to be specially interesting and intelligent. In 1896 Prussia had a population of 31,840,795 persons. It was then computed that 223 out of every thousand of the population were between the ages of five and fifteen, and that the nmnber of scholars actually in attendance in the Volkschulen was 5,236,826.

The famous Prussian Minister of Instruction, Dr Ealk, sought energetically in his anti-clerical campaign (the Kultur-Kampf) to make national education more completely secular in its character. The drastic "Palk Laws" of 1873 were chiefly directed against the Catholic Church and the influence of the priests in education. They gave to the State the right to inspect all educational institu- tions, both private and public, and resulted in the closing of many seminaries and establishments of religious orders. But after the death of Pius IX. in 1878, diplomatic relations between the Gov- ernment and the Vatican were restored, and Prince Bismarck suc- ceeded, after direct negotiations with Eome, in mitigating the sever- ity of the Anti-Catholic Laws. Subsequent efforts of the Catholic party in the Reichstag to increase clerical influence over education have, however, failed. But from 1887 a more conciliatory policy towards the religious bodies has been adopted in Prussia, and pro- vision has been made in the State schools for the separate religious instruction of Roman Catholics, Protestants, and Jews in accord- ance with the wishes of the parents. Dr Falk resigned office in 1879, and died in 1900.

It is evident that Germany owes as much as any other country to a strong sense of the national importance of education, and to the consistent and resolute efforts of her statesmen during many years to develop and to perfect it. HIence, as Mr Sadler has said (Problems in Prussia, Special B^orts, vol. iii. p. 89), " Through the labour of generations the public higher schools for boys stand, from several points of view and in many important respects, as models to the world. They are unrivalled in their high level of many-sided attainments. Thought has been lavished on the plan- ning and concentration of their studies. The quality, the range, and the method of their teaching are under the watchful care of State inspectors, themselves experienced in the work of secondary education. All the schools are thus scrupulously kept up to an exacting standard of excellence. Prussia, in particular, owes much to Stein, to HIumboldt, to WoU, and to

Schleiermacher, and in the department of primary education to the ideas of Pestalozzi and to the inspiration of Fichte." So early as 1794 the Allgemeines Landrecht formally declared schools and universities to be State institutions. In 1808 there was established a special section of the Home Office for worship and public instruction, and from the year 1817 this section has been separated from the Home Office and has constituted an independent Education Department.

Switzerland, with its small population of 2,993,334, has long been distinguished for its educational efforts and resources. It was the home of De Fellenberg and of Pestalozzi; and it is here that some of the most fruitful experiments in public Swltzer- instruction have been tried. An article in the Federal '

Constitution requires that throughout the country "primary instruction shall be obligatory, and in public schools gratuitous."

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All the cantons comply with t(iis general law of the Constitu- tion ; but each of them has its own school law, and the right to provide and to regulate their local schools is jealously guarded by the several cantons. Every proposal to extend the power of the Bund over primary education has been met with strenuous opposition.

The total expenditure from public funds on all the grades of education amounts to £1,617,201 ; that is to say, £948,788 on primary education, £223,118 on higher primary and continua- tion schools, £30,530 on training colleges, £167,089 on lyo^es and other secondary and intermediate schools, £97,250 on universities, and £150,426 on technical instruction. The contribution of the communes amounts to 51-7 per cent, of the total expenditure, that of the cantons to 42-2 per cent., and that of the Bund to 6-1 per cent. , this last being mainly a recent grant for technical instruc- tion only, and appropriated chiefly to the Polytechnicum, or Tech- nical University at Zurich, which is a federal and not a cantonal institution. The entire revenue for general education may thus be said to be derived from

local resources. There are differences of some importance in the proportion of revenue assigned in different cantons to primary and secondary instruction respectively ; e.^., in Bern and Lucerne secondary and higher schools are gratuitous and the public subvention is large ; in Zurich and other cantons moderate fees are charged.

By a decree of April 1891 the Swiss Confederation proposed to grant subsidies for the encouragement of technical and commer- cial instruction, and also to furnish bursaries for scholars specially qualified by their capacity and industry, to enable them to attend the higher courses of a local commercial school. These must be boys of fifteen, who are to undergo three years' instruction, and at the end to receive a diploma. There are fourteen such schools in Switzerland. The chief subjects of instruction are : mathematics, arithmetic (including book-keeping, office work, and commercial law), political economy, some branch of technology, natural science, chemistry and industrial geography, one foreign language at least, type-writing, shorthand, gymnastics and military exercises, visiting factories under supervision, and writing descrip- tive accounts of the same. Fees are paid amounting to from 30 to 100 frs. for natives and 60 to 200 frs. for foreigners. In 1895, in the school subsidized by the Federal Government, the fees paid by students amounted to 47,891 frs., and the Federal subsidy to 63,250 frs. The total number of pupils was 542.

The provision for the training of teachers is ample. There are 24 State and 13 private normal colleges, with 2600 students. Most of these institutions are training colleges pure and simple, but ten of them form parts or appendages of higher primary schools.

There are no pupil teachers, but candidates for admission to a training college must have been in a higher primary school for two years. The curriculum extends over two or three years. Prom- inent importance is given to music, to pedagogy, theoretical and practical, and every student is required to study one language other than the mother-tongue, and some branch of experimental science. Arrangements are also made for an annual Alpine excur- sion of three or four days for botanical or geological research, or for visits to famous institutions. The annual cost is about £22 for each student, the State and the communes contributing three- fourths;

the rest is partly derived from voluntary contributions and partly from the fees paid by parents ; but by means of bursaries, graduated to suit the private circumstances of the students, these fees are so reduced that they seldom amount to £6 per annum. Certificates of competency are granted by the Council of Education for each canton, and not by the Federal Government. There is only one (in Canton St Gall) traiping college for higher primary or for secondary schools, but candidates who have had the full qualification of an elementary teacher, and have in addition served one year as assistant teacher and studied for two years at a university, may come up for the higher teacher's certificate (^Sekunddrschullehrer). The teacher is not, as in England, required very early to pursue his professional and his general education pari passu; he must up to 17 at least con- tinue in a course of liberal training, and not attempt to take up pedagogic study or practice until after that age. The religious difficulty appears to have been for the present satisfactorily solved. Matthew Arnold (Special Beport to the EducationDepart- ment, 1886) cites the article of the Swiss Constitution: "The public schools shall be capable of being attended by adherents of all confessions without injury to their freedom of faith and conscience." He adds that no difficulty has arisen in giving effect to this principle. The Swiss communes have in every popular school religious instruction in the faith of the majority — Catholic instruction in cantons like Lucerne, and Protestant in Protestant cantons like Zurich; Where there are enough chil- dren of the confession of the minority, a separate school is established for them ; where there are not enough, the children often attend the religious instruction of the majority, if the

parents consent. In the great town school of Lucerne, 400 Prot- estant children were found attending in class with 2900 Catholics, the Catholic children receiving their religious instruction in the school, and the Protestant children out of school and out of hours.

The foregoing details as to four of the most progressive countries of Europe will serve as a basis of comparison, and will render more intelligible the fact that ^^g ti d Great Britain the educational problem has from the first presented special difficulties, and has been less systematically and more tardily solved. In the northern part of the island the solution of that problem has proved less complex than in England and Wales. Some of the conditions

in Scotland have been exceptionally favourable. So early as 1660 the Church Assembly, largely owing to the influence of John Knox, put forth its Book of Disci- pline, containing provisions, soon afterwards ratified by the Estates of the realm, requiring that every parish kirk in a town should have its Latin school, and that in the rural districts there should be elementary schools, and in large towns colleges for teaching logic, rhetoric, and the Greek and Eoman languages. This legislation, confirmed by Acts of the Scottish Parliament in 1633 and 1696, and further enforced in 1803 by requiring each parish to) provide a house and stipend for a schoolmaster, has resulted in the gradual production not only of a higher level of education in the country, but also of a universal recognition of the value of instruction on the part of the community, including peasants and persons of all ranks. The parochial schools, the burgh schools or academies, have for many generations been in close relation to the Universities. The religious difficulty so acutely felt in the southern portion of the island has been greatly reduced in Scotland owing to the practical unanimity of the people in the adoption of the Presbyterian form of faith. Hence the educational progress of Scotland has in many respects been more steady than in England, and has not been confined to the primary schools. The report of the Scottish Education Department for 1899 shows that with an esti- mated population of 4,290,619, the country possesses 3536 separate departments in primary schools, with an attendance of 681,334 scholars, and 1016 evening continu- ation schools, with 67,729 scholars. The return of teachers shows that 10,676 are fully certificated, 2371 are assistants, and 4111 are pupil teachers. .The expe];i- ence of the Scottish Education Department, like that of the English, has led by degrees to the gradual abandonment of the practice of individual examination of children in. standards as the basis for the computation of the parliar mentary grant, and to the substitution of a normal or block grant for one determined by the number of passes in separate subjects. Otherwise the features of the Scottish system which distinguish it from that of England are : (1) the provision that "the normal grant may, on the recommendation of the inspector, be reduced by not less than one-tenth nor more than "one-half for faults of in- struction and discipline," thus retaining the principle that public aid shall be proportioned to the efficiency of the school (Art. 32) ; (2) the award of a m erit certificate after the age of twelve to all who pass a satisfactory examination in the ordinary subjects of an elementary school course, thus

recognizing the importance of an individual examination of scholars at the end of their course; (3) the special encouragement given to advanced departments in element- ary schools ; (4) the larger proportion (more than two to one) of trained to untrained teachers, and of head teachers who have graduated at the Universities ; (6) the increasing influence of the Scottish Education Department over secondary and technical schools, exercised by means of inspection, by direct subsidies under the Education and

Local Taxation Account Act (Scotland) of 1892, and by the award of leaving certificates and bursaries after the examination of pupils.

In Ireland the problem of national education has as- sumed a shape differing in many ways from that prevailing in other parts of the United Kingdom. Its ireiaad. ^ present system owes less to local initiative — either private or municipal — and more to the direct action of the Government. The population is more sharply di- vided in religious profession, at least 75 per cent, being Eoman Catholics, about 11 per cent, members of the Anglican Church, and 11 per cent. Presbyterians, chiefly in the province of Ulster ; the minor dissenting commu- nities, so numerous in England, being almost unknown. These conditions should be borne in mind in any attempt to estimate the historical development of the Irish sys- tem or to compare it with that of Great Britain. In 1831, two years after the enactment of Catholic emancipation, Lord Grey's Government established a Board of Educa- tion composed partly of Eoman Catholic and partly of Protestant members. To this body was entrusted the control of all funds which might be annually voted by Parliament for the purpose of erecting schools, visiting and inspecting them, making gratuities to teachers, es- tablishing a model school for the training of teachers, and supplying school-books and necessaries. Before this date grants had been made in aid of the Charter Schools, the Foundling Hospital, and the Kildare Place Society — a body which had been founded in 1811, and had sought to provide a system of schools wherein Catholics and Protestants might be instructed together, and the Bible might be read without note or comment. This society did not wholly succeed in obtaining the co-operation of the heads of either the

Catholic or the Established Church. The Commissioners, however, in the earlier stages of their administration endeavoured to obtain such co-operation by means of a system of combined moral and literary instruction, and separate religious instruction for children of different faiths. At first the Board also prepared for general use books of Scripture extracts from the historical portions of the Bible and from the Psalms, the Gospel of St Luke and the Acts of the Apostles ; and for a time the use of such books continued in the schools with the partial approval of the authorities of both Churches. But this compromise ultimately failed. The story of its failure, and of the gradual steps by which the Commissioners have abandoned the attempt to secure a mixed and comprehen- sive plan and have adopted a practically denominational system, is fully told by Mr Sadler {Special Reports, 1896- 97, p. 211), and is further described in careful detail in a memorandum, in the same volume by Mr C. T. Eedington, late Resident Commissioner. It must suffice here to refer to the most recent changes, especially to those which have resulted from the Eeport of the Viceregal Commission of Inquiry into Manual and Practical Instruction, 1897. With regard to the administration of the public grant, there is a fundamental difference between the conditions under which the Irish Commission acts and those which have controlled the English Education Department. This Department does not appoint teachers nor dismiss them, promote them or pay them. It neither builds nor furnishes the schools, nor regulates the duties of the staff, the choice of books, or the course of instruction. It simply makes a grant in aid to local managers, who have full power to supply these things at their discretion. Hence there was no other way open to the central Department to secure the efficiency of a school than by withholding a grant, or grad- uating it in accordance with the result of examination. But in Ireland the Central Board generally erects the school buildings of the " vested schools," it has the power to fix the stipends of teachers, to augment those stipends

for good service, and to make all needful provision for the equipment of the school and for determining the course of instruction. Thus the Board has ample means of securing a good educational equivalent for its outlay. ISTevertheless, until recently a considerable portion of the grant paid to teachers was made to depend on the answers given by the scholars when examined individ- ually in each separate subject of a very extensive pro-

gramme. The Commissioners have lately recommended a considerable modification in the system of distributing the grant. New rules were sanctioned in 1900 providing that teachers should in future be paid (a) a fixed salary, called a grade salary, there being three grades of teach- ers; (6) an additional salary called continued good service salary, which may be increased triennially; and (c) a capitation grant on the average attendance of the schol- ars. The teacher's position in the school, his length of service, and the goodness of his teaching, as attested by the proficiency of the scholars and the reports of the inspectors, are all taken into account in determining the salary of the teachers and their promotion from one grade to a higher. In this way the administration of the funds is calculated to secure efficiency by other means than that of payment by the results of individual examination, a plan now definitely abandoned. Other provisions in the newest regulations of the Board, for increasing the responsibility of local managers, for the preparation of reports of progress, and for giv- ing to parents a more direct interest in the educational welfare of their children, have been very carefully framed in the light of recent experience, and are full of promise for the future.

A new. department has been created for the promo- tion of technical instruction, and an active society, for Irish Agricultural Organization, is already trying some valuable and most hopeful experiments in the establish- ment in the rural districts of creameries, fruit-growing, poultry-yards, and the economy and distribution of farm produce.

The estimated population of Ireland being 4,531,051, the returns show that the number of pupils on the rolls of the national schools was 796,163, or more than one-sixth of the population. The number in average daily attendance, how- ever, was 613,862, or only 64-5 per cent, as compared with the number on the rolls. Of the scholars in (a) schools under Eoman Catholic teachers exclusively, 192,278, or 94-7 per cent., are Catholics, and 11,103 are Protestants ; in (6) schools under Protestant teachers exclusively, 7612, or 9-8 per cent., are Catholics, and 69,240, or 90-2 per cent., are Protestants; and in (c) schools under Catholic and Protestant teachers conjointly, 3818, or 68-8 per cent., are Catholics, and 2672, or 41-2 per cent., are Protestants. The proportion of schools which are specially denomina- tional schools, and are solely attended by Eoman Catholic or by

Protestant scholars, has steadily though slowly in- creased, and the last returns show that it reaches 62-5 per cent. The total revenue of the schools is £1,215,816, of which £1,149,692 is derived from the State, including £83,818 from the Customs and Excise grant. From all local sources together, including subscriptions and endow- ments and the fees paid by parents, the amount available is only £66,124. It is computed that the sum needed per head for elementary education is £2, 7s. ll|d.,of which £2, 6s. 3d. is contributed by the State and 2s. 7^. from all other sources.

The Board of Education maintains one Training College (undenominational), in Marlborough Street, Dublin, under its own management, and subsidizes four other Training Colleges, of which two for men and one for women are under the care of the Catholic hierarchy, and one for men and women is managed by the Protestant Episcopal

Church of Ireland. These institutions provide training for 380 students in the two years' course, and for 217 in the course for one year. The total number of students who passed the final examination qualifying them for recognition as teachers was in 1899, 159 men and 159 women.

The Board does not provide or support secondary schools, but encouragement is furnished by the examina- tions and certificates, with result fees, under the Irish Intermediate Education Act of 1878. All schools, whether denominational or not, including those of the Christian Brothers, are admitted to participate in the distribution; and in 1890 the sum allocated under the Local Taxation Act made it possible to augment the result fees, and was placed at the disposal of the Intermediate Education Board for that purpose.

In England the problem of national education has been rendered more difficult, partly by the complete absence until 1846 of any national recognition of the md Wales, ii^cessity of public education, partly from the great variety of Churches and of theological beliefs in the nation, and partly from the practical isola- tion of the Universities, the intermediate schools,

and the public elementary schools from one another. Of these difficulties, one which has given most concern and trouble to English statesmen has doubtless been that of determining the religious basis of national education. As one studies the history of thought and controversy in other countries in regard to religious teaching, it is seen that there are possible three sharply-defined forms of opinion on this subject: — (1) There are those who con- tend that the State being a secular institution, having no religious creed of its own, and yet composed of persons of very different religious belief, ought to confine itself absolutely to secular instruction, and to leave the teach- ing of theology to the several Churches. This is the principle on which the school systems of France and of the States of the American Union are founded. (2) There are others who contend that education is wholly incomplete without religion, that the teaching of religion means the enforcement of a creed, that the proper exponents of a creed are the authorized ministers of religion, and hence that a system of national education should be essentially denominational, and that if the State helps or controls primary education at all, it should do so through the agency of the Churches and their ministers. Throughout all Europe the Eoman Catholic Church has always insisted on this view, and has been unwiMing to entertain any proposals for a compromise. In some sections of the English Church the same belief exists, although to a much smaller extent. (3) There is another and a large class of the friends of education who dread the exclusion of the Bible and religious teaching from the common schools, but who do not desire to make such schools the propaganda for any particular sect. They regard the reading of the Bible, with simple undogmatic explana- tion, as appropriate to the intellectual needs of child-hood, and well suited for general adoption by Christian parents, so long as full liberty is given to the minority to withdraw their children from any religious instruction which they may disapprove. This is the principle which was adopted by the supporters of Joseph Lancaster, and by the British and Foreign School Society in 1811, and recognized in the Education Act of Mr Forster in 1870. Clause 14 of that Act, generally known as the Cowper-Temple Clause, enacts that " in any school provided by a School Board, no religious catechism, or religious formu- lary which is distinctive of any particular denomination, shall be taught." The School Boards are not bound to include religion in their course of instruction. But in 83 per cent, of the School Boards of England, including that

~~of London, it is the custom to give careful scriptural teaching, to make the children familiar with Bible his- tory, with the life and teaching of the Founder of Chris- tianity, with the poetry and literature of the Old Testament, and with such devotional or ethical parts of the Bible as are suited to the comprehension of children, it being understood that controversial teaching on points on which the several Churches differ shall be wholly ex- cluded. This comprehensive and scriptural but unsecta- rian ideal has proved very acceptable to English people, and especially to parents. At this moment it prevails over a considerable and increasing majority of the schools aided and inspected by the State.~~

~~There is, however, nothing inconsistent between the views of those who hold this third opinion and the recog- nition of the denominational principle within certain limits. Accordingly, the Act of 1870 leaves full liberty to the schools attached to the several Churches to give to their scholars the distinctive dogmatic teaching to which the managers attach special importance, provided that the secular instruction shall fill four-fifths of the day's exercises, and shall be thoroughly efficient. On these conditions, which are verified and certified after examination by H.M. Inspectors, the State recognizes voluntary schools and makes liberal grants for their maintenance. And in consequence there is not a single religious body in England or Scotland which does not, in so far as it is concerned with elementary education, com- ply with the regulations of the State and receive aid from it ; nor is there a remote corner in either country where the inhabitants are not within reach of a public elemen- tary school under Government inspection.~~

~~The particulars given in vol. vii. p. 679 of the Encyclo- pcedia Britannica (ninth edition) bring up the story of administrative changes to the date of 1877, and show what was the constitution of the newly-formed School Boards and what were their powers. Mr Forster had hesitated to make school attendance compulsory by the Act of 1870, but in Clause 36 of that Act he plainly con- templated such an early change in public opinion as would justify local bodies in enforcing attendance. Hence a later Act in 1876 enforced the duty of every parent to send his child to school between the ages of' 5 and 14, forbade employment under that age except to those who procured a labour certificate, and provided that indigent parents might~~

claim from the guardians the payment of school fees. The same Act provided that the grant payable to a school should not exceed the limit either (a) of 17s. 6d. per scholar in average attendance, or (6) the total income derived from other source than the grant. These limitations have since dis-appeared. In 1880 Mr Mundella's Act established direct and universal compulsion, and empowered the local school authorities to enforce it. In 1891 Sir W. Hart Dyke's Act practically abolished the payment of school fees, and thus threw upon the State the duty of com- pensating school managers for the loss of nearly two millions of annual revenue hitherto contributed by par- ents. A subsequent Act in 1896, introduced by the Vice-President, Sir John Gorst, provided a Special Aid Grant for the further relief of voluntary school managers. In the year 1890, before these great changes were made, the Government grants to elementary schools amounted to £3,326,177, the voluntary subscriptions to £768,670, the local rates levied by School Boards to £1,320,487, and the contributions of parents in the form of fees to £1,940,546. Later legislation during the administration of Lord Salisbury had the effect of altering materially the proportions in which the educational revenue is provided.

The whole of that revenue for the year 1899-1900

amounted to £12,336,986. This sum was made up as follows : —

Endowment

School Board rates .... Voluntary contributions . Pees and payment for books . County Council gra,nts for technical in- struction ..... Other local sources .... Government grants, viz : —

Annual grants ....

Fee grant under the Act of 1891 .

Special aid grant to voluntary schools under Act of 1896 .

Science and Art Department

£156,012

2,959,717

812,104

262,135

35,930 108,107

4,993,115 2,327,416

669,772 12,678

£12,336,986

Thus it is seen that the contributions from public sources, including the grants from the Treasury and from local taxation, amounted to £11,106,735, out of a total expenditure of £12,336,986. In the near future the contributions of parents and of voluntary subscribers may reasonably be expected to bear a yet smaller proportion to the total expenditure, and public control will in corresponding measure supersede private manage- ment.

These financial changes have not been without an im- portant influence on the character of elementary education. It should be remembered that the Department does not appoint or dismiss the teachers, nor pay them, nor recognize them as civil servants. The curriculum of instruction is largely in the hands of the local managers, and from the first the main influence of the Education Department has been exercised through its methods of awarding grants to these bodies. In fact, during many years the prime func- tion of the Department was not to direct education or to set up a national system, but to distribute a grant in aid of local effort, and to do this on a graduated system under such conditions as would stimulate improvement and ensure to the nation a good educational return for its expenditure. In this respect the English system has materially differed from more imperative forms of

educational administration adopted in other countries. A Royal Commission of 1853, presided over by the Duke of Newcastle, recommended the adoption of the principle of payment by results in the crudest and most uncompromising form, and Mr Lowe's Code of 1860 was designed to give effect to that recom- mendation. He said in. effect : " We do not insist on the adoption of any educational system, but we say if the Vol- untary managers will show us certain results we will help them with a grant. Thus if our conditions are not fulfilled, the nation will find the plan economical. If the plan proves not to be economical, it will be very efficient, for the instruc- tion will be worth paying for." Thus originated the sys- tem commonly known as payment by results. The grants were to be proportioned to the efficiency of the school, as determined by the individual examination of the scholars in reading, writing, and arithmetic alone. Later experi- ence has by slow degrees materially modified the applica- tion of this principle, and has, indeed, partly discredited the principle itself. The plan of measuring the efficiency of the school solely by the number of scholars who were able to pass the examination led to the adoption by teach- ers, in many cases, of merely mechanical methods, designed rather to secure the maximum number of passes than to cultivate the intelligence of the scholars or to subserve the higher purposes of school discipline and training. Mr Eorster, in 1870, was one of the first to see the inadequacy of the system, and in the Code of that year he added grants

for history, grammar, science, and other humanizing subjects. Subsequently special grants were made for discipline and organization ; and in 1881 Mi Mundella sought to enlarge the curriculum by permitting a wider option of additional scientific subjects and otherwise, by encouraging for the first time the Frobelian system of training and manual exercise in the infant classes; and by the introduction of a supplementary " Merit Grant," care- fully graduated and designed to recognize and reward any form of excellence in discipline or organization or general intelligence which was not capable of measurement by the results of individual examination as tabulated in a schedule of " passes." A second Eoyal Commission of 1887, pre- sided over by Lord Cross, was instituted to inquire into the operation of the Elementary Education Acts, and in its final report declared its opinion

" That the distribution of the Parliamentary grant cannot be wholly freed from its present dependence on the results of examination without the risk of incurring graver evils than those which it is sought to cure. Nor can we believe that Parliament will continue to make so large an annual grant as that which now appears in the Education Estimates without in some way satisfying itself that the quality of the education given justifies the expen- diture. Nevertheless we are unanimously of opinion that the present system of payment by results is carried too far and is too rigidly applied, and that it ought to be modified and relaxed in the interests equally of the scholars, of the teachers, and of educa- tion itself."

Accordingly, the Commissioners proceeded to recommend some modifications of the plan by which the amount of the grant payable to schools was at that time awarded ; e.g., that there should be a fixed grant of 10s. per scholar, and a variable grant of not less than the same amount, dependent partly on the results of individual examination and partly on various conditions hitherto recognizable for the purpose under the name of the " Merit Grant," the principle of which they sought to retain, though under a slightly altered form. These were moral training, order, obedience, general intelligence, and right classification. The Commission added, however, that in distributing the variable grant special stress should be laid upon proficiency in elementary subjects. These recommendations were sub- atantiaUy enforced by subsequent changes made during the Vice-Presidencies of Sir W. Hart Dyke and Mr Arthur Acland. Later experience, however, has led the Education Department to abandon altogether the attempt to graduate the grant according to the degrees of efficiency in the schools. In place of "testing the proficiency of individual scholars, there is to be one summary estimate of the work of the school ; in place of an annual examination, occasional inspection without notice ; in place of a variable grant dependent on a report in detail on the several subjects of instruction and on particular educational merits and defects, one block grant payable to all schools alike. This grant is fixed at either 17s. or 16s. per head in infant schools or classes, and at either 22s. or 21s. for older children ; the gain or loss of one shilling being the only difference recognized between the best schools and those which are not so bad as to justify the withholding of the grant altogether. It is hardly to be expected that this arrange- ment will be regarded as the final solution of the problem.

It may possibly have the effect of reproducing the state of things which provoked the censure of the Duke of New- castle's Commission of 1853, and which led to the novel and somewhat drastic expedient of determining the amount of the grant solely on the results of individual examination of scholars. Various expedients have been suggested for neutralizing the effect of so large a relaxation of the conditions by which it has been hitherto sought to secure accuracy and thoroughness in teaching. Among these, two have already been referred to as having been adopted in

the Scottish Code : a provision enabling an inspector to recommend deductions for specified faults in instruction, and a provision for the award of a merit certificate, to be given to a scholar as the result of an individual exami- nation at the end of his or her school course ; this latter plan of a leaving certificate having been in practical work- ing, with very satisfactory results, in Trance for many years. Neither of these expedients has yet been adopted by the Board of Education for England and Wales, but by this or by some other means it will probably be found necessary to make greater provision than the newest Code furnishes for stimulating apathetic school managers apd teachers to make efforts for improvement, and for assuring Parliament that its large annual grants are wisely, economically, and fruitfully expended.

The character of the instruction in the public elemen- tary schools has in other ways been materially affected by the system on which the central Department has awarded money payments. Successive Codes and Acts of Parliament have recognized the age of fourteen as the limit of primary instruction ; and after that age, and the completion of the curriculutn known as the " seventh standard," the ordinary grant to elementary schools ceased to be payable in the case of any scholar. But increasing numbers of scholars have shown a readiness — to remain and pursue an advanced course of instruction, without going on to schools of the higher or secondary rank. The Science and Art Department has been for many years administering special grants for drawing, design, and various branches of science ; and these grants have been still available for scholars who had

completed the elementary school course. Hence School Boards and Voluntary managers who have desired to retain scholars after the age of 14 have been led by financial considera- tions to give special prominence to those subjects for which grants were claimable from the Science and Art Department. But this has proved to be a partial and very inadequate provision, since the developed pro- gramme of what are called "higher grade schools" is often needed in the literary and general as well as in the specific and technical direction. A demand has arisen for schools or upper departments analogous to the Scales primaires supirieures which have proved so successful in France. This want is being recognized by the Government. By the Act of 1900 the Science and Art Department ceases to have a separate existence and to make separate payments for special branches of science. The new Board of Education, by which title the whilom Education Department is now known, is charged with the general supervision of primary and secondary, including technical and scientific, instruction, and will doubtless bring the various educational agencies into due relation to each other and make them take their places as parts of one coherent system. In such a system a place must certainly be found for " higher grade schools " such as have proved highly popular, especially in the great industrial cities of the North. They are not secondary schools, but merely places for continuing the instruction for an additional two or three years on the general lines followed in good elementary schools. The precise relations which are to subsist between these institutions and others, and indeed the true delimitation of the respective provinces of primary and secondary instruction, are matters which have been the subject of judicial decision and much debate. But they remain at present unsettled, and await the decision of Parliament and the new Board. One result of the existence of higher grade schools occupying, as they do, a kind of borderland between primary and secondary instruction, will probably be that the future local authorities will no longer be School Boards charged with the interests of

elementary instruction only, nor new bodies concerning themselves with secondary instruction only, but single local authorities having cognizance of all the public educational resources of a district.

The statistical returns of public elementary education for the year ending 31st August 1900 show that while the population of England and Wales was

32,526,075, there were 31,313 separate departments under head teachers, of which 4060 were for boys, 3912 for girls, 16,300 for boys and girls (mixed), and 8041 for infants only. The total numbers on the register were : in Church of England schools, 2,300,150; in Wesleyan schools, 156,666 ; in Eoman Catholic schools, 316,769 ; in Brit- ish and other unsectarian schools, 269,421; and in schools under School Boards, 2,662,669. Thus the total of registered scholars is 5,705,676, of whom only 6823 were 15 years of age and over. Accommodation was pro- vided for 6,544,092, or about 20-11 per cent, of the estimated population. But the total average attendance was 4,687,646. The staff of teachers was composed of 64,038 certificated masters or mistresses, 32,436 adult assistants, 29,393 pupil teachers, and 17,512 additional assistants. '

There are at present nodata from which similar statistics can be compiled respecting secondary schools.

Experience has proved that the differentiation of primary and secondary and higher instruction cannot be determined by enumerating the subjects proper to be taught under each head. The true distinction is to be f" "^^ found by considering the probable age to which /^. the period of instruction is to be extended. A course of educational discipline which is to end at the age of fourteen is a primary or elementary course. The school which seeks to retain its pupil to the age of sixteen or seventeen, and to prepare him to enter a skilled trade or one of the minor professions, is a secondary or intermediate school ; and one which has a curriculum designed to suit the requirements of a youth till the nineteenth year, and to qualify him for entrance to a University or one of the learned professions, is an academic school of the highest educational rank. In various degrees, science, technology, manual instruction, classics, a modern language, history, geography, and mathematics may enter into the curriculum of all three ; but the character of the teaching must in the main be dominated by the length of the school-life. Local circumstances and the probable destination of the majority of the scholars will rightly influence the choice and the co-ordination of subjects ; but we may conclude, generally, that whatever may be taught honestly and without pre- tension within the limits of age may be regarded as a legitimate part of a primary, a secondary, or a high school course. Of Greek, for example, it may be safely said that, as a rule, it could

not be wisely introduced as a subject either into a primary or an intermediate school, because in such a school there would be no chance of carrying the course of instruction to the fruit-bearing stage ; but other- wise there is no good reason for excluding from a school of any one of the three grades the elements at least of some subject which will stimulate the appetite for self- improvement and serve as a good foundation for further acquisition after leaving school.

The existing provision for secondary instruction in England has been hitherto furnished chiefly (a) by endowed grammar schools, (6) by proprietary schools established by religious bodies or public companies, and (c) by private enterprise. An inquiry instituted by the Education Department in 1898 with a view to ascertain the number of pupils in public and private, secondary and other schools in England, not being public elementary or technical schools, resulted in a report to Parliament which was very significant of the varied and incoherent character of the

provision made for secondary instruction. The report

" Some are hoarding schools, some are only for day-scholars. Some are the property of private individuals or of partners in private enterprise ; some are controlled by committees representing bodies of subscribers ; some are the property of companies formed under articles of association with limited liability ; some are con- trolled by local public authorities ; some are regulated by Royal Charter, by Act of Parliament, by scheme under the Charitable Trusts Act or under the Endowed Schools Acts, or by some other legal instrument. Some are for boys only, some for girls only, some for both boys and girls. But as there is no general system of inspection applying to all the schools alike, it is not possible, with any approach to accuracy, to classify, the whole number of schools, private and public, into grades of educational service. Nor is there in existence any list or register of these schools which pre- tends to be exhaustive. The whole subject is exceedingly obscure and has never been brought within the scope of comprehensive statistical inquiry."

The statistics in this return are based on information from 6309 schools, of which 1958 are for boys, 3273 for girls, and 1078 are mixed. The total number of boys was 158,502, and of girls 133,642. In 343 schools— 224 for boys, with 13,-248 scholars; 101 for girls, with 3864 scholars ; and 18 mixed, with 2147 scholars — no day pupils were admitted.

Endowments have furnished from the earliest times a larger part of the provision for education in England than in any other country. But it is only mentT" within the present generation that a systematic attempt has been made to bring them under control and to provide a special tribunal for dealing with them. Before the Reformation there were schools attached to monasteries, chantries, cathedrals, and guilds ; and the education given in them was chiefly directed to the training of choristers or priests. ,The description given by Mr J. B. Mullinger (in The Schools of Oharles the Great) applies, not inaptly, to the schools attached to religious houses in England before the time of Henry VIII. : " They were designed mainly for the monastic life : boys were taught to read, that they might study the Bible and understand the services ; to write, that they might multiply copies of the sacred books ; to understand music, that they might give with due effect the Ambrosian chant. Even arithmetic found a place in the course of instruction, mainly on the plea that it • enabled the learner to understand the Computus, and to calculate the return of Easter and the festivals." Mr A. F. Leach, whose industry has unearthed the names of 200 such schools, does not in his well-known book, English Schools at the Reformation, enable us to tell to what extent these schools were available for laymen, or how far they helped to provide general liberal education. Among them Winchester and Eton are the only notable survivors. The dissolution of monasteriete and the policy of the Protector Somerset, under Edward VI., caused many of these schools to disappear in their old form ; but a resolute effort was made to liberate them from purely ecclesiastical control, to re-establish them on a new foot- ing, and to provide by these means a liberal education for all classes. The reign of Henry VIII. witnessed the foundation of '63 grammar schools ; that of Edward VI., 51 ; that of Mary, 19 ; that of Elizabeth, 138 ; of James I., 84 ; and of Charles I., 59. The general characteristic of these schools was the provision in them for teaching the Latin and Greek languages, and for encouraging quick-witted and diligent learners in all classes of the community to qualify themselves for entrance

to the Universities. After the time of the Commonwealth, and especially in the time of William and Anne, scholastic endowments took a new form, and were directed rather to the establishment of charity schools for the children of the poor than to the encouragement of liberal studies

in the community at large. The 18th century endow- ments provided, in what were popularly called charity schools, gratuitous instruction of a very elementary kind, besides clothing and apprentice premiums for the children of the poor. These schools were in almost every case closely connected with the Established Church, and designed to attach scholars to that communion. Lord Brougham in 1816 persuaded Parliament to make an elaborate inquiry into the condition and resources of endowed charities generally, and the reports made in that and the following years gave many particulars respecting the incomes of the several trusts and the way in which they were administered. But the Commissioners to whom the work was entrusted were not charged with the duty of reporting on the educational ef&ciency of the schools. It was not till the year 1865 that the first serious attempt was made by the Legislature to ascertain the condition of secondary education and to take measures for its im- provement. Two previous Commissions — that of Lord Clarendon in 1861 and that of the Duke of Newcastle in 1859 — had reported, the former on the nine great founda- tions known par excellence as the " public schools " — Eton, Harrow, Winchester, Shrewsbury, St Paul's, West- minster, Merchant Taylors', Charterhouse, and Eugby — and the latter on the condition of popular or elementary education. Between these two there was a wide field for investigation and report, which was entrusted to the Schools Inquiry Commission of 1865. This body, under the presidency of Lord Taunton, made, with the assistance of Sir Stafford Northcote, Dr Temple, Matthew Arnold, and others, an elaborate investigation into the whole sub- ject and an estimate of the provision then afforded, not only by endowed foundations, but also by private and proprietary establishments, for education other than ele- mentary. The general character of the report, so far as ancient endowments were concerned, was extremely dis- appointing. A large number of the grammar schools were found to be in a feeble or decaying condition. The writer of this article was Assistant-Commissioner for the purpose of this inquiry, and his testimony, confirmed by that of all his colleagues, was that the number of scholars who were receiving the sort of classical education contemplated by the founders was very small and was steadily decreasing ; that the general instruction in other subjects was seriously defective ; and that the existence of statutes prescribing the ancient learning often served as a reason for withhold- ing any modern addition to it. The causes

of this de- terioration were carefully examined and reported on by the Commission. They were declared to be (1) the faulty composition of the governing bodies, who were ofteii little groups of persons renewing the trusts from time to time by co-optation, and in no wise representative of local wishes or needs ; (2) the system of freehold masterships, which made it nearly impossible to remove incompetent teachers or to effect improvement ; (3) the absence of any public or other supervising authority to ensure efBciency; and (4) th haphazard distribution of endow- ments, often in places where they were least suited to the requirements of the population. The elaborate reports of this Commission made a great impression on the public. They revealed a lamentable state of decay and uselessness in regard to many of the ancient " classical " foundations ; they showed the supply of good intermediate schools, whether private or public, to be wholly inadequate; and they urged the necessity for legislation, to correct the abuses and revise the schemes of the grammar schools, and to co-ordinate, extend and improve, and bring under public supervision the work done by local and private bodies. The Endowed Schools Bill, brought into Parliament by Mr Forster in 1869, was the immediate fruit of this report. Its author contemplated alarge and comprehensive measure

for the organization of secondary education. But the Bill consisted of two parts : the first calling into exist- ence an executive body — the Endowed Schools Commis- sion — to frame new schemes for educational endowments generally ; and the second providing for the creation of local authorities and a central authority, also for a regis- ter of qualified teachers, and for the due examination and supervision of all intermediate and secondary schools, whether private or public. Of this great and statesmanlike proposal, the first part only received the sanction of Parliament, and the second was never re- vived. But the Endowed Schools Act — at first admin- istered by a separate body of Commissioners, created ad hoc, under the presidency of Lord Lyttelton; and afterwards, in 1874, by a department of the Charity Commission — proved during the last quarter of the 19th century to be one of the most fruitful and most beneficial measures ever passed by Parliament. Under it new schemes were framed, which restored the vital- ity of hundreds of ancient and feeble endowed schools : governing

bodies were reconstituted; obsolete and out^ worn restrictions were removed! freehold masterships were abolished ; scholarships and free places, obtainable by merit only, were substituted for nominations by private favour and patronage ; and many valuable reforms were effected in general harmony with the recommendations of the Schools Inquiry Ke;^ort, which was, in fact, referred to in the preamble of the Act, and which serves as the key to the general policy which the Commissioners were en- joined to adopt. According to a return furnished by the Charity Commissioners to Parliament, schemes under the Endowed Schools Act have provided for the reconstitution of 902 educational foundations in England, and received the Royal assent, since the passing of the Act of 1869. In the case of 203 charities which in their origin were partly educational and partly eleemosynary or religious, schemes for the due apportionment of the revenue to educational and non-educational objects respectively were framed so as to apply funds, in the form of scholarships or otherwise, to the improvement of education in the districts concerned. A later Royal Commission on Secondary Instruction, which was charged in 1894 with the duty of making a new inquiry, and which was presided over by Professor Bryce, himself one of the ablest and most influential of the Assistant-Commissioners under Lord Taunton's inquiry, brought down the history of the facts to more recent times, and made elaborate recommendations with a view to a more complete reorganization of secondary instruc- tion in the light of the new resources and requirements of the times. It estimated the total annual value of the endowments applicable to secondary education in England at £735,000, excluding the value of sites and buildings. The principal legislative result of this Commission was seen in the enactment in 1899 of the statute creating a Board of Education for England and Wales, which took the place of the Education Department, the Science and Art Department, and also of the Charity Commission and the Board of Agriculture in matters appearing to the Sovereign " to relate to education." The Act abolishes the office of Vice-President of the Council, and the Board is to consist of a President, and of the Lord President of the Council (unless he is appointed President of the Board), the prin- cipal Secretaries of State, the First Commissioner of the Treasury, and the Chancellor of the Exchequer. With this Board is associated a Consultative Committee con- sisting, as to not less than two-thirds, of persons qualified to represent the views of University and other bodies interested in education, for the

purpose (1) of framing a register of qualified teachers, and (2) of advising the Board of Education on any matter referred to the com- mittee by the Board.

Wales.

The educational requirements of the Principality of Wales were dealt with in accordance with the recom- mendations of a special Royal Commission, which resulted in the enactment in 1889 of the Welsh Intermediate Education Act, providing for the creation in every county in Wales and in the county of Monmouth of a Joint-Education Committee, to consist of three persons nominated by the County Council, and two others, " being persons well acquainted with the con- dition of Wales and with the wants of the people," to be nominated by the Lord President of the Council. To these Education Committees is entrusted the duty of framing schemes for the establishment of intermediate and technical schools, for the right application of endow- ments, and for administering a contribution out of the county rate for the purposes of intermediate education generally. This Act has exercised a marked influence in the Principality, has multiplied secondary schools, and has been received with much favour by the inhabitants. In 1899 the Central Welsh Board was able to report that they had examined and inspected 93 intermediate schools, under the charge of 72 headmasters and 21 headmistresses, and that 7390 scholars (3877 boys and 3513 girls) were in attendance in these schools. The subsequent grant of a charter to the Welsh University, with which are fed- erated the Colleges of Bangor, Aberystwyth, and Cardiff, has gone far to complete the equipment of Wales in the department of higher education.

In several notable ways the ancient Universities of Oxford and Cambridge have in recent years sought to enlarge the range of their intellectual influence beyond the traditional academic studies and dis- yetsity ' cipline, and have exerted themselves with great local effect to improve secondary schools. In 1857 the e^mina- University of Oxford established a scheme for annual examinations of persons not members of the Uni- versity. This step was taken chiefly at the instance of Sir Thomas Acland and Dr Temple, afterwards Archbishop of Canterbury, and in the following year a similar scheme of external examinations was adopted by the Senate of the

University of Cambridge. Local examinations were estab- lished, and during the first seven years boys only were ad- mitted. Each University offered two forms of certificate, the one for junior and the other for senior candidates. Besides the ordinary subjects of a good school course, these examinations offer a wide range of option, " in order to give as free a scope as possible to the development of schools belonging to different types." The far-reaching effect of these open examinations on intermediate schools, and on the aims and plans of their teachers, may be partly estimated by the fact that the report of the Oxford Delegacy for 1900 shows that in that year the total number of candidates examined was 9772, of whom 3391 (1739 boys and 1652 girls) were presented at the pre- liminary examination, 4455 (2590 boys and 1865 girls) were juniors, and 1926 (636 boys and 1290 girls) were senior candidates. The total number who satisfied the examiners was 6265, the numbers of the two sexes being nearly equal. Statistics for 1900 from the University of Cambridge show that examinations were held at 238 centres for boys and 221 for girls : 16,247 candidates presented themselves for examination, of whom 3423 boys and 2158 girls were entered for the preliminary examina- tion, 5414 boys and 2965 girls under sixteen for the junior examination, and 921 boys and 1366 girls for the senior. The failures at the preliminary and at the junior examina^ tions vary from 22 to 26 per cent., and at the examination for senior candidates under nineteen, from 23-8 to 29. Both at Cambridge and at Oxford arrangements have been made for the inspection and examination of schools, and a Joint Board of Examiners has been established by the

Universities for awarding to a scholar in a secondary or higher school a leaving certificate, which may be regarded either as a terminus ad quern, testifying that the scholar has reached a fair standard of general pro- ficiency, or as a terminus a quo, serving as an entrance examination to the University, and accepted by nearly all the colleges of Oxford and Cambridge as an equiva- lent for a matriculation test. These particulars do not, however, furnish an adequate estimate of the influence which the

ancient Universities have exercised on schools at a distance from academic centres. That influence has helped largely to widen and improve the standard of education in the schools, to encourage students, to give them a truer estimate of their own acquirements, and to give new suggestions and stimulus to teachers. The general confidence in the fairness of the examinations may safely be said to increase year by year.

The Oxford Eoyal Commission of 1860, which reported in 1853, discussed several schemes for extending the

usefulness of the University — e.g.,thB establish- . extension, iii^nt of new halls, as independent societies or in

connexion with colleges ; the permission to under-graduates to lodge in private houses, and to become members of the University; and the admission to pro- fessorial lectures of persons not matriculated members of the University. On these points the recommendations of the Commissioners were favourable, and had the effect of leading speedily to desirable reforms. On the thorny question of the abolition of religious tests at matricular tion and graduation the Commissioners abstained from direct recommendation, although they expressed their "conviction that the imposition of subscription in the manner in which it- was then imposed in the University of Oxford habituates the mind to give a careless assent to truths which it has never considered, and naturally leads to sophistry in the interpretation of solemn obliga- tions." It was not till 1871 that fuII legislative effect was given to these views by the abolition of religious tests for the higher degrees, except theology, the obligar tion to sign the Thirty-nine Articles at matriculation having been previously removed in 1854. Another pro- posal by Mr Sewell for founding, by way of experiment, at Manchester and Birmingham, and in conjunction with Cambridge, local centres of academic teaching for persons who resided at a distance from the Universities, was con- sidered by the Commissioners, but was not embodied in their recommendations. The project, however, was not allowed to drop. Lord Arthur Hervey, afterwards Bishop of Bath and Wells, put forth in 1865 a pamphlet urging the University to supply the literary and scientific and mechanics' institutions of Great Britain and Ireland with lecturers from the Universities, and so to furnish to the students more systematic and more

continuous courses of instruction than the isolated popular lectures commonly given in these institutions. But it is to Professor Stuart of Cambridge that the honour of taking the first practical step in this new direction must be ascribed. In 1867 he gave several courses of scientific lectures to ladies at Leeds, Liverpool, Manchester, and ShefBeld, on the invi- tation of the North of England Council for Promoting the Higher Education of Women, and in 1871 he ad- dressed a letter to the resident members of the University of Cambridge describing his experience, and urging strongly that the Universities were not local clusters of private establishments, but national institutions, and that they should seek to enlarge the scope of their intellectual influence by taking up the question of " University ex- tension " in a serious spirit. A syndicate was appointed in 1872 to consider the whole subject, and in the follow- ing year it reported in favour of adopting for an experi- mental period the proposed new scheme of local lectures.

In 1876 a society was founded in London, under the presidency of Mr (afterwards Lord) Goschen, for organ- izing, with the help of representatives of the three Universities of Oxford, Cambridge, and London, the scheme of University extension lectures for the metropolis and its neighbourhood. At the second Oxford University Commission in 1877 evidence was given by Dr Jowett, afterwards Master of Balliol, in favour of the establish- ment of an ofl&ce, and the appointment by the University of a secretary for University extension. He further suggested that the tenure of non-resident fellowships should be extended in the case of persons taking or hold- ing professorships in the large towns. In the following year, 1878, the scheme was formally established, and Mr Arthur Acland, afterwards Vice-President of the Com- mittee of Council, was appointed as the first secretary to the Delegacy. Prom that time the system has continueld to develop steadily, with increasing public favour and usefulness, and with friendly co-operation and division of labour on the part of the two Universities. By degrees lectures became supplemented by class-work and the systematic direction of private reading. In 1885 travelling libraries were formed; and in 1888 the first of a most successful series of summer meetings, to assemble at Oxford and Cambridge in the long vacation in alternate years, was held at Oxford. At two or three centres — notably at Exeter and at Colchester — a strong local desire has had the effect of

establishing a permanent college in connexion with the University. In a single session 192 courses of lectures were delivered in connexion with Oxford, 135 with Cambridge, 130 with London, and 7 with the Victoria University, giving a total of 464 courses, the number of lectures in a course varying from 8 to 12. The total of lectures in that session was 4408. In the same session 20,148 persons attended the Oxford courses, 10,947 the Cambridge courses, 12,923 the London courses, anct 910 the Victoria courses. Besides the 1100 members who attended the Oxford summer meeting, there was thus a total of 46,028 attendants at the courses, the number of lecturers employed being 88.

To this record of increasing activity in the older Universities is to be added the remarkable growth of local colleges of University rank in some of the most important industrial towns. In 1846 Mr '^^"""^' Owens endowed with nearly £100,000 the "' **"' coUege at Manchester which bears his name, in 1874 the Yorkshire College of Science at Leeds, and in 1878 University College at Liverpool, were founded ; and these three institutions became federated, and received in 1880 a Eoyal Charter under the name of the Victoria University. The Durham College of Science was founded at Newcastle-on-Tyne in 1871, and has since become incor- porated with the University of Durham. Mason College, Birmingham, was founded in 1876, and has been absorbed in the new University of Birmingham, which received a charter of incorporation in 1900. University College, Bristol, was established in 1876 ; Eirth College, Sheffield, in 1879 ; and University College, Nottingham, in 1881, the last two owing their origin in large measure to the stimulus afforded by successful courses of local " extension " lectures. No one of these institutions was founded by Government. All of them owe their origin to local patriotism, and to the large gifts which have been made to them by rich citizens; the equipment in Man- chester, Liverpool, Nottingham, and Newcastle being on an exceptionally liberal scale. But a Treasury Minute was issued in 1889 containing a provision that £16,000 a year should be distributed among these and similar colleges in sums varying from £1200 to £1800 a year each. King's College and University College and Bedford Collegefor Women, in London, were admitted to participate

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in this grant. There can be little doubt that all these modern developments of academic life and usefulness have supplemented the activity of the ancient Univer- sities in a remarkably effective way. The provincial colleges are yearly adding to the number of their students. Their freedom from traditional restrictions has enabled them to adapt their courses of study to the industrial requirements of the several communities in •which they are placed ; and hence practical and experi- mental science in its special bearing on the manufactur- ing interests of the district has taken a conspicuous place in some of the programmes of the local colleges. Yet in all of them ample provision is made for the teach- ing of language, history, and philosophy, and generally for the " humanities," as the basis of a liberal education. Nor would it be right to overlook their indirect effect on the social and intellectual life of the great industrial centres, for this has been scarcely less valuable than the actual teaching given in the colleges themselves. It has long been a subject of concern that many of the richer and some of the more cultivated inhabitants of great manufacturing towns ceased after a time to reside in them, and betook themselves to London or the country. The permanent inhabitants were for the most part ab- sorbed in business, and the lack has been felt of a class of persons engaged in intellectual pursuits, and obliged by the nature of their duties to become habitual resi- dents. The professors of the new provincial colleges form such a class ; and experience has shown that they have received cordial welcome, and that their influence on the local society has been generally recognized as a clear gain.

The future organization of University education in Ireland is not yet (1901) finally decided, and is still a

subject of much controversy in the sister island University ^^^ j^ Parliament. A Eoyal Commission has ^iahviand. been engaged in investigating the whole subject.

The principal existing provision for academic education in Ireland consists of the ancient University of Trinity College, Dublin, the Eoyal University founded in 1880, and the Queen's Colleges. The Provost and Fellows of Trinity College were until recently required to be mem- bers of the

~~Established Church, and the institution was long regarded as a stronghold of Evangelical Protestant- ism. But these restrictions and all religious tests have now been abolished. The Eoyal University consists of a Board empowered by charter to examine students and to confer degrees, but exercises no direct teaching functions. These provisions are not satisfactory to the heads of the Eoman Catholic Church, who have made a strong effort to induce the Government to grant a charter to a new Eoman Catholic University, which shall be largely under the supervision and influence of the hierarchy of that Church. The question thus raised is of great importan(;e to the whole empire, since by recent legislation all theo- logical tests, whether for the students or for the governing bodies, have been abolished at Oxford and Cambridge and at the Scottish Universities, and since every one of the newer academic institutions which are empowered to con- fer degrees, either in the United Kingdom or in the Col- onies, is wholly unsectarian in its character. The University of Laval, in Lower Canada, is almost the only exception — and not a very important one — to this general statement. Those persons who object to the proposed new departure from all these precedents in the case of the Eoman Catholics of Ireland, urge that there is a fundamental difference between a College and a Univer- sity. While Colleges with a pronounced denominational character deserve full recognition and public aid, a University is something more than a College. It is a chartered corporation empowered to set up a standard of~~

~~general scholarship and science, and to award degrees and distinctions, such as may have a recognized value in the learned world. In the discharge of this duty it is urged that theological considerations should have no place ; and the establishment of a University under the management, and charged with the interests, of a particular Church would be a reactionary step of very serious import in a nation which has deliberately divested all its Universities of their exclusive sectarian privileges, and in which there is not, in fact, an Anglican, a Presbyterian, or a Wesleyan University. Accordingly, a very general opinion has been expressed that, while providing amply to meet the reason- able desire of Eoman Catholics to maintain teaching insti- tutions adapted to their own needs, the University which is to possess the degree-conferring power should be gov- erned by persons distinguished for learning and science only, and not necessarily identified with a theological creed. It yet remains to be seen how far a~~

compromise on these lines can be arrived at in view not merely of politi- cal exigencies, but also of the higher interests of scholar- ship and of intellectual progress.

The reconstitution of the University of London in the year 1900, under the Act of 1898, is a fact of great sig- nificance in the history of the higher education in England. That institution was founded in ™/vere/

culture to bear on the practice, e.g., of engineering, of commercial and economical science, and of education con- sidered both as an art and as a science, and to aid by means of post-graduate courses the practitioners of these and other callings in their efforts to find a scientific basis for their several professions, is part of the task which awaits the Senate of the reorganized University, and on which they entered under the most hopeful auspices.

But, on the whole, it cannot yet be said that the part played by the English Universities in the higher pro- fessions, or in the general culture of the nation, is so important as could be desired. In 1871 Professor Bryce computed that whereas in Germany, with a population of 45 millions, there were 24,187 University students, Eng- land, with a population of 26 millions, had fewer than 5600 such students. Notwithstanding all the recent ad- ditions to her academic resources, England is still far behind other countries in the provision it makes for University education.

Successive Acts of Parliament have recognized the age of 14 as the limit of primary education ; and the Codes .of ^^^ Education Department have from time Hon schools to time prescribed that after passing the and poly- "standard" of instruction appropriate to that technics, g^gg^-^j^g grants on behalf of a scholar in a day- school should cease to be paid. Evening schools have, however, long been encouraged by special grants ^o give supplementary instruction to young people who had left the day-school. For a time these grants were made con- ditional, as in the day-schools, on the passing of the scholars in the examination in elementary subjects. Mr

Acland, however, in 1893 framed new regulations for evening continuation schools. The Code of that year gave greater variety of choice to managers in relation to the subjects of instruction, and substituted grants, calculated on the number of hours of regular teaching, for payments on the results of examination. These regulations gave a considerable impetus to the establishment of evening continuation schools, and the report of the Committee of Council (1900) records a total of 6154 such schools or departments, and of 206,335 scholars in average attend- ance. Of these, the number of boys and men nearly doubles that of girls and women, and the total number of evening scholars in Board schools as distinguished from Voluntary schools is in the ratio of three to two.

In the article on Technical Education will be found particulars respecting the provision which has been made for the encouragement of scientific and manual training in its special relation to skilled industry. A strong feeling had, however, become manifest, that both in the primary schools and in the supplementary evening courses the instruction was too literary in its character, and that the practical side of life — that which is concerned with the training of hand and eye, the use of tools and measurement, and the study of those branches of science which are most nearly related to the arts of life — had been unduly neglected. HIow far the defects thus apparent could be remedied by an altered curriculum in either the primary or the secondary school, or by the establishment of new and separate agencies, is a question not without difficulty, and one on which neither the public nor the higher educational authorities are yet clearly in accord. The young men and women who have acquired at the elementary school the habit of application and an interest in their own mental improvement, and especially those who desire to devote part of their leisure to the attain- ment of such scientific, technical, artistic, or literary knowledge as is most closely akin to their own business or profession, form a class for which the provision has

hitherto been inadequate, and which sorely needed, and still needs, further help and guidance.

In London part of the help thus needed came from an unexpected quarter. In 1878 a Eoyal Commission was appointed, with the late Duke of Northumberland as the chairman, for investigating the condition of the City

parochial charities. It was proved that many of them had become, under the altered conditions — social and residential — of the present day, obsolete and useless. Doles and Christmas gifts, pensions and apprentice funds, and other like forms of benevolence which had once been of service when the citizens of London lived at their places of business, were no longer needed when the resi- dents had flocked to the suburbs and lost all association with the London parishes. Moreover, the revenues of the charities had in many cases, owing to the greatly increased value of City property, grown out of all pro- portion to any wants of the few remaining City residents. The Conynissioners, e.g., refer to one parish, with a popu- lation of only 160 consisting chiefly of bank clerks, in which there was a pension fund of £1800 a year. Ac- cordingly, Parliament in 1883, mainly at the instance of Mr Bryce, passed the City Parochial Charities Act, which empowered a small body of Commissioners, after making due reservation of ecclesiastical and other prior claims, to apply the revenues to other objects of utility more suited to the present needs and circumstances of the London population. The sum of £165,000 was appropriated to the purchase of open spaces and recreation ground's in London and its suburbs, and a like sum to the establish- ing of Free Libraries and of Polytechnics. Besides the capital sum thus expended, an annual revenue of about £50,000 was retained in the hands of the Commissioners, and has been employed in the maintenance and extension of similar institutions. The People's Palace in Mile End and the Borough Eoad and Battersea Polytechnics are among the best-known examples of the institutions which have thus been aided. In them provision has been made for evening classes and lectures of a varied and attractive kind ; for manual and industrial training in workshops and in class-rooms ; for gymnastics, and for field-naturalist, musical, debating, and similar clubs, as well as for draw- ing and design and other forms of art. There can be little doubt that these institutions, all of which are crowded with students, are exercising an important and increasing influence on the intellectual culture of Lon- don, and especially on the career of the more thoughtful and more aspiring of young people engaged in commerce or in manufactures in the City and its environs. Other grants from the fund have been made, and will probably continue to be made, at the discretion of the trustees, in aid of smaller classes and institutes, the colleges for working men and women, and the like useful objects.

Another windfall became available in the year 1890, which had a large influence in extending the opportun- ities for the literary and the industrial improvement of young men and women after quitting the elementary school. In the previous year the Technical Instruction Act had empowered local authorities to supply, by means of rates, technical or manual instruction, and had defined such instruction as " instruction in the principles of science and art applicable to industries, and in the application of special branches of science and art to specific industries or employnients." Butin 1890 certain local taxation (customs and excise) duties having been directed to be paid to the same local account as the local taxation probate duty, it became necessary to make legal provision for the distribution and application of the duties so paid. At first it was proposed by the Government to employ a substantial part of this sum in compensating publicans for the loss of their business. But Parliament showed great unwillingness to assent to

such an appropriation of the funds, and, mainly on the initiative of Mr A. H. Acland, the Local Taxation (Customs and Excise) Act was passed, practically permit- ting the application of the whole fund, after the deduction of a fixed sum reserved for the superannuation of the police, to the encouragement of technical instruction as defined by the Act of 1889. The total annual sum thus available was nearly one million sterling, and it was placed at the disposal of County Councils and County Boroughs, in proportion to the ratable value of the property in the several populations which they represented. The share of London, which in 1890 was £162,572, has since increased, until in the year 1900 it amounted to £225,728, of which £180,000 is allotted to technical education. The County Council appointed a special Board for the admin- istration of this fund, and has applied it in various ways. The estimated expenditure for 1900-1 includes (a) Tech- nical departments of Polytechnics, including contributions towards the erection of buildings, £36,650; (6) other technical schools and institutes, £24,664 ; (c) establish- ment and initial equipment of new institutions, £22,000 ; (d) technical departments of public secondary

schools, £28,470; (e) higher education, £3500; (/) county scholarships, £30,362; (g) teaching in Art, Science, Technology, and manual instruction, including scholar- ships and pioneer lectures, £16,506; (h) domestic economy, £5874 ; (t) commercial subjects, £4798 ; (j) museums (art examples), £383 ; and (k) expenses of administra- tion, £7860. One of the chief features of the London scheme is the liberal provision of scholarships offered annually by the Technical Education Board. There are 600 junior scholarships open to all London children under thirteen, and carrying with them the right of free educar tion in some approved secondary or technical school, and in addition a gratuity of from £8 to £12. Other scholar- ships — e.g., intermediate, commercial, art and artisan, domestic economy, horticulture and practical gardening, and cooking — are also provided ; the general principles of award being that the scholarships are open to all resi- dents in London, that boys and girls are alike eligible, and that the sum granted is partly expended in the pay- ment of their fees in some school or technical college, and partly in a money payment in aid of the scholars' maintenance during the period of study. The number of such scholarships granted in 1899 was 1710, and the total sum thus expended by the Board was nearly £40,000. Thrdughout the country the sums of money thus specially assigned by the Act have been employed by the County Councils on educational objects more or less akin to the industrial and commercial requirements of the several districts. Without precedents to guide them in the exercise of their novel trust, many of the Councils have tried various experiments — e.g., in seaports, schools of navigation; in Newcastle and other places where great engineering works existed, the study of mechanical science has been helped, partly by providing laboratories and apparatus and special teachers in exist- ing schools, and partly by scholarships and exhibitions tenable in science colleges ; in rural districts, the study of agriculture and horticulture, and the encouragement, by the help of peripatetic lecturers and otherwise, of systematic instruction in dairy work, bee-keeping, or cheese-making. The total effect of this beneficent Act in reviving many local industries, in encouraging educa- tional enterprise and new forms of manual and scientific instruction, has already been powerfully felt, although the full application of the special fund thus received from the Exchequer still yet awaits further experience, and may require some modifications in the plans originally tried.

The influence of the Public Libraries Acts, of which the

first was passed mainly at the instance of Mr William Ewart in the session of 1850, has been very exten- sive and beneficial. At first the maximum rate which the various municipalities were empowered to levy was a halfpenny in the pound, but ^raries. the Act of 1892 removed this restriction and empowered the inhabitants to determine for themselves the amount which might be applied to this object. A rate of one penny is generally found to suffice, but in Wigan the library rate has reached twopence in the pound. English municipalities were slow to recognize the great intellectxial and social advantages of the Free Library, or to avail themselves of the permission given by the Act of 1860. In 1860 there were only twenty-one such libra- ries and reading rooms ; in 1870 there were thirty-five ; in 1880 fifty more were added. In 1890 the total had reached 187 ; and there are now 340 free libraries in Eng- land and Wales. Of these, 36 are in the metropolitan districts. The total number of volumes in use, for refer- ence or for distribution, is about six millions. Manchester furnishes 280,000 ; Birmingham, 215,000 ; Liverpool, 200,000; Leeds, 195,000; Sheffield, 110,000; Bristol, 90,000 ; and Nottingham, 85,000. Most of these libraries are housed in costly and convenient buildings provided by the several municipalities, and all of them are visited by increasing numbers of readers. It is becoming more and more evident that the public library is an indispen sable adjunct to the other agencies by which primary, secondary, and technical education are being promoted. Within the last few years the growth of public libraries ' has been stimulated to a large extent by the remarkable munificence of a private citizen. Mr J. Passmore Edwards has devoted more than a quarter of a million sterling to the erection, maintenance, or equipment of libraries, pic- ture galleries, or other kindred institutions. He has been singularly fortunate m the wise choice of objects, which are wholly outside the category of ordinary charities, and are all intended in various ways to help forward the intelligence and the social enjoyment of the people.

No survey of the educational history of the Victorian era would be complete if it omitted all reference to the remarkable increase of late years in the public and professional activity and in the intellectual ^aucaSim influence of women. Access for the first time in English history has been found for

them not only to the medical profession, and to high and responsible employ- ments in the CivU Service, but also to many posts in con- nexion with commerce and with journalism ; to engage- ments as librarians and secretaries, and as superintendents of skilled labour, in gardens, in offices, and in factories. Women have also been employed, both by the Central Edu- cation Department and by local Boards, as inspectresses and organizing mistresses. In art also, and in literature and in scientific research, women have achieved success, and even eminence, to an extent unknown two or three generations ago. Besides new avenues to honourable and lucrative employment in professions and trades, th^re has been a large increase in the amount and value of the unpaid public services which women are now rendering to the community. Many have become members of School Boards and of Boards of Guardians, trustees of endowed foundations, or skilled administrators of charity. Some have been placed by the Government on various Koyal Commissions of Inquiry ; three were included in the Consultative Committee to be attached to the new Board of Education; and three have recently been nominated as members of the Senate of the University of London. In all of these ways, and in many others, women are taking daily a larger and more important share in the public life of England, and are rendering signal service. It cannot be doubted that in this way the whole

community has been enriched by the application of pow- ers and talents which, under other conditions, would have remained undiscovered and therefore unused ; and that in enlarging the range of intellectual interests open to women, they themselves have found new opportunities of useful activity, and new means of adding to the dignity and the happiness of their lives.

But all these important changes have presupposed as essential conditions increased educational advantages, and a higher standard of what is suitable and necessary for the instruction of girls. In the sphere of primary education the action of the Education Department has from the first been favourable. The standards of in- struction which have been prescribed from

time to time have, except so far as needlework is concerned, been practically the same for girls as for boys. The qualifica- tions of pupil teachers and for head teachers of both sexes have, with a few unimportant exceptions, been identical. The total number of certificated mistresses recognized by the Board of Education is 36,435, as compared with 23,- 439 certificated schoolmasters ; while of assistant teachers 4065 are young men and 22,671 are young women. This disproportion has a tendency to increase year by year, as a larger share in elementary work falls into the hands of female teachers. In this connexion it is interesting to consider the experience of the United States. The sta- tistics of the American Bureau of Education include teachers of all ranks, from the kindergarten to the higher colleges and universities, and the last returns show that in all 131,750 men and 277,443 women were engaged in education, and that the proportion of men to women had since 1870 steadily diminished; In 1870 it was 42 per cent., in 1889 it had fallen to 34-5 per cent., and in 1898 to 32 per cent. In the Department of Secondary Edu- cation in England a like change is taiing place. Formerly all the more pretentious private "seminaries" for girls prided themselves on the number of visiting masters, who gave lessons in arithmetic, or history, or music, or astronomy and the use of the globes. But in just the proportion in which a liberal education has become ac- cessible to women, the need for masters is fast disap- pearing; since it is a familiar fact of experience that, given an equal amount of knowledge, women are likely to be better teachers of the young than men, as they have greater natural aptitude and a finer intuitive in- sight, enabling them to know the needs of childhood and to adapt lessons to these needs. What they know they can teach. The only reason why this fact has been so slowly recognized, is that the opportunities for obtaining sound and thorough scholarship were so long withheld. Of the public measures that have affected the intermediate education of women in England, one of the most effective was the report of the Schools Inquiry Commission in 1867, in which the defects of girls' sec- ondary instruction were characterized as " want of thor- oughness and foundation ; want of system ; slovenliness and showy superficiality ; inattention to rudiments ; undue time given to accomplishments, and those not taught intelligently or in any scientific manner ; and a complete absence of proper organization." In the Endowed Schools Act of 1869 there was inserted the 12th clause, " In fram- ing schema under this Act provision shall be made, as far as conveniently may

~~*be, for extending to girls the benefits of endowments." The last report of the Charity Commission shows that, in obedience to this clause, eighty-two new secondary schools for girls had been es- tablished, and that sixty-two other schemes contain inter alia special provisions for enabling girls to share, either by scholarships or otherwise, the advantage of ancient grammar school endowments. Schemes for some of the wealthier foundations, notably St Paul's School and*~~

~~*Christ's Hospital, provide liberally for the future appli- cation of large funds to the maintenance of secondary and higher schools for girls. The opening of the local examinations of the two Universities to girls has already been referred to, and has had a marked effect in raising the standard of efficiency in the intermediate schools for girls. In 1874, when the public had been much impressed with the serious revelations of the Schools Inquiry Commission, Mrs William Grey and her sister Miss Shirreff, with the subsequent aid of Miss Mary Gurney, founded the Girls' Public Day School Company, with a view to familiarize the public with an improved type of schools. The experiment has proved remarkably successful. The company possessed in 1900 thirty- three high schools, with upwards of 7000 pupUs ; and its example has been followed in many places, where schools of a similar character, under the care of qualified teach- ers and the government of responsible public bodies, have been founded independently. Before this effort, two of the most remarkable institutions for the secondary instruction of girls had furnished the pattern which the company to a large extent followed. The Ladies' Col- lege at Cheltenham had been founded in 1854, and under the skilful supervision of Miss Dorothea Beale had grown into one of the most important institutions in England. It is unrivalled in the completeness of its material equipment, in the qualifications of its teachers, and in the successes it has won in all the most important examinations open to women. Including its kindergar- ten and its training department for teachers, it numbers upwards of nine hundred pupils, of whom about half are boarders, and the rest are the daughters of residents in Cheltenham, many of whom have settled in the town and neighbourhood for the express purpose of availing themselves of the exceptional advantages which the college offers. The North London Collegiate School for Girls, which originated in the remarkable efforts of Miss Frances Buss in the year 1850, and which has gradually become a*~~

public foundation school of a high type, has served as a niodel, since largely imitated by the founders of local high schools for girls. • Bedford College and Queen's College in London were established in 1848, with a view to place opportunities of higher education within reach of girls who desired to prolong their educEu- tion beyond the ordinary term of school-life ; and the names of Professor P. D. Maurice, Charles Kingsley, Miss Anna Swanwick, and Miss Prances Martin have been honourably associated with the early successes of these institutions.

But the most important aid which women have received in regard to advanced education has been furnished by the English and Scottish Universities. In 1867 the first attempt was made to establish in England a college of University rank for women. A house was taken at Hitchin, midway between London and Cambridge, and fitted for the reception of six students. In 1873 the college was removed to new premises at Girton, near Cambridge. By successive additions it has been enabled to receive 150 students, and it will probably be still further enlarged. From the first the governing body of Girton College, prominent upon which were Miss Emily Davies and Lady Stanley of Alderley, sought to avail itself to the full of the academic education provided by the University, and to maintain the standard of learning in the college on the same level as that prescribed for men. In 1871 a similar enterprise was started under the care of Miss A. J. Clough, who took a house at Cambridge to prepare students for such examinations as were then open to women, and in this way established the institution known as Newnham College, which has been from time to time enlarged, untU it contains three halls of residence and accommoda-

tion for 150 students. Both colleges are thriving, and have always been well filled. In some minor respects the arrangements of Newnham are more elastic than those of Girton, since its students are not all required to pass through the regular University curriculum. But from the first both institutions have sought recognition from the Wniversity; and steps were taken to obtain for the students of the colleges admission to the examinations for degrees. At first personal application was made by Girton to

the examiners, with the cognizance of the Council of the Senate, requesting them to examine some of the college students, and to conduct the vivd voce examination, reporting on the attainments of the stu- dents according to the University standard ; and ujf to 1881 degree examinations were carried on by the courtesy of the examiners, on an informal but strictly regular system, simultaneously with those of undergraduates of the University. In 1881 the Senate by formal grace extended to women the "Little-go" and the Honour examinations, though not the examination for the ordi- nary degree; and since that date the students of both colleges have been admissible to the Previous and to the Tripos examinations, and have received from the Uni- versity a formal certificate attesting the result of the examination, though not at present conferring the actual academic title. The total number of students admitted to Girton from the time the college was opened till 1901 was 757, of whom 496 obtained honours according to the Cambridge University standard, 146 having passed in the Classical and 134 in the Mathematical Tripos, and others in History, Mediaeval and Modern Languages, or Natural Science. Newnham College also secured between 1880 and 1900 upwards of 500 places in the Tripos examination. In the single year 1899, 12 students passed in the first class, 29 in the second, and 20 in the third, besides 3 students who attained the standard qualifying for the ordinary degree.

The University of Oxfard has followed the example of Cambridge somewhat slowly and gradually, but with very notable results. Three colleges for female students have been established — Somerville College, Lady Margaret Hall, and St Hugh's Hall. The University instituted X special examinations for women in 1875 ; but in 1884 these special examinations were practically abolished, and a statute was passed in Convocation opening to women the ordinary Honour Moderations (Classics and Mathe- matics), and the Final Honour Schools of Mathematics, Natural Science, and Modern History. In 1886 women were admitted to Responsions, in 1888 to the Honour School of Literce Humaniores, in 1890 to the Honour School of Jurisprudence, in 1893 to the Honour Schools of Theology and of Oriental Studies, and in 1894 to the remaining examinations for the degree of B.A. In all, between 1884 and 1900, 56 women presented themselves for honours at moderations in Classics, and 17 in Mathe- matics ; for final honours, 146 in Modern History, 22 in Natural Science, 7 in Mathematics,

~~*17 in Literce Huma- niores, 2 in Jurisprudence, 22 in English Language and Literature, and 47 in Modern Languages; of these, 56 passed in the first class and 119 in the second at the Final Honour School.*~~

Holloway College, near Egham, founded and munifi- cently endowed by the late Mr Thomas Holloway in 1876, has taken high rank as a college for women, and is recognized as one of the schools of the University of London in the Faculties of Arts and Science. In the year 1899 it had 108 students, and a large staff of pro- fessors and lecturers. It is exceptionally rich in scholar- ships, of which 12 are open for competition on entrance, and 2 others for students of merit in the college.

The University of London, as a comparatively modern institution, unhampered by tradition or ancient statutes, has found itself free to take a step which has at present proved impossible in the two older Universities. In 1878 the Senate, with the concurrence of Convocation, obtained from the Crown a charter enabling persons of both sexes to graduate in all the Faculties on perfectly equal terms. Up to the year 1900, 6185 women passed the examination for Matriculation, 1383 the Intermediate examination in Arts ; 861 obtained the full degree of B.A., and 63 that of M.A. In the Faculty of Science, 266 passed the Intermediate examination, and 146 ob- tained the degree of B.Sc, while 9 proceeded to the D.Sc. degree. In Medicine, 74 obtained the degree of M.B., 21 that of M.D., and 23 that of Bachelor in Surgery.

The example of the London University has since been followed by the Victoria University, by the Scottish and Welsh Universities, and by Durham University, with which is now incorporated the flourishing College of Science in Newcastle-on-Tyne. The University of Bir- mingham also receives as students, and admits as candi- dates for degrees, women as well as men. Proposals have sometimes been put forth by influential persons for establishing a women's University. But they have not proved acceptable to academic or public authorities, nor indeed to women themselves. Women's colleges supply already a great want, and they will probably increase in number and in usefulness. But for a women's University, which shall give a separate feminine degree, and set up a special standard of liberal education supposed to be adapted to the intellectual needs of women only, there is at present no general demand. Nor is it probable that such a demand will arise in any practical form until philosophy and experience shall have enabled us to differentiate the mental characteristics of men and of women, and to

determine in what departments of human knowledge each of them should be encouraged or required to excel. Meanwhile the chief advocates of the intellec- tual progress of women are content to ask the Univer- sities to afford access to the same variety of optional courses, and the same rigorous tests of attainment which experience has shown to be needed by men, and then to leave female students at liberty to exercise their own choice. Hitherto the British Universities have given a generous response to this appeal, and there can be little doubt that in any future development of academic insti- tutions in England the claims of women to share in the highest intellectual privileges will be more and more recognized.

It is right to record here a recent and significant fact in the history of educational endowments. Mr Pfeiffer, a London merchant, and his wife, Mrs Emily Pfeiffer, determined in 1884 to bequeath the ^J^°^"^ whole of their residuary estate, amounting to meat tor nearly £70,000, "to charities and educational women's establishments on behalf of women, and of e'/^^io,, women solely " ; and the will expressly specified that what the testator desired most was the intellectual or professional training of women, " theirs being to my mind the great influence of the future." The persons entrusted with the distribution of this fund were the Vice-President of the Council of Education, Miss Anna Swanwick, and the writer of this article. The bequest became available in 1890, and under the sanction of the Court was distri- buted, in sums varying from £2000 to £6000, to iGirton and Newnham and Somerville- Colleges, the training colleges for secondary teachers at Cambridge and in London, Bedford and Queen's Colleges, the Halls of Kesidence for women students attached to Universities and Colleges in London, Edinburgh, Dublin, Cardiff,

ot teachers.

St Andrews, and Aberystwyth, the London School of Medicine for Women, the College for Working Women, and similar institutions. In this way, either by the erection of new buildings or by the establishment of studentships and prizes, substantial help has been given to some of the most promising of the

modern enterprises by which the intellectual advance of women has been stimulated in the United Kingdom.

Recent years have witnessed a great change in the state of public opinion in regard to the professional qualificar tions of teachers. That teaching is a fine art, Traiaiag ^jj^t Underneath its rules and processes there lie principles which deserve investigation, and that the skilled practitioner is distinguished from the unskilled by his knowledge of the history and philosophy of his art, and of the reasons why some methods of instruction and discipline are right and others are wrong, are truths which are being slowly recognized by public authorities, as well as by teachers themselves. The full appreciation of the importance of training began at the lower end of the social scale. Shuttleworth and Tufnell in 1846 urged the necessity of special training for the primary teacher, and hoped to establish State Training Colleges to supply this want. The opposition of the Churches prevented the fulfilment of this design, and the one college at Battersea which was founded as an experiment was soon transferred to the N'ational Society. Before this, Bell and Lancaster had made arrangements in their model schools for the reception of a few young people to learn the system by practice in the schoolroom, and to pursue their studies in the after hours. In Glasgow, David Stow, who founded in 1826 the Normal Seminary which afterwards became the Free Church College, was one of the first to insist on the need of systematic professional preparation. The religious bodies in England, notably the Established Church, availed themselves promptly of the failure of the central Government, and 12 diocesan colleges for men and 16 for women have been since established. In 1854 the British and Foreign School Society placed their establishments at the Borough Boad and Stockwell on a collegiate footing, and subsequently founded other colleges at Swansea, at Bangor, at Darlington and Saffron Walden ; the Roman Catholic Church provided two colleges for women and one for, men ; and the Wesleyans two — one for students of each sex. Other training institutions have since come into being. The newly founded provincial colleges of University rank have been invited by the Education Department to attach normal classes to their ordinary course, and to make provision for special training and for suitable practice in schools for those of their students who desired to become teachers, but who pursue their general literary and scien- tific studies in common with other learners who are not

intending to enter the profession. Thus the Education Department came to recognize two kinds of training insti- tutions— the residential colleges of the old type, and the day colleges attached to institutions of University rank. Both are subsidized by liberal grants from the Treasury, and are regularly inspected. The report of the Department for 1899 showed that in that year there were 3700 students in residence and 1230 day students. As the period of train- ing is two years, these figures show a yearly increment to the ranks of certificated teachers of about 2400. But this supply is insufiftcient to meet the annual demand ; and 28-67 per cent, of masters and 5148 per cent, of mistresses still enter the profession by serving as assistants and passing the certificate examination, but without receiving regular collegiate training. There is thus still need of more train- ing school accommodation, and this is being gradually furnished by voluntary and municipal effort. But regular provision for training has hitherto been available for

elementary teachers only. Fashions, either in social usages or in dress, descend readily from one stratum of society to a lower, but they seldom ascend ; and the accident which caused the earliest pedagogic experiments to be tried in connexion with the teachers of primary schools has led to a general impression that training was needed for lower but not for higher educational work. Hence it has happened that only slowly, and not without reluctance, teachers and public authorities have come to the conclu- sion that a like training and discipline might with great advantage be made available in higher and intermediate schools. The University of Cambridge in 1879 took a step which has had far-reaching consequences in this direction. It entrusted a special syndicate vrith the duty of provid- ing public lectures on educational principles and practice, and of examining candidates for a special teacher's diploma. Since 1882 the University has awarded certifi- cates in the theory, history, and practice of education to 60 men and 1477 women. The University of London in 1883, and the Victoria University in 1895, instituted similar examinations; and in such great provincial colleges of University rank as have ^een founded in Manchester, Liverpool, Newcastle, Bristol, Birmingham, Nottingham, Leeds, and Cardiff, as well as in the older Universities, efforts are already made to provide courses of special preparation for secondary as well as for primary teachers. More recently, the University of Oxford has adopted a scheme for

granting certificates in education. This scheme, while providing special courses of instruction and a comprehensive syllabus of examinar tion, insists on evidence of regular and continuous practice in teaching under due observation as an; indispensable qualification for the University diploma. The two permanent institutions for the training of high school mistresses are the Maria Grey Training College, near London, and the Training College at Cambridge; but several of the leading high schools for girls — notably the Ladies' College at Cheltenham and the Datchelor School at Camberwell — have attached to themselves a training department which is becoming year by year more efiBcient. These institutions prepare their students for the Teacher's Diploma of either Cambridge or London University. All these movements are symptoms of an increased sense of the need of skilled training for the teacher's pro- fession, and all will be greatly strengthened and encour- aged by the clause in the Board of Education Act of 1899 which provides for a public registration of qualified teachers, and for the gradual elimination from the profes- sion of those who are unqualified. But the question will still remain. How and where are the needful qualifications to be obtained, since the Government has not established a Training College of its own, and since it is hardly to be expected that the want will be supplied by the voluntary efforts of societies or by private initiative ? In London and some of the larger towns it is already proposed to apply some of the funds available under the Excise Act to the training of teachers. It is to the Universities chiefly that the public has a right to look for at least a partial solution of this difB^cult problem. Experience is gradually revealing to us the conditions under which those corporations will be able to take an increasing share in the duty of giving professional training to teachers, and thus to render new and signal services to the State. These conditions are: (1) that the function of the teacher shall be recognized as one of the learned professions, and take honourable rank with Law, Medicine, and Theology ; (2) that the University shall pro vide a Professor of Didactics or Pedagogy, whose duty it shall be, by means of post- graduate courses of study and by requiring systematic practice in the art of teaching under due supervision and criticism, to give to the future schoolmaster both a practi-

cal and a theoretical acquaintance with the principles of his profession ; (3) that the University shall institute an examination for all students who may have passed through the prescribed course, and that this examination shall set up a high standard of qualification in regard to the practice and the history of education, and to so much of mental and moral philosophy as stands in the closest relation to teaching, whether considered as an art or as a science. The third of these requirements is already ful- filled by Oxford and Cambridge and by most of the English and Scottish Universities, although there is at present no general agreement as to the ideal standard of professional qualifications, or as to the best way of test- ing these qualifications. In regard to the second of these conditions, the Universities of Edinburgh and St Andrews were enabled, by means of the fund bequeathed by Dr Andrew Bell, to be the first British Universities to create a Professorship of Education ; and the Victoria Univer- sity has lately taken the bold step of establishing a special Chair, whose occupant shall have the same rank as the other Professors of Science or of the Humanities. But until all three of the conditions here described shall have been fulfilled, the British Universities will fail to exercise their legitimate influence on public education, and will neglect' a great opportunity of ennobling and liberalizing the teacher's profession.

Among the administrative reforms yet needed there is one which will probably engage the early attention of Parliament. Several of the great departments Admiais- of the public service are incidentally and in a oper^ion. Subordinate sense concerned with education, and are at present in no official relation with the central Board of Education. For example, Marine and Dockyard Schools have long been maintained at the various naval stations by the Board of Admiralty, with a view to supply elementary instruction to the children of the sailors and workmen employed at these stations. The supervision of these schools has for many years been entrusted to the Chaplain of the Eleet and to various naval officers. A like arrangement has long prevailed in' the army. The Local Government Board, under which the Poor Laws are administered, is neces- sarily concerned with the maintenance of schools for all the children whose maintenance is chargeable to the rates, and this Board has its own staff of

inspectors, both for workhouses and for workhouse schools. The management of industrial and reformatory schools falls within the province of the Home Office, which is responsible for the efficiency of those institutions, but which is in no sense aided or advised by the Board of Education. The newly-constituted Board of Agriculture also is in a position to exercise much influence over rural education. It is manifest that in all those departments of the public service which have been created for other than educa- tional objects, and have nevertheless been incidentally charged with educational responsibilities, there should be established such a rapport between them and the Board of Education as would result in a division of labour and in greater administrative simplicity. If all the schools under the care respectively of the War Office, the Admiralty, the Local Government Board, the Home Office, and the Board of Agriculture were subject to the visitation of H.M. Inspectors, and to the same tests and influences by which public elementary schools are yearly controlled and improved, many advantages would accrue. There would be less waste of power; the schools and teachers wpuld benefit by stimulus and comparison ; and the several public departments would be relieved of a duty which they are not in a position to fulfil satis- factorily. Moreover, they would yet retain, as recognized local managers, all their present influence in respect of

the non-educational and special interests pertaining to the several establishments. The need of such a simple measure of administrative reform has been strongly urged upon the Government by three Departmental Committees or Commissions — ^that on the Marine and Dock- yard Schools, that on the Poor Law Schools, and that on the Reformatory and Industrial Schools ; but at present recommendations to this effect have only been adopted in one case, that of the navy. By an agreement, the annual inspection of the Marine Schools and of Green- wich Naval School has been entrusted by the Lords of the Admiralty to the Board of Education, and the result has proved so satisfactory as to furnish a very valuable precedent for future imitation.

Notwithstanding the far-reaching effect of recent legis- lation, especially the establishment of a Board of Educa- tion charged with the duty of co-ordinating the varied provision for primary, secondary, and \fj"' technical

instruction, there is still, and wiU needed. probably long remain, ample room for volun- tary effort on the part of societies, and for personal initiative on the part of individual thinkers and teachers. The two great societies which took the lead in promoting elementary education — the British and Eoreign School Society, founded in 1808, and the National Society for educating the poor in the principles of the Established Church, founded in 1811 — still continue to flourish and to render valuable public service, although the area of their useful action is practically restricted to the vindica- tion of the principles which they represent, the encourage- ment of voluntary effort, and the training of teachers, a work in which both societies, by means of their Normal Colleges, take a leading and effective part. The Eoman Catholic Poor School Committee, and the Wesleyan Con- nexional Committee, are charged with their respective denominational interests, and co-operate heartily with the central government. The National Association for the Promotion of Secondary and Technical Education has given a powerful stimulus to public opinion, and has been of special service in furnishing information to County Councils in relation to the duties which the Local Taxation Act cast upon them. Other Voluntary societies have been formed with a view to give greater solidity and corporate life to the teaching profession itself. The Head Masters' Conference, which met for the first time at Uppingham in 1869, at the instance of Mr Thring, has become in the course of years very influen- tial, by holding periodical conferences, and by concentra- ting for the benefit of the schools and of the public at large the experience and knowledge of headmasters of the public schools of the highest rank. Another society, the Incorporated Association of Head Masters (1890), admits to membership a larger body of teachers engaged in endowed or other public secondary schools. It num- bers 450 members, and in connexion with recent legisla- tion affecting the work of the Board of Education, the registration of teachers, and the organization of higher grade schools, its representations to the Government and to the public have exercised considerable influence. The Association of Head Mistresses of Endowed and Pro- prietary Schools was organized in 1874, with Miss Buss as its first president, and numbers 180 members. Other societies, such as that of Head Masters of Private Schools, of Higher Grade and Science Schools, and of Preparatory ' Schools respectively, have since been founded, with suc- cessful results. The College of Preceptms, a chartered society chiefly composed of private

teachers, was incor- porated in 1849, and was one of the first professional bodies to institute regular courses of pedagogic lectures, and to award after due examination the titles of Licentiate and Associate to teachers. It has also, by means of its

system of examining pupils, given a valuable stimulus to educational progress, especially in many schools which, while distinctly above the rank of elementary, have not availed themselves of the Oxford and Cambridge local examinations. The conferences and discussions which are held at the college during each session have proved of considerable value, both as a help to the members and other teachers in dealing with professional problems, and also as a means of enlisting the attention and sympathy of the general public in relation to these problems. By far the largest of the professional associations is the National Union of Teachers. It was established in 1870, and is composed mainly of teachers engaged in public elementary schools. It has 20 district unions, 430 local associations, and nearly 44,000 members ; and it holds in turn at each of the great provincial centres an annual con- ference, generally attended by 1500 members. It has a considerable revenue, and maintains two orphanages, a system of annuities, and a provident fund. Three of its most active officers became Members of Parlia- ment.

All of these are sectional organizations, concerned mainly with the professional interests of one class of teachers. All of them have tended to promote mutual helpfulness and a sense of corporate life among particular groups of members of the teachers' calling. One only of the pro- fessional associations has a broader and more compre- hensive design. The Teachers' Guild, founded in the year 1885, aims at bringing together teachers of both sexes and of all ranks. It has held from time to time many in- fluential public meetings and discussions on questions of educational principles and policy, and it already numbers 4300 members. It has sought from the first to associate in one strong society teachers of all classes ; it

has con- cerned itself rather with those problems and discussions which are common to all enlightened teachers alike than with the narrower professional or pecuniary interests of particular classes of teachers or of schools. The combined effect of all these efforts will probably be to raise the profession in public repute and influence. It would be a misfortune, however, if it tended to create a close pro- fession, or to exclude from the ranks of teachers persons distinguished by originality, enthusiasm, and natural aptitude, though unqualified by formal membership. The National Home Reading Union, a society which seeks, by the formation of local centres for reading, and by the suggestion of lists of books, to encourage efforts after self- improvement, exercises a beneficent and increasing influ- ence in many parts of England, especially in places and among persons remote from the chief centres of educa^ tional activity. It now numbers 13,500 members. The Working Men's College, founded in 1854 by Frederic Denison Maurice, and the College for Working Women have proved to be the exemplars of many similar institu- tions in London and the provinces.

In estimating the various agencies by which, in England, educational progress has been influenced, it is impossible ^, to overlook the importance of the opening tioa'hrthe of various employments in the public service public to general competition. The number of persons service. g^ engaged has increased as new departments have been created and new functions have been assumed by the central Government. The appointment to these offices once rested largely in the hands of the political heads of the several departments, and entailed consider able responsibility. In 1853 Sir Stafford Noi-thcote and Sir Charles Trevelyan reported on the unsatisfactory results of this system, and recommended the formation of a separate and independent Board to test the fitness of candidates for public employment in certain offices. In 1855 the Civil Service Commission was created, and for a

time its duties were limited to the holding of qualifying examinations and to the ascertainment of necessary facts respecting age, health, and character. In 1859 the Civil Service of India was thrown open, mainly at the instance of Lord Derby, the Secretary of State for India, and with the energetic support of Macaulay, whose own ex- perience during his four years of office (1834-1838) as legal member of the Supreme Council of India had led him to take great interest in the question. Since that date the principle of open

competition has been applied in succession to many branches of the public service. In 1870 an Order in Council made it applicable to home clerkships generally, as well as to many other offices; and more recently candidates for the colonial, the naval, and the military services have been examined by the Civil Service Commissioners. The following statistics are from the report of the Commission for the year 1899 : — In all, 38,739 cases have been dealt with, of which 11,478 were those of candidates nominated singly, 4891 were nominated to compete, and 22,360 were examined for open competition. Of these, 3306 succeeded at an open competition, and 7094 in the restricted competition after nomination. The list of offices thus rendered available includes clerkships in the Foreign and Colonial Offices, the Treasury, and the higher departments of the public service, the Indian Civil Service, commissions in the army and navy, surveyors, dockyard schoolmasters, writers, post and telegraph clerks (male and female), and many minor offices in all the Government departments. The effects of this great revolution in the administra- tive work of the State are far-reaching, and cannot even yet be fully estimated. The first and most obvious is that thereby Ministers and members of Parliament are saved from much importunity, and from a personal re- sponsibility which it was very difficult for them to exercise with entire fairness and a sole regard to the public interests. The practical abolition of favouritism and of personal patronage in Great Britain has in itself done much to purify the public service and to satisfy the national sense of justice. As a deiuocratic measure, the invitation to persons of all classes, without distinction of rank or social position, to compete on equal terms for honourable employment, has been generally welcomed and valued. There can be little doubt that an effective stimulus has been given to the efforts of many young people towards self-improvement, by the opening of a career as a reward and an encouragement to intellectual merit alone. There remain, however, some questions to which experience has not yet given a final answer, although the evidence which has been already accumu- lated is weighty and, on the whole, highly encouraging. They are : (a) Is the effect of the system to give to the State a more capable and better qualified body of public servants than would be procurable under other conditions ? (6) What effect has open competition had on the character of the education in the schools and colleges from which the candidates are drawn ? and (c) HOw far has it tended to improve or to lower the national estimate of the true worth of

education, and its relation to the active business of life ? To the first question the answers are not absolutely unanimous. There will always be some cases in which the system of selection by competitive examination appears to be unsatisfactory. But, exceptis excipiendis, the general testimony of experience is em- phatically favourable, and leads to the conclusion that on the whole the system does succeed in bringing to the front the best men. The warmest advocates of the system cannot, however, overlook its necessary limitations. There are virtues which do not "pay" in examinations, and there are grave faults of character which cannot be detected by any examination, and yet which are not

incompatible witli intellectual success. Manliness, cour tesy, promptitude, flexibility of mind, a conscientious sense of duty, and a respect for the feelings and the rights of others are all valuable and indeed indispensable attri- butes for an efficient public officer either in the civil or the military service. But these are precisely the qualities which no conceivable system of examination can adequately test. We can examine only what is examinable. The quali- fications which can be tested by examination are accurate knowledge, general intelligence, ability to think and to express the result of thinking in an orderly, coherent, and logical way. These qualifications are not less valuable than the others, and are at least as likely to coexist with them as to be possessed independently. And on this point the j udgment expressed by the Civil Service Commissioners in their thirty-third report is on the whole ratified by sub- sequent experience and by the general verdict of responsi- ble statesmen and of the public. The Commissioners say : —

" We think it sufficient to refer to the reports of the Royal Com- mission on Civil Establishments, the report of the Public Service Commission (India) , and the statements of the military authorities, which show that the persons selected by means of our examinations are well qualified for the public service. The Royal Commissioners on Civil Establishments, in their second report, paragraph 32, say of the lower division clerks : ' As stated in our former report, paragraph 109, we are of opinion that the young men of this grade who have entered the service since the Order in Council of 1876 are

~~of excellent quality and capacity.' This statement is further con- firmed by the fact that out of 3241 men clerks appointed between 1876 and 1888 only 23 have been rejected on probation on the score of inefficiency. A favourable opinion is also expressed of the officers of the higher division in paragraph 109 of the first report. The Public Service Commission (India) reports that ' on more than one occasion inquiries have been made by Government into the working of the competitive system, with the result that it has been generally acknowledged to have procured for the ranks of the Indian Civil Service officers who, as a body, are eminently quali- fied for the performance of the duties which devolve upon them, and many of whom have earned a reputation for administrative capacity of a high order.' They believe themselves to be justified in the conclusion that, ' apart from questions of detail as to the age of candidates, and the subjects, standards, and conditions of ex- amination, the general results of competition, as applied to the India Civil Service, have been satisfactory, and that the system should accordingly be maintained.' We have reason to believe that the military authorities are equally satisfied with the officers who have entered the army by means of our examinations."~~

~~The medical officer who in 1900 examined the selected candidates for the Civil Service of India reported most favourably of their physique. He said : " They pre- sented no indication of physical depreciation or damage to be attributed to the influences of study. For the most part they presented the evidence of vigorous health, and bore the stamp of the University and the public school."~~

~~The Civil Service Commissioners provide for several grades of examination, which may roughly be described as falling under one of these five heads : —~~

~~(1) University type : Indian Civil Service and Class I.~~

~~of the Home Civil Service.~~

~~(2) First Gh-ade or Public School type : Army and Navy~~

~~Examinations, e.g., Sandhurst and Woolwich.~~

(3) Second Gh'ade School type : Second division clerks.

(4) Elementary School type: Boy copyists and minor

offices.

(5) Technical and Po-ofessional groups : Various special

examinations.

The subjects and the scope of these several examina- tions are in all cases determined by the Commissioners, after full communication with the heads of the various departments concerned and with the Treasury.

It is important to consider the influence exerted by the competitive system on the aims and work of the places of education from which the ranks of public servants are from time to time recruited. At first there was on the part of teachers and professors a disposition, easily explicable, to

object to the setting up by any external body of an inde- pendent standard of attainment ; and the examinations of the Civil Service Commissioners were for nearly thirty years practically ignored by University authorities and by the masters of the great public schools, notwithstand- ing the great variety of optional subjects offered to candi- dates. Hence parents who desire to obtain commissions or public employment for their sons were fain to resort to private tutors, who made it their business to understand thoroughly the conditions of success in examination, and who often achieved great success in passing their candidates. They were sometimes vaguely denounced as "crammers," and their methods as contrivances for enabling young learners to deceive the examiners by the appearance without the reality of knowledge, and by crude and hasty efforts of memory rather than by diligent and solid study. There was no doubt some real danger in this direction, a danger from which the Universities themselves, in preparing undergraduates for Honour examinations, are not wholly free. But the best of the private tutors sought to guard against possible evil of this kind, partly by declining to accept as pupils youths who, owing to deficient preliminary training or to any other cause, had no reason- able prospect of success, and partly by insisting on diligent attention to a serious course of study and

discipline, such as would enable candidates to systematize and arrange their knowledge and express it in the best form. Nevertheless it has been more and more strongly felt that the break in the continuity of a youth's studies caused by his premature removal from a public school or a University to a private teacher had often an unfavourable effect both on his moral and his intellectual discipline. Hence it has become evident that the standard of qualification required for entrance into the public service ought to be as nearly as possible assimilated to the standard which is attained in a good school. To a large extent this object has been achieved. On the one hand, all the recent policy of the Commissioners has been in favour of taking the course prescribed in the Universities and^jublic schools, from which the candidates are recruited, as the best practical measure of the qualifications which ought to be required at the competitive examination. And on the other hand, the public schools and University authorities have co- operated with the Commissioners by widening their cur- riculum, and helping to render the services of special tutors outside the schools to a large extent unnecessary, except in the case of special technical departments. On this point the testimony of Dr Magrath, the Provost of Queen's College, and lately the Vice-Chancellor of the Uni- versity of Oxford, is significant and valuable. He says : —

" I strongly feel that, as at present conducted, the higher of these examinations directly and efficiently contribute to the maintenance of a considerable element of general culture in the studies of those schools in England which keep their pupils to seventeen or beyond. The excessive and unreasonable desire for the introduction of what are called useful, i.e., professional, sub- jects into all forms of education, from the highest to the lowest, would, I believe, have much more extensively affected the cur- ricula of these schools if the Civil Service Commissioners had not framed their examinations with a view to securing for the higher class of posts in the service those who have received the best general education. It is a curious example of the funny para- doxical way in which we blunder eventually into the best course, that it was not professional educators, or even members of what might be called our educational hierarchy, who have brought about this result, but persons appointed to secure fair play among those who aimed at administrative posts thrown open on the abolition of patronage and favouritism. It is the fact that these posts have been secured

to a large extent by lower middle class men who have had the ability and the good fortune to be able to continue their general studies for a longer period than usual, which has set before the parents of such boys an object of ambition on the boys' behalf, which has stimulated these parents to make often very considerable efforts to secure for their sons such educational

advantages as might enable them to compete with some degree of success for these posts ; and this result has reached already down to schools of a much lower educational class than could have been supposed to be affected by it. Its effects have been, I think, wholly beneficial."

To this weighty experience may be added that of Dr Wane, the headmaster of Eton, who says, in reference to competition for the army : —

"The army examination has had a very considerable influence here. It has caused the institution of an army class, the aim of which is to send boys straight from the school to Woolwich and Sandhurst, saving them from having to go to a private tutor for special preparation.

"The institution of the army class has reacted distinctly upon the school and its work. Formerly the boys who chose the army for their profession (mostly vigorous and high-spirited lads) were as a rule the idlest and the most difficult to manage, and conse- quently maintained a low standard of industry and discipline and of interest in their work. The army class has changed all this, and these lads are now among the hardest working and steadiest in the school.

' ' This has had its effect upon the rest. The consequence, briefly stated, is that the rank and file throughout the school do better as regards work. The general average of work has, in my opinion, distinctly improved in the last ten years, and among the causes I think that the institution of the army class has no small share, and this is therefore due to the public competition for entrance into Woolwich and Sandhurst."

In another great public school — that of St Paul's in London — the master of the army class points out " that although the aim of the form is mainly admission to Woolwich, and is based upon the syllabus of the Wool- wich Entrance Examination, not more than two-thirds of the boys are candidates for the army. Others desire to proceed to Cooper's HUl, the City and Guilds of London Technical Institute, or the navy as engineer-students, or to prepare for such examinations as the Institute of Actuaries, in which mathematics ■pla^ an important part. In respect of the qualities of characrer and intellect, the army form may be fairly taken as representative of the school as a whole, and discipline is maintained with the same ease. The intimate association of the two ele- ments, the military and the civil, benefits the whole form, and the boys in this department have always taken a prominent part in the athletics of the school." From many quarters other evidence comes showing that, in the opinion of the teachers, the examinations of the Civil Service Commissioners have been much improved, and that as experience grows there is greater similarity in aim and method between the views and plans of good teachers and the requirements of the Civil Service Commis- sioners.

The last quarter of the 19th century was characterized by considerable activity and productiveness in the literature

of education. Except Ascham's Scholemaster, educa- Mulcaster's Positions, MUton's Tractate, and itterature. Locke's Thoughts, the England of former generar

tions had contributed little to pedagogic theory. But in recent years contributions to the history, the philosophy, and the practice of education have been very numerous in Great Britain as well as in Germany, Prance, and the United States. Eor a general bibliography of the subject the student will do well to consult, in German, W. Rein's Encydopddisches Handbuch der Padagogik, and K. A. Schmid's Encyclopddia der gesammten Erziehungs- und Unterrichtswesens ; in French, F. Buisson's Diction- naire de pedagogie; and in English, W. S. Munroe's Bibliography of Education, Henry Barnard's English Pedagogy, and Sonnenschein's Cyclopoedia of Education. The history of the growth of ideas and theories on educa- tion can best be studied in Professor S. Laurie's Historical Survey of Pre-

Christian Education and Life of Comenius, Oscar Browning's Educational Theories, H. T. Mark's

Outlines of the History of Educational Theories, Com- payr^'s History of Pedagogy, Mahaffy's Old Greek Educa- tion, and Donaldson's, Kallmann's, or Joseph Payne's History of Education, J. B. Mullinger's The Schools of Charles the Oreat, J. H. Newman's Rise and Progress of Universities, R. H. Quick's Educational Reformers, J. M. Leitch's Practical Educationists, Sir J. K. Shuttleworth's Four Periods of Education, Matthew Arnold's article on " Schools " in Humphry Ward's Reign of Queen Victoria, and his Popular Education in France and official Reports to the Education Department, edited by Lord Sandford, Stanley's Life of Dr Arnold, Meiklejohn's Life of Dr Andrew Bell, Lupton's Life of Dean Colet, three lAves of Pestalozzi, by De Guimps, Dr Biber, and Karl von Raumer, John Morley's Rousseau, J. P. Richter's Autobiography, Hugh Miller's My Schools and School- masters, Sir Henry Craik's ' The State and Education, the volumes of Special Reports issued by the Board of Education, and the series of Great Educators published by Heinemann. From the theoretical or speculative as well as the practical side, other additions to educational literature have been Herbert Spencer's Education; In- tellectual, Moral, and Physical, Bain's Education as a Science, Herbart's Science of Education, F. Frobel's Educa- tion of Man, Pestalozzi's Leonard and Gertrude, J. P. Richter's Levana, the Reports of the American Committee of Fifteen, Educational Aims and Methods, and the Lectures on Teaching, delivered before the University of Cambridge by the present vn:iter, M. Breal's Quelques mots sur V instruction publique, Lloyd Morgan's Psychology for Teachers, Edward Thring's Theory and Practice of Teaching and Education and the School, President Eliot's Educational Reform, and Professor N. Murray Butler's TTie Meaning of Education, P^A. Barnett's Common Sense Applied to Education, and Bernard Bosanquet's The Education of the Young (in the Republic of Plato). The official Reports of Royal Commissions, notably those of the Schools Inquiry of 1867, Lord Cross's Com- mission on Primary Education, 1887, and Mr Bryce's Com- mission on Secondary Instruction, 1894, deserve special attention, and the Annual Reports of the Department now known as the Board of Education will always be found to give the latest financial and other statistical details

respecting the number of teachers and scholars in the elementary and other schools under the supervision of that Department.

*At the beginning of the 20th century the outlook on the future of English education is, though somewhat obscure, full of promise. The latest Act of the Govern- ment, constituting a central Board with power ™*p™*? to co-ordinate the scattered agencies hitherto ^rt. concerned with public elementary schools, with science and art, and with technical education, as well as with the administration of the Endowed Schools Acts, has possibilities of usefulness in it which are not yet fully realized. It will, it may be hoped, succeed in giving unity of purpose to the whole educational machinery of England, and will define the several duties of the School Boards, the County Councils, and other local authorities, and their relations to the central Government and to each other. It will provide for the information of parents an annual register of qualified teachers and of approved schools. It will furnish large and equal opportunities to promising learners in all classes of the community to pur- sue their studies and to cultivate their different powers and aptitudes. It will so far stimulate local authorities as to secure that ther6 is as ample a provision of secondary as already exists for primary schools all over England. It will afford to the public a guarantee of efficiency, by means of a judicious combination of inspection with examination, following in this particular the weighty recommendation*

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of the Royal Commission of 1895. " Education," says the Eeport (vol. i. p. 120), "needs organization, but it would be destroyed by uniformity : it is stimulated by inspection, but it would be crushed by a Code. In the public service, where the chief object is administrative ef&ciency, the individual officer is necessarily subordi- nate ; in education, where a chief object is the discovery of more perfect methods of teaching, the individual teacher must be left comparatively free. Every good teacher is a discoverer, and in order to make discoveries he must have liberty of experiment." It is not by

larger grants of public money alone that educational progress can be secured. The subsidies already paid out of the Treasury to elementary schools are very liberal, and the various religious bodies cannot reasonably ask for more pecuniary help than they at present receive, unless they are prepared to give their schools a more national char- acter by accepting representatives of the public as col- leagues in the management. But public funds for the erection of good secondary, technical, and commercial schools will, however, be needed, and the source from which these funds will be derived, and the constitution of the authority which is to control their administration, have yet to be determined. Endowments for schools and scholarships need to be made still more efficient; they are inadequate in amount, and too capriciously distrib- uted, to supply all modern needs. The parent who does not desire to avail himself of the public elementary school, and whose sons are not likely to succeed in a competitive examination, has still to complain that ad- vanced education is more costly in England than in any other country, and that institutions with moderate fees such as the Lycies of France, or the Mealschulen or the Oymnasien of Germany, are not accessible to him. There is therefore room for some further action on the part of the State. But it is not to legislation exclusively, or even mainly, that we must look for the completion of the edifice of public education. That part of the work of the future " which kings or laws can cause or cure " is com- paratively a small part. Parliament must in the last resort receive its mandate from the people, and can do little more than seek to fulfil the national ideals. The motive force which we need must be found in a higher and truer popular conception of a liberal education, and of its relation to the formation of character and to the duties of industrial, civic, and family life. That the acquisition of knowledge, though obviously the promi- nent business of a school, is not the whole of education, and that knowledge consciously directed to the special professional and industrial needs of life is of far less real value than the knowledge which helps to bring out the best powers of the reflective and accomplished man, are truths which are yet imperfectly recognized. We yet need a more general agreement as to the place which the training of the hand and eye, and the constructive and inventive faculties, should hold in a scheme of intellectual culture. And in an age in which merely ecclesiastical influence over public education is waning, we need to hold fast by all such agencies as exist for the cultivation of the spiritual part of man, his emotions, and his aspirations after

goodness, and his love of truth. How to cultivate in schools a genuine yet modest patri- otism, and a desire to render service in municipal or public life ; how to give to parents a stronger interest in the education of their children, and increased opportuni- ties of co-operating with the teachers ; how to enlarge the boundaries of educational science, and to give increased freshness and vitality to the methods of instruction — all these are problems which await solution in the 20th cen- tury. They were only partially and imperfectly solved in the 19th. (j. «• f-)

Education in the United States.

The first white settlers who came to North America were typical representatives of those European peoples who had made more progress in civilization than any other in the world. Those settlers, in particular those f^”.’ from England and from Holland, brought with them the most advanced ideas of the time on the subject of education. The conditions of life in the New World emphasized the need of schools and colleges, and among the earliest public acts of the settlers were provisions to estab- lish them . The steps taken between 1619 and 1622 to pro- vide schools for the colony of Virginia were frustrated by the Indian war which broke out in the latter year, and were never successfully renewed during the colonial period. In New York, where the influence of the Dutch was at first predominant, elementary schools were maintained at the public expense, and were intended for the education of all classes of the population. This policy reflected the very ad- vanced views as to public elementary education which were then held in the Netherlands. The assumption of control in the colony of New York by the English was a distinct check to the development of public elementary education, and little or no further progress was made until after the Rev- olution. The most systematic educational policy was pur- sued in the colony of Massachusetts. As early as 1635, five years after it was founded, the town of Boston took action to the end that ” our brother Philemon Pormort shall be entreated to become schoolmaster for the teaching and nur- turing children with us.” The General Court of the colony in 1636 made the first appropriation for what was to be- come Harvard College, taking its name in honour of the minister, John Harvard, who died in 1638, leaving his library and one-half of his property, having a value of £800, to the new institution. The amount of this appro- priation of

1636 (£400) was remarkable in that it was probably equal to the whole colony tax for a year. In 1642 followed a legislative Act which, while saying nothing of schools, gave to the selectmen in every town power to over- see both the education and the employment of children. It is made the duty of the selectmen to see that the children can read and understand the principles of religion and the capital laws of the country, and that they are put to some useful work. Eive years later, in 1647, was enacted the law which is not only the real foundation of the Massachusetts school system, but the type of later legislation throughout the United States. This epoch-making Act, the first of its kind in the world, represented the public opinion of a colony of about 20,000 persons, living in thirty towns. It required every town of fifty householders to establish a school, the master of which should be paid either by the parents of the children taught or by public tax, as the majority of the town committee might decide ; and it further required every town of one hundred families or householders to set up a grammar school in which pupils might be prepared for the "University," as the new institution at Cambridge was designated. More- over, a penalty was attached to neglect of this legis- lative requirement, in the form of a fine to be devoted to the maintenance of the nearest school. Horace Mann said of the Act of 1647 : " It is impossible for us ad- equately to conceive the boldness of the measure, which aimed at universal education through the establishment of free schools. As a fact, it had no precedent in the world's history; and, as a theory, it could have been refuted and silenced by a more forinidable array of argument and experience than was ever marshalled against any other institution of human origin. But time has ratified its soundness. Two centuries of successful op- eration now proclaim it to be as wise as it was courageous, and as beneficent as it was disinterested." The significance

of these Acts of 1642 and 1647 is that they foreshadow the whole American system of education, including ele- mentary schools, secondary schools, and colleges, and that they indicate the principles upon which that system

rests. These principles as summarized by George H. Martin in his Evolution of the Massachusetts Public School System are the following : — (1) The universal education of youth is essential to the well-being of the State. (2) The obli- gation to furnish this education rests primarily upon the parent. (3) The State has a right to enforce this obliga- tion. (4) The State may fix a standard which shall de- termine the kind of education and the minimum amount. (5) Public money raised by general tax may be used to provide such education as the State requires. The tax may be general, though the school attendance is not. (6) Education higher than the rudiments may be supplied by the State. Opportunity must be provided at the public expense for youths who wish to be fitted for college. These principles have now found expression in the public Acts of every State, and upon them education in the United States is founded.

Despite the praiseworthy attempts made in New York, New Jersey, and Pennsylvania to develop schools and school systems, very little was accomplished in meat*”” tliose Colonies which was permanent. The senti- ment in the more southern colonies was, as a rule, unfriendly to free schools, and nothing of import- ance was attempted in that section of the country until the time of Thomas Jefferson. Through religious zeal or philanthropy colleges were founded as far south as Virginia, and no fewer than ten of these institutions were in operar, tion in 1776. Their present naines and the dates of their foundation are: Harvard University, Massachusetts (1636); College of William and Mary, Virginia (1693); Yale University, Connecticut (1701) ; Princeton University, New Jersey (1746) ; Washington and Lee University, Virginia (1749) ; University of Pennsylvania, Pennsylvania (1751) ; Columbia University, New York (1754); Brown University, Rhode Island (1764) ; Rutgers College, New Jersey (1766) ; and Dartm outh College, New Hampshire (1770) . In the col- leges the ecclesiastical spirit was at first almost uniformly dominant. The greater number of their students were preparing for the ministry in some one of the branches of the Protestant Church. These facts caused the grammar schools to take on more and more the character of college- preparatory schools ; and when this was brought about they supplied the educational needs of but one portion of the community. As time passed, the interdependence of governmental and ecclesiastical interests began to weaken in the colonies, and there arose among those who represented the

new secularizing tenden% a distrust of the colleges and their influence. This gave rise to a new and influential type of school, the academy, which took its name from the secondary schools established in Eng- land by the dissenting religious bodies during the latter part of the seventeenth century at the suggestion of Mil- ton. These academies were intended to give an educa^ tion which was thought to be more practical than that offered by the colleges, and they drew their students from the so-called middle classes of society. The older academies were usually endowed institutions, organized under the control of religious organizations or of self- perpetuating boards of trustees. Their programme of studies was less restricted than that of the grammar schools, and they gave new emphasis to the study of the English language and its literature, of mathematics and of the new sciences of nature. For two generations the academies were a most beneficent factor in American edu- cation, and they supplied a large number of the better-prepared teachers for work in other schools. These schools were in a sense public in that they were chartered, but

they were not directly under public control in their man- agement. Early in the 19th century there arose a well- defined demandfor public secondaiy schools — high schools, as they are popularly known. They were the direct out- growth of the elementary school system. Boston, Phila- delphia, Baltimore, and New York were the first of the large cities to establish schools of this type, and they spread rapidly. These public secondary schools met with opposition, however, springing partly from the friends of the academies, and partly from those who held that gov- ernmental agency should be restricted to the field of ele- mentary education. The legal questions raised were settled by a decision of the Supreme Court of Michigan, which contained these words: "Neither in our State policy, in our constitution, nor in our laws do we find the primary school districts restricted in the branqhes of knowledge which their officers may cause to be taught, or the grade of instruction that may be given, if their voters consent, in regular form, to bear the expense and raise the taxes for the purpose." This decision gave marked impetus to the development of public secondary, or high schools, and they have increased rapidly in num- ber. ' The academies have relatively declined, and in the Western States are almost unknown.

Meanwhile the elementary school system had grown rapidly. The school district, the smallest civil division, was created in Connecticut in 1701, in Rhode Island about 1750, and in Massachusetts in 1789. From the point of view of efficient, well-supported schools, it has been felt since the time of Horace Mann that the substitution of the small school district for the town as the unit of school ad- ministration was a mistake. Yet the school district has exercised a profound influence for good upon the American people. In New York State, for example, there were in 1900 over eleven thousand school districts, and in Illinois over twelve thousand. The districts are small in extent and often sparsely settled. Their government is as demo- cratic as possible. The resident legal voters, often includ- ing women, hold a meeting at least once a year. They elect trustees to represent them in the employment of the teacher and the management of the school. They determine whether a new schoolhouse shall be built, whether repairs shall be made, and what sum of money shall be raised for school purposes. In the rural districts this system has often been itself a school in patriotism and in the conduct of public affairs. Recently the tendency is to merge the school districts into the township, in order that larger and better schools may be maintained, and that educational advantages may be distributed more evenly among the people. Most of the Southern states have the county system of school administration. This is because the county, rather than the tovmship, has been the political unit in the South from the beginning. Special laws have been made for the school system in cities, and the form of these laws differs very much. In nearly every city there is a separate board of education, sometimes chosen by the voters, sometimes appointed by the mayor or other official, which board has full control of the schools. The city board of education has as its executive officer a superintendent of schools, who has become a most important factor in American educational administration. He exerts great influence in the selection of teachers, in the choice of text-books, in the arrangement of the programme of studies, and in the determination of questions of policy. Some- times he is charged by law with the initiative in some or all of these matters. He is usually a trained administrator as well as an experienced teacher. The first superintendent was appointed in 1837 at Buffalo. Providence followed in 1839, New Orleans in 1841, Cleveland in 1844, Baltimore in 1849, Cincinnati in 1850, Boston in 1851, New York, San Francisco, and Jersey City in 1852, Newark and

Brooklyn in 1853, Chicago and St Louis in 1854, and Philadelphia in 1883. In general, it may be said that the progress of public education in the United States is marked by (1) compulsory schools, (2) compulsory licensing of teachers, (3) compulsory school attendance, and (4) compulsory school supervision, and by the increasingly efficient administration of these provisions. The compulsion comes in each case from the State government, which alone, in the American system, has the power to prescribe it and to enforce it. Each one of the 45 States is therefore an independent educational unit, and there is no single, uniform American system of education in any legal sense. In fact, however, the great mass of the American people are in entire agreement as to the principles which should control public education; and the points in which the policies of the several States are in agreement are greater, both in number and in importance, than those in which they differ. An American educational system exists, therefore, in spirit and in substance, though not in form.

Neither in the Declaration of Independence nor in the Constitution of the United States is there any mention

of education. The founders of the nation were poUcy?' ^y ^° means indifferent to education, but they

shared the common view of their time, which was that the real responsibility for the maintenance of schools and the expense of maintaining them should fall upon the several local communities. The relation of government to education was not then a subject of ordin- ary consideration or discussion. Later, when this question did arise and the power of taxation was involved, the several States assumed control of education, as it was necessary that they should do. Nevertheless, from the very beginning the national government has aided and supported education, while not controlling it. This policy dates from 13th July 1787, when there was passed the famous " Ordinance for the Government of the Territory of the United States North-

West of the Eiver Ohio," meaning the territory north and west of the Ohio river now represented by the States of Ohio, Indiana, Illinois, Michigan, Wisconsin, and the eastern side of Minnesota, em- bracing more than 265,000 square miles of territory. This Ordinance contains this declaration : " Eeligion, morality, and knowledge being necessary to good government and the happiness of mankind, schools and the means of education shall for ever be encouraged." The Ordinance of 1787 also reaffirmed the provisions of the so-called Land Ordinance of 1785, by which section No. 16 in every township (a township consists of 36 numbered sections of one square mile each), or one thirty-sixth of the entire North- West Territory, was set aside for the mainten- ance of public schools within the township. The funds derived from the sale and lease of these original " school lands " form the major portion of the public school endow- ment of the States formed out of the North- West Territory. The precedent thus established became the policy of the nation. Each State admitted prior to 1848 reserved section No. 16 in every township of public land for common schools. Each State admitted since 1848 (Utah being an exception, and having four sections) has re- served sections No. 16 and No. 36 in every township of public lands^ for this purpose. These national grants of land in aid of common schools amount to 67,893,919 acres. In addition, the national government has granted two townships in every State and Territory containing public lands for seminaries or universities. These grants amount to 1,165,520 acres. A third land grant is that made in 1862 for colleges of agriculture and the mechanical arts ; this amounts to 9,600,000 acres. The sum total of these three land grants is 78,659,439 acres, to which there must be added various special grants made from time to time to

the States and devoted to education. The portion of the public domain so set apart amounts in all to 86,138,473 acres, or 134,691 English square miles. This is an area greater than those of the six New England States, New York, New Jersey, Maryland, and Delaware added to- gether. It is a portion of the earth's surface as great as the kingdom of Prussia, about seven-tenths as great as France, and considerably greater than the combined areas of Great Britain (including the Channel Islands) and the kingdom of Holland. Besides the enormous grants of land in aid of education, the national government has maintained since 1802 a military academy at West Poiut, New York, for the training of officers for the army, and since 1845 a naval

academy at Annapolis, Maryland, for the training of officers for the navy. It has also taken charge of the education of the children of uncivilized Indians, and of all children in Alaska. It has voted, by Act of 1887, a perpetual endowment of $15,000 a year for each agricultural experiment station connected with a State agricultural college, and, by Act of 1890, an addi- tional endowment of f 25,000 a year for each of the agricultural colleges themselves. The aggregate value of land and money given by the national government for education in the several States and Territories is about

$300,000,000.

In 1867 the Congress established a bureau of educar tion, presided over by a Commissioner who is under the jurisdiction of the Secretary of the Interior, the purpose of which is declared to be to f^J^^onf collect " such statistics and facts as shall show the condition and progress of education in the several States and Territories, and of diffusing such information respecting the organization and management of school systems and methods of teaching as shall aid the people of the United States in the establishment and main- tenance of efficient school systems, and otherwise promote the cause of education throughout the country." The bureau has therefore no direct power over the educational policy of the several States. It has, however, exercised a potent influence for good in its advisory capacity. Up to 1900 this bureau had published 360 separate volumes and pamphlets, including 31 annual reports, covering from 800 to 2300 pages each. These are standard works of reference, and are distributed gratui- tously in large numbers to libraries, school officials and other persons interested, and to foreign Governments. The several commissioners of education have been: Henry Barnard of Connecticut, 1867-1870 ; John Eaton of Ohio, 1870-1886 ; Nathaniel H. R. Dawson of Alabama, 1886-1889 ; William T. Harris of Massachusetts, 1889 to date.

In the United States the sovereign powers are not all lodged in one place. Such of those powers as are not granted by the Constitution to the national g^^ government are reserved to the States respect- govern- ively, or to the people. The power to levy mentsand taxes for the support of public education has '"'"'^"<"" been almost universally held to be one of the

powers so re- served. The inhabitants of the several local communities, however indisposed they may have been to relinquish absolute control of their own schools, have been compelled to yield to the authority of the State government whenever it has been asserted, for except under such authority no civil division — county, city, township, or school district — possesses the power to levy taxes for school purposes. Moreover, since the exercise of State authority has uni- formly improved the quality of the schools, it has usually been welcomed, not resisted. In general, it may be said that the State has used its authority to prescribe a minimum of efficiency which schools and teachers must reach, and it enforces this minimum through inspection

and the witliliolding of its proper share of the State school fund from any locality where schools or teachers are permitted to fall below the required standard. In extreme cases the State authorities have interfered di- rectly to prevent the evil results of local inefficiency or contumacy. In addition, the States, almost without ex- ception, maintain at their own expense schools for the training of teachers, known as normal schools. Many of the States also offer inducements to the cities, towns, and districts to exceed the prescribed minimum of effi- ciency. Through the steady exercise of State supervision the school buildings have improved, the standard for entrance upon the work of teaching has been raised, the programme of studies has been made more effective and more uniform, and the length of the school term has increased. The Constitution of every State now contains some provision as to public education. Each State has an executive officer charged with the enforcement of the State school laws. Sometimes, as in New York, this official has plenary powers ; sometimes, as in Massachu- setts and Ohio, he is little more than an adviser. In twenty-nine States this official is known as the super- intendent of public instruction; in Massachusetts and Connecticut he is called secretary of the State board of education ; other titles used are commissioner of public schools, superintendent of common schools, and super- intendent of public schools.

The schools are administered, on behalf of the taxpayers, by an elected board of school trustees in rural school districts, atid by an elected (though sometimes appointed) board of education or school com- mittee in cities and towns. In 836 cities and towns there is a local superintendent of schools, who directs and supervises the educational work and acts as the executive officer of the board of education. The schools in the rural districts are under the direct supervision of a county superintendent of schools or similar official, who is often chosen by the people, but who sometimes is named by the State authorities. The county and city superintend- ents are often charged with the duty of holding examinar tions for entrance upon the work of teaching, and of issuing licences to those persons who pass the examinations. This system works best where it is carefully regulated by State law. Thirty States, one Territory, and the District of Columbia have enacted compulsory education laws, but the enforcement of them is usually very lax. In fifteen States and Territories there are no compulsory education laws, although there are in existence there fully organized school systems free to all children. The usual age during which school attendance is required is from 8 to 14. Provision is made in Maine, New Hamp- shire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Indiana, Minnesota, and Michigan, for sending habitual truants to some special institution. Laws forbidding the employment of children under a specified minimum age in any mercantile or manufacturing establishment are in force in twelve States, and are usually administered in connexion with the compulsory education laws. The universal establish- ment of public secondary schools (high schools), and the existence of State universities in all of the States south and west of Pennsylvania, has brought into existence a system of State education which reaches from the kinder- garten and the elementary school to the graduate instruc- tion offered at State colleges and universities. This system includes (1) about 1500 free public kindergartens scattered over fifteen States ; (2) free public elementary schools within reach of almost every home in the land ; (3) free public secondary schools (high schools) in every considerable city or town and in not a few rural commu- nities; (4) free land grant colleges, supported in large part by the proceeds of the nation's endowment of public

lands, paying particular attention to agriculture and the mechanical arts, in all the States ; (5) State universities, free or substantially so, in all the States south and west of Pennsylvania ; (6) free public normal schools, for the professional training of teachers, in every State except Nevada and Wyoming, and in every Territory except Indian Territory ; (7) free schools for the education of defectives in nearly all the States ; and ' (8) the national academies at West Point and Annapolis for the professional training of military and naval officers respectively.

Miss Susan E. Blow, herself the leading exponent of kindergarten principles in the United States, has pointed out that the history of the kindergarten move- ment reveals four distinct stages in its develop- g^^J^ ment : the pioneer stage, having Boston as its centre ; the philanthropic stage, which began in the village of Florence, Mass., and reached its climax at San Erancisco, California ; the national or strictly educational stage, which began at St Louis ; and the so-called mater- nal stage, which from Chicago as a centre is spreading over the entire country. During the first stage public attention was directed to a few of the most important aspects of Froebel's teaching. During the second stage the kindergarten was valued largely as a reformatory and redemptive influence. During the third stage the fundamental principles underlying kindergarten training were scientifically studied and expounded, and the kinder- garten became part of the public school system of the . country. The fourth stage, which, like the third, is fortunately still in existence, aims at making the kinder- garten a link between the school and the home, and so to use it to strengthen the foundations and elevate the ideals of family life. In 1898 there were 4363 kinder- gartens in the United States (1366 of which were public), employing 9937 teachers (2532 in the public kinder- gartens) and enrolling 189,604 children (96,867 in the public kindergartens). Of the 164 public normal schools, 36 make provision for training kindergarten teachers. The scientific and literary activity of some of the private kindergarten training classes is very great, and they exert a beneficial and stimulating effect on teaching in the elementary schools. It is generally admitted that from the point of view of the children, of the teachers, of the schools, and of the community at large, the kinder- garten has been and is an inspiration of incalculable value.

The elementary school course is from six to nine years in length, the ordinary period being eight years. The pupils enter at about six years of age. In the cities the elementary schools are usually in scboo"s7^ session for five hours daily, except Saturday and Sunday, beginning at 9 a.m. There is an intermission, usually of an hour, at midday, and short recesses during the sessions. In the small rural schools the pupils are usually ungraded, and are taught singly or in varying groups. In the cities and towns there is a careful gradation of pupils, and promotions from grade to grade are made at intervals of a year or of a half-year. The best schools have the most elastic system of gradation and the most frequent promo- tions. In a number of States there are laws authorizing the conveyance of children to school at the public expense, when the schoolhouse is unduly distant from the homes of a portion of the school population. Co-education of the sexes in the elementary school is the salutary and almost uniform practice in the United States. Fewer than 6 per cent, of the cities offer exceptions to this rule, and in most of these the separation of boys and girls has arisen from the position or original arrangement of the school buildings,and is likely to be discontinued under more favourable condi- tions. The programme of studies in the elementary school includes English (reading, writing, spelling, grammar, composition), arithmetic (sometimes elementary algebra

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also, or plane geometry in the upper grades), geography, history of the United States, and elementary natural science, including human physiology and hygiene. Physi- cal training, vocal music, drawing, and manual training are often taught. Sometimes a foreign language (Latin, German, or French) and the study of general history are begun. Formal instruction in manners and morals is not often found, but the discipline of the school offers the best possible training in the habits of truthfulness, honesty, obedience, regularity, punctuality, and conform- ity to order. Eeligious teaching is not permitted, although the exercises of the day are often opened with reading from the Bible, the repetition of the Lord's Prayer, and the singing of a hymn. Corporal punishment is not in- frequent, but is forbidden

by law in New Jersey, and in many States may be used only under restrictions. Text- books are used as the basis of the instruction given, and the pupils " recite " in class to the teacher, who, by use of illustration and comment, makes clear the subject- matter of the prescribed lesson. The purpose of the recitation method is to make the work of each pupil help that of his companion. Skilfully used, it is the most effectual instrument yet devised for elementary school instruction. In 1897-98 there were 14,589,036 pupils enrolled in the public elementary schools. The average length of the school term was 143-1 days. There were about 380,000 teachers engaged in the elementary schools. About 1,250,000 pupils were at the same time receiving elementary instruction in private or parochial schools.

The secondary school course is normally four years in length. The principal subjects studied are Latin, Greek,

French, German, algebra, geometry, physics, fcb^of^ chemistry, physical geography, physiology,

rhetoric, English literature, civics, and history. Although but 11-36 per cent, of the students in public high schools, and 25-36 per cent, of those in private secondary schools, are preparing for a college or scien- tific school, yet the conditions prescribed by the colleges for admission to their courses affect powerfully both the secondary school programme and the methods of teaching. Of late years no educational topic has been more widely discussed than that as to the proper relations of secondary schools and colleges. As a result, special examinations for admission to college are either greatly simplified or en- tirely abolished, and the secondary studies are much more substantial and better taught than formerly. An increasing proportion of secondary school teachers are college graduates. In 1897-98 there were 5315 public secondary schools and 1990 private secondary schools, or 7305 in all. In these schools 27,298 teachers were em- ployed, 14,681 of them being women. The secondary school students numbered 554,825, of whom 449,600 were in public high schools. The boys numbered 241,359 and the girls 313,466. The most extraordinary characteristic of secondary education in recent years is the rapid increase in the number of students taking Latin as a school sub- ject. In nine years the number of such

students has in- creased from 100,144 (33-62 per cent, of the total) to 274,293 (49-44 per cent.). Meanwhile the proportion of those studying physics and chemistry has fallen off slightly: The rate of increase in the number of pupils who study Latin is fully twice as great as the rate of increase in the number of secondary school students. Between 1890 and 1896, while the number of students in private secondary schools increased 12 per cent., the num- ber of students in public secondary schools increased 87 per cent. Since 1894 the number of students in private secondary schools has steadily declined. In 1897-98 there were 34 public high schools for boys only, 29 for girls only, and the remainder (6252) were co-educational.

In the same year there were 351 private secondary schools for boys only, 537 for girls only, and 1212 which were co- educational.

The American college, although it is the outgrowth of the English colleges of Oxford and of Cambridge, has de- veloped into an institution which has no counter- part in Europe. The college course of study, at ^,%ggg__fii'st three years in length, was soon extended to four years, and the classes are uniformly known as the freshman, the sophomore, the junior, and the senior. Whether or not, in view of changed educational and social conditions, a college course of four years is not too long is a question nowunder serious discussion. The traditional degree which crowns the college course is that of Bachelor of Arts (A.B.). The studies ordinarily insisted on in the case of candidates for this degree are Latin, Greek, mathematics, English, philosophy, political economy, history, at least one modern European language (French or German), and at least one natural science. The degrees of Bachelor of Science (B.S.), Bachelor of Philosophy (Ph.B.), and Bachelor of Letters (B.L.) are often conferred by colleges upon students who have pursued systematic courses of study which do not include, Greek or the amount of Latin required for the degree of Bachelor of Arts. The best colleges give instruction which is similar in character to that given in Germany in the three upper classes of the gymnasium and in the introductory courses at the universities, in France in the two upper classes of the lycee and in the first two years of university study, and in England in the upper form of the public schools and during the years of undergraduate residence at Oxford and Cambridge. Since 1870 the colleges have developed enormously. Their resources have multiplied, the num- ber of

their students has increased by leaps and bounds, the programme of studies has broadened and deepened, the standards have been raised, and the efficiency of the instruction has greatly increased. Eigidly prescribed courses of study have given way to elective courses, and a knowledge of Greek is no longer required for the degree of A.B. at such influential colleges as Harvard, Columbia, Cornell, and Williams. A strong effort is being made to have the leading colleges give but one degree, that of Bachelor of Arts, and to confer that upon those who complete any substantial course of college studies. A marked change has taken place in the attitude of the college authorities toward the students. A genera- tion ago the college president was a paterfamilias. He knew each student and came into direct personal contact with him- The president and the faculty had supervision not only of the studies of the students, but of their moral and religious life as well. The older type of college professor was not always a great scholar, but he was a student of human nature, with keen intuitions and shrewd insight. The new type is more scholarly in some special direction, often regards teaching as a check upon opportunities for investigation, and disdains troubling himself with a student's personal concerns or intellectual and moral difficulties. The change has not been altogether for the better, and a desirable reaction is now under way. Each college, however small or ill- equipped, exercises a helpful local influence. Ninety per cent, of all college students attend an institution not more than one hundred miles from their own homes. Few colleges have a national constituency, and even in these cases an overwhelming preponderance of the students come from the immediate neighbourhood. This explains, in a measure,' the powerful influence which the college has exercised in the life of the nation. While hardly more than one in a hundred of the white male youth of the country has had a college education, yet the college graduates have furnished one-half of all the Presidents of

the United States, most of the Justices of the Supreme Court, about one-half of the Cabinet ofl&ccers and United States senators, and nearly one-third of

the House of Eepresentatives. Before the Eevolution eleven colleges ■were founded. From 1776 to 1800, twelve more were added ; from 1800 to 1830, thirty-three ; from 1830 to 1865, one hundred and eighty ; from 1866 to 1898, two hundred and thirty-six. The present total is 472. Their standards, efficiency, and equipment are very diverse, many of the so-called colleges being less effective than some of the better-organized secondary schools. Except in New York and Pennsylvania, there is no statutory restriction upon the use of the name college. This is an abuse which is beginning to attract public attention. The number of undergraduate collegiate and technical school students has increased from 573 to each million of inhabit- ants in 1872, to 1193 in 1898. In 1897 the whole number of professedly collegiate students enrolled in colleges for men, for women, and for both sexes was 84,955, of whom 52,439 were men. There was, therefore, one college student to each 831 of population. There are 114 colleges, exclusive of those for women, enrolling 31,941 students, and as a rule possessing the largest endowments, which are under no ecclesiastical control. Fifty-nine colleges, enrolling 5954 students, are Eoman Catholic. Two hundred and eighty-four, enrolling 29,104 students, are under the control of some one of the Protestant denominations.

In the United States the title "university" is used indiscriminately of institutions which are in reality

universities, of institutions which are colleges,! The aniver- and of institutions which are so ill-equipped as sities. not to take rank with good secondary schools.

Only time and a greatly increased capacity to distinguish the various types of higher schools will remedy this error. Putting aside tentative and unsuc- cessful attempts to develop genuine university instruction much earlier, it may safely be said that the opening of the Johns Hopkins University at Baltimore in 1876 began the present movement to organize carefully ad- vanced study and research, requiring a college education of those who wish to enter upon it. This is university instruction properly so-called, and though found else- where, it is given chiefly at fourteen institutions : Cali- fornia University, Catholic University of Amterica, Chicago University, Clark University, Columbia Uni- versity, Cornell University, Harvard

University, Johns Hopkins University, Michigan University, Pennsylvania University, Princeton University, Stanford University, Wisconsin University, and Yale University. All of these institutions, except the Catholic University and Clark University, are also colleges. The combination of collegiate and university instruction under one corpora- tion and one executive administration is distinctive of higher education in the United States, and its chief source of strength. The crowning honour of the univer- sity student is the degree of Ph.D., although that of A.M. — obtainable in less time and much easier condi- tions— is also sought. The minimum period of study accepted for the degree of Ph.D. is two years after obtaining the bachelor's degree; but in practice, three, and even four, years of study are found necessary. In addition to carrying on an investigation in the field of his main subject of study, the candidate for the degree of Ph.D. is usually required to pass examinations on one or two subordinate subjects, to possess a reading know- ledge of French and German (often of Latin as Well), and to submit — usually in printed form — ^the dissertation which embodies the results of his researches. The methods of instruction in the universities are the lecture, discussion, and work in laboratory or seminary — ^the

latter transplanted from the German universities. The degree of Master of Arts is conferred upon students who, after one year of university residence and study, pass certain prescribed examinations. This degree, like those of D.D., S.T.D., and LLTD., is oftep^ conferred by colleges and universities as a purely honorary distinction. The degree of Ph.D. is not so conferred any longer 'by the best universities. Not a few of the universities maintain schools of law and medicine. Harvard and Yale univer- sities maintain schools of theology as well. The learned publications issued by the universities, or under the direction of university professors, are of great importance, and constitute an imposing body of scientific literature. The national and State governments make increasing use of university officials for public service requiring special training or expert knowledge. In 1871-72 there were only 198 resident graduate (or university) students in the United States. In 1887 this number had risen to 1237, and in 1897 to 4392. These figures are exclusive of professional students, and include only those who are studying in what would be called, in Germany, the. philosophical faculty. (See also Universities.) Most extensive provision is made for

professional, technical, and special education of all kinds, and for the care and training of the dependent and defective classes, as well as for the education of the Indian and — in the Southern states — of the negro.

The most complete exposition of education as it now exists will be found in Butler, Education in the United States, Albany, N.Y., 1900, a series of nineteen monographs which, taken together, cover the whole educational activity of the TJnitfed States, prepared for the Government educatioDal exhibit at the Paris Exposition of 1900. The official Reports, issued annually, df the Commissioner of Education, at Washington, contain the latest and most authori- tative educational statistics of every sort. They also include treatises on special topics, and are indispensable works of reference. The only historical sketch is Boone's HIstory of Education in the United States, New York, 1889. Martin, Evolution of the Massa- chusetts School System, New York, 1894, is accurate and valuable. Contemporary discussions of educational topics of interest are provided from year to year in the published Proc-eedings 6f the National Education Association, a voluntary organization of teachers of every grade. Cs, m. b.)

Edward VII. (Ai-bebt Edwabd), King of Great Britain and Ireland, and of the British Dominions beyond

the Seas, Emperor of India (1841), the eldest son

and second chUd of Queen Victoria and of Albert, Prince Consort, was born at Buckingham Palace on 9th November 1841. He was created prince of Wales and earl of Chester on 4th December following, and was baptized by the archbishop of Canterbury on 25th January 1842. In his chUdhood he was carefully educated, under the immediate supervision of the Queen, by the Dowager Lady Lyttelton, governess of the royal children ; and in his boyhood successively by the Eev. Henry Mildred Birch, formerly an assistant master at Eton, and by Mr F. W. Gibbs, assisted by the Rev. C. F. Tarver and Mr Herbert W. Fisher. He afterwards resided successively at Edinburgh, studying chemistry in its industrial applications under Professor (afterwards Lord) Playfair at the University ; at Christ Church college, Oxford ; and at the University of Cambridge, where he was a student at Trinity under Dr Whewell. In November 1858 he was made a Knight of the Garter, and received a commission as colonel in the army, ascending in due

time to the rank of field-marshal. In 1859 he travelled in Italy and Spain, returning to pursue his studies at the universities, and availed himself of the long vacation of 1860 to pay, a visit, under the incognito of « Lord Renfrew," to the United States, where he was received with cordiality, and to Canada, which welcomed him with enthusiasm. The duke of Newcastle, secretary of state for the colonies, acted as his guide and

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H. M. King Edwaed VII.

(Photograph hy W. and D. Downey, London.)

From an original graciously selected by His Majesty for the New Volumes.

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mentor upon this occasion. Upon the completion of his Cambridge 'course in June 1861 he joined the camp at the Curragh, where he acquainted himself with the details of military duty. While thus engaged he was, in common with the entire nation, overwhelmed by the unexpected death of his father, 13th December 1861, after a very brief illness. For long the prince remained in absolute seclusion, but in 1862 fulfilled a wi^h of the deceased Prince Consort by undertaking a tour in the Holy Land under the guidance of Arthur Penrhyn Stanley, afterwards dean of Westminster, who had already travelled in the East and written Sinai cmd Palestine. The travellers departed in February and returned in June. Stanley's Sermons preached in the East was among the fruits of their expedition. Early in 1863 the prince was sworn of the Privy Council, and took his seat in the House of Lords as duke of Cornwall. About the same time the estate of Sandringham, in Norfolk, was purchased for him out of the savings of his minority. His town residence was fixed at Marlborough House. His impending marriage to the Princess Alexandra, daughter of Christian IX., king of Denmark (bom 1st December 1844), had already been announced, and took place on 10th March in St George's Chapel, Windsor. From her first appearance on British soil the princess captivated the heart of the nation, and Tennyson

uttered the public sentiment when he sang, in his ode as poet-laureate, "We are all of us Danes in our welcome of thee." Parliament granted the prince an income of £40,000 a year, exclusive of the revenues of the duchy of Cornwall, and he relinquished his right of succession to the duchy of Saxe-Coburg-Gotha. Prince Albert Victor, afterwards duke of Clarence, was the first offspring of the marriage, being born on 17th January 1864. The births followed of Prince George Frederick Ernest Albert, duke of York, born 3rd June 1865 ; Princess Louise Victoria Alexandra Dagmar, by marriage duchess of Fife, born 20th February 1867; Princess Victoria Alexandra Olga Mary, born 6th July 1868; and Princess Maud Charlotte Mary Victoria, born 26th November 1869, married to Prince Charles, second son of the Crown Prince of Denmark. From the time of their marriage the prince and princess were more conspicuously before the country than had ever before been the case with any princely pair of the same position. The deep afflic- tion of the widowed sovereign, and the burden of public care which she was now compelled to undertake, unre- lieved by the participation of her mainstay and chief adviser, incapacitated her for the performance of most of the social functions of Royalty. The prince and princess of Wales stepped forward to fill her place, and by their tact and the affability of their bearing, and their diligence and punctuality in satisfying every public claim, fre- quently at great inconvenience to themselves, contributed not a little to that general popularity of the British monarchy among all classes which has proved so import- ant a factor in national politics. The prince's readiness to promote every worthy cause was most marked; no one was a more constant attendant at the meetings and gatherings for objects of public utility in which his position as a prince of the blood royal would permit him to take part, and his speeches were always most effective from their excellent sense and clear enunciation. The most important external event of these years was a tour to Egypt, undertaken in 1869 in company with the duke of Sutherland, Sir Samuel Baker, and others, an account Df which was published by Mrs William Grey. The prince also visited Ireland more than once, and opened the International Exhibition of 1871.

On 23rd November 1871 it was announced that the prince would be prevented from paying a visit which had been arranged to the Maharajah Dhuleep Singh by a

feverish attack. It soon appeared that the malady was typhoid, contracted, as was supposed, on a visit to Scar- borough. The case became so serious that on 29th November the Queen and Princess Alice hurried to Sandringham, where the prince had repaired on feeling the first symptoms of illness. On 1st December there was a slight rally, but on 8th December so serious a relapse occurred that all the royal family came to Sand- ringham, and for some days the prince's life was de- spaired of. Under the skilful treatment of Sir William Jenner, Sir William Gull, and Sir James Paget, however, the crisis was surmounted by 16l!h December, and by Christmas Day the danger was regarded as virtually over. On 27th February 1872 a public thanksgiving was held at St Paul's, amid the most imposing and most affecting demonstrations of public joy and gratitude throughout the empire. The importance attaching to the life of the heir to the Throne was emphasized by the consciousness of his danger and his escape. A re- publican agitation, indeed, which had seemed to be gathering strength throughout the year in connexion with labour disputes, collapsed entirely, and has never been revived.

In January 1874 the prince of Wales attended the mar- riage at St Petersburg of his brother, the duke of Edin- burgh, with the Grand Duchess Marie of Eussia. In the same year he paid a historic visit to Birmingham, where Mr Joseph Chamberlain, not yet a member of Parliament, received him oificially as mayor. In March 1875 it was officially announced that he would make a visit to India, carrying out an idea originally conceived by the first Indian viceroy. Earl Canning. He was supposed to travel as heir- apparent, not as representative of the Queen ; but the characters could not be kept apart, and in fact the prince's visit was a political event of great importance. Leaving England on 11th October, he was received at Bombay by the viceroy. Lord Northbrook. Here he met a very large number of Indian feudatory princes, whose acquaintance he subsequently improved by visiting at their courts during the seventeen weeks lyhich he spent in the country. During these foiur months the prince travelled nearly 8000 miles by land and 2500 miles by sea, became acquainted with more rajahs than had all the viceroys who had reigned over India, and saw more of the country than any living Englishman. The rajahs were enchanted by his tact and uibanity. The visit, moreover, led up, as was probably intended, to the Queen's assumption of the title of empress of India in the following year.

The prince's life after this date was full of conspicuous public appearances. In 1885 he visited Ireland at a time of much political excitement, and was received enthusi- astically in many quarters and without symptoms of ill-will in any. In 1886 he filled the presidency of the Indian and Colonial Exhibition, opened the Mersey Tunnel, and laid the first stone of the Tower Bridge. In 1887 a large share of the arrangements for the Queen's Jubilee devolved upon him. On 27th July 1889 his eldest daughter. Princess Louise, was married to the duke of Fife. In the autumn he paid a semi-incognito visit to Paris, where he has always been highly popular, viewed the Exhibition, and ascended the Eiffel Tower. In 1890 he opened the Forth Bridge. On 14th January 1892, however, a heavy blow f eU upon him and his house by the death of his eldest son, Prince Albert Victor, duke of Clarence and Avondale, after only five days' illness. The young prince, who with his brother had made the tour of the world in H.M.S. Bacchante, and after a short career at Oxford and Cam- bridge was just settling down to play his part in public life, had recently become engaged to Princess Victoria Mary of Teck (born 26th May 1867)i and the popularity of the

heir to the Crown had been increased by the expression of his satisfaction at his son's union to an Englishwoman. On 6th July 1893 the broken thread was reunited by the marriage of the princess (popularly known as Princess May) to the brother of the deceased prince, George Fred- erick, duke of York.

The year 1894 was a busy one for the prince of Wales, who became a member of the Eoyal Commission on the Housing of the Poor, opened the Tower Bridge, attended the Welsh Eisteddfod and was duly initiated, and paid two visits to Eussia — one on the marriage of the Grand Duchess Xenia, the other on the death of the Tsar, his brother-in-law. In 1896 he became first Chancellor of the University of Wales, and his first act after his installation at Aberystwith was to confer an honorary degree upon the princess. He had already been for some years a trustee of the British Museum, and par- ticipated actively in its administration. On 22nd July 1896 the prince's third daughter. Princess Maud, was married to Prince

Charles of Denmiark. The arrange- ments for the Queen's Jubilee of 1897 depended upon the prince even more than those of the corresponding celebration in 1887 : he rode on the Queen's right at the great procession to St Paul's, and as an Admiral of the Eleet presided at the naval review at Spithead, a spec- tacle unparalleled in the history of the world. In July 1898 the prince had the misfortune to fracture his knee- cap while on a visit to Baron Ferdinand de Rothschild, but completely recovered from the effects of the accident. In December 1899, while passing through Brussels on his way to St Petersburg, he was fired at by a miserable lad named Sipido, crazed by reading anarchist literature. Fortunately, no injury was done.

It was the especial distinction of Albert Edward, prince of Wales, to have been an ornament and support of the throne before he was called upon to fill it" himself. This cannot be said of any of his predecessors except Edward the Black Prince. Most princes of Wales have either died or attained the regal dignity too early to leave any con- spicuous mark in history as princes. Since the days of the Black Prince only two have enjoyed a popularity com- parable to Prince Albert Edward's — Henry of Monmouth and Henry, the son of James I. The glories of Henry V. have cast a veil over the irregularities of Prince Hal ; and the popularity of the Stuart Prince Henry arose in great measure from his suppressed antagonism to his father, and the expectation that he would reverse the latter's policy. The other two princes of Wales who have filled a con- spicuous place in the public eye, Prince Frederick and George IV., were neither dutiful nor popular. It was reserved for the son of Queen Victoria to show what strength an heir-apparent exemplary in the discharge of the duties of his station can bring to a monarchy, and how important a place, even with the most scrupulous absti- nence from party politics, he can fill in the life of a self-governing nation. He was a keen patron of the theatre, and made it his business to know and remember all the distinguished men of the time in arts and letters. His thoroughly British taste for sport was as pronounced as his inclination for most of the contemporary amusements of Society. The "Tranby Croft Case" (1890), in which Sir William Gordon Gumming brought an unsuccessful libel action for having been accused of cheating at a game of baccarat, caused some comment in connexion with the Prince's appearance in the witness-box on be- half of the defendants. But it did him no disservice with the people to have twice won the Derby with his horses

Persimmon (1896) and Diamond Jubilee (1900), and his interest in yacht-racing was conspicuously shown at all the important fixtures, his yacht Britannia being one of the best of her day. In other respects his activity

in the life of the nation and his wide interests may be illustrated by his establishment (1897) of the " Prince of Wales's Hospital Fund," his devotion to the cause of Masonry (he was first elected Grand Master of the Free- masons of England" in 1874), and his position as a Bencher of the Middle Temple, where he also became (1887) Treasurer. It was on the occasion of his first appearance at " Grand Night," that the students were for the first time allowed to follow the Prince's example and to smoke in Hall; and this was only one instance of the influ- ence in this respect which the Prince's taste for tobacco had on English society.

On the death of Queen Victoria on 22nd January 1901, the question what title the new king would assume was speedily set at rest by the popular announcement that he would be called Edward the Seventh. The new reign began auspiciously by the holding of a Privy Council at St James's Palace, at which the King announced his intention to follow in his predecessor's footsteps and to govern as a constitutional sovereign, and received the oaths of allegiance. On 14th February the King and Queen opened Parliament in state. Shortly afterwards it was announced that the visit of the duke and duchess of York to Australia, in order to inaugfurate the new Commonwealth, which had been sanctioned by Queen Victoria, would be proceeded with ; and on 16th March they set out on board the Ophir with a brilliant suite. The tour lastedjiill 1st November, the duke and duchess having visited Australia, New Zealand, the Cape, and Canada; and on their return the King, on 9th Novem- ber, created the duke prince of Wales and earl of Chester. In the meanwliile Parliament had settled the new Civil List (q.v.) at £470,000 a year. On 22nd May the King had a narrow escape in Southampton Water, on board Sir T. Lipton's yacht Shamrock II. (which was to com- pete for the America Cup). The yacht had her masts, spars, and entire spread of canvas carried away in a squall ; but the King suffered no injury. The question of enlarging the Eoyal title- to include specific mention of the colonial empire had been discussed during the year, and on 30th July Parliament passed a Bill to enable the King to style himself "Edward VII., by the grace of God of the United Kingdom of Great Britain and Ire- land,

~~and of all the British Dominions beyond the Seas, King, Defender of the Faith, Emperor of India." The Coronation was fixed for 26th June 1902. Two days earlier, however, the King was announced to be suffering from perityphlitis, and on 24th June an operation was performed by Sir Frederick Treves. The Coronation was consequently postponed. On 27th June the King was pronounced "out of immediate danger," and up to 1st July, when this volume was printed, he was stated to be progressing favourably.~~

~~The grandchildren of King Edward "VII. are— children of the prince and princess of "Wales— (1) Prince Edward Albert Christian George Andrew Patrick David, born 23rd June 1894 ; (2) Pririce Albert Frederick Arthur George, born 14th December 1896 ; (3) Princess "Victoria Alexandra Alice Mary, born 25th April 1897 ; (4) Prince Henry William Frederick Albert, born 15th March 1899. Children of the duke and duchess of Fife— (1) Lady Alexandra "Victoria Alberta Edwina Louise Dufl, bom 17th May 1891 ; (2) Lady Maud Alexandra "Victoria Georeina Bertha Duff, born 3rd April 1893.~~

~~Edwardsville, capital of Madison county, Illinois, U.S.A., on Cahokia creek, at an altitude of 554 feet. It has three railways, the Wabash, the Toledo, St Louis, and Kansas City, and the Chicago, Peoria, and St Louis. Population (1880), 2887 ; (1890), 3561 ; (1900), 4167.~~

~~Edwardsville, a borough of Lucerne county, Pa., U.S.A., in the anthracite coal region, on the north branch of the Susquehanna river. The official name of the post office is Edwardsdale. Population (1900), 5165.~~

~~EEL~~

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~~Eel. — The commoii fresh-water eel belongs to a group of soft-rayed fishes distinguished by the presence of an opening to the air-bladder and the absence of the pelvic fins. With its nearest relatives it forms the family Murseni- dse, all of which are of elongated cylindrical form. The special peculiarities of the eel are the rudimentary scales buried in the skin, the well-developed pectoral fins, the rounded tail fin continuous with the dorsal~~

and ventral fins. Only one other species of the family occurs in British waters, namely, the conger, which is usually much larger, and lives in the sea. In the conger the eyes are larger than in the eel, and the upper jaw overlap^ the lower, whereas in the eel the lower jaw projects beyond the upper. Both species are voracious and predatory, and feed on almost any animal food they can obtain, living or dead. The conger is especially fond of squid or other Cephalopods, while the eel is partial to carrion. The common eel occurs in all the rivers and fresh waters of Europe, except those draining towards the Arctic Ocean, the Black Sea, and the Caspian Sea. It also occurs on the Atlantic side of North America. The conger has a wider range, extending from the western and southern shores of Britain and Ireland to the East Indian Archipelago and Japan. It is common in the Mediterranean.

The ovaries of the eel resemble somewhat those of the salmon in structure, not forming closed sacs, as in the majority of Teleostei, hut consisting of laminse exposed to the hody cavity. The laminae in which the eggs are produced are very numerous, and are attached transversely by their inner edges to a membranous band running nearly the whole length of the body-cavity. The majority/of the eels captured for market are females with the ovaries in an immature condition. The male eel was first dis- covered in 1873 by Syrski at Trieste, the testis being described by him as a lobed elongated organ, in the same relative position as the ovary in the female, surrounded by a smooth surface without laminse. He did not find ripe spermatozoa. He discovered the male by examining small specimens, all the larger being female. Jaooby, a later observer, found no males exceeding 19 inches in length, while the female may reach a length of 39 inches or more. Dr Petersen, in a paper published in 1896, states that in Denmark two kinds of eels are distinguished by the fishermen, namely, yellow eels and silver eels. The silver eels are further dis- tinguished by the shape of the snout and the size of the eyes. The snout in front of the eyes is not flat, as in the yellow eels, but high and compressed, and therefore appears more pointed, while the eyes are much larger and directed outwards. In both kinds there are males and females, but Petersen shows that the yellow eels change into silver eels when they migrate to the sea. The sexual organs in the silver eels are more developed than in the yellow eels, and the former have almost or entirely ceased to take food. The male silver eels are from 11 J to 19 inches

in length, the females from 16^ to about 39 inches. It is evident, there- fore, that if eels only spawn once, they do not all reach the same size when they become sexually mature. The male conger was first described in 1879 by Hermes, who obtained a ripe speci- men in the Berlin Aquarium. This specimen was not quite 2J feet in length, and of the numerous males which have been identified at the Plymouth Laboratory, none exceeded this length. The large numbers of conger above this size caught for the market are all immature females. Female conger of 5 or 6 feet in length and weighing from 30 to 50 lb are common enough, and occasionally they exceed these limits. The largest recorded was 8 feet 3 inches long, and weighed 128 lb.

There is every reason to believe that eels and conger spawn but once in their lives, and die soon after, they have discharged their generative products. When kept in aquaria, both male and.female conger are vigorous and voracious. The males sooner or later cease to feed, and attain to the sexually mature condition, emitting ripe milt when handled and gently squeezed. They live in this condition five or six montis, taking no food, and showing gradual wasting and disease of the bodily organs. The eyes and skin become ulcerated, the sight is entirely lost, and the bones become soft through loss of lime. The females also after a time cease to feed, and live in a fasting condition for five or six months, during which time the ovaries develop and reach great size and weight, while the bones become soft and the teeth disappear. The female, however, always dies in confinement before the oVa are perfectly ripe and before they are liberated from the ovarian tissue. The absence of some necessary condition, perhaps merely of the pressure which exists at the bottom of the sea, evidently prevents the com-

plete developnjient of the ovary. The invariable death of the fish in the same almost ripe condition leads to the conclusion that under normal conditions the fish dies after the mature ova have been discharged. Grassi states that he obtained ripe male eels, and ripe specimens of Mursena, another genus of the family, in the whirlpools of the Strait of Messina. A ripe female Mursena has also been described at Zanzibar. Gravid female eels, i.e., specimens with ovaries greatly enlarged, have been 'occasionally obtained in fresh water, but there is no doubt that, normally, sexual maturity is attained only in the sea.

Until recent years nothing was known from direct observation concerning the reproduction of the common eel, or any species of the family. It was a well-known fact that large eels migrated towards the sea in autumn, and that in the spring small trans- parent eels of 2 inches in length and upwards were common on the shore under stones, and ascended rivers and streams in vast swarms. It was reasonable, therefore, to infer that the mature eels spawned in the sea, and that there the young were developed.

A group of peculiar small fishes were, however, known which were called Leptocephali, from the small proportional size of the

Leptocephall, {By Jc/iTid p&mviasion of J. (& A. Chwpchill.)

head. The first of these described was captured in 1763 near Holyhead, and became the type of L. Morrisii, other specimens of which have been taken either near the shore or at the surface of the sea. Other forms placed in the same genus had been taken by surface fishing in the Mediterranean and in tropical ocean currents. The chief peculiarities of Leptocephali, in addition to the smallness of the head, are their ribbon-like shape and their glassy trans- parency during life. The body is flattened from side to side, and broad from the dorsal to the ventral edge. Like the eels, they are destitute of pelvic flns, and no generative organs have been observed in them (see Fig. above).

In 1864 the American naturalist. Gill, published the conclusion that L. Morrisii was the young or larva of the conger, and Leptocephali generally the young stages of species of Muraenidse. In 1886 this conclusion was confirmed from direct observation by Yves Delage, who kept alive in a tank at Eoscoff a specimen of L. Morrisii, and saw it gradually transformed into a young conger. From 1887 to 1892 Professor Grassi and Dr Calandruccio carried on careful and successful researches into the development of the Leptocephali at Catania, in Sicily. The specimens were captured in considerable numbers in the harbour, and the transformation of L. Morrisii into young conger, and of various other forms of Leptocephalus into other genera of Mursenidse, such as Murxna, CongromurcBna, and Ophichthys, was observed. In 1894 the same authors published the announcement that another species of Lepto- cephalus, namely, L. bremrostris, was the larva of the common eel. This larval form was captured in numbers with other

Leptocephali in the- strong currents of the Strait of Messina. In the metamorphosis of all Leptocephali a great reduction in size occurs. The L. brevirostns reaches a lengSi of 8 cm., or a little more than 2^ inches, while the perfectly-formed young eel is 2 inches long or a little more.

The Italian naturalists have also satisfied themselves that certain pelagic fish eggs originally described by Raffaele at Naples are the eggs of Mursenidse, and that among them are the eggs of

Conger and Anguiila. They believe that these eggs^ although free in the water, remain usually near the bottom at great depths, and that fertilization takes place under similar conditions.' No fish eggs of the kind to which reference is here made have yet been obtained on the British coasts, alth'ough conger and eels are so abundant there. Raffaele described and figured the larva newly hatched from one of the eggs under consid*j|^on, and it is evident that this larva is the earliest stage of a Le^^fcohalus^^^

See " The Eel Question," Beport U. S. Co^TOH||MB^BkPisfterJes for 181/9. Washington, 1882. — Cunningham, 'H^^^^Bion and Development of the Conger," Journ. Mar. BioL^^^^mii. ii. — Petersen, Beport Dan. Biol. Station, v., 1894. — G^B^ Quart. Journ. Mic. Sci. vol. xxxix., 1897. (j. t. c.)

Eger, the chief town of the governmeut district of the same name in Bohemia; connected by rail with Nuremberg, Prague, Vienna, Reichenberg, &c. Population (1890), 18,658 ; (1900), 23,665, almost exclusively German (estimated at 91 per cent. Roman Catholic, 6 per cent. Protestant, and 3 per cent. Jewish). There is a garrison of 1069 men. Latterly Eger has been very prominent on account of its strong Pan-G-ermanic sentiment. The town is exceptionally interesting from its ancient buildings, collection of historical relics of Wallenstein, &c. There is a considerable textile industry, together with the manufacture of shoes, machinery, brewing, milling, &c. The inhabitants of the district are still distinguished from the surrounding population by their costumes, language, manners, and customs.

Egham, a town and railway station in the Chertsey parliamentary division of Surrey, England, on the Thames, 21 miles west by south of London by rail. The parish

*church contains monuments by Flaxman. Within the parish are the Royal Indian Engineering College on Cooper's Hill, the hill celebrated in Sir John Denham's poem, 1642, the Royal Holloway College for Women, the Holloway sanatorium for the treatment of mental ailments, and a cottage hospital ; also the field of Runnymede, where King John signed Magna Carta, and (partly in Berkshire) Virginia Water, a large artificial lake in the south of Windsox Great j*ark. Area of parish (with Englefield), 7786 acres. Bj|ulation (lg§), 8692 ; (1901), 11,894.*

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*Egin (Armenian, Agn, *^e spring"), an important town in the Memuret el-Aziz villyet of Asiatic Turkey (altitude, 3300 feet). It is picturesque^^ituated in a theatre of lofty, abrupt rocks, on the ri^H bank of the Western Euphrates, at the point wherethe Kharpiit- Erzingan road crosses the river by a wooden bridge. The stone houses stand in terraced gardens and orchards, and the streets are mere rock-ladders. The population numbers 10,000 (Moslems 6000, Armenians 4000). Egin was settled by Armenians who emigrated from Van in the 11th century with Senekherim. On 8th November 1895 many Armenians were massacred.*

Egorievsk, a district town of Russia, government and 74 miles north-east of Ryazan, connected by a branch line (14 miles) with the Moscow to Ryazan main line. Its cotton mills (yielding over £500,00C^ a year) and other factories give occupation to 6000 persons. It has impor- tant fairs for trade in grain, hides, &c., exported. Popular tion, 20,000.

EGYPT.

Geogbaphy and Statistics.

THE salient physical features of Egypt may be grouped as follows, each division having its own characteristic features, due essentially to the geological structure of the country :— (1) the Delta, (2) the Trough or " Rift " Valleys, (3) the Desert Plateaux, (4) the mountainous region in the east and north-east. The Nile must also be considered separately.

The Delta. — The delta of the Nile occupies a triangular area north of Cairo, measuring 100 miles from south to north, and having a width of 155 miles on the shore of the Mediterranean between Alexandria on the west and Port Said on the east. Beyond these two points the low hills of the desert form the coast-line, while between them the low sandy shore of the delta, slowly increasing by the annual deposit of silt by the river, is a barren area of sand hills and salty waste land, except in a few parts where reclamation has already made progress. Southwards the quality of the soil rapidly improves, and becomes the most fertile part of Egypt. This area is watered by the Damietta and the Rosetta branches of the Nile, and by the network of canals which, beginning at Cairo and the Barrage, intersects the whole delta and extends eastwards through the Wadi Tumilat as far as Suez. The soil of the delta is a dark grey line sandy soil, becoming at times almost a stiff clay by reason of the fineness of its particles, which consist almost wholly of extremely small grains- of quartz with a few other minerals, and often numerous flakes of mica. This deposit varies in thickness, as a rule, from 55 to 70 feet, at which depth it is underlain by a series of coarse and fine yellow quartz sands, with occasional pebbles, or even banks of gravel, while here and there thin beds of clay occur. These sand-beds are sharply distinguished by

their colour from the overlying Nile deposit, and are of considerable thickness. A boring made in 1886 for the Royal Society at Zagazig attained a depth of 375 feet without reaching rock, and another, recently sunk near Lake Abukir (close to Alexandria) by a company, reached a depth of 405 feet with the same result. Numerous other borings to depths of 100 to 200 feet have giv^ similar results, showing the Nile deposit to rest generally on these yellow sands, which provide a constant though not a very large supply of good water ; near the northern limits of the delta this cannot, however, be depended on, since the well water at these depths has proved on several occasions to be salt. The surface of the delta is a wide alluvial plain sloping

gently towards the sea, and having an altitude of 29 feet above it at its southern extremity. The only inequalities are the mounds, formed of ruined mud-brick dwellings, which mark the site of ancient towns, or on which the present towns and villages stand, occupying often the same site as their predecessors of earlier times. Its limits east and west are determined by the higher ground of the deserts, to which the silt-laden waters of the Nile in flood time cannot reach.

Tlie Valleys. — The valleys, which are a remarkable feature of the country, are those occupied respectively by the Nile, the Gulf of Su^z, and the Gulf of Akaba, and each of these is a rift-valley determined by the subsidence of a narrow belt in the neighbourhood of a line of fracture on the earth's surface. In the Gulf of Suez, certainly, an upward movement is still in progress, as salines along the coast are still being formed as the land rises ; but in the Nile Valley north of Assuan this is more difiicult to determine, though certain slight local earthquake shocks, which occasionally occur, seem to point to the fact that that movement has not wholly ceased. The trough so

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formed has been filled by deposits of coarse and fine sand and gravel, containing numerous fragments of igneous rocks, which underlie the present Nile mud deposit, as in the Delta ; and similarly, also, deep borings have reached no rock-floor up to the present. At Beni Suef, with the Tertiary limestone plateaux of the desert 3 miles distant, 400 feet of sands and clays

were penetrated without any sign of rock, and at Medinet el Payum a boring of 450 feet gave the same result.

Entering Egypt proper, a little to the north of the Second Cataract, the Nile flows through a valley in sand^ stone beds of Cretaceous age as far as latitude 25° N., and throughout this part of its course the valley is extremely narrow, rarely exceeding 2 miles in width. At two points, namely, Kalabsha and Assuan (First Cataract), its course is interrupted by outcrops of granites and other crystalline rocks, which have been uncovered by the erosion of the overlying sandstone, and to-day form the mass of islands, with numerous small rapids, which have been described not very accu- rately as cataracts ; no good evidence exists in support of the view that they are the remains of a massive barrier, broken down and carried away by some sudden convulsion. From latitude 25° N. northwards for 518 miles the valley is of the " rift-valley " type, a level de- pression in the limestone plateau, enclosed usually by steep cliffs, except where the tributary valleys drained into the main valley in early times, when there was a larger rainfall, and which now carry off the occasional rainstorms that burst on the desert. The average width of the cultivation is about 10 miles, of which the greater part lies on the left bank of the river ; and outside this is a belt, varying from a few hundred yards to 3 or 4 miles, of stony and sandy ground, reaching up to the foot of the limestone cliffs, which rise in places to as much as 1000 feet above the valley. This continues as far as lati- tude 29° N., after which the hills that close in the valley become lower, and the higher plateaux lie at a distance of 10 or 15 miles back in the desert. The fertile province of the Fayum, on the left bank of the Nile and separated from it by 6 miles of desert, seems to owe its existence to move- ments similar to those which determined the valley itself. Surrounded by Tertiary limestone strata on the north, west, and south, the boring above mentioned met with no representatives of these beds in the 450 feet which were penetrated. Lying in a basin sloping in a series of ter- races from an altitude of 65 feet above searlevel in the east to about 140 feet below sea-level on the north-west, at the margin of the Birket-el-Kerun, this province is wholly irrigated by a large canal, the Bahr Yusef, which, leaving the Nile at Beirut in Upper Egypt, follows the western margin of the cultivation in the Nile Valley, and at length enters the Fayum through a gap in the desert hills by the Xllth Dynasty pyramids of Lahun and Hawara.

~~The Desert Plateaux. — Speaking generally, Egypt con- sists of a broad plateau of sedimentary rocks, lying on the western side of a band of crystalline rocks which occupy the southern part of the peninsula of Sinai and the western side of the Eed Sea from latitude 29° N. southwards. In the north, where beds of Upper Tertiary age occur, the desert plateaux are comparatively low, but from Cairo southwards, as the Eocene limestones come in, they rise to 1000 and even 1500 feet above searlevel. Formed mostly of horizontal strata of varying hardness, they pre- sent a series of terraces of minor plateaux, rising one above the other, and intersected by small ravines worn by the occasional rainstorms which burst in their neighbour- hood. The weathering of this desert area is probably fairly rapid, and the agents at work are principally the rapid heating and cooling of the rocks by day and night, and the erosive action of sand-laden wind on the softer~~

~~layers ; these, aided by the occasional rain, are ceaselessly at work, and produce the successive plateaux, dotted with small isolated hills and cut up by valleys (wadis), which occasionally become deep ravines, thus forming the prin- cipal type of scenery of these deserts. From this it will be seen that the desert in Egypt is mainly a rock desert, where the surface is formed of disintegrated rock, the finer particles of which have been carried away by the wind ; and east of the Nile this is almost exclusively the case. In the western desert, however, those large sand accumulations which are usually associated with a desert are met with. They occur as lines of dunes formed of rounded grains of quartz, and lie in the direction of the prevalent wind, usually being of small breadth as com- pared with their length ; but in certain areas, such as that lying south-west and west of the Oases of Farafreh and Dakhleh, these lines of dunes, lying parallel to each other and about half a mile apart, cover immense areas, rendering them absolutely impassable except in a direc- tion parallel to the lines themselves. East of the Oases of Baharieh and Farafreh is a very striking line of these sand dunes ; rarely more than 3 miles wide, it extends almost continuously from Moghara in the north, passing along the west side of Khargeh Oasis to a point near the Nile in the neighbourhood of Abu Simbel in Nubia — having thus a length of nearly 550 miles. In the northern part of this desert the dunes lie about N.W.S.E., but far ther south incline more towards the meridian, becoming at last very nearly north and south.~~

Oases. — In the western desert lie the five large oases of Egypt, namely, Siwah, Baharieh, Farafreh, Dakhleh, and Khargeh, occupying depressions in the plateau or, in the case of the last three, large indentations in the face of the escarpment formed by the Lower Eocene and Upper Cre- taceous Limestones. Their fertility is due to a plentiful supply of water furnished by a sandstone bed 300 to 500 feet below the surface, whence the water rises through natural fissures or artificial boreholes to the surface, and sometimes to several feet above it. These oases were known and occupied by the Egyptians as early as 1600 B.C., and Khargeh rose to special importance at the time of the Persian occupation.

nie Mountainous Region. — The mountainous part of the country is that occupied by the crystalline rocks in the southern part of Sinai, and the belt occupying the western shore of the Gulf of Suez and Red Sea, where the principal peaks rise to heights of 6000 and 7000 feet. Owing to the slight rainfall, and the rapid weathering of the rocks by the great range of temperature, these hills rise steeply from the valleys at their feet as almost bare rock, supporting hardly any vegetation. In some of the valleys, wells or rock-pools filled by rain occur, and fur- nish drinking-water to the few Arabs who wander in these hills. Farther south, where the rainfall is greater, the valleys are more fertile, and support considerable numbers of camels, sheep, and goats.

Tlie Egyptian Nile. — The Nile {q.v^ enters Egypt proper a little to the north of the Second Cataract, and between there and the First Cataract has a length of 200 miles and a slope of y^^nr- I'rom this point to the Barrage at the apex of the Delta the length is 605 miles and the slope -^sm^, and thence to the sea, by either the Rosetta or Damietta branch, is 145 miles more. The Nile is at it lowest at Assuan at the end of May, then rises slowly until the middle of July, and rapidly throughout August, reaching its maximum at the beginning of September; it then falls slowly through October and November. At Cairo the lowest level is reached about the middle of June, after which the risei^ slow in July and fairly rapid in August, reaching the maximum at the beginning of

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October. In the month of June the water is clear and carries practically no suspended matter, but by August it is full of dark red-brown sediment brought down by the Blue Nile and the Atbara from the plateaux of Abyssinia, and is estimated to be then carrying 8 cubic yards per second ; by September this has been reduced to half the amount, and then diminishes rapidly. On the island of Elephantine at Assuan is the well-known Kilometer, dating from ancient Egyptian times, and altered and ex- tended in Roman times, while the remains of other ancient Kilometers exist at Philse, Edfu, and Esna, together with inscriptions recording aboutforty highKiles intheXXVth Dynasty, recently discovered on a quay wall of the temple of Karnak. The data furnished by these give about ^ inches per century as the rate at which the Nile is silting up its bed north of the First Cataract.

Climate. — Except a narrow belt on the north along the Mediter- ranean shore, Egypt lies in an almost rainless area, where the temperature is high by day ai^d sinks quickly at night in consequence of the rapid radiation under the cloudless sky. The mean temperature at Alexandria and Port Said varies between 57° F. in January and 81° F. in July ; while at Cairo, where the proximity of the desert begins to be felt, it is 53° F. 'in January, rising to 84° F. in July. January is the coldest month, when occa- sionally in the Nile Valley, and more frequently in the open desert, the temperature sinks to 32° F., or even a degree or two below. The mean maximum temperatures are 99° F. for Alexandria and 110° F. for Cairo. Farther soutll the range of temperature be- comes greater as pure desert conditions are reached.

Mean Temperature.

Place.

January.

July.

~~*Tear.*~~

~~*Annual Maximum.*~~

~~*Annual Minimuni*~~,

~~*Assuan*~~

~~*Wadi Haifa .*~~

~~*Khartum .*~~

~~*62 61 71*~~

~~*95 93 98*~~

~~*80 79 84*~~

~~*118 117 114*~~

~~*41*~~

~~*The relative humidity varies greatly. At Assuan the mean value for the year is only 38 per cent. , that for the summer being 29 per cent, and for the winter 51 per cent. ; while for Wadi Haifa the mean is 32 per cent., and 20 per cent, and 42 per cent, are the mean values for summer and winter respectively. In Alexandria and on all the Mediterranean coast of Egypt rain falls abundantly in the winter months, amounting to 8 inches in the year; but southwards it rapidly decreases, and south of latitude 31° N. but little falls. *~~

~~*Bainfall.*~~

~~*Place.*~~

~~*Inches per Annum.*~~

~~*Alexandria*~~

Port Said . . . .

Ismailia

Suez

81 3-4 2-1 1-1

Recent records at Cairo show that the rainfall is very irregular, and is furnished by occasional storms rather than by any regular rainy season ; still, most falls in the winter months, especially December and January, while, on the other hand, none has been recorded in June and July.

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Bainfall in

Cairo in Inches.

1887.

1888.

1889.

1390.

1891.

1892.

1893.

1894.

1895.

1896.

~~1897.~~

~~1898.~~

~~Inclies~~

~~0-86~~

~~1-TS~~

~~0-64~~

~~2-15~~

~~1-60~~

~~0-27~~

~~1-SO~~

~~0-66~~

~~1-70~~

~~1-43~~

~~0-3~~

~~16-1~~

~~In the open desert rain falls even more rarely, but it is by no means unknown, and from time to time heavy storms burst, causing sudden floods in the narrow ravines, and often drowning both men and animals These are more common in the mountamous region of the Sinai Peninsula, where they are much dreaded by the Arabs. Snow is unknown in the Nile Valley, but on the mountains of~~

~~Smai and the Red Sea Hills it is not uncommon, and a tempera- ture of 18° F. at an altitude of 2000 feet haS been recorded in January.~~

~~*The atmospheric pressure varies between a maximum in January and a minimum in July, the mean difference being about 0-29 inch. The following are the mean values for Cairo for the years 1885-1898 :—*~~

~~*Tear.*~~

~~*Temp. ° Fahr.*~~

~~*Atmospheric Pressure. Inches.*~~

~~*Tear.*~~

~~*Temp. ° rahr.*~~

~~*Atmospheric Pressure. Inches.*~~

~~*1885 .*~~

~~*1886 .*~~

~~*1887 .*~~

~~*1888 .*~~

~~*1889 .*~~

~~*1890 .*~~

~~*1891 .*~~

~~*70-3 69-6 70-6 71-6 72-0 71-5 71-4*~~

~~*29-84 29-86 29-87 29-87 29-88 29-84 29-88*~~

~~*1892*~~

~~*1893*~~

~~*1894.*~~

~~1895~~

~~1896~~

~~1897~~

~~1898~~

~~70-3 68-4 69-2 69-5 69-5 68-5 68-7~~

~~29-89 29-89 29-87 29-87 29-87 29-90~~

~~■29-88~~

~~The most striking meteorological factor in Egypt is the per- sistence of the north wind throughout the year, without which the climate would be very trying. In December, January, and February, at Cairo, the north wind slightly predominates, though those from the south and west often nearly equal it, btit after this the north blows almost continuously throughout the year. In • May and June the prevailing direction is north and north-north-east, and for July, August, September, and October north and north- west. From the few oWervations that exist, it seems that farther south these southern winter winds decrease rapidly, becoming westerly, until at Assuan and Wadi Haifa the northerly winds are almost invariable throughout the year. The Khamsin, or hot sand-laden winds of the spring months, come invariably from the south. They are preceded by a rapid fall of the barometer for about a day, until a gradient from south to north is formed, then the wind commences to blow, at first gently, from the south- east; rapidly increasing in violence, it shifts through south to south-west, finally dropping about sunset. The same thing is repeated on the second and sometimes the thijd day, by which time the wind has worked round to the north again. During a Khamsin the temperature is high and the air extremely dry, while the dust and sand carried by the wind form a thick yellow fog obscuring the sun. The southern winds of the summer months which occur in the low latitudes north of the equator are not felt much north of Khartum.~~

Minerals. — The minerals of Egypt which are worked at present are very few. The salines at Meks, near Alexandria, supply all the salt needed for ths country, except a small quantity used for curing fish at Lake Menzaleh ; while the lakes in the Wadi Natron, 45 miles north-west of the pyramids of Gizeh, furnish carbonate of soda in large quantities. The alum of the Western Oases is no longer worked, on account of the cost of transport. The turquoise mines of Sinai, in the Wadi Moghara, are worked regularly by the Arabs of the peninsula, who sell the stones in Suez; while the emerald mines of Jebel Zubara, south of Kosseir, have been recently examined, to see if they could be profitably worked. Petroleum occurs at Jebel Zeit, on the west shore of the Gulf of Suez, but up to the present attempts to obtain it in any quantity have not proved successful. Considerable veins of hjematite of good quality occur both in the Red Sea Hills and in Sinai, but difficulty of transport and want of fuel render them unimportant.

Flora. — Since practically the whole of the country which will support vegetable life is under cultivation, the flora of Egypt is limited. Besides the industrial crops cultivated throughout the country, the most important tree is the date palm, which grows all over Egypt and in the Oases. The dom palm is first seen a little north of latitude 26° N., and extends southwards. The vine grows well, and in ancient times was largely cultivated for wine ; oranges,' lemons, and pomegranates also abound. The sunt tree {Acacia Niloticd) grows everywhere, as well as the ^amarisk and the syca- more. In the deserts several kinds of thorn bushes grow ; and wherever raih or springs have moistened the ground, numerous wild flowers thrive. This is especially the case where there is also shade to protect them from the midday sun, as in some of the narrow ravines in the eastern desert and in the palm groves of the oases, where various ferns and flowers grow luxuriantly round the springs. Of late years new avenues and gardens have been extensively planted, especially near the towns ; and among many trees which have been imported, the "lebbek" {Alhizzia Lebbek) thrives espe- cially, and has been very largely employed. (

Fauna. — Besides the ordinary domestic animals, the camel, horse, donkey, goat, sl^eep, cow, water-buffalo, &c., there are few wild animals. The principal are the hysena, jackal, and fox ; numerous gazelles in the deserts ;

~~the ibex in Sinai and the Red Sea Hills ; and rarely the moufflon, or maned sheep, is met. The crocodile is never~~

~~now seen in Egypt. Birds are fairly numerous, and include eagles, vultures, kites, owls, as well as several kinds of plover ; sand grouse and pigeons are abundant, the latter being kept for their dung, which is used as manure. Quails arrive from the north about September, and return in the spring, passing through Egypt In February and March. Aquatic birds are very numerous — pelicans, storks, cranes, herons, geese, and duck.~~

~~Area and Population. — The total area of Egypt proper, including the Oases in the Libyan Desert, the regions between the Nile and the Eed Sea, and El-Arish in Syria, but excluding the Sudan, is about 400,000 square miles ; but the cultivated and settled area, that is, the Nile Valley and Delta, covers only 12,980 square miles. Canals, roads, date plantations, &c., cover 1900 square miles; 2850 square miles are comprised in the surface of the Nile, marshes, lakes, and desert.~~

~~The population is generally divisible into —~~

~~(1) The fellahin, or the peasant population of the Nile Valley ;~~

~~(2) The Beduin, or nomad Arabs of the desert ;~~

~~(3) The Nuba or Berberin, inhabitants of the Nile Valley be- tween Assuan and Dongola.~~

~~The first of these includes both the Moslem and Coptic inhabit- ants, who have probably changed but little since ancient Egyptian times, in spite of their conquest at different periods by various nations, each of whom has left but little mark on the inhabitants, except the change of religion.~~

The Beduin, or the Arabs of the desert, are of two different • classes : first, the Arabic-speaking tribes, who have probably immi- grated from Arabia and Syria, and who occupy the deserts as far south as latitude 26° N. ; secondly, the tribes who occupy the desert from Kosseir to Suakin, namely, the Hade^(foa, Bisharin and the Ababda tribes, who speak a language of their own, and are probably the descendants of the Blemmyes, who occupied these parts in ancient times.

The population according to the census of 1897 was 9,734,405, compared with 6,813,919 in 1882, being an increase of 43-5 per cent, in 15 years. In the two following tables are given the num- bers for Upper and Lower Egypt, as well as the number of foreigners resident in the country ; while in others are given the division by sex and mode of life, taken from the census of 1897: —

1882.

1897.

Increase per cent, in 15 Tears.

Population of Lower Egypt . Population ,of Upper Egypt .

Total population

Egyptians .... Foreigners ....

Town population . Number of towns, villages, and hamlets, &o.

4,008,746 2,805,173

5,676,109 4,058,296

41-5 45

6,813,919

6,723,033 90,886

857,617 13,247

9,734,405

9,621,831 112,574

1,225,365 18,141

43

43 24

42-8 37

Males.

Females.

Total.

Total population .

Mode of Life.

Sedentaries — Natives of fixed residence . Natives settled among Beduins Foreigners ....

Total.

Semi-Sedentaries —

Beduins resident in the vil- lages

Beduins among native seden- tary population

Total.

Nomad — Beduin

4,947,850

~~4,786,555~~

~~9,734,405~~

~~4,550,504 25,042 64,249~~

~~4,420,159 24,699 48,325~~

~~8,970,663~~

~~49,741~~

~~112,574~~

~~4,639,795~~

~~4,493,183~~

~~9,132,978~~

~~147,456 124,303~~

~~142,619 116,577~~

~~290,075 240,880~~

~~271,759~~

~~259,196~~

~~530,955~~

~~36,296~~

~~34,176~~

~~70,472~~

~~Fo'pulation according to Occupation.~~

- Males.

Females.

Votal.

Agriculturists

2,049,643

2,049,643

Exercising professions or

trades ....

1,013,758

35,825

1,049,583 148,723

Servants ....

113,377

35,346

Without profession, over 10

years of age

147,398

3,118,902

3,266,300

Without profession, under 10

~~years of age~~

~~1,623,674~~

~~1,596,482~~

~~3,220,156~~

~~Egypt is divided into 6 governorships and 14 provinces, of which 6 belong to Lower Egypt and 8 to Upper Egypt.~~

~~The governorships are : Cairo, Alexandria, Damietta, Suez Canal, Suez, El-Arish.~~

~~Lower Egypt includes the provinces of: Behera, Gharbieh, Menufieh, Dakahlieh, Kaliubieh, Charkieh.~~

~~Upper Egypt : Gizeh, Beni Suef, Fayum, Minia, Assiut, Girgeh, Kench, Assuan.~~

~~The following tables give the population of each governorship and province, with the number of persons per square mile in each : —~~

~~Area~~

~~in Square~~

~~Miles.~~

~~Population, 18S2.~~

~~Population,~~

~~1897.~~

~~Population per Sq. Mile,~~

~~GOVERNOKSHIPS.~~

~~Lower Egypt —~~

~~Cairo~~

~~6~~

~~374,838~~

~~570,062~~

~~95,010~~

~~Alexandria~~

~~76~~

~~231,396~~

~~319,766~~

~~4,568~~

~~Damietta .~~

~~A~~

~~43,616~~

~~43,751~~

~~9,722~~

~~Suez Canal~~

~~) ■»»(.~~

~~21,296~~

~~50,179~~

~~..*~~

~~Suez .~~

~~11,175~~

~~24,970~~

~~...~~

~~El-Arish .~~

~~h~~

~~2,936 1~~

~~16,991~~

~~...~~

~~Pkovinoes.~~

~~Lower Egypt —~~

~~Behera~~

~~932~~

~~401,730~~

~~631,225~~

~~677~~

~~Gharbieh .~~

~~2340~~

~~936,276~~

~~1,297,656~~

~~554~~

~~Menufich .~~

~~639~~

~~646,013~~

~~864,206~~

~~1,352~~

~~Dakahlich .~~

~~931~~

~~588,644~~

~~736,708~~

~~791~~

~~Kaliubich .~~

~~352~~

~~271,391~~

~~371,465~~

~~1,055~~

~~Charkieh .~~

~~905~~

~~471,139~~

~~749,130~~

~~826~~

~~Upper Egypt—~~

~~Gizeh~~

~~370~~

~~283,833~~

~~401,634~~

~~1,085~~

~~Beni Suef .~~

~~501~~

~~219,573~~

~~314,454~~

~~627~~

~~Fayum~~

~~493~~

~~. 228,709~~

~~371,006~~

~~752~~

~~Minia~~

~~772~~

~~315,803~~

~~548,632~~

~~711~~

~~Assiut~~

~~840~~

~~563,049~~

~~782,720~~

~~932~~

~~Girgeh~~

~~631~~

~~521,413~~

~~688,011~~

~~1,090~~

~~Kench~~

~~544~~

~~486,827~~

~~711,457~~

~~1,308~~

Assuan or

Nubia .

...

158,265

240,382

^ "Without Arabs, who were included in the tigures for 1897.

Government and Administration. — ^The Central Govern- ment consists of the Khedive, together with a CouncU of six Ministers of State, under the presidency of a Prime Minister. To these is added the British Financial Adviser, who attends all meetings of the Council of Ministers, but has not a vote ; on the other hand, no financial decision may he taken without his consent. The Ministries are those of the Interior, Finance, Public Works, Justice, War, and Public Instruction, and in each of these are prepared the drafts of decreeSj which are then submitted to the Council of Ministers for approval, and on being signed by the Khe- dive become law. The control of the different parts of the country is carried on by governors of the governor- ships, and mudirs of the provinces, each of whom is under the Ministry of the Interior. The provinces are further divided into districts, each of which is under a mamur, who in his turn supervises and controls the omda, or head-man, of each village in his district.

Jtistice. — In Egypt there are four judicial systems : — (1) the Mekhemehs or courts of the religious law, concerned

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mainly with questions affecting the personal status of Mahommedans; (2) the Mixed Courts, instituted in 1875, dealing with civil actions between persons of different nationalities, and to some extent with criminal offences

~~of foreigners; (3) the Consular Courts, where foreigners accused of crime are tried ; (4) the Native Courts, for civil actions between natives or crimes by natives. The Native Courts, instituted 1884-89, with both foreign and native judges, now consist of 6 courts of first in- stance, an appeal court at Cairo, and, . 42 summary courts for cases of moderate importance. With special reference to these tribunals a British judicial adviser was appointed in 1891. A committee of judicial surveillance watches the working of the courts of first instance and the summary courts, and endeavours, by letters and discussions, to maintain purity and sound law. There is a Procureur-Oiniral, who, with other duties, is entrusted with criminal prosecutions. His representatives are attached to each tribunal, and form the " parquet " under whose orders the police act in bringing criminals to justice. The police ser- vice, which has been subject to frequent modification, was in 1895 put under the orders of the Ministry of the Interior, to which a British adviser and British in- spectors are attached. The provincial police is under the direction of the local authorities, the mudirs or governors of provinces, and the mamurs or district officials ; to the omdas or village headmen, who are responsible for the good order of the villages, a limited criminal jurisdic- tion has been entrusted.~~

~~Religion. — The religion of the country is essentially Moslem, and its adherenj;s far outnumber those of all other creeds. The Christians are mostly of the Orthodox Greek Church. Jews are not very numerous, and are mostly found in the towns. In the following table, under the heading Orthodox are included Orthodox Copts, Orthodox Greeks, Greek Orthodox Syrians, and Orthodox Arme- nians; while with the Catholics are included Roman Catholics, Coptic Catholics, Syrian Catholics, Maronites, and Armenian Catholics : —~~

~~Creed.~~

~~Lower Egypt.~~

~~Upper Egypt.~~

~~Total.~~

~~Mahommed- ans~~

Christians — Orthodox . Catholic . Protestant

Total .

Jews . Various .

5,407,794

Per cent.

95-3

3,569,908

Per

cent.

88-0

8,977,702

Per cent.

92-2

174,516

56,660

K 11,901

3-0 1-0 0-2

471,259

4,391

12,508

11-6

•1 •3

645,775 61,051 24,409

6-6

■6 •3

243,077

4-2

488,158

12-0

731,235

7-5

24,973 265

0-5

227 3

...

25,200 268

•3

Education.—XJudL-Qi the Ministry of Public Instruction there is now a graduated system of teaching, commencing with the "kuttabs" or village schools attached to mosques, passing on to the primary and secondary schools, and finally the two technical schools, and the schools of agriculture, medicine, and law. Besides these there are nine missionary and

other schools of all grades. In 1898 there were in all 9702 kuttabs, with 14,700 teachers for the 183,470 pupils who attend them ; but only a few of these, at present about 100, are under Government inspection and receive the grant in aid to which it entitles them. In the rest the education given is of small value. There were 240 higher grade primary schools, and 28 secondary schools, besides 3 training colleges for teachers. The University of

El-Azhar attracts students to the number of nearly 8000, of whom some 2000 are resident, from all parts of the Mahom- medan world. Including this and the 3 training colleges, there are 26 higher or professional schools, with 486 teachers and 12,706 students. In 1897, of the sedentary Egyptian population over seven years of age, there could read and write in Lower Egypt 7 per cent., in Upper Egypt, 4-07 per cent., in all Egypt, 6-8 per cent. ; of the foreign population over seven years of age in all Egypt, 74 per cent, could read and write.

Agriculture.— T^ie total area of land, either cultivated, under reclamation, or which may later be reclaimed, is 6,250,000 acres, of which 4,690,000 pay full taxes, and 1,060,000 are in course of reclamation, paying a proportional tax. The remaining 500,000 acres are still waste land. The most important crops are those of cotton and sugar. The seasons for agriculture are —

Summer, from 1st AprU to 1st August. Flood, ,, 1st August ,, 1st December. Winter, ,, 1st December ,, 1st April.

The approximate area and average yield in each season is as follows : —

Season.

Area in Acres

Yield.

SuDimer ....

Flood

~~Winter . . ‘. .~~

~~2,046,500 1,510,000 4,260,000~~

~~£E.~~

~~15,177,500~~

~~6,870,000~~

~~17,013,000~~

~~The crops cultivated in the different seasons are as follows :-~~

~~9~~

~~Upper Egypt.~~

~~Season.~~

~~Crop.~~

~~Area.~~

~~Value.~~

~~Acres.~~

~~£B.~~

~~Summer~~

~~Sugar-cane~~

~~75,000~~

~~1,200,000~~

~~Cotton~~

~~110,000~~

~~1,100,000~~

~~Vegetables, &c.~~

~~15,000~~

~~150,000~~

~~Melons .~~

~~12,500~~

~~127,500~~

~~Sorghum~~

~~160,000~~

~~960,000~~

~~Flood .~~

~~Dates~~

~~5,200,000~~

~~1,040,000~~

~~Sorghum~~

~~510,000~~

~~2,040,000~~

~~Rice~~

~~20,000~~

~~80,000~~

~~Winter .~~

~~Wheat~~

~~600,000~~

~~. 3,000,000~~

~~Beans~~

~~500,000~~

~~2,145,000~~

~~‘~~

~~Clover~~

~~500,000~~

~~2,000,000~~

~~Barley~~

~~250,000~~

~~875,000~~

~~Lentils~~

~~140,000~~

~~420,000~~

~~Flax~~

~~1,000~~

■ 8,000

Onions

15,000

150,000

Vetches .

115,000

290,000

i,,_,

Double cropped area =703,500 acres. Lower Egypt.

Season.

Crop.

Area.

Value.

Acres.

£E.

Summer

Cotton

1,500,000

10,500,000

Sugar-cane

~~4,000~~

~~40,000~~

~~Vegetables, &c.~~

~~70,000~~

~~700,000~~

~~Eice~~

~~100,000~~

~~400,000~~

~~Flood .~~

~~Dates~~

~~2,200,000~~

~~440,000~~

~~Maize~~

~~900,000~~

~~3,150,000~~

~~Rice~~

~~80,000~~

~~120,000~~

~~Winter .~~

~~Wheat~~

~~600,000~~

~~2,700,000~~

~~Barley~~

~~330,000~~

~~660,000~~

~~Clover~~

~~955,000~~

~~3,396,000~~

~~Beans~~

~~180,000~~

~~630,000~~

~~Vegetables, &c.~~

~~70,000~~

~~700,000~~

~~Flax~~

~~4,000~~

~~40,000~~

~~Double cropped area=1,363,000 acres.~~

~~[geogeapht and statistics~~

~~The following table gives the cotton and sugar crops for twenty years : —~~

~~Tear.~~

~~Cotton Crop in Cantars 98-1 lb.~~

~~Sugar-Canc in Tons.~~

~~1878 . 1890 .~~

~~1894 .~~

~~1895 .~~

~~1896 .~~

~~1897 . 1898~~

~~1,700,000~~

~~4,100,000 4,600,000 5,200,000 ‘ 5,800,000 6,500,000 5,600,000~~

~~52’,‘600 62,000 83,000 91,000 74,000~~

~~In Upper Egypt there are 1,731,800 acres under flood irrigation, and 587,500 acres under perennial irrigation ; while in Lower Egypt 3,437,800 acres are dependent on the great perennial canals.~~

~~The ownership of the land Is shown in the following table : —~~

~~Class.~~

~~Acres owned by~~

~~Upper Egypt.~~

~~Lower Egypt.~~

~~State Domains Daira Sanieh Religious Bodies . Banks, Foreigners, &c. . Non-Resident Egyptians Resident Egyptians~~

~~47,399~~

~~306,956~~

~~‘ 16,622~~

~~64,645~~

~~394,808~~

~~1,488,905~~

~~192,910~~

~~31,581~~

~~56,638~~

~~519,637~~

~~1,982,558~~

~~1,654,603~~

~~The land is everywhere subdivided into extremely small plots, each of which is often owned by the members of a family, each having a share. Out of 767,260 proprietors of land in 1897, 611,074 owned less than 6 acres. Cattle and farm animals, including horses and camels, number 1,669,000.~~

~~The only fisheries of importance are those of Lake Menzaleh, which produce a net revenue of about £E. 60,000 annually.~~

~~Commerce. — Since 1875 the commerce has increased rapidly. Great Britain is the largest importer and exporter, and next come France, Turkey, Russia, Austria, and the United States, though the trade of Germany and Belgium is also rapidly increasing.~~

~~*The exterior commerce, comprising imports and exports of all kinds of merchandise and of specie, is given at the following figures since 1880 :—*~~

~~*Tear.*~~

~~*Merchandise.*~~

~~*Specie.*~~

~~*Imports*~~,

~~*Exports.*~~

~~*Imports.*~~

~~*Exports.*~~

~~*1880 1890 1895 1897 1898 1899 1900*~~

~~*£E.*~~

~~*6,649,983*~~

~~*8,081,297*~~

~~*8,389,933*~~

~~*10,603,672*~~

~~*11,033,219*~~

~~*11,441,802*~~

~~*14,112,869*~~

~~*£E.*~~

~~*12,983,208 11,876,086 12,632,450 12,321,220 11,805,179 15,350,908 16,766,609*~~

~~£B.~~

~~4,791,700 2,971,461 4,319,265 2,921,722 2,780,116 4,515,917~~

~~4,114,61?~~

~~£E.~~

~~405,600 .2,085,465 2,822,190 2,369,479 1,891,513 1,502,486 2,602,790~~

~~The following table shows the value of the commercial intercourse of Egypt with different foreign countries in 1900 : —~~

~~Countiy.~~

~~Imports frop.~~

~~Exports to.~~

~~£E.~~

~~£E.~~

~~Great Britain .....~~

~~5,800,447~~

~~9,141,932~~

~~British Colonies in the Mediterranean~~

~~144,431~~

~~4,404~~

~~British Colonies in the Extreme East~~

~~696,351~~

~~187,813~~

~~*Germany*~~

~~*485,933*~~

~~*900,824*~~

~~*America ....*~~

~~*289,331*~~

~~*1,035,600*~~

~~*Austria-Hungary .*~~

~~*900,958*~~

~~*642,477*~~

~~*Belgium ....*~~

~~*494,751*~~

~~*126,165*~~

~~*China and Extreme East*~~

~~*124,198*~~

~~*149,847*~~

~~*France and Algeria*~~

~~*1,314,869*~~

~~*1,430,153*~~

~~*Greece ....*~~

~~*121,468*~~

~~5,246~~

~~Italy~~

~~661,347~~

~~601,496~~

~~Morocco .~~

~~40,157~~

~~2,692~~

~~Persia .~~

~~42,778~~

~~4,642~~

~~Russia~~

~~608,901~~

~~1,209,563~~

~~Turkey .~~

~~2,220,966~~

~~290,198~~

~~Other countries Total~~

~~354,505~~

~~1,030,136~~

~~13,801,391~~

~~16,757,683~~

~~The value of the leading exports and imports of Egypt in 1900 is shown in the following table : —~~

~~Mercliandise.~~

~~Imports.~~

~~Exports.~~

~~Animals and animal food producte Skins and leather goods . Other animal products . Cereals, vegetables, &o. . Provisions and drugs~~

~~Spirits, oils, &c~~

~~Rags, paper, books .... Wood and coal, cane-work, &o. .' Stone, lime, glass, &c. . . ■ . Dyeing materials, &c. . Chemical products .... Textiles, ^ mainly raw cotton . Metals and metal goods .~~

~~Sundries~~

~~Tobacco .J~~

~~Total~~

~~£E.~~

~~652,367~~

~~206,860~~

~~84,373~~

~~1,682,341 404,735 815,888 177,103~~

~~2,093,061 899,008 282,875 276,509~~

~~4,011,498~~

1,817,971 439,609 677,203

£E.

129,788

84,856

41,611

2,615,433

676,226

16,318

15,690

16,850

1,528

21,112

16,547

13,104,860

6,691

12,689

13,801,391

16,767,683

1 In 1897 tlie cotton tissues imported amounted to £E.1,798,600 ; and io 1900 to £E.l, 987,095. In the cotton season of 1896-97 the quantity of raw cotton exported was 5,177,495 cantars, valued at £E.10,088,888 ; in 1897-

~~98, 6,764,686 cantars, valued at £E.9,040,150 ; in 1898-99, 6,001,222 cantars, valued at £E.11,598,222 ; and in 1899-1900, 4,868,696 cantars, valued at £E.18,089,008.~~

~~The receipts from tobacco were : In 1896, £E.1,006,626 ; in 1897, £E.1,044,780 ; in 1898, £E.1,080,669 ; In 1899, £E.1,068,497.~~

~~Of the total Imports in 1899 the value of £E .9,945, 165, and of the exports the value of £E.16,068,722, passed through the port of Alexandria.~~

~~Shipping and Navigation. — ^The following tables show the nationality and tonnage of vessels arriving and clearing at Alex- andria. Great facilities have been afforded to steamers since the completion of the docks, wharves, and quays ; and In order still further to facilitate navigation the Government have constructed a new pass, 300 feet wide, to enable vessels, which have often been delayed off the port during stormy weather, to make a direct run Into harbour. The new pass, 80 feet deep, was opened to navigation in July 1894.~~

~~Arrivals and clearances of commercial vessels at Alexandria in five years : —~~

~~, Tear.~~

~~Arrivals.~~

~~Clearances.~~

~~Vessels. .~~

~~Tons.~~

~~Vessels.~~

~~Tons.~~

~~1895 .~~

~~1896 .~~

~~1897 .~~

~~1898 .~~

~~1899 .~~

~~2393 2132 2203 2454 2806~~

~~2,206,667 2,123,591 2,267,120 2,555,396 2,414,674~~

~~2389 2106 2143 2428 2768~~

~~2,194,964 2,094,684 2,270,836 2,659,876 2,389,058~~

~~The following table shows the nationality of commercial vessels arrived and cleared in 1898, and the totals for 1899 : —~~

~~Nationality.~~

~~Arrivals.~~

~~Clearances.~~

~~Vessels.~~

~~Tons.~~

~~Vessels.~~

~~Tons.~~

~~British ....~~

~~French ....~~

~~Austrian~~

~~Turkish.~~

~~Russian ....~~

~~*Italian ....*~~

~~*Greek ....*~~

~~*Swedish and Norwegian*~~

~~*German*~~

~~*Egyptian*~~

~~*Other countries*~~

~~*Total for 1898 .*~~

~~*Total for 1899 .*~~

~~*729*~~

~~*125*~~

~~*139*~~

~~*847*~~

~~*95*~~

~~*153*~~

~~*163*~~

~~*36*~~

~~*27*~~

~~*82*~~

~~*68*~~

~~*1,111,481*~~

~~263,778~~

~~254,708~~

~~151,461~~

~~185,940~~

~~281,373~~

~~66,781~~

~~59,221~~

~~62,230~~

~~86,647~~

~~43,881~~

~~784~~

~~126~~

~~140~~

~~827~~

~~95~~

~~153~~

~~156~~

~~34~~

~~27~~

~~79~~

~~58~~

~~1,117,161~~

~~265,314~~

~~261,125~~

~~147,487~~

~~188,971~~

~~279,426~~

~~63,756~~

~~57,809~~

~~54,754~~

~~82,566~~

~~41,508~~

~~2454~~

~~2,556,396~~

~~2428~~

~~2,569,876~~

~~2805~~

~~2,414,674~~

~~2768~~

~~2,389,058~~

Suez Canal. — The following table shows the number and gross tonnage of vessels of all nationalities that passed through the Canal in 1898 :—

Country.	No.	Gross Tonnage.
Great Britain	2295	8,691,093
Germany	356	1,353,161
France .	221	891,642
Holland .	193	626,478
Austria-Hungary		

~~85~~

~~300,251~~

~~Japan~~

~~46~~

~~261,602~~

~~Russia .~~

~~- 48~~

~~248,881~~

~~Spain~~

~~49~~

~~232,358~~

~~Italy~~

~~74~~

~~208,418~~

~~Norway .~~

~~47~~

~~109,709~~

~~Turkey .~~

~~54~~

~~83,541~~

~~*Denmark*~~

~~*8*~~

~~*30,228*~~

~~*Egypt .*~~

~~*10*~~

~~*15,705*~~

~~*China*~~

~~*4*~~

~~*6,181*~~

~~*America .*~~

~~*4*~~

~~*3,162*~~

~~*Greece .*~~

~~*2*~~

~~*1,941*~~

~~*Rumanja*~~

~~*1*~~

~~*1,703*~~

~~*Sweden .*~~

~~*2*~~

~~1,021~~

~~Portugal .~~

~~3~~

~~606~~

~~Argentine Republic~~

~~1~~

~~451~~

~~Total~~

~~-~~

~~8508~~

~~12,962,632~~

~~In 1899 the British ships numbered 2310, with a tonnage of 9,046,031 ; and the German 387, with a tonnage of 1,492,657.~~

~~The number and gross tonnage of vessels that have passed through the Suez Canal, and the gross receipts of the company, were as follow during the twenty years after 1880 : —~~

~~Tear.~~

~~No. of Vessels.~~

~~Gross Tonnage.~~

~~Receipts.~~

~~1880 .~~

~~2026~~

~~4,344,519~~

~~1,593,620~~

~~1890 .~~

~~3389~~

~~9,749,130~~

~~2,679,360~~

~~1895 .~~

~~3434~~

~~11,833,637~~

~~8,124,149~~

~~1896 .~~

~~3409~~

~~12,039,859~~

~~3,182,800~~

~~1897 .~~

~~2986~~

~~11,123,403~~

~~2,913,222~~

~~1898 .~~

3503

12,962,682

, 3,411,791

1899 .

3607

13,815,992

3,652,751

The number of passengers who went through the Canal in 1899 was 221,347, as against 219,671 in 1898 and 191,224 in 1897.

Canals. — The canals, being designed specially for perennial or flood irrigation, are only partially used for communication, since the Nile serves for this purpose througlj the country. In the Delta, however, the large canals, Raya Behera, Raya Menufieh, Bahr Shebin Mahmudieh Canal, Raya Tevrfiqieh, and the Ismailieh Canal, are largely used to reach parts of the Delta which would otherwise be far from water transport.

Boads. — Until quite recently there were no roads laid out and maintained as such, except in the immediate neighbourhood of the large towns, and the only communication was by the footpaths across the cultivation. Now, however, agricultural roads are being constructed in most of the provinces, and 1268 miles are open, 824 miles having been constructed in Upper Egypt, and 944 in Lower Egypt, up to the end of 1899.

Bailways. — On 1st January 1901 there were in Egypt 1898 miles of railways belonging to and worked by the State, and 670 miles of light agricultural railways belonging to private companies (see below) : in all, 2063 miles; 1408 miles being in the Delta, and 660 miles in Upper Egypt, exclusive of the military railway in the Sudan. „ , , „ ,

The foUovring table shows since 1880 the length of Ime of the State railways, the number of passengers and the weight of goods carried, and

~~*the net receipts :•*~~

~~*Tear.*~~

~~*Line.*~~

~~*Number of Passengers.*~~

~~*Goods carried.*~~

~~*Net Beecipts.*~~

~~*Miles.*~~

~~*Tons.*~~

~~*£E.*~~

~~*1880 .*~~

~~*944*~~

~~*3,086,478*~~

~~*1,143,812*~~

~~*750,134*~~

~~*1890 .*~~

~~*961*~~

~~*4,696,286*~~

~~*1,721,492*~~

~~*798,418*~~

~~*1895 .*~~

~~1098~~

~~9,518,000~~

~~2,898,000~~

~~994,000~~

~~1896 .~~

~~1143~~

~~9,854,000~~

~~2,498,000~~

~~1,033,000~~

~~1897~~

~~1166~~

~~10,742,546~~

~~2,796,096~~

~~1,123,360~~

~~1898~~

~~1214~~

~~11,312,400~~

~~2,786,780~~

~~1,114,038~~

~~1899 .~~

~~1393~~

~~11,284,284~~

~~3,055,897~~

~~1,161,636~~

~~Of late years lines of light agricultural railways have been opened by private companies in the Delta and in the Fayum. In connexion with these lines there are 164 miles of telegraphs and 310 miles of telephones.~~

~~Telegraphs and Posts. — The telegraphs belonging to the Egyptian Government were, at the end of 1900, of a total length of 2106 miles, the length of the wire being 9440 miles. The Government have given concessions to a telephone company for urban telephone lines. The Eastern Telegraph Company, also by concessions, have telegraph lines across Egypt from Alexandria vid. Cairo to Suez, and from Port Said to Suez, connecting their cables to England and India. Number of telegrams, 2,994,332 in 1899, not includ- ing telegrams sent by the Eastern Telegraph Company. Receipts, £E.54,448 ; expenditure, £E.44,00b. In 1900 the number of tele- grams was 3,288,662.~~

~~There are 313 post ofBces in the towns of Egypt, 160 travelling offices, and 414 localities where the rural post has been established. The Egyptian Post Office now transacts all the services which exist in the post offices of other countries forming the Postal Union.~~

~~The foUovring table gives number of letters, post-cards, news- papers, &c., despatched through the Egyptian Post Office in 1898 : —~~

~~z~~

~~Inland.~~

~~Abroad.~~

~~Total.~~

Letters and post-cards

Newspapers

Parcels

Total .

12,260,000

7,100,000

274,000

2,478,000 940,000 289,800

14,733,000

8,040,000

568,800

19,634,000

3,702,800

28,336,800

In 1899 these totals had risen to : inland, 20,758,000 ; abroad, 3,903,700; total, 24,661,700. Receipts (1899), £E.129,874; ex- penditure, £E. 108, 198.

Post-office orders and remittances through the post office (1898) numbered 563,800, and amounted to the value of £E. 16,437,000 ; in 1899, post-office orders and remittances numbered 598,500, and amounted to a value of £E. 17,437,000.

Thirty per cent, of the total foreign correspondence was with Great Britain.

~~*Money. — Egyptian money is minted at the Berlin Mint. The nominal value of the coinage (including re-coinage) from 1887 to 1900 was :—*~~

~~*Tears.*~~

~~*Gold.*~~

~~*Silver.*~~

~~*Nickel.*~~

~~*Bronze.*~~

~~*Total.*~~

~~*1887-1900.*~~

~~*Piastres.*~~

~~*5,202,400*~~

~~*Piastres.*~~

~~*190,584,769*~~

~~*Piastres.*~~

~~*22,080,289*~~

~~*Piastres.*~~

~~*611,779 .*~~

~~*Piastres.*~~

~~*218,479,287*~~

~~*See also Sddan.*~~

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The history of Egyptian finance is the story of Egypt since 1863, the date of the accession of the Khedive Ismail. The notorious and unparalleled extravagance of mj^iare ^^ ruler necessitated continual recourse on in- creasingly onerous terms to the capitalists of Europe, and finally plunged his country into a sea of political and financial embarrassment from which it is only now emerging. When Ismail came to the throne the Egyptian debt amounted to a little over three millions. By the end of 1876 it was already estimated at ninety-one millions, and in reality considerably exceeded this figure. During the same period the taxation of the land, the prin- cipal source of revenue, had been increased about 60 per cent. Under the

improvident system of borrowing pursued by Ismail, the amount of debt contracted very consider- ably exceeded the money actually realized, and even of the latter very little was expended on developing the resources of the country. It is stated in Mr Cave's report of March 1876, that " for the present large amount of indebtedness there is absolutely nothing to show but the Suez Canal, the whole proceeds of the loans and floating debt having been absorbed in payment of interest and sinking funds, with the exception of the sum debited to that great work." The Suez Canal, from which, owing to the forced sale of the country's interests therein, Egypt derives no direct benefit to-day, cost the Egyptian Govern- ment sixteen millions. By the end of 1875 this wild career of prodigality had begun to produce its natural result of serious financial embarrassment. In May of that year, in order to allay the apprehensions of the foreign creditors of Egypt, and to put a curb on the extravagant borrowing of Ismail, the Caisse de la Dette was instituted. The Caisse was at first composed of only three members, a Frenchman, an Austrian, and an Italian, but in the following year an Englishman was added. The original functions of the members were to act as the receivers of certain revenues that had been assigned to the service of the debt. In order to render their powers effective, they were given the right to sue the Grovernment in the Mixed Courts for any breach of engagement towards the bondholders. The effects of this measure were far more momentous than was apparent at the time or than was intended by its authors. It was, in fact, the beginning of international interference in the financial administration of Egypt. From this moment the period of financial reform may be said to have com- menced. Shortly afterwards, in November of the same

1876-1882.

year, a general settlement of the liabilities of the country was effected on the proposals of Mr Goschen and M. Joubert. It was recognized that no mere rearrangement of existing liabilities could be expected to produce satis- factory results unless some guarantees were given against future maladministration. For this purpose the Dual Control was instituted. In its first form it consisted of two controllers, an Englishman and a Frenchman, the iovm^T superintending the revenue and the latter the expenditure of the country. This arrangement was of short duration. It was based upon

erroneous information supplied by the Khedive and his ministers as to the real resources of the country. It was only with the greatest possible difficulty, and by the application of the most rigorous and most arbitrary measures to the unfortunate Egyptian taxpayer, that the payment of the coupon could be continued. Finally, in the hope of obtaining a reduction of the rate of interest on the debt, Ismail consented, in January 1878, to the appointment of a commission armed with full powers to inquire into the whole state of the country. • The first report of this commission insisted on the necessity of a proper system of government through responsible ministers before any real reform could be effected. This was at first accepted by the Khedive, and in the new cabinet the two European controllers were changed into respon- sible ministers entrusted respectively with the portfolios of the ministries of Public Works and Finance. The new order soon became irksome to the autocratic spirit of IsmaiU The dismissal of the ministry, followed by the opposition of the Khedive to the later measures recom- mended by the commission of inquiry, culminated in his deposition in June 1879. Through the joint action of the British and French Governments the Dual Control was re-established in a different form, with increased powers. The two controllers took part in the deliberations of the council of ministers, and worked together in their super- vision of the financial administration, the principle of dividing their functions being abandoned.

These changes enabled the financial proposals of the commission of inquiry to be put into execution, and shortly after the accession of Tewfik they were embodied in the law of liquidation of July 1880, the next general settlement of the liabilities of Egypt. By this law the floating debt was paid off and the debt consolidated into a few large loans, the rate of interest being reduced to what it was at the time considered just possible for the country to pay. Under this settlement the Egyptian debt was composed as follows : —

Privileged debt £22,609,000 »

Unified debt 58,018,000

Dairaloan 9,513,000

Domains loan 8,500,000

£98,640,000

The rate of interest was fixed at 5 per cent, on the privileged and Domains loans, and 4 per cent, on the unified and Daira loans, the latter being entitled to an additional 1 per cent, contingent on certain circumstances that have never arisen. The total annual encumbrances of the country, including the tribute due to Turkey and the interest on the Suez Canal shares bought by Great Britain, but excluding the interest on the Daira and Domains loans — which were expected to be defrayed by the revenues of the respective estates on which these loans were secured — amounted to four and a half million pounds, about half the then annual revenue of Egypt. Further, the revenue was divided between the Government and the bondholders, any surplus in the latter's share after full

1 The sterling.

figures ot the Egyptian debt are always given in pounds

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695,

Plaanclal status.

payment of the interest being devoted to redemption of the capital. A brief period of prosperity followed the passing of the law of liquidation, but the Arabist rebel- lion and the events which culminated in the British occu- pation of Egypt in September 1882, immediately matmi. followed by the disastrous reverses in the Sudan, again plunged the country into financial embar- rassment. A new loan was absolutely necessary to settle the Alexandria indemnities and to pay off the liabilities arising out of the rebellion and the Sudan war. More- over, the proportion of the revenue assigned to the \ Government by the law of liquidation was altogether insufficient for the expenses of administration, so that while the sinking fund was in full operation, the Treas- ury was compelled to borrow on short loans at high rates of interest in order to meet its ordinary expenditure. At

the initiative of the British Government, negotiations were begun with the Great Powers and Turkey, which, after prolonged discussions, resulted in the London con- vention of March 1885. That convention was the last settlement of the liabilities of Egypt, and, with a few subsequent modifications of detail, its dispositions form the organic law under which Egyptian finance is adminis- tered at the present day.

It will be convenient here to state, as briefly as possible, the exact position of the Egyptian Government in respect of its financial autonomy, as established by the various treaties, conventions, and agreements in force. By the Imperial firman of June 1873, the Khedive of Egypt obtained, subject to the payment of an annual tribute to Turkey of £696,000, complete fiscal autonomy, including the right to conclude com- mercial conventions and to raise loans. The latter privilege was taken away by the firman appointing Tewfik Pasha, and since that time Egypt cannot raise a loan without the previous consent of the Sultan. The international obligations of Turkey remained, of course, binding upon Egypt, and amongst them the capitula- tions, by which certain privileges are conferred upon foreigners resident in the Ottoman dominions. From a financial point of view the most important of these privileges — based to a certain extent on the "text of the Original treaties, but still more on an abusive extension in practice which had grown up in Egypt — is immunity from all direct taxation without the assent of their re- spective governments. The only exception, resulting from the Ottoman law under which foreigners are allowed to acquire and hold real property, is in the case of the land- tax. At the present time all taxes that were formerly paid by natives and not by foreigners have been abolished in Egypt, but the immunity described above constitutes a most serious obstacle to all schemes for redistributing the burden of taxation in a more equitable manner. The supervision exercised over the finances of Egypt by the French and British controllers prior to the British occu- pation was abolished in 1883, and replaced by that of a British official called the Financial Adviser. This functionary is appointed by the Khedive on the recom- mendation of the British Government, and has a seat on the council of ministers, but without a vote. It has been laid down by the British Government that " no financial decision should be taken without his consent," an interpre- tation which has never been questioned by the Egyptian Government. In addition to the control of the Financial Adviser, there exist in Egypt certain

commissions or boards, known as " Mixed Administrations," appointed m virtue of international agreements, and having relations of a more or less ill-defined, but quasi-independent char- acter with the Egyptian ministry of finance. .B'lrst and foremost is the Caisse de la Dette, on which, since 1885, the six Great Powers— France, Austria, Italy, Great

Britain, Germany, and Eussia— are represented. The functions of the Caisse, originally limited to receiving certain assigned revenues on behalf of the bondholders, have since that date become much more important. The exact extent of their powers is not capable of accurate definition, nor would it be possible to lay down limits which would meet with general acceptance from all parties.' The widest interpretation of their functions that has been put forward would give them the right to control, on behalf of the Powers of Europe, the due execu- tion by the Egyptian Government of almost all the com- plicated international agreements regarding the finances of the country. In virtue of the law of liquidation, their assent, as well as that of the Sultan, is necessary before any new loan can be issued. Ko portion of the general reserve fund can be used without their sanction. All questions are decided by the vote of the majority of the members, with the exception of grants for extraordinary military expenditure, which, by an arrangement concluded with the Powers in November 1899, require unanimity. All assigned revenues are paid directly to the Caisse de la Dette by the collecting departments without passing through the Ministry of Finance. After the Caisse de la Dette come the Eailway Board and the Commissions of the Daira and Domains, each consisting of three mem- bers— an Englishman, a Frenchman, and an Egyptian. The former administers the railways, telegraphs, and port of Alexandria, paying the net receipts, after deduc- tion of the expenses, fixed for the railways at 45 per cent, of the gross receipts, into the Caisse. The Daira and Domains Commissions administer the large estates that are mortgaged to the holders of those loans. Out of the net profits they pay the annual interest charge, and any surplus and the produce of the sales of land are employed in paying off the capital. Should the net profits in any year be insufficient to meet the coupon, the Egyptian Government is bound to make good the difference. Since their creation both these administrations showed an annual deficit up to 1890. From that date, with the exception of the year 1895, the Daira has yielded a sur- plus; but the Domains continued to be administered at a

~~considerable los^ which formerly varied between £50,000 and' £200,000 a year, down to 1900, in which year there was a surplus for the first time..~~

~~It is now possible to explain the working of the finan- cial system prescribed by the London convention. The principle of dividing the revenues of the coimtry between the Ministry of Finance and the Caisse ""^ "*■ de la Dette was maintained. The revenue assigned to the service of the debt remained as before, so that the security of the bondholders was in no way diminished. At the same time it was recognized that the non-assigned revenue was insufficient to meet the expenses of adininis- tration. A certain scale of administrative expenditureVas, therefore, authorized, and the Caisse, after paying in full the interest on the debt, had to make good out of the balance of the assigned revenue any deficit between the authorized expenditure and the non-assigned revenue. If, after making good any such deficit, a surplus still re- mained, this surplus was divided equally between the Caisse and the Government, the share of the former being applied to the reduction of the debt, while the Govern- ment was free to dispose of its share as it thought best. By an arrangement with the Powers, concluded in 1888, the Caisse's half-share in the surplus is now paid into a reserve fund, and the sinking fund is suspended until that fund amounts to two millions. The authorized ex- penditure for administrative purposes was originally fixed at £E.5,237,000,^ but by subsequent agreement with the Powers certain other items have been added, so that in 1 The Egyptian pound = £1, Os. 6d.~~

~~[finance~~

~~1900 it amounted to £E.6,195,000. The effective ad- ministrative expenditure has always exceeded the amount fixed by the London convention, and of late years the growing wants of a country in process of development have naturally had a tendency to increase this excess. Any excess can, however, only be met out of the half- share of the eventual surplus which is at the free disposal of the Government. Consequently, in order to meet new expenditure necessitated by the new require- ments of the~~

~~cduntry, just double the amount of revenue must be raised. One-half of the new revenue increases the Government share of the surplus, and thereby pays for the new expenditure. The other half goes for the moment into the general reserve fund, and would ulti- mately, when that fund has attained its maximum, be employed in reducing the debt. This limitation of administrative expenditure is the great blot in the system designed by the authors of the London conven- tion, and now that the resources of the state are greatly on the increase, it has become a serious obstacle to the development of the national prosperity. The London convention left the permanent rate of interest on the debt, as fixed by the law of liquidation, unchanged, but in order to afford temporary relief to the Egyptian exchequer, a reduction of 5 per cent, on the interest of the debt was granted for two years, on the condition that if at the end of that period payment, including the arrears of the two years, was not resumed in full, another international commission was to be appointed to examine into the whole financial situation. Lastly, the London convention empowered Egypt to raise a loan of nine millions, guaranteed by all the Powers, at a rate of interest of 3 per cent. For the service of this loan an annuity of £315,000 is provided in the Egyptian budget for interest and sinking fund. This sum was sufficient to pay the Alexandria indemnities, to wipe out the deficits of the preceding years, to give the Egyptian treasury a working balance of £E.500,000 and thpreby avoid the creation of a fresh floating debt, and to provide a million for new irrigation works. To the wise foresight which, at a moment when the country was sinking beneath a weight of debt, did not hesitate to add this million for expenditure on productive works, the present prosperity of Egypt is largely due.~~

~~During the two years that followed the London con- vention, the financial policy of the Egyptian Government 1883-1899 ^^ directed to placing the country in a posi- tion to resume full payment of the interest on the debt in 1887, and thereby to avoid the appgintment of an international commission. By the exercise of the most rigid economy in all branches this end was attained, though budgetary equilibrium was only secured by a variety of financial expedients, justified by the vital importance of saving Egypt from further international interference. By , such means this additional complication was averted, but the struggle to put Egypt in a genuinely solvent position was by no means over. It was not until his report on the~~

financial results of 1888 that Sir Evelyn Baring (afterwards Lord Cromer) was able to inform the British Government that the situation was such that " it would take a series of untoward events seriously to endanger the stability of Egyptian finance and the solvency of the Egyptian Govern- ment." From this moment the corner was turned, and the era of financial prosperity commenced. The results of the labours of the preceding six years began to manifest themselves with a rapidity which surprised the most sanguine observers. The principal feature of the suc- cessive Egyptian budgets from 1890 was the fiscal relief afforded to the population. This period may be said to have been brought to a close in 1894, though a subse- quent reduction of the land-tax by £E.216,000 a year

was effected in 1898. From 1894 onwards it wag thought desirable to pay more attention than heretofore to the legitimate demands of the spending departments. Ac- cordingly, money was devoted to remunerative objects, such as irrigation works, railway extension, and also to others, such as the construction of hospitals, prisons, and other public buildings, the improvement of education, &c., which, although not directly remunerative, are equally necessary to the well-being of the country. In 1896 the decision of the British Government to undertake the expedition to Dongola, leading by the natural pro- gress of events to the reconquest. of the Sudan, subjected the finances of Egypt to a severer strain than had been experienced since they had been placed on a souiid footing. The endeavour to obtain assistance towards the cost of the military operations from the general reserve fund, with the co-operation of the Caisse de la Dette, failed, owing to an adverse decision of the Mixed Tribunals as to the legality of such a course. Neverthe- less, with a certain amount of financial aid from the British Government, the Egyptian treasury was able to meet the expenditure of the campaign without recourse to extraordinary expedients. The conduct of the war was quite as remarkable from a financial as from a military point of view, and there have been few instances in history of such great results being obtained at such comparatively small' copt. The total amount expended for the whole campaign, from the commencement of the Dongola expedition to the capture of Omdurman, was in round figures two millions. Of this about £E.900,000 was spent on railway and telegraph construction, works of permanent utility, the balance of £E.1,100,000 repre- senting the purely military expenditure. After the conclusion of the campaign a further

sum of £E.300,000 was granted for the extension of the railway to Elhartura. The British Government gave a grant-in-aid of £800,000, and the balance was borne by the Egyptian treasury out of its half-share in the annual surpluses. So far, then, the finances of the country triumphantly stood the test to which they were subjected. But a graver problem preoccupied the minds of those who were responsible for the financial administration of Egypt, and tl^at was whether the resources of the country could support the annual burden of the occupation and government of so large an area without detriment to the normal develop- ment of Egypt itself. It was wisely decided to leave no room for doubt on this point, by at once taking steps to increase those resources on a large scale in the imme- diate future. A vast scheme for the construction of a reservoir at Assuan for the storage of the waters of the Nile had long been under consideration. In 1898 a financial arrangement was concluded whereby the execu- tion of this project, which will enormously increase the productive powers of the country, was at once put in hand. The original estimate of the cost of the works was two millions, and the Egyptian Government arranged to meet the expenditure by the payment of an annuity of £160,000 a year for thirty years, beginning from the 1st July 1903. This important undertaking was brought to a successful termination in 1902, and the actual expenditure incurred amounted to about £E.3,250,000. The difference between the sum originally provided and the ultimate cost was granted by the Caisse de la Dette out of the general reserve fund. In the course of 1899 a great financial reform, the desirability of which had long made itself felt, was seriously taken in hand, namely, the reassessment of the land-tax. The existing assessment, which was made before the British occupation, had long been condemned by all competent authorities, but the inherent intricacies' and difficulties of the problem had hitherto postponed a solu- tion. After careful study and a preliminary examination

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of the land, a scheme was passed which has given satis- faction to the land-owning community, and which will, when completed, distribute the tax

equitably in propor- tion to the fertility of the soil.

This brief sketch of the history of Egyptian finance would not be complete without a few statistics showing R salts- ^^^^ definitely the remarkable progress made 1883-1900. ^^^^^ l&^Z. The following particulars, giving the general financial results obtained since the commencement of the British occupation, are taken from Lord Cromer's reports and other oflcial publications. The difference between the real ordinary revenue and ex- penditure of the Egyptian Government during these years is shown in the following table: —

Tear.

Surplus.

Deficit.

£E.

£E.

1883

921,000

1884

...

460,000

1885

...

733,000

1886

…

492,000

18871

348,000

■→

1888

…

~~53,000~~

~~1889~~

~~218,000~~

~~1890~~

~~647,000~~

~~1891~~

~~933,000~~

~~1892~~

~~746,000~~

~~1893~~

~~687,000~~

~~<•■~~

~~1894~~

~~692,000~~

~~1895~~

~~1,003,000~~

~~,,,~~

~~1896~~

~~1,089,000~~

~~1897~~

1,383,000

•-•:

1898

1,332,000

1899

1,270,000

■-•■

1900

1,552,000

...

This table shows very clearly the cleavage line be- tween the period of semi-insolvency and that of pros- perity through which Egypt has passed. During the four years 1883-86, both inclusive, the aggregate deficit ainoimted to £E.2,606,000. By 1886 the Sudan expendi- ture had greatly diminished. The efforts of the reform- ers, notably those of the irrigation officers, had begun to bear fniit. The aggregate surplus of the fourteen years from 1887 to 1900, both inclusive, was £E.11,847,000. During the same period direct taxation was reduced to the extent of about £E.1,275,000 a year. Arrears of land- tax to the extent of £E.1,245,000 were remitted. In the domain of indirect taxes the salt-tax was reduced by 40 per cent., the postal and telegraph rates were reduced by 50 per cent., and the octroi duties were abolished in all the provinciar towns. Large reductions were made in the railway rates. The only increase of taxation was in the tobacco duty, which has been raised from P.T. 14 to P.T. 20 per kilogramme. The house-tax was also im- posed on European residents in Egypt. In spite of the great relief thus afforded to the taxpayers of Egypt, the revenue increased by £E.2,512,000. In 1883 a revenue of £E.8,935,000 was wrung with diflculty from the country. In 1900 £E.11,447,000 was collected with

ease. On the other hand, a stringent control has been exercised over the expenditure. In 1883 the "ordi- nary " expenditure amounted to £E.9,856,000. In 1900 it amounted to £E.9,895,000, an increase of only £E.39,000.

In connexion with this subject it must be borne in mmd that, during the period under review, Egypt has suffered very severely from the general fall in prices. HIad it not been for Pallln tjjg great increase of production, the result of im-

?fi?.o„<, provements in the system of irrigation, and the fiscal 1885-1898. ^gjjgj afforded to the landowners, the agricultural depression would, without doubt, have seriously impaired the*

1 Owing to a change in the way of makin] expenditure of fE.340,000 was not mclude. . ^. ^

so S there was practically financial equilibrium m that year.

up the accounts, normal in the accounts of 1887,

financial situation. Cotton and sugar are the two principal pro- ducts of the country, forming together about 90 per cent, of the total value of the exports. The following tables show the amount and value of the cotton and sugar crops from 1885 to 1898 :—

Cotton.

Season.

Can tars of 50 Kilos.

Price

per Cantar.

Value.

P.T.i

~~£E.~~

~~1885-86~~

~~2,905,000~~

~~228~~

~~6,625,000~~

~~1886-87~~

~~3,026,000~~

~~240~~

~~7,262,000~~

~~1887-88~~

~~2,963,000~~

~~249~~

~~7,382,000~~

~~1888-89~~

~~2,766,000~~

~~264~~

~~7,310,000~~

~~1889-90~~

~~2,872,000~~

~~294~~

~~8,455,000~~

~~1890-91~~

~~3,638,000~~

~~255~~

~~9,281,000~~

~~1891-92~~

~~4,195,000~~

~~205~~

~~8,594,000~~

~~1892-93~~

~~4,610,000~~

~~206~~

~~9,510,000~~

~~1893-94~~

~~4,548,000~~

~~191~~

~~8,707,000~~

~~1894-95~~

~~4,347,000~~

~~168~~

~~7,326,000~~

~~1895-96~~

~~4,695,000~~

~~220~~

~~10,342,000~~

~~1896-97~~

~~5,177,000~~

~~195~~

~~10,089,000~~

~~1897-98~~

~~5,765,000~~

~~157~~

~~9,040,000~~

~~1898-99~~

~~5,056,000~~

~~175~~

~~8,832,000~~

~~Cotton Seed.~~

~~Season.~~

~~Ardebs.”~~

~~, Price per Ardeb.~~

~~Value.~~

~~P.T.~~

~~£E.~~

~~1885-86~~

~~1,967,000~~

~~62~~

~~1,229,000~~

~~1886-87~~

~~2,807,000~~

~~55~~

~~1,264,000~~

~~1887-88~~

~~2,182,000~~

~~58~~

~~1,277,000~~

~~1888-89~~

~~2,080,000~~

~~68~~

~~1,412,000~~

~~1889-90~~

~~2,211,000~~

~~61~~

~~1,344,000~~

~~1890-91~~

~~2,828,000~~

~~52~~

~~1,486,000~~

~~1891-92~~

~~3,128,000~~

~~58~~

~~1,828,000~~

~~1892-93~~

~~3,157,000~~

~~60~~

~~1,898,000~~

~~1893-94~~

~~3,032,000~~

~~58~~

~~1,756,000~~

~~1894-95~~

~~2,708,000~~

~~43~~

~~1,159,000~~

~~1895-96~~

~~2,982,000~~

~~41~~

~~1,213,000~~

~~1896-97~~

~~3,526,000~~

~~39~~

~~1,393,000~~

~~1897-98~~

~~3,736,000~~

~~41~~

~~1,542,000~~

~~1898-99~~

~~3,163,000~~

~~46~~

~~1,446,000~~

~~*Tear.*~~

~~*Tons of 1000 Kilos.*~~

~~*Price . per 100 Kilos.*~~

~~*Value.*~~

~~*P.T.*~~

~~*£E.*~~

~~*1885*~~

~~*50,000*~~

~~*116*~~

~~*579,000*~~

~~*. 1886*~~

~~*43,000*~~

~~*106*~~

~~*453,000*~~

~~*1887*~~

~~*50,000*~~

~~*99*~~

~~*490,000*~~

~~*1888*~~

~~*47,000*~~

~~115~~

~~541,000~~

~~1889~~

~~37,000~~

~~135~~

~~497,000~~

~~1890~~

~~30,000~~

~~113~~

~~339,000~~

~~1891~~

~~52,000~~

~~110~~

~~573,000~~

~~1892~~

~~65,000~~

~~127~~

~~705,000~~

~~1893~~

~~55,000~~

~~138~~

~~761,000~~

~~1894~~

~~56,000~~

~~111~~

~~629,000~~

~~1895~~

~~55,000~~

~~86~~

~~473,000~~

~~1896~~

~~74,000~~

~~104~~

~~765,000~~

~~1897~~

~~73,000~~

~~87~~

~~635,000~~

~~1898~~

~~58,000~~

544,000

Trade and Commerce, 188^98.— The following table shows the average annual value of the total imports and exports, excluding bullion, for the three quinquennial periods between 1884 and 1898 :—

Period.

‘ Imports.

Exports.

Total Trade.

1884-88 1889-93 1894-98

£E.

8,257,000 8,423,000 9,822,000

£E.

11,106,000 12,887,000 12,592,000

£E.

19,363,000 21,310,000 22,414,000

Owing to the great perturbation of prices that has characterized the period under review, the aboVe figures give a very imperfect impression of the real growth of the trade of the country. A clearer view is obtained by comparing the quantities of some of the

1 100 P.T.=£E.1=£1, Os. 6d. 2 An axdeb of cotton seed weighs 267 ib.

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more important categories of imports and exports. In the follow- ing tables those articles have been selected which have an intimate connexion with the national prosperity: —

Average Annual Imports.

Period.

Cotton Goods.

Steel and Iron Goods.

Building

Wood.

Coal.

1884-88 1889—93 1894-98

KUos.

13,452,000 13,665,000 16,984,000

Tons.

12,000

25,000 , 34,000

£E.

308,000 388,000 513,000

~~Tons.~~

~~449,000 513,000 701,000~~

~~Average Annual Exports.~~

~~Period.~~

~~Cotton.~~

~~Cotton Seed.~~

~~Sugar.~~

~~Onions.~~

~~1884-88 1889-93 1894-98~~

~~Kan tars.~~

~~2,707,000 3,659,000 4,951,000~~

~~Hectolitres.~~

~~■ 4,240,000~~

~~5,425,000~~

~~6,458,000~~

~~Kilos.~~

~~38,919,000 43,376,000 63,147,000~~

~~Kantars.~~

~~226,000~~

~~656,000~~

1,083,000

On the 31st December 1900 the total amount of the Egyptian debt was £102,714,000, of which £7,273,000 was held by the commissioners of the debt on account of the general reserve fund, and the fund of the economies of the conversion, as will be ex- plained hereafter, thus leaving £95,441,000 in the hands of the public. The particulars of the diEEerent loans are shown in the accompanying table : —

On the Market.

Held by the

Caiase de la Dette.

Total.

Guaranteed loan 3 per cent. . Preference debt 3 J per cent. . Unified debt 4 per cent. Domains loan 4J per cent. . Daira Sanieh loan 4 per cent. .

Total .

8,333,000

29,393,000

55,972,000

2,899,000

6,117,000

392,000

1,055,000

5,493,000

2,000

331,000

7,941,000

28,338,000

50,479,000

2,897,000

5,786,000

102,714,000

7,273,000

95,441,000

In June 1890 the assent of the Powers was obtained to the conversion of the preference, Domains, and Daira loans on the following conditions, imposed at tlie initi- ative of the French Government : —

1. The employment of the economies resulting from the conver- sion was to be the subject of future agreement with the Powers.

2. The Daira loan was to be reimbursed at 85 per cent., instead of 80 per cent., as provided by the law of liquidation.

3. The sales of Domains and Daira lands were to be restricted to £E.300,000 a year each, thus prolonging the period of liquida- tion of those estates.

The interest on the preference stock was reduced from 5 to 3^ per cent., and on the Domains from 5 to 4J per cent. As regards the Daira loan, there was no apparent reduction in the rate of interest, which remained at 4 per cent., but the bondholders received £85 of the new stock for every £100 of the old. The annual economy to the Egyptian Government amounted at the time of the con- version to £E.348,000. Further, an engagement was entered into that there should be no reimbursement of the loans till 1906 for the

~~preference and Daira, and 1908 for the Domains. By an arrangement concluded in June 1898, between the Egyptian Government and a syndicate, the unsold balance of the Daira estates will be taken over by the syndicate in October 1905, for the amount of the debt remaining. The Daira loan will then cease to exist.~~

~~The total amount of Egyptian bonds on the mai-ket on 1st January 1883 and 1st January 1901 respectively was as follows : —~~

~~1st January 1883 £96,457,000~~

~~1st January 1901 95,441,000~~

~~Shovnng a reduction of £1,016,000~~

~~During this period fresh debt was incurred for the following purposes : —~~

~~Alexandria indemnities £4,250,000~~

~~Deficits of years prior to 1886, including Sudan . 4,030,000 Commutations of pensions and allowances of the~~

~~Khedivial family 2,769,000~~

~~Treasury working balance 513,000~~

~~Irrigation works 1,959,000~~

~~Expenses of loans (commissions, &c.) . . . 1,169,000~~

~~Less — Paid out of special receipts (sales of land, &o.)~~

~~Leaving a net increase on this account of To this sum must be added the amount by which the debt was increased in consequence of the conversion of the preference and Daira stocks .~~

~~£14,690,000~~

~~1,305,000~~

~~£13,385,000~~

~~1,945,000~~

~~£15,330,000~~

~~Making a total increase of ... .~~

~~On the other hand, the amount of bonds on the market has been diminished by the following amounts : —~~

~~By sales of property (mostly Daira and Domains) £6,304,000~~

~~By surplus revenue, of which £7,273,000 is now held by the commissioners of the debt . . . 10,042,000~~

~~£16,346,000~~

~~Making a net reduction of £1,016,000~~

~~These figures are remarkable. They show that in spite of about £13,000,000 having been borrowed for various objects, and in spite of conversion operations, which added nearly £2,000,000 to the capital of the debt, the total amount of Egyptian bonds on the market in 1901 was one million less than in 1883. This result was mainly, although not entirely, due to the system under which large sums of money remained at the close of each year in the hands of the commissioners of the debt, and were by them invested in Egyptian stocks. Whatever objections may on other grounds be urged against this system, it cannot be doubted that its result is to accumulate what is practically a large and ever-increasing sinking fund. During the five years 1896-1900 debt was either paid off or withdravm from the market by Government purchase at an average rate of no less than £1,262,000 a year. It should be added that the interest charge on the bonds on the market, which on the 1st January 1883 stood at £4,166,000, was in 1901 £3,604,000, a diminution of £562,000.~~

~~In order to give a complete account of the financial position of the Egyptian Government, some explanation must be supplied of the various reserve~~

funds which are in operation. The general reserve fund was created with the assent of the Powers by the de- '^^ cree of the 12th July 1888. Beginning with a sum of £E.340,000, being the amount saved by- a change in the system of accounts introduced in 1887, this fund is increased annually by the share of the Caisse in the sur- plus, by the interest on the invested accumulations, and by the produce of the sale of certain Government lands. When the unpledged portion of the fund reaches the sum of £E.2,000,000, no further accumulation is allowed under the provisions of the above-mentioned decree, and the excess has to be applied to sinking fund. Up to the end of 1901 this contingency had never occurred. The fund is primarily intended to be used in making good any de- ficiency in the payment of the interest on the debt or of the administrative expenditure authorized by the London convention and subsequent agreements. It may also be drawn upon for extraordinary expenditure with the pre- vious consent of the commissioners of the Caisse. The total amount paid into the general reserve fund, from its constitution in 1888 down to the end of 1900, was £E.8,106,000, of which £E.4,577,000 was actually spent on extraordinary expenditure, and a further sum of

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i3E.2,342,000 was pledged for the execution of various works in course of progress, leaving an unpledged balance of £E.1,187,000. Out of the total amount advanced, £E.2,305,000 was granted for drainage and irrigation works, £E.2,669,000 for improving the state Railways, ieE.1,113,000 for the construction of public buildings, &c., and £E.647,000 for the relief of taxation. The unem- ployed balance of the fund, including the portion that is pledged but has not yet been actually advanced, is in- vested in Egyptian stocks. The special reserve fund was constituted in 1886, and is chiefly made up out of the net savings of the Government on its share of the annual surpluses. This fund is at the absolute disposal of the Egyptian Government. Since its creation the total re- ceipts have amounted to £E.4,815,000. At the end of 1900 extraordinary expenditure to the amount of £E.4,006,000 had been charged to this fund, leaving an apparent balance of £E.809,000. As,

however, fur- ther expenditure amounting to £E.50,000 had been authorized, although not actually incurred, when the accounts of 1900 were closed, the real state of the fund was a surplus of £E.759,000. The whole of the extraor- dinary expenditure of the Sudan campaign, with the exception of the amount granted on this account by the British Government, was charged to the special reserve fund, amounting, in round figures, to £E.1,500,000. The principal remaining items that have been debited to this fund are £E.758,000 for commutation of pensions and £E.350,000 for reproductive works.

A third fund is formed by the accumulation of the economies resulting from the conversion of the privi- leged, Domains, and Daiira loans in 1890. As ^nomles. already explained, this fund cannot be em- ployed without the assent of the Powers. Up to the end of 1899 none of the numerous proposals sub- mitted by Egypt had proved acceptable to the French Government. In the meantime, the annual economies, amounting, in 1900, to £E.307,000, together with the interest on the accumulations of the past, were invested in Egyptian stocks by the Caisse de la Dette, and on the 31st December 1900 the value of the fund amounted to £E.4,002,000. This system virtually acts as a sinking fund, but one of a very expensive nature for the Egyp- tian Government, inasmuch as bonds which the Govern- ment have the legal right to pay off at par are purchased at the market price,- which is, and appears likely to remain, considerably above par. While on this branch of the subject it may be of interest to refer to a passage in Lord Cromer's annual report for 1898, in which, after giving an approximate estimate of the annual charges unnecessarily borne by Egypt, he concludes by stating that, "broadly speaking, it is no exaggeration to say that internationalism imposes an extra charge of about ^1,750,000 a year on the Egyptian treasury."

In conclusion, it may be useful to give a brief analysis of the latest published accounts, namely, those for 1900. The total revenue amounts to £E.11,663,000, in ^f'f" which figure is included an annual contribution Budget ^^ jeE.216,000 from the general reserve fund, the result of an arrangement with the Powers to make good to the Government a reduction of the land-tax to that amount. This item is therefore not real revenue, but a mere transfer. Of the above revenue £E.7,339,000 was assigned to the*

service of the debt and was paid into the Caisse de la Dette, and the balance, £E.4,324,000, was received directly by the Govern- ment treasury. The service of the debt, including the economies of the conversion of the preference stock, amounted to £E.3,614,000, which figure is exclusive of a sum of £E.181,000 charged to the ad- ministrative budget on account of the debt, and the

administrative expenditure, as authorized by the London convention and subsequent arrangements, to £E.6,195,000. There remained, therefore, a sum of £E.1,864,000 to be divided between the Government and the general reserve fund. In virtue of certain agreements made with the Powers, the share of the Gov- ernment, originally fixed at one-half by the London con- vention, is increased by £E.45,000, and therefore amounted to £E.972,000. Prom this must be deducted the difference between the real and the authorized ex- penditure, namely, £E.413,000, so that the real surplus at the disposal of the Egyptian Government was £E.659,000. On the other hand, the amount received by the general reserve fund must be reduced by the contribution of £E.216,000 to the ordinary revenue to which allusion has already been made. The actual amount paid into the general reserve fund was, there- fore, £E.666,000 (the half-share £E.927,000 — £E.45,000 — £E.216,000). To sum up in an intelligible manner the results of this complicated system, the real surplus revenue of the country amounted to £E.1,552,000, of which £E.559,000 belongs to the Egyptian Govern- ment, £E.666,000 increases the general reserve fund, £E.265,000, representing the economies of the con- version of the preference stock, is paid into the econ- omies fund, and £E.62,000 is devoted to sinking fund.

The chief item of revenue is the land-tax, which brought in £E.4,367,000. The cultivated area paying taxes amounts to 5,641,000 feddans,^ so that the average tax per feddan is 788 milliemes (= 15s. 4d:). The customs (including the duty on tobacco) produced £B.2,418,000, and the raUways £E.2,159,000. These three heads of revenue account for £E.8,944,000, equal to 77 per cent, of the total receipts. The actual revenue collected amounted to £B.11,447,000, of which a certain proportion consists of receipts from administrations ren- dering direct service to the public, such as the railways, telegraphs, post office, &c. The net receipts from these latter services do not yield more than a normal return on the capital that

~~*has been expended on them. De- ducting these and certain other items of revenue, which are also not taxation properly so called, such as rents from state property, the total amount paid by the Egyp- tian taxpayer works out to £E.8,502,000, or 813 milliemes (= 15s. lOd.) per head of the population, as compared with £E.1-014 (= £1, Os. 9d.) in 1883.*~~

~~*The total expenditure in 1900 was £E.11,104,000. Under the existing system of accounts, first introduced in 1896, this figure includes (1) a sum of £E.265,000, being the annual economy resulting from the conversion of the preference debt ; (2) a sum of £E.62,000 paid into sinking fund ; and (3) a sum of £E.882,000, being the amount paid to the general reserve fund. As already explained, £E.216,000 of the latter sum is repaid to the Government on account of the reduction of the land-tax. The balance of £E.9,895,000 represents the effective expenditure of the year. The details of this expenditure may be summarized as follows : —*~~

~~*1. Charges on account of the tribute and the debt £E.4,340,000*~~

~~*2. Expenditure on railways, telegraphs, post office,*~~

~~*and other revenue-paying departments . . 1,295,000*~~

~~*3. Khedivial civil list and allowances to the*~~

~~*Khedivial family 258,000*~~

~~*4. Administration 2,228,000*~~

~~*5. Army (including the expenses of the army of*~~

~~*occupation) 807,000*~~

~~*6. Pensions 433,000*~~

~~*7. Suppression of the corvee .... 400,000*~~

~~*8. Sudan deficit 184,000*~~

Total- . . 9,895,000 1 The feddan is practically equivalent to the English acre.

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As regards the last item, it should be observed that the total cost of the civil administration of the Sudan in 1900 was £E.332,000. The revenue amounted to £E.167,000, leaving a deficit of £E.176,000, which was borne by the Egyptian Treasury. Of this sum £E. 134,000 (representing the amount provided in the budget on ~this account was) included in the ordinary expenditure of the Egyptian Government for 1900, and the balance of £E.41,000 was advanced out of the special reserve fund. The Sudan budget is also charged with a certain proportion of the army expenditure, amounting in 1900 to '£E.283,000. This represents the additional expenditure due to the reoccupation of the Sudan. The real cost of the Sudan to Egypt in 1900 was therefore £E.458,000.

The monetary system in force in Egypt dates from 1885, when through the efforts of Sir Edgar Vincent Curreacy *^® Currency was placed on a sound footing. Before that time the multiplicity of foreign silver coinage that circulated throughout the country caused grave inconvenience in all commercial transac- tions. The present system is based on the single gold standard, silver, nickel, and bronze being used for the subsidiary coinage. The unit is the Egyptian pound, which is divided into 100 piastres, the piastre being again divided into 10 milliemes. The Egyptian pound weighs 8-500 grammes, and contains 875 parts out of 1000 of fine gold. Its approximate value in English currency is £1, Os. 6d. The subsidiary coinage consists of pieces of 20, 10, 5, 2, and 1 piastres in silver ; 5, 2, and 1 milliemes in nickel ; and ^ and \ millieme in bronze. These coins are token coins, their intrinsic value being considerably less than their nominal value. The amount in circular tion is Controlled by the Ministry of Finance, and the coins are changed into gold on demand at the Government treasury. They are only legal tender up to 200 piastres. The history of the currency reform in Egypt is interest- ing as affording a practical example of a system

which has been much discussed in connexion, with the currency question in India, namely, a gold standard without a gold coinage. The Egyptian pound is practically non-existent, nearly all that were coined having been withdrawn from circulation. Their place has been taken by foreign gold, principally the English sovereign, which circulates at a value of 97^ piastres. In practice the system works per- fectly smooth, the gold flowing in and out of the country through the agency of private banking establishments in proportion to the requirements of the circulation. It is, moreover, very economical for the Government. As in most agricultural countries, there is a great expansion of the circulation in the autumn and winter months in order to move the crops, followed by a long period of contracted circulation throughout the rest of the year. Under the above system, the fluctuating requirements of the currency are met without the expense of alternately minting and melting down. Recently paper money has been intro- duced into the country, this privilege having been con- ceded by the Government to the National Bank. The notes are of the following values : — £E.100, £E.50, £E.10, £E.5, £E.l, and 50 piastres — and are pay- able in gold on demand. The issue department is kept wholly distinct from the general business of the Bank. An amount not exceeding one-half of the value of the notes in circulation may be invested in Egyptian stocks, and the balance of the reserve must always be held in gold. The notes are not legal tender, but are accepted by ihe Government in payment of taxes. Sufficient time has not yet elapsed to state whether this form of currency will become popular among the native population.

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The fellah soldier may be aptly likened to a bicycle, which although incapable of standing up alone, is very useful while under the control of a skilful master. As is the soldier, so is the army. It is generally believed that the successes gained in the time of the Pharaohs were due to foreign legions ; and from Cambyses to Alexander, from the Ptolemies to Antony (Cleopatra), from Augustus in the 7th century throughout the Arab period, and from Saladin's dynasty down to the middle of the 13th century, the military power of Egypt was dependent on mercenaries. The Mamelukes

(slaves), imported from the eastern borders of the Black Sea and then trained as soldiers, usurped the ^^„, government of Egypt, and held it tUl 1507, when the Ottomans began to rule. This form of govern- ment, speaking generally, endured till the French invasion at the end of the 18th century. British and Turkish troops drove the French out after an occupation of two years, the British troops remaining till 1803. Then Mehemet Ali, a small tobacconist of Kavala, Macedonia, coming with Albanian mercenaries, made himself governor, and later (1811), by massacring the Mamelukes, became the actual master of the country, and after seven years' war brought Arabia under Egypt's rule. He subdued Nubia and Sennar in 1820-22; and then, requiring a larger army, he obtained instructors from France. To them were handed over 1000 Turks and Circassians to be trained as officers, who later took command of 30,000 Sudanese. These died so rapidly in Egypt from pneu- monia^ that Mehemet Ali conscripted over 250,000 fellaheen, and in so arbitrary a fashion that many peasants mutilated themselves to avoid the much-dreaded ser- vice. The common practice was to place a small piece of nitrate of silver into the eye, which was then kept tightly bandaged till the sight was destroyed. Battalions were then formed of one-eyed men, and of soldiers who, having cut off their right-hand fingers, were made to shoot from the left shoulder. Every man who could not purchase exemption, with the exception of those living in Cairo, Alexandria, and Suez, on becoming 19 years old was liable nominally to 12 years' service ; but many men were kept for 30 or 40 years, in spite of constant appeals. Neverthe- less the experiment succeeded. The docile, yet robust and hardy peasants, under their foreign leaders, gained an unbroken series of successes in the first Syrian War ; and after the bloody battle of Konia (1832), where the raw Turkish army was routed and the Grand Vizier taken prisoner, it was only European intervention which pre- vented the Egyptian General, Ibrahim Pasha, from march- ing unopposed to the Bosphorus. The defeat of the Turkish army at Nezib, in the second Syrian War (1839), showed that it was possible to obtain favourable military results with Egyptians when stiffened by foreigners and well commanded. Ibrahim, the hero of Konia, declared, however, that no native Egyptian ought to rise higher than the rank of sergeant ; and in the Syrian campaigns nearly all the officers were Turks or Circassians, as were many of the non-commissioned officers. In the cavalry and artillery many of the privates were for- eigners, numbers of the

Janissaries who escaped the massacre at Stambul (1832) having joined Mehemet All's army.

In the reign of Abbas, who succeeded Mehemet Ali, the Egyptian troops were driven from Nejd, and the Wahabi State recovered its independence. The next ELhedive, Said,

1 Similar mortality, though on a smaTter scale, recurred in 1889, when Sudanese hattalions coming from Suakin were detained temporarily in Cairo.

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began as an ardent soldier, but took to agriculture, and at his death. (1863) 3000 men only were retained under arms. Ismail, the next Khedive, immediately added 27,000 men, and in seven years was able to put 100,000 men, well equipped, in the field. He sent 10,000 men to help suppress a rebellion in Crete, and conquered the greater part of the (Nile) Sudan ; but an expedition of 11,000 men, sent to Abyssinia under Prince Hassan and Eateb Pasha, well equipped with guns and all essentials, was, in two successive disasters (1875 and 1876), practi- cally destroyed. The education of Egyptians in Con- tinental cities had not produced the class of leaders who led the fellaheen to victory at Konia.

Ismail's exactions from the peasantry in 1880-81 re- acted on the army, causing discontent ; and when he was tottering on the throne he instigated military demonstra- tions against his own Government, and, by thus sapping the f oundatibns of discipline, assisted Arabi's revolution ; the result was the battle of Tel-el-Kebir, the British occu- pation, and the disbandment of the army, which at that time in Egypt Proper consisted of 18,000 men. Ismail had 500 field-guns, 200 Armstrong cannon, and factories of warlike and other stores. These latter were conducted extravagantly and badly administered.

In January 1883, Major-General Sir Evelyn Wood, V.C, was given £200,000, and directed to spend it in raising a fellaheen force of 6000 men for the defence of Egypt. He was assisted at first by 26 oflcers, amongst whom were two who later became successively Sirdars — Colonel E. Grenfell, commanding a brigade, and Lieu- tenant H. Kitchener, K.E., second in command of the cavalry regiment. There were four batteries, eight bat- talions, and a camel company. Each battalion of the 1st Infantry Brigade had three British mounted tarf/on"" officers, Turks and Egyptians holding the cor- responding positions in the battalions of the 2nd Brigade. The Sirdar selected these native officers from those of Arabi's followers who had been the least prominent in the recent mutiny ; non-commissioned offi- cers who had been drill-instructors in the old army were recalled temporarily, but all the privates were conscripted from their villages. The earlier merciless practice had been in theory abolished by a decree based on the Ger- man system, published in 1880 ; but owing to defective organization, and internal disturbances induced by Khe- dive Ismail's follies, the law had not been applied, and the 6000 recruits collected at Cairo in January 1883 repre- sented the biggest and strongest peasants who could not piirchase exemption by bribing the officials concerned. The difficulties experienced in applying the 1880 decree were great, but the perseverance of British officers gave the oppressed peasants, in 1885, an equitable law, since improved and altered by the Decree of 1900. Einancial requirements have in more recent years caused the Sirdar to allow exemption by paying (Badalia) £20 before bal- lot. The Recruiting Superintending Committee, travel- ling through districts, supervise every ballot, and work under stringent rules which render systematic bribery difficult. The recruits who draw unlucky numbers at 19 years of age are seldom called up till they are 23, w;hen they are summoned by name and escorted by a policeman to Cairo. To prevent substitution on the jour- ney each recruit wears a string girdle sealed in lead. The periods of service are : with the colours, 5 years ; in the reserve, 5 years, during which time they may be called up for police service, manoeuvres, &c. The pay is 30 piastres (one piastre being worth 2|d.) per month for all services, and the liberal scale of rations of meat, bread, and rice remained as before in theory, but in practice the value of pay and food received was greatly enhanced. So also with the pension and promotion regulations. They

were sufficiently liberal on paper, but had never been carried into effect.

The eiforts of 48 American officers, who under General Stone zealously served Ismail, had entirely failed to over- come Egyptian venality and intrigue ; and in spite of the military schools, with a comprehensive syllabus, the only perceptible difference between the Egyptian officer and private in 1879 consisted, according to one of the Amer- icans, in the fact that the first was the product of the harem, and the second of the field. Marshal Marmont, writing in 1839, mentions the capacity of the Egyptians for endurance ; and it was tested in 1883, especially in the 2nd Brigade, since its officers (Turks and Egyptians), anxious to excel as drill-masters, worked their men not only from morn till eve, but also by lamplight in the cor- ridors of the b^arracks. On the 31st March 1883, ten weeks after the arrival of the first draft of recruits, about 6600 men went through the ceremonial parade movements as practised by the British Guards in Hyde Park, with unusual precision. The British officers had acquired the words of command in Turkish, as used in the old army, an attempt to substitute Egyptian words having failed owing to lack of crisp, sharp-sounding words. As the Egyptian brigadier, who had spent some years in Berlin, spoke German fluently, and it was also under- stood by the senior British ofBcers, that language was used for all commands given by the Sirdar on that special parade. The British drill-book, minus about one-third of the least serviceable- movements, was translated by an English officer, and by 1900 every necessary British official book had been published in English and Arabic, except the new Eecruiting Law (1885) and a manufacturing manual, for which French and Arabic editions are in use. The discipline of the old army had been regulated by a translation of part of the Code Napoleon, which was inadequate for an Eastern army, and the Sirdar replaced it by the Army Act of 1881, slightly modified and printed in Arabic.

The task undertaken by the small body of British officers was difficult. There was not one point in the for- mer administration of the army acceptable to English gentlemen. That there had been no adequate auxiliary departments, without which an army cannot move or be efficient, was comparatively a minor difficulty. To suc- ceed, it was essential that the fellah should be taught that discipline might be strict without being

~~oppressive, that pay and rations would be fairly distributed, that brutal usage by superiors would be checked, that complaints would be thoroughly investigated, and impartial justice meted out to soldiers of all ranks. An epidemic of cholera in the summer of 1883 gave the British officers their first chance of acquiring the esteem and confidence of their men, and the opportunity was nobly utilized. While the patient fellah, resigned to the decrees of the Almighty, saw the ruling Egyptian class hurry away from Cairo, he saw also those of his comrades who were stricken tenderly nursed, soothed in death's struggles, and in many cases actually washed, laid out, and interred by their new self- sacrificing and determined masters. The regeneration of the fellaheen army dates from that epidemic.~~

~~When the Egyptian Army of the Delta was dispersed at Tel-el-IJebir, the Khedive had 40,000 troops in the Sudan, scattered from Massawa on the Red Sea to 1200 miles towards the west, and from Wadi Haifa, 1500 miles southward to Wadelai, near Albert Nyanza. These were composed of Turks, Albanians, Circassians, and some Sudanese. Ten thousand fellaheen, collected in March 1883, mainly from Arabi's former forces, set out from Duem, 100 miles south of Khartum, in September 1883, under Hicks Pasha, a dauntless retired Indian Army officer, to vanquish the Mahdi. They disappeared in the deserts~~

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~~f Kordofan, where they were destroyed by the Mahdists bout 50 miles south of El Obeid. In the wave of success- ul rebellion, except at Khartum, few of the Egyptian ;arrisons were killed when the posts fell, long residence nd local family ties rendering easy their assimilation ia he ranks of the Mahdists.~~

~~Baker Pasha, with about 4000 constabulary, who were lid soldiers, attempted to relieve Tokar in Februsfry 1884. ie was attacked by 1200 tribesmen and utterly routed, osing 4 Krupp guns, 2 machine guus, and 3000 rifles.)nly 1400 Egyptians escaped the slaughter.~~

The Sirdar made an attempt to raise a battalion of Ubanians, but the few men obtained mutinied when irdered to proceed to the Sudan, and it was deemed .dvisable, after the ringleaders had been executed, to bandon the idea, and rely on blacks to stiffen the fella^ leen. Then the 9th (Sudanese) Battalion was created or service at Suakin, and four others having been suc- lessively added, these (with one exception — at Gedaref) lave since borne the brunt of all the fighting which has »een done by the Khedivial troops. The Egyptian troops n the operations near Suakin behaved well, however ; and here were many instances of personal gallantry by in- lividual soldiers. In the autumn of 1884, when a British ixpedition went up the Nile to endeavour to relieve the leroie Gordon, besieged in Khartum, the Egyptians ,did emarkably good work on the line of communication from Lssiut to Korti, a distance of 800 miles, and the training iud experience thus gained were of great value in all ubsequent operations. The honesty and discipline of he fellah were undoubtedly of a high order. When the rews of the whale-boats were conveying stores, the orwarding officers tried to keep brandy and such like oedical comforts from the European crews, coffee and ea from Canadian voyageurs, and sugar from Kroo boys. Che only immaculate carrier was the Egyptian. A large um of specie having failed under British escort to reach)ongola, an equivalent sum was handed to an Egyptian ieutenant of six months' service, with 10 men, and duly eached its destination.

Twelve years later the standard of honesty was un- mpaired, and the British officers had imparted energy nd activity into Egyptians of all ranks. The intelligent irofessional knowledge of the native officers, taught inder British gentlemen, and the constant hard work heerfuUy rendered by the fellah soldiers, were the main actors of the success achieved at Omdurman on the 2nd September 1898. The large dep6ts of stores at Assuan, lalfa, and Dongola could only be cursorily supervised ly British officers, and yet when the stores were received t the advance dep5t the losses were, infinitesimal.

By nature the fellah is unwarlike. Born in the valley if a great river, he resembles in many respects the Ben- gali, who exists under similar conditions ; but f Egyp- tli6 Egyptian has proved capable of greater im- \an provement. He is stronger in frame, and can

ouier. undergo greater exertion. Singularly unemo- ional, he stood up at Tel-el-Kebir after Arabi Pasha and ,11 his officers, from general to subaltern, had fled, until le was mown down by case-shot poured in at close anges. Near Trinkitat in 1883 he allowed himself to be laughtered by tribesmen formerly despised, and about ne-fourth of his comrades escaped. Baker Pasha's force ras termed constabulary, yet his men were all old sol- iiers, though new to their gallant leader and to the small land of their brave but strange British officers. Since hat fatal day, however, many of the fellaheen have hown they are capable of devoted conduct, and much las been done to raise in the soldiers a sense of self- espect, and, in spite of centuries of oppression, of eracity. The barrack square drill was smart under the

old system, but there was no fire discipline, and all indi- viduality was crushed. Now both are encouraged, and the men, receiving their full rations, are unsurpassable in endurance at work and in |marching. All the troops present in the surprise fight at Eirket in June 1896 had covered long distances, and one battalion (the 10th Sudanese) accomplished 90 miles within 72 hours, includ- ing the march back to railhead immediately after the action. The troops under Colonel Parsons, Koyal Artil- lery, who beat the Dervishes at Gedaref, were so short of British officers that all orders were necessarily given in Arabic and carried to commanders of units by Arabs. While an Egyptian battalion was attacking in line, it was halted to repel a rush from the rear, and front and rear ranks were simultaneously engaged, firing in opposite directions — yet the fellaheen were absolutely steady; they shot well and showed no signs of trepidation. On the other hand, neither was thete any exultation after their victory. It has been said by one who has perhaps more knowledge of them than any other commander, that " the fellah would make an admirable soldier if he only wished to kill some one ! "

The well-educated Egyptian officer, with his natural aptitude for figures, does subordinate regimental routine carefully, and works well when supervised by men of stronger character. The ordinary Egyptian is not self-reliant or energetic by nature, and, like most Eastern people, finds it difficult to be impartial where duty and family or other personal relations are in the balance. The black soldier has, on the other hand, many of the

finest fighting qualities. This was observed by British officers, from the time of the preliminary operations about Kosheh, and at the action near Ginniss in December 1885, down to the brilliant operations in the pursuit of the Mahdists on the Blue Nile after the action of Gedaref (subsequent to the battle of Omdurman), and the fighting in Kordofan in 1899, which resulted in the death of the Khalifa and his Emirs.

Black soldiers served in Mehemet All's army, but their value was not then duly appreciated. At the present day (1902) they are nearly aU deserters from the Mahdist forces, or prisoners who have been captured in action. The greater number are Shilluks and Dinkas, coming from the country between Eashoda and the Equatorial Provinces, but a proportion come from the far west of Kordofan, some even from Bornu and Wadai. Many are absolute savages, difficult to control, wayward, and thoughtless like children. They are very excitable and apt to get out of hand; unlike the fellahs, they are not fond of drill, and are slow to acquire it, but their dash, their pugnacious instinct, and their desire to close with an enemy are of immense value. The Sudani, more- over, shoots better than the fellah, whose eyesight is often defective. The Sudanese captain can seldom read or write, and is therefore in the hands of the Egyptian-born company quartermaster-sergeant as regards pay and cloth- ing accounts. He is slow, and as a rule has little know- ledge of drill. Nevertheless he is self-reliant, much respected by his men, and can be trusted in the field to carry out any orders received from his British officer. The younger Sudanese officers who have been through the Military School are well instructed, but it is said that the Sudanese brought up in Cairo have lost, in some re- spects, the robust martial qualities inherent in the Sudan people. The most efficient companies in the Sudanese battalions are apparently those in which the captain is a black and the lieutenants are Egyptians.

The army raised by the first Sirdar in January 1883 was highly commended for its work on the line of com- munication in 1884-85, and its artillery and camelry distinguished themselves in the action at Kirbekan in

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February 1885. Colonel Sir Francis Grenfell succeeded General Sir Evelyn Wood in March 1885, and while under his command the army continued to improve, and fought successful actions at Gemazah, Arguin, Toski, and Tokar. At Toski the Dervish force was nearly annihilated. In, March 1892 Colonel Kitchener succeeded General Sir Francis Grenfell, and four years later began his successful reconquest of the Sudan. In June 1896, owing to the indefatigable exertions of Major Wingate, a per- fected system of secret intelligence enabled the Sirdar to bring an overwhelming force of 6 to 1 against the Dervish outpost at Firket and destroy it. In September

1896 a skirmish at Hafir, with similarly successful tactics, gave the British commander the possession of Dongola. On the 7th August 1897 Colonel Hunter surprised and annihilated a weak Dervish garrison at Abu Hamed, to which place, by the 31st October 1897, a railway had been laid across the Nubian desert from Wadi Haifa, a distance of '230 miles, the "record" construction of 6300 yards surveyed, embanked, and laid in one day having been attained. On the 26th December

1897 the Italian troops handed over Kassala to Colonel Parsons, E.A. On the 8th April 1898 a British division, with the Egyptian army, destroyed the Dervish force under the Emir Mahmud Ahmed, on the Atbara river. On the 2nd September the Khalifa attacked the British- Egyptian troops at Kerreri, and being routed, his men dispersed; Omdurman was occupied, and on the 19th September the Egyptian flag was rehoisted at Pashoda. On the 22nd September 1898 Gedaref was taken from the Emir Ahmed Fedil by Colonel Parsons, and on the 26th December the army of Ahmed Fedil was finally defeated and dispersed near Eoseires. The Khalifa's army, reduced to an insignificant number, after several unsuc- cessful engagements withdrew to the west of the Nile, where it was attacked, on the 24th November 1899, after a forced march by Colonel Wingate, and anni- hilated. The Khalifa himself was killed; while the victor, who had joined the Egyptian army in 1883 as aide-de-camp to the first Sirdar, in December 1899 became the fourth Sirdar, as Major-General Sir F. E. Wingate, K.C.B., K.C.M.G., &c.

The single Camel Company of 1883 grew by 1901 into six com- panies. A raid from Dongola into the Oasis of Beris caused the Sirdar to raise three

~~*companies of Sudanese drafted from the battalions, to which two more companies were added in 1896, one of fellaheen and one composed of Dervishes taken at Dongola. Six days' food for men and camels, 300 rounds for each rifle, and three days' water for men are carried in marching order.*~~

~~*In 1899 the infantry of the Egyptian army consisted of 20,000 men, of whom 12,000 were fellaheen and 8000 blacks, divided into battalions of 1000 and 800 men respectively. They are armed with Martini-Henry rifles, and carry into action 130 rounds per man, 80 being in the pouches and 50 in the bandoliers. In 1901 the infantry, reduced by 2 battalions since the war, num- bered 9 Egyptian and 7 Sudanese battalions.*~~ ■

~~*The artillery consists of 4 field batteries and 1 Maxim battery, each battery having one British officer and 5 Egyptian, the total comprising 34 officers and 900 men. There is a battalion of 3 companies of garrison artillery, consisting of 12 officers and 370 men.*~~

~~*There are 10 gunboats on the Nile, and a number of unarmed vessels.*~~

~~*The cavalry are mounted on hardy Syrian horses ; there are 5 squadrons, one being composed of Sudanese raised after the battle of Omdurman, and the remainder of Egyptians. Three squadrons are commanded by British officers, and two by native officers, each squadron having an average strength of 150. The front ranks carry lance and carbine, and the rear ranks carbine and sword.*~~

~~*The Egyptian soldier, when unfit for duty, had, under the pre- British command, been treated in civil hospitals, but there was a civilian doctor paid on Army Estimates, who was supposed to supervise the conscription, to avoid which large sums were given as bribes An outbreak of cholera in the summer of 1883 empha- sized the necessity of British doctors, and Surgeon-Major Rogers*~~

~~*organized a singularly efficient department, which now consists of 14 British officers, 39 Egyptian officers, and 284 non-commissioned officers and men.*~~

The Veterinary Department, represented originally by a single British veterinary officer, who joined in 1883, now consists of two British officers and five Egyptian officers, with 30 non-commis- sioned officers and men, who are selected for intelligence and education after one year's service in the ranks.

The ambitious Military School system of the Khedive Ismail Pasha was replaced, in consequence of financial pressure, by a smaller establishment in 1879, but, partly out of consideration for the capable French officer then at its head, no drastic changes were enforced in 1883, nor until 1887, when the notoriously bad state of the school necessitated its reorganization, which was effected by a British officer. A simpler programme was adopted ; elementary subjects were more thoroughly taught, and a knowledge of arithmetic, geometry, algebra, fortification, military history, topography, drawing, geography, English, French, and Arabic was imparted. The 200 students remain for two years ; the course is calculated to last for three years, but at present the demand for officers exceeds the output.

The Supply Department is supervised by a British officer as director, who has under him the Tura Mills, where biscuits and soap are produced much more cheaply than was possible under the contract system. A British officer supervises the stores, clothing, and equipment for both man and horse. The clothing for all arms of the service costs between £3 and £4 per head, and the rations from 4d. to 5d. daily for each soldier. Guns and equipment of all kinds are, as a rule, purchased in the United Kingdom. The total annual expenditure is £500,000.

On the assumption of command by the third Sirdar, then Colonel Kitchener, the Surveyor-General's Department was abolished ; the Engineer, Ordnance, and Supply services were administered as separate branches, while to a Financial Secretary was given the duty of preparing the Budget and making contracts, issuing pay, and carrying out a financial audit.

The army has been gradually reduced since the Dervish wars, and large numbers of officers and men are now employed in the civil administration of the Sudan. (s. wo.)

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In the ninth edition of this Encyclopaedia (vol. v. p. 767) an account is given of the reforms instituted during the Khediviate of Ismail Pasha, but it is justly pointed out that " the funds required for these public works, as well as the actual labour, have been remorselessly extorted from a poverty-stricken population, and there is probably no peasant now existing whose condition is worse than that of the long-suffering Egyptian fellah." The writer ven- tured, however, to predict that " future generations will gain at the fearful expense of the present," and that " a better time is beginning for Egypt." This prediction, made in 1877, has since been fulfilled ; but the better time has come in a way and to an extent which no one could have then foreseen.

The impoverishment of the fellah had reached in 1875 such a point that the ordinary resources of the country no l<)nger suf&ced for the most urgent necessities of administration ; and the Khedive Ismail, having le^Sfng to repeatedly broken faith with his creditors, could '« deposi- not raise any more loans on the European J^^^"^ market. The taxes were habitually collected many months in advance, and the colossal floating debt was increasing rapidly. In these circumstances Ismail had to realize his remaining assets, and among them sold 176,602 Suez Canal shares to the British Government for £3,976,582 (see Beaconsfield). This comparatively small financial operation brought about the long-delayed crisis and paved the way for the future prosperity of Egypt, for it induced the British Government to inquire more care- fully into the financial condition of the country. What is known as the Cave Mission was sent out to Cairo in 1875, and its report showed that under the existing administra- tion national bankruptcy was inevitable. Other commis- sions of inquiry followed, and each one brought Ismail more under European control. The establishment of the Mixed Tribunals (Ency. Brit. vol. v. p. 767) had already made*

some of the Courts of Justice international. The Caisse de la Dette, the result of the Cave Mission, established international control over a large

portion of the revenue. By the Goschen Mission, the next in order of time, the State railways were internationalized. Then came the Eiv^rs Wilson Mission, in consequence of which the con- trol was extended to the enormous landed property of the Khedive. Driven to desperation, Ismail made a virtue of necessity and accepted, in September 1878, a Constitu- tional Ministry, under the presidency of Nubar Pasha, with Rivers Wilson as Minister of Finance and De Blignieres as Minister of Public Works. Professing to be quite satisfied with this arrangement, he pompously announced that Egypt was no longer in Africa, but a part of Europe ; but before seven months had passed he found his Constitu- tional position intolerable, got rid of his irksome Cabinet by means of a secretly-organized military riot in Cairo, and reverted to his old autocratic methods of government. England and Prance could hardly sit still under this affront, and decided to administer chastisement by the hand of the Suzerain Power, which was delighted to have an opportunity of asserting its authority. On 26th June 1879 Ismail suddenly received from the Sultan a curt tel- egram, addressed to him as ex-Khedive of Egypt, inform- ing him that his son Tewfik was appointed his successor. Taken unawares, he made no attempt at resistance, and Tewfik was at once proclaimed Khedive.

After a short period of inaction, when it seemed as if the change , were for the worse, England and Prance Pe-estab- summoned up courage to look the situation Ushment boldly in the face, and re-established the Dual °f'^"" Control in the persons of Major Baring and M. " ™ ■ de Blignieres. For two years the Dual Control governed Egypt, and initiated the work of progress that England was to continue alone. Its essential defect was what might be called insecurity of tenure. Without any efl&cient means of self-protection and coercion at its dis- posal, it had to interfere with the power, privileges, and perquisites of a class which had long misgoverned the country. This class, so far as its civilian members were concerned, was not very formidable, because these were not likely to go beyond the bounds of intrigue and pas- sive resistance ; but it contained a military element who had more courage, and .who had learned their power when Ismail employed them for overturning his Constitutional

Ministry. Among the mutinous soldiers on that Arabiadd occasion was a fellah ofB^cer calling himself ofU82. Ahmed Arabi the Egyptian. He was

not a

man of exceptional intelligence or remarkable powers of organization, but he was a fluent speaker, and could exercise some influence over the masses by a rude kind of native eloquence. Behind him were a group pf men, much abler than himself, who put him forward as the figurehead of a party professing to aim at protecting the Egyptians from the grasping tyranny of their Turkish and European oppressors. The movement began among the Arab oflicers, who complained of the preference shown to the of&cers of Turkish origin ; it then expanded into an attack on the privileged position and predominant influence of foreigners, many of whom, it must be con- fessed, were of a by no means respectable type ; finally it was directed against all Christians, foreign and native. The Government, being too weak to suppress the agita- tion and disorder, had to make concessions, and each concession produced fresh demands. Arabi was first promoted, then made Under-Secretary for War, and ulti- mately a member of the Cabinet. The danger of a serious rising brought the British and French fleets in May 1882 to Alexandria, and after a massacre (11th June) had been perpetrated by the Arab mob in that city, the British Admiral bombarded the forts (11th July 1882). The

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leaders of the National Movement prepared to resist fur- ther aggression by force. A conference of Ambassadors was held in Constantinople, and the Sultan was invited to quell the revolt ; but he hesitated to employ his troops against Mussulmans who were professing merely to op- pose Christian aggression. At last the British Government determined to employ armed force, handed and invited France to co-operate. The French Briusb Government declined, and a similar invitation to Italy met with a similar refusal. England therefore, having to act alone, landed troops at Ismailia under Sir Garnet Wolseley, and suppressed the revolt by the battle of Tel-el-Kebir on 13th September 1882. The Khedive, who had taken refuge in Alexandria, returned to Cairo, and a Ministry was formed under SherLf Pasha, with Riaz Pasha as one of its leading members. On as- suming of&ce, the first thing it had to do was to bring to trial the chiefs of the rebellion. Had the Khedive and Riaz been allowed a free hand, Arabi and

his colleagues would have found little mercy. Thanks to the interven- tion of the British Government, their lives were spared. Arabi pleaded guilty, was sentenced to death, the sentence being commuted by the Khedive to banishment ; and Riaz resigned in disgust. This solution of the difBculty was brought about by Lord DufEerin, then British Ambassa- dor at Constantinople, who had been sent to Egypt as HIgh Commissioner to adjust affairs and report on the situation. One of his first acts, after preventing the ap- plication of capital punishment to the ringleaders of the revolt, was to veto the project of protecting the Khedive and his Government by means of a Praetorian guard re- cruited from Asia Minor, Epirus, Austria, and Switzerland, and to insist on the principle that Egypt must be gov- erned in a truly liberal spirit. Passing in review all the departments of the administration, he laid down the general lines on which the country was to be restored to order and prosperity, and endowed, if possible, with the elements of self-government for future use.

The laborious task of putting these general indications into a practical shape fell to Sir Evelyn Baring, who arrived as Consul-General and Diplom atic Agent, in succession to Sir Edward Malet, in January g^^^g^" 1884. At that moment the situation was singu- appointed larly like that which had existed on two previ- Consuh ous occasions : firstly, when Ismail was deposed, ^^" ' and secondly, when the Dual Control had under- mined the existing authority without having any power to enforce its own. For" the third time in little more than three years the existing authority had been destroyed and a new one had to be created. But there was one essential difference : the power that had now to reorganize the country possessed in the British army of occupation a support sufficient to command respect. Without that support Sir Evelyn Baring could have done little or noth- ing ; with it he did perhaps more than any other single man could have done. HIs method may be illustrated by an old story long current in Cairo. Mohammed Ali was said to have appointed as Mudir or governor in a turbulent district a young and inexperienced Turk, who asked, " But how am I to govern these people ? " " Listen," replied the Pasha ; " buy the biggest and heav- iest kurbash you can find; hang it up in the centre of the Mudirieh, well within your reach, and you will very seldom require to use it." The British army of occu- pation was Sir Evelyn's kurbash; it was well within his reach, as all the world knew, and its simple pres- ence sufi&ced

to prevent disorder and enforce obedience. He had one other advantage over previous English reformers in Egypt: his position towards France was more independent. The Dual Control had been abol- ished by a Khedivial decree of 18th January 1883,

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and replaced by an English financial adviser. France naturally objected ; but having refused to co-operate with England in suppressing the revolt, she could not reason- ably complain that her ofEer of co-operation in the work of reorganization was declined.

At first the intention of the British Government was simply to restore the power of the Khedive, to keep His Highness for some time in the right path by Itlva^Z fi'iendly advice, and to withdraw the British tion. troops as soon as possible. As Lord Granville

explained in a Circular to the Powers, the posi- tion of England in Egypt imposed on her " the duty of giving advice with the object of securing that the order of things to be established shall be of a satisfactory char- acter and possess the elements of stability and progress." But there was to be no embarkingon a general scheme of reforms, which would increase unnecessarily the re- sponsibilities of the protecting Power and necessitate the indefinite prolongation of the military occupation. So far, therefore, as the British Government had a definite policy in Egypt, it was ^.politique de repldtrage. Even this policy was not strictly adhered to. Mr Gladstone's Cab- inet was as unstable as the public opinion it sought to conciliate. It had its hot fits and its cold fits, and it gave orders now to advance and now to retreat. In the long- run circumstances proved too strong for it, and it had to undertake a great deal more than it originally intended. Each little change in the administration engendered a multitude of others, so that the modest attempts at reform were found to be like the letting out of water. A tiny rill gradually became a boisterous stream, and the bois- terous stream

grew into a great river, which spread to -all sections of the administration and ended by inundating the whole country.

Of the numerous questions awaiting solution, the first to claim immediatei attention was that of the Sudan. The British Government had begun by excluding it quesfitm." f'™ tli6 problem, and by declaring that for events in these outlying territories it must not be held responsible. In that sphere of activity, therefore, the Egyptian Government might do as it thought fit. The principle of limited liability which this attitude assumed was soon found to be utterly untenable. The Sudan was an integral part of the Khedive's dominions and caused, even in ordinary times, a deficit of £200,000 to the Egyptian Treasury. At that moment it was in a state of open rebellion, stirred up by a religious fanatic who proclaimed himself a Mahdi or Messias of Islam. An army of 10,000 men under an English general. Hicks Pasha, had been sent to suppress the revolt, and had been annihilated in a great battle fought on 5th Novem- ber 1883, near Obeid. The Egyptian Government wished to make a new attempt to recover the lost province, and the idea was certainly very popular among the gov- erning class, but Sir Evelyn Baring vetoed the project on the ground that Egypt had neither soldiers nor money to carry it out. In vain the Khedive and his Prime Minister, Sherif Pasha, threatened to resign, and the latter actually carried out his threat. The British representative remained firm, and it was decided that the Sudan should be, for the moment at least, aban- doned to its fate. Nubar, though as strongly opposed to the abandonment policy as Sherif, consented to take his place and accepted somewhat reluctantly the new regime, which he defined as " the administration of Egypt under the government of Baring." By this time the Mahdi was master of the greater part of the Sudan, but Khartum and some other fortified points still held out. The efforts made to extricate the garrisons, in- cluding .the mission of General Gordon, the fall of Khartum, and the Kile Expedition under Lord Wolseley

are described below, in the account given of military operations. The practical result was that the Khedive's authority was limited to the Nile Valley north of Wadi Haifa.

With the internal diflculties Sir Evelyn Baring had been struggling bravely ever since his appointment, try- ing to evolve out of the ever-changing policy and contradictory orders of the British Gov- loteraai ernment some sort of coherent line of action, i^t&a!' and to raise the administration to a higher standard. Eor two or three years it seemed doubtful whether he would succeed. All over Egypt there was a feeling of unrest, and the well-meant but not very suc- cessful efforts of the British to improve the state of things were making them very unpopular. The intro- duction of English officials and English influence into all the administrative departments was resented by the native officials, and the action of the irrigation officers in preventing the customary abuses of the distribution of water was resented by the great landowners, who had been, from time immemorial, in the habit of taking as much as they wanted, to the detriment of the fella- heen. Even these latter, who gained most by the re- forms, considered that they had good reason to complain, for the defeat of Arabi and the re-establishment of order had enabled the Christian money-lenders to return and insist on the payment of claims, which were supposed to have been extinguished by the rebellion. Worst of all, the Government was drifting rapidly towards insolvency, being quite unable to fulfil its obligations to the bond- holders and meet the expenses of administration. All departments were being starved, and even the salaries of poorly paid ofBcials were in arrear. To free itself from its financial difficulties the Government adopted a heroic remedy which only created fresh troubles. On the advice of Lord Northbrook, who was sent out to Cairo in Sep tember 1884 to examine the financial situation, certain revenues which should have been paid into the Caisse for the benefit of the bondholders were paid into the Treasury for the ordinary needs of the administration. Immediately the Powers protested against this infraction of the law of liquidation, and the Caisse applied for a writ to the Mixed Tribunals. In this way the heroic remedy failed, and to the internal difficulties were added international complications.

Fortunately for Egypt, the British Government con- trived to solve the international difficulty by timely con- cessions to the Powers, and succeeded in negotiating the London Convention of March 1885, by which the Egyp- tian Government was relieved from some of the most onerous stipulations of the Law of Liquidation, and was enabled to raise a loan of £9,000,000 for an annual pay- ment of £135,000. After paying out of the

capital the sums required for the indemnities due for the burning of Alexandria and the deficits of the years 1882 and 1883, it still had a million sterling, and boldly invested it in the improvement of irrigation. The investment proved most remunerative, and helped very materially to save the country from bankruptcy and internationalism. The danger of being again subjected to the evils of an inter- national administration was very great, for the London Convention contained a stipulation to the effect that if Egypt could not pay her way at the end of two years, another International Commission would be appointed.

To obviate this catastrophe the British reformers set to work most energetically. Already something in the way of retrenchment and reform had been accomplished. The public accounts had been put in order, and the abuses in the collection of the land tax removed. The constant drain of money and men for the Sudan had been stopped. A beginning had been made for creating a new army to

replace the one that had been disbanded and to allow of a portion of the British garrison being withdrawn. In this work Sir Evelyn Wood had shown much sound judgment as well as great capacity for military organiza- tion, and had formed an efficient force out of very unpromising material (see above, under Akmy). His colleague in the Department of Public Works, Sir Colin Scott Moncrieff, had been not less active. By mitigating the hardships of the corvie, and improving the irrigation system, on which the prosperity of the country mainly depends, he had conferred enormous benefits on the fella- heen, and had laid the foundation of permanent budgetary equilibrium for the future. Not less active was Sir Edgar Vincent, the Financial Adviser, who kept a firm hold on the purse-strings and ruthlessly cut down expenditure in all departments except that of irrigation.

The activity of the British officials naturally produced a certain amount of discontent and resistance on the part of their Egyptian colleagues, and Lord Granville be^eea^ was obliged to declare very plainly that such re- British sistance could not be tolerated. Writing (Janu- offLa/s™ ^^y ^^^^) *° ^" Evelyn Baring, he said: "It should be made clear to the Egyptian Ministers and Governors of Provinces that the responsibility which for the time rests on England obliges H.M. Government to insist on the adoption of the policy which they recom- mend ; and that it will be necessary that those Ministers and Governors who do not follow this course should cease to hold their offices." Nubar Pasha, who continued to be Prime Minister, resisted occasionally. What he chiefly objected to was direct interference in the provincial ad- ministration and the native tribunals, and he succeeded for a time in preventing such interference. Sir Benson Maxwell and Mr Clifford Lloyd, who had been sent out to reform the Departments of Justice and the Interior, after coming into conflict with each other were both re- called, and the reforming activity was for a time restricted to the Departments of War, Public Works, and Finance. Gradually the tension between natives and foreigners re- laxed, and mutual confidence was established. Experience had evolved the working principle which was officially formulated at a much later period : " Our task is not to rule the Egyptians, but as far as possible to teach the Egyptians to rule themselves. . . . European initiative suggests measures to be executed by Egyptian agency, while European supervision controls the manner in which they are executed." If that principle had been firmly laid down and clearly understood at the beginning, a good deal of needless friction would have been avoided.

The international difficulty remained. The British position in Egypt was anomalous, and might easily give rise to international complications. The Sultan ' "if / might well protest against the military occupa problems, tioi^ of a portion of his Empire by foreign troops. It was no secret that France was ready to give him diplomatic support, and other Pow- ers might adopt a similar attitude. Besides this, the British Government was anxious to terminate the occu- pation as soon as possible. With a view to regularizing the situation and accelerating the evacuation. Sir Henry Drummond Wolff was sent to Constantinople in August 1886 on a special mission. On 24th October of that year he concluded a preliminary Convention by which an Ottoman and an English High Commissioner, acting in concert with the Khedive, should

reorganize the Egyp- tian army, tranquillize the Sudan by Pacific means, and consider what changes might be necessary in the civil administration. When the two Commissioners were as- sured of the security of the frontier and the good working and stability of the Egyptian Government, they should present reports to their respective Governments, and these

should consult as to the conclusion of a Convention regu- lating the withdrawal of the English troops. Mukhtar Pasha and Sir Henry Drummond Wolff were appointed Commissioners, and their joint inquiry lasted till the end of 1886, when the former presented his report and the latter went home to report orally. The remaining stipu- lations of the preliminary Convention were duly carried out. Sir Henry Drummond Wolff proceeded to Constan- tinople and signed on 22nd May 1887 the definitive Convention, according to which the occupation should come to an end in three years, but England should have a right to prolong or renew it in the event of internal peace or external security being seriously threatened. The Sultan authorized the signature of this Convention, but under pressure of France and Russia he refused to ratify it. Technically, therefore, the preliminary Con- vention still remains in force, and in reality the Ottoman Commissioner continues to reside in Cairo.

The steadily increasing prosperity of the country dur- ing the years 1886 and 1887 removed the danger of national bankruptcy and international inter- ference, and induced Sir Evelyn Baring to J%*^ widen the area of administrative reforms. In the provinces the local administration and the methods of dispensing justice were still scandalously unsatisfac- tory, and this was the field to which the British repre- sentative next directed his efforts. Here he met with unexpected opposition on the part of the Prime Minister, Nubar Pasha, and a conflict ensued which ended in Nubar's retirement in June 1888. Riaz Pasha took his place, and remained in office till May 1891. During these three years the work of reform and the prosperity of the country made great progress. The new Egyptian army was so far improved that it gained successes over the forces of the Mahdi; the burden of the national debt was lightened by a successful conversion ; the con;ie was abolished; the land tax was reduced 30 per cent, in the poorest provinces, and in spite of this and other measures for lightening the public burdens, the budgetary surplus constantly increased; the quasi-judicial

Special Commis- sions for Brigandage, which were at once barbarous and inefficient, were abolished; the native tribunals were improved, and Mr (afterwards Sir John) Scott, an Indian judge of great experience and sound judgment, was appointed judicial adviser to the Khedive. This appoint- ment was opposed by Riaz Pasha, and led to his resigna^ tion on the plea of ill-health. HIs successor, Mustafa Pasha Fehmi, continued the work and co- operated cor- dially with the English officials. The very necessary reform of the native tribunals was then taken seriously in hand. The existing procedure was simplified and accelerated; the working of the Courts was greatly improved by a carefully organized system of inspection and control ; the incompetent judges were eliminated and replaced by men of better education and higher moral character; and for the future supply of well- qualified judges, barristers, and law officials, an excellent school of law was established. If the progress made in this direction is maintained, the Native Courts may some day, under proper European control, replace the anomalous Mixed Tribunals, and remove all necessity for the incon- venient consular jurisdictions, which are at present pro- tected by the Capitulations. Meanwhile the reforming activity has been extended to Prisons, Public HIealth, and Education, and has attained very satisfactory results without ruffling the religious susceptibilities of the people.

Only once since the retirement of Riaz has the policy of teaching the Egyptians to rule themselves led to friction with the native authorities. In January 1892 the Khedive Tewfik, who had always maintained cordial rela^- tions with Sir Evelyn Baring, died suddenly, and was

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succeeded by his son, Abbas HIilmi, a young man without political experience, who failed at first to understand the

peculiar situation in which a Khedive ruling oMfttesf iiiider British protection is necessarily placed.

Aspiring to liberate himself at once from foreign control, he summarily dismissed Mustafa Pasha Fehmi, whom he considered too amenable to English influence, and appointed in his place Fakhri Pasha, who was not a persona grata at the British Agency. Such an incident, which might have constituted a precedent for more im- portant acts of a similar kind, could hardly be over- looked by the British representative. He had always maintained that what Egypt most required, and would require for many years to come, was an order of things which would render practically impossible any return to that personal system of government which had well-nigh ruined the country. The young Khedive was made, therefore, to understand that he must not make such changes in the administration without a previous agree- ment with the representative of the protecting Power ; and a compromise was efEected by which Fakhri Pasha retired, and the post of Premier was confided once more to Eiaz. With this compromise the friction between the Khedive and Sir Evelyn Baring, who had now become Lord Cromer, did not end. For some time Abbas Hilmi clung to his idea of liberating himself from all control, and secretly encouraged a nationalist and anti-British agi- tation in the native press ; but he gradually came to perceive the folly, as well as the danger to himself, of such a course, and accordingly refrained from giving any occasion for complaint or protest. In like manner the relations between the British officials and their Egyp- tian colleagues gradually became more cordial, so that it was found possible at last to reform the local admin- istration in the provinces according to the recommenda- tions of Mr J. L. Grorst, who had been appointed adviser to the Ministry of the Interior. Nubar Pasha, it is true, who succeeded Eiaz as Prime Minister in April 1894, objected to some of Mr Gorst's recommendations, and in November 1895 resigned. He was succeeded by Mustafa Fehmi, who had always shown a conciliatory spirit, and who had been on that account, as above stated, sum- marily dismissed by the Khedive in January 1893. After his reinstatement the Anglo-Egyptian condominium worked without serious friction, and there is reason to believe that it will continue so to work in the future as long as England remains true to her mission and shows no signs of hesitation in carrying it out. In the Report by His Majesty's Agent and Consul-General on the finances, administration, and condition of Egypt presented to Parliament in 1901, Lord Cromer concluded by express- ing his belief " that His Highness the Khedive's recent visit to England (in 1900), coupled with the very remark-

able and touching sympathy displayed by every class of society in this country (Egypt) on the occasion of the death of Queen Victoria, will serve to cement more closely the bonds of friendship and goodwill which, now perhaps more than at any previous period, unite my own coun- trymen and the Egyptians."

The success of the Anglo-Egyptian condominium, and the consequent economic and financial prosperity of Egypt

Proper, rendered it possible to recover from the Pasboda. jytajj^ists the Sudanese provinces (see below. Military Operations in the Sudan), and to delimit in that part of Africa, in accordance with Anglo-Egyptian inter- ests, the respective spheres of influence of Great Britain and France. The arrangement was not effected without serious danger of a European conflict. Taking advan- tage of the temporary weakness of Egypt, the French Government formed the project of seizing the Upper Nile Valley and uniting her possessions in West Africa

with those at the entrance to the Red Sea. With this object a small force under Major Marchand was sent from the French Congo into the Bahr-el-Ghazal, with orders to occupy Fashoda on the Nile ; whilst a Franco-Abyssinian Expedition was despatched from the eastward, to join hands with Major Marchand. The small force from the French Congo reached its destination, and a body of Abyssinian troops, accompanied by French officers, ap- peared for a short time a little higher up the river ; but the grand political scheme was frustrated by the victorious advance of an Anglo-Egyptian force under General Kitcliener and the resolute attitude of the British Govern- ment. Major Marchand had to retire from Fashoda, and as a concession to French susceptibilities he was allowed to retreat by the Abyssinian route. By an agreement signed by Lord Salisbury and the French Ambassador on 21st March 1899, and appended as Art. IV, to the Anglo-French Convention of 14th June 1898, which dealt with the British and French spheres of influence in the region of the Niger, France was excluded from the basin of the Nile, and a line marking the respective spheres of influence of the two countries was drawn on the map from the northern frontier of the Congo Free State to the southern frontier of the Turkish province of Tripoli (see Africa: History).

The administration of the Sudan was organized on the basis of an agreement between the British and Egyptian Governments signed on 19th January 1899. . According to that agreement the British and Aagio-Egyptian flags are used together, and the Egyptian supreme military and civil command is vested ■S"'"- in a Governor-General, who is appointed by the Khedive on the recommendation of the British Government, and who cannot be removed without the British Government's consent. So far the arrangement has worked well. The Governor-General, Sir Reginald Wingate, in his report dated Khartum, 30th January 1901, after giving an ac- count of the progress made, says : " I cannot close this report without recording my appreciation of the manner in which officers, non-commissioned officers, soldiers, and offi- cials— British, Egyptian, and Sudanese, without distinc- tion— have laboured during the past year to push on the work of regenerating the country. Nor can I pass over without mention the loyal and valuable assistance I have received from many of the local Ulemas, Sheikhs, and Not- ables, who have displayed a most genuine desire to see their country once more advancing in the paths of progress and material and moral improvement." (d. m. w.)*

British Military Operations of 1882-1885.

In February 1879 a slight outbreak of discharged offi- cers and soldiers occurred at Cairo, which led to the des- patch of British and French ships to Alexandria. On 26th June of that year Ismail Pasha was removed from Egypt, and Tewfik assumed the Khediviate, becoming practically the protegi of the two Western Powers. On 1st February 1881 a more serious disturbance arose at Cairo from the attempt to try three colonels, Ahmed Arabi, Ali Fehmy, and Abd-el-Al, who had been arrested as the ringleaders of the military party. The prisoners were released by force, and proceeded to dictate terms to the Khedive. Again British and French warships were despatched to Alexandria, and were quickly withdrawn, their presence having produced no apparent impression. It soon became clear that the Khedive was powerless, and that the military party, headed by Arabi, threatened to dominate the country. The "dual note," communicated to the Khedive on 6th January 1881, contained an intima^ tion that Great Britain and France were prepared to afford material support if necessary; but the fall of Gambetta's Ministry produced a reaction, and both Governments

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proceeded to minimize the meaniug of their language. The Khedive was practically compelled to form a govern- ment in which Arabi was Minister of War and Mahmoud Sami Premier, and Arabi took steps to extend his rniluence throughout his army. The situation now be- came critically serious : for the third time ships were sent to Alexandria, and on 26th May 1882 the Consuls- General of the two Powers made a strong representa- tion to Mahmoud Sami which produced the resignation of the Egyptian Ministry, and a demand, to which the Khedive yielded, by the military party for the reinstate- ment of Arabi. The attitude of the troops in Alexandria now became threatening ; and on the 29th the British residents pointed out that they were " absolutely defence- less." This warning was amply justified by the massacres of 11th June, during which more than one hundred per- sons, including an officer and two seamen, were killed in Bombard- *^® streets of Alexandria, almost under the guns meat of of the s'hips in harbour. It was becoming clear Aiexaa- that definite action would have to be taken, and " "'^ on the 15th the Channel Squadron was ordered

to Malta. By the end of June twenty-six warships, rep- resenting the navies of Great Britain, France, Germany, Italy, Austria, Russia, the United States, Spain, Greece, and Turkey, lay off the port of Alexandria, and large numbers of refugees were embarked. The order received by Admiral Sir Beauchamp Seymour on 3rd July was as follows :—

Prevent any attempt to bar channel into port. If work is resumed on earthworks, or fresh guns mounted, inform Military Commander that you have orders to prevent it ; and if not imme- diately discontinued, destroy earthworks and silence batteries if they open fire, having given sufficient notice to population, ship- ping, and foreign men-of-war.

On the 9th the Admiral received a report that working parties had been seen in Fort Silsileh " pa,rbuckling two smoothbore guns — apparently 32- pounders — towards their respective carriages and slides, which were

facing in the direction of the harbour." Fort Silsileh was an old work at the extreme east of the defences of Alexandria, and its guns do not bear on the harbour. On the 10th an ultimatum was sent to Toulba Pasha, the Military Commandant, intimating that the bombardment would commence at sunrise on the following morning unless "the batteries on the isthmus of Ras-el-Tin and the southern shore of the harbour of Alexandria " were previously surrendered " for the purpose of disarming." The fleet prepared for action, and the bearer of the reply, signed by the President of the Council, and offering to dismount three guns in the batteries named, only suc- ceeded in finding the flagship late at night. This proposal was rejected, and at 7 a.m. on 11th July the Alexandra opened fire and the action became general. The attacking force was disposed in three groups : (1) the jilexandra, Sultan, and Superb, outside the reef, to engage the Ras-el-Tin and the earthworks under weigh ; (2) the Monarch, Invincible, and Penelope, inside the harbour, to engage the Meks batteries; and (3) the Inflexible and Temeraire, to take up assigned stations outside the reef and to co-operate with the inshore squadron. The gun- boats Beacon, Bittern, Condor, Cygnet, and Decoy were to keep out of fire at first and seek opportunities of engaging the Meks batteries. Meks fort was silenced by about 12.45 p.m., and a party from the Invincible landed and disabled the guns. As the fire delivered uuder weigh was not effective, the offshore squadron anchored at about 10.30 a.m., and succeeded in silencing Fort Eas-el-Tin at about 12.30 p.m., and Fort Adda, by the explosion of the main magazine, at 1.35 p.m. The Inflexible weighed soon after 8 a.m. and engaged E.as-el-Tin, afterwards attacking Forts Pharos and Adda. The Condor, followed by the Beacon, Bittern, and Decoy, engaged Fort Marabout soon

after 8 a.m. till 11 a.m., when the gunboats were recalled. After the works were silenced, the ships moved in closer, with a view to dismount the Egyptian guns. The bom- bardment ceased at 5 p.m. ; but a few rounds were fired by the Inflexible and Temeraire on the morning of the 12th at the right battery in Eas-el-Tin lines.

The bombardment of the forts of Alexandria is interesting as a gauge of the effect to be expected from the fire of ships under specially favourable conditions. The Egyptians at different times during the day brought into action about 33 R.M.L. guns (7-inch to 10-inch), 3 R.B.L. guns (40 prs.),

and 120 S.B. guns (6-5-inch and 10-inch), with a few mortars. These guns were disposed over a coast-line of about 10 sea miles, and were in many cases indif- ferently mounted. The Egyptian gunners had been little trained, and many of them had never once practised with rifled ordnance. Of seventy -five hits on the hulls of the ships only five can with certainty be ascribed to projectiles from riJSed guns, and thirty were unquestionably due to the old smooth-bores, which were not provided with sights. The total loss inflicted was 6 killed and 27 wounded. The British ships engaged fired 1741 heavy projectiles (7-inch to 16-inch) and 1457 light (7-prs. to 64-prs.), together with 33,493 machine-gun and rifle bullets. The result was compara- tively small. About 8 rifled guiLS and 19 smoothbores were dis-mounted or disabled and 4 and 1 temporarily put out of action respectively. A considerable portion of this injury was Inflicted, after the works had been silenced, by the deliberate fire of the ships. As many as twenty-eight rifled guns and 140 smoothbores would have opened fire on the following day. The Egyptians made quite as good a stand as could be expected, but were driven from their guns, which they were unable to use with adequate effect ; and the bombardment of Alexandria confirms previous experience, that the fire of ships cannot really compete with that of well-mounted and well-handled guns on shore.

In the afternoon of the 12th, fires, which were the work of -incendiaries, began to break out in the best quarters of Alexandria ; and the town was left to murder and pillage till the following day, when a party of bluejackets and marines was landed at about 3 p.m.

Military intervention being now imperatively demanded, a vote of credit for £2,300,000 was passed in the British House of Commons on 27th July. Five days later the French Government failed to secure a similar vote, and Great Britain was left to deal with the Egyptian question alone. An expeditionary force detailed from home stations and from Malta was organized in two divisions, with a cavalry division, corps troops, and a siege train, numbering in aU about 25,000 men. expedition An Indian contingent numbering about 7000 under sir combatants, complete in all arms and with its ^'f', own transport, was prepared for despatch to "*«*•>'• Suez. General Sir Garnet Wolseley was appointed Com- mander-in-Chief, with Lieut.-General Sir J. Adye as Chief of the Staff. The plan of operations*

contemplated the seizure of Ismailia as the base for an advance on Cairo, Alexandria and its suburbs to be held defensively, and the Egyptian forces in the neighbourhood to be occupied by demonstrations. The expeditionary force having rendezvoused at Alexandria, means were taken by Eear-Admiral Hoskins and Sir W. Hewett for the seizure of the Suez Canal. Under orders from the former, Captain Fairfax, E.N., occupied Port Said on the night of 19th August, and Commander Edwards, E.N., proceeded down the Canal, taking possession of the gares and dredgers, while Captain Fitzroy, E.N., occupied Ismailia after slight opposition. Before nightfall on 20th August the Canal was wholly in British hands. Meanwhile, leaving Sir E. Hamley in command at Alexandria, Sir G. Wolseley with the bulk of the expeditionary force arrived at Port Said on 20th August, a naval demonstration having been made at Abukir with a view to deceive the enemy as to the object of the great movement in progress. The advance from Ismailia now began. On the 21st Major-General Graham moved from Ismailia with about 800 men and a small naval force, occupying Nefiche, the junction, with the Suez line, at 1.30 a.m. without opposition. On the

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22nd he made a reconnaissance towards Suez, and on the 23rd another to El-Magfar, 4 miles from Nefiche. It now appeared that the enemy had dammed the sweet- water canal and blocked the railway at Tel-el-Mahuta, where entrenchments had been thrown up and resistance seemed to be contemplated. At 4 a.m. on the 24th Sir Garnet Wolseley advanced with 3 squadrons of cavalry, 2 guns, and about 1000 infantry, placed under the orders of Lieutenant-General Willis. The enemy showed in force, estimated at 7000 with 12 guns, and a somewhat desultory action ensued. Reinforcements from Ismailia were ordered up, and the British cavalry, operating on the right, helped to check the enemy's attack, which showed little vigour. At night the troops, now reinforced by the Guards Brigade, an infantry battalion, 2 cavalry regi ments, and 10 guns, bivouacked on the ground. Early on the morning of the 25th the advance was continued to Tel-el-Mahuta, which the enemy evacuated, while the mounted troops and horse

artillery pressed on to Mahsameh, capturing the Egyptian camp, with 7 guns and large quantities of ammunition and supplies. On the same evening Major-General Graham, with about 1200 marines (artillery and light infantry), reached Mahsameh, and on the following day he occupied Kassassin without opposition. The advance guard had now outrun its communications and was actually short of food, while a considerable force was distributed at intervals along the line Ismailia-Kassassin. The situation on the 27th tempted attack by an enterprising enemy, and Major- General Graham's force, consisting of a squadron of the 19th Hussars, the York and Lancaster Eegiment, the Duke of Cornwall's Light Infantry, the Marine Artillery Battalion and two E.H.A. guns, short of am- munition, was in danger of being overwhelmed by vastly superior numbers from Tel-el-Kebir. On the 28th Major-General Graham's troops were attacked, and after repulsing the enemy, made a general advance about 6.45 p.m. The cavalry, summoned by heliograph from Mahsameh, co-operated, and in a moonlight charge in- flicted considerable loss. The British casualties amounted to 14 killed and 83 wounded. During the lull which followed the first action of Kassassin, strenuous efforts were made to bring up supplies and troops and to open up railway communication to the front. On 9th Sep- tember the Egyptians again attacked Kassassin, but were completely repulsed by 9 a.m., with a loss of 4 guns, and were pursued to within extreme range of the guns of Tel-el-Kebir. The British casualties were 3 killed and 78 wounded. The three following days were occupied in concentrating troops at Kassassin for the attack on Tel-el-Kebir, held by about 38,000 men with 60 guns. The Egyptian defences consisted of a long line of trench (2|- miles) approxi- mately at right angles to the railway and the sweet- water canal. At 11 p.m. on 12th September the advance of about 15,000 men conimenced : the 1st Division, under Lieutenant-General Willis, was on the right, and the 2nd Division, under Lieutenant-General Hamley, was on the left. Seven batteries of artillery, under Brigadier-General Goodenough, were placed in the centre. The cavalry, under Major-General Drury Lowe, was on the right flank, and the Indian contingent, under Major-General Macpherson, starting one hour later, was ordered to move south of the sweet-water canal. The night was moonless, and the distance to be covered about 6\ miles. The ground was perfectly open, slightly undulating, and generally firm gravel. The conditions for a night march were thus ideal ; but during the movement the wings closed towards each other, causing great risk of an out- break of

~~firing. The line was, however, rectified, and after a halt the final advance began. By a fortunate~~

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~~accident the isolated outwork was just missed in the darkness by the left flank of the 2nd Division ; otherwise a premature alarm would have been given, which must have changed all the conditions of the operation. At dawn the Highland Brigade of the 2nd Division struck the enemy's trenches, and carried them after a brief struggle. The 1st Division attacked a few minutes later, and the cavalry swept round the left of the line of entrenchments, cutting down any fugitives who attempted resistance and reaching the enemy's camp in rear. ■ The Indian contingent, on the south of the canal, co-operated, intercepting the Egyptians at the canal bridge. The opposition encountered at some points was severe, but by 6 a.m. all resistance was at an end. The British loss amounted to 58 killed, 379 wounded, and 22 missing ; nearly 2000]5gyptians were killed, and more than 500 wounded were treated in hospital. An immediate pursuit was ordered, and the Indian contingent, under Major- General Macpherson, reached Zagazig, while the cavalry, under Major-General Drury Lowe, occupied Belbeis and pushed on to Cairo, 65 miles from Tel-el-Kebir, next day. On the evening of the 14th the 10,000 troops occupying Abassiyeh Barracks, and 5000 in the Citadel of Cairo, surrendered. On the 15th General Sir Garnet Wolseley, with the Brigade of Guards under H.E.H. the Duke of Connaught, entered the city.~~

~~The prompt following up of the victory at Tel-el-Kebir saved Cairo from the fate of Alexandria. and brought the rebellion to an end. The Egyptian troops at Kaf r Dauar, Abukir, and Eosetta surrendered without opposition, and those at Damietta followed on 23rd September, after being threatened with attack. On the 25th the Khedive entered Cairo, where a review of the British troops was held on the 30th. The expeditionary force was now broken up, leaving about 10,000 men, under Major-General Sir A. Alison, to maintain the authority of the Khedive. In twenty-five days, from the landing at Ismailia to the occupation of Cairo, the rebellion was completely sup-pressed, and the operations were thus signally successful.~~

The authority of the Khedive and the maintenance of law and order now depended absolutely on the British forces left in occupation. Lord Dufferin, who had been sent to Cairo to draw up a project of constitutional reforms, advocated the re-establishment of a native army, not to exceed 5000 to 6000 men, with a proportion of British offtcers, for purely defence purposes within the Delta; and on 13th December 1882 Sir Evelyn Wood left England to undertake the organization of this force, with the title of Sirdar. Lord Dufferin further advised the formation of a gendarmerie, which " should be in a great measure a mounted force and empowered with a semi-military character" (despatch of 1st Jan- uary 1883). The strength of this military police ™es«on?" force was fixed at 4400 men with 2562 horses, and Baker Pasha was entrusted with its formation, with the title of Inspector-General. In a despatch of 6th February 1883 Lord Dufferin dealt with the Sudan, and stated that Egypt " could hardly be expected to acquiesce" in a policy of withdrawal from her Southern territories. At the same time he pointed out that,

Unhappily, Egyptian administration in the Sudan had heen almost uniformly unfortunate. The success of the present Mahdi in raising the tribes and extending his influence over great tracts of country was a sufficient proof of the Government's inability either to reconcile the inhabitants to its rule or to maintain order. The consequences had been most disastrous. Within the last year and a half the Egyptians had lost something like 9000 men, while it was estimated that 40,000 of their opponents had perished.

Moreover, to restore tranquillity in the Sudan,

the first step necessary was the construction of a railway from Suakin to Berber, or, what, perhaps, would be more advisable, to

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Shendi, on the Nile. The completion of this enterprise would at once change all the elements of the problem.

The immense responsibilities involved were most imper- fectly understood by the British Government. Egyptian sovereignty in the Sudan dates from 1819, when Mehemet Ali sent a large force into the country, and ultimately es- tablished his authority over Sennar and Kordofan. In 1866 Suakin and

Massawa were assigned to Egyptian rule by the Sultan, and in 1870 Sir Samuel Baker pro- ceeded up the Nile to the conquest of the Equatorial Provinces, of which* General Gordon was appointed Gov- ernor-General in 1874. In 1875 Darfur and Harrar were annexed, and in 1877 Gordon became Governor- General of the Sudan, where, with the valuable assist- ance of Jessi Pasha, he laboured to destroy the slave trade and to establish just government. In August 1879 he returned to Cairo, and was succeeded by Eaouf Pasha. Misrule and oppression in every form now again pre- vailed throughout the Sudan, while the slave traders, exasperated by Gor- don's stern measures, were ready to re- volt. The authority of Egypt was rep- resented by scattered garrisons of armed men, badly officered, undisciplined, and largely demoralized. In such conditions a leader only was required to ensure widespread and dan- . gerous rebellion. A leader appeared in the person of Mahom- med Ahmed, born in 1848, who had taken up his abode on Abba Island, and, ac- quiring great reputa- tion for sanctity, had actively fomented in- surrection. In Aug- ust 1881 a small force sent by Kaouf Pasha to arrest Mahommed Ahmed was destroyed, and the latter, proclaim- ing himself the Mahdi, stood forth as the champion of revolt. Thus at the time when the Egyptian army was broken up at Tel-el-Kebir, the Sudan was already in flames. On 7th June 1882, 6000 men under Yusef Pasha, advancing from Eashoda, were nearly annihilated by the Mahdists. Payara and Birket in Kordofan quickly fell, and a few days before the battle of Tel-el-Kebir was fought, the Mahdi, with a large force, was besieging El Obeid. By the close of the year almost the whole of the Sudan south of Khartum was in open rebellion, except the Bahr-el-Ghazal and the Equatorial Provinces, where for a time Lupton Bey and Emin Pasha were able to hold their own. Abd-el-Kader, who had succeeded Eaouf, telegraphed to Cairo for 10,000 additional troops, and pointed out that if they were not sent at once four times this number would be required to re- establish the authority of the Government in the Sudan. After gaining some small successes, Abd-el- Kader was superseded by Suliman Niagi on 20th Feb- ruary 1883, and on 26th March Ala-ed-din Pasha was

appointed Governor-General. Meanwhile 5000 men, who had served in the Egyptian army, were collected and forcibly despatched to Khartum vid Suakin. In March 1883 Major-General Hicks, who in January had been appointed by the Khedive Chief of the Staff of the army of the Sudan, found

himself fj^^^*" at Khartum with nine European officers and Hicksf" about 10,000 troops of little military value. The reconquest of the Sudan having been determined upon, although Sir E. Malet reported that the Egyptian Government could not supply the necessary funds and that there was great risk of failure, General Hicks, who had resigned his post on 23rd July, and had been appointed Commander-in-Chief, started from Khar- tum on 9th September, with a total force of about 10,000 men, including non-combatants, for Kordofan. On 22nd May Sir E. Malet had informed Sherif Pasha that,

although General Hicks finds it convenient to communicate with

Lord Dufferin or with it must not be sup-

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posed that we endorse in any way the con- tents of his telegrams. . . . Her Majesty's Government are in no way responsible for his operations in the Sudan, which have been under- taken under the author- ity of His Highness's Government.

Walker & CockereU sc.

General Hicks was fully aware of the unfitness of his rabble forces for the contemplated task, and on 5th August he telegraphed: "I am convinced it would be best to keep the two rivers and province of Sennar, and wait for Kordofan to settle itself." Early in November the force from Khartum was caught by the Mahdists short of water at Kashgil, near El Obeid, and was almost totally destroyed. General Hicks, with all his European officers, perishing. Sinister rumours having reached Cairo, Sir E. Baring, who had succeeded Sir E. Malet, telegraphed that " if General Hicks's army is destroyed, the Egyptian Government will lose the whole of the Sudan, unless some assistance from the outside is given," and advised the withdrawal to some post on the Nile. On the following day Lord Granville replied : " We cannot lend English or Indian troops ; if consulted, recommend abandonment of the Sudan within certain limits " ; and on the 25th he added that "Her Majesty's Government can do nothing in the matter which would throw upon them the responsibilities for operations in the Sudan." In a despatch of 3rd December Sir E. Baring forcibly argued against British intervention in the affairs of the Sudan, and on 13th December Lord Granville telegraphed that " Her Majesty's Government recommend the Ministers of Khedive to come to an early decision to abandon all territory south of Assuan, or, at least, of Wadi Haifa." On 4th January 1884 Sir E. Baring was directed to insist upon the policy

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of evacuation, and on the ISth. General Gordon left London to. assist in its execution.

The year 1883 brought a great accession of power to the Mahdi, who had captured about 20,000 rifles, 19 guns, and large stores of ammunition. On the Red Sea littoral Osman Digna, a slave dealer of Suakin, appointed Emir of the Eastern Sudan, raised the local tribes and invested Sinkat and Tokar. On 16th October and 4th November Egyptian reinforcements intended for the former place were destroyed, and on 2nd December a force of 700 men was annihilated near Tamanieb. On 23rd December General Baker,

followed by about 2500 men, gendarmerie, blacks, Sudanese, and Turks, with 10 British officers, arrived at Suakin to prepare for the relief of Sinkat and Tokar. The Khedive appears to

have been aware of the risks to be incurred, Defeat of a^jj jq a private letter he informed the general Bake"' *^^^ "■'■ ^^^J ^^poii jonv prudence and ability

not to engage the enemy except under the most favourable circumstances." The tragedy of Kashgil was repeated on 4th February 1884, when General Baker's heterogeneous force, on the march from Trinkitat to Tokarj was routed at El Teb by an inferior body of tribesmen. Of 3715 men, 2375, with 11 European officers, were killed. Suakin was now in danger, and on 6th February British bluejackets and marines were landed for the defence of the town.

Two expeditions in the Sudan led by British officers having thus ended in disaster, and General Gordon with Lieutenant-Colonel Stewart having reached Khartum on 18th February, the policy of British non-intervention in regard to Sudan affairs could no longer be maintained. Public opinion in England was strongly impressed by the fact that the Egyptian garrisons of Tokar and Sinkat were perishing within striking distance of the Red Sea littoral. A British force about 4400 strong, with 22 guns, made up of troops from Egypt and from units detained on passage from India, was rapidly concentrated at Suakin and placed

under the orders of Major-General Sir G.Graham, expedition with Major-Generals Sir E,. Buller and J. Davis uader as Brigadiers. News of the fall of Sinkat, where o'^' • *^® starving garrison, under Tewfik Bey, made battie^Jt a gallant sortie and was cut to pieces, reached Bi Teb and Suakin on 12th February. On the 24th General Tamaaieb. Graham's force disembarked at Trinkitat and received information of the surrender of Tokar. At 8 a.m. on the 29th the force advanced towards Tokar in square, and came under fire at 11.20 a.m. from the enemy entrenched at El Teb. The tribesmen made desperate efforts to rush the square, but were repulsed, and the position was taken by 2 p.m. The cavalry, 10th and 19th Hussars, under Brigadier- General H. Stewart, became involved in a charge against an unbroken enemy, and suffered somewhat severely. The total British loss was

34 kiUed and 165 wounded; that of the tribes- men was estimated at 1500 killed. On the following day Tokar was reached, and on 2nd March the force began its return to Suakin, bringing away about 700 people belonging to the late garrison and the civil popula- tion, and destroying 1250 rifles and a quantity of ammuni- tion found in a neighbouring village. On 9th March the whole force was back at Suakin, and on the evening oi the 11th an advance to Tamai began, and the force bivouacked and formed a zeriba in the evening. Information was brought by a native that the enemy had assembled m the Khor Ghob, a deep ravine not far from the zeriba At about 8.30 a.m. on the 13th the advance began m echelon of brigade squares from the left. The left and leading squarl (2nd Brigade) moved towards the Khor, approach- in- at a point where a little ravine joined it. The enemy showing in front, the leading face of the square was

ordered to charge up to the edge of the Khor. This opened the square, and a mass of tribesmen rushed in from the small ravine. The brigade was forced back in dis- order, and the naval guns, which had been left behind, were temporarily captured. After a severe hand-to-hand struggle, in which the troops behaved with great gallantry, order was restored and the enemy repulsed, with the aid of the fire from the 1st Brigade square and from dismounted cavalry. The 1st Brigade square, having a sufficient field of fire, easily repelled all attempts to attack, and advancing as soon as the situation had been restored, occupied the village of Tamai. The British loss was 109 killed and 104 wounded; of the enemy nearly 2000 were killed. On the following day the force returned to Suakin.

Two heavy blows had now been inflicted on the followers of Osman Digna, and the road to Berber could have been opened, as General Graham and Colonel H. Stewart suggested. General Gordon, questioned on the point, telegraphed from Khartum, on 7th March, that he might be cut off by a rising at Shendi, adding, " I think it, therefore, most important to follow up the success near Suakin by sending a small force to Berber." He had previously, on 29th February, urged that the Suakin- Berber road should be opened up by Indian troops. This, and General Gordon's proposal to send 200 British troops to Wadi Haifa, was opposed by Sir E. Baring, who, realizing soon afterwards the gravity of the situation, telegraphed on 16th March : —

~~*It has now become of the utmost importance not only to open the road between Suakin and Berber, but to come to terms with the tribes between Berber and Khartum.*~~

~~*The Government refused to take this action, and Major-General Graham's force was employed in recon- naissances and small skirmishes, ending in the destruction of the villages in the Tamanieb Valley on 27th March. On the 28th the whole force was reassembled at Suakin, and was then broken up, leaving one battalion to garrison the town.*~~

~~*The abrupt disappearance of the British troops encour- aged the tribesmen led by Osman Digna, and effectually prevented the formation of a native movement. Entangle- which might have been of great value. The mentot ■first attempt at intervention in the affairs of General the Sudan was made too late to save Sinkat ^^^^ and Tokar. It resulted only in heavy slaughter of the tribesmen, which afforded no direct or indirect aid to General Gordon or to the policy of evacuation. The public announcement of the latter was a grave mis- take, which increased General Gordon's difficulties, and the situation at Khartum grew steadily worse. On 24th March Sir E. Baring telegraphed : —*~~

~~*The question now is, how to get General Gordon and Colonel Stewart away from Khartum. . . . Under present circumstances, I think an effort should be made to help General Gordon from Suakin, if it is at all a possible military operation. . . . We all consider that, however difficult the operations from Suakin may be, they are more practicable than any operations from Korosko and along the Nile.*~~

~~*A telegram from General Gordon, received at Cairo on 19th April, stated that.*~~

~~*We have provisions for five months and are hemmed in. . . . Our position will be much strengthened when the Nile rises. . . . Sennar, Kassala, and Dongola are quite safe for the present.*~~

~~*At the same time he suggested "an appeal to the millionaires' of America and England" to subscribe money for the cost of "2000 or 3000 Nizam s" (Turkish regulars) to be sent to Berber. A cloud now settled down upon*~~

Khartum, and subsequent communications were few and irregular. The Foreign Office and General Gordon appeared to be somewhat at cross purposes. The former

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hoped that the garrisons of the Sudan could be extricated without fighting. The latter, judging from the tenor of some of his telegrams, believed that to accomplish this work entailed the suppression of the Mahdi's revolt, the strength of which he at first greatly underestimated. He had pressed strongly for the employment of Zobeir as " an absolute necessity for success " (3rd March); but this was refused, since Sir H. Gordon advised at this time that it would be dangerous. On 9th March General Gordon proposed, " if the immediate evacuation of Khartum is determined upon irrespective of outlying towns," to send down the "Cairo employes" and the garrison to Berber with Lieutenant-Colonel Stewart, to resign his commis- sion, and to proceed with the stores and steamers to the Equatorial Provinces, which he would consider as placed under the King of the Belgians. On 13th March Lord Granville gave full power to General Gordon to " evacuate Khartum and save that garrison by conducting it himself to Berber without delay," and expressed a hope that he would not resign his commission.

By the end of March 1884 Sir E. Baring and the British officers in Egypt were convinced that force would o I, f . have to be employed, and the growing danger peditioa: of General Gordon, with the grave national qaestioa responsibility involved, began to be realized in of route. Great Britain. Sir Henry Gordon, however, who was in personal communication with Mr Gladstone, considered that his brother was in no peril, and for some time disbelieved in the need for a relief expe- dition. Meanwhile it was at least necessary to evolve some plan of action, and on 8th April the Adjutant- General addressed a memorandum to the Secretary of State for War detailing the measures required for plac- ing 6500 British troops " in the neighbourhood of Shendi." The battle of the routes began much earlier, and was continued for some months. Practically the choice lay between the

Nile and the Suakin-Berber road. The rirst involved a distance of 1650 miles from Cairo along a river strewn with cataracts, which obstructed navigation to all but small boats, except during the period of high water. So great was this obstruction that the Nile had never been a regular trade route to the Sudan. The second entailed a desert march of about 250 miles, of which one section, Obak-Bir Mahobeh (52 miles), was waterless, and the rest had an indifferent water supply (except at Ariab, about half-way to Berber), capable, however, of considerable development. From Berber the Nile is followed (210 miles) to Khartum. This was an ancient trade route with the Sudan, and had been used without difl&culty by the reinforcements sent to Hicks Pasha in 1883, which were accompanied by guns on wheels. The authorities in Egypt, headed by General Stephenson, svxbsequently supported by the Admiral Lord John Hay, who sent a naval officer to examine the river as far as Dongola, were unanimous in favour of the Suakin-Berber route. Erom the first Major- General Sir A. Clarke, then Inspector-General of Forti- fications, strongly urged this plan, and proposed to begin at once a metre gauge railway from Suakin, to be constructed by Indian labour under officers skilled in laying desert lines. Some preliminary arrangements were made, and on 14th June the Government sanctioned certain measures of preparation at Suakin. On the other side were the Adjutant-General (Lord Wolseley) and a small number of officers who had taken part in the Eed Eiver expedition of 1870. The memorandum of the Adjutant-General above referred to was based on the hypothesis that Khartum could not hold out be- yond 15th November, and that the expedition should reach Berber by 20th October. Steamers were to be employed in such reaches as proved practicable, but

the force was to be conveyed in special whale-boats, by which " the difficulty of transport is reduced to. very nar- row limits." The mounted force was to consist of 400 men on native horses and 450 men on horses or camels.. The question of routes continued to be the subject of animated discussion, and on 29th July a committee of three officers who had served in the Red River expedition reported : —

We believe that a brigade can easily be conveyed in small boats from Cairo to Dongola in the time stated by Lord Wolseley ; and, further, that should it

be necessary to send a still larger force by water to Khartum, that operation will present no insuperable difficulties.

This most inconclusive report, and the baseless idea that the adoption of the Nile route would involve no chances of bloodshed, which the Government was anxious to avoid, seemed to have decided the question. ° ^^'^' On 8th August the Secretary of State for War out ; Nile informed General Stephenson that " the time "> "'« had arrived when some further measures for " ""* ' obtaining accurate information as to his (General Gor- don's) position, and, if necessary, for rendering him assistance, should be adopted." General Stephenson still urged the Suakin-Berber route, and was informed on 26th August that Lord Wolseley would be appointed to take over the command in Egypt for the purposes of the expedition, for which a vote of credit had been taken in the House of Commons on 5th August. On 9tli Septem- ber Lord Wolseley arrived at Cairo, and the plan of operations was somewhat modified. A camel corps of 1100 men selected from twenty-eight regiments at home was added, and the " fighting force to be placed in line some- where in the neighbourhood of Shendi " was fixed at 5400. The construction of whale-boats began on 12th August, and the first batch arrived at Wadi Haifa on 14th October, and on the 25th the first boat was hauled through the second cataract. The mounted forces proceeded up the banks, and the first half-battalion embarked at Gemai, 870 miles from Khartum, on 5th November, ten days be- fore the date to which it had been assumed General Gor- don could hold out. In a straggling procession the boats worked their way up to Korti, piloted by Canadian voyageurs. The labour was very great, and the troops, most of whom were having their first lesson in rowing, bore the privations of their unaccustomed conditions with ad- mirable cheerfulness. By 26th December 2220 men had reached Korti, of whom about 800 only had been conveyed by the whale-boats, the last of which did not arrive till 27th January. Beyond Korti lay the very difficult section of the river to Abu Hamed, which was quite unknown. Meanwhile news of the loss of the Abbas and of the murder of Colonel J. D. Stewart and his party on 18th September had been received. A letter from Gordon, dated 4th November and received 17th November, stated that his steamers would await the expedition at Metemmeh, and added, " We can hold out forty days with ease ; after that it will be difficult." In his diary, on 13th

December, when his difficulties had become extreme, he noted that " if the expeditionary force does not come in ten days, the town may fall."

It was clear at Korti that something must be done at once ; and on 13th December 1100 men, with 2200 camels, under Colonel Sir H. Stewart, were despatched to occupy Jakdul wells, 96 miles on the desert n'TrT* route to Metemmeh. Stewart returned on column; 5th January, and started again on the 8th, with *««'« of orders to establish a fort at Abu Klea and to ^Jjis,'"' occupy Metemmeh. The " Desert Column," 1800 men, with 2880 camels in poor condition and 163 horses, found the enemy in possession of Abu Klea wells on the 16th, and was desperately attacked on the 17th. The

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want of homogeneity of the force, and the unaccustomed tactics imposed upon the cavalry, somewhat hampered the defence, and the square was broken at the left rear corner. Driven back upon the camels in the centre, the troops fought hand to hand with the greatest gallantry. Order was quickly restored, and the attack was repulsed, with a loss of 74 killed and 94 wounded. At least 1100 of the enemy were killed. The wells being occupied and a zeriba formed, the column started on the evening of the 18th. The wrong road was taken, and great con- fusion occurred, during the night, but at dawn this was rectified ; and after forming a rough fort under fire, by which Sir H. Stewart was fatally wounded, an advance was made at 3 p.m. The square was again heavily at- tacked, but the Arabs could not get to close quarters, and in the evening a bivouac was formed on the Nile. The British losses on this day were 23 killed and 98 wounded. The Desert Column was now greatly exhausted. On the 20th the village of Gubat was occupied ; and on the following day Sir C. Wilson, on whom the command had devolved, advanced against Metemmeh, which was found too strong to assault. On this day General Gordon's four steamers arrived ; and on the morning of the 24th Sir C. Wilson, with 20 British soldiers in red coats and about 280 Sudanese, started in the Bordein and Telahawiyeh for Khartum. The Bordein grounded on the following day, and again on the 26th, by

which twenty-four hours were lost. At 11 a.m. on the 28th Khartum was sighted, and it soon became clear that the town was in the hands of the enemy. After reconnoitring farther, the steamers turned and proceeded down stream under a heavy fire, the Sudanese crews showing signs of disaffection. The Telahawiyeh was wrecked on 29th January and the Bordein on the 31st, Sir C. Wilson's party being rescued on 4th February by Lord C. Beresford in the Safieh, which had come up from Gubat on receipt of news carried there by Lieuten- ant Stuart Wortley in a row-boat. Khartum had been taken and General Gordon killed on the morning of 26th January 1885, having thus held out thirty-four days beyond the date when he had expected the end. The garrison had been reduced to starvation; and Failure ot the arrival of twenty British soldiers, with "Jduioa' orders to return at once, could not have ^' "" affected the situation. The situation of the Desert Column and of its transport was most imperfectly understood at Korti, where impossible plans were formed. Fortunately Major-General Sir R. Buller, who arrived at Gubat on 11th February, decided upon withdrawal, thus averting impending disaster, and by 16th March the Desert Column had returned to Korti.

The advance from Korti of the "River Column," under Major-General Earle, began on 28th December, and great difficulties of navigation were encountered. On 10th February an action was fought at Kirbekan with about 800 of the enemy, entailing a loss of 10 killed, including Major-General Earle, and 47 wounded. The column, now commanded by Brigadier-General Brackenbury, continued its slow advance, and on the morning of 24th February it was about 26 miles below Abu Hamed, a point where the Korosko desert route strikes the Nile, 350 miles from Khartum. Here it received orders to retire, and it reached Korti on 8th IMftrch

The verbal message received from General Gordon on 30th December 1884 rendered the extreme danger of the position at Khartum painfully apparent, and Suakia the English Minister for War, acting on Sir E. operations, ^^^.j^^g,^ advice, offered to make an active demonstration from Suakin. To this proposal Lord Wolseley demurred, but asked that ships of war should

be sent to Suakin, and that " marines in red coats should be frequently landed and exercised." Lord Hartington replied that the Government did

not consider that a demonstration of this kind could be effective, and again suggested stronger measures. On 8th January 1885 Lord Wolseley repeated that "the measures you pro- pose will not assist my operations against Khartum," adding : —

I have from first endeavoured to impress on Government that I am strong enough to relieve Khartum, and believe in being able to send a force, when returning by way of Berber, to Suakin, to open road and crush Osman Digna.

On this very day the small Desert Column started from Korti on its hazardous m^psion to the relief of a town fully 270 miles distant, held by a starving garrison, and invested by 30,000 fighting men, mostly armed with good rifles. Before reaching the Nile the Desert Column had lost 300 men and was unable to take Metemmeh, while its transport had completely broken down. On the 8th February Lord Wolseley telegraphed, " The sooner you can now deal with Osman Digna the better," and recom- mended the despatch of Indian troops to Suakin, to "co- operate with me in keeping road to Berber open." On 11th February, the day on which Sir R. Buller most wisely decided to withdraw the Desert Column from a position of extreme danger, it was determined at Korti that the River Column should proceed to attack Berber, and Lord Wolseley accepted the proposal of the Govern- ment to make a railway from Suakin, telegraphing to Lord Hartington : —

By all means make railway by contract to Berber, or as far as you can, during summer. It will be invaluable as a means of supply, and I recommend it being begun immediately. Contract to be, if possible, for so much per ton military stores and supplies and men carried, per mile.

Every effort was now concentrated upon sending an expeditionary force to Suakin, and before the end of March about 13,000 men, including a brigade from India and a field battery from New South Wales, with nearly 7000 camels and 1000 mules, were there assembled. Lieutenant-General Sir G. Graham was placed in com- mand of this force, with orders to break down the power of Osman Digna and to press the construction of the rail- way towards Berber. The troops at Suakin, on arrival, were much harassed by small night attacks, which ceased as soon as the scattered camps were

drawn together. On 19th March Sir G. Graham, with the cavalry brigade and the infantry of the Indian contingent, reconnoitred as far as Hashin, finding the country difficult on account of the dense mimosa scrub. The enemy occupied the hills and fired upon the cavalry. On the 28lSi Sir C. Graham, with about 9000 men, again advanced to Hashin, and Dehilbat Hill was taken by the ^^jj*^/ Berkshire Regiment and the Royal Marines. A squadron of the 9th Royal Lancers, which was dis- mounted in the thick bush, was driven back with the loss of 9 men ; but elsewhere the Arabs never succeeded in closing, and the troops returned to Suakin in the after- noon, leaving the East Surrey Regiment in a zeriba covering some low hills near Hashin village. The total British loss was 9 killed and 39 wounded.

On 22nd March a force, consisting of two British and three Indian battalions, with a naval brigade, a squadron of Lancers, two companies of Engineers, and a large convoy of camels carrying water and sup- ’’’

required. On the 24th and 26th convoys proceeding in square to Tofrik were attacked, the enemy being repulsed without difficulty. On 2nd April a force exceeding 7000 men, with 14 guns and 1600 transport animals, started from Suakin at 4.30 a.m., and bivouacked twelve hours later at Tesela Hill. Next morning an advance was made towards Tamai, and a number of huts in the Khor Ghob were burned. The force then returned to Suakin. The railway was now pushed on without interruption, reaching Otao on the 30th. On the night of 6th May a combined movement was made from Suakin and Otao, which resulted in the surprise and break-up of a force of the enemy under Mahommed Sardun, and the capture of a large number of sheep and goats. The moral effect of this operation was marked, and large numbers of tribesmen placed them- selves unconditionally at the disposal of Sir G. Graham. A great native movement could now have been organized, which would have kept the route to Berber and enabled the railway to be rapidly pushed forward.

Meanwhile many communications had passed between the War OfiB.ce and Lord Wolseley, who at first believed that Berber could be taken before the summer. In a long despatch of 6th March he discussed the general situation, and pointed out that although the force at his disposal " was amply sufficient " for raising the siege of Khartum and defeating the Mahdi, the conditions were changed by the fall of the town. It was now "impossible ... to undertake any offensive oper- ations until about the end of the summer," when twelve additional British battalions, four strong squadrons of British cavalry, and two E.H.A. batteries, to- '^d*"7ii gether with a large extension of the Wadi Haifa tarysitua- railway, eleven steamers, and three hundred tion at end more whale-boats, would be required. He con- onsf sidered it necessary to hold Dongola, and he reported that he was "distributing this army along the left bank of the Nile, on the open reach of water" between the Hannek cataract and Abu Dom, opposite Merawi. On 30th March Lord Wolseley quitted the army and proceeded to Cairo. A cloud having arisen on the frontiers of Afghanistan, the withdrawal of the troops from the Sudan was ordered on 11th May. On the formation of Lord Salisbury's Cabinet, the new Secretary of State for War, Mr W. H. Smith, inquired whether the retirement could be arrested, but Major- General Sir E. BuUer reported that the difficulties of reoccupation would be great, and that if Dongola was to be held, a fresh expedition would be required. On 20th June, before the

British rearguard had left Dongola, the Mahdi died. The withdrawal of the Suakin force began on 17th May, and the friendly tribes, deprived of support, were compelled to make terms with Osman Digna, who was soon able to turn his attention to Kassala, which capitulated in August, nearly at the same time as Sennar.

The failure of the operations in the Sudan had been absolute and complete, and the reason is to be sought in a total misconception of the situation, which

caused vacillation and delay, and in the choice of a route by which, having regard to the date of the decision, the relief of General Gordon and Khartum was impossible.

(g. s. 0.)

MiLiTAET Operations in Egypt and the Sudan. 1885 TO 1896.

The operations against Mahdism during the eleven years from the end of the Nile expedition and the withdrawal from the Sudan to the commencement of the Dongola campaign will be more easily understood if, instead of narrating them in one chronological sequence, the opera- tions in each province are considered separately. The Mahdi, Mahommed Ahmed, died at Omdurman on 22nd June 1885. He was succeeded by the principal Khalifa, Abdullah el Taaishi, a Baggara Arab, who for the next thirteen years ruled the Sudan with despotic power. Cruel, vicious, unscrupulous, and strong, the country groaned beneath his oppression. He removed all possible rivals, concentrated at Omdurman a strong military force composed of men of his own tribe, and maintained the ascendency of that tribe over all others. As the British troops retired to Upper Egypt, his 'followers seized the evacuated country, and the Khalifa cherished the idea, already formulated by the Mahdi, of the conquest of Egypt, but for some years he was too much occupied in quelling risings, massacring the Egyptians in the Sudan, and fighting Abyssinia, to move seriously in the matter.

Upper Egypt. — Mahommed el Kheir, dervish Emir of Dongola, however, advanced towards the frontier in the autumn, and at the end of November

came in touch with the frontier field force, a body of some 3000 men composed in nearly equal parts of British and Egyptian troops. A month of harassing skirmishes ensued, during which the Egyptian troops showed their mettle at Mograkeh, where 200 of them held the fort against a superior number of dervishes, and in combats at Ambigol, Kosheh, and Firket. Sir Frederick Stephenson, com- manding the British army of occupation in Egypt, then concentrated the frontier field force at Firket, and at- tacked the main body of the enemy at Ginnis on theSOlh December 1885, completely defeating it and capturing two guns and twenty banners. It was here the new Egyptian army received its baptism of fire and acquitted itself very creditably. Although checked, the dervishes were not discouraged, and continued to press upon the frontier in frequent raids, and thus in many bloody skirmishes the fighting qualities of the Egyptian troops were developed. In April 1886 the frontier was drawn back to Wadi Haifa, a fortified camp at the northern end of the desolate defile, Batn-el-Hagar, through which the Nile tumbles amid black, rocky hills in a succession of rapids, and debouches on a wide plain. The protection of the frontier was now left'in the hands of the Egyptian army, a British force remaining at Assuan, 200 miles to the north, as a reserve in case of emergency, and two years later even this precaution was deemed unnecessary.

In October 1886 Wad en Nejumi, the Emir who had defeated Hicks Pasha in Kordofan three years before, and led the assault at Khartum when General Gordon was slain in January 1885, replaced Mahommed el Kheir as " Commander of the Force for the Conquest of Egypt," and brought large reinforcements to Dongola. An ad- vanced column under Nur-el-Kanzi occupied Sarras iu April 1887, was attacked by the Egyptian force under Colonel H. Chermside on the 28th of that month, and after a stubborn resistance was defeated with great loss. Nur-el-Kanzi was killed and ten standards taken.

The troubles in Darfur and with Abyssinia (q.v.) in- duced the Khalifa to reduce the garrisons of the north ; nevertheless the dervishes reoccupied Sarras, continued

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active in raids and skirmislies, and destroyed the railway south of Sarras, which during the Nile expedition of 1884 and 1886 had been carried as far as Akasheh. It was not until May 1889 that an invasion of the frontier on a large scale was attempted. At this time the power and pres- tige of the Khalifa were at their height : the rebellions in Darfur and Kordofan had been stamped out, the Anti- Mahdi was dead, and even the dervish defeat by the Abyssinians had been converted by the death of King John and the capture of his body into a success. It was there- fore an opportune time to try to sweep the Turks and the British into the sea. On tjfie 22nd June Nejumi was at Sarras with over 6000 fighting men and 8000 followers. On the 2nd July Colonel J. Woodhouse headed off a part of this force from the river at Argin and, after a sharp action, completely defeated it, killing 900, among whom were many important Emirs, and taking 600 prisoners and 12 banners, with very small loss to his own troops. A British brigade was on its way up stream, but the Sirdar, who had already arrived to take the command in person, decided not to wait for it. The Egyptian troops, with a squadron of the 20th Hussars, concentrated at Toski, and thence, on the 3rd August, General Grenfell, Toski."' ^^^^ slight loss, gained a decisive victory. Wad en Nejumi, most of his Emirs, and more than 1200 Arabs were killed; 4000 prisoners and 147 standards were taken, and the dervish army practically destroyed. No further serious attempts were made to disturb the frontier, of which the most southerly outpost was at once advanced to Serras.

The escape from Omdurman of Father Ohrwalder and of two of the captive nuns in December 1891, of Father Rossignoli in October 1894, and of Slatin Bey in February 1895, revealed the condition of the Sudan to the outside world, threw a vivid light on the rule of the Khalifa, and corroborated information already received of the discon- tent which existed among the tribes with the oppression and despotism under -which they lived.

The Eastern Sudan. — In 1884 Colonel Chermside, Gov- ernor of the Red Sea Littoral, entered into arrangements with King John of Abyssinia for the relief of the be- leaguered Egyptian garrisons. Gera, Amadib, Senhit, and

Galabat were, in consequence, duly succoured, and their garrisons and Egyptian populations brought away to the coast by the Abyssinians in 1885. Unfort- unately famine compelled the garrison of Kassala to capitulate on 30th July of that year, and Osman Digna hurried there from Tamai to raise a force with which to meet the Abyssinian general, Eas Alula, who was preparing for its relief. By the end of August Osman Digna had occupied Kufit, in the Barea country, with 10,000 men and entrenched himself. On the 23rd September Ras Alula attacked him there with an equal number of men and routed him with great slaughter. Over 3000 dervishes with their principal Emirs, except Osman Digna, lay dead on the field, and many more were killed in the pursuit. The Abyssinians lost 40 officers and 1600 men killed, besides many more wounded. Instead of marching on to Kassala, Ras Alula, who at this time was much offended by the transfer of Massawa by the Egyptians to Italy, made a triumphant entry into Asmara, and absolutely refused to make any further efforts to extricate Egyptian garrisons from the grip of the Khalifa. Meanwhile Osman Digna, who had fled from Kufit to Kassala, wreaked his vengeance upon the un- happy captives at Kassala.

In the neighbourhood of Suakin there were many tribes disaffected to the Khalifa's cause, and in the autumn of 1886 Colonel H. Kitchener, who was at the time Governor of the Red Sea Littoral, judiciously arranged a combina- tion of them to overthrow Osman Digna, with the result

that his stronghold at Tamai was captured on the 7th October, 200 of his men killed, and 60 prisoners, 17 guns, and a vast store of rifles and ammunition captured. For about a year there was comparative quiet. Then at the end of 1887 Osman Digna again advanced towards Sua kin, but his force at Taroi was routed by the " Friendlies," and he fell back on Handoub. Kitchener unsuccessfully endeavoured to capture Osman Digna on the 17th Janu- ary 1888, but in the attack was himself severely wounded, and was shortly after invalided. Later in the year Osman Digna collected a large force and besieged Suakin. In December the Sirdar arrived with reinforcements from Cairo, and on the 20th sallied out and attacked the der- vishes in their trenches at Gemaizeh, clearing the whole line and inflicting considerable loss on the enemy, who retired towards Handoub, and the country was again fairly quiet for a time. During 1889 and 1890 Tokar

became the centre of dervish authority, while Handoub continued to be occupied for the Khalifa. In January 1891 Osman Digna showed signs of increased activity, and Colonel Holled Smith, then Governor of the Red Sea Littoral, at- tacked Handoub successfully on the 27th and occupied it, then seized Trinkitat and Teb, and on the 19th February fought the decisive action of Afafit, occupied Tokar, and drove Osman Digna back to Temrin with a loss of 700 men, including all his chief Emirs. This ^^^J,l ”’ action proved the final blow to the dervish power in the neighbourhood of Suakin, for although raiding continued on a small scale, the tribes were grow- ing tired of the Khalifa's rule and refused to support Osman Digna.

In the spring of 1891 an agreement was made between England and Italy by which the Italian forces in Eritrea were at liberty, if they were able, to capture and occupy Kassala, which lay close to the western boundary of their new colony, on condition that they restored it to Egypt at a future day when required to do so. Three years passed before they availed themselves of this agreement. In 1893 the dervishes, 12,000 strong, under Ahmed Ali, invaded Eritrea, and were met on the 29th December at Agordat by Colonel Arimondi with 2000 men of a native force. Ahmed All's force was completely routed and himself killed, and in the following July Colonel Baratieri, with 2500 men, made a fine forced .march from Agordat, surprised and captured Kassala on the 17th of that month, and continued to hold it for three years and a half.

The Abyssinian Frontier. — On the Abyssinian frontier Ras Adal was in command of a considerable force of Abyssinians early in 1886, and in June of that year he invaded Galabat and defeated the dervishes on the plain of Madana ; the dervish Emir Mahommed Wad Ardal was killed and his camp captured. In the following year Emir Yunis ed Dekeim made two successful raids into Abys- sinian territory, upon which Ras Adal collected an enormous army, said to number 200,000 men, for the invasion of the Sudan. The Khalifa sent Emir Hamdan Abu Angar, a vei'y skilful leader, with an army of over 80,000 men against him. Abu Angar entered Abyssinia and, in August 1887, attacked Ras Adal in the plain of Debru Sin and, after a prolonged battle, defeated the Abyssinians, captured their camp, and marched on Gondar, the ancient capital of Abyssinia, which he sacked, and then returned into Galabat. King John, the Negus of Abyssinia, burning to

avenge this defeat,' marched, in February 1889, with an enormous army into Galabat, where the Emir Ez Zakl Tumal commanded the Khalifa's forces, some 60,000 strong, and had strongly fortified the town of Matanima and the camp. On the 9th March 1889 the Abyssinians made a terrific onslaught, stormed and burnt the town, and took thousands of prisoners. A small party of dervishes still held a zeriba, when King John was struck by a stray bullet. The Abyssinians decided to retire, fighting ceased, and they moved ofi with their prisoners and the wounded Negus. That night the king died, and the greater part of the army having gone ahead with the prisoners, a party of Arabs pursued the rearguard, which consisted of the king's body- guard, routed them, and captured the king's body, which was sent to Omdurman to confirm the report of a brilliant victory sent by Ez Zakl Tumal to the Khalifa. Internal strife prevented the new

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Negus of Abyssinia from prosecuting the war, which thus, in spite of the Abyssinian success, resulted in the increased power and prestige of the Khalifa.

Darfur and Eordofan. — On the outbreak of the Mahdi's rebellion Slatin Bey was governor of the province, and when Madibbo, the insurgent Sheikh of Eizighat, attacked and occupied Shakka and was following up his success, Slatin twice severely defeated him and, having concentrated his forces at El Fasher, repulsed the enemy again at Om — Shanga. Mahdism, however, spread over Darfur in spite of Slatin's eSorts to stay it. He fought no fewer than twenty-seven actions in varioiis parts of his province, but his own troops, in course of time, became infected with the new faith and deserted him. He was obliged to surrender at Dara in De- cember 1883, and was a prisoner, first at Obeid and then at Omdurman, untU he escaped in 1895. In January 1884 Zogal, the new dervish Emir of the province, attacked El Fasher, where Said Bey Guma and an Egyptian garrison 1000 strong with 10 guns was still holding out, and captured it. He also reduced the Jebel Marra district, where the loyal hill-people gave him some trouble.

After the death of the Mahdi in 1885, Madibbo revolted against the Khalifa, but was defeated by KaramaUa, the dervish Emir of the Bahr-el-Ghazal, and was caught and executed. A war then sprang up between KaramaUa and Sultan Yusef, who had suc- ceeded Zogalas Emir of Darfur. Yusef was joined in 1887 by Sultan Zayid, the black ruler of Jebel Marra, and Karamalla's trusted general, Ketenbur, was defeated with great slaughter at El Towaish on 29th June 1837. Osman wad Adam (Ganu), Emir of Kordofan, was sent by the Khalifa to Karamalla's assistance. He forced back the Darf urians near Dara on the 26th December, routed Zayid in a second battle, entered El Fasher, and, in 1888, became complete master of the situation, the two Sultans being killed. The Darf u- rian chiefs then allied themselves with Abu Gemaizeh, Sheikh of the Masalit Arabs, who had proclaimed himself "Khalifa Osman," and was known as the Anti-Mahdi. The revolt assumed large pro- portions, and became the more dangerous to Abdullah, the Khalifa, by reason of its religious character, wild rumours spreading over the country and reaching to Egypt and Suakin of the advent to power of an opposition Mahdi. Abu Gemaizeh attacked a portion of Osman Adam's force, under Abd-el-Kader, at Kebkebieh, 30 miles from El Fasher, and almost annihilated it on the 16th October 1888; and a week later another large force of Osman Adam met with the same fate at the same place. Instead of following up his victories, Abu Gemaizeh retired to Dar Tama to augment his army, to which thousands flocked as the news of his achievements spread far and wide. He again advanced to El Fasher in February 1889, but was seized with smallpox. His army, however, under Fiki Adam, fought a iierce battle close to El Fsisher on the 22nd, which resulted in its defeat and dispersion, and then Abu Gemaizeh himself dying the following day, the movement collapsed.

In 1891 Darfur and Kordofan were again disturbed, and Sultan Abbas succeeded in turning the dervishes out of the Jebel Marra district! Two years later a saint of Sokoto, Abu Naal Muzil el Muhan, collected many followers and for a time threatened the Khalifa's power, but the revolt gradually died out.

The Bahr-el^Ghazal. — The first outbreak in favour of Mahdism in the Bahr-el-Ghazal took place at Liffi in August 1882, when the Dinka tribe, under Jango, revolted and was defeated by Lupton Bey with considerable

slaughter at Tel Gauna, and again in 1883 near Liffi. In September of that year Lupton's captain, Rufai Aga, was massacred with all his men at Dembo, and Lupton, short of ammunition, was forced to retire to Dem Suliman, where he was completely cut off from Khartum. After gallantly fighting for eighteen months he was compelled by the defection of his troops to surrender on 21st April 1884 to KaramaUa, the dervish Emir of the province. He died at Omdurman in 1888.

In 1890 the ShUlouks in the neighbourhood of Fashoda rose against the Khalifa, and the dervish Emir of Galabat, Zeki Tumal, was engaged for two years in suppressing the rebellion. He got the upper hand in 1892, and was recalled to oppose an Italian force said to be advancing from Massawa ; but on reporting that it was impossible to invade Eritrea, as the Khalifa wished him to do, he was summoned to Omdurman and put to death. The country then relapsed into its original barbarous condition, and dervish influence was nominal only. In 1892 the Congo State Expedition established posts up to the seventh parallel of north latitude. In 1893 the dervish Emir, Abu Mariam, fought with the Dinka tribe and was killed and his force destroyed, the fugitives taking refuge in Shakka. In the following year the Congo Expedition established further posts, and in consequence the Khalifa sent 3000 men, under the Emir Khatem Musa, from Shakka to reoccupy the Bahr-el- Ghazal. The Belgians at Liffi retired before him, and he entered Faroga. Famine and disease broke out in Khatem Musa's camp in 1805, and a retreat was made towards Kordofan.

Equatoria. — In the equatorial province, which extended from the Albert Nyanza to Lado, Emin Bey, who had a force of 1300

Egyptian troops and 3000 irregulars, distributed among many stations, held out, hoping for reinforcements. In March 1885, however, Amadi fell to the dervishes, and on the 18th April KaramaUa arrived near Lado, the capital, and sent to inform Emin of the fall of Khartum. Emin and Captain Casati, an Italian, moved south to Wadelai, giving up the northern posts, and opened friendly relations with Kabarega, King of Unyoro. On 26th February 1886 Emin received despatches from Cairo vid, Zanzibar, from which he learned all that had occurred during the previous three years, and that "he might take any step he liked, should he decide to leave the

country." He determined to remain where he was and "hold together, as long as possible, the remnant of the last ten years." His troops were in a mutinous state, wishing to go north rather than south, as Emin had ordered them to do, and unsuccessfully endeavoured to carry him with them by force.

His communications to Europe through Zanzibar led to the Relief Expedition under Mr H. M. Stanley, which went to his rescue by way of the Congo in 1887, and after encountering incredible dangers and experiencing innumerable sufferings, met with Emin and Casati at Nsab6, on the Albert Nyanza, on 29th April 1888. Stanley went back in May to pick up his belated rearguard, leaving Mounteney Jephson and a small escort to accompany Emin round his province. The southern garrisons decided to go with Emin, but the troops at Laboreh mutinied, and a general revolt broke out, headed by Fadl el Maula, governor of Fabbo. On arriving at Dufileh in August 1888, Emin and Jephson were made prisoners by the Egyptian mutineers. In the meantime the arrival of Stanley at Lake Albert had caused rumours, which quickly spread to Omdurman, of a great invading White Pasha, with the result that in July the Khalifa sent up the river three steamers and six barges, containing 4000 troops, to oppose this new-comer. In October Omar-Saleh, the Mahdist commander, took Rejaf and sent messengers to Dufileh to summon Emin to surrender ; but on the 15th November the mutineers released both Emin and Jephson, who returned to Lake Albert with some 600 refugees, and joined Stanley in February 1889. The expedition arrived at Zanzibar at the end of the year.

Emin's mutinous troops kept the dervishes at bay between Wadelai and Rejaf, and eventually severely defeated them, driving them back to Rejaf. They did not, however, follow up their victory, and under the leadership of Fadl-el-Maula Bey remained about Wadelai, while the dervishes strengthened their post at Rejaf. In 1893 Fadl-el-Maula Bey and many of his men took service with Baert of the Congo State Expedition. The Bey was kiUed fighting the dervishes at Wandi in January 1894, and the renmant of his men eventually were found by Captain Thurston from Uganda on the 23rd March 1894 at Mahaji Sghir, on the Albert Nyanza, whither they had drifted from Wadelai in search of suppUes. They were enlisted by Thurston and brought back under the British flag'to Uganda.

In consequence of the Franco-Congolese Treaty of 1894, Major Cunningham and Lieutenant Vandeleur were sent from Uganda to Dufileh, where they planted the British flag on the 15th January

1895.

Sudan Operations, 1896-99.

*The wonderful progress — political, economical, and social — which Egypt had made during British occupation, so ably set forth in Sir Alfred MUner's England in Egypt (published in 1892), together with the revelation in so strong a light of the character of the Khalifa's despotism in the Sudan and the miserable condition of his misgoverned people, as detailed in the accounts of their captivity at Omdurman by Father Ohrwalder and Slatin Bey (published in 1892 and 1896), stirred public opinion in Great Britain, and brought the ques ooagoia tion of the recovery of the Sudan into prominence, i^^**"' A change of ministry took place in 1896, and Lord Salisbury's Cabinet, which had consistently assailed the Egyptian policy of the old, was not unwilling to con- sider whether the flourishing condition of Egyptian finance, the prosperity of the country and the settled state of its affairs, with a capable and proved little army ready to hand, did not warrant an attempt being made to recover gradually the Sudan provinces abandoned by Egypt in 1885 on the advice of Mr Gladstone's Gov- ernment.*

Such being the condition of public and official sentiment, the crushing defeat of the Italians by the Abyssinians at the battle of Adowa on 1st March 1896, and the critical

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state of Kassala — held by Italy at British suggestion, and now closely invested by the dervishes — made it not only desirable but necessary to take immediate action.

On the 14th March 1896 Major — General Sir H. Kitchener, who succeeded Sir Francis Grenfell as Sirdar of the Egyptian army in 1892, received orders to reoccupy Akasheh, 50 miles south of Sarras, and to carry the rail- way on from Sarras. Subsequent operations were to de- pend upon the amount of resistance he encountered. On the 20th March Akasheh was occupied without opposition by an advanced column of Egyptian troops under Major J. CoUinson, who formed an entrenched camp there. The reserves of the Egyptian army were called out, and re- sponded with alacrity. The troops were concentrated at Wadi Haifa; the railway reconstruction, under Lieutenant E. P. Girouard, R.E., pushed southward ; and a telegraph line followed the advance. At the commencement of the campaign the Egyptian army, including reserves, con- sisted of 16 battalions of infantry, of which 6 were Sudanese, 10 squadrons of cavalry, 5 batteries of ar- tillery, 3 companies of garrison artillery, and 8 companies of camel corps, and it possessed 13 gunboats for river work. Colonel L. Rundle was Chief of the Staff ; Major E. Wingate was head of the Intelligence Department, with Slatin Bey as his assistant ; and Colonel A. Hunter was in command of Sarras, and south. The 1st battalion of the North Staffordshire Regiment moved up from Cairo to join the Egyptian army.

In the meantime the advance to Akasheh had already relieved the pressure at Kassala, Osman Digna having withdrawn a considerable force from the investing army and proceeded with it to Suakin. To meet Osman Digna's movement Lieutenant-Colonel G. E. Lloyd, the Suakin commandant, advanced to the Taroi Wells, nineteen miles south of Suakin, on the 15th April to co-operate with the " Friendlies," and with Major H. M. Sidney, advancing with a small force from Tokar. His cavalry, under Major Fenwick, went out to look for Sidney's force, and were surprised by a large number of dervishes. Fenwick, with some 40 ofiicers and men, seized an isolated hill and held it through the night, repulsing the dervishes, who were the same night driven back with such heavy loss in attacking Lloyd's zeriba that they retired to the hills, and comparative quiet again reigned at Suakin. At the end of May an Indian brigade arrived for garrison duty, and the Egyptian troops were released for service on the Nile.

The dervishes first came in contact with the Egyptian cavalry on the Nile near Akasheh, on the 1st May, and were repulsed. The army concentrated at

Akasheh early in June, and on the 6th Kitchener moved to the attack of Firket, 16 miles away, where the Emir Hamuda, with 3000 men, was encamped. The attack was made in two columns : one, under Colonel Hunter, marching along the river-bank, approached Firket from the north ; while the other, under Major Burn-Murdoch, making a detour through the desert, approached it from the south. The co-operation of the two columns was admirably timed, and on the morning of the 7th the dervish camp was surrounded, and, after a sharp fight, Hamuda and many emirs and about 1000 men were killed and 500 prisoners taken. The dash and discipline of the Egyptian troops in this victory were a good augury for the future.

By the end of June the railway was advanced beyond Akasheh, and headquarters were at Kosheh, 10 miles farther south. Cholera and fever were busy both with the North Staffordshire Regiment at Gemai, whither they had been moved on its approach, and with the Egyptian troops at the front, and carried off many officers and men. The railway reached Kosheh early in August ; the cholera

disappeared, and stores were collected and arrangements steadily made for a farther advance. The North Stafford- shire moved up to the front, and in September the army moved on Kerma, which was found to be evacuated, the dervishes having crossed the river to Hafir. There they were attacked by the gunboats and Kitchener's artillery from the opposite bank, and forced to retire, with their commander, Wad Bishara, seriously wounded. Dongola was bombarded by the gunboats and captured by the army on the 23rd September. Bishara and his men retreated, but were pursued by the Egyptians until the retreat became a hopeless rout. Guns, small arms, and ammunition, with large stores of grain and dates, were captured, many prisoners taken, while hundreds surren- dered voluntarily, among them a brother of the Emir Wad en Nejumi. The dervish Dongola army had practi- cally ceased to exist. Debbeh was seized on the 3rd October, Korti and Merawi occupied soon after, and the principal sheiks came in and submitted to the Sirdar. The Dongola campaign was over, and the province re- covered to Egypt. The Indian brigade at Suakin returned to India, and was replaced by Egyptians. The North Staffordshire returned to Cairo. The work of consolidation began, and preparations were made for a farther advance when everything should be ready.

The railway up the right bank of the Nile was continued to Kermah, in order to evade the difficulties of the Third Cataract ; but the Sirdar had conceived the bold project of cutting off the great angle of the Nile from Wadi Haifa to Abu Hamed, involving nearly 600 miles of navigation and including the Fourth Cataract, TheSuaan by constructing a railway across the Nubian iggr. desert, and so bringing his base at Wadi Haifa within a few hours of his force, when it should have ad- vanced to Abu Hamed, instead of ten days. Early in 1897 this new line of railway was commenced from Wadi Haifa across the great Nubian desert 230 miles to Abu Hamed. The first-mentioned line reached Kerma in May, and by July the second had advanced 130 miles into the desert towards Abu Hamed, when it became necessary, before it was carried farther, to secure that terminus by an advance from Merawi.

In the meantime the Khalifa was not idle. He occupied Abu Klea Wells and Metemmeh ; recalled the Emir Ibra,- him Khalil, with 4000 men, from the Ghezira ; brought to Omdurman the army of the west under Mahmud — some 10,000 men ; entrusted the line of the Atbara — Ed Damer, Adarama, Asubri, and El Fasher — to Osman Digna ; constructed defences in the Shabluka Gorge ; and personally superintended the organization and drill of the forces gathered at Omdurman, and the collection of vast stores of food and supplies of camels for offensive expeditions.

Towards the end of June the chief of the Jaalin tribe, Abdalla wad Said, who occupied Metemmeh, angered by the Khalifa, made his submission to Kitchener and asked for support, at the same time foolishly sending a defiant letter to the Khalifa. The Sirdar sent him rifles and ammunition across the desert from Korti ; but before they arrived, Mahmud's army, sent by the Khalifa, swept down on Metemmeh on 1st July and massacred Abdalla wad Said and his garrison.

On the 29th July, after several reconnaissances, Major- General Hunter, with a flying column, marched up the Nile from near Merawi to Abu Hamed, 133 miles distant, along the edge of^he Monassir desert. He arrived on 7th August and captured it by storm, the dervishes losing 250 killed and 50 prisoners. By the end of the month the gunboats had surmounted the Fourth Cataract and reached Abu Hamed. Berber was

~~found to be deserted, and occupied by Hunter on the 5th September, and in the~~

~~following month a large force was entrenched there. The Khalifa, fearing an attack on Omdiirman, moved Osman Digna from Adarama to Shendi. On the 23rd October Hunter, with a flying column lightly equipped, left Berber for Adarama, which he burned on the 2nd November, and after reconnoitring for 40 miles up the Atbara, returned to Berber. The Nile was falling, and Kitchener decided to keep the gunboats above the im- passable rapid at Um Tuir, 4 miles north of the confluence of the Atbara with the Nile, where he constructed a fort. The gunboats made repeated reconnaissances up the river, bombarding Metemmeh with eifect. The railway reached Abu Hamed on the 4th November, and was pushed rapidly forward along the right bank of the Nile towards Berber.~~

~~The forces of the Khalifa remaining quiet, the Sirdar visited Kassala and negotiated with the Italian General Caneva for its restoration to Egypt. The Italians were anxious to leave it ; and on Christmas Day 1897 Colonel Parsons, with an Egyptian force from Suakin, took it formally over, together with a body of Arab irregulars employed by the Italians. These troops were at once despatched to capture the dervish posts at Asabri and El Easher, which they did with small loss.~~

~~On his return from Kassala to Berber the Sirdar received information of an intended advance of the Khalifa north- ward. He at once ordered a concentration of Egyptian troops towards Berber, and telegraphed to Cairo for a British brigade. By the end of January the concentration was complete, and the British brigade, under Sudan Major-General Gatacre, was at Dakhesh, south 1898. ^ ‘ of Abu Hamed. Disagreement among the Khalifa’s generals postponed the dervish ad- vance and gave Kitchener much-needed time. But at the end of February, Mahmud crossed the Nile to Shendi with some 12,000 fighting men, and with Osman Digna advanced~~

along the right bank of the Nile to Aliab, where he struck across the desert to Nakheila, on the Atbara, intending to turn Kitchener's left flank at Berber. The Sirdar took up a position at Eas el Hudi, on the Atbara. His force consisted of G'atacre's British brigade (1st Warwicks, Lincolns, Seaforths, and Camerons) and Hunter's Egyptian division (3 brigades under Colonels Maxwell, MacDonald, and Lewis respectively). Broad-wood's cavalry, Tudway's camel corps, and Long's artil- lery. The dervish army reached Nakheila on the 20th March, and entrenched themselves there in a formidable zeriba. After several reconnaissances, in which fighting took place with Mahmud's outposts, it was ascertained from prisoners that their army was short of provisions and that great leakage was going on. Kitchener, therefore, did not hurry. He sent his flotilla up the Nile and captured Shendi, the dervish depot, on the 27th March. On the 4th April he advanced to Abadar. A final recon- naissance was made on the 5th. On the following day he bivouacked at Umdabia, where he constructed a strong zeriba, which was garrisoned by an Egyptian battalion, and on the night of the 7th he marched to the attack of Mahmud's zeriba, which, after an hour's bombardment on the morning of the 8th April, was stormed with com- plete success. Mahmud and several hundred dervishes were captured, 40 emirs and 3000 Arabs killed, and many more wounded ; the rest escaped to Gedaref . The Sirdar's casualties were 80 killed and 472 wOunded.

Preparations were now made for the attack on the Khalifa's force at Omdurman ; and in the meantime the troops were camped in the neighbourhood of Berber, and the railway carried on to the Atbara. At the end of July reinforcements were forwarded from Cairo ; and on the 24th August the following troops were concentrated for the advance at Wad Hamad, above Metemmeh, on the

western bank of the Sixth Cataract: — British division, under Major-General Gatacre, consisting of 1st Brigade, commanded by Colonel H. G. Wauchope (1st Warwicks, Lincolns, Seaforths, ai/d Camerons), and 2nd Brigade, commanded by Colonel the Hon. N. G. Lyttelton (1st Northumberlands and Grenadier Guards, 2nd Lancashire and Rifle Brigade) ; Egyptian division, under Major- General Hunter, consisting of 4 brigades, commanded by Colonels MacDonald, Maxwell, Lewis, and Collinson ; mounted troops — 21st Lancers, Camel Corps, and Egyptian

~~Cavalry; artillery, under Colonel Long, 2 British batteries, 5 Egyptian batteries, and 20 machine guns; detachment of Eoyal Engineers. The flotilla, under Commander Keppel, E.N., consisted of 10 gun- boats and 5 transport steamers. The total strength was nearly 26,000 men.~~

~~While the army moved along the west bank of the river, a force of Arab irregulars or " Friendlies " marched along the east bank, under command of Major Stuart- Wortley and Lieutenant Wood, to clear it of the enemy as far as the Blue Nile ; and on the 12th September the gunboats bom- barded the forts on both sides of the river and breached the great wall of Omdurman. Kitchener met with no opposition ; and on the 1st September "'* "' the army bivouacked in zeriba at Egeiga, on the alan!"^' west bank of the Nile, within 4 miles of Omdurman. Here, on the morning of the 2nd September, the Khalifa's army, 40,000 strong, attacked the zeriba, but was repulsed with slaughter. Kitchener then moved out and marched towards Omdurman, when he was again twice fiercely attacked on the right flank and rear, MacDonald's brigade bearing the brunt. MacDonald dis- tinguished himself by his tactics, and completely repulsed the enemy. The 21st Lancers gallantly charged a body of 2000 dervishes which was unexpectedly met in a khor on the left flank, and drove them westward, the Lancers losing a fifth of their number in killed and wounded. The Khalifa was now in full retreat, and the Sirdar, sending his cavalry in pursuit, marched into Omdur- man. The dervish loss was over 10,000 killed, as many wounded, and 6000 prisoners. The Khalifa's black fiag was captured and sent home to the Queen. The British and Egyptian casualties together were under 600. The European prisoners of the Khalifa found in Omdurman — Charles Neufeld, Joseph Eagnotti, Sister Teresa Grigolini, and some 30 Greeks — were released; and on Sunday the 4th September the Sirdar, with representatives from every regiment, crossed the river to Khartum, where the British and Egyptian flags were hoisted, and a short service held in memory of General Gordon, near the place where he met his death.~~

~~Thes results of the battle of Omdurman were the practi- cal destruction of the Khalifa's army, the extinction of Mahdism in the Sudan, and the recovery of nearly all the country formerly under Egyptian authority.~~

The Khalif afled with a small force to Obeid in Kordofan. The British troops were quickly sent down stream to Cairo, and the Sirdar, shortly afterwards created Lord Kitchener of Khartum, was free to turn his attention to the reduction of the country to some sort of order.

He had first, however, to deal with a somewhat serious matter — the arrival of a French expedition at Fashoda, on the White Nile, some 600 miles above Khartum. He started for the south on the 10th September, with 5 gun-boats and a small force, dispersed a body of 700 dervishes at Eeng on the 15th, and four days ^^^”^^ later arrived at Fashoda, to find the French at Pasboda. Captain Marchand, with 120 Senegalese soldiers, entrenched there and the French flag flying. He arranged with Marchand to leave the political question to be settled

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by diplomacy, and contented himself with hoisting the British and Egyptian flags to the south of the French flag, and leaving a gunboat and a Sudanese battalion to guard them. He then steamed up the river and established a post at Sobat ; and after sending a gunboat up the Bahr- el-Ghazal to establish another post at Meshra-er-Eek, he returned to Omdurman. The French expedition had experienced great diflSculties in the swampy region of the Bahr-el-Ghazal, and had reached Fashoda on the 10th July. It had been attacked by a dervish force on the 25th August, and was expecting another attack when Kitchener arrived and probably saved it from destruc- tion. The Fashoda incident was the subject of import- ant diplomatic negotiations, which at one time ap- proached an acute phase; but ultimately the French position was found to be untenable, and on 11th De- cember Marchand and his men returned to France by the Sobat, Abyssinia, and Jibuti. In the following March the spheres of interest of Great Britain and France in the Nile basin were defined by a declaration making an addition to Article IV. of the Niger Conven- tion of the previous year..

During the Sirdar’s absence from Omdurman Colonel Hunter commanded an expedition up the Blue Nile, and by the end of September had occupied and garrisoned Wad Medina, Sennar, Karkoj, and Eoseires. In the meantime Colonel Parsons marched with 1400 men from Kassala on the 7th September, to capture Gedaref . He encountered 4000 dervishes under Emir

Saadalla outside the town, and after a desperate fight, in which he lost 50 killed and 80 wounded, defeated them and occupied the town on the 22nd. The dervishe sleft 600 dead on the field, among whom were four Emirs. Having strongly €ntrenched himself. Parsons beat off,, with heavy loss to the dervishes, two impetuous attacks made on the 28th by Ahmed Fedil. But the garrison of Gedaref suffered from severe sickness, and Colonel Collinson was sent to their aid with reinforcements from Omdurman. He steamed up the Blue Nile and the Eahad river to Ain-el-Owega, whence he struck across the desert, reaching Gedaref on the 21st October, to find that Ahmed Fedil had gone south with his force of 5000 men towards Eoseires. Colonel Lewis, who was at Karkoj with a small force, moved to Eoseires, where he received reinforcements from Omdurman, and on the 26th December caught Ahmed Fedil's force as it was crossing the Blue Nile at Dakheila, and after a very severe fight cut it up. The dervish loss was 500 killed, while the Egyptians had 24 killed and 118 wounded. Two thousand five hundred fighting men surrendered later, and the rest escaped with Ahmed Fedil to join the Khalifa in Kordofan.

On the 25th January 1899 Colonel Walter Kitchener was despatched by his brother, in command of a flying column of 2000 Egyptian troops and 1700 Friendlies, which had been concentrated at Faki Kohi, on the White Nile, some 200 miles above Khartum, to reconnoitre the Khalifa's camp at Sherkela, 130 miles west of the river, in the heart of the Baggara country in Kordofan, and if OperaWons p^gg^ijig ^o capture it. The position was found Sadaa, to be a strong one, occupied by over 6000 men ; '*"• and as it was not considered prudent to, attack

it with an inferior force at such a distance from the river base, the flying column returned. No further attempt was made to interfere with the Khalifa in his far-off re- treat until towards the end of the year, when, good order having been generally established throughout the rest of the Sudan, it was decided to extend it to Kordofan.

In the autumn of 1899 the Khalifa was at Jebil Gedir, a hill in Southern Kordofan about 80 miles from the White Nile, and was contemplating an advance. Lord Kitchener concentrated 8000 men at Kaka, on the river.

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380 miles south of Khartum, and moved inland on the 20th October. On arriving at Fongor it was ascertained that the Khalifa had gone north, and the cavalry and camel corps having reconnoitred Jebil Gedir, the expedi- tion returned. On the 13th November the Emir Ahmed Fedil debouched on the river at El Alub, but retired on finding Colonel Lewis with a force in gunboats. Troops and transport were then concentrated at Faki Kohi, and Colonel Wingate sent with reinforcements from Khar- tum to take command of the expedition and march to Gedid, where it was anticipated the Khalifa would be obliged to halt. A flying column, comprising a squad- ron of cavalry, a field battery, 6 machine guns, 6 com- panies of the Camel Corps, and a brigade of infantry and details, in all 3700 men, under Wingate, left Faki Kohi, on the 21st November. The very next day he encountered Ahmed Fedil at Abu Aadel, drove him from his posi- tion with great loss, and captured his camp and a large supply of grain he was convoying to the Khalifa. Gedid was reached on the 23rd, and the Khalifa was ascertained to be at Om Dubreikat. Wingate marched at midnight of the 24th, and was resting his troops on high ground in front of the Khalifa's position, wheti at day break of the 25th his picquets were driven in, and the dervishes attacked. They were repulsed with great slaughter, and Wingate, advancing, carried Dea** the camp. The Khalifa Abdullah el Taaishi, Kb^lfa. unable to rally his men, gathered many of his principal emirs around him, among whom were his sons and brothers; Ali Wad Helu, Ahmed el Fedil, and other well-known leaders, and they met their death unflinch- ingly from the bullets of the advancing Sudanese infan- try. Three thousand men and 29 emirs of importance, in- cluding Sheik-ed-din, the Khalifa's eldest son and intended successor, surrendered. The dervish loss in the two actions was estimated at 1000 killed and wounded, while the Egyptian casualties were only 4 killed and 29 wounded. Thus ended the power of the Khalifa and of Mahdism.

On the 19th January 1900 Osman Digna, who had been so great a supporter of Mahdism in the Eastern Sudan, and had always shown great discretion in secur- ing the safety of his own person, was surrounded and captured at Jebel Warriba, as he was wandering a fugitive among the hills beyond Tokar.

The reconquest of Dongola and the Sudan provinces during the three years from March 1896 to December 1898, considering the enormous extent and difftculties of the country, was achieved at an unprecedentedly small cost, whilethemain item of expenditure — therailway — remains a permanent benefit to the country. The figures are : ‘ —

Railways £E.l, 181,372

Telegraphs 21,825

Gunboats 154,934

Military 996,223

Total £E.2,354,354

The railway, delayed by the construction of the big bridge over the Atbara, was opened to the Blue Nile opposite Khartum, 187 miles from the Atbara, at the end of 1899. (e. h. v.)

Egyptology. — Since 1880 the appearance of almost every part of Egyptology has been changed. In the history, the kings who used to be thought mythical are now as well known as those of late times, and the long prehistoric age is better known than that of any other country. In the archaeology, total ignorance is now replaced by an accurate discrimination of the ages of all the usual manufactures. In the language, the guess-work

1 See Lord Cromer’s Report, dated at Cairo, 26th February 1899.

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of earlier times has faded before elaborate grammatical studies, which formulate a great deal more than the Egyptians themselves knew about their own writing.

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The earliest stage of man that is known in Egypt is the Palaeolithic ; this was contemporary with a rainy climate, which enabled at least some vegetation to grow on the high desert, for the great bulk of the worked flints are found 500-1500 ft. above the Nile, on a table- land which is now entirely barren desert. Water-worn palseoliths are found in the beds of the stream courses, now entirely dried up, and flaked flints of a rather later style occur in the deep beds of Nile gravels, which are 20 or 30 ft. above the highest level of the present river. This type of work, however, lasted on to the age of the exist- ing conditions, for perfectly sharp and fresh palaeoliths are found on the desert as low down as the present high Nile.

The date of the change of climate is roughly shown by the depth of the Nile deposits. It is well known, by a scale extending over about 3000 years, that in different parts of Egypt the rise of the Nile bed has been on an average about 4 inches per century, owing to the annual deposits of mud during the inundation f) (^). And in various borings that have been made, the depth of the Nile mud is only about 25 or 30 ft. (‘). Hence an age of about 8000 or 9000 years for the cultivable land may be taken as a minimum, probably to be somewhat extended by slighter deposit in the earlier time.*

The continuous history extends to about 5000 b.c, and the prehistoric age of continuous culture known to us covers probably 2000 years more ; hence our continuous knowledge probably extends back to about 7000 b.c, or to about the time when the change of climate took place. At that time we find a race of European type starting on a continuous career, but with remains of a steatopygous race of “Bushman” (Koranna) type known and repre- sented in modelled figures (*). We e9.n hardly avoid the conclusion that this steatopygous race was that of Palseo- lithic man in Egypt, especially as that equivalence is also known in the French cave remains. It is noticeable that all the figures known of this race — in France, Malta, and Egypt — are women, suggesting that the men were exter- minated by the newer people, but the women were kept as slaves, and hence were familiar to the pioneers of the European race. These Palaeolithic women were broadly built, with deep lumbar curve, great masses of fat on the hips and thighs, with hair along the lower jaw and over most of the body.

The fresh race which entered Egypt was of European type — slender, fair-skinned, with long wavy brown hair. The skull was closely like that of the ancient and modern Algerians of the interior; and as one of the earliest classes of their pottery is similar in material and decoration to the present Kabyle pottery, we may consider them a branch of Algerians (‘). They seem to have entered the country as soon as the Nile deposits rendered it habitable by an agricultural people. They already made well-formed pottery by hand, knew copper as a rarity, and were clad in goat-skins C). Entering a fertile country, and mixing probably with the earlier race, they made a rapid advance in all their products, and in a few generations they had an able civilization. Their work in flint was fine and bold, with more delicate handiwork than that of any other people except their descendants ; their stone vases were cut in the hardest materials with

- *Reference numbers refer to list of books at the end.*

exquisite regularity ; their carving of ivory and slate was better than anything which followed for over a thousand years ; and they had a large number of signs in use, which were probably the first stages of our alphabet (“).

After some centuries of this culture a change appears, at the same point of time in every kind of work. A difference of people seems probable, but no great change of race, as the type is unaltered. The later people show some Eastern affinities ; and it seems as if a part of the earlier Libyan people had entered Syria or North Arabia and had afterwards flowed back through Egypt, modi- fied by their Semitic contact. It is perhaps to this in- flux that the Semitic element in the Egyptian language is due.

This later prehistoric people brought in new kinds of pottery and more commerce, which provided gold, silver, and various foreign stones ; they also elaborated the art of flint-working to its highest pitch of regularity and beauty, and they greatly extended the use of copper, and developed the principal tools to full size (‘). But they show even less artistic feeling than the earlier branch, for all figure-carving quickly decayed, both in ivory and in stone. The use of amulets was brought in, and also forehead-pendants of shell. And the signs which were already in use almost entirely disappeared. (See Fig. 1.)

In the earlier, and still more in the later, age, ships or galleys rowed by oars were familiar ; and these were some- times of large size, figured with sixty oars. That com- merce was already carried on in the Mediterranean is shown by the foreign pottery imported into Egypt, even before the middle of the prehistoric age ; by the supply of gold in the 1st Dynasty, apparently from Asia Minor, and by the pottery of the -^gean being brought in at the same time Q^.

This prehistoric civilization was much decayed when it was overcome by a new influx of people, who founded the dynastic rule. These came apparently from the Red Sea, as they entered Egypt in the region of Koptos, and not either from the north or from the Upper Nile. They were a highly artistic people, as the earliest works attri- butable to them — the Min sculptures at Koptos — show better drawing (Plate, Fig. 2) than any work by the older inhabitants (“) ; and they rapidly advanced in art to the noble works of the 1st Dynasty. ‘ They also brought in the hieroglyphic system, which was developed along with their art. It seems prolDable that they came up from the Land of Pun, at the south of the Bed Sea, and they may have been a branch of the Punic race in its migration from the Persian Gulf round by sea to the Mediterranean. They rapidly subdued the various tribes who were in Egypt,’ and at least five different types of man are shown on the monuments of their earliest kings. The oldest records are those sculptured in relief on the palettes of slate, which show the battles, conquests, and triumphs of the dynastic race, culminating in the great palette of King Narmer (Fig. 2), who seems to have reigned very shortly before Menes (’”). These kings seem to be the dynasty of 10 kings of Thinis (Abydos) who reigned for 360 years, according to Manetho. The names recovered which appear to belong to them are Ka, Zeser, Nar-mer, and Sma : of Narmer a magnificent slate with triumphal carvings was found at Hierakonpolis Q”).

The completion of the conquest of Egypt led to Men (Mena, Menes) being called the founder of the 1st Dynasty (Fig. 3). And this period, which has often been supposed fabulous, is now as well known to us as most of the later dynasties, owing to the study of the inscriptions and remains from the royal tombs of Abydos (^^. The early dynasties have hitherto been known only by the list of kings carved in the XlXth Dynasty at Abydos by Sety I., and by the Greek transcription of Manetho. We now have recovered

OBJECTS OF THE PREHISTORIC CIVILIZATION

FIGURES

SLATE PALETTES

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DRAWINGS

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Fig. 1.— Objects of the Prehistokic Civilization of Egypt.

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the original forms of the names, and the names of the Ka or double of each king. Our present knowledge stands thus : —

List Kames.

KA name.

Tombs.

Setyl.

Manetho.

1.

AHA

MEN

MENA

Menes

f,.

ZER

TA

TETA

Athothis

~~3.~~

~~ZET~~

~~ATH~~

~~ATETH~~

~~Kenkenes~~

~~4.~~

~~MERNEIT~~

~~ATA~~

~~Uenefes~~

~~5.~~

~~DBS~~

~~SETUI~~

~~HESEPTI~~

~~Usafais~~

~~6.~~

~~AZAB~~

~~MERPABA~~

~~MERBAPA~~

~~Miebis~~

~~7.~~

MERSEE.HA

SHEMStJ

SAMENPTAH

Sempses

8.

QAA

SEN

QEBH

Bienekhes

the IVth Dynasty in the lists, thus throwing Seneferu back to the Illrd Dynasty.

The kings of the IVth Dynasty are nearly all recorded on the numerous monuments of this age, which was above all the period of colossal building (see art. Pyramid in ninth edition).

From the time of Seneferu the king's eldest son was high priest of Heliopolis, and in the close of the IVth Dynasty the kings took this priesthood themselves, and Shepseskaf and the Vth Dynasty kings built imment.e temples with obelisks dedicated to the sun-god Ra. One

On Menes, see Becueil, xxi. 105. King Merneit (Plate, Fig. 5) is only assigned to the name in the list of Sety I. by his presumable position ; but the order and the names of the others agree with those of the list, excepting that each name has been mis- read somewhat in the lapse of time between those kings and Sety I., which was longer than that between Sety and ourselves.

The course of civilization was rising at the beginning of the dynasty, and the finest work appears in the middle ; at the close the work is commoner and

~~*coarser.*~~

~~*Of the Ilnd Dynasty the names remaining*~~

~~*KA name in tomba.*~~

~~*Sety I.*~~

~~*Mane'.h^.*~~

~~*1. HOTEPAHAni*~~

~~*BEZAU*~~

~~*BOETHOS*~~

~~*2. RA NEB*~~

~~*KAKAU*~~

~~*KAIECHOS*~~

~~*3. NETEREN*~~

~~*EANETEREN*~~

~~*BINOTHRIS*~~

~~*4. PERABSEN*~~

~~*UAZSES*~~

~~*TLAS*~~

~~*KHASEKHEMUI*~~

~~*ZAZA?*~~

~~*?*~~

The order of the tombs is fixed, and the first three kings are named on the back of the granite figure No. 1 in Cairo Museum. The connexion of these Ka names with the names given by Sety I. seems probable at 2fo. 3. Two statues and some large vases of a King Khasekhem were found at Hierakonpolis, and probably belong to this time. But so far the remains cannot be •connected with the names in the historical lists.

Of the Ilird Dynasty the step-pyramid of Saqqara is the great monument ; for the late inscription at Sehel shows that Neterkhet is the name of King Zeser Q). But of the same king, Neterkhet, is also a great brick mastaba near Beit Khallaf ; and by that is also a tomb of another king, Hon-nekht. The step-pyramid is the first great develop- ment of the mastaba tomb, successively added to and enlarged; and it led to the more regularly enlarged tomb of Seneferu, which was the first to have a continuous sloping casing, and so to begin the series of pyramids.

At the close of the llird Dynasty we reach the period of abundant remains of the Old Kingdom, when in each reign many magnificent tombs were built by the court of&cials, and a complete picture of the civilization is preserved to us Q). A stone lately found at Saqqara shows the adoration of Zeser-nub (dyn. iii. 3), Teta (iii. 6), and Userkaf (v. 1) ; thus the kings of the llird Dynasty were still worshipped in the Vth. Seneferu, whose mastaba-pyramid remains at Medum (*), was certainly the same as Sefuris, the 8th king of the llird Dynasty. His position has been cleared up by finding the name of King Shaaru (S.B.A.P. xxi. 108), which is clearly the origin of Soris, the 1st king of

Fig. 8.— Slate Palette of King Narmer smiting the Chief of Fayum. (Circa 4S00 b.o.)

of these temples has been fully explored at Abusir by German work. This priesthood is echoed in later tales by the Vth Dynasty kings being said to be born of a priestess of Ra ; and the title " son of Ra " begins at this date. At the close of the Vth Dynasty begins the series of inscribed pyramids, with long copies of the early form of the Book of the Dead, and the texts of a ritual nature, intended to direct and preserve the soul. These pyramids of Unas, Teta, Pepy I., Merenra, and Pepy II. were all opened in 1881. The

texts are published in the Recueil, vols, iii.-xvi. The copper statues of Pepy I. and his

Fig. 8. — Pectoral of gold, inlaid with coloured stones, of IT.surtt'sen III. (Circa 2G50 n.c.)

Fig. 6. — Bust of Prince Merenra in copper. (Circii 3450 n.c.)

Fig. 2. — Figures in low relief of elephant, hird, hyaena, and bull. Earliest sculptures from Koptos. (Circa 5000 B.C.)

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Fio. 9.— GraTiite tablet of Merenptah i-ecording the conquest of tlie Israelites.

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Fig. 5.— Tombstone of King Mevneit. (Circa 8450 b.c.)

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son (Plate, Fig. 6) are the most important figures re- maining.

Of the Vlth-Xth Dynasties no great discovery has been made. The inscriptions at Siut of Khety I., Tefaba, and Khety II. belong to the age of Ka-mery-ra of the Xth Dynasty (*). The general course of art through this dark age has been traced out in the cemetery of Dendereh (^.)

The group of foreign kings mainly known by scarabs (Fig. 7) and cylinders, Khyan, Samqan, Anthar, Yaqebhar, Shesha, and Uazed, are pro- bably of the XVth-XVIth Dynasties, though some con- nexions place them shortly before

the Xllth Dynasty. The works of Khyan have been found as far apart Crete and Baghdad. The whole class of so-called Hyk- sos statues and sphinxes are also in the same position of doirbt. And in this class it seems most probable that the peculiar style and physi- ognomy was followed in the Vllth, the XVIth, and even the XXIst Dynasty. There are certainly several different foreign types confounded to- gether at present in one class of royal heads.

The Xlth Dynasty has been mainly illustrated by the sculp- tures of Koptos (Antef V.) (“) and of Dendereh tombs (). The old style of the IVth to Vlth Dynasties contin- ued in a constantly degrading form until the name of Antefs shows that the beginning of the Xlth Dynasty is reached Q). During that dynasty a rapid recovery took place, and the close of the Xlth and early Xllth Dynasty is the highest point of this age. The main new discoveries of this period are the temple sculp- tures of Koptos (“) (Amenemhat I., Usertesen I.) ; the statues and pyramid of Lisht (Usertesen I.); the jewellery of the princesses from Dahshur .(“) (User- tesen II., III. [Plate, Fig. 8], and Amenemhat III.); the pyramid of Usertesen III. (“) (Dahshur); the pyramid of Usertesen II. (“) (El Lahun) ; the pyra- mid of Hawara (“) and colossi of Biahmu Q^ (Ame- nemhat III.).

Of the Xlllth-XVIIth Dynasties no great discovery has been made. An attempt to bring some of the Antef Icings into the Xlllth Dynasty (see A.Z. xxxiii. 77) is •contradicted both by the style of the monuments and by the list of the Turin Papyrus.

The most astonishing discovery of the 19th century was that of the actual mummies of many of the kings of the XVIIIth-XXIst Dynasties at Thebes (‘=>). They had been collected into two hiding-places for safety, the tomb of Amenhotep II. (a), and the tomb of the priest-kmgs of the XXIst Dynasty, near Deir-el-Bahri (&). The bodies iound (*) are those of : —

XVn Dynasty :

7 Seqenenra III. 6 XVIII Dynasty :

1 Aahmes I. b Nefertari 6

2 Amenhotep I. 6

3 Tahutmes I. h

4 Tahutmes II. 6

4 Merenptah a

5 Sety II. a

7 Siptah a

8 Setnekht a

XX Dynasty:

1 Ramessu III. 6

2 Ramessu IV. a

3 Eamessu V. a

4 Ramessu VI. a 10 Ramessu XII. (?) 6

XXI Dynasty :

1 Nezemt b

2 Painezem I. 6

3 Masahart b

4 Fainezem II. b

Fi&. 4. — Ebony Tablet of Mena ; the oldest written sentence known. (Circa 4700 B.C.)

To the age of the XVIIIth Dynasty belong some of the most important foreign connexions (f). The discovery at Tell-el-Amarna of some hundreds of tablets of cuneiform correspondence, between the kings of Egypt and the kings and governors of Mesopotamia and Syria, has shown a brief glimpse

~~of about ten or fifteen years out of an intercourse of some centuries : we see the wealth of Asia, the con- tinual passage of messengers and of commerce, and the position of Egypt in heading for a time the widespread civilization of the East (^) (”).~~

~~The other view is opened westwards by the common occurrence of early Greek pottery in Egypt and of Egyptian objects in Greece. In prehistoric times-^about~~

~~6 Tahutmes III. 6~~

~~7 Amenhotep II. a~~

~~8 Tahutmes IV. a~~

~~9 Amenhotep III. a XIX Dynasty :~~

~~1 Ramessu I. b~~

~~2 Sety I. b~~

~~3 Ramessu II. b~~

~~TAQEB-HEB.~~

~~Fig. 7.— Scarabs of Foreign Kings. (Circa 3450 b.c.)~~

~~6000 B. 0. — large ships (seen painted on tombs and vases) carried the trade of the Mediterranean, and brought foreign pottery to Egypt. In the 1st Dynasty the earliest style of Greek pottery yet known is found in the tombs of the kings (about 4500 B.C.), and the silvery alloy of the royal gold points to its source in Asia Minor. In the Xllth Dynasty pottery identical with that of Crete is found in the town ruins (Kahun), and designs from objects of the Xllth Dynasty are found in Crete, as also a diorite statue from Egypt. In the XVIIIth Dynasty hundreds of pieces of vases of Rhodian types are found in the palace rubbish~~

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of Tell-el-Araarna (^, and whole vases in many tombs ; and in Mycenae and Cyprus many objects of Amenhotep III., and copies of designs of his age, show the common intercourse. The connexions of Egypt and Greece are the foundation for all accurate knowledge of early European chronology.

In the XlXth Dynasty the lai-gest monument lately found is the black granite stele of Amenhotep III., reinscribed by Merenptah (^), giving an account of his triumph over the Libyan invaders (Plate, Eig. 9). At the close is a mention of "the people of Israel being spoiled and having no seed," an allusion the sense of which has been much disputed, but which is the only instauce of the name Israel on any ancient monument. The probability of the Exodus having taken place in this reign is discussed, and the short period of Judges advocated, in a paper in S.B.A.P. xviii. 243.

The succession of the XXIst Dynasty kings is still obscure (see Recueil, xxi. 9). In the XXIInd Dynasty began a series of observations on high Nile levels at Thebes, during three centuries (see A.Z. xxxiv. 95, 119). These corroborate the general rising of the Nile plain by the mud of the inundation. The origin of the XXIInd Dynasty was formerly attributed to Assyria, on the ground of the names Takeloth (Tiglath), Usarkon (Sargon), and Namuroth (Nimrod) ; then these were disputed, and a Libyan origin advocated because the eldest sons were princes of the Mashuash (Libyan Maxyes). This fact, however, does not preclude their eastern origin ; and the recent discovery of Shushanqu as a Babylonian name strongly corroborates the Mesopotamian origin of this dynasty.

Of the XXVth Dynasty are the important inscriptions at Karnak about the royal estates, the female priesthood of Amen, and the adoption of royal heiresses (see A.Z. XXXV. 12). For all later periods see Maspero (^) and Wiedemann (').

The ruling family of the XXVIth Dynasty was certainly foreign, as shown by their names, and probably Libyan. The type was quite un-Egyptian, as seen in the head of Psamtik I. (A.Z. xxxiii. 116). The co-regency of Apries and

Amasis is described on a monument, which shows that Apries was still in authority until slain in a rising in the third year of Amasis (Recueil, xxii. 1). The early historic Greeks in Egypt have been traced in their great settlement at Naukratis (), from which a large number of very early inscriptions were obtained, and also in their fort and camp at Daphnse (). These were the two main posts of mercenaries, west and east of the Delta. The Greek and Roman periods are so well known that there is no ground for great discoveries. But the large quan- tities of papyri found in recent years, in the Fayum and at Oxyrhynchos (^), have made us familiar with the details of government and daily life, as well as providing some very valuable literary remains.

Some mention should be made of the chronology. It is generally agreed that as far back as the beginning of the XVIIIth Dynasty (1587 b.c.) there is certain dating by the occasional records of the day of the rising of Sirius in the movable calendar, which shifted through all the seasons in 1460 years (■*). A recent discovery of a papyrus (A.Z.), which seems by the same methods to date the Xllth Dynasty to about 2000 b.c, is, however, stUl de- bated ; as such a date would leave an impossibly short time for the Xllllth-XVIIth Dynasties, it would seem rather that (if this record be accurate) the date must go back a whole cycle of 1460 years, and place the Xllth Dynasty about 3400 B.C., which would closely accord with the full chronology of Manetho as given by Africanus. There is also a vague dating of the inundation in the reign of Pepy I., which would place that Vlth Dynasty about

3400 B.C. Other datings have been proposed by Mahler : (1) in connexion with the new moons for Tahutmes III., which has lately been amended by working from the visible new moon and not the theoretical ; and (2) by the star diagrams in the Ramesside tombs — but as these do not accord well with the safer dating by Sirius, it seems that they were probably copied from diagrams drawn up a generation or two before. (See several papers in A.Z.)

In the shorter periods, within a dynasty, much help is gained by studying the family relations (*) ; even vague facts of the ages of mummies of the kings are of value in working out the family genealogies and the possibilities of lengths of reigns. In several instances the accuracy of M'anetho has been well verified : the kings of the 1st Dynasty are in their right order ; and in

the later periods the family histories accord well with the lengths of reigns which he states ; in one case, where most writers had discredited a reign of 26 years (Amenhotep II.), it has lately been entirely confirmed (^).

AKCH.ffi;0L0GY.

When the article in the ninth edition was written, scarcely anything was known of the ages of Egyptian products ; even the commonest, such as pottery and beads, were entirely undated. The work of the period since 1880 has especially been the accurate dating and history of every kind of handwork. The large amount of carefully conducted and recorded excavation by English workers has given opportunity for this, and we now can date most objects to within a single dynasty, and some- times to a single reign.

Pottery is the most important material for dating, as it is so common, so variable, and so short a time in use. The principal varieties are shown in Fig. 10. Of the prehistoric age there are feeveral different kinds of pottery more or less contemporary, and there is such a great variety of form that over 900 are drawn for reference. All is hand-made. It is from this variety that the relative dating of the prehistoric periods is obtained; and the range of each form in an adopted scale of "sequence dates" is published (') (‘). The later pre- historic pottery leads us to the forms of the 1st Dynasty (): Those of the IVth and Vth are well known (), and the wheel became almost universal in this age. The decay of this pottery in the following dynasties has been traced Q^, until the rise of a new style in the Xllth Dynasty (drab pottery). That class modified gradually into the XVIIIth Dynasty, when a new class of highly polished hard pottery appears ("). After the XlXth the periods are not accurately known till the XXVIth, when new classes appeared (^) ; the Ptolemaic is not well known, but the Roman is very familiar, espe- cially the ribbed amphorae beginning in the middle of the 2nd century, and the Constantino ware.

Beads have been carefully studied also. In the pre- historic age there is great variety, both in stone and in glazed stone and pottery. Few have been found in the Old Kingdom, but in the Vlth and Vllth Dynasties discs- of black and green glaze and minute beads of earnelian. and gold are usual

(‘). In the Xllth Dynasty are mostly large ball beads of amethyst, earnelian, and blue glazed pottery (^. In the XVIIIth Dynasty the beads are smaller ; glass begins, and is very varied and common at the close. Green glazed beads and amulets are usual in the XXIIIrd Dynasty. Little is known about beads after that, until the Roman age, when a profusion of glass beads again appears. The only dated collections of beads and of pottery for study are in University College, London.

Stone vases are usual from the beginning of the prehis- toric age (*) 0, at first cylindrical and later barrel^shaped..

PRINCIPAL TYPES OF EGYPTIAN POTTERY SCALE 1:20

EARLY PREHISTORIC 7000-6000 B.C.

LATER PREHISTORIC

6000-5000 6C. I^B III ^^. ^ .^ ^^A ^L M. m m

ftiifTtT^fft**

P^ DYNASTY 4800-4500 B.C

IVTH-vr DYNASTY 4000-3300 BC

ll»-

Xir”-DYNASTY 2800-2500 B.C

ft

XVIir** DYNASTY 1500-1350 BiC.

§•

XI XT” DYNASTY 1300- 1100 B.C

XXVr” DYNASTY 700-500 B.C.

H

if*

S\i

vlf

Fig. 10. — Pbincipal Types of Potteky of Ancient Egypt. (Scale 1 : 20.)

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[the languagb

The most magnificent stones and finest work were early in the 1st Dynasty, after which there is a continued deteri- oration throughout the history. Only soft stones, ala- baster and serpentine, were used in the Xllth and XVIIIth Dynasties. The history of the forms has been traced from the Vlth to the XVIIIth Dynasties (^). After that time stone was rarely worked into vases.

Copper was wrought into thin vessels as early as the 1st Dynasty. The forms of tools and weapons are well known from the Xlth to the XlXth Dynasties (»)(“) ; and the vessels of bronze from the XVIIIth Dynasty to the Roman age ; but much has yet to be done to write a continuous history. Copper alone, or with some harden- ing such as arsenic, was used till the Xllth Dynasty ; and bronze appears general in the XVIIIth. The life- size copper statue of King Pepy I. (Vlth Dynasty) is the largest piece of metal-work preserved; it shows a complete artistic mastery of the material.

Textiles have rarely been preserved from the prehistoric time. The finest weaving known is that of the 1st and Vlth Dynasties, in royal wrappings; considerable outfits of the latter age have been found Q^). Enormous quantities of mummy linen of the XVIIIth Dynasty to Roman times are found. The coloured textiles and embroideries are of Christian period, preserved owing to the change of burying immediately in the daily dress, instead of embalming (‘^).

The recent works referred to are : —

History in general. — Maspero, (1) Dawn of Civilization; (2) Struggle of the Nations; (3) Passing of the Empires (English edition best, being indexed). Petrie, (i) Student's History of Egypt, vols. i. ii. Wiedemann, (5) Geschichte. Maspero, (6) Egyptian Archaeology.

Prehistoric. — De Morgan, (7) Becherches, 1. li. Petrie, (8) Naqada ; (9) Diospolis Parva.

Early Dynasties. — Quibell, (10) Hierakonpolis, i. Petrie, (11) Koptos; (12) Boyal Tombs, i. ii. ; (13) Deshasheh.

Vlth-XIIIth Dynasties. — De Morgan, (14) Dahshur. Petrie, (16) Dendereh; (16) Hawara; (17) Kahun; (18) Illahun.

XVIIIth-XXth Dynasties. — Maspero, (19) Momies Boyales de Deir el Bahari. Petrie, (20) Tell el Amarna; (21) Syria and Egypt; (22) Six, Temples.

XXVIth Dynasty and on. — Gardner and Petrie, (23) Naukratis, i. andii. Petrie, (24) Tanis, ii. (Daphn(B). Mahaffy, (25) Empire of the Ptolemies. Milne, (26) Boman Egypt. Grenfell and Hunt, (27) Oxyrhynchus Papyri, &c.

Journals. — A.Z. Zeitschrift fur JEgyptische Sprache. Becueil, published by Maspero. S.B.A.P. (Proceedings of Society of Biblical Archmology.) (w. m. f. p.)

The Laijguage.

The elaborate article on Hieboglvphics by Dr Poole in vol. xi. of the ninth edition of the Encydopcedia Britan- nica was founded on the then (1880) standard work of De Roug^ ; the chief recent developments of Egyptian gram- matical knowledge began, however, in that year, and they are of sufficient importance to deserve a somewhat full notice. In 1880 Ludwig Stern {KoptiscJie Orammatile) admirably classified the. grammatical forms of Coptic. The much more difficult task of recovering the grammar of

Egyptian has occupied a quarter of a century of spe- cial study by Adolph Erman and his school at Berlin, and has now reached an advanced stage. The greater part of Egyptian texts after the Middle Kingdom having been written in what was even then practically a dead language, as dead as Latin was to the mediaeval monks in Italy who wrote and spoke it, Erman selected for special investiga- tion those texts which really represented the growth of the language at different periods, and, as he passed from one epoch to another, compared and consolidated his results.

The Neumgyptische Grammatik (1880) dealt with texts written in the vulgar dialect of the New Kingdom (Dyns. XVIII. to XX.). Next followed, in the Zeitschrift fur ^gyptische Sprache und Alter- thumskunde, studies on the Old Kingdom inscription of Una, and the Middle Kingdom contracts of Siut, as well as on an "Old Coptic " text of the 3rd century a,d. At this point a papyrus of stories

written in the popular language of the Middle Kingdom provided Erman with a stepping-stone from Old Egyptian to the Late Egyptian of the Neucegyptische Grammatik, and gave the con- nexions that would bind solidly together the whole structure of Egyptian grammar (see Sprache des Papyrus Westcar, 1889). The very archaic pyramid texts enabled him to sketch the grammar of the earliest known form of Egyptian (Zeitschrift d. Deutsch. Morgenl. Gesellschaft, 1892), and in 1894 he was able to write a little manual of Egyptian for beginners (^gyptische Grammatik), centring on the language of the standard inscriptions of the Middle and New Kingdoms, but accompanying the main sketch with references to earlier and later forms. Of the work of Erman 's pupils we may mention Steindorff's little Koptische Grammatik, 1894, improving greatly on Stem's standard work in regard to phonology and the relationship of Coptic forms to Egyptian, and Sethe's Das ^gyptische Verbum, 1890. The latter is an extensive work on the verb in Egyptian and Coptic by a brilliant and laborious philologist. Owing to the very imperfect notation of sound in the writing, the highly important subject of the verbal roots and verbal forms was perhaps the obscurest branch of Egyptian grammar when Sethe first attacked it in 1895. The subject has been reviewed by Erman, Die Flexion des ^gyptischen Verbums in the Sitzungsberichte of the Berlin Academy, 1900. The Berlin school, having settled the main lines of the grammai-, next

turned its attention to lexicography. It has devised a scheme, founded on that for the Latin Thesaurus of the Berlin Academy, which almost mechanically sorts the whole number of occurrences of every word in any text examined. Scholars. in England, America, and Denmark, as well as in Germany, are taking part in this great enterprise, and though the com-pletion of it may be far off, the collections of classified material already made are very valuable for consultation. At present Egyptologists depend on Heinrich Bmgsch's admirable but some- what antiquated Worterbuch and on Levi's useful but entirely uncritical Vocabolario. Though demotic has not yet received serious attention at Berlin, the influence of that great school has made itself felt amongst demotists, especially in Switzerland, Germany, America, and England. The death of Heinrich Brugsch in 1895 was a very severe blow to demotic studies ; but it must be admitted that his brilliant gifts lay in other directions than exact grammatical analysis. Apart from their philological interest, as giving the history of a remarkable language during a period of several thousand years, the grammatical studies of ..ne last quarter of the 19th century are beginning to bear fruit in regard to the exact interpretation of historical documents on Egyptian monuments and papyri. Not long ago the supposed meaning of these was extracted chiefly by brilliant guessing, and the published translations of even the best scholars could carry no guarantee of more than approximate exactitude, where the sense depended at all on correct recognition of the syntax. Now the translator proceeds in Egyptian with some of the sureness with which he would deal with Latin or Greek. The meaning of many words may be still unknown, and many constructions are still obscure ; but at least he can distinguish fairly between a correct text and a corrupt text. Egyptian writing lent Itself only too easily to misunderstanding, and the writings of one period were but half intelligible to the learned scribes of another. The mistaken readings of the old inscriptions by the priests at Abydos, when attempting to record the names of the kings of the 1st Dynasty on the walls of the temple of Sety I., are now admitted on all sides ; and no palaeographer, whether his field be Greek, Latin, Arabic, Persian, or any other class of MSS., will be surprised to hear that the Egyptian papyri and inscriptions abound in corruptions and mistakes. The translator of to-day can, if he wishes, mark where certainty ends and mere conjecture begins, and it is to be hoped that advantage will be taken more widely of this new power. The Egyptologist who has long lived in the realm of conjecture is too

~~prone to consider any series of guesses good enough to serve as a translation, and forgets to insert the notes of interrogation which would warn workers in other fields from implicit trust.~~

~~The stages of the language are now distinguished as follows : —~~

~~Old Egyptian. — This is properly the language of the Old Kingdom. In it we have (a) the recently discovered inscriptions of the 1st Dynasty, too brief and concise to throw much light on the language of that time ; and the great collections of spells and ritual texts found inscribed in the Pyramids of the Vth and Vlth Dynasties, which must even then have been of high antiquity, though they contain later additions made in the same style. (6) A few historical texts and an abundance of short inscrip- tions representing the language of the IVth, Vth, and Vlth Dynasties.~~

~~THE language]~~

~~The ordinary literary language of the monuments of its later ages is modelled on Old Egyptian. It is often much affected by contem- porary speech, but preserves in the main the characteristics of the language of the Old Kingdom.~~

~~, Middle and Late Egyptian. — These represent the vulgar speech of the Middle and New Kingdom respectively. The former is found chiefly in tales, letters, «&c., written in hieratic on papyri of the Xlllth Dynasty to the end of the Middle Kingdom ; also in some inscriptions of the XVIIIth Dynasty. Late Egyptian is seen in hieratic papyri of the XVIIIth to the XXIst Dynasties. The spelling of Late Egyptian is very extraordinary, full of false etymologies, otiose signs, ,&c., the old orthography being quite unable to adapt itself neatly to the profoundly modified language; nevertheless, this clumsy spelling is expressive, and the very mistakes are instructive as to the pronunciation.~~

Demotic. — Demotic Egyptian seems to represent ap- proximately the vulgar speech of the Saite period, and is written in the " demotic " character, which may be traced back to the XXVth Dynasty, if not to a still earlier time. With but moderate changes, this form of the language is found in documents reaching down to the fall of paganism in the 4th century a.d.^ In the earlier times the spelling is excessively concise; in later Ptolemaic and in the Roman period it is comparatively full and expressive. Though documents from Egypt in Greek are more abundant than in demotic, the language of the ruling classes had not penetrated the masses deeply.

Coptic. — This, in the main, represents the popular language of early Christian Egypt from the 3rd to per- haps the 8th century a.d., when the growth of Coptic as a literary language must have ceased. The Greek alphas bet, reinforced by a few signs borrowed from demotic, rendered the spoken tongue so accurately that five distinct, though closely allied, dialects are readily distinguishable in Coptic MSS. ; ample remains are found of renderings of the Scriptures into all these dialects. The distinctions between the dialects consist largely in pronunciation, but extend also to the vocabulary, word-formation, and syntax. Such interchanges are found as I for r, CP (Jc, ch) for x (dj), final i for final e, a for e, a for o. Early in the 2nd century a.d., pagan Egyptians, or perhaps foreigners settled in Egypt, essayed, as yet unskilfully, to write the native language in Greek letters. This Old Coptic, as it is termed, was still alm,ost entirely free from Greek loan- words, and its strong archaisms are doubtless accounted for by the literary language having moved more slowly than the speech of the people. Christian Coptic, though probably at first contemporary with some documents of Old Coptic, contrasts strongly with the latter. The monks whose task it, was to perfect the adaptation of the alphabet to the dialects of Egypt and translate the Scriptures out of the Greek, flung away all pagan tradi- tions. It is clear that the basis which they chose for the new literature was the simplest language of daily life in the monasteries, charged as it was with expressions taken from Greek, pre-eminently the language of patristic Christianity. There is evidence that the amount of stress on syllables, and the consequent length of vowels, varied greatly in spoken Coptic, and that the variation gave much trouble to the scribes ; the early Christian writers must have taken as a model for each dialect the deliberate speech of grave elders or preachers, and so secured a uniform system of accentuation. The

remains of Old Coptic, though very instructive in their marked peculiarities, are as yet too few for definite classification. The main divisions of Christian Coptic as recognized and

1 In the temple of Philae, where the worship of Isis was permitted to continue till the reign of Justinian, Brugsch found demotic m- scriptions with dates to the end of the Sth century.

named at present are : Sahidic (formerly called Theban); spoken in the upper Thebais. Akhmimic ; in the neigh- bourhood of Akhmim. Eayumie; in the Eayum (for- merly named wrongly " Bashmuric," from a province of the Delta). Memphite; in the neighbourhood of Memphis. Bohairic, the dialect of the "coast district" (formerly named " Memphite ") ; spoken in the north-western Delta. Coptic, much alloyed with Arabic, was spoken in Upper Egypt as late as the 15th century, but it has long been a dead language.^ Sahidic and Bohairic are the most important dialects, each of these having left abundant remains; the former spread over the whole of Upper Egypt, and the latter since the 15th century has been the language of the sacred books of Christianity through- out the country, owing to the hierarchical importance of Alexandria and the influence of the ancient monasteries established in the north-western desert.

Coptic is the only stage of the language in which the spelling gives a clear idea of the pronunciation. It is therefore the mainstay of the scholar in investigating or restoring the word-forms of the ancient language. Greek transcriptions of Egyptian names are sometimes valuable as evidence for the vocalization of Egyptian, and they abound as far back as the 4th century e.g., but they seem very inaccurate. A few cuneiform tran- scriptions, reaching as far back as the XVIIIth Dynasty, also give valuable hints. Coptic itself is of course quite inadequate to enable us to restore Old Egyptian. In it the Old Egyptian verbal forms are mostly replaced by periphrases; though the strong roots are often pre- served entire, the weaker consonants and the 37 have largely or entirely disappeared, so that the language appears as one of biliteral rather than triliteral roots. Coptic is strongly impregnated with Greek, words adopted late; moreover, a certain number of Semitic loan-words had flowed into Egyptian from the 16th century b.c. onwards, displacing earlier words. It is only by the most careful

scrutiny and the exercise of the most piercing insight that the imperfectly spelled Egyptian is made to yield up one grammatical secret after another in the light brought to bear upon it from Coptic. Demotic grammar ought soon to be thoroughly compre- hensible in its forms, and the study of late Egyptian should not stand far behind that of demotic. Middle Egyptian and Old Egyptian, on the other hand, will perhaps always be to us little more than consonantal skeletons, the flesh and blood of their vocalization being for the most part irretrievably lost.

In common with the Semitic languages, the Berber languages of North Africa, and the Cushite languages of North-East Africa, Egyptian of all periods possesses grammatical gender, expressing masculine and feminine. Singularly few language groups have this peculiarity; and our own great Indo-European group, which possesses it, is distinguished from those above mentioned by having the neuter gender in addition. The characteristic triliteral roots of all the Semitic languages seemed to separate them widely from others ; but certain traits have caused the Egyptian, Berber, and Cushite groups to be classed together as three subfamilies of a Hamitic group, remotely related to the Semitic. The biliteral character of Coptic, and the biliteralism which was believed to exist in Egyptian, led philologists to suspect that Egyptian might be a surviving witness to that far-ofE stage of the Semitic languages when triliteral roots had not yet been formed from presumed original biliterals ; Sethe's investigations, however, prove that the Coptic biliterals are them- selves derived from Old Egyptian triliterals, and that

2 The Arabic dialects which gradually displaced Coptic as Mahom- medanism supplanted Christianity adopted but a few words of the "'^ native stock.

the triliteral roots enormously preponderated in Egyptian of tlie earliest known form; that view is, therefore, no longer tenable. Many remarkable

resemblances have been observed in the grammatical structure of the Berber and Cushite groups with Semitic (of. Zimmern, Vergleichende Grammatik d. Semitischen Sprache, especially pronouns and verbs) ; but the relationship must be very distant, and there are no ancient documents that can take back the history of any one of those languages more than a few centuries. Their connexion with Semitic and Egyptian, therefore, remains at present an obscure though probable hypothesis. On the other hand, Egyptian is certainly related to Semitic. Even before the trUiterality of Old Egyptian was recognized, Erman showed that the so- called pseudo-participle had been really in meaning and in form a precise analogue of the Semitic perfect, though its original employment was almost obsolete in the time of the earliest known texts. Trihteralism is considered the most essential and most peculiar feature of Semitic. But there are, besides, many other resemblances in structure between the Semitic languages and Egyptian, so that, although the two vocabularies present few points of clear contact, there seems no adequate reason for doubting that Egyptian was originally a characteristic member of the Semitic family of languages. See Erman, Das Verhdlt- niss d. jEgpptiichen zu d. Semitischen Sprachen (Zeitschrift d. Deutschen Morgerd. Gesellschaft, 1892) ; Zimmern, Vergl. Gram. 1898 ; Erman, Meocion d. JSgyptischen Verbum (Sitzwngsberichte d. Berl. Alead., 1900). The Egyptians proper are not, and so far as we can tell never were, Semitic in physical feature. As a possible explanation of the facts, Erman supposes that a horde of conquering Semites, like the Arabs of a later day, imposed their language on the country, but disappeared, being weakened by the climate or absorbed by the native population. The latter acquired the Semitic language imperfectly from their conquerors; they expressed the verbal conjugations by periphrases, mispronounced the consonants, and so changed greatly the appearance of the vocabulary, which also would certainly contain a large proportion of native non-Semitic roots. Strong consonants gave way to weak consonants (as J (?) to I (‘), in the modem Arabic of Egypt), and then the weak consonants disappearing altogether produced biliterals from the trUiterals. Much of this must have taken place, according to the theory, in the prehistoric period ; but the loss of weak consonants, of y, and of one of two repeated consonants, and the development of periphrastic conjugations continued to the end. The typical Coptic root thus became bUiteral rather than triliteral, and the verb, by means of periphrases, developed tenses of remarkable precision —

^perhaps under the influence of Greek. Such verbal resemblances as exist between Coptic and Semitic are largely due to late exchanges with Semitic neighbours.

The following sketch of the Egyptian language, mainly in its earliest form, which dates from some three or four thousand years B.C., is-foundeduponErman's works. It willserve to contrast with Coptic grammar on the one hand'and Semitic grammar on the other.

. ' The Egyptian AlphaibeU

(J =^ ; so transcribed in this article, but is often n, especially

\ at the beginning of words, and from the earliest times

is used m a manner corresponding to the Arabic Tiamza, to indicate a prosthetic vowel. Often lost or changed to '.

=' (k) ; easily lost or changes to y.

=" (v) ; lost in Coptic. This rare sound, well known in Semitic, occurs also in Berber and Cushite languages.

=w ; often changes to y.

=b.

<^^> =r ; often lost, or changes to y. r and I are distinguished in later demotic and in Coptic.

ra =T^-\

y distinction lost in Coptic.

={- ; in Coptic ^(sA) or Ij {Jch) correspond to it.

=h ; generally written with i i (5) in the Old Kingdom, corresponds to kh in Coptic.

~~p -.~~

~~but~~

~~distinction lost at the end of the Old Kingdom. =S (sh).~~

~~^ =j; Coptic K.~~

~~'^ *i =A"|~~

~~J-Coptic K; or 2t, CT according to dialect.~~

~~a =< ; often lost at the end of words. S=» =i (9) ; often changes to «. Coptic T; or 2C , CT. <— *=^j =cJ ; in Coptic reduced to t.~~

~~^^ =^ (:) ; often changes to rf ; in Coptic 2i.~~

~~Moats.~~

~~Egyptian roots consist of consonants and semi-consonants only, the inflexion being effected by internal vowel-change and the addition of consonants or vowels at the beginning or end. The Egyptian system of writing, as opposed to the Coptic, showed only the consonantal skeletons of words : it could not record internal vowel — changes ; and semi-consonants, even when radicals, were often omitted in writing.~~

~~Fersonal Pronouns.~~

~~Sing. 1.~~

~~2.~~

~~c. yw (?) later wy. PI. m. /cw. f. in.~~

~~1. c. n.~~

~~2. c. tn.~~

~~Dh.~~

~~2. c iny.~~

~~3.~~

~~m. *fy, surviving only in a special verbal form.~~

~~3. m. in.~~

~~early lost, 3. c. Sny. except as suffix.~~

~~f. ^.~~

~~f. *H,~~

~~surviving as 3. c.~~

~~From these are derived the suffixes, which are shortened forms attached to nouns to express the possessor, and to verbs to express the subject. In the latter case the verb was probably in the participle, so that idmyy-Sn, "they hear," is literally "hearing are they." The singular suffixes are : 1. c. -y ; 2. m. -k, f. -t ; 3. m. -/, f. -i ; — the dual and plural have no special forms.~~

~~Another series of absolute pronouns is : 2. m. Jjoi, tw ; f. tmt, tm ; 3. m. hvt. Mo ; f. Ut, St. Of these twt, imt, &o., are emphatic forms.~~

~~Many of the above absolute pronouns were almost obsolete even in the Old Kingdom. In ordinary texts some survive, especially as objects of verbs, namely : ioy, tw, tn, sw, st. The suffixes of all numbers and persons except the dual were in full use throughout, to Coptic ; -in, however, giving way to a new suffix, -w, which developed first in the New Kingdom.~~

~~Another absolute pronoun of the first person is ynk, AKIOK , like Heb. 'D3^s. It is associated with a series for the second and third persons : nt-k, nt-t, nt-f, nt-in, &c. ; but from their history, use, and form, it seems probable that the last are of later formation, and are not to be connected with the Semitic pronouns (chiefly of the 2nd person) resembling them.~~

~~Demonstrative Pronovns.~~

There are several series based on m. ^ ; f. < ; pi. n ; but ra as a. plural seems later than the other two. From them are developed a weak demonstrative to which possessive suffixes can be attached, producing the definite and possessive articles (p', t', n', "the," p'y-f, "his," p'y-s "her,"&c.) of Middle Egyptian and the later language.

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Nov/m.

Two genders, m. (ending w, or nothing), f. (ending «)• Three numbers : singular, dual (m. wy, f. ty, gradually became obsolete), jilural (m. w ; f. wtj. No case-endingd are recognizable, but con- struct forms— to judge by Coptic — were in use. Masculine and feminine nouns of instrument or material are formed from verbal roots by prefixing m ; e.g., m.sdm.t, " stibium," from sdm, "paint the eye." Substantives and adjectives are formed Irom substan- tives and prepositions by the addition of y in the masculine ; e.g., n.t, "city," nt.y, "belonging to a city," "citizen"; hr,

"upon," hr.y (f. hr.t ; pi. hr.w), "upper." This is not unlike the Semitic nisbe ending iy, ay {e.g., Ar. beled, "city," beledi,

" belonging to a city "). Adjectives Ibllow the nouns ihey qualify.

NumeralSi

1, w ; 2, Sn; 3, hmt ; 4, fdw ; 5, dw' ; 6, sys ; 7, s/J, ; 8, ^mn ; 9, psd ; 10, mt. 2, 6, 7, 8, and 9 (?) resemble Semitic numerals. 20 and 30 (m'J) had special names ; 40-90 were named as if plurals of the units 4-9, as in Semitic. 100, Snt ; 1000, j.' ; 10,000, s6' ; 100,000, hfnw.

Verbs.

The forms observable in hieroglyphic writing lead to the follow- ing classification : —

Strong Vebbs. BUiteral . . Often showing traces of an original

III. inf. ; in early times very rare. Triliteral . . Very numerous.

f Generally formed by reduplication. r.] -T, , In late Egyptian they were no

Quadriliteral , ^ inflected, and were con-

Qmnquehteral |j =^3^ ^^^^ ^^^ j^^j „j.

I "do." Weak Veebs. ii. geminatse . Properly triliterals, but, with^the

2nd or 3rd radical alike, these coalesced in many forms wliere no vowel intervened, and gave the word the appearance of a biliteral.

III. gem. . , . Eare.

III. inf. . . . Numerous. III. w, and iii. y were unified early. Some very common verbs, "do," ' ' give, " ' ' come, " ' ' bring " are irregular.

IT. inf. . . . Partly derived from adjectival formations in y, from nouns and infinitives: — e.g., i.yp, inf. iypt ; adj. hjply ; verb (4 lit.).

Many verbs with weak consonants — \y, Ijo, it. inf. (m[w]i), and those with K — are particularly diflBcult to trace accurately, owing to defective writing.

It seems that all the above classes may be divided into two main groups, according to the form of the infinitive : — with masculine in- finitive the strong triliteral type, and with feminine infinitive the type of the iii. inf. The former group includes all except iii. inf., IV. inf., and the causative of the biliterals, which belong to the second group.

It is probable that the verb had a special form denoting condi- tion, as in Arabic. There was a causative form prefixing S, and traces of forms resembling Ptcl and Niphal are observed. Some roots are reduplicated wholly or in part with a frequentative meaning, and there are traces of gemination of radicals.

Psevdo-Partiaiple. — In very early texts this is the past indicative, but more commonly it is used in sentences such as, gm-n-f wy ‘ h’.kivy, “he found me I stood,” i.e., “he found me standing.” The indicative use was soon given up and the pseudo-participle was employed only as predicate, especially indicating a state ; e.g., ntr.t hn.ty, “the goddess goes”; yw-k w^.ty, “thou art prosperous.” The endings were almost entirely lost in New Egyptian. For early times they stand thus : —

y, late w. Dual wyy. PI. w.

Sing. 3. masc.

fem. 2. masc.

fem. 1. c.

ty. ty. ty. kwy.

tyyw.

ty.

wyn.

The pseudo-participle seems, by its inflection, to have been the perfect of the original Semitic conjugation. The simplest form being that of the 3rd person, it is best arranged like the corre- sponding tense in Semitic grammars, beginning with that person. There is no trace of the Semitic imperfect in Egyptian. The ordi- nary conjugation is formed quite differently. The verbal stem is here followed by the subject-suffix or substantive— ^^m-/, “lie

hears”; “itfmu) ^

idm-f, “he hears”; idm-w-f, “he is heard” (pi. idm-yy-Sn, “ “they are heard”); idm-tw-f, “he is heard”; idm-n-f, “he heard”; iim-n-tw-f, ” he was . heard ” ; also, hdm-yn-f, &dm-hr-f, ^din-h’-f. Each form has special uses, generally difficult to define. id/in-f seems rather to be imperfect, idm-n-f perfect, and generally to express the past. Later, &dni-f is ordinarily

~~expressed by peii- phrases ; but by the loss of n, Mm-»-/ became itself sdm-f, wliich is the ordinary past in demotic. Coptic preserves &dm-f forms of~~

~~many verbs in its causative [e.g., TAMljOq "cause him to live,"~~

~~from Egyptian dy.t 'nh-f), and, in its periphrastic conjugation, the same forms of wn, "be," and yry, "do." With idm-f [iedmo-f) was a more emphatic iorm {eidomef), at any rate in the weak verbs.~~

~~The above, with the relative forms mentioned below, are sup- posed by Erman to be derived from the participle, which is placed first for emphasis: thus, idm.io Htn, "hearing is the king"; idm-f, for sdm-f y, "hearing he is." This Egyptian paraphrase of Semitic is just like the Irish paraphrase of English, " It is hearing he is."~~

~~The imperative shows no ending in the singular ; in the plural it has y, and later w ; cf. Semitic imperative.~~

~~The infinitive is of special importance on account of its being preserved very fully in Coptic. It is generally of masculine Iorm, but feminine in 111. inf. (as in Semitic), and in causatives of biliterals.~~

~~Theusii' are relative forms of idm-f and idni-nf, respectively idm.w-f (masc), idm.t-n-f (fem.), ho. They are used when the relative is the object of the relative sentence, or has any other position than the subject. Thus Mm. i-/ may mean "she whom he hears," "she who[se praises] he hears," "she [to] whom he hears [someone speaking]," &c. There are close analogies between the function of the relative particles in Egyptian and Semitic ; and the Berber languages possess a relative form of the verb.~~

~~Participles. — These are active and passive, perfect and imper- fect, in the old language, but all are replaced by periphrases in Coptic.~~

~~Verbal Adjectives. — There is a peculiar formation, idm-ty-fy, "he who shall hear," probably meaning originally "he is a hearer," idm.ty being an adjective in y formed from a feminine (t) form of the infinitive, which is occasionally found even in triliteral verbs; the endings are: sin^., masc. ty-fy, fem. ty-iy ; pi., masc. ty-ln, fem. ty-it. It is found only in Old Egyptian.~~

Particles. — There seems to be no special formation for adverbs, and little use is made of adverbial expressions. Prepositions, simple and compound, are numerous. Some of the commonest simple propositions are n "for," r "to," m "in, from," hr " upon. A few enclitic conjunctions exist, but they are indefinite in meaning — iwt a vague "but," grt a vague "moreover," &o.

Coptic presents a remarkable contrast to Egyptian in the pre- cision of its periphrastic conjugation. There are two present tenses, an imperfect, two perfects, a, pluperfect, a present and a past frequentative, and three futures besides future perfect ; there are also conjunctive and optative forms. The negatives of some of these are expressed by special prefixes. The gradual growth of these new forms can be traced through all the stages of Egyptian. Throughout the history of the language we note a tendency to periphrasis and pleonasm ; but there was no great advance towards precision before demotic. In demotic there are distinguishable a present tense, imperfect, perfect, frequentative, future, future perfect, conjunctive, and optative ; also present, past, and future negatives, &c. The passive was extinct before demotic ; demotic and Coptic express it, clumsily it must be confessed, by an im- personal "they," e.g., "they bore him" stands for "he was born."

It is worth noting how, in other departments besides the verb, the Egyptian language was far better adapted to practical endsduring and after the period of the Deltaic dynasties (XXII.XXX.) than ever it was before. It was both simplified and enriched. The in flections rapidly disappeared, and little was left of the distinctions between masculine and feminine, singular dual and plural — except in the pronouns. The dual number had been given up entirely at an earlier date. The pronouns, both personal and demonstrative, retained their forms very fully. As prefixes, suffixes, and articles, they, together with some auxiliary verbs, provided the principal mechanism of the renovated language. An abundaiit supply of useful adverbs was gradually accumulated, as well as conjunctions, so far as the functions of the latter were not already performed by the verbal prefixes. These great improvements in the langua<;e correspond to great changes in the economic condition of the country ; they were the result of active trade and constant inter- course of all classes of Egyptians with foreigners from Europe and Asia. Probably the best stage of Egyptian speech was that

which immediately preceded Coptic. Though Coptic is here and there more exactly expressive than the best demotic, it was spoilt

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[the whiting.

by too much Greek, duplicating and too often expelling native exprossious that were already adequate tor its very simple re<.|uire- mouts. Above all, it is absuidly aud clumsily pleonastic.

The Wetting.

The ancient Eg3rptian system of •writing, so far as we know, originated, developed, and finally expired strictly within the limits of the Nile Valley. The germ of its existence may have come from without, but, as we know it, it is essentially Egyptian and intended for the expres- sion of the Egyptian language. About the 2nd century B.C. the semi-barbarous inhabitants of Ethiopia contrived to adapt it to their own idiom in modified forms of hiero- glyphic and demotic, which are still undecipherable, and the demotic writing of Ethiopia may have been employed as late as the 5th or 6th century a.d. Egyptian hiero- glyphic was carried by conquest into Syria, certainly under the XlXth Dynasty, and again under the XXVIth for the engraving of Egyptian inscriptions ; but in the earlier period the cuneiform syllabary, and in the later the " Phoenician " alphabet, had obtained a firm hold there, and we may be sure that no attempt was made to substitute the Egyptian system for either of these. In very early times a number of systems of writing already reigned in different countries forming a compact and not very large area — from South Arabia to Asia Minor, and from Persia to Crete and Egypt. Whether they all sprang from one common stock of picture-writing we shall perhaps never know, nor can we as yet trace the influence which one great system may have had on another. From the evi- dence at present available, it seems likely that Egyptian hieroglyphic was not the direct ancestor of any system outside the valley of the NUe.

It is certain that the mode of vsriting in Egjrpt from the IVth Dynasty onwards was essentially the same as that which was extingtushed by the fall of paganism in the 4th century a.d. Its elements in the hieroglyphic form are pictorial, but each hieroglyph has one or more well- defined functions, fixed by convention in such a manner that the Eg3rptian language is expressed word by word. Although a picture sign may at times have embarrassed the skilled native reader by offering a choice of fixed values or functions, it was never intended to convey merely an idea, so as to leave to him the task of putting the idea into his own words. How far this holds good for the period before the rVth Dynasty it is difficult to say. The known inscrip- tions of the earlier times are so brief and so limited in range that the mode of writing them cannot yet be fully investi- gated. As far back as the 1st Djmas^, phonograms (see below) were in full use. But the spelling then was very con- cise : it is possible that some of the slighter words, such as prepositions, were omitted in the writing and were intended to be supphed from the context. As a whole, we gain the impression that a really distinct and more primitive stage of hieroglyphic writing by a substantially vaguer notation of words lay not far behind the time of the 1st Dynasty.

The employments of the signs are of three kinds : each represents (1) a whole word ; or (2) a sound as part of a word ; or (3) pictori- ally defines the meaning of a word the sound of which has already been given by a, sign or group of signs preceding. For instance, f™^ is the conventional picture of a draughtboard (shown in plan), with the draughtsmen (shown in elevation) on its edge : — this sign (1) signifies the word mn, "set," "firm" ; or (2),

111""%

in the group ^, represents the same sound as part of the word

mmg., "good" ; or (3), in the group wvwa {•"••"•>,, snt, it shows that

the meaning is a "draughtboard," or "draughts." Thus signs, according to their employment, are said to be (1) "word-signs," (2) "phonograms," or (3) "determinatives."

WoKD-SiGNS. — The word-sign value of a sign is, in the first place.

the name of the object it represents, or of some material, or quality, or action, or idea suggested by it. Thus ^ is i^r, "face";

W , a vase of ointment, is mrh.t, " ointment " ; ■■ is wdb,

" turn." Much investigation is stiU required to establish the origins of the values of the signs ; in some eases the connexion between the pictures and the primary values seems to be curiously remote. Probably all the signs in the hieroglyphic signary can be employed in their primary sense. The secondary value expresses the conso- nantal root of the name, and any, or almost any, derivative from that root : as when . n . , a mat with a cake upon it, is not only hip, an "offering-mat," but also htp in tlie sense of "conciliation," "peace," "rest," "setting" (of the sun), with many derivatives. In the third place, some signs may be transfei-red to express another root having the same consonants as the first : thus ^ , the ear, by a play upon words can express not only HM, "hear," but also idm, "paint the eyes."

Phonograms. — Only a limited number of signs are found with this use, but they are of the greatest importance. By searching throughout the whole mass of inscriptions, earlier than the periods of Greek and Koman rule, when great liberties were taken with the writing, probably no more than one hundred different phonograms can be found. The number of those commonly employed in good writing is between seventy and eighty. The most important phono- grams are the utjiliteral or alphabetic signs, twenty-tour in nimiber m the Old Kingdom and without any homophones : later these were increased by homophones to thirty. Of bifiteral phonograms — each expressing a combination of two consonants — there were about fifty commonly used : some fifteen or twenty were rarely used. As Egyptian roots seldom exceeded three letters, there was no need for triliteral phonograms to spell them. There is, however, one tri-

literal phonogram, the eagle.

, tyw, or tin (?), used for the

plural ending of adjectives in y formed from words ending in t (whether radical or the feminine ending).

The phonetic values of the signs are derived from their word- sign values and consist usually of the bare root, though there are rare examples of the retention of a flexional ending ; they often ignore also the weaker consonants of the root, and on the same principle reduce a repeated consonant to a single one, as when the hoe f\, Tinn, has the phonetic value hn. The history of some of the alphabetic signs is still very obscure, but a suflScient number of them have been explained to make it nearly certain that the values of all were obtained on the same principles.' Some of the ancient words from which the phonetic values were derived probably fell very early into disuse, and may never be discoverable in the texts that have come down to us. The following are among those most easily explained : —

(I , reed flower, value y and X ; from (1 '^. '^T , y', " reed."

(It seems as if the two values y and K are obtained by choosing first one and then the other of the two semi-consonants composing the name.)

1 , forearm, value "(1') j f" "^ > , mouth, = r \ ,,

belly and teats, = b; ,,

I

", '(V), "hand."

, v, "mouth."

, b-t, " beUy." (The feminine ending is hero, as usual, neglected.) I I, tank, value X ; from ' ', J, "tank."

^ .slope, = ,.. ,, W ,".,.,^'.

(The doubled weak consonant is here neglected.)

I, hand, value d; from '^, d.t, "hand."

^'

cobra,

^n- ‘■” ”

cobra.”

For some alphabetic signs more than one likely origin might be found, while for others, again, no clear evidence of origin is yet forthcoming.

‘ ” Acrophony ” (giving to a sign the value of the first letter of its name) was indulged in only by priests of the latest age, inventing fan- tastic modes of writing their ” vain repetitions ” on the temple walls.

THE WEITING.]

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It has already been explained that the writing expresses only consonants. lu the Graeoo — Roman period various laiperfeut attempts were made to render the vowels in foreign names and ■words by the semi-vowels as also by n , the consonant ‘aiyin,

which n originally represented, having been reduced in speech

b;, that time to the power of aUph only. Thus, IlToXe/iaios is spelt Ptwrm/ys, Antoninus, ‘M’nynws or Yntv/yns, &c. &c. Much earlier, throughout the New Kingdom, a special “syllabic” orthograpliy was used for foreign names and words ; according to W. MaxMuller (Amnvrnd Europa, 1893, chap, v.), this represents an endeavour to express the vocalization ; but, if so, it was carried out with very little system.

Determinatives. — Almost any sign can be used as a determin- ative, but there are certain generic determinatives that are very common, e.g. : —

A^ ; of all actions of the mouth — eating and speaking, likewise ^0 silence, and hunger.

nwww , ripple-lines ; of liquid.

j.^, hide ; of animals, also leather, &o. ■^^ ; of plants and fibres.

I "^ I, a sealed papyrus-roll ; of books, teaching, law, and of abstract ideas generally. Orthography. — The most primitive form of spelling in the hieroglyphic system would be by one sign for each word, and the monuments of the 1st Dynasty show a decided tendency to this mode. Examples of it in later times are preserved in the royal cartouches, for here the monumental style demanded special con- ciseness. Thus, for instance, the name of Thothmes III. —

MK-HPE-E

I'— is spelled f O c=S ^ j. (As K is the name of the

Sun-god, with customary deference to the deity it is written first though pronounced last.) A number of common words — preposi- tions, &o. — with only one consonant are spelled by single alpha- betic signs in ordinary writing. Word-signs used singly for the names of objects are generally marked with I in classical writing.

-9', yb, "heart," "f,

hr, "face," &c.

But the use of bare word-signs is not common. Flexional con- sonants are almost always marked by phonograms, except in very

early times ; as when the feminine word ^^ = z.t, "cobra," is

spelled ^^ . Also, if a sign had more than one value, a phono- gram would be added to indicate which of its values was intended : thus 1 in l^isM "he," but in £ it is Un, "king."

Further, owing to the vast number of signs employed, to prevent confusion of one with another in rapid writing they were generally provided with " phonetic complements," a group being less easily

misread than a single letter. E.g. 9, wd, "command," is regu- larly written <• >0, WfZM ; but T, Js, "white," is written , Y ^^, hz{z). Redundance in

writing is the rule ; for instance, V

is often spelled J "i^ '(*)' (' ^ - i ^^^^l phonograms are

very rare as phonetic complements, nor are two biliteral phono- grams employed together in writing the radicals of a word.

Spelling of words purely in phonetic or even alphabetic charac- ters is not uncommon, the determinative being generally added. Thus in the pyramid texts we find in one copy of a text Jipr,

"become," written , in another ® . Such variant spell- ings are very important for fixing the readings of word-signs It is noteworthy that though words were so freely speUed m alpha-

betic characters, especially in the time of the Old Kingdom, no advance was ever made towards excluding the cuuibersouie word- signs and biliteral phonograms, which, by a judicious use of deter- minatives, might well have been rendered quite superduous.

PALiEOOBAPHY. — Hieroglyphic. — The main division is into monumental or epigraphic hieroglyphs and written hiero- glyphs. The former may be rendered by the sculptor or the painter in stone, on wood, &c., with great delicacy of de- tail, or may be simply sunk or painted in outline. When finely rendered tliey are of great value to the student investigating the origins of their values. No other system of writing liears upon its face so clearly the history of its development as the Egyptian ; yet even in this a vast amount of work is still re- quired to detect and disentangle the details. Monumental hiero- glyphic did not cease till tlie 3rd century a.d. The written hieroglyphs, formed by the scribe \vith the reed pen on papyrus, leather, wooden tablets, &;c., have their outlines more or less abbreviated, producing eventually the cursive scripts hieratic and demotic. The written hieroglyphs were employed at all periods, especially for religious texts.

Hieratic. — A kind of cursive hieroglyphic or hieratic writing is found even in the 1st Dynasty. In the Middle Kingdom it is well characterized, and in

~~its most cursive form seems hardly to retain any definable trace of 'the original hieroglyphic pictures. The style varies much at different periods.~~

~~Demotic. — Widely varying degrees of cursiveness are at all periods observable in hieratic ; but, about the XXVIth Dynasty, which inaugurated a great commercial era, there was something like a definite parting between the uncial hieratic and the most cursive form afterwards known as demotio. The employment of the one was thenceforth almost confined to the copying of religious texts on papyrus, while the other was used for all common purposes. Towards the end of the Ptolemaic period, though hieroglyphic and hieratic continued to be employed, demotio became the medium for writing every class of text, literary and religious works as well as the legal documents and letters, to which its use up to tliat time seems to have been practically limited. The cursive ligatures of old demotic had given birth ti; new symbols which were carefully and distinctly formed, and an epigraphic variety was engraved on stone, as in the case of the Rosetta Stone itself. One of the most characteristic distinctions of later demotio is the minuteness of the writing.~~

~~Egypt had long been bilingual when, in papyri of the 2nd century A.D., we begin to find transcripts of the Egyptian language into Greek letters : so written we have a magical text and a horoscope, probably made by foreigners or for their use. The infinite superiority of the Greek alphabet with its full notation of vowels was readily seen, but religious scruples as yet barred the way to its full adoption. The triumph of Christianity banished the old system once and for all ; even at the beginning of tho 4th century the native Egyptian script scarcely survived north of the Nubian frontier at Philse ; a little later it expired entirely, leaving six signs as a legacy to the Coptic alphabet.~~

~~For investigations into the origins of hieroglyphs, see Petrie's Medum, 1892, and the Memoirs of the Archaeological Survey of the Egypt Exploration Fund, especially Beni Hasitn, pt. iii., 1896 ; A Collection of Hieroglyphs, 1898 ; and TheMastaba ofPtah- hetep and Akhethetep, pt. i. 1900. (f. Ll. G.)~~

~~Ehrenfeld, formerly a town of Prussia, now united municipally with Cologne (q.v.). Population (1900),~~

26,895.

EibenstOCk, a town of Germany, near the Mulde, 17 miles south-south-east by rail of the town and in the circle of Zwickau, kingdom of Saxony. It is a principal seat of the tambour-embroidery. Population (1890),

7166; (1900), 7468.

Eider, a river of Prussia, in the province of Schleswig- Holstein. It rises to the south of Kiel, flows first north, then west (with vidde- sweeping curves), and after a course of 117 miles enters the North Sea at Tonning. It is navigable up to Eendsburg, and is embanked through the marshes, across which in its lower course it cuts its way. The Eider Canal, constructed in 1777-84, leaves the Eider at the point where it turns to the west and enters the Bay of Kiel at Holtenau. Length, 28 miles ; super-

ficial width, 100 feet ; depth, 11| feet. It was hampered by six sluices, but was used annually by some 4000 vessels. This was in 1887-95 converted into the Emperor William Canal, for which see Canals.

Eiffel Tower. — Erected for the Exposition of 1889, the Eiffel Tower, in the Champ de Mars, Paris, is by far the highest artificial structure in the world, and its height of 300 metres (1092 feet) surpasses that of the obelisk at Washington by 537 feet, and that of St Paul's Cathedral by 688 feet. Its framework is composed essen- tially of four uprights, which rise from the corners of a square measuring 100 metres on the side; thus the area it covers at its base is nearly 2^ acres. These uprights are supported on huge piers of masonry and concrete, the foundations for which were carried down, by the aid of iron caissons and compressed air, to a depth of about 15 metres on the side next the Seine, and about 9 metres on the other side. At first they curve upwards at an angle of 54° ; then they gradually become straighter, until they unite in a single shaft rather more than half-way up. The first platform, at a height of 57 metres, has an area of 5860 square yards, and is reached either by staircases or lifts. The next, accessible by

lifts only, is 115 metres up, and has an area of 32 square yards ; while the third, at 276, supports a pavilion capable of holding 800 persons. Nearly 25 metres higher up still is the lantern, with a gallery 6 metres in diameter. The work of building this striioture, which is mainly composed of iron lattice-work, was begun on 28th January 1887, and the full height was reached on 13th March 1889. Begides being one of the sights of Paris, to which visitors resort in order to enjoy the extensive view that can be had from its higher galleries on a clear day, the tower is used to some extent for scientific and semi-scientific purposes ; thus meteorological observations are carried on. It formed the objective in the flying-machine trials of Octo- ber 1901, when M. Santos-Dumont succeeded in winning the Deutsch prize with an air-ship designed and con- structed by himself. The engineer under whose direction the tower was constructed was M. Alexandke Gustavb Eiffel (born at Dijon on 15th December 1832), who had already had a wide experience in the construction of large metal bridges, and who designed the huge sluices for the Panama Canal, in connexion with which there were the famous scandals in 1893.

Eilenburg, a town of Prussia, province of Saxony, 31 miles by rail east from Halle. It has manufactures of cloth, calico, chemicals, machinery, tobacco, and baskets, quilting, and brewing. Population (1885), 11,032 ; (1900),

15,145.

Einbeck, a town of Prussia, province of Hanover, 50 miles by rail south from Hanover. The municipal anti- quarium museum is preserved in the chapel (restored) of Zum Heiligen Geist. Here are an engineering school and a textile school. Population (1885), 7091 ; (1900), 7974.

Eisenach, a town of Germany, second capital of the grand duchy of Saxe-Weimar, at the north-west foot of the Thuringian Forest, 32 miles by rail west from Erfurt. The Nicolai Kirche was restored in 1887, and Georg Kirche in 1899. There are monuments to Sebas- tian Bach (1884), to Luther (1895), and to the war of 1870-71. The house (now museum) in which Fritz Renter lived (1863-74), his grave in the new churchyard, and the Richard Wagner Museum should be mentioned. At Eisenach are a school of forestry, a school of design and the industrial arts, teachers' seminaries, an infirm- ary, and a prison. Population (1885), 19,743; (1901),

~~31,580.~~

~~Eisenerz (" Iron ore "), a market-place and old min- ing town in the government district of Leoben, Upper Styria, Austria, the chief centre of the Styrian iron in- dustry. It is situated in a deep valley, dominated on the east by the Pfaffenstein (6140 feet) and on the west by the Kaiserschild (6830 feet). It has an interesting example of a mediaeval fortified church, a Gothic edifice founded by Rudolph of Hapsburg in the 13th century and rebuilt in the 16th. The Erzberg, or Ore Mountain, which closes the valley on the sbuth, furnishes such rich ore that it is quarried in the open air like stone, in the summer months. There is documentary evidence of the mines, having been worked as far back as the 12th century. They afford en^ployment to two to three thousand hands in summer and about half as many in winter, and yield some 160,000 tons of iron per annum. Eisenerz possesses, in addition, twenty five furnaces, which produce iron, and particularly steel, of exceptional excellence. It is con nected with the neighbouring mining and smelting centre of Vordernberg, at the other side of the Erzberg (300O inhabitants), by a mountain railway on the cogged-wheel system, with an average gradient of 68 : 1000. Populatioa~~

~~(1890), 5740; (1900), 6494.~~

~~Eisleben, a town of Prussia, province of Saxony, 24 miles by rail west by north from Halle. It was the birthplace and deathplace of Luther, to whom a monu- ment by Siemering was unveiled in 1883. Eisleben has a mining school, and is the seat of copper, silver, and iron mines, and of works for smelting the ore, and also produces flower and vegetable seeds. Population~~

~~(1885), 23,175 ; (1900), 23,898.~~

~~Ekaterinburg, a district town of Russia, 311 miles by rail south-east of Perm, on the Iset river. It is the most important and most rapidly developing town of the Urals. Population (I860), 19,830; (1897), 55,488. It is the seat of the central mining administration, and has a mining chemical laboratory for the assay of gold extracted both in the Urals and Siberia, a mining school, an Imperial stone-cutting factory, the Ural Society of Naturalists, a first-class magnetic and meteorological observatory, and many banks. Altogether, it is one of the best provincial towns of Russia. There are,~~

besides, one large steam flour mill, candle works, several machinery works, woollen mills, paper works, soap works, and tanneries, and many stone-cutting factories and workshops, the produce of which is widely exported. Altogether, over 2000 persons work in. the factories, and nearly as many in the workshops. Many of the residents are engaged in gold mining. The trade in goods exported from the Urals and imported from Russia is very large, and two important fairs are held. Nearly 40 gold and platimim mines, 32 iron works, and numbers of other works and factories are scattered in the district, while wheels, travelling boxes, all sorts of hardware, boots, and so on, are fabricated on a great scale in the villages.

Ekaterinodar, a town of Russia, North Caucasia, capital of the province of Kuban, situated on the right bank of the Kuban, 531 miles north-west of Tiflis, on the railway from Rostov to Novorossiysk, 85 miles by rail from this seaport. Founded in 1794 as a small fort, its population has grown from 9620 in 1860 to 65,700 in 1897. It has gymnasia for boys and girls, various pro- fessional schools, an experimental fruit-farm, and a natural' history museum. A considerable trade, especially in grain, is carried on by its merchants.

Ekaterfno-Nikolskaya, a Cossack village of Russia, province of the Amur, 340 miles below Blagovyes- chensk, at the spot where the Amur enters a gorge through which it pierces the Little Khingan. The road which runs along the middle Amur ends at this spot, and when the

river carries ice in spring and winter, all communication with the lower Amur is practically interrupted there. It is the centre of government for the Amur Cossacks. Population, about 2000.

Ekaterinoslav, a province of South Eussia, hav- ing Poltava and Kharkoff on the N., the Don province on the E., the Sea of Azov and Taurida on the S., and KhersoiiontheW. Area, 24,478 square miles. Its surface is undulating prairie gently sloping south and north, with a few hills reaching 1320 ft. in the north-east, where a gentle swelling (the Don Hills) compels

the Don to make a great curve eastwards. Another row of hills, to which the east- ward bend of the Dnieper is due, rises in the west. These hills have a crystalline core (granites, syenites, and dio- xites), while the surface strata are Carboniferous, Per- mian, Cretaceous, and Tertiary. The province is rich in minerals, especially in anthracite and coal, iron ores, and rock-salt. Granite, limestone, grindstone, slate, as also graphite, manganese, and mercury, are found. It is watered by the Dnieper, the Don, and their tributaries, and several afluents of the Sea of Azov. The soil is a very fertile black earth, but the crops have occasion- ally to suffer from droughts — the average yearly rainfall being only 15 inches. Forests are scarce. Popular tion(1860), 1,138,750; (1897), 2,112,661— chiefly Little Russians, partly Great Russians, and some Greeks. The land is owned as follows : the peasants hold in communal ownership 37 per cent., and in private ownership 4 per cent. ; nobility, 31 per cent. ; German colonists, 9-5 per cent. ; Greeks, 7 per cent. ; the remainder being owned by various persons and companies.

Wheat Is grown extensively with the aid of modern machinery, and the average crops are 7,580,000 quarters of various cereals, 677,000 quarters of potatoes, and about 1000 cwt. of tobacco. Vines have been grown lately. There were in 1895, 295,670 horses, 653,770 horned cattle, and 2,174,350 sheep — nearly 6700 tons of raw wool being obtained every year. Mining attains every year more and more importance, the returns in South Russia (Ekater- inoslav and Don) being, in 1896, coal from 83 mines, 2,926,000 tons (12,000 workers) ; iron ore from 19 mines, 1,208,000- tons ; manganese ore (4 mines), 45,550 tons ; iron (all in Ekaterinoslav), 608,600 tons ; steel, 51,100 tons ; rails, 246,000 tons ; iron goods, 50,000 tons. Besides, mercury, ore, and fireclay are extracted. Nearly 40,000 persons find occupation in factories, of which the iron works and the 34 agricultural machinery works are the most import- ant, while in the district of Mariupol the making of agricultural implements and machinery has undergone a very great extension as a domestic industry in the villages. Grain is exported to a very large extent (about 950,000 tons, and 520,000 tons in transit), ria the Dnieper, the Sebastopol railway, and the port of Mariupol. Nearly 4000 boats and 1000 rafts are loaded and unloaded every year, carrying over 2,000,000 tons of goods (value 13,000,000 roubles), and giving occupation to 27,000 men. The port of Mariupol is visited every year by about 80

steamers and 40 sail- ing vessels engaged in foreign trade, and 1600 vessels engaged in coasting. The government is better provided with schools, gymnasia, professional and primary, than many other governments of Russia. The chief towns of its 8 districts are : Ekaterinoslav (121,216 inhabitants), Alexandrovsk (16,393), Bakhmut (19,416), Mariupol (81,772), Novomoskovsk (12,862), Pavlograd (17,188), Slavyanoserbsk (3120), and Verkhnednyeprovsk (11,607).

(p. A. K.)

Ekaterinoslav, capital of the above province, on the right bank of the Dnieper, 607 miles by rail south- south-west of Moscow. It is a rapidly growing town, well provided with schools, including a number of professional ones, and is an important depot for timber shipped down the Dnieper, as also for grain. Its iron works, steam flour- mills, and agricultural machinery works give occupation to 5000 workers. Considerable trade is carried on in cattle, grain, and raw wool. Population (1861), 18,881, without suburbs ; (1897), 121,216.

Elabuga, a district town of Russia, government and 279 miles south-east of Vyatka, on Kama river, near its

junction with Totma. It has steam flour-mills, and carries on a brisk trade in exporting corn. Population, 9776.

The famous Ananiinskiy Moghilnik (burial-place) is on the right bank of the Kama, 3 miles from above the town. It was dis- covered in 1858, was excavated by Alabin, Lerch, and Nevo- struyeff, in charge of the Archaeological Commission, and has since supplied extremely valuable collections of archaeological objects belonging to the Stone, Bronze, and Iron Ages. It represented first a mound, about 500 feet in circumference, adorned with decor- ated stones (which have disappeared), and contained an inner wall, 65 feet in circumference, made of uncemented stone flags. Nearly 50 skeletons were discovered in it, mostly laid upon burned logs, surrounded with pots filled with partially burned bones. A great variety of bronze decorations and glazed clay pearls were strewn round the skeletons. The knives, daggers, and arrow- points are of slate, bronze, and/ iron, the two last being very rough imitations of stone implements. On one of the

~~funeral flags the image of a man, without moustaches or beard, dressed in a costume and helmet recalling those of the Circassians, was discovered. The exact period of these funeral mounds is not known.~~

~~Elastic Systems. — In the article Elasticity (Ency. Brit. vol. vii.) there is an outline of the general mathematical theory of Elasticity, and an account of the results obtained by applying it to the solution of the very important problem of the torsion of prisms. The present article is meant to supplement the former one by giving an account of some of the results that have been arrived at in the application of the theory to other problems.~~

~~1. Flexure of a Beam. — The simple theory of the bend- ing of a beam by applied couples has been explained in the original article, §§ 57-62. If M is the couple, the central line of the beam is bent into a circle of radius EI/M, where E is the Young's modulus of the material, and I is the moment of inertia of the cross-section about the axis through its centroid at right angles to the plane of flexure. This plane is supposed to contain one prin- cipal axis of inertia of each cross-section,' and the locus of the perpendicular principal axes after flexure is a surface cutting the plane of flexure at right angles and known as the " neutral sur- face " ; the traces of this surface are dotted in Fig. 1. The quantity EI is known as the "flex- ural rigidity." The applied couple M is balanced at any section by a couple arising from the stress exerted across the section. Supposing, to fix ideas, that the curve into which the central line is bent is concave downwards, the stress at any point above (below) the neutral surface is simple longi- tudinal tension (pressure) of amount per unit area equal to the product of M/I and the distance of the point from the neutral surface. The corresponding strain consists of extension (contraction) of the longitudinal fibres above (below) the neutral surface accompanied by lateral contraction (extension) of the perpendicular fibres, and the effect of the lateral strain is seen in the change of shape of the section producing the anticlastic curvature of the beam (of. Elasticity, Ency. Brit. vol. vii. p. 809). The extension (contraction) of a longitudinal fibre distant y above (below) the neutral surface is My /EI, and the lateral contraction (extension) is o-M^z/EI, where o- is the "Poisson's ratio" of the material (a fraction nearly equal to \ for most hard solids). The displacements produced are — (1) a deflexion of the central line by which the centroid of each cross-~~

iWheu this is the case the beam is said to be bent in a "principal plane."

section comes to its proper place on the curved central line ; (2) a rotation of the plane of each cross-section about the axis through its centroid at right angles to the plane of flexure, of such an amount as to place it at right angles to the curved central line ; (3) a distortion of the shape of each cross-section in its own plane producing the anti- clastic curvature. ;

2. That this theory requires modification when the load does not consist simply of terminal couples can be seen most easily by considering the problem of a beam loaded at one end with a weight W, and supported in a hori- zontal position at its other end. The forces that are exerted at any section p, to balance the weight W, must reduce statically to a vertic?il force W and a couple, and these forces arise from the action of the part Ap on the part Bp (see Fig. 2), i.e., from the stresses across the section at p. The stress that suffices in the simpler problem gives rise to no vertical force, and it is clear that in addition to longitudinal tensions and pressures there must be shearing stresses at the cross -sections. The determination of the character of these, and of the corresponding strains and displacements, was effected by Saint-Venant and Clebsch for a number of forms of sections by means of an analysis of the same kind as that employed in the solution of the torsion problem.

AW

W

Pig. 2.

8. Let I be the length of the heam, x the distance of the section p from the fixed end A, y the distance of any point below the horizontal plane through the centroid of the section at A, tlien the bending moment aXp is 'W(Z — x), and the longitudinal tension P at any point on the cross -section is -'W{l-

x)y/I, and this is related to the bending moment exactly as in the simpler problem.

4. The expressions for the shearing stresses depend on the shape of the cross-section. Taking the beam to be of isotropic material and the cross-section to be an ellipse of semiaxes aand 6(Fig. 3), the a axis being vertical in the un- strained state, anil drawing the axis 2 at right angles to the plane of flexure, the vertical shearing stress U at any point {y, z) on any cross-section is

2W[(a° — y') {2a'il + (r) + V'} — zV(l — 2a-)].

The resultant of these stresses is W, but the amount at the centroid, which is the maximum amount, exceeds the average amount, W/n-ai, in the ratio

y.

Fig. 3.

{ia'(l +

Taking

In the same problem tho horizontal shearing stress T at any point on any cross-section is of amount

4W^/^{a"(l-^<^)-^iV} Ta'>b{\ + a)(Sa:^ + b") '

The resultant of these stresses vanishes ; but, taking as before

As another example we may consider a circular tube of external radius r^ and internal radius Ty We find

4W \

U=

T=’

~~“W~~

~~2(1-1-~~

~~:;rr,[(3H-2.)(~~

~~ro’ + n’~~

~~w~~

~~{y^+z’y ^^{l + 2. + (3 + 2.)^j,},.~~

~~•i(2/”«’)}(l-2~~

~~{1 + (r)ir(ro” — T;~~

~~and for a tube of radius r and small thickness t the value of P and the maximum values of U and T reduce approximately to~~

~~T=-yf(l-x)ylTr^t U„„. = W/7rrt, Tmai. = W/2«rrf.~~

~~The greatest value of U is in this case approximately twice its average value, but it is possible that these results for the bending of very thin tubes may be seriously at fault if the tube is not plugged, and if the load is not applied in the manner contemplated in the theory (cf. § 9). In such cases the extensions and contrac- tions of the longitudinal fibres may be practically confined to a small part of the material near the ends of the tube, while the rest of the tube is deformed without stretching.~~

~~5. The shearing stresses U, T on the cross-sections arc necessarily accompanied by shearing stresses on the longi- tudinal sections, and on each such section the shearing stress is paraUel to the central line ; on a vertical section z = const, its amount at any point is T, and on a horizontal section y = const, its amount at any point is U.~~

~~The internal stress at any point is completely determined by the components P, U, T, but these are not principal stresses. Clebsch has given an elegant geometrical con- struction for determining the principal stresses at any point when the values of P, U, T are known.~~

~~From the point 0 (Fig. 4) draw lines OP, OU, OT, to represent the stresses P, U, T at 0, on the cross-section through O, in magni- tude, direction and sense, and compound U and T into a resultant represented by OE ; the plane EOP is a principal plane of stress at 0, and the principal stress at right angles to this plane van- ishes. Take M the middle point of OP, and with centre M and radius ME describe a circle cutting the line OP in A and B ; then OA and OB represent the magni- tudes of the two remaining principal sti esses. On AH describe a rectangle ABDG so that DC passes through E ; then OC is the direc- tion of the principal stress represented in magnitude by OA, and OD is the direction of tjie principal stress represented in magni- tude by OB.~~

~~6. As regards the strain in the beam, the longitudinal and lateral extensions and contractions depend on the bending moment in the same way as in the simpler prob- lem ; but, the bending moment being variable, the anti-clastic curvature produced is also variable. In addition to these extensions and contractions there are shearing strains corresponding to the shearing stresses T, U. The shear- ing strain corresponding to T consists of a relative sliding parallel to the central line of different longitudinal linear elements combined with a relative sliding in a transverse horizontal direction of elements of different cross-sections ; the latter of these is concerned in the production of these displacements by which the variable anticlastic curvaturo is brought about ; to see the effect of the former we may most suitably consider for the case of an elliptic cross- section the distortion of the shape of a rectangular portioii~~

~~Fig. 4.~~

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~~735~~

~~Fig. 5. ellipse the character of~~

~~Pig. 6.~~

~~of a plane of the material which in the natural state was~~

~~horizontal ; all the boundaries of such a portion become parabolas of small curvature, which is variable along the length of the beam, and the particular effect under consideration is the change of the transverse horizontal linear elements from straight lines such as HK to parabolas such as H'K' (Fig. 5) ; the lines HL and KM are parallel to the central line, and the figure is drawn for a plane above the neutral plane. When the cross-section is not an the strain is the same, but the~~

~~curves are only approximately parabolic.~~

~~The shearing strain corresponding to U is a distortion~~

~~which has the effect that the straight vertical filaments~~

~~become curved lines~~

~~which cut the longi- tudinal filaments~~

~~obliquely, and thus~~

~~the cross-sections do~~

~~not remain plane,~~

~~but become curved~~

~~surfaces, and the~~

~~tangent plane to any~~

~~one of these surfaces~~

~~at the centroid cuts~~

~~the central line ob- liquely (Fig. 6). The~~

~~angle between these~~

~~tangent planes and~~

the central line is

the same at all points of the line ; and, denoting it by

^jT + Sq, the value of s,, is expr^gsible as shearing stress at centroid rigidity of material '

and it thus depends on the shape of the cross-section ; for

the elliptic section of § 4 its value is

for a circle with a- = l, this becomes IW/ZEiraK The vertical filament through the centroid of any cross-section becomes a cubical parabola, as shown in Fig. 6, and the contour lines of the curved surface into which any cross- section is distorted are shown in Fig. 7 for a circular section. 7. The deflexion of the beam is determined from the equation

curvature of central line = bending moment-r-flexural rigidity,

and the special con- ditions at the sup- ported end ; there is no alteration of this statement on account of the shears. As regards the special condi- tion at an end which is encastrh, or built-in, Saint- Venant proposed to assume that the central tangent plane of the cross- section at the end is vertical ; with this assumption the tangent to the central line at the end is inclined downwards

Kg. 7.

and makes an angle s^ with the horizontal (see Fig. 8) ; it is, however, improbable that this condition is exactly realized in practice. In the application of the theory to the experimental determination of Young's modulus, the small angle which the central line at the support makes with the horizontal is an unknown quantity, to be eliminated by observation of the deflexion at two or more points.

8. We may suppose the displacement in a bent beam to be produced by the following operations : (1) the central line is deflected into its curved form, (2) the cross-sections are rotated about axes through their centroids at right

angles to the plane of flexure so as to make angles equal to ^tt + Sq with the central line, (3) each cross-section is distorted in its own plane in such a way that the appropriate variable anticlastic curvature is produced, (4) the cross- sections are further distorted into curved surfaces. The contour lines of Fig. 7 show the disturbance from the central tangent plane, not from the original vertical plane.

9. Practical Application of Saint- Venant's Theory. — The theory above described is exact provided the forces applied to the loaded end, which have W for resultant, are distributed over the ter- minal section in a particular way, not likely to be realized in practice ; and the appli- cation to practical problems depends on a principle due to Saint- Venant, to the effect that, except for compara- tively small portions of the beam near to the loaded and fixed ends, the resultant /y only is effective, and its /.. mode of distribution does not seriously affect the in- j,. g

ternal strain and stress. In

fact, the actual stress is that due to forces -with the required resultant distributed in the manner contemplated in the theory, superposed upon that due' to a certain distribution of forces on each terminal section which, if applied to a rigid body, would keep it in equilibrium ; according to Saint- Venant's principle, the stresses and strains due to such distributions of force are unimportant except near the ends. For this principle to be exactly applicable it is necessary that the length of the beam should be very great compared with any linear dimension of its cross- section ; for the practical application it is sufiicient that the length should be about ten times the greatest diameter.

10. The theoretical determination of tiie stress in a bent beam under conditions as to load and support other than those considered in §§ 2-8 is attended by difficulties which have not yet been surmounted, but the equation for the deflexion

curvature of central line = bending moment -=-flexurai rigidity

is sufficiently exact whenever the length is a consider- able multiple of the greatest diameter of the cross- section. This result is indicated by the

theories of in- definitely thin wires developed by Kirchhoff and Boussinesq, and has been confirmed by special researches made by Pochhammer and Pearson. The equation for the deflexion above written is the basis of the treatment of continuous beams resting on three or more supports and carrying distributed loads. The calculation of the bending moment can be replaced by a method of graphical construc- tion, due to Mohr, and depending on the two following theorems ; —

(I.) The curve of the central line of each span of a

beam, when the bending moment M is given,! is identical with the catenary or funicular curve passing through the ends of the span under a (fictitious) load per unit length of the span equal to M/EI, the horizontal tension in the funicular being unity.

(II.) The directions of the tangents to this funicular curve at the ends of the span are the same for all statically equivalent systems of (fictitious) load.

When M is known, the magnitude of the resultant shearing stress at any section is dM./doc, where a; is measured along the beam.

11. Let I be the length of a span of a loaded beam (Fig. 9), Mi and M2 the bending moments at the ends, M the bending moment at a section distant x from the end (Mj), M' the bending moment at

M,l :

re

A

Ai

l-x

M.

M

Fig. 9.

fi

the same section when the same span with the same load is simply supported ; then M is given by the formula

and thus a fictitious load statically equivalent to M/EI can be easily found when M' has been found. If we draw a curve (Fig. 10) to pass through the ends of the span, so that its ordinate repre- sents the value of M'/EI, the corresponding fictitious loads are

*statically equivalent to a single load, of amount represented ■ui by the area of the 'curve, placed at the point of the span ver- B tically above the centreof gravity of this area. If PN is the ordinate of this curve, and if at the ends of the span we erect ordinates in the proper sense to represent Mi/EI and M^/EI, the bending moment at any point is represented by the length PQ.^ For a uniformly dis- tributed load the curve of *M' is a parabola W=^x(l-x), where u is the load per unit of length ; and the statically equivalent fictitious load is ^jwZ^EI placed at the middle point G of the span ; also the loads statically equivalent to the fictitious loads Mi(?-a;)/ZEI and M^s/ZEI are JMi^/EI and iMjZ/EI placed at the points g, ^ of triseotion of the span. The funicular polygon for*

Fig. 10.

the fictitious loads can thus be drawn, and the direction of the central line at the supports is determined when the bending moments at the supports are known.

^ The sign of M is shown by the arrow-heads in Fig. 9, for which, with y downwards,

” The figure is drawn for a case where the bending moment has the same sign throughout.

Fig. 12.

12. When there is more than one span the funiculars in question may be drawn for each of the spans, and, if the bending moments at the ends of the extreme spans are known, the intermediate ones can be determined. This determination depends on two considera- tions : (1) the ticiitious loads coiTespouding to the bending moment at any support are proportional to the lengths of the spans which abut on that support ; (2) the sides of two funiculars that end at any support coincide in direction. Fig. 11 illustrates the method for the case of a uniform beam on three supports A, B, C, the ends A and C being freely supported. There will be an unknown bending moment M^ at B, and the system ^ of fictitious loads is ^wABVEI at G the middle point of AB, ^^BC^/EI at G’ the middle point of BC, -^MoAB/EI at g and iMoBC/EI at ^, where g and g’ are the points of trisection nearer to B of the spans AB, BC. The centre of gravity of the two latter is a fixed point independent of M,,, and tlie line VK of the figure is the vertical through this point. We draw AD and CE to represent the loads at G and G’ in magnitude ; then D and Eare fixed points. We construct any triangle UVW whose sides UV, UW pass through D, B, and whose ver tices lie on the verticals jU, VK, gi’W ; the point F where VW meets DB is a fixed point, and the lines EF, DK are the two sides (2, 4) of the required funiculars which do not pass through A, B, or C. The re- maining sides (I, 3, 5) can then be drawn, and the side 3 neces- sarily passes through B ; for the triangle UVW and the triangle whose sides are 2, 3, 4 are in perspective.

The bending moment M,, is represented in the figure by the vertical line BH where H is on the continuation of the side 4, the scale being given by

BH_pioBC.

CE tV«‘BC ‘ this appears from the diagrams of forces. Fig. 12, in which the oblique lines are marked to correspond to the sides of the funiculars to which they are parallel.

In the application of the method to more complicated cases there are two systems of fixed points corresponding to F, by means of which the sides of the funiculars are drawn.

13. Finite Bending of Thin Rod. — The equation curvature = bending moment-=-flexural rigidity may also be applied to the problem of the flexure in a principal plane of a very thin rod or wire, for which the curvature need not be small. When the forces that pro- duce the flexure are applied at the ends only, the curve into which the central line is bent is one of a definite family of curves, to which the name elastica has been given, and there is a division of the family into two species according as the external forces are applied directly to the ends or are applied to rigid arms attached to the ends ; the curves of the former species are characterized by the presence of inflexions at all the points at which they cut the line of action of the applied forces.

Selecting this case for consideration, the problem of determining the form of the curve (cf. Fig. 13) is mathematically identical with the problem of determining the motion of a simple circular pendulum oscillating through a finite angle, as is seen by comparing the differential equation of the curve

EI^-HWsin(^=0

with the equation of motion of the pendulum

Fig. 13. «'

The length L of th curve between two inflexions corresponds to the time of oscillation of the pendulum from rest to rest, and we thus have

LV(W/EI) = 2K, where K Is the real quarter period of elliptic functions of modulus

^ M,, is taken to have, as it obviously has, the opposite sense to that shown in Fig. 9.

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sinio, and a is the angle at which the curve cuts the line of)?S^T°/wf •^PP-‘,?’* iotcea Unless the length of the rod exceeds irV(Jiy W) It will not bend under the force, but when the length IS great enough there may be more than two points of inflexion and more than one bay of the curve ; for n bays Cn+1 inflexions) the length must exceed na- V(EI/W;. Some of the forms of the curve are shown in Fig. 14.

For the form d, in which two bays make a figure of eight, we have ° ‘

Lv(W/EI) =4-6, 0=130° approximately (see Hess, Math. Ann. xxiii. , 1884) . It is noteworthy that whenever the length and force admit of a sinuous form, such as a or 6, with more than two inflexions, there is also possible a crossed form, like e, with two inflexions only ; it is probable that the latter form is stable and the former unstable.

14.

small

The particular case of the above for which a is very is a curve of sines of small amplitude, and the result in this case has been ap- plied to the problem of the buckling of struts under thrust. When the strut, of length L’, is maintained upright at its lower end, and loaded at its upper end, it is simply com- pressed, unless

for the lower end corre- sponds to a point at which the tangent is vertical on an elastica for which the line of inflexions is also vertical, and thus the length must be half of one bay (Fig. 15, a). For greater lengths or loads the strut tends to bend or buckle under the load ; for a very slight excess of L’^W above ^EI, the theory on which the above dis- cussion is founded, is not quite adequate, as it assumes the central line of the strut to be free from extension or contraction, and it is probable that bend- ing without extension does not take place when the length or the force exceeds the critical value but slightly. It should be noted also that the formula has no application to short struts, as the theory from which it is derived is founded on the assumption that the length is great com- pared with the diameter (cf. § 10).

The condition of buck- ling, corresponding to tfie above, for a long strut, of length L', when both ends are free to turn is L'2W>,r='EI; for the central line forms a complete bay (Fig. 15, b); if both ends are a ^||

maintained in the same j,j^jg

vertical line, the condi- °'

tion is L'^W>47r^EI, the central line forming a complete bay and two half bays (Fig. 15, c).

15. In our consideration of flexure it has so far been supposed that the bending takes place in a principal plane. We may remove this restriction by resolving the forces that tend to produce bending into systems of forces acting in the two principal planes. To each plane there corresponds a particular flexural rigidity, and the systems of forces in the two planes give rise to independent systems of stress, strain, and displacement, which must be superposed in order to obtain the actual state. Applying this process to the problem of §§ 2-8, and supposing that

one principal axis of a cross-section at its centroid makes an angle 6 with the vertical, then for any shape of section the neutral surface or locus of unextended fibres cuts the section in a line DD', which is conjugate to the vertical diameter CP with respect to any ellipse of inertia of the section. The central line is bent into a plane curve which is not in a vertical plane, but is in a plane through the line CY which is perpendicular to DD' (Fig. 16).

16. Bending and Twisting of Thin Sods. — When a very thin rod or wire is bent and twisted by applied forces, the forces on any part of it limited by a normal section are balanced by the stresses across the section, and these stresses are statically equivalent to certain forces and couples at the centroid of the section ; we shall call them the stress-resultants and the stress-couples. The stress- couples consist of two flexural couples in the two princi-

Fig. 16.

pal planes, and the torsional couple about the tangent to the central line. The torsional couple is the product of the torsional rigidity and the twist produced ; the torsional rigidity is exactly the same as for a straight rod of the same material and section twisted without bending, as in Saint- Venant's torsion problem (Elasticity,^wc2/. Brit. vol. vii. p. 812) . The twist t is connected with the deformation of the wire in this way : if we suppose a very small ring which fits the cross-section of the wire to be provided with a pointer in the direction of one principal axis, and to move along the wire with velocity v, the pointer will rotate about the central line with angular velocity tv. The amount of the flexural couple for either principal plane at any section is the product of the flexural rigidity for that plane, and the resolved part in that plane of the curvature of the cen- tral line at the centroid of the section ; the resolved part of the curvature along the normal to any plane is obtained by treating the curvature as a vector directed along the normal to the osculating plane and projecting this vector. The flexural couples reduce to a single couple in the oscu- lating plane proportional to the curvature when the two flexural rigidities are equal, and in this case only.

The stress-resultants across any section are shearing stresses in the two principal planes, and a tension or thrust along the central line ; when the stress-couples and the applied forces are known these stress-resultants are determinate. The existence in particular of the resultant tension or thrust parallel to the central line does not imply sensible extension or contraction of the central filament, and the tension per unit area of the cross-section to which

it would be equivalent is small compared ■with the tensions and pressures in longitudinal filaments not passing through the centroid of the section ; the moments of the latter tensions and pressures constitute the fiexural couples.

~~17. We consider, in particular, the case of a naturally straight spring or rod of circular section, radius c, and of homogeneous isotropic material. The torsional rigidity is :^En-c*/(l + 0-) ; and the fiexural rigidity, which is the same for all planes through the central line, is ^'Etc* ; we shall denote these by C and A respectively. The rod may be held bent by suitable forces into a curve of double curva- ture with an amount of twist t, and then the torsional couple is Ct, and the fiexural couple in the osculating plane is Ajp, where p is the radius of circular curvature. Among the curves in which the rod can be held by forces and couples applied at its ends only, one is a circular helix ; and then the applied forces and couples are equi- valent to a wrench about the axis of the helix.~~

~~Let o be the angle and r the radius of the helix, so that p is r seo^o ; and let R and K be the force and couple of the wrench (Kg. 17).~~

~~Then the couple formed by R and an equal and opposite force at any section and the couple K are equivalent to the torsional and fiexural couples at the section, and this gives the equations for E and K~~

~~R=a:~~

~~sm a COS" a~~

~~-Ct~~

~~E=A-~~

~~- + Ct sin o.~~

~~The thrust across any section is R sin a parallel to the tangent to the helix, and the shearing stress- resultant is K cos o at right angles to the osculating plane.~~

~~When the twist is such that, if the rod were simply unbent, it would also be untwisted, t is sin a cos a/r, and then, re- storing the values of A and C, we have~~

~~R:~~

~~‘ ir^ 1 + ff.~~

~~sin a cos’ a,~~

~~„ Ettc* l+COS a.~~

~~ir 1 + 0-~~

~~18. The theory of spiral springs affords an application of these results. The stress couples called into play when a naturally helical spring (a, r) is held in the form of a helix (a, r’), are equal to the differences between those called into play when a straight rod of the same material and sec tion is held in the first form, and those called into play when it is held in the second form. Thus the torsional couple is~~

~~_, /sin a’cosa’ sinacosaX~~

~~and the fiexural couple is~~

~~/cos’g’ cos’ o\ \ r’ ~· r J’~~

~~The wrench (R, K) along the axis by which the spring can be held in the form (o’, r’) is given by the equations~~

~~P__, sin a’ /cos’ o’ cos’-* a\ ~· t’ \ ?•’ r J~~

~~sa’/si~~

~~sm a cos a sin a cos~~

~~K=A cos a’~~

~~Vcos’~~

~~^)~~

~~I 0 sin a~~

~~/sin a’ cos a’ sin a cos~~

When the spring is slightly extended by an axial force F, = — R, and there is no couple, so that K vanishes, and a', r', differ very little from o, r, it follows from these equations that the axial elongation, Sx, is connected with the axial length x and the force F by the equation

_, Eire sin o Sx ~ ir' l +*

and that the loaded end is rotated about the axis of the helix through a small angle

4

the sense of the rotation being such that the spring becomes more tightly coiled.

19. A horizontal pointer attached to a vertical spiral spring would be made to rotate by loading the spring, and the angle through which it turns might be used to measure the load, at any rate, when the load is not too great ; but a much more sensitive contrivance is the twisted strip devised by Ayrton and Perry. A very thin, narrow rectangular strip of metal is given a permanent twist about its longitudinal middle line, and a pointer is attached to it at right angles to this line. When the strip is subjected to longitudinal tension the pointer rotates through a considerable angle. Bryan (Phil. Mag., December 1890) has succeeded in constructing a theory of the action of the strip, according to which it is regarded as a strip of plating in the form of a right helicoid, which, after extension of the middle line, becomes a portion of a slightly different helicoid ; on account of the thinness of the strip, the change of curvature of the surface is con- siderable, even when the extension is small, and the pointer turns with the generators of the helicoid.

Taking 6 for the breadth and t for the thickness of the strip, • and T for the permanent twist, the approximate formula for the angle 9 through which the strip is untwisted on the application of a load W was found to be

W6r(l+ff) 2E«3fl-H(l±^*!liV

\ m fi)

The quantity 6t which occurs in the formula is the total twist in a length of the strip equal to its breadth, and this will generally be very small ; if it is small of the same order as tjh, or a higher order, the formula becomes 4W6t(1 I tr)/^fi, with sufficient approximation, and this result appears to be in agreement with observations of the behaviour of such strips.

20. General Theorems. — Passing now from these ques- tions of flexure and torsion, we consider some results that can be deduced from the general equations of equilibrium of an elastic solid body.

The form of the general expression for the potential energy (Elasticity, Ency. Brit. vol. vii. p. j823) stored up in the strained body leads, by a general property of quad- ratic f unQtions, to a reciprocal theorem relating to the effects produced in the body by two different systems of forces, viz. : The whole work done by the forces of the first system acting over the displacements produced by the forces of the second system is equal to the whole work done by the forces of the second system acting over the displacements produced by the forces of the first system. By a suitable choice of the second system of forces the average values of the com- ponent stresses and strains produced by given forces, con- sidered as constituting the first system, can be obtained, even when the distribution of the stress and strain cannot be determined.

Taking for example the problem presented by an isotropic body of any form ‘ pressed between tw” parallel planes distant I apart (Fig. 18), and denoting the result- ant pressure by p, the diminution of volume — 8b is given by the equation

Sv=lplZk, where Tc is the modulus of com pression, equal to JE/(1 — 2®. Again, taking the problem of the changes produced in a heavy body by different ways of supporting it ;

^ The line joining the points of contact must be normal to the

planes.

Fig. 18.

when the body ia suspended from one or more points in a horizontal plane its volume is increased by

Sv=Whl3!c, where W is the weight of the body, and h the depth of its centre of gravity below the plane ; when the body is supported by upward vertical pressures at one or more points in a horizontal plane the volume is diminished by

-sv=yrh'iik,

iwhere h' is the height of the centre of gravity above the plane ; if the body is a cylinder, of length I and section A, standing with its base on a smooth horizontal plane, its length is shortened by an amount

-SZ=“WZ/2EA;

if the same cylinder lies on the plane with its generators horizontal, its length is increased by an amount

S;=o-W/EA.

21. In recent years important results have been found by considering the effects produced in an elastic solid by forces applied at isolated points.

Taking the case of a single force F applied at a point in the interior, it can be shown that the stress at a distance r from the point consists of

(1) a radial pressure of amount

2-

(2) tension in.all directions at right angles to the radius of amount

l-2ir F cosg 2(1 — (t) 4x r' '

(3) shearing stress acting along the radius dr on the surface of the cone 5= const, and acting along the meridian d$ on the surface of the sphere r = const, of amount

l-2(r F^ sine 2(1 —

action of F. The line marked T in Fig. 19 shows the direction of this shear- ing stress on the spherical surface.

Thus the principal stresses are in and perpen- dicular to the meridian plane, and the direction of one of those in the meri- dian plane is inclined to the radius vector r at an angle

4 tan-if

The corresponding dis- placement at any point is compounded of a radial ^g- 19- displacement of amount

1+IT F cosg 2(1 —

22. The stress system considered in the last section is equivalent, on the plane through the origin at right angles to the line of action of F, to a pressure of magnitude ^F at the origin and a radial shearing stress of

*2(1 — 0-) 4irj^*

by the application of

this system of tractions pjg ^o.

to a solid bounded by a , .^,.,.,.,.,

plane the displacement just described would be produced.

There is also another (Fig. 20) stress system for a solid

2-4g- 5-4

tand

)•

so bounded which is equivalent, on the same plane, to a pressure at the origin, and a radial shearing stress pro- portional to l/r^, but these are in the ratio 25r : j-~^, instead of being in the ratio iirQ. — o-) : (1 — 2cr)r~^.

The second stress system consists of

(1) radial pressure FV~’,

(2) tension in the meridian plane across the radius vector of amount

F’r-”=cosfl/(l-l-cose),

(3) tension across the meridian plane of amount

FV-V(l + oos9),

(4) shearing stress as in the last section of amount

Tr-^ sin el(l + cose),

*and the stress across the plane boundary consists of a pressure of magnitude 27rF’ and a radial shearing stress of amount FV- *. If then we superpose the component stresses of the last section multi- plied by 4(1 — (r)W/F, and the component stresses here written down multiplied by — (1 — 2o-)W/27rF’, the stress on the plane boundary will reduce to a single pressure W at the origin. We shall thus obtain the stress system at any point due to such a force applied at one point of the boundary.*

In the stress system thus arrived at the stress across any plane parallel to the boundary is directed away from the place where W is supported, and its amount is 3Wcos^ 6l2irrK The corresponding displacement consists of

(1) a horizontal displacement radially outwards from the vertical through the origin of amount

*‘Wn + (7)siiie f . 1-20- *

— i '- oos^-,— „_),

\ l-^cosS/

2TrEr V l-^cos«

(2) a vertical displacement downwards of amount

mi^ {2(l-.) + oosH).

The effects produced by a system of loads on a solid bounded by a plane can be deduced.

23. The results stated in the last section have been ap- plied to give an account of the nature of the actions con- cerned in the impact of two solid bodies. The dissipation of energy involved in the impact is neglected, and the pressure between the bodies at any instant during the impact is equal to the rate of destruction of momentum of either along the normal to the plane of contact drawn towards the interior of the other. It has been shown that in general the bodies come into contact over a small area bounded by an ellipse, and remain in contact for a time which varies inversely as the fifth root of the initial relative velocity.

For equal spheres of the same material, with

where r is the radius of either, and V is the velocity of longi- tudinal waves in a thin bar of the material. The duration of the impact is approximately

For two steel spheres of the size of the earth impinging with a velocity of 10 mm. per second the duration of the impact would be about twenty-seven hours. The fact that the duration of impact is, for moderate velocities, a considerable multiple of the time taken by a wave of compression to travel through either of two impinging bodies has been ascertained experimentally,' and con- stitutes the reason for the adequacy of the statical theory here described.

24. Spheres and Cylinders. ■ — Simple results can be found for spherical and cylindrical bodies strained by radial forces.

For a sphere of radius a, and of homogeneous isotropic material of density p, strained by the mutual gravitation of its parts, the stress at a distance r from the centre consists of

(1) uniform hydrostatic pressure of amount $^{pa^{f}}$ *— (‘■)/(l —*

(2) radial tension of amount ^gp{r’^ja)[Z — tr)l{l — a-),

^ Of. Auerbaoh in Winkelmanu’s ffaruSmch der Physik, i. 303. Breslau, 1891.

(3) uniform tension at right angles to the radius vector of amount Affp(r7a) (l + 3

where g is the value of gravity at the surface. The corresponding strains consist of

(1) uniform contraction of all lines of the hody of amount

A-V/M(3-*

(2) radial extension of amount ^k-‘^gp{r^ja)(l +

(3) extension in any direction at right angles to the radius vector of amount

where Tc is the modulus of compression. The volume is diminished by the fraction gpa/5k of itself. The parts of the radii veotores within tha sphere r=a{(3-(r)/(3 + 3ff)}”^ are contracted, and the parts without this sphere are extended. The application of the above results to the state of the interior of the earth is restricted by the circumstance that, unless the modulus of compression is much greater than that of any known material, the stresses and strains expressed above would, in a sphere of the size of the earth, greatly exceed the elastic limits.

~~25. In a spherical shell of homogeneous isotropic material, of internal radius rj and external radius rg, subjected to pressure p^ on the outer surface, and Pi on the inner surface, the stress at any point distant r from the centre consists of~~

~~(1) uniform tension in all directions of amount ^^^-1= — „° ,~~

~~(2) radial pressure of amount \ \ "3 >~~

~~(3) tension in all directions at right angles to the radius vector of amount~~

~~The corresponding strains consist of~~

~~(1) uniform extension of all lines of the body of amount~~

~~1 PtTi-MI.~~

~~Sk~~

~~1 Pi- Pi, rln^~~

~~(2) radial contraction of amount g-~~

~~(3) extension in all directions at right angles to the radius vector of amount~~

~~i Pi-Po rpW^ in r^ -r^ 7^ '~~

~~where ii is the modulus of rigidity of the material, ='EK\ +~~

~~increased by the fraction ' ' 3 3° of itself, and the volume~~

~~within the inner surface is increased by the fraction~~

~~s(pi-Po) yp' ^ j>i»^i-yoV~~

~~of itself. For a shell subject only to internal pressure p the greatest extension is the extension at right angles to the radius at the inner surface, and its amount is~~

pTY

-/'l+l'Jl'V

the greatest tension is the transverse tension at the inner surface, and its amount is ^(Jro' + WW — "i')-

26. In the problem of a cylindrical shell under pressure a com- plication may arise from the effects of the ends ; but when the ends are free from stress the solution is very simple. With nota- tion similar to that in § 25 it can be shown that the stress at a distance r from the axis consists of

(1) uniform tension in all directions at right angles to the axis of amount

(2) radial pressrae of amount ^^ i ", ^',

(3) hoop tension numerically equal to this radial pressure. The corresponding strains consist of

(1) uniform extension of all lines of the material at right angles to the axis of amount

l-

(2) radial contraction of amount

l+a- p,-p„ t-qV E r^^-Ti" 7^ '

(3) extension along the circular filaments numerically equal to this radial contraction,

(4) uniform contraction of the longitudinal filaments of amount

E ro'-ri^ For a shell subject only to internal pressure p the greatest extension is the circumferential extension at the inner surface, and its amount is

P (rl + rl \.

Pj

r^ Tr?

the greatest tension is the hoop tension at the inner surface, and its amount isp(r^+r-f)l(r^-r-^).

27. The results just obtained have been applied to gun construction ; we may corisidfer that one cylinder is heated so as to slip over another upon which it shrinks by cooling, so that the two form a single body in a condition of initial stress.

We take P as the measure of the pressure between the two, and p for the pressure within the inner cylinder by which the system is afterwards strained, and denote by r' the radius of the common surface. To obtain the stress at any point we superpose the

system consisting of radial pressure ^A -|j and hoop tension

j upon a system which, for the outer cylinder, consists

*/2 j.2 ya j.'S r,?+r^*

of radial pressure P-j \ ,.i and hoop tension F-j'^g, '2

^'2 ^2 M 2

and, for the inner cylinder consists of radial pressure P— ^ 12 i

and hoop tension — P— j „ 'y The hoop tension at the inner

surface is less than it would be for a tube of equal thickness without initial stress in the ratio

P 2r'g rp^-ri' pr^^ + r^^r'-r^ '

This shows how the strength of the tube is increased by the initial stress.

28. The problem of determining the distribution of stress and strain in a circular cylinder, rotating about its axis, has not yet been completely solved, but solutions have been obtained which are sufficiently exact for the two special cases of a thin disk and a long shaft.

Suppose that a circular disk of radius a and thickness 21, and of density p, rotates about its axis with angular velocity u, and consider the following systems of superposed stresses at any point distant r from the axis and z from the middle plane :

(1) uniform tension in all directions at right angles to the axis of amount uy'pd(Z +

(2) radial pressure of amount Ju^/iw'(3 1 «•),

(3) pressure along the circular filaments of amount Ju'pr'fl + So),

(4) uniform tension in all directions at right angles to the axis of amount i^Yf— 3s^)(r(l + ir)/(l—

The corresponding strains may be expressed as

(1) uniform extension of all filaments at right angles to the axis of amount

4uV'(3 + <).

(2) radial contraction of amount

(3) contraction along the circular filaments of ajnount

(4) extension of all filaments at right angles to the axis of amount

(5) contraction of the filaments normal to the plane of the disk of amount

The greatest extension is the circumferential extension near the centre, and its amount is

{S +

of the disk free from pressure, and the terms in Z and z enable us to avoid shearing stress on any cylindrical surface. The system of stresses and strains thus expressed satisfies all the conditions except that there is a small radial tension on the bounding surface of amount per unit area J t. ‘ p(i2 — Sz’)ff(1 + (r)/(1 — o-). The resultant of these stresses on any part of the edge of the disk vanishes, and the stress in question is very small ia comparison with the other stresses involved when the disk is thin ; we may conclude that for a thin disk the expressions given represent the actual condition at all points which are not very close to the edge (cf. § 9). The effect of the longitudinal contraction is that the plane faces become slightly concave (Fig. 21).

In problems of the kind just considered, where the stress consists simply of a radial tension P and a circumferential tension Q, which

are functions of r and z, the stress components, besides satisfying the equations of equi- librium, are also subject to two conditions of compatibility which can be expressed in the forms

vP-Q 3Q ap

^.

r3

(l +

29. The corresponding solu- tion for a disk with a circular axle-hole (radius 6) will be ob- tained from that giten in the last section by superposing the following system of additional

Kg. 21.

(1) radial tension of amount i a^pb^{l — a^/r’^iS + tr),

(2) tension along the circular filaments of amount

and the corresponding additional strains are

(1) radial contraction of amount

(2) extension along the circular filaments of amount

S +

(l-(-

-wV6'.

(3) contraction of the filaments parallel to the axis of amount g:(3-Hir) 4E

Again, the greatest extension is the circumferential extension at the inner surface, and, when the hole is very small, its amount is nearly double what it would be for a complete disk.

30. In the problem of the rotating shaft we have the following stress-system :

(1) radial tension of amount i<^p{cfi — r')(3 — 2®/(l — «■),

(2) circumferential tension of amount

J«V {a'(3 — 2

(3) longitudinal tension of amount iui'pia^— 2r^)ir/(l —

*The resultant longitudinal tension at any normal section vanishes, and the radial tension vanishes at the bounding surface ; and thus the expressions here given may be taken to represent the actual condition at all points which are not very close to the ei»ds of the shaft. The contraction of the longitudinal filaments is uniform and equal to ior'pa^*

The value of any theory of the strength of long rotating shafts founded on these formulae is diminished by the circumstance that at suiBeiently high

speeds the shaft may tend to take up a curved form, the straight form being unstable. The shaft is then said to whirl. This occurs when the period of rotation of the shaft is very nearly coincident with one of its periods of lateral vibration. (See Greenhill, Proc. Inst. Mech. Engineers, April 1883.) The lowest speed at which whirling can take place in a shaft of length I, freely supported at its ends, is given by the formula oi'p^iEa'iw/l).*

As in § 14, this formula should not be applied unless the length of the shaft is a considerable multiple of its diameter. It implies that whirling is to be expected whenever u approaches this critical value.

31. Thin Plate vmder Pressure. — The theory of the de- formation of plates, whether plane or curved, is very intri- cate, partly because of the complexity of the kinematical relations involved. We shall here indicate the nature of the

effects produced in a thin plane plate, of isotropic material, ■which is slightly bent by pressure. This theory should have an application to the stress produced in a ship's plates. In the problem of the cylinder (§ 26) the most important stress is the circumferential tension, counter^ acting the tendency of the circular filaments to expand under the pressure ; but in the problem of a plane plate some of the filaments parallel to the plane of the plate are extended and others are contracted, so that the tensions and pressures along them give rise to resultant couples but not to resultant forces. Whatever forces are applied to bend the plate, these couples are always expressible in terms of the principal curvatures produced in the surface which, before strain, was the middle plane of the plate. The simplest case is that of a rectangular plate, bent by a dis- tribution of couples applied to its edges, so that the middle surface becomes a cylinder of large radius R ; the requisite couple per unit of length of the straight edges is of amount C/R, where C is a certain constant ; and the requisite couple per unit of length of the circular edges is of amount Co-/E, the latter being required to resist the tendency to anticlastic curvature (cf. § 1). If normal sections of the plate are supposed drawn through the generators and circular sections of the cylinder, the action of the neighbouring portions on any portion so bounded involves flexural couples of the above amounts. When the plate is bent in any manner, the curvature produced at each

section of the middle surface may be regarded as arising from the superposition of two cylin- drical curvatures ; and the flexural couples across normal sections through the lines of curvature, estimated per unit of length of those lines, are C(l/Ri -i-cr/Rj) and C(l/E2-K7”/Ej), where Rj and Ej are the principal radii of curvature. The value of C for a plate of small thick-

ness 2h is ^Ji^jil-cr’). Exactly as in the problem of

the beam (^2, 10), the action between neighbouring por- tions of the plate generally involves shearing stresses across normal sections as well as flexural couples ; and the resultants of these stresses are determined by the conditions that, with the flexural couples, they balance the forces applied to bend the plate.

32. To express this theory analytically, let the middle plane of the plate in the unstrained position be ^ken as the plane of (x, y), and let normal sections at right angles to the axes of x and y be drawn through any point. After strain let w be the displacement of this point in the direction perpendicular to the plane, marked p in Fig. 22, If the axes of x and y were parallel to the lines of

Pig. 22.

curvature at the point, the flexural couple acting across the section normal to x (or y) would have the axis of y (or x) for its axis ; but when the lines of curvature are inclined to the axes of co-ordinates.

the flexiiral couple across a section normal to either axis has a component about that axis as well as a component about the per- pendicular axis. Considering an element ABCD of the section at right angles to the axis of x, contained between two lines near together and perpendicular to the middle plane, the action of the portion of the plate to the right upon the portion to

th^ left, across the element, gives rise to a couple about the middle line (y) of amount, estimated per unit of length of that line, equal

to C I 5-3 +

say.

The

corresponding couples on an element of a section at r'ght angles to the axis of y, estimated per unit of length of the axis of x, are

■5^ + ff^-3 1, sGjSay, and -H. The resultant

before, is given by the equation Si = -^

Si of the shearing stresses on the element ABCD, estimated as

-^(cf. §10), and the corresponding resultant S3 for an element perpendicular to the

axis of y is given by the equation 83= — -^ «— ^. If the plate

is bent by a pressure p per unit of area, the equation of equili- brium is =-i-t-^=», or, in terms of ■ii', dx dy ■^

d^w d'w 3% p

This equation, together with the special conditions at the rim, suffices for the determination of iv, and then all the quantities here introduced are determined. Further, the most important of the stress-components are those which act across elements of normal sections : the tension in direction x, at a distance z from the middle plane measured in the direction of p, is of amount

-^fsi 02 + "■ 5T)i Jid there is a corresponding tension in direc tion y ; the shearing stress parallel to y on planes a; = const., and parallel to a; on planes 3/= const., is of amount — „, 5-3- ;

these tensions and shearing stresses are equivalent to two principal tensions, in the directions of the lines of curvature of the sm-face into which the middle plane is bent, and they give rise to the flexural couples.

33. In the special example of a circular plate, of radius a, sup- ported at the rim, and held bent by a uniform pressure p, the value of tc at a point distant r from the axis is

64 C^”

■):

and the most important of the stress components is the radial

9

tension, of which the amount at any point is — (3 +

the maximum radial tension is about -Aa-IKfp, and, when the

thickness is small compared with the diameter, this is a large multiple of ^.

Attthokities. — ^The analysis requisite to prove most of the results stated in this article is given by Love, Mathematical Theory of Elasticity, Cambridge, 1892, 1893. Eeferenoe may also be made to BotrssiNESQ, Application despotentiels, Paris, 1885 ; Clbbsoh, Theorie der Elasticitdt fester K’&rper, Leipzig, 1862 (Saint- Venant’s edition, Paris, 1883) ; Thomson and Tait, Natural Philosophy, Cambridge, 1879, 1883 ; Todhunter and Peakson, History of the Theory of Elasticity, Cambridge, 1886-93 ; Poohhammeb, GleichgewicM des elastischen States, Kiel, 1879 ; Chree, “Changes in the Dimensions of Elastic Solids due to given Systems of Forces, ” Trans. Camh. Phil. Soc. XV., 1892 ; “On Thin Rotating Isotropic Disks,” Proc. Camh. Phil. Soc. vii., 1891; “Long rotating, Circular Cylinders,” iVoc. Caml. Phil. Soc. vii., 1892 ; Hertz, “Uber die Beriihrung fester elastischer Kbrper,” Crelle, xcii., 1881 ; Michell, “On the Direct Determination of Stress in an Elastic Solid . . .” and other papers in /“roc. Lmd. Math. Soc. xxxi. xxxii., 1899-1900 ; Pearsok, “On the F'lexure of Heavy Beams

subjected to Continuous Systems of Load," Quart. Joum. Math, xxiv.,1889 ; Pearson and Filon, same title. Quart. Joum. Math, xxxi., 1899. (a. E. H. L.)

Elb£l| an island of Italy, belonging to the province of Leghorn, 4 miles from the nearest point of the mainland (Piombino), and 35 miles south from Leghorn. Iron is not only mined, but since 1900 smelted, in Elba. Iron ore, wine, and salt are exported to the average (1891-98) value of £197,250 (£244,000 in 1899). The shipping which cleared from the various ports increased from 2692

vessels of 209,500 tons in 1891 to 3004 of 568,930 tons in 1899. There is an institute of viticulture. On this and the neighbouring island of Pianosa there are convict prisons, in which from 3000 to 4000 convicts are lodged. The principal towns are Portoferrajo (population, 3737 in 1881), Marciana (5444), Portolungone (4172), and Eio Marina (2964). Population of the island, about 27,000.

Elbe (the Alhis of the Eomans), one of the most im- portant rivers of Central Europe. It rises in Bohemia, in the upper gathering-grounds of the Eiesengebirge, its chief feeders being the Weisswasser, which originates near the kingly Schneekoppe, at an altitude of about 4600 feet, and the Elbseifen, which is formed in the same neighbour- hood, but at a little lower elevation. After plunging down the 140 feet of the Elbfall, the latter stream unites with the steep torrential Weisswasser at Madelstegbaude, at an altitude of 2230 feet, and thereafter the united stream of the Elbe pursues a southerly course, emerging from the mountain glens at Hohenelbe (1495 feet), and continuing on at a soberer pace to Pardubitz, where it turns sharply to the west, and at Kolin (730 feet), some 27 miles farther on, bends gradually towards the north-west. A little above Brandeis it picks up the Iser, which, like itself, comes down from the Eiesengebirge, and at Melnik it has its stream more than doubled in volume by the Moldau, a river which winds northwards through the heart of Bohemia in a sinuous, trough-like channel carved through the plateaux. Some miles lower down, at Leitmeritz (433 feet), the waters of the Elbe are tinted by the reddish Eger, a stream which drains the southern slopes of the Erzgebirge. Thus augumented, and swollen into a stream 140 yards wide, the Elbe carves a path through the basaltic mass of the Mittelgebirge, churning its way through a deep, narrow

rocky gorge. Then the river winds through the fantastically sculptured sandstone mountains of the " Saxon Switzerland," washing succes- sively the feet of the lofty Lilienstein (932 feet above the Elbe), the scene of one of Frederick the Great's military exploits in the Seven Years' War, Konigstein (797 feet above the Elbe), where in times of war Saxony has more than once stored her national purse for security, and the pinnacled rocky wall of the Bastei, towering 650 feet above the surface of the stream. Shortly after crossing the Bohemian-Saxon frontier, and whilst stUl struggling through the sandstone defiles, the stream assumes a north- westerly direction, which on the whole it preserves right away to the North Sea. At Pima the Elbe leaves behind it the stress and turmoil of the Saxon Switzerland, rolls through Dresden, with its noble river terraces, and finally, beyond Meissen, enters on its long journey across the North German plain, touching Torgau, Wittenberg, Magde- burg, Wittenberge, Hamburg, Harburg, and Altona on the way, and gathering into itself the waters of the Mulde and Saale from the left, and those of the Schv^arze Elster,- Havel, and Elde from the right. Eight miles above Hamburg the stream divides into the Norder (or Hamburg) Elbe and the Siider (or Harburg) Elbe, which are linked together by several cross-channels, and embrace in their arms the large island of WUhelmsburg and some smaller ones. But by the time the river reaches Blankenese, 7 mUes below Hamburg, all these anastomosing branches have been reunited, and the Elbe, with a noble width of 4 to 9 miles between bank and bank, travels on between the green marshes of Holstein and Hanover until it becomes merged in the North Sea off Cuxhaven. From Dresden to the sea the river has a total fall of only 123 feet, although the distance is about 430 mUes. For ^e 75 miles between Hamburg and the sea the fall is only 3J feet. One consequence of this is that the bed of the river

just below Hamburg is obstructed by a bar, and still lower down is choked with sandbanks, so that navigation is con- fined to a relatively narrow channel down the middle of the stream. But Hamburg has been unremitting in her efforts to maintain a sufficient fairway, and now vessels drawing 26 feet are able to proceed right up to her wharves, the depth of water on the

bar having been increased from 14 feet in 1830 to 24^ feet in 1899. The tide advances as far as Geesthacht, a little more than 100 miles from the sea. The river is navigable as far as Melnik, that is,- the confluence of the Moldau, a distance of 525 miles, of which 67 are in Bohemia. Its total length is 725 miles, of which 190 miles are in Bohemia, 77 miles in the kingdom of Saxony, and 350 miles in Prussia, the remaining 108 miles being in Hamburg and other states of Germany. The area of the drainage basin is estimated at 56,000 square miles.

Since 1842, but more especially since 1871, improvements have been made in the navigability of the Elbe by all the states which border upon its banks. As a result of these labours, there is now in the Bohemian portion of the river a minimum depth of 2 feet 8 inches, whilst from the Bohemian frontier down to Magdeburg the minimum depth is 3 feet, and from Magdeburg to Hamburg, 3 feet 10 inches. In 1896 and 1897 Prussia and Hamburg signed covenants whereby two channels are to be kept open to a depth of 9i feet, a width of 656 feet, and a length of 550 yards between Bunthaus and Ortkathen, just above the bifurcation of the Norder Elbe and the Silder Elbe. In 1869 the maximum burden of the vessels which were able to ply on the upper Elbe was 260 tons ; but in 1899 it was increased to 800 tons. The large towns through which the river flows have vied with one another in building harbours, providing shipping accommodation, and fur- nishing other facilities for the efficient navigation of the Elbe. In this respect the greatest efforts have naturally been made by Hamburg (q.v.); but Magdeburg, Dresden, Meissen, Riesa, Tetsohen, Aussig, and other places have all done their relative shares, Magdeburg, for instance, providing a commercial harbour and a winter harbour. In spite, however, of all that has been done, the Elbe remains subject to serious inundations at periodic intervals. Some of the worst floods which have been occasioned by this river have occurred in the years 1774, 1799, 1815, 1830, 1845, 1862, and 1890.

The growth of the traffic up and down the Elbe during the last quarter of the 19th century will be illustrated by the subjoined table, which shows the number of vessels, with their tonnage, which passed the river stations of Schandau (near the Saxon- Bohemian frontier), the Plauer Sohleuse (some

20 miles below Magdeburg), and Hamburg-Entenwarder — (i.) the annual average for the years 1872-75, and (ii.) for the year 1899.

Up-stream.

Down-stream.

Vessels.

Tons.

Vessels.

Tons.

Schandau . {l«^^-75

Plauer / 1872-75 Schleuse . (.1899

Hamburg- f 1872-75 Entenwarder! 1899

4,336 8,489 2,313 5,149 5,053 24,480

30,600 3,045,600

108,600 1,223,100

438,700 6,607,000

3,152 7,795 2,099 5,269 4,725 26,706

429,200 4,509,500

148,000 1,7.39,500

256,400 6,174,600

In addition to this, timber rafts with an annual average of 154,500 tons of timber passed downwards through Schandau, and 34,400 tons through

Hamburg, in the years 1872-75 ; the corre- sponding figures for 1899 being 284,100 tons through Schandau and 23,600 tons through Hamburg. The value of the goods for- warded from Hamburg to the interior of Germany up the Elbe in the year 1899 was estimated at over 34^ millions sterling, equivalent to about 20 per cent, of the entire exports from Hamburg. This vast amount of traffic is directed principally to Berlin, by means of the Havel-Spree system of canals, to the Thuringian states and the Prussian province of Saxony, to the kingdom of Saxony and Bohemia, and to the various riverine states and provinces of the lower and middle Elbe. The passenger traffic, which is in the hands of the Sachsisch-B6hmische Dampfschifffahrtsgesellschaft, is limited to Bohemia and Saxony, steamers plying up and down the stream from Dresden to Melnik, occasionally contmuing the journey up the Moldau to Prague, and down the river as far as Riesa, near the northern frontier of Saxony. The carrying trade and the towmg of barges are conducted by several large navigation companies.

In 1877-79, and again in 1888-95, some 100 miles of canal were dug 5 to 6J feet deep and of various widths, for the purpose of

connecting the Elbe, through the Havel and the Spree, with the system of the Oder. The most noteworthy of these connexions ai-e the Elbe Canal (14J miles long), the Eeek Canal (91 miles), the Rudesdorfer Gewasser (llj miles), the Rheinsberger Canal (11 J miles), and the Sacrow-Paretzer Canal (10 miles), besides which the Spree has been canalized for a distance of 28 miles, and the Elbe for a distance of 70 miles. Since 1896 great improve- ments have been made in the Moldau and the Bohemian Elbe, with the view of facilitating communication between Prague and the middle of Bohemia generally on the one hand and the middle and lower reaches of the Elbe on the other. In the year named a special commission was appointed for the regulation of the Moldau and Elbe between Prague and Aussig, at a cost estimated at about £1,000,000, of which sum two-thirds were to be borne by the Austrian empire and one-third by the kingdom of Bohemia. The regulation is being effected by the construction of locks and movable dams, the latter so designed that in times of flood or frost they can be dropped flat on the bottom of the river. "When all these works are finished, the two rivers will have a minimum depth over the distances indicated of 6J feet, and will be able to accommodate barges of 700 to 800 tons when fully

laden. In 1901 the Austrian Government laid before the Reichsrath a canal Bill, with proposals (1) for constructing a canal from the Danube (probably near Linz) to the Moldau near Budweis, a distance of 80 miles, and for regulating the Moldau from Budweis down to Prague ; (2) for constructing a canal from the Danube to the Oder ; (3) for constructing a canal between this last, starting at Prerau and ending at Pardubitz on the upper Elbe, and for the canalization of the Elbe from Pardubitz to Melnik ; and (4) for making a navigable canal to unite the Danube-Oder section with the basin of the Vistula and with the navigable portion of the Dniester. The total cost was estimated at £31,000,000, and the time the works would take at twenty years. In 1900 Lubeck was put into direct communication with the Elbe at Lauenburg by the opening of the Elbe-Trave Canal, 42 miles in length, and con- structed at a cost of £1,177,700, of which the state of Liibeck contributed £802,700, and the kingdom of Prussia £375,000. The canal has been made 72 feet wide at the bottom, 105 to 126 feet wide at the top, has a minimum depth of 8 J feet, and is equipped with seven locks, ach 262J feet long and 39J feet wide. It is thus able to accommodate vessels up to 800 tons burden ; and the passage from Ltibeok to Lauenburg occupies 18 to 21 hours. In the first year of its being open (June 1900 to 1901) a total of 115,000 tons passed through the canal. A gigantic project has also been put forward for providing water communication between the Rhine and the Elbe, and so with the Oder, through the heart of Germany. Some particulars of this scheme, which is known as the Midland Canal, are given in the article Canals. Another canal has been projected for connecting Kiel with the Elbe by means of a canal trained through the Plbn Lakes.

The Elbe is crossed by numerous bridges, as at Koniggratz, Pardubitz, Kolin, Leitmeritz, Tetschen, Schandau, Pima, Dresden, Meissen, Torgau, Wittenberg, Rosslau, Barby, Magdeburg, Rathe- now, Wittenberge, DBmitz, Lauenburg, and Hamburg and Har- burg. At all these places there are railway bridges, and nearly all, but more especially those in Bohemia, Saxony, and the middle course of the river — these last on the main lines between Berlin and the west and south-west of the empire — possess a greater or less strategic value. At Leitmeritz there is an iron trellis bridge, 600 yards long. Dresden has four bridges, three built in the 19th century, one of them serving also as a railway bridge, and the fourth early in the 18th century; there is a fifth bridge at Loschwitz, about three miles above the city. Neissen has a new railway bridge, in addition to an old road

bridge. Magdeburg is one of the most important railway centres in Northern Germany ; and the Elbe, besides being bridged — it divides there into three arms — several times for vehicular traffic, is alsb spanned by two fine rail-way bridges. At both Hamburg and Harburg, again, there are handsome new railway bridges, the one (1868-73 and 1894) crossing the Northern Elbe, and the other (1900) the Southern Elbe ; and the former arm is also crossed by a fine triple-arched bridge (1888) for vehicular traffic.

The river is well stocked with fish, both salt-water and fresh- water species being found in its waters, and several varieties of fresh-water fish in its tributaries. The kinds of greatest economic value are sturgeon, shad, salmon, lampreys, eels, pike, and whiting.

In the days of the old German empire no fewer than thirty-five different tolls wera levied between Melnik and Hamburg, to say nothing of the special dues and privileged exactions of various riparian owners and political authorities. After these had been de facto, though not dejure, in abeyance during the period of the Napoleonic wars, a commission of the various Elbe states met and drew up a scheme for their regulation, and the scheme, embodied

1 See Der Bau des Slie-Trave Canals und seine Vorgeschichte. Lubeck, 1900.

in the Elbe Navigation Acts, came into force in 1822. By this a definite number of tolls, at fixed rates, was substituted for the often arbitrary tolls which had been exacted previously. Still further relief was afforded in 1844 and in 1850, on the latter occasion by the abolition of all tolls between Melnik and the Saxon frontier. But the number of tolls was only reduced to one, levied at Wittenberge, in 1863, about one year after Hanover was induced to give up the Stade or Brunsbuttel loll in return for a compensa-tion of 2,857,340 thalers. Finally, in 1870, 1,000,000 thalers were paid to Mecklenburg and 85,000 thalers to Anhalt, who thereupon abandoned all

~~claims to levy tolls upon the Elbe shipping, and thus navigation on the river became at last entirely free.~~

~~The Elbe cannot rival the Rhine in the pioturesqueness of the scenery it travels through, nor in the glamour which its romantic „. , and legendary associations exercise over the imagination.~~

- ~~”’■ But it possesses much to charm the eye in the deep glens of the Biesengebirge, amid which its sources spring, and in the bizarre rock-carving of the Saxon Switzerland. And it has been indirectly or directly associated with many stirring events in the history of the German peoples. In its lower course, whatever is worthy of record clusters round the historical vicissitudes of Hamburg — its early prominence as a missionary centre (Ansgar) and as a bulwark against Slav and marauding Northman, its commercial prosperity as a leading member of the Hanseatic League, and its sufferings during the Napoleonic wars, especially at the hands of the ruthless Davoiit. The bridge over the river at Dessau recalls the hot assaults of that ill-favoured condoJiiere Ernst von Mansfeld in April 1626, and his repulse by the crafty general- ship of Wallenstein. But three years later this imperious leader was checked by the heroic resistance of the ” Maiden ” fortress of Magdeburg ; though two years later still she lost her reputation, and suffered unspeakable horrors at the hands of Tilly’s lawless and unlicensed soldatesca. Miihlberg, just outside the Saxon frontier, is the place where Charles V. asserted his imperial authority over the Protestant elector of Saxony, John Frederick, the Magnanimous or Unfortunate, in 1547. Dresden, Aussig, and Ijeitmeritz are all reminiscent of the fierce battles of the Hussite wars, and the last-named of the Thirty Years’ “War. But the chief historical associations of the upper (i.e., the Saxon and Bohemian) Elbe are those which belong to the Seven Years’ War and the struggle of the great Frederick of Prussia against the power of Austria and her allies. At Pima (and Lilienstein) in 1756, he caught the entire Saxon army in his fowler’s net, after driving back at Lobositz the Austrian forces which were hastening to their assistance ; but only nine months later he lost his reputation for “invincibility” by his crushing defeat at Kolin, where the great highway from Vienna to Dresden crosses the Elbe. Not many~~

~~miles distant, higher up the stream, another decisive battle was fought between the same national antagoijists, but with a contrary result, on the memorable 3rd July 1866.~~

~~" See M. BucHMEisTER, "Die Elbe u. der Hafen von Hamburg," in Mitteil. d. Geog. Gesellsch.in Hamburg (1899), vol. xv. pp. igi- 188; V. KoRs, "Die kiinstlichen Wasserstrassen des deutschen Reichs," in G-eog. Zeitschrift (1898), pp. 601-617 ; and (the ofBcial) Der Elbstrom (1900). (j. t. Be.)~~

~~Elberfeld, a town of Prussia, in the Rhine province, on the river Wupper, 15 miles by rail east from Diisdel- dorf. Since 1874 several new and handsome quarters have been built to the south and west of the older part of the town. A new town-hall was erected in 1899-1900. The more recent buildings incltide the Roman Catholic church of St Suitbert's, the Reformed church in the ceme- tery, the royal engineering school, a hospital ; and there are monuments to Moltbe, Bismarck (1897), and the Em- perors William I. and Frederick III. There are, further, zoological gardens, and deaf and dumb and lunatic asy- lums. A railway 9 miles in length, with 20 stations, on the Langen mono-rail system, suspended on the river Wupper from Elberfeld to Barmen, has recently been opened. The industries are on a scale of great magni- tude ; various iron and steel industries, paper, musical instruments, tobacco, and carpet manufacture, and brew- ing are important. Population (1885), 109,218; (1900),~~

~~156,503.~~

~~Elbeuf, a town in the arrondissement of Rouen, de- partment of Seine Inferieure, France, 14 miles south-south- west of Rouen by rail. There is a large manufacture of~~

~~woollen goods, the raw material being imported chiefly from Argentina (average about 4700 tons). Elbeuf is also an irnportant entrepQfc for German wools. There is a state school of manufactures for the training of practical managers and foremen. Port traffic on the Seine (1898), 68,663 tons. Population (1901), 19,050.~~

Elbing, a town of Prussia, province of West Prussia, 49 miles east-south-east from Danzig by rail and 6 miles from the Frisches Haff. The town-hall (1894) contains the historical museum. The Marienkirche (15th and 16th centuries) was restored in 1887. There is a monument of the war of 1870-71 (1887). Elbing is a place of rapidly growing industry, the principal branches being iron ship- building (one firm alone employing more than 3000 hands and doing work for the Imperial navy) and other iron industries, and cigar manufacture. There is a large trade in agricultural produce. Population (1900), 52,298.

Elbing-Oberland Canal, in the Prussian pro- vinces of East and West Prussia, connecting Lake Drau- sen, and consequently the port of Elbing, with Lakes Geserich and Drewenz to the south — total distance, 110 miles. The width is 62^ feet, the depth A^ feet ; and the canal, which was made in 1845-60, cost £226,000. It consists of four inclined planes connected by three stretches of canal and shut off by five sluices, the altitude of the two lakes and their feeders being 338 feet above sea-level, and the altitude of Lake Drausen only 5\ feet. Boats are drawn up the inclined planes on waggons, which are hauled up by machinery.

Elche, a town and railway station of Spain, in the province of Alicante, on the river Vinalapo. It has grown in importance and there are now more than a million palm trees in the district, and 22,600 tons of dates are exported every year. Manufactures of oil, flour, soap, leather, alcohol, and esparto-grass rugs are prosperous industries. Population (1887), 23,847 ; (1897), 28,030.

Elduayen, Jose de, 1st Makquis del Pazo be LA Merced (1823-1898), Spanish politician, was born ir. Madrid, 22nd June 1823. He was educated in the capital, took the degree of civil engineer, and as such directed important works in Asturias and Galicia, entered the Cortes in 1856 as deputy for Vigo, and sat in all the par- liaments until 1867 as member of the Union Liberal, with Marshal O'Donnell. He attacked the Miraflores cabinet in 1864, and became under-secretary of the Home Office when Canovas was minister in 1865. He was made a councillor of state in 1866, and in 1868 assisted other members of the Union Liberal in preparing the revo- lution. In the Cortes of 1872 he took much part in financial debates.

~~*He accepted office as a member of the last Sagasta cabinet under King Amadeus. On the pro- clamation of the republic Elduayen very earnestly co-operated in the Alphonsist conspiracy, and endeavoured to induce the military and politicians to work together. He went abroad to meet and accompany the prince after the pronundamiento of Marshal Campos, landed with him at Valencia, was made governor-of Madrid, a marquis, grand cross of Charles III., and Minister for the Colonies in 1878. He accepted the portfolio of Foreign Affairs in the Canovas cabinet from 1883 to 1885, and was made a life senator. He always prided himself on having been one of the five members of the Cortes of 1870 who voted for Alphonso XII. when that parliament elected Amadeus of Savoy. He died at Madrid, 24th June 1898.*~~

~~*END OF THIRD VOLUME.*~~

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PREFATORY ESSAY.

THE GROWTH OF TOLERATION.

By Sir Leslie Stephen, K.C.B.

AT the opening of the 20th century we might plausibly congratulate ourselves upon the increase of mutual tolerance. A marked change had taken place even within a generation. In the ‘sixties there was a period of short controversy, which to some of the disputants seemed to herald an intellectual revolution as important as that which took place at the Reformation. Adherents of Darwinism in science, and advocates for the application of critical methods to the Bible, were denounced in a spirit recalling the ancient methods of controversial warfare. In 1902 orthodox divines could regard evolu- tion as an established principle, and were no longer alarmed by the critical results which seemed at first sight so ‘destructive. Whatever the meaning of this change, there is undoubtedly a gain in good temper and calmness of discussion. Perhaps we are a little inclined to exaggerate the real intensity of the previous struggle. The old phrases scarcely covered the old strength of feeling. A recent writer remarks that the Calvinistic dogmatism in which he was educated has vanished able “like a nightmare and hideous dream.” That may go to prove that it was not really believed even in his youth. It is exceedingly rash to infer men’s genuine beliefs from their most sincere avowals. They believe themselves to hold dogmas, the plain meaning of which is neutralized by all manner of tacit reservations and unconscious interpretations. The real utility of the ostensible creed may be sapped long before it is openly abandoned ; and when a doctrine vanishes rapidly, the inference is that it had already decayed at the roots. The apparent change may mean merely that men have come to avow clearly the conclusions which were already formed, though latent under various disguises. In any case, however, the general readiness to accept as harmless or obvious opinions which not long ago were regarded as dangerous and offensive is in itself a remarkable change, and may justify a few considerations as to its true nature. To understand it fully we should have to consider how it takes its place in the prolonged process by which a doctrine, universally repudiated three centuries ago, is now as universally accepted, even by some to whom the fundamental position requires a little straining to make room for it.

A full acceptance of the duty of toleration is often noticed as the most marked case of the addition of a new article to the code of morality. It seems so obvious to us now that it is necessary to recall the real obstacles by which its acceptance was impeded in order to understand more clearly the later steps in the development of the doctrine. We often look back with simple amazement at the state of mind in which the tyranny of the Inquisition or the atrocious penal laws could be reconciled by any ingenuity to the dictates of the human conscience. Considering the incapacity of the vast mass of mankind for reasoning at all, and the incapacity even of the ablest for establishing a philosophical

system solid enough to survive later inquiry ; and considering, too, how speedily, as the most confident dogmatists must admit, every speculation places us in front of insoluble mysteries, it seems to be not only atrocious, but grotesque, to punish men for losing their way in the labyrinth. The persecutor virtually admits, by appealing to force, that men cannot attain truth by reasoning. The obvious inference is that error is inevitable, and therefore innocent. When a heretic is punished for an honest error, honestly avowed, he is punished for doing what to him is his obvious duty. His “punishment,” then, cannot have a moral quality. It is clearly paradoxical to send a man to hell for the good of his soul. It has to be admitted, in fact, that so far persecution is not moral, though it may be expedient. The heretic is damned to save the soul of his neighbours. The

liberty of persccutor argues that he is not punishing a criminal, but stamping out a contagion, jne conscence. .^ working in the interests of society at large, though inflicting a palpable wrong upon the individual. If religion be regarded as simply a philosophical creed, the absurdity of regard- ing error as criminal is obvious. Philosophers often hate each other pretty heartily ; but they have never, I think, proposed to establish their own opinions by the stake. They have felt bound to admit that error is properly assailed by reason. But a religion is much more than a set of dogmas. It is a complex of

intellectual, ethical, and social instincts. It is the bond by which a vast and elaborately organized society is held together. It means devotion to the Church as well as acceptance of certain speculative results. The persecutions of the early Christians were not intended to suppress opinions which the persecutor regarded with simple indifference or contempt, but to put down a system of secret societies, naturally objects of suspicion to the statesmen, because they enforced a discipline of their own, and might come into conflict with the authority of the State. “When the empire had become Christian two great societies were fused together, and each had a direct interest in supporting, if also in limiting, the authority of the other. To rupture the unity of belief was to overthrow the authority of the Church, and intellectual dissent meant a revolt against the ties which held the whole social order together. The immediate motive of the persecutions of later days was not the love of men’s souls, but the desire to support the great institution against which the heretic was rebelling. From one point of view this makes the persecution the more hideous. It meant, as the unbeliever would say, the spirit of priestcraft, that is, the instinctive hatred of the hierarchy for any one who dared to attack its privileges or dispute its power. The persecutor, however, might be sincerely convinced of the identity between the interests of the Church to all the highest interests of mankind. His motives were no doubt complex. Loyalty to the Church might spring from the purest benevolence, or from political and personal ambition, or even from the love of rich endowments. The really benevolent must always, one fancies, have felt a certain inconsistency between the estimable motive of love for men’s souls, and the practical application to the individual sufferer ; but presumably persecution in general was a result of the spirit which is developed more or less in all corporate bodies. Their welfare becomes an end in itself apart from the good results by which their existence is supposed to be justified. The mediceval Church was identified in so many ways with a man’s whole life, and embodied his beliefs, aspirations, and interests in so many and such complex forms, that loyalty to its interests might become a second nature. The believer would require no further reason for suppressing any rebellion against its authority by the most drastic methods. From that point of view the persecuting impulse is fully in- telligible, and it is easy to perceive how difficult it would be to take into account the moral objection. If it were possible to admit that a heretic was a well-meaning person avowing what he believed to be true, he was not

the less a rebel against an essential part of the social order, who may be rightlv put to death as we should now put to death the most sincere anarchist who applied his principles by assassination.

Such obvious considerations show the difi&culty of the transformation of opinion, and may indicate some which are not yet quite surmounted. To make toleration practicable in the early days, men had not only to point out the immorality of persecution, but to show how the political and ecclesiastical constitu- tion could be reorganized. Cliurch and State, and the systems of law which they enforced, interpenetrated each other so thoroughly at the time of the Reformation, that a complete separation of functions was

inconceivable. Whether, as various disputants held, the State was properly subordinate to the Church, or the Church to, the State, or they were two co-ordinate powers of equal authority, they virtually formed parts of a single organization. Each relied upon the co-operation of the other, and though the spiritual and secular sanctions might be distinct, both were required to the working of a single system. Schism involved rebellion or war. It was not a simple separation of speculative sects, but a disruption of the social structure. The Calvinist changed the ecclesiastical system, but claimed for his Church the old right to the support of the State. The Anglican Church retained the old constitution, and enforced 6onformity, not the less because obedience was due to the king instead of the bishop of Rome. The breach of continuity no doubt suggested some doubts as to the authority of the new system. Elizabethan statesmen sometimes repudiated the doctrine of religious persecution, and declared that Catholics were punished not as heretics, but as rebels. So long as a priest, as such, was liable to be hanged, drawn, and quartered, it made little difference to him what was the ostensible reason. But, hypocritical as the apology seems, we cannot ignore the real difficulty. The priest was, in point of fact, a drilled and subordinate member of a vast and powerful body representing a main element in the jjolitical combination which instigated domestic conspiracies and foreign invasions. Even if his immediate purpose was to administer spiritual consolation to individuals, he was necessarily also an agent of a hostile

political power. Undoubtedly measures of political defence took the shape of religious persecution, and it would have been more expedient, as well as more just, to limit expression to the men who were guilty of directly treasonable purpose. The distinction, however, was difficult so long as the religious body used secular weapons. A certain reciprocity is required in international as in all morality. So long as a Catholic was bound by his dogma to be disloyal, the Protestant was strongly tempted to punish Catholicism. Meanwhile, in enforcing conformity, the State was supporting not merely certain dogmas, but the system of moral discipline in which it was essentially interested. Religion was the essence of morality, and to tolerate religious dissent was to demoralize the State. Nobody could be more tolerant and rational in speculative matters than the excellent Baxter. But he “was shocked by the claim of Independents and Quakers to “what they called liberty of conscience.” It meant, he explains, liberty not only to think, but to preach and do whatever they pleased ; that is, it was the plea for antinomianism and rebellion against all religious order and moral restraint.

The lesson of toleration, therefore, had to be learnt, not by logic alone ××× by proofs of the im- morality of punishing innocent men ××× ^but also by the bitter experience won through protracted civil and international warfare. Sects found that they could live side by side when they were forced to combine against a common oppressor. Statesmen, though they had made religious differences a pre- text, were most fully alive to material interests, and refused to make political aims subservient to religious bigotry. The greatest were content, like Richelieu, to make things easy for heretics on con- dition of submission to the secular power. The most effective persuasive to toleration, if not the most logical argument on its behalf, is the simple existence of the heretic. Ocular demonstration shows that he has not horns and hoofs, and it follows that he may be a decent person and a desirable customer. Meanwhile the endless controversies, which, instead of leading to any conclusion, branched out into countless multiplications and subdivisions of opposing theories, had an obvious lesson for the intel- ligence. The Catholic held that the evil was due to the rejection of the old authority, and that the only hope of restoring unity was to return to the fold. The opposite view was the scepticism which inferred that controversies which led to no result could only b.e concerned

with chimeras. But the natural development of Protestantism was the belief that the differences were superficial, and that a common ground might be discoverable. It should be possible to draw up a list of the fundamental doctrines common to all Christians, or perhaps to all religions whatever. It might still be held that men's salvation depended upon their creed ; but the creed might be so simplified and so obviously true, that very few people would have to be damned. , The development of this view led to the deism of the 18th century, or to the " Religion of Nature," the truth of which was demonstrable by reason. There was ample room for controversy as to the relation of this religion to the historical religions, which might be regarded either as adding corollaries or as really superfluous. In any case, theory was

naturally combined with a doctrine of toleration which is interesting by its limitations as well as its assertions.

Locke was the authorized exponent of the English revolution of 1688 ; and his treatise upon toleration gives the high-water mark of the advancing doctrine. He is anxious to indicate the widest practicable sphere for free thought ; but he has to draw the line at two points. He excludes atheists, that is, those who disbelieve the religion of nature, and who therefore, as he holds, repudiate the only motives which form an efficient sanction of the moral law. He excludes Catholics, because their religion binds them to disloyalty. Rousseau, the apostle of the French revolutionary creed, is still at the same point of view. The citizens of his ideal state must hold the " positive " doctrine that there is a benevolent, all- wise, and omnipotent Providence ; and the " negative " doctrine that salvation is not confined to the members of any sect. All who refuse these beliefs must be exiled. Every one, there- fore, must be tolerated except the intolerant and those who are anti-social on principle. Now, though we have ceased in theory to make even these exceptions, the ground of exception corresponds to a practical difficulty. If, in fact, we are justified in assuming that men's conduct will be governed by their opinions, or by what we regard as the logical deduction from these opinions, toleration would clearly have to be limited. If an atheist really held that he might kill any one he pleased, we should restrain

the application of his principles. ” I am an atheist ” would not be a sufficient plea in answer to an indictment for murder. So, if Catholicism implied actual disobedience to the constituted authorities, we should not the less put down a rebellion in the interests of Catholicism. As a matter of fact, atheists do not claim a right to murder nor modern Catholics to rebel, and no difficulty arises in regard to their conduct. Some cases may still occur in which a religious practice comes into conflict with secular laws ; as when the ” peculiar people ” refuse to call in medical aid for their children. In practice, there is a general de facto agreement to obey the laws ; but it must be noticed that such an agreement is a necessary condition of carrying out complete toleration, not only of opinions, but of the corresponding conduct.

The answer, in fact, to the problem which still perplexed Locke and Rousseau implies a distinction which they failed to take into account. Every one would now admit that we must attack philosophical error by reason alone, although we may find it necessary to restrain the corresponding conduct by legal coercion. Toleration of opinions, therefore, must be distinguished from toleration of practices. I may at once deny a man’s right to do things and admit his full right to show that the prohibition is unreason- able. The distinction is really fundamental. A certain ambiguit}^ still appears in popular arguments upon the question. Authority is often used in a double sense, as covering both coercion and a rational proof. ” Authority,” as used in scientific or historical questions, means simply one kind of evidence mean/zifi- ??? ^^^^ kind upon which by far the greatest part of every man’s knowledge is necessarily of Autbo- founded. I believe historical facts “on authority” when I have not been an ej-e-witness, but consider them to be sufficiently proved by appropriate evidence. I believe a scientific doctrine upon authority when I have not followed the reasoning or tried the experiments by which it is proved, but hold it to be established by the consent of experts and verified by the application of tests open to general observation. The discovery of Neptune was a sufficient proof of the value of astronomic theories to those who could not follow a step of the reasoning. The telegraph con- vinces us that electricians have real knowledge, though we may be utterly ignorant of their investi- gations. Such belief is, of course, perfectly reasonable ; for in this sense authority means an appeal to reason. The enormous growth of scientific knowledge in modern times has made the conception of rational authority familiar. The

existence of a vast body of truths, mutually consistent and corro- borative, and verified at every moment by whole systems of practical application, proves not only that such belief is reasonable, but that all but an infinitesimal proportion of every individual's knowledge must be taken on trust, that is, upon reasonable authority. It would be manifestly absurd to regard authority in this sense as opposed to reason or capable of being opposed to it. Reason imperatively commands the acceptance of sufficient evidence. The only alternative to believing on authority would be to take your beliefs by chance, which is a very common but not a rational practice.

PREFATOEY ESSAY XI

In philosophical or religious discussions, however, popular writers still oppose reason to authority, as if the words were mutually exclusive. If to believe on authority means to believe because you will be burnt for not believing, the process is clearly irrational. But it is simply rational to attach due weight to the opinions of competent inquirers. When the Protestant claimed the right of private judgment, the claim might be perfectly right or clearly preposterous. It would be right if he meant that he was to be guided by reason in choosing his guides. It would be preposterous if he meant that every ignorant man could settle for himself innumerable questions only to be answered by the combined efforts of profound critics and historical inquirers. But the absurdity would not be that he reasoned, but that he neglected the only kind of evidence which he was competent to appreciate. The argument from incompetence is not properly an argument for abandoning such reasoning power as you possess, but for respecting the opinions of your superiors, and holding your conclusions with due modesty. The two arguments, indeed, are easily confounded. An Irish peasant presumably accepts his creed without asking questions at all. It is to him a primary instinct. But if it should occur to him to inquire, it might be quite reasonable for him to hold that a creed accepted by all the wisest and best men whom he knew, and of whose competence no doubts had ever occurred to him, must have a strong presump- tion in its favour. If he really accepted it upon that ground, he would be as much a rationalist in principle as the free-thinking artizan who is convinced by Paine's Age of Reason. If, on the other hand, he accepted it because he was afraid of consequences, he would be submitting to authority of a radically irrational kind. One claim

unquestionably glides very easily into the other. ” Accept my creed because I am wiser ” is identified with the inconsistent claim, ” Accept it because I am stronger.” When a man is told to absorb whole systems of dogma in regard to matters which he is totally incapable of understanding, and when his salvation is held to depend upon his accepting the orthodox view, whatever may be the grounds of his acceptance, authority ceases to mean evidence and comes to mean coercion. The superior asserts his right to be believed, and refuses to say why his authority should be accepted. The historian or the man of science may ask us to believe, because, though we cannot follow his argument, he can prove his competence. But the priest who proves the incompetence of the layman from the weakness of the reasoning faculty in general, is proving that the guide is just as incompetent as the traveller. Thus the appeal to authority comes to be essentially sceptical, and involves the assertion that as truth is unattainable, belief may be arbitrary.

To assert authority, then, in its rational or scientific sense is to admit also the obligation of proving its rationality, and, therefore, of renouncing coercion. Every scientific man admits, in theory at least, that he is bound to establish his claims, and therefore to court every kind of investigation. He does not propose to forbid even the fool to reason, but only warns him to remember that he is a fool. Every now and then some ignorant person denies an established truth ; he squares the circle or invents perpetual motion. Nobody proposes to punish him except by demonstrating his error. Even his error may be useful, as an illustration of the existing state of mind. A quack remedy in medicine may do as much mischief as a theological heresy ; but to suppress whatever was disapproved by the College of Physicians would be to encourage an undesirable faith in the infallibility of that eminent body. If we agree, as we do in such matters, that even incompetence supplies no ground for exercising irrational authority, the doctrine of toleration takes its widest sense. It may then be laid down absolutely that to suppress freedom of discussion is, so far, invariably bad. There is not the least necessity for trying to prevent people from thinking. They are quite ready enough to be stupid or indifferent without external inducements. The huge dead-weight of established” prejudices is amply sufficient ; and the authority of their defenders more likely to be over than under estimated. We may say that free thinking is not only a right, but a

duty. A man, that is, is bound to be as reasonable as he can.- The main condition of progress is that the intellectual activity should be stimulated by all legitimate means ; not because it destroys, but because it creates a rational authority. The argument that free thought leads to scepticism is suicidal ; for a doctrine which can be destroyed by exposure to argument must be a doctrine which it is irrational to believe. The great thinker is one whose mind swarms with hypotheses, and who gradually puzzles out his way through the labyrinth by trying every turn and

rejecting those which end in a deadlock. A society in which speculative a&tivity is great must abound in erroneous sects ; but the doctrine of natural selection applies, if it applies anywhere, to the world of ideas. The fittest ideas will survive, and the keener the competition the sooner they will triumph over their rivals. The tendency is not to the destruction of ” authority,” but to the formation of the only reasonable authority ??? a consistent body of doctrine which has been raised by systematic unification and is authoritative in the sense of being supported by conclusive evidence.

At this stage, the doctrine thus implies not merely passive, if one may say so, but active toleration ; or that it is unconditionally desirable not only to permit btit to stimulate intellectual activity. It was reached, and the essential point was stated most cogently in Mill’s famous essay upon Liberty ; and so far as he dealt with liberty of thought little can be added to his argument. He felt, however, certain difhculties when he passed from liberty of speculation to liberty of conduct. As an individual, he en- deavoured to limit as much as possible the sphere of State interference ; and yet he could not deny that the State should have social aims, and therefore enforce rules, even while permitting free discussion of their underlying principles. This brings out one essential element of the problem. The accepted view of the Liberal of his time was that there should be a complete separation between Church and State. The sphere of religion was entirely separate from the sphere of political obligation. Macaulay put the

case in his usual trenchant fashion in arguing against Gladstone. A State, he said, should aad have no more religious colouring than a railway company. The individual minister of

State was, of course, bound to belong to the Church whose creed he took to be true, and so was the individual railway director. But the ministry or the directors in their corporate capacity had no concern whatever with religious questions. Religion is a matter of purely individual interest. My belief, it was said when it was desired to give a pious turn to the theory, is between myself and my God. No human being has even a right to inquire into it, and to do so is an act of gross impertinence ??? as Macaulay informed a constituent who had the audacity to ask the question. So long, indeed, as certain beliefs are regarded as in themselves disreputable there is some excuse for reticence. But when the duty of toleration is fully admitted and the inference drawn that a man ought to obey his own reason, I should say that an open avowal of opinion may become a dutj-. In any case, the theory that a man's religious opinions can have no bearing upon his political action is an assumption of fact. It is not self-evident even in the case of a railway company. If some of the shareholders believed while others denied that Sunday travelling was forbidden by the laws of God, a religious difficulty might arise in the company. Macaulaj^ observes that Marlborough's armies included Catholics and Protestants, who were equally ready to fight, whatever their differences about transubstantiation. That, however, would not have been equally true in the time of Cromwell or Gustavus Adolphus, when Protestants or Catholics had strong motives for betraying leaders of the opposite persuasion. It is a question of fact whether loyalty to a particular Church is or is not compat- ible with loyalty to a given State. Both spiritual and secular powers aim at enforcing certain rules of conduct, and it is not necessarily nor always true that the two systems of legislation will be consistent. Undoubtedly in the time of Mill and Macaulay the assumption corresponded very closely to the facts. The old Puritanic ideal of a theocratic State which should regard the laws of Moses as part of the laws of England had vanished, or only left some faint traces in the desire to enforce observance of the Sabbath. The Catholic might still hold that the State ought to obey the Church, and even that under some ideal order persecution of heretics would still be right. But, in point of fact, he was as ready as his neigh- bours to submit to the State and to accept the principle of toleration ??? so long, at any rate, as he was the person to be tolerated. The question, however, remains, whether or under what conditions this separation of the two powers can be absolutely maintained. The prevalent theory of individualism, which tended to limit the legitimate

action of the State to purely material interests, made the problem simple. But every Church holds that its creed embodies the essential motives for morality, whatever may be its precise theory ; and unless the laws of the State have nothing to do with morality, or happen in point of fact to be in conformity with the morality approved by the Churches, some conflict must always be possible.

If, therefore, we may develop toleration of opinion and discussion to the farthest point, and agree that intellectual activity should be not only unchecked but stimulated, there must still be a difficulty in regard to the toleration of the corresponding conduct. Coercion by physical force is essential to legal authority ; and the very existence of the State implies the forcible suppression of certain modes of conduct. This again presupposes a certain moral agreement. The State does not undertake to suppress immorality as such, and leaves many forms of vice to be discouraged by other agencies. But it is equally true that no conduct should be regarded as criminal which is not also regarded as immoral. If, in the usual and very sound formula, vice cannot be put down by Act of Parliament, still, so far as it goes, the legitimate action of the State must be in harmony with the general moral convictions. Though immorality may not be directly punishable, the laws of marriage will tend to heighten or diminish the general respect for the institution, and have therefore a moral or immoral tendency, according to the doctrine accepted.

The sphere of State action has greatly extended of late years, and the theory that it should be limited to purely material interests has been more and more discredited. The question, therefore, natu- rally occurs, What has been the bearing of recent political changes upon the principle of toleration? If the State takes to interfere in a greater number of cases, and to interfere with a moral purpose, must not the toleration of conduct become more difficult ? If the religious differences which divide sects are compatible with an agreement as to the moral issues involved, they may co-operate in suppressing the same modes of conduct ; but it is a question of fact whether there is or is not such an agreement.

One change of modern times has a bearing upon this question. The early Radicals held that the abolition of a State Church was a simple corollary from the doctrine of toleration. At the time of the first Reform BiU, the disestablishment of the Church and the confiscation of its revenues was regarded on both sides as an inevitable result of parliamentary reform. The prediction has hitherto been falsified. Disestablishment may be still part of the genuine Radical creed ; but the demand does not rouse the vehement passions of the previous generation. A State Church may be regarded as an anomaly ; but we take anomalies easily, and the hostile sentiment corresponds rather to (/on’”**’ a pious aspiration for theoretical symmetry than to a deep sense of a pressing injustice, disestab- One cause is obvious. In the first quarter of the 19th century the Church was regarded by Radicals as an essential part of the great political combination by which the country was governed. Rich bishops, non-resident clergy, and indolent cathedral chapters were familiar instances of the abuses which favoured corruption, political jobbery, and all the evils of irresponsible class govern- ment. The clergy were part of the garrison, which, in alliance with the nobility, the lawyers, and the stock-jobbers, held the position to be stormed by reformers. The removal of the old abuses diminished the strength of the antagonism ; and whatever may be said of bishops to-day, they are not idle sinecurists, owing their position to family claims, and trying to earn translation to the best sees by a course of political servility. At the same time the decline of the old jealousy of all Government interference has weakened one presumption in favour of a voluntary system, and favours the growth of another view. It is a disputed question whether disestablishment would really be favourable to toleration. In one way the change would clearly be more congenial to the high churchman than to his opponents. The higher the claims of the priesthood, the greater is the objection to the alliance with the State which ties the hands of the Anglican establishment. The Church, on a sacerdotalist theory, should command instead of obeying, and be able to define and interpret its own dogmas. Had the Church been ” free ” in the ‘sixties, the high and low churchmen would each have tried to expel the other and have combined to expel the broad churchmen. Pusey and Gorham and Maurice and Colenso could hardly have been kept in one fold. The anomalous position which makes a change impossible without the consent of a body representing all other sects has preserved its external unity. If toleration implies disestablishment, it may give greater authority to

the intolerant. A free Church might become more exclusive and obscurantist, or split up into separate Churches, each representing an intolerant creed. The liberty of the Church would really mean an increased power of the clergy.

XIV PEEFATORY ESSAY

A lover of toleration may prefer the Erastian view. The Church is for him a parliamentary institu- tion, the religious department of the State, which obviously cannot claim any power of deciding what doctrines are true, but which may very well be a good comfortable institution, so regulated as to provide such services and discharge such functions as are in fact acceptable to respectable persons in general. The existence of such a sentiment implies the belief that the laity in general take very little interest in the speculative controversies by which Churches are divided.

Nobody, indeed, can say that sectarian prejudices have died out. That they can be bitter enough is proved by the controversies upon educational questions. The prejudice against State interference has been rather inverted than diminished ; everybody accepts State schools in principle ; and it is even laid down as self-evident that education is the business of the Government and not of the Church. If the nation were co-extensive with the Church, the doctrine would seem to be rather preposterous than obvious. Education must surely be an essential function of the Church, not bare instruction in reading and writing, but inculcation of morality and the beliefs with which, according to every Church, morality is essentially connected. It is surely the most logical position that the class told off to inculcate these beliefs should control education. The acceptance of a State system implies either that religious instruction is not im- portant or that, as a matter of fact, we are all sufficiently agreed. It is presumed that there is such a thing as “unsectarian religion,” and the additional* dogmas may be added by priests or such and Eda- teachcrs as they prefer. Catholics, Anglicans, and Dissenters all accept the rule of three, and the secular teaching may be given in common, while the religious teaching is an extra^. A compromise upon these lines is not acceptable to advocates of denominational schools. But even their position implies a concession. They cannot argue on the ground that their distinctive creeds are essential. There

is no serious danger that the rising generation will take wrong views of apostolic succession or justification by faith or any of the speculative points upon which the Protestant Churches are divided. They must be abnormally precocious if they have any perception that any such con- troversies exist. The real argument is, of course, that a child may be brought up to feel a due respect for the parson or for the dissenting minister, and that the Church invested with the function may gain influence in its corporate capacity. The claim may be legitimate, and members of any Church may hold that the secret of its power depends ultimately upon its orthodoxy. But at least it is evident that the argument does not rest upon the importance of absolute purity of doctrine. The opinion that a child ought to be taught to have dogmas, because if it does not hold them it will probably be damned, is probably not held, and certainly cannot be put forward by any body. It is only held that Churches in general are useful ; and that people in general believe in the great importance of religion. But, whatever may be the creed of the more devoted, it is plain that the ordinary common-sense looks with very great indifference upon the purely speculative differences even if it is aware of their existence.

Indifference to the critical distinctions is conspicuous in another direction. The controversv between socialists and their antagonists suggests profound moral questions, but it is remarkable that the religious distinctions have so little bearing upon them. Some socialist theories are indeed avowedly based upon materialism and the rejection of all theological creeds. But the most influential individualists in English politics have been also the most thoroughgoing sceptics ; and complete ” agnosticism ” would seem to be equally capable of alliance witli either form of social philosophj-. On the other side, it cannot be said that the principles of orthodox Christians involve an and ladi- acceptance of either alternative. The Church of England no doubt was mainly on the vidua Ism. conservative side in general ; and when ” Christian Socialism ” made a stir in the middle of the 19th century, its leading advocates were accused of being tacit allies of freethinkers and atheists. But we have changed all that. Perhaps staunch socialists may retain a suspicion that their patrons, if not insincere, have some tacit reservations or want of complete svmpathv. But at any rate, the ecclesiastical as well as political parties seem to be anxious to accept as much rather than as little, as they can of the socialist platform.

Conservatives can aro-ue that thev are in one respect consistent. They were formerly denounced by the Radical for holdino- the doctrine of “paternal government.” Now that he renounces or modifies individualism, he has to admit that if

government should not be “paternal,” it ought to be at least “fraternal.” The true objection to the old theory was not to its interference, but to the hypocrisy which made a profession of in- terest in its governed a mere cloak for the selfishness of the ruler. When the Church appeared to the Radical to be essentially identified with a corrupt government, it shared the antipathy routed by the whole ruling class. It was one organ of a caste, and if it had remained in that position, the English Liberal would have agreed with his French contemporary that clericalism was the enemy. If the sentiment is not altogether absent on the English side of the Channel, it is far less bitter and does not connote the uncompromising animosity which instructs to intolerance. The difference might no doubt be explained by the social and intellectual differences ; by the absence of the sharp division of classes and the offensive privileges which embittered the French struggle ; or by the tendency to compromise which our neighbours consider to be illogical, and which we consider to be a proof of common-sense. Whatever the cause of the English attitude, the result is clearly favourable to toleration. The Church is not in solidarity with a close corporate system ; and the lines which divide the orthodox from heretics or unbelievers are not coincident with vital differences upon social questions. The changes of social and political organization have been enormous, and may be described as a victory of democracy. But the democracy has not had to crush a compact and hostile body ; it has rather found that the upper classes have been willing to accept its supremacy and carry out its policy. The Church, though an ” appendage ” of the aristocracy, has not been fitted either by its doctrines or its social position to ally itself unequivocally with the obstructive forces.

Toleration was closely associated with individualism. The most thoroughgoing individualists preached it with the greatest force and made it their most conspicuous doctrine. Yet the doctrine of individualism of the old

dogmatic and absolute variety ??? whatever may be the explanation of that phenomenon ??? has certainly not led to a doctrine of practical toleration. The implication would seem to be that the individualist sentiment owed much of its strength to the antipathies generated in the prolonged struggle against a privileged class. It was not a simply ” centrifugal ” force, but a revolt against the claim to an artificial and unjust unity imposed for the comfort of the governing classes. It approved of voluntary associations though it objected to union by coercion. But when the old offensive claims were abandoned and government was controlled by the masses, unity could be reached spontaneously, and the distinction between voluntary and compulsory association became less important. The differences, no longer accentuated by incidental irritants, showed themselves to be less important than they had appeared. When men are brought to co-operate in common aims, whether by voluntary agreement or as members of a State organization, superficial differences show their futility ; and toleration may be more acceptable when duties are discharged by public bodies than when they are left to organized sects, each propagating its own creed. Clearly, however, this presupposes a sufficient harmony in point of fact, and a certain underlying agreement between the various parties. The cause of such an agreement, so far as it exists, must be sought mainly in the intellectual develop- ment which is the correlative of the political changes.

One dominant factor in that development has of course been the vast growth of the natural sciences. The attempt to reach unity by discerning a residuum of belief common to all creeds seemed to be illusory. Atheists repudiated even the “religion of nature,” and Christians declared it to be worthless. Meanwhile scientific research was suggesting a more thorough method. It took no dogma whatever for granted. It started from Descartes’ principle of unlimited doubt, and aaa accepted unequivocally the Baconian maxim of impartially interrogating nature. Its success ceace.

in establishing a solid body of truth contrasted with the futility of metaphysical argumentations ; and philosophers began to inquire whether the saine methods might not be equally fruitful in a different sphere. History, politics, economics, and even philosophy and religion were treated by great thinkers on the precedent of the physical sciences ; and, if the full

constitution of the ” moral sciences ” is still indefinitely distant, the spirit of inquiry is at least radically changed. As historical knowledge extends and we become acquainted with the thoughts and institutions of remote races and periods, our theories have to expand. The acceptance of Newtonian astronomy.

revealing the infinitesimal importance of our planet, had suggested that the universe vras too big for the old-fashioned cosmogonies. The recognition that Christianity vras but one of the many forms of belief which had prevailed over vast areas and indefinite periods had a similar effect upon the historical imagination. To study religions in a scientific spirit is to admit that all religions, if not equally good, spring at least from a common source. To a simple-minded missionary the likeness of Buddhism to Christianity suggested an artifice of the devil to distract his dupes by caricaturing the genuine Church. To the rational inquirer the phenomenon is an interesting illustration of his fundamental principles. The spread of investigation goes along with the rapid confrontation of all nations, which make it as impossible for the vulgar as for the scientific inquirer to identify his village with the universe and his creed with the sole revelation of the Deity. The growth of science, in short, suggested the contrast at once between rational and arbitrary authority ; between fruitful methods and endless metaphysical logomachies, and between the impartial comparison of systems of belief as products of a common intellectual constitution and the assumption that one must come from God and all others from the devil.

The perception that a religion for philosophers must have some wider basis than a total tradition was of course nothing new. It was the essential contention of the old deists. Pope’s “universal prayer ” addressed to the ” Father of all in every age, in every clime adored,” gives the sentiment of the cultivated minds of his time. When Tennyson’s phrase about our ” little systems ” which ” have their day and cease to be ” became at once proverbial, it implied that the thought was already congenial to far wider circles. Pope scandalized his orthodox contemporaries ; Tennyson was taken to be obviously edifying. Huxley has said that Tennyson was the man of letters of his day who had most fully appreciated the tendencies of

scientific thought. Anyhow he expressed most clearly a sentiment with which the more educated classes were already saturated in the first half of the century, and which it would be easj^ to illustrate from all the chief writers of the time. A strong religious sentiment and a belief in a sufiiciently vague creed was combined with a conviction that the old dogmatic systems were effete. If the formulee were still current, and an attempt to challenge them openly exposed an unbeliever to general disapproval, the unreality of the “little systems ” was not’ the less felt ; and the distinctions betwsen rival sects could only interest professional divines, who had been somehow sheltered from the wider current of living thought.

The controversies which excited us in the ‘sixties illustrated the state of mind. The)^ indicated to the more thoughtful the fact that scientific theories were coming into direct collision with accepted religious creeds, and that, if philosophy was not to be, as materialists held, a simple department of physical science, it must at least conform to the established scientific base. To the ordinary mind, at first sight, it suggested simply an attack upon the first chapter of the book of Genesis. We were invited to substitute a pair of chimpanzees for Adam and Eve ??? the question upon M’hich Huxley had his famous encounter with Wilberforce. The apologists had gone on arguing upon the old issue, inherited from predecessors bj^ whom the literal truth of the whole Biblical narrative had been taken for granted as a postulate admitted on all hands. They tried for a time to maintain the old ground against Colenso and the Essayists and Reviewers as well as against the Darwinians. But it rapidly became plain that the position was an anachronism. Everything that could be called living thought had lone ebbed away from its foundations. The primitive history might still be taught in schools ; the old legends and the dogmas connected with them might live on as survivals ; but even to ordinary common- sense it was undeniable that it was a monstrous blunder really to stake the truth of religion in general upon the possibility of maintaining the validity of the ancient record. The history or the dogma could not be independently proved ; though they might, if properly rationalized, be admissible on some other authority, whether, as Catholics held, the authority were the Church, or as liberal theologians, a philosophy which might be adumbrated by imagery adapted to the prehistoric intellect. The position accordingly changed with singular rapidity. A creed must be defended, not by taking the discredited

accrescences as the fulcrum of your argument, but by accepting them as incidental, useful, or perhaps needless accessories of the vital principles really embodied. The process was less one of confuting

genuine beliefs than of a general awakening to the fact that many of the ostensible beliefs only lay on the surface of thought or could be abandoned without injury to deeper convictions.

The change, therefore, was clearly prepared by the whole course of speculation. It corresponds to the widening of the intellectual horizon which has made it more and more impossible to damn foreigners, heretics, and the heathen “in the lump,” and shown the wickedness of the persecuting sentiment. The orthodox position must be defended, so far as defensible, upon grounds far wider than the old. The divine who now maintains the truth of Christianity no longer holds himself pledged to show the absolute falsity of the other religions which have satisfied the vast majority of the race. He argues that they are imperfect approximations to the ideal which Christianity alone can present in its manifestations of purity and the working of the same divine favour in a distracting medium. The dogmatic system must be correspondingly modified. The old controversies in which Protestants and Catholics wrangled so long and so fiercely have become hopelessly uninteresting. When the assumption that every word of the Bible is literally true disappears, the most super- ^‘fhe’in- annuated theology can no longer appeal to isolated texts or attempt to explain the relations teiiectuat of man to his Creator from the details of ancient legends. Such argumentations have still a deep historical interest, but only when we come to see that that really represents the attempt to approach great moral problems with a hopelessly imperfect intellectual apparatus. Meanwhile the philosophical basis has changed as much as the historical. The old metaphysical system has been superseded by more fruitful schemes of thought, and if the dogmas are still verbally maintained, we admit that the reasoning by which they were at first elaborated was often more a juggling with words, and implied ignorance of the inevitable limits of human thought. They may be true in some sense ; they may, perhaps, be imperfect versions of vitally important truths, but our belief must at least be justified

by some different method. They must be regarded as corollaries from the truth of a religious system which is ultimately supported by its position in universal history or as an embodiment of a demonstrable philosophy. The modern apologist argues from the moral beauty of Christianity, no
from the internal evidence. He does not base his reasoning upon the miracles, though he is prepared to accept them as congenial incidents. The sceptic might be right in rejecting the supernatural, if an isolated interference with the order of nature were made an ultimate ground of belief. But the supernatural becomes in a sense natural, if we regard it as a manifestation of the divine power which underlies all phenomena. The apologist must appeal to history ; not to a particular narrative or to an isolated series of events, but to the whole history of mankind as becoming intelligible when we regard the Christian revelation as the central event to which all other history converges.

The agnostic of course holds that the implied concession is fatal to the creed defended. The dogmas have to be interpreted so as to lose all significance ; and to accept a genuine historical method is to abandon any really supernatural element. The divine is virtually surrendering when he tries an impossible conciliation. Still a certain approximation is implied as to the method of inqmry and the criterion of truth. The acceptance by divines of evolutiionist theories, to which I referred at starting, is no doubt perfectly sincere, and has obvious recommendations. When the first alarm subsided, it became evident that some such theory was congenial to the philosophical needs of the time as well as to scientific tendencies. The order of nature had to be regarded as a continuous process stretching indefinitely backwards and forwards, and every conception of an abrupt beginning or ending had to be banished. The barriers between species were not absolute and impassable gulfs, but implied a common origin, and the slow elaboration by antagonism or association of a consistent order. This change in the natural sciences corresponded
to the demands already made in a different sphere by the growth of more philosophical conceptions of the history of mankind. If man himself had to take his place among other living beings, and the impassable gulf to be obliterated, the religious creeds must be regarded as varying products of the instincts common to all men. They could not be simply false, and might contain elements capable of incorporation in superior form of belief. Authority could not be in any

single body laying down absolute decrees, but can only be claimed by the creed which submits to the test of the freest discussion, and is elaborated by the gradual convergence of reasonable

thought. This, again, is to assert the essential principle of toleration, to which men's minds had been slowly awakening .through the whole course of modern speculation. It expressed the ideal of all the more liberal divines who had seen the necessity of basing a tenable creed upon doctrines wide enough to correspond to all the results of inquiry in every department of human knowledge ; and the general sentiment even of popular audiences was already on their side. An arbitrary dogmatism, working by threats instead of argument, had grown to be hateful and contemptible, and it had become obvious that the identification of religions with adherence to a particular legend was not a support, but a fatal limi- tation to its credibility.

The same tendency, we may hope, is apparent in the sphere of politics. Popular orators, no doubt, have still to denounce each other pretty heartily, and to represent Toryism or Liberalism as an emanation from the good or evil principle. Still, some advance has been made in the last century. Democrats used to regard kings and priests as responsible for all the evils that afflict mankind, and aristocrats to denounce revolutionists as directly inspired by the devil. The antagonism is hardly so internecine, and the change, we may hope, is due to a more philosophical mode of thought. A revolu- tion, it has been said, always justifies itself, because it can only be brought about by profound grievances. This is perfectly true in the same sense in which it is true that the resistance to evolution has always some justification. There must have been some cause for the attachment to the old order. The line between good and evil is never precisely identical with the line between parties ; and the toieJa^L ^^^* condition of sound reasoning on such matters is to attempt to understand your adversary, instead of simply denouncing him. The doctrine applies to those social questions which still arouse the bitterest antipathies. Capitalists and labourers may regard each other as simply children of the devil. Still, so far as newer scientific methods of thought gain acceptance, this pleasing assumption is

modified. The old method of settling the question by laying down absolute principles of right is seen to be absurd. In place of it we have to try to understand the mode in which the complex order has been developed, to admit that the fact of its existence implied that it satisfied some general requirements, and that it must be modified tentatively and gradually, so as to approximate to a more widely satisfactory state. A tempting short-cut to the solution of problems was offered by the assumption that justice requires the enforcement of equality, or that it requires that every man should have an absolute right to improve his own position. Each doctrine may be stated plausibly, but when they come into collision we see that neither can be laid down absolutely. We have to consider the conditions by which each is limited, and how far it is applicable. That can only be done by understanding the real nature of the existing system, studying the way in which it has grown, and the functions which have been discharged by its constituent facts. The change which has come over the methods of political economists corresponds to a growing perception of the necessity of this as the only scientific treatment. So far as it is accepted, we are agreed as to the method to be pursued and the criterion which is to be decisive. It supposes not the triumph of one of two contradictory principles, but the gradual elaboration of a comprehensive theory which will do justice to both. The authority to which it appeals is that of impartial and laborious investigation of facts ; and that is the kind of authority which rests upon free discussion, and therefore implies toleration in the widest sense.

One other conclusion follows. The existence of any creed or institution is a prima facie o-round of justification. Some, it may be, are simply pernicious. But they must have had some cause ; and the longer they have thriven, the greater the presumption that they have had some utility. The scientific spirit, therefore, implies that explanation should precede, and will probably qualify, denunciation. The _ , ,,,, Darwinian assumes that the survival of a species proves its fitness to its conditions ××× and for

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presump- that rcason the evolutionist theory has commended itself to the orthodox. Undoubtedly favour ot it supplics the strongest argument in their favour. If they cannot safely appeal to any religion. arbitrary authority, or to

a purely dialectical proof, they can point to undeniable facts. That religious institutions have played an enormous part in the history of civilization, and that at the present day, in spite of all intellectual revolutions, the religious instinct in some shape represents a

social foxce of enormous power, is obviously undeniable. If the particular dogmatic systems have ceased to correspond to genuine beliefs, we must ask to what cause we attribute the enduring vitality of the sects and the loyal devotion which they command. The old explanations are no longer available. We cannot set down religious beliefs as simply the product of priestly imposture. That short and easy method has become obsolete along with the claims to which it was opposed. Nor is it easy to admit the proposition that religious beliefs as a whole represent simply a stupendous misunderstanding generated by the blunders of primitive savages, a set of simply erroneous superstitions, which can be eliminated without difficulty from the general system of thought. Unless they had been more deeply rooted in human nature, they would have died out before the newer lights of intellectual advance. The truth indeed may be that the view which identifies a religion with its avowed creed, and supposes that a man first persuades himself of the truth of certain tenets and then deduces rules for conduct, inverts the true process. A religion in the full sense is a product of the whole social, imaginative, and emotional nature, and the dogmatic system represents a congenial construction which has to use for its materials the prevalent conceptions of the period. When the dogmas become incredible to the more intelligent the underlying instincts do not lose strength, but cannot be fully satisfied until some more simple system is worked out. Meanwhile men are often con- tented with the old scheme of belief, subject to certain tacit reservations instead of open repudiation. The problem of replacing the old synthesis remains, and those who reject the old creeds most completely, and are most convinced of the duty of expressing their dissent, may be most aware of the extreme difficulty of the task.

What institutions, if any, are to take the place of the old churches, and how the emotions which found expression in times of the old belief are to find satisfactory utterance in terms reconcilable to scientific knowledge, is our

present problem, which has not been attacked with much success, and must be the work of many generations. The believer who admits, as he is forced to admit, that the old language is obsolete, but that it yet contains a pure essence of truth, has still to define what that truth may be. To me it appears that he will not find the problem of easy solution ; but, so far as I am here concerned, I need only note that the tendencies which I have attempted to describe imply a growth of mutual toleration. There is at least an agreement that a simple creed must be tested upon the widest appreciation of the whole process of intellectual development ; that the only authority which can permanently demand assent is the gradual convergence of belief under the freest possible play of thought, and that every honest phase of opinion has a right to a fair hearing, and may be of some use even if only by provoking the exposure of its own fallacy.

ENCYCLOPEDIA BRITANNICA.

(NEW VOLUMES.)

ELECTIONS.

Elections. ††† United Kingdom. ††† Considerable alter- ations have been made in recent years in the law of Great Britain and Ireland relating to the procedure at parlia- mentary and municipal elections, and to election petitions. The Local Government Acts have also introduced new classes of voters (county and parochial electors), and have extended to the elections in which they take part the rules applicable to municipal elections.

As regards parliamentary elections, the most important of the amending statutes is the Corrupt and Illegal Prac- tices Act, 1883. This Act, and the Parliamentary Elec- tions Act, 1868, as amended by it, and other enactments dealing with corrupt practices, are temporary Acts requir- ing annual renewal. As regards municipal elections, the Corrupt Practices (Municipal Elections) Act, 1872, has been repealed by the Municipal Corporations Act, 1882, for England, and by the Local Government (Ireland) Act, 1898, for Ireland. The governing enactments for England are now the Municipal Corporations Act, 1882, part iv., and the Municipal Elections (Corrupt and Illegal Prac- tices) Act, 1884, the latter annually renewable. The provisions of these enactments have been applied with

necessary modifications to municipal and other local gov- ernment elections in Ireland by orders of the Irish Local Government Board made under powers conferred by the Local Government (Ireland) Act, 1898. In Scotland the law regulating municipal and other local government elections is now to be found in the Elections (Scotland) (Corrupt and Illegal Practices) Act, 1890.

The alterations in the law have been in the direction of greater strictness in regard to the conduct of elections, and increased control in the public interest over the pro- ceedings on election petitions. Various acts and payments which were previously lawful in the absence of any corrupt bargain or motive are now altogether forbidden under the name of “illegal practices” as distinguished from “corrupt practices.” Eailure on the part of a parliamentary can- didate or his election agent to comply with the require- ments of the law in any particular is sufficient to invalidate the return. Certain relaxations are, however, allowed in

consideration of the difficulty of absolutely avoiding all deviation from the strict rules laid down. Thus, where the judges who try an election petition report that there has been treating, undue influence, or any illegal practice by the candidate or his election agent, but that it was trivial, unimportant, and of a limited character, and contrary to the orders and without the sanction or connivance of the candidate or his election agent, and that the candidate and his election agent took all reasonable means for preventing corrupt and illegal practices, and that the election was otherwise free from such practices on their part, the election will not be avoided. The court has also the power to re- lieve from the consequences of certain innocent contraven- tions of the law caused by inadvertence or miscalculation. The jurisdiction in regard to election petitions formerly exercised by the Court of Common Pleas was on the abolition of that court by the Judicature Act, 1873, transferred to the Common Pleas Division, p^^^^, and again on the abolition of that division was transferred to the King’s Bench Division, in whom it is now vested. The rota of judges for the trial of election petitions is also supplied by the King’s Bench Division. The trial now takes place before two judges instead of one ; and, when necessary, the number of judges on the rota may be increased. Both the judges who try a petition are to sign the certificates to be made to the Speaker. If they differ as to the

validity of a return, they are to state such difference in their certificate, and the return is to be held good; if they differ as to a report on any other matter, they are to certify their difference and make no report on such matter. The director of public prosecu- tions attends the trial personally or by representative. It is his duty to watch the proceedings in the public interest, to issue summonses to witnesses whose evidence is desired by the court, and to prosecute before the Election Court or elsewhere those persons whom he thinks to have been guilty of corrupt or illegal practices at the election in question. If an application is made for leave to with- draw a petition, copies of the affidavits in support are to be delivered to him ; and he is entitled to be heard and

to call evidence in opposition to such application. Wit- nesses are not excused from answering criminating ques- tions ; but their evidence cannot be used against them in any proceedings except criminal proceedings for perjury in respect of that evidence. If a witness answers truly all questions which he is required by the court to answer, he is entitled to receive a certificate of indem- nity, which will save him from all proceedings for any offence under the Corrupt Practices Acts committed by him before the date of the certificate at or in relation to the election, except proceedings to enforce any incapacity incurred by such offence. An application for leave to withdraw a petition must be supported by affidavits from all the parties to the petition and their solicitors, and by the election agents of all of the parties who were candidates at the election. Each of these affidavits is to state that to the best of the deponent’s knowledge and belief there has been no agreement and no terms or undertaking made or entered into as to the withdrawal, or, if any agreement has been made, shall state its terms. The applicant and his solicitor are also to state in their affida- vits the grounds on. which the petition is sought to be withdrawn. If any person makes an agreement for the withdrawal of a petition in consideration of a money payment, or of the promise that the seat shall be vacated or another petition withdrawn, or omits to state in his affidavit that he has made an agreement, lawful or unlaw- ful, for the withdrawal, he is guilty of an indictable mis-

demeanour. The report of the judges to the Speaker is to contain particulars as to illegal practices similar to those previously required as to corrupt practices ; and they are to report further whether any candidate has been guilty by his agents of an illegal practice, and whether certificates of indemnity have been given to persons re- ported guilty of corrupt or illegal practices.

The Corrupt Practices Acts apply, with necessary variar tions in details, to parliamentary elections in Scotland and Ireland.

The amendments in the law as to municipal elections are generally similar to those which have been made in parliamentary election law. The procedure on trial of petitions is substantially the same, and wherever no other provision is made by the Acts or rules the procedure on the trial of parliamentary election petitions is to be followed. The commissioner who tries a petition sends to the High Court a certificate of the result, ~~together with reports as to corrupt and illegal practices, &c., similar to those made to the Speaker by the judges who try a parlia~~ mentary election petition. The Municipal Elections (Cor- rupt and Illegal Practices) Act, 1884, applies to school board elections subject to certain variations, and has been extended by the Local Government Act, 1888, to County Council elections, and by the Local Government Act, 1894, to elections by parochial electors. The law in Scotland is on the same lines, and extends to all non-parliamentary elections, and, as has been stated, the English statutes have been applied with adaptations to all municipal and local government elections in Ireland. (l. l. s.)

United States. ††† Elections are much more frequent in the United States than they are in Great Britain, and they are also more complicated. The terms of elective officers are shorter ; and as there are also more offices to be filled, the number of persons to be voted for is necessarily much greater. In the year of a presidential election the citizen may be called upon to vote at one time for all of the following: ††† (1) National candidates ††† President and Vice- President (indirectly through the electoral college) and members of the House of Representatives; (2) state candidates ††† governor, members of the state legislature, attorney-general,

treasurer, &c.; (3) county candidates ??? sheriff, county judges, district attorney, &c. ; (4) municipal

or town candidates ??? mayor, aldermen, selectmen, &c. The number of persons actually voted for may therefore be ten or a dozen, or it may be many more. In addition, the citizen is often called upon to vote yea or nay on questions such as amendments to the state constitutions, granting of licences, and approval or disapproval of new municipal undertakings. As there may be, and generally is more than one candidate for each office, and as all elections are now, and have been for many years, con- ducted by ballot, the total number of names to appear on the ballot may be one hundred or may be several hundred. These names are arranged in different ways, according to the laws of the different states. Under the Massachusetts law, which is considered the best by re- formers, the names of candidates for each office are ar- ranged alphabetically on a ” blanket ” ballot, as it is called from its size, and the elector places a mark opposite the names of such candidates as he may wish to vote for. Other states, New York for example, have the blanket system, but the names of the candidates are arranged m party columns. Still other states allow the grouping on one ballot of all the candidates of a single party, and there would be therefore as many separate ballots in such states as there were parties in the field.

The qualifications for voting, while varying in the different states in details, are in their main features the same throughout the Union. A residence in the state is required of from three months to two years. Residence is also necessary, but for a shorter period, in the county, city or town, or voting precinct. A few states require the pay- ment of a poll tax. Some require that the voter shall be able to read and understand the Constitution. This latter qualification has been introduced into several of the South- ern states as a means of disqualifying the ignorant col- oured voters. In all, or practically all, the states idiots, convicts, and the insane are disqualified ; in some states paupers ; and in some of the “Western states the Chinese. In some states women are allowed to vote on certain ques- tions, or for the candidates for certain offices, especially school commissioners ; and in a few of the Western states women have the same rights of suffrage as men. The number of those who are qualified to vote, but do not avail themselves of the right, varies greatly in the different states and according to the

interest taken in the election. As a general rule, but subject to exceptions, the national elections call out the largest number, the state elections next, and the local elections the smallest number of voters. In an exciting national election between 80 and 90 per cent, of the qualified voters actually vote, a pro- portion considerably greater than in Great Britain or Germany.

The tendency of recent years has been towards a decrease both in the number and in the frequency of elections. A President and Vice-President are voted for every fourth year, in the years divisible by four, on the first Tuesday fol- lowing the first Monday of November. Members of the national House of Representatives are chosen for two years on the even-numbered years. State and local elections take place in accordance with state laws, and may or may not be on the same day as the national elections. Orig- inally the rule was for the states to hold annual elections ; in fact, so strongly did the feeling prevail of the need in a democratic country for frequent elections, that the maxim ” where annual elections end, tyranny begins,” be- came a political proverb. But opinion gradually changed even in the older or Eastern states, and in 1901 Massachu- setts and Rhode Island were the only states in the Union holding annual elections for governor and both houses of the state legislature. In the Western states espe- cially state officers are chosen for longer terms in the

case of the governor often for four years❓❓❓ aiid the number

of elections has correspondingly decreased. Another cause of the decrease in the number of elections is the growing practice of holding all the elections of any year on one and the same day. Before the Civil War the state of Pennsylvania, for instance, held its state elections sev- eral months before the national elections in November. Similarly, Ohio and Indiana, until within the last few years, held their state elections early in October. The selection of one day in the year for all elections held in that year has resulted in a considerable decrease in the total number.

Another tendency of recent years, but not so pro- nounced, is to hold local elections in what is known as the ” off ” year ; that is, on the odd-numbered year, when no national election is held. The object of this reform is to

encourage independent voting. The average American citizen is only too prone to carry his national political predilections into local elections, and to vote for the local nominees of his party, without regard to the question of fitness of candidates and the fundamental difference of issues involved. This tendency to vote the entire party ticket is the more pronounced because under the system of voting in use in many of the states all the candidates of the party are arranged on one ticket, and it is much easier to vote a straight or unaltered ticket than to change or ” scratch ” it. Again, the voter, especially the ignorant one, refrains from scratching his ticket, lest in some way he should fail to comply with the technicali- ties of the law and his vote be lost. On the other hand, if local elections are held on the ” off ” or odd year, and there be no national or state candidates, the voter feels much more free to select only those candidates whom he considers best qualified for the various offices.

On the important question of the purity of elections it is difficult to speak with precision. In many of the states, especially those with an enlightened public spirit, such as most of the New England states and many of the North- Western, the elections are fairly conducted, there being no intimidation at all, little or no bribery, and an honest count. It can safely be said that through the Union as a whole the tendency of recent years has been decidedly towards greater honesty of elections. This is owing to a number of causes : (1) The selection of a single day for all elections, and the consequent immense number voting on that day. Some years ago, when for instance the Ohio and Indiana elections were held a few weeks before the general election, each party strained every nerve to carry them, for the sake of prestige and the influence on other states. In fact, presidential elections were often felt to turn on the result in these early voting states, and the party managers were none too scrupulous in the means employed to carry them. Bribery has decreased in such states since the change of election day to that of the rest of the country. (2) The enactment in most of the states (the number in 1901 being 40 out of the 45) of the Australian or secret ballot laws. These have led to the secrecy of the ballot, and hence to a greater or less extent have prevented intimidation and bribery. (3) Educational or other such test, more particularly in the Southern states, the object of which is to exclude the coloured, and especially the ignorant coloured, voters from the polls. In those Southern states in which the

coloured vote was large, and still more in those in which it was the majority, it was felt among the whites that intimidation or ballot-box stuffing was justified by the necessity of white supremacy. With the elimination of the coloured vote by educational or other tests the honesty of elections has increased. (4) The enactment of new and more stringent registration laws. Under these laws only those persons are allowed to vote whose names have been placed on the rolls a certain number of days or months before election. These rolls are open to public inspection, and the names may be challenged at

the polls, and “colonization” or repeating is therefore almost impossible. (5) The reform of the civil service and the gradual elimination of the vicious principle of ” to the victors belong the spoils.” With the reform of the civil service elections become less a scramble for office and more a contest of political or economic principle. They bring into the field, therefore, a better class of can- didates. (6) The enactment in a number of states of various other laws for the prevention of corrupt practices, for the publication of campaign expenses, and for the prohibition of party workers from coming within a cer- tain specified distance of the polls. In the state of Massachusetts, for instance, an Act passed in 1892, and subsequently amended, provides that political committees shall file a full statement, duly sworn to, of all campaign expenditures made by them. The Act applies to all public elections except that of town officers, and also covers nominations by caucuses and conventions as well. Apart from his personal expenses such as postage, travelling ex- penses, &c., a candidate is prohibited from spending any- thing himself to promote either his nomination or his election, but he is allowed to contribute to the treasury of the political committee. The law places no limit on the amount that these committees may spend. The reform sought by the law is through publicity, and not only are details of receipts and expenditures to be published, but the names of contributors and the amount of their con- tributions. In the state of New York the Act which seeks to prevent corrupt practices, relies in like manner on the efficacy of publicity, but it is less eifective than the Massachusetts law in that it provides simply for the filing by the candidates themselves of sworn statements of their own expenses. There is nothing to prevent their con- tributing to political committees, and the financial methods and the amounts expended by such committees are not made

public. But behind all these causes that have led to more honest elections lies the still greater one of a healthier public spirit. In the reaction following the Civil War all reforms halted. In recent years, however, a new and healthier interest has sprung up in things political ; and one result of this improved civic spirit is seen in the various laws for purification of elections. It may now be safely affirmed that in the majority of states the elections are honestly conducted ; that intimidation, bribery, stuffing of the ballot boxes or other forms of corruption, when they exist, are owing in large measure to temporary or local causes ; and that the tendency of recent years has been towards a decrease in all forms of corruption. The expenses connected with elections, such as the rent- ing and preparing of the polling-places, the payment of the clerks and other officers who conduct the elections and count the vote, are borne by the community. A candi- date, therefore, is not, as f ai as the law is concerned, liable to any expense whatever. As a matter of fact he does commohly contribute to the party treasury, though in the case of certain candidates, particularly those for the presidency and for judicial offices, financial contributions are not general. The amount of a candidate's contribu- tion varies greatly, according to the office sought, the state in which he lives, and his private wealth. On one occasion, in a district in New York, a candidate for Con- gress is credibly believed to have spent at one election f 50,000. On the other hand, in a Congressional election in a certain district in Massachusetts, the only expendi- ture of one of the candidates was for the two-cent stamp placed on his letter of acceptance. No estimate of the average amount expended can be made. It is, however, the conclusion of Mr Bryce, in his American Comvion- wealth, that as a rule a seat in Congress costs the candi- date less than a seat for a county division in the House of Commons. (See also Ballot.) (f. h. h.)

ELECTRICITY.

"TTNDER tlie general heading of Electricity we place LJ the following articles on electric theory, which are given in the order named : ###

I. Electric Conduction. II, Electeolttic Conduction.

III. Electric Current.

IV. Electric Units.

V. Electric Discharge through Gases. VI. Electric Waves. In addition to these articles, the following, dealing with allied questions, practical and scientific, will be found under separate headings, to which reference must be made : ??? Accumulators ; Atmospheric Electricity ; Dynamo ; Electricity Supply (1. General Principles ; 2. Light- ing ; 3. Traction ; 4. Industrial Development) ; Electro- chemistry ; Electromagnet ; Electro-Metallurgy ; Magnetism; Magnetism, Terrestrial; Magneto- Optics ; Measuring Instruments, Electric ; Power Transmission, Electric ; Telegraph ; Telephone ; Thbemo-Electricity ; Transformers ; Welding, Electric.

I. Electric Conduction. The Electric Conductivity of a substance is that property in virtue of which all its parts come spontaneously to the same electric potential if the substance is kept free from the operation of electric force. Accordingly, the reciprocal quality, Electric Resistivity, may be defined as a quality of a substance in virtue of which a difference of potential can exist between different portions of the body when these are in contact with some constant source of electromotive force, in such a manner as to form part of an electric cir- cuit. Deferring more exact quantitative definitions for a moment, we may say that all material substances possess in some degree, large or small, Electric Conductivity, and may for the sake of convenience be broadly divided into five classes in this respect. Between these, however, there is no sharply-marked dividing line, and the classi- fication must therefore be accepted as a more or less arbitrary one. These divisions are: (1) Metallic Con- ductors, (2) Non-Metallic Conductors, (3) Electrolytic Conductors, (4) Dielectric Conductors, (6) Gaseous Con- ductors. The first class comprises all metallic substances, and those mixtures or combinations of metallic substances known as alloys. The second includes such non-metallic bodies as carbon, silicon, many of the oxides and per- oxides of the metals, and probably also some oxides, sul- phides, and selenides. Many of these substances, for instance carbon and silicon, are well known to have the property of existing in several allotropic forms, and in some of these conditions, so far from being fairly good conductors, they may be almost perfect non-conductors. An example of this is seen in the case of carbon in its three allotropic conditions, charcoal, graphite, and dia- mond. As charcoal it possesses a fairly well-marked but not very high conductivity in comparison with metals ; as graphite, a conductivity about one-four-hun- dredth of that of iron ; but as diamond, so little conduc- tivity that the

substance is included amongst insulators or non-conductors. The third class, namely, the Elec- trolytic Conductors, comprises all those substances which undergo chemical decomposition when they form part of .<illegible>an electric circuit traversed by an electric current. The whole subject of Electrolytic Conduction has of late years acquired an immense importance from its bearing on <illegible>chemical theory, and it is considered separately under the next heading (see II. Electrolytic Conduction). The fourth class includes those substances which are generally

called Insulators or Non-Conductors, but which are better denominated Dielectric Conductors ; it comprises such solid substances as mica, ebonite, shellac, indiarubber, guttar percha, parafan, and a large number of liquids, chiefly hydrocarbons. These substances differ greatly in insulat- ing power, and according as the conductivity is more or less marked, they are spoken of as bad or good insulators. Amongst the latter many of the liquid gases hold a high position. Thus, liquid oxygen and liquid air have been shown by J. Dewar to be almost perfect non-conductors of electricity, but their absolute resistivity has not yet been numerically determined. The fifth and last class of Con- ductors includes the Gases. The conditions under which this class of substance becomes possessed of electric con- ductivity are considered more in detail below (see V. Electric Discharge). In connexion with metallic con- ductors, it is a fact of great interest and considerable practical importance, that although the majority of metals when in a finely divided or powdered condition are practi- cally non-conductors, a mass of metallic powder or filings may be made to pass suddenly into a conductive condition by being exposed to the influence of an electric wave. The same is true of the loose contact of two metallic conductors. Thus if a steel point, such as a needle, presses very lightly against a metallic plate, say of aluminium, it is found that this metallic contact, if carefully adj usted, is non- conductive, but that if an electric wave (see VI. Electric Waves) is created anywhere in the neighbourhood, this non-conducting contact passes into a conductive state.^

Electric conductivity is measured by making a comparison with the conductivity of a known mass of a standard substance taken in a stated form. The practical unit of conduct- ivity is the conductivity of a columji of pure mercury ^“oard at 0<illegible> C. having a uniform cross-section, a length

of 106-.3 centimetres, and a mass of 14-4:521 grammes. The practical unit of electric resistance, to which was given legal definition in Great Britain by the authority of the Queen in Council in 1894, is defined to be the ” resistance offered to an invariable electric current by a column of mercury at the temperature of melting ice, 14-4621 grammes in mass, of a constant cross- sectional area, and a length 106-3 centimetres.” This has been legalized as a standard in Great Britain, France, Germany, and the United States, and is denominated ” The International or Standard Ohm.” It is intended to represent as nearly as possible a resistance equal to 10′ absolute C.G.S. units of electric resistance. Con- venient multiples and subdivisions of the ohm are the microhm and the megohm, the former being a millionth part of an ohm, and the latter a million ohms. The resistivity of substances is then numerically expressed by stating the resistance of one cubic centimetre of the substance taken between opposed faces, and expressed in ohms, microhms, or megohms, as may be most con- venient. The reciprocal of the ohm is called the mho, ^hich is the unit of conductivity, and is defined as the conductivity of a substance whose resistance is one ohm. The absolute unit of con- ductivity is the conductivity of a substance whose resistivity is one absolute C.G.S. unit, or one-thousandth-millionth part of an ohm. Resistivity is a quality in which material substances differ very widely. The metals and alloys, broadly speaking, are good conductors, and their resistivity is conveniently expressed in microhms per cubic centimetre, or in absolute C.G.S. units. Very small differences in density and in chemical purity make, however, immense differences in electric resistivity ; hence the values given by different experimentalists for the resistivity of known metals differ to a considerable extent.

It is found convenient to express the resistivity of metals in two different ways: (1) We may state the resistivity of one cubic centimetre of the material in microhms or absolute units taken between opposed faces. This is called the Volume- Resistivity. (2) We mav ex-

1 This fact, investigated and di.scovei-ed independently bv Hnches Onesti, Braiily Lodse, and others, is applied in the construction of the Coherer, or sensitive tube employed as a detector or receiver in that form of wireless telegraphy ” ehietiy developed by Marconi

press the resistivity by stating the resistance in ohms offered by a wire of the material of uniform cross-section, one metre in length, and one gramme in weight. This numerical measure of the resistivity is called the Mass-Besistivity. The mass-resistivity of a body is connected with its volume-resistivity and the density of the material in the following manner : ??? The mass-resistivity, expressed in microhms per metre-gramme, divided by 10 times the density is numerically equal to the volume-resistivity per centimetre-cube in absolute C.G.S. units. The mass- resistivity per metre-gramme can always be obtained by measuring the resistance and the mass of any wire of uniform cross-section of which the length is known, and if the density of the substance is then measured, the volume-resistivity can be immediately calculated.

If R is the resistance in ohms of a wire of length /, uniform cross-section s, and density d, then taking p for the volume-resist- ivity we have

108R=p-;butZs(Z=M s

where M is the mass of the wire. Hence

109E=pd|:- ‘^ M

If 1=100 and M=l, then E=pi= resistivity in ohms per metre- gramme and 10^ p^=10,OO0dp, or p = 10V/(i and /)i=10,000ME/i2.

The following rules, therefore, are useful in connexion with these measurements. To obtain the mass-resistivity per metre- gramme of a substance in the form of a uniform metallic wire : ??? Multiply together 10,000 times the mass in grammes, and the total resistance in ohms, and then divide by the square of the length in centimetres. Again, to obtain the volume-resistivity in C.G.S. units per centimetre-cube, the rule is to multiply the mass-resist- ivity in ohms by 100,000 and divide by the density. These rules, of course, apply only to wires of uniform cross-section. In the following Tables I., II., and III. are given the mass and

volume resistivity of ordinary metals and certain alloys expressed in terms of the Standard Ohm or the absolute C.G.S. unit of resistance, the values being calculated from the experiments of Matthiessen between 1860 and 1865, and from later results obtained by Fleming and Dewar in 1893.

Table I. Electric Mass-Resistivity of Various Metals at 0►► C, or Besistanae per Metre-gramme in Standard Ohms at 0►► O. (Matthiessen.)

Metal.

Resistance at 0►► C. In Standard Qhins of a Wire 1 Metre long and Weigh- ing 1 Gramme.

Approximate Tem- perature Co- efficient near 20►► 0.

Silver (annealed) .

►►►1523

0-00377

Silver (hard-drawn)

►►►1657

Copper (annealed) .

►►►1421

0-00388

Copper (hard-drawn)

►►►1449 (Matthies

sen’s Standard)

Gold (annealed)

0-00365

Gold (hard-drawn)

4094

Aluminium (annealed)

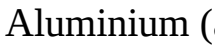
0757

Zinc (pressed)

4013

...

Platinum (annealed)

1-9337

Iron (annealed)

765

Nickel (annealed) .

1-058 1

Tin (pressed) .

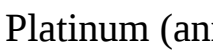
9618

0 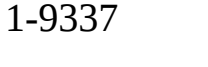
00365

Lead (pressed)

2-2268

0 ###00387

Antimony (pressed)

2-3787

0-00389

Bismuth (pressed) .

12-8554 2

0-00354

Mercury (iquid)

12-885 3

0-00072

1 and * Tile values for nickel and bismuth given in the table are much higher than more recent values obtained with pure electrolytic nickel and bismuth.

8 The value here given, namely, 12-885, for the electric mass-resistivity of liquid mercury as determined by Matthiessen is now known to be too higb by nearly one per cent. The value at present accepted is 12-789 ohms per metre- gramme at 0## 0. *

Table II. Electric Volume- Besistivity of Various Metals at 0## C, or Besistance per Centimetre-cube in 0.0.8. Units at 0## O.

This table is calculated from the results of experiments made by Matthiessen, employing the values given by Fleeming Jenkin

in Ms Cantor Lectures (Soc. of Arts, 1866) for the resistance in B.A. units of a uniform circular-sectioned wire of the metal, one metre long and one millimetre in diameter taken at 0## C. The figures given by Jenkin have been reduced to Standard Ohms and

C.G.S. units by multiplying by-^ x -9866 x 10^=77,485.

Metal.

Volume-Eesistlvity

at 0►► C. in C.G.S.

Units.

Silver (annealed) . Silver (hard-drawn) Copper (annealed) Copper (hard-drawn) Go d (annealed) . Gold (hard-drawn) Aluminium (annealed) Zino (pressed) Platinum (annealed) Iron (annealed) . Nickel (annealed) Tin (pressed) Lead (pressed) Antimony (pressed) Bismuth (pressed) Mercury (iquid)

1,602

1,629

1,594

1,630 1

2,052

2,090

3,006

5,621

9,035

10,568

12,429 2

13,178

19,580

35,418

130,872

94,896 8

1 The value (1680) here given for hard-drawn copper is about one-quarter

►►er cent, higher than the value now adopted, namely, 1626. The difference is ue to the fact that either Jenkin or Matthiessen did not employ precisely the value at present employed fpr the density of hard-drawn and annealed copper in calculating the volume-resistivities ft-om the mass-resistivities.

‘ Matthiessen’s value for nickel Is much greater than that obtained in more recent researches. (See Matthiessen and Vogt, Phil. Trans. Roy. Soc 1863 and J. A. Fleming, Proe. Boy. Soc, Deo. 1899.)

3 Matthiessen’s value for mercury is nearly one per cent, greater than the value adopted at present as the mean of the best results, namely, 94,070.

Table III. Electric Volume-Besistivity of Various Metals at 0►► O. or Besistance per Centimetre-cube of 0►► C. in C.G.S. Units. (Fleming and Dewar, Phil. Mag., Sept. 1893.)

Besistance at 0►► 0.

Mean Temperature

per Centimetre-

Coefficient be-

cube in 0.6.8.

tween 0►► C. and

l^nits.

100►► C.

Silver (electrolytic and well annealed) ‘ . .

1,468

0-00400

Copper (electrolytic and well

annealed) ^ .

1,561

0-00428

Gold (annealed)

2,197

0-00377

Aluminium (annealed)

2,665

0-00435

Magnesium (pressed)

4,355

0-00381

Zinc

5,751

0-00406

Nickel (electrolytic) i

6,935

0-00618

Iron (annealed)

9,065

0-00625

Cadmium

10,023

0-00419

Palladium

10,219

0-00354

Platinum (annealed)

10,917

0 ###003669

Tin (pressed)

13,048

0^00440

Thallium (pressed)

17,633

0-00898

Lead (pressed)

20,380

0-00411

Bismuth (electrolytic) ^ .

110,000

0-00433

1 The samples of silver, copper, and nickel employed for these tests were prepared electrolytically by Mr J. W. Swan, F.E.S., and were exceedingly pure and soft. The value for volume-resistivity of nickel as given in the above table (from experiments by J. A. Fleming, Proc. Roy. Soc, Dec. 1899) is much less (nearly 40 per cent.) than the value given by Matthiessen's researches.

3 The electrolytic bismiith here used was prepared by Messrs Hartmann and Braun, and the resistivity taken by J. A. Fleming. The value is nearly 20 per cent, less than that given by Matthiessen.

The volume-resistivity of pure mercury is a very important electric constant, and during the last two decades many of the most competent experimentalists have directed their attention to the determination of its value. The experimental process has usually been to fill a glass tube of known dimensions, having large cup-like extensions at the ends, with pure mercury, and determine the absolute resistance of this column of metal. For the practical details of this method the following references may be consulted : ??? "The Specific Resistance of Mercury," Lord Rayleigh and Mrs Sidgwick, Phil. Trans. Boy. Soc, 1883, part i. p. 173, and

ELECTEICITT

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K. T. Glazebrook, Phil. Mag., October 1885 ; ” On the Specific Re- sistance of Mercury,” R. T. Glazebrook and T. C. Fitzpatrick, Phil. Trans. Boy. Soc, June 1888, or Proc. Soy. Soc. vol. xliv. No. 270, or Electrician, vol. xxi. p. 538, 1888 ; ” Recent Determinations of the Absolute Resistance of Mercury,” R. T. Glazebrook, Electrician, vol. XXV. pp. 543, 588, 1890. Also see Professor J. V. Jones, “On the Determination of the Specific Resistance of Mercury in Absolute Measure,” Phil. Trans. Roy. Soc, 1891, A, p. 2. The table (IV.) be- low gives the values of the volume-resistivity of mercury as deter- mined by various observers, the constant being expressed (a) in terms of the resistance in ohms of a column of mercury one millime- tre in cross-section and 100 centimetres in length, taken at 0►► C. ; and (6) in terms of the length in centimetres of a column of mercury one square millimetre in cross-section taken at 0►► C. The result of all the most careful determinations has been to show that the resistivity of pure mercury at 0►► C. is about 94,070 C. G.S. electromagnetic units of resistance, and that a column of mercury 106-3 centimetres in length having a cross- sectional area of one square millimetre would have a resistance at 0►► C. of one Standard Ohm. These values have accord- ingly been accepted as the oflSoial and recognized values for the spe- cific resistance of mercury, and the definition of the ohm. The table also states the methods which have been adopted by the different ob- servers for obtaining the absolute value of the resistance of a known column of mercury, or of a resistance coil afterwards compared with a known column of mercury. A column of figures is added showing the value in fractions of a Standard Ohm of the British Association Unit (B.A.TJ.) , formerly supposed to represent the true ohm. The real value of the B.A.TJ. is now taken as -9866 of a Standard Ohm.

Tabi/E rv. Determinations of the Absolute Value of the Volume- Besistivity of Mercury and the Mercury Equivalent of the Ohm.

Lord Kayleigh Lord Rayleigll G-. “Wiedemann Mascart Rowland

Kohlrauscli

Glazebrook

Wuilleumeier Duncan and Wilkes Jones

Streker . Hutchinson SaMoni .

H. F. Vfeber H. F. Weber Koitl

Himstedt

Dorn Wild Lorenz

1882 1888 1884 1884

1S8T

18BT

(1882

11888

1890

1890

1891

1885 1888 1890

1884 1884 1885

1889 1888 1885

Eotating coll Lorenz Method Rotation through 180►► Induced current Mean of several

methods Damping of magnets Induced currents

Loren2 Lorenz

Value of B.A.U. in Ohnu.

98651

98677

98611 98644

98660 98665

Value of 100 Cend- metrea o^{??} Mercury in Ohma.

^{???}94061

94074

94077 94067 94067

Mean value -98658

An absolute determin- ation of resistance was not made. The value -98666 has been used.

^{???}94066 ^{???}94074

-94064 -94076

Mean value -94076

Induced current Rotating coil Mean effect of induced current

Damping of a magnet Damping of a magnet Lorenz method -^

Absolute meas- urements com- pared with Ger- man silver wire coils issued by Siemens and Streker

Value of

Ohm in

Ccuti-

metrea of

Mercury.

106-24 106-21 106-19

106-SS

106-32

106-32 106-29

106-27 106-34 106-81

106-82 106-30 106-83 106-80

105-37 106-16 105-89

106-24 106-08 105-93

For a critical discussion of the methods which have been adopted in the absolute determination of the resistivity of mercury, and the value of the British Association unit of resistance, the reader may be referred to the British Association Beports for 1890 and 1892 (Beport of Electrical Standards Committee), and to the Elec- trician, vol. XXV. p. 456, and vol. xxix. p. 462. A discussion of the relative value of the results obtained between 1882 and 1890 was given by Mr R. T. Glazebrook in a paper presented to the British Association at Leeds, 1890.

In connexion with electro-technical work the determination of the conductivity or resistivity values of annealed and hard-drawn copper wire at standard temperatures is. a very im- Standard portant matter. Matthiessen devoted considerable at- tor copper, fg^^j^j^ ^q ^jjjg gui^ieot between the years 1860 and 1864, and since that time much additional work has been carried out. Matthiessen’s value, known as Matthiessen’ s Standard, for the mass- resistivity of pure hard-drawn copper wire, expressed in Standard

Ohms, is the resistance of a wire of pure hard-drawn copper one metre long and weighing one gramme = -14493 Standard Ohms

at 0►► C. For many purposes it is convenient to express temper^ ture in Fahrenheit degrees, and there commendation of the 1899 Committee on Copper Conductors i is as follows :—" Matthiessen s standard for hard-drawn conductivity commercial copper shaU be considered to be a wire of pure hard-drawn copper one m^etre long weighing one gramme, the resistance of which at 60 i . is l&rf►►6►► Standard Ohms." Matthiessen also measured the mass-resistivity of annealed copper, and found that its conductivity is greater than that of hard-drawn copper by about 2-25 per cent, to 2-5 per cent. As annealed copper may vary considerably m its state of annealing, and is always somewhat hardened by bending and winding, it is found in practice that the resistivity of commercial annealed copper is about U per cent, less than that of hard-drawn copper The standard now accepted for such copper, on the recommendation of the 1899 Committee, is a wire of pure annealed copper one metre long, weighing one gramme, whose resistance at 0 C. is -14/1 Standard Ohnis, or at 60►► F., -150822 Standard Ohms The specific gravity of copper varies from about 8-89 to 8-95, and the standard value accepted for high conductivity commercial copper is 8-91^, corresponding to a weight of 555 ft per cubic foot at 60►► F. Hence the volume-resistivity of pure annealed copper at 0 C. is 1-094 microhms per c.c, or 1594 C.G.S. units, and that of pure hard- drawn copper at 0►► C. is 1-626 microhms per c.c, or 1626 C.G.S. units. Since Matthiessen's researches, the most careful scientific investigation on the conductivity of copper is that of Mr T. C. Fitzpatrick, carried out in 1890. Mr Fitzpatrick confirmed^ ilat-thiessen's chief result, and obtained values for the resistivity of hard-drawn copper which, when corrected for temperature varia- tion, are in entire agreement -vrith those of Matthiessen at the same temperature.

The volume-resistivity of alloys is, generally speaking, much higher than that of pure metals. A table (V.) is given below showing the volume-resistivity at 0►► C. of a number of well-known

Table V. Volume-Besistivity of Alloys of known Composition at 0►► C. in C.G.S. Units per Centimetre-cube. Mean Temperature Coefficients taken

at 16⁰⁰ C. (Fleming and Dewar.)

Tempera-

Resistivity

ture Co-

Composition in per

at 0⁰⁰ 0.

efficient at 15⁰⁰ C.

cents.

Platinum-silver

31,582

⁰⁰⁰000243

Pt 33 %, Ag 66 %

Platinum-lridium .

30,896

⁰⁰⁰000822

Pt 80 %, Ir 20 %

Platinum-rhodium .

21,142

⁰⁰⁰00143

Pt 90 %, Rd 10 %

Gold-silver

6,280

-00124

Au 90 , Ag 10

Manganese-steel

67,148

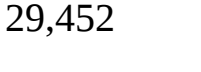 00127

Mn 12 %, Fe 78 %

Nickel-steel .

29,452

-00201

Ni 4-35 %, remain- ing percentage chiefly iron, but uncertain.

German silver

29,982

000273

Cu5Zn3Ni2

Platinoid 2

41,731

00031

Manganin

46,678

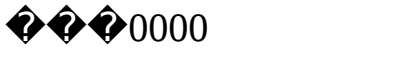

Cu 84 o/, Mn 12 %, Ni 4 o/

Aluminium-silver .

4,641

Al 94 %, Ag 6 o/ 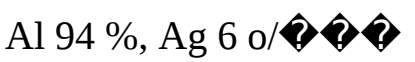

Aluminium-copper .

, 2,904

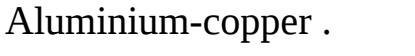

Al 94 %, Cu 6 %

Copper-aluminium .

8,847

Cu 97 %, Al 3 %

Copper-niokel-alu-

14,912

Cu 87 %, Ni 6-5 %,

mmium

Al 6-6 %

Titanium-aluminium

3,887

alloys, “with their chemical composition. Generally speaking, an alloy having high resistivity has poor mechanical qualities, that is to say, its tensile strength and ductility are small. It is possible to form alloys having a resistivity as high as 100 microhms par cubic centimetre ; but, on the other hand, the value of an alloy for electro-technical purposes is judged not merely by its resistivity, but also by the degree to which its resistivity varies with tempera- ture, and by its capability of being easily drawn mto fine wire of

1 In 1899 a Committee was formed of representatives ft-om eight of the leading manufacturers of insulated copper cables, and delegates ft-om the Post Office and Institution of Electrical Engineers, to consider the question of the values to be a’isigned to the resistivity of hard-drawn ond annealed copi’or. The sittings of the Committee were held in Loudon, the secretary hoing Mr A. H. Howard. The ^Lies given in the above paragraphs are in accordance with the decision of this Committee, and its recommendations have boon accepted by the General Post Office and the leading manufacturers of insulated copper wire and cables.

2 Platinoid is an alloy Introduced by Martino, said to be similar in composition to German silver, but with a little tungsten added. It varies a good deal in compo- sition according to manufacture, and the resistivity of different sjiocimens is not identical. Its electric properties were first made known bv J. T. Uottomlev, in a

- – lie * – -‘ ” 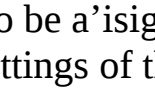 –

paper read at the Royal Society, May 6, 1685.

conduction]

not very small tensile strength. Some pure metals when alloyed with a small proportion of another metal do not suffer much change In resistivity, but in other cases the resultant alloy has a much higher resistivity. Thus an alloy of pure copper with 3 per cent. of aluminium has a resistivity about 5J times that of copper; but if pure aluminium is alloyed with 6 per cent, of copper, the re- sistivity of the product is not more than 20 per cent, greater than that of pure aluminium. The presence of a very small proportion . of a non-metallic element in a metallic mass, such as oxygen, sulphur, or phosphorus, has a very great effect in increasing the resistivity. Certain metallic elements also have the same power ; thus platinoid has a resistivity 30 per cent, greater than German silver, though it differs from it merely in containing a trace of tungsten.

The resistivity of non-metallic conductors is in all cases higher than that of any pure metal. The resistivity of carbon, for instance, in the forms of charcoal or carbon- ized organic material and graphite, varies from 600 to 6000 microhms per cubic centimetre, as shown in the following Table VI. :

Table VI. Electric Voltime-Sesistivity in Microhms per Oentimetre-cube of Various Forms of Carbon at 15 C

Arc lamp carbon rod .... Jablochkoff candle carbon

Carrfi carbon

Carbonized bamboo .... Carbonized parchmentized thread . Ordinary carbon filament from glow-lamp

” treated ” or flashed . Deposited or secondary carbon Graphite

Kesistivity.

8000 4000 3400 6000

4000 to 5000

2400 to 2500 600 to 900 400 to 500

The resistivity of liquids is, generally speaking, much higher than that of any metals, metallic alloys, or non-metallic conductors. Thus fused plumbic chloride, one of the best conducting liquids, has a resistivity in its fused condition of 0-376 ohm per oentimetre- cube, or 376,000 microhms per centimetre-cube, whereas that of metallic alloys only in few cases exceeds 100 microhms per centi- metre-cube. The resistivity of solutions of metallic salts also varies very largely with the proportion of the diluent or solvent, and in some instances, as in the aqueous solutions of mineral acids, there is a maximum conductivity corresponding to a certain dilution. The resistivity of many liquids, such as alcohol, ether, benzine, and pure water, is so high, in other words, their conductivity is so small, that they are practically insulators, and the resistivity can only be appropriately expressed in megohms per centimetre-cube.

In Table VII. are given the names of a few of these badly conducting liquids, with the values of their volume- resistivity in megohms per centimetre-cube : ###

Table VII. ### Electric Volume-Resistivity of Various Badly Conducting Liquids in Megohms per Centimetre-cube.

Substance.

Eesistivity in Megohms per c.c.

Observer.

Ethylic alcohol

0-5

Pfeiffer.

Ethylic ether

1-175 to 3-760

W. Kohlrausch.

Benzine ....

4-700

Absolutely pure water ap-

25-0 at 18►► C.

Value estimated

proximates probably to

by Kohlrausch and H e y- dweiler.

All very dilute aqueous salt

1-00 at 18►► C.

From results by

solutions having a concen-

F. Kohlrausch

tration of about 0-00001

and others.

of an equivalent gramme

molecule i per litre approxi-

mate to

1 An equivalent gramme molecule is a weight in grammes equal numerically to the chemical equivalent of the salt. For instance, one

equivalent gramme molecule of sodic chloride is a mass of 58”5 grammes. NaCl=58-5.

The resistivity of all those substances which are generally called dielectrics or insulators is also so high that it can only be appro- priately expressed in millions of megohms per centimetre-cube, or in megohms per quadrant-cube, the quadrant being a cube the side of which is 10^ cms. (see Table VIII.).

Table VIII. ††† Electric Volume-Resistivity of Dielectrics reckoned in Millions of Megohms (Mega-megohms) per Centimetre-cube, and in Megohms per Quadrant-cube, i.e., a Cube whose Side is 10 cms.

Eesistivity.

Tempera-

Substance.

ture Cent.

Mega-megohms

Megohms per

per c.c.

Quadrant-cube.

Bohemian glass

61

†††061

60††

Mica

84

-084

20

Gutta-percha

450

-45

24

Flint glass

1,020

1-02

60

Glover’s vulcanized india-

rubber ....

1,630

1-63

15

Siemens’ ordinai-y pure

vulcanized indiarubber .

2,280

2-28

15

Shellac ....

9,000

9-0

28

Indiarubber

10,900

10-9

24

Siemens’ high-insulating

fibrous material .

11,900

11-9

15

Siemens’ special high-insu-

lating indiarubber .

16,170

16-17

15

Flint glass

20,000

20 0

20

Ebonite ....

28,000

28-

46

Paraffin ....

34,000

34-

46

Temperature affects in various degrees the resistivity of these different classes of conductors. In all cases, so far as is yet known, the resistivity of pure metal is increased if its temperature is raised, and de- f^^ ”’ creased if the temperature is lowered so that if it could be brought to the absolute zero of temperature (~~273 C.) its conductivity would probably become per~~ fect or its resistivity would vanish, or at least arrive at a very small minimum value. With metallic alloys, how- ever, rise of temperature does not always increase re- sistivity ; it sometimes diminishes it, so that many alloys are known which have a maximum resistivity correspond- ing to a certain temperature, and at or near this point they vary very little in resistance with temperature. Such alloys have, therefore, a negative temperature-variation of resistance at and above fixed temperatures. Promi- nent amongst these metallic compounds are certain alloys of iron, manganese, nickel, and copper. Some of these were discovered by Mr Weston, in the United States. One well-known alloy of copper, manganese, and nickel, now called manganin, which was brought to the notice of

electricians by the careful investigations made at the Berlin Physikalisch-Technische Eeichsanstalt, is charac- terized by having a zero temperature coefficient at or about a certain temperature in the neighbourhood of 16►► C. Hence within a certain range of temperature on either side of this critical value the resistivity of manganin is hardly affected at all by temperature. Similar alloys can be produced from copper and ferromanganese. An alloy formed of 80 per cent, copper and 20 per cent, manganese in an annealed condition has a nearly zero temperature-variation of resistance between 20►► C. and 100►► C. In the case of non-metals the action of temperature is generally to diminish the resistivity as temperature rises, though this is not universally so. The interesting observation has been recorded by Mr J. ^V. Howell, that ” treated ” carbon filaments, and also graphite, are substances which have a minimum resistance corresponding to a certain temperature approaching red hea,t{Electrician,Yol. xxxviii. p. 835). At and beyond this temperature increased heat-

ing appears to increase their resistivity; this phenome- non may, however, be accompanied by a molecular change and not be a true temperature variation. In the case of dielectric conductors, and of electrolytes, the action of rising temperature is to reduce resistivity. Many of the so-called insulators, such as mica, ebonite, indiarubber, and the insulating oils, paraffin, &c., decrease in resistivity with great rapidity as the temperature rises. With gutta^ percha a rise in temperature from 0►► C. to 24►► C. is suffi- cient to reduce the resistivity to one-twentieth part of its value at 0►► C, and the resistivity of flint glass at 140►► C. is only one-hundredth of what it is at 60►► C.

A definition may here be given of the meaning of the term Temperature Coefficient. If, in the first place, we suppose that the restivity (p,) at any

temperature (t►►) is a simple linear function of the resistivity (p►►►) at 0►► C, then we can write

pt-P’ 1

or o= ►►►

po t

The quantity a is then called the temperature-coefBcient, and its reciprocal is the temperature at which the resistivity would be- come zero. By an extension of this notion we can call the quan- tity dp/pdt the temperature coeflicient corresponding to any temperature t at which the resistivity is p. In all cases the relation between the resistivity of a substance and the tempera- ture is best set out in the form of a curve called a temperature-resistance curve. If a series of such curves are drawn for various pure metals, temperature being taken as abscissa and resistance as ordinate, and if the temperature range extends from the absolute zero of temperature upwards, then it is found that these tempera- ture-resistance lines are curved lines having their convexity either upwards or downwards. In other words, the second difEerential coefficient of resistance with respect to temperature is either a positive or negative quantity. An extensive series of observations concerning the form of the resistivity curves for various pure metals over a range of temperature extending from ►►►200►► C. to -1-200►► C. was carried out in 1892 and 1893 by Fleming and Dewar {FUl. Mag., Oct. 1892 and Sept. 1893). The resistance observations were taken with resistance coils constructed with wires of various metals obtained in a state of great chemical purity. The lengths and mean diameters of the wires were care- fully measured, and their resistance was then taken at certain known temperatures obtained by immersing the coils in boiling aniline, boiling water, melting ice, melting carbonic acid in ether, and boiling liquid oxygen, the temperatures thus given being + 184►►-5 C, -1-100►► C, 0►► C, -78►►-2 C, and -182►►-5 C. The resistivities of the various metals were then calculated and set out in terms of the temperature. From these data a chart was pre- pared showing the temperature-resistance curves of these metals throughout a range of 400 degrees. The exact form of these curves through the region of temperature lying between ►►►200►► C.

and ◆◆◆273◆◆ C. is not yet known. As shown on the chart, the curves evidently do not converge to precisely the same point. It is, hovyever, much less probable that the resistance of any metal should vanish at a temperature above tlie absolute zero than at the absolute zero itself, and the precise path of these curves at their lower ends cannot be delineated until means are found for fixing independently the temperature of some regions in which the resistance of metallic wires can be measui'ed.

The resistivity curves of the magnetic metals are also remarkable for the change of curvature they exhibit at the magnetic critical temperature. Thus J. Hopkinson and D. K. Morris {Phil. Mag., September 1897, p. 218) observed the remarkable alteration that takes place in the iron resistance temperature curve in the neigh- bourhood of 780◆◆ C. At that temperature the direction of the curvature of the curve changes so that it becomes convex upwards instead of convex downwards, and in addition the value of the temperature coefficient undergoes a great reduction. The mean temperature coefficient of iron in the neighbourhood of 0◆◆ C. is ◆◆◆0057 ; at 7(15◆◆ C. it rises to a maximum value -0204 ; but at 1000◆◆ C. it falls again to a lower value, ~~00244. A similar rise to a maximum value and subsequent fall is also noted in the case of the specific heat of iron. The changes in the curvature of the resistivity curves are undoubtedly connected with the molecular changes that occur in the magnetic metals at their critical tem~~ peratures.

A fact of considerable interest in connexion with resistivity is the influence exerted by a strong magnetic field in the case of some metals, notably bismuth. It was discovered by Eighi and confirmed by Leduo (Journal de Physique, vol. v. p. 116, and

vol. vi. p. 189), that if a pure bismuth wire is placed in a magnetic field transversely to the direction of the magnetic field, its resistaiice is considerably increased (see Magnetism). This increase is greatly affected by the temperature of the metal (Dewar and llemmg, Proc. Boy. Soc, vol. Ix. p. 427).

In the case of dielectric conductors, commonly called insulators, such as indiarubber, gutta-percha, glass, and mica, the electric resistivity is not only

a ^^^^ function of the temperature but also of the time fi^ during which the electromotive force employed to measure it is imposed. Thus if an indiarubber-covered cable is immersed in water and the resistance of the dielectric between the copper conductor and the water measured by ascertaining the current which can be caused to flow through it by an electromotive force, this current is found to vary very rapidly with the time during which the electromotive force is applied. Apart from the small initial effect due to the electrostatic capacity of the cable, the application of an electromotive force to the dielectric produces a current through it which rapidly falls in value, as if the electric resistance of the dielectric were increas- ing. The current, however, does not fall continuously but tends to a limiting value, and it appears that if the electromotive force is kept applied to the cable for a pro- longed time, a small and nearly constant current will ul- timately be found flowing through it. It is customary in electro-technical work to consider the resistivity of the dielectric as the value it has after the electromotive force has been applied for one minute, the standard temperature being 76►► F. This, however, is a purely conventional pro- ceeding, and the number so obtained does not necessarily represent the true or ohmic resistance of the dielectric. If the electromotive force is increased, in the case of a large number of ordinary dielectrics the apparent resistance at the end of one minute's electrification decreases as the electromotive force increases.

The practical measurement of resistivity involves many processes and instruments (see Measuring Instruments, Electric). Broadly speaking, the processes are divided into Comparison Methods and Absolute ^^^^j. Methods. In the former a comparison is effected between the resistance of a material in a known form and some standard resistance. In the Absolute Methods the resistivity is determined without reference to any other substance, but with reference only to the fundamental standards of length, mass, and time. Immense labour has been expended during the last twenty years in investiga- tions concerned with the production of a standard of resistance and its evaluation in absolute measure. In some cases the absolute standard is constructed by filling a carefully calibrated tube of glass with mercury, in order to realize in a material form the official definition of the ohm; in this manner most of the principal national physical laboratories have been provided with standard mercury ohms. (For a full

description of the standard mercury ohm of the Berlin Physikalisch-Technische Reichsanstalt, see the Electrician, vol. xxxvii. p. 669.) For practical purposes it is more convenient to employ a standard of resistance made of wire.

Opinion is not yet perfectly settled on the question whether a wire made of any alloy can be considered to be a perfectly unalter- able standard of resistance, but experience has shown that a platinum-silver alloy (66 per cent, silver, 33 per cent, platinum), and also the alloy called manganin, seem to possess the qualities of permanence essential for a wire-resistance standard. A com- parison made in 1892 and 1894 of all the manganin wire copies of the ohm made at the Reichsanstalt in Berlin, showed that these standards had remained constant for two years to within one or two parts in 100,000. It appears, however, that in order that manganin may remain constant in resistivity when used in the manufacture of a resistance coil, it is necessary that the alloy should be aged by heating it to a temperature of 140►► C. for ten hours ; and to prevent subsequent changes in resistivity, solders

containing zinc must be avoided, and a silver solder containing 75 per cent, of silver employed in soldering the manganin wire to its connexions.

The authorities of the Berlin Reichsanstalt have de- voted considerable attention to the question of the best form for a wire standard of electric resistance. In that now adopted the resistance wire is carefully insulated and wound on a brass cylinder, being doubled on itself to annul inductance as much as possible. In the coil two wires are wound on in parallel, one being much finer than the other, and the final adjustment of the coil to an exact value is made by shortening the finer of the two. A standard of resistance for use in a laboratory now generally consists of a wire of manganin or platinum-sil- ver carefully insulated and enclosed in a brass case. Thick copper rods are connected to the terminals of the wire in the interior of the

case, and brought to the out- side, being carefully insulated at the same time from one another and from the case. The coil so constructed can be placed under water or paraflln oil, the temperature of which can be exactly observed during the process of tak- ing a resistance measurement. Equalization of the tem- perature of the surrounding medium is effected by the employment of a stirrer, worked by hand or by a small electric motor. The construction of a standard of elec- trical resistance consisting of mercury in a glass tube is an operation requiring considerable precautions, and only to be undertaken by those experienced in the matter. Opinions are divided on the question whether greater permanence in resistance can be secured by mercury-in- glass standards of resistance or by wire standards, but the latter are at least more portable and less fragile.

A full description of the construction of a standard wire-resistance coil on the plan adopted by the Berlin Physikalisch-Technische Reichsanstalt is given in the Report of the British Association Committee on Electrical Standards, presented at the Edinburgh Meeting in 1892. For the design and construction of standards of electric resistances adapted for employment in the comparison and measurement of very low or very high resistances, the reader may be referred to standard treatises on electric measurements.

(j. A. F.)

II. Electeolttic Conduction.

Many of the phenomena which accompany the passage of electricity through fused salts and solutions have been described in the articles Electkicity and Electkolysis (Ency. Brit., 9th ed.), in which the nomenclature of the subject is defined. But since the date of those articles much additional knowledge has been obtained : the dis- charge of electricity through gases has been proved to depend largely on electrolytic conduction, and the expla- nation both of this process and of the passage of a current through liquids has been extended on the lines of the theory of moving particles of matter, called ions, asso- ciated with definite electric charges. In this article we are concerned only with liquid electrolytes, the conduc- tion of gases being treated under Electric Dischaege (see v., below). The new developments of this section of the subject depend experimentally on the measure- ment of electrolytic resistance. The fundamental prob- lems

underlying such experiments have been considered in the article Electricity {Ency. Brit, 9th ed.).

In determining the electrical resistance of solutions, Kohlrausch's method of eliminating the effects of polarization Ijy the use of alternating currents (see as above) is now universally employed. The currents, usually obtained from a small induction coil, or from an alternating current supply reduced by- a transformer to a low voltage, are led to a Wheatstone's bridge, in one arm of which is placed the solution to be investigated. Instead of a galvanometer, which cannot indicate alternating currents, a tele- phone is used. A sound is heard when alternating currents pass through this instrument, and the bridge is adjusted till silence is obtained. A modification of the method, which eliminates several

disturbing causes, consists in alternating the current from a galvanic battery by means of a commutator revolving at a uniform speed, which at the same time alternates the connexions of the indicator. The differential current of the bridge thus again becomes direct, and a galvanometer, preferably of the moving coil type (see III. Electkic Current, below), can be employed (Wlietham, Phil. Trans. Roy. Soc, A, 1900). The solutions are usually placed in glass vessels, the shape of which depends on the order of the resistance to be measured. The platinum electrodes are coated with platinum black, in order to obtain a surface of very large area and thus diminish the effects of polarization. The determination of the conductivity of a liquid in absolute units involves a knowledge of the " cell constant " or " resistance capa- city " of the vessel containing it. This can be found if we already know the absolute conductivity of any definite solution. Kohlrausch has compared the specific resistance of many solutions with that of mercury, and from his results a cell constant can be calculated. The following numbers may be used for this purpose : a solution of potassium chloride, containing one-tenth of a gram-equivalent o►► salt per litre, has at 18►► C. a specific resistance of 89-37′ ohms per cubic centimetre, or a conductivity of l-119x lO-is in C.G.S. units.

As in the case of the other properties of solutions, the phenomena are much more simple when the concentration is small than when it is great, and a study of dilute solu- tions is therefore the best way of getting an insight into

the essential principles of the subject. The foundation of our knowledge was laid by Kohlrausch, who expresses his results in terms of ” equivalent conductivity,” that is, the conductivity (fc) of the solution divided by the number (m) of gram-equivalents of electrolyte per litre. He finds that, as the concentration diminishes, the value of fc/m ap- proaches a limit, and eventually becomes constant, that is to say, at great dilution the conductivity is proportional to the concentration. Kohlrausch first prepared very pure water by repeated distillation, and found that its resist- ance continually increased as the process of purification proceeded. The conductivity of the water, and of the slight impurities which must always remain, was sub- tracted from that of the solution made with it, and the re- sult, divided by m, gave the equivalent conductivity of the substance dissolved. This procedure appears justifiable, for as long as conductivity is proportional to concentration it is evident that each part of the dissolved matter produces its own independent effect, so that the total conductivity is the sum of the conductivities of the parts ; when this ceases to hold, the concentration of the solution has in gen- eral become so great that the conductivity of the solvent may be neglected. The general result of these experiments can be graphically represented by plotting k/m as ordinates

1 1

andm^ as abscissae, m^ being a number proportional to the reciprocal of the average distance between the molecules, to which it seems likely that the molecular conductivity may be related. The general types of curve for a neutral salt and for a caustic alkali or acid are shown in Fig. 1. The curve for the neutral salt comes to alimitingvalue; that for the acid attains a maxi- mum at a certain very small concentration, and falls again when the dilution is carried to an extreme. It has usually been considered that this de- struction of conductivity is due to chemical action be- tween the acid and the resid- ual impurities in the water. At such great dilution these impurities are present in quantities comparable with the amount of acid, which they convert into a less highly conducting neutral salt. In the case of acids, then, the maximum must be taken as the limiting value. The decrease in equivalent conductivity at great dilution is, however, so constant that this explanation seems insufS-

cient. The true cause of the phenomenon may perhaps be connected with the fact that the bodies in -which it occurs, acids and alkalis, contain the ions, hydrogen in the one case, hydroxyl in the other, which are present in the solvent, water, and have, perhaps because of this relation, vel ocities higher than those of any other ions. The values of the molecular conductivities of all neutral salts are, at great dilution, of the same order of magnitude, while those of acids at their maxima are about three times as large. The influence of increasing concentration is greater in the case of salts containing divalent ions, and greatest of all in such cases as solutions of ammonia and acetic acid, which are substances of very low conductivity.

Kohlrausch found that, when the polarization at the electrodes was eliminated, the resistance of a solution was constant however determined, and thus established Ohm's

Law for electrolytes, which was confirmed in the Theory of g^g ^j strong Currents by Fitzgerald and Trouton

(B. A. Report, 1886, p. 312). Now, Ohm's Law implies that no work is done by the current in overcoming reversible electromotive forces such as those of polarization. Thus the molecular interchange of ions, which must occur in order that the products may be able to work their way through the liquid and appear at the electrodes, continues throughout the solution whether a current is flowing or not. The influence of the current on the ions is merely directive, and when it flows, streams of electrified ions travel in opposite directions, and, if the applied electro- motive force is enough to overcome the local polarization, give up their charges to the electrodes. We may therefore represent the facts by considering the process of electrolysis to be

akind of convection. Faraday's classical experiments proved that when a current flows through an electrolyte the quantity of substance liberated at each electrode is proportional to its chemical equivalent weight, and to the total amount of electricity passed. Accurate determinar tions have since shown that the mass of an ion deposited by one electromagnetic unit of electricity, i.e., its electro- chemical equivalent, is 1-036 x 10^* x its chemical equivar lent weight. Thus the amount of electricity associated

 with one gram-equivalent of any ion is ^^r

=9663 units.

Each monovalent ion must therefore be associated with a certain definite charge, which we may take to be a natural unit of electricity ; a divalent ion carries two such units, and so on. A cation, i.e., an ion giving up its charge at the cathode, as the electrode at which the current leaves the solution is called, carries a positive charge of electricity; an anion, travelling in the opposite direction, carries a negative charge. It will now be seen that the quantity of electricity flowing per second, i.e., the current through the solution, depends on (1) the number of the ions concerned, (2) the charge on each ion, and (3) the velocity with which the ions travel past each other. ISTow, the number of ions

is given by the concentration of the solution, for Velocity ot gyg^ jf ^n tjj^e ions are not actively engaged in

carrying the current at the same instant, they must, on any dynamical idea of chemical equilibrium, be all active in turn. The charge on each, as we have seen, can be expressed in absolute units, and therefore the velocity with which they move past each other can be calculated. This was first done by Kohlrausch^ about

1879.

In order to develop Kohlrausch's theory, let us take, as an example, the case of an aqueous solution of potassmm chloride, of concentration n gram-equivalents per cubic centimetre. There will then be re gram-equivalents of potassium ions and the same number of chlorine ions in this volume. Let us

suppose that on each gram-equivalent of potassium there reside ~ e units of elec-

tricity, and on each gram-equivalent of chlorine ions -e units. If u denotes the average velocity of the potassium ions, the positive charge carried per second across unit area normal to the flow is n e u. Similarly, if v be the average velocity of the chlorine Ions, the negative charge carried in the opposite direction is nev. But positive electricity moving in one direction is equivalent to negative electricity moving in the other, so that, before changes m concentration sensibly supervene, the total current, C, ^ane{u + v). Now let us consider the amounts of potassium and chlorine liberated at the electrodes by this current. At the cathode, if the chlorine ions were at rest, the excess of potassium ions would be simply those arriving in one second, namely, nu. But since the chlorine ions move also, a further separation occurs, and nu potassium ions are left without partners. The total number of gram-equivalents liberated is therefore n{u+v). By Faraday s law, the number of grams liberated is equal to the product oi the current and the electro-chemical equivalent of the ion ; the number of gi-am-equivalents therefore must be equal to 7;C, where ~~n de~~ notes the electro-chemical equivalent of hydrogen in C.G.S. units.

Thus we get

n(u+v)=riC = -nne(u+v),

and it follows that the charge, e, on 1 gram-equivalent of each kind of ion is equal to If-q. We know that Ohm's Law holds good for electrolvtes, so that the current C is also given by k ××× d××/dx, where k denotes the conductivity of the solution, and dP/dx the potential gradient, i.e., the change in potential per unit length along the lines of current flow. Thus

'^(u+v) = k.c[P/dx; v

k dip therefore m-H>='>;- ××× ××× ×××

Now ij is 1-036 + 10-'', and the concentration of a solution is usually expressed in terms of the number, m, of gram-equivalents per litre instead of per cubic centimetre. Therefore

h dP

u+i)=l-036xl0-i—^-

m dx

“When the potential gradient is one volt (10^ C.G.S. units) per centimetre this becomes

n + v = l ~~036 X 10~~‘ X k/m.

Thus by measuring the value of k/m, which is known as the equivalent conductivity of the solution, we can at once find u+v, the velocity of the ions relative to each other. For instance, the equivalent conductivity of a solution of potassium chloride con- taining one-tenth of a gram-equivalent per litre is 1113 xlO-^^ C. G. S. units at 18►► C. Therefore

M + B = 1 -036 X lOT X 1113 x 10-13 = 1-153 X 10-3=0-001153 cm. per sec.

In order to obtain the absolute velocities u and v, we must find some other relation between them. Let us resolve u into J(m+d) in one direction, say to the right, and ^(u►►►v) to the left. Simi- larly, 17 can be resolved into l(v+u) to the left and (v ►►► u) to the right. On pairing these velocities we have a combined move- ment of the ions to the right, with a speed of l{u►►►v) and a drift right and left, past each other, each ion travelling with a speed of i(u + v}, constituting the electrolytic separation. If !t is greater than V, the combined movement involves a concentration of salt at the cathode, and a corresponding dilution at the anode, and vice vers The rate at which salt is electrolysed, and thus removed from the solution at each electrode, is ^{u+v). Thus the total loss of salt at the cathode is ^{u + v)►►►l{u~v), or v, and at the anode, ►►►l(v ►►► u), or u. Therefore, by measuring the dilution of the liquid round the electrodes when a current passed, Hittorf deduced the ratio of the two velocities. Many further experiments have been made on the subject.’

By combining the results thus obtained with the sum of the velocities, as determined from the conductivities, Kohlrausch cal- culated the absolute velocities of difierent ions under stated condi- tions. Thus, in the case of the

solution of potassium chloride considered above, Hittorf's experiments show us that the ratio of the velocity of the anion to that of the cation in this solution is ###51 : ~~49. The absolute velocity of the potassium ion under unit po~~ tential gradient is therefore 0-000664 cm. per sec. , and that of the chlorine ion 0-000589 cm. per sec. Similar calculations can be made for solutions of other concentrations, and of difierent substances.

The following table shows Kohlrausch's latest values for the ionic velocities of three chlorides of alkali metals at 18## C, calculated for a potential gradient of 1 volt per

^ Leitvermogen den Mlektrolyte, Leipzig, 1898.

2 Pogq. Ann. vol. Ixxxix. p. 177 ; xcviii. p. 1 ; ciii. p. 1 ; cvi. pp. 337, 513,185.3-59. Ff .

8 Kuschel, Wied. Ann. vol. xlii. p. 289, 1881, and Lob and Nernst, Zeits.f.physik. Ghem. vol. ii. p. 948, 1888; for other references see Electrolytic Conduction, ed. by H, M. Goodwin (New York, 1S99).

conduction]

ELECTEICITT

11

cm. ; the numbers are in terms of a unit equal to lO"* cm. per sec. : ###

Table IX.

KCl

Had

LiCl

m

n+v

u

u+v

tt

1i+V

u

v

0

1350

660

690

1140

450

690

1050

360

690

0-0001

1335

654

681

1129

448

681

1037

356

681

001

1313

643

670

1110

440

670

1013

343

670

1263

619

644

1059

415

644

962

318

644

1218

597

621

1013

390

623

917

298

619

1153

564

589

952

360

692

853

259

594

1088

531

557

876

324

552

774

217

667

1-0

1011

491

620

765

278

487

651

169

482

3^0

911

442

469

582

206

376

463

115

348

5-0

438

153

285

334

80

264

10-0

117

25

92

These numbers clearly show that there is an increase in ionic velocity as the dilution proceeds. Moreover, if we compare the values for the chlorine ion obtained from observations on these three different salts, we see that as the concentrations diminish the velocity of the chlorine ion becomes the same in all of them. A similar relation appears in other cases, and, in general, we may say that at great dilution the velocity of an ion is independent of the nature of the other ion present. This at once intro- duces the conception of specific ionic velocities, for which some values at 18►► C. are given by Kohlrausch in the following table : ►►►

Table X.

K

. 66 X 10-* cms.

per sec.

CI . 69×10-5 cms.

per sec.

Na

. 45

I . 69

Li

. 36

NO3 . 64

NH4

. 66

OH . 162

H

. 320

(J2Jtl2^2 *^^))

Ag

. 57

CsHsOz 33

Having obtained these numbers we can deduce the conductivity of the dilute solution of any salt, and the comparison of the calculated with the observed values furnished the first confirmation of Kohlrausch’s theory. Some exceptions, however, are known. Thus acetic acid and ammonia give solutions of much lower conductivity than is indicated by the sum of the

specific ionic veloci- ties of their ions as determined from other compounds. An attempt to find in Kohlrausch's theory some explana^ tion of this discrepancy shows that it could be due to one of two causes. Either the velocities of the ions must be much less in these solutions than in others, or else only a fractional part of the number of molecules present can be actively concerned in conveying the current. We shall return to this point later.

Friction on the Ions. ??? It is interesting to calculate the magnitude of the forces required to drive the ions with a certain velocity. If we have a potential gradient of 1 volt per centimetre the electric force is 10″ in C.G.S. units. The charge of electricity on 1 gram- equivalent of any ion is 1/^0001036=9663 units, hence the mechanical force acting on this mass is 9653 xlO" dynes. This, let us say, produces a velocity u ; then the force required to pro- duce unit velocity is p^=9-653 x 10"dypes = 9-84 x lO^jiograms-

u u

weight. If the ion have an equivalent weight A, the force pro- ducing unit velocity when acting on 1 gram is Pi = 9-84 x ???

Am kilograms-weight. Thus the aggregate force required to drive 1 gram of potassium ions with a velocity of 1 centimetre per second through a very dilute solution must be equal to the weight of 38 million kilograms.

Table XI.

Kllo^ams-weight.

Kilograms- weight.

Pa p.

Pa

Pi

K .

. 15×108 38xl0^{??}

CI . . 14×108

40×108

Na .

^{???} 22 ^{???} 95 ^{???}

I . . 14 ^{???}

11 ^{???}

Li .

. 27 ^{???} 390 ^{???}

NO3. . 15 ^{???}

25 ,,

NHi

^{???} 15 ^{???} 83 ^{???}

OH . . 5^4 ^{???}

32 ,,

H .

. 3^1 ^{???} 310 ^{???}

C2H3O2 .27 ,,

46 ^{???}

Ag .

C3H6O2 .30

41

Since the ions move with uniform velocity, the frictional resist- ances brought into play must be equal and opposite to the driving forces, and therefore these numbers also represent the ionic friction coefficients in very dilute solutions at 18 C.

Direct Measurement of Ionic Velocities. Oliver Lodge was the first to directly measure the velocity of an ion {B. A. Report, 1886, p. 389). In a horizontal glass tube connecting two vessels filled with dilute sulphuric acid he placed a solution of sodium chloride in solid agar-agar jelly. This solid solution was made alkaline with a trace of caustic soda in order to bring out the red colour of a little phenol-phthalein added as indicator. An electric current was then passed from one vessel to the other. The hydrogen ions from the anode vessel of acid were thus carried along the tube, forming hydrochloric acid as they travelled, which decolourized the phenol-phthalein. By this method the velocity of the hydrogen ion through a jelly solution under a known potential gradient was observed to be about 0‘0026 cms. per sec, a number of the same order as that required by Kohlrausch’s theory. Direct determina- tions of the velocities of a few other ions have been made by W. C. D. Whetham {Phil. Trans. Boy. Soc. vol. clxxxiv., A, p. 337 ; vol. clxxxvi., A, p. 507 ; Fhil. Mag., October 1894). Two solutions, having one ion in common, of equivalent concentrations, different densities, different colours, and nearly equal specific resistances, were placed one over the other in a vertical glass tube. In one case, for example, decinormal solutions of potassium carbonate and potassium bichromate were used. The colour of the latter is due to the presence of the bichromate group, Cr207. When a current was passed across the junction, the anions CI and Cr207 travelled in the direction opposite to that of the current, and their velocity could be determined by measuring the rate at which the colour boundary moved. Similar experiments were made with alcoholic solutions of cobalt salts, in wnioh the velocities of the ions were found to be much less than in

water. The behaviour of agar jelly was then investigated, and the velocity of an ion through a solid jelly was shown to be very little less than in an ordinary liquid solution. The velocities could therefore be measured by tracing the change in colour of an indicator or the formation of a precipitate. Thus decinormal jelly solutions of barium chloride and sodium chloride, the latter containing a trace of sodium sul- phate, were placed in contact. Under the influence of an electro- motive force the barium ions moved up the tube, disclosing their presence by the trace of insoluble barium sulphate formed. Again, a measurement of the velocity of the hydrogen ion, when travelling through the solution of an acetate, showed that its velocity was then only about the one-fortieth part of that found during its passage through chlorides. From this, as from the measurements on alcohol solutions, it is clear that where the equivalent con- ductivities are very low the effective velocities of the ions are reduced in the same proportion.

Another series of direct measurements has been made by Orme Masson {Phil. Trans. Boy. Soc. vol. cxcii.. A, p. 331). He placed the gelatine solution of a salt, potassium chloride, for example, in a horizontal glass tube, and found the rate of migration of the potassium and chlorine ions by observing the speed at which they were replaced when a coloured anion, say, the Cr207 from a solu- tion of potassium bichromate, entered the tube at one end, and a coloured cation, say, the Cu from copper sulphate, at the other.

All the direct measurements which have been made agree with Kohlrausch’s results within the limits of ex- perimental error. His theory therefore prob- ably holds good in every case, whatever be the koM- solvent, if the proper values are given to the tbegry. ionic velocities, i.e., the values expressing the velocities with which the ions actually move in the solu- tion of the strength taken, and under the conditions of the experiment. If we know the specific velocity of any one ion, we can, from the conductivity of very dilute solutions, at once deduce the velocity of any other ion with which it

may be associated, a proceeding wliicli does not involve the difficult task of determining the migration constant of the compound. Thus, taking the specific ionic velocity of hydrogen as 0-00032 cm. per second, we can, by determin- ing the conductivity of dilute solutions of any acid, at once find the specific velocity of the acid radicle involved. Or again, since we know the specific velocity of silver, we can find the velocities of a series of acid radicles at great dilu- tion by measuring the conductivity of their silver salts.

By such methods Ostwald, Bredig, and other observers have found the specifio velocities of many ions both of inorganic and organic compounds, and examined the relation between constitution and ionic velocity, i The velocity of elementary ions is found to be a periodic function of the atomic weight, similar elements lying on corresponding portions of a curve drawn to express the relation between these two properties. Such a curve much resembles that giving the relation between atomic weight and viscosity in solution. For complex ions the velocity is largely an additive property; to a continuous additive change in the composition of the ion corre- sponds a continuous but decreasing change in the velocity. The following table gives Ostwald’ s results for the formic acid series : ###

Table XII.

Velocity.

Difference for OHj.

Formic acid .

. HCO2

61-2

Acetic ###

H2C2O2

38-3

-12-9

Propionic ,,

. H5CSO2

34-3

- 4-0

Butyric ,,

H7C4O2

30-8

- 3-5

Valeric ,,

II9C5O2

28-8

- 20

Caprionic ,,

HiiCeOa

27-4

- 1-4

electro’ lytes.

We have as yet said nothing about the fundamental cause of electrolytic activity, nor considered why, for example, a solution of potassium chloride

is a Nature ot good Conductor, while a solution of sugar allows practically no current to pass. All the preceding account of the subject is, then, independent of any view we may take of the nature of electrolytes, and stands on the basis of direct experiment. Nevertheless, the facts considered point to a very definite conclusion. The specific velocity of an ion is independent of the nature of the opposite ion present, and this at once suggests that the ions themselves, while travelling through the liquid, are dissociated from each other. Further evidence, point- ing in the same direction, is furnished by the fact that since the conductivity is proportional to the concentration at great dilution, the equivalent-conductivity, and therefore the ionic velocity, is independent of it. The importance of this relation will be seen by considering the alternative to the dissociation hypothesis. If the ions are not permanently free from each other their mobility as parts of the dissolved molecules must be secured by continual interchanges. The velocity with which they work their way through the liquid must then increase as such molecular rearrangements become more frequent, and will therefore depend on the number of solute mole- cules, i.e., on the concentration. On this supposition the observed constancy of velocity would be impossible. We shall therefore adopt as a working hypothesis the theory, confirmed by other phenomena to be described later, that an electrolyte consists of dissociated ions. It is necessary to point out that the dissociated ions of such a body as potassium chloride are not in the same condition as potassium and chlorine in the free state. The ions are associated with very large electric charges, and, whatever their exact relations with those charges may be, it is certain that the energy of a system in such a state must be different from its energy when unelectrified. It is not unlikely, therefore, that even a compound as stable in

1 Data collected in a paper by Bredig, Zeits. f. physikal. Ghemie, 1894, vol. xiii.p. 191.

the solid form as potassium chloride should be thus dis- sociated when dissolved. Again, water, the best electrolytic solvent known, is also the body of the highest specific inductive capacity (di-electric constant), and this property, to whatever cause it may be due, will reduce the forces between electric charges in the neighbourhood, and may therefore enable two ions to separate.^

This view of the nature of electrolytic solutions, which we owe to Arrhenius,^ at once explains many well-known phenomena. Other physical properties of these solutions, such as density, colour, optical rotatory [l]^”’’’’’ power, &c., like the conductivities, are additive, theory. i.e., can be calculated by adding together the corresponding properties of the parts. This again suggests that these parts are independent of each other. For in- stance, the colour of a salt solution is the colour obtained by the superposition of the colours of the ions and the colour of any undissociated salt that may be present. All copper salts in dilute solution are blue, which is therefore the colour of the copper ion. Solid copper chloride is brown or yellow, so that its concentrated solution, which contains both ions and undissociated molecules, is green, but changes to blue as water is added and the ionization becomes complete. A series of equivalent solutions all containing the same coloured ion have absorption spectra which, when photographed, show identical absorption bands of exactly equal intensity.^ The colour changes shown by many substances which are used as indicators of acids or alkalis can be explained in a similar way. Thus para^nitro-phenol has colourless molecules, but an intensely yellow negative ion. In neutral, and still more in acid solutions, the dissociation of the indicator is practically nothing, and the liquid is colourless. If an alkali is added, however, a highly dissociated salt of para- nitro-phenol is formed, and the yellow colour is at once evident. In other cases, such as that of litmus, both the ion and the undissociated molecule are coloured, but in different ways.

Electrolytes possess the power of coagulating solutions of colloids such as albumen and arsenious sulphide. The mean values of the relative coagulative powers of sulphates of mono-, di-, and trivalent metals have been shown experi- mentally to be approximately in the ratios 1 : 35 : 1023. The dissociation theory refers this to the action of electric charges carried by the free ions. If a certain minimum charge must be collected in order to start coagulation, it will need the conjunction of 6n monovalent, or 3n divalent, to equal the effect of 2n trivalent ions. The ratios of the coagulative powers can thus be calculated to be 1 : x : a~, and putting a; =32 we get 1 : 32 : 1024, a satisfactory explanation of the facts.*

The dissociation of electrolytes in solution is also sug- gested by other phenomena. If a solution be separated from a volume of its pure solvent by

a membrane permeable to the solvent but not to the solution, Osmotic the solvent passes through until a definite excess ’”***”**** of pressure, called osmotic pressure, exists. By experiments on non-conducting solutions in water and other solvents, it has been found that this osmotic pressure shows the same volume and temperature relations as gaseous pressure, and has the same absolute value. Solutions of electrolytes, however, have abnormally high osmotic pressures, and we are thus led to conclude that, in their case, either the usual laws fail, or else that the number of molecules is greater than the chemical molecular weight and the concentration

2 Mdm. p. a I’ Acad, des Sci.eiices de Suede, 1883. Abstract in B. i Report, 1886, p. 357. Zeils.f. physikal. Chemie, 1887, vol. i. p. 631.

8 Ostwald, Zeits. physikal. Chemie, 1892, vol. ix. p. 579; Ewan Phil. Mac/. (5), 1892, vol. xxxiii. p. 317; Liveing, Cambridge Phil Trans., 1900, vol. xviii. p. 298. w ‘

- See Hardy, Journal of Physiology, 1899, vol. xxiv. p. 288- and Whetham, Phil. Mag., November 1899.

conduction]

of the solution would lead us to expect. Similar relations hold for the lowering of the vapour pressure and the de- pression of the freezing-point of a solvent caused by dis- solving some substance in it. Both these effects are related to the osmotic pressure, and can be calculated from it, and the values of both are abnormally great for electrolytes. We may conclude, then, that the cause of the electrolytic property is also the cause of the increase in the osmotic pres- sure effects, and the phenomena are at once explained if we assume that the number of effective particles in solution is abnormally great in the case of electrolytes, that is, that electrolytes are partially or completely dissociated into their ions. It will be noticed that such a supposition does not commit us to any definite view as to the nature

of solu- tion or the cause of osmotic pressure. If solution be a purely physical process, analogous to evaporation, and the osmotic pressure be due to the impact of the dissolved molecules, the extra pressure of electrolytes is caused by similar impacts of the ions. If solution, on the other hand, be due to chemical action, and osmotic pressure be caused by chemical affinity of solvent for solute, then the same affinity, acting between the ions and the solvent, explains the properties of electrolytes. All that the dissociation theory demands is the freedom of the ions from each other ; they may or may not be united with solvent molecules.

Freezing-points are easier to determine than osmotic or vapour pressures, and are therefore more suitable for the experimental investigation of this relation. The Pi'eezing- connexion between freezing-point and conduct- '"' " " ivity is well shown by Arrhenius' original table, the following short extract from which will serve our present purpose. The last two columns, headed i, give the ratio of the total number of dissolved particles to the number which would exist if all the molecules were un- dissociated. In column II. the ratio is calculated from Kaoult's experiments on the freezing-points, and in column III., from the measurements of Kohlrausch, Ostwald, and others on the electrical conductivities. The first column, showing the ionization (dissociation) coefficients, is also calculated from these latter results.

Table XIII.

Nou-Oonductors.

I.

II.

III.

Ethyl alcohol

. CaHsOH

0-00

0-94

1-00

Cane sugar .

. C12H22O11

0-00

1-00.

1-00

Acetone

. CsHsO

0-00

0-92

1-00

Bases, Acids, and Salts.

Sodium hydroxide .

. NaOH

0-88

1-96

1-88

Ammonia

. NHs

0-01

1-03

1-01

Hydrochloric acid

. HCl

0-90

1-98

1-90

Nitric acid .

. HNO3

0-92

1-94

1-92

Sulphuric acid

. H2SO4

0-60

2 06

2-19

Phosphoric acid .

. H3PO4

0-08

2-32

1-24

Acetic acid .

. CH3COOH

0-01

103

1-01

Potassium chloride

. KCl

0-86

1-82

1-86

Sodium chloride .

. NaCl

0-82

1-90

1-82

Potassium sulphate

. K2SO4

0-67

2-11

2-33

Copper sulphate .

. CUSO4

0-35

0-97

1-35

The remarkable general agreement of these numbers is broken by a few exceptions, such as those seen in the cases of phosphoric acid and copper sulphate. More recent work has not succeeded in finally establishing the strict accuracy of this relation, but its approximate truth seemsundoubted. The chief experimental difficulty consists in the precise determination of the very small temperature differences between the freezing-point of the solvent and that of very dilute solutions.

An interesting relation appears when the electrolytic conductivity of solutions is compared with their chemical activity. The readiness and speed with which electrolytes react are in sharp contrast with the f‘ difficulty experienced in the case of non-electro- lytes. Moreover, a study of the chemical relations of electrolytes indicates that it is always the electrolytic ions that are concerned in their reactions. The tests for a salt, potassium nitrate, for example, are the tests not for KNOs, but for its ions K and NO3, and in cases of double decom- position it is always these ions that are exchanged for those of other substances. If an element is present in a compound otherwise than as an ion it is not interchange- able, and cannot be recognized by the usual tests. Thus neither a chlorate, which contains the ion CIO3, nor mon- ochloracetic acid, shows the reactions of chlorine, though it is, of course, present in both substances ; again, the sul- phates do not answer to the usual tests which indicate the presence of sulphur as

sulphide. The chemical activity of a substance being independent of the reaction in which it is concerned, it is possible to assign to each body a specific coefficient of affinity. Arrhenius has pointed out that the coefficient of affinity of an acid is proportional to its elec- trolytic ionization.

The affinities of acids have been compared in several ways. Ostwald (Lehrbuch der allg. Chemie, vol. ii., Leipzig, 1893) inves- tigated the relative affinities of acids for potash, soda, and ammonia, and proved them to be independent of the base used. The method employed was to measure the changes in volume caused by the action. His results are given in column I. of the following table, the affinity of hydrochloric acid being taken as one hundred. Another method is to allow an acid to act on an insoluble salt, and to measure the quantity which goes into solution. Determinations have been made with calcium oxalate, CaC204-|- H2O, which is easily decomposed by acids, oxalic acid and a soluble calcium salt being formed. The affinities of acids relative to that of oxalic acid are thus found, so that the acids can be com- pared among themselves (column II.). If an aqueous solution of methyl acetate is allowed to stand, a slow decomposition goes on. This is much quickened by the presence of a little dilute acid, though the acid itself remains unchanged. It is found that the influence of different acids on this action is proportional to their specific coefficients of affinity. The results of this method are given in column III. Finally, in column IV. the electrical conduct- ivities of normal solutions of the acids have been tabulated. A better basis of comparison would be the ratio of the actual to the limiting conductivity, but since the conductivity of acids is chiefly due to the mobility of the hydrogen ions, its limiting value is nearly the same for all, and the general result of the comparison would be unchanged.

Table XIV.

Add.

I.

II.

III.

IV.

Hydrochloric .

100

100

100

100

Nitric

102

110

92

99-6

Sulphuric

68

67

74

66-1

Formic

4-0

2-5

1-3

1-7

Acetic

1-2

1-0

0-3

0-4

Propionic

1-1

...

0-3

0-3

Monochloracetic

7-2

5-1

4-3

4-9

Dichloracetic .

34

18

23-0

25-3

Trichloracetic .

82

63

68-2

62-3

Malic

3-0

5-0

1-2

1-3

Tartaric .

5-3

6-3

2-3

2-3

Succinic .

0-1

0-2

0-5

0-6

It must be remembered that, the solutions not being of quite the same strength, these numbers are not strictly comparable, and that the experimental difficulties involved in the chemical measurements are considerable. Never- theless, the remarkable general agreement of the numbers in the four columns is quite enough to show the intimate connexion between chemical activity and electrical conduct- ivity. We may take it, then, that only that portion of a

[electeolytio

body is chemically active wMch is electrolytically active ??? that ionization is necessary for chemical activity just as it is necessary for electrolytic conductivity.

The ordinary laws of chemical equilibrium have been applied to the case of the dissociation of a substance into its ions. Let x be the number of molecules which dissociate per second when the number of undissociated molecules in unit volume is unity, then xp is the number when the concentration is^j. Recombination can only occur when two ions meet, and since the frequency with which this will happen is proportional to the square of the ionic concen- tration, we shall get for the number of molecules re-formed in one second yg”’ where g is the number of dissociated molecules in one cubic centimetre. When there is equilibrium, xp=yq^. If ;x be the molecular conductivity, and /j.^ its value at infinite dilution, the fractional number of molecules dissociated is /i//ioo , which we may write as a. The number of undissociated molecules is then 1 – a, so that if V is the volume of the solution containing 1 gram- jnoleoule of the dissolved substance, we get

g=ya and J) =^(1 -a), = -=constant=A.

V(l-a) ^

This constant Ic gives a numerical value for the chemical affinity, and the equation should represent the effect of dilution on the molecular conductivity of binary electrolytes. Ostwald has con- firmed it by observation on an enormous number of weak acids {Zeits. f. physikaZ. Chemie, 1888, ii. p. 278 ; 1889, iii. pp. 170, 241, 369). Thus in the case of cyanacetic acid, while the volume V changed by doubling from 16 to 1024 litres, the values of k were 0‘00(376, 373, 374, 361, 362, 361, 368). The mean values of k for other common acids were ††† formic, 0 ‘000021 4 ; acetic, 0-0000180; monochloracetic, 0-00155; dichloracetic, 0-051; trichlor- acetic, 1-21 ; propionic, 0-0000134. From these numbers we can, by help of the equation, calculate the conductivity of the acids for any dilution. In the case of substances like ammonia and acetic acid, where the dissociation is very small, 1 – a is nearly equal to unity, and only varies slowly with dilution. The equation then becomes

or o=^V5, . , . (31)

so that the molecular conductivity is proportional to the square root of the dilution. The value of k, however, does not keep so satisfactorily constant in the case of highly dissociated substances, and empirical formulas have been constructed to represent the effect

of dilution on them. Thus the values of the expressions j†††

1 ††† (Z\/V {Eudolphi, Zeits. physikal. Chem., 1895, vol. xvii. p. 385) and

“†††^ (Van’t Hoff, iUd.. 1895, vol. xviii. p. 300) are found to <1 – afM ^ , . .

keep constant as V changes. Van’t Hoff’s formula is equivalent to taking the frequency of dissociation as proportional to the square of the concentration of the molecules, and the frequency of recombin- ation as proportional to the cube of the concentration of the ions. No good explanation of the failure of the usual dilution law in these cases has yet been given.

When the solutions of two substances are mixed, similar con- siderations to those given above enable us to calculate the resultant changes in

dissociation. (See Arrhenius, loc. cit.) The simplest and most important case is that of two electrolytes having one ion in common, such as two acids. It is evident that the undis- sociated part of each acid must eventually be in equilibrium with the free hydrogen ions, and if the concentrations are not such as to secure this condition, readjustment must occur. In order that there should be no change in the states of dissociation on mixing, it is necessary, therefore, that the concentration of the hydrogen ions should be the same in each separate solution. Such solutions were called by Arrhenius, “isohydric.” The two solutions, then, will so act on each other when mixed that they become isohydric. Suppose we have one very active acid like hydrochloric, in whi(‘h dissociation is nearly complete, and another like acetic, in which it is very small. In order that the solutions of these should be isohydric and the concentrations of the hydrogen ions the same, we must have a very large quantity of the feebly dissociated acetic acid, and a very small quantity of the strongly dissociated hydro- chloric, and in such proportions alone will equilibrium be possible. Tliis explains the action of a strong acid on the salt of a weak acid. Let us allow dilute sodium acetate to react with dilute hydrochloric acid. Some acetic acid is formed, and this process will go on till the solutions of the two acids are isohydric ; that is, till the dis-

sociated hydrogen ions are in equilibrium with both. In order that this should hold, we have seen that a considerable quantity of acetic acid must be present, so that a corresponding amount of the salt will be decomposed, the quantity being greater the less the acid is dissociated. This “replacement” of a “weak” acid by a, “strong” one is a matter of common observation in the chemical laboratory. Similar investigations applied to the general case of chemical equilibrium lead to an expression of exactly the same form as that given by Guldberg and Waage, which is univers- ally accepted as an accurate representation of the facts.

The temperature coefBcient of conductivity has approxi- mately the same value for most aqueous salt solutions. It decreases both as the temperature is raised and as the con- centration is increased, ranging from about 3-5 per cent, per degree for extremely dilute solutions {i.e., practically pure water) at 0►► to about 1 ~~5 for concentrated solutions at 18►►. For acids its value is usually rather less than for salts at equivalent concentrations. The~~

~~influence of temperature on the conductivity of solutions depends on (1) the ionization, and (2) the frictional resistance of the liquid to the passage of the ions, the reciprocal of which is called the ionic fluidity. At extreme dilution, when the ionization is complete, a variation in temperature cannot change its amount. The rise of conductivity with tempera~~ ture, therefore, shows that the fluidity becomes greater when the solution is heated. As the concentration is in- creased and un-ionized molecules are formed, a change in temperature begins to affect the ionization as well as the fluidity. But the temperature coefficient of conductivity is now generally less than before ; thus the effect of tempera- ture on ionization must be of opposite sign to its effect on fluidity. The ionization of a solution, then, is usually diminished by raising the temperature, the rise in con- ductivity being due to the greater increase in fluidity. Nevertheless, in certain cases, the temperature coefficient of conductivity becomes negative at high temperatures, a solution of phosphoric acid, for example, reaching a maxi- mum conductivity at 75►► centigrade.

The dissociation theory gives an immediate explanation of the fact that, in general, no heat-change occurs when two neutral salt solutions are mixed. Since the salts, both before and after mixture, exist mainly Thermal as dissociated ions, it is obvious that large mena’ thermal effects can only appear when the state of dissociation of the products is very different from that of the reagents. Let us consider the case of the neutraliz- ation of a base by an acid in the light of the dissociation theory. In dUute solution such substances as hydrochloric acid and potash are almpst completely dissociated, so that, instead of representing the reaction as

HCl-|-K0H = KCl-t-H20, we must -write

H -f CI -f K ł OH = K -h CI ₣ H2O. The ions K and CI suffer no change, but the hydrogen of the acid and the hydroxyl (OH) of the potash unite to form water, which is only very slightly dissociated. The heat liberated, then, is almost exclusively that produced by the formation of water from its ions. An exactly similar process occurs when any strongly dissociated acid acts on any strongly dissociated base, so that in all such cases the heat evolution should be approximately the same. This is fully borne out by the experiments of Thomsen, who found that the heat of neutralization of one

gram-molecule of a strong base by an equivalent quantity of a strong acid was nearly constant, and equal to 13,700 or 13,800 calories. In the case of weaker acids, the dissociation of which is less complete, divergences from this constant value will occur, for some of the molecules have to be separated into their ions. For instance, sulphuric acid, which Ln the fairly strong solutions used by Thomsen is only about half

dissociated, gives a higher value for the heat of neutraliz- ation, so that heat must be evolved when it is ionized. The heat of formation of a substance from its ions is, of course, very different from that evolved when it is formed from its elements in the usual way, since the energy associated with an ion is different from that possessed by the atoms of the element in their normal state. We can calculate the heat of formation from its ions for any substance dissolved in a given liquid, from a knowledge of the temperature coefficient of ionization, by means of an application of the well-known thermodynamical process, which also gives the latent heat of evaporation of a liquid when the temperature coefficient of its vapour pressure is known. The heats of formation thus obtained may be either positive or negative, and by using them to supplement the heat of formation of water, Arrhenius calculated the total heats of neutralization of soda by different acids, some of them only slightly dissociated, and found values agreeing well with observation {Zeits. f. physikal. Chemie, 1889, vol. iv. p. 96; and 1892, voL ix. p. 339).

Diffusion of Electrolytes. ??? An application of the theory of ionic velocity due to Nernst ‘ and Planck ” enables us to calculate the diffusion constant of dissolved electrolytes. According to the molecular theory, diffusion is due to the motion of the molecules of the dissolved substance through the liquid. When the dis- solved molecules are unifonnly distributed, the osmotic pressure will be the same everywhere throughout the solution, but if the concentration varies from point to point the pressure will vary also. There must, then, be a relation between the rate of change of

the concentration and the osmotic pressure gradient, and thus we may consider the osmotic pressure gradient as a force driving the solute through a viscous medium. In the case of non-electro- lytes and of all non-ionized molecules this analogy completely represents the facts, and the phenomena of dilfusion can be deduced from it alone. But the ions of an electrolytic solution can move independently through the liquid, even when no current flows, as the consequences of Ohm's Law indicate. The ions will therefore diffuse independently, and the faster ion will travel quicker into pure water in contact with a solution. The ions carry their charges with them, and, as a matter of fact, it is found that water in con- tact with a solution takes with respect to it a positive or negative potential, according as the positive or negative ion travels the faster. This process will go on until the simultaneous separation of electric charges produces an electrostatic force strong enough to prevent further separation of ions. We can therefore calculate the rate at which the salt as a whole will diffuse by examining the con- ditions for a steady transfer, in which the ions diffuse at an equal rate, the faster one being restrained and the slower one urged forward by the electric forces. In this manner the diffusion con- stant can be calculated in absolute units (HCl=2-49, HN03=2‘27, NaCl = l”12), the unit of time being the day. By experiments on diffusion this constant has been found by Scheffer, and the numbers observed agree with those calculated (HCl=2-30, HN03=2-22, NaCl=l-ll).

Contact Difference of Potential.^A.s we have seen above, when a solution is placed in contact with water the water will take a positive or negative potential with regard to the solution, accord- ing as the cation or anion has the greater specific velocity, and therefore the greater initial rate of diffusion. Thia idea can be developed to explain the difference of potential at the surface of contact of two solutions. If e is the electric charge on each ion, and dP/dx the potential gradient, the electrical force on each ion is e dP/dx. Again, if dp/dx denote the osmotic pressure gradient, the osmotic force on one of the ions in a small cylindrical space Adx is the force on the whole element shared among the total

-^ when n is the number of dx

ions in unit volume. We have called u and v the velocities of the cation and anion under unit potential gradient, so that their velo- cities under unit force wiU be u/e and vje. Now, let us write down the velocities under the actual forces, and equate them, as the con- dition of the final state of steady transfer. dp ^dF- dx dx,

dV 1 v-u dp dx ne v + v, dx Osmotic pressure, as we have said, shows the same volume and

^ Zeits. physilml. Ohem. vol. ii. p. 613. ►► Wied. Awn., 1890, vol. xl. p. 561.

number of ions, that is, . \ , or – . nAdx n

\n dx dx/ e \n

dV\ ndx dx/’

temperature relations as gaseous pressure, and has the same abso- lute value. We can therelbre apply to it the usual equation for a mass M of gas at an absolute temperature T, ^) x volume = MET, where R is a characteristic constant. Putting M/volume = density = mn, where m is the mass of each ion, we have dp=mB,Tdn, at constant temperature. Then, substituting in our equation, and in- tegrating, we get

P,-P, = ►►►RT^^log^ e v+u ^ %

as the difference of potential between two solutions in contact, which differ in concentration, m/e denoting the electro-chemical equivalents. In the case of a galvanic cell, we must also consider the metal-liquid functions. Ions from the zinc plate enter the liquid, but no acid anions enter the zinc ; thus at the anode, ►►►w=0. So also at the cathode, u=0, and the equation for the total electro- motive force becomes

F=►►►RT(logZ^ + ?^{log}+ log^Y

Ni and Nj denoting the concentrations of cations and anions in the substance of the anode and cathode respectively. In common forms of cells,

where different metals are used, our ignorance of the meaning of these constants prevents the application of the formula, but galvanic cells can be constructed with two electrodes of the same metal placed in solutions of different substances, or even of the same substance at different concentrations. In the.se cases, since the unknown contribution from the metal is the same at the opposite electrodes, we can calculate the total electromotive force of the cell, for the equation becomes

E

m _^ 2v , n

- RT log -2,

e v + u n.

where everything is known in absolute measure. The values cal- culated for such ” concentration cells ” (usually of the order of 0‘05 volt) agree well with observation. As the equation shows, the electromotive force will be greater if the concentration of the ions of the metal in the solution round one electrode is made very smalL This can easily be done by placing the electrode in a solu- tion which precipitates the metal. Thus Ostwald found that a cell with silver electrodes, one of which was surrounded by a chloride, had an electromotive force of 0 ‘SI volt, Nernst’s formula indicating a theoretical value of 0”52 volt. By placing copper in the solution of a cyanide it can even be made electropositive with regard to zinc, and the cell arranged in accordance with the scheme.

Zn/ZnSoJK^SoJKCSICu

has a reverse electromotive force, the current outside the cell passing_ from zinc to copper. Similar ideas have been used to explain the potential difference between a metal and a liquid. Nernst ascribes to each metal a solution pressure with regard to water, which depends on the value of N used above, and tends to drive the metal into solution in the form of positively electrified ions. This process will electrify the liquid positively, and leave the metal negatively charged. Whether this last ex- tension of the theory can be justified or not is still a subject of discussion.^

In the early development of the present theory of the subject no attention was paid to the part played by the solvent. It was looked on simply as furnishing a space into which the dissolving solid could P”►►^tioti diffuse, and, in the case of electrolytes, as provid- solvent. ing a screen for separating the ions from one another. The very different power of various solvents, both in dissolving substances and in enabling them to con- duct electricity when dissolved, directed attention to the general question of their influence, and measurements of conductivity of the same salt in water and alcohol were made by Fitzpatrick,* Vollmer,^ and others. The problem of the cause of solubility stiU remains unsettled, but towards the explanation of ionizing power some advance has been made. If the forces holding the ions together in a molecule are electrical in their nature (as is quite possible), it follows that they wiU be much weakened by immersing the molecule in a medium of high specific

s See Lodge, Phil. Mag., 1900 ; and Lehfeldt, Phil. Mag., Nov.

1899.

- B. A. P^port, 1886, p. 328 ; and Phil. Mag., 1887, xxiv. p. 378. ►► Wied. Ann., 1894, lii. p. 328.

inductive capacity like water. This may explain tlie differences observed in the molecular conductivities of the same salt dissolved in different solvents, such as water and alcohol, for example, for, other conditions being the same, the effect of solvents in loosening the connexion between two ions, i.e., their relative ionization powers, will depend on their specific inductive capacities. Some experimental evidence which, as far as it goes, confirms this idea has been obtained (Whetham, Phil. Mag., 1894, p. 392 ; and 1897, p. 1). Kohlrausch’s experiments have shown that the conductivity of pure water is exceedingly small, indicat- ing only a slight amount of dissociation. But this is what we should expect, for the concentration is so great and the

molecules are so crowded together that no dissociation can be permanent. Nevertheless, there are many indications that even chemically pure water would, if it could be pre- pared, be slightly dissociated and possess some conducting power (see Kohlrausch and Heydweiler, 2eits. f. physikad. Chemie, 1893, p. 492). Allied to this subject is the ques- tion of the nature of electrolytic conduction in fused salts. Here, however, the small amount of experimental work makes further consideration premature.

With regard to the fundamental principles of electro- lytic conduction, it seems possible that a great step in Blectr as ^^’’^^^ ^^J ^e made by the application of ideas obtained from the study of electric discharge through gases (q.v.). J. J. Thomson has shown (Phil. Mag., 1897, vol. xliv. p. 293, 1898; vol. xlvi. p. 528, 1899 ; vol. xlviii. p. 547. Swnimary in Reports- of the Physical Congress at Paris, 1900, vol. iii. p. 138) that the negative ions in certain cases of discharge are enorm- ously more mobile than the positive ones, and that their mass is only about the one-thousandth part of that of the hydrogen molecule. These negative ions perhaps realize the conception of electrons due to Lorentz and Larmor {Phil. Trans. Boy. Soc, 1895, vol. clxxxvi., A, p. 695, and 1898, vol. cxc. A, p. 205), and may be the ultimate particles of which, in varying number, different atoms are composed. A body containing an excess of these cor- puscles is negatively charged, but positively when some of them have been removed. A current consists in the motion of electrons ; in the case of gases, the electron particles sometimes travel alone, but in liquid electrolytes they cannot be detached from atoms, and hence their movement involves chemical action. An atom plus an electron is a monovalent anion, an atom minus an electron, a monovalent cation. In metallic conductors the electrons can pass from one atom to the next, and thus allow a current to flow without chemical decomposition.

Mo.st of the new work on the snh.jpot, which does not appear in the general physical and chemical journals, is published in the Zeitschrift filr vhysikalische Chemie, Leipzig, the Zeitschrift fiir Elektrochemie, Halle, or the Journal of Physical Chemistry, Cornell University, Ithaca, New York State. In these periodicals aljstracts of papers published elsewhere will be found. Reference mny also be made to the following : ••• ARRHBNitr,’!. Rdcherches sur la con- ductivit^galvanique des Electrolylen. Stockholm, 1883.••• Goodwin. The Fundamental Laws

of Electrolytic Conduction (Memoirs of Faraday, Hittorf, and Kohlrausch) New York and London, 1899. ††† JONKS. The Modern Thmry of SoUdion (Memoirs by Pfeffer, Van't Hoflf, Arrhenius, and Raoult). New York and London, 1899. ††† Kohlrausch and Holborn. Leitvermogen de.r Elektrolyte. Leipzig, 1898. ††† Larmor. ther and Matter. Cambridge, 1900. ††† Lehfeldt. Text-Book of Physical Chemistry. London, 1899. ††† Lodge. Repm-ts on Electrolysis. Brit. Ass. 1886 ; " Address to the Physical Society of London," Phil. Mag., 1900.††† LApke. Grvmd- zilge der Elektrochemie. Berlin, 1896. Translation by Muir. London, 1897. ††† N ERNST. Theoretische Clh:mie,2ie kn. Stuttgart, 1898. ††† OsTWALT), Lehrbuch der Allgemeinen Chemie,. Leipzig, 1893. ††† Shaw. Report on Electrolysis, Brit. Ass. 1890.††† Walker. Intro- duction to Physical Cliemistry. London, 1899.††† Whetham. Solu- tion, and Electrolysis. Cambridge, 1895. Report on Electrolysis, Brit. Ass., 1897.
Ay_ q_ j,^ .^y ^

III. Electeic Cueeent.

When a conductor is connected to two other con- ductors maintained at different electric potentials (see I. Electeic Conduction, above) it immediately exhibits physical qualities which are commonly described by stating that an electric cun-ent flows through it. We are in ignorance whether this effect involves any actual flow or circulation of a material or medium in the con- ductor, and the term is, therefore, to be understood only as a comprehensive and convenient expression for all the physical actions taking place in and near the con- ductor which determines the locality of the current. These actions are chiefly the production of a magnetic field or of magnetic force in and around the conductor, and the gen- eration of heat in its mass. An electric current considered as a mathematical quantity has direction as well as magni- tude, and belongs to that class of quantities called circuital quantities, because they can only exist at all when they exist simultaneously everywhere along a completely closed circuit. The path of electric current is, therefore, called an electric circuit, and may be made up partly of conductors, metallic or electrolytic, or partly of those substances known as insulators, or better, as dielectric conductors. Energy is associated with every circuit traversed by a current, and the continual dissipation of this energy causes the conduct- ing circuit to become heated. Three qualities of a circuit determine the amount of the electric kinetic energy and potential

energy which can be connected with it, and the rate at which it dissipates electric energy; these are its Inductance (L), its Capacity (C), and its Resistance (B). If a portion of the circuit is an electrol5^e (see II. Electeo-LYTio Conduction), chemical decomposition of the elec- trolyte takes place. A magnetic field or magnetic flux is always associated with the circuit conveying a current, and the lines of this magnetic flux are always closed loops embracing or linked with the electric circuit. The prin- cipal facts connected with the electric circuit are : (1) the magnetic force at any point outside a conducting circuit which is traversed by an unvarying electric current is proportional to the chemical decomposition produced per second by the current in an electrolyte forming part of the circuit, provided that no ferromagnetic material is in the neighbourhood of the circuit ; (2) the rate of dis.sipation of energy in any circuit traversed by an electric current is proportional to the square of the current, and varies in- versely as the conductivity of the circuit ××× (this assertion is a statement of Joule's Law, and applies not only to the circuit as a whole but to any part of it) ; (3) if two points on an electric circuit, not including an active electromotive force, are selected and the difference of their electric potential measured, the current in the circuit is propor- tional to this difference of potential and to the conductivity of the circuit between these two points.

The magnitude or strength of an electric current may be estimated either by the electrolytic or the magnetic method. In the first case a standard electrolyte is selected, and a unit current defined as the unvarying cur- *'××'''××× rent which, when passed through this standard electrolyte, liberates from it on the electrodes a certain mass of ions. It has been agreed that the standard electrolyte for this purpose shall be a neutral solution of nitrate of silver in water, and that the ion which shall bo con.sidered is the silver deposited on the cathode. The process of making an electrolytic measurement, there- fore, of the strength of an electric current uniform in direction and unvarying in magnitude, consists in passing it through a neutral solution of nitrate of silver contained in a platinum bowl, the anode being a plate of pure silver. The direction of the current is defined to be the direction

in which the silver ion moves. For the performance of this experiment the British Board of Trade have issued a particular specification. The practical unit of current is called the ampere, which in Great Britain is legally defined as the “unvar3dng electric current which, when passed through a solution of nitrate of silver made according to a certain specification, deposits silver on the cathode at the rate of ###001118 of a gramme per second.” The ampere is intended to reproduce one-tenth of an absolute electro- magnetic unit of current. The magnetic method of measur- ing an electric current is as follows : ### Let a thin wire be bent into a circle of unit radius (1 cm.), and let it be supposed to be traversed by a uniform unvarying current ; then at the centre of this circular conductor there will be a magnetic force perpendicular to the plane of the circuit. At that point imagine a unit magnetic pole to be placed (see IV. Electeic Units), belonging to a thin uniformly magnetized fUament of great length; the magnetic field due to this current will then exert a mechanical force on the unit pole. Let the current be adjusted until this mechanical force is 23r/10 dynes. The unvarying current so regulated is one- tenth part of an absolute C.G.S. electromagnetic unit of current. The direction of the current is conventionally defined by the following rule : ### Let the circular circuit be supposed to be placed horizontally on the ground, and a watch or clock placed, face upwards, at the centre ; then if the magnetic pole is a North-seeking or marked pole, and the force on it tends to raise the pole, the current is said to flow round the circuit in the opposite direction to that in which the hands of the clock or watch move. There are reasons for believing that the practical unit of current as recovered eleotrolyticaUy by the Board of Trade specification differs from the true ampere as defined electro- magnetically by about one part in 1100 ; that is to say, if the ampere were defined as the unvarying current which would deposit in one second ‘001119 of a gramme of sUver, it would reconcile the two defimtions more completely than at present. The two definitions were originally intended to define one and the same unit current, but as a matter of fact the Board of Trade ampere is probably about one- tenth per cent, smaller than the

electromagnetic ampere defined as one-tenth part of the absolute electromagnetic unit in the C.G.S. system.

If an electric current is not unvarying, it may be irregular or periodic. If periodic, it may pass through a cycle of values from a maximum value in one direction to an equal value in the opposite direc- tion, and is in this case also called an alterinating current. Such a current is measured by the heating eflfect it produces, and is said to have an effective value of one ampere if it produces the same total heat per unit of time in any given conductor as an unvarying current of one ampere measured electrolyticaUy or magnetically. If a current is periodic or alternating, we have to consider also the law of its variation, and we are concerned first with its instantaneons value (i), its maximum value (I), its true mean value (T.M.), and its root^mean^square value (E.M.S.), the two latter quantities being respectively the mean of the instantaneous values taken at numerous equidistant intervals of time during the cycle, and the square root of the mean of the squares of the instantaneous values so taken. Lastly, many of the properties of a periodic current depend upon the manner in which its variations in instan- taneous magiiitude take place. It is convenient to delineate the mode of variation of a periodic or irregular current by a curve. This may be of such nature that either the ordinates or radii represent the instantaneous values of the periodic current, and it may be therefore either a wave curve,^-th.a,t is, one so drawn that the ordinates represent the instantaneous values and the abscissae represent the

Periodic currents.

flow of time; or a polar curve, in which radii represent instantaneous values, and angles round a point represent time, the complete periodic time of the variable being represented by four right-angles. If a current is periodic, the frequency (n) is the number of cycles per second, which is usually denoted by the symbol ~~x^. The periodic time (T) is the duration of one cycle, and the frequency obviously varies inversely as the periodic time. In the case of peri~~ odic currents we have to consider also another quantity called the form factor (/), which is defined as the ratio between the root-mean-square (E.M.S.) value of the periodic

current and its true mean (T.M.) value, or y^^^-M-S. value_

^ ‘ ‘ -^ T.M. value

Alternating or periodic currents may be also subdivided into single phase and polyphase, the latter depending upon the union of two or more circuits traversed by currents having certain relative differences of phase. Two periodic currents are said to differ in phase when their zero values do not happen at the same instant. In this case one cur- rent is said to lag behind the other. We have, therefore, the following classification of electric currents : ###

1. Unvarying and uni-directional currents.

2. Irregular currents.

3. Periodic or alternating currents, including

(a) Single phase currents,

(b) Polyphase currents.

The relation between the instantaneous value (i) of the current and the impressed electromotive force {e) acting in the circuit, and the constants of the circuit, namely, the Inductance (L), Resistance (R), and the Capacity (C), is expressed by a current eauation. Consider first the simplest case, namely, when L and R are constant quantities and C is zero, the electromotive force having a constant value E. Then the current equation is formed by equat- ing the impressed electromotive force to the sum of the effective electromotive forces, which is always the product Ei, and the electromotive force positive or negative which is created by the inductance or capacity of the circuit. In a circuit of constant inductance this electromotive force is a counter electromotive force and is numerically equal to L dildt. Hence the differential current equation for a circuit of constant inductance and resistance acted upon by a constant electromotive force E is

di

(1)

E=Ri-l-L:Tr- dt

The solution of this equation is

-E

(2)

where e is the base of the Napierian logarithms.

Hence as the time (t), reckoned from the instant when the electro- motive force is first applied, increases indefinitely, the value of the current (i) approximates to E/E, or to the value given by Ohm's Law. The ratio L/R which occurs in the equation (2) is of the dimensions of a time, and is called the tiTtie-consiant of the circuit.

Consider next the case when the impressed electromotive force is not constant but periodic, and is a simple sine function having a periodic time T and a frequency n. Let 2?r7i be called p. Then the electromotive force at any instant has a value e = E sin 2it, where E is the maximum value 6f e. The current equation for a circuit of constant resistance and inductance is

e = % sin pt='B.i + 'L^, (3)

and the solution for i is

E sin {pt – e)

dt'

+ C',

(4)

VR'-t-i^'L^

where S = tan-' Lp/E, and C is an exponential function of t which diminishes to zero as t increases indefinitely. The quantity ijW+^T? is called the Impedance of the circuit.

If we have a condenser of capacity C in series with a conduct- ing circuit possessing an inductance L, and capacity R, then the back electromotive force due to the accumulation of electric charge in the condenser is equal to the quotient of the total electric quantity in the condenser divided by its capacity. Hence if i is the current at any instant flowing into the condenser at the time t, the total electric charge of the condenser is

cfidt, and the counter electromotive force created by that charge is ††† f at. Hence the differential current equation in the case of a

cy o

s. rv. ††† 3

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circuit formed of a circuit having impedance, in series with a condenser having capacity, and acted upon by a simple periodic electromotive force e = †† sin jji, is

e^Ri + L

The solution of this equation for i is E

di 1 /”. †††di^-cJo”

sin{pt-e) + C\

(5)

(6)

where 6 is a constant phase angle, and C^ is a function of t which dies out rapidly as the time t continually increases. The equation (2) shows that if a constant unidirectional electromotive force is applied to an inductive

circuit, the current does not immediately attain its fall strength, but beginning at zero gradually rises up towards a constant value E/R at a rate which depends upon the rate of increase of the quantity e-^‘l^ towards unity. The larger the value of the inductance L, the slower is the rate of growth. Accordingly, in an inductive circuit it is not possible to make very rapid changes in current strength. If the circuit has a vari- able inductance, such for instance as the circuit of an electro- magnet, in which coils of wire are wrapped round an iron core, the inductance L is a function of the exciting current i, and the differential equations cannot be solved unless the form of the func- tion is known.

In the case of simple periodic currents it is interesting to study the initial effects in a circuit of constant inductance L which take place on first bringing an alternating electromotive force into operation on the circuit. To obtain the complete solution of the ditfereutial current equation

Esini)<=e=RiH-L❓❓❓ , dt

(7)

we differentiate the equation twice to eliminate E sin pt, and arrive at a linear differential equation of the third order, namely.

The solution of the above equation is

i=A❓❓-‘’/+B sin pt + B^ cos pt (9)

where A, B, and B’ are constants. This may be written

i = Ae-’”/L-|-Isin(^<-0) (10)

where I is the maximum value of the periodic euiTent and ^ is a constant angle, called the aTigle of lag. To find the value of the constant A we note that at the instant of closing, the circuit i must be zero. Let this closure happen at a time fi reckoned from the instant when the electromotive force is zero, then we have

i=I sin {pt-i>) + lsm {pit^-‘f) e-‘$^{f-‘}$)!^ as the complete solution of the above differential current equation. We notice that the solution for i is made up of a simple periodic function added to an exponential function of which the initial value is I sin (pit’- –). The complete graph of the solution of the current equation is therefore a curve similar to the dotted curve in Fig 2, the ordiuates of which are equal to the sum of the ordinates of the (firm line) periodic curve and the (firm line) exponential curve. The initial value of the exponential curve depends upon the phase of / the electromotive force when the , circuit is closed. We are therefore led to the conclusion that if a simple periodic electromotive force is ap- plied suddenly to an inductive cir- j^g. 2 cuit, there may be a short period of

time during which the current curve is lop-sided, and more current flows in one direction than in the other. The occurrence of this initial stage depends upon the phase of the electromotive force when the circuit is closed.

In the above equations is the angle by which the current when steady lags behind the electromotive force. Hence tan 0 = Lp/R. We may in the same manner discuss the initial conditions when a periodic electromotive force is suddenly applied to an inductive circuit having a condenser in series with it, and arrive at a solution of the form

1 = 1 sin (;)□□-□□) -HA e-B‘1’sin (pt-4>) where I is the maximum value of the current during the cycle in the steady state and A and q are constants. The solution shows us that the physical operations which take place when a condenser in series with an inductive circuit suddenly has a simple periodic electromotive force applied to it is as follows ; □□□ Before the oscillations of current settle down into a steady periodic state, a second set of oscillations of current is superimposed on the steady set, the latter having possibly a frequency and amplitude different from those which ultimately survive. The simultaneous existence of these oscillations may give rise to variations of eleotromotive force acting on the condenser which are much greater in amplitude than those which take place in the steady state. The extent to

which these superimposed oscillations of current occur, depends upon the phase of the electromotive force when the current is closed.

In dealing with problems connected with electric currents we have to consider the laws which govern the flow of currents in Unear conductors (wires), in plane conductors (sheets), and throughout the mass of a material conductor. In the first case consider the collocation of a number of linear conductors, such as rods or wires of metal, joined at their ends to form a iietworlc of coTiduclors. The network consists of a number of conductors joining certain points and forming meshes. In each conductor a current may exist, and along each conductor there is a fall of potential, or an active electromotive force may be acting in it. Each conductor has a, certain resistance. To find the current in each conductor when the individual resistances and electromotive forces are given, proceed as follows : ??? Consider any one mesh. The sum of all the eleotromotive forces which exist in the branches bounding that mesh must he equal to the sum of all the products of the resist- ances into the currents flowing along them, or 2(E)=2(C.R.). Hence if we consider each mesh as traversed by imaginary currents all circulating in the same direction, the real currents are the sums or differences of these imaginary cyclic currents in each branch. Hence we may assign to each mesh a cycle symbol x, y, z, &c., and form a cycle equation. Write down the cycle symbol for a mesh and prefix as coefficient the sum of all the resistances which bound that cycle, then subtract the cycle symbols of each adjacent cycle, each multiplied by the value of the bounding or common resistances, and equate this sum to the total electromotive force acting round the cycle. Thus i{ x y z are the cycle currents, and a b c the resistances bounding the mesh x, and b and e those separating it from the meshes y and z, and E an electro- motive force in the branch a, then we have formed the cycle equation x {a + b + c) x ??? by-cz = E. For each mesh a, similar equation may be formed. Hence we have as many linear equations as there are meshes, and we can obtain the solution for each cycle symbol, and therefore for the current in each branch. The solution giving the current in such branch of the network is therefore always in the form of the quotient of two determinants. The solution of the well-known problem of finding the current in the galvanometer circuit of the arrangement of linear conductors called Wheatstone’s Bridge is thus easily obtained. For if we call the cycles (see Fig. S] {x + y), y and z, and the resistances P, Q, K, S, G, and B, and if E be the electromotive force in the battery circuit, we have the cycle equations

(P + G + ‘R)x + y-Gy-‘Rz=0. (Q. + G + S)y-Gx + y-Sz = 0. (R + S4-B)z-Ra:-l-j/-Sj/ = E.

From these we can easily obtain the solution {oTx + y-y=x, which is the current through the galvanometer circuit in the form

x = E►►/A, where S and A are two determinants. (Fleming, ” Problems on the Distribution of Electric Currents in Networks of Conductors,” Phil. Mag., Sept. 1885.)

In the case of current flow in plane sheets, we have to consider certain points called sources at which the current flows into the sheet, and certain points called sinks at which it leaves. We may investigate, first, the simple case of one source and one sink in an infinite plane sheet of thickness 5, and conductivity k. Take any point P in the plane at distances R and r from the source and sink respectively. The potential V at P is obviously given by

where Q is the quantity of electricity supplied by the source per second. Hence the equation to the equipotential curve is rjr2 = Const.

If we take a point half-way between the sink and the source as the origin of a system of rectangular co-ordinates, and if the distance between sink and source is equal to jj, and the line join- ing them is taken as the axis of x, then the equation to the equipotential line is

y^ + x + p’ _,

y^+(x-pf

= Const.

This is the equation of a family of circles having the axis of y for a common radical axis, one set of circles surrounding the sink and

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another sot of circles surrounding the source. In order to discover the form of the stream of current lines we have to determine the orthogonal trajectories to this family of coaxial circles. It is easy to show that the orthogonal trajectory of the system of circles is another system of circles all passing through the sink and the source, and as a corollary of tliis fact, that the electric resistance of a circular disc of uniform thickness is the same between any two points taken anywhere on its circumference as sink and source. These equipotential lines may be delineated experimentally by attaching the terminals of a battery or batteries to small wires which touch at various places a sheet of tinfoil. Two wires attached to a galvanometer may then be placed on the tinfoil, and one may be kept stationary and the other may be moved about, so that the galvanometer is not traversed by any current. The moving terminal then traces out an equipotential curve. If there are n sinks and sources in a plane conducting sheet, and if r, r’, r”, be the distances of any point from the sinks, and r ,r’,r “, the distances of the source, then

LJL ××× – ××× ××× ××× ××× =a constant, r r’r”. . .

is the equation to the equipotential lines. The orthogonal trajectories or stream lines have the equation’

S (××-××’) = a constant, where 9 and 6′ are the angles which the lines drawn from any point in the plane to the sink and corresponding source make with the line joining that sink and source. Generally it may be shown that if there are any number of sinks and sources in an infinite plane-conducting sheet, and if r, B are the polar co-ordinates of any one, then the equation to the equipotential surfaces is given by the equation

S (A log ?×××) = a constant,

where A is a constant ; and the equation to the stream or current lines is

S (S)=a constant.

In the case of electric flow in three dimensions the electric potential must satisfy Laplace’s equation, and a solution is therefore found in the form S

(7)= a constant, as the equation to an equipotential surface, where r is the distance of any point on that surface from a source or sink.

The practical measurement of electric current involves the use of instruments which are variously called galvano- scopes, galvaiwrneters, amperemeters or ampere- Practical balances. The most frequently-recurring opera- ments ^^'^^ " electric work is the determination of the presence or the absence of an electric current in a circuit. For this purpose we may employ galvanoscopes when a mere quaUtative determination is required, indicat- ing in a general way the presence of a current, without any reference to its strengtL On the other hand, if a current has to be measured in terms of the unit current, then a galvanometer or amperemeter must be made use of. Current measuring instruments may be constructed by taking advantage of any measurable effect due to the presence of a current in a conductor. Hence we may classify them as: 1. Electromagnetic; 2. Electrodynamic ; 3. Mectrotherm/il ; 3. Electro-optic ; 5. Electrochemical, according as they depend in principle upon the magnetic, electrod3mamic, thermal, optical, or chemical effects which are associated with an electric circuit when traversed by a current. The majority of instruments in use depend upon the properties of the magnetic field round a circuit through which a current is flowing, and such instruments may be classified into : (i.) movable needle and fixed coil instru- ments ; (ii.) movable coil and fixed magnet instrwments ; (iii.) movable iron and fixed coil instrwnents. In the first class a magnetic needle is suspended in or near a coil which is traversed by the current to be measured. The magnetic field due to this current brings into existence a magnetic torque or couple which causes the needle to tend to set in a certain direction, and this movement is resisted by some opposing couple called the control.

^ See W. G. Adams, The Bakerian Lecture " On the Forms of Equipotential Curves and Surfaces and Lines of Flow," Proc. Roy. Soe. London, 1872; also G. C. Foster and 0. J. Lodge, "On the Flow of Electricity in a Uniform Plane-Conducting Circuit," PhU. Mag., May and June 1875.

Of this type are many forms of galvanometer, such as the simple needle, the mirror galvanometer, the tangent galvanometer in various lorms. In the miiTor instrument the movement of a single magnetic needle or of an astatic

system is detected by attaching to the needle system a light concave mirror on which a ray of light is thrown from a lamp. The mirror reflects the ray upon a scale, where it is made to form the sharp image of the source of light or of an opening thi-ough which it passes. The scale is gener- ally placed at a distance of one metre from the mirror. A con- venient method for obtaining a sharp image is to focus on the screen the image of a portion of a hlament of an incandescent electric lamp. If the scale is semi-transparent, the bright line of light BO foriiied can be read from the other side, and its position determined with great accuracy. The sensibility of the galvano- meter is expressed by stating the deflection of the spot of light in millimetres on the scale when the mirror is at a distance of one metre from the scale, and when a known fraction of an ampere, say a microampere, is passing through the galvanometer. In the movable cod instruments a current passes through the light sus- pended coil of wire, the current entering and leaving the coil by a fine suspension wire, generally composed of phosphor- bronze. This coil is placed in the field of a strong permanent magnet, so arranged that the direction of the plane of the coil is parallel to the lines of flux of the field. The coil thus stands in a very intense field ; and if a feeble current is passed through it, a couple is brought into operation, tending to twist it round so that its plane becomes inclined to the field. A small movement of the coil can be detected by attaching to it a mirror, and reflecting therefrom a ray of light upon a scale. Of this type are the galvanometers now much used in electrical laboratories. One great advantage possessed by tliem is that they are not disturbed by the presence of electric currents in neighbouring conductors. By winding the coil on a silver frame the galvanometer can be made very dead-beat ; that is to say, the galvanometer coil will come to rest very quickly after being dis- turbed, without executing many oscillations. For many purposes a galvanometer is required which possesses exactly an opposite character, that is to say, as little dead-beat as possible. A ballistic galvanometer, as such an instrument is termed, is employed ibr the purpose of measuring, not current, but the time-integral of current. The value of a galvanometer for practical purposes is determined by the degree to which it possesses the following quali- ties : ××× (1) The deflection of the coil or needle should be in some constant relation to the current causing it. In mirror instruments it is generally found that, over the limits of scale-length usually employed, the scale deflection is proportional to the current flowing through the instrument. The number by

which the scale deflec- tion must be multiplied to obtain the ampere value of the current is called the galvanometer constant. (2) The galvanometer should possess a zero-keeping quality ; that is to say, when a known current is flowing through it, the galvanometer coil or needle should always take up precisely the same position. (3) For many purposes it is convenient that the value of the galvanometer constant should be capable of being varied by altering the nature of the control. In needle instruments the control generally consists of an external magnet, the proximity of which to the needle determines the magnitude of the control.

A large class of current measuring and detecting instruments depend for their operation on the fact that a mass of ferromagnetic material, say soft iron, if placed in a magnetic field of variable strength, tends to move from places of weak to places of strong magnetic force. If the ferromagnetic material has an elongated shape like a needle, and if it is placed in a uidfonn field, the direction of the field being inclined to the direction of the longer axis of the needle, then the needle will tend to set its greatest length in the direction of the field. An instrument of this last kind is called a soft-iron needle galvanometer, and it may be made suffi- ciently sensitive to detect the feeble current through a telephone. A large number of commercial forms of amperemeter are constructed by taking advantage of the same fact. (See Measuuing I nstru- MENTS, Electkic.) Thus if a circular coil of insulated wire of no very great depth is arranged with its plane in a vertical position, and if a small piece of soft iron attached to a pivoted index-needle is so arranged that under the action of gravity the piece of iron occupies a position near the centre of the coil, then when a current is sent through the coil the iron will be displaced to a position nearer the inner surface of the coU. This movement will bring into existence a restoring force due to gravity ; hence if the index -needle is’made to move over a divided scale, the instrument may be calibrated so as to show directly the value of the current passing through the coil. Another type of current-measuring instrument depends for its action upon the mechanical force discovered by Ampere to exist between conductors which are parallel, or nearly parallel, to each other, and are conveying the same or diff’erent electric ciu-rents. One of the best-known forms of instrument depending on this principle is the Electrodynamometer of Siemens.

Yery convenient and accurate instruments based on the

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above principles have been devised by Lord Kelvin, and a large variety of these ampere balances, as they are called,

suitable for measuring currents from a fraction baiaaces ►►^ ^^ ampere up to many thousands of amperes,

have been constructed by that illustrious inventor. The dif&culty which has generally presented itself to those who have tried to design instruments on the electrodyna- mometer principle for use with large currents, has been that of getting the current into and out of the movable con- ductor, and yet permitting that conductor to remain free to move under very small force. The use of mercury cups is open to many objections on account of the fact that the mercury becomes oxidized, and such instruments are not very convenient for transportation. The great novelty in the ampere balances of Lord Kelvin was a joint or electric coupling, which is at once exceedingly flexible and yet capable of being constructed to carry with safety any desired current. This he achieved by the introduction of a device which is called a metallic ligament. The general principle of its construction is as follows: ►►► Let+A►►► A

Fig. 4.

(Fig. 4) be a pair of semi-cylindrical fixed trunnions which are carried on a supporting frame and held with flat sides

downwards. Let-{-B-B be two smaller trunnions which project out from the sides of the two strips connecting together a pair of rings CC. The rings and the connecting strips constitute the circuit which is to be rendered mov- able. A current entering by the trunnion -f-B flows round the two halves of the circuit, as shown by the arrows, and comes out at the trunnion ~~B. In Fig.~~

~~4 the current is shown dividing round the two rings ; but in all the balances, except those intended for the largest currents, the current really circulates first round one ring and then round the other. To make the ligament, a very large number of ex~~ ceedingly fine copper wires laid close together are soldered to the upper surface of the upper trunnion, and also to the end surface of the lower trunnion. The movable circuit CC thus hangs by two ligaments which are formed of very fine copper wires. This mode of suspension enables

I

‘^-KD

V-l-

Kg. 5.

the conductor CC to vibrate freely like a balance, but at the same time very large currents can easily be passed through this perfectly flexible joint. Above and below these movable coils, which form as it were the two scale pans of a balance, are fixed other stationary coils, and the connexions of all these six coils (shown in Fig. 5) are such that when a current is passed through the whole of

Fig. 6.

the coils in series, forces of attraction and repulsion are brought into existence which tend to force one movable coil upwards and the other movable coil downwards. This tendency is resisted by the weight of a mass of metal, which can be caused to slide along a tray attached to the movable coils. The appearance of the complete instrument is shown by Fig. 6. When a current is passed through the instrument it causes one end of the movable system to tilt downwards, and the other end upwards ; the sliding weight is then moved along the tray by means of a silk

cord until equilibrium is again established. The value of the current in amperes is then obtained approximately by observing the position of the weight on the scale, or it may be obtained more accurately in the following

manner : ??? The upper edge of the shelf on which the weights slide (see Fig. 7) is graduated into equal divisions, and the weight is provided with a sharp tongue of metal in order that its position on the shelf maybe accurately determined. Since the current passing through the balance when equili- brium is obtained with a given weight is proportional to

current]

the square root of the couple due to this -weight, it follows that the cmTent strength when equilibrium is obtained is

Fig. 7.

proportional to the product of the square root of the weight used and the square root of the displacement dis- tance of this weight from its zero position. Each instm- ment is accompanied by a pair of weights and by a square- root table, so that the product of the square root of the number corresponding to the position of the sliding weight, and a certain constant for each weight, gives at once the value of the current in amperes.

These balances are made to cover a certain range of reading, thus : ???

The centi-ampere balance ranges from 1 to 100 centi- amperes.

The deci-ampere balance ranges from 1 to 100 deci- amperes.

The ampere balance ranges from 1 to 100 amperes.

The deka-ampere balance ranges from 1 to 100 amperes.

The hecto-ampere balance ranges from 6 to 600 amperes.

The kilo-ampere balance ranges from 100 to 2500 amperes.

They are valuable for the measurement not only of continuous or unvarying, but also of alternating currents. In those intended for alternating currents the main cur- rent through the movable coil, whether consisting of one turn or more than one turn, is carried by a wire rope, of which each component strand is insulated by silk cover- ing, to prevent the inductive action from altering the distribution of the current across the transverse section of the conductor. To avoid the creation of induced cur- rents, the coil frames and the base boards are constructed of slate. Kelvin ampere balances are now made in two types ??? (1) a variable weight type suitable for obtaining the ampere value of any current within their range ; and (2) a fixed weight type intended to indicate when a current which can be varied at pleasure has a certain fixed value. An instrument of the latter type of con- siderable accuracy was designed by Lord Kelvin for the British Board of Trade Electrical Laboratory, and it is there used as the principal standard ampere bal- ance. A fixed weight is placed on one coil and the current is varied gradually until the balance is just in equilibrium. Under these circumstances the current is known to have a fixed value in amperes determined by the weight attached to the instrument. Eor the measurement of alternating currents, instruments con- taining soft iron or permanent magnets are not avail- able, and the only forms that can then be employed are those the indications of which do not depend upon the direction of the current, such as the electrodynamometer instruments or ampere balances just described. There are, however, a number of instruments in use for measuring alternating currents in which the heating action of a cur- rent is utilized. If a fine wire is traversed by a current either alternating or continuous, heat is generated in it at

a rate depending upon the square of the current strength. If the wire is contained in an enclosure which can radiate back to it, the temperature of the wire when it is traversed by a constant current will gradually rise until it reaches a point at which the rate of radiation of heat from the wire is balanced by the rate of generation of heat in it. Under these circumstances the wire expands until it reaches a constant state, and the elongation in its length, being dependent upon its temperature, may be made a measure of the E.M.S. value of the current flowing in the wire. This elongation may be ascertained either by a multiplying arrangement which measures the actual linear elongation, or the two ends of the wire may be fixed, and we may in

some way measure the sag of the wire as it is heated. Convenient instruments of the latter class have been devised and made by Messrs Hartmann & Braun, and are of considerable use in the laboratory for the measurement of alternating currents. The well-known Cardew voltmeter is an instrument of this type. For the measurement of continuous currents over any range, no instrument is more convenient than that called the Poten- tiometer.

For further details as to current measurement the reader Is referred to the article on Measuring Instecments, Electkic ; and for additional information the following treatises may be consulted : ††† Clerk Maxwell. Electricity and Magnetism, 2 vols. Oxford, 1881. ††† Mascart and Joubert. Electricity and Magnet- ism, translated by E. Atkinson. London, 1883. ††† J. A. Fleming. Handbook for the Electrical Testing Boom and Laboratory. London, 1901. ††† A. Gray. Absolute Measurements in Electricity and Magnetism. London, 1893. ††† T. H. Blakeslet. Alter- nating Currents of Electricity. London, 1889. ††† F. Bedell and A. C. Crehore. Alternating Currents. New York, 1893. ††† R. M. ††† Walmslet. The Electric Current. London, 1894. ††† Oliver Heaviside. Electromagnetic Theory. London, 1893. ††† W. Fisher. The Potentiometer. London, 1897. ††† W. E. Atrton. Practical Electricity. London, 1890. ††† S. P. Thompson. Poly- phase Electric Currents. 2nd ed. London, 1900.

(j. A. F.)

IV. Electric Units.

In order that our acquaintance with any part of Nature may become exact, we must have not merely a qualitative but a quantitative knowledge of facts. Hence the moment that any branch of science emerges from an early stage, attempts are made to measure and evaluate the quantities and effects foimd to exist. To do this we have to select for each measurable magnitude a Unit or standard sample of each quantity, by com- parison with which amounts of other like quantities may be numerically defined. There is nothing to prevent us from selecting these standard samples in a perfectly arbi- trary and independent manner, and as a matter of fact this is what is generally

done in the early stages of eveiy science. The progress of knowledge, however, is greatly assisted if all the measurable quantities are brought into relation with each other by so selecting the units that they are related in the most simple manner, each to the other and to one common set of measurable magnitudes, called the fundamental quantities. The progress of this unifica- tion of units has been greatly aided by the discovery that forms of physical energy can be converted into one another, and that the conversion is by definite rule and amount. Thus the mechanical energy associated with moving masses can be converted into heat, and the amount of heat required to raise one gramme of water 1►► C. in the neighbourhood of 10►► C. is equal to forty-two million ergs, the erg being the energy of motion associated with a mass of 2 grammes when moving uniformly without rotation with a velocity of 1 cm. per second. This number is commonly called the mechanical equivalent of heat, but would be more exactly described as the mechanical equivar lent of the specific heat of water at 10►► C. Again, the

fact that the maintenance of an electric current requires energy, and that when produced its energy can be wholly utilized in heating a mass of water, enables us to make a similar statement about the energy required to maintain a current of one ampere through a resistance of one ohm for one second, expressed in its equivalent in the energy of a moving mass. Electric and magnetic units have therefore been selected with the object of establishing simple relations between each of them and the fundamental mechanical units. Electric and magnetic measurements based on such relations are called Absolute Measwrements. The science of dynamics, as far as that part of it is concerned which deals with the motion and energy of material substances, is based upon certain fundamental definitions concerning the measurable quantities involved. In constructing a system of electric and magnetic units, the first thing to consider is the manner in which we shall connect the system with our dynamical measurements.

“What, for instance, shall be the unit of electric quantity, and how shall it be determined by simple reference to mechanical units, and, therefore, to units of mass, length, and time 1 The unit of electric charge may be defined as that charge which if collected on a small conductor repels an equally charged conductor at a unit of distance with the unit of force, and this definition was in fact one of the original starting- points of the Committee of the British Association on Electrical Units. It is well known, however, that the mechanical stress between two electrified bodies depends also upon, and varies inversely as, the Dielectric Constant or Specific Inductive Capacity K of the medium in which they are immersed. Hence unless we take this fact into account, our statement is imperfect ; and unless we know the manner in which the mechanical stress is produced and the mechanical details of the operation, we are unable to express the whole of the facts by d5Tiamical statements. The Committee of the British Association evaded this difficulty by omitting aU reference to the medium in which the electric operations take place, and thereby they intro- duced a subsequent difiiculty.

If for the moment we neglect all questions of the medium, and regard the mechanical stress between two small electrified con- ductors merely as a ease of action-at-a-distance, then we can obtain the dimensions of electrical quantity from the fact discovered by Coulomb, that the mechanical stress between such small bodies varies directly as the product of the electric charge on each, and inversely as the square of their distance (see Ency. Brit. vol. vii. p. 241). Hence it follows that if the charges are equal, the dimen- sions of electrical quantity must be the same as those of a length multiplied by the square root of a force ; in other words, they are

1 3, _i

M’L^T . It has been pointed out, however, by Professor A. W. Eiicker (Phil. Mag., February 1889), that we have no right to omit in these dimensional expressions all reference to the qualities of the medium, which are determining factors in the production of the forces ; and that in the absence of any exact knowledge as to the true dynamical nature of the operations concerned in electrostatic phenomena, we should treat the Dielectric Constant of the medium in which the operations take place as a fundamental quantity of dimensions as yet unknown, thus introducing into

the dimensional equations a quantity K not yet resolved into its equivalent in terms of mass, length, and time. If, then, we take into account this di- electric constant, the dimensions of electric quantity are expressible in terms of length, mass, time, and dielectric constant by the

1 n _i 1 symbol M^L^T K^. If a, conductor is charged with a certain quantity of electricity represented by Q which is discharged through another conductor n times per second, this in effect con- stitutes an electric current which would be represented in mag- nitude by the product nQ. In other words, the strength of a current is measured by quantity per second passing any section of the circuit. It follows, therefore, that on the above system of electrical measurement the dimensions of electric current must be those of electric quantity per second ; in other words, must be

1 a _2 1

represented by the dimensional expression M^L^‘T K^. There is, however, another way of approaching the subject. If we consider two linear conductors parallel to one another conveying the same electric current, we know there is an attractive force

between them which is proportional to the square of the strength of the current, and inversely proportional to the magnetic perme- ability /n of the medium in which the conductors are placed. From this point of view the dimensions of electric current must be those of the square root of a force divided by the square root of a mag- netic permeability. Hence the dimensional expression for an

electric current will be M^L^T” yii-J, and since electric current is quantity per second the dimensions of electric quantity of measure- ment will be M^L*/i~*’

We have here, then, two ways of measuring electric quantity ; in one, starting from the electrostatic phenomenon, we find that the dielectric constant K of the medium must be considered, while in the other, starting from an electromagnetic phenomenon, we see that the magnetic permeability a(is an important quantity. If we fully understood the structure of the electromagnetic medium, and the mode of its operation in creating

electrostatic and electro- magnetic effects, we might determine the dynamical nature of its two qualities denominated the dielectric constant and the magnetic permeability. We might then express E and fi. in terms of L, M, and T, the units of length, mass, and time, and we should arrive at the same dimensional expressions in both cases ; for it is obvious that if the nature of the dynamical machinery involved were thoroughly understood, the dimensions of an electric current or electric quantity would be the same, whatever be the point of view from which we start, or whatever facts we make the basis of our determination of the dimensional expression. As it is, however, being ignorant of the real mechanical nature of the medium, we have two systems of measurement : one called the electrostatic, and the other called the electromagnetic.

It was formerly the custom to ignore the presence of the quan- tities K and /j., and to express the dimensions of electric and mag- netic quantities on the electrostatic system by assuming that K on the electrostatic system, and /i on the electromagnetic system, was always unity. If, however, we insert the symbols K and /j. to stand for the unknown dimensions of the dielectric constant and the magnetic permeability, we can obtain two dimensional expres- sions for an electric current ; and the ratio of the dimensions of electric quantity or electric current on the electrostatic system to

the dimensions on the electromagnetic system isthatofLT” KV ,

hence K^/x~* must be of the dimensions of a, velocity. Accord- ing^, it appears that although we do not know the dimensions of K and /i independently in terms of length, mass, and time, we do know that their product is of the dimensions of the reciprocal of the square of a velocity.

Turning now to another point, we may consider the dimensions of a magnetic pole strength on the two systems. If two uniformly magnetized filaments of equal strength and great length have their poles brought close to one another, it is known, in accordance with Coulomb’s experiments, that the mechanical stress or force between the poles is proportional to the product of their strengths, and varies inversely as the square of the distance between them. It is also known to be inversely proportional to the magnetic perme- ability of the medium in which the poles are placed. Hence, if the

poles are of equal strength, it follows that the dimensions of polar strength on the electromagnetic system of measurement must

be M*L*T fi ^ where /i stands for the unknown dimensions of magnetic permeability. If a magnetic pole is carried round a current, it can be shown that the mechanical work done in taking the pole once round the conductor, conveying the current against the direction of the magnetic force due to the current, is 47rCm. Hence the dimensions of the quantity 47rCm, where C stands for the total cuiTent and m for the strength of the magnetic pole,

must be those of energy or work, namely, ML T~ . Accordingly, the dimensions of a magnetic pole strength in electrostatic measure must be those of work divided by those of current in electrostatic

measure, or ML’T~%MWT”^;*=MWK~i. Hence the ratio of a magnetic pole strength in electrostatic measure to that

in electromagnetic measure must be M^L^K~i-^M^L^T~‘u^ =

_i _i _i , , ^

L TK V ‘, and this ratio we see to be that of K*/t* to the reciprocal of a velocity, or of K/x to the reciprocal of the square of a velocity.

Again, we may arrive at two dimensional expressions for electro- motive force or difference of potential. Electrostatic difference of potential between two places is measured bv the mechanical work required to move a small conductor charged with a unit electric charge from one place to the other against the electric force Hence if V stands for the difference of potential between the two places, and Q for the charge on the small conductor, the product QV must be of the dimensions of the work or energy, or of the

force X length, or of ML’T”’ But Q on the electrostatic system

of measurement is of the dimensions MiL^T~‘K^ ; the potential

tnnrs.]

ELECTRICITY

difference V must be therefore of the dimensions M’L^‘T K ^. Again, since by Ohm’s Law and Joule’s Law electromotive force multiplied by a current is equal to the power expended ou a circuit, the dimensions of electromotive force, or, what is the same thing, of potential difference, in the electromagnetic system of measure- ment must be those of power divided by a current. Since mechan- ical power means rate of doing work, the dimensions of power must be ML^T~ . We have already seen that on the electromagnetic

system the dimensions of a current are M*L*T~ /x’^ ; therefore the dimensions of electromotive force or potential on the electromagnetic

system must be M*L*T~V*- Here again we find that the ratio of the dimensions on the electrostatic system to the dimensions on

the electromagnetic system is L~ TK V ??? ^ w ^ j

In the same manner we may recover from fundamental facts and relations the dimensions of every electric and magnetic quantity on the two systems, starting in one case from electrostatic phenomena and in the other case fi- om electromagnetic or magnetic. The electrostatic dimensional expression will always involve K, and the electromagnetic dimensional expression will always involve u, and in every case the dimensions in terms of K are to those in terras of fi. for the same quantity in the ratio of a power of LT~^kV^- This therefore confirms the view that whatever may be the true dimensions in terms of fundamental units of fi and K, their product is the inverse square of a velocity. . . ,

The following table gives the dimensions of all the principal electric and magnetic quantities on the electrostatic and electro- magnetic systems :
???

Table XV. Dimensions of Electric Quantities.

Quantity. Symbol.

- (B)

Dimensions on the Electro- static System E.S.

L-2 ,j2 g^-1

L”? j/jh KT^ L”2 M^ K”*

E L-i M’ T’^ K^

L K

Dimensions on the Electro- magnetic System E.M.

L-i mi T”* ijT^

Ratio of E.S. to E.M.

-2???2

-1 -1

L r^K* AC*

tr’-t

-1

r^K* ,??*

1

L

L”’ T K”* iu. ^

L T^K* 1^

(M)}

L

T-1

Ki

;^*

L”

It

K-*

^-*

ir

2^2

K->

-

^}

T^

K

A*

L”

2^2

K-1

-

It will be seen that in every case the ratio of the dimensions on

‘-liriJ

??? of a velocity multi-

the two systems is a power of LT ^{KV}. or of ^ velocity muiu- plied by the square root of the product K and ii ; in other words, it is the product of a velocity multiplied by the geometric mean of E and /x. This quantity 1/ /^“K/Tmust therefore be of the dimen- sions of a velocity, and the questions arise, what is the absolute value of this velocity ? and how is it to be determined ? The answer is, that the value of the velocity in concrete numbers may be obtained by measuring the magnitude of any electric quantity in two ways, one making use only of electrostatic phenomena, and the other only of electromagnetic. To take one instance : ??? It is easy to show that the electrostatic cai)aoity of a sphere suspended

in air or in vacuo at a, great distance from other conductors is given by a number equal to its radius in centimetres. Suppose such a sphere to be charged and discharged rapidly with electricity from any source, such as a battery. It would take electricity from the soune at a certain rate, and would in fact act like a resistance in permitting the passage through it or by it of a certain quantity of electricity per unit of time. If K is the capacity and n is the number of discharges per second, then wK is a quantity of the dimensions of an electric conductivity, or of the reciprocal of a, resistance. If a conductor, of which the electrostatic capacity can be calculated, and which has associated with it a commutator that charges and discharges it n times per second, is arranged in one branch of a Wheatstone’s Bridge, it can be treated and measured as if it were a resistance, and its equivalent resistance calculated in terms of the resistance of all the other branches of the bridge. (See Phil. Mag., Sept. 1885, vol. xx. p. 258.)

Accordingly we have two methods of measuring the capacity of a conductor. One, the electrostatic method, depends only on the measurement of a length, which in the case of a sphere in free space is its radius ; the other, the electromagnetic method, deter- mines the capacity in terms of the quotient of a time by a resist- ance. The ratio of the electrostatic to the electromagnetic value of the same capacity is therefore of the dimensions of

a velocity multiplied by a resistance in electromagnetic value, or of the dimensions of a velocity squared. This particular experimental measurement has been carried out carefully by many observers, and the result has been always to show that the velocity v which expresses the ratio is very nearly equal to 30 thousand million centimetres per second ; v=nearly 3 x 10’►►. The value of this important constant can be determined by experiments made to measure electric quantity, potential, resistance, or capacity, both in electrostatic and in electromagnetic measure. For details of the various methods employed, the reader must be referred to standard treatises on Electricity and Magnetism, where full particulars will be found. (See Maxwell, Treatise on Electricity aTid Magnetism, vol. ii. ch. xix., 2nd ed. ; also Mascart and Joubert, Treatise on Elec- tricity and Magnetism, vol. ii. ch. viii , Eng . trans, by Atkinson.)

The following table gives a list of most of the detei-minations ►►►of V yet made, with references to the original papers.

Table XVI. Table of Observed Valves of ‘v’ in Ceiitimetres per Second.

Date.

1867 1868

1872

1878

1880

1881

1882 1883

1884

1888

Name.

1889 1889 1889 1890

1897

Weber and Kohl- rausch

Lord Kelvin and W. F. King

Clerk Maxwell .

Lord Kelvin

and Dugald

M’Kichan Ayrton and

Perry Lord Kelvin and

Shida Stoltow

F. Exner .

J. J. Thomson .

Klemencic .

Himstedt .

Lord Kelvin, Ayrton, and Perry

Fison .

Lord Kelvin Rowland . E. B. Eoaa J. J. Thomson

and Searle M. E. Maltby .

Electrodynamische MaasbestinmiuTigen and Pogg. Ann. xcix., August 10,

1856

Report 0/ British AsS0C.,lS69, p. 434; and Reports on Elec- trical Standards, F. Jenkin, p. 186

PhU. Trans. Boy. Soc. 1868, p. 64S

Phil. Trans. Boy. Soc. 1873, p. 409

Jonm. Soc. Tel. Eng.

vol. viii. p. 126 Phil. Mag. vol. i.

431, 1880 Soc. Franc, de Phys.

1881

Wien. Ber., 1882 Phil. Trans. Boy. Soc.

1883, p. 707 Proc. Soc, of Tel

Eng., 1887, p. 162 Electrician, Mar. 23,

1888, voL XX. p. 630 British Association,

Bath ; and Elec- trician, Sept. 28,

1888

Electrician, vol xxi.

215; and Proc.

Phys. Soc. Lond.,

June 9, 1888 Proc. Roy. Inst. , 1889 Phil. Jlfc(jr.,lS89 Phil. ilfa6f.,1889 PhU. Trans., 1890

Wied. Ann., 1897

Electric Quantity Measured.

Quantity

Potential

‘ V ‘ in Centi- metres per Second.

Capacity

Potential

Capacity

Potential Capacity

Potential

Capacity

Potential Quantity Capacity

Alternating currents

3-107 X 10i⬚⬚

2-81 xlOio

2-84 X lOlO 2-89 XlOlO

2-94 X 1010

2-956 X 1010

2-99 X 1010

2-92 X 1010 2-963 X 1010

3-019 X 1010

3-007 X 1010

2-92 X 1010

2-966 X 1010

3-004 X 1010 2-981 X 1010 3-000 X 1010 2-995 X 1010

3-016 X 1010

Tt will be seen that all the most recent values, especially those ••• 1,[1,,] nommrison of capacity has been made, approximate to rx'a'centiSTsper'eco'nd, a" value which is closely in accord tith the latest and best determinations of the velocity of light.

[electeic

Practical units.

We have in the next place to consider the question of practical electric units and the determination and con- struction of practical standards. The Committee of the British Association charged with the duty of arranging a system of absolute and magnetic units settled also on a system of practical units of conveni- ent magnitude, and gave names to them as follows : •••

10•• Absolute Electromagnetic Units of Resistance = 1 Ohm 10′ ,, ,, Units of Electromo- tive force = 1 Volt fifftofan,, ,, Unit of Current = 1 Ampere ,Jjy*ofan••• ••• Unit of Quantity = 1 Coulomb lO-' ,, ,, Units of Capacity = 1 Farad 10-1^ ,, ,, Units of Capacity = 1 Microfarad

Since the date when the preceding terms were adopted, other multiples of absolute C.G.S. Units have received practical names, thus : •••

10′ Ergs or Absolute C.G.S. Units of Energy = 1 Joule 10′ Ergs per second or C.G.S. Units of Power = 1 Watt 10^ Absolute Units of Inductance = 1

Henry

108 Absolute Units of Magnetic Flux = 1 “Weber i

1 Absolute Unit of Magnetomotive Force = 1 Gauss i

An Electrical Congress was held in Chicago, U.S.A., in August 1893, to consider the subject of International Practical Electrical Units, and the result of a conference between scientific representatives of Great Britain, the United States, France, Germany, Italy, Mexico, Austria, Switzerland, Sweden, and British North America, after deliberation for six days, was a unanimous agreement to recommend the following resolutions as the definition of Practical International Units. The resolutions have since that date been received and adopted by the Governments above mentioned : ???

” Besolved, That the several Governments represented by the delegates of this International Congress of Electricians be, and they are hereby, recommended to formally adopt as legal units of elec- trical measure the following : ???

” As a unit of resistance, the International Ohm, which is based upon the ohm equal to 10′ units of resistance of the C.G.S. System of electromagnetic units, and is represented by the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice 14-4521 grammes in mass, of a constant cross-sectional area and of the length of 106-3 cm.

” As a unit of current, the International Ampere, which is one- tenth of the unit of current of the C.G.S. System of electro- magnetic units, and which is represented sufficiently well for practical use by the unvarying current which, when passed through a solution of nitrate of silver in water, deposits silver at the rate of 0-001118 of a gramme per second.

” As a unit of electromotive force, the International Volt, which is the electromotive force that, steadily applied to a conductor whose resistance is one international ohm, will produce a current of one international ampere, and which is represented sufficiently well for practical use by MJJ of the

electromotive force between the poles or electrodes of the voltaic cell known as Clark's Cell, at a temperature of 15►► C, and prepared in the manner described in a certain specification.

" As a unit of quantity, the Internfitional Coulomb, which is the quantity of electricity transferred by a current of one international ampere in one second.

' ' As the unit of capacity, the International Farad, which is the capacity of a condenser charged to a potential of one international volt by one international coulomb of electricity.

" As a unit of work, the Joule, which is equal to 10′ units of work in the C.G.S. System, and which is represented sufBciently well for practical use by the energy expended in one second by an international ampere in an international ohm.

" As a unit of power, the Watt, which is equal to 10′ units of power in the C.G.S. System, and which is represented sufficiently well for practical use by the work done at the rate of one joule per second.

1 Neither the Weber nor the Gauss has received very general adop- tion, although recommended by the Committee of the British Asso- ciation on Electrical Units. Many different suggestioua have been made as to the meaning to be applied to the word " Gauss." The practical electrical engineer, up to the present, prefers to use one ampere-turn as his unit of Magnetomotive Force, and one line of force as the unit of Magnetic Flux, equal respectively to 10/47r times and 1 times the C.G.S. absolute units.

"As a unit of inductance, the Henry, which is the induction in a circuit when an electromotive force induced in this circuit is one international volt, while the inducing current varies at the rate of one ampere per second."

It can hardly be said that the present system of practical units is entirely satisfactory in all respects. Great difficulty would of course be experienced in again altering the accepted units, but if at any future time a uai^?" reformation should be possible, it would be de- sirable to bear in mind the recommendations made by Mr Oliver Heaviside with regard to their

rationalization. The British Association Committee defined the strength of a magnetic pole by reference to the mechanical stress between it and another equal pole: hence the British Association unit magnetic pole is a pole which at a distance of one centimetre attracts or repels another equal pole with a force of one dyne. This, we have seen, is an imperfect definition, because it omits all reference to the permeability of the medium in which the experiment takes place ; but it is also unsatisfactory as a starting-point for a system of units for another reason. The important quantity in con- nexion with polar magnets is not a mechanical stress be- tween the free poles of different magnets, but the magnetic flux emanating from, or associating with, them. From a technical point of view this latter quality is far more im- portant than the mechanical stress between the magnetic poles, because we mostlyemploy magnets to create induced electromotive force, and the quantity we are then mostly concerned with is the magnetic flux proceeding from the poles. Hence the most natural definition of a unit magnet pole is that pole from which proceeds a total magnetic flux of one unit. The definition of one unit of magnetic flux must then be that flux which, when inserted into or with- drawn from a conducting circuit of one turn having unit area and unit conductivity, creates in it a flow or circula- tion of one unit of electric quantity. The definition of a unit magnetic pole ought, therefore, to have been ap- proached from the definition of a unit of electric quantity.

On the ordinary or British Association system, if a magnetic filament has a pole strength m, ??? that is to say, if it has a magneti- zation I, and a section s, such that Is equals m, ??? then it can be shown that the total flux emanating from the pole is 4irm. The factor 47r, in consequence of this definition, makes its appearance in many practically important expressions. For instance, in the well-known magnetic equation connecting the vector values of mag- netization I, magnetic force H, and magnetic flnx density B, where we have the equation

B = H-H47rI,

the appearance of the quantity 47r disguises the real physical meaning of the equation.

The true remedy for this difficulty has been suggested by Heavi- side to be the substitution of rational for irrational formulae and definitions. He proposes to restate the definition of a unit mag- netic pole in such a manner as to remove this constant 4t from the most frequently employed equations. His starting-point is a new definition according to which a unit magnetic pole is said to have a strength of m units if it attracts or repels another equal pole placed at a distance of d centimetres with a force of

j^ dynes. It follows from this definition that a rational unit magnetic pole is weaker or smaller than the irrational or British Association unit pole in the ratio of 1/ Vl^ to 1, or ###28‘205 to 1. The magnetic force due to a rational pole of strength m at a dis- tance of d centimetres being j—j units, if we suppose a magnetic

filament having a pole of strength m in rational units to have a smaller sphere of radius ##### described round its pole, the magnetic force on the surface of this sphere is mMirr^ units, and this is therefore also the numerical value of the flux density. Hence the total magnetic flux through the surface of the sphere is

iirr^x -. ### 5 units =m units ;

and therefore the number which denotes the total magnetic flux coming out of the pole of strength m in rational units is also m.

XTNITS]

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The rational system thus gives us an obvious and natural defi- nition of a unit magnetic pole, namely, that it is a pole through which proceeds the unit of magnetic flux. It follows, therefore, that if the intensity of magnetization of the magnetic filament is I and the section is s, the total flux traversing the centre of the magnet is Is units ; and that if the filament is an endless or pole- less iron filament magnetized uniformly by a resultant external magnetic force H, the flux density will be expressed in rational units by the

equation B = I+H. The physical meaning of this equation is that the flux per square centimetre in the iron is simply obtained by adding together the flux per square centimetre, if the iron is supposed to be removed, and the magnetization of the iron at that place. On the rational system, since the unit pole strength has been decreased in the ratio of I to 1/V4t, or of .3 ###5441 to 1, when compared with the magnitude of the present irrational unit pole, and since the unit of magnetic flux is the total flux proceed- ing from a magnetic pole, it follows that Heaviside's unit of magnetic flux is larger than the C.G.S. unit of magnetic flux in the ratio of 3-5441 to 1.

It will be seen, therefore, that the Heaviside rational units are all inoommeasurable with the practical units. This is a great barrier to their adoption in practice, because it is impossible to discard all the existing resistance coils, ammeters, voltmeters, &c., and equally impossible to recalibrate or readjust them to read in Heaviside Units. Recently, however, a suggestion has been made, in modification of the Heaviside System, which would provide a system of rational practical units not impossible of adoption. It has been pointed out by J. A. Fleming that if in place of the ampere, ohm, watt, joule, farad, and coulomb, we employ the dekampere, dekohm, the dekawatt, the dekajoule, the dekafarad, and the dekacoulomb, we have a system of practical units such that measurements made in these units are equal to measurements made in Heaviside rational units when multiplied by some power of iir. Moreover, he has shown that this power of 47r, in the case of most units, varies inversely as the power under which /n appears in the complete dimensional expression for the quantity in electromagnetic measurement. Thus a current measured in Heaviside rational units is numerically equal to (4ir)i times' the same current measured in dekamperes, and in the electromagnetic

dimensional expression for current, namely, L^M^T"^^"*, p. ap- pears as m"2. If, then, following the suggestion of Fessenden and Fleming, we consider the permeability of the aether to be numeri- cally Air instead of unity, the measurement of a current in dekam- peres will be a number which is the same as that given by reckon- ing in Heaviside rational units. In this way a system of national Practical Units (R.P. Units) might be constructed as follows : ###

The E.P. Unit of Magnetic Force =4Tr x the C.G.S. Unit.

,, ,, Magnetic Polarity =l/47r x ,, ,,

,, ,, Magnetic Flux =1 ,,

❓❓❓ ,, Magnetomotive Force =1 ,,

❓❓❓ ,, Electric Current =1 ,,

,, ,, Electric Quantity =1 ,,

❓❓❓ ❓❓❓ Electromotive Force =10′ ,,

,, ,, Resistance =10′ ,,

,, ,, Inductance =10′ ,,

,, ,, Power = 10′ ,,

❓❓❓ “Work = 10′

❓❓❓ ,, Capacity = 10-‘ ,,

All except the Unit of Magnetic Force and Magnetic Polarity are commeasurable with the corresponding C.G.S. Units, and in multiples which form a convenient practical system.

Turning to the practical recovery of the International Electric Units, as generally accepted by the Chicago Elec- trical Conference, the most important matter is the realization of the International Ohm, which is intended as nearly as possible to realize in a concrete form 10′ C.G-.S. electromagnetic units of resistance. The old Brit- ish Association Unit of electrical resistance (denoted by 1 B.A.U.) was found to be too small when compared with the theoretical ohm in the ratio of ~~9866 to 1. In creating better sta.ndards, it has been decided to express it in terms of the resistance of a column of mercury of a certain length and weight, the reason being that mercury is a homo~~ geneous liquid metal the density of which is very accurately known, and which is without much difficulty obtained in a state

of very great chemical purity by distillation in a vacuum. Hence it is an easily recovered material, and observers in different parts of the world can be tolerably certain of obtaining specimens nearly identical in every

respect. This is not the case with other solid metals, in the electric resistivity of which great differences may occur, even in chemically pure specimens (see I. Electric Con- duction). Hence the absolute determination of the ohm really resolves itself into a determination of the specific resistance of mercury or the volume resistivity in absolute C.G.S. units.

The full description of the different methods for determining electric quantities, and especially electric resistance, in absolute measure is given, in Maxwell's Treatise on Electricity and Mag- netism, vol. ii. ch. X. ; also in Mascart and Joubert's Treatise on Electricity and Magnetism (English translation by Atkinson), vol. li. ch. ix. The relative advantages and disadvantages of the various methods which have been proposed for the determination of resistance in absolute measure are very fully discussed in the Phil. Mag., November 1882, p. 329, by Lord Rayleigh, whose researches on this subject have been mo.st extensive and profound. On the subject of Electric Units the reader may with advantage consult the following books and original papers for additional information : ###

J. Clekk Maxwell. Treatise on Electricity and Magnetism, vol. ii. ch. X., 2nd ed. Oxford, 1881.### Mascart and Joubert. Treatise on Electricity and Magnetism, translated by E. Atkinson, vol. i. ch. ix. London, 1883.### J. D. Evebett. Illustrations of the C.G.S. System of Units. London, 1891.### Magnus Maclean. Physical Units. London, 1896.### J. A. Fleming. Magnets and Electric Currents. London, 1898. ### H. J. Chanet. Our Weights and Measures. London, 1897. ### ^F.Jenkin. Reports on Electrical Standards. London, 1873. ### ^F. Keenetlee. Die UnitdtdesAbsolutenMaass-Systems. Budapest, 1899. ### TheBeport of the Committee on Electrical Units of the British Association for the Advancement of Science, from 1862 to present date. ### G. Johnstone Stone y. "A Survey of that Part of the Range of Nature's Operations which Man is Competent to Study," Phil. Mag., November 1899, vol. xlviii. ### W. Williams. " On the Re- lation of the Dimensions of Physical Quantities to Directions in Space," Phil. Mag.,

September 1892 ; also Proc. Phys. Soc, June 1892. ††† A. W. RiJOKEB. “On the Suppressed Dimensions of Physical Quantities,” Proc. Phys. Soc, vol. x. p. 37. ††† W. E. Aykton and J. V. Jones. ‘ ‘ Determination of the Ohm by a Lorentz Apparatus,” Electrician, vol. xl. p. 151. ††† J. V. Jones. “Sug- gestions towards the Determination of the Ohm by Lorentz Apparatus,” Electrician, vol. xxv. p. 552 ; ” The Absolute Measure- ment of Electrical Resistance,” Proc. Boy. Inst., vol. xiv. part ill. p. 601. ††† R. A. Fessenden. ” A Determination of the Nature of the Electric and Magnetic Quantities,” Physical Beview, Jan. 1900. (j. A. F.)

V. Electkic Dischaege Thkough Gases.

A gas in the normal state can conduct very little electricity unless the strength of the electric field to which it is exposed exceeds a certain value, which depends on the kind of gas and its pressure. It is, however, possible to bring by various means a gas into a state in which it conducts electricity under even the feeblest electric forces. As a study of the properties of gases when in this state throws a great deal of light on the processes by which conduction through gases in general is accomplished, we shall begin by considering the properties of a gas and the laws of electric conduction through it when it is in this conducting state.

†† 1. Properties of a Gas in the Conducting State. ††† Gases may be brought into this conducting state in many ways. Thus they conduct when exposed to Eontgen rays,’ to the radiation from uranium,^ thorium,^ or the radio-active substances polonium, radium, and actinium, discovered by Curie, Curie and Bemont, and Debierne ; * they become conductors by the passage through them of cathode rays,^ of Lenard rays,’ or the radiation emitted by electric sparks (E Wiedemann’s Entladungstrahlen).’’ They become con- ductors when in contact with glowing metal or carbon, and when their temperature is raised beyond a certain point. Gases drawn from the neighbourhood of flames and arcs are also good conductors, as are those which have diffused from a region through which an electric discharge is pass- ing.* Air becomes a conductor bypassing over phosphorus,’

and retains the property for some little time after it has left the phosphorus. By whatever means the gas may have been made a conductor, when it has reached this state it possesses characteristic properties. In the first place, it does not lose its conductivity immediately after it is removed from the agency which made it a conductor ; its conductivity, however, always diminishes, in some cases very rapidly, after the agent is removed, and finally disappears. Thus a gas exposed to Eontgen rays retains its conductivity for some little time after the rays have ceased to pass through it, and flame gases retain their conductivity for a considerable time after their removal from the flame. If, however, the conducting gas is filtered through a plug of tightly packed glass wool or through water it loses its conductivity ; ’” it also loses its conductivity slowly by being passed through metal tubes, and the finer the bore of the tube the more rapidly does the conductivity disappear. The conductivity also may be at once removed by making the gas traverse a strong electric field, and thus sending a current of electricity through it. The effect of filtering and of passage through metal tubes shows that the conductivity is due to some- thing which is mixed with the gas, and that this something is removed from the gas in the one case by filtration, and in the other by diffusion to the sides of the tube. Again, the experiment with the electric field shows that this something is charged, and moves under the field, while since the gas when in the conducting state often shows as a whole no charge, the charges which move in the field must be both positive and negative. We thus regard the conductivity of the gas as due to the presence of electri- fied particles, some of these particles having positive charges, others negative. These particles we shall call ions, but they must not be assumed to be the same as the ions in the electrolysis of solutions. We shall see that in several cases we can determine the charge and masses of these gaseous ions. The process by which the gas is changed into a conductor we shall call the ionization of the gas.

In a gas made a conductor by any of the means we have described, the conductivity does not obey Ohm’s

law, except for very small electromotive forces. The relation between the current passing between two paral- lel metal plates immersed in such a gas and the potential difference between the plates is represented by a curve such as that shown in Fig. 8, in which the abscissee re- present the potential differ- ence, and the ordinates the current." We see that when the potential differ- ence is small, the curve is straight; in this stage the conduction obeys Ohm's law, but the current soon begins to increase more slowly than the potential dif- ference, until we reach a stage when there is no ap- preciable increase in the current however great the increase in the potential difference, provided the increase is not sufficient to make the electric field ionize the gas ; when this stage is reached the current increases very rapidly with the strength of the field. There is thus, until the electric field ionizes the gas, a limiting value to the current which can be carried by the gas ; this maximum value is often called the fiuturation current. The maximum current which can be obtained between two parallel plates of given area depends upon the amount of ionization between the plates ; if the ionization is a volume ionization, the greater the distance between the

plates the greater the value of the maximum current, so that if we use potential differences large enough to pro- duce saturation, the thicker the layer of gas between the plates the greater the current ××× a result which would seem paradoxical on the ordinary resistance view of conduction, as here the resistance of a thick layer appears to be less than that of a thin one.

The limiting value of the current is very easily explained on the assumption that the conduction is due to ions. For suppose that in the gas between the plates the ionizing agent produces in one second g positive, and q negative ions, if a current c pass between the plates and if e is the charge on an ion, the number of positive ions delivered up at the negative electrode and of negative ions at the positive electrode is in one second c/e. Now when the gas is in a steady state the number of ions taken out of it in a given time cannot be greater than the number of ions produced in the same time : hence c/e cannot be greater than q ××× that is, the maximum value c is qe. If the ionization takes place uniformly throughout the gas, and if ? is the distance between the plates, A the area of the plates, which are supposed to be equal and parallel, and go the number of ions produced in unit volume,

then q=qaA.l, so that the maximum value of c is qoAle, and is thus pro-portional to the distance between the plates. Excellent examples of this law are afforded by conduction through gas ionized by Eontgen rays.i^ Even if there is no current through the gas to carry off the ions as they are produced, the ions do not increase indefinitely with the time which has elapsed since the gas was exposed to the ionizing agent ; their number and the conductivity of the gas very soon acquire a steady value beyond which they do not increase if the rate of ionization remains constant. Eor the positive and negative ions moving about in the gas sometimes come into collision with each other, and in a certain proportion of these collisions they will remain united, forming a neutral particle, the constituents of which have ceased to be ions. Thus the collisions will cause a certain number of ions to disappear, and the steady state in a gas which is not carrying a current will be reached when the number of ions which disappear in a second from the effect of collisions is equal to the number produced in the same time by the ionizing agent. If g is the number of ions produced in one cubic centimetre of the gas per second by the ionizing agent, and ni, n^ the number of positive and negative ions respectively in a cubic centimetre, the number of collisions per second between the posi- tive and negative ions will be proportional to niWa- If we sup- pose that a certain fraction of the collisions lead to the formation of a neutral particle, then the number of ions which disappear in a second will be equal to anxn^, when a is a quantity which is independent of ××i and ××2 ; hence we have

××× = q×××an-in2, dt

dt ~

q×××anin2,

Ml ××× 112 remaining constant, so that if the gas is uncharged to begin with, ni always equals kj- Putting ni = n2, we get

f =^—^ (^)-

When things have settled into a steady state, dni/dt=0, and hence by equation (1)

n-L

Equation (1) may be used to calculate the rate at which the conductivity of the gas decays when the ionizing agent is removed, for putting in that equation g=0, we have

dt ‘

-ani’

or,

nx N

(2)

$$\frac{dN}{dt} = \frac{N}{1+Na\,dt}$$

where N is the number of ions present when the ionization was stopped, and t the time which has elapsed since the stoppage. This equation has been verified in the case of a gas ionized by the Eontgen rays by Eutherfoid,!^ and in the case of the gases drawn from flames and arcs by M’Clelland,i* who measured the quantity of electricity which could be carried by the gas at successive small intervals of time after the ionizing agent had ceased to act. For air, oxygen, carbonic acid, and hydrogen at atmospheric pressure and ionized by Eontgen rays, Townsend ^^ found for a the values 3420e, 3380e, 3500e, and 3020e, where e is the charge on the ion

discharge]

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in electrostatic measure ; we shall see later that e is about 6 x lO-i”, so that for air, carbonic acid, and oxygen at atmospheric pressure

0 is about 2 x 10-^, while for hydrogen it is about 15 per cent. less.

Thus an ion after being formed does not last for ever, nor does it on the other hand disappear instantaneously, but must be regarded as having a certain duration of life, the value of which on the average is seen by equation (2) to be 1/aw, where n is the number of ions per cubic centi- metre of the gas. When the gas between a pair of parallel metal plates is carrying the maximum current, all the ions must reach the plates before they recombine ; for this to happen, the velocity of the ions along the lines of electric force must be great enough to make the ion during its life move through a distance equal to the distance between the plates. If V is the velocity of the ion, T its life, and

1 the distance between the plates, the current will not have its maximum value unless V is greater than l/T ; hence the greater the velocity of the ion under a given electromotive force, and the longer its life, the smaller will be the potential difference required to produce the limiting current through the gas. As the ionization produced by an agent like Eontgen rays diminishes as the pressure of the gas diminishes, the life of an ion at low pressure will be longer than at high, since n is smaller ; again, the velo- city of an ion under a given electromotive force increases as the pressure diminishes (see below). Both these effects tend to diminish the potential difference required to pro- duce the limiting cui’rent, so that when the pressure is diminished the potential difference required to pro- duce the maximum current diminishes more rapidly than the pressure. As another illustration of the effect of the life of the ion, let us take the case of a gas where the pressure is kept constant, but the distance between the parallel plates is varied; if we diminish the distance between the plates we increase in the same proportion the potential gradient due to a constant difference of potential. Now the velocity of an ion is proportional to the potential gradient (see below), while when the plates are nearer together the ions have not so far to travel to reach them; taking these effects together, we see that the potential difference required to pro- duce the maximum current between two parallel plates wiU be proportional to the square of the distance between the plates.

2. Velocity of the Ions.

Thevelocitywithwhichtheions move under given electric forces are quantities of primary importance in the consideration of the passage of electricity through gases. They have been m easured by Eutherf ord ‘ and by Zeleny‘ for ions produced by Eontgen rays, by Eutherf ord “^ for the ions produced by uranium radiation and for the negative ions produced when ultra-violet light is incident on a metal plate ;‘ H. A. Wilson has measured the velocity of the ions produced by putting various salts into flames, M’Clelland ^^ the velocity of the ions in gases sucked from the neighbourhood of flames and arcs, and Chattock ^ the velocity of the ions produced when electri- city escapes from a sharp needle-point into a gas. Several methods have been employed to determine these velocities. The one most frequently employed is to find the electro-motive intensity required to force an ion against a stream of gas moving with a known velocity parallel to the lines of electric force. Thus, of two perforated plane electrodes vertically over each other, suppose the lower to be posi- tively, the upper negatively electrified, and suppose that the gas is streaming vertically downwards with the velocity V ; then unless the upward velocity of the positive ion is greater than V, no positive electricity will reach the upper plate. If we increase the strength of the field between the plates, and hence the upward velocity of the positive ion, until the positive ions just begin to reach the upper plate, we know that with this strength of field the velocity

of the positive ion is equal to V. By this method, which has been used by Eutherford, Zeleny, and H. A. Wilson, the velocity of ions in fields of various strengths has been determined.

The arangement used by Zeleny is represented in Fig. 9. P and Q are square brass plates. They are bored through their centres, and to the openings the tubes R and S are attached, the space between the plates being covered in so as to form a closed box.

EARTH

Fig. 9.

K is a piece of wire gauze completely covering the opening in Q ; T is an insulated piece of wire gauze nearly but not quite filling the opening in the plate P, and connected with one pair of quadrants of an electrometer E. A plug of glass wool G filters out the dust from a stream of gas which enters the vessel by the tube D and leaves it by F ; this plug also makes the velocity of the flow of the gas uniform across the section of the tube. The Kontgen rays to ionize the gas were produced by a bulb at 0, the bulb and coil being in a lead-covered box, with an aluminium window through which the rays passed. Q is connected with one pole of a battery of cells, P and the other pole of the battery are put to earth. The changes in the potential of T are due to ions giving up their charges to it. With a given velocity of air-blast the potential of T was found not to change unless the differ- ence of potential between P and Q exceeded a critical value. The field corresponding to this critical value thus made the ions move with the known velocity of the blast.

Another method which has been employed by Rutherford and M'Clelland is based on the action of an electric field in destroying the conductivity of gas streaming through it. Suppose that BAB, DCD (Fig. 10) are a system of parallel plates boxed in so that a stream of gas, after

flowing between BB, .

passes between DD a c

without any loss ××^ ××× ×××

gas in the interval.

Suppose the plates DD Fig. 10.

are insulated, and con- nected with one pair of quadrants of an electrometer, by charging up C to a sufSoiently high potential we can drive all the positive ions which enter the system DCD against the plates D ; this will cause a deflection of the electrometer, which in one second will be proportional to the number of positive ions which have entered the system in that time. If we charge A up to a high potential, B being put to earth, we shall find that the deflexion of the electrometer connected with DD is less

than it was when A and B were at the same potential, because some of the posi- tive ions in their passage through BAB are driven against the plates B. If M is the velocity along the lines of force in the uniform electric field between A and B, and { the time it takes for the gas to pass through BAB, then all the positive io;is within a distance ut of the plates B will be driven up against these plates, and thus if the positive ions are equally distributed through the gas the number of positive ions which emerge from the system when the electric field is on wiU bear to the number which emerge when the field is off the ratio of 1 – ut/l to unity, where I is the distance between A ‘and B. This ratio is equal to the ratio of the deflexions in one second of the electrometer attached to D hence the observations of this instrument give l-nt/l. If we know the velocity of the gas and the length of the plates A and B we can determine t, and since I can be easily measured, we can fiAd u the velocity of the positive ion in a field of given strength. Bv charging A and C negatively instead of positively we can arrive at the velocity of the negative ion. In practice it is more con- venient to use cylindrical tubes with coaxial wires instead of the systems of parallel plates, though in this case the calculation of the velocity of the ions from the observations is a little more complicated, inasmuch as the electric field is not uniform between the tubes.

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A method which gives very accurate results, though it is only applicable in certain cases, is the one used by Rutherford^ to measure the velocity of the negative ions produced close to a metal plate by the incidence on the plate of ultra-violet light. The principle of the method is as follows : ??? AB (Mg. 11) is an in- sulated horizontal plate of well- polished zinc, which can be moved vertically up and down by means of a screw ; it is connected with

one pair of quadrants of an electro- meter, the other pair of quadrants B being put to earth. CD is a base- plate with a hole EF in it ; this

Q hole is covered with fine wire

gauze, through which ultra-violet light passes and falls on tlie plate AB. The plate CD is connected with an alternating current dynamo, which produces a simply- periodic potential difference between AB and CD, the other pole being put to earth. Suppose that at any instant the plate CD is at a higher potential than AB, then the negative ions from AB will move towards CD, and will continue to do so as long as the potential of CD is higher than that of AB. If, how- ever, the potential difference changes sign before the negative ions reach CD, these ions will go back to AB. Thus AB will not lose any negative charge unless the distance between the plates AB and CD is less than the distance traversed by the negative ion during the time the potential of CD is higher than that of AB. By altering the distance between the plates until CD just begins to lose a negative charge, we find the velocity of the negative ion under unit electromotive intensity. For suppose the difference of potential between AB and CD is equal to asaipt, then iid is the distance between the plates, the electric intensity is equal to asinptjd; if we suppose the velocity of the ion is proportional to the electric intensity, and if ►► is the velocity for unit electric in- tensity, the velocity of the negative ion will be uasinpt/d. Hence if X represent the distance of the ion from AB

dx_iM di^‘d

x = ►►►^{l-ooapt), if a;=0 when i=0.

Thus the greatest distance the ion can get from the plate is equal to 2au/pd, and if the distance between the plates is gradually reduced to this value the plate AB will begin to lose a negative charge ; hence when this happens

, 2au d = ►►► r 1 or u =

2a ‘

an equation by means of which we can find u.

The velocity of the ions produced by the discharge of electricity from a fine point has been determined by Chattook by an entirely different method. In this case the electric field is so strong and the velocity of the ion so great that the preceding methods are not applicable. Suppose P represents a vertical needle discharg- ing electricity into air, consider the force acting on the ions in- cluded between- two horizontal planes A, B. If /) is the density of the electrification, and Z the vertical component of the electric intensity, F the resultant force on the ions between A and B is vertical and equal to

/VyZpdxdydz.

Let us suppose that the velocity of the ion is proportional to the electric intensity, so that if w is the vertical velocity of the ions, which are supposed all to be of one sign, ►►>=RZ..

Substituting this value of Z, the vertical force on the ions between A and B is equal to

- / / / wpdxdydz,

‘Bntjfwpdxdij = i., where i is the current streaming from the point. This current, which can be easily measured by putting a galvano- meter in series with the discharging point, is independent of z, the vertical distance of a plane between A and B below the charging point. Hence we have

= R-^-

This force must be counterbalanced by the difference of gaseous pressures over the planes A and B ; hence if ;)jj and Pj^ denote respectively the pressures over B and A, we have

—?‘A = i

Hence by the measurement of these pressures we can determine

R, and hence the velocity with which an ion moves under a given electric intensity.

There are other methods of determining the velocities of the ions, hut as these depend on the theory of the conduction of electricity through a gas containing charged ions, we shall consider them in our discussion of that theory.

►► 3. Remits of Measwrements. ►►► The results of experiments made by the preceding methods on the velocity of ions pro- duced by Eontgen rays, by uranium rays, by the incidence of ultra-violet light on metals, and by the discharge of electricity from points, show that, whether the ions are produced in one or other of these ways, their velocities in a given gas are as nearly equal, considering the great difficulties of these experiments, as we could expect, on the supposition that the ions are identical. We may therefore conclude that the ions produced by these agents depend only on the gas, and not on the agent. It has been proved by direct experiment that in the case of the first three agents the velocity of an ion is proportional to the electric intensity acting upon it. In the case of the ions produced by ultra-violet light Kutherford {loc.cit.)has, shown that, at any rate dovra to pressures as low as 34 mm. of mercury, the velocity of the ion under a given electric intensity is inversely proportional to the pressure. He has also shown that the velocity of the ion remains un- altered however the metal on which the light falls is changed, provided that the gas in which the metals are immersed remains the same. Zeleny made the very interesting discovery that the velocity of the negative ions was always greater than that of the positive in the case of ions produced by Eontgen rays. Eutherford showed that this was true for the ions produced by uranium radiation, and Chattock {loc. cit.) that it held also for those produced by the discharge of electricity from points. Townsend,^* by measuring the rates of diffusion of ions, has shown that the ratio of the velocity of the negative ion to that of the positive is considerably greater in a dry gas than in a wet one. The presence of moisture produces a very appreciable diminution in the velocity of the

negative, while its effect on the positive ion is comparatively small, and generally in the opposite direction ; i.e., the positive ions seem to move a trifle faster in a damp gas than they do in a dry one. Eutherford’s results for the velocity of the ions in difierent gases produced by different agents are given in the following table. The velocities given are those due to a potential gradient of 1 volt per centimetre.

Gas.

Mean Velocity of Positive

and Negative Ions in Bfintgen Hay Conduction.

Velocity of Negative Ions

in Ultra- Violet Light

Conduction.

Air

Hydrogen Carbonic acid .

1‘6 cm./sec. 5-2 ###

1-07 ###

1‘4 cm./sec.

3-9

###‘8 ###

Eutherford also compared the velocities of the ions produced by uranium radiation with those produced by Eontgen rays, and found them equal within the limits of error of the experiments. For the ions produced by the escape of electrification from a point Chattock (Joe. cit.) found 1 -SScm./sec. as the velocity of the positive ion, and 1 -8 cm./sec. as that of the negative. For the ratio of the velocity of the negative ion to that of the

positive Zeleny found the following values. The gases were not specially dried.

Gas.

Velocity of Negative Ion divided by Velocity of Positive Ion.

Gas.

Velocity of Negative Ion divided by Velocity of Positive Ion.

Air.

Oxygen . Nitrogen Hydrogen Coal gas .

1-24 1-24 1-23 1-14

1]] 5

Carbonic acid Ammonia Acetylene Nitrogen monoxide

1-

1-045

9S5

1-105

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The effect of moisture on the ratio of the velocities of the ions is shown by the results given by Townsend in the following table. The quantity K determined by Townsend is not the velocity of the ion, but the coefficient of

diffusion of the ion through the gas. K is, however, proportional to that velocity.

Coefficients of Diffusion of Ions produced hy Sontgen Bays in Dry Gases.

Gas.

K for + ion.

K for – ion.

Mean Values ofK.

Ratio of Values of K.

Air .

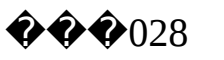 028

043

0347

1^54

Oxygen .

025

0396

0323

1^58

Carbonic Acid .

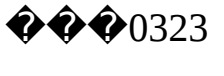 023

026

0245

1-13

Hydrogen

123

190

156

1-54

Coefficients of Diffusion in Moist Gases.

Air .

032

035

0335

1^09

Oxygen .

0288

0358

0323

1-24

Carbonic Acid .

1-04

Hydrogen

128

142

135

1-11

We can derive some information as to the constitution of the ions by calculating the velocity with which a molecule of the gas would move in the electric field if it carried the same charge as the ion. From the theory of the diffusion of gases, as developed by Maxwell (see Diffusion, Sncy. Brit. vol. vii.), we know that if the particles of a gas A are surrounded by a gas B, then, if the partial pressure of A is small, the velocity it with which its particles will move when acted upon by a force X 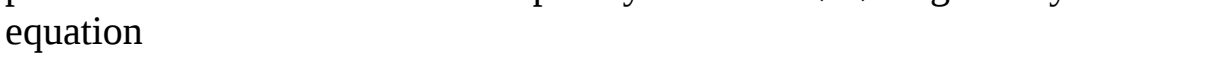 is given by the equation

Xe

“(WN.)

D.

where D represents the coefficient of inter-diffusion of A into B, and Nj the number of particles of A pei- cubic centimetre when the pressure due to A is p^. Let us calculate by this equation the velocity with which a molecule of hydrogen would move through hydrogen if it carried the charge carried by an ion, wliich we shall prove shortly to be equal to the charge carried by

an atom of hydrogen in the electrolysis of solutions. Since Pi/‘Si is independent of the pressure, it is equal to tt/N, where ir is the atmos- pheric pressure and N the number of molecules in a cubic centimetre of gas at atmospheric pressure. Now 1^6= 1^22 x 10^►►, if e is measured in electrostatic units ; 7r=106, and D in this case is the coefficient of diffusion of hydrogen into itself, and is equal to 1‘7. Substituting these values we find

M=l-97xl0*X.

If the potential gradient is 1 volt per centimetre, X = 1/300. Substituting this value for X, we find u = 66 cm. /sec, for the velocity of a hydrogen molecule. We have seen that the velocity of the ion in hydrogen is only about 5 cm./sec., so that the ion moves more slowly than it would if it were a single molecule. The most obvious inference would seem to be that the ion is bigger than the molecule, and is in fact an aggregation of molecules, the charged ion acting as a nucleus around which molecules collect like dust round a charged body. This view is supported by the effect produced by moisture in diminishing the velocity of the negative ion, for, as C. T. R. Wilson’^ has shown, moisture tends to collect round the ions, and condenses more easily on the negative than on the positive ion. In connexion with the velocities of ions in the gases drawn from flames, we shall find other instances which suggest that condensation takes place round the ions. An increase in the size of the system is not, however, the only way by which the velocity might fall below that calculated for the hydrogen molecule, for we must remember that the hydrogen molecule, whose coefficient of diffusion is 1^7, is not charged, while the ion is. The forces exerted by the ion on the other molecules of hydrogen are not the same as those which would be exerted by a molecule of hydrogen, and as the coefficient of diffusion depends on the forces between the molecules, the coefficient of diffusion of a charged molecule into hydrogen, might be very different from that of an uncharged one.

►► 4. Velocity of Ions in Gases from Flames and Arcs. ►►► The velocities of the ions in gases drawn from Bunsen flames and arcs are very much smaller than those of the ions previously considered. They were found by M’Clelland ^s to depend upon the distance the gases had travelled from the flame. Thus with a Bunsen flame the velocity of the ion at a

distance of 5^5 cm. from the flame, where the temperature was 230►► C, with a potential gradient of 1 volt per cm., was -23 cm./sec. ; at a distance of 10 cm.

from the flame, where the temperature was 160►► C, it was ►►►21 cm./sec. ; while at a distance of 14^5 cm. from the flame, where the temperature was 105►► C, it was only ~~04: cm./sec. If the temperature of the gas at a distance from the flame was raised by external means the velocity of the ions increased. Similar results were obtained with a CO flame. These results suggest a rapid condensation on the ions as they get into cooler regions. With these ions, as with those previously considered, the velocity of the negative ion is always greater than that of the positive, the difference amounting to about 15 per cent. M'Clelland also found that, with the ions from flames, arcs, and the neighbourhood of incandescent wires, the velocity diminishes as the temperature of the flame, arc, or wire increases, the other circumstances remaining the same. The velocities of the ions produced by putting salts into flames have been measured by H. A. Wilson.^^ The salts used were Na^COg, K2CO3, Li^COg, Cs^COg, Eb^COj, KCl, NaCl, KF, KI, KBr. They were sprayed by a Gouy sprayer into a flame whose temperature was estimated at about 2000►► C. It was found that in all cases the velocity of the positive ion under a potential gradient of 1 volt per centi~~ metre was about 62 cm./sec, while the velocity of the negative ion under the same potential gradient was about 1030 cm./sec. The velocity of the negative ions is thus independent of the nature of the salt from which they are derived. The velocities of these ions are much greater than those of the ions produced by Kontgen rays, and very much greater than those in the comparatively cold gases sucked from flames. The ratio of the velocity of the negative ion to that of the positive is also very much greater. Experi- ments were also made by Wilson on the velocities of the ions when the salts were volatilized by a stream of hot air at a temperature of about 1000►► C. The salts tried were NajCOj, NaOH, NaCl, K^COg, KOE, KCl, KBr, KI, KF, LiCl, LijCOg, EbCl, Rb^COj, CsCl, Cs.COg, CaCl,, BaClg, SrClj, Ba(N03)2. The velocities of the ions under , a potential gradient of 1 volt per centimetre are : for (1) negative ions of all the salts, 26 cm. /sec. ; for (2) positive ions of salts Li, Na, K, Eb, and Cs, 7 '2 cm./sec. ; and for (3) positive ions of salts of Ba, Sr, and Ca, 3^8 cm./sec. These numbers, on account of the difficulties of the experi-

ment, are only to be considered as approximately true. The velocities in the hot air are very much smaller than those in the flame. They show, however, the same peculiarities, the velocities of all the negative ions being the same, as well as those of the positive ions from the alkali metals. It will be noticed that the fall in temperature from 2000 C. in the flame to 1000 C. in the hot air has had a much greater effect on the velocity of the negative ion than on that of -the positive. The reduction in the velocity which follows the fall in temperature is analogous to that observed by M'Clelland in the case of the gases drawn from flames.

5. Determination of the Electric Charge carried hy an Ion.
The charge on the ions was first measured by the present writer, ^^ using a method founded on C. T. R. Wilson's ^' discovery that when Eontgen rays are passed through dust-free air a cloud is produced by an expansion of the gas, which is too small to produce cloudy condensation when the gas is not exposed to these rays. When the gas is exposed to the rays the ions produced by them seem to act as nuclei around which the water condenses. It has been shown (J. J. Thomson, Applications of DyTiamics to Physics and Chemistry, p. 164) that for a charged sphere of less than a certain radius the effect of the charge in promoting condensation more than counterbalances the effect of surface tension in preventing it. Thus a charged ion will produce a very small drop of water, which may act as a nucleus for larger drops. That the drops con-

stituting the cloud are formed round the ions is proved by the fact that the cloud is not formed when the gas is exposed to a strong electric field while the rays are passing through it, the electric field removing the ions from the gas as fast as they are formed. The experiment also shows that the drops are only formed round the ions. Suppose now we wish to count the number of ions in a cubic centimetre of air, we cool the air by sudden expan- sion until the supersaturation produced by the cooling is sufl&cient to cause a cloud to be formed round the ions. The problem of finding the number of ions per

cubic centimetre of the gas is thus reduced to finding the number of drops per cubic centimetre in the cloud. Knowing the amount of the expansion, we can calculate the amount of water deposited per cubic centimetre of the cloud. The water is deposited as drops, and if the drops are of equal size the number per cubic centimetre will be equal to the volume of the water deposited per cubic centimetre divided by the volume of one of the drops. Hence we can calculate the number of the drops if we know their size, and this can be determined by measuring v, the velocity with which they fell under gravity through the air. From the theory of the motion of a sphere through a viscous fluid,

2 rf

9 ij.’

where a is the radius of the drop, g the value of gravity, and jx the coefloioient of viscosity of the gas through which the drop falls. From this equation we can determine a, and hence deduce n, the number of ions per cubic centi- metre. If we place two parallel metal plates in the gas, and establish between them a known potential difference, we shall get a current of electricity through the gas which we can measure by means of an electrometer. If e is the charge on an ion, and u the mean velocity of the positive and negative ions in the electric field between the plates, the current across a square centimetre is neu ; hence, by the electrical measurements we determine the product neu. We know n by the experiments on the clouds, and M by the determinations which have been made of the velocities of the ions. We can therefore deduce the value of e, the charge on the ion. For the details of the experi- ment see papers by J. J. Thomson, Phil. Mag. xlvi. p. 528 ; xlviii. p. 547. The result of measurements made by this method is that the charge on the ion is the same whether the ionization is produced by Eontgen rays or by the incidence of ultra-violet light on a metal plate. It is also the same whether the gas ionized is hydrogen, air, or CO2, and thus is presumably independent of the nature of the gas. The value of the ionic charge in electrostatic units is about 6”5 x lO”!” c.g.s. units:

The ratio of the ionic charge to the charge carried by an atom of hydrogen in the electrolysis of solutions has been determined by Townsend by a

method depending upon the measurement of the rate of diffusion of the ions into the surrounding gas (Phil. Trans, cxciii. p. 129). If we have a quantity of positive and negative ions in a gas contained in a vessel with metal walls, their number will diminish in two ways : (1) some of the positive and negative ions will unite and form a neutral system, and (2) the ions will diffuse to the walls of the vessel, and coming in contact with the metal, cease to behave like ions, so that the metal sides can be regarded as absorbing all the ions which come in contact with it. The number absorbed in a given time depends upon the coefficient of diffusion of the ions through the gas in the vessel, and if we arrange the experiment so that the first cause of the decrease in the number of ions produces effects small compared with those produced by the second, a measurement of the rate at which ‘ the ions disappear will give the coefiicient of

diflfusion of the gas. The theory of the connexion between these quantities may be illustrated by the consideration of a very simple case.

Suppose that initially the distribution of ions between two parallel metal plates is uniform, and that the ions are left to diminish by diffusion to the plates. Then if D is the coefficient of diffusion of the ions into the gas, we have by the theory of gaseous diffusion (see Diffusion, ××!ncy. Brit. 9th edition), if m is the number of ions per cubic centimetre of the gas,

dn [d^n cPn O’n.‘S.

Tt-“'M’dy‘^ dz’)’ Let vta take the axis of x normal to the metal plate ; then if the distribution of ions was initially uniform, n will be independent of y and z, and the equation becomes

dn_

7t=!×× _’-

IT jL^

2××-l

~~sin (2ji ××× 1)~~

If N is the number of ions between the plates at the time t, Nj, the number when < = 0,

^^ _ (2M—I)2n-2D►►

(1).

Now N/No can easily be determined, as it is equal to the ratio of the quantities of electricity which can be sent across the plates by a strong electromotive force at the time t and at the time 0. These quantities can readily be measured by an electrometer. Knowing N/N, we can then, by means of equation (1), calculate D. In practice it was found more convenient to use cylindrical tubes instead of parallel plates, and though the calculation of the con-nexion between N/Nj and D is in this case a little more trouble- some, the principles involved are the same. “We have seen (see ►► 3) that if M is the velocity of the ion under sm electric intensity X, e the charge on the ion,

X►► ^

where Nj is the number of ions per cubic centimetre of the gas required to produce a partial pressure of the ions equal to ^1, but

Nj-N’

where N is the number of molecules in a cubic centimetre of any gas at the atmospheric pressure, ir. Putting 7r = 10^, X = 1/300 (this corresponds to a potential gradient of 1 volt per centimetre), 1*1 the velocity of the ion under this potential gradient, we have

►►l = o-7^7^►►N..D,

300×108

or N”

D

Now Ml is known from the experiments on the velocity of the ions, and D is known by iTownsend's experiments. In this way Townsend found that if ××j^ i^ e^ e^ denote the charges on the ions produced by Rbntgen rays in air, oxygen, carbonic acid, and hydrogen respectively, we have Ne^ =1-35×10"; Ncq =1-25x 10″ ; Neo = 1 -30 X 10″ ; N

It follows from these results that the charges on the ions produced by Eontgen rays in the gases named are all equal to each other and to the electrolytic charge on the hydrogen atom. Thus these results confirm that obtained by the method of clouds, viz., that the charge on the ion is independent of the nature of the gas from which it is produced. If we substitute for E the value obtained by the cloud method, viz., 6'5 x lO-i", we obtain for N the value 1 -9 X 10^^. This value, obtained by direct experiment, thus agrees very closely with the value 2-1 x IQi* obtained by Maxwell for the number of particles in a cubic centi- metre of air by the application of the kinetic theory of

dischaege]

gases. Townsend has applied his method to the calculation of the charges on the ions produced by the incidence of ultra-violet light on metals, by radio-active substances, and by the discharge of electricity from points, as well as those produced by Rontgen rays, and has found that in all these cases the charges are the same. Thus the charge on the ion seems to be independent of the agent by which it is produced as well as of the gas from which it originates.

×× 6. Calculation of the Mass of the Ions at Low Pressures. ××× Although at ordinary pressures the ion seems to have a very complex structure and to be the aggregate of many molecules, yet we have evidence that at very low pressures the structure of the ion, and especially of the negative one, becomes very much simpler. This evidence is afforded by determination of the mass of the atom. We can measure the ratio of the mass of an ion to the charge on the ion by observing the deflexion produced

by a given magnetic force on a moving ion. If an ion carrying a charge e is moving with a velocity v, at a point where the magnetic force is H, a mechanical force acts on the ion, whose direction is at right angles both to the direction of motion of the ion and to the magnetic force, and whose magnitude isei'Hsin^, where 0 is the angle between v and H. Suppose then that we have an ion moving through a gas whose pressure is so low that the free path of the ion is long compared with the distance through which it moves whilst we are experiment- ing upon it ; in this case the motion of the ion will be free, and wiU not be affected by the presence of the gas.

Let the mass of the ion be m, its charge e, and let it move in a field where the electric and magnetic forces are both uniform, the electric force X being parallel to the axis of sc, and the magnetic force Z parallel to the axis of z, then if x, y, are the co-ordinates of the ion at the time t, the equations of motion of the ion are ???

The solution of these equations, if x, y, dxjdt, dy/dt all vanish ???when <=0, is

y=M>H??}

These equations show that the path of the ion is a cycloid, the generating circle of which has a diameter equal to 2XOT/eH^, and rolls on the line x=0.

Suppose now that we have a number of ions starting from the plane x=0, and moving towards the plane x=a. The particles starting from a:=0 describe cycloids, and the greatest distance they can get from the plane is equal to the diameter of the generating _ circle of the cycloid, i.e., to iXmjeH.· (After reaching this dis- tance they begin to approach the plane.) Hence if a is less than the diameter of the generating circle, all the particles starting from a;= 0 will reach the plane a; = a, if this is unlimited in extent ; while if a is greater than the diameter of the generating circle none of the particles which start from x=Q will reach the plane x=a. Thus, if a; =0 is a plane illuminated by ultra-violet light, and con- sequently the seat of a supply of negative ions, and x=aa, plane connected with an electrometer, then if a definite electric intensity is established between the planes, i.e., if X be fixed, so that the rate of emission of negative ions from the illuminated plate is given, and if a is less than 2Xm/eH, all the ions which start from x=0 will reach x=a. That is, the rate

at which this plane receives an electric charge will be the same whether there is a magnetic field between the plate or not, but if a is greater than 2Xm/eH^, then no particle which starts from the plate x = 0 will reach the plate x=a, and this plate will receive no charge. Thus the supply of electricity to the plate has been entirely stopped by the magnetic field. Thus, on this theory, if the distance between the plates is less than a certain value, the magnetic force should produce no effect on the rate at which the electrometer plate receives a charge, while if the distance is greater than this value the magnetic force would completely stop the supply of electricity to the plate. The actual phenomena are not so abrupt as this theory indicates. We find that when the plates are very near together the magnetic force produces a very slight efTect, and this an increase in the rate of charging of the plate. On increasing the distance we come to a

stage where the magnetic force produces a great diminution in the rate of charging. It does not, however, stop it abruptly, there being a considerable range of distance, in which the magnetic force diminishes but does not destroy the current. At still greater dis- tances the current to the plate under the magnetic force is quite inappreciable compared with that when there is no magnetic force. We should get this gradual instead of abrupt decay of the current if the particles, instead of all starting from the actual surface of the plate x=0, started from a layer of finite thickness t ; in that case the first particles stopped would be those which started from the surface of the plate. This would be when a=2Xm/eB^, but particles would continue to reach the plate until a=t + 2XmlcBK Thus if we measure the value of a when the magnetic force first begins to afl'ect the leak to the electrometer we determine 2Xm/e'B^, and as we can easily ueasure X and H, we can deduce the value of m/e.

By this method the writer determined the value of m/e for the negative ions produced when ultra-violet light falls on a metal plate, as well as for the negative ions produced by an incandescent carbon filament in an atmosphere of hydrogen {Phil. Mag. xlviii. p. 547). For the ions pro- duced by ultra-violet light the value e/m was found to be 7 "3 X 10', and for those produced by the incandescent carbon filament, 8"7 x 10 (e is measured in electro-magnetic units). The difference between these values is not greater than the error of experiment. When we consider the properties of the cathode rays

we shall see that for the negatively electrified particles which constitute those rays the value of e/m is the same as that just found, and is independent of the nature of the gas from which the rays originate ; in fact, in all cases in which the value of ejm has been determined for gases at low pressures, the result has been to show that it is a constant quantity independent both of the nature of the gas from which the ions are produced and of that of the agent used to produce them. Townsend's experiments {loc. cit.) show that the value of e, the charge on the ion, is equal to the charge carried by an atom of hydrogen in the electrolysis of solutions. But if M is the mass of an atom of hydrogen, e/M is equal to 10*, and M is equal to about lOOOwi. Thus the mass of the negative ion is exceedingly small compared with that of the mass of the atom of hydrogen, the smallest mass recognized in chemistry. The production of negative ions thus involves the splitting up of the atom, as from a collection of ions something is detached whose mass is less than that of a single atom. It is important to notice in connexion with this subject that an entirely different line of argument, based on what is known as the Zeeman effect (see Magneto-Optics), leads to the recognition of negar tively electrified particles, for which e/m. is of the same order as that just deduced from the consideration of purely electrical phenomena.

When we determine e/m for the positive ions we find an entirely different set of laws from those which hold for the negative ions. The value of e/m for the positive ions is not constant, nor has it the exceedingly large value which is characteristic of the negative ions. The writer has de- termined the value of e/m for the positive ions produced near an incandescent platinum wire in an atmosphere of oxygen or carbonic acid gas at a very low pressure, using the method already described for the determination of the corresponding quantity for the negative ions, i.e., by measuring the distance between two parallel plates when a magnetic field begins to affect the current passing between them. To get any result with positive ions, it is necessary to use exceedingly strong magnetic fields, for while a magnetic force of about 150 was found a convenient one for the experiment with the negative ions, it had no appreciable effect on the positive ions, and for these it was necessary to use a magnetic force of about 8000. _ Using this magnetic force, the value of e/m for the positive ions in oxygen was found

to be about WjiO, while for carbonic acid gas it was slightly less. If the charge on the positive

ion had been carried by a molecule of oxygen, the value of e/m would have been 10*/32, so that the carrier of the positive charge is probably a molecule of oxygen. Ex- periments, which we shall have to consider later in con- nexion vrith another part of the subject, made by W. Wien’” and Ewers ^^ on the value of e/►►i for the positively charged particles in what are called the Kanal-strahlen, are entirely consistent with the view that the mass of the carrier of the positive charge in this case is that of a mole- cule of some substance present in the vessel in which the ions are produced and varying as these substances are changed. Thus the carriers of negative electricity at a low pressure have a constant mass very small compared with that of the atom of any known substance, while the carriers of positive electricity have a variable mass which is comparable with that of the molecule of the chemical elements.

►► 7. Distribution of Potential between two Parallel Plates in a Conducting Gas. ►►► Zeleny^^ and Child *^ have shown that when a current of electricity is passing between two parallel plates immersed in a gas exposed to Eontgen rays, the electric “a intensity in the space between the s plates is not constant, but is greater S in the immediate neighbourhood of the plates than it is in the rfi.st of the gas, where it has a nearly constant value. The general character of the distribution of electric potential be- tween the plates is shown in Fig. 12, where the ordinates represent the potential. We can readily see why the electric intencity should be greater near the plates than in the rest of the gas, for from the layer of gas next the positive plate the positive ions will be driven out, so that there will be an excess of negative ions in this layer. Similarly, in the layer of gas next the negative plate there will be an excess of positive ions, and this free electrification will increase the slope of potential in the neighbourhood of

the plates. The distribution of electric intensity between the plates can be deduced by the following considerations : ???

Let the two plates be at riglit angle.s to the axis of x ; then we may suppose that between the plates the electric intensity X is everywhere parallel to the axis of x. The velocities of both the positive and negative ions are assumed to be proportional to X. Let KjX, RjX represent these velocities respectively ; let Jij, n^ be respec- tively the number of positive and negative ions per unit volume at a point fixed by the co-ordinate x; let q be the number of positive or negative ions produced in unit time per unit volume at this point ; and let the number of ions which recombine in unit volume in unit time be ajijJij ; then if e is the charge on the ion, the volume density of the electrification is (rej – n^)^, hence

^

Id

\

???|

\

s.

•

0

s

s.

sn

iranc

J s

\,

\

IfW

\

Fig. 12.

(1).

If I is the current through unit area of the gas and if we neglect any diffusion except that caused by the electric field,

nie’RiX + n^eK^X = l .... (2). From equations (1) and (2) we have

(3),

“i’~Ri-mj VX’^47r dx)

W,

and from these equations we can, if we know the distribution of electric intensity between the plates, calculate the number of positive and negative ions.

In a steady state the number of positive and negative ions in unit volume at a given place remains constant, hence

. . (5)

dx

- (Ro.2X) = g-aj!im3 . dx

(7),

If Ri and E^ are constant, we have from (1), (5), and (6)

5==8►►(,-a►►,►►,)(l+i). .

an equation which is very useful, because it enables us, if we know the distribution of X^ to find whether at any point in the gas the ionization is greater or less than the recombination of the ions. We see that g – an^n^, which is the excess of ionization over recombination, is proportional to d'X'/dsi. Thus when the ionization exceeds the recombination, i.e., when q-anin^ is positive, the curve for X^ is convex to the axis of 05, while when the recombination exceeds the ionization the curve for X- will be concave to the axis of a. Thus, for example. Fig. 13 represents the

Fig. 13.

curve for X^ observed by Graham (TVied. Ann. Ixiv. p. 49) in a tube through which a steady current is passing. Interpreting it by equation (7), we infer that ionization was much in excess of recombination at A and B, slightly so along C, while along D the recombination exceeded the ionization. Substituting in equation (7) the values of % Jtj given in (3), we get

d-X2_ r g (r R2<^X-Yj RirfX'\-|

-^-►►►►j^J 2X.(Jj^ + K^)2l^ '^i.T dx)\ 8,r dx J J

(ri + R,)

(8).

This equation can be solved (see Thomson, Phil. Mag. xlvii. p. 253), when q is constant and Ri = R2. From the solution it appears that if Xj be the value of x close to one of the plates, and Xq the value midway between them,

Xi

= S2-2//5

where /3=

SireJci

Since e = 6‘5xlO-“, a=2xl0~^ and Rj for air at atmospheric pressure = 450, j3 is about 3 “8 for air at atmospheric pressure and it becomes much greater at lower pressures.

Thus Xi/Xo is always greater than unity, and the value of the ratio increases from unity to infinity as /3 increases from zero to infinity. As fi does not involve either q or I, the ratio of Xj to X,, is independent of the strength of the current and of the intensity of the ionization.

No general solution of equation (8) has been found when Rj is not equal to R^, but we can get an approximation to the solution when q is constant. The equations (1), (2), (3), (4) are satisfied by the values ###

(6).

RjJljXc R#####!.,X<^.

X =

= (?/##)##. Ri R1+R2′

^-2 T R1-I-R2 ‘ * I

I.

q/ ##(R, + R^)’

These solutions cannot, however, hold right up to the surface of the plates, for across each unit of area, at a point P, KiI/(Ri + R2)## positive ions pass in unit time, and these must all come from the region between P and the positive plate. If X is the distance of P from this plate, this region cannot furnish more than X positive ions, and only this iinmber if there are no recombinations. Henco tlie solution cannot hold wbenjX is less than Rjl/(Ri-(-R)c, or where X is less than H,I/(Ri-l-R###V7’;.

Similarly the solution cannot hold nearer to the negative plato than the distance R2I/ (Rj + ‘R^)qe.

We can arrive at the same value of X in another way. The force cannot by equation (7) be constant unless as many ions recombine as are produced by the ionizing agent. Now the ions travel a

discharge]

certain distance before theyrecombine, this distance being the product of the velocity of the ion and the duration of its life. Now the life of the positive ion is l/a►►2, and its velocity is RiX ; hence the distance an ion will travel before it recombines is equal to average RiX/a►►2-

If we suppose X and Wj to have the values they have in the region where X is constant, we find, substituting the values for

Rx I

X and Jij, that this distance is equal to

the value we

found before for the thickness of the layer within which X was vari- able ; hence in this region we may assume that there is no recom- bination going on. We shall suppose that the electric intensity is uniform, except in a layer of thickness RiI/(Rj ┤R2)g’►► next the positive electrode, and In one of thickness R^IKR^ + R^)!^ next the ne►►;ative electrode, and that within these layers there is no recombination of the ions. On these suppositions, it can readily be proved that if Xj, Xj, X are respectively the values of the electric intensity next the positive electrode, next the negative electrode, and between the layers.

Xi = X{l-Hft)►►,

X2=X(1 + /3,)J. here ft=l^ |l(R, + E,), ft = i^ |{R, + R,).

Thus Xi and Xj are always greater than X, and if the velocity of the negative ion is greater than that of the positive, p^ ^ greater than ^j ; hence the electric intensity at the negative electrode is greater than that of the positive, and the thickness of the layer of inconstant X is greater at the _ negative than at the positive electrode. The curve representing the distribution of electric intensity between the plates when R2/R1 is large is shown in Mg. 14. When /Sj and /Sj are large, as they are for hydrogen up to the atmospheric pressure ‘and for air at somewhat lower pressures, the potential difference on crossing the layers next the positive and negative electrodes may easily be shown to be respectively

Fig. 14.

Thus if Rj is greater than Ri the fall of potential at the negative electrode is greater than that at the positive ; both are proportional to the square of thecurrent. If V is the potential difference between the plates, and I the distance between them, it follows from these expressions that

-Raje

Ri-hlijje ge J

This relation between the current and potential difiFerence between the plates is of the form

V = AI-fBP.

If I is small, so that we may neglect P,

II

‘??(Ri + R,)-

This solution has been applied by Rutherford {Phil. Mag. xliv. p. 422) to find (Rj ǂ E2). Since (y/a)* is the number of positive and negative ions per unit volume, if we stop the ionizing agent at the instant it is cut oflf,

l{q/a,)ie is the quantity of positive electricity between the plates. By applying a very large potential difference between the plates we can drive this positive electricity to one of the plates before it has time to recombine with the negative ions. Hence Q, the positive charge received by the plate, is equal to l{q/a)ie, and

y=lP/Q{Ki + -R,) ;

and as we can measure V, I, and Q, we can determine (Rj-f-Ra). The measurements of the velocities of the ions by this method agree well with those made by the direct methods already described.

The solution given above only holds as long as the layers of variable force next the positive and negative plates do not meet. As the current increases the layers expand, until, when the saturating current is reached, they touch. After this there is no space between the plates where the electric intensity is uniform. The electric intensity at a place at a distance x from the positive plate is given by the equation

‘=M1{tiyih‹

where Xj is the electric intensity at the positive plate. We see again that, if the velocity of the negative ion is greater than that of the positive, the electric intensity ia greater at the negative electrode than it is at the positive.

►► 8. Path of a Moving Ion in a Magnetic Field. ►►► For the ezplanation of some of the effects of a magnet on the electric discharge we require to know the path of an ion in a magnetic field. We have already investigated one case of this problem (see ►► 6) ; there are, however, two other important cases which it is necessary to consider.

The first case is that of a charged ion moving in a uniform field of magnetic force, and free from the action of any electric force, the pressure of the gas being so low that it does not retard the motion of the particle. Then if v is the velocity of the particle, m its mass, and e its charge, H the magnetic force and d the angle between v and H, the mechanical force acting on the particle is at right angles both to v and H, and equal to raHsine. Since the force on the particle is at right angles to its direction of motion, the velocity

of the par- ticle will be constant, and since the force is at right angles to the magnetic force, the components of the velocity parallel to the magnetic force will be constant, i.e., ###wcog d is constant, so that as V is constant, 6 is also constant. If p is the radius of curvature of the path of the particle mii'/ p=Biev sin ff, so that as v and 6 are con- stant p is constant. Thus the path of the particle is a curve whose tangent makes a constant angle ff with the direction of the mag- netic force, and whose radius of curvature is mv/Re sin 8. The path of the particle is therefore a helix wound on a circular cylinder whose axis is parallel to the magnetic force, and whose radius is p sin 9 or mv sin ff/He.

The other case we shall consider is when the pressure of the gas through which the particle moves is considerable, so that the vis- cosity of the gas makes the velocity of the particle proportional to the force acting upon it. In this case there must be an electric field acting on the particles, otherwise the viscosity of the gas will reduce them to rest. Let X, Y, Z be the x, y, z components of the electric intensity, o, /3, ~~y those of the magnetic force, and u, V, w the components of the velocity of the particle. The com~~ ponents of the force on the particle are

Xe + e{pw-yv), Ye + e{yu- aw), Ze + e{av-pu).

If the velocitv of the particle is R/## times the force acting on it, we have

ji= R(X -H /Sio – -yu),

##=R(Y + 7M ### aw),

w='R{Z + av-pu).

Solving these equations, we have

_ RX + -R^yY – ;8Z) + R3a(aX -^ ;8Y -^ 7Z) '*"" l + RV+lS-H-V

_ RY + R^(aZ -yX) + R^/3(aX + pY + 7Z)

'"- Ih-ev+zS'+t")

_ RZ -H R^(;3X ~~aY) + R^yjaX + pY + 7Z) ”” l + K\d~~ + l3-‘+y’)

We see at once from these equations that when R times the magnetic force is small compared with unity, u, v, w are propor- tional to X, Y, Z ; that is, the particle follows a line of electric force. But on the other hand, when R times the magnetic force is large, u, v, w are proportional to a, |3, 7 ; that is, the path of the particle is a line of magnetic force. In the general case, if H is the magnetic, F the electric force, and 6 the angle between them, the velocity has a component along the electric force pro- portional to EF, another component along the magnetic force proportional to R^H^FcosS, and a third component at right angles to both the electric and magnetic forces, and proportional to R^HF sin 6. In this case the path is along the lines of neither electric nor magnetic force, but is a spiral. The quicker the par- ticle moves under a given force the more likely it is to follow the lines of magnetic force. Thus the negative particles are more likely to do this than the positive. If the particle moves with a velocity of n cm./sec. under a potential gradient of 1 volt per centi- metre through the gas when at a iiressnre of one atmosphere, then at the pressure of 1/m atmosphere R is equal to mjnlO-*. Thus from what we know of the velocities of the ions it is only at very low pressures that RH can be large for practicable values of H.

►► 9. Difference of Potential between Metals immiersedin a Conducting Gas. ►►► If plates of different metals immersed in a conducting gas are connected with the quadrants of an electrometer, they will show the same potential difference

as if they had been immersed in an electrolyte. This has been proved when the conductivity is due to gases from flames by Maclean and Goto,^ when due to ultra- violet light by Stoletow,^ Eighi/^ Hallwachs,^ Arrhe- nius,^

when due to Eontgen rays by Erskine Murray/^ and when due to rays from uranium by Lord Kelvin.^”

We shall now leave the consideration of conducting gases in general and proceed to discuss the phenomena accompanying the discharge of electricity through them in special cases.

►► 10. Conduction through Gases when in a Normal State. ►►► Even in its normal state a gas possesses a small amount of conductivity, which, however, is so small that it is only quite recently that the existence of a leak from a charged body through the air and independent of dust in the air has been unmistakably proved. The experiments of Matteucci, Warburg, Boys, Linss, Elster and Geitel, and C. T. E. Wilson^ have proved that there is a very slight leak from a charged body through the surrounding gas, that this leak takes place in the dark as well as in daylight, in caves as well as above ground, and that the rate of leak is approximately proportional to the pressure of the gas. Matteucci could detect no difference between the rate of leak through hydrogen and that through air or carbonic acid. Warburg, however, found, on the other hand, that the rate of leak through hydrogen was only about one-half of that through the other two gases.

►► 11. Conduction of Electricity through Hot Gases, &c. ►►► Gases become conductors when raised to a temperature at which metals become luminous. Thus BecquereP’* found that air at a white heat would allow electricity to pass through it, even though the potential difference was only a few volts. This result was confirmed by Blondlot,^ who observed that air at a bright red heat allowed a current to pass through it under a potential difference of xww^ o^ a volt. The writer” observed that gases which are dis- sociated by heat, such as iodine, chlorine, bromine, and their compounds, conduct much better at the same tem- perature than gases such as air, hydrogen, nitrogen, which are not dissociated. The vapours of many met- als are good conductors, mercury, however, being an exception. It is probable that a large part of the con- ductivity is produced at the surface of contact of the gas with the glowing electrodes or other solids which may be immersed in it, as H. A. Wilson^ has shown that when salts are put into a flame there is great ioniza- tion where the salt-bearing flame comes into contact with glowing metals, and comparatively little anywhere else. We

shall see later on that there is always a produc- tion of ions at the surface of a glowing metal. The view that the greater part of the ions are produced next the surface of the glowing electrodes explains a curious phenomenon observed by the writer, who found that when a current of electricity was passing between two glowing electrodes in a hot gas the interposition of a cold piece of thin metal stopped the current as completely as the interposition of a non-conductor, but that as soon as the metal began to glow the current was re-established. If the ions came from the glowing elec- trodes, then the negative ion, which travels to the posi- tive electrode, started from the negative electrode ; thus an interposed piece of metal, so long as no ions are produced at its surface, will stop the negative ions from reaching the positive electrode and the positive ions from reaching the negative electrode. The current will, however, begin again as soon as the plate begins to glow, for then ions are produced at the plate, furnishing a sup- ply of positive ions for the negative electrode and of neg- ative ions for the positive. The same view will explain

the fact discovered by Blondlot Q,oc. cit.), and also by Pringsheim,^ that for the conduction of electricity through hot gases under small potential differences the current in- creases faster than the potential difference. If the ions are produced at the surface of the electrodes, the number torn from the electrode and sent into the gas will depend upon the potential difference. But the velocity with which these ions move is proportional to the potential difference, and as the current is proportipnal to the product of the number of ions into the velocity of an ion, it will increase more rapidly than the potential difference. Pringsheim has succeeded in observing a polarization analogous to elec- trolytic polarization in the conduction through hot gases. The gases coming from flames are conductors of elec- tricity, and retain this property for some time after leaving the flame. In one case observed by Giese^^ the conduc- tivity lasted for fifteen minutes after the gases had left the flame. The conductivity of flame gases is more per- sistent than that of gases which have been exposed to Eontgen rays, and can survive bubbling through a con- siderable column of conducting liquid,* such as water or mercury, without total destruction. The gas, however, loses its conductivity when forced through a porous pot of unglazed earthenware. This difference between flame gases and other conducting gases is connected with the very slow speed with which the ions in the former move in the electric field (see

►► 4). This implies a correspond- ingly slow rate of diffusion, so that in going, for example,

through a long metal tube a very much smaller proportion of the ions will diifuse to the walls of the tube than would be the case with the more rapidly moving ions from a gas exposed to Eontgen rays. We owe a large portion of our knowledge of the laws of conduction through flames to Giese, whose researches on flames led him to the view, which he was the first to suggest, that electricity is carried through them by oppositely charged particles. Thus Giese showed that the conductivity can be removed from the gas by making the gas traverse an electric field, and that the current in the great majority of cases does not increase so rapidly as the potential difference. Certain exceptions which he found to this rule can be explained in the same way as the analogous cases in the conduction through hot gases. A more extensive investigation of the relation between current and potential difference for flame gases has been made by M'Clelland," who finds that the rela- tion between current and potential difference is represented by a curve like Eig. 8. The current through the flame exhibits polar properties, for if the electrodes are of different sizes the current is much greater when the larger electrode is negative than when it is positive. We can easily see that this result is a direct consequence of the greater part of the ionization taking place next the glow- ing electrode, and of the velocity of the negative ion greatly exceeding that of the positive, for in consequence of this difference in velocity the current will be chiefly carried by the negative ions, and if the ionization takes place at the surface of the glowing electrodes, there will be a much larger quantity of negative ions available for carrying the current when the larger electrode is negative than when it is positive. The same considerations will explain why if the electrodes are of equal size, but placed in parts of the flame where the temperatures are different, the current will be greater when the hotter electrode is negative than when it is positive. If the electrodes are connected with a galvanometer without any battery there is a small current from the colder to the hotter electrode through the flame, for the negative ions diffuse faster than the positive, so that there will be an excess of positive ions at the elec- trodes. This excess will be greater at the hotter electrode than at the colder, because there are more ions formed at the hotter electrode, which will therefore be continually

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receiving a charge of positive electricity. Arrhenius* has shown that when solutions of salts of the alkali metals are thrown into a flame by a spray-producer, the conductivity of the flame is greatly increased, and that the conductivity of salt vapours in flames is closely analogous to the con- ductivity of an aqueous solution of the salt, being propor- tional to the square root of the concentration of the salt vapour in the flame. He concluded that the salt vapour is partly ionized at the high temperature of the flame. H. A. Wilson {loc. cit.) has shown, however, that the greater part of the ionization takes place, not in the general body of the flame, but at the surface of the glow- ing electrodes. He gives several independent proofs of this; perhaps the simplest is one where the salt was introduced as a bead between two glowing electrodes immersed in the flame. If the bead was placed between the electrodes, so that the salt vapour did not come into contact with the glowing metal, the current was not increased at all ; if it came into contact with the negative electrode the current was very greatly increased ; while if it only came into contact with the positive electrode the current was but slightly increased. The difference between the effects at the positive and negative electrodes is due to the velocity of the negative ion being much greater than that of the positive. Hittorf^’ long ago showed that the current is greater when the bead of salt is placed near the negative electrode than when it is placed near the positive. The distribution of potential between two electrodes immersed in a flame sprayed with salt solution is not by any means uniform, as is obvious from the curves in Fig. 15, which are taken from the

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Fig. 15.

paper by H. A. Wilson (loc. cit.). The electrodes were horizontal strips of metallic gauze. The first curve repre- sents the distribution of potential when both the elec- trodes are red-hot; near each electrode there is a rapid fall of potential, which is greatest at the negative one, while between the electrodes- there is an approximately uniform small potential gradient. The general distribu- tion of potential is analogous to that observed in electric discharge through gases at low pressures. In the second curve the electrodes are so far apart that the upper one is appreciably colder than the lower, and in the third the tendency of the fall of potential to be greatest at the nega- tive electrode is very well marked. The current sent by a given potential difference through a flame depends upon the material of which the electrodes are made. Thus Petinelli ►►^ found that, ceteris paribus, the current between two carbon electrodes was about 500 times that between two iron electrodes. If one electrode was carbon and the other iron, the current when the carbon was negative and the iron positive was more than a hundred times greater than when the electrodes were reversed. A charged body placed near a flame will lose its charge even although it is placed below or to one side of the flame, so as to be out of the way of the flame gas. The electric field due to the charged body drags out of the flame the ions of opposite sign to the charge on the body. These ions move up to the body and gradually discharge it.

►► 12. Ionization produced by Glowing Metals. ►►► It will thus be seen that in conduction through flames ionization in the neighbourhood of glowing metals plays a large

part. The electrical properties of glowing metals have been studied with great care by Elster and Geitel,^ to whom we owe most of our knowledge of this subject. They found that when a platinum wire is heated to lumin- osity in air, the air in the neighbourhood of the wire is charged with positive

electricity, while the wire itself receives a negative charge. The close coincidence be- tween the appearance of luminosity in the wire and positive electrification in the air is very remarkable. So far as we know, we do not get one without the other. At first the amount of positive electrification in the air is small, but this very rapidly increases as the temperature increases. Though at a dull red heat only positive elec- trification appears in the air round the wire, yet as the temperature increases some negative electricity begins to come off, until at a white heat there are as many negative as positive ions in the gas round the wire. When the pressure of the gas is very low there are always more negative than positive ions round the wire when it is white hot. This is in accordance with the experiments of Guthrie," who was the first to make observations on the electrical effects near glowing bodies. He found that if a heated iron sphere was connected with the earth and held near a charged body, then when it was white hot the body soon lost its charge, whether this was positive or negative ; but when it became colder the body was discharged when negatively, but not when positively, electrified. Elster and Geitel tried the effect of heating the wire in various gases, such as air, hydrogen, oxygen, carbonic acid, water vapour, and vapours of sulphur, phosphorus, and mercury. In the last they got no sign of electrification ; in hydrogen at a red heat the electrification in the gas was negative ; and in all the other gases and vapours the electrification at a red heat was positive. When carbon filaments were heated the electrification in the gas was always negative ; these filaments, however, give off so much gas that the conditions of the experiment are somewhat indefinite. Branly ^ observed that the effects at a dull red heat depended on the nature of the glowing body ; thus, when this was a lamp shade covered with oxides of lead or bismuth a positively electrified body in the neighbourhood was discharged, whilst a negatively electrified one was not. This is a reversal of the effect observed with surfaces of clean metal. Stanton ►►^ found that a hot surface of clean copper dis- charges a positively electrified conductor in its neighbour- hood, but ceases to do so as soon as the copper gets coated with a layer of oxide. When, however, the hot oxidized copper and a positively electrified body are placed in an atmosphere of hydrogen, the electrified body loses its charge as long as the oxide is being reduced, but ceases to do so as soon as the reduction is complete. M'Clelland has found that by sending a strong blast against a red-hot wire both positive and negative ions are blown off, though there are more positive than negative

ones. It would thus appear that by the incandescence of the metal the gas was ionized, and both positive and negative ions produced, but that then at a red heat more of one kind of ion than of the opposite went to the wire. In this case chemical forces probably exert a very large effect. For example, if we have oxidation going on we should expect the electro- positive metal to combine with a negative ion and have an excess of positive ions in the surrounding gas, while if reduction is going on we should expect the oxide to com- bine with a positive ion, and so leave an excess of negative ions in the gas. This accords with the observations. The different rates at which the positive and negative ions diffuse would also have an influence on the sign of the charge in the gas, as in consequence of the more rapid diffusion of the negative ions more negative than positive ions would come in contact with the metal, and this would tend to make the

charge in the gas positive. M'Clelland " has found that the velocity of the ions coming from the neighbourhood of the wire depends upon the temperature of the wire ; the higher this temperature the smaller the velocity. When a wire is heated occluded gas is driven out, and this has an effect upon the electrical phen9mena. The writer observed that the behaviour of a wire in a high vacuum did not become regular until it had been raised to a white heat repeatedly at intervals for more than a week, the irregularities being probably due to occluded gases, which are only got out with great difficulty. Elster and Geitel ⁸⁸' showed that in gases at very low pressures the discharge of a positively electrified conductor near an incandescent wire in hydrogen, where the gas in the neighbourhood of the wire is negatively electrified, is retarded by a magnetic field when the lines of magnetic force are transverse to those of electric force. When the incandescent wire is in oxygen, where the electrification in the gas is positive, they found a very much smaller effect, and in the opposite direction. The writer has found, however, that in very intense magnetic fields the discharge of a negatively electrified body is retarded according to the same laws as that of a positively elec- trified body in hydrogen in much

weaker fields. The theory of this effect, given in ►► 6, shows that the greater sensitiveness of the discharge in hydrogen to the mag- netic force is due to the smallness of the mass of the negative ion at low pressures, as compared with that of the positive ion.

►► 13. Conducting Gas produced by Arcs. ►►► The effect of an arc on the gas in its neighbourhood is very similar to that of an incandescent wire. Thus in the neighbour- hood of the arc, in air or oxygen, there is positive electri- fication, while near the arc, between platinum terminals in hydrogen, there is, at atmospheric pressure, a slight negative electrification.'^ The gases sucked from the neighbourhood of the arc retain their conductivity for some time, and, like those from flames, can be bubbled through conducting liquids, or passed through several layers of wire gauze, without losing it. The conduction through these gases, which has been studied by M'Clel- land,* and Merritt and Stewart,^^ exhibits the ordinary characteristics of discharge through ionized gas. M'Clel- land has measured the velocity of the ions in an electric field, and finds it to be of the same order as for ions from flames. The velocity of the negative ion is greater than that of the positive, and the brighter the arc the slower the velocity. The electrification in the neighbourhood of the arc depends upon the nature of the terminals. Thus if an arc be sent through hydrogen, between well- oxidized copper terminals, the oxide gets reduced, and while reduction is going on there is negative electri- fication in the hydrogen near the arc; when, however, the oxide has been reduced and the terminals are bright, there is positive electrification near the arc. This shows the influence exerted by chemical effects on the sign of the electrification. The considerations advanced to ex- plain the analogous effects with incandescent metals will apply to this case.

Conducting gas seems to be produced not only by the arc discharge, but also to a greater or less degree by every form of electric discharge. Thus Hittorf ^^ showed that a few galvanic cells can send a current through a gas which is conveying a discharge at right angles to the current. Schuster "" made an experiment which showed this effect in a very clear way. A large discharge-tube containing air at a low pressure was divided into two compartments by a metal plate with openings round the perimeter, these openings allowing the gas in one compartment to flow into the other, while

the metal screened off one compart- ment from any electrical action occurring in the other.

When a vigorous discharge passed through one compart- ment a potential difference of about one-quarter of a volt was sufficient to send a current through the gas in the other compartment. Again, if a blast of air be blown across the terminals of an electrical machine in action upon the disc of an electroscope, charged with either positive or negative electricity, the electroscope is rapidly discharged.'^ A charged body placed near a place where sparks are passing, whether from an induction coil or an electrical machine, will soon lose its charge.

. Conductivity produced by Ultra- Violet Light. The discovery by Hertz,^^ in 1887, that the incidence of ultra- violet light on a spark gap facilitates the passage of a spark, led to a series of investigations by Hallwachs,^ Hoor,"' Eighi,'^ and Stoletow "^ on the effect of ultra-violet light on electrified bodies. These researches have shown that a freshly cleaned metal surface, charged with nega- tive electricity, rapidly loses its charge, however small, when exposed to ultra-violet light, and that if the surface is insulated and without charge initially, it acquires a positive charge under the influence of the light. The mag- nitude of this positive charge may be very much increased by directing a blast of air on the plate. This, as Zeleny has shown, has the effect of blowing from the neighbour- hood of the plate negatively electrified gas, which has simi- lar properties to the charged gas obtained by the separation of ions from a gas exposed to Eontgen rays or uranium radiation. If the metal plate is positively electrified, there is no loss of electrification caused by ultra-violet light. This has been questioned, but a very careful examination of the question by Elster and Geitel" has shown that the apparent exceptions are due to the accidental ex- posure to reflected ultra-violet light of metal surfaces in the neighbourhood of the plate negatively electrified by induction, so that the apparent loss of charge is due to negative electricity coming up to the plate, and not to positive electricity going away from it. The ultra-violet light may be obtained from an arc-lamp, the effectiveness of which is increased if one of the terminals is made of zinc or aluminium, the light from these substances being very rich in ultra-violet rays; it may also be got very conveniently by sparking with an induction coil between

zinc or cadmium terminals. Sunlight is not rich in ultra-violet light, and does not produce anything like so great an effect as the arc light. Elster and Geitel,'^ who have investigated with great success the effects of light on electrified bodies, have shown that the more electro- positive metals lose negative charges when exposed to ordinary light, and do not need the presence of the ultra- violet rays. Thus they found that amalgams of sodium or potassium enclosed in a glass vessel lose a negative charge when exposed to daylight, though the glass stops the small amount of ultra-violet light left in sunlight after its passage through the atmosphere. If sodium or potas- sium be employed, or, what is more convenient, the mer- cury-like liquid obtained by mixing sodium and potassium in the proportion of their combining weights, they found that negative electricity was discharged by an ordinary petroleum lamp. If the still more electro-positive metal rubidium is used, the discharge can be produced by the light from a glass rod just heated to redness; but there is no discharge till the glass is luminous. Elster and Geitel arrange the metals in the following order for the facility with which negative electrification is discharged by light: ××× rubidium, potassium, alloy of sodium and potassium, sodium, lithium, magnesium, thallium, zinc. With copper, platinum, lead, iron, cadmium, carbon, and mercury the effects with ordinary light are too small to be appreciable. The order is the same as that in Volta's electro-chemical series. With ultra-violet light the differ- ent metals show much smaller differences in their power

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of discharging negative electricity than they do with ordinary light. Elster and Geitel found that the ratio of the photo-electric effects of two metals exposed to approxi- mately monochromatic light depended upon the wave-length of the light, different metals showing a maximum sensitiveness in different parts of the spectrum. This is shown by the following table for the alkaline metals. The numbers in the table are the rates of emission of negative electricity under similar circumstances. The rate of emission under the light from a petroleum lamp was taken as unity : ×××

Blue. Yellow. Orange. Ked.

Rb . . . -16 -64 -33 -039

Na . . . -37 -36 -14 -009

K ... -57 -07 -04 -002

The table shows that the absorption of light by the metal has great influence on the photo-electric eifect, for while K is more sensitive in blue light than Na, the strong absorption of yellow light by N”a makes it more than five times more sensitive to this light than K. Stoletow, at an early period, called attention to the connex- ion between strong absorption and photo-electric effects. He showed that water, which does not absorb to any great extent either the ultra-violet or visible rays, does not show any photo-electric effect, while strongly col- oured solutions, and especially solutions of fluorescent substances such as methyl green or violet, do so to a very considerable extent; indeed, a solution of methyl green is more sensitive than zinc. Hallwaohs××× has proved that in liquids showing photo-electric effects there is always strong absorption; we may, however, have absorp- tion without these effects. Phosphorescent substances, such as sulphide of calcium, show this effect, as also do various specimens of fluor-spar. As phosphorescence and fluorescence are probably accompanied by a very intense absorption by the surface layers, the evidence is strong that to get the photo-electric effects we must have strong absorption of some kind of light, either visible or ultra-violet.

The connexion between the potential gradient and the rate of escape of negative electricity from the plate has

been investigated by

Stoletow,^* Eighi,” and Elster and Geitel. ^×× The method adopted by Stoletow was as follows: ××× Light from an arc-lamp A, Fig. 16, passed through a hole in a metal screen; it then fell on the metal plates C, con- nected up with a

Fig. 16.

battery and galvanometer. The plate nearest the light was perforated, and the light passed through the perfora- tions on to the sensitive plate connected with the nega- tive pole of the battery. The current passing round the circuit was measured by a galvanometer. The results of Stoletow's investigations are shown in the curves of Fig. 17, where the ordinates represent the current, the abscissae the potential difference between the plates, and the numbers on the curves the distance between the plates in millimetres. X is a small unknown distance. The conduction does not obey Ohm's law, the current not increasing so fast as the potential difference. There seem, however, indications of a stage when the current increases more rapidly than the potential difference, probably due to a greater number of ions being pulled away by the greater potential gradient. For large poten-

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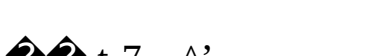

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tial differences the curves seem to approximate to straight lines inclined to the axis along which potential differ- ences are measured. In the corresponding curves for conduction through a gas exposed to Eontgen rays or uranium radiation the curves ultimately become straight lines parallel to this axis. Stoletow has shown, how- ever, that at low pressures the curves for ultra-violet light become parallel to the axis, so that the current gets “saturated,” just as it does in other cases of dis- charge through conducting gases. At atmospheric pres- sures Stoletow has shown that the current for a given gas depends only on the po- tential gradient, so that it is not altered if the potential difference and the distance between the plates are in- creased in the same proportion. The nature of the gas between the plates has a considerable effect upon the current through the gas. Elster and Geitel ” measured the current when the illuminated plate was immersed in air, carbonic acid, oxygen, and hydrogen, and found that it was much greater through carbonic acid than through any of the other gases. Stoletow ‘* and Eighi ’” have investigated the effect of the pressure of the gas on the current

passing through it, and find that the current increases as the pressure diminishes, until a certain pressure is reached, below which further diminution causes a diminution in the current, though the change in the current is small compared with the change in the pressure. The stage at which the change of current with pressure is most rapid is at a pressure a little greater than that at which the current is a maximum. The amount of change in the current with the pressure may be illustrated by the following measurements given by Stoletow. The potential difference was equal to that of 66 Clark's cells, and the distance between the plates was 3-71 mm. ; %> stands for the pres- sure in millimetres of mercury, and c for the correspond- ing current.

p = 754, 152, 21, 8-8, 3-3, 2-48, 1-01, -64, -52, -275, -105, -014, -0047,

0031 c = 8-46, 13-6, 26-4, 32-2, 48-9, 74-7, 106-8, 108-2, 102-4, 82-6, 65-8,

53-8, 50-7, 49-5

If p is the pressure at which the current is a maximum, Stoletow has shown that p is proportional to the potential gradient; he has also shown that at very low pressures the current is not, as it is at atmospheric pressures, fixed by the potential gradient, but that with the same potential gradient the current increases with the distance between the plates. This seems to indicate that at these low pressures the ioni- zation is not confined to the surface of the plate, but ex- tends throughout a layer of finite thickness, so that when the plates are brought nearer together than the thickness of this layer the supply of ions is curtailed and the cur- rent consequently reduced. Stoletow found that at ex- ceedingly low pressures the current was independent of the pressure. This would seem to indicate that in these cases the current was carried either by mercury vapour from the pump or more probably by corpuscles from the metal surface. At these very low pressures the cui-rent is very easily saturated and thus becomes independent both of the electric field and of the pressure. The fact that Eutherford found the velocity of the ions at higher pressures to be the same whatever metal was used, indi- cates that at higher pressure little, if any, of the current

is carried by molecules torn from the metal plate. Stole- tow (loc. dt.) made a series of experiments to see if the discharge from a negatively electrified plate lasted an appreciable time after the light was cut off. He was not able to obtain any evidence that the cessation of the leak was not contemporaneous with the cessation of the light, and was able to show that there was no leak after the light had been cut off for ɟ^Vir ‘^ ^ second.

Elster and Geitel * found that the orientation of the plane of polarization of the incident light had consider- able influence upon the amount of the photo-electric effect. The effect produced by light polarized in a plane at right angles to the plane of incidence is at oblique incidence much greater than that produced by light polarized in the plane of incidence. To show this effect the reflecting surface ought to be very smooth; a suitable surface is most easily obtained by using the liquid alloy of sodium and potassium, which has the further advantage of being sensitive to ordinary light. In light polarized in a plane at right angles to that of incidence, the periodic electric intensity which, on the electro-magnetic theory of light, exists in the incident light-wave has a component at right angles to the reflecting surface, and produces a periodic effect on the electrification of the surface. When the light is polarized in the plane of incidence the electric intensity is parallel to the reflecting surface, and does not produce a periodic variation in the electrification over this surface. The periodic electric intensity at right angles to the surface seems to facilitate the escape of negative electricity from the surface. Another circumstance which may be connected with the effect produced by the position of the plane of polarization, is the fact discovered by Quincke,^^ that light polarized at right angles to the plane of incidence penetrates more deeply into metal than light polarized in that plane. At normal incidence the electric intensity in the incident light has no component at right angles to the reflecting surface, whatever the plane of polarization. Elster and Geitel have shown that when the surfaces are smooth there is little photo-electric effect at normal incidence.

The question whether ultra-violet light produces any ionization when it passes through a gas without falling on a metallic surface has been investigated by Buisson ^ in the case of air, and by Henry ^ for the vapours of iodine and methyl iodide, two gases which are very much ionized when Kontgen rays pass through them ; neither of these observers could detect any trace of ionization. Quite recently, however, Lenard ^ has shown that ioniza- tion is produced in certain cases by the passage through a gas of ultra-violet light ; the kind of light which pro- duces this effect is, however, absorbed so rapidly by the gas that the ionization can only be observed within a few centimetres of the source of light, which in Lenard's case was a spark between aluminium terminals. C. T. R. Wilson ^ has shown that when ultra-violet light passes through dust-free damp air it produces cloudy condensa- tion along its path; he could, however, detect no sign of electriflcation on the drops, so that this is not evi- dence of ionization. Elster and Geitel*^ found that at very low pressure the rate of escape of negative electri- fication is very much diminished by a magnetic force parallel to the reflecting surface. We have already considered the theory of this effect in ►► 6. Lenard and Wolff ^ **found that a steam jet in the neighbourhood of a negatively electrified surface illuminated by ultra-violet light showed by its change of colour that the steam in it had been condensed. They attributed this con- densation to metallic dust coming from the electrified surface, the metallic dust, in accordance with Aitken's** experiments, producing condensation by forming nuclei around which the water-drops collect. The indications of

a steam jet are, however, very ambiguous, as condensation is produced not only by dust, but also by chemical action and by the presence of ions. We have already seen reasons for thinking that little, if any, of the current from the negatively electrified surface is carried by metallic particles.

The phenomena connected with the discharge of negar tive electricity by ultra-violet light admit of explanation by the theory that the incidence of ultra-violet light on a metal causes a discharge of negatively electrified cor- puscles from the metal; when the metal is surrounded by a gas at a very low pressure we have seen that the existence of this stream of corpuscles from the metal can be detected by direct experiment. Those rapidly moving corpuscles coming from ,the metal will ionize the gas through which they

pass ; but if the gas is at a pressure comparable with the atmospheric pressure, they will only be able to penetrate a short distance into the gas ; the metal will thus be surrounded by a thin layer of ionized gas. If the metal is positively electrified the electrostatic attraction will prevent the escape of the negatively electrified corpuscles, so that in this case there will not be any layer of ionized gas round the metal. When this ionized layer exists, and is acted on by an electric field, the positive ions in the layer will move in towards the metal plate, while the negative ones will move away from it. These positive and negative ions, however, tend to recombine and form a neutral molecule, so that the only ions which are available for carrying a current of electricity through the gas are those which ai'e torn from the ionized layer before they have time to recom- bine. Thus the stronger the field the greater the number of negative ions liberated from the layer, and therefore the greater the current. As the strength of the electric field is increased, the strength of the current will increase until all the negative ions are torn from, the layer before they have time to combine with the positive ions ; when this occurs the current will be saturated, and will not increase with the electric field, until the latter gets so strong that it imparts so great a velocity to the ions already in the field that they are able to produce fresh ions. Let us now consider what on this theory would be the effect of diminishing the pressure of the gas surrounding the metal. The corpuscles coming from the metal will travel farther through a gas the lower the pressure, while the number of ions per cubic centimetre produced by the passage of the ions through the gas will diminish as the pressure diminishes : thus, as the ions are a greater distance apart, the rate of recombination will be slower, as each ion has to move through a greater distance before meeting with an oppositely charged ion ; in addition to this the velocity of the ions in an electric field of given strength increases as the pressure of the gas diminishes. Thus the negative ions will be more easily torn from the ionized layer when the pressure is low than when it is high, and thus the current will increase when the pressure of the gas is diminished. This increase will go on until the layer through which the ionization extends fills the space between the electrodes between which the current is passing ; when this stage is reached any further diminution in the pressure will diminish the number of ions produced between the electrodes, and hence the number available for carrying the current. The satura- tion value of the current will therefore diminish ; thus there will be a certain pressure, at

which, with a given electric field, the current through the gas is a maximum. When the pressure of the gas is exceedingly low, the corpuscles coming from the metal will make very few collisions before reaching the other electrode. Thus there will be very little ionization between the electrodes, and there will be very little recombination, as there are so few

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positive ions for the negative ones to combine with. Thus the current will be very easily saturated, and will become independent both of the electric field and of the pressure, becoming equal to that carried by the negative corpuscles discharged from the surface of the metal by the action of the ultra-violet light. Thus this theory gives a simple explanation of the most conspicuous photo-electric effect. When the pressure of the gas is low and the potential gradient large the negative ions will be moving through the gas with very great velocities ; for, as we have seen, the velocity varies inversely as the pressure, and at atmo- spheric pressure in air the velocity is about 1-6 cm. /sec. for a potential gradient of 1 volt per centimetre. Now, in the case of the cathode and Lenard rays (see ►► 19) we have also negatively electrified particles moving with great velocities, and we know that in these cases the gas is ionized by the passage through it of the particles. We should expect then at low pressure, in the case of the discharge by ultra-violet rays, to get a secondary volume ionization due to the motion of the negative ions. The fact that the saturation current through a thick layer of gas is greater than that through a thin layer, indicates that there is some such volume ionization.

►► 15. Conductivity in Gases produced by Rontgen Rays. ►►► Eontgen rays passing through a gas turn it into a conductor, and the gas retains its conductivity for some little time after the rays have ceased. The gas through which the rays have passed shows all the characteristics mentioned in ►► 1 ; the conductivity is discharged when the gas is sucked through a plug of cotton-wool or bubbled through water, or subjected to a strong current of elec- tricity. If the gas is sent through a metal tube or

allowed to stand in a metal vessel it acquires a positive charge, because the negative ions, diffusing more rapidly than the positive, reach the walls in greater numbers, and so leave an excess of positive ions in the gas. The ease with which the negative ions give up their charges to the metal seems to depend to some extent on the nature of the metal, for Rutherford ^ found that the excess of positive ions was greater when the Eontgenized gas had passed through zinc tubes than when it had passed through copper. If the tubes through which the Eontgenized gas is blown are made of insulating material the ions cling to the walls of the tube for a considerable time, and a blast of air sent through them will dislodge ions hours after the Eontgenized air has passed. Minchin^ has shown that metal plates previously uncharged get, when exposed to Eontgen rays, charges of electricity, positive in some eases, negative in others. The potentials to which these metals are raised by the charges are not large, being, except in the case of sodium or sodium amalgam, much less than 1 volt. The effects are due to the Eontgenized gas acting, as far as the contact difference of potentials of metals immersed in them go, like a bath of an electrolyte (see ►► 9), so that two different metals connected with the quadrants of an electrometer will show the same potential difference as they would if immersed in an electrolyte.

“We oaa measure g, the number of ions produced per second by the rays in a cubic centimetre of the gas, by measuring I, the saturation current through the gas, for (see ►► 7) l=qle, where I is the distance between the parallel plates which act as electrodes, and e is the charge on the ion. If we use this method to determine the ionization of the gas by the rays we must be careful, for a reason which will be explained later, not to let the rays strike against the electrodes. From experiments made by Perrm,^! Rutherford, ^2 and the writer,” the results of which are given in the following table, it will be seen that the amount of ionization of gas at the same pres- sure varies very much with the nature of the gas. It is least for hydrogen and greatest for mercury vapour, but is not proportional to the density of the gas, for the ionization is much greater for HCl than it is for CO2.

Value of

J (Air =

1).

Gas.

Rutherford. Perrin.

J. J. Thomson

H, . .

5

026

33

N2 . .

9

...

89

O2 . .

1-2

11

CO2 .

1-2

i”k

1-4

CO .

NO

1^08

N2O

1-3

1-47

C2N2 .

...

...

105

C2H2 .

”

1

H2S .

6

6

SO2 .

4

e”’

6-4

HCl .

11

8?

8^9

CI2

18

17-4

NHs .

◆◆◆i?

1?

Coal Gas

“◆◆◆8

[For helium Strutt (Phil. Mag., March 1900) found the value ◆◆◆44]. The values of q for the vapours of mercury and iodine are greater than any of those given in the preceding table, but the diflSculties in the way of getting accurate numerical values are very great. The numbers given above show that, with the exception of CN, the coefficients of ionization of the gases obey, approximately at any rate, the addition law, i.e., if 2[A], 2[B] represent the coeffi- cients of ionization for the elementary gases A2, B2 respectively, the ionization of the compound gas, ApB, will be equal top[A] +p[B]. It is only when the current is saturated that it is proportional to the coefficient of ionization. With very small potential differences the current through hydrogen is greater than that through air, though the coefficient of ionization is very much less. We have by◆◆7-

. = e(Ei + R2) Vf

if the current is small ; hence this current is proportional to Ri 4- R2, the mean velocity of the ions under a given electric intensity. Now, the velocity of the ions in hydrogen is about three times that in air, and this greater

velocity is more than sufficient to counterbalance the effect of the smaller ionization. The very large ionization of mercury vapour is interesting, as this is a monatomic gas ; the process of ionization must, therefore, involve much finer subdivision than the splitting of a molecule into atoms. The number of ions produced by the rays is very small compared with the number of molecules, the proportion between the two depending, of course, upon the intensity of the radiation. It may, however, give some idea of the order of this quantity to state that in some experiments made by the writer, using the rays from a bulb of the kind ordinarily used for taking Rontgen photographs, the proportion of the number of ions to the number of the molecules of the gas was as 1 to 10’^. Perrin (loc. cit.} has shown that the number of ions produced in a cubic centimetre of a gas is proportional to the pressure of the gas, and independent of the temperature. This statement is equivalent to saying that the number of ions produced from a given number of molecules of the gas is independent of the pressure and directly proportional to the absolute temperature of the gas.

►► 16. Absorption of Rays by the Gas. ►►► The rays gradually get absorbed by the gas. The intensity of a parallel beam of rays after travelling through a distance d in the gas may be represented by c”^”, the intensity when the beam entered the gas being taken as unity. X may be called the co-efficient of absorption of the gas ; it depends upon the kind of rays travelling through the gas, being small for rays emitted from a very highly exhausted bulb ►►► Eontgen’s “hard rays ” ►►► and larger for the rays emitted by a bulb at a higher pressure. As we have no way of specifying the kind of ray we are using, the determinations of X are indefinite. We can, however, by using the same bulb in the same condition, compare the values of X for different gases for the same kind of radiation. Eutherford found that while the intensity of the radiation after passing through 10 cm. of air, oxygen, or coal gas was only diminished by about 1 per cent., it was diminished by about 4 per cent, after passing through 10 cm. of sulphuretted hydrogen, by 20 per cent, after passing through 20 cm. of chlorine, by 50 per cent, after passing through 7 cm. of mercury vapour at atmospheric pressure, and by 60 per cent, after passing through 13 cm. of the vapour of methyl iodide. The order of the absorbing

power of the gases was the same as that of the amount of ionization, and in many cases the coefficient X seemed to be roughly proportional to the ionization. If more accurate determinations of X should confirm this result, which seems to be true for uranium radiation, and if the energy absorbed is spent in ionizing the gas, then since the amount of energy absorbed is proportional to the number of ions formed, whatever the gas from which the ions are derived, it follows that the work required to pro- duce a given number of ions is the same for all gases.

17. Ionization near a Metal Plate exposed to Bontgen Rays.

Perrin (loc. cii.) found that the ionization close to a metal plate struck by Eontgen rays was greater than in the gas at some distance from the rays. This may be shown by the following experiment due to Perrin :

AAi (Fig. 18) is a condenser with a guard ring. A beam of Eontgen rays, indicated by the arrows, passes between its plates without touching them, and enters a second condenser BBi at right angles to the plates, through a window KL covered with thin

aluminium. The distance between the plates of the condenser BB^ is equal to a/3. The plates B and a/3 are connected with the needle of an electro- meter, and put to earth, and the plates B’ and A^ are connected with the terminals of a battery containing a large number of cells, the middle of this battery being put to earth. Thus Bi and Ai are at equal and opposite potentials. The connexion between the needle and the earth is then broken, and the rays sent through the condensers. If there is no secondary effect due to the impact of the rays on the metal, since rays of the same intensity pass through the same- volume of gas in the two con- densers, the ionization between the plates of the condenser ought to be the same, and so under strong electric fields the charge received by B would be equal and opposite to that received by ojS. Hence the needle of the electrometer would remain uncharged. It is found, however, that the needle does receive a charge if the metal plates of the condenser BBi are dry, the amount of the charge depending upon the material of which the plates are made. The sign of the

charge is such as to show there is more ionization in BBI tiian in AAi. If the plates are wet with water, alcohol, or petroleum, the needle of the electrometer remains uncharged. There is thus an increased ionization produced when Rbntgen rays strike directly against metal. The interposition of a film of water between the metals and the rays seems to destroy, or at any rate greatly reduce, this effect, which was called by Perrin the metal effect.

The method of studying this effect adopted by Langevin and Townsend^ was to measure the saturation currents between two parallel metal plates. A considerable portion of one of these plates was made of aluminium, and its inner surface wetted, so as to get rid of the metal effect. The Eontgen rays, passing through this plate at right angles, fell on the other. Apart from the metal effect, the total amount of ionization between the plates is proportional to the distance between them; hence increasing this distance from d to d+x should increase the amount of ionization and therefore the saturation current by an amount independent of d. It was found, however, that the amount by which the saturation current is increased for a given value of x is much greater when d is small than when it is large, and although it attains a constant value when the plates are a considerable distance apart, it does not do so before, in a gas at atmospheric pressure, d amounts to several millimetres. Thus the abnormal ion- ization extends from the surface through a layer of gas several millimetres thick. By making a series of deter- minations of the saturation current for a consecutive series of values of d, we can determine the amount of ionization in the various layers of the gas. In this way Townsend

has shown that the ionization in a layer near the surface of the metal is sometimes more than twenty times that in a layer of equal thickness some distance away from the metal. The effect depends greatly on the particular metal of which the plate is made. If it is a heavy one, the ionization near the metal is very great, but the thickness of the layer through which the ionization is abnormal is comparatively small ; but if the metal is a light one, the ionization near the surface is not so great, though the thickness of the layer through which the influence of the metal is felt is much greater. The results of Townsend’s experiments are represented in Pig. 19, where the ordinates represent the total ionization due to the secondary rays within a

distance from the surface re- presented by the abscissae. Curves are given when the reflecting surfaces are copper, zinc, and aluminium. The line P represents the ionization due to the direct rays. Perrin seemed to think that the metal effect might be due to the greater ease with which a gas is ionized when brought near to a conductor ; we had an example of this in the case of conduction through flames. The thickness of the layer through which the ionization is anomalous seems to imply that some other cause must be at work. It would seem most probable that this ionization is the result of the secondary radiation which is produced when Eontgen rays pass through matter. Eontgen^ showed that when the rays pass through air, the air gives off secondary radiations having all the properties of Eontgen rays, but of less penetrating power. Sagnac ^ showed that metals on which Eontgen rays fall give out secondary rays ; these are not the primary rays irregularly reflected, but are different in character, not being nearly so penetrating. The lighter the metal struck by the primary rays, the more penetrating are the secondary rays, although when the metal is light the rays are not so numerous as when it is heavy. He showed that when the secondary rays strike against a metal, tertiary rays are given out which are still less penetrating than the secondary. As these secondary and tertiary rays ionize a gas when they pass through, it is clear that until we are so far away from the metal that they are absorbed by the gas before reaching us, the ionization in the gas is greater than that due to the primary rays. The secondary rays observed by Sagnac could traverse several centimetres of air before being absorbed. The fact that the greater part of the metal effect takes place within a few millimetres of the surface of the metal shows that the rays producing this ionization are ab- sorbed by a few millimetres of air; they are probably tertiary rays produced by the passage through the surface layers of the metal of secondary rays starting from a little behind them.

18. Conduction produced by the Radiation from Uranium, Thorium, &c.

Becquerel ’’ showed that a gas surrounding a piece of uranium or one of its salts becomes a conductor of electricity, and Schmidt ^ found that the same is true of thorium. Subsequently M. and Mme. Curie ^ found that this property was possessed to a very much greater extent by two new substances, radium and polonium, which they obtained from pitch-blende. Polonium appears to emit a kind of radiation very similar to the Eontgen rays, inasmuch as, besides rendering gases conductive, it produces

phosphorescent effects on a potassium platino- cyanide screen, and affects a photographic plate even when protected by a screen opaque to ordinary light. Like the Eontgen radiation, it ^an be neither refracted nor polarized ;

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it is not, however, nearly so penetrating as the ordinary primary Eontgen radiation, resembling, in this respect, the secondary Eontgen radiation. Radium emits radia^ tion of at least two types ??? one, easily absorbed, resembles Kontgen, the other, more penetrating, resembles cathode rays, being deflected by a magnet, and carrying a charge of negative electricity. The properties of gas ren- dered conducting by uranium or thorium radiation have been investigated by Becquerel {loc. cit), Rutherford,'* Owens,'" De Smolan and Beattie.'"^ These properties are the same as when the gas is made a conductor by Eontgen radiation ; the velocities of the ions are the same, as are also the laws connecting the current and the potential difference. The uranium radiation being much more quickly absorbed than Rontgen radiation, the phenomena due to the former are liable to be com- plicated by absorption effects. Rutherford has shown that uranium salts emit at least two kinds of radiation ??? one is absorbed in a few millimetres of air at atmospheric pressure, while the other can traverse many centimetres before being extinguished. The ionization in thin layers of air close to the surface of the uranium is chiefly due to the more easily absorbed radiation, and as this is wholly absorbed by a few millimetres of the gas, we can by altering the gas over the uranium compare the total amount of ionization in different gases when all this radiation is absorbed. Rutherford found that this was the same for air, hydrogen, oxygen, carbonic acid, coal gas, hydrochloric acid, and ammonia, and that though in hydrogen the ionization close to the uranium was not so great as in a heavier gas, yet the greater thickness of ??? the layer through which it extended just compensated for the deficiency in intensity. If we could be sure that all the energy of the rays is spent in ionizing the gas, and none in raising the temperature, this would indicate that the work required to

produce a definite number of ions is independent of the gas from which they are produced, a result suggested also by the experiments on conduction due to Rontgen radiation. Rutherford's experiments on compounds of thorium indicate that, be- sides emitting radiation, these emit something which is itself radio-active. The activity of this emanation gradu- ally disappears, but lasts long enough to be appreciable for some minutes after it has left the thorium. It is not destroyed by being passed through plugs of cotton-wool or being bubbled through water or sulphuric acid, pro- cesses which, as we have seen, would be fatal to the existence of ions. The emanation can pass through very thin plates of metal and through several sheets of paper. It is blown about by the slightest draught, even when acted upon by a strong electric field ??? in fact, an electric field seems to have no effect upon it, a fact which suggests that it is not permanently charged with electri- city. This deduction is confirmed by the circumstance that on blowing a quantity of it into an inductor no evi- dence of any charge can be detected. Rutherford has also shown that if the air between two plates is made conducting by thorium radiation, and a current of electri- city sent between them, the metal against which the positive ions discharged becomes radio-active, and retains, though with gradually diminishing intensity, this power long after the current has ceased. The radiation it emits is not identical in character with that emitted by the thorium, there being great differences in the pro- portion of the two radiations stopped by an aluminium plate of given thickness. A plate rendered radio-active in this way can be washed with water, caustic potash, or nitric acid without losing its activity, which is, however, considerably diminished by warm sulphuric acid. M. and Mme Curie (Comptes Rendus, Nov. 1899) have shown that substances exposed to the radiation from radium

become themselves radio-active for a time ; the radiation from polonium produces a similar effect, but to a much smaller extent. Debierne {Comptes Rendus, July 1900) has shown that the radiation from actinium produces very intense induced radio-activity.

Elster and Geitel ??? have shown that the current through a gas at a very low pressure made a conductor by the radiation from radium is much diminished by a strong magnetic field, when the lines of magnetic force are at right angles to the current.

►► 19. Conductivity due to Passage of Cathode and Lenard Rays through a Gas.►►► The passage through a gas of the small particles carrying negative charges which constitute cathode and Lenard rays makes it a conductor in which both positive and negative ions are present. This has been proved for cathode rays by the writer,’”* and by Lenard ”” for the rays which bear his name. The con- duction through gas ionized in this way follows the same laws as in the cases hitherto considered, the current in- creasing less rapidly than the potential difference, and reaching a saturation value at which it remains constant even though the potential difference is greatly increased. The number of ions produced by the passage of these negative charges through a gas is many times the number of these charged particles. The amount of ionization pro- duced by Lenard rays in different gases has been investi- gated by M’Lennan,►►► who found that, for all the gases he tried (air, oxygen, nitrogen, carbonic acid, hydrogen, and nitrous oxide), the amount of ionization produced in one second by Lenard rays of given intensity in 1 cubic centi- metre was proportional to the density of the gas, and in- dependent of its chemical composition. Thus the ionization in 1 cc. of oxygen at 47 mm. pressure is the same as in 1 cc. of hydrogen at 16 x 47 mm. pressure. Lenard ”” has shown that the absorption of his rays depends only on the density and not on the chemical composition, so that in this case, as in the case of uranium and probably of Rontgen radiation, equal absorption gives equal ionization, whatever the nature of the gas.

►► 20. Spark Discharge through Gases. ►►► Hitherto we have only considered cases when conductivity was conferred on the gas by agents independent of the electric field used to drive the current through it, and for the conducting gases hitherto considered the weakest electric field was sufficient to cause some current to flow through the gas. We shall now proceed to consider cases where the conductivity of the gas is due to the electric field itself. Here there is neither appreciable conductivity nor currentunlesstheelec- tric field is strong. Let us suppose that we have two parallel plates of metal placed close together, and that one plate is connected through a large resistance to one pole of a large battery of cells, while the other plate is connected with the other pole ; no appreciable current will pass round this cir- cuit unless the electromotive force of the battery exceeds a definite value, but when it does exceed this value a

current will pass, accompanied by luminosity between the plates, the potential difference between which will be found to be little if at all affected by the number of cells in the circuit. This potential difference, which is frequently called the statical spark potential, we will call the spark potential difference ; its value depends on the distance between the plates, and on the nature and pressure of the gas in which they are immersed. It must not be supposed, however, that whenever it is applied to the plates we always get a spark to pass. If it is only maintained for a short time, it may be that no spark passes ; indeed, it is possible under certain circumstances to apply to the plates a much greater potential difference without getting a spark. Faraday ××× long ago showed that it takes a greater potential difference to start the first spark than is required to keep up the sparks, and that the effect of one spark in facilitating the

passage of a second does not die away until the gas has rested for several minutes. The writer ××× found that if the gas between the electrodes was dried with extreme care, it was possible to get the gas to stand without discharge a potential difference between the electrodes three or four times as great as that which was sufficient to produce a discharge in less perfectly dried gas ; the gas, however, seemed to be in an unstable state as far as its electrical behaviour was concerned, for when once a spark had been forced through it, the potential difference between the plates at once fell to the value it had before the gas was dried, and the gas was not again able to withstand a potential differ- ence any greater than this without discharge until it had had a rest for several minutes. The very great potential dif- ference withstood in this case without discharge seems to suggest that if we had a perfectly pure dry gas it might be able to withstand almost any potential difference without discharge. It would, however, be in an unstable state, and might be compared to a supersaturated solution, into which a foreign body has to be introduced to start the crystallization, though the

process, when once started, goes on until the solution ceases to be supersaturated ; another analogy would be gas supersaturated with aqueous vapour, where for condensation to take place we require the pres- ence of nuclei round which the drops may collect. Various influences may prevent the gas getting into the unstable electric state, such as the presence of moisture, the fall of ultra-violet light on the cathode or of Eontgen rays on the spark gap, the presence of gases from flames, sparks, or arcs ??? in short, the presence of any ion seems fatal to the continuance of this unstable state. The influence of several of these agents has been investigated by Warburg,"" whose method consisted in measuring the interval which elapses between the application of a potential difference greater than the spark potential difference and the passage of the spark. This lag of the spark, as we may call it, is a very important quantity in the phenomena attending the passage of the spark, for if it is great, and the spark terminals are connected with an induction coil or some other source of electricity furnishing a potential difference which changes quickly, the terminals may support for the short time during which it lasts a potential difference which would cause a spark to pass if the lag were much shorter. Thus an agent may make sparks pass when the potentials of the terminals are inconstant by diminishing the time of lag, even though it has no effect on the steady poten- tial difference required to produce a spark. A notable illustration of this is afforded by the action of ultra-violet light on sparks passing between the terminals of an in- duction coil. Hertz "' showed that when the spark gap was exposed to such light, sparks passed much more easily than when the light was screened off ; then E. Wiedemann and Ebert "^ showed that it was only when the cathode was exposed to the light that any effect was produced (it is only in this case that any ions are sent into the spark gap) ; finally, Warburg (loc. cit.) showed that the effect of the ultra-violet light was to diminish very greatly the lag, without producing much effect on the statical spark po- tential. Swyngedauw"* also showed that ultra-violet light had a much greater effect on the sparking potential when this was rapidly changing than it had on the statical spark potential.

The effect of ultra-violet light on the lag is strikingly shown by the following table taken from Warburg's paper. The fractions in the columns have for their numerator the number of times a spark passed when the potential difference at the top of the column was applied to the electrodes

for a time ‘0012 seconds ; the denominator of the fraction is the number of times the potential difference was applied ; thus the fraction ^^ indicates that the spark never passed, the fraction {^ that it always did so. Hydrogen at a pressure of 11 millimetres of mercury was employed. The statical spark potential was 960 volts in daylight, 1200 in the light from an arc

lamp which had passed through glass, and 1080 in the direct light from the lamps : ###

Potential Difference in Volts.

960.

1440.

1500.

1920.

2040.

2940.

8000.

8960.

5040.

8940,

In the dark In daylight In the arc light through glass In the arc light

A

A M

^5

}8

ji

A

A

A

A

A

It will be seen from this table that we may apply in the dark for ###0012 sec. a potential difference nine times that required to produce a spark with a steady potential difference without always producing a spark, and also tlial daylight has a distinct effect in diminishing the lag of the spark. It was also shown by Warburg that the chief effect of a small quantity of water vapour was to make the lag very much less than for a perfectly dry gas.

The significance of this lag seems first to have been pointed out by Jaumann,”^ who showed that it was much diminished if very rapid changes took place in the potential of the electrodes. During the lag some process is going on by which the gas between the electrodes is being changed from an insulator into a conductor. Experiments were made by Jaumann and Warburg “^ to see whether this process was accompanied by a dark discharge of electricity through the gas ### no luminous effects can be observed in the darkest room, ### but they could get no indi- cation by means of electroscopes of the existence of such a discharge, though Warburg obtained some indirect evi- dence which led him to the conclusion that such a dis- charge takes place. This evidence is based upon the action of a magnet upon the discharge of electricity through a gas at low pressure. If the magnetic force is transverse to the current of electricity through the gas, the discharge is hindered by the magnetic field, owing to the deflexion of the conducting gas. Now Warburg found that not only was the luminous discharge at low pressures hampered by the magnetic fleld, but that the lag

was much increased by the magnetic field. He concluded from this that during the lag there is a current of electricity through the gas too feeble to affect an electroscope, and without luminosity. Walter “^ and Boys,”’ by taking photographs of sparks on rapidly moving plates, have shown that the bright spark is preceded by faintly luminous brush dis- charges. It seems to the writer probable that the process by which the gas is changed from an insulator to a conduc- tor is analogous to the ionization of a gas by cathode or Lenard rays. In these cases the rapid motion of an ion through the gas ionizes the gas surrounding the moving ion. Suppose then that in some way or another we had some ions in the gas between the electrodes, these would be acted on by the electric field and set in motion, and if they had sufficient energy given them during their life by the electric field for each to give rise to more than one ion, the number of ions would go on increasing, the gas become a conductor, and a spark would pass. If, how- ever, the energy given by the electric field to the ion were not sufficient to enable each ion to provide more than one successor, the number would not grow, and the gas would remain an insulator. Thus for the electric field to turn a gas into a conductor would on this view require a field of sufficient intensity to give the requisite energy to an ion already in the field. This is in accordance with the phe- nomena. It is also necessary that some ions (a 'erv small number would suffice) should be present to start the spark, and the very great values to which the potential difference may attain under certain conditions without any discharge passing seem to lend support to this view.

that when the electrodes are planes, or spheres whose radii are large compared with the length of the spark, the relation between the potential difference V and the length of spark I, when I for gases at atmospheric

pressure is greater than two millimetres, can be expressed by the linear relation V=a+/8Z. For air at atmospheric pres- sure a=4-997, /8=99-593, in electrostatic measure. Thus the curve representing the relation between spark length and potential difference is a straight line which does not pass through the origin. For sparks at atmospheric pres- sures whose length is less than 2 millimetres the curve ceases to be a straight line, and for slightly shorter sparks becomes concave to the axis along which the sp'ark length is measured. There is some evidence that for still shorter sparks the curve has a point of inflexion, so that the po- tential required to produce very short sparks increases as the length of the spark diminishes. An illustration of this is that sparks passing between a plane and a slightly curved surface, when these are very near together, do not pass between the points which are nearest together, but prefer a longer route. There is a certain minimum po- tential required for the production of a spark, and no spark can pass if the potential falls below this value. This minimum is independent of the pressure of the gas ; for air it is 341 volts, for hydrogen 302 volts, for nitro- gen 251 volts, and for helium 261 volts.'^^ The fact that the potential difference required to produce a spark can be represented by an equation of the form V=a+6Z shows that the electric intensity between the plates Y/l is greater for short sparks than it is for long. Bailie found that to spark across a layer of air ~~0015 cm. thick required an electric intensity about nine times that required to spark across a layer 1 cm. thick. The fact that a greater elec~~ tric intensity is required to spark across a thin layer of gas than a thick one was discovered by Lord Kelvin ^^ in 1860.

Baille,^^ Paschen,* and Ereyberg^ have made some very interesting experiments on the potential difference required to spark between two equal spheres of small enough radius to make the variations in electric intensity in different parts of the field considerable. These experi- ments show that for a given length of spark passing be- tween two equal spheres, one charged and insulated and the other put to earth, the potential difference varies with the diameter of the sphere. Starting from plane electrodes, the potential difference at first increases with the curva- ture, and attains a maximum when the spheres have a certain diameter, depending upon the spark length and increasing with it. When the spheres are smaller than this, the potential difference falls off quickly, so that a much smaller difference of potential is required to produce a spark between very small spheres than between

parallel planes. When the spark passes between pointed elec- trodes the potential difference is still smaller. Schuster ^^ has calculated from Bailie and Pasohen's experiments the maximum electric intensity in the field when the spark is passing, and has shown that, keeping the spark length constant, the maximum intensity increases as the diameter of the spheres diminishes. Thus with a spark length of 1 cm. the maximum electric intensity between plane elec- trodes was 106, and between spheres 1 cm. in diameter 733. If the diameter of the electrodes is kept constant and the length of the spark increased, Schuster found that, starting with very short sparks, an increase in the length of the spark at first diminished the maximum electric intensity in the field, but that this attained a minimum, after which any further increase in the spark length increased the maximum electric intensity. The smaller the spheres the shorter the spark corresponding to the minimum electric intensity. When the sparks pass between spherical electrodes of different diameter, Farar

day>27 and, later, De la Eue and Mlllleri^s found dif- ferent values for the spark potential according as the smaller electrode was positive or negative. According to Wesendonck,^^ this difference only occurs when a brush discharge accompanies the spark; when nothing but a spark passes between the balls he finds that the potential difference remains the same when the signs of the electrodes are reversed. Photographs of long sparks, such as those in Fig. 20, show distinct differences be-

Mg. 20.

tween the appearances at the positive and negative electrodes ; thus there is a straight piece of considerable length at the positive electrode which is wanting at the negative, and when the spark branches as in Pig. 20, the branches point to the negative electrode. Experiments made by Eighi,"" Peace,"i and others show that the ma- terial of which the electrodes are made has little if any effect on the potential difference required to produce a spark. It is just possible that this result might be modi- fied if a large quantity of electricity were allowed to pass with each spark.

►► 22. Connexion between Spark Potential and Pressure of Gas. ►►►

As the pressure of the gas diminishes, the po- tential difference required to produce a spark of given length also diminishes, until the pressure reaches a

criti- cal value, which depends mainly upon the length of the spark and the nature of the gas. At this pressure, the potential difference being a minimum, any further diminu- tion in the pressure leads to its increase. The critical pressure is higher the shorter the spark. The following values for the critical pressures corresponding to different spark lengths are due to Peace.^^

Spark Length. Critical Pressure. Spark Length. Critical Pressure.

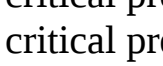 001 cm. 250 mm. -01016 cm. 55 mm.

0025 cm. 150 mm. -02032 cm. 35 mm.

00508 cm. 110 mm.

The connexion between spark potential and pressures at pressures much greater than the critical pressure has been investigated by Bailie,”* Macfarlane,^ and Paschen,^ who have found that this relation can be represented by a very slightly curved portion of a hyperbola. Paschen showed that as long as the product of the density of the gas and the spark length is constant, the sparking po- tential is also con- stant over a wide range of pressure for the same gas. His results can be approximately re- presented by an equation of the form

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Fig. 21.

V is the potential difference, I the spark length, A, the mean free path of a molecule of the gas, and a and h constants. The relation between the spark potential and the pressure, for pressures in the neighbourhood of the

[electkic

critical pressure, has been investigated by Peace (loc. cit.) ; the results of some of his experiments are shown by the curves in Fig. 21, where the ordinates represent the potential and the abscissae the pressure. The small changes in the potential over a considerable range of pressure in the case of the shorter sparks is very well marked; the curves corresponding to different spark lengths cut one another, indicating that at low pressures it requires a greater potential difference to produce a short spark than it does to produce a longer one.

 The potential difference required to produce a spark of given length depends, as Faraday showed, on the nature of the gas between the electrodes. Thus in hydrogen it is much less than in air at the same pressure. Measurements have been made by Faraday,’” Bailie,’’ Liebig/^ Paschen,’^’’ Wolf,►► R6ntgen,i” and Natterer.’ The following table gives the ratio of the potential difference required to produce sparks in hydrogen and carbonic acid to that required to produce a spark of the same length in air, the pressure in all cases being 760 mm.

Spark Length in Centimetres.

Hydrogen.

Carbonic Acid.

Bailie.

Liebig.

Paschen.

Bailie.

Llebig.

Paschen.

►►►1 ►►►2 ►►►3 ►►►4 ►►►5 ►►►6

49 ### 49 ### 50 ### 50 ### 50

873 ### 787 ### 753 ### 704 ### 670 ### 656

639 ### 578 ### 560 ### 553 ### 548 ### 555

1-67

1^24

94

76

1^20

1-16

1^07 1^03 ### 994 ### 974

1^05 ### 988 ### 962 ### 930 ### 910 ### 910

Wolf found that the electric intensity required to produce a spark 1 mm. in length between electrodes 5 cm. in radius, when the pressure was x atmospheres, was ### for hydrogen, 65‘09 x + 62; for oxygen, 96^0 a;+44 ; for air, 107 a;+39; for nitrogen, 120^8 x + 50 ; for carbonic acid, 102^2 a;+72. Rontgen came to the con- clusion that the potential difference required to produce a spark of given length from a pointed electrode in different gases is inversely proportional to the mean free path of the molecules of the gas. Ebert ”’ found that if a vessel containing two electrodes was pumped until the pressure was reached when the discharge went with the minimum potential difference, then the pressures for different gases were such as to make the free path of the molecules of the different gases the same at the critical pressure. Natterer, as the result of a series of experiments on the lengths of spark given by a small induction coil, came to the conclusion that for gases with the same number of atoms in the molecule the spark length diminished as the molecular weight of the gas increased. The measurements made by this method are hardly definite

enough to enable us to say whether this statement is more in accordance with the facts than the statement that the spark length diminishes as the mean free path of the molecule diminishes, for as far as the mean free path of these gases has been determined the latter view seems to accord equally well with Natterer's results.

We can explain why the electric intensity required to spark across a gas at a low pressure is less than that required at a high one, and why it requires a greater electric intensity to spark across a very thin layer of gas than across a thick one, if we take the view already mentioned, that for the spark to pass^ the gas has to be ionized and made a conductor, this ionization being effected by the agency of ions which are already in the gas before the spark actually passes. The ions acquire under the electric field a certain amount of energy, and when this exceeds a certain value the ions ionize the surrounding gas just as Lenard or cathode rays ionize the gas through which they pass. When an ion is moving through a gas with whose molecules it is continually coming into collision, the energy it acquires in the electric field will not go on increasing indefinitely with the time it is in the gas ; for in consequence of the collisions it will almost as often be moving in the opposite direction to the electric force (when it loses energy) as it does in the direction of the force (when it gains energy). It follows, therefore, that the energy acquired by the ion in the electric field will be approximately equal to the work done by the field on the ion as it moves through the average distance it traverses before its direction of motion is reversed. This distance will be proportional to X, the mean free path of the ion ; let it equal cX. Then if F is the electric intensity and e the charge on the ion, the energy acquired by the ion is FecX. If the ion is to ionize the gas and so allow the spark to pass, this energy must exceed a certain value q, hence the limiting value of P for a spark is given by the equation Fec\=5,

or FX is constant. Thus F is inversely proportional to X, or directly proportional to the pressure of the gas, so that a smaller electric intensity is required to spark at a low pressure than at a high one. Next suppose that d, the distance between the electrodes, is less than cX, then the greatest distance the ion can move in the direction of the force is d, so that to get ionization 'Fed=q ; hence F will be greater than before. This is on the supposition that the chances in favour of the moving ion ionizing the

surrounding gas are as great as they were in the other case ; it would seem, however, that, if this ionization is due to collisions between the ions and the gas, the chances are not so great, because the ion is delivered up against an electrode before it has completed its collisions. This would tend still further to increase F, the intensity required to pro- duce a spark.

The spark itself at atmospheric pressures is not in general affected by the magnetic field, but the kind of aureole or glory of luminous gas with which it is surrounded spreads out in strong magnetic fields into a wide band. Prechti** has observed that if the discharge passes between a point as the positive electrode and the rounded end of a wire as the negative electrode, it can be charged from a brush to a spark discharge by a strong magnetic field even at atmospheric pressures. Schuster and Hemsalech “^ have made some very interest- ing researches on the constitutions of sparks following rapidly one after another, such as are produced by the oscillatory discharge of a Leyden jar. These were photographed on a rapidly moving film mounted on the rim of a wheel making about thirty rotations per second ; the motion of the film was at right angles to the direction of the spark, so that the line traced on the film by any luminous matter moving with finite velocity along the spark length would be inclined to the direction of the spark, and the inclination would, if the velocity of the film were known, determine the velocity of the lumi- nous matter. By sending the light of the spark through a spectro- scope before reaching the film, the velocity corresponding to any line in the spectrum could be determined. The conclusion arrived at by the authors was that the first spark passed through air, but that if the sparks followed each other very quickly, and the spark was not too long, the succeeding ones passed through metal vaporized by the heat produced by the first spark. The measurement of the velocity of diffusion of the metallic vapours in the flame gave some very interesting results, since different lines of one and the same metal indicated different velocities. Thus in bismuth some of the lines indicated a velocity of diffusion of 1420 metre/sec, others a velocity of about 300 metre/sec. , and others a still smaller velocity.

►► 24. Discharge from a Point. ►►► A very interesting case of electric discharge is that between a sharply pointed elec- trode, such as a needle, and a metal surface of considerable area. At atmospheric pressures the luminosity is confined to the immediate neighbourhood of the point. If the

sign of the potential of the point does not change, the discharge is carried by ions of one sign ??? that of the charge on the pointed electrode. The velocity of these ions under a given potential gradient has been measured by Chattock,' and found to agree with that of the ions produced by Eontgen or uranium radiation, while Townsend"' has shown that the charge on these ions is the same as that on the ions streaming from the point. If the pointed electrode be placed at right angles to a metal plane serving as the other electrode, the discharge takes place when, for a given dis- tance of the point from the plane, the potential difference between the electrodes exceeds a definite value depending upon the pressure and nature of the gas through which the discharge passes ; its value also depends upon whether, beginning with a small potential difference, we gradually increase it until discharge commences, or, beginning with a large potential difference, we decrease it until the discharge stops. The value found by the latter method is less than that by the former. According to Chattock's measure- ments the potential difference V for discharge between the point and the plate is given by the linear relation V=a-|-Z)/, where I is the distance of the point from the plate and a and b are constants. From v. Obermayer's '** experiments, in which the distance I was greater than in Chattock's, it would seem that the potential for larger distances does not increase quite so rapidly with I as is indicated by Chattock's relation. The potential required to produce this discharge is much less than that required to produce a sjiark of length I between parallel plates ; thus from Chattock's ex- periments to produce the point discharge when l=-5 cm. in

disohabgb]

air at atmospheric pressure requires a potential difference of about 3800 volts when the pointed electrode is posi- tive, while to produce a spark at the same distance be- tween plane electrodes would require a potential difference of about 15,000 volts. Chattock showed that with the same pointed electrode the value of the electric intensity at the point was the same whatever the distance of the point from the plane. The value of the

electric intensity- depended upon the sharpness of the point. When the end of the pointed electrode is a hemisphere of radius a, Chattock showed that for the same gas at the same pres- sure the electric intensity / when discharge takes place is roughly proportioned to a~’- The value of the electric intensity at the pointed electrode is much greater than its value at a plane electrode for long sparks; but we must remember that at a distance from a pointed elec- trode equal to a small multiple of the radius of curvature of its extremity the electric intensity falls very far below that required to produce discharge in a uniform field, so that the discharge from a pointed electrode ought to be compared with a spark whose length is comparable with the radius of curvature of the point. For such short sparks the electric intensity is very high. The electric intensity required to produce the discharge from a gas diminishes as the pressure of the gas diminishes, but not nearly so rapidly as the electric intensity for long sparks. Here again the discharge from a point is comparable with short sparks, which, as we have seen, are much less sensi- tive to pressure changes than longer ones. The minimum potential at which the electricity streams from the point does not depend upon the material of which the point is made ; it varies, however, considerably with the nature of the gas. The following are the results of some experi- ments on this point. Those in the first two columns are due to Eontgen,” those in the third and fourth to Precht^=□□: □□□

Discharge Potential. Point +.

Pressure T60.

Pressure 205.

Pressure 110.

Point +.

Point -.

02

CO CH4 NO CO2

N2 Air

Volts.

1296 2402 2634 2777 3188 8287

Volts.

1174 1975 2100 2317 2543 2655

Volts.

2125 2800

3475 2600 2750

Volts.

1550 2350

2100 2000 2050

We see from this table that in the case of the discharge from a positively electrified point the greater the molecu- lar weight of the gas the greater the potential required for discharge. Eontgen concluded from his experiments that the discharging potential from a positive point in different gases at the same pressure varies inversely as the mean free path of the molecules of the gas. In the same gas, however, at different pressures the discharging potential does not vary so quickly with the pressure as does the mean free path. In Precht's experiments, in which different gases were used, the variations in the discharging potential are not so great as the variations in the mean free path of the gases.

The current of electrified air flowing from the point when the electricity is escaping ??? the well-known " elec- trical wind " ??? is accompanied by a reaction on the point which tends to drive it backwards. This reaction has been measured by Arrhenius,'^ who finds that when posi- tive electricity is escaping from a point in air the reaction on the point for a given current varies inversely as the pressure of the gas, and for different gases (air, hydrogen, and carbonic acid) inversely as the square root of the molecular weight of the gas. The reaction when nega-

tive electricity is escaping is much less. The proportion between the reactions for positive and negative currents depends on the pressure of the gas. Thus for equal positive and negative currents in air at a pressure of 70 cm. the reaction for a positive point was 1-9 times that of a negative one, at 40 cm. pressure 2-6 times, at 20 cm. pressure 3-2 times, at 10-3 cm. pressure 7 times, and at 5-1 cm. pressure 16 times the reaction for the negative point. An investigation similar to that in ►► 2 shows that the reaction should be proportional to the quotient of the current by the velocity acquired by an ion under unit potential gradient. Now this velocity is inversely proportional to the pressure, so that the re- action should on this view be directly proportional to the pressure. This agrees with Arrhenius' results when the point is positive. Again, the velocities of an ion in hydrogen, air, and carbonic acid at the same pressure are approximately inversely proportional to the square roots of their molecular weights, so that the reaction should be directly proportional to this quantity. This also agrees with Arrhenius' results for the discharge from a positive point. The velocity of the negative ion is greater than that of a positive one under the same potential gradient, so that the reaction for the negative point should be less than that for a positive one, but the excess of the positive reaction over the negative is much greater than that of the velocity of the negative ion over the velocity of the positive. There is, however, reason to believe that a considerable condensation takes place around the negative ion as a nucleus after it is formed, so that the velocity of the negative ion under a given potential gradient will be greater immediately after the ion is formed than when it has existed for some time. The measurements which have been made of the velocities of the ions relate to those which have been some time in existence, but a large part of the reaction will be due to the newly-formed ions moving with a greater velocity, and thus giving a smaller reaction than that calculated from the observed velocity.

With a given potential difference between the point and the neighbouring conductor the current issuing from the point is greater when the point is negative than when it is positive, except in oxygen, when it is less. Warburg ^^^ has shown that the addition of a small quan- tity of oxygen to nitrogen produces a great diminution in the current from a negative point, but has very little effect on the discharge from a positive point. Thus the removal of a trace of oxygen made aleak from a neg- ative point 50 times what it was

before. Experiments with hydrogen and helium showed that impurities had a great effect in these gases on the current when the point was negative, and but little when it was positive. This suggests that the impurities, hy condensing round the negative ions as nuclei, seriously diminish their velocity. If a point is charged up to a high and rapidly alternating potential, such as can be produced by the electric oscilla- tions started when a Leyden jar is discharged, then in hydrogen, nitrogen, ammonia, and carbonic acid gas a conductor placed in the neighbourhood of the point gets a negative charge, while in air and oxygen it gets a positive one.^'' There are two considerations which are of import- ance in connexion with this effect. The first is the veloc- ity of the ions in the electric field, and the second the ease with which the ions can give up their charges to the metal point. The greater velocity of the negative ions would, if the potential were rapidly alternating, cause an excess of negative ions to be left in the surrounding gas This is the case in hydrogen. If, however, the metal had a much greater tendency to unite with negative than with positive ions, such as we should expect to be the case m oxygen, this would act in the opposite direction, and tend

to leave an excess of positive ions in the gas. In oxygen and air the second effect seems to overpower the first. Precht (loc. cit.) has observed the changes which take place in the pointed electrodes after the discharge has Been running for some time. He finds that the metal is torn from the positive point, which sometimes gets hol- lowed out into a kind of crater, but that there is no change in a negative point.

 The discharges we have hith- erto considered have been characterized by large potential differences and small currents. In the arc discharge we get very large currents with comparatively small potential differences. We may get the arc discharge by taking a battery of cells large enough to give a potential difference of 60 to 80 volts, and connecting the cells with two carbon terminals, which are put in contact, so that a current of electricity flows round the circuit. If the

terminals, while the current is on, are drawn apart, a bright discharge, which may carry a current of many amperes, passes from one to the other. This arc discharge, as it is called, is charac- terized by intense heat and by the brilliant luminosity of the terminals. This makes it a powerful source of light. The temperature of the positive terminal is much higher than that of the negative. According to Violle,^** the tem- perature of the tip of the former is about 3600►► C, and that of the latter 2700►► C. The temperature of the arc itself he found to be higher than that of either of its terminals. As the arc passes, the positive terminal gets hollowed out into a crater-like shape, but the negative terminal remains pointed. Both terminals lose weight.

The appearance of the terminals is shown in Fig. 22, given by Mrs Ayrton ;i5►► a, b represent the terminals when the arc is quiet, and c when it is accompanied by a hissing sound. The intrinsic

Fig. 22.

brightness of the positive crater does not increase with an increase in the current ; an increased current produces an increase in the area of the luminous crater, but the amount of light given out by each unit of area of luminous surface is unaltered. This indi- cates that the temperature of the crater is constant ; it is probably that at which carbon volatilizes. “W. E. Wilson ^^ has shown that at pressures of several atmospheres the intrinsic brightness of the crater is considerably diminished.

The connexion between V, the potential difference between the terminals, and I, the length of the arc, is somewhat analogous to that which holds for the spark discharge. Frohliohi’”’ gives for this connexion the relation V = m + ni, where m and n are constants. Mrs Ayrton finds that both m and n depend upon the current passing between the terminals, and gives as the relation between

V and I, ►►►V=a+^+(7-| ►►► \l, where u., ^, 7, 5 are constants and

I the current. The relation between current and potential differ- ence was made the subject of a series of experiments by Ayrton, i^^ some of whose results are represented in Fig. 23. For a quiet arc an increase in current is

accompanied by a fall in potential differ- ence, while for the hissing arc the potential difference is independent of the current. The quantities to and n which occur in Frohlich's equation have been determined by several experimenters. For carbon electrodes in air at atmospheric pressure m is about 39 volts, varying somewhat with the size and purity of the carbons ; it is diminished by soaking the terminals in salt solution. The value of n given by different observers varies considerably, ranging

from -76 to 2 volts when I is measured in millimetres ; it depends upon the current, diminishing as the current increases. When metallic terminals are used instead of carbons, the value of m depends upon the nature of the metal, m in general being larger the higher the temperature at which the metal volatilizes. '''^'''

Thus

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Currant- in Amperes

Fig. 23.

V. Lang 153 found the following values for m in air at atmospheric pressure :[illegible] C=35; Pt=27-4 ; Fe=25 ; Ni=26-18; Cu=23-86 ; Ag= 15-23 ; Zn=19-86; Cd = 10-28. Lecher is" gives Pt=28, Fe=20, Ag= 8, while Arons 1*1 found for Hg the value 12-8 ; in this case the fall of potential along the arc itself was abnormally small. In comparing these values it is important to remember that Lecher (loc. cit.) has shown that with Fe or Pt terminals the arc discharge is inter- mittent. Arons has shown that this is also the case with Hg terminals, but no intermittence has been detected with terminals of C, Ag, or Cu. The preceding measurements refer to mean potentials, and no conclusions as to the actual potential differences at any time can be drawn when the discharge is discontinuous, unless we know the law of discontinuity. The ease with which an arc is sustained depends greatly on the nature of the electrodes ; when they are brass, zinc, cadmium, or magnesium it is exceedingly difhcult to get the arc.

The potential difference between the terminals is affected by the pres- sure of the gas. The most extensive series of experiments on this point is that made by Duncan, Rowland, and Tod,i^8 whose results are represented in Fig. 24. We see from these curves that for very short arcs the potential difference increases continuously with the pressure, but for longer ones there is a critical pressure at which the potential difference is a mini- mum, and that this critical pressure seems to increase with the length of arc. The nature of the gas also affects the potential dif- ference. The magnitude of this effect may be gathered from the fol- lowing values given by Arons ^^ for the potential difference required to produce an arc 1-5 mm. long, carrying a current of 4-5 amperes, between terminals of different metals in air and pure nitrogen.

Fig. 24.

Terminal.

Air.

Nitrogen,

Terminal.

Air.

Nitrogen.

Ag . .

21

f

Pt . .

86

30

Zn . .

23

21

Al . .

39

27

Cd . .

25

21

Pb . .

18

Cu . .

27

30

Mg . .

22

Fe . .

29

20

Thus, with the discharge for an arc of given length and current the nature of the terminals is the most important factor in deter- mining the potential difference. The effects produced by the pres- sure and nature of the surrounding gas, although quite appreciable, are not of so much importance, while in the spark dischar

The potential gradient in the arc is very far from being uniform With carbon terminals Luggin i►►6 found that, with a, current of 15 amperes, there was a fall of potential of 33-7 close to tlie anode and one of 8‘7 close to the cathode, so that the curve representing the distribution of potential between the terminals would be some- what like that shown in Fig. 25. We have seen that a somewhat analogous distribution of potential holds in the case of conduction through flames (see ►►11), though in that case the greatest drop of

DIS(3HABGb]

ELECTEICITY

47

Pig. 25.

potential is in general at the cathode and not at the anode. The difference between the changes of potential at the anode and cath- ode are not so large

with Fe and Cu terminals as with carbon ones ; with mercury terminals, Arons i^^ found the anode fall to be 7-4 volts, the cathode fall 5-4 volts. If we take the view that the Catiiadi I 4(SjW conduction in the arc is effected

by means of charged ions, the ex- periments on conduction through flames would lead us to believe that the larger part of the cur- rent would be carried by the negative ions. In a flams at a temperature of about 2000►► C. the velocity of the negative ion is about 17 times that of the positive, while at a temperature of 1000►► C. it is only about four times th^t of the positive. If the ratio of the velocity of the negative goes on increasing with the tempera- ture, we should expect that at the high temperature of the arc it would reach a very large value, so that the ability of the negative ions to carry the current would be very much greater than that of the positive. If the current is carried by the negative ions we can see why the electric field close to the positive electrode must be very strong, for in consequence of the volatilization of the elec- trodes there is a wind of metallic vapour issuing from the electrodes. The experiments of Schuster and Hemsalech on the spark dis- charge indicate that the velocity of this wind would be several hundred metres per second. Thus in order to bring the negative ions up to the positive electrode it is necessary to have an electric field strong enough to drive them against this very rapid wind. Fleming i^' has given reasons for thinking that the discharge in the arc proceeds from the negative to the positive terminal. Placing in the arc a carbon electrode whose temperature was much lower than that of either terminal, he found that when this was connected with the negative electrode of the arc through a galvanometer and a battery of a few cells, a current could be sent by the cells through the circuit in the direction of the current through the arc, but not in the opposite one. He advances the view that the parti- cles of metal torn from the cathode are the carriers of the current ; it seems to the writer more probable that the main portion of the current is carried by the negative ions of very small mass, which we meet with in so many oases of the discharge of electricity through gases. There is in the arc a transport of matter from one terminal to the other ; thus, if one terminal is made of copper and the otlier of iron, after the arc has passed for some time, copper will be found on the iron terminal and iron on the copper one. Experiments have been made by Groves, i** Matteucci,!^^ and Her- wig 1►►► to see whether there is any connexion between the quantity of metal so transferred and the amount

of the same metal that would have been deposited in the ordinary electrolysis of solutions by the same current, but no definite relations have been established. The vaporization of the terminals and the subsequent condensation of the metallic vapours would make this relation, if it existed, very difficult to detect. It is, however, worthy of notice that the amount of metal lost by the terminals is in many cases much less than the product of the quantity of electricity which has passed through the arc and the electro-chemical equivalent of the metal, showing that the bulk of the electricity must be carried by some- thing different from positively charged atoms of the metal.

The fact that the potential difference required to produce a spark of length I is of the form m + nl shows that no electricity can be carried across an arc, however short, without the expenditure of a finite amount of work. The nature of the physical process which this work has to do has not been settled. According to the theory of S. P. Thompson, this work is that required to vaporize the terminals, but though this is doubtless a part of the work the cur- rent has to do, it cannot be the whole, as a calculation of the work required to vaporize the amount of mercury that would carry one unit of electricity shows that it corresponds to a potential differ- ence of less than a volt, while the actual potential difference is about 12 volts. On the view that the discharge in the arc is car- ried by ions, part at least of the work must be spent in producing the ions, part in getting the small ions from the negative terminals. That chemical processes play an important part is shown by the fact, discovered by Mrs Ayrton, that access of oxygen to the posi- tive crater lowers the potential difference by about 10 volts, and also by the difference between the potential differences in air and pure nitrogen.

Hissing Ares. ??? When the current is increased beyond a certain value the discharge becomes noisy, and is accompanied by a hissing sound, while the potential difference between the electrodes falls considerably, and no longer varies with the current (see Fig. 23). The hissing of the arc has been studied by Mrs Ayrton, who has shown that it is caused by the crater extending beyond the tip of

the terminal, and being no longer completely protected by the car- bon vapour from oxidation by the air. She has proved that if the arc passes in a

closed vessel no hissing takes place on an increase in the current after the oxygen has been burnt up, but that it at once recurs when fresh oxygen is blown into the vessel. lYotter”^ has shown that the arc is in rapid rotation in the unstable stage through which it passes just before hissing.

Magnetic Deflexion of the ^re.❓❓❓ The arc is deflected by a magnetic in much the same way as a flexible current between its terminals. As the arc lengthens when deflected by a magnet the potential difference between the terminals is increased by the magnetic field, and by using very strong magnetic fields it can be blown out.

A very interesting example of the arc discharge is when by means of transformers we produce a great difference of potential between the terminals, and transmit a considerable current. The discharge rises from the electrodes in two columns, sometimes some feet long, which unite at the top, where striations are often seen. These columns flicker slowly about and are very easily blown out, a slight puff of air being sufficient to extinguish them. The air-blast apparently breaks the belt of ionized gas along which the current passes, and the current is stopped just as a current through a wire would be stopped if the wire were cut. This arc differs from the arc hitherto considered in that it passes through the air, and not through the metallic vapours from the terminals.

❓❓ 26. Discharge through Oases at Low Pressures. ❓❓❓ As the pressure of a gas through which a spark is passing is gradually reduced, the luminous discharge broadens out, and pronounced differences begin to appear between the brightness and colour of various parts of the discharge, until at a pressure of about -6 mm. of mercury the discharge presents an appearance similar to that shown in Fig. 26.

A velvety glow spreads, often in irregular patches, over the sur- face of the negative electrode k, and a body placed in the glow casts a shadow on the electrode.”^ Next to this there is a comparatively dark region, called the first dark space, or Crookes dark space ; its length depends on the pressure of the gas, increasing as the pressure diminishes. Schuster has shown that an increase in the current produces a slight increase in the thickness of the dark space, the luminous boundary of which is approximately the locus of the extremities of normals of constant length drawn from the negative

electrode. According to Hittorf,!’* this dark space disappears when the negative electrode is raised to a temperature at which it is incandescent. Adjoining it is a luminous column called the negative glow, the length of which is very variable, even when the pressure is constant. It is independent of the position of the positive electrode, its development is checked when the space round the negative electrode is too much restricted by the walls of the tube, and its size increases with the current. Thus if the cathode is a straight wire, it may, with a very small current, only just cover the tip of the wire, but as the current is increased it will cover more and more of the wire until it reaches the glass through which the wire passes. Next after the negative glow comes a second comparatively non- luminous space, ph (Fig. 26), called by some writers the “second negative dark space,” and by others the “Faraday dark space”; it is of very variable length, and is sometimes entirely absent. Next after this we have a luminous column reaching right up to the positive electrode, called the positive column. When the pressure is within certain limits its lumi- nosity often exhibits remarkable periodic alterations in intensity, such as those shown in Fig. 26 ; these are called striations. The bright parts of the striations are slightly concave to the positive electrode, and the distance between them increases as the pressure of the gas diminishes. If the discharge takes place in a tube which is wider at some places than others, they are nearer together in the narrow parts than they are in the wide. They are much influenced by the strength of the current, disappearing when it is increased beyond a certain value, and they are especially noticeable when the gas contains traces of the vapour of some organic com- pounds, e.g., ether. The positive column behaves very differently from the negative glow and the Crookes dark space, for while the latter do not depend on the position of the positive electrode, and are not increased when the length of the tube is increased, the positive column takes the shortest route from the positive to the negative electrode, and by the use of sufficiently long tubes can be made of almost any length. The writer has had tubes with positive columns 50 feet long. The colours of the various parts of the discharge are very different, depending

Fig. 26.

on the nature of the gas ; thus, in nitrogen the positive column is somewhat the colour of chamois leather, while the negative glow is bluish. There are also very interesting difierences in the spectra “^ of different parts of the discharge. Besides the difference in lumi- nosity and colour there are also great variations in other quantities, such as the electric force at various points in the discharge and the mean temperature of the gas.

The distribution of electric force was measured by Hittorf ,1[illegible] and recently by Graham, i’’ A. Herz,“8 Skinner, I’s and H. A. Wilson.i^o Fig. 27 is a curve given by Wilson, showing the distribution in a tube filled with hydrogen at a pressure of 2-25 mm. of mercury, and carrying a current of -568 milli-amperes ; the luminous parts of the discharge are indicated by the dotted lines. The electric

Volts per C m .

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Pressure Z 2s m. m. Current 0 568 ‘ lO’^ampen

Fig. 27. force is a minimum just outside the Crookes dark space, and in- creases with great rapidity inside that space. In the Faraday dark space the potential gradient indicates an excess of negative electrification. In the positive column there is a periodic variation in the potential gradient corresponding to the striation, while in front of the anode the electric force is again a minimum, and in- creases rapidly right up against the anode. In 7 we saw that on the hypothesis that the discharge is carried by ions moving with a, velocity proportional to the force acting upon them, the excess of ionization over recombination is proportional to S./dx’’, when X is the electric force ; hence the ionization will exceed the recombination when the curve for X is convex to the axis of X, and be less than the recombination when the curve is concave to the axis of x. Applying this to the curve in Fig. 27, we see that there is strong ionization near each of the electrodes, and that the ionization exceeds the recombination in the Faraday dark space, while in thfe

luminous parts of the discharge the re- combination exceeds the ionization. In the striated discharge we see from Fig. 13 that recombination is greater than ionization in the bright parts, and less in the dark parts.

Cathode Fall of Potential. ??? The electric field in the neighbour- hood of the electrodes, and especially of the cathode, has been made the subject of many researches. Hittorf showed that the potential difference between the cathode and a point in the negative glow was independent of the current, unless the current was so large that the negative glow covered the whole of the cathode. When that stage was reached an increase in the current increased the fall of potential. Warburg I'l showed that this fall of potential was independent of the pressure of the gas, and that if the terminals were made of aluminium or magnesium the fall of potential was considerably less than when they were made of other metals, all of which gave approximately the same potential fall. He showed too that the potential fall was very much influenced by impurities in the gas. Thus the potential fall in nitrogen containing traces of moisture and oxygen was 260 volts, but after the gas was care- fully dried the potential rose to 343, while on the removal of the oxygen it fell again to 243 volts. Measurements of the cathode fall of potential have been made by Capstick 1^2 and Strutt,''^ whose results are shown in the following table. The cathode fall of potential seems to agree very nearly with the minimum potential difference required to produce a spark :^

Oas.

Cathode FaU with Pt Electrodes.

Minimum Potential

Dllference required

to produce a Spark

(Strutt).

Warburg.

Capstick.

Strutt.

Air .

H, . . .

n”, . . . Hg. vapour . Helium . H,0

840-850 volts. About 800 volts.

230 if free from 0.

840

298 869 282

469

226

841 802-808

251

261-826

Schuster found that the potential difference V in the dark space at a distance x from the cathode was represented by the formula V=Vo(l-6H►►^). Graham (?oc. cit.} found that this formula did not hold right up to the cathode, but that the curve representing the electric intensity in the neighbourhood of the cathode had a minimum value immediately in front of the electrode.

Anode FaU of Potential.►►► A finite fall of potential occurs between the anode and the luminous gas in its immediate neighbourhood ; this is much less than the cathode fall, and it seems to take place within even a shorter distance. ” Skinner, who investigated the anode fall of potential in the

unstriated dis- charge through nitrogen, found that it was independent of the current through the gas, increased slowly with the pressure of the gas, and depended upon the material and state of surface of the elec- trodes. For Al and Mg, the metals for which the cathode fall is least, the anode fall is greatest. The anode fall for different metals and for different

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28.

ous pressures is repre- sented in Fig. 28. Both Skinner and H. A. Wilson found the po- tential gradient in the gas just in front of the anode beyond the region of the anode fall was exceedingly small, not amounting to a volt per centimetre. A. Herz showed that the potential gradient in the unstriated posi- tive column diminished as the current increased, in such a way that if X is the electric intensity when the current is l, Xo when it is 10, then X𝍐𝍐𝍐Xo= 𝍐𝍐𝍐 6(1-10), where 6 is a constant.

Heat produced by the Discharge.𝍐𝍐𝍐 The average temperature of a gas at low pressure conveying a luminous discharge is by no means high. E. Wiedemann 1** proved that the average temperature of the gas in a tube containing air at a pressure of 3 mm. of mercury is less than 100𝍐𝍐 C, though the discharge is luminous. These measure- ments refer to the average temperature of all the molecules in a considerable space, and the low average temperature does not of course preclude the possibility of a small number of molecules having velocities very much greater than the mean velocity corre- sponding to the temperature indicated by the thermometer. Hittorf,i85 measuring the mean temperature at three points in the discharge, one in the positive column, the second in the negative glow, and the third in the Crookes dark space, found that the tem- perature was highest in the darkest space, and lowest in the posi- tive column. E. Wiedemann i^^ showed that the distribution of temperature along the discharge depended on the pressure, and that while at low pressures the temperature at the cathode was higher than at the anode, the reverse was true when the pressure exceeded 26 mm. A very complete investigation of the distribution of tem- perature along the discharge has been made by

Wood,!^’ who ob- served that in the unstriated discharge the temperature is constant in the positive column, diminishes in the Faraday dark space, reaches a minimum at a point in this space a little in front of the negative glow, and rapidly increases in the dark space next the cathode. In the striated discharge the temperature is a maximum in the bright parts of the striations and a minimum in the dark parts ; in no part of the discharge did Wood find the mean temper- ature to exceed 100►► C. The distribution of temperature thus fol- lows the same course as the distribution of electric force in the tube. The rate of work done by the current at any point of the path is proportional to the product of the current and the electric force, or since the current is constant all along the tube, to the electric force. If this work were entirely converted into heat, the temperature curves would be the same as the curves for the electric force, and from the investigations of Wood and Graham this would seem to be very approximately the case. We conclude that in tubes at moderate pressures the greater part of the electrical work done appears as heat in the gas at a place not very distant from where the work was done.

►► 27. Cathode Rays. ►►► When the gas in the discharge tube is at avery low pressure some remarkable phenomena occur in the neighbourhood of the cathode. These seem to have been first observed by Plucker,^^ who noticed on the walls of the glass tube near the cathode a greenish phosphores- cence, which he regarded as due to rays proceeding from the cathode, striking against the sides of the tube, and then travelling back to the cathode. He found that the

discharge]

action of a magnet on these rays was not the same as the action on the part of the discharge near the positive elec- trode. Hittorf ^*’ showed that the agent producing the phosphorescence was intercepted by a solid, whether con- ductor or insulator, placed between the cathode and the sides of the tube. He regarded the phosphorescence as caused by a motion starting from the cathode and travel- ling in straight lines through the gas. Goldstein * con-

firmed this discovery of Hittorf's, and further showed that a distinct, though not very sharp, shadow is cast by a small object placed near a large plane cathode. This is a proof that the rays producing the phosphorescence must be emitted almost normally from the cathode, and not, like the rays of light from a luminous surface, in all directions, for such rays would not produce a perceptible shadow if a small body were placed near the plane. Goldstein regarded the phosphorescence as due to waves in the ether, for whose propagation the gas was not nec- essary. Crookes,'^ who made many remarkable researches in this subject, took a different view. He regarded the rays as streams of negatively electrified particles pro- jected normally from the cathode with great velocity, and, when the pressure is sufficiently low, reaching the sides of the tube, and by their impact producing phosphorescence and heat. The rays on this view are deflected by a magnet, because a magnet exerts a force on a charged moving body. These rays striking against glass make it phosphores- cent. The colour of the phosphorescence depends on the kind of glass ; thus the light from soda glass is a yellow- ish green, and that from lead glass blue. Many other bodies phosphoresce when exposed to these rays, and in particular the phosphorescence of some gems, such as ru- bies and diamonds, is exceedingly vivid. The spectrum of the phosphorescent light is generally continuous, but Crookes has shown that the phosphorescence of some of the rare earths, such as yttrium, gives a spectrum of bright bands, and he has founded on this fact a spectro- scopic method of great importance. Goldstein ^^ discov- ered that the haloid salts of the alkali metals change colour under the rays, sodium chloride, for example, be- coming violet. The coloration is a surface one, and has been traced by E. Wiedemann and Schmidt ^^' to the for- mation of a sub-chloride. Chlorides of tin, mercury, and lead also change colour in the same way. E. Wiedemann❓❓❓ discovered another remarkable effect, which he called thermo-luminescence ; he found that many bodies after being exposed to the cathode rays possess for some time the power of becoming luminous when their temperature is raised to a point far below that at which they become lumi- nous in the normal state. Substances belonging to the class called by van't Hoff^'' solid solutions exhibit this property of thermo-luminescence to a remarkable extent. They are formed when two salts, one greatly in excess of the other, are simultaneously precipitated from a solution. A trace of MnS04 in CaSO^ shows very brilliant thermo-luminescence. The impact of cathode rays produces after a time percep- tible changes in the glass. Crookes^^ found that after glass has been phosphorescing for some time under the

cathode rays it seems to get tired, and the phosphorescence is not so bright as it was initially. Thus, for example, when the shadow of a Maltese cross is thrown on the walls of the tube as in Eig. 29, if after the discharge has been going on for some time the cross is shaken down or a new cathode used whose line of fire does not cut the cross, the pattern of the cross will still be seen on the glass, but it will now be brighter instead of darker than the surrounding portion. The portions shielded by the cross, not being tired by be- ing made to phosphoresce for a long time, respond more vigorously to the stimvilus than those portions which have not been protected. Skinner '^ and the writer found on the glass which had been exposed to the rays gelatinous

Fig. 29.

filaments, apparently silica, resulting from the reduction of the glass. A reducing action was also noticed by Vil- lard❀❀❀ and Wehnelt.'"* It can be well shown by letting the rays fall on a plate of oxidized cop- per,whenthe part struck by the rays will become bright. The rays heat bodies on which they fall, and if they are con- centrated by

using as a cathode a portion of a spherical surface, the heat at the centre becomes so great that a piece of plati- num wire can be melted or a diamond charred. Measure- ments of the heating effects of the rays have been made by the writer and Cady. Crookes ' has shown that a vane mounted as in a radiometer is set in rotation by the rays, the direction of the rotation being the same as would be produced by a stream of particles proceeding from the cathode. Eiecke ❀❀❀ made a series of measujements of the pressure produced on the vanes.

❀❀ 28. Effect of a Magnet. ❀❀❀ The rays are deflected by a magnet, so that the distribution of phosphorescence over the glass and the shape and position of the shadows cast by bodies in the tube are altered by the proximity of a magnet. The laws of magnetic deflexion of these rays have been investigated by Pliicker,❀❀❀ Hittorf,❀❀❀ Crookes,^" and Schuster. ^^ The deflexion is the same as that of nega- tively electrified particles travelling along the path of the rays. Such particles would in a magnetic field be acted on by a force at right angles to the direction of

motion of the particle and also to the magnetic force, the magnitude of the force being proportional to the product of the ve- locity of the particle, the magnetic force, and the sine of the angle between these vectors. In this case we have seen (►► 8) that if the particle is not acted on by an electro-static field, the path in a uniform magnetic field is a spiral, which, if the magnetic force is at right angles to the di- rection of projection of the particle, becomes a circle in the plane at right angles to the magnetic force, the radius being mv/He, where m, v, e are respectively the mass, velocity, and charge on the particle, and H is the mag- netic force. The smaller the difference of potential between the electrodes of the discharge tube the greater the deflexion produced by a magnetic field of given strength, and as the difference of potential rapidly in- creases with diminution of pressure, after a certain pres- sure has been passed, the higher the exhaustion of the tube the less the magnetic deflexion of the rays. Birke- land^ has shovra that when the discharge is from an induction coil the cathode rays produced in the tube at any one time are not equally deflected by a magnet, but that a narrow patch of phosphorescence when deflected by a magnet is split up into several distinct patches, giv- ing rise to what Birkeland calls the magnetic spectrum. Strutt ”” has shown that this magnetic spectrum does not occur if the discharge of a large number of cells is em- ployed instead of the coil. The writer ^ has shown that if the potential difference between the electrodes is kept the same the magnetic deflexion is independent of the nature of the gas filling the discharge tube; this was tested with gases so different as air, hydrogen, carbonic acid, and niethyl iodide.

►► 29. Charge of Negative Electricity carried by the Bays. ►►► We have seen that the rays are deflected by a magnet,

[electric

Earrh

Fig. 30.

as if they were particles charged with negative electricity. Perrin ^ showed by direct experiment that a stream of negative electricity is associated with the rays. A modi- fication made by the writer of Perrin's experiment is sketched in Fig. 30.

The rays start from the cathode A, and pass through a slit in a solid brass rod B fitting tightly into the neck of the tube. This rod is connected with earth and used as the anode. The rays after passing through the slit travel through the vessel C. D and E are two insulated metal cylinders insulated from each other, and ^ each having a slit cut in

its face so as to enable the rays to pass into the inside of the inner cylinder, which is con- nected with an electro- meter, the outer cylinder being connected with the earth. The two cylinders are placed on the far side of the vessel, but out of the direct line of fire of the rays. When the rays go straight through the slit there is only a very small negative charge communicated to the inner cylinder, but when they are deflected by a magnet so that the phosphorescent patch falls on the slit in the outer cylinder the inner cylinder receives a very large negative charge, the increase coinciding very sharply with the appearance of the phosphorescent patch on the slit. When the patch is so much deflected by the magnet that it falls below the slit, the negative charge in the cylinder again disappears. This experiment shows that the cathode rays are accompanied by a stream of negative electrification. The same apparatus can be used to show that the passage of cathode rays through a gas makes it a conductor of electricity. For if the induction coil is kept running and a stream of the rays kept steadily going into the inner cylinder, the potential of the inner cylinder reaches a definite negative value below which it does not fall, however long the rays may be kept going. . The cylinder reaches a steady state in which the gain of negative electricity from the cathode rays is equal to the loss by leakage through the conducting gas, the conductivity being produced by the passage of the rays through it. If the inner cylinder is charged up initially with a greater negative charge than corresponds to the steady state, on turning the rays on to the cylinder the negative charge will decrease and not increase until it reaches the steady state. The conductivity produced by the

passage of cathode rays through a gas diminishes rapidly with the pressure. When rays pass through a gas at a low pressure, they are deflected by an electric field ; when the pressure of the gas is higher the con- ductivity it acquires when the cathode rays pass through it is so large that the potential gradient cannot reach a sufficiently high value to produce an appreciable de- flexion. In prov- ing the existence of this defiexion the writer 211 used the apparatus represented in Fig. 31. The rays from the cathode C pass through a slit in the anode A, which is a metal plug fitting tightly into the tube and connected with the earth. After passing through a second slit in another earth-connected metal plug B, they travel between two aluminium plates D and E, and then fall on the end of the tube, where they produce a narrow, well-defined phosphorescent patch. At high exhaustions the rays were deflected when the aluminium plates were connected with the terminals of a battery of storage cells, the direction of the deflexion being such as would occur if the rays were negatively electrified particles.

Thus the cathode rays carry a charge of negative elec- tricity, they are deflected by an electric field as if they were negatively electrified, and are acted on by a magnetic force in just the way this force would act on a nega- tively electrified body moving along the path of the

Fig. 31.

rays. There is therefore every reason for believing that they are charges of negative electricity in rapid motion, and by measuring the deflexion produced by magnetic and electric fields we can determine the velocity with which these particles move and the ratio of the mass of the particle to the charge carried by it.

If the rays travel through a space I in a uniform electric field acting at right angles to the direction of motion of the rays, and if the electric force is equal to F, the acceleration at right angles to the path is Fe/m, where e is the charge on the particle and m its mass. Hence, if 6 is the angle through which the direction of motion is twisted, e=FeZ/m►►2, where v is the velocity of the particle. Again, if the particle moves through a distance I in a uniform magnetic field of strength H at right angles to its direction of motion, the acceleration at right angles to the path is H ev/m.. Hence if is the angle through which the direction of motion is twisted, = Bevl/mv^ =

Hel/mv. Hence if we measure 6 and 4> we can determine the values of V and m/e. The easiest way of determining v is to make the electro- static and magnetic forces act in opposite directions on the particle.and adjust the magnetic force until it just neutralizes the electric; then if H is the magnetic and F the electric force, F = H►►). From experi- ments made in this way at very low pressures by the writer [i] the value of m/ e for the mean of seven determinations was l‘3xl0~’, and was the same whatever the nature of the gas, the gases tried being air, hydrogen, and carbonic acid. The velocity v depends upon the pressure of the gas, increasing as the pressure decreases. The veloci- ties observed in these experiments ranged between 2‘2 x lO^cm./sec. to 3-6 X 10^ cm. /sec. Another method used by the writer to measure ►►►u and m/e was to allow a bundle of rays to enter a metal cylinder and measure the charge of negative electricity carried in by them. In the cylinder a thermo-electric junction was arranged, and the impact of the rays against this raised its temperature by an amount which could be measured by the current sent round the thermo-electric circuit. Thus with a knowledge of the thermal capacity of the junction it was possible to determine the mechanical equivalent of the heat given up by the rays to the surface on which they impinged. Let N be the number of charged particles entering the cylinder, and Q the negative charge it receives ; thenNe=Q. If E is the mechanical equivalent of the heat produced by tlie impact, then assuming that the particles give up all their energy on collision, we have J Nmw2=E ; hence m!)%=2E/Q, Thus measurements of E and Q combined with measurements of the magnetic deflexion which gives mv/e will enable us to determine m/e and v. Measurements made by this method gave for m/e the value ~~9 x 10~~‘ with velocities ranging from 2-4 x 10 cm. /sec. to 3 ~~2 x 10′ cm. /sec. Kauffmann.’~~‘is who has made an extensive series of measurements of the value of m/e and v, uses a somewhat difierent process. One of the quantities measured by him is the magnetic deflexion, and the other is the difference in potential between the cathode and anode. If V is this difference, and if we assume that the energy of the moving particle is due to passing between two places differing in potential by V, we have mv’=2Ve. If V is measured this equa- tion, combined with the equation for the magnetic deflexion, enables us to find m/e and v. In this way Kauffmann found m/e= ►►►54×10”’. He confirms the result that this value is in- dependent of the nature of the gas and of the electrodes. This method assumes that the potential at the commencement of the path of a particle is the same as the potential of the cathode. Now the potential

close to the cathode changes with great rapidity, so that if the cathode particle started from a place close to but not absolutely in contact with the cathode a considerable correction would be necessary. The effect of this correction would be to increase the value of m/e. By measuring directly the value of V Wieohert^i* has deduced the value of m/e. He deter- mined V by making the cathode rays pass through two equal spirals at a considerable distance from each other, the spirals being traversed by a very rapidly alternating current produced by discharging condensers. If the velocity of the cathode rays was infinite the currents in the two circuits would be in the same phase when the rays passed through them, and the magnetic deflexion would be the same. If, however, the rays took a►►time equal to half the time of oscillation of the current to pdss from one spiral to another, the deflexions would be opposite. There- fore, by comparing the deflexions in the two spirals the velocity of the rays can be determined. The result was that any value of e/m between 1-01 x 10′ and 1 -55 x 10′ was quite probable, but that it was unlikely that e/m was greater than 1 -84 x 10′ or less than -87 x 10’.

We may conclude from these experiments that the value of m/e for the particles constituting the cathode rays is of the order 10-‘, and we have seen that ?)i/e has the same value in all the other cases of negative ions

in a gas at low pressure for which it has been measured

viz., for the ions produced when ultra-violet light falls ou

discharge]

a metal plate, or when an incandescent carbon filament is surrounded by a gas at a low pressure. We have also seen that the value of the charge on the gaseous ion, in all cases in which it has been measured ►►► viz., the ions pro- duced by Eontgen and uranium radiation, by ultra-violet light, and by the discharge of electrification from a point ►►► is the same in magnitude as the charge carried by the hydrogen atom in the electrolysis of

solutions. The mass of the hydrogen alone is, however, lO”* times this charge, while the mass of the carriers of negative electrification is only 10~’ times the charge ; hence the mass of the carriers of the negative electrification is only j-^ of the mass of the hydrogen atom. We are thus, by the study of the electric discharge, forced to recognize the existence of masses very much smaller than the smallest mass hitherto recognized in chemistry.

Direct determinations of the velocity of the cathode rays have been made by the writer^’^ by measuring the interval between the appearance of phosphorescence on two pieces of glass placed at a known distance apart, and by Maiorana^is and Battelli and Stefan- ini,2i7 who measured the interval between the arrival of the negative charge carried by the rays at two places separated by a known distance. The values of the velocity got in this way are much smaller than the values got by the indirect methods previously described : thus the writer at a fairly high pressure found the velocity to be 2×10′ cm. /sec. Maiorana found values ranging between 10′ and 6 x 10′ cm. /sec, and Battelli and Stefanini values ranging from 6×106 to 1-2×10’. In these methods it is very difficult to eliminate the effect of the Interval which elapses between the arrival of the rays and the attainment by the means of detection, such as the phosphorescence of the glass or the deflexion of the electrometer, of sufficient intensity to affect the senses.

30. Transmission of Cathode Bays through Solids Lenard Rays.

It was for a long time believed that all solids were absolutely opaque to these rays, as Crookes and Goldstein had proved that very thin glass, and even a film of collodion, cast intensely black shadows. Hertz, how- ever, showed that behind a piece of gold-leaf or aluminium foil an appreciable amount of phosphorescence occurred on the glass, and that the phosphorescence moved when a magnet was brought near. A most important advance was next made by Lenard,^’ who got the cathode rays to pass from the inside of a discharge tube to the air outside. For this purpose he used a tube like that shown in Fig. 32. The cathode K is an aluminium disc 1-2 cm. in diameter fastened to a stiff wire, which is surrounded by a glass tube. The anode A is a brass strip partly surrounding the cathode. The end of the tube in front of the cathode is closed by a strong metal cap, fastened in with marine glue, in the middle of which a hole 1-7

mm. in diameter is bored, and covered with a piece of very thin aluminium foil about ~~0026 mm. in thickness. The aluminium window is in metallic contact with the cap, and this and the anode are connected with the earth. The tube is then ex~~ hausted until the cathode rays strike against the window. Diffuse light spreads from the window into the air outside the tube, and can be traced in a dark room for a distance of several centimetres. From the window, too, proceed rays which, like the cathode rays, can produce phosphor- escence, for certain bodies phosphoresce when placed in the neighbourhood of the window. This effect is conveniently observed by the platino-cyanide screens used to detect Routgen radiation. The properties of the rays outside the tube resemble in all respects those of cathode rays ; they are deflected by a magnet and by an electric field, they ionize the gas through which they pass and make it a conductor of electricity, and they affect a photo- graphic plate and change the colour of the haloid salts

Fig. 32.

of the alkali metals. As, however, it is convenient to distinguish between cathode rays outside and inside the tube, we shall call the former Lenard rays. In air at atmospheric pressure the Lenard rays spread out very diffusely. If the aluminium window, instead of opening into the air, opens into another tube which can be ex- hausted, it is found that the lower the pressure of the gas in this tube the farther the rays travel and the less diffuse they are. By filling the tube with different gases Lenard showed that the greater the density of the gas the greater is the absorption of these rays. Thus they travel farther in hydrogen than in any other gas at the same pressure. Lenard showed, too, that if he adjusted the pressure so that the density of the gas in this tube was the same ~~***~~ if, for example, the pressure when the tube was filled with oxygen was ~~^^ of the pressure when it was filled with hydrogen *** the absorption was constant whatever the nature of the gas. The distance to which the Lenard rays penetrate into this tube depends upon the pressure in the discharge tube ; if the exhaustion in the latter is very high, so that there is a large potential difference between the cathode and the anode, and therefore a high velocity for the cathode rays, the Lenard rays will pene~~ trate farther than when the pressure in the discharge tube is higher and the velocity of the cathode rays smaller. Lenard showed that the greater the penetrating power of his rays the smaller was

their magnetic deflexion, and therefore the greater their velocity ; thus the greater the velocity of the cathode rays the greater is the velocity of the Lenard rays to which they give rise. Lenard^ has studied the passage of his rays through solids as well as through gases, and has arrived at the very interesting result that the absorption of a substance depends only upon its density, and not upon its chemical composition or physical state ; in other words, the amount of absorption of the rays when they traverse a given distance depends only on the quantity of matter they cut through in the distance. By measuring the magnetic and electric de- flexion of these rays Lenard^^ determined the value of e/m and also v, m being the mass of the particle, e its charge, and v its velocity. He found e/m=6-4 x 10^, which agrees well with the value found for the cathode rays, and V in his experiments reached the value 8 x 10′ cm. /sec. for penetrating rays. M'Clelland❓❓❓ showed that the rays carry a charge of negative electricity, and M'Lennan measured the amount of ionization rays of given intensity produced in different gases, finding that if the pressure is adjusted so that the density of the different gases is the same the number of ions per cubic centimetre is also the same. In this case, as Lenard has shown, the absorption is the same, so that with the Lenard rays, as with uranium and probably with Eontgen rays, equal absorption corresponds to equal ionization. A convenient method for producing Lenard rays of great intensity has been described by Des Coudres.^

Diffuse Seflexion of Cathode Bays. ❓❓❓ When cathode rays fall upon a surface, whether of an insulator or a conductor, cathode rays start from the surface in all directions. This phenomenon, which was discovered by Goldstein,^^* has been investigated by Starkej^"^ Campbell-Swinton,^^' and Merritt; it is often regarded as analogous to the difluse reflexion of light from such a surface as gypsum, and is spoken of as the difiuse reflexion of the cathode rays. According to Merritt the deviation in a magnetic field of these reflected rays is the same as that of the incident rays. The experiments, how- ever, were confined to rays reflected so that the angle of reflexion was nearly equal to that of incidence. According to Campbell-Swinton the diffuse "reflexion" is accompanied by a certain amount of specular reflexion.

Bepulsion of two Cathode Streams. ??? Goldstein^^T discovered that if in a tube there are two cathodes connected together, the cathodic rays from one cathode are deflected when they pass near the other. Experiments bearing on this subject have been made by Crookes^'^ and Wiedemann and Ebert.^' The phenomena may be described

by saying that the repulsion of the rays from a cathode A by a cathode B is only appreciable when the rays from A pass through the Crookes dark space round B. This is what we should expect if we remember that the electric field in the dark space is far stronger than in the rest of the discharge, and that the gas in the other parts of the tube is rendered a conductor by the passage through it of the cathode rays, and therefore incapable of transmitting electrostatic repulsion.

?? 31. Positive Rays or " Kanal-str allien." ??? Goldstein ^ fofind that with a perforated cathode certain rays oc- curred behind the cathode which were not appreciably deflected by a magnet ; these he called Kanal-strahlen, but we shall, for reasons which will appear later, call them " positive rays."

Their appearance is well shown in Fig. 33, taken from a paper by Wehneltj^si in which they are represented at B. Goldstein found that their colour depends on the gas in which they are formed, being gold-colour in air and nitrogen rose-colour in

hydrogen, yellowish rose in oxygen, and greenish grey in carbonic acid. W. Wien282 showed that by using very intense magnetic fields they can be deflected (although the deflexion is very small compared with that of the cathode rays) in a direction corresponding

Pig. 33.

to that of positive ions moving away from the cathode. He proved directly that the rays carry a charge of positive electricity ??? a fact which was confirmed by Ewers. ss Villard,^! on ^,iie other hand, was unable to detect any positive charge until the rays had been started some time ; then he observed a positive charge, which he ascribed to the diffusion of ions from the other part of the dis- charge tube. Wien also showed that the rays are deflected by an electric field, and by measuring the magnetic and electric deflexions he was able to determine m/e and v. For the former he found with iron electrodes the value 3‘2xl0-3, and for v 3-6 X 10′ cm. /sec. The value m/e contrasts very markedly with the value of the same quantity 10”’ for the cathode rays, for Wien’s value is of the same order as the mass of a molecule divided by its charge, and suggests that the carriers of the positive electricity are chemical atoms or molecules. According to Ewers (loc. cit.) the value of m/e depends upon the nature of the elec- trodes, and he regards the metallic ions from the electrode as being the carriers of the positive electricity in the positive rays. The researches of Schuster, ^35 Villard {loc. cit.), and Wehnelt have established that in the Crookes dark space there is a flow of posi- tive electricity up to the cathode ; according to Schuster a body placed in the dark space throws a shadow on the cathode. An example of these shadows is shown in Fig. 33. The flow of positive electricity to the cathode and of negative away from the cathode are mutually dependent ; it is only from those parts of the cathode struck by the positive flow that cathode rays start, and it is only those parts of the gas which are struck by the cathode rays that furnish the stream of positive electricity. The positive

rays seem to be the continuation of this positive stream through the perforations in the cathode.

Rbntgen Rays. Rontgen discovered in 1895 a very remarkable effect arising from the cathode rays. He found that, in the neighbourhood of a discharge tube ex- hausted so highly that the cathode rays produced a vivid green phosphorescence on the glass, a plate covered with a phosphorescent substance such as potassium platino- cyanide began to glow. He found that if a thick piece of metal were placed between the bulb and the phosphor- escent screen, a sharp shadow of the metal was cast upon the screen, but that other substances, such as wood and thin pieces of aluminium, cast but slight shadows, show- ing that the agent which produced the phosphorescence could traverse with considerable freedom bodies which are opaque to ordinary light. He found that as a general nde the greater the density of the substance the greater its opacity to this agent. Thus while the effect produced by the phosphorescence could pass through the flesh, it was stopped by the bones of the hand, so that if a hand were held between the discharge tube and the phosphorescent screen the outline of the bones was distinctly visible as a

shadow cast on the screen, or if a purse containing coins were placed between the tube and the screen the purse itself threw but little shadow, while the coins cast a dark one. Rontgen showed that the cause of the phosphor- escence now called Rontgen rays was propagated in straight lines, and was not bent on passing from one medium to another, there thus being no refraction. Again, no deflexion by a magnet can be detected ; Rontgen could discover none with the strongest magnetic fields at his disposal, and the writer has sent the rays through a magnetic field of about 8000 lines of force per sq. cm. for a distance of about a centimetre without producing any appreciable effect. Many attempts have been made to detect signs of polarization by measuring their absorp- tion by two thin plates of tourmaline placed first with their axes parallel and then with their axes crossed, but no sensible difference has been detected in the two cases ; the absorption of ordinary light would have been very much greater in the second case than in the first. The rays affect a photographic plate as well as a phosphor- escent screen, and shadow photographs can be readily taken. The time of exposure depends on the intensity of the rays, and this depends

on the discharge through the tube and on the substances traversed by the rays in their journey to the plate. In some cases an ex- posure of a few seconds is sufiicient, in others hours may be required. The rays coming from different discharge tubes have very different penetrating power. If the pressure in the tube is fairly high, so that the potential difference between its electrodes is small and the velocity of the cathode rays low, the Rontgen rays will be very readily absorbed. Such rays are called ” soft rays.” If the exhaustion of the bulb is carried further, so that there is a considerable increase in the potential difference between the cathode and anode and therefore in the velocity of the cathode rays, the Rontgen rays have much greater penetrating power and are often called ” hard rays.” With a highly exhausted tube and a large induction coil it is possible to get appre- ciable effects from rays which have passed through sheets of iron or brass several millimetres thick. The penetrating power of the rays thus varies with the pressure in the tube ; as the pressure in the tube gradually diminishes when the discharge is kept running through the tube, the type of discharge proceeding from the tube is con- tinually changing. This lowering of the pressure finally leads to such a high degree of exhaustion that the discharge has great difficulty in passing, and the emission of the rays becomes very irregular. Heating the tube causes some gas to come off the sides, and by thus increasing the pressure causes a temporary improvement. Tubes are sometimes provided with pieces of carbon or caustic potash, which when heated give up gas and so tend to restore the original pressure. The lowering of pressure by the discharge is not confined to the very low pressures which occur in the tubes used to generate Rontgen rays, but is found also at pressures greater than 1 mm. of mercury. An appreciable amount of gas can be made to disappear in this way when introduced gradually into the tube ; the writer in a small tube used up a quantity whifih would occupy a volume of 6 c.c. at atmospheric pressure. The gas seems to be absorbed by the glass rather than by the electrode, as the absorption goes on when a ring discharge is sent through a bulb without electrodes. Not only do different bulbs emit different kinds of rays, but the same bulb may emit at the same time rays of different kinds. The property by which it is most convenient to identify a ray is the absorption it suffers when it passes through a certain thickness di. aluminium and tin-foil. In some experiments made by M’Clelland and the writer ^’ on the absorption of the ravs

produced by sheets of tin-foil, it was found that the absorption by the first sheets of tin-foil traversed by the rays was much greater than that by the same number of sheets when the rays had already passed throvigh several sheets of tin-foil. This effect is just what would occur if some of the rays were readily absorbed by tin-foil, whilst others passed through with greater facility ; thus the first few layers would stop all the readily absorbable ††† rays, while those left would get through. M'Clelland showed that if he took thicknesses of two different substances such as to give equal absorptions with the rays from one bulb, they would not necessarily give equal absorptions with the rays from another, again proving the variety which exists in these rays. The fact that the rays when they pass through a gas ionize it and make it a conductor of electricity (see †† 15) provides one of the best means of investigating their intensity, as the meas- urement of the amount of conductivity they confer on a gas is both more exact and more convenient than meas- urements of photographic or phosphorescent effects.

When RSntgen rays impinge on a surface there is a diffuse return of rays. The absence of refraction would lead us to expect that there would be no regular reflection, but the experiments of Rood,288 jolyj239 anij Lord Blythswood^*" seem to prove that it does exist to a small extent. By far the larger part, however, of the effect pro- duced when the rays strike a surface is the emission of secondary Rbntgen radiation, which possesses the characteristic properties of primary Rbntgen radiation, but differs in being far less penetrating. The effects produced when Rbntgen rays fall upon the surfaces of solids or liquids have been investigated by Perrin,*! Sagnac,*^ and Townsend.2'8 The results obtained by these observers have already been discussed (†† 17).

†† 33. Nature ofBontgen Bays. ††† Whether Eontgen rays are a form of light, that is, are some form of electro-mag- netic disturbance propagated

through the ether, is a ques- tion on which .t present the evidence is not quite decisive. They resemble light in their rectilinear propagation'. They affect a photographic plate, and, as Brandes and Dorn^ have shown, they produce an effect, though a small one, on the retina, giving rise to a very faint illumination of the whole field of view. They resemble light in not being deflected by either electric or magnetic forces, while the secondary rays, of small penetrating power, produced by the incidence of the more penetrating primary rays, may be compared with the fluorescent visible light given out by certain substances when illuminated with ultra-violet light. The absence of refraction is not an argument against the rays being a kind of light, for all theories of refraction make this property depend upon the relation between the period of vibration, T, of the refracting sub- stance, and the period t of the light vibrations, the refrac- tion vanishing when T/t is very small. Thus there would be no refraction for light of very small period, and this would also be true if instead of regular periodic undula- tions we have a pulse of electro-magnetic disturbance, provided the time taken by light to travel over the thick- ness of the pulse be small compared with the periods of vibration of the molecules of the refracting substance. The absence of polarization in Eontgen rays after passing through tourmaline is again not decisive ; the structure of tourmaline may be too coarse to produce polarization by absorption in waves of such small wave-length, or of such thin pulses as we must, if we accept this view, regard as forming Eontgen rays. The difiiculties of experiments on the diffraction of these rays are very great, apart from those which would be caused by the smallness of the wave-length or the thinness of the pulse. The secondary radiation produced when the rays strike against the photo- graphic plate or pass through air might give rise to what might easily be mistaken for diffraction effects. Eont-gen^* has never succeeded in observing effects which prove the existence of diffraction. I'omm^'' observed.

in the photograph of a narrow slit, light and dark bands which look like diffraction bands, but observations with slits of different sizes showed that they were not of this nature, and Haga and Wind^^ have explained them as contrast effects. The last two observers, however, noticed with a very narrow wedge-shaped slit a broadening of the image of the narrow part which they are satisfied could not be explained by the causes previously mentioned, and which they regard as conclusive proof of diffraction. Other

observations on this point have been made by Maier.^’” We may sum up our present state of knowledge by saying that while there is nothing in the properties of these waves inconsistent with their being a form of light, the direct experimental proof of this result is not very strong. Sir George Stokes❖❖❖” has put forward the view that the disturbances which constitute them are not regular periodic undulations, but very thin pulses. The writer❖❖❖’ has shown that when charged particles are sud- denly stopped, pulses of very intense electric and mag- netic disturbance are started ; as the cathode rays consist of negatively electrified particles, the impact of these on a solid would give rise to these intense pulses. Electro-magnetic theory thus shows that effects resembling light in being electro-magnetic disturbances propagated through the ether must be produced when the cathode rays strike against an obstacle. Since under these circumstances Eontgen rays are produced, it seems natural, unless direct evidence to the contrary is obtained, to connect the Eont- gen rays with these pulses.

Absorption of Bontgen Bays. ❖❖❖ Though as a rule dense bodies absorb Rbntgen rays more powerfully than light ones, there does not appear to be that simple connexion between density and ab- sorption which Lenard has shown to exist in the case of the Lenard rays. For the latter the absorption by slabs of different substances is the same, independent of the nature and physical condition of the substance, if the thickness of the slab is inversely proportional to the density of the substance. For the Rbntgen rays Benoist^^i’ gives the following numbers for the absorption by slabs whose thicknesses are inversely proportional to their densities : ❖❖❖

Pt. Pd. Ag. On. Sn. Mica. Glass. Al. P. Air. SOj. CH3CI.

❖❖❖81 -83 -75 -60 -74 -13 -26

❖❖❖09

❖❖❖1

❖❖❖14

We do not know yet whether the proportion between the ab- sorption of different substances is the same for the more penetrating rays as for those

easily absorbed, and it is quite possible that the numbers in the preceding table only hold for one particular kind of ray. Gladstone and Hibbert,^^^ Humphreys,^” Novak and Sale,265 have shown that the absorption of a compound is equal to the sum of the absorptions due to its components.

Apparatus for producing Bontgen Bays. ??? The tube now used most frequently for producing Rbntgen rays is of the kind intro- duced by Porter,256 and known as a focus tube (Kg. 34). The cathode Is a portion of a hollow sphere, and the cathode rays come to a point on or near a metal plate A, con- nected with the anode ; this plate is the source of the rays. The walls of the tube get strongly electrified. This electri- fication affects the work- ing of the tube, and the

production of rays can often be improved by having an earth- connected piece of tin-foil on the outside of the bulb, and moving it about until the best position is attained. To produce the discharge an induction coil is generally employed. Recently an interrupter called Wehnelt’s^”’ interrupter (though it was used by Spottiswoode many years ago) has been much used. One of its forms is shown in Fig. 35. A pointed platinum terminal forms the cathode, while the anode consists of a large lead plate. These are placed in a vessel containing dilute sulphuric acid, and an electromotive force of about 50 volts is applied to the terminals. In consequence there is a vigorous development of gas at the cathode, and the bubbles, interrupting the continuity of the circuit from the electrode to the electrolyte, render the current

[elbcteic

Fig. 35.

intermittent. With this device a very rapid rate of intermission can be’obtained with large currents, but its use is apt to curtail the life of the bulb ; there is also considerable waste of platinum in the interrupter, which

is dissipated as iine powder from the cathode, and remains suspended in the electrolyte.

Fhosfphonsc&nt Screens. ††† Screens which become fluorescent under the influence of the Eontgen rays are generally made of platino- cyanides ; that of potassium is very efficacious, ;but others can be used. Scheelite prepared in a particular way is sometimes em- ployed. Though bodies which fluoresce under the Rontgeu rays generally do so under Lenard rays, yet according to Precht,' there are substances which fluoresce brightly under the latter which only do so to a very slight extent under the former.

†† 34. Scattering of the Negative Electrodes. ††† In addition to the cathode rays, portions of metal start normally from

the cathode and form a metallic deposit on the walls of the tube. The amount of this deposit varies very much with the metal. Crookes ^^' found that the quantities of metal torn from electrodes of the same size, in equal times, by the same current, are in the order Pd, Au, Ag, Pb, Sn, Pt, Cu, Cd, Ni, In, Fe. ... In air there is very little deposit from an Al cathode, but it is abundant in tubes filled with the monatomic gases, mercury vapour, argon, or helium.^*"" The scattering increases as the density of the gas diminishes. The particles of metal are at low pressures deflected by a magnet, though not nearly to the same extent as the cathode rays. According to Grandquist,26i the loss of weight of the cathode in a given time is pro- portional to the square of the current; it is therefore not, like the loss of the cathode in ordinary electrolysis, proportional to the quantity of current which passes through it.

†† 35. Action of a Magnet on the Discharge. ††† The older observations on this point are described in the article Electeicity, Ency. Brit. vol. viii. p. 74. More recent experiments have furnished some interesting results. The writer ^^^ found that with a ring discharge at low pressures a transverse magnetic field stopped 'the discharge, while a longitudinal one facilitated it. This can be explained by the fact that the ions left behiad by one discharge facilitate the passage of the next ; the action of the transverse field is to remove the ions from the path of the discharge, while that of the longitudinal field is to restrain them from straying from it. The experiments

of Birkeland ^83 and Campbell-Swinton 28* have shown that a longitudinal magnetic force applied to a vacuum tube at a very low pressure diminishes to a remarkable degree the difference of potential between the electrodes ; thus when a spark gap was placed in parallel with the discharge tube, and adjusted so that the discharge went both across the air gap and through the tube, the length of the air gap when the magnetic field was present could be reduced to a small fraction of the value when the field was absent. Birkeland showed that the great diminution occurred suddenly when the magnetic force at the cathode reached a definite value, depending on the pressure of the gas. Warburg ^sb dis- covered an effect of a magnetic field on the discharge from a small electrode in the neighbourhood of a large one, which was subsequently re-observed by Phillips. [e] When the small electrode is positively electrified and raised to a potential of a few hundred volts, the electricity escaped

from it readily when a strong magnetic field was applied, although it insulated well when there was no field ; when the small electrode was negatively electrified there was no such effect. This may be due to the velocity of the negative ion being greater than that of the positive, whereby the discharge is carried mainly by the negative ions. When the small electrode is negative, these ions will be shot off from places of strong electric force, and acquiring a high velocity, will consequently be but little affected by a magnet ; when the small electrode is positive the negative ions starting from the weak parts of the field, having only a small velocity, will consequently be greatly affected by the magnetic field, and may by it be so concentrated that they form a conducting path_ and so cause the discharge. Philhps observed that if a discharge is first sent through a tube, then stopped and a strong magnetic field started, a luminous ring discharge appears, which rotates around a line of magnetic force as axis.

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VI. Electeic Waves.

^{??} 1. Maxwell proved that on Ms theory electromagnetic disturbances are propagated as a wave motion through the dielectric, while Lord Kelvin ^ had in 1853 proved from electromagnetic theory that the discharge of a condenser is oscillatory, a result which Feddersen^ verified by a beautiful series fif experiments. The oscillating discharge of a condenser had been inferred by Henry as long ago as 1842 from his experiments on the magnetization produced in needles by the discharge of a condenser. From these two results it follows that electric waves must be passing through the dielectric surrounding a condenser in the act of discharging, but it was not until 1887 that the existence of such waves was demonstrated by direct experiment. This great step was made by Hertz,^ whose experiments on this subject form one of the greatest contributions ~~ever made to experimental physics. The difficulty which had stood in the way of the observa~~ tions of these waves was the absence of any method of detecting electrical and magnetic forces, reversed some millions of times per second, and only lasting for an ex- ceedingly short time. This was removed by Hertz, who showed that such forces would produce small sparks between pieces of metal very nearly in contact, and that these sparks were sufficiently regular to be used to detect electric waves and to investigate their properties. Other and more delicate methods have subsequently been discovered, but the results obtained by Hertz with his detector were of such signal importance, that we shall begin our account of experiments on these waves by a description of some of Hertz's more fundamental experiments. To produce the waves he used two forms of vibrator. The first is reoresented in Fig. 36. A and B are two zinc plates about

Fig. 36,

40 cm. square ; to these brass rods, C,D, each about 30 cm. long, are soldered, terminating in brass balls E and F. To get good results it is necessary that these balls should be very brightly polished, and as they get roughened by the sparks which pass between them it is necessary to

repolish them at short intervals ; they should be shaded from light and from sparks, or other source of ultra-violet light. In order to excite the waves, C and D are con- nected to the two poles of an induction coil ; sparks cross the air-gap which becomes a conductor, and the charges on the plates oscillate backwards and forwards like the charges on the coatings of a Leyden jar when it is short circuited. The object of polishing the balls and screening off light is to get a sudden and sharp discharge : if the balls are rough there will be sharp points from which the

charge will gradually leak, and the discharge will not be abrupt enough to start electrical vibrations, as these have an exceedingly short period. From the open form of this vibrator we should expect the radiation to be very large and the rate of decay of the amplitude very rapid. Bjerknes'' found that the amplitude fell to 1/e of the original value, after a time 4T where T was the period of the electrical vibrations. Thus after a few vibrations the amplitude becomes inappreciable. To detect the waves produced by this vibrator Hertz used a piece of copper- wire bent into a circle, the ends being furnished with two balls, or a ball and a point connected by a screw, so that the distance between them admitted of very fine adjust- ment. The radius of the circle for use with the vibrator just described was 35 cm., and was so chosen that the free period of the detector might be the same as that of the vibrator, and the effects in it increased by resonance. It is evident, however, that with a primary system as greatly damped as the vibrator used by Hertz, we could not expect very marked resonance effects, and as a matter of fact the accurate timing of vibrator ^nd detector in this case is not very important. With electrical vibrators which can maintain a large number of vibrations, res- onance effects are very striking, as is beautifully shown by the following experiment due to Lodge,* whose re- searches have greatly advanced our knowledge of electric

Fig. 37.

waves. A and C (Fig. 37) are two Ley den jars, whose inner and outer coatings are connected by wires, B and D, bent so as to include a considerable area. There is an air-break in the circuit connecting the inside and outside of one of the jars, A, and electrical oscillations are started in A by joiniag the inside and outside with the terminals of a coil or electrical machine. The circuit in the jar C is provided with a sliding piece, F, by means of ‘ which the self-induction of the discharging circuit, and, therefore, the time of an electrical oscillation of the jar, can be adjusted. The inside and outside of this jar are put almost, but not quite, into electrical contact by means of a piece of tin-foil, E, bent over the lip of the jar. The jars are placed face to face so that the circuits B and D are parallel to each other, and approximately at right angles to the line joining their centres. When the electrical machine is in action sparks pass across the air- break in the circuit in A, and by moving the slider F it is possible to find one position for it in which sparks pass from the inside to the outside of C across the tin-foil, while when the slider is moved a short distance on either side of this position the sparks cease.

Hertz found that when he held his detector in the neigh- bourhood of the vibrator minute sparks passed between the balls. These sparks were not stopped when a large plate of non-conducting substance, such as the wall of a room, was interposed between the vibrator and detector, but a large plate of very thin metal stopped them completely.

To illustrate the analogy between electric waves and waves of light Hertz found another form of apparatus more convenient. The vibrator consisted of two equal brass cylinders, 12 cm. long and 3 cm. in diameter, placed

with their axes coincident, and in the focal line of a large zinc parabolic mirror about 2 metres high, with a focal length of 12-5 cm. The ends of the cylinders nearest each other, between which the sparks passed, were carefully polished. The detector, which was placed in the focal line of an equal parabolic mirror, consisted of two lengths of wire, each having a straight piece about 50 cm. long and a curved piece about 15 cm. long bent round at right angles so as to pass through the back of the mirror. The ends which came through the mirror were connected with a spark micrometer,

the sparks being observed from behind the mirror. The mirrors are shown in Fig. 38.

►► 2. Reflexion and Refraction.►►► To show the reflexion of the waves Hertz placed the mirrors side by side, so that their openings looked in the same direction, and

rig. 38.

their axes converged at a point about 3 m. from the mirrors. No sparks were then observed in the detector when the vibrator was in action. When, however, a large zinc plate about 2 m. square was placed at right angles to the line bisecting the angle between the axes of the mirrors sparks became visible, but disappeared again when the metal plate was twisted through an angle of about 15►► to either side. This experiment showed that electric waves are reflected, and that, approximately at any rate, the angle of incidence is equal to the angle of re- flexion. To show refraction Hertz used a large prism made of hard pitch, about 1-6 m. high, with a slant side of 1-2 m. and an angle of 30►►. When the waves from the vibrator passed through this the sparks in the detector were not excited when the axes of the two mirrors were parallel, but appeared when the axis of the mirror contain- ing the detector made a certain angle with the axis of that containing the vibrator. When the system was adjusted for minimum deviation the sparks were most vigorous, when the angle between the axes of the mirrors was 22►►. This corresponds to an index of refraction of 1-69.

►► 3. Analogy to a Plate of Tourmaline. ►►► If a screen be mad e by winding wire round a large rectangular framework, so that the turns of the wire are parallel to one pair of sides of the frame, and if this screen be interposed between the parabolic mirrors when placed so as to face each other, there will be no sparks in the detector when the turns of the wire are parallel to the focal lines of the mirror ; but if the frame is turned through a right angle so that the wires are perpendicular to the focal lines of the mirror the sparks will recommence. If the framework is substituted for the metal plate in the experiment on the reflexion of electric waves, sparks will appear in the detector when the wires are parallel to the focal lines of the mirrors, and will disappear when the wires are at right angles to these lines.

Thus the frameworTs reflects but does not transmit the waves when the electric force in them is parallel to the wires, while it transmits but does not reflect waves in which the electric force is at right angles to the wires.

waves]

The wire framework behaves towards the electric waves exactly as a plate of toui'maline does to waves of light. Dubois and Rubens/ by using a framework wound with very fine wire placed very close together, have succeeded in polarizing waves of radiant heat, whose wave length, although longer than that of ordinary light, is very small compared with that of electric waves.

►► 4. Angle of Polarization. ►►► When light polarized at right angles to the plane of incidence falls on a refracting substance at an angle tan "'/*, where /a is the refractive index of the substance, all the light is refracted and none reflected; whereas when light is polarized in the plane of incidence some of the light is always reflected whatever the angle of incidence. Trouton has shown that similar effects take place with electric waves. From a paraffin wall 3 feet thick, reflection always took place when the electric force in the incident wave was at right angles to the plane of incidence, whereas at a certain angle of incidence there was no reflection when the vibrator was turned, so that the electric force was in the plane of incidence. This shows that on the electromagnetic theory of light the electric force is at right angles to the plane of polar- ization.

►► 6. Stationary Electrical Vibrations. ►►► Hertz^ made his experiments on these in a large room about 15 m. long. The vibrator, which was of the type first described, was placed at one end of the room, its plates being parallel to the wall, at the other end a piece of sheet zinc about 4 m. by 2 m. was placed vertically against the wall. The de- tector►►► the circular ring previously described ►►► was held so that its plane was parallel to the metal plates of the vibrator, its centre on the line at right angles to the metal plate, bisecting at right angles the spark gap of the

vibrator, and with the spark gap of the detector parallel to that of the vibrator. The following effects were ob- served when the detector was moved about. When it was close up to the zinc plate there were no sparks, but they began to pass feebly as soon as it was moved for- ward a little way from the plate, and increased rapidly in brightness until it was about 1-8 m. from the plate when they attained their maximum. When its distance was still further increased they diminished in brightness, and vanished again at a distance of about 4 m. from the plate. When the distance was still further increased they reap- peared, attained another maximum, and so on. They thus exhibited a remarkable periodicity similar to that which occurs when stationary vibrations are produced by the interference of direct waves with those reflected from a surface placed at right angles to the direction of propagation. Similar periodic alterations in the spark were observed by Hertz when the waves, instead of passing freely through the air and being reflected by a metal plate at the end of the room, were led along wires, as in the arrangement shown in Fig. 39. L and K are metal plates placed parallel to the plates of the vibrator, long parallel wires Fig. 39. being attached to act as guides to

the waves which were reflected from the isolated end. (Hertz only used one plate and one wire, but the double set of plates and wires introduced by Sarasin and De la Rive make the results more definite.) In this case the detector is best placed so that its plane is at right angles to the wires, while the air space is parallel to the plane containing the wires. The sparks instead of vanishing when the detector is at the far end of the wire are a maximum in this position, but wax and

wane periodically as the detector is” moved along the wires. The most obvious interpretation of these exper- iments was the one given by Hertz ??? that there was interference between the direct waves given out by the vibrator and those reflected either from the plate or from the ends of the wire, this interference giving rise to stationary waves. The places where the electric force was a maxima were the places where the sparks were brightest, and the places where the electric force was zero were the places where the sparks vanished. On this explanation the distance between two consecutive places where the sparks vanished would be half the wave length of the waves given out by the vibrator. Some very in- teresting

experiments made by Sarasin and De la Rive^ showed that this explanation could not be the true one, since by using detectors of different sizes they found that the distance between two consecutive places where the sparks vanished depended mainly upon the size of the detector, and very little upon that of the vibrator. With small detectors they found the distance small, with large detectors, large ; in fact it is directly proportional to the diameter of the detector. We can see that this result is a consequence of the large damping of the oscillations of the vibrator and the very small damping of those of the de- tector. Bjerknes showed that the time taken for the amplitude of the vibrations of the vibrator to sink to 1/e of their original value was only 4T, while for the detector it was 500T', when T and T' are respectively the times of vibration of the vibrator and the detector. The rapid decay of the oscillations of the vibrator will stifle the in- terference between the direct and the reflected wave, as the amplitude of the direct wave will, since it is emitted later, be much smaller than that of the reflected one, and not able to annul its effects completely ; while the well-main- tained vibrations of the detector will interfere and produce the effects observed by Sarasin and De la Rive. To see this let us consider the extreme case in which the oscilla- tions of the vibrator are absolutely dead-beat. Here an im- pulse, starting from the vibrator on its way to the reflector, strikes against the detector and sets it in vibration ; it then travels up to the plate and is reflected, the electric force in the impulse being reversed by reflexion. After reflexion the impulse again strikes the detector, which is still vibrating from the effects of the first impact ; if the phase of this vibration is such that the reflected impulse tends to produce a current round the detector in the same direction as that which is circulating from the effects of the first impact, the sparks will be increased, but if the reflected impulse tends to produce a current in the oppo- site direction the sparks will be diminished. Since the electric force is reversed by reflexion, the greatest increase in the sparks will take place when the impulse finds, on its return, the detector in the opposite phase to that in which it left it ; that is, if the time which has elapsed between the departure and return of the impulse is equal to an odd multiple of half the time of vibration of the detector. If d is the distance of the detector from the reflector when the sparks are brightest, and V the velocity of propagation of electromagnetic disturbance, then 2d!/V=(2n-|-l)(T72); where n is an integer and T' the time of vibration of the detector, the distance between two spark maxima will be VT72, and the

places where the sparks are a minimum will be midway between the maxima. Sarasin and De la Rive found that when the same detector was used the distance between two spark maxima was the same with the waves through air reflected from a metal plate and with those guided by wires and reflected from the free ends of the wire, the inference being that the velocity of waves along wires is the same as that through the air. This result, which as we shall see follows from Maxwell's theory, when the wires are not

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too fine, had been questioned by Hertz on account of some of his experiments on wires.

†† 6. Detectors. ††† The use of % detector with a period of vibration of its own thus tends to make the experi- ments more complicated, and many other forms of detector have been employed by subsequent experimenters. For example, in place of the sparks in air the luminous discharge through a rarefied gas has been used by Dra- goumis;'" Lecher " (who used tubes without electrodes laid across the wires in an arrangement resembling that shown in Fig. 42) ; and Arons.^^ Zehnder ^^ used an exhausted tube to which an external electromotive force almost but not quite sufficient of itself to produce a discharge was applied ; here the additional electromotive force due to the waves was sufficient to start the discharge. Detectors depending on the heat produced by the rapidly alternat- ing currents have been used by Paalzow and Rubens," Eubens and Ritter," and Klemencic.^^ Rubens measured the heat produced by a bolometer arrangement, and Klemencic used a thermo-electric method for the same purpose. Boltzmann ' used an electroscope as a detector. The spark gap consisted of a ball and a point, the ball being connected with the electroscope and the point with a battery of 200 dry cells. When the spark passed the cells charged up the electroscope. Ritter " utilized the contraction of a frog's leg as a detector, Lucas and Garrett' the explosion produced by the

sparks in an explosive mixture of hydrogen and oxygen ; while Bjerknes^ and Franke^' used the mechanical attraction between oppositely charged conductors. If the two sides of the spark gap are connected with the two pairs of quadrants of a very delicate electrometer, the needle of which is connected with one pair of quadrants, there will be a deflexion of the electrometer when the detector is struck by electric waves. A very efficient detector, in- deed by far the simplest and best for metrical work, is that invented by Rutherford ^ ; it consists of a bundle of fine iron wires magnetized to saturation and placed inside a small magnetizing coil, through which the electric waves cause rapidly alternating currents to pass which demagnetize the soft iron. If the instrument is used to detect waves in air, long straight wires are attached to the ends of the demagnetizing coil to collect the energy from the field ; to investigate waves in wires it is sufficient to make a loop or two in the wire and place the magne- tized piece of iron inside it. The amount of demagneti- zation, which can be observed by the change in the deflexion of a magnetometer placed near the iron, meas- ures the intensity of the electric waves, and very accurate determinations can be made with ease with this apparatus. It is also very delicate, though in this respect it does not equal the detector to be next described, the coherer; Rutherford got indications in 1895 when the vibrator was I of a mile away from the detector, and where the waves had to traverse a thickly populated part of Cam- bridge. It can also be used to measure the coefficient of damping of the electric waves, for since the wire ic initially magnetized to saturation, if the direction of the current when it first begins to flow in the magnetizing coil is such as to tend to increase the magnetization of the wire, it will produce no effect, and it will not be until the current is reversed that the wire will lose some of its magnetization. The effect then gives the measure of the intensity half a period after the commencement of the waves. If the wire is put in the coil the opposite way, i.e., so that the magnetic force due to the current begins at once to demagnetize the wire, the demagnetization gives a measure of the initial intensity of the wave. Comparing this result with that obtained when the wires were re- versed, we get the coefficient of damping.

7. Coherers.

The most sensitive detector of electric

waves is the ” coherer,” although for metrical work it is not so suitable as that just described. It depends upon the fact discovered by Branly,^^ that the resistance be- tween loose metallic contacts, such as a pile of iron turn- ings, diminishes when they are struck by ah electric wave. One of the forms made by Lodge ”* on this principle con- sists simply of a glass tube containing iron turnings, in contact with which are wires led into opposite ends of the tube. The arrangement is placed in series with a galvano- meter (one of the simplest kind will do) and a battery ; when the iron turnings are struck by electric waves their resistance is diminished and the deflexion of the galvano- meter is increased. Thus the deflexion of the galvano- meter can be used to indicate the arrival of electric waves. The tube must be tapped between each experiment, and the deflexion of the galvanometer brought back to about its original value. This detector is marvellously delicate, but not metrical, the change produced in the resistance depending upon so many things besides the intensity of the waves, that the magnitude of the galvanometer de- flexion is to some extent a matter of chance. Instead of the iron turnings we may use two iron wires, one resting on the other ; the resistance of this contact will be altered by the incidence of the waves. To get greater regularity Bose^ uses instead of the iron turnings spiral springs, which are pushed against each other by means of a screw until the most sensitive state is attained. The sensitive- ness of the coherer depends on the electromotive force put in the galvanometer circuit. Very sensitive ones can be made by using springs of very fine silver wire coated electrolytically with nickel. Though the impact of electric waves generally produces a diminution of resist- ance with these loose contacts, yet there are exceptions to the rule. Thus Branly ^ showed that with lead oxide, Pb02, there is an increase in resistance. Aschkinass ^ proved the same to be true with copper sulphide, CuS ; and Bose^ has shown that with potassium there is an increase of resistance and great power of self-recovery of the original resistance after the waves have ceased. Several theories of this action have been proposed. Branly (toe. cit.) thought that the small sparks which certainly pass between adjacent portions of metal cleared away layers of oxide or some other kind of non-conducting film, and in this way improved the contact. It would seem that if this theory is true the films must be of a much more refined kind than layers of oxide or dirt, for the coherer effect has been observed with clean non-oxidizable metals. Lodge (toe. cit.) explains the effect by supposing that the heat produced by the sparks fuses

adjacent por- tions of metal into contact and hence diminishes the re- sistance ; it is from this view of the action that the name coherer is applied to the detector. Auerbeck ^ thought that the effect was a mechanical one due to the electro- static attractions between the various small pieces of metal. It is probable that some or all of these causes are at work in some cases, but the effects of potassium make us hesitate to accept any of them as the complete explana- tion. The coherer is the form of detector used in tele- graphy without wires. (See Telegraphy, Wireless.)

Bose 80 has designed an instrument wliioh generates electric waves with a length of not more than a centimetre or so, and therefore allows their properties to be demonstrated with apparatus of moderate dimensions. The waves are excited by sparking between two platinum beads carried by jointed electrodes ; a platinum sphere is placed between the beads, and the distance between the beads and the sphere can be adjusted by bending the electrodes. The diameter of the sphere is 8 mm., and the wave length of the shortest electrical waves generated is said to be about 6 nun. The beads are connected with the terminals of a small induction coil which, with the battery to work it and the sparking arrangement' are enclosed in a metal box, the radiation passing out through a metal tube opposite to the spark gap. The ordinary vibrating break of the coil is not used, a single spark made by making and

breaking the circuit by means of a button outside the box being employed instead. The detector is one of the spiral spring coherers previously described ; it is shielded from external disturbance by

Fig. 40.

being encloeed in a metal box provided with a funnel-shaped open- ing to admit the radiation. The wires leading from the coherers to the galvanometer are also surrounded by metal tubes to protect them from stray

radiation. The radiating apparatus and the re- ceiver are mounted on stands sliding in an optical bench. If a parallel beam of radiation is required, a cylindrical lens of ebonite or sulphur is mounted in a tube fitting on to the radiator tube and stopped by a guide when the spark is at the principal focal line of the lens. For experiments requiring angu- lar measurements a spectrometer circle is mounted on one of the sliding stands, the receiver being car- ried on a radial arm and pointing to the centre of the circle. The arrangement is represented in Fig. 40.

With this apparatus the laws of reflexion, refrac- tion, and polarization can readily be verified, and also the double refraction of crystals, and of bodies possessing a fibrous or laminated structure such as jute or books. (The double refraction of electric waves seems first to have been observed by Righi,[! and other researches on this subject have been madeby Garbasso^ a^d Mack.[3) Bose* showed the rotation of the plane of polarization by means of pieces of twisted jute rope ; if the pieces were arranged so that their twists were all in one direction and placed in the path of the radiation, they rotated the plane of polarization in a di- rection depending upon the direction of twist ; if they were mixed so that there were as many twisted in one direction as the other, there was no rotation.

A series of experiments showing the complete analogy between electric and light waves is described by Eighi in his book L^Ottica delle OscUlazioni Mettriches. Righi’s ex- citer, which is especially convenient when large statical electric

The period of the vibrations given out by the system is adjusted by means of metal plates M and N attached to AB and CD. ►► 8. Waves in Wires. ►►► Many problems on electric waves along wires can readily be investigated by a method due to Lecher,^^ and known as Lecher’s bridge, which furnishes us with a means of dealing with waves of a definite and determinable wave length. In this arrangement (Fig. 42) two large plates A and B are, as in Hertz’s exciter, connected with the terminals of an induction coil ; opposite these and insulated from them are two smaller plates D, E, to which long parallel wires DFH, EGJ are attached. These wires are bridged across by a wire LM, and their farther ends H, J may be insulated, or con- nected together, or with the plates of a condenser. To

detect the waves in’ the circuit beyond the bridge. Lecher used an exhausted tube placed across the wires, and Rubens a bolometer, but Rutherford’s detector is the most convenient and accurate. If this detector is placed in a fixed position at the end of the circuit, it is found that the deflex- ions of this detector depend greatly upon the position of the bridge

BOO 700 ^eo e9o 690 eoQ xo aso cao vto vio 3eo jeo sao tm zoo
Oisi’Bncss in Centrme/nrs along mn

I60 ISO m ⍰⍰Q

Fig. 41,

machines are used instead of induction coils, is shown in Fig. 41. E and F are balls connected with the terminals of the machine, and

e M

fig. 42.

AB and CD are conductors insulated from each other, the ends B, C, between which the sparks pass, being immersed in vaseline oil.

Fig. 43.

LM, rising rapidly to a maximum for some positions, and falling rapidly away when the bridge is displaced. As the bridge is moved from the coil end towards the detector the deflexions show periodic variations, such as are represented in Fig. 43 when the ordinates re- present the deflexions of the detector and the abscissse the distance of the bridge from the ends D, E. The maximum deflexions of the detector correspond to the positions in which the two circuits DFLMGE, HLMJ (in which the vibrations are but slightly damped), are in resonance. For since the self-induction and resistance of the bridge LM is very small compared with that of the circuit beyond, it follows from the theory of circuits in parallel that only a small part of the current will in general flow round the longer circuit ; it is only when the two circuits DFLMGE, HLMJ are in resonance that a considerable current will flow round the latter. Hence when we get a

maximum effect in the detector we know that the waves we are dealing with are those corresponding to the free periods of the system HLMJ, so that if we know the free periods of this circuit we know the wave length of the electric waves under consideration. Thus if the ends of the wires H, J are free and have no capacity, the current along them must vanish at H and J, which must be in opposite electric condition. Hence half the wave length must be an odd sub- multiple of the length of the circuit HLMJ. If H and J are connected together the wave length must be a sub-nraltiple of the length of this circuit. When the capacity at the ends is appreciable the wave length of the circuit is determined by a somewhat complex expression (see ►► 30). To facilitate the determination of the wave length in such cases, Lecher intro- duced a second bridge L'M', and moved this about until the deflexion of the detector was a, maximum ; when this occurs the wave length is one of those correspoi,iding to the closed circuit LMM'L', and must therefore be a submultiple of the length of the circuit. Lecher showed that if instead of using a single wire LM to form the bridge, he used two parallel wires PQ, LM, placed close together, the currents in the fui-ther circuit were hardly appreci- ably diminished when the main wires were cut between PL and QM. Blondlot^s used a modification of this apparatus better

suited for the production of short waves. In his form (Fig. 44) the exciter consists of two semicircular arms connected with the terminals of an induction coil, and the lo3g wires, instead of being

connected with the small plates, form a circuit round the exciter.

4s an example of the use of Lecher's arrangement, we may quote Drude's^' ap- plication of the method to find the specific induction capacity of dielectrics under electric os- cillations of varying frequency. In this application the ends of the wire are con- nected to the plates of a condenser, the space between whose can be filled with the liquid whose specific inductive capacity is required, and the bridge is moved until th? detector at

the end of the circuit gives the maximum deflexion. Then if \ is the wave length of the waves, X is the wave length of one of the free vibrations of the system HLMJ ; hence if C is the capacity of the condenser at the end in electrostatic measure we have by equation (1) ►► 30

‘”’-T c

Fig. 44.

2W

‘G’l

where I is the distance of the condenser from the bridge and C is the capacity of unit length of the wire. In the condenser part of the lines of force will pass through air and part through the dielectric ; hence 0 will be of the form Cp + KCj where K is the specific inductive capacity of the dielectric. Hence if I is the dis- tance of maximum deflexion when the dielectric is replaced by air, I’ when filled with a dielectric whose specific inductive capacity is known to be K’, and I” the distance when filled with the dielectric whose specific inductive capacity is required, we easily see that ►►►

cot cot

cot

l-wl

cot

1-K’

1-n-l’ 1 _ K

an equation by means of which K can be determined. It was in this way that Drude investigated the specific inductive capacity with varying frequency, and found a falling off in the specific inductive capacity with increase of frequency when the dielectrics contained the radicle OH. In another method

used by him^ the wires were led through long tanks filled with the liquid whose specific inductive capacity was required ; the velocity of propagation of the electric waves along the wires in the tank being the same as the velocity of propagation of an electromagnetic dis- turbance through the liquid filling the tank, if we find the wave length of the waves along the wires in the tank, due to a vibration of a given frequency, and compare this with the wave lengths cor- responding to the same frequency when the wires are surrounded by air, we obtiiin the velocity of propagation of electromagnetic disturbance through the fluid, and hence the specific inductive capacity of the fluid.

►► 9. Velocity of Propagation of EleclromagTietic Effects through Air.

►►► The experiments of Sarasin and De la Eive already described (see ►► 5) have shown that, as theory requires, the velocity rof propagation of electric effects through air is the same as along wires. The same result had been arrived at by the writer,^" although from the method he used greater differences between the velocities might have escaped detection than was possible by Sarasin and De la Rive's method. The velocity of waves along wires has been directly determined by Blondlof" by two diflferent methods. In the first the detector consisted of two parallel plates about 6 cm. in diameter placed a fraction of a millimetre apart, and forming a condenser whose capacity C was determined in c4ectroraagnetic measure by Maxwell's method. The plates were connected by a rectangular circuit whose self-induc- tion L was calculated from the dimensions of the rectangle and the size of the wire. The time of vibration T is equal to 27rN/LG. (The wave length corresponding to this time is long compared with the length of the circuit, so that the use of this formula is legitimate.) This detector is placed between two parallel wires, and the waves produced by the exciter are reflected from a movable bridge. When this bridge is placed just beyond the detector vigorous sparks

are observed, but as the bridge is pushed away a place is reached where the sparks disappear ; this place is distance X/4 from the detector, when'X is the wave length of the vibration given out by the detector. The sparks again disappear when the distance of the bridge from the detector is 3V4. Thus by measuring the distance between two consecutive positions of the bridge at which the sparks disappear X can be deter- mined, and 0, the velo- city of

propagation, is equal to X/T. As the means of a number of experiments Blondlot found 1) to be 3-02 xlQi” cm. /sec. which, within the errors of experiment, is equal to 3×10^” cm. /sec, the velocity of light. A second method used by Blondlot,‘ and one which does not in- volve the calculation of the period, is as follows : ††† A and A’ (Fig. 45) are two equal Leyden jars coated inside and out- side with tin-foil. The outer coatings form two separate rings a, u ; a’, a\, and the inner coat- ings are connected with the poles of the induc- tion coil by means of the metal pieces b, V. The sharply pointed conductors p and p’, the points of which are about J mm. apart, are connected with the rings of the tin-foil a and a’, and two long copper wires pca^, p’c’a\, 1029 cm. long connect these points with the other rings ai, ai’. The rings aa’, a^Oi’, are connected by wet strings so as to charge up the jars. When a spark passes between b and b’, a spark at once passes between pp’, and this is followed by another spark when the waves travelling by the paths a^ cp, a{iip’ reach p and^. The time between the passage of these sparks, which is the time taken by the waves to travel 1029 cm., was observed by means of a rotating mirror, and the velocity measured in 15 experiments varied between 2‘92xl0’” and 3‘03 x 10’†† cm./sec, thus agreeing well with that deduced by the preceding method. Other deter- minations of the velocity of electromagnetic propagation have been made by Lodge and Glazebrook,’’^ and by Saunders.

On Maxwell’s electromagnetic theory the velocity of propagation of electromagnetic disturbance should equal the velocity of light, and also the ratio of the electromagnetic unit of electricity to the electrostatic unit. A large number of determinations of this ratio have been made, the more recent of which are given in the follow- ing table : †††

Observer. Date.

Klemencic,^’ 1884

Himstedt,” 1888

Rowland,^ 1889

Rosa,†† 1889

J. J. Thomson and Searle,” 1890

Webster,’^ 1891

Pellat,<9 1891

Abraham, ►►►► 1892

Hurmuzesou,”’ 1895

K^

V_/

Fig. 45.

Ratio 10″ X. 3-019 cm. /sec. -3 009 cm. /sec. 2-9815 cm./seo. 2-9993 cm./seo. 2-9955 cm./seo. 2-987 cm. /sec. 3-009 cm. /sec. 2-992 cm. /sec. 3-002 cm. /sec.

The mean of these determinations is 3-001 x 10’►► cm./seo., while the mean of the last five determinations of the velocity of light in air is given by Himstedt’” as 3-002 x lO’” cm./sec. From these experiments we conclude that the velocity of propagation of an electromagnetic disturbance is equal to the velocity of light, and to the velocity required by Jlaxwell’s theory.

In experimenting with electromagnetic waves it is in general more difficult to measure the period of the oscillations than their wave length. Rutherford ^ has used a method by which the period of the vibration can easily be determined ; it is based upon the theory of the distribution of alternating currents in two circuits ACB, ADB in parallel. If A and B are respectively the maximum currents in the circuits ACB, ADB, then

A B’

/S’-H V R-i-H

(N – nff

dt ~ dy dz _db^dX_dZ

dt dz dx _&_dY_^

dt dx dy

where X, Y, Z are the components of the electric intensity parallel to the axes of x, y, z respectively, and a, b, c are the components of the magnetic induction. The vector whose components are

dZ dY dX dZ dY dK. ., ,, , ,, , _,

3 ~~1~~, -J ~~T~~, -1 T IS oiten called the curl of the vector

ay dz dz dx dx dy

whose components are X, Y, Z; thus if B is the magnetic induction and E the electric force, we may write equations A in the form

where cl. E denotes the curl of the vector E. Another funda- mental law of electromagnetic action is that the work done on a unit pole travelling round any closed circuit is equal to iir times the current passing through the circuit, whatever the nature of the substances through which the circuit passes : the analytical expres- sion of this law is

dy dp^ dz

da dy

dz dx , dB da

dx ay

where M, V, w are the components of the electric current, and

a, ^, y the components of the magnetic force. If i is the current,

H the magnetic force (i and H being vectors), we may write these

equations as , . i tt

^ 45ri=cl. H.

The electric current contemplated in this law may arise in one or other of three ways : ††† it may be wholly or in part an ordinary con- duction current obeying Ohm's law, such as flows through metals or electrolytes, or it may be a convection current arising from the motion of charged ions, or it may be a dielectric current which on Maxwell's theory exists whenever the electric field is changing. In order that all currents may flow in closed circuits, which is essential on Maxwell's theory, the magnitude of the dielectric

current must be †††: r- > hence if

iir dt '^

4iru=-

4ir††=

B,

medium we have

. E K dE ^ IT iir dt ^

where e is the charge on an iuu and q its velocity {q is to be regarded as a vector), while S denotes the sum of the product of these quantities for all the ions in the field. †† 11. We shall begin with the case of an insulating medium in which

there are no ions : in this case i= †††, and equations B become

iw dt

^ dX _ dy d^ dt dy dz

jT dY _da _dy dt dz dx

.dZ –d _da dt dx dy

(1).

If /4 is the magnetic permeability, and if the variable magnetiza- tion is entirely induced, we may put a, b, c = ij, (o, ft y), and from equations A and (1) on elimination of X, Y, Z, remembering that

we get

dx dy dz

ǂ + ^ = 0 dx dy dz ‘

‘^ dC dx^ dy^ IF

We have equations of precisely the same form for 3, y, and X, Y, Z ; hence these quantities all satisfy Poisson’s equation ”

ir’ dt’- dx’ dy’^ dz^ ‘ ‘ ‘ ^ ” which is known to represent an effect propagated with a velocity v through the medium, hence changes in magnetic and electric force ”’’^^el through the medium with the finite velocity l/V/iKl

If the electric disturbance travels as a plane wave, so that X,

Y, Z, a, A y, are proportional to ;r<'"-('^+"+-where X is the wave length, I, m, n, the direction cosines of the normal to the wave front, and v=ljJ/iK, then we have from equations (A) and(l), itp = 2Tv/\

hence

iptia = i^{mZ-nY);

mp=3^inX-lZ);

iirM.y=,^(,lY-mX); A

KipX = t – (wj3 – my) ;

A

KipY=i^{ly-na); KtpZ=2^{ma-lp);

A

la + mp + ny=0, lX + mY+nZ=0, aX + pY + yZ = 0,

where H is the resistant magnetic force and E the resultant electric force. Hence we see that both the magnetic and electric forces are at right angles to the direction of propagation of the wave, the electric and magnetic forces are at right angles to each other, and the product of the magnetic induction and the velocity of propagation is equal to the electric force.

Poisson's equation takes a very simple form when the solution is periodic and depends only on the distance from a fixed point. If the frequency of the solution is p, and if r is the distance from the

point, then since (p varies as e''. = ₱(p, and since ^ only de pends upon r,

d^ _ 2di>.

dx^'^dy'^ d^ ~ dr^'^ r dr ' hence

or

d"0 2dd> p2 ^ ???

The solution of this equation is

rip=Ae ' or restoring the time factor

4- Be ?? '

*=A'

-f-B

A'-d

If the waves start from the origin and there is no reflexion the solution will consist of the second term only, as the first term represents a wave travelling towards the origin. When there is reflexion both terms must be retained. Since Poisson's equation

is linear if 0 is a solution, ††† 0 will also be a solution

daf dy^ d††" when I, m, n, are positive integers ; and starting with this primary solution we may by differentiation arrive at the solution of more complicated problems, just as in electrostatics, starting with 1/r as the potential due to a unit charge, we obtain the potential for complex distributions of electricity. In the case of electric waves

we substitute f for 1/r.

r †† 12. We shall now proceed to consider some special cases of electric waves, taking first a case investigated by Hertz, ^†† that of the vibrating electric doublet. By a doublet is meant a system of

[electeio

two equal and oppositely electrified particles placed near together. The direction of the line joining the particles is the axis of the doublet, and the product of one of the charges into the distance between them is its moment. We shall suppose that the moment varies harmonically, and is proportional to the real part of

e'* ; such a doublet would be produced if we had a positive charge e moving parallel to the axis of s, its distance from the origin being I cos pt, while the distance of the negative charge is -I cos pt. The moment of this doublet is the real part of

me where in = 2le. For a doublet of constant moment m with its axis along the axis of z, and its centre at the origin, the com- ponents X, Y, Z of the

electric force at a point at a distance r from the origin are given by the equations

cP 1 ††† m d'^ 1 ††† m I d? _ 6?

K dxAz r

K dydz r'

Z=-

E

+ –

Hence if the moment is me'' , and if the greatest distance between the charges is small compared with vjp, the components of the electric force due to the vibrating doublet will be given by the equations

^-1

dxdz

y=

z=-

K dydz

dy\

It follows from equations A that a, j3, 7, the components of the magnetic force, will be given by the equations

_TOip d e

*0-^)

/"^=-

TUlf d

‘(t-v)

Kv’ dy r ‘ Ev^ dx

/iE’!)^=l, by

7=0;

a=mip –

-TTup

dx

p(□□-f)

7=0 (3).

Performing the differentiations and taking the real parts of the expressions, we find

□□□ xzm r 3 I , i’\

Zp

Z = ^r

otTSz^

ir

□□□{Jco^□□-^)

sm^

1

sin^l

‘p’ 1

o=TOp||^sin^^r!

/3= -mp

x(l_

sva.p

I)

+ – – cos V r

p 1 + – – cosp vr

<'-l)}

(÷)}

7=0.

Thus aX + ;3Y + 7Z = 0, so that the electric force is everywhere at right angles to the magnetic force, and is in the plane through the axis of 2 ; the lines of magnetic force are circles with their centres along and their planes at right angles to the axis of z. At a distance from the centre large compared with v/p, the last terms inside the brackets are the most important, and retaining only these, the equations take the simple form, m p’ xz 1 (. r\

yz 1

K^ + ii^

E

~E2 ,

mr)^i/ 1 a. = ^— cos V r r

- aoip

7=0.

X 1

(‘-:) 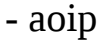

; cos pi t

In this case Xx + Yy + Zz=0, so that the electric force is at right angles to the radius. If E is the resultant electric force, and H the resultant magnetic force, m p^ sin 9

_ mp^ sin ff

H = -^ cos

V r

The magnetic force is at right angles to the radius and also to the electric force, and we see that, as in the plane wave, v/j,H = E. The lines of electric force at a great distance from the oscillator aie represented in Fig. 46 ; it will be seen that they consist of a series of detached bundles, which travel outwards with the velocity u. The detachment of these bundles from the lines of force which originally stretched from one pole to the other of the doublet is shown in Fig. 47, which is taken from Hertz’s paper. It will be noticed that a dent gradually develops in the lines of force and gets deeper and deeper until two portions of the lines meet. When this happens the line of force breaks off into two portions, one of which rushes into the doublet while the other travels outwards and produces one of the bundles of lines of force shown in Fig. 46. The point at which the lines break off is evidently in the plane 2=0, and since at this point the equation Z = 0 has two equal

roots, the point is determined by Z = 0, t=0- These equations

Fig. 46.

give r= J2v/p, so that the rupture of the lines of force always occurs at a fixed point. Diagrams of the lines of force of a vibrator whose vibrations are damped by radiation have been drawn by Pearson and Lee.^^

##13. Miergy radiated from t?ie Vibrator. ### The movement of these bundles of lines of electric force away to an infinite distance from the vibrator is accompanied by a flow of energy outwards through space, as the lines of force carry energy with them. Thus if the oscillations of the vibrator are to be maintained energy must be supplied to it. To calculate the amount of energy radiated per unit time we make use of a theorem due to Poynting,*’ which states that the movement of energy in the electro-magnetic field is the same as if the energy at any point moved along the normal to the plane containing the magnetic force and the electric force at that point, the amount of energy flowing in unit time across a unit area at right angles to the flow being equal to HE sin e/47r where H is the magnetic and E the electric force, and 6 the angle between these vectors. If we apply this theorem to find the flow of energy across a sphere with its centre at the centre of the vibrator, and with so great a radius that over its surface the magnetic and electric forces are both transverse, the quantity of energy flowing per unit time across unit area of the surface of this sphere is equal to

Fig. 47.

1 m## p* 1 ### 1

ecos^ p(t-iy

The total flow of energy across the surface of the sphere is there- fore

2 m^ p*

3 E 1? ‘##’^

H)

(4).

1 m^ 2)* the average value of which is – ××× ^. If the vibrations are to be 3 K D’’

maintained energy must be supplied at this rate to the vibrator.

×× 14. Magnetic Force due to a moving electrified Sphere. ××× Let us consider the doublet as arising from the motion in opposite directions with equal velocity along the axis of z, of two oppositely charged particles, the distance of one particle from the origin being repre- sented by Z cos pi, that of the other by -Icospt. Now the magnetic force by equation (3) due to this doublet is equal to

2elsinepsinp(t—\^ + 2ei sia ep’’ cos p(t—\ ××× .

This may be written

- 2eu sin 9-= – 2cm sin 6 ××× . (5),

r^ vr

where ××, ii are respectively the velocities and accelerations of the positive particle at the time t – r/v. Now since the electromagnetic effects are propagated with a velocity 1;, the magnetic effect at a point r at the time t must have started from the moving particle at the time t – r/v, and must depend on the condition of the sphere at that time. It is also clear that the magnetic effects due to the positive and negative particles are equal. Thus equation (5) shows that from a moving particle there starts a wave of magnetic

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force proportional to the velocity, whose magnitude at a distance r from the particle is ×××× sin 5/?~~‘, where u is the velocity of the particle, the lines of magnetic forces being circles with the direc~~ tion of motion of the

particle as axis. Accompanying this is another wave proportional to the acceleration, producing at a distance r a magnetic force equal to eii sin 9lvr, the direction of the magnetic force being the same as in the velocity wave.’^ Thus while the magnetic force in the velocity wave varies inversely as the square of the distance, that in the “acceleration” wave only varies inversely as the distance. The importance of the second wave in comparison with the first will increase as the distance in- creases. If the particle is moving uniformly there is no ” accelera- tion ” wave, and the magnetic force at a distance r is mi sin fl/r^. Thus a uniformly moving particle produces the same magnetic field as an element of current placed at the particle and pointing along its direction of motion.’^ The magnetic effects due to moving electrified charges have been detected by Rowland ”” in experiments made for this purpose.

From equation (4) we see that the rate at which energy is leaving the vibrating doublet is on the average

3K i;►► ‘

this is equal for each particle to

2 e^ 2.77 Tr-T(►►►ean value of ft’’).

Thus work must be done on the particle to replace the energy radiated into space ; in other words, there will be a resistance offered to the motion of the particle if its acceleration is finite. This resistance is such that the work spent in overcoming it in a time M Is equal to the energy radiated in that time.

►► 15. Electric Oscillations on a perfectly conducting Sphere. ►►► We can apply the preceding analysis to the case of a conducting sphere, charged so that the density of the surface electrification at a point is proportional to cos S where 6 is the angle which the radius to the point makes with the axis of z. If the field were steady the components of the electric force would be given by equations of the form

cP 1 ►►► cP 1 ►►► (

X=m

dxdz r’

Y=m

dydz r’

i z=.

Xdx’ dy^ } r

}l

hence when the charge is free to move over the surface and the electric field to vary, the components of the force will be given by the equations

tp((-) ..pit-‘-)

X=m

Y=m^

dxdz r dydz r

~~ \dx^ dy’^j r

In this case it is one of the objects of the problem to determine p. This can be done from the condition that the electric force at the surface of the sphere must be radial, as a finite tangential force at the surface of the sphere would in consequence of the perfect con- ductivity correspond to an infinite current. If a is the radius of the sphere, then when r=a we must have

x~ y ~ z’

Substituting the values of X, Y, Z we find that this condition leads to the equation

the roots of which are

if V

pa._\ JZ V ~2- 2 ???

Thus the time of vibration is iTa/\ySv, and the wave length iiral^JS.^^ The amplitude of the vibration falls to 1/e of its original value after a time 2ajV, that is, after the time taken by light to pass across the diameter of the sphere. In the time

occupied by one complete vibration the amplitude falls to e or about ^ of its original value. Thus the vibrations will hardly make a complete oscillation before they are practically extinguished. This very rapid extinction is due to the radiation of energy from the sphere. The state of a sphere charged initially so that the normal force at its surface is equal to 2s cos 0 is after a time t represented by the equations

P =

is cos 8

vt-ir-a) 2a

e=

^/3r2

2s sin 9

V3

7=

2s sin B a

_ /l-f

^3 W (. T

2 , vt-i^r-a^ . ^^} ??’ ^” cos(0-t-5”),

P, 9 being the normal and tangential components of the electric force, and 7 the magnetic force.

0=

^{vt- 2a ^

ir

-a)}; tan►► = (|:-l)/v3

tan 5 =

r-a 1

tan S’ ►►►

_2a r

those equations hold for positive values of (/>, i.e.., after a wave starting from the sphere and travelling with velocity ►►►;; has had tirne to reach the point under consideration. Wlien r is very great compared with a, P is small compared with 6 and Q=‘o^.

We can get the time of vibration of distributions of electricity represented by the higher harmonics by a similar process. If the electrification is proportional to the ►►’* zonal harmonic we put

X=7

dxdi^

A’-i)

Y=i

:=-m(

(P d’\d”~^ dx^ dz^Jdz”-^

dydi” ###

A-d

and proceed as before.

16. Scattering of Electric Waves by small dielectric Spheres.

This problem may be solved by analysis similar to that used in the preceding investigations. If the length of the incident wave is long compared with the radius of the sphere, the intensity of the electric field due to the incident wave will be practically constant over the sphere. Let the incident wave be travelling parallel to the axis of x, let the electric intensity in it be parallel to the axis

of z, and equal to the real part of ZqC ”’, let K be the specific

inductive capacity of the sphere, and a its radius ; then if this sphere were placed in a constant electric field where the external force was Z,,, the components X, Y, Z at a point outside the sphere of the electric intensity due to the polarization of the dielectric sphere would be given by the equations

###^-kT2’##“5S?

K-1 3_^1 “K-l-2 ##” dydzr’

Z =

K-1, ‘K-1-2′

, 3/cP (Z2\l ’”” ### [di^’^dfjr

These equations suggest that when the field is variable the com- ponents of the electric intensity due to the sphere are given by the equations

K-1 d^ /K’-F) K-1 (P f’Ki-i) ###^-K + 2^<'" dxdz-^^' -K + 2’’’’’ dydz r

K-l_ 3/-KT2<'"-[d^^+df)

M*-l)

The forces inside the sphere may easily be calculated, but they are not required for the present investigations. Corresponding to these values of the electric force we have, if a, /3, y are the com- ponents of the magnetic force.

-K + 2^^‘P

M*-l)

dy

E-I7 3

,‘pH)

dx

7=0

when it is to he understood that only the real part of these expressions is to be taken. The magnetic force inside the sphere corresponding to the internal electric field is continuous with that outside. These expressions satisfy all the boundary conditions if the sphere is not magnetic, for since pa/v is by hypothesis very small, the expressions for the electric force close to the sphere are very approximately the same as those in the electrostatic problem, which satisfy the boundary conditions of continuity of the tan- gential electric force and of the normal electric polarization ; if the sphere is non-magnetic there is no discontinuity in the magnetic force and magnetic induction. Both the external field and that calculated from the preceding equations satisfy this condition. The values of X, Y, Z, a, ^, 7 can be got from the equations in

►► 12 by putting m = =j: ►►► ^Zoffi’ ; at a considerable number of wave

lengths from the sphere they take the simple form

,K – 1 xzp’

X =

Y—Za►►5^^^

K-1 xzf r r\ 1

^ ►►► 7; -o ‘S COS ►► t I –

-Vg + 2^^

,K-1 yzp’ 1. r\

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[electeic

- ►►►““2 + 2 r^ T^’’►►^Py vjr

” K + ‘A V r

-(-9

p

►►►►► + 2 V r

Thus X, Y, Z, a, /3 all vanisli along the axis of z, and there is no wave scattered by the sphere in this direction. This problem of the scattering of waves by dielectric spheres was solved by Lord Rayleigh.^ **We see that for a given value of Zq and a, the mag- nitude of the forces in the scattered wave vary as p^, that is, inversely as the square of the wave length of the incident wave. The energy in the scattered wave varies inversely as the fourth power of the wave length. Thus on the electromagnetic theory of light, according to which light consists of electromagnetic waves, the intensity of the light scattered by small particles varies in- versely as the fourth power of the wave length. Tlie part of the incident light in which the electric force is along the axis of z does not give rise**

to any scattered light along this axis. Thus when ordinary light is incident on small particles the scattered light in a direction at right angles to the incident light must be plane polarized, the plane of polaiization being such that the electric force is at right angles to the plane through the observer and the incident beam ; this implies that the scattered light is polarized in the plane through the observer and the incident beam. For the application of the theory of the scattering of light by small par- ticles to the explanation of the blue of the sky the reader is referred to a series of papers by Lord Rayleigh ;‘ in one of these he has shown that the scattering may be produced by the molecules of the air without the aid of any extraneous small particles.

►► 17. Scattering of Electric Waves by perfectly conducting Spheres. ►►► When a train of plane electric waves is incident on a perfectly con- ducting sphere, the expressions for the scattered waves are not quite so simple as those in the last case. In the perfectly conducting sphere the total electric force at the surface must be radial, and the total magnetic force entirely tangential ; in the case of the dielectric sphere just treated the magnetic force in the scattered wave is entirely tangential, and so there is nothing to balance the normal component of the magnetic force in the incident wave. The follow- ing values of the components of the electric and magnetic forces will be found to satisfy the conditions that the tangential electric, and normal magnetic force vanish over the sphere. The electric intensity in the incident wave is supposed to be represented by

/ __5\ the real part of Zqe’ ‘ , and to be parallel to z ; the magnetic force will be parallel to y and equal to the real part of

(Zo/t))e ” . The radius, a, of the conducting sphere is very small compared with the length of the wave.

pG-^)

X= Z►►►a’

‘►►”►►► dxdz

^7..JJ’Y

1 Zpa^ d e “2”’ V dz

^p(t-0

⬜⬜0-^)

Y= Z⬜⬜⬜a’

\dydzj

‘p(⬜⬜-0

o=Zoa’ip

dy

1 Zpo? (P f

2 V dxdy

dx r 2 V ydx’ dz^J r

7=

2

1 Z.a?

13)

(⬜⬜—J

P V r t’H 2r2 r J ^\ vj

‘ Y r v^ 2 r^ \ v)

Thug x^ + yY + zZ = , ax + Py + yz=0, Xa Ł Y -f Z7 = 0, so that both the electric and magnetic forces are at right angles to the radius, and the magnetic and electric forces are at right angles to each other. We see from the preceding

expressions that the electric and magnetic forces both vanish when 2/ = 0 and a;/r= -^ thus the scattered wave due to the incidence of a plane wave on a conducting sphere vanishes along a line making an angle ot bU with the direction of the incident wave measured backwards from the sphere, and in the plane through the centre of the sphere at right angles to the magnetic force in the incident wave in the cas^ of the non-conducting sphere this angle was 90 instead of 60 The preceding investigation applies to a perfect conductor, we snaii show later that when a wave in which the frequency of vibration is p falls upon a conductor of specific resistance a, it only penetrates the conductor to a depth comparable with aJtJp. If, then Ja/p is small compared with the radius of the sphere, i.e., if

►► 18. Bejkxion and Refraction of Electric Waves by Insulators.►►►

Let us take the plane of the paper as the plane of incidence and of xy, and let a; = 0 be the equation to the reflecting surface. In the case when the electric force in the wave is in the plane of incidence, if V is the velocity of the wave in air, X its wave length in air, and i the angle of incidence, the incident wave may be represented by

the real part of Ae

ii?(a:cosi-l-j(sini-t-V()

This will give rise to a

reflected wave which may be represented by the real part of

I►►► (-xcost-t-S(sini-)-Ve) , j. r i- -ir’ ti,.

^‘e A . If r is the angle of refraction, V the

velocity, and X’ the wave length in the refracting medium, the refracted wave may be represented by the real part of

3^(x msr+y sin T+'t)

Since at the reflecting surface, x=o, the incident and reflected and refracted waves must keep time with each other, the coefiicients of t in all the

exponentials must be the same ; the coefficients of j^ must also be the same, since the relation between the waves must be the same at all parts of the reflecting surface. Hence we have

sin i sin r

V V

sini sin r

X X’

X’X’

Of V – V

The last equation is the well-known law of refraction. To deter- mine the values of A’ and A” in terms of A, we have the condition that the electric force parallel to the surface of separation must be continuous as we pass from one medium to another. The electric force parallel to the surface in the air is

itL(ysXni+Nf) (A – A’) cost e ^ ,

and in the refracting medium it is

2 V dydz r

At a distance from the sphere, large compared with the wave length, these expressions reduce to

y=zo;^^:cos,(.÷)

^~ ►►r v\ r-” Ir) ^\ 11 J “- V r v\2 r” rj ^V ‘►►)

hence we have

i?5(2,sinr-|-V’t) A” cos re >” ,

(A – A’) cos i = A” cos r.

The electric polarization normal to the surface must also be con- tinuous ; in the air this is

(A ł A’) sin ie ^ in the refracting medium it is

:^(!/sini+VO

—47r;

KA” sin re

!r(!/sinr-|-V’t)

-T-47r,

when K is the specific inductive capacity of the refracting medium.
Equating these expressions wo have

hence we find

(A -f A’) sin i = KA” sin r \

A’ = A

A”=A-T

K tan r – tan i K tan r + tan i

sin2i

sini’cosr-l-Kcoaisinr

waves]

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If the refracting medium is non-magnetic V7 V = sin Hj sin ^r = K. Substituting this value for K we find

^,_^tan(t-r) ta,n{i + r)

A”=4A-

sm r cos i sin 2i + sin 2r

Thus the reflected wave vanishes when i + r=-, Trouton,^^ who

has investigated experimentally the reflexion of electric waves from a paraffin wall 3 feet thick, found that when the electric force was in the plane of incidence the reflected wave vanished at a par- ticular angle of incidence ; but if the electric force was at right angles to the plane of incidence the reflected ray never vanished. This observation has an important application to the electromagnetic theory of light, for we know that when light is polarized at right angles to the plane of incidence the reflected wave vanishes when the directions’ of the refracted and reflected waves are at right angles, but that it never vanishes when the light is polarized in the plane of incidence. Thus the electric force is at right angles to the plane of polarization while the magnetic force is in that plane.

►► 19. We can easily verify that the energy transmitted along the incident beam is equal to the sum of the energies transmitted along the reflected and refracted beams ; for by Poynting’s theorem the energy passing unit section of a beam per unit time is EH/4jr, where E is the electric and H the magnetic force. But in a plane wave E=V/iH, where n is the magnetic permeability, hence the rate at which energy passes through unit area of the beam is W/V/iiT. Thus the average rate at which it passes across unit area of the incident beam is A^/SirV, across the reflected beam

2 2

A’ /SttV, and across unit area of the refracted beam A” /STfiY’- Now, if the area of cross section of the incident beam is unity, that of the reflected beam will also be unity, and that of the refracted beam cos r/cos i ; hence the

energy transmitted along the incident beam will equal the sum of the energies transmitted along the re- flected and refracted beam if

2 2

A2_A’ A” oosj- T~T’^~irV’ coal

This relation follows at once from the values of A’ and A” given above.

Let us next consider the case when the electric force is at right angles to the plane of incidence. Let, as before,

o_ o_

i^xcosi+yaini+Vt) iZ^(~xco3i+y aini+Vt) Ae ^ , A’e ###^

represent respectively the electric force in the incident and reflected waves, and

i-Ux COS r+ysinr+Y’t) A”e >”

that in the refracted wave ; then the magnetic forces will be in the plane of incidence and will be proportional to A/V, A’/V, A”/VV- Since the magnetic force parallel to the surface of separation is continuous we have

V (A – A’) cos i= A”tT7### cos r, V >

and since the magnetic induction at right angles to the surface of separation is continuous,

(A + A’) sin i = A”=7 sin r.

Solving these equations we get

, {/i tan r – tan i) _ IX tsm r + ta,n i ‘ 2A/1, cos i sin r

A’ = A^-^

, sin(i-r) .### , = -A ### , . , i if iH=l,

A”=-

oos r sm i + fx cos ►► sm r

sin (i ǂ r) 2A cos t sin r sin (i ǂ r)

ifM=l.

In this case the reflected wave never vanishes. Assuming the electromagnetic theory of light, these and the preceding investiga- tions give the intensity of the reflected and refracted beams when plane polarized light is incident upon a reflecting surface.

►► 20. Reflexion of Electric Waves hy a Plate of Dielectric offmite thickness. ►►► We shall suppose that the plate is bounded by the parallel planes x=(i, x= – h, and shall limit ourselves to the case of normal incidence ; the general case of oblique incidence is discussed in J. J. Thomson’s Recent, Researches on Electricity and Magnetism,

i^{x+Vt) p. 407. Let the incident ray be represented by Ae ^ , and

2ir.

►►► (-X+^{i

the reflected ray by A’e ^

waves travelling in both directions ; let one of these be represented

i-w-(a;-|-V’() I►►► (-i-l-V’rt

byBe -^ , and the other by B’e ^ , and let the

emergent wave be represented by Ce ^ . Then introducing

the boundary conditions at x=Q and x= -h, and solving the four equations we find if the plate is non-magnetic

A’=-A(K-l)(/^’’-r*^‘O^A,

B = 2A(, + l)e’‘^.^A,

B’ = 2A(|,-l)e’’^\A,

where

C = 4Ay7e ^ -=-A,

In the plate there will be

n

Thus corresponding to the incident wave A cos ⁇⁇⁇(x + Yt) we have

A

a reflected wave represented by

-A(K-l)sin^A oos{^(-x-l-V<)H-|-a)-HD, two waves in the plate represented respectively by

A^”^ H- 1 Vos {?^(a; -f A ~~1~~ V’<) – ^} -7-D

and a(y,~~i\ cos~~ {x+h) + Y’t)-^^II,

and a wave emerging from the plate represented by 2A^cos {^(a; + A -f-V<) ~~&|~~=-D,

where I)’’=(K + l)^sw?h + iKoos’^h; tan3-=^iitan?^A.

Thus we see that when 2nh/' is very small the reflected wave is very feeble. This is what we should naturally expect, as we could not expect to get appreciable reflexion unless the thickness of the plate were comparable with the length of the wave. Trouton ^ has verified that there is no appreciable reflexion of electric waves from window glasa unless it is covered with moisture which makes it a conductor. The reflected wave vanishes whenever 2Trh/' is a multiple of x, or whenever the thickness of the plate is a multiple of half the wave length of the wave in the plate. Trouton used as a reflecting plate a wall built of paraffin bricks, a method

which enabled him to try the eff’ect of varying the thickness of the plate ; he found that after reaching the thickness at which the reflected wave became sensible by making the wall still thicker, the reflected wave became again insensible when the wall reached a certain thickness. The case is analogous to the colours of thin plates where we have darkness when the thickness of the plate is a multiple of half the wave length. The intensity of the electric force in the plate is proportional to

V V

thus the average value of the square of the electric force is propor- tional to

V2 .27r, , ,,, . ###27r, , ,, ###cos^ -y{x + h)+ sia’^ix+h).

The maxima of this expression occur when x+h is a multiple of \72. Thus if the substance of the plate is changed by the action of the electric field the plate would develop a periodic structure, the wave length of which would be half that of the electric waves in the plate.

##21. Reflexion of Ffaves by OondtKtors; Opacity of Condiictors. ### In conductors there are, in addition to the polarization currents which are proportional to the rate of increase of the electric intensity, conduction currents which, obeying Ohm’s law, are proportional to the electric intensity. Thus in a conductor, if i is the current and E the electric intensity,

._K^ E *~47rrf<'^o-'

where ff is the specific resistance of the substance. Substituting this value for the current in equations B we find that the com-

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,coSp-(a; + A)cos (p”‘*”) ~ sin ^/(a; (A) sin f-j-7T’<-& J ;

ponents of the electric intensity and of the magnetic force satisfy equations of the form

[elbcteic

Kfi.

dt^

a dt dx^ dip dz^

Suppose now we have an electric wave travelling through the air and striking normally against a conductor, the plane of separation between the air and the conductor being the plane a;=0. Let the electric intensity in the incident wave be represented by the real

part of Ae -^ . Then if E is the electric intensity in the

wave m the conductor, it satisfies the differential equation

1^'^ a dt~ dx^'

The frequency of the electric intensity in the conductor must be the same as that in the air ; hence E must be proportional to 6 if ^ = 27rV/X. On this supposition the equation for E becomes

hence E will be of the form e '^^*+"> here n=yKf- – ^"^P. Thus

mis a complex quantity of the form a + i/3. We must take the root which has /3 negative, for in the conductor x is negative, and if ^ were positive the expression would represent a disturbance continually increasing in intensity as the distance from the surface of the conductor increases. Let the electric intensity in the con- ductor be represented by Be'^P'+''*, and let the reflected wave in

the air be represented by A'e '^ ; then since the electric force

parallel to the surface of separation is continuous

A + A’ = B,

and since the magnetic force parallel to the surface is, by equations A (►► 10), (l//iip) id’&ldx) and is continuous, we have

hence

^^(A-A’)=^, A /t

a’=a(i-^^

B=

1 +

2A

1.+

27r/i’

J’JV,

Now ‘j^=ii.‘Ejp’’₩^\ the ratio of the first term in this expres- sion to the real part of the second is ^K^ir/4ir/i. But K = E’/V^ where K’ is the ratio of the specific inductive capacity of the conductor to that of air, and V the velocity of light, i.e., 3 x lO^” cm. /sec; hence the preceding ratio is equal to K’(r/367rx 10►►►. If we put in the value of a for the ordinary metals we see that unless K’ is enormous this ratio is exceedingly small even when the frequency is as large as it is in the waves which constitute visible light. Even for electrolytes it is exceedingly small for electric waves a few millimetres in wave length, and the longer the wave length the smaller it becomes. We shall, therefore, in the expression for n neglect the term /iKp’ in comparison with ivixpfsy but when we can do this TiKjiirij, is exceedingly large ; hence approximately A’= -A

B.{|_-)’.V

Itt,.

Thus the reflected wave is represented by- A cos ^(V<-

X

x). To

this approximation the electric force parallel to the surface of the conductor vanishes at the surface. The transmitted wave is represented by

In the conductor x is always negative, so that the amplitude of the transmitted wave is small to begin with, and diminishes rapidly in consequence of the exponential term.

►► 22. Transmission of Electric Waves through a condiccting Flate.^ ►►► Let us take the case of electric waves incident normally upon a conducting plate bounded by the planes x = 0, a;= ►►► A. Using the same notation as before, let the incident wave be represented by

2ir 2ir,

<►►► ►►► (yt+x) '►►► ►►► \\t-x)

Ae ^ , the reflected wave by A’e ‘^ , the wave in

the plate by Be’^^*+►►►^ and B’e’^^’ ”””’►►►’, and the transmitted wave

by Ce ^ . The boundary conditions at the two surfaces of

the plate give four equations from which we deduce

/ inh -tnh\ A’= – AiTi^l/x^ – 47r7X2) ye – e j-J-D,

_ 47rA, , r, ;x\ tnh . T. B’ = ^A(VM-27r/X)e -^D,

L►►►Th

C=yA(m//i)e’ >^ —D,

where

/ inTi ~inh\ I Ltih -tnh\

D = (n2/;U=-l-4irVX2) le -e) + iiT/\)(n/fi)[e +□□□).

When nh is large we see that A’ = □□□ A, and the electric force parallel to the plate vanishes at the surface of the plate. The

magnitude of nh is (iir/j.ph’/cr) , and the condition that the force should vanish at the surface is that this quantity should be large. For metals very small values of h are sufiicient to satisfy this condition ; thus for waves one metre in length in air and for an iron plate, nh is about 1500 h, so that if the plate were only 1/15 mm. thick nh would be equal to 10, and as c” is a very large number the reflexion is practically perfect. We see from this example how it is that tin-foil and gold-leaf are practically perfect reflectors for very rapid electric waves. With electrolytes, on the other hand, for which cr may easily be as large as 10^□□, it will require a. plate many millimetres thick to produce complete reflexion. The case of nh large is practically that of the infinitely thick plate previously considered. Let us now consider the case of a plate so thin that nh is small ; in this case there are two subcases to con- sider□□□ (1) when n^h\/2ir/i or iwYhja is small ; (2) when it is large. In case (1)

^ = -2^^’2’2>= =

thus the reflected wave is represented by A cos ^r-(T< – x), the

ff X

waves in the plate by \ A cos (|^y..2. ^g.) .\ A cos (|y.-2. ^g.)

and the transmitted wave by A cos -^{Yt + x + h).

X

In the second case when n%\/2Tr/i is large we have approxi- mately

A’=-A; B = 27rA^/m%X, B’ = 27rA/i/m%X, C = 47rAe’□□□ /□□%X.

A

Thus the reflected wave is approximately – Acos—^(V^-x), the waves in the plate

4^y7^M- (t^^-^^ ^/S^yH>≙ ^/g❑❑)}.

and the transmitted wave ^-^A-cos -^{Yt + x + h).

Thus the thickness of the slab which produces a given diminu- tion in the intensity of the transmitted wave is proportional to the specific resistance. This result has been applied by the writer ^ and Erskino ^^ to compare the resistance of electrolytes under the very rapidly alternating electric forces which occur in electi-ie waves. These investigations have shown that the ratio of the resistances of electrolytes under electric forces changing their direc- tion several million times a second is the same as under steady currents. Similar measurements by a somewhat diff’erent method have been made by Zeemann.’”

The preceding equations are general, and if we know the values of X, cm. incident on a plate of gold-leaf wlSse thickness IS X/25,

““l A n?**” ‘i**.‘i’,’”^ *”‘? ‘❑❑❑’❑❑❑”” ^ *^❑❑ equations when nh is large we find C/A = ~~0001 approximately, so that the intensity of the trans~~ mitted wave would only be about 10-8 of the incident wave This indicates that such a film would be practically opaque. Experi- ments on the transparency of thin metallic plates made bv W Wieni and others have shown that such plates have a much greater transparency than is indicated by the prec.-‘ding figures lor examide the intensity of the transmitted wave in the case of the film of gold-leaf just considered is found to be not much less than

waves]

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J of that of the incident one. This enormous discrepancy seems to indicate that when the electric force is changing its direction with the rapidity which it does in the case of waves of light, the effective resistance of metals is

much greater than un^der steady currents ; we shall return to this point when we consider the propagation of an electric wave through a medium containing ions.

The theory of reflexion of electric waves from a grating of parallel wires has been discussed by the writer ’’^ and Lamb.’’’

►► 23. Waves along Wires. ►►► A most important case of electric waves is when there is a wire in the field parallel to the direction of their propagation. The wire acts as a guide to the waves, which may in a certain sense be said to run along it. The reader will find a full dis- cussion of this problem in papers by the writer,’^ by Heaviside,” and in recent ones by Sommerfeld ‘^ and by Mie.►►► We shall confine ourselves here to an outline of the method by which the problem can be solved. Let us first take the case when the only conductor in the field is a cylindrical wire of radius a, the axis of which we shall take as the axis of z. Let P, Q, R, a, b, c be the components of the electric force and the magnetic induction respectively parallel to the axes of ic, y, s, and let us suppose that the electric field is symmetrical about the axis of z. Then in the air around the wire R satisfies the equation

where v is the velocity of propagation of electromagnetic disturb- ance through the air. If R varies as e’’►►►*”” ‘ this equation becomes

R I C I T Y

and

67

(PR ^ ^

dx^ dy^ or since the field is symmetrical about the axis of z (PR IdR ^

My

bout the a

(???’-S)=o

(2),

where p^=x^+y^. Since the field is symmetrical about the axis of z we may put

dx’ ^~ dy’

where X is a function of p and z, which satisfies a differential equa- tion of the type (1) or (2). Since

dP dQ dU

we have

hence

dx dy dz

P=-

, Q=

X

2 P^ dx’

+ imR=0;

im dR T^dy ‘

From the equitions of the type

(te_rfQ d&

dt ~ dz dy

we get

ip 1 dS, , ip 1 cCK .

“ 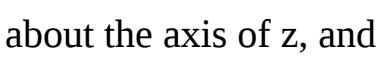 ^-rk 5^-) =0′

‘fi p’ dy V’ 2 p’ dx

y2

P

h^^P-

a= -^Q, 5= – ^P, c=0.

mv’ Tnrr

Thus the lines of magnetic force are circles with their centres long the axis of s, and their planes at right angles to it. In the wire itself, R satisfies an equation of the form

dx^ dy’ dz^ ~ a dt’

where ij, is the magnetic permeability, and cr the specific resistance of the wire. In this equation we have neglected the term /j.K(PR/dt’ in comparison with (4ir/i/(r)((iR/rf<), and for all metallic conductors this is legitimate unless the waves are smaller than the wave length of light. Introducing the conditions that the field is symmetrical

about the axis of z, and that R varies as e’+J’ ‘^ y^^ get

dp’ p dp We find also

%1_r(,. + !^)=0.

P=—

dR

m’+

iv/jup dx

;Q=

dR

JTT/up dy ‘

OT^-f

dR

iir/i

dR

I i-rrfup dy’ ^ i-n-fup dx”

c=0.

Ihus all the quantities both in the air and the metal can be ex- pressed in terms of the z component of the electric force. Now, both in the air and the metal, R satisfies a differential equation of

‘□□□^^^”” ^ d^RldR ,^ □□□

W’+pd’p-i’^=□□ □□□ □□□ □□□ □□□ (3).

where in the air f=‘m?-‘^;m the metal q’’=m’+iTr/up/

R=AJo{iqp) + BKo{iqp), where Jo and Ko are Bessel’s functions of the first and second kinds. The expressions for J□□□{x) and Ko(a;) are (see Art. Spherical Harmonics)

□□<>—(T)^(i)^(2^(ir-(A

Ko(a;)=Jo(a;)|log|-)-| H- C } – 2^hix)-lux)+lux)... |

where

‘*>=i(i)-(-i:^.(i) -r

m-)

i(n+l)(n+2)\ and C=‘577…=log7, where 7=1-781. ..

For large values of a; the following approximate expressions are useful :

Jo (a;)

= /if

‘V TTIXK

.’(+f)_, -‘(+^

Koix)

~V 2x^

i^+l).

^

From these expressions we see that when x=0, Ko(ia;) is infinite, and when x is infinite Jo(ia;) is infinite. Thus in the wire where p may vanish R is represented by the Jo function, and in the air where p may become infinite R is represented by the Ko function. Thus in the wire we have

R=AJ(mrie’(‘+‘>,

where n’=m^+iTnip/a; and in the air

R = BK (.,cp)e’(~+^’, where k” = m p^ji?. The magnetic induction at right angles to p in the wire ia

where

J’aimp)

_dJ^ iynp) d{mp)

The magnetic induction at right angles to p in the air is equal to

^^=_^BK’o(<□□/,)e'(□□□^+^'>

where

dV dp v^K

” dAKp

(4),

The boundary conditions at the surface of the wire when p=a are (1) that the electric force parallel to the surface is continuous, i.e., that R is continuous ; this gives A Jo(ma) = BKo(iKa) ; and (2) that the magnetic force parallel to the surface is continuous ; this gives 4□□□ Pt?17W ^

an ITK ”

Eliminating A and B from these equations we get

a transcendental equation to determine ?i. In all cases of electric

waves along wires where the wave length is large compared with

the radius of the wire)ca is very small. When sa is very small

27 1

Ko(i(ta) = log □□□□□□□ and K’o(iKa)= -□□□ □□□

Substituting these values in (4) we get

map- Jo(ma) _ _ 2ff /ik□□^ , / JvV 45r J’o(iKa)~ p’\iy) □□^\iKa.)

ma

4ir J’o(ma) p

13 log z

(5).

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 ^The physical meaning of r becomes clearer when the electric conditions are made precise by supposing that the dielectric is enclosed by a conducting cylinder coaxial with the wire. If the radius of the internal boundary of this cylinder is 6, proceeding as in the simpler problem we find the following equation connecting p and m

., ip’Cl” Jo(ma) li’ ‘K(m’h)-\ 1

v’ \na. J’(|(ma) n’b K’(|(m’J) / log (6/a)

(7),

where /j.’ is the magnetic pernieability of the outer conduction and

2

n’ =‘m!’ + iirij.‘ip/a’

y being the specific resistance of the outer conductor. When tia is very small equation (7) becomes

,^_ipV2iAt / KoKi)\ 1

73

B? w‘6K’o(m‘6)Jlog(6/a)

(8).

The first term is very large as ma is small, the second term is zero when 6 is infinite, and even when b is so small that n’b is a small quantity. For the ratio of the second term inside the bracket to the first is equal to

I^Vlog^ 2/1 i.n’b

and is thus exceedingly small unless n’b is vanishingly small com- pared with na. Hence very approximately equation (8) gives since K’^=m?-p’^liP’

’”~dH 27r^aMog(6/a)/ or approximately

pia 1

If R is the resistance and V the capacity of unit length of the wire in electromagnetic measure, R=o-/‘n-a’’ and r = l/2V log(*/a), hence

rrfi=- i.p’RV or m= – ipRT) (Tg ~ ‘JV’

Thus the velocity of propagation is (2p/Rr)* the amplitude dies away to l/ ►► of its original value after passing over a distance {ij’S.Vpf ; the greater the frequency the greater the velocity and the more rapid the damping. As a numerical example, let us take the case of a cable transmitting electrical vibrations, whose period is 1/100 of a second ; let the copper core be 4 millimetres m dia- meter, and the ex-ternal radius of the gutta-percha covering be 2-5 times the radius of the copper. In this case R is 1 ~~3 x 10~~!* ohms and in absolute units 1-3 x 10^ while V is about 15 x 10- ►► ; hence the velocity of propagation is about 8 X 10″ cm./sec, and the disturbance will travel about 1-28 xilO’ cm. before falling to 1/e of its initial value. This is an illustration of the velocity of a very long wave. With very fine wires the condition na. small can be fulfilled with quite short waves. Thus take the case of a platinum wire 2 x 10”^ cm. in radius, carrying a wave whose wave length in air would be 1 metre ; then since a for platinum is about l‘4x 10*, and p for this wave length 27r x 3 x 10*, we see that ma is small. Substituting the value of p, a, a in equation (6), we find that the velocity of propagation is only about 80 per cent, of that of an electromagnetic disturbance through air, and the amplitude of the vibration will fall to 1/e of its original value after passing over a distance of about 17 cm.

The relation?n.^= – ipRFistheone at which we should arrive for the propagation of a disturbance along a cable if we neglected the effects of electromagnetic induction. The equation satisfied by the current

I along the wire is in this case “B-V-j- = -r^. As in this case the

effects of self-induction are neglected, the disturbance is propagated

by “diffusion” rather than by ordinary wave propagation. This remark applies to the case we are considering. Whenever jia is small we are dealing with diffusion and not true wave propagation ; hence when we study electric waves by their effects along wires we must be careful that ma is large. For if this quantity is small, the velocity of propagation depends upon the frequency, and there is no more a definite velocity of propagation of an arbitrary disturbance lasting for not too short a time, than there is a definite velocity of propagation of heat through a conducting solid.

If ma is small nr will be small everywhere within the wire, and if nr is small J(i(mr) is approximately unity. Hence the electric force parallel to the axis of the wire, and therefore the electric current, is in this case uniform over the cross section of the wire; when this is the case the prob- lem of waves along wires is one of diffusion. A reference to the equations giving the com- ponents of the electric force along and perpendicular to the axis of the wire shows that

11^ 2ffa^ log (6/a)

Fig. 48.

inside the wire the force is everywhere approximately parallel to the axis, while in the dielectric at the surface of the wire the electric force is approximately radial. At a distance from the wire com- parable with the wave length this ceases to be true, and the lines of force are bent so that at some points they are parallel to the axis of the wire. The strong damping of the waves in this case is due to the absorption of energy caused by the heating of the wire by the current flowing through it. Fig. 48 represents the lines of electric force in a case of this kind. It is taken from Sommerfeld's paper.

26. Case of Sigh Frequency Currents or very good Conductors. When p is so large or a so small that ma is a very large quantity the preceding considerations no longer hold. If na. is very large J'o(ima)= -iJ5(ima) and equation (5) becomes

logs=

ipa SttyV

= M(l-i),

where

4721,2 \ 27r ;

waves]

In deducing this equation we have substituted for ma the approxi- mate value sjiiriu-pja. The approximate solution of this equation is

0=i

logMV2

Since : = (iKa/27)’’ and i<'=m.$^{-p'l'V}$, we get

TO^-.P’ , a /;^gy\i 1 ,. ., ” ^;2+i>=aV2’ry’logM^2^^ ‘^’

as the real part of the second term on the right-hand side is very small compared with Palis’, we have approximately

or

’”=S^-*(2^)i3TO2’}-

(9).

If we take the case when the air is bounded by a conducting cylinder whose internal radius is b, we arrive at a similar expression, the only difference being that instead of log M ij2 we have 2 log 6/a. Since p/m is the velocity with which a dis- turbance is propagated along the wire, we see from equation (9) that in this case the velocity of propagation is v, and is inde- pendent of the frequency ; the amplitude of the disturbance falls to 1/e after passing over a distance equal to ‘K(2pa?//nrff)i log (M ^2), when X is the wave length 2irv/p. By hypothesis pa?l

►► 27. Distribution of the Currents in the Wire. ►►► To calculate the variation in the electric force as the distance from the surface of the wire increases, we may proceed as follows. Let the total current flowing through the cross section of the wire at the place s, and the time t, be the real part of I|,e’(‘^+P’) ; now the magnetic force tangential to the surface of the wire is at the surface

0-7!. “* ‘

and since the line integral of this taken round the oiroumference of the wire is equal to 47rl(|e’(~+*’), we get ^__iffm Iq

27ra J’|,(ima)’ Thus in the wire

27ra J (,(trea) “^ ‘ When as in this case na is large, then at a point near the surface of the wire.

J’o(‘******a)=—

:; Jo(inr) = –

/27r?ia ‘ ”’ ******* sjivnr Substituting these values, and taking the real part of K, we get

where

I. Trar J

f=mz pt – {2Trfip/-r.

Similarly we find that the radial electric force in the cylinder is equal to

_ -2 ******lo J – (2,rM3>/

and the tangential magnetic force to

_2^j^^-(2.pWV-r)eosf-|). v/ar V * /

Since all these expressions contain the factor {-(“MPwCa-’”), we see that the maximum values of these quantities at a distance {(r/2irfi.p) from the surface are only (1/e) of their maximum values at the surface, and they diminish in geometrical progression as the distance from the boundary increases in arithmetical progression. Thus the currents are practically confined to a thin

skin at the surface of the wire, and we may take (i7/2ir/tp)* as the nieasure of the thickness of this skin. For currents making 100 vibrations per second, the thickness of the akin for soft iron with a magnetic permeability of 1000 is about -5 mm., and for copper it is about? ‘5 mm. For electric waves 1 metre wave length, the skin for iron is only about ~~0001 mm., while for copper it is about 15 times as great. In these oases there is an enormous con~~ centration of the current in the surface layers, producing a great increase in the apparent resistance. We see from the equation for R that the maximum value of R= (maximum value of current through the wire) x {/ip)K Thus we may look upon (fipalTra?) as the apparent resistance per unit length of the wire to these alternating currents. It is the same as the resistance to a steady

current of a tube whose radius is a, and whose thickness is 1/V2 times the thickness of the skin.

It is instructive to look upon the transmiasiou of waves along wires from the point of view of Poynting's theorem (see ►► 13). According to this view the energy does not travel through the wire, but through the dielectric ; when the energy from the dielectric passes into the, wire it is gradually converted into heat. Now when we were considering the reflexion of waves from metallic plates we sa_w that we got practically complete reflexion when A, the thickness of the plate, was great enough to make nh large, while the waves were transmitted through the plate when nh is small. Thus in the case of wires when na, is large the waves striking against the wires will he completely reflected, and their energy will remain in the dielectric, which when nh is small they will pass through the metal, and part of their energy will be dissipated in heating the wire. We should thus expect that there would be considerable damping in the second case and very little in the first, and this, as we have seen, is the case.

There will be a surface charge of electricity on the wires, and this will give rise to an electrostatic potential

27ras

If Iq f is the total current through the wire at the place z

and the time t, then ►►►

d ., ,.(fra+pt)._ ^ ds ^(V)—2'^►►d4′

or since all the quantities vary, as e'►►►+P '^ we have

P Hence

"" y dmz+ft)

pKC

When ns, is very large, p/m=v the velocity of propagation of electromagnetic disturbances through the dielectric, and if the dielectric is non-magnetic and we use the electromagnetic system of units K = l/i;’’, thus the preceding equation becomes

^-“t ‘(‘“2+3‘0

“We can apply this equation to find the reflected and transmitted currents when the circumstances suddenly change along the wire.

28. Wave reflected at the Junction of two Dielectrics. Sn^i-pose the plane s=0 separates two dielectrics, in the first of which the velocity of propagation of electromagnetic action is v, and in the

second v’. Let Ije be the incident current coming along

the wire from the first medium to the second, i’g^~’’’’’+V) ^jjg reflected current, and Ijc the current in the second medium,

then Ii = Io + ro . . . . (1).

The potential at z= 0 in the first medium is (/C)(Io – l’i,)e^ , and in the second ‘ii’/CIje’^ . As the potential is continuous we have

r’Ii = ii(I-ro) .... (2). From (1) and (2) we get

^- v’ + v”

formulae, which, as we might have expected, since the energy is entirely in the dielectric, are of the same type as those giving the reflected and transmitted waves when electromagnetic waves are incident on a reflecting surface and there are no wires in the field.

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29. Beflexionfrom a Condetiser at the End of the Wire. Let us suppose that a condenser whose capacity is C^ is joined to the end of the wire at z=0 ; let the incident current be l^f’(^+3”) and the reflected current y^^^-‘+V)^ ^.j^g^ ^^ j,_q j^ j.^^^ ^^ which

electricity is running into the condenser is (lo + I^e’^’. If 0 is the potential of the plate of the condenser connected with the wire, the other plate being to earth, the change in the condenser is Ci0, and the rate at which it is increasing Oj{d

hence

i + ro=”-g^^.

‘i’(Io-I’o)

-g-V + 1

iftane=^;

thus if the incident current is represented by cos (mz+pt) the reflected current will be – cos (pt-m(z-\ 11. Thus the magni- tude of the reflected current is equal to that of the incident ; this we could have seen as there is no loss of energy ; there is, however, a change of phase. If there is no capacity at the end the current is reversed in direction ; when there is a small capacity the change of phase is such as would be produced if the wire were prolonged to a distance 2i;^Ci/0=2Cj/KC = 2 capacity at the end divided by capacity per unit length of the wire.

30. Time of Oscillations of a System consisting of a Wire connect- ing two equal Condensers. Suppose that we have a. system where a vrire of length 2Z connects two equal condensers, each having a capacity Cj, the other plates of the condenser being at zero potential. Let the current in the wire be regarded as the sum of two currents, one represented by Iq cos (mz +pt) and the other by I’o cos (– otz +pt), and let the origin from which z is measured be the middle of the wire ; then when z= -I, the current flowing into the condenser, is Iq cos {-ml+pt) + Vf, cos (ml+pt), and the charge in the

condenser is Cji/) = -⬛⬛⬛⬛⬛⬛ {Iq cos (– ml +pt) – I’o cos {ml +pt)} . Hence

lo cos (-ml+pt) + l’fi cos (ml+pt)

J^ . i-{\cos{-mZ+pt)-VaCOi{ml+pt)}. \j at

Equating coefficients of cos pt and sin pt we get cotml^C-if

(2)

io=-ro

ml

ta.‘n m,l_ ‘ ml

CI

C^ ‘ CI

l=m2

these give the values of m, and hence the periods of the vibration. Let us consider the first equation. Taking first the solution when the wave length is long compared with the length of the wire, ml is very small and equation (1) becomes

ycj c ⬛⬛⬛

or since mv=p

P Q ‘⬛⬛⬛⬛⬛⬛

If the ends of the wire are connected one to one plate of a condenser and the other to the other, instead of to the plates of separate condensers, the second plates of which are kept at poten- tial zero, we can prove in a similar way that when ml is small the equation for ⬛⬛ is

I^^^ = l .... (3).

Now when the currents are varying so rapidly that na is large, 1/C = L where L is the coefficient of self-induction of the wire per unit length. For if I is the current in the wire the electro- magnetic energy is equal to

IJLPd.

where dz is an element of the wire. The electrostatic energy is equal to

lJKC

where (p is the electrostatic potential, but in this case

-Vdz,

so that the electrostatic energy is equal to

2j C or since K'!)^=l to

2JC'''-

Since the meajfelectrostatic energy is equal to the mean electro- magnetic, we have L=l/C. Thus equation (3) becomes

p'^2Cl'L = l, or if L' = 2ZL, i.e., if L' is the coefficient of self-induction of the circuit

1

This is the value given by Lord Kelvin in 1853 in his paper on the oscillatory discharge of a condenser.'^

Iiet us now consider the value of m given by (1) when CiifjOl is small. In this case we see from the equation that

mZ=(2w-)-lW-ha; whereKissmalland jiia an integer. Substituting

this value of ml in (1) we find

⁇C= – {2n+l} or, if X is the wave length =27r/m.

2 CI’

_ii f cy]

~2n + lV+^]-

Thus when CjiJ^/C is small the effect of the condenser at the end on the wave length is the same as if the condenser were removed, and the length of the wire increased by Ci’!j’^/2C. If we know the wave length of the electrical vibrations emitted by the system and also Ci, we can from this equation determine Cj the capacity of the condenser at the end. If we fill the space between the plates of the condenser with difl’erent substances, and determine the corre- sponding value of the capacities, we can compare the specific induc- tive capacities of the substances when exposed to alternating electric forces of the frequency corresponding to the wave length. This method has been employed by Drude.’’

⁇ 31. Seflexion from a Wire without Self -induction. ⁇ If the end of the wire is connected with a place of zero potential by a resistance R without self-induction, then if

But0=^(I,-l2).

Substituting these values we find

1^=

RC ~J-

RC

H- 1

Ii-

This equation was first obtained by Heaviside.⁇ The reflected current is smaller than the incident current, and so there is loss of energy by the

reflexion. In the special case where RC = v the reflected wave vanishes and all the energy is absorbed by the resistance.

►► 32. Reflexion from a leaky Condenser. ►►► If the material separating the plates of the condenser is not a perfect insulator, but has a finite resistance R, there will be a conduction current through it equal to 0/R. The rate at which the charge accumulates on the

plate is ►►► i-^ ; hence at the end of the wire the condition is, if

Ij and Ij are respectively the incident and reflected currents.

Ii + l2=Ci^> +

where

‘

A- ” T “t

Substituting these values we find

where

I, = pe-“‘li

P –

tan 6=

{k+vf+7,y’

2np

i-e-vV

►►►waves]

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where

?=’!)/R0. ###i;=dOi/0; p is the coefficient of damping, aud 9 the change in phase at reflexion. We can measure 0 if we determine X, the length of the wave with which the circuit is in resonance ; in order, how- ever, that the resonance should he appreciable the damping must he small. To find X let A, B be the ends of the wire, and suppose a disturbance starts from B, travels to A, is reflected there back to B, and is again reflected. If after the second reflexion the phase differs by 2ir, or by a multiple thereof, from the phase of the disturbance at starting, the resonance will be greatest. Now in travelling from B to A the loss of phase is 2ir{2lj\) if 2Z=AB ; at reflexion from A there is the loss of phase 8, and there are equal losses of phase from the backward journey and reflexion at B. Hence for resonance we have

8tI

+ 20=2nT,

when n is an integer, or

irl

^-ll=nT-e.

tan ### =tan (mr-6)= -tanS= ###

2rip

-^

Hence if we determine p and X, we have from the equations in this section the means of calculating E and Cj, and therefore the specific resistance and specific inductive capacity of the medium separating the plates of the condenser. This method has been used by Drude, ## 37.

►► 33. Self-induction and effective Resistance of a Wire carryimg an alternating Current. ►►► -Returning to ►► 27 we see that without any limitation as to ma being large, we have

0=

(1),

where C is the capacity of unit length of the wire. If the wire is surrounded by a cylindrical conductor of internal radius 6, C=l/2 log i/a. Differentiating equation (1) with respect to z, and writing E for – dtpjdz, we have

E = 2,p.$^{\log(J/a)l/\sim+‘'}$

By equation (7), ►► 25, when the conductivity of the outer con- ductor is sufficiently large to make n’h very large

v’ ^ \►►a J’o(i?ia) /

log(6/a)

or since we have very approximately

1 ncr Jo(►►►a)

hence

/a))’

’”- ir^y-‘ii^ T J’►►►(ma) log (6/i

►►► f , , 1 n

E=2.^{log6/a-,—j4(^Jl;

I is the total current and is equal to J^g’v’i^+P). Now (J. J. Thomson, Recent Researches, p. 275)

J’n(‘►►a)

2-

96 1536 23040 4423680

►►‘a►► TV i

Substituting this value and writing for ra^ its approximate value iirfupla we find

E=PipH-QI = P^-l-QI

at

(2),

where

T=2\oglla, + ^p.

13

48

Tra- L

1 Ł

8640 IT*

1 ^4r,4►►►4a

7r>*,a*a►►

...}

12 0-2 180 ff-*

Now if L is the coefficient of self-induction of a circuit and R its resistance, the external electromotive force when the current I is

flowing through the circuit=I>❓❓❓ -1-RI.

‘ Comparing this equation with (2) we may call P the self-induc- tion and Q the effective resistance per unit length of the wire, and we see that these depend on the frequency of the current flowing through the wire. The expressions for P and Q show that as the frequency increases the self-induction diminishes, and the effective resistance increases ; both these effects arise from the fact that as the frequency increases the current gets more and more concentrated in the outer layers of the wire. The expressions for the self-induction and the effective resistance are the same as

those given by Maxwell (Electricity and Magnetism, ❓❓ 690), with the exception that in Maxwell a constant A is written for log b/a., and /I is put equal to unity. It was Heaviside, however, who first explicitly called attention to the great effect produced by the frequency on the self-induction and resistance of a wire. When

^ = 0, i.e. , when the currents are steady P = 2 log (6/a) + -^ ; thus the

self-induction of a straight iron wire is very much greater than that of one made of a non-magnetic metal. When na, is very large J’o(ima)= – Jo(‘ma) and we have

E=2.,{logWa).(¯,)i(J-_-^)}l;

in this case the self-induction P=21og(6/a)-l-(ir/t/27rpa2)* and the effective resistance Q={

When ma is so small that P and Q may be regarded as inde- pendent of p, or when the period is given, equation (2) may be transformed into a form which is often convenient. We have

-g = $^{-Q}$

(3).

Now if s is the surface density of the electricity on the wire 27ras = 00, where C is the capacity per unit length of the wire and we have

hence (3) becomes

ds dl dd) dl 2ira.j= or C = — : at dz at dz

dt^’^^dt~ C dz^’

which is sometimes called the telegraphic equation, as representing the variation of the current along a telegraph wire. It has been discussed by Poinoar^, Picard,*’ Boussinesq,^ and very exhaust-

ively by Heaviside.^ Putting I’ = e ^-^I it may be transformed to

dJ’V 1 cPr Q\,

(4).

dV

dfi

“CP dz2+4pai

If r=F{a;) ; - =f(x) when i!;=0 the solution of (4)’* is

-irA

X -i i= cos

a JJo (=-pi sin a j sin ada

34. Passage of an Electric Wave through a Medium containing Ions; anomalous Dispersion of Electric Waves. ^To take a simple case, let us consider a plane wave travelling parallel to the axis of z, the electric force in the wave being parallel to x and the magnetic force to y. In the medium through which the wave is travelling let there be a number of charged ions, and let the x co-ordinates of these be li, ^^, . . . The ions will be moved by the electric field and will produce a convective current equal to ^{ed}/dt, where the summation refers to the ions in unit volume round the point where the current is measured. The charges on the ions will produce

an electric field, and in considering the dielectric currents in the field we must remember that the part due to the variation of the electric field due to the charged ions has already been included in the convection current 2ed^/dt. Hence if Xq is the part of the field not arising from the charged atoms the dielectric current will her K^X^/dt where K^ is the specific inductive capacity of the space when free from atoms. Thus equations B and A (►► 10) become

” dt dt dz

so that

ɟ= – – (if the medium is non -magnetic),

^o+ilSe5?!l=14!5o

(1).

Now if m he the mass of an ion, oj Jj the force tending to bring

the ion back to |=0, and Ej-i^ is the frictional resistance acting on the ion.

^^ + ‘B^^ + <^i^i=i^o + ^>

(2),

where X is the force arising from the charges on the ion. To find X we notice that the system is electrically neutral when all the ^‘s vanish, and that when an ion is displaced through f, the electrical effect is the same as that of an electric doublet whose axis is parallel to x, and whose moment is cf. The electric field is that due to a system of electric doublets the sum of whose moments

[electeic

per unit volume is Sc|. To find the electric force due to these at a point, describe with that point as centre a sphere whose radius is large compared with the range of molecular action, but small compared with the length of the wave passing through the medium, so that inside this sphere the conditions may be taken as uniform. X will be the electric force due to the doublets in this sphere, and this will be the same as the magnetic force due to a system of little magnets provided the electrical moment of the doublet is equal to the magnetic moments of the magnets. The force due to the magnets is 47rI/3, when I is the intensity of magnetization, i.e. , the sum of the moments of the magnets per unit

volume; hence X=-5- =r-; where the factor Kj is put equal to

unity when e is measured in electrostatic units, and to 1/V| when e is measured in electromagnetic units, Vj being the velocity of light through the ether.

Let us suppose that all the quantities are proportionate to c’* ; then from equation (2) we have

J =

hence if

o + Ejp – mp*

e=s

SeJ=

a + Rip –

Xpe

ire 3K⬚⬚

mp^

hence equation (1) becomes if Xj varies as e ” pHirO Xq

4^K□□□- 3K□□□

(3).

If V is the velocity of propagation through this medium filled with ions, Vq the velocity through empty space, then Y=p/m, T□□=l/K5, and if v is the refractive index of the medium, since r^ = YlfV'=m''lp''Kf□□□ we have by equation (3),

4Te/Ko _..,

1 +

l-47re/3Ko

iv e _y^-l 3 K□□□~y^ + 2-

This equation is given by Lorentz.^ If Pi is the free period of

the ion when there are no frictional terms, ai=mpf ; hence if

there are Nj molecules having periods Pi, Nj having P2> ^^^ ^□□ ‘”’□□□

N e^ N □□^

□□=mi(p?~~^2) + Eiip+m,(^l~~^2) + Rrfp+-

This equation gives the refractive index in terms of the fre- quency, and is therefore the dispersion formula. To find the general character of the results to which it leads, let us take the simple case where all the ions are equal, and there is only one period, and no frictional resistance. Then

y'-l_47r Ke'Vg ?=' + 2~ 3 m{pl-p^y

The curve whose abscissae are p^ and ordinates v^ is shown in

At N□□^V Fig. 49 ; we see that when^^ is less than pi—; -, v' increases

with p, and the dispersion is said to be normal as the refractive index for short waves is greater than that for long. Since y^ must be positive, the curve must be discontinuous between L when

►►2=j,2_ J and M where ►►^ =►►►► + ═ -, and there

can be no corresponding real values of y' : ►►► that is, waves with

frequencies between these values cannot be propa- gated through the medium, but are totally reflected from it. At the point L on the curve the velocity of propagation of waves through the medium is in- finitely small, at the point M it is infinitely great, and after passing M y becomes real again, but is always less than unity, and ap- proaches unity as the limit when the frequency

Fig. 49.

is infinitely rapid. In this region beyond M the refractive index is less, though the wave lengths are smaller, than for the region

before L ; the dispersion is said to be anomalous. A mechanical model showing these peculiarities of wave propagation has been described by Vincent. *►► If we include frictional terms, i.e., the term iRp in our ex- pression for e, then though y is complex, there is always a real part. In the curve which now represents the relation between the real part of y^ and p2 (Fig. 50), there is no break, but through- out the range of values of p^ in which there is no propagation of the waves without

friction, there is very intense absorption, indicated by the dot and dash line. The long waves on one side of the absorption band have a greater index of refraction than the short waves on the other side. If^i and Pj are the values corresponding to the points I, k, between which the absorption is most intense, v is infinite for the frequency ^1 and zero for the frequency ^j- Hence, neglecting the frictional terms, we have

V

►►►

9\

b

i

\

!

A

\

f^

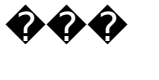

1

i

\

1

h

!

\

/’

V

^

- .

c

p^o

I

k-

Fig. 50.

iw Ne^V? .,

3 m, ‘

The specific inductive capacity K of the medium under steady electric force is the value of v’^ when ^=0, hence

K-1

e:+2′

ijr_’SfVJ ’’ Z mpl ###

(1).

Substituting for Ne^Vg/m in the preceding equations we get

Pl=Pl

K + 2′

Pi

=Pl^, OT pl=:-Kpl.

Thus if the specific inductive capacity is large there will be a long range of frequencies for which there is very intense absorption. Anomalous dispersion of electric waves has been observed in many dielectrics. In liquids it was observed by Cole ^ for ethyl-alcohol. Drude** has made very

extensive researches on this subject in a large number of liquids, the most conspicuous being glycerine, amyl-alcohol, acetic and formic acids ; he found that the existence of anomalous dispersion was closely related with the chemical com- position, the liquids showing it in a marked degree containing the hydrosyl radicle OH. If we assume the truth of the theory of dis- persion just given, it follows that the anomalous dispersion of the electric waves must be due to a small number of molecules or aggregates of molecules being mixed with the fluid, and not to a property possessed by each individual molecule of the fluid. As an example, glycerine has been shown to exhibit anomalous dis- persion for waves over a range which includes ^= Sir x2”5x 10’, y = 23rx 1‘5 X 10*, p = 27rx 4 X 10*, numbers from which we conclude that^o is of the order of magnitude 2ir x 10*. Now from equation (1) we must have 47rN►►^Vg/3mpg less than 1. Putting in this expression the smallest admissible value of e, viz., the charge oil the hydrogen ion in electrolysis, and for m the largest admissible value, which if the eff’ect were due to the individual molecules is the mass of the molecule of glycerine, we find that Ne^Vg/mp^ would be of the order 10’. As this quantity must be less than unity we see that our supposition is inadmissible, and we conclude that the anomalous dispersion of glycerine and other fluids, and the high value of their specific inductive capacity in steady electric fields, is due to the presence of a small number of bodies in an exceptional state. The remarkable experiments of Dewar and Fleming*’ on the specific inductive capacities of liquids at very low temperatures, such as that of boiling liquid air, seem in harmony with this result, for they have shown that the abnormally high values for the specific inductive capacity which are characteristic of many liquids at ordinary temperatures disappear, and are re- placed by values which are approximately the squares of the refrac- tive indices of the substances at ordinary temperatures ►►► a result which indicates that at very low temperatures the dissociation, or whatever action produced the bodies, which when mixed with the glycerine caused the high specific inductive capacity, no longer exists. Dewar and Fleming have examined a very large number of solutions, and find marked differences in the temperatures at which the great drop in the specific inductive capacity takes places. The nature of these differences is shown by the following curve (Fig. 51), the ordinates of which represent the specific inductive capacity and the abscissfe the temperatures.

Some solids exhibit anomalous dispersion. Thus the experiments made by Blondlot”” and the writer ’’ on the specific inductive capa- city of glass show that it is higher for steady electric forces than for those which accompany electric waves. Lowe ^ found that while the

waves]

specific inductive capacity of glass for electrical waves was smaller than in a steady electric field, the difference was not so large as

that observed by Blondlot and the writer. Anomalous dispersion for electric waves has been ob- served in beryl by Fomm and Graetz.”’ Farther experiments in electrical dis- persion will be found described in papers by Marx,** Lowe,’” Cole9►► and Thwing.9′ ►► 35. We have seen that, on the theory of anomalous dis- persion sketched above, the anomalous dispersion of electric waves a few centi- metres long involves the existence of sys- tems other than the ordinary molecules of the dielectric; we can press this result further, and show that on this theory the luminous vibrations given out by gases, or at any rate by some gases, cannot proceed from all the molecules ; but that only a comparatively small number, which are probably in a special state, are luminous. For we see that if K is the specific inductive capacity of the gas under steady electric force, i.e., when^=o,

K-J. ^2 47rlW K-1-2 ZK^mpl

where pi is the frequency of one of the free periods of the molecule. Since KopJ = iir^l\ when \ is the wave length of this vibration, we have

K-1

Fig. 51,

K4-2

37rm ^

Let us take the case of hydrogen and confine our attention to the vibration corresponding to the red line for which \i = 6”5xl0~’ cm. For hydrogen at atmospheric pressure K-l = 2‘7 x 10~^. Thus

eir X 10* (e/m)

We have reason to think that e/m is about 10’, in which case Ne=l‘9xl0~^. If N^ is the number of hydrogen molecules in unit volume, then by the laws of electrolysis We= ‘i, and hence N/N^ = 1/20 nearly. Thus the number of systems vibrating with the period pi is small compared with the number of molecules. We have only considered the effect of one line in the spectrum of hydrogen. If we took into account the other lines the discrepancy between N and N’ would be still further increased. Hence we conclude that if this theory of anomalous dispersion is true the source of the hydrogen lines is a comparatively small number of systems in a special state.

►► 36. Scattering of Electric Wanies by the refracting Medium. Opacity of the Medium. ►►► If f is the displacement of an ion under the external electric force X,,, then by ►► 34

ei=.

Xae”

i-irem{pl-p’^) + ‘Sip’ – 3E►►►

The effect of the displaced ion is the same as that of an electric doublet whose moment is ef ; this doublet has a frequency p, and gives rise to a system of electric waves expressed by the equations in ►► 12. The radiation of these waves involves an expenditure of energy per unit time for each doublet equal to

2 p*

If between two planes of unit area at right angles to s, separated by the distance dz, there are “Sdz doublets, then the energy radiated from this

region in unit time is

1 N&XS e*

3

r

Vo

{m{pl-p^) + ^ipf

To supply this energy, the energy transmitted in unit time by the incident wave across the further plane must be less than that trans-

mitted across the nearer plane by this amount. But by Poynting's theorem this difference is equal to

hence -e/'^^=-B^□□.^

dzXiirN^

3V□□□

V 3K□□□y

(m(pl-f') + 'Bipf

Solving this equation we have

X? = Ce-'□□,

where a = ?^^^ SL

3 ;

"(i-ii?y

{m{pl-p'^) + 'Ripf

this may be written

” In?? 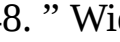 ’

where ^ is the refractive index, \ the wave length. Thus, even when there is no conductivity, there is opacity due to the scatter- ing of the waves by the ions. This effect has been investigated by Lord Eayleigh ^ in connexion with the bine colour of the sky. For waves whose frequency is very great compared with the free vibrations of the system, yi=4irNc’’/3m^ ; in this case the opacity becomes in the limit independent of the frequency.

1 Phil. Mag. [4] 5, p. 393. ^ Pogg. Ann. 103, p. 69 ; 108, p. 497 ; 112, p. 452 ; 113, p. 437 ; 116, p. 132. * Wied. Ann. 34, pp. 155, 551, 609 ; Ausbreitwng der JBlektrischen Kraft, Leipzig, 1892. * Wied. Ann. 44, p. 74. JVatwre, 41, p. 368. ‘ Wied. Ann. 49, p. 693. ‘ Ifature, 39, p. 391. Wied. Ann. 34, p. 609. ” Gomptes rendus, 115, p. 439. ’” Nature,

39, p. 548. ” Wied. Ann. 41, p. 850. ‘^ jj^^ 45^ p_ 553, ” Ibid. 47, p. 77. ” Ibid. 37, p. 529. ” Ibid. 40, p. 55. ” Ibid. 42, p. 416 ; 45, p. 62. ” Ibid. 40, p. 399. i* Ibid.

40, p. 53. ” PhU. Mag. 33, p. 299. ^ Wied. Ann. 44, p. 74. ” Ibid. 44, p. 713. “^ Trans. Roy. Sac. A. 1897, 189, p. 1. ‘^ Comptes rendus. 111, p. 785 ; 112, p. 90. “^ The Work of Hertz and some of his Siuxesscrrs. London, 1894. ^* Phil. Mag. 43, p. 55. ^ iMmiire ilectrique, 40, p. 511. ^ Wied. Ann. 66, p. 284. ^ Proc. Roy. Soc. 65, p. 166. ^ Wi^d. Ann. 64, p. 611. ^o pj^n Mag. 43, p. 65. ’’ Mem. delta R. Ace. de Bologna, [v.] iv. p. 487. =‘2 Atti de Tonno, 30, p. 442, 1895. ^ Wied. Ann. 54, p. 342 ; 66, p. 717. ^ Proc. Roy. Soc. 63, p. 146. ’’ Wied. Ann. 41, p. 850. ^ Comptes rendus, 114, p. 628. ’’ Wied. Ann. 60, p. 1. ^ Ibid. 55, p. 633. ^ Proc. Roy. Soc. 46, p. 1. ’” Jowrn. de phys. X. p. 549. ‘^ Comptes rendus, 117, pp. 543, 893. ’^ Proc. Camh. Phil. Soc. (Stokes jubilee volume). *’ Sitzungsber. W’ltn. Akad. 89, p. 298. ” WiM. Ann. 33, p. 1 ; 35, p. 126. ” PhU. Mag. 28, p. 304. * Ibid. 28, p. 315. *’ PhU. Trans. 181, A. p. 583. ^ British Association Report, 1891, p. 580. ^ Comptes rendus, 112, p. 783. ^ Journ. de phys. [3] 1, p. 361. ” Comptes rendus, 121, p. 815. *2 jyjg^_ ^. 35_ p_ 136, 63 p^j;. Trans. 189, A, p. 1. ” The properties of Poisson’s equation

and its application to physical problems are fully discussed in Lord Eayleigh's Theory of Scnind, voL ii. chap. 14, and v. Helmioltz's Vorlesungen idler die Elektromagnetische Theorie des lAchts, p. 131 et seq. **" Wied. Ann. 36, p. 1. ^ Phil. Trans. 193, A, p. 159. " PhU. Trans. 1884, pt. 2, p. 343. " J. J. Thomson. Proc. Math. Soc. xv. p. 197. =9 J. J. Thomson, Phil. Mag. 11, p. 229, 1881. ??? Pogg. Ann. 158, p. 487. ^' J. J. Thomson. Proc. Math. Soc. xv. p. 197. ^ Phil. Mag. 12, p. 81. ^ Phil. Mag. 47, p. 375. " J. J. Thomson. Recent Researches in Electricity and Magnetism, p. 437. ^ Nature, 39, p. 891. ???? Nature, 40, p. 398. ??? J. J. Thomson, Proc. Roy. Soc. 45, p. 269. ^ Proc. Roy. Soc. 45, p. 269. " Wied. Ann. 62, p. 454, 1887. '" Com/munications from Physical Lahoratory at Leiden, No. 22. " Wied. Ann. 36, p. 49. See also Lodge, Phil. Mag. 47, p. 385. ??? Recent Researches, p. 425. " Proc. Lond. Math. Soc. 29, Pt. 2, p. 523. "** Ibid. 17, p. 310 ; Recent Researches, p. 262 et seq. " Phil. Mag. 22, pp. 118, 273, 332 ; 23, pp. 10, 173. '?? Wied. Ann. 67, p. 233 ; Drude Ann. 2, p. 201. " Phil. Mag. [4] 5, p. 393. ??? ^^i^^^ ^^n. 60, p. 1. '' Electromagnetic Theory, p. 387. ^ Comptes rendus, 117, p. 1027. 81 Ibid. 118, p. 16. ??2 j^^_ 118, p. 162. ^ Electromagnetic Theory, chap. vi. ** Webster's Electricity and Magnetism, p. 545. ^^ Konink. Akad. van Wetenschappen, Amsterdam, Ap. 6, 1888. For another method of treating this question, see v. Helmholtz, Collected Papers, vol. iii. p. 605. 86 p^^^. j/^. 45^ p. 557. 87 wied. Ann. 57, p. 290. 88 Ibid. 58, p. 1 ; 59, p. 17 ; Zeitscknft fir Physihalische Chemie. 23, p. 267. 89 Proc. Roy. Soc. 61, pp. 299, 358. *> Comptes rendus, 112, p. 1058. 31 Proc. Roy. Soc. 46, p. 292. ^ Wied. Ann. 66, pp. 390, 582. 93 Fomm and Graetz, Wied. Ann. 64, p. 626. 'Marx, Wied. Ann. 66, pp. 411, 597. ' Loc. cit. ^ Wied. Ann. 57, p. 290. 9′ Zeitschriftfur Physihalische Chemie, 14, p. 286. '8 pj^n Mag. 47, p. 375. (j. j. t.^I

S. IV. ??? 10

ELECTRICITY SUPPLY.

I. General Principles.

THE improvements made in the dynamo and electric motor between 1870 and 1880, and also in the de- tails of the arc and iacandescent electric lamp towards the close of that decade, induced engineers to turn their attention to the question of the private and public sup- ply of electric current for the purpose of lighting and power. T. A. Edison^ and St G. Lane Eox^ were among the first to see the possibilities and advantages of public electric supply, and to devise plans for its practical es- tablishment. In the case of private plants, provision has to be made for a source of electric current. In spite of a great amount of ingenuity devoted to the development of the primary battery and the thermopile, no means of generation of large currents is so economical and conven- ient as the dynamo (see Dynamo). Hence a ptant? private electric generating plant involves the erection of a dynamo, which may be driven either by a steam, gas, or oil engine, or by power obtained by means of a turbine from a low or high fall of water. It may be either directly coupled to the motor, or driven by a belt ; and it may either be a continuous-current ma- chine or an alternator ; and, if the latter, either single- phase or polyphase. The convenience of being able to employ storage batteries in connexion with a private-sup- ply system is so great that, unless power has to be trans- mitted long distances, the invariable rule is to employ a continuous-current dynamo. Where space is valuable, this is always coupled direct to the motor ; and if a steam engine is employed, an enclosed engine is most cleanly and compact. Where coal or heating gas is available, a gas engine is exceedingly convenient, since it requires little attention. Where coal gas is not available, as in country houses, a Dowson gas-producer can be employed, or an oil engine. In connexion with the generator, it is almost the invariable custom to put down a secondary battery (see Accumulators), to enable the supply to be given after the engine has stopped. If the building to be lighted is at some distance from the engine-house, the battery should be placed in the basement of the building, and underground or overhead conductors, to convey the charging current, brought to it from the dynamo. It is usual, in the case of electric lighting installations, to reckon all lamps in their equivalent number of 8 candle-power (c.p.) incandescent lamps. In lighting a private house or building, the first thing to be done is to settle the total number of incandescent lamps and their size, whether 32 c.p., 16 c.p., or 8 c.p. Five c.p. lamps can be used with advantage in small bedrooms and passages. Each candle-power can be taken as equivalent to 3-^ watts, or the 8 c.p. lamp as equal to 30 watts, the

16 c.p. lamp to 60 watts, and so on. Hence if the equivalent of 100 8 c.p. lamps is required in a building, the maximum elec- tric power supply available must be 3000 watts, or 3 kilo- watts. It is of course prudent to make allowance for extensions. The next matter to consider is the pressure of supply. If the battery can be in a position near the building to be lighted, it is best to use 100-volt incandes- cent lamps and enclosed arc lamps, which can be worked singly off the 100-volt circiiit. If, however, the lamps are scattered over a wide area, or in separate buildings somewhat far apart, as in a public school, college, asy- lum, or hospital, it may be better to select 200 volts as the supply pressure. Arc lamps can then be worked two

1 British Patent Specifications, No. 5306 of 1878, and No. 602 of 1880.

2 lUd., No. 3988 of 1878.

in series. The third step is to select the size of the dy- namo unit and the amount of spare plant. It is desir- able that there should be at least three dynamos, two of which are capable of taking the whole of the full load, the third being reserved to replace either of the others when required. The total power to be absorbed by the lamps and motors (if any) being given, together with an allowance for extensions, the size of the dynamos can be settled, and the power of the engines required to drive them determined. A good rule is that the indicated horse-power (I.H.P.) of the engine should be double the dynamo full-load output in kilowatts ; that is to say, for a 10-kilowatt dynamo an engine should be capable of giv- ing 20 indicated (not nominal) H.P. Prom the I.H.P. of the engine, if a steam engine, the size of the boiler re- quired for steam production becomes known. For small plants it is safe to reckon that, including waste, boiler capacity should be provided equal to evaporating 40 pounds of water per hour for every I.H.P. of the engine. The locomotive boiler is a convenient form ; but where large amounts of steam are required, some modification of the Lancashire boiler or the water-tube boiler is gen- erally adopted. In settling the electromotive force of the dynamo to be employed, attention must be paid to the question of charging secondary cells, if any. If a secondary battery is employed in connexion with 100- volt lamps, it is usual to put in 53 or 54 cells. The elec- tromotive force of these cells varies between 2-2 and 1-8 volts as they discharge ; hence the above number of cells is sufficient for maintaining the

necessary electromotive force. For charging, however, it is necessary to provide 2^ volts per cell, and the dynamo must therefore have an electromotive force of 135 volts, plus any voltage re- quired to overcome the fall of potential in the cable connecting the dynamo with the secondary battery. Sup- posing this to be 10 volts, it is safe to install dynamos having an electromotive force of 150 volts, siace by means of resistance in the field circuits this electromotive force can be lowered to 110 or 116 if it is required at any time to dispense with the battery. The size of the sec- ondary cell to be selected will be determined by the nature of the supply to be given after the dynamos have been stopped. It is usual to provide sufficient storage capacity to run all the lamps for three or four hours without assistance from the dynamo.

As an example taken from actual practice, the following figures give the capacity of the plant put down to supply 500 8 c.p. lamps in a hospital. The dynamos were 16-unit machines, having a full-load capacity of 100 amperes at 150 volts, each coupled direct to an engine of 25 I.H.P. ; and a double plant of this descrip- tion was supplied from two steel locomotive boilers, each capable of evaporating 800 pounds of water per hour. One dynamo during the day was used for charging the storage battery of 54 cells; and at night the discharge from the cells, together with the current from one of the dynamos, supplied the lamps until the heaviest part of the load had been taken ; after that the current was drawn from the batteries alone. In working such a plant it is necessary to have the means of varying the electromotive force of the dynamo as the charging of the cells proceeds. When they are nearly exhausted, their electromotive force is less than 2 volts ; but as the charging proceeds, a counter electromotive force is gradually built up, and the engineer in charge has to raise the voltage of the dynamo in order to maintain a constant charging current. This is effected by having the dynamos designed to give normally the highest E.M.F. required, and then inserting resistance in their field circuits to reduce it as may be necessary.

Turning next to the consideration of public electric supply, we may divide the methods at present in success- ful operation into two broad divisions, namely, (1) contin- uous-current systems and (2) alternating-current systems.

Public supply.

Leaving out of consideration a discussion of the conditions under wMch continuous-current or alternating-current sys- tems are most applicable, we may describe briefly the general outlines of the methods adopted under each heading. Continuous-current systems are either low- or high-pressure. In the former the current is generated by dynamos at some pressure less than 600 volts, generally about 460 volts, and is supplied to users at half this pressure by means of a three-wire system of distribution, with or without the addition of storage batteries. The general arrangements of a low- pressure continuous-current supply station are as follow : ••• If steam is the motive power selected, it is generated under all the best conditions of economy by a battery of boilers, and supplied to engines which are now almost invariably coupled direct, each to its own dynamo, on one common bed-plate; a multipolar dynamo is very frequently employed, coupled direct to an enclosed engine. In choos- ing the size of unit to be adopted, the engineer has need of considerable experience and discretion, and also a full knowledge of the nature of the public demand for electric current. The over-all efficiency of a steam dynamo ••• that is, the ratio between the electrical power output, reckoned say in kilowatts, and the I.H.P. of the engine, reckoned La the same units ••• is a number which falls rapidly as the load decreases ; but at full load may reach some such value as 80 or 85 per cent. It is common to specify the efB.ciency, as above defined, which must be attained by the plant at full load, and also the efficiencies at quarter- and half ~~load which must be reached or exceeded. Hence in the selection of the size of the units the engineer is guided by the consideraticm that whatever units are in use shall be as nearly as possible fully loaded. If the demand on the station is chiefly for electric lighting, it varies during the hours of the day and night with tolerable regularity. If the output of the station, either in amperes or watts, is represented by the ordinates of a curve, the abscissae of wMch represent the hours of the day, this load~~ diagram is a curve as shown in Pig. 1, having a high peak

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somewhere between 6 and 8 p.m. The area enclosed by this load-diagram compared with the area of the circum- scribing rectangle is called the load-factor of the station. This varies from day to day during the year, but on the average is not generally above 10 or 12 per cent., and it may be lower. Thus the total output from the station is only some 10 per cent, on an average of that which it would be if the supply were at all times equal to the maximum demand. Eoughly speaking, it generally amounts to this, that the total output of an electric supply station furnishing current chiefly fbr electric lighting is at best equal to about two hours' supply during the day at full load. Hence during the greater part of the twenty- four hours a large part of the plant is lying idle. It is usual to provide certain small sets of steam dynamos,

which are called the daylight machines, for supplying the demand during the day and later part of the evening, the remainder of the machines being called into requisi- tion only for a short time. Provision must be made for sufficient reserve of plant, so that the breakdown of one or more sets will not cripple the output of the station. Assuming current to be supplied at about 460 volts by different and separate steam dynamos, the machines are connected through proper amperemeters and voltmeters with two bars on a main switchboard, called omnibus bars, so that any one can be put in connexion or removed. From this switchboard proceed a number of insulated conductors, called the positive and negative feeders. The switchboard is generally divided into three parts ××× one panel for the connexion of the positive feeders with the positive terminals of the generators, one for the nega- tive feeders and negative generator terminals, while from the third (or middle-wire panel) proceed an equal number of middle-wire feeders. These sets of middle conductors are led out into the

district to be supplied with current, and are there connected into a distributing system, con- sisting of three separate insulated conductors, respectively called the positive, middle, and negative distributing mains. The lamps in the houses are connected between the middle and negative and middle and positive mains by smaller triple supply and service wires. As far as possible the number of lamps installed on the two sides of the system are kept equal ; but since it is not possible to control the consumption of current, it becomes neces- sary to provide at the station two small dynamos, called the balancing machines, connected respectively between the middle and positive and the middle and negative omnibus bars. These machines may have their shafts connected together, or they may be separate steam dyna- mos; their function is to supply the difference in the total current circulating through the whole of the lamps respectively on the two opposite sides of the middle wire. If storage batteries are employed in the station, it is usual to install two complete batteries, which are placed in a separate battery room and connected between the middle omnibus bars and the two outer omnibus bars. The extra electromotive force required to charge these batteries is supplied by two small dynamos, called boosters. It is not unusual to join together the two balancing dynamos and the two boosters on one common bed-plate, the shafts being coupled and in line, and to employ the balancing machines as electromotors to drive the boosters as required. The use of the boosters is to supply the extra half-volt per cell over and above the switchboard pressure which is required to drive the charging current through the battery towards the end of the charging operation.

In the high-pressure continuous-current system of supply the current is generated at a pressure of 1000 or 2000 volts, and transmitted from, the generating station by con- ductors, called high-pressure feeders, to certain sub-centres or transformer centres, which are either buildings above ground, or cellars, or excavations under the road. In these transformer centres are placed machines, called continuous- current transformers (see Tkajstsfobmers), which transform the electric energy and create a secondary electric current at a lower pressure, perhaps 100 or 160 volts, to be sup- plied by distributing mains to users. From these sub- centres insulated conductors are run back to the generating station, by which the engineer can start or stop the continuous-current rotatory transformers, and at the same

time inform himself as to their proper action, and the electromotive force at the secondary terminals. This system was first put in practice in Oxford, England, and hence has been sometimes called by British engineers ” the Oxford System.” It is now in operation in a number

of places in England, sucli as Wolverhampton, Walsall, and Shoreditch in London. It has the advantage that in connexion with the low-pressure distributing system, secondary batteries can be employed, so that a storage of electric energy is effected. Further, continuous-cur- rent arc lamps can be worked in series off the high- pressure mains, that is to say, sets of 20 to 40 arc lamps can be operated for the purpose of street lighting by means of the high-pressure continuous current.

The alternating-current systems in operation at the present time are the single-phase system, with distrib- uting transformers or transformer sub-centres, and the polyphase systems, in which the alternating current is transformed down into an alternating current of low pressure, or, by means of rotatory transformers, into a continuous current. The general arrangement of a single- phase alternating-current system is as follows : ??? The gen- erating station contains a number of alternators producing single-phase alternating current, either at 1000, 2000, or sometimes, as at Deptford and other places, 10,000 volts. These machines are sometimes worked in parallel, that is to say, all furnish their current to two common omni- bus bars on a high-pressure switchboard, and each is switched into circuit at the moment when it is brought into step with the other machines, as shown by some form of phase-indicator. A number of high-pressure feeders are carried from the main switchboard to various transformer sub-centres, or else run throughout the dis- trict to which current is to be furnished. In some cases, instead of the high-pressure feeders starting from omni- bus bars, each alternator works independently, and the feeders are grouped together on the various alternators as required. If the system laid down is the transformer sub-centre system, then at each of these sub-centres is placed a battery of alternating-current transformers, having their primary circuits all joined in parallel to the terminals of the high-pressure feeder, and their sec-

ondary circuits all joined in parallel on a distributing main, suitable switches and cut-outs being interposed. The pressure of the current is then transformed down by these transformers to the required supply pressure. The secondary circuits of these transformers are generally pro- vided with three terminals, so as to supply the low-pressure side on a three- wire system. It is not advisable to connect together directly the secondary circuits of all the different sub-centres, because then a fault or short circuit on one secondary system affects all the others. In banking together transformers in this manner in a sub-station it is necessary to take care that the transformation ratio and secondary drop (see Teansformbrs) are exactly the same, otherwise one transforjner will take more than its full share of the load, and will become overheated. The transformer sub-station system can only be adopted where the area of supply is tolerably compact. Where the con- sumers lie scattered over a large area, it is necessary to carry the high-pressure mains throughout the area, and to place a separate transformer or transformers in each build- ing. From a financial point of view, this house-to-house system of alternating-current supply, generally speaking, is less satisfactory in results than the transformer sub-centre system. In the latter the transformers can be switched off,' either by hand or by automatic apparatus, during the time when the load is light, and then no power is expended in magnetizing their cores. But with the house-to-house system the whole of the transformers continually remain connected with the high-pressure circuits ; hence in the case of supply stations which have only an ordinary electric lighting load, and therefore a load-factor not above 10 per cent., the efficiency of distribution is con- siderably diminished.

The single-phase alternating-current system is defective

in that it cannot be readily combined with secondary bat- teries for the storage of electric energy. Hence in many places preference is now given to the polyphase system. In such a system a polyphase alternating current, either two or three phase, is transmitted from the generating station at a pressure of 5000 to 10,000 volts, or some- times higher, and at various sub-stations is transformed down, first by static transformers into an alternating current of lower pressure, say 600 volts, and then by means of rotatory transformers into a continuous cur- rent of 600 volts or lower, for use for lighting or trac- tion. A remarkable system of this kind has been established

at Niagara. A portion of the water at the Palls is employed to drive 6000 h.p. turbines, placed at the bottom of a deep chase ; these drive 6000 h.p. two- phase alternators, fixed on the ground surface 150 feet above the turbines, and the two-phase current thus generated at 5000 volts is transmitted to various sub- centres, where it is transformed as already described. Large systems of distribution by polyphase currents transformed into continuous current are now in opera- tion in New York, and similar systems have been estab- lished in London. When stations supply current not only for lighting but for traction, the current for the latter purpose must be generated at a pressure of 500 volts, and it is an economical arrangement to employ continuous-current machines which are wound to gen- erate 500 to 560 volts, but can have their electromotive force reduced by resistance in the fields to between 400 and 460 volts. Such machines can be used either to operate a three-wire 230-volt lamp system of electric lighting or an electric traction system of 500 volts, being used chiefly in the daytime for traction and in the even- ings for lighting.

The distribution of electric energy involves the arrange- ment of a system of insulated conductors, the conducting material being invariably copper having a con- ductivity of not less than 98 per cent, according to Matthiessen's standard (see Electricity, L). These conductors may be divided into three classes ××× overhead, underground, and interior conductors. The overhead conductors may consist of bare stranded copper cables carried on porcelain insulators mounted on stout iron or wooden poles. If the current is a high-pressure one, these insulators must be carefully tested, and are preferably of the pattern known as oil insulators. A system of transmission at 5000 volts by bare overhead conductors on the above plan is in operation for electric transmission between Tivoli and Rome, a distance of 18 miles, and also in many places in the United States for long-distance high-pressure transmission. In and near towns it is necessary to employ insulated overhead con- ductors, generally indiarubber-covered stranded copper cables, suspended by leather loops from steel bearer wires which take the weight. The British Board of Trade have elaborated rules for the construction of overhead lines to transmit large electric currents. "Where telephone and telegraph wires pass over such overhead electric lighting wires, they have to be protected from falling on the latter by means of guard wires. By far the largest part, however, of

electric distribution is now carried out by underground conductors, which are either bare or insulated. Bare copper conductors may be carried underground in culverts or chases, air being in this case the insulating material, as in the overhead system. A culvert and covered chase is constructed under the road or side-walk, and properly shaped oak crossbars are placed in it carry- ing glass or porcelain insulators, on which stranded copper cables, or, preferably, copper strips placed edgeways, are stretched and supported. The advantages of this method of construction are cheapness and the ease with which con-

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nexions can be made with service lines for house supply, the disadvantages are the somewhat large space in which coal gas leaking out of case pipes can accumulate, and the difficulty of keeping the culverts at all times free from rain-water. Moisture has a tendency to collect on the negative insulators, and hence to make a dead earth on the negative side of the main ; while unless the culverts are well ventilated, explosions from mixtures of coal gas and air are liable to occur. Insulated cables are insulated with a material which is in itself waterproof, or with one which is only waterproof in so far as it is enclosed in a water- proof tube, e.g., of lead. Gutta-percha and indiarubber are examples of materials of the former kind. Gutta—percha, although practically everlasting when in darkness and laid under water, as in the case of submarine cables, has not been found, satisfactory for use with large systems of electric distribution, although much employed for tele- phone and telegraph work. Insulated cables are of three classes : ××× (a) Insulated cables drawn into pipes. In this system of distribution cast-iron or stoneware pipes, or special stoneware conduits, or conduits made of a material called bitumen concrete, are first laid underground in the street. These contain a number of holes or ” ways,” and at intervals drawing-in boxes are placed which consist of a brick or cast-iron box having a water-tight lid, by means of which access is gained to a certain

section of the conduit. Wires are used to draw in the cables, which are either indiarubber or lead-covered; the copper being insu- lated by means of paper, impregnated jute, or other similar material. The advantages of a drawing-in system are that spare ways can be left when the conduits are put in, so that at a future time fresh cables can be added without breaking up the roadway. (&) Armoured cables. A very extensively used system of distribution is by means of armoured cables. In this case the copper conductors, two, three, or more in number, may be twisted together or arranged concentrically, and are insulated by means of specially prepared jute or paper insulation, overlaid with a continuous tube of lead. Over the lead, but separated by a hemp covering, is put a steel armour consisting of two layers of steel strip, wound in opposite directions and kept in place by an external covering. Such a cable can be laid directly in the ground without any preparation other than the excavation of a simple trench, junction-boxes being inserted at intervals to allow of branch cables being taken off. (c) Cables in bitumen. One of the earliest systems of distribution employed by Edison consisted in fixing two segment-shaped copper conductors in a steel tube, the interspace between the conductors and the tube being filled in with a bitumen compound. A later plan is to lay down an iron trough, in which the cables are sup- ported by wooden bearers at proper distances, and fill in the whole with natural bitumen. This system has been carried out extensively by the Callendar Cable Company. Occasionally concentric lead-covered and armoured cables are laid in this way, and then form an expensive but highly efficient form of insulated conductor. In selecting a system of distribution regard must be paid to the nature of the soil in which the cables are laid. Lead is easily attacked by soft water, although under some conditions it is apparently exceedingly durable, and an atmosphere containing coal gas is injurious to indiarubber.

The third large class of conductors comprises those placed in the interior of houses and buildings. These

generally consist of indiarubber covered cables, conrfue*- ^^^^ in wood casing. The copper wire must be ors. tinned and then covered, first with a layer of

unvulcanized pure indiarubber, then with alayer of vulcanized rubber, and lastly one or more layers of protective cotton, twist, or tape. No conductor of this character employed for interior house-wiring should have

a less insulation resistance than 300 megohms per mile when tested with a pressure of 600 volts after soaking 24 hours in water. The wood casing should, if placed in dam p positions or under plaster, be well varnished with water- proof varnish. As far as possible all joints in the run of the cable should be avoided, and after the wiring is com- plete, careful tests for insulation should be made. The Institution of Electrical Engineers of Great Britain have drawn up rules to be followed in interior house-wiring, and the principal fire offices, following the lead of the Phoenix Eire Office, of London, have made regulations which, if followed, are a safeguard against bad workman- ship and resulting possibility of damage by fire. Where fires having an electric origin have taken place, it has invariably been traced to some breach of these rules. Opinions differ, however, as to the value and security of this method of laying interior conductors in buildings, and two or three alternative systems have been much employed.

In one of these, called the interior conduit system, highly insulating waterproof and practically fireproof tubes or conduits replace the wooden casing ; these being either of plain insulating material, or covered with brass or steel armour, may be placed under plaster or against walls. They are connected by bends or joint-boxes. The insu- lated wires being drawn into them, any short circuit or heating of the wire cannot give rise to a fire, as it can only take place in the interior of a non-inflammable tube. A third system of electric light wiring is the safety con- centric system, in which concentric conductors are used. The inner one, which is well-insulated, consists of a copper-stranded cable. The outer may be a galvanized iron strand, a copper tape or braid, or a brass tube, and is therefore necessarily connected with the earth. A fourth system consists in the employment of tvidn insulated wires twisted together and sheathed with a lead tube ; the con- ductor thus formed can be fastened by staples against walls or laid under plaster or floors. The general arrange- ment for distributing current to the different portions of a building for the purpose of electric lighting is to run up one or more rising mains, from which branches are taken off to distributing boxes on each floor, and from these boxes to carry various

branch circuits to the lamps. At the distributing boxes are collected the cut-outs and switches controlling the various circuits. When alternat- ing currents are employed, it is usual to select as a type of conductor either twin-twisted conductor or concentric; and the employment of these types of cable, rather than two separate cables, is essential in any case where there are telephone or telegraph wires in proximity, for otherwise the alternating current would create inductive disturbances in the telephone circuit. A concentric cable, however, possesses considerable electrostatic capacity, and when employed in connexion with high-pressure alternators or transformers gives rise to certain peculiar effects, called resonance effects. The general nature of these is best understood by considering the action of a condenser con- nected to the terminals of an alternator.

Let an alternator have its terminals closed by a condenser of capacity C ; let the connexion be through a conductor having resistance R and inductance L; letj)=27rK where n is the frequency ; and let Vo be the maximum value of the alternating potential difference of the alternator terminals, and Vi be that at the condenser terminals. Then assuming the potentials vary harmonically, it is easy to show that

VoV ViV = (1 – CLp2)2 + C2R2p2.

(See J. Hopkinson, Proc. Inst. Elec. Eng., 1884, p. 513; Tleming, Ibid., 1891, p. 362.) The ratio Vi/Vo can therefore be greater than unity, and the ratio is a maximum when C=L/(R2-|-p2x,’~~!) Hence if an alternator is run at a constant speed and excitation, and a con~~ ductor, such as a long length of concentric cable, is attached to its terminals, the actual potential difference between the concentric

conductors may be many times greater than that of the open circuited alternator. This rise of pressure is called a resonance effect, and the engineer must be on his guard against it when testing long lengths of concentric cable, because if the length should be such as to give the critical capacity corresponding to the other conditions present in the circuit, the actual

enhanced electric pressure on the cable may be sufficient to break it down. With high frequency these effects are more marked, and it is possible to have a progressive rise iu potential all along a conductor connect- ing a, condenser to an alternator as we proceed away from the alternator terminals. Thus Tesla {Electrician, March 6, 1891) has observed that when a condenser was connected by wires 20 feet long to an alternator whose frequency was 20, 000 per second, there was a progressive rise in the difference of potential between the ??? wires as points were taken nearer and nearer to the condenser. These condenser or resonance effects were observed on a large scale and investigated during the laying-out of the scheme of electric supply by alternating currents from Deptford to London carried out by Ferranti (see Fleming, Joum. Inst. Elec. Eng. vol. xx. p. 383). In that system there are several large concentric conductors having a length of 6 miles, and it was found that if the mains were switched into connexion with the alternators when kept running at constant speed and excitation, the potential difference between the mains, measured anywhere, was greater than that between the alternator terminals when the mains were not con- nected. If the cable is open-circuited at the far end, a current will still be found flowing through the armature of an alternator connected to it. This is called the condenser current or capacity current of the cable. If C is the total capacity of the cable in microfarads and p=2Tn, where wis half the number of alternations per second, then, the maximum or R.M.S. (effective) value of the condenser current being called I and the potential difference between the conductors V, then on the assumption that V varies harmonically, but not otherwise, we have

I = QjV/10S. Thus, if the capacity of a concentric main is, say, 0 ‘3 microfarad per mUe, and the length 10 miles, the capacity current which would flow through an alternator connected with it, having an effective electromotive force of 10,000 volts and a frequency of lOO, would be 10 X 0-3 X 2 X 100 X 10,000/18 = 132/7=19 amperes nearly. Itmight happen, however, if the right resonance condition were established, that the impressed electromotive force, and therefore the capacity current, would be grearly augmented on connecting the cable to the alternator. The capacity in microfarads (C) of a concentric main of length L centimetres, insulated with a dielectric having an inductive capacity K, is easily calculated from the formula p_ 1 KL

9 X 10►► ‘^ 2 log -Djd ‘

and hence since one mile = 160,933 cms., the capacity per mile is given by

_^ 160,933 K

4,145,400 logioD/c? where D is the inner diameter of the outer tube or conductor, d ~~the outer diameter of the inner tube or conductor, and K the dielec~~ tric constant of the insulator. This is very nearly equal to

K

25 log,

D

Thus il’D = 2d, the logarithm is nearly 0-3, and if the dielectric is indiarubber, K would be nearly equal to 4, hence the capacity per mile would be nearly one-half of a microfarad. It has been shown, however, that the capacity of a condenser, as measured by alternat- ing electric currents, depends to a small extent upon the wave form of the alternating electromotive force.

In addition to these steady resonance effects, there are peculiar initial conditions which arise when long concentric cables are switched into connexion with alternating-current generators. In this case violent oscillations of potential may take place, giving rise to excessive electric strains, if the cables, when feeding alter- nating-current transformers, are suddenly switched into or out of connexion with the generators. Long concentric cables should therefore never be so connected, but always be brought into or out of connexion with the generators through a resistance or impedance, which can be gradually removed or put in. It is necessary to avoid making sudden changes in the capacity or self- induction of an alternating-current system of supply, especially when the electromotive force is large, or else oscillations of potential of excessive amplitude are set up which break down the insulation of the conductors at some point.

A subject which has attracted much attention is the amount and measurement of the true power-absorption in the dielectric of cables. All ordinary dielectrics, such as indiarubber, pnper, gutta- percha, or bitumen, absorb and dissipate energy when electric strain through them is reversed. This is usually called dielectric

hysteresis loss. The ratio of the true power absorbed by an alter- nating-current cable to the product of the impressed voltage and condenser current is called the power-factor, and may amount to about 2 to 3 per cent. For further information the reader may consult the record of a useful discussion following on a paper by Mr “W. M. Mordey. (See Proc. Inst. Elec. Eng. Land., February 1901.)

(j. A. F.)

II. Electeic Lighting.

The utilization of electric energy for tlie purpose of Electric Lighting is effected by devices called Electric Lamps, of vi’hich there are two varieties : (1) Arc Lamps and (2) Incandescent Lamps. Under these headings we may briefly consider the history, physical principles, and present practice of the Art of Electric Lighting. If a voltaic battery of a large number of cells has its terminal wires provided with rods of electrically-conducting carbon, and these are brought in contact and then slightly separated, a form of electric discharge takes place between them called the electric arc. It is not quite certain who first observed this effect of the electric current. The usually expressed opinion that Sir Humphry Davy, in 1801, first produced and studied the phenomenon is probably correct. In 1808, however, Davy had provided for him at the Royal Institu- tion a battery of 2000 cells, with which he exhibited the electric arc on a large scale.

Arc Lamps.

The electric arc as a form of discharge may be pro- duced between any conducting materials maintained at different potentials, provided that the source of electric supply is able to furnish a sufficiently large current; but for illuminating purposes pieces of hard graphitic carbon are most convenient. If some source of continuous electric current, such as a battery

or dynamo, is connected to rods of such carbon, first brought into contact and then slightly separated, the following facts may be noticed : ❖❖❖ With a low electromotive force of about 50 or 60 volts no discharge takes place until the carbons are in actual contact, unless the insulation of the air is broken down by the passage of a small electric spark. AYhen this occurs, the space between the carbons is filled at once with a flame or luminous vapour, and the carbons themselves become highly incandescent at their extremities. If they are horizontal the flame takes the form of an arch springing between their tips ; hence the name arc. This varies some- what in appearance according to the nature of the current, whether continuous or alternating, and according as it is formed in the open air or in an enclosed space to which free access of oxygen is prevented. Electric arcs between metal surfaces differ greatly in colour according to the nature of the metal. When formed by an alternating current of high electromotive force they resemble a lambent flame, flickering about and producing a somewhat shrill humming sound.

Electric arcs may be classified into continuous- or alter- nating-current arcs, and open or enclosed arcs. Observing a carbon arc, we notice that if the current is continuous the positive carbon becomes much hotter at the end than the negative, and that in the open air it is worn away, partly by combustion, becoming hollowed out at the ex- tremity into a crater. At the same time the negative carbon gradually becomes pointed, and also wears away, though much less quickly than the positive. In the continuous- current open arc the greater part of the light proceeds from the highly incandescent positive crater. When the arc is examined through dark glasses, or by the optical projection of its image upon a screen, a violet band or stream of vapour is seen to extend between the two carbons, sur- rounded by a nebulous golden flame or aureole. If the carbons are maintained at the right distance apart the arc

inclined about 40 or 50 degrees below the horizon, and at other directions has different values, which may be represented by the lengths of radial hues drawn from a centre, the extremities of which define a curve called the Ulwminating cv/rve of the arc lamp (see Fig. 3). Consider- able differences

exist be- tween the forms of the illuminating-powercurves of the continuous and alternating current and the open or enclosed arcs. The chief portion of the emitted light proceeds from the incandescent crater ; hence the form of the illuminating – power

remains steady and silent, but if the carbons are impure, or the distance between them too great, the true eleclsric arc rapidly changes its place, flickering about and frequently becoming extinguished ; when this happens it can only be restored by bringing the carbons once more into contact. If the current is alternating, then the arc is symmetrical, and both carbons possess nearly the same appearance. If it is enclosed in a vessel nearly air-tight, so as to prevent the access of free oxygen, the rate at which the carbons are burnt away is greatly reduced, and if the current is continuous the positive carbon is no longer cratered out and the negative no longer so much pointed as in the case of the open arc.

Davy used for his first experiments rods of wood charcoal which had been heated and plunged into mercury to make

them better conductors. Not until much later

(1843) was it proposed by Foucault to employ pencUs cut from the hard graphitic carbon deposited in the interior of gas retorts. In 1846 Greener and Staite patented a process for manufacturing carbons for this purpose, but it was not until after the invention of the Gramme dynamo in 1870 that any great demand existed for them. Carr^ in France in 1876 began to manufacture arc lamp carbons of high quality from coke, lampblack, and syrup. Now they are made by taking some specially refined form of finely divided carbon, such as the soot or lampblack formed by cooling the smoke of burning paraffin or tar, or by the carbonization of organic matter, and making it into a paste with gum or syrup. This carbon paste is forced through dies of appropriate size and shape by means of a hydraulic press, the rods thus formed being subsequently baked with such precautions as to preserve them perfectly straight. In some cases they are cored, that is to say, have a longitudinal hole down them, filled in with a softer carbon. Sometimes, too, they are covered with a thin layer of copper by electro-

deposition. They are supphed for the market in sizes varying from 4 or 5 to 30 or 40 millimetres in diameter, and from 8 to 16 inches in lengtL The value of carbons for arc lighting purposes greatly depends on their purity and freedom from ash in burning, and on perfect uniformity of structure. For ordinary purposes they are generally round in section, but for certain special uses, such as lighthouse work, they are made fluted or with a star-shaped section. The positive carbon is usually of larger section than the negative. For continuousxurrent arcs a cored carbon is generally used as a positive, and a smaller soUd carbon as a negative. Countless researches have been made on the subject of carbon manufacture, and the art has been brought to great perfection. Special manuals must be consulted for further information.

The physical phenomena of the electric arc are best examined by forming a carbon arc between two carbon

rods of the above description, held in hne in a Physical special apparatus, and arranged so as to be mena' capable of being moved to or from each other

with a slow and easily regulated motion. An arrangement of this kind is called a ha/nd-regulated arc lamp (see Fig. 2). If such an arc lamp is connected to a source of electric supply having an electromotive force preferably of 100 volts, and if some resistance is included in the circuit, say about 5 ohms, a steady and continuous arc is formed when the carbons are brought together and then slightly separated. Its appearance may be most con- veniently examined by projecting its image upon a screen of white paper by means of an achromatic lens. A very little examination of the distribution of Ught from the arc shows that the illuminating or candle-power is not the same in different directions. If the carbons are vertical and the positive carbon is the upper of the two, the illu- minating power is greatest in a direction at an angle

Fig 2.

Rg.3.

curve, as shown by Trotter in 1892, is due to the apparent area of the crater surface which is visible to an eye regard ing the arc in that direction. The form of the iUuminating- power curve varies with the length of the arc and relative size of the carbons. Leaving out of account for the moment the properties of the arc as an illuminating agent, the variable factors with which we are concerned are (i.) the current through the arc; (iL) the potential differ- ence of the carbons ; (iiL) the length of the arc; and (iv.) the size of the carbons. Taking in the first place the

typical direct-current arc between solid carbons, and forming arcs of different lengths and with carbons of different sizes, it will be found that, beginning at the lowest current capable of forming a true arc, the potential difference of the carbons (the arc P.D.) decreases as the current increases. Up to a certain current strength the arc is silent, but at a particular critical value P.D. suddenly drops about 10 volts, the current at the same time rising 2 or 3 amperes. At that moment the arc begins to hiss, and in this hissing con dition, if the current is still further increased, P.D. remains constant over wide limits. This drop in voltage on hiss- ing was first noticed by Niaudet {La Lwmiire Electrique, voL iii. p. 287). It has been shown by Mrs Ayrton (Journ. Inst. Elec. Eng. vol. xxviii. p. 200) that the hissing is mainly due to the oxygen which gains access from the air to the crater, when the latter becomes so large by reason of the increase of the current as to overspread the end of the positive carbon. According to A. Blondel and Luggin, hissing takes place whenever the current density becomes greater than about 0‘3 or 0‘5 ampere per square millimetre of crater area.

The relation between the current, the carbon P.D., and tbe length of arc in the case of the direct-cnrrent arc has been investi- gated by many observers with the object of giving it mathematical expression.

Let V stand for the potential difference of the carbons in volts, A for the current through the arc in amperes, L for the length of the arc in millimetres, E for the resistance of the arc ; and let a, b, c, d, &c., be constants. Edlund in 1867, and other workers after him, considered that their experiments showed that the re- lation between V and L could be expressed by a simple linear equation,

$$V = a + 6L.$$

Later researches by Mrs Ayrton (Electrician, vol. xli. p. 720) have, however, shown that for a direct-current arc of given size

with solid carbons, the observed values of V can be better repre- sented as a function both of A and of L of the form

V = a+ 6L +

c + dh

In the case of direct-current arcs formed with solid carbons, Edlund and other observers agree that the arc resistance E may be expressed by a simple straight line law, R = c ǂ / L. If the arc is formed with cored carbons, Mrs Ayrton has demonstrated that the lines expressing resistance as a function of arc length are no longer straight, but that there is a rather sudden dip down when the length of the arc is less than 3 mm.

The constants in the above equation for the potential difference of the carbons have been determined by Mrs Ayrton in the case of solid carbons to be ###

V = 38-9 + 2-07L+-iil^tl##:^. A

There has been much debate as to the meaning to be given to the constant a in the above equation, which has a value apparently not far from forty volts for a direct-current arc with solid carbons. The suggestion made in 1867 hy Edlund,^ that it implied the existence of a counter-electromotive force in the arc, was opposed by Luggin in 1889,^ Lecher in 1888,* and by Stenger in 1892;^ whereas von Lang and Arons, in 1896,## concluded that experiment indicated the presence of a counter-electromotive force of 20 volts. A. Blondel concludes, from experiments made by him in 1897,## that there is no counter-electromotive force in the arc greater than a fraction of a volt. More recently Duddell (Froc. Boy. Soc. vol. Ixviii. p. 518) has described experiments tending to prove the real existence of a counter-

electromotive force in the arc, probably having a thermo-electric origin, residing near the positive electrode, and of an associated lesser adjuvant cm./, near the negative carbon.

This fall in voltage between the carbons and the arc is not uniformly distributed. In 1898 Mrs Ayrton described the results of experiments showing that if Vj is the potential difference be- tween the positive carbon and the arc, then

A

and if Vj is the potential difference between the arc and the negative carbon, then

V, = 7-6 + ip.

The total potential difference between the carbons, minus the fall in potential down the arc, is therefore equal to the sum of

Hence Y3=38-88H- ”^ ‘^-

The difference between this value and the value of V, the total potential difference between the carbons, gives the loss in potential due to the true arc. These laws are simple consequences of straight-line laws connecting the work spent in the arc at the two electrodes with the other quantities. If W be the work spent in the arc on either carbon, measured by the product of the current and the potential drop in passing from the carbon to the arc, or vice versd, then for- the positive carbon W = a Ł 6A, if the length of arc is constant, ‘W = c + d’L, if the current through the arc is constant, and for the negative carbon W=□□-t-/A.

In the above experiments the potential difference between the carbons and the are was measured by using a third exploring carbon as an electrode immersed in the arc. This method, adopted by Lecher, Uppenborn, S. P. Thompson, and Fleming, is open to the objection that the introduction of the third carbon mav to a considerable extent disturb the distribution of potential.

The total work spent in the continuous-current arc with solid carbons may, according to Mrs Ayrton, be expressed by the equation

W=ll-7-l-10-5L4-(38-9 f 2-07L)A.

It will thus be seen that the arc, considered as a conductor, has the property that if the current through it is increased, the difference of potential between the carbons is decreased, and in one sense, therefore, the arc may be said to act as if it were a negative retistance. Messrs Frith and Eodgers (Electrician, vol. xxxviii. p. 75) have suggested that the resistance of the arc should be measured by the ratio between a small increment of carbon poten- tial difference and the resulting small increment of current ; in other words, by the equation dVjdk, and not by the ratio simply of V : A. Considerable discussion has taken place whether an electrical resistance can have a

negative value, belonging as it does to the class of scalar mathematical quantities. Simply considered

‘ Phil. Mag., series i., vol, xxxvi. p. 358.

2 Wien. Ber. vol. 98, p. 1198. * Wied. Ann. 33, p. 609.

►► Ibid., 45, p. 33. ►► Jlid., 30, p. 95.

‘ Journal de Physique, or Electrician, vol. xxxix. p. 615.

as an electrical conductor, the arc resembles an intensely heated rod of magnesia or other refractory oxide, the true resistance of which is decreased by rise of temperature. Hence an increase of current through such a rod of refractory oxide is accompanied by a decrease in the potential difference of the ends. This, how- ever, does not imply a negative I’esistanoe, but merely the presence of a resistance with a negative temperature coefficient.

Other physical investigations have been concerned with the intrinsic brightness of the crater. It has been asserted by many observers, such as Blondel, Abney, S. P. Thomp- son, Trotter, Violle, and others, that this is practically independent of the current passing, but great differences of opinion exist as to its value. Abney’s values lie be- tween 39 and 116, Trotter’s between 80 and 170 candles per square millimetre. Blondel in 1893 made careful determinations of the brightness of the arc crater, and came to the conclusion that it was 160 candles per square millimetre. More recently J. E. Petavel has found a value of 147 candles per square millimetre for current densities varjdng from ‘06 to ‘26 amperes per square millimetre {Proc. Boy. Soc. vol. Ixv. p. 475). VioUe also, in 1893, supported the opinion that the bright- ness of the crater per square miUimetre was independent of the current density, and from certain experiments and assumptions as to the specific heat of carbon, he asserted the temperature of the crater was about 3500►► C. It has been concluded that this constancy of temperature, and therefore of brightness, is due to the fact that the crater is at the temperature of the boiling-point of carbon, and in that case its temperature should be raised by increasing the pressure under which the arc works. W. E. Wilson in 1895 attempted to measure the brightness of the crater under various pressures, and found that under five

atmo- spheres the resistance of the arc appeared to increase and the temperature of the crater to fall, until at a pressure of 20 atmospheres the brightness of the crater had fallen to a dull red. In a later paper W. E. WUson and G. Fitz- gerald stated that these preliminary experiments were not confirmed, and their later researches throw considerable doubt on the suggestion that it is the boiling-point of carbon which determines the temperature of the crater. (See Electrician, vol. xxxv. p. 260, and voL xxxviii. p. 343.) On the whole, although valuable work has been done in exploring the physics of the electric arc, much knowledge yet remains to be gained before we can be said to under- stand the f uU meaning of this simple physical phenomenon, which is hardly likely to be fully interpreted before our information is greatly increased as to the process by which electric current is transmitted through gas or vapour.

The study of the alternating-current arc has proved to be fertile in suggesting a number of new experimental problems for investigators. In this case all the factors, namely, current, carbon P.D., resistance, Aitemat- and illuminating power, are periodically varying ; ’”“^ and as the electromotive force reverses itself periodically, at certain instants the current through the arc is zero. Owing to the fact that the current can be interrupted for a moment without extinguishing the arc, it is possible to work the electric arc from an alternating current generator without apparent intermission in the light, provided that the frequency is not much below 50. During the moment that the current is zero the carbon continues to glow. Each carbon in turn becomes, so to speak, the crater carbon, and the illuminating power is therefore symmetrically distributed. The curve of illumin- ation is as shown in Fig. 4. The nature of the variation of the current and arc P.D. can be examined by one of two methods, or their modifications, originally due to Joubert and A. Blondel. Joubert’s method, which has been perfected by many observers, consists in attaching to the shaft of the alternator a contact which closes a circuit

Fig. 4.

at an assigned instant during the phase. This contact is made to complete connexion either with a voltmeter or with a galvanometer placed as a shunt across the carbons or in series with the arc. By this arrangement these instruments do not read, as usual, the root-mean-square value of the arc P.D. or current, but give a constant indica- tion determined by, and indicating, the , instantaneous values of these quantities I at some assigned instant during the phase. By progressive variation of the phase-instant at which the contact is made, the successive instantaneous values of the electric quantities can be measured and plotted out in the form of curves. This method has been much employed by Blondel, Fleming, Steinmetz, Tobey and Walbridge, Frith, Gorges, and many others. The second method, due to Blondel, depends on the use of the Oscillograph, which is a galvanometer having a needle or coU of very small periodic time of vibration, say -^ 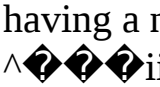 iis-s''^ P^'^ of a second or less, so that its deflections can follow the variations of current passing through the galvanometer. An improved form of oscillograph, devised by Duddell, consists of two fine wires, which are strained transversely to the lines of flux of a strong magnetic field (see Measue ING Instruments, Electric). The current to be examined is made to pass up one wire and down the other, and these wires are then slightly displaced in opposite directions. A small mirror attached to the wires is thus deflected rapidly to and fro in synchronism with the variations of the current. From the mirror a ray of light is reflected which falls upon a photographic plate made to move across the field with a uniform motion. In this manner a photographic trace can be obtained of the wave form. By this method we are enabled to watch the variations of electric quanti- ties in an alternating- current arc. The variation of illuminating power can be, followed by examining and measuring the light of the arc through slits in a revolving stroboscopic disc, which is driven by a motor synchron- ously with the variation of current through the arc.

Without entering into an exact historical summary' of discovery, it suffices to say that the general phenomena of the alternating-curreiit arc are as foUow : 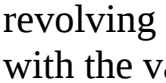 If the arc is supplied by an alternator of low inductance, and soft or cored carbons are employed to produce a steady and silent arc, the potential difference of the carbons periodically varies in a manner not very diSerent from that of the alternator on open circuit. If, however, hard carbons are used, the alternating-current arc deforms the shape of the

alternator electromotive force curve; the carbon P.D. curve may then have a very different form, and becomes, in general, more rectangular in shape, usually having a high peak at the front. The arc also impresses the deformation on the current curve. Blondel in 1893 (Electrician, vol. xxxii. p. 161) gave a number of poten- tial and current curves for alternating-current arcs, obtained by the Joubert contact method, using two movable coil galvanometers of high resistance to measure respectively potential difference and current. Blondel's deductions were that the shape of the current and volt curves is greatly affected by the nature of the carbons, and also by the amount of inductance and resistance in the circuit of the alternator. Blondel, Ayrton, Sumpner, and Steinmetz have all observed that the alternating-current arc, when hissing or when formed with uncored carbons, acts like an inductive resistance, and that there is a lag between the current curves and the potential difference curves. Hence the power-factor, or

ratio between the true power and the product of the root- niean-square values of arc current and carbon potential difference, in this case is less than unity. For silent arcs Blondel found power-factors lying between 0-88 and 0-95, and for hissing ones, values such as 0-70. Ayrton and Sumpner stated that the power-factor may be as low as 0-5. Joubert, as far back as 1881, noticed the deforma- tion which the alternating-current arc impresses upon the electromotive force curve of an alternator, giving an open circuit a simple harmonic variation of electromotive force Tobey and Walbridge in 1890 gave the results of a number of observations taken with commercial forms of alternating-current arc lamps, in which the same deforma- tion was apparent. Blondel in 1896 came to the con- clusion that with the same alternator we can produce carbon P.D. curves of very varied character, according to the material of the core, the length of the arc, and the inductance of the circuit. Hard carbons gave a P.D. curve with a flat top even when worked on a low induct^ ance alternator. The periodic variation of Ught in the alternating-current arc has also been the subject of inquiry. H. Gorges in 1895 carried out experiments on this subject at Berlin, and applied a stroboscopic method to steady the variations of iUuminating power. Fleming and Petavel also employed a similar arrangement, driving

the strobo- scopic disc by a synchronous motor {Phil. Mag., April 1896). The light passing through slits of the disc was selected in one particular period of the phase, and by means of a lens could be taken from any desired portion of the arc or the incandescent carbons. The light so selected was measured relatively to the mean value of the horizontal light emitted by the arc, and accidental vari- ations were thus eliminated. They found that the Ught from any part is periodic, but owing to the slow cooling of the carbons never quite zero, the minimum value happen- ing a little later than the zero value of the current. The light emitted by a particular carbon when it is the negative, does not reach such a large maximum value as when it is the positive. The same observers brought forward experi- ments which seemed to show that for a given expenditure of►►,power in the arc the alternating current arc in general gives less mean spherical candle-power than the continuous current one.

The effect of the wave form on the efficiency of the alternating-current arc has engaged the attention of many workers. Eossler and Wedding in 1894 gave an account of experiments with alternating-current arcs produced by alternators having electromotive force curves of very different wave forms, and they stated that the efficiency or mean spherical candle-power per watt expended in the arc was greatest for the flattest of the three wave forms by nearly 50 per cent. Burnie in 1897 gave the results of experiments of the same kind. His conclusion was, that since the light of the arc is a function of the temperature, that wave form of current is most efficient which main- tains the temperature most uniformly throughout the half period. Hence, generally, if the current rises to a high value soon after its commencement, and is pre- served at that value, or nearly at that value, during the phase, the efficiency of the arc will be greater when the current curve is more pointed or peaked. An important contribution to our knowledge concerning alternating-current arc phenomena was made in 1899 by Messrs W. Duddell and E. W. Marchant, in a paper con- taining valuable results obtained with their improved oscillograph.! They studied the behaviour of the alter-

‘ Jown. Inst. Elec. Eng. vol. xxviii. p. 1. The authors of this paper give numerous instructive curves taken with the oscillograph, showing the form of the arc P.D. and current curves for a great variety of alternating-current arcs.

nating-current arc wlien formed both with solid carbons, ???with cored carbons, and with carbon and metal rods. They found that with solid carbons the arc P.D. curve is always square-shouldered and begins with a peak, as shown in Fig. 5 (a), but with cored carbons it is more sinusoidal. Its shape depends on the total resistance in the circuit, but is almost independent of the type of alternator, whereas the current wave form is largely dependent on the machine used, and on the nature and amount of the imped- ance in the circuit; hence the importance of selecting a suitable alternator for operating alternating-current arcs. The same observers drew attention to the remarkable fact that if an arc is formed between a carbon and metal rod, say a zinc rod, there is a complete interruption of the cur- rent over half a period corresponding to that time during which the carbon is positive ; this suggests that the rapid

Fig. B.

cooling of the metal facilitates the flow of the current from it, and resists the flow of current to it. The dotted curve in Fig. 5 (6) shows the current curve form in the case of a copper rod. By the use of the oscillograph Messrs Duddell and Marchant showed that the hissing continuous- current arc is intermittent, and that the current is oscUlat- ory and may hsdve a frequency of 1000 per second. They also showed that enclosing the arc increases the arc reaction, the front peak of the potential curve becoming more marked and the power-factor of the arc reduced.

If a continuous-current electric arc is formed in the open air with a positive carbon having a diameter of about 15 millimetres, and a negative carbon having a diameter of about 9 millimetres, and if a current of 10 amperes is employed, the potential difierence between the carbons is generally from 40 to 50 volts. Such a lamp is therefore called a 500 watt arc. Under these conditions the carbons each burn away at the rate of about one inch per hour, actual combustion taking place in the air which gains access to the

highly-heated crater and negative tip ; hence the most obvious means of preventing this disappearance is to enclose the arc in an air-tight glass vessel. Such a device was tried very early in the history of arc lighting. The result of using a completely air-tight globe, however, is that the contained oxygen is removed by combustion with the carbon, and carbon vapour or hydrocarbon com- Enclosed pQ^jj(jg diffuse through the enclosed space and

ope ESttlDS QJ A

deposit themselves on the cool sides of the glass, which is thereby obscured. It was, however, shown by L. B. Marks (Electrician, vol. xxxi. p. 502, and vol. xxxviii. p. 646) in 1893, that if the vessel is not completely closed, and if the arc is an arc formed with a small current and relatively high voltage, namely, 80 to 85 volts, it is possible to admit air in such small amount that though the rate of combustion of the carbons is reduced, yet the air destroys by oxidation the carbon vapour escaping from the arc, and so prevents the obscuration of the glass con- taining-vessel. An arc lamp operated in this way is called an enclosed arc lamp (see Fig. 6). The top of the enclosing bulb is closed by a gas check plug which admits through a smaU hole a limited supply of air. The peculiarity of an enclosed arc lamp operated with a con- tinuous current is that the carbons do not burn to a crater on the positive, and a sharp tip or mushroom on the negative, but preserve nearly flat surfaces. This feature

affects the distribution of the light. The illuminating curve of the enclosed arc, therefore, has not such a strongly marked maximum value as that of the open arc, but on the other hand the true arc or column of incandescent carbon vapour is less steady in position, wandering round from place to place on the surface of the carbons. As a compensation, however, for this defect, the actual com- bustion of the carbons per hour in commercial forms of enclosed arc lamp is about one-twentieth part of that of an open arc lamp taking the same current.

Before leaving the discus- sion of the physical pheno- mena of the electric arc, one or two other facts in con- nexion with it may be men- tioned. It was shown by Fleming in 1890 that the column of incandescent carbon vapour constituting the true arc possesses a unilateral con- ductivity (Proc. Roy.

Inst. vol. xiiL p. 47). If a third carbon is dipped into the arc so as to constitute a third pole, and if a small voltaic battery of a few cells, vpith a galvanometer in circuit, is connected in between the middle pole and the negative carbon, it is found that when the negative pole of the battery is in connexion with the negative carbon the galvanometer indicates a current, but does not when the positive pole of the battery is in connexion with the negative carbon of the arc.

Turning next to the consideration of the electric arc as a source of light, we have already noticed that the illumin- ating power in different directions is not the same. If we imagine an electric arc, formed The arc as between a pair of vertical carbons, to be placed f^^gJ”” in the centre of a hoUow sphere painted white on the interior, then it would be found that the various zones of this sphere are unequally illuminated. If the points in which the carbons when prolonged would intercept the sphere are called the poles, and the line where the hori- zontal plane through the arc would intercept the sphere is called the equator, we might consider the sphere divided up by lines of latitude into zones, each of which would be differently illuminated. The total quantity of light or the total illumination of each zone is the product of the area of the zone and the intensity of the light falling on the zone measured in candle-power. We might regard the sphere as uniformly illuminated with an intensity of light such that the product of this intensity and the total surface of the sphere was numerically equal to the surface integral obtained by summing up the products of the areas of all the elementary zones and the intensity of the light falling on each. This mean intensity is called the mean spherical candle-power of the arc. If the distribution of the illumin- ating power is known and given by an illumination curve, the mean spherical candle-power can be at once deduced by a construction due to JM. Kousseau (La Lwmiere Eleetrique, vol. xxxvii. p. 415).

Fig. 6.

Let BMO (see Fig. 7) be a semicircle which by revolution round the diameter BO sweeps out a sphere. Let an arc be situated at A, and let the element of the circumference FQ,=ds sweep out a zone of the sphere. Let the intensity of ††† r

light falling on this zone be I. Then if fl = the angle MAP and dd the incremental angle PAQ, and if R is the radius of the sphere, we have

ds = Rd0 ; also, if we project the element PQ on * the line DE we have

ab=ds cos 6, .†††. a6 = R cos 6dS Ia6 = IRcos ede.

and

the

9| ^^^ r

††

Fig. 7.

Let r denote the radius PT of zone of the sphere, then r=R cos 6. Hence the area of the zone swept out by PQ is equal to

2irR cosfl ds=2Tr'R^ cos Odd in the limit, and the total quantity of light falling on the zone is equal to the jiroduot of the mean intensity or candle-power I in the direction AP and the area of the zone, and therefore to

2ffIR2 cos ede. Let Id stand for the mean spherical candle-power, that is, let Iq be defined by the equation

47rE2I(, = 2ffRS(Ia6) where S(Ia5) is the sum of all the light actually falling on the sphere surface, then

lo =2R 2{IaJ)

2(Ia5

Imax

2B,Imax

where Imax stands for the maximum candle-power of the arc. If, then, we set off at 6 a line 5H perpendicular to DE and in length proportional to the candle-power of the arc in the direction AP, and carry out the same construction for a number of different observed candle-power readings at known angles above and below the horizon, the summits of all ordinates such as 5H will define a curve DHE. The mean spherical candle-power of the arc is equal to the product of the maximum candle-power {Imax), and a fraction equal to the ratio of the area included by the curve DHE to its circumscribing rectangle DFGE. The area of the curve DHE multiplied by 2?r/R gives us the total flux of light from the arc.

Owing to the inequality in the distribution of light from an electric arc, it is impossible to define the illuminating power by a single number in any other way than by stating the mean spherical candle-power. All such commonly used expressions as “an arc lamp of 2000 candle-power ” are, therefore, perfectly meaningless.

The photometry of arc lamps presents particular diffi- culties, owing to the great difference in quality between the light radiated by the arc and that given by any of the ordinarily used light standards. (For standards of light and photometers, see Light.) All photometry depends on the principle that if we illuminate two white surfaces

respectively and exclusively by two separate Pfio/onieriygQ^j.ggg q►► hght, we can by moving the lights

bring the two surfaces into such a condition that their illumination or brightness is the same without regard to any small colour difference. The quantitative measurement depends on the fact that the illumination or brightness produced upon a surface by a source of light is inversely as the square of the distance of the source. The trained eye is capable of making a comparison between two surfaces illuminated by different sources of light, and pronouncing upon their equality or otherwise in respect of brightness, apart altogether from a certain colour difference ; but in order that this

should be capable of being done with accuracy, it is essential that the two Uluminated surfaces, the brightness of which is to be compared, shall be absolutely contiguous and not separated by any harsh line. The process of comparing the light from the arc directly with that of a candle or other similar flame standard is exceedingly difficult, owing to the much greater proportion and intensity of the violet rays in the arc. The most convenient practical working standard is an incandescent lamp run at a high temperature, that is, at an efficiency

of about 2| watts per candle. If it has a sufficiently large bulb, and has been aged by being worked for some time previously, it will at a constant voltage preserve a constancy in illuminating power sufficiently long to make the neces- sary photometric comparisons, and it can itself be compared at intervals with another standard incandescent lamp, or with a flame standard such as a Harcourt pentane lamp.

In measuring the candle-power of arc lamps it is neces- sary to have some arrangement by which the brightness of the rays proceeding from the arc in different directions can be measured. For this purpose the lamp may be suspended from a support, and a radial arm arranged to carry three mirrors, so that in whatever position the arm may be placed, it gathers light proceeding at one particular angle above or below the horizon from the arc, and this light is reflected out finally in a constant horizontal direction. 7^ easUy-arranged experiment enables us to determine the constant loss of light by reflection at all the mirrors, since that reflection always takes place at 45 degrees. The ray thrown out horizontally can then be compared with that from any standard source of hght by means of a fixed photometer, and by sweeping round the radial arm the photometric or illuminating curve of the arc lamp can be obtained. From this we can at once determine the nature of the illumination which would be produced on a hori- zontal surface if the arc lamp were suspended at a given distance above it. a^- ??? ^ Let A (see Fig. 8) ‘’ >”>”’’’’’’’’ be an arc lamp placed at a height h(= AB) above a horizontal plane. Let ACD be the illuminating power . curve of the arc, and hence AC the candle-

Fig. s.

power in a direction AP.

ness on the horizontal

cos APM^

FC

h^ + x^

The niumination (I) or bright-

AC plane at P is equal to TTpTj

= IwhereBP =

Hence if the candle-

power curve of the arc and its height above the surface are knovni, we can describe a curve BMN, whose ordinate PM will denote the brightness on the horizontal surface at any point P. It is easily seen that this ordinate must have a maximum value at some point. This brightness is best expressed in candle-feet, taking the unit of Ulumination to be that given by a standard candle on a white surface at a distance of one foot. If any number of arc lamps are placed above a horizontal plane, the brightness at any point can be calculated by adding together the illuminations due to each respectively.

In the practical use of arc lamps for street and public lighting, the question of the distribution of light on the horizontal surface is aU-important. The aim should be to produce as far as possible a uniform ^l”ylt”’ illumination sufficient for visual purposes. We form an opinion on the success of such hghting by observ- ing the mean, maximum, and minimum illumination. In order that street surfaces may be well lighted, the minimum illumination should not fall below O’l candle-foot, and in general, in well-lighted streets, the maximum illumination wiU be 1 candle-foot and upwards. By means of an illumination photometer, such as that of Preece and Trotter, it is easy to measure the illumination in candle-feet at any point in a street surface, and to plot out a number of con- tour lines of equal illumination. Experience has

shown that to obtain satisfactory results the lamps must be placed on a high mast 20 or 25 feet above the roadway surface. These

posts are now generally made of cast-iron in various orna- mental forms (see Fig. 9), tlie necessary conductors for conveying the current up to the lamp being taken inside the iron mast. (The pair of incandescent lamps half-way down the standard are for use in the middle of the night, -when the arc lamp would give more light than is required ; they are lighted by an automatic switch whenever the arc is extinguished.) The lamp itself is generally enclosed in an opalescent spherical globe, which is woven over with wire-netting so that in case of fracture the pieces may not cause damage. The necessary trimming, that is, the replacement of carbons, is effected either by lowering the lamp or, preferably, by carrying round a portable ladder enabling the trimmer to reach it. For the purpose of public illumination it is very usual to employ a lamp taking 10 amperes, and therefore absorbing about 600 watts. Such a lamp is called a 500 watt are lamp, and it is found that a satis- factory illumination is given for most street purposes by placing 500 watt arc lamps at distances varying from 40 to 100 yards, and at a height of 20 to 25 feet above the roadway. The maximum candle- power of a 500 watt arc enclosed in a roughened or ground-glass globe will not exceed 1500 candles, and that of a 6-8 ampere arc (continuous) about 900 candles. If, however, the arc is an enclosed arc with double globes, the absorption of light would reduce the effective maximum to about 200 c.p. and 120 c.p. respectively. When arc lamps are placed in public thoroughfares not less than 40 yards apart, the illumina- tion anywhere on the street surface is prac- tically determined by the two nearest ones. Hence the total illumination at any point may be obtained by adding together the illuminations due to each arc separately. Given the photometric polar curves or illuminating-power curves of each arc taken outside the shade or globe, we can therefore draw a curve representing the resultant illumination on the horizontal surface. It is obvious that the higher the lamps are placed, the more uniform is the street sur- face illumination, but the less its average value ; thus two 10 ampere arcs placed on masts 20

feet above the road surface and 100 feet apart will give a maximum illumination of about 1-1 and a minimum of about 045 candle-feet in the interspace (see Fig. 10). If the lamps are raised on40-feet posts the max- imum illumination will fall to 0-3, and the minimum will rise to 0-2. For this reason some engineers have advo- cated very high masts, and masts have been employed as high as 90 feet. In docks and railway yards high masts (50 feet) are an advantage, because the strong contrasts due to shadows of trucks, carts, &c., then become less marked, but for street illumination they should not exceed 30 to 35 feet in height. Taking the case of 10 ampere and 6-8 ampere arc lamps in ordinary opal shades,

Fig. 9.

r-?-

4.

100 rar-

s*

Fig. 10.

the following figures have been given by Trotter as indicating the nature of the resultant horizontal illumi- nation : ???

Arc Current

in

Amperes.

Height above

Eoad

in Feet.

Distance

apart in Feet.

Horizontal Illumination in Candle-Feet.

Maximum.

Minimum.

10 . 10 . 10

6-8 .

6-8 .

20 25 40 20 40

120 120 120 90 120

1-85 1-17

5

1-1 0-3

0-12 0-15 0-28 0-21 0-17

As regards distance apart, a very usual practice is to place the lamps at spaces equal to six to ten times their height above the road surface. Blondel (Electrician, vol. xxxv. p. 846) gives the following rule for the height (h) of the arc to afford the maximum illumination at a dis- tance (d) from the foot of the lamp-post, the continuous current arc being employed :

For naked arc ,, arc in rough glass globe ,, 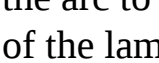 opaline globe

opal globe 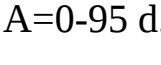 holophane globe .

A=0-95 d. A =0-85 d. h= ft=0-5 d. h=0-6d.

These figures show that the distribution of light on the horizontal surface is greatly affected by the nature of the enclosing globe. For street illumination naked arcs, although sometimes employed in works and factory yards, are entirely unsuitable, since the result produced on the eye by the bright point of light is to paralyse a part of the retina and contract the pupil, hence rendering the eye less sensitive when directed on feebly illuminated surfaces. Accordingly, diffusing globes have to be employed. It is usual to place the arc in the interior of a globe of from 12 to 18 inches in diameter. This may be of ground glass, opal glass, or be a dioptric globe such as the holo- phane. The two former are strongly absorptive, as may be seen from the results of experiments by Messrs Guthrie and Bedhead. The following table shows the astonishing loss of light due to the use of opal globes :
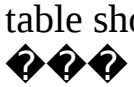

Naked Arc.

Arc in Clear Globe.

Arc in Rough Glass Globe.

Arc in Opal Globe.

Mean spherical c.p. Mean hemispherical c.p. Percentage value of transmitted light . Percentage absorption

319 450

100 0

235 326

53

47

160 215

23

144 138

19 81

By using Trotter’s, Fredureau’s, or the holophane globe, the light may be so diffused that the whole globe appears uniformly luminous, and yet not more than 20 per cent, of the light is absorbed. Taking the absorption of an ordinary opal globe into account, it is not usual to find that a 500 watt arc gives more than 500 c.p. as a maxi- mum candle-power. Even with a naked 500 watt arc the mean spherical candle-power is not generally more than 500 c.p., or at the rate of 1 c.p. per watt. The maximum candle-power for a given electrical power is, however, greatly dependent on the current density in the carbon, and to obtain the highest current density the carbons must be as thin as possible. (See T. Hesketh, “Notes on the Electric Arc,” Electrician, vol. xxxix. p. 707.)

The practical employment of the electric arc as a means of illumination is dependent upon mechanism for auto-

Arc lamp mechan- ism.

matically keeping two suitable carbon rods in the piroper position, and moving them so as to enable a steady arc to be maintained. Means must be provided for holding the carbons in line, and when the lamp is not in operation they must fall together, or come together when the current is switched on, so as to start the arc. As soon as the current passes, they must be moved slightly apart, and gripped in position immediately the current reaches its right value, being moved farther apart if the current increases in strength, and brought together if it decreases. Moreover, it must be possible for a considerable length of carbon to be fed through the lamp as required.

One early devised form of arc-lamp mechanism was a system of clock-work driven by a spring or weight, which was started and stopped by the action of an electromagnet; in modern lighthouse lamps a similar mechanism is still employed. There is no need to occupy space by reference to the early arc-lamp mechanism of Staite (1847), Foucault (1849), Serrin (1857), and Duboscq (1858). These, and a host of later inventors, devised numerous forms of mechanical and clock-work lamps. The modern self-regulating type may be said to have been initiated in 1878 by the differential lamp of von Hefner- Alteneck, and the clutch lamp of C. F. Brush. The general principle of the former may be explained as follows : ??? There are two solenoids, placed one above the other. The lower one, of thick wire, is in series with the two carbon rods forming the arc, and is hence called the series coil. Above this there is placed another solenoid of fine wire, which is called the shunt coil. Suppose an iron rod to be placed so as to be partly in one coil and partly in a,nother; then when the coils are traversed by currents, the iron core will be acted upon by forces tending to pull it into these solen- oids. If the iron core be attached to one end of a lever, the other end of which carries the upper carbon, it will easily be seen that if the carbons are in contact and the current is switched on, the series coil alone will be traversed by the current, and its magnetic action will draw down the iron core, and therefore pull the carbons apart and strike the arc. The moment the carbons separate, there will be a difference of potential between them, and the shunt coil will then come into action, and will act on the core so as to draw the carbons together. Hence the two solenoids act in opposition to each other, one increasing and the other diminishing the length of the are, and maintaining the carbons in the proper position. In the actual lamp of this type the upper carbon is in reality attached to a rod having a side-rack gearing, with a train of wheels governed by a pendulum. The action of the series coil on the mechanism is to first lock or stop the train, and then lift it as a whole slightly. This strikes the arc. When the arc is too long, the series coil lowers the gear and finally releases the upper carbon, so that it can run down by its own weight. The principle of a shunt and series coil operating on an iron core in opposition is the basis of the mechanism of a number of arc lamps. Thus the lamp invented by Krizik and Piette, called the Pilsen Lamp, comprises an iron core made in the shape of a double cone or spindle (see Pig. 11), which is so arranged in a brass tube

that it can move into or out of a shunt and series coil, wound the one with fine and the other with thick insulated wire, and

jUe

Fig. 11.

Fig. 12.

hence regulate the position of the carbon attached to it. The movement of this core is made to feed the carbons directly without the intervention of any clock-work, as in the case of the Hefner-Alteneck lamp. In the clutch-lamp mechanism the lower carbon is fixed, and the upper carbon rests upon it by its own weight and that of its holder. The latter consists of a long rod passing through guides, and is embraced somewhere by a ring capable of being tilted or lifted by a finger attached to the armature of an electromagnet, the coils of which are in series with the arc. When the current passes through the magnet it attracts the armature, and by tilting the ring lifts the upper carbon-holder, and hence strikes the arc. If the current diminishes in value, the upper carbon drops a little by its own weight, and the feed of the lamp is thus effected by a series of small lifts and drops of the upper carbon (see Fig. 12). Another element sometimes employed in arc- lamp mechanism is the brake- wheel regu- lator. This is a feature of one form of the Brockie and of the Crompton-Pochin lamps. In these the movement of the carbons is effected by a cord or chain which passes over a wheel, or by a rack geared with the brake wheel. When the current is passing through the lamp, the wheel is free to move, and the carbons fall together ; but when the current is switched on, the chain or cord passing over the brake wheel, or the brake wheel itself, is gripped in some way, and at the same time the brake wheel is lifted so that the arc is struck.

Although countless forms of self-regulating device have been invented for arc lamps, nothing has survived the test of time so well as the typical mechanisms which work with carbon rods in one line, one or both rods being moved by a controlling apparatus as required. The early forms of semi-incandescent arc lamp, such as those of Werdermann and others, have dropped out of existence. These were not really true arc lamps, the light being produced by the incandescence of the extremity of a thin carbon rod

pressed against a larger rod or block. The once famous Jablochkoff candle has also disappeared from practice. This was invented in 1876, and consisted of two carbon rods about 4 mm. in diameter, placed parallel to each other and separated by a partition of kaolin, steatite, or other refractory non-conductor. Alternating currents were employed, and the candle was set in operation by a match or starter of high-resistance carbon paste which connected the tips of the rods. When this burned off, a true arc was formed between the parallel carbons, the separator volatilizing as the carbons burned away. Although much ingenuity and capital were expended on this system of lighting between 1877 and 1881, it no longer exists. One cause of its disappearance was its relative ineflB.ciency in light-giving power when compared with other forms of carbon arc taking the same amount of power, and a second equally important reason was the waste in carbons. If the arc of the electric candle was accidentally blown out, no means of relighting existed; hence the great waste in half- burnt candles. Wilde, Jamin, Eapieff, and others en- deavoured to provide a remedy, but without success. Of late years great advantages have attended the introduction of the enclosed arc lamp, in consequence of the economy effected in carbon consumption and in the labour-cost of trimming.

It is impossible to give here detailed descriptions of a fraction of the arc-lamp mechanisms devised, and it must suffice to indicate the broad distinctions between various types. (1) Arc lamps may be either continuous-current or alternating-current lamps. For outdoor public illumination the former are greatly preferable, as owing to the form of the illuminating power-curve they send the light down on the road surface where it is most required, provided the upper carbon is the positive one. For indoor, public room, or factory lighting, inverted arc lamps are sometimes employed. In this case the positive carbon is the lower one, and the lamp is carried in an inverted metallic reflector shield, so that the light is chiefly thrown up on the ceiling, whence it is diffused all round. The alternating-current arc is not only less eflicient in mean spherical candle-power per watt of electric power absorbed, but its distribution of light is disadvantageous for street

purposes. Hence of late years, when arc lamps have to be worked off an alternating-current circuit for public lighting it is usual to make use of a rectifier, which rectifies the alternating current into a unidirectional though pulsating current. (2) Arc lamps may be also classified, as above described, into open or enclosed arcs. The enclosed arc has the advantage that it can be made to bum for 200 hours with one pair of carbons, whereas open arc lamps are usually only able to work 8, 16, or 32 hours without recarboning, even when fitted with double carbons. (3) Arc lamps are further divided into focussing and non-focussing lamps. In the former the lower carbon is made to move up as the upper carbon moves down, and the arc is therefore maintained at the same level. This is advisable for arcs included in a globe, and absolutely necessary in the case of lighthouse lamps and lamps for optical purposes. (4) Another subdivision is into hand-regulated and self-regulated lamps. In the hand-regulated arcs the carbons are moved by a screw attachment as required, as ir(some forms of search-light lamp and lamps for optical lanterns. The carbons in large search-light lamps are usually placed horizontally. (5) The self-regulating lamps may be classified into groups depending upon the nature of the regulating appliances. In some cases the regula- tion is controlled only by a series coil, and in others only by a shunt coil. Examples of the former are the original Gtilcherand Brush clutch lamp, and some modem enclosed arc lamps ; and of the latter, the Siemens “band” lamp and the Jackson-Mensing lamp. In series coil lamps the variation of the current in the coil throws into or out of action the carbon-moving mechanism ; in shunt coil lamps the variation in voltage between the carbons is caused to effect the same changes. Other types of lamp involve the use both of shunt and series coils acting against each other. A further classification of the self-regulating lamps may be found in the nature of the carbon-moving mechanism. This may be some modification of the Brush ring clutch, hence called clutch lamps ; or some variety of brake wheel, as employed in Brockie and Crompton lamps; or else some form of electric-motor is thrown into or out of action and effects the necessary changes. In many cases the arc-lamp mechanism is provided with a dash-pot, or con- trivance in which a piston moving nearly air-tight in a cylinder prevents sudden jerks in the motion of the mechanism, and thus does away with the ” hunting” or rapid up-and-down movements to “which some varieties of clutch mechanism are liable. As with the dynamo, the struggle for existence has gradually eliminated the less efficient forms

of mechanism, and a few particular types survive which combine the maximum of efficiency in action with least cost of manufacture. One very efficient form is illustrated in the Thomson lamp and Brush-Vienna lamp. In this mechanism a shunt and series coil are placed side by side, and have iron cores suspended to the ends of a rocking arm held partly within them. Hence, according as the magnetic action of the shunt or series coil prevails, the rocking arm is tilted backwards or forwards. When the series coil is not in action the motion is free, and the upper carbon-holder slides down, or the lower one slides up, and starts the arc. The series coil comes into action to withdraw the carbons, and at the same time locks the mechanism. The shunt coil then operates against the series coil, and between them the carbon is fed forwards as required. The control to be obtained is such that the arc shall never become so long as to flicker and become extinguished, when the carbons would come together again with a rush, but the feed should be smooth and steady, the position of the carbons responding quickly to each change in the current.

‘ Arc lamps may be arranged either (i.) in series, (ii.) in parallel, or (iii.) in series parallel. In the first case a number, say 20, may be traversed by the same Arrange- current, in that case supplied at a pressure of ”’*” ‘ 1000 volts. Each must have a magnetic cut-out,

so that if the carbons stick together or remain apart the current to the other lamps is not interrupted, the function of such a cut-out being to close the main circuit im- mediately any one lamp ceases to pass current. Arc lamps

worked in series are generally supplied with a current from a constant-current dynamo, which maintains an invariable current of, say 10 amperes, independently of the number of lamps on the external circuit. If the lamps, however, are worked in series off a constant-potential circuit, such as one supplying at the same time incandescent lamps, provision must be made by which a resistance coil can be substituted for any one lamp that is removed or short- circuited. In the case when lamps are worked in parallel, each lamp is independent, but it is then necessary to add a resistance in series with the lamp. By special devices three lamps can be worked iii series of 100-volt circuits. Alternating-current arc lamps can be worked off a high-tension circuit in parallel by providing each lanip with a small transformer.

In some cases the alternating high- tension current is rectified and supplied as a unidirectional current to lamps in series. If single alternating-current lamps have to be worked off a 100-volt alternating-circuit, each lamp must have in series with it a choking coil or economy coil, to reduce the circuit pressure to that re- quired for one lamp. Alternating-current lamps take a larger effective current, and work with a less effective or virtual carbon P.D., than continuous-current arcs of the same wattage.

The cost of working public arc lamps is made up of several items. There is first the cost of supplying the necessary electric energy, then the cost of car- ^^

bons and the labour of recarboning, and, lastly, an item due to depreciation and repairs of the lamps. An ordinary open-type 10-ampere arc lamp, burning car- bons 15 and 9 mm. in diameter for the positive and neg- ative, and working every night of the year from dusk to dawn, uses about 600 feet of carbons per annum. If the positive carbon is 18 mm. and the negative 12 mm., the consumption of each size of carbon is about 70 feet per 1000 hours of burning. It may be roughly stated that at the present prices of arc- lamp carbons the cost is about 15s. per 1000 hours of burning ; hence if such a lamp is burnt every night from dusk to midnight tJie annual cost in that respect is about ––1, 10s. The annual cost of labour per lamp for trimming is in Great Britain from ––2 to ––S per annum ; hence, approximately speak- ing, the cost per annum of maintenance of a public arc lamp burning every night from dusk to midnight is about ––4 to ––5, or perhaps ––6, per annum, depreciation and repairs included. Since such a 10-ampere lamp uses half a Board of Trade unit of electric energy every hour, it will take 1000 Board of Trade units per annum, burning every night from dusk to midnight ; and if this energy is supplied, say at 3d. per unit, the annual cost of energy will be about ––12, and the upkeep of the lamp, including carbons, labour for trimming, and repairs, will be about ––16 to ––18 per annum. The cost for labour and carbons is considerably reduced by the employment of the en- closed arc lamp, but owing to the absorption of light pro- duced by the inner enclosing globe, and the necessity for generally employing a second outer globe, there is a lower resultant candle-power per watt expended in the arc. Enclosed arc lamps as now made (1899) burn without attention for 200 hours, singly on

100-volt circuits, or two in series on 200-volt circuits, and in addition to the cost of carbons per hour being only about one-twentieth of that of the open arc, have another advantage in the fact that there is a more uniform distribution of light on the road surface, because a greater proportion of light is thrown out horizontally.

Incandescent Lamps.

Incandescent electric lighting, although not the first, is yet in one sense the most obvious method of utilizing electric energy for illumination. It was evolved from the

early observed fact that a conductor is heated when traversed by an electric current, and that if it has a high resistance and a high melting-point it may be rendered incandescent, and therefore become a source of light. Naturally every inventor turned his attention to the em- ployment of wires of refractory metals, such as platinum or alloys of platinum-iridium, &c., for the purpose of making an incandescent lamp, and in the middle and latter half of the 19th century many attempts of this kind were made. No reference need be made to the experiments of De Moleyns in 1841, King and Starr in 1845, Watson in 1853, and Staite in 1848, for in spite of their ingenuity these inventors achieved no satisfactory result. Part, however, of their want of success is attri- butable to the fact that in their day the problem of the economical production of electric current by the dynamo m^,chine had not been solved. In 1878 Edison directed his attention to the same subject, and devised lamps in which a platinum wire was employed as the light-giving agent, carbon being made to adhere round it by pressure. Abandoning this, he next directed his attention to the construction of an ” electric candle,” consisting of a thin cylinder or rod formed of finely-divided metals, platinum, iridium, &c., mixed with refractory oxides, such as mag- nesia, or ziconia, lime, &c. This refractory body was placed in a closed vessel and heated by being traversed by an electric current. In a further improvement he proposed to use a block of refractory oxide, round which a bobbin of fine platinum or platinum-iridium wire was coiled. Every

other inventor who worked at the problem of incandescent lighting seems to have followed nearly the same path of invention. Long before this date, how- ever, the notion of employing carbon as a substance to be heated by the current had entered the minds of inventors ; even in 1845 King had employed a small rod of plumbago as the substance to be heated. It was obvious, however, that carbon could only be so heated when in a space desti- tute of oxygen, and accordingly King placed his plum- bago rod in a barometric vacuum. Konn in 1872, and Kosloif in 1875, followed in the same direction.

Without entering into a detailed history of the develop- ment of incandescent electric lighting, we may say that no real success attended the efforts of inventors Carbon until it was finally recognized, as the outcome of

a lesser degree, Lane Eox and Sawyer and Mann, that the conditions of success were as follows : ??? First, the substance to be heated must be carbon in the form of a thin wire rod or thread, technically termed a filament; second, this must be supported and enclosed in a vessel formed entirely of glass ; third, the- vessel must be exhausted as perfectly as possible; and fourth, the current must be conveyed into and out of the carbon filament by means of platinum wires hermetically sealed through the glass. By successive stages inventors were led to perfect all the details of the process of manufac- turing an incandescent electric lamp in its present form. One great difficulty was the production of the carbon filament. Early inventors, such as King, Sawyer, and Mann, and others, had attempted to cut out a suitably shaped piece of carbon from a solid block; but Edison and Swan were the first to show that the proper splution of the difficulty was to carbonize an organic substance to which the necessary form had been previously given. For this purpose cardboard, paper, and ordinary thread were originally employed, and even, according to Edison, a mixture of lampblack and tar rolled out into a fine wire and bent into a spiral. At one time Edison employed a filament of bamboo, carbonized after being bent into a horse-shoe shape. Swan used a material formed by treating ordinary crochet cotton-thread with dilute sulphuric acid,

the ” parchmentized thread ” thus produced being after- wards carbonized. In the modern incandescent lamp the filament is generally constructed by preparing first of all a form of soluble cellulose. Carefullypurified cotton-wool is dissolved in some solvent, such as a solution of zinc chloride, and the viscous material so formed is forced by hydraulic pressure through a die. The long thread thus obtained, when hardened, is a semi-transparent substance resembling cat-gut, and when carefully carbonized at a high temperature gives a very dense and elastic form of carbon filament. It is cut into appropriate lengths, which, after being bent into horse-shoes, double-loops, or any other shape desired, are tied or folded round carbon formers and immersed in plumbago crucibles, packed in with finely divided plumbago. The crucibles are then heated to a high temperature in an ordinary combustion or electric furnace, whereby the organic matter is destroyed, and a skeleton of carbon remains. The higher the temperature at which this carbonization is conducted, the denser is the resulting product. The filaments so prepared are sorted and measured, and short leading-in wires of platinum are attached to their ends by a carbon cement or, by a carbon depositing process, carried out by heating electrically the junction of the carbon and platinum under the surface of a hydrocarbon liquid. They are then mounted in bulbs of lead glass having the same coefficient of expansion as platinum, through the walls of which, therefore, the platinum wires can be hermetically sealed. The bulbs pass into the exhausting-room, where they are exhausted by some form of mechanical or mercury pump. During this process an electric current is sent through the fila- ment to heat it, in order to disengage the gases occluded in the carbon, and exhaustion must be so perfect that no luminous glow appears within the bulb when held in the hand and touched against one terminal of an induction coil in operation. Finally, the lamp is provided with a collar having two sole plates on it, to which the terminal wires are attached, or else the terminal wires are simply bent into two loops ; in a third form, the Edison screw

Fig. 18.

terminal, it is provided with a central metal plate, to which one end of the filament is connected, the other end being joined to a screw collar. The collars and screws are formed of thin brass embedded in plaster of Paris, or in some material like vitrite or black glass (cp. Fig. 13).

In order to put the lamp into connexion with the circuit supplying the current, it has to be fitted into a socket or holder. Three of the principal types of holder in use are the bottom contact (B.C.) or Dornfeld socket, the Edison screw-collar socket, and the Swan or loop socket. In the Dornfeld socket (Fig. 14,. a and d) two spring pistons, in contact with the two sides of the circuit, are fitted into the bottom of a short metallic tube having bayonet joint slots cut in the top. The brass collar on the lamp has two pins, by means of which a bayonet con- nexion is made between it and the socket ; and when this is done, the spring pins are pressed against the sole plates

Fig. 14.

on the lamp. In the Edison socket (Fig. 14, 6) a short metal tube with an insulating lining has on its interior a screw sleeve, which is in con- nexion with one wire of the circuit; at the bottom of the tube, and insulated from the screw sleeve, is a central metal button, which is in connexion with the other side of the circuit. On screwing the lamp into the socket, the screw collar of the lamp and the boss or plate at the base of the lamp make contact with the corre- sponding parts of the socket, and complete the connexion. In some cases a form of switch is included in the socket, which is then termed the key-holder. For loop lamps the socket consists of an insulated block, having on it two little hooks, which engage with the eyes of the lamp. This insulating block also carries some form of spiral spring or pair of spring loops, by means of which the lamp is pressed away from the socket, and the eyes kept tight by the hooks. This spring or Swan socket (Fig. 14, c) is found useful in places where the lamps are subject to vibration, for in such cases the Edison screw collar cannot well be used, because the vibration loosens the contact of the lamp in the socket. The sockets may be fitted with appliances for holding ornamental shades or conical reflectors. The incandescent filament being a sharp and very brilliant line of light, makes a dis- agreeable impression upon the eye if looked at directly ; hence various devices are adopted for moderating its brilliancy and distributing the light. A simple method is to sand-blast the exterior of the bulb, whereby it ac- quires an appearance similar to that of ground glass, or the bare lamp may

be enclosed in a suitable glass shade. Such shades, however, if made of opalescent or semi- opaque glass, absorb a large proportion of the light, about 40 to 60 per cent. ; hence various forms of dioptric shade have been invented, consisting of clear glass ruled with prismatic grooves in such a manner as to diffuse the light without any very great absorption, and make the whole globe appear equally luminous. Invention has been fertile in devising etched, coloured, opalescent, frosted, and ornamental shades for decorative purposes, and in constructing special forms for use in situations, such as mines and factories for explosives, where the globe con- taining the lamp must be air-tight. High candle-power lamps, 500, 1000, and upwards, are now made by placing in one large glass bulb a number of carbon filaments arranged in parallel between two rings, which are con- nected with the main leading-in wires. When incandescent lamps are used for optical purposes it is necessary to compress the filament into a small space, so as to bring it into the focus of a lens or mirror. The filament is then coiled or crumpled up into a spiral or zigzag form. Such lamps are called focus lamps. Incandescent lamps are technically divided into several broad divisions, called respectively high and low voltage lamps, high and low efficiency lamps, standard and fancy lamps. The differ- ence between high and low eflftciency lamps is based upon the relation of the power absorbed by the lamp to the candle-power emitted. Every lamp when manufactured is marked with a certain figure, called the marked volts. This is understood to be the electromotive force in volts which must be applied to the lamp terminals to produce through the filament a current of such magnitude that the lamp will have a practically satisfactory life, and give in a horizontal direction a certain candle-power, which is also

marked upon the glass. The numerical product of the current in amperes passing through the lamp, and the difference in potential of the terminals measured in volts, gives the total power taken up by the lamp in watts; and this number divided by the candle-power of the lamp (taking generally a horizontal direction) gives the watts ixr candle-power. This is an important figure, because it is determined by the temperature ; it therefore determines the quality of the light emitted by the lamp, and also fixes the average duration of the filament when rendered incandescent by a current. Even in a good vacuum the filament is not permanent. Apart altogether from accidental defects, which may sooner or later cause it to break, the carbon is

slowly volatilized, and carbon molecules are also projected in straight lines from different portions of the filament. This process not only causes a change in the nature of the surface of the filament, but also a deposit of carbon on the interior of the bulb, whereby the glass is blackened and the candle-power of the lamp reduced. The volatilization increases very rapidly as the temperature rises. Hence at points of high resistance in the filament, more heat being generated, a higher temperature is attained, and the scattering of the carbon becomes very rapid ; in such cases the filament is sooner or later cut through at the point of high resistance. In order that incandescent lighting may be practically possible, it is essential that the lamps shall have a certain average life, that is, duration ; and this useful duration is fixed not merely by the possibility of passing a current through the lamp at all, but by the rate at which the candle-power diminishes. The decay of candle-power is called the ageing of the lamp, and the useful life of the lamp may be said to be that period of its existence before it has deteriorated to a point when it gives only 75 per cent, of its original candle-power. It is found that in practice carbon filament lamps, as at present made, cannot be worked at a higher efficiency than 2^ watts per candle-power without a too rapid duration and a too short life. Hence lamp manu-facturers classify lamps into various classes, marked for use say at 2^, 3, 3-^, and 4 watts per candle. A 2-1- watt per candle lamp would be called a high-efficiency lamp, and a 4 watt per candle lamp wou.ld be called a low-efficiency lamp. Under ordinary circumstances the low-efficiency lamp would probably have a longer life, but its light would be less suitable for many purposes of illumination in which colour discrimination is required. The possibility of employing high-efficiency lamps depends greatly on the uniformity of the electric pressure of the supply. If the voltage is exceedingly uniform, then high-efficiency lamps can be satisfactorily employed ; but they are not adapted for standing the variations in pressure which are liable to occur.with public supply-stations, since, other things being equal, their filaments are less substantial. The classifica- tion of lamps into high and low voltage lamps is based upon the watts per candle-power corresponding to the marked volts. When incandescent lamps were first intro- duced, the ordinary working voltage was 50 or 100, but at the present time a large number of public supply-stations furnish current to consumers at a pressure of 200 or 250 volts. This increase was necessitated by the enlarging area of supply in towns, and therefore the necessity” for

conveying through the same subterranean copper cables a large supply of electric energy without increasing the maximum current value and the size of the cables. This can only be done by employing a higher working electro- motive force ; hence arose a demand for incandescent lamps having marked volts of 200 and upwards, techni- cally termed high-voltage lamps. The employment of higher pressures in public supply-stations has necessitated greater care in the selection of the lamp fittings, and in

the manner of carrying out the wiring work. Switches, sockets, fuses, ceiling roses, &c., which are adequate for use with 100 volts become unsuitable when employed with higher pressures, because of the greater risk of start- ing an electric arc between adjacent metallic parts. The advantages, however, of higher supply pressures, from the point of view of supply-stations, are undoubted. At the same time the consumer desires a lamp of a higher efficiency than the ordinary carbon filament lamp. The demand for this has resulted in inventors turning their attention to substances other than car- bon which can be rendered incandescent by the electric current.

The luminous efficiency of any source of light, that is to say, the percentage of rays emitted which affect the

eye as light compared with the total radia- Recent tion, is dependent upon its temperature. In ‘mea^^’ ‘ Ordinary oil lamp the luminous rays do

not form much more than 3 per cent, of the total radiation. In the carbon-filament incandescent lamp, when worked at about 3 watts per candle, the luminous efficiency is about 5 per cent. ; and in the case df the arc lamp the radiation from the crater contains about 10 to 15 per cent, of eye-affecting radiation. Hence any improvement in the incandescent lamp must involve the use of a substance which is capable, without destruc- tion, of enduring a higher temperature than the carbon fila- ment. The temperature of a carbon filament working at about 3 watts per candle is not far from the melting-point of platinum, that is to say, is nearly 1776►► C. If it is worked at a higher efiB.ciency, say 2-5 watts per candle-power, the temperature rises

rapidly, and at the same time th^ volatilization and molecular scattering of the carbon is rapidly increased, so that the average duration of the lamp is very much shortened. An improve- ment, therefore, in the efficiency of the incandescent lamp can only be obtained by finding some substance which will endure heating to a higher temperature than the carbon filament. Inventors turned their attention many years ago, with this aim, to the refractory oxides and similar substances. Jablochkoff in 1877 described and made a lamp consisting of a piece of kaolin, which was brought to a state of incandescence first by passing over it an electric spark, and afterwards maintained in a state of incan- descence by a current of lower electromotive force. Lane Fox and Edison, in 1878, proposed to employ platinum wires covered with films of lime, magnesia, steatite, or with the rarer oxides, zirconia, thoria, &c. ; and Lane Fox, in 1879, suggested as an incandescent substance a mixture of particles of carbon with the earthy oxides. These earthy oxides ††† magnesia, lime, and the oxides of the rare earths, such as thoria, zirconia, erbia, yttria, &c. ††† possess the peculiarity that at ordinary temperatures they are practically non-conductors, but if heated to very high temperatures, their resistance at a certain point rapidly falls, and they become fairly good conductors. Hence if they can once be brought into a state of incan- descence a current can pass through them and maintain them in that state. On the other hand, at this tempera- ture they give up oxygen to carbon ; hence no mixtures of earthy oxides with carbon are permanent when heated. Nernst in 1897, however, patented an incandescent lamp

in which the incandescent body consists entirely tampf’ ††-^ ^ slender rod or filament of magnesia. If

such a rod is heated by the oxy hydrogen blowpipe to a high temperature it becomes conductive, and can then be maintained in an intensely luminous condition by pass- ing a current through it after the flame is withdrawn. Kernst found that by mixing together, in suitable propor- tions, magnesia with oxides of the rare earths, he was able to prepare a material which can be formed into

slender rods and threads, and which is rendered sufficiently conductive to pass a current with an electromotive force as low as 100 volts, merely by

being heated for a few moments with a spirit lamp, or even by the radiation from a neighbouring platinum spiral brought to a state of incandescence. The Nernst lamp, therefore, consists of a slender rod of the mixed oxides attached to platinum wires by an oxide, paste. The rod is surrounded by, or brought into proximity with, a coil of platinum wire which can be heated to incandescence, and the radiation from which suflices to heat the oxide rod to a point at which it is able to pass sufficient current to maintain itself in a state of incandescence. When this condition is reached, the current is autdmatically cut off from the platinum coil. Oxide filaments of this description need not be enclosed in an exhausted glass vessel, and they can be brought, without risk of destruction, to a temperature considerably higher than a carbon filament ; hence the lamp has a higher luminous efficiency. Many attempts have been made to cover over the carbon filament in a glow lamp with such substances, as thoria, zirconia, and the rare oxides, generally under the conception that at the same temperature such a surface would radiate a larger proportion of luminous rays than carbon ; but all such attempts have been a failure, from the fact that these oxides are rapidly reduced by contact with carbon at any temperature near the melting-point of platinum.

In the manufacture of carbon-filament lamps a process is very generally applied to the carbon which is technically termed ” treating.” The carbon filament, when formed, is placed in a vessel surrounded by an atmosphere of hydro- carbon, such as coal gas or vapour of benzol. If current is then passed through the filament the hydrocarbon vapour is decomposed, and carbon is thrown down upon the fila- ment in the form of a lustrous and dense deposit having an appearance like steel when seen under the microscope. This deposited carbon is not only much more dense than ordinary carbonized organic material, but it has a much lower specific electric resistance. An untreated carbon filament is generally termed the primary carbon, and a deposited carbon the secondary carbon. In the process of treating, the greatest amount of deposit is at any places of high resistance in the primary carbon, and hence it tends to cover up or remedy the defects which may exist. The bright steely surface of a well-treated filament is a worse radiator than the rougher black surface of an untreated one, hence it does not require the expenditure of so much electric power to

bring it to the same temperature, and probably on account of its greater density it deteriorates or ages much less rapidly.

The arrangement most suitable for the photometry and testing of incandescent lamps is a gallery or room large enough to be occupied by several workers, the walls being painted dead black. The photometer, ^^J’”’ preferably one of the Lummer-Brodhun form, is ^stiag.” set up on a gallery or bench. On one side of it must be fixed a working standard, which may be an incandescent lamp ; if this has a glass bulb much larger than the ordinary lamp, it will not so easily become blackened by a deposit of carbon. Its candle-power can be compared, at regular intervals andknown voltages, with that of some accepted flame standard, such as that of Vernon Harcourt ; in a lamp factory or electrical laboratory it is convenient to have a number of such large bulb standard lamps. This working standard should be maintained at a fixed distance on one side of the photometer, such that when worked at a standard voltage it creates an illumin- ation of one candle-foot on one side of the photometer disc. The incandescent lamp to be examined is then placed on the other side of the photometer disc on a

travelling carriage, so that it can be moved to and fro. Arrangements must be made to measure the current and the voltage of this lamp under test, and this is most ac- curately accomplished by employing a potentiometer (see Measueixg Instruments, Electkic). The holder which carries the lamp should be of such a description that the lamp can be held with its axis in any required posi- tion ; in making normal measurements the position of the lamp should be with its axis vertical, the filament being so situated that none of the turns or loops overlie one another as seen from the photometer disc. Observations can then be made of the candle-power correspondiag to different currents and voltages.

The candle-power of the lamp varies with the other variables in accordance with exponential laws of the following kind : ???

If A is the current in amperes through the lamp, V the voltage or terminal potential difference, W the power absorbed in watts, c.p. the maximum candle-power, and a, b, c, &c., constants, it has been found that A and c.p. are connected by an exponential law such that,

c.p. = aA^

where x is a number lying between 5 and 6, generally equal to 6-5 or 5-6. Also it has been found that c.p. = ftW^ very nearly, and that

c.p. = cV^ nearly

where c is some other constant, and ?/ is a number nearly equal to 6. It is obvious that if the candle-power of the lamp varies very nearly as the 6th power of the current and of the voltage, the candle-power must vary as the cube of the wattage.

Abney and Festing have also given a formula connecting candle- power and watts equivalent to c.p. = (W-dy where d is a constant.

Curves delineating the relation of these variables for any incan- descent lamp are called its characteristic-curves. The life or average duration is a function of W /c.p., or of the watts per candle- power, and therefore of the voltage at which the lamp is worked. It follows from the above relation that the watts per candle-power vary inversely as the fourth power of the voltage.

iS-om limited observations it seems that the average life of a carbon-filament lamp varies as the fifth or sixth power of the watts per candle-power. If V is the voltage at which the lamp is worked and L is its average life, then L varies roughly as the twenty-fifth power of the reciprocal of the voltage, or

L = aV-26.

A closer approximation to experience is given by the formula

V V2 logi$\bullet\bullet\bullet$L = 13.5-^-2o;^.

(See J. A. Fleming, “Characteristic Curves of Incandescent Lamps,” Phil. Mag., May 1885.)

Allusion has already been made to the fact that car- bon-filament glow lamps by use deteriorate in light-giving power. This is due to two causes. As already ^amps”’ explained, carbon is scattered from the filament and deposited upon the glass, and also changes take place in the filament which cause it to become re- duced in temperature, even when subjected to the same terminal voltage. In many lamps it is found that the first effect of running the lamp is to slightly increase its candle-power, even although the voltage be kept constant ; this is the result of a small decrease in the resistance of the filament. The heating to which it is subjected slightly increases the density of the carbon at the outset ; this has the effect of making the filament lower in resistance, and therefore it takes more current at a constant voltage. The greater part, however, of the subsequent decay in candle- power is due to the deposit of carbon ui)on the bulb, as shown by the fact that if the filament is taken out of the. bulb and put into a new clean bulb the candle-power in the majority of cases returns to its original value. Since the lamp ceases to be as useful, considered as a trans- forming device, when the candle-power falls below a cer- tain percentage of the original value, it has been suggested that for every lamp there is a certain point in its career which may be called the ” smashing-point,” when it is ad-

vantageous to replace it by a new one. Variations of pressure in the electric supply exercise a very prejudi- cial effect upon the light-giving qualities of incandescent lamps. If for instance glow lamps, nominally of 100 volts, are supplied from a public electric lightiag-station, in the mains of which the pressure varies between 90 and 110 volts, their life will be greatly abbreviated, and they will become blackened much sooner than would be the case if the pressure were perfectly constant. Since the candle- power of the lamp varies very nearly as the fifth or sixth power of the voltage, it follows that a variation of 10 per cent, in the electromotive force creates a variation of nearly 50 per cent, in the candle-power. Thus a 16 can- dle-power glow lamp, marked for use at 100 volts, was found on test to give the

following candle-powers at vol- tages varying between 90 and 105 : ††† At 105 volts it gave 22-8 c.p. ; at 100 volts, 16-7 c.p. ; at 95 volts, 12-2 c.p. ; and at 90 volts, 8-7 c.p. Thus a variation of 25 per cent, in the candle-power was caused by a variation in voltage of only 5 per cent. The same kind of variation in work- ing voltage exercises also a marked effect upon the aver- age duration of the lamp. The following figures show the results of some tests on typical 3-1 watt lamps run jft voltages above the normal, taking the average life when worked at the marked volts (namely, 100) as 1000 hours : †††

At 101 volts the life was 818 hours.

††† 102 ††† ††† 681

††† 103 ††† ††† 662

††† 104 ††† ††† 452

††† 105 ††† ††† 374

,, 106 ,, ††† 310

To remedy these effects, self-acting regulators have been devised by which the voltage at the points of consumption is kept constant, even although it varies at the point of generation. If, however, such a device ^l^Jf ^rs is to be effective, it must operate very quickly, as even the momentary effect of increased pressure is felt by the lamp. It is only therefore in those cases where the working pressure can be kept exceedingly constant that high- efB.ciency lamps can be advantageously em- ployed, otherwise the cost of lamp renewals more than counterbalances the economy in the cost of power. The slow changes that occur in the resistance of the filament make themselves evident by an increase in the per watts candle-power. The following table shows some typical figures indicating the results of ageing in a 16 candle- power carbon-filament glow lamp : †††

Hours Eun.

Candle-Po-vver.

Watts per Candle-Power.

0 .

16-0

3-16

100 .

15-8

3-26

200 .

15.86

3-13

300 .

15-68

3-37

400

15-41

3-53

500 .

15-17

3.51

600 .

14-96

3-54

700 .

14-74

3-74

The above table shows a gradual increase in watts per candle-power. This, however, does not imply necessarily an increase in the total power taken by the lamp, but is merely the consequence of the decay in candle-power produced by the blackening of the lamp. It is clear, therefore, that in estimating the value of an incandescent lamp for illuminating purposes the user must take into account not merely the price of the lamp and the initial watts per candle-power, but the rate of decay of the lamp. The scattering of carbon from the filament to the glass

Edisoa effect

Domestic use.

bulb produces interesting physical effects, which have been studied by Edison, Preece, and Fleming. If into an ordinary carbon-filament glow lamp a platinum plate is sealed, not connected to the filament but attached to a third terminal, then it is found that when the lamp is worked with continuous current a galvanometer connected in between the middle plate and the positive terminal of the lamp indicates a current, but not when connected in between the negative terminal of the lamp and the middle plate. If the middle plate is placed between the legs of a horse-shoe-shaped filament, it becomes blackened most quickly on the side facing the negative leg. The above effect, commonly called the Edison effect, is connected with

an electric discharge and convection of carbon which takes place between the two extreme ends of the filament, and, as experiment seems to show, consists in the conveyance of an electric charge, either by carbon molecules or something smaller than molecules. There is, however, an electric discharge between the ends of the filament, which rapidly increases with the temperature of the filament and the terminal voltage; hence one of the difficulties of manufacturing high-voltage glow lamps, that is to say, glow lamps for use on circuits having an electromotive force of 200 volts and upwards, is the discharge which thus takes place across from one leg of the filament to the other.

A brief allusion may next be made to the mode of use of incandescent lamps for interior and private lighting. At the present time hardly any other method of distribu- tion is adopted than that of an arrangement in parallel ; that is to say, each lamp on the circuit has one terminal connected to a wire which finally terminates at one pole of the generator, and its other terminal connected to a wire leading to the other pole. The lamp fila- ments are thus arranged between the conductors like the rungs of a ladder. In series with each lamp is placed a switch and a fuse or cut-out. The lamps themselves are attached to some variety of ornamental fitting, or in many cases suspended by a simple pendant, consisting of an insulated double flexible wire attached at its upper end to a ceiling rose, and carrying at the lower end a shade and socket in which the lamp is placed. Lamps, however, hung in this manner, head downwards, are disadvantageously used because their end-on candle- power is not generally more than 60 per cent, of their maximum candle-power. For descriptions of the immense varieties of ornamental fittings employed, special manuals must be consulted. Suffice it to say here that in interior lighting one of the great objects to be attained is a uniform- ity of illumination and the avoidance of harsh shadows. This can be achieved by a proper distribution of the lamps. It is impossible to give any hard and fast rules as to what number must be employed in the illumination of any room, as a great deal depends upon the nature of the reflecting surfaces, such as the walls, ceilings, &c. A room papered with dark paper, or having dark oak panels, will require double as many lights to produce satisfactory interior illumination, as will be the case in a room whose walls are very light in colour, or which contains many mirrors. As a rough guide, it may be stated that for every 100 square feet of floor surface

one^ 16 candle-power lamp placed about 8 f ^et above the floor will give a dull illumination, two will give a good illumination, and four will give a brilliant illumination. We generally judge of the nature of the illumination in a room by our ability to read comfortably in any position. In order that this may be done, the horizontal illuminar tion on the book should not be less than one candle-foot. The following table shows approximately the illumina- tions in candle-feet, in various situations, derived from actual experiments : ###

In a well-liglited room on the floor or tables

On a theatre stage ....

On a railway platform ....

In a picture gallery ....

The mean daylight in May in the interior of a room

In full sunlight

In full moonlight

1-0 to 3 c.f.

3 to 4 c.f.

###05 to -5 c.f.

###56 to 3-5 c.f.

30 to 40 c.f. . 7000 to 10,000 o.f. l/60th to 1/lOOth c.f.

From an artistic point of view, one of the worst meth- ods of lighting a room is by pendant lamps, collected in single centres in large numbers. Properly speaking, the lights ought to be distributed in different portions of the room, and so shaded that the naked filament is nowhere visible to the eye, but the light is received only by reflec- tion from surrounding objects. Ornamental effects are frequently produced by means of candle lamps in

which a small incandescent lamp, imitating the flame of a candle, is placed upon a white porcelain tube as a holder, and these small units are distributed and arranged in electroliers and brackets. It conduces to economy in the consumption of electric energy if a sufficient number of switches is pro- vided, so that only those lights which are actually re- quired need be used. For details as to the various modes of placing conducting wires in houses, and the various precautions for safe usage, the reader is referred to the article I. General Peinciples above.

We may conclude with a brief reference to the histori- cal development of electric lighting in Great Britain. In the year 1879 the Government had its attention directed for the first time to electric lighting as a possible subject for legislation, and a consideration of the existing state of electric lighting was referred to a Select Committee of the House of Commons. No legislative action, however, was taken at that time ××× in fact, the invention of the incandes- cent lamp was incomplete. Edison's British master-patent was only filed in Great Britain in ISTovember 1879. In 1882 an important Electrical Exhibition was held at the Crystal Palace, and the perfected electric incandescent lamp was for the first time seen by the public in large numbers. Owing, however, to the legislative enactments of the first Electric Lighting Act, 1882, progress was at first retarded, and it was not until after 1888, when the Electric Lighting Amendment Act was passed, that much advance began to be made in the development of electric lighting. After an important inquiry held by the Board of Trade in May 1889, rapid progress began to be made, and from and after that date public and private electric lighting has extended at an enormous rate. At the end of 1893 there were rather over one million 8 can- dle-power lamps in use in Great Britain ; at the end of 1895, about two millions ; at the end of 1896, about three millions; at the end of 1898, five millions; and at the end of 1899, rather over seyen millions.

Additional information on the subjects treated above may be found in the following books and original papers :^ ×××

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electricity, was the line built in Eiclimond, Va., U.S.A.,

by Frank J. Sprague in 1887. This railway had 13

miles of track, and started with an eqxiipnient of forty

It has been in continuous and successful com-

all Electrical Purposes. London, 1899.
Also the Preliminary Report of the Sub-Committee of the American Institute of Electrical Engineers on ” Standards of Light.” (j. – -p

III. Electric Teaction.

Electric traction, as treated in this article, will refer to the operation of vehicles for the transportation of passengers and goods upon tracks, as distinguished from what are known as telpherage systems on the one hand, and automobiles intended to run on common roads on the other.

Possibly the first electric motor was that made by the Abbe Dal Negro, in Italy, in 1830. As early as 1836, History Thomas Davenport, a blacksmith of Brandon, Vt., U.S.A., constructed and exhibited an auto- mobile electric car, operated by batteries carried upon it. Robert Davidson, of Aberdeen, Scotland, began experi- menting about 1838 with the electric motor as a means of traction, and constructed a very powerful engine, weigh- ing five tons and carrying a battery of forty cells. This locomotive made several successful trips on Scottish rail- ways, but was finally wrecked by jealous employees of the railway while it was lying in the car sheds at Perth. In 1840 a provisional patent was granted in England to Henry Pinkus, which described a method of supplying electric energy to a moving train from fixed conductors. A little later, in 1845, French and Austrian patents granted to Major Alexander Bessolo described practically what is to-day the third-rail system. In 1847 Professor Moses G-. Farmer, of Maine, U.S.A., built a model loco- motive operated by electricity, which he exhibited at Dover,]^ew Hampshire, and later at other places in New England. Shortly afterwards Professor C. G. Page, of the Smithsonian Institution, in Washington, constructed an electric railway motor, which made a trip on April 29, 1851, from Washington, D.C., to Bladensburg, Md., over the Baltimore and Ohio railway. This machine carried 100 Grove's cells, and attained speeds as high as 19 miles an hour. Perhaps the beginning of modern electric traction may be said to date from 1879, when the firm of Siemens & Halske put in operation the first electric railway at the Industrial Exposition in Berlin. In America it was not until a year later that real work began, and Mr T. A. Edison built an experimental line near his laboratory in Menlo Park, N.J. In 1880 a locomotive driven by accumulators was constructed and operated at a linen bleaching establishment at Breuil en Auge, in France ; and in 1881 a similar car was worked upon the Vincennes tramway line. On May 12, 1881, the first commercial electric railway for regular service was opened for operation at Lichterfelde, in Germany. The first really noteworthy road was that constructed at the Giant's Causeway at Portrush, in the North of Ireland. This line was 6 miles long, and the power was obtained from turbine wheels actuated by a cascade on the river Rush. The method of supply was, curiously enough, the third-rail. In 1883 invention in electric railways seems to have taken a decided advance in America. It was in this year that the conflicting interests of Edison and S. D. Field were consolidated ; and at the same time Van Depoele and Daft began

their experimental work, which later resulted in numerous commercial railways. Next year Messrs Bentley & Knight opened to the public in Cleveland, Ohio, U.S.A., a railway operated by an open-slot conduit, and for the first time worked in com- petition with horse traction on regular street railway lines. For the next two years much experimental work was done, but it may be said with fairness that the first of the thoroughly modern systems, in which a large railway was equipped and operated under service conditions by

cars.

mercial operation ever since. The original Richmond system was in all its essential particulars the overhead trolley system now in use. Many improvements have been made in the construction of the motors, the con- trollers, the trolleys, and the various details of car equipment and overhead construction, but the broad principles have not been departed from. The success of the Richmond line called the attention of tramway managers to the advantages of electricity as a motive power, and its substitution for other systems has pro- gressed with astonishing rapidity. In the United States practically all the horse and cable tram-lines have been or are being provided with one form or another of electric traction, and Europe also is at present actively engaged in changing from the older methods of tramway operation to electrical methods. In the United States the original city lines have been extended into the suburbs, and interurban lines have been built, so that there are con- tinuous electric lines of several hundred miles in length. The interurban service has developed electric railways competing with steam railways in speed and in the size and comfort of the cars. Electric locomotives have been constructed for special purposes. In Baltimore, Md., U.S.A., the Baltimore and Ohio railroad has a tunnel which, with its covered approaches, is over a mile and a half long, and in which is a grade of 42 feet to the mile. The steam locomotive gases, due especially to the very heavy freight trains that were hauled, made the operation of the tunnel impossible. Electric locomotives were built and put in operation in 1895. These machines weigh 96 tons, all of the weight being on the drivers, and they can haul trains of over 2000 tons up the grade. Other locomotives of various sizes and designs have also been built.

At the present time it may fairly be said that electricity has shown its superiority over its competitors ??? horses and moving cables ??? fortramway work. It is cheaper and more flexible. The relative cost of operation tar^' varies, of course, with the local conditions, but a fair average estimate would be that cable lines cost 25 per cent, more to operate than electric, and horse lines 100 per cent. more. The increased speed of the electric cars and the comfort rendered possible by larger vehicles always increase the receipts when horse traction is replaced by electric, while the latter, as compared with the cable, allows better and easier control of the car and a much greater possible speed variation. The installation of an overhead electric line costs less than a cable system, though the expense of a conduit electric line is about the same. By the extension of the urban tramway systems into the suburbs and the construction of interurban lines, elec- tricity has come into competition with steam. Here the conditions are different. For ordinary suburban service the electric cars, running through the city streets and on the highways, cannot, in speed, compete with steam trains operated on private rights of way. The fact that they run more frequently and can be entered anywhere along the line gives them an advantage, and within limited distances they have taken a large proportion of suburban traf&c from steam railways. For long-distance service, in order to compete with steam, a speed much greater than tha.t used on ordinary tram-lines must be used, while owing to the time spent on the car more attention must be paid to the comfort of the passenger. Speed and comfort being equal, the great advantage of electricity is that, when it is used, the most economical way of transporting a given number of passengers between two

points is in a large number of small" trains; with steam the converse is true. A frequent service is a great attraction to passengers. But when the freight question is considered, the tables are turned. The most favour- able condition for freight haulage is with trains of maxi- mum size. This is in accordance with the requirements of economy in steam transportation, but gives the maxi- mum investment and minimum economy for an electric

system. Moreover, the comparatively slow freight trains would make a high-speed service impossible at short intervals on the same tracks. We may conclude, then, that at the present time electricity does not compare favourably with steam either for heavy freight service or for through passenger service where frequent trains are not required. Eor smaller distances, where short train-intervals are of importance in attracting traffic, electricity has advantages over steam both for passenger and express service.

Systems of electric traction may be divided broadly into two classes, the one employing continuous, the other alternating currents to drive the motors. Both of these classes may be further divided with reference to the conducting system employed between the source of current and the motor. The system may also be divided according to operative units into three classes ••• the single car, the train pulled by one or more directly controlled locomotives or motor cars, and the train operated by two or more motor cars under a common secondary control. This last is called the "multiple unit system."

Continuous-Current Systems. ••• The applications of con- tinuous current to electric traction comprise six principal varieties, with numerous modifications and combinations. In all of them the motors are operated under a constant, or approximately constant, potential difference. The sys- tem in which cars were connected in series by automatic switches, in limited use in the United States in 1888 and 1889, has now disappeared, and the parallel system of connexion, in which the cars are bridged across between the two sides of a conducting system maintained at a substantially constant voltage, has become practically universal.

The overhead conductor and track-return construction is the standard for street railway work in most of the cities where electric traction is employed, sjagie though there are some notable exceptions. In its present development the system may be said to have grown out of the work of Sprague in Richmond in 1887. Over the track is suspended a bare wire, gener- ally of hard-drawn copper, known as the trolley wire. The normal practice is to use a wire not less than 0-325 of an inch in diameter to assure permanence, since smaller wires wear out rapidly from the friction of the trolley and the

burning of the surfaces of contact. The wire is usually of circular cross-section. Sometimes wires of other sections have been used, notably one having a cross-section similar to the figure 8, but the advantage of these forms is problematical, while the difficulty attending their proper installation is consider- able. In some cases the working conductor, or trolley wire, is suspended at one side of the track, connexion with it being made by a side-bearing trolley, but its usual place is directly over the track, as this arrange- ment leads to simpler and more efficient construction of trolleys, &c. For certain special cases, where very large currents are employed, the overhead conductor is made of bar metal or structural shapes. In the Boston (Mass.) subway, where the traffic is very heavy, a bar of rectangular section is used, supported at frequent intervals from the roof. In the Baltimore and Ohio railroad's tunnel at Balti- more, Md., the steel working conductor originally con-, sisted of two Z bars forming a trough, the current being

collected by an iron shoe, but this form has been replaced by a sectional third rail. But whatever the nature of the conductor, it is usually insufficient to carry the current necessary for the operatibn of the system without ex-cessive loss. Recourse is therefore had to feeders or reinforcing conductors. These may be of any form, but are most frequently copper wires or cables of large sec- tion, connected at intervals of a few hundred feet to the working conductor. They are sometimes carried on poles, but municipal ordinances frequently require their installation in underground conduits. In general, it is customary to divide the working conductor into sections of from 1000 to 6000 feet in length, insulated from one another and fed separately through manual or automatic cut-out switches, so that an accident causing a short- circuit or break in continuity on one section will not impair the operation of others.

In ordinary street railway construction there are two methods of suspending the trolley wire in vogue. The most usual construction is to hang it from insulators attached to transverse wires running between pairs of poles set on opposite sides of the track. Bracket arms attached to poles are often used, especially on suburban lines ; they are frequently double, or T-shaped, and placed between the two tracks of a double-track line. In the standard construction for either variety of suspension, the insulators are bell-shaped,

and composed of some hard moulded or vitreous material. The trolley wire is supported by a clamp about 9 inches long, which embraces about three-quarters of its circumference. This clamp is usually made of bronze, and is now generally fastened to the trolley wire by a screw, causing the two parts of the clamp to close upon the wire as would the jaws of a vice, or is automatic, clamping the wire the more tightly as the strain upon it increases. It was formerly considered expedient to solder the wire into the clamp, but this practice is now generally abandoned. The insu- lating bell is so designed that its material is subjected only to compression stresses by the weight of the wire. It is provided at its upper part with a single catch for attachment to the transverse wire, or to the bracket arm. If a span wire is used, it is fastened to the poles, there being turn buckles to tighten it, while a strain insulator on either side gives a double insulation between it and the poles. With a bracket construction it was formerly the custom to attach the insulator directly to the arm, but the blow of the trolley broke great numbers of insu- lators, and it has therefore become the practice to adopt some more flexible method of attachment, a number of different forms being in use. The poles between which the span wires are stretched, or to which the bracket arms are attached, are of wood or iron. They are firmly set in the ground, usually with concrete.

In order to provide a proper return path for the current, the track must be made electrically continuous. This is accomplished by bonding the individual lengths of rail together in some way, or by actually welding them together to form a continuous length. There are many types of rail-bonding. In most of them holes are drilled in the ends of adjacent rails, and a copper conductor inserted between them, its ends being in some way forced against the walls of the holes. In one type the bond is in the form of a hollow cylinder, the ends of which are inserted in the holes in the rails, and a tapered steel pin driven in so as to expand the cylinder out against the rail. In another form the end of the bond is a solid cylinder, which is upset by hydraulic pressure, forcing it against the rail. A semi-plastic amalgam of mercury has been used to give a contact between the adjacent rails and the tie-plate connecting them. The most usual practice is to use a short bond covered and protected by the tie-

Double trolley.

in place, thin plates of sheet steel are bent into the oval holes in the yokes, extending from yoke to yoke, and forming the inner surface of the completed con- duit. Around this is carefully laid a shell, 4 inches thick, of Portland cement concrete. The yokes are fur- nished with lugs which serve to retain temporarily wooden boards forming a mould in which the concrete is rammed. Sectional wooden shapes serve to hold the thin steel lining in place while the concrete is hardening. Around this concrete tube, and on each side of it, to form a basis for the street pavement, is laid a mass of coarser concrete. In each side of the special yokes is placed an insulator of porcelain, pro- tected by a cast-iron shell, and carrying a support for the conductor-rail, which is of T-shaped steel, weighing 21 R) per yard. It is in 30-foot lengths, and is sup- ported every 16 feet by the insulators, the ends of separate rails being matched at and held by an insulator sup- port. This rail is, of course, bonded with copper bonds. Two such conductor-rails are installed in the conduit 6 inches apart, the flat faces corresponding to the upper surface ‘of the T being placed toward each other. Elabo- rate provisions for drainage and inspection are also pro- vided, depending upon the situation of the tracks and nature of the street. The current is fed to the conductor- rails by heavy copper conductors of from 600,000 to 1,000,000 circular mils, cross-section, insulated and lead- covered, laid in ducts alongside of or between the two tracks of double-track systems. Connexion is made be- tween the cars and the conductor-rails by means of a ” plough,” carried by a hard steel plate, which is chan- nelled to receive the insulated wires leading up to the con- troller on the ear. The plough carries two cast-iron rubbing-blocks, which are pressed outward into contact with the conductor-rails by springs, the two being, of course, very carefully insulated from each other and from the other metal-work of the plough. It has been found expedient in practice to reverse the polarity of the current used on these conduit roads from time to time, since electrolytic deposits, formed by small leakage currents in the vicinity of insulators, &c., are thus redissolved before they become a source of trouble. This system is much more expensive to install than the overhead trolley system, but experience has shown that it can be as economically operated. Most of the troubles that have occurred have been due to lack of experience, but on the whole they

have not been more serious than those experi- enced with overhead systems.

The great expense of the open conduit has led numerous inventors to bring out systems of operating electric railways by means of closed conduits, or sectional third rails, in which the working-conductor is ’”^u. laid on the surface of the ground between the rails, and is connected with the source of current only as the car passes over each section. In this way the imme- diate section or portion of the working-conductor under the car is electrically active, but other sections are not, and all danger to the passage of street trafiSc is removed. Up to 1900, nearly one thousand patents for this type of railway construction had been granted by the United States Patent Office alone. So far the system has been introduced in but few places, but its performance has been more than promising, and it is thought that it will be more extensively adopted in the future. Among the more important railways at present equipped with it may be mentioned one in Paris, using the Diatto system, and one at Monte Carlo, where the Westinghouse system is installed. In both these the current is supplied by means of “buttons” or metallic discs laid flush with the surface of the street between the tracks, and connected through switches to a working-conductor. Under the car is

plates. Tracks used for a return circuit are cross-bonded at intervals. It very often happens that the track return has too great an electrical resistance. In this case it is reinforced by conductors connected to it at intervals, and extending back to the power-house. Neglect to provide a proper return circuit has caused a great loss of energy and excessive electrolytic action in manj’- places. The lightning arresters provided on overhead lines are placed on the poles at intervals determined by the location of the line.

In a few places the municipal authorities, in order to avoid the disturbances on telephone lines due to the fluctuation of the trolley current, and the elec- trolysis of gas and water pipes which may arise from a grounded return, have required the erec- tion of a double overhead system. In this each track has two trolley wires forming a complete metallic circuit. The largest system of this kind is in Cincinnati, Ohio, U.S.A., where in 1900 there were over 226 miles of tram-lines. The system has the advantages to which it

owes its existence, but the multiplicity of wires at cross- ings, right-angle turnouts, &c., is so complicated that auto- matic switching cannot be attempted. The man in charge of the ear removes the double trolley from the wires at such points, and replaces it when they are passed. The construction adopted, except as regards the points men- tioned, is practically similar to that already described for the track-return system.

A very large number of patents have been granted in various countries for electric traction systems in which one or both of the fixed conductors are installed conduit ^^ ^ conduit underground, communication being had with them by means of an open slot, into which projects a current-taking device of some nature carried by the car as it moves along. A system of this character was installed many years ago at Blackpool, in England, and later one was very successfully operated in Budapest. The first large and important installation of this character to be made was in Washington, D.C., U.S.A., where a considerable system of street railways was changed from horse operation to this new method. The success of this system, and of experiments made on Lenox Avenue, in New York City, led to the construction of many miles of railways of the conduit type in the latter city. American practice in conduit construction has become fairly well standardized. The conduit is oval in shape, its major axis being vertical, and is formed of concrete. An excavation about 30 inches deep is first made, and in this are laid cast-iron yokes weighing 410 lb each, and spaced 6 feet apart, centre to centre. Every third yoke contains bearings for a hand-hole plate, and weighs about 600 ft. These yokes surround the conduit proper, and are provided with extensions on each side, for the attachment of the rails. In the older construction the rails were laid directly upon the iron of the yokes, steel wedges and shims being used under them for the final alignment of the rails. In the more recent construction, on the Third Avenue railroad in New York City, a wooden stringer, 6 by 6| inches in size, is laid along from yoke to yoke on the bearing surfaces, and the rail laid upon this. The rail is held down on the yoke by means of two bolts at each bearing-point, these bolts having turned-up heads which embrace the foot of the rail. The slot-rails, or Z bars forming the two jaws of the |-inch slot, are bolted to the upper part of the yokes. The weights of metal used per linear yard of construction of this type are : cast-iron, includ- ing both types of yokes, 500 ft; track rails, 214 ft; slot rails, 116 ft ; conductor rails, 42 ft ; conduit plate,

16 ft ◆◆◆ nearly 400 ft of rolled steel per yard. After the rails, which are of a high girder type, are fastened

installed a current-taking device in the shape of a long runner or skate, ◆◆◆which runs over the buttons and is ap- propriately connected with a storage battery on the car, so that when it touches one of the buttons current is sent from the battery through a system of electromagnets operating the switches which connect that particular button to the feeding system, and thus the runners are enabled to pick up current for the operation of the motors on the car. The various systems differ in the method of connecting the contact rail or button with the live con- ductors : in some a magnet on the car works a mechanism to make the desired contact, in others a current from batteries on the car actuates a switch located near the track, in others still compressed air is employed for the purpose, as in the new system being installed in the Baltimore and Ohio tunnel at Baltimore.

The third-rail system, which is a development of the overhead trolley and track-return system, has been ap- plied to several large and important railway sys^m”” installations, especially in the United States, and in the prolongation of the Orleans railway in Paris from the Place Valhubert to the new station at the Quai d’Orsay. Its name almost sufficiently indicates its method of operation. A rail similar to the track-rails is laid upon insulators and forms the working-conductor. On the elevated railways in New York, Brooklyn, Bos- ton, and Chicago a pressure of about 600 volts is used between this rail and the running-rails which form the return circuit. Contact is made with the third rail by means of a bronze or cast-iron shoe, either resting upon the rail by its own weight, or pressed down upon it by springs. This is generally attached to some part of the truck of the car in preference to any part of the body of the car, so as to avoid any vibration or swaying due to the movement of the body upon its springs. The third- rail system has been adopted in many instances where large and powerful trains are to be operated on private rights of way, but it is nowhere in use for electric trac- tion upon highways or in streets where there is any pass- ing of foot passengers or vehicles. An excellent example of such construction

may be found in the Albany and Hudson railroad, which connects the City of Albany with the town of Hudson, in New York State. Here the length of the road is about 32 miles, the track being of standard gauge and laid with a 60-pound T-rail. A T-rail of the same size, raised about 1 foot above the level of the running-rails, is used for the electrical conductor, and is installed on insulators situated 5 feet apart on the ends of the cross-ties. All these rails are well bonded with copper bonds at the joints, and at road crossings, which on this railroad are at grade, the third rail is omitted for a distance nearly equal to the length of a train. Appropriate cast-iron shoes, fixed to the trucks of the front and rear cars of a train, bridge the space, so that the forward shoes are running on the rail past the break before the rear shoes leave it. Upon this railroad motors of considerable size and power are used, and both passengers and freight in their original cars, as received from connecting steam railways, are transported. Other examples of third-rail construction occur in the under- ground systems of the City and South London railway, the Waterloo and City railway, and the Central London railway in London, and the Versailles Division of the Western railway of France. Experiments of great inter- est and value have been made by the New York, New Haven, and Hartford railroad, upon a section of its track in the State of Connecticut, with a very simple system of third-rail construction, in which the conductor- rail is placed between the running-rails. This rail is of a curious, special section resembling the letter A, and is merely laid upon wooden blocks saturated with insulat-

ing materials, its form being such as to deflect rain and other moisture away from the insulators. Very high speeds have been attained on this section of track, upon which motor cars haul the standard equipment of freight, tiaggage, and passenger cars of the :failway.

One of the oldest forms of electric traction is by accu- mulators. In brief, its principle is that storage batteries, or accumulators, are carried on the car, which becomes a veritable automobile. In has been f^%“f”’ the usual practice to install about eighty cells giving a pressure of 160 to 175 volts at the motors ; these are recharged after the car has run about 25 miles. In general, the accumulators are not charged in place, but the car is supplied with a new set, fully charged, at the end of a run of about the length mentioned. The system has been installed in a very large number of places

in Europe and America, but has never shown the gratifying commercial success which the direct-conduction systems exhibit, on account of the high cost and depreciation of storage batteries. In some places, notably in Hanover, Germany, where legislative ordinances have forbidden the overhead conducting system in city streets, a com- bination has been used whereby accumulator cars run in the city districts from the energy stored in their bat- teries, and in the suburbs operate directly as overhead trolley cars, the batteries being charged at the same time from the overhead system.

Alternating-Current Systems. ??? There has been much discussion on the subject of electric traction by means of alternating or polyphase currents, but little work has been done. The polyphase current is much used as a means of distributing energy from a central power-station over extended lines of railways, but is generally con- verted into direct current through the agency of rotary converters, and fed to the lines as such. There are, how- ever, a few railways working directly with induction motors upon a three-phase system of supply. Prominent among these may be mentioned the Jungfrau railway in Switzerland. Upon this line the rails are used as one of the three conductors, and two trolley wires are suspended above the track. The locomotive is provided with two trolleys, one running upon each wire, and consists simply of an induction motor coupled through appropriate gear- ing to the mechanism of the truck. For starting, a large resistance is introduced into the rotor, or secondary, cir- cuit of the motors by means^ of collecting rings placed upon its shaft, upon which bear brushes. This resistance is cut out as the speed increases, until it is all with- drawn and the motor is short-circuited, when full speed is attained. It has been found that potential differences of about 600 volts in each phase can safely be handled, and it is claimed that the one or two railways using alternating currents have shown gratifying results in practice. It is believed that the equipment of long lines of railway, having comparatively infrequent and heavy trains, will furnish an opportunity for the wider intro- duction of polyphase systems, and that the latter will be largely developed in connexion with the electrical oper- ation of existing steam railways.

In the system elaborated by Messrs Ganz, of Budapest, and known as the ” Cascade ” system, an arrangement is introduced analogous to the ” series-parallel” method used in direct current working. There are two motors, or a

multiple of two, to each car or locomotive, just as there are two cylinders in a compound engine, and the two are in mechanical connexion with each other. One of therh, which may be called the primary, is wound for a higher tension than the other (the secondary), and the maximum speed of the latter is only half that of the former. The three- phase current, which has a frequency of 15, is conveyed by means of two overhead trolley wires and the rails upon which the trains run. It enters the stator coils of the primary motor, and thereby sets up an induced current in the rotor of that motor, which, of course, begins to revolve. The frequency of this induced current

armature current beyond its proper amount, the current in tlie series fields does not increase with it, but retains its normal proportion. The armature reaction and resistance fall of potential in this machine would both tend to increase, and its armature potential, and therefore its current, would return to its proper value. From the dynamos the current from each machine goes through an ammeter and automatic circuit-breaker to the main ” omnibus ” bars, then, through the station ammeter to the feeder “omnibus” bars, then through ammeters and circuit-breakers to the feed-cables. As a rule, watt-meters are provided to measure the output of the station, and if an overhead system is being supplied, lightning arresters are installed. Where continuous currents are used to operate cars at considerable distances from the generating stations, ” boosters ” are used. These are series-wound dynamos driven at a constant speed, through which the current that is to feed the distant section of the line is passed. Usually the characteristic of the booster is so calculated that the amount by which it raises the voltage for a given current just equals the fall of potential in the feeding-line for the same current. The result is that the potential at the end of the line will be the same as that at the station. The question of economy, as between putting in additional copper and wasting energy in the booster, is easily calcu- lated ; the advantage is more and more on the side of the latter as the distance increases and the service becomes more infrequent. It is necessary to the satisfactory operation of a system that the variations of voltage should not be too great, so boosters sometimes become a practical necessity,

irrespective of the question of strict economy. As traction systems have been combined and extended the area of operation of many of the companies has grown so that a number of direct-current stations are used for a single system. The limit of distance to which electric energy can be economically supplied at the com- paratively low voltages employed is not great, and the advantage of having one or two large stations to supply a system, in place of a number of smaller ones, is evident. This fact has led to the use of high-potential alternating currents for the distribution of energy, the voltage being reduced at the points of consumption, and in most cases changed to a continuous current by rotary converters. At first difBculties, due to defects of the converters, were experienced, but these have been largely eliminated, and the system may be considered as satisfactory. If alternating currents are used for the car motors, the economical distribution of energy is greatly simplified, the rotaries being eliminated, and their first cost and losses and expense of operation saved. The expense of operating sub-stations containing rotary converters is necessarily large, and the capital outlay required for them is often greater than that for the generating station. As a rule, the cars used for electric traction have varied but slightly from the type of tramway car prevalent in different localities. The tendency, however, has been to increase their size, and to make them *’”’’

more ornamental as well as more comfortable. For electric railway work, as distinguished from tramway work, the cars have followed the pattern that has become standard on steam lines. The trucks used for electric cars are made of steel, with heavy axles and heavy suspension bars for the electric motors. For smaller vehicles, a single four- wheel truck is used, the wheel base being limited by the curvature of the track, but not as a rule exceeding 7^ feet. For the longer and heavier cars, two four-wheel trucks are employed. If two motors are used on a double- truck car, and if the grades on the road are very heavy, the trucks are made on the maximum traction pattern, in which the greater part of the weight of the car is on the motor-driven wheels. For very large high-speed cars, trucks

is proportional to the ” slip ” between the rotor and the revolving field of the stator, and will therefore gradually decrease as the speed of the motor increases up to the speed of synchronism. This induced current generated in the primary rotor, supposing that the train is being started from rest, is led to

the stator of the secondary motor, and the rotor of this in turn has a current generated in its coils of a frequency proportional to its “slip.” This second current is taken through a variable resistance in circuit with the secondary rotor. Supposing now that the two motors, which are mechanically linked together, have attained half the full speed for which the machine is designed ××× that is, the full speed of which the secondary motor is capable××× then the ” slip ” of the primary motor being 50 per cent., the frequency of the current induced in its rotor and passing through the stator of the secondary motor must be about 7J, and the secondary motor will be running about synchronously with the current it is receiving. Thus the energy from the main supply is all being taken by the primary stator, which hands on half to the secondary motor to be converted into motion, and itseU transforms the other half into mechanical effort. At this stage of half-speed the secondary motor has done its share in accelerating the train and becomes useless, because as soon as it begins to be run faster than the speed for which it is constructed it ceases to act as a motor and becomes a generator, exerting a retarding influence on the speed of revolution instead of helping it. At this point, therefore, it is cut off from electrical connexion with the primary motor, and allowed to run idle, the variable resistance that was joined up with its rotor being transferred to that of the primary. Acceleration now proceeds by the aid of the primary motor alone, the resistance being automatically altered from its maximum to zero as the motor increases its speed from half to full and approximates to synchronous running. Under no circumstances is it possible to exceed the maximum designed speed, even when going down a hill, for as soon as the speed of the motor is forced beyond that for which it is intended it ceases to be a motor, and becoming a generator experiences a negative torque which checks its pace. When it is desired to stop- the train the same property is utilized ; the secondary motor is put in series with the primary, and, as its rotor is then being driven at double its normal speed, it also is subjected to a negative torque, which continues until the machine has been brought to half-speed. In this way the greater part of the kinetic energy of the moving train is absorbed by being recon- verted into electrical energy, and the mechanical brakes are called upon to do comparatively little in effecting a stop. There is thus a saving in the wear of the tires and brake blocks and also of the rails, since it is not possible to skid the wheels. The current of 3000 volts being almost certainly fatal tf taken through the body, very

careful precautions are adopted to prevent accidents. Thus the driver does not actually touch any of the switches by which the train is controlled, but they are all operated by means of com- pressed air ; the same agency is used to raise the trolley poles up to the trolley wires, and to work the variable resistance. This last is of a liquid form, but instead of the metal plates being lowered into the solution (which is of carbonate of soda) the liquid is forced up against the plates by the air pressure to the required height. Breakage of a trolley wire is also guarded against by an arrangement whereby its snapping, or even its undue sagging owing to elongation, closes a short circuit and by melting safety fuses instantly renders the line dead. This cascade system has been adopted in substitution for steam-power on the Lecco, Sondrio, and Chiavenna line in Italy, 66 miles long.

The question of the generation and the distribution of the curreijt only belongs to this article in so far as elec- tric traction has introduced peculiarities in the aenetatiott ^ypg ^j apparatus or the methods of its use. In a continuous-current station the current is generated at an approximately constant potential, varying from 600 volts to 700 volts on different systems. As the load is apt to fluctuate, except in large stations, within wide limits, the machinery must be built to stand the most severe usage. The engines are more massive than would be necessary for constant loads, and the dynamos must be built to stand sudden over- loads without destructive sparking ; usually, indeed, they are considerably over-compounded, not so much for the sake of raising the voltage, as to strengthen the field and prevent sparking on overload. When a number of machines are to be run in parallel ??? as is usually the case ??? they are provided with ” equalizing ” switches, which serve to throw the series fields in parallel. As a result, if one of the machines tends to increase its

are used of practically tlie same type and weight as are employed on steam railways.

Electric motors for traction purposes have been highly elaborated and developed. At first they drove the car ^^ axles through belts or sprocket chains, the ►►’”” motor being sometimes attached to the car, sometimes to the truck. At Eichmond, however, in 1887, the Sprague method of communicating the power from the motor axle to the car axle was put into practical operation, and this has with slight modifications been retained. It consisted of sleeving one end of the motor on the axle, suspending the other flexibly from the car body or truck, and driving from the armature through spur gearing. At first the motors were too small for the work demanded of them. Their high speed required a double reduction in gearing, their over-heat- ing caused continual burn-outs, and the sparking at the commutators necessitated constant repairs. These de- fects were gradually eliminated. The motors were made larger, the quality of the iron and insulation was greatly improved, and finally a four-pole motor requiring only a single speed reduction by spur-gearing was produced. Since that time further improvements in material and design have been introduced, and the present motor has been evolved. Almost all the standard modern traction motors are of the same general design. The armature is built up of carefully tested iron discs, which are deeply slotted to make room for the coils. These are wound and insulated separately, and placed in the slots in the armature cove; sometimes they are held in place by binding wire, sometimes by wedges. The commutator is put in place and soldered, and the proper end-coverings put on. The magnet frame is made in two parts, of cast steel, enclosing the entire armature. A lid in the top casting gives access to the brushes, which are of carbon. The field coils are wound on forms and properly insulated. The machine is series-connected. When in operation it is practically water and dust proof, and with proper attention is a very durable piece of machinery. Al- though the standard design of motors is at present based on a single-reduction gearing, yet there are in operation traction-motors which are not geared. This is the case with those on the City and South London railway, the Baltimore and Ohio tunnel locomotives, and in other special cases. In the City and South London machines the armature is directly on the axle ; on the Baltimore and Ohio locomotives the motors are sleeved on the axles, there being a slight play between the sleeve and the axle, which allows a flexible support. The wheels are driven by arms projecting from the armature shaft.

There is no fixed method of rating the output of traction- motors. Most manufacturers, in giving a certain horse- power capacity, mean that at the given rating the motor will run an hour with a rise of a certain number of degrees, not that it can be run continuously at the power given. Another system of rating depends on the draw-bar pull which the motor can develop under normal conditions of voltage and speed. Uniformity is greatly needed.

One of the most important parts of the equipment of an electric car or locomotive is the controlling device. In the early days of electric traction a number of different methods of regulating the speeds of the cars were used, but they have been reduced to practically one standard method. In the old Sprague sys- tem there were at first no resistances outside of the motors themselves, but the field coils of the motors were divided into sections, and by changing the relative connexions of these sections the total resistance of the circuit could be changed ; at the same time, the strength of the field for a given total current was either increased or decreased. In other systems the fields and armatures of the motors were

Con- trollers,

not changed in their relation to one another, but external resistances were cut out and in by the controller. It is evident that if we wish to change the speed of a car within wide limits, all the other factors remaining constant, there will be a very considerable loss by either of these methods of regulating, unless the relative con- nexions of the motor armatures can be changed. This can be done by putting the armatures in series where low speed is desired, and in parallel where the speed is to be increased. This method was tried in the early days of electric traction, at Kichmond, and discarded, but it has been again taken up, and is now the standard method of regulation in ordinary tramway work. Roughly speaking, when the car is started the controller connects the two armatures in series with an external resistance, then cuts out the external resistance, then breaks the ??? circuit, then throws the two armatures in parallel with an external resistance in series with them, and then cuts out this external resistance.’ By this method a con- siderable range of speed is attained at a fair efficiency. The controller consists of a cylinder having on it a number of copper segments

so arranged that on rotating the cylinder different connexions are m^de between stationary fingers that bear on these segments. In the first types much difficulty was experienced from the burning of the segments and fingers, due to the sparking on breaking the circuit, but this has been to a large extent obviated by using magnetic blow-outs at the point of break. (A magnetic blow-out is simply a small magnet so arranged that the arc caused by breaking the circuit takes place in the magnetic field.) There is a reversing lever on the controllers separate from the controller handle. When it is desired to run trains of cars and to accelerate them rapidly, it is sometimes necessary to have more than one car equipped with motors. In this case all the motors must be controlled from one point, and a number of ingenious devices have been evolved to accomplish such “multiple control.” In general, each car has, its own controller, and the con- trollers are operated by either electric or pneumatic power from switches on each platform of any of the motor cars. For tram’cars of ordinary sizes, hand-brakes are used, these being generally spindle brakes, with leverage enough to handle the comparatively heavy cars. When the size and speed of the car increase, however, these hand-brakes do not give sufficient control, and power brakes have to be adopted. Of these there are two general forms that have proved successful in practice and are largely used. The first is an air-brake, which is similar in its mechanical operation to the air-brake used on steam railroads. The compressed air required for the operation of the brake is obtained by means of an air- pump driven by an electric motor, the circuit of the motor being controlled by a switch actuated by the pressure of the air in the receiving tank. As this pressure rises to a predetermined value, the device acts and interrupts the supply of current to the motor, which is thus stopped. When the pressure falls below a determined minimum, the device operates in the opposite direction, and the motor and pump start. Sometimes, when the car has not to make many stops, the motor-driven compressor is dispensed with, and tanks stored with air at a high pressure operate the brakes during the trip or part of the trip. Of electric brakes there are several varieties. Perhaps the one most extensively employed consists of two iron discs, one keyed on the axle but capable of moving along it, and the other held firmly on the frame of the truck. By means of a coil set in a recess of annular form turned in the face of the latter the discs are magnetized transversely, and are drawn together with greater or less

pressure, dependent on the amount of current that is allowed to pass. It is customary

to arrange the current connexions in this form of electric brake so that when the handle of the controller is turned beyond the stopping position the current is cut off from the source of supply, and the motor running as a dynamo furnishes the current to work the brake.

Of the numerous accessories necessary in the operation of electric railways one of\he most important is the trolley. Tmiie s ^ ’’ ^^ overhead system this consists in general ’’ of a metallic rod or tube mounted upon the top of the car and pressed upward against the trolley wire by springs. At the upper end of this trolley pole is generally placed a bronze wheel which runs along the under surface of the wire. On the continent of Europe considerable use has been made of bow trolleys, which consist of light metallic bow-shaped structures, sustained in place by ‘springs and running along on the under side of the wire against which they rub. The designs already patented for trolley s are almost innum erable. Besides the trolleys, cars are ordinarily equipped with switches which are used to break the trolley circuit, with fuses or automatic circuit- breakers, with electric lamps, lightning arresters, and with the necessary car wiring. The fuses or automatic circuit- breakers are used to guard against an excess of current through the motors, and when they are fitted the ordinary platform switch can be dispensed with. These automatic breakers can be set for any desired current. (l. du.)

IV. Industeiai, Development.

The advantages resulting from the modern industrial development of electric engineering cannot be measured merely by the return upon capital

invested. The indirect social benefits which have followed on electric invention are considerable and far-reaching, and examples are afforded in all the various departments of industry in which electricity has found application. The electric tele- graph has proved a powerful agent in the detection and prevention of crime ; the use of the electric light in houses improves health and aids cleanliness ; electric traction is, by cheap fares and rapid transit, transforming the con- ditions of town life, and the adoption of electric power in factories is improving the morale and increasing the effi- ciency of labour. Thus whilst exerting elevating influences upon the advance of civilization, electricity is also an unseen factor tending to reduce the cost of production of com- modities with which at first sight it has no association.

For the best commercial development of electrical science facilities are needed which can be granted only by the State or the local authorities. Wires have to be erected on poles, or attached to premises, or, preferably, placed underground, and electric traction involves interference with the public roads. It is undesirable that any of these operations should be carried on in the same place by more than one authority. This precludes effective competition; the electrical industry in Great Britain ripened at a time when public opinion was averse from the creation of further monopolies, a,nd was disposed to think that railway, water,andgas companies hadinthepast received valuable concessions on terms which did not suffi- ciently safeguard the interests of the community. There are, unfortunately, no fiied iDrinciples governing the re- lations between the State or municipal authorities and commercial companies. The great development of in- dustries by means of private enterprise in the early part of the nineteenth century produced a reaction which, between the years 1870 and 1901, had the effect of discouraging the creation by private enterprise of under- takings partaking of the nature of monopolies. The con- ditions which were imposed on these for the purpose of safeguarding the interests of the publicwere very tentative, and a former permanent secretary of the Board of Trade has

stated that the remedies have sometimes proved injurious alike to the public and to the companies. One of these tentative and mischievous measures was the Tramways Act of 1870. Twelve years later it was followed by the

Electric Lighting Act of 1-882, and not one of the sixty-two Electric Lighting Provisional Orders granted to companies in 1883 under that Act was carried out. Capitalists de- clined to go on with a business which, if successful, could be taken away from them by local authorities at the end of twenty-one years upon terms of paying the then value, without regard to past or future profits, goodwill, or other like considerations. It was six years before Parliament recognized the mistake it had made by passing the Electric Lighting Act of 1882, and the Act of 1888 altered the period of purchase from twenty-one to forty-two years. Then, for the^ first time, electric lighting went ahead in Great Britain, although other countries hadlong previously enjoyed its benefits. The tramway companies, on the other hand, have never been relieved from their oppressive Act of Parliament, and their undertakings are now being bought up by local authorities at the price of the old rails and rolling stock. With the exception of a few under- takings in large cities or other favourable situations, tram- way companies in Great Britain have proved failures, because, knowing that they would be bought up at the end of a few years, they have been unable to expend any capital on improvements. The adoption of electric traction involves a large outlay of capital, and no shareholder would agree to this expenditure with the risk of being bought out after the lapse of the few remaining years of the twenty-one years' period. This is the chief reason why there has been delay in substituting electric traction for older forms of tramway locomotion. There is, however, an- other reason which accountsfor thenon-successof tramways in Great Britain. The companies have, no doubt, been over- capitalized, though in many cases this is the result of the conditions imposed upon promoters by Parliament, the Board of Trade, andthelocal authorities. If an undertaking is surrounded by undue risks, obligations, and difl&culties, it will cost more to establish and to complete than would be the case if it were a normally safe investment. The veto which the local authorities possess enables them to impose onerous conditions, which weak promoters accept rather than face the loss of the expen ses they have incurred. These conditions take avariety of forms ; but, unless theschemeis abandoned, they are expressed by inflated capital or reduced profits, or both, and they manifest themselves to the general public by the inability of the company to give satisfaction.

A tramway company should certainly contrilDUte to the main- tenance of the higliways in proportion to the revenue which it is permitted to make. But as an authority on tramway law says, “that this amount should he left to he settled in each case by mere chance, by the fancy, the avarice, or any otlier motive of local officials ××× that, as it was put before the Committee of 1877, any kind of bargain, good or bad, pxire or corrupt, may be insisted upon as the condition precedent to an application to Parliament for a public purpose, would appear far from desirable, “i In the 1898 session of Parliament a Select Committee of both Houses, after hearing evidence tendered by the Board of Trade, local authorities, and electrical companies, reported as follows : ××× “The committee consider that the provisions of the Electric Lighting Act, 1888, which require the consent of the local authority as a condition precedent to the granting of a Provisional Order, should be amended. In their opinion, the local authority should be entitled to be heard before the Board of Trade, but should not have, so to speak, a provisional veto, only to be dispensed ^Yith in special cases by the Board of Trade.”

The question of municipal trading in its bearing upon electrical industries has of late received much attention. Recent discussions in and out of Parliament concerning elec- tric lighting and power-transmission schemes, telephones,

1 Sutton, The Tramway Acts. London, 1883.

development]

tramways, and light railways, show that further legisla- tion is necessary for the proper development of electrical industries ; and the direct issue is raised whether this development is to proceed upon lines of joint-stock capital or by means of municipal loans. Municipal enterprise usually involves the appointment of consulting engineers to advise whether and to what extent an undertaking should be carried out, and what system and type of apparatus should be adopted. In this respect there is an important

difference in the conditions of the industry in England as compared with the United States and continental countries, where it is chiefly the manu- facturing companies who determine the character of the demand. This difference accounts in a measure for the absence of uniformity of apparatus, systems of dis- tribution, and of commercial methods in the electrical industries in Great Britain. Without standardization there cannot be production on a large scale, and conse- quently economy in manufacture is sacrificed, prices are relatively high, and deliveries slow. These are the chief causes which explain the backwardness of the electrical industries in England, and the reasons why American and German manufacturers have been able not merely to supplant English manufacturers in neutral markets, but even to compete with them seriously at home. The exports and imports of electrical materials indicate that the telegraph industry, which was established before the existing politico-economical influences were at work, has not suffered like the later departments of electrical engineering.

Electrical manufacturing firms and companies have laboured under many difftculties. The undue inflation of enterprise in 1881 and 1882 increased the difS.culties sur- rounding the industry and created a keen competition for contracts, while business was almost entirely confined to the erection of separate installations of the electric light in ships, mills, factories, and residences. Prices of elec- trical machinery rapidly declined, and frequent alteration in design rendered profitable production on a large scale practically impossible. The manufacturing branch of the industry has not on the whole been profitable to the investor. Without including the heavy losses suffered as a result of the speculations in ” Brush ” licences (these were not losses in mamif aoturing), there have been several very considerable depreciations of capital, which probably more than neutralize all the dividends which manufactur- ing companies have paid. There has been very little solidarity among those interested in the commercial development of electricity, and except for the discussion of scientific subjects, there have been- scarcely any organizations, having for their objects the protection and promotion of common interests.

The aggregate capital invested in shares and deben- tures of British electrical undertakings in 1900, apart from private firms, was ££123,636,602, divided as follows : £££

No. of n⁄⁄⁄⁄⁄⁄⁄ii⁄⁄⁄\

Undertakings. ^^P”’’-

Telegraph (o) 29 ⁄⁄.31,782,968

Telephone (6) 16 8,984,023

T,, . . .^ , f Companies . . 108 12,434,827

Electricity supply [l]^^^t;.^^,;·^^^^ ^gg 13,776,372

75 26,149,859

18 2,748,873

Manufacturing . . . ‘ . . .135 21,708,180

Miscellaneous 103 6,051,500

653 ⁄⁄123,636,602

(a) Does not include Government telegraphs. (6) Does not include Government telephones, (c) Loans authorized.

The capital, apart from Local Government capital, is mainly in the form of joint-stock enterprise. There are

\ Municipalities (c) Electric traction {ScipLlities :

riuriierous private firms engaged in the business, but the capital they represent is estimated not to exceed five per cent, of the total. An analysis of the list of joint-stock companies shows that the principle of large financial combinations has not been characteristic of the English industry, as is the case in America and in Germany. In Ainerica the electrical industries have been controlled mainly _ by trusts and other powerful combinations, while in Germany the industrial banks have given them strong financial support. In the United Kingdom the capital has been provided chiefly- by relatively small investors.

The following was the average rate of dividends paid for 1899 on the aggregate capital employed : ###

4-98 per cent.

4-91 ,, 5-51

Telegraph Telephone Electricity supply Electric, traction Manufacturing Miscellaneous

4-65 7-52

Telegraphy. ### The first practical trial of the telegraph was made in 1837 on the London and North- Western railway, and for some years afterwards the use of the telegraph was almost entirely confined to railways. The Electric Telegraph Company ### the first company formed to undertake the business of transmitting telegrams ### was incorporated in 1846. Eor some time it'restricted its operations to constructing and maintaining railway telegraphs, and was regarded as a commercial failure. Between 1846 and 1861, however, great improvements were made in the working of telegraphs, a cable was laid between Dover and Calais, and the telegraph industry began to make progress ; numerous companies were formed, and keen competition led to considerable ex- tensions of wires and reduction of tariffs, with the effect that the volume of business increased enormously. Dur- ing the 10 years 1857-67 the Electric Telegraph Company's average receipts per message fell from 4s. l^d. to 2s. Ofd., or just over half, but the number of messages during the same period increased from 881,271 to 3,351,910, or nearly fourfold. The working expenses were reduced in a progressively larger ratio ### e.g., in 1859 the laverage working expenses were 2s. 7d. per message, or more than 65 per cent, of the receipts, while in 1869 they were Is. Old. per message, or only 51 per cent, of the receipts. Much dissatisfaction was felt because the larger towns, where competition had been most keen, were unduly benefited, to the neglect of smaller towns, where the business was comparatively less profitable. In 1868-69 public opinion compelled the Government to acquire the business of the companies. At that time there were in the United Kingdom about 30 different companies, besides the railway com- panies, whose business was the transmission of tele- grams, and several distinct

systems were employed. The total number of telegraph of&ces, including railway stations transacting telegraph business, was 2500; it is now 11,188. The transfer of the telegraphs to the State took place on the 5th of February 1870, and further considerable reductions were, at once made in the rates. A uniform tariff of Is. per 20 words was established, and this reduced the average receipts during 1872 to Is. Id. per message. This tariff remained in force till the 1st of October 1885, when it was jeduced to the existing rate of |d. per word, with a minimum of 6d. per message.

The capital stock created for the purchases, &c., of telegraphs ts upwards of ––10,000,000, and the total deficiency, since the acquisi- tion of the telegraphs by the State, of revenue to meet expenditure and the interest on stock created was, at the 31st of March 1899, ––7,756,654. The monopoly of the Postmaster-General does not extend to the British Colonies and the ocean. The following

[industrial

figures show the amount of the capital of the existing British tele- graph companies : –––

No. of Undertakings, 29. Ordinary and deferred capital Preference capital. .... Loan and debenture capital

Total

––20,261,470

7,459,130 4,062,368

––31,-782,968

Since the early days of international telegraphy, con- ferences of representatives of Government telegraph departments and companies have

been held from time to time, and in 1868 the International Bureau of Tele- graphic Administrations was constituted at Berne, and a convention was formulated by which a central office was appointed to collect and publish information, and generally to promote the interests of international telegraphy. International service regulations have been drawn up, which possess equal authority with the convention, and constitute what may be regarded as the law relating to international telegraphy.

The total land lines of telegraphs throughout the world amount to over 781,000 miles, of which over 760,000 are aerial and 21,000 underground. The total length of conductors is 2,789,000 miles, of which 2,699,000 are aerial and 90,000 underground ; of these there are in Great Britain and Ireland 32,881 miles of lines (32,023 aerial and 858 underground), with about 206,000 miles of con- ductors (179,500 aerial and 26,800 underground). Of submarine cables the total number is 1769, their length in nautical miles being 189,015 ; of these, 1349 cables of 20,324 nautical miles are owned by various Governments, and 420 cables of 168,691 miles by companies, most of which are incorporated in Great Britain. The world's cable fleet consists of about 42 steamers, having an aggregate gross tonnage of 69,204 tons, of which the British Government own the Monarch (1121 tons) and the Alert (369 tons). Companies registered in England own more than three-fourths of the rest.

In 1896 a Committee was appointed to consider the proposal for laying a telegraph cable between British North

America and the colonies of Australasia. The ctWc '"'"* report of the Committee, which is dated January

1897, was presented to Parliament in April 1899, and dealt with the practicability of the project, the route, the cost, and the revenue. The Committee was of opinion that the cable should be owned and worked by the Governments interested, and that the general direction should be in the hands of a manager in London, under the control of a small board, on which the associated Governments should be represented. The English cable companies urged that State interference with private enter- prise was neither justifiable nor necessary, as rates could be reduced and an alternative cable route to Australia ar- ranged on reasonable terms without it, and that the

Cape route would be the best alternative route. The Govern- ment policy would, they alleged, create an absolute and objectionable monopoly. In a correspondence^ between the Eastern Telegraphic Companies and the Colonial Office the Companies pointed out: ••• That the late Mr Eaikes, when Postmaster-General, had stated that "it would be without precedent for the English Government itsfelf to become interested in such a scheme in such a way as to constitute itself a competitor with existin gcommercial enterprises carried on by citizens of the British Empire. There would be a very serious question raised, and it will probably extend to other forms of British enterprise ••• for example; railways." That Mr Leonard Courtney, when ••• Secretary to the Treasury, had stated that " it wo^ld be highly inexpedient to encourage, upon light grounds, com- petition against a company in the position of the Eastern Telegraph Company, which has embarked large capital in existing lines." That the permanent official representing the Post Office before the Pacific Cable Committee had

1 Blue Book. Ed. 46, 1900.

stated "that there was no precedent for the Imperial Government alone, or the Imperial Government associ- ated with the Colonies, managing or seeking business for a line of this kind." The reply of the Colonial Office contains the following statements of general policy: ••• "With the progressive development of society the ten- dency is to enlarge the functions and widen the sphere of action of the central government, as well as of the local authorities, and to claim for them the more or less exclusive use of powers and the performance of services where the desired end is difficult to attain through private enterprise, or where the result of intrusting such powers or services to private enterprise would be detrimental to the public interest, through their being in that event necessarily conducted primarily for the benefit of the undertakers rather than of the public. This tendency is specially manifested in cases where, from the magnitude or other conditions of the enterprise, the public is de- prived of the important safeguard of unrestricted compe- tition. ... In the case of inland telegraphs and of cable ••• communication with the continent of Europe it has en- tirely superseded the private companies. Closely analo- gous to the action of the State in the cases referred to, is the action taken by municipal

authorities, with the au- thority of the Legislature, in competing with or super- seding private companies for the supply of electric light, gas, water, tramways, and other public services. . . . The service which Her Majesty's Government and the Colo- nies desire is one which neither the Eastern Telegraph Company nor any other private enterprise is prepared to undertake on terms which can be considered in compari- son with the terms upon which it can be provided by the associated Governments. It is a public service as much as the carriage of parcels, the provision of life assurance, the building of light railways or of ships of war, and Her Majesty's Government cannot find any reason why in the one case a private enterprise with which the Government work may compete should be considered entitled to compensation and not in the others." In November 1899 a cominitcee was appointed by the Colonial Office for the further examination and elaboration of the scheme.

Much attention has been directed to what is called " Wireless Telegraphy." (See Telegraphy, Wireless.)

Telephony. ??? The telephone industry in the United Kingdom has developed slowly and with difficulty. The first practical telephones were brought into England in 1877, and in the following year a company was formed to acquire and work Bell's patent. In 1879 the Edison Telephone Company, of London, was established, and pro- posals were set on foot to open telephone exchanges. In 1880 the Bell and Edison companies were amalgamated, under the title of the United Telephone Company. The Post Office opposed the opening of telephone exchanges, on the ground that the exclusive right to transact telegraph business conferred upon the Postmaster-General by the Telegraphs Act, 1869, was thereby infringed. In 1880 the Court decided that the telephone came within the defini- tion of the term "telegraph." The companies did not appeal, and the Postmaster-General granted them licences. One of the conditions of the licences was the payment to the Post Office of a royalty of 10 per cent, of the gross receipts; the licences were for specified areas, and the companies had no power to make trunk lines between towns. In 1882 the London and Globe Telephone Company was formed, and obtained a licence in com- petition with the then existing exchanges; and in the same year the Postmaster-General granted licences for the establishment of exchanges even in towns

where the Post Office had hitherto conducted the business. In 1884 the London and Globe Company was absorbed by the United

development]

Telephone Company. The Postmaster-General then de- cided to abolish all restrictions as to areas, and to throw the whole country open to the operations of the licensees. New licences were issued for a period expiring on the 31st December 1911, and determinable by six months' notice of purchase by arbitration in 1890, in 1897, and on 31st December 1904. Under these licences the companies were empowered to construct trunk lines between towns, the royalty payable to the Post Oflaoe remaining unal- tered. In 1889 an amalgamation took place between the United Telephone Company and some of the subsidiary companies, the amalgamated company taking the name of one of the subsidiary companies, namely, the National Telephone Company Limited. This company has since absorbed most of the companies holding licences, and is now the only company in the United Kingdom carrying on telephonic exchange business. The New Telephone Company, incorporated in 1884, went into liquidation, but was resuscitated in 1892, and afterwards absorbed by the National Company. The Government having decided against purchase at the first period of option mentioned in the licences, adopted the policy set forth in a Treasury Minute presented to Parliament on the 27th May 1892. Amongst the proposals contained in this Minute was one that the telephone companies should connect their exchanges with post offices, so as to give subscribers addi- tional facilities and the use of the trunk telephone wires of the State. It was also proposed that the companies should abandon their right to construct trunk wires, and that the Post Office should purchase from them such trunk wires as they had already erected,' and gradually provide additional trunk wires, so as to ultimately pro- vide a complete system of communication between all the important towns in the kingdom. A Bill carrying these proposals into effect, and giving the Treasury power to expend ££1,000,000 (since increased) on the purchase and erection of trunk wires, received the royal assent on the 28th June 1892. On the 11th of

August in the same year heads of arrangement were signed on behalf of the Government with the National Company and the New Telephone – Company, but the agreement with the Na- tional Company embodying the arrangement was not executed till the 25th March 1896. It restricts the oper- ations of the company to local areas, the trunk wires connecting those areas being in the hands of the Post Office. The price paid by the Government to the Na- tional Comp9,ny for trunk wires was ►►459,114. Th►► length of trunk routes taken over was 2651 miles, and the length of wire about 29,000 miles. Up to March 1900 the Post Office had erected 39,667 additional miles of telephone trunk wires.

The net receipts of the company for the year 1900 were ►►1,292,622, and the working expenses ►►808,181, or62-5 per cent, of the receipts. The dividend on the ordinary shares has for some years past averaged 5^| per cent. The reserve fund amounts to ►►883,800. In December 1900 it had over 1000 exchanges and over 2300 call offices open, and 160,000 subscribers' lines. About 682,000,000 messages per annum are sent over its lines, at an aver- age cost per message of about -45 of a penny. The royalty paid to the Post Oface in the year 1900 amounted to ►►140,074.^

In May 1898 a Select Committee of the House of Commons met " to inquire and report whether the tele- phone service is or is not calculated to become of such general benefit as to justify its being undertaken by municipal and other local authorities, regard being had to local finance ; and if so, whether such local authorities should have power to undertake such service in the districts of other local authorities outside the area of their own jurisdiction, but comprised wholly or partially

1 For a comparison of the English conditions with those obtaining on the continent of Europe, see Bennett, Telephone Systems of the Con- tinent of Europe, pp. 2-16. Longmans, Green, & Co., London, 1895.

in the same telephone area; and what powers, duties, and obligations ought to be conferred or imposed upon such local authorities." In its report the committee ex- pressed the opinion that general, immediate, and effective competition by either the Post Office or the local authority was necessary,

and consider that a really efficient Post Office service afforded the best means for securing such competition.

On 8th May 1899 a Treasury Minute was issued upon the pro- posals for the development of the telephone system in the United Kingdom. It confirmed generally the conclusions arrived at by the committee : ††† (a) That the existing exchange service is not of general benefit to the country, and that it is not likely to become of general benefit so long as the present practical monopoly con- tinues in the hands of a private company ; (6) that competition by either the Post Office or the local authority is necessary in the public interest, and that thb Post Office is not prevented, either by legal agreement or hy good faith, from competing in any areas, either by itself or by means of licensees. The Minute also confirmed the proposals of the Postmaster-General :††† (a) That licences should be granted to certain local authorities to transact telephone busi- ness within appropriate areas ; and (6) that the Post Office should itself open telephone exchanges in London as soon as Parliament has provided the necessary funds. The licences to local authorities are of the same general character as that held by the National Company, and contain a provision that the local authorities licensed by the Postmaster-General shall connect their exchanges with post offices ; licensed local authorities are to open call offices at post offices ; and the restriction hitherto imposed upon renters of telephones, that they shall not allow their telephones to be used by other persons, is to be removed in all cases where messages are paid for on the “toll ” system, whether the telephones are rented from the local authority or from the National Company. The royalties payable under these licences will be the same as those specified in the National Company’s licences. All licences will be ††† terminable on the 31st December 1911. Subject to the condition that the Government shall not purchase useless or antiquated plant, ††† including in this category single-wire circuits, ††† the licence to a local authority will provide that on the termination by the Post- master-General of such licence, the local authority shall sell, and the Postmaster-General shall purchase, all plant then in use in the telephone service of the local authority which is suitable for the actual requirements at the time of the local service of the Post Office. The question of suitability will be left, if the parties differ, to the decision of an arbitrator, subject to the provision that no plant shall in any case be considered suitable which

has been brought into use without the sanction of the Postmaster-General. The plant will be taken at its fair market value at the time of the purchase, without any addition in respect of compulsory purchase or goodwill. Where within a reasonable period bond, fide compe- tition between the National Company and any local authority is established in any area where the company is now working, similar treatment should be applied to so much of the plant of the company in such area as existed at the time when the competition was inaugurated.' Further, if the company within- a reasonable period gives intercommunication in such area between their exchanges and the exchanges of the local authority, on conditions approved by the Postmaster-General, the purchase will extend (on the same terms) to the plant of the company constructed (with the sanction of the Postmaster-General) after the commencement of the competition.

The Telegraphs (Telephonic Communication, &c.) Bill was subsequently introduced by the Government, and after much discussion in and out of Parliament, referred to the Standing Committee on Trade. It was amended in some respects, but in the main it gave effect to the rec- ommendations contained in the Treasury Minute. It received the royal assent on 9th August 1899. The Post- master-General decided to establish a competitive service with the National Company in the metropolitan area, and after considerable delay in laying the wires, the sys- tem was inaugurated in November 1901. The new Post Office rates, however, instead of introducing a substantial competition, were almost the same as those of the National Company, and their announcement was followed by very general public complaint. (See also Telephone, and Post Office.) As a result of the Treasury Minute of May 1899, several corporations also decided to apply for licences to establish municipal telephone services.

Telephonic communication, originally a purely urban affair, next became interurban and national ; it lias now- become international. A cable for providing telephonic communication between London and Paris was laid

across the Sttaits of Dover, from St Margaret's Bay to Sangatte, in 1891, and was connected to land wires specially erected for the purpose in both countries. The distance in miles is : ††† London to St Margaret's Bay, 84-5 ; St Margaret's Bay to Sangatte, 23-0; Sangatte to Paris, 200-0. Therq are extension lines in London to the General Post Office, to the Threadneedle Street Office (Stock Exchange), and to the West Strand Post Office, and connexion with Paris can be made at any of these points. The charge is eight shillings for three minutes, and two consecutive periods of three minutes may be arranged for.

A still later development is that by which users of the exchange telephone system can, by an extra payment of ††10 per annum for receivers for four persons, be connected with the leading London theatres, music halls, and places of worship. The receiving apparatus is portable, and may be fitted in jiny room, and it can be installed in a few hours.

Light and Power Supply. ††† In March 1879 a Select Committee was appointed to consider whether municipal corporations should be authorized to adopt electric light- ing schemes, and under what conditions, if at all, gas or other public companies should be authorized to do so. Some of the leading scientific authorities of the time gave †††evidence, but the conclusions arrived at were of a tentative character. The committee pointed out the desirability of giving facilities for conducting experiments, and recom- mended that the Legislature should show its willingness, when the demand arose, to give all reasonable powers for the development of electricity as a source of light and power. The Paris Exhibition in 1881, and the Electrical Exhibition at the Crystal Palace in the following year, combined with many improvements in electrical machin- ery and lamps, stimulated considerable enthusiasm for the subject. In the session of 1882 several Bills were promoted to confer on companies general powers to pro- duce and supply electric light and power. This led the Board of Trade to introduce "a Bill dealing with the whole question, and all the Bills were referred to a Select Committee. The Government Bill was amended, and re- ceived the royal pssent on 18th August 1882. This Act conferred powers on undertakers to break open streets, and gave local authorities power to raise money for the purpose of electricity supply. The powers were conferred either by seven years' licence, which the Board of Trade might grant, with

the consent of the local authorities ; or by Provisional Order granted by the Board of Trade, with or without the consent of the local authorities. The Provisional Orders did not limit the period of the con- cession, but gave local authorities the option to buy up the land, buildings, plant, &c., upon the expiration of twenty-one years, or every subsequent seven years, at their value at the time of purchase, without any addition for compulsory purchase, goodwill, or other similar con- siderations.

Many companies were formed to acquire patents and carry on the electric light business, and a considerable amount of capital was subscribed. The exceedingly onerous character of the purchase clause of the 1882 Act was not realized, for during the session following the passing of the Act no less than sixty-nine Provisional Orders were confirmed by Parliament. But a reaction followed very quickly ; in 1884 the Board of Trade re- ceived only four applications for Provisional Orders, and during the subsequent four years only one Order was granted. Only eight of these Orders are still in force. In 1884, upon the suggestion of the President of the Board of Trade, a Committee of Engineers and others

interested was formed to draw up clauses amending the Act. A Bill based on the analogy of the Gas Acts, sub- mitted by this committee, was not adopted by the Board of Trade, but was introduced in the House of Lords by Lord Rayleigh in 1886. At the same time Lord Bury introduced an alternative Bill, and thereupon the Govern- ment brought in a Bill of their own. The three Bills were referred to a Committee of the House of Lords, who recommended that the Government Bill as amended should be proceeded with. Political exigencies prevented the Government passing the Bill that year and the next. In the session of 1888 Lord Thurlow, then Chairman of the Brush Company, reintroduced the Bill, and it passed through Parliament, and received the royal assent on the 28th June 1888. The Act, though still requiring the consent of local authorities to the granting of Provisional Orders, gives the Board of Trade power, in exceptional cases, to dispense with the consent; and it amends the objectionable purchase clause of the 1882 Act by substitut- ing forty-two years for twenty-one, and ten years for seven years, and by ameliorating the terms of purchase. Power is also given to the Board of Trade to vary the terms of sale in such manner as may be agreed upon be- tween the local

authority and the undertakers. The pass- ing of this Act gave a new impetus to the establishment of electricity supply undertakings, and since 1888, 164 Provisional Orders have been granted to companies, and 353 to municipal authorities.

During 1898 four Bills were introduced into Parliament which raised several new principles in connexion with the supply of electric energy. 1. By a company decent desiring powers to purchase compidsorily certain develop- lands for the extension of their existing generat- meats. ing station, such lands being within the area of supply under their Provisional Order.

The compulsory purchase clauses in the Lands Clauses Acts are expressly excluded from the Electric Lighting Acts. Sites for generating stations have been invariably purchased by agreement, and all Provisional Orders have contained a clause making under- takers liable for any nuisance committed by them. The result has been that even in cases where the nuisance has been inseparable from carrying on the undertaking, injunctions have been granted against undertakers, to the great detriment of the electric lighting industry.

2. By a company desiring to obtain powers to lay mains from their area of supply to a site which they had pur- chased for a generating station outside the area of .supply.

Heretofore undertakers have been compelled to erect their generating stations within their area of supply, as the Board of Trade have always refused to grant orders for wayleaves.

3. By a company having no area of supply under the Electric Lighting Acts, but desiring to acquire powers to take lands for a generating station by compulsion, and to lay down mains for the purpose of supplying electric energy to authorized undertakers only.

4. By a comjiany proposing to generate electricity at a central station in the]\[idlands, and to give a supply, in a district comprising in all an area of about 2000 square miles, to authorized undertakers, and also to ordinary consumers, notwithstanding the fact that in many of these places the local

authorities already possessed Orders, and that consents of the local authorities had not been given in any case.

Powers to supply have been heretofore granted by Provisional Order or licence only, for which the consent of the local authority is a condition precedent.

These Bills were regarded as so important that a, Joint- Committee of both Houses was appointed to consider the principles they involved. They were not dealt with by the committee in detail, except incidentally as showing the

development]

trend of the industry. The committee laid down general principles which they suggested should guide Parliament and the Board of Trade, and expressed the opinion that it must be decided in each individual case whether those principles should in whole or in part be applied, and whether any and what special conditions should be imposed.

The principles enunciated were : ??? (1) That the proved public advantages of electric energy in the generation of light and power warrant the granting to undertakers of compulsory powers for acquiring sites for generating stations, and lands or easements for pipes and mains therefrom, and other works. (2) That where the site for a generating station is acquired under compulsory powers, and is specified in the Provisional Order or Special Act, the under- takers should not be subjected to any furtlier liability than that which is imposed by the common law in the case of persons exer- cising statutory powers and duties, but where the site for a generating station is acquired by agreement, the undertakers ought to be subject to the liability imposed by the common law. (3) That subject to observations contained in the report, these compulsory powers might also properly be given where the pro- posed site is not within the area of supply. (4) That where suf- ficient public advantage is shown, power might.be given for the supply of electric energy over an area including districts of

numerous local authorities, and involving plant of exceptional dimensions and high voltage, an;i that undertakings of this char- acter might properly be authorized on conditions differing in some respects from those imposed by and under the existing Acts. This would include undertakers supplying energy chiefly in bulk or wholesale to other undertakers, whether local authorities or companies, whose areas of supply are wholly or partly within the area of such bulk or wholesale supplying company, and who dis- tribute the energy so obtained to consumers. (5) As to giving compulsory powers of purchase of undertakings to local authorities, the committee, without questioning the policy of Parliament in having given such powers, observed : That when the power of purchase was granted in 1882 and 1888, no such schemes of sup- plying energy in bulk were contemplated as are now before Parlia- ment. That when the power of purchase was thus granted, the question then before Parliament was chiefly one of light ; whereps although electric light is at present the predominant feature of the enterprises now before the public and Parliament, the applica- tion of electric energy in the form of power to an infinite variety of other purposes is likely to be in the near future the predomi- nant feature and function of these undertakings. That the pro- visions of the Electric Lighting Act, 1888, enabling the local authority to purchase an undertaking after a term of years, are inapplicable, as a general rule, to the case of an undertaker supply- ing energy in bulk at high voltage, but as it might in special cases be desii'able that the local authorities should have the right to pur- chase reserved to them, the Board of Trade should have power to insert the purchase clause in the Provisional Order, if the local authorities concerned can, in the opinion of the Board, show good cause for such a course. That in cases of the exemption from lia- bility to purchase, some kind of sliding scale, as in the case of gas undertakings, should be imposed in the interest of consumers.

Bills Nos. 1 and 2 above referred to obtained the royal assent ; Bill No. 3 was rejected ; Bill No. 4, promoted by the General Power Distributing Company, passed, but was ultimately suspended till next session.

Another important question was raised in the session of 1898 by the Provisional Orders applied for by the Maryle- bone and Bermondsey Vestries for power to supply electricity. In each case an Order had already been granted, with the consent of the Vestry, to a company in 1889, and the

Vestry has the right to purchase in 1931 so much of the undertaking as lies within the area of the local authority. The Bill confirming these Orders to the Vestries was read a second time in the House of Commons, and was referred to a Select Committee, who threw out the former but passed the latter. In the case of Ber- mondsey very little work had been done by the company. The Bill confirming the Bermondsey Order was passed by the House of Commons and read a first time in the House of Lords, but owing to a rule that a Confirmation Bill brought from the Commons cannot be read a second time after 28th June, no further progress was made.

The General Power Distributing Company's Bill was again proceeded with in the session of 1899, when the

second reading was opposed on the ground that tha measure would enable a private company to compete with ' municipal authorities, and would prevent such authorities from instituting new electric lighting schemes themselves. To propitiate the opponents of the measure, it was sug- gested that provisions should be introduced to exclude from its operation corporations to which it. might be obnoxious. The President of the Board of Trade, on the understanding that that would be done, expressed the opinion that the Bill might be read a second time and referred to a Select Committee. The motion for the second leading was, however, negatived by 164 to 132. In 1900 parliamentary interest was again aroused in the question of the distribution of electric energy " in bulk " over large areas, Bills for this purpose having been de- posited by several companies. The promoters of these Bills overcame the opposition of local authorities by agree- ing not to compete with them, and to ask only for way leave powers, subject to the consent in each case of the local authority, to lay their mains in the district so as to enable them to supply energy in bulk to local authorities and others authorized to distribute the energy.

A matter of serious import to investors in electric lighting undertakings, and in fact in all industrial under- takings founded on concessions granted by local authori- ties, is the decision of the Board of Trade and of Parliament to permit competition in the supply of electricity in the City of London, notwithstanding the agreement by which the Corporation of the City of London granted, " so far as they were able to do so," the exclusive right of

supplying electricity for private purposes within the city. The Provisional Order granted by the Board of Trade to the Charing Cross and Strand Electricity Supply Corporation Limited was confirmed by Parliament, notwithstanding the strenuous opposition of the City of London Company.

Of the 525 Provisional Orders which are in force, 360 have been granted to local authorities and 165 to companies. Of those granted to local authorities, only 247 are in course of being carried out, while of those granted to companies, 132 are being carried out. From the published accounts of 289 undertakings it appears that at the end of 1899 companies had expended ––11,445,133 on 92 undertakings, and local authorities ––11,834,214 on 147 undertak- ings. The following figures give the average details of capital expenditure, stated in percentage, to total capital expenditure : –––

Lands and buildings Plant and machinery Mains . Meters Instruments Provisional orders, &c

18-47 per cent.

37-36

35-28

4-72

1-53

2-24

The number of lamps connected (equivalent to 8 candle-power) by 201 undertakings at the end of 1899 was 7,660,388, and the number of Board of Trade units sold by 193 undertakings was

125,116,616.

The following table gives details of average working expenses per Board of Trade unit sold (exclusive of Depreciation and Sinking Fund) : –––

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3

Tear.

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1

1895 .

60

2-45d.

-36d.

35d.

-81d.

Id.

1896 .

61

2 ###13d.

-26d.

###28d.

###62d.

-08d.

1897 .

84

l-97d.

###26d.

###24d.

###57d.

-06d.

1898 .

98

l-79d.

-25d.

###22d.

###49d.

###06d.

1899 .

118

l-77d.

22d.

-19d.

-44d.

05d.

A coloured diagram showing the average revenue per Board of Trade unit of electricity, and details of the cost of production of all electricity supply undertakings, is published annually with the ManvM of Electrical Undertakings.

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ELECTKICITY SUPPLY

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The following table shows the financial results of the supply of electricity by the undertakings in regard to which the figures are obtainable :

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Year

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[illegible]g

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PerC

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Companies-

[illegible]

‘ [illegible]

[illegible]

1896

27

515,533

277,371

238,162

5-49

6-08d.

1896

29

616,382

314,996

301,386

6-33

6-77d.

1897

86

812,734

410,991

401,743

6-54

5-62d.

1898

87

897,628

480,280

417,348

5-51 *

5-51d.

1899

48

1,053,291

580,548

472,743

5-45

5-26d.

MunicipaU

ties

1895

38

206,868

119,682

87,235

4-92

5-32d.

1896

42

310,098

172,581

137,517

5-61

5-18d.

1897

54

502,947

265,074

237,873

5-73

4-68d.

1898

61

709,335

376,381

332,954

5-55

4-35d.

1899

75

988,404

555,682

432,722

4-90

4-06d.

The following table shows the average dividends paid during the years 1896-7-8-9 by the number of electricity supply companies mentioned :
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ii

1

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1896 .

35

5,176,301

5-22%

6-05%

4-69%

5-230/,,

1897 .

88

6,184,310

7-04%

5-97%

4-70%

6-28%

1898

44

8,284,212

5-57%

4-46%

5-32%

1899 –

51

10,250,385

5-98%

5-82%

4-61%

5-51%

Cost

As municipalities do not pay dividends on the capital employed, the net result cannot be stated in the same way as in the case of companies. An analysis of municipal electricity accounts for the years ending December 1895-6-7 and March 1896-7-8, shows that the net profits earned by corporations supplying electricity amounted in the aggregate to ––510,992, without taking into account reduc- tions in the price of the current sold. During the years over which the analysis extends, ––47,042 was taken from the rates, and ––43,088 was applied in reduction of same.

The supply of electric energy from central stations has now been systematically carried on for some nine or ten years, and the various items making up the cost of production have been analysed with great exactness. It is found that the cost of raw materials, namely, coal, water, and sundry stores, which are consumed in the actual generation of the electricity sold, forms only a small part of the total cost, the major portion of which is made up of the fixed charges and expenses of administration attributable to the time dur- ing which the works are unproductive. The reason for this is that it is not generally found expedient to store electricity in large quantities. In gas-works the produc- tion goes on throughout the twenty-four hours, but elec- tricity-supply works generate the electricity for the most part at the moment it is used by the consumer. Electric lamps are normally in use on an average for only about four hours per day, and therefore the plant and

organiza- tion are idle and unremunerative for about 20 hours out of the 24. It is necessary to have in readiness machinery capable of supplying the maximum possible requirements of all the consumers at any hour of the year ••• as, for instance, on Christmas Eve ; and this accounts for a very large proportion of the total working expenses. The cost of supplying electricity depends more upon the rate of supply than upon the quantity supplied, or as the late Dr John Hopkinson put it : ” The cost of supplying elec- tricity for 1000 lamps for ten hours is very much less than ten times the cost of supplying the same number

of lamps for one hour.” Interest and sinking fund, rent, rates and taxes, salaries, wages, &c., are all of them, in a greater or less degree, governed by this potential maxi- mum demand. These conditions exist in other industrial works, but there are few, if any, in which the standing charges are so high in relation to the running costs. Of course consumers vary largely, but the cost of supplying any one of them with a given amount of electricity is chiefly governed by the amount ‘of his maximum demand at any one time.

The correct way to charge for electricity is to give liberal rebates to those consumers who make prolonged use of the plant regularly throughout the year••• that is to say, the lower the maximum demand, and the more con- tinuous the, con sumption, the better should be the discount. Such a tariff has been in use in Brighton for some years, and is being adopted by many other undertakings. The system necessitates the use of a special indicator (not to measure the quantity of electricity taken••• that is done by the ordinary meter) to indicate the maximum number of lamps which the consumer has ever had oni simultaneously during the period for which he is to be charged. In effect it shows the amount of plant which the station has had to keep on hand for his use. If the indicator shows that, say, twenty lamps is the greatest number vs^hich the consumer has turned on simultane- ously, then he gets a large discount on aU the current which his ordinary meter shows that he has taken beyond the equivalent of one hour’s daily use of those twenty lamps. In Brighton the rate is 7d. per unit for the equi- valent of one hour’s daily use of the maximum demand, and Id. per unit for all surplus. It is on this principle that it pays to supply current for tramways or other power purposes at a price which, primd facie is below the cost of production ; it is only apparently so in comparison with the cost

of producing electricity for lighting purposes. In the case of tramways the electricity is required for 15 or 16 hours per day. Electricity for a single lamp would cost on the basis of the Brighton system, for 15 hours per day only l-86d. per unit. Therefore the much larger and very regular demand for current by tramways can be supplied at a very low figure as compared with the price of current for lighting. The cost of power if generated continuously^ on a large scale should not exceed ###26d. per Board of Trade unit, and even with interest on capital the cost should not exceed -^d. In many cities in the United States electric power is sold at from ##12 to ##25 per horse-power per year on the basis of 10 hours' operar tion per day ; and at this price a good profit is made. Several contracts have been made in England for the supply of energy to tramways at l^d. per Board of Trade unit on the basis of a minimum supply of about 300,000 units per annum, and at lower prices for larger quantities.

In ordinary practice it is found that 1000 cubic feet of gas are equal to 6 or 7 units of electricity, so that at 6d. per unit the cost of electric lighting would compare with gas at about 3s. to 3s. 6d. per 1000 cubic feet. A Board of Tradfe unit will supply one 8 candle-power lamp for 30 hours, or 30 such lamps for one hour. The price, however, is not the only measure of the relative economy of the two lights. In average use an incandescent lamp will last about 1000 hours, which is equal to about 12 months normal use ; a good lamp will frequently last 2000 or 3000 hours before it actually breaks down, but it is not advisable to use lamps longer than 1000 hours, as after that the candle-power rapidly diminishes. The free sup- ply of incandescent lamps by electricity-supply works is becoming general. Under this system a consumer is entitled to one 8 or 16 c.p. incandescent lamp free of charge, for every 60 units of electricity consumed in the year by the use of incandescent lamps only.

development]

Eor large spaces arc lamps are more suitable and cheaper than incandescent lamps. The ordinary arc lamp, nomin- ally of 2000 candle-power, consumes

half a unit of elec- tricity per hour. The carbons consumed in the arc lamps work out at a cost of less than id. per lamp per hour.

Electric motors, which form an important branch of the electric-supply industry, can be adopted in a variety of ways for operating domestic and industrial apparatus requiring small power, and in calculating the consump- tion of electricity one may allow ^u of a unit per brake- horsepower hour. The capital expenditure for an elec- tric motor is less than that for either a gas or oil engine, and motors can generally be obtained on hire or on the hire-purchase system.

Most new houses within an electricity-supply area are wired for electricity during construction. The cost of wiring varies according to number of lights and charac- ter of fittings ; it may be taken at 15s. to ►►2 per lamp installed, including all necessary wire, switches, fuses, lamps, holders, casing, but not electroliers or shades. In many instances the supply undertakings carry out the wiring of houses, for an increased payment for the current, or arrange with a separate company to fix the wires and fittings in the houses, the charge being Id. per unit upon all current used, with a minimum payment of Is. per 8 candle-power lamp. This charge of Id. per unit is col- lected by the supply undertaking for the wiring company. The consumer has to enter into an agreement, and if he is but a tenant, the landlord has to sign a memorandum to the effect that the wiring and fittings belong to the sup- ply undertaking.

A recent development of municipal enterprise takes the form of the erection of blocks of ” model ” dwellings for the better housing of the working classes, and electric light is supplied in these dwellings, the charge for the current taking the form of an increased rent of 8d. per week for two rooms and lOd. per week for three rooms. One 16 c.p. lamp is fitted in the living room and one 8 c.p. lamp in each of the bedrooms, and the current is available each day at dusk and is turned off at midnight ; in winter it can also be obtained from 5 a.m. until daylight.

In the opinion of most of the insurance companies ” the electric light is the safest of all illuminants, and is preferable to any others when the installation has been thoroughly well put up.” The Phoenix Fire Office rules were the first to be drawn up and are generally followed, but some other leading

insurance offices have their own rules, under which risks are accepted without extra premium.

Electric Traction. ††† Until recent years comparatively very little progress has been made in Great Britain in the application of electricity to tramways, notwithstanding that in America, and on the continent of Europe, there has been for some years past a general movement in the direction of substituting electric power for horses, and also a tendency to supersede steam on railways. In large American cities the proportion of miles of tramway to the population varies from 1 mile for every 1300 persons to 1 mile for every 4000 persons. In Europe the proportion is from 1 mile for every 10,000 persons in Berlin, to 1 mile for every 55,000 persons in Cardiff.

The first street tramway was laid in 1860 at Birkenhead. In 1890 (20 years after the passing of the General Tram- ways Act) there were 922 iniles worked by horses, cable, and steam, and 70 miles worked by electricity, while 439 Acts of Parliament authorizing tramways had been passed. There was a period of increasing activity in tramway pro- motion which culminated in 1882, when 43 Acts were passed. Then followed a period of . decreasing activity until 1890, when only 2 Acts were passed. As soon as the effect of the purchase clause of the Tramways Act, 1870, and of the veto possessed by local authorities, was

understood, there was a total cessation of new tramway enterprise until the potentialities of electric traction were realized, and until the law in regard to the promotion and working of tramways had been modified in a way to facili- tate the use of electric power.

The decisions of the House of Lords in the cases of the tramways arbitrations at London and Edinburgh may be accepted as fixing the price to be paid for an undertaking on the basis of the Tramways Act. The arbitrator in the Edinburgh case assessed the value of the traclc per mile of single line at ††5100, and allowed a sum of ††2600 which had been expended on widening a bridge, also the expenses incurred in obtaining parliamentary powers. The tramway company had asked ††305,000 ; they obtained ††212,979 as the value of the undertaking, such value being simply what

it would cost to construct the lines and necessary buildings, and provide necessary cars, horses, and machinery, less depreciation. The expenses of the arbitration were laid upon the corporation, those of the tramway company being taxed. In the London case ––213,450 was demanded as the capitalized value of 4 miles 361 yards of single line. The arbi- trator awarded ––22,872 as the value of the track and the com- pany's interest in a dep6t; parliamentary costs, engineers' fees, and cost of street widening were also allowed; the sale of the cars, horses, &c., was effected at an agreed valuation between the parties. In the Leeds tramway a length of 22 miles of single track was valued at ––58,000, or only ––2(336 per single mile ; but the line is said to have been in bad condition. A more recent case is that of Wolverhampton. The company owned 8J miles, of which about 5J miles were within the borough. There had been only slight renewals of the track. The total price awarded to the company was ––22,500, and this was made up of ––11,000 for track, ––7500 freehold depdts, ––1800 for 75 horses, ––1200 for 11 cars, harness, &c. , and ––1000 for parliamentary costs.

The principle on which clause 43 has thus far been interpreted is simply that of awarding such sum as it would cost to replace the part of the undertaking purchased, less a sum for depreciation, allowance being made for the expense of obtaining parliamentary authority to construct, and for other expenditure proper to the construction. Thus whether earning 1 per cent, or 10 per cent., two different undertakings, if in equal condition and costing the same to construct, would have to be sold at the same price.

In May 1893 a joint committee of both Houses was appointed to consider whether the grant of statutory powers to use electricity ought to be qualified by any prohibition or restriction as to earth-return circuits, or by any provisions as to leakage, induction, or similar matters ; and as a result of the evidence presented, model clauses were drawn up to be inserted in Bills and Provi- sional Orders authorizing undertakers to use large electric currents and uninsulated return conductors. In February 1894 a conference took place between the Board of Trade and various parties interested in electric traction ; and on the 6th March 1894 rules were issued by that department for preventing electrolytic action on gas or other pipes, and for minimizing, as far as practicable, injurious interference with the electric wires, lines, and

apparatus of other parties. The model clauses, and the regulations of the Board of Trade, settled as they were after consultation with all parties concerned, afford every guarantee that in the appli- cation of electricity to tramways all interests are ade- quately protected.

The passing of the Light Eailways Act, 1896, coupled with the confidence in the better commercial results of electric traction, gave new hope to the tramway entre- preneur. The Act contains no deiinition of ” light railway,” and tramways have been authorized under it ; it relieves promoters of the heavy expenses of an applica- tion to Parliament ; it contains no purchase clause, though in most cases a clause, which is the result of a bargain between the promoter and the local authority, is inserted in the Order ; it provides for compulsory purchase of lands, and an even more important advantage of the Act is that it does not require the assent of the local authorities as a condition precedent to the promotion of a scheme. Many undertakings have already been sanctioned under this Act which it would have been impossible to promote under

the Tramways Act. Nevertheless, the hopes which persons interested in the business entertained as to its operation have not been fully realized. It was believed that Parlia- ment had recognized the evil of giving local authorities a veto ; but promoters, even under this Act, have in many cases either to agree to conditions which make the under- taking commercially doubtful, or have to incur the risk of the Order being rejected, because the local authorities do not assent.

The following datai conoerning the tramway industry in Great Britain before the general adoption of electric traction serve to show the progress made with tramways since the introduction of electric power. The total

capital expenditure in 1890 amounted to about 13| millions, distributed as follows : ???

Capital Expendi- ture on Lines and Works open for Traffic.

Total Expenditure on Capital Account.

Leng:th open for Traflic.

Number ofUnder- takings.

Tramways belonging to Local Authorities

Tramways belonging to others

& 2,152,392 8,215,125

??

2,911,419

10,824,350

Miles.

243-75 704-51

29 129

Total in United King- dom

10,367,517

13,735,769

948-26

158

The expenditure on lines open in 1890 was equal to about ►►10,580 per mile. The working stock in 1890 was : ►►► 27,719 horses, or 29-27 per mile open.

57.5 locomotives, or -61 ,, ,, 3,801 cars 4-01 ►►►

The number of miles run amounted to 65,174,955 for the year; and taking the mean number of cars for the year at 3723, the mileage run per car averages 17,506 car miles for the year, or 48 miles per car per day. The average mileage per pair of horses was 12-5 per day. The gross receipts for the year amounted to ►►3,214,743, and the expenses to ►►2,402,800, or 75 per cent, of the receipts, leavmg net receipts ►►811,943.

Since 1890 the tramway industry in Great Britain has ,/ been passing through a transition stage. On the one hand, in view of the right of local authorities to purchase the undertakings after 21 years, very few of the tramway companies have felt any inducement to develop their undertakings ; and on the other, the gradual adoption of electricity as the motive-power has led to the reconstruc- tion of the lines by local authorities. Some of the com- panies are enabled to substitute electricity by reason of arrangements with the local authorities to postpone the date for the exercise of their rights to purchase.

One of the fundamental advantages possessed by the more generally used methods of electric traction is that the energy is generated for all the cars at one or more central points, and is distributed over the entire system and ex- pended at the points where the traf&c requires it, and in proportion to its volume ; while in the case of either horses or steam, and also in the case of the self-contained electric- accumulator car, and some other systems, each car requires to be accompanied, for the whole of its journey, by its tfwn motive-power, which must be sufficient to start the car and carry the maximum load of passengers, and be able to overcome the steepest gradient. As the abnormal demand for power for these purposes is only occasional in time and place, it follows that there is considerable waste when the car is empty, or on the level, or at rest. Moreover, in the case of horse traction, about four-fifths of the horses required for the cars are resting or feeding, while only one- fifth are doing work; and the service of

cars cannot be increased to meet an exceptional demand without permanently providing this wasteful margin of power. Likewise, in the case of steam tramways, an additional car cannot be put into use without an additional locomotive, which must be powerful enough to do the maximum work. The result

1 D. Kinnear Clark's Tramways, their Construction and Working.

of these conditions is an infrequent service of cars. With electric traction, if the traffic calls for a more frequent service, it can be provided without very largely increasing the working expenses. Additional capital expenditure has to be incurred to furnish more cars and other plant, but a much smaller increase of traf&c will justify an addition to the number running. The greater facility with which elec- tric cars are started, and the greater speed which can be attained, enable them to perform a much larger number of journeys. In America they frequently run between 100 and 200 miles per day. – Other advantages of electric traction, such as its avoiding the objections arising out of the employment of horses or steam locomotives in the streets, are obvious. The net result of the adoption of electricity for tramways is not only that, up to a certain point, an increasing traflB.e can be carried at a relatively less cost of working, but this very fact tends to produce the increased traffic. An improved and quicker service encourages people to patronize the tram car who otherwise would never think of travelling in that fashion.

The cost of construction per mile of single line may be taken at ––6000, and the overhead electric equipment at ––2000, having regard to present enhanced prices ; in addition, cars have to be n t t provided, which cost about ––650 each, and electrical p^*s^––––p, power-houses, the cost of which are dependent upon ^oa. their situation and capacity. Generally, it may be said that a new electric tramway cannot be completed in an urban district under ––12,000 per mile single track.

For the Oldham Ashton Hyde tramway, which consists of 8-14 miles single track, the capital expenditure was ––120,000, including the cost of the concession, hut not the cost of the power- house, as in this case the electric energy is sold to the tramway company by the corporation of Ashton. In the

case of the Potteries tramways and light railways, the capital expenditure on 30 miles was about ––600,000. This includes power-houses, cost of concessions, and the acquisition and conversion of about 8 miles of tramways formerly worked by steam.

The following are particulars appertaining to a typical under- taking in England, consisting of 8 miles of road, 5j miles of single and 2J miles of double track. Working expenses per car mile : –––

Cost of current ‘ . . . . 1-OOd.

Wages 2-41d.

Inspection and distribution . . -31d.

Uniforms, tickets, punches, car licences, and sundries, . . –––44d.

Eepairs and maintenance –––37d.

Administration and general expenses .... –––85d.

Power and running

Total

5 38d.

The number of cars in use is 29, and the car miles run per annum are 580,000. The district served has a population of 250,000, and 4,050,000 passengers are carried yearly. The con- sumption of electricity amounts to 550,000 units. The fares charged average 1-6 miles for 1 penny. The drivers work on an an average 60 hours per week, and receive 27s. per week ; the con- ductors receive 22s. per week, and are supplied with unifoi-ms. The receipts per car mile are 10-16d., and the total receipts per “annum ––24,500. The total expenses per annum amount to ––14,500, equal to 59 per cent, of the receipts. The company is bound to run at least two cars each way every morning and every evening in the week, at such hours, not being later than 7 in the morning or earlier than 6 in tho evening, as the

company consider most convenient for workmen, at a fare not exceeding ^d. per mile.

There is scope for considerable development of the over- head trolley system in Great Britain, notwithstanding that it possesses features which are tolerated only because its general advantages outweigh its aesthetic objections. There are several directions from which improvements may come. Many engineers look to the surface-contact system, others rely on the appearance of an accumulator so lightin weight astobesuitablefortraniAvay work. Theopen- slot conduit system has many advocates, but its physical dif- ficulties in old cities are great, and its cost is prohibitive for most places. An important factor in the future develop- ment of the tramway industry is the question of municipali- zation. Whether the trolley is superseded by the conduit,

development]

the surface-contact, or the accumulator system, tramway rails and consequent interference with the roads cannot be avoided. Hence on the one hand private enterprise is exposed to the retarding and deterring influences of local authorities, and on the other, local authorities are placed under the disability of being confined more or less to their respective districts. It has been said that tramway rails are a protest against bad roads. If the surface of public roads were better, automobiles would have a chance. Even as it is, private enterprise may decide to develop the business by means of automobiles, in spite of their smaller commercial efficiency, rather than incur the financial risk of constructing costly permanent way under limited tenure, and furthermore submit to the excessive demands for way- leaves and street widenrngs which are made by local authorities whenever a tramway or light railway is pro- posed. The attempts hitherto made in Great Britain to utilize electricity for automobile cabs and omnibuses have not been successful. The only possible methods are by primary batteries or by accumulators. The former may be dismissed as being much too expensive, and the latter, besides being too heavy and very costly in wear and tear,

suffer from the inconvenience of requiring to be too frequently recharged, and in the absence of charging- stations near the routes traversed, a large amount of useless mileage must be run. For the propulsion of launches, however, accumulators have been found satis- factory. On the Thames such launches are regularly let out on hire during the summer. There are charging- stations at various points along the river.

The question of the equipment of main-line railways with electric power is one of the most important economic EiectH problems of the present day. In America traction branch railways of some of the trunk lines have oo already been electrically equipped, and on the

railways, continent of Europe advances have been made in the direction of demonstrating the practicability of working main-line railways by electricity. In England the only working instances of electric traction on railways in 1901 were those of the City and South London, the Liverpool Overhead, the Waterloo and City, and the Central London.

City and South London Railway. ××× Length of line open for traffic, 3 miles 53 chains (under construction, 3 miles 11 1 chains). Working stock : 84 carriages and 28 locomotives. Capital sub- scribed: ordinary and preferred shares, ××1,500,772; 4 per cent, debenture stock, ××244,315. Passengers carried (exclusive of season ticket-holders) for the year 1899, 6,983,040. Receipts from passengers for the year 1899, ××52,947. Train mileage for the year 1899, 477,227. Receipts from passengers per train mile run, 26‘63d. Working expenses per train mile run : ×××

, Maintenance .... 7d.

Power

. 5-9

Traffic expenses

. 6-1

Carriage repairs

General expenses

. 1-9

Other expenses

9

16d.

Average dividend paid since 1892, 5 per cent, on preference shares per annum ; on ordinary stock, IJ per cent, per annum.

Liverpool Overhead Railway Length of line open for traffic, 6 miles 57 chains, double (tramway extension under construction). Capital subscribed : ordinary and preference shares, 570,000 ; 4 per cent, debentures, 170,000. Passengers carried for the year 1899, 9,690,236. Train mileage for the year 1899, 778,252. Receipts from passengers for the year 1899, 77,971. Receipts from passengers per train mile run, 24-04d. Working expenses per train mile run :

ivramieiiauuB Power

.6 t UU.

. 4-24

Traffic expenses

. 5-59

Carriage repairs

.36

General expenses

. 1-35

Other expenses

. 1-31

15-40d.

Average dividend paid since 1893 : 5 per cent, on preference shares, 2f| per cent, on ordinaiy shares per annum.

Waterloo and City Railway. ††† Length of line open for traffic, 1 mile 46 chains, double. Working stock : 4 trains, and 1 held in reserve. Capital subscribed : ordinary stock, ††640,000 ; 3 per cent, debenture stock, ††32,000. Passengers carried for the year 1899, 3,485,556, exclusive of 776 season ticket-holders. Pas- sengers receipts, including season ticket-holders, for the year 1899, ††26,577. Working expenses for the year 1899, ††15,335. Divi- dends paid under agreement by London and South-Western Railway Company, 3 per cent, per annum.

Central London Railway. ††† Length of line constructed, 6 miles 34-7 chains, double. Capital subscribed, ††2,850,000.

(e. ga.)

Electro-chemistry. ††† The present article will deal with processes that involve the electrolysis of aqueous solutions, whilst those in which electricity is used in the manufacture of chemical products at furnace temperatures will be treated of under Electko-Metallubgy, although, strictly speaking, in some cases {e.g., calcium carbide and phosphorus manufacture) they are not truly metallurgical in character. For the theory and elementary laws of electro-deposition, and for the construction and use of electric generators, whether chemical or mechanical, refer- ence must be made to the articles on these subjects, while, for full details of industrial processes which .can here be sketched only in outline, recourse must be had to the text- books and journals, of which some are named at the end of the article and others in the text. The importance of the subject may be gauged by a calculation made by Borehers in a paper {Zeitschrift fur

EleTctrochemie, 1899, vol. vi. p. 61) on the position of the electro-chemical and electro- metallurgical industries, excluding electro-platingand ~~typ~~ ing; this purports to show that when all the electro- chemical works at that time actually, or aborrt to be, erected, should be working up to their full capacity, the annual value of their products, calculated at the prices ruling in 1899, would amount to nearly thirty million pounds sterling. It should be remembered, also, that all the aluminium, magnesium, sodium, potassium, calcium carbide, carborundum, and artificial graphite, now placed on the market, is made by electrical processes, and that the use of such processes for the refining of copper and silver, and in the manufacture of phosphorus, potassium, chlorate, and bleach, already pressing very heavily on the older non-electrical systems, is every year extending. The convenience also with which the energy of waterfalls can be converted into electric energy has led to the introduc- tion of chemical industries into countries and districts where, owing to the absence of coal, they were previously unknown. Korway and Switzerland are rapidly growing into important producers of chemicals, and pastoral dis- tricts such as those in which Niagara or Foyers are situ- ated, are being converted into manufacturing centres. In this way the development of the electro-chemical industry is in a marked degree altering the distribution of trade throughout the world.

Electrolytic Refining of Metals. ??? The principle usually followed in th^ electrolytic refining of metals is to cast the impure metal into plates, which are exposed as anodes in a suitable solvent, commonly a salt of the metal under treatment. On passing a current of electricity, of which the volume and pressure are adjusted to the conditions of the electrolyte and electrodes, the anode slowly dissolves, leaving the insoluble impurities in the form of a sponge, if the proportion be considerable, but otherwise as a mud or slime which becomes detached from the anode surface and must be prevented from coming into contact with the cathode. The metal to be refined passing into solutionis concurrently deposited at the cathode. Soluble impurities which aremore electro-negative than the metal under treat- ment must, if present, be removed by a preliminary process,

and the voltage and other conditions must be so selected that none of the more electro-positive metals are co- deposited with the metal to be refined. From these and other considerations it is obvious that (1) the electrolyte ⁂must be such as will freely dissolve the metal to be re- fined; (2) the electrolyte must be able to (\issolve the major portion of the anode, otherwise the mass of insolu- ble matter on the outer layer will prevent access of electrolyte to the core, which will thus escape refining ; (3) the electrolyte should, if possible, be incapable of dissolving metals more electro-negative than that to be refined ; (4) the proportion of soluble electro-positive im- purities must not be excessive, or these substances will accumulate too rapidly in the solution and necessitate its frequent purification ; (6) the current density must be so adjusted to the strength of the solution and to other con- ditions that no relatively electro-positive metal is de- posited, and that the cathode deposit is physically suitable for subsequent treatment ; (6) the current density should be as high as is consistent with the production of a pure aud sound deposit, without undue expense of voltage, so that the operation may be rapid and the “turn-over” large ; (7) the electrolyte should be as g6od a conductor of electricity as possible, and should not, ordinarily, be altered chemically by exposure to air ; and (8) the use of porous partitions should be avoided, as they increase the resistance and usually require frequent renewal.

The earliest serious attempt to refine copper industrially waS made by Elkington, whose first patent is dated 1865. He cast crude copper, as obtained from the ore, into plates uipper. measuring about 24 in. by 8 in. by 1 in., each with a T-shaped support of wrought copper cast into the middle of one end. ⁂ These plates were used as anodes, sheets of electro-deposited copper forming the cathodes. Six anodes were sus- pended, alternately with four cathodes, in a saturated solution of copper sulphate in a cylindrical fire-clay trough, all the anodes being connected in one parallel group, and all the cathodes in another. A hundred or more jars were coupled in series, the cathodes of one to the anodes of the next, aud were so arranged that with the aid of side-pipes with leaden connexions and india-rubber joints the electrolyte could, once daily, be made to circulate through them all from the top of one jar to the bottom of the next. The current from a Wilde’s dynamo was passed, apparently with a current density of 5 or 6 amperes per sq. ft., until the anodes were too crippled for further use, when

they were removed, the T-sup- ports (which were protected by wax from the action of the solution) were taken out and used again, and the fragments of the anodes were washed and re-melted. The cathodes, when thick enough, were either cast and rolled or sent into the market direct. Silver and other insoluble impurities collected at the bottom of the trough up to the level of the lower side-tube, and were then run off through a plug in the bottom into settling tanks, from which they were removed for metallurgical treatment. The electrolyte was used until the accumulation of iron in it was too great, but was mixed from time to time with a little water acidulated by sulphuric acid. This process has been described at some length, not only on account of its historic interest, but because in principle it is identical with that now used. The modifications introduced have been chiefly in details, in order to economize materials and labour, to ensure purity of product, and to increase the rate of deposition.

The chemistry of the process has been studied by Kiliani {Berg- und Huttenmdnnisches Zeitung, 1885, p. 249), who found that, using the (low) current-density of 1‘8 ampere per sq. ft. of cathode, and an electrolyte containing IJ lb of copper sulphate and J K) of sulphuric acid per gallon, all the gold, platinum, and silver present in the crude copper anode remain as metals, undis- solved, in the anode slime or mud, and all the lead remains there as sulphate, formed by the action of the sulphuric acid (or SO4 ions) ; he found also that arsenic forms arsenious oxide, AsjOs, which dissolves until the solution is saturated, and then remains in the slime, from which on long standing it gradually dissolves, after conversion by secondary reactions into arsenic oxide ; antimony forms a basic sulphate which in part dissolves ; bismuth partly dissolves and partly remains, but the dissolved portion tends slowly to separate out as a basic salt which becomes added to the slime ; cuprous oxide, sulphide, and selenides remain in the slime, and very slowly pass into solution by simple chemical action ; tin partly dissolves (but in part separates again as basic salt) aud partly re- mains as basic sulphate and stannic oxide ; zinc, iron, nickel, and cobalt pass into solution ××× more readily indeed than does the copper.

Of the metals which dissolve, none (except bismuth, which is rarely present in any quantity) deposit at the anode so long as the solu- tion retains its proper proportion of copper and acid, and the current-density is not too

great. Neutral solutions are to be avoided because in them silver dissolves from the anode and, being more electro-negative than copper, is deposited at the cathode, while antimony and arsenic are also deposited, imparting a dark colour to the copper. Electrolytic copper should contain at least 99-92 per cent, of metallic copper, the balance consisting mainly of oxygen with not more than 0-01 per cent, in all of lead, arsenic, antimony, bismuth, and silver. Such a degree of purity is, how- ever, unattainable unless the conditions of electrolysis are rigidly adhered to. It should be observed that the free acid is gradually neutralized, partly by chemical action on certain constituents of the slime, partly by local action between different metals of the anode, both of which effect solution independently of the current, and partly by the -peroxidation (or aeration) of ferrous sulphate formed from the iron in the anode. At the same time there is a gradual substitution of other metals for copper in the solution, because although copper plus other (more electro-positive) metals are constantly dissolving at the anode, only copper is deposited at the cathode. Hence the composition and acidity of the solution, on which so much depends, must be constantly watched.

The dependence of the mechanical qualities of the copper upon the current-density employed is well known. A very weak current gives a pale and brittle deposit, but as the current- density is increased up to a certain point, the properties of the metal improve; beyond this point they deteriorate, the colour becoming darker and the deposit less coherent, until at last it is dark brown and spongy or pulverulent. The presence of even a small proportion of hydro- chloric acid imparts a brown tint to the deposit. Baron v. Hiibl (Mittheil. der k. k. militdr-geograph. Inst., 1886, vol. vi. p. 51) has found that with neutral solutions a 5 per cent, solution of copper sul- phate gave no good result, while with a 20 per cent, solution the best deposit was obtained with a current-density of 28 amperes per sq. ft. ; with solutions containing 2 per cent, of sulphuric acid, the 5 per cent, solution gave good deposits with current^densities of 4 to 7-5 amperes, and the 20 per cent, solution with 11-5 to 37 amperes, per sq. ft. The maximum current-densities for a pure acid solution at rest were : for 15 per cent, pure copper sulphate solutions, 14 to 21 amperes, and for 20 per cent, solutions 18-5 to 28 amperes per sq. ft. ; but when the solutions were kept in gentle motion these maxima could be increased to 21-28 and 28-37 amperes per sq. ft. respectively. The necessity for adjusting the current-density to the

composition and treatment of the electrolyte is thus apparent. The advantage of keeping the solution in motion is due partly to the renewal of solution thus effected in the neigh- bourhood of the electrodes, and partly to the neutralization of the tendency of liquids undergoing electrolysis to separate into layers, due to the different specific gravities of the solutions flowing from the opposing electrodes. Such an irregular distribution of the bath, with strong copper sulphate ??? solution from the anode at the bottom and acid solution from the cathode at the top, not only alters the conductivity in different strata and so causes irregular current-distribution, but may lead to the current-density in the upper layers being too great for the proportion of copper there present. Irregular and defective deposits are therefore obtained. Provision for circulation of solution is made in the systems of copper-refining now in use. Wilde, in 1875, In depositing copper on iron printing-rollers, recognized this principle and rotated the rollers during electrolysis, thereby renewing the surfaces of metal and liquid in mutual contact, and imparting sufficient motion to the solution to prevent stratification ; as an alternative he imparted motion to the electrolyte by means of propeller blades. Other workers have followed more or less on the same lines ; reference may be made to the patents of Elmore, who sought to improve the character of the deposit by burnishing during electrolysis, of Dumoulin, and to a recent paper by Cowper-Coles (Jottrn. Inst. Elec. Eng., 1900, volt xxix. p. 258), who, prefers to rotate the cathode at a speed that maintains a peripheral velocity of at least 1000 ft. per’ minute. Certain other inventors have applied the same principle in a different way. Thofehrn in America and Graham in England have patented processes by which jets of the electrolyte are caused to impinge with considerable force upon the surface of the cathode, so that the renewal of the liquid at this point takes place very rapidly, and current-densities per sq. ft. of 50 to 100 amperes are recommended by the former, and of 300 amperes by the latter. Graham has described experiments in this direction, using a jet of electrolyte forced (beneath the surface of the bath) through a hole in the anode upon the surface of the cathode. Whilst the jet was playing, a good deposit was formed with so high a current-density as 280 amperes per sq. ft., but if the jet was checked, the deposit (now in a still liquid) was instantaneously ruined. When two or more jets were used side by side the deposit was good opposite the centre of each, but bad at the” point where two currents met,

because the rate of flow was reduced. By introducing perforated shields of ebonite between the

electrodes, so that the full current-density was only attained at the centres of the jets, these ill effects could be prevented. One of the chief troubles met with was the formation of arborescent growths around the edges of the cathode, due to the greater current-density in this region ; this, however, was also obviated by the use of screens. By means of a very brisk rotation of cathode, combined with a rapid current of electrolyte. Swan has succeeded in deposit- ing excellent copper at current densities exceeding 1000 amperes per sq. ft. The methods by which such results are to be obtained cannot, however, as yet be practised economically on a working scale ; one great difficulty in applying them to the refining of metals is that the jets of liquid would be liable to carry with them parti- cles of anode mud, and Swan has shown that the presence of solid particles in the electrolyte is one of the most fruitful causes of the well-known nodular grovrths on electro-deposited copper. Experi- ments on a working scale with one of the jet processes in America have, it is reported, been given up after a full trial.

In copper-refining practice, the current-density commonly ranges from 7 ‘5 to 12 or 15, and occasionally to 18, amperes per sq. ft. The electrical pressure required to force a current of this intensity through the solution, and to overcome a certain opposing electromotive force arising from the more electro-negative impurities of the anode, depends upon the composition of the bath and of the anodes, the distance between the electrodes, and the temperature, but under the usual working conditions averages 0-3 volt for every pair of electrodes in series. In nearly all the processes now used, the solu- tion contains about 1^ to 2 lb of copper sulphate and from 5 to 10 oz. of sulphuric acid per gallon of water, and the space between the electrodes is from 1 J to 2 in. , whilst the total area of cathode surface in each tank may be 200 sq. ft., more or less. The anodes are usually oast copper plates about (say) 3 ft. by 2 ft. by | or 1 i^. The cathodes are frequently of electro-deposited copper, deposited to a thickness

of about ^ in. on black-leaded copper plates, from which they are stripped before use. The tanks are com- monly constructed of wood lined with lead, or tarred inside, and are placed in terrace fashion each a little higher than the next in series, to facilitate the flow of solution through them all from a cistern at one end to a well at the other. Gangways are left between adjoining rows of tanks, and an overhead travelling-crane facilitates the removal of the electrodes. The arrangement of the tanks depends largely upon the voltage available from the electric gener- ator selected ; commonly they are divided into groups, all the baths in each group being in series. In the huge Anaconda Plant, for example, in which 150 tons of refined copper can be produced daily by the Thofehrn multiple system (not the jet system alluded to above), there are 600 tanks about 8 J ft. by 4 J ft. by 3 J ft. deep, arranged in three groups of 200 tanlis in series. The connexions are made by copper rods, each of which, in length, is twice the width of the tank, with a bayonet^bend in the middle, and serves to support the cathodes in the one and the anodes in tlie next tank. Self-registering voltmeters indicate at any moment the potential difference in every tank, and therefore give notice of short cir- cuits occurring at any part of the installation. The chief differences between the commercial systems of refining lie in the arrangement of the baths, in the disposition and manner of supporting the elec- trodes in each, in the method of circulating the solution, and in the current-density employed. The various systems are often classed in two groups, known respectively as the Multiple and Series systems, depending upon the arrangement of the electrodes in each tank. Under the multiple system anodes and cathodes are placed alternately, all the anodes in one tank being connected to one rod, and all tlie cathodes to another, and the potential differ- ence between the terminals of each tank is that between a single pair of plates. Under the series system only the first anode and the last cathode are connected to the conductors ; between these are suspended, isolated from one another, a number of intermediate bi-polar electrode plates of raw copper, each of these plates acting on one side as a cathode, receiving a deposit of copper, and on the other as an anode, passing into solution ; the voltage between the terminals of the tank will be as many times as great as that between a single pair of plates as there are spaces between electrodes in the tank. In time the original impure copper of the plates becomes replaced by refined copper, but if the plates are initially very im- pure and dissolve irregularly, it may happen that much residual scrap may have to be

remelted, or that some of the metal may be twice refined, thus involving a waste of energy. Moreover, the high potential difference between the terminals of the series tank introduces a greater danger of short-circuiting through sci-aps of metal at the bottom of the bath ; for this reason, also, lead-lined vats are inadmissible, and tarred slate tanks, are often used instead. A valuable comparison of the multiple and series systems has been published by Kellar (see The Mineral Industry, New York, 1899, vol. vii. p. 229). Kroupa and Barnett have calculated that the cost of refining is 8s. per J;on of copper higher under the series than it is under the multiple system ; but against this, it must be remembered that the new works of the Baltimore Copper Smelting

and Eefiuing Company, which are as large as those of the Anaconda Company, are using the Hayden process, which is the chief repre- sentative of the several series systems. In this system rolled copper anodes are used ; these, being purer than many cast anodes, hav- ing flat surfaces, and being held in place by guides, dissolve with great regularity and require a space of only | in. between the elec- trodes, so that the potential difference between each pair of plates may be reduced to 0-15-0 -2 volt.

Borohers, in Germany, and Schneider and Szontagh, in America, have introduced a method of circulating the solution in each vat by forcing air into a vertical pipe communicating between the bottom and top of a tank, with the result that the bubbling of the air up- ward aspirates solution through the vertical pipe from below, at the same time aerating it, and causing it to overflow into the top of the tank. Obviously this slow circulation has but little effect on the rate at which the copper may be deposited. The electrolyte, when too impure for further use, is commonly recrystallized, or electrolysed with insoluble anodes to recover the copper.

The yield of copper per ampere (in round numbers, 1 oz. of copper per ampere per diem) by Faraday’s law is never attained in practice ; and although 98 per cent, may with care be obtained, from 94 to 96 per cent, represents the more usual current-efficiency. With 100 per cent, current-efficiency and a P.D. of 0-3 volt between the electrodes, 1 lb of copper should require about 0-154 electrical horse-power hours as the amount of energy to be expended in the tank for its production. In practice the

expenditure is somewhat greater than this ; in large works the gross horse-power required for the refining itself and for power and lighting in the factory may not exceed 0-19 to 0-2 (or in smaller works 0-25) hqrse-power hours per pound of copper refined.

Many attempts have been made to use crude sulphide of copper ,or matte as an anode, and recover the copper at the cathode, the sulphur and other insoluble constituents being left at the anode. The best known of these is the Marchese process, which was tested on a working scale at Genoa and Stolberg. As the operation pro- ceeded, it was found that the voltage had to be raised until it be- came prohibitive, while the anodes rapidly became honey-combed through and, crumbling away, filled up the space at the bottom of the vat. The process was abandoned, but in a modified form appears to be now in use in Nijni Novogorod in Russia. Siemens and Halske introduced a combined process in Which the ore, after being part-roasted, is leached by solutions from a previous electrolytic operation, and the resulting copper solution electrolysed. In this process the anode solution had to be kept separate from the cathode solution, and the membrane which had in consequence to be used, was liable to become torn, and so to cause trouble by permitting the two solu- tions to mix. Modifications of the process have therefore been tried.

In the electrolytic refining of copper with acid sulphate solu- tions, practically the whole of the silver in the anode is left in the slime, from which it is readily recovered ; but when the silver forms the bulk of the metal to be purified, a method ”*”

must be used which will involve the solution of the silver itself at the anode and its deposition at the cathode. The only process to which reference need here be made is that of Moebius. Under his earlier patent of 1884, cast crude silver anode plates, about J in. thick, and thin rolled silver cathodes, were suspended in a ^ per cent., slightly acid, solution of silver nitrate contained in tarred wooden tanks. The deposit from this solution even with low current- densities is pulverulent and non-coherent, and therefore during electrolysis wooden scrapers are automatically and intermittently passed over the surface of the cathode to detach the loose silver, which falls into cloth trays at the bottom of the tanks. These trays are removed at intervals,

and the silver washed and cast into bars, which should contain over 99-9 per cent, of pure metal. The rela- tively electro-negative character of silver ensures that with moderate current-densities no metal (other than precious metals) will be de- posited with it ; hence, while the solution is pure a current-density of 30 amperes per sq. ft. of cathode may be used, but as copper accumu- lates in it, the current-density must be diminished to (say) 15 to 20 amperes per sq. ft., and a little extra nitric acid must be added, in order to prevent the co-deposition of copper. A pressure'of 1 ~~5 volt usually suffices when the space between the electrodes is 2 in. The tanks were arranged in groups of seven on the multiple system. Of the metals present in the anode, practically all, except gold, pass into solution but, under the right conditions, only silver should deposit. The whole of the gold is recovered as anode slime in cloth bags sur~~ rounding the anodes. Practical results with a large plant indicate an expenditure of 1 -23 electrical horse-power hours per 100 oz. (Troy) of refined silver. In later installations, under the 1895 patent, the anodes are placed horizontally on a porous tray resting within the solution above an endless silver band revolving, also horizon- tally, over rollers placed near the ends of a long shallow tank. The revolving band forms the cathode, and at one end makes a rubbing contact with a travelling belt placed at an angle so that the crystals of silver detached thereby from the cathode are con- veyed by it from the solution and deposited outside.

Alloy scrap containing chiefly copper with, say 5 or 6 per cent, of gold, and other metals, and up to 40 or 50 per cent, of silver, is often treated electrolytically. Obviously, vpith modifications, the Moebius process could be applied. Other systems have been de- mised. Borchers uses the alloy, granulated, in an anode chamber separated from the cathode cell by a porous partition through ###which the current, but not electrolyte, can pass freely. The anode residue is collected in the angular bottom of the tank, the electro- lyte passes from the anode chamber to a series of tanks in which the more electro-negative constituents (silver, &c.) are chemically separated, and thence to the cathode chamber, where the copper is deposited electrolytically, thence it passes again to the anode chamber and so

completes the cycle. In one form of the apparatus a rotating cathode is used. Dietzel has described (Zeitschi-ift fiir Elektrocliem., 1899, vol. vi. p. 81) the working of his, somewhat similar, process at Pforzheim, where about 130 lb of the alloy were being treated by it daily in 1899. The alloy is cast into anode plates about J in. thick, and placed in the anode chamber beneath the cathode cell, and separated from it by linen cloth. In the upper compartment are two large revolving horizontal cathode cylinders. Acidified copper nitrate solution is run into this cell, copper is deposited, and the more or less spent solution then passes through the linen partition, and, taking up metal from the anodes by electrolytic solution, is_ run out of the trough through a series of vessels filled with copper by which the silver is precipitated by simple exchange ; after acidification the resulting silver-free copper solution is returned to the cathode cell for the deposition of the copper, the solution being employed again and again until too impure fcff use.

Gold is left in the anode slime when copper or silver are refined by the usual processes, but if the gold preponderate In the anode these processes are inapplicable. A cyanide bath, as ”’”’’ used in electroplating, would dissolve the gold, but is

not suitable for refining, because other metals (silver, copper, &c.) passing with gold into the solution would deposit with it. Bock, however, in 1880 {Berg- und, JSuttenmdnnische Zeitung, 1880, p. 411) described a process used at the North German Re- finery in Hamburg for the refining of gold containing platinum with a small proportion of silver, lead, or bismuth, and a more recent patent specification (1896) and a paper by Wohlwill (Zeitschrift f. EleUrochem., 1898, pp. 379, 402, 421) have thrown more light upon the process. The electrolyte is gold chloride (2 ‘5-3 parts of pure gold per 100 of solution) mixed with from 2 to 6 per cent, of the strongest hydrochloric acid to render the gold anodes readily soluble, which they are not in the neutral chloride solution. The bath is used at 65 to 70 C. (150 to 158 F.), and if free chlorine be evolved, which is known at once by its pungent smell, the temperature is raised, or more acid is added, to promote the solubility of the gold. The bath is used with a current-density of 100 amperes per sq. ft. at 1 volt (or higher) , with electrodes about 1-2 in. apart. In this process all the anode metals pass into

solu- tion except iridium and other refractory metals of that group, which remain as metals, and silver, which is converted into insoluble chloride ; lead and bismuth form chloride and oxychloride respectively, and these dissolve until the bath is saturated with them, and then precipitate with the silver in the tank. But if the gold-strength of the bath be maintained, only gold is deposited at the cathode ??? in a loose powdery condition from pure solutions, but in a smooth detachable deposit from impure liquors. Under good conditions the gold should contain 99-98 per cent, of the pure metal. The tank is of porcelain of glazed earthenware, the elec- trodes for impure solutions are J in. apart (or more with pure solutions), and are on the multiple system, and the potential differ- ence at the terminals of the bath is 1 volt. A high current-density being employed, the turn-over of gold is rapid ??? an essential factor of success when the costliness of the metal is taken into account. Platinum and palladium dissolved from the anode accumulate in the solution, and are removed at intervals of, say, a few months by chemical precipitation. It is essential that the bath should not contain more than 5 per cent, of palladium, or some of this metal will deposit with the gold. The slimes are treated chemically for the separation of the metals contained in them.

Many patents have been taken out for the electrolytic solution of gold from its ores ; but the difficulty of extracting in this way so little, perhaps, as a fraction of an ounce of the metal from each ton of sand or other finely crushed material renders the problem an exceedingly difficult one. In some of the processes electrolytic chlorine is used, in some an attempt is made to render the gold particles anodes, whilst in others electrolysis is called in to aid the solvent power of mercury for the precious metal. It is unnecessary here to refer further to any of these. Electrolysis has, however, been successfully applied by Siemens and Halske to the recovery of gold from the potassium cyanide solutions now so largely em- ployed to dissolve gold from ores and tailings. The solution of the double cyanide of gold and potassium formed by the action of potassium cyanide on gold in the presence of air is run oft and

washed from the ore, and is passed through a series of iron tanks, in which it is electrolysed between lead cathodes and iron anodes (which do not dissolve, although Prussian blue and other insoluble iron compounds are

formed), with a current-density of about 0‘04 to 0-06 amperes per sq. ft. , at a pressure of about 4 volts. The lead cathodes with their adherent gold deposit are removed about once a month, and melted up, the gold being recovered by cupellation. Several modifications of the process have been proposed, e.g., Andreoli uses lead peroxide anodes, and iron cathodes from which the gold is removed from time to time by a brief immersion in molten lead, and Cowper-Coles uses an aluminium cathode, from which the gold is readily stripped, being imperfectly adherent by reason of the film of oxide which always exists on the surface of aluminium.

Thin deposits of nickel have long been obtained with readiness, but thick deposits are troublesome, as they tend to curl up and peel off the cathode surface. Cathode-nickel is now made both jv/c*e/ in England and in America, but the details of the pro- cess used have not been disclosed. Foerster {Zeitschrift f. Elek- trochem., 1897, vol. iv. p. 160) has, however, found that with a suitable curreijt-density, using soluble nickel anodes and a neutral solution of nickel sulphate at 50►►-90►► C. (120►►-200►► F.), a perfect deposit of any desired thickness can be obtained. Thus with the electrodes 1-5 in. apart in a bath at 60►► C. (140►► F.) containing 1 lb of (metallic) nickel dissolved as sulphate per gallon, a current- density of 14‘5-18-5 amperes per sq. ft., at 1-1 ~~3 volt, gave a solid deposit ^ in. thick. Nickel chloride could be used, but less sat~~ isfactorily. Practically all the cobalt and iron present were depos- ited with the nickel, and this fact renders the problem of the continuous and direct electrolytic refining of nickel a very difficult one. According to the patent of Salve, iron, zinc, and cobalt can be separated electrolytically from nickel in solution by a process which necessitates intermittency and the use of insoluble anodes. Andrfe, Hoepfner, UIke, and others have devised processes for the treatment of nickel ores, sulphides, or other compounds electrolytically.

The deposition of pure zinc is beset with many difficulties. Zinc being more electro-positive even than nickel, all the heavy metals must be removed before its deposition is attempted. Moreover, unless the conditions are closely watched, zinc

it is liable to be thrown down in a spongy form. Kiliani found that the sponge was produced chiefly when a weak solution, or a low current-

density, was used, and that hydrogen was usually evolved simultaneously ; sound deposits resulted from the use of a current-density of 200 amperes, or more, per sq. ft., and strong solutions. The cause of the spongy deposit is variously explained, soipe (Siemens and Halske) ascribing it to the existence of a com- pound of zinc and hydrogen, and others, among whom are Nahnsen, l^ylius and Fromm, Foerster and Borchers, trace it to the presence of oxide, produced, for example, either by the use of a solution containing a trace of basic salt of zinc (to prevent which the bath should be kept just ??? almost imperceptibly ??? acid), or by the presence of a more electro-negative metal, which, being co-de- posited, sets up local action at the expense of the zinc. Many processes have been patented, the ore being acted upon by acid, and the resulting solution treated, by either chemical or electrolytic means, for the successive removal of the other heavy metals. The pure solution of zinc is then electrolysed. Ashcroft patented a process of dealing with complex ores of the well-known Broken Hill type, containing sulphides of silver, lead, and zinc, but the system was abandoned after a long trial on a practical scale. A full account of the process (Trans. Inst. Min. and Met., 1898, vol. vi. p. 282) has been published by the inventor, describing the practical trial at the Cockle Creek Works. The ore was crushed, roasted, and leached with sulphuric acid (with or without ferric sulphate) ; the solution was purified and then electrolysed for zinc with lead anodes and with a current^density of 6 amperes per sq. ft. at 2-75 volts when diaphragms were used, or 2-5 volts when they were dispensed with, or with 10 amperes per sq. ft. at 3-5 or 2-5 volts respectively, the electrolyte containing 1-2 lb of zinc in the form of sulphate, and J to | oz. of sulphuric acid per gallon. The current efficiency was about 83 per cent. Canvas diaphragms were used to prevent the acid formed by electrolysis at the anode from mixing with the cathode liquor, and so hindering deposition. Hoepfner has patented several processes, in one of which (No. 13,336 of 189-t) a rapidly rotating cathode is used in a chloride solution, a porous partition separating the tank into anode and cathode compartments, and the chlorine generated by electrolysis at the anode being recovered. Hoepfner’s processes have been employed both in England and in Germany. Nahnsen’s process, with an electrolyte containing alkali -metal sulphate aud zinc sulphate, has been used in Germany, and a process invented by Diefienbach has also been tried in that country. Siemens and Halske have proposed the addition of o.xidizing agents such as

free halogens, to preveTit the formation of zinc hydride, to which they attribute the formation of zinc -sponge. Borchers and others deposit zinc from the fused chloride. In Borchers' process the

chloride is heated partly by external flriag partly by the heat generated owing to the use of a current-density of 90 to 100 amperes per sq. ft.

Keith electrolysed lead in an acetate solution, choosing this

compound because, being organic and oxidizable in character, it

prevents the formation of lead peroxide at the

tl nv "**''^- ^^ ^^ tried, but its use appears to have been ***o y- generally discontinued on a large scale. Tommasi has also introduced a process in which the acetates of lead and an alkali-metal are electrolysed. A certain amount of eleotrolytically refined antimony has been placed on the market. Siemens and Halske patented a process in which the antimony sulphide from the ore is dissolved in an alkaline sulphohydrate and electrolysed in a tank with two divisions, the anode compartment containing an alkaline chloride, and the cathode cell the antimony solution ; in another process the antimony is deposited from the chloride. Borchers recommends the solution of the antimony sulphide in sodium sulphide, forming soluble sodium thio-antimonite ; this solution is then electrolysed with iron electrodes, between which a pressure of about 2 volts produces a current-density of 9-14 amperes per sq. ft. at first. As the solution loses antimony by deposi- tion, the current-density is reduced to 3-5-4 amperes per sq. ft. The antimony deposit from the sulphide process is loose, and therefore requires to be scraped off the cathflde and fused together under a flux.

Electrotyping. *** Reference should be made to the article Electbo-Metalluegy, Ency. Brit, 9th ed., vol. viii. In copyingengravedplatesfor printing purposes, copper may be deposited upon the original plate', the surface of which is first rendered slightly dirty, by means of a weak solution

of wax in turpentine or otherwise, to prevent adhesion. The reversed plate thus produced is then stripped from the first and used as cathode in its turn, with the result that even the finest lines of the original are faithfully repro- duced. The electrolyte commonly contains about 1^ ft of copper sulphate and ^ ft of strong sulphuric acid per gallon, and is worked with a current^density of about 10 amperes per sq. ft., which should give a thickness of 0-000563 in. of copper per hour. As time is an object, the conditions alluded to under the head of copper refining as being favourable to the use of high current-densities should be studied, bearing in mind that a tough copper deposit of high quality is essential. Moulds for reproducing plates or art-work are often taken in plaster, beeswax mixed with Venice turpentine, fusible metal, or gutta- percha, and the surface being rendered conductive by . powdered black-lead, copper is deposited upon it evenly throughout. The details of these processes may be found in the text-books referred to at the end of this article. For statuary, and ” undercut ” work generally, an elastic mould ××× of glue and treacle (80:20 parts) ××× may. be used; the mould, when set, is waterproofed by iminersion in a bichromate solution followed by exposure to sunlight, or in some other way. The best results, however, are obtained by taking a wax cast from the elastic mould, and then from this a plaster mould, which may be waterproofed with wax, black-leaded, and used as cathode. In art-work of this nature the principal points to be looked to in depositing are the electrical connexions to the cathode, the shape of the anode (to secure uniformity of deposition), the circula- tion of the electrolyte, and, in some cases, the means for escape of anode oxygeij. Silver electrotyping is occasion- ally resorted to for special purposes.

Electroplating. ××× As the durability of the electro-depos- ited coat on plated wares of all kinds is of the utmost importance, the greatest care must be taken to ensure its complete adhesion. This can only be effected if the surface of the metal on which the deposit is to be made is chem- ically clean, and the cleansing processes referred to in the article ELEOTEO-METAiiiiUEGT (Ency. Brit., 9th ed.) must be rigorously applied. Grease must be removed by potash, whiting, or other means, and tarnish by acid or potassium cyanide, washing in plenty of water being resorted to after each operation. The vats for depositing may’ be of enamelled iron, slate, glazed earthenware, glass, lead-lined

wood, &c. The current-densities and potential differences frequently used for some of the commoner metals are given in the following table, taken from M'Millan's Treatise on Electro-Metallurgy. It must be remembered, however, that variations in conditions modify the electro- motive force required for any given process. For exam- ple, a rise in temperature of the bath causes an increase in its conductivity, so that a lower E.M.F. will sufBce to give the required current-density ; on the other hand, an abnormally great distance between the electrodes, or a diminution in acidity of an acid bath, or in the strength of the solution used, will increase the resistance, and so require the application of a higher E.M.F.

Amp

eres.

VoltB between Anode and

Metal.

Per Sq, Decimetre

Per Sq. In, of

of Cathode

Cathode

Cathode.

Surface.

Surface.

Antimony

0-4-0-5

0-02-0-03

1-0-1-2

Brass .

0-5-0-8

0-03-0-05

3-0^-0

Copper, acid bath

1-0-1-5

0-065-0-10

0-5-1-5

,, alkaline ###

0-3-0-5

0-02-0-03

3-0-5-0

Gold .

0-1

0-006

0-5-4-0

Iron

0-5

0-03

1-0

Nickel, at first

1-4-1-5

0-09-0-10

5-0

,, after

0-2-0-3

0-015-0-02

1-5-2-0 ,

,, on zinc

0-4

0.025

40-5-0

Silver .

0-2-0-5

0-015-0-03

0-75-1-0

Zinc

0-3-0-6

0-02-0-04

2-5-3-0

Large objects are suspended in the tanks by hooks or wires, care being taken to shift their position and so avoid wire-marks. Small objects are often heaped together in perforated trays or ladles, the cathode connecting-rod being buried in the midst of them. These require constant shifting because the objects are in contact at many points, and because the top ones shield those below from the de- positing action of the current. Hence processes have been patented in which the objects to be plated are suspended in revolving drums between the anodes, the rotation of the drum causing the constant renewal of surfaces and affording a burnishing action at the same time. Care must be taken not to expose goods in the plating-bath to too high a current-density, else they may be “burnt”; they must never be exposed one at a time to the full anode surface, with the current flowing in an empty bath, but either one piece at a time should be replaced, or some of the anodes should be transferred temporarily to the place of the cathodes, in order to distribute the current over a sufficient cathode-area. Burnt deposits are dark coloured, or even pulverulent, and useless. The strength of the current may also be regulated by introducing lengths of German silver or iron wire, carbon rod, or other inferior conductors in the path of the current, and a series of such resistances should always be provided close to the tanks. Ammeters to measure the volume, and voltmeters to deter- mine the pressure of current supplied to the baths, should also be provided. Very irregular surfaces may require the use of specially shaped anodes in order that the distance between the electrodes may be fairly luiiform, otherwise the portion of the cathode lying nearest to the anode may receive an undue share of the current, and therefore a greater thickness of coat. Supplementary anodes are sometimes used in difficult cases of this kind. Large metallic surfaces (especially external surfaces) are some- times plated by means of a ” doctor,” which, in its simplest form, is a brush constantly wetted with the electrolyte, with a wire anode buried amid the hairs or bristles ; this brush is painted slowly over the surface of the metal to be

coated, whicli must be connected to the negative terminal of the electrical generator, i Under these conditions electrolysis of the solution in the brush takes place. Iron ships' plates have recently been coated with copper in sections (to prevent the adhesion of barnacles), by build- ing up a temporary trough against the side of the ship, making the thoroughly cleansed plate act both as cathode and as one side of the trough. Decorative plating-work in several colours {e.g., " parcel-gilding ") is effected by painting a portion of an object with a stopping-out (i.e., a non-conducting) varnish, such as copal varnish, so that this portion is not coated. The varnish is then removed, a different design stopped out, and another metal de- posited. By varying this process, designs in metals of different colours may readily be obtained.

Eeference must be made to Electeo-Metalluegy {Ency. Brit., 9th ed.) for a slight indication of the solu- tions commonly used, and to the text-books (see the end of this article) for a fuller account of the very varied solutions and methods employed for electroplating with silver, gold, copper, iron, and nickel. It should be men- tioned here, however, that solutions which would deposit their metal on any object by simple immersion should not be generally used for electroplating that object, as the resulting deposit is usually non-adhesive. For this reason the acid copper-bath is not used for iron or zinc objects, a bath containing copper cyanide or oxide dis- solved in potassium cyanide being substituted. This solution, being an inferior conductor of electricity, re- quires a much higher electromotive force to drive the current through it, and is therefore more costly in use. It is, however, commonly employed hot, whereby its re- sistance is reduced. Zinc is now commonly deposited by electrolysis on iron or sleel goods which would ordinarily be " galvanized," but which for any reason may not con- veniently be treated by the method of immersion in fused zinc. The zinc cyanide bath may be used for small objects, but for heavy goods the sulphate bath is employed. Cowper-Coles has patented a process in which, working with a high current-density, a lead anode is used, and powdered zinc is kept suspended in the solution to main- tain the proportion of zinc in the electrolyte, and so to guard against the gradual acidification of the bath. Cobalt is deposited by a method analogous to that used for its sister-metal nickel. Platinum, palladium, and tin are occasionally deposited for special purposes. In the deposition of gold the colour of the deposit is influenced by the presence of impurities in the solution ; when copper is present, some is

deposited with the gold, imparting to it a reddish colour, whilst a little silver gives it a greenish shade. Thus so-called coloured-gold deposits may be pro- duced by the judicious introduction of suitable impuri- ties. Even pure gold, it may be noted, is darker or lighter in colour according as a stronger or a weaker current is used. The electro-deposition of brass ??? mainly on iron ware, such as bedstead tubes ??? is now very widely prac- tised, the bath employed being a mixture of copper, zinc, and potassium cyanides, the proportions of which vary according to the character of the brass required, and to the mode of treatment. The colour depends in part upon the proportion of copper and zinc, and in part (Tpon the current-density, weaker currents tending to produce a redder or yellower metal. Other alloys may be produced, such as bronze, or German silver, by selecting solutions (usually cyanides) from which the current is able to de- posit the constituent metals simultaneously.

Electrolysis has m a few instances been applied to processes of manufacture. For example, Wilde produced copper printing surfaces for calico printing-rollers and the like by immersing rotating iron cylinders as cathodes in a copper bath. Elmore, Dumoulin, Cowper-Coles, and others

have prepared copper cylinders and plates by depositing copper on rotating mandrels with special arrangements, to which allusion has already jDcen made. Others have arranged a means of obtaining high conductivity wire from cathode-copper without fusion, by depositing the metal in the form of a spiral strip on a cylinder, the strip being subsequently drawn down in the usual way ; at present, however, the ordinary methods of wire-production are found to be cheaper. Swan (Journ. Inst. Elec. Eng., 1898, vol. xxvii. p. 16) also worked out, but did not pro- ceed with, a process m which a copper wire whilst re- ceiving a deposit of copper was continuously passed through the draw-plate, and thus indefinitely extended in length. Cowper-Coles {Journ. Inst. Elec. Eng., 1898, vol. xxvii. p. 99) has very successfully produced true para- ^bolic reflectors for projectors, by depositing copper upon carefully ground and polished glass surfaces rendered conductive by a film of deposited silver.

Electrolytic Manufacture of OJiemical Products. ??? When aqueous solution of the salt of an alkali-metal is electro- lysed, the metal reacts with

the water, as is well known, forming caustic alkali, which dissolves in the solution, and hydrogen, which comes off as a gas. So early as 1851 a patent was taken out by Cooke for the production of caustic alkali without the use of a separate current, by immersing iron and copper plates on opposite sides of a porous (biscuit-ware) partitionina suitable cell, containing a solution of the salt to be electrolysed, at 21►►-65►► C. (70►►- 160►►E.). The solution of the iron anode was intended to afford the necessary energy. In the same year another patent was granted to C. Watt for a similar process, involving the employment of an externally generated current. When an alkaline chloride, say sodium chloride, is electrolysed with one electrode immersed in a porous cell, while caustic soda is formed at the cathode, chlorine is deposited at the anode. If the latter be insoluble, the gas diffuses into the solution and, when this becomes saturated, escapes into the air. If, however, no porous division be used to prevent the intermingling by diffusion of the anode and cathode solutions, a complicated set of subsidiary reactions takes place. The chlorine reacts with the caustic soda, forming sodium hypochlorite, and this in turn, with an excess of chlorine and at higher temperatures, becomes for the most part converted into chlorate, whilst any simultaneous electrolysis of a hy- droxide or water and a chloride (so that hydroxyl and chlorine are simultaneously liberated at the anode) also produces oxygen-chlorine compounds direct. At the same time, the diffusion of these compounds into contact with the cathode leads to a partial reduction to chloride, by the removal of combined oxygen by the instrumentality of the hydrogen there evolved. In proportion as the original chloride is thus reproduced, the efficiency of the process is of course diminished. It is obvious that, with suitable methods and apparatus, the electrolysis of alkaline chlorides may be made to yield chlorine, hypochlorites (bleaching liquors), chlorates, or caustic alkali, but that great care must be exercised if any of these products is to be obtained pure and with economy. Many patents have been taken out in this branch of electro-chemistry, but it is to be remarked that that granted to C. Watt traversed the whole of the ground. In this process a current was passed through a tank divided into two or three cells by porous partitions, hoods and tubes were arranged to carry off chlorine and hydrogen respectively, and the whole was heated to 120►► E. by a steam jacket when caustic alkali was being made. Hypochlorites were made, at ordinary temperatures, and chlorates at higher temperatures, in a cell without a partition in which the cathode was

placed horizontally immediately above the anode, to favour the mixing of the ascending chlorine with the descending caustic solution.

The relation between the composition of the electrolyte and the various conditions of current-density, temperature, and the like has been studied by Oettel (Zeitschrift f. Elektrochem., 1894, vol. i. pp. 354 and 474) in connexion with the produotjon of hypochlorites and chlorates in tanks without diaphragms, l5y Haussermann and Naschold (Ohemiker Zeitung, 1894, vol. xviii. p. 867) for their pro- duction in cells with porous diaphragms, and by Haber and Grin- berg {Zeitschrift f. anorgan. Chem., 1898, vol. xvi. pp. 198,329, 438) in connexion with the electrolysis of hydrochloric acid. Oettel, using a 20 per cent, solution of potassium chloride, obtained the best yield of hypochlorite with a high current-density, but as soon as IJ per cent, of bleaching chlorine (as hypochlorite) was present, the formation of chlorate commenced. The yield was at best very low as compared with\hat theoretically possible. The best yield of chlorate was obtained when from 1 to 4 per cent, of caustic potash was present. With high current-density, heating the solu- tion tended to increase the proportion of chlorate to hypochlorite, but as the proportion of water decomposed is then higher, the amount of chlorine produced must be less and the total chlorine efficiency lower. He also traced a connexion between alkalinity, temperature, and current-density, and showed that these conditions should be mutually adjusted. With a current-density of 130-140 amperes per sq. ft., at 3 volts, passing between platinum electrodes, he attained to a current-efficiency of 52 per cent., and each (Brit- ish) electrical horse-power hour was equivalent to a production of 1378-5 grains of potassium chlorate. In other words, each pound of chlorate would require an expenditure of nearly 5-1 E.H.P. hours. One of the earliest of the more modern processes was that of Hermite, which consisted in the production of bleach-liquors by the electrolysis (according to the 1st edition of the 1884 patent) of magnesium or calcium chloride between platinum anodes carried in wooden frames, and zinc cathodes. The solution, containing hypochlorites and chlorates, was then applied to the bleaching of linen, paper-pulp, or the like, the

solution being used over and over again. Many modifications have been patented by Hermite, one of the latest (1895) specifying the use of platinum gauze anodes, held in ebonite or other frames. Rotating zinc cathodes were used, with scrapers to prevent the accumulation of a layer of insoluble magnesium compounds, which would otherwise in- crease the electrical resistance beyond reasonable limits. The same inventor has patented the application of electrolysed chlorides to the purification of starch by the oxidation of less stable organic bodies, to the bleaching of oils, and to the purification of coal gas, spirit, and other substances. His system for the disinfection of sewage and similar matter by the electrolysis of chlorides, or of sea-water, has been tried, but for the most part abandoned on the score of expense. Reference may be made to papers written in the early days of the process by Cross and Bevan {Journ. Soc. Chem. Industry, 1887, vol. vi. p. 170, and 1888, vol. vii. p. 292), and to later papers by Schoop (Zeitschrift f. Elektrochem., 1895, vol. ii. pp. 68, 88, 107, 209, 289).

Kellner, who in 1886 patented the use of cathode (caustic soda) and anode (chlorine) liquors in the manufacture of cellulose from wood-fibre, and has since evolved many similar processes, has pro- duced an apparatus that has been largely used. It consists of a stoneware tank with a thin sheet of platinum-iridium alloy at either end forming the primary electrodes, and between them a number of glass plates reaching nearly to the bottom, each having a platinum gauze sheet on either side ; the two sheets belonging to each plate are in jnetallic connexion, but insulated from all the others, and form intermediary or bi-polar electrodes. A 10-12 per cent, solution of sodium chloride is caused to flow upwards through the apparatus and to overflow into troughs, by which it is conveyed (if necessary through a cooling apparatus) back to the circulating pump. Such a plant has been reported as giving 0‘229 gallon of a liquor containing 1 per cent, of available chlorine per kilowatt hour, or 0-171 gallon per E.H.P. hour. Kellner has also patented a ” bleaching-block,” as he terms it, consisting of a frame carrying parallel plates similar in principle to those last described. The block is immersed in the solution to be bleached, and may be lifted in or out as required. Knofler and Gebauer have also a system of bi-polar electrodes, mounted in a frame in appearance resembling a filter-press.

It is estimated that fully two-thirds of the annual pro- duction of chlorate is obtained by electrolytic methods.

The experiments of Oettel and those of Haus- chiorate sermann and Naschold, above referred to, Ao^re. showed that the best results were obtained when

the (anode) solution was maintained slightly alkaline throughout. The electrolyte should also be at a temperature of 70►►-80►► 0. (160►►-180►► F.),as a better yield of chloride is then obtained ; the current-density should also be high. Haussermann and Naschold, with a current- density of 31 amperes per sq. ft. of platinum anode sur-

face (at 4 volts), obtained on a small scale a yield of 7-7 grains of chlorate per ampere hour, or a current-efiftciency of 67 per cent. Oettel obtained about 52 per cent, in practice. These numbers are equivalent to an expendi- ture of 4-77, and 6-07, E.H.P. hours respectively, per pound of chlorate. In the practical working of the pro- cess, platinum or carbon electrodes were commonly em- ployed. Platinum, however, is liable to become slowly attached when used as anode with chlorine, deposition taking place at its surface, although the action is far less with neutral chlorides than with hydrochloric acid as electrolyte, and carbon is subject to rapid disintegration unless the pores can be filled up, or a very dense form of it, such as graphite, be used. An alloy containing 90 per cent, of platinum andlO of iridium is very largely employed, on account of its high power of resisting the attack of anode chlorine ; and many other anode materials have been suggested for various purposes, among them being ferrosilicon, chromium phosphide, and lead peroxide. The Gall and Montlaur process is that most commonly used at the large Continental works. At Vallorbes, in Switz- erland, 3000 H.P. were being consumed in this industry so far back as 1891. Here a 26 per cent, solution of potassium chloride was electroylsed in 270 rectangular lead-lined tanks, each holding 1765 cb. ft. of liquid, with thin (0-1 mm.) platinum-iridium anodes and iron cathodes, with a porous diaphragm between. The current-density was 460 amperes per sq. ft., and the pressure required to force this current through the liquid and diaphragm was 6 volts, the temperature of the bath being 45►►-55►► C. (115►►-130►► P.). The anode and cathode solutions were kept distinct,

each having its own system of circulation. Potassium chlorate is far less soluble than the chloride, and the liquid rapidly becomes saturated with it ; from this period, onward, the chlorate crystallizes out as fast as it is formed, and may be removed in the solid form for recrystallization for the market; meanwhile fresh chloride is constantly introduced, to take the place of that which has been converted into chlorate. At the St Michael Works in the Rhone Valley (France) the same process is employed, but the cathodes are of ferronickel covered by asbestos cloth. It is believed by Kershaw (Elec. Review, 1898, vol. xliii. p. 791) that the use of diaphragms has now been abandoned.

In any process by which it is attempted to utilize the caustic alkali produced at the cathode in the electrolysis of sodium chloride, it is obvious that the chlo- rine from the anode must be prevented from Alkali coming in contact withthe cathode solution. Po- (******, rous partitions have naturally been largely used in many electrolytic alkali processes ; but they are costly, inasmuch as they entail the expenditure of electromotive force to urge the current through them and require more or less frequent renewal. Being subject to the action of caustic alkali on the one side, and of chlorine and hypo- chlorites on the other, it is not easy to find a substance of low electrical resistance that is able chemically to with- stand the influence of both classes of corrosive. Moreover, no suitable porous partition yet found can entirely prevent intermingling of solutions and, therefore, loss.

Cooke and Watt were the first to patent electrolytic alkali manufacture, but before the invention of the dyna,mo no such process could compete economically with the existing chemical methods. Fitzgerald and MoUoy patented a process in 1872 ; and Marx in 1887, in the first of a series of patents, protected the use of carbon dioxide gas in the electrolytic cell to precipitate sodium bicarbonate from the caustic soda solution formed by the electro- lysis of common salt solutions, and so to remove it from the influence of chlorine. The principal processes lately in use on a practical scale, some of them still on their trial, are the Kellner, Castner-Kellner (now very extensively employed), the Hargreaves- Bird, the Richardson and Holland, the Le Sueur and the Hulin process. Of these, Richardson and Holland avoided the use

of porous partitions by separating the anode and cathode com- partments by a non-porous wall reaching above the top, but not down to the bottom, of the cell, so that electrolytic conduction ###could take place freely between the electrodes through the medium of the liquid beneath the division, yet the chlorine gas would for the most part escape upwards from the anode, and the hydrogen liberated at the cathode was depended upon to carry upwards the caustic alkali produced in the cathode cell. Obviously by this process it would be difficult entirely to prevent diffusion and also to obtain a caustic alkali free from admixture with the original chloride electrolyte. In another patent, open to the same objections, the same inventors protected the use of copper- oxide cathodes placed horizontally beneath the anodes ; here the oxide would be reduced by the electrolytic hydrogen, and the caustic alkali formed would sink downwards from the electrode. This process has been used in paper-mills. In the Hargreaves-Bird apparatus (of which the first British patent was No. 18,039 of 1892) a combined porous cell and cathode is used ; the cathode itself is of wire gauze, which is covered with a mixture of lime and asbestos dipped into a solution of silicate of soda, after drying, in order to bind the material together ; the whole is then dried again. According to a later specification, a layer of Portland cement is

WWV^UW^kUUW^kkkU^^TCTOW^

O^

NaCI

^>

T7TT

Fig. 1.

introduced between the gauze and the asbestos lime mixture, and means are taken to prevent the gauze being in absolute contact with the cement. There results a thin sheet, which forms one side of the electrolytic cell, the gauze being outwards. Elec- trolysis of the sodium chloride takes place as usual, the electrolyte passes, by osmosis, through the partition to the gauze, sodium is there deposited and, with the water present, forms caustic soda, which is washed away by a spray of water, the hydrogen liberated in the reaction escaping. If necessary, the caustic soda may be carbonated by bringing carbon dioxide into contact with the gauze during electrolysis. Hulin, in an early process, proposed to use a porous carbon cathode through which the solution filtered, the rate of flow being so adjusted that the whole of the salt was decomposed and only solution of cathode alkali escaped. Obviously, however, such regulation would be exceedingly difficult. In the Le Sueur process, which has been for some time used in certain American works, a porous division is used, and the liquid in the anode compartment is said to be main- tained at a higher level than in the cathode cell, in order to lessen the loss by diffusion of alkaline liquid from the latter to the former. In Le Sueur's 1891 patent, it is provided that hydro- chloric acid shall be added to the anode liquid to neutralize any caustic soda that may diffuse through.

Kellner has taken out many patents. In one of them a mercury cathode is used, which dissolves the sodium deposited, forming an amalgam that, on exposure to water, gives up its alkali and leaves a solution of caustic soda. Almost simultaneously Castner also patented a mercury process, which in its modified form is now in con- stant use. The tank, of which the principle is illustrated in Fig. 1, may be 6 ft. long by 3 ft. wide by 3 in. deep, and is divided by verti- cal partitions P P (impervious to water) into three compartments. The whole of the floor is covered with a layer of mercury M, and beneath each partition a groove is cut in the bottom of the tank to allow mercury to flow between the compartments. It is essential, however, that at all times this passage should be filled with mercury, which acts as a seal, effectually preventing any inter- change of solutions between the compartments. The cell is kept at a constant level at one end, but at the other end is alternately raised and depressed through a very small space by means of the

cam B, so that a slight rocking motion is given, causing the mercury to flow gently to and fro without at any moment leaving space for the electrolyte to pass under the partitions. In each end compartment is a carbon anode A, placed horizontally just above the surface of the mercury, and beneath the level of a 20 per cent, solution of sodium chloride (NaCl) ; these compartments are covered, and are provided with pipes E to carry off the anode- chlorine. The middle compartment contains an iron cathode 0 immersed in water (H2O), and is open above. Means are provided for the circulation of the anode liquors and to replenish them with salt ; the cathode solution may be drawn off at will. In operation the current flows from the anode, where it deposits chlorine (ultimately given off in the gaseous form), through the sodium chloride solution to the mercury layer in the outer compartments, and thence by metallic conduction to the mercury in the centre compartment, and from this through the water to the cathode, where hydrogen is evolved. Thus the mercury forms an inter- mediary, bi-polar electrode, acting as cathode in the outer and as anode in the inner division. The sodium deposited on the mercury in the outer cells is at once dissolved, forming an amalgam. The amalgam-laden mercury mixes by the rocking action with the mercury in the inner cell, and there (being an anode) passes into the water, forming caustic soda. A current of 550 am- peres and 4 volts per cell has been employed. No chlorine or chloride can escape into the cathode cell, and the caustic alkali may therefore contain 99J per cent, of pure sodium hydroxide. A certain amount of energy-loss is inevitable, owing to the recombination of a little of the sodium dissolved in the mercury in the outer cells with chlorine, and with oxygen from the water (the chlorine contains commonly 3 to 5 per cent, of hydrogen, indicating that some water is attacked) . But the constant flux of the mercury and loss of sodium in the inner oell should keep down the quantity of sodium in the mercury to about 0-02 per cent., so that the loss due to this cause is minimized. The same mercury is used constantly, and as it need not suffer appreciable loss, and only a thin layer is required, it does not add greatly to the cost of the process, one of the greatrecommendations of which is that a strong solution of a pure soda may be readily produced. In the Hulin process a furnace method is employed, molten lead being used as cathode, and carbon as anode, in a.bath of fused lead and sodium chlorides, with a current-density of about 700 amperes per sq. ft. A rich alloy of sodium with

lead is de- posited. This is cast into plates and, on cooling, treated with water, whereby the sodium contained in it dissolves, forming caustic soda.

The following table, calculated into British units from Ker- shaw's account (Engineering and, Mining Journal, 1899, vol. Ixvii. p. 497) of the Hulin process at Clavaux, Shows the comparative efficiencies of these processes from published data, the term current- efficiency showing the proportion of the actual yield per coulomb actually obtained, and the energy-efficiency the proportion use-

X

a

3

s

Actual Yield.

Per Amp. Hr. in Grains.

Per Kw-Hr.

in lb.

Approx. H.P. Hra.perTonof

Efficiency per cent.

FrocesB.

NaOH.

CI.

NnOH.

CI.

Pure NaOH.

70%

Caustic Soda.

0

H

Wet Pro- .

Hargreaves-

Bird Castne r-

3-4

18-46

16-81

0-77

0-68

8880

8500

SO

64

cesses

Kellner Theoretical

4-0

21-OS

17-58

0-75

0-63

4000

3610

91

62-8

V

Figures

28-07

20-40

1-48

1-26

2100

1900

100

100

Dry J Pro- <

Hulin Theoretical

T-0

16-28

14-00

0-34

0-28

8780

7SS0

69-8

41-5

cesses (

Figures .

4-2

28-07

20-40

0-78

0-69

8825

8450

100

fully applied of the energy theoretically necessary. The relatively low efficiency of the Hulin (dry) process is, to some extent, com- pensated for by the high current-density used, and by consequent rapidity of working.

It is obvious that electrolytic iodine and bromine, and oxygen compounds of these elements, may be produced by methods similar to those last described, and Kellner and others have patented processes vfith this end in view.

Hydrogen and oxygen may also be produced electrolytically as gases, and their respective reducing and oxidizing other powers at the moment of deposition on the elec-

eiectro- trode are frequently used in the laboratory, and frlaSL *►► so’^e extent industrially, chiefly in the field of organic chemistry. Similarly, the formation of organic halogen products may be effected by electro- lytic chlorine, as, for example, in the production of cliloral by the gradual introduction of alcohol into an anode cell in which the electrolyte is a strong solution of potassium chloride. Again, anode reactions, such as are observed in the electrolysis of the fatty acids, may be utilized, as, for example, when the radical CH3CO2O ►►► deposited at the anode in the electrolysis of acetic acid ►►► is dissociated, two of the groups react to give one mole- cule of ethane, CaHa, and two of carbon dioxide. This, which has long been recognized as a class-reaction, is obviously capable of endless variation. Many electrolytic methods have been proposed for the purification of siigar; in some of them soluble anodes are used for a few minutes in weak alkaline solutions, so that the caustic alkali from the cathode reaction may precipitate chemi- cally the hydroxide of the anode metal dissolved in the liquid, the precipitate carrying with it mechanically some of the impurities present, and thus clarifying the solution. In others

the current is applied for a longer time to the original sugar-solution with insoluble (e.g., carbon) anodes. Peters has found that with these methods the best results are obtained when ozone is employed in addition to electrolytic oxygen. Use has been made of electrolysis in tanning operations, the cur- rent being passed through the tan-liquors containing the hides. The current, by endosmosis, favours the passage of the solution into the hide-substance, and at the same time appears to assist the chemical combinations there occurring; hence a great reduction in the time required for the completion of the process. Many patents have been taken out in this direction, one of the best known being that of Groth, experimented upon b^r Eideal and Trotter (Journ. Sac. Chem. IndusL, 1891, vol. x. p. 425), who employed copper anodes, 4 sq. ft. in area, with cur- rent-densities of 0-375 to 1 (ranging in some eases to 7-5) ampere per sq. ft., the best results being obtained with the smaller current-densities. Electro-chemical processes are often indirectly used, as for example in the Villon process (Elec. Rev., New York, 1899, vol. xxxv. p. 375) applied in Bussia to the manufacture of alcohol, by a series of chemical reactions starting from the production of acetylene by the action of water upon calcium carbide. The production of ozone in small quantities during elec- trolysis, and by the so-called silent discharge, has long been known, and the Siemens induction tube has been developed for use industrially. The Siemens and Etalske ozonizer, in form somewhat resembling the old laboratory instrument, is largely used in Germany ; working with an alternating current transformed up to 6600 volts, it has been found to give 280 grains or more of ozone per E.H.P. hour. Andreoli (whose first British ozone-patent was No. 17,426 of 1891) uses flat aluminium plates and points, and working with an alternating current of 3000 volts is said to have obtained 1440 grains per E.H.P. hour. Yarnold's process, using corrugated glass plates coated on one side with gold or other metal leaf, is stated to have yielded as much as 2700 grains per E.H.P. hour. The ozone so prepared has numerous uses, as, for ex- ample, in bleaching oils, waxes, fabrics, &c., sterilizing drinkina-water, maturing wines, cleansing foul beer- casks, oxidizing oil, and in the manufacture of vanillin.

For further information the following books, among others, may be consulted : ××× Haber. Grundriss der Technischen Mlektrochemie. Munohen, 1898. ××× Borcheks aad M'Millan. Electric Smelting

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Electromagnet. The technical applications of electricity and magnetism depend to a very large extent upon the employment of electromagnets.

Iron and other ferromagnetic materials, such as steel, cobalt, nickel, and some of their mixtures, alloys, and oxides, can be thrown into a state in which they are said .to be magnetized (see Magnetism). This magnetization may be more or less permanent, as in the case of an ordinary hardened steel magnet or the natural magnetized material Magnetite, or it may be temporary and due to the continual action on the iron or ferromagnetic material of magnetic force arising from the proximity of a conductor conveying an electric current. The terfai electromagnet is generally employed ““to describe an arrangement in which a core of iron of some kind is surrounded with coils of insulated wire whiclp. create in and around it a magnetic force when they are traversed by an electric current.

Magnetic force is defined as the cause, whatever its nature, which produces or changes the state called mag- netization. In the neighbourhood of every polar magnet, and also every conductor conveying an ^^g”” - electric current, there is a distribution of mag- “*” netic force. If a piece of soft iron or any ferromagnetic substance is placed in this region it becomes magnetized, and its magnetization may be in part or entirely retained when the magnetizing force is withdrawn. If the mag- netizing force arises from

the presence of an electric current in the neighbourhood, and if the ferromagnetic material which is in its field is a piece of annealed or wrought-iron, then the persistence of the magnetization of the iron will be largely dependent upon the presence of the current in the conductor. If the iron is of such a form that the lines of magnetization are entirely closed lines, the arrangement constitutes a poleless electro- magnet. Such a magnet may be realized in practice by closely winding insulated copper wire uniformly round an iron ring. If, on the other hand, the coils embrace an iron bar not forming a closed circuit, then the ar- rangement will constitute a polar electromagnet.

It is essential to distinguish between the mere reten- tivity and the power of preserving magnetization against demagnetizing influences, called the coercivity. Pure annealed or soft iron can retain 90 per cent, or more of the magnetization it acquires under the influence of a strong magnetizing force when the force is removed, but the magnetization so retained is held very lightly, and even a slight knock or twist or any form of mechanical shock is sufBcient to deprive the iron of nearly all its magnetization if it is in the form of a short bar. On the other hand, hardened high carbon steel, though not able to acquire such a high degree of magnetization under the action of a given magnetizing force, retains it with much greater tenacity, and a much stronger reverse magnetized force is required to demagnetize the steel than is the case with soft iron. Steel containing tungsten possesses a large coercivity.

Whatever may be the material which is thrown into

Magnetic flax.

a state of magnetization, if the lines of magnetization terminate anywhere on the surface they give rise to magnetic poles. These points or regions are themselves sources of magnetic force. If a uniformly magnetized magnetic filament has everywhere a section S, and if its magnetization is denoted by I, the product IS is called the magnetic strength of the filament, and this

product is also a measure of the strength of the pole of the filament. If a ferromagnetic body is magnetized so that its lines of magnetization are self-closed lines, it is also said to form a complete or dosed magnetic circuit. If, on the other hand, they are not self-closed, the magnetic circuit is called an open magnetic circuit. Abrupt or gradual changes in the magnetization along the circuit create in the mag- netic circuit (even if closed) polar regions from which magnetic force proceeds.

The most simple and direct method of estimating the condition of a substance as regards magnetization in the case of Open magnet circuits or linear magnets is to measure the magnetic force at some assigned position out- side the magnetic body, where in virtue of the presence of free poles a production of magnetic force takes place. The magnetic force at any point can be estimated as regards magnitude by its mechanical action on another movable magnetic pole or polar magnet. This is called the magnetometric method.

So far we have directed consideration only to two magnetic quantities, namely, magnetization and magnetic force, but at this stage a third magnetic vector claims attention. If in front of the pole of a polar magnet a loop of insulated wire of one turn, and con- nected to a galvanometer, is held with its plane normal to the field, and tl;e loop then snatched away, this circuit becomes the seat of an electromotive force which creates an induced electric current in the loop. The induced electromotive force is proportional to the time-rate of change of the surface integral of the magnetic force integrated all over the area of the loop, and hence the time-integral of the induced current, mul- tiplied by the value of the resistance of the loop circuit, must be equal to the value of this surface integral of the normal magnetic force. The quantity so measured is now generally called the magnetic flux, but also denomi- nated the total magnetic induction, or total number of lines of force perforating through the loop. We find that if a loop is held in front of the pole of a polar magnet and snatched away, the electromotive force set up in it is in the same direction as if the loop were placed like a girdle closely round the centre of the bar magnet and then sud- denly drawn off, all other circumstances remaining the same. This experiment is sufiicient to show that the vector with which we are here concerned is not identi- cal with that properly called the magnetic force,

since in a permanent straight steel bar magnet, when not in the neighbourhood of other magnets or electric currents, the magnetic force in the interior of the bar is in the opposite direction to the magnetic force just outside either of its poles.

The quantity, therefore, measured by the time-integral of this induced current is a definite physical quantity, and in this article will be called the magnetic flux. The flux, through a unit of surface normal to the direction of the flux, is called the flux density, and is denoted by B. It is called by Maxwell and other writers following him the induction, or the number of lines of force per square CMtimetre. It is essential, however, to notice that the exploring loop used in the above manner measures a mag- netic vector quantity which is not to be confused with the magnetic force. In the region outside the polar magnet the flux in the space and the magnetic force have the same direction, and as there is nothing to distinguish them they

may be assumed to have the same magnitude. Inside the magnet, however, the flux and the force have not the same magnitude, and not always the same direc- tion. The flux through any area may, however, always be evaluated by the time-integral of the current set up in a conducting loop placed in that locality with its plane normal to the direction of the flux when the flux is sup- pressed, or the loop suddenly removed. The flux is a quantity which, mathematically considered, is circuital. Its direction may be delineated by lines of flux, and every line of flux is a self-closed line.

The quantity called B is more important than I from an electro-technical point of view, because the chief practical use of magnets or electromagnets is to create in conductive circuits an electromotive force by varying the magnetic flux linked with them. This effect depends upon the vari- ation of the total flux linked with the conductive circuit. The ratio of B to H is denoted by ju, and is called the magnetic permeability of the material corresponding to that particular flux density. The permeability is a function of the flux density, and varies with it. Corre- sponding to a certain value of the flux density, /u, has a maximum value. The relation of B and H and B and ix. are best represented by two curves called respectively the flux-density curve and the permeability curve (see Figs. 2 and 3). We may also in the same manner set out in the form of a curve the relation of the

magnetization I to the magnetizing force H, and the ratio of I to H, which is called the susceptibility Qc) of the material.

An immense number of observations have been carried out of late years on the permeability and susceptibility of different forms of iron and steel, and in the following tables are given some typical results, mostly from experiments made by Ewing (see Proc. Inst. C. E. vol. cxxvi.), in which the ballistic method has been employed to deter- mine the flux density corresponding to various magnetiz- ing forces acting upon samples of iron and steel in the form of rings. The samples were prepared and furnished by various manufacturers of iron and steel, and may be taken as typical of the materials which are at present (1899) in demand for the construction of cores of electro- magnets of different kinds.

Table I. ??? Magnetic Flux Density corresponding to various Magnetizing Forces in the case of certain Sampjles of Iron and Steel (Ewing).

Magnetiz-

ing Force H (C.G.8.

Magnetic Flux Density B (O.G.S

. Units).

Units).

I.

II.

III.

IV,

V.

VI.

5

12,700

10,900

12,300

4,700

9,600

10,900

10

14,980

13,120

14,920

12,250

13,050

13,320

15

15,800

14,010

15,800

14,000

14,600

14,350

20

16,300

14,580

16,280

15,050

15,310

14,960

30

16,950

15,280

16,810

16,200

16,000

16,660

40

17,350

15,760

17,190

10,800

16,510

16,150

50

16,060

17,600

17,140

16,900

16,480

60

16,340

17,750

17,450

17,180

16,780

70

16,580

17,970

17,750

17,400

17,000

80

16,800

18,180

18,040

17,620

17,200

90

17,000

18,390

18,2.30

17,830

17,400

100

17,200

18,600

18,420

18,030

17,600

The figures under heading I. are values given in a paper by- Messrs Lydall and Pooltlington {Proc. Boy. Soc. vol. ii. p. 228) as the results of a magnetic test of an exceptionally pure iron supplied for the purpose of

experiment by Colonel Dyer, of the Elswiok Works. The substances other than iron in this sample were stated to be: carbon, trace; silicon, trace: phosphorus, none ; sulphur, 0-013 per cent. ; manganese, 0-1 per cent. The other five specimens, II. to VI., are samples of commercial iron or steel. No. II. is a sample of Low Moor bar iron forged into a

ring, annealed, and turned. No. III. is a steel forging furnished by Mr R. Jenkins as ai sample of forged ingot-metal for dynamo magnets. No. IV. is a steel, casting for dynamo magnets, un- forged, made by Messrs Edgar Allen and Company by a special pneamatio process under the patents of Mr A. Tropenas. No. V. is also an unforged steel casting for dynamo magnets, made by Messrs Samuel Osborne and Company by the Siemens process. No. VI. is also an unforged steel casting for dynamo magnets, made by Messrs Fried. Krupp, of Essen.

It will be seen from the figures and the description of the materials that the steel forgings and castings have a remarkably high permeability under small magnetizing force.

Table II. shows the magnetic qualities of some of these materials as found by Ewing when tested with small magnetizing forces.

Table II. ××× Magnetic Permeability of Samples of Iron and Steel under Weak Magnetizing Forces.

Magnetic Flux

Density B (O.G.8. Units).

I.

Pure Iron.

III.

Steel Forging.

VI.

Steel Casting.

H.

*

H.

i”

H. f.

2,000

0-90

2220

1-38

1450

1-18 1690

4,000

1-40

2850

1-91

2090

1-66 2410

6,000

1-86

3240

2-38

2520

2-16 2790

8,000

2-30

3480

2-92

2740

2-83 2830

10,000

310

3220

3-62

2760

4-05 2470

12,000

4-40

2760

4-80

2500

6-65 1810

The numbers I., III., and VI. in the above table refer to the samples mentioned in connexion with Table I.

It is a remarkable fact that certain varieties of low carbon steel (commonly called mild steel) have a higher permeability than even annealed Swedish wrought iron under large magnetizing forces. The term steel, however, here used has reference rather to the mode of production than the final chemical nature of the material. In some of the mild-steel castings used for dynamo electromagnets, it appears that the total foreign matter, including carbon, manganese, and silicon, is not more than 0-3 per cent, of the whole, the material being 99-7 per cent, pure iron.

50 SO 70 SO

Fig. 1.

This valuable magnetic property of steel capable of being cast is, however, of great utility in modern dynamo build- ing, as it enables field magnets of very high permeability to be constructed, which can be fashioned into shape by casting instead of being built up as formerly out of masses of forged wrought iron. The curves in Fig. 1 illustrate the manner in which the flux density, or, as it is usually called, the magnetization curve, of this mild cast steel crosses that of Swedish wrought iron, and enables us to

obtain a higher flux density corresponding to a given magnetizing force with the steel than with the iron.

From the same paper by Ewing we extract a number of results relating to permeability tests of thin sheet iron and sheet steel, such as is used in the construction of dynamo armatures and transformer cores.

Table III. ??? Permeability Tests of Transformer Plate and

Wire.

Magnetic

VII.

VIII.

1

13

X

Density B (COS

Transformer-

Transformer-

Transformer-

Transformer-

plate of

plate of

plate of

wire.

Units).

Swedish Iron.

Scrap-iron.

Steel.

H.

M

H.

/*

H.

/i

-H.

y

1,000

0-81

12,30

1-08

920

0-60

1470

1-71

590

2,000

1-05

1900

1-46

1370

0-90

22,S0

2-10

950

3,000

1-26

2320

177

1690

1-04

2880

2-30

1300

4,000

1-54

2600

2-10

1900

1>19

3360

2-60

1600

5,000

1-82

2760

2-53

1980

1-38

3620

2-70

1850

6,000

2-14

2800

3-04

1970

1-59

.3770

2-92

2070

7,000

2-54

2760

3-62

1930

1-89

3700

3-16

2210

8,000

3-09

2590

4-37

1830

2-25

3600

3-43

2330

9,000

3-77

2390

5-3

1700

2-72

3310

3-77

2390

10,000

4-6

2170

6-5

1540

3-33

3000

4-17

2400

11,000

5-7

1930

7-9

1390

4-15

2650

4-70

2340

12,000

7-0

1710

9-8

1220

5-40

2220

5-45

2200

18,000

8-5

1530

11-9

1190

7-1

1830

6-5

2000

14,000

11-0

1270

15-0

930

10-0

1400

8-4

1670

15,000

15‘1

990

19-5

770

...

11-9

1260

16,000

21-4

750

27-5

580

21-0

760

No. VII. is a specimen of good transformer-plate, 0-301 milli- metre thick, rolled from Swedish iron by Messrs Sankey of Bilston. No. VIII. is a specimen of specially thin transformer- plate rolled from scrap iron. No. IX. is a specimen of trans- former-plate rolled from ingot-steel. No. X. is a specimen of the wire which was used by Mr Swinburne some years ago to form the core of his “hedgehog” transformers. Its diameter was 0-602 millimetre. All these samples were tested in the form of rings by the ballistic method, the rings of sheet-metal being stamped or turned in the flat. The wire ring No. X. was coiled and annealed after coiling.

Some typical flux-density curves of iron and steel as used in dynamo and transformer building are given in Fig. 2.

Fig. 2.

The numbers in Table III. well illustrate the state- ment already made that the permeability /x = B/H has a maximum value corresponding to a certain flux density. The tables also are explanatory of the fact that steel has gradually replaced iron in the manufacture of dynamo electromagnets and transformer-cores.

Broadly speaking, the materials which are now em- ployed in the manufacture of the cores of electromagnets for technical purposes of various kinds may be ^^^^^j^,^ said to fall into three classes, namely, forgings, fyrZres. castings, and stampings. In some cases the iron or steel core which is to be magnetized is simply a mass of ironhammered or pressed into shape by hydraulic pressure ;

in other cases it has to be fused and cast j and for certain other purposes it must be rolled first into thin sheets, which are subsequently stamped out into the required forms.

Por particular purposes it is necessary to obtain the highest possible magnetic permeability corresponding to a high, or the highest attainable flux density. This is generally the case in the electromagnets which are em- ployed as the field magnets in dynamo machines. It may generally be said that whilst the best wrought iron, such as annealed Low Moor or Swedish iron, is more per- meable for low flux densities than steel castings, the cast steel may surpass the wrought metal for high flux density. For most electro-technical purposes the best magnetic results are given by the employment of forged ingot-iron. This material is probably the most permeable throughout the whole scale of attainable flux densities.

Permeji’GTfily Carves oflnok aad Steef

2000 1900 1300 1700 1600 1500 11-00

f30Q

1200

f/00

1000 900

BOO

700 600 500

‘too too

zoo too

4/agrtBtiG Flux Oensitii q’ Induction 3 in CS.S units

Fig. 8.

It is slightly superior to wrought iron, and it only be- comes inferior to the highest class of cast steel when the flux density is pressed above 18,000 C.G.S. units (see Fig. 3). For flux densities above 13,000 the forged ingot-iron has now practically replaced for electric engineering purposes the Low Moor or Swedish iron. Owing to the method of its production it might in truth be called a soft steel with a very small percentage of combined car- bon. The best description of this material is conveyed by the German term ” Flusseisen,” but its nearest British equivalent is “ingot-iron.” Chemically speaking, the material is for all practical purposes very nearly pure iron. The same may be said of the cast steels now much employed for the production of dynamo magnet-cores. The cast steel which is in demand for this purpose has a slightly lower permeability than the ingot-iron for low flux densities, but for flux densities above 16,000 the re- quired result may be more cheaply obtained with a steel casting than with a forging. When high tensile strength is required in addition to considerable magnetic permea- bility, it has been foimd advantageous to employ a steel containing 5 per cent, of nickel. The rolled sheet iron and sheet steel which is in request for the construction of magnet cores, especially those in which the exciting current is an alternating current, are, generally speaking, produced from Swedish iron. Owing to the mechanical treatment necessary to reduce the material to a thin sheet, the permeability at low flux densities is rather higher than, although at high flux densities it is inferior

“ – x

4 V ^

/ ^1 a

r . S V:

A<2 Tr

\^ IC

,.d|i!:^;j ^,

^t ^l i-

3 J ^^ X

% f c i

4 ^ ^

1 ^

3 ^^C

^4

W

^ ii.^ ~~i S r~~

^^ H

^S; ^^

-=. ^

⁇l 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

to, ~~the same iron and steel when tested in bulk. For most purposes, however, where a laminated iron magnet~~ core is required, the flux density is not pressed up above 6000 units, and it is then more important to secure small hysteresis loss than high permeability. The magnetic permeability of

cast iron is much inferior to that of wrought or ingot-iron, or the mild steels taken at the same flux densities.

The following Table IV. gives the flux density and permeability of a typical cast iron taken by Fleming by the ballistic method.

Table TV. Magnetic Permeability and Magnetization

Curve of Cast Iron.

H.

B.

M

H.

B.

/*

H.

B.

/i

27

139

8-84

4030

456

44 ###es

8,071

181

###41

62

150

10-60

4491

424

56 ^57

8,548

151

1^11

206

176

12-33

4884

396

71^98

9,097

126

2^53

768

.303

13-96

5276

378

88^99

9,600

108

3-41

1251

367

15-61

5504

353

106 ###35

10,066

95

4^45

1898

4>n

18-21

5829

320

120-60

10,375

86

5-67

2589

456

26-37

6814

258

140-37

10,725

76

7^16

.3350

468

36^54

7580

207

152^73

10,985

72

i, The metal, of which the tests are given in Table IV., contained 2 per cent, of silicon, 2^86 per cent, of total carbon, and Q)-5 per cent, of manganese. It will be seen that a magnetizing force of about 5 C.G.S. units is suffi- cient to impart to a wrought-iron ring a flux density of 18,000 C.G.S. units, but the same force hardly produces more than one-tenth of this flux density in cast iron.

The testing of sheet iron and steel for magnetic hys- teresis loss has developed into an important factory process, giving as it does a means of ascertaining the suitability of the metal for use in the manufacture of transformers and alternating-current electromagnets.

In Table V. are given the results of hysteresis tests by Ewing on samples of commercial sheet iron and steel. The numbers VII., VIII., IX., and X. refer to the same samples as those for which permeability results are given in Table III.

Table V. ??? Hysteresis Loss in Transformer-iron.

Maxi- mum Flux Density B.

Ergs per Cubic Centimetre per Cycle.

Watts per lb at a Frequency of 100.

VII.

Swedish

Iron.

VIII. Forged Scrap- iron.

IX.

Ingot- steel.

X. Soft Iron Wire.

VII.

VIII.

IX.

X.

2000 3000 4000 5000 6000 7000 8000 9000

240 520 830 1190 1600 2020 2510 3050

400 790 1220 1710 2260 2940 3710 4560

215 430 700 1000 1350 1730 2150 2620

600 1150 1780 2640 3360 4300 5300 6380

0^141

0-306

0^490

0-700 0-940 1-200 1-480 1-800

0-236 0-465 0-720 1-010 1-330 1-730 2-180 2-680

0-127 0-253 0-410 0-590 0-790 1-020 1-270 1-540

0-356 0-630

1^050 1^550

1-980

2^530

3-120 3-750

In Table VI. are given the results of a magnetic test of some exceedingly good transformer-sheet rolled from Swedish iron.

Table VI. ††† Hysteresli Loss in Strip of Transformer- plate rolled from Swedish Iron.

Ma.>††imum FUix

Ergs per Cubic Centimetre

. Watts per lb at a

Density B.

per Cycle,

Frequency of 100.

2000

220

0-129

3000

410

0-242

4000

640

0-376

5000

910

0-585

6000

1200

0-710

7000

1520

0-890

8000

1900

1-120

9000

2310

1-360

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In Table VII. are given some values obtained by Flem- ing for the hysteresis loss in the sample of cast iron, the permeability test of which is recorded in Table IV.

Table JV^II. ??? Observations on the Magnetic Hysteresis of Cast Iron.

Loop.

B. (max.)

Hysteresis Loss.

Ergs per cc. per Cycle.

Watts per H) per 100 Cycles per sec.

I.

1475

466i

???300

II.

2545

1,288

???829

III.

3865

2,997

1-934

IV.

6972

7,397

4-765

V.

8930

13,423

8-658

For most practical purposes the constructor of electro- magnetic machinery requires his iron or steel to have some one of the following characteristics. If for dynamo or magnet making, it should have the highest possible permeability at a flux density corresponding to practically maximum magnetization. If for transformer or alternat- ing-current ii)agnet building it should have the smallest possible hysteresis loss at a maximum flux density of 2500 C.Gr.S. units during the cycle. If required for perma- nent magnet making it should have the highest possible coercivity combined with a high retentivity. Manufac- turers of iron and steel have been able to meet these demands in a very remarkable manner, during the last few years, by the commercial production of material of a quality which at one time would have been considered a scientific curiosity.

It is usual now to specify iron and steel for the first purpose by naming the minimum permeability it should possess corresponding to a flux density of 18,000 C.G.S. units ; for the second, by stating the hysteresis loss in watts per ft, per 100 cycles, per second, corresponding to a maximum flux density of 2500 C.G.S. units during the cycle ; and for the third, by mentioning the coercive force required to reduce to zero magnetization a sample of the metal in the form of a long bar magnetized to a stated magnetization.

In dealing with problems involving the use of an elec- tromagnet, we are confronted with the notion and laws of the magnetic circuit.

Consider in the first instance the simple case of a ring of iron magnetized by an endless solenoid. Let the section of the ring be S and the main perimeter L.

Let H be the magnetizing force to which the iron is subjected. In the interior of the solenoid this force is equal to 4x/10 times the exciting ampere-turns per unit length of perimeter. The product HL is called the line integral of magnetic force, or the magnetomo- tive force (M . M. F.) . It is obviously measured by 0-47r times the ex- citing ampere-turns (A.T.).

Hence since |uH=B if we write p-^ for fi and call p the reluc- tivity of the material, we have ###

HL M.M.F. 0-47rA.T. ^^-^###B### R

S or the total magnetic flux is numerically equal to the quotient of the magnetomotive force by a quantity (R) called the magnetic re- luctance of the circuit. ‘

Hence if the reluctivity (p) of the material or its reciprocal the permeability (/t) corresponding to a given flux density (B) is knovrn, we can calculate the ampere-turns (A.T.) required to pro- duce a given total flux in the iron core.

The value of /i. corresponding to any given flux density can always be obtained from the permeability curve of the material (see Pig. 3).

Hence the ampere-turns (A.T.) necessary to produce a required total flux in a magnetic circuit of length L and section S can be calculated from the expression

A.T. = 0 -8 (BS) X R = 0-8 X (BS) X ^

where BS is the total flux and R is the reluctance of the circuit. This last is equal to i/ij.S where /i is the permeability correspond- ing to B. (For all

practical purposes 0-8 = 10/47r.)

The fundamental law of the non-homogeneous magnetic circuit traversed by one and the same total magnetic flux is that the sum of all the magnetomotive forces acting on the circuit is numerically equal to the product of 0-8 times the total flux in the circuit, and the sum of all the reluctances of the various parts of the circuit. If then the circuit consists of materials of different permeability, and it is desired to know the ampere-turns required to pro- duce a given total of flux round the circuit, we have to calculate from the magnetization curves of each part the necessary magnetomotive forces and add these forces to- gether. The practical application ~~of this principle to the predetermination of the field windings of dynamo mag~~ nets was first made by Drs J. and E. Hopkinson (see Phil. Trans. Boy. Soc. vol. clxxvii. p. 331).

We may illustrate the principles of this predetermination by a simple example. Suppose a ring of iron has a mean diameter of 10 cms. and a cross section of 2 square cms. and a transverse cut or air gap made in it one millimetre wide, required the ampere- turns to be put upon the ring to create in it a total flux of 24,000 C.G.S. units. The total length of the iron part of the circuit is (IOt-O-I) cms., and its section is 2 sq. cms., and the flux density in it is to be 12,000. From Table II. we see that the permeability of pure iron corresponding to a flux density of 12,000 is 2760. iHence the reluctance of the iron circuit is equal

, lOir-O-l 220 ××× ^ ××× .^ to ^^^^ -= C.G.S. units.

2760 X 2″

The length of the air gap is 0-1 cm., its section 2 sq. cms., and its permeability is unity. Hence the reluctance of the air gap is

Accordingly the magnetomotive force in ampere-turns required to produce the required flux is equal to

0-8(24,000) (1+JI-J =1070 nearly.

It will be seen that the part of the magnetoinotive force required to overcome the reluctance of the narrow air gap is about nine times that required for the iron alone.

In the above example we have for simplicity assumed that the flux in passing across the air gap does not spread out at all. In dealing with dynamo designing we have to take into consideration this spreading as well as the leakage of flux across the circuit (see Dynamo) .

It will be seen, therefore, that in order that we may predict the effect of a certain kind of iron or steel when used as the core of an electromagnet we must be provided with tables or curves showing the reluctivity corresponding to given flux densities or ??? which copies to the same thing ??? ^with (B, H) curves for the sample.

The commercial testing of iron for electro-technical purposes has of late years become a very important mat- ter. The electrical engineer is now enabled to specify the particular kind of iron or steel required for his pur- pose with the same accuracy and definiteness that a mechanical engineer specifies for certain mechanical quali- ties in the materials he employs. The process for obtaining hysteresis loops and permeability curves from the series of observations made with the ballistic galvanometer to determine a (B, H) curve or (B, H) cycle is a tedious operation, yet at the same time it is the most accurate and trustworthy method. In order to shorten the process many instruments have been devised of late years for use in the workshop. Instruments of this kind for determin- ing the flux density corresponding to a given magnetizing force in a complete magnetic circuit formed in part or in whole of a particular material are called permeameters (see Magnetism).

The measurement of hysteresis losses in samples of sheet iron is facilitated by the employment of various forms of hysteresis metre. The principle on which some of these instruments depend for their operation is the

fact that if a mass of laminated iron or steel is caused to revolve in a magnetic field, or suspended in a revolving magnetic field with the plane of the laminations parallel to the direction of the field, forces will be brought to bear tending to create a rotation either of the magnet or of the mass of laminated metal. In order that sources of error may be eliminated it is necessary that the specimen tested should be so well laminated as to destroy all electric eddy- currents in its mass. A simple yet convenient instrument of this kind has been devised by Ewing, and is shown in

Fig. 4. The instrument consists of Si curved metavf'^ permanent steel magnet, nicely balanced on

knife edges, and having attached to it a long index needle. The specimen of iron to be tested for hysteresis is prepared in the form of thin sheets of a rectangular shape, 3 inches long and | of an inch wide. Seven of these little sheets are fixed together and attached to a shaft which can be caused to revolve be- tween the poles of the magnet. The user of the instru- ment by rotating the handle causes the specimen to revolve rapidly between the poles of the balanced magnet with the plane of its laminations parallel to the direction of the interpolar field. In consequence of the waste of energy in the sample due to hysteresis a torque is brought into existence which displaces the magnet through a certain angle depending upon the counter-balance attached

Fig. 4.

to the magnet, which tends to bring it back into a vertical position. The instrument is provided with certain samples of iron plate cut to the proper size, the hysteresis loss in which is accurately known. By comparing the deflexions of the permanent magnet given by these standard speci- mens with that produced by the specimen under test, the hysteresis loss in the specimen can be at once obtained. The assumptions made in the construction of the instru- ment are that for samples of iron not differing very much in magnetic quality the hysteresis losses at different induction densities are in 'the same ratio ; also that slight differences in permeability do not affect the result by causing the magnetic forces on the two specimens to be very different.

One objection which has been raised to the employment

of such a rotating hysteresis meter is, that the character of the cyclic change of the magnetizing force is quite different in this case from that which it is when the mag- netic force undergoes the periodic change without any alteration in this direction. These two cases are clearly different. In the first case, which is that of the alternat- ing transformer, the magnetic force passes through a/jycle of values, the iron remaining stationary, and the direction of the magnetic force being always the same. In the other case, the direction of the magnetic force in the iron is constantly changing, and at the same time undergoing a change in magnitude.

It has been shown by F. Gr. Baily that if a mass of laminated iron is rotating in a magnetic field, the field remaining constant in direction and magnitude in any one experiment, as the magnitude of the flux density in the iron is increased the hysteresis loss rises to a maximum, and then falls away again to nearly zero value. These observations have been confirmed by other observers. The question has been much debated whether the values of the hysteresis loss obtained by these two different methods are identical for magnetic cycles in which the flux density reaches the same maximum value. This question is also connected with another one,namely,whether the hysteresis loss per cycle is or is not a function of the speed with which the cycle is traversed. Early experiments by Steinmetz and others seemed to show that there was a difference be- tween slow-speed and high-speed hysteresis cycles, but later experiments by Hopkinson and by Tanakadate, though not absolutely exhaustive, tend to prove that up to 400 cycles per second the hysteresis loss per cycle is practically unchanged.

Experiments made in 1896 by Fleming, Beattie, and Clinker on magnetic hysteresis in rotating fields were partly directed to determine whether the hysteresis loss at moderate flux densities, such as are employed in trans- former-work, was the same as that found by measure- ments made with alternating-current fields on the’ same iron and steel specimens. These experiments showed that over moderate ranges of induction, such as may be expected in electro-technical work, the hysteresis loss per cycle per cubic centimetre was practically the same when the iron was tested in an alternating field with a periodicity of 100, the field remaining constant in

direc- tion, and when the iron was tested in a rotating field giving the same maximum flux density.

In the hysteresis tester of Ewing the field magnet is arranged to give a mean flux density of about 4000 C.G.S. units on the specimen under test. Hence the hysteresis loss in the standard specimens is deter- mined for that value. If the loss is required at any other flux density, it is determined by means of a series of factors which show the ratio of hysteresis losses at various flux densities. The factors are as follows : ###

Maximum Flux Density In C.G.S. Units.

2000 2500 3000 4000 5000 6000 7000 8000

Relative Amount of Hysteresis Loss.

0-33 0-47 0-63 1-00 1-41 1‘89 2-41 3-00

With respect to the variation of hysteresis loss in mag- netic cycles having different maximum values for the flux density, Steinmetz found that the hysteresis loss {^Y) as measured by the area of the complete (B, H) cycle and ex- pressed in ergs per centimetre-cube per cycle, varies pro- portionately to a constant called the hysteretic constant, and to the l-6th power of the maximum flux density (B), orW=,,B>-##.

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The liysteretic constants for various kinds of iron and steel are given in the table below : ###

Metal. Hysteretic Constant.

Swedish wrought iron, well annealed . ‘0010 to ###0017 Annealed cast steel of good quality ; small

percentage of carbon .... ‘0017 to -0029

Cast Siemens-Martin steel .... -0019 to -0028

Cast ingot-iron -0021 to -0026

Cast steel, with higher percentages of

carbon, or inferior qualities of wrought

iron -0031 to -0054

Steinmetz's law, though not strictly true for very low or very high maximum flux densities, is yet a convenient Empirical rule for obtaining approximately the hysteresis loss at any one maximum flux density, knowing it at another, provided these values fall within a range varying say from 1 to 9000 C.G.S. units. (See also Magnetism.)

The standard maximum flux density which is adopted in electro-technical work is 2500, hence in the construc- tion of the cores of alternating-current electromagnets and transformers iron has to be employed having a known hysteretic constant at the standard flux density. It is generally expressed by stating the number of watts per ft of metal which would be dissipated for a fre- quency of 100 cycles, and a maximum flux density (B max.) during the cycle of 2500. In the case of good iron or steel for transformer-core making, it should not exceed 1-25 watt per ft per 100 cycles per 2500 B (max- imum value).

It has been found that if the sheet iron employed for cores of alternating electromagnets or transformers is heated to a temperature somewhere in the neighbourhood of 200►► C. the hysteresis loss is very greatly increased. It was noticed in 1894 by Partridge that alternating- current transformers which had been in use some time had a very considerably augmented core loss when com- pared with their initial condition. BMthy and Mordey in 1895 showed that this augmentation in hysteresis loss in iron was due to heating. Parshall investigated the effect up to moderate temperatures, such as 140►► C, and an extensive series of experiments was made in 1898 by Roget {Proc. Roy. Soc, May and Dee. 1898). Roget found that below 40►► C. a rise in temperature did not produce any augmentation in the hysteresis loss in iron, but if it is heated to between 40►► C. and 135►►

C. the hysteresis loss increases continuously with time, andthis increase is now called ” ageing ” of the iron. It proceeds more slowly as the temperature is higher. If heated to above 135 C, the hysteresis loss soon attains a maximum, but then begins to decrease. Certain specimens heated to 160 C. were found to have their hysteresis loss doubled in a few days. The effect seems to come to a maximum at about 180 C. or 200 C. Mere lapse of time does not remove the increase, but if the iron is re-annealed the augmentation in hysteresis disappears. If the iron is heated to a-higher temperature, say between 300 C. and 700 C, Eoget found the initial rise of hysteresis happens more quickly, but that the metal soon settles down into a state in which the hysteresis loss has a small but still augmented con- stant value. The augmentation in value, however, becomes more nearly zero as the temperature approaches 700 C. Brands of steel are now obtainable which do not age in this manner, but these non-ageing varieties of steel have not generally such low initial hysteresis values as the ” Swedish Iron,” commonljy considered best for the cores of transformers and alternating current magnets.

The following conclusions have been reached in the matter : (1) Iron and mild steel in the annealed state are more liable to change their hysteresis value by heating than when in the harder condition ; (2) all changes are removed by re-annealing; (3) the changes thus pro- duced by heating affect not only the amount of the

hysteresis loss, but also the form of the lower part of the (B, H) curve.

The form which an electromagnet must take will greatly depend upon the purposes for whiCh it is to be used. A design or form of electromagnet which will be very suitable for some purposes will be useless for others. Supposing it is desired to make an electromagnet which shall be capable of undergoing very rapid changes of strength, it must have such a form that the coer- civity of the material is overcome by a self- Porms of demagnetizing force. This can be achieved by magnet making the magnet in the form of a short and stout bar rather than a long thin one. It has already been explained that the ends or poles of a polar magnet exert a demagnetizing power upon the mass of the metal in the interior of the bar. If then the electromagnet has the form of a long thin bar, the length of which is several hundred times its

diameter, the poles are very far re- moved from the centre of the bar, and the demag- netizing action will be very feeble; such a long thin electromagnet, although made of very soft iron, retains a considerable “amount of magnetism after the magnet- izing force is withdrawn. On the other hand, a very thick bar very quickly demagnetizes itself, because no part of the metal is far removed from the action of the free poles. Hence when, as in many telegraphic instru- ments, a piece of soft iron, called an armature, has to be attracted to the poles of a horseshoe-shaped electromagnet, this armature should be prevented from quite touching the polar surfaces of the magnet. If a soft iron mass does quite touch the poles, then it completes the magnetic circuit and abolishes the free poles, and the magnet is to a very large extent deprived of its self-demagnet- izing power. This is the explanation of the well- known fact that after exciting the electromagnet and then stopping the current, it still requires a good pull to detach the ” keeper ” ; but when once the keeper has been detached, the magnetism is found to have nearly disappeared.

Various forms of electromagnets used in connexion with dynamo machines are considered in another place (see Dynamo), and there is, therefore, no necessity to refer particularly to the numerous different shapes and types employed in electro-technics.

For additional information on the above subject the reader may be referred to the following works and original papers : ###

Dtj Bois. The Magnetic Circuit in Theory and Practice. ### S. P. Thompson. The Electromagnet. ### J. A. Fleming. Magnets and Electric Currents. ### J. A. Ewing. Magnetic Induction in Iron and other Metals. ### J. A. Fleming. “The Ferromagnetic Pro- perties of Iron and Steel,” Proceedings of Sheffield Society of En- gineers and Metallurgists, Oct. 1897.### J. A. Ewing. The Magnetic Testing of Iron and Steel.### Ji. F. Pakshall. “The Magnetic Data of Iron and Steel,” Proc. Inst. Civil Engineers, vol. oxxvi. 1895-96.### J. A. Ewing. “The Molecular Theory of Induced Magnetism,” Phil. Mag., Sept. 1890.### W. M. Mokdet. ” Slow Changes in the Permeability of Iron,” Proc. Boy. Soc. vol. Ivii. p. 224. ### F. G. Bailt. ” Hysteresis of Iron in a Rotating Mag- netic Field,” Proc. Boy. Soc, 1896.### J. A. Ewing. ” Magnet-

ism,” James Forrest Lecture, Proc. Inst. Civil Engineers, vol. oxxxviii. ††† S. P. Thompson. ” Electromagnetic Mechanism, ” Elec- trician, vol. xxvi. pp. 238, 269, 293.††† J. A. Ewing. “Experi- mental Eesearches in Magnetism,” Phil. Trans. Boy. Soc, 1885, Part ii.††† Ewing and Klassen. ” Magnetic Qualities of Iron,” Proc Boy. Soc, 1893. (j. A. F.)

Electro-Metallurgy.††† The present article will, asexplainedunderELECTKO-CHBMiSTEY,treatonly of those processes in which electricity is applied to the production of chemical reactions or molecular changes at ftu-nace temperatures. In many of these the application of heat is necessary to bring the substances used into th6 liquid state for the purpose of electrolysis, aqueous solutions being unsuitable. Among the earliest experiments in this branch of the subiect were those of Davy, who in 1807

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{Phil. Trans. Boy. Soc, 1808, p. 1), produced the alkali metals by passing an intense current of electricity, from a platinum wire to a platinum dish, through a mass of fused caustic alkali. The action was started in the cold, the alkali being slightly moistened to render it a con- ductor ; then, as the current passed, heat was produced, and the alkali fused, the metal being deposited in the liquid condition. Later, Matthiessen (Quarterly Journ. Chem. Soc. vol. viii. p. 30) obtained potassium by the electrolysis of a mixture of potassium and calcium chlorides fused over a lamp. There are here foreshadowed two types of electrolytic furnace-operations : (a) those in which external heating maintains the electrolyte in the fused condition, and (&) those in which . a current- density is applied sufficiently high to develop the heat necessary to effect this object unaided. Much of the earlier electro-metallurgical work was done with furnaces of the (a) type, while nearly all the later developments have been with those of class (6). There is a third class of operations, exemplified by the manufacture of calcium carbide, in which electricity is employed solely as a heat- ing agent ; these are termed electrothermal, as distinguished from electrolytic. In certain

electrothermal processes (e.g., calcium carbide production) the heat from the cur- rent is employed in raising mixtures of substances to the temperature at which a desired chemical reaction will take place between them, while in others (e.g., the production of graphite from coke or gas-carbon) the heat is applied solely to the production of molecular or physi- cal changes. In ordinary electrolytic work only the continuous current may of course be used, but in electro- thermal work an alternating-current is equally available. Electric- Furnaces. ??? Independently of the question of the application of external heating, the furnaces used in electro-metallurgy may be broadly classified into (i) arc furnaces, in which the intense heat of the electric arc is utilized, and (ii) resistance and incandescence furnaces, in which the heat is generated by an electric current overcoming the resistance of an inferior conductor.

Excepting such experimental arrangements as that of Depretz, for use on a small scale in the laboratory, Pichou in France and P”ohnson in England appear, in 1853, to have introduced the earliest practical form of furnace. In these arrangements, which were similar if not identical, the furnace charge was crushed to a fine powder and passed through two or more electric arcs in succession. When used for ore smelting, the reduced metal and the accompanying slag were to be caught, after leaving the arc and while still liquid, in a hearth fired with ordinary fuel. Although this primitive furnace could be made to act, its ejBB.ciency was low, and the use of a separate fire was dis- advantageous. In 1878 Sir William Siemens patented a form of furnace ^ which is the type of a very large num- ber of those designed by later inventors.

In the best known form a plumbago crucible was used with a hole cut in the bottom to receive a carbon rod, which was ground in so as to make a tight joint. This rod was connected with the positive pole of the dynamo or electric generator. The crucible was fitted with a cover in which were two holes; one at the side to serve at once as sight-hole and charging door, the other in the centre to allow a second carbon rod to pass freely (without touch- ing) into the interior. This rod was connected with the negative pole of the generator, and was suspended from one arm of -a, balance-beam, while from the other end of the beam was sus- pended a vertical hollow iron cylinder, which could be moved into or out of a wire coil or solenoid joined

as a shunt across the two carbon rods of the furnace. The solenoid was above the iron cylinder, the supporting rod of which passed through it as a core. When the furnace with this well-known regulating device was to

1 Cf . Siemens's account of the use of this furnace for experimental purjioses in British Association Report for 1882.

be used, say, for the melting of metals or other conductors of electricity, the fragments of metal were placed in the crucible and the positive electrode was brought near them. Immediately the current passed through the solenoid it caused the iron cylinder to rise and, by means of its supporting rod, forced the end of the balance beam upwards, so depressing the other end that the nega^ tive carbon rod was forced downwards into contact with the metal in the crucible. This action completed the furnace-cfrcuit, and current passed freely from the positive carbon through the frag- ments of metal to the negative carbon, thereby reducing the current through the shunt. At once the attractive force of the solenoid on the iron cylinder was automatically reduced, and the falling of the latter caused the negative carbon to rise, starting an arc between it and the metal in the crucible. A counterpoise was placed on the solenoid end of the balance beam to act against the attraction of the solenoid, the position of the counterpoise determining the length of the arc in the crucible. Any change in the resistance of the arc, either by lengthening, due to the sinking of the charge in the crucible, or by the burning of the carbon, affected the propor- tion of current flowing in the two shunt circuits, and so altered the position of the iron cylinder in the solenoid that the length of arc was, within limits, automatically regulated. Were it not for the use of some such device the arc would be liable to constant fluctua- tion and to frequent extinction. The crucible was surrounded with a bad conductor of heat to minimize loss by radiation. The positive carbon was in some cases replaced by a water-cooled metal tube, or ferrule, closed, of course, at the end inserted in the crucible. Several modifications were proposed, in one of which, intended for the heating of non-conducting substances, the elec- trodes were passed horizontally through perforations in the upper part of the crucible walls, and the charge in the lower part of the crucible was heated by radiation.

The furnace used by Moissan in his experiments on reactions at high temperatures, on the fusion and volatil- ization of refractory materials, and on the formation of carbides, silicides, and borides of various metals consisted, in its simplest form, of two superposed blocks of lime or of limestone with a central cavity cut in the lower block, and with a corresponding but much shallower inverted cavity in the upper block, which thus formed the lid of the furnace. Horizontal channels were cut on opposite walls, through which the carbon poles or electrodes were passed into the upper part of the cavity. Such a furnace, to take a current of 4 H.P. (say, of 60 amperes and 50 volts), measured externally about 6 by 6 by 7 in., and the elec- trodes were about 0-4 in. in diameter, while for a current of 100 H.P. (say, of 746 amperes and 100 volts) it meas- ured about 14 by 12 by 14 in., and the electrodes were about 1-5 i*i. in diameter. In the latter case the crucible, which was placed in the cavity immediately beneath the arc, was about 3 in. in diameter (internally), and about 3^ in. in height. The fact that energy is being used at so h-igh a rate as 100 H.P. on so smallacharge of material sufficiently indicates that the furnace is only used for experimental work, or for the fusion of metals which, like tungsten or chromium, can only be melted at temperatures' attain- able by electrical means. Moissan succeeded in fusing about f lb of either of these metals in 6 or 6 minutes in a furnace similar to that last described. He has also arranged an experimental tube-furnace by passing a carbon tube horizontally beneath the arc in the cavity of the lime blocks. When prolonged heating is required at very high temperatures it is found necessary to line the furnace-cavity with alternate layers of magnesia and carbon, taking care that the lamina next to the lime is of magnesia; if this were not done the lime in contact with the carbon crucible would form calcium carbide and would slag down, but magnesia does not yield a carbidein this way. Chaplet has patented a mufle or tube furnace, similar in principle, for use on a larger scale, with a number of electrodes placed above and below the muffle-tube. The arc furnaces now widely used in the manufacture of calcium carbide on a large scale are chiefly developments of the Siemens furnace. But whereas, from its construction, the Siemens furnace was intermittent in operation, necessitating stop-

page of the current while the contents of the crucible were poured out, many of the newer forms are specially designed either to minimize the time required in affectiag the with- drawal of one charge and the introduction of the next, or to ensure absolute continuity of action, raw material being constantly charged iu at the top and the finished sub- stance and bye-products (slag, &c.) withdrawn either continuously or at intervals, as sufficient quantity shall have accumulated. In the King furnace, for example, the crucible, or lowest part of the fui'nace, is made detachable, so that when full it may be removed and an empty crucible substituted. In the United States a revolving furnace is used which is quite con- tinuous in action.

The class of furnaces heated by electrically incandescent materials has been divided by Borchers into two groups :

(1) those in which the substance is heated by lacan- contact with a substance offering a high resist- furnaces. SiXLce to the current passing through it, and (2)

those in which the substance to be heated itself affords the resistance to the passage of the current whereby electric energy is converted into heat. Practically the first of these furnaces was that of Depretz, in which the mixture to be heated was placed in a carbon tube rendered incandescent by the passage of a current through its substance from end to end. In 1880 Borchers intro- duced his resistance-furnace, which, in one sense, is the converse of the Depretz apparatus. A thin carbon pencil, forming a bridge between two stout carbon rods, is set in the midst of the mixture to be heated. On passing a current through the carbon the small rod is heated to incandescence, and imparts heat to the surrounding mass. On a larger scale several pencils are used to make the connexions between carbon blocks which form the end walls of the furnace, while the side walls are of fire-bricks laid upon one another without mortar. Many of the furnaces now in constant use depend mainly on this principle, a core of granular carbon fragments stamped together in the direct line between the electrodes, as in Acheson's carbor- undum furnace, being substituted for the carbon pencils. In other cases carbon fragments are mixed throughout the charge, as in

Cowles’s zinc-smelting retort. In practice, in these furnaces, it is possible for small local arcs to be temporarily set up by the shifting of the charge, and these would contribute to the heating of the mass. In the remaining class of furnace, in which the electrical resist- ance of the charge itself is utilized, are the continuous- current furnaces, such as are used for the smelting of aluminium, and those alternating-current furnaces (e.g., for the production of calcium carbide) in which a portion of the charge is first actually fused, and then maintained in the molten condition by the current passing through it, while the reaction between further portions of the charge is proceeding.

For ordinary metallurgical work the electric furnace, requiring as it does (excepting where waterfalls or other cheap sources of power are available) the intervention of the boiler and steam engine, or of the gas or oil engine,

with a consequent loss of energy, has not usually Uses aaa proved so economical as an ordinary direct fired

furnace. Bu.t in some cases in which the current

is used for electrolysis and for the production of extremely high temperatures, for which the calorific intensity of ordinary fuel is insufl&cient, the electric furnace is employed with advantage. The temperature of the electric furnace, whether of the arc or incandescence type, is practically limited to that at which the least easily vaporized niaterial available for electrodes is converted into vapour. This material is carbon, and as its vaporizing point is (estimated at) over 3500►► C, and less than 4000►► C, the temperature of the electric furnace cannot rise much

advan-

above 3500►► C. (6330►► F.) ; but Moissan has shown that at this temperature the most stable of mineral combina- tions are dissociated, and the most refractory elements are converted into vapour, only certain borides, silicides, and metallic carbides having been found to resist the action of the heat. It is not necessary that all electric furnaces shall be run at these high temperatures ; obviously, those of the incandescence or

resistance type may be worked at any convenient temperature below the maximum . The electric furnace has several advantages as compared with some of the ordinary types of furnace, arising from the fact that the heat is generated from within the mass of material operated upon, and (unlike the blast-furnace, which presents the same advantage) without a large volume of gaseous products of combustion and atmospheric nitrogen being passed through it. In ordinary reverberatory and other heating furnaces the burning fuel is without the mass, so that the vessel containing the charge, and other parts of the plant, are raised to a higher temperature than would otherwise be necessary, in order to compensate for losses by radiation, convection, and conduction. This advantage is especially observed in some cases in which the charge of the furnace is liable to attack the containing vessel at high temperatures, as it is often possible to main- tain the outer walls of the electric furnace relatively cool, and even to keep them lined with a protecting crust of unfused charge. Again, the construction of electric fur- naces may often be exceedingly crude and simple ; in the carborundum furnace, for example, the outer walls are of loosely piled bricks, and in one type of furnace the charge is simply heaped on the ground around the carbon resistance used for heating, without containing- walls of any kind. There is, however, one (not insuperable) drawback in the use of the electric furnace for the smelting of pure m etals. Ordinarily carbon is used as the electrode material, but when carbon comes in contact at high temperatures with any metal that is capable of forming a carbide a certain amount of combination between them is inevitable, and the carbon thus introduced impairs the mechanical properties Of the ultimate metallic product. Aluminium, iron, platinum, and many other metals may thus take up so much carbon as to become brittle and unforgeable. It is for this reason that Siemens, Borchers, and otherS substituted a hollow water-cooled metal block for the carbon cathode upon which the melted metal rests while in the furnace. Liquid metal coming in contact with such a surface forms a crust of solidified metal over it, and this’ crust thickens up to a certain point, namely, until the heat from within the furnace just overbalances that lost by conduction through the solidified crust and the cathode material to the flowing water. In such an arrangement, after the first instant, the melted metal in the furnace does not conle in contact with the cathode material.

Electrothermal ~~Processes. ??? In these processes the elec~~ tric current is used solely to generate heat, either to induce chemical reactions between admixed substances, or to pro- duce a physical (allotropic) modification of a given sub- stance. Borchers predicted that, at the high temperatures available with the electric furnace, every oxide would prove to be reducible by the action of carbon, and this prediction has in most instances been justified. Alumina and lime, for'example, which cannot be reduced at ordinary furnace temperatures, readily give up their oxygen to carbon in the electric furnace, and then combine with an excess of carbon to form metallic carbides. In 1885 the brothers Cowles patented a process for the electrothermal reduction of oxid- ized ores by exposure to an intense current of electricity when admixed with carbon in a retort. Later in that year they patented a process for the reduction of aluminium by carbon, and in 1886 an electric furnace with sliding carbon

lutn alloys.

rods passed through the end walls to the centre of a rect- angular furnace. The impossibility of working with just sufficient carbon to reduce the alumina, without AiumiB- using any excess which would be free to form at least so much carbide as would suffice, when dif- fused through the metal, to render it brittle, prac- tically restricts the use of such processes to the production of aluminium alloys. Aluminium bronze (aluminium and copper) and ferroaluminium (aluminium and iron) have been made in this way ; the latter is the more satisfactory product, because a certain proportion of carbon is expected in an alloy of this character, as in ferromanganese and cast-iron, and its presence is not objectionable. The fur- nace is built of fire-brick and may measure (internally) 5 ft. in length by 1 ft. 8 in. in width, and 3 ft. in height. Into each end wall is built a short iron tube sloping down- wards towards the centre, and through this is passed a bundle of five 3-in. carbon rods, bound together at the outer end by being cast into a head of cast-iron for use with iron alloys, or of cast-copper for aluminium bronze. This head slides freely in the cast-iron tubes, and is con- nected by a copper rod with one of the terminals of the dynamo

supplying the current. The carbons can thus, by the application of suitable mechanism, be withdrawn from or plunged into the furnace at will. In starting the fur- nace, the bottom is prepared by ramming it with charcoal-powder that has been soaked in milk of lime and dried, so that each particle is coated with a film of lime, which serves to reduce the loss of current by conduction through the lining when the furnace becomes hot. A sheet-iron case is then placed within the furnace, and the space between it and the walls rammed with limed charcoal ; the interior is filled with fragments of' the iron or copper to be alloyed, mixed with alumina and coarse charcoal, broken pieces of carbon being placed in position to connect the electrodes. The iron case is then removed, the whole is covered with charcoal, and a cast-iron cover with a central flue is placed above all. The current, either continuous or alternating, is then started, and continued for about 1 to 1\ hours, until the operation is complete, the carbon rods being gradually withdrawn as the action proceeds. In such a furnace a continuous current, for example, of 3000 amperes, at 50 to 60 volts, may be used at first, increas- ing to 5000 amperes in about half an hour. The reduction is not due to electrolysis, but to the action of carbon on alumina (Alij03-|-3C=Al2-|-3CO), a part of the carbon in the charge being consumed and evolved as carbon monoxide gas, which burns at the orifice in the cover so long as reduction is taking place. The reduced aluminium alloys itself immediately with the fused globules of metal in its midst, and as the charge becomes reduced the glob- ules of alloy unite until, in the end, they are run out of the tap-hole after the current has been diverted to another furnace. It was found in practice (in 1889) that the ex- penditure of energy per pound of reduced aluminium was about 23 H.P.-hours, a number considerably in excess of that required at the present time for the production of pure aluminium by the electrolytic process hereafter to be described.

Wohler, in 1862, had obtained an impure calcium car- bide, and Borchers had unintentionally produced some of the carbide (CaCj) in his incandescence electric furnace, but Willson, in America, working with an arc furnace, seems to have been the first to make the product industrially, and to have realized the possibilities of its use in the manufacture of acetylene by mere contact with water. Willson and Moissan (Oomptes Bendtis, vol. cxv. p. 558), in 1892, described the produc- tion of the carbide in their respective electric furnaces, the one commercially the other

experimentally, and since then many inventors have turned their attention to its manufac-

Calclam carbide.

ture by electrothermal methods. In every case the prin- ciple is the same, the charge, consisting of pure lime and good hard coke-dust, very finely crushed and intimately mixed in the approximate proportion of 10 to 7, is intro- duced into a carbon-lined vfessel, in the interior of which a powerful arc is passing between carbon electrodes (usually between a vertical carbon and a carbon bottom). Part of the carbon reduces the lime, whilst a further portion com- bines with the liberated calcium to form the carbide, thus (CaO-|-3C = CaC2-l-CO), and the carbide fuses and sinks to the bottom. . The system of treatment may be either continuous or intermittent. In the continuous process a carbon-lined furnace is commonly used, with a massive carbon electrode (made up of several blocks of carbon clamped together) within it. Sufficiently high current- density is employed to ensure that the carbide formed remains fluid, and the passage of the (alternating) current through the fluid carbide, after the surface is once in work- ing order, is depended upon to generate the heat necessary both to keep it molten and to continue the action. A part of the carbide is tapped out of the furnace from time to time as it accumulates. In the intermittent process the current is stopped in about 12 to 18 hours when sufficient carbide is formed, and after cooling the solidified product is removed. In the King type of furnace a movable hearth is used, so that the action of the furnace is practically con- tinuous, the current being broken only for the few minutes necessary to effect the exchange of hearths.

Although continuous processes appeared at one time to be grow- ing in favour, there is in many places a tendency to revert to intermittent furnaces. Carlson, in a comparison of the two types {Zeitschnft f. Elektrochem., 1900, vol. vi. pp. 413-429), has pointed out that the intermittent process is more economical, mainly on ac- count of the higher temperature necessary in the continuous furnace to maintain the carbide fluid, but partly owing to the fact that the cooling carbide to some extent continues the reaction on portions of the surrounding charge still unconverted after the cun-ent has been diverted. The reaction between lime and carbon appears to begin at a

temperature not greatly above 1500►► C, but fusion does not occur until 2800►► C. is reached, and the product only flows freely at temperatures between 3500►► and 4000►► C. In order that the carbide may be tapped from the furnace, it must attain a tempera- ture, therefore, of at least 3500►► C. , whereas in the intermittent process 2800►► to 3000►► C. (3500►► to 3800►► F.) sufdces. This leads to a saving in many directions, too numerous here to mention in detail. In the intermittent process, using an electrode of about 100 sq. in. in cross section, a current of about 2000 amperes at 70 to 100 volts (equal to about 250 E.H.P.) has been found to give in practice about 11 cwt. of a product containing, say, 80 per cent, of pure carbide for each ton of charge. This is equivalent to a pro- duction of about 0-4 lb of carbide per E.H.P.-hour.

Carborundum, which on account of its great hardness has assumed an important place among abrasives used for polishing, and also has possible applications in the metallurgy of iron and steel, is a silicide of u^oum. carbon (SiC) formed by the action of carbon on sand (silica) at high temperatures. Its name was derived from carbon and corundum (a form of alumina), from a mistaken view as to its oomposition. It was first obtained accidentally in 1891 by Acheson, in America, when he was experimenting with the electric furnace in the hope of pro- ducing artificial diamonds. The experiments were followed up in an incandescence furnace, which on a larger scale is now employed for the industrial manufacture of the pro- duct. A full description of the process has been given by Kohn {Journ. Soc. Chem. Industry, 1897, vol. xvi. p. 863). The furnace is rectangular, about 16 ft. long and .6 ft. wide by 6 ft. high, with massive brick end waJls 2 ft. thick, through which are built the carbon poles, consisting of bundles of 60 parallel 3-in. carbon rods, each 3 ft. in length, with a copper rod let into the outer end to connect it with a copper cap, which in turn is connected with one of the terminals of the generating dynamo. The spaces

between the carbons of the electrode are packed tightly with graphite. In preparing the furnace for use, trans- verse iron screens are placed

temporarily across each end, the space between these and the end walls being rammed with fine coke, and that in the interior is filled to the level of the centre of the carbon poles with the charge, con- sisting of 34 parts of coke, with 54 of sand, 10 of sawdust, and 2 of salt. A longitudinal trench is then formed in the middle, and in this is arranged a cylindrical pile of fragments of coke about ^ in. or more in diameter, so that they form a core, about 21 in. in diameter, connecting the carbon poles in the end walls. Temporary side walls are then built up, the iron screens are removed, and a further quantity of charge is heaped up about 3 ft. above the top of the furnace. An alternating current of about 1700 amperes at 190 volts is now switched on ; as the mass becomes heated by the passage of the current the resistance diminishes, and the current is regulated until after about

2 hours or less from starting it is maintained constant at about 6000 amperes and 125 “Volts. Carbon monoxide is given off and burns freely around the sides and top of the furnace, tinged yellow after a time by the sodium in the salt mixed with the charge. Meanwhile a shrinkage takes place, which is made good by the addition of a further quantity of charge until the operation is complete, usually in about 36 hours from the commencement. The current is then switched of, and the side walls, after cooling for a day, are taken down, the comparatively unaltered charge from the top is removed, and the products are carefully extracted. These consist of the inner carbon core, which at the temperature of the furnace will have been for the most part converted into graphite, then a thin black crust of graphite mixed with carborundum, next a layer of nearly pure crystallized carborundum about a foot in thickness, then grey amorphous carbide of silicon mixed with increasing proportions of unaltered charge, and lastly, on the outside, the portion of the charge which had never reached the temperature necessary for reaction, and which is altered only by the intru.sion of salt from the inner part of the furnace. Special precautions are taken in making and breaking the intense current here used (amounting at the end to about 750 kilowatts, or 1000 E.H.P.), a water-regulator consisting of removable iron plates dipped in salt water being used for the purpose. In such a furnace as that above described the cha*rge weighs about 14 tons, the yield of carborundum is about

3 tons, and the expenditure of energy about 3-9 kilowatt- hours (5-2 H.P.~~hours) per pound of finished product. The carborundum thus produced is crystalline, greenish, bluish, or brownish in colour, sometibies opaque, but often translucent, resisting the action of even the strongest acids, and the action of air or of sulphur at high tem~~ peratures. The crude product can therefore be treated with hot sulphuric acid to purify it. In hardness it nearly equals the diamond, and it is used for tool grinding in the form of vitrified wheels (mixed with powdered porcelain and iron, pressed into shape and fired in a kiln). Carborundum paper, made like emery paper, is now largely used in place of garnet paper in American shoe factories, and is rapidly finding a market in other direc- tions. The amorphous carbide, which was at first a waste product, has been tried, it is reported, with success as a lining for steel furnaces, as it is said hot to be affected by iron or iron oxide at a white heat.

The alteration of carbon at high temperatures into a material resembling graphite has long been known. In 1893, Girard and Street patented a furnace and Graphite. ^ process by which this transformation could be effected. Carbon powder compressed into a rod was slowly passed through a tube in which it was subjected to the action of one or more electric arcs. In this way

they converted into graphite about 85 per cent, of the car- bon in a |-in. rod, the electric conductivity being increased fourfold, and the specific gravity being raised from 1-98 to 2-6. But Acheson, in 1896, patenting an application of his carborundum process, to graphite manufacture, was apparently the first to undertake the production of graphite in large quantities. Powdered coke or other form of carbon is mixed with a small proportion of an oxide or silicate, and is moulded into the desired shape with the aid of water containing a little sugar. The moulded pieces are then embedded in carbon dust, sur- rounded with a bad conductor of heat, such as amorphous carbide of silicon, and subjected to the action of the current. The oxides present form carbides which, in turn, are probably dissociated, the metal being volatilized. In time the whole of the carbon could be converted into graphite, but it is preferred to leave a small proportion unchanged, as the product is then somewhat stronger than if it were pure graphite. Graphite so produced is widely used for electrodes in electro-

chemical operations, as well as for dynamo brushes, lead pencils, and the like.

During the last few years an electrothermal process has been largely employed for the manufacture of phosphorus. Calcium phosphate, mixed with sand and carbon, is fed into an electric furnace provided with a pttns closely fitting cover with an outlet for the vapour and gases produced during the operation ; these gases are then passed through a condenser to separate the con- densible portion. The furnaces are smaller than those used in carborundum production, and commonly make about 1^ cwt. of phosphorus each per diem. At the temperature of the furnace the silica (sand) attacks the calcium phosphate, forming silicate, and setting free phosphorus pentoxide, which is attacked by the carbon of the charge, forming phosphorus and carbon monoxide gas. As phosphorus boils at 290►► C. (654►► P.), it is produced in the form of vapour, which, mingled with the carbon monoxide, passes to the condenser, where it is condensed. It is then cast under water into the sticks in which it is known in commerce. The calcium silicate remains in the furnace in the form of a liquid slag, which may be run off to make room for a further charge, so that the action is practically continuous. Kaolin may with advantage be used in addition to or in part substitution for sand, be- cause the double silicate thus formed is more fusible than the single silicate of lime. The alternating current is generally used, the action not being electrolytic. One of the special advantages of the electrical over the older process is that the distilling vessels have a longer life, owing to the fact that they are not externally heated, and so subjected to a relatively high temperature when in contact with the corrosive slag formed in the process. The Eeadman-Parker process (see Journ. Soc. Chem. Industry, 1891, vol. x. p. 445) appears to be very generally adopted. Readman, experimenting with a Cowles furnace in Staffordshire in 1888, patented his process, and in the same year Parker and Robinson, working independently, patented a similar one. The two inventors then co- operated, an experimental plant was run successfully, and the patents were taken over by the leading firm of phos- phorus manufacturers. With the object of obtaining a valuable bye-product in place of the slag produced in this furnace, several patentees {e.g., Hilbert and Prank, Billau- dot, Bradley and Jacobs, and others) have sought to com- bine the manufacture of calcium carbide and phosphorus by using only

calcium phosphate and carbon, effecting direct reduction by carbon at a high temperature. It remains to be seen whether the result will be satisfactory industrially.

Electrolytic Processes. ??? Bunsen and Deville, working independently, both produced metallic aluminium on a small scale in 1854 by the electrolysis of the fused double

chloride of aluminium and sodium contained in a porcelain crucible, heated externally in a gas flame, and divided into

two compartments, one containing a carbon f^^’”’ anode, the other a carbon or platinum (Deville) redaction, cathode. This process could not well be used

industrially, not only because at that time there was no cheap source of electric energy, but because the double chloride employed is very hygroscopic, and is therefore liable, unless stored in a perfectly dry place, to become converted into hydrated chloride which will not fuse, but is, on heating, decomposed into alumina and hydrochloric acid. The dry chloride, too, is volatile at comparatively low temperatures, so that it is practically impossible to avoid loss by vaporization ; and, moreover, the use of a chloride at all is objectionable, because of the difficulty in dealing with the corrosive and suffocating chlorine evolved at the anode. The actual system adopted in these experiments involves the use of external firing, which, as already pointed out, is usually to be avoided. Attempts to deposit aluminium from aqueous solution have been unsuccessful, and the reduction of alumina (alumin- ium oxide) by carbon in the electric furnace cannot well be used for the production of pure aluminium, on account of the readiness with which the metal at these high tempera- tures combines with carbon, and is thus rendered brittle. The use of the electric arc for the reduction of aluminium compounds other than the oxide has not met with success industrially. Speaking generally, the heat of the arc is too local and too intense for use except for the production of extremely high

temperatures. From 1870 to the present time numerous patents have been granted for methods of reducing aluminium. The processes by which it is now for the most part made ††† the Heroult, the C. M. Hall, and the Minet ††† are in principle practically the same, and have entirely replaced the older, purely chemical method.

The furnace consists of an iron or other tank lined with stamped carbon dust, the whole of the lining acting as the cathode. A stout carbon rod, or a bundle (jf such rods, forms an anode, which may be lowered into the tank to any required depth. A cover to the tank is provided, with apertures for the anode and for intro- ducing the charge. In some furnaces a tap-hole, fitted with a removable plug, is placed at one side, on a level with the bottom, so that a portion of the reduced aluminium may be run into a ladle from time to time; in others, the aluminium is removed from the tank by means of a ladle or a siphon. The bath consists usually of a mixture of the fluorides of aluminium, sodium, and calcium, or of cryolite (a natural double fluoride of aluminium and sodium), with or without admixture with other fluorides. The mixture chosen must be one which melts readily at a bright red heat ; it is either melted, little by little, in the furnace itself, with the aid of the current, a further quantity of charge being added as required until the tank is sufliciently full, or it is melted in an ordinary furnace outside, and then run into the electric furnace when ready for use. But it is not the fluoride that is electrolysed. The mixture of fluorides has the power, when melted at a red heat, of dissolving about one-fifth of its weight of aluminium oxide (alu- mina), just as water will dissolve copper sulphate. The electrolysis of this solution is comparable with tl^at of copper sulphate ††† it is the dissolved substance (alumina), not the solvent (fluoride), which is dissociated by the electric current. The voltage theoretically required for the reduction is therefore that necessary for the decomposition of alumina, or about 2-8 volts. But since no ex- ternal heat is applied, and during the whole period loss of heat by radiation is taking place, the mass would soon cool below its fusing point, and would therefore solidify, unless a current- density were usdd suflioiently high to ensure that the heat lost is made good by the conversion of electric into heat energy by the current in over- coming the resistance of the bath. For this reason a high electro- motive force is necessary to drive the current through the mass, and of the total energy consumed a great part employed is expended to produce heat. In practice,

the pressure applied is about 4 volts. The alumina is electrolysed into aluminium, which is deposited on the bottom and side walls of the tank, and oxygen, which, being liberated on the surface of the red-hot carbon anode, combines with it to form carbonic oxide (CO). The anode thus wears away, but in so doing contributes by its combustion towards the heat necessary to maintain the fluidity of the electrolyte. The expenditure of

anode carbon is, however, somewhat In excess of the amount (2 ^ of carbon : 3 lb of aluminium) theoretically necessary according to the equation AljOs-f 3C=Al2-|-3CO, partly owing to oxidation by air, partly, no doubt, to, disintegration ; and in practice the con- sumption of carbon is often equal in weight to the aluminium reduced. The aluminium is deposited at the temperature of the bath, which is commonly about 800►► C. (1,500►► F.), and therefore above the fusing-point of the metal (654►► C. or 1200►► F.), so that it is perfectly fluid and may readily be tapped or ladled out Fresh alumina is introduced from time to time to dissolve into the bath and take the place of that which has been electrolysed. Thus the action of the furnace is continuous. The fluorides are practically unchanged, and may remain in use for a long period. The alumina and the carbon anode, both of which are used up in the process, must be as pure as possible. As aluminium stands very high in the list of electro-positive metals, nearly every other metal, and even certain metalloids, such as silicon, if present in the bath, would be deposited more readily than it, and would therefore be co-precipitated, rendering the product impure and less marketable. The fluorides, on the other hand, need not be absolutely pure initially, because they remain in use for a long time, and any impurity they may contain at first is removed in the first batch of aluminium deposited, the solvent then remaining fairly pure. Commercial aluminium now rarely contains more than from 1 to \ per cent, of impurities, which consist chiefly of iron, silicon, and carbon, and the best qualities are even purer.

In the early days of the electric smelting of alumin- ium an expenditure of 22 electrical horse-power hours (16|- kilowatt hours) was necessary for every pound of aluminium produced; this, at a later date, was reduced to 16 E.H.P. hours (or 12 K.W. hours), and at Foyers, in Scotland, the expenditure per pound has now been reduced to 12 E.H.P. hours (or 9 K.W. hours). It may be noted that at Foyers (see Joum. Soc. Chem. Industry, 1898, vol.

xvii. p. 308) the total current employed in each furnace is 8000 amperes, and the current-density is 35 amperes per sq. in. of anode surface, and nearly 4-8 amperes per sq. in. of cathode surface, thus indicating that the areas of anode and cathode immersed are re- spectively about 228 sq. in. and 11-^ sq. ft. It would appear that rather more than one-third of the energy consumed, and about three-fifths of the current volume applied, are usefully employed in depositing aluminium.

Many other processes have been proposed for cheapen- ing the process of reducing aluminium. The direction in which many inventors have worked has been to find a suitable compound of aluminium with a lower heat of formation than the oxide, as such a substance would require a lower electromotive force to effect its decomposi- tion, and would therefore entail a smaller expenditure of energy to produce a given weight of the metal. Alumin- ium sulphide is such a substance, requiring only 0-9 volt theoretically for decomposition, but one of the chief diffi- culties is to find a sufficiently economical method of pre- paring it. The Aluminium Industrie Aktiengesellschaft took out a patent in Germany in 1890 for the electrolysis of this substance. Peniakoff in 1896, Blackmore in 1897, and others have also worked at sulphide processes, but there is at present no indication that any of them will displace the oxide-electrolysis process already described.

The’problem of magnesium reduction is in many respects similar to that of aluminium extraction, but the lightness of the metal as compared, bulk’ for bulk, with its fused salts (its specific gravity is only 1-75 in the^Ju^on” solid state), and the readiness with which it burns when exposed to air at high temperatures, render the problem somewhat more difficult. Moissan found that the oxide resists reduction by carbon in the electric furnace, so that electrolysis of a fusible salt of the metal must be re- sorted to. Bunsen, in 1852, electrolysed fused magnesium chloride in a porcelain crucible, divided into two compart- ments by a porcelain partition which did not quite reach the bottom. The electrodes were shaped carbon rods passing through perforations in a fire-clay lid, the cathode having inverted steps cut on the side facing the anode, so

that there should be three or four ledges to intercept and retain globules of molten magnesium accumulating on the cathode service, and tending to float upwards to the top of the bath. The separation into two compartments was necessary to prevent the passage of chlorine to the cathode side, where it would recombine with magnesium. In later processes, carnallite (a natural double chloride of magne- sium and potassium) has commonly, after careful dehydra- tion, been substituted for the single chloride. Graetzel's process, which was at one time employed, consisted in elec- trolysing the chloride in a metal crucible heated exter- nally, the crucible itself forming the cathode, and the mag- nesium being deposited upon its inner surface. Suspended within this was a fire-clay cell closed at the top and bot- tom, but with large perforations around the side walls near the bottom,and with a side-tube near the top to conduct away the chlorine generated on the surface of the carbon anode, which is suspended within this cell through a hole in its cover. The outer crucible was also provided with an annular cover, so that the space above the melted charge could be filled with a reducing gas, such as coal gas, to prevent oxidation of the reduced magnesium by contact with air. The apertures at the bottom of the fire-clay cell allowed the passage of melted electrolyte, and therefore of the current, but, being near the bottom, prevented the escape of chlorine into the outer cell excepting by diffusion. Following a suggestion made by Deville in the case of aluminium reduction, an attempt was made to replenish the bath with magnesium by introducing into the anode cell a compressed rod of magnesia and carbon, in the expectation that, in the presence of chlorine, the magnesia would be reduced by the carbon. The rods, however, crumbled into the bath and were unsatisfactory. Borchers also uses an externally heated metal cathode vessel as the cathode ; it is provided with a supporting collar or flange a little below the top, so that the upper part of the vessel is exposed to the cooling influence of the air, in order that a crust of solidified salt may there be formed, and so prevent the creeping of the electrolyte over the top. The carbon anode passes through the cover of a porcelain cylinder, open at the bottom, and provided with a side- tube at the top to remove the chlorine formfed during electrolysis. The operation is conducted at a dull red heat (about 760►► C. or 1400►► F.), the current density being about 0'64 amperes per sq. in. of cathode surface, and the pres- sure about 7 volts. The fusing-point of the metal is about 730►► C. (1350►► F.), and the magnesium is therefore re- duced in the form of melted globules which

gradually ac- cumulate. At intervals the current is interrupted, the cover removed, and the temperature of the vessel raised considerably above the melting-point of magnesium. The metal is then removed from the walls with the aid of an iron scraper, and the whole mass poured into a sheet-iron tray, where it solidifies. The solidified chloride is then broken up, the shots and fused masses of magnesium are picked out, run together in a plumbago crucible without flux, and poured into a suitable mould. Smaller pieces are thrown into a bath of melted carnallite and pressed together with an iron rod, the bath being then heated until the globules of metal float to the top, when they may be removed in perforated iron ladles, through the holes in which the fused chloride can drain away, but through which the melted magnesium cannot pass by reason of its high surface tension. The globules are then re-melted. For some years past practically the whole of the magnesium made has been obtained electro- lytically.

The isolation of the alkali metals from caustic alkalis by Davy, in 1808, was one of the earliest triumphs of electro- lysis. Until quite recently, however, the whole output of these metals was obtained by a metallurgical method ;

but now electrolytic processes alone are used. Since 1851, when Charles Watt patented his process for the re- duction of the metals from fused chlorides, many inventors have worked at the subject, most of ###f sodium them electrolysing pure or mixed chlorides, and pot- Among the diflaculties here to be contended with ######’””###### are the destructive action of fused chlorides and of the reduced alkali metals upon most non-metallic substances available for the containing vessel and its partition, and also of the anode chlorine upon metals ; also the low fusing- point (95## C. or 203## F. for sodium, and 62## C. or 144## F. for potassium), and the low specific gravity of the metals, so that the separated metal floats as a fused layer upon th^ top of the melted salt. Again, pure sodium chloride melts at about 775## C. (1427## F.), while sodium boils at about 900## C, so that the margin of safety is but small if loss by vaporization is to be prevented. Borchers (Zeitschrift f. angewandte Cliem., 1893, vol. xvi. p. 486) en- deavours to contend against the first difficulty by employ- ing an iron cathode vessel and a chamotte (fire-clay) anode chamber united by a specially constructed water- cooled joint. The other difficulty is to some extent met by using mixed chlorides

(e.g., sodium, potassium, and strontium chlorides for sodium extraction), as these melt at a lower temperature than does the pure chloride. Castner, whose sodium process (as employed at Oldbury and Niagara and in Germany) has displaced not only the old metallurgical, but the chloride method, reverted to the electrolysis of fused caustic soda. The apparatus described in the patent specification is an iron cylinder heated by gas rings below, with a narrower cylinder be- neath, through which passes upwards a stout iron cathode rod cemented in place by caustic soda solidified in the narrower vessel. Iron anodes are suspended around the cathode, and between the two is a cylinder of iron gauze at the bottom with a sheet-iron continuation above, the latter being provided with a movable cover. During elec- trolysis, oxygen is evolved at the anode and escapes from the outer vessel, while the sodium deposited in globules on the cathode floats upwards into the iron, cylinder, within which it accumulates, and from which it may be removed at intervals by means of a perforated iron ladle, the fused salt, but not the metal, being able to pass freely through the perforations. The sodium is then cast into moulds. Sodium hydroxide has certain advan- tages compared with chloride, although it is more costly ; its fusing-point is only 320 C. (600 F.), and no anode chlorine is produced, so that both containing vessel and anode may be of iron, and no porous partition is neces- sary. Alloys of sodium and lead have been prepared suc- cessfully from their fused chlorides, and in the article on Elbctbo-Chemistbt allusion is made to their use in the production of caustic alkalis.

Calcium, barium, and strontium have all been produced by electro-metallurgical methods, but the processes have only a laboratory interest at present. Lead, zinc, and other metals have also been reduced in this manner, but the industrial development of these processes has yet to come.

For further information the following books, in addition to those mentioned at the end of the article Electeo-Chemistkt, may be consulted : Borchers. Electrometallurgie. Halle, 1897. Elektrische Oefen. Halle, 1897. Moissan. Le Four Electrique. Paris, 1897. Richards. Aluminium: Its History, Occurrence, Property, Metallurgy, and Applications (the chapters relating to Electro-Metallurgical Extraction), 3rd ed. Philadelphia, 1896.

(w. G. M.) EletS (pronounced Yelets), a district town of Eussia, government and 121 miles by rail east-south-east of” Orel. It has grown rapidly since the development of the r>ilway system, has gymnasia for boys and girls and other schools, and is now an important centre and depot for trade in corn,

live-stock, hides, tallow, wool, metals, and leather. The goods sent to it by rail during the year amount to an average of 171,500 tons. Population (1897), 37,455.

Eleusis. ••• The excavations at Eleusis have been carried on systematically by M. Philios for the Greek Archaeological Society since 1882, and have laid bare the whole of the sacred precinct. It is now possible to trace its boundaries as extended at various periods, and also many successive stages in the history of the Telesterion, or Hall of Initiation. These complete excavations have shown the earlier and partial excavations to have been in some respects deceptive.

In front of the main entrance of the precinct is a large paved area, with the foundations of a temple in it, usually identified as that of Artemis Fropylsea ; in their present form both area and temple date from Roman times ; and on each side of the Great Propylsea are the foundations of a Roman triumphal arch. Just below the steps of the Propylaea, on the left as one enters, there has been dis- covered, at a lower level than the Roman pavement, the curb surrounding au early well. This is almost certainly the KoWixopov 4’P^<'^p mentioned by Pausanias. The Great Propylaea is a structure of Roman Imperial date, in close imitation of the Propylsea on the Athenian Acropolis. It is, however, set in a wall of 6th-century work, though repaired in later times. This wall encloses a sort of outer court, of irregular triangular shape. The Small Propylaea is not set exactly opposite to the Great Propylaea, but at an angle to it; an inscription on the architrave records that it was built by Appius Claudius Pulcher, the contemporary of Cicero. It is also set in a later wall that occupies approximately the same position as two earlier ones, which date from the 6th and 5th centuries respectively, and must have indicated the boundary of the inner precinct. Prom the Small

Propylaea a paved road of Roman date leads, to one of the doors of the Telesterion. Above the Small Propylaea, partly set beneath the overhanging rock, is the precinct of Pluto ; it has a curious natural cleft approached by rock-cut steps. Several inscriptions and other antiqui- ties were found here, including the famous head, now in Athens, usually called Eubuleus, though the evidence for its identification is far from satisfactory. A little farther on is a rock-cut platform, with a well, approached by a broad flight of steps, which probably served for spectators of the sacred procession. Beyond this, close to the side of the Telesterion, are the foundations of a temple on higher ground; it has been conjectured that this was the temple of Demeter, but there is no evidence that such a building existed in historic times, apart from the Telesterion.

The Telesterion, or Hall of Initiation, was a large covered building, about 170 feet square. It was siir- rounded on all sides by steps, which must have served as seats for the mystae, while the sacred dramas and pro- cessions took place on the floor of the hall : these seats were partly built up, partly cut in the solid rock ; in later times they appear to have been cased with marble. There were two doors on each side of the hall, except the north-west, where it is cut out of the solid rock, and a rock ter- race at a higher level adjoins it ; this terrace may have been the station of those who were not yet admitted to the full initiation. The roof of the hall was carried by rows of columns, which were more than once renewed.

The architectural history of the hall has been traced by Professor Dorpfeld with the help of the various foun- dations that have been brought to light. The earliest building on the site is a small rectangular structure, with walls of polygonal masonry, built of the rock quarried on the spot. This was succeeded by a square hall, almost

of the same plan as the later Telesterion, but about a quarter of the size ; its eastern corner coincides tvith that of the later building, and it appears to have had a por- tico in front like that which, in the later hall, was a later additi\Dn. Its roof was carried by columns, of which the bases can still be seen. This building has with great probability been assigned to the time of Pisistratus ; it was destroyed by the Persians. Between►►*his event and the erection of the present hall, which must be substan- tially the one

designed by Ictinus in the time of Pericles, there must have been a restoration, of which we may see the remains in a set of round sinkings to carry col- umns, which occur only in the north-east part of the hall ; a set of bases arranged on a different system occur in the south-west part, and it is difficult to see how these two systems could be reconciled unless there were some sort of partition between the two parts of the hall. Both sets were removed to make way for the later columns, of which the bases and some of the drums still remain. These later columns are shown, by inscriptions and other fragments built into their bases, to belong to later Roman times. At the eastern and southern corners of the hall of Ictinus are projecting masses of masonry, which may be thp foundation for a portico that was to be added; but perhaps they were only buttresses, intended to resist the thrust of the roof of this huge structure, which rested at its northern and western corners against the solid rock of the hill. On the south-east side the hall is faced with a portico, extending its whole width ; the marble pavement of this portico is a most conspicuous feature of Eleusis at the present day. The portico was added to the hall by the architect Philo, under Demetrius Phalereus, about the end of the 4th century b.c. It was never completed, for the fluting of its columns still remains unfinished.

The Telesterion took up the greater part of the sacred precinct, which seems merely to have served to keep the profane away from the temple. The massive walls and towers of the time of Pericles, which resemble those of a fortress, are quite close in on the south and east ; later, probably in the 4th century B.C., the precinct was ex- tended farther to the south, and at its end was erected a building of considerable extent, including a curious apsidal chamber, for which a similar but larger curved structure was substituted in Roman times. This was pr&bably the Buleuterium. The precinct was full of altars, dedications, and inscriptions ; and many fragments of sculpture, pot- tery, and other antiquities, from the earliest to the latest days of Greece, have been discovered. It is to be noted that the su.bterranean passages, which some earlier ex- plorers imagined to be connected with the celebration of the mysteries, have proved to be nothing but cisterns or water-courses.

The excavations of Eleusis, and the antiquities found in them, have been published from time to time in the ‘Ei^Tj^nepis ‘Apxai- 0X071/0) and in

the UpaKTiKh of the Greek Archseological Society, especially for 1887 and 1895. See also D. Philios, Mleusis, ses myateres, ses mines, et son Musee. Inscriptions have also been published in the Bulletin de Correspondance Hellenique.

(e. gr.)

Elevators or Lifts are machines for raising or lowering loads, whether of people or material, from one level to another. They are operated by steam, hydraulic, or electric power, or, when small and light, by hand. Their construction varies with the magnitude of the work to be performed and the character of the motive power. In private houses, where only small weights, as coal, food, &c., have to be transferred from one floor to another, they usually consist simply of a small counter- balanced platform suspended from the roof or an upper floor by a tackle, the running part of which hangs from

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top to bottom and can be reached and operated at any level. If the platform is sufficiently large and strong to

Fig. 1. ??? The Plunger, or Direct Lift Hydraulic Engine.

permit one or more persons to be carried, the hoisting is ???often performed by the person raised, or by an attend- ant, who manages the tackle from the ” car ” or cage. In hotels and warehouses, where great weights and numbers of people have to be lifted, or a high speed ???of elevation is demanded, some form of motor is neces- sary. This is usually, directly or indirectly, a steam engine or occasionally a gas engine ;

sometimes a water-pressure engine is adopted, and recently it has become more and more common to employ an electric motor deriving its energy from the general distribu- tion of the city. Large establishments, hotels or business houses, commonly have their own source of energy, an electric or other power “plant,” on the premises.

The Hydraulic Elevator is the simplest in construction of elevators proper, sometimes consisting merely of a long pipe set deeply in the ground under the cage and containing a correspondingly long plunger, which rises and falls as required and carries the elevator-cage on its upper

end (Fig. 1). The ” stroke ” is thus necessarily equal to the height traversed by the cage, with some surplus to keep the plunger steady within its guiding-pipe. The pipe or pump chamber has a length exceeding the maximum rise and fall of the plunger, and “ll’y‘“JJ^ must be strong enough to sustain safely the heavy hydraulic pressures needed to raise plunger and cage with load. The power is usually supplied by a steam pump (occasionally by a hydraulic motor), which forces water into the chamber of the great pipe as the elevator rises, a waste-cock drawing off the liquid in the process of lowering the cage. A single handle within the cage generally serves to apply the pressure when raising, and to reduce it when lowering the load. When an ample supply of water can be commanded at the top of the hoist, a still simpler mechanism is available. The cable is supported from a pulley, and the cage, which is attached to one of its ends, is nearly balanced by a water tank attached to the other. When it is desired to raise the cage and its load, the water tank, which is then at the top, is filled with water until it becomes suflB.ciently heavy to overbalance the weight of the cage, when it falls by the force of gravity. To reverse the motion, water is with- drawn from the tank until it becomes lighter than the cage, when it then descends by virtue of its superior weight. A suitable brake regulates the speed of the cage, whether rising or falling. The most common form of this class of elevator, for important work and under usual conditions of operation, as in cities, consists of a suspended cage, carried by a tackle, the running part of which is connected with a set of pulleys at each end of a frame (Fig. 2). The rope is made fast at one end, and its intermediate part is carried round first one pulley at the farther end of the frame and then round another at the nearer end, and so qu as often as is found advisable in the

particular ease. The two pulley shafts carrying these two sets of pulleys are made to traverse the frame in such a way as, by their separation, to haul in on the running part, or, by their approximation, to permit the weight of the cage to haul out the rope. By this alternate hauling and ” rendering ” of the rope the cage is raised and lowered. The use of a number of parallel and inde- pendent sets of pulleys and tackles assures safety in case of the breakage of any one, each being strong enough alone to hold the load. The movement of the pair of pulley shafts is effected by a water-pressure engine, actu- ating the plunger of a pump which is similar to that used in the preceding apparatus, but being relatively of short stroke and large diameter, is more satisfactory in design and construction as well as in operation. This form of construction is the usual one for elevators em- ployed in commercial work. A steam engine, however, or electric motor, may be directly attached to the system of pulleys. The majority of the existing elevators are constructed on such a plan, being denominated steam, hydraulic, or electric, according to the form of energy employed as the primary source of power.

An account of the older hydraulic elevators having been given in Ency. Brit. (9th ed., vol. xiv. p. 575), it is the intention here to describe the later forms in common use, especially in the United States, where, owing to the erection of tall buildings and the general adoption of such machines in great warehouses, there has been much more rapid and more extensive development than in other countries, and where enterprise, sharp competition, and exceptional in- genuity on the part of both manufacturer and artisan have combined to evolve most ingenious and most efficient systems of general construction and details. The electric elevator, particularly in the cities, has undergone remark- able development, and the commencement of the 20th century finds it in by far the most extensive use ; the older

Wh-^^’^i,

Fig. 2,❓❓❓ The Otis Stnndarrt Hydraulic Passenger Lift, with pilot Talve and lever-operating device.

forms are rapidly disappearing, except in localities which offer special advantages for their employment. The his- tory of the elevator is chronologically extensive, but only since 1850 has rapid or important progress been effected. In that year George H. Fox & Co. built an elevator oper- ated by the motion of a vertical screw, the nut on which carried the cage. This device was used in a number of in- stances, especially in hotels in the large cities, during the succeeding twenty years, and was then generall}^ sup- planted by the hydraulic lift of the kind already de- scribed as the plunger-lift. With the increased demand for power, speed, safety, convenience of manipulation, and comfort in operation, the inventive ability of the engineer developed each of the known systems more and more per- fectly, and experience gradually showed to what service each type was best adapted and the best construction of each for its peculiar work. Whatever the class, the following are the essentials of design, construction, and operation : the elevator must be safe, comfort- able, speedy, and convenient; must not be too Essentials expensive in either first cost or maintenance, and ^c. ‘ must be absolutely trustworthy. It must not be liable to fracture of any element of the hoisting gear that will permit either the fall of the cage or its projection by an overweighted balance upwards against the top of its shaft. It must be possible to stop it, whether in regu- lar working or in emergency, or when accident occurs, with sufficient promptness, yet without endangering life or property, or even very seriously inconvenienc- ing the passengers. Acceleration and retardation in starting and stopping must be smooth and easy, the stop must be capable of being made precisely where and when intended, and no danger must be incurred by the passengers from contact with running parts of the mechanism or with the walls and doors of the elevator shaft.

These requirements have been fully met in the later forms of elevator commonly employed for passenger ser- vice, and those designed for lifting heavy ” freight ” and merchandise have hardly less safety and trustworthiness. Usual sizes range from loads of 1000 to 5000 pounds, but special constructions are not infrequently called for which can take a loaded dray, weighing with its burden several tons, from the ground to the upper

floors of high buildings at the rate of from 100 to 300 feet per minute. Capacities of 100,000 to 750,000 foot-pounds, speeds of from SO to 250 feet a minute unloaded, and 75 to 200 feet loaded, are a standard, with a height of travel of from 50 to 200 feet. Where electric motors are employed, as now usual in cities where current can always be readily obtained, their speed ranges from 600 and 700 revolutions per minute in the larger to 1000 and 1200 in the smaller sizes^ corresponding to from 20 down to 4 or 5 horse-power. Two or more counter-weights are employed, and from four to six suspension cableg ensure as nearly as possible absolute safety. The electric elevators of the Central Electric railway, Loudon, are guaranteed to raise 17,000 pounds () ”) feet, in some of its shafts, in 30 seconds from start to stop. Over 100,000 feet of finch and 17,000 feet of |-inch steel rope are required for its 24 shafts, and each rope carries from 16 to 22 tons without breaking. The steel used in the cables, of which there are four to six for each car and counter-weight, has a tenacity of 85 to 90 tons per square inch of section of wire. The maximum pull on each set of rope is assumed to be not over 9.”>00 pounds, the remainder of the load being taken by the counter-balance. Oil ’ dash-pots ” or buffers, into \‘hich enter plungers attached to the bottom of the cage, prevent too sudden a stop in case of accident, and safety-clutches with friction adjustments of ample power and fully tested before use give ample insurance against a fall even if all

the cables should yield at once an almost inconceivable contingency. The efiBciency, i.e., the ratio of work performed to power expended in the same time, was in these elevators found by test to be between 70 and 75 per cent.

Safety devices constitute perhaps the most important of the later improvements

in elevator construction where feWces. passengers are carried. The

simplest and, where practicable, most certain of them is the ” air-cushion,’’ a chamber into which the cage drops if de- tached or from any cause allowed to fall too rapidly to the bottom, compression of the air bringing it to rest with- out shock (Fig. 3). This chamber must be perfectly air-tight, except in so far as a purposely arranged clear- ance around the sides, diminishing downwards and in well-established proportion, is adjusted to permit a ” dash-pot ” action and to prevent rebound. The air-cushion should be about one-tenth the depth of the elevator shaft ; in high build- ings it may be a well 20 or 30 feet deep. The Empire Building, in New York, is twenty storeys in height, and its air-cushion, at the bottom of 287 feet of travel of cage, is 60 feet deep, extending from the floor of the third storey to the bottom of the shaft. Sliding doors of great strength, and automatic in action, at the first and second floors, are the only openings. The shaft is tapered for some dis- tance below the third floor, and then carried straight to the bottom. An inlet valve admits air freely as the cage rises, knd an adjusted safety-valve provides against excess pressure. A “car,” falling freely from the twentieth storey, was checked by this arrangement without injury to a basket of eggs placed on its floor, the weight being about 1 ton. The velocity of the fall attained a maximum at about 70 miles an hour, assuming retardation by friction to the extent of about 10 per cent. Other safety devices usually employed consist of catches under the floor of the cage, so arranged that they are held out of engagement by the pull on the cables. But if the strain is suddenly relieved, as by breakage of a cable or accident to the engine or motor, they instantly fly into place and, engaging strong side-struts in the shaft, hold the car until it can be once more lifted by its cables. These operate well when the cables part at or near the car, but they are apt to fail if the break occurs on the opposite side of the carrying sheaves at the top of the shaft, since the friction and inertia of the mass of the cables may in that case be sufficient to hold the pawls out of gear either entirely or until the

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Fig. 3. Safety A.ir-Oushion.

Fie. 4. Oentrifngal Elevator Governor (Stoke and PariBh).

headway is so great as to cause the smashing of all resist- ances when they do engage.

Another principle employed in safety arrangements is the action of inertia of parts properly formed and attached. Any dangerous acceleration of the cage causes the inertia of these parts to produce a retardation relative to the car which throws into action a brake or a catch, and thus controls the motion within safe limits or breaks the fall, entirely without injury. The hydraulic brake has been used in this apparatus, as have mechanical and pneumatic apparatus. This control of the speed of fall is most commonly secured by the employment of a centrifugal or other governor or regulator (Fig. 4). The governor may be on the top of the cage and driven by a stationary rope fixed between the upper and the lower ends of the shafts, or it may be placed at the top of the shaft and driven by a rope travelling with the car. Its action is usually to trip into service a set of spring grips or friction clutches, which, as a rule, grasp the guides of the cage and by their immense pressure and great resultant friction bring the cage to rest within a safe limit of speed, time, and distance. A coefficient of friction of about 15 per cent, is assumed in their design, and this estimate is con- firmed by their operation. Pressures of ten tons or more are sometimes provided in these grips to ensure the friction required. There are many different forms of safety device of these various classes, each maker having his own. The importance of absolute safety against a fall is so great that the best builders are not satisfied with any one form or principle, but combine provisions against every known danger, and often duplicate such precautions against the most common accidents.

The hoisting cables are handled by means of a winding drum driven by steam, electric, or other motor. Most commonly a system of gearing is arranged between the motor and the drum to accommodate the normal speeds of the two each to the other. This intermediate gearing consists of either a series of ” spur ” gears and pinions, or

Fig. 5. 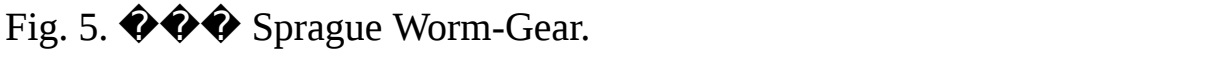 Sprague Worm-Gear.

a ~~worm and gear. The latter is now coming more into general use. Recent improvements in construction and in form, as, for example, the introduction of the now old but never common Hindley worm, and the use of systems of accurate cutting, have made the efficiency of the worm~~ gear approximate closely to that of the spur-gear train, while the cost of construction has been greatly reduced by its employment, and the complexity and the space required have also been much lessened. In the Sprague electric elevator (the worm-gear of which is shown in Fig. 6) a motor of suitable design is coupled directly to a screw, the nut of which carries and displaces the moving sheaves of the cables. The efficiency of the apparatus is greatly in-

FiG. 6. ××× Multiple sheave type ××× hoisting nut at upper end of screw.

creased by the use of a ball-bearing system between the thread of the screw and that of the nut (Fig. 6).

The “Travelling Staircase” may be classed among the passenger elevators, as may be the ” Travelling Platform or Sidewalk ” among the ” conveyors.” It usually con- sists of a staircase so constructed that while the passen- ger is ascending it the whole structure is also ascending at a predetermined rate, so that the progress made is the sum of the two rates of motion. The system of ” treads and risers ” is carried on a long endless band of chain sus- tained by guides holding it in its desired line, and rend- ering at either end over cylinders or sprockets. The junctions between the stairway and the upper or lower floors are ingeniously arranged so as to avoid danger of injury to the passengers.

“Freight” elevators have the same general forms as the passenger elevators, but are often vastly larger and more powerful, and are not as a rule fitted up for such heights of lift, or constructed with such elaborate pro- vision for safety or with any special finish. They are simple, strong, and durable, and should be economical in operation. Elevators raising grain, coal, earth, and simi- lar materials, such as can be taken up by scooping into a bucket, or

can be run into and out of the bucket by gravity, constitute a class by themselves, and entirely differ in construction from those j ust described. A set of buckets of suitable form and dimensions is fitted upon some kind of flexible carrying arrangement extending from the point of reception of the grain, fuel, or other material, to the point of delivery, with provisions for loading the bucket at the one end and discharging it at the other (Fig. 7).

Fia. 7.❓❓❓ Conveyor for carrying material from the loading point to tho storage bins, vertically, horizontally, or inclined, without shock or breakage.

The term grain elevator is often used to include buildings as well as machinery, and it is not unusual in Europe to hear a flour-mill, with its system of motor machinery, mills, elevator, and storage departments, spoken of as an ” American elevator.” The ” conveyor ” or bucket-chain elevator is very extensively employed where, as in trans- ferring coal from point to point for the supply of large batteries of boilers or in excavating earthwork on large contracts, the path to be traversed has a variable direction

in either a vertical or a horizontal plane, or in both. The flexibility of the system adapts it to such cases, and it often constitutes part, in this manner, of an extensive system of transportation of such materials. It is also the operative part of the apparatus often employed for dredg- ing, the buckets acting also as scoops and taking the earth from the bottom of the channel and conveying it to the point of discharge. The bucket-and-chain dredge is some- times built upon a large scale, as for the deepening of harbours or the cutting of canals, and somewhat similar mechanism is employed in the making of railway cuttings.

(k. h. t.)

Elgin, or MoBAYSHiRE, a maritime county of North Scotland, bounded on the N. by the Moray Firth, on the E. and S.E. by Banffshire, on the S. and S.W. by Inverness-shire, and on the W. by Nairnshire.

Area and Population.❓❓❓ Jn 1891 the parish of Bellie and nearly all Rothes were placed in Elgin, and Boharm and Inveravon wholly in Banff; the Nairn portions of Dyke and Moy and Ardclaoh were transferred to Elgin

; and the Elgin portion of the parish of Cromdale was constituted a parish of itself. The area of the county (foreshore excluded) is 308,499 acres, or 482 square miles. The population was, in 1881, 43,788 ; in 1891, 43,453 ; in 1891, on the above area, 43,471, of whom 20,368 were males and 23,103 females; in 1901, 44,808. On the old area, taking land only (304,606 acres or 475-9 square miles), the number of persons to the square mile in 1891 was 91, and the number of acres to the person 7 ~~0. In the registration county the popula~~ tion decreased between 1881 and 1891 by 0-8 per cent. Between 1881 and 1891 the excess of births over deaths was 5925, and the decrease of the resident population 367. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899:

Tear.

Deaths.

Marriages.

Births.

Percentage of Illegitimate.

1880 1890 1899

812 818 760

274 233

270

1391

1237 1179

16-8

12-69

12-6

The birth-rate, death-rate, and marriage-rate are all below the rates for Scotland. The following table gives the birth-rate, death-rate, and marriage-rate per thousand of the population for a series of years : ???

ISSO.

1S81-90.

1S90.

1891-9S.

1699.

Birth-rate . Death-rate . Marriage-rate

30-86

18-02

6-08

30-23

17-06

5-52

27-58

18-23

5-19

27-79

17-12

6-02

27-54

17-78

6-31

In 1891 the number of Gaelic-speaking persons in the county was 2262, of whom 12 spoke Gaelic only ; and there were 24 foreigners. The valuation in 1889-90 was ££181,296 ; 1899-1900, ££188,911.

Administration. £££ The county returns a member to Parliament in conjunction with Nairnshire. The royal burghs are Elgin, the county town (8407), and Forres (4313), the former belonging to the Elgin parliamentary group and the latter to the Inverness group. Lossiemouth (3889) is the largest police burgh. There are 19 civil parishes, 14 of which belong to the Morayshire Combination. The number of paupers and dependants in September 1899 was 1489. Elgin is included in one sheriffdom with Inverness and Nairn, and there is a resident sherifi- substitute at Elgin.

Education. ••• Twenty-one school boards manage 45 schools, which had in 1898-99 an average attendance of 6674 ; and 8 voluntary schools (one Episcopal and one Roman Catholic) had 7(3(i. There are academies at Elgin and Fochabers (Jlilne's Insti- tution), and science and art and technical schools at Elgin and Grantown, and twelve other schools in the county earned grants in 1898 forgiving higher education. The bulk of the "residue" grant is spent in subsidizing the agricultural department of Aberdeen University, the science schools at Elgin and Grantown, Milne's Institution, and science and art and technical classes elsewhere in the county.

Aijriculturc. ••• There has been a good deal of "improving" agriculture in Elgin of recent years, and the standard of farming is generally high. Of 1907 holdings in 1895, the average size was 53 acres. The percentage under 5 acres was 23-o9, between 5 and 50 aovos 44-05, and over 50 acres 32-66. The number of farms between 50 and 100 acres was 299 ; between 100 and

300, 282 ; between 300 and 600, 86 ; and over 600, 5. The percentage of cultivation was 32-9 in 1898. Heavy crops of barley are grown in the Laigh of Moray, and the barley acreage approximates more nearly to the oat acreage than in any other county except Haddington. In 1895 there were 46,688 acres under wood, 1936 having been planted since 1881. The following table gives the principal acreages at intervals of five years from 1880 : •••

Year.

Area under Crops.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1880 1885 1890 1895 1899

104,992 106,004 102,738 101,758 101,689

40,192

40,651 39,034 36,922 36,497

20,410 19,738 18,786 17,996 17,793

39,264 39,709 39,257 37,.343 38,964

4973 6920 5465 9378 8373

153 86

137 91 44

The following table gives particulars of the live-stock during the same years : ???

Year.

Total Horses.

Total Cattle.

Cows or

Heifers in

Milk or Calf.

Sheep.

Pigs.

1880 1885 1890 1896 1899

5186 6060 4810 6211 4967

23,031 23,572 21,536 21,489 22,296

6832 7286 6571 6197 6895

62,202 60,364 55,957 61,802 72,614

2667 3116 3391 2771 2472

At the census of 1891, 4404 men and 450 women were returned as being engaged in agriculture.

Industries and Trade. ××× Distilling is the leading industry, there being as many as 15 distilleries in the county. There are woollen mills at Elgin and other places, and chemical works at Porres and Burghead. Extensions have been made in the harbours of Burghead (××60,000) and Hopeman (××20,000). Timber, fish, agricultural produce, and whisky are the principal articles of export, and coal and the raw materials for the chemical works are imported. Fishing is a considerable industry. To the four Morayshire ports there belonged, in 1899, 321 boats of 5429 tons, and 1004 resident fishermen and boys, and the value of the fish landed (about half herrings) was ××32,575. The chief changes of recent years have been the decrease in the number of men and boys engaged, and the increase in the value of the boats and gear.

At the census of 1891, 4558 men and 1242 women were returned as being engaged in industrial pursuits. There are valuable sandstone quarries in the county ; 28,348 tons of ××5646 value were raised in 1895, and 37,124 tons of ××8835 value in 1899. The average weight of the salmon despatched from the Spey, Lossie, and Findhorn district in the years 1894-98 was 486 tons. The railway mileage of the county was increased by 15 miles between 1875 and 1900, the longest of the new lines being one from Elgin to Garmouth (8| miles).

Authorities. ††† R. Young. Annals of the Parish and Burgh of Elgin. Elgin, 1879. The Parish of Spynie. Elgin, 1871.††† Lachlan Shaw. History of the Province of Moray (Gordon's edition). Glasgow, 1882. ††† E. Dunbar Dunbar. Documents relating to the Province of Moray. Edinburgh, 1895. Social Life in Former Days. Edinburgh, 1865 and 1866. ††† C. A. Gordon. History of the Hotise of Gordon. Aberdeen, 1890. ††† An Account of the Family of Innes. (Spalding Club) 1864. ††† C. Eampini. History of Moray and Nairn. Edinburgh, 1897. ††† W. Cramond. Life in Elgin 350 years ago. Elgin, 1896. ††† C. Innes. Elgin Past and Present. Elgin, 1860. ††† J. Cooper. " Church and Convent of the Greyfriars" {Trans, of the Aberdeen Eccles. Soc). 1890. ††† C. Cordier. Antiquities and Scenery of the North of Scotland. Banff, 1880. ††† J. Macdonald. "Burghead " (Proceedings of Glas- gow Archceo. Soc). 1891.††† Sir T. Dick Lauder. The Wolf of Badenoch. Glasgow, 1886. ††† M. Macdonald. Covenanters in Moray and Boss. Inverness, 1892. ††† G. Gordon. Flora of Moray. Elgin, 1893. Fauna of Moray. Elgin, 1895. ††† Harvie- Brown and Buckley. Vertebrate Fauna of Scotland. Edin- burgh, 1896. ††† J. Watson. Some Local Wild Birds. Elgin, 1889. (w. WA.)

Elgin, a city, royal and parliamentary burgh (Elgin group), and county town of Elgin, Scotland, 71-^ miles by rail north-west by west of Aberdeen. Modern structures include a new town-hall, public baths, a new academy, and the Victoria School of Science and Art. Lossie Green recreation ground was extended in 1888. Population of royal burgh (1881), 6286 ; (1901), 8260.

Elgin, a city of Kane county, Illinois, U.S.A., on the Fox river, at an altitude of 716 feet. It has fine water-power in the river. Amongst its large manufac- turing interests is the Elgin watch factory, the products of which are widely known. One of the state hospitals for insane is situated here. Elgin is on branches of the Chicago and North- Western and the Chicago, Milwaukee, and St Paul railways. Population (1880), 8787 ; (1890), 17,823; (1900), 22,433, of whom 5419 were foreign-born and 187 were negroes.

Elgon Mount, also known as Masawa, an extinct volca,no in British East Africa, cut by 1†† N. and 34|†† E., forming a vast isolated mass over

40 miles in diameter. The outer slopes are in great measure precipitous on the north, west, and south, but fall more gradually to the east. The southern cliffs are remarkable for extensive caves, which have the appearance of water-worn caves on a coast-] ine and have for ages served as habitations for the natives. The higher parts slope gradually up- wards to the rim of an old crater, lying somewhat north of the centre of the mass, and measuring some 8 miles in diameter. The highest point of the rim is about 14,100 feet above the sea. Steep spurs separated by narrow ravines run out from the mountain, affording the most picturesque scenery. The ravines are traversed by a great number of streams, which flow north-west and west to the Nile (through Lake Choga), south and south-east to Victoria Nyanza, and north-east to Lake Eudolf by the Turkwell, the head-stream of which rises within the crater, breaking through a deep cleft in its rim. To the north-west of the mountain a grassy plain, swampy in the rains, falls towards the chain of lakes ending in Choga ; towards the north-east the country becomes more arid, while towards the south it is well wooded. The outer slopes are clothed in their upper regions with dense forest formed in part of bamboos, especially to- wards the south and west, in which directions the rainfall is greater than elsewhere. The lower slopes are excep- tionally fertile on the west, and produce bananas in abundance. On the north-west and north the region between 6000 and 7000 feet possesses a delightful cli- mate, and is well-watered by streams of icy-cold water. The district of Save on the north is a halting-place for Arab and Swahili caravans going north. On the west the slopes are densely inhabited by small Bantu tribes, who style their country Masawa (whence the alternative name for the mountain) ; but on the south and north there are tribes which seem akin to the Gallas. Of these, the best known are the El-gonyi, from whom the name Elgon has been derived. They formerly lived almost entirely in the caves, but with the establishment of order most of them have descended to villages at the foot of the moun- tain. Elgon was first visited in 1883 by Joseph Thom- son, who brought to light the cave-dwellings on the southern face. It was crossed from north to south, and its crater reached, in 1890 by Messrs Jackson and Gedge, while the first journey round it was made by Mr C. W. Hobley in 1896.

See Proceedings B. G. S. 1891, p. 202 ; Geog. Journ. vol. ix. (1897), pp. 178-185 ; Ibid., vol. xiv. p. 133. (e. he.)

-), president

Eliot, Charles William (1834- of Harvard University, U.S.A., was born in Boston, Mass., on the 20th of March 1834. He was the only son of Samuel Atkins Eliot, mayor of Boston, representa- tive in Congress, and treasurer of Harvard College from 1842 to 1853. He attended the Latin School of Boston, and received the degree of B.A. from Harvard College in 1853. The next year he was made tutor in mathe- matics, and also studied chemistry. In 1857 he gave a course of lectures in chemistry in the medical college of

the University, and in 1858 he was made assistant pro- fessor of mathematics and chemistry. In 1861 he was put in charge of the chemical department of Lawrence Scientific School. Two years later he went to Europe, where he spent two years in studying chemistry and the educational systems of England, Erance, and Germany. In 1865 he was appointed professor of analytical chemistry in the newly established Massachusetts Institute of Tech- nology. This chair he held for four years, but in 1867-68 he was in Europe for fourteen months. In 1869 he was chosen president of Harvard University. President Eliot has laboured for increasing the unity of the educational system of the United States, for promoting the spirit of free inquiry on the part of teachers and of unrestricted choice of studies on the part of students, and for making available to the community, under wise conditions, all the resources of the university. The result has been the establishment at Harvard of a free optional system of studies, the advancement of professional and technical education, and other developments, which have given to Harvard a position in American education which it had not previously enjoyed. The university funds have in- creased from two and a quarter millions of dollars to twelve millions of dollars. A vast amount of money has been devoted to the erection of buildings and to the equipment of laboratories and libraries. The students have increased from about a thousand to about five thousand, and the tutorial staff from a hundred and fifty to five hundred. He has written two manuals of chemis- try in collaboration with Professor F. H. Storer, and has

published a few volumes of essays, largely upon edu- cational or related subjects. (c. r, t.)

Eliot, George. See Cross, M. A.

Elisabethgrad, or Elizavbtgbad, a fortress and district town of Russia, government and 162 miles north of Kherson, on Balta Kremenchug railway, on the Ingul. It is a wealthy town, which has become an indus- trial centre for the region, especially on account of its steam flour-mills, in which it is second only to Odessa, distilleries, mechanical works, &c., the aggregate annual produce of which exceeds ––500,000. It is also a great centre for trade in corn and flour for export, and also in sheep, cattle, wool, leather, and timber. Five fairs are held annually. It has several gymnasia, a military school, a first-class meteorological station, and a spacious botanical garden. The population increased from 23,725 in 1860 to 61,841 in 1897.

Eiisabethpol, a government of Russia, Transcau- casia, having Tiflis, Zakataly, and Daghestan on the N., Baku on the E., Persia on the S., and Erivan on the W. Area, 16,721 square miles. This vast government in- cludes : (a) the southern slope of the main Caucasus range in the north-east, where the Tkhfan-dagh (13,764 ft.), Bazardyuz (14,722 ft.), and other peaks rise above the snow-line ; (b) the dry and unproductive steppes on the Kura, reaching 1000 ft. of altitude in the west and from 100 to 200 ft. only in the east, where irrigation is necessary for culture ; and (c) the northern slopes of the Transcaucasian escarpment and portions of the Armenian plateau, which is intersected towards its western boundary, near Lake Gokcha, by chains of mountains consisting of trachytes and various crystalline rocks, and reaching from 11,000 to 12,856 ft. in Mount Kapud- jikh. Elsewhere the country has the character of a plateau, 7000 to 8000 ft. high, deeply ravined by the tributaries of the Aras. All varieties of climate are found in this province, from the snowclad peaks, Alpine meadows, and stony deserts of the high levels, to the hill slopes, clothed with gardens and vineyards, and the dry

Caspian steppes. Thus, at Shusha, on the plateau, at an altitude of 1368 ft., the average temperatures are : year 48––, January 26––, July 66–– ; yearly rainfall, 26-4 in. ; while at Eiisabethpol, in the valley of the Kura,

they are : year 55, January 32-2, July 77, and rainfall only 10-3 in. Nearly one-fifth of the surface is under forests.

The population, which was 871,557 in 1897 (only 392,124 women; 84,130 urban), consists chiefly of Azerbaijan Tatars (56 per cent.) and Armenians (35 per cent.). The remainder are Kurds (4-7 per cent.), Russians (a little over 1 percent.), andafew Udines, Tates, &o. Peasants form the great bulk of the population, nearly two- thirds of them living on Crown lands, and the remainder on land belonging to landlords. Some of the Tatars and the Kurds still are nomadic. Wheat, Indian corn, barley, oats, and rye are grown, and the crops are estimated at 1,787,100 quarters of various cereals and 158,400 quarters of rice. Cultivation of the cotton tree has begun, but the rearing of silkworms is of old standing, especially at Nukha (32,700 cwts. of cocoons on the average are obtained every year). Nearly 8000 acres are under vine. Gardening reaches a high level of perfection. Liquorice root is obtained to the ex- tent of about 700,000 cwts. The rearing of live-stock is largely carried on in the steppes, there being about 76,140 horses, 464,000 horned cattle, and 1,157,000 sheep. Copper (37,000 cwts.), some magnetic iron ore, cobalt ore, and a small quantity of naphtha are extracted, and nearly 9300 persons are employed in the 2200 factories and workshops. Carpet-weaving is widely spread. Owing to the Transcaucasian railway, which crosses the province, trade, both in the interior and with Persia, is very brisk. The government is divided into 8 districts : Eiisabethpol, Aresh, Jebrail, Jevanshir, Kazakh, Nukha, Shusha, and Zanglzur. The only towns, besides the capital, are Nukha (24,811 inhabitants) and Shusha (25,656).

Eiisabethpol, formerly Ganja, capital of the above government, 120 miles by rail south-east of Tiflis and 3 miles from the railway. It is a very old town, which changed hands between Persians, Khozars, and Arabs even in the 7th century, and later fell into the possession of Mongols, Georgians, Persians, and Turks, until the Russians took it in 1796, and finally annexed it in 1813. It is situated in a very unhealthy locality, but has been much improved lately, a new European quarter having been built on the site of the old fortress. Popu- lation (1897), 20,706. Its inhabitants are chiefly Tatars and Armenians, famed for their excellent gardening, and also for silkworm breeding. It has a beautiful mosque, built in 1620, and a renowned ” Green

Mosque ” amidst the ruins of old Ganja. The Persian poet Sheikh Nizam (Nizameddin) is said to have been buried close to the town.

Elizabeth, queen of Rumania (“Carmen Sylva’’). See Chables I., king of Rumania.

Elizabeth, capital of Union county, New Jersey, U.S.A., in 40►► 40′ N. lat. and 74►► 13′ W. long., on Newark Bay. Its site is level, its plan regular, and it is divided into twelve wards. Its water supply is pumped from Ursine Lake. It is entered by the Pennsylvania, the Central of New Jersey, and the Lehigh Valley railways. Though to a certain extent a residential city for business men in New York, it has commercial and manufacturing interests of its own. In 1890 the capital invested in manufactures was $7,785,553, employing 6561 persons, and turning out goods valued at $10,489,364. The prin- cipal productions were foundry and machine-shop articles, valued at about one-seventh of all the manufactures. In 1900 the assessed valuation of real and personal property was $17,402,021, the net debt f 3,207,835, and the rate of taxation 129.60 per $1000. Population (1880), 28,229; (1890), 37,764; (1900), 52,130, of whom 14,770 were foreign-born and 1139 were negroes. The death-rate in 1900 was 17-5.

Elizabeth City, capital of Pasquotank county, North (/arolina, U.S.A., situated on Pasquotank river and the Norfolk and Southern railway. Being in a forest region, its industries consist largely of lumber trade and

manufactures ; it contains several saw and shingle mills. Population (1880), 2315; (1890), 3251; (1900), 6348, of whom 44 were foreign-born and 3164 were negroes.

Elkhart, a city of Elkhart county, Indiana, U.S.A., on the St Joseph river, at an altit\ide of 725 feet. It is on two railways, the Lake Shore and Michigan Southern (the repair shops of which are here) and the Cleveland, Cincinnati, Chicago, and St Louis. It has varied manu- factures. Population (1880),

6953; (1890), 11,360; (1900), 15,184; of whom 1353 were foreign-born and 35 were negroes.

Elland, a town and urban district in the Elland parliamentary division of Yorkshire, England, on the Calder, 2^ miles south of Halifax by rail. There are two endowed schools, a public recreation ground, a church house, and a town-hall and public baths. Cotton-mills, woollen factories, ironworks, flagstone quarries, and fire- clay works supply industries. Area of urban district, 1992 acres. Population (1901), 10,412.

El I ice, or Lagoon, a Polynesian archipelago, in about 9^ i~<., nearly midway between Fiji and Gilbert, and some 700 miles north-west of Samoa. It comprises a large num- ber of low coralline islands and atolls, which are disposed in nine clusters extending over a distance of 360 miles in the direction from north-west to south-east. Their total area is 14 square miles, and in 1900 the population was 2400. The chief groups, all yielding cocoanuts, pandanus fruit and yams, are Funafuti, Sophia (Rocky Island), Nui, ISTukufetau, Vaitupu, Netherland, and Lynx. Nearly all the natives are Christians, Protestant missions having been long established in several of the islands. Those of Nai speak the language of the Gilbert Islanders, and have a tradition that they came some generations ago from that group. All the others a^-e of Samoan speech, and their tradition that they came thirty generations back from Samoa is supported by recent research. The soundings taken at Funafuti in 1897 indicate almost be- yond doubt that the whole of this Polynesian region is an area of comparatively recent subsidence.

Elllchpur, or Ilichpue, atown and district of India, in Berar or the Haidarabad Assigned Districts. The town is on the left bank of the river Bichan. The popu- lation is about 36,000. The cantonment accommodates a battery of artillery and an infantry regiment, both of the Haidarabad Contingent. There are two steam fac- tories for ginning cotton. The District ov Ellichpue has an area of 2623 square miles, and had a population in 1881 of 313,805, and in 1901 of 295,392, the decrease being due to the famine of 1899-1900. The land revenue and rates were Es.9,53,383, the incidence of assessment being E. 1-10-4 per acre ; the cultivated area in 1897-98 was 608,048 acres, of which 2971 were irrigated from Tvells ; the number of

police was 367 ; the death-rate in 1897 was 58-6 per 1000. There is no railway, but cotton is largely exported from Amraoti.

Ellis, Robinson (1834-

-), English classical

scholar, was born at Barming, near Maidstone, on 5th September 1834. He was educated at Elizabeth College, Guernsey, Rugby, and Balliol. In 1858 he became fellow of Trinity College, Oxford. In 1870 he was appointed to the professorship of Latin at University College, London, but in 1876 he returned to Oxford, where from 1883 to 1893 he held the University readership in Latin. In 1893 he succeeded Henry Nettleship as professor. As early as 1859 he had turned his attention to Catullus, an author at that time much neglected by scholars both at home and abroad. His first Commentary on CaUillus was published in 1876. It aroused great interest, and

called forth a flood of Catullian literature and criticism. In 1889 appeared a second and enlarged edition, which summed up the results of thirty years' work and definitely placed its author in the first rank of authori- ties on Catullus. Professor Ellis quotes largely from the early Italian commentators, maintaining that the land where the Renaissance originated had done more for exact scholarship than was commonly recognized. He had supplemented his critical work by a translation of the poems in the metres of the originals. These were dedicated to Tennyson, whose alcaics and hendecasyl- labics had paved the way for an experiment of this char- acter. In the introduction he points out the necessity of observing the laws of position as well as accent in determining quantity. Another author to whom Rob- inson Ellis has devoted many years' study is Manilius, the astrological poet, whom Scaliger and Bentley edited and Goethe read and quoted, but who had fallen into complete neglect in an age which took a somewhat narrow view of the scope of classical scholarship. Manilius first engaged Mr Ellis's attention in 1862, but it was only in 1891 he published his Noctes Maniliance, a series of dis- sertations on the Astronomicu, with a number of happy emendations which will help to pave the way for a re- vised text of Manilius. Other less known writers with whom Robinson Ellis has dealt are Aviapus, Velleius Paterculus, and the Christian poet Orientius, whom he edited for the Vienna Corpus Scriptorum Ecclesiastico- rum. He has also edited the Ibis of Ovid,

and contributed to the Anecdocta Oxoniensia various unedited materials drawn from manuscripts in the Bodleian and other libraries.

El lore, a town in British India, in the Godavari dis- trict of Madras, on the East Coast railway, 303 miles from Madras. Population, about 28,000. The two canal systems of the Godavari and the Kistna deltas meet here. There are manufactures of cotton and saltpetre ; a high school, with 214 pupils in 1896-97; and two printing- presses.

Elmira, capital of Chemung county, New York, U.S.A., in 42►► 05′ N. lat. and 76►► 60′ W. long., on the Chemung river, at an altitude of 863 feet. It is on four railways, the Delaware, Lackawanna, and Western, the Erie, the Lehigh Valley, and the Northern Central (a part of the Pennsylvania system). It contains the carriage works of the Erie railway. Its manufactures had in 1890 an invested capital of $6,895,180, employed 5171 hands, and the products were valued at $8,844,936. These were varied, consisting in part of boots and shoes, flour, iron and steel goods, and lumber. Elmira College, which is situated here, is a Presbyterian institution, with, in 1900, 24 instructors and 237 students, aU women, although the college is nominally for both sexes. The celebrated Elmira Reformatory for criminals is also here (see Peison Dis- cipline). The assessed valuation of real and personal property in 1900 was $17,616,158, the net debt of the city was $1,085,202, and the rate of taxation $24 per $1000. Population (1880), 20,541; (1890), 30,893; (1900), 35,672, of whom 5511 were foreign-born and 803 were negroes. The death-rate in 1900 was 15-4.

Elmshorn, atown of Prussia, province of Schleswig- Holstein, 19 miles by rail north-west from Altona. Amongst its chief industries are tanneries, breweries, linen and cotton mills, and shipbuilding yards. Popu- lation (1885), 8712 ; (1900), 13,640.

El Paso, capital of El Paso county, Texas, U.S.A., in 31►► 45′ N. lat. and 106►► 29′ W. long., on the east bank of the Rio Grande, at an altitude of 3710 feet. It is reg- ularly laid out on the level bottom lands, stretching to

the slopes on the east. Opposite, on the west bank of the river, is the Mexican town of Ciudad Juarez, with which El Paso is connected by bridges and by horse and steam trams. The city is entered by five railways, the Texas and Pacific, from the east ; the Southern Pacific, which passes through it ; the Atchison, Topeka, and Santa Fe, from the north ; the Mexican Central, from Mexico ; and the El Paso and North-Eastern. Its situation on the Mexican frontier gives it a large trade with that country. There are also extensive manufactures, including smelting works, to which are brought ores for treatment from Northern Mexico and Arizona. Population (1880), 736; (1890), 10,338 ; (1900), 15,906, of whom 6309 were foreign-born and 466 were negroes. A large proportion of the inhabitants are of Mexican descent.

El re no, capital of Canadian county, Oklahoma, U.S.A., in 35►► 32′ IST. lat. and 97►► 57′ W. long., on the north fork of Canadian river, at an altitude of 1372 feet. Its situation is on the level bottom lands, and the street plan is regular. It has two railways, a branch of the Chicago, Rock Island, and Pacific, and the Choctaw, Oklahoma, and Gulf. Near it is the military post of Fort Eeno. Popu- lation (1890), 285; (1900), 3383, of whom 165 were foreign-born and 223 were negroes.

Elsinore (Danish, Helsingor), a seaport town of Denmark, co. Frederiksborg, on the west shore of the Sound, 28 miles by rail north from Copenhagen. Com- munication is maintained with Helsingborg by means of a steam ferry. Elsinore has shipbuilding yards, with foundry, engineering shops, &c. ; it exports agricultural produce and imports iron, coal, cereals, and yarn. The port was entered by 899 vessels of 116,541 tons in 1899, and cleared by 918 of 127,040 tons. Population (1880),

8968; (1890), 11,076 ; (1900), 13,902.

Elssler, Fanny (1810-1884), the famous dancer, was born in Vienna on the 23rd of June 1810. From her earliest years she was trained for the ballet, and made her appearance at the Karnther-Thor theatre in Vienna before she was seven. She almost invariably danced with her sister Theresa, who was two years her senior ; and, after some years’ experience together in Vienna, the two went in 1827 to Naples. Their success there (to which Fanny contributed more largely than her sister, who used to efface herself in

orderto heighten the effect of Fanny’s more brilliant powers) led to an engagement in Berlin in 1830. This was the beginning of a series of triumphs for Fanny’s personal beauty and skill in dancing. After captivating all hearts in Berlin and Vienna, she paid a visit to London, where she received much kindness at the hands of Mr and Mrs Grote, who practically adopted the little girl who was born three months after Fanny’s arrival in England. This kind-hearted action subsequently cost them much distress of mind, but they eventually succeeded in removing the child from the atmosphere in which her mother lived. In September 1834 Fanny Elssler appeared at the Opera in Paris, a step to which she looked forward with much misgiving on account of Taglioni’s supremacy on that stage. The result, however, was another triumph for Fanny Elssler, and the temporary eclipse of Taglioni, who, although the finer artist of the two, could not for the moment compete with the newcomer’s personal fascination. It was con- spicuously in her performance of the Spanish cachnca that Fanny Elssler outshone all rivals. In 1840 she sailed with her sister for New York, and after two years’ unmixed success they returned to Europe, where during the follow- ing five years Fanny appeared in Germany, Austria, France, England, and Eussia. In 1845, having amassed a large fortune, she retired from the stage and settled near Ham- burg. Afewyears later her sister Theresa contracted amor-

ganatic marriage with Prince Adalbert of Prussia, and was ennobled under the title of Baroness von Barnim. Fanny Elssler died at Vienna on the 27th of November 1884. Theresa was left a widow in 1873, and died at Meran, 19th November 1878. (►►►►►► ^- ◄◄◄◄◄◄)

ElSter, the name of two rivers of Germany. 1. The Schwarze (Black) Elster rises in the Lausitz Mts., on the southern border of Saxony, flows north and north-west, and after a course of 112 miles enters the Elbe a little above Wittenberg. It is a sluggish stream, battling its way through sandy soil and frequently along a divided channel. 2. The Weisse (White) Elster rises in the north-western corner of Bohemia, a little north of Eger, cuts through the Vogtland in a deep and picturesque valley, passing Plauen, Greiz, Gera, and Zeitz on its way north to Leipzig, just below which city it receives its most important tributary, the Pleisse. At Leipzig it divides, the main stream turning north-west and entering the Saale from the right a little above Halle

; the other arm, the Luppe, flowing parallel to the main stream and south of it, enters the Saale below Mer- seburg. Total length, 121 miles; total descent, 1286 feet.

Elswick. See Newcastle-on-Tyne.

Elvas, a city, episcopal see, and first-class fortress of Portugal, district Portalegre, 41 miles from the right bank of the river Guadiana and 33 south-south-east from Portalegre. It is celebrated for its olives and its plums, the last named being exported, both fresh and dried, in large quantities. It also has distilleries and potteries. Population, about 13,000.

Elvey, Sir George Job (1816-1893), English organist and composer, was born at Canterbury on 27th March 1816. He was a chorister at Canterbury Cathedral under Highmore Skeats, the organist. Subsequently he became a pupil of his elder brother, Stephen, and then studied at the Eoyal Academy of Music under Cipriani Potter and Dr Crotch. In 1834 he gained the Gresham Prize Medal for an anthem, and in 1835 was appointed organist of St George's Chapel, Windsor, a post he filled for 47 years, retiring in 1882. He took the degree of Mus.B. at Oxford in 1838, and in 1840 that of Mus.D. Anthems of his were commissioned for the Three Choirs Festivals of 1853 and 1857, and in 1871 he received the honour of knighthood. He died at Windlesham in Surrey on 9th December 1893. His works, which are nearly all for the Church, include two oratorios, a great number of anthems and services, and some pieces for the organ. A memoir of him, by his widow, was published in 1894.

Elwood, a town of Madison county, Indiana, U.S.A., on Duck creek, at an altitude of 862 feet. It is on the Lake Erie and Western and the Pittsburg, Cincinnati, Chicago, and St. Louis railways. Population (1880), 751 ; (1890), 2284 ; (1900), 12,950, of whom 1386 were foreign- born.

Ely, a city and market-town in the Newmarket parlia- mentary division of Cambridgeshire, England, on the Ouse, 15 miles by rail north-north-east of Cambridge. The restora- tion of the cathedral was continued until 1884, when nearly ––80,000 had been expended. Eecent erections are two Established churches, a theological college, and a Eoman Catholic chapel. The grammar school now occupies the room over the ancient archway to

the monastery of which there are some remains ; the chapel built by Prior John of Crandene has been restored and is used as a school chapel. Fruit growing and preserving are carried on. The water supply from the chalk is excellent. Area of urban district, 16,738 acres. Population (1881), 8177; (1891), 8017;

(1901), 7713.

E L Y E I A ××× E MBRYOLOGY

1st

Elyria, capital of Lorain county, Ohio, U.S.A., on Black river, at an altitude of 720 feet. It is at the intersection of the Lake Shore and Michigan Southern and the Cleveland, Lorain, and Wheeling railways. Popu- lation (1880), 4777 ; (1890), 6611 ; (1900), 8791, of whom 1397 were foreign-born and 201 were negroes.

Embroidery. ××× Embroidery is the enrichment of a stuff (generally woven) with the needle. It is mainly an affair of stitches, though the stitching on of other stuff {appliquS) or of gold thread or cord (conching) goes also by the name. The stitching, whether only, as it were, dipping into the stuff (darning, chain stitch, &c.), or distributed equally on both sides of it (crewel stitch, satin stitch, &c.), usually penetrates it at each ply of the needle. When it forms only a network upon the surface it belongs, strictly speaking, to lacework. Eecent development of embroidery has been in the direction of domestic work. The Gothic Revival led to the study of old work, but chiefly of Church embroidery and in an antiquarian spirit. Greater attention is now being paid to the work itself and the way of doing it, than to its style and date. Moreover, we now know more about embroidery other than Gothic or Eenaissance or Old English. There has been a discovery of early Coptic stuffs in Upper Egypt, which has found itsway to the Victoria and Albert Museum in London, where also have been collected treasures of Persian, Indian, and other Oriental work. Much gorgeous Chinese and Japanese stitchery on silk, and more homely work from the Greek islands (Crete, &c.), has also been imported into England. Some of this is of a kind to appeal directly to the simple needlewoman, who, without pretending to be an artist, arrives by sincerity and thoroughness of work at artistic results.

Schools of art needlework, patronized by royalty and assisted by artists, have done something to encourage the art of needlework. It is a mistake, however, to consider it too entirely as an art. It is essentially a handicraft. The needlework of to-day has long passed the stage of Berlin wool work ; but it has yet to get over some of its high artistic pretensions, and settle down into the modest but beautiful needlework in which gentlewomen of earlier generations took honest pride. For embroidery begins and ends with the needle. In the simplest of work, where the stitch determines the character of the design, as in the most ambitious, where the design dictates the stitch, the one depends upon the other. K”eatness or precision of stitch is a point of good workmanship ; but its direction is of at least equal importance, for it is the means both of varying the shades of colour and of ex- pressing form within the outlines of the design. A skilled worker gets accustomed to sort the varieties of sketches in her mind, according as they are available for outline, flat surfaces, shading, and so forth. Familiarity with the stitches is indispensable alike to the worker and to the designer, who must not ask of his interpreter more than needle and thread can do. A good design gives scope for the needle, and does justice to the material ??? to the gloss of lustrous silk, for instance. The term ” Art Needlework ” is commonly jnisused. Needlework is worthy of that title, not according to its pretensions, but as it is appropriately designed and cunningly worked, and beautiful accordingly. Good work does not mean only fine work. There is art in expressing form by the stepped outline which comes of accepting the square lines given by the mesh of a coarse canvas, no less than in following the subtle sweep of an easy brush stroke. ‘.Nor is one stitch or kind of embroidery intrinsically more artistic than another. There is no material so coarse it may not be embroidered, no stitch so mechanical it may not be employed to artistic purpose. All that is necessary is the artist, and he

must understand his craft and work in sympathy with it. Great strides have been made in machine embroidery, and every year imitation is carried to further perfection. It is all the more incumbent, therefore, upon the needlewoman to avoid futile competition with loom or sewing-machine, and to do what sensitive hands alone can do.

(l. f. d.)

Embryology. ??? The word embryo is derived from the Greek l/A/Spuov, which signified the fruit of the womb before birth. In its strict sense, therefore, embryology is the study of the intrauterine young or embryo, and can only be pursued in those animals in which the offspring are retained in the uterus of the mother until they have acquired, or nearly acquired, the form of the parent. As a matter of fact, however, the word has a much wider application than would be gathered from its derivation. All animals above the Protozoa undergo at the beginning of their existence rapid growth and considerable changes of form and structure. During these changes, which consti- tute the development of the animal, the young organism may be incapable of leading a free life and obtaining its own food. In such cases it is either contained in the body of the parent or it is protruded and lies quiescent within the egg membranes ; or it may be capable of leading an independent life, possessing in a functional condition all the organs necessary for the maintenance of its existence. In the former case the young organism is called an embryo, in the latter a larva. It might thus be concluded that embryology would exclude the study of larvae, in which the whole or the greater part of the development takes place outside the parent and outside the egg. But this is not the case ; embryology includes not only a study of embryos as just defined, but also a study of larvae. In this way the scope of the subject is still further widened. As long as embryology confines its attention to embryos, it is easy to fix its limits, at any rate in the higher animals. The domain of embryology ceases in the case of viviparous animals at birth, in the case of oviparous animals at hatching ; it ceases as soon as the young form acquires the power of existing when separated from the parent or when removed from the protection of the egg .membranes. But as soon as post-embryonic developmental changes are admitted within the scope of the subject, it becomes on close consideration difficult to limit its range. It must include all the developmental processes which take place as a result of sexual repro- duction. A man at birth, when he ceases to be an embryo, has still many changes besides those of simple growth to pass through. The same remark applies to a young frog at the metamorphosis. A chick even, which can run about and feed almost immediately after hatching, possesses a plumage very different from that of the full-grown bird ; a starfish at the metamorphosis is in many of its features quite different from the form with which we are familiar. It might be attempted to meet this difficulty by

limiting embryology to a study of all those changes which occur in the organism before the attainment of the adult state. But this merely shifts the difficulty to another quarter, and makes it necessary to define what is meant by the adult state. At first sight this may seem easy, and no doubt it is not difficult when man and the higher animals alone are in question, for in these the adult state may be defined comparatively sharply as the stage of sexual maturity. After that period, though changes in the organism still continue, they are retrogressive changes, and as such might fairly be excluded from any account of development, which clearly implies progression, not retrogression. But, as so often happens in the study of organisms, formulae which apply quite satisfactorily to one group require modification when others are considered.

S. IV. ††† i8

Does sexual maturity always mark the attainment of the adult state ? Is the Axolotl adult when it acquires its reproductive organs ? Can a larval Ctenophore, which acquires functional reproductive glands and still possesses the power of passing into the form ordinarily described as adult in that group, be considered to have reached the end of its development ? Or ††† to take the case of those animals, such as Amphioxus, Balanoglossits, and many segmented worms in which important developmental processes occur, e.g., formation of new gill slits, of gonadial sacs, or even of whole segments of the body, long after the power of reproduction has been acquired ††† how is the attainment of the adult state to be defined, for it is clear that in them the attainment of sexual maturity does not correspond with the end of growth and development ? If, then, embryology is to be regarded as including not only the study of embryos, but also that of larvae, i.e., if it includes the study of the whole developmental history of the individual ††† and it is impossible to treat the subject rationally unless it is so regarded ††† it becomes exceeding difficult to fix any definite limit to the period of life with which embryology concerns itself. The beginning of this period can be fixed, but not the end, unless it be

the end of life itself, i.e., death. The science of embry- ology, then, is the science of individual development, and includes within its purview all those changes of form and structure, whether embryonic, larval, or post- larval, which characterize the life of the individual. The beginning of this period is precise and definite ??? it is the completion of the fertilization of the ovum, in which the life of the individual has its start. The end, on the other hand, is vague and cannot be precisely defined, unless it be death, in which case the period of life with which embryology concerns itself is coinci- dent with the life of the individual. To use the words of Huxley ("Cell Theory," Collected Works, vol. i. p. 267) : " Development, therefore, and life are, strictly speaking, one thing, though we are accustomed to limit the former to the progressive half of life merely, and to speak of the retrogressive half as decay, considering an imaginary resting-point between the two as the adult or perfect state."

There are two kinds of reproduction, the sexual and the asexual. The sexual method has for its results an increase

of the number of kinds of individual or organism, Reproduc- -^i^ereas the asexual affords an increase in the

number of individuals of the same kind. If the asexual method of reproduction alone existed, there would, so far as our knowledge at present extends, be no increase in the number of kinds of organism : no new individuality could arise. The first establishment of a new kind of individual by a sexual process is effected in a very similar manner in all Metazoa. The parent produces by a process of unequal fission, which takes place at a part of the body called the reproductive gland, a small living organism called the reproductive cell. There are always two kinds of reproductive cells, and these are generally produced by different animals called the male and female respectively (when they are produced by the same animal it is said to be hermaphrodite). The reproductive cell produced by the male is called the spermatozoon, and that produced by the female, the ovum. These two organisms agree in being small uninucleated masses of protoplasm, but differ con- siderably in f orijti. They are without the organs of nutri- tion, &c., which characterize their parents, but the ovum nearly always possesses, stored up within its protoplasm, a greater or less quantity of

vitelline matter or food-yolk, while the spermatozoon possesses in almost all cases the power of locomotion. The object with which these two minute and simple organisms are produced is to fuse with one another and give rise to one resultant uninucleated

(for the nuclei fuse) organism or cell, which is called the zygote. This process of fusion between the two kinds of reproductive cells, which are termed gametes, is called con- jugation : it is the process which is sometimes spoken of as the fertilization of the ovum, and its result is the establishment of a new individual. This new individual at first is simply a uninucleated mass of living matter, which always contains a certain amount of food-yolk, and is generally bounded by a delicate cuticular membrane called the vitelline membrane. In form the newly estab- lished zygote resembles the female gamete or ovum ??? so much so, indeed, that it is frequently called the ovum ; but it must be clearly understood that although the bulk of its matter has been derived from the ovum, it consists of ovum and spermatozoon, and, as shown by its subsequent behaviour, the spermatozoon has quite as much to do with determining its vital properties as the ovum.

To the unaided eye the main difference between the newly formed zygotes of different species of animals is that of bulk, and this is due to the amount of food-yolk held in suspension in the proto- plasm. The ovum of the fowl is 30 mm. in diameter, that of the frog 1-75 mm., while the ovum of the rabbit and Amphioxus have a diameter of . 1 mm. The food-yolk is deposited in the ovum as a result of the vital activity of its protoplasm, while the ovum is still a part of the ovary of the parent. It is an inert substance which is used as food later on by the developing embryo, and it acts as a dilutant of the living matter of the ovum. It has a profound influence on the subsequent developmental process. (For details as to what may be called the natural history of fertilization, see Reproduction.) The newly formed zygotes of different species of animals have undoubtedly, as stated above, a certain family resemblance to one another ; but however great this resemblance may be, the differences must be most profound, and this fact becomes at once obvious when the properties of these remarkable masses of matter are closely investigated.

As in the case of so many other forms of matter, the more important properties of the zj-gote do not become apparent until it is submitted to the action of external forces. These forces constitute the ex- Causes of ternal conditions of existence, and the properties <>^^^’►►p- which are called forth by their action are called the acquired characters of theorganism. The investigation of these properties, particularly of those which are called forth in the early stages of the process, constitutes the science of Embryology. “With regard to the manifestation of these properties, certain points must be clearly under- stood at the outset : ►►► (1) If the zygote is withheld from the appropriate external influences, e.g., if a plant- seed be kept in a box free from moisture or at a low temperature, no properties are evolved, and the zygote remains unchairged and eventually dies ; (2) the acquisition of the properties, which constitutes the growth and development of the organism, proceeds in a perfectly definite sequence, which, so far as is known, cannot be altered ; (3) just as the features of the grow- ing organism change under the continued action of the external conditions, so the external conditions them- selves must change as the organism is progressively evolved. With regard to this last change, it may be said generally that it is usually, if not always, effected by the organism itself, making use of the properties which it has acquired at earlier stages of its growth, and acting in response to the external conditions. There is, to use a phrase of INIr Herbert Spencer, a continuous ad- justment between the external and internal relations. For every organism a certain succession of conditions is neces- sary, if the complete and normal evolution of properties is to take place. Within certain limits these conditions may vary, without interfering with the normal evolution of the properties, though such variations are generally responded to by slight but unimportant variation of the properties (variation of acquired characters). But if the variation of the conditions is too great, the evolved properties become abnormal, and are of such a nature as to preclude the

normal evolution of the organism ; in other words, the action of the conditions upon the organism is injurious, causing abortions and, ultimately,

death. For many organ- isms the conditions of existence are well known for all stages of life, and can be easily imitated, so that they can be reared artificially and kept alive and made to breed in confinement ??? e.g., the common fowl. But in a large num- ber of cases it is not possible, through ignorance of the proper conditions, or on account of the difficulty of imi- tating them, to make the organism evolve all its properties. For instance, there are many marine larvae which have never been reared beyond a certain point, and there are some organisms which, even when nearly full-grown ??? a stage of life at which it is generally most easy to ascer- tain and imitate the natural conditions ??? will not live, or at any rate will not breed, in captivity. Of late years some naturalists have largely occupied themselves with experi- mental observation of the effects on certain organisms of marked and definite changes of the conditions, and the name of Developmental Mechanics (or Physiology of De- velopment, under which title it is discussed below, p. 148) has been applied to this branch of study.

In normal fertilization, as a rule, only one spermatozoon fuses with the ovum. It has been observed iu some eggs that a membrane, formed round the ovum immediately after the entrance Oameto- ^f jj^g spermatozoon, prevents the entrance of others. If ^^“y- more than one spermatozoon enters, a corresponding

number of male pronuclei are formed, and the subsequent develop- ment, if it takes place at all, is abnormal and soon ceases. An egg by ill-treatment (influence of chloroform, carbonic acid, &o.) can be made to take more than one spermatozoon. In some animals it appears that several spermatozoa may normally enter the ovum (some Arthropods, Selachians, Amphibians, and Mammals), but of these only one forms a male pronucleus (see below), the rest being absorbed. Gametogeny is the name applied to the formation of the gametes, i.e., of the ova and spermatozoa. The cells of the reproductive glands are the germ cells (oogonia sperma- togonia). They undergo division and give rise to the progametes, which in the case of the female are sometimes called oocytes, in the case of the male spermatocytes. The oocytes are more familiarly called the ovarian ova. The nucleus of the oocyte is called the germinal vesicle. The oocyte (progamete) gives rise by division to the ovum or true gamete, the nucleus of which is called the

female pronucleus. As a general rule the oocyte divides unequally twice, giving rise to two small cells called polar bodies, and to the ovum. The first formed polar body frequently divides when the oocyte undergoes its second and final division, so that there are three polar bodies as well as the ovum resulting from the division of the oocyte or progamete. Sometimes the ovum arises from the oocyte by one division only, and there is only one polar body (mouse, Sobotta, Arch. f. mikr. Anat., 1895, p. 15). The polar bodies are ova, but as a rule they are so small as to be incapable of fertilization. They may therefore be regarded as abortive ova. In one case, however (see Francotte, Bull. Acad. Belg. (3), xxxiii., 1897, p. 278), the first formed polar body is nearly as large as the ovum, and is sometimes fertilized and develops. The spermatogonia are the cells of the testis ; these produce by division the spermatocytes (progametes). These divide and produce the spermatids, which become the spermatozoa. The spermatocytes give rise to the young spermatozoa (spermatids) by division, but the number of divisions is more variable than in the case of the process by which the female gamete arises from the progamete. In Asearis and some other forms there appear to be two binary divisions, giving rise to four equal spermatids, each of which becomes a functional spermatozoon ; but in other cases, e.g., Lmiibricus, a much greater number of fissions follow each other, and many spermatids (young spermatozoa) result from one progamete (spermatocyte). The nucleus of the male gamete is not called the male pronucleus, as would be expected, that term being reserved for the second nucleus which appears in the ovum after fertilization. As this is in all probability derived entirely from the nucleus of the spermatozoon, we should be almost justified In calling the nucleus of the spermatozoon the male pronucleus. In Asearis and some other forms in which the formation of the gametes from the progamete has been accurately followed, and in which the pro- gamete of both sexes divides twice in forming the gametes, the division of the nucleus presents certain peculiarities. In the first place between the first division and the second it does not enter into the resting state, but immediately proceeds to the second division. In the second place, the number of chromosomes which appear in the final divisions of the progametes and assist in con-

stituting the nuclei of the gametes, is half the number which go to constitute the new nuclei in the ordinary nuclear divisions of the animal. The number of chromosomes of the nucleus of the gamete is therefore reduced, and the

divisions by which the gametes arise from the progametes are called reducing divisions. It is not certain, however, that this phenomenon is of universal occurrence, or has the significance which is ordinarily attributed to it.

As soon as the spermatozoon has conjugated with the ovum, a second nucleus appears in the ovum. This is undoubtedly derived from the spermatozoon, possibly from its nucleus only, and is called the male pronucleus. It possesses in the J'ert/Wza- adjacent protoplasm a well-marked centrosome. The general rule appears to be that the female pronucleus is without a centrosome, and that no centrosome appears in the female in the divisions by which the gamete arises from the pro- gamete. If this is true, the centrosome of the zygote nucleus must be entirely derived from that of the male pronucleus. This accounts for the fact, which has been often observed, that the female pronucleus is not surrounded by protoplasmic radiations, whereas such radiations are present round the male pronucleus in its ap- proach to the female. In the mouse the subsequent events are as follow : ??? Both pronuclei assume the resting form, the chromatin being distributed over the nuclear network, and the nuclei come to lie side by side in the centre of the egg. A long loop of chromatin then appears in each nucleus and divides up into twelve pieces, the chromosomes. The centrosome now divides, the membranes of both nuclei disappear, and a spindle is formed. The twenty-four chro- mosomes arrange themselves at the centre of this spindle and split longitudinally, so thatforty-eightohromosomesare formed. Twenty- four of these, twelve male and twelve female, as it is supposed, travel to each pole of the spindle and assist in giving rise to the two nuclei. At the next nuclear division twenty-four chromosomes appear in each nucleus, each of which divides longitudinally ; and so in all subsequent divisions. The fusion of the two pronuclei is sometimes effected in a manner slightly different to that described for the mouse. In Echinus, for instance, the two pronuclei fuse, and the spindle and chromosomes are formed from the zygote nucleus, whereas in the mouse the two pronuclei retain their dis- tinctness during the formation of the chromosomes. There appears, however, to be some variation in this respect : cases have been observed in the mouse in which fusion of the pronuclei occurs before the separation of the chromosomes.

Parthenogenesis, or development of the female ga.mete without fertilization, is known to occur in many groups of the animal kingdom. Attempts have been made to connect this phenomenon with peculiarities in the gametogeny. P^rtheao- For instance, it has been said that parthenogenetic ova seaesls. form only one polar body. But, as we have seen, this is some- times the case in eggs which are fertilized, and parthenogenetic ova are known which form two polar bodies, e.g., ova, of the honey-bee which produce drones (Morph. Jahrb. xv., 1889, p. 85), ova of Botifera which produce males (Zool. Anzeiger, xx., 1897, p. 455). It is quite probable that parthenogenesis is more common than has been supposed, and it appears that there is some evidence to show that ova, which in normal conditions are incapable of developing without fertilization, may yet develop if subjected to an altered environment. For instance, it has been asserted that the addition of a certain quantity of chloride of magnesium and other substances to sea-water will cause the unfertilized ova of certain marine animals (Arbacia, Chaetoptents) to develop (J. Loeb, American Journal of Physiology, ix., 1901, p. 423) ; but it it is not known whether in such cases a previous formation of polar bodies has occurred. This experiment, if authenticated, suggests that ova have the power of development, but are not able to exercise it in their normal surroundings. There is reason to believe that the same assertion may be made of spermatozoa. Phenomena of the nature of parthenogenesis have never been ob- served in the male gamete, but it has been suggested by Giard (Cinquantenaire de la Soc. de Biol., 1900) that the phenomenon of the so-called fertilization of an enucleated ovum which has been described by Boveri and Delage in various eggs, and which results in development up to the larval form, is in reality a case in which the male gamete, unable to undergo development in ordinary cir- cumstances on account of its small size and specialization of structure, has obtained a nutritive environment which enables it to display its latent power of development. Moreover, Giard suggests that in some cases of apparently normal fertilization, one of the pronuclei may degenerate, the resultant embryo being the product of one pronucleus only. In this way he explains certain cases of hybridization in which the paternal (rarely the maternal) type is exclusively reproduced. For instance, in the batrachiate Amphibia, H^ron Royer succeeded in 1883 in rearing, out of a vast number of attempts, a few hybrids between a female Pelobates fuscus and a male Bana fusca ; the product was a Bana fusca. He

also crossed a female Bufo vulgaris with a male Bufo calamita; in the few cases which reached maturity the product was obviously a Bufo calamita. Finally, Ziegler (Arch. f. Ent.-Mech., 1898,

249) divided the just fertilized ovum of a sea-urchin in such a way that each half had one pronucleus ; the half with the male pronucleus segmented and formed a blastula, the other de- generated. It is said that in a few species of animals males do not occur, and that parthenogenesis is the sole means of reproduction (a species of Ostracoda among Crustacea ; species of Tenthredinidce, Cynipidx, and Ooccidce among Insecta) ; this is the thelytoky of Siebold. The number of species in which males are unknown is constantly decreasing, and it is quite probable that the phenomenon does not exist. Parthenogenesis, however, is un- doubtedly of frequent occurrence, and is of three kinds, namely, (1) that (arrhenotoky) in which males alone are produced, e.g., honey-bees ; (2) that in which the product is generally a female, but males occasionally occur, e.g., some A2Jhid(B, Phyllopod Crustacea ; (3) that in which there is an alternation of a sexual generation with a parthenogenetxc generation (many Cynipidce). It would appear that “parthenogenesis does not favour the production of one sex more than another, but it is clear that it decidedly favours the production of a brood that is entirely of one sex, but which sex that is differs according to circumstances ” (Sharp, Cambridge Natural History, “Insects,” pt. i. p. 498). In some Insecta and Crustacea exceptional parthenogenesis occurs : a certain proportion of the eggs laid are capable of undergoing either the whole or a part of development parthenogenetically, e.g., Bombyx mori, &c. (Brauer, Arch. /. mikr. Anat., 1893 ; consult also Maupas on parthenogenesis of Rotifera, Comp. Bend., 1889-91, and Lauterborn, Biol. GentralUatt, xviii., 1898, p. 173).

The question of the determination of sex may be alluded to here. Is sex determined at the act of conjugation of the two gametes ? Is it, in other words, an unalterable property Determla- ^f ^j^g zygote, a genetic character ? Or does it depend ation of upon the conditions to which the zygote is subjected in **^’ its development? In other words, is it an acquired

character ? It is impossible in the present state of knowledge to answer these questions satisfactorily, but the balance of evidence appears to favour the view that in most cases sex is an unalterable, inborn character, though in a few it may be an acquired character. Thus those twins which are believed to come from a split zygote are always of the same sex, members of the same litter which have been submitted to exactly similar conditions are of different sexes, and all, attempts to determine the sex of offspring in the higher animals by treatment have failed. On the other hand, the male bee is a portion of a female zygote ??? the queen-bee. The same remark applies to the male Rotifer, in which the zygote always gives rise to a female, from which the male arises partheno- genetically, and parthenogenetic eggs which would ordinarily give rise to females may be made by certain treatment to become males. It is said that in human societies the number of males bom increases after wars and famines, but this, if true, is probably due to an affection of the gametes and not of the young zygote. For a review of the whole subject, see CuSnot, Bull. Sci. France et Belgique, xxxii., 1899, pp. 462-535.

Tlie first change tlie zygote undergoes in all animals is

what is generally called the segmentation or cleavage of

the ovum. This consists essentially of the

eavage. ^^yjgiQ^ Qf i^\^Q nucleus into a number of nuclei, around which the protoplasm sooner or later becomes arranged in the manner ordinarily spoken of as cellular. This division of the nucleus is effected by the process called binary fission; that is to say, it first divides into two, then each of these divides simultaneously again into two, giving four nuclei; each of these after a pause again simultaneously divides into tvro. So the process continues for some time until the ovum becomes possessed of a large number of nuclei, all of which have proceeded from the original nucleus by a series of binary fissions. This division of the nucleus, which constitutes the essential part of the cleavage of the ovum, continues through the whole of life, but it is only in the earliest period that it is dis- tinguished by a distinct name and used to characterize a stage of development. The nuclear division of cleavage is usually at first a rhythmical process ; all the nuclei divide simultaneously, and periods of nuclear activity alternate with periods

of rest. Nuclear divisions may be said to be of three kinds, according to the accompanying changes in the surrounding protoplasm : (1) accompanied by no visible change, e.g., the multinucleated Protozoon Actino- sphmrium; (2) accompanied by a rearrangement of the protoplasm around each nucleus, but not by its division

into two separate masses, e.g., the division which results in the formation of a colony of Protozoa ; (3) accompanied by the division of the protoplasm into two parts, so that two distinct cells result, e.g., the divisions by which the free wandering leucocytes are produced, the reproduc- tion of uninuclear Protozoa, &c. In the cleavage of the ovum the first two of these methods of division are found, but probably not the third. At one time it was thought that the nuclear divisions of cleavage were always of the third kind, and the result of cleavage was sup- posed to be a mass of isolated cells, which became reunited in the subsequent development to give rise to the later connexions between the tissues which were known to exist. But in 1885 it was noticed that in the ovum of Peripaius capensis (Sedgwick, Q.J.M.S., xxv., 1886, p. 449) the extranuclear protoplasm did not divide in the cleavage of the ovum, but merely becanie re- arranged round the increasing nuclei : the continuity of the protoplasm was not broken, but persisted into the later stages of growth, and gave rise to the tissue con- nexions which undoubtedly exist in the adult. This dis- covery was of some importance, because it rendered intelligible the unity of the embryo so far as its develop- mental processes are concerned, the maintenance of this unity being somewhat surprising on the previous view. On further inquiry and examination it was found that the ova of many other animals presented a cleavage essentially similar to that of Peripatus. Indeed, it was found that the nuclear divisions of cleavage were of the first two kinds just described. In some eggs, e.g., the Alcyonaria, the first nuclear divisions are effected on the first plan, i.e., they take place without at first producing any visible effect upon the protoplasm of the egg. But in the later stages of cleavage the protoplasm becomes arranged around each nucleus and related to it as to a centre. In the majority of eggs, however, the protoplasm, though not undergoing complete cleavage, becomes rearranged round each nucleus as it is formed. The best and clearest instance of this is afforded by many Arthropodan eggs, in which the nucleus of the just-formed zygote takes up a cen- tral position, where it undergoes its first division, subse- quent

divisions taking place entirely within the egg and not in any way affecting its exterior. The result is to give rise to a nucleated network or foam-work of proto- plasm, ramifying through the yolk particles and contain- ing these in its meshes.

In other Arthropodan eggs the cleavage is on the so-called centrolecithal type, in which the dividing nuclei pass to the cortex of the ovum, and the surface of the ovum becomes indented with grooves corresponding to each nucleus. In this kind of cleavage all the so-called seg- ments are continuous with the central undivided yolk-mass. It sometimes happens that in Arthropods the egg breaks up into masses, which cannot be said to have the value of cells, as they are frequently without nuclei. In other eggs, characterized by a considerable amount of yolk, e.g., the ova of Cephalopoda, and of the Yertebrata with much yolk, the first nucleus takes up an eccentric position in a small patch of protoplasm which is comparatively free from yolk particles. This patch is the germinal disc, and the nuclear divisions are confined to it and to the transitional region, where it merges into the denser yolk which makes up the bulk of the egg. At the close of segmentation the germinal disc consists of a number of nuclei, each sur- rounded by its own mass of protoplasm, which is, however, not separated from the protoplasm round the neighbouring nuclei, as was formerly supposed, but is continuous at the points of contact. In this manner the germinal disc has become converted into the blastoderm, which consists of a small watch-glass-shaped mass of so-called cells resting on, but continuous with, the large yolk-mass. It is character-

istic of this kind of ovum that there is always a row of nuclei, called the yolk nuclei, placed in the denser yolk immediately adjacent to the blastoderm. These nuclei are continually undergoing division, one of the products of division, together with a little of the sparse yolk proto- plasm, passing into the blastoderm to reinforce it. The other product of the dividing yolk nuclei remains in the yolk, in readiness for the next division. In this manner nucleated masses of protoplasm are continually being added to the periphery of the blastoderm and assisting in its growth. But it must be borne

in mind that all the nucleated masses of which the blastoderm consists are in continuity with each other and with the sparse proto- plasmic reticulum of the subjacent yolk.

In the great majority of eggs, then, the nuclear division of cleavage is not accompanied by a complete division of the ovum into separate cells, but only by a rearrange- ment of the protoplasm, which produces, indeed, the so- called cellular arrangement, and an appearance only of separate cells. But there still remain to be mentioned those small eggs in which the amount of yolk is incon- siderable, and in which the division of the nuclei does appear to be accompanied by a complete division of the surrounding protoplasm into separate unconnected cells ••• ova of many Annelida, Mollusca, Echinoderma, &c., and of Mammalia amongst Vertebrata. In the case of these (Andrews, Zool. Bulletin, ii., 1898) also, it has been shown that the apparently separate spheres are connected by a number of fine anastomosing threads of a hyaline proto- plasm, which are not easy to detect and are readily destroyed by the action of reagents. It is therefore probable that the divisions of the nuclei in cleavage are in no case accompanied by complete division of the sur- rounding protoplasm, and the organism in the cleavage stage is a continuous whole, as it is in all the other stages of its existence.

Of late years a great number of experiments have been made to discover the effects of dividing the embryo during its cleavage, and of destroying certain portions of embryo. ••’ ^*- These experiments have been made with the object of testing the view, held by some authori- ties, that certain segments are already set apart in cleav- age to give rise to certain adult organs, so that if they were destroyed the organs in question could not be devel- oped. The results obtained have not borne out this view. Speaking generally, it may be said that they have been diiferent according to the stage at which the separation was effected and the conditions under which the experiment was carried out. If the experiment be made at a sufficiently early stage, each part, if not too small, will develop into a normal, though small, embryo. In some cases the embryo remained imperfect for a certain time after the experiment, but the loss is eventually made good by regeneration. (For a summary of the work done on this subject, see Berg, Zool. Centralblatt, vii., 1900, p. 1.)

The end of cleavage is marked by the commencement of the differentiation of the organs. The first differenti- ation is the formation of the layers. These are The three in number, being called respectively the

ectoderm, endoderm, and mesoderm, or, in em- bryos in which at their first appearance they lie like sheets one above the other, the epiblast, hypoblast, and mesoblast. The layers are sometimes spoken of as the primary organs, and their importance lies in the fact that they are supposed to be generally homologous through- out the series of the Metazoa. This view, which is based partly on their origin and partly on their fate, had great influence on the science of comparative anatomy during the last thirty years of the 19th century, for the homo- logy of the layers being admitted, they afforded a kind of final court of appeal in determining questions of doubt-

layer- tbeory.

ful homologies between adult organs. Great importance was therefore attached to them by embryologists, and both their mode of development and the part which they play in forming the adult organs were examined with the greatest care. It is very unusual for all the layers to be established at the same time. As a general rule the ecto- derm and endoderm, which may be called the primary layers, come first, and later the mesoderm is developed from one or other of them. There are two main methods in which the first two are differentiated ??? invagination and delamination. The former is generally found in small eggs, in which the embryo at the close of cleavage as- sumes the form of a sphere, having a fluid or gelatinous material in its centre, and bounded externally by a thin layer of protoplasm, in which all the nuclei are contained. Such a sphere is called a blastosphere, and may be re- garded as a spherical mass of protoplasm, of which the central portion is so much vacuolated that it seems to consist entirely of fluid. The central part of the blasto- sphere is called the segmentation cavity or blastoccsl. The blastosphere soon gives rise, by the invagination of one part of its wall upon the other, and a consequent oblit- eration of the segmentation cavity, to a double-walled cup with a wide opening, which, however, soon becomes narrowed to a small pore. This cup stage is called the gastrula stage ; the outer wall of the gastrula is the ecto- derm, and its inner the endoderm ; while its cavity is the enteron, and the opening to the exterior the

blastopore. Origin of the primary layers by delamination occurs universally in eggs with large yolks (Cephalopoda and many Vertebrata), and occasionally in others. In it cleavage gives rise to a solid mass, which divides by delamination into two layers, the ectoderm and endo- derm. The main difference between the two methods of development lies in the fact that in the first of them the endoderm at its first origin shows the relations which it possesses in the adult, namely, of forming the epithelial wall of the enteric space, whereas in the second method the endoderm is at first a solid mass, in which the enteric space makes its appearance later by excavation. In the delaminate method the enteric space is at first without a blastopore, and sometimes it never acquires this opening, but a blastopore is frequently formed, and the two- layered gastrula stage is reached, though by a very dif- ferent route to that taken in the formation of the invag- inate gastrula. According to the layer-theory, these two layers are homologous throughout the series of Metazoa ; their limits can always be accurately defined, they give rise to the same organs in all cases, and the adult organs (excluding the mesodermal organs) can be traced back to one or other of them with absolute precision. Thus the ectoderm gives rise to the epidermis, to the nervous system, and to the lining of the stomodseum and proc- todseum, if such parts of the alimentary canal are pres- ent. The endoderm, on the other hand, gives rise to the lining of the enteron, and of the glands which open into it.

So far as these two layers are concerned, and excluding the mesoderm, it would appear that the layer-theory does apply in a very remarkable manner to the whole of the Metazoa. But even here, when the actual facts are closely scanned, there are found to be difficulties, which appear to indicate that the theory may not perhaps be such an infallible guide as it seems at first sight. Leaving out of consideration the case of the Mammalia, in which the differentiation of the segmented ovum is not into ectoderm and endoderm, and the case of the sponges, the most im- portant of these difficulties concern the stomodaeum and proctodseum. The best case to examine is that of Peripatus capensis, in which the blastopore is at first a long slit, and gives rise to both the mouth and the anus of the adult.

Here there is always found at the lips of the blastopore, and extending for a short distance inwards as enteric lining, a certain amount of tissue, which by its characters must be regarded as ectoderm. Now, in the closure of the blastopore between the mouth and anus, this tissue, which at the mouth and anus develops into the lining of the stomodseum and proctodeeum, is left inside, and actually gives rise to the median ventral epithelium of the alimentary canal. Hence the development of Peripatus capensis suggests the conclusion, if we strictly apply the layer-theory, that a considerable portion of the true mesenteron is lined by ectoderm, and is not homologous with the corresponding portion of the mesenteron of other animals ††† a conclusion which will on all hands be admitted to be absurd. The difficulties in the application of the layer-theory become vastly greater when the origin ††† _, and fate of the mesoderm is considered. The

Mesoderm. , ††† ‘j; ††† i j? j_t_ i

mesoderm is, it we may judge irom the number

of organs which are derived from it, much the most im- portant of the three layers. It generally arises later than the others, and in its very origin presents difficulties to the theory, which are much increased when we consider its history. It is generally, though not always, developed from the endoderm, either as hollow outgrowths con- taining prolongations of the enteric cavity, which be- come the coelom, or as solid proliferations. But in some groups the mesoderm is actually laid down in cleavage, and is present at the end of that process. In others it is entirely derived from the ectoderm {Peripatus capensis). In yet others it is partly derived from endoderm and partly from ectoderm (primitive streak of amniotic Verte- brates). Finally, in whatever manner the first rudiments are developed, it frequently receives considerable rein- forcements from one of the primary layers. For instance, the structure known as the nerve crest of the vertebrate embryo is not, as was formerly supposed, exclusively con- cerned with the formation of the spinal nerves and ganglia, but contributes largely to the mesoderm of the axial region of the body. This is particularly clearly seen in the case of the anterior part of the head of Elasmobranch and probably of other vertebrate

embryos, where all the mesoderm present is derived from the anterior part of the neural crest (Q.J.M.S. xxxvii. p. 92).

The layer- theory, then, will not bear critical examina- tion. It is clear, both from their origin and history, that the layers or masses of cells called ectoderm, endoderm, and mesoderm have not the same value in different animals; indeed, it is misleading to speak of three layers. At the most we can only speak of two, for the mesoderm is formed after the others, has a composite origin, and has no more claim to be considered an embry- onic layer than has the rudiment of the central nervous system, which in some animals, indeed, appears as soon as the mesoderm. Arguments as to homology, based on derivation or non-derivation from the same em- bryonic layer, have therefore in themselves but little value.

It has frequently been asserted that the reproductive cells are marked off at a very early stage of the development (Sagitta, certain Crustacea, Scorpio). Recently it has been asserted that in Ascaris (Boveri, Kuppfer‘‘s Festschrift, 1899, p. 383) the repro- ductive cells are set apart after the first cleavage, and that they can be traced by certain peculiarities of their nuclei into the adult reproductive glandn.

It has been already stated that the mesoderm is a composite tissue. This fact is frequently conspicuous at its first establish- ment. In many Coelomata it is present under two Mesen- forms from the beginning. One of these Is epithelial chyme. ^^ character, while the other has the form of a net^ work of protoplasm, with nuclei at the nodes. The former is called simply epithelial mesoderm, the latter mesenchyme. Sometimes the epithelial mesoderm is the first formed, and what little mesen- chyme there is is developed from it (Amphioxus, Balanoglossus,

&o.). Sometimes the mesenchyme is the first to arise, the epithelial mesoderm developing from it (most, if not all, Vertebrates). Finally, it sometimes happens that these two kinds of tissue arise separately from one or other of the primary layers (Echinoder- mata). As already hinted, in Balanoglossus and Amphioxus the whole of the mesoderm of the body is at first in an epithelial con- dition, being developed as an outgrowth of the gut wall. In Peripatus capensis also, and possibly in other Arthropods, it has at first an intermediate form, being derived from a primitive streak and not

from the gut wall, but it rapidly assumes an epithelial structure, from which all the mesodermal tissues are developed. In Annelids the bulk of the mesoderm has at first a modified epithelial form similar to that of Arthropods, but it is formed, not from a primitive streak, but from some peculiar cells produced in cleavage, called pole-cells. In Annelids with trochosphere larvse a certain amount of mesenchyme is formed at an earlier stage and gives rise to the muscular bands of the young larva. In Echino-dermata a certain amount of mesenchyme appears before the epithelial mesoderm, which is formed later as gut diverticula. In these forms the mesenchyme is said to arise as wandering amoeboid cells, which are budded into the blastocoel by the endoderm just before and during its invagination, but the writer has reason to believe that this account of it does not quite describe what happens. It would seem to be more probable that the mesen- chyme arises in these forms, as it certainly does in the case of the later-formed mesenchyme of the Vertebrate embryo, as a proto- plasmic outflow from its tissue of origin, passing at first along the line of pre-existent protoplasmic strands which traverse the blasto- coel, and sending out at the same time processes which branch and anastomose with neighbouring processes (see MacBride, Proc. Camb. Phil. Soc, 1896, p. 153). In the Vertebrata the whole of the mesoderm has at first the mesenchyme form. Afterwards, when the body ~~cavity split appears, the bulk of it assumes a kind of modified epithelial condition, which later on yields, by a process of outflow very similar in its character to what has been supposed to occur in the Echinoderm blastula, a considerable mesenchyme of the reticulate character. Mesenchyme is the tissue which in Vertebrate embryology has frequently been called embryonic con~~ nective tissue. This name is no doubt due to the fact that it was supposed to consist of isolated stellate cells. It is, however, in no sense of the word connective tissue, because it gives rise to many organs having nothing whatever to do with connective tissue. For instance, in Vertebrata this tissue gives rise to nervous tissue, blood-vessels, renal tubules, smooth muscular fibres, and other structures, as well as to connective and skeletal tissues. The Vertebrata, indeed, are remarkable for the fact that the epithelial tissues of the so-called mesoderm, e.g., the epithelial lining of the body-cavity, and of the renal tubules and urogenital tracts, all pass through the mesenchymatous condition, whereas in Amphioxus, Balanoglossus, and presumably Sagitta and the Brachiopoda, all the mesodermal tissues pass through the epithelial

condition, the epithelial mesodermal tissues of the adult retaining this condition permanently. As has been implied in the above account, mesenchyme is usually formed from epithelial mesoderm or from endoderm, or from tissue destined to form endoderm. It is also sometimes formed from ectoderm, as in the Vertebrata at the nerve crest and other places. In some Coelenterata also it appears certain that the ectoderm does furnish tissue of a mesenchymatous nature which passes into the jelly, but this phenomenon takes place comparatively late in life, at any rate after the embryonic period. In this connexion it may be interesting to point out that in many Ccelenterates all the tissues of the body retain throughout life the epithelial condition, nothing comparable to mesenchyme ever being formed.

Finally, before leaving this branch of the subject, the fact that the three germinal layers are continuous with one another, and not isolated masses of tissue, may be emphasized. Indeed, an embryo may continuity be defined as a multinucleated protoplasmic “a^^rs. mass, in which the protoplasm at any surface ??? whether internal or external ??? is in the form of a relatively dense layer, while that in the interior is much vacuolated and reduced to a more or less sparse reticulum, the nuclei either being exclusively found in the surface protoplasm, or if the embryo has any bulk and the internal reticulum is at all well developed, at the nodes of the internal reticulum as well.

The origin of some of the more important organs may now be considered. It is a remarkable fact that the mouth and anus develop in the most diverse ways in different groups, but as a rule either one or both of them can be traced into relation with the blastopore, the history

of which must therefore be examined. In most, if not all, the great groups of the animal kingdon, e.g., in Coelen-

terata, Annelida, Mollusca, Vertebrata, and in Mdiaus. Arthropoda, the blastopore or its representative

is placed on the neural surface of the body, and, as will be shown later on, within the limits of the central nerve rudiment. Here it undergoes the most diverse fate, even in members of the same group. For instance, in Peripatus capensis it extends as a slit along the ventral surface, which closes up in the middle, but remains open at the two ends as the permanent mouth and anus. In other Arthropods, though full details have not yet in all cases been worked out, the following general statement may be made: ??? A blastopore (certain Crustacea) or its representative is formed on the neural surface of the embryo and always becomes closed, the mouth and anus arising as independent perforations later. Here no one would doubt the homology of the mouth and anus through- out the group ; yet within the limits of a single genus ??? Peripatus ??? they show the most diverse modes of develop- ment. In Annelids the blastopore sometimes becomes the mouth (most Ghmtopoda) ; sometimes it becomes the anus (Serpula) ; sometimes it closes up, giving rise to neither, though in this case it may assume the form of a long slit along the ventral surface before disappearing. In Mollusca its fate presents the same variations as in Anne- lida. Now in these groups no zoologist would deny the homology of the mouth and anus in the different forms, and yet how very different is their history even in closely allied animals. How are these apparently diverse facts to be reconciled ? The only satisfactory explanation which lias been offered (Sedgwick, Q.J.M.S. xxiv., 1884, p. 43) is that the blastopore is homologous in all the groups mentioned, and is the representative of the original single opening into the enteric cavity, such as at present char- acterizes the Coelenterata. From it the mouth and anus have been derived, as is indicated by its history in Peripatus capensis, and by the variability in its behaviour in closely allied forms ; such variability in its subsequent history is due to its specialization as a larval organ, as a result of which it has lost its capacity to give rise to both month and anus, and sometimes to either.

That the blastopore does become specialized as a larval organ is ???obvious ia those cases in which it becomes transformed into the .single opening with which some larvae are, for a time at least, alone provided) e.g., Pilidium, Echinoderm larvae, &c., and that larval ???characters have been the principal causes of the form of embryonic characters, strong reason to believe will be adduced later on. In the

Vertebrata the behaviour of the blastopore (anus of Rusooni)isalso variable in a very remarkable manner. As a rule it is slit-like in form and closes completely, but in most cases one portion of it remains open longer than the rest, as the neurenteric canal. In a few forms {e.g., tlfe-wt, Lepidosiren, &c.) the very hindermost portion of the slit-like blastopore remains permanently open as the anus, and from such cases it can be shown that the neurenteric aperture (when present) is derived from a portion of the blastopore just anterior to its hindermost end. The words ” hindermost ” and ” anterior ” are used on the assumption that the whole blastopore has retained its dorsal position ; as a matter of fact the hindermost part of it ††† the part which persists or reopens as the anus ††† loses this position in the course of development and becomes shifted on to the ventral surface. This is clearly seen in Lepidosiren (Kerr, Phil. Trans. cxcii., 1900), in Elasmobranchii, andin Amniota (primitive streak). Moreover, in Lepidosiren, and possibly in some other forms, the anus, j. e. , the hind end of the blastopore, is at first contained within the medullary plate and bounded behind by the medullary folds. Later the portions of the medullary plate in the neighbourhood of the anus completely atrophy, and this relation is lost. This ex- tension of the hind end of the blastopore on to the ventral surface, and atrophy of the portion of the medullary plate in relation with it, is a highly important phenomenon, and one to which attention will be again called when the relation of the mouth to the blasto- pore is being considered. The remarkable fact about the Verte- brata, a feature which that group shares in common with all other Chordata {Amphioxus, Tunicatu, Enteropneusta) and with the Echinodermata, is that the mouth has never been traced into rela-

^††?A T blastopore. Eor this reason, among others, it has been

held by some zoologists that the mouth of the Vertebrata is not homologous with the mouth of such groups as the Annelida, Arthropoda, and Mollusca. But, as has been explained above, m the face of the extraordinary variability in the history of the mouth and anus in these groups, this view cannot be regarded as in any way established. On the contrary, there are distinct reasons for think- mg that the Vertebrate mouth is a derivate of the blastopore. In loL ††’ P’**^††’ ††† Elasmobranchii (Sedgwick, Q.J.M.S. xxxiii., 1892, p. 559), and in a less conspicuous form in other

groups, the mouth has at first a slit-like form, extending from the anterior end of the central nerve tube backwards along the ventral surface of the anterior part of the embryo. This sliMike rudiment, recalling as It does the form which the blastopore assumes in so many groups and in many Vertebrata, does suggest the view thatpossibly the mouth of the Vertebrata may in reality be derived from a portion of an originally long slit-like neural blastopore, which has become extended anteriorly on to the ventral surface and has lost its original relation to the nerve rudiment, as has undoubtedly happened with the posterior part, which persists as the anus.

Of the other organs which develop from the two primary layers, it is only possible to notice here the central nervous system. This in almost all animals develops from the ectoderm. In Cephalopods among Central Mollusca❓❓❓ the development of which is remark- “^^^^ ablefromthealmostcompleteabsence of features which, for want of a better name, we must call vestigial- ancestral ❓❓❓ and in one or two other forms, it has been said to develop from the mesoderm ; but apart from these ex- ceptional and perhaps doubtful cases, the central nervous system of all embryos arises as thickenings of the ectoderm, and in the groups above mentioned, namely, Annelida, Mollusca, Arthropoda, and Vertebrata;, and probably others, from the ectoderm of the blastoporal surface of the body. This surface generally becomes the ventral surface, but in Vertebrata it becomes the dorsal. These thickened tracts of ectoderm in Peripatus and a few other forms can be clearly seen to surround the blastopore. This relation is retained in the adult in Peripatus, some Mollusca, and some Nemertines, in which the main lateral nerve cords are united behind the anus as well as in front of the mouth ; in Other forms it cannot always be demon- strated, but it can, as in the case of the Vertebrata just referred to, always be inferred ; only, in the Inverte- brate groups the part of the nerve rudiment which has to be inferred is the posterior part behind the blastopore, whereas in Vertebrata it is the anterior part, namely, that in front of the blastopore, assuming that the mouth is a blastoporal derivate.

In the Echinodermata, Enteropneusta, and one or two other groups, It is not possible, in the present state of knowledge, to bring the mouth into relation with the blastopore, nor can the blastopore be shown to be a perforation of the neural surface. For the Echinoderms, at any rate, this fact loses some of

the importance which might at first sight be attributed to it when the remarkable organization of the adult and the sharp contrast which exists be- tween it and the larva is remembered. In some Annelids the central nervous system remains throughout life as part of the outer epider- mis, but as a general rule it becomes separated from the epidermis and embedded in the mesodermal tissues. The mode in which this separation is effected varies according to the form and structure of the central nervous system. In the Vertebrata, in which this organ has the form of a tube extending along the dorsal surface of the body, It arises as a groove of the medullary plate, which becomes constricted into a canal. The lining of this canal consists of ecto- derm, which at an earlier stage formed part of the outer surface of the body, and which now thickens, to give rise to the epithelial lining of the canal and to the nervous tissue which forms the bulk of the canal wall. The fact that the blastopore remains open at the hind end of the medullary plate explains to a certain extent the peculiar relation which always exists iii the embryo between the hind end of the neural and alimentary canals. This communica- tion between the hind end of the neural tube and the gut is one of the most remarkable, and constant features of the Vertebrate embryo. As has been pointed out, it is not altogether unintellig- ible when we remember the ifelation of the blastopore to the medullary plate of the earlier stage, but to give a complete explar nation of it is, and probably always will be, impossible. It is

Cranial flexure.

no doubt the impress of some remarkable larval condition of the blastopore of a stage of evolution now long past.

In Ceratodus the open part of the blastopore is enclosed by the medullary folds, and probably persists as the anus, the portion of the folds around the anus undergoing atrophy (Semon, Zool. Forschungsreisen in Australien, 1893, Bd. i. p. 39). In Urodeles the blastopore persists as anus, so far as is known, but the relation to the medullary folds has not been noticed. The same may be said of Petromyzon (Shipley, Q.J.M.S. xxviii., 1887).

The nerve tube of the Vertebrata at a certain early stage of the embryo becomes bent ventralwards in its anterior portion, in such a manner that the anterior end, which is represented in the adult by the infundibnlum, comes to project back- wards beneath the mid-brain. This bend, which is called the cranial flexure, takes place through the mid-brain, so that the hind-brain is unaffected by it. The cranial flexure is not, however, confined to the brain : the anterior end of the notochord, which at first extends almost to the front end of the nerve tube (this extension, which is quite obvious in the young embryo of Elasmobranchs, becomes masked in the later stages by the extra-ordinary modifications which the parts undergo) , is also affected by it. Moreover, it affects even other parts, as may be seen by the oblique, almost antero-posterior, direction of the anterior gill slits as compared with the transverse direction of those behind. No satisfactory explanation has ever been offered of the cranial flexure. It is found in all Vertebrates, and is effected at an early stage of the development. In the later stages and in the adult it ceases to be noticeable, on account of an alteration of the relative sizes of parts of the brain. This is due almost entirely to the enor- mous growth of the cerebral vesicle, which is an outgrowth of the dorsal wall of the fore-brain just short of its anterior end. The anterior end of the fore-brain remains relatively small throughout life as the infundibnlum, and the junction of this part of the fore- brain with the part which is so largely developed, as the rudiment of the cerebrum, is marked by the attachment of the optic chiasma. The optic nerve, .indeed, is morphologically the first cranial nerve, the olfactory being the second ; both are attached to what is morphologically the dorsal side of the nerve tube. The morpholog- ical anterior end of the central nerve tube is the point of the Infundi- bulum which is in contact with the pituitary body. While on the subject of the cranial flexure, it may be pointed out that there is a similar downward curve of the hind end of the nervous axis, which leads into the hind end of the enteron. If it be supposed that originally there was a communication betwe^ Jlje infuijdibulqm and pituitary body, then the ventral flexure found at both ends of the nerve axis would originally have had the same result, namely, of placing the neural and alimentary canals in communication. Moreover, the mouth would have had much the same relation to this imaginary anterior nenrenteric canal that the anus has to the actual posterior one.

In Ampkioxus and the Tunicata the early development of the central nervous system is very much like that of the Vertebrata, but the later stages are simpler, being without the cranial flexure. The Tunicata are remarkable for the fact that the nervous system, though at first hollow, becomes quite solid in the adult. In Bala- noglossus the central nervous system is iu part tubular, the canal being open at each end. It arises, however, by delamination from the ectoderm, the tube being a secondary acquisition. This is probably due to a shortening of development, for the same feature is found in some Vertebrata (Teleosteans, Lepidosteus, &c.), where the central canal is secondarily hollowed out in the solid keel-like mass which is separated from the ectoderm. Parts of the central nervous system arise by invagination in other groups ; for instance, the cerebral ganglia of Dentalium are formed from the walls of two invaginations of ectoderm, which, eventually disappear at the ante- rior end of the body (Kowalevsky, Ann. Mus. Hist. Nat. Marseilles, “Zoology,” vol. i.). In Peripatus the cerebral ganglia arise in a similar way, but in this case the cavities of the invagination become separated from the skin and persist as two hollow appendages on the lower side of the cerebral ganglia. In other Arthropods the cerebral ganglia arise in a similar way, but the invaginations disap- pear in the adult. In Nemertines the cerebral ganglia contain a cavity which communicates with the exterior by a narrow canal.

Although the central nervous system is almost always developed from the ectoderm of the embryo, the same cannot be said of the peripheral nerve trunks. Peripheral These structures arise from the mesoblastic re- system^ ticulum already described (Sedgwick, Q.J.M.S. XXX vii. p. 92). Inasmuch as this reticulum is perfectly continuous with the precisely similar though denser tissue in the ectoderm and endoderm, it may well be that a portion of the nerve trunks should be described as being ectodermal and endodermal in origin, though the

bulk of them are undoubtedly formed from that portion of the reticulum commonly described as mesoblastic. But, however that may be, the tissue from which the great nerve trunks are developed is continuous on all sides with a similar tissue which pervades all the organs of the body, and in which the nuclei of these organs are contained.

In the early stages of development this tissue is very sparse and not easily seen. It would appear, indeed, that it is of a very deli- cate texture and readily destroyed by reagents. It is for this reason that .the layers of the Vertebrate embryo are commonly represented as being quite isolated from one another, and that the medullary canal is nearly always represented as being completely isolated at certain stages from the surrounding tissues. In reality the layers are all connected together by this delicate tissue❓❓❓ in a sparse form, it is true❓❓❓ which not only extends between them, but also in a denser and more distinct form pervades them. In the germinal layers themselves, and in the organs developing from them, this tissue is in the young stages almost entirely obscured by the densely packed nuclei which it contains. For instance, in the wall of the medullary canal in the Vertebrate embryo, in the splanchnic and somatic layers of mesoderm of the same embryo, and in the developing nerve cords of the Peripatus embryo, the nuclei are at first so densely crowded together that it is almost im- possible to see the protoplasmic framework in which they rest, but as development proceeds this extra-nuclear tissue becomes more largely developed, and the nuclei are forced apart, so that it be- comes visible and receives various names according to its position. In the wall of the medullary canal of the Vertebrate embryo, on the outside of which it becomes especially conspicuous in certain places, and on the dorsal side of the developing nerve cords of the Peripatus embryo, it constitutes the white matter of the developing nerve cord ; in the mesoblastic tissue outside, where it at the same time becomes more conspicuous (Sedgwick, ” Monograph of the Development of Peripatus capensis,” Studies from the Morph. Lah. of the University of Cambridge, iv.,i889, p. 131), it forms the looser network of the mesoblastic reticulum ; and connecting the two, in place of the few and delicate strands of this tissue of the former stage, there are at certain places well-marked cords of a relatively dense texture, with the meshes of the reticulum elon- gated in the direction of the cord. This latter structure is an incipient nerve trunk. It can be traced outwards into the meso- blastic reticulum, from the strands of which it is indeed developed, and with which it is continuous not only at its free end, but also along its whole course. In this way the nerve trunks are devel- oped❓❓❓ by a gathering up, so to speak, of the fibres of the reticulum into bundles. These bundles are generally marked by the posses- sion of nuclei, especially in their cortical parts, which becom& no doubt the nuclei of the nerve sheath,

and, in the neigh- bourhood of the ganglia, of nerve cells. In some parts of the body of Vertebrata (particularly in the case of the cranial nerve* of Elasmobranchii) the course of the future nerve is at first marked by a tract of densely packed nuclei extending through a portion of fhe reticulum, in which the nuclei have become less closely packed. Such nerve tracts soon reveal themselves by the loosen- ing of their nuclei, and become transformed into cords containing^ a core of the pale fibrous substance with a cortex of nuclei. From this account of the early development of the nerves, it is apparent that they are in their origin continuous with all the other tissues of the body, with that of the central nervous system and with that which becomes transformed into muscular tissue and connective and epithelial tissues. All these tissues are developed from the general reticulum, which in the young embryo can be seen to per- vade the whole body, not being confined to the mesoderm, but extending between the nuclei of the ectoderm and endoderm, and forming the extra-nuclear, so-called cellular, protoplasm of those layers. Moreover, it must be remarked that in the stages of the embryo with which we are here concerned the so-called cellular constitution of the tissues, which is such a marked feature of the older embryo and adult, has not been arrived at. It is true, indica- tions of it may be seen in some of the earlier-formed epithelia, but of nerve cells, muscular cells, and many kinds of gland cells no distinct signs are yet visible. This remark particularly applies to nerve cells, which do not make their appearance until a much later stage ??? not, indeed, until some time after the principal nerve trunks and ganglia are indicated as tracts of pale fibrous sub- stance and aggregations of nuclei respectively. The neuroblasts of His and other authors have no existence, at any rate until long after the stages are past in which they are described as taking part in the formation of nerves by the extension of their cell-bodies.

The embryos of Elasmobranchs ??? particularly of Scyllium ??? are the best objects in which to study the development of nerves. In many embryos it is difficult to make out what happens, because the various parts of the body remain so close together that the.

process is obscured, and the loosening of the mesoblastio nuclei is deferred until after the nerves have begun to be differentiated. The process may also be traced in the embryos of Peripatus, where the main features are essentially similar to those above described {op. cit. p. 131).

To sum up, the development of nerves is not, as has been recently urged, an outgrovi^th of cell processes from certain cells, but is a differentiation of a substance which was already in position, and from which all other organs of the body have been and are developed. It frequently happens that the young nerve tracts can be seen sooner near the central organ than elsewhere, but it is doubtful if any importance can be attached to this fact, since it is not constantly observed. For instance, in the case of the third nerve of ScyUium the differentiation appears to take place earliest near the ciliary ganglion, and to proceed from that point to the base of the mid-brain.

There are two main methods in which new organs are

developed. In the one, which indicates the possibility

of physiological continuity, the organ arises

’”” by the direct modification of a portion of a pre- existing organ ; the development of the central nervous system of the Vertebrata from a groove in the embryonic ectoderm may be taken as an example of this method. In the other method there is no continuity which can be in any way interpreted as physiological ; a centre of growth appears in one of the parts of the embryo, and gives rise to a mass of tissue which gradually shapes itself into the required organ. The development of the central nervous system in Teleosteans and in other similar exceptional cases may be mentioned as an ex- ample of the second plan. Such a centre of growth is frequently called a blastema, and consists of a mass of closely packed nuclei which have arisen by the growth- activity of the nuclei in the neighbourhood. The eoelom, an organ which is found in the so-called coelomate animals, and which in the adult is usually divided up more or less completely into three parts, namely, body- cavity, renal organs, generative glands, presents in different animals both these methods of development. In certain animals it develops by the direct modification of a part of the primitive enteron, while in others it arises by the gradual shaping of a mass of tissue which consists of a compact mass of nuclei derived by nuclear proliferation from one or more of the pre-existing tissues of the body. Inasmuch as the first rudiment of the eoelom nearly always makes its appearance at an early stage, when the ectoderm and endoderm are almost the only tissues present, and as it then bulks relatively very large and frequently contains within itself the potential centres of growth of other, not allied, organs, it has come to be regarded by embryologists as being the forerunner of all the so-called mesodermal organs of the body, and has been dignified with the somewhat mysterious rank which attaches to the con- ception of a germinal layer. Its prominence and im- portance at an early stage led embryologists, as has already been explained, to overlook the fact that although some of the centres of growth for the formation of other non-coelomic organs and tissues may be contained within it, all are not so contained; that there are centres of growth still left in the ectoderm and endoderm after its establishment ; and, finally, that there are some animals in which probably no potential centres of growth, other than those connected with the formation of ccelomic organs, are contained in the ccBlomic rudiment. If these considerations, and others

like them, are correct, it would seem to follow that the conception implied by the word mesoderm has no objective existence, that the tissue of the embryo, called mesoderm, is mainly, sometimes exclu- sively, the rudiment of the eoelom, and that though this

rudiment may contain within itself the potential centres of growth of other organs and tissues which are com- monly ranked as mesodermal, it is not different in this respect from the rudiments of the two other organs already formed, namely, the ectoderm and endoderm ; for these contain within themselves centres of growth for the production of the so-called mesodermal tissues, as witness the nerve-crest of Vertebrata, the growing-point of the pronephric duct, and the formation of blood-vessels from the hypoblast described for some members of the same group. In Echinodermata, AmpMoxus, Enteropneusta, and a few other groups, the eoelom develops from a portion or portions of the primitive enteron, which eventually becomes separated from the rest and forms a variable number of closed sacs lying between the gut and the ectoderm. The number of these sacs varies in different animals, but the evidence at present available seems to show that the maximum number is five ??? an unpaired one in front and two pairs behind ??? and, further, that if a less number of sacs is actually separated from the enteron, the rule is for these sacs so to divide up that they give rise to five sacs arranged in the manner indicated. The Entero- pneusta present us with the clearest case of the separation of five sacs from the primitive enteron (Bateson, Q.J.M.S. xxiv. 1884).

In AmpMoxus, according to the important researches of MacBride (Q.J.M.S. xl. p. 689), it appears that a similar process occurs, though it is complicated by the fact that the sacs of the posterior pair become divided up at an early stage into many pairs. In Phoronis there are indications of the same phenomenon (Masterman, Q.J.M.S. xliii. p. 375). In the Chsetognatha a single sac only is separated from the enteron, but soon becomes divided up. The exact method of this division is not known, but the facts so far observed suggest that a renewed investigation may show that the division is into five sacs arranged as in the Enteropneust embryo. In the Brachiopoda one pair of sacs is separated from the enteron, but our knowledge of their later history is not sufficient to enable us to say whether they divide up into the typically arranged five sacs. (The embryology of the Chatognatha and

Brachiopoda would well repay investigation by modern methods with regard to this point.) In Echinodermata the number of sacs separated from the enteron varies from one to three ; but though the history of these shows considerable differences, there are reasons to believe that the typical final arrangement is one unpaired and two paired sacs. But however many sacs may arise from the primitive enteron, and however these sacs may ultimately divide up and arrange them- selves, the important point of development common to all these animals, about which there can be no dispute, is that the ccelom is a direct differentiation of a portion of the enteron.

In the majority of the Coslomata the ccelomic rudiment does not arise by the simple differentiatioii of a pre- existing organ, and there is considerable variation in its method of formation. Speaking generally, it may be said to consist at first of a blastema (see above), which arises at an early stage as a nuclear proliferation from one or more growth-centres in one or both of the primary layers. When the ccelomic rudiment arises in this way, and not by the direct differentiation of a portion of a pre-existing organ, its later history always shows that it contains within itself the growth-centres of a large number of non-coelomic organs. In some cases, it is true, it receives later such important reinforcements, which become in- distinguishably mingled with it, that it is possible that the number of those originally present in it may be less than is supposed (Vertebrata) ; but making all allowances

for this, it must be admitted that there are some embryos, e.g., Peripatus capensis, in which the coelomic rudiment is not appreciably reinforced after its first establishment, but contains within itself the germs of practically all the organs which are not developed from the original ectoderm and endoderm. Apart from the Mollusca, in which the history of the mesoderm can only be followed with great difficulty, and is not in all cases known or understood, the mesoderm of Coelomate animals, when once estab- lished, immediately proceeds to show its real nature by assuming the form and

relations of the Coelom. In the first place it acquires a cavity or series of coelomic cavi- ties, which become transformed into the body-cavity (ex- cept in the Arthropoda), into the renal organs (with the possible exception, again, of some Arthropoda), and into the reproductive glands. In metamerically segmented animals the appearance of these cavities is synchronous with, and indeed determines, the appearance of meta- meric segmentation. In all segmented animals in which the ccfilomic rudiment appears as a continuous sheet or band of tissue on each side of the body, the coelomic cavity makes its first appearance not as a continuous space on each side, which later becomes divided up into the structures called mesoblastic somites, but as a series of paired spaces round which the coelomic tissue arranges itself in an epithelial manner. In the Vertebrata, it is true, the ventral portion of the coelom appears at first as a continuous space, at any rate behind the region of the two anterior pairs of somites, but in the dorsal portion the coelomic cavity is developed in the usual way, the coelomic tissue becoming transformed into the muscle plates and rudimentary renal tubules of the later stages. With regard to this ventral portion of the coelom in Vertebrata, it is to be noticed that the cavity in it never becomes divided up, but always remains continuous, forming the perivisceral portion of the coelom. The probable explanation of this peculiarity in the develop- ment of the Vertebrate coelom, as compared with that of Ainphioxus and other segmented animals, is that the segmented stage of the ventral portion of the coelom is omitted. This explanation derives some support from the fact that even in animals in which the coelom is at its first appearance wholly segmented, it frequently happens that in the adult the perivisceral portion of it is unsegmented, i.e., it loses during development the segmentation which it at first possesses. This happens in many Annelida and in Aniphioxus. The lesson, then, which the early history of the coelom in segmented animals teaches, is that however the coelomic cavity first makes its appearance, whether by evaginations from the primitive enteron, or by the hollowing out of a solid blastemarlike tissue which has developed from one or both of the primary layers, it is in its first origin segmented, and forms the basis on which the segments of the adult are moulded. In Arthropoda the origin of the coelom is similar to that of Annelids, but its history is not com- pletely known in any group, with the exception of Peripatus. In this genus it develops no perivisceral portion, as in other groups, but gives rise solely to the nephridia and to the

reproductive organs. It is probable, though not certainly proved, that the history of the coelom in other Arthropods is essentially similar to that of Peripatus, allowance bein^ made for the fact that the nephridial portion does not attain full develop- ment in those forms which are without nephridia in the adult.

With regard to the development of the vascular system, little can be said here, except that it appears to arise in all cases from the spaces of the mesoblastic reticulum. These acquire special epithelial walls, and form the main trunks and network of smaller vessels found in animals with

a canalicular vascular system, or the large sinus-like spaces characteristic of animals with a haemocoelic body- cavity.

The existence of a phase at the beginning of life during which a young animal acquires its equipment by a process of growth of the germ is of course intelligible enough ; such a phase is seen in the for.mation ^^“f’””* of buds, and in the sexual reproduction of both I’Ji”” ” animals and plants. The remarkable point is that while in most cases this embryonic growth is a direct and simple process ??? e.g., animal and plant buds, embryonic development of plant seeds ??? in many cases of sexual reproduction of animals it is not direct, and the embryonic phase shows stages of structure which seem to possess a meaning other than that of being merely phases of growth. The fact that these stages of structure through which the embryo passes some- times present for a short time features which are per- manent in other members of the same group, adds very largely to the interest of the phenomenon and necessi- tates its careful examination. This may be divided into two heads : (1) in relation to embryos, (2) in relation to larvae. So far as embryos are concerned, we shall limit ourselves mainly to a consideration of the Vertebrata, because in them are found most instances of that remarkable phenomenon, the temporary assumption by certain organs of the embryo of stages of structure which are permanent in other members of the same group. As is well known, the embryos of the higher Vertebrata possess in the structure of the pharynx and of the heart and vascular system certain features ??? namely, paired pharyngeal apertures, a simple tubular heart, and a single ventral aorta giving off right and left a number of branches which pass between the pharyngeal apertures ??? which per-

manently characterize those organs in fishes. The skeleton, largely bony in the adult, passes through a stage in which it is entirely without bone, and consists mainly of cartilage ••• the form which it permanently possesses in certain fishes. Further, the Vertebrate embryo possesses for a time a notochord, a segmented muscular system, a continuity between the pericardium and the posterior part of the perivisceral cavity ••• all features which characterize cer- tain groups of Pisces in the adult state. Instances of this kind might be multiplied, for the work of anatomists and embryologists has of late years been largely devoted to adding to them. Examples of embryonic characters which are not found in the adults of other Vertebrates, are the following: ••• At a certain stage of development the central nervous system has the form of a groove in the skin, there is a communication at the hind end of the body between the neural and alimentary canals, the inouth aperture has at first the form of an elongated slit, the growing end of the Wolffian duct is in “some groups continuous with the ectoderm, and the retina is at one stage a portion of the wall of the medullary canal. In the embryos of the lower Vertebrates many other instances of the same interesting charac- ter juight be mentioned ; for instance, the presence of a coelomic sac close to the eye, of another in the jaw, and of a third near the ear (Elasmobranchs), the opening of the Miillerian duct into the front end of the Wolifian duct, and the presence of an aperture of communica- tion between the muscle-plate coelom and the nephridial coelom.

The interest attaching to these remarkable facts is much increased by the explanation which has been given of them. That explanation, which is a deduction from the theory of evolution, is to the effect that the peculiar embryonic structures and relations just mentioned are due to the retention by the embryo of features which, once possessed by the ancestor, have been lost in the course of evolution.

latloa theory.

This explanation, which at once suggests itself when we are dealing with structures actually present in adult members of other groups, does not so obviously Hecapita- apply to those features which are found in no adult animal whatsoever. Nevertheless it has been extended to them, because they are of a nature which it is not impossible to suppose might have existed in a working animal. Now this explanation, which, it will be observed, can only be entertained on the assumption that the evolution theory is true, has been still further extended by embryologists in a remarkable and frequently unjustifiable manner, and has been applied to all embryonic processes, finally leading to the so-called recapitulation theory, which asserts that embryonic his- tory is a shortened recapitulation of ancestral history, or, to use the language of modern zoology, that the ontogeny or development of the individual contains an abbreviated record of the phylogeny or development of the race. A theory so important and far-reaching as this requires very careful examination. When we come to look for the facts upon which it is based, we find that they are non-existent, for the ancestors of all living animals are dead, and we have no means of knowing what they were like. It is true there are fossil remains of animals which have lived, but these are so imperfect as to be practically useless for the present requirements. Moreover, if they were perfectly preserved, there would be no evidence to show that they were ancestors of the animals now living. They might have been animals which have become extinct and left no descendants. Thus the explanation ordinarily given of the embryonic structures referred to is purely a deduction from the evolution theory. Indeed, it is even less than this, for all that can be said is something of this kind : ××× if the evolution theory is true, then it is conceivable that the reason why the embryo of a bird passes through a stage in which its pharynx presents some resemblance to that of a fish is that a remote ancestor of the bird pos- sessed a pharynx with lateral apertures such as are at present found in fishes.

But the explanation is sometimes pushed even farther, and it is said that these pharyngeal apertures of the ancestral bird had the same respiratory function as the corresponding structures in modern fishes. That this is going too far a little reflection will show. For if it be admitted that all so-called vestigial structures had once the same function as the homologous structures when fully developed in other animals, it becomes necessary to admit that male mammals must once have had fully developed mammary

glands and suckled the young, that female mammals formerly were provided with a functional penis, and that in species in which the females have a trace of the secondary sexual characters of the male the latter were once common to both sexes. The second and more extended form of the explanation plainly introduces a considerable amount of contentious matter, and it will be advisable, in the first instance, at any rate, to confine ourselves to a critical examiuar tion of the less ambitious conception. This explanation obviously implies the view that in the course of evolu- tion the tendency has been for structures to persist in the embryo after they have been lost in the adult. Is there any justification for this view ? It is clearly impossible to get any direct evidence, because, as ex- plained above, we have no knowledge of the ancestors of living animals ; but if we assume the evolution theory to be true, there is a certain amount of indirect evidence which is distinctly opposed to the view. A s is well known, living birds are without teeth, but it is generally assumed that their edentulous condition has been comparatively recently acquired, and that they are descended from animals which, at a time not very remote from the

present, possessed teeth. Considering the resemblance of birds to other terrestrial vertebrates, and the fact that extinct birds, not greatly differing from birds now living, are known to have had teeth, it must be allowed that there is some warrant for the assumption. Yet in no single case has it been certainly shown that any trace of teeth has been developed in the embryo. The same remark applies to a large number of similar cases ; for instance, the reduced digits of the bird's hand and foot, and the limbs of snakes. Moreover, organs which are supposed to have become recently reduced and function- less in the adult are also reduced in the embryo; for instance, digits 3 and 4 of the horse's foot, the hind limbs of whales (Guldberg and Nansen, " On the Development and Structure of Whales," Bergen Museum, 1894), the spiracle of Elasmobranchii. In fact, considerations of this kind distinctly point to the view that any tendency to the reduction or enlargement of an organ in the adult is shared approximately to the same extent by the embryo. But there are imdoubtedly some, though not many, cases in which organs which were presumably present in an ancestral adult have persisted in the embryo of the modern form. As an instance may be mentioned the presence in whalebone whales of imperfectly formed teeth,

which are absorbed comparatively early in foetal life (Julin, Arch. Biologie, i., 1880, p. 76).

It therefore becomes necessary to inquire why in some cases an organ is retained by the embryo after its loss by the adult, whereas in other cases it dwindles and presum- ably disappears simultaneously in the embryo and the adult. The whole question is examined and discussed by the present writer in the Q.J. M.S. xxxvi., 1894, p. 35, and the conclusions there reached are as follow : ??? A dis- appearing adult organ is not retained in a relatively greater development by an organism in the earlier stages of its individual growth unless it is of functional impor- tance to the young form. In cases in which the whole development is embryonic this rarely happens, because the conditions of embryonic life are so different from free life that functional embryonic organs are usually organs sui generis, which cannot be traced to a modifica- tion of organs previously present in the adult. It does, however, appear to have happened sometimes, and as an instance of it may be mentioned the ductus arteriosus of the Sauropsidan and Mammalian embryo. On the other hand, when there is a considerable period of larval life, it does appear that there is a strong case for thinking that organs which have been lost by the adult may be retained and made use of by the larva. The best-known example that can be given of this is the tadpole of the frog. Here we find organs, viz., gills and gill-slits, which are universally regarded as having been attri- butes of all terrestrial Vertebrata in an earlier and aquatic condition, and we also notice that their reten- tion is due to their being useful on account of the sup- posed ancient conditions of life having been retained. Many other instances, more or less plausible, of a like retention of ancestral features by larvae might be men- tioned, and it must be conceded that there are strong reasons for supposing that larvae often retain traces, more or less complete, of ancestral stages of structure. But this admission does not carry with it any obligation to accept the widely prevalent view that larval history can in any way be regarded as a recapitulation of ancestral history. Far from it, for larvae in retaining some ances- tral features are in no way different from adults ; they only differ from adults in the features which they have retained. Both larvae and adults retain ancestral features, and both have been modified by an adaptation to their respective conditions of life which has ever been becoming more perfect.

The conclusion, then, has been reached, that whereas larvae frequently retain traces of ancestral stages of adult structure, embryos will rarely do so; and we are confronted again with the question, How are we to account for the presence in the embryo of numerous functionless organs which cannot be explained otherwise than as having been inherited from a previous condition in which they were functional ? The answer is that the only organs of this kind which have been retained are organs which have been retained by the larvae of the ancestors after they have been lost by the adult, and have become in this way impressed upon the development. As an illustration taken from current natural history of the manner in which larval characters are in actual process of becoming embryonic may be mentioned the case of the viviparous salamander {Salamander atra), in which the gills, &c., are all developed but never used, the animal being born with- out them. In other and closely allied species of sala^ mander there is a considerable period of larval life in which the gills and gill-slits are functional, but in this species the larval stage, for the existence of which there was a distinct reason, viz., the entirely aquatic habits of life in the young state, has become at one stroke embryonic by its simple absorption into the embryonic period. The view, then, that embryonic development is essentially a recapitulation of ancestral history must be given up ; it contains only a few references to ancestral history, namely, those which have been preserved probably in a much modified form by previous larvae.

We must now pass to the consideration of another supposed law of embryology ××× the so-called law of v. Baer. This generalization is usually stated as follows : ××× Embryos of different species of the same group v^^aer. ^^×× mor×× alike than adults, and the resem- blances are greater the younger the embryo examined. Great importance has been attached to this generalization by embryologists and naturalists, and it is very widely accepted. Nevertheless, it is open to serious criticism. If it were true, we should expect to find that embryos of closely similar species would

be indistinguish- able, but this is notoriously not the case. On the con- trary, they often differ more than do the adults, in support of which statement the embryos of the different species of Peripatus may be referred to. The generaliza- tion undoubtedly had its origin in the fact that there is what may be called a family resemblance between embryos, but this resemblance, which is by no means exact, is purely superficial, and does not extend to anatomical detail. On the contrary, it may be fairly argued that in some cases embryos of widely dissimilar members of the same group present anatomical differences of a higher morphological value than do the adults (see Sedgwick, loc. cit.), and, as stated above, the embryos of closely allied animals are distinguishable at all stages of development, though the distinguishingfeatures are not the same as those which distinguish the adults. To say that the development of the organism and of its component parts is a progress from the simple to the complex is to state a truism, but to state that it is also a progress from the general to the special is to go altogether beyond the facts. The bipinnaria larva of an echinoderm, the trochosphere larva of an annelid, the blastodermic vesicle of a mammal are all as highly specialized as their respective adults, but the specialization is for a different purpose, and of a different kind to that which characterizes the adult.

For an account of the history of the subject the reader is referred to the article Embryology in the 9th edition of this Encyclopcedia, where he will also find under the heading Reproduction informa- tion respecting the menstruation, fertilization, gestation, parental care, formation of ovum, and spermatozoon. The following books contain fuller information : ††† K. E. von Baer. Ueber Ent-

wicklungsgeschichte der Thiere. Konigsberg, 1828, 1837. ††† F. M. Balfour. A Monograph of the Development of Elasmohranch Fishes. London, 1878. A Treatise on Comparative Embryology, vols, i. and ii. London, 1885 (still the most important work on Vertebrate Embryology). ††† M. Duval. Atlas d^Embryologie. Paris, 1889. ††† M. PosTKK and F. M. Balfour. Elements of Embryology. London, 1883. ††† O. Hektwig. Lehrbuch der Entwicklungs- geschichte des Menschen u. der Wirbelthiere, 6th edition. Jena, 1898. ††† A. Kolliker. Entwicklungsgeschiehte des Menschen u. der hoheren Thiere. Leipzig,

1879. ††† E. Korschelt and K. Heider. Lehrbuch der vergleich. Entwicklungsgeschiehte der wirbellosen Thiere. Jena, 1890. (English translation, London, 1895-1900). ††† A. M. Marshall. Vertebrate Embryology. London, 1893.††† C. S. MiNOT. Human Embryology. New York, 1892.

(a. se.*)

Physiology of Development.

Physiology of Development [in German, EntwicMungs- mechanik (Roux), EntwicMungspliysiologie (Driesch), Phy- siologische Morphologic (Loeb)] is, in the broadest meaning of the word, the experimental science of morphogenesis, i.e., of the laws that govern morphological differentiation. In this sense it embraces the study of regeneration and variation, and would, as a whole, best be called rational morphology. Here we shall treat of the Physiology of Development in a narrower sense, as the study of the laws that govern the development of the adult organism from the egg, Eegeneeation and Variation forming the subjects of special articles.

After the work done by His, Goette, and Pfliiger, who gave a sort of general outline and orientation of the sub- ject, the first to study developmental problems properly in a systematical way, and with full conviction of their great importance, was Wilhelm Roux. This observer, hav- ing found by a full analysis of the facts of ” development ” that the first special problem to be worked out was the question when and where the first differentiation appeared, got as his main result that, when one of the two first blastomeres (cleavage cells) of the frog’s egg was killed, the living one developed into a typical half ~~embryo, i.e., an embryo that was either the right or the left part of a whole one. From that Roux concluded that the first cleavage plane determined already the median plane of the adult ; and that the basis of all differentiation was given by an unequal division of the nuclear substances during karyo~~ kinesis, a result that was also attained on a purely theoretical basis by Weismann. Hans Driesch repeated Eoux’s fundamental experiment with a different method on the sea-urchin’s egg, with a result that was abso- lutely contrary to that of Roux : the isolated blastomere cleaved like half the egg, but it resulted in a whole blastula and a whole embryo, which differed

from a normal one only in its small size. Driesch's result was obtained in somewhat the same manner by Wilson with the egg of Amphioxus, by Zoja with the egg of Medusae, &c. It thus became very probable that an inequality of nuclear division could not be the basis of differentiation. The following experiments were still more fatal to the theories of Roux and of Weismann. Driesch found that, even when the first eight or sixteen cells of the cleaving egg of the sea-urchin were brought into quite abnormal positions with regard to one another, still a quite normal embryo was developed; Driesch and Morgan discovered jointly that in the Ctenophore egg one isolated blastomere devel- oped into a half-embryo, but that the same was the case if a portion of protoplasm was cut off from the fertilized egg not yet in cleavage ; last, but not of least importance, in the case of the frog's egg which had been Roux's actual subject of experiment, conditions were discovered by 0. Schultze and 0. Hertwig under which one of the two first blastomeres of this egg developed into a whole embryo of half size. This result was made still more decisive by

development]

Morgan, who showed that it was quite in the power of the experimenter to get either a half -embryo or a whole one of half size, the latter dependent only upon giving to the blastomere the opportunity for a rearrangement of its matter by turning it over.

Thus we may say that the general result of the intro- ductory series of experiments in the physiology of develop- ment is the following : ††† In many forms, e.g., Echinoderms, Amphioxus, Ascidians, Fishes, and Medusae, the potenti- ality {prospective Potenz ††† Driesch) of all the blastomeres of the segmented egg is the same, i.e., each of them may play any or every part in the future development ; the prospective value {prosp. Bedentung ††† D.) of each blasto- mere depends upon, or is a function of, its position in the whole of the segmented egg ; we can term the " whole " of the egg after cleavage an " aequipotential system" (Driesch). But though aequipotential, the whole of the segmented egg is nevertheless not

devoid of orientation or direction ; the general law of causality compels us to assume a general orientation of the smallest parts of the egg, even in cases where we are not able to see it. It has been experimentally proved that external stimuli (light, heat, pressure, &c.) are not responsible for the first differ- entiation of organs in the embryo; thus, should the seg- mented egg be absolutely equal in itself, it would be incomprehensible that the first organs should be formed at one special point of it, and not at another. Besides this general argument, we see a sort of orientation in the typical forms of the polar or bilateral cleavage stages.

Differentiation, therefore, depends on a primary, i.e., innate, orientation of tlie egg's plasma in those forms, tlie segmented eggs of which represent aequipotential systems ; this orientation is capable of a sort of regulation or restoration after disturbances of any sort ; in the egg of the Ctenophora such a regulation is not possible, and in the frog's egg it is facultative, i.e., possible under certain conditions, but impossible under others. Should this inter- pretation be right, the differences between the eggs of different animals would not be so great as it seemed at first: difierences with regard to the potentialities of the blastomeres would only be differences with regard to the capability of regulation or restoration of the egg's protoplasm.

The foundation of physiological embryology being laid, we now can shortly deal with the whole series of special problems offered to us by a general analysis of that science, but at present worked out only to a very small extent.

We may ask the following questions : ??? "What are the general conditions of development ? On what general factors does it de- pend ? How do the different organs of the partly developed em- bryo stand with regard to their future fate ? What are the stimuli (Beize) effecting differentiation ? What is to be said about the specific character of the different formative effects ? And as the most important question of all : Are all the problems offered to us in the physiology of development to be solved with the aid of the laws known hitherto in science, or do we want specifically new "vitalistic" factors?

Energy in difPerent forms is required for development, and is provided by the surrounding medium. Light,

though of no influence on the cleavage (Driesch), Coaditioas has a great effect on the later stages of develop- en►►i'/oD. ment (Young), and is also necessary for the

formation of polyps in Eudendrium (Loeb). That a certain temperature is necessary for ontogeny has long been known ; this was carefully studied by 0. Hert- wig, as was also the influence of heat on the rate of development. Oxygen is also wanted, either from a certain stage of development or from the very beginning of it, though very nearly related forms differ in this re- spect (Loeb). The great influence of osmotic pressure on growth was studied by Loeb, Herbst, and Davenport. In all these cases energy may be necessary for develop- ment in general, or a specific form of energy may be necessary for the formation of a specific organ ; it is

clear that, especially in the latter case, energy is shown to be a proper factor for morphogenesis. Besides energy, a certain chemical condition of the medium, whether offered by the water in which the egg lives or (especially in later stages) by the food, is of great importance for normal ontogeny ; the only careful study in this respect was carried out by Herbst for the development of the egg of Echinids. This investigator has shown that all salts of the sea water are of great importance for devel- opment, and most of them specifically and typically; for instance, calcium is absolutely necessary for holding together the embryonic cells, and without calcium all cells wUl fall apart, though they do not die, but live to develop farther.

What we have dealt with may be called external fac- tors of development ; as to their complement, the internal factors, it is clear that every elementary factor of general physiology may be regarded as one of them. Chemical metamorphosis plays, of course, a great part in differen- tiation, especially in the form of secretions ; but very little has been carefully studied in this respect. Move- ment of living matter, whether of cells or of intracellular substance, is another important factor (Biltschli, Dreyer, Ehumbler). Cell-division is another, its differences in direction, rate, and quantity being of great importance for differentiation. We know very little about it ; a so-called law of 0. Hertwig, that a cell would divide at right angles to its longest diameter, though experimentally stated in some cases, does not hold for all, and the only thing we can say is, that the unknown primary

organization of the egg is here responsible. (Compare the papers on ” cell-lineage” of Wilson, Lillie, Jennings, Zurstrassen, and others.) Of the inner factors of ontogeny there is an- other category that may be called physical, that already spoken of being physiological. The most important of these is the capillarity of the cell surfaces. Berthold was the first to call attention to its role in the arrange- ment of cell composites, and afterwards the matter was more carefully studied by Dreyer, Driesch, and especially Roux, with the result that the arrangement of cells fol- lows the principle of surfaces minimm arece (Plateau) as much as is reconcilable with the conditions of the system.

It has already been shown that in many cases the embryo after cleavage, i.e., the blastula, is an ” aequipo- tential system.” It was shown that in the egg p^^g^,, of Echinids there existed such an absolute lack aiities of of determination of the cleavage cells that (a) embryonic the cells may be put in quite abnormal posi- **”*” tions with reference to one another without disturbing development; (6) a quarter blastomere gives a quite normal little pluteus, even a sixteenth yields a gastrula ; (c) two eggs may fuse in the early blastula stage, giving one single normal embryo of double size. Our next question concerns the distribution of potentiality, when the embryo is developed farther than the blastula stage. In this case it has been shown that the potentialities of the different embryonic organs are different: that, for instance, in Echinoderms or Amphibians the ectoderm, when isolated, is not able to form endoderm, and so on (Driesch, Barfurth) ; but it has been shown at the same time that the ectoderm in itself, the intestine in itself of Echinoderms (Driesch), the medullary plate in itself of Triton (Spemann), is as aequipotential as was the blastula: that any part whatever of these organs may be taken away without disturbing the development of the rest into a normal and proportional embryonic part, ex- cept for its smaller size.

If the single phases of differentiation are to be regarded as effects, we must ask for the causes, or stimuli, of these effects. For a full account of the subject we refer to Herbst, by whom also the whole botanical literature, much

more important than the zoological, is critically reviewed. We have already seen that when the blastula represents an aequipotential system, there must be some ^stimaiu” sort of primary organization of the egg, re- coverable after disturbances, that directs and localizes the formation of the first embryonic organs ; we do not know much about this organization. Directive stimuli {Riditungsreize) play a great role in ontogeny; Herbst has analysed many cases where their existence is probable. They have been experimentally proved in two cases. The chromatic cells of the yolk sac of Fundulus are attracted by the oxygen of the arterise (Loeb) ; the mesenchyme cells of Echinus are attracted by some specific parts of the ectoderm, for they move towards them also when removed from their original positions to any point of the blastocoel by shaking (Driesch). Many directive stimuli might be discovered by a careful study of grafting experiments, such as have been made by Born, Joest, Harrison, and others, but at present these experiments have not been carried out far enough to get exact results.

Formative stimuli in a narrower meaning of the word, i.e., stimuli affecting the origin of embryonic organs, have long been known in botany ; in zoology we know (especially from Loeb) a good deal about the influence of light, gravitation, contact, &c., on the formation of organs in hydroids, but these forms are very plant-like in many respects ; as to free-living animals, Herbst proved that the formation of the arms of the pluteus larva depends on the existence of the calcareous tetrahedra, and made in other cases (lens of vertebrate eye, nerves and muscles, &c.) the existence of formative stimuli very probable. Many of the facts generally known as func- tional adaptations (functionelle Anpassung- ××× Eoux) in botany and zoology may also belong to this category, i.e., be the effects of some external stimulus, but they are far from having been analysed in a satisfactory manner. That the structure of parts of the vertebrate skeleton is always in relation to their function, even under abnormal conditions, is well known ; what is the real ” cause ” of differentiation in this case is diflSeult to say.

It is obvious that we cannot answer the question why the different ontogenetic effects are just what they are. Developmental physiology takes the specific specific nature of form for granted, and it may be left for a really rational theory of the evolution of species in the future to answer the

problem of species, as far as it is answerable at all. What we intend to do here is only to say in a few words wherein consists the specific character of embryonic organs. That embryonic parts are specific or typical in regard to their protoplasm is obvious, and is well proved by the fact that the different parts of the embryo react differently to the same chemical or other reagents (Herbst, Loeb). That they may be typi- cal also in regard to their nuclei was shown by Boveri for the generative cells of Ascaris ; we are not able at present to say anything definite about the importance of this fact. The specific nature of an embryonic organ consists to a high degree in the number of cells composing it ; it was shown for many cases that this number, and also the size of cells, is constant under constant conditions, and that under inconstant conditions the number is variable, the size constant ; for instance, embryos which have developed from one of the two first blastomeres show only half the normal number of cells in their organs (Morgan, Driesch). We have learnt that the successive steps of embryonic development are to be regarded as effects, caused by stimuli, which partly exist in the embryo itself. But it must be noted that not every part of the embryo is dependent on every other one, but that there exists a great independence of the parts, to a varying degree in

charac- ters.

every case. This partial independence has been called self-differentiation (Selbstdifferenzierung) by Epux, and is certainly a characteristic feature of ontogeny. At the same time it must not be forgotten that ff^e n- the word is only relative, and that it only ex- tiatioa. presses our recognition of a negation.

For instance, we know that the ectoderm of Echinus may develop farther if the endoderm is taken away ; in other words, that it develops by self-differentiation in regard to the endoderm, that its differentiation is not de- pendent on the endoderm ; but it would be obviously more important to know the factors on which this differ- entiation is actually dependent than to know one factor on which it is not. The same is true for all other experi- ments on ” self -differentiation,” whether analytical (Loeb, Schaper, Driesch) or not (grafting experiments. Born, Joest, &c.).

Can we understand differentiation by means of the laws of natural phenomena offered to us by physics and chemistry ? Most people would say yes, though Yitaiism not yet. Driesch has tried to show that we are absolutely not able to understand development, at any rate one part of it, i.e., the localization of the various suc- cessive steps of differentiation. But it is impossible to give any idea of this argument in a few words, and we can only say here that it is based on the experiments upon isolated blastomeres, &c., and on an analysis of the character of aequipotential systems. In this way physiology of de- velopment would lead us straight on into Vitalism.

Eefebesces. ††† An account of the subject, with full literature, is given by Dkiesch, Besultate und Frobleme der Entwicklungs- physiologie der Thiere in Ergebnisse der Anat. u.Entw. gesch., 1809. Other works are : ††† Davenport. Experimental Morpliolorjy. New York, 1897-99. ††† Delage. La structure du protoplasm, &c. 1895. ††† Driesch. Mathem. mech. Betraehtung morpholog. Frobleme. Jena, 1891. Entxoicklungsmechan. Stndien, 1891-93. Anahj- tische Theorie d. organ. Entw. Leipzig, 1894. Studien uber d. Regulationsvermogen, 1897-1900, &o. ††† Herbst. Ueber die Bed< n- tung d. Beizphysiologie fur die kansale Anfassung von Vorgdng' n i. d. thier. Onlogenese. Biolog. Centralblatt., vols. xiv. u. xv. Leipzi,;, 1901. ††† Many papers on influence of salts on development in An h. f. Entw. Mech. ††† 0. Hertwig. Papers in Airh. f. mikr. Amit. Die Zelle und die Gewebe, ii. Jena, 1897. ††† His. XJnsere Korper- form. Leipzig, 1875. ††† J. Loeb. tfntersuch. z. physiol. Morph. Wiirzburg, 1891-92. Papers in Arch. f. Entw. Mech. andPfliiger's Archiv. ††† Morgan. TTie Development of the Frog^s Egg. New York, 1897. Yapevs in Arch. f. Entw. Mcch. ††† Roux. Gesammelte Abhandlungen. Leipzig, 1895. Papers in Arch. f. Entw. Mech. ††† Weismann. Das Keimplasma. Jena, 1892. ††† Wilson. Papers in Journ. Morph. The Cell in Development and Inheritance. New York, 1896. (h. a. B. d.)

Emden, a town of Prussia, province of Hanover, near the mouth of the Ems, 49 miles north-west frcm Oldenburg by rail. The town-hall (1574-76) possesses an exceptionally interesting callection of weapons of war. There are two other museums, one of art, coins, and Frisian antiquities, the other

containing specimens of natural history. It has a school of navigation. Emdi n is the seat of an active trade in agricultural produce and live-stock, timber, coal, tea, wine, and fish. Cement, wire ropes, sugar, tobacco, woollens, and leather aie manufactured. The harbour has been greatly improved in consequence of the construction of the Ems-Jade and the Ems-Dortmund canals ; and in 1900 the Prussian Government resolved to enlarge the outer harbour and deepen it to 37 ft. 8^ in., as well as deepen the lower Ems to 32 ft. 9 in., the total cost being estimated at close upon ►►400,000. Population (1885), 14,019: (1900),

16,453.

Emerson, Ralph Waldo (1803-1882), American poet and essayist, was born in Boston, IMassa- chusetts, 25th May 1803. Seven of his ancestors were ministers of New England churches. Among them were some of those men of mark who made the backbone of

the American character : the sturdy Puritan, Peter Bulke- ley, sometime rector of Odell in Bedfordshire, and after- ward pastor of the church in the wilderness at Concord, New Hampshire ; the zealous evangelist. Father Samuel Moody of Agamenticus in Maine, who pursued graceless sinners even into the alehouse; Joseph Emerson of Maiden, “a heroic scholar,” who prayed every night that no descendant of his might ever be rich; and William Emerson of Concord, Mass., the patriot preacher, who died while serving in the army of the Eevolution. Sprung from such stock, Emerson inherited qualities of self- reliance, love of liberty, strenuous virtue, sincerity, sobriety, and fearless loyalty to ideals. The form of his ideals was modified by the metamorphic glow of Trans- cendentalism which passed through the region of Boston in the second quarter of the 19th century. But the spirit in which Emerson conceived the laws of life, reverenced them, and lived them out, was the Puritan spirit, elevated, enlarged, and beautified by the poetic temperament.

His father was the Kev. William Emerson, minister of the Eirst Church (Unitarian) in Boston. Ralph Waldo was the fourth child in a family of eight, of whom at least three gave evidence of extra- ordinary mental powers. He was brought up in an atmo- sphere of hard work, of moral discipline, and (after his father's death in 1811) of that wholesome self-sacrifice which is a condition of life for those who are poor ii money and rich in spirit His aunt. Miss Mary Mood; Emerson, a brilliant old maid an eccentric saint, was i potent factor in his educa tion. Loving him, believing in his powers, passionately desiring for him a successful career, but clinging with both hands to the old forms of faith from which he floated away, this solitary, intense woman did as much as any one to form, by action and reaction, the mind and character of the young Emerson. In 1817 he entered Harvard College, and graduated in 1821. In scholarship he ranked about the middle of his class. In literature and oratory he was more distinguished, receiving a Boylston prize for declamation, and two Bowdoin prizes for dis- sertations, the first essay being on " The Character of Socrates " and the second on " The Present State of Ethical Philosophy " ××× both rather dull, formal, didactic productions. He was fond of reading and of writing verse, and was chosen as the poet for class-day. His cheerful serenity of manner, his tranquil mirthfulness, and the steady charm of his personality, made him a favourite with his fellows, in spite of a certain reserve. His literary taste was conventional, including the stan- dard British writers, with a preference for Shakespeare among the poets, Berkeley among the philosophers, and Montaigne (in Cotton's translation) among the essayists. His particular admiration among the col- lege professors was the stately rhetorician, Edward

EALPIi WALDO EMEESON. {From a photograph by EllioU t& Fry^ London.)

Everett ; and this predilection had much to do with his early ambition to be a professor of rhetoric and elo- cution.

Immediately after graduation he became an assistant in his brother William's school for young ladies in Boston, and continued teaching, with much inward reluctance and discomfort, for three years. The routine was distasteful ; he despised the superficial details which claimed so much of

his time. The bonds of conventionalism were silently dissolving in the rising glow of his poetic nature. Inde- pendence, sincerity, reality, grew more and more necessary to him. His aunt urged him to seek retirement, self- reliance, friendship with nature; to be no longer “the nurseling of surrounding circumstances,” but to prepare a

celestial abode for the muse. The passion for spiritual leadership stirred within him. The ministry seemed to offer the fairest field for its satisfaction. In 1825 he entered the divinity school at Cambridge, to prepare himself for the Unitarian pulpit. His course was much interrupted by ill-health. His studies were irregular, and far more philosophical and literary than theological. In October 1826 he was “approbated to preach” by the Middle- sex Association of Ministers. The same year a threatened consumption compelled him to take a long journey in the south. Returning in 1827, he continued his studies, preached as a can- didate in various churches, and improved in health. In 1829 he married a beautiful but delicate young woman. Miss Ellen Tucker of Concord, and was installed as associate minister of the Second Church (Unitarian) in Boston. The retirement of his senior col- league soon left him the sole pastor. Emerson’s early sermons were simple, direct, unconventional. He dealt freely with the things of the spirit. There was a homely elevation in his discourses, a natural freshness in his piety, a quiet enthusiasm in his manner, that charmed thoughtful hearers. In 1831 he lost his wife, a sorrow that deeply depressed him in health and spirits. In 1832, following his passion for independence and sincerity, he arrived at the conviction that the Lord’s Supper was not intended by Christ to be a permanent sacra- ment. To him, at least, it had become an outgrown form. He was willing to continue the service only if the use of the elements should be dropped and the rite made simply an act of spiritual remembrance. Setting forth these views, candidly and calmly, in a sermon, he found his congregation, not uimaturally, reluctant to agree with him, and therefore retired, not without some disappointment, from the pastoral oflice. He never again took charge of a parish; but he continued to preach, as opportunity offered, until 1847. In fact, he was always a preacher, though of a singular order. His supreme task was to befriend and guide the inner life of man.

The strongest influences in his development about this time were the liberating philosophy of Coleridge, the mystical visions of Swedenborg, the intimate poetry of Wordsworth, and the stimulating essays of Carlyle. On Christmas Day 1832 he took passage in a sailing vessel for the Mediterranean. He travelled through Italy, visited Paris, spent two months in Scotland and England, and saw the four men whom he most desired to see ??? Landor, Coleridge, Carlyle, and Wordsworth. ” The com- fort of meeting such men of genius as these,” he wrote, ” is that they talk sincerely.” But he adds that he found all four of them, in different degrees, deficient in insight into religious truth. His visit to Carlyle, in the lonely farmhouse at Craigenputtock, was the memorable begin- ning of a lifelong friendship. Emerson published Car- lyle’s first books in America. Carlyle introduced Emer- son’s Essays into England. The two men were bound together by a mutual respect deeper than a sympathy of tastes, and a community of spirit stronger than asimilarity of opinions. Emerson was a sweet-tempered Carlyle, living in the sunshine. Carlyle was a militant Emer- son, moving amid thunderclouds. The things that each most admired in the other were self-reliance, directness, moral courage. A passage in Emerson’s Diary, written on his homeward voyage, strikes the keynote of his remaining life. ” A man contains all that is needful to his government within himself. . . . All real good or evil that can befall him must be from himself. . . . There is a correspondence between the human soul and every- thing that exists in the world ; more properly, everything that is known to man. Instead of studying things with- out, the principles of them all may be penetrated into within him. . . . The purpose of life seems to be to acquaint man with himself. . . . The highest revelation is that God is in every man.” Here is the essence of that intuitional philosophy, commonly called Transcen- dentalism. Emerson disclaimed allegiance to that phi- losophy. He called it ???’’ the saturnalia, or excess of faith.” His practical common sense recoiled from the amazing conclusions which were drawn from it by many of its more eccentric advocates. His independence revolted against being bound to any scheme or system of doctrine, however nebulous. He said : ” I wish to say what I feel and think to-day, with the proviso that to-morrow per- haps I shall contradict it all.” But this very wish com- mits him to the doctrine of the inner light. All through his life he

navigated the Transcendental sea, piloted by a clear moral sense, warned off the rocks by the saving grace of humour, and kept from capsizing by a good ballast of New England prudence.

After his return from England in 1833 he went to live with his mother at the old manse in Concord, Mass., and began his career as a lecturer in Boston. His first dis- courses were delivered before the Society of Natural History and the Mechanics' Institute. They were chiefly on scientific subjects, approached in a poetic spirit. In the autumn of 1835 he married Miss Lydia Jackson of Plymouth, having previously purchased a spacious old house and garden at Concord. There he spent the re- mainder of his life, a devoted husband, a wise and tender father, a careful householder, a virtuous villager, a friendly neighbour, and, spite of all his disclaimers, the central and luminous figure among the Transcendentalists. The doctrine which in others seemed to produce all sorts of extravagances ??? communistic experiments at Brook Farm and Fruitlands, weird schemes of political reform, long hair on men and short hair on women^n his sane, well-balanced nature served only to lend an ideal charm to the familiar outline of a plain, orderly New England life. Some mild departures from established routine he tran- quilly tested and as tranquilly abandoned. He tried

vegetarianism for a while, but gave it up when he found that it did him no particular good. An attempt to illus- trate household equality by having the servants sit at table with the rest of the family was frustrated by the dislike of his two sensible domestics for such an incon- venient arrangement. His theory that manual labour should form part of the scholar's life was checked by the personal discovery that hard labour in the fields meant poor work in the study. " The writer shall not dig," was his practical conclusion. Intellectual independence was what he chiefly desired ; and this, he found, could be attained in a manner of living not outwardly different from that of the average college professor or country minister. And yet it was to this property-holding, debt- paying, law-abiding, well-dressed, courteous-mannered citizen of Concord that the ardent and enthusiastic turned as the prophet of the new idealism. The influence of other Transcendental teachers, Dr Hedge, Dr Eipley, Bronson Alcott, Orestes Brownson, Theodore Parker, Margaret Fuller, Henry Thoreau, Jones Very, was narrow and parochial compared with that of Emerson. Some- thing in his

imperturbable, kindly presence, his angelic look, his musical voice, his commanding style of thought and speech, announced him as the possessor of the great secret which many were seeking ??? the secret of a freer, deeper, more harmonious life. More and more, as his fame spread, those who ” would live in the spirit ” came to listen to the voice, and to sit at the feet, of the Sage of Concord.

It was on the lecture-platform that he found his power and won his fame. The courses of lectures that he delivered at the Masonic Temple in Boston, during the winters of 1835 and 1836, on “Great Men,” “English Literature,’’ and “The Philosophy of History,” were well attended and admired. They were followed by two discourses which commanded for him immediate recognition, part friendly and part hostile, as a new and potent personality. His Phi Beta Kappa oration at Harvard College in August 1837, on ” The American Scholars,” was an eloquent appeal for independence, sin- cerity, realism, in the intellectual life of America. His address before the graduating class of the divinity school at Cambridge, in 1838, was an impassioned protest against what he called ” the defects of historical Chris- tianity ” (its undue reliance upon . the personal authority of Jesus, and its failure to explore the moral nature -of man as the fountain of established teaching), and a daring plea for absolute self-reliance and a new inspira- tion of religion. ” In the soul,” he said, ” let redemption be sought. Wherever a man comes, there comes revolu- tion. The old is for slaves. Go alone. Eefuse the good models, even those which are sacred in the imagina- tion of men. Cast conformity behind you, and acquaint men at first hand with Deity.” In this address Emerson laid his hand on the sensitive point of Unitarianism, which rejected the divinity of Jesus but held fast to his supreme authority. A blaze of controversy sprang up at once. Conservatives attacked him ; Eadicals defended him. Emerson made no reply. But amid this somewhat fierce illumination he went forward steadily as a public lecturer. It was not his negations that made him popular ; it was the eloquence with which he pre- sented the positive side of his doctrine. Whatever the titles of his discourses, “Literary Ethics,” “Man the Reformer,” “The Present Age,” “The Method of Nature,” “Representative Men,” “The Conduct of Life,” their theme was always the same, namely, “the infinitude of the private man.” Those who thought him astray on the subject of religion listened to him with delight when he poetized the

commonplaces of art, politics, literature, or the household. His utterance was Delphic, inspirational.

There was magic in his elocution. The simplicity and sym- metry of his sentences, the modulations of his thrilling voice, the radiance of his fine face, even his slight hesi- tations and pauses over his manuscript, lent a strange charm to his speech. For more than a generation he went about the country lecturing in cities, towns, and villages, before learned societies, rustic lyceums, and colleges; and there was no man on the platform in America who excelled him in distinction, in authority, or in stimulating eloquence.

In 1847 Emerson visited Great Britain for the second time, was welcomed by Carlyle, lectured to appreciative audiences in Manchester, Liverpool, Edinburgh, and London, made many new friends among the best Eng- lish people, paid a brief visit to Paris, and returned home in July 1848. ” I leave England,” he wrote, ” with increased respect for the Englishman. His stuif or sub- stance seems to be the best in the world. I forgive him all his pride. My respect is the more generous that I have no sympathy with him, only an admiration.” The impressions of this journey were embodied in a book called English Traits, published in 1856. It might be called “English Traits and American Confessions,” for nowhere does Emerson’s Americanism come out more strongly. But the America that he loved and admired was the ideal, the potential America. Eor the actual conditioas of social and political life in his own time he had a fine scorn. He was an intellectual Brahmin. His principles were democratic, his tastes aristocratic. He did not like crowds, streets, hotels ??? ” the people who fill them oppress me with their excessive civility.” Hu- manity was his hero. He loved man, but he was not fond of men. He had grave doubts about universal suf- frage. He took a sincere interest in social and political reform, but towards specific ” reforms ” his attitude was somewhat remote and visionary. On the subject of tem- perance he held aloof from the intemperate methods of the violent prohibitionists. He was a believer in wom- an’s rights, but he was lukewarm towards conventions in favour of woman suffrage. Even in regard to slavery

he had serious hesitations about the ways of the abolition- ists, and for a long time refused to be identified with them. But as the irrepressible conflict drew to a head Emerson's hesitation vanished. He said in 1856, "I think we must get rid of slavery, or we must get rid of freedom." With the outbreak of the Civil War he be- came an ardent and powerful advocate of the caaise of the Union. James Russell Lowell said, " To him more than to all other causes did the young martyrs of our Civil War owe the sustaining strength of thoughtful heroism that is so touching in every record of their lives."

Emerson the essayist was a condensation of Emer- son the lecturer. His prose works, with the exception of the slender volume entitled Nature (1836), were collected and arranged from the manuscripts of his lectures. His method of writing was characteristic. He planted a subject in his mind, and waited for thoughts and illustrations to come to it, as birds or in- sects to a plant or flower. When an idea appeared, he followed it, "as a boy might hunt a butterfly"; when it was captured he pinned it in his "Thought- book." The writings of other men he used more for stimulus than for guidance. He said that books were for the scholar's idle times. "I value them," he said, "to make my top spin." His favourite reading was poetry and mystical philosophy: Shakespeare, Dante, George Herbert, Goethe, Berkeley, Coleridge, Sweden- borg, Jacob Boehmen, Plato, the new Platonists, and the religious books of the East (in translation). Next to these he valued books of biography and anecdote: Plu- tarch, Grimm, St Simon, Varnhagen von Ense. He had

some odd dislikes, and could find nothing in Aristophanes, Cervantes, Shelley, Scott, Miss Austen, Dickens. Novels he seldom read. He was a follower of none, an original borrower from all. His illustrations were drawn from near and far. The zodiac of Denderah; the Savoyards who carved their pine-forests into toys ; the naked Derar, horsed on an idea, charging a troop of Eoman cavalry ; the long, austere Pythagorean lustrum of silence ; Napo- leon on the deck of the Bellerophon, observing the drill of the English soldiers ; the Egyptian doctrine that every man has two pairs of eyes; Empedocles and his shoe; the horizontal stratification of the earth ; a soft mushroom pushing its way through the hard ground ; ??? all these allu- sions and a thousand more are found in the same volume. On his

pages, close beside the Parthenon, the Sphinx, St Paul's, jEtna, and Vesuvius, you will find the White Mountains, Monadnock, Agiocochook, Katahdin, the pick- erel-weed in bloom, the wild geese honking through the sky, the chick-a-dee braving the snow. Wall Street and State Street, cotton-mills, railroads, and Quincy granite. For an abstract thinker he was strangely in love with the concrete facts of life. Idealism, in him, assiimed the form of a vivid illumination of the real. From the pages of his teeming note-books he took the material for his lec- tures, arranging and rearranging it under such titles as Nature, School, Home, Genius, Beauty and Manners, Self- Possession, Duty, The Superlative, Truth, The Anglo- Saxon, The Young American. When the lectures had served their purpose he rearranged the material in essays and published them. Thus appeared in succession the follow- ing volumes : Essays (First Series), 1841 ; Essays (Second Series), 1844; Representative Men, 1S50; English Traits, 1856 ; Tlie Conduct of Life, 1860 ; Society and Solitude, 1870; Letters and Social Aims, 1876. Besides these, many other lectures were printed in separate form and in various combinations.

Emerson's style is brilliant, epigrammatic, gem-like; clear in sentences, obscure in paragraphs. He was a sporadic observer. He saw by flashes. He said, " I do not know what arguments mean in reference to any ex- pression of a thought." The coherence of his writing lies in his personality. His work is fused by a steady glow of optimism. Yet he states this optimism moderately. " The genius which preser-MC and guides the human race indicates itself by a small Scess of good, a small balance in brute facts always favourable to the side of reason."

His verse, though in form inferior to his prose, was perhaps a truer expression of his genius. He said, " I am born a poet " ; and again, writing to Carlyle, he called himself "half a bard." He had "the vision," but ilot "the faculty divine" which translates the vision into music. In his two volumes of verse (Poems, 1846 ; May Day and other Pieces, 1867) there are many passages of beautiful insight and profound feeling, some lines of sur-prising splendour, and a few poems, like " The Ehodora," " The Snowstorm," " Ode to Beauty," " Terminus," " The Concord Ode," and the marvellous " Threnody " on the death of his first-born boy, of beauty unmarred and pene- trating truth. But the total value of his poetical work is

discounted by the imperfection of metrical form, the presence of incongruous images, the predominance of the intellectual over the emotional element, and the lack of flow. It is the material of poetry not thoroughly worked out. But the genius from which it came ††† the swift faculty of perception, the lofty imagination, the idealizing spirit enamoured of reality ††† was the secret source of all Emerson's greatness as a speaker and as a writer. What- ever verdict time may pass upon the bulk of his poetry, Emerson himself must be recognized as an original and true poet of a high order.

His latter years were passed in peaceful honour at

Concord. In 1866 Harvard College conferred upon him the degree of LL.D., and in 1867 he was elected an over- seer. In 1870 he delivered a course of lectures before the university on " The Natural History of the Intellect." In 1872 his house was burned down, and was rebuilt by popular subscription. In the same year he went on his third foreign journey, going as far as Egypt. About this time began a failure in his powers, especially in his memory. But hischaracter remained serene and unshaken in dignity. Steadily, tranquilly, cheerfully, he finished the voyage of life.

I trim myself to the storm of time,

I man tlie rudder, reef the sail,

Obey the voice at eve obeyed at prime :

" Lowly faithful, banish fear.

Eight onward drive unharmed ;

The port, well worth the cruise, is near.

And every wave is charmed."

Emerson died on 27th April 1882, and his body was laid to rest in the peaceful cemetery of Sleepy Hollow, in a grove on the edge of the village of Concord.

AtTTHOKiTiES. ††† Emevson's Complete Works, Riverside edition (edited by J.E.Cabot), 11 vols. 'Boston,188S-Si.††† The Correspondence of Thomas Garlyle and Balph Waldo Emerson (edited by Charles Eliot Norton). Boston, 188.3. ††† Geokge Willis Cooke. Jtalph Waldo Emerson : His Life, Writings, and Philosophy. Boston, 1881. ††† Alexander Irelakd. Balph Waldo Emerson : His Life, Genius, and Writings. London, 1882. ††† A. Bronson Alcott. Balph Waldo Emerson, Philosopher and Seer. Boston, 1882. ††† MoNCURE Baxiel Conwat. Emerson at Home and Ahroad. Boston, 1882. ††† Joel Benton. Emerson as a Poet. New York, 188.3. ††† F. B. Sanborn (editor). The Genius and Character of Emerson .- Lectures at the Coiicord School of Philosophy. Boston, 1885. ††† ††† Oliver Wendell Holmes. Balph Waldo Emerson ("American Men of Letters" Series). Boston, 1885. ††† James Elliott Cabot. AMemoir of Balph Waldo Emerson, 2 ††††††iols. (the authorized biography). Boston, 1887. ††† Edward Waldo Emerson. Emerson in Concord. Boston, 1889. ††† Richard Garnett. Life of Balph Waldo Emerson. London, 1888. (h. van d.)

Emery Grinding Machinery. ††† Emery wheels, being cleaner, safer, and more efficient than the old grindstone, have become a necessity in all iron, steel, and other metal works. An emery wheel, properly mounted, runs at a peripheral speed of 6000 feet per minute, whereas a file in the hands of the best mechanic can only travel, and that with far less cuttin|y30wer, at the rate of 60 feet per minute. Moreover, thJ^fficiency of a file lessens every hour as its teeth become duller, but the emery wheel continually presents a fresh cutting surface, and remains the same until worn down to the wrought- or cast- iron washers which generally form the mount. Emery grinding operations may be divided into four classes : (1) tool and cutter grinding, for sharpening tools which would otherwise require to be softened, filed, and then hardened again ; (2) cylindrical grinding, as in a grinding lathe ; (3) surface grinding, where the emery wheel does the work of a shaping or planing machine, or of files ; (4) surface edge grinding, where the emery wheel takes the place of the ordinary steel tools, such as

the cold chisel and files. The qualities required in an emery wheel are : (1) sufficient tenacity to withstand the centrifugal strain caused by the high speed at which it revolves ; (2) ability to resist heat, inasmuch as the friction of grinding rapidly increases the temperature of the metal being operated on ; and (3) uni- formity of strength, density, and texture. The wheel must not be so hard as to allow the compound to project above the surface of the emery; in other words, the binding material must wear away about as fast as the emery, and also be of such a nature that it will not put a glaze on the surface of the wheel, or combine with the object operated upon. This glazing is in fact one of the most serious difficulties to be encountered in the use of emery wheels. The fineness or coarseness of the emery used is deter-

mined by passing the crushed rock or stone through sieves or wire cloths having from 6 to 100 wires to the inch ; thus emery that will pass through a sieve of 6 wires to the inch is called No. 6 grade or grit. The numbers re- presenting the various grades run from No. 6 to No. 100, and the smoothness of surface which the wheel leaves on the article ground may be compared with that left by files as follows : ###

No. 6 to 10 represents the cut of a wood rasp. ,, 16 ,, 20 ,, ,, ,, coarse rough file.

,, 24 ,, 35 ,, ,, ,, bastard file.

,, 40 ,, 60 ### ### ,, second cut file.

,, 70 ,, 80 ,, ,, ,, smooth file.

,, 90 ,, 100 ,, ,, ,, superfine.

To obtain the best result from an emery wheel it must be perfectly true, run at a high speed, and free itself from disengaged particles of metal, so as to allow of continuous contact between itself and the work. With equal speed and proportional pressure, a wheel six inches wide ought to grind off six times as much metal from a steel or iron bar six inches wide as a wheel one inch wide would from a steel or iron bar one inch wide. Experiments show that, taking the moderate price of one shilling per pound for the emery

wheel, the maximum cost of grinding one pound of cast-iron is about sixpence, whereas the cost per pound of filing cast-iron is at least one shilling and sixpence. In the case of grinding a tempered saw, where the steel resists the file, an emery wheel will remove fifty-five times more than a file in the same time.

The speed at which the wheel may be run without danger of bursting varies with its size, as well as with the quality of the binding material and the general excellence of the manufacture. The centrifugal force evolved varies as the square of the velocity ; hence a wheel of anj- given size is subjected to four times the bursting strain at 2000 revolutions that it is at 1000. Hence a comparatively small increase in the number of revolutions adds 100 per cent, to the breaking strain. It is practically impossible for one standard speed to be maintained in the workshop, since to do so would entail the continual alteration of driving pulleys to increase the speed so as to compensate for the wear in the diameter of the emery wheel. It is a common practice, therefore, to use wheels of a certain diameter upon machines running at the appropriate speed, and to transfer them to faster ones as their size is dimin- ished by use.

Corundum wheels are manufactured from the mineral corundum, which resembles emery, and they are made and used in the same manner as emery wheels. They are superior to the latter, both in cutting more freely and in being more durable, with less liability to glaze, but corundum is only found in limited quantities, and is consequently too expensive for the general uses for which emery wheels are equally well suited.

Emilia, a territorial division of Italy, enclosed gen- erally between the lower Po, the Apennines, and the Adriatic, and comprising the provinces of Bologna, Eerrara, Forli, Modena, Parma, Piacenza, Ravenna, and Reggio, with an area of 7967 sq. miles, and a population (1881) of 2,1S;’,,391, and (1901) of 2,451,752. Alongside the Po and the Adriatic there are extensive marshy tracts. The principal crops are maize, wheat, vine, hemp, fruit, tobacco, flax, rice, and chestnuts. Salt and sulphur are extracted, and granite is quarried. The greatest number of people are engaged in making strawplait and chip hats in their own homes. The industries which claim the next largest numbers of workpeople are the making of mats and baskets,

furniture, and cheese and butter, the manufacture of silks, tobacco, and fireworks, the production of cocoons, and ironworks. The region gets its name from the old Roman road, the Via Emilia, which traversed it from north- west to south-east. The most important towns are Bologna,

Ferrara, Ravenna, Modena, Eeggio, Parma, Forli, Pia- cenza, Eimini, Faenza, Correggio, and Guastalla. Rimini is the only seaport. The history of Emilia is coincident with the history of the duchies of Modena, Parma, and Massa-Carrara, and of the States of the Church.

Emin Pasha [Eduard Schnitzer] (1840-1892), German traveller and naturalist, was the son of Ludwig Schnitzer, a merchant of Oppeln in Silesia, and was bora in Oppeln, 28th March 1840. He was educated at the universities of Breslau, Berlin, and Konigsberg, and took the degree of M.D. at Berlin. He displayed an early predilection for zoology and ornithology, and in later life became a skilled and enthusiastic collector, particu- larly of African plants and birds. When he was four and twenty he determined to seek his fortunes abroad, and made his way to Turkey, where, after practising medicine on his own account for a short time, he was appointed (in 1865) Quarantine Medical Officer at Antivari. The duties of the post were not heavy, and allowed him leisure for a diligent study of Turkish, Arabic, and Persian. From 1870 to 1874 he was in the service of the Governor of Northern Albania, had adopted a Turkish name (though not that by which he afterwards became so widely known), and was practi- cally naturalized as a Turk. After a visit home in 1875, he went to Cairo, and then to Khartum, in the hope of an opportunity for travelling in the interior of Africa. This came to him in the following year, when General Gordon, who had recently succeeded Sir Samuel Baker as Governor of Equatorial Africa, invited Schnitzer, who was now known as “Emin Effendi,” to join him at Lado. Although nominally Gordon’s medical officer, Emin was soon entrusted with political missions of some importance to Uganda and IJnyoro. In these he acquitted himself so well that when, in 1878, Gordon’s successor in the governorship was deprived of his office on account of malpractices (Gordon himself having been made

Governor-General of the Sudan), Emin was chosen to fill the post, with the title of “Bey.” He proved an energetic and enterprising governor ; indeed, his enterprise on more than one occasion brought him into conflict with Gordon, who eventually decided to remove Emin to Suakin. Before the change could be effected, however, Gordon resigned his post in the Sudan, and his successor revoked the order. The next three or four years were employed by Emin in various journeys through his provinces, and in the initiation of various schemes for their development, until in 1882, on his return from a visit to Khartum, he became aware that the Mahdist rebellion, which had originated in the Sudan, was spreading to Equatoria. The effect of the rebellion was, of course, more markedly felt in Emin’s province after the abandonment of the Sudan by the Egyptian Government in 1884. He was obliged to give up sev- eral of his stations in face of the rebel advance, and ultimately to retire from Lado, which had been his capital, to Wadelai. This last step followed upon his receipt of a letter from Nubar Pasha, informing him that it was impossible for the Egyptian Government to send him help, and that he must stay in his province or retire towards the coast as best he could. Emin (who about this time was raised to the rank of Pasha) had some thoughts of a retreat to Zanzibar, but decided to remain where he was and endeavour to hold his own. To this end he carried on protracted negotiations with neigh- bouring native potentates. When, in 1887, Stanley’s expedition was on its way to relieve him, it is clear from Emin’s diary that he had no wish to leave his province, even if relieved. He had done good work there, and established a position which he believed himself able to

maintain. He hoped, however, that the presence of Stanley’s force, when it arrived, would strengthen his position ; but the condition of the relieving party, when it arrived in April 1888, did not seem to Emin to promise this. Stanley’s proposal to Emin, as stated in the latter’s diary, was that Emin should either remain as Governor-General on behalf of the King of the Bel- gians, or establish himself on Victoria Nyanza on be- half of a group of English merchants who wished to start an enterprise in Africa on the model of the East India Company. After much hesitation, and prompted by a growing disaffection amongst the natives (owing, as he maintained, to his loss of prestige after the arrival of Stanley’s force), Emin decided to accompany Stanley to the coast, where the expedition arrived in December

1889. Unfortunately, on the evening of a reception dinner given in, his honour, Emin met with an acci- dent which resulted in fracture of the skull. Careful nursing gradually restored him to health, and on his con- valescence he resolutely maintained his decision to remain in Africa, and, if possible, to work there in future on behalf of the German Government. The seal was definitely set upon this decision by his formal engage- ment on behalf of his native country, early in 1890. Preparations for a new expedition into the interior were set on foot, and meanwhile Emin was honoured in various ways by learned societies in Germany and elsewhere. The object of the new expedition was (to quote Emin's in- structions) " to secure on behalf of Germany the terri- tories situated south of and along Victoria Nyanza up to Albert Nyanza," and to " make known to the population there that they were placed under German supremacy and protection, and to break or undermine Arab influence as far as possible." The force, which was well equipped, started at the end of April 1890. For a time things went well enough with the expedition, but by degrees ill-fortune clouded its prospects. Difficulties on the route ; dissensions between Emin and the authorities in German East Africa, and misunderstandings on the part of both ; epidemics of disease in Emin's force, followed by a grow- ing spirit of mutiny among his native followers ; an ill- ness of a painful nature which attacked himself ; ??? all this gradually undermined Emin's courage, and his diaries at the close of 1891 reflect a gloomy and almost hopeless spirit. The only pleasurable incident of the expedition had been his unexpected meeting with Dr Peters, who since the spring of 1888 had been at the head of a German expedition which had been sent to attempt the relief of Emin at the time when it was thought improbable that Stanley's expedition would ever reach its goal, and had itself in turn been completely lost sight of and reported annihilated. At last the hatred with which Emin had inspired the African Arabs found its vent in his treach- erous murder by order of a native chief at the instigation of an Arab slave dealer, on 23rd or 24th October 1892, at Kinena in the Congo State. His journals and biography have been published since his death. (e. f. s.)

Emmaus, the name of two places in Palestine. 1. A village mentioned by St Luke (xxiv. 13), without any indication of direction, as being 60 stadia (6y^j- miles), or according to some MSS. 160 stadia, from Jerusalem. It has been identified (o) with Emmaus-Nicopolis, distant 176 stadia from

Jerusalem ; (&) with Kuryet el-‘Enab, distant 66 stadia, on the carriage road to Jaffa ; (c) with Kuldnieh, distant 36 stadia, on the same road ; (d) with el-Kubeibeh, distant 63 stadia, on the Roman road to Lydda ; (e) with Urtas, distant 60 stadia ; and (/) with Khurbet el-Khamasa, distant 86 stadia, on the Roman road to Eleutheropolis. Of these, el-Kubeibeh or Urtas seems the most probable. 2. Emmaus-Nicopolis, now

Amwas, a town on the maritime plain, and a place of importance during the Maccabaean and Jewish wars. Near it Judas Maccabseus defeated Lysias, 164 b.c, and Vespasian established a fortified camp a.d. 69. It was afterwards rebuilt and named Nicopolis.

Employers’ Liability.❓❓❓ The law of England as to the liability of employers in respect of personal in- juries to their servants can only be regarded as in a stage of transition. It depends upon no universal principles. It confers rights and imposes liabilities differing widely according to the employment, and even according to the accidental circumstances of the same employment. Some servants are practically insured against accident, others serve almost at their own risk, and no logical reason can be discovered for the difference. The common law, in- deed, is definite enough, and in its strict limitation of a master’s obligations admits of little ambiguity ; but by the Employers’ Liability Act, 1880, such exceptions have been grafted upon the common law, and by the Work- men’s Compensation Act, 1897, principles so alien to the common law have been applied to some but not to all employments, that it is impossible now to present any view of this branch of the law as a logical whole. All that can be done is to state the nature of the liability at common law, the extension of it effected by the Em- ployers’ Liability Act, 1880, and the new liabilities intro- duced by the Acts of 1897 and 1900. It is necessary to bear in mind that while all servants have such rights as the common law gives them, and most may have the further rights conferred by the Act of 1880, some in certain specially favoured employments are also entitled to the peculiar benefits of the Workmen’s Compensation Act.

At common law the liability of a master is of a very limited character. There is, of course, nothing to prevent a master and servant from providing by special contract in any way they please for their mutual rights in cases of personal injury to the servant. In such cases the liability will depend upon the terms of the special contract. But apart from any special agreement, it may be broadly stated that a master is liable to his servants only for injuries caused by his own negligence. Injuries to a servant may arise from accident, from the nature of the service, or from negligence ; and this negligence may be of the master, of another servant of the master, or of a stranger. If the injury is purely accidental, the loss lies where it falls. If it arises from the nature of the service, the servant must bear it himself ; he has undertaken a service to which certain risks are necessarily incident ; if he is injured thereby, it is the fortune of war, and no one can be made responsible. If the injury is caused by the negligence of a stranger, the servant has his ordinary remedy against the wrong-doer or any one who is respon- sible as a principal for the conduct of the wrong-doer. If it is caused by the negligence of a fellow-servant, he like- wise has his ordinary remedy against the actual wrong- doer ; but, by virtue of what is known as the doctrine of common employment, he cannot at common law make the master liable as a principal. The only case (inde- pendently of recent legislation : see below) in which he can recover damages from the master is where the injury has been caused by the negligence of the master himself. A master is negligent if he fails to exercise that skill and care which, in the circumstances of the particular employ- ment, are used by employers of ordinary skill and careful- ness. If he himself takes part in the work, he must act with such skill and care as may reasonably be demanded of one who takes upon himself to do work of that kind. If he entrusts the work to other servants, he must be careful in their selection, and must not negligently employ persons who are incompetent. He must take proper care

Common law.

so to arrange the system of work that his servants are not exposed to unnecessary danger. If tools or machinery are used, he must take proper care to provide such as are fit and proper for the work, and must either himself see that they are maintained in a fit condition or employ competent servants to do so for him. If he is bound by statute to take precautions for

the safety of his servants, he must himself see that that obligation is discharged. For breach of any of these duties a master is liable to his servant who is injured thereby, but his liability extends no further.

That his obligations to a servant are so much less than to a stranger is chiefly due to the doctrine of common employment. As a rule a master is responsible for the negligence of his servant acting in the course of his employ- ment ; but, from about the middle of the 19th century, it became firmly rooted in the law that “““f this principle did not apply where the person “mfnt‹ injured was himself a servant of the master and engaged in a common employment with the servant guilty of the negligence. In effect this rule protects a master as against his servant from the consequences of negligence on the part of any other of his servants ; to this there is no qualification except that, for the rule to apply, both the injured and the negligent servant must be acting in pursuance of a common employment. They must both be working for a common object, though not necessarily upon the same work.

It is not easy to define precisely what constitutes a common employment in this sense, and there is peculiarly little judicial authority as to the limit at which work for the same employer ceases to be work in a common employment. It does not depend on difference in grade ; all engaged in one business, from the manager to the apprentice, are within the rule. It does not depend on difference in work, if the work each is doing is part of one larger operation ; all the servants of a railway company, whether employed on the trains, or at the stations, or on the line, are in a common employment. It does not necessarily depend on differ- ence of locality ; a servant who packs goods at the factory and a servant who unpacks them in the shop may well be in a common employment. On the other hand, it is not enough that the two servants are working for the same employer, if there is nothing in common between them except that they are making money for the same man ; apart from special circumstances, the crews of two ships owned by the same company are probably not in common employment while navigating their respective ships. The test in each case must be derived from the view, invented by the courts, upon which the doctrine was based, namely, that the servant by entering upon the service consented to run all the risks incidental to it, including the risk of negligence on the part of

fellow-servants ; if the relation between the two servants is such that the safety of the one may, in the ordinary course of things, be affected by the negligence of the other, that negligence must be taken to be one of the risks of the employment assented to by the servant, and both are engaged in a common employment. In ninety-nine cases out of a hundred it will be found that the doctrine is applicable, and the master protected from liability. It is thus seen that, in general, no action will lie agamst a master at the suit of his servant, unless the servant can prove personal negligence on the part of the master causing injury to the servant. And in such action the master may avail himself of those defences which he has against a stranger. He may rely upon contributory negligence, and show that the servant was himself negligent, and that, not- withstanding the negligence of the master, the injury was proxi- mately caused by the negligence of the servant. Or (except in cases where the injury results from a breach of a statutory duty) he may prove such facts as establish the defence expressed in tlie maxim, volenti non fit injuria; that is, he may prove that the injured servant knew and appreciated the particular risk he was running, and incurred it voluntarily with full understanding of its nature. Mere knowledge on the part of the servant, or even his continuing to work with knowledge, does not necessarily establish this defence ; it must be knowledge of such ii kind and in such circumstances that it can be inferred that the servant contracted to take the risk upon himself. The action at common law is sub- ject to the general rule that personal actions die with the person ; except so far as the remedy for money loss caused by death by negligence has been preserved in favour of a husband or wife and certain near relatives, under Lord Campbell’s Act.

The Act of 1880.

Such was the law up to 1880. So long as industry was conducted on a small scale, and the master worked with his men, or was himself the manager, its hardship was perhaps little felt ; his personal negligence could in many cases be established. But with the development of the factory system, and the ever-growing expansion of the scale on which all industries were

conducted, it became increasingly difficult to bring home individual responsi- bility to the employer. As industry passed largely into the control of corporations, difficulty became almost im- possibility. The employer was not liable to a servant for the negligence of a fellow-servant, and therefore, in most cases of injury, was not liable at all. It is not surprising that the condition of things thus brought about, partly by the growth of mod- ern industry and partly by the decisions of the courts, caused grave dissatisfaction. The justice of the doctrine of common employment was vigorously called in question. In the result the Employers' Liability Act, 1880, was passed. The effect of this Act is to destroy the defence of common employment in certain specified cases. It does not abolish the doctrine altogether, nor, on the other hand, does it impose upon the master any new standard of duty which does not exist as regards strangers. All that it does is to place the servant, in certain cases, in the posi- tion of a stranger, making the master liable for the negli- gence of his servants notwithstanding the fact that they are in common employment with the servant injured. It is still necessary under the Act, as at common law, to prove negligence, and the master may still rely upon the defences of contributory negligence and volenti non fit injuria. But under the Act he cannot, as against the workmen who come within it and in the cases to which it applies, set up the defence that the negligence complained of was the negligence of a servant in a common employ- ment. The Act does not apply to all servants. It does not apply to domestic or menial servants, or to seamen, or to any except railway servants and "any person who, being a labourer, servant in husbandry, journeyman, artificer, handicraftsman, miner, or otherwise engaged in manual labour . . . has entered into or works under a contract with an employer, whether the contract be oral or in writing, and be a contract of service or a contract personally to execute any work or labour." Whether a servant, not being one of those specially named, is within the Act depends on whether manual labour is the real and substantial employment, or whether it is merely incidental thereto ; thus a carman who handles the goods he carries may be within the Act, but a tramcar driver or an omni- bus conductor is not. The Act does not make the master liable for the negligence of all his servants, but, speaking generally, only for the negligent discharge of their duties by such as are eatrusted with the supervision of machin- ery and plant, or with superintendence, or the power of giving orders, with the addition, in the case of a railway, of the

negligence of those who are given the charge or control of signals, points, locomotive engines, or trains. The cases dealt with by the Act are five in number ; in the first and fourth the words are wide enough to include negligence of the employer himself, for which, as has been seen, he is liable at common law. In such instances the workman has an alternative remedy either at common law or under the Act, but in all other respects the rights given by the Act are new, being limitations upon the defence of common employment, and can be enforced only under the Act.

The first case is where the injury is caused by reason of any defect in the condition of the ways, worlds, machinery, or plant connected with or used in the business of the employer, provided that such defect arises from, or has not been discovered or remedied owing to, the negligence of the employer, or of some person in the

service of the employer and entrusted by him with the duty of see- ing that the ways, works, machinery, or plant are in proper condi- tion. The second case is where the injury is caused by reason of the negligence of any person in the service of the employer who has any superintendence entrusted to him (that is, a person whose sole or prmcipal duty is that of superintendence, and who is not ordinarily engaged in manual labour) whilst in the exercise of such superintendence. The third case is where the injury is caused by reason of the negligence of any person in the service of the employer to whose orders or directions the workman at the time of the injury is bound to conform and does conform, where such injury results from his so conforming. The fourth case is where the injury is caused by reason of the act or omission of any person in the service of the employer done or made in obedience to the rules or bye-laws of the employer, or in obedience to particular instructions given by any person delegated with the authority of the employer in that be- half, provided that the injury results from some impropriety or defect in such rules, bye-laws, or instructions. The fifth case is where the injury is caused by reason of the negligence of any per- son in the service of the employer who has the charge or control of any signal, points, locomotive engine, or train upon a railway.

In all these cases it is provided that the employer shall not be liable if it can be shown that the workman knew of the defect or negligence which caused

his injury, and failed within a reasonable time to give, or cause to be given, information thereof to the employer or some person superior to himself in the service of the employer, unless he was aware that the employer or such superior already knew of the said defect or negligence. It was inevitable that these provisions should call for judicial interpretation, and a considerable body of authority has grown up about the Act. Where general words are used, it must always occur that, between the cases which are obviously within and those which are obviously without the words, there are many on the border line. Thus, under the Act, the courts have been called upon to determine the precise meaning of ” way,” ” works,” ” machinery,” ” plant,” and to say what is precisely meant by a “defect” in the con- dition of each of them. They have had to say what is included in “railway” and in “train,” what is meant by having ” charge ” or ” control,” and to what extent one whose principal duty is superintendence may participate in manual labour without losing his character of superin- tendent, and what is the precise meaning of negligence in superintendence. These are only illustrations of many points of detail which, having called for judicial interpre- tation, will be found fully dealt with in the text-books on the subject. A workman who, being within the Act, is injured by such negligence of a fellow-servant as is in- cluded in one or other of the five cases mentioned above, has against his employer the remedies which the Act gives him. These are not necessarily the same as those which a stranger would have in the like circumstances ; the amount of compensation is not left at large for a jury to determine, but is limited to an amount not exceeding such sum as may be found to be equivalent to the estimated earnings, during the three years preceding the injury, of a person in the same grade employed during those years in the like employment and in the district in which the workman is employed at the time of the injury. More- over, the right to recover is hedged about with technicali- ties which are unknown at the common law ; proceedings must be taken in the County Court, within a strictly limited time, and are maintainable only if certain elaborate provisions as to notice of injury have been complied with. Where the injury causes death the action is maintainable for the benefit of the like persons as are entitled under Lord Campbell’s Act in an action at common law.

The law continued in this condition up to 1897. In the majority of cases of injury to a servant, the doctrine of common employment still protected the

master ; and where, under the Employers' Liability Act, it failed to do so, the liability was of a limited character and often,

owing to teclinicalities of procedure, dif&cult to enforce. Moreover, there is nothing in the Act to prevent master and servant from entering into any special contract they please ; and in many trades it became a common prac- tice for contracts to be made wholly excluding the operation of the Act. In 1893 an attempt was made to alter the law by a total abolition of the defence of common employment, so as to make a master liable to a servant as to a stranger for the negligence of any of his servants acting in the course of their employment, and at the same time to prohibit any agreements to forego the rights so given to the servant. The Bill did not become law, and no further change was made until, in 1897, Parliament took the first step in what must ultimately be a complete revolution in the law of em- ployers' liability. Up to that year, as has been seen, the foundation of a master's liability was negligence, either of the master himself, or, in certain cases, of his servants. But by the Workmen's Compensation Act, 1897, a new principle was introduced, whereby certain servants in certain employments were given a right to compensation for injuries, wholly irrespective of any consideration of negligence or contributory negligence. As regards such servants in such employments the master is in effect made an insurer against accidental injuries. The Act was confessedly tentative and partial ; it dealt only with selected indus- tries, and even within these industries was not of universal application. But where it does apply, it gives a right to a limited compensation in every case of injury by accident arising out of and in the course of the employment, whether that accident has been brought about by negli- gence or not, and whether the injured servant has or has not contributed to it by his own negligence. Owing in part to the novelty of the principles sought to be estab- lished, in part to the way in which the sections are drawn, the Act presents considerable difficulties of interpretation. In many respects, as has been said by the Court of Appeal, definition is difficult or impossible, and all that can be done is in each case, as it comes

before the court, to say whether it falls within or without the Act. Many ambiguities have already been made clear by authoritative decision, but no statement of the effect of the Act can be made with any approach to finality.

The Act applies only to employment on, or in, or about certain localities where, at the same time, the employer is what the Act calls an “undertaker,” that is, the person whose business is there being carried on. If we want to know whether a workman is within the Act, we must ask, first, was he employed on, or in, or about a railway, or a factory, or a mine, or a quarry, or an engineering shop, or a building of the kind mentioned in the Act ; secondly, was he employed by one who was, in relation to that rail- way, &c., the undertaker as defined by the Act; and, thirdly, was he at the time of the accident at work on, or in, or about that railway, &c. Unless these three con- ditions are fulfilled the employment is not within the Act. What is included in the named localities and who are the undertakers in respect thereof will be dealt with below. But it must here be pointed out that an under- taker is in some cases liable as an employer, though he is in fact not the actual master of the workman. Section 4 of the Act in effect provides that where the undertaker has let out])art of the work of his undertaking to a con- tractor, the workmen of such contractor shall be treated as employed by the undertaker, provided that the work so let out is part of or a process in the trade or business carried on by the undertaker ; to such workmen the under- taker is made liable, whether for claims under the Act, or for claims founded on personal negligence or wilful act. The employment must be on, or in, or about the locality.

and ” about ” means ” in close propinquity to ” ; to this the Act makes one exception, where it provides that a work- man employed in a factory which is a shipbuilding yard shall not be excluded by reason only that the accident arose outside the yard in the course of his work upon a vessel in any dock, river, or tidal water near the yard ; with this exception no outworker has the benefit of the Act.

The effect of what has been said will best be seen by an illustra- tion. A carries on business in an engineering shop, which is a factory. He employs B in the shop, and C to erect an engine in another person’s mill ; he also makes a contract with X whereby X undertakes part of the engineering

work in the shop, X employ- ing his own men, among whom is T> ; he also contracts with Y for the installation of electric light in the shop, and Y employs E to do the work. Among these workmen B and D are within the Act, C and E are without it. B is employed in a factory by the undertaker, and D is employed indirectly by the undertaker in a factory upon work which is part of the business carried on by the undertaker. C is not employed on, or in, or about a factory in relation to which his employer is an undertaker, and E, though employed about a factory and indirectly by the undertaker, is not doing work which is part of the business carried on by the undertaker.

The particular employments included in the Act are as follows : ###

(1) Employment by a railway company on, in, or about a railway. A railway means the railway of any railway company to which the Regulation of Railways Act, 187.3, applies, and includes a light railway made under the Light Railways Act, 1896. The ” undertakers ” are the railway company as defined by those Acts.

(2) Employment on, in, or about a factory by the occupier thereof. A factory means a factory within the Factory and Workshop Acts, 1878 to 1891. The ” under- taker ” is the occupier within the meaning of those Acts (see Labour Legislation).

(.3) Employment on, in, or about a laundry worked by steam, water, or other mechanical power, by the occupier thereof. The “undertaker” is the occupier within the meaning of the Factory and Workshop Acts, 1878 to

1895.

(4) Employment on, in, or about any dock, wharf, quay, warehouse, machinery, or plant, to which any provision of the Factory Acts is applied by the Factory and Workshop Act, 1895, by the occupier thereof within the meaning of that Act. The ” undertaker ” is the occupier as defined by the Act of 1895.

Section 23 of the Factory and Workshop Act, 1895, extends certain provisions of the Factory Acts (relating to dangerous machines, notice of

accidents and the like) to (a) every dock, wharf, quay, and warehouse, and, so far as re- Docks.

lates to the process of loading or unloading therefrom or thereto, all machinery and plant used in that process ; and (6) any premises on which machinery worked by steam, water, or other mechanical power, is temporarily used for the purpose of the construction of a building or any structural work in connexion with a building. The section further provides that the person having the actual use or occupation of a dock, wharf, quay, or warehouse, or of any premises within the same, or forming part thereof, and the person so using any such machinery, shall be deemed to be the occupier. This class has been the subject of much litigation, but after considerable conflict of judicial decision, most of the doubts have been set at rest. A workman engaged in an employment on, in, or about a dock, whether on the quays or on board a ship in the dock, is engaged in an employment on, in, or about a “factory” within the meaning of the Act. This does not settle the question whether the workman is within the Act, for the Act will not apply unless the employer is the “undertaker,” that is to say, the occupier ; and to be the occupier the employer must have the actual use or occupation of the dock, wharf, quay, or warehouse, or of premises within the same, and forming part thereof. If the workman is employed by the dock company or the warehouseman, he is clearly employed by the occupier, but if he is employed by others, say, the shipowner, or the receiver of goods, or the master stevedore who merely uses the dock or quay, or the merchant who merely stores his goods in the warehouse of “another, it has to be determined whether such employer has the actual use

or occupation of the dock, &c., or of premises within the same. Actual use means much more than legal occupation. On the other hand, it does not include a merely casual use. So far as the decisions go, the test seems to be whether the employer has a more or less exclusive use of something which can be defined as an area of the docks or quay. Thus a shipowner has the use of the berth in which his ship lies and of the quay ou which he discharges cargo. A ship repairer has the use of the dry dock in which he is

painting the ship. A merchant who merely sends a clerk across the quay has not the use of the quay. It is a question of fact to be determined according to the circumstances of each case. As to machinery or plant used in loading or discharge the question is less complicated ; for, by the Factory Act, the person who, by himself, his agents or workmen, temporarily uses such machinery, is made the occupier, and is therefore an ” undertaker.” In general, there- fore, a workman employed on or about machinery or plant used in loading or discharge will be within the Act, provided that his em- ployer is the person who is in fact using that machinery or plant. Speaking broadly, it may be said that the majority of dock labour- ers are within thie Act.

(.3) Employment on, in, or about any mine to which the Coal Mines Regulation Act, 1887, or the Metallifer- ous]Mines Regulation Act, 1872, applies, by the owner thereof within the meaning of those Acts. This includes all mines. The “undertaker” is the owner as defined by those Acts ; that is to say, any person or body corporate who is the immediate proprietor, or lessee, or occupier of any mine, or of any part thereof ; this does not include a person or body corporate who merely receives a royalty, rent, or fine from a mine, or is merely the proprietor of a mine subject to any lease, grant, or license for the working thereof, or is merely the owner of the soil, and not interested in the minerals of the mine.

(6) Employment on, in, or about any quarry under the Quarries Act, 1894, by the occupier thereof. A quarry includes every place (not being a mine) in which persons work in getting slate, stone, coprolites, or other minerals, and any part of which is more than twenty feet deep. The ” undertaker ’’ is the occupier.

(7) Employment on, in, or about an engineering work ; that is to say, any work of construction, or alteration, or repair of a railroad, harbour, dock, canal, or sewer, includ- ing any other work for the construction, alteration, or repair of which machinery driven by steam, water, or other mechanical power is used. The employment must be by the person undertaking the construction, alteration, or repair, such person being the ” undertaker ” in respect of an engineering work.

(8) Employment on, in, or about certain buildings in course of construction, repair, or demolition, by the per- sons undertaking that work. The buildings included are (a) any building which exceeds thirty feet in height, and is being constructed or repaired by means of a scaf- folding, (&) any building which exceeds thirty feet in height and is being demolished, and (c) any building on which machinery driven by steam, water, or other me- chanical power is being used for the purpose of the con- struction, repair, or demolition thereof. The ” undertaker” is the person undertaking the construction, repair, or demolition.

This class has been the subject of much litigation. What is meant by “construction,” by “repair,” by “scaffolding,” are among the questions which have come before the courts. Ques- tions such as these can only be determined in reference to the par- ticular facts of each case. In practice further difficulties must arise in determining who is the undertaker. In work such as is included in classes (7) and (8), the operations are often divided among several employers who do different branches of the work. If the several contractors are indeed separate, each doing a part of the work for the building owner, each is an undertaker and liable to his own workmen. But where, as is more often the case, one con- tractor undertakes with the building owner to do the whole work, and then sublets portions of it to sub-contractors, such sub-con- tractois are not undertakers, and only the principal contractor is liable under the Act.

Given an employment to which the Act applies, all who are engaged therein are workmen within the Act, includ- ing workmen engaged in any employment (exclusive of naval or military service) by or under the Crown.

To entitle a workman engaged in an employment to which the Act applies to compensation all the following conditions must be fulfilled : ••• (1) There must be personal injury by accident. This, it is “/a’“* submitted, will exclude (a) injury wilfully inflicted ; (b) injury arising from the nature of the occu- pation without the occurrence of any fortuitous event, e.g., lead poisoning; and (c) injury proximately due to a diseased condition of the workman. In the last case, where there is a diseased condition of the workman and also a fortuitous event, it will be a question of fact whether the injury was or was not proximately caused by the accident. (2) The

accident must arise out of and in the course of the employment. In each case it will have to be determined whether the workman was at the time of the accident in the course of his employment, and whether the accident arose out of the employment. It will have to be considered when and where the particular employment, which, it must be remembered, must be one ” on, in, or about ” a particular locality, began and ended. Other difiiculties have arisen and will frequently arise when the workman at the time of the accident is doing something which is no part of the work he is employed to do. So far as the decisions have gone, they indicate that if what the workman is doing is no act of service, but merely for his own pleasure, or if he is improperly med- dling with that which is no part of his work, the accident does not arise out of and in the course of his employment ; but if, while on his master’s work, he upon an emergency acts in his master’s interest, though what he does is no part of the work he is employed to do, the accident does arise out of and in the course of his employment. (3) The injury must be such as disables the workman for a period of at least two weeks from earning full wages at the work at which he was employed. (4) Xotice of the accident must be given as soon as practicable after the happening thereof, and before the workman has vol- untarily left the employment in which he was injured; and the claim for compensation (by which is meant notice that he claims compensation under the Act addressed by the workman to the employer) must be made within six months from the occurrence of the accident or, in case of death, from the time of death. “Want of notice of the accident or defects in it are not to be a bar to proceedings, if occasioned by mistake or other reasonable cause, and the employer is not predjudiced thereby. But want of notice of a claim for comjjensation is a bar to proceedings, unless the employer by his conduct has estopped himself from relying upon it. (5) A workman who has giveiL notice of an accident must, if so required by the employer, submit himself to medical examination.

“When these conditions are fulfilled, an employer who is within the Act has no answer unless he can prove that the injury arose from the serious and wUful misconduct of the workman. The precise effect of these terms is not clear ; but mere negligence is not within them.

“V^“here the injury causes death, the right to compensa- tion belongs to the workman’s ” dependants ” ; that is, such members of the workman’s family specified in Lord Campbell’s Act as were at the time of the death wholly or in part dependent upon the earnings of the workman for their maintenance.

Under the Act compensation is for loss of wages oply, and is, as has been said, based upon the actual previous earnings of the injured workman in the employment of the employers for whom he is working at the time of the injury. In case of death, if the workman leaves

dependants who were wholly dependent on his earnings, the amount recovered is a sum equal to his earnings in the employment of the same employer during the three years next preceding the injury, or the sum of Amoun . ××igQ^ whichever is the larger, but not exceed- ing ××300 ; if the period of his employment by the same employer has been less than three years, then the amount of his earnings during the three years is to be deemed to be 156 times his average weekly earnings during the period of his actual employment under the said em- ployer. If the workman leaves only dependants who were not wholly dependent, the amount recovered is such sum as may be reasonable and proportionate to the injury to them, but not exceeding the amount payable in the previous case. If the workman leaves no depend- ants, the amount recoverable is the reasonable expenses of his medical attendance and burial, not exceeding ××10. In case of total or partial incapacity for work resulting from the injury, what is recovered is a weekly payment during the incapacity after the second week not exceed- ing 50 per cent, of the workman’s average weekly earn- ings during the previous twelve months, if he has been so long employed, but if not, then for any less period during which he has been in the continuous employment of the same employer ; such weekly payment is not to exceed ××1 ××× and in fixing it regard is to be had to the difference between the amount of his average weekly earnings before the accident and the average amount which he is able to earn after the accident. Any pay- ments, not being wages, made by the employer in respect of the injury must also be

taken into account. If the workman is maimed, but for the time being suffers no loss, e.g., if he loses a finger but continues to earn the same wages as before, no compensation can be awarded, but the Court will make a declaration of liability of the employer, leaving the amount and duration of the com- pensation to be fixed, upon an application to review, should the workman at any future time be unable, by reason of the injury, to earn the same wages as before the accident. The weekly payment may from time to time be reviewed at the request of either party, upon evidence of a change in the circumstances since the award was made, and after six months may be redeemed by the em- ployer by payment of a lump sum. When the workman at the time of the injury has been in the employment for less than two weeks, so that there are no actual earnings from the same employer upon which a weekly average can be comj)uted, the Act presents much difiiculty. It has been finally decided by the House of Lords that such a workman is within the Act. But how are the average weekly earnings which he would have earned from the same employer to be estimated ? The question must be determined as one of fact by reference to all the circum- stances of the particular case. Suppose the workman to be engaged at six shillings a day and injured on the first day. If it can be inferred that he would have remained in such employment for a whole week, his average weekly earnings from the same employer may be taken at thirty shillings. If it can be inferred that he would have worked one day and no more, his average weekly earn- ings from the same employer may be taken at six shillings. The result is that the casual labourer is within the Act, but that the amount of compensation for which the casual employer is liable may be very small.

All questions as to liability or otherwise under the Act, if not settled by agreement, are referred to arbitra- tion in accordance with a scheme prescribed by the Act. Contracting out is not permitted, save in one event : where a scheme of comijensation, benefit, or insurance for the workmen of an employer has been certified by the Registrar of Friendly Societies to be not less favour-

able to the general body of workmen and their depend- ants than the provisions of the Act, the employer and any of his workmen may contract that the provisions of the scheme shall be substituted for the Act ; such

certifi- cate may not be for more than five years, and may in certain circumstances be revoked. The Act does not touch the workman's rights at common law or under the Employers' Liability Act, but the workman, if more than one remedy is open to him, can enforce only one. When the circumstances create a legal liability in some other person, e.g., where the injury is caused by the negligence of a sub-contractor or of a stranger, in such cases the employer, if required to pay compensation under the Act, is entitled to be indemnified by such other person.

By the Workmen's Compensation Act, 1900, the benefits of the Act of 1897 were, after the 1st July 1901, extended to some workm en in agriculture. To com e within the Act, the workman must be employed in agri- J/ /poof culture by an employer who habitually employs one or more workmen in such employment. "Agricul- ture " includes horticulture, forestry, and the use of land for any purpose of husbandry, inclusive of the keeping or breeding of live stock, poultry, or bees, and the grow- ing of fruit and vegetables. If a workman is employed by the same employer mainly in agricultural, but partly or occasionally in other work, the Act applies to the employment of the workman in such other work. The provisions of the Act of 1897, which entitle a workman employed by a contractor to recover against the under- taker whose work the contractor is doing, are limited by a provision that, where the contractor provides and uses machinery driven by mechanical power for the purpose of threshing, ploughing, or other agricultural work, he, and he alone, shall be liable to pay compensation to any workman employed by him on such work.

Under the Factory Acts, offences, when they result in death or bodily injury to health, may be punished by fine not exceeding ––100, and the whole or any part of such fine may be applied for the benefit of the injured person or his family, or otherwise as the Secretary of State determines. Similar provisions occur in the Mines Acts. Any sum so applied must be taken into account in estimating compensation under the Employers' Liability and Workmen's Compensation Acts.

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Emporia, capital of Lyon county, Kansas, U.S.A., in 38†† 24′ N. lat. and 96†† 10′ W. long., on the Neosho river, at an altitude of 1138 feet. It is regularly laid out on the level bottom-lands, and is divided into four wards. It has two railways, the Atchison, Topeka, and Santa Fe and the Missouri, Kansas, and Texas. It is the seat of the College of Emporia, a Presbyterian institution, estab- lished in 1883. In 1900 the college had 12 instructors and 127 students, including those in the preparatory department. Emporia is also the seat of the State Nor- mal School. Population (1880), 4631; (1890), 7551; (1900), 8223, of whom 686 were foreign-born and 663 were negroes.

Ems, a river of Germany, rising on the south slope of the Teutoburg Forest at an altitude of 358 ft., and flowing

generally north-west and north through Westphalia and Hanover to the east side of the DoUart, immediately south of Emden. After passing through the Dollart the navi- gable stream bifurcates, the eastern Ems going to the east, and the western Ems to the west, of the island of Borkum to the North Sea. Length, 205 miles.

Between 1892 and 1899 the river was canalized along its right bank for a distance of 43 miles. At the same time, and as part of the” same general plan, a canal, the Dortmund-Ems Canal, was dug to connect the river (trom Mtinster) with Heme in the Weatphalian coalfield. At Heinrichenburg a branch from Heme (5 miles long) connects with another branch from Dortmund (lOJ miles long). Another branch, from Olfen (north of Dortmund), connects with Duisburg, and so with the Rhine. There is, how-ever, a difference in elevation of 46 ft. between the two branches first named, and vessels are transferred from the one to the other by means of a huge lift. The canal, which was constructed to carry small steamers and boats up to 220 ft. in length and 750 tons burden, measures 169 miles in length, of which 108J miles were actually dug, and cost altogether ––3,728,750. The surface width throughout is 98 J ft., the bottom width 69 ft., and the depth 8Jft.

See Victor Kurs. “Die kiinstlichen Wasseistrassen des Deutsohen Reichs,” in Cfeog. Zeitschrift (1898), pp. 601-617 and 665-694 ; and Deutsche Mundschau f. Qeog. und Stat. (1898), pp.

130-181.

Ems, a town and watering-place of Prussia, province Hesse-Nassau, on the river Lahn, 11 miles by rail east from Coblenz. The hot alkaline springs (70––-135–– F.), about a score in all, and on both sides of the stream, were apparently known in Roman times. A monument to the Emperor William I. was unveiled in 1893, and a stone has been set into the promenade to commemorate the spot where the emperor abruptly dismissed Benedetti, the French ambassador to Prussia. A funicular railway has been constructed to the Malberg, a favourite sanatorium. The population of 6492 (1900) is greatly increased during the summer months by visitors from all parts of the world, for whose accommodation many handsome villas have been erected.

Enamel. ––– The art of enamelling upon metals was practised in its simplest forms as far back in the history of man’s achievements as the Assyrian and Egyptian civilizations. Since those remote ages there has been a succession of luxurious developments, followed by lapses into the decline

and death of the art. In each revival there has been something added to that which was known and practised before, bearing witness to a slow progres- sion. The last revival took place five hundred years ago, accompanying the rebirth of learning and the arts ; but after flourishing for over a century, the art gradually fell into disuse, and remained so until the recent revival and further development, with which alone we are here con- cerned. The development consists, first, in the more complete knowledge of the technical processes, following upon the great advances which science has made ; and, secondly, in a finer and more subtly artistic treatment of them. The advance in technical knowledge comprises greater facility and perfection in the production of the substance enamel, and its subsequent application to metal surfaces ; more intimate knowledge of metals and their alloys to which it is applied, and greater ease in obtaining them from the metalliferous ores and reducing them to suitable dimensions and surfaces. For instance, it is now a simple matter to obtain perfectly pure copper by means of electricity. Again, formerly a flat sheet of metal was obtained by hammering, which involved an infinite amount of hard labour, whereas it is accomplished to-day with ease by means of flatting and rolling mills ××× i.e., after the metal has been obtained from the ore in the form of an ingot, it is stretched equally to any degree of thinness by steel rollers. Further, the furnaces have been greatly improved by the introduction of gas as the

heating power, instead of the wood or charcoal employed formerly.

In the manufacture of the substance enamel a much greater advance has been made, for whereas the colours, and consequently the schemes of colour, were extremely limited, we now possess an infinite gradation in the colours, as well as the transparency and opacity, the hardness and softness, of enamels. There are only two colours which cannot yet be obtained: these are opaque vermilion and lemon yellow. Many of the colours we now employ were not known by such enamellers as Leonard Limousin. Our enamels are also perfect in purity, bril- liancy, and durability, qualities which are largely due to the perfect knowledge of the proportion of parts compos- ing an enamel, and their complete combination. It is this complete combination, together with the absence of any destructible matter, which gives the enamel its lasting quality. The base of enamel is a clear,

colourless, trans- parent, vitreous compound called flux, which is composed of silica, minium, and potash. This flux or base ^termed fondant in France is coloured by the addition of oxides of metals while in a state of fusion, which stain the flux throughout its mass. Enamels are either hard or soft, according to the proportion of the silica to the other parts in its composition. They are termed hard when the temperature required to fuse them is very high. The harder the enamel the less liable is it to be affected by atmospheric agencies, which in soft enamels produce a decomposition of the surface first, and ultimately of the whole enamel. It is therefore advisable to use hard enamel in all cases. This involves the employment of pure or almost pure metals for the plates, which are in most respects the best to receive and retain the enamel. For if there is an excess of alloy, either the metal will possibly melt before the enamel is fused, or afterwards they will part company. To the inferior quality of old silver may be attributed the fact that in all cases the enamel has flown ofE it ; if it has not yet wholly dis- appeared, it will scale off in time. It is therefore essen- tial that metals should be pure and the enamels hard. It is also noteworthy that enamels composed of a great amount of soda or potash, as compared with those wherein red lead is in greater proportion, are more liable to crack, and have less cohesion to the metal. It is better not to use silver as a basement, although it is capable of re- flecting a higher and more brilliant white light than any other metal. Fine gold and pure copper, as thin as possible, are the best metals upon which to enamel. If silver is to be used, it should be fine silver, treated in the methods called champlevi and doisonni.

The brilliancy of the substance enamel depends upon the perfect combination and proportion of its component parts. The intimacy of the combination depends upon an equal temperature being maintained throughout its fusion in the crucible. For this purpose it is better to obtain a flux which has been already fused and most carefully prepared, and afterwards to add the colouring oxides, which stain it dark or light according to the amount of oxide introduced. Many of the enamels are changed in colour by the difference of the proportion of the parts composing the flux, rather than by the change of oxides. For instance, turquoise blue is obtained from the black oxide of copper by using a comparatively large proportion of carbonate of soda ; and a yellow green from the same oxide by increasing the proportionate amount of the red lead.

All transparent enamels are made opaque by the addition of calx, which is a mixture of tin and lead calcined. White enamel is made by the addition of stannic and arsenious acids to the flux. The amount of acid regulates the density or opacity of the enamel.

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E K A M E L

‘ To elucidate the -development ‘whicli has occurred, it will be necessary to describe some of the processes. After the enamel ha’S be^-pro- cure!d in the lump, the next stage in the process, common to all “methods of enamelling, is to pulverize it. To do this properly the enamel must first be placed in an agate mortar and covered with water; next, with a wooden mallet a number of Sharp blows must be given to a pestle held vertically over the enamel, to break it ; then, holding the mortar firmly in the left hand, the pestle must be rotated with the right, with as much pres- sure as possible on the enamel, grinding it until the particles are reduced to a fine grain (T”ig. 1). The powder is then sub- jected to a series of wash- ings in distilled water until all the floury particles are removed. After this the metal is cleaned by im- mersion in acid and water. For copper, nitric acid is used ; for silver, sulphuric ; and for gold, hydrochloric is then removed, first by

art in the order in which they are named. To-day they are all known in their entirety. Each has been

Fig. 1. ••• Laying enamel on a copper plate, and pulverizing enamel with a pestle and mortar.

acid. All trace of acid scratching with a brush and water, and finally by drying in warm oak sawdust. After this the pulverized enamel is carefully and evenly spread over those parts of the metal designed to receive ‘ it, in suflficient thickness just to cover them and no more. The piece is then dried in front of the furnace, and when dry is placed gently on a fire-clay or iron planche, and introduced carefully into the muffle of the furnace, which is heated to a bright pale red (Fig. 2). It is now attentively watched until the

enamel shines all over, when it is with- drawn from the furnace. The firing of enamel, unlike that of glass or pottery, takes only a few minutes, and in nearly all processes no annealing is required.

The following are the different modes of en- amelling: Champleve, Cloisonne, Basse-taille, Plique a jour, Painted Enamel, Encrusted, and Miniature-painted, eesses were known at successive periods

largely developed and improved. No new method has been discovered, although variations have been intro- duced, into all. The most important are those connected

Fia. 2.□□□ Placing an object covered with pulverized enamel into a muffle.

These pro- 1 with painted enamels, encrusted enamels, and plique d. of ancient | jour.

Ghamplevi enamelling is done by cutting away troughs or cells in the plate, leaving a metal line raised between them, which forms the outline of the design. In these cells the pulverized enamel is laid and then fused ; after- wards it is filed with a corundum file, then smoothed with a pumice stone, and polished by means of crocus powder and rouge.

In cloisonne enamel upon a metal plate or shape, thin metal strips are bent to the outline of a pattern, then fixed by silver solder or by the enamel itself. These strips form a raised outline, giving cells as in the case of champlevi. The rest of the process is identical with that of champlevi enamelling.

The basse-taille process is also a combination, of metal- work in the form of engraving, carving, and enamelling. The metal, either silver or gold, is engraved with a design and then carved into a bas-relief below the general surface of the metal, like an Egyptian bas-relief, so that when the enamel is

fused it shall be level with the uncarved parts of the enamel and the design show through the transparent enamel.

Painted enamels are different from any of these pro- cesses, both in method and in result. The metal in this case is either copper, silver, or gold, but usually copper. It is cut with shears into a plate of the size required, and slightly domed with a burnisher or hammer, after which it is cleaned by acid and water. Then the enamel is laid equally over the whole surface, both back and front, and afterwards ” fired.” The first coat of enamel being fixed, the design is carried out, first by laying it in white enamel or any other which is opaque and most advantageous for subsequent coloration.

In the case of a grisaille painted enamel, the white is mixed with water or turpentine, or spike oil of lavender, or essential oil of petroleum (according to the taste of the artist), and the white is painted thickly in the light parts and thinly in the grey ones,’ whereby a slight sense of relief is obtained and a great degree of light and shade.

In coloured painted enamels the white is coloured by transparent enamels spread over the grisaille treatment, parts of which when fired are heightened by touches of gold, usually painted in lines. Other parts can be made more brilliant by the use of foil, over which the transpar- ent enamels are placed and then fired.

Enamels by the plique d, jour method might be best described as translucejit cloisonni enamels ; for they are similar to cloisonn4, except that the ground upon which they are fired is removed, thus making them transparent, like stained glass.

Miniature enamel painting is not true enamelling, for after the white enamel is fired upon the gold plate, the colours used are not vitreous compounds ††† not enamels, in fact ††† as is the case in any other form of enamelling ; but they are either raw oxides or other forms of metal, with a little flux added, not combined. These colours are painted on the white enamel, and afterwards made to adhere to the surface by partially fusing the enamel, which when in a state of partial fusion becomes viscous.

There are many of these so-called enamels to-day, which are much easier of accomplishment than the true enamel, but they possess none of the beautiful quality of the latter. It is most apparent when parts of a work are true enamels and parts are done in the manner described above. These enamel paintings ??? or rather paintings on enamel^re afterwards coated over with a transparent flux, which gives them a surface of enamel. Many are done in this way for the market.

AH these methods were used formerly, before the present revival ; but they were not so completely understood or carried so far as they are to-day, nor were the whole methods practised by any artist as they are now. The greatest advance has been in painted

enamels. This process requires that both sides of the metal plate shall be covered with enamel ; for this reason the plate is made convex on the top, so that the concave side does not touch the planche on which it is supported for firing, but rests upon its edges throughout. There are several reasons why these plates are bombe, the principal one being that in the firing they resist the tendency to warp and curl up at the edges, as a flat thin plate would do. Further, the enamel having been fused to both sides, is not so liable to crack or split in subsequent firings. This is most important, for otherwise the white which is placed on afterwards would be a network of cracks. The manner of firing has also to do with this, but not nearly so much as the pre- liminary care and mechanical perfection with which a plate is prepared. Nearly all the old enamels are seen to be cracked in the white if minutely examined. To obviate this the following points must be observed : ??? The plate must be of an excellent quality of metal, equal in thickness throughout and of per- fectly regular shape. It must be arched equally from end to end. The first coat of enamel must be of a perfectly regular equal thickness on both sides, entirely covering the plate. Whatever the medium employed in painting the white on to the enamel, it must be completely evaporated before the plate is placed in the furnace. The furnace must be heated to a bright red heat, and the planche must be red-hot before being taken out for the enamel to be placed upon it, and then quickly returned to the furnace and the muffle door shut tight so as to allow no draught of cool air to enter. Then as soon as it has begun to fuse, which, if a small piece, it would do in a minute or so, the muffle door is slightly

opened to afford a view of it. As soon as it shines all over its surface, it is withdrawn from the muffle.

The method of laying the white upon an enamel ground is a matter of individual taste, so far as the medium is concerned. By some, pure distilled water is preferred to any other liquid for mixing the enamel. Otherwise turpentine and the fat oil of turpentine, as well as spike oil of lavender. The oil mixture takes longer to dry, and thus gives a greater chance for modeUing into fine shades, than the water. But it has several drawbacks. rirstly, there is the difflculty of drying the oil out ××× a process which takes some time and increases the risk of cracking in the drying process; and secondly, the enamel is not so fresh and clear after it is fired as when pure water has been employed. Besides, there is a great difference in the result ; the water involves a quick, decided, direct touch and method, which carries with it its own charm. The oil medium, besides giving an effect of laborious rounded stippled surfaces, is apt partly to reduce the enamel, thus giving it a dull surface. The coloration of the white is comparatively simple, and is done by transparent enamels finely ground and evenly spread over the white after the latter has been fused. The only danger to be avoided is that of over-firing, which is produced by too great heat or a prolonged duration of firing, which causes the stannic and arsenious acids in the white to volatilize.

Plique a jour enamelling is done in the same way as cloisonne enamelling, except that the wires or strips of metal which enclose the enamel are not soldered to the metal basement, but are soldered to each other. Then these are simply placed upon a sheet of platinum, copper, silver, gold, or hard brass, which, after the enamel is fused and sufficiently annealed and cooled, is easily removed. For small pieces ot plique a jour there is no necessity to apply any metallic basement, as the particles of enamel quickly fuse, become viscous, and when drawn set quite hard. Neither is there any need for annealing, as would be the case in larger work.

Commercially there has lately been an activity in enamels such as ××has never before occurred. This has been the case throughout Europe, Japan, and the United States of America. In London there has been a demand for a cheap form of gaudy coloured enamel, fused into sunk spaces of metal

obtained by stamping with a steel dye ; this has been applied to small objects of cheap jewellery, in the form of brooches, bracelets, and the like. There has also been a great demand for enamel watch-cases and small pendants, done mainly by hand, of a better class of work. Many of these have been produced in Birmingham, Berlin, Paris, and London. In Paris copies of pictures in black and white enamel, with a little gold paint in the draperies and background, have been manu- factured in very large quantities and sometimes of great dimensions. Another curious demand, followed by as astonishing a production, is that of the imitations (a harder name for which is ” forgeries “) of old enamels,

made with much skill, giving all the technical excellence of the originals, even to the cracks and scratches inci- dental to age. These are duly signed, and will deceive the most expert. They are copies of enamels by Nardon and Jean Penicaud, Leonard Limousin, Pierre Reymond, Courtois, and others. The same artificers also produce copies of old Chinese cloisonni and champlevi enamels, as well as old Battersea enamel snuff-boxes, patch-boxes, and indeed every kind of enamelling formerly practised. It is advisable for the collector never to purchase any piece of enamelling as the work of an old master without having a pedigree extending at least over thirty years. Prom Japan there has been a continuous flow of cloisonni enamelled vases, boxes, and plates, either entirely covered with enamel or applied in parts. Compared with this enormous output, only a few small pieces of jewellery have come from Jaipur and other towns in India. There has also been a great quantity of plique d jour enamelling manufactured in Russia, Norway, and Sweden. And, finally, it has been used in an unprecedented manner in large pieces upon iron and copper for purposes of adver- tisement.

Amongst the chief workers in the revival of this art are Claudius Popelin, Alfred Meyer, M. Grandhomme, Fernand Thesmar, Professor von Herkomer, and Mr Alexander Pisher. The work of Claudius Popelin is characterized by good technical skill, correctness, and a careful copying of the work of the old masters. Conse- quently it suffers from a lack of invention and individu- ality. His work was devoted to the rendering of mytho- logical subjects and fanciful portraits of historical people. M. Alfred Meyer and M. Grandhomme are both accom- plished and careful enamellers ; the former is a painter- enameller and the author of a book dealing technically with enamelling. M. Grandhomme paints mythological subjects and portraits in a very tender manner, with con- siderably more artistic feeling than either Meyer or Pope- lin. There is a specimen of his work in the Luxembourg Museum. M. Fernand Thesmar is the great reviver of plique d jour enamelling in France. Specimens of his work are possessed by the Art Museums throughout Europe, and one is to be seen in the Victoria and Albert Museum, London. They are principally valued on

account of their perfect technical achievement. Lucien Falize was an employer of artists and craftsmen, and to him we are indebted for the production of specimens of basse-taille enamel upon silver and gold, as well as for a book review- ing the revival of the art in France, bearing particularly upon the work of Claudius Popelin. Until within the last few years there was a clear division between the art and the crafts in the system of producing art objects. The artist was one person and the workman another. It is now acknowledged that the artist must also be the crafts- man, especially in the higher branches of enamelling. M. Falize initiated the production of a gold cup, which was enamelled in the basse-taille manner. The band of figures was designed by M. Luc Olivier Merson, the painter, and carved by a metal carver and enamelled by an enameller, both able craftsmen employed by M. Falize. Other pieces of enamelling in champlevd and doisonni were also pro- duced under his supervision and on this system ; therefore lacking the one quality which would make them complete as an expression of artistic emotion by the artist's own hands. M. Kene Lalique is among the jewellers who have applied enamelling to their work in a peculiarly techni- cally perfect manner. In England Professor Hubert von Herkomer has produced painted enamels of considerable dimensions, aiming at the execution of pictures in enamel, such as have been generally regarded as peculiar to the province of oil or water-colour painting. Among numerous works is a large shield, into which plaques of enamel were

inserted, as well as several portraits, one of which, made in several pieces, is 6 feet high ††† a portrait of the Emperor William II. of Germany. The present writer rediscovered the making of many enamels, the secrets of which had been jealously guarded. He has worked in all these processes, developing them from the Art side, and help- ing to make enamelling not only a decorative adjunct to metal-work, but raising it to a Fine Art. His work may be seen in the Victoria and Albert Museum, Brussels Museum, and the Chicago Art Galleries. Others who have been enamelling with success in various branches, and who have shown individuality in their work, are Messrs John Eyre, George Frampton, Nelson Dawson, and William Colton.

,See also L. Falize. Claudius Popelin et la Benaissance des Emaux Feints. ††† L. Dalpayrat. Limoges Enamels. ††† H. Oun- TNGHAME. The

Art of Enamelling upou Metals. (a. n.*)

Energetics. ??? The most fundamental result attained by the progress of physical science in the 19th century was the definite enunciation and development of the doctrine of energy. Ever since physical speculation began in the atomic theories of the Greeks, its main problem has been that of unravelling the nature of the underlying correlation which binds together the various natural agencies. But it is only in recent times that scientific investigation has definitely established that there is a quantitative relation of simple equivalence between them, whereby each is expressible in terms of heat or mechanical power ; that there is a certain measurable quantity associated with each type of physical action which is always numerically identical with a cor- responding quantity belonging to the new type into which it is transformed, so that the energy, as it is called, is conserved in unaltered amount. The main obstacle in the way of an earlier recognition and development of this principle had been the doctrine of caloric, which was suggested by the principles and practice of calorimetry, and taught that heat is a substance that can be transferred from one body to another but cannot be created or de- stroyed, though it may become latent. So long as this idea maintained itself, there was no possible compensation for the destruction of mechanical power by friction; it appeared that mechanical effect had there definitely been lost. The idea that heat is itself convertible into power, and is in fact energy of motion of the minute invisible parts of bodies, had been held by Newton and in a vaguer sense by Bacon, and indeed long before their time; but it dropped out of the ordinary creed of science in the follow- ing century. It held a place, like many other anticipa- tions of subsequent discovery, in the system of Natural Philosophy of Young (1804) ; and the discrepancies attending current explanations on the caloric theory were insisted on, about the same time, by Count Rumford and Sir H. Davy. But it was not till the actual experiments of Joule verified the same exact equivalence between heat produced and mechanical energy destroyed, by whatever process that was accomplished, that the idea of caloric had to be definitely abandoned. Some time previously R. Mayer, physician, of Heilbronn, had founded a weighty theoretical argument on the production of mechanical power in the animal system from the food consumed ; he had, moreover, even calculated the value of a unit of heat, in terms of its equivalent in power, from the data afforded by Regnault’s

determinations of the specific heats of air at constant pressure and at constant volume, the former being the greater on Mayer's hypothesis (of which his calcu- lation in fact constituted the verification) solely on account of the power required for the work of expansion of the gas against the surrounding constant pressure. About the

sanfe time Helmholtz, in his early memoir on. the Conser- vation of Energy, constructed a cumulative argument by tracing in a highly original manner the ramifications of the principle throughout the whole range of physical science.

Mechanical and TJiermal Energy. ??? The amount of en- ergy, defined in this sense by convertibility with mechan- ical work, which is contained in a material system, must be a function of its physical state and chemical constitu- tion and of its temperature. The change in this amount, arising from a given transformation in the system, is usually measured by degrading the energy that leaves the system into heat ; for it is always possible to do this, while the conversion of heat back again into other forms of energy is impossible without assistance, taking the form of compensating degradation elsewhere. If we adopt the provisional view which is the basis of abstract physics, that all these other forms of energy are in their essence mechanical, that is, arise from the motion or strain of material or sethereal media, their distinction from heat will lie in the fact that these motions or strains are sim- ply co-ordinated, so that they can be traced and controlled or manipulated in detail, while the thermal energy con- sists in irregular motions of the molecules or smallest por- tions of matter, which we cannot analyze on account of the bluntness of our sensual perceptions, but can only measure as regards their total amount.

Historical : Abstract Dynamics. ??? Even in the ease of a purely mechanical system, capable only of a finite num- ber of definite types of disturbance, the principle of the conservation of energy is very far from giving a complete account of its motions ; it is only one among the equations that are required to determine their course. In its appli- cation to

the kinetics of invariable systems, the principle was first emphasized as fundamental by Leibnitz, was then improved and generalized by the Bernoullis and by Euler, and was ultimately expressed in its widest form by Lagrange. It is recorded by Helmholtz that it was largely his acquaintance in early years with the works of those mathematical physicists of the previous century, who had formulated and generalized the principle as a help towards the theoretical dynamics of complex sys- tems of masses, that started him on the track of ex- tending the principle throughout the whole range of natural phenomena. On the other hand, the ascertained validity of this extension to new types of phenomena, such as those of electrodynamics, now forms a main foundation of our belief in a mechanical basis for these sciences.

In the hands of Lagrange the mathematical expression for the manner in which the energy is connected with the geometrical constitution of the material system became a sufficient basis for a complete knowledge of its dynamical phenomena. So far as statics was concerned, this doc- trine took its rise as far back as Galileo, who recognized in the simpler cases that the work expended m the steady driving of a frictionless mechanical system, is equal to its output. The expression of this fact was generalized in a brief statement by Newton m the Primipia, and more in detail by the Bernoullis, until, m the analytical guise of the so-called principle of ” virtual velocities” or virtual work, it finally became the basis of Lagrange’s general formulation of dynamics. In its application to kinetics a purely physical principle, also indicated by Newton but developed long after with mas- terly applications by d’Alembert, that the reactions of the infinitesimal parts of the system against the accelera- tions of their motions statically equilibrate the forces applied to the system as a whole, was required m order to form a sufficient basis, and one which Lagrange soon afterwards condensed into the single relation of Least

Action. As a matter of history, however, the complete formulation of the subject of abstract dynamics actually arose (in 1758) from Lagrange’s precise demonstration of the principle of Least Action for a particle, and its im- mediate extension, on the basis of his new Calculus of Variations, to a system of connected particles such as might be taken as a representation of any material system ; but here too the same physical as distinct from

mechani- cal considerations come into play as in d'Alembert's principle. (See Dynamics, Analytical.)

It is in the cases of systems whose state is changing so slowly that kinetic reactions can be neglected, that the conditions are by far the simplest. In such systems, whether stationary or in a state of steady motion, the energy depends on the configuration alone, and its mathe- matical expression can be determined from measurement of the work required for a sufficient number of simple transformations ; once it is thus found, all the statical relations of the system are implicitly determined along with it, and the results of all other transformations can be predicted. Thus the complete specification of a mechan- ical system as regards statical change is involved in its geometrical configuration and the function expressing its mechanical energy in terms thereof. Systems which have statical energy-functions of the same analytical form behave in corresponding ways, and can serve as models or representations of one another.

Extension to Tliermal and Chemical Systems. ??? This dominant position of the principle of energy, in ordinary statical problems, has in modern times been extended to transformations involving change of physical state or chemical constitution as well as change of geometrical configuration. In this wider field we cannot assert that mechanical (or available) energy is never lost, for it may be degraded into thermal energy; but we can use the principle that on the other hand it can never spontane- ously increase. If this were not so, cyclic processes might theoretically be arranged which would continue to supply mechanical power so long as energy of any kind remained in the system ; whereas the irregular and uncontrollable character of the molecular motions and strains which constitute thermal energy, in combination with the vast number of the molecules, places an effectual bar on their unlimited co-ordination. In order, therefore, to establish a doctrine of energetics that shall form a sufficient foun- dation for a theory of the trend of chemical and physical change, we have to impart precision to this notion of available energy.

Carnot's Principle : Entropy. ??? The whole subject is in- volved in the new principle contributed to theoretical physics by Sadi Carnot in 1824, in which the far-reaching modern conception of cyclic processes was first

scientific- ally developed. It was shown by Carnot, on the basis of certain axioms, whose theoretical foundations were sub- sequently corrected and strengthened by Clausius and Lord Kelvin, that a reversible mechanical process, working in a cycle and involving thermal changes, which takes heat, say H], into the material system at a given temperature Ti, and delivers the part of it not utilized, say Hj, at a lower given temperature T,, is more efficient, considered as a working engine, than any other such process, operat- ing between the same two temperatures but not reversible, could be. This relation of inequality involves a definite law of equality, that the efficiencies of all reversible cyclic processes are the same, whatever be the nature of their action or the’ material substances involved in them ; that in fact the efficiency is a function solely of the tempera- tures at which the cyclically working system takes in and gives out heat. These considerations constitute a funda- mental general principle to which all possible slow re- versible processes, so far as they concern matter in bulk.

must conform in all their stages ; its application is almost coextensive with the scope of general physics, special kinetic theories excepted. (See Thermodynamics.) If the system is an ideal gas-engine, in which a perfect gas (known from experience to be a possible state of matter) is passed through the cycle, and if temperature is measured from the absolute zero by the expansion of this gas, then simple direct calculation on the basis of the laws of ideal gases shows that Hi/Ti = H2/T2; and as by the conservation of energy the work done is Hj ××× Hj, it follows that the efficiency is 1 ××× Tj/Ti. If we change the sign of Hj, and thus consider heat as positive when it is taken in by the system, the equation becomes Hj/Ti + H2/T2 = 0 ; and as any complex reversible working system may be considered as compounded in various ways of elementary systems of this type, wliose effects are additive, the general proposition follows, that in any reversible complete cyclic change which involves the taking in of heat by the system of amount SH^ when its temperature is between T, and T, + 8T, the equation 28H,/T,= 0 holds good. Moreover,if thechangesarenot reversible, the proportion of the heat supply that is utilized for mechanical

work will be smaller, so that SSH^T, or, as it may be expressed, /dH/T , must have a smaller value, and must thus be negative. The first statement involves further, that for all reversible paths of change of the system from one state C to another state D, the value of /dH/T must be the same, because any one of these paths and any other one reversed would form a cycle ; whereas for any irreversible path of change between the same states this integral must be less. The quantity represented by this integral was introduced by Clausius, and was named by him the increase of the entropy of the system in passing from the state C to the state D. This increase, being thus the same for the unlimited number of possible reversible paths involving independent variation of all its finite co-ordinates, along which the system can pass, can depend only on the terminal states. The entropy belong- ing to a given state is therefore a function of that state alone, irrespective of the manner in which it has been reached; and this is the justification of the assignment to it of a special name, connoting a property of the system depending on its actual condition and not on its previous history. Every reversible change in an isolated system thus maintains the entropy of that system unaltered; no possible spontaneous change can involve decrease of the entropy; while any defect of reversibility, arising from diffusion of matter or motion in the system, necessarily produces an increase of entropy. For a physical or chemical system with given total energy, only those changes are spontaneously possible which would increase the entropy; if the entropy is already a maximum, and so incapable of further continuous increase, there must be stable equilibrium.

This definite quantity belonging to a material system, its entropy <^, is thus concomitant with its energy E, which is also a definite function of its actual state by the law of conservation of energy, its temperature T, and the various co-ordinates expressing its geometrical con- figuration and its physical and chemical constitution; these are the quantities with which the thermodynamics of the system deals. That science develops the consequences involved in just two principles, (i) that the energy of every isolated system is constant, and (ii) that its entropy can never diminish; any complication that may be involved arises from complexity in the systems to which these two laws have to be applied.

The General Thermodynamic Equation. ••• When the physical or chemical system undergoes an infinitesimal change of state, we have 8E = 8H + 8U, where 8H is the heat that has been acquired from sources extraneous to

the system during the change, and 8U may be called -the change in the internal energy of the system. It is, however, not possible to distinguish between heat acquired and internal energy, for neither 8H nor 8U is the exact differential of a function of the constitution of the system and independent of its previous history, although their sum is such; but SH is equal to T8<^ where 8(^ is such, as has just been seen. Thus E and ^ are properties of the system which, along with temperature, pressure, and other independent data specifying its constitution, must form the variables of an analytical argument. We have therefore to substitute T8^ for 8H; also we have

8XJ = •••pSv + 8 W ł ;ui8mi + ix^^m^ -\ h jti•••8m•••,

when the system consists of an intimate mixture (solution) of masses m^, m^, •••••••••••••• m••• of given constituents, which differ physically or chemically but may be partially transformable into each other by chemical or physical action during the changes under consideration, the whole being of volume v and under extraneous pressure p, while W is potential energy arising from physical forces such as those of gravity, capillarity, &c. The

variables m^, m^, to••• may not be all independent;

for example, if the system were chloride of ammonium gas existing along with its gaseous products of dissociation, hydrochloric acid and ammonia, only one of the three masses would be independently variable. The sufficient number of these variables together with two other variables, which may be v and T, or v and ^, specifies and determines the state of the system, considered as matter in bulk, at each instant. It is usual to include 8W in

/UiSmiH ; in aU cases where this is possible the single

equation

8E = T8<^ ⬛⬛⬛phv + fjLiSm^ + /X28?ji2 ~~\ 1~~ fi⬛⬛⬛8m⬛⬛⬛ (1)

thus expresses the complete variation of the energy- function E arising from change of state; and when the part involving the n constitutive differentials has been expressed in terms of the number of them that are really independent, this equation by itself is the unique expres- sion of all the thermodynamic relations of the system. These are in fact the various relations ensuring that the right-hand side is an exact differential, and are of type dfj.[/d = dT/dm]

The condition that the state of the system be one of stable equilibrium is that 8<^, the variation of entropy, be negative for all formally possible infinitesimal transforma- tions which make 8E vanish; for as S cannot actually be negative for any spontaneous variation, none of these transformations can then occur. From the form of the equation, this condition is the same as that 8E ⬛⬛⬛ T8(^ must be positive for all possible variations of state of the system without restriction.

We can change one of the independent variables express- ing the state of the system from (^ to T by subtracting 8(<^T) from both sides of the equation of variation : then

8(E-T<#.)= -ST-pSv+ix,8mi-\ l-/x⬛⬛⬛8m⬛⬛⬛.

It follows that for isothermal changes, i.e., those for which 8T is null, the condition of stable equilibrium is that the function E ⬛⬛⬛ T(^ shall be a minimum. If the system is subject to an external pressure p, which as well as the temperature is imposed constant from without and thus incapable of variation through internal changes, the con- dition of stable equilibrium is similarly that E⬛⬛⬛ Tc/i-t-p-y shall be a minimum.

A chemical system maintained at constant temperature may thus have several states of stable equilibrium corresponding to different minima of the function here considered, just as there may be several minima of elevation on a landscape, one at the bottom of each depression ; in fact, this analogy, when extended to space

of n dimensions, exactly fits the case. If the system is sufficiently disturbed, for example, by electric shock, it may pass over from a higher to a lower minimum, but never (without compensation from outside) in the oppo- site direction. The former passage is often effected by introducing a new substance into the system ; sometimes that substance is recovered unaltered at the end of the process, and then its action is said to be purely catalytic ; its presence modifies the form of the function E<^ so as to obliterate the ridge between the two equilibrium states in the geometrical representation. There are sys- tems in which the equilibrium states are but very slightly dependent on temperature and pressure within wide limits, outside which reaction takes place. Thus while there are cases in which a state of mobile dissocia- tion exists in the system which changes continuously as a function of these variables, there are others in which change does not sensibly occur at all until a certain temperature of reaction is attained, after which it pro- ceeds very rapidly owing to the heat developed, and the system again becomes sensibly permanent in a trans- formed phase by completion of the reaction. In some cases of this latter type the cause of the delay in starting lies probably in passive resistance to change, of the nature of viscosity or hysteresis ; but in many such reac- tions there seems to be no exact equilibrium at any temperature, short of the ultimate state of dissipated energy in which the reaction is completed, although the velocity of reaction is found to diminish exponentially with change of temperature, and thus becomes insignifi- cant at a small interval from the temperature of pro- nounced activity.

Free Energy. The quantity E T<^ thus plays the same fundamental part in the thermal statics of general chemical systems at uniform temperature that the potential energy plays in the statics of mechanical systems of unchanging constitution. It is a function of the geometrical co-ordinates, the physical and chemical con- stitution, and the temperature of the system, which determines the conditions of stable equilibrium at each temperature ; it is, in fact, the potential energy generalized so as to include temperature, and thus be a single function

available at each temperature and connecting the proper- ties of the system at different temperatures. It has been called the free energy of the system by Helmholtz, for it is the part of the energy whose variation is con- nected with changes in the bodily structure of the sys- tem represented by the variables mi, mj, ††† ††† ††† ††† m†††, and not with the irregular molecular energy represented by heat, so that it can take part freely in physical transformations. Yet this holds good only subject to the condition that the temperature is not varied; it has been seen above that for the more general variation neither 8H nor 8U is an exact differential, and no line of separation can be drawn between thermal and mechanical energies.

Available Energy. ††† The same quantity <^ arose iri the early development of the subject, in the train of ideas of Rankine and Kelvin, in the expression of the avail- able energy A of the material system. Suppose there were accessible an auxiliary system containing an un- limited quantity of heat at absolute temperature T†††, forming a condenser into which heat can be discharged from the working system, or from which it may be recovered at that temperature : we proceed to find how much of the heat of our system is available for trans- formation into mechanical work in a process which reduces the whole system to the temperature of this condenser. Provided the process of reduction is per- formed reversibly, it is immaterial, by Carnot's principle, in what manner it is effected : thus in following it out in detail we can consider each elementary quantity of heat

SH removed from the system as set aside a,t its actual temperature between T and T-f-8T for the production of mechanical work 8W, and the residue of it SH††† as di- rectly discharged into the condenser at T††† ; the principle of Carnot gives 8H/T=8HyT†††, so that the portion of the heat 8H that is not available for work is SH†††, equal to T†††SH/T. In the whole process the part not available in connexion with the condenser at T††† is therefore T†††/dH/T. This quantity must be the same whatever reversible process is employed: thus, for example, we may first transform the system reversibly from the state C to the state D, and then from the state D to the final state of uniform temperature T†††. It follows that the value of T†††/dH/T, representing the heat degraded, is the same along all reversible paths of transformation from the state C to the state D ; so that the function /dH/T is the excess of a definite quantitative

property 4> of the sys- tem in the former state as compared with the latter. It is usual to change the law of sign of 8H so that gain of heat by the system is reckoned positive ; then, relative to a condenser of unlimited capacity at T►►►, the state C contains more mechanically available energy than the state D by the amount E,►►► E►►►-|-T►►►/dH/T, that is, by E,,►►► E►►►►►► T►►►((^c►►► <^d)- In this way the exist- ence of an entropy function with a definite value for each state of the system is again seen to be the direct analytical equivalent of Carnot's axiom that no process can be more efficient than a reversible process between the same initial and final states. The name motivity was proposed by Lord Kelvin in 1879 for this conception of available energy. It is here relative to a condenser of unlimited capacity at an assigned temperature T►►► : the latter specification is necessary to the definition ; in fact, if T►►► were the absolute zero all the energy would be mechanically available.

But we can obtain an intrinsically different and more definite comparison of the available energies in a system in two different states at different temperatures, by ascer- taining how much energy is dissipated in each in a reduc- tion to the same standard state of the system at a standard temperature T►►►. We have only to reverse the operation, and change back this standard state to each of the others in turn. This will involve abstractions of heat 8II►►► from the separate portions in the standard state, and returns of 8H to the state at T ; if this return were 8H►►►-T/T►►► there would be no loss of availability in the direct process : hence there is actual dissipation 8H►►► 8H►►►-T/T►►► that is T(8<^►►► 8c^►►►). On passing from state 1 to state 2 through state 0 the difference of these dissipations will represent the energy of the system that has become unavailable. Thus in this sense E►►► T<^+T<^►►►-|-const. represents for each state the. amount of energy that is available; but instead of implying an unlimited source of heat at the standard temperature T►►►, it implies that there is no such source. The available energy thus defined differs from E►►► T(^, the free energy of Helmholtz, which involves no reference to any standard state, by a simple linear func- tion of the temperature alone which is immaterial as regards its applications.

The determination of the available mechanical energy arising from differences of temperature between the parts of a system is a more complex

problem, because it involves a determination of the common temperature to which re- versible processes will ultimately reduce them ; for the simple ease in which no changes of state occur the solution was given by Lord Kelvin in 1853, in connexion with the above train of ideas (cf. Tait's Thermodynamics, ►► 179). In the present exposition the chemical system is in equilibrium, so that its temperature T is always uniform throughout ; isolated portions at different temperatures would be treated as different systems.

Thermodynamic Potentials. ►►► We have now to develop the relations involved in the general equation (1) of thermodynamics. Suppose the system includes two co- existent states or phases, with opportunity for free inter- change of constituents ►►► for example, a salt solution and the aqueous vapour in equilibrium above ►►► it may be included in the material system. Then in equilibrium a slight transfer hn of the water-substance of mass m, existing in the vapour, into the water-substance of mass m, existing in the solution, should not produce any alter- ation, of the first order in 8E►►► T8

When a slight constitutive change occurs in a galvanic element at given temperature, producing available energy of electric current in a reversible manner and isothermally at the expense of chemical energy, it is the free energy of the system E►►► T<^, not its total intrinsic energy, whose value must be conserved during the process. Thus the electromotive force is equal to the change of this free energy per electro-chemical equivalent of reaction in the cell. This proposition, developed by Gibbs and later by Helmholtz, modifies the earlier one of Kelvin ►►► which tacitly assumed all the energy of reaction to be availar ble ►►► except in the cases in which the magnitude of the electromotive force does not depend sensibly on the temperature.

The effects produced on electromotive forces by differ- ence of concentrations in dilute solutions can thus be accounted for and traced out,

from the knowledge of the form of the free energy for such cases ; as also the effects of pressure in the case of gas “batteries. The free energy does not sensibly depend on whether the substance is solid or fused, though the total energy differs in these two cases by the heat of fusion; for this reason, as Gibbs has pointed out, voltaic potential differences are the same for the fused as for the solid state.

Relations involving Constitution only. ††† The potential of a component in a given solution can depend only on the temperature and pressure of the solution, and the densi- ties of the various components, including itself; as no distance-actions are usually involved in chemical physics, it will not depend on the aggregate masses present. The example above mentioned, of two coexistent phases liquid and vapour, indicates that there may be relations be- tween the constitutions of the phases present in a chemical system which do not involve their total masses. These are developed in a very direct manner in Willard Gibbs’s original procedure. In so far as attractions at a distance (a uniform force such as gravity being excepted) and capillary actions at the interfaces between the phases

are inoperative, the fundamental equation (1) can be inte- grated. Increasing the volume k times, and all the masses to the same extent ††† in fact, placing alongside each other k identical systems at the same temperature and pressure ††† will increase ,(^ and E in the same ratio k ; thus E must be a homogeneous function of the first degree of the independent variables <^, v, m,, ..., m", and therefore by Euler's theorem relating to such func- tions

‘E=T†††*pv+ |X^my^ l-Mnmn-*

This integral equation merely expresses the additive char- acter of the energies and entropies of adjacent portions of the system at uniform temperature, and thus depends only on the absence of sensible physical action directly across finite distances. If we form from it the expres- sion for the complete differential 8E, and subtract (1), there remains the relation

0=^ST-‘u8p-|-††?ii8/xiH |-m†††8/††,†††- ††† ††† ††† (2)

This implies that in each phase the change of pressure depends on and is determined by the changes in T, fi.^, ^ ; as we know beforehand that a physical property like pressure is an analytical function of the state of the sys tem, it is therefore a function of these m + 1 quantities. When they are all independently variable, the densities of the various constituents and of the entropy in the phase are expressed by the partial fluxions of p with respect to them : thus

^ _ dp V_ f^P

*V dT' V d//.^*

When, as in the case above referred to of chloride of ammonium gas existing partially dissociated along with its constituents, the masses are not independent, neces- sary linear relations, furnished by the laws of definite combining proportions, subsist between the partial fluxions, and the form of the function which expresses p is thus restricted in a manner which is easily expressible in each special case.

This proposition, that the pressure in any phase is a function of the temperature and of the potentials of the independent constituents, is a consequence of Carnot's axiom combined with the energy principle and the ab- sence of effective actions at a distance. It shows that at a given temperature and pressure the potentials are not all independent, that there is a necessary relation con- necting them, an equation of state or constitution of the phase, whose existence forms one mode of expression of Carnot's principle, and from which all the properties of the phase can be derived by simple differentiation.

The Phase Ride. When the material system contains only a single phase, the number of independent variations that can spontaneously occur in its constitution is thus one less than the number of its independent components ; in addition, the temperature and pressure can change. But where several phases coexist in the same system, the num- ber of possible independent variations may be much sra aller.

The present independent variables /nj, , ;u. are specially

appropriate in this problem, because each of them has the same value in all the phases. Now each phase has its own characteristic equation, giving a relation between 8p, 8T, and 8/u.i, ††† ††† ††† ††† S/ii†††, or such of the latter as are independent ; if r phases coexist, there are r such relations ; hence the number of possible independent variations, including those of V and T, is reduced to m††† r-|-2, where m is the number of independently variable chemical constituents the system contains. This number of degrees of constitutive freedom cannot be negative; therefore the number of possible phases that can coexist alongside each other cannot exceed m+2. If m-t-2 phases actually coexist, there is no variable quan- tity in the system, thus the temperature and pressure and constitutions of the phases are all determined ; such is the

triple point at which ice, water, and vapour exist in presence of each other. If there are m + 1 coexistent phases, the system can vary in one respect only ; for example, at any temperature of water-substance different from the triple point two phases only, say liquid and vapour, coexist, and the pressure is definite, as also are the densities and potentials of the components. Finally, when but one phase, say water, is present, both pressure and temperature can vary independently. The first example illustrates the case of systems, physical or chemical, in which there is only one possible state of equilibrium, forming a point of transition between different con- stitutions ; in the second type each temperature has its own completely determined state of equilibrium ; in other cases the constitution in the equilibrium state is inde- terminate as regards the corresponding number of degrees of freedom. By aid of this phase rule of Gibbs the number of different chemical substances existing in a given complex system can be determined from observation of the degree of spontaneous variation which it exhibits ; the rule thus lies at the foundation of the modern subject of chemical equilibrium and continuous chemical change in mixtures or alloys, and in this connexion it has been widely applied and developed in the experimental in- vestigations of Roozeboom and van 't Hoff and other physical chemists, mainly of the Dutch school.

Gases in whicli the Tlieory can be practically developed. ??? It is only in systems in which the number of inde- pendent variables is small that the forms of the various potentials, ??? or the form of the fundamental characteristic equation expressing the energy of the system in terms of its entropy and constitution, or the pressure in terms of the temperature and the potentials, ??? which includes them all, can be readily approximated to by experimental de- terminations. Even in the case of the simple system water-vapour, which is fundamental for the theory of the steam engine, this has not yet been completely accom- plished. The general theory is thus largely confined, as above, to defining the restrictions on the degree of variability of a complex chemical system which the prin- ciple of Carnot imposes. The tracing out of these general relations of continuity is much facilitated by geometrical ???diagrams, such as James Thomson first introduced in order to exhibit and explain Andrews's results as to the range of coexistent phases in carbonic acid. Gibbs's earliest thermodynamic surface had for its co-ordinates volume, entropy, and energy ; it was constructed to scale by Maxwell for water-substance, and is fully explained in later editions of the Tlieory of Heat (1875) ; it forms a relief map which, by simple inspection, reveals the course of the transformations of water, with the corresponding mechanical and thermal changes, in its three coexistent states of solid, liquid, and gas. In the general case, when the substance has more than one independently variable constituent, there are more than three variables to be represented ; but Gibbs has shown the utility of surfaces representing, for instance, the entropy in terms of the constitutive variables when temperature and pressure are maintained constant. Such graphical methods are now of fundamental utility in connexion with the phase rule, for the experimental exploration of the trend of the changes of constitution of complex mixtures with interacting com- ponents, as the physical conditions are altered. The study of the phenomena of condensation in a mixture of two gases or vapours, initiated by Andrews and developed in this manner by van der Waals and his pupils, forms a case in point. (See Gases, Condensation of.)

There are, however, two simple limiting cases, in which the theory can be completed by a determination of the functions involved in it, which throw much light on the phenomena of actual systems not far removed from

these ideal limits. They are the cases of mixtures of perfect gases, and of very dilute solutions.

If, following Gibbs, we apply his equation (2), expressing the pressure in terms of the temperature and the potentials, to a very dilute solution of substances m^, mj, ❓❓❓ ❓❓❓ ❓❓❓ ❓❓❓ m❓❓❓ in a substance wii, and vary the co-ordinate m,. alone, p and T remaining unvaried, we have in the equilibrium state

dm, dm.

dm.

in which every m except m, is very small, while dixi/dm, is presumably finite. This requires (when applied, for example, to the case where only two components are present) that the total potential of each component m❓❓❓ which is _m4fi,/dm,, shall be finite, say A;, in the limit when m, is null. Thus for very small concentrations the potential /❓❓,, of a dilute component must be of the form k, log m,/v, being proportional to the logarithm of the density of that component ; it thus tends to an infinite value at evanescent concentrations, showing that removal of the last traces of any impurity would demand infinite expendi- ture of available energy.

The value of this logarithmic expression can be readily determined for the case of a perfect gas from its known properties, and can be thence extended to other dilute forms of matter. We have pv=Ti/m ❓❓❓ T for unit mass of the gas, where m is the molecular weight being 2 for hydrogen, and R is a constant equal to 8-2 x 10^ in C.G.S. dynamical units, the same for all gases because they have all the same number of molecules per unit volume. The increment of heat received by the unit mass of the gas is 8H =2o8v + k8T, where k is the specific heat at constant volume, which can be a function only of the temperature. Thus ^=/dH/T=R/m. log ❓❓❓;; ~~H/xT~~'dT;

and the available energy A per unit mass is E❓❓❓ T0 T(f> ❓❓❓ where E = ❓❓/Kd!T, e being intrinsic energy of chemical constitution, so that

A=e .^❓❓❓T/KdT-T/KT-'dT-R/m. T log v.

If there are v molecules in the unit mass, and IST per unit volume, we have mv = ‘Nmv, each being 2v’ where v is the number of molecules per unit mass in hydrogen ; thus the free energy per molecule is a’-f-R’Tlog&N, where 6=m/2v’, R’=R/2i/’, and a’ is a function of T alone. In thermal energy units (calories) the gas-constant R is very approximately equal to 2. It is customary to avoid introducing the unknown molecular constant v by express- ing the available energy per ” gramme-molecule,” that is, for a number of grammes equal to the molecular weight of the substance ; this is a constant multiple of the avail- able energy per molecule, and is a+RTlogp, p being the density, equal to b’S where 6=m/2v’. This formula may now be extended by simple summation to a mixture of gases, on the ground of Dalton’s experimental principle that each of the components behaves in presence of the others as it would do in a vacuum. The components are actually separable wholly or partially in reversible ways which may be combined into cycles ; for example, either (i) by diffusion through a porous partition, taking account of the work of the pressures, or (ii) by utilizing the modified constitution towards the top of a long column of the mixture arising from the action of gravity, or (iii) by reversible absorption of a single component. If we employ in place of available energy the form of charac- teristic equation which gives the pressure in terms of the temperature and potentials, the pressure of the mixture is expressed as the sum of those belonging to its com- ponents ; this equation was made by Gibbs the basis of his analytical theory of gas mixtures, which he tested by its application to the only data then available, those of the mobile dissociation of nitric oxide vapour.

S. IV. ❖❖❖ 22

E N E EG E T I C S

Van ‘t Hoff’s Osmotic Principle : Theoretical Explancu- Hon. ❖❖❖ We proceed to examine how far the same formulie as hold for gases apply to the available energy of matter in solution which is so dilute that each molecule of the dissolved substance, though possibly the centre of a com- plex of molecules of the solvent, is nearly all the time beyond the sphere of direct influence of the other molecules of the dissolved substance. The available energy is a function only of the co-ordinates of the matter in bulk

and the temperature ; its change on further dilution, with which alone we are concerned in the transformations of dilute solutions, can depend only on the further separation of these molecular complexes that is thereby produced, as no one of them is in itself altered. The change is therefore a function only of the number N of the dissolved molecules per unit volume, and of the temperature, and is, per molecule, entirely independent of their constitution and of that of the medium in which they are dissolved. This suggests that the expression for the change is the same as the known one for a gas in which the same molecules would exist free and in the main outside each others' spheres of influence ; which confirms and is verified by the experimental principle of van 't Hoff, that osmotic pressure obeys the laws of gaseous pressure with the same physical constants as those of gases. It can be held, in fact, that this suggestion does not fall short of a demonstration, on the basis of Carnot's principle, and independent of special molecular theory, that in all cases where the molecules of a component, whether it be of a gas or of a solution, are outside each others' spheres of influence, the available energy, so far as regards dilution, must have a common form, and the physical constants must therefore be the known gas-constants.

The single new element that thermodynamics introduces into the ordinary dynamical specification of a material system is temperature. This conception is akin to that of potential, except that it is given to us directly by our sense of heat. But if that were not so, we could still demonstrate, on the basis of Carnot's principle, that there is a definite function of the state of a body which must be the same for all of a series of connected bodies, when thermal equilibrium has become established so that there is no tendency for heat to flow from one to another. For we can by geometrical displacement change the order of the bodies so as to bring different ones into direct contact. If this disturbed the thermal equilibrium, we could con- struct cyclic processes to take advantage of the resulting flow of heat to do mechanical work, and such processes might be carried on without limit. This argument can be applied, by aid of adiabatic partitions, even when the bodies are in a field of force so that mechanical work is required to change their order ; it has, in fact, been employed by Maxwell to extend from the case of a gas to that of any other system the proposition that the temperature is the same all along a vertical column in equilibrium under

gravity. It had been shown from the kinetic theory by Maxwell that in a gas-column the mean kinetic energy of the molecules is the same at all heights. If the only test of equality of temperature consisted in bringing the bodies into contact, this would be rather a proof that thermal temperature is of the same physical nature in all parts of the field of force ; but temperature can also be equalized across a distance by radiation, so that this law for gases is itself already necessitated by Carnot's general principle, and is merely confirmed by the special gas-theory.

Chemical Equilibrium based on Available Energy. ??? The complete theory of chemical and physical equilibrium in gaseous mixtures and in very dilute solutions may readily be developed in terms of available energy (cf. Phil. Trans., 1897, A, pp. 266-280), which forms perhaps the most

vivid and most direct procedure. The available energy per molecule of any kind, in a mixture of perfect gases in which there are N molecules of that kind per unit volume, has been found to be a'-|-E.'Tlog&]Sr. This expression represents the marginal increase of available energy due to the introduction of one more molecule of that kind into the system as actually constituted. The same formula also applies, by what has already been stated, to sub- stances in dilute solution in any given solvent. In any isolated system in a mobile state of reaction or of internal dissociation, the condition of chemical eqiiilibrium is that the available energy at constant temperature is a minimum, so that it is stationary and slight change arising from fresh reaction would not sensibly alter it. Suppose that this reaction, per molecule, is equivalent to introducing n, molecules of type Nj, n^ of type Nj, &c., into the system, jii, Wj, ... being the numbers of molecules of the different types that take part in the reaction, as shown by its chem- ical equation, reckoned positive when they appear, negative when they disappear. Then in the state of equilibrium

Mi(a'i+Il'T log 6i]Sri)-i-n2(a'2+R'T log h^^)-]-

must vanish. Therefore Ni"i 'S^^ . . . must be equal to K, a function of the temperature alone. This law, originally based by Guldberg and Waage on direct molecular statistics, expresses for each temperature the relation connecting the densities of the interacting substances, in dilution

comparable as regards density with the perfect gaseous state, when the reaction has come to the state of mobile equilibrium.

All properties of any system, including the heat of re- action, are expressible in terms of its available energy A, equal to E□□□ T<^-|-<^□□□T. Thus as the constitution of the system changes with the temperature, we have dA^dE_ d^_. dT dT cZT ^^ □□-‘ where dE=dH+dW, dH=Td<, dH being heat and dW mechanical and chemical energy imparted to the system ;

hence <^-%^, so that A=E-hTd^^□□□ ^,

This general formula,

dT -W=□□□ T^□□□ /’□□□

n-

leadingtoE- ., – □□□, □□□

& dTV T

applied differentially, expresses the heat SE□□□ 8W absorbed

by a reaction in terms of 8A, the change produced by it

in the available energy of the system, and of SW, the

mechanical and electrical work done on the system during

its progress.

In the problem of reaction in gaseous systems or in

very dilute solution, the change of available energy per

molecule of reaction has already been found to be

8A=SA□□□-|-R’T log K’, where K’ = V&2”= □□□ □□□ □□□ □□□ K;

thus, when the reaction is spontaneous without external

work, the heat absorbed per molecule of reaction is

*d 8A***

d

T²^^, or E'T^-^log K. This formula has been di T dT

utilized by van 't Hoff to determine, in terms of the heat of reaction, the displacement of equilibrium in various systems arising from change of temperature, K being the reaction-parameter through which alone the temperature enters into the law of chemical equilibrium.

*Interfacial Phenomena : Liquid Films. *** The character- istic equation hitherto developed refers to the state of an element of mass in the interior of a homogeneous sub- stance : it does not apply to matter in the neighbourhood of an interface between two adjacent phases. A remark- able analysis has been developed by Gibbs in which the present methods concerning matter in bulk are extended to the phenomena at an interface, without the introduction of any molecular theory ; it forms the thermodynamic completion of Gauss's purely mechanical theory of capil-*

larity, based on the principle of energy. The validity of the fundamental doctrine of available energy, so far as regards all mechanical actions in bulk such as surface tensions, is postulated, even when applied to interfacial layers so thin as to be beyond our means of measure- ment; the argument from perpetual motions being available here also as soon as we have experimentally ascertained that the said tensions are definite physical properties of the state of the interface and not merely accidental. The procedure will then consist in assuming a definite excess of energy, of entropy, and of the masses of the various components, each per unit surface, at the interface, the potential of each component being, in

equilibrium, the same as it is in the adjacent masses. The interfacial transition layer thus provides in a sense a new phase coexistent with those on each side of it and having its own characteristic equation. It is only the extent of the interface and not its curvatures that practically enters into this relation, because any slight influence of the latter can be eliminated from the equa- tion by slightly displacing the position of the surface which is taken to represent the interface geometrically. By an argument similar to one given above it is shown that one of the forms of the characteristic equation is a relation expressing the surface tension as a function of the temperature and the potentials of the various compo- nents present on the two sides of the interface, from the differentiation of which the surface densities of the super- ficial distributions of these components (as above defined) can be obtained. The conditions that a given new phase may become developed when two other given ones are brought into contact, i.e., that a chemical reaction may start at the interface, are thence formally expressed in terms of the surface tensions of the three transition layers and the pressures in the three phases. In the case of a thin soap-film, sudden extension of any part reduces the interfacial density of each component at each surface of the film, and so alters the surface tension, which requires time to recover by the very slow diffusion of dissolved material from other parts of the film ; the system being stable, this change must be an increase of tension, and constitutes a species of elasticity in the film. Thus in a vertical film the surface tension must be greater in the higher parts, as they have to sustain the weight of the lower parts ; the upper parts, in fact, stretch until the superficial densities of the components there situated are reduced to the amounts that correspond to the tension required for this purpose. Such a film could not there- fore consist of pure water. But there is a limit to these processes : if the film becomes so thin that there is no water in bulk between its surfaces, the tensions cannot adjust themselves in this slow way by migration of com- ponents from one part of the film to another ; if the film can survive at all after it has become of molecular thick- ness, it must be as a definite molecular structure all across its thickness. Of such type are the black spots that break out in soap-films, as has been suggested by Gibbs and proved by the measures of Eeinold and Eiicker : the spots increase in size because their tension is less than that of the surrounding film, but their indefinite increase is presumably stopped in practice by some clogging or viscous agency at their boundary.

Transition to Molecular Theory. ??? The subject of ener- getics, based on the doctrine of available energy, deals with matter in bulk and is not concerned with its molecular constitution. This analysis of the phenomena of surface tension shows how far the principle of negar tion of perpetual motions can carry us into regions which at first sight might be classed as molecular. But, as in other cases, it is limited to pointing out the general scheme of relations within which the phenomena

can have their play. There is now a considerable body of knowledge correlating surface tension with chemical constitution, especially to a certain extent with the numerical density of the distribution of molecules; this takes us into the sphere of molecular science, and at present we have only somewhat vague indications largely derived from experiment, if we except the mere notion of interatomic forces of unknown character on which the older theories of capillarity, those of Laplace and Pois- son, were constructed.

In other topics the same restrictions on the scope of the simple statical theory of energy appear. From the ascertained behaviour in certain respects of gaseous media we are able to construct their characteristic equation, and correlate their remaining relations by means of its conse- quences. Part of the experimental knowledge required for this purpose are the values of the gas-constants, which prove to be the same for all nearly perfect gases. The doctrine of energetics can give no clue as to why this should be so ; it can only construct a scheme for each simple or complex medium on the basis of its own experimentally determined characteristic equation. The explanation of uniformities in the intrinsic constitutions of various media belongs to molecular theory, which is a distinct and in the main more complex and more speculative department of knowledge. When we proceed further and find, with van 't Hoff, that these same universal gas-constants reappear in the relations of very dilute solutions, our demand for an explanation such as can only be provided by molecular theory (as supra) is intensely stimulated. But except in these respects the doctrine of energetics gives a complete synthesis of the course and relations of the chemical reactions of matter in bulk, from which we can eliminate atomism altogether by restating the merely numerical atomic theory of Dalton as a principle of equivalent combining proportions. Of recent years there has been a

considerable school of chem- ists who insist on this procedure as a purification of their science from the hypothetical ideas as to atoms and mole- cules in terms of which its experimental facts have come to be expressed. A complete system of doctrine can be developed in this manner, but its scope will be limited. It makes use of one principle of correlation, the doctrine of available energy, and discards another such principle, the atomic theory. Nor can it be said that the one principle is really more certain and definite than the other. This may be illustrated by what has sometimes in Germany been called Gibbs's paradox : the energy that is available for mechanical effect in the inter-diffusion of given volumes of two gases depends only on these volumes and their pressures, and is independent of what the gases are ; if the gases differed only infinitesimally in constitution it would still be the same, and the question arises where we are to stop, for we cannot suppose the inter-diffusion of two identical gases to be a source of power. This then looks like a real failure, or rather limitation, of the prin- ciple ; and there are other such, that can only be satisfac- torily explained by aid of the complementary doctrine of molecular theory. That theory, in fact, shows that the more nearly identical the gases are, the slower will be the process of inter-diffusion, so that the mechanical energy will indeed be available, but only after a time that becomes indefinitely prolonged. It is a case in which the simple doctrine of energetics becomes inadequate before the limit is reached. The phenomena of highly rarefied gases pro- vide other cases. And in fact the only reason hitherto thought of for the invariable tendency of available energy to diminish, is that it represents the general principle that in the kinetic play of a vast assemblage of independent molecules individually beyond our control the tendency is for the regularities to diminish and the motions to become less correlated : short of some such reason, it is an un-

explained empirical principle. In the special departments of theoretical physics on the other hand, the molecular theory, there dynamical and therefore much more difficult and less definite, is an indispensable part of the frame- work of science; and even experimental chemistry now leans

more and more on new physical methods and instru- ments. Without molecular theory the clue which has developed into spectrum analysis, bringing with it stellar chemistry and a new physical astronomy, would not have been available ; nor would the laws of diffusion and con- duction in gases have attained more than an empirical form ; nor would it have been possible to weave the phe- nomena of electrodynamics and radiation into an entirely rational theory, as is now being done.

The doctrine of available energy, as the expression of thermodynamic theory, is directly implied in Carnot's Essai of 1824, and constitutes, in fact, its main theme ; it took a fresh start, in the light of fuller experimental knowledge regarding the nature of heat, in the early memoirs of Rankine and Lord Kelvin, which may be found in their collected scientific papers ; a subsequent exposition occurs in Maxwell's Theory of Heat; its most familiar form of statement is Lord Kelvin's principle of the dissipation of available energy. Its principles were very early applied by James Thomson to a physico- chemical problem, that of the influence of stress on the growth of crystals in their mother liquor. The " thermo- dynamic function" introduced by Kankine into its de- velopment is the same as the "entropy" of the material system, independently defined by Clausius about the same time. Clausius's form of the principle, that in an adiabatic system the entropy tends continually to increase, has been placed by Professor Willard Gibbs, of Yale University, at the foundation of his magnificent but complex and diffi- cult development of the theory, " On the Equilibrium of Heterogeneous Substances," Trans. Connecticut Academy, 1876-78, pp. 320, abstracted by its author in the American Journal of Science, vol. xvi., which has been translated into German by Ostwald, and into French (as regards the more purely chemical part) by Le Chatelier. This monumental memoir made a clean sweep of the sub- ject; and workers in the modern experimental science of physical chemistry have returned to it again and again to find their empirical principles forecasted in the light of pure theory, and to derive fresh inspiration for new departures. As specially preparatory to Gibbs may be mentioned Lord Kayleigh's memoir on the thermody- namics of gaseous diffusion (Phil. Mag., 1876), which has been expounded by Maxwell in the 9th edition of the Ency. Brit. (vol. vii. p. 214, art. Diffusion). The fundamental importance of the doctrine of dissipation of energy for the theory of chemical reaction had already been insisted on

in general terms by Eayleigh; subse- quent to, but independently of, Gibbs's work it had been elaborated by von Helmholtz (Gesamm. AbhandL ii. and iii.) in connexion with the thermodynamics of voltaic cells, and more particularly in the calculation of the free or available energy of solutions from data of vapour-pres- sure, with a view to the application to the theory of con- centration cells, therein also coming close to the doctrine of osmotic pressure. Expositions and developments on various lines will be found in papers by Riecke and by Planck in Annalen der Physik between 1890 and 1900, in the course of a memoir by Larmor, Phil. Trons., 1897, A, in Voigt's Compendium der Physik, in Planck's Vorle- sungen ilber ThermodynamJk, and in Duhem's elaborate Trait& de M&canique Chimique and Le Potentiel Thermo- dynamique. Numerous actual applications are expounded in van 't Hoff's Lectures on Chemical Physics, translated by Lehfeltd.

See also Thermodynamics. (j. l.)*

Enfield, a township in the Enfield parliamentary division of Middlesex, England, 10 miles north of Lon- don by rail. There are nine Established churches (one containing ancient memorials) ; also Roman Catholic and various Nonconformist chapels. Recent erections are a church institute, parish hall, and public library. Asso- ciated with Enfield by residence have been Charles Lamb, Isaac D'Israeli (born here in 1766), Babbage the mathe- matician. Captain Marryat the novelist, and Keats the poet, who were educated within the parish. Area of township (an urban district), 12,600 acres. Population

(1881), 18,944 ; (1901), 42,738.

Enfield, a town of Hartford county, Connecticut, U.S.A., on the east bank of the Connecticut river, and traversed by the New York, New Haven, and Hartford rail- way. It includes an area of 35 square miles, containing a considerable rural population, together with the villages of Enfield, Thompsonville, and Hazardville. It is mainly known from its manufacture of gunpowder. Population of the town (1880), 6755 ; (1890), 7199 ; (1900), 6699.

Engadlne, the upper or Swiss portion of the Valley of the Inn. Its length from the Maloja to Martinsbruck, by an excellent high road, is 59^ miles, of

which 26f miles are in the Upper Engadine and the rest in the Lower Engadine. The Upper Engadine is now best known as one of the great " air cures " of Europe, especially in winter, though the mineral waters of St Moritz are also much employed in the summer time. Many good carriage roads lead to the Upper Engadine over the ila- loja, Julier, Albula, and Bernina Passes, all built between 1820 and 1865. A railway is now being constructed by the Albula (tunnel beneath the pass). The Lower Enga- dine begins at the Punt 'Ota, close to the hamlet of Brail. It is far more picturesque and more romantic than the flat, level valley of the Upper Engadine, but is not so well known to tourists, though the waters of Tarasp have long been celebrated. The Lower Engadine is poor in carriage roads over the side passes, there being but two ••• over the Elliela Pass to Davos, and over the Ofen Pass to Mais, the former built in 1867, and the latter in 1871-72. Since 1282 the Lower Engadine has been sep- arated from Tirol by the wild and savage gorge of Fin- stermllnz, passable only on foot, the carriage road from Martinsbruck to Pfunds making a great ascent to Nau- ders, and then a great descent. In 1900 the population of the Upper Engadine (capital, Samaden, 1028 souls) was 5498, and that of the Lower Engadine (capital, Schuls, 1116 souls) 6275. Practically the whole population speaks the quaint Romance dialect known as Ladin.

E. Imiiof. Itinerarium des S. A. C. fur die Silvretta- und Ofenpassgruppe (Mountains of the Lower Engadine). Bern, ISHS. ••• E. Lechner. Das Oberengadin in der Verganrienheit nnd Gegenwart. Leipzig, 1900.••• A. Lokria and E. A. s'Iartel. Le Massif de la Bernina (complete monograph on the Upper Engadine, with full bibliography). Zurich, 1894.••• P. C. von I'lanta. Die Ciirmtlschen Herrschaften in der Feitdalzcit. Bern. 1881. ••• Z. and E. Pallioi'pi. Dizionari dels Idioms Somauntsrhs tVJingiadiiia Ota e bassa, ttr. Samaden, 1895. ••• F. de B. Strickland. Tlie Enr/adine. 2nd edition. London and Samaden, 1901.

(w. A. B. C.)

Engels, Friederich (1820-1896), German So- cialist. See Makx.

Engineers, Military.••• Military engineers first came to England Avith William of Normandy in 1066, and until the 18th century all engineers were

mili- tary. They were the builders of castles and defensible strongholds, as well as the inventors, manufacturers, and directors in action of engines of war with which to attack or defend them. By the middle of the 13th century there existed an organized body of skilled workmen em-

ployed under a " chief engineer." At the siege of Calais ??? in 1347 this corps consisted of masons, carpenters, smiths, tentmakers, miners, armourers, gunners, and artillerymen. At the siege of Harfleur in 1416, the chief engineer was designated Master of the King's Works, Guns, and Ordnance, and the corps under him numbered 600 men, including 21 foot-archers. Headquarters of engineers existed at the Tower of London before 1350, and a century later developed into the Office of Ordnance (afterwards the Board of Ordnance), whose duty was to administer all matters connected with fortifications, artillery, and ordnance stores.

Henry VIII. employed many engineers (of whom Sir Richard Lee is the best known) in constructing coast defences from Penzance to the Thames and thence to Berwick-on-Tweed, and in strengthening the fortresses of Calais and Guisne in France. He also added to the organization a body of pioneers under trenchmasters and a master trenchm aster. Charles II. increased the peace establishment of engineers and formed a separate one for Ireland, with a chief engineer who was also Surveyor- General of the King's Works. In both countries only a small permanent establishment was maintained, a special ordnance train being enrolled in war-time for each ex- pedition and disbanded' on its termination. The com- mander of an ordnance train was frequently, but not necessarily, an engineer, but there was always a chief engineer of each train. At the battle of Blenheim in 1704 Marlborough's ordnance train was commanded by Holcroft Blood, a distinguished engineer, who brought up the guns and placed them in position. But after the rebellion of 1715 it was decided to separate the artillery from the engineers, and the royal warrant of 26th May 1716 established two companies of artillery as a separate regiment, and an engineer corps composed of 1 chief engineer, 3 directors, 6 engineers-in-ordinary, 6 engineers extraordinary, 6 sub-engineers, and 6 practitioner en- gineers.

From this wfirrant the Eoyal Artillery date their birth and the Eoyal Engineers their release from artillery duties.

Until 14th May 1757 oflBcers of engineers frequently held, in addition to their military rank in the corps of engineers, commis- sions in foot regiments ; but on and after that date all engineer officers were gazetted to army as well as engineer rank❓❓❓ the chief engineer as colonel of foot, directors as lieutenant-colonel, and so forth down to practitioners as ensigns. On 18th November 1782 engineer grades, except that of chief engineer, were abolished, and the establishment was fixed at : 1 chief engineer and colonel, 6 colonels commandant, 6 lieutenant-colonels, 9 captains, 9 captain lieutenants (afterwards second captains) , 22 first lieutenants, and 22 second lieutenants. Ten years later a small invalid corps was formed; On 2oth April 1787 the designation ” Eoyal ” was con- ferred upon the engineers, and its precedence settled to be on the right of the army, with the royal artillery.

In 1802 the title of Chief Engineer was changed to Inspector- General of Fortifications. From this time to the conclusion of the Crimean War various augmentations took place, consequent on the increasing and widely extending duties thrown upon the officers. These, in addition to ordinary military duties, comprised the con- struction and maintenance of fortifications, barrack and ordnance store buildings, and all engineering services connected with them.

The cadastral survey of the United Kingdom (called the ” Ord- nance Survey “) had been entrusted to the engineers as far back as 1784, and absorbed many officers in its execution. Officers were also selected for various important civil positions, such as perma- nent under-secretaries of State, colonial governors, railway in- spectors, mint-masters, consuls-general, international boundary and other commissioners, colonial engineers and surveyors-general, directors of Admiralty works, and so on.

On 6th March 1772 the formation at Gibraltar of “The Company of Soldier Artificers,” officered by Royal Engineers, was authorized, and a second company was added soon afterwards. By royal warrant of 10th October 1787 ” The Corps of Royal Military Arti- ficers ” was established at home, consisting of six companies, with which the Gibraltar companies were

amalgamated. In 1806 this corps was doubled, and in 1811 increased to 32 companies. In 1813 its title was changed to "The Royal Sappers and Miners." On 12th October 1856, at the close of the Crimean War, it was incorporated with "The Corps of Royal Engineers," by whom it had always been officered. At that date the corps numbered about 340 officers and 4000 non-commissioned officers and men, com- prised in 1 troop and 32 companies.

In 1770 the East India Company reorganized the engineer corps of the three Presidencies, composed of officers only. Native corps of sappers or pioneers were formed later, and officered principally by engineers. The officers of engineers were employed in peace- time on the public works of the country, their services when required being placed at the disposal of the military authorities. The Indian Engineers have not only distinguished themselves in the operations of war, but have left monuments of engineering skill in the irrigation works, railways, surveys, roads, bridges, public buildings, and defences of the country. When Indian administra- tion was transferred to the Crown (1862) the Indian Engineers became "Royal," and have since almost died out, so that there now exists but one corps, the Royal Engineers.

The corps is composed of about 1000 officers of all ranks, and 7700 warrant and non-commissioned officers and men. Of the officers some 220 are attached to imits, about 400 are employed either at home or in the colonies on engineering duties in military commands, on the staff, or on special duty, and about 370 are on the Indian establishment.

The head of the corps at the War Office is the Inspector-General of Fortifications, who is assisted by two deputy inspectors-general of fortifications, one in charge of the fortification subdivision and the other of the barrack subdivision. Each of these deputies has two assistant inspectors-general with a staff of officers, warrant officers, civil surveyors, clerks, and draughtsmen. There is at the present time a third deputy Inspector-general with his staff, forming a special barrack subdivision for the administration of the loans for the construction of new barracks. In the fortifica^ tions subdivision the deputy inspector-general has imder him inspectors of submarine mining defences and of iron structure with their

staffs. A post-captain of the Royal Navy and a field officer of artillery are attached to the office of the Inspector-General of Fortifications as expert advisers. A deputy adjutant-general and an assistant adjutant-general of Royal Engineers, under the adjutant-general to the forces and in consultation with the Inspector-General of Fortifications, deal with all questions of personnel of the corps and the armament and equipment in its possession.

The officer commanding the Royal Engineers in a military dis- trict or command is called the District Commanding Royal Engineer, and is the staff officer of the general or other officer commanding for engineer services. A district is generally divided into subdistricts, to each of which is appointed a Subdistrict Com- manding Royal Engineer, who carries out the engineer services in the subdistrict by means of a staff of officers of Royal Engineers, military foremen of works, and other subordinates, and is respon- sible to the District Commanding Royal Engineer. The senior officer of Royal Engineers in Ireland is called the Chief Engineer.

(k. h. t.)

E JN" a I :^E s.

1. Steam Engines.

EEGENT developments in steam engineering have been directed, for the most part, towards improving the efficiency of the engine as a thermodynamic machine. Increase in speed, with consequent increase in the power developed by an engine of given weight, has also been aimed at, and the mechanical problems involved in high- speed running have received much attention. Eeduction

of weight is in some cases a matter of primary importance, but much more generally the chief consideration is that the engine may convert into work as large as possible a fraction of the heat which is supplied to it. The early progress of steam engineering was largely empirical ; in the most recent developments the influence of theory is apparent. Eecognizing that thermodynamic principles establish a limit of efficiency which in given conditions cannot be surpassed, engineers have directed their

attention to tracing, and as far as possible removing, the causes which make the real performance fall short of this ideal. Any scientific criticism of the actual steam engine requires that we should in the first place consider what is the ideal which may fairly be set up as a standard with which the real performance is to be compared.

In the sketch of thermodynamics as applied to heat engines which was given in the article Steam Engines in

*the ninth edition of this Encydopcedia, it was Ji'm?"of" s^**''* t^^* t^** action of a heat engine depends efficiency. **^ i^s receiving heat at a temperature higher*

*than that at which it is capable of rejecting heat to surrounding objects. The working substance in the engine must necessarily pass from an upper temper- ature, at which it takes in heat, to a lower temperature, at which it rejects heat, the difference between the heat taken in and the heat rejected being the thermal equiv- alent of the work done. It was further shown that when the conditions are such as to make this difference as great as possible, *** in other words, to make the efficiency reach its ideal limit, *** the ratio of the heat taken in to the heat rejected depends only on the temperature at which reception and rejection of heat occur. Calling ti and tj the absolute temperatures at which heat is taken in and rejected respectively, and Qi and Q2 the quantities of heat taken in and rejected, the limit of efficiency is reached when*

Ql_Tj

*Q2 ***"2*

and the efficiency then has the value

Ql Ti

In the ideal engine imagined by Carnot the action is of this simple character. The working substance is brought by adiabatic compression from the lower to the upper extreme of temperature. It then takes in heat, without changing in temperature. It then expands adiabatically until its temperature falls to the lower extreme, and at that temperature it rejects enough heat to restore it to its initial state, thereby completing a cycle of operations. The ideal cycle of Carnot is not, however, an appropriate standard with which to compare the action of a steam engine, for the steam engine makes no attempt to restore the working substance to its upper limit of temperature by adiabatic compression. Taking the case of a con- densing engine, the working substance passes through a cycle of operations which, except for practical imper- fections, has three stages corresponding to three of the stages in the Carnot process. At the boiler temperature it takes in heat ; it then expands, doing work and falling in temperature towards the lower limit, at which con- densation is to occur. It then gives out heat at this lower temperature by being condensed, and if the ex- pansion were adiabatic the correspondence would so far be exact. But the stage of adiabatic compression is wanting, and its place is taken by the direct return of the condensed water to the boiler, a process which in- volves the heating of the water by its taking in heat at a varying temperature, which ranges from the lower to the upper limit. The chief part of the heat which the working substance receives is still taken in at the upper limit of temperature, during the process of evaporation, but a certain part has been taken in before this, namely, during the heating of the feed water, while the water had a lower temperature. Any heat so taken in loses some- thing of its availability for conversion into work, because it is taken in at a temperature below the top of the range, and consequently the ideal efficiency of the cycle is reduced.

To determine the theoretical limit in the amount of work obtain- able from a given quantity of heat in a cycle in which heat is taken in at various temperatures, let 5Q represent that portion of the whole heat which is taken in at any temperature t. The temperature of rejection of heat will be represented, as before, by T2. Then the amount of work which may be obtained under ideally favourable conditions from this portion of the heat is, by Carnot's principle,

* *

T

and the whole amount of work ideally obtainable in the complete process is to be found by calculating

T

where the summation includes all the heat that is taken in. In a steam engine using saturated steam the principal item in this sum is the latent heat Li, which is taken in at constant temperature ti, during the change of state from water to steam. But there is, in addition, the heat taken in by the feed-water before it reaches the temperature at which steam is formed, and this may be represented as the sum of a series of elements (tSt taken in at varying tempera- tures T, where o- is the specific heat of water. Thus if W represents the thermal equivalent of the work theoretically obtainable per lb of steam, under ideally favourable conditions,

* yy_va-ST(T-T2) ^ Li(t,-T2)_*

T Tl

The experiments of Kegnault show that o-, within the limits of temperature that obtain in boilers, is a nearly constant quantity, and no serious error will be introduced in this integration by treating it as a constant, with a value equal to the mean value, as determined by Regnault, between the limits of ti and t^. On this basis

W = ^(ri-T2) -ar, log^ri+Mlmlsl.

T2 Tl

This expresses the greatest amount of work which a lb of steam can yield when the temperature ti at which it reaches the engine and the temperature Tj at which it leaves the engine are assigned. It consequently serves as a standard with which the actual per- formance may usefully be compared. The actual yield per flb of steam is always considerably less, chiefly

because the ideal condi- tion of adiabatic expansion from the higher to the lower extreme of temperature is never satisfied.

In practice the lower limit of temperature, in a condensing en- gine, is in favourable cases about 100 Fahr., which corresponds to a pressure in the exhaust pipe of nearly 1 lb per square inch. Tak- ing this as a fairly representative figure, the following table of values of W has been calculated for various pressures of admission. The table also gives the number of lb of steam which would be required per horse-power-hour under the same ideally favourable conditions. Taking the thermal unit to be equivalent to 778 foot- pounds, one horse-power-hour is equivalent to 2545 thermal units, and the ideal number of lb of steam per horse-power-hour is there- fore got by dividing 2545 by W :

Ideal Performance of Saturated Steam, assuming the Lower Limit of Temperature to be 100 Fahr.

Absolute Pressure

Number of ib of

of Supply in lb

W Thermal Units.

Steam per Horse-

per Square Inch.

Power-hour.

50

248

10-26

60

259|

9-81

70

269

9-46

80

277i

9-17

90

285

8-93

100

292

8-72

110

298

8-54

120

303i

8-39

130

308i

8-25

140

313"

8-12

150

318

8-00

160

322

7-90

170

326

7-81

180

329i

7-73

190

333

7-66

200

335i

7-59

210

338|

7-53

The performance of the ideal engine may be exhibited graphic- ally by drawing the pressure- volume curve or "indicator diagram" of the process, but a more interesting construction is to draw the diagram of eiitropy and temperature. The study

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of this diagram has contributed materially to the elucidation of steam-engine problems. Entropy is a condition of the working substance defined by the statement that when a substance takes in or rejects any quantity of heat SQ at the (absolute) temperature

T, its entropy is increased or reduced by the amount ??? ??? Thus

T

S??? ^ measures the whole change of entropy in a process which

T

involves the taking in or rejection of heat at more than one

temperature. We shall denote entropy by 0, and consider it as

reckoned per unit of mass of the substance. Since by

*Entropy definition of entropy S(I>=SQ/t, tS<(>=**Q, and hence if*

*J”***”*** ’ a curve be drawn with t and 0 for ordinates to exhibit*

*diagrams. *”** action of a working substance, the area under the*

curve, OTfrdtjj, being equal to S5Q, measures the heat

which the substance has received or rejected during the operation

which the curve represents.

In a reversible cycle of operations Carnot’s principle shows

*that 2*** =0, and it is obvious in such a case that the entropy*

T

returns at the end of the cycle to its primitive value. The same result may be extended to a cycle which includes any non- reversible step, by taking account of the heat generated within the substance by such a step, as if it were heat communicated from outside, in the reckoning of entropy. Thus, for example, if at one stage in the cycle the substance passes through a throttle-valve, which lowers its pressure without letting it do work, the action is equivalent in effect to an adiabatic expansion, together with the communication to the substance, as heat, of the work which is lost in consequence of the irreversible expansion through the throttle- valve taking the place of adiabatic expansion against a piston. If

*/JO this heat be included in the reckoning, S*** =0 for the complete*

cycle.

The entropy-temperature diagram for any complete cyclic process is a closed curve, and the area it encloses, being the excess of the heat received

over the heat rejected, measures the work done. The entropy-temperature diagram shares this useful characteristic with the pressure-volume diagram, but in addition it shows directly the heat received and the heat rejected by the areas under the forward and backward limbs of the curve. To draw the entropy-tempera^ ture diagram for the ideal steam engine, we have to reckon first the entropy which water acquires in being heated, and next the

entropy ००० which is acquired when the conversion into steam

has taken place. Reckoning from any standard temperature t०००, in the heating of the feed-water up to any temperature t, the entropy acquired is

, _ .’^(rdr tpfti ००० i 1

and taking o- as sensibly constant,

0००० = (r(logjT-lOgeT०००).

During evaporation at ti a quantity of heat Li is taken in at temperature t\, and hence the entropy of the steam

05=0०००-)-ii = ir(log e Ti-log e T०००) 1^.

Tl Tl

There results the diagram illustrated in Fig. 1, where a 6, a

h

Z’SSA

e

/

०००^m^^l^^^ii^^^^^^^*^

**

**

f

1

0

m

n Entmpii

P

??

Fig. 1.

logarithmic curve, represents the process of heating the feed-water, and 6 c the passage from the state of water into that of steam. The diagram is drawn to scale for a case in which steam is formed at a pressure of 180 fb per square inch, and condensed at a pressure of 1 R) per square inch. After the formation of the steam, ‘

the

next step in the ideal process is adiabatic expansion from the higher to the lower limit of temperature, which is represented by the vertical straight line c d, an adiabatic process bemg also isentropic. Finally, the cycle is completed by d a, which represents the con- densation of the steam after its temperature has been reduced by adiabatic expansion to the lower limit of temperature. The area abed represents the work done, and its value per lb of steam is identical with W as reckoned above. The area m ab cp is the whole heat taken in, and the area m a dp is the heat rejected.

Further, let a curve c / be drawn to show the values of the entropy of steam for various temperatures of saturation: then if

a d be produced to meet the curve in /, the ratio ??? represents the

fa fraction of the steam which was condensed during adiabatic expan- sion. For the point /represents the state of 1 lb of saturated steam, and in the condensation of 1 lb of saturated steam the heat given out would be the area under / a, whereas the heat actually given out in the condensation from d was the area under d a. Thtis the

state at d is that of a wet mixture in which ??? ??? represents the frac-

fa

tion present as steam, and ~ the fraction present as water.

/a It obviously follows that by drawing horizontal lines at inter- mediate temperatures the development of wetness in the expanding steam can be readily traced. Again, if the steam is not dry when expansion begins, its state may be represented by making the expansion line begin at a point in the line 6 c, such that the seg- ments into which the line is divided are proportional to the con- stituents of the wet mixture. In this way the ideal process may be exhibited for steam with any assumed degree of initial wetness. Further, the entropy-temperature diagram admits of ready applica- tion to the case of incomplete expansion. Suppose, for example, that after adiabatic expansion from c to c' (Fig. 2) the steam is

*\m-^^*

Fig. 2.

directly cooled to the lower-limit temperature by the application of

cooling water instead of by continued expansion. This process is

represented by the line c' e d, which is a curve of constant volume.

Its form is determined by the consideration that at any point e the

I e proportion of steam still uncondensed, or ??? , is such that the

mixture fills the same volume as was filled at c .

In the above calculation of ideal performance, and in the dia- grams which have been sketched, it has been assumed that the steam is supplied to the engine in a saturated state. To extend the same treatment to the case of superheated steam, we have to take account of the supplementary supply of heat which the steam re- ceives after the point

*c is reached, and be- '**

fore expansion begins. When superheating is resorted to, aS is now often the case in practice, . the super- heat is. 'given at con- stant pressure. If k represent the specific heat of steam at con- stant- preas-ure, the addition of entropy during the process of superheating ' from tx to t' is k(t' ??? Tl). In the absence of precise knowledge regarding the value of k it is usually treated as a constant, and the addition to the en- tropy may then be written as K(log r'-log ti). This gives a line such as c ???? on the entropy diagram (Fig. 3), and increases the

value of W by the amount C '"???('^-???^2), which is represented

on the diagram by the area d cr s. During adiabatic expansion from r the steam remains superheated until it reaches the state t,

when it is just saturated, and further expansion results in the con- dition o?? wetness indicated by s. The extra work dcrs is done at the expense of the extra supply of heat p cru, and an inspection of the diagram suffices to show that the efficiency of the ideal cycle Is only very slightly increased by even a large amount of super- heating. In practice, however, superheating does much to promote efficiency, because it materially reduces the amount by which the actual performance of an engine falls short of the ideal perform- ance, by keeping the steam comparatively dry in its passage through the engine, and thereby reducing exchanges of heat between the steam and the metal.

Trials of engines using saturated steam show that in the most favorable cases from 60 to 65 per cent, of the

*ideally possible amount of work is realized as '^'^orm- " iii'iic^t**??**'! " work, One of the causes of loss is aoce. that the expansion is incomplete. In practice*

*the steam is allowed to escape to the condenser, while its pressure is still considerably higher than the pressure at which condensation is to take place. When the pressure of steam in the cylinder has been so far reduced by expansion that it can only overcome the fric- tion of the piston, there is no advantage in going on further ; the indicated work due to any additional expan- sion would add nothing to the output of the engine, when allowance is made for the work spent on friction within the mechanism itself. Considerations of bulk often lead to an even earlier release of the expanding steam ; and another consideration which points the same way is that when expansion is carried very far, the losses due to exchange of heat between the cylinder and the steam, referred to below, tend to increase. Again, since ex- perience shows that the most efficient engines are those in which the process of expansion is divided into two, three, or more stages by the use of compounded cylinders, a certain amount of loss is to be ascribed to the drops in pressure which are liable to occur through unresisted expansion in the transfer of steam from one vessel to another. But the chief cause of loss is to be found in the exchanges of heat which take place between the steam and the metal. In each cylinder there is a process of alternate condensation and re-evaporation **???** condensation during the period of admission, when the steam finds itself brought into contact with metal which has been chilled by evapora- tion during thepreceding exhaust stroke, and then evapora- tion, when the pressure has fallen sufficiently, during the later stage of expansion as well as during exhaust. The consequence is that the steam, though supplied in a dry state, may contain some 20 or 30 per cent, of moisture when admission to the cylinder is complete, and the entropy diagram for the real process of expansion takes a form such as is indicated by the line c' c" in Fig. 4. The heat supplied is still measured by the area under a b c. The condensation from c to c' occurs by contact with the walls of the cylinder; and though part of the heat thus abstracted is restored*

Fig. 4.

before release occurs at c", the general result is to make a large reduction in the area of the diagram.

The exchanges of heat between steam and metal in the engine cylinder have been made the subject of an elaborate experimental examination by Professors Callendar and Nicolson (see Min. Proc. Inst. C.E. vol. cxxxi. p. 147), who studied the cyclic variations of temperature throughout the metal by means of thermo-electric junctions set at various depths. They found that the range of temperature through which the surface of the metal fluctuates is much less than the range of temperature passed through by the steam ; the processes of condensation and re-evaporation are slow,

and the time is too short to bring the surface of the metal into anything like equilibrium with the steam. The amount of condensation up to the point of cut-off, as inferred from the heat which the metal takes uji, is also much less than the " missing quantity " or dif- ference between the steam supplied per stroke and the dry steam then present. According to their experiments, the discrepancy is accounted for by leakage of steam past the valve, direct from the steam chest to the exhaust, and they suggest that this source of error may have been present in many estimates of initial condensation based on determinations of the missing quantity. This may explain cases in which the initial condensation has ap- parently been excessive, but large amounts of initial condensation certainly do occur, and constitute the most potent factor in making the real performance of the engine fall short of the ideal standard.

In the alternate condensation and re-evaporation of steam in the cylinder more heat is given to the metal by each pound of steam that is condensed than is taken from the metal by each pound of steam that is re-evaporated, the temperature of condensation being higher than that of re-evaporation. The quantity Hi ??? Hj, namely, the differ- ence of total heat at the two temperatures, represents this excess of heat. Unless this is in some way abstracted from the metal, the process cannot occur. Hence the action of the cylinder walls in causing alternate con- densation and re-evaporation to

occur may be limited by imposing conditions which prevent or reduce the abstrac- tion of heat. By the use of a steam jacket the metal may be prevented from losing heat externally, and may even be made to take up heat. Under these conditions the action depends on the fact that more water is re- evaporated than is condensed. To some extent this is a necessary result of the work done during expansion, which (in an adiabatic process) would make the steam become wetter as expansion proceeds, and would there- fore leave more water to be evaporated than is initially condensed by the action of the cylinder walls. But it is important to notice that any water which is introduced into the cylinder along with the steam will be an im- portant factor in supplying the means by which this thermal balance is maintained. With steam that is per- fectly dry before admission the action of the walls takes its limit from the condensation which expansion brings about ; with steam that is wet before admission no such limit applies. Hence the importance of having steam that is initially dry. To secure this, no method is so certain as to give some initial superheat to the steam, and hence the practical advantage which even a small amount of super- heating is found to bring about.

To a considerable extent the slide-valve itself promotes initial condensation, for it requires that the hot steam shall enter the cylinder through a passage which, immedi- ately before, was chilled by being used for the escape of exhaust steam. The use of entirely distinct admission and exhaust ports and valves tends towards economy of steam, partly for this reason and partly because it allows the clearance spaces to be reduced. Accordingly, we find that many of the best recorded results of tests relate to engines in which each cylinder has four separate valves of the Corliss or of the drop type. By using horizontal cylinders with admission valves on the top and exhaust valves below, the further advantage of drainage through the exhaust valves is secured. Water which is present at release has then the chance of escaping without being re-evaporated, a cir- cumstance which contributes largely to reduce the exchange of heat between the working substance and the metal. Thus a horizontal triple-expansion engine with drop valves, by Messrs Sulzer, using saturated steam atan absolute pressure of 160 lb per square inch, and indicating not much more

Experi- mental results as to efficiency.

than 200 horse-power, is reported, in a test by Professor Stodola, to have used only 11-52 ft of steam per indicated horse-power-hoiir (see Eiigineer, 1st July 1898 ; also summary of trials by B. Donkin, Ibid., 13th October 1899). By the table given above it will be seen that the ideal consumption for the same pressure of supply will be 7-9 ft. The performance in the test is therefore equivalent to nearly 69 per cent, of the ideal, an exceptionally high figure. In other particularly favourable records of trials the consumption of steam with triple-expansion engines has been found to lie between 12 and 13 ft per indicated horse-power-hour. Some of the best results relate to slow- running pumping engines fitted with steam jackets on the barrels and on the covers of the cylinders, and may be taken as showing how influential, in a long-period engine, the jacket may prove in reducing the evils of initial condensation. In the mean of several apparently authoritative trials by dif- ferent observers on different engines, the consumption of steam was 12-2 ft per horse-power-hour, at an absolute pressure of about 140 ft per square inch, which corresponds to 66 per cent, of the ideal performance. It should be added that these figures are ex- ceptional. A consumption of 13 or 14 ft of steam per horse-power-hour is much more usual even in large and well-designed triple-expansion engines ; and with two-cylinder compound en- gines, using steam with an absolute pressure of 100 or 120 ft per square inch, anything from 14 to 15 ft may be reckoned a good performance.

Amongst comparatively recent de- velopments in steam-engine practice a conspicuous place must be given to the work of the late Mr P. W. Willans, who, both by his design and manufacture of engines and by his published trials, did much to introduce a highly suc- cessful type of engine, the character- istic of which is great frequency of stroke. The quicker the period of the engine, the less time is there given for exchanges of heat to take place between the working substance and the metal, and consequently the more near is the approach towards adiabatic action. Thus high frequency tends to reduce the deleterious action of the cylinder walls, and in this respect to

cause a close approximation to the con- dition of the ideal engine. As a partial set off, however, it augments to some extent the losses by throttling in admission and exhaust and in transfer from one cylinder to another, and it presents to the designer what is in several respects a more difficult mechanical problem than he has to face in dealing with low speeds. The comparatively high speed of rotation required in the driving of dynamo-electric machinery has been an important factor in stimulating the use of high-frequency engines, which admit of being directly coupled to high-speed dynamos without the intervention of gearing. Most, though by no means all, of such high-speed engines are of the single-acting class, of which the Willans engine is a conspicuous example. In this the piston-rods are

vertical, and steam is admitted to the upper side only of each piston, with the result that the rods are kept in a state of thrust throughout the action, and no reversal of stress is allowed to occur at the joints. Notwithstanding the admission of steam to one side only, reversal of thrust would occur, as a consequence of the inertia of the reciprocating parts, if special means were not taken to prevent it. This is done by introducing a cushion cyl- inder in which air is compressed during the up-stroke of the piston, so that the energy which the reciprocating masses have to part with during the second half of their up-stroke is absorbed in compressing air, and is restored during the down-stroke. In the compound and triple expansion forms

Wlllaas engine.

Fig. 5.

of this engine the two or three compoimded cylinders are set in tandem, and the space below the upper piston serves as an intermediate receiver. In some of the smaller engines a single crank is used, but generally two or three sets of cylinders are grouped in parallel vertical lines, each set acting on one crank. The piston-rod of each set is hollow, and within it there is a valve-rod furnished with piston- valves for the admission and release of the steam. The valve-rod is worked by an eccentric on the crank-pin, so that it may have the proper relative movement with respect to the hoUow piston-rod in which it works. The cross-head takes the form of a piston, which acts

as the air-buffer to produce the cushioning referred to above. These features will be better understood by reference to Fig. 5, which

gives a section through the two lines of cylinders in a two- crank compound engine. The two lines are alike, but in the drawing the pistons and piston-rod of one line are shown in section, so that the piston-valves may be seen. Steam enters at A through a throttle valve which is con- trolled by a shaft governor, and is admitted to the top- most cylinder through the ports B and C in the hollow piston-rod. Cut-off occurs when the ports B are covered by disappearing into the gland of the top cylinder cover as the rod descends. Subsequently the relative motion of the valve-rod within makes the valve Vj cover the port C, and near the end of the down-stroke the ports C and D are put in communication with each other be- tween the valves V2 and V3, so that the steam which has expanded in the upper cylinder passes during the up- stroke into the space below the upper piston. From this space, which serves as a receiver, it is admitted in the next down-stroke to the cylinder below, where it con- tinues its expansion. The air-cushion which prevents reversal of the thrust at the crank-pin is formed by com- pressing air in the cylinder E above a piston, which also serves as guide and cross-head. The engine is completely encased, and much of the lubrication is effected by letting the cranks dip into oil and splash it about freely within the case. Engines of this type with three cranks have been built which work up to 2400 horse-power, and engines of 1200 horse-power are in common use. In the larger sizes a speed of 200 or 250 revolutions per minute is usual ; with small engines of the same type indicating one or two hundred horse-power the speed is commonly about 450. That such engines are capable of highly economical working was demonstrated by the remarkably thorough series of experiments carried out and published by Mr Willans (" Steam Engine Trials," Proc. Inst. C.E., 1888 and 1893). An important feature of these trials was that they dealt not simply with the consumption of steam under

the favourable conditions which hold when the engine is fully loaded, but also with the consumption under various amounts of light load, including the ex- treme case in which the engine is merely overcoming its own frictional resistance without doing any external work. To represent the results of such tests Willans

???a .

so 25

Indicated Horse Power Fig. 6.

introduced the practice of drawing curves which show the total consumption of steam per hour in relation to the horse-power. He found that the Willans line, as such a curve is now generally called, is sensibly straight when the reduction of power from full load to lighter load

or to no load is effected by throttling the steam, while the point of cut-off remains unchanged. Examples of two such lines are given in Fig. 6, which shows the results of two tests by Willans of the same engine, using two different ratios of total expansion, namely, 4-8 and 10. Another useful curve is drawn by plotting the relation between the horse-power and the steam used per horse- power-hour ; the same trials are exhibited in this way in Fig. 7.

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Other

high-speed

engines.

35 30

Indica/ed Horse Power

Fig. 7.

The high-speed single-acting type of engine has been successful in the hands of more than one maker, and suc- cess has also attended efforts which have been made to secure the advantages of high speed without the sacrifice of power which is involved in single-action. Of double- acting high-speed engines an interesting form is that of Messrs Belliss and Morcom, the chief distinctive feature of which is the use of forced lubrication at the pin-joints and shaft-bearings. In a double-acting engine, where the thrust acts alternately on one and the other side of the crank-pins and cross-head pins, high frequency of stroke tends to produce much knocking and wear unless the brasses are very closely adjusted, and in that case the pins are liable to get hot, and to ” seize ” by expanding sufficiently

to fill the small clearance. This difficulty, which exists when lubrication is carried out in the ordinary way, is over- come in the Belliss engine by feeding the bearings with a continuous supply of oil, which is pumped in under a pressure of about 15 lb per square inch. The pres- ence of a film of oil is thereby continuously secured, and knocking is prevented although the brasses are not set very close (see Dales, "High-Speed Engines," Proc. Inst. G.E., 1899 ; and Morcom, " High-Speed Self- Lubricating Steam Engines," Proc. Inst.Mech. Eng., 1898). Notable examples in which double action is combined with a relatively high frequency of stroke are found in naval engineering practice, especially in the engines of high-speed cruisers and torpedo-boat destroyers. As a rule these engines employ triple expansion, with four cranks and four cylinders, the third stage of the expansion being performed in two cylinders, which divide the steam between them. The steam is supplied from water-tube boilers at a pressure of about 250 lb per square inch. The engines of the Powerful, which develop nearly 26,000 horse-power under forced draught, have cylinders 45 inches, 70 inches, and two of 7) inches in diameter, with a stroke of 4 feet. The cylinder ratio is therefore 1 : 2-4 : 5-7. At 114 revolu- tions per minute the piston speed is 915 feet per minute, and the total weight of machinery per indicated horse- power is made up of 93 ft in the engine and 101 ft in the boilers, which are of the Belleville water-tube type. In recent torpedo-boat destroyers the mean piston*

speed approaches 1200 feet per minute, with nearly 400 revolutions per minute and an 18-inch stroke, and the horse-power developed is about 6000. In some in- stances this is accomplished with a total weight of 50 tb per indicated horse-power, which is nearly equally divided between the engines and the boilers (Durston and Oram^ "The Machinery of Warships," Proc. Inst. G.E.,

1899).

In such engines, and in other cases where quickly re- ciprocating masses have to be dealt with, the problem of ??? , , balancing the forces due to inertia assumes great

importance. This is especially true of marine engines, on account of the absence of massive foundations; but even in land engines a want of balance may, at high speeds, cause enough vibration to constitute a serious nuisance. In considering the question of balance, the system of excentrically revolving masses and the system of reciprocating masses have to be considered separately. A reciprocating mass such as a piston cannot be balanced by the use of revolving masses, for the forces which are due to the inertia of the piston necessarily act along the line of its stroke, while those due to revolving masses are continually changing their direction. The inertia of each connecting-rod may be approximately treated by resolv- ing its mass into two constituents, one of which moves with the crank-pin, and is therefore an addition to the revolving system, while the other moves with the cross- head, and is therefore an addition to the reciprocating system. The mass of the rod may be divided for this purpose into parts which are inversely proportional to the distances of its centre of gravity from the crank-pin and the cross-head respectively. Let Mj, Mj, M3, &c., represent the various revolving masses, r^, r^, r^, &c., their effective radii of rotation, and Oj, 02, a^, &c., their dis- tances from any assumed plane of reference taken per- pendicular to the shaft. Then the conditions necessary for balance amongst them are that the vector sum of M r shall vanish, and also that the vector sum of M a r shall vanish, this latter quantity being the resultant of the moments of the centrifugal forces with respect to the plane of reference. In a four-crank engine there is no serious difficulty in arranging the revolving masses in such a manner that these conditions shall be satisfied, so far as those masses are concerned. The problem, as Professor Dalby has shown, lends itself readily to graphical treatment (see " Balancing of Engines," Trans. Inst. Naval Architects, 1899). With respect to the reciprocating masses, a first approximation towards balance is attained by satisfying the conditions which would secure balance if the motions were simply harmonic. These conditions are identical with those which have just been stated for the revolving masses, when r is interpreted

as the semi- amplitude of the harmonic motion. When the conditions in question are satisfied, the only remaining source of disturbance is that which comes from the fact that the reciprocating masses are connected to the cranks by rods of finite length ; in other words, that the motions are not simply harmonic. For this reason the force required to accelerate each piston is greater when the piston is at the end of the stroke farthest from the shaft than when it is at the other end, and consequently the balance, which would be perfect if the connecting-rods were indefinitely long, is disturbed by the presence of forces which vary periodi- cally with a frequency twice that of the rotation. When three cranks, 120►► apart, are employed, it will be found that the effect of the shortness of the connecting-rods in causing forces to act in the line of the stroke is almost completely eliminated ; or rather the effect is reduced to a couple tending to tilt the engine in a fore and aft direction, which may in its turn be balanced by using a second set of three cranks on the same shaft, the second

set being so arranged that the couple to which it gives rise neutralizes the couple due to the first set. A six- crank engine may be arranged in this way to secure an extremely close approximation to perfect balance, and the same state of balance can be secured when the number of cranks is reduced to five (see Eobinson, " Single Acting High-Speed Engines," Joum. Inst. Elec. Eng., 1895).

The advantage of superheated steam, which arises mainly from its influence in reducing the exchange of heat between the steam and cylinder walls, was demonstrated by the experiments of Him, and f " "f^ as early as 1860 it was not unusual to supply suam. superheaters with marine engines. But the practice of superheating was soon abandoned, chiefly on account of difficulties in regard to lubrication. By the introduction of heavy mineral oils this objection has been removed, and a revival in the iise of superheating has recently taken place, with striking effect on the thermodynamic economy of engines. Experiments made in 1892 by the Alsatian Society of Steam Users on a large number of engines, showed that superheating effected an average saving in coal to the extent of about 20 per cent, when the superheater was simply placed in the boiler flue, so that it utilized what would otherwise be waste heat, and about 12 per cent, when the super- heater was separately fired. In those cases the steam was

superheated only about 60 or 80 Fahr. above the temperature of saturation, but in more recent practice much greater amounts of superheat have been success- fully applied. Professor Schroter has tested a factory engine of 1000 horse-power, using steam superheated by some 93 Fahr., and has shown that this amount of superheat is not sufficient to prevent some of the steam from becoming condensed on the walls during admission to the cylinder {Zeitsclirift der Vereins deutscher Ingenieure, vol. xL, 1896). It follows that still larger amounts of superheat will be thermodynamically advan- tageous. That this is the case has been demonstrated by the remarkable results which have been obtained with very highly superheated steam by Mr W. Schmidt. Using engines of somewhat special design, Mr Schmidt has shown that it is- perfectly practicable to employ steam superheated by as much as 300 Fahr., and that an efficiency not attainable from steam in any other way is thereby reached. In several authentic trials of Schmidt engines the consumption of steam has been considerably -less than 10 ft per indicated horse-power- hour, a figure which, after allowance is made for the heat taken up during the process of superheating, repre- sents a better performance than that of the best engines using saturated or slightly superheated steam. It has been found that the consumption of coal, in the boiler and superheater together, need not exceed 1+ ft per indicated horse-power even with engines of small power. To attain this remarkable result it is of course necessary that, after the hot gases have passed the superheater, a further extraction of heat from them should take place. This is done by an economizer or feed-water heater of peculiar form, consisting of a long coil of small pipes which maintain a circulation of hot distilled water through a closed system containing an external coil, which forms the heater of a tank through which the feed-water passes on its way to the boiler. Some of the Schmidt engines adopt the principle of single action, to escape the necessity of having a piston-rod and gland on the side which is exposed to contact with high- temperature steam ; but it is found that this precaution is not essential, and that with glands of suitable design a double-acting piston may be used without inconvenience, and without risk of undue wear. In some instances Mr

ENGINES

[steam engines

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Schmidt transfers to the partially expanded steam in the intermediate receiver a portion of the heat which is con- veyed to the engine by the highly superheated steam ; and when this is done, the steam may properly receive a still higher degree of initial superheat. In tests by the present writer of a Schmidt plant indicating 180 horse-power, in which this device was employed, the initial superheat wag as much as 385►► Fahr., namely, from 360►► Fahr., the temperature of saturation, to 745►► Fahr. In this trial the temperature of the chimney gases was reduced, by the use of Mr Schmidt's feed- water, to 347►► Fahr., and the consumption of coal was 1-31 lb per indicated horse- power-hour.

The most interesting, and without doubt also the most important, feature of modern steam practice is the development of the steam turbine. In the hands of Mr 0. A. Parsons the steam turbine has reached a degree of efficiency which equals, even if it does not surpass, that of the best engines of the piston and cylinder type. The mechanical problems to be solved before this result could be attained were of a high order of difficulty, but the success with which they have been overcome is not more conspicuous than the simplicity of the means by which it has been achieved. The central idea in the Parsons steam turbine has been to make the action compound; the steam is allowed to fall in pressure by a long series of steps, each step so small that the steam acquires comparatively little velocity through its drop in pressure. This enables the kinetic energy which is acquired in each step to be given up with a good degree of efficiency to turbine blades running at a moderate speed, before the steam passes on to ac- quire more velocity before it encounters the next series of moving blades. The whole turbine is made up of a long series of rings of moving blades, sandwiched be- tween which there are rings of fixed blades, forming guides to deliver the steam with proper direction and velocity against the moving blades. The latter are mounted on a drum, from which they project radially outwards ; the fixed

blades project radially inwards from a casing, within which the drum revolves. The arrangement of guide

FIXED BUADES

utilize pressures as low as can be reached ; there is no such lower limit, as friction and other considerations

MOVING BLADES,

^

MOVINQ BLADESl

Fig. 8.

blades and moving blades is illustrated in Fig. 8, where the guide blades are shown in section. Fig. 9 shows a portion of the drum, with the moving blades project- ing from it as they appear when part of the cover is removed. The general direction taken by the steam is parallel to the axis as it passes from ring to ring of blades. In its passage the energy of the steam is gradually extracted as it expands from a pressure which is in some cases as much as 200 or 250 lb per square inch, down to 1 ft per square inch. With a condenser it is practicable in the steam turbine to

Fig. 10.

Fig. 9.

impose in engines of the ordinary type. Even with this division of the whole expansion into many steps the speed of the turbine blades has to be fairly high ; and to permit the shaft to revolve smoothly at a high speed the bearings are of a special design, which is shown in section in Fig. 10. In each bearing a number of coaxial cylindrical sleeves are slipped over the shaft to form the bush in which the shaft revolves, and oil is continuously pumped in under pressure. The result is that a film of oil is main- tained round the. shaft and between each sleeve and the one outside it. This gives the shaft some freedom to adjust itself by lateral displacement, but at the

same time the viscosity of the oil films effectively damps out any oscillations which may tend to become set up. The general arrangement of a Parsons steam turbine is shown in Fig. 11, which is a section through a turbine with some eighty successive rings of moving blades. Steam is admitted to the turbine .rings at A, and passes through them to the right, passing first through short and closely spaced blades, and then through blades which are longer and of coarser pitch, to give a greater area of passage as the pressure falls and the volume increases. It finally escapes to the condenser at B. The moving blades are grouped in three sets, on three drums of different diameters. Owing to the one-sided action of the steam, each of these drums is forced to the right ; and to balance this pressure there are sets of " dummies " or balance-discs of corresponding diameter, which are forced with equal pressure to the left. _ These are shown at C, D, and E. Each dummy consists of a group of discs revolving in close juxtaposi- tion to rings which project inwardly between the discs from the casing; and between each dummy and the corre- sponding portion of the turbine drum there is a channel, which secures that both shall be subjected to the same pressure of steam. Finally, a thrust block at F serves to take up any longitudinal force that may remain un- balanced. A worm on the turbine shaft at G gives a comparatively slow motion of rotation to the worm-wheel H, from the axis of which the air-pump and oil-pump are driven. Admission of steam takes place through the valve J, which is periodically lifted to let the steam enter in a series of gusts; and the speed of the turbine is regulated by adjusting the duration of each gust. The

valve J is opened by the action of steam admitted through a small relay-valve K to the spring piston L. The duration of each gust depends on the amplitude of motion of the relay-valve K; and this is controlled by the governor, which acts by varying the position of the fulcrum of a rocking-lever M, by which the relay-valve is actuated. This lever is caused to rock periodically by a connexion between it and the worm-wheel H. When the turbine

has only a light load, the rocking of the lever barely suffices to open the relay-valve, and each gust of steam is accordingly of very brief duration. When the load is heavy, the gusts are so long as to become blended into a nearly continuoiis blast. In turbines iised for electric lighting, the control of the rocking-lever is usually effected by an electro-magnetic solenoid with the result that the speed is so regulated as to keep the volts constant; in

Fig. 11.

other cases the control is supplied by a centrifugal gov- ernor, which acts so as to preserve a uniform speed. This governor is remarkably effective ; and a conspicuous merit of the steam turbine is that nearly the whole of the load may be suddenly thrown on or off without causing more than a trifling variation in the speed, and without in any way straining the machine. Another important mechanical advantage is the perfect balance of the moving parts, ??? a balance much more perfect than is attainable in any reciprocating engine, ??? which allows the steam turbine to be used with practically no foundations. Other points to be noted are the small internal friction of the turbine as a mechanism, its small weight and small size in relation to the power it develops, the extreme simplicity of its working parts, and the fact that as there are no rubbing surfaces exposed to the action of the steam, the steam can be kept free from oil, a matter of considerable moment in engines which condense the steam and return it to the boiler.

The compound steam turbine dates from 1886, but it was not till 1891 that the introduction of the condensing type demonstrated that the turbine is capable of yielding results which are on a par, as regards efficiency, with those given by piston and cylinder engines. In the turbine one great source of loss is avoided which is present in the piston engine, namely, the periodic give and take of heat between the steam and the cylinder walls. On the other hand, the turbine suffers losses through leakage of steam in the clearance spaces round the blades and round the "dummies," as well as from the imperfect utilization of the kinetic energy acquired by the steam in each step of the expansion. The ideal return which the steam is capable of giving is the same in both types of engine ; and though the sources of loss are very different in the two, it appears that their total effect in making the

actual performance fall short of the ideal performance is, in the best cases, much alike. Large steam turbines succeed in utilizing between 60 and 70 per cent, of the energy which the steam is ideally capable of giving out, which is fully as high a fraction as is reached in the most favourable tests of large piston

engines. With small turbines the results are less favour- able, the losses due to clearance leakage being relatively greater. Trials, made in April 1900 by the present writer, of a Parsons turbine of about 2000 horse-power, running at 1500 revolutions per minute, directly coupled to a dynamo, gave striking evidence of the high degree of efficiency to which this type of engine has been brought. Electrical measurements were used to deter- mine the effective output. In one of the trials, with steam at 156 ft per square inch, superheated 84 Fahr., the useful electrical output was 1436 kilowatts and the consumption of steam was 18\ ft per kilowatt-hour. Since 1 kilowatt is 1-34 horse-power, this consumption is equal to 13-6 ft per electrical horse-power-hour. Trials of the best piston engines, driving dynamos, show that under the most favourable conditions about 84 per cent, of the indicated power may take the form of useful electrical output. Accordingly, the above result is equivalent to the performance of an engine using 11-4 ft of steam per indicated horse-power-hour. This represents about 68 per cent, of the work theoretically obtainable from the steam. An important characteristic of the steam turbine is that it maintains its efficiency while working under lighter loads. The table below illustrates this by giving the result of a series of trials of the same machine under various conditions as to load;

Load in Kilowatts.

1450 1250 1000

750

500

250

Consumption of Steam per Kilowatt-hour in lb.

18-1 18-5 19-2 20-3 22-6 34-0

The most considerable application of the steam turbine has hitherto been to the driving of dynamo-electric machinery, but Mr Parsons has demonstrated its suitability for the propulsion of steamships, and it may confidently be expected to come widely into use for this purpose. The Turbinia, a vessel of the dimensions of a torpedo-boat,

tions.

fitted with Parsons steam turbines adapted to use steam with a pressure of fully 200 ft per square inch, achieved in 1897 the then unprecedented speed of 32| knots in trials on the measured mile ; and more recently the Vipe?; a torpedo-boat destroyer with turbine engines of about 10,000 horse- power, built to the order of the British Admiralty, reached a speed of 35J knots. In the Turbinia three steam tur- bines were used, on three separate shafts, each of which carried three small screw propellers. The three turbines were arranged to form a single compound system through which the steam passed in series, becoming finally ex- panded about two-hundredfold. At full speed the shafts made about 2200 revolutions per minute, and developed rather more than 2000 horse-power, with a consumption of steam no greater than would have been found in a triple-expansion engine of the usual type under like con- ditions. The advantage in respect of lightness of the turbine engines is shown by the fact that in the Turbinia the weight of the whole propelling mechanism, including engines, boiler, condenser, and propellers, was about 22 ft per horse-power developed. The running machinery was completely encased and was well below the water-line, although the draught of the vessel was only 3 feet. The engines were found to be remarkably handy, allowing sudden starts and stops to be made with great ease.

Enough has been said to show that the invention of the steam turbine is the most important step in steam engineering since the time of Watt. It is the first solu- tion of the problem of using steam efficiently in an engine without reciprocating parts. The object in most steam engines is to deliver power to revolving machinery, and much ingenuity has been expended in attempts to devise engines which will produce rotation directly, in- stead of by conversion of reciprocating motion. No rotary engine, however, was permanently successful until the steam turbine took a practical form. The direct impact of a jet of steam on moving vanes was used by Hero of Alexandria in a philosophical toy, which may be described as the very earliest steam engine. Attempts were made in the 17th century by Giovanni Branca to turn this method to practical ac- count, but no success was achieved until the compound system of working a turbine was developed by Parsons.

Subsequently to his invention, the simpler type of steam turbine, which utilizes the direct impact of a steam jet against a single ring of revolving blades, has frWn❓❓❓” been brought to a remarkable degree of efficiency by De Laval. In De Laval’s turbine the steam expands at one step from the full pressure of the supply to the pressure of the exhaust by discharge in the form of a jet from a conical orifice, and the jet acquires a corre- sponding amount of kinetic energy. It then acts on a ring of blades in much the same way as the jet of water acts on the blades of a Pelton wheel or other form of pure impulse turbine. To utilize this impact of steam the blades have to run at an enormous velocity, and the speed of the shaft which carries them is so great that gearing down is resorted to before the motion is applied to useful purposes. The general arrange- ment of the steam nozzle and turbine blades is illustrated in Fig. 12. The blades project from the circumference of ^*

a disc-shaped wheel ~~p~~ jg

and form a com- plete ring round it, only a few of the blades being shown in the sketch. The nozzle has a divergent form.

which causes the steam to expand before it leaves the mouth, and so causes the pressure energy to be used in giving kinetic energy to the jet before it is projected against the blades. The jet impinges at one side, and escapes at

the other after having had its direction of motion nearly reversed. The expansion in the nozzle is carried to atmospheric pressure, or near it, if the turbine is to be used without a condenser ; but in many cases an ejector condenser is employed, and when that is done the nozzle is of a form which adapts it to expand the steam to a corre- spondingly lower pressure. It is only in the smaller sizes of these turbines that a single nozzle is used; in the larger steam turbines, as in large Pelton wheels, several nozzles are applied at intervals along the circumference of the disc. To permit the blades to run at the high speed which is necessary in order that they may take full advantage of the kinetic energy of the jet, they are strengthened by shrinking a ring of steel round their tips ; and this also serves as a cover to prevent the ring of blades from acting as a centrifugal fan. In a 60 horse-power De Laval turbine the shaft which carries the turbine disc makes 16,000 revolutions per minute ; in the 5 horse-power size it makes as many as 30,000 revolutions per minute. A turbine developing 300 horse-power uses a wheel 30 inches in diameter, running at over 10,000 revolutions per minute, with a peripheral speed of nearly 1400 feet per second. These enormous speeds are made possible by the ingenious device of using a flexible shaft, which protects the bearings and foundations from the vibration which any want of balance would otherwise produce. The elasticity of the shaft is such that its period of vibration is much longer than the time taken to complete a revolution. The high-speed shaft which carries the turbine disc is geared, by means of double helical wheels with teeth of specially fine pitch, to a second-motion shaft, which runs at one-tenth of the speed of the first ; and from this the motion is taken, by direct coupling or otherwise, to the machine which the turbine is to drive. Turbines of this class are now in extensive use for driving dynamos, fans, and centrifugal pumps. Compared with the Parsons turbine, De Laval's lends itself well to work where comparatively small amoimts of power are wanted, and there it achieves a higher efficiency, though in large sizes the Parsons turbine is the more efficient of the two. Trials of a De Laval tur- bine used with a condenser, and developing about 63 horse- power, have shown an average steam consumption at the rate of about 20 ft per brake-horse-power hour, and even better results are reported in turbines of a larger size.

(j. A. E.)

2. Gas Engines.

A gas engine is a heat engine in which the working fluid is atmospheric air and the fuel an inflammable gas or vapour. It differs from a hot air or a steam engine in that the heat is given to the working fluid by combustion within the motive power cylinder. In most gas engines ??? in fact, in all those at present on the market ??? the working fluid and the fuel that supplies it with heat are mixed with each other before the combustion of the fuel. The fuel ??? which in the steam and in most hot air engines is burned in a separate furnace ??? is, in the gas engine, intro- duced directly to the motor cylinder and burned there ; it is, indeed, part of the working fluid. A gas engine, there- fore, is an internal combustion engine using gaseous or vapour fuel.

The commercial history of the gas engine dates from 1876, when the late Dr Otto patented the well-known engine now in exten- sive use ; but long before that year inventors had been at work, attempting to utilize gas for producing motive power. The first proposal made in Great Britain is found in Street's Patent

GAS engines]

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No. 1983 of 1794, where an explosion engine is suggested, the explo- sion to be caused by vaporizing spirits of turpentine on a heated metal surface, mixing the vapour with air in a cylinder, firing the mixture, and driving a piston by the explosion produced. Most of the early engines were suggested by the fact that a mixture of an inflammable gas and atmospheric air gives an explosion when ignited ??? that is, produces pressure which can be applied in a cylin- der to propel a piston. Lebon, in France, proposed a gas engine in which the gas and air were raised to a pressure above that of the atmosphere before use in the cylinder, but he did not appear to be clear in his ideas. Samuel Brown, in patents dated 1823 and 1826, proposed to fill a closed chamber with a gas flame, and so expel the air ; then he condensed the flame by injecting water, and operated an air engine by exhausting into the partial vacuum so obtained. The idea was evidently suggested by Watt's condensing steam engine, flame being employed instead of steam to obtain a vac- uum. Brown's engine is said to have been actually employed to pump water, drive a boat on the Thames, and propel a road carriage. L. W. Wright in 1833 described an explosion engine working at atmospheric pressure and exploding on both sides of the piston. The cylinder is shown as water-jacketed. In William Barnett's engine of 1838 two great advances were made. The engine was so constructed that the mixture of gas and air was compressed to a considerable extent in the motor cylinder before ignition. The method of igniting the compressed charge was also efflective. The problem of transferring a flame to the interior of a cylinder when the pressure is much in excess of that of the external air was solved by means of a hollow plug cook having a gas jet burning within the hollow. In one position the hollow was opened to the atmosphere, and a gas jet issuing within it was lit by an external flame, so that it burned within the hollow. The plug was then quickly rotated, so that it closed to the external air and opened to the engine cylinder ; the flame continued to burn with the air contained in the cock, until the compressed inflam- mable mixture rushed into the space from the cylinder and ignited at the flame. This mode of ignition is in essentials the one adopted by Otto about thirty years later. To Barnett belongs the credit of being the first to realize clearly the great idea of compression be- fore explosion in gas engines, and to show one way of

carrying out the idea in practice. Barnett appears to have constructed an engine, but he attained no commercial success. Several attempts to produce gas engines were made between 1888 and 1860, but they were all failures. Several valuable ideas were published in 1855. Drake, an American, described a mode of igniting a com- bustible gaseous mixture by raising a thimble-shaped piece of metal to incandescence. In 1857 Barsanti and Matteucci proposed a free-piston engine, in which the explosion propelled a free piston against the atmosphere, and the work was done on the return stroke by the atmospheric pressure, a partial vacuum being produced under the piston. The engine never came into commercial use, although the fundamental idea was good.

*Previous to 1860 the gas engine was entirely in the experimental stage, and in spite of many attempts no practical success was attained. Lenoir, whose patent is dated 1860, was the inventor of the first gas engine that was brought into general use. The piston, moving forward for a portion of its stroke by the energy stored in the fly-wheel, drew into the cylinder a charge of gas and air at the ordinary atmospheric pressure. At about half stroke the valves closed, and an explosion, caused by the electric spark, propelled the piston to the end of its stroke. On the return stroke the burnt gases were discharged, just as a steam engine exhausts. These operations were repeated on both sides of the piston, and the engine was thus double-acting. Four hundred of these engines were said to be at work in Paris in 1865, and the Reading Iron Works Company Limited built and sold one hundred of them in Great Britain. They were quiet, and smooth in running ; the gas consumption, however, was excessive, amounting to about 100 cubic feet per indicated horse-power per hour. The electrical ignition also gave trouble. Hugon improved on the engine in 1865 by the introduction of a flame ignition, but no real commercial success was attained till 1867, when Otto and Langen exhibited their free- piston engine in the Paris Exhibition of that year. This engine was identical in principle with the Barsanti and Matteucci, but Otto succeeded where those inventors failed. He worked out the engine in a very perfect manner, used flame ignition and designed a practical clutch, which allowed the piston free movement in one direction but engaged with the fly-wheel shaft when moved in the other ; it consisted of rollers and wedge-shaped pockets****???****the same clutch, in fact, as has since been so much used in free-wheel bicycles. This engine consumed*

*about 40 cubic feet of gas per brake horse- power per hour**** *less than half as much as the Lenoir. Several thousands were made and sold, but its strange appearance and un- mechanical operation raised many objections. Several inventors meanwhile advocated compression of the gaseous mixture before ignition, among them being Schmidt, a German, and Million, a Frenchman, both in 1861.*

To a Frenchman, M. Alpb.Beau de Rochas, belongs the credit of proposing, with perfect clearness, the cycle of operations now widely used in compression gas engines. In a pamphlet published in Paris in 1862, he stated that to obtain economy with an explosion engine fourconditions are requisite : (1) The greatest possible cylinder vol- ume with the least possible cooling surface ; (2) the greatest possi- ble rapidity of explosion ; (3) the greatest possible expansion ; and (4) the greatest possible pressure at the beginning of the expansion. The sole arrangement capable of satisfying these conditions he stated would be found in an engine operating as follows : (1) Suc- tion during an entire outstroke of the piston ; (2) compression during the following instroke ; (3) ignition at the dead point, and expansion during the third stroke ; (4) forcing out of the burnt gases from the cylinder on the fourth and last return stroke. Beau de Rochas thus exactly contemplated, in theory at least, the engine produced by Dr Otto fourteen years later. He did not, however, put his engine into practice, and probably had no idea of the prac- tical difficulties to be overcome before realizing his conception in iron and steel. To the late Dr Otto belongs the honour of indepen- dently inventing the same cycle, now correctly known as the Otto cycle, and at the same time overcoming all practical difiiculties and making the gas engine of world-wide application. This he did in 1876, and his type of engine very rapidly surpassed all others, so that now the Otto cycle engine is manufactured over the whole world by hundreds of makers. In 1876 Dr Otto used low compres- sion only about 30 lb per square inch above atmosphere. Year by year compression was increased and greater power and economy were obtained, and at present compressions of 100 lb per square inch are commonly used with most satisfactory results.

The history of the subject since 1876 is one of gradual improve- ment in detail of construction, enabling higher compressions to be used with safety. Attempts have also been made to produce gas engines giving an impulse at

every revolution insteaxi of one at every two revolutions, but these attempts so far have not been commercially successful. Perhaps the best known of this type is the Clerk engine, produced in 1881, and since followed by many designers.

Gas engines may be divided, so far as concerns their working process, into three well-defined types : ???

(1) Engines igniting at constant volume, but without previous compression ;

(2) Engines igniting at constant pressure, with previous compression ;

(3) Engines igniting at constant volume, with previous compression.

Eor practical purposes engines of the first and second types may be disregarded. Gas engines without compres- sion are now considered to be much too wasteful of gas to be of commercial importance. Those of the second type have never really reached the stage of commercial appli- cation ; they are scientifically interesting, however, and may take an important place in the future development of the gas engine. The expectations of the late Sir Will- iam Siemens with regard to them have not been realized, althoitgh he spent many years in experiments. Of other engineers who also devoted much thought and work to this second type may be mentioned Bray ton, 1872 ; Eoulis, 1878 ; Crowe, 1883 ; Hargreaves, 1888 ; Clerk, 1889 ; and Diesel, 1892. All the gas and oil engines now in com- mercial use are of the third type.

The working cycles of the three types are as follows : ???

First Type. ??? Four operations.

(o) Charging the cylinder with explosive mixture at atmo- spheric pressure.
(6) Exploding the charge.

(c) Expanding after explosion.

(d) Expelling the burnt gases.

Second Type. ??? Five operations.

(a) Charging the pump cylinder with gas and air mixture at

atmospheric pressure. (6) Compressing the charge into an intermediate receiver.

(c) Admitting the charge to the motor cylinder, in a state

of flame, at the pressure of compression.

(d) Expanding after admission.

(e) Expelling the burnt gases.

Third Type. ??? Five operations.

(a) Charging the cylinder with gas and air mixture at

atmospheric pressure. (6) Compressing the charge into a combustion space.

[gas engines

(c) Exploding the charge.

(d) Expanding after explosion.

(e) Expelling the burnt gases.

In all these types the heating of the working fluid is accomplished by the rapid method of combustion within the cylinder, and for the cooling necessary in all heat engines is substituted the complete rejection of the working fluid with the heat it contains, and its re- placement by a fresh portion taken from the atmosphere at atmos- pheric temperature. This is the reason why those cycles can be repeated with almost indefinite rapidity,

while the old hot-air engines had to run slowly in order to give time for the working fluid to heat or cool through metal surfaces.

Otto Cycle engines belong to the third type, being ex- plosion engines in which the combustible mixture is com- pressed previous to explosion. Eig. 1 is a side elevation, Fig. 2 is a plan, and Fig. 3 is an end elevation of an en-

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Fig. 1. ??? Side elevation of Otto Cycle Engine.

gine built by Messrs Crossley of Manchester, who were the original makers of Otto engines in Great Britain. In external appearance it somewhat resembles a modern high-pressure steam engine, of which the working parts are excessively strong. In its motor and only cylinder, which is horizontal and open-ended, works a long trunk piston, the front end of which carries the crosshead pin. The crank shaft is heavy and the fly-wheel large, consid- erable stored energy being required to carry the piston through the negative part of the cycle. The cylinder is considerably longer than the stroke, so that the piston when full in leaves a space into which it does not enter. This is the combustion space, in which the charge is first com- pressed and then burned. On the forward stroke, the piston A (Fig. 2) takes into the cylinder a charge of

.&.

Fig. 2.??? Plan of Otto Cycle Engine.

mixed gas and air at atmospheric pressure, which is com- pressed by a backward stroke into the space z at the end of the cylinder. The compressed charge is then ignited, and so the charge is exploded with production of a high pressure. The piston now makes a forward stroke under the pressure of the explosion, and on its return, after the exhaust valve is opened, discharges the products of com- bustion. The engine is then ready to go through the same cycle of operations. It thus takes four strokes or two revolutions of the shaft to complete the Otto cycle, the cylinder being used^ alternately as a pump and a motor,

and the engine, when working at full load, thus gives one impulse for every two revolutions. The valves, which are all of the conical-seated lift type, are four in number ??? charge inlet valve, gas inlet valve, igniting valve, and ex- haust valve. The igniting valve is usually termed the timing valve, because it determines the time of the ex- plosion. Since the valves have each to act once in every two revolutions, they cannot be operated by cams or ec- centrics placed directly on the crank shaft. The valve shaft D is driven at half the rate of revolution of the crank shaft c by means of the skew or worm gear e, one wheel of which is mounted on the crank shaft and the other on the valve shaft. Ignition is accomplished by means of a metal tube heated to incandescence by a Bunsen burner. At the proper moment the ignition or timing valve is opened, and the mixed gas and air under pressure being admitted to the interior of the tube, the inflammable gases come into contact with the incandes- cent metal surface and ignite ; the flame at once spreads back to the cylinder and fires its contents, thus producing the motive explosion.

The working parts are as follows: ??? a the piston, e the connect- ing rod, c the crank shaft, d the side or valve shaft, e the skew gearing, r the exhaust valve, g the exhaust valve lever, h the ex- haust valve cam, i the charge inlet valve, j the charge inlet valve lever, k the charging valve cam, l the gas inlet valve, m the gas valve cam, n lever and link operating gas valve, o igniting or timing valve, p timing valve cam, q timing valve lever or tumbler, E igniting tube, s governor, t water jacket and cylinder, u Bunsen burner for heating ignition tube. On the first forward or charg- ing stroke the charge of gas and air is admitted by the inlet valve I, which is operated by the lever j from the cam k, on the valve shaft D. The gas supply is admitted to the inlet valve i by the lift valve 1^, which is also operated by the lever and link n from the cam M, controlled, however, by the centrifugal governor s. The governor operates either to admit the gas wholly, or to cut it ofi completely, so that the variation in power is obtained by varying

Fig. 3.??? End elevation of Otto Cycle Engine.

the number of the explosions. The exhaust valve f is actuated by the lever o and cam ii. The ignition is produced by admitting a portion of the compressed inflammable charge from the com- pression space to the metal

tube k, rendered incandescent by the Bunsen flame. The passage to the incandescent tube is controlled by the tuning valve o, operated by the lever q from cam p. The valve o is double-seated, and during the compression period of the engine the face nearest the compression space is kept up against the seat by a powerful spring. The incandescent tube is thus kept open to the atmosphere, and notwithstanding any leak which may occur from the cylinder, the tube remains empty until the moment when it is rccjuired for ignition. When the valve is lifted from one seat, a small portion of the compressed mixture is discharged through a small port to the air, and this clears out the burnt gases from the passages between the cylinder and the igniting tube ; these burnt gases would otherwise render the ignition

irregular. By this device a pure combustible mixture at onoe readies the incandescent interior surface of the igniting tube, when the outer valve closes on its seat and the charge at once ignites:

The adoption of lift valves for the admission and discharge of gases to and from the engine cylinder is an important advance on the slide valve employed in the earlier engines, for it renders possible the use of much higher compressions. So long as slide valves were used it was difficult to provide a sufficiently large inlet area, as the area of the port determined the pressure necessary to hold tlie slide valve up against the cylinder face ; hence a large port necessitated a heavy pressure, and a slide pressed up by a heavy pressure against a port carrying flame at a temperature of at least 1600 C. was easily overheated, and cut on the surface. Slide valves therefore made it practically impossible to use either large

Fig. 4. Crossley Otto Engine.

ports or high explosion pressures. The slide valve, too, with its flame igniter, proved more troublesome in practice than the tube igniter. With lift valves and tube ignition the dif&culties are removed. In Great Britain slide valves

and flame igniters have quite disappeared, and all designs of Otto cycle engines use lift valves and tube ignition in various forms. In the older Otto engines also the side shaft was driven by bevel or spur gear from the crank shaft. In recent engines the skew or worm gear is gen- erally adopted. It is found to produce a more sightly engine, and also to operate much more smoothly than the old arrangement.

Since the engine shown in Figs. 1 to .3 was built further modi- fications have been made, principally in the direction of dispensing

^e^tfee^'-

FiG. 5. 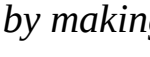 *530 I.H.P. Crossley Otto Engine.*

with or diminishing port space, that is, so arranging the ports that the compression space is not broken up into several separate chambers. In this way the cooling surface in contact with the intensely hot gases is reduced to a minimum. This is especially important when high compressions are used, as then the com- pression space being small, the port spaces form a large proportion of the total space. For maximum economy it is necessary to get

rid of port space altogether ; this is done by making the lift valves open directly into the compression space. This arrangement can be readily made in small and medium-sized engines, but in the larger engines it becomes necessary to provide ports, so as to allow the valves to be more easily removed for cleaning. Fig. 4 is an external view of a modern Crossley Otto engine, arranged with its valves opening directly into the combustion chamber, as made for engines of moderate powers. Fig. 5 is an external view of one of the largest gas engines built by Messrs Crossley. It is a double cylinder engine, with the cylinders facing each other ; the opposing connecting rods engage the same crank pin. The valve arrangements involve the use of short ports, but the port space is relatively very small. The cylinders are each of 26 inches diameter, and the stroke is 3 feet. The speed is 150 revolutions

per minute, and the maxi- ^ mum indicated horse-power

530. The engine was built for Messrs Brunner, Mond, and Co. of Northwich, to work with Mond producer gas.

Otto cycle engines, with slight variations from the type described above, are made by a number of British firms. The minor points in which they differ often display considerable ingenuity.

rig. 6 is an indicator diagram from a Crossley Otto Gas engine, a b is the atmospheric line, b c the compression line, c d the explosion line, d e the expansion line, and B B A the exhaust line. The scale of this dia- gram is small because of the heavy pressures to be registered, and accordingly the suction line and the exhaust lines are not distinguishable from the atmo- spheric line. Fig. 7 is an indicator diagram taken from the same engine by means of a light spring in the indi- cator ; it gives only part of the compression and part of the fall of pressure, because the movement of the indi- cator piston was limited. It shows clearly, however, the different course of the exhaust line and the suction line. As before, a b is the atmospheric line, f g h is the exhaust line, during which the piston is moving in the direction of the arrow 1. At g this line crosses below the atmospheric line, and remains below till the end of the stoke at i. The suction line is i h k. It remains slightly below atmospheric pressure dur- ing the whole time the piston is mov- ing in the direction of the arrow 2. In both Figs. 6 and 7 the arrows in- dicate the direction of the movement of the piston of the engine while the parti- cular curve is being traced. It will be seen from Fig. 6 that the gas con- sumption is 14-8 cubic feet per indicated horse-power per hour, and 17 cubic feet per brake horse-power hour, the engine being a small one, with cylinder 7 inches diameter and 15 inches stroke, giving practically 12 brake horse-power. Larger engines recently made by Messrs Crossley give one brake horse-power hour on so low a consumption as 13-5 feet of the same gas. Man- chester coal gas used in these tests has a heating value of 630,000 foot pounds per cubic foot, so that the latter result gives a conversion of 27‘6 per cent, of the whole heat of the gas into brake, that is, eifective, horse- power. It may now be taken that a modern Otto cycle

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gas engine by a standard maker will consume in ordinary work, if of large size, about 17 cubic feet of gas per brake horse-power-hour, and about 25 cubic feet per brake horse-power-liour if of small size.

It was first pointed out by the present writer that the theoretic efaciency of an Otto cycle engine depends on the compression, and that it is constant for any given com- pression and independent of the maximum temperature of

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Figs. 6, 7. 4 N.H.P. Crossley Otto Scavenging Engine.

Diameter of cylinder, 7 inelies ; stroke, 15 inches ; rCToIutions per minute, 200 ; I.H.P., 14 at 100 lb per square incJi mean pressure (average of three cards); gas consumption per l.H.P. per hour, 148 cubic feet (Openshaw gas, 20 candle-power) ; B.H.P. 11-9T: gas consumption per B.H.P. per hour, 17 cubic feet ; maximum pressure of explosion, 275 lb per square inch ; pressure of com- pression, 87‘5 ib per square inch ; compression space, 34 per cent, of volume swept by piston.

the explosion. Assume an ideal Otto cycle engine, operat- ing with pure air ; assume the compression line to be truly adiabatic, the explosion to take place at constant volume, and the expansion from the maximum temperature to be adiabatic 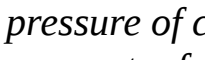 i.e., assume an air engine in which the air does not lose heat to the enclosing walls of the cylinder, or gain it from

these walls ; further, suppose that the air is ad- mitted to and discharged from the cylinder without loss. Then on such an engine the proportion of heat given to the engine, and converted into indicated work upon the piston, depends only on the compression, and is constant for any given compression. The indicated efiEiciency is the proportion of heat given to the engine which is converted into work, and it may be expressed in terms of the volume of the air before and after compression as

When v❓❓❓ is the total volume of gases in the cylinder and compression space before compression, and v❓❓❓ is the volume at maximum compression, y= 1-408, a constant for the ratio between the specific heat of air at constant pressure and constant volume, and b is the efficiency. Working out the theoretic eflBciencies for different pres- sures of compression in an Otto cycle engine, the following values are found for certain selected compressions : ❓❓❓

Pressure in lb per

Square Inch above

Atmosphere.

Theoretic Eflficiency

for Corresponding

Pressure.

1

2 3 4

38

67

87

210

0-33 0-40 0-43 0-56

The first three pressures have been chosen as pressures which have been used at different times in the Otto cycle engine. The fourth is chosen as a probable limit for Otto cycle engines without added compounding. It is now universally accepted that the theoretic efficiency depends absolutely on the compression. Hence, since the introduction of the Otto cycle engine, the history is one of gradually increasing compression and gradually increasing economy. The following figures give the actual indicated efficiency found in practice from 1882 to 1894 in engines using different degrees of compression : ???

Tears.

Efficiency.

Pressure of Compression above Atmosphere.

1

2 3

1882-88 1888-94 1894

0-16

0-19 025

38 lb per square inch. 67 lb per square inch. 87 ft) per square inch.

The pressures correspond to the pressures in the pre- ceding table, and the actual efficiency steadily rises with increased compression, and practically in proportion to the increased theoretic efficiency. In each case, in fact, the actual efficiency is equal, roughly, to half the theoretic efficiency. The actual engine, of course, has losses of heat to the cylinder ; with the flame within the cylinder at the temperature of a blast-furnace these could not be avoided. There are other losses, too, from im- perfection in carrying out the condi- tions of the cycle. The heat is not all added at the beginning of the

stroke, as theory requires. On the contrary, combustion goes on through the stroke. The expansion line thus is not truly adiabatic, nor is the compression line. However, the losses and departures from perfection of cycle make practice come within 50 per cent, of theory, and even with this the gas engine converts a far larger proportion of heat given to it into work than any steam engine and boiler. In steam engines of moderate dimen- sions only 12 per cent, of the total heat given to the boiler in the form of coal appears in the engine as indicated work. It is found in practice that with increased compression the percentage of actual to theoretic efficiency increases. Taking the third figure, for ex- ample, 0-25, the highest of the actual efficiencies is 0-58 of the theory, while 0-16 is only 0-45 of the lower effici- ency. The compression to over 200 lb per square inch only increases the theoretic efficiency to 0-55; but an actual engine with this compression would probably give an efficiency of 0-38. The engine, however, would have a maximum pressure of about 700 ft per square inch, with a usual explosion temperature of about 1700 C. This would make it too heavy in proportion to its power to be commercially successful.

Some 50,000 Otto cycle engines have been made and sold in the British Isles alone, and 35,000 on the Continent. About the year 1880 most of the engines were of small dimensions ; the largest size was known as 16 horse-power nominal, and the most popular engine was the 3 horse-power size. Gradually the power of the engines increased, and engines have since been buUt with two cylinders indicating over 500 horse-power. The whole gas engine power now at work in Britain cannot fall far short of half a million horse-power, nor can the Continental power be much short of 300,000 horse-power. The work performed is multifarious all the stationary work of the steam engine, in fact. An interesting inquiry has been made by Schaefer into the distribution of the gas engine among the various industries in Germany. He found in 1894 that of 2300 gas engines distributed throughout thirty-six German cities 65-6 per cent, were distributed among the following industries : printing, pumping water, textile, electric lighting, machine shops, joiners and cabinetmakers, butchers, locksmiths, cofiee-roasters, cutlery, elevators. Of these the number used in the printing industry was in excess of the others by 14-4 per cent. ; next came pumping with 8-6 per cent., and so on. The remaining 34-4 per cent, was scattered through 140 more industries. One-half the engines

were used in large factories. In England the average power per engine used has been stated by Mr Dowson to be about V2 horse-power per engine. So far the substantial application of the gas engine has been confined to stationary engines. Several attempts have been made to propel tramcars and cars running in Germany, and between Blackpool and St Anne's in England, in which tlie motive power is given by gas engines supplied with gas compressed and carried in reservoirs. Compressed gas, too, has been used in one barge in France to operate gas engines driving a screw propeller, but no important application has been made in this direction. The light oil engines, now largely used for motor- cars, are practically gas engines, and will be described later.

The unit of heat supplied to a gas engine in the form of coal gas is more costly than the unit of heat supplied to the steam engine in the form of coal, so that the gas engine using town's gas is at a disadvantage. So long as coal gas alone was used, only the smaller powers really

competed with steam, their lower cost of attendance and the wastefulness of the small steam engine giving them the advantage. The disadvantage of the more expensive heat unit is not felt in such cases, because the governing of the engine (so far as fuel consumption is concerned) and the heat efficiency are so much superior to any- small steam engine, that the gas engine is more econom- ical even in actual expense of fuel. Accordingly it is quite unnecessary to trouble about gas other than town's gas for engines under 20 horse-power, but larger engines working at or near full load require cheaper gas to compete. They are therefore supplied with gas by a Dowson or some similar producer. Good results are thus obtained. With an engine indicating, for example, 100 horse-power, a consumption of 1 lb of anthracite per indicated horse-power is usual, and even lower ???consumptions have been recorded. (See Gas Plants FOR Power Purposes.)

Blast-furnace gases are now used to a limited extent on the Continent for the purpose of producing motive power by gas engines. Although the experiments were first made in Great Britain, yet Continental engineers have been first in the field commercially. Mr B. H. Thwaite in 1895 started an experimental plant at the Glasgow Iron Works, Wishaw, arranging an apparatus which took gas from the blast-furnace main, purified it by scrubbing and passed it into a gas-holder. A 20 horse-power gas engine, supplied from the holder, drove a dynamo for electric lighting with good results. Mr Thwaite con- sidered that one brake horse-power per hour could be obtained for every 1^ lb of fuel fed into the blast-furnace, and he further calculated that each blast-furnace of ordi- nary dimensions would provide suflS.cient gas to give a spare power by gas engine of about 2500 horse-power. This opens up a great field for the saving of fuel and the cheap production of power. The blast-furnaces of the United States of America, Mr W. H. Booth calculated, could produce 2,000,000 horse-power continuously by gas engine. Mr Thwaite's plant has also been set up at Prodingham, near Doncaster. Simultaneously with Mr Thwaite's experiments, the Societe Cockerill at Seraing, in Belgium, also attacked the problem. They have estab- lished at their Seraing works two engines each of 200 horse-power, and one engine of 600 horse-power, operated by blast-furnace gas. The three engines were working well when inspected by the present writer in 1901. Several engines of 1200 horse-power have been constructed at the same works. The Cockerill engines operate on the Otto cycle. Two engines, each of 600 horse-power, have been set up at the Hoerde Iron Works in Westphalia. These engines are of the impulse every revolution type, some- what after the Clerk cycle, and are the invention of Mr Oechelhauser. The Gas Motoren Pabric Deutz have built large engines for this purpose, among them being one with two cylinders, each giving 300 horse-power; this has been erected at Oberhausen. English makers are also constructing large gas engines for blast-furnace gases, and an interesting advance in the power of the engines may be expected. The largest English gas engine constructed so far is one by Messrs Crossley Brothers of 700 horse-power for Sir Alfred Hickman's works, to be operated with blast-furnace gas. Other large gas en- gines have been constructed by the Premier Company, 500 horse-power; Stockport engine, 300 horse-power; Tangye engine, 100 horse-power; Fielding engine, 100 horse- power; Campbell engine, 100 horse-power; and Westing- house engine, 650 horse-power. The last of

these was built in America, but the new works of the British Westinghouse Electric Company at Manchester have been built to undertake their manufacture in Great Britain. The Westinghouse gas engine is of the enclosed crank.

vertical cylinder type; electrical ignition is used, and there is an interesting system of mixing the gas and air before admission to the engine cylinder. The engine is governed by throttling the gas and air charge after mixing. The Otto cycle is followed, and in the large gas engines the piston is supplied with a forced water circulation. All the large gas engines of both English and Continental makers now water-jacket the pistons.

3. Oil Engines.

Oil engines resemble gas engines in that the power is generated by the explosion of a compressed inflammable gaseous mixture in an engine operating according to the Otto cycle. In the earlier forms, and in those used on motor cars, where very light inflammable oils of the gasoline or petrol kind are consumed, the problem of vaporizing the oil is comparatively simple. It is only necessary to draw air over a surface saturated with gasoline or some lighter oil to produce a mixture of vapour and air which, when taken into the cylinder, readily supplies the place of coal gas, and gives explosions under compression closely resembling those obtained with coal gas. The earliest proposal to use oil as a means of producing motive power by explosion was made by Street in 1791, but the first practical petroleum engine was that of Julius Hock of Vienna, produced in 1870. It was of the non-compression kind, like Lenoir's ; it took in a charge of air and light petroleum spray during part of the forward stroke of the piston, ignited the charge by a flame jet, and so produced a low-pressure explosion. In 1873' Brayton, an American engineer, produced an oil engine using light oil on the constant-pressure system. The engine was a flame engine, operating without explosion, and it was the earliest compression engine to use oil fuel instead of gas. Shortly after the introduction of the Otto gas engine in 1876, air charged with inflammable vapour by being passed through gasoline was drawn into the engine cylinder with a further supply of air to form an explosive mixture, which was compressed and ignited in the usual way. The Spiel petroleum engine

was the first Otto cycle engine introduced into practice which dis- pensed with an independent vaporizing apparatus. Light oil, of specific gravity not greater than -725, was injected directly into the cylinder on the suction stroke. It mixed with the air and was vaporized, and on compression an explosion was obtained, just as with a gas engine. Many engines consuming light oil are used in America for stationary work, but in Great Britain they are confined almost entirely to motor-cars, motor-cycles, and motor vehicles generally.

*The first and the most successful of all the light oil road carriage motors is the Daimler. Many other ingenious motors are in use, hut if the peculiarities of this form be understood, it is not difficult to follow the others. Fig. 8 is a diagrammatic section of the Daimler motor, a is the cylinder, b the piston, c the connecting rod, and d the crank, which is entirely enclosed in a casing. A small fly-wheel is carried by the crank shaft, and it serves the double purpose of a fly-wheel and a clutch, a is the combustion space, E the single port, which serves both for inlet and charge and for discharge of exhaust, w is the exhaust valve, f the charge inlet valve, which is automatic in its action, and is held closed by a spring /, 6 the vaporizer, h "the igniter tube, i the igniter tube lamp, k the air charge inlet passage, l the air filter chamber, and m an adjustable air inlet cap for regulating the air inlet area. The light oil**** *or petrol, as it is commonly called* *** *is supplied to the float chamber n of the vaporizer by means of the valve o. So long as the level of the petrol is high, the float n, acting by levers above it, holds the valve o closed against oil forced by air pressure along the pipe p. When the level falls, however, the valve opens and more oil is admitted. When the piston B makes its suction stroke, air passes from the atmosphere by the passage k through the valve f, which it opens automa- tically. The pressure falls within the passage k, and a spurt of petrol passes by the jet g^, separate air at the same time passing*

by the passage k^ round the jet. The petrol breaks up into spray- by impact against the walls of the passage k, and then it vaporizes and passes into the cylinder a as an inflammable mixture. When the piston b returns it compresses the charge into a, and upon compression the incandescent igniter tube h fires the charge, h is a short platinum tube, which is always open to the compression space. It is rendered incandescent by the burner i, fed with petrol from the pipe supplying the vaporizer. The open incan-

PiG. 8. ००० Diagrammatic section of Daimler Motor.

descent tube is found to act well for small engines, and it does not ignite the charge until compression takes place, because the inflammable mixture cannot come into contact with the hot part till it is forced up the tube by the compression. The engine is started by giving the crank shaft a smart turn round by means of a detachable handle. The exhaust valve is alone actuated from the valve shaft. The shaft q is operated by pinion and a, spur wheel q2 at half the rate of the crank shaft. The governuig is accomplished by cutting out explosions as with the gas engine, but the governor operates by preventing the exhaust valve from opening, so that no charge is discharged from the cylinder, and therefore no charge is drawn in. The cam r operates the exhaust valve, the levers shown are so controlled by the governor (not shown) that the knife edge s is pressed out when speed is too high, and cannot engage the recess t until it falls. The engine has a water jacket v, through which water is circulated. Cooling devices are used to economize water. Most of the motor-car engines resemble the Daimler. Tor the

smaller vehicles, however, such as cycles, the cylinders are not water-jacketed, but are provided with ribs to radiate away the heat. Some engines also use electric spark ignition generated by battery and CQil, or by magneto-electric devices. The application of oil engines to motor carriages has led to a multitude of most ingenious details, which cannot here be dealt with. The Daimler engine and similar engines have been extensively applied to small marine work, such as launches and dinghies.

Heavy oil engines are those which con- sume oil having a flashing point above 73०० I'. ००० the minimum at present allovred by Act of Parliament in Great Britain for oils to be consumed in ordinary illu-minating lamps. Such oils are American and Eussian petroleums and

Scottish par- affins. They vary in specific gravity from ⁄⁄⁄78 to -825, and in flashing point from 75⁄⁄ to 152⁄⁄ r. Engines burning such oils may be divided into three distinct classes : ⁄⁄⁄

1st. Engines in which the oil is sub- jected to a spraying operation before va- porization.

2nd. Engines in which the oil is in- jected into the cylinder and vaporized within the cylinder.

3rd. Engines in which the oil is vapor- ized in a device external to the cylinder, and introduced into the cylinder in the state of vapour.

The method of ignition might also be used to divide the engines into those igniting by the electric spark, by an in- candescent tube, or by the heat of the internal surfaces of the combustion space. Spiel's engine was ignited by a flame- igniting device similar to that used in Clerk's gas engine, and it was the only one introduced into Great Britain in which this method was adopted, though on the Continent flame igniters were not uncommon. Recently, however, elec- trically-operated igniters have come into extensive use on the Continent. In Great Britain all other methods of igni- tion both in gas and oil engines have for practical purposes been displaced by hot-tube and hot-surface igniters.

The engines at present in use in Great Britain which fall under the first head are the Priestman and the Samuelson, the oil being sprayed before being vapor- ized in both. The principle of the spray producer used is that so well and so widely known in connexion with the atomizers or spray producers used by perfumers. Fig. 9 shows such a spray producer in section. An air blast passing from the small jet a crosses the top of the tube b, and creates within it a partial vacuum. The liquid contained in c flows up the tube b, and issuing at the top of the tube through a small orifice is at once blown into very fine spray by the action of the air jet. If sach a scent distributor be filled with petroleum oil, such as Royal Daylight or Russoline, the oil will be blown into fine spray, which can be ignited by a flame and will burn, if the jets be properly proportioned, with an intense blue non-luminous flame. The earlier inventors often ex- pressed the idea that an explosive mixture could be prepared without any vaporization

whatever, by simply producing an atmosphere containing inflammable liquid in extremely small particles distributed throughout the

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air in such proportion as to allow of complete combustion. The familiar explosive combustion of lycopodium, and the disastrous explosions caused in the exhausting rooms of flour mills by the presence of finely-divided flour in the air, have also sug- gested to inventors the idea of produc- ing explosions for power purposes from combustible solids. Although, doubtless, explosions could be produced in that way, yet in oil en- gines the produc- tion of spray is only a preliminary to the vaporization of the oil. If a sample of oil be sprayed in

Fig. 9. ??? ^Perfume Spray Producer.

the manner just described, and injected in a hot chamber also filled with hot air, it at once passes into a state of vapour within that chamber, even though the air be at a temperature far below the boiling point of the oil. The spray producer, in fact, furnishes a ready means of saturating any volume of air with heavy petroleum oil to the full extent possible from the vapour tension

the exhaust valve n is opened and the exhaust gases discharged by way of the pipe o, round the jacket p, enclosing the vaporizing chamber. The latter is thus kept hot Ijy the exhaust gasfes when the engine is at Work, and it remains sufficiently hot without the use of the lamp o. To obtain the electric spark a bichromate

Fig. 10.??? Priestman Oil Engine (general arrangement).

of the oil at that particular temperature. The oil engines described below are in reality explosion gas engines of the ordinary Otto type, with special arrangements to enable them to vaporize the oil to be used. Only such parts

of them as are necessary for the treatment and ignition of the oil will, therefore, be described.

In rig. 10 is shown the general arrangement of the Priestman engine, which was the iirst capable of using heavy safe oils. Fig. 11 is a vertical section through the cylinder and vaporizer, and Fig. 12 is a section on a larger scale, showing the vaporizing jet and the air admission and regulation valVe leading to the vaporizer. Oil is forced by means of air pressure from the reservoir A through the pipe e to the spraying nozzle c, and air passes from the air-pump d by way of the annular channel 6 into the sprayer c, and there meets the oil jet issuing from a. The oil is thus broken up into spray, and the air charged with spray flows into the vaporizer e, which is heated up in the first place on starting the engine by means of a lamp g. In the vaporizer the oil spray becomes oil vapour, saturating the air within the hot walls. On the out-charging stroke of the piston the mixture passes by way of the inlet valve h into the cylinder, air flowing into the vaporizer to replace it through the valve i (Fig. 12). The cylinder k is thus charged with a mixture of air and hydrocarbon vapour, some of which may exist in the form of very fine spray. The piston l then returns and compresses the mixture, and when the compression is quite complete an electric spark is passed between the points m, and a compression explosion is obtained precisely similar to that obtained in the gas engine. The piston moves out, and on its return stroke

Fig. 11. ??? Priestman Oil Engine (vertical section through cylinder and vaporizer).

battery with an induction coil is used. The spark is timed by contact pieces q, operated from the eccentric rod k, used to actuate the exhaust valve and the air-pump for supplying the oil chamber and the spraying jet. To start the engine the hand pump is worked until the pressure is suffi- cient to force the oil through the spraying nozzle, and oil spray is formed in the lamp g ; the spray and air mixed produce a blue flame which heats the vaporizer. The fly-wheel is then rotated by hand, and the engine moves away. The eccentric shaft is driven from the crank shaft by means of toothed wheels, which reduce the speed to one-half the revolutions of the crank shaft. The charging inlet valve is automatic. Governing is effected by throttling the oil and air supply. The governor operates on the butterfly valve t (Fig. 12), and on the

plug-cock t connected to it, by means of the spindle fi-. The air and oil are thus simul- taneously reduced, and the attempt is made to maintain the charge entering the cylinder at a constant proportion by weight of oil and air, while reducing the total weight, and therefore volume, of the charge entering. The Priestman engine thus gives an explosion on every second revolution in all circumstances, whether the engine be running light or loaded. The com- pression pressure of the mixture before admission is, however, steadily reduced as the load is reduced, and at very light loads the engine is running practically as a non-compression engine. This is a grave disadvantage, as the fuel consump- tion per indicated horse- ji power rises rapidly with

the reduction of com- pression.

A test by Professor Unwin of a 4J nominal horse-power Priestman engine, cylinder 8-5 inches diameter, 12 inches stroke, normal speed 180 revolutions per minute, showed the consumption of oil per indicated horse – power hour to be 1-066 lb, and per brake horse- power hour 1-243 tb. The oil used was that known as Broxburn Lighthouse, a Scottish paraffin oil produced by the destructive dis- tillation of shale, hav- ing a density of -81 , and a flashing point about 152 F. With a 5 horse-power engine of the same dimensions, the volume swept by the piston per stroke being -395 cubic feet, and the clearance space in the cylinder at

Fig. 12. Priestman Oil Engine (section on a larger scale).

the end of the stroke -210 cubic feet, the principal results were :

Daylight Oil.

Eussoline Oil.

Indicated Horse-Power .

Brake Horse-Power

Mean Speed (revolutions per minute)

Mean available Pressure (revolu-“!

*tions per minute) . . J Oil consumed per Indicated Horse- *

*Power per Hour . . . / Oil consumed per Brake Horse- *

Power per Hour . . . /

9-369

7-722 204-33

53-2

-694 lb -842 lb

7-408 6-765 207-73

41-38

-864 H) -946 K)

With Daylight oil the explosion pressure was 151-4 lb per square inch above atmosphere, and with Russoline 134-3 lb. The ter- minal pressure at the moment of opening the exhaust valve with Daylight oil was 35-4 lb, and with Kussoline 33-7 per square inch. The compression pressure with Daylight oil was 35 tb, and with Russoline 27-6 lb pressure above atmosphere. Professor Unwin calculated the amount of heat accounted for by the indicator as 18-8 per cent, in the case of Daylight oil and 15-2 in the case of Russoline oil.

Messrs Samuelson’s engine is constructed under the GrifSn patents, and it resembles Priestman’s in subjecting the oil to the preliminary process of

spraying before vaporizing ; the vaporizer also is heated during the run- ning of the engine by the ex- haust gases. It differs, however, from the Priestman engine in the methods of igniting and governing. The tube igniter is used, and the governing device, instead of reducing the power of the explosions, so operates that when speed becomes too high the air supply is entirely cut off and the exhaust valve closed, after the combustion products of the last explosion have been discharged from the cylinder. The piston consequently moves

out, expanding the contents of the compression space, while the oil valve is simultaneously shut off in the sprayer, so that no oil is injected. Pig. 13 is a section of the Griffin patent oil sprayer.

*Fig. 13.****???****Section of Griffin Oil Sprayer.*

Pig. 14. ***???****Samuelson Engine Vaporizer (longitudinal transverse section, plan and end elevation).*

The air enters by way of the passage a, and discharges through the nozzle a^, thereby causing a partial vacuum in the annular space B formed between the air nozzle and the oil nozzle. The passage b^ connects to the oil-supply chamber b1 by way of a spraying valve c attached to a plunger stem ci. The air pressure, when admitted, forces down the plunger o', and thus opens the valve o against the pressure of the spring. Oil thus passes up the passage b^ from the chamber b^, and is discharged with the air from the nozzle a^ in a state of fine spray. Whenever the air-pressure is removed from the plunger c^, the spring forces the valve to its seat and cuts off the oil supply. The air pressure is maintained at from 12 to 15 lb above atmosphere by a pump driven from an eccentric on the valve shaft. The vaporizer is shown in longi- tudinal transverse section, plan and end elevation, in Fig. 14. The vaporizer e, corrugated in outline, is surrounded by the ex- haust jacket F. The air is admitted from the atmosphere by the

adjustable perforated plate g, and the spray nozzle, attached at a point H, discharges the spray into the centre of the vaporizer. In- stead of the electric spark for igniting, an incandescent tube is adopted, heated and kept hot by an ingenious lamp shown in Fig. 15. In this lamp oil is admitted to the chamber J by the pipe K, and it is maintained at a constant level there by

means of the overflow pipe l. A short piece of wire m is immersed m the oil, and the oil runs up the wire and covers the bent part by reason of capillary attraction. Air under pressure is admitted by way of the pipe n adjusted by the screw n1, and it passes to the nozzle o, striking upon the bent part of the wire in. The air thus blows the oil off the wire, and at the same time- the jet sucks in a

Fig. 15. *Samuelson Engine Spray Lamp.*

further supply of air through holes p, and the mixed air and oil spray pass through the tube q to the asbestos-lined funnel k. The mixture, on being ignited within this funnel, burns with a fierce blue flame, and heats up the igniter tube s ; this opens into the engine cylinder, and ignites the mixture when it is compressed. To start the engine the air-pump is worked by hand until the required pressure is obtained ; air is then turned on the sprayer, and the spray lighted. By this means the vaporizer is heated for about ten minutes from within, the burnt gases being discharged through a special valve opening into the exhaust, this valve being closed when sufficient heat is attained. The heating lamp of the incandescent tube is in the meantime lighted, and the engine is ready to start.

The Hornsby-Ackroyd engine is an example of the class in which the oil is injected into the cylinder and there vaporized. Fig. 16 is a section through the vaporizer and cylinder of this engine, and Fig. 17 shows the inlet and exhaust valves also in section placed in front of the vaporizer and cylinder section. Vaporizing is conducted in the interior of the combustion chamber, which is so arranged that the heat of each explosion main- tains it at a temperature suffi- ciently high to enable the oil to be vaporized by mere injection upon the hot surfaces. The vaporizer a is heated up by a separate lamp, the oil is injected at the oil inlet b, and the engine is rotated by hand. The piston then takes in a charge of air by the air inlet valve into the cylinder, the air passing by the port directly into the cylinder without passing through the vaporizer chamber. While the piston is moving forward, taking in the charge of air, the oil thrown into the vaporizer is vaporizing and diffusing itself through the vaporizer chamber, mixing, however, only with the hot products of combustion left by the preceding explosion. During the charging stroke the air enters through the cylinder, and the vapour

formed from the oil is almost entirely confined to the combustion chamber. On the return stroke of the piston air is forced through the somewhat narrow neck a into the combustion chamber, and is there mixed with the vapour con- tained in it. At first, however, the mixture is too rich in inflammable vapour to be capable of ignition. As the com- pression proceeds, however, more and more air is forced into the vaporizer chamber, and just as compression is completed the mix- ture attains proper explosive proportions. The sides of the chamber are sufficiently hot to cause explosion, under the pressure

Fig. 16. ××× Hornsby-Ackroyd Engine (section through vaporizer and cylinder).

Fig. 17. ××× Hornsby-Ackroyd Engine (section through valves, vaporizer, and cylinder).

of which the piston moves forward. As the vaporizer a is not waterrjacketed, and is connected to the metal of the back cover only by the small, section or area of cast iron forming the metal neck a, the beat given to the surface by each explosion is sufBoient to keep its temperature at about 700-800×× (_'. Oil vapour mixed with air will explode by contact with a metal surface at a compara- tively low temperature ; this accounts for the explosion of the compressed mixture in the combustion chamber a, which is never really raised to a red heat. It has long been known that under certain conditions of internal surface a gas engine may be made to run with very great regularity, without incandescent tube or any other form of igniter, if some portion of the interior surfaces of the cylinder or combustion space be so arranged that the temperature can rise moderately ; then, although the temperature may be too low to ignite the mixture at atmospheric pressure, yet when com- pression is completed the mixture will often ignite in a perfectly regular manner. It is a curious fact that with lieavy oils ignition is more easily accomplished at a low temperature than with light

Fig. 18. ††† Hornsby-Ackroyd Oil Engine.

oils. The explanation seems to-be that while in the case of light oils the hydrocarbon vapours formed are tolerably stable from a chemical point of view, the heavy oils very easily decompose by heat, and separate out their carbon, liberating the combined hydrogen, and at the moment of liberation the hydrogen, being in what chemists know as the nascent state, very readily enters into combination with the oxygen beside it. To start the engine the vaporizer is heated by a separate heating lamp, which is supplied with an air blast by means of a hand-operated fan. This operation should take about nine minutes. The engine is then moved round by hand, and starts in the usual manner. The oil tank is placed in the bed plate of the engine. The air and exhaust valves are driven by cams on a valve shaft. Fig. 18 is a general view of the external appearance of the engine, from which it will be seen that the governing is effected by a centrifugal governor. This governor

OUTLET WATER

Fig. 19. ††† Vertical section of Crossley Oil Engine.

operates a bye-pass valve, which opens when the speed is too high, and causes the oil pump to return the oil to the oil tank. The fan and starting lamp will be seen in . the lower part of the illus- tration. At a test of one of these engines, which weighed 40 cwts. and was given as of 8 brake horse-power, with cylinder 10 inches in diameter and 15 inches stroke, according to Professor Capper's

report, the revolutions were very constant, and the power developed did not vary one quarter of a brake horse-power from day to day. The oil consumed, reckoned on the average of the three days over which the trial extended, was '91 !) lb per brake horse-power per hour, the mean power exerted being 8-35 brake horse. At another full-power trial of the same engine a brake horse-power of 8 -57 was obtained, the mean speed being 2.39-66 revolutions per minute, and

Fig. 20. ††† Sectional plan of Crossley Oil Engine.

the test lasting for two hours ; the indicated power was 10-3 horse, the explosions per minute ,119-83, the mean effective pressure 28-9 R) per square inch, the oil used per indicated horse-power per hour was -81 lb, and per brake horse-power per hour -977 ib. In a test at half power, the brake horse-power developed was 4-57 at 235-9 revolutions per minute, and the oil used per brake horse- power per hour was 1-48 lb. On a four hours' test, without a load, at 240 revolutions per minute, the consumption of oil was 4-23 lb per hour.

Other engines of this class are those manufactured by Messrs Robey & Co. and one, a German engine, known as the Capitaine.

IIR VALVE LEVER

*Fig. 21.**End elevation of Crossley Oil Engine.*

The former vaporizes its charge by the injection of the oil against the heated walls of the combustion chamber, and ignition is accomplished also by contact with these hot walls. The Capitaine engine has a vaporizer and igniter placed within the combustion space of a cylinder ; the oil is vaporized by injection upon the hot surfaces of the vaporizer, and ignition also takes place when com- pression is completed by contact with these hot surfaces. The late Mr Brayton also proposed and experimented with an engine somewhat of this type.

*Fig. 22.**Oil Pump for Crossley Oil En- gine (elevation).*

As a type of the engines in which the oil is vaporized in a device external to the cylinder, and introduced into the cylinder in a state of vapour, the Crossley oil engine may be described. Figs. 19, 20, and 21 show respectively vertical section, sectional plan, and end elevation of the combustion chamber and cylinder. Fig. 22 shows in. elevation the oil pump on a larger scale, a is the combus- tionspace, b the piston, c the air inlet valve, d the exhaust valve, e the vaporizer, p the vaporizer and igniter

casing, g the igniter tube, h the heating lamp, i the oil measurer, j the valve shaft, k the oil pump, i. the air valve lever, m the exhaust valve lever, and n the oil tank. The lamp H consists of a chamber into which oil is pumped. This chamber is heated in the first instance by burning a little oil upon waste. The oil vaporizes within the chamber when forced in by the pump, and it issues under pressure at a small nozzle at the foot of the lamp. The flame sucks air with it, and bums within a space passing through the lamp chamber. The flame so formed proceeds into the vaporizer casing f, heating first the igniter tube a, which is surrounded with a metal shield. The flame, after passing from the igniter tube, heats the vaporizer e, which consists of a casting having one passage within it, made continuous by a corresponding passage in the face shown in Fig. 20. Oil is pumped into the measurer i by means of the oil pump k. The measurer passes only a certain fixed volume at each stroke, the excess Tolume being sent back to the oil reservoir. The oil vaporizes in the vaporizer passage, and it is admitted to the engine by the oil valve o, which is operated by governor from the cam shaft j, as shown in Fig 22. The advance of the piston b draws in a charge of air through the valve c. At the same time the oil valve o is opened, and the vapour of oil passes into the cylinder from the vaporizer passage. A small quantity of air is at the same time sucked through the passage. A vaporized charge of oil is thus passed into the cylinder with the air charge, and the piston b on its return stroke compresses the charge into the combustion space A. There it is ignited by the igniter tube g, and the engine makes its explosion or power stroke. This operation is repeated so long as power is required. When the speed of the engine exceeds the limit, the governor prevents the vapour valve o from opening, and no oil charge finds its way through the measurer to the vaporizer passage. One of these engines declared of 7^ brake horse-power developed on the brake 6-28 horse-power, and consumed -90 lb of Russoline oil per brake horse-power per hour. The Tangye oil en- gine made under Pinkney's patents has also an external vaporizer, but all the air charge is dragged through the vaporizer to the cylinder, and the vaporizer is always opened to the cylinder, so that the port space is somewhat excessive. Many other oil engines are now upon the market, but all appear to be constructed in accordance with the types described.

Mr Diesel has, however, produced an engine which departs some- what from other types. In it air alone is drawn into the cylinder on the charging stroke. The air is compressed on the return stroke to a very high pressure, generally over 700 lb per square inch. This compression raises the air to incandescence, and then oil is injected into the incandescent air by a small portion of air compressed to a still higher point. The oil ignites at once as it enters the com- bustion space, and so a power impulse is obtained, but without explosion. The pressure does not rise above the pressure of air and oil injection. The Diesel engine thus embodies two very original features : it operates at pressures very much higher than those used on any other internal combustion engines and it dispenses with all the usual igniting devices by rendering the air charge incandescent by compression. The engine has been built both as an Otto cycle engine and as an impulse-every-revolution en- gine. One of the latter type was exhibited at the Glasgow Exhibition of 1901. So far the engine has not attained any com- mercial position. Although economical, it appears to be a heavy engine for the power developed.

The oil engine is at present in the development stage. Large alterations are continually being made, and in a tew years great extensions may be looked for in the applications of oil engines to industrial purposes. At present, so far as dimensions are concerned, they are in the stage which the gas engine had attained about 1880. The difficulties have not been so thoroughly over-come as in gas engines, and especially the difficulties of constructing them of large size. An oil engine giving

about 60 brake horse-power would at present be regarded as a large one, whereas now a large gas engine would be one giving about 300 brake horse-power. Great future developments may be expected both in gas and oil engines. So far as economy of heat is concerned, both have con-siderably surpassed the best steam engines, but much remains to be done before they equal the latter in frequency of impulses, in absolute steadiness of governing, iand in power of control for cases where, for instance, reversing is required. As yet the applications of gas and oil to any but fixed engines have been limited, but ultimately they will be used with great advantage for propelling ships and for driving locomotives. Many engineers are now at work on the subject, and when the problem is further solved it

will aid much in economizing fuel for all purposes where both large and small motive powers are required. (d. cl.)

England, Church of. ??? Subsequently to the period covered by the article in the 9th edition of this work, there has only been one material change in the constitutional status of the English Church. As a con- sequence of the disestablishment of the Irish Church, the "union created by Act of Parliament between the Churches of England and Ireland" was dissolved from 1st January 1871, although the Churches remain in full communion with one another. The projected disestablishment and disendowment of the four Welsh dioceses in 1893 would, if carried out, have had far more sweeping consequences ; but it was rejected on an appeal to the country (see Establishment). There are other events, however, which must be recorded, both as being more important in them- selves and as likely to lead to far-reaching consequences in the future. The so-called Catholic revival, of which the Oxford Movement was the most prominent feature, has, on the one hand, entirely remodelled the popular con- ception of the Church, and profoundly affected every side of its work ; whilst, on the other hand, many of its developments have been stigmatized as popish, and have called forth strenuous opposition on this account. A more liberal cast of thought and a revival of exact scholarship have done much to assuage the apprehen- sion with which natural science and Biblical criticism were formerly alike regarded ; and a sounder and deeper theology, chief amongst the pioneers of which was Frederick Denison Maurice, has not only displaced that which was widely current until long after the middle of the 19th century, but has found a strong support in the modern conceptions of evolution and the solidarity of the human race. Meanwhile, resolute efforts have been made to keep pace with the ever- growing religious and social needs of the great centres of population ; and a growing sense of the responsibility of the Church towards her own members in the colonies and elsewhere, and towards the heathen at large, has borne fruit in the growth and organization of the colonial Churches and in a greatly increased zeal for foreign missions. Eecourse must be had to other articles for information upon these subjects (see Anglican Communion, Missions) ; all that can be done here is to deal shortly with certain special heads, and to sup- plement what is said under these with statistical in- formation.

(1) The changes in ritual, based in the main upon the express provisions of the Ornaments Rubric, or else upon an interpretation of it, as referring to the year before the introduction of the First Prayer-book of Edwas-d VI., have given rise to frequent legislation, the more important early cases being those of Westerton v. Liddell (1855-n7), Martin v. Mackonochie (1867-68), and Elphin- stone (afterwards Hebbert) v. Purchas (1869-70). Each

of these was carried to the Privy Council, tl;e judgments of which not only varied in different cases, but showed no signs of being based upon an adequate knowledge of the facts under review. A Royal Commission on Ritual (1867-70) put forth valuable material, but did nothing to set matters at rest ; and several unsuccessful efforts at legislation culminated at length, in 1874, in the passing of the Public Worship Regulation Act, in spite of strong opposition. This only made things worse, by constituting a new civil court in place of the ancient Court of Arches (see Akches, Court of), and facilitating litigation, without in any way conducing to a better in- terpretation or administration of the law. In the Folke- stone case (1875-76) the defendant, the Rev. C. J. Ridsdale, only conformed to its judgment under a formal dispensation from his diocesan, Dr Tait, from the ob- servance of the rubric as he interpreted it; and in six other cases, the last being that of the Rev. J. Bell Cox in 1887, clergymen went to prison for contempt of court rather than obey its monitions. Public opinion declared itself very strongly against this, however, and largely owing to the influence of Archbishop Tait (who bore witness that nothing of the kind had been intended by the promoters of the Act), it gradually came to an end. An entirely new departure was marked by the case of the Bishop of Lincoln, in which a purely spiritual judg- ment was given (Lincoln Judgment), which was very widely accepted by Churchmen. Prom 1898 there has been renewed agitation on the subject of ritual excesses, but the temper of Parliament was opposed to any in- troduction of legislation which should overrule the power of the bishops. The question of the meaning of the Ornaments Rubric was again raised in 1899, in regard to the ceremonial use of incense and the reservation of the Eucharist. At the request of the bishops concerned,

the two Archbishops heard counsel and received evidence on both subjects (the Archbishop of York acting as assessor only as regards the former), and gave it as their opinion that both were forbidden (see Incense; Reservation). The directions of the bishops in accordance with these opinions have been very generally, but by no means universally, obeyed by the clergy; and an attempted prosecution of some of those who had not done so (by a non-parishioner) was stopped by the veto of the Bishop of London in December 1900. It was generally felt that action of some kind was desirable, but that it should be remedial rather than penal. Something has been done already by the restoration of the old Court of Arches ; but the recommendations of the Ecclesiastical Courts Commission (1881-83) have not yet borne fruit, and nothing has yet been done to adapt to modern con- ditions the rigidity of an order of service which was largely moulded by the conditions of the 16th and 17th centuries.

(2) Closely connected with the subject of ritual is that of doctrine, of which it is in general the outward expres- sion. As regards this, two things are noteworthy : on the one hand a tendency to permit the largest possible liberty of opinion, and on the other a fuller realization of ~~*the ancient doctrine of the Church as expressed in its formu*~~ *laries. The judgment of the Privy Council in the Gorham case (1847-50), to the effect that Mr Gorham's views were " not contrary or repugnant to the declared doctrine of the Church of England," is almost a dead letter excepting from the former point of view. Although* ~~*the Essays and Reviews, published in 1860, caused a great sensation at the time of their publication, the condemnation of two of the essayists in the Court of Arches was reversed by the Privy Council, and a third became Archbishop of Canter*~~ *bury in the person of Dr Temple. And Whilst many of the views advanced would now be repudiated as contrary*

*19^*

to sound learning, others are now on all hands accepted. Again, the Colenso controversy, if it showed that there was a rooted objection to the use of modern critical methods in the interpretation of Scripture, showed also that there was no Socinianism in the Church as a whole. Turning to the other side, the case of the Rev. W. J. E. Bennett (1870-72) vindicated for English Churchmen the right to hold and to teach the ancient doctrine of

the Real Presence in the Eucharist. Naturally, changes such as these have not come about without much party feeling. The opposing tendencies are represented by (for the High Church party) the English Church Union, founded in 1859 " to defend and maintain unimpaired the doctrine, discipline, and ritual of the Church of England," and (for the Low Church party) the Church Association, founded in 1865 "to counteract the efforts now being made to pervert the teaching of the Church of England." The more aggressive spirits in the Low Church party (with whom the name of Mr Kensit was associated in their more violent outbreaks) have been active in making public protests against what they regarded as Roman tendencies ; while similar tactics have been pursued by Father Black and others against the' marriage of divorced persons in church, and other practices objectionable to the advanced High Church section.

(3) As regards corporate action, considerable advances have been made. The revival of the meeting of Convocar tion for business, if it has not given autonomy to the Chvu'ch, has at least supplied it with a mouthpiece. In 1885 there was inaugurated a House of Laymen for the province by vote of both Houses of the Convocation of Canterbury. The Convocation of York followed suit in 1892, and the Houses of Laymen, although purely consultative bodies, have already done notable service. The Diocesan Synod is now a real bishop's council in some dioceses. A more popular element is supplied by the Church Congresses, held annually since 1861 at some selected centre, and presided over by the Bishop of the diocese, and by the various diocesan conferences; and the Lambeth Conferences (q-v.) have done very valuable work in keeping the Church at home in touch with its daughter Churches abroad. A widely felt need is being supplied by the Church House, proposed by Bishop Harvey Good- win in 1886, founded as the Church's memorial of Queen Victoria's jubilee, and inaugurated by royal charter in 1888, to be a place of meeting for the Convocation of Canterbury, a home for Church organizations of all kinds, and a centre of operations for the whole Anglican com- munion.

(4) Nor can it be doubted that this enlarged corporate action has been accompanied by increased activity of the whole body. Without going into details here, one or two points may be noticed. A number of theological colleges have been founded which aim at supplying training for candidates

for holy orders. New agencies for work of various kinds are supplied by brotherhoods and sister- hoods, and by institutions of deaconesses. The missionary activities of the Church of England ais greater to-day than ever before. New interests are represented or stimulated by such societies as the Christian Social Union, the Church Historical Society, and the Church Reform League.

See also the articles England and Wales, Confirma- tion OF Bishops, Christian Church, &c. ; and the biographies of Tait, Benson, Ceeighton, &c.

(w. E. Co.)

Church Work.

In summarized form the work and progress of the Church of England during the period 1875-1900 is treated on the next page from a statistical standpoint.

Home Missions. ††† The abnormal growth of population during the last quarter of the 19th century was met by the maintenance of ex- ceptional agencies for ministering to the spiritual wants of the people. Bishops' Eunds were established for creating new districts, build- ing churches, and for the increase of parochial clergy, at a cost averaging not less than ††80,000 a year. The Additional Curates Society, the Church Pastoral Aid, and kindred societies also pro- vide for additional clergy, and otherwise assist in the extension and maintenance of Home Mission work, raising annually for this purpose about ††275,000. To bring wealth and intellectual culture into closer touch with the needs of the masses, the late Bishop Walsham How took the initiative in the formation of Universities and Public Schools' Missions. Eight colleges and twenty-four public schools maintain such missions in populous centres. The Oxford House in

Bethnal Green, the Cambridge House in South London, with the Inns of Court Mission in Drury Lane, have become permanent and active centres for the advancement of the religious and social welfare of the people. For the maintenance of these missions and settlements at least ––35,000 is annually contributed. (See also Church Army.) To supplement the work of the parochial clergy, systematic provision has been made for the holding of parochial missions. This work mainly originated with the Aitken Memorial Mission, now employing a stafE of experienced preachers. In eighteen dioceses provision of a similar kind has been made by the appointment of diocesan missioners, or the creation of societies of mission clergy. The spiritual needs of the seafaring population have been vigorously ministered to by the missions to seamen and kindred societies. The increased activity of the military chaplains has been greatly aided by the work of the Soldiers' Institutes Association in establishing institutes at eight of the principal military depots. At least ––65,000 is annually contributed for the work of the Church among soldiers and sailors.

Foreign Missions. ––– The total sum contributed in voluntary offerings at home for the support of foreign missions in the year ending Easter 1900 was ––831,093, 14s. 9d. To further corporate action, a Board of Missions has been established for the Provinces of Canterbury and York, and works in systematic connexion with the Houses of Convocation, collecting information, presenting reports upon the operations of various agencies, and organizing missionary unions and festivals. Associations of junior clergy have now been formed in almost every diocese : there are 91 such associations, representing a membership of 4921 ; they seek to pro- mote an interest in missions by means of conferences, lectures, and services of intercession. (See also the article on Missions.)

The Episcopate.––– Since 1877 the sum of ––533,909, 17s. lOd. has been contributed in voluntary offerings for the endowment of seven new sees, this sum being entirely independent of any assistance from the relieved dioceses or any sources of ecclesiastical income. These sees, with the date of creation and the amount contributed, are as follows :––– Truro, 1877, ––70,948 ; St Albans, 1877, ––55,073 ; Liverpool, 1880, ––94,676; Newcastle, 1882, ––88,866; Southwell, 1884, ––65,834 ; Wakefield, 1888, ––83,510 ; Bristol, 1897, ––75,000. The following

suffragan bishops have been appointed since 1879 : Bedford, 1879 ; Colchester, 1882 ; Marlborough, Shrewsbury, and Leicester, 1888 ; Richmond, Beverley, Reading, Derby, and Barrow-in-Furness, 1889; Swansea, 1890; Hull, Southwark, and Coventry, 1891 ; Thetford, 1894 ; Stepney and Southampton, 1896; Crediton, 1897 ; Islington, 1898 ; Ipswich, 1899 ; Kensington and Barking, 1901.

Colonial and Missionary Bishopries. ??? There are now 99 Colonial and Missionary sees, and of these the following have been created since 1875 : ???

Asia.' ??? Lahore and Rangoon in 1877 ; Travancore and Cochin, 1879 ; North China, 1880 ; South T6ky6, 1883 ; Korea, 1889 ; Chhota Nagpur, 1890 ; Lucknow, 1893 ; Kiushiu, 1894 ; Western China, 1895 ; Tinnevelly, Osaka, and Hokkaido, 1896.

Africa. ??? Pretoria, 1878 ; Uganda, 1884 ; Lebombo and Mashona-land, 1891 ; Likoma, 1892.

Australia. ??? Ballarat, 1875 ; North Queensland, 1878 ; Riverina, 1883 ; Rockhampton, 1892 ; New Guinea, 1897 ; Carpentaria,

1899.

British North America. ??? Niagara, 1875; Athabasca and Qu' Appelle, 1884 ; Calgary, 1887 ; Selkirk, 1890 ; Ottawa, 1896 ; Keewatin, 1899 ; Kootenay, 1899 ; West Indies and South America, Windward Isles, 1878 ; Honduras, 1883.

The Clergy. ??? The number of deacons ordained 1875-1900 was . 17,904 ; regarding these as additions to the ranks of the clergy, this will represent an average of 716 for each year. According to the official returns for the year ending Easter 1900, the paro- chial clergy numbered 21,750, representing 13,873 incumbents and 7877 assistant clergy. To these figures should be added the cathedral clergy, and a considerable number attached to the universities, public schools, hospitals, prisons, workhouses, and other institutions ; with the army and navy chaplains. The official returns of the bishops for 1899-1900 report that there were

[church work 4625 clergy vrorking in the Colonies, India, and the Missionary

*Statistics of Parochial Work.**** *The following figures have been carefully registered in exact detail from the official returns of the clergy for the year ending Easter 1900:* *** *Baptisms, infants 578,489, adults 12,244 ; communicants, 1,974,629 ; communicants' classes, 227,268 ; celebrations of the holy communion (monthly), before midday 32,293, at midday 23,045, after midday 2142 ; church accommodations, parish churches, appropriated 1,342,980, free 4,333,913; chapels of ease, appropriated 67,295, free 532,503 ; mission rooms, 609,307 ; other buildings systematically used for service, 114,377 ; total accommodation, appropriated 1,410,276, free 5,590,100; churches open for daily prayer, 4848; for private prayer, 6838 ; Sunday schools, infants 647,313, boys 805,453, girls 934,914 ; teachers, male 55,453, female 148,449 ; Bible classes, male 220,665, female 233,527 ; guDds, male 122,501, female 322,322 ; temperance work, adult ab- stainers 117,851, adult non-abstainers 45,798, juvenile abstainers 437,046 ; lay-help : district visitors, male 3406, female 67,376 ; lay- readers, licensed 2280, unlicensed 1969 ; sisters, 641 ; deaconesses, 379 ; nurses, 2030 ; mission women, 980 ; choir, male 251,192, female 86,278. With regard to confirmation, the number of candidates for 1900 were : males 79,058, females 116,511, total 195,669.*

Church Extension. *** *During the last quarter of the 19th cen- tury 1712 churches were built or rebuilt, and 6325 churches restored ; the cost of such work in the year 1899 was* ***1,183,739, practically representing the annual expenditure. Taking a period of sixteen years (1884-99), the following sums were contributed in purely voluntary offerings for these specific branches of Church extension : church building,* ***17,631,626 ; endowment of benefices,* ***2,348,611 ; burial-grounds,* ***410,572 ; parsonage houses,* ***1,567,739 : making a total of* ***21,858,548. A parliamentary return shows that from 1868 to 1896, 1461 new parishes were constituted under Church Building Acts, providing for a population of 4,926,243.*

Education. *** *The Church has vigorously maintained her voluntary schools. The accommodation increased from 2,011,434 in 1876 to*

2,794,791 in 1899 ; the average attendance from 1,175,289 to 1,895,569 ; the number of assistant and certificated teachers from 15,763 to 45,823 ; the average cost per scholar was ––l,lls.lld., in- creasing to ––2, 4s. lid. in 1899. In that year the sum of ––42,880 was spent upon the maintenance of thirty training colleges for masters and mistresses, and the diocesan religious inspection of schools. For the year 1899, ––996,808 was voluntarily contributed for the general maintenance of elementary schools, and the enlargement of school buildings. The total amount of voluntary expenditure on church schools and training colleges since 1870 was ––27,352,967. The educational work of the Church has been immensely aided by the National Society, through its liberal grants for the build- ing and maintenance of Church training colleges, the religious inspection of schools, and by the assistance it has given in grants of books and fittings. In the Sunday Schools of the Church of England there are now 2,387,680 children receiving instruction from 203,892 teachers. In adult Bible classes, more or less connected with Sunday schools, there are 454,182 members. The Sunday- school work is voluntarily maintained at an annual cost of about ––160,000. For the instruction of children and adults of the higher and middle classes in the principles and teaching of the Church of England, reading societies have been formed in sixteen dioceses ; by this provision courses of lectures are given at certain fixed centres, and examinations annually held. Seven schools have been established since 1875 in development of the Woodard scheme, making in all thirteen. Consideralsly over ––500,000 has been volun- tarily contributed for the foundation and maintenance of these schools. For the education of children above the class attending elementary schools, the Church Schools Company was formed in 1883, and in 1900 had 27 schools, educating about 2500. The Society for Promoting Christian Knowledge has, to a most valuable extent, advanced the higher education of the people by its publica- tions and circulation of pure and popular literature, and its generous grants of books and tracts. In the British colonies and depend- encies the work of the society has much assisted the bishops and clergy.

Philanthropic work. ––– The extent of the efiorts of the Church in this direction may be inferred from the following records of voluntary contributions during 1900 : for industrial schools, penitentiaries, and preventive homes, ––208,279, 18s. ; orphan- ages, ––124,792, 10s. 3d.

; nursing institutions, convalescent homes, and cottage hospitals, ––189,757, Os. 5d. ; making a total of ––522,829, 8s. 8d. The figures relating to the Metropolitan Hospital Sunday Fund are especially instructive ; the contributions between 1872 and 1900 represented a total of ––922,116, 13s.; of this the Cliurch of England contributed ––716,562, 7s. in 24,282 separate collections out of a total of 41,199.

Clerical Incomes and Support of the Clergy. ––– The official returns for the year ending Easter 1900 represented the gross income

of the clergy arising from all sources to be ––4,38‘6,451, 4s. lid., the total deductions ––973,611, 19s. 6d., leaving a net income of ––3,412,839, 4s. 5d. This will give the average income of a benefice as ––241, and to this figure should be generally added the value of the parsonage-house. Owing to the serious diminution in the value of tithe, with the consequent prevalence of poverty it has created, it has become necessary to organize provision for subsidizing diminished clerical incomes ; this has been made by the inauguration of the Queen Victoria Clergy Fund, incorporated by Royal Charter in 1897 ; working in co- operation with this Fund, each diocese has its own distinct organ- ization, and by this union of effort a sum averaging about ––30,000 is annually raised. A large number of educational and charitable societies also exist for the assistance of the poorer clergy, their widows and orphans, representing an expenditure of about ––140,000.

Voluntary Offerings. ––– The Church of England raised during the year ending Easter 1900 a sum total of ––7,770,992, 15s. Id. by purely voluntary effort and gifts, completely exclusive of any grants from the Ecclesiastical Commissioners, Queen Anne’s Bounty, or anything in the nature of Government aid ; nor does this amount embrace the contributions to societies supported by the co-operation of Churchmen and Nonconformists.

Brotherhoods. ††† There has been a growing recognition of the value of Brotherhoods, and of their work and life in the Church of England. Several new societies have been founded. The Society of Mission Priests of St John the Evangelist, otherwise known as the Cowley Fathers, was founded by the Rev. R. M. Benson in 1865 at Cowley St John, for the cultivation of a life dedicated to God, upon the principles of poverty, chastity, and obedience. It works by missionary and educational efforts for the advancement of Christ's kingdom at home and abroad ; lay brothers are united with the clergy in dedication to the religious life, and

generally assist in carrying out the aims of the society. The society has extended its labours to Bombay and Poonah in India, Cape Town in South Africa, and Boston in the United States.††† The Community of the Besurrection had its origin in 1892 at Pussy House, Oxford, its founder being the Rev. Charles Gore. Subsequently it re- moved to Radley, then to Westminster, and it is now permanently located at Mirfield, in Yorkshire. The society consists of celibate clergy living under rule and with a common purse. As a con- dition of membership each priest must serve a period of probation with the intention of permanent association with the community, without binding himself, however, by any life vow. Taking the basis of study and prayer, each member is pledged to occupy him- self in various works for the edification of the Church, pastoral, evangelistic, literary, and educational.††† 27ie Society of the Sacred Mission originated in the widely felt necessity for an agency which should train working-men and others who might be deterred by want of means or education for the foreign mission field. The work was begun in 1891, at the desire of Bishop Corfe of Korea, by the Rev. H. Kelly. The house is now located atMildenhall,in Suffolk, and is recognized by the Bishop of Ely as a theological and missionary college. Each applicant for admission declares his intention (1) to serve for his whole life unpaid, receiving only the necessaries of life ; (2) to remain unmarried ; {3) not to seek ordination or undertake any work not assigned to him. The training varies from one to eight years ; the life is of the simplest, the discipline that of a religious house. ††† JTie Order of St Paul is a community for priests and laymen " dedicated to God and our merchant seamen in holy religion." The house is at Alton, in Hampshire. ††† There is also a community, consisting of clerical and lay members, which has its headquarters in the mission district of St Philip's, Plaistow, E.

The members are engaged in the work of the mission. (See also Sisterhoods.)

(f. bu.)

EJ^GLAISTD Al^B WALES/

I. Geography.

THE object of this section is to give a physical descrip- tion of England and Wales according to natural regions, vrhich usually follow the geology of the country Tery closely. The lines of division thus do not correspond with the political or official divisions used for other pur- poses, and the general description which follows is intended to be supplemented by the statistics of the separate counties and towns, which will be found in separate articles. The southern portion of the island of Great Britain, to which alone the name of England is properly applied,extends from the mouth of the Tweed in 55►► 48' N. lat. to Lizard Head in 49►► 68' N., in a roughly triangular form. The base of the triangle runs from the South Foreland to Land's End W. by S., a distance of 316 miles in a straight line, but 545 miles following the larger curves of the coast. The east coast runs N.N.W. from the South Foreland to Berwick, a dis- tance of 348 miles, or, following the coast, 640 miles. The west coast runs N.N.E. from Land's End to the head of Sol way Firth, a distance of 354 miles, or, following the much-indented coast, 1225 miles. The total length of the coast-line may be put down as 2350 miles.^ The most easterly point is at Lowestoft, 1►► 46' E., the most westerly is Land's End, in 6►► 43' W. The total area is given oflB.cially as 58,309 square miles, of which 50,867 square miles are assigned to England and 7442 square miles to Wales. The coasts are nowhere washed Sirectly by the ocean, except in the extreme south-west ; the south coast faces the English Channel, which is bounded on the southern side by the coast of France, converging from 100 miles apart at the Lizard to 21 at Dover. The east coast faces the shallow North Sea, which widens from the point

1 See also United Kingdom, The.

2 Measurements made on a map on the scale of 12| miles to 1 inch, the coast being assumed to run up estuaries until the breadth became 1 mile, and no bays or headlands of less than one mile across being reckoned. The coast-line of Anglesea and the Isle of Wight, but of no other islands, is included.

*where it joins the Channel to 376 miles off the mouth of the Tweed, the opposite shores being occupied in succession by France, Belgium, Holland, Germany, and Denmark. The west coast faces the Irish Sea, with a width varying from 45 to 130 miles. Except along the centre of the Irish Sea, at one point off the Tweed, and one between Devon and Normandy, the depth of water between Eng- land and the nearest land nowhere exceeds 50 fathoms. The east and south coasts show considerable stretches of uniform uninflected coast-line, and except for the Fame Islands and Holy Island in the extreme north, and the Isle of Wight in the south, they are without islands. The west coast, on the other hand, is minutely fretted into capes and bays, headlands and inlets of every size, and an island-group lies off every great headland. The coast-line, both on the west and east, is curved into numerous large inlets, which may be grouped in pairs ??? the Thames and Severn, the Wash and Cardigan Bay, the Humber and Mersey, the Tyne and Solway. In this way the land is so deeply penetrated by the water that no part is more than 75 miles from the sea.^*

General Configuration and Geology. ??? In their broad lines the configuration and geology of the country are*

2 Buckingham appears to be the most inland town in England, being 75 miles from the estuaries of the Severn, Thames, and Wash ; Coles- hill, near Birmingham, is also almost exactly 75 miles from the Mersey, Severn, and Wash.

- *The work of the Ordnance Survey, the Geological Survey, and the Hydrographic Survey of the Admiralty suffices to delineate the con- figuration and the geology of England and the adjacent sea-beds with a completeness not surpassed in the case of any country. Statistics of every kind ??? of climate, agriculture, mining, manufactures, trade, population, births, marriages, deaths, disease, migration,*

education ??? are liberally furnished by Government agencies at the public expense ; but the form in which they are compiled and published makes it impossible to utilize the data for the purpose of discussing general distributions in relation to the fixed geographical features. Hence this sketch is more imperfect than the space devoted to it necessitates. For a scheme for the complete geographical description of the British Islands and a specimen worked out in detail for a small area, see papers by H. R. Mill in Geographical Journal, vii., 1896, p. 345: XV., 1900, p. 205.

closely related, though the relationship is not so simple or so clearly marked as in Scotland. The land is highest in the west and north, where the rocks also are oldest, most disturbed, and hardest, and the land surface gradually sinks towards the east and south, where the rocks become successively less disturbed, more recent, and softer. The study of the scenery of England and Wales as a whole, or the study of orographical and geological maps of the country, allows a broad distinction to be drawn between the types of land-forms in the west and in the east. This distinction is essential, and applies to all the conditions of which geography takes account. The contrasted districts are separated by an intermediate area, which softens the transition between them, and may be described separately.

The Western Division is composed entirely of Archaean and Palaeozoic rocks, embracing the whole range from pre- Cambrian up to Carboniferous. The outcrops of these rocks succeed each other in order of age in roughly concentric belts, with the Archaean mass of the island of Anglesea as a centre, but the arrangement in detail is much disturbed and often very irregular. Contemporary igneous outbursts are extremely common in some of the ancient formations, and add, by their resistance to atmospheric erosion, to the extreme ruggedness of the scenery. The hills and uplands of ancient rocks do not form regular ranges, but rise like islands in four

distinct groups from a plain of New Eed Sandstone (Permian and Triassic), which separates them from each other and from the newer rocks of the Eastern Division. Each of the uplands is a centre for the dispersal of streams ; but with only one prominent exception (the Humber), these reach the sea without crossing into the Eastern Division of the country.

The Eastern Division, lying to the east of the zone of New Eed Sandstone, may be defined on the west by a slightly curved line drawn from the estuary of the Tees through Leicester and Stratford-on-Avon to the estuary of the Severn, and thence through Glastonbury to Sidmouth. It is built up of nearly uniform sheets of Mesozoic rock, the various beds of the Jurassic lying above the New Red Sandstone (Triassic), and dipping south-eastward under the successive beds of the Cretaceous system. In exactly the same way the whole of the south-east of the island appears to have been covered uniformly with gently dipping beds of Tertiary sands and clays, beneath which the Cretaceous strata dipped. At some period subsequent to this deposition there was a movement of elevation, which appears to have thrown the whole mass of rocks into a fold along an anticlinal axis running west and east, which was flanked to north and south by synclinal hollows. In these hollows the Tertiary rocks were protected from erosion, and remain to form the London and the Hampshire Basins respectively, while on the anticlinal axis the whole of the Tertiary and the upper Cretaceous strata have been dissected away, and a complex and beautiful configuration has been impressed on the district of the Weald. The general character of the landscape in the Eastern Division is a succession of steep escarpments formed by the edges of the outcropping beds of harder rock, and long gentle slopes or plains on the dip-slopes, or on the softer layers ; clay and hard rock alternating throughout the series.

The contrast between the lower grounds of the Western and the Eastern Divisions is masked in many places by the general covering of the surface with glacial drift, a stiff clay composed on the whole of the detritus of the rocks upon which it rests, but usually containing fragments of rocks which have been transported from a considerable distance. This boulder clay covers almost all the low ground north of the Thames Basin, its southern margin fading away into washed sands and gravels.

The history of the origin of the land-forms of England,

as far as they have been deduced from geological studies, is exceedingly complicated, and cannot be touched on here. The fact that every known geological formation (except the Miocene) is represented, proves of itself how long the history has been, and how multifarious the changes. It must suffice to say that the separation of Ireland from England was a comparatively recent episode, while the severance of the land-connexion between England and the Continent by the formatiop of the Strait of Dover is so recent as probably to have come within the human period.

Temperature. ××× The mean annual temperature of the whole of England and Wales (reduced to seA-level) is about 50×× F., varying from something over 52×× in the Scilly Isles to something climate under 48×× at the mouth of the Tweed. The mean "^'

annual temperature diminishes very regularly from south-west to north-east, the west coast being warmer than the east, so that the mean temperature at the mouth of the Mersey is as high as that at the mouth of the Thames. During the coldest month of the year (January) the mean temperature of all England is about 40××. The influence of the western ocean is very strongly marked, the temperature falling steadily from west to east. Thus while the temperature in the west of Cornwall is 44××, the tem- perature on the east coast from north of the Humber to the Thames is under 38××, the coldest winters being experienced in the Fenland. In the hottest month (July) the mean temperature of England and Wales fs about 61××-5, and the westerly wind then exercises a cooling effect, the greatest heat being found in the Thames basin immediately around London, where the mean tem- perature of the month exceeds 64××. The average temperature along the south coast is 62××, and that at the mouth of the Tweed a little under 59××. In the centre of the country along a line drawn from London to Carlisle the temperature is found to diminish gradually at an average rate of 1×× per 60 miles. The coasts are cooler than the centre of the country, but the west coast is much cooler than the east, modified continental conditions prevailing over the North Sea. The natural efiect of the heating of the air in summer and the cooling of the air in winter by contact with the land is largely masked in England on account of the

strength of the prevailing south-westerly vrind carrying oceanic influence into the heart of the country. This efiect is well seen in the way in which the wind blowing directly up the Severn estuary is directed along the edges of the Oolitic escarpment north- eastward, thus displacing the centre of cold in winter to the east coast, and the centre of heat in summer to the lower Thames, from the normal position of both centres in a narrow strip running from Birmingham to Buckingham. As to how far the narrow portion of the North Sea modifies the influence of the European continent, there seems reason to believe that the prevailing winds blowing up the English Channel carry oceanic conditions some distance inland, along those parts of the Continent nearest to England. The Mersey estuary, being partly sheltered by Ireland and North Wales, does not serve as an inlet for modifying influences to the same extent as the Bristol Channel ; and as the wind entering by it blows squarely against the slope of the Pennine Chain, it does not much afiect the climate of the central plain.

Winds. ❓❓❓ The average barometric pressure over England is about 29-940 inches, and normally diminishes from south-west to north- east at all seasons, the mean pressure on the south coast being 29-970, and that on the northern border 29-880. The pressure at any given latitude is normally highest in the centre of the country and on the east coast, and lowest on the west coast. The direction of the mean annual isobars shows that the normal wind in all parts of England and Wales must be from the south-west on the west coast, curving gradually until in the centre of the country, and on the east coast it is westerly, without a southerly component. The normal seasonal march of pressure-change produces a maximum gradient in December and January, and a minimum gradient in April ; but for every month in the year the gradient is for winds from southerly and westerly quarters. In April the gradient is so slight that any temporary fall of pressure to the south of Eng- land, or any temporary rise of pressure to the north, which would suffice in other months merely to reduce the velocity of the south- westerly wind, is sufficient in that month to reverse the gradient and produce an east wind over the whole country. The liability to east wind in spring is one of the most marked features of the English climate, the effect being naturally most felt on the east coast. The southerly component in the wind is as a rule most marked in the winter months, the westerly component predominat- ing in summer. The west end of a town receives the

wind as it blows in fresh from the country at all seasons, and consequently the west end of an English town is with few exceptions the resi- dential quarter, while smoke-producing industries are usually relegated to the east end.

Storms. ❓❓❓ On account of the great frequency of cyclones passing

In from the Atlantic, the average conditions of wind over the British Islands give no idea of the frequency of change in the direction and force of the wind. The chief cyclone paths are from south-west to north-east across England; one track runs across the south-east and eastern counties, and is that followed by a large proportion of the summer and autumn storms, thereby perhaps helping to explain the peculiar liability of the east of England to damage from hail accompanying thunderstorms. A second tracl❓❓ crosses central England, entering by the Severn estuary and leaving by the Humber or the Wash ; while a third crosses the north of England from the neighbourhood of Moreoambe Bay to the Tyne. While these are tracks frequently followed by the centres of baro- metric depressions, individual cyclones may and do cross the country in all directions, though it is very rarely indeed that they move from east to west or from north to south.

Rainfall. ❓❓❓ The rainfall of England, being largely due to passing cyclones, cannot be expected to show a very close relation to the physical features of the country, but looked at in a general way the relation between prevailing winds and orographic structure is not obscure. The western or mountainous division is the wettest at all seasons, each orographic group forming a centre of heavy precipitation. There are few places in the Western Division where the rainfall is less than 35 inches, while in Wales, the Cornwall- Devon peninsula, the Lake District, and the southern part of the Pennine Chain the precipitation exceeds 40 inches, and in Wales and the Lake District considerable areas have a rainfall of over 60 inches. In the

Eastern Division, on the other hand, an annual rainfall exceeding 30 inches is rare, and in the low ground about the mouth of the Thames estuary and around the Wash the mean annual rainfall is less than 25 inches. In the Western Division and along the south coast the driest month is usually April or May, while in the Eastern Division it is February or March. The wettest month for most parts of England is October, the most noticeable exception being in East Anglia, where July is the month in which most rain falls, although October is not far behind. In the Western Division there is a tendency for the annual maximum of rainfall to occur later than October. It may be stated generally that the Western Division is mild and wet in winter, and cool and less wet in summer ; while the Eastern Division is cold and dry in winter and spring, and hot and less dry in summer and autumn. The south coast occupies an intermediate position between the two as regards climate. Attention has been called to the fact that the bare rocks and steep gradients which are common in the Western Division allow of the heavy rainfall running ofE the surface rapidly, while the flat and often clayey lands of the Eastern Division retain the scantier rain- fall in the soil for a longer time, so that for agricultural purposes the effect of the rainfall is not very dissimilar throughout the country. Sunshine. ??? The distribution of sunshine is not yet fully investi- gated, but it appears that the sunniest part is the extreme south coast, where alone the total number of hours of bright sunshine reaches an average of 1600 per annum. The north-east, including the Pennine Chain and the whole of Yorkshire, has less than 1300 hours of sunshine, and a portion of North Wales is equally cloudy. Although little more than a guess, 1375 hours may be put down as approximately the average duration of bright sunshine for Eng- land as a whole, which may be compared with 2600 hours for Italy, and probably about 1200 hours for Norway.

For the purpose of forecasting the weather, the Meteorological Office divides England into six districts, which are known as Eng- land N.E., Midland Counties, England East, London and Channel, England N.W. and North Wales, and England S.W. and South Wales.

Natural Divisions. ??? The four prominent groups of high land risjpg from the plain of the Red Rocks are : (1) the Lake District, bounded by the Solway Firth, Morecambe Bay, and the valleys of the Eden and the Lune ;

(2) the Pennine Chain, which stretches from the Scottish border to the centre of England, running due south ; (3) Wales, occupying the peninsula between the Mersey and the Bristol Chan- nel, and extending beyond the political boundaries of the princi- pality to include Shropshire and Hereford ; and (4) the peninsula of Cornwall and Devon. They are all similar in the great features of their land-forms, which have been impressed upon them by the prolonged action of atmospheric denudation rather than by the original order and arrangement of the rocks ; but each group has its own geological character, which has imparted something of a distinctive individuality to the scenery. Taken as a whole, the Western Division depends for its prosperity on mineral pro- ducts and manufactures rather than on farming ; and the staple of the farmers is live-stock rather than agriculture. The people of the more rugged and remoter groups of this Division are by race survivors of the early Celtic stock, which, being driven by suc- cessive invaders from the open and fertile country of the Eastern Division, found refuges in the less inviting but more easily defended lands of the west. Even where, as in the Pennine region and the Lake District, the people have been completely assimilated with

The

western

division.

the Teutonic stock, they retain a typical character, marked by mdependence of opinion approaching stubbornness, and by great determination and enterprise.

*Lake District.**** *The Lake District occupies the counties of Cum- berland, Westmorland, and North Lancashire. It forms a roughly circular highland area, the drainage lines of which radiate outward from the centre in a series of narrow valleys, the upper parts of* ***\

*south- west, Ennerdale water, Buttermere, and Crummock water (origi- nally one lake, now divided by a delta), draining nortli-west; Derwent water and Bassenthwaite water (which were probably originally one lake), and Thirlmere, draining north ; Ullswater and Haweswater, draining north- east. There are, besides, numerous mountain tarns of small size, most of them in hollows barred by the glacial drift which covers a great part of the district. The cen- tral and most picturesque part of the district is formed of great masses of volcanic ashes and tuffs, with intrusions of basalts and granite, all of Ordovician (Lower Silurian) age. Scafell and Scafell Pike (3210 feet and 3162 feet), at the head of Wastwater, and Helvellyn (3118), at the head of Ullswater, are the loftiest amongst many summits the grandeur of whose outlines is not to be esti- mated by their height. Sedimentary rocks of the same agr form a belt to the north, and include Skiddaw (3054 feet) ; whil
॥. to the south a belt of SUurian rocljs, thickly covered with boulder clay, forms the finely wooded valleys of Coniston and Wii de ~~mere. Round these central masses of early Palaeozoic rocks there is a broken ring of Carboniferous Limestone, and several patches of Coal Meas~~ ures, while the New Red Sandstone appears as a boundary belt outside the greater part of the district. Where the Coal Measures reach the sea at Whitehaven, there are coal-mines, and the hematite of the Carboniferous Limestones has given rise to the active iron- works of Barrow-in-Furness, now the largest town in the district. Except in the towns of the outer border, the Lake District is very thinly peopled ; and from the economic point of view, the remark- able beauty of its scenery, attracting numerous residents and tourists, is the most valuable of its resources. The very heavy rain- fall of the district, which is the wettest in England, has led to the utilization of Thirlmere as a reservoir for the water supply of Manchester, over 80 miles distant.*

Pennine District. ॥॥॥ The Pennine District, the centre of which forms the so-called Pennine Cham, occupies the country from the Eden valley to the North Sea in the north, and from the lower Tees, Yorkshire Ouse, and Trent, nearly to the Irish Sea, in the south. It includes the whole of Northumberland and Durham, the West Riding of Yorkshire, most of Lancashire and Derbyshire, the north of Staffordshire, and the west of Nottinghamshire. The Pennine Chain forms a north and south watershed which deter- mines the course of the rivers of the whole of the north. It is

entirely composed of Carboniferous rocks, the system which transcends all others in the value of its economic minerals. The coal and iron have made parts of the region the [busiest manufac- turing districts, and the centres of densest population, in the country, or even in the world. The whole region may be looked upon as formed by an arch or anticline of Carboniferous strata, the axis of which runs north and south ; the centre has been worn away by erosion, so that the Coal Measures have been removed, and the underlying Millstone Grit and Carboniferous Limestone exposed to the influences which form scenery. On both sides of the arch, east and west, the Coal Measures remain intact, forming outcrops which disappear towards the sea under the more recent strata of Permian or Triassic age. The northern part of the western side of the anticline is broken off by a great fault in the valley of the Eden, and the scarp thus formed is rendered more abrupt by the presence of a sheet of intrusive basalt. Seen from the valley, this straight line of lofty heights, culminating in Cross- fell (2900 feet), presents the nearest approach in England to the appearance of a mountain range. In the north the Pennine region is joined to the Southern Uplands of Scotland by the Cheviot Hills, a mass of granite and Old Red Sandstone ; and the northern part is largely traversed by dykes of contemporary volcanic or intrusive rock. The most striking of these dykes is the Great Whin Sill, which crosses the country from a short distance south of Durham almost to the source of the Tees, near Crossfell. The elevated land is divided into three masses by depressions, which furnish ready means of communication between east and west. The South Tyne and Irthing valleys cut off the Cheviots on the north from the Crossfell section, which is also marked off on the south by the valleys of the Aire and Ribble from the Kinderscout or Peak section. The numerous streams of the region carry off the rainfall down long valleys or dales to the east and the south, and by shorter and steeper valleys to the west. The dales are

separated from each other by high uplands, which for the most part are heathery moorland or, at best, hill pastures. The agricul- ture of the region

is confined to the bottoms of the dales, and is of small importance. Crossfell and the neighbouring hills are formed from masses of Carboniferous Limestone, which received its popular name of Mountain Limestone from this fact. Farther south, such summits as High Seat, Whernside, Bow Fell, Peny- ghent, and many others, all over 2000 feet in height, are capped by portions of the Grits and Sandstones, which rest upon the Lime- stone. The belt of Millstone Grit south of the Aire, lying between the great coal-fields of the North Riding and Lancashire, has a lower elevation, and forms grassy uplands and dales ; but farther south, the finest scenery of the whole region occurs in the lime- stones of Derbyshire, in which the range terminates. The rugged beauty of the south-running valleys, and especially of Dovedale, is enhanced by the rich woods which still clothe the slopes. There are remarkable features underground as well as on the surface, the caverns and subterranean streams of Yorkshire and Derbyshire being amongst the deepest that have yet been explored. Compared with the rugged and picturesque scenery of the Lower Carboniferous rocks, that of the Coal Measures is, as a rule, featureless and mono- toaous. The coal-fields on the eastern side, from the Tyne nearly to the Trent, are sharply marked off on the east by the outcrop of Permian dolomite or Magnesian limestone, which forms a low terrace dipping towards the east under more recent rocks, and in many places giving rise to an escarpment facing westward towards the gentle slope of the Pennine dales. To the west and south the Coal Me isures dip gently under the New Red Sandstone, to reappear at sev(ral points through the Triassic plain. The clear water of the uplanc b icks and the plentiful supply of water-power led to the founding of small paper-mills in remote valleys before the days of steam, and many of these primitive establishments still exist. The prosperity and great population of the Pennine region dates from the discovery that pit- coal could smelt iron as well as char- coal ; and this source of power once discovered, the people bred in the dales developed a remarkable genius for mechanical invention and commercial enterprise, which revolutionized the economic life of the world and changed England from an agricultural to an industrial country. The staple industry of the district in ancient times was sheep-rearing, and the villages in nearly all the dales carried on a small manufacture of woollen cloth. The introduc- tion of cotton caused the woollen manufactures on the western side to be superseded by the working up of the imported raw material ; but woollen manufactures, themselves carried on now almost

entirely with imported raw material, have continued to employ the energies of the inhabitants of the east. Some quiet market-towns, such as Skipton and Keighley, remain, but most of them have developed by manufactures into great centres of popula- tion, lying, as a rule, at the junction of thickly peopled valleys, and separated from one another by the empty uplands. Such are Leeds, Bradford, Sheflfield, Huddersfield, and Halifax on the great and densely peopled West Riding coal-field, which Hes on the eastern slope of the Pennines. The iron ores of the Coal Measures have given rise to great manufactures of steel, from cutlery to machinery and armour-plates. High on the barren crest of the Pennines, where the roclcs yield no mineral wealth, Harrogate, Buxton, and Matlock are types of health resorts, prosperous from their pure air and fine scenery. Across the moors, on the western side of the anticline, the vast and dense population of the Lanca- shire coal-field is crowded in the manufacturing towns which surround the great commercial centre, Manchester, which itself stands on the edge of the Triassic plain. Ashton, Oldham, Rochdsle, Bury, Bolton, and Wigan form a nearly confluent semicircle of great towns, their prosperity founded on the under- lying coal and iron, maintained by imported cotton.' The Lanca- shire coal-field, and the portion of the bounding plain between it and the seaport of Liverpool, contains a population greater than that borne by any equal area in the country, the county of London and its surroundings not excepted. In the south-west of the Pennine region the coal-field of North Staffordshire supports the group of small but active towns known collectively from the staple of their trade as "The Potteries." On the north- east the great coal-field of Northumberland and Durham, traversed midway by the Tyne, supports the manufactures of Newcastle and its satellite towns, and leaves a great surplus for export from the Tyne ports.

Wales. ??? The low island of Anglesea, which is built up of the fundamental Archaean rooks, is important as a link in the main line of communication with Ireland, because it is separated from the mainland by a channel narrow enough to be bridged, and lies not far out of the straight line joining London and Dublin. The mainland of Wales rises into three main highlands, the mountain groups of North, Mid, and South Wales, connected together by land over 1000 feet in elevation in most places ; but separated by valleys forming easy highways. The streams of the southern

and western slopes are short and many, flowing directly to the Bristol Channel and the Irish Sea ; but the no less numerous streams of

*the eastern slopes gather themselves into three river systems, and reach the sea as the Dee, the Severn, and the Wye. The mount- ain group of North Wales is the largest and loftiest; its scenery resembles that of the Scottish Highlands because of the juxtaposi- tion of ancient Palaeozoic rocks**** *Cambrian and Ordovician, often altered into slate* *** *and contemporaneous volcanic outbursts and igneous intrusions. Here rises the peak of Snowdon (3560 feet), the culminating point of South Britain, and near it half a dozen summits exceed 3000 feet, while Cader Idris, farther south, though slightly lower, presents a singularly imposing outline. The mild winter climate has fringed the coast with seaside resorts ; the rugged heights attract tourists in summer, and the vast masses of slate have given rise to the largest slate quarries in the world. The heavy rainfall of the upper valleys unfits them for agriculture, and the farms are poor. There are several lakes : that of Bala being the largest, except the old lake of Vyrnwy, reconstituted artificially to store the rainfall for the water supply of Liverpool, 68 miles distant. The Vyrnwy is tributary to the Severn ; but north of it the streams gather into the Dee, and flow eventually northward. Mid Wales is built up, for the most part, of Silurian or Ordovician rocks, practically free from igneous intrusions except in the south-west. There the resistance of a series of igneous dykes gives prominence to the Pembroke peninsula, in which the fine fjord-like harbour of Milford Haven lies far out towards the Atlantic. The coast north of Pembroke and Merioneth has been worked into the grand sweep of Cardigan Bay, its surface carved into gently rounded hills, green with rich grass, which sweep down- ward into wide rounded valleys. Plynlymmon (2468 feet) is the highest of the hills, and forms a sort of hydrographic centre for the group, as from its eastern base the Severn and the Wye take their rise* *** *the former describing a wide curve to east and south, the latter forming a chord to the arc in its southward course. Mid Wales is mainly a pastoral country, and very thinly peopled. The group of heights of South Wales, running on the whole from west to east, marks the outcrops of the Old Red Sandstone and Carboniferous strata which lie within a vast syncline of the Silurian rocks. The Brecon Beacons of Old Red Sandstone are the highest (2907 feet), but the Black Mountain bears a number of picturesque peaks carved out of*

Millstone Grit and Carboniferous Limestone, which rise frequently to over 2000 feet. Throughout Hereford, and in part of Monmouthshire, the Old Red Sandstone sinks to a great undulating plain, traversed by the exquisite windings of the Wye, and forming some of the richest pasture and fruit lands of England. This plain formed an easy passage from south to north, and since the time of the Romans was a strategical line of the greatest importance, a fact which has left its traces on the present distribution of towns. Around the western and northern edge of the Old Red Sandstone plain the underlying Silurian rocks (and even the Cambrian and Archaean in places) have been bent up so that their edges form hills of singular abruptness and beauty. Of these are the Malvern Hills, east of Hereford, and in particular the hills of Shropshire. Wen- lock Edge, running from south-west to north-east, is an escarpment of Silurian limestone, while the broad upland of Long Mynd, nearly parallel to it on the north, is a mass of Archaean rock. The Wrekin, the Caradoc and Cardington HUls, are isolated outbursts of pre-Cambrian volcanic rocks. The outer rim of the Welsh area contains a broken series of coal-fields, where patches of Carboni- ferous strata come to the surface on the edge of the New Red Sandstone plain. Such are the coal-fields of Flint in the north, the Forest of Wyre and the Forest of Dean, close to the Severn, on the east. The great coal-field on the south is a perfect example of a synclinal basin, the Millstone Grit and Carboniferous Limestone which underlie the Coal Measures appearing all round the margin. This coal-field occupies practically the whole of Glamorgan alid part of Monmouth, and its surface slopes from the Black Mountain and Brecon Beacons to the sea as a gently inclined plateau, scored by deep valleys draining south. Each chief valley has a railway connecting a string of mining villages, and converg- ing seaward to the busy ports of Nevfport, Cardiff, and Barry Dock (a town created on a sandy island to form an outlet for the mines). In the north of the field, where the limestone crops out and supplies the necessary flux, Merthyr Tydfil has become great through iron-smelting; and in the west Swansea is the chief centre in the world for copper and tin smelting. The unity and ruggedness of the highlands of Wales have proved sufficient to isolate the people from those of the rest of South Britain, and to preserve a purely Celtic race, still very largely of Celtic speech.

Cornwall and Devon. ••• The peninsula of Cornwall and Devon may be looked upon as formed from a synclinal trough of Devonian rocks, which appear as plateaux on the north and south, while the centre is occupied by Lower Carboniferous strata at a lower level. The northern coast, bordering the Bristol Channel, is steep, with picturesque cliffs and deep bays or short valleys running into the high land, each occupied by a little seaside town or village. The plateau culminates in the barren heathy upland of Exmoor, which slopes gently southward from an elevation of

1600 feet, and is almost without inhabitants. The Carboniferous rocks of the centre form a soil which produces rich pasture under the heavy rainfall and remarkably mild and equable temperature, forming a great cattle-raising district. The Devonian strata on the south do not form such lofty elevations as those on the north, and are in consequence, like the plain of Hereford, very fertile and peculiarly adapted for fruit-growing and cider-making. The remarkable features of the scenery of South Devon and Cornwall are due to a narrow band of Archaean rock which appears in the south of the peninsulas terminating in Lizard Head and Start Point, and to huge masses of granite and other eruptive rocks which form a series of great bosses and dykes. The largest granite boss forms the wild upland of Dartmoor, culminating in Yes Tor at 2000 feet. The clay resulting from the weathering of the granite has formed marshes and peat bogs, and the desolation of the district has been emphasized by the establishment in its midst of a great convict prison. The Tamar flows from north to south on the Devonian plain, which lies between Dartmoor on the east and the similar granitic boss of Bodmin Moor (where Brown Willy rises to 1346 feet) on the west. There are several smaller granite bosses, of which the mass of Land's End is the liiost important. Most of the Lizard peninsula, the only part of England stretching south of 50•• N., is a mass of serpentine. The great variety of the rocks which meet the sea along the south of Cornwall and Devon has led to the formation of a singularly picturesque coast ••• the head- lands being

carved from the hardest igneous rocks, the bays cut back in the softer Devonian strata. The fjord-like inlets of Fal- mouth, Plymouth, and Dartmouth are splendid natural harbours, which would have developed great commercial towns but for their remoteness from the centres of commerce and manufactures. China clay from the decomposing granites ; tin and copper ore, once abounding at the contacts between the granite and the rocks it pierced, were the former staples of wealth, and the mining largely accounts for the exceptional density of population in Cornwall. Pishing has always been important, the numerous good harbours giving security to fishing-boats ; and the fact that this coast is the mildest and almost the sunniest, though by no means the driest, part of Great Britain has led to the establish- ment of many health resorts, of which Torquay is the chief. The old Cornish language of the Celtic stock became extinct only in the 18th century, and the Cornish character remains as a heritage of the time when the land had leisure to mould the life and the habits of the man. Projecting farthest of all England into the Atlantic, it is not surprising that the West country has supplied a large proportion of the great naval commanders in British history, and of the crews of the navy.

Between the separate uplands there extends a plain of Permian and Triassic rocks, which may conveniently be considered as an

intermediate zone between the two main divisions. zv",... To the eye it forms an almost continuous plain with plain. ^^^ ^^^^ ►►^ -"'^ clays, which is the outer border of the

Eastern Division ; for although a low escarpment marks the line of junction, and seems to influence the direction of the main rivers, there is only one plain so far as regards free move- ment over its surface, and the construction of canals, roads, and railways. The plain usually forms a distinct border along the landward margins of the uplands of more ancient rock, though to the east of the Cornwall-Devon peninsula it is not very clear, and its continuity in other places is broken by inliers of the more ancient rocks, which everywhere underlie it. One such out- crop of Carboniferous Limestone in the south forms the Mendip Hills ; another of the Coal Measures increases the importance of Bristol, where it stands at the head of navigation on the southern Avon. In the north-west a tongue of

the Red rocks forms the Eden valley, separating the Lake District from the Pennine Chain, with Carlisle as its central town. Farther south, these rocks form the low coastal belt of Lancashire, edged with the longest stretches of blown sand in England, and dotted here and there by pleasure towns, like Blackpool and Southport. The plain sweeps round south of the Lancashire coal-field, forms the valley of the Mersey from Stockton to the sea, and farther south in Cheshire the salt- bearing beds of the Keuper marls give rise to a characteristic industry. The plain extends through Staffordshire and Worcester, forming the lower valley of the Severn. The greater part of Manchester, all Liverpool and Birkenhead, and innumerable busy towns of medium size, which in other parts of England would rank as great centres of population, stand on this soil. Its flat surface and low level facilitate the construction of railways and canals, which form a closer network over it than in other parts of the country. The great junction of Crewe, where railways from south-east, south-west, east, west, and north converge, is thus ex- plained. South of the Pennines, the Bed rocks extend eastward in a great sweep through the south of Derbyshire, Warwick, the west of Leicestershire, and the east of Nottingham, their margin being approximately marked by the Avon, flowing south-west, and the Soar and Trent, flowing north-east. South and east of these streams the very similar country is on the Lias clay. Several

small coal-fields rise through the Red rocks ??? the largest, between Stafford and Birmingham, forms the famous "Black Country," with Wolverhampton and Dudley as centres, where the manu- facture of iron has preserved a historic continuity, for the great Forest of Arden supplied charcoal until the new fuel from the pits took its place. This coal-field, ministering to the multifarious metal manufactures of Birmingham, constitutes the centre of the Midlands. Smaller patches of the Coal Measures appear near Tamworth and Burton, while deep shafts have been sunk in many places through the overlying Triassic strata to the coal below, thus extending the mining and manufacturing area beyond the actual outcrop of the Coal Measures. A few small outcrops occur where still more ancient strata have been raised to the surface, as, for instance, in Charnwood Forest, where the Archsean rocks, with intrusions of granite, create a patch of highland scenery in the very heart of the English plain ; and in the Lickey Hills, near Birmingham, where the prominent features are

due to volcanic rocks of very ancient date. The ” Waterstones,” or Lower Keuper Sandstones, ††† forming gentle elevations above the softer marls, and usually charged with an abundant supply of water, which can be reached by wells, ††† form the site of many towns, such as Birmingham, Warwick, and Lichfield, and of very numerous villages. The plain as a whole is fertile and undulated, rich in woods and richer in pasture : the very heart of rural England. Cattle- grazing is the chief farm industry in the west, sheep and horse- rearing in the east ; the prevalence of the prefix ” Market” in the names of the rural towns is noticeable in this respect. The manu- facture of woollen and leather goods is a natural result of the raising of live stock ; Leicester, Coventry, and Nottingham are manu- facturing towns of the region. The historic castles, the sites of ancient battles, and the innumerable mansions of the wealthy, combine to give to Central England a certain aesthetic interest which the more purely manufacturing districts of the west and north fail to inspire. The central plain curves northward between the outcrop of the Dolomite on the west and the Oolitic heights on the east. It sinks lowest where the estuary of thB” Humber gathers in its main tributaries, and the greater part of the surface is covered with recent alluvial deposits. The Trent runs north in the southern half of this plain, the Ouse runs south through the northern half, which is known as the Vale of York, lying low between the Pennine heights on the west and the Yorkshire moors on the east. Where the plain reaches the sea, the soft rocks are cut back into the estuary of the Tees, and there Middlesbrough stands at the base of the Moors. The quiet beauty of the rural country in the south, where the barren Bunter pebble-beds have never invited agriculture, and where considerable vestiges of the old woodland still remain in and near Sherwood Forest, has attracted so many seats of the landed aristocracy as to earn for that part the familiar name of, “the Dukeries.” The central position of York in the north made it the capital of Roman Britain in ancient times, and an important railway junction in our own.

Five natural regions may be distinguished in the Eastern Division of England, by no means so sharply marked oflE as those of the west, but nevertheless quite clearly charac- terized. The first is the Jurassic belt, sweeping along ††††t††††††† the border of the Triassic plain from the south coast division. at the mouth of the Exe to the east coast at the mouth of the Tees. This is closely followed on the south-east by the Chalk

country, occupying the whole of the rest of England ex- cept where the Tertiary Basins of London and Hampshire cover it, where the depression of the Fenland carries it out of sight, and where the lower rocks of the Weald break through it. Thus the Chalk appears to run in four diverging fingers from the centre or palm on Salisbury Plain, other formations lying wedge-like between them. Various lines of reasoning unite in proving that the Mesozoic rocks of the south rest upon a mass of Palaeozoic rocks, which lies at no very great depth beneath the surface of the anticlinal axis that runs from the Bristol Channel to the Strait of Dover. The theoretical conclusion has been confirmed by the discovery of Coal Measures, with workable coal seams, at Dover at a depth of 2000 feet below the surface.

The Eastern Division is built up of parallel strata, the edges of the harder rocks forming escarpments, the sheets of clay forming plains ; and on this account similar features are repeated in each of the successive geological formations. The rivers exhibit a remarkably close relation to the geological structure, and thus contrast with the rivers of the Western Division. There are two main classes of rivercourse ??? those flowing down ^ the dip-slopes at right angles to the strike, and cutting through opposed escarpments by deep valleys, and those following the line of strike along a bed of easily eroded rock. A third class of streams, tributary to the second, flows down the steep face of the escarpments. "By the study of the adjustment of these rivers to their valleys, and of the relation of the valleys to the general structure. Professor W. M. Davis has elaborated a theory of river classification, and a scheme of the origin of surface-features which

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is attractive in its simplicity. Tlie Tiiames is the one great river of tlie division, rising on tlie Jurassic belt, crossing the Chalk coun- try, and finishing its course in the Tertiary London Basin, tovfards which, in its prevailing westr-to-east direction, it draws its tributa- ries from north and south. The other rivers are shorter, and flow either to the North Sea on the east, or to the English Channel on the south. With the exception of the

Humber, they all rise and pursue their whole course within the limits of the Eastern Division itself.

*The Eastern Division is the richest part of England agriculturally, it is the part most accessible to trade with the Continent, and that least adapted for providing refuges for small bodies of men in con- iliot with powerful invaders. Hence the latest of the conquerors, the Saxon and other Germanic tribes, obtained an easy mastery, and spread over the whole country, holding their own against marauding Northmen, except on the northern part of the east coast ; and even after the political conquest by the Normans, con- tinuing to form the great mass of the population, though influenced not a little by the fresh blood and new ideas they had assimilated. The present population is so distributed as to show remarkable dependence on the physical features. The chalk and limestone plateaux are usually almost without inhabitants, and the villages of these districts occur grouped together in long strings, either in drift-floored valleys in the calcareous plateaux, or along the expos- ure of some favoured stratum at their base. In almost every case the plain along the foot of an escarpment bears a line of villages and small towns, and on a good map of density of population the lines of the geological map may be readily discerned.^*

The Jurassic Belt. ❓❓❓ The Jurassic belt is occupied by the counties of Gloucester, Oxford, Buckingham, Bedford, North- ampton, Huntingdon, Rutland, Lincoln, and the North Riding of Yorkshire. The rocks of the belt may be divided into two main groups : the Lias beds, which come next to the Triassic plain, and the Oolitic beds. Each group is made up of an alternation of soft marls or clays and hard limestones or sand- stones. The low escarpments of the harder beds of the Lias are the real, though often scarcely perceptible, boundary between the Triassic plain and the Jurassic belt. They run along the right bank of the Trent in its northward course to the Humber, and simi- larly direct the course of the Avon southward to the Severn. The great feature of the region is the long line of the Oolitic escarpment, formed in different places by the edges of different beds of rock. The escarpment runs north from Portland Island on the English Channel, curves north-eastward as the Cotswold Hills, rising abruptly from the Severn plain to heights of over 1000 feet ; it sinks to insignificance in the Midland counties, is algain clearly marked in Lincolnshire, and rises in

the North Yorkshire moors to its maximum height of over 1500 feet. Steep towards the west, where it overlooks the low Lias plain as the Oolitic escarpment, the land falls very gently in slopes of Oxford Clay towards the Cretaceous escarpments on the south and east. Throughout its whole extent it yields valuable building stone, and in the Yorkshire moors the great abundance of iron ore has created the prosperity of Middlesbrough, on the plain below. The Lias plain is rich grazing country, the Oxford Clay foims valuable agricultural land, yielding heavy crops of wheat. The towns of the belt are comparatively small, not one attains a population of 76,000, and the favourite site is on the Lias plain below the great escarpment. They are for the most part typical rural market-towns, the manufactures, where such exist, being usually of agricultural machinery, or woollen and leather goods. 'Bath, Gloucester, Oxford, Northampton, Bedford, Rugby, Lincoln, and Scarborough are amongst the chief. North of the gap in the low escarpment in which the town of Lincoln stands, a close fringe of villages borders the escarpment on the west ; and throughout the belt the alternations of clay and hard rook are reflected in the grouping of population.

The Chalk Country. ??? The dominating surface-feature formed by the Cretaceous rocks is the Chalk escarpment, the northern edge of the great sheet of chalk that once spread continuously over the whole south-east. It appears as a series of rounded hills of no great elevation running in a curve from the mouth of the Axe to Flam- borough Head, roughly parallel with the Oolitic escarpment. Suc- cessive portions of this line of heights are known as the Dorset Downs, the Marlborough Downs, the Chiltem Hills, the East Anglian Heights, the Lincolnshire Wolds, and the Yorkshire Wolds. The rivers from the gentle southern slopes of the Oolitic heights pass by deep valleys through the Chalk escarpments, and flow on to the Tertiary plains within. The typical scenery of the Chalk country everywhere is unrelieved by small streams of running water ; the hills rise into rounded downs, often capped with fine clumps of beech, and usually covered with thin turf, affording pasture for sheep. The chalk, when exposed on the surface, is an excellent foundation for roads, and the lines of many of the Roman roads were probably determined by this fact. The Chalk country extends over

^See F. Bosse's Map of Density of Population In Bartholomew's ' Handy Royal Atlas of England." London (Newnes) , 1899.

part of Dorset, most of Wiltshire, a considerable portion of Hamp- shire and Oxfordshire, most of Hertfordshire and Cambridgeshire, the west of Norfolk and Suffolk, the east of Lincoln, and the East Riding of Yorkshire. From the upland of Salisbury Plain, which corresponds to the axis of the anticline marking the centre of the double fold into which the strata of the south of England have been thrown, the great Chalk escarpment runs north-eastward ; fingers of Chalk run eastward on each side of the Weald, forming the North and South Downs, while the southern edge of the Chalk sheet appears from beneath the Tertiary strata at several places on the south coast, and especially in the Isle of Wight. Flamborough Head, the South Foreland, Beachy Head, and the Needles are examples of the fine scenery into which chalk weathers where it fronts the sea, and these white cliffs gave to the island its early name of Albion. The Chalk is everywhere very thinly peopled, except where it is thickly covered with boulder clay, and so becomes fertile, or where it is scored by drift-filled valleys, in which the small towns and villages are dotted along the high roads. The thickest covering of drift is found in the Holderness district of Yorkshire, where, from the chalk cliffs of Flamborough Head to the sandspit of Spurn Point, the whole coast is formed of boulder- clay resting on chalk. Of the few towns in the Chalk country, the interest of which is largely historical or scholastic, Salisbury, Winchester, Marlborough, and Cambridge are the most distin- guished. Reading flourishes from its position on the edge of the London Tertiary Basin, Croydon is a suburb of London, and Hull, though on the Chalk, derives its importance from the Humber estuary, which cuts through the Chalk and the Jurassic belts, to drain tiie Triassic plain and the Pennine region. The narrow strip of Greensands appearing from beneath the Chalk escarpment on its northern side is crowded with small towns and villages on account of the plentiful water supply.

The Weald. ??? The dissection of the great east and west anticline in the south-east of England has resulted in a remarkable piece of country, occupying the east of Hampshire and practically the whole of Sussex, Surrey, and Kent, in which each geological stratum pro- duces its own type of scenery, and exercises its own specific in- fluence on every natural

distrilsution. The sheet of Chalk shows its cut edges in the escarpments facing the centre of the Weald, and surrounding it in an oval ring, the eastern end of which is broken by the Strait of Dover, so that its completion must be sought in France. From the crest of the escarpment, all round on south, west, and north, the dip-slope of the Chalk forms a gentle descent outwards, the escarpment a very steep slope inwards. The cut edges of the escarpment forming the Hog's Back and North Downs on the north, and the South Downs on the south, meet the sea in the fine promontories of the South Foreland and Beachy Head. The Downs are almost without population, waterless and grass-covered, with patches of beech wood. Their only im- portant towns are on the coast, e.g., Brighton, Eastbourne, Dover, Chatham, or in the gaps where rivers from tfie centre pierce the Chalk ring, as at Guildford, Rochester, Canterbury, Lewes, and Arundel. Within the Chalk ring, and at the base of the steep escarpment, there is a low terrace of the Upper Greensand, sel- dom so much as a mile in width, but in most places crowded with villages scarcely more than a mile apart, and ranged like beads on a necklace. Within the Upper Greensand an equally narrow ring of Gault is exposed, its stiff clay forming level plains of grazing pasture, without villages, and with few farmhouses even ; and from beneath it the successive beds of the Lower Green- sand rise towards the centre, forming a wider belt, and reaching a considerable height before breaking off in a fine escarpment, the crest of which is in several points higher than the outer ring of Chalk. Leith Hill and Hindhead are parts of this edge in the west, where the exposure is widest. Several towns have originated in the gaps of the Lower Greensand escarpment which are con- tinuous with those through the Chalk : such are Dorking, Reigate, Maidstone, and Ashf ord. Folkestone and Pe vensey stand where th e two ends of the broken ring meet the sea. It is largely a region of oak and pine trees, in contrast to the beech of the Chalk Downs. The Lower Greensand escarpment looks inwards in its turn over the wide plain of Weald Clay, along which the Medway flows in the north, and which forms a fertile soil, well cultivated, and particu- larly rich in hops and wheat. The primitive forests have been largely cleared, the primitive marshes have all been drained, and now the Weald Clay district is fairly well peopled and sprinkled with villages. From the middle of this plain the core of Lower Cretaceous sandstones, known as the Hastings Beds, emerges steeply, and reaches in the centre an elevation of 796 feet at Crow- borough Beacon. It is on the whole a region with few streams, and a

considerable portion of the ancient woodland still remains in Ashdown Forest. The greater part of the area is almost without inhabitants. Towns are found only round the edge bordering the Weald Clay, such as Tonbridge, Tunbridge Wells, and Horsham ; and along the line where it is cut off by the sea, e.g., Hastings and St Leonards. The broad low tongue of Romney Marsh running

out to Dungeness is a product of shore building by the Channel tides, attached to the Wealden area, but not essentially part of it.

The London Basin. ??? The London Basin occupies a triangular depression in the Chalk which is fiUed up with clays and gravels of Tertiary and later age. It extends from the eastern extremity of Wiltshire in a widening triangle to the sea, which it meets along an irregular line from Deal to Cromer. It thus occupies parts of Wiltshire, Hampshire, Surrey, Kent, Berkshire, Hertfordshire, the whole of Middlesex, the county of London and Essex, and the eastern edge of Suffolk and Norfolk. The scenery is quiet in its character, but the gravel hills are often- prominent features, as at Harrow and in the northern suburbs of London; the country is well cultivated, and many parts, of which Epping Forest is a fine example, are still densely wooded, the oak being the prevailing tree. The coast is everywhere low and deeply indented by ragged and shallow estuaries, that of the Thames being the largest. Sh allow lagoons formed along the lower courses of the rivers of Norfolk have given to that part of the country the name of the Broads, a district of low and nearly level land. Apart from the huge area of urban and suburban London, the London Basin has few large towns. Norwich and Ipswich, Yarmouth, Harwich, and Colchester may be mentioned in the north-eastern part, all depending for their prosperity on agriculture or on the sea ; and a fringe of summer resorts on the low coast has arisen on account of the bracing climate. Beading and Windsor lie in the western portion, beyond the suburban sphere of London. The Bagshot Beds in the west form infertile tracts of

sandy soil, covered with heath and pine, where space is available for the great camps and military training grounds round Aldershot, and for the extensive cemeteries at Woking. The London Clay in the east is more fertile and crowded with villages, while the East Anglian portion of the basin consists of the more recent Pliocene sands and gravels, which mix with the boulder clay to form the best whea1>growing soil in the country.

The Hampshire Basin. ??? The Hampshire Basin forms a triangle with Dorchester, Salisbury, and Worthing near the angles, and the rim of Chalk to the south appears in broken fragments in the Isle of Purbeck, the Isle of Wight, and to the east of Bognor. On the infertile Bagshot Beds the large area of the New Eorest remains untilled under Its ancient oaks. The London Clay of the east is more fertile, but the greatness of this district lies in its coast-line, which is deeply indented, like that of the London Basin. South-ampton and Portsmouth have gained importance through their fine natural harbours, improved by engineering works and fortifioa^ tions; Bournemouth and Bognor, from their favourable position in the sunniest belt of the country, as health resorts.)

The Fenland. ??? The continuity of the belts of Chalk and of the Middle and Upper Oolites is broken by the shallow depression of the Wash and the Fenland. The Fenland comprises a strip of Norfolk, a considerable part of Cambridgeshire, and the Holland district of Lincoln. Formerly a great inlet with vague borders of lagoons and marshes, the Fenland has been reclaimed partly by natural processes, partly by engineering works patiently continued for centuries. The whole district is flat and low, for the most part within 15 feet of sea-level ; the seaward edge in many places is below the level of high tide, and is protected by dykes as in Holland, while straight canals and ditches carry the sluggish drainage from the land. The soil is composed for the most part of silt and peat. A few small elevations of gravel, or of underlying formations, rise above the level of 25 feet ; these were in former times islands, and now they form the sites of the Infrequent villages. Boston and King's Lynn are memorials of the maritime importance of the Wash in the days of small ships. The numerous ancient churches and the cathedrals of Ely and Peterborough bear evidence to the share taken by religiotis communities in the reclamation and cultivation of the land.

Communications. ••• The configuration of England, while suffi- ciently pronounced to allow of the division of the country into natural regions, is not strongly enough marked to exercise any very great influence upon lines of communication. The navigable rivers are all connected by barge-canals, even across Oeneral. ^j^g Pennine Chain. Although the waterways are much neglected, compared with those of France or of Germany, they could easily be made very useful if they were developed by free competition with railways. The main roads developed as arteries of intercommunication by the Romans, suffered to fall into neglect, and revived in the coaching days of the beginning of the 19th century, fell into a second period of comparative neglect when the railway system was completed ; but they are now recovering a considerable share of their old importance in consequence of the development of cycling and the use of motor- cars. Following the Roman roads, the high roads of the Eastern Division very frequently run along the crests of ridges or escarp- ments ; but in the Western Division they are, as a rule, forced by the more commanding relief of the country to keep to the river valleys and cross the rougher districts through the dales and passes.

The railways themselves, radiating from the great centres of popula- tion, and especially from London, are only in a few instances much affected by configuration. The Pennine Chain has always separated the traffic from south to north into an east coast route through the Vale of York, and a west coast route by the Lancashire plain. The Midland railway, running through the high and rugged country between the two, was the last to be constructed. The most notable bridges over navigable water affording continuous routes are those across Menai Strait, the Tyne at Newcastle, the Severn at Severn Bridge, and the Manchester Ship Canal. It is more usual to tunnel under such channels, and the numerous Thames tunnels, the Mersey tunnel between Liverpool and Birken- head, and the Severn tunnel, the longest in the British Islands (4J miles) , on the routes from London to South Wales, and from Bristol to the north of England, are all important. The Humber estuary is neither bridged nor tunnelled below Goole.

Density of Population. ••• The present distribution of population over England and Wales shows a dense concentration at all large seaports, in the neighbourhood of London, and on the coal-fields where manufactures

are carried on. Agricultural areas are very thinly peopled ; purely pastoral districts can hardly be said to have any settled population at all. There are very few dwellings situ- ated at a higher level than 1000 feet, and on the lower ground the Chalk and the Oolitic limestones, where they crop out on the sur- face, are very thinly peopled, and so as a rule are areas of alluvial deposits and the Tertiary sands. But, on the other hand, the broad clay plains of all formations, and the Triassic plain, are peopled more densely than any other districts without mineral wealth or sea trade.

Political Divisions. ??? In the partition of England and Wales into counties, physical features play but a small part. The forty ancient counties, remnants of various historical groupings and partings, are occasionally bounded by rivers. Thus the Thames divides counties along nearly its whole length, forming the southern boundary of four and the northern boundary of three. Essex and Suffolk, Suffolk and Norfolk, Cornwall and Devon, Durham and Yorkshire, Lancashire and Cheshire, are all separated by rivers, while rivers form some part of the boundaries of almost every county. Still, it is noteworthy that the Severn and Trent nowhere form continuous county boundaries. Watersheds are rarely used as boundaries for any distance ; but, although slightly overlapping the watershed on all sides, Yorkshire is very nearly coincident with the basin of the Ouse. The boundaries of the parishes, the fundamental units of English political geography, are very often either rivers or watersheds, and they frequently show a close rela- tion to the strike of the geological strata. The hundreds, or groups of parishes, necessarily share their boundaries, and groups of hundreds are often aggregated to form larger subdivisions of counties. A vride grouping according to natural characteristics may be recognized still only in the cases of Wales, East Anglia, Wessex, and such less definite groups as the Home Counties around London, or the Midlands around Birmingham. Configuration is only one out of many conditions modifying distributions, and its effects on England as a whole appear to be suggestive rather than determinative.

For detailed descriptions of parts of England and Wales, see the articles on individual counties, towns, rivers, etc. For more general references, see Eueope, Geology, Meteobology.

Ahthokities. ††† A. J. Jukes-Brown. The Building of the British Islands. London, 1888. ††† Sir A. C. Ramsay. Physical Geography and Geology of Great Britain. Edited by H. B. Woodward. Lon- don, 1894. ††† Sir A. Geikie. Geological Map of 'England and Wales (scale, 10 miles to 1 inch). Edinburgh, 1897.††† E. Reclus. Universal Geography, vol. iv. The British Isles. Edited by E. G. Ravenstein. London, 1880. ††† G. G. Chtsholm. " On the Distribu- 'tion of Tovras and Villages in England," in Geographical Journal, vol. ix. (1897), pp. 76-87 ; vol. x. (1897), pp. 511-530.††† A. Havi- LAND. The Geographical Distribution of Disease in Great Britain. London, 1892. ††† A. Buchan. "The Mean Atmospheric Tempera- ture and Pressure of the British Islands " (with maps), Journal of the Scottish Meteorological Society, vol. xi. (1898), pp. 3-41.††† W. M. Davis. "The Development of Certain English Rivers," Geographical Journal, vol. v. (1895), pp. 127-148.

(h. b. m.)

II. Statistics. Area and Population.

The area of England and Wales, exclusive of 840,448 acres of tidal water and foreshore, consists of 37,317,885 acres or 58,309 square miles, 37,106,272 acres or 67,979 square miles being land, and 216,613 acres or 330 square miles being water. The population at the date of the

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census of March 31, 1901, was returned (preliminary report) at 32,526,075. The increase since 1871, and the decennial rate of increase, are shown in the following table : †††

Date of Enumeration.

Population.

Decennial Increase.

Decennial In- crease per cent.

1871, April 3 . 1881, April 4- . 1891, April 6 1901, March 31 .

22,712,266- 25,974,439 29,002,525 32,526,075

2,646,042 3,262,173 3,028,086 3,523,550

13-20 14-36 11-65 12-17

The increase of population took place chiefly in the commercial centres and in the industrial and mining dis- tricts, there having been little or no increase, or even in some places in the west of England and in North Wales a considerable decrease, of the agricultural population. The following table shows the population of each of the eleven registration divisions of England and Wales in 1891 and 1901, and the increase per cent, in the inter- censal period : ???

Registration Divisions.

Population.

Increase per cent.

1891.

1901.

1891-1901.

I. London

4,228,317

4,536,063

7-2

II. S.E. counties (Surrey, Kent,

Sussex, Hampshire, Berk-

shire) . ...

2,867,078

3,312,163

15-5

III. S. Midland (Middlesex,

Hertfordshire, Buckingham-

shire, Oxfordshire, North-

amptonshire, Huntingdon-

shire, Bedfordshire, Cam-

bridgeshire)

1,847,309

2,181,105

18-1

IV. Eastern (Essex, Suffolk,

Norfolk) ....

1,575,311

1,891,922

20-1

~~V. S. W. (Wiltshire, Dorset~~

shire, Devonshire, Corwall,

Somersetshire)

1,855,262

1,913,082

3-1

VI. W. Midland (Gloucester-

shire, Herefordshire, Shrop-

shire, Staffordshire, Worces-

tershire, Warwickshire)

3,305,841

3,679,264

11-3

VII. N. Midland (Leicester-

shire, Rutlandshire, Lincoln-

shire, Nottinghamshire,

Derbyshire)

1,808,494

2,042,151

VIII. N.W. (Cheshire, Lan-

cashire) ....

4,664,749

5,230,261

12-1

IX. Yorkshire

3,212,188

3,596,395

11-9

X. Northern (Durham, North-

umberland, Cumberland,

Westmorland)

1,863,166

2,128,633

14-2

XI. Monmouthshire and Wales England and Wales

1,774,810

2,015,036

13-5

29,002,525

32,526,075

12-1

The total number of males and of females, and the number of females to 1000 males, at the last four enumerations were as follows : ???

Tear.

Population.

Males.

Females.

Females to 1000 Males,

1871 . 1881 . 1891 . 1901 .

22,712,266 25,974,4.39 29,002,525 32,526,075

11,058,934 12,639,902 14,052,901 1.5,721,728

11,653,332 13,.334,537 14,949,624 16,804,347

1054 1055 1064 1069

Wales in 1891 and 1901 (preliminary report), with the number of inhabited houses In 1901, were as follows : ???

The areas and population of the ancient counties of England and

Population.

Area.

Inhabited

Counties.

Acres.

1901.

1891.

1901.

Bedford

298,494

38,356

160,704

171,249

Berks

462,224

53,889

238,709

254,931

Buckingham

475,694

43,476

185,284

195,.534

Cambridge .

549,749

44,430

188,961

190,687

Chester

657,068

169,191

730,058

814,555

Cornwall

868,208

72,601

322,571

322,957

Cumberland

970,161

54,823

266,549

266,921

Derby .

658,876

128,039

528,033

620,196

Devon

1,667,097

123,598

631,808

660,444

Dorset

632,272

43,474

194,517

202,962

Durham

647,281

201,099

1,016,559

1,187,324

Essex .

987,028

201,059

785,445

1.085,576

Gloucester .

795,734

128,514

599,947

634,6C..

Hants .

1,037,764

155,743

690,097

*798,7!,.^*

Hereford

537,363

25,579

115,949

114,401

Hertford

406,161

53,272

220,162

250,3.50

Huntingdon

234,218

13,620

57,761

57,773

Kent .

995,-344

249,139

1,142,324

1,351,849

Lancaster

1,207,605

888,261

3,926,760

4,406,787

Leicester

527,124

94,545

373,584

433,994

Lincoln

1,693,547

113,738

472,878

498,781

Middlesex .

181,301

463,038

3,251,671

3,585,139

Monmouth .

341,688

54,533

252,416

292,327

Norfolk

1,308,440

106,821

454,516

460,040

Northampton

641,992

74,039

302,183

338,064

Northumberland .

1,289,756

93,717

506,030

602,859

Nottingham

539,752

111,594

445,823

514,537

Oxford

483,614

41,089

185,669

182,768

Rutland

97,273

4,595

20,659

19,708

Shropshire .

859,516

51,484

236,339

239,321

Somerset

1,043,485

108,154

484,337

508,104

Stafford

749,601

247,976

1,083,408

1,234,382

Suffolk

952,709

86,334

371,235

384,198

Surrey

485,128

311,761

1,731,343

2,008,923

Sussex

933,269

116,518

550,446

605,052

Warwick

577,462

188,963

805,072

897,678

Westmorland

500,906

13,737

66,098

64,.305

Wiltshire

880,248

61,321

264,997

273,845

Worcester .

480,560

104,238

413,760

488,401

York, E. Riding .

753,104

96,688

408,5;30

445,112

[?]?? N. Riding

1,.361,465

81,820

360,383

393,143

[?]?? W. Riding Total England .

Anglesey

1,768,279

601,974

2,4.39,895

2,746,8(i7

32,538,560

5,916,840

27,483,490

30,805,466

175,8.36

12,269

50,098

50,590

Brecknock .

475,224

12,745

57,031

59,906

Cardigan

440,630

15,136

62,630

60,237

Carmarthen

587,816

29,137

1.33,566

135,325

Carnarvon .

361,097

29,041

118,204

126,835

Denbeigh

423,477

27,758

117,872

129,935

Flint .

164,050

17,978

77,277

81,725

Glamorgan .

516,959

157,634

687,218

860,022

Meriotieth .

427,810

11,324

49,212

49,130

Montgomery

510,111

12,282

58,003

54,892

Pembroke .

395,151

19,469

80,133

88,749

Radnor Total Wales .

301,164

4,883

21,791

23,263

4,779,325

349,fl’i(>

1,519,035

1.720,609

Total England . Total England

32,538,560

5,916,840

27,483,490

30,805,466

and Wales

37,317,885

6,266,496

29,002,525

32,526,075

At the census of 1891 the number of inhabited houses was 6,451,497, so that there was an increase of 814,999 in the ten years. The average number of occupants to a house was 6-32 in 1891, as against 5-38 in 1881, and 5-33 in 1871. The proportion was highest in the larger towns: in London it was 7-72 per inhabited house; in Newcastle-ou-Tyne, 7-73; in Sunderland, 7-00. The number of tenements {i.e., houses or parts of houses separately occupied) was 6,131,001 in 1891. This gives an average of 4-7 persons to each tenement, and 1-12 tenements to each house. The density of population in England and Wales, and the average number of persons to an

statistics]

inhabited tiouse, at the last four census enumerations, were as follows :
???

Census Tears.

Persons per Square Mile.

Acres per Person.

Persons to a House.

1871 .... 1881 .... 1891 .... 1901 ....

390 445 497

558

1-64 1-44 1-29 1-14

5-33 5-38 5-32 5-19.

The density of population and the average number of persons to a house in England and in Wales, as compared with Scotland and Ireland, in 1891 and 1901 were : ???

Persons per Square MUe.

Acres to a Person.

Persons to an

Inhabited

House.

1891.

1901.

1891.

1901.

1891.

1901.

England . “Wales Scotland . Ireland .

540 203 135 148

606 230 150

140

1-18 3-14 4-73 4-32

1-05 2-78 4-26 4-56

5-33 5-01 5-92 5-40

5-21 4-94 4-83 5-19

The following table gives the Registrar-General’s estimate of the population of England and Wales in the middle of every fifth year from 1871 to 1911, the estimates from 1901 to 1911 being pro- visional and based on the assumption that the rate of increase from 1891 to 1901 will be continued to 1911 :

Tears.

Population.

Tears.

Population.

1871 .

22,788,594

1896 .

30,799,461

1876 .

24,370,267

1901 .

32,619,410

1881 .

26,046,142

1906 .

34,546,904

1886 .

27,522,532

1911 .

36,588,288

1891 .

29,081,053

The population of the administrative county of London (com- prising the 29 metropolitan boroughs), that of the 1121 urban dis- tricts (of which 67 are county boroughs, 248 municipal, but not county boroughs, and 806 non-municipal districts), and that of the 666 rural districts of England and

Wales in 1901, with the popula- tion on the same groups of areas in 1891, are given as follows : ???

Groups of Areas.

Population.

Increase

1891-1901.

1891.

1901.

Administrative county of London

4,228,317

4,536,063

307,746

Urban districts .

17,515,660

20,518,206

3,002,545

Rural districts .

7,258,145

7,471,242

213,097

Areas neither in urban nor in rural districts

England and Wales .

403

565

162

29,002,525

32,526,075

3,523,550

In 1901 there were 75 large towns (including London) each of which had over 60,000 inhabitants, their total population being 14 506 273 ; on the same areas in 1891 the total population amounted to 12 729,545, the increase in the ten years having been 13-96 percent.

The following is a list of 40 of the largest county boroughs with the population of each in 1901 and the population on the same areas in 1891 :

Enumerated

Enumerated

Population.

Population.

County Boroughs.

County Boroughs.

1891.

1901.

1891.

1901.

Liverpool

629,648

684,947

Brighton .

115,878

123,478

Manchester

505,868

648,969

Preston .

107,573

112,982

Birmingham

478,118

522,182

Norwich .

100,970

111,728

Leeds

367,505

428,963

Birkenhead .

99,857

110,926

Sheffield .

324,243

880,717

Gateshead

85,692

lOi ,887

Bristol .

289,280

328,842

Plymouth

88,926

10’i,509

Bradford .

265,728

279,809

Derby Halifax .

94,146

106,785

West Ham

204,908

267,808

97,714

104,938

Hull

200,472

240,618

Southampton .

82,126

104,911

Nottingham

213,877

239,758

South Shields .

78,891

97,267

Salford .

198,139

220,956

Burnley .

87,016

97,044

Newcastle upon-

Huddorsfleld .

95,420

95,008

Tyne .

186,300

214,803

Swansea .

90,349

94,514

Leicester .

174,624

211,574

Wolverhampton

82,662

94,179

Portsmouth

159,278

189,160

Middlesbrough

75,532

91,317

Bolton

146,487

168,205

Northampton .

75,075

87,021

Cardiff .

128,915

164,420

Walsall .

71,789

86,440

Sunderland

131,686

146,665

St Helens

72,418

84,410

Oldham .

131,463

187,238

Rochdale .

76,161

88,112

Croydon .

102,695

133,885

Stockport .

70,263

78,871

Blackburn

120,064

127,527

Movement of Population. ††† The number of marriages, births, and deaths in England and Wales in 1871, in every succeeding fifth year, and in 1898 and 1899, was as follows : †††

Tears.

Marriages.

Births.

Deaths.

1871 . . . .

190,112

797,428

514,879

1876 .

201,874

887,968

510,315

1881 .

197,290

883,642

491,935

1886 .

196,071

903,760

537,276

1891 .

226,526

914,167

687,926

1896 .

242,764

915,331

526,727

1898

256,379

923,166

552,141

1899 . . . .

262,334

928,646

581,799

In the same years the number of persons married, of births, and of deaths per 1000 persons living was : ???

Tears.

Persons Married in 1000 Living.

Births to 1000 Living.

Deaths to 1000 Living.

1871 1876 1881 1886 1891 1896 1898 1899

16-7 16-6 15-1 14-2 15-6 15-8 16-3 16-5

35-0 36-3 33-9 32-8 31-4 29-7 29-4 29-3

22-6 20-9 18-9 19-5 20-2 17-1 17-6 18-3

The marriage-rate is evidently closely associated with the general prosperity of the country. In the period embraced by the table given above, it was highest in 1873, when it was 17-6 per 1000 living, and lowest in 1886, when it fell to 14-2. In the former year the value of the total imports and exports per head of population of the United Kingdom was also at its highest, and in the latter year, at its lowest. The following figures for recent years illustrate this connection : ???

Tears.

Marriage- Eate.

Value per Head of Population of TJiited Kingdom.

Exports of British Pro- duce.

Imports.

Total Ex- ports and Imp' .rts.

1895

1896 . 1897 1898 1899

15-0 15-8 16-0 16-3 16-6

►► s. d.

5 15 8

6 18 5 17 7

5 16 2

6 10 5

►► s. d.

10 13 1

11 3 11 11 6 6 11 14 1 11 19 2

►► 1. d.

17 19 3

18 14 1

18 14 3

19 0 5

20 1 8

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Since 1871 there has been a steady decline in the numher of marriages of minors. Among the persons who married in the five years 1871-75, 81-6 per 1000 of the husbands and 223-2 per 1000 of the wives were under 21 years of age ; in the five years 1891-95 the proportions were, 56-2 per 1000 of husbands, and 182-6 of wives ; in the year 1899, 50 per 1000 of husbands, and 165 per 1000 of wives.

For the 29 years 1871-99 the average birth-rate of England and Wales was 31-1 to 1000 persons living. The rate was highest in 1876, when it rose to 36-3, and lowest in 1899, when it fell to 29-3, the lowest rate on record. In 1899 the birth-rate was highest in Durham (35-3), Staffordshire (35-1), and Northumberland (33-4); it was lowest iu Westmorland (22-7) and Rutland (22-9). Wit'iin the period 1871-98 the proportion of illegitimate births has steadily decreased. In 1871 it was 56 to 1000 births ; in 1881, 49 ; in 1891, 42. This proportion continued down to 1898, except that in 1894 the number rose temporarily to 43 ; in 1899 it fell to 40. The proportion varies widely in different parts of the country. In 1899 the lowest proportions were 28 per 1000 births in Essex, where the average of the preceding 10 years was 29, 29 in Monmouthshire, 30 in Warwickshire, 31 in Middlesex (average of 10 years, 31), 31 in South Wales (average 35). The highest proportions in 1899 were 60 per 1000 births in North Wales, where the average of the preceding 10 years was 66, 61 in Norfolk and in Huntingdon, 62 in Westmorland (average 63), 64 in Cumberland (average 71), 65 in Shropshire (average 73), and 66 in Herefordshire (average 71). Though, as already shown, the female population is considerably in excess of the male, yet the number of male births exceeds that of the female. During the 29 years 1871-99 the average number of male to 1000 female births was 1038 ; the highest was 1043 in 1875, and the lowest was 1032 in 1898 ; in 1899 the number was 1039. The variations in the proportion over the whole country range within comparatively narrow limits, but in particular localities they are considerable. In 1899 the lowest proportions of male to female births were 929 in Huntingdonshire, where the average of the preceding ten years was 1042, 933 in Rutland (average 1059), and 991 iu Monmouth- shire (average 1041). The highest were 1063 male to 1000 female births in South Wales (average of ten years, 1038), 1064 in Oxford (average 1037), 1064 in Buckinghamshire (average' 1031), 1065 in Essex (average 1029), and 1094 in Dorsetshire (average

1051).

The average annual death-rate of England and Wales for the 29 years 1871-99 was 19-0 per 1000 persons living; the highest was 22-7 in 1875; the lowest was 16-6 in 1894. For the 5 years 1871-75 the average was 22-0; for 1891-95, 18-7. In the 5 years 1871-75 the average death-rate of males was 23-3 per 1000 living ; of females, 20-7 ; in 1891-95, of males 19-8, and of females 17-7 per 1000 living. In 1899, 19-5 males died per 1000 living, and 17-3 females per 1000. In 1899 the lowest death-rates were 12-9 in Westmorland, where the average .of the preceding 10 years was 14-9 per lOiOO living, 14-7 in Middlesex (average 14-7), 4-9 in Cambridgeshire (average 16-4); the highest were 19-6 in Staffordshire (average 19-8), 20-1 in Northumberland (average 19-3), and 21-1 in Lancashire (average

21-4).

For the purpose of comparison the following table is given, showing for the United Kingdom and its several parts, and for various continental countries, the average number of births and of deaths per 1000 living in the 25 years 1874-98 :

Countries.

BlrthB.

Deaths.

OountrieB.

Births.

Deaths,

United Kingdom

31-4

19-3

Austria

38-1

29-0

England and

Hungary .

43-0

33-2

Wales .

32-6

19-4

Switzerland

28-9

20-9

Scotland .

.32-6

19-7

Prussia

37-8

24-1

Ireland

24-0

181

Netherlands

34-4

20-9

Denmark .

31-4

18-6

Belgium .

30-3

20-3

Norway .

30-7

16-7

France

23-8

22-0

Sweden

28-9

17-2

Italy .

38-8

27-1

The increase of population is retarded and obscured by the large outflow and inflow of passengers to and from the United States and the British Colonies. In the 25 years 1876-1900 the gross number of emigrants, British and foreign, to countries out of Europe amounted to 7,172,800, of whom 5,010,707 were of British or Irish origin. On the other hand, the immigrants, British and foreign, from non-European countries numbered 3,123,025, of whom 2,122,150 were of British or Irish origin. The net number of emi- grants was thus 4,049,775, of whom 2,888,567 were of British or Irish origin. The following table shows the gross numbers and the percentages of emigrants, English, Scots, and Irish, who left

*the United Kingdom for non-European countries in quinquennial periods 1876-1900:***???**

Periods.

English.

Scots.

Irish.

Total,

Number.

Pei- c.

Number.

Per

0.

Number.

Per c.

Number,

1876-80

1881-85 1886-90 1891-95 1896-00

1876-00

425,550 760,124 788,841 617,869 478,022

60 59 62 63 63

70,596 133,527 141,568 100,878

85,104

10 10

11

10

11

213,236 398,658 335,817 259,827 201,090

30 31

27 27 26

709,382

1,292,309

1,266,226

978,574

764,216

3,070,406

61

531,673

10

1,408,628

28

5,010,707

The following summary shows the movement of emigration and immigration between the United Kingdom and the United States, British North America, and Australasia in 25 years, 1876-1900 :

Total Emigration . Total Immigration

Net Emigration .

British and Irish

Emigration British and Irish

Immigration

Net British and Irish Emigration

To and

from United

States.

4,973,292 2,230,206

2,743,086

3,272,962 1,351,171

1,921,791

To and from

British N. America,

810,872 226,810

584,062

555,459 211,469

343,990

To and from Australasia,

684,450 214,312

470,138

664,381 197,820

466,561

Total

(including

others).

7,172,800 3,123,025

4,049,775

5,010,707 2,122,150

The total number of emigrants to Cape Colony and Natal, 1876- 1900, was 339,334 ; the immigrants therefrom, 1882-1900, numbered 183,335. The number of British and Irish emigrants to these colonies, 1877-1900, was 268,729 ; of British and Irish immi- grants therefrom, 1882-1900, 156,015. The net emigration of persons of British and Irish origin in quinquennial periods 1876-95 and in the 6 years 1896-1900 was as follows : ???

Periods.

Emigrants.

Immigrants.

Balance of Emigrants.

1876-80 .

709,382

275,181

434,201

1881-86

1,292,309

368,046

934,268

1886-90

1,266,226

472,166

794,060

1891-96

978,574

530,663

447,911

1896

161,925

101,742

60,183

1897

146,460

95,221

51,239

1898

140,644

91,248

49,396

1899

146,362

100,246

46,116

1900

168,826

97,637

71,188

1876-1900

5,010,707

2,122,150

2,888,557

In the 25 years 1876-1900 the rate of British and Irish emigration fluctuated between wide limits. The smallest net emigration was in 1877, when the number was 31,305, or 0-09 per cent, of the population of the United Kingdom ; the largest was in 1883, when the net number of emigrants was 246,314, or 0-69 per cent, of the whole population. The following table shows the rate of the net British and Irish emigration in recent years : ???

Per cent.

Per cent.

Per cent.

Years.

of

Years.

of

Tears.

of

Population.

Population,

Population,

1886 .

0-42

1891

0-31

1896

0-15

1887

0-54

1892 .

0-29

1897

0-13

1888 .

0-50

1893 .

0-28

1898

012

1889 .

0-41

1894 .

0-10

1899

0-11

1890

0-29

1895 .

0-19

1900

0-17

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Aliens. ??? Regarding the increase of the foreign element in the population of the United Kingdom there is no precise information, but a rough estimate is formed on the basis of the figures showing the passenger

movement between the United Kingdom and the Continent of Europe. The excess of the inward over the outward passengers is assumed to represent foreigners not returning to the Continent ; from this excess the number of foreigners known to have emigrated within the year to places out of Europe, and the number of foreign sailors, coming as passengers but departing as crews of vessels, are deducted, and the remainder is taken to repre- sent approximately the increase to the foreign population of the United Kingdom within the year. For 1898, 1899, and 1900 the figures are given as follows :

1898.

1899.

1900.

Inwards from Europe . Outwards to Europe .

Excess inwards

Net foreign emigrants . Foreign sailors

Total to be deducted .

Net foreign increase

620,123 590,226

666,230 609,570

748,725 669,292

29,897

56,660

79,433

14,801 12,299

31,231 13,362

50,685 14,950

27,100

44,593

65,635

2,797

12,067

13,798

Political divisions.

The increase consists largely of Russian, Polish, and Rumanian Jews, who, arriving in a state of destitution, are assisted by Jewish Boards of Guardians and Relief Committees in London and other large towns.

Local Government.

For most practical purposes the ancient counties of England and Wales have been superseded by the ad- ministrative counties created by the Local Government Act of 1888. The ancient division, however, forms the basis on which the system of distribution of parliamentary representation now in force was constructed. After the Eepresentation of the People Act, 1884, had extended to householders and lodgers in counties the franchise which in 1867 had been conferred on householders and lodgers in boroughs, the Redistribution of Seats Act, 1885, made a new division of the country into county and borough constituencies. All the English counties, with the exception of Rutland, are now divided into two or more constituencies, each return- ing one member, the number of English county parlia- mentary areas being 234. In Wales the eight smaller or less populous counties form each one parliamentary con- stituency, while the four larger are divided, the number of Welsh county parliamentary areas being 19. The num- ber of county areas for parliamentary purposes in England and Wales is thus 263,

and the total number of their representatives is the same. Outside the county constitu- encies are the parliamentary boroughs. Of these there are 135 in England, one of them, Monmouth district, being made up of three contributory boroughs, while many are divided into several constituencies, the number of borough parliamentary areas in England being 206, of which 61 are in the metropolis. Of the 205 borough constituencies, 184 return each one member, and 21 return each two members, so that the total number of English borough members is 226. Besides the county and borough members there are in England five university members, namely, two for Oxford, two for Cambridge, and one for London. In Wales there are 10 borough parliamentary areas, all of which except Merthyr Tydfil and Swansea town division, consist of groups of several contributory boroughs. Each Welsh borough constituency returns one member, except Merthyr Tydfil, which returns two, so that there are eleven Welsh borough members.

*The following summary shows the population (1891), the regis- tered electors (1901), the numbers, and representation of the various classes of constituencies in England and Wales : ***

Description ConsOtuendes.

Population,

1891.

Electors,

1901.

Constitu- encies Number.

Represent- atives in Parliament

*England *** County Borough University .*

Total England .

Wales- County Borough

Total Wales .

England and Wales

13,848,294 13,636,100

2,835,019

2,232,278

17,702

234

205

3

234

226

5

27,484,394

5,084,999

442

465

999,957 518,174

211,881 92,985

19 10

19 11

1,168,131

304,866

29

30

29,002,525

5,389,865

471

495

*At the general parliamentary election of 1895 the total number of votes recorded was 3,190,826. If the university constituencies are left out of account, the average representation, according to the census returns of 1901, is one member of parliament for every 66,380 inhabitants of England and Wales. The distribution, how- ever, is still very unequal, ranging from one representative for 14,935 inhabitants in Durham, to one for 167,679 in the Cardifi dis- trict of boroughs. This inequality is shown by the following statement from the preliminary report on the census of 1901 : ***

Number of Constituencies.

1891.

1901.

100,000 and upwards 90,000 and under 100,000

80,000 ,, ,, 90,000

*70,000 *

*80,000 60,000 *

*70,000 50,000 *

*60,000 40,000 *

*50,000 30,000 *

*40,000 20,000 *

*30,000 10,000 *

20,000

7 19 26 66 108 128 79 23 19 15

41 34 47 69 82 102 56 28 19 12

490

490

Under the Local Government (England and Wales) Act, 1888, which established a new system of county administration, 62 administrative counties have been created, each having a county council. Of ^^"'"'" the new counties, 14 coincide in area with ancient divisions. counties, and 7 others, together with county boroughs situated within their boundaries but now under separate administration, have areas coinciding with an- cient counties of the same name. Generally, however, the areas of the new counties are different from those of the ancient. (1) In some cases portions of ancient counties are now administrative counties. Thus, the Isle of Ely in Cambridgeshire; the Parts of Holland, the Parts of Kesteven, the Parts of Lindsey, in Lincolnshire; the Soke of Peterborough in Northamptonshire; the Isle of Wight in Hampshire; the East Eiding, the West Eiding, and the North Riding of Yorkshire; the eastern portion and the western portion of Suffolk; and the eastern portion and the western portion of Sussex, have been formed each into a separate ad- ministrative county. The Scilly Islands, which form part of the ancient county of Cornwall, without being ranked as an administrative county, are provided with a county council and have separate administration. (2) The administrative county of London has an area taken entirely from the counties of Middlesex, Kent, and Surrey.*

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(3) All boroughs which on June 1, 1888, had a population of not less than 50,000, boroughs which were already counties having a population of not less than 20,000, and a few others, were formed into separate administrative areas, with the name of county boroughs. Of these there

w^ere originally 61, but their number has been increased to 67. (4) Provision was made for including entirely Tvithin one administrative county each of such urban dis- tricts (then called urban sanitary districts) as were situated in more than one ancient county.

The councils of the administrative counties consist of councillors chosen for three years by duly qualified electors in electoral divi- sions, aldermen chosen for six years by the councillors, either from among themselves or from outside, and a chairman chosen by the council, either from its own members or from outside. Municipal boroughs of sufBoient importance to have separate representation on the councils form one or more electoral divisions, according to population. The county council of each administrative county is a body corporate, having perpetual succession and a common seal, and has power to acquire and hold land for the purposes of its constitution. The administrative business of the county councils is generally that formerly managed by the Quarter Sessions, with the exception of judicial business. Their powers relate principally to the levying of rates, the borrowing of money, the manage- ment of county buildings and property, the licensing of places for music and dancing and of racecourses, the maintenance of asylums for pauper lunatics, reformatories, and industrial schools, the management of bridges and roads, the regulation of fees of county officials and of salary and fees of coroners, the appointment of polling districts for parliamentary elections, and arrangement for the registration of electors and revision of electoral lists. County coroners, formerly chosen by popular election, are now elected by the county council. The county police is under the control of a standing committee of magistrates and members of the council in equal numbers, except in the county of London, where the police is under the Home Secretary. In the county boroughs the town councils have powers similar to those of the county councils.

*The number of municipal boroughs in England and Wales has largely increased since the passing of the Municipal Reform Act of 1835. That Act ap- bo^'gbt P^^^'l *►► 178 boroughs, while 68 places (including London) with municipal powers of various origin were left outside its scope. These were mostly unimportant, and have either been reincorporated under the Municipal Corporations Act, 1883, or have ceased to exist as boroughs.*

The municipal boroughs in 1881 num- bered 243 ; in 1891, 295 ; in 1901, 316 (exclusive of metro- politan boroughs). In 1900, under the London Government Act, 1899, the administrative county of London, exclusive of the City, was divided into 28 boroughs, the councils of which, with some additions and some limitations, took over the property, powers, and duties of the vestries.

The governing bodies in boroughs are the councils, consisting of the mayor, aldermen, and councillors. Their constitution and powers were amended by the Municipal Corporations Act, 1882, and to a large extent formed the models on which those of the county and district councils were framed in 1888 and 1894. The councillors are elected by the burgesses (in cities, citizens) for three years ; the mayor and aldermen are elected by the council, either from within or from those outside who are qualified to be elected coun- cillors, the mayor for one year and the aldermen for six years. The basis of the municipal franchise is ratepaying residence, and women may be enrolled and vote. The powers of the town councils comprise the levying of rates, the borrowing of money, manage- ment of borough property, police, markets, lighting, cleansing, water-supply, paving, bridges, and powers under various Acts relating to artizans' dwellings, cemeteries, free libraries, and matters affecting public health. As the urban district council the town council holds separate sittings.

The areas into which England and Wales were divided under the Public Health Act of 1875 were called Urban and Eural Sanitary Districts. By the Local ratal Government Act of 1894 this division was

district retained, but its purpose was greatly extended. councils, jjj |.jjg designation the word " sanitary " was dropped, and, in urban and rural districts, district councils

were established. In the boroughs this involved no change, but in Improvement Act districts, and in Local Government districts, the Improvement Commissioners and the Local Boards, respectively, were superseded by the new councils. In the rural districts the Boards of Guardians were formerly the sanitary authorities, but while such boards, under new regulations, continue to exist in urban districts, they are entirely

abolished in rural districts, and their place is filled by rural district councils.

These councils, urban and rural, consist of councillors chosen for three years by the electors in wards or parishes, and a chairman chosen by the council for one year, either from within or outside this body, provided he have the qualification necessary for election as councillor. No disqualification for elector or councillor arises from sex. To the councils have been transferred powers formerly exercised by sanitary and highway authorities, and others exercised by justices out of session, and by Quarter Sessions, and they have duties relating to right of way, the Adoptive Acts, the compulsory purchase of land, and various other matters. Under the same Act every parish with a population of more than 300 has a parish coun- cil ; parishes with smaller population may either be grouped together, or each have a council. Among other business, these councils ap- point overseers and, except with respect to church affairs and ecclesiastical charities, exercise the powers formerly possessed by the vestries. In every rural parish there is a parish meeting held at least once a year, with powers relating to election of parish council- lors, parish finance, and other matters.

Among the county, district, and parish councils there is much interdependence, and all of them are under the administrative and financial control of the central authority, the Local Government Board.

Parishes, for local government purposes, are poor-law parishes, areas for each of which a separate poor-rate is or can be levied. In 1891 there were in England and Wales 14,684 such

parishes, but under various Acts their boundaries

Poor Law.

and their number are subject to alteration. Poor-law unions, formed under an Act of 1834, are groups of parishes for the local administration of the Poor Laws. In 1898 the number of unions and of separate parishes was 649. Begistration districts are gener- ally, but not invariably, coextensive with unions of the same name. These districts are divided into sub-districts,

within which the births and deaths are registered by registrars appointed for that purpose. Begistration counties are groups of registration districts, and their boundaries differ more or less from those both of the an- cient and the administrative counties. In England and Wales there are eleven registration divisions, consisting of groups of registration counties. Within the unions the local poor-law author- ities are the Boards of Guardians. In rural districts the functions of these boards are, under the Local Government Act of 1894, per- formed by the district councils, and in other places their constitution is now similar to that of the urban and district councils. The guardians, elected for three years by the parochial electors, may choose two additional guardians, and the chairman, appointed annually, may be chosen either from within or from outside. There are now no ex officio or nominated guardians, and no disqualifica- tion for the office of guardian arises from sex or marriage. The principal duties of the guardians are the preparation or revision of the valuation lists on which the poor-rate is assessed, though the rates are levied not in union but in parish areas, and the adminis- tration of relief to the poor, involving the appointment of officers and the supervision of their work. The action of the guardians, however, in many cases requires the confirmation of the Local Government Board.

*Pauperism.**** *ThQ total number of paupers in England and Wales relieved, either within the union workhouses or outside, on January 1st of each fifth year from 1881 to 1896, and of each of the last three years, is given below. The few who received both indoor and outdoor relief are in the total counted only*

January 1.

Indoor Paupers.

Outdoor Paupers.

Total.

1881 .

195,286

614,232

809,341

1886 .

199,041

613,532

813,014

1891 .

198,218

682,413

780,467

1896 .

229,721

610,904

840,456

1899 .

230,916

590,323

821,096

1900 .

220,871

680,724

807,471

1901 .

227,148

674,812

801,460

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The following table shows for entire parochial years, ending March 25th, the mean number per 1000 of estimated population of England and Wales :
(1) of indoor and outdoor paupers,

(2) of in- and outdoor paupers, exclusive of vagrants and insane,

(3) of adult able-bodied paupers only :

Paujjers per 1000 of Estimated ropulatlon.

Tear ending

March 26.

Total In- and Out-

Exclusive of Va-

Adults, able-

door,

grants and Insane.

bodied only.

1882 .

30-3

27-0

3-9

1887 .

28-9

26-2

3-7

1892 .

25-6

22-8

3-2

1897 .

26-5

23-3

3-3

1899 .

26-5

23-2

3-4

1900 .

25-0

21-7

3-0

The paupers relieved on January 1, 1901, exclusive of vagrants, were as follows : ???

Description.

Male.

Female.

Children {under 16).

Total.

Indoor ??? Able-bodied Not able-bodied Insane ....

Total indoor

Outdoor ??? Able-bodied . Not able-bodied Insane .... ??? Total outdoor

Total

19,470

65,587

7,486

18,100

44,110

8,959

13,267

37,561

1,083

50,837

147,258

17,528

92,543

71,169

51,911

215,623

10,632 77,109 34,857

48,456

201,120

43,249

130,696

27,417 643

189,748

305,646

78,749

122,598

292,825

158,756

574,179

215,141

363,994

210,667

789,802

The total number of vagrants relieved was 11,658 (11,525 indoor and 133 outdoor), and, including these, the total number of paupers relieved was 801,460, of whom 113 received both indoor and outdoor relief. Of the 10,632 “able-bodied” outdoor male paupers, the great majority were relieved on account of sickness or accident ; of the 48,456 ” able-bodied” female outdoor paupers, 34,082 were widows, 7588 were wives of ” able-bodied ” men relieved, 4183 were wives of non-resident males, 2374 were single women without chil- dren, and 229 were mothers of illegitimate children. The great majority of the children relieved out-of-doors were children of widows relieved.

The cost of poor-relief steadily Increases. The gross expenditure, with the amount per head of population, and the relief expenditure from rates, with the average rate per ►► of rateable value, in the parochial years 1891 and 1899 (ending March 25) , were as follows : ►►►

Tears.

Gross Expendi- ture.

Per Head of Population.

Expenditure from Eates.

Per ►► of Rate- able Value.

1891 . 1899 .

►►

8,643,318 11,286,973

s. d.

6 0

7 2i

►►

5,857,436 8,161,532

8. d.

0 9i

1 0-2

In these years the sums expended on in-maintenance, out-relief, and on lunatics in asylums, etc., were : ►►►

Tears.

In-maintenance.

Out-relief.

Lunatics in Asylums, &o.

1891 . 1899 .

Increase .

* *

1,951,486 2,462,008

* *

2,400,089 2,764,854

* *

1,284,656 1,748,558

510,522

364,765

463,902

Other expenditure in 1899 consisted of ££919,313 for interest and repayment of workhouse loans, ££1,971,614 for salaries, &c., and ££1,420,626 for other purposes, bringing the total expenditure up to

The number of paupers and the cost of poor-relief are very un- equally distributed over England and Wales. The following table shows, for January 1, 1901, the number of in- and outdoor paupers per 1000 of estimated population, and for 1899 the gross expendi- ture on poor-relief per head of estimated population, in each of the eleven registration divisions :£££

Per 1000 of Population.

111

Divisions.

Indoor Paupers.

Outdoor Paupers.

Total,

including

Asylums,

&c.

London . Soutli-Eastern . South Midland Eastern . Soulh-Western West Midland . North Midland North-Western Yorkshire Northern . Welsh .

14-9 7-3 5-2 6-0 5-5. 6-8 4-7 6-9 4-4 4-5 3-9

8-7 15-0 17-8 23-0 27-2 17-6 20-2 10-1 13-4 13-8 23-8

26-9 24-7 25-4 31-2 35-5 26-8 26-9 19-0 19-6 200 29-8

8. d. 15 3i 6 lOf 6 2f 6 10|

6 Hi

6 01 6 21

4 lOi

4 11

4 4i 6 6i

Total

7-1

15-6

25-0

7 2i

Justice.

The highest court of appeal is the House of Lords, where the Lord Chancellor presides, the other judges being ex-Lords of Appeal in Ordinary (appointed under the Appellate Jurisdiction Act, 1887) and such other peers of Parliament as hold or have held high judicial ofB.ce. The Judicial Committee of the Privy Council is concerned chiefly with appeals from Colonial and Indian Courts, but it has also ecclesiastical and other jurisdiction, and it decides concerning petitions for exten- sion of letters patent. Its judgments are given in the form of reports to the King. Members of this court are the Lord Chancellor and the four Lords of Appeal, but the Lord Chief Justice, the Lords Justices, and others who hold or have held high judicial ofBce, and are members of the Privy Council, are qualified to sit. One member of the court is a specially appointed expert in Indian law ; and in 1897, under an Act of 1895, three colonial judges, the Chief Justices of Cape Colony, Canada, and South Australia, were added.

In the Supreme Court of Judicature there is a Court of Appeal, where the Master of the Polls and five Lords Justices usually sit, the Lord Chancellor, the Lord Chief Justice, and the President of the Probate, Divorce, and Admiralty Division being also judges in this court.

In the Chancery Division of the High Court of Justice there are six judges, besides the Lord Chancellor ; in the King's Bench Division are the Lord Chief Justice and fourteen other judges ; in Probate, Divorce, and Admiralty Division are two judges ; and in the Bankruptcy Division, one. The Court of Arches for ecclesiastical cases has one judge.

Assize courts, in which the judges of the High Court try civil and criminal cases, are held in eight circuits, Ivhich at present are constituted as follows : ••• The South-Eastern, in two divisions ••• the Home Division (Sussex, Kent, Essex, Hertford) and the Norfolk Division (Norfolk, Suffolk, Huntingdon, Cambridge) ; the Midland (Buckingham, Bedford, Northampton, Leicester, Eutland, Lincoln, Derby, Nottingham, Warwick) ; the Northern (Westmorland, Cumberland, Lancashire) ; the North-

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Eastern (Northumberland, Durham, York) ; the Oxford (Berkshire, Worcester, Gloucestershire, Monmouth, Here- ford, Stafford, Shropshire, Oxford) ; the Western (Hamp- shire, Wiltshire, Somerset, Dorsetshire, Devonshire, Corn- wall) ; the North Wales (Chester and the six northern Welsh counties) ; South Wales (the six southern Welsh counties).

Courts with jurisdiction in special matters are the Lunacy Commission, the Railway and Canal Commission, the Lancaster and Durham Chancery Courts. For the determination of civil cases in which the. value in dispute is of small amount, there are County Courts, England and Wales being divided into sixty County Court circuits. Other civil courts which may be mentioned are the Lord Mayor's Court, London, Bankruptcy Courts, and Borough Courts of Record. The number of civil cases in which proceedings were commenced in courts of first instance in England and Wales in 1899 was 1,272,143. Of these 78,326 were in the High Court, and 1,159,062 in County Courts, the remainder being mostly in the Lord Mayor's Court, London, in Borough Courts of Record, and in Bankruptcy Courts. In the same year there were 446 appeals in the High Court from inferior courts ; 826 in the Court of Appeal ; 76 in the Judicial Committee of the Privy Council ; and 75 in the House of Lords.

Crime. ??? The Queen's Bench Division of the High Court has power to try criminal cases, but this power is seldom used (in two cases in 1898), and, practically, the principal criminal courts are the Assize courts, and the Central Criminal Court, which, in law, is included in the assizes. Assize courts are usually held three times (in some cases four times) a year, by judges on circuit, or by commissioners appointed for the purpose. The Central Criminal Court holds twelve sessions a year. Courts with less extensive jurisdiction are Quarter Sessions, held by two or more justices of the peace in counties, and by the recorder in boroughs which have a separate court. These courts, sitting four times (in London thirty-six times) a year, dispose of the less serious cases, while more serious charges, e.g., treason, murder, perjury, are tried at assizes. Neither from Assize courts nor from Quarter Sessions is there any appeal, but the judges or magistrates

may reserve doubt- ful points of law for decision by the Court for Crown Cases Re- served, consisting of five or more judges of the High Court. At Assizes and Quarter Sessions all trials are by jmy.

Courts of summary jurisdiction consist of at least two justices of a petty sessional division of a county or of a borough sitting in petty sessions, but in large towns the stipendiary magistrate may sit alone. In these courts there is no jury ; the decisions are in most cases subject to appeal, but appeals are rare. The magistrates conduct the preliminary investigation of cases afteri^vards tried at Quarter Sessions or Assizes, and they have also certain civil jurisdiction.

*The number of persons committed for trial at the Assizes and at Quarter Sessions, the number convicted, and the number acquitted (including those not proceeded against), in 1881, in each fifth year to 1896, and in 1898 and 1899, were as follows :***???**

Years.

Committed for Trial.

Convicted.

Acquitted.

1881 .

14,786

11,353

3401

1886 .

13,974

10,686

3245

1891 .

11,695

9,055

2585

1896 .

11,214

8,856

2317

1898 .

11,594

9,273

2267

1899 .

11,044

8,749

2240

The decrease in the number of persons annually convicted of serious crime since 1880 is evident, and is the more remarkable when it is considered that this absolute decrease has been concur- rent with a large increase in the population.

The different classes of offences for which prisoners were committed, and of which they were convicted or acquitted, at

Assizes and Quarter Sessions in the years 1897-1899, were follows :
???

Classes of Offences.

Tears.

09

c S

^5

11

*I. Against the person . *

II. Against property, with J violence . . .1

III. Against property, with- J

out violence . . j

IV. Malicious offences J

against property . 1

V. Forgery and offences J against the currency 1

VI. Other offences . . ???! Total

1897 1898 1899 1897 1898 1899 1897 1898 1899 1897 1898 1899 1897 1898 1899 1897 1898 1899 1897 1898 1899

2,606

2,629

2,649

1,997

2,136

1,908

5,524

5,657

5,3.34

277

251

259

304

351

311

507

430

441

11,215

11,454

10,902

1750

1800

1785

1762

1888

1702

4527

4625

4340

209

189

180

275

317

275

344

314

326

8867

9133

8608

856

829

864

235

248

206

997

1032

994

68

62

79

29

34

36

163

116

115

2348

In 1899, 39,592 persons were tried summarily for indictable offences, and 31,879 were convicted, the total number of convic- tions for indictable offences within the year having thus been

40,487.

The criminal statistics since 1895 show a slight increase in the number of cases, but this is due to increase not of the number of criminals, but of offences. Sentences of imprisonment are now for shorter terms than formerly^ old offenders are more frequently at large, are oftener brought to justice, and thus swell the numbers in the statistical returns. This view is borne out by the following figures, showing for the years 1893-1898 the number of receptions of convicted prisoners into the prisons of England and Wales, and also the number and percentage that had been previously convicted : ???

Tears.

Number of Convicted Prisoners.

Number having

Previous

Convictions.

Percentage of the whole.

1893 1894 1895 1896

1897 1898 1899

151,462 155,132 143,441 149,000 148,962 158,323 154,754

75,867 84,603 79,711 85,405 85,890 94,972 93,250

58-1 54-9 55-6 57-3 57-7 600 60-0

The total number of receptions into the various prisons, and the number of criminal and non-criminal prisoners, in 1899, were as follows : ???

Prisoners,

Male.

Female.

Total.

Convicted on indictment . Convicted summarily

Total convicted criminals Convicted by court-martial Remanded and discharged

Total criminal prisoners . Surety prisoners Debtors .... Others ....

Total

6,718 102,657

787 44,592

7,505 147,249

109,375

1,626

12,629

45,379 3,165

154,754

1,626

15,794

123,630

1,248

10,247

56

48,544

648

462

8

172,174

1,896

12,706

64

137,178

49,662

186,840

In 1899 sentence of death was passed in 29 cases, and carried out in 15. Of the prisoners received into prisons, 735 were under sentence of penal servitude.

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Of the 154,754 convicted prisoners received in 1899, 93,250 vrere old offenders. These, classed according to the number of their pre- vious convictions, were : ???

Previously Convicted.

Males.

Females.

Total.

Once . Twice

Three times Four times Five times . Six to ten times Above ten times

19,422 8,755 5,557 3,952 2,953 8,834

10,468

6,023 3,436 2,606 1,925 1,636 5,468 12,215

25,445

12,191

8,163

5,877

4,689

14,302

22,683

Total

<u>59,941</u>

<u>33,309</u>

<u>93,250</u>

<u>The condition of the convicted criminals received into prisons in 1899 with respect to education, is shown in the subjoined statement :</u>

<u>Prisoners.</u>

<u>Male.</u>

<u>Female.</u>

<u>Total.</u>

<u>Not able to read or write .</u>

<u>17,703</u>

<u>11,483</u>

<u>29,186</u>

<u>Per cent, of whole,</u>

<u>16-18</u>

<u>25-30</u>

<u>18-86</u>

<u>Able to read and write imper-</u>

<u>fectly</u>

84,854

33,114

117,968

Per cent, of whole

77-58

72-98

76-23

Able to read and write well

5,658

740

6,398

Per cent, of whole

5-17

1-63

4-14

??? Superior instruction .

84

6

90

Per cent, of whole

0 08.

0-01

0-05

Instruction not described .

1,075

37

1,112

Per cent, of whole

Toul ....

0-99

0-08

0-72

109,374

45,380

154,754

With respect to age, the prisoners received in 1899 were as follows :
???

Ages.

Hale.

Female.

Total.

Under 16

16 and under 21 ...

21 ” ” 30 ... 30 ” ” 60 ...

60 and upwards Age not ascertained .

Total ....

1,286 12,826 29,777 57,352

8,056 77

72

2,386

12,006

28,856

2,042

18

1,358 15,212 41,783 86,208 10,098 95

109,374

4^,380

154,754

In 1899, 1134 offenders under 16 years of age were committed to reformatory schools, 44 being from Assize and Quarter Sessions, and 1090 from courts of summary jurisdiction. In the great majority of the cases the offence was larceny or other form of dis- honesty. In 131 cases a preliminary term of imprisonment was Imposed. In the same year 7245

offenders under 16 years of age were sent to industrial schools, many of them for such offences as begging and absenting themselves from school. The following are the figures showing receptions into reformatory and industrial schools in 1899 : ???

Boys.

Giris.

Total.

Reformatory schools

Industrial schools .... Truant industrial schools Truant industrial day schools .

Total, industrial schools

987

147

1134

2422 2323 1405

617 478

3039 2323 1883

6150

1095

7245

Police. ??? The average number of men employed daily in police

duties in England and Wales in 1900, and the net cost of the police force in the same year, were as follows : ???

Average Number.

Net O.ist.

Counties

Cities and boroughs . Metropolitan police . City of London police

Total ....

13,080

13,296

13,688

1,001

??

1,127,360

1,226,596

1,291,070

99,007

40,965

3,743,022

Educatioti.

The Board of Education, -which ~~was formed April 1, 1900, under an Act of 1899, is charged with the superin~~ tendence of all matters relating to

education in England and Wales. It consists of a president, the Lord President of the Council (unless he is appointed president), the principal Secretaries of State, the First Lord of the Treasury, and the Chancellor of the Exchequer. This board has taken the place of the Education Department and the Department of Science and Art, and, under the Act by which it was created. Orders in Council have been made whereby it will exercise, concurrently with the Charity Commissioners, certain powers relating to educa- tional endowments in England and Wales, and there have been transferred to it from those Commisfsioners powers relating to educational endowments in Wales and Mon- mouth, regulated by schemes under the Endowed Schools Acts. A consultative committee has been appointed to frame regulations for a register of teachers, and to advise the board on any matter on which the board may request advice. The Education Office has been organized in two branches, one concerned chiefly with elementary, and the other with secondary education, the administration of science and art instruction being intrusted to the latter. Arrangements are in progress to enable the board, with the Charity Commissioners, to undertake the complete inspection, administrative and educational, of schools which desire it.

The Elementary Education Act of 1870 has been amended, and its purpose extended, by several important Acts. By an Act of 1876 it was made a punishable offence for a parent to neglect the education of his child ; and the employment of children at work under the age of ten, and of children over ten unless they should have reached a certain standard of proficiency, was made illegal. The age of exemption from attendance at school on account of proficiency was in 1893 raised to eleven, and in 1899 to twelve. The Act of 1876 further required that attendance at school should be enforced by school boards or, where there are no school boards, by school attend- ance committees appointed annually for the purpose ; and it empowered the authorities to send neglected children to industrial schools. An Act of 1891 provided for the payment of a fee grant of ten shillings per annum for each child (over three and under fifteen years of age) of average attendance at day schools, the grant being made conditional on the abolition or reduction of school fees. The Voluntary Schools Act, 1897, provided that an aid grant, not exceed- ing in the aggregrate five shillings per scholar, should be paid to public elementary schools not provided by

school boards, and it also exempted such schools from the pay- ment of^rates. This Act contemplated the formation of associations of voluntary schools, and a school may be required to belong to an association to receive the grant. A separate Act of the same year provided for an increase in the grants to school boards, thus reducing the school board rates. Among other educational Acts passed in

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recent years are those of 1893 and 1899, providing for the instruction of blind and deaf, and of epileptic children.

The progress of elementary education in the country is roughly shown by the following table, which gives the annual average pro- portion of persons signing the marriage register with marks : ???

Proportion signed by Mark in 1000 Marriages.

Husbands,

Wives.

Botli.

1881-85 .

1886-90 .

1891-95 .

1896

1897

1898

1899

‘ 123-4 84-0 51-2 37 33 31 29

154-8 98-2 59-6 43 40 .36 34

54-4 30-2 16-6 11 10 10 9

The average proportion of persons who signed the marriage regis- ter by mark in 1889-98, and the proportion in 1899, in the registrar tion counties, are given as follows : ???

In 1000 Marriages signed by

Mark.

Eeglstration County.

1889-98.

1899.

Men.

Women.

Men.

Women.

London ....

32

43

25

33

Surrey

30

19

17

12

Kent

41

28

23

17

Sussex .

42

19

22

12

Hampshire

36

24

18

15

Berkshire

47

24

28

15

Middlesex

36

26

21

16

Hertfordshire

75

45

36

20

Buckinghamshire

69

36

30

22

Oxfordshire .

56

29

29

21

Northamptonshire

47

42

24

25

Huntingdonshire

69

36

27

18

Bedfordshire .

67

65

37

28

Cambridgeshire

82

47

38

30

Essex

52

38

28

25

Suffolk .

83

46

41

20

Norfolk .

74

46

38

22

Wiltshire

58

30

29

19

Dorsetshire

56

28

29

24

Devonshire

36

35

17

22

Cornwall

83

76

49

47

Somerset

62

47

42

25

Gloucester

51

49

27

29

Hereford

75

43

26

26

Shropshire

76

58

41

35

Staffordshire .

76

89

39

44

Worcestershire

63

71

33

30

Warwickshire

51

67

30

39

Leicestershire

38

42

19

20

Rutland

48

20

38

23

Lincolnshire .

48

37

23

24

Nottinghamshire

53

60

23

34

Derbyshire

46

46

22

26

Cheshire

47

55

25

24

Lancashire

49

81

25

43

York, W. Riding

56

78

32

45

E. Riding

39

49

21

25

N. Riding

51

62

32

43

Durham

63

82

35

46

Northumberland

39

61

22

37

Cumberland .

42

56

27

31

Westmorland

21

23

16

4

Monmouthshire

93

102

56

65

South Wales .

72

102

41

57

North Wales .

87

94

50

53

According to this test, the illiteracy of both men and women is greater in the northern than in the southern counties ; in the southern, except London, there are more illiterate men than women married, while in the northern and London, the women are the more illiterate.

Elementary Schools. ??? The number of elementary schools (both voluntary and board schools) inspected, the number of children for whom accommodation was provided in these schools, and the aver-

age attendance in years ending August 31, 1881, 1891, and in 1897- 1900 were : ???

Years.

Scliools Inspected.

Accommodation.

Average Attendance.

1881 .

1891 .

1897 .

1898 .

1899 .

1900 .

18,062 19,508 19,958 19,937 20,064 20,100

4,389,633 5,628,201 6,215,199 6,316,866 6,417,514 6,509,611

2,863,535 3,749,956 4,488,543 4,554,165 4,636,938 4,666,130

Voluntary schools are Church of England (National), Roman Catholic, British, Wesleyan, and Jewish. The number of volun- tary schools of various denominations, and of board schools in- spected, and the average attendance at the schools in 1881, 1891, and 1900 were : ???

Denomination and Year (ending

Schools

Average

August 81).

Inspected.

Attendance.

rl881

11,589

1,490,429

Church of England

] 1891

11,908

1,675,634

il900

11,804

1,882,854

fl881

1,992

544,113

British, Wesleyan, &c. .

.^1891

1,893

384,597

1.1900

1,553

350,899

ri88i

789

152,641

Roman Catholic .

\ 1891

955

195,663

1900

1,052

255,124

ri881

3,692

856,351

Board schools

\ 1891

4,779

1,498,599

1900

5,691

2,177,253

In 1901 there were in England and Wales 2545 school boards and 788 school attendance committees. The voluntary school associa- tions formed up to March 31, 1901, numbered 75, of which 46 were Church of England, 17 British and Wesleyan, 11 Roman Catholic, and 1 Jewish. There were 181 unassociated voluntary schools.

*The increase in the number of teachers in elementary schools is shown thus : ***

Years.

Certificated Teachers.

Assistant and Additional.

Pupil Teachers.

1881 . 1891 . 1900 .

33,562 47,823 64,038

11,018 29,189 49,948

33,639 28,131 29,393

Of the certificated teachers in 1900, 24,557 were men, and 39,481 women. Of the assistant and additional teachers, 5121 were men. There are 44 residential training colleges, of which 30 belong to the Church of England, 11 are British, Wesleyan, &c., and 3 are Roman Catholic. They contained in 1899, 3866 students. There were also 1334 students in 16 day training colleges. In ad- dition to the day schools there were, in 1900, 5263 evening continu- ation schools, with an average attendance of 206,335.

For the building of schools and for permanent structural improve- ments, loans are advanced to school boards by the Public Works Loan Commissioners, and are obtained otherwise on the security of the rates. Up to April 1, 1900, the loans amounted to ––39,428,860; the outstanding balance on September 29, 1899, amounted to ––29,352,590.

The income of public elementary schools is derived partly from Government grants and partly from local sources. The local income is mainly from endowment, voluntary contributions, school pence, rates, and county council grants. The local income, the total income, and the total expenditure of elementary schools in 1881, 1891, and 1900 were as follows :–––

Years.

1881 1891 1900

Revenue.

Local.

––

3,194,175 4,480,162 4,334,005

Total.

––

5,349,840

7,813,706

12,330,986

Expenditure.

––

5,336,979

7,829,665

12,453,006

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In the school year ending August 31, 1900, the income and ex- penditure of voluntary and board schools were : ???

Schools,

Eevenue.

Expenditure.

Local.

Total.

Church of England . British, Wesley an, &c. Roman Catholic Board

Total .

937,609

223,607

93,835

3,078,954

??

4,345,148 881,758 556,327

6,553,753

***\

variously regulated ??? some under the Charitable Trusts Acts, others under the, Endowed Schools Acts, while a few are regulated by their charters, special Acts of Parliament, and in other ways. A small number of second- ary schools is under local public authority. " The number of secondary schools in England, exclusive of Monmouthshire, and the number of their pupils on June 1, 1897, according to the results of the inquiry, are set forth as follows : ???

rorai of Control.

For Boys.

For Girls.

Mixed.

Schools.

Pupils.

Schools.

Pupils.

Schools.

PupUs.

Private enterprise . Subscribers . Companies Endowed, &c. Local authority

1311

70

48

602

27

46,617 8,719 5,188

59,617 2,272

2886

99

99

86

3

80,286

6,321

13,238

14,119

3,275

970

28

3

31

46

26,027

3,626

308

3,035

6,996

Of the 6209 schools to which the return relates, 1958 were for boys, 3173 were for girls, and 1078 were mixed. The total number of boys at the schools was 158,502, and of girls 133,042, or, respect- ively 5-4 and 4-5 per 1000 of the total population of England (ex- clusive of Monmouthshire) in 1897. Of the pupils, 68,785, or 24-8 per cent, of the whole, were boarders. The teaching staff of the schools consisted of 8362 attached male teachers, and 14,980 female, with 6874 visiting male teachers, and 5204 female. Of the male teachers (attached and visiting), 5821 were university gradu- ates ;□□□ of the female, 2323.

By the Board of Education Act, 1899, provision was made for the inspection of secondary schools desiring to be inspected, except those under the Welsh Intermediate Education Board. This board, constituted under the Welsh Intermediate Education Act, 1889, consists of 80 members appointed by councils of counties and county boroughs, school-governing bodies and other bodies inter- ested, and it provides for the inspection and examination of secondary schools in Wales and Monmouthshire. In 1899, 93 schools were examined, of which 22 were for boys, 21 for girls, 43 dual, and 7 mixed. The teaching staff consisted of 241 male and 204 female attached teachers, besides 204 visiting teachers. Of 7390 pupils examined, 8877 were boys, and 3513 were girls.

In England and Wales technical instruction has made great pro- gress, and technical schools have been mrdtiplied. In London the City and Guilds Technical Institute has a central college, an inter- mediate college, and two schools, employing in all about 76 pro- fessors and teachers, and giving instruction to over 1600 students. The metropolis contains many other institutions of a similar nature, among them being the Northampton Institute, the Regent Street Polytechnic, the Bolt Court Technical School, the Camber- well School of Arts and Crafts, the Central School of Arts and Crafts, the Hackney Technical Institute, the Crafts School, Mile End, Herold's Institute, the Shoreditch Municipal Technical School, and the National Training School of Cookery. But in ad- dition to such institutions primarily Intended for technical instruc- tion, over 100 schools and

colleges and institutes in London have been turned to account for the same purpose. Throughout the counties and boroughs of England and Wales similar development has taken place. Municipal and other technieal institutes have been founded in great numbers, while already- existing colleges, grammar schools, and board schools are encouraged and assisted in the work of technical instruction. The amount expended by local authorities on technical instruction in the year 1897-98 in England and Wales was: from grant under Local Taxation (Cus- toms and Excise) Act, ––756,717 ; from rates, ––97,739 ; total, ––854,- 456. The estimated total for the year 1898-99 was ––870,087.

In 1899 the Board of Education had 2056 science schools in England and Wales and Ireland, the number of science pupils being 174,670, while the number of its art schools and classes was 1745, with 130,126 pupils. Eor the year 1901-02 the parliamentary vote for art and science schools amounted to ––321,295.

Colleges. ––– In England, in 1900, there were 11 university colleges, receiving annual parliamentary grants amounting in the aggregate to ––24,000 ; in Wales there were 3, each receiving annually a grant of ––4000. Among the subsidized English colleges is Bed- ford College, London, for ladies ; similar institutions not receiving grants are Newnham College and Girton College, Cambridge ; Lady Margaret Hall and Somerville Hall, Oxford ; and the Royal Hollo way College, Egham.

iVew Universities. ––– In 1878 the University of London received a supplemental charter whereby women are admitted equally with men to its degrees and honours, and in 1900 it was reconstituted so as to have teaching as well as examining functions. The first schools of the university are University College and King's College, London, 6 theological colleges, 2 colleges for ladies, 10 medical schools, and 4 other schools and colleges. Provision is also made for the admission from time to time of other institutions as schools of the university. Victoria University was created by charter in 1880, with power to grant degrees to men and women who have studied in its colleges ; in 1888 it was empowered to confer medical degrees. Its colleges are Owen's College, Manches- ter ; University College, Liverpool ; and the Yorkshire College, Leeds. The University of

Wales was created in 1895, with power to grant degrees (but not medical degrees) to men and women. Its constituent colleges are those of Aberystwith, Bangor, and Cardiff. The University of Birmingham, created by charter of May, 1900, is a teaching and examining university, and confers degrees on persons of either sex.

University and College Attendances. ??? The University of Oxford in 1899 had 8446 undergraduates, 814 students having matriculated during the year. The University of Cambridge in 1900 had 2985 undergraduates ; in 1899-1900 there were 932 matriculations. The University of Durham had in 1899, 170 students. In 1900 the 2 colleges for ladies at Oxford contained 141 students, and the 2 at Cambridge, 286 ; that in London had 183, and that at Egham, 120. At other university colleges (except those at Aberystwith, Bangor, and Lampeter, and the Medical College at Newcastle), the attend- ance of students is largely in the evening, and in the following figures, referring to the winter session of 1900, both day and even- ing students are included. University College and King's College, London, had together 2566 students. The 3 colleges associated together in the Victoria University had 2400 ; the 3 within the University of Wales had 2730 ; the 2 at Newcastle (1 of medicine and the other of science), connected with Durham University, had 1700 students ; Mason College, Birmingham, had 935 ; and the 4 colleges at Nottingham, Sheffield, Bristol, and Lampeter had altogether 3600 students.

Charities.

The information concerning the endowed charities of England and Wales contained in the Eeports of the Com- mission of 1818 to 1837 has been and is being supple- mented by digests compiled by the Charity Commissioners, and, since 1892, by the results of local inquiries, towards

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*the cost of which the County Councils are authorized to contribute. As yet, however, there is no complete account of the income of these charities. According to a return laid before Parliament in 1898, the amount applicable for alms-people and pensioners, and the amount ap- plicable to gifts of money and in kind, were at that date, as far as had been ascertained, as follows : ***

For Alms- people and Pensioners.

Tor Distri- bution.

*I. Results of Local Inquiry ***

West Riding of Yorkshire

Part of Wales ....

II. According to Digests, 1868-76, and

Supplementary Digests, 1890-97

III. According to Digests, 1868-76 .

Total

***

37,918 3,156

301,887 268,504

***

13,.330 3,739

218,790 91,796

611,465

327,655

__939,120

In the 48th Report of the Commissioners it is stated that the number of returns of accounts of charities made to their office in 1900 was 36,764 ; in 1899, 38,516 ; in 1898, 29,478 ; but according to the 46th Eeport the number of charities from which accounts were annually due in 1898 was 70,547. The stock and investments which had been transferred to the official trustees of charitable funds (exclusive of retransferments) from 1864 to December 31, 1900, amounted to __20,829,650.

The number and value of endowed charities is rapidly increasing. In the 20 years 1875-94 charities of __1000 and upwards subject to the Charitable Trusts Acts were founded, amounting to over __8,000,000, and in the 6 years 1895-99 the new charities in the aggregate amounted to over 2^ millions sterling. On the average, about 500 new charities are created annually, and the average amount annually so given is estimated at a capital value of about __1,000,000, of which about half is permanent, or subject to a perpetual trust for investment, and the remainder is not so subject.

Of the large amount annually raised by voluntary contribution for charitable purposes in England and Wales, no trustworthy estimate can be formed. In the metropolis the income of chari- table institutions (exclusive of the amount devoted to religious purposes) is probably not much less than __4,000,000, of which about __950,000 goes to the hospitals, general and special. The number of hospitals in London and its suburbs is about 126 ; 23 are general and 76 are for special diseases, and there are about 27 suburban and cottage hospitals. Of the general hospitals, 13 are provided with medical schools. St Bartholomew's Hospital in 1899 had an income, from all sources, amounting to __72,454 ; treated 6343 in-patients and 14,017 out-patients, besides 125,233 cases of accident, &c. The income of St Thomas's Hospital was __72,841, of which __46,792 was from estates ; the in-patients during 1899 numbered 5831 ; the out-patients, 18,417 ; and the cases of accident, &c., 44,920. In the same year the London Hospital had a total income of __93,679, of which __61,521

was ordinary income ; the in-patients numbered 13,234, and the out-patients, 189,638. Guy's Hospital had an ordinary income of ––41,541, and to meet current expenditure ––38,479 was transferred from permanent funds ; it had 7548 in-patients and 85,198 out-patients during the year. St George's Hospital had a total income of ––29,692 ; St Mary's Hospital, ––32,513 ; and the Royal Free Hospital, ––11,930. The Bethlehem Hospital for lunatics had in 1899 a revenue of ––39,000 ; the patients cared for during the year were 179 men and 259 women, besides 47 men and 63 women at the Witley convalescent estate. Owing to the decrease in the value of land and from other causes, the permanent income of several of the hospitals has decreased in recent years, and consequently many nf the beds have been unoccupied. The amount raised by the Hospital Sunday Fund in 1901 was ––51,000; in 1900, ––49,500; in 1899, ––63,604. Tlie Hospital Saturday Fund in each of those years raised about ––20,000. The Prince of Wales's Hospital Fund

for London amounted, at the beginning of 1900, to ––315,364, of which ––176,015 remained in hand.

Beligion.

There are no comprehensive statistics showing the population of England and Wales according to religious denominations. In the Eegistrar-General's Eeport for 1899 the number of churches and chapels of the Estab- lished Church in which marriages could be solemnized was stated to be 16,309, and the number of buildings on the register for marriages by rites other than those of the Church of England was 12,578. The latter number comprised 2551 Congregationalist buildings, 2195 Baptist, 2695 Wesleyan, 1124 Primitive Methodist, 533 United Methodist Pree Church, 203 Methodist New Connexion, 96 other Wesleyan Methodist, 666 Calvinistic Methodist, 397 Presbyterian, 177 Unitarian, 149 Bible Christian, and 678 belonging to other bodies. Of 1000 marriages solemnized in each of the years 1881, 1891, 1898, and 1899, the proportion solemnized according to the rites of the Church of England, and of those solemnized other- wise was as follows : –––

1881.

1891.

1898.

1899.

Established Church .

715

699

685

678

Roman Catholic .

45

42

40

41

Various other Christian

111

118

121

124

Friends ....

0-3

0-3

0-4

0-3

Jews

2-5

4-6

5-7

6-4

In Registrar's office .

126

136

148

1.50

Judged by this test, the Church of England predomi- nates over the length and breadth of England and Wales, except in the northern counties of Wales.

Established Church. ??? In 1900 the Established Church was governed by 2 archbishops, 33 bishops, 17 suffragan and 5 assistant bishops in England and Wales. Since the year 1880 five bishoprics have been founded or reconstituted, one of them, that of Bristol, being in the province of Canterbury, and the others in the province of York. These new dioceses, with the year of their foundation and the amount of an- nual income, are as follows : ??? Liverpool, 1880, income, ??4000 ; Newcastle, 1882, income, ??3500 ; Southwell, 1884, income, ??3500 ; Wakefield, 1888, income, ??3000 ; Bristol, 1897, income, ??3000. The see of Bristol

was originally founded in 1542, but in 1836 it was united with that of Gloucester. In 1897, however, it was, by Order in Council, reconstituted as a separate diocese. Steps were being taken in 1901 towards the foundation of a bishopric of Southwark, with an endowment of ––4000 a year. Under the bishops are 31 deans, 91 archdeacons, and 810 rural deans. The total number of bishops and clergymen at work in 1899 was approximately 22,800, of whom 13,873 were beneficed, the remainder being curates and unbeneficed clergymen. Church extension is steadily progressing, churches and chapels being built, new districts and parishes formed, and the incomes of the poorer clergy increased. This work is being advanced with the assistance of diocesan funds, and by the labours of 31 diocesan Church extension societies. The number of new districts, parishes, &c., formed in the year 1898-99, under the Church Building and New Parishes Acts, was 26, and in the years 1818 to 1899, 3725. The voluntary contributions alone which were applied to this purpose in the 16 years 1884-99 amounted to ––21,858,548, of which ––17,531,626 was applied to church building and restora- tion, ––2,348,611 to endowments, ––1,567,739 to parsonages, and ––410,ri72 to burial-grounds. Through the instrumentality of the Ecclesiastical Commissioners, assisted by private liberality, the inooinps of the underpaid clergy have been largely increased, 5800 benefices having been augmented during the years 1840 to 1898, the total annual income being increased by ––l,0.‘12,o00. Within the Church there are many clerical and lay agencies for scliool work, for home and foreign mission work, and for many other purposes, for which voluntary contributions of large amount are received. The gross annual income of the Church of Eng- land, according to a return of the Ecclesiastical Commissioners

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in 1891, was as follows, from ancient endowments and from benefactions since 1703 : –––

Ancient Endowments.

Private Bene- factions since

1708.

Archiepiscopal and Episcopal sees . Cathedral and Collegiate churches . Ecclesiastical benefices . Ecclesiastical Commissioners Queen Anne's bounty .

Total

??

87,827

192,460

3,941,057

1,247,827

??

11,081

272,605

700

??5,469,171

??284,386

The income from voluntary contributions for church purposes, raised by offertories in church and by parochial organization, in 1897-98 was ??5,919,706, in 1898-99, ??5,954,738, and in 1899- 1900, ??5,504,395. If to these sums be added the money con- tributed for general purposes, the total for 1898-99 rises to ??7,464,430, and for

1899-1900, ►►7,770,993 ; but this is exclusive of many contributions devoted to church or parish purposes through other channels. The Church House at Westminster is regarded as a centre for the many societies within the Church of England. It con- tains a large hall, library, and offices, and though not yet complete, it began to be used by Convocation in 1896. It is intended that the building shall contain a hall for the use of the House of Laymen.

Boman Catholics. ►►► The number of Koman Catholics in England and Wales in 1891 was estimated at about 1,500,000, but there are no trustworthy statistics on the subject. The Roman Catholic hierarchy in England in 1900 consisted of 1 archbishop and 14 bishops, besides 2 auxiliary bishops and a coadjutor bishop. In Wales there was a bishop, vicar-apostolic. At the same date the number of officiating Roman Catholic clergy in England and Wales was 2837, and of their chapels and stations, 1536.

Protestant Dissenting Bodies. ►►► The Protestant Dissenting bodies are numerous and active, possessing organizations for charitable work and for home and foreign mission work, their efforts for the last-named purpose being made largely through the London Missionary Society, while they raise large amounts annually for congregational purposes. The following list, which shows the number of members (communicants), of ministers, of local preach- ers, and of sittings in the churches and chapels of the several bodies, refers in general to the year 1900 : ►►►

Members.

Ministers.

Local Preachers.

Sittings.

Congregational

398,741

2509

5,050

1,643,400

Baptist ....

346,083

1855

5,074

1,273,325

Presbyterian .

74,541

3.36

???

164,491

Wesleyan

552,933

1858

17,834

2,224,057

Primitive Methodist

185,075

1060

15,730

962,720

Calvinistic Methodist

156,058

626

409

451,200

United Methodist Free

Church

78,692

355

3,028

426,500

Meth. New Connexion .

35,962

193

1,029

137,478

Bible Christian

29,150

169

1,473

153,600

Friends ....

16,611

???

400

???

Churches of Christ

11,939

???

397

20,000

Independent Methodist .

8,599

???

495

33,000

Wesleyan Reform

Union

7,192

18

???

43,834

Moravians

3,371

51

???

Lady Huntingdon Con-

nexion

2,355

29

???

13,347

Free Church of England

1,500

27

???

6,500

Reformed Episcopal

1,500

28

???

7,200

The Unitarians have about 345 chapels. Smaller bodies are the Catholic Apostolic Church, with about 80 churches, and the New Jerusalem Church, with about 75 societies. The Salvation Army, a religious body with a quasi-military organization, has carried on since 1865 active work, both of a spiritual and social nature, and has extended its labours to the colonies and to many foreign countries. In the United Kingdom alone it has 1610 corps and societies, with 4854 officers and others wholly engaged in its work, and it maintains 142 institutions for assisting the destitute, or for rescuing those who have lapsed into crime or immorality. At these institutions, in 1899, work was obtained for 12,460 applicants ; over 2J million cheap meals and nearly If million cheap lodgings were provided, for which (combined) the recipients paid ??33,610. There were received into homes in the same year 2129 women and girls, of whom 1820 were sent to situations or restored to their friends.

The number of Jews in England and Wales in 1899 was estimated at 97,350, the great majority of them being in London. They have about 80 synagogues, and about 100 ministers.

Agriculture. The land area of England and Wales extends over 37,120,000 acres, of which, on the average of the three years 1897-99, 27,591,000 acres are under crops and grass, 3,427,000 acres consist of mountain and heath land used for grazing, and 1,848,000 acres (according to an estimate of 1895) are under woods and plantations ; the area which is not arable, nor pastoral, nor woodland, thus extends to 4,254,000 acres. The following statement shows the dis- tribution of these areas in England and in Wales, and the proportion which each bears to the total land area : ???

Description of Land.

England.

Wales.

Area.

Per

cent.

Area.

Per cent.

Under crops and grass

(1897-99) .

Mountain and heath land used for graz- ing (1897-99) Woods and plantations

(1896) .

Other land areas

Total land area .

Acres.

24,763,000

2,243,000

1,666,000 3,703,000

76-6

6-9

5-1 11-4

Acres.

2,828,000

1,184,000

182,000 551,000

59-6

24-9

3-9 11-6

32,375,000

100-0

4,745,000

100-0

*The area under crops and grass in England and Wales in 1881, 1891, 1896, and 1900 was as follows : ***

1881.

1891.

1896.

1900.

Acres.

Acres.

Acres.

Acres.

Corn crops ???

Wheat

2,731,071

2,253,983

1,656,228

1,796,210

Barley

2,171,817

1,889,533

1,886,481

1,750,070

Oats .

1,870,548

1,906,890

2,087,372

2,076,960

Rye .

34,277

39,167

66,387

47,566

Beans .

420,327

339,377

238,115

250,116

Peas .

Total com 1 crops J

Green crops ???

215,233

203,181

195,251

155,837

7,443,273

6,632,131

6,129,834

6,076,759

Potatoes

390,173

392,844

433,-952

430,161

Turnips and

swedes

1,545,038

1,438,567

1,408,218

1,223,372

Mangold

346,771

353,348

336,399

411,755

Cabbage, &c.

139,437

147,666

151,244

181,705

Vetches 1

216,370

167,598

168,263

Other green j-

383,084

crops J

Total green “1 crops /

Grasses,&c.,un-

103,840

131,560

139,611

2,806,503

2,652,635

2,628,971

2,554,867

der rotation ???

For hay \ Not for hay j

Total

Flax

1,762,851

1,778,992

1,795,558

2,880,353

1,323,914

1,245,473

1,369,162

2,880,353

3,086,765

3,024,465

3,164,720

6,243

1,791

1,765

466

Hops

64,943

56,145

54,249

51,308

Small fruit

54,077

70,885

67,858

Fallow . Total arable

Permanent pas-

776,167

420,041

424,505

301,230

13,977,662

12,903,585

12,334,674

12,217,207

ture ???

For hay \ Not for hay /

Total

Total??? Crops “1 and grass j

13,471,238

4,349,685

4,467,991

4,241,343

10,747,864

10,862,960

11,079,579

13,471,238

15,097,549

15,330,951

15,320,922

27,448,900

28,001,134

27,665,625

27,538,130

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The horses (used for agriculture) , cattle, sheep, and pigs in the same years were in number as follows : ???

1881.

1891.

1896.

1900.

Number.

Number,

Number.

Number.

Horses .

1,231,870

1,293,236

1,846,003

1,305,605

Cattle

4,815,430

5,629,524

5,286,582

5,607,084

Sheep

17,849,801

21,108,658

19,238,820

19,277,229

Pigs

1,925,072

2,731,267

2,734,186

2,249,519

*In 1900 the agricultural animals were thus distributed between England and Wales : ***

Horses.

Cattle.

Sheep.

Pigs.

England . Wales .

1,152,321 153,284

4,848,698 758,386

15,844,713 3,432,516

2,021,422 228,097

The figures given above show that between 1881 and 1900 the arable area of England and Wales decreased nearly 13 per cent., while the permanent pasture increased nearly 14 per cent. The acreage under wheat contracted 34 per cent., while that under oats extended 11 per cent. Flax cultivation,, never extensive, shrank almost out of existence, while the cultivation of small fruit increased. It should be mentioned, also, that the orchard area of England and Wales, yielding grass or other produce, besides fruit, expanded from 183,033 acres in 1881 to 208,069 in 1891, 219,319 in 1896, and 226,378 in 1899.

The area of England (apart from Wales) is divided into two sections, " arable " and " grass," corresponding with the old divi- sion into " corn

counties ” and “grazing counties, ” except that the county of Leicester is included not in the “grass” but in the “arable ” section. Most of the eastern part of England is “arable,” while the western and northern part is “grass,” the boundary be- tween the sections being the western limit of the counties of Hants, Berks, Oxford, Warwick, Leicester, Nottingham, and of the East Eiding of Yorkshire. The difference between the agricultural con- ditions of the sections is shown by the following table, giving the acreage under crops and grass, and the number of agricultural animals, with the proportion per cent, in each section in 1899 : ???

Acreage.

Percentage.

Arable Section.

Grass Section.

Arable Section.

Grass Section.

Arable land ??? Corn crops . Green crops . Clover, grass, &c.

(rotation) . Hops.small fruit,&c. Fallow .

Total arable

Permanent pasture ??? For hay . Not for hay . Total permanent “1 pasture . J Total crops and\ grass . J

Orchards .

Woods and planta- tions (1895)

Mountain and heath, for grazing .

Farm animals ??? Horses . Cattle . Sheep . Pigs

Acres.

3,692,240 1,436,936

1,340,891

88,686

236,144

Acres.

2,063,236 973,020

1,465,719 28,489 86,440

64-2 59-6

47-8 69‘8 73-2

35-8 40-4

52-2 30-2 26-8

6,794,897

4,616,904

59-5

40-6

1,481,219 3,606,044

2,272,648 6,964,249

39-5

37-7

60-5 62-3

5,087,263

8,236,897

38-2

61-8

11,882,160

70,581

825,266

216,509

Number.

576,555 1,815,258 7,314,478 1,018,650

12,853,801 152,131 840,475

2,055,254

Number.

587,157 3,026,595 8,946,939 1,143,770

480

31-7

49-6

9-5

48-8 37-5 45-6 48-6

52-0 68-3 50-5 90-5

51-2 62-6 65-0 51-4

The yield of the principal crops in England and 1896, and 1900, and the yield per acre in the same in the following statement : ???

[statistics

In Wales in 1891, years, are shown

England.

Wales.

1891.

1896.

1900.

1891.

1896.

1900.

Wheat Barley Oats . Beans , Peas

Potatoes . Turnips, ifcc. Mangold

Hops . Hay .

Bushels.

68,694,456 60,900,824 69,786,176 9,966,524 6,702,714

Tons.

2,050,923

17,703,675

6,697,827

Cwt.

486,716 140,646,806

Bushels.

64,623,269 59,843,647 69,402,160 5,974,472 4,911,784

Tons.

2,589,868 14,656,850 4,968,864

Cwt.

463,188 106,860,449

Bushels.

49,528,885 60,977,266 78,604,178 6,928,152 3,995,030

Tons.

1,986,108 15,865,818 8,243,786

Cwt.

347,894 188,619,980

Bushels.

1,461,740 3,488,620 7,698,529 64,834 30,638

Tons.

207,851

1,010,162

180,485

Cwt.

12,902,192

Bushels.

1,078,090 2,828,170 7,179,786 80,681 25,680

Tons.

218,264 956,988 98,764

Cwt.

9,726,809

Bushels.

1,882,299 3,841,872 7,288,806 82,648 83,891

Tons.

153,162 966,943 170,947

Cwt.

14,130,322

Wheat Barley Oats . Beans . Peas .

Potatoes Turnips Mangold .

Hops .

Per Acre.

Bushels.

81-33 84-36 41-72 29-54 28-81

Tons.

6-78 12-94 19-10

Cwt.

7-78

Per Acre.

Bushels.

33-88 88-64 87-60 26-27 25-40

Tons.

6-35 10-96 16-10

Cwt.

8-36

Per Acre.

Bushels.

28-89 30-99 89-56 27-88 25-94

Tons.

6-00 13-66 20-61

Cwt.

6-78

Per Acre.

Bushels.

28-78 29-36 32-89 29-11 19-98

Tons.

6-44

14-81

16-55

Per Acre.

Bushels.

22-95 26-21 29-71 20-68 16-64

Tons.

5-46

18-47

18-28

Per Acre.

Bushels.

25-79 31-81 33-44 25-34 21-66

Tons.

4-61

18-84

17-87

The number of agricultural holdings in England and Wales arranged in 4 classes according to their size, and the acreage comprised in each class, in 1885 and in 1895, are given in the subjoined table. The first class includes holdings of 1 acre and not over 5 acres ; the second, those over 5 and not over 50 ; the third, those over 50 and not over 300 ; while the fourth class comprehends all over 300 acres : ???

Holdings.

England.

Wales.

Acres.

*fl885 1-5 *

(.1895

Number.

103,229

Acreage.

286,526

Number.

11,044

Acreage.

34,352

101,428

279,641

11,763

36,633

fl885 5-50 \

(.1895

170,431 170,591

3,262,033 3,288,669

29,715 30,969

620,651 635,024

fl886 50-300.^

(.1895

104,073 106,955

13,571,338 13,837,899

17,888 18,113

1,969,045 1,988,034

fl885 Over 300.^

(.1895

fl885 Total \

(.1895

16,148 15,578

7,761,654 7,462,852

460 443

193,789 179,668

393,881 394,552

24,881,551 24,859,061

59,107 61,288

2,817,837 2,839,359

In 1895 the number of allotments under 1 acre in size in England was 522,163 ; in Wales, 12,179. It would appear that between 1885 and 1895 the small holdings of 1 to 5 acres decreased in number and in acreage in England, but increased in Wales, and that the tendency was towards increase in the number and area of holdings from 6 up to 300 acres, but towards decrease in the case of those over 300 acres.

Most of the agricultural holdings in England and Wales are rented, but the acreage of those farmed by the owners is consider- able. In the following table the holdings are grouped in 8 classes according to size, the first class consisting of those over 1 acre and not over 6 acres. The figures show for 1895 the aggregate area of the cultivated land, and the percentage of owner-farmed land in each class. For large farms this percentage is high ; it is at its

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lowest in the class embracing holdings of from 60 to 100 acres, and it slowly rises as the holdings decrease in size : ???

Holdings of Acres.

England,

Wales.

Total Area.

Owner-Farmed. Per cent, of total.

Total Area.

Owner-Farmed. Percent, of total.

1-5

5-20

20-50

60-100

100-300

300-500

600-1000

Over ipoo

Acres.

265,268 1,210,716 2,077,953 3,403,761 10,434,138 4,188,651 2,570,684

693,617

17-5 16-3 13-0 11-6 11-6 15-8 25-3 40-8

Acres.

35,633

211,267

423,757

749,465

1,238,569

142,925

32,818

3,926

11-8 12-6 11-0 10-8 11-0 12-8 42-8 69-4

Over 1 .

24,844,688

14-9

2,838,369

11-6

Thus it appears that in England and "Wales, in 1895, of the total acreage under crops and grass, 14-5 per cent, belonged to owner- farmed holdings.

In 1881, according to the census returns, there were in England and Wales 1,278,624 persons (including 64,171 females) engaged in agriculture, those who worked "in fields and pastures" being to the number of 1,196,836 (including 61,073 females) . In 1891 there were 1,311,720 persons (including 51,696 females) engaged in agri- culture, but the number of those who worked "in fields and pastures " had fallen to 1,096,362 (including 45,999 females).

Communications.

Roads. ❖❖❖ In England and Wales the high-roads, or roads on which wheeled vehicles can travel, are of two classes : (1) the main roads, or the great arteries along which the main traflBc of the country passes ; and (2) ordinary high- ways, which are by-roads serving only local areas. The length of the former in 1882 was stated to be 12,199 miles; in 1899, 22,025 miles. The mileage of the ordinary highways in 1882 was stated to be 102,615; in 1899, 96,573. By the Local Government Act of 1888 the duty of maintaining main roads was imposed on county coun- cils, but these bodies were enabled to make arrangements with the respective highway authorities for their repair. Under the Local Government Act of 1894 the duties of all the highway authorities were transferred to the rural district councils on or before March 31, 1899.

For the year 1898-99 the total receipts of all the highway authorities (exclusive of ❖❖29,721 from loans) amounted to ❖❖2,217,703, of which ❖❖1,410,931 was from rates, the remainder being chiefly from Local Taxation Account and County Council contributions. The expenditure (exclusive of ❖❖23,587 from loans) amounted to ❖❖2,188,422, of which ❖❖350,228 was spent on repairs of main roads, and ❖❖1,632,070 on repairs of ordinary highways. In England and Wales the assessable value for the purposes of highway authorities was ❖❖40,508,546, and on this value the rates levied for highway purposes were equivalent to 8-4d. on the ❖❖. The last turnpike trust ceased to exist on November 6, 1895, and the final accounts in connexion with its debt were closed in the year 1898-99.

Railways. ❖❖❖ In the period from 1880 to 1899 the mile- age of the railways of the United Kingdom increased by 21 per cent., while their paid-up capital was augmented to the extent of 58 per cent. In 1880 their total length was 17,933 miles ; in 1890, 20,073 miles ; in 1900, 21,855 miles. Their authorized capital in 1880 amounted to ❖❖802,014,004; in 1890, to ❖❖1,004,529,164; in 1900, to ❖❖1,302,674,079. The paid-up capital rose from ❖❖728,316,848 in 1880 to ❖❖897,472,026 in 1890, and ❖❖1,176,001,890 in 1900. The growth of the railway systems of England and Wales alone during the same period is shown by the following figures, giving the length of line, double (or more) and single, the authorized capital

and the paid-up capital on December 31 of the years named : ❖❖❖

Leng:th of Line.

Capital.

Tears.

Double or More.

Single.

Total.

Authorized.

Paid-up.

Miles.

Miles.

Miles.

[illegible]

[illegible]

1880

8,105

4551

12,656

663,067,719

602,242,678

1890

9,094'

6026

14,119

833,049,003

740,033,907

1895

9,481

5170

14,651

924,266,307

826,195,880

1899

9,933

5111

15,044

1,071,417,937

950,179,607

1900

10,101

5086

15,187

1,095,042,057

970,147,581

The English and Welsh railways for their whole length, except 124 miles, have a gauge of 4 ft. 8^ in.

The number of passengers carried in the course of a year on the railways of the United Kingdom increased between 1880 and 1900 by 88 per cent., and the weight of goods carried, by 81 per cent., while the receipts from passenger traffic had an increase of 67 per cent., and those from goods

traffic an increase of 49 per cent. The number of passengers conveyed (exclusive of season ticket-holders) in 1880 was 603,885,026; in 1890, 817,744,046; in 1900, 1,142,276,686. The total weight of goods carried in 1880 was 235,305,629 tons; in 1890, 303,119,427 tons; in 1900, 424,929,513 tons. The receipts from passenger traffic in 1880 amounted to ►►27,200,464 ; in 1890, to ►►34,327,966 ; in 1900, to ►►45,383,988. The receipts from goods traffic in 1880 reached ►►35,761,303 ; in 1890, ►►42,220,382 ; in 1900, ►►53,470,564. The number of season ticket-holdei-s in 1880 was 502,174 ; in 1900, 1,749,804. In 1880 the goods traffic comprised 166,670,304 tons of minerals ; in 1900, 306,389,083 tons, the receipts for the carriage of which amounted to ►►22,870,694. The expansion of the passenger and goods traffic and of the receipts therefrom in England and Wales alone are shown in the following statement : ►►►

Tears.

Passengers Conveyed.

Goods Carried.

Eeoelpts for Carriage of

Passengers.

Goods.

1880 . 1890 . 1895 .

1899 .

1900 .

Number.

540,669,175 721,114,781 816,921,056 959,601,776 992,425,769

Tons.

200,393,357 259,150,132 280,324,042 350,070,663 369,624,742

23,141,065 29,207,694 31,687,774

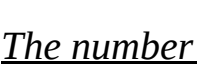 37,225,740

38,633,679

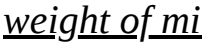

30,457,932 35,976,180 37,014,948 44,186,881 45,339,962

The number of season ticket-holders (not included in the num- ber of passengers in the table) was, in 1880, 449,823; in 1900, 1,610,754. The weight of minerals carried on the English and Welsh railways in 1880 was 140,065,836 tons; in 1900, 256,895,900 tons, the receipts for the carriage of minerals in the latter year having amounted to ––19,628,603. Of the railway passengers in the United Kingdom in 1900, 34,318,809 travelled in first-class car- riages ; 69,804,629 in second-class ; and 1,038,873,248 in third- class. Of the passengers on the English and Welsh railways alone, 27,446,980 travelled in first-class, 65,167,076 in second-class, and 899,821,713 in third-class carriages. The total receipts of the railways of the United Kingdom for the year 1880 amounted to ––65,491,625; the working expenses to ––33,601,124; and the net receipts to ––31,890,501, or 4-.$8 per cent, of the paid-up capital. For 1900 the total receipts reached the sum of ––104,801,858 , the working expenses, ––64,743,520 ; and the net receipts, ––40,068,338, or 3-41 per cent, of the paid-up capital. Of the railways in England and Wales alone, the total receipts, the working expenses, and the net receipts, with their proportion per cent, of paid-up capital, were as follows in various years. The receipts include not only those from traffic, but also those from rentsj tolls, &c. : ––

Tears.

Receipts. –

Working Ex- penses.

Net Eeceipts.

Amount.

Per cent, of Paid-up Capital.

1880 . 1890 . 1895 .

1899 .

1900 .

* 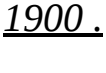 *

55,795,186 68,272,908 72,791,758 86,708,006 89,392,501

28,677,111

36,964,677 41,126,298 51,922,103 55,882,810

* *

27,218,075 31,308,331 31,665,460 34,785,903 33,609,691

4-52 4-23 3-83 3-65 2-89

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ENGLAND AND WALES

[statistics

*In 1880 the railways of the United Kingdom had 13,384 locomo- tive engines; in 1900, 21,195. In 1880 they Ijad 29,565 carriages for passengers ; in 1900,47,433. In 1880 the waggons, &c., num- bered 402,901 ; in 1900, 727,784. The increase in the rolling stock of the English and Welsh railways is shown as follows : *

Years.

Locomotives.

Passenger Carriages.

Waggons, &c.

1880 . 1890 .

1895 .

1899 .

1900 .

11,172 13,731 15,901 17,411 18,040

24,658 31,374 35,773 38,805 40,115

301,921 426,791 486,394 537,786 559,917

In England and Wales there are about 190 railway companies, but most of them are small, and of 81 companies the lines have been leased to, or are worked by, the great companies named in the subjoined table. The mileage and traffic include those of the absorbed companies' lines. The figures relate to the year 1900 : ???

Companies.

Miles Open.

Goods Carried.

Passengers Carried.

Tons.

Number.

Great Western

2627

37,500,510

80,944,483

London and N. -Western

1937

44,465,277

82,069,748

North-Eastem

1654

53,126,913

67,573,747

Midland

1487

40,937,111

61,932,911

Great Eastern

1110

11,642,386

116,103,401

London and S. -Western

898

6,411,400

63,710,860

Great Northern

825

17,548,466

87,671,162

S.-E. and Chatham . .

609

6,655,824

73,834,089

Lancashire and Yorks .

556

21,795,887

64,665,969

Great Central

494

20,779,795

18,443,272

‘London, Brighton, and

S. Coast .

448

4,262,974

55,770,006

On the metropolitan railway of 73 miles there were 77,126,753 passengers ; on the Metropolitan District, 19 miles, 40,444,073 passengers ; and on the North London, 12 miles, 38,382,728 pas- sengers in 1900, the numbers being in each case exclusive of season ticket-holders.

Light Hallways. ??? The railway statistics given above do not in- clude those relating to light railways, for the construction of which in Great Britain encouragement was offered by the Light Railways Act, 1896, with a view to benefiting agricultural, fishing, and other interests. A Commission which is continued under the Expiring Laws Continuance Act (1901), examines schemes and submits its Orders to authorize light railways for confirmation by the Board of Trade. Local authorities, as well as companies or individuals, may apply for Orders, and may make advances for light railways, as the Treasury also, under certain conditions, is empowered to do. Up to December 81, 1900, out of 309 ap- plications, 167 had been approved by the Commission, the aggre- gate length of the approved lines amounting to 1360 miles, and their estimated construction cost to ??8,824,275. Those actually submitted to the Board of Trade numbered 133, and they related to 1063 miles of line, and a construction cost of ??6,517,311. Of these Orders the Board of Trade had confirmed 71, of which 12 were for Scotland. Of the projected lines, about three-fourths in length resemble ordinary railways, the remainder being road or street railways.

Tramways. ??? On June 30, 1900, there were in the United Kingdom 177 tramway undertakings, with altogether 1177 miles of tramway line. Of these undertakings, 70 with 586 miles of line belonged to local authorities, while 107 with 592 miles of line belonged to others than local authorities.

The capital expenditure on the former amounted to ►►10,203,604, on the latter to ►►11,532,384. The development of tramway enterprise in England and Wales, as shown by the mileage open, the paid-up capital, gross receipts, working expenses, and number of passengers carried, has been as follows : ►►►

Tears

ending

June 80.

Miles Open.

Paid-up Capital.

Gross Eecolpts.

Working Expenses.

Passengers

carried

during Year.

1880 1890

1895 1899 1900

269 753

774 881

9:y.i

►►

4,206,637 10,994,341 11,812,338 13,964,628 15,901,923

972,513 2,673,535 3,038,804 3,860,701 4,347,142

****

812,876 1,932,444 2,344,802 2,962,089 3,816,590

Number.

118,218,415 418,399,936 526,838,417 700,436,783 816,768,639

*For the whole of the United Kingdom in 1899-1900 the paid-up capital amounted to **20,582,692 ; the gross receipts, to **5,445,620 ; the working expenses to **4,075,352 ; and the number of passengers carried was 1,065,374,847. In the same year, in England and Wales the tramway cars numbered 5051, and they were drawn by 29,827 horses and 526 locomotive engines. In the United Kingdom there were 6410 cars, drawn by 37,481 horses and 558 locomotive engines.*

*Canals.*** Ot the canals and navigations in the United Kingdom in 1898, the^ total length reached 8907 miles, of which 2768 miles did not, and 1139 miles did, belong to railway companies. The total length in 1888 was given as 8813 miles, of which 2608 miles did not, and 1204 miles did, belong to railway companies. The canal returns for 1898 are more complete than those for 1888, but the figures as they stand indicate an increase of 160 miles in the length of the canals not belonging to railway companies, and a decrease of 66 miles in that of the railway canals, the net increase thus reaching 94 miles. In 1898 the total paid-up capital (from all sources) of the canals not belonging to railway companies amounted to **37,929,280 ; in 1888 it amounted to **24,286,175. Of the total paid-up capital in 1898, the sum of **35,091,404 stood against the names of canal companies in England and Wales. The develop- ment in canal enterprise in England and Wales between 1888 and 1898, according to Board of Trade Returns, is shown by the follow- ing figures, giving the mileage, the traffic conveyed, the gross reve- nue, and the expenditure in the respective years of A, canals and navigations not belonging to railway companies, and B, of those belonging to railway companies : ****

A. Non-Bailway Canals and Navigations.

Years.

Length.

Traffic.

Eevenue.

Expenditure.

1888 . 1898 .

Miles.

2026 2208

Tons Conveyed.

27,715,875 32,618,800

1,439,343 1,896,506

??

861,068 1,-322,201

B. Mailway Canals and Navigations.

1888 . 1898 .

1024 959

6,609,804 4,913,085

437,080 831,306

335,603 309,025

The increase in the length of the English canals is due mainly to the construction of the Manchester Ship Canal, which was opened in 1894.

From its commencement at Eastham, where it joins the Mersey, to Its termination in the city of Manchester, it has a length of 35J miles, while, including the Bridgewater canals and the Mersey and Irwell navigations, the whole system has a length of about 110 miles. From Eastham to Manchester the canal may be used by vessels 550 feet in length and 60 feet wide, with 25 feet of draught and 70 feet of headway. The bottom width at the full depth is in general 120 feet, but at several places it exceeds this ; while between Latchford Locks and Partington Canal Basin it does not exceed 90 feet. At Eastham there are three locks, and the Latch- ford, Irlam, Barton, and Modewheel locks are in pairs. A junction with the Shropshire Union Canal is made at EUesmere Port ; with the Weaver Navigation, at Weston Point ; with the Bridgewater canals, at Runcorn ; and with the Runcorn and Latchford Canal, at Stockton Heath Bridge. The paid-up capital (from all sources) of the canal up to December 31, 1898, amounted to ►►16,459,369. The traffic (not sea-borne) using the company's canals, &c., in the year 1898 reached 3,548,894 tons, while the sea-borne traffic to and from Manchester amounted to 2,640,961 tons. The receipts during the same year reached the sum of ►►551,039, and the work- ing expenses amounted to ►►447,356. Many of the old canals are of importance for the development of the industries of the country. The Birmingham canal navigations consist of the Birmingham and Wolverhampton Canal, with many branches, the total length ex- tending to 159 miles. In 1898 the traffic conveyed on this system amounted to 8,627,074 tons, of which 4,543,008 tons represented coal ; the total revenue reached ►►208,036, and the expenditure, ►►88,848. The Leeds and Liverpool Canal, with its connected sys- tem, has a length of 141 miles ; in 1898 the traffic conveyed on it reached 2,824,968 tons. The Grand Junction Canal, extending, with many branches, from Brentford to Aylesbury, Northampton, Leicester, and Market Harborough, besides joining other canal systems, has a length of 188 miles, and in 1898 served for the con- veyance of 1,620,552 tons of goods.

See also the article United Kingdom, and the separate articles on Banking, Armies, Post Office, Local Government.

Books of Mefercnee. ►►► Tlie following official publications are issued in London :.►►►/?cj)(i)'{ on the Census of England and Wales, 1891, 4

vols., 1893 ; Preliminary Report on the Census vf 1901 ; Annual

Jteport and Quarterly Beturns of the Registrar-General ; Annual Statistical Tables relating to Emigration and Immigration ; Annual Beport of Local Government Board ; Judicial Statistics of England and Wales (Annual) ; Beports of Inspectors of Constabulary in England and Wales ; Annual Beport of the Board of Education ; Beturn on Technical Education {Local Authorities), 1900 ; Beports from University Colleges. Agricultural Beturns : Beports ofBoyal Commission on Agriculture, and Beports of Assistant Commission- ers, 24 vols., 1896 ; Beport of Boyal Commission on Land in Wales and Monmouth, 6 vols., 1896 ; Beturns as to Number and Size of Agricultural Holdings in Great Britain in 1895, 1896 ; Canals and Navigations, Beturns made for 1898 ; Bailway Beturns (Annual). Other works relating to England and Wales are : Booth. Life and Labour of the People of London. 9 vols. London, 1889-97. The Aged Poor in England and Wales. London, 1894. Locii. The Annual Charities Begister and Digest. London. Maltbie. English Local Government of To-day. New York, 1897. Odgers. Local Government in England and Wales. London, 1899. Rhys and Jones. Tfye Welsh People. London, 1900. Pendleton. Our Bailways. London, 1896. Stephen. History of the Criminal Law of England. 3 vols. London, 1883. Wright and Hobhouse. An Outline of Local Government and Local Taxation in England and Wales. London, 1898. Thornbuky and Walford. Old and New London. 6 vols. . E. Walford. Greater London. 2 vols. (i. p. a. e.)

Englewood, a city of Bergen county, New Jersey, U.S.A., near the Palisades of the Hudson river, and on a branch of the Erie railway. It was organized in 1871, its area being taken from the town of Hackensack. Population (1880), 4076; (1890), 4785; (1900), 6253.

English Bazar or Angrazabad, a town of British India, headquarters of Malda district in Bengal, situated on the right bank of the river

Mahananda. The population is about 13,500. Silk-weaving, as a centre for which it was originally chosen, is now a decaying industry. There are a high school, with 171 pupils in 1896-97; three printing-presses, one of which issues a fortnightly newspaper in the vernacular ; a public library, and a Mahommedan Association.

English Bible. ??? In accordance with the report presented by the Joint Committee of the two Houses of the Convocation of Canterbury in May 1870, two com- panies were formed for the revision of the Authorized Version of the Old and New Testaments. These compa- nies consisted of the following. 1. For the Old Testar ment: ??? (a) Anointed by Convocation. ??? The Bishops of St Davids, Llandaff, Ely, Lincoln, and Bath and Wells, Archdeacon Eose, Canon Selwin, Dr Jebb, and Dr Kay. (/8) Invited. ??? Alexander, Dr W. L. ; Chenery, Professor ; Cook, Canon ; Davidson, Professor A. B. ; Davies, Dr B. ; Eairbairn, Professor ; Eield, Eev. P. ; Ginsburg, Dr ; Gotch, Dr ; Harrison, Archdeacon ; Leathes, Professor ; M'Gill, Professor ; Payne Smith, Canon ; Perowne, Professor J. H. ; Plumptre, Professor ; Pusey, Canon ; Wright, Dr (British Museum) ; Wright, W. A. (Cambridge). Of these. Canons Cook and Pusey declined to serve, and ten mem- bers died during the progress of the work. The secretary of the company was Mr W. Aldis Wright, FeUow of Trinity, Cambridge. 2. For the New Testament: ??? (a) Appointed by Convocation. ??? Bishops of Winchester, Gloucester and Bristol, and Salisbury, The Prolocutor (Dr Bickersteth), the Deans of Canterbury and Westminster, Canon Blakesley. (j8) Invited. ??? Angus, Dr ; Brown, Dr David; Dublin, Archbishop of; Eadie, Dr; Hort, Eev. F. J. A. ; Humphrey, Eev. W. G. ; Kennedy, Canon ; Lee, Archdeacon ; Lightfoot, Dr ; Milligan, Professor ; Moulton, Professor ; Newman, Dr J. H. ; Newth, Professor ; Eoberts, Dr A.; Smith, Eev. G. Vance; Scott, Dr ; Scrivener, Eev. F. H. A.; St Andrews, Bishop of; Thompson, Dr ; Tregelles, Dr ; Vaughan, Dr ; Westcott, Canon. Of these, Dr Thompson and Dr Newman declined to serve. Dean Alford, Dr Tregelles, Bishop Wilberf orce, and Dr Eadie were removed by death. Only

the first vacancy was filled up. Dean Merivale was co-opted, and on his resignation Professor, afterwards Archdeacon, Palmer. The Eev. J. Troutbeck, Minor Canon of Westminster, acted as Secretary. Negotiations

were opened with the leading scholars of the Protestant de- nominations in America, with the result that similar companies were formed in the United States. The work of the English revisers was regularly submitted to their consideration ; their comments were carefully considered and largely adopted, and their divergences from the version ultimately agreed upon were printed in an Appendix to the published work. Thus the Eevised Version was the achievement of English-speaking Christendom as a whole ; only the Eoman Catholic Church, of the great English- speaking denominations, refused to take part in the undertaking. The Church of England, which had put forth the version of 1611, fitly initiated the work, but for its performance most wisely invited the help of the sister Churches. The delegates of the Clarendon Press in Oxford, and the syndics of the Pitt Press in Cambridge, entered into a liberal arrangement with the Eevisers, by which the necessary funds were provided for all their expenses. On the completion of its work the New Tes- tament Company divided itself into three Committees, working at London, Westminster, and Cambridge, for the purpose of revising the Apocrypha.

The work of the Old Testament Company was different in some important respects from that which engaged the attention of the New Testament Company. The Ee- ceived Hebrew text has undergone but little emendation, and the revisers had before them substantially the same Massoretic text which was in the hands of the translators of 1611. It was felt that there was no sufficient justifi- cation to make any attempt at an entire reconstruction of the text on the authority of the versions. The Old Testament revisers were therefore spared much of the la- bour of deciding between different readings, which formed one of the most important duties of the New Testament Company. But the advance in the study of Hebrew since the early part of the 17th century enabled them to give a more faithful translation of the received text. The value of their work is evident, especially in Job, Ecclesiastes, and the prophetical books.

It is the work of the New Testament Committee which has attracted most attention, whether for blame or praise. The critical resources at the disposal of scholars in 1611 were very meagre, and the few early manuscripts with which they were acquainted failed to receive the attention they deserved. The translators appear to have mainly relied on the later

editions of Stephanus and Beza, and also to a certain extent the Complutensian Polyglott. All these were founded, for the most part, on a few manu- scripts of late date. It is evident, therefore, that the Greek text of 1611 is largely Erasmian, and has no claim to any great critical value. The ancient versions were not examined, with the exception of the Vulgate, which the translators possessed in late and corrupt texts.' The testimony of the fathers received no attention. Nearly all the more ancient documentary authorities have become known since 1611, and some of the most important of them have only been studied in quite recent times. Not one of the four most ancient and most im- portant manuscripts was known to be in existence. Codex D, though it was known, was scarcely considered. Even Beza was unaware of the true value of the manu- script which bears his name, and scarcely any weight was assigned to it.

It was not until the middle of the 17th century that the preparation for an effective critical study of the New Testament began. The subject from the first excited the interest of English scholars, and received a consider-

able impulse in Great Britain by the gift of the Alex- andrian manuscript (A) to Charles I. by Cyril Lucar, the Patriarch of Constantinople. At the beginning of the 18th century Mill collated a mass of documentary evidence ; and though he failed to arrange the information which he had gained, he laid the foundation of work that has helped all subsequent textual critics. It became clear that the value of documents depended on antiquity rather than on their numerical superiority. It was Griesbach who first carried out this principle of textual criticism, and became the pioneer of that work of tracing the genealogical rela- tions of the whole extant doeumei^tary evidence of the 'New Testament which has been developed with so much learning and skill by Lachmann, Tischendorf, and Tre- gelles. The results of these critical methods could not fail to make the incompleteness of the " Received Text," and of the " Authorized Version," which was based on it, obvious. It had long been the opinion of all competent scholars that a

thorough revision was necessary. A pro- posal in favour of this course was made in Convocation in 1856, but it was not until fourteen years later that the Committee was appointed to undertake the work. The Revisers' first task was to reconstruct the Greek text, as the necessary foundation of their work. In this difficult duty they were no doubt influenced by Westcott and Hort's edition of the New Testament. These two scholars were members of the Committee which prepared the Re- vised Version, and on the question of various readings they appear to have exercised a predominating influence. The Revisers were privately supplied with instalments of Westcott and Hort's text as their work required them. But it is scarcely necessary to say that the Revised Ver- sion is not the work of one or two scholars. Different schools of criticism were represented on the Committee, and the most careful discussion took place before any decision was formed. Every precaution was taken to ensure that the version should represent the result of the best scholarship of the time, applied to the work before it with constant devotion and with the highest sense of responsibility. The changes in the Greek text of the Authorized Version when compared with the textus receptus are numerous, but the contrast between the English Ver- sions of 1611 and 1881 are all the more striking because of the difference in the method of translation which was adopted. The Revisers aimed at the most scrupulous faithfulness. They adopted the plan ??? deliberately re- jected by the translators of 1611 ??? of always using the same English word for the same Greek word. " They endeavoured to enable the English reader to follow the correspondences of the original with the closest exactness, to catch the solemn repetition of words and phrases, to mark the subtleties of expression, to feel even the strange- ness of unusual forms of speech."

The revision of the New Testament was completed in 407 meetings, distributed over more than ten years. It was formally presented to Convocation on May 17, 1881. The revision of the Old Testament occupied 792 days, and was finished on June 20, 1884. The revised Apocrypha did not make its appearance until 1895.

The text of the Revised Version is printed in para- graphs, the old division of books into chapters and verses being retained for convenience of reference. By this arrangement the capricious divisions of some books is

avoided. Various editions of the New Version have been published, the most complete being the edition of the whole Bible with marginal references. These references had their origin in the work of two small sub-committees of the Revisers, but they received their present form at the hands of a specially appointed committee. The marginal references given in the original edition of the Authorized Version of 1611 have been retained as far as possible.

The work of the Revisers was received without enthusi- asm. It was too thorough for the majority of religious people. Partisans found that havock had been played with their proof texts. Ecclesiastical conservatives were scandalized by the freedom with which the traditional text was treated. The advocates of change were discontented with the hesitating acceptance which their principles had obtained. The most vulnerable side of the Revision was that on which the mass of English readers thought itself capable of forming a judgment. The general effect of so many small alterations was to spoil the familiar sonorous style of the Authorized Version. The changes were freely denounced as equally petty and vexatious; they were, moreover, too often inconsistent with the avowed prin- ciples of the Revisers. The method of determining readings and renderings by vote was not favourable to the consistency and literary character of the Version. A whole literature of criticism and apology m ade its appearance, and the achievement of so many years of patient labour seemed destined to perish in a storm of resentments. On the whole, the Revised Version weathered the storm more successfully than might have been expected. Its con- siderable excellences were better realized by students than stated by apologists. The hue and cry of the critics largely died away, and was replaced by a calmer and juster appreciation.

Quite recently the work of the Revisers has been sharply criticized from the standpoint of specialists in New Testament Greek. Dr Rutherford has stated the case briefly and pointedly in the Preface to his translation of the Epistle to the Romans (London, 1900). He maintains that " the Greek of the New Testament may never be understood as classical Greek is understood," and accuses the Revisers of distorting the meaning " by translating in accordance with Attic idiom phrases that convey in later Greek a wholly

different sense, the sense which the earlier translators in happy ignorance had recognized that the context demanded."

The use of the new Version has become general. Familiarity has mitigated the harshness of the Revisers' renderings ; scholarship, on the whole, has confirmed their readings. The Version has been publicly read in parish churches both in London and in the country. In Canterbury Cathedral and Westminster Abbey it has definitely displaced the older Version. Bishops have acquiesced and congregations approved. It is no longer possible to maintain the plausible and damaging conten- tion that the Revised Bible is ill-suited for public use. The Upper House of the Convocation of Canterbury, in May 1898, appointed a Committee to consider the expediency of " permitting or encouraging " the use of the Revised Version in the public services of the Church.

The Eevisers have fully explained their principles and methods in the Preface to their Vei-sion. The American Committee of Revision issued an historical account of their work (New York, 1886). The case against the Revisers is ably stated in The Bevision Revised, by Dean Burgon f London, 1883). The literary defects of the Version are elaborately exhibited by G. Washington Moon in two works: Tlie Revisers^ English (London, 1882); and Ecclesiastical English (London, 1886). The Version is successfully defended by J. B. Lightfoot, On a Fresh Revision of the English New Testament (London, 1871 ; 3rd edition, 1891) ; Westcott, Some Lessons of the Revised Version (London, 1897) ; Kennedy, Ely Lectures on the Revised Version (London, 1882). Reference may also be made to Some-Thoughts on the Textual Criticism of the Ncio Testament, by G. Salmon, D.D. (London, 1897) ; Bishop EUicott's Charge (1901). The Greek Text of the New Testament adopted by the Revisers was edited for the Clarendon Press by Archdeacon Palmer (Oxford, 1881). Parallel editions of the Bible, showing both the Authorized and Revised Versions, a large type edition for public use, a reference edition, and finally (1900) a "Two Version" edition, have been issued by one or both the University Presses. (h. h. h.)*

THE death of William IV., on the 20th June 1837, placed on the throne of England a young princess, who was destined to reign for a longer period than any of her predecessors. The new Queen, the only daughter of the duke of Kent, the fourth son of George III., had just attained her majority. Educated in comparative seclu- sion, her character and her person were unfamiliar to her future subjects, who were a little weary of the extrava- gances and eccentricities of her immediate predecessors. Her accession gave them a new interest in the House of Hanover. And their loyalty, which would in any case

have been excited by the accession of a young vfcT"/ ‘ ^^^ inexperienced girl to the throne of the accession, greatest empire in the world, was stimulated by

her conduct and appearance. She displayed from the first a dignity and good sense which won the affection of the multitude who merely saw her in public, and the confidence of the advisers who were admitted into her presence.

The ministry experienced immediate benefit from the ???change. The Whigs, who had governed England since 1830, under Lord Grey and Lord Melbourne, were suffer- ing from the reaction which is the inevitable consequence of revolution. The country which, in half a dozen years, had seen a radical reform of Parliament, a no less radical reform of municipal corporations, the abolition of slavery, and the reconstruction of the poor laws, was longing for a period of political repose. The alliance, or understand- ing, between the Whigs and the Irish was increasing the distrust of the English people in the ministry, and Lord Melbourne's Government, in the first half of 1837, seemed doomed to perish. The accession of the Queen gave it a new lease of power. The election, indeed, which fol- lowed her accession did not materially alter the compo- sition of the House of Commons. But the popularity of the Queen was extended to her Government. Taper's suggestion in Coningsby that the Conservatives should go to the country with the cry, " our young Queen and our old institutions," expressed, in an epigram, a prevalent idea. But the institution which derived most immediate benefit from the new Sovereign was the old Whig ministry.

The difficulties of the ministry, nevertheless, were great. In the preceding years they had carried most of the re- forms which were demanded in Great Britain ; but they had failed to obtain the assent of the House of Lords to their Irish measures. They had desired (1) to follow up

the reform of English corporations by a corre- Lord Mel- sponiing reform of Irish municipalities ; (2) to difficulties con'^eJ't tl^►► tithes, payable to the Irish church,

into a rent charge, and to appropriate its sur- plus revenues to other purposes; (3) to deal with the chronic distress of the Irish people by extending to Ireland the principles of the English poor law. In the year which succeeded the accession of the Queen they accomplished two of these objects. ' They passed an Irish poor law and a measure commuting tithes in Ireland into a rent charge. The first of these measures was carried in opposition to the views of the Irish, who thought that it imposed an intolerable burden on Irish property. The second was only carried on the Govern- ment consenting to drop the appropriation clause, on which Lord Melbourne's Administration had virtually been founded.

It was not, however, in domestic politics alone that the ministry was hampered. In the months which immedi- ately followed the Queen's accession news reached England

of disturbances or even insurrection in Canada. The ris- ing was easily put down ; but the condition of the colony ►►►v\fas so grave that the ministry decided to suspend the constitution of Lower Canada for three years, and to send out Lord Durham with almost dictatorial powers. Lord Durham's conduct was, unfortunately, marked by indis- cretions which led to his resignation ; but before leaving the colony he drew up a report on its condition and on its future, which practically became a text-book for his successors, and has influenced the government of British colonies ever since. Nor was Canada the only great colony which was seething with discontent. In Jamaica the planters, who had sullenly accepted the abolition of slavery, were irritated by the passage of an Act of Parli- ament intended to remedy some grave abuses in the management of the prisons of the island. The colonial House of Assembly denounced this Act as a violation of its rights, and determined to desist from its legislative functions. The

*governor dissolved the assembly, but the new house, elected in its place, reaffirmed the decision of its predecessor; and the British ministry, in face of the crisis, asked Parliament in 1839 for authority to suspend the constitution of the island for five years. The Bill in- troduced for this purpose placed the Whig ministry in a position of some embarrassment. The advocates of popular government, they were inviting Parliament, for a second time, to suspend representative institutions in an import- ant colony. Supported by only small and dwindling ma- jorities, they saw that it was hopeless to carry the measure, ' and they decided on placingtheir resignations in the Queen's hands. The Queen naturally sent for Sir Robert Peel, who undertook to form a government. In the course of the negotiations, however, he stated that it would be nec- essary to make certain changes in the household, which contained some great ladies closely connected with the leaders of the Whig party. The Queen The bed- shrank from separating herself from ladies who *es?. had surrounded her since she came to the throne, and Sir Robert thereupon declined the task of forming a ministry. Technically he was justified in adopting this course, but people generally felt that there was some hardship in compelling a young Queen to separate herself from her companions and friends, and they consequently approved the decision of Lord Melbourne to support the Queen in her refusal, and to resume office. The Whigs returned to place, but they could not be said to return to power. They did not even venture to renew the original Jamaica Bill. They substituted for it a modified pro- posal which they were unable to carry. They were obviously indebted for office to the favour of the Queen, and not to the support of Parliament.*

Yet the session of 1839 was not without important re- sults. After a long struggle, in which ministers narrowly escaped defeat in the Commons, and in the course of which they suffered severe rebuifs in the Lords, they succeeded in laying the foundation of the English system of national education. In the same session they were forced against their will to adopt a reform, which had been rec- ommended byMrEowland Hill, and to confer ^f^ge. on the nation the benefit of a uniform penny postage. No member of the Cabinet foresaw the conse- quences of this reform. The postmaster-general, in op- posing it, declared that, if the revenue of his office was to be maintained, the correspondence of the country, on which postage was paid, must be increased from 42,000,000 to 480,000,000 letters a year, and he

contended that there were neither people to write, nor machinery to deal with.

Fiscal policy.

SO prodigious a mass of letters. He would have been astonished to hear that, before the end of the century, his office had to deal with more than 3,000,000,000 postal packets a year, and that the net profit which it paid into the exchequer was to be more than double what it received in 1839.

In 1840 the ministry was not much more successful than it had proved in 1839. After years of conflict it succeeded indeed in placing on the statute book a measure dealing with Irish municipalities. But its success was purchased by concessions to the Lords, which deprived the measure of much of its original merit. The closing years of the Whig Administration were largely occupied with the financial difiiculties of the country. The first three years of the Queen's reign were memorable for a constantly de- ficient revenue. The deficit amounted to ––1,400,000 in 1837; to ––400,000 in 1838, and to ––1,- 457,000 in 1839. Mr Baring, the chancellor of the exchequer, endeavoured to terminate this deficiency by a general increase of taxation, but this device proved a disastrous failure. The deficit rose to ––1,842,000 in 1840. It was obvious that the old expedient of in- creasing taxation had failed, and that some new method had to be substituted for it. This new method Mr Baring endeavoured to discover in altering the differential duties on timber and sugar, and substituting a fixed duty of 8s. per qr. for the sliding duties hitherto payable on wheat. By these alterations he expected to secure a large increase of revenue, and at the same time to maintain a suf&cient degree of protection for colonial produce. The Conserva- tives, who believed in protection, at once attacked the proposed alteration of the sugar duties. They were re- inforced by many Liberals, who cared very little for pro- tection, but a great deal about the abolition of slavery, and consequently objected to reducing the duties on for- eign or slave-grown sugar. This combination of interests proved too strong for Mr Baring and his proposal was re- jected. As ministers,

however, did not resign on their de- feat. Sir Robert Peel followed up his victory by moving a vote of want of confidence, and this motion was carried in an exceptionally full house by 312 votes to 311.

Before abandoning the struggle, the Whigs decided on appealing from the House of Commons to the country. The general election which ensued largely increased the strength of the Conservative party. On the meeting of the new Parliament in August 1841, votes of want of confidence in the Government were proposed and carried in both houses ; the Whigs were compelled to resign office, and the Queen again charged Sir Robert Peel with the task of forming a government. If the sir R. Peel Queen had remained unmarried, it is possible niinistry- /strong> *^* **friction which had arisen in 1839 might have recurred in 1841. In February 1840, however. Her Majesty had married her cousin. Prince Albert of Saxe-Coburg. She was, therefore, no longer dependent on the Whig ladies, to whose presence in her court she had attached so much importance in 1839. By the management of the Prince ??? who later in the reign was known as the Prince Consort ??? the great ladies of the household voluntarily tendered their resig- nations ; and every obstacle to the formation of the new government was in this way removed.**

Thus the Whigs retired from the offices which, except for a brief interval in 1834-35, they had held for eleven years. During the earlier years of their administration they had succeeded in carrying many memorable reforms : during the later years their weakness in the House of Commons had prevented their passing any considerable measures. But, if they had failed in this respect. Lord Melbourne had rendered conspicuous service to the Queen. Enjoying her full confidence, consulted by her on every

occasion, he had always used his influence for the public good; and perhaps those who look back now with so much satisfaction at the Queen's conduct during a reign of unexampled length, imperfectly appreciate the debt which in this respect is owed to her first prime minister. The closing years of the Whig Government were marked by external complications. A controversy on the boundary of Canada and the United States was provoking increasing bitterness on both sides of the Atlantic. The intervention of Lord Palmerston in Syria, which resulted in

a great military success at Acre, was embittering the relations between France and England, while the unfor- tunate expedition to Afghanistan, which the Whigs had approved, was already producing embarrassment, and was about to result in disaster. Serious, however, as were the complications which surrounded British policy in Europe, in the East, and in America, the country, in August 1841, paid more attention to what a great writer called the " condition of England " question. There had never been a period in British history when distress and crime had been so general. There had hardly ever been a period when food had been so dear, when wages had been so low, when poverty had been so widespread, and the con- dition of the lower orders so depraved and so hopeless, as in the early years of the Queen's reign. The condi- tion of the people had prompted the formation of two great associations. The Chartists derived their name from the charter which set out their demands. The re- jection of a monster petition which they presented to Parliament in 1839 led to a formidable riot in Birming- ham, and to a projected march from South Wales on London, in which twenty persons were shot dead at Newport. Another organization, in one sense even more formidable than the Chartist, was agitating at the same time for the repeal of the corn laws, and was known as the Anti-Corn Law League. It had already secured the services of two men, Mr Cobden and Mr Bright, who, one by clear reasoning, the other by fervid eloquence, were destined to make a profound impression on all classes of the people.

The new Government had, therefore, to deal with a position of almost unexampled difficulty. The people were apparently sinking into deeper poverty and misery year after year. As an outward and visible sign of the inward distress, the state was no longer able to pay its way. It was estimated that the deficit, which had amounted to ££1,842,000 in 1840, would reach ££2,334,000 in 1841. It is the signal merit of Sir Robert Peel that he terminated this era of private distress and public deficits. He accom- plished this task partly by economical administration £££ for no minister ever valued economy more £££ and partly by a reform of the financial system, effected in three great budgets. In the budget of 1842 Sir Robert Peel termin- ated the deficit by reviving the income tax. The proceeds of the tax, which was fixed at 7d. in the ££, and was granted in the first instance for three ^^f^ years, were more than sufficient to

secure this ” ””” object. Sir Robert used the surplus to reform the whole customs tariff. The duties on raw materials, he proposed, should never exceed 5 per cent., the duties on partly manufactured articles 12 per cent., and the duties on manufactured articles 20 per cent., of their value. At the same time he reduced the duties on stage coaches, on foreign and ‘colonial coffee, on foreign and colonial timber, and repealed the export duties on British manufactures. The success of this budget in stimulating consumption and in promoting trade induced Sir Robert Peel to follow it up in 1845 with an even more remarkable proposal. Instead of allowing the income tax to expire, he induced Parliament to continue it for a further period, and with the resources which were thus placed at*

hia disposal lie purged the tariff of various small duties ___which produced little revenue, and had been imposed for purposes of protection. He swept away all the duties on British exports ; he repealed the duties on glass, on cotton wool, and still further reduced the duties on foreign and colonial sugar. This budget was a much greater step towards free trade than the budget of 1842. The chief object in his third budget in 1846 ___ the reduction of the duty on corn to Is. a quarter ___ was necessitated by causes which will be immediately referred to. But it will be convenient at once to refer to its other features. Sir Robert Peel told the house that, in his previous budgets, he had given the manufacturers of the country free access to the raw materials which they used. He was entitled in return to call upon them to relinquish the protection which they enjoyed. He decided therefore to reduce the protective duties on cotton, woollen, silk, metal, and other goods, as well as on raw materials still liable to heavy taxation, such as timber and tallow. As the policy of 1842 and 1845 had proved unquestionably successful in stimulating trade, he proposed to extend it to agriculture. He reduced the duties on the raw materials which the farmers used, such as seed and maize, and in return he called on them to give up the duties on cattle and meat, largely to reduce the duties on butter, cheese, and hops, and to diminish the duty on corn by gradual stages to Is. a quarter. In making these changes Sir

Eobert Peel avowed that it was his object to make the country a cheap one to live in. There is no doubt that they were followed by a remarkable development of British trade. In the twenty-seven years from 1815 to 1842 the export trade of Great Britain diminished from ––49,600,000 to ––47,280,000 ; while in the twenty-seven years which succeeded 1842 it increased from ––47,280,000 to nearly ––190,000,000. These figures are a simple and enduring monument to the minister's memory. It is fair to add that the whole increase was not due to free trade. It was partly attributable to the remarkable development of communications which marked this period.

Two other financial measures of great importance were accomplished in Sir Robert Peel's ministry. In 1844 some ––250,000,000 of the national debt still bore an interest of 3^ per cent. The improvement in the credit of the coun- try enabled the Government to reduce the interest on the stock to 3J per cent, for the succeeding ten years, and to 3 per cent, afterwards. This conversion, which effected an immediate saving of ––625,000, and an ultimate saving of ––1,250,000 a year, was by far the most important measure which had hitherto been applied to the debt ; and no operation on the same scale was attempted for more than forty years. In the same year the necessity of renewing the charter of the Bank of England afforded Sir Robert Peel an opportunity of reforming the currency. He separated the issue department from the banking department of the Bank, and decided that in future it should only be at liberty to issue notes against (1) the debt of ––14,000,000 due to it from the Govern- ment, and (2) any bullion actually in its coffers. Few measures of the past century have been the subject of more controversy than this famous Act, and at one time its repeated suspension in periods of financial crises seemed to suggest the necessity of its amendment. But opinion on the whole has vindicated its wisdom, and it has survived all the attacks which have been made upon it.

The administration of Sir Eobert Peel is also remarkable for its Irish policy. The Irish, under O'Connell, had con- stantly supported the Whig ministry of Lord Melbourne. But their alliance, or understanding, with the Whigs had not procured them all the results which they had expected from it. The two great Whig measures, dealing with the

church aud the municipalities, had only been passed after years of controversy, and in a shape which deprived them of many expected advantages. Hence arose a notion in Ireland that nothing was to be expected from a i i a. British Parliament, and hence beganamovement for the repeal of the Union which had been accomplished in 1801. This agitation, which smouldered during the reign of the Whig ministry, was rapidly revived when Sir Eobert Peel entered upon office. The Irish contributed large sums, which were known as repeal rent, to the cause, and they held monster meetings in various parts of Ireland to stimulate the demand for repeal. The ministry met this campaign by coercive legislation regulating the use of arms, by quartering large bodies of troops in Ireland, and by prohibiting a great meeting at Clontarf, the scene of Brian Boru's victory, in the immediate neighbourhood of Dublin. They further decided in 1843 to place O'Connell and some of the leading agitators on their trial for conspiracy and sedition. O'Connell was tried before a jury chosen from a defective panel, was convicted on an indictment which contained many counts, and the court passed sentence without distinguishing between these counts. These irregularities induced the House of Lords to reverse the judgment, and its reversal did much to prevent mischief. O'Connell's illness, which resulted in his death in 1847, tended also to establish peace. Sir Eobert Peel wisely endeavoured to stifle agitation by making considerable concessions to Irish sentiment. He increased the grant which was made to the Eoman Catholic College atMaynooth; he established three colleges in the north, south, and west of Ireland for the undenom- inational education of the middle classes ; he appointed a commission ??? the Devon Commission, as it was called, from the name of the nobleman who presided over it ??? to investigate the conditions on which Irish land was held ; and, after the report of the commission, he intro- duced, though he failed to carry, a measure for remedying some of the grievances of the Irish tenants. These wise concessions might possibly have had some effect ???.

in pacifying Ireland, if in the autumn of 1845 they had not been forgotten in the presence of a disaster which suddenly fell on that unhappy country. The potato, which was the sole food of at least half the people of an overcrowded island, failed, and a famine of unpre- cedented proportions was obviously imminent. Sir Robert Peel, whose original views on

protection had been rapidly yielding to the arguments afforded by the success of his own budgets, concluded that it was impossible to provide for the necessities of Ireland without suspending the corn laws ; and that, if they were once suspended, it would be equally impossible to restore them. He failed,^ however, to convince two prominent members of his cabinet ??? Lord Stanley and the duke of Buccleuch ??? that Protection must be finally abandoned, and considering it hopeless to persevere with a disunited cabinet he resigned office. On Sir Robert's resignation the Queen sent for Lord John Russell, who had led the Liberal party in the House of Commons with conspicuous ability for more than ten years, and charged him with the task of forming a new ministry. Differences, which it proved impossible to remove, between two prominent Whigs ??? Lord Palmerston and Lord Grey ??? made the task impracticable, and after an interval Sir Eobert Peel consented to resume power. Sir Robert Peel was probably aware that his fall had been only postponed. In the four years and a half during which his ministry had lasted he had done much to estrange his party. They said, with some truth, that, whether his measures were right or wrong, they were op- posed to the principles which he had been placed in power to support. The general election of 1841 had been mainly fought on the rival policies of Protection and Free Trade.

The country had decided for Protection, and Sir R. Peel had done more than all his predecessors to give it Eree Trade. The Conservative party, moreover, was closely allied with the church, and Sir Eobert had offended the church by giving an increased endowment to May- nooth, and by establishing undenominational colleges ??? "Godless colleges" as they were called ??? in Ireland. The Conservatives were, therefore, sullenly discontented with the conduct of their leader. They were lashed into positive fury by the proposal which he was now making to abolish the corn laws. Lord George Bentinck, who, in his youth, had been private secretary to Mr Canning, but who in his maturer years had devoted more time to the turf than to politics, placed himself at their head. He was

assisted by a remarkable man ❓❓❓ Mr Disraeli ❓❓❓ who joined great abilities to great ambition, and who, embittered by Sir Eobert Peel's neglect to appoint him to office, had already displayed his animosity to the minister. The policy on which Sir Eobert Peel resolved facilitated attack. Por the minister thought it necessary, while providing for famine by repealing the corn laws, to ensure the preservation of order by a new Coercion Bill. The Financial Bill and the Coercion Bill were both pressed forward, and each gave opportunities for^ discussion and, what was then new in Parliament, for obstruction. At last, on the very night on which the fiscal proposals of the ministers were accepted by the Lords, the Coercion Bill was defeated in the Commons by a combination of Whigs, Eadicals, and Protectionists; and Sir E. Peel, worn out with a protracted struggle, placed his resignation in the Queen's hands.

Thus fell the great minister, who perhaps had conferred more benefits on his country than any of his predecessors. The external policy of his ministry had been almost as remarkable as its domestic programme. Whenhe accepted office the country was on the eve of a great 2^*" disaster in India ; it was engaged in a serious*

poUcy. dispute with the United States ; and its relations with Prance were so strained that the two great countries of Western Europe seemed unlikely to be able to settle their differences without war. In the earlier years of his administration the disaster in Afghanistan was repaired in a successful campaign ; and Lord Ellen- borough, who was sent over to replace Lord Auckland as governor-general, increased the dominion and responsibili- ties of the East India Company by the unscrupulous but brilliant policy which led to the conquest of Scinde. The disputes with the United States were satisfactorily com- posed ; and not only were the differences with Prance terminated, but a perfect understanding was formed between the two countries, under which M. Guizot, the prime minister of France, and Lord Aberdeen, the foreign minister of England, agreed to compromise all minor questions for the sake of securing the paramount object of peace. The good understanding was so complete that a disagreeable incident in the Sandwich Islands, in which the injudicious conduct of a French agent very nearly precipitated hostilities, was amicably settled; and the ministry had the satisfaction of knowing that, if

their policy had produced prosperity at home, it had also maintained peace abroad.

On Sir R. Peel's resignation the Queen again sent for Lord John Eussell. The difficulties which had prevented his forming a ministry in the previous year were satis- factorily arranged, and Lord Palmerston accepted the seals of the Foreign Office, while Lord Grey was sent to the Colonial Office. The history of the succeeding years was destined, however, to prove that Lord Grey had had solid reasons for objectingtoLordPalmerston's return to his old post ; for, whatever judgment may ultimately be formed on Lord Palmerston's foreign policy, there can be little doubt

that it did not tend to the maintenance of peace. The first occasion on which danger was threatened arose immediately after the installation of the new ministry on the question of the Spanish marriages. The queen of Spain, Isabella, was a little girl still in her teens ; the J!,^ heir to the throne was her younger sister, the marriages. infanta Fernanda. Diplomacy had long been occupied with the marriages of these children ; and Lord Aberdeen had virtually accepted the principle, which the French Government had laid down, that a husband for the queen should be found among the descendants of Philip V., and that her sister's marriage to the due de Montpensier ??? a son of Louis Philippe ??? should not be celebrated till the queen was married and had issue. While agreeing to this compromise. Lord Aberdeen declared that he regarded the Spanish marriages as a Spanish and not as a European question, and that, if it proved impossible to find a suitable consort for the queen among the descendants of Philip V., Spain must be free to choose a prince for her throne else- where. The available descendants of Philip V. were the two sons of Don Francis, the younger brother of Don Carlos, and of these the French Government was in favour of the elder, while the British Government preferred the younger, brother. Lord Palmerston strongly objected to the prince whom the French Government supported ; and, almost immediately after acceding to office, he wrote a despatch in which he enumerated the various candidates for the queen of Spain's hand, including Prince Leopold of Saxe-Coburg, a near relation of the Prince Consort, among the number. Louis Philippe regarded this*

despatch as a departure from the principle on which he had agreed with Lord Aberdeen, and at once hurried on the simulta- neous marriages of the queen with the Prench candidate, and of her sister with the due de Montpensier. His action broke up the entemXe, cordiale which had been established between M. Guizot and Lord Aberdeen.

The second occasion on which Lord Palmerston's vigor- ous diplomacy excited alarm arose out of the revolution which broke out almost universally in Europe in 1848. A rising in Hungary was suppressed by Austria with Eussian assistance, and, after its suppression many leading Hungarians took refuge in Turkish territory. Austria and Eussia addressed demands to the Porte for their surrender. Lord Palmerston determined to support the Porte in its refusal to give up these exiles, and actually sent the British fleet to the Dardanelles with this object. His success raised the credit of Great Britain and his own reputation. The presence of the British fleet, however, at the Dar- danelles suggested to him the possibility of settling another long-standing controversy. Por years British subjects settled in Greece had raised complaints against the Greek Government. In particular, Don Pacifico, a Jew, but a native of Gibraltar, com- f^cWco plained that, at a riot, in which his house had been attacked, he had lost jewels, furniture, and papers which he alleged to be worth more than ►►30,000. As Lord Palmerston was unable by correspondence to induce the Greek Government to settle claims of this character, he de- termined to enforce them ; and by his orders a large number of Greek vessels were seized and detained by the British fleet. The French Government tendered its good offices to compose the dispute, and an arrangement was actually ar- rived at between Lord Palmerston and the French minister in London. Unfortunately, before its terms reached Greece, the British minister at Athens had ordered the resumption of hostilities, and had compelled the Greek Government to submit to more humiliating conditions. News of this settlement excited the strongest feelings both in Paris and London. In Paris, Prince Louis Napoleon, who had acceded to the presidency of the French republic, decided on recalling his representative from the British

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court. In London the Lords passed a vote of censure on Lord Palmerston's proceedings; and the Commons only sustained the minister by adopting a resolution approving in general terms the principles on which the foreign policy of the country had been conducted.

In pursuing the vigorous policy which characterized his tenure of the Foreign Office, Lord Palmerstou frequently omitted to consult his colleagues in the Cabinet, the prime minister, or the Queen. In the course of 1849 Her Majesty formally complained to Lord John Russell that important despatches were sent off without her knowledge ; and an arrangement was made under which Lord Palmer- ston undertook to submit every despatch to the Queen through the prime minister. In 1850, after the Don

Pacifico debate, the Queen repeated these dtem/ssed." Commands in a much stronger memorandum.

But Lord Palmerston, though all confidence between himself and the court was destroyed, continued in office. In the autumn of 1851 the Queen was much annoyed at hearing that he had received a deputation at the Foreign Office, which had waited on him to express sympathy with the Hungarian refugees, and to denounce the conduct of " the despots and tyrants " of Russia and Austria, and that he had, in his reply, expressed his grati- fication at the demonstration. If the Queen had had her way. Lord Palmerston would have been removed from the Foreign Office after this incident. A few days later the coup d'Mat in Paris led to another dispute. The Cabinet decided to do nothing that could Wear the appearance of interference in the internal afEairs of France ; but Lord Palmerston, in conversation with the French minister in London, took upon himself to approve the bold and decisive step taken by the president. The ministry naturally refused to tolerate this conduct, and Lord Palmerston was summarily removed from his office.

The removal of Lord Palmerston led almost directly to the fall of the Whig Government. Before relating, how- ever, the exact occurrences which produced its defeat, it is necessary to retrace our steps and describe the

policy which it had pursued in internal matters during the six years in which it had been in power. Throughout that period the Irish famine had been its chief anxiety and difficulty. Sir Robert Peel had attempted to deal with it (1) by purchasing large quantities of Indian corn, which he had retailed at low prices in Ireland, and (2) by enabling the grand juries to employ the people on public works, which were to be paid out of monies advanced by the state, one-half being ultimately repay- able by the locality. These measures were not entirely successful. It was found, in practice, that the sale of Indian corn at low prices by the Government checked the

efforts of private individuals to supply food; t' * and that the offer of comparatively easy work*

to the poor at the cost of the public prevented their seeking harder private work either in Ireland or in Great Britain. The new Government, with this experi- ence before it, decided on trusting to private enterprise to supply the necessary food, and on throwing the whole cost of the works, which the locality might undertake, on local funds. If the famine had been less severe, this policy might possibly have succeeded. Universal want, however, paralysed every one. The people, destitute of other means of livelihood, crowded to the relief works. In the beginning of 1847 nearly 750,000 persons or nearly one person out of every ten in Ireland were so employed. With such vast multitudes to relieve, it proved impracticable to exact the labour which was required as a test of destitution. The roads, which it was decided to make, were blocked by the labourers employed upon them, and by the stones, which the

labourers were supposed to crush for their repair. In the presence of this difficulty the Government decided, early in 1847, gradually to discontinue the relief works, and to substitute for them relief committees charged with the task of feeding the people. At one time no less than 3,000,000 persons more than one-third of the entire population of Ireland were supported by these commit- tees. At the same time it decided on adopting two measures of a more permanent character. The poor law of 1838 had made no provision for the relief of the poor outside the workhouse, and outdoor relief was sanctioned by an act of 1847. Irish

landlords complained that their properties, ruined by the famine, and encumbered by the extravagances of their predecessors, could not bear the cost of this new poor law ; and the ministry introduced and carried a measure enabling the embarrassed owners of life estates to sell their property and discharge their lia- bilities. It is the constant misfortune of Ireland that the measures intended for her relief aggravate her distress. The Encumbered Estates Act, though it substituted a sol- vent for an insolvent proprietary, placed the Irish tenants at the mercy of landlords of whom they had no previous knowledge, who were frequently absentees, who bought the land a^ a matter of business, and who dealt with it on busi- ness principles by raising the rent. The new poor law, by throwing the maintenance of the poor on the soil, encour- aged landlords to extricate themselves from their respon- sibilities by evicting their tenants. Evictions were made on a scale which elicited from Sir Robert Peel an expres- sion of the deepest abhorrence. The imfortunate persons driven from their holdings and forced to seek a refuge in the towns, in England, or ??? when they could afford it ??? in the United States, carried with them everywhere the seeds of disease, the constant handmaid of famine.

Famine, mortality, and emigration left their mark on Ireland. In four years, from 1845 to 1849, its population decreased from 8,295,000 to 7,256,000, or by more than a million persons; and the decline which took place at that time went on to the end of the century. The popu- lation of Ireland in 1901 had decreased to 4,457,000 souls. This fact is the more remarkable, because Ireland is almost the only portion of the British Empire, or indeed of the civilized world, where such a circumstance has occurred. We must go to countries like the Asiatic provinces of Turkey, devastated by Ottoman rule, to find such a diminu- tion in the numbers of the people as was seen in Ireland during the last half of the 19th century. It was probably inevitable that the distress of Ireland should have been followed by a renewal of Irish outrages. A terrible series of agrarian crimes was committed in the autumn of 1847 ; and the ministry felt compelled, in consequence, to strengthen its hands by a new measure of ^/f/jg”” coercion, and by suspending the Habeas Corpus Act in Ireland. The latter measure at once brought to a crisis the so-called Rebellion of 1848, for his share in which Mr Smith O’Brien, an Irish member of

Parliament, was convicted of high treason. The Government, how- ever, did not venture to carry out the grim sentence which the law still applied to traitors, and introduced an Act enabling it to commute the death penalty to transporta- tion. The ” insurrection ” had from the first proved abor- tive. With Mr Smith O’Brien’s transportation it practically terminated.

In the meanwhile the difficulties which the Government was experiencing from the Irish famine had been aggra^ vated by a grave commercial crisis in England. In the autumn of 1847 a series of failures in the great commercial centres created a panic in the City of London, which forced consols down to 78, and induced the Government to take upon itself the responsibility of suspending the Bank Char- ter Act. That step, enabling the directors of the Bank of

*England to issue notes unsecured by bullion, had the effect of gradually restoring confidence. But a grave commercial crisis of this character is often attended with other than financial consequences. The stringency of the money market increases the distress of the industrial classes by diminishing the demand for work ; and, when labour suffers, political agitation flourishes. Early in 1848, moreover, revolutions on the Continent produced a natural craving for changes at home. Louis Philippe was driven out of Paris, the emperor of Austria was driven out of Vienna, the Austrian soldiery had to withdraw from Milan, and even in Berlin the crown had to make terms with the people. While thrones were falling or tottering in every country in Europe, it was inevitable that excitement and agitation should prevail in Great Britain. The Chartists, reviving the machinery which they had endeavoured to employ in 1839, decided on pre- paring a monster petition to Parliament, which was to be escorted to Westminster by a monster procession. Their preparations excited general alarm, and on the invitation Chartism ‘^^ *^ ?? Government no less than 170,000 special*

constables were sworn in to protect life and pro- perty against a rabble. By the judicious arrangements, however, which were made by the duke of Wellington, the peace of the metropolis was secured. The Chartists were induced to abandon the procession which had caused so much alarm, and the monster petition was carried in a cab to the House of Commons. There it was mercilessly picked to pieces by a select committee. It was found that, instead of containing nearly 6,000,000 signatures, as its originators had boasted, less than 2,000,000 names were attached to it. Some of the names, moreover, were obviously fictitious or even absurd. The exposure of these facts turned the whole thing into ridicule, and gave Parliament an excuse for postponing measures of organic reform which might otherwise have been brought forward.

If the ministry thus abstained from pressing forward a large scheme of political reform, it succeeded in carrying

two measures of the highest commercial and ^rtsT"""" social importance. In 1849 it supplemented

the free traiie policy, which Sir Robert Peel had developed, by the repeal of the Navigation Acts. Briefly stated, these Acts, which had been originated during the Protectorate of Cromwell, and continued after the Restoration, reserved the whole coasting trade of the country for British vessels and British seamen, and much of the foreign trade for British vessels, commanded and chiefly manned by British subjects. The Acts, therefore, were in the strictest sense protective, but they were also designed to increase the strength of Great Britain at sea, by maintaining large numbers of British seamen. They had been defended by Adam Smith on the ground that defence was " of much more importance than opulence," and by the same reasoning they had been described by Mr John Stuart Mill as "though economically disadvantageous, politically expedient." The Acts, however, threw a grave burden on British trade and British shipowners. Their provisions by restricting competition naturally tended to raise freights ; and by restricting employment made it difficult for shipowners to man their vessels. Accordingly the Government wisely determined on their repeal; and one of the last and greatest battles between Eree Trade and Protection was fought over the question. The

second reading of the Government Bill was carried in the House of Lords by a majority of only ten : it would not have been carried at all if the Government had not secured a, much larger number of proxies than their opponents could o|)tain.

If the repeal of the Navigation Acts constituted a

measure of the highest commercial importance, the pass- age of the Ten Hours Bill in 1847 marked the first great advance in factory legislation. Some- g►►, ►►”” thing, indeed, had ^Iready been done to remedy the evils arising from the employment of women and very young children in factories and mines. In 1833 Lord Ashley, better known as Lord Shaftesbury, had carried the first important Factory Act. In 1842 he had succeeded, with the help of the striking report of a Royal Commission, in inducing Parliament to prohibit the employment of women and of boys under ten years of age in mines. And in 1843 Sir James Graham, who was Home Secretary in Sir Robert Peel’s Administration, had been compelled by the pressure of public opinion to introduce a measure providing for the education of chil- dren employed in factories, and for limiting the hours of work of children and young persons. The educational clauses of this Bill were obviously framed in the interests of the Church of England, and raised a heated controversy which led to the abandonment of the measure ; and in the following year Sir James Graham introduced a new Bill dealing with the labour question alone. Briefly stated, his proposal was that no child under nine years of age should be employed in a factory, and that no young per- son under eighteen should be employed for more than twelve hours a day. This measure gave rise to the famous controversy on the ten hours clause, which com- menced in 1844 and was protracted till 1847. Lord Ash- ley and the factory reformers contended, on the one hand, that ten hours were long enough for any person to work ; their opponents maintained, on the contrary, that the adoption of the clause would injure the working-classes by lowering the rate of wages, and ruin the manufacturers by exposing them to foreign competition. In 1847 the reform was at last adopted. It is a remarkable fact that it was carried against the views of the leading statesmen On both sides of the House. It was the triumph of common-sense over of&eial arguments.

During the first four years of Lord John Russell's Government, his administration had never enjoyed any very large measure of popular support, but it had been partly sustained by the advocacy of Sir ^^ "' Robert Peel. ??? The differences which estrai^ged Sir Robert from his old supporters were far greater than those which separated him from the Whigs, and the latter were therefore constantly able to rely on his assist- ance. In the summer of 1850, however, a lamentable accident ??? a fall from his horse ??? deprived the country of the services of its great statesman. His death naturally affected the position of parties. The small remnant of able men, indeed, who had been associated with him in his famous administration, still maintained an attitude of neutrality. But the bulk of the Conservative party rallied under the lead of Lord Stanley (afterwards Derby) in the House of Lords, and gradually submitted to, rather than accepted, the lead of Mr Disraeli in the House of Commons.

In the autumn which succeeded Sir Robert Peel's death, an event which had not been foreseen agitated the country and produced a crisis. During the years which had succeeded the Reform Bill a great religious w'^'"'' ., movement had influenced politics both m Eng- land and Scotland. In England, a body of eminent men at Oxford ??? of whom Mr, afterwards Cardinal, Newman was the chief, but who numbered among their leaders Mr Hurrell Froude, the brother of the historian, and Mv Keble, the author of the Christian Year ??? endeavoured to prove that the doctrines of the Church of England were identical with those of the primitive Catholic Church, and that every Catholic doctrine might be held by those who were within its pale. This view was explained in

a remarkable series of tracts, which gave their authors the name of Tractarians. The most famous of these, and the last of the series, Tract XC, was published three years after the Queen's accession to the throne. In Scotland, the Presbyterian Church ??? mainly under the guidance of Dr Chalmers, one of the most eloquent preachers of the century

was simultaneously engaged in a contest with the state on the subject of ecclesiastical patronage. Both movements had this in common, that they indicated a revival of religious energy, and aimed at vindicating the authority of the church and resisting the interference of the state in church matters. The Scottish movement led to the disruption of the Church of Scotland and the formation of the Free Church in ISiS. The Tractarian movement was ultimately terminated by the secession of Newman and many of his associates from the Church of England, and their admission to the Church of Rome. These secessions raised a feeling of alarm through- out England; The people, thoroughly Protestant, were excited by the proofs which they thought were afforded that the real object of the Tractarians was to reconcile England with Rome ; and practices which are now regarded as venial or even praiseworthy such as the wearing of the surplice in the pulpit, and the institution of the weekly offertory were denounced because they were instituted by the Tractarians, and were regarded as insidious devices to lead the country Eomewards. The sympathies of the Whigs, and especially of the Whig prime minister. Lord John Russell, were with the people ; and Lord John displayed his dislike to the Romanizing tendencies of the Tractarians by appointing Mr Hampden whose views had been formally condemned by the Heb- domadal Board at Oxford to the bishopric of Hereford. The High Church party endeavoured to oppose the appointment at every stage ; but their attempts exposed them to a serious defeat. The courts held that, though the appointment of a bishop by the crown required con- firmation in the archbishop's court, the confirmation was a purely ministerial act which could not be refused. The effort which the High Church party had made to resist Dr Hampden's appointment had thus resulted in showing conclusively that authority resided in the crown and not in the archbishop. It so happened that about the same time this view was confirmed by another judicial decision. The lord chancellor presented Mr Gorham to a living in Devonshire; and Dr Phillpotts, the bishop of Exeter, declined to institute him, on the ground that he held heretical views on the subject of baptism. The Court of Arches upheld the bishop's decision. The finding of the court, however, was reversed by the Privy Council, and its judgment dealt a new blow at the Tractarian party. For it again showed that authority even in doctrine resided in

*the crown and not in the church. Within a few months of this famous decision the Pope
ॢ perhaps en- couraged by the activity and despondency of the High Church party ॢ issued a brief " for re-establishing and ex- tending the Catholic faith in England," and proceeded to divide England and Wales into twelve sees. One of them ॢ Westminster ॢ was made an archbishopric, and the new dignity was conferred on Mr Wiseman, who was almost immediately afterwards created cardinal. The publication of this brief caused much excitement throughout the country, which was fanned by a letter from the prime minister to the bishop of Durham, con- demning the brief as "insolent and insidious" and "inconsistent with the Queen's supremacy, with the rights of our bishops and clergy, and with the spiritual independence of the nation." Somewhat unnecessarily the prime minister went on to condemn the clergymen of the Church of England who had subscribed the Thirty- nine Articles, " who have been the most forward in lead-*

ing their own flocks, step by step, to the very edge of the precipice."

In accordance with the promise of Lord John Russell's letter, the ministry, at the opening of the session of 1851, introduced a measure forbidding the assumption of territorial titles by the prieSts and bishops of ""'f!.'^' the Roman Catholic Church, declaring all gifts b% made to them and all acts done by them under these titles null and void, and forfeiting to the crown all property bequeathed to them. The Bill naturally en- countered opposition from many Liberals, while it failed to excite any enthusiasm among Conservatives, who thought its remedies inadequate. In the middle of the debates upon it the Government was defeated on another question ॢ a proposal to reduce the county franchise ॢ and, feeling that it could no longer rely on the support of the House of Commons, tendered its resignation. But Lord Stanley, whom the Queen entrusted with the duty of forming a new administration, was compelled to decline the task, and Lord John resumed office. Mild as the original Ecclesiastical Titles Bill had been thought, the new edition of it, which was introduced after the restoration of the Whigs to power, was still milder. Though, after protracted debates, it was at last placed on the Statute Book, it satisfied nobody. Its provisions, as was soon found, could

be easily evaded, and the Bill, which had caused so much excitement, and had nearly precipitated the fall of a ministry, remained a dead letter. The Government, in fact, was experiencing the truth that, if a defeated ministry may be occasionally restored to place, it cannot be restored to power. The dismissal of Lord Palmerston from the Foreign Office in 1851 further increased the embarrassments of the Government. In February 1852 it was defeated on a proposal to revive the militia, and resigned.

The circumstances which directly led to the defeat of the Whigs were, in one sense, a consequence of the revo- lutionary wave which had swept over Europe in 1848. The fall of Louis Philippe in that year created a panic in Great Britain. Men thought that the unsettled state of France made war probable, and they were alarmed at the defenceless con- dition of England. Lord Palmerston, speaking in 1846, had declared that " steam had bridged the Channel " ; and the duke of Wellington had addressed a letter to Sir John Burgoyne, in which he had demonstrated that the country was not in a position to resist an invading force. The panic was so great that the ministry felt it necessary to make exceptional provisions for allaying it. Lord John Russell decided on asking Parliament to sanction increased armaments, and to raise the income tax to Is. in the pound in order to pay for them. The occasion deserves to be recollected as the last on which a prime minister, who was not also chancellor of the exchequer, has him- self proposed the budget of the year. But it was still more memorable because the remedy which Lord John proposed at once destroyed the panic which had suggested it. A certain increase of the income tax to a shilling seemed a much more serious calamity than the uncertain prospect of a possible invasion. The estimates were recast, the budget was withdrawn, and the nation was content to dispense with any addition to its military and naval strength. Events in France, in the meanwhile, moved with railway speed. Louis Napoleon became president of the French Republic: in 1851 he became emperor of the French. The new emperor, indeed, took pains to reassure a troubled Continent that "the empire was peace." The people insisted on believing ??? and, as the event proved, rightly ??? that the empire was war. Not- withstanding the success of the Great Exhibition of 1851, which was supposed to inaugurate a new reign of peace,

French scare.

Lord Derby.

the panic, which had been temporarily allayed in 1848, revived at the close of 1861, and the Government en- deavoured to allay it by reconstituting the militia. There were two possible expedients. An Act of 1757 had placed a militia, composed of men selected in each parish by ballot, under the direct authority of the crown, liable to be called out for active service, and to be placed under military law. But the Act had been supplemented by a series of statutes passed between 1808 and 1812, which had provided a local militia, raised, like the regular militia, by ballot, but, unlike the latter, only liable for service for the suppression of riots, or in the event of imminent invasion. Lord John Eussell's Government, forced to do something by the state of public opinion, but anxious ⬛⬛⬛ from the experience of 1848 ⬛⬛⬛ to make that something moderate, decided on reviving the local militia. Lord Palmerston at once suggested that the regular and not the local militia should be revived ; and, in a small house of only 265 members, he succeeded in carrying a resolution to that effect. He had, in this way, what he called his " tit for tat " with Lord John ; and the Queen, accepting her minister's resignation, sent for Lord Derby ⬛⬛⬛ for Lord Stanley had now succeeded to the title ⬛⬛⬛ and charged him with the task of forming a ministry.

The Government which Lord Derby succeeded in forming was composed almost exclusively of the men who had rebelled against Sir Kobert Peel in 1845. It was led in the House of Commons by the brilliant but somewhat unscrupulous statesman who had headed the revolt. With the exception of Lord Derby and one other man, its members had no experience of high office; and it had no chance of commanding a majority of the House of Commons in the existing Parlia- ment. It owed its position to the divisions of its oppo- nents. Profiting by their experience, it succeeded in framing

and passing a measure reconstituting the regular militia, which obtained general approval. It is perhaps worth observing that it maintained the machinery of a ballot, but reserved it only in case experience should prove that it was necessary. Voluntary enlistment under the new Militia Bill was to be the rule : com- pulsory service was only to be resorted to if voluntary enlistment should fail. This success, to a certain ex- tent, strengthened the position of the new ministry. It was obvious, however, that its stability would ulti- mately be determined by its financial policy. Composed of the men who had resisted the free trade measures of the previous decade, its fate depended on its atti- tude towards free trade. In forming his administra- tion Lord Derby had found it necessary to declare that, though he was still in favour of a tax on corn, he should take no steps in this direction till the country had re- ceived an opportunity of expressing its opinion. His leader in the House of Commons went much farther, and declared that the time had gone by for recurring to protection. The view which Mr Disraeli thus pro- pounded in defiance of his previous opinions was con- firmed by the electors on the dissolution of Parliament. Though the new Government obtained some increased strength from the result of the polls, the country, it was evident, had no intention of abandoning the policy of free trade, which by this time, it was clear, had conferred sub- stantial benefits on all classes. When the new Parliament met in the autumn of 1852 it was at once plain that the issue would be determined on the rival merits of the old and the new financial systems. Mr Disraeli courted the decision by at once bringing forward the budget, which custom, and perhaps convenience, would have justified him in postponing till the following spring. His pro- posal ??? in which he avowedly threw over his friends on the ground that " he had greater subjects to consider than

the triumph of obsolete opinions" ??? was, in effect, an attempt to conciliate his old supporters by a policy of doles, and to find the means for doing so by the increased taxation of the middle classes. He offered to relieve the shipping interest by transferring some of the cost of lighting the coasts to the Consolidated Fund ; the West India interest by sanctioning the refining of sugar in bond ; and the landed classes by reducing the malt tax by one-half, and toy repealing the old war duty on hops. He suggested that the cost of these measures should be defrayed by

extending the income tax to Ireland, to industrial incomes of ►►100 and to permanent incomes of ►►50 a year, as well as by doubling the house tax; and extending it to all ►►10 householders. The weight, there- fore, of these measures was either purposely or uninten- tionally thrown mainly on persons living in houses worth from ►►10 to ►►20 a year, or on persons in receipt of in- comes from ►►60 to ►►150 a year. This defect in the budget was exposed in a great speech by Mr Gladstone, which did much to ensure the defeat of the scheme and the fall of the ministry.

On the resignation of Lord Derby, the Queen, anxious to terminate a period of weak governments, decided on endeavouring to combine in one cabinet the chiefs of the Whig party and the followers of f^”’”” Sir Robert Peel. With this view she sent both for Lord Aberdeen, who had held the Foreign Office under Sir Robert, and for Lord Lansdowne, who was the Nestor of the Whigs; and with Lord Lansdowne’s concurrence charged Lord Aberdeen with the task of forming a government. In the new ministry Lord Aberdeen became first lord of the treasury, Mr Glad- stone chancellor of the exchequer, Lord John Russell foreign minister ►►► though he was almost immediately replaced in the Foreign Office by Lord Clarendon, and assumed himself the presidency of the Council. Lord Palmerston went to the Home Office. One other ap- pointment must also be mentioned. The secretary of state for the colonies was also at that time secretary of state for war. No one in 1852, however, regarded that office as of material importance, and it was entrusted by Lord Aberdeen to an amiable and conscientious noble- man, the duke of Newcastle.

The first session of the Aberdeen Administration will be chiefly recollected for the remarkable budget which Mr Gladstone brought forward. It constituted a worthy supplement to the measures of 1842, S^*’►►’ 1845, and 1846. Mr Gladstone swept away the duty on one great necessary of life ►►► soap ; he re- pealed the duties on 123 other articles ; he reduced the duties on 133 others, among them on tea ; and he found means for paying for these reforms, and for the gradual reduction and ultimate abolition of the income tax, which had become very unpopular, by (1) extending the tax to incomes of ►►100 a year ; (2) an increase of the spirit du- ties ; and (3) applying the death duties to real

property, and to property passing by settlement. There can be little doubt that this great proposal was one of the most striking which had ever been brought forward in the House of Commons ; there can also, unhappily, be no- doubt that its promises and intentions were frustrated by events which proved too strong for its author. For Mr Gladstone, in framing his budget, had contemplated a continuance of peace, and the country was, unhappily, already drifting into war.

For some years an obscure quarrel had been conducted at Constantinople about the custody of the holy places at Jerusalem. France, relying on a treaty con- cluded in the first half of the 18th century, J;'-^"^ claimed the guardianship of these places for the Latin Church. But the ritrhts which the Latin Church

had thus obtained had practically fallen into disuse, while the Greek branch of the Christian Church had occupied and repaired the shrines which the Latins had neglected. In the years which preceded 1853, however, France had shown more activity in asserting her claims ; and the new emperor of the French, anxious to conciliate the church which had supported his elevation to the throne, had a keen interest in upholding them. If, for reasons of policy, the emperor had grounds for his action, he had personal motives for thwarting the Tsar of Kussia ; for the latter potentate had been foolish enough, in recogniz- ing the second empire, to address its sovereign as " Mon Cher Ami," instead of, in the customary language of sovereigns, as " Monsieur Mon Frfere." Thus at the close of 1852, and in the beginning of 1853, Eussia and France were both addressing opposite and irreconcilable de- mands to the Eorte, and France was already talking of sending her fleet to the Dardanelles, while Russia was placing a corps d'armee on active service and despatching Prince Mentschikoff on a special mission to Constanti- nople. So far the quarrel which had occurred at the Porte was obviously one in which Great Britain had no concern. The Aberdeen ministry, however, thought it desirable that it should be represented in the crisis by a strong man at Constantinople ; and it selected Lord Stratford de Redcliffe for the post,

which he had filled in former years with marked ability. Whatever merits Lord Stratford possessed ??? and he stands out in modern diplomacy as the one strong man whom England has produced ??? there was no doubt that he had this dis- qualification : the Emperor Nicholas had refused some years before to receive him as ambassador at St Peters- burg, and Lord Stratford had resented, and never for- given, the discourtesy of this refusal. Lord Stratford soon discovered that Prince Mentschikoff was the bearer of larger demands, and that he was requiring the Porte to agree to a treaty acknowledging the right of Eussia to protect the Greek Church throughout the Turkish dominions. By Lord Stratford's advice the Porte ??? while making the requisite concession respecting the holy places ??? refused to grant the new demand; and Prince Mentschikoff thereupon withdrew from Con- stantinople.

The rejection of Prince Mentschikoff's ultimatum was followed by momentous consequences. Eussia ??? or rather her Tsar ??? resolved on the occupation of the prin- cipalities ; the British ministry ??? though the quarrel did not directly concern Great Britain ??? sent a fleet to the Dardanelles and placed it under Lord Stratford's orders. Diplomacy, however, made a fresh attempt to terminate the dispute, and in July 1853 a note was agreed upon by the four neutral Powers, France, Great Britain, Austria, and Prussia, which it was decided to present to Con- stantinople and St Petersburg. This note, the adoption of which would have insured peace, was accepted at St Petersburg ; at Constantinople it was, unfortunately, re- jected, mainly on Lord Stratford's advice, and in opposition to his instructions from home. Instead, however, of insist- ing on the adoption of the note to which it had agreed, Lord Aberdeen's ministry recommended the Tsar to accept some amendments to it suggested by Lord Stratford, which it was disposed to regard as unimportant. It then dis- covered, however, that the Tsar attached a different mean- ing to the original note than it had itself applied to it, and in conjunction with France it thereupon ceased to recom- mend the Vienna Note ??? as it was called ??? for acceptance. This decision separated the two western Powers from Austria and Prussia, who were disposed to think that Eussia had done all that could have been required of her in accepting the note which the four Powers had agreed upon. '

It was obvious that the control of the situation was passing from the hands of the Cabinet at home into those of Lord Stratford at Constantinople. The' ambassador, in fact, had the great advantage that he knew his own mind ; the Cabinet laboured "under the fatal disadvantage that it had, collectively, no mind. Its chief. Lord Aberdeen, was dominated by a desire to preserve peace ; but he had not the requisite force to control the stronger men who were nominally serving under him. Lord John Eussell was a little sore at his own treatment by his party. He thought that he had a claim to the first j)lace in the ministry, and he did not, in consequence, give the full support to Lord Aberdeen which the latter had a right to expect from him. Lord Pahnerston, on the other hand, had no personal grudge to nurture, but he was convinced that the first duty of England was to support Turkey and to resist Eussia. He represented in the Cabinet the views which Lord Stratford was enforc- ing at Constantinople, and step by step Lord Stratford, thus supported, drove the country nearer and nearer to war.

In October the Porte, encouraged by the presence of the British fleet in the Bosphorus, took the bold step of summoning the Eussians to evacuate the principalities. Following up this demand the Turkish troops attacked the Eussian army, and inflicted on it one or two sharp defeats. The Eussians retaliated by loosing their squadron from Sebastopol, and on the 30th of November it attacked and destroyed the Turkish fleet at Sinope. The massacre of Sinope ??? as it was rather inaccurately called in Great Britain, for it is diflScult to deny that it was a legiti- mate act of a belligerent Power ??? created an almost irresistible demand for war among the British people. Yielding to popular opinion, the British ministry assented to a suggestion of the French emperor that the fleets of the Allied Powers should enter the Black Sea and "invite" every Eussian vessel to return to Sebastopol. The decision was taken at an unfortunate hour. Diplomatists, pursuing their labours at Vienna, ^^*"" had succeeded in drawing up a fresh note which they thought might prove acceptable both at St Peters- burg and at Constantinople. Presented almost at the moment at which the Tsar learned that the French and British fleets had entered the Black Sea, the Eussian Government, instead of considering it, withdrew its ministers from London and Paris ; the French and British ambassadors were thereupon withdrawn from St

Peters- burg. An ultimatum was soon afterwards addressed to Eussia requiring her to evacuate the principalities, and war began. In deciding on war the British Government relied on the capacity of its fleet, which was entrusted to the command of Sir Charles Napier, to strike a great blow in the Baltic. The fleet was despatched with extraordinary rejoicings, and amidst loud and confident expressions of its certain triumph. As a matter of fact it did very little. In the south of Europe, however, the Turkish armies on the Danube, strengthened by the advice of British ofiicers, were more successful. The Eussians were forced to retire, and the principalities were evacuated. A prudent Adminis- tration might possibly have succeeded in stopping the war at this point. Bu:t the temper of the country was by this time excited, and it was loudly demanding somethingmore than a preliminary success. It was resolved to invade the Crimea and attack the great arsenal, Sebastopol, whence the Eussian fleet had sailed to Sinope, and in September 1854 the Allied armies landed in the Crimea. On the 20th the Eussian army, strongly posted on the banks of the Alma, was completely defeated, and it is almost cer- tain that, if the victory had been at once followed up, Sebastopol would have fallen. The commanders of the Allied armies, however, hesitated to throw themselves

against the forts erected to the north of the town, and de- cided on the hazardous task of marching round Sebastopol and attacking it from the south. The movement was successfully carried out, but the Allies again hesitated to attempt an immediate assault. The Russians, who were advised by Colonel Todleben, the only military man who attained a great reputation in the war, thus gained time to strengthen their position by earthworks ; and the Allies found themselves forced, with scanty preparations, to undertake a regular siege against an enemy whose force was numerically superior to their own. In the early days of the siege, indeed, the Allied armies were twice in great peril. A formidable attack on the 20th October on the British position at Balaclava led to a series of encounters which displayed the bravery of British troops but did not enhance the reputation of British com- manders. A still more formidable

sortie on the 5th of November was with difficulty repulsed at Inkerman. And the Russians soon afterwards found, in the climate of the country, a powerful ally. The Allied armies, imperfectly organized, and badly equipped for such a campaign, suffered severely from the hardships of a Crimean winter. The whole expedition seemed likely to melt away from want and disease.

The terrible condition of the army, vividly described in the letters which the war correspondents of the news- papers sent home, aroused strong feelings of indignation in Great Britain. When Parliament met Mr Roebuck gave notice that he would move for a committee of inquiry. Lord John Russell ___ who had already vainly urged in the Cabinet that the duke of Newcastle should be superseded, and the conduct of the war entrusted to a stronger minis- ter___ resigned office. His resignation was followed by the defeat of the Government, and Lord Aberdeen, thus driven from power, was succeeded by Lord Palmerston. In select- ing him for the post, the Queen undoubtedly placed her seal on the wish of the country to carry out the Palmer- ^^^ ^q ^j^g bitter end. But it so happened that

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Miaistry. the formation of a newministry was accompanied by a fresh effort to make terms of peace. Before the change of administration a conference had been de- cided on, and Lord Palmerston entrusted its management to Lord John Russell. While the latter was on his way to Vienna an event occurred which seemed at first to facilitate his task. The Tsar, worn out with disappoint- ment, suddenly died, and was succeeded by his son Alexander. Unfortunately the conference failed, and the war went on for another year. In September 1856 the Allied troops succeeded in obtaining possession of the southern side of Sebastopol, and the emperor of the French, satisfied with this partial success, or alarmed at the expense of the war, decided on withdrawing from the struggle. The attitude of Napoleon made the conclusion of peace only a question of time. In the beginning of 1856 a congress to discuss the terms was assembled at Paris ; in February hostilities were suspended ; and in April a treaty was concluded. The peace set back the boundaries of Russia from

the Danube to the Pruth ; it secured the free navigation of the first of these rivers ; it opened the Black Sea to the commercial navies of the world, closing it to vessels of war and forbidding the es- tablishment of arsenals upon its shores. The last condi- tion, to which Great Britain attached most importance, endured for about fourteen years. Peace without this provision could undoubtedly have been secured at Vienna, and the prolongation of the war from 1855 to 1856 only resulted in securing this arrangement for a little more than one decade.

The Crimean war left other legacies behind it. The British Government had for some time regarded with anxiety the gradual encroachments of Russia in Central

Asia. Russian diplomacy was exerting an increasing influence in Persia, and the latter had always coveted the city of Herat, which was popularly regarded as the gate of India. In 1856 the Persian Government, believing that England had her hands fully occupied in the Crimea, seized Herat, and, in consequence, afresh war ??? in which a British army under Sir James Outram rapidly secured a victory ??? broke out. The campaign, entered upon when Parliament was not in session, was unpopular in ^^y^*^'^* the country. A grave constitutional question, china. which was ultimately settled by legislation, was raised as to the right of the Government to undertake military operations beyond the boundaries of India with- out the consent of Parliament. But the incidents of tlie Persian war were soon forgotten in the presence of a still graver crisis ; for in the following year, 1857, the coun- try suddenly found itself involved in war with China, and face to face with one of the greatest dangers which it has ever encountered ??? the mutiny of the Sepoy army in India. The Chinese war arose from the seizure by the Chinese authorities of a small vessel, the Arroiv, commanded by a British subject, and at one time holding a license (which, however, had expired at the time of the seizure) from the British superintendent at Hong-Kong, and the detention of her crew on the charge of piracy. Sir John Bowring, who represented Great Britain in China, failing to secure the reparation and apology which he demanded, directed the British admiral to bombard Canton. Lord Palmerston's Cabinet decided to approve and support Sir John Bowring's vigorous action. Mr Cobden, however, brought forward a

motion in the House of Commons condemning these high-handed pro-ceedings. He succeeded in securing the co-operation of his own friends, of Lord John Russell, and of other inde- pendent Liberals, as well as of the Conservative party, and in inflicting a signal defeat on the Government. Lord Palmerston at once appealed from the House to the country. The constituencies, imperfectly acquainted with the technical issues involved in the dispute, rallied to the minister, who was upholdipg British interests. Lord Palmerston obtained a decisive victory, and returned to power apparently in irresistible strength. Lord Elgin had already been sent to China with a consider- able force to support the demand for redress. On his way thither he learned that the British in India were reduced to the last extremities by the mutiny of the native army in Bengal, and, on the application of Lord Canning, the governor-general, he decided on diverting the troops, intended to bring the Chinese to reason, to the more pressing duty of saving India for the British crown.

During the years which had followed the accession of the Queen, the territories and responsibilities of the East India Company had been considerably enlarged by the annexation of Scinde by Lord Ellenborough, 'mm" the conquest of the Punjab after two desperate " """"

military campaigns under Lord Dalhousie, the conquest of Pegu, and the annexation of Oudh. These great additions to the empire had naturally imposed an increased strain on the Indian troops, while the British garrison, instead of being augmented, had been depleted to meet the necessities of the Russian war. Several circumstances, moreover, tended to propagate disaffection in the Indian army. Indian troops operating outside the Company's dominions were granted increased allowances, but these were automatically reduced when conquest broughttlie provinces in which they were serving within the British pale. The Sepoy sagain had an ineradicable dislike to serve beyond the sea, and the invasion of Pegu necessitated their transport by water to the seat of war. Finally, the invention of a new rifle led to the introduction of a cartridge which, though it waS'

officially denied at the moment, was in fact lubricated with a mixture of cow's fat andlard. The Sepoys thought that their caste would be destroyed if they touched the fat of the sacred cow or unclean pig; they were even persuaded that the British Government wished to destroy their caste in order to facilitate their conversion to Christianity. Isolated mutinies in Bengal were succeeded by much more serious events at Cawnpore in Oudh, and at Meerut in the North- West Provinces. Prom Meerut the mutineers, after some acts of outrage and murder, moved on Delhi, the capital of the old Mogul empire, which became the headquarters of the mutiny. In Oudh the native regi- ments placed themselves under a Mahratta chief, Nana Sahib, by whose orders the British ih Cawnpore, includ- ing the women and children, were foully murdered. In the summer of 1857 these events seemed to imperil British rule in India. In the autumn the courage of the troops and the arrival of reinforcements gradually restored the British cause. Delhi, after a memorable siege, was at last taken by a brilliant assault. Lucknow, where a small British garrison was besieged in the Residency, was twice relieved, once temporarily by Sir James Outram and Gen- eral Havelock, and afterwards permanently by Sir Colin Campbell, who had been sent out from England to take the chief command. Subsequent military operations broke up the remnants of the revolt, and in the beginning of 1858 the authority of the Queen was restored through- out India. The mutiny, however, had impressed its lesson on the British people, and, as the first consequence, it was decided to transfer the government from the old East India Company to the crown. Lord Palmerston's administration was defeated on another issue before it succeeded in carrying the measure which it introduced for the purpose, though Lord Derby's second ministry, which succeeded it, was compelled to frame its proposals on somewhat similar lines. The home government of India was entrusted to a secretary of state, with a coun- cil to assist him ; and though the numbers of the council have been reduced, the form of government which was then established has endured.

The cause which led to the second fall of Lord Palmerston was in one sense unexpected. Some Italian refugees living in London, of whom Orsini was the chief, formed a design to assassinate the emperor of the French. On the evening of 14th January 1858, while the emperor,

accompanied by the empress, was driving to the opera, these men threw some bombs under his carriage. The brutal attempt happily failed. Neither the emperor nor the empress was injured by the explosion, but the car- riage in which they were driving was wrecked, and a large number of persons who happened to be in the street at the time were either killed or wounded. This horrible outrage naturally created indignation in France, and it un- fortunately became plain that the conspiracy had been hatched in England and that the bombs had been manu- factured in Birmingham. On these facts becoming known, Count Walewski, the chief of the French Foreign Office, who was united by ties of blood to the emperor, called on the British Government to provide against the danger to which France was exposed. " Ought the right of asylum to protect such a state of things ? " he asked. " Is hospi- tality due to assassins ? Ought the British Legislature to continue to favour their designs and their plans ? And can it continue to shelter persons who by these flagrant acts place themselves beyond the pale of common rights ? " Lord Clarendon, the head of the British Foreign Office, told the French ambassador, who read him this despatch, that " nO' consideration on earth would induce the British Parliament to pass a measure for the extradition of political refugees," but he added that it was a question whether the law was as complete and as stringent as it should be, and

he stated that the Government had already referred the whole subject to the law officers of the crown for their consideration. Having made these remarks, however, he judged it wise to refrain from giving any formal replyto Count Walewski's despatch, and contented himself with privately communicating to the British ambassador in Paris the difficulties of the British Government. After receiving the opinion of the law officers the Cabinet decided to intro- duce a Bill into Parliament increasing in England the punishment for a conspiracy to commit a felony either within or without the United Kingdom. The first read- ing of this Bill was passed by a considerable majority. But, before the Bill came on for a second reading, the language which was being used in France created strong resentment in England. The regiments of the French army sent addresses to the emperor congratulating him on his escape and violently denouncing the British people. Some of these addresses, which were published in the Moniteur, spoke of London as " an assassins' den," and

invited the emperor to give his troops the order to destroy it. Such language did not make it easier to alter the law in the manner desired by the Government. The House of Commons, reflecting the spirit of the country, blamed Lord Clarendon for neglecting to answer Count Walewski's despatch, and blamed Lord Palmerston for introducing a Bill at French dictation. The feeling was so strong that, when the Conspiracy Bill came on for a second reading, an amendment hostile to the Government was carried, and Lord Palmerston at once resigned.

For a second time Lord Derby undertook the difficult task of carrying on the work of government without the support of a majority of the House of Commons. If the Liberal party had been united his attempt Derby's would have failed immediately. In 1858, how- second ever, the Liberal party had no cohesion. The '"'"'^'v- wave of popularity which had carried Lord Palmerston to victory in 1857 had lost its strength. The Radicals, who were slowly recovering the influence they had lost during the Crimean war, regarded even a Conservative govern- ment as preferable to his return to power, while many Liberals desired to entrust the fortunes of their party to the guidance of their former chief, Lord John Russell. It was obvious to most men that the dissensions thus visible in the Liberal ranks could be more easily healed in the cold shade of the Opposition benches than in the warmer sunlight of office. And therefore, though no one had much confidence in Lord Derby, or in the stability of his second Administration, every one was disposed to acqui- esce in its temporary occupation of office.

Ministries which exist by sufferance are necessarily compelled to adapt their measures to the wishes of those who permit them to continue in power. The second ministry of Lord Derby experienced the truth of this rule. For some years a controversy had been conducted in the Legislature in reference to the admission of the Jews to Parliament. This dispute had been raised in 1847 into a question of practical moment by the "election of Baron Rothschild as representative of the City of London, and its importance had been emphasized in 1851 by the return of another Jew, Alderman Salomons, for another constituency. The Liberal party generally in the House of Commons was in favour of such a modifi- cation of the oaths as would enable the Jews so elected to take their seats.

The bulk of the ;^^^*^^" Conservative party, on the contrary, and the ???ent. House of Lords, were strenuously opposed to the change. Early in 1858 the House of Commons, by an increased majority, passed a Bill amending the oaths imposed by law on members of both Houses, and direct- ing the omission of the words " on the true faith of a Christian " from the oath of abjuration when it Was taken

by a Jew. If the Conservatives had remained in Opposi- tion there can be little doubt that this Bill would have shared the fate of its predecessors and have been rejected by the Lords. The lord chancellor, indeed, in speaking upon the clause relieving the Jews, expressed a hope that the peers would not hesitate to pronounce that our " Lord is king, be the people never so impatient.',' But some Conservative peers realized the inconvenience of main- taining a conflict between the two Houses when the Con- servatives were in power ; and Lord Lucan, who had commanded the cavalry in the Crimea, suggested as a compromise that either House should be authorized by resolution to determine the form of oath to be adminis- tered to its members. This solution was reluctantly accepted by Lord Derby, and Baron Eothschild was thus enabled to take the seat from which he had been so long excluded. Eight years afterwards Parliament was in- duced to take a fresh step in advance. It imposed a new oath from which the words which disqualified the Jews were omitted. The door of the House of Lords was thus thrown open, and Baron Rothschild, raised to the peerage, was enabled to take his seat in the upper chamber.

??? This question was not the only one on which a Conserva- tive Governm 3nt, without a majority at its back, was com- pelled to make concessions. For some years past BW/"/s59. ^ growing disposition had been displayed among the more earnest Liberals to extend the provi- sions of the Eeform Ac^t of 1832. Lord John Russell's ministry had been defeated in 1851 on a proposal of Mr Locke King to place ??10 householders in counties on the same footing as regards the franchise as

10 householders in towns, and Lord John himself in 1854 had actually in- troduced a new Eeform Bill. After the general election of 1857 the demand for reform increased, and, in accept- ing office in 1858, Lord Derby thought it necessary to declare that, though he had maintained in Opposition that the settlement of 1832, with all its anomalies, afforded adequate representation to all classes, the promises of previous governments and the expectations of the people imposed on him the duty of bringing forward legislation on the subject. The scheme which Lord Derby's Govern- ment adopted was peculiar. Its chief proposal was the extension of the county franchise to 10 householders. But it also proposed that persons possessing a 40s. free- hold in a borough should in future have a vote in the borough in which their property was situated, and not in the county. The Bill also conferred the franchise on holders of a certain amount of stock, on depositors in sav- ings banks, on graduates of universities, and on other per- sons qualified by position or education. The defect of the Bill was that it did nothing to meet the only real need of reform the enfranchisement of a certain proportion of the working classes. On the contrary, in this respect it' perpetuated the settlement of 1832. The 10 householder was still to furnish the bulk of the electorate, and the or- dinary working man could not afford to pay 10 a year for his house. While the larger proposals of the Bill were thus open to grave objection, its subsidiary features provoked ridicule. The suggestions that votes should be conferred on graduates and stockholders were laughed at as " Fancy Franchises." The Bill, moreover, was not brought forward with the authority of a united Cabinet. Two members of the Government Mr Spencer Walpole and Mr Henley declined to be responsible for its pro- visions, and placed their resignations in Lord Derby's hands. In ~~Mr VValpole's judgment the lUll was objec~~ tionable because it afforded rio reasonable basis for a stable settlement. There was nothing in a 10 fran- chise which was capable of permanent defence, and if it was at once applied to counties as well as boroughs it

would sooner or later be certain to be extended. He him- self advocated with some force that it would be wiser and more popular to fix the county franchise at 20 and the borough franchise at 6 rateable value ; and he contended that such a settlement could be defended on the old

prin- ciple that taxation and representation should go together, for ►►20 was the minimum rent at which the house tax commenced, and a rateable value of ►►6 was the point at which the householder could not compound to pay his rates through his landlord. Weakened by the defection of two of its more important members, the Government had little chance of obtaining the acceptance of its scheme. An amendment of Lord John Eussell,. condemning its main provisions was adopted in an unusually full house by a substantial majority, and the Cabinet had no alternative but to resign or dissolve. It chose the latter course. The general election, which almost immediately took place, in- creased to some extent the strength of the Conservative party. For the first time since their secession from Sir Robert Peel the Conservatives commanded more than three hundred votes in the House of Commons, but this increased strength was not sufficient to ensure them a majority. When the new Parliament assembled, Lord Hartington, the eldest son of the duke of Devonshire, was put forward to propose a direct vote of want of confidence in the Ad- ministration. It was carried by 323 votes to 310, and the second Derby Administration came to an end.

It was plain that the House of Commons had withdrawn its support from Lord Derby, but it was not clear that any other leading politician would be able to form a paja,er. government. The jealousies between Lord John ston's Russell and Lord Palmerston still existed ; the second more extreme men, who were identified with the "”'”'►►► policy of Mr Cobden and Mr Bright, had little confidence in either of these statesmen ; and it was still uncertain whether the able group who had been the friends of Sir Eob- ert Peel would finally gravitate to the Conservative or to the Liberal camp. The Queen, on the advice of Lord Derby, endeavoured to solvethe first of these difficulties by sending for Lord Granville, who led the Liberal party in the Lords, and authorizing him to form a government which should combine, as far as possible, all the more prominent Liberals. The attempt, however, failed, and the Queen thereupon fell back upon Lord Palmerston. Lord John Eussell agreed to accept office as foreign minister; j\[r Gladstone consented to take the chancellorship of the exchequer. Mr Cobden was offered, but declined, the presidency of the Board of Trade ; and the post which he refused was con- ferred on a prominent free trader, who had associated him- self with*

Mr Cobden's fortunes, Mr MUner Gibson. Thus Lord Palmerston had succeeded in combining in one min- istry the various representatives of political progress. He had secured the support of the Peelites, who had left him after the fall of Lord Aberdeen in 1855, and of the free traders, who had done so much to defeat him in 1857 and 1858. His new Admini stration was accordingly based on a broader bottom, and contained greater elements of strength than his former Cabinet. And the country was requiring more stable government. The three first minis- tries of the Queen had endured from the spring of 1835 to the spring of 1852, or for very nearly Seventeen years ; but thenext seven years had seen theformation and dissolution of no less than four Cabinets. It was felt that these fre- quent changes were unfortunate for the country, and every one was glad to welcometheadvent of aGovernment which seemed to promise greater permanence. That promise was fulfilled. The Administration which Lord I'almerston succeeded in forming in 1859 endured till his death in 1865, and with slight modifications, under its second chief Lord John (afterwards Earl) Eussell, till the summer of 1866. It had thus a longer lifethan any Cabinet whichhad governed

England since the first Eeform Act. But it owed its lasting character to the benevolence of its opponents rather than to the enthusiasm of its supporters. The Conservatives learned to regard the veteran statesman, "who had combined all sections of Liberals under his banner, as the most powerful champion of Conservative principles ; a virtual truce of parties was established during his continuance in office ; and, for the most part of his ministry, a tacit understanding existed that the minister, on his side, should pursue a Conservative policy, and that the Conservatives, on theirs, should abstain from any real attempt to oust him from power. Lord John Eussell, indeed, was too earnest in his desire for reform to abstain from one serious effort to accomplish it. Early in 1860 he proposed, with the sanction of the Cabinet, a measure providing for the extension of the county franchise to ►►10 householders, of the borough franchise to ►►6 householders, and for a moderate redis- tribution of seats. But the

country, being in enjoyment of considerable prosperity, paid only a languid attention to the scheme ; its indifference was reflected in the House; the Conservatives were encouraged in their opposition by the lack of interest which the new Bill ex- cited, and the almost unconcealed dislike of the prime minister to its provisions. The Bill, thus steadily opposed and half-heartedly supported, made only slow progress ; and at last it was withdrawn by its author. He did not again attempt during Lord Palmerston's life to reintroduce the subject. Absorbed in the work of the Foreign OfB.ce, which at this time was abnormally active, he refrained from pressing home the arguments for internal reform.

In one important department, however, the ministry departed from the Conservative policy it pursued in other

matters. Mr Gladstone signalized his return to Mr aiad- the exchequer by introducing a series of budgets Au'^ete. which excited keen opposition at the time, but

in the result largely added to the prosperity of the country. The first of these great budgets, in 1860, was partly inspired by the necessity of adapting the fiscal system to meet the requirements of a commercial treaty which, mainly through Mr Cobden's exertions, had been concluded with the emperor of the Erench. The treaty bound France to reduce her duties on English coal and iron, and on many, manufactured articles ; while, in return. Great Britain undertook to sweep away the duties on all manufactured goods, and largely to reduce those on French wines. But Mr Gladstone was not content with these great alterations, which involved a loss of nearly ►►1,200,000 a year to the exchequer; he voluntarily undertook to sacrifice another million on what he called a supplemental measure of customs reform. He proposed to repeal the duties on paper, by which means he hoped to increase the opportunities of providing cheap literature for the people. The budget of 1860 produced a protracted controversy. The French treaty excited more criticism than enthusiasm on both sides of the Channel. In France the manufacturers complained that they would be unable to stand against the competition of English goods. In England many people thought that Great Britain was wasting her resources and risking her supremacy by giving the French increased

facilities for taking her iron, coal, and machinery, and that no adequate advantage could result from the greater consumption of cheap claret. But the criticism which the French treaty aroused was drowned in the clamour which was created by the pro- posed repeal of the paper duties. The manufacture of paper was declared to be a struggling industry, which would be destroyed by the withdrawal of protection. The dissemination of cheap literature, and the multipli- cation of cheap newspapers, could not compensate the nation for the ruin of an important trade. If money

could be spared, moreover, for the remission of taxation, the paper duties were much less oppressive than those on some other articles. The tax on tea, for example, which had been raised during the late war to no less than Is. 5d. a ft, was much more injurious ; and it would be far wiser ??? so it was contended ??? to reduce the duty on tea than to abandon the duties on paper. Notwithstanding the opposition which the Paper Duties Bill undoubtedly excited, the proposal was carried in the Commons ; it was, "'Pf however, thrown out in the Lords, and its rejec- repealed. tion led to a crisis which seemed at one time to threaten the good relations between the two houses of Parliar ment. It was argued that if the Lords had the rightto reject a measure remitting existing duties, they had in effect the right of imposing taxation, since there was no material dif- ference between the adoption of a new tax and the continu- ance of an old one which the Commons had determined to repeal. Lord Palmerston, however, with some tact post- poned the controversy for the time by obtainingthe appoint- ment of a committee to search for precedents ; and, after the report of the committee, he moved a series of resolutions affirming the right of the Commons to grant aids and supplies as their exclusive privilege, stating that the occar sional rejection of financial measures by the Lords had always been regarded with peculiar jealousy, bst declaring that the Commons had the remedy in their own hands by so framing Bills of Supply as to secure their acceptance. In accordance with this suggestion the Commons in the following year again resolved to repeal the paper duties ; but, instead of embodying their decision in a separate Bill, they included it in the same measure which dealt with all the financial arrangements of the year, and thus threw'Tm the Lords the responsibility of either accepting the proposal, or of paralysing the whole machinery of administration by depriving the crown

of the supplies which were re- quired for the public services. The Lords were not pre- pared to risk this result, and they accordingly accepted a reform which they could no longer resist, and the Bill became law. In order to enable him to accomplish these great changes, Mr Gladstone temporarily raised the income tax, which he found at 9d. in the pound, to lOd. But the result of his reforms was so marked that he was speedily able to reduce it. The revenue increased by leaps and bounds, and the income tax was gradually reduced till it stood at 4d. in the closing years of the Administration. During the same period the duty on tea was reduced from Is. 5d. to 6d. in the ft ; and the national debt was diminished from rather more than ” ►►800,000,000 to rather less than ►►780,000,000, the charge for the debt declining, mainly through the falling in of the Long Annuities, by some ►►2,600,000 a year. With the possible exception of Sir Robert Peel's term of office, no previous period of British history had been memorable for a series of more remark- able financial reforms. Their success redeemed the char- acter of the Administration. The Liberals, who complained that their leaders were pursuing a Conservative policy, could at least console themselves by the reflection that the chancellor of the exchequer was introducing satisfactory budgets. The language, moreover, which Mr Gladstone was holding on other subjects encouraged the more ad- vanced Liberals to expect that he would ultimately place himself at the head of the party of progress. This expecta- tiori was the more remarkable because Mr Gladstone was the representative in the Cabinet of the old Conservative party which Sir Robert Peel had led to victory. As lately as 1858 he had reluctantly refused to serve under Lord Derby ; he was still a member of the Carlton Club ; he sat for the university of Oxford; and on many questions he dis- played a constant sympathy with Conservative traditions. Yet, on all the chief domestic questions which came before Parliamentin LordPalmerston's second Administration,Mr

Gladstone almost invariably took a more Liberal view than his chief. It was understood, indeed, that the relar tions between the two men were not

always harmonious ; that Lord Palmerston disapproved the resolute conduct of Mr Gladstone, and that Mr Gladstone deplored the Conservative tendencies of Lord Palmerston. It was believed that Mr Gladstone on more than one occasion desired to escape from a position which he disliked by resigning office, and that the resignation was only averted through a consciousness that the ministry could not afford to lose its most eloquent member.

While on domestic matters other than those affecting finance the Liberal ministry was pursuing a Conservative policy, its members were actively engaged on, and the attention of the public was keenly directed to, affairs abroad. Por the period was one of foreign unrest, and the wars which were then waged have left an enduring mark on the map of the world, and have affected the position of the Anglo-Saxon race for all time. In the far East, the operations which it had been decided to undertake in China were necessarily postponed on account of the diversion of the forces, intended to exact redress at Peking, to the suppression of mutiny in India. It was only late in 1858 that Lord Elgin and Baron Gros, the French plenipotentiary (for France joined England in securing simultaneous redress for grievances of her own), were enabled to obtain suitable reparation. It was arranged that the treaty, which was then provisionally concluded at Tientsin, should be ratified at Peking in the

following year; and in June 1859 Mr Bruce, fgggfgo^' Lord Elgin's brother, who had been appointed

plenipotentiary, attempted to proceed up the Peiho with the object of securing its ratification. The Allied squadron, however, was stopped by the forts at the mouth of the Peiho, which fired on the vessels ; a landing party, which was disembarked to storm the forts, met with a disastrous check, and the squadron had to retire with an acknowledged loss of three gunboats and 400 men. This reverse necessitated fresh operations, and in 1860 Lord Elgin and Baron Gros were directed to return to China, and, at the head of an adequate force, were instructed to exact an apology for the attack on the Allied fleets, the ratification and execution of the treaty of Tientsin, and the payment of an indemnityf orthe expenses of the war. The weakness of the Chinese empire was not appreciated at that time ; the

unfortunate incident on the Peiho in the previous summer had created an exaggerated impression of the strength of the Chinese arms, and some natural anxiety was felt for the success of the expedition. But the Allied armies met with no serious resistance. The Chinese, indeed, endeavoured to delay their progress by negotiation rather than by force ; and they succeeded in treacherously arresting some distinguished persons who had been sent into the Chinese lines to negotiate. But by the middle of October the Chinese army was decisively defeated ; Peking was occupied ; those British and French prisoners who had not succumbed to the hardships of their confinement were liberated; Lord Elgin determined on teaching the rulers of China a lesson by the destruction of the Summer Palace ; and the Chinese Government was compelled to submit to the terms of the Allies, and to ratify the treaty of Tientsin. There is no doubt that these operations helped to open the Chinese markets to British trade ; but incidentally, by regulating the emigra- tion of Chinese coolies, they had the unforeseen effect of exposing the industrial markets of the world to the serious competition of cheap " yellow " labour. A distinguished foreign statesman observed that Lord Palmerston had made a mistake. He thought that he had opened China to Europe ; instead, he had let out the Chinese. It was perhaps a happier result of the war that it tended to the

continuance of the Anglo-French alliance. French and British troops had again co-operated in a joint enterprise, and had shared the dangers and successes of a campaign. War was not confined to China. In the beginning of 1859 diplomatists were alarmed at the language addressed by the emperor of the French to the Austrian ambassador at Paris, which seemed to breathe the menace of a rupture. Notwithstanding the exertions which Great Britain made to avert hostilities, the provocation of Count Cavour induced Austria to declare war against Piedmont, and Napoleon thereupon moved to the support of his ally, promising to free Italy from the Alps to the Adriatic. As a matter of fact, the attitude of northern Germany, which was massing troops on the Ehine, and the defence- less condition of Prance, which was drained of soldiers for the Italian campaign, induced the emperor to halt before he had carried out his purpose, and terms of peace were hastily concerted at Villafranca, and were afterwards confirmed at Zurich, by which Lorn- "fj^^*'"" bardy was given to Piedmont, while Austria was left in possession of Venice and

the Quadrilateral, and Central Italy was restored to its former rulers. The refusal of the Italians to take back the Austrian grand dukes make the execution of these arrangements impracti- cable. Napoleon, indeed, used his influence to carry them into effect; but Lord John Eussell, who was now in charge of the British Foreign Office, and who had Lord Palmerston and Mr Gladstone on his side in the Cabinet, gave a vigorous support to the claim of the Italians that their country should be allowed to regulate her own affairs. The French emperor had ultimately to yield to the determination of the inhabitants of Central Italy, when it was backed by the arguments of the British Foreign Office, and Tuscany, Modena, Parma, as well as a portion of the States of the Church, were united to Piedmont. There was no doubt that through the whole of the negotiar tions the Italians were largely indebted to the labours of Lord John Russell. They recognized that they owed more to the moral support of England than to the armed assist- ance of France. The French emperor, moreover, took a step which lost him the sympathy of many Italians. Before the war he had arranged with Count Cavour that France should receive, as the price of her aid, the duchy of Savoy and the county of Nice. After Villafranca, the emperor, frankly recognizing that he had only half kept his promise, consented to waive his claim to these provinces. But, when he found himself unable to resist the annexation of Central Italy to Piedmont, he reverted to the old arrangement. The formation of a strong Piedmontese kingdom, with the spoliation of the papal dominion, was unpopular in France ; and he thought ??? perhaps naturally ??? that he must have something to show his people in return for sacrifices which had cost him the lives of 50,000 French soldiers, and con- cessions which the whole Catholic party inFrance resented. Count Cavour consented to pay the price which Napoleon thus exacted, and the frontier of France was accordingly extended to the Alps. But it is very doubtful whether Napoleon did not lose more than he gained by this addition to his territory. It certainly cost him the active friendship of Great Britain. The Anglo-French alliance had been already strained by the language of the French colonels in 1858 and the Franco-Austrian war of 1859 ; it never fully recovered from the shock which it received by the evidence, which the annexation of Savoy and Nice gave, of the ambition of the French emperor. The British people gave way to what Mr Oobden called the last of the three panics. Lord Palmerston proposed and carried the provision

of a large sum of money for the fortification of the coasts ; and the volunteer movement, which had its origin in 1859, received a remarkable stimulus in 1860. In this year the course of events in

Italy emphasized the differences between the policy of Great Britain and that of France. Garibaldi, with a thousand followers, made his famous descent on the coast of Sicily. After making himself master of that island, he crossed over to the mainland, drove the king of Naples out of his capital, and forced him to take refuge in Gaeta. In France these events were regarded with dis- may. The emperor wished to stop Garibaldi's passage across the Strait, and stationed his fleet at Gaeta to pro- tect the king of Naples. Lord John Eussell, on the con- trary, welcomed Garibaldi's success with enthusiasm. He declined to intervene in the affairs of Italy by confin- ing the great liberatot to Sicily; he protested against the presence of the French fleet at Gaeta; and when other foreign nations denounced the conduct of Piedmont, he defended it by quoting Vattel and citing the example of William III. When, finally, Italian troops entered the dominions of the pope, France withdrew her ambassa- dor from the court of Turin, and England under Lord John Russell's advice at once recognized the new king- dom of Italy.

In these great events ??? for the union of Italy was the greatest fact which had been accomplished in Europe since the fall of the first Napoleon ??? the British ministry had undoubtedly acquired credit. It was everywhere felt that the new kingdom owed much to the moral sup- port which had been steadily and consistently given to it by Great Britain. Soon afterwards, however, in the autumn of 1863, the death of the king of Denmark led to a new revolution in the north of Europe, in which Lord Palmerston's Government displayed less resolution and lost much of the prestige which it had acquired by its Italian policy. The duchies of Schleswig and Holstein had been for centuries united to the kingdom of Denmark

by the golden link of the crown ; in other re- Schieswig- spects they had been organically kept distinct, question, while One of them ??? Holstein ??? was a member of

the German confederation. The succession to the crown of Denmark, however, was different from that in the duchies. In Denmark the crown could descend, as it descends in Great Britain, through females. In the duchies the descent was confined to the male line ; and, as Frederick VII., who ascended the Danish throne in 1848, had no direct issue, the next heir to the crown of Denmark under this rule was Prince Christian of Glucks- burg, afterwards king ; the next heir to the duchies being the duke of Augustenburg. In 1850 an arrangement had been made to prevent the separation of the duchies from the kingdom. As a result of a conference held in London, the duke of Augustenburg was induced to re- nounce his claim on the receipt of a large sum of money. Most of the Great Powers of Europe were parties to this plan. But the German confederation was not represented at the conference, and was not therefore committed to its conclusions. During the reign of Frederick VII. the Danish Government endeavoured to cement the alliance between the duchies and the kingdom, and specially to separate the interests of Schleswig, which was largely Danish in its sympathies, from those of Holstein, which was almost exclusively German. With this object, in the last year of his life, Frederick VII. granted Holstein autonomous institutions, and bound Schleswig more closely to the Danish monarchy. The new King Christian IX. confirmed this arrangement. The German Diet at Frank- fort at once protested against it. Following up words with acts it decided on occupying Holstein, and it delegated the duty of carrying out its order to Hanover and Saxony. While federal execution was taking place, the duke of Augustenburg ??? regardless of the arrangements to which he had consented ??? delegated his rights in the duchies to his son, who formally claimed the succession. So far the

situation, which was serious enough, had been largely dependent on the action of Germany. In the closing days of 1863 it passed mainly into the control of the two chief German Powers. In Prussia Bismarck had lately become prime minister, and was animated by ambitious projects for his country's aggrandizement. Austria, afraid of losing her influence in

Germany, followed the lead of Prussia, and the two powers required Denmark to cancel the arrangements which Frederick VII. had made, and which Christian IX. had confirmed, threatening in case of refusal to follow up the occupation of Holstein by that of Schleswig. As the Danes gave only a provisional assent to the demand, Prussian and Austrian troops entered Schleswig. These events created much excite- ment in England. The great majority of the British people, who imperfectly understood the merits of the case, were unanimous in their desire to support Denmark by arms. Their wish had been accentuated by the circum- stance that the marriage in the previous spring of the prince of Wales to the daughter of the new king of Den- mark had given them an almost personal interest in the struggle. Lord Palmerston had publicly expressed the views of the people by declaring that, if Denmark were attacked, her assailants would not have to deal with Den- mark alone. The language of the public press and of Englishmen visiting Denmark confirmed the impression which the words of the prime minister had produced ; and there is unfortunately no doubt that Denmark was en- couraged to resist her powerful opponents by the belief, which she was thus almost authorized in entertaining, that she could reckon in the hour of her danger on the active assistance of the United Kingdom. If Lord Palmerston had been supported by his Cabinet, or if he had been a younger man, he might possibly, in 1864, have made good the words which he had rashly uttered in 1863. But the Queen, who, it is fair to add, understood the movement which was tending to German unity much better than most of her advisers, was averse from war. A large section of the Cabinet shared the Queen's hesitation, and Lord Pal- merston ??? with the weight of nearly eighty summers upon him ??? was not strong enough to enforce his will against both his sovereign and his colleagues. He made some attempt to ascertain whether the emperor of the French would support him if he went to war. But he found that the emperor had not much fancy for a struggle which would have restored Holstein to Denmark ; and that, if he went to war at all, his chief object would be the liberation of Venice and the rectification of his own frontiers. Even Lord Palmerston shrank from entering on a campaign which would have involved all Europe in conflagration, and would have unsettled the boundaries of most Conti- nental nations ; and the British Government endeavoured thenceforward to stop hostilities by referring

the question immediately in dispute to a conference in London. The labours of the conference proved abortive. Its members were unable to agree upon any methods of settlement, and the war went on. Denmark, naturally unable to grapple with her powerful antagonists, was forced to yield, and the two duchies, which were the subject of the dispute, were taken from her.

The full consequences of this struggle were not visible at the time. It was impossible to foresee that it was the first step which was to carry Prussia forward, under her ambi- tious minister, to a position of acknowledged supremacy on the Continent. But the results to Great Britain were plain enough. She had been mighty in words and weak in deeds. It was no doubt open to her to contend, as perhaps most wise people consider, that the cause of Denmark was not of sufficient importance to justify her in going to war. But it was not open to her to encourage a weak Power to resist, and then desert her in the hour of her necessity. Lord

Palmerston should not have used the language which he employed in 1863, if he had not decided that his brave words would be followed by brave action. His conduct lowered the prestige of Great Britain at least as much as his Italian policy had raised it. Continental statesmen thenceforward assumed that Great Britain, however much she might protest, would not resort to arms, and the influence of England suffered, as it was bound to suffer, in consequence.

Meanwhile, in this period of warfare, another struggle was being fought out on a still greater .scale in North America. The election of Mr Abraham Lincoln to the presidency of the United States emphasized the fact that the majority of the inhabitants of the Northern States were opposed to the continuance of slavery ; and, in the beginning of 1861, several of the Southern States formally seceded from the union. A steamer sent by the Federal Government with reinforcements to Fort

Sumter was fired upon, and both parties made prepara- tions for the civil war which was apparently CMiwar. inevitable. On the one side the Confederate States ??? as the seceding states were called ??? were animated by a resolution to protect their property. On the other side the " conscience " of the North was ex- cited by a passionate desire to wipe out the blot of slavery. Thus both parties were affected by some of the most powerful considerations which can influence mankind, while the North were further actuated by the natural incentive to preserve the union, which was threatened with disruption. The progress of the great struggle was watched with painful attention in England. The most important manufacturing interest in England was para^ lysed by the loss of the raw cotton, which was obtained almost exclusively from the United States, and tens of thousands of workpeople were thrown out of employment. The distress which resulted naturally created a strong feeling in favour of intervention, which might terminate the war and open the Southern ports to British commerce ; and the initial successes which the Confederates secured seemed to afford some justification for such a proceeding. In the course of 1862 indeed, when the Confederate armies had seciu'ed many victories, Mr Gladstone, speaking at Newcastle, used the famous expression that President Jef- ferson Davis had " m ade a nation " ; and Lord Palmerston's language in the House of Commons ??? while opposing a motion for the recognition of the South ??? induced the impression that his thoughts were tending in the same direction as Mr Gladstone's. The Emperor NapoleoU), in July of the same year, confidentially asked the British minister whether the moment had not come for recogniz- ing the South ; and in the following September Lord Palmerston was himself disposed in concert with France to offer to mediate on the basis of separation. Soon afterwards, however, the growing exhaustion of the South improved the prospects of the Northern States : an increasing number of persons in Great Britain objected to interfere in the interests of slavery; and the com- batants were allowed to fight out their quarrel without the interference of Europe.

At the beginning of the war, Lord John Russell (who was made a peer as Earl Russell in 1861) acknowledged the Southern States as belligerents. His decision caused some ill-feeling at Washington; but it was inevitable. For the North had proclaimed a blockade of the Southern ports ; and it

would have been both inconvenient and un- fair if Lord Russell had decided to recognize the blockade and had refused to acknowledge the belligerent rights of the Southern States. Lord Russell's decision, however, seemed to indicate some latent sympathy for the Southern cause; and the irritation which was felt in the North was increased by the news that the Southern States were

accrediting two gentlemen to represent them at Paris and at London. These emissaries, Messrs – ^^^, Mason and Slidell, succeeded in running the jacident" blockade and in reaching Cuba, where they embarked on the Trent, a British mail steamer sailing for England. On her passage home the Trent was stopped by the Federal steamer Saji Jacmto ; she was boarded, and Messrs Mason and Slidell were arrested. There was no doubt that the captain of the San Jacinto had acted irregularly. While he had the right to stop the Trent, examine the mails, and, if he found de- spatches for the enemy among them, carry the vessel into an American port for adjudication, he had no au- thority to board the vessel and arrest two of her pas- sengers. "The British Government," to use its own language, "could not allow such an affront to the nar tional honour to pass without due reparation." They decided on sending what practically amounted to an ulti- matum to the Federal Government, calling upon it to liberate the prisoners and to make a suitable apology. The presentation of this ultimatum, which was accom- panied by the despatch of troops to Canada, was very nearly provoking war with the United States. If, in- deed, the ultimatum had been presented in the form in which it was originally framed, war might have ensued. But at the Prince Consort's suggestion its language was considerably modified, and the responsibility for the outrage was thrown on the ofBLcer who committed it, and not on the Government of the Republic. It ought not to be forgotten that this important modification was the last service rendered to his adopted country by the Prince Consort before his fatal illness. He died before the answer to the despatch was received; and his death deprived the Queen of an adviser who had stood by her side since the earlier days of her reign, and who, by his prudence and conduct, had done much to raise the tone of the court and the influence of the Crown. Happily for the future of the world, the Government of the United States felt itself able to accept the despatch which had been thus addressed to it, and to give the reparation

which was demanded; and the danger of war between the two great branches of the Anglo-Saxon race was averted. But, in the follow- ing summer, a new event excited fresh animosities, and aroused a controversy which endured for the best part of ten years.

The Confederates, naturally anxious to harass the commerce of their enemies, endeavoured from the com- mencement of hostilities to purchase armed cruisers from builders of neutral nations. In June 1862 the American minister in London drew Lord Russell's attention to the fact that a vessel, lately launched at Messrs Laird's yard at Birkenhead, was obviously intended to be employed as a Confederate cruiser. The solicitor to the Commissioners of Customs, however, considered that no facts had been revealed to authorize the detention of the vessel, and this opinion was reported in the beginning of July to the American minister, Mr Adams. He thereupon supplied the Government with additional facts, and at the same time furnished them with the opinion of an eminent English lawyer, Mr Collier (afterwards Lord Monkswell), to the effect that "it would be ^.^X,abama.'- difficult to make out a stronger case of in- fringement of the Foreign Enlistment Act, which if not enforced on this occasion is little better than a dead letter." These facts and this opinion were at once sent to the Law Officers. They reai'hed the Queen's advocate on Saturday, the 26th July; but, by an unfortunate mischance, the Queen's advocate had just been wholly incapacitated by a distressing illness ; and the papers, in consequence, did not reach the Attorney- and Solicitor-

General till the evening of the following Monday, when they at once advised the Government to detain the vessel. Lord Russell thereupon sent orders to Liverpool for her detention. In the meanwhile the vessel ??? probably aware of the necessity for haste ??? had put to sea, and had commenced the career which made her famous as the Alabama. Ministers might even then have taken steps to stop the vessel by directing her detention in any British port to which she resorted for supplies. The Cabinet, however, shrank from this course. The Alabama was allowed to

prey on Federal commerce, and undoubtedly inflicted a vast amount of injury on the trade of the United States. In the autumn of 1862 Mr Adams demanded redress for the injuries which had thus been sustained, and this demand was repeated for many years in stronger and stronger language. At last, in 1871, long after Lord Palmerston's death and Lord Russell's retirement, a joint commission was appointed to examine into the many cases of dispute which had arisen between the United States and Great Britain. The commissioners agreed upon three rules by which they thought neutrals should in future be bound, and recommended that they should be given a retrospective effect. They decided also that the claims which had arisen out of the depredations of the Alabama should be referred to arbitration. In the course of 1872 the arbitrators met at Geneva. Their finding was adverse to Great Britain, which was condemned to pay a large sum of money ___ more than ___3,000,000 ___ as compensation. A period of exceptional prosperity, which largely increased the revenue, enabled a chancellor of the exchequer to boast that the country had drunk itself out of the Alabama difficulty.

In October 1865 Lord Palmerston's rule, which had been characterized by six years of political inaction at home and by constant disturbance abroad, was terminated by his death. The ministry, which had suffered many losses from death during its duration, was temporarily reconstructed under Lord Russell ; and the new minister at Lord ___'^"___ decided to put an end to the period of internal

Russell's stagnation, which had lasted so long, by the intro- secoad duction of a new Reform Bill. Accordingly, in miaisiry. ^^^^^1 1866 Mr Gladstone, who now led the House of Commons, introduced a measure which proposed to extend the county franchise to ___14 and the borough franchise to ___7 householders. The Bill did not create much enthusiasm among Liberals, and it was naturally opposed by the Conservatives, who were reinforced by alarge section of moderate Liberals, nicknamed, in consequence of a phrase in one of Mr Bright's speeches, Adullamites. After many debates, in which the Commons showed little dis- position to give the ministry any effective support, an amendment was carried by Lord Dunkellin, the eldest son of Lord

Clanricarde, basing the borough franchise on rating instead of rental. The Cabinet, recognizing from the division that the control of the House had passed out of its hands, resigned office, and the Queen was compelled to entrust Lord Derby with the task of forming a new administration.

Por the third time in his career Lord Derby undertook the formidable task of conducting the government of the Lord country with only a minority of the House of

Derby's Commons to support him. The moment at third which he made this third attempt was one of

ministry, unusual anxiety. Abroad, the almost simul- taneous outbreak of war between Prussia and Austria was destined to affect the whole aspect of Continental politics. At home, a terrible murrain had fallen on the cattle, inflict- ing ruin on the agricultural interest ; a grave commercial crisis was creating alarm in the City of London, and, in its consequences, injuring the interests of labour ; while the

working classes, at last roused from their long indifference, and angry at the rejection of Lord Russell's Bill, were assembling in their tens of thousands to demand reform. The Cabinet determined to prohibit a meeting which the Reform League decided to hold in Hyde Park on the 23rd July, and closed the gates of the park on the people. But the mob, converging on the park in thousands, surged round the railings, which a little inquiry might have shown were too weak to resist any real pressure. Either acci- dentally or intentionally, the railings were overturned in one place, and the people, perceiving their opportunity, at once threw them down round the whole circuit of the park. Pew acts in Queen Victoria's reign were attended with greater consequences. For the riot in Hyde Park led almost directly to a new Reform Act, and to the transfer of power from the middle classes to the masses of the people.

Yet, though the new Government found it necessary to introduce a Reform Bill, a wide difference of opinion existed in the Cabinet as to the form which the measure should take. Several of its members IssV"' were in favour of assimilating the borough fran- chise to that in force in municvipal elections, and practi- cally conferring a vote on every

householder who had three years' residence in the constituency. General Peel, however ––– Sir Robert Peel's brother ––– who held the seals of the War Office, objected to this extension; and the Cabinet ultimately decided on evading the diiSculty by bringing forward a series of resolutions on which a scheme of reform might ultimately be based. Their success in 1868, in dealing with the government of India in this way, commended the decision to the acceptance of the Cabinet. But it was soon apparent that the House of Commons required a definite scheme, and that it would not seriously consider a set of abstract resolutions which committed no one to any distinct plan. Hence on the 23rd February 1867 the Cabinet decided on withdrawing its resolutions and reverting to its original Bill. On the following day Lord Cranborne ––– better known afterwards as Lord Salisbury ––– discovered that the Bill had more democratic tendencies than he had origina' ly supposed, and refused to be a party to it. On Monday, the 25th, the Cabinet again met to consider the new difficulty which had thus arisen ; and it decided (as was said afterwards by Sir John Pakington) in ten minutes to substitute for the scheme a mild measure extending the borough fran- chise to houses rated at ––6 a year, and conferring the county franchise on ––20 householders. The Bill, it was soon obvious, would be acceptable to no one; and the Government again fell back on its original proposal. Three members of the Cabinet, however. Lord Cranborne, Lord Carnarvon, and General Peel, refused to be parties to the measure, and resigned office, the Government being necessarily weakened by these defections. In the large scheme which the Cabinet had now adopted, the borough franchise was conferred on all householders rated to the relief of the poor, who had for two years occupied the houses which gave them the qualification; the county franchise was given to the occupiers of all houses rated at ––15 a year or upwards. But it was proposed that these extensions should be accompanied by an educational fran- chise, and a franchise conferred on persons who had paid twenty shillings in assessed taxes or income tax ; the tax- payers who had gained a vote in this way being given a second vote in respect of the property which they occupied. In the course of the discussion on the Bill in the House of Commons, the securities on which its authors had relied to enable them to stem the tide of democracy were, chiefly through Mr Gladstone's exertions, swept away. The dual vote was

abandoned, direct payment of rates was sur- rendered, the county franchise was extended to ??12

householders, and the redistribution of seats was largely increased. The Bill, in the shape in which it had been introduced, had been surrounded with safeguards to property. With their loss it involved a great radical change, which placed the working classes of the country in the position of predominance which the middle classes had occupied since 1832.

The passage of the Bill necessitated a dissolution of Parliament ; but it had to be postponed to enable Parlia- ment to supplement the English Reform Act of 1867 with measures applicable to Scotland and Ireland, and to give time for settling the boundaries of the new con- stituencies which had been created. This delay gave the Conservatives another year of office. But the first place in the Cabinet passed in 1868 from Lord Derby to his lieutenant, Mr Disraeli. The change added in- Disraeii terest to political life. Thenceforward, for the Minister, ^i^xt thirteen years, the chief places in the two great parties in the state were filled by the two men, Mr Gladstone and Mr Disraeli, who were unques- tionably the ablest representatives of their respective followers. But the situation was also remarkable because power thus definitely passed from men who, without ex- ception, had been born in the 18th century, and had all held Cabinet offices before 1832, to men who had been born in the 19th century, and had only risen to Cabinet rank in the 'forties and the 'fifties. It was also interesting to reflect that Mr Gladstone had begun life as a Conservative, and had only gradually moved to the ranks of the Liberal party; while Mr Disraeli had fought his first election under the auspices of Mr O'Connell and Mr Hume, had won his spurs by his attacks on Sir Robert Peel, and had been only reluctantly adopted by the Conservatives as their leader in the House of Commons.

The struggle commenced in 1868 on an Irish question. During the previous years considerable attention had been paid to a secret conspiracy in Ireland and among the Irish in America. The Fenians, as they were

called, actually attempted insurrection in Ireland, and an inva- sion of Cana la from the United States. At the begin- ning of 1866 Lord Russell's Government i aought itself compelled to suspend the Habeas Corpus Act in Ireland ; and in 1867 Lord Derby's Government was confronted in the spring by a plot to seize Chester Castle, and in the autumn by an attack on a prison van at Manchester con- taining Fenian prisoners, and by an atrocious attempt to blow up Clerkenwell Prison. Conservative politicians deduced from these circumstances the necessity of apply- ing firm government to Ireland. Liberal statesmen, on the contrary, desired to extirpate rebellion by remedying the grievances of which Ireland still com- cburcb. plained. Chief among these was the fact that the Established Church in Ireland was the church of only a minority of the Irish people. In March 1868 Mr Maguire, an Irish Roman Catholic, asked the House of Commons to resolve itself into a committee to take into immediate consideration the affairs of Ireland. Mr Gladstone, in the course of the debate, declared that in his opinion the time had come when the Irish Church, as a political institution, should cease ; and he followed up his declaration by a series of resolutions, which were accepted by considerable majorities, pledging the House to its disestablishment. Mr Disraeli, recognizing the full significance of this decision, announced that, as soon as the necessary preparations could be made, the Government would appeal from the House to the country. Parliament was dissolved at the end of July, but the general election did not take place till the end of the following November. The future of the Irish Church naturally formed one of the chief subjects which occupied the attention of the

electors, but the issue was largely determined by wider considerations. The country, after the long political truce which had been maintained by Lord Palmerston, was again ranged in two hostile camps, animated by opposing views. It was virtually asked to decide in 1868 whether it would put its trust in Liberal or Conservative, in Mr Gladstone or Mr Disraeli. By an overwhelming majority it threw its lot in favour of Mr Gladstone; and Mr Disraeli, without even venturing to meet Parliament, took the unusual course of at once placing his resignation in the Queen's hands.

The Conservative Government, which thus fell, will be chiefly recollected for its remarkable concession to demo- cratic principles by the passage of the Reform Act of 1867 ; but it deserves perhaps a word of “f.^^’”’^” praise for its conduct of a distant and unusual war. The emperor of Abyssinia had, for some time, de- tained some Englishmen prisoners in his country ; and the Government, unable to obtain redress in other ways, decided on sending an army to release them. The expedition, entrusted to Sir Robert Napier, afterwards Lord Napier of Magdala, was fitted out at great expense, and was rewarded with complete success. The prisoners were re- leased, and the Abyssinian monarch committed suicide. Mr Disraeli ––– whose oriental imagination was excited by the triumph ––– incurred some ridicule by his bombastic declaration that ” the standard of St George was hoisted upon the mountains of Rasselas.” But the ministry could at least claim that the war had been waged to rescue Englishmen from captivity, that it had been conducted with skill, and that it had accomplished its results. The events of the Abyssinian war, however, were forgotten in the great political revolution which had swept the Con- servatives from office and placed]\Ir Gladstone in power. His Government was destined to endure for more than five years. During that period it experienced the alternate prosperity and decline which nearly forty years before had been the lot of the Whigs after the passage of the first Reform Act. During its first two sessions it accomplished greater changes in legislation than had been attempted by any ministry since that of Lord Grey. In its three last sessions it was destined to sink into gradual disrepute ; and it was ultimately swept away by a wave of popular re- action, as remarkable as that which had borne it into power.

It was generally understood that Mr Gladst9ne intended to deal with three great Irish grievances ––– “the three branches of the upas tree ” ––– the religious, agricul- tural, and educational grievances. The session oiadstone’s of 1869 was devoted to the first of these subjects, nifnistry. Mr Gladstone introduced a Bill disconnecting the Irish Church from the state, establishing a synod for its government, and ––– after leaving it in possession of its churches and its parsonages, andmaking ample provision for the life-interests of its existing clergy ––– devoting the bulk of its property to the relief of distress in Ireland. The l>ill was carried by large majorities through the House of Com- mons ; and the

feeling of the country was so strong that the Lords did not venture on its rejection. They satisfied themselves with engrafting on it a series of amendments which, on the whole, secured rather more liberal terms of compensation for existing interests. Some of these amend- ments were adopted by Mr Gladstone ; a compromise was effected in respect of the others ; and the Bill, which had practically occupied the whole session, and had perhaps involved higher constructive skill than any measure passed in the previous half-century, became law. Having dealt with the Irish Church in 1869, Mv Gladstone turned to the more complicated question of Irish land. So far back as the 'forties Sir R. Peel had appointed a commis- sion, known from its chairman as the Devon " "" ' Commission, which had recommended that the Irish tenant,

in the event of disturbance, should receive some compen- sation for certain specified improvements which he had made in his holding. Parliament neglected to give effect to these recommendations; inacountry where agriculture was the chief or almost only occupation, the tenant re- mained at his landlord's mercy. In 1870 Mr Gladstone proposed to give the tenant a pecuniary interest in im- provements, suitable to the holding, which he had made either before or after the passing of the Act. He pro- posed also that, in cases of eviction, the smaller tenantry should receive compensation for disturbance. The larger tenantry, who were supposed to be able to look after their own interests, were entirely debarred, and tenants enjoying leases were excluded from claiming compensa- tion except for tillages, buildings, and reclamation of lands. A special court, it was further provided, should be instituted to carry out the provisions of the Bill. Large and radical as the measure was, reversing many of the accepted principles of legislation by giving the tenant a gwasi-partnership with the landlord in his holding, no serious opposition was made to it in either House of Parliament. Its details, indeed, were abundantly criti- cized, but its principles were hardly disputed, and it became law without any substantial alteration of its original provisions. In two sessions two branches of the upas tree had been summarily cut off. But Parliament in

1870 was not solely occupied with the wrongs of Irish tenantry. In the same year Mr Forster, as vice-president of the Council, succeeded in carrying the great measure which for the first time made education compulsory. In devising his scheme, Mr Porster endeavoured to utilize, as far as possible, the educational machinery which had been voluntarily provided by various religious organizar tions. He gave the institutions which had been thus established the full benefit of the assistance which the Government was prepared to afford to board schools, on their adopting a conscience clause under which the reli- gious susceptibilities of the parents of children were pro- tected. This provision led to many debates, and produced the first symptoms of disruption in the Liberal party. The Nonconformists contended that no such aid should be given to any school which was not conducted on undenominational principles. Supported by the bulk of

the Conservative party, Mr Porster was enabled Eieweat^ry to defeat the Dissenters. But the victory

which he secured was, in one sense, dearly purchased. The first breach in the Liberal ranks had been made ; and the Government, after 1870, never again commanded the same united support which had enabled it to pursue its victorious career in the first two sessions of its existence.

Towards the close of the session of 1870 other events, for which the Government had no direct responsibility,

introduced new difficulties. War unexpectedly Black Sea ^joke out between Prance and Prussia. The

French empire fell; the German armies marched on Paris ; and the Russian Government, at Count Bis- marck's instigation, took advantage of the collapse of Prance to repudiate the clause in the treaty of 1866 which neutralized the Black Sea. Lord Granville, who had succeeded Lord Clarendon at the Poreign Office, pro- tested against this proceeding. But it was everywhere felt that his mere protest was not likely to affect the result ; and the Government at last consented to accept a suggestion made by Count Bismarck, and to take part in a conference to discuss the Russian proposal. Though this device enabled them to say that they had

not yielded to the Russian demand, it was obvious that they entered the conference with the foregone conclusion of conceding the Russian claim. The attitude which the Government thus chose to adopt was perhaps inevitable in the cir-

cumstances, but it confirmed the impression, which the abandonment of the cause of Denmark had produced m 1864, that Great Britain was not prepared to maintain its principles by going to war. The weakness of the British Poreign Office was emphasized by its consenting, almost at the same moment, to allow the claims of the United States, for the depredations of the Alabama, to be settled under a rule only agreed upon in 1871. Most Englishmen now appreciate the wisdom of a concession which has gained for them the friendship of the United States. But in 1871 the country resented the manner in which Lord Granville had acted. Whatever credit the Government might have derived from its domestic meas- ures, it was discredited, or it was thought to be, by its foreign policy. In these circumstances legislation in 1871 was not marked with the success which had attended the Government in previous sessions. The Government suc- ceeded in terminating a long controversy by abolishing ecclesiastid^l tests at universities. But the Lords ventured to reject a measure for the introduction of the ballot at elections, and refused to proceed with a Bill for the aboli- tion of purchase in the Army. The result of these deci- sions was indeed remarkable. In the one case, the Lords in 1872 found it necessary to give way, and to pass the Ballot Bill, which they had rejected in 1871. In the other, Mr Gladstone decided on abolishing, by the direct authority of the Crown, the system which the Lords had refused to do away with by legislation. But his high-handed proceeding, though it forced the Lords to reconsider their decision, strained the allegiance of many of his supporters, and still further impaired the popu- larity of his Administration. Most men felt that it would have been permissible for him- at the commencement of the session, to have used the Queen's authority to ter- minate the purchase system; but they considered that, as he had not taken this course, it was not p^{???}, open to him to reverse the decision of the Legis- lature by resorting to the prerogative. Two appointments, one to a judicial office, the other to an ecclesiastical pre- ferment, in which Mr Gladstone, about the same time, showed more disposition to obey the letter than the spirit of

the law, confirmed the impression which the abolition of purchase had made. Great reforming ministers would do well to recollect that the success of even liberal meas- ures may be dearly purchased by the resort to what are regarded as unconstitutional expedients.

In the following years the embarrassments of the Gov- ernment were further increased. In 1872 Mr Bruce, the home secretary, succeeded in passing a measure of licens- ing reform. But the abstainers condemned the Bill as inadequate ; the publicans denounced it as oppressive ; and the whole strength of the licensed victuallers was thence- forward arrayed against the ministry. In 1873 Mr Glad- stone attempted to complete his great Irish measures by conferring on Ireland the advantage of a university which would be equally acceptable to Protestants and Roman Catholics. But his proposal again failed to satisfy those in whose interests it was proposed. The second reading of the Bill was rejected by a small majority, and Mr Gladstone resigned ; but, as Mr Disraeli could not form a government, he resumed office. The power of the great minister was, however, spent; his ministry was hopelessly discredited. History, in fact, was repeating itself. The ministry was suffering, as Lord Grey s Government had suffered nearly forty years before, from the effect of its own successes. It had accomplished more than any of its supporters had expected, but in doing so it had harassed many interests and excited much opposition. Mr Gladstone endeavoured to meet the storm by a re-arrangement of his crew. Mr Bruce, who had offended the licensed victuallers, was removed from the Home

Office, and made a peer and president of the Council. Mr Lowe, who had incurred unpopularity by his fiscal measures, and especially by an abortive suggestion for the taxation of matches, was transferred from the Exchequer to the Home Ofifice, and Mr Gladstone himself assumed the duties of chancellor of the exchequer. He thereby created a difficulty for himself which he had not foreseen. Up to 1867, a minister leaving one office and accepting another vacated his seat ; after 1867 a transfer from one post to another did not necessitate a fresh election. But Mr Gladstone

in 1873 had taken a course which had not been contemplated in 1867. He had not been transferred from one office to another. He had accepted a new in addition to his old office. It was, to say the least, un- certain whether his action in this respect had or had not vacated his seat. It would be unfair to suggest that the inconvenient difficulty with which he was thus confronted determined his policy, though he was probably insensibly influenced by it. However this may be, on the eve of the session of 1874 he suddenly decided to dissolve Parlia- ment and to appeal to the country. He announced his decision in an address to his constituents, in which, among other financial reforms, he promised to repeal the income tax. The course which Mr Gladstone took, and the bait which he held out to the electors, were generally condemned. The country, wearied of the ministry and of its measures, almost everywhere supported the Con- servative candidates. Mr Disraeli found himself re- stored to power at the head of an overwhelming majority, and the great minister who, five years before, had achieved so marked a triumph temporarily with- drew from the leadership of the party with whose aid he had accomplished such important results. His minis- try had been essentially one of peace, yet its closing days were memorable for one little war in which a great soldier increased a reputation already high. Sir Garnet Wolseley triumphed over the difficulties which the climate of the west coast of Africa imposes on Europeans, and brought a troublesome contest with the Ashantees to a successful conclusion.

The history of Mr Disraeli's second Administration affords an exact reverse to that of Mr Gladstone's first

Cabinet. In legislation the ministry attempted Disraeli's little and accomplished less. They did some- miafstry. thing to meet the wishes of the publicans, whose

discontent had contributed largely to Mr Glad- stone's defeat, by amending some of the provisions of Mr Bruce's licensing Bill ; they supported and succeeded in passing a measure, brought in by the Primate, to restrain some of the irregularities which the Ritualists were intro- ducing into public worship ; and they were compelled by the violent insistence of Mr Plimsoll to pass an Act to protect the lives of merchant

seamen. Mr Disraeli's Gov- ernment, however, will be chiefly remembered for its for- eign policy. Years before he had propounded in Tancred the theory that England should aim at eastern empire. Circumstances in his second term of office enabled him to translate his theory into practice. In 1875 the country was suddenly startled at hearing that it had acquired a new position and assumed new responsibilities in Egypt by the purchase of the shares which the Khedive of Egypt held in the Suez Canal. In the following spring a new surprise was afforded by the introduction of a measure authorizing the Queen to assume the title of Empress of India. But these significant actions were almost forgotten in the presence of a new crisis ; for in 1876 misgovern- ment in Turkey had produced its natural results, and the European provinces of the Porte were in a state of armed insurrection. In the presence of a grave danger. Count Andrassy, the Austrian minister, drew up a note which was afterwards known by his name, declaring that the

Porte had failed to carry into effect the promises of re- form which she had made, and that some combined ac- tion on the part of Europe was necessary to compel her to do so. The note was accepted by the three Con- tinental empires, but Great Britain refused in the first instance to assent to it, and only ultimately consented at the desire of the Porte, whose statesmen seem to have imagined that the nominal co-operation of Eng- land would have the effect of restraining the 'Jf"J^^'f_ action of other Powers. Turkey accepted the ??es." note and renewed the promises of reform which she had so often made, and which meant so little. The three northern Powers thereupon agreed upon what was known as the Berlin Memorandum, in which they de- manded an armistice, and proposed to watch over the completion of the reforms which the Porte had promised. The British Government refused to be a party to this memorandum, which in consequence became abortive. The insurrection increased in intensity. The Sultan Ab- dul Aziz, thought unequal to the crisis, was hastily de- posed ; he was,either murdered or led to commit suicide ; and insurrection in Bulgaria was stamped out by massacre. The story of the "Bulgarian atrocities" was published in Great Britain in the summer of 1876. Mr Disraeli characteristically dismissed it as "coffee-house babble," but official investigation proved the substantial accuracy of the reports which had reached England. The people regarded these events with

horror. Mr Gladstone, emerg- ing from his retirement, denounced the conduct of the Turks. In a phrase which became famous he declared that the only remedy for the European provinces of the Porte was to turn out the Ottoman Government " bag and baggage." All England was at once arrayed into two camps. One party was led by Mr Disraeli, who was sup- posed to represent the traditional policy of England of maintaining the rule of the Turk at all hazards ; the other, inspired by the example of Mr Gladstone, was resolved at all costs to terminate oppression, but was at the same time distrusted as indirectly assisting the ambitious views by which the Eastern policy of Bussia had always been animated. The crisis soon became intense. In June 1876 Servia and Montenegro declared war against Turkey. In a few months Servia was hopelessly beaten. Through the insistence of Russia an armistice was agreed upon; and Lord Beaconsfield ||| for Mr Disraeli had now been raised to the peerage ||| endeavoured to utilize the breathing space by organizing a conference of the Great Powers at Constantinoijle, which was attended on behalf of Great Britain by Lord Salisbury. The Constantinople Conference proved abortive, and in the beginning of 1877 Russia declared war. For some time, however, her success was hardly equal to her expectations. The Turks, en- trenched at Plevna, delayed the Russian advance ; and it was only towards the close of 1877 that Plevna at last fell and Turkish resistance collapsed. With its down- fall the war party in England, which was led by the prime minister, increased in violence. From the refrain of a song, sung night after night at a London music hall, its members became known as Jingoes. The Government ordered the British fleet to pass the Dardanelles and go up to Constantinople ; and though the order was sub- secjuently withdrawn, it asked for and obtained a grant of ||6,000,000 for naval and military purposes. When news came that the Russian armies had reached Adrianople, that they had concluded some arrangement with the Turks, and that they were pressing forward towards Constantinople, the fleet was again directed to pass the Dardanelles. Soon afterwards the Government decided to call out the reserves and to bring a contingent of Indian troops to the Medi- terranean. Lord Derby, who was at the Foreign Office, thereupon retired from the ministry, and was succeeded by

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Berlla treaty.

Afghan

wars.

Lord Salisbury. Lord Derby's resignation was every- where regarded as a proof that Great Britain was on the verge of war. Happily war did not occur. At Prince Bismarck's suggestion Russia consented to refer the treaty which she had concluded at San Stefano to a con- gress of the Great Powers ; and the congress, at which Great Britain was represented by Lord Beaconsfield and Lord Salisbury, succeeded in substituting for the treaty of San Stefano the treaty of Berlin. The one great advantage derived from it was the tacit acknowledgment by Eussia that Europe could alone alter arrangements which Europe had made. In every other sense it is doubtful whether the provisions of the treaty of Berlin were more favourable than those of the treaty of San Stefano. On Lord Beaconsfield's re- turn, however, he claimed for Lord Salisbury and him- self that they had brought back " peace with honour," and the country accepted with wild delight the phrase, without taking much trouble to analyse its justice.

If Lord Beaconsfield had dissolved Parliament imme- diately after his return from Berlin, it is possible that the wave of popularity which had been raised by his success would have borne him forward to a fresh victory in the constituencies. His omission to do so gave the country time to meditate on the consequences of his policy. One result soon became perceptible. Differences with Eussia produced their inevitable consequences in fresh complica- tions on the Indian frontier. The Eussian Government, confronted with a quarrel with Great Britain in eastern Europe, endeavoured to create difficulties in Afghanistan. A Eussian envoy was sent to Kabul, where Shere Ali, who had been placed on the throne after the war of 1841, was still reigning ; and the British Government, alarmed at this new em- barrassment, decided on sending a mission to the Afghan capital. The mission was stopped on the frontier by an agent of Shere Ali, who declined to allow it to proceed. The British

Government refused to put up with an affront of this kind, and their envoy, supported by an army, continued his advance. Afghanistan was again invaded. Kabul and Kandahar were occupied ; and Shere Ali was forced to fly, and soon afterwards died. His successor, Yakoob Khan, came to the British camp and signed, in May 1879, the treaty of Gandamuk. Under the terms of this treaty the Indian Government undertook to pay the new Ameer a subsidy of ??60,000 a year; and Yakoob Khan consented to receive a British mission at Kabul, and to cede some territory in the Him- alayas which the military advisers of Lord Beaconsfield considered necessary to make the frontier more "scien- tific." This apparent success was soon followed by disastrous news. The deplorable events of 1841 were re-enacted in 1879. The new envoy reached Kabul, but was soon afterwards murdered. A British army was again sent into Afghanistan, and Kabul was again occu- pied. Yakoob Khan, who had been made Ameer in 1879, was deposed, and Abdurrahman Khan was selected as his successor. The British did not assert their superiority without much fighting and some serious re- verses. Their victory was at last assured by the excellent strategy of Sir Donald Stewart and Sir Frederick (after- wards Lord) Eoberts. But before the final victory was gained Lord Beaconsfield had fallen. His policy had brought Great Britain to the verge of disaster in Afghanistan : the credit of reasserting the superiority of British arms was deferred till his successors had taken ofiice.

It was not only in Afghanistan that the new imperial policy which Lord Beaconsfield had done so much to encourage was straining the resources of the empire. In South Africa a still more serious diflELculty was already

commencing. At the time at which Lord Beaconsfield's administration began, British territory in South Africa was practically confined to Cape Colony and Natal. Years before, in 1852, the British Government, at that time a little weary of the responsibilities of colonial rule, had recognized the independence of the two Dutch republics, the Transvaal and the Orange Free State. Powerful native tribes occupied the territory to the north of Natal and the east of the Transvaal. War broke out between the Transvaal Republic and one of the most powerful of these native chieftains, Secoceni ; and the Transvaal was worsted in the struggle.

Alarmed at the possible con- sequences of this defeat, and conscious of their inability to carry on the struggle, a party in the Transvaal openly recommended the annexation of the country to British territory. Sir Theophilus Shepstone, who was sent to inquire into the proposal, mistook the opinion of a party for the verdict of the republic, and declared the Trans- vaal a part of the British empire. His policy entailed far more serious consequences than the mission to Afghanistan. The first was a war with the Zulus, the most powerful and warlike of the native . African tribes, who under their ruler, Cete- wayo, had organized a formidable army. A dispute had been going on for some time about the possession of a strip of territory which some British arbitrators had awarded to the Zulu king. Sir Bartle Erere, who had won distinction in India, and was sent out by Lord Bea- consfield's Government to the Cape, kept back the award ; and, though he ultiinately communicated it to Cetewayo, thought it desirable to demand the disbandment of the Zulu army. In the war which ensued, the British troops who invaded Zulu territory met with a severe reverse ; and, though the disaster was ultimately retrieved by Lord Chelmsford and Sir Garnet Wolseley, the war involved heavy expenditure and brought little credit to the British army, while one unfortunate incident, the death of Prince Napoleon, who had obtained leave to serve with the Brit- ish troops, and was siirprised by the Zulus while recon- noitring, created a deep and unfortunate impression. Imperialism, which had been excited by Lord Beacons- field's policy in 1878, and by the prospect of a war with a great European Power, fell into discredit when it degen- erated into a fresh expedition into Afghanistan, and an inglorious war with a savage African tribe. A period of distress at home increased the discontent which Lord Bea- consfield's external policy was exciting ; and, when Parlia- ment was at last dissolved in 1880, it seemed no longer certain that the country would endorse the policy of the minister who only a short time before had acquired such popularity. Mr Gladstone, emerging from his retirement, practically placed himself again at the head of the Liberal party. In a series of speeches in Midlothian, where he offered himself for election, he denounced the whole policy which Lord Beaconsfield had pursued. His impassioned eloquence did much more than influence his own elec- tion. His speeches decided the contest throughout the kingdom. The Liberals secured an even more surprising success than that which had rewarded the

Conservatives six years before. For the first time in the Queen's reign, a solid Liberal majority, independent of all extraneous Irish support, was returned, and Mr Gladstone resumed in triumph his old position as prime minister.

The new minister had been swept into power on a wave of popular favour, but he inherited difficulties from his predecessors in almost every quarter of the world ; and his own language had perhaps oiadstoae's tended to increase them. He was committed to niintsuy. a reversal of Lord Beaconsfield's policy ; and, in politics, it is never easy, and perhaps rarely wise, suddenly and violently to change a system. In one quarter of

the world the new minister achieved much success. The war in Afghanistan, which had begun with disaster, was creditably concluded. A better understanding was grad- ually established with Russia ; and, before the ministry went out, steps had been taken which led to the delimita- tion of the Russian and Afghan frontier. In South Africa, however, a very different result ensued. Mr Gladstone, before he accepted office, had denounced the policy of an- nexing the Transvaal ; his language was so strong that he was charged with encouraging the Boers to maintain their independence by force; his example had naturally been imitated by some of his followers at the general election ; and, when he resumed power, he found himself in the dif- ficult dilemmaof either maintaining an arrangement which he had declared to be unwise, or of yielding to a demand which the Boers were already threatening to support in arms. The events of the first year of his administration added to his difficulty. Before its close the Boers seized Heidelberg and established a republic ; they destroyed a detachment of British troops at Bronker's Spruit ; they treacherously murdered a British officer; and they sur- rounded and attacked the British garrisons in the Trans- vaal. Troops were of course sent from England to maintain the British cause; and Sir George Colley, who enjoyed a high reputation and had experience in South African war- fare, was made governor of Natal, and entrusted with the military command. The events which immediately fol- lowed will not be easily

forgotten. Wholly miscalculating the strength of the Boers, Sir George Colley, at the end of January 1881, attacked them at Laing's Nek, in the north of ISTatal, and was repulsed with heavy loss. Some ten days afterwards he fought another action on the Ingogo, and was again forced to retire. On the 26th February, with some 600 men, he occupied a high hill, known as Majuba, which, he thought, dominated the Boer position. The following day the Boers attacked the hill, overwhelmed its defenders, and Sir George Colley was himself killed in the disastrous contest on the summit. News of these occurrences was received with dismay in England. It was, no doubt, pos- sible to say a good deal for Mr Gladstone's indignant denunciation of his predecessor's policy in annexing the Transvaal ; it would have been equally possible to advance many reasons for reversing the measures of Lord Beacons- field's Cabinet, and for conceding independence to the Trau svaal in 1880. But the great maj ority of persons considered that, whatever arguments might have been urged for concession in 1880, when British troops had suffered no reverses, nothing could be said for concession in 1881, when their arms had been tarnished by a humiliating disaster. Great countries can afford to be generous in the hour of victory; but they cannot yield, without loss of credit, in the hour of de- feat. Unfortunately this reasoning was not suited to Mr Gladstone's temperament. The justice or injustice of the British cause seemed to him a much more impor- tant matter than the vindication of military honour ; and he could not bring himself to acknowledge that Majuba had altered the situation, and that the terms which he had made up his mind to concede before the battle could not be safely granted till military reputation was re- stored. The independence of the Transvaal was accord- ingly recognized, though it was provided that the Republic should remain under the suzerainty of the Queen. Even this great concession did not satisfy the ambition of the Boers, who were naturally elated by their victories. Three years later some Transvaal deputies, with their president, Kruger, came to London and saw Lord Derby, the Secretary of State for the Colonies. Lord Derby consented to a new convention, from which any verbal reference to suzerainty was excluded; and the South African Republic was made independent, subject only

Boer war,

to the condition that it should conclude no treaties with Foreign Powers without the approval of the Crown. (For the details and disputes concerning the terms of this Convention the reader is referred to the articles Teansvaal and Suzerainty.)

Mr Gladstone's Government declined in popularity from the date of the earliest of these concessions. Mr Gladstone, in fact, had succeeded in doing what Lord Beaconsfield had failed to accomplish. Annoyance at his foreign policy had rekindled the imperialism which the embarrassments created by Lord Beaconsfield had done so much to damp down. And, if things were going badly with the new Government abroad, matters were not progressing smoothly at home. At the general election of 1880, the borough of Northampton, which of late years has shown an unwavering preference for Liberals of an advanced type, returned as its members Mr Henry Labouchere and Mr Bradlaugh. Mr Bradlaugh, g^^^j j^ who had attained some notoriety for an aggres- sive atheism, claimed the right to make an affirmation of allegiance instead of taking the customary oath, which he declared was, in his eyes, a meaningless form. The Speaker, instead of deciding the question, submitted it to the judgment of the House, and it was ultimately re- ferred to a select committee, which reported against Mr Bradlaugh's claim. Mr Bradlaugh, on hearing the deci- sion of the committee, presented himself at the bar and offered to take the oath. It was objected that, as he had publicly declared that the words of the oath had no clear meaning for him, he could not be permitted to take it ; and after some wrangling the matter was referred to a fresh committee, which supported the view that Mr Bradlaugh could not be allowed to be sworn, but recom- mended that he should be permitted to make the affir- mation at his own risk. The House refused to accept the recommendation of this committee when a Bill was in- troduced to give effect to it. This decision naturally enlarged the question before it. For, while hitherto the debate had turned on the technical points whether an affirmation could be substituted for an oath, or whether a person who had declared that an oath had no meaning for him could properly be sworn, the end at which Mr Bradlaugh's opponents were thenceforward aiming was the imposition of a new religious test ??? the belief in a God

<u>[illegible] on members of the House of Commons. The con- troversy which thus began continued through the Parlia- ment of 1880, and led to many violent scenes, which lowered the dignity of the House. It was quietly termi- nated, in the Parliament of 1886, by the firm action of a new Speaker. Mr Peel, who had Ijeen elected to the chair, decided that neither the Speaker nor any other member had the right to intervene to prevent a member from taking the oath if he was willing to take it. Parliament subsequently, by a new Act, permitted affirmations to be used, and thenceforward religion, or the absence of reli- gion, was no disqualification for a seat in the House of Commons. The atheist, like the Roman Catholic and the Jew, could sit and vote.</u>

<u>The Bradlaugh question was not the only difficulty with which the new Government was confronted. Ireland was again attracting the attention of politicians. The Fenian movement had practically expired; some annual motions for the introduction of Home Rule, made with all the de- corum of parliamentary usage, had been regularly defeated. T.iit the Irish were placing themselves under new leaders and adopting new methods. During the Conservative CJovernment of 1874, the Irish members had en- deavoured to arrest attention by organized ob- struction. Their efforts had increased the difficulties of Government and taxed the endurance of Parliament. These tactics were destined tobe raised to a fine art by Mr Parnell,</u>

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<u>who succeeded to the head of the Irish party about the time of the formation of Mr Gladstone's Government. It was MrParnell's determination to make legislation imprac- ticable and Parliament unendurable till Irish grievances were redressed. It was his evident belief thg,t by pursu- ing such tactics he could force the House of Co'mmons to concede the legislation which he desired. The Irish members were not satisfied with the legislation which Parliament had passed in 1869-1870. The Land Act of 1870 had given the tenant no security in the case of</u>

eviction for non-payment of rent ; and the tenant whose rent was too high or had been raised was at the mercy of his landlord. It so happened that some bad harvests had temporarily increased the difficulties of the tenantry, and there was no doubt that large numbers of evictions were taking place in Ireland. In these circumstances, the Irish contended that the relief which the Act of 1870 had afforded should be extended, and that, till such legis- lation could be devised, a temporary measure should be passed giving the tenant compensation for disturbance. Mr Gladstone admitted the force of this reasoning, and a Bill was introduced to give effect to it. Passed by the Commons, it was thrown out towards the end of the ses- sion by the Lords ; and the Government acquiesced ??? per- haps could do nothing but acquiesce ??? in this decision. In Ireland, however, the rejectionof the measure was attended with disastrous results. Outrages increased, obnoxious landlords and agents were " boycotted " ??? the name of the first gentleman exposed to this treatment adding a new word to the language ; and Mr Forster, who had accepted the office of chief secretary, thought it necessary, in the presence of outrage and intimidation, to adopt stringent measures for enforcing order. A measure was passed on his initiation, in 1881, authorizing him to arrest and detain suspected persons ; and many well-known Irish- men, including Mr Parnell himself and other members of Parliament, were thrown into prison. It was an odd commentary on Parliamentary government that a Liberal ministry should be in power, and that Irish members should be in prison; and early in 1882 Mr Gladstone determined to liberate the prisoners on terms. The new policy ??? represented by what was known as the Kilmain- ham Treaty ??? led to the resignation of the viceroy. Lord Cowper, and of Mr Porster, and the appointment of Lord Spencer and Lord Frederick Cavendish as their successors. On the 6th May 1882 Lord Spencer made his entry into Dublin, and on the evening of the same day Lord Freder- ick, unwisely allowed to walk home alone with Mr Burke, the under-secretary to the Irish Government, was mur- dered with his companion in Phoenix Park. This gross outrage led to fresh measures of coercion. The disclosure, soon afterwards, of a conspiracy to resort to dynamite still further alienated the sympathies of the Liberal party from the Irish nation. Mr Gladstone might fairly plead that he had done much, that he had risked much, for Ireland, and that Ireland was making him a poor return for his services. In the meanwhile

another difficulty was further em- barrassing a harassed Government. The necessities of the Khedive of Egypt had been only temporarily Egypt- relieved by the sale to Lord Beaconsfield's Gov- ernment of the Suez Canal shares. Egyptian finance, in the interests of the bondholders, had been placed under the dual control of England and France. The new arrange- ment naturally produced some native resentment, and Arabi Pacha placed himself at the head of a movement which was intended to rid Egypt of foreign interference. His preparations eventually led to the bombardment of Alexandria by the British fleet, and still later to the invasion of Egypt by a British army under Sir Garnet, afterwards Lord Wolseley, and tothe battle of Tel-el-Kebir, after which Arabi was defeated and taken prisoner. The

bombardment of Alexandria led to the immediate resig- nation of Mr Bright, whose presence in the Cabinet had been of importance to the Government ; the occupation of Egypt broke up the dual control, and made Great Britain responsible for Egyptian administration. The effects of British rule were, in one sense, remarkable. The introduc- tion of good government increased the prosperity of the people, and restored confidence in Egyptian finance. At the same time it provoked the animosity of the French, who were naturally jealous of the increase of British in- fluence on the Nile, and it also threw new responsibilities on the British nation. For, south of Egypt, lay the great territory of the Sudan, which to some extent commands the Nile, and which with Sir Samuel Baker's assistance had been conquered by the Khedive. In 1881 a fanatic sheikh ??? known as the Mahdi ??? had headed an insurrec- tion against the Khedive's authority ; and towards the close of 1883 an Egyptian army under an Englishman, Colonel Hicks, was almost annihilated by the insurgent soldiery. The insurrection increased the responsibilities which intervention had imposed on England, and an expe- dition was sent to Suakin to guard the littoral of the Bed Sea ; while, at the beginning of 1884, General Gor- don ??? whose services in China had gained him a high reputation, and who had previous experience in the Sudan ??? was sent to Khartum to report on the condition of affairs. These decisions led to momentous results. The British expedition to Suakin was engaged in a series of battles with Osman Digna, the Mahdi's lieu- tenant; while General Gordon, after

alternate oordon. reverses and successes, was isolated at Khartum. Anxious as Mr Gladstone's ministry was to restrict the sphere of its responsibilities, it was compelled to send an expedi- tion to relieve General Gordon ; and at the close of 1884 Lord Wolseley, who was appointed to the command, decided on moving up the Nile to his relief. The expedi- tion proved much more difficult than Lord Wolseley had anticipated. And, before it reached its goal, Khartum was forced to surrender, and General Gordon and his few faithful followers were murdered. General Gordon's death inflicted a fatal blow on the Liberal Government. It was thought that the General, whose singular devotion to duty made him a popular hero, had been allowed to assume an impossible task ; had been feebly supported ; and that the measures for his relief had been unduly postponed and at last only reluctantly undertaken. The ministry ultimately experienced defeat on a side issue. The budget, which Mr Childers brought forward as chancellor of the exchequer, was attacked by the Con- servative party ; and an amendment proposed by Sir Michael Hicks-Beach, condemning an increase in the duties on spirits and beer, was adopted by a small majority. Mr Gladstone resigned office, and Lord Salisbury, who, after Lord Beaconsfield's death, had succeeded to the lead of the Conservative party, was instructed to form a new Administration.

It was obvious that the new Government, as its first duty, would be compelled to dissolve the Parliament that had been elected when Mr Gladstone was enjoy- ing the popularity which he had lost so rapidly —"^s4 in office. But it so happened that it was no longer possible to appeal to the old constituencies. For, in 1884, Mr Gladstone had introduced a new Keform Bill ; and, though its passage had been arrested by the Lords, unofficial communications between the leaders of both parties had resulted in a compromise which had led to the adoption of a large and comprehensive Keform Act. By this measure, household franchise was extended to the counties. But counties and boroughs were broken up into a number of small constituencies, for the most part return- ing only one member each ; while the necessity of increasing

the relative weight of Great Britain, and the reluctance to inflict disfranchisement on Ireland, led to an increase in the numbers of the House of Commons from 658 to 670 members. This radical reconstruction of the electorate necessarily made the result of the elections doubtful. As a matter of fact, the new Parliament comprised 334 Liberals, 250 Conservatives, and 86 Irish Nationalists. It was plain beyond the possibility of doubt that the future depended on the course which the Irish Nationalists might adopt. If they threw in their lot with Mr Gladstone, Lord Salisbury's Government was evidently doomed. If, on the contrary, they joined the Conservatives, they could make a Liberal Administra- tion impracticable.

In the autumn of 1885 it was doubtful what course the Irish Nationalists would take. It was generally under- stood that Lord Carnarvon, who had been made Viceroy of Ireland, had been in communication with Mr Parnell ; that Lord Salisbury was aware of the interviews which had taken place ; and it was whispered that Lord Carnarvon was in favour of granting some sort of administrative autonomy to Ireland. Whatever opinion Lord Carnarvon may have formed ??? and his precise view is uncertain ??? a greater man than he had suddenly arrived at a similar conclusion. In his election speeches Mr Gladstone had insisted on the neces- sity of the country returning a Liberal majority which could act independently of the Irish vote ; and the result of the general election had left the Irish the virtual arbiters of the political situation. In these circumstances Mr Gladstone arrived at a momentous decision. He recognized that the system under which Ireland had been governed in the past had failed to win the allegiance of her people ; and he decided that it was wise and safe to entrust her with a large measure of self-government. It was perhaps characteristic of Mr Gladstone, though it was unquestionably unfortunate, that, in determining on this radical change of policy, he consulted few, if any, of his previous colleagues. On the meeting of the new Parliament Lord Salisbury's Government was

defeated on an amendment to the address, demanding facilities for agricultural labourers to obtain small holdings for gardens and pasture ??? the policy, in short, which was described as " Three acres and a cow." Lord Salisbury resigned, and Mr Gladstone resumed power. The attitude, however, which Mr Gladstone was understood to be taking on the subject of Home Eule threw many difficul- ties in his way. Lord Hartington, and others of his former colleagues, declined to join his Administration; Mr Chamberlain, who, in the first instance, accepted ofRce, retired almost immediately from the ministry ; and Mr Bright, whose eloquence and services gave him a unique position in the House, threw in his lot in opposition to Home Rule. A split in the Liberal party thus began, which was destined to endure ; and Mr Gladstone found his difficulties increased by the defection of the men on whom he had hitherto largely relied. He persevered, however, in the task which he had set himself, and intro- duced a measure endowing Ireland with a parliament, and excluding the Irish members from Westminster. He was defeated, and appealed from the House which had refused to support him to the country. Por the first time in the Queen's reign, two general elections occurred within twelve months. The country showed no more dis- position than the House of Commons to approve the course which the minister was taking. A large majority of the members of the new Parliament were pledged to resist Home Rule. Mr Gladstone, bowing at once to the verdict of the people, resigned office, and Lord Salisbury returned to power.

The new Cabinet, which was formed to resist Home

Rule, did not succeed in combining all the opponents to this measure. The secessionists from the Lib- u^ioaism. eral party ??? -the Liberal Unionists, as they were called ??? held aloof from it ; and Lord Salisbury was forced to form his Cabinet out of his immediate followers. The most picturesque appointment was that of Lord Randolph Churchill, who was made chancellor of the exchequer, and leader of the House of Commons. But before many months were over, Lord Randolph ??? unable to secure acceptance of a policy of financial retrenchment ??? resigned office, and Lord Salisbury was forced to reconstruct his ministry. Though he again failed to obtain the co-opera- tion of the Liberal

Unionists, one of the more prominent of them ??? Mr Goschen ??? accepted the seals of the Ex- chequer. Mr W. H. Smith moved from the War Office to the Treasury, and became leader of the House of Com- mons; while Lord Salisbury himself returned to the Foreign OiSce, which the dramatically sudden death of Lord Iddesleigh, better known as Sir Stafford Northcote, vacated. These arrangements lasted till 1891, when, on Mr Smith's death, the Treasury and the lead of the Commons were entrusted to Lord Salisbury's nephew, Mr Arthur Balfour, who had made a great reputation as chief secretary for Ireland (q-v.).

The ministry of 1886, which endured till 1892, gave to London a county council ; introduced representative government into every English county ; and made ele- mentary education free throughout England. The alliance with the Liberal Unionists was, in fact, compel- ling the Conservative Government to promote measures which were not wholly consistent with the stricter Con- servative traditions or wishes. In other respects, the legislative achievements of the Government were not great ; and the time of Parliament was largely occu- pied in devising rules for the conduct of its business, which the obstructive attitude of the Irish members made necessary, and in discussing the charges brought against the Nationalist party by the Times, of complicity in the Phoenix Park murders. Under the new rules, the sittings of the House on ordinary days were made to commence at 3 p.m., and opposed business was auto- matically interrupted at midnight,^ while for the first time a power was given to the majority in a House of a certain size to conclude debate by what was known as the closure. Notwithstanding these new rules ob- structive tactics continued to prevail ; and, in the course of the Parliament, many members were suspended for disorderly conduct. The hostility of the Irish mem- bers was perhaps increased by some natural indignation at the charges brought against Mr Parnell. The Times, in April 1887, printed the facsimile of a letter purport- ing to be signed by Mr Parnell, in which he declared that he had no other course open to him but to denounce the Phoenix Park murders, but that, while he regretted "the accident" of Lord Frederick Cavendish's death, he could not " refuse to admit that Burke got no more than his deserts." The publication of this letter, and later of other similar documents, naturally created a great sensation ; and the Government ultimately appointed a special commission of three judges to

inquire into the charges and allegations that were made. In the course of the inquiry it was proved that the letters had emanated from a man named Pigott, who had at one time been associated with the Irish Nationalist movement, but who for some time past had earned a precarious living by writing begging and threatening letters. Pigott, subjected to severe cross-examination by Sir Charles Russell (after- wards Lord Russell of Killowen), broke down, fled from justice, and committed suicide. His flight practically settled the question ; and an inquiry, which many people had thought at its inception would brand Mr Parnell as a

Nationalist split.

criminal, raised him to an influence which he had never enjoyed before. But in the same year, which witnessed his triumph, his fall was doomed. He was made co- respondent in a divorce suit brought by Captain O'Shea ??? another Irishman ??? for the dissolution of his marriage ~~and the disclosures made at the trial induced Mr Glad~~ stone, who was supported by the Nonconformists generally throughout the United Kingdom, to request Mr Parnell to withdraw from the leadership of the Irish party. Mr Parnell refused to comply with this request, and the Irish party was shattered into fragments by his de- cision. Mr Parnell himself did not long sur- vive the disruption of the party which he had done so much to create. The exertions which he made to retrieve his waning influence proved too much for his strength, and in the autumn of 1891 he died suddenly at Brighton. Mr Parnell's death radically altered the political situation. At the general elections of 1885 and 1886 the existence of a strong, united Irish party had exercised a dominating influence. As the Parliament of 1886 was drawing to a close, the dissensions among the Irish members, and the loss of their great leader, were visibly sapping the strength of the Nationalists. At the general election of 1892, Home Eule was still the promi- nent subject before the electors. But the English Liberals were already a little weary of allies who were quarrelling among themselves, and whose disputes were introducing a new factor into politics. The political struggle virtually turned not on measures but on men. Mr Gladstone's great age, and the marvellous powers which he displayed at a time when most men seek the repose of retirement, were the chief causes which affected the results. His influence enabled him to secure a small Liberal majority. But it was noticed that the majority depended on Scottish, Irish, and Welsh votes, and that England ??? the " pre- dominant partner," as it was subsequently called by Lord Rosebery ??? returned a majority of members pledged to resist any attempt to dissolve the union between the three kingdoms.

On the meeting of the new Parliament Lord Salis- bury's Government was defeated on a vote of want of confidence, and for a fourth time Mr Gladstone wn^mJ" became prime minister. In the session of 1893 he again introduced a Home Eule Bill. But the measure of 1893 differed in many respects from that of 1886. In particular, the Irish were no longer to be excluded from the Imperial Parliament at Westminster. The bill which was thus brought forward was actually passed by the Commons. It was, however, rejected by the Lords. The dissensions among the Irish themselves, the hostility which English constituencies were displaying to the proposal, emboldened the Peers to arrive at this decision. Some doubt was felt as to the course which Mr Gladstone would take in this crisis. Many persons thought that he should at once have appealed to the country, and have endeavoured to obtain a distinct mandate from the constituencies to introduce a new Home Eule fiill. Other persons imagined that he should have followed the precedent which had been set by Lord Grey in 1831, and, after a short prorogation, have re-introduced his measure in a new session. As a matter of fact, Mr Gladstone adopted neither of these courses. The Govern- ment decided not to take up the gauntlet thrown down by the Peers, but to proceed with the rest of their politi- cal programme. With this object an autumn and winter session was held, during which the Parish Councils Act, introduced by Mr Powler, was passed, after several im- portant amendments which had been introduced into it in the House of Lords had been reluctantly accepted by Mr Gladstone. On the qther hand an Employers' Liability Bill, introduced by Mr Asquith, the Home Secretary, was

Lord Rosebery.

ultimately dropped by Mr Gladstone after passing all stages in the House of Commons, rather than that an amendment of the Peers, allowing "contracting out," should be accepted.

Before, however, the session had quite run out (3rd March 1894), Mr Gladstone, who had now completed his eighty-fourth year, laid down a load which his increasing years made it impossible for him to sustain (see the article Gladstone). He was succeeded by Lord Rosebery, whose abilities and attainments had raised him to a high place in the Liberal

counsels. Lord Eosebery did not succeed in popularizing the Home Eule proposal which Mr Gladstone had failed to carry. He declared, indeed, that success was not attainable till England was converted to its expediency. He hinted that success would not even then be assured until something was done to reform the constitution of the House of Lords. But if, on the one hand, he refused to introduce a new Home Eule BiU, he hesitated, on the other, to court defeat by any attempt to reform the Lords. His Government, in these circumstances, while it failed to conciliate its opponents, excited no enthusiasm among its supporters. It was generally under- stood, moreover, that a large section of the Liberal party resented Lord Eosebery's appointment to the first place in the ministry, and thought that the lead should have been conferred on Sir W. Harcourt. It was an open secret that these differences in the party were reflected in the Cabinet, and that the relations between Lord Eosebery and Sir W. Harcourt were too strained to ensure either the harmonious working or the stability of the Administration. In these circumstances the fall of the ministry was only a question of time. It occurred ??? as often happens in Parliament ??? on a minor issue which no one had foreseen. Attention was drawn in the House of Commons to the insufficient supply of cordite provided by the War Of&ce, and the House ??? notwithstanding the assurance of the War minister (Sir Henry Campbell-Bannerman) that the supply was adequate ??? placed the Government in a minority. Lord Eosebery resigned ofiice, and Lord Salisbury for the third time became prime minister, the duke of Devonshire, Mr Chamberlain, and other Liberal Unionists joining the Government. The Parliament of 1892 was dissolved, and a new Parliament, in which the Unionists obtained an overwhelming majority, was returned.

The Government of 1892, which was successively led by Mr Gladstone and Lord Eosebery, will, on the whole, be recollected for its failures. Yet it passed two measures which have exercised and are exercising a wide influence. The Parish Councils Act introduced electoral institu- tions into the government of every parish, and in 1894 Sir W. Harcourt, as Chancellor of the Exchequer, availed himself of the opportunity, which a large addition to the navy invited, to reconstruct the death duties. He swept away in doing so many of the advantages which the owner of real estate and the life tenant of settled property had previously enjoyed, and

drove home a prin- ciple which Mr Goschen had tentatively introduced a few years before by increasing the rate of the duty with the amount of the estate. Eich men, out of their superfluities, were thenceforward to pay more than poor men out of their necessities.

It is difiicult to recapitulate the history of the Unionist Government of 1895, which (with minor changes) was still in oflB.ce in 1901. History may hereafter conclude that the most significant circumstance of the period is to be found in the demonstration of loyalty and affection to which the sixtieth anniversary of Queen Victoria's accession led in 1897. Ten years before, her jubilee had been the occasion of enthusiastic rejoicings, and the Queen's

*progress through London to a service of thanksgiving at Westminster had impressed the imagination of her sub- jects and proved the affection of her people. yuwi^s. ^^^ *^ rejoicings of 1887 were forgotten amid the more striking demonstrations ten years later. It was seen then that tlie Queen, by her conduct and character, had gained a popularity which has had no parallel in history, and had won a place in the hearts of her subjects which perhaps no other monarch had ever previously enjoyed. There was no doubt that, if the opinion of the English-speaking races throughout the world could have been tested by a plebiscite, an over- whelming majority would have declared that the fittest person for the rule of the British empire was the gracious and kindly lady who for sixty years, in sorrow and in joy, had so worthily discharged the duties of her high position. This remarkable demonstration was not confined to the British empire alone. In every portion of the globe the sixtieth anniversary of the Queen's reign excited interest ; in every country the Queen's name was mentioned with affection and respect; while the people of the United States vied with the subjects of the British empire in praise of the Queen's character and in expressions of regard for her person. Only a year or two before, an ob- scure dispute on the boundary of British Venezuela had brought the United States and Great Britain within sight of a quarrel. The jubilee showed conclusively that, what- ever politicians might say, the ties*

of blood and kinship, which united the /two peoples, were too close to be severed by either for some trifling cause ; that the wisest heads in both nations were aware of the advantages which must arise from the closer union of the Anglo-Saxon races ; and that the true interests of both countries lay in their mutual friendship. A war in which the United States was subsequently engaged with Spain cemented this feeling. The Government and the people of the United States recognized the advantage which they derived from the goodwill of Great Britain in the hour of their neces- sity, and the two nations drew together as no other two nations had perhaps ever been drawn together in the his- tory of the world.

If the jubilee was a proof of the closer union of the many sections of the British empire, and of their warm attachment to their Sovereign, it also gave expression to the " Imperialism " which was becoming a dominant fac- tor in British politics. Few people realized the mighty change which in this respect had been effected in thought and feeling. Forty years before, the most prominent English statesmen had regarded with anxiety the huge responsibilities of a world-wide em.pire. In 1897 the whole tendency of thought and opinion was to enlarge the burden of which the preceding generation had been weary. The extension of British influence, the protec- tion of British interests, were almost universally advo- cated ; and the few statesmen who repeated in the 'nineties the sentiments which would have been generally accepted in the 'sixties, were regarded as " Little Eng- landers." It is perhaps needless in this page to refer to the effect which these new ideas had on Oriental politics, whether in China or Turkey. But a few words must be added on the consequences which they produced in Africa. Both in the north and in the south of this great and imperfectly explored continent, memories still clung which were ungrateful to Imperialism. In the north, the murder of Gordon was still unavenged; and the vast territory known as the Sudan had escaped from the control of Egypt. In the south, war with the Trans- vaal had been concluded by a British defeat; and the Dutch were elated, the English irritated, at the recollec- tion of Majuba. In 1898 Lord Salisbury's Government decided on extending the Anglo-Egyptian rule over the

Sudan, and a great expedition was sent from Egypt under the command of Sir Herbert (afterwards Lord) Kitchener to Khartum. Few military

expeditions have been more elaborately organized, or have achieved a more brilliant success. The Sudanese forces were decisively beaten, with great slaughter, in the immediate neighbourhood of Omdurman; and Khartum Omdur- became thenceforward the capital of the new Pashoda. province, which was placed under Lord Kitch- ener's rule. Soon after this decisive success, a French exploring expedition under Major Marchand reached the Upper Nile and hoisted the French flag at Fashoda. It was obvious that the French could not be allowed to remain at a spot which the Khedive of Egypt claimed as Egyptian territory ; and after some negotiation, and some irritation, the French were withdrawn. In South Africa still more important events were in the meanwhile progressing. Ever since the independence of the South African Eepublic had been virtually conceded by the Con- vention of 1884, unhappy differences had prevailed be- tween the Dutch and British residents in the Transvaal. The discovery of gold at Johannesburg and elsewhere had led to a large immigration of British and other colonists. Johannesburg had grown into a great and prosperous city. The foreign population of the Trans- vaal, which was 'chiefly English, became actually more numerous than the Boers themselves, and they com- plained that they were deprived of all political rights, that they were subjected to unfair taxation, and that they were hampered in their industry and unjustly treated by the Dutch courts and Dutch ofiicials. Failing to obtain redress, at the end of 1895 certain persons among them contemplated a revolution. Dr Jameson, who was administering the adjacent territory of Khodesia, accompanied by some British officers, actually attempted an invasion of the Transvaal. His force, utterly inadequate for the purpose, was stopped by the Boers, and he and his fellow-of&cers were taken prisoners. There was no doubt that this raid on the territory of a friendly state was totally unjustifiable. Unfortunately, Dr Jameson's original plans had been framed with the knowledge of Mr Ehodes, the Prime Minister at the Cape, and many persons thought that they ought to have been suspected by the Colonial Ofiice in London. England at any rate would have had no valid ground of complaint if the leaders of a buccaneer- ing force had been summarily dealt with by the Trans- vaal authorities. The president of the republic, Mr Kruger, however, handed over his prisoners to the British authorities, and Parliament instituted an inquiry by a select committee into the circumstances of the raid. The inquiry was terminated somewhat

abruptly. The com- mittee acquitted the Colonial Office of any knowledge of the plot; but a good many suspicions remained unan- swered. The chief actors in the raid were tried under the Foreign Enlistment Act, found guilty, and subse- quently released after short terms of imprisonment.]Mr Rhodes himself was not removed from the privy council, as his more extreme accusers demanded; but he had to abandon his career in Cape politics for a time, and confine his energies to the development of Rhodesia.

In consequence of these proceedings, the Transvaal au- thorities at once set to work to accumulate armaments, and they succeeded in procuring vast quantities of artil- lery and military stores. The British Government would undoubtedly have been entitled to insist that these arma- ments should cease. It was obvious that they could only be directed against Great Britain ; and no nation is bound to allow another people to prepare great armaments to be employed against itself. The criminal folly of the raid prevented the British Government from making this de-

mand. It could not say that the Transvaal Government had no cause for alarm when British officers had attempted an invasion of its territory and had been treated rather as heroes than as criminals at home. Ignorant of the strength of Great Britain, and elated by the recollection of their pre- vious successes, the Boers themselves believed that a new struggle might give them predominance in South Africa. The knowledge that a large portion of the population of Cape Colony was of Dutch extraction, and that public men at the Cape sympathized with them in their aspirations, increased their confidence. In the meantime, while the Boers were silently and steadily continuing their military preparations, the British settlers at

Johannesburg ––– the Uitlanders, as they were called ––– were demanding con- sideration for their grievances. In the spring of 1899, Sir Alfred Milner, governor of the Cape, met Presi- dent Kruger at Bloemfontein, the capital of the Orange Free State, and endeavoured to accom- plish that result by negotiation. He thought, at the time, that if the Uitlanders were given the franchise and a fair proportion of influence in the legislature, other difficulties might be left to settle themselves. The negotiations thus commenced unfortunately failed. The discussion, which had originally turned on the franchise, was enlarged by the introduction of the question of suzerainty or supremacy ; and at last, in the beginning of October, when the rains of an African spring were causing the grass to grow on which the Boer armies were largely dependent for forage, the Boers declared war and invaded Natal. The British Government had not been altogether happy in its conduct of the pre- ceding negotiations. It was certainly unhappy in its preparations for the struggle. It made the great mistake of underrating the strength of its enemy ; it suffered its agents to commit the strategical blunder of locking up the few troops it had in an untenable position in the north of Natal. It was not surprising, in such circumstances, that the earlier months of the war should have been memorable for a series of exasperating reverses. These reverses, however, were redeemed by the valour of the British troops, the spirit of the British nation, and the enthusiasm which induced the great autonomous colonies of the empire to send men to support the cause of the mother country. The gradual arrival of reinforcements, and the appointment of a soldier of genius ––– Lord Roberts ––– to the supreme command, changed the military situation ; and, before the summer of 1900 was concluded, the places which had been besieged by the Boers ––– Kimberley, Ladysmith, and Mafeking ––– had been successively relieved ; the capitals of the Orange Free State and of the Transvaal had been occupied; and the two republics, which had rashly declared war against the British empire, had been formally annexed to the dominions of the Queen.

The defeat and dispersal of the Boer armies, and the apparent dollapse of Boer resistance, induced a hope that the war was over ; and the Government seized the oppor- tunity to terminate the parliament, which had already endured for more than five years. The election was con-

ducted with unusual bitterness ; but the constituencies practically affirmed the policy of the Government by inaintaining, almost unimpaired, the large majority which the Unionists had secured in 1895. Unfortunately, the expectations which had been formed at the time of the dissolution were disappointed. The same circum- stances which had emboldened the Boers to declare war in the autumn of 1899, induced them to renew f%o'o" a guerilla warfare in the autumn of 1900 ??? the approach of an African summer supplying the Boers with the grass on which they were dependent for feeding their hardy horses. Guerilla bands suddenly appeared in different parts of the Orange River Colony

and of the Transvaal. They interrupted the communicar tions of the British armies ; they won isolated victories over British detachments; they even attempted the invasion of the Cape Colony. Thus the year which con- cluded the century closed in disappointment and gloom. The serious losses which the war entailed, the heavy expenses which it involved, and the large force which it absorbed, filled thoughtful men with anxiety.

No one felt more sincerely for the sufferings of her soldiers, and no one regretted more truly the useless pro- longation of the struggle, than the venerable lady who occupied the throne. She had herself lost a grandson (Prince Christian Victor) in South Africa ; and sorrow and anxiety perhaps told even on a constitution so un- usually strong as hers. At any rate, towards the close of 1900 it was reported, in well-informed circles, that Her Majesty was not enjoying her usual health. About the middle of January 1901 it was known that she was seri- ously ill ; on the 22nd she died. The death of the Queen thus occurred immediately after the The death close of the century over so long a period of Queen. which her reign had extended. That reign witnessed the greatest industrial triumphs which the world had ever seen ; the expansion of the Anglo-Saxon race and the development of Anglo-Saxon rule in every quarter of the globe. Commencing in a period of great internal suffering, it ended at a time of unusual prosperity ; and of all the remarkable facts in the reign, there is, perhaps, nothing more noteworthy than these : during the first five years of it poverty and crime in England attained their maxima ; while, during the last five years of it, the pressui'e of poverty and the burden of crime were reduced to the lowest proportions which had ever been known. The

vast expansion of the empire, and the marked improvement in the condition of the people, were due to causes with which the Queen herself had no direct concern. But in other respects the Queen rendered services to the country of the highest importance. In the first place, her own example exerted a beneficial influence on all who surrounded her. The atmosphere of the court, which had been injuriously affected during the leigns of her immediate predecessors, was purified by her influence and her conduct. The tone of society was insensibly raised by her example, and it is not too much to say that she left her country better than she found it. The Queen's public conduct, moreover, was as much above criticism as her private life. It would, perhaps, be an exaggeration to say that she invented constitutional government; but she practically determined by her example the right course for constitutional sovereigns to pursue. Though, throughout her reign, she exercised a great and increasing influence on the counsels of her ministers, she never identified herself with a^^y minister or any party. Each of the ten men who successively filled the first place in her counsels, was able to rely on the same loyal and unwavering support, and each of them was ready to acknowledge the debt that was due to her judgment and her experience.

The reign of the Queen may, perhaps, be divided into three periods. During nearlj^ the whole oJE the first period, from 1837 to 1862, she had her consort by her side, and was largely influenced by his advice. The Prince's stiff and reserved manners, however, diverted attention from his many admirable qualities ; and the court hardly enj oy ed the full measure of popularity which it deserved at the time and which it acquired later on. During the second period, from the death of the Prince Consort to the earlier 'eighties, the sorrow which had fallen on the Queen induced her to withdraw from the more prominent duties of her posi- tion ; the people grew accustomed to the absence of their sovereign, and forgot or were unaware of the many great

services wliicli she was rendering to them. Even during these years of mourning, however, the Queen's sympathy with suffering made a

profound impression on the nation ; and if in some respects she lost ground as a ruler, she gained the affection of her subjects by her many excellent qualities as a woman. But it was not till her jubilee of 1887 that the people generally became thor- oughly acquainted with the great qualities of their sovereign. The Queen herself saw with surprise the admiration and love which her presence everywhere excited. Thenceforward she emerged more and more from her retirement, and made exertions, which were the more remarkable from the growing infirmities of her age, to display her gratitude for her people's appreciation. She acquired in these years a popularity which no British sovereign, and perhaps no sovereign in the world, has ever enjoyed; and, partly through her connexion with the ruling houses of Europe, and partly in consequence of the authority bestowed by age and experience, she exercised an influence abroad almost as great and benefi- cial as that which she exerted at home.

The long period over which her reign extended was, in one sense, the most remarkable in the history of the world. So far as the English-speaking races were concerned, it witnessed a material and moral progress which has no parallel in their annals. During her reign the people of Great Britain doubled their number ; but the accumulated wealth of the country increased at least threefold, and its trade sixfold. All classes shared the prevalent prosperity. Notwithstanding the increase of population, the roll of paupers at the end of the reign, compared with the same roll at the beginning, stood as 2 stands to 3 ; the criminals as 1 to 2. The expansion abroad was still more remark- able. There were not 200,000 white persons in Australasia when the Queen came to the throne ; there were nearly 5,000,000 when she died. The great Australian colonies were almost created in her reign ; two of them ––– Victoria and Queensland ––– owe their name to her ; they all received those autonomous institutions, under which their pros- perity has been built up, during its continuance. Expan- sion and progress were not confined to Australasia. The opening months of the Queen's reign were marked by rebellion in Canada. The close of it saw Canada one of the most loyal portions of the empire. In Africa, the advance of the red line which marks the bounds of British dominion has been even more rapid ; while in India the Punjab, Scindh, Oudh, and Burma are some of the acqui- sitions

which were added to the British empire while the Queen was on the throne. When she died one square mile in four of the land in the world was under the

British flag, and at least one person out of every five persons alive was a subject of the Queen.

Material progress was largely facilitated by industry and invention. The first railways had been made, the first steamship had been built, before the Queen came to the throne. But, so far as railways are concerned, none of the great trunk lines had been constructed in 1837 ; the whole capital authorized to be spent on railway con- struction did not exceed ??55,000,000 ; and, five years after the reign had begun, there were only 18,000,000 passengers. The paid-up capital of British railways now exceeds ??1,100,000,000; the passengers, not including season ticket-holders, also number 1,100,000,000 ; and the sum which is annually spent in working the lines con- siderably exceeds the whole capital authorized to be spent on their construction in 1837. The progress of the commercial marine was still more noteworthy. In 1837 the entire commercial navy comprised 2,800,000 tons, of which less than 100,000 tons were moved by steam. At the end of the reign the tonnage of British merchant vessels had reached 13,700,000 tons, of which more than 11,000,000 tons were moved by steam. At the beginning of the reign it was supposed to be impossible to build a steamer which could either cross the Atlantic or face the monsoon in the B,ed Sea. The development of steam navigation since then has made Australia much more accessible than America was in 1837, and has brought New York, for all practical purposes, nearer to London than Aberdeen was at the commencement of the reign. Electricity has had a greater effect on communi- cation than steam on locomotion ; and electricity, as a> practical invention, had its origin in the reign. The first experimental telegraph line was only erected in the year in which Queen Victoria came to the throne. Submarine telegraphy, which has done so much to knit the empire together, was not perfected for many years afterwards ; and long ocean cables were almost entirely constructed in the last half of the reign.

These are some of the more striking changes which have taken place in the period with which this article is concerned. Concentrated as they have been in the years which have been covered by a single reign, they impart additional importance and interest to the age of Queen Victoria. On personal grounds her memory will be con- secrated in history as that of the best of sovereigns ; on imperial grounds her reign will be recollected for the extension of the British empire, the expansion of the British race, and the material and moral progress of the British people. (s. w.)

[See also the articles British Empire, and Victoria, Queen.]

English Law (Histoey of). ??? In English juris- prudence "legal memory" is said to extend as far as, but no farther than the coronation of Richard I. (Sept. 3, 1189). This is a technical doctrine concerning pre- scriptive rights, but is capable of expressing an important truth. For the last seven centuries, little more or less, the English law, which is now over-shadowing a large share of the earth, has had not only an extremely continuous, but a matchlessly well-attested history, and, moreover, has been the subject-matter of rational exposition. Already in 1194 the daily doings of a tribunal which was controlling and moulding the whole sysfaun were being punctually recorded in letters yet legible, and from that time onwards it is rather the enormous bulk than any dearth of available materials that prevents us from tracing the transformation of every old doctrine and the emergence and expansion of every new idea. If we are content to look no farther than the text-books ??? the books written by lawyers for

lawyers ??? we may read our way backwards to Blackstone (d. 1780), Hale (d. 1676), Coke (d. 1634), Fitzherbert (d. 1638), Littleton (d. 1481), Bracton (d. 1268), Glanvill (d. 1190), until we are in the reign of Henry of Anjou, and yet shall perceive that we are always reading of one and the same iDody of law, though the little body has become great, and the ideas that were few and indefinite have become many and explicit.

Beyond these seven lucid centuries lies a darker period. Nearly six centuries will still divide us from the dooms of /Ethelbirht (circ. 600), and nearly seven from the Lex Salica (circ. .^00). We may regard the Norman

conquest of England as marking the confluence of two streams of law. The one we may call French or Frankish. If we follow it upwards we pass through the capitularies of Carlovingian emperors and Merovingian kings until we see Chlodwig and his triumphant Franks invading Gaul, submitting their Sicambrian necks to the yoke of the

imperial religion, and putting their traditional usages into "written Latin. The other rivulet we may call Anglo- Saxon. Pursuing it through the code of Cnut (d. 1036) and the ordinances of Alfred {circ. 900) and his successors, ???we see Ine publishing laws in the newly-converted Wessex {circ. 690), and, almost a century earlier, Jllthelbirht doing the same in the newly-converted Kent (circ. 600). This he did, says Beda, in accordance with Roman precedents. Perhaps from the Eoman missionaries he had heard tidings of what the Eoman emperor had lately been doing far off in New Rome. We may at any rate notice with interest that in order of time Justinian's law-books fall between the Lex Salica and the earliest Kentish dooms ; also that the great Pope who sent Augustine to England is one of the very few men who between Justinian's day and the 11th century lived in the Occident and yet can be proved to have used the Digest. In the Occi- dent the tirde for the Germanic "folk-laws" {Leges Sarbarorum) had come, and a Canon law, ambitious of independence, was being constructed, when in the Orient the lord of church and state was "enucleating" all that was to live of the classical jurisprudence of pagan Rome. It was but a brief interval between Gothic and Lombardic domination that enabled him to give law to Italy : Gaul and Britain were beyond his reach.

The Anglo-Saxon laws that have come down to us (and we have no reason to fear the loss of much beyond some dooms of the Mercian Offa) are best studied as members of a large Teutonic family. Those that proceed from the Kent and Wessex of the 7th century are closely re- lated to the Continental folk-laws. Their next of kin seem to be the Lex Saxonum and the laws of the Lom- bards. Then, though the 8th and 9th centuries are un- productive, we have from Alfred {circ. 900) and his

successors a series of edicts which strongly resemble the Prankish capitularies ??? so strongly that we should see a clear case of imitation, were it not that in Prankland the age of legislation had come to its disastrous end long before Alfred was king. This, it may be noted, gives to English legal history a singular continuity from Alfred's day to our own. The king of the English was expected to publish laws at a time when hardly any one else was attempting any such feat, and the English dooms of Cnut the Dane are probably the most comprehensive statutes that were issued in the Europe of the 11th century. No genuine laws of the sainted Edward have descended to us, and during his reign England seems but too likely to follow the bad example of Prankland, and become a loose congeries of lordships. Prom this fate it was saved by the Norman duke, who, like Cnut before him, sub- dued a land in which ^'i igs were still expected to publish laws.

In the study of early Germanic law ??? a study which now for some fifty years has been scientifically prosecuted in Germany ??? the Anglo-Saxon dooms have re- Taw^"" ceived their due share of attention. A high degree of racial purity may be claimed on their behalf. Celtic elements have been sought for in them, but have never been detected. At certain points, notably in the regulation of the blood-feud and the construction of a tariff of atonements, the law of one rude folk will always be somewhat like the law of another; but the existing remains of old Welsh and old Irish law stand far remoter from the dooms of jEthelbirht and Ine than stand the edicts of Eothari and Liutprand, kings of the Lom- bards. Indeed, it is very dubious whether distinctively Celtic customs play any considerable part in the evolution of that system of rules of Anglian, Scandinavian, and Prankish origin which becomes the law of Scotland. Within England itself, though for a while there was

fighting enough between the various Germanic folks, the tribal differences were not so deep as to prevent the formation of a common language and a common law. Even the strong Scandinavian strain seems to have rapidly blended with the Anglian. It amplified the language and the law, but did not permanently divide the country. If, for example, we can to-day distinguish between law and right, we are debtors to the Danes ; but very soon law is not distinctive of eastern or right of western

England. In the first half of the 12th century a would-be expounder of the law of England had still to say that the country was divided between the Wessex law, the Mercian law, and the Danes' law, but he had also to point out that the law of the king's own court stood apart from and above all partial systems. The local customs were those of shires and hundreds, and shaded off into each other. We may speak of more Danish and less Danish counties ; it was a matter of degree ; for rivers were narrow and hills were low. England was meant by nature to be the land of one law.

Then as to Roman law. In England and elsewhere Germanic law developed in an atmosphere that was charged with traditions of the old world, and many of these traditions had become implicit in the Christian religion. It might be argued that all that we call pro- gress is due to the influence exercised by Roman civiliza- tion ; that, were it not for this, Germanic law would never have been set in writing; and that theoretically unchangeable custom would never have been supplemented or superseded bj^ express legislation. All this and much more of the same sort might be said ; but the survival in Britain, or the re-introduction into England, of anything that we should dare to call Roman jurisprudence would be a different matter. Eyes, carefully trained, have minutely scrutinized the Anglo-Saxon legal texts without finding the least trace of a Roman rule outside the ecclesiastical sphere. Even within that sphere modern research is showing that the church-property-law of the Middle Ages, the law of the ecclesiastical "benefice," is permeated by Germanic ideas. This is true of Gaul and Italy, and yet truer of an England in which Chris- tianity was for a while extinguished. Moreover, the laws that were written in England were, from the first, written in the English tongue; and this gives them an unique value in the eyes of students of Germanic folk-law, for even the very ancient and barbarous Lex Salica is a Latin document, though many old Prankish words are enshrined in it. Also we notice ??? and this is of grave imj^ jrtance ??? that in England there are no vestiges of any " Romani " who are being suffered to live under their own law by their Teutonic rulers. On the Continent we may see Gundobad, the Burgundian, publishing one law-book for the Burgundians and another for the Romani who own his sway. A book of laws, excerpted chiefly from the Theodosian code, was issued by Aiaric the Visigoth for his Roman subjects before the days of Justinian, and this

book (the so-called Breviarium Alarici or Lex Somana Visigothorum) became for a long while the chief repre- sentative of Roman law in Gaul. The Prankish king in his expansive realm ruled over many men whose law was to be found not in the Lex Salica or Lex Ribuaria, but in what was called the Lex Bomana. " A system of personal law " prevailed : the homo Bomanus handed on his Roman law to his children, while Prankish or Lombardic, Swabian or Saxon law would run in the blood of the homo barbarus. Of all this we hear nothing in England. Then on the mainland of Europe Roman and barbarian law could not remain in juxtaposition without affecting each other. On the one hand we see distinctively Roman rules making their way into the law of the victorious tribes, and on the other hand we see a decay and debasement of juris-

prudence which ends in the formation of what modern his- torians have called a Roman " vulgar law" (Vulgarrecht). For a short age which centres round the year 800 it seemed possible that Prankish kings, who were becoming Roman emperors, would be able to rule by their capitu- laries nearly the whole of the Christian Occident. The dream vanished before fratricidal wars, heathen invaders, centrifugal feudalism, and a centripetal church which found its law in the newly-concocted forgeries of the Pseudo-Isidore (circ. 850). The " personal laws " began to transmute themselves into local customs, and the Roman vulgar-law began to look like the local custom of those districts where the Romani were the preponderating element in the population. Meanwhile, the Norse pirates subdued a large tract of what was to be northern Trance ??? a land where Romani were few. Their restless and boundless vigour these Normans retained ; but they showed a wonderful power of appropriating whatever of alien civilization came in their way. In their language, religion, aud law, they had become French many years before they subdued England. It is a plausible opinion that among them there lived some sound traditions of the Frankish monarchy's best days, and that Nor- man dukes, rather than German emperors or kings of the French, are the truest spiritual heirs of Charles the Great.

In our own day German historians are apt to speak of English law as a " daughter " of French or Frankish law. This tendency derived its main impulse from Brunner's proof that the germ of trial by jury, which cannot be found in the Anglo-Saxon laws, can be found in the pre- rogative procedure of the Frankish kings. We must here remember that during a long age English lawyers wrote in French and even thought in French, and that to this day most of the technical terms of the law, more especially of the private law, are of French origin. Also, it must be allowed, that when the law has taken shape in the 13th century it is very like one of the coiitumes of northern France. Even when linguistic diflB-Culties have been surmounted, the Saxon Mirror of Eike von Repgow will seem far less familiar to an Englishman than the so-called Establishments of St Louis. This was the outcome of a slow process which fills more than a century (1066-1189), and was in a great measure due to the reforming energy of Henry II., the French prince who, in addition to England, ruled a good half of France. William the Conqueror seems to have intended to govern Englishmen by English law. After the tyranny of Rufus Henry I. promised a restoration of king Edward's law : that is, the law of the Confessor's time {Lagam Ectdwardi regis vohis reddo). Various attempts were then made, mostly, so it would seem, by men of French birth, to state in a modern and practicable form the laga Eadwardi which was thus restored. The result of their labours is an intricate group of legal tracts which has been recently explored by Dr Liebermann. The best of these has long been known as the Leges Henrici Primi, and aspires to be a comprehensive law-book. Its author, though he had some foreign sources at his command, such as the Lex liiljiiji.ria and an epitome of the Breviary of Alaric, took the main part of his matter from the code of Cnut and the older English dooms. Neither the Conqueror nor either of his sons had issued many ordinances : the invading Normans had little, if any, written law to bring with them, and had invaded a country where kings had been lawgivers. Moreover, there was much in the English system that the Conqueror was keenly interested in retaining ??? especially an elaborate method of taxing the land and its holders. The greatest product of Norman government, the grandest feat of government that the

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world had seen for a long time past, the compilation of Domesday Book, was a conservative effort, an attempt to fix upon every landholder, French or English, the amount of geld that was due fro'm his predecessor in title. Him- self the rebellious vassal of the French king, the duke of the Normans, who had become king of the English, knew much of disruptive feudalism, and had no mind to see England that other France which it had threat- ened to become in the days of his pious but incom- petent cousin. The sheriffs, though called vice-comites, were to be the king's officers; the shire-moots might be called county courts, but were not to be the courts of counts. Much 'that was sound and royal in English public law was to be preserved if William could pre- serve it.

The gulf that divides the so-called Leges Heiirici {circ. 1115) from the text-book ascribed to Ranulf Glanvill {circ. 1188), seems at first sight very wide. The one represents a not easily imaginable chaos and clash of old rules and new ; it represents also ' f►►sff^ a stage in the development of feudalism which in other countries is represented chiefly by a significant silence. The other is an orderly, rational book, which through all the subsequent centuries will be readily understood by English lawyers. Making no attempt to tell us what goes on in the local courts, its author, who may be Henry II.'s chief justiciar, Ranulf Glanvill, or may be Glanvill's nephew, Hubert Walter, fixes our attention on a novel element which is beginning to subdue all else to its powerful operation. He speaks to us of the justice that is done by the king's own court. Henry II. had opened the doors of his French-speaking court to the mass of his subjects. Judges chosen for their ability were to sit there, term after term ; judges were to travel in circuits through the land, and in many cases the procedure by way of " an inquest of the coun- try," which the Norman kings had used for the ascer- taimnent of their fiscal rights, was to be at the disposal of ordinary litigants. All this had been done in a piece- meal, experimental fashion by ordinances that were known as " assizes." There had not been, and was not to be, any enunciation of a general principle inviting all who were wronged to bring in their own words their complaints to the king's audience. The general preva- lence of feudal justice, and of the world-old methods of supernatural probation (ordeals, battle, oaths sworn with oath-helpers), was to be theoretically respected ; but in exceptional cases, which would soon begin to devour the rule, a

royal remedy was to be open to anyone who could frame his case within the compass of some carefully- worded and prescript formula. With allusion to a remote stage in the history of Roman law, a stage of which Henry's advisers can have known little or noth- ing, we may say that a "formulary system" is estab- lished which will preside over English law until modern times. Certain actions, each with a name of its own, are open to litigants. Each has its own formula set forth in its original (or, as we might say, originating) writ; each has its own procedure and its appropriate mode of trial. The litigant chooses his writ, his action, and must stand or fall by his choice. Thus a book about royal justice tends to become, and Glanvill's book already is, a commentary on original writs.

The precipitation of English law in so coherent a form as that which it has assumed in Glanvill's book is not to be explained without reference to the revival of Roman jurisprudence in Italy. Out of a school of Lombard lawyers at Pavia had come Lanfranc the Conqueror's adviser, and the Lombardists had already been studying Justinian's Institutes. Then at length the Digest came by its rights. About the year 1100 Irnerius was teaching

at Bologna, and from all parts of the West men were eagerly flocking to hear the new gospel of civilization. About the year 1149 Vacarius was teaching Roman law in England. The rest of a long life he spent here, and faculties of Roman and Canon law took shape in the nascent University of Oxford. Whatever might be the fate of Roman law in England, there could be no doubt that the Canon law, which was crystallizing in the Decretum Gratiani (circ. 1139) and in the decretals of Alexander III., would be the law of the English ecclesi- astical tribunals. The great quarrel between Henry II. and Thomas of Canterbury brought this system into collision with the temporal law of England, and the king's ministers must have seen that they had much to learn from the methodic enemy. Some of them were able men who became the justices of Henry's court, and bish- ops to boot. The luminous Dialogue of the Exchequer (circ. 1179), which expounds the English fiscal system, came from the

treasurer, Richard Fitz Nigel, who became bishop of London ; and the treatise on the laws of Eng- land came perhaps from Glanvill, perhaps from Hubert Walter, who was to be both primate and chief justiciar. There was healthy emulation of the work that was being done by Italian jurists, but no meek acceptance of foreign results. '

A great constructive era had opened, and its outcome was a large and noble book. The author was Henry of Bratton (his name has been corrupted into ra a. Bracton), who died in 1268 after having been for many years one of Henry III.'s justices. The model for its form was the treatise of Azo of Bologna (" master of all the masters of the laws," an Englishman called him), and thence were taken many of the generalities of jurisprudence: maxims that might be regarded as of universal and natural validity. But the true core of the work was the practice of an English couft which had yearly been extending its operations in many directions. Eor half a century past diligent record had been kept on parchment of all that this court had done, and from its rolls Bracton cited numerous decisions. He cited them as precedents, paying special heed to the judg- ments of two judges who were already dead, Martin Pateshull and William Raleigh. For this purpose he com- piled a large Note Book, which was discovered by Prof. Vinogradoff in our own day. Thus at a very early time English " common law " shows a tendency to become what it afterwards definitely became, namely " case law." The term " common law " was just being taken over from the canonists by English lawyers, who used it to dis- tinguish the general law of the land from local customs, royal prerogatives, and in short from all that was ex- ceptional or special. Since statutes and ordinances were still rarities, all expressly enacted laws were alSo ex- cluded from the English lawyer's notion of " the common law." The Great Charter (1215) had taken the form of a grant of '"liberties and privileges," comparable to the grants that the king made to individual men and favoured towns. None the less, it was in that age no small body of enacted law, and, owing to its import- ance and. solemnity, it was in after ages regarded, and is by English lawyers regarded at the present day, as the first article of a statute book. There it is followed by the " provisions " issued at Merton in 1236, and by those issued at Marlborough after the end of the Barons' War. But during Henry III.'s long reign the swift development of English law was due

chiefly to .new ” original writs ” and new ” forms of action ” devised by the Chancery and sanctioned by the court. Bracton knew many writs that were unknown to Glanvill, and men were already perceiving that limits must be set to the inventive power of the Chancery unless the king was

to be an uncontrollable law-maker. Thus the common law was losing the power of rapid growth when Bracton summed the attained results in a book, the success of which is attested by a crowd of manuscript copies. Bracton had introduced just enough of Roman law and Bolognese method to save the law of England, from the fate that awaited German law in Germany. His book was printed in 1669, and Coke’s head was full of Bracton.

The comparison that is suggested when Edward I. is called the English Justinian cannot be pressed very far. Nevertheless, as is well known, it is in his reign (1272- 1307) that English institutions finally take the forms that they are to keep through coming centuries. We already see the Parliament of the Three Estates, the Convocations of the Clergy, the King’s Council, the Chancery or secretarial department, the Exchequer or financial department, the King’s Bench, the Common Bench, the Commissioners of Assize and Gaol Delivery, the small group of professionally learned judges, and a small group of professionally learned lawyers, whose skill is at the service of those who will employ them. Moreover, the statutes that were passed in the first eighteen years of the reign, though their bulk seems slight to us nowadays, bore so fundamental a character that in subsequent ages they appeared as the substruc- ture of huge masses of superincumbent law. Coke commented upon them sentence by sentence, and even now the merest smatterer in English law must profess some knowledge of Quia emptores and De donis conditiona- libus. If some American states have, while others have not, accepted these statutes, that is a difference which is not unimportant to citizens of the United States at the dawn of the 20th century. Then from 1292 comes the first “law report” that has descended to us. It is the precursor of the long series of Year Books (Edw. II.~~Hen. VIII.) which runs through the residue of the Middle Ages. Lawyers, we perceive, are already mak~~ ing and preserving notes of the discussions that take place in court: French notes that will be more useful to them than the formal

Latin records inscribed upon the plea rolls. From these reports we learn that there are already, as we should say, a few " leading counsel," some of whom will be retained in almost every im- portant cause. Papal decretals had been endeavouring to withdraw the clergy from secular employment. The clerical element had been strong among the judges of Henry III.'s reign : Bracton was an archdeacon, Pate- shull a dean, Raleigh died a bishop. Their places be- gin to be filled by men who are not in orders, but who have pleaded the king's causes for him ??? ^his Serjeants or servants at law ??? and beside them there are young men who are "apprentices at law," and are learning to plead. Also we begin to see men who, as " attor- neys at law," are making it their business to appear on behalf of litigants. The history of the legal pro- fession and its monopoly of legal aid is intricate, and at some points still obscure; but the influence of the canonical system is evident: the English attorney cor- responds to the canonical proctor, and the English bar- rister to the canonical advocate. The main outlines were being drawn in Edward I.'s day; the legal pro- fession became organic, and professional opinion became one of the main forces that moulded the law.

The study of English law fell apart from all other studies, and the impulse that had flowed from Italian jurisprudence was ebbing. We have two comprehensive text-books from Edward's reign : the one known to us as Fleta, the other as Britton; both of them, however, quarry their materials from Bracton's treatise. Also we have two little books on procedure which are attributed to Chief-

Justice Hengham, and a few other small tracts of an in- tensely practical kind. Under the cover of fables about king Alfred, the author of the Mirror of Justices made a bitter attack upon king Edward's judges, some of whom had fallen into deep disgrace. English legal history has hardly yet been purged of the leaven of falsehood that was introduced by this fantastic and unscrupulous pam- phleteer. His enigmatical book ends that

literate age which begins with Glanvill's treatise and the Treasurer's dialogue. Between Edward I.'s day and Edward IV.'s hardly anything that deserves the name of book was written by an English lawyer.

*During that time the body of statute law was growing, but not very rapidly. Acts of Parliament intervened at a sufficient number of important points to gener- '***'* ate and maintain a persuasion that no limit, or*

*centuries, 1** ascertainable limit, can be set to the legisla- tive power of king and Parliament. Very few are the signs that the judges ever permitted the validity of a statute to be drawn into debate. Thus the way was being prepared for the definite assertion of parliamentary " omnicompetenee " which we obtain from the Elizabethan statesman Sir Thomas Smith, and for those theories of sovereignty which we couple with the names of Hobbes and Austin. Nevertheless, English law was being devel- oped rather by debates in court than by open legislation. The most distinctively English of English institutions in the later Middle Ages are the Year Books and the Inns of Court. Year by year, term by term, lawyers were re- porting cases in order that they and their fellows might know how cases had been decided. The allegation of specific precedents was indeed much rarer than it after- wards became, and no calculus of authority so definite as that which now obtains had been established in Coke's day, far less in Littleton's. Still it was by a perusal of reported cases that a man would learn the law of Eng- land. A skeleton for the law was provided, not by the Eoman rubrics (such as public and private, real and per- sonal, possessory and proprietary, contract and delict), but by the cycle of original writs that were inscribed in the Chancery's Megistrum Brevium. A new form of action could not be introduced without the authority of Parliament, and the growth of the law took the shape of an explication of the true intent of ancient formulas. Times of inventive liberality alternated with times of cautious and captious conservatism. Coke could look back to Edward III.'s day as to a golden age of good pleading. The otherwise miserable time which saw the Wars of the Roses produced some famous lawyers, and some bold doctrines which broke new ground. It pro- duced also Sir Thomas Littleton's (d. 1481) treatise on Tenures, which (though it be not, as Coke thought it, the most perfect*

work that ever was written in any human science) is an excellent statement of law in exquisitely simple language.

Meanwhile English law was being scholastically taught. This, if we look at the fate of native and national law in Germany, or Erance, or Scotland, appears as a fact of primary importance. From beginnings, so small and formless that they still elude research, the Inns of Court had grown. The lawyers, like other men, had grouped themselves in gilds, or gild-like "fellow- ships." The fellowship acquired property; it was not technically incorporate, but made use of the thoroughly English machinery of a trust. Behind a hedge of trustees it lived an autonomous life, unhampered by charters or statutes. There was a hall in which its members dined in common ; there was the nucleus of a library ; there were also dormitories or chambers in which during term- time lawyers lived celibately, leaving their wives in the country. Something of the college thus enters the con-

stitution of these fellowships ; and then something aca- demical. The craft gild regulated apprenticeship ; it would protect the public against incompetent artificers, and its own members against unfair competition. So the fellowship of lawyers. In course of time a lengthy and laborious course of education of the mediaeval sort had been devised. He who had pursued it to its end received a call to the bar of his inn. This call was in effect a degree. Like the doctor or master of a university, the full-blown barrister was competent to teach others, and was expected to read lectures to students. But further, in a manner that is still very dark, these societies had succeeded in making their degrees the only steps that led to practice in the king's courts. At the end of the Middle Ages (circ. 1470) Sir John Fortescue rehearsed the praises of the laws of England in a book which is one of the earliest efforts of comparative politics. Contrasting Eng- land with Erance, he rightly connects limited monarchy, public and oral debate in the law courts, trial by jury, and the teaching of national law in schools that are thronged by wealthy and well-born youths. But nearly a century earlier, the assertion that English law affords as subtle and civilizing a discipline as any that is to be had from Eoman law was made by a man no less famous than John Wyclif. The heresiarch naturally loathed the Canon law; but he also spoke with reprobation of the " paynims' law," the " heathen men's law," the study of which in the two universities was

being fostered by some of the bishops. That study, after inspiring Bracton, had come to little in England, though the canonist was com- pelled to learn something of Justinian, and there was a small demand for learned civilians in the Court of Ad- mirality, and in what we might call the king's diplomatic service. ISTo mediaeval Englishman did anything consid- erable for Eoman law. Even the canonists were content to read the books of French and Italian masters, though John Acton {circ. 1340) and William Lyndwood (1430) wrote meritorious glosses. The Angevin kings, by appro- priating to the temporal forum the whole province of ecclesiastical patronage, had robbed the decretists of an inexhaustible source of learning and of lucre. The work that was done by the legal faculties at Oxford and Cambridge is slight when compared with the inestimable services rendered to the cause of national continuity by the schools of English law which grew within the Inns of Court.

A danger threatened: the danger that a prematurely osseous system of common law would be overwhelmed by summary justice and royal equity. Even when courts for all ordinary causes had been established, a reserve of residuary justice remained with the king. "Whatever lawyers and even parliaments might say, it was seen to be desirable that the king in council should with little re- gard for form punish offenders who could break through the meshes of a tardy procedure, and should redress wrongs which corrupt and timid juries would leave un- righted. Papal edicts against heretics hac^ "'_ _ _"^'y- made familiar to all the notion that a judge should at times proceed summarie et de piano et sine strepilit etjigura jiistitid'. And so extraordinary justice of a penal kind was done by the king's council upon misdemeanants, and extraordinary justice of a civil kind was ministered by the king's chancellor (who was the specially learned member of the council) to those who " for the love of God and in the way of charity," craved his powerful assistance. It is now well established that the chancellors started upon this course, not with any desire to introduce rules of " equity '_ _ _' which should supplement, or perhaps supplant, the rules of law, but for the purpose of driving the law through those accidental impediments which sometimes unfortunately beset its due course. The wrongs that the

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chancellor redressed were often wrongs of the simplest and most brutal kind: assaults, batteries, and forcible dispossessions. However, he was warned off this field of activity by Parliament ; the danger to law, to lawyers, to trial by jury, was evident. But just when this was hap- pening, a new field was being opened for him by the growing practice of conveying land to trustees. The English trust of land had ancient Germanic roots, and of late we have been learning how in far-off centuries our Lombard cousins were in effect giving themselves a power of testation by putting their lands in trust. In England, when the forms of action were crystallizing, this practice had not been common enough to obtain the protection of a writ; but many causes conspired to make it common in the 14th century ; and so, with the general approval of lawyers and laity, the chancellors began to enforce by summary process against the trustee the duty that lay upon his conscience. In the next century it was clear that England had come by a new civil tribunal. Negatively, its competence was defined hy the rule that when the common law offered a remedy, the chancellor was not to intervene. Positively, his power was conceived as that of doing what " good con- science " required, more especially in cases of " fraud, accident, or breach of confidence." His procedure was the summary, the heresy-suppressing (not the ordinary and solemn) procedure of an ecclesiastical court; but there are few signs that he borrowed any substantive rules from legist or decretist, and many proofs that within the new field of trust he pursued the ideas of the com- mon law. It was long, however, before lawyers made a habit of reporting his decisions. He was not supposed to be tightly bound by precedent. Adaptability was of the essence of the justice that he did.

A time of strain and trial came with the Tudor kings. It was questionable whether the strong " governance " for which the weary nation yearned could work within the limits of a parliamentary system, or would be compatible with the preservation of the common law. We see new courts appropriating large fields of justice and proceeding summarie et de piano : the Star Chamber, the Chancery, the Courts of Requests, of Wards, of Augmentations, the Councils of the North and Wales ; a little later we see

the High Commission. We see also that judicial torture which Fortescue had called the road to hell. The stream of law reports became intermittent under Henry VIII. ; few judges of his or his son's reign left names that are to be remembered. In an age of humanism, alphabeti- cally arranged " abridgments " of mediaeval cases were the best work of English lawyers : one comes The Tudor ^^ g fj.^ Anthony Fitzherbert (d. 1538), and

**' /' another from Robert Broke (d. 1558). This was the time when Roman law swept like a flood over Germany. The modern historian of Germany will speak of "the Reception" (that is, the reception of Roman law), as no less important than the Renaissance and Reformation with which it is intimately connected. Very probably he will bestow hard words on a movement which disintegrated the nation and consolidated the tyranny of the princelings. Now a project that Roman law should be " received " in England occurred to Regi- nald Pole (d. 1558), a humanist, and at one time a re- former, who with good fortune might have been either king of England or pope of Rome. English law, said the future cardinal and archbishop, was barbarous ; Roman law was the very voice of nature pleading for " civility " and good princely governance. Pole's words were brought to the ears of his majestic cousin, and, had the course of events been somewhat other than it was. King Henry might well have decreed a reception. The role of English Justinian would have perfectly suited him, and there are*

distinct traces of the civilian's Byzantinism in the doings of the, Church of England's supreme head. The academic study of the Canon law was prohibited ; regius professor- ships of the civil law were founded ; civilians were to sit as judges in the ecclesiastical courts. A little later, the Protector Somerset was deej)ly interested in the estab- lishment of a great school for civilians at Cambridge. Scottish law was the own sister of English law, and yet in Scotland we may see a reception of Roman jurisprudence which might have been more whole-hearted than it was, but for the drift of two British and Protestant kingdoms towards union. As it fell out, however, Henry could get what he wanted in church and state without any decisive supersession of English by foreign law. The omnicompetence of an Act of Parliament stands out the more clearly if it settles the succession to the throne, annuls royal marriages, forgives royal

debts, defines religious creeds, attaints guilty or innocent nobles, or prospectively lends the force of statute to the king's proclamations. The courts of common law were suf- fered to work in obscurity, for jurors feared fines, and matter of state was reserved for council or Star Cham- ber. The Inns of Court were spared ; their moots and read- ings did no perceptible harm, if little perceptible good.

Yet it is no reception of alien jurisprudence that must be chronicled, but a marvellous resuscitation of English mediaeval law. We may see it already in the Commentaries of Edward Plowden (d. 1585) who reported cases at length and lovingly. Bracton's great book was put in print, and was a key to much that had been forgotten or misunder- stood. Under Parker's patronage, even the Anglo-Saxon dooms were brought to light ; they seemed to tell of a Church of England that had not yet been enslaved by Rome. The newnational pride that animated Elizabethan England issued in boasts touching the antiquity, humanity, enlight- enment of English law. Resuming the strain of Fortescue, Sir Thomas Smith, himself a civilian, wrote concerning the Commonwealth of England a book that claimed the attention of foreigners for her law and her polity. There was dignified rebuke for the French jurist who had dared to speak lightly of Littleton. And then the common law took flesh in the person of Edward Coke (1552-1634). With an enthusiastic love of English tradition, for the sake of which many offences may be forgiven him, he ranged over nearly the whole field of law, commenting, reporting, arguing, deciding, ??? disorderly, pe- dantic, masterful, an incarnate national dog- " matism tenacious of continuous life. Imbued with this new spirit, the lawyers fought the battle of the constitu- tion against James and Charles, and historical research appeared as the guardian of national liberties. That the Stuarts united against themselves three such men as Edward Coke, John Selden, and William Prynne, is the measure of their folly and their failure. Words that, rightly or wrongly, were ascribed to Bracton rang in Charles's ears when he was sent to the scaffold. For the modern student of mediaeval law many of the reported cases of the Stuart time are storehouses of valuable material, since the lawyers of the 17th century were mighty hunters after records. Prynne (d. 1669), the fanatical Puritan, published ancient documents with fer- vid zeal, and made possible a history of Parliament. Selden (d. 1654) was in all Europe

among the very first to write legal history as it should be written. His book about tithes is to this day a model and a masterpiece. When this accomplished scholar had declared that he had laboured to make himself worthy to be called a common lawyer, it could no longer be said that the common lawyers were indoctissiinitm genus doctissimorum hominum. Even pliant judges, whose tenure of ofiice depended on the king's will, were compelled to cite and

discuss old precedents before they could give judgment for their master ; and even at their worst moments they would not openly break with mediaeval tradition, or declare in favour of that " modern police-state " which had too often become the ideal of foreign publicists trained in Byzantine law.

The current of legal doctrine was by this time so strong and voluminous that such events as the Civil War, the Restoration, and the Revolution hardly deflected the course of the stream. In retrospect, Charles II. reigns so soon as life has left his father's body, and James II. ends a law- less career by a considerate and convenient abdication. The statute book of the restored king was enriched by leaves excerpted from the Acts of a Lord Protector ; and ^^^ Matthew Hale (d. 1676), who was, perhaps,

the last of the great record – searching judges, sketched a map of English law which Blackstoue was to colour. Then a time of self-complacency came for the law, which knew itself to be the perfection of wisdom, and any proposal for drastic legislation would have worn the garb discredited by the tyranny of the Puritan Caesar. The need for the yearly renewal of the Mutiny Act se- cured an annual session of Parliament. The mass of the statute law made in the 18th century is enormous ; but, even when we have excluded from view such Acts as are technically called " private," the residuary matter bears a wonderfully empirical, partial, and minutely particular- izing character. In this " age of reason," as we are wont to think it, the British Parliament seems rarely to rise to the dignity of a general proposition, and in our own day the legal practitioner is likely to

know less about the statutes of the 18th century than he knows about the statutes of Edward I., Henry VIII., and Elizabeth. Par- liament, it should be remembered, was endeavouring directly to govern the nation. There was little that resembled the permanent civil service of to-day. The choice lay between direct parliamentary government and royal " prerogative " ; and lengthy statutes did much of that work of detail which would now be done by virtue of the powers that are delegated to ministers and govern- mental boards. Moreover, extreme and verbose particu- larity was required in statutes, for judges were loath to admit that the common law was capable of amend- ment. A vague doctrine, inherited from Coke, taught that statutes might be so unreasonable as to be null, and any political theory that seemed to derive from Hobbes would have been regarded with not unjust suspicion. But the doctrine in question never took tan- gible shape, and enough could be done to protect the common law by a niggardly exposition of every legis- lating word. It is to be remembered that some main features of English public law were attracting the admira- tion of enlightened Europe. When Voltaire and Mon- tesquieu applauded, the English lawyer had cause for complacency.

The common law was by no means stagnant. Many rules which come to the front in the 18th century are hardly to be traced farther. Especially is this the case in the province of mercantile law, where Mansfield's (d. 1793) long presidency over the King's Bench marked an epoch. It is too often forgotten that, until Elizabeth's reign, England was a thoroughly rustic kingdom, and that trade with England was mainly in the hands of foreigners. Also'in mediaeval fairs, the assembled merchants declared their own " law merchant," which was considered to have a supernational validity. In the reports of the common law courts it is late in the day before we read of some mercantile usages which can be traced far back in the statutes of Italian cities. Even on the basis of the excessively elaborated land law ??? a basis which Coke's Commentary on Littleton seemed to have settled for ever

??? a lofty and ingenious superstructure could be reared. One after another, delicate devices were invented for the accommodation of new wants within the law ; but only by the assurance that the old law could not be frankly abolished can we be induced to admire the subtlety that was

thus displayed. As to procedure, it had become a maze of evasive fictions, to which only a few learned men held the historical clue. By fiction the courts had stolen business from each other, and by fiction a few comparatively speedy forms of action were set to tasks for which they were not originally framed. Two fictitious persons, John Doe and Richard Roe, reigned supreme. On the other hand, that healthy and vigorous institution, the Commission of the Peace, with a long history behind it, was giving an important share in the administration of justice to numerous country gentlemen who were thus compelled to learn some law. A like beneficial work was being done among jurors, who, having ceased to be re- garded as witnesses, had become "judges of fact." No one doubted that trial by jury was the "palladium," of English liberties, and popularity awaited those who would exalt the oflEice of the jurors and narrowly limit the powers of the judge.

But during this age the chief addition to English jurisprudence was made by the crystallization of the chancellor's equity. In the 17th century the Chancery had a narrow escape of sharing the '" ^'

fate that fell on its twin sister the Star Chamber. Its ???younger sister the Court of Requests perished under the persistent attacks of the common lawyers. Having outlived troubles, the Chancery took to orderly habits, and administered under the name of " equity " a growing group of rules, which in fact were supplemental law. Stages in this process are marked by the chancellorships of Nottingham (1673-6) and Hardwicke (1737-56). Slowly a continuous series of Equity Reports began to flow, and still more slowly an " equity bar " began to form itself. The principal outlines of equity were drawn by men who were steeped in the common law. By way of ornament a Roman maxim might be borrowed from a Erench or Dutch expositor, or a phrase which smacked of that " nature-rightly " school which was dominating Continental Europe; but the influence exercised by Roman law upon English equity has been the subject of gross exaggeration. Parliament and the old courts being what they were, perhaps it was only in a new court that the requisite new law could be evolved. The result was not altogether satisfactory. Freed from contact with the plain man in the jury-box, the chan- cellors were tempted to forget how plain and rough good law should be, and to screw up the

legal standard of reasonable conduct to a height hardly attainable except by those whose purses could command the constant advice of a family solicitor. A court which started with the idea of doing summary justice for the poor became a court which did a highly refined, but tardy justice, suitable only to the rich.

About the middle of the century William Blackstone, then a disappointed barrister, began to give lectures on English law at Oxford (1758), and soon after- wards he began to publish ‘ (1765) his Com- ‘”^”””’*- mentaries. Accurate enough in its history and doctrine to be an invaluable guide to professional students and a useful aid to practitioners, his book set before the unprofessional public an artistic picture of the laws of England such as had never been drawn of any similar system. No nation but the English had so eminently readable a law-book, and it must be doubtful whether any other lawyer ever did more important work than was done by the first professor of English law. Over and over again the Commentaries were edited, sometimes by*

distinguished men, and it is hardly too much to say that for nearly a century the English lawyer’s main ideas of the organization and articulation of the body of English law were controlled by Blackstone. This was far from all. The Tory lawyer little thought that he was giving law to colonies that were on the eve of a great and successful rebellion. Yet so it was. Out in America, where books were few and lawyers had a mighty task to perform, Blackstone’s facile presentment of the law of the mother country was of inestimable value. It has been said that among American lawyers the Commentaries ” stood for the law of England,” and this at a time when the American daughter of English law was rapidly growing in stature, and was preparing herself for her destined march from the Atlantic to the Pacific Ocean. Excising only what seemed to savour of oligarchy, those who had defied King George retained with marvellous tenacity the law of their fore- fathers. Profound discussions of English mediaeval law have been heard in American courts ; admirable researches into the recesses of the Year-Books have been made in

American law schools ; the names of the great American judges are familiar in an England which knows little indeed of foreign jurists ; and the debt due for the loan of Blackstone's Commentaries is being fast repaid. Lec- tures on the common law delivered by the present Chief-Justice of Massachusetts (0. W. Holmes) may even have begun to turn the scale against the old country. No chapter in Blackstone's book nowadays seems more anti- quated than that which describes the modest territorial limits of that English law which was soon to spread throughout Australia and New Zealand and to follow the dominant race in India.

Long wars, vast economic changes, and the conservatism generated by the Erench Revolution piled up a monstrous arrear of work for the English Legislature. Bentham. j^je^^while, Jeremy Bentham (d. 1832) had laboured for the overthrow of much that Blackstone had lauded. Bentham's largest projects of destruction and reconstruction took but little effect. Profoundly convinced of the fungibility and pliability of mankind, he was but too ready to draw a code for England or Spain or Eussia at the shortest notice ; and, scornful as he was of the past and its historic deposit, a code drawn by Bentham would have been a sorry failure. On the other hand, as a critic and derider'of the system which Blackstone had com- placently expounded he did excellent service. Reform, and radical reform, was indeed sadly needed throughout a system which was encumbered by noxious rubbish, the useless leavings of the Middle Ages : trial by battle and compurgation, deodands and benefit of clergy, John Doe and Richard Roe. It is perhaps the main fault of " judge- made law" (to use Bentham's phrase) that its destructive work can never be cleanly done. Of all vitality, and therefore of all patent harmfulness, the old rule can be deprived, but the moribund husk must remain in the system doing latent mischief. English law was full of decaying husks when Bentham attacked it, and his per- sistent demand for reasons could not be answered. At length a general interest in " law reform " was excited ; Romilly and Brougham were inspired by Bentham, and the great changes in constitutional law which cluster round the Reform Act of 1832 were accompanied by many measures which purged the private, procedural, and criminal law of much, though hardly enough, of the medieval dross. Some credit for rousing an interest in law, in definitions of legal terms, and in schemes of codi- fication, .is due to John

Austin (d. 1859) who was re- garded as the jurist of the reforming and utilitarian group. But, though he was at times an acute dissector of confused thought, he was too ignorant of the English, the Roman, and every other system of law to make any

considerable addition to the sum of knowledge ; and when Savigny, the herald of evolution, was already in the field, the day for a "Nature-Right" ??? and Austin's pro- jected " general jurisjjiudence " would have been a Nature-Right ??? was past beyond recall. The obso- lescence of the map of law which Blackstone had inherited from Hale, and in which many outlines were drawn by mediaeval formulas, left intelligent English lawyers without a guide, and they were willing to listen for a while to what in their insularity they thought to be the voice of cosmopolitan science. Little came of it all. The revived study of Germanic law in Germany, which was just beginning in Austin's day, seems to be showing that the scheme of Roman jurisprudence is not the scheme into which English law will run without distortion.

In the latter half of the 19th century some great and wise changes were made by the Legislature. Notably in 1875 the old courts were merged in a new Supreme Court of Judicature, and a concurrent administration of law and equity was introduced. Successful endeavours have been made also to reduce the bulk of old statute law, and to improve the form of Acts of Parliament ; but the emergence of new forces whose nature may be suggested by some such names as " socialism " and " imperialism " has distracted the attention of the British Parliament from the commonplace law of the land, and the development of obstructive tactics has caused the issue of too many statutes whose brevity was purchased by disgraceful obscurity. By way of " partial codification" some branches of the common law (bills of exchange, sale of goods, partnership) have been skilfully stated in statutes ; but a draft criminal code, upon which much expert labour was expended, lies pigeon-holed and almost forgotten. British India has been the scene of some large legislative exploits, and in America a few big experiments have been made in the way of code-making, but have given little satisfaction to the bulk of those who are competent to appreciate their residts. In England there are large portions of the law which, in their present condition, no one would think of

codifying : notably the law of real property, in which may still be found numerous hurtful relics of by-gone centuries. So omnipresent are statutes throughout the whole field of jurisprudence, that the opportunity of doing any great feat in the development of Jaw can come but seldom to a modern court. More and more, therefore, the fate of English law depends on the will of Parliament, or rather of the ministry. The quality of legal text-books has steadily improved ; some of them are models of clear statement and good arrangement ; but no one has with any success aspiredtobethe Blackstone of a new age. In the matter of legal education it is to be feared that England has fallen behind America. The civil law that was taught in the two universities began to lose its interest in the 17th century. The domain which nominally belonged to its doctors, the old ecclesiastical domain, was being covered by English statutes and English precedents; the Chancery stole work from the ecclesiastical courts, and diplomatists of the modern type appropriated a field in which civilians had been active. On the other hand, the scholastic scheme which obtained in the Inns of Court quickly degenerated into a course of perfunctory exercises, and finally into a course of dinners supplemented by such instruction as a busy barrister might or might not give to his private pupils. Endeavours to remedy this state of things have been made, both by the Inns and by the Universities, but no plan of legal education that can be unreservedly commended has yet been established. Owing to the non-existence of flourishing schools of law, England has hardly taken the share which should by rights have been hers in that systematic study of the history of law which was one of the main tasks of the 19th century. (f. w. m.)

ENGLISH LITEEATURE

English Literature (smce 1879). ??? If we take up the history of English literature at the close of 1879 the first thing we notice is that the moment was one of a highly transitional character. In other words, it was remarkable not so much for what was being done as for what had lately been done, and for what was still suffusing through the country the warmth and colour of life. The aspect of literature in England when 1880

opened was brilliant ; but we can see now what we could not see then, that the nature of its brilliance belonged to sunset and not to sunrise. The list of living men of letters at that

moment was an extraordinarily splendid one. survey! ^^ ranked, in that matter, with the most shining

*instants that English literature has ever enjoyed. At that moment, on the 1st of January 1880, there were alive in Great Britain, Carlyle, Darwin, Tennyson, Browning, Euskin, Matthew Arnold, Lord Beaconsfield, Stanley, Eroude, Ereeman, George Eliot, Huxley, Tyndall, Dante Gabriel and Christina Rossetti, Patmore, William Morris, E. L. Stevenson, Walter Pater, and Edward EitzGerald. Of men who in pure literature could at that time, or in the next decade, be for one moment named with these twenty, only four were still alive in 1902 ––– Mr Herbert Spencer, Mr Swinburne, Mr George Meredith, Mr John Morley. Perhaps there are only two dates in English literary history ––– 1600 and 1810 ––– which could compete with 1880 in the magnificence of the living names producible on a bare list. But we see at once that to compare 1880 with either of the earlier dates would be to resign ourselves to a fallacy. The fact, just mentioned, of the deaths of so large a proportion of the illustrious persons would be enough to make us suspect a condition of things which a close examination of the circumstances shows to be the truth. Let it then be said at once, the concluding portion of the 19th century is remark- able, first and foremost, for the extinction of the great representative lights of that century. If we strain to the utmost our appreciation of what younger men have achieved, it is impossible to give it the importance of the passing away of the elder spirits. When we look broadly at the period we see above all else the quenching of the lights. It has been pre-eminently a period of great funerals. Death has followed death until we were tempted to believe that the stage would be left to us altogether darkened and empty. Nor, if again we look closer still, shall we find that a large pro- portion of the very eminent persons who adorned the opening of these later years contributed any- thing to the period. Most of them, or many, be- longed to it merely by the accident of longevity. We must begin our history, then, by a record of these silenced voices.^*

The first to pass away was George Eliot (1819-1880), who had written no work of imagination for four years, and who, though probably unimpaired in power, gave signs of having finished saying what she had been born with the special gift to say. Charles Eeade (1814- 1884), although after his death a surprising number of unimportant volumes were extracted from his papers, had ceased for several years to be a contributor to current

1 In the present article it lias been tliouglit well to confine the attention of the reader strictly to the movement of English literature during the years 1879-1902, the article English LiTEEATORE in the 9th edition of the Ency. Brit, having been published in 1879. In order, however, to cover the gap between the earlier and the later periods, reference should be made to the various biographies of prominent deceased aiithors, which will be found either in the 9th edition of the E-ucy. Brit., as in the cases of Dickens, Macaulay, Thackeray, Kingsley, D. G. Rossetti, and many others, or in the course of the present Supplement, as in the cases of Newman, Tennyson, Carlyle, Browning, George Eliot, and Raskin.

literature. Anthony TroUope (1815-1882), on the other hand, was in the full flow of active invention when he died, and must be considered as a living element in the very beginning of our period. But the main body of Charles Darwin's work (1809-1882) was done, although his lively and interesting monograph on The Formation of Vegetable Mould belongs to 1881. Beaconsfield (1804-1881) closed his long career as a novelist with Endymion just as our period was opening. Arthur Penrhyn Stanley (1815-1881) was writing to the last, but published nothing of more importance than the Christian Institutions of 1881. Of a still earlier generation, Carlyle (1795-1881), a por- tent of mysterious celebrity, in the melancholy isolation and decay of extreme old age, had long ceased to take the least part in the movement of letters. He survived, un- seen, unheard, scarcely putting pen to paper during the last ten years of his existence. Nor though Newman (1801-1890) lived on so late, has he much more claim to count as an active factor in the literature of this period. One or two trifles, privately printed, alone reminded the circle of his disciples that he was think- ing of them in his cell at Edgbaston. The literary life of Dante Gabriel Eossetti (1828-1882) had closed with the publication of his

Ballads and Sonnets. Edward EitzGerald (1809-1883) had never been active ; he had long been entirely indolent before his death. Of the greatest names, therefore, which we began by enumerat- ing as the principal glory of 1880, we have already elimi- nated half as having no part whatever in the production of the subsequent years.

The presence and activity of Tennyson, Browning, Eus- kin, Eroude, and Mr Herbert Spencer, with the authority of certain writers a little younger than these, in particular Matthew Arnold, Huxley, Tyndall, and Mr George Mere- dith, formed a feature of literary life in 'the 'eighties which cannot be overlooked. It constituted, indeed, the principal fact of that particular decade. English litera- ture was held, to a very remarkable, perhaps to an unpre- cedented, degree under the sway of a group of very old men of genius, who showed no tendency to disappear. These very old men were supported by those who were but slightly their juniors, and who might be expected to sur- vive them and take their place. As a matter of fact, Tennyson, whose figure was the most dignified and most imposing of all, survived several of them, and continued intellectually active to the very last. The result of this governance by the aged was very curious. In some degree it may be held to have checked the productive enthusiasm of the newest men. Certainly the young writers occasion- ally groaned under what they took to be a gerontocracy, a tyranny by the aged. They ??? or some of them at least ??? were in a great hurry to come to the throne, neglectful of the fact that but one monarch is accustomed to hold it at a time. It may well be that a youthful poet could not hope, from 1880 to 1890, to publish a volume of verse which should interest even his friends so much as a new volume by Tennyson or Browning. But if this was a dis- advantage to him, it is not certain that it was a disadvan- tage to the literary profession. It is a matter of immense importance in the practice of a living literature to have certain dignified figureheads to point to. It was a useful, because a steadying and sobering, thing to have even the silent Carlyle and Newman to look up to ??? great accepted masters of the art of writing, who had passed out of the dust of battle and become half-divine, who were recognized as giant figures challenged no longer. It was a far more inspiring and stimulating thing to have Brown- ing, Euskin, and Tennyson there, equally lifted out of mere vain discussion, and yet still actively engaged in composition. It gave just such

a dignity to the mere art and tradition of authorship as is missing when no great

and unchallengeable reputation is before the public of a country. During the decade 1880-1890 the number and dignity of these figureheads was greater, perhaps, than it had ever been before ; it was so great that it is with them ??? with the astonishing group of veterans ??? that the honours of the period lie. ‘ It was salutaiy that it should be so. Every one who loves the literature of his country will say with Jean Paul, ” Gott, segne die Menschen mit grossen Menschen.”

*In the history of the poetry of the period the earliest event which served as a landmark in the passage of time Poetr ^^?? *^?? death of Dante Gabriel Rossetti (1828-*

1882). This was in itself of little importance, as the health of the poet had long been in a condition which could only point to the total obscuration of his genius. But the passing of Rossetti was the earliest public intimation of the fact that the so-called pre- Eaphaelite school of English poetry, which had occupied so large a share of public attention for fifteen years, had now reached its height, and had even begun to decline. This school had been combative and full of audacity ; it had shaken the coteries, and had made the recognized masters question the bases of their own authority. It had presented, pre-eminently, the aspect of militant youth, and thus the general public continued to regard it. After the death of the brilliant Rossetti, in physical and mental decay, it was impossible quite to regard it so any longer, and, indeed, as will presently be seen more in detail, its work as a school was over. But on this withdrawal of the rich pre-Raphaelite influences there followed a phenomenon of rare historical interest. This was the revival, the fresh outburst of sustained energy, of the two most celebrated poets of an earlier generation. In 1879 Tennyson (1809-1892) was in his seventy-first year ; Browning three years younger. Each of these illustrious men had been before the public for half a century, had overcome misconception and detraction, had accustomed an

ever-widening public to their mannerisms, and might well have been expected to withdraw into a dignified enjoyment of their fame. But this neither was content to do. In the face of advanced years, in the face of successive generations of more youthful rivals, they competed with the youngest and bore away, like the octogenarian Sophocles, prize after prize. Through the 'seventies Tennyson had mainly devoted his attention, since the completion of the Idylls of the King, to drama. Few were prepared, therefore, for the volume of Ballads in 1880 that enriched English poetry by such master- pieces as " Rizpah," " The Revenge," and " The Voyage of Maeldune." These may have been earlier in time of com- position, but the same can hardly have been the case with the Tiresias volume of 1885, which contained " To Virgil " and " Frater ave atque vale." All doubt about the amaz- ing and sustained fecundity of Tennyson's genius was set at rest by his publishing in the very next year a fresh volume of miscellanies, Locksley Hall Sixty Years after. At the age of eighty (1889) he put forth Demeter, a volume of narratives and lyrics in which there was, at last, a certain decline of energy, but in which such pieces as " Parnassus " and " Crossing the Bar " showed the old poet in the quintessence of his talent. Even this was not the latest of his appearances, for The Foresters appeared in the year of his death (1892) and jTJie Death of (Enone a few weeks later than that event.

Robert Browning (1812-1889) showed a similar persist- ence, if it was, as must be confessed, combined with less charm. His works were extended by the publication of five considerable collections of short poems, from the second series of Dramatic Idylls (1880) to Asolando, pub- lished on the very day of his death. The intellectual element was stronger than the poetical in the bulk of

these productions, which we may now look back upon as interesting and characteristic, but in the main not beauti- ful. To the essential work of Browning which posterity will read and value, these volumes (with the exception of Asolando in certain pages) added little, and in this respect he compared unfavourably with Tennyson, who preserved to the very last the key to the mystery of beauty. But the moral effect of Browning's punctual activity was not less marked than that of Tennyson. If what the former published was too hard and crabbed for unabated ad- miration, it showed

no lessening of intellectual power. The giant was there, and still lusty and voluble. All through, the^ decade 1879-1889, in spite of the heaped-up years, the interest of readers continued to centre in Tennyson and Browning.

At the death of Tennyson, Mr Algernon Charles Swin- burne (b. 1837) was left without a rival as the principal living poet of England. He had originally been identified with the pre-Raphaelites, but he had long severed himself from them. He was moving on, upon his own planetary course, without any reference to any of his contemporaries. No poet has been less affected, since his early youth, by the example of other writers or by the presumable taste of the public. In isolation he has repeated his effects and dwelt upon siich chords of life and literature as per- sonally attracted him. His earliest publications in our period were Mary Stuart (1881), in which he completed his Scots trilogy, and Tristram of Lyonesse (1882), a short romantic epic, followed by a collection of lyrics. These are volumes so typical that if the other works of Mr Swinburne were unhappily to be lost they could almost be reconstructed on the pattern of these. Since that time eight or nine volumes of verse have testified to Mr Swinburne's untiring persistency ; he will doubtless become, he is perhaps already, one of the most prolific of all the English poets. It is a matter of history that the position of Mr Swinburne greatly altered during the last twenty years of the century. In 1880 he was the most eminent of the younger writers, and seemed to the public more youthful still on account of his ebullience and literary courage. He carried high the flag of revolu- tionary ardour, although careful observers might even in 1880 have noted that it was no longer driven by so fierce a wind of feeling as it had been in 1870. Since then Mr Swinburne has not changed so much as his public has. New aspects of art and politics and conduct have attracted the minds of Englishmen, and Mr Swinburne, in his unflinching and unbending attitude, has been left more and more solitary. He no longer leads the army of impatient youth, but in a dignified isolation, never stooping for a moment to win the ear of a capricious public, he states the old formulas and insists upon the old ideals, a figure universally respected, but without a perceptible following.

The death of D. G. Rossetti, in 1882, has already been mentioned. The two authors who were particularly identi- fied with him at the outset survived much longer, but did not add very largely to their poetical assets. During the last twenty years of the life of William Morris (1834- 1896) he was mainly occupied with the socialist pro- paganda and with the practice of the decorative arts. The latest of his great poems, Sigurd the Volsung, does not come under our cognizance here, and in our period almost his only serious contributions to verse were contained in the collection of Poems by the Way (1891). But the abund- ance of Morris's fancy was bound to find some outlet, and he invented or adapted from the late mediaeval romances a form of prose-poem, a wild and solemn narrative, out of place, out of time, which he cultivated without a rival or an imitator. The first of these was the Tale of the House of the Wolfings (1891), and the eighth and last, Tlie Water

of the Wondrous Isles (1897), was posthumous. Archaistic in language, closely parallel in mode of evolution to the old French romances, extremely artificial in their elaborate artlessness, these curious books form a little province of recent literature all by themselves. Christina G. Eossetti (1830-1894) never quitted the recognized methods of lyrical writing, and she continued to write and to publish until near the time of her death. Yet she also, as a poet, mainly belongs to the period prior to 1880. Her blossoming-time as a writer of secular verse had closed by 1875, and what is most remarkable and most beautiful in her later religious poetry (Time Flies, 1885; Verses, 1893) is mainly a variation on themes which she had in- vented in her earlier volumes. Her Goblin Market, nearly twenty years old when our period commenced, continued to contain the most perfect revelation of her genius. An interesting feature of the history of this time was the revival of the fame of Coventry Patmore (1823-1896). Exceedingly popular in his youth, Patmore had fallen into desuetude and ridicule, and his finest work, his irregular Odes, had passed almost entirely unnoticed. About 1880, however, a new generation rediscovered Patmore, not a? the too domestic idyllist of TJie

Angel in the House, but as the austere and mystic singer of The Unknown Eros. During the last sixteen years of his life he wrote no more verse, but he steadily increased in fame, and died leaving a little school of ardent disciples. A greater than any we have mentioned, except the two dioscuri themselves, was Matthew Arnold (1822-1888), whose career came abruptly to a close at the very moment when he seemed about to cross, in the fulness of health and energy, the threshold of a dignified old age. It was Arnold who, it was hoped and supposed, would step into the places ultimately. left by Tennyson, Brown- ing, and Ruskin, and would be the central ornament of the living world of thought for another generation. Had this been the case the advantage to literature from so dignified a figure-head might have proved inestimable. In point of fact, he died before all these his elders, even before the still more aged Newman. His additions to poetry, moreover, since 1879 had been extremely slight, and we meet with him again farther on. The most venerable of the British poets of this time, Mr Aubrey de Vere (1814^1902), survived all whom we have mentioned, and did not cease to publish poems until 1890. With him the latest of the pure Words worthians passed away.

The name of the " Parnassian School " has been given to a group of poets who belonged to the generation suc- ceeding that of the Eossettis and William Morris, and who were more in sympathy, perhaps, with Arnold. In this title, which has no other recommendation, there seems to be a reference to the French poets who were the con- temporaries of these particular writers, and who made their first appearance together in the Parnasse Contemporain. The poets of this group had not the ample flight of their predecessors, and attempted smaller effects. They were united, with all their individual distinctions, in a common effort after great technical precision and perfection of form. Whether in the lighter or the graver mood, they aimed at exactitude of verbal expression, the careful record of shades of emotion, delicate phenomena, avoidance of hackneyed or rhetorical phrases. In their different ways these poets were artists in miniature, and relied on the freshness and sharpness of their touch. Such writers rarely attain to a great prominence in the history of literature, for they never move the masses. But if they live, they live by the sincerity of their workmanship, and at certain epochs the meticulous

production of such artists in verse is salutary for language as well as for literature. The group of later Victorian poets of which mention is

here made possessed considerable influence between 1880 and 1890, but since then none of them have been so active in verse-writing.

The death of Tennyson (October 1892) was followed by a positive " crisis " in poetry. The field seemed almost empty, and it was freely predicted that it would remain uncultivated. Like most prophecies, this was not fulfilled. Within a few months of Tennyson's ceremonious public funeral a whole army of new poets made their appear- ance, and were greeted, in some cases, with extravagant approval. One or two writers who had struggled in vain to win attention to their poetry suddenly found it widely welcomed. The years from 1893 to 1895 saw the arrival of a surprising number of candidates for the laurel. Of these newest poets, two or three of whom possess unques- tionable touches of genius, it m.ay be said collectively that they aimed rather at suggesting an effect than at toilsomely producing it. In other words, the excessive attention to form, to technical perfection, which had been carried so far by the Parnassians, failed to please, and broader modes of expression were aimed at. Into this entered what has been called the "Celtic" spirit, by which music rather than painting, the ear rather than the eye, is appealed to. Here again, as so often in recent English poetical history, some distant analogy with French fashions was to be perceived, and several of the youngest and most promising British poets might be welcomed as brothers by the Symbolists across the Channel. Yet another movement, in extreme opposition to this, has been the Imperialist or Nationalist school of poetry, of which the fountain and origin has cer- tainly been the much-discussed and disputed talent of Mr Rudyard Kipling (&. 1865), whose influence as a force in recent English literature the most adverse criticism could not dream of denying. This kind of poetry, about which it is not unfair to say that ??? for better or for worse ??? it abandons the slopes of Parnassus for the hustings and the music-hall, has attracted to its practice several writers of talent and a host that have no talent at all. On the whole, although poetry is still cultivated in England, the opening of the 20th century could not be said to find it in a very wholesome

condition, and in its best forms it seems to be as remote as ever from the sympathies of the public.

To turn from the consideration of the poetry of our period to that of its prose fiction is to enter upon a field of observation at once complicated and bewilder- ing. In later Victorian poetry, despite its record of losses and of broken activities, we can at least trace certain definite movements, which, whatever their direction, have a share in the general development of literary art. Certain traditions are common to the craft; a thread of continuity combines the scattered groups. But the record of the novel during this period is tangled, confused, amorphous. So many interests other than those of pure literature have interfered in its development that it is difficult to trace any definite progress at all.. At first sight the field presents the appearance of an over- grown, neglected garden, ??? not, indeed, devoid of flowers of beauty and rarity, ??? but so crowded with weeds and under- growth that the paths and beds can scarcely be dis- tinguished. The history of the novel since 1879 presents, however, one feature in common with that of poetry : its early record is one of depopulation. The leading figures of Victorian fiction do not, it is true, enter upon our period at all. Thackeray (1811-18Ci3) had been dead seventeen years, and Dickens (1812-1870) ten, before our survey commences. Other losses of paramount importance to the novel followed during the 'seventies ; Lytton's career closed in 1873, and the notes of gaiety and chivalry lost much of their resonance with the silencing of Lever (1806-1872) and of Kingsley (1819-1875). Then again, at the threshold of our inquiry, George Eliot (1819-1880)

ceases to exercise her strenuously intellectual influence ; and her death is followed in quick succession by those of Lord Beaconsfield (1881), Anthony TroUope (1882), and Charles Eeade (1884). Thus many various and widely diverse schools of fiction were deprived of their legitimate leaders. The philosophical study of character, the politi- cal and social satire, the kindly but critical portraiture of British domesticity, and the

intrepid crusade against current abuses ❓❓❓ all those forms of fiction were suddenly left without a pilot. At such a crisis we might reason- ably expect to find some paralysis, some sudden arrest of production. But this was far from being the case. The fecundity of fiction immediately increased with the mag- nitude of its losses, and from 1879 to 1901, when fewer novels of the highest order were published than during any equal period of the Victorian era, the positive num- ber of novels issued was steadily advancing. Figures, we are often told, will prove any case ; but in the present instance they are perhaps less fallacious than usual, since they rest upon the very accurate statistics of a central and authoritative bureau. In 1879, then, there were pub- lished 4294 new books in every class of literature, of which 607 only were works of fiction. Ten years later the number of new >books was 4694 (no very great in- crease), but of this number no fewer than 1040 were novels. The proportion of fiction had therefore risen in ten years from less than one-seventh to very nearly one-fourth of the entire " literary output." By 1899 this proportion was actually increased. In that year 5971 new books were printed, and of these 1825 were novels. These figures take account only of first editions ; but nowadays, when many novels are reprinted twenty or thirty times, it is hardly possible to overlook the claims of the reprint, especially as an indication of the kind of literature that the public welcomes most eagerly. If, then, we include the new editions in the statistics for 1899, we find that out of 7567 works issued from the press .no fewer than 2561 were works of fiction, designed either for the old or young reader. The proportion has now become one-third, and the story-book is found to be riding roughshod over the entire field of literature.

When we proceed to examine this vast productivity rather more closely we are at once struck by one conspicu- ous characteristic. The recent history of the novel has no continuity ; its succession is without method or develop- ment. It is true that the tendency of literature can only be observed with difficulty within the narrow limits of two decg,des ; still, even within that period it ought to be possible to trace some significance in a phase of activity represented by considerably over 20,000 separate works. The curious analyst, however, will only be bafiled if he seeks for a guiding thread running through the prose fiction that lies between the death of George Eliot and the opening of the 20th century. Not only is

there no animating spirit in its production, but it is even shaken by every false wind of transient and passionate caprice. Fashion follows fashion without reason or excuse, for the gusts of taste and distaste that convulse the modern novel have scarcely any relation even to the passing fashions that affect society ; they are manufactured for the moment in the offices of commercialism, and pass at once into exhaustion. We are thus confronted with the really regrettable fact that this form of representative and pictorial literature, which of all others ought to pre- serve the characteristics of the time, and hand on the natural lineaments of contemporary people to the remem- brance of their children, has largely ceased to represent or depict anything of importance in British national life and character. Observation and consistency, its saving graces, are no longer preserved in any just proportion to the multiplicity of its energies. The novel of commerce

has neither morality nor tendency : in the sifting fire of criticism it falls into ashes.

If we seek to find reasons for this, we can perhaps tra<;e them in two principal defects of modern workmanship, the one subjective, the other affecting the author from without. The subjective defect is due to the extraordi- nary audacity with which the modern novelist plunges into the exercise of his craft. The great works of fiction had hitherto been produced by graduates in the university of life : men who had experienced and felt the various and poignant emotions of sorrow and aspiration ; em- pirical judges fortified with culture. But nowadays a young man has no sooner concluded a desultory educa- tion, broken by every siren-charm of the river and cricket- field, than he is ready to attack the problems of life in the pages of a novel. Easy young spirits, with no leisure to look life in the face, scribbling against time in an atmosphere of sheltered ignorance, ??? what can these ama- teurs know of life or of their fellow-men ? The result of their home-keeping energy is unfortunately harmful both to themselves and their " public " ; for while the writer labours for his thirty or forty years in depicting con- ditions that never existed, the reader carries away from his yearly volumes an equally false ideal of life that clouds his own perception, and leaves him, at threescore years and ten, with the judgment of a child. Meanwhile from without there is the

commercial temptation offered to young men of promise more lavishly every year. The man of business " sees money," as his phrase runs, in some imaginary aspect or problem ; the book is suggested and commissioned : the warped and false philosophy main- tained. Perhaps it is not so much to be wondered at that, under conditions so perilous to talent, so many bad novels should be produced, as that there should still be found men content to perfect themselves in their art by experience and observation, and to work upon the lines laid down for them by those unfailing allies, instead of succumbing to the easy persuasions of the market-place.

It will be interesting to look more closely at some of these fashions which have passed over the troubled field of fiction before we consider the small body of those who have risen above them. The most attractive, perhaps, is the romantic, adventurous story, clean-handed and clean- witted. In our own time there has been one master of this form of fiction, a master, too, of exquisite English, who, taking what was by descent the ” boy's ” story of Mayne Eeid (1818-1883), moulded it to the noble uses of literature, ??? the fresh, humane, buoyant, humorous Robert Louis Stevenson (1850-1894). Few things should have been more helpful to literature than the fact that Stevenson chose this peculiarly popular form of novel for the exercise of his delightful genius ; but unfortunately the full significance of his example has been but little felt. He has had one or two conscientious followers, and others have diverged from his wake into waters of a different but still pleasant romance ; the majority, however, have missed his lessons of selection, elaboration, and style. In a spirit of more tremendously boyish vigour, roughly eloquent in a whirl of volcanic invention, Mr Eider Haggard (b. 1856) has dreamed dreams of inaccessible mountains, and lakes of molten gold. But too much of the purely popular romance of a later hour has lost the fervour of fancy altogether, and has wasted itself in purposeless pastiches and vague attempts to reconstruct Dumas for the use of the nursery-schoolroom . Invention, the quality most strained after by the mass of later Englishnovelists, seems to be that most conspicuously lacking to them. It is not that realism, or more accurately naturalism, has found a congenial home in England ; the English temperament will probably never be ready

to accept a frankly naturalistic consideration of life, ??? it is certainly not ready yet. But there was, in the early 'nineties, a

feverish attempt made, moribund at its birth, to combine the movement for Women's Eights with certain eternal but insoluble problems of sex. The attempt was made by women, and appealed chiefly to women. It produced much newspaper rhetoric, but no literature. Side by side with this movement, but unaffected by it, certain novelists have laboured with conscientious energy, but some lack of grace and persuasiveness, to establish, in the teeth of pre- judice, a school of realism in British fiction ; while in the very latest years of the 19th century one or two romance-writers succeeded in recovering the old flush and pulse of genuine imaginative invention, on semi-realistic lines.

The dif&culty, however, of representing to the English novelist the true limits of realism and purpose in fiction is nowhere more apparent than in the strange, sensational, pseudo-religious form of fiction that has sprung up from a confusion of the methods of the two elements. These shapeless and gaudy productions, addressed often to the name of great causes and exquisite ideals, mar, by their entire lack of sensibility and reasonableness, the very loyalties which they profess, and render criticism of themselves impossible by their own violence. Their im- mense vogue only shows that there is still a vast English- speaking public untouched by appreciation of the literary spirit. No doubt, when over a thousand novels have to be produced every year to supply the demand of the cir- culating libraries, the difficulty of finding new subjects is responsible for many of these divagations. The same difSculty is probably the cause of the spread of the paro- chial novel, and more particularly of the Scottish paro- chial novel. Every corner of the United Kingdom has been ransacked in search of what the journalist calls ???"local colour," and Scottish village-life seems to have offered the most acceptable result. There was nothing new in this class of novel, which was originated by Sir Walter Scott, and

worked out on the- modern plan by Gait and Miss Ferrier, and which in the hands of Mr George MacDonald (6. 1824) was the delight of readers in the 'seventies. But it is a notable example of lack of judgment on the part of the public that while this Scot- tish movement produced at once some of the most ex- quisite and some of the most worthless literature of the decade 1890-1900, both classes, good and bad, were equally acclaimed, and blindly devoured. The public seemed to perceive no difference between the work of Stevenson or his delicate successor Mr J. M. Barrie (6. 1860) and the crudest vegetation of the kail-yard. Nor has the criticism of the press always helped the public to discernment.

Finally, among these shifting movements, we come to what is the most characteristic of the time, the literature of colonial imperialism, inspired by the extension of the British Empire, and its assumption of new interests and complexions. Here, at any rate, we have a movement which bears a definite relation to the history of the time. In the forefront of this moving army stands the figure of Mr Rudyard Kipling (h. 1865), whose literary appearance in England, in 1890, was so novel, so vigorous, so over- whelming in its sense of individuality and young life, as to raise him at once to a position in the public gaze bril- liant enough almost to discountenance criticism. In India he had already published Departmental Ditties (1886) in verse, and the still more remarkable prose stories collected in 1887-89 under the general title oi Plain Tales from the Hills. The reception of these Indian studies, so dazzling in their novelty, and that of the somewhat perverse romance, The Light that Failed (1890), led on to a still more brilliant success in the volume of poems which took its name from the Barrack-Room Ballads (1891). The youthful Anglo-Indian swept everything before him ; no such world-wide notoriety had, perhaps, ever been ob- tained by an author so rapidly or so early in life. Since

then Mr Kipling's work, from the Many Inventions of 1893 and Tlie Jungle Book of 1894, down to the Kim of 1901, has been poured forth with great profusion, but has caused less critical amazement. It has naturally fallen into perspective, and taken its place in the general scheme. The picturesqueness of a new landscape, the persuasiveness of a new manner, have lost their first be- wildering glitter, and criticism has

not failed to note that these .qualities are sometimes achieved at the cost of literary tone and moral distinction. He has had imita^ tors, who have found some of his most effective tricks easy enough to catch. Still, among the new-comers Mr Kipling fills incomparably the most conspicuous place, and his influence upon the taste and thought of the mass of his countrymen is unparalleled among that of active men of letters at the opening of the 20th century.

*In this brief survey we have considered many develop- ments of the novel, but found in them little stability. But there are a few ??? unfortunately a very few ??? names that are found in none of these muster-rolls ; for they are those of men who have been consistently faithful to an ideal of outlook and workmanship unaffected by passing fashions of taste. At the head of this little body of stalwarts stands Mr George Meredith (b. 1828), whose work was the unquestioned glory of English fiction dur- ing the last forty years of Queen Victoria's reign. Mr Meredith preserved the traditions of English fiction un- tarnished during one of its most prolific and most peril- ous periods. The preservation of the moral idea in fiction, ??? an idea standing as a backbone to the work, and itself sustained by the interaction 'of the characters dis- played, ??? the preservation of this essential tradition is largely due to his loyal and unswerving devotion to the canons of literature. During the last years of the 19th ceutury the abundance of his direct imitators among young men of ambition was curiously noticeable. With Mr Meredith is Mr Thomas Hardy (6. 1840), the master of modern English realism, in his stories of pastoral life in " Wessex." A third great figure was E. L. Stevenson, pure romanticist of an even purer style, the lineal de- scendant of Scott, touched with modernity and moved by more picturesque exotic interests than Scott ever knew. These three writers stand alone, towering above their fellows. In th*e prose fiction of the period there seems no fourth novelist quite on the same level. But Mr Joseph Henry Shorthouse (p. 1834) preserved the philosophical romance from extinction. Mrs Humphry Ward (h. 1851) sustained the tradition of George Eliot's later manner, and lent sincere intellectuality to the statement of hard and harassing problems of contemporary thought. Among earlier novelists Sir Walter Besant (1836-1901) and James Payn (1830-1899) worthily continued the humorous and humane tradition of Dickens. The moral*

and didactic side of fiction was supported by Charlotte Yonge (1823-1901). Wilkie Collins (1824-1889), Richard Doddridge Blackmore (1825-1900), and Margaret Oliphant (1828- 1897) were eminent in their different fields. These have all passed away, but among their successors there are to be found, no doubt, a multiplicity of talent and many encouraging signs of the general vivacity of fiction. Yet it is not in the ranks of the triumphantly popular novel that these are found, and before recording the conquests of the few in this peculiarly deciduous class of contem- porary literature the wise will probably prefer to wait and see what the winnowing years will leave of genuine wheat in the mass of redundant vegetation.

To follow the achievement of a given period of modern history in pure criticism is rendered difficult by the pre- judice which, in the minds of the vulgar, reduces this fine branch of literature to its basest expression, namely, to mere fault-finding, to the " picking of holes " in a particular

product. Yet in the proper sense, criticism is not en- gaged with doling out blame or even praise, but ~~with Criticism. ^113'lysis, with the exact determination of the constituent parts of a work and their relation to one another. Applied to the past, it melts easily on one side into the history and on the other into the philosophy of literature or art. In recording, therefore, what was done well between 1879 and 1902, it will be found that there are many important factors which seem to have little connexion with one another, but which are so ejjcellent as to deserve no less attention than is given to creative literature, being indeed at their best of the imaginative order, and that these have at last to be brought together under the general heading of criticism. Since 1880, although working against great difficulties, the leading English critics have shown, in their extreme and unfortunate diversity, one common tendency which is new. Their criticism, wherever and however directed, has tended to be subjective to a degree never acknow~~ ledged before. The two most famous English critics of the time were John Euskin (1819-1900) and Matthew Arnold (1822-1888), alike in scarcely anything else than in their rejection

of the objective vacuum. Each of them boldly essayed to recount, as M. Anatole France has put it, the adventures of a soul journeying among masterpieces. Neither of these great men belongs entirely or mainly to our period. But from 1880 to 1887 Euskin was extremely active, and his work was remarkably characteristic of his genius. A sort of wild exuberance possessed him, and whether he wrote of the water-colour drawings of Turner and Prout, of the architecture of the Gothic cathedrals of Northern France, of English prosody, or of the principles of St George's Guild, his tone grew more and more unshackled, more and more violently personal. He measured his impressions less and less by tradition, even the tradition of his own earlier experience, and more and more by the eye and the mood of the moment. So that in Fors Glavigera, which did not cease to appear until 1884, we had at last one of the most stimulating, but at the same time one of the most reckless, contributions to autobiographical criticism which the world has ever seen. Immensely admired and closely studied by young people, although condemned to the last for his anar-chical judgments by the organs of traditional opinion, the example of Euskin in his fetterless old age was very widely felt. His tacit advice to every one was ❓❓❓ Use your own eyes and ears ; say how the object impresses you at such a moment, under such a light, in such a mood ; and let the professors go hang. Euskin never said this, of course, but this was the obvious effect of his system, and we have seen the result in much that is fresh and curious, as well as in much that is callow and pert.

Wholly distinct was the influence of Matthew Arnold. It is first to be remarked that although a younger man, he quitted the field of positive criticism sooner than Euskin did. His Irish Essays of 1882 and his Isaiah of Jeru- salem of 1883 indicated the direction which the mind of Matthew Arnold was taking at the end of his life. These, indeed, were criticisms of a sort, but not of that direct kind which influences literary workmanship. This latter had once been Arnold's peculiar province and glory; but neither his Essays in Criticism, nor On Translating Homer, nor The Study of Celtic Literature belongs to our period. These famous little books, indeed, were all published in the 'sixties. Arnold in his later years was drawn away from pure literature to speculations of a political, religious, and educational nature ; into the treatment of these he brought his lucid temper and his elevated moral tone, but in such exercises he

ceased to be a critic. The posthumous and valuable Second Series of Essays in Criticism is the only work of its class which mainly, though not entirely, belongs

to dates subsequent to 1880, and as lately as 1886 Arnold was writing on Sainte Beuve. But the indifference of the English public to pure literature depressed and checked him more and more in the production of the kind of work in prose in which he was best fitted to stimulate and lead. The potency, however, of his early writings continued, and was never more an active force than between 1880 and 1890. During those years, it may be said that almost everything in the way of criticism which was really excellently done in English literature bore at least a faint relation to Arnold. Perhaps there was less than usual of Arnold and more of Euskin, though surely most of all of the critic himself, in the criticism of Walter Pater (1839-1894) ??? so laborious, solid, and rich. His Appre- ciations (1889), his Plato and Platonism (1893), and two or three posthumous collections, have been read more and more widely since his death, ??? up to which time he was scarcely appreciated outside a narrow circle, ??? and have exercised an unquestionable force in contemporary writing. A critic of much acuteness and humour, pre- vented only, perhaps, by lack of concentrated effort from achieving the highest things, was Henry Duff Traill (1842-1900). Enthusiasm, wide knowledge, and a poetic habit of mind were combined with some laxity of judg- ment in the copious and illuminating, but not sufficiently concise, criticism of John Addington Symonds (1840- 1893). Among veteran leaders of literary criticism in the elder generation in 1902 were Mr Leslie Stephen (&. 1832) and Mr Frederic Harrison (p. 1831). There has in general been no lack of acute, graceful, and personal criticism, bjit its influence has been weakened, and it has often been 'put out of sight altogether by the floods of what is called "reviewing" which darken the daily and weekly press, the incessant gabble of nobodies about the little books of other nobodies as ill-trained in judg- ment as themselves.

In history the work done has been solid and consider- able, and it has had the advantage of moving on a more consistent plane than has been the case in other branches of literature. It is impossible to say that any particular school of poetry or fiction or criti- cism flourished pre-

eminently in the period from 1880 onwards, but of an Oxford school of historians it is per- missible to speak. These men were the direct successors and inheritors of the historians who, in the opening quarter of the 19th century, had determined that their first duty was to build the history of the country " upon unques- tionable muniments." Of the leaders of this brilliant school, the eldest was James Anthony Froude (1818- 1894), who was much exercised with the legacy of Carlyle's memoirs in the earlier part of our period, but who returned to his old investigations in his Divorce of Catharine of Aragon (1891), and his Erasmus (1894). He outlived his lifelong rival and opposite, Edward A. Freeman (1823 ? ? ? 1892), whom, by a curious irony, Froude succeeded for a few months as regius professor at Oxford. Freeman was, on the whole, the most characteristically active historian of these years ; during the first twelve of them he was ceaselessly at labour, and at his death he left a body of disciples engaged on important and prominent research according to his particular methods. Freeman's William Rufus belongs to 1882 ; his History of Sicily (1892-94) was unfinished at his death. During the interval he was incessantly working, and for eight years he was Professor at Oxford. Dr William Stubbs (1825-1901) had com- pleted his Constitutional History before our period begins, and his later energies principally went out in the direction of diocesan work; in 1884 he was appointed bishop of Chester, and in 1889 translated to Oxford. His subse- quent historical work was principally confined to the editing of one or two texts. The fourth of these great

historians, Dr Samuel Eawson Gardiner (1829-1902), was engaged during the whole period with his patient de- lineation of the Commonwealth and the Protectorate. Two historians who derived their inspiration from the example of Stubbs and Freeman were John Richard Green (1837-1883) and Mandell Creighton (1843-1901), the former as much distinguished for the agreeable vivacity of his style as the latter for the austerity of his irreproachable search for truth. A historian who stood apart from the Oxford school was Sir John Eobert Seeley (1834-1895),

whose work on Tlie Expansion of England (1883), and whose posthumously printed lectures on The Growth of British Policy (1895), had a very deep influence in in- ducing the development of imperialistic ideas in intelligent minds.

The influences of the time have been very unfavourable to the essay as a branch of independent literature. This was, however, the field in which Eobert Louis The essay, gtevenson (1850-1894) excelled before he was led away by the temptations of success to an almost exclusive cultivation of prose romance. The essay ??? from which criticism of books is here distinguished ??? tends more and more to disappear in journalism. It is very doubtful whether the successes of Sir Arthur Helps (1813- 1875) or even of George Augustus Sala (1828-1895) could have been repeated in this generation. Perhaps the last of the specific essayists, who treated speculative themes in a dignified and yet popular manner, was Richard Holt Hutton (1826-1897), whose life, however, was almost entirely devoted to the best class of journalism. Several of the most distinguished critics of literature of the period, however, have divagated, in the composition of essays, to the criticism of life as well. The better kind of monthly reviews and magazines were open at the beginning of our epoch to the essay on abstract subjects, but the tendency of the monthly press has been to assimilate itself more and more with the newspaper. The brilliant writers of the pres- ent day, who might in other conditions have been essay- ists, give to the " leaders " of the daily journal what might have been matured and purified and made part of a book.

A curious feature of English literary history during

the last twenty years of the 19th century was the growth

of the custom of biography. Almost entirely

ograp y. ^^^^^^^ ^q England, this habit has struck Con- tinental critics with amazement. During these years, and with an ever-increasing inevitability, few persons of any notoriety have died without the event being immediately followed by the publication of a " Life," very often ??? no matter how dull a cgrrespoudent the deceased had been ??? of a " Life and Letters." These books, in the vast majority entirely

ephemeral, often enjoyed a momentary success of curiosity equalled only by that of the fashionable novel. Their " best stories " were quoted, and then they took their place with the lumber of the library. In no branch of literature was less skill shown, or the standard of merit kept so low, as it was in biography, and the best that can be said of most of these lives is that, where the subject happened to be one of any real note, the volumes remain as a storehouse of material available for the future critic. Several well-balanced and skilfully-built biographies were, in the period under discussion, produced by authors who had proved their distinction in other fields, but no biographer, pure and simple, was revealed to the world, and, as a rule, the last thing thought of in the prepara- tion of these works was professional skill or a practised sense of proportion. In most cases, some one who had no experience of composition and no training in the art of portraiture was selected, merely because he (or she) was related to the subject of the book. In no branch of recent English literature is there less to boast of than in the conduct of biography.

tenden' cles.

In theology the period has been remarkable for the extinction of a great many lives long surrounded by peace and respect, but around which in earlier j.^^^, years there raged the roar of battle. The High Church lost its intellectual protagonist in Edward Bouverie Pusey (1800-1882), and later luminaries in Bishop Joseph Barber Lightfoot (1828-1889), Dean R. W. Church (1815-1890), Canon Liddon (1829-1890), and Brooke Foss Westcott (1825-1901). The Church of Rome lost Newman (1801-1890) and Manning (1808-1892). The Broad Church had to mourn Mark Pattison (1813- 1884) and Benjamin Jowett (1817-1893). Archbishop Edward White Benson (1829-1896) was one of the few English prelates who preserved an interest in general literature. The death of these venerable men changed the entire aspect of theology as a branch of current letters. As much in this province as in that of poetry, England was in 1880 under the rule of a body of old men who have passed away, removing with them the tradition of an eager and brilliant time of ardour and contest, but of those who took a prominent part in the Tractarian movement of 1835-1845, most of whom were still living in 1880, in 1902 not one was left. There has, however, been the beginning of a new

treatment of certain old problems, auspiciously repre- sented by Lux Mundi (1890), a collection of studies edited by Dr Charles Gore (h. 1853), now bishop of Worcester.

The history of literature is, and always has been, diver- sified by inequalities of activity and merit. If a meteoro- logical map of the subject could be devised it would be found to present, not straight lines, but Modera great curves or undulations. It is difficult not to be persuaded that in 1880 English literature was near the height of one of its periodic waves, although perhaps the actual culmination should be placed a little farther back than that year. To pursue the image, the line was still high all through the 'eighties, although steadi ly descending. It has, if we can trust our observation, con- tinued to descend, and whether there are as yet any signs of its recovery may be very gravely doubted. That pure literature of a very distinguished kind was, at the close of the 19th century, produced or encouraged to any signal degree ––– in comparison with the production and en- couragement of it a quarter of a century earlier ––– is not to be maintained. But this is a very different thing from despairing of literature, from thinking that it is, as the phrase goes, " played out." At no time is the best kind of writing really welcome to the great mass of the population. It is kept alive by a minority ; it appeals, in truth, to a small minority. But this minority is energetic, and at irregular periods its energy takes the form of forcing literature oa the indifference of the public, of winning for it perforce an unwelcome warmth of consideration. The presence of men of genius ––– men, that is, of exceptional vitality, whose force of life is led along literary lines ––– greatly adds to this artificial predominance of letters, although that presence is not necessary to it, as the analogies of 1680 and 1790 may show us. But we are apt to forget how artificial it always is, how exaggerated ––– to put it plainly ––– are the fame and prominence of men of letters in comparison with the real part they bear in the experience of the millions. It would therefore be, perhaps, more true to say that 1875 was an exceptionally high- water mark of literary effort than to say that 1901 was a particularly low one. The latter was rather a return to the normal condition, an unbending of the bow, a relaxation of intellectual energy. We do not question for a moment that it will be followed, as every such period has been in history, by a fresh outbreak of

effort, a fresh artificial insistence upon a kind of vitality interesting to, and indeed conceivable by, only a few

persons. The authority of literature is mainly empirical, so far as the great world is concerned. The vast body of " men in the street " is not more capable of comprehending the difference between good writing and bad than it is of observing the difference between good painting or sculpture and bad. What is worse is that the cruder forms of edu- cation tend to encourage false judgment in these matters, so that bad books and bad pictures are deliberately pre- ferred to good ones. This condition continues to extend, and to become more frequent and more threatening as the democracy becomes more and more confident. The absence of a recognized authority adds to the difficulty, and this is why, from time to time, the value of an Academy of Letters is maintained, in spite of its obvious defects and dangers. In the early months of 1902 several schemes of this nature were brought forward, with more definite purpose than ever before. It is now possible that an Academy, or better still, an Institute, embracing a cluster of academies, may yet be founded in England. That such institutions may be of very great value as a bulwark against the invasions of bad taste is not to be doubted, but we can hardly hope that a body with anything like the prestige of the French Academy will be seen in Great Britain, at least in our time. The great chance of such a foundation was lost when Charles II. hesitated in 1662. He created the Eoyal Society instead, and few would be found to deny that British science has benefited. But a Royal Society, founded now, would find it difficult to assert its authority ; to be useful, such corporations must be venerable and must hand on a tradition. In the mean- time, although the millions do not distinguish between a good book and a bad one, and although their tendency is to like the bad one best, there remains a distinction between good writing and bad. Experts disagree in detail about almost every contemporary product, but hitherto, and on large lines, they have agreed to a remarkable degree about what has been before the world for fifty years. As far as we can distinguish, no very worthless book

<u>✓✓✓ however successful in its own day ✓✓✓ continues to collect suffrages half a century after its publication. It seems scarcely less certain that no remarkably fine book ✓✓✓ however obscure when it was published ✓✓✓ misses the meed of fame at last. If these conditions are to be repeated in the future, and there is every, reason to suppose that they will, the winnowing of the wheat will remove even the remarkably abundant and flowering tares which are almost all that some despairing critics can see in the cornfield of to-day.</u>

<u>At the same time, it is not improbable that we may be on the edge of a much wider and more radical curve than any of those which have marked the course of English literature for one hundred years. Movements become ex- hausted, like men and races of men. It is unusual for one order of literary activity to last more than a century. After the course of a hundred years the varieties of ex- pression are apt to become exhausted, the forms grow hard, all the obvious motives tend to express themselves no longer as thoughts but as cliches. The Eomantic move- ment, in its different aspects, has entertained Europe for a century and more with little radical alteration. Between the various great poets of the Victorian age, for instance, no such difference is found as distinguished Herrick from Pope, or Goldsmith from Shelley. The distinctions have been matters of temperament, of execution, and of per- sonal style. Wordsworth and Mr Swinburne, Byron and Browning, differ only as great poets must differ among themselves, as Ben Jonson, for example, does from Mar- lowe, or Corneille from Eacine. Each and all belong to the modern English Eomantic school, as it was founded in 1798. It is quite possible ✓✓✓ one may go further and say it is not improbable ✓✓✓ that the reduction of energy in</u>

<u>literary creation of the first order, which we cannot pre- vent ourselves from recognizing as a feature of to-day, will be followed by a still more marked exhaustion and fatigue before the whole Eomantic movement, having had its century, is swept away to make room for some wholly different mode of literary expression.</u>

<u>The years which followed 1880 were marked by a revival of the classical writers of English, and a persistency of investigation into their biography</u>

and text, which form a rematkable and creditable feature of the literary life of the time. Never before were the famous authors of past times, and of the second as well as of the first class, placed before readers with so exact a scholarship and in a form so attractive. The wide sale which these reprints have had should be taken into consideration as an im- portant element in the culture of the time. In point of fact, while the abundance, beauty, and cheapness of re- prints have added a very real disadvantage to the young author, who finds Milton and Eielding become his formid- able rivals, yet at the same time, and from the point of view of the general education of taste, it cannot but be regarded as a very satisfactory thing that opportunities of studying what is best in the national literature should have been thus multiplied. To descend to particulars, the work of English scholars on Chaucer belongs, in its pub- lic results, almost wholly to this period. It culminated in the great edition of that poet by Professor Skeat (1896- 97), in which for the first time Chaucer is presented to his own people in a really intelligent and intelligible form. In Shakespearean study, too, there has been an extraordi- nary revival of scholarship, conducted with discretion and good sense by Dr Aldis Wright, Mr Sidney Lee, Dr Fur- nivall, and many others. The work of editing the texts of the great Elizabethan poets has proceeded so actively that for the moment there seems little of importance left to do in this province, and for a few shillings each the reader might collect around him in 1901 the works of poets which hundreds of pounds would hardly have placed within his reach in 1880. The great Dictionary of National Biogra- phy (1882-1901) has been completed in time to be recorded here as a finished thing, and among the principal monu- ments raised to English scholarship in the period under consideration we can hardly hesitate to name this ad- mirable dictionary. So much, indeed, has been achieved in historical and biographical work of this class, so ex- haustively have the documents been examined, and so closely the existing records collated, that it is difficult to see what remains for future investigation to occupy itself upon. In elucidating the study of the early Scottish poets, of the Elizabethans, of Pope, of the writers of the centre of the 18th century, and finally, of the great poets of the beginning of the 19th century, so much has been done since 1880 that the main fields must, one is tempted to think, be permanently despoiled of their harvests. All this zeal for the writers of the past serves, no doubt, to counteract the frivolity and bad taste of

uninstructed readers. The authority of the great dead is unimpeached, and every year it widens and deepens the bases on which it is built. It is of little moment what errors are popu- larly made as to the value of this or that contemporary author, if we all grow more and more sure of the degree and species of merit possessed by Dryden or Gibbon or Wordsworth. Sooner or later the products so wildly misjudged in contemporary popular esteem will have to be measured by this standard, and will inevitably take their right place in the harmony of literary history. It cannot be denied, however, that a great deal of talent and cleverness, and even weightier qualities, are wasted or are allowed to miss their fullest expression from neglect of the principles of literary art. Writing is pursued too rapidly, too perfunctorily, with too little previous study and present

care. There is a want of unity of purpose in the lit- erary products of the age which cannot but be deplored. When an author thinks that his chief business is to bow to the vague prejudice of crowds, the cause of pure litera- ture is in a parlous state. It is not the large " returns," the reverberating and unprecedented " sales," which pro- claim the author whose happiness it will be to live in the history of his country's literature. Good and careful writing is at this moment little approved of, and the con- quering masses m.arch gaily over it and leave it bleeding ; but the true lover of letters and adept in style will disre- gard the gods of mere material success, ??? he will remem- ber that Victrix cmisa diisplacuit, sed victa Gatoni. It is for the highest criticism to insist on playing the role of Cato. A final reflection may be permitted. Through the history of English literature its vitality and health have been marked, in a manner curiously recurrent, by a curiosity to know what is being done in foreign literatures, and by a vigorous use of what can be adapted from them. In 1880 the reciprocity between England and the Conti- nent in this matter was very close. There was a living curiosity to know what was being done by Russia in the novel, by Scandinavia in the drama, by Eranoe in criticism. This interest in foreign literature has steadily

declined. The reasons may be perfectly intelligible ; it remains that this is precisely one of the signs of a decline in, native literary vitality which has never hitherto failed to be recognizable afterwards in history. (e. g.)

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[As a supplement to the above survey, some others among the best-known writers of the period may be mentioned, excluding those to whom separate articles are devoted.

Poetry: Rev. H. C. Beeching (6. 1859. In a Garden, &c., 1895). A. C. Benson (6. 1862. Poems, 1893). Wilfrid Scawen Blunt (6. 1840. Love Sonnets of Proteus, 1880). F. "W. Bourdillon (6. 1852. A Lost God, 1891). Robert Bridges (6. 1844. Shorter Poems, 1890). W. J. Courthope (6. 1842. The Paradise of Birds, 1870). John Davidson (6. 1857. Fleet Street Eclogues, \%'dZ,l□□Q^'). "Michael Field" {The Tragic Mary, 1885). Edmund Gosse (6. 1849. Collected Poems, 1896. In prose: Sistory of Modern English Literature, 1897 ; Gossip in a Library, 1891 ; Life of Donne, 1899). A. P. Graves (6. 1846. Songs of Killarney, 1872). W. E. Henley (6. 1849. Book of Verses, 1888. In prose : Views and Beviews, 1890). Lionel Johnson (6. 1867. Poems, 1895. In prose : The Art of Thomas Hardy, 1894). Andrew Lang (6. 1844. Ballads in Blue China, 1880. In prose : Custom and Myth, 1884). Richard le Gallienne (6. 1866. English Poems, 1892. In prose : George Meredith, 1890 ; Prose Fancies, 1894, 1896). Sir Alfred C. Lyall (6. 18.35. Verses written in India, 1889. In prose : Asiatic Studies, 1882). J. W. Mackail (6. 1859. Part author of Love in, Idleness, 1883. In prose : Life of William Morris, 1899). Alice Meynell (nee Thompson, 1850. Preludes, 1875 ; Poems, 1893. In prose : The Bhythm of Life, 1893). Henry Newbolt (6. 1862. Admirals All, 1897). Stephen Phillips (b. 1868. Poems, 1897). A. Mary F. Robinson (Madame Duclaux, previously Madame Dar- mesteter, 6. 1857. Collected Poems, 1902. In prose : TTie End of the Middle Ages, 1888). Owen Seaman (6. 1861. In Cap and Bells, 1899). Arthur Symons (6. 1865. Collected Poems, 1901. In prose : Studies in Two Literatures, 1897) . Francis Thompson (6. 1863. Poems, 1893). John Todhunter (6. 1839. The Ban- shee, ISSS). William Watson (6. 1858. Wordsworth' s Grave, 1S90) . Theodore Watts-Dunton (6. 1839. The Coming of Love, 1897. In prose : Ayhein, 1898).

Margaret L. Woods (nee Bradley, 1856. Lyrics and Ballads, 1889. In prose: A Village Tragedy, 1887). W. B. Yeats (b. 1865. Poems, 1895).

Prose Fiction: Grant Allen (b. 1848, d. 1899. The Woman Who Bid, 1895. Also a popular writer on scientific subjects). "F. Anstey" (T. Anstey Guthrie, b. 1856. Vice Versa, 1882). Rev. S. Baring-Gould (b. 1834. Mehalah, 1880). Rev. W. F. Barry (6. 1849. The New Antigone, 1887). E. F. Benson (b. 1867. Dodo, 1893). Miss Rhoda Broughton (b. 1840. Belinda, 1883). F. T. Bullen (b. 1857. The Cruise of the Cachalot, 1898). F. C. Burnand (6. 1836. Sappy Thoughts, 1866). Mrs F. Hodgson Burnett (6. 1849. Little Lord Fauntleroy, 1886). Samuel Butler (6. 1835. Erewhon, 1872). T. H. Hall Caine (b. 1853. The Christian, 1897). Miss Marie Corelli (A liomance of Two Worlds, 1886). S. R. Crockett (6. 1860. The Baiders, 1894). A. Conan Doyle (6. 1859. Adventures of Sherlock Holmes, 1891). " George Egerton" (Mrs Clairmonte. Keynotes, 1893). Harold Frederic (b. 1856, d. 1898. Illumination, 1896). George Gissing (b. 1857. Demos, 1886). Sarah Grand (The Heavenly Twins, 1893).

Anthony Hope Hawkins (b. 1863. The Prisoner of Zenda, 1894). Maurice H. Hewlett (6. 1861. The Forest Lovers, 1898). "John Oliver Hobbes" (Mrs Craigie, b. 1867. Some Emotions and a Moral, 1891). Jerome K. Jerome (b. 1859. Idle Thoughts of an Idle Fellow, 1889). "Vernon Lee" (Miss Violet Paget, 6. 1859. Baldwin, 1886). "Edna Lyall" (Miss A. E. Bayly. Donovan, 1882). "Ian Maclaren" (Rev. J. Watson, 6. 1850. Beside the Bonnie Brier Bush, 1894). "Lucas Malet" (Mrs Harrison. The Wages of Sin, 1891). W. H. Mallock (6. 1849. The New Bepublic, 1877. In sociological criticism : Aristocracy and Evolu- tion, 1898). Herman Merivale (6. 1839. All for Her, 1874). H. Seton Merriman (The Sowers, 1896). George Moore (Esther Waters, 1894:) . Arthur Morrison (6. 1863. Tales of Mean Streets, 1894). W. E. Norris (b. 1846. The Bogue, 1888). Barry Pain (b. 1867. Playthings and Parodies, 1892). Gilbert Parker (6. 1862. The Seats of the 3Iighty, 1896). A. T. Quiller-Couch (6. 1863. Dead Man's Bock, 1887). W. Pett Ridge (Mord EmHy, 1898). Mrs Richmond Thackeray Ritchie (Miss Angel, 1875). W. Clark Russell (6. 1844. The Frozen Pirate, WTl). " Mark Rutherford " (W. Hale White. The Autobiography of Mark Butherford, 1885). Mrs F. A. Steel (6. 1847. On the Face of the Waters, 1896). G. R. Sims (6. 1847. Bogues and

Vagabonds, 1885. Also The Dagonet Ballads). G. S. Street (6. 1867. Autobiography of a Boy, 1894). Frederick Wedmore (b. 1844. Benunciations, 1895). H. G. Wells (b. 1866. The Time Machine, 1895). Stanley J. Weyman (b. 1855. Under the Bed Bobe, 1894). Richard White-ing (b. 1840. No. .5, John Street, 1899). "John Strange Winter" (Mrs Stannard, 6. 1856. Booties' Baby, 1874). Israel Zangwill (b. 1864. Children of the Ghetto, 1892). Others are : David Christie Murray (b. 1847), Silas Hocking (6. 1850), C. F. Keary, Robert Barr (6. 1850), R. H. Hichens (6. 1864), Egerton Castle (6. 1858), Frankfort Moore (b. 1855), Eden Philpotts (6. 1862), Percy White (6. 1852), J. A. Steuart (6. 1861),Mortey Roberts (6. 1857), E. W. Hornung (6. 1866), Benjamin Swift (b. 1871), A. E. W. Mason (6. 1865), J. M. Cobban (6. 1849), Hamilton Aidg, Max Pemberton (b. 1863), G. A. Henty (6. 1832), G. Manville Fenn (6. 1831), W. Le Queux (b. 1864), W. W. Jacobs (b. 1865), Mrs. B. M. Croker, Mrs Campbell-Praed, Mrs Alexander, Mrs Riddel!, "Iota" (Mrs CaflEyn), Mrs Hungerford, Mrs E. FuUer-Maitland, Miss Betham-Edwards, M. E. Francis, E. Thorneycroft Fowler, Violet Hunt, Mary Cholmondeley, Beatrice Harraden, "Fiona Macleod."

History, Criticism, &c. : Evelyn Abbott (6. 1843, d. 1901. History of Greece). Canon Alfred Ainger (6. 1837. Editor of Lamb's Works). William Archer (6. 1856. The Theatrical World, 1893- 97). E. S. Beesly (6. 1831. Queen Elizabeth, 1892). Augustine Birrell (b. 1850. Obiter Dicta, 1884). J. E. C. Bodley (6. 1853. France, 1898). A. K. H. Boyd (6. 1825, d. 1897. Becreations of a Country Parson, 1859-61). J. Franck Bright (b. 1832. History of England). Rev. Stopford Brooke (b. 1832. History of Early English Literature, 1892. Also Poems, 1888). James Bryce (b. 1838. The Holy Boman Empire, 1862 ; The American Common- wealth, 1888). J. B. Bury (6. 1861. History of Later Boman Empire, 1889). Edward Caird (6. 1853. The Evolution of Beligion, 1893). Rev. Professor Lewis Campbell (b. 1830. Sophocles in English Verse, 1883; Beligion in Greek Literature, 1898). J. Churton Collins (6. 1848. Ephemera Critica, 1901). Sidney Colvin (b. 1845. Life of Keats, 1887). Sir Martin Conway (b. 1856. The Alps from End to End, 1895). W. L. Courtney (b. 1850. Studies, Nem and Old, 1888). Sir Henry Craik (6. 1846. Life of Sioift, 1882). Lord Curzon of Kedleston (6. 18.5i9. Problemsof the Far East, 1894). Edward Dicey (6. 1832. Eng- land and Egypt, 1884). Edward Dowden (6. 1843. Life of

Shelley, 1886). Rev. Dr Fairbairn (6. 1838. Studies in the Philosophy of Beligion, 1896). C. H. Firth (b. 1857. Oliver Cromwell, 1900). J. G. Frazer (6. 1854. Tlie Golden Bough, 1890). Richard Garnett (6. 1835. Essays of an Ex-Librarian, 1901. Also Poems, 1893). Frederick Greenwood (6. 1830. Publicist). Thomas Hodgkin (b. 1831. Italy and her Invaders, 1880-99). Sir Richard Jebb (6. 1841. Sophocles, 7 vols., 1883-96). Rev. Augustus Jessopp (6. 1824. The Coming of the Friars, 1886). W. P. Ker (6. 1855. Epic and Romance, 1897). Benjamin Kidd (b. 1858. Social Evo- lution, 1894). Professor W. A. Knight (6. 1836. The Philosophy of tlie. Beautiful, 1891, 1893). W. S. Lilly (6. 1840. On Shib-boleths, 1892). F. W. Maitland (b. 1850. English Law and the Benaissance, 1901). David Masson (6. 1822. Life of Milton, 1859-80). Uev. W. Robertson Niooll (6. 1851. Literary Anecdntes of the Nineteenth Century, 1895). Henry Norman (6. 1858. The BealJapan, IS92). C. W. C. Oman (6. 1860. The An of War, 1898). H. F. Pelham (b. 1846. Boman History, 1890). t^ir Frederick Pollock, Bart. (b. 1845. Principles of Contract, 1876 ; Spinoza, 1880). G. W. Prothero (b. 1848. Simon de Montfort, 1877). Walter Raleigh (6. 1861. Style, 1897). George E. B. Saintsbury (6. 1845. A History of Criticism, vol. i., 1900). G. W. Steevens (6. 1869, d. 1900." With Kitchener to Khar- tum, 1898). Sir Spencer Walpole (&. 1839. History of England, 1878-80).]

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Etchiitg.

IN the article on Engraving in the 9th edition of this work Mr Hamerton devoted some paragraphs to that branch of engraving w^hich is known as Etching ; and the present writer was enabled to supplement those paragraphs by a later article on M^ryon. In the interval much has passed ??? much remains to be said. To the greatest and almost the oldest living practitioner of etching a separate article is devoted (see Whistlek) : the writer's business in this place will chiefly be to discuss those etchers most or all of whose work has been accomplished since Mr Hamerton wrote ; but opportunity shall first be taken to make good several omissions in Mr Hamerton's necessarily brief refer- ence to comparatively recent etchers who may yet claim to be classics. The

etchings of Andrew Geddes (1783-1844) and of Sir David Wilkie (1785-1841) somehow escaped him. Of these two men, G-eddes was the finer artist with, the needle ; he it was whom Rembrandt best inspired ; his work was in the grand manner. Of the rich and rare dry- points "At Peckham Iiye"and " At Halliford-on-Thames," the deepest and most brilliant master of Landscape would have no need to be ashamed. David Wilkie's prints were, naturally, not less dramatic than his pictures, but the etcher's particular gift was possessed by him more inter- mittently : it is shown best in " The Receipt," a strong and vivid, dexterous sketch, quite full of character. Cotman's (1782-1842) etchings might have been mentioned, though they were " soft ground " for the most part. They show all his qualities of elegance and freedom as a draughts- man, and much of his large dignity in the distribution of light and shade. Turner too, who etched in outline the subjects for the Liber Studiorum, might have been men- tioned as one who, while not seeking to rely upon etching for the completion of his effect, was yet singu- larly great in that selection of leading lines to which, as far as etching is concerned, he made it his business to confine himself. And Girtin (1775-1802), in the prepa- rations for his views of Paris, was scarcely less happy.

Mr Hamerton had no space to devote to his own illus- trious contemporaries, or he would have been amply eulo- gistic in his reference to Sir Seymour Haden (b. 1818), one of the most varied, prolific, and delightful of the etchers of Landscape. Between 1868 and 1879 Seymour Haden ___ the first president of the Royal Society of Painter Etchers ___ produced the vast majority of his plates, which have always good draughtsmanship, unity of effect, and a personal impression. They show a strong feeling for Nature. If, amongst nearly two hundred subjects, it were necessary to select one or two for peculiar praise, they might probably have to be the " Breaking up of the Agamemnon," the almost perfect " Water Meadow," the masterly presentment of " Erith Marshes," and the later dry-point of " Windmill Hill." Alphonse Legros ___ French- man by birth, but Englishman by long residence ___ has been etching admirably, at various periods, since 1860. Great in expression and suggestive draughtsmanship, austere and economical in line, Legros's work (see Lbgkos) is the grave record of the observation and the fancy of an imaginative mind. In poetic Portraiture, nothing can

well exceed his etched vision of G. F. Watts ; ” La Mort du Vagabond ” is noticeable for terror and homely pathos ; ” Communion dans I’lSglise St Medard ” is perhaps the best instance of the dignity, vigour, and grave sympathy with which he addresses himself to ecclesiastical themes. Something of these latter qualities, in dealing with similar themes, Legros has passed on to his pupil, Charles

Holroyd (6. 1861) ___ an etcher in the true vein; whilst an earlier pupil, prolific as himself, as imaginative, and some- times more deliberately uncouth ___ William Strang (b. 1859) ___ carries on in his own way the tradition of that part of Legros’s practice, the preoccupation with the humble, for which Legros himself found certain warrant in a portion of the great oeuvre of Rembrandt. Frank Short, who, as with the very touch of Turner, has carried to completion great designs that Turner left unfinished, and who has translated into perfect mezzotint something that is most characteristic in De Wint and in Constable, has found in the interpretation of other men’s visions an obstacle to the encouragement of fertility in his own. Time ___ not skill ___ has been wanting to him ; for the delicacy of ” Sleeping till the Flood,” the curiously suggestive realism of ” Wrought Nails ” ___ a scene in the Black Country ___ entitle him to a lasting place in the list of the fine wielders of the etching needle. Oliver Hall, a good free sketcher, bring- ing into his prints a quite unusual sense of wind and tree movement, has learnt something from Seymour Haden and is yet thoroughly himself. D. Y. Cameron betrays the influence of Rembrandt in a noble etching, “Border Towers,” and the influence of Meryon in the firm elaboration ___ the finality, one may say ___ and the weirdness besides, of such a print as that of “The Palace, Stirling.” His London Set is to be cherished even more. The individuality of C. J. Watson is less marked, but his skill, chiefly in architectural work, is noticeable. ‘ Ad- mirers of the studiously accurate portraiture of a great monument may be able to set Watson’s print of ” St fitienne du Mont” by the side of Meryon’s august and mysterious and ever memorable vision ; but to the lover of high imaginative art such a juxtaposition , is impossible.

Minna Bolingbroke and Elizabeth Armstrong (Mrs Watson and Mrs Stanhope Forbes) have done observant, dexterous work, on quite a high

level. A painter of the popularity and charm of Alfred East has several times trifled happily with the copper. Robert Macbeth has set down upon it sometimes his first thoughts and sometimes his elaborate interpretation of his own and other men's pictures. Walter Sickert is an artist of graceful and vivid impromptus. Robert Goff , in more than a hundred coppers, has shown the readiest perception of an attractive and a suitable theme, and has carried the work far enough to suggest the impression, and never so far as to confuse it. Mortimer Meupes, in his Japanese etchings, has found almost an individual touch, and has been alert in the dainty suggestion of artificial as well as of natural light and shade. Whistler has influenced Percy Thomas, and yet more nota- bly an artist who has etched much less, but who has etched convincingly ??? Raven Hill. Herkomer is at his best in " Gwenydd." J. P. Heseltine and Holmes May carry on the best traditions of the amateur ??? the amateur who, had circumstances allowed it, might have been a considerable artist. Roussel, an artist of refined performance in many a medium, has devoted much time to the perfection of his decorative methods of printing plates in several colours. The coloured etchings of Raffaelli must be mentioned with these, and Menpes, named already, claim s here a fresh place. Little known, but full of an observation that is his own, and thoroughly characteristic, are the exercises in black and white, upon the copper, of that audacious and yet subtle colourist, Besnard. Another Frenchman, J. J. Tissot, before he turned to sacred subjects, was in Etching an adept at the effective presentation of mundane themes ; and he it was who first led to thoughts of etching that

genius of a sketcher, Paul Helleu, whose " snapshots at the grace of women " are among the freshest, truest, and most delightful things that the art of etching has witnessed in its later history. Helleu's dry-points ??? frank sketches, with elegance as their motive ??? are very numerous, but as the artist does not tolerate the slightest deterioration, and as dry-point deteriorates almost at once, the impressions of each are almost inconceivably few. If any further remark requires absolutely to be

made about contemporary Etching, it is one to this effect ??? that the tendency, manifested about 1875, to use the medium very greatly for interpretation and reproduction of painted work, has now already long been on the wane ; and it is probable that while the medium may still, and always, do some useful work in that direction, it will continue to be resorted to mainly as a convenient and delightful vehicle for the swift yet well-considered record of personal feeling and thought about the aspects of the world. (f. we.)

Mezzotint.

During the 19th century two veritable revolutions oc- curred in the British art of Mezzotinto Engraving ??? " la Maniere Anglaise." The original defect of the method was the incapacity of the mezzotint " burr " on copper to yield as many fine impressions as other form s of engraving. To this defect was attributable the introduction in 1823 of steel instead of the soft copper plates previously used, ??? a change which, in conjunction with the endeavour to avoid inherent technical difficulties, led to the "mixed style," or combination of mezzotint with etching, and a general departure from the traditional form of the art, " pure mezzotint " on copper. The affinity of the method to painting in black and white which differentiates it from other kinds of engraving, and was the distinguishing charm of the mezzotints of the 17th and 18th centuries, was for a time lost, but a revival of pure mezzotint on copper beginning in 1880 ??? a return, in fact, to the mode in which the classics of the art were engraved in the time of Sir Joshua Reynolds ??? was made possible by the invention of steel-facing. By this process engraved copper plates are electroplated with a film of steel, renewable when worn in course of printing; and a mezzotint on copper, so protected, yields more of fine impressions than if it had been engraved on steel, whilst the painter-like quality remains unimpaired.

In "pure mezzotint" the design is evolved from dark to light entirely by scraping away more or less of the previously laid "ground," the original "burr" of which is left un- Method touched in the extreme darks, and no acid, etching, or ot work. j^j^g work is used in it at all. The usual short descrip- tions of the method are misleading, because they fail to explain

that it is the "ground," and not the "burr" of it only, which is scraped away in greater or smaller degree to produce the varying tones of the design. The necessity of realizing that there are two constituents of the "ground," the "burr," and the indentations out of which the " burr" is raised, will be appreciated later. The "burr" consists of innumerable particles of copper (resembling velvet pile in the finished "ground") raised above the surface of the plate out of the indentations made in it by the teeth of the rocking-tool in laying the ground before scraping the design.

Assuming that a mezzotint is to be scraped from a lady's portrait by Sir Joshua Reynolds in which a piece of black drapery crosses a white dress ??? the engraver begins to work on a previously laid "ground" which would print uniformly black before scraping commences. In the extreme darks of the black drapery the raised " burr" is left untouched by the " scraper," ??? a two-edged steel instrument resembling an ancient Roman sword-blade in miniature, but having a longer point. Working from dark to light, the engraver produces the varying tones of the folds of the black drapery by scraping the raised " burr " down more or less, lower- ing it in fact so that it will not hold so much ink as where it is left untouched in the extreme darks. In the highest lights of the black drapery all the raised "burr" will have been removed and the original surface of the plate reached, but as yet the engraver

has not produced any tone lighter than middle tint (although he has completely modelled up the black drapery), because the indentations out of which the "burr" was raised still remain in the plate and hold ink in printing. In order to produce the infinite gradation of delicate tones in the white dress, or in a sky, the scraping is continued, the indentations being thus made shallower in the passages scraped and therefore less capable of holding ink, whilst they are obliterated almost entirely in the highest lights. When the mezzotint is finished, the black drapery will stand higher than the surface of the plate modelled in a relief composed of the raised " burr," whilst all the tones of the white dress from middle tint to pure white will be so many actual depressions in the plate, the highest lights being the deepest. The speck of light in the eye, for instance, is a pit in the plate, surrounded by a tract of more or less raised "burr," which pro- vides the

intense black of the pupil and the half tints of the iris. The difference of surface levels is very appreciable where high- lights impinge on strong darks, but it exists in varying degree all over the plate, and the greatest technical difficulty in pure mezzotint is to obtain adequate "edge" and definition, because the tendency is to remove too much "ground" from the edges of adjacent darks in the course of the constant scrapings necessary to smooth and polish the depressed lights.

In printing a mezzotint a non-fluid ink is thoroughly worked into every part of the plate and the superfluities wiped off again, leaving as much ink' as possible in the darks, the raised "burr." If the bottom of the small lights is not quite smooth, the ink sticks in the roughness and they print dark instead of light, or the printer has to wipe so bard to get the ink out of the depressed lights that he removes too much from the raised darks. In either case loss of definition and contrast of effect results. This inherent difficulty of scraping to a sharp edge caused the use of the " mixed ' ' methods, in which the details were sharpened by outlining them with stipple or line-etching.

The scarcity of fine impressions of the pure mezzotints on copper of Sir Joshua's time was due to the "burr" which provides the extreme darks being raised above the surface of the plate, and thus exposed to all the wear and tear of printing processes, unlike the darks of an etching or line-engraving, which are protected by being sunk in the plate. The evanescence of the " burr " on copper led to the use of steel plates, and the temporary decay of the art.

Mezzotint is the best form of engraving for completeness of representation, but etching is better adapted for sketching from nature or for the expression of any fleeting idea. The two arts have distinct uses and limitations. The art function of true etch- ing as practised by Rembrandt lies in economy of expressive line to suggest the artist's meaning, and that of mezzotint in com- pletion of tonality to explain it. ArtLstic suggestion, which is not inherent in the solid tones of mezzotint, has to be imparted to the work entirely by the free play of the "scraper " on the " ground," much as the painter attains it on canvas with the brush. The best painter cannot, however, acquire the same facility with the " scraper" that he may

possess in the use of the brush until he has had long practice in scraping and in “laying” grounds, even in texture, suitable to the subject to be engraved, and therefore offer- ing the least possible resistance to his own idiosyncraoies of execution with the “scraper.”

The first reputed mezzotint was produced at Amsterdam in 1643 by Ludwig von Siegen, an officer in the service of the Landgrave/ of Hesse, and an amateur artist; but the History work was rather a direct drawing on copper with an instrument of comparative precision resembling the roulette than a mezzotint, ground-laid with the rockin^tool and scraped from dark to light in the present manner of the art. Siegen’ s innova- tion was led up to by the previous stipple work of Giulio Campagnola aijd Janus Lutma ; the roulette appears to have been used before his time ; and though he shared in the evolution of the rocking-tool, he was not the sole inventor of it. The earliest works referable to the method at the Print Room of the British Museum afford evidence, though inconclusive, that Prince Rupert, to whom Siegen showed his mode of work in 1654, and possibly also their common friend Th. Caspar von Fiirstenberger, and Rupert’s assistant, Vallerant Vaillant, were more or less concerned in the gradual development of mezzotint engraving. The rocking- tool was apparently improved by Abraham Blooteling, a Dutch painter and engraver of fine portrait mezzotints, who worked in Holland and in England about the year 1680.

Rupert brought the new art over to England at the Restora- tion, and the portrait of Charles II., dated 1C69, by William Sherwin, the first English mezzotinter, bears the engraver’s acknow- ledgment of his indebtedness to Rupert for the secrets of the method. Mezzotint continued to be practised for a while on the Continent, but the successors of Sherwin in England so excelled in it that it early acquired abroad the title of “la maniere anglaise,” and has since become an exclusively British art. Though used for transcribing the subject-pictures of the

lithography]

Creat Italian masters, and of Rembrandt, Vandyck, and Rubens, almost every kind of subject being later engraved in it, the staple production in mezzotint has always been the portrait. Until the middle of the 18th century the tools continued somewhat archaic, causing in the prints an appearance of warp and woof, like that of ill-woven material, which detracted from reality of representation. The coarseness and unequal depth of the "grounds" ofiered so much resistance to freedom of execution with the ' ' scraper ' ' that, though the early engravers were quite as good artists as their successors, painter-like touch was not conspicuous in the work until M'Ardell and the interpreters of Sir Joshua Reynolds had improved the tools and technique.

Except for the collector, therefore, the chief attraction in the prints of P. Place and Luttrell, Beckett and Williams, and later those of John Simon, John Smith, and John Faber, jun., who were the principal exponents of mezzotint in the last years of the seventeenth and first half of the eighteenth centuries, lies in their long series of portraits after Vandyck, Lely, Kneller, and the Dutch painters then practising in England, representing such interesting personages as Charles II. and Nell Gwynn, Addison and Pope, Congreve and Wycherley, Locke, and the great Duke of Marlborough.

The classics of mezzotint engraving are to be found amongst the best plates after Sir Joshua Reynolds by James M'Ardell, J. R. Smith and Valentine Green, the Watsons, Dickinson, Fisher, Dixon, and some others who worked during the last half of the 18th century. The brush-work of Reynolds was more in harmony with the mezzotint method than the slighter painting technique of Gainsborough and Romney, who were much less frequently engraved, perhaps because it is the highest technical difficulty in mezzotint to render the sharp edges of a sketch. For this reason a typical Gainsborough was never successfully engraved in the method. Though professional publishers and printers existed at this time and earlier, the word "excudit" on an old print implying "published," not "engraved," the authors of the " Sir Joshua" mezzotints in most cases printed, published, and sold their own works, and pure mezzotint, unmixed with etching, was almost exclusively the method they employed. Mezzotints were occasionally printed in colours, notably those engraved

later after George Morland, the primary object being to conceal the worn-out condition of the plates.

The departure from pure mezzotint and temporary decay of the art began when, towards the end of the eighteenth century, Richard Earlom, otherwise a fine artist in the traditional method, notably in translations of Vandyck and Wright of Derby, began to outline the details of his plates with stipple etching in order to avoid the labour and diflSculty of scraping them to a sharp edge, using the "ground" alone. Earlom, however, did not destroy the mystery of the rich velvety darks by etching into them. A demand then arose for larger editions than the soft copper plates would yield, and the engravers attempted to meet it by combining mezzotint with positive line-etching throughout the work, thus shortening the labour of scraping the details, and fortifying the darks with lines sunk below the surface of the plate. The harmony of line and tone in some of the prints in this style by S. W. Reynolds and Charles Turner, after Sir Joshua, Hoppner, and their contem- poraries, was more convincing than the later " mixed style " of Samuel Cousins, because there was a certain artistic significance in the etched line itself apart from the mezzotint tone, but every touch of line in a mezzotint does something to destroy the painter-like quality, and a decadence was in progress.

The same mixed method on copper was used by J. W. M. Turner in his Liber Studiorum series of landscape plates, his object being to rival the pen-and-wash drawings of Claude's Liber Veritatis. Turner, however, was not so practised in etching or mezzotint as the engravers before mentioned, and the etched foundation of the Liber plates was too strong for the mezzotint tone, destroying the breadth of the light, the richness of the darks, and the artistic "keeping" of the whole effect. It is the grand design of Turner reflected in the plates, rather than any quality of mezzotint or etching in them, which appeals to the artist and the connoisseur. Perhaps the greatest success in harmonizing line and tone in one plate was achieved by David Lucas in his " English Landscape" series of mezzotint after John Constable, in which he sharpened his details with the roulette, or with a slight line put in with the point of the scraper as scraping proceeded, retaining the pure "burr" in his darks. Lucas, like Samuel Cousins and his con- temporaries, was handicapped

by being compelled to work on the steel plates introduced in 1823, and this was the cause of the chief defect of his plates, the excessive opposition of black and white. The warm general tone which assisted the picturesqueness of the 18th-century mezzotints was lost by the use of steel, because the ink did not cling to it as it does to the more porous copper.. Steel being harder than copper, the rocking-tool penetrated less deeply, raising less " burr," and the consequent loss of force in the darks necessitated the scraping up of the lights to a higher

key to force contrast of effect, which was also enhanced by the use of very white paper and a coarse black ink. It was soon fouiid that the unfortified " burr," even on steel, would not yield the constantly increasing numbers of impressions demanded. The labour of scraping sharp lights was greatly enhanced, and though some pure mezzotints were engraved on steel, painter-like touch was practically unattainable on it, and the general effect was cold and uninteresting.

The early work of Samuel Cousins after Lawrence in the comparatively pure method, and the final development of the " mixed style " on steel in his later plates after Reynolds, Millais, and Landseer, are referred to in the article on Samuel Cousins.

For nearly forty years pure mezzotint ceased to be practised altogether, and the revival of it, which began in 1880, was led up to by the invention of steel-facing. The competition of photo- gravure, which steel-facing made a commercial possibility, for a time checked the new movement, but a photogravure, despite a mere surface resemblance to a mezzotint, is a photograph manipulated to imitate an engraving, and the qualities of artistic individuality are entirely wanting. In 1898 for the first time a Society of Mezzotint Engravers was formed to foster the art.

See also British 3Iezzotinto Portraits, by John Challoner Smith. London, 1878. This standard book of reference contains a long list of others at page xiv, part i. Lectures on Etching and Mezzo- tint, by Hubert von Herkomer, R.A. London, 1890. (The most useful work on the technique.) Etching, Engraving, and other Methods of Printing Pictures, by H. W. Singer and William Strang. London, 1897. On the Making of Etchings, by Frank Short. London, 1898. (Containing a slight reference to mezzotint

technique.) Art of Engraving, by T. H. Fielding. London, 1854. Masters of Mezzotint, by Alfred Whitman. London, 1898. A little anonymous book, A History of the Art of Engraving in M$zzotinto, from Its Origin to the Present Times [by Dr James Chelsum], Winchester, 1786, is of considerable interest. Works on the technique are somewhat elementary, and no complete history of the art exists. (g. p. e.)

LiTHOGBAPHT.

In Great Britain the art of lithography, as distinct from its numerous commercial uses, was for all practical purposes killed by the competition of wood-engraving, which had been so largely developed in the years after 1860. (See Illusteation.) In 1871 Thomas Way in- duced a number of artists to experiment with the pro- cess, the result being the publication of Hogarth Sketches, an interesting portfolio, which had, however, no immediate results. For some years no further attempt was made at a revival ; the only art productions in any sense of the word being supplements, generally in colour, ??? those to various periodicals, such as Vanity Fair, The Illustrated London News, and Tlie Graphic being the most noteworthy. There were also facsimile reproductions of popular pic- tures. But in both these categories the artist had little to do with the actual lithography, a notable exception, however, existing in the case of J. McNeill Whistler, whose contributions to Tlie Wliirlwind and other short- lived periodicals were entirely his personal work. In 1893 T. R. Way demonstrated the possibilities of the tise of lithographic transfer paper to a meeting of the Art Workers' Guild in London ; and the interest thus excited again encouraged many artists to try the method, both by this means and by working on the stone direct. It thus became possible for Great Britain to be represented at the Paris Centenary Exhibition of Lithography (1896) by a series of lithographic drawings which were at all events by artists of good position in other branches of the fine arts. Some have continued to practise lithography from time to time ; those of most note being Alphonse Legros, Frank Short, Oliver Hall, Will Eothenstein, Charles H. Shannon, William Strang, Thomas K. Way, and Charles J. Watson, the last a representative of a small circle of lithographers centred at Norwich who had kept up the old tradition. Working in England or France, the American artists, J. McNeill Whistler and Joseph Pennell,

must also be counted with the foregoing. The numerous productions of the former are of extreme delicacy and great

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excellence, within their own limits. In France the great traditions left by EaHet, E. Isabey, ►► Gavarni " (H. G. S. Chevalier), Daumier, and Decamps, had been maintained chiefly by H. Fantin-Latour, whose first lithograph was published in 1876. His work was hardly known or appre- ciated in England until recently, but the splendid series exhibited in the Centenary Exhibition at South Kensington Museum did not a little towards a proper realization of his true place as a lithographer. A great revival of litho- graphy in France came in the 'eighties, influenced mainly by the development of the pictorial poster; and thus the use of colour, so markedly absent in the unsubstantial effort of the English artists, became a characteristic of the French school, and of the Germans who took their cue from it. Among the leaders of this school may be sig- nalized A. Willette, H. de Toulouse-Lautrec, Steinlen, H. Eivifere, and A. Lunois. In Getmany the art was warmly adopted, and about the year 1891 began the ap- pearance of a series of plates in colour, many of extreme daring, but all of at least experimental interest. These were mainly done by artists of Munich, Dresden, and Carlsruhe, and are noteworthy for the attention paid in many of them to landscape effects, as compared with the French tendency to deal mainly with the figure. The chief exponents of the modern German school ►►► Menzel belonging essentially to the past ►►► are H. K. von Volk- mann, F. Unger, Hans Thoma, Cornelia . Paczka, G. Kampmann, H. Daur, and Otto Greiner. Th. van Hoytema and Jan Veth represent the same phase of art in Holland. Technically, the art of lithography stands very much where Senefelder left it, the only improve- ments being in the fine adjustment of printing machinery, and the adoption of certain modern photographic print- ing processes in combination with the old use of the stone. Successful work, especially in

colour, has also been pro- duced lately by algraphy ??? a process in which aluminium takes the place of the stone. (b. f. s.)

Wood-Engeaving.

Since 1877 the position of wood-engraving in England has wholly changed. At that time it was the chief means of book and newspaper illustration, and a frequent method of fine-art reproduction; but by the beginning of the 20th century it had been all but driven out of the field by "process" work of various kinds. It still flourishes in its commoner style for commercial and mechanical work ; it is still occasionally maintained in its finest form by a sympathetic publisher here and there, who deplores and would arrest its decay. But the photograph and its facsimile reproduction have captivated the public, who want "illustration" and who do not want "art." The great body of the wood-engravers have therefore found their occupation entirely gone, while the minority have found themselves forced to devote their skill to " re-touching " the process-block ??? sometimes carrying their work so far that the print from the finished block is a close imita- tion of a wood-engraving. This system has been carried farthest in America.

It is not only to considerations of economy that the supersession of engraving by " process " is due. The apparent superiority of truthfulness claimed by the photo- graph over the artist's drawing is a factor in the case ??? the public forgetting that a photographic print shows us what a thing or a scene looks like to the lens, rather than what it looks like to the two eyes of the spectator. The rank and file of the engravers ??? even those who can "engrave" after a picture as well as "cut" a "special artist's " sketch ??? have succumbed not only to the public, but to the artists themselves, who frequently insist upon the process-block for the translation of their work. They

seem to prefer the greater truth of outline (though not necessarily of tone) yielded by " process," to all the in- herent charm of the beautiful (and expensive) art of xylography.

In England a few engravers of high rank and ability still followed in 1901 the art which was raised to so high a pitch by W. J. Linton (died 1898).

Such were Mr Charles Eoberts, Mr Biscombe Gardner, Mr Comfort, Mr Ulrich, and a few more ??? the first two the better engravers for being also practising artists. But there is every reason to fear that if wood-engraving as a craft, for ordinary purposes, ceases to exist, wood-engraving as a fine art must disappear as well ; as there would be nothing to support the young craftsman during the years of ap- prenticeship and practice required to make an " artist " of him, and nothing to compensate him if he fail to attain at once the highest accomplishment.

Another circumstance which has contributed to the overthrow of wood-engraving in England is the rapture begotten of the extraordinaiy perfection to which the art had been brought in America. These engravings, pub- lished in magazines and books, having wide circulation in England, awakened not an intelligent but a foolish appreciation among the public. Just as Finden's over- refinement of engraving on steel killed his art by stripping it of all interest, so the unsurpassable perfection of the American wood-engraver, by the law of paradox, effectually stifled xylography in England. The reason is simple. With the object of " disindividualizing " himself, as he called it, the engraver sought to suppress his own recognizable manner of craftmanship when translating the work of the artist for the public ; and the more he succeeded in effacing himself, and the more he refined and elaborated his tech- nique and imitated textures, and the more he developed extreme minuteness and excessive dexterity (so as to secure faithfulness and smoothness), the more closely did the result approximate to a photograph. The result, in fact, became the reductio ad absurdum of the passion for the minute and the perfection of technique. The result was amazing in its completeness, but curiously grey and monotonous ; and matter-of-fact publishers and public alike preferred the photograph, which in their eyes did not differ so very much (except in being a little greyer and more monotonous) from the half-tone block, while the cost of the latter was but a fraction of that of the former. The extreme elaboration, satisfying a craving of an acrobatic kind, defeated its own end. The public were pleased, and the result has been disastrous for the art.

In England, in spite of the International Society of Wood-Engravers, there are but slight signs of a general revival, and it seems as if the art must be born again, so long as the public interest in photographs continues. Mr C. Eicketts has gone back to a Dlireresque, or perhaps Florentine, manner of the Early Renaissance wood-cut, while others are striving to begin engraving where Bewick began it. There is hope that the true art may be restored, but such revival will rather be based on a revolt against the greyness of the process-block, and the offensively shiny surface of the chalk-coated paper on which it is printed, than on any

aesthetic deHght in intelligent wood-engraving, its expressive line, its delicate, pearly tones, and its rich, fat blacks.

In America, where the power of resuscitation is great, the miraculous technical perfection brought about by IMr Timothy Cole and the late Frederick Juengling, as leaders of the school, has promptly given way to a greater feeling for art and a lesser worship of mechanical achievement, and wood-engraving is saved. Curiously enough, Mr Cole (himself, by the way, an Englishman by birth) was equally a leader in recognizing the danger which his own brilliant proficiency had helped to bring about. The

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"decadent" de luxe who had overwhelmed his art in the refinements which threatened to destroy it, and who had been seconded by the splendid printing-presses of America (which might without exaggeration be called instruments of precision), gave up what may be termed hyper-engrav- ing, and, surrendering his wonderful power of imitating surfaces and textures, Mr Cole changed his manner. ' He became broader in handling ; his example was followed by others, and wood-engraving in a few hands still prospers in the United States.

In France, where the art has reached the highest perfec- tion and the most consummate and logical development, it flourishes on the true artistic instinct of the engraver, on the taste of an intelligent and appreciative public, and on ofiicial recognition and encouragement. Nevertheless, it has been found necessary to establish a " Society of Wood- Engravers" (with a magazine of its own) to protect it against the inroad of the process-block. The art doubtless produces more engravers of skill than it can provide work for ; but that is evidence rather of vitality than of decay. M. Lep^re, M. Baude, M. Jonnard, are among the leaders who, in different styles of wood-engraving, sustain the extraordinarily high level which has been attained in France, and which is likely to be maintained by virtue of the encouragement on which it flourishes.

Florian, who died in 1900, was a man who successfully sought to obtain effects of tone rather than line, leaving masses of unengraved surface to enhance the delicate beauty of his pearly greys. But in rebelling against the mechanical style so much affected in Germany, of indicating roundness of form by curved lines carried at right angles to the convexity, and in substituting longitudinal lines of shading, he sacrificed a good deal of the logic of form-rendering, and started a method that has not been entirely successful.

In Germany the artistic standard is lower than in France. It is true that few outside Germany could model a head as finely as Herr M. Klinkicht in his own style of a judicious mingling of the black line and the white line ; but, as a rule, German engraving is far more precise, more mechanical, more according to formula, and more old- fashioned than that of either France or America. The art has been injured by the great " studios " or factories which flourish on strictly business principles, and which, in the education of the craftsman, have to some extent annihilated the artist. A few there are, however, of great ability and taste. The attempt to print wood- engravings in colours has done little to improve the status of the art. In other countries, however, " original " work has done much to raise the standard. Thus the work of Mr Elbridge Kingsley, who would sit down in the woods and engrave the scene before him directly on to the block, exercised no little influence in America. The similar ability of M. Lep^re to engrave directly from nature, whether from the trees of Fontainebleau Forest or the towers of Westminster, has been much appreciated in his own country and in England. The efforts at block-printing by M. Charpentier and others, not only with colour, but by reinforcing it with blocks that print neither lines nor colour but " blind " pattern, raised or depressed upon the paper, prove .that there is a movement afoot to seek new methods to interest the public. The immediate results may not be very serious ; yet the fact shows the existence of a vitality that gives hope for the future. But while the practice of dry-printing upon " surface paper " is maintained, it is hopeless to expect in the immediate future, in England at least, any permanently good results from orthodox wood-engraving.

See (in addition to those works cited in the 9th edition) : ??? W. J. Linton. The Masters of Wood- Engraving. Folio ; issued to sub- scribers only. London, Stevens, Charing Cross, 1889 and 1892. ??? W. J. Linton. Wood-Engraving. G. Bell & Sons, London, 1884. ???

W. J. Linton. History of Wood-Engraving in America. Chatto, 1882. ??? ??. G. Hamerton. Drawing and Engraving. A. & 0. Black, 1892. An extended reprint of the article on "Engraving" in the 9th edition of the Encyclopaedia Britannica. ??? P. G. Hamer- ton. The Oraphic Arts. Seeley, 1882. ??? J. E. Woodbebey. History of Wood-Engraving. S. Low, 1883. ??? W. S. Baker. American Engravers and their Work. Philadelphia, 1875.

(m. h. s.)

Line-Engeaving.

The record of the art of engraving in line upon copper or steel, since the ninth edition of this Encyclopaedia was published, is one of continued decay. The impulse therein referred to has faded away. Technical improvements, it was hoped, might save the art ; it was thought by some that the slight revival resultant on the turning back of the burin's cutting-point ??? whereby the operator pulled the tool towards him instead of pushing it from him ??? might affect much, in virtue of the time and labour saved by the de- vice. At the beginning of the 20th century it is seen that pictorial line-engraving in England is practically non- existent, and that the spasmodic demand by publishers for engravers to cut new plates is unanswered. There are cer- tainly a few men still working in line who are capable of touching-up old plates, and engraving new ones of a more or less mechanical kind. Mr C. W. Sherborn, the exquisite and facile designer and engraver of book-plates, has scarcely been surpassed in his own line, but his art is mainly heraldic, and he is himself a veteran. There are now no men capable of such work as that with which Doo, J. H. Robinson, and their fellows maintained the credit of the English school. Line-engraving has been killed by etch- ing, mezzotint, and that bastard form of line-engraving known as the " mixed method" ??? a combination of etching, graving, and machine-ruling, such as is seen in

Thomas Landseer's " Stag at Bay." The disappearance of the art is due not so much to the artistic objection that the per- sonality of the line-engraver stands obtrusively between the painter and the public ; it is rather that the public refuse to wait for several years for the proofs for which they have subscribed, when by another method they can obtain their plates more quickly. An important line plate may occupy a prodigious time in the engraving. Robinson's "Napoleon and the Pope" took about twelve years. The invention of steel-facing a copper plate would now enable the engraver to proceed more expeditiously ; but even in this case he can no more compete with the etcher than the mezzotint-engraver can keep pace with the photogravure manufacturer. The Royal Academy has within recent years withdrawn from the list of school prizes the offer of a medal for line-engraving, for which for a long while pre-viously there had been no competition ; the late Mr Lumb Stocks, R.A., and the living Mr F. Stacpoole, (retired) A.R.A. (who is best known for his plates after Briton Riviere's " Circe," Lady Butler's "Roll-Call," andHolman Hunt's " Shadow of the Cross"), will have no successors on the list of Academicians ; and the privilege of Academic recognition so'fiercely won by Sir Robert Strange will lapse for lack of claimants". The Art Union of London has given what encouragement it could ; but with the death of F. Bacon (1887) and J. Stephenson (1886) it was evident that all hope was gone. John Saddler came at last, in spite of his capacity to do original work, to spend most of his time in assisting Thomas Landseer to rule the skies on his plates, simply because there was not enough line-engraving to do. Since then there was some promise of a revival, and Mr Bourne engraved a few of the pictures by Gustave Dore. But little followed. It is not generally known that the last of the line-engravers of Turner's pictures died in the person of Sir Daniel Wilson, who, recognizing the hopelessness of his early profession, laid his graver aside, and in due time

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left Europe for Canada and eventually became President of the University of Toronto (died 1892).

If line-engraving still flourishes in France, it is due not a little to official encouragement and to intelligent foster- ing by collectors and connoisseurs. The prizes offered by the ificole des Beaux Arts would probably not suffice to give vitality to the art but for the employment afforded to the finished artist by the " Chalcographie du Musee du Louvre," in the name of which commissions are judiciously distributed. At the same time, it must be recognized that although French gravers are little less busy than they were in days when line-engraving was the only " important " method of picture-translation, they work for the most part for much smaller rewards. Moreover, the class of the work has entirely changed, partly through the reduction of prices paid for it, partly through the change of taste and fashion, and partly through the necessities of the situation. That is to say, that public impatience is but a partial factor in the abandonment of the fine broad sweeping trough cut deep into the copper which was characteristic of the earlier engraving, either simply cut or crossed 'diagonally so as to form the series of "lozenges" typical of engraving at about its finest and grandest period. That method was slow ; but not less slow was the shallower work rendered possible by the steel plate or the steel-faced copper plate, by reason of the much greater degree of elaboration of which such plates were capable, and which the public was taught ??? mainly by Finden ??? to expect. The French engravers were therefore driven at last to simplify their work if they were to satisfy the public and live by the burin. To compensate for loss of colour, the art developed in the direction of elegance and refinement. Gaillard (died 1887), Blanchard, and Alphonse Francois (died 1888) were perhaps the earliest chiefs of the new school, the character- istics of which are the substitution of exquisite greys for the rich blacks of old, simplicity of method being often allied to extremely high elaboration. Yet the aim of the modern engraver has always been, while pushing the capability of his own art to the farthermost limit, to retain throughout the individual and personal qualities of the master whose work is translated on the plate. The height of perfection to which the art is reached is seen in the triptych of Mantegna by M. Achille Jacquet, to whom may perhaps be accorded the first place among several engravers of the front rank.

This "Passion " (from the three pictures in the Louvre and at Tours, forming the predella of the San Zeno altarpiece in Verona) not only conveys the forms, sentiment, and colour of the master, but succeeds also in rendering the peculiar luminosity of the originals. M. Jacquet, who gained the Prix de Home in 1870, has also translated the pictures of Sir Joshua Reynolds, and has engraved fine plates after Paul Dubois, Cabanel, Bouguereau, Meissonier, and Detaille. The free- dom of much of his work suggests an affinity with etching and dry-point ; indeed, it appears that he uses the etching- needle and acid to lay in some of his groundwork and out- lines. M. Leopold Flameng's engraving after Jan van Eyck's " Virgin with the Donor," in the Louvre, is one of the most admirable works of its kind, retaining the quality and sentiment of the master, extreme minuteness and elaboration notwithstanding. M. Jules Jacquet is known for his work after Meissonier (especially the " Friedland") and after Bonnat ; M. Adrien Didier for his plates after Holbein (" Anne of Cleves"), Raphael, and Paul Veronese, among the Old Masters, and Bonnat, Bouguereau, and Roybet among the new. M. Jazinski (Botticelli's " Primavera"), M. Sulpis (Mantegna and Gustave Moreau), M. Patricot (Gustave Moreau), M. Burney, and M. Cham- poUion (died 1901), are among the leaders of the modern school. Their object is to secure the faithful transcript of the painter they reproduce, while readily sacrificing the

power of the old method, which, whatever its force and its beauty, was easily acquired by mediocre artists of techni- cal ability who were nevertheless unable to appreciate or reproduce anything beyond mechanical excellence.

The Belgian School of engraving is not without vitality. The veteran M. Gustave Biot is equally skilful in portrai- ture and subject (engraving after Gallait, Cabanel, Gustave Dore, among his best work); M. A. M. Danse has exe- cuted plates after leading painters, and has elaborated an effective " mixed method " of graver-work and dry-point ; and M. de Meerman has engraved a number of good plates ; but private patronage is hardly sufficient in Belgium to maintain the school in a high state of prosperous efficiency.

In Germany, as might be expected, line-engraving retains not a little of its popularity in its more orthodox form. The novel Stauff er-Bern method, in which freedom and lightness are obtained with such delicacy that the fine lines, employed in great numbers, run into tone, and yield a supposed advantage in modelling, has not been without appreciation. But the more usual virtue of the graver has been best sup- ported, and many have worked in the old-fashioned manner. Friedrich Zimmermann (died 1887) began his career by engraving such prints as Guido Eeni's " Ecce Homo " in Dresden, and then devoted himself to the translation of modern German painters. Rudolf Pf nor was an ornament- ist representative of his class ; and Joseph Kohlschein, of Dtlsseldorf, a typical exponent of the intelligent conserva- tive manner. His " Marriage at Cana " after Paul Veronese, " The Sistine Madonna" after Raphael, and " St Cecilia " after the same master, are all plates of a high order.

In Italy the art is well-nigh as moribund as in England. When Signer Vittorio Pica (of Naples) and Signer Conconi (of Milan) have been named, it is difficult to mention other successors to the fine school of the 19th century which followed Piranesi and Volpato. A few of the pupils of Rosaspina and Paolo Toschi lived into the last quarter of the century, but to the present generation Asiolo, Jesi, C. Raimondi, L. Bigola, and Antonio Isac are remembered rather for their efforts than for their success in supporting their art against the combined opposition of etching, process, and public indifference.

Outside of Europe line-engraving can no longer be said to exist. Here and there a spasmodic attempt may be made to appeal to the artistic appreciation of a limited public; but no general attention is paid to such efforts, nor, it may be added, are these inherently worthy of much notice. There are still a few who can engrave a head from a photograph or drawing, or a small engraving for book-illustration; there are more who are highly proficient in mechanical engraving for decorative purposes ; but the engraving-machine is fast superseding this class. In short, the art of worthily trans- lating a fine painting, outside France, Belgium, Germany, and perhaps Italy, can scarcely be said to survive.

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(m. h. s.)

Ennis (Gaelic, Lmls, an island; Irish, Ennis and Inish), an inland town and urban sanitary district in the county of Clare, Ireland, on the river Fergus, 2.~> miles west-north-west of Limerick by rail. It ceased to be a parliamentary borough in 1886. Population, about 6460.

Enniskillen, a market-town and urban sanitary district in the county of Fermanagh, Ireland, or an island

in the river connecting the upper and lower lakes of Lough Erne, 102 miles north-west of Dublin by rail. It ceased to be a parliamentary borough in 1885. Steamers now ply between Enniskillen and Belleek on the lower lake, and between Enniskillen and Knockninny on the upper lake. Population (1881), 6900; (1891), 6570; (1901), about 5339.

Enns, an ancient town in Upper Austria (the Eoman Laureacum), on the Enns near its confluence with the Danube. It possesses the oldest charter (1212) of any town in the monarchy. The walls are said to have been built with the ransom paid by England for the release of Richard Cceur de Lion. It has an old Gothic church, a 16th-eentury castle, and a Eathhaus erected in 1565. There are numerous ironworks in the adjoining Enns valley. Population (1890), with suburbs, 4674 ; (1900),

4371.

Enschede, a town in the province of Overyssel, Netherlands, near the Prussian frontier, about 45 miles south-east of Zwolle. As a centre of the cotton-spimiing and weaving industry it has flourished greatly, the popu- lation (24,263 in 1900) having quadrupled since 1875. The transport of coal has been much increased by the construction of a railway to the coal- fields of the Euhr, and over 44,000 tons are now carried annually. A new park has been opened, more especially for the benefit of the working classes, and an industrial trade school has been established.

Entomostraca. ??? This term, as now restricted, includes the Branchiopoda, Ostracoda, and Copepoda. The Ostracoda have the body enclosed in a bivalve shell- covering, and normally unsegmented. The Branchiopoda have a very variable number of body-segments, with or without a shield, simple or bivalved, and some of the post-oral appendages normally branchial. The Copepoda have normally a segmented body, not enclosed in a bivalved shell-covering, the segments not exceeding eleven, the limbs not branchial.

Under the heading Ceustacea the Entomostraca have already been distinguished not only from the Thyrostraca or Cirripedes, but also from the Malacostraca, and an intermediate group of which the true position is still dis- puted. The choice is open to maintain the last as an independent subclass, and to follow Glaus in calling it the Leptostraca, or to introduce it among the Malacostraca as the Nebaliacea, or with Packard and Sars to make it an entomostraean subdivision under the title Phyllo- carida. At present it comprises the single family Neba- liidae. The bivalved carapace has a jointed rostrum, and covers only the front part of the body, to which it is only attached quite in front, the valve-like sides being under control of an adductor muscle. The eyes are stalked and movable. The first antennae have a lamellar appendage at the end of the peduncle, a decidedly non- entomostracan feature. The second antennae, mandibles, and two pairs of maxillae may also be claimed as of malacostracan type. To these succeed eight pairs of foliaceous branchial appendages on the front division of the body, followed on the hind division by four pairs of powerful bifurcate swimming feet and two rudimentary pairs, the number,

though not the nature, of these append- ages being malacostracan: On the other hand, the two limbless segments that precede the caudal furca are decidedly non-malacostracan. The family was long limited to the single genus Nehalia (Leach), and the single species N. bipes (0. Fabricius). / Eecently Sars has added a Norwegian species, JSf. typhlops, not blind but weak-eyed. There are also now two more genera, Paranebalia (Glaus, 1880), in which the branchial feet are much longer than

in Nehalia, and Nebaliopsis (Sars, 1887), in which they are much shorter. All the species are marine.

Beanchiopoda. ??? In this order, exclusion of the Phyllo- carida will leave three suborders of very unequal extent, the Phyllopoda, Cladocera, Branchiura. The constituents of the last have often been classed as Gopepoda, and among the Branchiopods must be regarded as aberrant, since the "branchial tail" implied in the name has no feet, and the actual feet are by no means obviously branchial.

Phyllopoda. ??? This " leaf ~~footed " suborder has the ap~~ pendages which follow the second maxillae variable in number, but all foliaceous and branchial. The develop- ment begins with a free nauplius stage. In the outward appearance of the adults there is great want of uniformity, one set having their limbs sheltered by no carapace, another having a broad shield over most of them, and a third having a bivalved shell-cover within which the whole body can be enclosed. In accord with these dif- ferences the sections may be named Gymnophylla, Noto- phylla, Gonchophylla. The equivalent terms applied by Sars are Anostraca, Notostraca, Conchostraca, involving a termination already appropriated to higher divisions of the Grustacean class, for which it ought to be reserved.

1. Crymnophylla. ??? These singular crustaceans have long soft flexible bodies, the eyes stalked and movable, the first antennae small and filiform, the second lamellar in the female, in the male prehensile ; this last character gives rise to some very fanciful developments. There are three families, two of which form companies rather severely limited. Thus

the Polyartemiidse, which compensate themselves for their stumpy little tails by having nineteen instead of the normal eleven pairs of branchial feet, consist exclusively of Polyariemia forcipata (Fischer, 1851). This species from the high north of Europe and Asia carries green eggs, and above them a bright pattern in ultramarine (Sars, 1896, 1897). The Thamnocephalidse have likewise but a single species,' Thamnocephalus platyurus (Packard, 1877), which justifies its title " bushy-head of the broad tail " by a singularity at each end. Forward from the head extends a long ramified appendage described as the " frontal shrub," backward from the fourth abdominal segment of the male spreads a fin-like expansion which is unique. In the ravines of Kansas, pools supplied by torrential rains give birth to these and many other phyllopods, and in turn " millions of them perish by the drying up of the pools in July " (Packard). The remaining family, the Branchipodidse, includes eight genera. In the long familiar Branchipus, Chirocephalus, and Streptocephalus the males have frontal appendages, but these are wanting in the "brine-shrimp" Artemia, and the same want helps to distinguish Branchinecta (Verrill, 1869) from the old genus Branchipus. Of Branchiopsyllus (Sars, 1897) the male is not yet known, but in his genera of the same date, the Sihevian Artemiopsis and the South African Branchipodopsis (1898), there is no such appendage. Of the last genus the type species B. hodgsoni belongs to Cape Colony, but the specimens described were born and bred and observed in Norway. For the study of fresh-water Entomostraca large possibilities are now opened to the naturalist. A parcel of dried mud, coming for example from Palestine or Queensland, and after an indefinite interval of time put into water in. England or elsewhere, may yield him living forms, both new and old, in the most agreeable variety. Some caution should be used against confounding accidentally introduced indigenous species with those reared from the imported eggs. Those, too, who send or bring the foreign soil should exercise a little thought in the choice of it, since dry earth that has never had any Entomostraca near it at home will not become fertile in them by the mere fact of exportation.

2. Notophylla. ❓❓❓ In this division the body is partly covered by a broad shield, united in front with the head ; the eyes are sessile, the first antennae are small, the second rudimentary or wanting ; of the numerous

feet, sometimes sixty-three pairs, exceeding the number of segments to which they are attached, the first pair are more or less unlike the rest, and in the female the eleventh have the epipod and exopod (flabellum and sub-apic41 lobe of Lankester) modified to form an ovisac. Development begins with a nauplius stage. Males are very rare. The single family Apodidse contains only two genera, Apus and its very near neighbour Lepidwns. Apus australiensis (Spencer and Hall, 1896) may rank as the largest of the Entomostraca, reaching in the male, from front of shield to end of telson, a length of 70 mm., in the female of 64 mm. In a few days, or at most a fortnight, after a rainfall numberless

specimens of these sizes were found swimming about, "and as not' a single one was to be found in the water-pools prior to the rain, these must have been developed from the egg." Similarly, in Northern India Apus himalayanus was "collected from a stag- nant pool in a jungle four days after ►► shower of rain had fallen," following a drought of four months (Packard).

3. Conchophylla. ►►► Though concealed within the bivalved shell-cover, the mouth-parts are nearly as in the Gymnophylla, but the flexing of the caudal part is in contrast, and the biramous second antenna correspond with what is only a larval character in the other phyllopods. In the male the first one or two pairs of feet are modified into grasping organs. The small ova are crowded beneath the dorsal part of the valves. The development usually begins with a nauplius stage (Sars, 1896, 1900). There are four families; ►►► (a) The Limnadiidae, with feet from 18 to 32 pairs, comprise four (or five) genera. Of these, Limnadella (Girard, 1855) has a single eye. It remains rather obscure, though the type species originally " was discovered in great abundance in a roadside puddle subject to desiccation." Lim- nadia (Brongniart, 1820) is supposed to consist of species exclu- sively parthenogenetic. But when asked to believe that males never occur among these amazons, one cannot but remember how hard it is to prove a negative. (&) The Lynceidae, with not more than

twelve pairs of feet. This family is limited to the species, widely distributed, of the single genus Lynceus, established by 0. F. MuUer in 1776 and 1781, and first restricted by Leach in 1816 in the Encycloprndia Britannica (art. Annulosa, of that edition). Leach there assigns to it the single species L. hrachyurus (Miiller), and as this is included in the genus Limnetis (Loven, 1846) , that genus must be a synonym of Lynceus as restricted, (c) Lept- estheriidse. Estheria (Rttppell, 1837) was instituted for the species daJialacensis, which Sars includes in his genus Leptestheria (1898) ; but Estheria was already appropriated, and of its synonyms Cyzicus (Audouin, 1837) is lost for vagueness, while Isaura (Joly, 1842) is also appropriated, so that Leptestheria becomes the name of the typical genus, and determines the name of the family. {d) CyclestheriidEe. This family consists of the single species Cyclestheria hislopi (Baird), reported from India, Ceylon, Celebes, Australia, East Africa, and Brazil. Sars (1887) having had the opportunity of raising it from dried Australian mud, found that, unlike other phyllopods, but like the Cladocera, the parent keeps its brood within the shell until their full development.

Cladocera. ??? In this suborder the head, is more or less distinct, the rest of the body being in general laterally compressed and covered by a bivalved test. The title " branching horns " alludes to the second antennae, which are two-branched except in the females of Holopedium, with each branch setif erous, composed of only two to four joints. The mandibles are without palp. The pairs of feet are four to six. The eye is single, and in addition to the eye there is often an "eye-spot," Monospilus being unique in having the eye-spot alone and no eye, while Leydigiopsis (Sars, 1901) has an eye with an eye-spot equal to it, or larger. The heart has a pair of venous ostia, often blending into one, and an anterior arterial aorta. Respiration is conducted by the general surface, by the branchial lamina (external branch) of the feet, and the vesicular appendage (when present) at the base of this branch. The "abdomen," behind the limbs, is usually very short, occasionally very long. The " postabdomen," marked olf by the two postabdominal setae, usually has teeth or spines, and ends in two denticulate or ciliate claws, or it may be rudimentary, as in Polyphemus. Many species have a special glandular organ at the back of the head, which Sida crystallina uses for attaching itself to various objects. The Leydigian or nuchal organ is supposed to be

auditory and to contain an otolith. The female lays two kinds of eggs ___ " summer-eggs," which develop without fertilization, and " winter-eggs " or rest- ing eggs, which require to be fertilized. The latter in the Daphniidae are enclosed in a modified part of the mother's shell, called the ephippium from its resemblance to a saddle in shape and position. In other families a less elaborate case has been observed, for which Mr Scourfield has proposed the term protoephippium. In Leydigia he has recently found a structure almost as complex as that of the Daphniidae. In some families the resting eggs escape into the water without special covering. Only the

embryos of Leptodora are known to hatch out in the nauplius stage. Penilia (Dana, 1849) is perhaps the only exclusively marine genus. The great majority of the Cladocera belong to fresh water, but their adaptability is large, since 3Toina rectirostris (0. F. Miiller) can equally enjoy a pond at Blackheath, and near Odessa live in water twice as salt as that of the ocean. In point of size a Cladoceran of 5 mm. is spoken of as colossal.

Dr Jules Richard in his revision (1895) retains the sections, proposed by Sars in 186"^ Calyptomera and Gymnomera. The former, with the feet for the most part concealed by the carapace, is subdivided into two tribes, the Ctenopoda, or " comb-feet," in which the six pairs of similar feet, all branchial and non- prehensile, are furnished with sets arranged like the teeth of a comb, and the Anomopoda, or "variety-feet," in which the front feet differ from the rest by being more or less prehensile, without branchial laminse.

The Ctenopoda comprise two families: (a) the Holopediidse, with a solitary species, Holopedium gibberum (Zaddaoh), queerly clothed in a large gelatinous involucre, and found in mountain tarns all over Europe, in large lakes of N. America, and also in shallow ponds and waters at sea-level ; (6) the Sididae, with no such involucre, but with seven genera, and rather more than twice as many species. Of Diaphanosoma modiglianii Richard says that at different points of Lake Toba in Sumatra millions of specimens were obtained, among which he had not met with a single male.

The Anomopoda are arranged in four families, all but one very extensive, (a) DaphniidEe. Of the seven genera, the cosmopolitan Daphnia contains about 100 species and varieties, of which Mr Thomas Scott (1899) observes that "scarcely any of the several characters that have at one time or another been selected as affording a means for discriminating between the different forms can be relied on as satisfactory." Though this may dishearten the systematist, Mr Scourfield (1900) reminds us that "It was in a water-flea that Metschnikoff first saw the leucocytes (or phagocytes) trying to get rid of disease germs by swallowing them, and was so led to his epoch-making discovery of the part played by these minute amoeboid corpuscles in the animal body." For Scapholeberis mucronata (0. F. Miiller), Mr Scourfield has shown how it is adapted for movement back downwai'ds in the water along the under side of the surface-film, which to many small crustaceans is a dangerously disabling trap. (6) Bosminidse. To Bosmina (Baird, 1845) Richard adds Bosminopsis, in 1895. (c) MacrotrichidaB. In this family Macrothrix (Baird, 1843) is the earliest genus, among the latest being Grimaldina (Richard, 1892) and Jheringula (Sars, 1900). Dried mud and vegetable dfibris from S. Paulo in Brazil supplied Sars with representatives of all the three in his Norwegian aquaria, in some of which the little Macrothrix elegans "multiplied to such an extraordinary extent as at last to fill up the water with immense shoals of individuals." "The appearance of male specimens was always contemporary with the first ephippial formation in the females." For Streblocerus pygmceus, grown under the same conditions, Sars observes : "This is perhaps the smallest of the Cladocera known, and is hardly more than visible to the naked eye," the adult female scarcely exceeding 0'25 mm. Yet in the next family Alonella nana (Baird) disputes the palm and claims to be the smallest of all known Arthro- poda. (d) Chydoridse. This family, so commonly called Lynceidse, contains a large number of genera, among which one may usually search in vain, and rightly so, for the genus Lynceus. The key to the riddle is to be found in the Encyclopaedia Britannica for 1816. There, as above explained. Leach began the subdivision of Mliller's too comprehensive genus, the result being that Lynceus belongs to the Phyllopoda, and Chydorns (Leach, 1816) properly gives its name to the present family, in which the doubly con- voluted intestine is so remarkable. Of its many genera, Leydigia, Leydigiopsis, Ilonospilus, have been already mentioned. Dadaya macrops

(Sars, 1001), from South America and Ceylon, has a very large eye and an eye-spot fully as large, but it is a very small creature, odd in its behaviour, moving by jumps at the very surface of the water. “To the naked eye it looked like a little black atom darting about in a most wonderful manner.”

The Gymnomera, with a carapace too small to cover the feet, which are all prehensile, are divided also into two tribes, the Onychopoda, in whjch the four pairs of feet have a toothed maxillary process at the base, and the Haplopoda, in which there are six pairs of feet, without such a process. To the Polyphemidse, the well- known family of the former tribe, Sars in 1897 added two remark- able genera, Cercopagis, meaning ” tail with a sling,” and Apagis, ” without a sling,” for seven species from the Sea of Azov. The Hap- lopoda likewise have but a single family, the Leptodoridse, and this has but the single genus Leptodora (Lilljeborg, 1861). Dr Richard (1895, 1896) gives a Cladoceran bibliography of 601 references.

ENTOMOSTEACA

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Branchiura. ??? This term was introduced by Thorell in 1864 for the Argulidse, a family which had been trans- ferred to the Branchiopoda by Zenker in 1854, though some- times before and since united with the parasitic Copepoda. Though the animals have an oral siphon, they do not carry ovisacs like the siphon- ostomous copepods, but glue their eggs in rows to extra- neous objects. Their lateral, compound, feebly movable eyes agree with those of the Phyllopoda. The family are described by Glaus as ” in- termittent parasites,” be- cause when gorged they leave their hosts, fishes or frogs, and swim about in freedom for a considerable period. The long-known Argulus (0. F. Milller) has the second maxillae trans- formed into suckers, but in s,,,,, nolopsrauarum(.StuUm^nn).

Dolops (Audoum, 1837)

(Fig. 1), the name of which supersedes the more familiar Gyropeltis (Relier, 1857), these effect attachment by ending in strong hooks

(Bouvier, 1897). A third genus, Chonopeltis (Thiele, 1900), has suckers, but has lost its first antennae, at least in the female.

OsTKAcoDA. ??? The body, seldom in any way segmented, is wholly encased in a bivalved shell, the caudal part strongly inflexed, and almost always ending in a furca. The limbs, including antennae and mouth organs, never exceed seven definite pairs. The first antennae never have more than eight joints. The young usually pass through several stages of development after leaving the egg, and this commonly after, even long after, the egg has left the maternal shell. Parthenogenesis is frequent.

The four tribes instituted by Sars in 1865 were reduced to two by G. W. Mliller in 1894, the Myodocopa, which almost always have a heart, and the Podocopa, which have none.

Myodocopa. ??? These have the furcal branches broad, lamellar, with at least three pairs of strong spines or ungues. Almost always the shell has a rostral sinus. Muller divides the tribe into three families, CypridinidEe, Halocypridse, and the heartless Polycopidse, which constituted the tribe Cladocopa of Sars. Erom the first of these Brady and Norman distinguish the Asteropidse (Fig. 3), re- markable for seven pairs of long branchial leaves which fold over the hinder extremity of the animal, and the Sarsiellidse, still some- what obscure, besides adding the Rutidermatidse, knowledge of which is based on skilful maceration of minute and long-dried speci- mens. The halooypridse are destitute of compound lateral eyes, and have the sexual orifice unsymmetrically placed.

Podocopa. ??? In these the furcal branches arelinear or rudimentary, the shell is without rostral sinus, and, besides distinguishing charac- ters of the second antennas, they have always a branchial plate well developed on the first maxillse, which is inconstant in the other tribe. There are five families : ??? (a) Cyprididas (? including Cypri- dopsidse of Brady and Norman). In some of the genera partheno- genetic propagation is carried to such an extent that of the familiar Cypris it is said, "until quite lately males in this genus were un- known ; and up to the present time no male has been found in the British Islands " (Brady and Norman, 1896).

On the other hand, the ejaculatory duct with its verticillate sac in the male of Cypris and other genera is a feature scarcely less remarkable. (6) Baird- iidsB, which have the valves smooth, with the hinge untoothed. (c) Cytheridse (? including Paradoxostomatidje of Brady and Norman), in which the valves are usually sculptured, with toothed hinge. Of this family the members are almost exclusively marine, but Limnicythere is found in fresh water, and Xestoleberis bromeliarum (Fritz Muller) lives in the water that collects among the leaves of Bromelias, plants allied to the pine-apples, (d) Dar- winulidse, including the single species Darwinulastevensoni, Brady and Robertson, described as " perhaps the most characteristic Ento- mostracan of the East Anglian Fen District." (e) Cytherellidae, which, unlike the Ostracoda in general, have the hinder part of the

body segmented, at least ten segments being distinguishable in the female. They have the valves broad at both ends, and were placed by Sars in a separate tribe, called Platycopa.

The range in time of the Ostracoda is so extended that, in Gr. W. MtlUer's opinion, their separation into the families now living may have already taken place in the Cambrian period. Their range in space, including carriage by birds, may be coextensive with the distribution of water, but it is not known what height of temperature or how mtich chemical adulteration of the water they can sustain, how far they can penetrate underground, nor what are the limits of their activity between the floor and the surface of aquatic expanses, fresh or saline. In individual size they have never been important, and of living forms the largest is one of recent discovery, Crossophorus africanus, aCypridinid about three-fifths of an inch, 155 mm. long; but a length of one or two millimetres is more common, and it may descend to the seventy-fifth of an inch. By multitude they have been, and still are, extremely important.

Though the exterior is more uniform than in most groups of Crustacea, the bivalved shell or carapace may be strongly calcified and diversely sculptured (Fig. 2), or membranaceous and polished, hairy or smooth, oval or round or bean-shaped, or of some less simple pattern ; the valves may fit neatly, or one overlap the other, their hinge may have teeth or be

edentulous, and their front part may be excavated for the protrusion of the antennae or have no such " rostral sinus." By various modifications of their valves and appendages the creatures have become adapted for swimming, creep- ing, burrowing, or climbing, some of them combining two or more of these activities, for which their structure seems at the first glance little adapted. Considering the imprisonment of the ostracod body within the valves, it is more surprising that the Asteropidae and Cypridinidse should have a pair of compound and sometimes large eyes, in addition to the median organ at the base of the "frontal tentacle," than that other members of the group should be limited to that median organ of sight, or have no eyes at all. The median eye when present may have or not have a lens, and its three pigment- cups may be close together or wide apart and the middle one rudimentary. As might be expected, in thickened and highly em- bossed valves thin spaces occur over the visual organ. The frontal organ varies in form and apparently in function, and is sometimes absent. The first antennse, ac- cording to the family, may assist in walking, swimming, burrowing, climbing, grasping, and besides they carry sensory setae, and sometimes they have suckers oiUheir setae (see Brady and Norman on Oypridina norvegica). The second antennae are usually the chief motor-organs for swimming, walking, and climbing. The mandibles are normally five-jointed, with remnants of an outer branch on the second joint, the biting edge varying from strong development to evanescence, the terminal joints or "palp" giving the organ a leg-like appearance and function, which disappears in suctorial genera such as Paracytherois. The variable first maxillae are seldom pediform, their function being concerned chiefly with nutrition, sensation, and respiration. The variability in form and function of the second maxillae is sufBciently shown by the fact that G. W. Muller, our leading authority, adopts the confusing plan of calling them second maxillae in the Cypridinidae (including Asteropidae), maxillipeds in the Halocypridae and Cyprididae, and first legs in the Bairdiidae, Cytheridae, Polycopidae, and Cytherel- lidae, so that in his fine monograph he uses the term first leg in two quite different senses. The first legs, meaning thereby the sixth pair of appendages, are generally pediform and loco- motive, but sometimes unjointed, acting as a kind of brushes to cleanse the furca, while in the Polycopidae they are entirely wanting. The second legs are sometimes wanting, sometimes pediform and locomotive, sometimes

strangely metamorphosed into the "vermiform organ," generally long, many-jointed, and distally armed with retroverted spines, its function being that of an extremely mobile cleansing foot, which can insert itself among the eggs in the brood-space, between the branchial leaves of Asterope (Fig. 3), and even range over the external: surface of the valves. The " brush-formed " organs of the Podocopa are medially placed, and, in spite of their sometimes forward situation, Miiller believes

Fig.

2, ??? Cyihereis omaia (G. W. Muller). One eye-space is shown above on the left.

among other possibilities, that they and the penis in the Cypri- dinidse may be alike remnants of a third pair of legs, not homologous with the penis of other Ostracoda (Podocopa in- cluded). The furca is, as a rule, a powerful motor organ, and has its laminae edged with strong teeth (ungues) or setae, or both. The young, though born with valves, have at first a nauplian body, and pass through various stages to ma- turity.

Brady and Norman, in their Monograph of the Ostracoda of the North Atlantic and North- western Europe, 1889, give a bibliography of 125 titles, and in the second part, 1896, they give 55 more. The lists are not meant to be exhaustive, any more than G. W. Miiller's lit- erature-list of 125 titles in 1894. They do not refer to Latreille, 1802, with whom the term Os- tracoda originates.

Fig. Z. ???Asterope artkuri. Left Talve removed. M, end of ad- ductor muscle; OC, eye; AI, second antenna; MX. 1, first maxilla ; MX. 2, second maxilla ; P. 1, first foot ; VO, vermiform organ; BR, seven branchial leaves ; F, projecting ungues of the furca.

CopEPODA. ??? The body is not encased in a bivalved shell ; its articulated segments are at most eleven, those behind the genital segment

being without trace of limbs, but the last almost always carrying a furca. Sexes separate, fertilization by spermatophores. Ova in single or double or rarely several packets, attached as ovisacs or egg-strings to the genital openings, or enclosed in a dorsal marsupium, or deposited singly or occasionally in bundles. The youngest larva; are typical nauplii. The next, the copepodid or cyclopid, stage is characterized by a cylin- drical segmented body, with fore- and hind-body distinct, and by having at most six cephalic limbs and two pairs of swimming-feet.

The order thus defined (see Giesbrecht and Schmeil, Das Tierreich, 1898), with far over a thousand species (Hansen, 1900), embraces forms of extreme diversity, although, when species are known in all their phases and both sexes, they constantly tend to prove that there are no sharply dividing lines between the free-living, the semi-parasitic, and those which in adult life are wholly parasitic and then sometimes grotesquely unlike the normal standard. Giesbrecht and Hansen have shown that the mouth-organs consist of mandibles, first and second maxillae, and maxillipeds ; and Claus himself re- linquished his long-maintained hypothesis that the last two pairs were the separated exopods and endopods of a single pair of appendages. Thorell's classification (1859) of G-nathostoma, Poecilostoma, Siphonostoma, based on the mouth-organs, was long followed, though almost at the outset shown by Claus to depend on the erroneous sup- position that the Poecilostoma were devoid of mandibles. Brady added a new section, Choniostomata, in 1894, and another, Leptostomata, in 1900, each for a single species. Canu in 1892 proposed two groups, Monoporodelphya and Diporodelphya, the copulatory openings of the female being paired in the latter, unpaired in the former. It may be questioned whether this distinction, however important in itself, would lead to a satisfactory grouping of families. In the same year Giesbrecht proposed his division of the order into Gymnoplea and Podoplea.

In appearance an ordinary Copepod is divided into fore- and hind-body, of its eleven segments the composite first being the head, the next five constituting the thorax, and the last five the abdomen. The coalescence of segments, though frequent, does not after a little experience mate- rially confuse the counting. But there is this]>eculiarity, that the middle

segment is sometimes continuous with the broader fore-body, sometimes with the narrower hind-body.

*In the former case the hind-body, consisting only of the abdomen, forms a pleon or tail-part devoid of feet, and the species so constructed are Gymnoplea, those of the naked or footless pleon. In the latter case the middle segment almost always carries with it to the hind-body a pair of rudimentary limbs, whence the term Podoplea, meaning species that have a pleon with feet. It may be objected that hereby the term pleon is used in two different senses, first applying to the abdomen alone and then to the abdomen plus the last thoracic segment. Even this verbal flaw would be obviated if Giesbrecht could prove his tentative hypothesis, that the Gymnoplea may have lost a pre-genital segment of the abdomen, and the Podoplea may have lost the last segment of the thorax. The classi- fication is worked out as follows : ***

*1. Gymnoplea. *** First segment of hind-body footless, bearing the orifices of the genital organs (in the male unsymmetrically placed) ; last foot of the fore-body in the male a copulatory organ ; neither, or only one, of the first pair of antennae in the male geniculating ; cephalic limbs abundantly articulated and provided with many plumose setae ; heart generally present. Animals usually free- living, pelagic (Giesbrecht and Schmeil).*

*This group, with 65 genera and four or five hundred species, is divided by Giesbrecht into tribes: *** (a) Amphaskandria. In this tribe the males have both antennae of the first pair as sensory organs. There is but one family, the Calanidae, but this is a very large one, with 26 genera and more than 100 species. Among them is the cosmopolitan Calanus finmarchicus, the earliest described (by Bishop Gunner in 1770) of all the marine free-swimming Copepoda. Among them also is the peacock Calanid, C'alocalanus*

*Fig. 4. *** Caloealanus pavo (Dana), pave (Dana), with its highly ornamented antennae and gorgeous tail, the most beautiful species of the whole order (Fig. 4). (6) Heter- arthrandria. Here the males have one or the other of the firet pair of antennae modified into a grasping organ for*

holding the female. There are four families, the Diaptomidae with 27 genera, the Pontellidae with 10, the Pseudocyclopidae and Candaciidae each with one genus. The first of these families is often called Centropagidae, but, as Sars has pointed out, Diaptomus (Westwood, 1836) is the oldest genus in it. Of 177 species valid in the family Giesbrecht and Schmeil assign 67 to Diaptomus. In regard to one of its species Dr Brady says : " in one instance, at least (Talkin Tarn, Cumberland) , I have seen the net come up from a depth of 6 or 8 feet below the surface with a dense mass consisting almost entirely of D. gracilis." The length of this net-filling species is about a twentieth of an inch.

2. Podoplea. ??? The first segment of the hind-body almost always with rudimentary pair of feet ; orifices of the genital organs (sym-metrically placed in both sexes) in the following segment ; neither the last foot of the fore-body nor the rudimentary feet just men- tioned acting as a copulatory organ in the male ; both or neither of the-first pair of antenn* in the male geniculating ; cephalic limbs less abundantly articulated and with fewer plumose setae or none, but with hooks and clasping sets. Heart almost always wanting. Free-living (rarely pelagic) or parasitic (Giesbrecht and Schmeil).

This group is also divided by Giesbrecht into two tribes, Am-pharthrandria and Isokerandria. In 1892 he distinguished the former as those in which the first antennae of the male have both members modified for holding the female, and the genital open- ings of the female have a ventral position, sometimes in close proximity, sometimes strongly lateral ; the latter as those in which the first aiitenni-e of the male are similar to those of the female, the function of holding her being transferred to the male maxillipeds, while the genitaropenings of the female are dorsal,

though at times strongly lateral. In 1899, with a view to the many modifications exhibited by parasitic and semi-parasitic species, the definitions, stripped of a too hampering precision, took a difierent form ???. ???(a) Ampharthrandria. ' ' Swimming Podo- piea with

genioulating first antennae in the male sex, and de- scendants of such ; first antenn* in female and male almost always aiaerently articulated." The families occupy fresh water as well as the sea. Naturally "descendants" which have lost the char- acteristic feature of the definition cannot be recognized without some further assistance than the definition supplies. Of the fami- lies comprised, the Mormonillidae consist only of Mormonilla (Giesbrecht), and are not mentioned by Giesbrecht in 1899 in the grouping of this section. The Thaumatoessidse include Thauma- toessa (Krbyer), established earlier than its synonym Thaumaleus (Kroyer), or than Monstrilla (Dana, 1849). The species are im- perfectly known. The defect of mouth-organs probably does not apply to the period of youth, which some of them spend para- sitioally in the body-cavity of worms (Giard, 1896). To the Cyclo- pidsB six genera are allotted by Giesbrecht in 1900. Cyclops (O. F. MuUer, 1776), though greatly restricted since MuUer's time, still has several scores of species abundantly peopling inland waters of every kind and situation, without one that can be relied on as exclusively marine like the species of Oithona (Baird). The Miso- phriidse are now limited to Misophria (Boeck). The presence of a heart in this genus helps to make it a link between the Podoplea and Gymnoplea, though in various other respects it approaches the next family. The Harpacticidse owe their name to the genus Arpaclicus (Milne-Edwards, 1840). Brady in 1880 assigns to this family 33 genera and 81 species. Canu (1892) distinguishes eight sub-families, Longipediinse, Peltidiinse, Tachidiinse, Amymoninae, Harpacticinse, Idyinse, Canthooamptinse (for which Canthooam- pinsB should be read), and Nannopinae, adding Stenheliinse (Brady) without distinctive characters for it. The Ascidicolidse have varia- ble characters, showing a gradual adaptation to parasitic life in Tunioates. Giesbrecht (1900) considers Canu quite right in group- ing together in this single family those parasites of ascidians, sim- ple and compound, which had been previously distributed among families with the more or less significant names Notodelphyidse, Doropygidae, Buproridae, Schizoproctidse, Kossmechtridse, Entero- colidae, Enteropsidse. Further, he includes in it his own Enterog- nathus comatulce, not from an ascidian, but from the intestine of the beautiful starfish Antedon rosaceus. The Asterocheridse, which have a good swimming capacity, except in the case of Can- cerilla tubulata (Dalyell), lead a semi-parasitic life on echino- derms, sponges,

&c., imbibing their food. Giesbrecht, displacing the older name Ascomyzontidge, assigns to this family 21 genera in five sub-families, and suggests that the long-known but still puz- zling Nicothoe from the gills of the lobster might be placed in an additional subfamily, or be made the representative of a closely related family. The Dichelestiidse, on account of their sometimes many-jointed first antennae, are referred also to this tribe by Gies- brecht. (6) Isokerandria. " Swimming Podoplea without geniou- lating first antennae in the male sex, and descendants of such. First antennae of male and female almost always articulated alike." To this tribe Giesbrecht assigns the families Clausidiidae, Cory- caeidae, OnosBidae, Lichomolgidse, Ergasilidsi, Bomolochidae, Clau- siidae, Nereicolidae. Here also must for the time be placed the Caligidae, Philichthyidae (Philichthydae of Vogt, Cams, Claus), Lernaeidae, Chondracanthidae, Sphaeronellid□□ (better known as Choniostomatidae, from H. J. Hansen's remarkable study of the group), Lernsopodidae, Herpyllobiids, Entomolepidae. For the distinguishing marks of all these, the number of their genera and species, their habits and transformations and dwellings, the reader must be referred to the writings of specialists. Sars (1901) pro- posed seven suborders□□□ Calanoida, Harpaoticoida, Cyolopoida, Notodelphoida, Monstrilloida, Caligoida, Lernaeoida.

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Entre Rios, a province in the east of the Argentine Eepublic, bounded to the N. by Corrientes, to the S. by- Buenos Ay res, to the E. by Uruguay, and to the W. by Santa Fe. Area, 28,784 miles. Population, about 300,000. The province is divided into 14 departments. The capi- tal, Parana, has a population of 24,098.

Enzymes. See Physiology of Plants.

Epidaurus. ??? Recent Archmological Discoveries. ??? The Hieron of Asclepius, which lies inland about 8 miles from the town of Epidaurus, has been thoroughly excavated by the Greek Archaeological Society since the year 1881, under the direction of M. Cavvadias. In addi- tion to the sacred precinct, with its temples and other buildings, the theatre and stadium have been cleared ; and several other extensive buildings, including baths, gymnasia, and a hospital for invalids, have also beeti found. The sacred road from Epidaurus, which is flanked by tombs, approaches the precinct through a gateway or propyleea. The chief buildings are grouped together, and include temples of Asclepius and Artemis, the Tholos, and the Abaton, or portico where the patients slept. In addition to remains of architecture and sculp- ture, some of them of high merit, there have been found many inscriptions, throwing light on the cures attributed to the god. The chief buildings outside the sacred pre- cinct are the theatre and the stadium.

The temple of Asclepius, which contained the gold and ivory statue by Thrasymedes of Paros, had six columns at the ends and eleven at the sides ; it was raised on stages and approached by a ramp at the eastern front. An inscription has been found recording the contracts for building this temple ; it dates from about 460 e.g. The sculptor Timotheus ??? one of those who collaborated in the Mausoleum ??? is mentioned as undertaking to make the acroteria that stood on the ends of the pediments, and also models for the sculpture that filled one of them. Some of this sculpture has been found; the acroteria are Nereids mounted on sea^-horses, and one pediment contained a battle of Greeks and Amazons. The great altar lay to the south of the temple, and a little to the east of it are what appear to be the remains of an earlier altar, built into the corner of a large square edifice of Roman date, perhaps a house of the priests. Just to the south of this are the foundations of a small temple of Artemis. The Tholos lay to the south-west of the temple of Asclepius ; it must, when perfect, have been one of the most beautiful buildings in Greece ; the exquisite carving of its mouldings is only equalled by 'that of the Erechtheum at Athens. It consisted of a circular chamber, surrounded on the outside by a Doric colonnade, and on the inside by a Corinthian one. The architect was Poly- clitus, probably to be identified with the younger sculptor of that name. In the inscription recording the contracts for its building it is called the Thymele ; and this name may give the clue to its purpose ; it was probably the idealized architectural representative of a primitive pit of sacrifice, such as may still be seen in the Asclepianum at Athens. The foundations now visible present a very curious appearance, consisting of a series of concentric walls. Those in the middle are thin, having only the pavement of the cella to support, and are provided with doors and partitions that make a sort of subterranean

labyrinth. There is no evidence for the statement some- times made that there was a well or spring below the Tholos. North of the Tholos is the

long portico described in inscriptiows as the Abaton ; it is on two different levels, and the lower or western portion of it had two storeys, of which the upper one was on a level with the ground in the eastern portion. Here the invalids used to sleep when consulting the god, and the inscriptions found here record not only the method of consulting the god, but the manner of his cures. Some of the inscriptions are contemporary dedications ; but those which give us most information are long lists of cases, evidently compiled by the priests from the dedications in the sanctuary, or from tradition. There is no reason to doubt that most of the records have at least a basis of fact, for the cases are in accord with well-attested phenomena of a similar nature at the present day ; but there are others, such as the miraculous mending of a broken vase, which suggest either invention or trickery.

In early times, though there is considerable variety in the cases treated and the methods of cure, there are certain characteristics common to the majority of the cases. The patient consulting the god sleeps in the Abaton, sees cer- tain visions, and, as a result, comes forth cured the next morning. Sometimes there seem to be surgical cases, like that of a man who had a spear-head extracted from his jaw, and found it laid in his hands when he awoke in the morning, and there are many examples resembling those known at the present day at Lourdes or Tenos, \ where hysterical or other similar affections are cured by the influence of imagination or sudden emotion. It is, however, difficult to make any scientific use of the rec- ords, owing to the indiscriminate manner in which gen- uine and apocryphal cases are mingled, and circumstantial details are added. We learn the practice of later times from some dedicated inscriptions. Apparently the old faith-healing had lost its efficacy, and the priests substi- tuted for it elaborate prescriptions as to diet, baths, and regimen which must have made Epidaurus and its visitors resemble their counterparts in a modern spa. At this time there were extensive buildings provided for the accommodation of invalids, some of which have been dis- covered and partially cleared ; one was built by Antoninus Pius. They were in the form of great courtyards sur- rounded by colonnades and chambers.

Between the precinct and the theatre was a large gymnasium, which was in later times converted to other purposes, a small odeum being built in the middle of it. In a valley just to the south-west of the precinct is the stadium, of which the seats and goal are well preserved. There is a gutter round the level space of the stadium, with basins at intervals for the use of spectators or competitors, and a post at every hundred feet of the course, thus dividing it into six portions. The goal, which is well preserved at the upper end, is similar to that at Olympia ; it consists of a sill of stone sunk level with the ground, with parallel grooves for the feet of the runners at starting, and sockets to hold the posts to which were fixed the strings that separated the tracks assigned to the various competitors. For these were submitted later a set of stone columns resembling those in the proscenium of a theatre. There was doubtless a similar sill at the lower end for the start of the stadium, this upper one being intended for the start of the diaulos and longer races.

The theatre still deserves the praise given it by Pausanias as the most beautiful in Greece. The auditorium isln remarkable preser- vation, almost every seat being still in situ, except a few where the supporting walls have given way on the wings. The whole plan is drawn from three centres, the outer portion of the curves being arcs of a larger circle than the one used for the central portion ; the complete circle of the orchestra is marked by a sill of white limestone, and greatly enhances the effect of the whole. There are benches with backs not only in the bottom row, but also above and below the diazoma. The acoustic properties of the theatre are extraordinarily good, a speaker in the orchestra being heard throughout the auditorium without raising his voice. The stage buildings are not preserved much above their foundations, and show signs of later repairs ; but their general character can be

clearly seen. They consist of a long rectangular building, with a proscenium or column front which almost forms a tangent to the circle of the orchestra; at the middle and at either end of this proscenium are doors leading into the orchestra, those at the end set in projecting wings ; the top of the proscenium is approached by a ramp, of which the lower part is still preserved, running parallel to the parodi, but sloping up as they slope down. The proscenium was originally about 14 feet high and

12 feet broad ; so corresponding approximately to the Greek stage as described by Vitruvius. M. Cavvadias, who excavated the theatre, believes that the proscenium is contemporary with the rest of the theatre, which, like the Tholos, was built by Polyolitus (the younger) ; but Professor Dorpfeld maintains that it is a later addition. In any case, the theatre at Epidaurus ranks as the most typical of Greek theatres, both from the simplicity of its plan and the beauty of its proportions. The excavations at Epidaurus have been recorded as they went on in, the UpaKTiKi, of the Greek Archjeological Society, especially for 1881-84 and 1889, and also in the'E4i7iij.epis' Apxaw^oyiK^, especially for 1883 and 1885 ; see also Cavvadias, Lesfouilles d," Epidaure and TA 'lepbv Tov 'A(7/cXi;7rioO iv 'EiriBaipip Kai ij Oepdireia twv dcr6evQiv ; Defrasse and Leohat, Epidaure. (e. ge.)

Epsom, a market-town in the Epsom parliamentary division of Surrey, England, 16 miles south-west by south of London by rail. Kecent erections are Christ Church (rebuilt), a town-hall, a cottage hospital, and a technical and art school. The Eoyal Medical Benevolent College has been enlarged. Area of urban district, 4424 acres. Population (1881), 6916 ; (1901), 10,915.

Erckmann-Chatrian, the joint names of two French writers whose collaboration made their work that of, so to speak, one personality. Emile Erckmann was born in 1822 at Phalsbourg, and ??? Alexandre Chatrian in 1826 at Soldatenthal, Lorraine. In 1847 they began to write together, and continued doing so till 1889. Chatrian died in 1890 at Villemomble, and Erckmann at Luneville in 1899. The list of their publicaitions is a long one, ranging from L'illustre docteur MatMus (1859), L'ami Fritz {1864t), Histoire d'un consmt de 1813 (1864), Waterloo (1865), Le blocus (1867), Histoire d'un Paysan (1868), L'histoire d'un plibiscite (1872), to Le grand-p^re Lehigre (1880) ; besides dramas like Le Juif Polonais (1869), and Les Rantzau (1882). Without any special literary claim, their stories are distinguished by simplicity and genuine descriptive power, particularly in the battle scenes and in connexion with Alsatian peasant life, and also by their democratic spirit, to which was added, after the war of 1870, a markedly anti-German feeling.

Erdmann, Johann Eduard (1805-1892), Ger- man philosophical writer, was born at Wolmar in Livonia, 13th June 1805. He studied theology at Dorpat and afterwards at Berlin, where he fell under the influence of Hegel. Prom 1829 to 1832 he was a minister of religion in his native town ; then finally resolved to devote him- self to philosophy, and qualified in that subject at Berlin in 1834. In 1836 he was professor-extraordinary at Halle, became full professor in 1839, and died there 12th June 1892. He published many philosophical text-books and treatises, and a number of sermons ; but his chief claim to remembrance rests on his Darstellung der Geschichte der Philosophie, 3 vols. (1834-53), which has been translated into English, and is still the best work of the kind. Erdmann's special merit is that he does not rest content with being a mere summarizer of opinions, but tries to exhibit the history of human thought as a continuous and ever-developing effort to solve the great speculative problems with which man has been confronted in all ages. (h. st.)

Erfurt, a town of Prussia, province of Saxony, 73 miles by rail southwest from Leipzig and 14 miles west from Weimar. On the west and south-west extensive new quarters have grown up within recent years ??? e.g., Hirsch- brUhl. The town-hall (1869-75) has been adorned with

legendary and historical pictures by Kampffer and Jans- sen. Erfurt possesses also a picture gallery, library, antiquarian collection (in the hospital), musical academy, agricultural school, commercial school, and shoemaking school ; also, a monument to Luther (1890). On the west side the old town is dominated by the two citadels of Petersberg and Cyriaxburg. The chief industry is still market-gardening and the production of vegetable and flower seeds. There is also a trade of some magnitude. Population (1885), 58,386 ; (1900), 85,828.

Erichsen, Sir John Eric, Bakt. (1818-1896), British surgeon, born 19th July 1818, was the son of Eric Erichsen, a member of a well-known Danish family. He studied medicine at University College, London, and at Paris, devoting himself in the early years of his career to physiology, and

lecturing on General Anatomy and Physiology at University College Hospital. In 1844 he was secretary to the Physiological Section of the British Association, and in 1846 he was awarded the Eother- gillian Gold Medal of the Royal Humane Society for his essay on Asphyxia. In 1848 he was appointed Assistant Surgeon at University College Hospital, and in 1856 became full Surgeon, his lectures and clinical teaching being much admired ; and in 1875 he joined the Consult- ing Staff. His Science and Art of Surgery (1853) went through many editions. He rose to be President of the College of Surgeons in 1880. Prom 1879 to 1881 he was President of the Royal Medical and Chirurgical Society. He was created a baronet in 1895, having been for some years Surgeon-Extraordinary to Queen Victoria. As a surgeon his reputation was world-wide, and he counts (says Sir W. MacCormac in his volume on the Centenary of the Royal College of Surgeons) " among the masters of modern surgery." He was a recognized authority on concussion of the spine, and was often called to give evidence in court on obscure cases caused by railway accidents, &c. He died 23rd September 1896.

Ericsson, John (1803-1889), naval engineer, was born at Langbanshyttan, Wermland, Sweden, on the 31st July 1803. He was the second son of Olaf Erics- son, an inspector of mines. Showing from his earliest years a strong mechanical bent, at the age of nine he was already skilled in the use of drawing instruments, and had made a very ingenious working model of a saw mill driven by water-power. At twelve he was employed as a draughtsman by the Swedish Canal Company, and at thirteen as an assistant leveller. The death of his father in 1818 left the family in very straitened circum- stances ; and though from 1820 to 1827 young Ericsson served in the army and attained the rank of captain, he was all the time working also as a draughtsman, and occupying his leisure with projects of invention. In 1826 he went to London, at first on leave of absence from his regiment, and in partnership with John Braith- waite constructed the "Novelty," a locomotive engine for the Liverpool and Manchester railway conipetition at Rainhill in 1829, when the prize was won by Stephen- son's "Rocket." In 1830 the firm constructed a steam fire-engine, which was proved at different fires to be effective, though prejudice for the time prevented it from coming into general use. The number of Ericsson's in- ventions at this period was very great.

Among other things he worked out a plan for marine engines placed entirely below the water-line. Such engines were made for the Victory, for Captain Ross's voyage to the Arctic in 1829, but they did not prove satisfactory. In 1833 his caloric engine was made public. In 1836 he took out a patent for a screw-propeller, and though the priority of his invention could not be maintained, he was after- wards awarded a one-fifth share of the ??20,000 given by

the Admiralty for it. At this time he made the acquaint- ance of Captain Stockton, of the United States Navy, who gave an order for a small iron vessel to be built by Laird of Birkenhead, and to be fitted by Ericsson with engines and screw. This vessel reached New York in May 1839, thus giving a practical proof of the possibility of screw propulsion in the open sea. A few months later Ericsson followed his steamer to New York, and there he resided for the rest of his life, establishing himself as an engineer and a builder of iron ships. In 1848 he was naturalized as a citizen of the United States. He had many difficulties to contend with ; he quarrelled with Stockton, for whom he had worked on an " under- standing " without any definite agreement, and the Gov- ernment denied his claims and left him a loser both in money and in credit. It was only by slow degrees that he established his fame and won his way to competence. Fortune, as it is understood in the United States, he never reached ; at his death he seems to have been worth about ??50,000. He was always busy over new ideas, attempting the solution of problems which were engag- ing the attention of many others. At one of these, the provision of defensive armour for ships of war, he had long worked, and had constructed plans and a model of a vessel lying low in the water, carrying one heavy gun in a circular turret mounted on a turn-table. His priority in this idea seems established. In 1854 he sent his design to the Emperor of the Prench, hoping that it might prove of use against the Russians, whom he re- garded as the natural enemies of his native country. Louis Napoleon returned the plans with thanks, but declined to use them, being guided in this, we may sup- pose, by the skilled opinion of Dupuy de L6me. They were then put on one side, till the American Civil War, and the report that the Confederates were converting the Merrimac into an ironclad, caused the Navy Department to invite proposals for the construction of armoured ships. Among others, Ericsson replied, and as it

was thought that his design might be serviceable in inland waters, the first armoured turret ship, the Monitor, was ordered; she was launched on the 30th January 1862, and on the 9th March she fought the celebrated action with the Confederate ram Merrimac. The peculiar circumstances in which she was built, the tremendous importance of the battle, and the decisive nature of the result gave the Monitor an exaggerated reputation, which further experi- ence did not confirm. Other turret ships were built and answered the immediate purpose ; nine built for the United States proved of great service during the war, one crossed the Atlantic, and another rounded Cape Horn and reached San Francisco ; but as seagoing vessels they were judged unsafe, and are now considered imprac- ticable. Ericsson's work was marked by great ingenuity, but in no case does he seem to have attained an entirely satisfactory result, though his inventions served as finger- posts for others' guidance. In later years he devoted himself to the study of torpedoes and sun motors. He died at New York on 8th March 1889, and in the follow- ing year, on the request of the Swedish Government, his body was sent to Stockholm and thence into Wermland, where, at Filipstad, it was buried on the 15th September.

Ericsson's life has been written at length by William Conant Church, who had access to his letters and papers, and was person- ally acquainted both with him and his most intimate associates.

(j. K. L.)

Erie, capital of Erie county, Pennsylvania, U.S.A., in 42-07 N. lat. and 8010 W. long., on the shore of Lake Erie, at an altitude of 684 feet. It is the only lake port of Pennsylvania, and has a large lake commerce, in grain, lumber, and iron ore as imports, and coal as an export. It is entered by four railways, the Lake Shore

and Michigan Southern, the New York, Chicago, and St Louis, the Pennsylvania, and the Pittsburg, Bessemer, and Lake Erie, which give it great importance in inland traffic. It has an excellent water supply and

sewerage system, and it is divided into six wards ; the streets of the central part are paved with brick and asphalt. Its manufactures had in 1890 a capital of $12,800,000, employed 7029 hands, and had products valued at $12,765,768. One-third of these were foundry and machine-shop products, besides which flour and lumber were of great importance. The assessed valuation of property, real and personal, was, in 1900, $19,667,488 ; the net debt was but $765,040, and the rate of taxation was $24.00 per $1000. Population (1880), 27,737 ; (1900), 52,733. Death-rate (1900), 15-2.

Erith, a town in the Dartford parliamentary division of Kent, iSngland, on the Thames, 14 miles east-south-east of London by rail. The churches are two Established, one ancient in Early English and later styles of archi-tecture, containing ancient monuments and brasses, Eoman Catholic, and various Nonconformist chapels. There is a public hall, a recreation ground (12 acres), and a sanatorium for infectious diseases. In the parish are the southern outfall works of the metropolitan main drainage system. The town has large engineering works and gun factories, and in the neighbourhood are powder works. Area of civil parish (an urban district), 3860 acres. Pxjpulation (1881), 9812 ; (1901), 25,296.

Eritrea. ??? Under this name, which Italian taste for classical reminiscences resuscitated at the beginning of 1890, are designated the Italian possessions on the west coasts of the Red Sea and on the most northerly spurs of the Ethiopian high plateau. Originally the name covered both the territories really occupied and those over which a protectorate was claimed, but now Italy exercises suze- rainty over all. It extends on the coast from Ras (Cape) Kasar (18?? 2′ N. lat.), the limit fixed by the Anglo- Italian agreement of 1887, as far as Ras Dumeira (12?? 42′ N. lat.), the southern boundary, settled by the Franco- Italian convention of January 1900, a coast-line of about 620 miles. In the vicinity of Ras Dumeira the territory extends inland for 38 miles, but to the north, towards Abyssinia, its boundary is marked by the torrents Muna and Belesa, and by the river Mareb as far west as the village of Mai Dar5, whence it runs in a straight line to Tomat, a hut encampment situated at the confluence of the Setit and the Atbara. Towards the Sudan the frontier, as delimitated by the Anglo-Italian agreements of 1898-99,

follows the watershed between the rivers Gash and Barka, and, on approaching the coast, crosses the northern slopes of the Haggar Nush plateau and follows the Thalweg of the torrent Carora to Ras Kasar. The Dahlak Archipelago and other groups of islands along the coast belong to Eritrea. The inhabitants of these islands live by fishing for mother-of-pearl, and the pearl-bearing oyster. The control of the fisheries is entrusted to a special company. The total area is about 88,500 square miles. The population is approximately 400,000, of which 1050 are whites, exclusive of soldiers. The inhabitants belong to many different tribes and races, much akin to those of Abyssinia (g.v.). Most of the tribes descend more or less directly from Ethiopian stock, and retain evident traces of their origin in their dialects.

Climate. ––– The climate is varied. The plateau, of which the average height is 6500 feet, but which at places rises to 10,000 feet (Sauria), the valleys of the Anseba and the Barka, and the lower course of the Mareb (or Gash) follow in their seasons the Ethiopian monsoon ; some rain falls at the end of April, and abundant rain from June to September. The zone between the sea and 6500 feet has,

on the other hand, abundant rain from November till March. At 6500 feet the temperature is mild, and grows cooler with increased altitude until, at 10,000 feet, it becomes almost cold. From the height of 3000 feet downwards the climate is torrid during the greater part of the year, and only becomes tolerable during the winter rains. In this zone malarial fevers prevail in winter. The heat is greatest at Massawa, where the mean tempera- ture averages 88 ––, but where, in summer, the thermometer often rises to 120 –– in the shade. In the Barka Valley a like temperature is reached, but there it is rendered less trying by the breeze, the dry atmosphere, and the great difference between the temperatures of day and night.

Crops and Cultivation. ––– Almost all European cereals flourish on the high plateau, while the olive tree grows at more than 6500 feet, and covers the flanks of the plateau to within 3000 feet of sea-level. Lower down, dhurra, maize, and bultuc grow in profusion. Experiments in the cultivation of coffee, tobacco, and cotton have given good results in the

intermediate zones. The fauna is similar to that of Abyssinia. Except for a short tract of land near the coast, and the locality of Sheb on the caravan route from Massawa and Monkullo to Keren, no part can be called a desert (atmur) ; but in the lower regions there are wide tracts, covered with mimosa and acacia trees, forming a kind of jungle which the natives term khala. The Danakil, Samhar, and Barka plains are broken by small chains ojf hills running in various directions ; the torrents are covered by dense vegetation, and, especially in the Barka region, by the dum palm ; in the dry season water is generally to be found in the torrent beds. The high plateau has a more fertile appearance. It is covered by rich, well-watered valleys, verdant plains and flat-topped hills with steep sides running in ranges or isolated.

Inhabitants. ??? The Mussulman inhabitants of the lower zone are for the most part semi-nomad shepherds, living on dhurra and milk; the inhabitants of the high zone are almost exclusively Coptic Christians with fixed abodes. They, are agriculturists, living in round huts or in low, rectangular, flat-roofed houses. The nomad Mussulmans are, as a rule, docile, submissive, and pacific; the Christians, unruly and bellicose. Neither have succeeded in developing industry to any considerable extent, except mat-weaving, some little cotton-weaving, silver-working, and rudimentary iron and leather-working.

Centres of Population. ??? The principal places on the coast are Massawa, a city of more than 12,000 native and European in- habitants, huilt partly upon an island of the same name, partly on the island of Taudub, and partly on the small peninsula of Gherar and Abd-el-Kader. Formerly seat of the colonial govern- ment, it is now only the capital of the region between the sea and the lower slopes of the high plateau. It is well built in brick, is clean, and has considerable trade with the interior and with the other Red Sea ports. Assab, chief town of the Dankali region, is a small town to which converges the trade from Abyssinia across the Aussa country. The chief places in the interior are Asmarii, the present capital, formerly capital of the province of Hamasien, and favourite headquarters of Ras Alula. It is situated at nearly 6500 feet above the sea, and is beginning to assume the aspect of a European town. Several reefs of auriferous quartz of good promise have been found

around it. Keren, centre of the tribal villages established to the north of the Anseba ; Agordat, on the river Barka, a town on the road from Keren to Kassala, the centre of the Beni-Amer, Algheden and Sabdarat tribes ; Mogolo, on the lower Mareb, rendezvous of the BariJi and Bazft, tribes. Towards Abyssinia the chief towns are Saganeiti (capital of the Okulfi-Kusai province), Godofelassi and Adi-IJgri, the two latter situated in the fertile plain of the Sera6 ; Adiqual^, on the edge of the Mareb gorge ; and Arras^, the centre of the districts constituting the province of Peki-Tesfii. The whole territory is crossed by camel- and nmle-paths between the sea and the high plateau and between various centres of population. Every valley that brings water to the Red Sea has a route leading to the high plateau. The great arteries, however, can be reasonably reduced to three, which, starting from Massawa by way of Asmark, run, two to Abyssinia,

and one to Kassala and Khartum. They are all more or less prac- ticable for �arts, and are flanked by a good telegraph line as long as they lie in Italian territory. The trade is indicated approxi- mately by the Massawa harbour returns, which show an annual traffic (imports and exports) of ре1,000,000. At Massawa there is a customs house, with branches at Assab, Edd, Meder, Mersa, Taclai, and Sabdarat.

Administration. ре Eritrea is administered by a civil governor with a corps of colonial oflicers and clerks. It is divided into six pro- vinces, each governed by a regional commissioner. Some tracts of frontier territory are detached from the various regions and en- trusted to political residents, as, for instance, on the Abyssinian boundary, where strict surveillance is necessary to repress raiding incursions from Tigr6, and where the chief Intelligence Department is established. The six regions or principal provinces are : ре AsmarS,, which includes Hamasien and other small districts ; Keren, which comprises the high territories to the north of the Anseba; Mas- sawa, extending over all the tribes between the high plateau and the sea from the Habab to the DanakUs ; Assab, which extends from Edd to Raheita ; Okiil^Kusai ; Sera6, including Deki-

TesfS-. The political residences are at present only three, namely, Shi-menzana, which governs the district of the same name, and other small districts along th^e BelesS. ; AdiquaM, having jurisdiction over the boundary from the Mareb-Beles^ confluence to Mai Dar6 ; the BariS,, which governs that tribe as well as the Baz^, and watches over the lower course of the Mareb and over the frontier as far as Tomat. The regional commissioners and the political residents act eitherbymeansof the village headmen (/SAMm or Gfticca) ; the chiefs of districts in the few localities where villages are still organized in districts ; or by the headmen of tribes, and by the Councils of the Elders wherever these remain in vigour.

Justice. ❓❓❓ Civil justice for natives is administered, in the first instance, by the headmen of villages, provinces, tribes, or Councils of Notables {Shumagalle) ; in Appeal, by the residents, regional commissioners, and regional tribunals, and, in the last instance, by the Colonial Court of Appeal. Europeans are under the jurisdic- tion of the commissioners, residents, regional tribunals, and Court of Appeal. Penal justice is administered by Italian judges only. An administrative tribunal settles, without appeal, questions of tribute, disputes concerning family, village, or tribal landmarks, as well as suits involving the colonial government. The civil laws for the natives are those established by local usage. Europeans are answerable to the Italian civil code. Penal laws are the same as in Italy, except where modified by local usages. Appeal to the Rome Court of Cassation is admitted against all penal and civil sentences. A company of Royal Carabineers, consisting partly of Italians and partly of natives, is entrusted with police service. The company is divided into the lieutenancies of Asmarii, Saganeiti, and Mas- sawa, and subdivided into some twenty stations.

Defence. ❓❓❓ Defence is entrusted to a corps of colonial troops, partly Italian and partly native ; to a militia {milizia mobile) formed by natives who have already served in the colonial corps ; and to the chitet or general levy which, in time of war, places all male able-bodied inhabitants under arms. The regional commis- sioners and political residents have at their disposal some hundreds of irregular, paid soldiers under native chiefs. In war time these irregulars form part of the colonial corps, but in time of peace serve as frontier police. The colonial corps is commanded

by an Italian colonel. It is composed of (1) three companies of African light infantry (Oacciatori d" Africa), composed exclusively of Italians, and stationed at AsmarJi, Keren, and Saganeiti, with a detachment at Massawa ; (2) six battalions of native regulars, of which two battalions are stationed at Asamar^, one at Adi Cajeh, one at Saga- neiti, one at Adi Ugri, one at Keren, with a company at Agordat ; (3) a squadron of native cavalry stationed at Godofellassi ; (4) two native batteries (six guns) of mountain artillery, one stationed at Keren and the other at AsmarJi ; (5) a native gunner company divided between Keren, Saganeiti, and Asmara ; (6) an engineer company with headquarters at AsmarSi and detached sections at Keren and Saganeiti ; (7) a train company with headquarters at AsmarS,, and detachments at Ghinda and Saganeiti. All these troops have Italian cadres. They constitute a total force of about 6000 men. The irregular troops, on foot, or mounted on camels, at the disposal of the regional commissioners and political residents number about 1000 men. The militia, whose members are regis- tered by name, consists of 3500 men of all arms, and is intended in time of war to reinforce the various divisions of the colonial corps, while any surplus constitutes a special division under Italian oflicers who are chosen for that command in time of peace. The chitet yields between 3000 and 4000 men, to be employed on the lines of communication or in caravan service. All these troops are intended to ward off a first attack, so as to allow time for the arrival of rein- forcements from Italy. The customs and political surveillance along the coast is entrusted, afloat, to the Massawa naval station, and, ashore, to a coastguard company 400 strong stationed at Meder, with detachments at Assab, Massawa, Raheita, Edd, and Taclai.

-The administration and defence cost annually about ►►400,000, of which three-fourths are paid by the Italian Exchequer and one-fourth by the inhabitants. This expenditure has been much exceeded in the past, but may now and for the future be considered the normal maximum. Indeed, one-tenth of the ►►400,000 is avail- able for useful public works. In the past the internal revenue has been small, on account of insecurity and of the wars against the Abyssiuians and the Dervishes ; but now, with the restoration of peace and tranquillity, tribute returns are constantly increasing, so that the contribution of the home exchequer will probably be pro- gressively reduced. "When all the resources have been explored

and developed, and trade resumed with Northern Abyssinia ??? now sus- pended by the anarchy existing in Tigrfe ??? its prosperity will reach a level corresponding to the fertility of its soil, the habits of its people, and the position of its ports on the Red Sea, and Eritrea will gradually cease to be a burden upon the home exchequer.

History.' ??? Traces of the ancient Eritrean civilization are scarce. During the prosperous periods of ancient Egypt, Egyptian squad- rons asserted their rule over the west Red Sea coast, and under the Ptolemies the port of Golden Berenice (Adulis ?) was an Egyp- tian fortress, afterwards abandoned. During the early years of the Roman Empire, Eritrea formed part of an important independent state ??? that of the Assamites. At the end of the reign of Nero, and perhaps even earlier, the King of the Assamites ruled over the Red Sea coast from Suakin to the strait of Bab-el-Mandeb, and traded constantly with Egypt. This potentate called himself " King of Kings," commanded an army and a fleet, coined money, adopted Greek as the oflfioial language, and lived on good terms with the Roman Empire. The Assamites belonged originally to the Ha- mitic race, but the immigration of the Himyaritic tribes of Southern Arabia speedily imposed a new language and civilization. There- fore the ancient Abyssinian language, Gheez, and its living dialects, Amharic and Tigrin, are Semitic, although modified by the influ- ence of the old Agau. Adulis (Adovlis), slightly to the north of Zula, was the chief Assamite port. Several traces remain of this emporium, which a Greek merchant of the time of Vespasian called a "well-arranged market"; namely, the ruins of a temple, frag- ments of columns and obelisks, and a Greek inscription of an Assamite king (Corpus Inscr. Gr. 51,276). From Adulis started the main road, which led across the high plateau to the capital Axomis (Axum). Along the road are still to be seen vestiges of cities and inscribed monuments, such as the Himyaritic inscrip- tions on the high plateau of Cohait, the six obelisks with a Saban inscription at Toconda, and an obelisk with an inscription at Amba Salt. Other monuments exist elsewhere, as well as coins of the Assamite period with Greek and Ethiopian inscriptions. After the rise of the Ethiopian Empire the history of Eritrea is bound up with that of Ethiopia, but not so entirely as to be completely fused. The documents of the Portuguese expedition of the six- teenth century and other Ethiopian records show that all the country

north of the Mareb enjoyed relative autonomy imder a vassal of the Ethiopian emperor.

Michael, counsellor of Solomon, who was king of the country north of the Mareb, usurped the throne of Solomon during the reign of the Emperor Atzife Jasii II. (1729-1753), and, after proclaiming himself Ras of the Tigrfe and "protector of the Empire," ceded the North Mareb country to an enemy of the rightful dynasty. Hence a long struggle between the dispossessed family and the occupants of the North Mareb throne. The Egyptians took advantage of the struggle to seize Keren and the Bogos country. Ras Uddenchiel, who had remained master of the North Mareb district, fought as ally of the Egyptians at Gura, but was betrayed to the Abyssinians and imprisoned upon an amba, or flatr-topped mountain (1879), whence he only succeeded in escaping in 1890. In 1879 his territory was given by the Negus Johannes to Ras Alula, who retained it until, in August 1889, the Italians occupied Asmara,.

The purchase of Assab and the neighbouring territory from the Sultan Berehan of Raheita by the Italian Steamship Com- pany Rubattino (1870) formed the nucleus of Italian possessions on the Red Sea. In 1882 the Italian Government took over the rights of the Rubattino Company. On 5th February 1885 an Italian expedition under Colonel Saletta landed at Massawa, which, in virtue of the treaty concluded between Admiral Hewett and the Negus Johannes (3rd June 1884), had been recognized as Egyptian territory. Besides Massawa, the Italians occupied Arafali (10th April) and Arkiko(12thApril). Colonel Saletta's suc- cessor. General Genfi, in order to protect caravans, occupied the wells of Wa (23rd November 1886) and Saati (14th January 1887V This was the signal for hostilities with Abyssinia. Ras Alula arrested an Italian mission bound for Ethiopia under Major Piano, and made an unsuccessful attack upon Saati (25th January). Next day, however, in the gorge of Dogali, he succeeded in destroying a detachment of Italian infantry under Colonel De Cristoforis. An expedition of 20,000 men under General di San Marzano was dispatched to avenge this disaster. In good relations with Mene-

lek, king of Shoa, and after the failure of a British attempt at mediation made by Sir Gerald Portal (December 1887), hostilities were opened with Abyssinia. The Negus Johannes advanced towards the Italian lines at Saati, but finding them impregnable withdrew to the interior with the intention of chastening Menelek for his neutrality. The San Marzano expedition then returned to Italy, leaving General Baldissera, the first organizer of the colony, in command. A year later Johannes fell at Metemmeh fighting the Dervishes (March 10, 1889), and his succession was dis- puted between Mangashi, Ras of Tigrfe, natural son of Johannes, and Menelek, who claimed descent from King Solomon and the Queen of Sheba. The Italians supported Menelek by threaten- ing the chiefs of Tigr6 and occupying Keren (June 2), Asmara (August 3), and extending the Italian frontier to the Mareb, Belesa, and Muna. Menelek, having secured the imperial crown owing to Italian help, concluded with the Italian representative. Count Pietro Antonelli, a treaty at Ucciali (May 11, 1889), and sent to Rome a mission under one of his lieutenants, Makonnen, for the ratification of the treaty and the negotiation of a loan of 160,000. General Orero, who in the meantime had succeeded General Baldissera in the government of Eritrea, made a reconnaissance in force as far as Adowa towards the west and Makallfe to the south. This move aroused the suspicions of both Menelek and MangashJi, who became reconciled at Ausien. Shortly afterwards Menelek disputed the Italian claim to the protectorate over Abyssinia, based on Article 17 of the treaty of Ucciali, and demanded for Ethiopia the Cis-Mareb provinces of Serafe and Okul^-Kusai. Almost simultaneously began a period of hostilities between Italy and the Dervishes. In June 1890 Dervish raiders plundered the Beni-Amer, an Arab tribe under Italian pro- tection, but were defeated near Agordat by Captain Eara. The Italians then occupied and fortified Agordat. In consequence of this extension of territory an Anglo-Italian convention (March- April 1891) was concluded in order to delimitate the respective spheres of influence of the two countries. The convention also authorized Italy temporarily to occupy Kassala, if necessary. In June 1892 the Dervishes attacked the Italians, but were defeated at Sarobeiti (June 16) beyond Agordat. The Khalifa then ordered a holy war, but the Dervishes were routed with loss at Agordat (December

21, 1893). The Italians followed up their success by occupying Kassala on July 17, 1894, after surprising and defeating the Dervish garrison. Meanwhile Menelek and MangashS, prepared to attack the Italians, and fomented the rebellion of Batha-Agos, who had ruled the Okul6-Kusai, under Italian suzerainty. General Baratieri, however, with 3900 men defeated and killed Batha^ Agos at Halai (December 18, 1894), marched upon Adowa, routed Mangash^ at Coatit (January 13-14, 1895) and at Senaf6 (January 15), and prepared to conquer Tigrfe. Meanwhile Mene-lek having collected a large army and secured the support of various chiefs, set out to reconquer Tigrfe after the Eeast of the Cross (September 27, 1895). A battalion under Major Toselli attempted, through a misunderstanding, to arrest the Abyssinian vanguard, 35,000 strong, and was annihilated at Amba Alagi (December 7). , Pushing forwards, the Abyssinians, after taking the fort at Makallfe (January 21, 1896), moved on to Adowa. Here their forces, numbering 90,000, armed with rifles, 8600 cavalry, and 42 guns, encountered the Italians. The Italian army, under General Baratieri, numbered less thkn 20,000 men, and was, moreoverj molested by the rebellion of native bands. Neverthe- less, the Italian commander decided to attack. A body of 12,500 men, of whom 10,450 were Italians, with 56 guns, divided into three columns under Generals Arimondi, Albertone, and Dabormida, and a reserve under General Ellena, moved against the Abyssinian camp at daybreak on March 1, 1896. The action developed into three separate and successive combats. Albertone was first defeated at Abba-Carima ; Arimondi and Ellena later at Mounts Rajo and Rebbi-Arienni ; and Dabormida at Mariam Shiavitii. The Italian losses were : killed, 6600, of whom 4600 were Italians ; wounded, 1500, of whom 500 were Italians ; prisoners, 1700, of whom 1500 were Italians. Among the dead were Generals Dabor-niida and Arimondi, Colonels Romero and Airaghi, and 264 other ofiioers. The Abyssinian losses were : killed, 7000 ; wounded, 10,000. Among the dead were the Fitaurazi Jabeju, victor of Amba Alagi, and many other chieftains.

A few days later General Baldissera, reappointed Governor of Eritrea, reached Massawa with reinforcements. With a new army 16,000 strong he took the offensive and liberated the garrison of Adigrat. Menelek, discouraged by his heavy losses and lacking supplies, rapidly withdrew

southwards. About the same time Colone/1 Stevani repelled a great Dervish invasion at Mount Mokram and at Tucruf , driving the invaders beyond the Atbara. Friendly relations between Abyssinia and Eritrea were re-estab- lished by the treaty of Addis Abbaba (October 26, 1896), by which Italy revoked the treaty of Ucciali, and Abyssinia agreed to release the Italian prisoners on payment of an indemnity of 10,000,000 lire, and provisionally recognized the Mareb boundary.

Kassala was handed over to Great Britain (December 25, 1897). The Government was placed upon a civil basis (October-November 1897) ; the frontiers were further regulated by a Franco-Italian Convention (January 24, 1900) fixing the limit between the French and Italian possessions at Eas Dumeira ; and by agreements with Menelek, guaranteeing to Eritrea the possession in perpetuity of the Mareb-Belesa-Muna line.

AuTHOKiTiES. ??? LuiGi Chiala. La Spedizione di Massana. Turin, 1888. Abyssinian Qreenbooks, published at intervals in 1895 and 1896, covering the period from 1870 to the end of the ItalO – Abyssinian War. ??? Vico Mantegazza. La (xuerra in Africa. Florence, 1896. ??? General Baeatieki. Memorie d' Africa. Rome, 1898. ??? C. de la Jonquieke. Les Italiens en Erythree. Paris, 1897. (l. Mb.)

Erivan, a province of Eussia, Transcaucasia, having Kars on the W., Tiflis on the N., Elisabethpol on the E., Persia and Turkey on the S. It lies entirely on the sur- face of a plateau (6000-8000 ft.), covered with volcanic formations. Eegular chains of mountains are only met with on its borders and in its eastern portion, but the whole surface of the plateau is covered with short ridges and isolated mountains of volcanic origin, of which Alaghoz (13,436 ft.) and Ararat (17,212 ft.) are the main ones. Both are volcanoes which must have been active in Tertiary times. Lake Gokcha is surrounded by such volcanoes, and the neighbourhood of Alexandropol is a " volcanic amphitheatre," the surface of which is entirely covered with superficial volcanic deposits. The same is true of the slopes leading to the Arax, the valley of the upper Arax being consequently a stone desert, refreshed only by irrigation, which is conducted with considerable difficulty owing to the character of the soil. It is watered by the Arax, which forms the boundary with Persia, and

flows with an extreme rapidity in its stony bed ??? the height of its fall being 22 and 17 ft. per mile in its upper part, and 9 ft. at Ordubat, and 23 ft. lower down. The chief lakes are Gokcha and Balykh-gol ; many small lakes, filling up volcanic craters, are of great depth. Wood is very scarce. There is a variety of useful minerals, but only rock-salt is obtained at Nakhichevan and Kulp. The climate is extremely varied, the following being the average temperatures and mean rainfall at Alexandropol (alt. 5078 ft.) and Aralykh (2732 ft.) : ??? year 42??, January 12, July 65??, mean rainfall, 16-2 in. in Alexandropol ; and year 53??, January 20??-5, July 79??, rainfall, 6-3 in. in Aralykh.*

The population numbers 830,000 (only 375,086 women), of whom 82,278 lived in towns. They are chiefly Armenians (376,700), Azerbaijan Tatars (407,949), Kurds (36,484), and 4150 Russians to whom some Aisors, Greeks, and Jews must be added. Most Armenians are Gregorians (only 5763 Catholics), and the Tatars are mostly Shiite Mussulmans (only 29,723 Sunnites). The percentage of births was (1897) 8-9, and of mortality only 1‘9.

While barley only can be grown on the high parts of the plateau, the cotton tree, the mulberry tree, the vine, and all sorts of fruit trees are cultivated in the Arax valley. The total corn crop (mainly wheat and barley) attained 1,178,000 in 1897, and there were about 90,000 acres under cotton crop and 17,000 acres under vineyards. Cattle-breeding is extensive, and there were 35,650 horses, 26,200 donkeys, 336,000 horned cattle, and 684,500 sheep. Industry is in infancy, but cottons, carpets, felt goods, and so on are fabricated in the villages. A considerable foreign trade is carried on with Persia, but trade with Asia Minor is on decline.

The government is divided into 7 districts : ??? Erivail, Alexandro-pol, Echmiadzin (chief town, Vagarshapad), Nakhichevaii, Novo- bayazet, Surmalinsk (chief town, Igdyr), and Sharuro-Daralaghoz (chief town, Norashen). The main towns are: Erivafl, Alex- andropol (32,018 inhabitants), Nakhichevaii (8845), Novobayazet (8607), and Vagarshapad (2910). (p. a. k.)

Erivan, capital of the above government, is situated in 42 ́ ́ 14′ N., 44 ́ ́ 57′ E., 173 miles south-west of Tiflis, on Zanga river, from which a great number of irrigation canals are drawn. Altitude, 3087 ft. It has several remarkable relics of the I'ersian dominion in its old fortress. Popula- tion (1873), 11,938; (1897), 29,033.

Eriangen, a town of Bavaria, Germany, dist. Middle Franconia, on the river Regnitz, 15 miles by rail north from Nuremberg. Its chief importance centres in its

tmiversity, ~~which in 1900 was attended by 974 students, and had 69 professors. The principal buildings are those connected with the university, such as the library, which possesses 180,000 volumes, lecture halls (1889), and vari~~ ous scientific institutes and laboratories. Population

(1885), 15,828; (1900), 22,953.

Erie, Sir William (1793-1880), English lawyer and judge, was born at Fifehead-Magdalen, Dorset, 1st October 1793, and was educated at Winchester and at New College, Oxford. Having been called to the Bar, he went the Western circuit, became counsel to the Bank of England, sat in Parliament from 1837 to 1841 for the city of Oxford, and, although of opposite politics to Lord Lyndhurst, was made bj' him a judge of the Common Pleas in 1845. He was transferred to the Queen's Bench in the following year, and in 1869 came back to the Common Pleas as Chief Justice upon the promotion of Sir Alexander Cockburn. He retired in 1866, receiving the highest eulogiums for the ability and impartiality with which he had discharged the judicial office. He died at his estate at Bramshott, Hampshire, on 28th January 1880 ; and a monument in his memory stands on the top of Hindhead.

Ernst 11. [August Kakl Johannes Leopold Alex- ander Eduaed], duke of Saxe-Coburg-Gotha (1818-1893), was born at Coburg on the 21st of June 1818. He was the eldest son of Ernst I., duke of Saxe-Coburg-Saalfeld. In

1826, when the line of Saxe-Gotha became extinct, a rearrangement of the Saxon duchies took place. The duke of Coburg gave up the small territory of Saalfeld and acquired instead that of Gotha, and he changed his title to that of Ernst I. of Saxe-Coburg-Gotha. Ernst enjoyed a many-sided education; he studied at the Uni- versity of Bonn with his brother Albert; his military training he received in the Saxon army. The widespread connexions of his family opened to him many courts of Europe; after he became of age he travelled much. The position of his uncle, who was King of the Belgians, and especially the marriage of his brother to the Queen of Eng- land, his cousin, gave him peculiar opportunities for be- coming acquainted with the political problems of Europe. In 1840-41 he undertook a journey to Spain and Portugal ; in the latter country another cousin was King-Consort. In 1844 he succeeded his father. His own character and the influence of the King of the Belgians, made him one of the most Liberal princes in Germany. He was able to bring to a satisfactory conclusion disputes with the Coburg estates. He passed through the ordeal of the Revolution with little trouble, for he anticipated the de- mands of the people of Gotha for a reform, and in 1852 introduced a new constitution by which the adminstration of his two duchies was assimilated in many points. The government of his small dominions did not afford sufficient scope for his restless and versatile ambition ; his desire to play a great part in German affairs was probably increased by thei feeling that, though he was the head of his house, he was to some extent overshadowed by the younger branches of the family which ruled in Belgium, England, and Portugal. He was one of the foremost supporters of every attempt made to reform the German constitution and bring about the unity of Germany. He took a warm interest in the proceedings of the Frankfort Parliament, and it was often said, probably without reason, that hehoped to be chosen Emperor himself. However that may be, he strongly urged the King of Prussia to accept that position when it was offered him in 1849 ; he took a very prominent part in the complicated negotiations of the following year, and it was at his suggestion that a congress of princes met at Berlin in 1850. He highly valued the opportunities

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which this and similar meetings gave him for exercising political influence, and he would have felt most at home as a member of apermanent council of the German princes. Ambitious also of military distinction, and sympathizing with the rising of the people of Schleswig-Holstein against the Danes in 1849, he accepted a command in the Federal army. In the engagement of Eckernforde the troops under his orders succeeded in capturing two Dan- ish frigates, a remarkable feat of which he was justly proud. His greatest services to Germany were performed during the years of reaction which followed ; almost alone among the German princes he remained faithful to the Liberal and National ideals, and he allowed his domin- ions to be used as an asylum by the writers and politicians who had to leave Prussia and Saxony. The reactionary parties looked on him with great suspicion, and it was at this time that he formed a friendship with Gustav Frey- tag, the celebrated novelist, whom he protected when the Prussian Government demanded his arrest. His con- nexion with the English court gave him a position of much influence, but no one was more purely German in his feelings and opinions. The marriage of his niece with the heir to the Prussian throne strengthened his connexion with Prussia, but caused the Conservative party to look with increased suspicion on the Coburg influence. He was the first German prince to visit Napoleon III., and was present when Orsini made his celebrated at- tempt on the Emperor's life. After 1860 he became the chief patron and protector of the National Verein; he en- couraged the newly-formed rifle clubs, and notwithstand- ing the strong disapproval of his fellow-monarchs, allowed his court to become the centre of the rising national agi- tation. Still a warm adherent of Prussia, in 1862 he set an example to the other princes by voluntarily making an agreement by which his troops were placed in war under the command of the King of Prussia. Like all the other Nationalists, he was much

embarrassed by the policy of Bismarck, and the democratic opinions of the Coburg court, which were shared by the Crown Prince, were a very serious embarrassment to that minister. The oppo- sition became more accentuated when the duke allowed his dominions to be used as the headquarters of the Augustenburg agitation, and it was at this time that Bismarck is reported to have said that if Frederick the Great had been 'alive the duke would have been in the fortress of Spandau. He was naturally present at the Fursten-Tag in Frankfort, and from this time was in more frequent communication with the Austrian' court, where his cousin Count Mensdorff was minister (see the annexed Genealogical Table). However, when war broke out in 1866, he at once placed his troops at the disposition of Prussia ; Bismarck had in an important letter explained to him his policy and tactics. He was personally concerned in one of the most interesting events of the war ; for the Hanoverian army, in its attempt to march south and join the Bavarians, had to pass through Thuringia, and the battle of Langensalza was fought in the immediate neigh- bourhood of Gotha. His troops took part in the battle, which ended in the route of the Prussians, the duke, who was not present during the battle, in vain attempt- ing to stop it. He bore an important share in the nego- tiations before and after the battle, and his action at this time has been the subject of much controversy, for it was suggested that while he offered to mediate he really acted as a partisan of Prussia. For his services to Prus- sia he received as a present the forest of Schmalkalden. He was with the Prussian headquarters in Bohemia dur- ing the latter part of the war.

With the year 1866 the political role which he had played ended. The result was perhaps not quite equal to his expectations, but it must be remembered how difficult

was the position of the minor German princes ; and he quoted with great satisfaction the words used in 1870 by the Emperor William at Versailles, that " to him in no small degree was due the establishment of the empire." He was a man of varied tastes, a good musician, ??? he com- posed several operas and songs, ??? and a keen sportsman, a quality in which he differed from his brother. Notwith- standing his Liberalism, he had a great regard for the dignity of his rank and family, and in his

support of con- stitutional government would never have sacrificed the essential prerogatives of sovereignty. Several anonymous political pamphlets were attributed to him. He brought out, also, an account of travels in Egypt and Abyssinia, which he undertook in 1868 ; and in 1890 published his memoirs Aus meinefn Leben und meiner Zeit, in three vol- umes, a work which contains much valuable information on the most critical period of German history ; there is an English translation. See also The Life of the Prince Consort, by Sir Theodobb Maktin ; The Early Years of the Prince Consort, by Sir G. Geey ; and for the war of 1866, Hassell, Geschichte Hannovers, 1897-1901. He died on the 22nd of August 1893 at Eeinhardsbrunn.

The Duke married, in the year 1842, Amelia, daughter of the Grand Duke of Baden. There was no issue to the marriage ; the succession therefore passed on his death to the children of his younger brother. By the marriage contract of Prince Albert the duchy could not be held with the crown of England ; it therefore passed to Prince Albert's second son, the Duke of Edinburgh. The latter's only son predeceased him, and therefore on his death it passed again to the Duke of Connaught; and he and his son passed on their claims to the Duke of Albany.

The genealogical table on p. 279 displays the widely- spread connexions of the family of Saxe-Coburg, and shows how large a part it has played in the recent his- tory of Europe. (j. w. he.)

Erode, a town of British India, in the Coimbatore district of Madras; situated in 11 ◆◆ 20′ N. lat. and 77 ◆◆ 46′ E. long,, on the right bank of the river Cauvery, which is here crossed by an iron railway girder bridge of 22 spans. Population (1881), 9864; (1891), 12,238. Here the South Indian railway joins the South-Western line of the Madras railway, 243 miles from Madras. There are exports of cotton and saltpetre ; and the town has a steam cotton press, a high school, and two printing- presses.

Error, Law of. ◆◆◆ Error is defined in popular diction- aries as " deviation from truth " ; and since truth com- monly lies in a mean, while measurements are some too large and some too small, the term in scientific diction is extended to deviations of statistics from their average,

even when that average ⬚ like the mean of human or barometric heights ⬚ does not stand for any real objective thing. A law of error is a relation between the extent of a deviation and the frequency with which it occurs : for instance, the proposition that if a digit is taken at random from mathematical tables, the difference between that figure and the mean of the whole series (indefinitely prolonged) of figures so obtained. Definition namely, 4-6, will in the long run prove to be ^^Ws/on equallyoften ⬚0-r), ⬚1-5, ⬚2-5, ⬚3-6, ⬚4-5.i The more general term " law of frequency " is appropriate when there is no explicit reference to the mean, e.g., the statement that one digit occurs as often as the other. The assignment of frequency to discrete values ⬚ as 0, 1, 2, &c., in the preceding example ⬚ is often replaced by a con-

1 See as to the fact and the evidence for it, Venn, Logic of Chancp, 3rd ed.,pp. Ill, 114. Cp. Ency. Brit.,Wa ed., art. " Probability," p. M12.

tiauous curve with a corresponding equation. For ex- ample, it is found by Professor Pareto ^ that the number of incomes of different size (above a certain size) is ap- proximately represented by the equation y = A/a^, where x denotes the size of an iucome, y the number of incomes of that size, A and a are constants differing for diiferent countries. Although this' law is found to hold good for many countries, it is but a law of error or frequency ; the right to be called the law of error is reserved for a function which is applicable not merely to one sort of statistics ⬚ such as digits or incomes ⬚ but to a great variety of mis- cellaneous groups generally at least, if not un^ersaUy. What form is most deserving of this distinction is not decided by uniform usage : different authorities do not attach the same weight to the grounds on which the claim is based, the extent of cases to which the law may be applicable, the closeness of the application, and the pre- sumption prior to specific experience in favour of the law. Three conceptions of the law of error, characterized by different degrees of these qualifications, will be considered here (sections 1 to 47, 48 to 51, 52 to 54) ; a fourth divi- sion (sections 55 to end) is

required for certain derivative laws which may be expected to result from the law of error if prevalent in any of the three senses.

1. The simplest and best recognized statement of the law of error, often called the " normal law," is the equation

1 ❓❓❓ C2 .

*more conveniently written(l/ Jtt c) exp – (x ❓❓❓ dy/c% where jc is the magnitude of an observation or " statistic," ^ e.c/., the stature of an individual man, z is the proportional frequency of observations measuring x, d is the arithmetic mean of the group (supposed indefinitely ^ multiplied) of similar statistics : c is a constant sometimes called the " modulus " * proper to the group ; and the equation signifies that if any large number N of such a group is taken at random, the number of observations between X and X + /\x is (approximately) equal to the right-hand side of the equation multiplied by NAa^-*

2. An a priori proof of this law was given by Herschel^ as follows : " The probability of an error depends law of solely on its magnitude and not on its direc- error : tion " ; positive and negative errors are equally k priori probable. " Suppose a ball dropt from a given '"""' ' height with the intention that it should fall on a given mark," errors in all directions are equally probable, and errors in perpendicular directions are independent. Accordingly, the required law, " which must necessarily be general and apply alike in all cases, since the causes of error are supposed alike unknown,"^ is for one dimension of the form {oo^), for two dimensions (jtix^ + y^) ; and

' Oours d'EconomM politique, vol. ii. p. 306.

' The corresponding curve ❓❓❓ often called the " probability-curve " ❓❓❓ is represented in the art. on " Probability," Ency. Brit., 9th ed., vol. zix.

^ On this conception see below, ❓❓ 15.-

- *E.g., in the art. on " Probability " in the 9th ed. of the Ency. Brit. ; also by Airy and other authorities. Bravais, in his article Swr la probability des erreurs. . . . " M^moires pr&eutfe par divers savants," 1846, p. 257, takes as the " modulus or parameter " the inverse square of our u. Doubtless different parameters are suited to different purposes and contexts ; c when we consult the common tables ; k(= 4c^) when we investigate the formation of the probability-curve out of independent elements (below, ►► 5) ; h(= 1/c^) when we are concerned with weights or precisions (below, ►► 26). If one form of the coefficient must be uniformly adhered to, probably o-(=c/;y/2), for which Professor Pearson expresses a preference, appears the best. It is called by him the "standard deviation."*

' Edinburgh Remew, 1850, vol. xoii. p. 19.

^ The italics are in the original. The passage continues : " And it ia on this ignorance, and not on any peculiarity in cases, that the idea of probability in the abstract is formed." Cp. below, ►► 24.

*times that Q assumes magnitudes between x and x + ►►\xia the course of N trials is KzA^i if z = (l/*y2irk) exp – (a; – a)72k ; where a is the sum of the arithmetic means of all the elements,*

any one of which ar, = I / a;fr(x)da; I, the square brackets denoting

that the integrations extend between the extreme limits of the element's range, if the frequency-locus for each element is continu- ous, it being understood that I / fr(a;)da! =1; and k is the sum ^

of the mean squares of error for each element,' =2! / |'fr(ar 1 J)d|,

if the frequency-locus for each element is continuous, where a, is the arithmetic mean of one of the elements, and f the deviation of any value assumed by that element from a,, 2 denoting summa- tion over all the elements. When the frequency-locus for the element is not continuous,

the integrations which give the arithmetic- mean and mean-square of error for the element must be replaced by summations. For example, in the case of the dice above in- stancedj the law of frequency for each element is that it assumes equally often each of the values 1, 2, 3, 4, 5, 6. Thus the arith- metic mean for each element is 3 '5, and the mean square of error {(3-5-l)2-l-(3-5-2f-l-etc.}/6 = 2-916. Accordingly, the sum of the points obtained by tossing a large number, ►►, of dice at random will assume a particular value x with a frequency which is approximately assigned by the equation

z=(l/^a-5-83?i) exp-(^-3-6)75-85►►.

The rule equally applies to the case in which the elements are not similar ; one might be the nilmber of points on a die, another the number of points on a domino, and so on. Graphically, each element is no longer represented by a step which is either null or i, but by a step which may be, with an assigned probability, one or other of several degrees between those limits, the law of fre- quency and the range i being different for the different elements.

6. The evidence for these statements can only be indicated here. The best-known proof that the sum of multinomial elements will vary according to the normal law of error approximately is that which was given by Laplace for elements with one and the same law of frequency of (almost) any kind ; and was extended by Poisson to elements with different laws of frequency.' A simpler proof of the general theorem has been given by De Forest, based on certain proportions respecting the multiplication of multinomials of the form (ao Ɨ a,^z -f ajz' -f . . .-t-anZ"). Another simple proof is based by Mr Morgan Crofton ►► on certain partial differential equa- tions which must be satisfied in order that the taking in of a new element should not alter the form, but only the constants, of the resulting law of frequency.*

7. The three proofs which have been mentioned have been ex- tended to errors in two (or more) dimensions. ►► Let Q be the sum of a number of elements, each of which, being a function of two vari- ables, X and y, assumes different pairs of values according to a law of frequency

[illegible]T=/r(o5,?/), the functions being in general different for different elements. The frequency with which Q assumes values of the variables between x and x + ^x and between y and y + Ay is z^x^y, if

^ "1 g^ m(a;-a)'-21(a-a)(g-b)-^k(^/-b)g .

^ 27rVkm^ "" 2(km-l^)

where, as in the simpler case, a = Sa5, ar being the arithmetic mean of the values of x assumed in the long run by one of the elements, b is the corresponding sum for values of y, and

k = sf //'([illegible] – ^rYHx, i/)da:di/ J

m = \//(y – ^r)%{x, y)dxdy J

1 = 2 // (x-a.r){y-hr)(,{x,y)(ixdy\;

^ Or rather what that sum would he if the series of observation could he indefinitely prolonged. Cp. below, [illegible] 15.

' In the case of binomial, 'k = n{pq' + qp') = npq.

^ Laplace, Th4orie analytique des ProlabiliUa, bk. ii. ch. iv. ; Poisson, Recherches sur la ProbabilitS des jugemenis. Good restatements of this proof are given by Todhunter, History of Probabilities, Art. 1004, and by Czuber, Theorie der Beobachtungsfehler, Art. 38 and Th. 2, [illegible] 4.

- *The Analyst (Iowa), vols, v., vi., vii. passim; and especially vol. vi. pp. 142-47, vol. vii. pp. 173-74.*

^ Ency. Brit., 9th ed., art. "Probability." Cp. Trans. Roy. Soc, 1870, vol. clx. pt. i., "On the Proof of the Law of Errors."

- *The first by Mr Burbury, in Phil. Mag., 1894, vol. xxxvii. p. 145, the second by its author in the Analyst for 1881, the third by the present writer in Phil. Mag., 1896, xli. p. 247.*

the summation extending over all the elements, and the integra- tion between the extreme limits of each ; supposing that the law 2 of frequency lor each element is

continuous, othenvise summation is to be suhstituted for integration. For example, let each element he constituted as follows. Three coins having been tossed, the number of Heads presented by tlie first and second coins together is put for x, the number of Heads presented by the second and third coins together is put for y. The law of frequency for the element is represented by the annexed diagrams, the integers outside denoting the values of a: or y, the fractions inside probabilities of particular values of x and y concurring.

If i is the distance from 0 to 1 and from 1 to 2 on the abscissa, and i' the corresponding distance on the ordinate, the mean of the values of x for the element ??? Aa, as we may say, ??? is i, and the cor- responding mean square of horizontal deviations is i. Likewise Ab = i' ; Am = i" ; and Al = i(– ?? x +i"-ix ~~i') = iii'~~ Accord- ingly, if n such elements are put together (if n steps of the kind which the diagram represents are taken), the frequency with which a particular pair of aggregates x and y will concur, with which a particular point on the plane of at/, namely, a;=riand y=v'i', will be reached, is given by the equation

'16

0

i

i i i i

i

i

(

i

-1 /

exp Zn 3 ⬜⬜|

[”

nfi”^ – (r – 5i)(r’ – n)ii’ -f (r’

⬜⬜⬜ iC)i’”^.

A veriiioation is afforded by a set of statistics obtained with dice by Professor Weldon, and here reproduced by his permission. A success is in this experiment defined, not by obtaining a Head when a coin is tossed, but by obtaining a face with more than three points on it when a die is tossed ; the probabilities of the two events are the same, or rather would be if coins and dice were per- fectly symmetrical. Professor Weldon virtually took six steps of the sort above described when, six painted dice having been thrown, he added the number of successes in that painted batch to the number of successes in another batch of six to form his x, and to the number of successes in a third batch of six to form his y. The result is represented in the annexed dia;;ram, where each*

12 11 10 9 8 7 6 5 4 3 2 1

0

1

3

2

2

2

9

12 16 14 7 2

3

1 6 12 29 51 55 28 12 4

4

2

18

47

77

119

100

63

13

5

2 11 49 109 199 181 117 43 18 2

6

1 6

43

IIG

208 244 200 91

Zi

4 1

7

1

28

76

138

213

198

129

46

17

1

8

5

7

57

118

118

121

69

19

1

1

9

1

19 54 59 71 32 18

3

10

2

15 25 23 3 3

11

1 4 1

12

1

0

degree on the axis of x and y respectively corresponds to the i and i' of the preceding paragraphs, and i = i'. The observed frequen- cies being represented by numerals, a general correspondence between the facts and the formula is apparent. The maximum frequency is, as it ought to be, at the pointa; = 6i, y = 6i'. The density is particularly great along a line through that point, making 45 with the axis of x ; particularly small in the com- plementary direction. This also is as it ought to be. For if the centre is made the origin by substituting x for {x – a) and y for {y – b), and then new co-ordinates X and Y are taken, making an

” Compare the formula for the .simple case, above, ►►4. 8 On the irregularity of the dice with which Professor Weldou ex- perimented, see Professor Pearson, Phil. Mag., 1900, p. 167.

angle 0 with x and y respectively, the curve which is traced on the plane of 2X by its intersection with the surface is of the form

z = J exp – X2[k sin^ 9 – 2 1 cos 9 sin 9 + m cos^ fi]/2(km – P), a probability-curve which will be more or less spread out according as the factor k sin^ fl-2 1 cos fl sin 9 + m cos^ B is less or greater. Now this expression has a minimum or maximum when (k – m) sin 9-21oos29 = 0; a minimum when (k-m) cos 29 + 21 sin 2B is positive, and a maximum when that criterion is negative ; that is, in the present case, where k = m, a minimum when 9=4irand a maximum when $ = ^ir,

9. Tlie law which has been stated, that if numerous elements, each independently varying (in one or more dimensions) according to (almost) any law of frequency, are added together, the sum is apt to vary according to the (normal) law of error, may be called the laio of great numbers.^ As may be presumed from the examples just given, in order that there should be some approximation to the normal law the number of elements need not be very gi’eat. A very tolerable imitation of the probability-curve has been obtained by superposing three elements, each obeying a law of frecjuency quite different from the normal one,^ that simple law according to which one value of a variable occurs as frequently as another between the limits within which the variation is con- fined (j/ = ►►►, between limits x= +&, x= -a). If the component

elements obey unsymmetrical laws of frequency, the compound will indeed be to some extent unsymmetrical, unlike the ” normal ” probability-curve. But, as the number of the elements is increased, the portion of the compound curve in the neighbourhood of its centre of gravity tends to be rounded off into the normal shape. The portion of the compound curve which is sensibly identical with a curve of the “normal”

family becomes greater the greater the number of independent elements ; ceteris paribus, and gi'anted certain conditions as to the equality and the range of the eleiiients. It will readily be granted that if one component predominates, it may unduly impress its own character on the compound. But it should be pointed out that the characteristic with which we are now concerned is not average magnitude, but deviation from the average. The component elements may be very unequal in their contributions to the average magnitude of the compound without prejudice to its "normal" character, provided that the fluctuation of all or many of the elements is of one and the same order. The proof of the lawof greatnumber3(by way of partial differential equa- tions) requires that the contribution made by each element to the mean square of deviation for the compoiind, k (see ____5-7), should be small, capable of being treated as differential with respect to k. It is not necessary that all these small quantities should be of the same order, but only that they should admit of being rearranged, by massing together those of a smaller order, as a numerous set of independent elements in which no two or three stand out as sui generis in respect of the magnitude of their fluctuation. For example, if one element consist of the number of points on a domino (the sum of two digits taken at random), and other elements, each of either 1 or 0 according as Heads or Tails turn up when a coin is cast, the first element, having a mean square of deviation 16 '5, will not be of the same order as the others, each having 0"25 for its mean square of deviation. But sixty- six of the latter taken together would constitute an independent element of the same order as the firit one, and accordingly if there are several times sixty-six elements of the latter sort, along with one or two of the former sort, the conditions for the genera- tion of the normal distribution will be satisfied. These proposi- tions would evidently be unaffected by altering the average jnagnitude, without altering the deviation from the average, for any element, that i.s, by adding a greater or less fixed magnitude to each element. The propositions are adapted to the case in which the elements fluctuate according to a law of frequency other than the normal. For if they are already normal, the aforesaid conditions are unnecessary. The normal law will be obeyed by the sum of elements which each obey it, even though they are not numerous and not independent and not of the same order in respect of the extent of fluctuation. A similar distinction is to be drawn with respect to some further conditions which the reasoning

requires. A limitation as to the range of the elements is not necessary when they are already normal, or even have a certain affinity to the normal curve. Very large values of the element are not excluded, provided they are sufficiently rare. What has been said of curves with special reference to one dimension is of course to be extended to the case of surfaces and many dimensions. In all cases the theorem that under the conditions stated the normal law of error will be generated is to be distinguished from the hypothesis that the conditions are fairly well fulfilled in ordinary experience.

^ This definition is not identical with Poisson's use of the term " law of great numbers " in his Recherches sur la Probability des jiig&ments.

" Jowm. Stat. Soc., March 1900, p. 73, referring to Dr Burton, fhil. Mag., 1883, vol. xvi. p. 301.

Errors proper.

*10. (/8) The principles won by.studying the sort of model which games of chance present are now to be applied to important concrete cases; among which errors-of-observa- tion occupy a leading place. The law of great numbers is brought to bear on this case by the hypothesis that an error is the algebraic sum of numerous elements, each varying according to a law of frequency special to itself. This hjrpothesis involves two assumptions: (1) that an error is dependent on numerous independent causes ; (2) that the function expressing that dependence can be treated as a linear function, by expanding in terms of ascending powers (of the elements) according to Taylor's theorem and neglecting higher powers,^ or otherwise. The first assumption seems, in Dr Glaisher's words, "most natural and true. In any observation where great care is taken, so that no large error can occur, we can see that its accuracy is influenced by a great number of circumstances, which ultimately depend on independent causes : the state of the observer's eye and his physiological condition in general, the state of the atmosphere, of the different parts of the instrument, &c., evidently depend on a great number of causes, while each contributes to the actual error." * The second assump- tion seems to be frequently, but by no means univers- ally, realized in nature. This rationale is applicable not only to the fallible perceptions of the senses,*

but also to impres- sions into which a large ingredient of inference enters, such as estimates of a man's height or weight from his appear- ance,^ and even higher acts of judgment.^ Aiming at an object is an act similar to measuring an object, misses are produced by much the same variety of causes as mistakes ; and, accordingly, it is found that shots aimed at the same bull's eye are apt to be distributed according to the normal law, whether in two dimensions on a target or according to their horizontal deviations, as exhibited below (►► 47).

11. (y) A residual class comprises miscellaneous statistics, physical as well as social, in which the normal law of error makes its appearance, presumably in consequence

of the action of numerous independent influences, ~~'see/~~ Well-known instances are afforded by human statistics. heights and other bodily measurements, as tabu- lated by Quetelet ' and others. The tendency of social phenomena to conform to the normal law of frequency is well exemplified by Mr Bowley's grouping of the wages paid to different classes. ^

12. Instances of the normal law might also be divided into two classes ; observations which stand for

*a real objective thing, and such statistics as are 5/y/ri►►►

referred to in the preceding paragraph) would be sufficient for the generation of the normal law. The necessary condition is some- what less stringent.

^ Memoirs 0/ Astronomical 'Society, 1878, p. 105.

^ Jov/rn. Stat. Soc, 1890, p. 462 et seq.

' Ji.g., the marking of the same work by different examiners. Jbid.

' Lettres sur la ThSorie des Probabilites and Physique Sociale.

' ~~E.g'., the measurements of Italian recruits, adduced in the Atlante Statistico, published under the direction of the Ministero di Agricid~~ tura, Rome, 1882 ; and Professor Weldon's measurements of crabs, Proc. Roy. Soc, vol. hv. p. 321 ; discussed by Professor Pearson in the Trans. Roy. Soc, 1894, vol. clxxxv, A.

- *Wages in the United Kingdom in the Nineteenth Century ; and art. on " Wages " in the Supplement to the Ency. Brit., 9th ed.*

or " fictitious " ; the first class nearly corresponding with our (a) and (_) put together, the second class with our (y). But the division would be neither clear nor useful. On the one hand so-called real means are often only approxi- mately equal to objective quantities. Thus the proportional frequency with which one face of a die ??? the six suppose ??? tui-ns up is only approximately given by the objective fact that the six is one face of a nearly perfect cube. For a set of dice with which Professor Weldon experi- mented, the average frequency of a throw, presenting either five or six points, proved to be not -3, but 0-3377.^ The difference of this result from the regulation 0-3 is as unpre- dictable from objective data, prior to experiment, as any of the means called subjective or fictitious. So the mean of errors of observation often differs from the

thing observed by a so-called "constant error." So shots maybe constantly deflected from the bull's eye by a steady wind or " drift."

13. On the other hand, statistics, not purporting to represent a real object, have more or less close relations to magnitudes which cannot be described as fictitious. Where the items averaged are ratios, e.g., the proportion of births or deaths to the total population in several districts or other sections, it sometimes happens that the distribu- tion of the ratios exactly corresponds to that which is obtained in the simplest games of chance ??? "combi- national " distribution, in the phrase of Professor Lexis." There is unmistakably suggested a sortition of the simplest type, with a real ascertainable relation between the num- ber of " favourable cases " and the total number of cases. The most remarkable example of this property ispresented by the proportion of male to female (or to total) births. Some other instances are given by Professor Lexis ' and Professor Westergaard. A similar correspondence be- tween the actual and the "combinational" distribution has been found by Professor Bortkevitch * in the case of very small probabilities (in which case the law of error is no longer " normal "). And it is likely that some ratios ??? such as general death-rates ??? not presenting combinational distribution, might be broken up into subdivisions ??? such as death-rates for different occupations or age-periods ??? each distributed in that simple fashion.*

14. Another sort of averages which it is difficult to class as subjective rather than objective occurs in some social statistics, under the designation of index-numbers. The percentage which represents the change in the value of money between two epochs is seldom regarded as the mere average change in the price of several articles taken at random, but rather as the measure of something, e.g., the variation in the price of a given amount of commodities, or of a unit of commodity.^ So something substantive appears to be designated by the volume of trade, or that of the consumption of the working classes, of which the growth is measured by appropriate index-numbers," the former due to Mr Bourne and Sir Robert Giffen,' the latter to Mr George Wood."

15. But apart from these peculiarities, any set of statistics may be related to a certain quoBsitum, very much as measurements are related to the object measured. That

T^Phil. Mag., 1900, p. 168.

2 Cp. Journ. Stat. Soc, Jubilee No., p. 192.

‘ Massenerscheinungen.

- *Grundziige der Statistik. Cp. Bowley, Elements of Statistics, p.*

302.

s Das Gesetz der kleinen Zahlen.

c See for other definitions Report of the British Association, 1889, pp. 136 and 161, and compare Mr “Walsh’s exhaustive Measurement of General Exchange- Valve.

‘ Cp. Bowley, Elements of StaXistics, chap. ix.

<?><?> Journ. Stat. Soc., 1874 and later. Parly. Papers [C. 2247] and [C. 3079].

” ” Working-Class Progress since 1860,” Journ. Stat. Soc., 1899, p. 639.

gucBsitum is the limiting or ultimate mean to which the series of statistics, if indefinitely prolonged,would converge, the mean of the complete group ; this conception of a limit applying to any frequency-constant, to ” c,” for instance, as well as ” a ” in the case of the normal curve.’” The given statistics may be treated as samples from which to reason up to the true constant by that principle of the Calculus which determines the comparative probability of different causes from which an observed eventmay have emanated.”

16. Thus it appears that there is a characteristic more essential to the statistician than the existence of an objective qumsitum, namely, the use of that method which is primarily, but not exclusively, proper to that sort

of qucesitum ??? inverse probability. Without that delicate instrument the doctrine of error can seldom be fully utilized ; but some of its uses may be indicated before the introduction of technical difficulties.

*17. The mere presumption that wherever three or four independent causes co-operate, the law of error tends to be set up, has a certain speculative interest.'^*

The assumption of the law as a hypothesis ^ appuL- is legitimate. When the presumption is con- tionsot firmed by specific experience, this knowledge is fienormsi apt to be turned to account. It is usefully applied *"" to the practice of gunnery ; a use which, so far as it involves inverse probabilities," belongs, with the treatment of errors proper, or fallible observations, to a later section. In many kinds of examination it is found that the total marks given to different candidates for answers to the same set of questions range approximately in conformity with the law of error. It is understood that the Civil Service Commissioners have founded on this fact some practical directions to examiners. Apart from such direct applications, it is a useful addition to our knowledge of a class that the measurable attributes of its members range in conformity with this general law. Something is added to the truth that " the days of a man are threescore and ten," if we may regard that epoch, or more exactly for England 72, as "Nature's aim, the length of life for which she builds a inan, the dispersion on each side of this point being . . . nearly normal." " So Herschel says : " An [a mere] average gives us no assurance that the future will be like the past. A [normal] mean may be reckoned on with the most complete confidence." '^ The existence of independent causes," inferred from the fulfilment of the normal law, may be some guarantee of stability. In Natural History especially have the con- ceptions supplied by the law of error been fruitful. Investi- gators are already on the track of this inquiry : if those members of a species whose size or other measurable attributes are above (or below) the average are preferred ??? by "natural" or some other kind of selection ??? as parents, how will the law of frequency as regards that attribute be modified in the next generation ?*

18. The relations between different generations involve the law of error in two or more dimensions. It was found

1" On this conception compare Venn, iosrico/ Chance,chs. iii. andiv,, and Sheppard, Proceedings of the Land. Mathematical Society, p. 363 et seqq.

11 Laplace's 6th principle, Thiorie Analytique, Introduction x.

12 Cp. Galton's enthusiasm. Natural Inheritance, p. 66.

15 The distribution of velocities according to law of error as the condition of the stability of molecular motion (cp. Clerk Maxwell, Phil. Trans., 1867, p. 63; Trans. Camb. Phil. Soc, 1879) is connected by Mr Burbury (Phil. Mag., 1894, vol. xxxvii. p. 151) with what is here called the law of great numbers (above, ►►9).

i< Employed, for instance, by Didion (Calcul des Probahilit^s ap-pliqu►►► au tir) to determine, from the results of past shooting, tlie probable accuracy of a future shot.

16 Venn, Journ. Stat. Soc, 1891, p. 443. 16 Ed. Rev., 1850, xcii. p. 23.

1' Cp. Galton, Phil. Mag., 1875, vol. xlix. p. 44.

by Galton tliat tlie heights and other measurable attributes of children of the same parents range about a mean which is not that of the parental heights, but nearer the average of the general population. The amount of this " regression " is simply proportional to the distance of the " mid-parent's " height from the general average. This is a case of a very general law which governs the relations not only between members of the same family, but also between members of the same organism, and generally between two (or more) coexistent or in any way co-ordinated observations, each belonging to a normal group. Let x and y be the measure- ments of a pair thus constituted. Then i it may be expected that

the conjunction of particular values for x and y will approximately obey the two-dimensioned normal law which has been already exhibited (see ►►7).

19. In the expression above given, put l//^km = r, and the equation for the frequency of pairs having values of the attribute under measurement becomes

1 r{x-d)\►►►^{x-d){y-b)

It ;^km f,

exp

^’]/2(l-r►►).

v/k ,^m

This formula is of very general application.^ If two sets of measurements were made on the height, or other measurable feature, of the proverbial “Goodwin Sands” and “Tenterden Steeple,” and the first measurement of one set was coupled with the first of the other set, the second with the second, and so on, the pairs of magnitudes thus presented would doubtless vary according to the above-written law, only in that case r would presumably be zero ; the expression for z would reduce to the product of the two independent probabilities that particular values of x and y should concur. But slight interdependences between things supposed to be totally unconnected would often be discovered by this law of error in two or more dimensions. It may be put in a, more convenient form by substituting f for {x – d)/ ^k and i; for {y -h)/ Jm. The equation of the surface then becomes z = (l/27r^l-r=) exp – r^). If the frequency of observations in the vicinity of a point is represented by the number of dots in a small increment of area, when r=0 the dots will be distributed uniformly about the origin, the curves of equal probability will be circles. When r is different from zero the dots will be distributed so that the majority will be massed in two quadrants : in those for which { and 17 are both positive or both negative when r is positive, in those for which f and 17 have opposite signs when r is negative. In the limiting case, when r = l*

the whole host will be massed along the line ;=|, every deviation { being attended with an equal deviation ij. In general, to any deviation of one of the variables f there corresponds a set or ” array ” (Pearson) of values of the other variable ; for which the frequency is given by substituting f for { in the general equation. The section thus obtained proves to be a normal probability-curve with standard deviation /! – r’. The most probable value of 71 corresponding to the assigned value of f is r^’. The equation i7 = r|, or rather what it becomes when translated back to our original co-ordinates {d-h)/a-2=i{x d)m respectively, is often called a regression-equation. A verifica- tion is to hand in the above-cited statistics, which Professor Weldon obtained by casting batches of dice. If the dice were perfiect, r (= l/^km) would equal J, and as the dice proved not to be very imperfect, the coefficient is doubtless approximately =4. Accord- ingly, we may expect that, if axes x and y are drawn through the point of maximum-frequency at the centre of the compartment con-‘ taining 244 observations, corresponding to any value of x, say 2;‘i (where i is the side of each square compartment), the most probable value of y should be A, and corresponding to y 2n the most probable value of x should be vi. And in fact these regression-equations are fairly well fulfilled for the integer values of v (more than which could not be expected from discrete observations) :

‘ Where plurality of independent causes is presumable.

2 HSrsohel’s d priori proposition concerning the law of error in two dimensions (above, 2) might still be defended either as generally true, so many phenomena showing no trace of interdependence, or on the principle which justifies our putting ^ for a probability that is unknown (below, 24), or 5 for a decimal place that is neglected ; correlation being equally likely to be positive or negative. The latter sort of explanation may be offered for the less serious contrast between the d priori and the empirical proof of the law of error in one dimension (below, 44).

*Cp. above, 8. * Cp. note to 1, above. Cp. above, 18.*

e.g., when a; = -l-4i, the value of j/, for which the frequency (25) is a maximum, is as it ought to be -l-2i; when x= ~~2i the maxi~~ mum (119) is at y= -i ; when x= -4i the maximum (16) is at y= -2i; when y is -(-2i the maximum (138) is at x=+i; when y is -2i, the maximum (117) at x= -i, and in the two cases (a!=+2i, and y= + ii), where the fulfilment is not exact, the iaiUire is not very serious.

20. Analogous statements hold good for the case of three or more dimensions of error.' The normal law of error for any number

of variables, Xi x^ x^, may be put in the form z = O-H'tY ij ??1) exp-[Riia;i"-l-R22a;2 + etc. ~~I~~ 2Ri2a^??C2 -t-eto]/2A where A is the determinant :

1 rig rio ??????

each r, e.g., r^ (=r32)> 's the ooeffioient of correlation be- tween two of the variables, e.g., x^, x^; Rn is the first minor of the determinant formed by omitting the first row and first column ; Rjj is the first minor formed by omitting the second row and the second column, and so on; Rjj (=R2i) is the first minor formed by omitting the first column and second row (or vice iiersd). The principle of correlation plays an

important rdle in Natural History. It has replaced the notion that there is a simple proportion between the size of organs by the appropriate conception that there are simple proportions existing between the deviation from the average of one organ and the most probable value for the coexistent deviation of the other organ from its average.' Attributes favoured by "natural" or other selection are found to be correlated with other attributes which are not directly selected. The extent to which the attri- butes of an individual depend upon those of his ancestors is measured by correlation.^ The principle is instrumental to most of the important "mathematical contributions" which Professor Pearson has made to the theory of Evolution.' In social inquiries, also, the principle promises a rich harvest. Where numerous fluctuating causes go to produce a result like pauperism or im- munity from small-pox, the ideal

method of eliminating chance would be to construct "regression-equations" of the following type: ??? "Change per cent, in pauperism [in the decade 1871-81] in rural districts = – 27 '07 per cent. , ‡ 0 '299 (change per cent, out- relief ratio), -1-0 '271 (change percent, on proportion of old), + '064: (change per cent, in population)." '"

21. In order to determine the best values of the coefficients involved in the law of error, and to test the worth of the results obtained by using f^'JIhnity any values, recourse must be had to inverse probability.

22. The simplest problem under this head is where the qucesitwm, is a single real object and the data consist of a large number of ob- servations, XifX^,, . . x???, such that if the number were indefinitely increased, the completed series would form a normal probability- curve with the true point as its centre, and having a given modulus c. It is as if we had observed the position of the dints made by the fragments of an exploding shell so far as to know the distance of each mark measured (from an origin) along a right line, say the line of an extended fortification, and it was known that the shell was fired perpendicular to the fortification from a distant ridge parallel to the fortification, and that the shell was of a kind of which the fragments are scattered according to a normal la^ '^ with a known coefficient of dispersion ; the question is at what position on the distant ridge was the enemy's gun probably placed ? By received principles the probability, say P, that the given set of observations should have resulted from measuring (or aiming at) an object of which the real position was between x and X + Aa; is

A! J exp – ;*

/+?? PdiB

' Phil. Mag., Aug. 1892, p. 200 et seqq.; March 1896, p. 211 ; Pearson, Trans. Roy. Soc., 1896, vol. clxxxvii. p. 302 ; Burbury, Pha.' Mag., 1894, p. 145.

' Pearson, " On the Reconstmotion of Prehistoric Races," Trans. Roy. Soc., 1898, A, p. 174 et seqq.; Proc. Roy. Soc, 1898, p. 418.

- *“The Law of Ancestral Heredity,” Pearson, Trans. Roy. Soc, Proc Roy. Soc, 1898.*

‘ Papers in the Royal Society in progress since 1895. ’” An example instructively discussed by Mr Yule, Joum. Stat. Soc.

1899.

^^ If normally in any direction indifferently according to the two- or three-dimensioned law of error, then normally in one dimension when collected and distributed in belts perpendicular to a horizontal right line, as in the example cited below, ►►47.

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ERROR, LAW OF

(since the given set of observations must have resulted from some position on the axis ot x). The value of x, from whioh the given set of observations inosl probably resulted, is obtained by making P

a maximum.

Putting -Tr; = 0, we have for the maximum (

dx2 being negative for this value), the arithmetic mean of the given observations. The accuracy of the determination is measured by a probability-curve with modulus c/ ^n. Thus in the course of a very long siege if every case in which the given group of shell-marks Xi, x^►►►Xn was presented could be investigated, it would be found that the enemy’s cannon was fired from the position x’, the (point right opposite to the) arithmetic mean of x^, x^, &c., Xn, with a frerjuenoy assigned by the equation I z = (s/nj i^irc) exp. ~~n(x~~ x’fjaK

23. Simple as this solution is, it is not the one which has most recommended itself to Laplace. He envisages the quoesitum not so much as that point which is most probably the real one, as that point which may most advantageously be put for the real one. In our illustration it is as if it

were required to discover from a number of shot-marks not the point '___ which in the course of a long siege would be most frequently the position of the cannon which had scattered the observed fragments, but the point which it would be best to treat as that position ___ to fire at, say, with a view of silencing the enemy's gun ___ having regard not so much to the frequency with which the direction adopted is right, as to the extent to which it is wrong in the long run. As the measure of the detriment of error, Laplace ^ takes "la valeur moyenne de I'erreur k craindre," the mean first power of the enors taken positively on each side of the real point. The mean square of errors is proposed by Gauss as the criterion.' Any mean power indeed, the integral of any function which increases in absolute magnitude with the increase of its variable, taken as the measure of the detriment, will lead to the same conclusion, if the normal law prevails."

24. Yet another speculative difficulty occurs in the simplest, and recurs in the more complicated, inveise problem. In putting P as the probability, deduced from the observations that the real point for which they stand is x (between x and x + ^x), it is tacitly assumed that prior to observation one value of x is as probable as another. In our illustration it must be assumed that the enemy's gun was as likely to be at one point as another of (a certain tract of) the ridge from which it was fired. If, apart from the evidence of the shell-marks, there was any reason for thinking that the gun was situated at one point rather than another, the formula would require to be modified. Tlus dpriori probability is sometimes grounded on our ignorance ; according to another view, the procedure is justified by a rough general knowledge that over a tract of x for which P is sensible one value of x occurs about as often as another."

25. Subject to similar speculative difficulties, the solution which has been obtained may be extended to the analogous problem in which the giuesitum is not the real value of an observed magnitude, but the mean to which a series of statistics indefinitely prolonged converges.'

26. Next, let the modulus, still supposed given, not be the same for all the observations, but Cj for x^, Cj for x^, &c. Then P becomes proportional to

*exp – [k – scJVci^ + (**C – ajjJVa” + &c.]. Method ot And the value of x which is both the most probable and least the “most advantageous” is {x^jc-^ + xjc^ + Bta.JUllQ.-^*

squares. -f l/cj^ (&c.) ; each observation being weighted with the inverse mean square of observations made under similar conditions.’ This is the rule prescribed by the “Method

^ Or small interval (cp. preceding section).

^ ” Toute erreur soft positive soit negative doit 6tre consider^e comme un d&avautage ou une perte rfeUe, k un jeu queloonque,” Theorie analytique. Art. 20 et seqq., especially Art. 25. As to which it is acutely remarked by Bravais {op. cit. p. 258), ” Cette regie simple laisse i desirer une demonstration rigoureuse, car I’analogue du cas actuel avec celui des jeux de hasard est loin d’etre complete.”

‘ Theoria ComMnatwnis, part i. s. 6. Among contemporaries Pro- fessor Simon Newcomb is conspicuous by walking in the way of Laplace and Gauss in his preference of the irwst advantageous to the most probable determinations. With Gauss he postulates that “the evil of an error is proportioned to the square of its magnitude ” {American Journal of Mathematics, vol. viii. No. 4).

- *As argued by the present writer, Oamb. Phil. Trans., 1885, vol. xiv. part ii. p. 161. Cp. Glaisher, Mem. Astronom. Soc. xxxix. p. 108.*

” The view taken by the present writer on the ” Philosophy of Chance,” in Mind, 1880 (approved by Professor Pearson, Grammar of Science, 2nd ed., p. 146). See also ” A priori Probabilities,” Phil. Mag., Sept. 1884, and Gamb. Phil. Trans., 1885, vol. xiv, part ii. p. 147 et seqq.

*8 Above, ** 15.*

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‘ The mean square / {x’j ^Jttc) exp – k^c^ = cflj2dx.

J ◆◆◆00

of Least Squares ” ; but as the rule in this case has been deduced by genuine inverse probability, the problem does not exemplify what is most characteristic in tliat method, namely, that a rule deducible from the hypothesis that the errors of obaeiTations obey the normal law of error is emiiloyed in cases where the normal law is not known, or even is known not, to hold good. For example, let the law of error lor each o uservation be of the form of

z = (1 V^c) X exp[– 2:Vo2 – 2j (x/c – 22^/30^)],

where j is a small fraction, so that z may equally well be equated to (l/;v/)rc)[l-2j(a;/c-2a5/3c”)] exp-^Vo^ a law which is actually very prevalent.* Then, according to the genuine inverse method, the most probable value of x is given by the quadratic equation*

-^ log P = 0, where log P= Const. – ^(a; – ◆◆)7cr= – S2!j[(!K – iEr)/cr –

2{x – a;r)73cr’], S denoting summation over all the observations. According to the Method of Least Squares, the solution is the weighted arithmetic mean of the observations, the weight of any observation being inversely proportional to the corresponding mean square, i.e. c^l’l (the terms of the integral which involve j vanishing), which would be the solution if the j’s are all zero. We put for the solution of the given case what is known to be the solution of an essentially different case. How can this paradox be justified ? Many of the answers whioh have been gi\en to this question seem to come to this. When the data are unmanageable, it is legitimate to attend to a part thereof, and to determine the most probable (or the ” most advantageous “) value of the quatsUum, and the degree of its accuracy, from the selected portion of the data as if it formed the whole. ‘This throwing overboard of part of the data in order to utilize the remainder has often to be resorted to in the rough course of applied probabilities. Thus an Insurance Office only takes account of the age and some other simple attri- butes of its customers,’ though a better bargain might be made in particular cases by taking into account all available details. The nature of the method is particularly clear in the case where

the given set of observations consists of several batches, the observations in any batch ranging under the same law of frequency with mean a;‘r and mean square of error kr, the function and the constants different lor different batches ; then if we confine our attention to those parts of the data which are of the type x’r and kr ??? ignoring what else may be given as to the laws of error ??? we may treat the a;‘r’s as so many observations, each ranging under the normal law of error with its coefficient of dispersion ; and apply the rules proper to the normal law. Those rules applied to the selected data give, as the most probable (and also the most advantageous) solu- tion, that which is prescribed by the method of least squares, and for the law of error to which the relation is liable, the normal law with modulus ^1 Sk/7s.

27. This principle might be illustrated by the proposal to make the economy of datum a little less rigid ; to utilize not indeed all, but a little more, of our materials ??? not only the mean square of error for each batch, but also the mean cube of error. To begin with the simple case of a single homogeneous batch ; suppose that in our example the fragments of the shell are no longer scattered according to the normal law. By the Method of Least Squares it would still be proper to put the arithmetic mean of the given observations for the true i>oiut required, and to measure the accuracy of that determination by a probability -curve of which the modulus is rJlVfn, where k is the mean square of deviation (of fragments from their mean). If it is thought desirable to utilize more of the data, there is available the proposition that the arithmetic mean of a numerous set of observations, say a;,, x^” x???, taken as a sample from an indefinitely large group obeying any the same law of frequency, varies fiom set to set according to the following law of error (to be established later ^??) ???

z= V??Ml/c) exp-[?ia;Vc2-l-2)y(a:/c-2ar’/3c5)/c’]=/(a;) say ; where 0^= the mean square of deviation a,udj= the mean cube of deviation and j/c’, say j, is small. Then by abstraction analo- gous to that which has just been attributed to the Method of Least Squares, we may regard the datum as a single observation, the arithmetic mean subject to the law of eiror z=f{x). ‘The most probable value of the guccsitumis th-refore ” given by the equation f’{x-x’) = 0, where x’ is the arithmetic mean of the given

obser- vations. From the resitlting quadratic equation, putting x = x’ + ’ and recollecting that j is small, we have J/c=j/o, f=jc. That is the correction due to the utilization of the mean cube of error. The most advantageous solution cannot now be determined {f{x) being unsyinmetriral) without assuming a particular form for the function of detriment. The (additional) degree of accuracy is no longer measured by a normal probability-curve. This method of

8 Below, ►► 49.

‘ Cp. Venn, Logic of Chance, 3rd ed., ch. ix. Arts, 21, 22. ” Below, ►► 49.’ ” Cp. above, ►► 22.

least squares plus cubes may easily be extended ‘ to the case of several batches, or even individual observations, having different laws of frequency.

28. This application of the rules of Inverse Probability not to the actual data but to a selected part thereof, this economy of probability, is widely practised in miscellaneous statistics in

order to determine the worth of an average : whether thH ^ observed difference between two averages is aooi- metboas. [9](.jjj qj. significant of a real difference.” For instance, let the data be ages at death of individuals of two classes {fi.g., temperate or drunken, urban or rural, &c.) who have been under observation since the age of, say, 20. Granted that the ages of death conform to Gompertz’s law,* the determination of the most probable mean of either class and of the probability that the observed means of say n individuals of one class, n’ of another, should differ by so nmch, would most perfectly be effected by the genuine inverse method : dealing with Gompertz’s law in the same manner as with the normal law of error in a case where the observations were known to obey the latter law. But it sufiBces by assumed inversion to proceed as if our data consisted of two observations x’and y’ , the average ages at death of the

two classes, each average obeying the normal law of error, with respective moduli 0;= 2/n, where x, x^, &c., y^ y^, &c., are the respective sets of observed ages at death ; as follows from the law of great numbers, whatever the law of distribution of the given observations. According to a well-known property of the normal law, the difference between the averages of n and n' observations respectively will range under a probability-curve with modulus ;v/ci^ ∓ 02^ say c. Whence for the probability that a difference as great as the observed one, say ??, should have occurred by chance*

we have J[l – Sir)], where t = e/c, and 8{x) is the integral (2/ ^ir /

*(exp – a;")da!, given in many treatises.^*

29. This principle may be applied to other kinds of means besides the arithmetic, in particular the median (that point which has as many of the given observations above as below it). By simple induction we know that the median of a large sample of observations is a probable value for the true median ; how probable is determined as follows from a selection of our data. First suppose that all the observations are of the same weight. If a' were the true median, the probability that as many as i??. ∓ r of the observations should fall on either side of that point is given by the normal law for which the exponent is-2r7??.' This probability that the observed median will differ from the true one by a certain number of observations is connected with the probability that they will differ by a certain extent of the abscissa, by the proposition that the number of observations contained between the true and apparent median is equal to the small difference between them multi- plied by the density of observations at the median ??? in the case of normal and generally symmetrical curves the greatest ordinate. This is the second datum we require to select. In the case of the normal curve it may be calculated from the modulus itself, determined by induction from a selection of data. If the obser- vations are not all of the same worth, weight may be assigned IjV counting one observation as if it occurred oftener than another. This is the essence of Laplace's Method of Situation.'

*30. In its simplest form, where all the given observations are of equal weight, this method is of wide applicability. Compared with the genuine inverse method, it is always more convenient, seldom much less accurate, sometimes even more accurate. If the given observations obey the normal law, the precision of the median is less than the precision of the arithmetic mean by only some 25 per cent. ??? a discrepancy not very serious where only a rough esti- mate of the worth of an average (see ?? 28) is required. If the observations do not obey the normal law ??? especially if the ex- tremities are abnormally divergent ??? the precision of the median may be greater than that of the arithmetic mean.^*

‘ See on the method of least squares. Proceedings of the Cambridge Philosophical Societi/, 1887, vol. vi. part ii., and references there given.

2 The present writer’s Methods of Statistics in the Jubilee volume of the Joum. Stat, Soc. is designed to illustrate this use of the normal law.

5 Text-Book of Institute of Actuaries, oh. vi.

- *Above, ?? 9.*

” MJ.g., Ency. Brit., art. ” Probabihty,” 8th and 9th ed.

??? Above, ?? 4.

” Thlorie analytique, supplement ii. p. 614. MScanique Celeste, “book iii. Art. 40 ; on which see the note in Bowdich’s translation. The method may be extended to other percentiles. See Czuber, Beobachtungsfehler, ?? 59. Cp. Phil. Mag., October 1886, p. 375 ; and Sheppard, Trans. Roy. Soc, 1889, A, vol. cxcii. p. 135, et ante, where the error incident to this kind of determination is ascertained with , ???much precision.

8 Cp. Phil. Mag., 1887, vol. xxiv. p. 269 et seqq.

31. Yet another instance of the contrast between genuine and abridged inversion is afforded by the problem to determine the modulus as well as the mean for a set of observations Determln- known to obey the normal

law ; what the first problem" a ◻◻oa of becomes when the coeifioient of dispersion is not given, treqaeacy- By inverse probability we ought in that case, in addi- constants.

tion to the equation g ◻◻◻ = 0, to put r= 0. Whence c" = 2[a/ – a^)'"

+ {x'- x^f + etc. t {x' – x ◻◻◻ fljn, and x' = (xj + jcj + etc. + af^)/n. This solution differs from that which is often given in the text- books Mn that there, in the expression for c\ (n-l) occurs in the denominator instead of n. The difference is explained by the fact that the authorities referred to determine c, not by genuine in- version, but by ordinary induction, by a condition which certainly would be fulfilled in the long run, but does not express the whole of our data ; a condition in this respect like the equation of c to ^7r(Se)/w, where e is the difference (taken positively, without regard to its sign) between any observation and the arithmetic mean of all the observations. "

32. Of course the determination of the most probable value is subject to the speculative difficulties proper to Apriori probability; which are particularly striking in this case, as it appears equally natural to take as that constant, of which the values are (i priori equally probable, k(=c2/2), or even" h(= l/c2), the measure of weight, as in fact Laplace has done ; " yet no two of these assump- tions can be exactly true."

33. A more convenient determination is obtained from simple induction by equating the modulus to some datum of the observed group to which it would be equal if the group were complete ◻◻◻ in particular to the distance from the median of some percentile (or point which marks off a certain percentage, e.g., 25 of the given observations) multiplied by a factor corresponding to the percentile obtainable from a familiar table. Mr Sheppard has given an interesting proofs that we cannot by way of percentiles obtain such good " results for the frequency-constants as by the use of "the average and average square" [the method prescribed by inverse probability].

34. The same philosopHcal subtleties, with greater mathe- matical complications, meet us when we pass on to the case of two or more qucesita. The problem under

*this head which mainly exercised the older Entangled writers was to determine a number of unknown ***^”’*’ quantities, given a larger number, n, of equations involving them.*

35. Supposing the true values approximately known, by substi- tuting the approximate values in the given equations and expand- ing, according to Taylor’s theorem, there will be obtained for the corrections, say x, y ,n linear equations of the form

aia;~~H6ii/~~-=/i

where each a and 6 is a known coefficient, and each / is a fallible observation. Suppose that the error to which each is liable obeys the normal law, and that the modulus pertaining to each observ- ation is the same which latter condition can be secured by multi- plying each equation by a proper factor then if k’ and y are the true values of the qucesita, the frequency with which {ojx’ + b^y’ ~~f^) assumes different values is given by the equation z = l/(;~~ ~~7rc,) exp~~ [oja;~~fjlt~~/i]7oi, where Oj is a constant which, if not known beforehand, may be inferred, as in the simpler case, from a set of observations. Similar statements holding for the other equa- tions, the probability that the given set of observations /i, /j, &c. , should have resulted from a particular system of values for x,y ” is 3 exy [(aTX + b-^y-f-^flc^ + (a^+b^-f2flc^ + kc.\ where J is a constant determined on the same principle as in the analogous simpler cases.” The condition that P should be a maximum gives as many linear equations for the determination ot x’ y’ as there are unknown quantities.

36. The solution proper to the case where the observations are

Above, 22.

’” E.g., Airy, Theory of Errors, Art. 60.

” It is a nice point that the expression for c”, which has (n – 1) instead of n for denominator, though not the more probable, may yet be the more advantageous (supposing that there were any sensible difference between the two). Cp. Canib. Phil. Trans., 1885, vol. xiv. part ii. p. 165.

” Above, ►►1, note.

^ Theorie analytique, 2nd Supp., ed. 1847, p. 578.

” See the matter discussed in Camb, Phil. Trans., loc. cit.

” Trans. Roy. Soc, 1899, A, vol. cxcii. p. 135.

^^ Good as tested by a comparison of the mean squares of errors in the frequency-constant determined by the compared methods {loc cit., cp. below, ►►41, note). ” Above, ►►22.

known to range according to the normal law may be extended to numerous observations ranging under any law, on the principles which justify the use of the Method of Least Squares in the case of a single qucBsitnm.

37. As in that simple case, the principle of economy will now justily the use of the median, e.g., in the case of two qucesita, putting for the true values of x and y that point for which the sum of the perpendiculars let fall from it on each of a set of lines representing the given equations (properly weighted) is a minimum.’

38. The older writers have expressed the error in the determination of one of the variables without reference to

the error in the other. But the error of one om- “^’^riable may be regarded as correlated with that Hon. of another ; that is, if the system x’, y’ ►►► ►►► ►►► forms

the solution of the given equations, while x’ + i, y’ + ri- ►►► is the real system, the (small) values of ^, r; ►►► ►►► which will concur in the long run of systems from which the given set of observations result are normally correlated. From this point of view Bravais, in 1846, was led to

several theorems which are applicable to the now more important case of correlation in which f and t) are given (not in general small) deviations from the means of two or more correlated members (organs or attributes) forming a normal group.

39. To determine the frequency-constants of such a group it is proper to proceed on the analogy of the simple ease of one- dimensioned error. In the case of two dimensions, for instance, the probability Pi that a given pair of observations (x^, y{) should have resulted from a normal group of which the means are x' y' respectively, the standard deviations tr, and jj, and the coefficient of correlation r, may be written ???

Aa'Aj/Ao-iA' aAr (l/27r V, where ???S?=(x' – x,fl^^^ – 2t{x' – x^){y' – y,)/a,

A similar statement holds for each other pair of observations (^2^2)1 (^2/3) ' ' '; w'ith analogous expressions for P2, Pj" ' '. Whence, as in the simpler case, we have Pi x p2 x &c. x pn/J (a constant) for P, the d posteriori probability that the given observations should have resulted from an assigned system of the frequency-constants. The most probable system is determined by making P a maximum, and aocord!ingly equating to zero each of the following expressions ???

dP dP dP dP dP dx, dy, do-j, do-j, dr.

The values of the arithmetic mean and of the standard deviation for each variable are what have been obtained in the simple case of one dimension. The value of r is S(a;' – Xi){y' – yr)/c-i

40. This application of inverse probabilit;y to determine correla- tion-coefficients and the error to which the determination is liable was first made by Professor Pearson.^ He has pointed out a circumstance which seems to be of great importance in the theory of evolution : that the errors incident to the determination of different frequency-coefficients are apt to be mutually correlated. Thus if a random selection be made from a certain population, the correlation-coefficient which fits the organs of that set is apt to differ from the coefficient proper to the complete group in the same sense as some other frequency-coefficients.

41. The last remark applies also to the determination of the coefficients, in particular those of correlation, by abridged methods, on principles explained with reference to the simple case ; for instance, by the formula r = 2ij/S{, where 2? is the sum of (some or all) the positive (or the negative) deviations of the values for one organ or attribute measured by the modulus pertaining to that member, and 2j; is the sum of the values of the other member, which are associated with the constituents of 2|.' There is a variety of this method which is certainly much less troublesome,

' See Phil. Mag,, 1888. " On a New Method of Reducing Observa- tions " ; where a comparison in respect of convenience and accuracy with the received method is attempted.

' Corresponding to the 1/ .^km of ____7, 19.

' Pearson, Trans. Roy. Soc, A, vol. cxci. p. 234.

- *Pearson, Grammar of Science, ed. 2, p. 402 and p. 431.*

" Trans. Roy. Soc, 1898, vol. cxci., A.

__ Pha. Mag,, 1893, July, p. 101.

and is perhaps not much less accurate, than the method prescribed by genuine inversion.'

42. A method of rejecting data analogous to the use of percentiles ia cue dimension is practised when, given the frequency of observa- tions for each increment of area, e.g,, each [.x Ay, we utilize only the frequency for integral areas. Mr Slieppard has given an elegant solution of the problem : to find the correlation between two attributes, given the medians li, and M^ of a normal group for each attribute and the distribution of the total group, as thus ^___

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P

If cos D is put for r, the coefficient of correlation, it is found that D = 7rR/(P-HE). For example, let the group of statistics relating to dice already ‘ cited from Professor Weldon be arranged in four quadrants by a horizontal and a vertical line, each of which separates the total groups into two halves : lines of which the equa- tions prove to be respectively j/ = 6-ll andx=6”156. For R we have 1360-5, and for P 687-5 roughly. Whence D = 7r x 0-66 ; r = cos 0-66 X ir= -4 nearly, as it ought ; the negative sign being required by the circumstance that the lower part of Mr Sheppard’s diagram shown here corresponds to the upper part of Professor Weldon’s diagram shown in | 8.

43. Necessity rather than convenience is sometimes the motive for resort to percentiles. Professor Pearson has applied the median method to determine the correlation between husbands and wives in respect of the darkness of eye-colour, a character which does not admit of exact graduation : “our numbers merely refer to certain groupings, arranged, it is true, in increasing darkness of colour, but in no way corresponding to equal increases in colour-intensity.” ’” From data of this sort, having ascertained the number of husbands with eye-colour above the median tint who marry wives with eye- colour above the median tint. Professor Pearson finds for r the coefficient of correlation -1-0-1. A general method for determining the frequency-constants when the data are, or are taken to be, of the integral sort has been given by Professor Pearson.’” Attention should also be called to Mr Yule’s treatment of the problem by a sort of logical calculus on the lines of Boole and Jevons.’^

44. In the cases of correlation which have been so far con- sidered, it has been presupposed that the things correlated range according to the normal law of error. But now, suppose the law of distribution to be no longer normal : for instance, that

the dots on the plane of xy,^^ representing each a pair of ~/.. members, are no longer grouped in elliptic (or circular) '? rings of equal frequency, that the locus of the maximum y deviation, corresponding to an assigned x deviation, is no longer a right line. How is the interdependence of these deviations to be formulated ? It is submitted that such data may be treated as if they were normal : by an extension of the Method of Least Squares, which is justified by the law of great numbers, in two or more dimensions.'* Thus when the amount of pauperism together with the amount of outdoor relief is plotted in several unions, there is obtained a distribution far from normal. Nevertheless if the average pauperism and average outdoor relief are taken for aggre- gates ss-y quintettes or decades of unions taken at random, it may be expected that these means will conform to the normal law, with coefficients obtained from the original data, according to the rule which is proper to the case of the normal law. By obtaining averages conforming to the normal law, as by the simple applica- tion of the method of least squares, we should not indeed have utilized the whole of our data, but we shall put a part of it in a very useful shape. Although the regression-equations obtained would not accurately fit the original material, yet they would have a certain correspondence thereto. What sort of correspondence may be illustrated by an example in games of chance, which*

' Ihid. p. 103. But it should be observed that here as in some other comparisons more favourable to genuine inversion the rival is the judge: the test is prescribed by that abridged or "assumed" inversion (above, 26, and Camb. Phil. Trans, vol. xiv. part ii. p. 153), which falls short of the genuine inversion, not fully utilizing by means of the expression P (above, 22) what is given as to the form of the required function.

" Trans. Roy. Soc., 1899, A, vol. cxcii. p. 141.

” Above, ►►8. ” Grammar c/ Science, p. 432.

” Trans. Roy. Soc., A, vol. cxcv.

” Trans. Roy. Soc, 1900, A, vol. oxoiv. p. 257 ; 1901, A, vol. cxcvii. p. 91.

” Above, ►►19. ” Above, ►►9.

ERROR, LAW OF

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Professor Weldon has kindly supplied. Three half-dozen of dice having been thrown, the number of dice with more than three points in that dozen which is made up of the first and the second half-dozen, is taken for y, the number of sixes in the dozen made up of the first and the third half-dozen, is taken for x. Thus each twofold observation {xy) is the sum of six twofold elements, each of which is subject to a law of frequency represented by the annexed diagram ; where ‘ the , figures outside denote the number of successes of each kind, for the ordinate the number of dice with more than three points (out of a cast of two dice), for the co-ordi-nate the number of sixes (out of a cast of two dice, one of which is common to the aforesaid cast) ; and the figures inside denote the comparative probabilities of each twofold value {e.g. , the probability of obtaining in the first cast two dice each with more than three points, and in the second cast two sixes, is 1/72). Treating this law of frequency according to the rule which is proper to the nonual law, we have (for the element) if the sides of the compartments each=i

Whence for the regression-equation which gives the value of the ordinate most probably associated with an assigned value of the abscissa we have y=x>’.yiT^I(ri = Q’Zx ; and for the other regression-equation, x=y/6. Accordingly, in Professor Weldon’s statistics, wnioh are reproduced in the annexed diagram, when

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135 195

154 260

150 179

64 112

21 35

5 5

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90 93 86 37

248 220 162 86

254 230 127 56

170 124 75 17

75 51 19 6

26 8 4 2

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fl!=3 the most probable value of y ought to be 1. And in fact this expectation is verified, x and y being measured along lines drawn through the centre of the compartment, which ought to have the maximum of content, representing the concurrence of one dozen with two sixes and another dozen with six dice having each more than three points, the compartment which in fact contains 254 {almost the maximum content). In the absence of observations a,tx=-Sioiy= + Si, the regression-equations cannot be further verified. At least they have begun to be verified by batches com- posed of six elements, whereas they are not verifiable at all for the simple elements. The normal formula describes the given statistics as they behave, not when by themselves, but when massed in crowds: the regression-equation does not tell us that, if x' is the magnitude of one member, the most probable magnitude of the other member associated therewith is tx , but that, if x' is the average of several samples of the first member, then ix' is the most probable average for the specimens of the other member associated with those sam- ples. In the view of the present writer this is the rationale of Mr Yule's proposal to construct regression-equations according to the normal rule "without troubling to investigate the normality of the distribution." ^ Mr Yule's own view of the subject is, how- ever, well worthy of attention.

1 Cp. above, ►► 8.

‘ ❓❓❓ Proc. Roy. Soc. vol. Ix. p. 477.

45. Professor Pearson has given a beautiful application of the theory of correlation to test the empirical evidence that a given group conforms to a proposed Empirical formula, e.a., the normal law of error.^ veriiica-

Hon.

46. Supposing the constants of the proposed function to be k^own, ❓❓❓ in the case of the normal law the arithmetic mean and modulus ❓❓❓ we could determine the position of any percentile, e.g., the median, say a. Now the probability that if any sample numbering n were taken at random fi’om the complete group, the median of the sample, a’, would lie at such a distance from a that there should be r

/

observations between a and a’ is / /J2/Tn exp – 2i^/n.”

If, then, any observed set has an excess which makes the above- written integral very small, the set has probably not been formed by a random selection from the supposed given complete group. To extend this method to the case of two, or generally n, percentiles, foi-ming (m-H) compartments, it must be observed that the excesses, say e and e’, are not independent but correlated. To measure the probability of obtaining a pair of excesses respectively as large as e and e’, we have now (corresponding to the extremity of the probability-curve in the simple case) the solid content of a certain probability-surface outside the curve of equal probability which passes through the points on the plane xy assigned by e, e’ (and the other data). This double, or in general multiple, integral, say P, is expressed by Professor Pearson with great elegance in terms of the quadratic factor, called by him x’t which forms the exponent of the expression for the probability that a particular system of the values of the correlated e, e’, &c. , should concur ❓❓❓

P= v‘2/7r/ e dx +

-4z2

*1-3^*

1-3 ???

(??-2).

when n is odd ; with an expression different in form, but nearly coincident in result, when n is even. The practical rule derived from this general theorem may thus be stated. Find from the given observations the probable values of the coefficients pertaining to the formula which is supposed to represent the observations. Calculate from the coefficients a certain number, say n, of percentiles ; thereby dividing the given set into n ł 1 sections, any of which, according to calculation, ought to contain say m of the observations, while in fact it contains m'. Put e foi m' -m; then X^=2e7?K. Professor Pearpon has given in an appended table the values of P corresponding to values of M-t-1 up to 20, and values of X^ up to 70. He does not conceal that there is some laxity involved in the circumstance that the coeflicients employed are not known exactly, only inferred with probability.'

47. One of Professor Pearson's illustrations is particularly rele- vant here. The annexed table gives the distribution of 1000 shots fired at a line in a target, the hits being arranged in belts drawn on the target parallel to the line : ???

Belt.

Observed Frequency.

Normal Distribution.

e

e2/m

1 .

2 .

3 .

4 .

5 .

6 .

7 .

8 .

9 .

10 .

11 .

1

4

10

89

190

212

204

193

79

16

2

1

6

27

67

162

242

240

157

70

26

2

0 -2

-17

-H22

-1-28 -30 -36 -1-36 -1-9 -10 0

0 0-667 10-704 7-224 4-839 3-719 5-400 8-255 1-157 3-846 0

1000

1000

45-811

The "norma^ distribution" is obtained from a normal curve, of which the coefficients are determined from the observations. From the value of x=,

viz. 45-8, and of (re-H), viz. 11, we deduce, with sufficient accuracy from Professor Pearson's table, or more exactly from the formula on which the table is based, that P= -000,001,5 – -. "In other words, if shots are distributed on a target according to the normal law, then such a distribution as that cited could only be expected to occur on an average some 15 or 16 times in 10,000,000 times."

= Pha. Mag., July 1900. ^ Loc. cit. p. 166.

^ As shown above, ►►29.

S. IV. ►►►37

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ERROR, LAW OF

the law ot error.

48. That the normal law of error should not be exactly fulfilled is not disconcerting to those who ground the law

upon the plurality of independent causes. On farther ^" ^^^^ view the normal law would only be exact approxi- when the numbers of elements from which it is mations to generated is very great. In general, when that number is large, but not indefinitely great,i there is required a correction, formed by adding to the exponent of the normal function, namely, ►►►x^/c^, a descending series of terms of the order 1/ jn, \jn, &c., respectively, where n is the number of the elements.^

49. The first term of this series may be written

- 2{jjc^)[x/o – 2 K^So^] ; ►►►where c^/2 is the mean square of deviation for the compound and also the sum of the mean squares of deviations for the component elements, / is the mean cube of deviations for the compound and the sum of the mean cubes for the components ; and- the elements are supposed to be such and so numerous that j/a^ is of the order 1/ ijn. The order of the term being such, it is permissible to

bring the term down from the exponent by expanding and neglecting higher powers.' This second approximation, first given by Poisson, was rediscovered by De Forest." The present writer has obtained it ^ by extending the method of partial differential equations which Mr Morgan Crofton had applied to find the first approximation. By a further extension of this method a third and further approximations may be found. The corrected normal law is then of the form**

*2a^^*

'Ai-'ii'^T-mM-h

10-

*20 a^ " 3 C**

iafi\ . / , ??? a^ 2 an-]

where i=jl

c^=2npq, j = ii]jq [q -p), i=n2)q (1 – 5jiq).^ These values being substituted for the coefficients in the general formula, there results an expression which may be obtained directly by continuing ^ to expand the expression for a term of the binomial.

50. In virtue of the second approximation a ' set of observations is not to be excluded from the affinity to the normal curve because, like the curve of barometric heights, ^" it is slightly asymmetrical. In virtue, of the third approximation it is not excluded because, like the group of shot-marks above examined, it is, though almost perfectly symmetrical, in other respects apparently somewhat abnormal. If the thus corrected quasi-normal curve be submitted to the same criterion as just now the normal curve, to test its capacity to represent a given group of shot-marks, the improb-

'??? As probably in Natural History. Cp. Galton, Phil. Mag., 1875.

^ The elements being supposed independent and of the same order of magnitude ; mutatis mutandis if there is a superior order. Cp. above, ►► 9.

8 The form employed by Todhunter, History of Probability, Art. 993, and in the article on ” Probability ” in the 8th edition of Mncy. Brit, ►► 136.

^ The Analyst (Iowa), vol. ix.

5 Phil. Mnrj., February 1896.

- *The part of the third approximation affected with j^ may be found by proceeding to another step in the method described (Phil. Mag., 1896 vol., p. 96). The remaining part of the third approximation is found by the same method (or tie variant on p. 97) from the new partial*

di 24 dx’*

actual mean fourth power of deviation and what it would he if the normal law held good. Further approximations may be obtained on the same principle.

*‘ ,1*4 – 3/^2^ in the notation which Professor Pearson has made familiar.*

- *Cp. Pearson, Trans. Roy. Soc, 1895, vol. clxxxvi., A, p. 347.*

- *Above, ►► 4, referring to Todhunter, Uislury, Art. 993. The third (or second additional term of) approximation for the binomial, given explicitly by Profi-KKor Pearson, Trans. Rny. Soc, 1895, A, footnote of 347, will be found to agree with the general formula above giveu, when it is observed that the correction affecting the absolute term, his y►►►, disappears in his formula by division.*

” Jom-n. Stat. Soc, 1899, p. 550, referring to Pearson, Trans. Roy. Soc, 1898, A.

ability is reduced from odds of millions to one to odds of hundreds to one." The details of the calculation are given elsewhere," but some points of general interest may be noticed here.

51. Regarding the contents of the first "belt" as spread out between 0 '5 and 1-5, and so on, we have 6-482 for the arithmetic mean. For the mean square of deviation we have (2e2)/1000, where e is the distance of the centre of a belt from 6-482 ; upon the supposition that the contents of each belt are massed at its centre. But, as Mr Sheppard has pointed out," in order to obtain from this sum, say fi^, the proper integral, say (ms), the rough value ought to be corrected thus: {ix^)=iJ..i-K'll2, where h is the breadth of a "belt." Here h is unity, and accordingly, the r

52. A formula much more comprehensive than the corrected normal law is proposed by Professor ·^ Pearson under the designation of the "general- "general- ized probability-curve." The ground and scope Ized prob- of the new law cannot be better stated than in bmty- the words of the author : ???

53. " The slope of the normal curve is given by a relation of the form

1 dy X y dx Cj

The slope of the curve correlated to the skew binomial, as the normal curve to the symmetrical binomial, is given by a relation of the form

Ti dy X

y dx~ Cj-HCjO;

Finally, the slope of the curve correlated to the hypergeometrical series (which expresses a probability distribution in which the contributory causes are not independent, and not equally likely to give equal deviations in excess and defect), as the above curves to their respective binomials, is given by a relation of the form 1 dy X

y dx Cj-fOjai-l-Csa;^ This latter curve comprises the two others as special cases, and, sa far as my investigations have yet gone, practically covers all

homogeneous statistics that I have had to deal with. Something still more general may be conceivable, but I have found no necessity for it. “18

54. The “hypergeometrical series,” it should be explained, had appeared as representative of the distribution of black balls ” in the following case. “Take n balls in a bag, of which -jji!. are black and qn are white, and let r balls be drawn and the number of black be recorded. If r > pn, the range of black balls will lie between 0 and pn ; the resulting frequency ~~polygon is given by a hyper~~ geometrical series.” The “generalized probability-curve ” presents, two forms ^^ ???

and y=yo

3/=2/o(l + a:/??i)

1

(l-aj/ttj) ,

{l+x-ja^)”

- V tan“‘a;/a

” Tliat the improbabiUty still remains so considerable is perhaps due to the fact that the statistics form a mixture of two types, as suggested by Professor Pearson, Trans. Roy. Soc, 1894, vol. clxxxv., A, p. 91.

12./U7(r??. Stat. Soc (1901).

1' Proceedings of London jSfathtmaticaZ Society, vol. xxix. p. 369, &c.

” Todhunter, History qf Probahility, Art. 1006.

>?? Above, ?? 10. ‘m Cf. J,>um. Stat. Si’C, 1899.

” Such as Table TIT. appended to De]\Iorgan’s article on the “Calculus of Probabilities” in the Bncy.~~Metropol. Mr Burgess’s tables in the Transactions of the Edinburgh Royal Society for 1900, giving the values~~

~~of the ordinate as well the integral, are most con~~ venient for the present purpose.

” Trans. Roy. Soc, 1895, A, p. 381; et ante

1" Ibid. p. 360. 2 Ibid. p. 367.

E R Z E R tr M

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When a,, osj, v are all finite and positive, the first fonn represents, in general, a skew curve, with limited range in both directions ; in the particular case, when i=a2 a symmetrical curve, with range limited in both directions. If aj = > tl^^ curve reduces to

y=yo{l + xlai) e ;

representing an asymmetrical binomial with i> = fjf, and i = 2/^27/^ – M3/2M2, /J.2, and ^^3, being respectively the mean second and mean third power of deviation measured from the centre of gravity. In the particular case, when /j^ is small, this form reduces to what is above called the ” quasi-normal ” curve ; and when /ij is zero, ttj becoming infinite, to the simple normal curve. The preg- nant general lorm yields two less familiar shapes apt to represent curves of the character shown in the annexed diagrams the

*one occurring in a good number of instances, such as infant deaths, the values of houses, the number of petals in certain flowers ; the other less familiarly illustrated by ConsumpHvity and Cloudiness.^ The second solution represents a skew c\jrve with unlimited range in both directions. Professor Pearson has successfully applied these formulae to a number of beautiful specimens culled in the most diverse fields of statistics. The flexibility with which the generalized probabihty-curve adapts itself to every variety of existing groups no doiibt gives it a great advantage over the normal curve, even in its extended form. It is only in respect of A priori evidence that the latter can claim precedence.^*

55. Any law which has claims to be called the law of error may be expected in certain circumstances to give rise to some derivative laws which should be noticed here. First, statistics relating to two (or more) different types are apt to be mixed; for instance, the measurements of human heights in a country comprising two distinct races. ^

56. If the measurements for each race are grouped according to a normal law of error, the qucesita are the constants in the curve

2/=a(l/V'r0i) exp ~~7o,2~~|-;8(l/^/^C2) exp – (x – bf/e^", where a and /3 are the proportionate sizes of the two groups (a-l-;3 = l) ; a and b are the respective centres of gravity ; and Oj Cj the respective moduli. The data are measurements each of which relates to one or other of these component curves. A splendid solution of this difficult problem has been given by Professor Pearson. ??? The five unknown quantities are connected by him with the centre' of gravity of the given observations, and the mean second, third, fourth, and fifth powers of their deviations from that centre of gravity, by certain rational algebraic equations, which reduce to an equation in one variable of the ninth dimension. In an example worked by Professor Pearson, this fundamental equation had three possible roots, two of which gave very fair solutions of the problem, while the third suggested that there might be a negative solution, importing that the given system would be obtained by subtracting one of the normal gi'oups from the other ; but the coefficients for the negative solution proved to be imaginary. " In the case of crabs' foreheads, therefore, we cannot represent the frequency curve for their forehead length as the difference of two normal curves." In another case, whidh primd facie seemed normal. Professor Pearson found that "all nine roots of the funda- mental nonio lead to imaginary solutions of the problem. The best and most accurate representation is the normal curve. "

57. Another modification may be introduced by an objection which has been made against the normal curve, and might be made, with as much or as little justice, against any other formula claiming to be the law. If there is any law applicable to things in general, it must be applicable to functions of things, which also are things. But if a group is transformed by substituting for the size of each member a certain function of that size,

the resulting gi'oup will not conform to the same law of error as the original one, in general and except when the function is linear. If the diameters of oranges of the same species vary according to the normal, or any

' Pearson, loc. cit. p. 364, and Proc. Roy. Soc. ' Journ. Stat. Soc, 1895, p. 506.

5 See references to instances in Professor Pearson's paper cited below. ' ^ Trans. Roy. Soc, 1894, vol. clxxxv., A.

other law of error, then the volume of oranges, being pro- portioned to the cube of the diameter, will not vary according to that law. The answer to this difficulty is that, very generally, the variable part of an organ or attribute is so small relatively to the whole, that the cube or other ordinary function of the whole may be treated as a linear function of the variable part. Thus the cubes of a man's height may be written M'(l-t-??/M^), where M is the mean, say 67", and e is the deviation of the individual's height from the mean. The modulus for human heights being about 3'7, it appears that the transformed measure is very nearly M'(l-f3e/M), for five-sixths of the group differing by a proportion less than '01 from the true cube. Occasionally, however, it may be expected that the deformation due to such transformations will be sensible. The case in which the

compound magnitude is a function other than linear of a sum of elements is a species of the more general case in which the com- pound is a function, explicit or implicit, of the elements. If the function admits of expansion in ascending powers of the variables,^ the second and further approximations to the law of error for the compound have the same form as that which has been given for the case in which the compound is a linear function of the ele- ments (see ?? 49), the constants c j i, and have the same relation as before to the mean powers of the compound ; but not the same relation to the mean powers of the elements. For instance, the mean cube of error for the compound (which, divided by the cube of the modulus, forms the constant j) is now affected not only by the asymmetry of the laws of frequency for the elements but also by the asymmetry of the structure, the function combining the elements. "When the function involving the elements

*does not admit of expansion, being not even approximately linear, then the law of frequency for the compound will be not even approximately normal. For example, if the velocities (in any assigned direction) of molecules of equal, say unit, mass are distri- buted according to a normal law of which the centre is zero, then the squares of the velocities, the energies, will be distributed according to a quite different law * represented by a unilateral curve, in that respect like the statistics of infant mortality (above, ►► 54).*

58. Other deformations of the law of error might be suggested. But the question recurs : How far does the fact that a certain function fits the facts tolerably establish that this, and not another, is the true formula? For instance, the hump in the curve representing the column headed d,^ in a life-table, which has been regarded as a prob- abUity-curve of the " normal" '^ or of the " generalized " ^ variety, may really be due to those conditions of acceler- ated mortality which render the Gompertz-Makeham law appropriate to the facts ; the expression for the decrement of Ix according to that law having a unique maximum when values of the constants suited to life-tables are substituted in the formula. The statistician must not forget that there are other laws besides the law of error.

An exhaustive list of writings on a nearly related subject, the "Method of Least Squares," was given byMerriman in Connecticut Trans, iv. Leading publications up to 1884 are noticed under Peobability, Ency. Brit., 9th edition. Czuber, the latest there mentioned, has referred to, criticized, and improved on many of his predecessors. Since that date a great advance has been made by Pearson in the mathematical papers frequently cited above. See also the references to Burbury, Galton, Lewis, Sheppard, and others. Bowley's EUments of Statistics, part ii., forms an introduction which leads the beginner easily, yet far. (f. y. E.)

ErzeriJm. ►►► 1. A vU^yet of Asiatic Turkey, divided into t!^ree sanjaks ►►► Erzenim, Erzingan, and Bayezid ; its area is about 29,600 square mUes, and the population numbers 645,500 (Moslems, chiefly Kurds, 500,500 ; Christians, 145,000, of whom 135,500 are Armenians). It includes the highest portion of the Armenian plateau (see Armenia),

and in it the two arms of the Euphrates, the Araxes and the Acampsis, take Ijheir rise. It is an agricultural country vsdth few industries. There are large forests ; iron, salt, sulphur, and other mineral springs ; and unworked salt and coal mines. 2. A fortified town,

- *The species has been illustrated by the present writer in the Journ. Stat. Soc, Deo. 1898, ^. 678 et seq., and Sept. 1899, p. 540 ; the genus to be discussed in a later paper.*

" Journ. Stat. Soc, 1898, p. 676, and Sept. 1899, p. 543.

' Above, ►► 17.

^ Pearson, Trans. Roy. Soc, 1895, A, p. 406, and Chances of Death.

capital of the vilayet and sanjak of the same name, resi- dence of a Governor-General, situated at an altitude of 6250 ft., on the lower slopes of the Palentoken Dagh (10,300 ft.), at the southeast corner of a plain (5760 ft.), through which the Western Euphrates runs. North of the town there are large marshes, and to the east is the Deveboyun range (6960 ft.). It is an important military station, with a large garrison, military school, and hospi- tal. It has an enceinte which encloses an area of 3 square miles, only partially covered by the town, and is protected against an attack from the east and south-east by a strong line of defences, 27 miles long. The houses are partly well built and partly underground. There are interesting remains of Seljuk buildings of the 12th cen- tury, including tombs and the beautiful Chifte Minareh. The chief Armenian quarter is on the north side. The streets are irregular, badly drained, and dirty, and the town, though well supplied with water, is said to be the most insanitary in Asia Minor. The climate is healthy, and the atmosphere clear and dry except in spring. The winter is very severe, with great cold (-20►► to – 22►► F.), deep snow, and blizzards. The summer heat is moderate (59►► to 77►► T.). Roads lead to Trebizond and Riza on the Black Sea ; westwards to Sivas, Kara- hissar, and Kelkit Chiftlik; southwards to

Diarbekr, Mush, and Van ; and eastwards to Olti and Kars. The industries, excepting blacksmith's and coppersmith's work and tanning, have died out. The fertile plain north of the toT^^n was well cultivated with wheat, barley, mil- let, and vegetables, but since the Armenian massacres of 1896 much of the land has lain fallow. The exports are wheat, linseed, furs, live-stock, &c. (value in 1896, ££148,610; in 1900, ££177,760). The imports are Man- chester goods, sugar, copper, petroleum, &c. (value in 1896, ££188,610; in 1900, ££262,366). The Persian trade has almost disappeared since 1890 ; poverty has been increas- ing ; and, with the Kiirds unsubdued and the Armenians impoverished, there seems little prospect of an early re- covery of prosperity. The population is 40,000 (Moslems, 26,500; Armenians, 11,000 ; Greeks and Protestants, 1600 ; Persians, Jews, &c., 1000). There are British and other European consulates, and an American mission, with schools. The town was unsuccessfully attacked by the Russians, 9th November 1877 ; occupied by them, 7th Feb- ruary 1878, during the armistice ; and restored to Turkey after the Treaty of Berlin. On the 30th and 31st October 1896 there was a massacre of Armenians, in which officers and men of the Turkish army took part. In November 1901 an earthquake caused serious damage to the town.

See Consular Reports in Parliamentary Papers, Turkey, 1878- 99 ; Murray, Handbook to Asia Minor, 1895. (c. w. w.)

Erzingan, Erzinjan, or Ebiza (Arsinga of Middle Ages), the chief town of a sanjak of the Erzerum vilayet of Asiatic Turkey. It is the headquarters of the 6th Array Corps, and a place of great military importance, and is situated, at an altitude of 3900 feet, on the Sivas-Erzeriim road, near the western extremity of a rich well-watered plain, through which the Fr^t Su, or Western Euphrates, runs. It is surrounded by orchards and gardens, and stands on nearly level ground, about one mile from the right bank of the Fr^t, which here runs in two channels crossed by bridges. The main street, which forms part of the military road from west to east, is 30 feet wide ; the other streets are narrow, unpaved, and dirty. In the town and its vicinity are large barracks, military stores, school, hospital. Govern- ment tanneries, and boot and clothing factories. There are also silk, cotton, and copper industries. The climate is hot in summer and

moderate in winter. Eoads lead to Sivas, Kerasund, Trebizond, Erzerum, and Kharpiit. The popu- lation numbers 23,000 (Moslems 15,500, Armenians 7600).

The plain, which is almost surrounded by lofty mountains, is highly productive, and has many villages. Wheat, fruit, vines, &c., are grown, and cattle and sheep are bred. About 11 miles south-west of the town is the celebrated Arme- nian Monastery of St Gregory, " The Illuminator." It occupies the site of an early town in which there was a temple of Anaitis, and was an important place early in the 4th century, when St Gregory lived in it. The dis- trict passed from the Byzantines to the Seljiiks after the defeat of Eomanus, 1071, and from the latter to the Mon- gols, in 1243. After having been held by Mongols, Tatars, and Turkomans, it was added to the Osmanli Empire by Muhammad II. in 1473. (c. w. w.)

Esbjerg, a seaport of Denmark, co. Elbe, on the west coast of Jutland, over against the island of Fano. It was granted municipal rights in 1900, having grown with astonishing rapidity from 13 inhabitants in 1868 to 13,000 in 1899. This growth it owes to the construction of a large harbour in 1868-88. It is the principal outlet westwards for S. Jutland ; exports pork and meat, butter, eggs, fish, cattle and sheep, skins, lard, and agricultural seeds. The port was entered by 774 vessels of 267,418 tons in 1899 and cleared by 776 of 269,205 tons. There are very large slaughter-houses.

Escanaba, capital of Delta county, Michigan, U.S.A., on Little Bay de Noquette, an inlet of Green Bay, Lake Michigan, at an altitude of 608 feet. It is regularly laid out, with seven wards. The manufacture of lumber is its principal industry, and it has a large lake commerce in lumber and iron ore. Population

(1880), 3026; (1890), 6808; (1900), 9649.

Esher, William Baliol Brett, 1st Yiscoukt (1817-1899), English lawyer and Master of the Eolls, was a son of the Eev. Joseph G. Brett, of Chelsea, and was born on 13th August 1817. He was educated at Westminster and at Caius College, Cambridge. Called to the Bar in 1840, he went the

Northern Circuit, and became a Q.C. in 1861. On the death of Eichard Cobden he unsuccessfully contested Eochdale as a Con- servative, but in 1866 was returned for Helston in unique circumstances. He and his opponent polled exactly the same number of votes, whereupon the Mayor, as return- ing officer, gave his casting vote for the Liberal candidate. As this vote was given after four o'clock, however, an appeal was lodged, and the House of Commons allowed both members to take their seats. Brett rapidly made his mark in the House, and in 1868 he was appointed Solicitor-General and received the honour of knighthood. On behalf of the Crown he prosecuted the Fenians charged with having caused the Clerkenwell explosion. In Par- liament he took a leading part in the promotion of Bills connected with the administration of law and justice. He was shortly afterwards appointed a Justice in the Court of Common Pleas. Some of his sentences in this capacity excited much criticism, notably so in the case of the gas stokers' strike, when he sentenced the defendants to imprisonment for twelve months, with hard labour, which was afterwards reduced by the Home Secretary to four months. On the reconstitution of the Court of Appeal in 1876, Brett was elevated to the rank of a Lord Justice. After holding this position for seven years, he succeeded Sir George Jessel as Master of the Eolls in 1883. In 1886 he was raised to the House of Lords as Baron Esher. He opposed the Bill proposing that an accused person or his wife might give evidence in their own case, and supported the Bill which empowered Lords of Appeal to sit and vote after their retirement. The Solicitors Act of 1888, which increased the powers of the Incorporated

Law Society, owed much to his influence. In 1880 he delivered a remarkable speech in the House of Lords, deprecating the delay and expense of trials, which he regarded as having been increased by the Judicature Acts. Lord Esher suffered, perhaps, as Master of the Kolls from succeeding a lawyer of such eminence as Jessel. He had a caustic tongue, but also a fund of shrewd common sense, and one of his favourite considerations was whether a cer- tain course was " business " or not. He

retired from the Bench at the close of 1897, and a Viscounty was con- ferred upon him on his retirement, a dignity never given to any judge, Lord Chancellors excepted, "for mere legal conduct since the time of Lord Coke." He died 24th March 1899.

Eskilstuna, a town of Sweden, province of Soder- manland, on the navigable river Eskilstuna, which con- nects Lakes Malar and Hjelmar, 65 miles west from Stockholm, the chief seat in Sweden of the iron and steel industries, its cutlery being especially noted. There is a technical school for the metal industries. Population

(1880), 8161 ; (1900), 13,663.

Eski-Shehr, a town in Asia Minor, in the Kutaya sanjak, of the Khudavendikiar (Briisa) viMyet; a station on the Haidar Pasha-Angora railway, 194^ miles from the former and 164 miles from Angora, and the junction for Konia ; situated on the right bank of the Pursak Su (Tembris), a tributary of the Sakaria, at the foot of the hills that border the broad treeless valley. The town is divided by a small stream into a commercial quarter on low ground, in which are the bazars, khans, and the hot sul- phur springs (122 ?? P.) ; and a residential quarter on the higher ground. The population numbers 20,000 (Moslems 15,000, Christians 5000). The town is noted for its good climate, the Pursak Su for the abundance of its fish, and the plain for its fertility. The annual output of the cel- ebrated meerschaum mines is valued at ??272,000.

Eski-Zagra or Stara-Zagora, chief town of a department in Eastern Eumelia, in the principality of Bulgaria, situated on the southern slope of the Balkans, 70 miles north-west of Adrianople. It is surrounded by vineyards, and has also cloth and carpet manufactures, copper foundries, and tanneries. The production of cocoons is also carried on in the district. The town hav- ing been almost wholly destroyed during the war of 1877, has been rebuilt on a regular plan, with wide and broad streets radiating from a fine central square, where are sit- uated the principal public buildings. During the rebuild- ing of the town the foundations and remains of a very old town were discovered, with important Thracian, Roman, Byzantine, and Turkish antiquities. The old town, founded probably by the Macedonians, attained to such prosperity under the

Romans that it was known as Augusta Traiana, but afterwards, to distinguish it from a Macedonian town of this name, it vas named Beroe or Berrhoea. By the Turks the name was changed in the 17th century to Eski- Zagra or Eski-Zaara, but by the Bulgarians it is known as St^ra-Zagdra. Population, 17,457, of whom about four- fifths are Bulgarians.

Esmarch, Johannes Friedrich August

von (1823), German surgeon, was born at Ton-

ning, in Schleswig-Holstein, on 9th January 1823. He studied at Kiel and Gottingen, and in 1846 became Langenbeek's assistant at the Kiel surgical hospital. He served in the Schleswig-Holstein War of 1848, first as ofiicer and then as junior surgeon, and this directed his mind to the subject of military surgery. He was taken prisoner, but afterwards exchanged, and was then appointed as surgeon to a field hospital. During the truce of 1849

he settled at Kiel, but on the fresh outbreak of war he returned to the troops and was promoted to the rank of senior surgeon. In 1854 he became director of the surgical clinic at Kiel, and in 1857 head of the general hospital and professor at the university. During the Schleswig-Holstein War of 1864 Esmarch rendered good service to the field hospitals of Flensburg, Sundewitt, and Kiel. In 1866 he was called to Berlin as member of an Emergency Hospital Commission, and also to take the superintendence of the surgical work in the hospitals there. When the Franco-German War broke out in 1870 Esmarch was appointed surgeon-general and army consultant, and after- wards consulting surgeon at the great military hospital near Berlin. In 1872 he married Princess Henrietta von Schleswig-Holstein Sonderburg Augustenburg, aunt of the Empress Auguste Victoria. In 1887 a patent of nobility was conferred on him. Esmarch is one of the greatest authorities on hospital management and military surgery. His Surgeon's Handbook on the Treatment of Wounded in War was written for a prize offered by the Empress Augusta, on the occasion of the Vienna Exhibition of 1877, for the best handbook for the battlefield of surgical appliances and operations. This book is illustrated by admirable diagranls, showing the different methods of bandaging and dressing, as well as the surgical

operations as they occur on the battlefield. Esmarch him self invented an apparatus, which bears his name, for squeezingthe blood out of a limb before amputation. No part of Esmarch's work is more widely known than that which deals with " First Aid." First Aid to the Wounded and First Aid to the Injured are popular manuals on the subject. The latter is the substance of a course of lectures delivered by him in 1881 to a " Samaritan School," the first of the kind in Germany, founded by Esmarch in 1881, in imitation of the St John's Ambulance Classes which had been organized in England in 1878. These lectures were very generally adopted as a manual for First Aid Students, edition after edition has been called for, and they have been translated into twenty-three languages, the English version being the work of H.E.H. Princess Christian. No Ambulance course would be complete without a demonstration of the Esmarch bandage. It is a three-sided piece of linen or cotton, of which the base measures four feet and the sides two feet ten inches. It can be used folded or open, and applied in thirty-two different ways. It answers every purpose for temporary dressing and field-work, while its great recommendation is that the means for making it are always at hand.

Esperance, a town in West Australia, 275 miles north-east from Albany, with a large and safe natural harbour. It is a summer resort, and in the neighbour- hood are interesting caves. Being on the high road be- tween the Eastern states and the goldfields, it is likely to become an important seaport. It has a Government jetty 2000 feet long, with 18 feet depth of water alongside, and a new town jetty 600 feet long with 22 feet of water. Population, about 450.)

Esperanza. ❓❓❓ An old country town of Santa Clara Province, Cuba. It is noted for the quality and quantity of the guava jelly manufactured there. Population, 2177.

Espartero, Baldomero (1792-1879), Duke of Vitoria, Duke of Morella, Prince of Vergara, Count Luchana, Knight of the Toison d'Or, &c. &c., a famous Spanish soldier and statesman, was born at Grana- tula, a town of the province of Ciudad Real, on 27th February 1792. He was the ninth child of a carter, who wanted to make him a priest, but the lad at fifteen

en- listed in 'a battalion of students to fight against the armies of Napoleon I. In 1811 Espartero was appointed

a lieutenant of Engineers in Cadiz, but having failed to pass his examination, he entered a line regiment. In 1815 he went to America as a captain under General Morillo, who had been made commander-in-chief to quell the ris- ings of the colonies on the Spanish Main. For eight years Espartero distinguished himself in the struggle against the colonists. He was several times wounded, and was made major and colonel on the battlefields of Coehabamba and Sapachni. He had to surrender to Sucre at the final battle of Ayacucho, which put an end to Cas- tilian rule. He returned to Spain, and, like most of his companions in arms, remained under a cloud for some time. He was sent to the garrison town of Logrono, where he married the daughter of a rich landowner. Dona Jacinta Santa Cruz, who eventually survived him. Hence- forth Logrono became the home of the most prominent of the Spanish political generals of the nineteenth century. Espartero became in 1832, on the death of King Ferdinand VII., one of the most ardent defenders of the rights of his daughter, Isabella II. The Government sent him to the front, directly the Carlist war broke out, as com- mandant of the province of Biscay, where he severely defeated the Carlists in many encounters. He was quickly promoted to a divisional command, and then made a lieutenant-general. At times he showed qualities as a guerillero quite equal to those of the Carlists, like Zumalacarregui and Cabrera, by his daring marches and surprises. When he had to move large forces he was greatly superior to them as an organizer and strategist, and he never disgraced his successes by cruelty or need- less severity. Twice he obliged the Carlists to raise the siege of Bilbao before he was appointed commander-in- chief of the northern army on September 17, 1836, when the tide of war seemed to be setting in favour of the Pi^etender in the Basque provinces and Navarre, though Don Carlos had lost his ablest lieutenant, the Basque Zumalacarregui. His military duties at the head of the principal national army did not prevent Espartero from showing for the first time his

political ambition. He dis- played such radical and reforming inclinations that he laid the foundations of his popularity among the lower and middle classes, which lasted more than a quarter of a century, during which time the Progessists, Democrats, and advanced Liberals ever looked to him as a leader and adviser. In November 1836 he again forced the Carlists to raise the siege of Bilbao. His troops included the British Legion under Sir de Lacy Evans. This success turned the tide of war against Don Carlos, who vainly attempted a raid towards Madrid. Espartero was soon at his heels, and obliged him to hurry northwards, after several defeats. In 1839 Espartero carefully opened up negotiations with Maroto and the principal Carlist chiefs of the Basque provinces. These ended in their accepting his terms under the famous Convention of Vergara, which secured the recognition of their ranks and titles for nearly 1000 Carlist officers. Twenty thousand Carlist volunteers laid down their arms at Vergara ; only the irreconcilables led by Cabrera held out for a while in the central prov- inces of Spain. Espartero soon, however, in 1840, stamped out the last embers of the rising, which had lasted seven years. He was styled " El pacificador de Espana," was made a grandee of the first class, and received two dukedoms.

During the last three years of the war Espartero, who had been elected a Deputy, exercised from his distant headquarters such influence over Madrid politics that he twice hastened the fall of the Cabinet, and obtained office for his own friends. At the close of the war the Queen Eegent and her Ministers attempted to elbow out Espar- tero and his followers, but a pronuvciamiento ensued in Madrid and other large towns which culminated in the

Marshal's accepting the post of Prime Minister. He soon became virtually a dictator, as Queen Christina took offence at his popularity and resigned, leaving the king- dom very soon afterwards. Directly the Cortes met they elected Espartero Regent by 179 votes to 103 in favour of Arguelles, who was appointed guardian of the young Queen. For two years Espartero ruled Spain in accord- ance with his Radical and conciliatory dispositions, giving special attention to the reorganization of the administra- tion, taxation, and finances, declaring all the estates of the church, congregations, and religious orders to be na- tional property, and

suppressing the diezma, or tenths. He suppressed the Republican risings with as much severity as he did the military pronwiciamientos of Generals Concha and Diego de Leon. The latter was shot in Madrid. Espartero crushed with much energy a revolu- tionary rising in Barcelona, but on his return to Madrid was so coldly welcomed that he perceived that his pres- tige was on the wane. The advanced Progressists co- alesced with the partisans of the ex-Regent Christina to promote pronunciamientos in Barcelona and many cities. The rebels declared Queen Isabelle of age, and, led by General Narvaez, marched upon Madrid. Espartero, deeming resistance useless, embarked at Cadiz on July 30, 1843, for England, and lived quietly apart from poli- tics until 1848, when a Royal decree restored to him all his honours and his seat in the Senate. He retired to his house in Logrono, which he left six years later, in 1864, when called upon by the Queen to take the lead of the powerful Liberal and Progressist movement which pre- vailed for two years. The old Marshal vainly endeavoured to keep his own Progressists within bounds in the Cortes of 1864-56, and in the great towns, but their excessive demands for reforms and liberties played into the hands of a Clerical and reactionary Court, and of the equally retrograde governing classes. The growing ambition of General O'Donnell constantly clashed with the views of Espartero, until the latter, in sheer disgust, resigned his Premiership and left for Logrono, after warning the Queen that a conflict was imminent between O'Donnell and the Cortes, backed by the Progessist militia. O'Don- nell's pronunciamiento in 1866 put an end to the Cortes, and the militia was disarmed, after a sharp struggle in the streets of the capital. After 1856 Espartero reso- lutely declined to identify himself with active politics, though at every stage in the onward march of Spain towards more liberal and democratic institutions he was asked to take a leading part. He refused to allow his name to be brought forward as a candidate when the Cortes of 1868, after the Revolution, sought for a ruler. Espartero, strangely enough, adopted a laconic phrase when successive Governments on their advent to power invariably addressed themselves to the venerable cham- pion of liberal ideas. To all ??? to the Revolution of 1868, the Constituent Cortes of 1869, King Amadeus, the Fed- eral Republic of 1873, the nameless Government of Mar- shal Serrano in 1874, the Bourbon restoration in 1875 ??? he simply said: " Cumplase la voluntad nacional " ??? "Let the national will be

accomplished." King Amadeus made him Prince of Vergara. The Restoration raised a statue to him near the gate of the Retiro Park in Madrid. Span- iards of all shades, except Carlists and Ultramontanes, paid homage to his memory when he passed away at his Logroiio residence on January 8, 1879. His tastes were singularly modest, his manners rather reserved, but always kind and considerate for humble folk. He was a typical S]ianish soldier-politician, though he had more of the bet- ter traits of the soldier born and bred than of the arts of the statesman. His military instincts did not always make it easy for him to accommodate himself to courtiers and professional politicians. (a. e. h.)

E S P I R I T 0 ◆◆◆ E S S E X

295

EspiritO Santo, an Atlantic state of Brazil, between 18◆◆ 6' and 21◆◆ 28' S. lat., and 39◆◆ 48' and 41◆◆ 30' W. long,, bounded on the N. by the state of Bahia, on the W. by that of Minas Geraes, on the S. by that of Eio de Janeiro, and on the E. by the Atlantic. Its area is 17,312 square miles, and it had a population in 1870 of 82,137, and in 1890 of 136,000. Its coast-line is about 250 miles long. The capital, Victoria, has 8000 inhabit- ants. Amongst other towns are Anchieta, S. Matheus, Serra, Guarapary Conceiqao da Barra, Porto do Cachoeiro, but of all of them the population is small. There are short railways at Cachoeiro do Ita, one along the Kio Castello, the other to Alegre.

Essen, a town of Prussia, in the Rhine province, 22 miles by rail north-east from Dtisseldorf, the seat of the well-known iron and steel works of Krupp, employing (1900) some 25,160 persons. The buildings cover an area of 150 acres, and the area owned by the firm 870 acres. Here, too, are extensive coal-fields. Essen possesses a mining school and a deaf and dumb asylum. The very interesting minster church was restored in 1881-86. The Roman Catholics have a new church (St Joseph's) built in 1895, and the Evangelicals one (Holyrood) built in 1896. There are monuments to the Emperor William I. (1898), Alfred Krupp, and Bismarck. Population (1885),

65,064 ; (1895), 96,128 ; (1900), 118,863.

Essendon, a town in Victoria, Australia, in the county of Bourke, 6 miles north-west of Melbourne, with a station on the North-Eastern railway. Meat-preserving and rope-making are the principal industries. Population, 15,200.

Essentuki, a watering town of Russia, North Caucasia, province of Terek, 10 miles by rail from Pyati- gorsk ; altitude, 1980 ft. Its alkaline and ,$ulphur- alkaline mineral waters, similar to those of Ems, Selters, and Vichy, but superior in carbon dioxide and salts, are much visited in summer. The vegetation is poor, and the climate shows great variations in temperature. Population (1897), 9515.

Essex, one of the London home counties, situated on the south-east coast of England, and bounded on the E. and S.E. by the North Sea. On the S. it is separated from Kent by the river Thames, on the W. from Middlesex and Hertfordshire by the Lea and the Stort, and on the N.E. from Suffolk by the Stour, while on the N". it is conterminous with Cambridgeshire.

Area and Population. ??? The area of tlie ancient and geographical county is 987,028 acres, or 1542 square miles, with a population in 1881 of 576,4.34, and in 1891 of 785,445, of whom 390,515 were males and 394,930 females, the number of persons per square mile being 509, and of acres to a person 1-26. The population in 1901 was 1,085,576. Parts of Sudbury and Hawerhill Urban Sanitary Districts are in the administrative county of Suffolk, and must therefore be deducted from the administrative county of Essex, leaving an area of 985,545 acres. The area of the registration county is 904,642 acres, with a population in 1891 of 701,191; in 1901 of 1,062,452, of whom 524,634 were males and 537,818 females. Within this area the increase of population between 1891 and 1901 was 51-52 per cent. Between 1881 and 1891 the excess of births over deaths was 107,152, and the Increase in resident population 208,894. The following table gives the number of marriages, births, and deaths, with the number' of illegitimate births, for 1880, 1890, and 1899 : ???

Tear.

Marriages.

Births.

Deaths.

Illegitimate Births.

Males,

Females.

1880 . 1890 . 1899 .

3235 4699 7279

18,548 23,264 30,097

10,165 12,873 16,603

331 360 413

338 331

415

per 1000 of the population, with the percentage of illegitimate births, for a series of years : ???

18T0-79.

1880.

1880-89.

1890.

1889-98.

1899.

Marriages

12-0

11-9

12-1

12-6

13-0

14-7

Births .

33-3

34-1

33-9

31-3

31-0

30-5

Deaths .

18-3

18-7

17-3

17-3

16 0

16-8

Percentage of Ille-

gitimate Births .

4-1

3-6

3-3

3-0

2-9

2-8

The following table shows the marriage-, birth-, and death-rates

The birth-rate is above the average and the death-rate is below the average. In 1891 there were in the county 8061 natives of Scotland, 7224 natives of Ireland, and 4012 foreigners.

Administration. ???The ‘ ancient county is divided into eight parliamentary divisions, and it also includes the parliamentary boroughs of Colchester and West Ham, the latter consisting of two divisions. The administrative county includes six municipal boroughs, namely, Chelmsford (12,580), Colchester (38,351), Harwich (10,019), Maldon (5564), Saffron Walden (5896), South- end-on-Sea (28,857), and one county borough. West Ham (267,308). The following are urban districts : ??? Barking Town (21,547), Brain- tree (5330), Brentwood (4932), Brightliugsea (4501), Buckhurst Hill (4786), Bumham-on-Crouch (2918), Chingford (4372), Clacton (7453), East Ham (95,989), Epping (3789), Gray’s Thurrock (13,831), Halstead (6072), Eford (41,240), Leigh-on-the-Sea (3663), Leyton (98,899), Loughton (4730), Portslade-by-Sea (5217), Romford (13,656), Shoeburyness (4081), Waltham Holy Cross (6547), Walthamstow (95, 125) , Walton-on-the-Naze (2014), Wan- stead (9179), Witham (3454), Wivenhoe (2560) , Woodford (13,806). Essex is in the South-Eastern Circuit, and the assizes are held at Chelmsford. The

boroughs of Harwich and West Ham have sepa- rate Commissions of the Peace, and the boroughs of Colchester, Maldon, and Saffron Walden have, in addition, separate courts of quarter sessions. The county is ecclesiastically within the diocese of St Albans, and is divided into two archdeaconries. There are 413 civil parishes and parts of three others.

Education. ❓❓❓ The number of elementary schools on the 31st of August 1899 was 535, of which 175 were board and 360 were voluntary schools ; the latter including 314 national Church of England schools, 6 Wesleyan, 14 Roman Catholic, and 27 " British and other." The average attendance at board schools was 67,026, and at voluntary schools 44,364. The total school board receipts for the year ended 29th September 1899 was over ❓❓612,516. The Income under the Agricultural Rates Act was over ❓❓3604. There are five certified industrial schools in Essex, namely, Chelmsford, Essex Industrial School for Boys (150 boys) ; Grays, School Board for London Industrial School Ship Shaftesbury (350 boys) ; Halstead, Industrial School for Girls (70 girls) ; Little Ilford, St Nicholas Industrial School for Roman Catholic Boys (150 boys) ; Waltham- stow, St John's Industrial School for Roman Catholic Boys (150 boys) ; also the Davenport Hill Industrial School (late of Brentwood, now in temporary premises at the Sanatorium, Margate), 100 boys ; and Islington Home for Working Boys, closed for the present.

Agriculture. ❓❓❓ About three-fourths of the total area is under -^ cultivation, and of this area about one-third is under permanent pasture. Less than 2200 acres are in hill pasture, and nearly 31,000 acres are under woods. Wheat, barley, and oats are the principal com crops (in this relative order), and their acreage has within recent years greatly diminished. Beans and peas are each nearly half the produce of oats. Turnips and Swedes and man- gold occupy about half the area under green crops.

The following table gives the main divisions of the cultivated area at intervals of ten years from 1880 : ❓❓❓

Year.

Total Area

under Cultivation.

Corn Crops.

Green Crops.

ClOTer.

Per- manent Pastm-e.

Fallow.

1880 1890 1899

830,135 834,151 805,916

386,399 353,918 310,602

100,310 98,677 93,990

87,829 94,807 99,364

195,534 236,314 266,047

59,531 49,630 33,895

The following table gives particulars regarding the principal live stock for the same years : ???

Tear.

Total Horses.

Total Cattle.

Cows or Heifers in Milk or in Calf.

Sheep.

Pigs,

1880 . 1890 . 1899 .

43,385 39,570 39,040

77,332 82,556 90,377

23,886 29,209 35,766

356,536 313,787 295,051

83,245

101,749

88,743

296

E S S 0 N N E S ⬛⬛⬛ E STABLISHMENT

Industries and Trade. ⬛⬛⬛ According to the annual report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 53,608, as compared with 50,494 in 1896. Textile factories employed 3288, of whom 1745 were employed in the manufacture of silk, and 757 in that of flax, hemp, jute, and China grass. In non- textile factories 43,912 persons were employed, of whom 6381 were employed in chemical industries and 5761 in the gas industry. Husbandry and stock-feeding are the chief industries of Essex. The manufacture of silk is carried on at Braintree and Halstead, and there is a silk mUl at Chelmsford. Government powder works are situated at Waltham Abbey, and powder stores at Pur- fleet. The Royal "Victoria and Albert Docks are in Plaistow Level ; Tilbury docks were opened in 1886. The ports of the county are Barking, Bradwell, Brightlingsea, Burnham, Colchester, Grays, Harwich, Leigh, Maldon, Manningtree, Purfleet, Salcott, Southend, Wakering. There is steamer communication between London and Purfleet, Grays, Tilbury, Southend, Walton, Clacton, and Harwich. Steamers on the Orwell run from Harwich to Ipswich. There is a daily service of steamers between Harwich and Antwerp and

the Hook of Holland. The oyster-beds of the Colne produce the famous Colchester native. The rivers Crouch, Koaoh, and Blaokwater also produce native oysters.

Essex is supplied with railways by the Great Eastern Company ??? which has several distinct lines, with various branches.

There is a military station and depot for recruits at Warley, and a garrison at Tilbury. At Shoeburyness there is an extensive ground for testing Government artillery of the largest calibre.

(h. b. w.)*

Essonnes, a town in the arrondissement of Corbeil, department of Seine-et-Oise, France, about 1 mile south- west of Corbeil, of which it may be regarded as a suburb. The church dates from the 13th century. The principal manufactures are machinery and paper, both conducted on a very extensive scale, the latter employing about 3000 men. Population (1881), 4999; (1896), 6844, (comm.) 8956 ; (1901), 9405.

Establishment and Disestablishment. ???

Perhaps the best definition which can be giyen, and which will cover all cases, is that establishment implies the existence of some definite and distinctive relation between the State and a religious society (or conceivably more than one) other than that which is shared in by other societies of the same general character. Of course, a certain relationship must needs exist between the State and every society, religious or secular, by virtue of the sovereignty of the State over each and all of its members. Every society must possess certain principles or perform certain acts, and the State may make the profession of such prin- ciples unlawful, or impose a penalty upon the performance of such acts ; and, moreover, every society is liable before the law as to the fulfilment of its obligations towards its members and the due administration of its property should it possess any. With all this establishment has nothing to do. It is not concerned with what pertains to the religious society qud society, or with what is common to all religious societies, but with what is exceptional. It denotes any special connexion with the State, or privileges and

responsibilities before the law, possessed by one religious society to the exclusion of others ; in a word, establish- ment is of the nature of a monopoly. But it does not imply merely privilege. The State and the Church have mutual obligations towards one another : each is, to some extent, tied by the existence of this relationship, and each accepts the limitations for the sake of the advantages which accrue to itself. The State does so in view of what it believes to be the good of all its members ; for " the true end for which religion is established is not to provide for the true faith, but for civil utility " (Warburton), even if the latter be held to be implied in the former. On the other hand, the Church accepts these relations for the facilities which they involve, i.e., for its own benefit. It will be seen that this definition excludes, and rightly, many current presuppositions. Establishment affirms

the fact, but does not determine the precise nature, of the connexion between the State and the religious society. It does not tell us, for example, when or how it began, whether it is the result of an unconscious growth (as with the Gallican Church previous to the French Revolution), or of a determinate legislative act (as with the same Church re-established by the Concordat of 1801). It does not tell us whether an endowment of the religious society by the State is included ; what particular privi- leges are enjoyed by the religious society; and what limitations are placed upon the free exercise of its life. These things can only be ascertained by actual inquily ; for the conditions are precisely similar in no two cases.

To proceed to details. At the present day there is no established religion in the United States, the German Empire as a whole, Holland, Belgium, France (although France still exercises a certain influ- BrHail ence in the East by virtue of its ancient rela- tions with the Holy See, and certain provisions with regard to Eoman Catholicism still exist by concordat), and Austria-Hungary (saving, indeed, "the rights of the sovereign arising from ecclesiastical dignity "^ ; whereas there are religious establishments in Eussia, Greece, Sweden, Norway, Denmark, Prussia, Spain, Portugal, and even in Italy, as well as in England and Scotland. These, however, diifer greatly amongst them- selves. In Etjssia the " Orthodox Catholic Eastern " is the State religion. The emperor is, by the funda- mental laws of the empire, " the sovereign defender and protector of the dogmas of the

dominant faith, who maintains orthodoxy and holy discipline within the Church," although, of course, he cannot modify either its dogmas or its outward order. Further, "tlae auto- cratic (i.e., imperial) power acts in the ecclesiastical ad- ministration by means of the Most Holy Euling Synod, created by it " ; and all the officers of the Church are appointed by it. The enactments of the Synod do not become law till they have received the emperor's sanc- tion, and are then published, not in its name but in his ; and a large part of the revenues of the Church is de- rived from State subsidies. In Gkeece "the dominant religion ('H cViKparowa OprjcrKeia) is that of the Eastern Orthodox Church of Christ " ; and although toleration is otherwise complete, no proselytism from the Church of Greece is allowed. The king swears to protect it, but no powers pertain to him with regard to it such as those which the Tsar enjoys; the present king is not a mem- ber of it, but his successors must be. In Sweden, Luth- eranism was adopted as the State religion by the Synod of ITpsala (Vpsala mote) in 1593, and the king must pro- fess it. The "Lutheran Protestant Church" retains an episcopal order, and is supported out of its own revenues. Archbishops and bishops are chosen by the king out of those names submitted to him, and he also nominates to royal peculiars. The ecclesiastical law {Kyrkolag), first constituted in 1686, is part of the law of the State, but may not be modified or abrogated without the consent of a General Synod ; and although ad interim interpretations of that law may be given by the king on the advice of the Supreme Court, since 1866 these have been subject to review and rejection by the next General Synod. In Norway the "Evangelical-Lutheran" is the " official religion," but the Church is supported by the State, its property having been secularized. It is also more subject to the king, who by the constitution is to " regulate all that concerns divine service and the clergy," and to see that the prescribed order is carried out. It is much the same in Denmark, where, however, the "Evangelical-Lutheran Church" has since 1849 been described as theNational Church (Folkekirche) in- stead of the State Church (Statskirche) as formerly, and the constitution provides for a new fundamental law for its

regulation, -which has not yet been passed. Tor Prussia, see Ency. Brit, 9th edit., vol. xx. p. 17 ; it need only be added that self-government still tends to increase, but that the present emperor has exercised his office as summus episcopus more freely than most of his predecessors. In Spain the " Catholic, Apostolic, and Roman " religion is that of the State, '"the nation binds itself to maintain its ???worship and its ministers," and the rites of any other religion are only permitted in private. The patriarch of the Indies and the archbishops are senators by right, and the king may nominate others from amongst the bishops ; only laymen may sit in the chamber of deputies. Con- vents vsrere suppressed, and their property confiscated, in 1835 and 1836 ; in 1859 the remaining ecclesiastical property was exchanged for untransferable Government securities, and the support of the clergy of the State Church is assured by an unrepealed law previous to the present constitution. In Portugal it is ihuch the same, but all the home bishops sit in the upper chamber as peers (Pares do Beino) by right, and there is no restric- tion on membership of the chamber of deputies. A more important point is that the king confers all ecclesiastical benefices and nominates the bishops, instead of their being chosen, as in Spain, by agreement between the civil power and the Papacy. In Italy, in spite of the feud between the Papacy and the civil power, the fact remains that, by the Statuto fondamentale, " the Catholic, Apostolic, and Roman religion is the sole religion of the State," and the king may nominate " archbishops and bishops of the State " to be senators. The Legge suite prerogative del Summo Pontifice, &c., or " Law of Guarantees," by which the papal prerogatives are secured, has been declared by the Council of State to be a fundamental law; and whilst many civil restrictions upon the activities of the Church are removed by it, outside Rome and the suburbicarian dioceses the royal exequatur is still required before a bishop is installed. Moreover, the bulk of Church pro- perty having been secularized, the Italian clergy receive a stipend from the State.

Establishment is, of course, a distinctively English term, but it implies precisely the same thing as " Staats-

religion " or " ^glise dominante " does elsewhere. Church and neither more nor less. It denotes the existence Britain. oi a special relationship

between Church and

State without defining its precise nature. The statement that the Church of England or the Scottish Kirk is ” established by law ” denotes that it has a pecu- liar status before the law ; but that is all. (a) There is no basis whatever for the once popular assumption that the word ” established ” as applied to the Church means ” created,” or the like ; on the contrary, the modern use of the word in this sense is a misleading perversion. To establish is to make firm or stable ; and a thing cannot be established unless it is already in existence. A few examples will make it clear that this is the true sense of the word, and that in which it is used here. ” Stablish the thing, 0 God, that thou hast wrought in us” (Ps. Ixviii. 28, P.B. ; A.V. and R.V. “strengthen”) implies that the thing is already wrought; it could not be ” stablished ” else. ” Stablish your hearts ” (Jas. v. 8) implies that the hearts are already in existence. ” Until he had her settled in her raine With safe assuraunce and establishment ” (Faerie Queene, v. xi. 36) would have been impossible unless the reign had already begun. This is the meaning of the words in many Tudor Acts of Parliament, “be it enacted, ordained, and established,” or the like (21 Hen. VIII. c. 1 ; 27 Hen. VIII. c. 28, ^. 9 ; 28 Hen. VIII. c. 13 [Ireland] ; 28 Hen. VIII. c. 18 [Ireland] ; 33 Hen. VIII. c. 27; 1 Eliz. c. 1, ss. 16, 17; 1 Eliz. c. 4,’ s. 4) ; that which is then and there enacted is to be valid for the future, (b) Nor is it necessarily implied that

establishment is a process completed once for all. Every law touching the Church slightly alters its conditions; everything that affects the relations of Church and State may be regarded as a measure of establishment or the reverse. When the two Houses of Parliament, in an address to William III. after his coronation, spoke of their proposed measures of toleration, the king said in his reply, ” I do hope that the ease which you design to Dis- senters will contribute very much to the establishment of the Church” (Cobbett, Part. Hist. v. 218). And Defoe (in 1702) published an ironical tract with the title, Tlie Shortest Way with the Dissenters, or Proposals for the Establishment of the Church, (c) Nor is it necessarily implied that there was any specific time at which establish- ment took place. Such may indeed be the case, as with the Kirk in Scotland ; but it certainly cannot be said that the English Church was established at any

particular time, or by any particular legislative act. There were, no doubt, periods when the existing relations between Church and State were modified or re-defined, notably in the 16th and 17th centuries ; but the relations themselves are far older. In fact, they existed from the very first : the English Church and State grew up side by side, and from the beginning they were in close relations with one another. But although the state of thing which it represented was there from the first, the term "established" or "estab- lished by law " only came into use at a later date. Until there was some other religious society to be compared with it such a distinctive epithet would have had no point. As, however, there arose religious societies which had no status before the law, it became more natural ; and yet more so when the formularies of the Church came to be " established " by civil sanctions (the Books of Common Prayer by 5 and 6 Edw. VI. c. 1, s. 4, &c. ; the Articles by 13 Eliz. c. 12 ; the new Ordinal by 13 and 14 Car. II. c. 4, title). Accordingly, the Church itself came to be spoken of as established by law ; first, it would seem, in the Canons of 1604, and subsequently in many statutes (12 and 13 Will. III. c. 2 ; 6 Anne, c. 8 and c. 11, &c.). In all such cases the Church is described as already established, not as being established by the particular canon or statute. In other words, the constitiitional status of the Church is affirmed, but nothing is said as to how it arose.

The legislative changes of the 16th and 17th centuries brought "establishment" into greater prominence and greatly modified its conditions, but a moment's thought will show that it did not commence then. If, e.g., all post- Reformation ecclesiastical statutes were nop-existent, the relations between Church and State would be very different, but there would still be an " establishment." The bishops would sit in the House of Lords, the clergy would tax themselves in convocation, the Church courts would possess coercive jurisdiction, and so on. The present relations of Church and State in England may be briefly summed up as follows : ??? 1. The personal relation of the Grown to the CUiurch, including (a) restraints upon the action of con- vocation (formulated by 26 Hen. VIII. c. 19) ; (6) nomina- tion of bishops, &c. (25 Hen. VIII. c. 20) ; (c) power of supervision as Visitor, long disused (26 Hen. VlII. c. 1 ; 1 Eliz. c. 1, s. 17) ; (dl) power of receiving appeals as the fount of civil justice (26 Hen. VIII. c. 19, &c.). In con- nexion with these, it must be

borne in mind that (a) the holder of the Crown receives coronation from the Church and takes an oath having reference to it (1 Will. III. c. 6), and (6) the Crown is held on the condition of communion with the Church of England (12 and 13 Will. III. c. 2, s. 3 ; the conditions of communion are laid down in the Prayer Book, which itself is sanctioned by law). 2. Tlie relation of the Church to the Crown in Parliament. No change has been permitted in its doctrine or formularies without the sanction of an act of Parliament. 3. Privileges of the

Church and clergy. Of these may be mentioned (a) the coercive jurisdiction of the Church courts; (6) the right of bishops to sit in the House of Lords. It need hardly be said that establishment in England does not include an endowment of the Church by the State. Nothing of the kind ever took place on any large scale, and the grants for Church purposes in the 18th century are comparable ⁇ with the regium donum to Nonconformists.

The position of the Church of Ireland until its dises- tablishment (see below) was not dissimilar. With Scot- land the case is different : it cannot with any accuracy be said that the legal status of the unreformed Church of Scotland survived the Reformation, even in a modified form. The establishment of -the Kirk was an entirely new process, carried out by a more or less definite series of legislative and administrative Acts. Por example, the Scottish Act of 1567, c. 6, declares it to be ” the onely true and halie kirk of Jesus Christ within this realme.” Again, by the Act of 1690, c. 6, the Crown and estates “ratifie and establish the Confession of Paith, ... as also they do establish, ratifie, and confirm the Presbyterian government and discipline.” The ” Act of Security ” of 1705, as incorporated in the Act of Union (5 Anne, c. 8, ss. 2-6), speaking of it ” as now by law established,” says that “Her Majesty . . . doth hereby establish and con- firm ” it, and finally declares this Act, ” withtlie Establish- ment therein contained,” to be ” a fundamental and essential condition of the

Union." Nevertheless, the conditions of establishment in the Scottish Kirk are much easier than those of the Church of England. It is bound by the statutes sanctioning itg doctrine and order, but within these limits its legislative and judicial freedom is unim- paired. A Royal Commissioner is present at the meetings of the General Assembly, but he need not be a member of the Kirk ; and there is no constitutional tie between the Crown and the Kirk such as there is in England. There is what may accurately be described as a State endow- ment, the bulk of the property of the old Church having been conferred upon the Scottish Kirk.

Not unnaturally, the organization of Anglican Churches in the Colonies was followed in some cases by their estab- lishment, which included endowment. It was so, for example, in the East and West Indies : and the disestablishment of the West Indian Church in 1868 was followed, in 1873, by a re-establish- ment of the Church in Barbadoes by the colonial legisla- ture. India is the only other part of the empire (out- side Great Britain) in which there is to-day a religious establishment.

Disestablishment is in theory the annulling of establish- ment ; but since an established Church is usually rich, disestablishment generally includes disendowment, even where there is no State endowment of religion. It is, in a word, the abrogation of establishment, coupled Disesiab- ^lith such a Confiscation of Church property as the State thinks good in the interests of the community. The disestablishment of the West Indian Church in 1868 has already been referred to ; in 1869 the Irish Church Disestablishment Bill was passed ; and although nothing of the kind has yet taken place in England or Scotland, it is not for want of effort. Private bills relating to Scotland have more than once been brought forward ; and in 1893 Mr Gladstone's Government made a determined attempt to disestablish and disendow the Church in Wales. A bill was passed through the House of Commons to suspend the creation of new interests in the four Welsh dioceses with a view to this ; but it was thrown out by the House of Lords, and the subsequent general election showed that the feeling of the country was strongly against it.

The case of the Irish Church will illustrate the process

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of disestablishment, although, of course, the precise details would vary in other cases. The Irish Church Act (32 and 33 Vict. c. 42) was passed in 1869 by Mr Gladstone's first Government, after considerable opposition, and pro- vided that from January 1, 1871, the union created by statute (39 and 40 Geo. III. c. 67) between the Churches of England and Ireland should be dissolved, and the Church of Ireland should " cease to be established by law." Existing ecclesiastical corporations were dissolved, and their rights ceased, compensation being given to all in- dividuals and their personal precedence being secured for life. All right of patronage, including those of the Crown, were abolished, with compensation in the case of private patrons ; and the archbishops and bishops ceased to have the right of summons to the House of Lords. All laws restraining the freedom of action of the Church were repealed ; the ecclesiastical law, however, to subsist by way of contract amongst the members of the Church (until altered by a representative body). Provision was made for the incorporation by charter of the representar tive body of the Church, should such a body be found, with power to hold landed property. All existing ecclesi- astical property was vested in a Commission, which was to give compensation for life interests, to transfer to the new representative body the churches, glebe houses, and ►►500,000 in compensation for endowments by private persons since 1660, and to hold the rest for such purposes as Parliament might thereafter determine. Eor the sub- sequent fortunes of the disestablished Church, see Iee- lAND, Church of.

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Estate Duty. ––– The Finance Act, 1894, imposed on all property passing by death after 1st August 1894 a duty called estate duty, in lieu of certain other duties previously payable. The objects of the Act were ––– (1) simplification of the death duties and equalization as between real and personal property, and (2) aggregar tion of all the property passing on a death, and taxation at rates graduated according to the value of the whole. Before the Act a duty (probate duty) was taken on the free personal property of deceased persons in the hands of the executor or administrator, without regard to the sub- sequent distribution. The legacy and succession duties were levied on distribution of the property passing on the death, from the persons taking any property under the will or intestacy of the deceased, or under settlement, or by devolution of title on his death. These two latter duties were mutually exclusive, and" together covered practically all property passing by death. They were levied at rates graduated according "to consanguinity. In 1888 an a,ttempt was made to e(iualize the rates of the death duties as between property (mainly personalty in the United Kingdom not settled) which paid the probate and legacy duties, and property (mainly realty and settled

personalty) which paid succession duty only. But the rinance Act, 1894, replaced the probate duty by a duty extending to all property real or

personal passing, on or by reference to death, whether by disposition of the de- ceased or not, without regard to its tenure or destination.

For this purpose all property passing on a death is aggregated to form one estate, on the capital value of which the duty is charged, at rates graduated from 1 to 8 per cent, according to the aggregate value. Besides the property of which the deceased was competent to dispose at his death, the aggregated estate includes property in which he had an interest ceasing on his death, from the cesser of which a benefit accrues, or which was disposed of by him within twelve months of death, or at any time, with reservation of an interest to himself. The extent to which property is deemed to pass on the cesser of a limited interest is measured by the proportion of the income to which the interest extended, without regard to the tenure of the deceased or his successor. Property may therefore be included in the aggregate estate at its capital value owing to the passing of a life-interest only, the property being settled so that the absolute owner- ship does not pass at all. But when the duty has once been paid on property passing under a settlement, the pro- perty does not again become chargeable until it passes on the death of a person who is or has been competent to dispose of it. To compensate for this advantage, when property passing under a settlement made after the Act pays the estate duty, a further duty of 1 per cent, (settlement estate duty) is taken, except where the only subsequent life-interest is that of the wife or hus- band of the deceased.

The rate of duty being fixed according to the aggregate capital value of the whole estate, the charge is distributed according to the different modes of disposition of the property comprised in the estate. The duty on the personalty which passes to the executor as such is paid by him, as the probate duty was, and comes out of the general estate. For the other property passing, trustees, or any person to whom it passes for a beneficial interest in possession, are made accountable, and are required to bring in an account of the property and pay the duty. The duty is a first charge on such property, and, when it is paid by a person having a life-interest only, he may charge the corpus of the property with it. The duty on real property included in an account is payable by eight yearly or sixteen half-yearly instalments, becoming due twelve months after the

death, and bearing interest at 3 per cent, from that date. On other property, excep't in a few special cases, the duty bears interest at 3 per cent, from the date of the death. When the estate duty has been paid no further duty is chargeable on property comprised in the estate which passes to lineal relations of the deceased. But on property passing to collaterals or strangers legacy or succession duty, as the case may be, is payable by the devisees or successors, at a rate (which is the same which-ever duty be payable) fixed according to consanguinity.

The total amount raised by death duties for the year 1893-94, the last complete year of the old system, was ►►9,941,855. For the year 1900-1901 the amount was ►►16,676,290, to which the estate duty contributed ►►12,685,211.

For a detailed account of the provisions of the Act of 1894 and subsequent amending Acts, and of the practical working of the new duty, reference is made to Caktmell, Finance Acts, 1894-96 ►►► Death Duties, London, 1896 ; Soward, Handbook to the Estate Duty, 4th edit., London, 1900 ; and to the Reports of the Commissioners of Inland Revenue for 1894-95 and subsequent years. (p. d.)

United States. ►►► The United States imposed a succession duty, by the War Revenue Act of 1898, on all legacies or distributive shares of personal property exceeding $10,000. It is a tax on the privilege

of succession. Devises or distributions of land are not afiected by it. The rate of duty runs from 75 cents on the f 100 to $5 on the |100, if the legacy or share in question does not exceed $25,000. On those of over that value the rate is multiplied IJ times on estates up to .|100,000, twofold on those from $100,000 to $500,000, 2J times on those from $500,000 to a million, and threefold for those exceeding a million. This statute has been supported as constitutional by the Supreme Court. Many of the States also impose succession duties, or transfer taxes ; generally, however, on collateral and remote successions ; sometimes progressive, according to the amount of the succession. The State duties generally touch real estate successions as well as those to personal property. If a citizen of State A. owns registered bonds of a corporation chartered by State B., which he

has put for safe keeping in a deposit vault in State C, his estate may thus have to pay four succession taxes, one to State A., to which he belongs and which, by legal fiction, is the seat of all his personal property; one to State B., for per- mitting the transfer of the bonds to the legatees on the books of the corporation ; one to State C. , for allowing them to be removed from the deposit vault for that purpose ; and one to the United States. (s. B. B.)

Este, a town of Italy (Venetia, prov. Padua), at the south end of the Euganean Hills, 21 miles by rail south- west from Padua. The town possesses a cathedral, an archaeological museum, the Euganean Prehistoric Museum, and a technical school. Population, about 6800.

Esthonia (German, JS/is

Eeval and the Baltic Port, with a branch from Taps to Dor- pat. A considerable traffic is carried on along this line, Reval and Baltic Port being important towns, both for import and export. Hapsal and Kunda are next in im- portance, and Dago for imports. Esthonia is divided into four districts, the chief towns of which are Eeval, capital of the province (64,578 inhabitants in 1897) ; Hapsal, a lively watering-place (3238); Weissenstein (2509); and Wesenberg (5660). (p. a. k.)

Eston, a township and urban district, partly in the Cleveland parliamentary division of the North Riding of Yorkshire, England, 8 miles east from Stockton by rail. There are extensive blast-furnaces, iron foundries, and steam sawing mills in the district. Population of urban district (area, 2252 acres) (1881), 6297; (1891), 10,695.

Estremadura, a former province of Portugal, now divided into the administrative districts of Leiria, Lis- bon, and Santarem (qq.vv.). Area, 6710 square miles. Population, 1,083,290 ; giving 161 inhabitants to the square mile. There are mineral waters and baths at Caldas da Eainha, Cueos (near Torres Vedras), Estoril (Cascaes), and Lisbon. Marble is

quarried, and coal is mined at Porto de Moz. In 1892 the vineyards covered 88,560 acres, and their produce amounted to 17,941,850 gallons of wine, valued at ►►827,800. The fishing employs over 9600 men and 1600 boats, and the average value of the fish caught annually is ►►311,100. The ports of the province were entered in 1897 by 2615 vessels, of 3,569,589 tons.

Esztergom (Gran), a corporate town of Hungary, the capital of a county of the same name. In 1898 it was united with its suburbs, and in 1900 had a popular tion of 17,909.

Etah, a town and district of British India, in the Agra division of the North- West Provinces. The town is situated on the Grand Trunk Eoad, but with no railway station. Population, about 8000. The municipal income in 1897-98 was Es.12,577.

The DisTKiGT OF Etah has an area of 1741 square miles. It had a population in 1881 of 756,523 ; and in 1891 of 702,063, giving an average density of 403 persons p^r square mile. In 1901 the population was 863,719, showing an increase of 23 per cent., due to the extension of canal irrigation. The land revenue and rates were Es.13,16,370, the incidence of assessment being just over E.l per acre ; the cultivated area in 1896-97 was

570,194 acres, of which 340,424 were irrigated; the number of police was 2031 ; the number of vernacular schools in 1896-97 was 89, with 4158 pupils ; the regis- tered death-rate in 1897 was 24-25 per 1000. Part of the district is watered by the Ganges Canal. It is also now traversed by a branch of the Eajputana railway from Agra to Cawnpore, with stations at Kasganj and Soron, which are the two largest towns. It has 5 printing-presses; 141 indigo factories, employing 7743 persons, with an outturn valued at Es.5,70,000 ; and one factory for pressing cotton.

Etampes, Erench town, in the department of Seine- et-Oise, 31 miles south of Versailles by rail. In addition to its great trade with Paris in food-stuffs, it supplies large quantities of sandstone for street-paving. Manu-facturing industries are of little importance. Population (1881), 7466; (1896), 8094, (comm.) 8390; (1901), 8760.

Etawah, a town and district of British India, in the Agra division of the ISTorth-West Provinces. The town is situated on the left bank of the Jumna, and has a railway station, 206 miles from Allahabad. Population, about 38,000. The municipal income in 1897-98 was Es.39,583 ; the registered death-rate in 1897 was 49-83 per 1000. Etawah is now only the civil headquarters of the district, the military cantonment having been aban- doned in 1861. Considerable trade is carried on by rail and river. It makes specialities of cotton cloth, skin- bottles, combs and horn- ware, and sweetmeats.

The DISTRICT OF Etawah has an area of 1691 square miles. It had a population in 1881 of 722,371 ; and in 1891 of 727,629, giving an average density of 430 persons per square mile. In 1901 the population was 806,626, showing an increase of 11 per cent. The land revenue and rates were Es.16,06,190, the incidence of assessment being E. 1-3-8 per acre; the cultivated area in 1896-97 was 459,395 acres, of which 286,477 were irrigated ; the number of police was 2094 ; the number of vernacular schools in 1896-97 was 84, with 3507 pupils ; the registered death- rate in 1897 was 46-36 per 1000. It has six printing- presses, issuing two vernacular periodicals; 216 indigo factories, employing 11,128 persons, with an outturn valued at Es.11,00,000 ; and three factories for cleaning and pressing cotton. The district is partly watered by branches of the Ganges Canal, and it is traversed throughout by the main line of the East Indian railway from Cawnpore to Agra.

ETHICS.

THE object of the following article is to describe and estimate the work done in Ethics since 1878, the date of Professor Sidgwick's article in the ninth edition of this Uncydopoedia. The convenience of the reader will probably be best served if an outline is given of the general position in 1878, with some prefatory re- marks on the ' Scope of Ethics,' which may help to indi- cate the point of view taken in regard to that position, and to the work by which it was modified during the last quarter of the 19th century. Eollowing Professor Sidg- wick's example, we practically confine our remarks to English Ethics, only mentioning a few foreign writers in the list of authorities given at the end.

Ethics may be defined as the Theory of Conduct. It has two parts, which may be distinguished as the General and the Particular Theory of Conduct. The General Theory of Conduct seeks to embrace, within one archi-

tectonic survey, all the functions of human nature ??? all the modes of conduct by which man, as sentient animal, as moral agent, and as thinker, realizes his Type in an environment, which he ‘ conquers by obeying.’ ?????^^^ This Type ??? the end in relation to which alone all objects of human endeavour have ‘ reality ‘ and ‘ value,’ and are, and ought to be, desired ??? the General Theory of Conduct seeks to set forth, with the special view of furnishing principles by means of which the Particular Theory of Conduct may interpret that mode of ‘ conduct ‘ which bulks most largely in man’s life, and seems to be ‘practical’ in an eminent sense ??? moral conduct, which may be defined as conduct willed by members of the so- cial system for the sake of that system. Moral conduct, as thus defined, is the central part of the subject-matter of Ethics, but must be exhibited in connexion with what is its necessary setting, conduct other than moral.

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rrom ‘Man in the State’ our range of view must be extended till we can survey ‘Man in the Cosmos.’ As setting forth ‘ Man in the Cosmos,’ the General Theory of Conduct will (1) describe him as he now is, and trace the history of the process from animal or even lower beginnings, by which he has become what he now is; and (2) will call attention to the significance of his being what he now is. Ethical schools differ chiefly as they take greater or, it may be, exclusive interest in one or the other of these two inquiries embraced within the scope of the General Theory of Conduct. Corresponding to these two ethical ‘interests’ or ‘tendencies,’ we find two ways of setting forth man’s Type in relation to the Cosmos, ??? the positive way, and the way of imaginative representation. The way of imaginative representation recommends itself to ??? indeed, is forced upon ??? those whose reflection dwells on the significance of

man’s being what he is ??? a self- conscious subject. Man’s Type for them is intuitively apprehended, being present in self-consciousness. It is “Eternal Consciousness present in my consciousness.” This is the True Self, which constitutes the world ??? makes it the intelligible system that it is. Plato is the master of those who set forth the Type imaginatively. The reverence which the True Self inspires (it is what Aristotle would call Tifxiov) finds, with Plato, expression in a solemn ritual, as it were, of mythic or prophetic representation. The his- tory of the immortal soul (which in itself ‘ has no history ‘) is unfolded in a vision, or miracle-play, before our eyes, from its ‘ creation ‘ to the time when, purified by penance and philosophy, it is finally disembodied, and, returning to its own star, there participates in, and understands, the eternal motion of the Cosmos, being made ‘ like unto God.’ This is not the place to discuss the reasons which justify Plato in thinking, as he certainly does, that such ‘ mythology ‘ is part of ‘ philosophy.’ We would only say that much of what hais passed since his day under the name of ‘ metaphysic ‘ ??? for example, the main part of the metaphysic which the ‘Cambridge Platonists’ and their present-day English successors supply as basis for morals ??? is best regarded as rationalized ‘ myth,’ and owes its attractiveness and, we would add, its valud to its ‘ mythological ‘ character. The other way of setting forth man’s Type we have called the positive way. While the way of imaginative representation is essentially ‘pro- treptic,’ making a personal appeal to the individual soul as such ??? ‘ Reverence thyself, for thou art worthy,’ ??? and relying largely on the ‘ prophetic ‘ genius ^ and personal influence of him who employs it, the positive way merely aims at providing instruction for those who care to receive it. Those who employ this latter way, leaving it to others to say that ‘ we see all things in God,’ and letting it go without saying that ‘the world is intelligible by man’s intelligence,’ turn to the natural history of mankind for data out of which to construct a positive theory of man’s Type. This ‘theory’ may either set forth the genetic process by which the Type has been evolved,” or amount to nothing more than a descriptive account of the Type as it now appears ; in either case the moral life ??? the life of conduct willed for the sake of the Public Good ??? being taken as central, the range of view is enlarged, and other than moral elements are included within the survey. In the difference between the descriptive and the genetic account lies the

distinction between the old manner and the new of setting forth the Type positively. The posi- tive method was employed in the descriptive manner by Plato (for he by no means confined himself to the method of imaginative representation) and by Aristotle when they

1 Understood in the sense defined by Spinoza in his account of the nature and function of Prophecy: Tractatus theologico-politicus, chaps. 1, 2, 3.

took the civilization achieved by their own race ??? the ensemble of all its activities ??? as the Type to be described. Fortunately for Ethics, it was a many-sided, well- balanced Type; and the concrete presentation of it by Plato and Aristotle has been worth immeasurably more than any exposition starting from the abstract notion of human nature as such would have been. They pre- sent human nature as such in a fine rendering of their own particular Civilization ??? 'EXXriuh ea-rai, says Plato, speaking Of his xaXXiiroXts. The result is a portrait which, like all great portraits, is an ideal, setting forth universal human traits, while rendering faithfully the features of an individual. The peculiar charm of the ethical por- traiture which we have received from the great Greek masters depends, doubtless, on the circumstance that the Type portrayed was accepted without arri&re pensie as final. The new biology has taught us that Type is never final ??? that there is no such thing as completed adjust- ment of organism to environment. Is portraiture, then, in the classical manner, a thing which Ethics, as General Theory of Conduct, cannot now hope to succeed in, and will not seriously attempt ? We hold that Ethics must still attempt it. Provisional (or, if any one prefers the word, ideal) description of Type achieved is necessary to give aim to the genetic account. The only way in which the Type can be set forth positively (i.e., for our guid- ance, as distinguished from our encouragement) is that which combines the genetic with the descriptive account. And the descriptive account will still take the form of the portraiture of some particular civilization. Some specific National Type must alway^e sit as artist's model. Thus, if the moralist is an Englishman, he will do well to keep his eye on the civilization of England. But the new biology will make a great difference to his work. However tempted, as artist, he may be to follow his mas- ters in setting forth the Type as if it were final, he is bound now to remember that it is not final,

and, at the same time, that the relations involved are so complicated that calculation of what it will become even in the com- paratively near future is not to be attempted. No biolo- gist thinks of speculating about the form which a given organic type may assume in the future, or of interpreting present structure and function in the light of such hypo- thetical form. He knows that the calculation is too in- tricate. The scientific character of his 'teleology' is guaranteed by the definiteness of the already achieved organic whole or result, which is always taken as starting- point for the explanation of parts or stages clearly and distinctly perceived to be parts or stages. The scientific caution observed by the biologist in his employment of ' teleology ' is likely to be imitated more and more by moralists in their attitude towards ' ideals.' When it is said that 'Ethics' is not really touched by the new biology, the remark must be taken as true only of ' Ethics ' as setting forth the Type in the way of imagina- tive representation. As setting forth the Type in this way. Ethics is certainly not touched by the new biology, just as the Divina Commedia is not touched by it. But positive Ethics (whether its manner be principally that of the descriptive or that of the genetic account) is touched, and very nearly, by it, in the respects indicated.

We pass now to Ethics as Particular Theory of Conduct. It has for its subject-matter that branch of general conduct distinguished as ' moral conduct.' It is not necessary to describe 'moral conduct' here. It is enough to ask the reader to recall the subject-matter of any standard treatise' on ' morals,' such as Eeid's Essays on the Active Powers or Adam Smith's Theory of Moral Sentiments. But it is important to say, that, in our view, 'moral conduct' belongs to man not as individual, but only as member of society. Were there only one human being in the universe,

there might conceivably be ' branches of knowledge,' and ' logic ' or theory of the ways in which the endeavour after knowledge is made ; but there could be no ' Ethics ' in the narrower sense we are now considering ; for the conduct which is its special subject-matter is the behaviour of

*persons to one another as members of a common concern in which they are fellow-workers. Aristotle recognizes this when he makes his solitary abstracted God a 'thinker,' but denies 'morality' to him. The distinction between 'politics,' i.e., the science of man as ***jtoXi.tikov ^wov, and I morals,' or ' private ethics,' is thus apt to be mislead- ing as a distinction within the bounds of Ethics as Par- ticular Theory of Conduct. 'Private morality' is an abstraction, like a caged bird. It may be convenient for observation to have it caged; but what is observed in the cage must always be interpreted with reference to the natural habitat of the prisoner. It may be convenient, for the moment, to look at moral virtue as simply the qual- ity of an individual ; but, after all, the quality is what it is because it puts its possessor in certain relations to others in society ^ l^is Tais evcpyttais opi^erai Kol mv i(TTi. The distinction, however, between ' private ethics ' and 'politics' where strongly pressed, has been urged not on the mere ground of its convenience for the methodical study of the individual as iroXtriKov ^wov, but because it is thought that, after all, the individual for 'Ethics' is not the irokiTLKov i*

To understand the position which ' private ethics ' ought to occupy within the Particular Theory of Conduct, we must turn to the work of such moralists as Shaftesbury, Hutcheson, and Adam Smith. The 'moral sentiments' so admirably described and analysed by these writers doubtless belong to the individual; but it is assumed throughout that they are ' designed ' to operate for the ' Public Good.' The significance of the passage from Hobbes to the moralists of the ' sentimentalist ' school is that the centre of interest is shifted from 'state' or ' sovereign ' to ' private citizen.' Hobbes intrusts the ' Public Good ' entirely to the sovereign, reducing the character of the subject, or private citizen, to the one

quality of obedience. The sentimentalist moralists dwell on the initiative of the ' benevolent ' private citizen, as reflectively pursuing the Public Good. The Public Good is thus placed in a new light. It is no longer regarded as identical with the stability of a centralized government armed against anarchy, but as gradually realizing itself in the progress of reforms suggested by the experience of enlightened and public-spirited private citizens. Starting .from the principle that the private citizen can and ought to work as private citizen for the Public Good, the senti-

mentalist moralists analyse that character in the private citizen which makes him capable and desirous of working for the Public Good. Their psychology of the moral senti- ments, though not very 'scientific,' indicates with sufiicient clearness the lines on which the education of the private citizen must be conducted with a view to the establish- ment of the character in question. Their work may there- fore be said appropriately to lie in the field of ' private ethics ' or ' morals ' as distinguished from ' politics ' or ' legislation,' inasmuch as the private citizen, and not the sovereign or state, is the centre of interest. ' Private ethics ' as cultivated by these moralists attempts to determine, always ui relation to the Public Good, what is ' meritorious ' in the private citizen, when acting in the ordinary eveiy- dayconcerns of hislife ; notto estimate the ' value,' in rela^ tion to the same standard, of general rules proposed by a legislative body. It was fortunate for English Ethics that it passed through the hands of psychologists, who made it their business to furnish a theory of the ' merit ' of the individual, before it reached the political and legal reform- ers, Bentham and his followers. It is the individual, as described in the ' private ethics ' of the sentimentalist moral- ists, who ultimately inspires, and is willing to live under, the legislation outlined in the 'politics ' of the later utilita- rians. At the same time, it must be admitted that the sentimentalists go as far as it is possible to go safely in insisting on ' personal merit ' or the ' moment of good ' in the individual. They often come very near the substitu- tion of the subjective standard of ' good intentions ' for that of the Public Good. It was time that the centre of ethical interest should begin to be shifted back again to the state from the individual ??? that ' utilitarianism ' should cease to be mainly a theory of ' morality,' and fulfil its end by be- coming the theory of ' legislation.'

We have now said enough to explain our view of the nature and position of ' private ethics ' as dealt with positively. It is the theory of the moral character of the individual ; it is complementary to and, in turn, comple- mented by ' politics,' the theory of the state in which the individual inheres as citizen. There can properly be no ' private ethics ' without ' politics,' or ' politics ' without 'private ethics.' Both together make what we have called the Particular Theory of Conduct. This might well be

called ‘ Politics ‘ ❑❑❑ iroXniKr) ❑❑❑ in the generic sense ; for it deals with man as ttoXltlkov i

Ethical systems may be conveniently classified according as the interest which inspires them is political, religious, or scientific. English interest has been political and religious throughout, and only lately scien- f’/l^g” tific. We do not mean, of course, that the ‘ political ‘ moralists ❑❑❑ Hobbes, Locke, Shaftesbury, Hut- cheson, Adam Smith, Hume, Bentham, J. S. Mill ❑❑❑ had no ‘scientific’ basis ❑❑❑ they certainly had it i oa-ov iKavws eX’t TTjoos TO. ^riTovfueva ; and the ‘ Cambridge Platonists ‘ were most anxious to press ‘ modern science ‘ into their service, in this respect resembling some of their present-day

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representatives. But it was not till the introduction of evolutionary theory into Ethics that the subject began ~~to be studied as one of purely scientific interest ❑❑❑ man’s manner of life being investigated in the same spirit in which the habits of bees and ants are investigated. Where the chief interest is religious or scientific, the system is mainly a contribution to the General Theory of Conduct ; where political, to the Particular Theory of Conduct. We shall best explain the position of Ethics in England when the last quarter of the 19th century opened by showing how the three inijerests ❑❑❑ political, religious, and scientific ❑❑❑ were then balanced. The prevailing interest of English Ethics was then no longer political, as it had been in Bentham’s time. Bentham’s preaching of the doctrine of the Public Good had borne fruit in the reforms, constitutional and legal, with which his name will always be associated : ” I do not know,” says Maine (Early Hist, of Inst. p. 397), ” a single law reform effected since Bentham’s day which cannot be traced to his influence.” But when these reforms had been effected, utilitarianism entered on a long period of academic retirement, or even inactivity. As time went on it became more and more difficult for the young men, who made acquaintance with it at the universities, to appreciate the circumstances and temper of those to whom it had been a living gospel ; more and more~~

~~easy to cavil at the 'handy' psychology which had been good enough for Bentham's practical purpose, especially as that psychology was presented by J. S. Mill and Professor Bain. These later exponents of Bentham's system almost courted the charges (mis~~ taken as they were) of ' hedonism,' and of converting a principle of 'legislation' into a principle of 'morals,' which began to be brought against utilitarianism in the 'sixties, and have been reiterated ever since. Here it is only necessary to say that they came chiefly from those whose paramount interest in Ethics was religious ??? who were dissatisfied with the merely secular aim of utilitarianism.

While Ethics had lost in the third quarter of the 19th century the inspiration of keen political interest, the other interests ??? the scientific and the religious ??? were both making themselves powerfully felt. It was during this period that, for the first time in the history of English Ethics, moral conduct was presented frankly as a subject of purely scientific interest ??? as part of the great ensemble covered by Biology, a science, or rather group of sciences, which had now found its Newton. Darwin had brought light into Biology, and made it a study of absorbing in- terest ; Mr Spencer had definitely, without qualification, placed ' Ethics ' within its borders. This he did even in writings published before the Origin of Species, although without anticipating the distinctive idea of that work.^ If Darwin's was the greatest influence of the 19th century, it was chiefly through Mr Spencer's writings that it made itself felt among professional students of Ethics during the 'sixties and' early 'seventies, although afterwards it reached them through other channels.

But the same period which saw Ethics thus claimed by the biologists for science, saw also a great awakening of the religious interest among the professional students of Ethics. The introduction of Darwinism into Ethics coin- cided with a notable revival of idealism in Ethics. > Vari- ous causes contributed to this result. The spirit of the ' Cambridge Platonists,' which had always been cloistered in England, was powerfully appealed to by the so-called ' Oxford Movement.' Idealism became conscious of itself even in men who seemed to stand aloof from that move- ment. The newly

awakened idealism found itself con- fronted by the utilitarianism of J. S. Mill, and the biologi-

1 See the interesting note Princ. of Biol. ii. 500.

cal ethics of Mr Spencer, just as, two centuries before, it had been confronted by Hobbism and ‘ materialism.’ At first it was merely with utilitarianism that idealism came into action. With arguments similar to those used by the Cambridge Platonists against ‘materialism,’ and in a similar spirit, their modern successors attacked the end of the popular utilitarianism. Utilitarianism seemed to them to acquiesce in the material welfare of masses, whereas the true end lies beyond in the perfection of persons. The good effected by utilitarian legislation in England was too great to be overlooked, and T. H. Green (whom we take in this article as representative of the idealist school) was not the man to underrate it ??? but the true end lies beyond in the perfection of persons. If the devotees of this ideal go forth from the cloister, as they often, in our day, feel it to be their duty to do, in order to take an active part in ‘ social work,’ we must still dis- tinguish them from the utilitarians. The ideal of the utilitarians, or political moralists, is a secular one ??? that of public prosperity. The ideal of the modern Platonist is a religious one ??? it is (to use a phrase which we hope will not be misunderstood as we use it) the ideal of ‘ souls to be saved’ ??? of individuals to be made more perfect by personal care, in a social system which is the life of each one of them writ large. Another influence which contrib- uted (though perhaps not so largely as might be supposed) to the revival of idealism in England was, of course, the study now beginning to be given to German philosophy. German philosophy, elaborated in universities, without the distraction of political interest, has always dwelt more on Self than on Citizen ; and its influence, as felt by the English idealists twenty-five years ago, was entirely in favour of substituting the ideal of personal perfection, or self-realization, for the utilitarian standard. At the same time Hegel had insisted on the progressive realization of Self in Society. Here the English idealists readily followed Hegel’s lead, for he seemed to indicate how they might, without sacrifice of philosophical principle, retain much with which they were in sympathy in the national utilitarianism. It is in social life, then, that personality must realize itself

<u>[illegible] in the Family, in the State, and, it is important to add, in the visible Church. The idea of ‘ visible church ‘ had of late years become very vivid and attractive in England. A philosophical reason for its attractiveness seemed to many minds to be added by the teaching of the idealist school. The historian of religious opinion in England during the latter half of the 19th century will have to take serious account of the influence of that teaching within the Church.</u>

<u>The polemic of the new idealism was mainly, at first, directed against utilitarianism [illegible] against J. S. Mill and his philosophical predecessors Locke and Hume. In time, how- ever, it was turned against the biological ethics, with which it is now chiefly engaged. This conflict is more interesting to the critic than that with utilitarianism, inasmuch as it serves to show more clearly the ‘ tendency ‘ of English idealism, by bringing out two connected doctrines as of cardinal importance to its whole teaching [illegible] (a) that man, as self-conscious, is absolutely distinct from the animals, and (&) that in his self-consciousness the eternal self-con- sciousness is present. The position, it is contended, which biological ethics gives to man, is inconsistent with the ultimate fact that self-consciousness exists, presenting him to himself , in respect of his intelligence and moral freedom, not as product but as principle [illegible] as ‘ reproduction ‘ of the eternal self-conscious principle which is the cause to all ‘ products ‘ of their coming into existence and being intel- ligible. This epistemological Theism of the modern ideal- ists, it is to be noted, is essentially that of Cudworth and the other ‘ Cambridge Platonists,’ who argue that through the eternal and immutable truths of which reflection</u>

<u>(Plato would say dva/ivijcns) makes man aware as constitu- tive of Ms understanding and as conditioning Ms experi- ence, he comes into communion with the Eternal Wisdom of God, Whose vo-^fiara they are. Who created the world after their pattern. To put tliis into the language of to- day: [illegible] in man’s consciousness of self, the Eternal Con- sciousness is present. Judging from their recent writings, we take it that</u>

the modern representatives of Cud worth's school find Theistic Theory the most interesting part of their system ; and we may expect that the chief develop- ments of English idealism will be towards the elaboration of such theory.

We must not close this general review of the position at the date of Professor Sidgwick's article without referring

to his own Methods of Ethics, wMch appeared sfdj^ick. ^^ 1^^^- '^^ Methods of Ethics is important as

being a critical restatement of utilitarianism by one who was intimately acquainted with the history of that doctrine, from Hobbes downwards, as a chapter in the History of the English People, and saw very clearly that that side of it, which received so much perhaps too much attention from the sentimentalist moralists, had been too little regarded by utilitarians since Bentham's time. It was, accordingly, to a re-examination of the problems of ' private ethics ' (considered always as the other side of ' politics ') that Professor Sidgwick mainly devoted his remarkable powers of insight and analysis. The Methods of Ethics, we believe, will stand as a landmark in the his- tory of our national utilitarianism. It marks the shifting back of the centre of etMcal interest from State or G-overn- ment to private citizen. For Hobbes, as we have seen, the Public Good was secured entirely by the eflB.ciency of the Government; for Shaftesbury and his school, mainly by the benevolent initiative of private citizens ; for Bentham, again, mainly by the legislative action of the State ; while the new utilitarianism represented by Professor Sidgwick comes back again to the importance of investigating the moral sentiments of the individual, in order to grasp the lines on which his education for citizenship may be con- ducted. The lead given by Professor Sidgwick has been followed by other adherents of utilitarianism. This devel- opment of utilitarianism in the direction of an exact posi- tive psychology of the moral sentiments is likely to be an important one. The talent for such inquiry is native in England; and, aided by the scientific methods now em- ployed in psychology, ought to produce valuable results. Political, as distinguished from scientific and religious, in- terest will doubtless again resume its normal influence in English Ethics. New social conditions have arisen

which demand, and will undoubtedly create, a new utilitarianism, in which a theory of the moral and political education of the individual citizen based on an exact positive psycho- logy of his moral sentiments will hold a prominent place. Since the publication of Professor Sidgwick's article in the ninth edition of this Encyclopcedia, important works

have been published by English representatives Develop- of the evolutionary school ??? especially Princi- ments/nce ^^^^ ^^ Ethics by Mr Spencer, The Science of

Ethics by Mr Leslie Stephen, and Moral Order and Progress by Prefessor Alexander.

Mr Spencer defines Conduct as 'acts adjusted to ends,' and proceeds to lay down the principle that the part of conduct with which Ethics deals cannot be understood without the study of human conduct as a whole, or the latter without the study of conduct as belonging to animate beings in general. This means that Ethics must begin with the study of the ' evolution of con- duct ' out of that which cannot be called ' conduct.' The ' evolu- tion of conduct' is marked by improvement in the Spencer. adjustment of means to ends, so that life gains in ' length ' and ' breadth ' ??? life being at once that of the individual, and that of the species maintained by the rearing of offspring. Conduct subserving the life of the individual and conduct subserving the life of the species are mutually dependent. Each reaches

its highest form simultaneously with the other; but not until the highest form of a third kind of conduct ??? social conduct ??? is reached. When this is reached, the ends of the two lower kinds of conduct are achieved without 'struggle for existence.' 'The limit of evolution can be reached by conduct only in permanently peaceful societies.' That conduct is best which simultaneously achieves- the greatest totality of life in self, in offspring, and in fellow-men ; the postulate involved in this judgment being that 'life is worth living ' ???which means that it brings a surplus of 'pleasure' or 'happiness.' Evolutionary theory enables us to substitute a scientific for an empirical utilitarianism, by exhibiting certain fundamental truths common to ethics with physios, biology, psychology,

and sociology. In physics we see evolution always tending towards the better maintenance of a ‘ moving equilibrium.’ This appears in biology as ‘ balance of functions ‘ ; the notion of ‘balance of functions’ yielding, on examination, the truth that “sentient existence can evolve only on condition that pleasure- giving acts are life-sustaining acts.” Passing from the biological to the psychological view of ethics, we pass from presented pleas- ures and pains to represented pleasures and pains as constituting deliberate motives, and arrive at the conclusion that evolution is marked by the increasing subordination of simple representative feel- ings to compound representative feelings. Thus the ‘ moral con- sciousness ‘ ❓❓❓the ‘ feeling of obligation,’ or ‘ sentiment of duty ‘ ❓❓❓ begins to emerge, as a balanced complex of representative feelings, an internal control gradually emancipating itself from three pre- paratory external controls, the political, religious, and social. Standing, as it does, for the experience of the individual and his progenitors, the ‘moral consciousness ‘ is a feeling ” at once mas- sive and vague.” It is the “abstract consciousness” of the superior “authority” of the guidance supplied by the complex representative (and re-representative) feelings occupied with the future rather than the present. But “the sense of duty or moral obligation is transitory, and will diminish as fast as moralization Increases.” Passing to the sociological view of ethics, we find that what here corresponds to the ‘ equilibrium ‘ of the physical view is realized under conditions which, formulated, make a ‘ code ‘ that confers on Ethics the rank of a ‘ science ‘ : namely, The associated individuals shall (1) inflict no injury (o) directly or (6) indirectly on one another ; and (2) shall help one another (a) un- der agreement and (6) beyond agreement. ‘ Happiness,’ special and general, is the ultimately supreme end. Although ‘ Happiness ‘ itself is not a thing that can be cut up and distributed at all ; and although the concrete means to it cannot be distributed equally ; yet each man may have like liberty to pursue ‘ happiness,’ and like security in the possession of it. The ‘ greatest Happiness principle ‘ is meaningless except as asserting the necessity of this. Although egoism, biologically considered, comes before altruism, yet ” from the dawn of life altruism has been no less essential than egoism.” ” Self-sacrifice is no less primordial than self-preserva- tion.” Its primordial form is the “physical altruism” of repro- duction by fissure. Scientific ethics has to recognize the fact (ignored by the ”

transformed utilitarianism “which assumes ” pure altruism”) that egoism and altruism coexist. Provisionally we must reconcile their respective claims by compromise. But the op- position between them tends to disappear. ‘ Sympathy’ tends to become stronger ; men tend more and more to make each others’ pleasures, ‘ egoistic ‘ and ‘ altruistic,’ their own. This is the ideal of ‘perfect conduct,’ the subject-matter of ‘absolute ethics,’ which stands to ‘ relative ethics ‘ (concerned with conduct which, as in- volving pain, is only relatively right, i.e., partially wrong) as rational stands to experimental mechanics.

Mr Leslie Stephen summarizes his system in one sentence {op. cit. p. 454) : ??? “Morality is a product of the social factor; the individual is moralized through his identification with the social organism ; the conditions, therefore, of the ^e??“e security of morality are the conditions of the persist- Stephen. ence of society ; and if we ask from the scientific point of view what these conditions are, we can only reply by stating that the race is dependent upon the enviroment ; by tracing so far as we are able the conditions under which it has been developed, and trying to foresee the future from the past.” The ethical prob- lem??? to discover the general characteristic of the moral senti- ments??? Mr Stephen attacks from the position that human beings are the product of a long series of processes of adaptation acting either on the individual or the social organism in which he Inheres as a member. The social organism (or better, ‘social tissue ‘) is a growth the laws of which can ba studied apart from those of the individual atom. The ‘ social tissue ‘ develops without a corre- sponding change of individual organism. We are born with brains very like those of remote progenitors ; but we use them in an en- vironment of laws, institutions, literature, tangible products of labour, scientific knowledge, logical and mathematical formulje ??? a ‘social tissue ‘ very different from that in which these progenitors lived. It i.s on the social tissue, as primary unit, that the process of evolution impinges ; and consequently it is in relation to the vitality of the social tissue that we speak of the Individual’s con-

duct as ‘ useful.’ ” That form of bee will flourish which forms the most efficient hives. The hive . . . will be the unit which must be taken into account in considering the general problem of survival.” The social tissue ??? the all-pervading substance from which the various ‘ organs ‘ or subordinate associations (govern- mental, religious, industrial, &o.) are constructed ??? is its own end. Society being an organic growth, certain instincts or customs are formed corresponding to a given state of the social tissue. What is the nature of those social instincts which give rise to ‘ morality ‘ ? Morality, gradually developed out of Law and Custom by natural process, is distinguished from them by substituting ‘ Be this ‘ for ‘ Do this.’ Rules of conduct are seen to be rules of character. “The individual must, so far as moral, be capable of aiming at the social welfare before his own.” But is such ‘self-sacrifice’ possible ? Yes. The reduction of altruism to egoism involves- a confusion of thought. Altruistic does not differ from non- altruistic conduct In any sense which would imply that my conduct can spring from anything but my own feelings. Moreover, ‘ sympathy ‘ is implied from the first in the very structure of knowledge (see pp. 230 ff.), and, as a matter of fact, is a stronger feeling than egoistic feeling. “The sympathetic being becomes, in virtue of his sympathies, a constituent part of a larger organiza- tion,” apart from which he is unintelligible. ” Altruism is the faculty essentially necessary to moral conduct.” ” The moral code is a statement of the conditions of social vitality.” It is in relation to social vitality, as end, that we must explain merit, obligation, virtuous character, conscience, responsibility. Merit belongs only to voluntary actions, which are actions put forth by character in environment. Responsibility is the dependence of actions on character ; conscience is not an instinct co-ordinate with other instincts, but ” implies a judgment of the whole character.” So far as I indentify myself with the social organism I feel a sense of obligation to conform to the conditions of its welfare. While ‘ happiness ‘ is the criterion of the old utilitarianism, the ‘ health of society’ is that of evolutionary ethics. These two criteria are not really divergent, but the former is unscientific, the latter scientific. Can we modify the utilitarian sanction (that which supplies the motive to virtue) correspondingly with its criterion ? Yes; we can show that the acquisition of virtuous character is conducive to ‘ happiness ‘ ??? although we must admit that ” there is no absolute coincidence between virtue and happiness.’ ‘

In the first part of his work, dealing with ‘ moral statics,’ Professor Alexander arrives at results similar to those reached by Mr Leslie Stephen. “Conduct and character are the same thing facing different ways.” Biology has brought this truth to the front, and, with it, the conception (of course not a new one) of character and conduct as relative to society ??? ‘ social organism,’ or ‘ social tissue. ‘ In respect of the individual, the goodness of an act depends upon its occupying a definite position in an equi- . . . libriated order of action. The good character in

exaa er. pgi^yon to which any act is judged good or bad is “an order or systematic arrangement of volitions ” ??? an equilibrium of functions, and of structure. ” The conception of a man’s char- acter is represented under the name of an ideal ??? a plan of conduct or way of life upon which he acts.” “The good man’s life is the good or moral ideal.” In respect of society, a good act is one “by which the agent seeks to perform the function required of him by his position in society. ” ‘ Efficiency ‘ is what is required by the moral judgment of every act. ” Conduct is good, not because it leads to some further result, such as pleasure, or because it is determined by some inexplicable idea of good, but in virtue of the equilibrium it establishes between the various parts of conduct itself.” “Good conduct (defined as a system or order), as it is the complete statement of the object of morality, is the complete form of the criterion or standard.” There is no need to refer to the abstract standard of ‘ perfection ‘ or of ‘ pleasure ‘ ; good conduct is ‘ perfect ‘ ; and ‘ pleasure ‘ is part of the standard ??? for “without the pleasure the standard would be something divorced from our experience.” The individual’s good, then, “is ipso facto an element of the general welfare, and it is a common good because it binds him with others in the moral system.” The common good is a medium of communication like language. Egoism and altru- ism are equally fundamental and original. Having dealt, as above, with ‘ moral statics,’ Professor Alexander goes on to discuss ‘ moral dynamics,’ of which there are two main problems: (1) to show how the moral equilibrium is produced and maintained, and (2) to examine the meaning and law of moral progress. Dealing with the first problem, he explains that the moral ideal, as a system or order, is ” a species under which the various ideals as they exist in the minds of good men , are the dlHerent individuals ‘ ‘ ; and that “the course of morality

represents the struggle between moral ideals, and the phenomena of the maintenance and growth of morality offer parallels to the history of natural forms." Pro- fessor Alexander claims great importance for this theory. It is a question, he thinks, " whether as much light may not be reflected on the natural problem by the ethical, as the reverse." Dealing

with the problem of 'progress,' he explains that "the good is always ultimate, but, owing to the development of human nature, it is always in motion"; and that, therefore, there can be no contrast of a 'good' and a 'best,' but only of a 'good' an'd a ' better ' ??? that adaptation, wherever, and so far as, it exists, is perfect adaptation. This amounts to saying that " goodness means progi'ess," for "in changing from one form to another morality changes from what is right under one set of conditions to what is right under another set, and such change from good to good is what we mean by becoming better." The law of moral progress is stated as the 'law of comprehension' ??? i.e., the tendency of evolution is towards one dominant ideal, such as that of Christian civilization.

What strikes one most on looking back over the last quarter of the 19th century is that evolutionary ethics in England becomes more and more Darwinian. To Mr Spencer is due the credit of having Evolution- given vogue to the evolutionary point of view ; ^rhicizedl but he has never shown himself, we venture to think, sufficiently alive to the importance of the dis- tinctively Darwinian ideas of ' struggle for existence ' and ' natural selection.' To the younger members of the school these ideas are all-important. The writings of Darwin himself and of the biologists who, on all sides, raise crop from the seed he gave them, have taught these younger moralists better to realize the meaning of ' cqiTe- spondence of organism with environment' ??? indeed, to appreciate the complexity and delicacy of biological adaptation in a way which, once for all, gives a new aspect to the moral life. Some little variation which the complexity of the phenomena puts it beyond the power of science to explain, except as involved Swa/net in an original germ, occurs and makes all the difference in the ' struggle for existence ' ; for not only does it enable the organism manifesting it to adjust itself to a pressing need in its present environment, but creates a new environment with fresh needs to be met,

and so on indefinitely. The com- plexity and mobility of the relations between organism and environment, as understood by Darwinism, are such as to preclude entirely the idea of ‘ final correspondence.’ Deeply impressed, then, with this, the younger moralists referred to decline to follow Mr Spencer in his doctrine of ‘ Absolute Ethics,’ and ‘ perfect conduct.’ ^ Ethics is only ‘relative’; moral conduct, like all other conduct, is always realized in ‘ struggle.’ ‘Aet irovct to ^ ov. This is the greatest lesson which Ethics, in our day, has taken home to itself from biology. Of course, ‘ moral struggle ‘ has been recognized since the dawn of Ethics, but never before has the necessity of it been clearly seen. Again, the endless complexity of the relations between organism and environment, which makes perpetual struggle inevit- able, also prescribes the method of that struggle as a little- by-little movement of adjustment to new circumstances as they arise. A ‘ leap in the dark,’ or ‘ shot ‘ aimed at the ideal as some far-off future condition, is out of the question. The balance of the innumerable forces involved is so precarious that any intervention other than slight would overturn it. Those who have learnt the lesson which the new biology teaches are content to think of a succession of ‘ ideals ‘ which are always being realized

1 That Mr Spencer himself has come to realize more fully than he once did the complexity of the ‘ relations which evolutionary theory obliges us to take account of, is shown by a noteworthy statement made in the Preface to vol. ii. of Principles of Ethics (1893) : “The Doctrine of Evolution has not furnished guidance to the extent I had hoped. . . . Some such result might have been foreseen. Right regulation of the actions of so complex a being as Man, living under conditions so complex as those presented by a society, evidently forms a subject-matter unlikely to admit of definite conclusions throughout its entire range.” That Moral Science does not admit of t6 aKpiph is indeed as true now as it was in Aristotle’s day, and more evidently true. Whether recent attempts to introduce iKpil3o\o-yla fia$riiMTi.Kifj into Biology (see K. Pearson, The Grammar of Science, chaps, x. and xi.) are likely to give results of appreciable value for Moral Science remains to be seen. S. IV. 39

and perfectly realized ??? and tlien superseded ??? a succession of short yiews of betterment to be effected on customary lines, eacb one of these views being naturally suggested by the situation which the realization of its immediate prede- cessor has created.

It is because they favour the theory of one distant ideal (the aiming at which shall make the great difference between man and brute) that the English opponents of evolutionary ethics are not satisfied with the reasonable positive ‘ teleology ‘ of the Darwinian moralists (identical with Aristotle’s method in biology and ethics, which always has some definite organic whole before it in rela^ tion to which the parts are explained), and accuse them of ‘ explaining the higher by the lower.’ This hackneyed phrase entirely misrepresents the method of the Darwin- ian moralists. They ‘ explain the higher by the lower ‘ in explaining the lower by the higher. They know well, as biologists, that the parts or stages (the lower) cannot be understood in abstraction from the whole or result (the higher), any more than the whole or result can be understood in abstraction from the parts or stages. The fault which their critics have to find with them is really that they confine themselves to this sober Aristotelian or Darwinian teleology ??? ^that they take an achieved organic result, open to our observation (in this case ‘Human ITature ‘), as a many-in-one to be positively set forth in the way of descriptive or genetic account, and do not allow themselves to interpret facts in the light of some theory of what ought to he. Thus it is objected that the ‘ historical method ‘ cannot decide between various ethical ends and determine which ought to be followed ??? that an ethical theory from the standpoint of science is impossible ??? that it is the ‘ ideal ‘ that explains the evolution, not vice versd ??? that the Darwinian moralist does not tell us why we desire that society should be in equilibrium with itself ??? that it is necessary to show (which ‘natural his- tory ‘ cannot do) that equilibrium is a good ??? conduces to the realization of the absolute good towards which, as terminus ad quern, ‘ the stream of development is leading.’ The Darwinian moralist denies that such an objective is before us. It is always man’s Type, as developed ‘ up to date,’ that expresses itself in the successive ideals of slight betterment by which the moral life is

maintained and transformed. This current Type must not be pushed forward into the unknown future, and set up there as an Absolute towards which ‘ the stream of development is leading.’ The contention that this ” Absolute ” is ever present in my self-consciousness cannot be allowed to mean more than that, as a matter of fact, I am a being capable of knowledge and action in the world in which I find myself. From this truism no criterion of what ethical ends ought to be followed can be derived ; for that we must go to the experience supplied by the ‘ natural his- tory ‘ which traces the actual development of my knowledge and action. Moreover, the idealist’s admission that there is a history of the process by which the animal organism has become the ‘ vehicle ‘ of consciousness con- cedes all that the Darwinian moralist contends for. What the idealist contends for, after this admission, is that consciousness itself ‘ has no histdry.’ This is ex- plained Ho mean that “Existence, as a whole, contained within itself prior to its manifestation as consciousness, all that so manifested itself . . . What is posterior in time is prior in nature : the first is last, and the last first.” ‘ Teleology ‘ here falls back on an original SvVa/xi?, which it rehabilitates as ivepytui: arguing that, inasmuch as consciousness has. actually manifested itself, the universe must always have contained the possibility of it ??? that is, the actuality of it. Here it is instructive to observe

1 Watson, An Outline of Philosophy, p. 182.

that ‘ mechanism,’ in our day, seems inclined to take up with a similar employment of logical terms. Professor Weismann {Romanes Lecture, 1894) seems to argue that variations (some of which ‘ catch on ‘ in the struggle for existence) are all actually provided for in the microcosm of the original germ-plasm, since that microcosm contains the possibility of all that manifests itself afterwards in the secular history of the species.

The polemic of the idealist against the evolutionist appears to us, then, to leave the position of the latter un- affected. The evolutionist never professed to do more than trace the process by which the animal nature has become ‘organic’ to knowledge and morality, and to supply reasons why, man’s Type having a certain known constitution and history, certain actions ouxjht to be pre- ferred to others, if (as must be assumed) that

Type is to be maintained. There is nothing beyond the competence of the evolutionary moralist in the determination of this ought, for the question is always about some immediate step to which he can see his way in the light of past ex- perience. What the distant steps ought to be he cannot foresee ; nor, indeed, does the idealist profess to tell him. The idealist merely supplies a ‘ protreptic’ He appeals to us in the language of ‘ prophecy,’ and thereby helps to make more vivid and effectual in us that yXvKiia cXttiV which is the very principle of life itself ––– the belief that ‘ life is worth living,’ in the strength of which man struggles on and on, always seeking after a fuller and fuller ‘ com- prehension of conditions ‘ ––– a wider and wider ‘ correspond- ence with environment,’ finding himself, after every successful act of adjustment to a given environment, confronted by a new environment, which does not appal him, but, as being of his own making, interests him and calls forth renewed efforts.

As evolutionary ethics in England becomes more and more Darwinian, greater prominence is given to the idea of ‘ social organism.’ Mr Spencer’s use of the idea ––– inter- esting as it undoubtedly is ––– is marred by his individual- ism and laisser faire theory of the functions of the State, inherited from the ultilitarian politicians ; but the younger evolutionist moralists, coming more directly under the influence of Darwin, use the idea in a ^^ way which promises results of great scientific o^M/sm. and practical value. Some of them too, like some of their idealist rivals, owe much, in this connexion, to the political ethics of Plato and Aristotle, who still fortunately hold an important place in English philosophical study ––– perhaps a more important place than in the philosophical study of any foreign nation. When we say that our evolutionist moralists make great and increasing use of the idea of social organism, it must not be understood that they are constantly finding more and more points of close analogy between the body and the ‘body politic’; on the contrary, it would seem that the more they know of each ‘ organism,’ the less inclined they are to press into detail the analogy between them. What they do rather is to look at the social system in the light of the general concep- tions of heredity, variability, struggle for existence, natural selection, and, above all, with a deep sense of the endless complexity and mobility of the relations involved. The result of

this way of looking at society is that several truths of the first importance are brought home to us. It is made clear that moral and political reform is a slow process, and never can be 'radical' ??? that the general disturbance produced even by a little change may be a good reason for avoiding the latter, if possible ; but, that since it is impossible to do so always, the most valuable quality a man or nation can have (always together with

2 Plato, Rep. 331 A.

love of routine) is fortitude, wherewith to face the dangerous situations which may be produced by the most trifling constitutional interferences with the status quo; that, in any case, however, the imexpected is likely to happen ??? some quite inexplicable 'variation' will occur ??? a great man, for example, coinciding with his oppor- tunity, will appear and alter the course of history ; and, most important thing of all, it is made clear that ' War ' can never cease, for, since development means the con- tinuous differentiation of species, there will always be com- peting national types of life. Moralists who confine their view to morals strictly so called ??? whose Ethics is merely a Particular Theory of Conduct ??? are apt to lose sight of this, and to figure ' progress ' as towards a cosmopolitan life of ' industrial prosperity ' and civilized manners, under a Pax CEcumenica. Within each nation, as such, the art of political ' horticulture ' may keep in abeyance the fierce physical struggle for existence characteristic of the ' cosmic process,' or ' state of nature ' ; but its place is taken by another struggle, as fierce ??? the ethical struggle be- tween persons and parties representing ' ideals ' of social life; while between different nations the struggle is always bound to be largely physical. It is easy to mis- read Huxley when he says (Romanes Lecture, 1893) : " Let us understand, once for all, that the ethical progress of society depends not on imitating the cosmic process, still less in. running away from it, but in combating it." The best commentary on the above is in his own words (Col- lected Essays, vol. ix. p. 11 ??? Prolegomena

to Romanes Lecture) : " Man, physical, intellectual, and moral, is as much a part of nature, as purely a product of the cosmic process, as the humblest weed."

Idealism in England received a great stimulus from the posthumous publication of Green's Prolegomena to Ethics, and Works (with E. L. Nettleship's Memoir), and from the comment which these

Idealistic Ethics.

books called forth.

Green's ethical doctrine is, briefly, that in the consciousness of a moral ideal ❓❓❓ 'the ideal of a best' ❓❓❓ and the determination of

human conduct thereby, a principle 'which is not Oreen. natural ' is involved. We are prepared for this result

by a metaphysic of knowledge, the gist of which is con- tained in the following sentences. "The knowledge of nature is not itself a part or product of nature in the sense in which it is said to be an object of knowledge." " It is only because we are consciously objects to ourselves, that we can conceive the world as an object to a single mind, and thus as a connected whole. It is the irreducibility of this self-objectifying consciousness to any- thing else, the impossibility of accounting for it as an effect, that compels us to regard it as the presence in us of the mind for which the world exists." "The concrete whole which may be described indifferently as an eternal intelHgenoe realized in the related facts of the world, or as a system of related facts rendered possible by such an intelligence, partially and gradually repro- duces itself in us, communicating piece-meal, but in inseparable correlation, understanding and the facts understood, experience and the experienced world." "In the growth of our experience an animal organism, which has its history in time, gradually becomes the vehicle of an eternally complete consciousness." From the metaphysic of knowledge Green passes to the meta- physic of morality. " The transition from mere want to conscious- ness of wanted object, from impulse to satisfy the want to effort for the realization- of the wanted objects, implies the presence of the want to a

subject which distinguishes itself from it." Thus the want becomes a motive. Man Is a ' free cause ' in conduct, as in knowledge, because he is a ' reproduction ' of the eternal self- conscious subject of the world, " carrying with it under all its limitations and qualifications the characteristic of being an object to itself." But how are we to distinguish between virtuous and vicious action ? In either case the motive is the achievement of what the self-conscious subject presents to himself as his greatest good. Green's answer is that the true good is an end in which the effort of a moral agent "can really find rest" ___ "the Ideal of a Best." The distinction between the good and the bad man is that the former is 'conscientious,' wills what is in accordance with the system constituted by the eternal consciousness repro- duced in him ; while the latter is he whose "will does not answer

to his reason," who habitually ___ knowing that he should not ___ acquiesces in ' self-satisfaction ' inconsistent with man's betterment ___his progressive i/wiaa-is t<^ eeip in 'the Rational Life.' The ultimate standard of worth is an ideal of personal worth. The spiritual progress of mankind is " o/ personal character to personal character." As to man's future, the best conclusion we can draw is that "the end of human development is not one in which persons are extinguished." Meanwhile it is in society that, as a matter of fact, the human person realizes himself ___ his goodness appearing under the categories given in the Greek classification of the ' virtues.' The ' unconditional good ' to which the ' good will ' is directed ___ the 'ideal of humanity,' 'the perfection of man' (in principle identical with God), is thus a Common Good. This ideal of ' human perfection ' is more definite, Green contends, than the ' pleasant life ' of the utilitarians.

We take Green as standing for the whole idealist school, with a few exceptions to be mentioned afterwards. He set his mark on English idealism ; and its repre- sentatives are distinguished by a remarkable i___odera unanimity of opinion, the chief difference be- 'critici^. tween them being, perhaps, with regard to the Theistic inference, in which the interest of the bulk of the school seems always to become stronger.

1. As regards the constructive part of the system, one asks why the primacy of self-consciousness is dwelt upon with such insistence. It seems unnecessary to say that without knower there can be no knowledge, without agent no action ??? that knowledge and action are relative to the nature and needs of the being that knows and acts. At any rate, this is just what the new biology teaches us ??? that organism and environment must not be abstracted from each other ??? that organism moulds environment no less than it is moulded by it. It is rather for the sake of the theistic inference that self-consciousness is made so prominent. The inference is (a) the fact that I know the world at all, involves the perfect knowability or rationality of the world ; and (h) its perfect knowability involves an Eternal Knower, of whom I am an imperfect 'reproduc- tion. ' I know the world imperfectly, therefore there is One who knows it perfectly. If I were not conscious of knowing imperfectly, it would be unnecessary to represent me as ' reproduction ' of a Perfect Knower. My imper- fection must be sustained by a Perfect ??? an actual Perfect, not an ideal. Holding as we do that the ethical system to which this argument belongs is best regarded as ' pro- phetic ' or ' protreptic,' we are not concerned to examine the logic of the argument ; if it were fair (which it is not) to bring it to logical test, we should say that it neglects Kant's distinction of the Determinant and the Eeflective Judgment, and concludes ' I cannot explain the world without the supposition of a God ; therefore He exists,' We should also agree with Professor A. Seth (Hegelianism and Personality) and Mr Balfour (Mind, Oct. 1893) when they describe the God of this epistemological Theism as & focus imaginarius ??? a 'bare principle of unity,' without personality ??? or perhaps we should prefer to say that He has a personality which is inconsistent with human per- sonality, putting Green's position thus : ??? On the one hand there is a ' personal ' God, and on the other there is an indefinite number of human spirits, ' reproductions ' of Him, the ideal of each one of which is to become indis- tinguishable from Him. This seems to us not to differ from the pantheistic ideal of the absorption of finite spirits in the Infinite Spirit. Such an ideal has never satisfied the ' religious consciousness ' ??? at least, in the West ??? which demands ' personal relations ' between man and God or gods, and ' personal immortality.' We ven- ture to think that wherever the ground for an effectual Theism is to be sought, it is not in epistemology.

1 Bradley {App. and Reality, pp. 44S ff.) sets forth the difficulties under which theistic theory Uibouis.

ETHICS

2. As regards the critical attitude taken up by the English idealists towards other ethical systems, we have already said enough about their attitude towards evolu- tionary ethics; but a few additional remarks on their criticism of English utilitarianism may be offered here. The English utilitarians from Hobbes to J. S. Mill are condemned for neglecting to recognize, in moral action, the agency of the self-conscious principle which presents to itself objects of desire ??? converts wants into motives, and is accordingly self-determined or free. Thus, speak- ing of Hobbes and Locke, Green says {Hume, Treat, vol. ii. p. 22) : " Each started from the position that the ulti- mate motive to any action can only be the imagination of one's own pleasure or pain, and neither properly left room for the determination of desire by a conceived object, as distinct from remembered pleasure " ; and again he says (op. cit. p. 11) that iitilitarianism " excludes any test of pleasure but pleasure itself." We venture to think that the charge of ' hedonism ' ??? whether ' ethical ' or ' psychological ' ??? brought against the English utilita- rians is not reasonable. The English utilitarians were men of affairs in close touch with the actualities of Eng- lish life. The national history is a testimony to the extraordinary influence which the conception of the ' Public Good ' as ' Life of virtuous action sufficiently furnished with external good things ' has had in England. The national character may be defined as ' Tendency to make organized social work, not ease and pleasure of separate individuals, the end.' It therefore seems to us to be paradoxical to say that English utilitarian moralists ??? men of affairs, in whose writings the national ^6os is reflected with remarkable clearness ??? are ' hedonists ' and ' individualists.' Indeed, one has only to reflect how largely the growth of the English Constitution and the progress of English legislation have been affected by the writings of those chiefly accused of 'hedonism' ??? Hobbes, Locke, and Bentham ??? to see how groundless the accusa- tion really is. 'Hedonists' and 'individualists,' as de- scribed by the critics, could not have contributed anything effective towards the development of such embodiments of the ' Public Good.' Laisser faire, as it appears in Bentham's system, does not justify the charge of 'individualism.' It was forced upon Bentham and his associates by the political circumstances of which their utilitarianism took

such careful account. Let us remem- ber always that their utilitarianism was the theory which inspired the reforms of which 1832 is the central date. In order to break up the oligarchical regime, it was neces- sary to insist on the claim of obscure individuals to be left alone, under equal laws and a system of popular representation, to look after their own interests. The time had not yet come to think of organizing the life of these emancipated individuals on lines to be suggested by their own communis sensus. That ‘ individualism ‘ is inseparable from utilitarianism it is quite incorrect to maintain. Benevolence, not self-interest, is its motto. The doctrine that society is an ‘ organism ‘ (as we now say), of which the individual is conscious in ‘ Benevo- lence,’ or ‘ Good Will ‘ (see Introd. to Princ. of Mor. and Leg. ch. x., Princ. of Pen. Code, part iv. ch. xvi.), is essential to Bentham’s system. It may, indeed, rank beside the doctrine of his critics that ‘ the end is realiza- tion as member of the community ‘ (Bradley, Eth. Stud. p. 157). Bentham’s social ideal is not that of a loose collection of individuals to be separately pleased, but of a body of fellow-workers to be organized under a system of equal laws ??? a prosperous industrial community the members of which are animated by the spirit of self-help and mutual help. The ‘ General Happiness ‘ is not an ‘abstraction’ (Green, Hume, Tr. vol. ii. p. 7), but the most concrete ‘ object ‘ which man, as rational being, sets

before himself ??? a certain condition of social life, like the Greek eiSaifi-ovia. In bringing the formal charge of ‘hedonism’ the critics seem to us to put too much into the language used by moralists who were writing for the large public, not for schoolmen. In the first place, it ought to be recognized that the utilitarians speak of pleasures in the plural, rather than of Pleasure ; and, in the second place, that by ‘pleasures’ Bentham means things which men, constituted as they are, like ??? desire, and make their ends or objects of pursuit, it being often possible to measure the desirability of an object ??? described as ‘ mass or portion of happiness ‘ ??? very accu- rately in terms of wealth (see Principles of the Civil Code, part i. ch. vi.). Among objects desired, the welfare of fellow-workmen, and the success of the common work, must be included. Bentham’s view of the legislator’s aim does not differ from that of Plato and Aristotle, who are not commonly accused of ‘ hedonism,’ namely, that it

is to get people xitpctv re koI XvireLO-dai ols Set, the oh Set

being determined by the test of to Koivrj va-ti roLavra ??? pursuits which take their place in the harmonious rhythm of the public life are distinguished from those which jar. It is incorrect, then, to say that ‘ utilitarianism excludes any test of pleasure but pleasure itself ‘ ; and J. S. Mill is fully entitled, as a utilitarian, to recognize a qualitative difference between pleasures, and bring pleasure to a test which is not pleasure, namely, to the judgment of the connoisseur ??? the man who has been educated to corre- spond as accurately as may be with the best social con- ditions. His judgment is not based on mere ‘ feeling,’ but on ‘ consciousness of adaptation.’ It does not prefer certain ‘ feelings,’ but certain ‘ objects ‘ of pursuit suitable to human life as understood and valued by the good man. Of course, no system of morals can get out of the circle ??? ‘ Those are good things which the good man likes.’

The charge, then, of ‘ ethical hedonism ‘ ??? of holding that pleasure ought to be our end ??? is disposed of, we think, by a broad view of what utilitarianism is as a phase of the national life. But, it is said, utilitarianism is tainted by ‘ psychological hedonism,’ defined by the critics as the theory that ‘ the ultimate motive of every action can only be the imagination of one’s own pleasure or pain.’ The utilitarians, it is admitted, are good men, and have done good, but they do not see how inconsistent their theory is with their practice. ” The heart is in the right place, but the brain is wanting.” It seems to us that what is stigmatized as ‘ psychological hedonism ‘ is really nothing more than the Aristotelian theory of voluntary action. According to this theory (adopted without quali- fication by Hobbes and Locke), voluntary actions are those which proceed from, or are caused immediately by, a principle within the man. Just as a man can only see with his own eyes, or walk with his own legs, so he can only act from his own likes and dislikes. But this does not mean that his motives are always ‘ selfish,’ or that even when they are he is seeking the abstraction ‘Pleasure,’ and not ‘ the pleasant thing.’ We think, then, that the charge of ‘psychological hedonism’ is founded on a mis- take, and that the charge of ‘ ethical hedonism ‘ is mis- placed as laid to the account of the English utilitarians. It is indeed to the English utilitarians, along with Plato and Aristotle, that the idealists are chiefly

indebted for their conception of ‘ self-realization in society.’ By this conception Green balances what, unbalanced, would be a more thoroughgoing individualism or ‘ solipsism ‘ than that with which Bentliam is charged. As we have said, the true objection of the idealists to utilitarianism is that it is a merely secular system. It must not be forgotten, however, that Green’s writings, while they derive their

interest from their religious character, have given a con- siderable impetus to utilitarianism ❓❓❓ no longer that of laisser faire, but of social endeavour.

Besides the idealists who belong to the group of which Green is the central figure, there are others, more or less in sympathy with them, who stand somewhat apart ; of whom we may mention the following ; ❓❓❓ The late Dr Mar- tineau, whose Types of Ethical Theory has done much to popularize the idealist point of view ; Professor Campbell Fraser, whose long sympathetic study of Berkeley, as man and philosopher, has helped him to the doctrine, which he sets forth in his Oifford Lectures (Philosophy of Theism), and elsewhere, that Faith underlies Knowledge; the late Professor Wallace, whose luminous Lectures and Essays on Natural Theology and Ethics, ❓❓❓ notably the Essay on Hedonism, ❓❓❓ neglecting the commonplaces of current controversy, reach conclusions which idealist and utilitarian might well agree to accept ; and Professor Andrew Seth (A. S. Pringle-Pattison), whose criticism {Hegelianism and Personality) of Green’s Theism has been alluded to. Mr Bradley’s ethical position, so far as one may judge from Appearance and Reality, also seems to differ from Green’s.

While English Ethics has thus been chiefly represented, during the last twenty-five years, by idealists and evolu- tionists, ❓❓❓ by moralists whose main interest is religious and scientific respectively, political interest (interest in the Public Good as served by legislation, and by

education of the private citizen), ??? the animating principle of utilitarianism, has shown dis- tinct signs of revival. We have already mentioned Sidg- wick's Methods of Ethics as a landmark in the history of English utilitarianism. The utilitarian revival has since been marked by the appearance of two important works. Progressive Morality by Dr Fowler, and The Principles of Morals by the late J. M. Wilson and Dr Fowler ??? the latter having had by far the larger share in the work. These books are notable for the skill with which the moral experience of the individual is probed and analysed, always with the view of suggesting lines on which char- acter may be educated for the duties of life. The world ch^,nges, and a re-examination of the ' moral sentiments ' haS' to be undertaken periodically in the history of com- munities. The time for such re-examination has come, and the work begun afresh by Sidgwick and Dr Fowler is likely to occupy more and more the attention of moral- ists as distinguished from anthropologists and religious teachers. We must add here, to prevent possible misun- derstanding, that Green incidentally makes some valuable contributions to a practical psychology of the 'moral sentiments ' in his discussion of the Greek and Chris- tian ' virtues.' It may be further added that economists, in taking, as they now do, greater account of moral and political considerations, are contributing to the revised 'utilitarianism' of the day. The vogue which the eco- nomic term 'value' has lately obtained in Ethics is chiefly interesting as showing that professed moralists are now feeling themselves in sOme sort of touch with economists. Of course, the idea of ' value ' is no nov- elty in Ethics ; and we do not think that the elaboration lately given to it has added anything to what was, though somewhat differently expressed, already familiar to all students. The reader, however, can form his own judgment on this point after perusing such a work as Meinong's Psychologisclirethische Untersuchungen zur Werththeorie.

We have confined ourselves entirely to English Ethics ; and will only say, in conclusion, that foreign influences have not been noticeable during the last twenty-five years. English utilitarianism rests on its own bottom ; evolution- ary ethics is the outcome of the work of Darwin and Mr

Spencer, and of such anthropologists as Professor Tylor; and idealism, though Kant and Hegel stimulated it at first, has, since Green set his mark on it, become prac- tically independent of outside influence ??? indeed, appears now as a product peculiar to ourselves. It does not seem to have influenced foreign thought except in America. On the other hand, the influence of Darwin and Mr Spencer, as well as of the English anthropologists, has been felt throughout the world.

In addition to the works referred to in the article, a few others, published since 1878, may be mentioned as bearing directly or indirectly on the subject of Ethics : ??? W. Wundt. Ethik, 1886 (Eng. trans, by Titohener, Gulliver, and Washburn, 1897). ??? F. Paulsen. Ethik, 1889, 1893 (Eng. trans, by Thilly, 1899). ??? H. HoFFDiNG. Psychologie, 1882, 1892 (Eng. trans, by Lowndes, 1892). ??? G. SiMMEi.. Einleitung in die Moralwissenschaft, 1892, 1893. ??? A. EouiLf;E. Le mouvement idealiste et la reaction contre la science positive, 1896 ; La Libert^ etledeterminisme, 3rd ed., 1890 ; ^'enseignement au point de vue national{Eng. trans, by Greenstreet, 1892).- ??? J. M. GuTAu. La morale Anglaise contemporaine (morale de Vutilite et de revolution), 1879 ; Education et heredite, 1889 (Eng. trans, by Greenstreet, with introduction by Stout, 1891) ; Esquisse d'une morale sans obligation ni sanction, 1885 (Eng. trans, by Kapteyn, 1898). ??? Leslie Stephen. The English Utilitarians, 1900. ??? W. James. Principles of Psychology, 1891 ; The Will to Believe, 1897. ??? J. Maetineau. A Study of Religion, 1887. ??? A.J. Balfouk. Tlie Foundations of Belief, 189i>. ??? E. Caied. Gifford Lectures {The Evolution of Beligion), 1893. ??? J. Wabd. Gifford Lectures (Naturalism and Agnosticism), 1899. ??? J. Royce. Gifford Lectures (The World and the Individual), 1900. ??? T. B. Steong. Bampton Lectures (Christian Ethics), 1896. ??? H. Sidgwick. The "Philosophy of T. H. Green," Mind, Jan. 1901. ??? In Ueberweg's Gesch. der Phil, part iii. vol. ii, (Nach-Kantische Systeme u. Phil, der Gegenwart), edited by M. Heinze (1897), exhaustive listsof books and review articles up to date will be found. (j. a. St.)

Etna, a borough of Allegheny county, Pa., U.S.A.,

on the Allegheny river, opposite Pittsburg, and on the Pennsylvania and the Pittsburg and Western railways. Population (1890), 3767 ; (1900), 5384.

Eton, a parish and town in the Wycombe parlia- mentary division of Buckinghamshire, England, on the Thames opposite Windsor. The town is under an Urban District Council, the public offices connected with which were erected in 1891. Area of town, 147 acres. Popu- lation, exclusive of Eton College (1901), 3293. Area of parish, 783 acres. Population, 2956. Two new boarding- houses have been erected by the governing body of Eton College, and the portion of land between Slough and Eton, known as Agar's Plough, has been converted into playing fields. The teaching staff has been greatly increased, and new laboratories have been built for the teaching of science. The average number of pupils at the college in 1900 was 1027.

Eugenie, Empress. ??? Marie -Eugenie ~~Ignace~~ Augustine, daughter of Don Cipriano Guzman y Porto Carrero, Count of Teba, subsequently Count of Monti jo, and Grandee of Spain, was born at (jrenada on 5th May 1826. Her mother was a daughter of William Kirk- patrick. United States Consul at Malaga, a Scotsman by birth and an 'American by nationality. Her childhood was spent in Madrid, but after 1834 she lived with her mother and sister chiefly in Paris, where she was educated, like so many French girls of good family, in the Convent of the Sacre Coeur. When Louis Napoleon became President of the Republic she appeared frequently with her mother at the balls given by the Prince President at the Elysee, and it was here that she made the acquaintance of her future husband. In November 1852 mother and daughter were invited to Fontainebleau, and in the picturesque hunting parties the beautiful young Spaniard, who showed herself an expert horsewoman, was greatly admired by all present, and by the host in particular. Three weeks later,

on 2nd December, the Empire was formally proclaimed, and during a series of fgtes at Compiegne, which lasted eleven days (19th to 30th

December) the Emperor became more and more fascinated. On New Year's Eye, at a ball at the Tuileries, MdlledeMontijo, who had necessarily excited much jealousy and hostility in the female world, had reason to complain that she had been insulted by the wife of an official personage. On hearing of it the Emperor said to her, " Je vous vengerai " ; and within three days he made a formal proposal of marriage. In a speech from the Throne on 22nd January he formally announced his engagement, and justified what some people considered a mesalliance. " I have preferred," he said, " a woman whom I love and respect to a woman unknown to me, with whom an alliance would have had advantages mixed with sacrifices." Of her whom he had chosen he ventured to make a prediction : " Endowed with all the qualities of the soul, she will be the ornament of the throne, and in the day of danger she will become one of its courageous supports." The marriage was celebrated with great pomp at Notre Dame on 30th January 1853, and on 16th March 1866 the Empress gave birth to a son, who received the title of Prince Imperial. The Emperor's prediction regarding her was not belied by events. By her beauty, elegance, and charm of manner she con- tributed largely to the brilliancy of the Imperial regime, and when the end came, she was, as the official Enqu&te made by her enemies proved, one of the very few who showed calmness an3 courage in face of the rising tide of revolution. The Empress acted three times as Eegent during the absence of the Emperor, ??? in 1859, 1865, and 1870, ??? and she was generally consulted on important questions, but the materials, for estimating her political influence are not yet available. What can be said with tolerable certainty is that when the Emperor vacillated between two lines of policy, she generally urged on him the bolder course, that she deprecated everything tending to diminish the temporal power of the Papacy, and that she disapproved of the Emperor's liberal policy at the close of his reign. On the collapse of the Empire she fled to England, and settled with the Emperor and her son at Chislehurst. After the Emperor's death she removed to Earnborough, where she^ built a mausoleum to his memory. In 1879 her son was killed in the Zulu War, and in the following year she visited the spot and brought back the body, to be interred beside that of his father at Earnborough. Here, and in a villa she built at Cap Martin on the Riviera, she continued to live in retirement, following closely the course of events, but abstaining from all interference in French politics.

Euphrates (Greek, Ev<^paT9/s, from the Old

Persian, Ufrdtu; Babylonian, Purat, from the Sumerian, Pura, ” the water ” ; Hebrew, PratJi ; Arab, Frdt or Furdf), the largest and most notable river of Western Asia. It may be divided into the upper, middle, and lower Euphrates, each division being distinguished by special physical features. The Upper Euphrates consists of two arms, which, rising on the Armenian plateau, and flowing west in long shallow valleys parallel to Mount Taurus, eventually unite and force their way southwards through that range to the lower level of Mesopotamia. The northern and shorter arm, ErEit or Kara Su (Armenian, Ephrdt or Yephrdt; Arab, Nahr el-Furdt), so well known as the Euphrates in the West, from its having been the boundary of the Roman Empire, is regarded by Orientals as the main stream. It rises in the Domlu Dagh, north- north-east of Erzeriim, in a large circular pool (altitude, 8625 ft.), which is venerated by Armenians and Moslems, and flows south-west^to the plain of Erzeriim (5760 ft.).

Thence it continues through a narrow valley west-south- west to Erzingan (3900 ft.), receiving on its way the Ovajik Su (right), the Tuzla Su (left), and the Merjan and Chanduklu (right). Below Erzingan, the Erat flows south- west through a rocky gorge to Kemakh {Kamacha; Ar- menian, Gamukh), where it is crossed by abridge and re- ceives theKumur Su (right). At Avshin it enters a canon, with walls over 1000 ft. high, which extends to the bridge at Pingan, and lower down itis joined from the west by the Chalta Irmak (Lycus; Arab, Lvkiya), on which stands Divrik (Tephrike). Then, entering a deep gorge, with lofty rock-walls and magnificent scenery, it runs south-east to its junction with the Murad Su. The Frit, separated by the easy pass of Deve-boyiin from the valley of the Araxes, marks the natural line of communication between Northern Persia and the West, ??? a route followed by the nomad Turks, Mongols, and Tatars on their way to the rich lands of Asia Minor. It is a rapid river of consid- erable volume, and below Erzingan is navigable, down stream, for rafts. The southern and longer arm, Murad Su (Arsanias Fl. ; Armenian, Aradzani; Arab, Nahr Arsands), rises south-west of Diadin, in the northern flank of the Ala Dagh (11,500 ft.), and flows west to the Alash- gerd plain. Here it is joined by the Sharian Su

from the west, and the two valleys form a great trough through which the caravan road from Erzerum to Persia runs. The united stream breaks through the mountains to the south, and, receiving on its way the Patnotz Su (left) and the Khinis Su (right), flows south-west, west, and south, through the rich plain of Bulanik, to the plain of Mush. Here it is joined by the Kara Su (Teleboas), which, rising near Lake Van, runs past Miish and waters the plain. The river now runs west-south-west through a deep rocky gorge, in which it receives the Gunig Su (right), to Palu (cuneiform inscriptions) ; and continues through more open country to its junction with the Erat Su. About 10 miles east-north- east of Kharpiit the Murad is joined by its principal tribu- tary, the Peri Su, which drains the wild mountain district, Dersim, that lies in the loop between the two arms. The Murad Su is of greater volume than the Frat, but its valley below Miish is contracted and followed by no great road. Below the junction of the two arms the Euphrates flows south-west past the lead mines of Keban Maden, where it is 120 yards wide, and is crossed by a ferry (altitude, 2426 ft.), on the Sivas-Kharpiit road. It then runs west, south, and east round the rock-mass of Musher Dagh, and receives (right) the Kuru Chai, down which the Sivas-Malatia road runs, and the Tokhma Su, from Gurun (Gauraina) and Derendeh. At the ferry on the Malatia-Kharpiit road (cuneiform inscription) it flows eastwards in a vallay about a quarter of a mile wide, but soon afterwards enters a re- markable gorge, and forces its way through Mount Taurus in a succession of rapids and cataracts. After running south-east through the grandest scenery, and closely ap- proaching the source of the western Tigris, it turns south-west, and leaves the mountains a few miles above Samsit (Samosata, altitude 1600 ft.). At Samosata, the capital of the Seleucid Kings of Commagene, the Persian Royal Road, from Sardis to Susa, probably crossed the river. The general direction of the great gorges of the Euphrates, Pyramus, and Sarus seems to indicate that their formation was pri- marily due to the same terrestrial movements that produced the Jordan- Araba depression to the south. The length of the Frit is about 275 miles ; of the Murad, 415 miles ; and of the Euphrates from the junction to Samsat, 115 miles. In the middle division, which extends from Samsat to Hit, the Euphrates runs through an open, treeless, and sparsely peopled country, in a valley a few miles wide, which it has eroded in the rocky surface. The valley bed is more or less covered with alluvial soil,

and cultivated in places by artiiicial irrigation. Its rocky sides, which some-

times closely approach the river, as at Helebi-Jelebi, are composed of gypsum, sandstone, and conglomerates ; and beyond them, on both banks, is the steppe-like desert, covered in spring with verdure. The right bank, or esh- Sh^m, is occupied by the 'Anazeh Arabs, and the left, or el-Jezire, by the graat Shammar tribe. Below SamsSit the river runs south-west to Rum Kaleh {Anneman, Hrhomgla), and then south past Khalfat (ferry) to Birejik, where it is only 110 miles from the Mediterranean. From Birejik (Apamea-Zeugma, altitude 1170 ft.), where the high road from east to west crossed it, the river runs sluggishly south- wards, over a sandy or pebbly bed, past Jerabliis {Europus, Carchemisli), and the confluence of the Sajiir (right), to Meskine, the highest point reached by steamers. At old Meskine, now some distance from the river, was Barbalissus (Arab, Balis), once the port of Syria on the Euphrates. Eight miles below Meskine, near Kalat Dibse, was Thap- sacus (Tiphsah of 1 Kings iv. 24), the most important pas- sage of the Middle Euphrates, and here the river turns east. Lower down is Eakka (Nicephorium), at the junction of the Belikh (Bilechas), which flows south through the Biblical Aram Naharaim from Urfa (Edessa) and Harran (Carrhae). The direction is now south-east between banks green with willow and tamarisk, and before reaching Deir ez-Zor the river meets the first groves of date palms, lemons, and oranges, and encloses several islands. Below Deir the bed is rocky, and the river is joined near Kirkisieh (Cireisium; Assyrian, SirTci) by the Khabiir (Ohaboras), which rises in the Karaja Dagh, and with its tributary the Jaghjagh (Mygdonius; Arab, Hirmds) flows south through the land of Gozan. In early Arab times a canal or river, eth-Thar- thar, is said to have run from the Hirmds, through Jebel Sinjar^ and past el-Hadhr (Hatrae), to the Tigris atTekrit. Below the Khabtir the river has no affluents. From Werdi to Ana (Anatho) it runs east over a rocky bed, passing Deir el-Kaim (Gordian's Tomb (?) and the Perso-Roman bound- ary) ; and then south-east to Hit. Between Ana and

Hit it is thickly studded with islands, on which are the ruins of several castles. The Middle Euphrates was important as a boundary in early times. It separated Assyria from the Khita or Hittites ; was the limit of the Jewish king- dom in its widest extent; divided the eastern from the western satrapies of Persia (Ezra iv. 17 ; Neh. ii. 7) ; and was at several periods the boundary of the Roman Empire. ‘ Until the advent of the nomads from Central Asia, there were many flourishing cities on its banks ; but the river- ain population is now sparse, and the only towns are Sam- sat, Birejik, Deir, Ana, and Hit. From Sams^t to Hit the river is about 720 miles.

Hit (Is or IM), noted for its bitumen springs, stands at the head of the alluvial deposit, and marks the commence- ment of the Lower Euphrates. Thence the river flows south- east and south-south-east, to its junction with the Tigris at Korna, through an unbroken plain with no natural hill, and, except at el-Haswa, above Hillah, with no trace of rock. In the latitude of Baghdad the Euphrates and Tigris closely approach each other, and then, widening out, enclose the plain of Babylonia (Arab, Sawdd). In early times great irrigating canals distributed the waters over the plain, and made it one of the richest countries of the East. The river then formed, as it does now, large salt marshes (Paludes Chaldaici; Arab, el-Batiha), before meeting the Tigris in the tidal estuary, Shatt el-Arab, which, in the time of the Khalif ate, reached the open sea about 20 miles above the present shore-line. The distance from Hit to the Persian Gulf is about 550 miles. The ancient system of canalization described by Sir Henry Rawlinson in the 9th edition of this work (viii. 670) was inherited, from the Persians, by the Arabs, who long maintained it in working order (Ibn Serapion, translated by Guy le Strange in Journal Royal Asiatic Society, 1896, 1897). Its remote origin may

be inferred from the excavations at Abu Habba, Tello, Niffer, &c., which have shown that those sites were occu- pied by towns 5000-4000 b.c. The astonishing fertility, and consequent prosperity, of the country watered by the Euphrates, its tributaries, and its canals is noticed by ancient writers. Its decline dates from the appearance of the Turkish nomads in the 11th century; its ruin was completed by the Shammar Arabs in the 17th century. If the ancient system of irrigation were restored, suffi- cient

grain could be grown to alter the conditions of the wheat supply of the world.

The length of the Euphrates from its source near Diadin to the sea is about 1800 miles, and its fall during the last 1200 miles is about 10 inches per mile. The river begins to rise in the end of March, and attains its greatest height between the 21st and 28th May. It is lowest in November, and rocks, shallows, and the remains of old dams then render it unnavigable. During high water small steamers ascend to Meskine, but most of the naviga- tion is by native rafts (Keleh). Boats, built in Syrian ports, were placed on the Euphrates by Sennacherib and Alexander ; and the river was formerly a frequented route followed by merchants on their way from the Mediterra- nean to Babylon {Herodotus i. 186). In its present state it is unsuitable for continuous steam navigation, but the advantageous geographical position of its valley has origin- ated schemes for connecting the Mediterranean and the Persian Gulf by railway as an alternative means of com- munication with India. All these schemes have fallen through, hitherto, on the money question, or on the vm will- ingness of the Turkish Government to sanction any line that was not connected directly with Constantinople. In 1872 and 1882 a line from Suedia, near the mouth of the Orontes, by Aleppo, to Meskine, and thence by the Euph- rates to Basra, found favour with Committees of the House of Commons. Other schemes were for aline from Tripolis, on the Syrian coast, across the desert to Tekrit ontheTigris, and thence to Baghdad and Basra ; from Alexandretta, by Aleppo, to Meskine ; and an extension of the Mersina- Tarsus-Adana railway to Aintab and Birejik. In 1898 Count Kapnist, a Russian subject, applied for a conces- sion to construct a line from Tripolis to Hit, and thence along the Euphrates valley to Basra, and Koweit on the Persian Gulf, with branches to Baghdad and Kerbela. In the same year the scheme of a British syndicate to extend the- Anatolian railway from Konia, by Adana, Aleppo (with a branch to Alexandretta), and the valley of the Euphrates, to Hit, and thence by Baghdad and Basra to the Persian Gulf between Fao and Koweit, failed through the opposition of theAnatolian Railway Company, which is in German hands. This company has under con- sideration an extension of its Anatolian lines to Baghdad and Basra, either from Angora, by Kaisarieh, Diarbekr,

and Mosul, or from Konia by Marash, Aleppo, and Hit, but the preliminary surveys had not been completed iu 1901.

Chesnet. Euphrates Expedition. ◆◆◆ Ainswoeth. Personal Nar- rative of the Euphrates Expedition. ◆◆◆ Latakd. Nineveh and Baby- lon. ◆◆◆ LoFTUs. Chaldcea and Susiana. ◆◆◆ Rawlinson. Herodotus i. essay ix. ◆◆◆ Bltjnt. Bedouin Tribes of the Euphrates. ◆◆◆ Peters. Nippur, 1897. ◆◆◆ Sachati. Am Euphrat und Tigris, 1900. ◆◆◆ von Oppenheim. Fom Mittelmeer zum Persischen Golf, 1900. ◆◆◆ Mdkeat. Handbook to Asia Minor, &c., section iii. ◆◆◆ Guy le Steange. Bagdad under the Abbasid Caliphate, 1901.

(c. w. w.)

Eure, a department in Northern France, watered by the Seine and the Eure.

Area, 2331 square miles. The population had dropped to 358,829 in 1886, and in 1901 counted only 331,181. Births in 1899, 6598, of which 697 illegitimate ; deaths, 8108 ; man-iages, 2477. The schools in 1896 numbered 855, with 42,000 pupils, and the illiterate formed 7 per cent, of the population. Evreux, the capital, has 17,000 inhabitants. The area under cultivation

in 1896 amounted to 1,383,840 acres, 872,313 acres of which were plough-land. The wheat crop of 1899 returned a value of ◆◆1,231,000 ; mangold-wurzel, ◆◆140,000 ; the grass lands, including the natural pastures, ◆◆780,000 ; cider-apples, ◆◆245,000. Of live- stock, Eure had, in 1899, 48,060 horses, 6450 asses, 133,250 cattle, 286,880 sheep, and 42,820 pigs. Though without either coal or iron, the industry in metals produced in 1898 nearly ◆◆45,000 in value. Louviers manufactures cloth of esteemed quality ; Evreux and Gisors, yarn and cotton stuffs.

Eure-et-Loir, a department in Northern France, watered by the Eure.

Area, 2293 square miles. The population has decreased from 283,719 in 1886 to 274,862 in 1901. Births in 1899, 5742, of which 444 illegitimate ; deaths, 6311 ; marriages, 2100. There were in 1896 731 primary schools, with 40,000 pupils ; 2 per cent, of the population is illiterate. Out of 1,388,782 acres of culti- vated land in 1896, 1,146,609 acres were arable, 69,190 acres were natural pastures, and 49,420 acres were woods and forests. The wheat crop of 1899 amounted to the value of ––1,903,000 ; rye, ––80,000; barley, ––227,000; oats, ––1,170,000; mangold-wurzel, ––153,000 ; the natural pastures and grass lands, ––650,000 ; beetroot, ––275,000. The live-stock of 1899 included 44,330 horses ; 102,990 cattle, 577,260 sheep, and 28,180 pigs. Agriculture is the only forward industry in this department, which forms one of the

granaries of the basin of the Seine. The production of alcohol in 1898 exceeded 70,000 gallons. Chartres, the capital, counts 23,000 inhabitants.

Eureka, capital of Humboldt county, California, U.S.A., on the south shore of Humboldt Bay, and con- nected with San Francisco and Portland by steamship lines. Its site is level and the plan of its streets regular. It is in the celebrated coast redwood belt, and is the principal point for the manufacture and shipment of redwood lumber. Several short lumber railways run from this city and from Areata, across the bay, into the forests, and bring lumber to the mills, most of which are in or near Eureka. The operations, both of lumbering and of milling the timber, are carried on here on a scale nowhere else to be seen. Population (1880), 2639;

(1900), 7327.

Eureka Springs, capital of Carroll county, Arkansas, U.S.A., in the Ozark Hills, at an altitude of 1800 feet. It is chiefly noted for its medicinal springs, which attract a large summer population. Population

(1880), 3984; (1900), 3572.

EUROPE,

I. Geography and Statistics.

On the subject of the boundaries of Europe there is still divergence of opinion. While some authorities take the line of the Caucasus as the boundary in the ariesf' south-east, others take the line of the Manich de- pression, between the upper end of the Sea of Azov and the Caspian Sea, nearly parallel to the Caucasus. Various limits are assigned to the continent on the east. Officially the crest of the Caucasus and that of the Urals are regarded in Kussia as the boundaries between Europe and Asia on the south-east and east respectively,^ although in neither case does the boundary correspond with the great administrative divisions, and in the Urals it is impossible to mark out any continuous crest. Eeclus, without attempting to assign any precise position to the boundary-line between the two continents, makes it run through the relatively low and partly depressed area north of the Caucasus and east of the Urals. The Manich depression, marking the lowest line of this area to the north of the Caucasus, has been taken as the boundary of Europe on the south-east by Wagner in his edition of G-uthe's Lehrbuch der Geographie,' and the same limit is adopted in Kirchhoff's Ldnderkunde des Erdteils Europa ' and Stanford's Compendium of Geography and Travel. In favour of this limit much weight ought, we think, to be given to the consideration put forward by Wagner, that from time immemorial the valleys on both sides of the Caucasus have formed a refuge for Asiatic peoples, espe- cially when it is borne in mind that this contention is reinforced by the circumstance that the steppes to the north of the Caucasus must interpose a belt of almost unpeopled territory between the more condensed popu- lations belonging undoubtedly to Asia and Europe respectively.

Continuity of population would be an argu- ment in favour of assigning the whole of the Urals to Europe, JDut here the absence of any break in such con- tinuity on the east side makes it more dif&cult to fix any boundary-line outside of that system. Hence on this side it is perhaps reasonable to attach greater importance to

1 At the summit of each ol the Trans-Ural railways (Perm-Tyumen and Ufa-Chelyabinsk) and that of the road across the Caucasus from Vladikavkaz to Tiflis, sign-posts, with the name Europe on one side, Asia on the other, mark this boundary.

2 Fifth edition, vol. ii. pp. 24-25. ►► Pt. i. pp. 11-12.

Extent.

the fact that the Urals form a boundary not only orographically, but to some extent also in respect of climate and vegetation, and hence to take a line following the crest of the different sections of that system as the eastern limit between the two continents.* Obviously, however, any eventual agreement among geographers on this head must be more or less arbitrary and conventional, and provisionally it is advisable to give the area of the continent within different limits.*

The following calculations in English square miles (round numbers) of the area of Europe, within different limits, are given in Behm and Wagner's Bevol- kerung derErde, No. viii. (Gotha, Justus Perthes, 1891), p. 53 : ►►►

Europe, within the narrowest physical limits (to the crest of the Urals and the Manich depression, and including the Sea of Azov, but excluding the Caspian Steppe, Iceland, Novaya Zemlya, Spitsbergen, and Bear Island), 3,570,000 square miles. The same, with the addition of the Caspian Steppe up to the Ural Eiver and the Caspian Sea, 3,687,750 square miles. The same, with the addition of the area between the Manich depression and the Caucasus, 3,790,500 square miles. The same, with the addition of territories east of the Ural Mountains, the portion of the Caspian Steppe east of the Ural Eiver as far as the Emba, and the southern slopes of the

Caucasus, 3,988,500 square miles. The same, with Iceland, Novaya Zemlya, Spitsbergen, and Bear Island, 4,093,000 square miles.

In all these calculations the Marmora Islands, Canary Islands, Madeira, and even the Azores, are left out of account.

The estimate of the length of the coast-line in the 9th edition of the Ency. Brit., 19,820 miles (Eeuschle, 1869),

- *Griesbach, on the strength of Middendorff's observations, remarks that, in addition to European fruit trees, oak, maples, elms, ashes, and the black alder do not cross the Urals, while the lime tree is reduced to the size of a shrub (,La V6g(tation du Globe, translated by Tchihatchef, i. p. 181).*

6 On the history of the boundary between Asia and Europe, see F. G. Halm in the Mitteilungen des Vereinsfilr Erdkiinde zu Leipzig, 1881, pp. 83-104. Hiihn, on the grounil that true mountain systems must be regarded as forming geographical units, pronounces against the practice of making " natural boundaries " run alons; mountam crests, and assigns the whole of the Caucasus region to Europe as all belonging to such a system, but orographically quite different from the Armenian plateau (p. 103). But surely it is no less different from the European plain.

Coast' line.

Relief.

is one that does not take into account minor indentar tions. Eeclus' estimate, including the more important indentations, brings the coast-line up to 26,700 miles, and that of Strelbitsky up to 47,790 miles (smaller islands not included), or 1 mile of coast for about 75 square miles of area.

It may be pointed out, however, that the commercial value of this relation is diminished not merely by the absence in many parts of natural harbours, but in many other parts by the absence of natural facilities for communica- tion between such harbours and a productive interior ❑❑❑ in other words, by the absence of a hinterland.

Several new estimates have been made of the mean elevation of the continent. The following list gives the results of all the estimates that have hitherto been made : ❑❑❑ Humboldt, 675 ft. ; Leipoldt,^ 975 ft. ; De Lapparent,2 960 ft. ; Murray ,3 939 ft. ; Supan, 960 ft. ; V. Tillo,* 1040 ft. ; Heiderich," 1230 ft. ; Penck,^ 1085 ft. The exceptionally high estimate of Heiderich is due to the fact that by him Transcaucasia and the islands of Novaya Zemlya, Spitsbergen, and Iceland are reckoned as included in Europe.*

Since the publication of the ninth edition an estimate has been made by Strelbitsky of thd length and of the area of the basins of all the principal rivers of Europe. In the following table all the estimates given without any special authority are based on Strel- bitsky's figures, but it should be mentioned that the estimates of length made by him evidently do not take into account minor windings, and are therefore generally less than those given by others. The authorities are separately cited for the originals of all other figures given in the table.

Rivers.

Length in English Miles.

Area of Basin in Square Miles.

Strelbitsky.

Other Authorities.

strelbitsky.

Volga

Danube .

Ural

Dnieper (Dnyepr)

Kama

Don (Russia) .

Pechora .

Rhine .

Oka

Dniester (Dnyestr)

Elbe

Vistula .

Vyatka .

Tagus

Theiss (Tisza)

Loire

Save

Meuse .

Mezen .

Donets .

Douro .

Duna (W. Dvina)

Ebro

Rhone .

Desna .

Niemen (Nyeman)

Drave

Bug (Southern)

Seine

1977* 1644 1446 1064

984

980

915

709

706

646

612

596

596

566

550

543

535

530

496

487

486

470

470

447

438

437

434

428

425

2107t

1477t 1328t 1115t 1123t 1024t

9141

835t

646t 680t

eon

613t

576t

590t 537t

477t

563,300 315,436 96,350 203,460 202,615 166,126 127,226 63,265 93,205 29,675 65,340 73,905 50,555

31,865t

69,350 46,756 37,595 12,740 30,410 37,890 36,705 32,975

38,580t

38,180 33,635 34,965 15,746 26,226 30,030

1 Die mittlere Hohe Europas. Plauen, 1874.

2 TraiU de Giologie, Paris, 1883. ?? Scot. Qeog. Mag., 1888, p. 23. 1 Petermanns Mitteilungen, 1889, p. 17.

6 Trans. (Izvestiya) Imp. Rus. Oeog. Soc, 1889, p. 113. 8 Die mj,ttleren Erhehungsverhdltnisse der Erdoberfldche, pt. i., in Penck's GeographischeAbhandlungen, vol. v., Vienna, 1891. f Morphologie der Erdoberfldche, vol. i.

Length In English Miles.

Area of Basin in Square Miles.

Name of Elver.

^

Strelbitsky.

other Authorities.

Strelbitsky.

Oder ....

424

17,150

Kuban .

405

509t

21,490

Khoper .

387

563t

23,120

Maros

390

16,975

Pripet .

378

404t

46,805

Guadalquivir .

374

21,580t

Pruth (Pruta)

368

603t

10,330

Northern Dvina

358

447t

141,075

Weser-Werra .

355

19,928

Po .

354

28,920t

Garonne-Gironde

342

32,745

Vetluga .

328

464t

14,.325

Pinega .

328

407t

17,425

Glommen

326

***352 ?? ***

15,930

Bug (Western)

318

450t

22,460

Guadiana

316

25,300t

Aluta (Alt, OltG)

308

9,095

Mosel

300

10,950

Main

300

10,600

Maritsa .

272

20,790

Jucar

270

7,620t

Mologa .

268

338t

16,005

Tomea .

268

...

13,045

Inn .

268

...

9,825

Sa6ne

268

...

8,295

Moldau .

255

267 ? ?

10,860

Moksha .

249

371t

19,090

Ljusna-elf

243

7,700

Mur

242

5,200

Morava, Servian

235

15,715

Klar-elf .

224

...

4,520

Voronezh

218

305t

7,760

Berezina.

218

285t

9,295

Saale

215

...

8,970

Onega .

212

246t

22,910

VagCWaag) .

212

6,246

Dema

209

275t

4,830

San.

203

444t

6,135

Moskva .

189

305t

5,910

Western Manich

176

296t

37,820

Klyezma

159

394t

15,200

- *The equivalent of the figures given in Superfide de VEurope. A later measurement by Strelbitsky yielded a result equal to 2215 English miles.*

t General v. Tillo, in Transactions (Izvestiya) Imp. Bus. Geog. Soc. vol. xix. (1883), pp. 160-161.

} Dr Al. Blndau in Petermanns Mitteilungen, 1898, pp. 185-187, has given new calculations of the areas of the basins of certain European rivers, namely, the Tagus, 31,250 sq. m. ; Ebro, 32,810 sq. m. ; Guadal-quivir, 21,620 sq. m. ; Po, 28,800 sq. m. ; Guadiana, 25,810 sq. m. ; and Jucar, 8245 sq. m.

**

The observations on the temperature of European rivers have been collected and discussed by Dr Adolf E. Forster. He finds that the dominant factor in determin- ing that temperature is the temperature of the air above, but that rivers are divisible into four groups with respect to*

the relation between these temperatures at diiferent seasons of the year, groups are rivers flowing from glaciers, in which the temperature is warmer than the air in winter, colder in summer; rivers flowing from lakes, characterized by peculiarly high winter temperatures, in consequence of which the mean temperature for the year is always above that of the air ; rivers flowing from springs, which, at least near their source, are more rapidly cooled by low than warmed by high air temperatures ; and rivers of the plains, which have a higher mean temperature than the air in all months of the year.

River tempera- tures.

These

8 Penck's Geographiscke Abhandlungen, vol. v. pt. iv., Vienna, 1894; noticed in Geog'. Journ. vol. vi. p. 264.

S. IV.

3M

EUROPE

[geogkapht

Great attention has recently been given to limnology. Por many European lakes, especially the smaller ones, Lakes. estimates have been made of the mean depth and the volume. A list of all the European lakes for which the altitude, extent, and greatest depth could be ascertained, compiled by Dr K. Peucker, is published in the Geog. Zeitschrift, 1896, pp. 606-16, where estimates of the mean depth and the volume are also given where procurable. The following table, comprising only the larger lakes, is mainly based on this list, where the original authorities are mentioned. The figures entered in the following table not taken from this list are after Strelbitsky or the Qiog. Universelle of V. de St Martin :

Name of Lake and

Height above Sea.

Area.

Greatest

Mean

Volume. Millions

Country.

Depth.

Depth.

of Cubic Feet.

Feet.

Sq. miles.

Feet.

Feet.

Ladoga, Eussia .

15

7004

780

Onega, ???

115

8765

About 1200

...

Wener, Sweden .

146

2409

280

Chudskoye or Pelpus,

Eussia

100

1857*

90

Wetter, Sweden

290

758

415

Saima, Eussia

255

680*

185

Pajane

255

608*

Enare, ___

490

549

Segozero, ,,

481

140

Byeloye Ozero, Eussia

ioo

4S4

85

PieUs, Eussia .

805

422

:.:.

...

Topozero, ___

411

...

...

Ulea,

875

880

‘60

Xlmen, ???

lOT

868

...

Vigozero, ???

882

...

Imandra, ,,

829

Balaton, Hungary

850

266

‘is

Geneva, France and

Switzerland

1220

225

1015

500

3,140,000

Kovdozero, Eussia

225

Star Sjo, Sweden

290-305

216

Constance, Germany

and Switzerland

1295

208

825

295

1,711,000

Hjelmar, Sweden

Lulea- Vattnen, Sweden

178

Neagh, Ireland .

“is

158

118

Kubinskoye, Eussia .

[152

...

Mjosen, Norway

395

152

1485

Garda, Italy and

Austria

215

143

1185

445

1,757,000

Tornea, Sweden .

1140

189

...

Nensiedler-see, Hun-

gary ….

8T0

137

13

Scutari, Turkey .

20

About 130

83

“m

45’,900

Siljan, Eussia (.

128

Virzjarvl, „,

115

107

‘24

...

Seliger, ???

825

100

105

Stor Afvan, Sweden .

1870

92

925

Yalpukh, Eussia .

89

Neuchatel, Switzerland

li'is

85

600

210

560,000

Tikitkakarvi, Eussia .

680

85

80

Maggiore, Italy and

Switzerland

645

82

1220

575

1,316,000

Oorrib, Ireland

80

71

152

Como, Italy .

655

66

1360

- *Including L. Pskov as well as the connecting arm known as Teploye.*

Of engineering works carried out on European lakes since the publication of the article on Europe in the ninth edition, the most important are those for the drain- ing of Lake Copais in Boeotia, completed in 1893, by means of which nearly 100 square miles have been added to the cultivable area of Greece ; those by which Lake Eucino or Celano, in the Abruzzi, was completely drained in 1876, about 60 square miles having thus been reclaimed since the beginning of the operations in

1854; and those by which Lake Trasimeno, in Umbria, was reduced in size, and an area of about 8 square miles of land (includ- ing malarial swamp) reclaimed in 1898.

The most important event in connexion with the geology of Europe as a whole in recent years has been the commencement of the publication of The eo ogy. International Oeological Map of Europe on the scale of 1 : 1,500,000. It is to be completed in forty- nine sheets, of which eighteen had in October 1901 been published.

In the way of geological research and theoretical inves-

tigation an immense amount of detailed work has of course been done in every part of the continent, but the most extensive work has been in connexion with the Ice Age. It is enough to mention here that the chief ques- tions now under discussion are the number of times that glacial phenomena were repeated in Europe, and the ori- gin of the boulder-clay. While most glacialists appear to consider that there were three periods of ice expansion over parts of Europe, Professor Geikie believes that as many as six periods of glacial expansion and five inter- glacial periods can be distinguished.^ With regard to boulder-clay, while the great majority of glacialists ad- here to the belief that it was formed and transported under land-ice, there are still upholders of the theory that it is of subaqueous origin, and some adherents of the former view admit that in places it must have been finally deposited in a glacial lake.

With regard to the mineral production of Europe, the most notable fact to record is the relatively lower place taken by the United Kingdom in the produc- ,^,^^ tion of the two minerals of the greatest indus- trial importance coal and iron. Here it is enough to state the main results. In the production of coal the United Kingdom is indeed still far ahead of all other European countries, but notwithstanding the fact that the British export of coal has been increasing much more rapidly than the production, it has not been able to keep pace with Germany and Eussia in the rate of increase of production. In 1878 the production of coal in the German Empire was only about 34 per cent of that of the United Kingdom, but in 1900 it had grown to about 49 per cent. This, too, was exclusive of lignite, the pro- duction of which

in Germany is increasing still more rapidly. It was equal to little more than one-fourth of the coal production in 1878, but more than one-third in 1900. The Russian coal production is still small, but it is increasing more rapidly than that of any other Euro- pean country. While in 1878 it was little more than 2 per cent, of that of the United Kingdom, in 1900 the corresponding ratio was slightly above 7 per cent. In the production of iron ores the decline in the position of the United Kingdom is much more marked. The pro- duction reached a maximum in 1882 (18,032,000 tons), and since then it has sunk in one year (1893) as low as 11,200,000 tons, while, on the other hand, there has been a rapid increase in the production of such ores in the German Zollverein (including Luxemburg), Spain, Swe- den, Eussia, and Greece. In the total amount of produc- tion the United Kingdom now takes the second place. While in 1878 the production of iron ores in the German Zollverein was little more than a third of that in the United Kingdom, it has since 1892 regularly exceeded the British production.

The changes that have taken place in the production of the minor minerals may be seen by comparing the following table,^ relating to the year 1898, with the cor- responding table in the ninth edition : ???

Cold.

SUver.

(Quicksilver Ore.

Tin Ore.

Austria

71 kilos.

40,805 kilos.

88,519 m. t.

18 m. t

German Empire

2S-1-

480,riTS

51

Hunparv .

27 IW

18,7!)9

55 ,,

Norway (1897) .

6,872

Portugal

6-8

119-5

102

Spain

81,361

United Kiiigdoui .

895 oz.

211,408 oz.

...

7,498 ???

Kilos. = kilograms. M. t. = metric tons.

1 J. Geikie, The Great Tee Aqe, 3rd ed., London, 18!U.

2 Based on Minex and Quarries: General Report and Statistics for 1898, pt. iv. (Cd. 112), 1900.

AND statistics]

EUROPE

315

Copper

Lead

Zinc

Manganese

Ore.

Ore.

Ore.

Ore.

Austria .

6,791 m. t.

14,862 m. t.

27,895 m. t.

6,182 m. t.

Belgium .

133 ???

11,475 ???

16,440 ???

Bosnia-Herzegovina

4,828 ???

10 ???

5,819 ,,

France

882 ???

28,842 ???

85,550 ???

81,935 ???

German Empire

702,781 ???

151,601 ???

641,706 ???

43,354 ???

Greece .

82,620 ???

14,097 ???

Hungary .

428 ???

4,721 ???

55 ???

. 8,055 ???

Italy

95,128 ???

84,180 ???

182,099 ???

3,002 ???

Norway (1897)

27,606 ???

908 ???

Portugal .

290 ???

8,242 ???

907 ???

Spain

2,978 ???

894,540 ???

99,836 ???

102,228 ???

Sweden .

28,335 ???

6,743 ???

61,627 ???

2,721 ???

United Kingdom .

9,145 ???

88,614 ???

23,930 ???

M. t. = metric tons.

The period since 1878 has been peculiarly rich in im- portant papers on the subject of the climate of the continent. It must suffice to state here com- pendiously the nature of their subjects, and to refer the reader for their titles to the bibliography at the end of this article, where they are enumerated together. It may be added that the maps illustrating the more im- portant of these papers are all either reproduced in the Atlas of Meteorology by Bartholomew and Herbertson (Westminster, 1899), or represented there by new maps based on a wider range of material. The temperature of the continent has been illustrated by Dr Supan in an in- teresting series of maps based on actual observations not reduced to sea- level, and showing the duration in months of the periods within which the mean daily temperature lies within certain ranges (at or below 32?? F.;

50 ́́-68 ́́ F.; above 68 ́́ F.).^ Under this head may be mentioned also Mr Dickson's paper on the sea temperatures round the British Isles,^ inasmuch as it is of wider interest than its immediate subject indicates, throwing new light on the nature of the influence of the. Gulf Stream and the Gulf Stream Drift.

*The map accompanying Konig's paper on the duration of sunshine ' shows on the whole, outside of the Mediter- ranean peninsulas, an increase from north-west to south- east (Orkney Is., 1145 hours =26 per cent, of the total possible; Sulina, 2411 h. = 65 per cent.). In the Mediter- ranean peninsulas the duration is everywhere great ́́́́ greatest, so far as the records go, at Madrid, 2908 h.=66 per cent. Dr P. Elfert's * map illustrating cloud-distribu- tion in Central Europe embraces the region from Den- mark to the basin of the Arno, and from the confluence of the Loire and Allier to the mouths of the Danube.*

The seasonal distribution of rainfall in Europe has been illustrated by Dr Supan in four maps ́́ showing the per- centage of the total rainfall of the year occurring in spring, summer, autumn, and winter respectively.

Since 1893 M. Alf. Angot has been publishing in the Annales du Bureau Central Metior. de France a series of memoirs in which the rainfall observations of Europe for the thirty years 1861-90 are recorded and discussed. The first paper (1893, B, pp. 157-194) deals with the Iberian Peninsula, the second (1895, B, pp. 155-192) with West- ern Europe (from about 43 ́́ to 58 ́́ N. and as far east as about 19 ́́-21 ́́ E.). Both papers are accompanied by maps showing by six tints the mean rainfall for each month as well as for the entire year; and that on Western Europe, by maps extending in the west as far south as Avila, the proportion of the rainfall occurring during the winter, spring, autumn, and summer months respectively.

Mention should here be made also of Bruckner's remark- able treatise on the variations of climate in time. Though

i Petermanns Mitteilungen, 1887, PI. 10 (text, pp. 165-172). 2 Quart. Jour, of the Roy. Meteor. Soc. vol. xxv. No. 112. 8 Nova Acta Leap. Karol. d. Deutschen Akad. d. Naturforscher, vol. Ixvii. No. 3 (Halle, 1896). i

Petermanns Mitteil. 1890, PI. 11 (text, pp. 137-145). ►► Petermanns Mitteil. 1890, PI. 21 (text, pp. 296-297).

it deals with such variations over the entire land-surface of the globe, a large proportion of the data are derived from Europe, for which continent, accordingly, it fur- nishes a great number of particulars with regard to secular variations in temperature, rainfall, the date of the vintage, the frequency of cold winters, the level of rivers and lakes, the duration of the ice-free period of rivers (in this case all Russian), and other matters. Those relating to the date of the vintage are of peculiar interest. They apply to 29 stations in France, South- West Germany, and Switzerland, and for one station (Dijon) go back with few breaks to the year 1391 ; and as the variations of climate of which they give an indication correspond precisely to the indications derived from temperature and rainfall in those periods in which we have corresponding data for these meteorological ele- ments, they may be taken as warranting conclusions with regard to these points even for periods ,for which direct data are wanting. A period of early vintages corresponds to one of comparatively scanty rains and high tempera/- tures. It is accordingly interesting to note that the data referred to indicate, on the whole, for Dijon an earlier vintage for the average of all periods of five years down to 1436 than for the average of the periods of the same length from 1816-80 ; but that the figures generally show no regular retardation from period to period, but more or less regular oscillations, differing in their higher and lower limits in different periods of , long duration. (See particularly pp. 261-267 and the chart at the end of the treatise cited.)

An enormous amount of investigation with regard to this subject has been carried on in recent years. These labours have chiefly consisted in the study of the physical type of different countries or dis- Kaces. tricts, but it is not necessary to consider in detail the results arrived at. It should, however, be pointed out that the idea of an Aryan race may be regarded as defin- itely abandoned. One cannot even speak with assurance of the diffusion of an Aryan civilization. It is at least not certain that the civilization that was spread by the migration of peoples speaking Aryan tongues originated amongst and remained for a time peculiar to such peoples. The utmost that can be said is that the Aryan languages must in

their earliest forms have spread from some geo- graphical centre. That centre, however, is no longer sought for in Asia, but in some part of Europe, so that we can no longer speak of any detachment of Aryan-speaking peoples entering Europe.

The most important works, summarizing the labours of a host of specialists on the races of Europe, are those of Eipley ^ and Deniker." Founding upon a great multitude of data that have been collected with regard to the form of the head, face, and nose, height, and colour of the hair and eyes, most of the leading anthropologists seem to have come to the conclusion that there are three great racial types variously and intricately intermingled in Europe. As described and named by Eipley, these are : (1) the Teutonic, characterized by long head and face and narrow aquiline nose, high stature, very light hair, and blue eyes ; (2) the Alpine, characterized by round head, broad face, variable rather broad heavy nose, medium height and " stocky " frame, light chestnut hair, and hazel grey eyes ; and (3) the Mediterranean, characterized by long head and face, rather broad nose, medium stature and slender build, dark brown or black hair, and dark eyes. The Teutonic race is entirely confined to North-Western Europe, and embraces some groups speaking Celtic languages. It is believed by Eipley to have been differentiated in this con- tinent, and to have originally been one with the other

6 See Bibliography at the end of the article.

[geogbapht

long-headed race, sometimes known as the Iberian, and to the Italians as the Ligurian race, ???which " prevails every- where south of the Pyrenees, along the southern coast of France, and in Southern Italy, including Sicily and Sar- dinia," and which extends beyond the confines of Europe into Africa. The Alpine race is geographically intermedi- ate between these two, having its centre in the Alps, while in Western Europe it is spread most widely over the more elevated regions, and in Eastern

Europe " becomes less pure in proportion as we go east from the Carpathians across the great plains of European Eussia." This last race, which is most persistently characterized by the shape of the head, is regarded by Ripley as an intrusive Asiatic element which once advanced as a wedge amongst the earlier long-headed population as far as Brittany, where it still survives in relative purity, and even into Great Britain, though not Ireland, but afterwards retired and contracted its area before an advance of the long- headed races. Deniker, basing his classification on essen- tially the same data as Ripley and others, while agreeing with them almost entirely with regard to the distribution of the three main traits (cephalic index, colour of hair and eyes, and stature) on which anthropologists rely, yet proceeds further in the subdivision of the races of Europe. He recognizes six principal and four secondary races. The six principal races are the Nordic, answering ap- proximately to the Teutonic of Ripley, the Littoral or Atlanto-Mediterranean, the Ibero-Insular, the Oriental, the Adriatic or Dinaric, and the Occidental or Cevenole.

Popula' Hon.

The following table shows the area of the countries of Europe, with their estimated or enumerated populations at different dates : ???

Area,

Population in Thous. (000 omitted).

Pop.

per

Sq.m.

Countries.

Eng. Sq. miles.

About

1980.

About

1890.

Latest Census or Estimate.

Austria^

Hungary .

241,466

37,884

41,358

43,80011

181

Bosnia-Herze-

govina .

19,735

1,3361

...

1,59112

81

Liechtenstein

61

9^

147

Belgium .

11,373

5,520

6,069

6,‘587i ? ?

597

Denmark”

15,431

1,980

2,185

2,465"

160

France .

207,206

38,343f

38,596"

186

Monaco

8

...

1518

German Empire

208,760

46,234

49,428

56,34516

270

Luxemburg .

1,003

21812

218

Greece .

24,974

2,‘r878

2,43415

97

Italy

110,676

28,4603

...

32,450"

293

San Marino .

23

...

...

9?

391

Montenegro .

3,500

22815

65

Netherlands .

12,741

4,0138

4,‘5118

5,103"

400

Portugal .

34,347"

4,160*

4,660

136

Rumania

50,588

...

^ 5^13"

117

Russia .

1,951,249

89,6851

...

103,671"

63

Finland

144,255

2,1761

...

J,655ii

18

Servia .

18,762

1,9085

” 2,4‘9 ????’

133

Spain” .

191,994

16,4328

17,2628

17,74418

92

Andorra

175

6

29

Sweden .

173,968

4,‘566

4,785

5,“i36i6

30

Norway .

126,053

...

2,001'

2,23116

18

Switzerland .

15,976

2,846

2,98310

3,31418

207

Turl!;ey(Europ.)*

66,840

...

5,892?

90

Bulgaria

37,323

2,0082

***3,1541 ?? ***

3,7331”

100

Crete .

3,328

3029

...

88

Thasos .

152

...

12?

79

United

Kingdom .

121,742

35,026"

37,881”

*41,4551**

341

[illegible] Including Faroe Islands.

[illegible]> Area exclusive of Tagus and Sado Inlets (together 161 sq. miles).

[illegible] Excluding Canary Islands.

1 1885. 2 1881.

6 1877. ‘ 1891.

11 Estimate 1896. 1 Census 1901. I’ Census 1899.*

8 1879.

8 1889.

12 Census 1896. 15 Census 1896. 18 Census 1897.

4 1878.

[illegible] Census 1900. 18 Estimate 1897. 18 Census 1900.

6 1884. 10 1888.

The following table shows that the process of aggregation of the people in large towns referred to in the ninth edition is still going on rapidly :
[illegible]

comm. = commune. Population est. = estimate. in Thous.

w. subs. = with suburbs. (000 omitted).

London (Greater, 1901) . 6581 London (Registration,

1901) 4536

**Paris (w. subs.) . . 2877*

___ (City, 1901) . . 2661 Berlin (w. subs.) . . 2073

*___ (1900) . . . 1884 Vienna (1900) . . . 1662 *St. Petersburg (w. subs.,*

1897) 1267

**Constantinople (w. subs;) 1200 Moscow (w. subs., 1897) . 1036 Glasgow (w. subs., 1901) . 910 Hamburg-Altona (1900) . 867 Liverpool (w. subs., 1901). 767 Manchester- Salford (1901) 766 Warsaw (1897) . . .638 Budapest (1896) . . 618 Birmingham (w. subs., f*

1901) 599

- *Naples (comm., est. 1898) 640 Brussels (w. subs., est.*

1897) 532

**Madrid (1897) . . 612*

*Amsterdam (comm., 1899) 511 *Barcelona (1897) . . 510 *Rome (comm., est. 1898) 500 Munich (1900) . . .500 Marseilles (1901) . . 496 *Milan (comm., est. 1898) 481 Copenhagen (w. subs.,*

1901) 477

*Leipzig (1900) . . .466 *Lyons (w. subs., 1896) . 462 Leeds (w. subs., 1901) . 444 Breslau (1900) . . .423 Odessa (1897) . . .405 Dresden (1900) . . 395*

*Edinburgh-Lelth (1901) . 393 Sheffield (1901) . . 381 Dublin (w. subs., 1901) . 373 Cologne (1900) . . .372 Turin (comm., 1898) ” . 366 Belfast (1901) . . .349 Bristol (1901) . . .329 Newcastle-Gateshead (1901) 326 Rotterdam (comm., 1899) 318 Prague (w. subs., 1900) . 317 Lddz (1897) . . .316 *Lisbon (1890) . . .301 Stockholm (est. 1901) . 301 Elberfeld-Barmen (1901) . 299 *Palermo (comm., 1898) . 291 Bordeaux (w. subs., 1896) 289 Frankfurt a/M (1900) . 288 Riga (w. subs., 1897) . 283*

Bucarest (1899) . . 282 Bradford (1901) . . 280 Antwerp (comm., 1897) . 271 West Ham t (1901) . . 267 Nuremberg (1900) . . 261 Kieve (1897) . . .247 Hull (1901) . . .241 Nottingham (1901) . . 240 Hanover (1900) . . 237 Genoa (comm., est. 1898) 233 Magdeburg (1900) . . 230 Christiania (1900) . 226

Dttsseldorf (1900) . . 214 Florence (comm., est. 1898) 213 Leicester (1901) . . 212 Chemnitz (1900) . . 207 Roubaix – Tourcoing (w.

subs., 1896) . . .205 ??Valencia (1897) . 205

Population = estimate. in Thous.

comm. = commune.

est.

w. subs.= with suburbs. (000 omitted).

Lille (w. subs., 1896) Hague, The (comm., e

1897) .

Portsmouth (1901) . Charlottenburg (1900) Konigsberg (1900) . Trieste (1900) . Plymouth, Devonport

(1901) .

*Stuttgart (1900) Kharkov (1897) Bolton (1901) . Lifege (comm., 1897) . Cardiff (1901) . Bremen (1900) . Dundee (1901) . Ghent (comm., 1897) Rouen (w. subs., 1896) Vilna (1897) . Brighton-Hove (1901) Lemberg (1900) *Venice (comm., est. 1898) Halle a/S. (1900) . Bologna (comm., est*

1898) ...

Messina (comm., est. 1898) Aberdeen (1901) Salonica . Strassburg (1900) . Zurich (comm., 1900) Sunderland (1901) . Seville (1897) . Dortmund (1900) Danzig (1900) . Manheim (1900) Stettin (1896) . Oporto (1890) . Croydon (1901) Graz (1900) Oldham (1901) . Saratov (1897) . Aachen

(1900) . Toulouse (1896) Catania (comm., est. 1898) Kazan (1897) . Nantes (w. subs., 1896) Havre (w. subs., 1896) Blackburn (1901) Brunswick (1900) St Etienne (1896) Malaga (1897) . Gbteborg (est. 1898) Ekaterinoslav (1897) Rostov-on-Don (1897) Essen (1900) . Posen (1900) . Preston (1901) . Astrakhan (1897) Norwich (1901) Birkenhead (1901) Athens (1896) . Tula (1897) Brunn (1900) . Kishinev (1897) Basel (comm., 1900) Kiel (1900) Murcia (1897) . Krefeld (1900) . Reims (1896) . Derby (1901) . Kassel (1900) . Halifax (1901) . Southampton (1901) Leghorn (comm., est. 1898) Utrecht (1899) .

202

196 189 189 188 179

177 176 174 168 167 164 163 161 161 161 160 160 160 157 157

156 164 163 160 160 160 147 146 142 141 140 140 139 139 138 137 137 135 134 132 132 131 129 128 128 127 126 123 121 120 119 117 113 113 112 111 111 111 110 109 109 108 108 107 107 106 106 105 105 105 102

+

- *For explanation see top of next column. t The contiguous parliamentary boroughs of Birmingham and Aston Manor. } Part of Greater London.*

AND statistics]

E U E 0 P E

317

It is estimated that to-day more than 10 per cent, of Europeans live in great cities, i In 1800 only those to which an asterisk is prefixed rose above 100,000. Thirty-four out of the 140 towns enumerated in the list above belong to the British Isles.

The following tables must be allowed to speak for themselves : ???

Land Forces.*

Countries.

Total Strength in Kound Numbers.

Notes.

Peace Footing.

War Footing.

Austria- Hungary .

Belgium

Bulgaria

Denmark .

France

German Empire .

Greece

Italy .

Netherlands

Portugal

Rumania .

Russia

Servia .

Spain .

Sweden

Norway

Switzerland.

Turkey

United Kingdom .

361,700

51,500

Abt. 40,000

9,800

540,000

585,000

26,300

325,0002

27,700

Abt. 40,000

_?_?_? 63,000

900,000*

161,0006

98,000

39,000

18,000

148,000'

232,000'

1,872,000 163,000

“61,600 2,500,0001

Abv. 3,000,0001

82,000

1,305,0003

68,000

149,000

172,000

3,500,000*

363,0001

184,000

500,0001

510,0001 900,000"

670,0008

1 Estimated total available force.

2 Number perma- nently under arms.

8 Exclusive of territorial militia ofnearly2,000,000.

- *Whole empire.*

6 Full mobilized strength of regular army and reserve.

‘Strength of eiiie.

‘ Regu ar forces, home, colonial, and Indian.

8 The same, with the addition of the first-class army reserve, militia, and volunteers.

- *Based on The StaieamoM’a Year-Booi:,19l)0.*

*Naval Strength.^*

Countries.

Battle- Bhlps.

Cruisers.

Coast Defence Vessels.

Torpedo- Boats.i

Torpedo stroyers.

Afl.

Bdg.

Afl.

Bdg.

Afl.

Bdg.

Afl.

Bdg.

17 6

10(?)

4

2

Afl.

18 27 “9

26 100

Bdg.

14 16

io

10

Austria- Hungary .

Bulgaria

Denmark .

France ^

German Empire .

Greece

Italy .

Netherlands

Norway

Sweden ???.

Portugal

Rumania

Russia

Spain .

Turkey

United Kingdom .

5

25

17 6 9

1

“i

19 1

53

3

“2

7

“2 1

“5

8

10

“e

51 16

14

8

“4 1

15

13

6

125

3

“% 4

“i

1

“3 “4

3 ...

18

7

3

6

21

11

“58 5 6*

116

“k

2 12

13

“2

“2

“38 2

“i

83

1

34

196

163

7

201

40

25

45

201

27 16

233

- *Based on The StaUsman^n Year-Booh, 1900.*

1 Including torpedo gunboats.

2 While the United Kingdom had one submarine afloat and four building, and one ram-ship of special construction, France had eleven submarines afloat and twenty-eight building.

8 Old battleships.

- *Armoured or protected.*

1 All turret-ships.

1 A. F. Weber, The Growth of Cities in the Nineteenth Century (1899), p. 451.

*Finance.**

Countries.

Tear.

Revenue.

Expendi- ture.

PubMc Debt.

Thous. ??

Thous, ??

Thous. ??

Austria

Est. 1900

66,076

66,100

135,650

Austria-Hungaryi

??? 1899

13,988

13,071

Belgium

??? 1900

18,090

18,037

104,152

Bosnia-Herzeg. .

_?_?_? 1900

1,736

1,730

Bulgaria

_?_?_? 1899

3,364

3,361

10,400

Denmark .

Finlnnrl

_?_?_? 1900-01

4,045

4,006

11,555

France

_?_?_? 1899

138,019

1.36, i82

1,19‘7,933

German Empire .

„ 1900-01

98,957

102,916

115,112

Greece

„ 1900

4,463

4,409

27,9852

Hungary

___ 1900

43,938

43,863

203,737

Italy .

___ 1899-1900

68,026

68,072

490,838

Luxemburg

,, 1900

491

456

480

Netherlands

*** 1900***

12,060

12,605

96,687

Norway

*** 1899-1900***

4,394

4,394

10,090

Portugal

*** 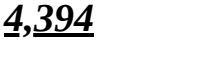 1900-01***

11,634

12,122

128,0008

Rumania

_?_?_ 1900-01

8,904

8,904

51,228

Russia

_?_?_ 1900

186,283

186,283

541,375

Servia

1 ?? 1

3,087

3,028

16,676

Spain

_?_?_ 1899-1900

37,617

37,487

358,133

Sweden

_?_?_? 1900

7,689

7,689

16,890

Switzerland

_?_?_? 1900

4,090

4,120

3,376

Turkey

_?_?_? 1897-98

16,660

16,586

126,833

United Kingdom

_?_?_? 1898-99

108,336

108,150

627,663

4

11 ????

???1901-02

132,265

187,612

705,724

Agricul- tural pro- ducts and live- stock.

Between

- Based mainly on The Statesraari' s Yea/r-Book, 1900.

Common revenue and expenditure.

- Gold debt, in addition to which there is a paper debt of about 174,000,000 drachma!.

??Exclusive of a debt of about ??80,000,000 stated to be " partly In the hands of the Government."

- The actual revenue for 1900-01 was ??180,886,000, and the expenditure ??188,692,000.

Though agricultural statistics are not obtainable for aU European countries, and where obtainable not in every case for the same years, still the analysis of such as can be got brings out some very striking and interesting results. Since 1880 there has been a rise in the area under wheat in Hungary, the German Empire, Austria, and France, that in Hungary being the largest (more than 25 per cent.), whUe in the German Empire it has been about 8 J; in Austria, about 7 per cent.; and in France, slight, 1890 and 1899 there was a rise in the wheat area of

Rumania of about 10 per cent., and in Italy one of 4 per cent, between 1890 and 1896. On the other hand, there has been a great decline in the wheat area in Denmark, Belgium, the Netherlands, and the United Kingdom; that in the United Kingdom nearly reaching to, and in the other countries mentioned exceeding, 30 per cent. The area under rye has been extended in the Netherlands by more than 8 per cent. ; slightly also in Denmark ; while in Austria, Germany, and Hungary it has been practically stationary, and in France it has declined by nearly 20 per cent. Only two countries, Belgium and Ireland, show a decline in the area under potatoes ; that in Ireland amounting to more than 11 per cent. In Great Britain and Sweden the area under this crop has been practically stationary ; while Hungary, France, Austria, Denmark, the German Empire, and the Netherlands have added to the area under this crop by an amount varying from nearly 40 per cent, in Hungary to 8 per cent, in the Netherlands. All European countries for which statistics are available show a deoUne in the flax area, but these countries do not include Russia. In Ireland the decline between 1880 and 1899 amounted to nearly 80 per cent. Under maize, Hungary has increased its area by 25 per cent, since 1880, and Rumania in the same proportion since 1890. The area under the vine has declined in France since 1880 by more than 25, and in Hungary by more than 30 per cent. ; while in Italy there has been an extension of the vineyards since 1890, and in the German Empire their area has remained almost constant. In most European countries for which statistics are available the numbers of the main kinds of live-stock, except sheep, have been stationary or advancing (mostly advancing), but, except in Ireland and Poland, there has been a decline, generally a considerable decline, in the numbers of sheep and lambs. In Belgium, France, Ireland, the Netherlands, and Norway, the number of horses has remained nearly the same since 1880; but in Germany, Russia, Great Britain, Austria, and Sweden there has been an increase in numbers, amounting in Germany to as much as 14 per cent, between 1883

and 1897 (since 1873 more than 20 per cent.)- The number of cattle increased in all countries publishing statistics except Russia and Norway, the increase amounting to as much as 20 per cent, in Denmark (1881 to 1898), 17 per cent, in the German Empire (1885 to 1897), 16 per cent, in Great Britain, and 15 per cent, in Ireland (both from 1880 to 1899), and 14 per cent, in France and Sweden (both from 1880 to 1898). In Russia the decline amounted to 10 per cent, between 1877 and 1888. The increase was in a much higher ratio in the case of swine, Russia in this case being the only country showing a decline (amounting to 15 per cent, between 1877 and 1888). The increase varied from 20 per cent. in Norway (1876 to 1890) to nearly 100 per cent, in the Nether- lands (1880 to 1895). In Belgium it was nearly 80 per cent. (1880 to 1895) ; in the German Empire, 55 per cent., between 1883 and 1897, and over 100 per cent, between 1873 and 1897 ; in Sweden, over 90 per cent. (1880 to 1898) ; in Ireland, over 60 per cent. (1880 to 1899) ; and in Great Britain, above 25 per cent, (same period). The decline in the number of sheep and lambs amounted in the German Empire to over 50 per cent, between 1873 and 1897, over 40 per cent, between 1888 and 1897 ; in Belgium, between 1880 and 1895, it was more than 35 per cent. ; in Denmark and Italy it vcas nearly 20 per cent., in the first case between 1881 and 1893, in the second between 1881 and 1890. In most other countries it varied from 6J to 16 per cent. In Great Britain it was as low as about 3 per cent. (1880 to 1899), and, on the other hand, there was a rise in the number of sheep in Ireland in the same period of nearly 23 per cent. In the United Kingdom, as a whole, the number was nearly the same at both dates. In Poland there was a rise of nearly 37 per cent, between 1890 and 1897.

With regard to commerce, industries, and railways, as a whole, Europe may be said to be characterized by the rapid development of manufacturing at the expense of agricultural in- dustry. With few exceptions the countries of Europe that export agricultural products are able to spare a diminishing proportion of the aggregate of such pro- duce for export. Other countries are becoming more and more dependent on imported agricultural products. Most European countries, even if not able to export a large proportion of manufactured articles, are at least securing a greater and greater command of the home market for such products.^ Inland centres of manufacturing industry are extending the

range of their markets. All these changes have been largely, if not chiefly, pro- moted by the improvements in the means of communication, and the methods of transport by sea and land. Larger ships more economically propelled have brought grain at a cheaper and cheaper rate from all parts of the world, and since the date of the ninth edition improved methods of refrigeration have made fresh meat, butter, and other perishable commodities even from the southern hemisphere articles of rapidly growing importance in European markets. Improvements in shipping have likewise tended to cheapen British coal in many parts of the mainland of Europe. On the other hand, the extension of the railway network of the Continent has brought a wider area within the domain of the manufacturing regions associated with the coal-fields occurring at

Bailways in European Countries.

Commerce, industries, and rail- ways.

Date of

Miles open.

Opening of First Line.

1876.

1880.

1885.

1890.

1895.

1898.

Austria .

Nov. 17, 1837

6,402

7,088

8,270

9,506

10,180

10,8222

Belgium .

May 6, 1836

2,171

2,899

2,740

2,810

2,889

2,867

Bosnla-Herzeg

842

471

646

Bulgaria .

835 ??

Denmark

June 26, 1847

689

976

1,195

1,217

1,871

1,568

France

Aug. 1, 1828

13,529

16,276

20,177

20,666

22,505

23,824

German Em-

pire

Dec. 7, 1886 Dec. 27, 1825

17,376

22,640

26,411

27,392

80,0982

Great Britain .

14,510

20,698

16,594

17,281

18,001

18,488

Greece

1869

7

15,568

278

462

?

691

Hungary .

Sep. 15, 1846

8,992

7

6,606

6,984

8,651

10,137

Ireland .

2,148

4,421

2,675

2,792

8,178

8,176

Italy

Oct. 4, 1886

4,771

2,370

6,408

7,983

9,679

9,881*

Luxemburg .

110

5,840

270

276

Netherlands .

Sep. 20, 1889

1,006

1,496

1,663

1,869

1,722

Norway

Sep. 1, 1864 Oct. 30, 1856

345

1,148

970

970

1,071

1,218

Portugal .

648

662

949

1,816

1,886

1,464

Nov. 1, 1869

766

710

1,100

1,690

1,617

1,896

Russia ►►.

April 4, 1838

12,166

869

16,934

18,069

21,948

29,856

Servia

Sop. 15, 1884

14,026

166

885

835

584

Spain

Oct. 28, 1848

8,801

6,547

6,211

7,488

8,020

Sweden .

March 5, 1866

2,171

4,560

4,279

4,980

6,063

6,860

Switzerland .

June 16, 1844

1,257

3,664

1,796

2,014

2,238

2,816

Turkey

1,696 727

667

657

936

1,240

1 Probably the most complete synopsis of the evidence on this point Is to be found in Prince Kropotkin's Melds, Factories, and Workshops. London, 1899.

*2 1897. s 1899. * 1896. " Excluding Finland.*

intervals in central Europe from the upper Oder to the basin of the Ruhr, as well as some of the more detached coal-fields of Russia. Among the more important railways that have been opened since the date of the ninth edition (mentioned roughly in the order from west to east in the trunk of Europe, and those in the peninsulas separately) are the line connecting Besangon with the watch- making region of the Swiss Jura ; one from Zweibrlicken by the valley of- the Mosel to the Rhine, thus bringing the great iron- mining district on the borders of Luxemburg and Alsace-Lorraine into the most direct connexion with that river and its valley ; three important trans-Alpine lines, ??? that through the St. Gothard tunnel (opened in 1882), that connecting Venice with Vienna by way of Udine, Pontebba, and Klagenfurt, and that through the Arlberg tunnel (opened in 1884) connecting Zlirich and the Rhine valley above the Lake of Constance with the valley of the Inn : lines connecting Breslau directly with Bohemia ; the lines connect- ing Constantinople (since August 1888) and Salonica with Belgrade,

Telegraphic Communication in Europe.

1880.

1897 or 1898.

Lines. Miles.

Wires. Miles.

Lines. Miles.

Wires. MUes.

Stations.

ThouB. Tele- grams.

Austria (1898) . Belgium (1898) Bosnia-Herzegovina Bulgaria . Denmark (1898) France (1898) . German Empire (1898) Greece .... Hungary (1898) Italy (1897) Luxemburg (1898) Netherlands (1898) . Norway (1898) . Portugal (1897) Eumania (1898) Russia

Servia (1898) . Spain (1897) . Sweden (end 1897) . Switzerland (1898) United Kingdom

21,770

8,461

...

2;i94

41,079 43,984

9^047

16,217

2;873 4,668 2,713

58,m

10^018

6,147 4,071

56,953 16,148

6[818

122,100 158,888

82;433 53,240

8^582

8,486 6,762

183^815

25;692

12,628

9,947

82,368

8,960

1,580

2,269

3,0291

62,952

76,418

560

18,675

25,715

694

8,6712

8,665

4,584

4,290

2^526

19,672

8,594

4,485

48,803

96,680

46,944

4,880

6,728

8,7381

218,684

278,411

6,090

66,689

99,821

1,162

18,0172

19,793

9,475

10,920

S^fMl

45,224

26,026

18,092

309,629

5,172 1,058

“1711

“218 3,026 6,028 151 5872 546 425 539

“140 1,428

2ib89

10,816

14,168

10,505

422

1,843

2,106 44,515 42,127

1,020 13,584

9,705

4,9582 4,172 2,337 2,587

“996 5,160 2,870 3,820 87,044

^ state. There were also 258 railway and private telegraphic offices. 3 State telegraph only. There are several private lines.

Elementary Education in Europe^

Scholars.

Scholars to

Tear.

Schools.

Kound Numbers.

every 1000 Inhabitants.

Austria

1897

19,565

3,424,000

136

Belgium

1897

8,513

840,000

127

Bulgaria

1898

4,686

349,000

105

Denmark

(?)

2,940

308,000

115

Finland

1897

1,475

88,000

France .

1897-8

83,915

5,635,000

34

Great Britain

1898

23,0042

6,296,0002

177

Greece .

1892

2,745

139,000

61

Hungary

1897-8

18,486

2,428,000

129

Ireland .

1898

8,651

808,000

184

Italy .

1895-6

67,026

3,058,000

98

Netherlands

1897-8

5,6683

831,000'

166

Norway

1895

(?)

320,000

156

Portugal

1899

4,483

Prussia .

1896

36,138

5,237,000

164

Rumania

1895-7

3,618*

298,000*

53

Russia .

1896

78,7246

3,780,000

29

Servia .

1893-4

914

77,000

32

Spain .

1885

30,105

1,843,000

104

Sweden

1897

11,494

734,000

146

Switzerland

1897

5,131

613,000

164

- *Derived from the SfaU/mian's Year-Book-,, 1900. "Where the number of and attendance at infant schools are recorded, these particulars are included ; but for the reasons stated in the ninth edition, it is impossible to draw up a table in which all the entries are strictly comparable with one another. For the most part returns relating to private schools are not included. No particulars under the head of this table are obtainable for the entire German Empire.*

3 BchoolB inspected and number of pupils on the register. 8 Private Infant and primary schools included.

- *Number of urban schools as in 1891; of pupils as in 1895-96; particulars for rural schools as in 1896-97.*

5 Whole empire.

AND statistics]

and thus whh the general European system ; that bringing Bucarest into connexion with the Black Sea port of Kustenji by means of a bridge across the Danube at Chernavoda (opened in , Sept. 1895) ; a line across the Carpathians connecting Debrecsen with Lemberg, the continuation of the line eastwards from Lemberg to Kiev ; a network bringing the coal-field of the Donets basin into connexion with ports on the Sea of Azov ; a line in the south-east of Kussia connecting Novocherkassk with Vladikavkaz, and branches run- ning from the same point connecting that line with Novorossyisk on the Black Sea on the one hand, and with Tsaritsyn at the last angle of the Volga on the other hand ; a line in Northern Russia bringing Archangel into connexion with the European system at Vologda (opened in 1898) ; a detached line in the north-east across the Urals from Perm by Ekaterinburg (completed in 1878) to Tyumeil (completed in 1884) ; and a line in the east connecting the European system at Samara with the great mining centre of Zlatoust, already in 1890 continued across the Urals to Miyas, and since then carried farther east as the great Siberian railway. All the railways in Greece have been opened since 1878 ; and since that date Madrid has first been brought into fairly direct connexion with Lisbon and with Oporto. The growth of telegraphic commu- nication is shown on the table on p. 318.

In recent years two European canals of international interest have been excavated : the canal through the Isthmus of Corinth, opened in 1893 (August 6), and the Kaiser Wilhelm Canal between the Elbe and the Baltic Sea, opened in 1896 (June 20).

The table on p. 318 shows the condition of elementary education for the years named, and the following table that of religions : ???

*Seligions.^*

Other

Roman

Greeks.

Christians,

Jews.

Mahom-

Catholics.

chiefly Pro-

medans.

testants.

Austria (1890)

18,934,000

3,859,000

454,000

1,148,000

(f)

Belgium .

6,650,000

10,000

4,000

Bosnia – Herzegov-

ina (1895) .

334,000

678,000

3,860

8,200

549,000

Bulgaria (1893)

22,600

2,607,000

9,000

28,800

643,000

Denmark (1890)

3,650

2,174,000

4,100

German Empire

(1890) .

17,675,000

31,172,000

568,000

Greece (before cen-

sus 1889)

(?)'

1,908,000

(?)

5,800

24,200

Hungary (1890)

8,221,000

4,308,000

3,491,000

725,000

Ireland (1891)

3,560,000

526,000

1,800

Italy (1881)

28,360,000

62,000

88,000

Luxemburg (1895)

216,000

Abt. 1,600

1,060

Montenegro (?)

18,000

201,000

li^OOO

Netherlands (1889) .

1,596,000

2,785,000

gfjooo

Norway .

1,000

2,000,000

Poland (1890) .

6,215,000

400,000

445,000

1,1M,‘000

Portugal .

5,049,000

500

Rumania .

150,000

4,950,000

25,000

SOO^OOO

25^000;

Russia (excluding

Poland)

8,800,000

75,000,000

8,000,000

8,000,000

2,600,000

Servia (1891) .

11,600

2,128,000

1,100

4,660

16,800

Spain (188T)

17,535,000

6,600

400

Sweden (1890)

1,400

4,780,000

Switzerland (1888)

1,184,000

1,717,000

i'ooo

United Kingdom .

93,000

1 Compiled from the Statesman's Tear-Book, 1900. There are no data under this head for France, Great Britain, and Turkey. The last religous census in France was in 1872.

2 14,677 other Christians, mainly Eoman Catholics.

Authorities.   ^Prestwich.   Geological Map of Europe. Oxford, 1880.   Strelbitsky. La Superficie de VEurope. St Peters- burg, 1882.   Oppel. ” Die progressive Zunahme der Bevolkerung Europas,” Petermanns Mitteil. Gotha, 1886.   Kirchhofp and others. Die LanderTcunde des Erdteils Europa, vols. ii. and iii. of Unser Wissen von der Erde (comprising all the countries of Europe except Eussia). Vienna, &c., 1887-1893.   Papers relating to the climate of Europe: Sdpan. “Die mittlere Dauer der Haupt-Warme-perioden in Europa,” Petermanns Mitteil., 1887, PI. 10, and pp. 165-172.   Supan. ” Die jahreszeitliohe Verteilung der Niederschlage in Europa,” &c., ibid. 1890, PI. 21, and pp. 296, 297.   Elfert. “Die Bewolkung in Mitteleuropa mit Ein- schluss der Karpatenlander,” ibid. 1890, PI. 11 and pp. 137-145.   KoNiG. ” Die Dauer des Sonnenscheins in Europa,” in Nova Acta Leopoldina Karol. der deutschen Akad. der Naturforscher, vol. Ixvii. No. 3 (Halle, 1896).   Angot. “Regime des pluies de la p^ninsule ib^rique,” in Annales du Bur. Cent. Meteor, de France (1893, B, pp. 157-194), and ” Regime des pluies de I’Europe occidentale,” ibid. (1895, B, pp. 155-192).   BrBckner. “Die Klimaschwankungen seit 1700,” in Penck’s Geographische Abhandlungen, iv. PI. 2 (Vienna, 1890).   Munro. Lake Dwellings of Europe. London, 1890.   Supan. ” Die Verschiebung der Bevolkerung in Mitteleuropa mit Einschluss der Karpatenlander,” Petermanns Mitteil. , 1892.   Block. L^ Europe Politique et Sociale. 2nd edition, 1892.   E. Eeclus. ” H6g6monie de I’Europe,” in

La Societi Nouvelle. Brussels, 1894.   Philippson and Naumann. Europa. Eine allgemeine Landeskunde. Leipzig, 1895.   Publications relating to the measurement of a degree of longitude on the parallel of 52   N. from Valentia (Ireland) to the eastern frontier of Russia :   (1) Stebnitskt. Account of the Russian section of this work in the Memoirs (Zapiski) of the Milit. Topog. Section of the Russian General Staff, vols. xlix. and 1. St Petersburg, 1893. (In Russian, see notice in Petermanns Mitteil., 1894 ; Litteraturbericht, No. 289.) (2) and (3) Die europiiische Ldngengradmessung in 52   Br. von Greenwich bis Warschau. (2) Part i.   Hklmeut. Hauptdreiecke und Grundlinienanschlusse von England bis Polen. Berlin, 1893.   (3)

Partii. Borsch and Kruger. Geodatisehe Linien, Parallelbogen, und Lothabweichungen zwischen Feaghmain und Warschau. Berlin, 1896. ??? Meuriot. Des agglo- merations urbaines dans VEurope contemporaine. Paris, 1898. ??? Chisholm. Europe, vol. i. (in Stanford's Compendium of Geo- graphy and Trayel) ??? The Countries of the Mainland (excluding the North- West) . London, 1899. ??? Scharff. The History of the Euro- pean Fauna. London, 1899. ??? Ripley. The Maces of Europe. London, 1900. ??? Denikee. The Baces of Man. London, 1900. ??? SopAN. Die Bevolkerung der Erde, x. Gotha, 1899.

(g. g. c.)

II. History, 1870-1900.

By the Franco-German War of 1870-71 and the creation of the German Empire the political condition of Europe was profoundly changed. Germany became for a time the leading Power on the Continent, and German statesman- ship had to devise means for preventing, until the new edifice was thoroughly consolidated, the formation of a hostile coalition of jealous rivals. The first thing to be done in this direction was to secure the suppjjf t of Russia and Austria to the new order of things.

With regard to Eussia there was little cause for apprehension. She had aided Bismarck to carry out his audacious schemes in the past, and there was no reason to suppose that she would change her policy in the immediate future. The rapprochement dated from the Polish In- surrection of 1863, when the Governments of Prance and England, yielding to popular excitement, made strong diplomatic representations to Eussia ia favour of the Poles, whereas Bismarck not only refused to join in the diplomatic campaign, but made a Convention with the Cabinet of St Petersburg by which the Eussian Russian and German military authorities on the fron- policy tiers should aid each other in suppressing the towards disturbances. From that time the friendship ""—"y- ripened steadily. The relations between the two Powers were not, it is true, always without a cloud. More than once the bold designs of Bismarck caused uneasiness and dissatisfaction in St Petersburg, especially during the

Schleswig-Holstein complications of 1864 and the Austro- Prussian conflict of 1866 ; but the wily statesman of Berlin, partly by argument and partly by dexterously manipulat- ing the mutual trust and affection between the two Sover- eigns, always succeeded in having his own way without producing a rupture, so that during the Franco-German War Russia maintained an extremely benevolent neu- trality, and prevented Austria and Italy from taking part in the struggle. So benevolent was the neutrality that the Emperor William at the end of the campaign felt constrained to write to the Tsar that he owed to His Majesty the happy issue of the war. Having thus helped to create the German Empire, Alexander II. was not likely to take an active part in destroying it, and Bismarck could look forward confidently to a long continuance of the cordial relations between the two Courts.

The second part of the German Chancellor's programme, the permanent conciliation of Austria, was not so easily carried out. Austria had been the great sufferer, more perhaps even than France, from Bismarck's aggressive policy. For generations she had resisted strenuously and successfully the efforts of the Hohenzollerns to play the leading part in Germany, and she had always considered

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her own influence in Germany as essential to the main- tenance of her position as a first-class Power. By the dis- Austrian astrous Campaign of 1866 and the consequent relations Treaty of Prague, Austria had been formally ;" excluded from all direct influence in German*

etmany. ^^.^.Yis. With these events still fresh in his recol- lection, the Emperor Francis Joseph could hardly be ex- pected to support the new Empire created by his rival at Austria's expense, and it was known that on the eve of the Eranco-German War he had been negotiating with the Erench Government for a combined attack on Prussia. To an ordinary statesman the task of permanently conciliating such a Power might well

have seemed hopeless, but Bismarck did not shrink from it, and even before the signature of the Treaty of Prague he had prepared the way for attaining his object. " With regard to Austria," he himself explained on one occasion, "I had two courses open to me after her defeat, either to destroy her entirely or to respect her integrity and prepare for our future reconcili- ation when the fire of revenge had died out. I chose the latter course, because the former would have been the greatest possible act of folly. Supposing that Austria had disappeared, consider the consequences." He then de- scribed very graphically those probable consequences, and drew the conclusion : " Eor the sake of our own life Austria must live. I had no hesitation, therefore, and ever since 1866 my constant effort has been to stitch up the great torn texture and to re-establish amicable relations with our ancient associate of the Confederation." For this purpose he tried to soothe Austrian susceptibilities, and suggested confidentially that compensation for the losses of territory, influence, and prestige in Italy and Germany might be found in South-Eastern Europe, especially by the acquisition of Bosnia and Herzegovina ; but so long as his rival Count Beust was Minister for Foreign Affairs in Vienna, and Austria had the prospect of being able to recover her lost position by the assistance of Russia and France, these efforts had no success. It was only when Prince Gortchakoff had declined Count Beust's advances, which took the form of suggesting the abolition of the Black Sea clauses of the Treaty of Paris, and when France had been paralysed for some years by her war with Germany, that a rapprochement between the Cabinets of Vienna and Berlin became possible. Bismarck lost no time in making advances. From the German headquarters at Versailles he sent a despatch to Vienna suggesting the establishing of more cordial relations between the two countries, and Count Beust replied in an equally amicable tone. The Emperor Francis Joseph, finding himself isolated, had evidently accepted the inevitable with his customary resignation, and abandoned his dreams of again playing the leading part in Germany. As a further proof of the change in his disposition and aims he replaced Count Beust by Count Andrassy, who was a personal friend of Bismarck, and who wished, as a Hun-garian, to see Austria liberated from her German entangle- ment, and he consented to pay a visit to Berlin for the purpose of drawing still closer the relations between the two Governments.

Bismarck was delighted at this turn of affairs, but he advanced with his usual caution. He gave it to be clearly understood that improvement in his relations with Vienna must not disturb the long-established friendship with St Petersburg. The Tsar, on hearing privately of the intended meeting, gave a hint to Prince Reuss, the German ambassador, that he expected an invitation, and was invited accordingly. The meeting of the three Sovereigns took place at Berlin at the end of August 1872. Thethree Ministers, Prince Bismarck, Prince Gortchakoff, and Count Andrassy, held daily conferences, on the basis that the chief aim in view should be the maintenance of

peace in Europe, and that in all important international affairs the three Powers should consult with each other and act in concert. As a result of three days' consultation the Three Emperors' League was founded, without any formal treaty being signed. In this way the danger of a powerful coalition being formed against the f^^f' young German Empire was averted, for in the hand. event of a conflict with France, Germany could count on at least the benevolent neutrality of Russia and Austria, andfrom the other Powers she had nothing to fear. What ulterior designs Bismarck may have had in forming the League, or Alliance as it is often called, must be to some extent a matter of conjecture, but we shall probably not be far wrong in adopting the view of a competent Russian authority, who defines the policy of the German Chancellor thus : " To make Austria accept definitively her deposition as a Germanic Power, to put her in per- petual conflict with Russia in the Balkan Peninsula, and to found on that irreconcilable rivalry the hegemony of Germany."

For more than two years there was an outward appearance of extreme cordiality between the three Powers. They acted together diplomatically, and on all suitable occasions the three allied monarchs exchanged visits and sent each other congratulations and good wishes. There was, how- ever, from the beginning very little genuine confidence between them. Before the breaking up of the Conferences at Berlin, Alexander II. and his Chancellor had conversar tions with the French Ambassador, in which they not only showed that they had suspicions of future aggressive designs on the part of Germany, but also gave an assurance that so long as France fulfilled her engagements to Germany she had nothing to fear.

A few months later, when the Emperor William paid his return visit to the Tsar in St Petersburg, a defensive convention was concluded by the two monarchs behind the back of their Austrian ally. Without knowing anything about the existence of this convention, the Austrian ally did not feel comfortable in his new position. In Vienna the old anti- Prussian feeling was still strong. The so-called party of the Archdukes and the military resisted the policy of Andrassy, and sought to establish closer relations with Russia, so that German support might be xmnecessary, but as Bismarck has himself testified, " Russia did not yet respond. The wound caused by the conduct of Austria during the Crimean War was not yet healed. Andrassy made himself very popular in the Court Society of St Petersburg during his visit there with his Imperial Master, but the traditional suspicion of Austrian policy remained." Altogether, the new League was not a happy family. So long as all the members of it were content to accept the status quo, the latent germs of dissension remained hidden from the outside world, but as soon as the temporary state of political quietude was replaced by a certain amount of activity and initiative, they forced their way to the surface. No one of the three Powers regarded the status quo as a satisfactory permanent arrangement. In Berlin much anxiety was caused by the rapid financial and military recovery of France, and voices were heard suggesting that a new campaign and a bigger war indemnity might be necessary before the recuperation was complete. In St I'etersburg there was a determination to take advantage of any good opportunity for recovering the portion of Bessarabia ceded by the Treaty of Paris, and thereby removing the last tangible results of the Crimean War. In Vienna there was a desire to obtain in the Balkan Peninsula, in accordance with the suggestion of Bismarck, compensation for the losses in Italy and Germany. Thus each of the members of the League was hatching secretly a little aggressive scheme for its own benefit, and the danger for the rest of Europe lay in the possibility of their

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reconciling their schemes so far as to admit of an agree- ment for action in common. Fortunately for the on- lookers there were important conflicting interests, and the task of reconciling them was extremely dif&cult, as the subsequent course of events proved.

The first of the three Powers to move was Germany. In February 1875 M. de Eadowitz was despatched to

St Petersburg on a secret mission in order to The storm- discover whether, in the event of hostilities "I'sTs."' between Germany and France, Eussia would

undertake to maintain a neutral attitude, as she had done in 1870-71; in that case Germany might be relied on to co-operate with her in her great designs in the East. Prince Gortchakoff did not take the bait with the alacrity that was expected. Having overcome in some measure his hatred of Austria, which had distorted for so many years his political vision, he had come to understand that it was not for the interests of his own country to have as neighbour a powerful united Germany instead of a weak confederation of small states, and he now perceived that it would be a grave error of policy to allow Germany to destroy still more to her own advan- tage the balance of power in Europe by permanently weakening France. No doubt he desired to recover the lost portion of Bessarabia and to raise Eussian prestige in the East, but he did not wish to run the risk of excit- ing a great European war, and he believed that what he desired might be effected without war by the diplomatic skUl which had warded off European intervention during the Polish troubles of 1863, and had recovered TEor Eussia her freedom of action in the Black Sea during the Franco- Prussian War of 1870-71. In reply, therefore, to M. de Eadowitz's inquiries and suggestions, he declared that the Eussian Court fostered no ambitious designs in the East or in the West, and desired only peace and the main- tenance of the status quo, with possibly an amelioration in the miserable condition of the Christian subjects of the Sultan. This rebuff did not suffice to dispel the gathering storm. The warlike agitation in the German inspired press continued, and the French Government be- came thoroughly alarmed. General Lefl8, the French Ambassador in St Petersburg, was instructed to sound the Eussian Government on the

subject. Prince Gortcha- koff willingly assured him that Eussia would do all in her power to incline the Berlin Cabinet to moderation and peace, and that the Emperor would take advantage of his forthcoming visit to Berlin to influence the Em- peror William in this sense. A few days later General Leflo received similar assurances from the Emperor him- self, and about the same time the British Government volunteered to work likewise in the cause of peace. Eepresentations were accordingly made by both Govern- ments during the Tsar's visit to Berlin, and both the Emperor William and his Chancellor declared that there was no intention of attacking France. The danger of

war, which the well-informed German press be- Russiaand Heved to be "in sight," was thus averted, but dlvUid.'^ the incident sowed the seeds of future troubles,

by awakening in Bismarck a bitter personal resentment against his Eussian colleague. By certain incautious remarks to those around him, and stUl more by a circular to the representatives of Eussia abroad, dated Berlin and beginning with the words maintenant la paix est assurde, Gortchakoff seemed to take to himself the credit of having checkmated Bismarck and saved Europe from a great war. Bismarck resented bitterly this conduct on the part of his old friend, and told him frankly that he would have reason to regret it. In the Eussian official world it is generally believed that he took his revenge in the Eusso-Turkish War and the Con- gress of Berlin. However this may be, he has himself

explained that " tbe first cause of coldness " was the above incident, "when Gortchakoff, aided by Decazes, wanted to play at my expense the part of a saviour of France, to represent me as the enemy of European peace, and to pro- cure for himself a triumphant quos ego to arrest by a word and shatter my dark designs ! " In any case the incident marks the begirming of a new phase in the relations of the three Powers : henceforth Bismarck can no longer count on the unqualified support of Eussia, and in con- trolling the Eusso-Austrian rivalry in South-Eastern Europe, while professing to be impartial, he will lean to the side of Count Andrassy rather than to that of Prince Gortchakoff. He is careful, however, not to carry this tendency so far as to produce a rapprochement

between Eussia and France. The danger of a Franco-Eussian alliance hostile to Germany is already appearing on the political horizon, but it is only a little cloud no bigger than a man's hand.

The next move in the aggressive game was made by Austria, with the connivance of Eussia. During the sum- mer of 1875 an iasurrection of the Christian Slavs in Herzegovina, which received support from the neighbour- ing Principalities of Montenegro and Servia, was fostered by the Austrian authorities and encouraged by the Eussian consuls on the Adriatic coast. A European Concert was formed for the purpose of settling the disturbance by means of local administrative reforms, but the efforts of the Powers failed, because the insurgents hoped to obtain complete liberation from Turkish rule ; and in the begin- ning of July, with a view to promoting this solution, Servia and Montenegro declared war against the Porte. Thereupon Eussia began to show her hand more openly. The Government allowed volunteers to be recruited in Moscow and St Petersburg, and the Eussian General Tchernayef, who had distinguished himself in Central Asia, was appointed to the command of the Servian army. When the ball had thus been set rolling, the two Powers chiefly concerned considered that nussiaa the time had come for embodying the result agree- of their informal confidential pourparlers in a Tstk' secret agreement, which is known as the agree- ment of Eeichstadt, because it was concluded by the two Emperors in the little Bohemian town of that name. It bore the date of July 8, 1876, ??? exactly a week after Servia and Montenegro had declared war, ??? and it contained the following stipulations : ??? (1) That so long as the struggle which had just begun remamed undecided, the two Sover- eigns should refrain from interference, and that in the event of the Principalities being defeated, any modifica- tion of the territorial or political status quo ante to their detriment should be prevented ; (2) That in the event of the Principalities proving victorious, and territorial changes taking place, Austria would claim compensation in Bosnia and Herzegovina, and Eussia would demand the restitution of the portion of Bessarabia which she had lost by the Crimean War ; (3) That in the event of the collapse of the Ottoman Empire, the two Powers should act together to create autonomous principalities in Euro- pean Turkey, to unite Thessaly and Crete to Greece, and to proclaim Constantinople a

free town. The contracting parties evidently expected that the two Principalities would be victorious in their struggle with the Porte, and that . the compensations mentioned would be secured without a great European war. Their expectations were disappointed. Montenegro made a brave stand against superior forces, but before five months had passed Servia was at the mercy of the Turkish army, and Eussia had to come to the assistance of her protege. A Eussian ulti- matum stopped the advance of the Turks on Belgrade," and an armistice, subsequently transformed into a peace, was signed.

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Eussia and Austria had now to choose between aban- doning their schemes and adopting some other course of action, and unforeseen incidents contributed towards making them select the latter alternative. In June an attempt at insurrection in Bulgaria had been Qu'f^taa" repressed with savage brutality by the Turks, and the details,, as they became known some weeks later, produced much indignation all over Europe. In England the excitement, fanned by the eloquence of Mi- Gladstone, became intense, and compelled the Dis- raeli Cabinet to take part, very reluctantly, in a diplo- matic campaign, with the object of imposing radical reforms on Turkey. In Eussia the excitement and in- dignation were equally great, and the Tsar gradually formed the resolution that if the Powers would not act collectively and energetically, so as to compel the Porte to yield, he would undertake the work single- handed. This resolution he announced publicly in a speech deliv- ered at Moscow on November 10. The Powers did not like the idea of separate Eussian action, and in order to prevent it they agreed to hold a Conference in Con- stantinople for the purpose of inducing the Porte to introduce the requisite reforms. The Porte was at that moment under the

influence of popular patriotic excite- ment, which made it indisposed to a^ccept orders, or even well-meant advice, from Governments more or less hos- tile to it, and the inconsiderate mode of procedure sug- gested by General Ignatief, and adopted by the other delegates, made it still more unconciliatory. At the first plenary sitting of the Conference the proceedings were disturbed by the sound of artillery, and the Turkish representative explained that the salvo was in honour of the new Ottoman Constitution, which was being promul- gated by the Sultan. The inference suggested was that as soon as Turkey had spontaneously entered on the path of liberal and constitutional reform for all Ottoman sub- jects, it became superfluous and absurd to talk of small reforms for particular provinces, such as the Conference was about to propose. The deliberations continued, but finally the Porte refused to accept what the plenipoten- tiaries considered an irreducible minimum, and the Cone ference broke up without obtaining any practical result. The Tsar's Moscow declaration about employing single- handed the requisite coercive measures now came to be fulfilled.

In order to make a successful aggressive move on Turkey, Eussia had first of all to secure her rear and flank by an arrangement with her two allies. In Berlin she encountered no difficulties. Bismarck had no objec- tion to seeing Eussia weaken herself in a struggle with Turkey, provided she did not upset the balance of Power in South-Eastern Europe, and he felt confident that he could prevent by diplomatic means any such catastrophe. He was inclined, therefore, to encourage rather than restrain the bellicose tendencies of St Petersburg. In Vienna the task of coming to a definite arrangement was much more difiicult, and it was only after protracted and laborious negotiations that a Conventioa was concluded on January 15, 1877, and formally signed three months later. It was a development of the agreement of Eeich- stadt, modified according to the changes in the situation, but retaining the essential principle that in the event of the , territorial status quo being altered, Eussia should recover the lost portion of Bessarabia, and Austria should get Bosnia and a part of Herzegovina. Having made these preliminary arrangements, Eussia began the campaign simultaneously in Europe and Asia Minor, and after many reverses and enormous sacrifices of blood and treasure, she

succeeded in imposing on the Turks the "preliminary peace" of San Stefano. That peace was negotiated with very little consideration for the

interests of the other Powers, and as soon as the terms of it became known in Vienna and London, there was an outburst of indignation. In negotiating the treaty General Ignatief had ignored the |^a ◆◆◆o, wishes of Austria, and had even, according to the contention of Andrassy, infringed the Conven- tion signed at the beginning of the war. However this may be, the Peace of San Stefano brought to the surface the latent conflict of interests between the two Empires. Eussia's aim was to create a big Bulgaria under the influence of St Petersburg, and to emancipate Servia and Montenegro as far as possible from Austrian influence, whereas Austria objected to the creation of any large Slav State in the Balkan Peninsula, and insisted on maintaining her influence in Servia and Montenegro. In vain Prince Gortchakoff endeavoured to conciliate Austria and to extract from Count Andrassy a clear statement of the terms he would accept. Count Andrassy was in no hurry to extricate Eussia from her difS-Culties, and suggested that the whole question should be submitted to a European Congress. The suggestion was endorsed by Great Britain, which like- wise objected to the San Stefano arrangements, and Bismarck declined to bring any pressure to bear on the Cabinet of Vienna.

Deceived in her expectations of active support from her two allies, Eussia found herself in an awkward posi- tion. Prom a military point of view it was absolutely necessaryfor her to come to an arrangement either with Austria or with England, because the communications of her army before Constantinople with its base could be cut by these two Powers acting in concert ◆◆◆ ^the land route being dominated by Austria, and the Black Sea route by the British |[eet, which was at that time anchored ,in the Sea of Marmora. As soon, therefore, as the efforts to obtain the support of her two allies against the demands of England had failed, negotiations were opened in Lon- don, and on May 30 a Secret Convention was signed by Lord Salisbury and Count Schuwaloff. By that agree- ment the obstacles to the assembling of the Congress were removed. The Congress met in Berlin on 13th June, and after many prolonged sittings and much secret negotiations, the Treaty of Berlin

^”””” was signed on 13th July. By that treaty the “sress. Preliminary Peace of San Stefano was considerably modi- fied. The big Bulgaria defined by General Ignatief was divided into three portions, the part between the Danube and the Balkans being transformed into a vassal Princi- pality, the part between the Balkans and the Ehodope- being made into an autonomous province, with a Christian governor named by the Sultan, with the assent of the- Powers, and the remainder being placed again under the direct rule of the Porte. The independence of IMonten- egro, Servia, and Eumania was formally recognized, and each of these Principalities received a considerable acces- sion of territory. Eumania, however, in return for the Dobrudja, which it professed not to desire, was obliged to give back to Russia the portion of Bessarabia ceded after the Crimean War. In Asia Minor Eussia agreed to confine her annexations to the districts of Kars, Ardar han, and Batum, and to restore to Turkey the remainder of the occupied territory. As a set-off against the large acquisitions of the Slav races, the Powers recommended that the Sultan should cede to the kingdom of Greece the greater part of Thessaly and Epirus, luider the form of a rectification of frontiers. At first the Sultan refused to act on this recommendation, but in March 1881 a com- promise was effected by which Greece obtained Thessaly without Epirus. Bosnia and Herzegovina were to be occupied and administered by Austria-Hungary, and the Austrian authorities were to have the right of making.

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roads and keeping garrisons in the district of Novi-Bazar, which lies between Servia and Montenegro. In all the provinces of European Turkey

for which special arrange- ments were not made in the Treaty, the Porte undertook (Art. 23) to introduce . organic statutes similar to that of Crete, adapted to the local conditions. This article^ like many of the subordinate stipulations of the Treaty, has remained a dead letter. We may mention specially Art. 61, in which the Sublime Porte undertook to realize without delay the ameliorations and reforms required in the provinces inhabited by Armenians, and to guarantee their safety against the Circassians and Kurds. Equally unreliable proved the scheme of Lord Beaconsfield to secure good administration throughout the whole of Asia Minor by the introduction of reforms under British control, and to prevent the further expansion of Russia in that direction by a de- fensive alliance with the Porte. A Convention to that effect was duly signed at Constanti- nople a few days before the meeting of the Con- gress (4th June 1878), but the only part of it which was actually realized was the occupation and ad- ministration of Cyprus by the British Government. The new frontiers stipu- lated in the Treaty of San Stefano, and subsequently rectified by the Treaty of Berlin, are shown in the accompanying sketch-map. The secret schemes of Russia and Austria, in so far as they were defined in the agreement of Eeich- stadt and the subsequent Austro-Russian Treaty of Vienna, had thus been realized. Russia had re- covered the lost portion of Bessarabia, and Austria had practically annexed Bosnia and Herzegovina, though the nominal suzer- ainty of the Sultan over the two provinces was maintained. But Russia was far from satisfied with the results, which seemed to her not at all commensurate with the sacrifices imposed on her by the war, and her dissatisfaction led to a new grouping of the Powers. Before the opening of the Congress Bismarck had an- nounced publicly that he would refrain from taking sides with any of the contending parties, and would confine himself to playing the part of an honest broker. The announcement was received by the Russians with astonishment and indignation. What they expected was not an impartial arbiter, but a cordial and useful friend in need. In 1871 the Emperor William, as we have seen, had spontaneously declared to the Tsar that Germany owed to His Majesty the happy issue of the war, and that she would never forget it, and we may add that on that occasion he signed himself " Your ever grateful Friend." Now, in 1878, when the moment had come for paying at least an instalment of this debt, and when Russia was being compelled to make con-

cessions which she described as incompatible with her dignity, Bismarck had nothing better to offer than honest brokerage. The indignation in all ___ ^ classes was intense, and the views commonly resentment held regarding Bisiparck's "duplicity" and as^a/ast "treachery" were supposed to receive ample "'"' confirmation during the sittings of the Congress and' the following six months. On February 4, 1879, Prince Gortchakoff wrote to the Ambassador in Vienna : " Need- less to say, that in our eyes the Three Emperors' Alliance is practically torn in pieces by the conduct of our two allies. At present it remains for us merely to terminate the liquidation of the past, and to seek henceforth our support in ourselves alone." The same view of the situation was taken in Berlin and Vienna, though the result was attributed, of course, to different causes, and

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the danger of serious complications became so great that Bismarck concluded with Andrassy in the follow- ing October a formal defensivfe alliance, which was avowedly directed against Russia, and which subse- quently developed into the Triple Alliance, directed against Russia and France.

The causes of the rupture are variously described by the different parties interested. According to Bismarck the Russian Government began a venomous campaign against Germany in the press, and collected, with appar- ently hostile intentions, enormous masses of troops near the German and Austrian frontiers, whilst the Tsar adopted in his correspondence with the Emperor William an arrogant and menacing tone which could not be tolerated. On th,e other hand, the Russians declared that the so-called Press- Campaign was merely the spontaneous public expression of the prevailing disappointment among all classes in Rus- sia, that the military preparations had a purely defensive

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character, and that the Tsar's remarks, which roused Bismarck's ire, did not transgress the limits of friendly expostulation such as Sovereigns in close friendly rela- tions might naturally employ. Subsequent revelations tend rather to confirm the Eussian view. After an exhausting war and without a single powerful ally, Russia was not likely to provoke wantonly a great war with Germany and Austria. The press attacks were not more violent than those which frequently appear in newspapers which draw their inspiration from the German Foreign Office, and the accusations about the arrogant attitude and menacing tone of Alexander II. are not at all in harmony with his known character, and are refuted by the documents since published by Dr Busch. The truth seems to be that the self-willed Chancellor was actuated by nervous irritation and personal feeling more than by considerations of statecraft. His Imperial master was not convinced by his arguments, and showed great reluctance to permit the conclusion of a separate treaty with Austria. Finally, with much searching of heart, he yielded to the importunity of his Minister ; but in thus committing an unfriendly act towards his old ally, he so softened the blow that the personal good re- lations between the two Sovereigns suffered merely a momentary interruption. Bismarck himself soon recog- nized that the permanent estrangement of Eussia would be a grave mistake of policy, and the very next year (1880), negotiations for a treaty of defensive alliance be- tween the two Cabinets were begun. Nor did the acces- sion to the throne of Eussia of Alexander III., who had long enjoyed the reputation of being systematically hos- tile to Germans, produce a rupture, as was expected. Six months after his father's death, the young Tsar met the old Kaiser at Danzig (Sept. 1881), and some progress was made towards a complete renewal of the traditional friend- ship. Immediately afterwards a further step was taken towards re- establishing the old state of things with regard also to Austria. On his return to St Petersburg, Alex- ander III. remembered that he had received some time previously a telegram of congratulation from the Emperor Francis Joseph, and he now replied to it very cordially, re- ferring to the meeting at Danzig, and describing the Em- peror William as "that

venerable friend with whom we are united in the comjnon bonds of a profound affection." The words foreshadowed a revival of the Three Emperors' League, which actually took place three years later.

The removal of all immediate dangerof aFranco-Eussian alliance did not prevent Bismarck from strengthening in

other ways the diplomatic position of Germany, Orowth of ajj^ ^iie result of his efforts soon became appar- AUiana." ent in the alliance of Italy with the two Central

Powers. Ever since the Franco-German War of 1870-71, and more especially since the Congress of Berlin in 1878, the Italian Government had shown itself restless and undecided in its foreign policy. As it was to France that Italy owed her emancipation from Austrian rule, it seemed natural that the two countries should remain allies, but anything like cordial co-operation was prevented by conflicting interests and hostile feeling. The French did not consider the acquisition of Savoy and Nice as sufficient compensation for the assistance they had given to the cause of Italian unity, and they did not know, or did not care to remember, that their own Government was greatly to blame for the passive attitude of Italy in the hour of their great national misfortunes. On the other hand, a considerable .amount of bitterness against France had been gradually .accumulating in the hearts of the Italians. As far back as the end of the war of 1859, popular opinion had been freely expressed against Napoleon III., because he had failed to keep his promise of liberating Italy " from the Alps to the Adriatic." The feeling was revived and intensified when

it became known that he was opposing the annexation of Central and Southern Italy, and that he obtained Savoy and Nice as the price of partly withdrawing his opposi- tion. Subseqiiently, in the war of 1866, he was supposed to have insulted Italy by making her conclude peace with Austria, on the basis of the cession of Venetia, before she could wipe out the humiliation of her defeats at Custozza and Lissa. Then came the French protection of the Pope's temporal power as a constant source of irritation, pro- ducing occasional explosions of violent hostility, as when the new ChassepSt rifles were announced to have "worked wonders " among the Garibaldians at Mentana. When the Second Empire was

replaced by the Eepublic, the relations did not improve. French statesmen of the Thiers school had always condemned the Imperial policy of permitting and even encouraging the creation of large, powerful states on the French frontiers, and Thiers himself publicly at- tributed to this policy the misfortunes of his country. With regard to Italy, he said openly that he regretted what had been done, though he had no intention of un- doing it. The first part of this statement was carefully noted in Italy, and the latter part was accepted with scepticism. In any case his hand might perhaps be forced, for in the first Eepublican Chamber the Monarchical and Clerical element was very strong, and it persistently at- tempted to get something done in favour of the Temporal Power. Even when the party of the Left undertook the direction of affairs in 1876, the Government did not become anti-Clerical in its foreign policy, and Italian statesmen resigned themselves to a position of political isolation. The position had its advantages. Events in the Balkan Peninsula foreshadowed a great European war, and it seemed that in the event of Europe's being divided into two hostile camps, Italy might have the honour and the ad- vantage of regulating the balance of power. By maintain- ing good relations with all her neighbours and carefully avoiding all inconvenient entanglements, she might come forward at the critical moment and dictate her own terms to either of the contending parties, or offer her services to the highest bidder. This Machiavellian policy did not give the expected results. Being friends with everybody in a general way may be the best course for an old, con- servative country which desires merely the maintenance of the status quo, but it does not secure the energetic diplo- matic support required by a young enterprising state which wishes to increase its territory and influence. At the Con- gress of Berlin, when several of the Powers got territorial acquisitions, Italy got nothing. The Italians, who were in the habit of assuming, almost as a matter of principle, that from all European complications they had a right to obtain some tangible advantage, were naturally disap- pointed, and they attributed their misfortune to their political isolation. The policy of the free hand conse- quently fell into disrepute, and the desire for a close, effi- cient alliance revived. But with what Power or Powers should an alliance be made ? The remnants of the old party of action, who still carried the Italia Trredente ban- ner, had an answer ready. They recommended that alli- ances should be concluded with a view to wresting from Austria the Trentino and Trieste, with

Dalmatia, perhaps, into the bargain. On the other hand, the Conservatives and the Moderates considered that the question of the Trentino and Trieste was much less important than that of political influence in the Mediterranean. A strong Austria was required, it was said, to bar the way of Russia to the Adriatic, and France must not be allowed to pursue un- checked her policy of transforming the Mediterranean into a French lake. Considerations of this kind led naturally to the conclusion that Italy should draw closer to the Powers of Central Europe. So the question appeared from the standpoint of " la haute politique." From the less

elevated standpoint of immediate political interests, it presented conflicting considerations. A rapprochement with the Central Powers might prevent the conclusion of a commercial treaty with Prance, and thereby increase the financial and economic difficulties with which the young kingdom was struggling, whereas a rappn-ochement with France would certainly excite the hostility of Bismarck, who was retiring from the Culturkampf and journeying towards Canossa, and who might possibly conciliate the Pope by helping him to recover his tem- poral sovereignty at the expense of Italy. Altogether the problem was a very complicated one. The conflicting currents so nearly balanced each other, that the question as to which way the ship would drift might be decided by a little squall of popular sentiment. A very big squall was brewing.

During the Congress of Berlin, the French Govern- ment was very indignant when it discovered that Lord

Beaconsfield had recently made a secret conven- n)n”sf ”” i ^ i’ *^^ Sultan for the British occupation*

of Cyprus, and in order to calm its resentment Lord Salisbury gave M. Waddington to understand that, so far as England was concerned, France would be allowed a free hand in the Eegency of Tunis, which she had long coveted. Though the conversations on the subject and a subsequent exchange of notes were kept strictly secret, the Italian Government soon got wind of the affair, and it was at first much alarmed. It considered, in common with Italians generally, that Tunis, on the ground of his- toric right and of national interests, should be reserved for Italy, and that an extension of French territory in that direction would destroy, to the detriment of Italy, the balance of power in the Mediterranean. These appre- hensions were calmed for a time by assurances given to the Italian Ambassador in Paris. M. Gambetta assured General Cialdini that he had

no intention of making Italy an irreconcilable enemy of France, and M. Waddington declared, on his word of honour, that so long as he remained Minister of Foreign Affairs nothing of the sort .would be done by France without a previous understand- ing with the Cabinet of Eome. M. Waddington honour- ably kept his word, but his successor did not consider himself bound by the assurance; and when it was found that the Italians were trying systematically to establish their influence in the Eegency at the expense of France, the French authorities, on the ground that a Tunisian tribe called the Kroumirs had committed depredations in Algeria, sent an armed force into the Eegency, and imposed on the Bey the Bardo treaty, which transformed Tunis into a French Protectorate.

The establishment of a French Protectorate over a country which the Italians had marked out for themselves as necessary for the defence and colonial expansion of the kingdom had the effect which Gambetta had foreseen ??? it made Italy, for a time at least, the irreconcilable enemy of France. Whilst the French were giving free expression to their patriotic exultation, and even Gambetta himself, in defiance of what he had said to Cialdini, was congratulating Jules Ferry on having restored France to her place among the nations, the Italians were trying to smother their in- dignation and to discover some means of retrieving what they had lost. The only remedy seemed to be to secure foreign alliances, and there was now no hesitation as to where they should be sought. Simple people in Italy imagined that if an alliance had been concluded sooner with Germany and Austria, these Powers would have pre- vented France from trampling on the sacred interests of Italy. This idea was entirely erroneous, because Austria had little or no interest in the Tunisian Question, and Bis- marck was not at all sorry to see France embark on an enterprise which distracted her attention from Alsace-

Lorraine and removed all danger of a Franco-Italian alliance. The illusion, however, had a powerful influence on Italian public opinion. The Government was now urged to conclude without further delay an alliance with the' Central Powers, and the recommendation was not un- welcome to the King, because most of the Italian Gallo- phils had anti-dynastic and Eepublican tendencies, and he was naturally disposed to draw nearer to Governments which proclaimed themselves the defenders of Monarchi-

*cal institutions and the opponents of revolutionary agita- tion. After protracted negotiations, in which Italy tried in vain to secure protection for her own separate interests in the Mediterranean, defensive treaties of alliance were concluded with the Cabinets of Vienna and Berlin in May 1882. Though the Italian statesmen did ^ ^^ not secure by these treaties all they wanted, Ainance they felt that the kingdom was protected against signed any aggressive designs which might be enter- **" tained by France or the Vatican, and when the treaties were renewed in 1887, they succeeded in getting somewhat more favourable conditions.*

By the creation of this Triple Alliance, which still subsists, the diplomatic position of Germany was greatly \ strengthened, but Bismarck was still haunted by the apprehension of a Franco-Eussian alliance, and he made repeated attempts to renew the old cordial relations with the Court of St Petersburg. He was bold enough to hope that, notwithstanding the Austro-German treaty of October 1879, avowedly directed against Eussia, and the New Triple Alliance, by which the Austro-German Alliance was strengthened, he mightresuscitate the Three Emperors' League in such a form as to ensure, even more effectually than he had done on the former occasion, the preponder- ance of Germany in the arrangement. With this object he threw out a hint to the Eussian Ambassador, M. Sabourof, in the summer of 1883, that the evil results of the Congress of Berlin might be counteracted by a formal agreement between the three Emperors. The suggestion was transmitted privately by M. Sabourof to the Tsar, and was favourably received. Alexander III. was disquieted by the continuance of the Nihilist agitation, and was not averse to drawing closer to the Conservative Powers ; and as he desired tranquillity for some time in the Balkan Peninsula, he was glad to have security that his rival would do nothing in that part of the world without a previous understanding. M. de Giers, who had now succeeded Prince Gortchakoff in the direction of Foreign Affairs, was accordingly despatched to Friedrichsruh to discuss the subject with Bismarck. The practical result of the meeting was that negotiations between the two Governments were begun, and on March 21, 1884, a formal document was signed in Berlin. About six months later, in the month of September, the three Emperors met at Skiernevice and ratified the agreement. Thus, without any modification of the Triple Alliance, which was directed against Eussia, the old Three Emperors'

League, , which included Eussia, was revived. Germany and Austria, being members of both, were doubly Oreikaiser- protected, for in the event of being attacked y/yg^ i884. they could count on at least the benevolent neutrality of both Eussia and Italy. France was thereby completely isolated.

In drawing up the secret treaty of Skiernevice, which may be regarded as the chef d'oeuvre of Bismarckian diplomacy, the German Chancellor's chief aims evidently were to paralyse Eussia by yoking her to Germany and Austria, to isolate France, and to realize his old scheme of holding the balance between Eussia and Austria in the Balkan peninsula. With a view to attaining the first two objects it was stipulated that if any one of the three Powers were forced to make war on a fourth Power, the

two other contracting parties should observe a benevo- lent neutrality towards their ally. If we may believe a well-informed Eussian authority, Bismarck wished it to be understood that in the event of two of the Powers being at war with a fourth, the stipulation about benevo- lent neutrality should still hold good, but Alexander III. objected, on the ground that he could not remain a passive spectator of a duel in which France would be confronted by two antagonists. In his third object Bismarck was successful, for it was expressly laid down that in all cases of a disagreement between two of the parties in the affairs of the Balkan Peninsula, the third Power should decide between them. This meant, of course, that in all discussions between Russia and Austria, the two great rivals in the Eastern Question, Bismarck should always have a casting vote. In return for all this, Russia obtained two small concessions : firstly, that Germany and Austria should seek to restrain the Sultan from permitting the passage of the Darda- nelles to an English fleet, as he had done in 1878, when the, Russian army was before Constantinople ; and, sec- ondly, that they should not oppose the union of Bulgaria and Eastern

Rumelia, if it was accomplished by the force of things and within the limits traced by the Congress of Berlin.

This new form of the Three Emperors' League had all the organic defects of its predecessor, and was destined to be still more shortlived. The claims of Russia and Austria might be reconcilable in theory, but in practice they were sure to conflict ; and however much Bismarck might try to play the part of an honest broker, he was certain to be suspected of opposing Russia and favouring Austria. It was, therefore, only during a period of political stagnation in South-Eastern Europe that the arrangement could work smoothly. The political stag- nation did not last long. Prince Alexander of Bulgaria had for some time been fretting under the high-handed interference of the Eussian agents in the Principality, and had begun to oppose systematically what the Rus- sians considered their legitimate influence. Relations

between Sofia and St Petersburg had conse- o-lsfs"'^ quently become strained, when a crisis was

suddenly brought about by the revolution of Philippopolis in September 1885. The conspirators ar- rested and expelled the Governor-General, who had been appointed by the Sultan with the assent of the Powers, and at the same time proclaimed the union of the autono- mous province of Eastern Rumelia with the Principality of Bulgaria, in defiance of the stipulations of the Treaty of Berlin. The revolution had been effected with the connivance and approval of the regularly accredited Eus- sian agents in Philippopolis, but it had not received the sanction of the Russian Government, and was resented as a new act of insubordination on the part of Prince Alex- ander. When he arrived in Philippopolis and accepted the declaration of union, the Cabinet of St Petersburg protested against any such infraction of the Berlin Treaty, and the Porte prepared to send an army into the province. It was restrained from taking this step by the Ambassadors in Constantinople, so that an airmed conflict between Turks and Bulgarians was prevented; but no sooner had the Bulgarians been relieved from this danger on their eastern frontier than they were attacked from the west by the Servians, who were determined to get ample compensation for any advantage which the Bulga- rians might obtain.

The Bulgarian army defeated the Servians at Slivnitza (Nov. 19-20, 1885), and was march- ing on Belgrade when its advance was stopped and an armistice arranged by the enorgetic intervention of the Austrian Government. Following the example of the Servians, the Greeks were preparing to exact territorial

compensation likewise ; but as their mobilization was a slow process, the Powers had time to restrain them from entering on active hostilities, first by an ultimatum (April 26, 1886), and afterwards by a blockade of their ports (May 1886).' By that time, thanks to the interven- tion of the Powers, a peace between Bulgaria and Servia had been signed at Bucarest (March 3) ; and with regard to Eastern Rumelia, a compromise had been effected by which the formal union with the Principality was re- jected, and the Prince was appointed Governor-General of the province for a term of five years. This was in reality union in disguise.

The diplomatic solution of the problem averted the danger of a European war, but it left a great deal of dis- satisfaction, which soon produced new troubles. Not only had Prince Alexander escaped punishment for his insub- ordination to Russia, but he and the anti-Russian party among the Bulgarians had obtained a decided success. This could not well be tolerated. Before six months had passed (August 21, 1886), Prince Alexander was kidnapped by conspirators in his palace at Sofia and conveyed secretly to Eussian Bessarabia. As soon as the incident was re- ported to the Tsar, the Prince was released, and he at once returned to Sofia, where a counter-revolution had been effected in his favour ; but he considered his position un- tenable, and formally abdicated. A fortnight after his departure General Kaulbars arrived from St Petersburg with instructions from the Tsar to restore order in accord- ance with Russian interests. In St Petersburg it was supposed that the Bulgarian people were stUl devoted to Russia, and that they were ready to rise against and expel the politicians of the Nationalist party led by Stambolof. General Kaulbars accordingly made a tour in the country and delivered speeches to the assembled multitudes, but Stambolof's political organization counteracted all his efforts, and on November 20 he left Bulgaria and took the Russian consuls with him. Stambolof maintained his position, suppressed energetically several insurrectionary movements, and

succeeded in getting Prince Ferdinand of Coburg elected Prince (July 7, 1887), in spite of the opposition of Russia, who put forward as candidate a Russian subject. Prince Nicholas of Mingrelia. Prince Ferdinand was not officially recognized by the Sultan and the Powers, but he continued to reign under the direction of Stambolof, and the Russian Government, passively ac- cepting the accomplished facts, awaited patiently a more convenient moment for action.

*These events in the Balkan Peninsula necessarily affected the mutual relations of the Powers composing the Three Emperors' League. Austria could not remain a passive and disinterested spectator of the action of Russia in Bulgaria. Her agents gave a certain amount of support to Prince Alexander in his efforts to emancipate himself from Russian domination ; and when the Prince was kidnapped and indu.ced to abdicate. Count Kalnoky did not conceal his intention of opposing further aggression. Bismarck resisted the pressure brought to bear on him from several quarters in favour of the anti-Russian party in Bulgaria, but he was suspected by the Eussians of siding with Austria and secretly encouraging the opposi- tion to Russian influence. This revived the hatred against him which had been created by *"ss/an his pro-Austrian leanings after the Eusso-Turkish 0"**War. The feeling was assiduously fomented by the Eussian press, especially by M. Katkoff, the editor of the iVo.srojo Gazette, who exercised great influence on public o]iinion and had personal relations with Alex- ander TIT. On July 31, 1886, three weeks before the kidnapping of Prince Alexander, he began a regular journalistic campaign against Germany, and advocated strongly a new orientation of Eussian policy. M. de Giers,*

history]

Minister of Foreign Affairs, was openly attacked as a partisan of the German alliance, aJnd his " pilgrimages to Friedrichsruh and Berlin " were compared to the hiimiliating journeys of the old Eussian Grand Princes to the Golden Horde in the time of the Tartar domina- tion. The

moment had come, it was said, for Russia to emancipate herself from German diplomatic thraldom, and for this purpose a rapprochement with France was suggested. The idea was well received by the public, and it seemed to be not unpalatable to the Tsar, for the Moscow Gazette was allowed to continue its attacks on M. de Giers's policy of maintaining the German alliance. In Berlin such significant facts could not fail to produce uneasiness, because one of the chief aims of Bismarck's policy had always been to prevent a Russo- French entente cordiale. The German press were in- structed to refute the arguments of their Eussian col- leagues, and to prove that if Russia ha4 really lost her influence in the Balkan Peninsula, the fact was due to the blunders of her own diplomacy. The controversy had no practical result, and caused no serious estrangement between the Cabinets of Berlin and St Petersburg. When the Treaty of Skiernevice was about to expire in 1887, the Russian Government positively declined to renew the Three Emperors' League, but the seductive eloquence of the German Chancellor induced the Tsar to make a new secret treaty of alliance with Germany for three years ; and feeling his hands strengthened by this new instrument Bismarck thought he might use pressure to obtain greater advantages. An attack was made in the press and else- where on Russian credit, which was rapidly gaining a footing in the Paris Bourse. In the use of this kind of pressure the German Government generally remained in the background, and even expressed its regret, but on one occasion it showed its hand plainly by prohibiting the Reichsbank from accepting Russian securities as guaran- tees. From that moment the Tsar's attitude changed. All his dormant suspicions of German policy revived. When he passed through Berlin in November 1887, Bismarck had a long audience, in which he defended himself with his customary ability, but Alexander III. re- mained unmoved in his conviction that the German Government had systematically opposed Russian interests, and had paralysed Russian action in the Balkan Penin- sula for the benefit of Austria ; and he failed to understand the ingenious theory put forward by the German Chancel- lor, that two Powers might have a severe economic struggle without affecting their political relations. Bis- marck had to recognize that, for the moment at least, the Three Emperors' League, which had served his purposes so well, could not be resuscitated, but he had still a certain security against the hostility of Eussia in the secret Eusso- German

defensive treaty of 1887, which had been con- cluded without the knowledge of Austria. Soon, however, this link was also to be broken. When the secret treaty expired in 1890 it was not renewed. By that time Bis- marck had been dismissed, and he subsequently reproached his successor. Count Caprivi, with not having renewed it, but in reality Count Caprivi was not to blame. Alexan- der III. was determined not to renew the alliance, and ,was already gravitating slowly towards an understanding with France.

No treaty or formal defensive engagement of any kind existed between Eussia and France, but it was already

tolerably certain that in the event of a great war Franco- ^jjg two nations would be found fighting on the entente! Same side, and the military authorities in both

countries felt that if no arrangements were made beforehand for concerted action, ??? such arrangements hav- ing been long ago completed by the Powers composing the Triple Alliance, ??? they would begin the campaign at a great

disadvantage. This was perfectly understood by both Governments; and after some hesitation on both sides, Generals Vannofski and Obrutchef, on the one side, and Generals Saussier, Miribel, and Boisdeffre on the other, were permitted to discuss plans of co-operation. At the same time a large quantity of Lebel rifles were manufac- tured in France for the Eussian army, and the seclet of making smokeless powder was communicated to the Eus- sian military authorities. The French Government wished to go further and conclude a defensive alliance, but the Tsar was reluctant to bind himself with a Government which had so little stability, and which might be induced to provoke a war with Germany by the prospect of Eussian support. Even the military convention was not formally ratified until 1894. The enthusiastic partisans of the al- liance flattered themselves that the Tsar's reluctance had been overcome, when he received very graciously Admiral Gervais and his officers during the visit of the French fleet to Cronstadt in the summer of 1891, but their joy was premature. The formal rapprochement between the two Governments was much slower than the unofficial rap-

prochement between the two nations. More than two years passed before the Cronstadt visit was returned by the Eussian fleet, under Admiral Avelan. The enthusi- astic ovations which the admiral and his subordinates received in Toulon and Paris (October 1893) showed how eager and anxious the French people were for an alliance with Eussia, but the Eussian Government was in no hurry to gratify their wishes. Of the official action all we know with certainty is, that immediately after the Cronstadt visit in 1891 a diplomatic protocol about a defensive alliance was signed; that during the special mission of General Boisdeffre to St Petersburg in 1892 negotiations took place about a military convention ; that in 1894 the military convention was ratified; that in the summer of 1895 M. Eibot, when Prime Minister, first spoke publicly of an alliance ; and that during the visit of the President of the French Eepublic to St Petersburg,, in August 1897, France and Eussia were referred to as allies in the complimentary speeches of the Tsar and of M. Felix Faure. Though we are still in the dark as to the precise terms of the arrangement, there is no doubt that close friendly relations exist between the two Powers, and that in all important international affairs they seek to act in accord with each other. It is equally certain that hitherto Eussia has been the predominant partner, and that, in accordance with the pacific tendencies of the Tsar, she has systematically exercised a restraining influence on France. The great expectations excited among the French people by the entente cordiale have consequently not been realized, and there have already been premonitory symptoms of a reaction in public opinion. So long, however, as the Triple Alliance of Germany, Austria, and Italy exists, the Dual Alliance of Eussia and France is likely to be maintained as a measure of self-defence. England has persistently refrained from joining either group, in ac- cordance with her traditional policy of making no alli- ances except for specific purposes ; but as her interests in the East and in the Mediterranean conflict with those of Eussia and France rather than with those of Germany, Austria, and Italy, she has a tendency to lean towards the Triple, rather than towards the Dual, Alliance.

The grouping of the great Continental States into two opposite but not necessarily hostile camps has helped to preserve the balance of power and the peace of Europe. Since the two groups were formed, the causes of

conflict flrhich have arisen from time to time have been localized. Among these may be specially mentioned the Armenian Question, the Cretan Question, the partition of Africa, and the conflicts of interest in the Far East.

The Armenian Question was brought prominently be- fore Europe by the Russo-Turkish War of 1877-78. In the Treaties of San Stefano and Berlin the Sublime Porte undertook " to carry out without delay the ameliorations and reforms required by local needs in the provinces inhabited by the Armenians, and to guarantee their security against the Circassians and the Kurds." This stipulation remained a dead letter, and the relations between the Armenians and the Mussulmans became worse than before, because the protection of the Powers encouraged in the oppressed nationality far-reach- ing political aspirations, and the Sultan regarded the political aspirations and the intervention of the Powers as dangerous for the integrity and independence of his Empire. Eor some fifteen years the Armenians continued to hope in the efficacious intervention of their protectors, but when their patience became exhausted and the ques- tion seemed in danger of being forgotten, they determined to bring it again to the front. Some of them confined themselves to agitating abroad, especially in England, in favour of the cause, whilst others made preparations for exciting an insurrectionary movement in Constantinople and Asia Minor. These latter knew very well that an in- surrection could be suppressed by the Turkish Government without much difficulty, but they hoped that the savage measures of repression which the Turks were sure to em- ploy mightj^ lead to the active intervention of Europe and ensure their liberation from Turkish rule, as the famous " atrocities " of 1876 had led to the political emancipation of Bulgaria. In due course ??? 1895-96 ??? the expected atrocities took place, in the form of wholesale massacres in Constantinople and various towns of Asia Minor. The Sultan was subjected to diplomatic pressure and threat- ened with more efficient

*means of coercion. In the diplomatic campaign England took the lead, and was warmly supported by Italy, but Germany, Austria, and France showed themselves lukewarm, not to say indiffer- , ent, and Russia, departing from her traditional policy of protecting the Christians of Turkey, vetoed the employment of force for extracting concessions from the Sultan. In these circumstances the Porte naturally confined itself to making a few reforms on paper, which were never carried out. Thus the last state of the Armenians was worse than the first, but the so-called European Concert was main- tained, and the danger of a great European war was averted. The next attempt to raise the Eastern Question was made by the Greeks. In 1896 a semi-secret society called the Ethnike Hetairia began a Panhellenic agitation, and took advantage of one of the periodical insurrections in Crete to further its projects. In Eebruary 1897 the Cretan revolutionary committee proclaimed the annexa- tion of the island to the Hellenic Kingdom, " *□□□ and a contingent of Greek regular troops landed*

near Canea under the command of Colonel Vassos to take possession of the island in the name of King George. The Powers, objecting to this arbitrary proceeding, im- mediately occupied Canea with a mixed force from the ships of war which were there at the time, and summoned the Greek Government to withdraw its troops. The summons was disregarded, and the whole of the Greek army was mobilized on the frontier of Thessaly and Epirus, In consequence of a raid into Turkish territory the Porte declared war on 17th April, and the short campaign ended in the defeat of the Greeks. The Powers inter- vened to put an end to the hostilities, and after prolonged negotiations a peace was concluded by which Greece had to consent to a strategical rectification of frontier and to pay a war indemnity of □□4,000,000. Thus a second time the European Concert acted effectually in the interests of peace, but it did not stand the strain of the subsequent efforts to solve the Cretan Question. Finding the Turks

less conciliatory after their military success, and being anxious to remain in cordial relations with the Porte, Germany withdrew from further co- operation with the Powers, and Austria followed her example. They did not, however, offer any active opposition, and the question received a

temporary solution by the appoint- ment of Prince George, second son of the King of Greece, as High Commissioner and Governor-General of the island.

During the period under review the friendly relations of the leading European Powers were frequently troubled by the conflicting desires of several of these Powers to obtain colonial possessions in various parts of ^f^ica. the world, and to forestall their competitors in the act of taking possession. In the complications of this kind England, as the greatest of Colonial Powers, was generally involved ; and as the unappropriated portions of the earth's surface at the beginning of the period in question were to be found chiefly in Africa, it was in the Dark Continent that the conflicts of interests mostly took place. England's chief competitors were France and Germany. Her traditional policy, except in the south of the continent, where the conditions of soil and climate were favourable to European colonists, has been purely commercial. She had refrained from annexation of territory, as involving too much expenditure and respon- sibility, and confined her protection to the trading stations on the coast. When France came into the field this policy had to be abandoned. The policy of France was also commercial in a certain sense, but the methods she adopted were very different. Feeling that she could not compete with England on equal terms, she endeavoured to bring under her authority, by annexation or the establishment of protectorates, the largest possible extent of territory, in order to increase her trade by a system of differential tariffs ; and not content with holding long strips of coast, she systematically encroached on the hinterland of British settlements, and endeavoured to direct artificially the native inland trade towards her own ports. A glance at the map of the African West Coast will suffice to show the success with which this policy has been carried out. When the British Govern ment awoke to the danger, it was too late to prevent the evil. All that could be' done was to prevent further encroachments by likewise annexing territory and creating protectorates. The final result has been a series of delimitation treaties, which are dealt with in the article Afeica, History. In her dealings with France about the partition of Africa, England was generally very conciliatory, but on one point she felt the necessity of being firm, namely, regarding the two entrances to the Mediterranean. France has long coveted the possession of Morocco, but

she has powerful rivals in the field, and she is well aware that an attempt to gain possession of Tangier, or anj- other part of the south coast of the Straits of Gibraltar, would meet with determined opposition from England. In like manner the eastern entrance to the Mediterranean by the Suez Canal is carefully watched. When England in 1882 considered it necessary to suppress the Arabi insurrec- tion, she invited France to co-operate, but the French Government declined, and left the work to be done by England alone. England had no intention of occupy- ing the country permanently, but she had to take pre- cautions against the danger of French occupation after her withdrawal, and these precautions were embodied in an Anglo-Turkish Convention signed at Constantinople in May 1887. France prevented the ratification of the Convention by the Sultan, with the result that the British occupation has been indefinitely prolonged. She still clung persistently, however, to the hope of obtaining a

predominant position in the valley of the Nile, and she tried to effect her purpose by gaining a firm foothold on the upper course of the river. The effort which she made in 1898 to attain this end, by simultaneously despatching the Marchand Mission from her Congo possessions and inciting the Emperor Menelek of Abyssinia to send a force from the east to join hands with Major Mar- chand at Fashoda, was defeated by the overthrow of the Mahdi and the British occupation of Khartum. For a few days the two nations seemed on the brink of war, but the French Government, receiving no en- couragement from St Petersburg, consented to with- draw the Marchand Mission, and a convention was signed defining the respective spheres of influence of the two countries.

With Germany likewise, from 1880 onwards, England had some diplomatic diflS.culties regarding the partition of Africa, but they never reached a very acute phase, and were ultimately settled by mutual concessions. By the arrangement of 1890, in which several of the outstanding questions were solved, Heligoland was ceded to Germany in return for concessions in East Africa. A conflict of interest in the Southern Pacific was amicably arranged by the Anglo-German

Convention of April 1886, in which a line of demarcation was drawn between the respective spheres of influence in the islands to the north and east of the Australian continent, and by the Convention of 1899, in virtue of which Germany gained possession of Samoa and renounced in favour of England all pretensions to the Tonga Archipelago.

In Asia the tendencies of the European Powers to terri- torial expansion, and their desire to secure new markets for their- trade and industry, have affected from time to time their mutual relations. More than once England and Russia have had disputes about the limits of their respective spheres of influence in Central Asia, but the causes of friction have steadily diminished as the work of frontier delimitation has advanced. The important agreement of 1872-3 was supplemented by the Protocol of 22nd July 1887 and the Pamir delimitation of 1895, so that the Eusso- Afghan frontier, which is the dividing line between the Russian and British spheres of influence, has now been carried right up to the frontier of the Chinese Empire. The delimitation of the English and French spheres of influence in Asia has also pro- gressed. In 1886 France endeavoured to get a footing on the Upper Irrawaddy, the hinterland of British Burma, and England replied in the following year by annexing the dominions of King Thebaw, including the Shan States as far east as the Mekong. Thereupon France pushed her Indo-Chinese frontier westwards, and in 1893 made an attack on the Kingdom of Siam, which very nearly brought about a conflict with England. After prolonged negotiations an arrangement was reached and embodied in a formal treaty (Jan. 1896), which clearly foreshadows a future partition between the two Powers, but guarantees the independence of the central portion of the kingdom, the Valley of the Menam, as a buffer-state. Further north, in Eastern China, the aggressive tendencies and mutual rivalries of the European Powers have produced a problem of a much more complicated kind. Firstly Germany, then Russia, next England, and finally France took portions of Chinese territory, under the thin disguise of long leases. They thereby excited in the Chinese population and Government an intense anti-foreign feel- ing, which produced the Boxer movement and culminated in the attack on the foreign legations at Pekin in the summer of 1900. An account of these events will be found in the article on China,

In 1899-1901 the relations of the European Powers were disturbed by the war in South Africa. In nearly

every country of Europe popular feeling was much ex- cited against England, and in certain influential quarters the idea was entertained of utilizing this feeling for fihe formation of a coalition against the British Empire ; but in view of the decided attitude assumed by the British Government, and the loyal enthusiasm displayed by the Colonies, no foreign Government ventured to take the initiative of intervention, and it came gradually to be recognized that no European state had any tangible in- terest in prolonging the independence and maladministrar tion of the Boer Republics. One permanent factor in the history of Europe during the last thirty years has been the constant increase of armaments by all the great Powers, and the proportionate increase of taxation. The fact made such an impression on the young Emperor of Russia, Nicholas II., that he invited the Powers to consider whether the further increase of the burdens thereby imposed on the nations might not be arrested by mutual agreement ; and a Conference for this purpose was convened at The Hague (18th May-29th July 1899), but the desirable object in view was not attained. (See

Akbitkation, International.) , ^

(d. m. w.)

Eutaw Springs, a village of Berkeley county. South Carolina, U.S.A. The Atlantic Coast railway con- nects it with Charleston and its fine harbour. One of the battles of the Revolutionary War was fought here, 8th Sep- tember 1781 ; the Americans losing 564, the British, 1000.

Eutin, a town of Prussia, capital of the principality of Lubeck, belonging to the grand duchy of Oldenburg. It is situated as an enclave in the most picturesque part of Holstein, 20 miles north from the city of Lilbeck by the railway to Kiel. It dates from the 12th century, and possesses a grand ducal castle, with a fine park, and a monument to Weber, the musician, who was born here in 1786. Towards the end of the 18th century Eutin acquired some fame as the residence of a group of contem- porary poets

and writers, of whom the best known were Voss, the two Stolbergs, and F. H. Jacobi. Population

(1900), 5204.

Evangelical Alliance. ??? This alliance, which is not a religious " denomination " but an association of in- dividual members of various Christian bodies, continues its effort to " enable Christians of different denominations and in all countries to realize in themselves, and to exhibit to others, that living and essential union which binds all true believers together in the fellowship of Christ," mean- while endeavouring to counteract " Infidelity, Romanism, and Ritualism, and the desecration of the Lord's Day." General conferences of the whole Alliance were held at Basle 1879, Copenhagen 1884, Florence 1891, and London 1896 ; and the fifty-fourth annual conference of the British organization was held in October 1900. The objects of the Alliance are now sometimes stated as follows: ??? (a) r/ie world girdled by prayer: a world-wide week of prayer is held annually, beginning on the first Sunday in the year. (6) Tlie maintenance of religious liberty throughout the world, (c) The relief of persecuted CJiristians in all parts : the Alliance has agents in many coimtries to help the persecuted, distribute relief, &c., and in Russia there is a travelling agent who endeavours to help the Stundists. (d) The manifestation of the ^m^ty of all believers and the upholding of the evangelical faith. The following publications maybe mentioned: ??? TTje^w?;- gelical Alliance Magazine, TJie Evangelical Alliance Quarterly, both published in London, and Jubilee of the Evangelical Alliance, London, 1897.

Evans, Sir John (1823), English archae- ologist, son of the Rev. Dr Evans, headmaster of

Market Bosworth Grammar School, was born at Britwell Court, 17th Novfember 1823. He was for many years head of the extensive paper manufactory at Nash Mills, Hemel Hempstead, still carried on by his family, but is especially distinguished as an antiquary and numismatist. He is the author of three books, standard in their respect- ive departments, Tlie Coins of the Ancient Britons, 1864; The Ancient Stone Implements, Weapons, and Ornaments of Great Britain, 1872 ; and The Ancient Bronze Imple- ments, Weapons, and Ornaments of Great Britain and Ireland, 1881. He has also written a number of separate papers on archaeological subjects. He was President of the Society of Antiquaries from 1885 to 1892, and has been President of the Numismatic Society since 1875 ; he has also presided over the Geological Society and the Anthropological Institute, and is a trustee of the British Museum. He was made a K.C.B. in 1892. His eldest son, Arthur John, born in 1851, has been keeper of the Ashmolean Museum at Oxford since 1884, and has taken a prominent part in the recent archaeological discoveries in Crete.

Evanston, a town of Cook county, Illinois, U.S.A., north of Chicago, of which it is a suburb, on the shore of Lake Michigan, and connected with Chicago by branches of the Chicago and North-Western and the Chicago, Mil- waukee, and St Paul railways. It is the seat of North- western University, a flourishing Methodist Episcopal coeducational institution, founded in 1855, of which the schools of medicine, law, pharmacy, and dentistry are located at Chicago. In 1900 its corps of professors and instructors in all departments numbered 265, and the students in attendance 2246, about one-quarter of whom were women ; 643 of the students were in the academic department and the remainder in the professional depart- ments. Population (1880), 6703 ; (1900), 19,259.

Evansville, capital of Vanderburg county, Indiana, U.S.A., in 38 ́́-00 N. lat. and 87 ́́-30 W. long,, on the north bank of Ohio river, at an altitude of 400 feet. The site of the city is the level valley of the Ohio ; the street plan is regular, and the houses are numbered on the decimal plan ; the city is supj)lied with water by the Holly pumping system, and is well sewered. The central part of the city is well paved with brick. It is the most important commercial and manufacturing city of South- ern Indiana, and the second city in population in the State. It has eight railways, affording

communication in all directions, and these, with the Ohio river, which is open and navigable at all times of the year, afford excel- lent avenues for trade. The invested manufacturing capital was, in 1890, $9,166,859 ; 7435 hands were em- ployed ; and the product was valued at $12,809,334. The principal products were clothing, flour, iron and steel goods, lumber and leather goods. The assessed valuation of real and personal property was, in 1900,' $25,321,680, the net debt of the city was $2,144,937, and the rate of taxation $27.80 per $1000. Population (1880), 29,280; (1900), 59,007, of whom 7518 were negroes. The death- rate in 1900 was 17-7.

Evarts, William Maxwell (1818-1901), Ameri- can lawyer, was born in Boston, 6th February 1818. Pie graduated at Yale in 1837, was admitted to the Bar in New York in 1841, and soon took high rank in his])r(:>- fession. In 1860 he was chairman of the NeV York delegation to the Eepublican national convention. In 1861 he was an unsuccessful candidate for the United States senatorship from New York. He \^as chief coun- sel for President Johnson during the impeachment trial, and from July 1868 until Marcli 1800 he was Attorney- General of the United States. In 1S72 he was counsel

for the United States in the Alabama arbitration. During President Hayes's administration, 1877-81, he was Secre- tary of State ; and from 1885 to 1891 he was one of the senators from New York. As an orator Senator Evarts stood in the foremost rank, and some of his best speeches were published. He died on 28th February 1901.

Everett, a city of Middlesex county, Massachusetts, U.S.A., a few miles north of Boston, and adjoining Maiden, of which it formed a part until 1870, when it was incor- porated as a town. It received a city charter in 1893. It has an undulating surface, and its street plan is irregular. It is on a branch of the Boston and Maine railway. Its manufactures, according to the State census of 1895, em- ployed a capital of $714,757, with 807 hands, and pro- duced goods valued at $1,884,193. Population (1880), 4159 ; (1900), 24,336, of whom 6882 were foreign-born.

Everett, a city of Snohomish county, Washington, U.S.A., on Puget Sound. At this point the main trans- continental line of the Great Northern railway reaches the western coast, whence it turns southwards

to Seattle and northwards to Vancouver. Kegular steamboat lines connect Everett with Seattle, Tacoma, and other Puget Sound ports. It has a good harbour and some com- merce ; in manufactures it has several large lumber and shingle mills, and a smelter, which is supplied with ores from the Cascade range. The city is of very recent growth. Population (1900), 7838, of whom 1677 were foreign- born.

Eversley, Charles Shaw Lefevre, Yiscouxt (1794-1888), Speaker of the British House of Com- mons, only son of Mr Charles Shaw (who assumed his wife's name of Lefevre in addition to his own on his marriage), was born in London on 27th February 1794, and educated at Winchester and at Trinity College, Cam- bridge. He was called to the Bar in 1819, and though a diligent student was also a keen sportsman. Marrying a daughter of Mr Samuel Whitbread, whose wife was the sister of Earl Grey, afterwards Premier, he thus became connected with two influential political families, and in 1830 he entered the House of Commons as member for Downton,in the Liberal interest. In 1831 he was returned, after a severe contest, as one of the county members for Hampshire, in which he resided ; and after the passmg of the Reform Act of 1832 he was elected for the North- ern Division of Hampshire. For some years Mr Shaw Lefevre was Chairman of a Committee on Petitions for Private Bills. In 1835 he was Chairman of a Committee on Agricultural Distress, but as his report was not accepted by the House, he published it as a pamphlet addressed to his constituents. He acquired a high reputation in the House of Commons for his judicial fairness, combined with singular tact and courtesy, and when Mr Speaker Abercromby suddenly retired in 1839, he was nominated as the Liberal candidate for the chair. The Conservatives put forward Mr Goulburu, but INlr Shaw Lefevre was elected by 317 to 299 votes. The period was one of fierce party conflict, and the debates were frequently ver)- acrimonious ; but the dignity, temper, and firmness of the new Speaker were never at fault. In 1867 he had served longer than any of his i)redecessors except the celebrated Arthur Onslow, and retired on a pension, being raised to the peerage as Viscount Eversley of Heckfield, in the county of Southampton. His appearances in the House of Lords were very infrequent, but in his own county he was active in tlie public service. From 1859 he was an Ecclesiastical Commissioner, and he was also appointed a Trustee of the

British Museum. He died on 29th December 1888, the title becoming extinct. (g. b. s.)

E V E S H A M ???E V I D E N C E, LAW OF

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Evesham, a municipal borough and market town in the Evesham parliamentary division (since 1885) of Worcestershire, England, on the Avon, 15 miles south-east by east of Worcester by rail. A cottage hospital, a sana- torium, and a Catholic church have been erected. The

Evesham Institute Buildings have been acquired by the Corporation and opened as a free library and for classes of technical education ; and the grammar school has been reorganized. Area, 2265 acres : population (1881), 6112 ;

(1901), 7100.

EYIDEJ^CE, LAW OF

EVIDENCE may be described briefly as consisting of facts presented to the mind of a person for the purpose of enabling him to decide a disputed question of fact. Evidence in the widest sense includes all such facts. In a narrower sense it includes only such facts as are allowed by English law to be so presented in the course of judicial proceedings. Thus we say that a fact is not evidence, meaning thereby that it is not admissible as evidence in accordance with the rules of English law. The law of evidence is part of the law of procedure. It determines the kinds of evidence which may be produced in judicial proceedings, and regulates the mode in which, and the conditions under which, evidence may be produced and tested.

The English law of evidence is of comparatively modern growth. It enshrines certain maxims, some derived from Roman law, some invented by Coke, who, as Mr History. Thayer says, “spawned Latin maxims freely.” But for the most part it was built up by English judges in the course of the 18th century, and consists of this judge-made law, as

modified by statutory enactments of the 19th century. Early Teutonic procedure knew nothing of evidence in the modern sense, just as it knew nothing of trials in the modern sense. What it knew was ‘ ‘ proofs. ‘ ‘ There were two modes of proof, ordeals and oaths. Both were appeals to the supernatural. The judicial combat was a bilateral ordeal. Proof followed, instead of preceding, judgment. A judgment of the court, called by German writers the Beweis-urtheil, and by Mr Bigelow the “medial judgment,” awarded that one of the two litigants must prove his case, by his body in battle, or by a one-sided ordeal, or by an oath with oath-helpers, or by the oaths of witnesses. The court had no desire to hear or weigh conflicting testimony. To do so would have been to exercise critical faculties, which the court did not possess, and the exercise of which would have been foreign to the whole spirit of the age. The litigant upon whom the burden of furnishing proof was imposed had a certain task to perform. If he performed it, he won ; if he failed, he lost. The number of oath-helpers varied in different cases, and was determined by the- law or by the court. They were probably, at the outset, kinsmen, who would have had to take up the blood-feud. At a later stage they became witnesses to character. In the cases, comparatively rare, where the oaths of witnesses were admitted as proof, their oaths differed materially from the sworn testimony of modern courts. As a rule no one could testify to a fact unless, when the fact happened, he was solemnly “taken to witness.” Then, when the witness was adduced, he came merely to swear to a set formula. He did not make a promissory oath to answer questions truly. He merely made an assertory oath in a prescribed form.

In the course of the 12th and 13th centuries the old formal, accusatory procedure began to break down, and to be super- seded by another form of procedure known as inquisitio, inquest, or enquete. Its decay was hastened by the decree of the fourth Lateran Council in 1215, which forbade ecclesiastics to take part in ordeals. The Norman administrative system introduced into England by the Conquest was familiar with a method of ascertain- ing and determining facts by means of a verdict, return, or find- ing made on oath by a body of men drawn from the locality. The system may be traced to Carolingiau, and even earlier, sources. Henry II., by instituting the Grand Assize and the four petty assizes, placed at the disposal of litigants in certain actions the

opportunity of giving proof by the verdict of a sworn inquest of neighbours, proof "by the country." The system was gradually extended to other cases, criminal as well as civil. The verdict given was that of persons having a general, but not necessarily a particular, acquaintance with the persons, places, and facts to which the inquiry related. It wa;s, in fact, a finding by local popular opinion. Had the finding of such an inquest been treated as final and conclusive in criminal oases, English criminal procedure might, like the Continental inquisition, the French enquete, have taken the path which, in the forcible language

of Fortescue (De Laudibus, &c.) "leads to hell" {Semita ipsa est ad gehennam). Fortunately English criminal procedure took a different course. The spirit of the old accusatory pro- cedure was applied to the new procedure by inquest. In serious cases the words of the jurors, the accusing jurors, were treated not as testimony, but as accusation, the new indictment was treated as corresponding to the old appeal, and the preliminary finding by the accusing jury had to be supplemented by the verdict of another jury. In course of Jtime fhe second jury were required to base their findings not on their own knowledge, but on evidence submitted to them. Thus the modern system of inquiry by grand jury and trial by petty jury was gradually developed.

A few words may here be said about the parallel development of criminal procedure on the Continent. The tendency in the 12th and 13th centuries to abolish the old formal methods of procedure, and to give the new procedure the name of inquisi- tion or inquest, was not peculiar to England. Elsewhere the old procedure was breaking down at the same time, and for similar reasons. It was the great pope Innocent III., the pope of the fourth Lateran Council, who introduced the new in- quisitorial procedure into the canon law. The procedure was applied to cases of heresy, and, as so applied, especially by the Dominicans, speedily assumed the features which made it in- famous. " Every safeguard of innocence was abolished or dis- regarded ; torture was freely used. Everything seems to have been done to secure a conviction." Tet, in spite of its monstrous defects, the inquisitorial procedure of the ecclesiastical courts, secret in its methods, unfair to the accused, having torture as an integral element, gradually forced its way into the temporal courts, and may almost be said

to have been adopted by the common law of western Europe. In connexion with this in- quisitorial procedure Continental jurists elaborated a theory of evidence, or judicial proofs, which formed the subject of an extensive literature. Under the rules thus evolved full proof (plena prohatio) was essential for conviction, in the absence of confession, and the standard of full proof was fixed so high that it was in most cases unattainable. It therefore became material to obtain confession by some means or other. The most effective means was torture, and thus torture became an essential feature in criminal procedure. The rules of evidence attempted to graduate the weight to be attached to different kinds of testi- mony and almost to estimate that weight in numerical terms, "ie parlement de Toulouse," said Voltaire, "a un usage tres singulier dans les preuves par temoins. On admet ailleurs des demi-preuves. . . . mais a Toulouse on admet des quarts et des huitiemes de preuves." Modern Continental procedure, as em- bodied in the most recent codes, has removed the worst features of inquisitorial procedure, and has shaken itself free from the trammels imposed by the old theory and technical rules of proof. But in this, as in other branches of law, France seems to have paid the penalty for having been first in the field with codification by lagging behind in material reforms. The French Code of Criminal Procedure was largely based on Colbert's Ordonnance of 1670, and though embodying some reforms, and since amended on certain points, still retains some of the features of the un- reformed procedure which was condemned in the 18th century by Voltaire and the philosophes. Military procedure is in the rear of civil procedure, and the trial of Dreyfus at Eennes presented some interesting archaisms. Among these were the weight attached to the rank and position of witnesses as compared with the intrinsic character of their evidence, and the extraordinary im- portance attributed to confession even when made under suspicious circumstances and supported by flimsy evidence.

The history of criminal procedure in England has been traced by Sir James Stephen. The modern rules and practice as to evidence and witnesses in the Common Law courts, both in civil and in criminal oases, appear to have taken shape in the course of the 18th century. The first systematic treatise on the English law of evidence appears to have been written by Chief Baron Gilbert, who died in 1726, but whose Law of

Evidence was not published until 1761. In writing it he is said to have been much influenced by Locke. i It is highly praised by Black-

‘Reference may be made to a well-known passage in the Essay

stone as ” a work which it is impossible to abstract or abridge with- out losing some beauty and destroying the charm of the whole ” ; but Bentham, who rarely agrees with Blackstone, speaks of it as running throughout “in the same strain of anility, garrulity, narrow-mindedness, absurdity, pei-petual misrepresentation, and indefatigable self-contradiction.” In any case it remained the standard authority on the law of evidence throughout the remainder of the 18th century. Bentham wrote his Rationale of Judicial Evidence, specially applied to English Practice, at various times between the years 1802 and 1812. By this time he had lost the nervous and simple style of his youth, and required an editor to make him readable. His great interpreter, Dumont, condensed his views on evidence into the Traite des Preuves Judiciaires, which was published in 1823. The manuscript of the Mationale was edited for English reading, and to a great extent rewritten, by J. S. Mill, and was published in five volumes in 1827. The book had a great effect both in England and on the Continent. The English version, though crabbed and artificial in style, and unmeasured in its invective, is a storehouse of comments and criticisms on the principles of evidence and the practice of the courts, which are always shrewd and often profound. Bentham examined the prac- tice of the courts by the light of practical utility. Starting from the principle that the object of judicial evidence is the discovery of truth, he condemned the rules which excluded some of the best sources of evidence. The most characteristic feature of the com- mon-law rules of evidence was, as Bentham pointed out, and, in- deed, still is, their exclusionary character. They excluded and prohibited the use of certain kinds of evidence which would be used in ordinary inquiries. In particular, they disqualified certain classes of witnesses on the ground of interest in the subject-matter of the inquiry, instead of treating the interest of the witness as a matter affecting his credibility. It was against this

confusion between competency and credibility that Bentham directed his principal attack. He also attacked the system of paper evidence, evidence by means of affidavits instead of by oral testimony in court, which prevailed in the Court of Chancery, and in ecclesiastical courts. Subsequent legislation has endorsed liis criticisms. The Judicature Acts have reduced the use of affidavits in Chancery proceedings within reasonable limits. A series of Acts of Parliament have re- moved, step by step, almost all the disqualifications which formerly made certain witnesses incompetent to testify.

Before Bentham's work appeared, an Act of 1814 (54 Geo. III. c. 170, s. 9) had removed the incompetency of ratepayers as wit- nesses in certain cases relating to parishes. The Civil Procedure Act, 1833, enacted that a witness should not be objected to as incompetent solely on the ground that the verdict or judgment would be admissible in evidence for or against him. An Act of 1840 (3 and 4 Vict. c. 26) removed some doubts as to the compe- tency of ratepayers to give evidence in matters relating to their parish. The Evidence Act, 1843, enacted broadly that witnesses should not be excluded from giving evidence by reason of incapacity from crime or interest. The Evidence Act, 1851, made parties to legal proceedings admissible witnesses subject to a proviso that " nothing herein contained shall render any person who in any criminal proceeding is charged with the commission of any indict- able offence, or any offence punishable on summary conviction, competent or compellable to give evidence for or against himself or herself, or shall render any person compellable to answer any question tending to criminate himself or herself, or shall in any criminal proceeding render anV hixsband competent or compellable to give evidence for or against his wife, or any wife competent or compellable to give evidence for or against her husband." The Evidence (Scotland) Act, 1853, made a similar provision for Scot- land. The Evidence Amendment Act, 1853, made the husbands and wives of parties admissible witnesses, except that husbands and wives could not give evidence for or against each other in criminal proceedings or in proceedings for adultery, and could not be compelled to disclose communications made to each other dur- ing marriage. Under the Matrimonial Causes Act, 1857, the peti- tioner can be examined and cross-examined on oath at the hearing, but is not bound to answer any

question tending to show that he or she has been guilty of adultery. Under the Matrimonial Causes Act, 1859, on a wife's petition for dissolution of marriage on the ground of adultery coupled with cruelty or desertion, husband and wife are competent and compellable to give evidence as to the cruelty or desertion. The Crown Suits &c. Act, 1865, de-

concerning Human Understanding (Book iv. ch. xv.) : ??? "The grounds of probability are ??? First, the conformity ot anything with our owu knowledge, observation, and experience. Second, the testimony of others touching their observation and experience. In the testimony of others is to be considered (1) the number. (2) The integrity. (3) The skill of the witnesses. (4) The design of the author, where it is a testimony out of a book cited. (5) The consistency of the parts and circumstances of the relation. (6) Contrary testimonies."

clared that revenue proceedings were not to be treated as crimi- nal proceedings for the purposes of the Acts of 1851 and 1853. The Evidence Further Amendment Act, 1869, declared that par- ties to actions for breach of promise of marriage were competent to give evidence in the action, subject to a proviso that the plaintiff should not recover unless his or her testimony was corroborated by some other material evidence. It also made the parties to proceedings instituted in consequence of adultery, and their husbands and wives, competent to give evidence, but a witness in any such proceeding, whether a party or not, is not to be liable to be asked or bound to answer any question tending to show that he or she has been guilty of adultery, unless the wit- ness has already given evidence in the same proceeding in disproof of the alleged adultery. There are similar provisions applying to Scotland in the Conjugal Eights (Scotland) Amend- ment Act, 1861, and the Evidence Further Amendment (Scotland) Act, 1874. The Evidence Act, 1877, enacts that " on the trial of any indictment or other proceeding for the non-repair of any public highway or bridge, or for a nuisance to any public highway, river, or bridge, and of any other indictment or proceeding instituted for the purpose of trying or enforcing a civil right only, every defendant to such indictment or proceeding, and the wife or husband of any such defendant, shall be admissible witnesses and compeUable to give evidence." From 1872 onwards numerous enactments were passed

making persons charged with particular offences, and their husbands and wives, competent witnesses. The language and effect of these enactments were not always the same, but the insertion of some provision to this effect in an Act creating a new offence, especially if it was punishable by summary proceedings, gradually became almost a common form in legisla- tion. In the year 1874 a bill to generaUze these particular provisions, and to make the evidence of persons charged with criminal offences admissible in all cases was introduced by Mr Gladstone's Government, and was passed by the Standing Com- mittee of the House of Commons. During the next fourteen years bills for the same purpose were repeatedly introduced, either by the Government of the day, or by Lord Bramwell as an independ- ent member of the House of Lords. Finally, the Criminal Evi- dence Act, 1898, introduced by Lord Halsbury, has enacted in general terms that "every person charged with an offence, and the wife or husband, as the case may be, of the person so charged, shall be a competent witness for the defence at every stage of the proceedings, whether the person so charged is charged solely or jointly with any other person." But this general enactment is qualified by some special restrictions, the nature of which will be noticed below. The Act applies to Scotland but not to Ireland. It was not to apply to proceedings in courts-martial unless so applied by general orders or rules made under statutory authority. The provisions of the Act have been applied by rules to militaiy courts-martial, but have not yet been applied to naval courts- martial. The removal of disqualifications for want of religious belief is referred to below under the head of " Witnesses."

The Act of 1898 finishes for the present the history of legisla- tion on evidence. For a view of the legal literature on the subject it is necessary to take a step backwards. Early in the 19th century Chief Baron Gilbert was ^ ❑❑❑❑"""'❑❑❑- superseded as an authority on the English law of evidence by the books of Phillips (1814) and Starkie (1824), who were followed by Roscoe (Nisi Prius, 1827; Criminal Cases, 1835), Greenleaf (American, 1842), Taylor (based on Greenleaf, 1848), and Best (1849). In 1876 Sir James FitzJames Stephen brought out his Digest of the Law of Evidence, based upon the Indian Evidence Act, 1872, which he had prepared and passed as law member of the Council of the Governor-General of India. This Digest ob- tained a rapid and well-deserved

success, and has materially influenced the form of subsequent writings on the English law of evidence. It sifted out what Stephen conceived to be the main rules of evidence from the mass of extraneous matter in which they had been embedded. Roscoe's Digests told the lawyer what things must be proved in order to sustain particular actions or criminal charges, and related as much to pleadings and to sub- stantive law as to evidence proper. Taylor's two large volvimes were a vast storehouse of useful information, but his book was one to consult, not to master. Stephen eliminated much of this ex- traneous matter, and summed up his rules in a series of succinct propositions, supplemented by apt illustrations, and couched in such a form that they could be easily read and remembered. Hence the English Digest, like the Indian Act, has been of much educational value. Its most original feature, but unfortunately also its weakest point, is its theory of relevancy. Pondering the multitude of "exclusionary" rules which had been laid down by the English courts, Stephen thought that he had dis- covered the general principle on which those rules reposed, and could devise a formula by which the principle could be expressed. "My study of the subject," he says, "both practically and in books has convinced me that the doctrine that all facts in issue

and relevant to the issue, and no others, may be proved, is the unexpressed principle which forms the centre of and gives unity to all the express negative rules which form the great mass of the law." The result was the chapter on the Relevancy of Facts in the Indian Evidence Act, and the definition of relevancy in s. 7 of that Act. This definition was based on the view that a distinc- tion could be drawn between things which were and things which were not causally connected with each other, and that relevancy depended on causal connexion. Subsequent criticism convinced Stephen that his definition was in some respects too narrow and in others too wide, and eventually he adopted a definition out of which all reference to causality was dropped. But even in their amended form the provisions about relevancy are open to serious criticism. The doctrine of relevancy, i.e., of the probative effect of facts, is

a branch of logic, not of law, and is out of place both in an enactment of the Legislature and in a compendium of legal rules. The necessity under which Stephen found himself of extending the range of relevant facts by making it include facts " deemed to be relevant," and then narrowing it by enabling the judge to exclude evidence of facts which are relevant, illustrates the difference between the rules of logic and the rules of law. Relevancy is one thing ; admissibility is another ; and the con- fusion between them, which is much older than Stephen, is to be regretted. Rightly or wrongly English judges have, on prac- tical grounds, declared inadmissible evidence of facts, which are relevant in the ordinary sense of the term, and which are so treated in non-judicial inquiries. Under these circumstances the attempt so to define relevancy as to make it conterminous with admissibility is misleading, and most readers of Stephen's Act and Digest would find them more intelligible and more useful if " ad- missible" were substituted for "relevant" throughout. Indeed it is hardly too much to say that Stephen's doctrine of relevancy is theoretically unsound and practically useless. The other parts of the work contain terse and vigorous statements of the law, but a Procrustean attempt to make legal rules square with a pre- conceived theory has often made the language and arrangement artificial, and the work, in spite of its compression, still contains rules which, under a more scientific treatment, would find their appropriate place in other branches of the law. These defects are characteristic of a strong and able man, who saw clearly, and expressed forcibly what he did see, but was apt to ignore or to deny the existence of what he did not see, whose mind was vigorous rather than subtle or accurate, and who, in spite of his learning, was somewhat deficient in the historical sense. But notwithstanding these defects, the conspicuous ability of the author, his learning, and his practical experience, especially in criminal cases, attach greater weight to FitzJames Stephen's statements than to those of any other English writer on the law of evidence.

Before proceeding to summarize the existing rules of the law of evidence, it may be useful to make some pre- liminary remarks.

The object of every trial is, or may be, to determine two classes of questions or issues, which are usually dis- tinguished as questions of law,

and questions of fact, although the distinction between them is not so clear as might appear on a superficial view. In a trial by jury these two classes of questions are answered by different persons. The judge lays .down the law. The jury, under the guidance of the judge, find the facts. It was with reference to trial by jury that the English rules of evidence were originally framed ; it is by the peculiarities of this form of trial that many of them are to be explained ; it is to this form of trial alone that some of the most important of them are exclusively applicable. The negative, exclusive, or exclusionary rules which form the characteristic features of the English law of evidence, are the rules in accordance with which the judge guides the jury. There is no diiierence of principle between the method of inquiry in judicial and in non-judicial pro- ceedings. In either case a person who wishes to find out whether a particular event did or did not happen, tries, in the first place, to obtain information from persons who were present and saw what happened (direct evidence), and, failing this, to obtain information from persons who can tell him about facts from which he can draw an inference as to whether the event did or did not happen (indirect evidence) . But in judicial inquiries the informa- tion given must be given on oath, and be liable to be

Rales.

tested by cross-examination. And there are rules of law which exclude from the consideration of the jury certain classes of facts which, in an ordinary inquiry, would, or might, be taken into consideration. Eacts so excluded are said to be " not admissible as evidence," or " not evidence," according as the word is used in the wider or in the narrower sense. And the easiest way of determining whether a fact is or is not evidence in the narrower sense, is first to consider whether it has any bearing on the question to be tried, and, if it has, to consider whether it falls within any one or more of the rules of exclusion laid down by English law. These rules of exclusion are peculiar to English law and to systems derived from English law. They have been much criticized, and some of them have been repealed or materially modified by legislation. Most of them may be traced to directions given by a judge in the course of trying a particular case, given with special reference to the circumstances of that case, but expressed in general language, and, partly through the influence of text-

writers, eventually hardened into general rules. In some cases their origin is only intelligible by reference to obsolete forms of pleading or practice. But in most cases they were originally rules of convenience laid down by the judge for the assistance of the jury. The judge is a man of trained experience, who has to arrive at a conclusion with the help of twelve un-trained men, and who is naturally anxious to keep them straight, and give thfem every assistance in his power. The exclusion of certain forms of evidence assists the jury by concentrating their attention on the questions immediately before them, and by preventing them from being distracted or bewildered by facts which either have no bearing on the question before them, or have so remote a bearing on those questions as to be practically useless as guides to the truth. It also prevents a jury from being misled by statements the effect of which, through the prejudice they excite, is out of all proportion to their true weight. In this respect the rules of exclusion may be compared to blinkers, which keep a horse's eyes on the road before him. In criminal cases the rules of exclusion secure fair play to the accused, because he comes to the trial prepared to meet a specific charge, and ought not to be suddenly confronted by statements which he had no reason to expect would be made against him. They protect absent persons against statements affecting their character. And lastly they prevent the infinite waste of time which would ensue in the discussion of a question of fact if an inquiry were allowed to branch out into all the subjects with which that fact is more or less connected. The purely practical grounds on which the rules are based, according to the view of a great judge, may be illustrated by some remarks of the late Mr Justice Willes. In discussing the question whether evidence of the plaintiff's conduct on other occasions ought to be admitted, he said : ???

It is not easy in all cases to draw the line and to define with accuracy where probability ceases and speculation begins ; but we are bound to lay down the rule to the best of our ability. No doubt the rule as to confining the evidence to that which is relevant and pertinent to the issue is one of great importance, not only as regards the particular case, but also with reference to saving the time of the court, and preventing the minds of the jury from being drawn away from the real point they have to decide. . . . Now it appears to me that the evidence proposed to be given in this case, if admitted, would not have shown that it was more probable that the

contract was subject to the condition insisted upon by the defendant. The question may be put thus, Does the fact of a person having once or many times in his life done a particular act in a particular way make it more probable that he has done the same thing in the same way upon another and different occasion? To admit such speculative evidence would, I think, be fraught with great danger. ... If such ??? evidence were held admissible it would be difficult to say that the defendant might not in any case, where the question was whether

or not there had been a sale of goods on credit, call witnesses to prove that the plaintiff had dealt with other persons upon a certain credit ; or, in an action for an assault, that the plaintiff might not give evidence of former assaults committed by the de- fendant upon other persons, or upon other persons of a particular class, for the purpose of showing that he was a quarrelsome individual, and therefore that it was highly probable that the particiilar charge of assault was well founded. The extent to which this sort of thing might be carried is inconceivable. . . . To obviate the prejudices, the injustice, and the waste of time to ???which the admission of such evidence would lead, and bearing in mind the extent to which it might be carried, and that litigants are mortal, it is necessary not only to adhere to the rule, but to lay it down strictly. I think, therefore, the fact that the plaintiff had entered into contracts of a particular kind with other persons on other occasions could not be properly admitted in evidence where no custom of trade to make such contracts, and no con- nexion between such and the one in question, was shown to exist {Hollingham v. Hmd, 1858, 4 C.B. N.S. 388).

There is no difference between the principles of evidence in civil and in criminal cases, although there are a few special rules, such as those relating to confessions and to dying declarations, which are only applicable to criminal proceedings. But in civil proceedings the issues are narrowed by mutual admissions of the parties, more use is made of evidence taken out of court, such as affidavits, and, generally, the rules of evidence are less strictly applied. It is often impolitic to object to the

admission of evidence, even when the objection may be sustained by previous rulings. The general tendency of modern procedure is to place a more liberal and less technical con- struction on rules of evidence, especially in civil cases. In recent volumes of law reports cases turning on the admissibility of evidence are conspicuous by their rarity. Various causes have operated in this direction. One of them has been the change in the system of pleading, under which each party now knows before the actual trial the main facts on which his opponent relies. Another is the interaction of chancery and common-law practice and traditions since the Judicature Acts. In the Chancery Courts the rules of evidence were always less carefully observed, or, as Westminster would have said, less under- stood, than in the courts of common law. A judge trying questions of fact alone might naturally think that blinkers, though useful for a jury, are unnecessary for a judge. And the chancery judge was apt to read his affidavits first, and to determine their admissibility afterwards. In the meantime they had affected his mind.

The tendency of modern text-writers, among whom the late Professor Thayer, of Harvard University, was perhaps the most independent, instructive, and suggestive, is to restrict materially the field occupied by the law of evidence, and to relegate to other branches of the law topics traditionally treated under the head of evidence. Thus in every way the law of evidence, though still em- bodying some principles of great importance, is of less comparative importance as a branch of English law than it was half a century ago. Legal rules, like dogmas, have their growth and decay. First comes the judge who gives a ruling in a particular case. Then comes the text-writer who collects the scattered rulings, throws them into the form of general propositions, connects them together by some theory, sound or unsound, and often ignores or obscures their historical origin. After him comes the legislator who crystallizes the propositions into enact- ments, not always to the advantage of mankind. So also with decay. Legal rules fall into the background, are explained away, are ignored, &,re denied, are overruled. Much of the English law of evidence is at present in a stage of decay.

The subject-matter of the law of evidence may be arranged differently according to the taste or point of view of the writer. It will be arranged

here under the

following heads ; ❓❓❓ I. Preliminary Matter ; II. Classes of Evidence; IIL Eules of Exclusion; IV. Documentary Evidence; V. Witnesses.

I. Preliminary Matter.

Under this head may be grouped certain principles and considerations which limit the range of matters to which pvi flf HOP rGiSitiGS

1. Law and J'acf. ❓❓❓ Evidence relates only to facts. It is therefore necessary to touch on the distinction between law and facts. Ad quaestionem facti non respondent judices; ad quaestionem juris non respondent juratores. Thus Coke, attributing, after his wont, to Bracton a maxim which may have been invented by himself. The maxim became the subject of political controversy, and the two rival views are represented by Pulteney's lines ❓❓❓

For twelve honest men have decided the cause. Who are judges alike of the facts and the laws,

and by Lord Mansfield's variant ❓❓❓

Who are judges of facts, but not judges of laws. '

The particular question raised with respect to the law of libel was settled by Pox's Libel Act. Coke's maxim describes in a broad general way the distinction between the functions of the judge and of the jury, but is only true subject to important qualifications. Judges in jury cases constantly decide what may be properly called ques- tions of fact, though their action is often disguised by the language applied or the procedure employed. Juries, in giving a general verdict, often practically take the law into their own hands. The border line between the two classes of questions is indicated by the " mixed questions of law and fact," to use a common phrase, which arise in such cases as those relating to " necessaries," " due dili- gence," " negligence," " reasonableness," " reasonable and probable cause." In the treatment of these cases the line has been drawn differently at different times, and two conflicting tendencies are

discernible. On the one hand, there is the natural tendency to generalize common infer- ences into legal rules, and to fix legal standards of duty. On the other hand, there is the sound instinct that it is a mistake to define and refine too much in these cases, and that the better course is to leave broadly to the jury, under the general guidance of the judge, the question what would be done by the " reasonable " or " prudent " man in particular cases. The latter tendency predominates in modern English law, and is reflected by the enactments in the recent Acts codifying the law on bills of exchange and sale of goods, that certain questions of reasonableness are to be treated as questions of fact. On the same ground rests the dislike to limit the right of a jury to give a general verdict in criminal cases. Questions of custom begin by being questions of fact, but as the custom ob- tains general recognition it becomes law. JNIauy of the rules of the English mercantile law were " found " as customs by Lord Mansfield's special juries. Generally, it must be remembered that the jury act in subordinate co-operation with the judge, and that the extent to which the judge limits or encroaches on the province of the jury is apt to depend on the personal idiosyncrasy of the judge.

2. Judicial Notice. ❓❓❓ It may be doubted whether the subject of judicial notice belongs properly to the law of evidence, and whether it does not belong rather to the general topic of legal or judicial reasoning. Matters which are the subject of judicial notice are part of the equipment of the judicial mind. It would be absurd to require evidence of every fact ; many facts must be assumed to be known. The judge, like the juryman, is supposed to bring with him to the consideration of the question which he

has to try common sense, a general knowledge of human nature and the ways of the world, and also knowledge of things that " everybody is supposed to know." Of such matters judicial notice is said to be taken. But the range of general knowledge is indefinite, and the range of judi- cial notice has, for reasons of convenience, been fixed or extended, both by rulings of the judges and by numerous enactments of the Legislature. It would be impossible to enumerate here the matters of which judicial

notice must or may be taken. These are to be found in the text- books. For present purposes it must suffice to say that they include not only matters of fact of common and cer- tain knowledge, but the law and practice of the courts, and many matters connected with the government of the country.

3. Presumptions. ??? A presumption in the ordinary sense is an inference. It is an argument, based on observa- tion, that what has happened in some cases will prob- ably happen in others of the like nature. The subject of presumptions, so far as they are mere inferences or arguments, belongs, not to the law of evidence, or to law at all, but to rules of reasoning. But a legal presump- tion, or, as it is sometimes called, a presumption of law, as distinguished from a presumption of fact, is some- thing more. It may be described, in Stephen's language, as " a rule of law that courts and judges shall draw a particular inference from a particular fact, or from particular evidence, unless and until the truth " (perhaps it would be better to say ' soundness ') "of the infer- ence is disproved." Courts and legislatures have laid down such rules on grounds of public policy or general convenience, and the rules have then to be observed as Tules of positive law, not merely used as part of the ordinary process of reasoning or argument. Some so- called presumptions are rules of substantive law under a disguise. To this class appear to belong " conclusive presumptions of law," such as the common-law pre- sumption that a child under seven years of age cannot ???commit a felony. So again the presumption that every one knows the law is merely an awkward way of saying that ignorance of the law is not a legal excuse for breaking it. Of true legal presumptions, the majority may be dealt with most appropriately under different branches of the substantive law, such as the law of crime, of property, or of contract, and' accordingly Stephen has included in his Digest of the Law of Evidence only some which are common to more than one branch of the law. The effect of a presumption is to impute to certain facts or groups of facts a, primd facie significance or operation, and thus, in legal proceedings, to throw upon the party against whom it works the duty of bringing forward evidence to meet it. Accordingly the subject of presumptions is intimately connected with the subject of the burden of proof, and the same legal rule may be expressed in different forms, either as throwing the advantage of a presumption on

one side, or as throwing the burden of proof on the other. Thus the rule in Stephen's Digest, which says that the burden of proving that any person has been guilty of a crime or wrongful act is on the person who asserts it, appears in the article entitled " Presumption of Innocence." Among the more ordinary and more important legal presumptions are the presumption of regularity in proceedings, described generally as a presumption omnia esse rite acta, and in- cluding the presumption that the holder of a public office has been duly appointed, and has duly performed his official duties, the presumption of the legitimacy of a child born during the mother's marriage, or within the period of gestation after her husband's death, and the presumptions as to life and death. "A person shown not to have been heard of for seven years by those (if any) who, if he had been alive, would naturally have

heard of him, is presumed to be dead unless the circum- stances of the case are such as to account for his not being heard of without assuming his death ; but there is no presumption as to the time when he died, and the burden of proving his death at any particular time is upon the person who asserts it. There is no presump- tion" ((.e., legal presumption) "as to the age at which a person died who is shown to have been alive at a given time, or as to the order in which two or more per- sons died who are shown to have died in the same acci- dent, shipwreck, or battle" (Stephen, Dig., art. 99). A document proved or purporting to be thirty years old is presumed to be genuine, and to have been properly executed and (if necessary) attested if produced from the proper custody. And the legal presumption of a " lost grant," i.e., the presumption that a right or alleged right which has been long enjoyed without interruption had a legal origin, still survives in addition to the common law and statutory rules of prescription.

4. Burden of Proof. ??? The expression onus probandi has come down from the classical Roman law, and both it and the Roman maxims, Agenti incumbit probatio, Neces- sitas probandi incumbit ei qui dicit non, ei qui negat, and Reus excipiendo fit actor, must be read with reference to the Roman system of actions, under which nothing was admitted, but the plaintiff's case was tried first ; then, unless that failed, the defendant's on his exceptio ; then, unless that failed, the plaintiff's on his replicatio, and

so on. Under such a system the burden was always on the " actor." In modern law the phrase " burden of proof " may mean one of two things, which are often confused ??? the burden of establishing the proposition or issue on which the case depends, and the burden of producing evidence on any particular point either at the beginning or at a later stage of the case. The burden in the former sense ordinarily rests on the plaintiff or prosecutor. The burden in the latter sense, that of going forward with evidence on a particular point, may shift from side to side as the case proceeds. The general rule is that he who alleges a fact must prove it, whether the allegation is couched in affirmative or negative terms. But this rule is subject to the effect of presumptions in particular cases, to the principle that in considering the amount of evidence necessary to shift the burden of proof regard must be had to the opportunities of knowledge possessed by the parties respectively, and to the express provisions of statutes directing where the burden of proof is to lie in particular cases. Thus many statutes expressly direct that the proof of lawful excuse or authority, or the absence of fraudulent intent, is to lie on the person charged with an offence. And the Summary Jurisdiction Act, 1848, provides that if the information or complaint in summary proceedings nega- tives any exemption, exception, proviso, or condition in the statute on which it is founded, the prosecutor or com- plainant need not prove the negative, but the defendant may prove the affirmative in his defence.

II. Classes of Evidence. Evidence is often described as being either oral or documentary. To these two classes should be added a third, called by Bentham real evidence and consisting of things presented immediately to the senses of the judge or the jury. Thus the judge or jury may go to view any place the sight of which may help to an understanding of the evidence, and may inspect anything sufficiently- identified and produced in court as material to the deci- sion. Weapons, clothes, and things alleged to have been stolen or damaged are often brought into court for this purpose. Oral evidence consists of the statements of witnesses. Documentary evidence consists of documents submitted to the judge or jury by way of proof. The

distinction between primary and secondary evidence re- lates only to documentary evidence, and will be noticed in the section under that head. A division of evidence from another point of view is that into direct and indirect, or as it is sometimes called, circumstantial evidence. By direct evidence is meant the statement of a person who saw, or otherwise observed with his senses, the fact in question. By indirect or circumstantial evidence is meant evidence of facts from which the fact in question may be inferred. The difference between direct and indirect evi- dence is a difference of kind, not of degree, and there- fore the rule or maxim as to "best evidence" has no application to it. Juries naturally attach more weight to direct evidence, and in some legal systems it is only this class of evidence which is allowed to have full probative force. In some respects indirect evidence is superior to direct evidence, because, as Paley puts it, " facts cannot lie," whilst witnesses can and do. On the other hand facts often deceive; that is to say, the inferences drawn from them are often erroneous. The circumstances in which crimes are ordinarily committed are such that direct evidence of their commission is usually not obtain- able, and when criminality depends on a state of mind, such as intention, that state must necessarily be inferred by means of indirect evidence.

III. Rules of Exclusion.

It seems desirable to state the leading rules of exclusion in their crude form instead of obscuring their historical origin by attempting to force them into the shape of pre- cise technical propositions forming parts of a logically connected system. The judges who laid the foundations of our modern law of evidence, like those who first dis- coursed on the duties of trustees, little dreamt of the elaborate and artificial system which was to be based upon their remarks. The rules will be found, as might be expected, to be vague, to overlap each other, to require much explanation, and to be subject to many exceptions. They may be stated as follows : ??? (1) Facts not relevant to the issue cannot be admitted as evidence. (2) The evidence produced must be the best obtainable under the circumstances. (3) Hearsay it not evidence. (4) Opinion is not evidence.

1. Rule of Relevancy. ??? The s^called rule of relevancy is sometimes stated by text-writers in the form in which it was laid down by Baron Parke in 1837 (Wright v. Doe and TatJiam, 7 A. and E. 384), when he described " one great principle " in the law of evidence as being that " all facts which are relevant to the issue may be proved." Stated in different forms, the rule has been made by PitzJames Stephen the central point of his theory of evidence. But relevancy, in the proper and natural sense, as we have said, is a matter not of law, but of logic. If Baron Parke's dictum relates to relevancy in its natural sense it is not true ; if it relates to rele- vancy in a narrow and artificial sense, as equivalent to admissible, it is tautological. Such practical importance as the rule of relevancy possesses consists, not in what it includes, but in what it excludes, and for that reason it seems better to state the rule in a negative or exclusive form. But whether the rule is stated in a positive or in a negative form its vagueness is apparent. No precise line can be drawn between " relevant " and " irrelevant " facts. The two classes shade into each other by imper- ceptible degrees. The broad truth is that the courts have excluded from consideration certain matters which have some bearing on the question to be decided, and which, in that sense, are relevant, and that they have done so on grounds of policy and convenience. Among the mat- ters so excluded are matters which are likely to mislead

the jury, or to complicate the case unnecessarily, or which are of slight, remote, or merely conjectural importance. Instances of the classes of matters so excluded can be given, but it seems difficult to refer their exclusion to any mor4 general principle than this. Eules as to evi- dence of character and conduct appear to fall under this principle. Evidence is not admissible to show that the person who is alleged to have done a thing was of a dis- position or character which makes it probable that he would or would not have done it. This rule excludes the biographical accounts of the prisoner which are so famil- iar in French trials, and is an important principle in Eng- lish trials. It is subject to three exceptions : first, that evidence of good character is admissible in favour of the prisoner in all criminal cases ; secondly, that a prisoner indicted for rape is entitled to call evidence as to the im- moral character of the prosecutrix ; and thirdly, that a witness may be called to say that he would not believe a previous witness on his oath. The exception allowing the good character

of a prisoner to influence the verdict, as distinguished from the sentence, is more humane than logical, and seems to have been at first admitted in capi- tal cases only. The exception in rape cases does not allow evidence to be given of specific acts of immorality with persons other than the prisoner, doubtless on the ground that such evidence would affect the reputations of third parties. Where the character of a person is ex- pressly in issue, as in actions of libel and slander, the rule of exclusion, as stated above, does not apply. Nor does it prevent evidence of bad character from being given in mitigation of damages, where the amount of damages virtually depends on character, as in cases of defamation and seduction. As to conduct there is a similar general rule, that evidence of the conduct of a person on other occasions is not to be used merely for the purpose of showing the likelihood of his having acted in a similar way on a particular occasion. Thus, on a charge of murder, the prosecutor cannot give evidence of the prisoner's conduct to other persons for the purpose of proving a bloodthirsty and murderous disposition. And in a civil case a defendant was not allowed to show that the plaintiff had sold goods on particular terms to other persons for the purpose of proving that he had sold simi- lar goods on the same terms to the defendant. But this general rule must be carefully construed. "\Miere several offences are so connected with each other as to form parts of an entire transaction, evidence of one is admissible as proof of another. Thus, where a prisoner is charged with stealing particiilar goods from a particular place, evidence may be given that other goods, taken from the same place at the same time, were found in his possession. And where it is proved or admitted that a person did a par- ticular act, and the question is as to his state of mind, that is to say, whether he did the act knowinglj', inten- tionally, fraudulently, or the like, evidence may be given of the commission by him of similar acts on other occasions for the purpose of proving his state of mind on the occa- sion. This principle is most commonly applied in charges for uttering false documents or base coin, and not uncom- monly in charges for false pretences, embezzlement, or murder. In proceedings for the receipt or possession of stolen property, the Legislature has expressly authorized evidence to be given of the possession by the prisoner of other stolen property, or of his previous conviction of an offence involving fraud or dishonesty (Prevention of Crimes Act, 1871). Again, where there is a question whether a person

committed an offence, evidence may be given of any fact supplying a motive or constituting prep- aration for the offence, of any subsequent conduct of the person accused, which is apparently influenced by the com- mission of the offence, and of any act done by him, or by his

authority in consequence of the offence. Thus, evidence may be given that, after the commission of the alleged offence, the prisoner absconded, or was in possession of the property, or the proceeds of the property, acquired by the offence, or that he attempted to conceal things which were or might have been used in committing the offence, or as to the manner in which he conducted himself when statements were made in his presence and hearing. State- ments made to or in the presence of a person charged with an offence are admitted as evidence, not of the facts stated, but of the conduct or demeanour of the person to whom or in whose presence they are made, or of the general character of the transaction of which they form part (under the res gestce rule mentioned below).

2. Best Evidence Rule. ??? Statements to the effect of the best evidence rule were often made by Chief Justice Holt about the beginning of the 18th century, and be- came familiar in the courts. Chief Baron Gilbert, in his book on evidence, which must have been written before 1726, says that " the first and most signal rule in relation to evidence is this, that a man must have the utmost evidence the nature of the fact is capable of." And in the great case of Omichund v. Barker (1744), Lord Hard- wicke went so far as to say, " The judges and sages of the law have laid down that there is but one general rule of evidence, the best that the nature of the ease will admit" (1 Atkyns 49). It is no wonder that a rule thus solemnly stated, should have found a promi- nent place in text-books on the law of evidence. But, apart from its application to documentary evidence, it does not seem to be more than a useful guiding principle which ilnderlies, or may be used in support of, several rules.

It is to documentary evidence that the principle is usually applied, in the form of the narrower rule exclud- ing, subject to exceptions, secondary

evidence of the con- tents of a document where primary evidence is obtainable. In this form the rule is a rule of exclusion, but may be most conveniently dealt with in connexion with the special subject of documentary evidence. As noticed above, the general rule does not apply to the difference between direct and indirect evidence. And, doubtless on account of its vague character, it finds no place in Stephen's Digest.
* 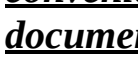 *

3. Hearsay. 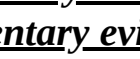 The term "hearsay" primarily applies to what a witness has heard another person say in respect to a fact in dispute. But it is extended to any statement, whether reduced to writing or not, which is brought be- fore the court, not by the author of the statement, but by a person to whose knowledge the statement has been brought. Thus the hearsay rule excludes statements, oral or written, made in the first instance by a person who is not called as a witness in the case. Historically this rule may be traced to the time when the functions of the wit- nesses were first distinguished from the functions of the jury, and when the witnesses were required by their for- mula to testify de visu suo et auditu, to state what they knew about facts from the direct evidence of their senses, not from the information of others. The rule excludes statements the effect of which is liable to be altered by the narrator, and which purport to have been made by persons who did not necessarily speak under the sanc- tion of an oath, and whose accuracy or vei^acity is not tested by cross-examination. It is therefore of practical utility in shutting out many loose statements and much irresponsible gossip. On the other hand, it excludes statements which are of some value as evidence, and may indeed be the only available evidence. Thus, a statement has been excluded as hearsay, even though it can be proved that the author of the statement made it on oath, or that it was against his interest when he made it, or that he is prevented by insanity or other illness from giving

evidence himself, or that he has left the country and disappeared, or that he is dead.

Owing to the inconveniences which would be caused by a strict application of the rule, ijt has been so much eaten into by excep- tions that some persons doubt whether the rule and the exceptions ought not to

change places. Among the exceptions the follow- ing may be noticed: ⁄ ⁄ ⁄ (a) Certain Sworn Statements. ⁄ ⁄ ⁄ In many cases statements made by a person whose evidence is material, but who cannot come before the coirrt, or could not come before it without serious difBculty, delay, or expense, may be admitted as evidence under proper safeguards. Under the Indictable Offences Act, 1848, where a person has made a deposition before a justice at a preliminary inquiry into an offence, his deposition may be read in evidence on proof that the deponent is dead, or too ill to travel, that the deposition was taken in the presence of the accused person, and that the accused then had a full oppor- tunity of cross-examining the deponent. The deposition must appear to be signed by the justice before whom it purports to have been taken. Depositions taken before a coroner are admis- sible imder the same principle. And the principle probably extends to cases where the deponent is insane, or kept away by the person accused. There are other statutory provisions for the admission of depositions, as in the Criminal Law Amendment Act, 1867 ; the Foreign Jurisdiction Act, 1890 ; and the Prevention of Cruelty to Children Act, 1894. In civil cases the rule ex- cluding statements not made in court at the trial is much less strictly applied. Frequent use is made of evidence taken before an examiner, or under a commission. AflBdavits are freely used for subordinate issues or under an arrangement between the parties, and leave may be given to use evidence taken in other proceedings. The old chancery practice, under which evidence, both at the trial and at other stages of a proceeding, was nor- mally taken by affidavit, irrespertively of consent, was altered by the Judicature Acts. Under the existing rules of the supreme court evidence may be given by affidavit upon any motion, petition, or summons, but the court or a judge may, on the application of either party, order the attendance for cross-examination of the person making the affidavit. (6) Dying Declarations. ⁄ ⁄ ⁄ In a trial for murder or manslaughter a declaration by the person killed as to the cause of his death, or as to any of the circum- stances of the transaction which resulted in his death, is admissi- ble as evidence. But this exception is very strictly construed. It must be proved that the declarant, at the time of making the declaration, was in actual danger of death, and had given up all hope of recovery, (c) Statements in Pedigree Cases. ⁄ ⁄ ⁄ On a question of pedigree the statement of a deceased person, whether based on his own personal

knowledge or on family tradition, is admissible as evidence, If it is proved that the person who made the statement was related to the person about whose family relations the statement was made, and that the state- ment was made before the question with respect to which the evidence is required had arisen, (d) Statements as to Matters of Public or General Interest. ??? Statements by deceased persons are admissible as evidence of reputation or general belief in questions relating to the existence of any public or general right or custom, or matter of public and general interest. Statements of this kind are constantly admitted in questions relating to right of way, or rights of common, or manorial or other local customs. Maps, copies of court rolls, leases and other deeds, and verdicts, judgments, and orders of court fall within the exception in cases of this kind, (e) Statements in course of Duty or Business. ??? A statement with respect to a particular fact made by a deceased person in pursuance of his duty in connection with any office, employment, or business, whether public or private, is admissible as evidence of that fact, if the statement appears to have been made from personal know- ledge, and at or about the time when the fact occurred. This exception covers entries by clerks and other employees. (/) Statements against Interest. ??? A statement made by a deceased person against his pecuniary or proprietary interest is admissible as evidence, without reference to the time at which it was made. Where such a statement is admissible the whole of it becomes ad- missible, though it may contain matters not against the interest of the person who made it, and though the total effect may be in his favour. Thus, where there was a question whether a particu- lar sum was a gift or a loan, entries in an account book of re- ceipt of interest on the sum were admitted, and a statement in the book that the alleged debtor had on a particular date ac- knowledged the loan was also admitted, (g) Public Documents. ??? Under this head may be placed recitals in public Acts of Par- liament, notices in the London, Edinburgh, or Dublin Gazette (which are made evidence by statute in a large number of cases), and entries made in the performance of duty in oilicial registers or records, such as registers of births, deaths, or marriages, registers of companies, records in judicial proceedings, and the like. An entry in a public document may be treated as a state-

inent made in the course of duty, Mt it is admissible whetlier the person who made the statement is alive or dead, and without any evidence as to personal knowledge, or the time at which the statement is made. (K) Admissions. ❓❓❓ By the term " admission," as here used, is meant a statement made out of the witness-box by a party to the proceedings, whether civil or criminal, or by some person whose statements are binding on that party, against the interest of that party. The term includes admissions made in answer to interrogatories, or to a notice to admit facts, but not admissions made on the pleadings. Admissions, in this sense of the term, are admissible as evidence against the person by whom they are made, or on whom they are binding, without reference to the life or death of the person who made them. A person is bound by the statements of his agent, acting within the scope of his authority, and barristers and solicitors are agents for their clients in the conduct of legal proceedings. Conversely, a person suing or defending on behalf of another, e.g., as agent or trustee, is bound by the statements of the person whom he represents. Statements respecting property made by a predecessor in title bind the successor. "Where a statement is put in evidence as an admission by, or binding on, any person, that person is entitled to have the whole statement given in evidence. The principle of this rule is obviously sound, because it would be unfair to pick out from a man's statement what tells against him, and to suppress what is in his favour. But the application of the rule is sometimes attended with difficulty. An admission will not be allowed to be used as evidence if it was made under a stipulation, express or implied, that it should not be so used. Such admissions are said to be made "without prejudice." (i) Confessions. ❓❓❓ A confession is an admission by a person accused of an offence that he has committed the offence of which he is accused. But the rules about admitting as evidence confessions in criminal proceedings are much more strict than the rules about admissions in civil proceed- ings. The general rule is, that a confession is not admissible as evidence against any person except the person who makes it. But a confession made by one accomplice in the presence of another is admissible against

the latter to this extent, that, if it implicates him, his silence under the charge may be used against him, whilst on the other hand his prompt repudiation of the charge might tell in his favour. In other words, the confession may be used as evidence of the conduct of the person in whose presence it was made. A confession cannot be admitted as evidence unless proved to be voluntary. A confession is not treated as being voluntary if it appears to the court to have been caused by any inducement, threat, or promise which proceeded from a magistrate or other person in authority concerned in the charge, and which, in the opinion of the court, gave the accused person reasonable ground for supposing that by making a confession he would gain some advantage or avoid some evil in reference to the proceedings against him. This applies to any inducement, threat, or promise having reference to the charge, whether it is addressed directly to the accused person or is brought to his knowledge indirectly. But a confession is not involuntary merely because it appears to have been caused by the exhortations of a person in authority to make it as a matter of religious duty, or by an inducement collateral to the proceedings, or by an inducement held out by a person having nothing to do with the apprehension, prosecution, or examination of the prisoner. Thus, a confession made to a gaol chaplain in consequence of religipus exhortation has been admitted as evidence. So also has a confession made by a prisoner to a gaoler in conse- quence of a promise by the gaoler, that if the prisoner confessed he should be allowed to see his wife. To make a confession invol- untary, the inducement must have reference to the prisoner's escape from the charge against him, and must be made by some person having power to relieve him, wholly or partially, from the consequences of the charge. A confession is treated as voluntary if, in the opinion of the court, it was made after the complete removal of the impression produced by any inducement, threat, or promise which would have made it involuntary. Where a confes- sion was made under an inducement which makes the confession involuntary, evidence may be given of facts discovered in conse- quence of the confession, and of so much of the confession as distinctly relates to those facts. Thus, A., under circumstances which make the confession involuntary, tells a policeman that he, A., had thrown a lantern into the pond. Evidence may be given that the lantern was found in the pond, and that A. said he had thrown it there. It is of course improper to try to extort a con- fession by fraud or

under the promise of secrecy. But if a confes- sion is otherwise admissible as evidence, it does not become inadmissible merely because it was made under a promise of secrecy, or in consequence of a deception practised on the accused person for the purpose of obtaining it, or when he was drunk, or because it was made in answer to questions, whether put by a magistrate or by a private person, or because he was not warned that he was not bound to make the confession, and that it might be used against him. If a confession is given in evidence, the

whole of it must be given, and not merely the parts disadvan- tageous to the accused person. Evidence amounting to a con- fession may be used as such against the person who gave it, though it was given on oath, and though the proceeding in which it was given had reference to the same subject-matter as the proceeding m which it is to be used, and though the witness might have refused to answer the questions put to him. But if, after refusing to answer such questions, the witness is improperly compelled to answer, his answers are not a voluntary confes- sion. The grave jealousy and suspicion with which the English law regards confessions offer a marked contrast to the importance attached to this form of evidence in other systems of proce- dure, such as the inquisitorial system which long prevailed, and still to some extent prevails, on the Continent. Q) Bes gestce. ??? Statelnents are often admitted as evidence on the ground that they form part of what is called the "transaction," or res gestcB, the occurrence or nature of which is in question. For instance, where an act may be proved, statements accompanying and 'explaining the act made by or to the person doing it, may be given in evidence. There is no difficulty in understanding the principle on which this exception from the hearsay rule rests, but there is often practical difficulty in applying it, and the practice has varied. How long is the "transaction" to be treated as lasting? "What ought to be treated as "the immediate and natural effect of continuing action," and, for that reason, as part of the res gestae ? "When an act of violence is committed, to what extent are the terms of the complaint made by the sufferer, as distinguished from the fact of a complaint having been made, admissible as evidence? These are some of the questions raised. The cases in which statements by a person as to his bodily or mental condition may be put in evidence may perhaps be treated as falling under the same

principle. In the Rugeley poisoning case, statements by the deceased person before his illness as to his state of health, and as to his symptoms during illness, were admitted as evidence for the prosecution. Under the same principle may also be brought the rule as to statements in conspiracy cases. In charges of conspiracy, after evidence has been given of the existence of the plot, and of the connexion of the accused with it, the charge against one conspirator may be sup- ported by evidence of anything done, written, or said, not only by him, but by any other of the conspirators, in furtherance of the common purpose. On the other hand, a statement made by one conspirator, not in execution of the common purpose, but in narra^ tion of some event forming part of the conspiracy, would be treated, not as part of the " transaction," but as a statement ex- cluded by the hearsay rule. Thus the admissibility of writings in conspiracy cases may depend on the time when they can be shown to have been in the possession of a fellow-conspirator, whether before or after the prisoner's apprehension, (k) Complaints in rape cases, &c. ??? In trials for rape and similar offences, the fact that shortly after the commission of the alleged offence a complaint was made by the person against whom the offence was committed, and also the terms of the complaint, have been admitted as evidence, not of the facts complained of, but of the consistency of the com- plainant's conduct with the story told by her in the witness-box, and as negativing consent on her part.

4. Opinion. ??? The rule excluding expressions of opinion also dates from the first distinction bet-sveen the functions of "witnesses and jury. It "was for the "witnesses to state facts, for the jury to form conclusions. Of course every statement of fact involves inference, and implies a judg- ment on phenomena observed by the senses. And the in- ference is often erroneous, as in the ans"wer to the question, " Was he drunk ? " A prudent "witness will often guard him- self, and is allo"wed to guard himself, by ans"wering to the best of his belief. But, for practical purposes, it is possible to draw a distinction bet"ween a statement of facts observed and an expression of opinion as to the inference tobedra"wn from these facts, and the rule teUing "witnesses to state facts and not express opinions is of great value in keeping their statements out of the region of argument and conjecture. The evidence of "experts," that is to say, of persons ha"ving a special kno"wledge of some particulax subject,

is generally described as constituting the chief exception to the rule. But perhaps it "would be more accurate to say that experts are allo"wed a much wider range than ordinary "witnesses in the expression of their opinions, and in the statement of facts on -which their opinions are based. Thus, in a poisoning case, a doctor may be asked as an expert "whether, in his opinion, a pai'ticular poison produces particular symptoms.

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And, ???where lunacy is set up as a defence, an expert may be asked whether, in his opinion, the symptoms exhibited by the alleged lunatic commonly show unsoundness of mind, and whether such unsoundness of mind usually renders persons incapable of knowing the nature of their acts, or of knowing that what they do is either wrong or contrary to the law. Similar principles are applied to the evidence of engineers, and in numerous other cases. In cases of disputed handwriting the evidence of experts in handwriting is expressly recognized by statute (28 and 29 Vict. c. 18, s. 8).

IV. Documentary Evidence.

Charters and other writings were exhibited to fee jury at a very early date, and it is to writings so exhibited that the term "'evidence " or " evidences " seems to have been originally applied par excellence. The oral evidence of witnesses came later. Where a document is to be used as evidence the first question is how its contents are to be proved. To this question the principle of " best evi- dence" applies, in the form of the rule that primary evidence must be given except in the cases where second- ary evidence is allowed. By primary evidence is meant the document itself produced for inspection. By second- ary evidence is meant a copy of the document, or verbal accounts of its contents.

The. rule as to the inadmissibility of a copy of a document is applied much more strictly to private than to puhlic or official documents. Secondary evidence may be given of the contents of a private document in the following cases : ???

(a) Where the original is shown or appears to be in the possession of the adverse party, and he, after having been served with reasonable notice to produce it, does not do so. (6) Where the onginal is shown or appears to be in the possession or power of a stranger not legally bound to produce it, and he, after having been served with a writ of suhpcena duces tecum, or after having been sworn as a witness and asked for the document, and having admitted that it is in court, refuses to produce It.

(c) Where it is shown that proper search has been made for the

original, and there is reason for believing that it is destroyed or lost.

(d) Where the original is of such a nature as not to be easily

movable, as in the case of a placard posted on a wall, or of a tombstone, or is in a country from which it 4s not permitted to be removed.

(e) Where the original is a document for the proof of which

special provision is made by any Act of Parliament, or any law in force for the time being. Documents of that kind are practically treated on the same footing as private documents. (/) Where the document is an entry in a banker's book, prov- able according to the special provisions of the Bankers' Books Evidence Act, 1879. Secondary evidence of a private document is usually given either by producing a copy and calling a witness who can prove the copy to be correct, or, when there is no copy obtainable, by calling a witness who has seen the document, and can give an account of its contents. No general definition of public doctmient is possible, but the rules of evidence applicable to public documents are ex- pressly applied by statute to many classes of documents. Primary evidence of any public document may be given by producing the document from proper custody, and by a witness identifying it as being what it professes to be. Public documents may always be proved by secondary evidence, but the particular kind of second- ary evidence required is in many cases defined by statute. Where a document is of such a public nature as to be admissible in evidence on its mere production from the proper custody, and no statute exists which renders its contents provable by means of a copy, any copy thereof or extract therefrom is admissible as proof of its

contents, if it is proved to be an examined copy or extract, or purports to be signed or certified as a true copy or extract by the officer to whose custody the original is entrusted, ^any statutes provide that various certificates, official and public docu- ments, documents and proceedings of corporations and of joint stock and other companies, and certified copies of documents, bye- laws, entries in registers and other books, shall be receivable as evidence of certain particulars in courts of justice, if they are authenticated in the manner prescribed by the statutes. When-

ever, by virtue of any such provision, any such certificate or certi- fied copy is receivable as proof of any particular in any court of justice, it is admissible as evidence, if it purports to be authenti- cated in the manner prescribed by law, without calling any witness to prove any stamp, seal, or signature required for its authentica- tion, or the official character of the person who appears to have signed it. The Documentary Evidence Acts, 1868, 1882, and 1895, provide modes of proving the contents of several classes of procla- mations, orders, and regulations.

If a document is of a kind which is required by law to be attested, but not otherwise, an attesting witness must be called to prove its due execution. But this rule is subject to the follow- ing exceptions : ???

(a) If it is proved that there is no attesting witness alive, and capable of giving evidence, then it is sufficient to prove that the attestation of at least one attesting witness is in his handwriting, and that the signature of the person executing the document is in the handwriting of that person. (&) If the document Is proved, or purports to be, more than thirty years old, and is produced from what the court considers to be its proper custody, an attesting witness need not be called, and it will l3e presumed without evidence that the instrument was duly executed and attested.

Where a document embodies a judgment, a contract, a grant, or disposition of property, or any other legal trans- action or " act in the law," on which rights depend, the validity of the transaction may be impugned on the ground of fraud, incapacity, want of consideration, or other legal ground. But this seems outside the law of evidence. In this class of cases a question often arises whether extrinsic evidence can be produced to vary the nature of the trans- action embodied in the

document. The answer to this question seems to depend on whether the document was or was not intended to be a complete and final statement of the transaction which it embodies. If it was, you cannot go 'outside the document for the purpose of ascertaining the nature of the transaction. If it was not, you may. But the mere statement of this test shows the diflB.culty of formulating precise rules, and of applying them when formulated. FitzJames Stephen mentions, among the facts which may be proved in these cases, the existence of separate and consistent oral agreements as to matters on which the document is silent, if there is reason to believe that the document is not a complete and final statement of the transaction, and the existence of any usage or custom with reference to which a contract may be presumed to have been made. But he admits that the rules on the subject are "by no means easy to apply, inasmuch as from the nature of the case an enormous number of trans- actions fall close on one side or the other of most of them." The underlying principle appears to be a rule of substan- tive law rather than of evidence. When parties to an arrangement have reduced the terms of the arrangement to a definite, complete, and final written form, they should be bound exclusively by the terms embodied in that form. The question in each case is under what circumstances they ought to be treated as having done so.

The expression " parol evidence," which includes written as well as verbal evidence, has often been applied to the extrinsic evidence produced for the purpose of varying the nature of the transaction embodied in a document. It is also applied to extrinsic evidence used for another purpose, namely, that of explaining the meaning of the terms used in a document. The two questions. What is the real nature of the transaction referred to in a document ? and. What is the meaning of a document ? are often confused, but are really distinct from each other. The rules bearing on the latter question are rules of construction or interpretation rather than of evidence, but are ordinarily treated as part of the law of evidence, and are for that reason included by FitzJames Stephen in his Digest. In stating these rules he adopts, with verbal modifications, the six pro- positions laid down by Vice-Chancellor Wigram in his

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Examinations of the Rides of Lam respecting the admission of Extrinsic Evidence in Aid of the Interpretation of Wills. The substance of these propositions appears to be this, that wherever the meaning of a document cannot be satisfactorily ascertained from the document itself, use may be made of any other eyidence for the purpose of elucidating the meaning, subject to one restriction, that, except in cases of equivocation, i.e., where a person or thing is described in terms applicable equally to more than one, resort cannot be had to extrinsic expressions of the author's intention.

V. Witnesses.

1. Attendance. ??? If a witness does not attend voluntarily he can be required to attend by a writ of subpcena.

2. Competency. -^Ks a general rule every person is a competent witness. Formerly persons were disqualified by crime or interest, or by being parties to the proceedings, but these disqualifications have now been removed by statute, and the circumstances which formerly created them do not affect the competency, though they may often affect the credibility, of a witness.

Under the general law as it stood before the Criminal Evidence Act, 1898, came into force, a person charged with an offence was not competent to give evidence on his own behalf. But many exceptions had been made to this rule by legislation, and the rule itself was finally abolished by the Act of 1898. Under the new law a person charged is a competent witness, but he can only give evidence for the defence, and can only give evidence if he himself applies to do so. Under the law as it stood before 1898, persons jointly charged and being tried together were not competent to give evidence either for or against each other. Under the new law a person charged jointly with another is a competent witness, but only for the defence, and not for the prosecution. If, therefore, one of the persons charged applies to give evidence his cross-examination must not be conducted with a view to establish the guilt of the other. Consequently, if it is thought desirable to use against one prisoner the evidence of another

who is being tried with him, the latter should be released, or a separate verdict of not guilty taken against him. A prisoner so giving evi- dence is popularly said to turn King's evidence. It follows that, subject to what has been said above as to persons tried together, the evidence of an accomplice is admissible against his principal, and vice versd. The evi- dence of an accomplice is, however, always received with great jealousy and caution. A conviction on the un- supported testimony of an accomplice may, in some cases, be strictly legal, but the practice is to require it to be con- firmed by unimpeachable testimony in some material part, and more especially as to his identification of the person or persons against whom his evidence may be received. The wife of a person charged is nowa competent witness, but, except in certain special cases, she can only give evidence for the defence, and can only give evidence if her husband applies that she should do so. The special cases in which a wife can be called as a witness either for the prosecution or for the defence, and without the' consent of the person charged, are cases arising under particular enactments scheduled to the Act of 1898, and relating mainly to offences against wives and children, and cases in which the wife is by common law a competent witness against her husband, i.e., where the proceeding is against the husband for bodily injury or violence inflicted on his wife. The rule of exclusion extends only to a lawful wife. There is no ground for supposing that the wife of a prosecutor is an incompetent witness. A witness is incompetent if, in the opinion of the court, he is pre- vented by extreme youth, disease affecting his mind, or

any other cause of the same kind, from recollecting the matter on which he is to testify, from understanding the questions put to him, from giving rational answers to those questions, or from knowing that he ought to speak the truth. A witness unable to speak or hear is not in- competent, but may give his evidence by writing or by signs, or in any other manner in which he can make it intelligible. The particular form of the religious belief of a witness, or his want of religious belief, does not affect his competency. This ground of incompetency has now been finally removed by the Oaths Act, 1888 .(see below). It will be seen that the effect of the successive enactments which have gradually removed the disqualifications attaching to various classes of witnesses has been to draw a distinction between the competency of a witness and his credibility.

No person is disqualified on moral or religious grounds, but his character may be such as to throw grave doubts on the value of his evidence. ISTo relationship, except to a limited extent that of husband and wife, excludes from giving evidence. The parent may be examined on the trial of the child, the child on that of the parent, master for or against servant, and servant for or against master. The relationship of the witness to the prosecutor or the prisoner in such cases may affect the credibility of the witness, but does not exclude his evidence.

3. Privilege. ??? It does not follow that, because a person is competent to give evidence, he can therefore be com- pelled to do so.

No one, except a person charged with an offence when giving evidence on his own application, and as to the offence wherewith he is charged, is bound to answer a question if the answer would, in the opinion of the court, have a tendency to expose the witness, or the wife or husband of the witness, to any criminal charge, penalty, or forfeiture, which the court regards as reasonably likely to be preferred or sued for. Accordingly, an accomplice cannot be examined without his consent, but if an accomplice who has come forward to give evidence on a promise of pardon, or favourable consideration, refuses to give full and fair information, he renders himself liable to be convicted on his own confession. However, even accomplices in such circumstances are not required to answer on their cross-examination as to other offences. Where, under the new law, a person charged with an offence offers himself as a witness, he may be asked any question in cross-examination, notwithstanding that it would tend to criminate him as to the offence charged. But he may not be asked, and if he is asked must not be required to answer, any question tending to show that he has committed, or been convicted of, or been charged with, any other offence, or is of bad character, unless : ??? (i.) The proof that he has committed, or been convicted of, the other offence is admissible evidence to show that he is guilty of the offence with which he is then charged ; or, (ii.) He has personally, or by his advocate, asked ques- tions of the witnesses for the prosecution, with a view to establish his own good character, or has given evidence of his good character, or the nature or conduct of the defence is such as to involve im- putations on the character of the prosecutor or the witnesses for the prosecution ; or,

(iii.) He has given evidence against any other person charged with the same offence. He may not be asked questions tending to criminate his wife.

The privilege as to criminating answers does not cover answers merely tending to establish a civil liability. No one is excused from answering a question or producing a

document only because the answer or document may establish or tend to establish that he owes a debt, or is otherwise liable to any civil proceeding. It is a priv- ilege for the protection of the witness, and therefore may be waived by him. But there are other privileges which cannot be so waived. Thus, on grounds of public policy, no one can be compelled, or is allowed, to give evidence relating to any affairs of state, or as to official communi- cations between public officers upon public affairs, except with the consent of the head of the department concerned, \ and this consent is refused if the production of the infor- mation asked for is considered detrimental to the public service.

Again, in cases in which the Government is immedi- ately concerned, no witness can be compelled to answer any question the answer to which would tend to discover the names of persons by or to whom information was given as to the commission of offences. It is, as a rule, for the court to decide whether the permission of any such question would or would not, under the circum- stances of the particular case, be injurious to the admin- istration of justice.

A husband is not compellable to disclose any com- munication made to him by his wife during the marriage ; and a wife is not compellable to disclose any communica- tion made to her by her husband during the marriage.

A legal adviser is not permitted, whether during or after the termination of his employment as such, unless with his client's express consent, to

disclose any communi- cation, oral or documentary, made to him as such legal adviser, by or on behalf of his client, during, in the course of, and for the purpose of his employment, or to disclose any advice given by him to his client during, in the course of, and for the purpose of such employment. But this protection does not extend to ???

(a) any such communication if made in furtherance of any criminal purpose ; nor

(6) any fact observed by a legal adviser in the course of his employment as such, showing that any crime or fraud has been committed since the commencement of his employment, whether his attention was directed to such fact by or on behalf of his client or not ; nor

(c) any fact With which the legal adviser became acquainted otherwise than in his character as such.

Medical men and clergymen are not privileged from the disclosure of communications made to them in pro- fessional confidence, but it is not usual to press for the disclosures of communications made to clergymen.

4. Oaths. ??? A witness must give his evidence under the sanction of an oath, or of what is equivalent to an oath, that is to say, of a solemn promise to speak the truth. The ordinary form of oath is adapted to Christians, but a person belonging to a non-Christian religion may be sworn in any form prescribed or recognized by the I custom of his religion.

Special provisions have been made by statute for two classes of persons: (1) Christians who object on conscientious grounds to the taking of an oath ; and (2) persons who refuse to admit the binding force of an oath. Special provision was first made for Quakers and Moravians (9 Geo. IV. c. 32 ; 3 and 4 Will. IV. c. 49 ; 1 and 2 Vict. c. 77) and for Separatists. Then came general enact- ments relating to civil (Common Law Procedure Act, 1854, s. 20) and criminal (24 and 25 Vict. c. 66, s. 1) proceedings respectively, and allowing a witness who alleged conscientious objections to being sworn to make a solemn affirmation. The Evidence Further Amendment Act, 1869, s. 4, enabled any person

who objected to take an oath, or was objected to as incompetent to take an oath (i.e., on the ground that he did not recognize its binding force) to make a solemn promise and declaration in a prescribed form. The law is now embodied in the Oaths Act, 1888, under which any person, on objecting to being sworn, and stating as the ground of his objection, either that he has no religious belief, or that the taking of an oath is contrary to his religious belief, may make a solemn affirmation, which is to have the same effect, and Involve

the same penalties for false statement, as an oath. Under s. 5 of the same Act a person may swear in the Scottish form, with uplifted hand, and if he desires to do so " the oath shall be ad- ministered to him in such form and manner without further question " ??? in other words, he must not be asked as to his religious belief.

5. Publicity. ??? The evidence of a witness at a trial must, as a general rule, be given in open court in the course of the trial. The secrecy which was such a character- istic feature of the "inquisition" procedure is abhor- rent to English law, and, even where publicity conflicts with decency, English courts are very reluctant to dis- pense with or relax the safeguards for justice which pub- licity involves.

6. Examination. ??? The normal course of procedure is this. The party who begins, i.e., ordinarily the plaintiff or prosecutor, calls his witnesses in order. Each witness is first examined on behalf of the party for whom he is called. This is called the examination in chief. Then he is liable to be cross-examined on behalf of the other side. And, finally, he may be re-examined on behalf of his own side. After the case for the other side has been opened, the same procedure is adopted with the witnesses for that side. In some cases the party who began is allowed to adduce further evidence in reply to his opponent's evi- dence. The examination is conducted, not by the court, but by or on behalf of the contending parties. It will be seen that the principle underlying this procedure is that of the duel, or conflict between two contending parties, each relying on and using his own evidence, and trying to break down the evidence of his opponent. It differs from the principle of the "inquisition" procedure, in which the court takes a more active part, and in which the cases for the

two sides are not so sharply distin- guished. In a Continental trial it is often difficult to de- termine whether the case for the prosecution or the case for the defence is proceeding. Conflicting witnesses stand up together and are " confronted " with each other. In the examination in chief questions must be confined to matters bearing on the main question at issue, and a witness must not be asked leading questions, i.e., ques- tions suggesting the answer which the person putting the question wishes or expects to receive, or suggesting disputed facts about which the witness is to testify. But the rule about leading questions is not applied where the questions asked are simply introductory, and form no part of the real substance of the inquiry, or where they relate to matters which, though material, are not dis- puted. And if the witness called by a person appears to be directly hostile to him, or interested on the other side, or unwilling to reply, the reason for the rules applying to examination in chief breaks down, and the witness may be asked leading questions and cross-examined, and treated in every respect as though he was a witness called on the other side, except that a party producing a witness must not impeach his credit by general evidence of bad character (28 and 29 Vict. c. 18, s. 3). In cross-examination questions not bearing on the main issue and leading questions may be put and (subject to the rules as to privilege) must be answered, as the cross-examiner is entitled to test the examination in chief by every means in his power. Questions not bearing on the main issue are often asked in cross-examination merely for the purpose of putting off his guard a witness who is supposed to have learnt up his story. In cross-examina- tion questions may also be asked which tend either to test the accuracy or credibility of the witness, or to shake his credit by impeaching his motives or injuring his character. The license allowed in cross-examination has often been seriously abused, and the power of the court to check it is recognized by one of the rules of the supreme court (E.S.C. xxxvi. 39, added in 1883). It is

considered wrong to put questions which assume that facts have been proved which have not been proved, or that answers have been given

contrary to the fact. A witness ought not to be pressed in cross-examination as to any facts which, if admitted, would not affect the question at issue or the credibility of the witness. If the cross- examiner intends to adduce evidence contrary to the evidence given by the witness, he ought to put to the witness in cross-examination the substance of the evidence which he proposes to adduce, in order to give the vdtness an opportunity of retracting or explaining. Where a witness has answered a question which only tends to affect his credibility by injuring his character, it is only in a limited niimber of cases that evidence can be given to contradict his answer. Where he is asked whether he has ever been convicted of any felony or misdemeanour, and denies or refuses to answer, proof may be given of the truth of the facts suggested (28 and 29 Vict. c. 16, s. 6). The same rule is observed where he is asked a question tending to show that he is not impartial. Where a wit- ness has previously made a statement inconsistent with his evidence, proof may be given that he did in fact make it. But before such proof is given the circumstances of the alleged statement, sufficient to designate the particular occasion, must be mentioned to the witness, and he must be asked whether he did or did not make the statement. And if the statement was made in, or has been reduced to, writing, the attention of the witness must, before the writing is used against him, be called to those parts of the writing which are to be used for the purpose of con- tradicting him (28 and 29 Vict. c. 18, ss. 4, 5). The credi- bility of a witness may be impeached by the evidence of persons who swear that they, from their knowledge of the witness, believe him to be unworthy of credit on his oath. These persons may not on their examination in chief give reasons for their belief, but they may be asked their reasons in cross-examination, and their answers can- not be contradicted. When the credit of a witness is so impeached, the party who called the witness may give evidence in reply to show that the witness is worthy of credit. Re-examination must be directed exclusively to the explanation of matters referred to in cross-examina- tion, and if new matter is, by the permission of the court, introduced in re-examination, the other side may further cross-examine upon it. A witness under examination may refresh his memory by referring to any writing made by himself at or about the time of the occurrence to which the writing relates, or made by any other person, and read and found accurate by the

witness at or about the time. An expert may refresh his memory by reference to professional treatises.

For the history of the English law of evidence, see Beunnee, Entstehung der Schwurgerichte ; Bigelow, History of Procedure in England; Stephen (Sir J. F.), History of the Criminal Lam of England; Pollock and Maitland, History of English Law, blc. ii. oh. ix. ; Thater, Preliminary Treatise on Evidence at the Common Law. The principal text-books now in use are ??? Eoscoe, Digest of the Law of Evidence on the Trial of Actions at Nisi Prius, 16th ed., 1891 ; Roscoe, Digest of the Law of Evidence in Criminal Cases, 12th ed., 1898 ; Taylor, Treatise on the Law of Evidence, 9th ed., 1895 ; Best, Principles of the Law of Evidence, 8th ed., W.)?^ ; Powell, Principles and Practice of the Law of Evidence, 7th ed., 1898 ; Stephen, /Jic/i-st of the Law of Evidence, 5th ed., 18'.)'.) ; Wills, Theory and Practice of the Law of Evidence, 1894. For history of the law of criminal evidence in France, see Esmein, Hist, de la procedure criminelle en France. For Germany, see IIoltzendorff, Encyclopddie der Bechtswissenschaft (passages indexed under head " Beweis ") ; Holtzendorff, liechtslexikon, ("Beweis"). (c. p. i.)

Evolution. ??? Since Professors Huxley and Sully wrote their masterly essays in the ninth edition of this Encyclopaedia, the doctrine of evolution has outgrown the

trammels of controversy and has been accepted as a fundamental principle. Writers on biological subjects no longer have to waste space in weighing evolution against this or that philosophical theory or religious tradition ; philosophical writers have frankly accepted it, and the supporters of religious tradition have made broad their phylacteries to write on them the new words. A closer scrutiny of the writers of all ages who preceded Charles Darwin, and, in particular, the light thrown back from Darwin on the earlier writings of Herbert Spencer, have made plain that without Darwin the world by this time might have come to a general acceptance of evolution; but it seems established as a historical fact that the world has come to. accept evolution, first, because of Darwin's theory of natural selection, and second, be- cause of Darwin's exposition of the evidence for the act- ual occurrence of organic evolution. The evidence as

set out by Darwin has been added to enormously; new knowledge has in many cases altered our conceptions of the mode of the actual process of evolution, and from time to time a varying stress has been laid on what are known as the purely Darwinian factors in the theory.' The balance of these tendencies has been against the attachment of great importance to sexual selection, and in favour of attaching a great importance to natural selection ; but the dominant feature in the history of the theory since 1876 has been its universal acceptance and the recognition that this general acceptance has come from the stimulus given by Darwin.

A change has taken place in the use of the word evolution. Huxley, following historical custom, devoted one section of his article to the "Evolution of the Individual." The facts and theories " ^^"^' respecting this are now discussed under such headings as Embrtologt, Heredity, and Variation; under these headings must be sought information on the im- portant recent modifications with regard to the theory of the relation between the development of the in- dividual and the development of the race, the part played by the environment on the individual, and the modern developments of the old quarrel between evolu- tion and epigen'esis. The most striking general change has been against seeing in the facts of ontogeny any direct evidence as to phylogeny. The general proposition as to a parallelism between individual and ancestral devel- opment is no doubt indisputable, but extended knowledge of the very different ontogenetic histories of closely allied forms has led us to a much fuller conception of the mode in which stages in embryonic and larval history have been modified in relation to their surround- ings, and to a consequent reluctance to attach de- tailed importance to the embryological argument for evolution.

*The vast bulk of botanical and zoological work on living and extinct forms published during the last quarter of the 19th century increased almost beyond all ex- pectation the evidence for the fact of evolution. "' "**"❓❓❓"❓❓❓ The discovery of a single fossil creature in a geological stratum of a wrong period, the detection of a single anatomical or physiological fact irreconcilable with origin by descent with modification, would have been destructive of the theory and would have made the reputation of the observer. But in the j)rodigious number of*

supporting discoveries that have been made no single negative factor has appeared, and the evolution from their "predecessors of the forms of life existing now or at any other period must be taken as proved. It is necessary to notice, however, that although the general course of the stream of life is certain, there is not the same certainty as to the actual individual pedigrees of the existing forms. In the attempts to place existing creatures in approximately

phylogenetie order, a striking change, due to a more logical consideration of the process of evolution, has become established and is already resolving many of the earlier difficulties and banishing from the more recent tables the numerous hypothetical intermediate forms so familiar in the older phylogenetie trees. The older method was to attempt the comparison between the highest member of a lower group and the lowest member of a higher group ??? ^to suppose, for example, that the gorilla and the chimpanzee, the highest members of the apes, were the existing representatives of the ancestors of man, and to compare these forms with the lowest members of the human race. Such a comparison is necessarily illogical, as the existing apes are separated from the common ancestor by at least as large a number of generations as separate it from any of the forms of existing man. In the natural process of growth, the gap must necessarily be wider between the summits of the twigs than lower down, and, instead of imagining "missing links," it is necessary to trace each separate branch as low down as possible, and to institute the comparisons between the lowest points that can be reached. The method is simply the logical result of the fact that every existing form of life stands at the summit of a long branch of the whole tree of life. A due consider- ation of it leads to the curious paradox that if any two animals be compared, the zoologically lower will be separated from the common ancestor by a larger number of generations, since, on the average, sexual maturity is reached more quickly by the lower form. Naturally very many other factors iiave to be considered, but this alone is a sufficient reason to restrain attempts to place existing forms in linear phylogenetie series. In

em- bryology the method finds its expression in the limitation of comparisons to the corresponding stages of low and high forms and the exclusion of the comparisons between the adult stages of low forms and the embryonic stages of higher forms. Another expression of the same method, due to Cope, and specially valuable to the tax- onomist, is that when the relationship between Orders is being considered, characters of sub-ordinal rank must be neglected. It must not be supposed that earlier writers all neglected this method, or still less that all writers now employ it, but merely that formerly it was frequently overlooked by the best writers, and now is neglected only by the worst. The result is, on the one hand, a clearing away of much fantastic phylogeny, on the other, an enormous reduction of the supposed gaps between groups.

There has been a renewed activity in the study of existing forms from the point of view of obtaining evidence as to the nature and origin of species. Com- Com- parative anatomists have been learning to re-

aa^^omy. frain from basing the diagnosis of a species, or the description of the condition of an organ, on the evidence of a single specimen. Naturalists who deal specially with museum collections have been compelled, it is true, for other reasons to attach an increasing importance to what is called the type specimen, but they find that this insistence on the individual, although convenient as a guard against rash or imperfect diagnosis, is unsatisfactory from the point of view of scientific zoology ; and propositions for the amelioration of this condition of affairs range from a refusal of Linnaean nomenclature in such cases, to the institution of a division between master species for such species as have been properly revised by the comparative morphologist, and provisional species for such species as have been provisionally registered by those working at collections. Those who work with living forms of which it is possible to obtain a large number of specimens, and those who

make revisions of the provisional species of palaeon- tologists, are slowly coming to some such conception as that a species is the abstract central point around which a group of variations oscillate, and that the peripheral oscillations of one species may even overlap those of an allied species. It is plain that we have moved far from the connotation and

denotation of the word species at the time when Darwin began to discuss the origin of species, and that the movement, on the one hand, tends to simplify the problem philosophically, and, on the other, to make it difficult for the amateur theorist.

The conception of evolution is being applied more rigidly to the comparative anatomy of organs and systems of organs. When a series of the modifications of an anatomical structure has been sufficiently examined, it is frequently possible to decide that one particular condition is primitive, ancestral, or central, and that the other conditions have been derived from it. Such a condition has been termed, with regard to the group of animals or plants the organs of which are being studied, archecentric. The possession of the character in the archecentric condition in (say) two of the members of the group does not indicate that these two members are more nearly related to one another than they are to other members of the group; the archecentric con- dition is part of the common heritage of all the members of the group, and may be retained by any. On the other hand, when the ancestral condition is modified, it may be regarded as having moved outwards along some radius from the archecentric condition. Such modified conditions have been termed apocentric. It is obvious that the mere apocentricity of a character can be no guide to the affinities of its possessor. It is necessary to determine if the modification be a simple change that might have occurred in independent cases, in fact if it be a multiradial apocentricity, or if it involved intricate and precisely combined anatomical changes that we could not expect to occur twice in- dependently; that is to say, if it be a uniradial apo- centricity. Multiradial apocentricities lie at the root of many of the phenomena that have been grouped under the designation Convergence. Especially in the case of manifest adaptations, organs possessed by creatures far apart genealogically may be moulded into conditions that are extremely alike. Ray Lankester's term, homoplasy, has passed into currency as designating such cases where different genetic material has been pressed by similar conditions into similar moulds. These may be called heterogeneous homoplasies, but it is necessary to recognize the existence of homogeneous homoplasies, here called multiradial apocentricities. A complex apo- centric modification of a kind which we cannot imagine to have been repeated independently, and which is to be

designated as uniradial, frequently forms a new centre around which new diverging modifications are produced. With reference to any particular group of forms such a new centre of modification may be termed a metacentre, and it is plain that the archecentre of the whole group is a metacentre of the larger group of which the group under consideration is a branch. Thus, for instance, the archecentric condition of any Avian structure is a metar centre of the Sauropsidan stem. A form of apocentricity extremely common and often perplexing may be termed pseudocentric ; in such a condition there is an apparent simplicity that reveals its secondary nature by some small and apparently meaningless complexity.

Another group of investigations that seems to play an important part in the future development of the theory of evolution relates to the study of what is known g^^^^^.^^ as organic symmetry. The differentiations of structure that characterize animals and plants are being

shown to be orderly and definite in many respects ; the relations of the various parts to one another and to the whole, the modes of repetition of parts, and the series of changes that occur in groups of repeated parts appear to be to a certain extent inevitable, to depend on the nature of the living material itself and on the necessary conditions of its growth. Closely allied to the study of symmetry is the study of the direct effect of the circumambient media on embryonic young and adult stages of living beings (see Embryology, Physiology of ; Heredity ; and Varia- tion), and a still larger number of observers have added to our knowledge of these. It is impossible here to give even a list of the names of the many observers who in recent times have made empirical study of the effects of growth-forces and of the symmetrical limitations and definitions of growth. It is to be noticed, however, that, even after such phenomena have been properly grouped and designated under Greek names as laws of organic growth, they have not become explanations of the series of facts they correlate. Their importance in the theory of evolution is none the less very great. In the first place, they lessen the number of separate facts to be

explained ; in the second, they limit the field vsdthin which explanar tion must be sought, since, for instance, if a particular mode of repetition of parts occur in mosses, in flowering- plants, in beetles, and in elephants, the seeker of ultimate explanations may exclude from the field of his inquiry all the conditions individual to these different organic forms, and confine himself only to what, is common to all of them ; that is to say, practically only the living mar terial and its environment. The prosecution of such inquiries is beginning to make unnecessary much ingen- ious speculation of a kind that was prominent from 1880 to 1900 ; much futile effort has been wasted in the endeavour to find on Darwinian principles special " selection-values " for phenomena the universality of which places them outside the possibility of having relations with the particular conditions of particular organisms. On the other hand, many of those who have been specially successful in grouping diverse phenomena under empirical generalizations have erred logically in posing their generalizations against such a vera causa as the preservation of favoured individuals and races. The period between the publication of the Origin of Species and the writing of the article Evolution in the ninth edition of this Encyclopaedia was characterized chiefly by anatomical and embryological work ; the period to which this supplementary article refers has been marked by no diminution in anatomical and embryological enthusiasm, but by the fact that a large number of the continually increasing body of investigators have turned again to bionomical work. Inasmuch as Lamarck attempted to frame a theory of evolution in which the principle of natural selection had no part, the interpretation placed on their work by many bionomical investigators recalls the theories of Lamarck, and the n&m.e'Weo-Lamarckism has been used of such a school of biologists, particularly active in America. The weakness of the Neo-Lamarckian view lies in its interpretation of heredity ; its strength lies in its zealous study of the living world and the detection therein of proximate empirical laws, a strength shared by very many bionomical investigations, the authors of which would prefer to call themselves Darwinians, or to leave themselves without sectarian designation.

Statistical inquiry into the facts of life has long been employed, and in particular Galton, within the Darwinian period, has advocated its employment and '"""'"'"'*"'* developed its methods. Within*

quite recent years, however, a special school has arisen with the main object of treating the processes of evolution quantitatively. It has been the habit of biologists to use the terms varia-

tion, selection, elimination, correlation, and so forth, vaguely ; the new school, which has been strongly rein- forced from the side of physical science, insists on quan- titative measurements of the terms. When the anatomist says that one race is characterized by longheads, another by round heads, the biometricist demands numbers and percentages. When an organ is stated to be variable, the biometricist demands statistics to show the range of the variations and the mode of their distribution. When a character is said to be favoured by natural selection, the biometricist demands investigation of the death-rate of individuals with or without the character. When a character is said to be transmitted, or to be correlated with another character, the biometricist declares the statement vahieless without numerical estimations of the inheritance or correlation. The subject is still so new, and its technical methods (see Variation) have as yet spread so little beyond the group which is formulating and defining them, that it is difficult to do more than guess at the importance of the results likely to be gained. Enough, however, has already been done to show the vast importance of the method in grouping and codifying the empirical facts of life, and in so preparing the way for the investigation of ultimate "causes." The chief pitfall appears to be the tendency to attach more meaning to the results than from their nature they can bear. The ulti- mate value of numerical inquiries must depend on the equivalence of the units on which they are based. Many of the characters that up to the present have been dealt with by biometrical inquiry are obviously composite. The height or length of arm of a human being, for instance, is the result of many factors, some inherent, some due to environment, and until these have been sifted out, numeri- cal laws of inheritance or of correlation can have no more than an empirical value. The analysis of composite characters into their indivisible units and statistical in- quiry into the behaviour of the units would seem to be a necessary part of biometric investigation, and one to which much further attention will have to be paid.

It is well known that Darwin was deeply impressed by differences in flora and fauna, which seemed to be functions of locality, and not the result of obvious dis- similarities of environment. Wallace's studies segrega- of island life, and thfe work of many different observers on local races of animals and plants, marine, fluviatile, and terrestrial, have brought about a con- ception of segregation as apart from differences of environment as being one of the factors in the differenti- ation of living forms. The segregation may be geographi- cal, or may be the result of preferential mating, or of seasonal mating, and its effects plainly can be made no more of than proximate or empirical laws of differenti- ation, of great importance in codifying and simplifying the facts to be explained.

Consideration of phylogenetic series, especially from the palseontological side, has led many writers to the concep- tion that there is something of the nature of a growth-force inherent in organisms and tending " *"' inevitably towards divergent evolution. It is suggested that even in the absence of modification produced by any possible Darwinian or Lamarckian factors, that even in a neutral environment, divergent evolution of some kind would have occurred. The conception is necessarily some- what hazy, but the words BatJimism. and Bathmic Evolu- tion have been employed by a number of writers for some such conception. Closely connected with it, and probably underlying many of the facts which have led to it, is a more definite group of ideas that may be brought together under the phrase " phylogenetic limitation of variation." In its simplest form, this phrase implies such an obvious fact as that whatever be the future development of, say,*

existing cockroaches, it will be on lines determined by the present structure of these creatures. In a more general way, the phrase implies that at each successive branching of the tree of life, the branches become more specialized, more defined, and, in a sense, more limited. The full implica- tions of the group of ideas require, and are likely to receive, much attention in the immediate future of biological investi- gation, but it is enough at present to point out that until the more obvious lines of

inquiry have been opened out much more fully, we cannot "be in a position to guess at the existence of a residuum, for which such a metaphysical conception as Bathmism would serve even as a convenient disguise for ignorance.

Contributions to the theory of evolution have been ex- tremely numerous since 1879. It has been a feature of great promise that such contributions have received atten- tion almost directly in proportion to the new methods of observation and the new series of facts with which they have come. Those have found little favour who brought to the debate only formal criticisms or amplifications of the Darwinian arguments, or re-marshallings of the Darwinian facts, however ably conducted. The time has not yet come for the attempt to synthesize the results of the many different and often apparently antagonistic groups of workers, however plainly it may appear that they are pressing towards similar conclusions under different banners. The great work that is going on is the simpli- fication of the facts to be explained by grouping them under empirical laws ; and the most general statement relating to these that can yet be made is that no single one of these laws has as yet shown signs of taking rank as a vera causa comparable with the Darwinian principle of natural selection.

References. ??? Practically, every botanical and zoological pub- lication of recent date has its bearing on evolution. The following are a few of the more general works : ??? Bateson. Materials for the Study of Variation. ??? Bunoe. Vitalismus und Mechanismus. ??? Cope. Origin of the Fittest ; Primary Factors of Organic Evolution ; Darwin's Life and Letters. ??? Eimee. Organic Evolution. ??? Gulick. " Divergent Evolution through Cumulative Segregation," Jour. Linn. Soc.xs.. ??? Haacke. Schopfung des Menschens. ??? Mitchell. " Valuation of Zoological Characters," Tfans. Linn. Soc. viii. pt. 7. ??? Peaeson. Grammar of Science. ??? Romanes. Darwin and after Darwin. ??? Sedgwick. Presidential Address to Section Zoology, Brit. Ass. Bep. 1899. ??? Wallace. Darwinism. ??? Weismann. The Germ-Plasm. Further references of great value will be found in the works of Bateson and Pearson referred to above, and in the annual volumes of

the Zoological Record, particularly under the head " General Subject." (p. c. M.)

Evora, a city and archiepiscopal see of Portugal, capital of district Evora, about 60 miles east by south from Lisbon, at an altitude of 909 feet. Here is held, in June, one of the largest fairs in the country. The " Temple of Diana" is now used as a library. Good marble is quarried. Population, 15,134 The district of Evora has an area of 2736 square miles, and population 118,408, giving 43 inhabitants to the square mile. A great part of its surface is uncultivated. The district is famous for its mules, and abounds in eock-woods ; there are mines of iron, copper, and asbestos, and marble quarries.

Evreux, chief town of department Eure, France, 67 miles west-north-west of Paris by rail. The cathedral has been entirely restored (finished 1896). The HQtel de Ville is a handsome edifice, completed 1895 ; in front of it is a sculptured fountain with allegorical figures. The manufacture of ticking is the principal textile industry, and there are important copper and iron works. Popula- tion (1881), 9286 ; (1891), 10,825; (1901), 18,322.

Eweli, Richard Stoddert (1817-1872), Ameri- can soldier, was born in Georgetown, D.C., 8th February 1817, and graduated at the U.S. Military Academy in

1840. He resigned his captain's commission in 1861, and entering the Confederate army, rose by successive grades (1861-65) from lieutenant-colonel to lieutenant-general. He lost a leg during the second Bull Eun engagement in August 1862. General " Stonewall " Jackson trusted him greatly, and when fatally wounded nominated him as his successor. At the head of Jackson's veterans he fought at Winchester, Gettysburg, and the Wilderness, but was cap- tured with his entire force by Sheridan on 6th April 1865. He died in Springfield, Tenn., on 25th January 1872.

Ewing, Juliana Horatia Orr (1842-1885), English writer of books for children, daughter of the Rev. Alfred Scott Gatty and of Margaret Gatty (see Ency. Brit. 9th ed. vol. x. p. 109), was born at Ecclesfield, Yorkshire, in 1842. One of a large family, she was accustomed to act as nursery story-teller to her brothers and sisters, and her brother Alfred Scott Gatty provided music to accom- pany her plays. She was well educated in classics and modern languages, and at an early age began to publish verses, being a contributor to Aunt Judy's Magazine, which her mother started in 1866. In 1867 she married Major Alexander Ewing, himself an author, and the com- poser of the well-known hymn " Jerusalem the Golden. " From this time until her death (l3th May 1885), previously to which she had been a constant invalid, Mrs Ewing pro- duced a number of charming children's stories. The best of these are : The Brownies (1870), A Flatrlron for a Farthing (1873), Lob-lie-by the Fire (1874), and Jack- anapes (1884), the last-named, in particular, obtaining a great success ; among others may be mentioned Mrs Over- the- Way's Remembrances (1869), Six to Sixteen, Jan of the Windmill (1876), A Great Emergency (1877), We and the World (1881), OldrFashioned Fairy Tales, Brothers of Pity (1882), TJie Doll's Wash, Master Fritz, Our Garden, A Soldier's Children, Three Little Nest-Birds, A Week Spent in a Glass-House, A Sweet Little Dear, and Blue- Red (1883). Many of these were published by the S.P.C.K. Simple and unaffected in style, and sound and wholesome in matter, with quiet touches of humour and bright

sketches of scenery and character, Mrs Ewing's stories have never been surpassed in the style of literar ture to which they belong.

Exchequer. ??? The ancient term "Exchequer" has survived mainly as the ofiicial title of the national banking account of the United Kingdom. For the conduct of the complicated business of a modern state many subsidiary accounts are necessary ; but it is an essential part of the financial system of Great Britain that there should be one central account into which all sources of revenue fiow, out of which all expenditure is provided, and on the operations of which the principal statements of national finance are based. This central account is commonly called the Exchequer, and its statutory title is " His Majesty's Exchequer." It may also be described with statutory authority as " The Account of the Consolidated Fund of Great Britain and Ireland." This account is, in fact, divided between the Banks of England and Ireland. At the head ofBee of each of these institutions receipts are accepted and payments made on account of the Exchequer; but in published documents the two accounts are consolidated into one, the balances only at the two banks being shown separately.

Operations affecting the Exchequer ai-e regulated by the Exchequer and Audit Departments Act, 1866. Section 10 prescribes that the gross revenue of the United King- dom (less drawbacks and repayments, which are not really revenue) is payable, and must sooner or later be paid into the Exchequer. Section 11 directs that payments should be made from the fund so formed to meet the current re- quirements of spending departments. Sections 13, 14, 15

lay down the conditions under which money can be drawn from the Exchequer. Drafts on the Exchequer require the approval of an officer independent of the executive Government, the Comptroller and Auditor-General. But the description of the formal procedure required by statute

cannot adequately express the actual working of the system, or the part it plays in the national finance. The simplicity of the system laid down by the Act of 1866 has been disturbed by the diversion of certain branches or portions of revenue from the Exchequer to "Local Taxation Accounts," under a system initiated by the Local Government Act, 1888, and much extended since.

While the Exchequer is, as already stated, the central account, it is not directly in contact with the details of either revenue or expenditure. As regards revenue, the produce of taxes and other sources of income passes, in the first instance, into the separate accounts of the re- spective receiving departments ??? mainly, of course, those of the Customs, Inland Kevenue, and Post Office. A not inconsiderable portion is received in the provinces, and remitted to London or Dublin by bills or otherwise, and the ultimate transfers to the Exchequer are made (in round sums) from the accounts of the receiving depart- ments in London or in Dublin. Thus, there are always considerable sums due to the Exchequer by the revenue departments ; on the other hand, as floating balances are (for the sake of economy) used temporarily for current expenses, there are generally amounts due by the Ex- chequer to the receiving departments ; such cross claims are adjusted periodically, generally once a month. Pages 16 and 17 of the " Finance Accounts of the United King- dom for 1898-99 " (House of Commons paper No. 258 of 1899), or the corresponding pages of the volume for any other year, show the gross amounts due to the Exchequer from the departments, and likewise the amounts payable out of the gross revenue in priority to the claim of the Exchequer. On the expenditure side a similar . system prevails. No detailed payments are made direct from the Exchequer, but round sums are issued from it to subsidiary accounts, from which the actual drafts for the public services are met. Eor instance, the interest on the national debt is paid by the Bank of England from a separate account fed by transfers of round sums from the Exchequer as required. Similarly, payments for army, navy, and most civil services are met by the Pay- master-General out of an account of his own, fed by daily transfers from the Exchequer.

This system has two noticeable effects. Firstly, it secures the simplicity and finality of the Exchequer ac- counts, and therefore of all ordinary

statements of national finance. Every evening the Chancellor of the Exchequer can tell his position so far as the Exchequer is concerned ; on the first day of every quarter the Press is able to comment on the national income and expendi- ture up to the evening before. The annual account is closed on the evening of 31st March, and there can be no reopening of the budget of a past year such as may occur under other financial systems. The second effect of the system is to introduce a certain artificiality into the financial statements. Actual facts cannot be reduced to the simplicity of Exchequer figures ; there is always (as alrgady explained) revenue received by Government which has not yet reached the Exchequer; and there must always be a considerable outstanding liability in the form of cheques issued but not yet cashed. The sug- gested criticism is, however, met if it can be shown that, on the whole, the differences between the true revenue and the Exchequer receipts, or between the true (or audited) expenditure and the Exchequer issues, are not, taking one year with another, relatively considerable. The following figures illustrate this point : ???

Expenditure (000' omitted)

Exchequer

Audited

Issues.

Expenditure.

??

??

??

1888-89

85,674

86,070

-1-396

1889-90

86,083

86,033

- 50

1890-91

87,732

87,638

- 94

1891-92

89,928

90,125

-fl97

1892-93

90,375

90,164

-211

1893-94

91,303

91,530 >

-1-227

1894-95

93,919

93,818

-101

1895-96

97,764

97,667

- 97

1896-97

101,477

101,543

~~1~~ 66

1897-98

102,936

103,010

~~1~~ 74

Total for X 10 years /

927,191

927,598

-F407

Eevenub (000' omitted)

1888-89 1889-90 1890-91 1891-92 1892-93 189.3-94 1894-95 1895-96 1896-97 1897-98

Exchequer Receipts.

Actual Eevenue.

Difference.

_?_?_

88,473

89,304

89,489

90,995

90,395

91,133

94,684

101,974

103,960

106,614

88,038

89,416

89,282

91,428

90,181

91,265

94,873

102,031

104,089

106,691

_?_?_

-435 -1-112.

-207

-f433

-214 ‘

-M32

-1-189 ‡ 57

‘ -fl29

+ 77

Total for I 10 years J

947,011

947,294

+273

Surplus (000' omitted)

1888-89 1889-90 1890-91 1891-92 1892-93 1893-94 1894-95 1895-96 1896-97 1897-98

Exchequer Accounts.

Diff. between

Actual Eev. and

Aud. Exp.

Difference.

2799

3221

1757

1067

20

- 170

765

4210

2473

3678

The third column in the above shows the price which has to be paid (in the form of discrepancies between facts and figures) for the simplicity secured to statements and records of the national finance by the present system embodied in the term Exchequer. Probably few will tiiink the price too high in consideration of the advan- tages secured.

The principal official who derives a title from the Ex- chequer in its living sense is, of course, the Chancellor of the Exchequer. He is the person named second in the patent appointing commissions for executing the office of Lord High Treasurer of Great Britain and Ireland ; but he is appointed Chancellor of the Exchequer for Great Britain and Chancellor of the Exchequer for Ireland by two additional patents. Although, in fact, the finance minister of the United Kingdom, he has no statutory power over the Exchequer apart from his position as second commissioner of the

Treasury ; but in virtue of his office he is by statute master of the Mint, senior com-

missioner for the reduction of the national debt, a trustee of the British Museum, an ecclesiastical commissioner, a member of the Board of Agriculture, a commissioner of Public Works and Buildings, Local Government, and Education, a commissioner for regulating the offices of the House of Commons, and has certain functions con- nected with the office of the Secretary of State for India. The only other Exchequer officer requiring mention is the Comptroller and Auditor-General, whose functions as Comptroller-General of the Exchequer have been already described.

The ancient name of the national banking account is still attached to one (until recently two) of the forms of unfunded national debt. Exchequer bills, which date from the reign of William and Mary, became extinct in 1897, and are not likely to be revived, but Exchequer bonds still possess a practical importance. An Exchequer bond is a promise by Government to pay a specified sum after a specified period, generally three or five years, and meanwhile to pay interest half-yearly at a specified rate on that sum. Government possesses no general power to issue Exchequer bonds ; such power is only conferred by^ a special Act, and for specified purposes ; but when the power has . been created. Exchequer bonds issued in pursuance of it are governed by general statutory pro- visions contained in the Exchequer Bills and Bonds Act, 1866, and amending Acts. These Acts create machinery for the issue of Exchequer bonds and for the payment of interest thereon, and protect them against forgery.

Some traces may be mentioned of the ancient uses of the name Exchequer which still remain. The Chancellor of the Exchequer still presides at the ceremony of ???" pricking the list of sheriffs," which is a quasi-judicial function ; and on that occasion he wears a robe of black silk with gold embroidery, which suggests a judicial costume. In England the last judge who was styled Baron of the Exchequer (Baron

Pollock) died in 1897. In Scotland the jurisdiction of the Barons of the Exchequer was transferred to the Court of Session in 1856, but the same Act requires the appointment of one of the judges as "Lord Ordtaary in Exchequer causes," which office still exists. In Ireland there remains a Lord Chief Baron of the Exchequer (Palles), who, however, is now a member of the King's Bench Division, and will be replaced by an ordinary judge of the division. A street near Dublin Castle is called Exchequer Street, recalling the separate Irish Exchequer, which ceased in 1817. The old term also survives in the full title of the Treasury represen- tative in Scotland, which is " The King's and the Lord Treasurer's Remembrancer in Exchequer," while his office in the historic Parliament Square is styled " Exchequer Chambers." (s. e. s.-e.)

Excise Revenue. ??? The duties of excise ia the United Kingdom are under the control of the Commis- sioners of Inland Revenue ; the amount raised, apart from changes in the rate, shows a fairly constant tendency to increase, and is usually regarded as one of the best tests of the prosperity of the working classes. In the year 1900-1 the amount raised under the several heads of duty was as follows : ??? Spirit duty, ??20,124,003 ; beer duty, ??13,940,536 ; excise licences, ??4,136,526 ; railway passenger duty, ??331,214 ; miscellaneous, ??7808 ; total, ??38,640,087. Of this total about ??33,200,000 was paid into the Exchequer, and about ??5,200,000 to the Local Taxation Account in aid of the expenditure of local author- ities. More than 88 per cejit. of the whole revenue was derived from the taxation of two articles ??? spirits and beer.

The spirit duty is levied according to the quantity of " proof spirit " contained in the product of distillation, and the charge is taken at three different points in the

process of manufacture, the trader being liable for the result of the highest of the three calculations. What is known as " proof spirit " is obtained by mixing nearly equal weights of pure alcohol and water, the quantity of pure alcohol being in bulk about 67 per cent, of the whole. The rate of duty in the year 1900 was lis. per proof gallon, of which .6d. per gallon was paid to the Local Taxation Account. Owing to the high rate

of duty as compared with the volume and intrinsic value of the spirits, the whole process Of manufacture is carried on under the close supervision of revenue officials. All the vessels used are measured by them and are secured with revenue locks ; the premises are under constant survey ; and notice has to be given by the distiller of the materials used and of the several stages of his operations. Though the charge for duty is raised at the time when the process of distilla- tion is completed, the duty is not actually paid until the spirits are required for consumption. In the meanwhile they may be retained in an approved " warehouse," which is also subject to close supervision.

The heer duty dates from 1880, in which year it was substituted for the duty on malt. In the first complete year after its imposition it produced ££8,500,000. The rate of duty in 1900 was 7s. 9d. for eveiy 36 gallons of worts at the standard gravity of 1066 ££. Out of this sum 3d. was paid to the Local Taxation Account and the re- mainder to the Exchequer. The specific gravity of the worts depends chiefly on the amount of sugar which they contain, and is ascertained by the saccharometer.

Excise licences may be divided into £££ (a) licences for the sale or manufacture of excisable liquors (about ££2,180,000), (&) licences for other trades, such as tobacco dealers or manufacturers, auctioneers, pawnbrokers, &c. (about ££330,000), (c) licences for male servants, carriages, and armorial beariugs (about ££749,000), and (d) gun, game, and dog licences (about ££868,000). Nearly the whole of the licence duties (with the exception of about ££250,000) is paid over to the Local Taxation Account.

The railway passenger duty, which was made an excise duty by 10 and 11 Vict. cap. 42, applies only to Great Britain. It is levied on all passenger fares exceeding Id. per mile, the rate being 2 per cent, on urban, and 5 per cent, on other traffic.

The other items which go to make up the excise rev- enue are the charges on deliveries from bonded ware- houses (££5168), and the duties on coffee mixture labels (££1573), and on chicory (££1067). Eor more detailed information reference should be made to Highmore's Excise

Laws, and the annual reports of the Commission- ers of. Inland Revenue, especially those issued in 1870 and 1885. (g. h. m.)

Execution, Civil. ^Execution may be defined as the process by which the judgments or orders of courts of law are made effectual. The English law of execution is very complicated, and only a statement of the principal forms can here be attem^jted. To begin with the High Court of Justice: A judgment for the recovery of money or costs is enforced, as a rule, by a writ of fieri facias addressed to the sheriff, and directing him to cause to be made (fieri facias) of the goods and chattels of the debtor a levy of a sufficient sum to satisfy the judgment. The wearing apparel, bedding, tools, &c., of the debtor to the value of 5 are protected. Competing claims are brought before the courts by the procedure of "interpleader." Where it is necessary to have recourse to the debtor's land for the purpose of getting payment of a judgment debt, a writ of elegit is issued to the sheriff, and the value of the land is assessed by an inquisition before a jury. Where a judgment directing the payment of money into court, or the performance by the defendant of any

act within a limited time, has not been complied with, or where a corporation has wilfully disobeyed a judgment, a writ of sequestration is issued, to not less than four seques- trators, ordering them to enter upon the real estate of the party in default, and " sequester " the rents and profits until the judgment has been obeyed. Judgments for the recovery or for the delivery of the possession of land are enforceable by writ of possession. The recovery of specific chattels is obtained by writ of delivery. A judgment creditor may " attach " debts due by third parties to his debtor by what are known as garnishee proceedings. Stock and shares belonging to a judgment debtor may be charged by a charging order, so as, in the first instance, to prevent transfer of the stock or payment of the dividends, and ultimately to enable the judgment creditor to realize his charge. Under the Judgments Act, 1864, a debtor's interest in land may be sold. Where a judgment creditor is otherwise unable to reach the

property of his debtor he may obtain equitable execution, usually by the appoint- ment of a receiver, who collects the rents and profits of the debtor's land for the benefit of the creditor. A writ of attachment of the person of a defaulting debtor or party may be obtained in a variety of cases akin to contempt (e.g., against a person failing to comply with an order to answer interrogatories, or against a solicitor not entering an appearance in an action, in spite of his written under- taking to do so), and in the cases where imprisonment for debt is still preserved by the Debtors Act, 1869. Con- tempt of court {q.v.) in its ordinary forms is also punish- able by summary committal. In the county courts the chief modes of execution are " warrant of execution in the nature of a writ oi fieri facias " ; garnishee proceedings ; equitable execution ; warrants of possession and delivery, corresponding to the writs of possession and delivery above mentioned ; committal, where a judgment debtor has, or, since the date of the judgment has had, means to pay his debt ; and attachment of the person for con- tempt.

The principal modes of execution or " diligence " in Scots law are (i.) Arrestment and furthcoming, which corresponds to the English garnishee proceedings ; (ii.) Arrestment Jwrndiciiora is /jtjidawdce causd, i.e., the seizure of movables within the jurisdiction to found jurisdiction against their owner, being a foreigner; this procedure, which is not, however, strictly a " diligence," as it does not bind the goods, is analogous to the French saisie-arrM, and to the obsolete practice in the Mayor's Court of London known as " foreign attachment " (see Glyn and Jackson, Mayor's Court Practice, 2nd ed., vii. 260) ; (iii.) Arrest- ment under meditatione fugm warrant, corresponding to the old English writ of ne exeat regno, and applicable in the case of a debtor who intends to leave Scotland to evade an action ; (iv.) Arrestment on dependence, i.e., of funds in security ; (v.') Poinding, i.e., valuation and sale of the debtor's goods ; (vi.) Sequestration, e.g., of tenant's effects under a landlord's hypothec for rent ; (vii.) Action of adjudication; by which a debtor's " heritable " {i.e., real) estate is transferred to his judgment creditor in satis- faction of his debt or security therefor. In Scots law " multiple-poinding " is the equivalent of " inter pleader."

Execution in the United States is founded upon English law, which it closely resembles. See Bouvier, Law. Diet. (ed. Rawle, 1897, s.v. "Execution"). The "homestead laws " of various states exempt a certain amount or value of real estate occupied by a debtor as his homestead from a forced sale for the payment of his debts. This homestead legislation has been copied in some British Colonies (see Journ. Soc. Comp. Leg. N.S. No. III. pp. 441-48).

AuTHOKiTiEa. ◆◆◆ Andekson. Execution. London, 1889. ◆◆◆ John- ston. Ayinual Practice. London, 1900 ◆◆◆ Edwards, Execution.

London, 1888. ◆◆◆ Mackay. Manual of Practice. Edinburgh, 1893. (a. w. R.)

Exeter, a city and county of itself, municipal, county (1888), and parliamentary borough, port and county town of Devonshire, England, on the Exe, 194 miles by rail west-south-west of London. In 1885 the parliamentary representation was reduced to one. In 1877 the grammar school was reorganized, the present buildings being erected on a new site in 1886. There are also a technical university extension college, an industrial, and a reforms^ tory school. Among recent erections are four Established churches, a Eoman Catholic church, a public hall, a volunteer drill hall, and an additional wing to the Techni- cal and University Extension College. Belmont Pleasure Ground and the city asylum, costing ◆◆80,000, were both opened in 1886. There are four daily newspapers. Exeter has several large foundries. The imports of foreign and colonial merchandise in 1898 amounted to the value of ◆◆117,665, against ◆◆173,069 in 1888. In 1898, 24 vessels of 1514 tons were registered at the port. Showing a slight increase on 1888 were: entrances, 981 vessels of 79,333 tons ; clearances, 979 of 78,193. Area of municipal and county borough and city prior to extension in 1900, 1883 acres. Population (1881), 37,447; (1891), 37,404. Extended area, 3168' acres. Population (1891), 45,688;

(1901), 47,180.

Exhibitions. ❓❓❓ The first exhibition of which there is any account, in either sacred or profane history, was that held by King Ahasuerus, who, according to the Book of Esther, showed in the third year of his reign "the riches of his glorious kingdom, and the honour of his excellent majesty, many days, even a hundred and four- score days." The locale of this function was Shushan, the palace and the exhibits consisted of " white, green, and blue hangings, fastened with cords of fine linen and purple to silver rings and pillars of marble : the beds were of gold and silver, upon a pavement of red, and blue, and white, and black marble. And they gave them drink in vessels of gold, the vessels being diverse one from another." The first exhibition since the Christian era was at Venice during the dogeship of Lorenzo Tiepolo, in 1268. On that occasion there was a grand display, consisting of a water fgte, a procession of the trades, and an industrial exhibition. The various guilds of the Queen City of the Seas marched through the narrow streets to the great square of St Mark, and their leaders asked the Dogaressa to inspect the products of their industry. Other mediaeval exhibitions were the fairs held at Leipzig and Nijni-Novgorod in Europe, at Tantah in Egypt, and in 1689 that by the Dutch at Leyden.

The first modern exhibition was held at London in 1756 by the Society of Arts, which offered prizes for improvements in the manufacture of tapestry, carpets, and porcelain, the exhibits being placed side by side. Five years afterwards, in 1761, the same society gave an exhibition of agricultural machinery. In 1797 a collective display of the art factories of France, in- cluding those of Sfevres, the Gobelins, and the Savonnerie, was made in the Palace of St Cloud, and the exhibition was repeated during the following year in the Rue de Varennes, Paris. This experiment was so successful that in the last three days of the same year an exhibition under official auspices, at which private exhibitors were allowed to compete, was held in the Champ de Mars. Four years later, in 1801, there was a second official exhibition in the Grand Court of the Louvre. Upon that occasion juries of practical men examined the objects shown, and the winners of a gold medal were invited to dine with Napoleon, who was at that time First Consul. In the

EXHIBITIONS

report of the jury the following remarkable sentence appeared: ??? "There is not an artist or inventor who, once obtaining thus a public recognition of his ability, has not found his reputation and his businessvlargely increased." The third Paris exhibition, held in 1802, was the first to publish an of&cial catalogue. There were 540 exhibitors, including Montgolfier, the first aeronaut, and Jacquard, the inventor of the loom which bears his name. The fourth exhibition was held in 1806 in the esplanade in front of the Hotel des Invalides, and at- tracted 1422 exhibitors. There were no more exhibi- tions till after the fall of the empire, but in 1819 the fifth was held during the reign of Louis XVIII., with 1622 exhibitors. Others were held at Paris at various intervals, that in 1849 having 4300 exhibitors.

Other exhibitions, though on a smaller scale, were held in Dublin, London, and in various parts of Germany and Austria during the first half of 'the 19th century ??? that in 1844, held at Berlin, having 3040 exhibitors. Switzerland, Holland, Belgium, Sweden, Russia, Poland, Italy, Spain, and Portugal all held exhibitions, and there was a Free Trade Bazaar of British Manufactures at Co- vent Garden Theatre in 1845, which at the time created a great deal of interest. But all these exhibitions were confined to the products of the country in which they took place, and the first great International Exhibition was held in London in 1851 by the Society of Arts, under the Presidency of the Prince Consort. All nations were invited to compete ; a site was obtained in Hyde Park, and a building 20 acres in extent was erected, after the design of Sir Joseph Paxton, at a cost of ??193,168. The exhibition was open for five months and fifteen days. The receipts amounted to ??506,100, and the surplus was ??186,000. The number of visitors was 6,039,195, and the money taken at the doors was ??423,792. The total number of exhibitors was 13,937, of which Great Britain contributed 6861, the British Colonies 520, and foreign countries 6556. The International Exhibition of 1851 was followed by those of New York and Dublin in 1853, Melbourne and Munich in 1854, and Paris in 1855, ??? this latter was held in the Palais d'Industrie, which remained in existence until pulled down to make room for the two Palais des Beaux Arts, which formed one of the

attractions of the 1900 exhibition. The exhibitors numbered 20,839, and the visitors 5,162,330. There were national exhibitions during the following years in several European countries, but the next great world's fair was held at London in 1862. The total space roofed in amounted to 988,000 square feet, 22-65 acres, the number of visitors was 6,211,103, and the amount re- ceived at the doors ££408,530. The death of the Prince Consort had a depressing effect upon the enterprise. In 1865 an exhibition was held at Dublin, the greater proportion of the funds being supplied by Sir Benjamin Lee Guinness. The number of attendances during six months was 900,000, and ??? the exhibition was opened at night. An Italian exhibition was held at Rome in

1862.

The Paris Exhibition of 1867 was upon a far larger scale than that of 1855. It was held, like those that preceded and succeeded it, at the Champ de Mars, and covered 41 acres. The building resembled an exaggerated gasometer. The external ring was devoted to machinery, the internal to the gradual development of civilization, commencing with the stone age and continuing to the present era. A great feature of the exhibition was the park, which was studded with specimens of every style of modern architecture ??? Turkish mosques, Swedish cot- tages, English lighthouses, Egyptian palaces, and Swiss chalets. The number of attendances was 6,805,969. The exhibitors numbered 43,217, and the total amount re-

ceived for entrances, concessions, &c., was ££420,735. This was the first exhibition at which there were inter- national restaurants. The cost of the exhibition was defrayed partly by the State and partly by private subscriptions.

Small exhibitions were held in various parts of Europe between 1867 and 1870, and in the latter year a series of international exhibitions, confined to ene or two special descriptions of produce or manufactures, was inaugurated in London at South Kensington. These continued till 1874, but they failed to attract any very large attendance of the public, and were abandoned. A medal was given to each exhibitor, and reports on the

various exhibits were published, but there was no examination of the exhibits by jurors. In 1873 there was an International Exhibition at Vienna. The main building, a rotunda, was erected in the beautiful park of the Austrian capital. There were halls for machinery and agricultural prod- ucts, and hundreds of buildings, erected by different nations, were scattered amongst the woodlands of the Prater. Unfortunately, an outbreak of cholera dimin- ished the attendance of visitors, and the receipts were only ??206,477, although the visitors were said to have reached 6,740,500, and the number of exhibitors was

25,760.

None of the International Exhibitions held between 1857 and 1873 had attracted as many as 7,000,000 visitors, but the gradual extension of education amongst the masses, and the greater facilities for locomotion, brought about by the growth of the railway system in all portions of the civilized world, largely increased the at- tendances at subsequent World's Fairs. The Centennial Exhibition of 1876, to celebrate the one-hundredth anni- versary of American Independence, was held at Fair- mount Park, Philadelphia. The funds were raised partly by private subscriptions, and partly by donations from the city of Philadelphia, from Pennsylvania, and some of the neighbouring states. The Central Government at Washington made a large loan, which was subsequently repaid. The principal buildings, five in number, occu- pied an area of 48^ acres, and there were several smaller structures, which in the aggregate must have filled half as much space more, the largest being that devoted to the exhibits of the various departments of the United States Government, which covered 7 acres. Several novelties in exhibition management were introduced at Philadelphia. Instead of gold, silver, and bronze medals, only one de- scription, bronze, was issued, the difference between the merits of the different exhibits being shown by the re- ports. Season tickets were not issued, and the price of admission, the same on all occasions, was half a dollar, or about 2s. id. The exhibition was not open at night or on Sundays, thus following the British, and not the con- tinental, precedent. The number of visitors was 9,892,- 625, of whom 8,004,214 paid for admission, the balance being exhibitors, officials, and attendants. The total re- ceipts amounted to ??763,899. Upon one occasion, the

Pennsylvania day, 274,919 persons ??? the largest number that had visited any exhibition up to that date ??? passed through the turnstiles. The display of machinery was the finest ever made, that of the United States occupying 480,000 square feet. The motive-power was obtained from a Corliss engine of 1600 horse-power. At this ex- hibition the United Kingdom and the British Colonies of Canada, Victoria, New South Wales, New Zealand, Cape Colony, and Tasmania made a very fine display, which was only excelled by that of the United States.

The Paris Exhibition of 1878 was upon a far larger scale in every respect than any which had been previ- ously held in any part of the world. The total area covered not less than 66 acres, the main building in the

Champ de Mars occupying 54 acres. The French exhibits filled one-half the entire space, the remaining moiety being occupied by the other nations of the world. The United Kingdom, British India, Canada, Victoria, New South Wales, Queensland, South Australia, Cape Colony, and some of the British Crown Colonies occupied nearly one-third of the space set aside for nations outside France. Germany was the enly great country which was not repre- sented, but there were a few German paintings. The display of fine arts and machinery was upon a very large and comprehensive scale, and the Avenue des Nations, a street 2400 feet in length, was devoted to specimens of the domestic architecture of nearly every country in Europe, and to several in Asia, Africa, and America. The palace of the Trocadero, on the northern bank of the Seine, was erected for the exhibition. It was a handsome structure, with towers 250 feet in height, and flanked by two galleries. The rules for admission were the same as those at Philadelphia, and every person ??? exhibitor, journalist, or official ??? who had the right of entrance was compelled to forward two copies of his or her photograph, one of which was attached to the card of entry. The ordinary tickets were not sold at the doors, but were obtainable at various Government offices and shops, and from numerous pedlars in all parts of the city and sub- urbs. The

buildings were somewhat unfinished upon the opening day, political complications having prevented the French Government and the French people from paying much attention to the exhibition till about six months before it was opened; but the efforts made in April were prodigious, and by June 1st, a month after the opening, the exhibition was complete, and afforded an object-lesson of the recovery of France from the calamities of 1870-71. The decisions arrived at by the international juries were accompanied by medals of gold, silver, and bronze. The expenditure by the United Kingdom was defrayed out of the consolidated revenue, each British colony defraying its own expenses. The display of the United Kingdom was under the control of a Koyal Commission, of which the Prince of Wales was President. The number of paying visitors to the exhibition was 13,000,000, and the cost of the enterprise to the French Government, which supplied all the funds, was a little less than a million sterling, after allowing for the value of the permanent buUdings and the Trocadero Palace, which were sold to the city of Paris. The total number of persons who visited Paris during the time the exhibition was open was 571,792, or 308,974 more than came to the French metropolis during the year 1877, and 46,021 in excess of the visitors during the previous exhibition of 1867. It was stated at the time that, in addition to the impetus given to the trade of France, the revenue of the Republic and of the city of Paris from customs and octroi duties was increased by nearly three millions sterling as compared with the previous year.

Exhibitions on a scale of considerable magnitude were held at Sydney and Melbourne in 1879 and 1880, and many Continental and American manufacturers took advantage of them in order to bring the products of their industry directly under the notice of Australian consumers, who had previously purchased their supplies through the instrumentality of British merchants. The United Kingdom and India made an excellent display at both cities, but the effect of the two great Australian exhibitions was to give a decided impetus to German, American, French, and Belgian trade. One of the imme- diate results was that lines of steamers to Melbourne and Sydney commenced to run from Marseilles and Bremen ; another, that for the first time in the history of the Aus- tralian Colonies, branches of French banks were opened

in the two principal cities. The whole cost of these exhibitions was defrayed by the local Governments.

Exhibitions were held at Turin and Brussels during 1880, and smaller ones at Newcastle, Milan, Lahore, Adelaide, Perth, Moscow, Ghent, and Lille during 1881 and 1882, and at Zurich, Bordeaux, and Caraccas in Venezuela during 1883. The next of any importance was held at Amsterdam in the latter year. On that occasion a new departure in Exhibition management was made. The Government of the Netherlands was to a certain extent responsible for the administration of the exhibition, but the funds were obtained from private sources, and a charge was made to each nation represented for the space it occupied. The United Kingdom, India, Victoria, and New South Wales took part in the exhibition, but there was no o^cial representation of the mother country. Exhibitions on somewhat similar lines were held at Nice and Calcutta in thfe winter of 1883 and 1884, and at Antwerp in 1895.

A series of exhibitions, under the presidency of the Prince of Wales, and managed by the late Sir Cunliffe Owen, was commenced at South Kensington in 1883. The first was devoted to a display of the various indus- tries connected with Fishing; the second, in 1884, to objects connected with Hygiene ; the third, in 1885, to Inventions ; and the fourth, in 1886, to the British Colonies and India. These exhibitions attracted a large number of visitors, and realized a substantial profit. They might have been continued indefinitely if it had not been that the buildings in which they were held had become very dilapidated, and that the ground covered by them was required for other purposes. There was no exam- ination of the exhibits by juries, but a tolerably liberal supply of instrumental music was supplied by military and civil bands. The Crystal Palace held a successful Inter- national Exhibition in 1884, and there was an Italian Exhibition at Turin, and a Forestry Exhibition at Edin- burgh, during the same year. A World's Industrial Fair was held at New Orleans in 1884-85, and there were Universal Exhibitions at Montenegro and Antwerp in 1885, at Edinburgh in 1886, Liverpool, Adelaide, Newcastle, and Manchester in 1887, and at Glasgow, Barcelona, and Brussels in 1888. Melbourne held an International Exhibition in 1888-89 to celebrate the Centenary of Australia. Great Britain, Germany, France,

Austria, and the United States were officially represented, and an expenditure of ??237,784 was incurred by the local Government.

The Paris Exhibition of 1889 marked an important change in the policy which had previously characterized the management of these gatherings. The funds were contributed partly by the State, which voted 17,000,000 francs, and by the municipality of Paris, which gave 8,000,000. A guarantee fund amounting to 23,124,000 francs was raised, and on this security a sum of 18,000,- 000 francs was obtained and paid into the coffers of the administration. The bankers who advanced this sum recouped themselves by the issue of 1,200,000 "bons," each of 25 francs. Every bon contained 25 admissions, valued at 1 franc, and certain privileges in the shape of participation in a lottery, the grand prix being ??20,000. The calculations of the promoters were tolera- bly accurate. The attendances reached the then un- precedented number of 32,350,297, of whom 25,398,609 paid in entrance tickets, and 2,723,366 entered by season tickets. A sum of 2,307,999 francs was obtained by concessions for restaurants and "side-shows," upon which the administration relied for much of the at- tractiveness of the exhibition. The total expenditure was 44,000,000 francs, and there was a small surplus. The space covered in the Champ de Mars, the Trocadero,

the Palais d'lndustrie, the Invalides, and the Quai d'Orsay was 72 acres, as compared with 66 acres in 1878, and 41 acres in 1867. Amongst the novelties was the Eiffel Tower, 1000 feet in height, and a faithful reproduction of a street in Cairo. The system of international juries was continued, but instead of gold, silver, and copper medals, diplomas of various merits were granted, each entitling the holder to a uniform medal -of bronze. Some of the " side-shows " did not add to the dignity, although perhaps to the pecuniary success, of the ex- hibition. The date at which it was held, the Cen- tenary of the French Revolution, did not commend it to several European Governments. Austria, Hungary, Belgium, China, Egypt, Spain, Great Britain, Italy, Luxembourg, Holland, Peru, Portugal, Rumania, and Russia took part, but not officially, while Germany,

Sweden, Turkey, and Montenegro were conspicuous by their absence. On the other hand, Argentina, Bolivia, Chili, the United States, Greece, Guatemala, Morocco, Mexico, Nicaragua, Norway, Paraguay, Salvador, the South Africa Republic, Switzerland, Uruguay, and Ven- ezuela sent Commissioners, who were accredited to the Government of the French Republic. The total number of exhibitors was 61,722, of which Prance contributed 33,937, and the rest of the world 27,785. The British and Colonial section was under the management of the Society of Arts, which obtained a guarantee fund of ££16,800, and, in order to recoup itself for its expendi- ture, made a charge to exhibitors of 6s. per square foot for the space occupied. There were altogether 1149 British exhibitors, of whom 429 were in the Fine Arts section. One of the features of the exhibition was the number of congresses and conferences held in connexion with it.

During the year 1890 there was a Mining Exhibition at the Crystal Palace, and a Military Exhibition in the grounds of Chelsea Hospital; in 1891, a Naval Exhi- bition at Chelsea, and an International at Jamaica. In 1891-92 there were exhibitions at Palermo and at Launceston in Tasmania ; in 1892, a Naval Exhibition at Liverpool, and one of Electrical Appliances at the Crystal Palace. A series of small national exhi- bitions under private management were held at Earls Court between 1887 and 1891. The first of the series was that of the United States £££ Italy followed in 1888, Spain in 1889, France in 1890, and Germany in 1891.

The next Exhibition of the first order of magnitude was at Chicago in 1893, and was held in celebration of the 400th anniversary of the discovery of America by Columbus. The financial arrangements were undertaken by a company, with a capital of ££2,000,000. The Central Government at Washington allotted ££20,000 for the purposes of foreign exhibits, and ££300,000 for the erection and administration of a building to contain exhibits from the various Departments of State. The exhibition was held at Jackson Park, a place for public recreation, 680 acres in extent, situated on the shore of Lake Michigan, on the southern side of the city, with which it was connected by railways and tramways. Special provision was made for locomotion in the grounds themselves by

a continuous travelling platform and an elevated electric railway. The proximity of the lake, and of some artificial canals which had been constructed, rendered possible the service of electric and steam launches. The exhibition remained open from May 1st to October 30th, and was visited by 21,477,212 persons, each of whom paid half a dollar (about 2s. Id.) for admission. The largest number of visitors' on any one day was 716,881. In addition to its direct vote of ££320,000, Congress granted ££500,000 to the Exhibition in a special coinage, which sold at an enhanced price. The

receipts from admissions were ££2,120,000 ; from con- cessions, ££750,000; and the miscellaneous receipts, ££159,000: total, ££3,029,000. The total expenses were ££5,222,000. Of the sums raised by the Company, ££400,000 was returned to the subscribers. Speaking roughly, it may be said that the total outlay on the Chicago Exhibition was six millions sterling, of which three millions were earned by the Fair, two millions sub- scribed by Chicago, and a million provided by the United States Government. The sums expended by the partici- pating foreign Governments was estimated at ££1,440,000. The total area occupied by buildings at Chicago was as nearly as possible 200 acres, the largest building, that devoted to Manufactures, being 1687 feet by 787, and 30-6 acres. The funds for the British Commission, which was under the control of the Society of Arts, were provided by the Imperial Government, which granted ££60,000. The number of British exhibitors was 2236, of whom 697 were Industrial, 601 Fine Arts, and 1138 Women's work. In this total was included 18 Indian exhibitors. The space occupied by Great Britain was 306,285 square feet ; and, in addition, separate buildings were erected in the grounds. These were Victoria House, the headquarters of the British Commission ; the Indian Pavilion, erected by the Indian Tea Association ; the Kiosk of the WTiite Star Steamship Company; and the structure set up by the Maxim-Nordenfelt Company. Canada and New South Wales had separate buildings, which covered 100,140 and 50,951 square feet respectively; and Cape Colony occu- pied 6260, Ceylon 27,674, British Guiana 3367, Jamaica 4250, Trinidad 3400, and India 3584 square feet in the several buildings. The total space occupied by the British Colonies was therefore 193,660 square feet. The system of awards was considered extremely

unsatisfactory. Instead of international juries, a single judge was appointed for e^ch class, and the recompenses were all of one grade, a bronze medal and a diploma, on which was stated the reasons which induced the judge to make his decision. Some judges took a high standard, and refused to make awards except to a small proportion of selected exhibits ; others took a low one, and gave awards indiscriminately. About 1183 awards were made to British exhibitors. The French refused to accept any awards. The value of the British goods exhibited was estimated, exclu- sive of Fine Arts, at ►►430,000, and the expenses of showing them at ►►200,000. A large expenditure was incurred in the erection of buildings, which were more remarkable for their beauty and grandeur than for their suitableness to the purposes for which they were intended. Considerable areas were devoted to "side-shows," and the midway Plaisaunce, as it was termed, resembled a gigantic fair. Every country in the world contributed something. There were sights and shows of every sort from everywhere. The foreign countries represented were Argentina, Austria, Belgium, Bolivia, Brazil, Bulgaria, Chili, Columbia, Costa Rica, Cuba, CupaQoa, Denmark, Danish W^est Indies, Ecuador, France, Germany, Greece, Guatemala, Honduras, Hayti, Japan, Johore, Korea, Liberia, Mexico, Monaco, Netherlands, Norway, Orange Free State, Paraguay, Persia, Portugal, Russia, Siam, Spain, Sweden, Turkey, United Kingdom and Colonies, Uruguay, and Venezuela.

Exhibitions were .held at Antwerp, Madrid, and Buc- harest in 1894 ; Hobart in 1894-95 ; Bordeaux, 1896 ; Niji Novgorod, Berlin, and Budapest in 1896 ; Brussels and Brisbane in 1897. A series of exhibitions, under the management of the London Exhibitions Company, com- menced at Earls Court in 1896 with that of India. India and Ceylon followed in 1896, the Victorian Era in 1897, the Universal in 1898, the Greater Britain (at which Victoria, Queensland, West Australia, Rhodesia, West

Africa, and tlie West Indies were represented) in 1899, Woman's Work in 1900, and a Military Exhibition in

1901.

The Paris Exhibition of 1900 was larger than any which had been previously held in Europe. The buildings did not cover so much ground as those at Chicago, but many of those at Paris had two or more floors. In addition to the localities occupied in 1889, additional space was obtained at the Champs Blysees, the Park of Vincennes, on the north bank of the Seine between the Place de la Concorde, and at the Trocadero. The total superficial area occupied was as follows : ??? Champs de Mars, 124 acres ; Esplanade des Invalides, 30 acres ; Trocadero Gardens, 40 acres ; Champs Elysees, 37 acres ; quays on left bank of Seine, 23 acres ; quays on right bank of Seine, 23 acres ; Park at Vincennes, 270 acres : total, 549 acres. The space occupied by buildings and covered in amounted to 4,865,328 square feet, 111-|- acres. The French section covered 2,691,000 square feet, the Foreign 1,829,880, and those at the Park of Vincennes 344,448 square feet. About one hundred French and seventy-live Foreign pavilions and detached buildings were erected in the grounds in addition to the thirty-six official pavilions, which were for the most part along the Quai d'Orsay. Funds were raised upon the same system as was adopted in 1889. The French Government granted ??800,000, and a similar sum was contributed by the municipality of Paris. ??2,400,000 was raised by the issue of 3,250,000 " bons," each of the value of 20 francs, and containing 20 tickets of admission to the Exhibition of the face value of one franc each, and a document which gave its holder a right either to a reduced rate for admis- sion to the different " side-shows " or else to a diminution in the railway fare to and from Paris, together with a participation in the prizes, amounting to six million francs, drawn at a series of lotteries. Permission to erect restaurants, and to open places of amusement in buildings erected for that purpose, were sold at high prices, and for these privileges, which only realized 2,307,999 francs in 1889, the concessionaires agreed to pay 8,864,442 francs in 1900. The results did not justify the expectations which had been formed, and the administration finally consented to receive a much smaller sum. The adminis- tration calculated that they would have 65,000,000 paying

visitors, though there were only 13,000,000 in 1878 and 25,398,609 in 1889. A very few weeks after the opening day, April 16th, it became evident that the estimated figures would not be reached, and as a large number of holders of " bons " threw them on the market, and the selling price of an admission ticket declined from the par value of one franc to less than half that amount, or from 30 to 50 centimes. The proprietors of the restaurants and " side-shows " discovered that they had paid too much for their concessions, that the buildings they had erected were far too handsome and costly to be profitable, and that the public preferred the Exhibition itself to the so- called attractions. The Exhibition was largely visited by foreigners, but various causes kept away many persons of wealth and position. Although many speculators were ruined, the Exhibition itself was successful. The attend- ance was unprecedentedly large, and during the seven months the Exhibition was open, 39,000,000 persons paid for admission with 47,000,000 tickets, since from two to five tickets were demanded at certain times of the day and on certain occasions. The entries of exhibitors, at- tendants, and officials totalled 9,000,000. The receipts were 114,456,213 francs (£4,578,249), and the expenditure 116,500,000 (£4,660,000), leaving a deficiency of rather more than two millions of francs (£80,000). It was cal- culated that the expenditure of the foreign nations which took part in the Exhibition was six millions sterling, and

of the French exhibitors and concessionaries three millions sterling.

A new plan of classifying exhibits was adopted at Paris, all being displayed according to their nature, and not ac- cording to their country of origin, as had been the system at previous Exhibitions. One-half the space in each group was allotted to France, so that the exhibitors of that nation were enabled to overwhelm their rivals by the number and magnitude of the objects displayed by them. All the agricultural implements, whatever their nation- ality, were in one place, all the ceramics in another, so that there was no exclusively British and no exclusively German court. The only exception to this rule was in the Trocadero, where the French, British, Dutch, and Portuguese Colonies, Algeria, Tunis, Siberia, the South African Republic, China, and Japan were allowed to erect at their own cost separate pavilions. The greater

number of the nationalities represented had palaces of their own in the Rue des Nations along the Quai d'Orsay, in which thoroughfare were to be seen the buildings erected by Italy, Turkey, the United States, Denmark, Portugal, Austria, Bosnia, Herzegovina, Peru, Hungary, the United Kingdom, Persia, Belgium, Norway, Luxemburg, Finland, Germany, Spain, Bulgaria, Monaco, Sweden, Rumania, Greece, Servia, and Mexico. Scattered about the grounds, in addition to those in the Trocadero, were the buildings of San Marino, Morocco, Ecuador, and Corea. Nearly every civilized country in the world was represented at the Exhibition, the most conspicuous absentees being Argentina, Brazil, Chili, and some other South and Central American Republics, and a number of the British Colonies. The most noteworthy attractions of the Exhibition were the magnificent effects produced by electricity in the Palace devoted to it in the Chateau d'Eau and in the Hall of Illusions, the two Palaces of the Fine Arts in the Champs Elysees, and the Bridge over the Seine dedicated to the memory of Alexander II. These permanent Fine Art palaces were devoted, the one to modern painting and sculpture, the other to the works of French artists and art workmen who flourished from the dawn of French art up to the end of the 18th century.

The United Kingdom was well but not largely rep- resented both in Fine Arts and Manufactures, the ad- ministration of the section being in the hands of a Royal Commission, presided over by the Prince of Wales. The British Pavilion contained an important collection of paint- in gs of the British school, chiefly by Reynolds, Gains- borough, and their contemporaries, and by Turner and Burne-Jones. Special buildings had been erected by the British Colonies and by British India. Canada, West Australia, and Mauritius occupied the former, India and Ceylon the latter. For the first time since the war of 1870 Germany took part in a French International Exhibition, and the exhibits showed the great industrial progress which had been made since the foundation of the empire in 1870. The United States made a fine display, and fairly divided the honours with Germany. Remarkable progress was manifested in the exhibits of Canada and Hungary. France maintained her superiority in all the objects in which good taste was the first con- sideration, but the more utilitarian exhibits were more remarkable for their number than their quality, except those connected with electrical work and display,

auto- mobiles, and iron-work. The number of exhibitors in the Industrial Section from the British Empire, including India and the Colonies, was 1250, who obtained 1647 awards, as many persons exhibited in several classes. There were, in addition, 465 awards for " collaborateurs," that is, assistants, engineers, foremen, craftsmen, and workmen who have co-operated in the production of the exhibits. In

the British Fine Arts section there were 429 exhibits by 282 exhibitors, and 175 awards.

Important International Exhibitions were held at Glas- gow, and at Buffalo, New York, during 1901. (g. c. l.)

Exmouth, a market-town, seaport, and watering- place in the Honiton parliamentary division of Devon- shire, England, 10 miles south-east by south of Exeter by rail. The scenery of the neighbourhood is unrivalled, and the drives over Black Hill and Woodbury Common are very beautiful. Eecent erections are two district churches, a mission church, a Catholic chapel, a Reformed Church of England, a Congregational chapel, a Wesleyan chapel, a public hall, yacht clubhouse, and the Maud Hospital. A pleasure ground and public garden has been opened. A new system of sewerage is nearly completed, at a cost of ◆◆35,000. There is an excellent supply of pure water. Two commodious excursion steamers run to different places on the coast daily during the summer. A new dispensary has lately been built, and it is proposed to erect a new hospital to take the place of the Maud Hospital. Area of urban district (two parishes), 4800 acres. Population

(1881), 7265; (1901), 10,442.

Experiments on Animals. ◆◆◆ The purpose of this article is to give some account of the present method of experiments on animals in the United King- dom, and to set forth the chief discoveries that have been made by the help of such experiments.

I. Methods Employed. ??? The Act relating to experi- ments on animals was passed in 1876. At that time the majority of these experiments were physiological. There was, it may be fairly said, no such thing as bacteriology, and the doctrine of spontaneous generation was still held by one, at least, among men eminent in science. A few experiments were made in pathology, for instance in tubercle ; and a few in surgery, in pharmacology, and in the action of poisons, especially snake-venom. But the chief use of experiments on animals was for the advance- ment of physiology. The evidence given before the Royal Commdssion (1875) was, almost entirely, on physiological matters, on the discoveries of Harvey, Bell, Magendie, and Claude ^einaid, on the ITandbook for the Physiological Laboratory, and so forth. The Act, therefore, was drafted with a view to physiology, without much concern for pathology, and without foreknowledge of bacteriology. At the present time, about 80 per cent, of the experiments are inoculations.

The chief conditions of the Act must be mentioned here, though they are also referred to under Vivisection. Every experiment must be made in a registered place open to Government inspection. As the Home Secretary said in 1898, " The only experiments performed elsewhere than at registered places are inoculation operations in connexion with the diseases of cattle ; and inspection in such cases is deemed unnecessary and does not take place." Every experiment must be made under a licence; and every application for a licence must be recommended by the signatures of two out of a small body of authorities specified in the Act ??? presidents of certain learned societies, and professors of certain universities and colleges. The word " experiment " is not allowed to cover the use of more than one animal.

Most experiments are made not under a licence alone, but under a licence plus one or more certificates, and the wording and working of these certificates must be clearly understood, because it is over them that the question arises as to the amount of pain inflicted by these experi- ments. Under the licence alone the animal must be kept under an anaesthetic during the whole of the experi- ment; and "if the pain is likely to continue after the

effect of the anaesthetic has ceased, or if any serious injury has been inflicted on the animal," it must be killed forth- with under the anaesthetic. Thus, under the licence alone, it is impossible to make an inoculation ; for the experiment consists not in the introduction of the needle under the skin, but in the observation of the results of the inoculation. A guinea-pig inoculated with tubercle can- not be kept under an anaesthetic till it dies of the disease. The disease is the experiment, and it is therefore an ex- periment made without an anassthetic, and not authorized by the licence alone. Again, under the licence alone it would have been impossible to work out the thyroid treatment of Myxoedema, or the facts of cerebral locali- zation. Eor to remove the thyroid gland, or to remove a portion of the surface of the brain, is to inflict a serious injury on the animal. The operation is done under pro- found anaesthesia ... it would be impracticable otherwise : the wound is treated and dressed by the antiseptic method ... suppuration would invalidate the result. But a serious injury has been inflicted. Nevertheless, the animal must not be killed forthwith: the result must be watched. These and the like experiments cannot therefore be made under the licence alone. For the removal of such dis- abilities as these, the Act empowers the Home Secretary to grant certain certificates, to be held with the licence. They must be recommended by two signatures, and various restrictions are put upon them by the Home Secretary. On July 11, 1898, the Home Secretary was asked, in the House of Commons, what were the conditions and regula- tions attached by the Home Office to licences and certifi- cates ; and he answered ...

" The conditions are not always the same, but may vary according to the nature of the investigation. It is hardly possible, therefore, for me to state all the conditions attached to licences and cer- tificates. The most important conditions, however (besides the limitations as to place, time, and number of experiments), and the conditions most frequently imposed, are those as to reporting and the use of antiseptics. The latter condition is that the animals are to be treated with strict antiseptic precautions, and if these fail and pain results, they are to be killed immediately under anaesthetics. The reporting conditions are, in brief, that a written record, in a prescribed form, is to be kept of every experi- ment, and is to be open for examination by the inspector ; that a report of all experiments is to be

forwarded to the inspector ; and that any published account of an experiment is to be transmitted to the Secretary of State. Another condition requires the im. mediate destruction under anaesthetics of an animal in which severe pain has been induced, after the main result of the experi- ment has been attained."

The certificates are distinguished as A, B, C, E, EE, and F. Certificate D, which permitted the testing, by experiments, of " former discoveries alleged to have been made," has fajllen into disuse. Certificate C permits experiments to be made by way of illustration of lectures. They must be made under the provisions contained in the Act as to the use of anaesthetics. Certificates E, EE, and F permit experiments to be made on the dog, cat, horse, ass, or mule. These certificates are linked with Certificate A or Certificate B. It is round these two certificates, A and B, that the controversy as to the pain caused by experiments on animals is centred.

Certificate A permits experiments to be made without anaesthesia. It is worded as follows : ??? " Whereas A. B. of [here insert address and prof ession] has represented to us (i.e., two authorities) that he proposes, if duly authorized under the above-mentioned Act, to perform on living animals certain experiments described below: We hereby certify that, in our opinion, insensibility in the animal on which any such experiment may be performed cannot be pro- duced by anaesthetics without necessarily frustrating the object of such experiment." All inoculations under the skin, all feeding experiments, and the like, are scheduled under this certificate. They must be scheduled somehow : they cannot legally be made under a licence alone. Though the only instrument used is a hypodermic needle, yet every inoculation is officially returned as an experiment, calculated to give pain, performed without an

ansesthetio. It is for inoculations and the like experiments, and for them alone, and for nothing else, that Certificate A is allowed (or A linked with B or F). This want of a special certificate for inoculations, and this wresting of Certificate A for the purpose, have led to an erroneous belief that "cutting operations" are per- mitted by the Act without an anaesthetic. But, as the Home Secretary said in Parliament, in March 1897, " Certificate A is never allowed except for inoculations and similar trivial operations, and in every case a condition is attached to prevent unnecessary pain." And again he wrote in 1898, "Such special certificates (dispensing with ansesthetios) are granted only for inoculations, feeding, and similar procedures involving no cutting. The animal has to be killed under ansesthetics if it be in pain, so soon as the result of the experiment is ascertained."

Certificate B permits the keeping alive of the animal after the initial operation of an experiment. It is worded as follows : ??? " Whereas A. B. of [here insert address and profession] has repre- sented to us (i. e. , two authorities) , that he proposes, if Aulj author- ized under the above-mentioned Act, to perform on living animals certain experiments described below, such animals being, during the whole of the initial operation of such experiments, under the influence of some anaesthetic of sufficient power to prevent their feeling pain : We hereby certify that, in our opinion, the killing of the animal on which any such experiment is performed before it recovers from the influence of the anaesthetic administered to it would necessarily frustrate the object of such experiment. " Cer- tificate B (or B linked with EE or E) is used for those experiments which consist in an operation plus subsequent observation of the animal. The section of a nerve, the removal of a secretory organ, the establishment of a fistula, the plastic surgery of the intestine, the transplantation of particles of a tumor, the sub-dural method of inoculation ??? these and the like experiments are made under this certificate. We may take, to illustrate the use of Certificate B, Mr Horsley's observations on the thyroid gland. The removal of the gland

was the initial operation ; and this was performed under an anaesthetic, and with the antiseptic method. Then the animal was 'kept under observation. The experiment is neither the operation alone nor the observation alone, but the two together.

It has been said that Certificate B allows a licensee to make an incision under an anaesthetic, and then, when the anaesthetic has passed off, to keep the animal under curare, and make painful experiments on it through the incision. Curare, however, is not an anaesthetic under the Act; and Certificate B is granted "on condition that antiseptic precautions are used ; and if these fail and pain continues after the anaesthetics have ceased to operate, the animal is immediately killed painlessly" (Letter from the Home Secretary, 1898). The purpose of this certificate is set forth in the Inspector's report for 1899: ??? "In experiments performed under Certificate B (or BE or E linked with B) the animal is anaes- thetized 'during the operation, but is allowed to recover. These operations, in order to ensure success, are necessarily done with as much care as are similar operations upon the human subject, and the operations being performed aseptically, the process of healing takes place without pain."

Prom tliis brief account of the chief provisions of the Act, we come to consider the general method of experi- ments on animals in the United Kingdom, and the ques- " tion of the infliction of pain on them. The total number of licensees in Great Britain and Ireland in 1899 was 259, of whom 74 (or 30 per cent.) performed no experiments. The total number of experiments was 8696. Of these, only 227 were made in Ireland ; and since the repiort of the Inspector for Ireland is separate from that of the Chief Inspector for England and Scotland, we may take separately the experiments made in Great Britain. These are 8469 in number. They are tabulated in two divisions, called iii. A and iii. B : ???

Table iii. is divided into two parts, A and B, for the purpose of separating experiments which are performed without anaesthetics from experiments in which anaesthetics are used. The only experi- ments performed without anaesthetics are inoculations, hypodermic injections, vaccinations, and similar proceedings, in which the pain inflicted is not greater than the

prick of a needle. No experiments requiring anything of the nature of a surgical operation, or that would cause the infliction of an appreciable amount of pain, are allowed to he performed without an anmsthetic.

The total number of experiments included in Table iii. (A) is 1656. Of these there were performed ???

Under licence alone 820

??? Certificate C 182

,, Certificate B 449

,, Certificate B and EE 205

In experiments performed under the licence alone, or under Cer- tificate C, the animal suffers no pain, because it is kept under Jhe infiuence of an anesthetic from the beginning of the experiment until it is killed.

In experiments performed under Certificate B (or EE or F linked with B) the animal is anaesthetized during the operation, but is allowed to recover. These operations, in order to ensure success, are necessarily done with as much care as are similar operations upon the human subject, and the operations being per- formed aseptically, the process of healing takes place without pain. Inoculations made (upon rodents) with the object of diagnosing rabies in dogs have been placed, together with other inoculations requiring a preliminary incision in order to expose the part into which the injection is made, in Table iii. (A). In all these cases the whole operation is performed under an anaesthetic.

Table iii. (B) is devoted entirely to inoculations, hypodermic injections, and some few other proceedings, performed without anesthetics. It includes 6813 experiments, whereof there were performed ???

Under Certificate A 6689

,, Certificate A and E . . . 83

,, Certificate A and F 41

A large number of these experiments were performed as a matter of professional duty for the diagnosis and prevention of disease, for the standardization of remedies, and for the testing of articles of food, such as water, milk, and butter, many of them on behalf of Government Departments, County Councils, and Municipal Corporations. The demand for antitoxins continues to increase, and during the past year 54,569 doses of diphtheria antitoxin have been sent out from two institutions.

It may be well to consider first the 6813 experiments included in Table iii. B. All, except 124, were performed on animals not especially protected by the Act. The animals most used for inoculations are mice, rats, guinea-pigs, and rabbits. The act of inoculation is not in itself painful. A small area of the skin is carefully shaved and cleansed, that it may be aseptic, the hypodermic needle is sterilized, and the method of hypodermic injection or of vaccination is the same as it is in medical practice. " A guinea-pig that will rest quietly in your hands before yon commence to inject it, will remain perfectly quiet during the introduction of the needle under the skin ; and the moment it is returned to the cage it resumes its inter- rupted feeding. Arteries, veins, and most of the parts of the viscera are without the sense of touch. We have actual proof of this in what takes place when a horse is bled for the purpose of obtaining curative serum. With a sharp lance a cut may be made in the skin so quickly and easily that the animal does nothing more than twitch the skia- muscle of the neck, or give his head a shake, while of the further proceeding of introducing a hollow needle into the vein, the animal takes not the slightest notice. Some horses, indeed, will stand perfectly quiet during the whole operation, munching a carrot, niblDling at a wisp of hay, or playing with a button on the vest of the groom standing at its head." These sentences, written in the Medical Magazine (June 1898) by Dr AYoodhead, Professor of Pathology at Cambridge, are sufficient evidence that inoc- ulations and the like experiments are not painful in the act. In a few instances cultures of micro-organisms have been jnade in the anterior chamber of the eye, by the introduction of a needle behind the cornea. This might be thought painful, but cocain renders the surface of

the eye wholly insensitive. Many operations of ophthalmic surgery are done under cocain alone, and the anterior chamber of the eye is so far insensitive that a man may have blood or pus (Jiypopyon) in it, and hardly be conscious of the fact. The results of inoculation are in some cases negative, in others positive: the positive results are, in the great majority of cases, not a local change, but a general infection which may end in recovery, or in death. The diseases thus induced may, in many cases, fairly be called painless ... such are septicemia in a mouse, snake ~~venom in a rat, and malaria in a spar~~ row. Eabbits affected with rabies do not suffer in

the same way as dogs and some other animals, but be- come subject to a painless kind of paralysis. It is pro- bable that animals kept for inoculation have, on the whole, less pain than falls to the lot of a like number of animals in a state of nature or in the service of man : they are well fed and sheltered, and escape the rapacity of larger animals, the inevitable cruelties of sport, and the drudg- ery and sexual mutilation that man inflicts on the higher domestic animals.

The Inspector's report for 1899 says : ... ' ' The animals being experimented on under Certificates A and B have been carefully examined, and among the large number that I have seen there have been none showing any signs of pain. The guinea-pigs and rabbits, for example, which have been inoculated under Certiiicate A for the testing of antitoxins, for the diagnosis of disease, and so forth, are generally indistinguishable from the untouched animals in stock ; and in most oases that have come under my notice of animals operated on under Certificate B, it would be quite impos- sible, apart from the soar or healing wound, to recognize that anything had been done to them."

We have now to consider Table iii. A, which includes all experiments other than inoculations and the like. In all of them (1656) anaesthetics were used. Those that were made under the licence alone, or under Certificate C, may be excluded, so far as the question of pain is con-

cerned ; for the animals were killed under the anaesthetic. There remain 654 experiments, made under Certificate B, or B linked vnth EE, in which the animal was an- aesthetized during the operation, but was allowed to recover.

If it were lawful, under Certificate B, to make an inci- sion under an anaesthetic, to call this the "initial operar tion," and then, without an anaesthetic, to make painful experiments through the incision on the deeper structures, doubtless much pain might be inflicted under this certifi- cate. But experiments of this kind can be, and are, made under the licence alone, the animal being kept under an anaesthetic all the time, and killed under it. " No experiments requiring anything of the nature of a surgical operation, or that would cause the infliction of an appre- ciable amount of pain, are allowed to he performed without an anaesthetic" (Inspector's Report for 1899). " These certificates (B) are granted on condition that antiseptic precautions are used ; and if these fail and pain continues after the anaesthetics have ceased to operate, the animal is immediately killed painlessly" (Letter from the Home Secretary, 1898). Of the 654 experiments inade in 1899 under Certificate B, more than a fourth part were of the nature of inoculations only ; but an anaes- thetic was given, because the inoculation was made not under the skin, but by incision into the deeper structures.

Of other experiments such as are made under this certificate (which must be linked with Certificate EE for any experiment on a dog or a cat), three instances may be given here : an operation on the brain, a removal of part or the whole of a secreting gland, and the establishment of a fistula. It is to be noted that, for these and the like operations, profound anaesthesia and the strict observance of the aseptic method are matters of absolute necessity for the success of the experiment : the operation could not be performed without anaesthesia ; and the experiment would come to nothing if the wound suppurated. It is to be noted, also, that these operations are such as are per- formed in surgery for the saving of life or for the relief of pain.

As to operations on the brain, it must be remembered that the surface of the brain is not sensitive. Therefore the removal or destruction of a

portion of the surface of the brain, or the division of some tract of central nervous tissue, though it might entail some loss of power or of control, does not cause pain : a wound of the brain is pain- less. Tension within the cranial cavity, as in cases of

cerebral tumour or cerebral abscess, may indeed cause great pain ; and if the aseptic method failed in an exper- iment, inflammation and tension would ensue: in that case the animal must be killed.

The removal of part or the whole of a secreting gland (e.g., the thyroid, the spleen, the kidney) is performed by the same methods, and with the same precautions, as in human surgery. Profound anaesthesia, and the use of a strict antiseptic or aseptic procedure, are of absol,ute necessity. The skin over the part to be removed must be shaved and carefully cleansed for the operation; the instruments, sponges, and ligatures must be sterile, not capable of infecting the wound; and when the operation is over, the wound must be carefully closed with sutures, and left to heal under a proper surgical dressing.

The establishment of a fistula, again, is an operation practised, as a matter of course, in large numbers of surgical cases. The stomach, the gall-bladder, the large intestine, are opened for the relief of obstruction, and kept open either for a time or permanently, according to the nature of the case. Under anaesthesia, the organ that is to be opened is exposed through an incision made through the structures overlying it, and is secured in the wound by means of fine sutures. Then, when it has become adherent there, it is opened by an incision made into it ; no anaesthetic is needed for this purpose, because these internal organs are so unlike the skin in sensitiveness that an incision is hardly felt : the patient may say that he " felt a prick," or he may be wholly unconscious that anything has been done. A fistula thus established is not afterward painful, though there may be some discomfort now and again.

The classical instance is the case of Alexis St Martin, who was shot in the stomach in 1822, and recovered, but with a fistula. He let Dr Beaumont make experiments on him for nine years : ??? " During the whole of these periods, from the spring of 1824 to the present time (1833), he has enjoyed general good health . . . active, athletic, and vigorous ; exercising,

eating, and drinking like other healthy and active people. For the last four months he has been unusually plethoric and robust, though constantly sub- jected to a continuous series of experiments on the interior of the stomach ; allowing to be introduced or taken out at the aperture different kinds of food, drinks, elastic catheters, thermometer tubes, gastric juice, chyme, &c., almost daily, and sometimes hourly. Such have been this man's condition and circumstances for several years past ; and he now enjoys the most perfect health and constitutional soundness, with every function of the system in full force and vigour" (Beaumont, Experiments and Observations on the Gastric Juice, 1838).

We come now to the question. What anaesthetics are used in these experiments, and are they properly admin- istered ? In almost every case the anaesthetic used is chloroform or ether, sometimes combined with and followed by morphia or chloral. The anaesthetic given in each case must be stated in the returns sent to the Home OfB.ce. Animals take ether well, and there is no diflBculty in rendering them unconscious with it. With some animals, chloroform is equally good ; with others, it is dangerous to life ; but Professor Hobday, of the Royal Veterinary College, published in 1898 an account of five hundred administrations of chloroform to dogs, in veterinary sur- gery, with only one death (Lancet, September 1898). Still, for dogs and cats ether is generally used. Morphia is seldom used alone, but in some cases it is used after chloro- form or ether. It is certain that an animal, so far under the influence of morphia that it lies still, cannot be suffer- ing, for the drug does not act directly on the muscles, but on the higher nervous centres. It happens now and again that a dog is excited, not narcotized, by morphia (see Professor Lugaro's paper, Brit. Med. Journ., January 14, 1899). But this is altogether exceptional ; an animal in such a condition could not be used for experiment ; and

the physiologist has other anaesthetics. Except in these rare cases, animals take morphia well, and are profoundly influenced by it. Curare is not an anaesthetic under the Act. Its use was thus defined in 1899 by the Home Secretary : " It is illegal to use curare as an anaesthetic. It is often

used in addition to anaesthetics, for very good reasons ; and as it does not render an anaesthetized animal sensitive, it would be absurd to forbid its use."

The following accounts of the action of curare are by Professor Ruffer, some time Hon. Secretary of the Institute of Preventive Medicine, and by a writer in the Edinburgh Review, who seems to speak from experience : ???

1. "It is quite true that curare in small doses has the effect of paralyzing the motor nerves without affecting the nerves of sense ; but in such doses as are used in the laboratory it paralyzes both sets of nerves, and this has actually been proved on man, as there have been cases of accidental curare poisoning in men who re- covered, and in whom sensation has been totally abolished, while the action of the drug was apparent. Moreover, curare is nowa- days not used alone, but is always used in combination with morphia, ether, chloroform, or other anaesthetics" (Professor Rtiffer, Liberty Review, October 1893) .

2. "It is pretty certainly known now that Claude Bernard was wrong, and that though curare acts first upon the motor nerves, it also, though less rapidly, paralyzes the sensory nerves, always supposing that by artificial respiration the animal is kept alive long enough for the less rapid effect to be produced. It would be out of place here to give the experimental evidence which satisfies physiologists upon this point. . . . Probably the truth is that, like all other nerve-poisons, the effect of curare varies with the dose. The muscular nerves are the first affected, then the sensory, and finally the central nervous system. As a matter of fact, how- ever, morphia or some other narcotic is always given in addition to curare when it is used in laboratory work in England " {Edinburgh Review, July 1899).

*The administration of chloroform or ether is performed by the ordinary methods of surgery ; and *he drug is given freely, if only for the reason that the absolute unconscious- ness of the animal makes the accuracy and success of the experiment more certain. Lately, in an account of some experiments, it was stated that in two or three cases the anaesthesia was "incomplete." Such use of chloroform or ether may be made sometimes in surgery because of the general condition of the patient, or the special*

circum- stances of the operation. But alike in surgery and in experiments on animals it is altogether exceptional, or something more than exceptional. The administration of morphia or of chloral is pushed beyond the point at which these drugs are " sedatives," almost to the point at which they become fatal.

It may be interesting to compare the pain or death or discomfort of these 8469 animals, used for experiment in Great Britain in 1899, with the fate of an equal number of the same kinds of animals, either wild, or preserved as game, or kept for the service or the amusement of man. Of the 8469 animals, the vast majority, no less than 6813, were used for inoculation only ; and these were, most of them, mice, rats, guinea-pigs, or rabbits. Those which died may fairly be said to have suffered neither more nor less than the like number of domestic animals dying in the ordinary course of nature. Of the remaining 1656, the majority, 1002, were put under an ansesthetic, and kept in a condition of profound anips- thesia, and killed under the anaesthetic, there and then. The minority, 654, were subjected under profound ansesthesia to a surgical operation, and were allowed (provided their wounds healed well and they were not in pain) to recover. These 654 may fairly be put against the like number of animals wounded in the course of sport, or mutilated as live stock.

In 1900, in England and Scotland, the total number of licensees was 247, of whom 63 performed no experiments ; and the inspec- tor, Mr Thane, reported that licences and certificates had been granted and allowed only upon the recommendation of persons of bigh scientific standing ; that the licensees were persons who, by their training and education, were fitted to undertake experimental work and to profit by it ; and that all experimental work had been conducted in suitable places. The total number of experi- ments was 10,839, being 2370 more than in 1899. This increase is accounted for by 229 under Table III. (A): "experiments other than those of the nature of simple inoculations, hypodermic injections, or similar proceedings " ; and 2141 under Table III. (B) :

"inoculations, hypodermic injections, and some few other pro- ceedings performed without anesthetics." Few of these experi- ments had been in any serious degree painful. Taking first those recorded in Table III. (A),

1885 in number, the experiments performed under licence alone or under Certifi- cate C, "permitting experiments in illustration to lectures," together amounting to 1299, were unattended by pain, because the animal was kept under an anaesthetic during the whole of the experiment, and, if the pain was likely to continue after the effect of the anesthetic had ceased, or if any serious injury had been inflicted on the animal, was killed before it re- covered. In the remaining 586 experiments the operations were performed under anaesthetics, from the influence of which the animals were allowed to recover. The operations were performed aseptically, and the healing of the wounds as a rule took place without pain. If the antiseptic' precautions failed and suppuration occurred, the animal was required to be killed. Mr Thane re- ported that he had seen numerous animals on which serious operations had been performed ??? removal of organs and the like ??? and which were clearly not in pain ; indeed, they were often to all appearance in perfect health. The experiments included in Table III. (B), 8954 in number, were all performed without anaes- thetics. They were mostly inoculations, but a few were feeding experiments or the administration of various substances by the mouth. In no case had a certificate dispensing with the use of anaesthetics been presented for an experiment involving a serious operation.

In a large proportion of the inoculations included in Table III. (B) the result was negative ??? the animal did not exhibit any ill effects, and therefore did not suffer any pain. This was especially the case with many inoculations for purposes of diagnosis, with the great majority of the inoculations performed for the testing of articles of food, and with many of the inoculations made for the purpose of standardizing antitoxic serum, namely, those cases in which the antitoxin was sufficiently powerful to neutralize the amount of toxin injected, so that the latter had no action. It was only a small proportion of the inoculations practised that were followed by disease or poisoning. In some of these cases, such as the injection of certain drugs or of tetanus toxin, the effect pro- duced wais without doubt painful ; but in the two most frequently employed proceedings of this kind ??? namely, inoculation for the diagnosis of tuberculosis and for the standardization of diphtheria antitoxin ??? there was some diSerence of opinion, amongst those who had had most

experience, as to whether the effects produced were attended by pain or not. There was, however, strong reason for holding that the gradual development of tuberculosis, and the poisoning by diphtheria^toxin, resulting from such inoculations, although they might not be accompanied by acute sufiering, were conditions which brought those proceedings within the category of "experiments calculated to give pain." In the event of pain ensuing as the result of an inoculation, a condition attached to the licence required that the animal^hould be killed under ansesthetics as soon as the main result of the experiment had been attained. Therefore in a very large number of instances, especially in the case of experiments performed without the use of anaesthetics, the experiments were entirely painless. The large increase in the number of inoculation experiments included in Table III. (B) was mainly due to the growing appreciation of their great value as a means of detecting, curing, and preventing disease. Inoculations for the purpose of diagnosis were now part of the routine of medical practice. During the year 1900, 2230 inoculations were made by three licensees for the purpose of standardizing antitoxins, and over 1500 inoculations were made by two licensees for the testing of milk. These experiments were performed in large numbers on behalf of the authorities responsible for the care of the public health. The appearance of the bubonic plague in England had afforded an illustration of the value of the experimental method in diagnosis. " It is," Mr Thane says, " of the greatest importance that this disease should be recognized as early as possible. This can only be done with certainty with the aid of inoculations into animals. Two fresh places were registered and two new licences were granted during 1900 expressly to allow of the necessary experiments being performed in localities where infection was apprehended."

Six licences were in existence in Ireland during 1900. The experiments performed were 135. They had been of a useful character, and were attended by little or no pain. The experi- ments were chiefly in connexion with the identification of canine rabies and tuberculosis, or the investigation of tetanus and epidemic cerebro-spinal meningitis.

II. Scientific Eesults. ??? The advantages that have been obtained by the help of experiments on animals may be arranged under two heads

<u>(A) Physiology, (B) Path- ology, Bacteriology, and Therapeutics.</u>

<u>EXPEEIMENTS ON ANIMALS</u>

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<u>A. Physiology.</u>

<u>1. The Blood. Galen (a.d. 131) confuted the doctrine of Erasis- tratus, that the arteries contained iri/eO/io, the breath of life, proving by experiment that they contain blood. ” Ourselves, having tied the exposed arteries above and below, opened them, and showed that they were indeed full of blood.” Realdus Colum- bus (1569), though he did not discover the general or ” systemic ” circulation of the blood, yet seems to have discovered, by experi- ment, the pulmonary circulation. ” The blood is carried through the pulmonary artery to the lung, and there is attenuated ; thence, mixed with air, it is carried through the pulmonary vein to the left side of the heart. Which thing no man hitherto has noted or left on record, though it is most worthy of the observance of all men. . . And this is as true as truth itself ; for if you will look not only in the dead body but also in the livifig animal, you will always find this pulmonary vein full of blood, which assuredly it would not be if it were designed only for air and vapours. . . . Verily I pray you, 0 candid reader, studious of authority, but more studious of truth, to make experiment on animals. You will find the pulmonary vein full of blood, not air or fuligo, as these men call it, God help them.” Harvey’s treatise De Motu Cordis et Sanguinis in Animalibus was published at Frankfort in 1621. It begins thus : ” When by many dissections of living animals, as they came to hand Cum multis vivorum dissectionibus, uti ad manum dabantur I first gave myself to observing how I might discover, with my own eyes, and not from books and the writings of other men, the use and purpose of the movement of the heart in animals, forthwith I found the matter hard indeed and full of difficulty ; so that I began to think, with Frascatorius, that the movement of the heart was known to God alone. ... At last, having daily used greater disquisition and diligence, by frequent examination of many and various living animals multa frequenter et varia animalia viva introspiciendo I came to believe that I had</u>

succeeded, and had escaped and got out of this labyrinth, and therewith had discovered what I desired, the movement and use of the heart and the arteries. And from that time, not only to ray friends but also in public in my anatomical lectures, after the manner of the Academy, I did not fear to set forth my opinion in this matter." Here, and again at the end of the Preface, and again in the eighth chapter of the De Motu, he puts his experiments in the very foreground of the argument. Take the headings of his first four chapters : ??? 1. Causce, quibus ad scribendum auctor permotus fuerit. 2. Ex vivorum dissectionef qualis Jit cordis motus. 3. Arteriarum motus qualis, ex vivorum dissections. 4. Motus cordis et auricularum qualis, ex vivorum dissections. He had, of course, help from other sources ??? from anatomy, and from physics ; but it is certain, from his own words, that he attributed his discovery, in a very great measure, to experiments on animals. Malpighi (1661), professor of medicine at Bologna, by examining with a microscope the lung and the mesentery of the live frog, made out the capillary vessels. He writes to Borelli, professor of mathematics at Pisa, that he has failed in every attempt to discover them by injecting fiuids into the larger vessels, but has succeeded by examining the tissues with the microscope : " Such is the divarication of these little vessels, coming off from the vein and the artery, that the order in which a vessel ramifies is no longer preserved, but it looks like a network woven from the offshoots of both vessels " (De Pulmonibus, 1661). Stephen Hales (1733), rector of Farringdon and minister of Ted- dington, and a Fellow of the Royal Society, made the first exact estimates of the blood-pressure, the real force of the blood, by in- serting one end of a vertical glass tube into the crural artery of a mare, and noting the rise of the blood in the tube {Statical Essays, containing Hoemostaticks, &c., 17SS). John Hunter, bom 1738, made many observations on the nature and processes of the blood ; and, above all, he discovered the facts of collateral circula- tion. These facts were fresh in his mind when he first ventured, in December 1785, to tie the femoral artery in " Hunter's canal " for the cure of aneurism in the popliteal space. The experiment that gave him his knowledge of the collateral circulation was made on one of the deer in Richmond Park : he tied its external carotid artery, to see what effect would be produced on the shedding of the antler. Some days later he found that the circulation had returned in the antler. He had the buck killed, and found that the artery

had been completely closed by the ligature ; but the small branches coming from it, between the heart and the ligature, were enlarged, and were in communication with others of its branches beyond the ligature ; and by this collateral circulation the flow of blood to the antler had been restored. Among later observations on the circulation must be mentioned the use of the mercurial manometer by Poiseuille (1828) and Ludwig (1849), the study of the blood-pressure within the heart by Bering (1849), and the permanent tracing of the pressure-curves by Chauveau and Marey (1863). Finally, the study of those more abstruse problems of the circulation that the older physiologists had left alone ??? the influences of the central nervous system, the relations between

blood-pressure and secretion, the automatism of the heart-beat, and the influence of gravitation.

2. The Lacteals. ??? Asellius (1022) by a single experiment de-monstrated the flow of chyle along the lacteals. The existence of these minute vessels had been known even to Galen and Erasis- tratus, but they had made nothing of their knowledge. Asellius says: "I observed that the nerves of the intestines were quite distinct from these white threads, and ran a different course. Struck with this new fact, I was silent for a time, thinking of the bitter warfare of words among anatomists as to the mesenteric veins and their purposes. When I came to myself, to satisfy myself by an experiment I pierced one of the largest cords with a scalpel. I hit the right point, and at once observed a white, liquid like milk flowing from the divided vessel." Jehan Pecquet (1647), in the course of an experiment on the heart, observed the flow of chyle into the subclavian vein, and its identity with the chyle in the lacteals ; and by further experiment found the thoracic duct, and the chyle flowing up it : "I perceived a white substance, like mUk, flowing from the vena cava ascendens into the pericardium, at the place where the right auricle had been. . . . I found these vessels (the thoracic duct) all along the dorsal vertebrae, lying on the spine, beneath the aorta. They swelled below a ligature ; and when I relaxed it, I saw the milk carried to the orifices that I had observed in the subclavian vein." The existence of this duct, which is empty and collapsed after death, had been overlooked hy Vesalius and all the great anatomists of his time.

3. The Gastric Juice. ❖❖❖ Our knowledge about digestion dates back to the end of the 17th century, when Yalisnieri first ob- served that the stomach of a dead animal contained a fluid which acted on certain bodies immersed in it ❖❖❖ "a kind of aqua fortis." In 1752 Reaumur began his observations on this fluid : making birds swallow fine fenestrated tubes containing grain or gieat, or sponges with threads attached ; and observed that digestion con- sists in the dissolution of food, not in any sort of mechanical action or trituration. His observations were extended and per- fected by Spallanzani (1777). Then came a period of uncertainty, without further advance ; imtil in 1823 the French Academy ofiered a prize for the best work on the subject, and Tiedemann and Gmelin submitted their observations to them : "The work of Tiedemann and Gmelin is of especial interest to us on account of the great number of their experiments, from which came not only the absolute proof of the existence of the gastric juice, but also the study of the transformation of starch into glucose. Thus the theory of digestion entered a new phase : it was finally recognized, at least for certain substances, that digestion is not simply dissolu- tion, but a true chemical transformation " (Claude Bernard, Physi- ologie Operatoire, 1879). Beaumont's experiments on Alexis St Martin (vide supra) were published in 1838. They were, of course, based on the work of the physiologists : "I make no claim to origi- nality in my opinions as it respects the existence and operation of the gastric juice. My experiments confirm the doctrines (with some modifications) taught by Spallanzani and many of the most enlightened physiological writers" (Preface to Dr Beaumont's book). Eberl6, in 1834, showed how this knowledge of the gastric juice might be turned to a practical use, by extracting it from the mucous membrane of the stomachs of animals after death : hence came the invention of the various preparations of pepsin. Later, Blondlot of Nancy, in 1842, studied the gastric juice by the method of a fistula, like that of St Martin. More recent observations have been made on the movements of the stomach during digestion, and on the influences of the nervous system on the process.

4. Glycogen. ❖❖❖ The importance of Claude Bernard's discovery of glycogen is not annulled either by the fact that there is still work to be done on the finer issues of this part of physiology, or by the fact that many cases of diabetes are still past cure. It must be measured by the ignorance

about the liver, which his work dispelled, and by the far-reaching influence of his discovery. His first experiments on the assimilation and destruction of sugar in the body were made in 1843. His discovery of the glycogenic action of the liver was made by keeping two dogs on different diets, one with sugar, the other without it, then killing them during digestion, and testing the blood in the veins coming from the liver : " What was my surprise when I found a considerable quantity of sugar in the hepatic veins of the dog that had been fed on meat only, and had been kept for eight days without sugarl . . . Finally, after many attempts ??? apres beaucoup d'essais et plusieurs ilhisions que je fus oblige de rectifier par des tMonnements ???1 succeeded in showing, that in dogs fed on meat the blood passing through the portal vein (from the stomach) does not contain sugar before it reaches the liver ; but when it leaves the liver and comes by the hepatic veins into the inferior vena cava, this same blood contains a considerable quantity of a sugary substance (glucose)" (Nouvelle Fonction du Foie, Paris, 1853).

5. The Pancreas. ??? The 17th century was a time of very fanciful theories about the pancreas (Lindanus, Wharton,

Bartholini), which need not be recalled here. But Sylvius (Frangois de Bois) had the wisdom to see that the pancreas must he estimated, not according to its position, but according to its structure, as of the nature of the salivary glands. He urged his pupil, Regnier de Graaf, to study it by experiment, and de Graaf says: "I put my hand to the work; and though many times I despaired of success, yet at last, by the blessing of God on my work and prayers, in the year 1662 I discovered a way of collecting the pancreatic juice." By the method of a fistula he collected and studied the secretion of the pancreas ; and by further experiment he refuted Bartholini's theory that the pancreas was a sort of ap- panage or " biliary vesicle " of thespleen. But he got no help from the chemistry of his time ; and could no more discover the amyloly tic action of the pancreatic secretion than Galvani could discover wireless telegraphy. Still, he did

good work ; and Claude Bernard, 180 years later, went back to de Graaf 's method of the fistula. His observations, begun in 1846, received a prize from the French Academy in 1850. Sir Michael Foster says of them : "Valentin, it is true, had in 1844 not only inferred that the pancreatic juice had an action on starch, but confirmed his view by actual experiment with the juice expressed from the gland ; and Eberl6 had suggested that the juice had some action on fat ; but Bernard at one stroke made clear its threefold action. He showed that it on the one hand emulsified, and on the other hand split up into fatty acids and glycerine, the neutral fats ; he clearly proved that it had a powerful action on starch, converting it into sugar ; and lastly, he laid bare its remarkable action on proteid matters." Of late years it has been discovered that the pancreas, besides its work in digestion, has an "internal secretion" : that it, like the thyroid gland and the supra/- renal capsules, helps to keep the balance of the general chemistry of the whole body. Professor Schafer, writing in 1894, says on this subject : " It was discovered a few years ago by von Mering and Minkowski that if, instead of merely diverting its secretion, the pancreas is bodily removed, the metabolic processes of the organism, and especially the metabolism of carbo-hydrates, are entirely de- ranged, the result being the production of permanent diabetes. But if even a very small part of the gland is left within the body, the carbo-hydrate metabolism remains unaltered, and there is no diabetes. The small portion of the organ which has been allowed to remain (and which need not even be left in its proper place, but may be transplanted under the skin or elsewhere) is sufficie'nt, by the exchanges which go on between it and the blood generally, to prevent those serious consequences to the composition of the blood, and the general constitution of the body, which result from the complete removal of this organ." These later facts, not con- tradicting Bernard's work but Eidding to it, are of the very highest importance, alike in physiology and in pathology.

6. The Growth of Bone. ??? The experiments made by du Hamel (1739-1843) on the growth of bone by deposit from the periosteum (the thin membrane ensheathing each bone) rose out of Belchier's observation (1735) that the bones take up the stain of madder mixed with their food. Du Hamel studied the whole subject very carefully, and discovered this bone-producing power of the perios- teum, that is an important fact in all

operations on the bones. As he puts it, in the title of one of his own memoirs, Les os croissent en grosseur par Vaddition de couches osseuses qui tirent leur origine du perioste, comme le corps ligneuz des Arbres augmente en grosseur par Vaddition de couches ligneuses qui se forment dans Vecorce. By feeding pigs at one time with dyed food, at another with undyed food, he obtained their bones in concentric layers alternately stained and unstained. His facts were confirmed by Bazan (1746) and Boehmer (1751) ; but his conclusions, un- fortunately, were opposed by Haller. Still, he brought men to study the whole subject of the growth of bones, in length as well as in thickness, and the whole modelling of the bones, in adult life, by deposit and absorption. Bichat, John Hunter, Troja, and Cruveilhier took up his work in physiology and in surgery. Later, from the point of view of surgery, Syme (1837) and Stanley (1849) made experiments on the growth of bone, and on the exfoliation of dead bone ; and, after them, Oilier, whose influence on this part of surgical practice has been of the very highest value.

7. The Nervous System. ??? A. The Nerve-Roots. Through all the centuries between Galen, who lived in the time of Commodus, and Sir Charles Bell, who lived in the time of George III., no great advance was made in our knowledge of the nervous system. The way of experiment, which had led Galen far ahead of his age, was neglected, and everything was overwhelmed by theories. Bell in London and Magendie in Paris took up the experimental study of the nervous system about where Galen had left it. The question of priority of discovery does not concern us he~~e : we may take Sir Michael Foster's judgment, that Magendie brought exact and full proof of the 'truth which Bell had divined rather than de~~ monstrated, that the anterior and posterior roots of spinal nerves have essentially different functions ??? "a truth which is the very foundation of the physiology of the nervous system." The date of Bell's work is 1811, An Idea of a New Anatomy of the Benin,

submitted for the Observation of the Author^ s Friends. In it he says : " Considering that the spinal nerves have a double root, and being of opinion that the properties of the nerves are derived from their connexions with the parts of the brain, I thought that I had an opportunity of putting my opinion to the test of experi- ment, and of

proving at the same time that nerves of different endowments were in the same cord (the same nerve-trunk) and held together by the same sheath. On laying bare the roots of the spinal nerves I found that I could out across the posterior fasciculus of nerves, which took its origin from the spinal marrow, without convulsing the muscles of the back ; but that on touching the anterior fasciculus with the point of the knife, the muscles of the back were immediately convulsed. Such were my reasons for concluding that the cerebrum and cerebellum were parts distinct in function, and that every nerve possessing a double function obtained that by having a double root. I now saw the meaning of the double connexion of the nerves with the spinal marrow ; and also the cause of that seeming intricacy in the connexions of nerves throughout their course, which were not double at their origins." His other work, on the cranial nerves, which are "not double at their origins," bore fruit at once in surgery. Sir John Erichsen says of it : " Up to the time that Sir Charles Bell made his experiments on the nerves of the face, it was the common custom of surgeons to divide the facial nerve for the relief of neuralgia, tic douleureux; whereas it exercises, and was proved by Sir Charles Bell to exercise, no influence over sensation, and its division consequently for the relief of pain was a useless opera- tion." B. Reflex Action. ??? The observations made by Sir Robert Boyle, Redi, Le Gallois, and others on the reflex movements of decapitated vipers, frogs, eels, and butterflies were of no great use 'from the point of view of physiology ; but they led toward the discovery that nerve-power is stored in the spinal cord, and is liberated thence in action independent of the higher cerebral centres. Marshall Hall (1832-1837) discovered, by his experiments, that reflex actions are the work of definite groups of cells, set at certain points or levels in the cord ; he proved the segmental structure of the cord, the existence of nerve-centres in it ; and thus foreshadowed the discovery of the like centres in the brain. In his earlier writings (1832-1833) he extended the principles of the doc- trines of reflex action to the larynx, the pharynx, and the sphincter muscles ; later, in 1837, he demonstrated the course of nerve- impulses within the cord, from one level to another, and the efiects of direct stimulation of tlie cord. Also he noted the effects of opium and strychnine on reflex action ; and the reflex character of the convulsions that occur in certain diseases. C. The Medulla Ob- longata and the Cerebellum. ??? Flourens, who was among the earliest

students of the use of chloroform, is best known for his experi- ments on the respiratory centre and the cerebellum. He localized the cells in the medulla that govern the reflex movement of respira^ tion. Afterward came the discovery of cardiac and other centres in the neighbourhood of the respiratory centre. He showed also that the cerebellum is concerned with the equilibration and co-ordina- tion of the "muscles : that an animal, a few days old, deprived of sensation and consciousness by removal of the cerebral hemispheres, was yet able to stand and move forward, but when the cerebellum also was removed, lost all power of co-ordination {Recherches Experimentales, Paris, 1842). And from the observations made by him and by others, it was found that the semicircular canals of the internal ears are the terminal organs of this sense of equilibration. Z). The Vaso-Motor Nerves. ??? Claude Bernard, studying the sympathetic nervous system, discovered the vaso-motor nerves, that control the calibre of the arteries. The question of priority between him and Brown Sfiquard need not be considered here. His first account of his work was communicated to the Soci6t6 de Biologie in December 18ol. The following account of it is from his Lef^ns de Physiologie Opcratoire (1879) : ???

" Let me remind you how I was led to discover the vaso-motor nerves. Starting from the clinical observation, made long ago, that in paralyzed limbs you find at one time an increase of cold and at another an increase of heat, I thought that this con- tradiction might be explained by supposing that, side by side with the general action of the nervous system, the sympathetic nerve might have the function of presiding over the production of heat ; that is to say, that in the case where the paralyzed limb was chilled, I supposed the sympathetic nerve to be paralyzed, as well as the motor nerves ; while in the paralyzed limbs that were not chilled the sympathetic nerve had retained its function, the systematic nerves alone having been attacked. This was a theory, that is to say, an idea, leading me to make experiments ; and for these experiments I must find a sympathetic nerve-trunk of sufficient size, going to some organ that was easy to observe ; and must divide the trunk to see what would happen to the heat- supply of the organ. You know that the rabbit's ear, and the cervical sympathetic of this animal, offered us the required condi- tions.

So I divided this nerve ; and, at once, the experiment gave the lie direct to my theory ❓❓❓ Je coupaidonc ce filet etaussitot V expert-

ence donna a nion hypothese leplus eclatant dementi. I had thought that the section of the nerve would suppress the function of nutrition, of calorification, over which the sympathetic system had been supposed to preside, and would cause the hollow of the ear to become chilled ; and here was just the opposite, a very warm ear, with great dilatation of its vessels." The experiments of Budge and Waller (1853) and of Schiff (1856) threw light on the action of these vaso-motor nerves, and on the place of the vaso- motor centre in the cord; and in 1858 Claude Bernard, by his experiments on the chorda tympani and the submaxillary gland, demonstrated their twofold influence, either to dilate or to con- strict the vessels. "It is almost impossible to exaggerate the importance of these labours of Bernard on the vaso-motor nerves, since it is almost impossible to exaggerate the influence which our knowledge of the vaso-motor system, springing as it does from Bernard's researches as from its fount and origin, has exerted, is exerting, and in widening measure will continue to exert, on all our physiological and pathological conceptions, on medical practice, and on the conduct of human life. There is hardly a physiological discussion of any width in which we do not sooner or later come on vaso-motor questions" (Foster). E. Cerebral Localization. ❓❓❓ The study of the motor and sensory centres of the cerebral hemispheres began in clinical observation. Observation of cases, and examination of the brain after death (Bouillard, 1825, Dax, 1836, Broca, 1861), led men to believe that a particular area of the left frontal lobe of the brain did indeed govern and permit the use of speech. Physiological experiments had nothing to do with the discovery of the speech centres. "Bouillard in 1825 collected a series of cases to show that the faculty of speech resided in the frontal IoTdos. In 1861 his views were brought by Aubertin before the notice of the Anthropological Society of Paris. Broca, who was present at the meeting, had a patient under his care who had been aphasio for twenty-one years, and who was in an almost moribund

state. The autopsy proved of great interest, as it was found that the lesion was confined to the left side of the iDrain, and to what we now call the third frontal convolution. ... In a subsequent series of fifteen typical cases examined, it was found that the lesion had destroyed, among other parts, the posterior part of the third frontal in fourteen " (Hamilton, Text-Book of Path- ology'). Prom this clinical fact, that the movements of speech depend on the integrity of a special area of the brain's surface, and from the facts of " Jaoksonian epilepsy," and similar observations in medicine and surgery, began the experimental work of cerebral localization, by Hitzig, Goltz, Schiff, Ferrier, Yeo, Horsley, Beevor, and many more. It would be hard to find a more striking instance of the f amUiar truth that science and practice work hand in hand.

[These notes cover a part only of the results that have been obtained in physiology by the help of experiments on animals. The work of Boyle, Hunter, Lavoisier, Despretz, Kegnault, and Haldane, on animal heat and on respiration ; of Petit, Dupuy, Breschet, and Reid, on the sympathetic system; of Galvani, Volta, Hallex, du Bois-Reymond, and Pfliiger, on muscular contrac- tion ??? all these subjects have been left out, and many more. In his evidence before the Royal Commission (1875), Mr Darwin said: "I am fully convinced that physiology can progress only by the aid of experiments on living animals. I cannot think of any one step which has been made in physiology without that aid."]

E. Pathology, Bacteriology, and Therapeutics.

*1. /??i;?amma!rto*i. ??? Pathology is so intimately associated with the work of the microscope that it is a new study, in comparison with physiology. Fifty years ago the microscope was not in general use as it is now ; nor did men have the lenses, microtomes, and straining-fluids that are essential to modem histology. Bacteriology, again, is even younger than pathology. Five and twenty years ago it had hardly begun to exist. For example, in the evidence before the Royal Commission (1875) one of the witnesses said that they "believed they were beginning to get an idea of the nature of tubercle." Anthrax was the first disease studied by the methods of bacteriology ; and in his evidence con- cerning this disease. Sir John Simon speaks of bacteriology as of a discovery wholly new and*

unexplored: "We are going through a progressive work that has many stages, and are now getting more precise knowledge of the contagium. By these experiments on sheep it has been made quite clear that the contagium of sheep-pox is something of which the habits can be studied, as the habits of a fern or a moss can be studied; and we look forward to opportunities of thus studying the contagium outside the body which it infects. This is not a thing to be done in a day, or perhaps in ten years, but must extend over a long period of time." A few years later (1881) came Koch's discovery of the bacillus of tubercle. But a great advance was made in days before 1875 by the more general use of the microscope. Every change in the tissues during inflammation ... the slowing of the blood-stream in

the capillary vessels, the escape of the leucocytes through their walls into the surrounding tissues, the stagnation of the blood in the affected part ... all these were observed in such transparent structures as the web or the mesentery of the frog, the bat's wing, or the tadpole's tail, irritated by a drop of acid, or a crystal of salt, or a scratch with a needle. It was in the course of observations of this kind that Wharton Jones observed the rhythmical contraction of veins, and Waller and Cohnheim observed the escape of the leucocytes, diapedesis, through the walls of the capillaries. From these simple experiments under the microscope arose all our present knowledge of the minute processes of inflammation. Later, came the work of Metchnikoff and others, showing the importance of diapedesis in relation to the presence of bacteria in the tissues.

2. Suppuration and Wound-Infection. ... Suppuration may, in exceptional conditions, occur without micro-organisms, but practically every case of suppuration, wound-infection, or "blood-poisoning," all abcesses, boils, carbuncles, and all cases of puei-peral fever, septicaemia, pyaemia, are due to infection, either from without or from within the laody, by various forms of micrococcus. The same is true of every case of erysipelas, or cellulitis, or acute gangrene ... in short, of the whole multitude of "septic" diseases. The work done on these micrococci, and on other pathogenic micro-organisms, involved the study of the phases, antagonisms, and preferences of each kind, their range of variation and of virulence, and their products, and the influences on them of air, light,

heat, and chemical agents. To establish a micro-organism as the cause of a disease, Koch postulated that it should be found in the diseased tissues, should be cultivated outside the body in vitro, should reproduce the same disease by inoculation in animals, and should be found again in the animals inoculated; and these postulates are but a single instance of the strict methods of bacteriology.

From the study of these organisms of suppuration arose Lister's work on the antiseptic method, as well as the serum-treatment for cases of microcoocio infection.

3. Anthrax. ??? The bacillus of anthrax (charbon, malignant pustule, wool-sorter's disease) was the first specific micro-organism discovered. Rayer and Davaiue (1850) observed the petits batonnets in the blood of sheep dead of the disease; and in 1863, when Pasteur's observations on lactic-acid fermentation were published, Davaine recognized that the bcttonnets were not blood-crystals but living organisms. Koch afterward succeeded in cultivating the bacillus, and in reproducing the disease in animals by inoculation from these cultures. Pasteur's discovery of preventive inocula^ tion of animals against the disease was communicated to the Academic des Sciences in February 1881; and in May of that year he gave his public demonstration at Pouilly-le- Fort. Two months later, at the International Medical Con- gress in London, he spoke as follows of this discovery : ??? ". . .La m^thode que je viens de vous exposer pour obtenir des vaccins du charbon gtait k peine connue qu'elle passait dans la grande pratique pour prgvenir I'affection charbonneuse. La France perd chaque aunge pour une valeur de plus de vingt millions d'animaux frappfis du charbon, plus de 30 millions, m'a dit une des personnes autorisfies de notre Ministfere de 1' Agriculture ; mais des statistiques exactes font encore d^faut. On me demanda de mettre &, I'gpreuve les rfesultats qui prficfedent par une grande experience publique, k Pouilly-le-Fort, prfes de Melun. ... Je la resume en quelques mots : 50 moutons furent mis k, ma disposi- tion, nous en vaccin??,mes 25, les 25 autres ne subirent aucuu traitement. Quinze jours aprfes environ, les 50 moutons furent inoculfe par le microbe charbonneux le plus virulent. Les 25 vaccinas rgsistferent ; les 25 non-vaccinfe moururent, tons charbonneux, en cinquante heures. Depuis lors, dans

mon laboratoire, on ne pent plus suffire k preparer assez de vaccin pour les demandes des fermiers. En quinze jours, nous avons vaccine dans les d^partements voisins de Paris prfes de 20,000 moutons et un grand nombre de boeufs, de vaches et de chevaux." The extent of this preventive vaccination may be judged from the fact that a single institute, the Sero-Therapeutic Institute of Milan, in a single year (1897-1898) sent out 165,000 tubes of anti-charbon vaccine, enough to inoculate 33,734 cattle and 98,792 sheep. In France, during the years 1882-1893, more than thijee million sheep and nearly half a million cattle were inoculated. In the Annates de VInstitut Pasteur, March 1894, M. Chamberland published the results of these twelve years in a paper entitled BesuUats Pratiques des Vaccinations contre le Charbon et le Rouget en France. The mortality from charbon, before vaccination, was 10 per cent, among sheep and 5 per cent, among cattle, according to estimates made by veterinary surgeons all over the country. With vaccination, the whole loss of sheep was about 1 per cent.; the average for the twelve years was 0-94. The loss of vaccinated cattle was still less; for the twelve years it was 0-34, or about one-third per cent. The annual reports sent to M. Chamberland by the veterinary surgeons repre- sent not more than half of the work. "A certain number of

veterinary surgeons neglect to send their reports at tlie end of the year. The number of reports that come to us even tends to become less each year. The fact is, that many veterinary surgeons wlio perform vaccinations every year content themselves with writing, ' The results are always very good ; it is useless to send you reports that are always the same.' We have every reason to believe, as a matter of fact, that those who send no reports are satisfied ; for if anything goes wrong with the herds, they do not fail to let us know it at once by special letters."

The following tables, from M. Chamberland's paper, give the re- sults of Pasteur's treatment against charbon during 1882-1893, and against rouget (swine-measles) during 1886-1892. It is to be noted that the mortality from rouget among swine, in years before vac- cination, was

much higher than that from charbon among sheep and cattle : " it was about 20 per cent.; a certain number of reports speak of losses of 60 and even 80 per cent.; so that almost all the vet- erinary surgeons are loud in their praises of the new vaccination."

Vaccination against Charbon {France).

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1882

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1883

268,505

108

198,119

436

272

784

1,492

0-77

1884

316,558

109

231,693

770

444

1033

2,247

0-97

1885

842,040

144

280,107

884

735

990

2,609

0-93

1886

313,288

88

202,064

652

803

514

1,469

0-72

1887

293,572

107

187,811

718

737

968

2,423

1-29

1888

269,574

50

101,834

149

181

300

630

0-62

1889

239,974

48

88,488

238

285

501

1,024

1-16

1890

223,611

69

69,865

831

261

244

886

1-20

1891

218,629

65

53,640

181

102

77

360

0-67

1892

269,696

70

63,125

819

183

126

628

0-99

1893

281,883

80

78,989

234

66

224

614

0-69

Total

3,296,815

990

1,788,879

5668

4406

6798

16,872

0-94

???

Cattle.

1882

85,654

127

22,916

22

12

48

82

0-86

5%

1883

26,458

180

20,601

17

1

46

64

0-81

1884

83,900

189

22,616

20

13

52

85

0-37

1885

34,000

192

21,078

32

8

67

107

0-60

1886

39,154

135

22,113

18

7

89

64,

0-29

188T

48,484

148

28,083

23

18

68

109

0-39

1888

34,464

61

10,920

8

4

35

47

0-48

1889

32,261

68

11,610

14

7

81

52

0-45

1890

83,966

71

11,067

5

4

14

23

0-21

1891

40,736

68

10,476

6

4

4

14

0-13

1892

41,609

71

9,757

8

8

15

26

0-26

1898

88,154

45

9,840

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Total

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Vaccination against Souget {France).

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1888

16,968

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6,968

31

25

88

94

1-86

1889

19,888

41

11,267

92

12

40

144

1-28

1890

17,658

41

14,992

118

64

72

264

1-70

1891

20,683

47

17,656

102

84

70

206

1-17

1892

87,900

88

10,128

48

19

46

108

1-07

Total

111,487

296

75,465

534

188

846

1067

1‘45

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4. Tubercle. ___ Laennec, who in 1816 invented the stethoscope, recognized the fact that tubercle is a specific disease, not a simple

degeneration of the affected tissues. Villemin, in 1865, communi- cated to the Aoaddmie des Sciences the fact that he had produced the disease in rabbits, by inoculating them with tuberculous matter ; and he appealed to these inoculations ___ era void les preuves ___ to show that La tuberculose est une affection spccifique: 8a cause reside dans un agent inoculable ; U inoculation sefait tres-bien de Vhomme au lapin : La tuberculose appartient done a la classe des maladies virulentes. In 1868 Chauveau produced the disease not by inoculation but by admixture of tuberculous matter with the animals’ food. In 1880, after a period of some uncertainty and confusion of doctrines, Cohnheim reaffirmed the infectivity of the disease, and even made the proof of tubercle depend on inoculation alone: “everything is tuberculous that can produce tuberculous disease by inoculation in animals that are susceptible to the disease ; and nothing is tuberculous that cannot do this.” In 1881 Koch discovered the tubercle-bacillus, and, in spite of the tragic failure of his

tuberculin in 1890-91, avast amount of practical advantage has already issued out of Koch's discovery, if not by way of cure, yet by way of prevention. It has been proved, by experiment on ani- mals, that the sputa of phthisical patients are infective ; and this and the like facts have profoundly influenced the nursing and gen- eral care of such cases. Bacteriology has brought about (under the safeguard of modern methods of surgery) a thorough and early surgical treatment of all primary tuberculous sores or deposits ??? the excision of tuberculous ulcers, the removal of tuberculous glands, and the like. It has helped us to make an early diagnosis, in ob- scure cases, by finding tubercle-bacilli in the sputa, or in the dis- charges, or in a particle of the tissues. It has proved, past all reasonable doubt, that tabes mesenterica, a disease that kills every year in England alone seven or eight thousand children, may arise from infection of the bowels by the milk of tuberculous cows. It has helped to bring about the present rigorous control of the milk- trade and the meat-trade. Moreover, tuberculin is used, because of the reaction that it causes in tuberculous animals, as a test for the detection of latent tuberculosis in cattle. An injection of one to two cubic centimetres under the skin of the neck is followed by a high temperature, if the amimal be tuberculous. If it be not, there is no rise of temperature, or only a very slight rise. For example, in 1899 this test was applied to 270 cows on farms in Lancashire : 180 reacted to the test, 85 did not, 5 were " doubtful." Tuberculous disease was actually found in 175 out of the 180. Eber of Dresden used the test on 174 animals, of whom 136 reacted, 32 did not react, and 6 were doubtful. Of the 136, 22 were slaughtered, and were all found to have tubercle ; of the 32, 3 were slaughtered, and were found free. The opinion of Professor M'Padyean, one of the highest authorities on the subject, is as follows : ??? " I have most implicit faith in tuberculin as a test for tuberculosis when it is used on animals standing in their own premises and undisturbed. It is not reliable when used on animals in a market or slaughter-house. A considerable number of errors at first were found when I exam- ined animals in slaughter-houses after they had been conveyed there by rail, &c. Since that, using it on animals in their own premises, I have found that it is practically infallible. I have notes of one particular case where 25 animals in one dairy were tested, and afterwards all were killed. There was only one animal which did not react, and it was the only animal not found to be tuberculous when killed."

5. Diphtheria. ??? The Bacillus diphtherioe (Klebs-LoefBer bacillus) was described by Klebs in 1875, and obtained in pure cultures by Loeffler in 1884. Behring and Kitasato, in 1890, succeeded in immunizing animals against the disease. The first cases treated with diphtheria-antitoxin were published in 1893, by Behring, Kossel, and Huebner. In England the antitoxin treatment was begun in the latter part of 1894. Beside its curative use, the antitoxin has also been used as a preventive, to stop an outbreak of diphtheria in a school or institute or hospital or village, and with admirable success. (See Diphtheria.)

6. Tetanus (Lock-jaw). ??? Experiments on animals have taught us the true nature of this disease, and have led to the discovery of an antitoxin which has given fairly good results. We possess, moreover, a preventive treatment against the disease ; though, unfortunately, the time of latency, when the antitoxin is most needed, cannot be recognized. The old, mischievous doctrine, that tetanus was due to acute inflammation of a nerve, tracking up from a wound to the central nervous system, was abolished once and for ever by Sternberg (1880), Carle and Rattone (1884), and Nicolaier (1884), who proved that the disease is due to in- fection by a specific flagellate organism in superficial soil. "It is said to be present in almost all rich garden-soils, and that the presence of horse-dung favours its occurrence. There seems to be no doubt as to the ubiquity of the tetanus germ " (Poore, Milroy Lectures, 1899). The work of discovering and isolating the ba- cillus was full of diflBculty. Nicolaier, starting from the familiar fact that the disease mostly comes from wounds or scratches con- taminated with earth, studied the various microbes of the soil, and inoculated rabbits with garden-mould: he produced the

disease, and succeeded in finding and cultivating tlie bacillus, but failed to obtain a pure culture. Kitasato, in 1899, obtained a pure culture. Otliers iiave studied the chemical products of the bacillus, and have been able to produce the symptoms of the disease by in- jection of these chemical products obtained from cultures, or from the tissues in cases of tetanus. It has been proved that the infec- tion tends to remain local ; that

the bacilli in and near the wound pour thence into the blood their chemical products, and that these have a selective action, like strychnine, on the cells of the central nervous system. Therefore the rule, that the vfounded tissues should be at once excised, in all cases where this can possibly be done, has received confirmation. Before Nicolaier, while men were still free to believe that tetanus was the result of an acute ascending neuritis, this rule was neither enforced nor explained.

The antitoxin-treatment has given the following results. The Journal of the American Medical Association, November 13, 1897, gives 26 oases, with 12 recoveries. The Milnchener Med. Wochen- schrift, November 16, 1897, gives 98, vnth 67. The Brit. Med. Journ., July 23, 1898, gives 36, with 25. Erdheim, in September 1898, published 22, with 11. Engelmann, in 1898, 51, with 36. But some of these cases may have been published more than once. Tavel of Berne lately published 10 cases, with 7 recoveries, against 13 cases treated without antitoxin, of whom 11 died. On the other hand, Baccelli (BrjJ. Med. Journ., 1899) reported better results than these, without antitoxin. The figures are all of them too small, and the disease too variable in intensity, for a final judg- ment at present. At all events, the use of the antitetanic serum does not exclude the use of other drugs also. The mortality of tetanus in this country, before the serum-treatment, may be esti- mated at 75 or 80 per cent.

The preventive use of the serum, in veterinary practice, has yielded admirable results. In some parts of the world tetanus is terribly common among horses. Nocard of Paris has reported as follows: ❓❓❓ " The use of antitetanus serum as a preventive has been in force for some years in veterinary practice in cases of wounds or surgical procedures. To this end the Pasteur Institute has sup- plied 7000 doses of antitetanus serum, a dose being 10 cubic centi- metres ; a quantity which has sufficed to treat preventively 3100 horses in those parts of the country where tetanus is endemic. Among these there has been no death from tetanus. In the case of one horse, injected five days after receiving a wound, tetanus developed, but the attack was slight. During the same time that these animals were injected, the same veterinary surgeon ob- served, among animals not treated by injection, 259 cases of tetanus" (Lancet, August 7, 1897).

7. Babies. ??? The date of the first case treated by Pasteur's preventive method ??? Joseph Meister, an Alsatian shepherd-boy ??? is July 1885. The existence of a specific micro-organism of rabies was a matter of inference. The incubation period of the disease is so variable that no preventive treatment was possible unless this incubation period could be regulated. Inoculations of the saliva of a rabid animal, introduced under the skin of animals, sometimes faijed ; and if they succeeded, the incubation period of the disease thus induced was hopelessly variable. Next, Pasteur used not saliva, but an emulsion of the brain or the spinal cord ; because the central nervous system is the chief seat of the poison. But this emulsion, introduced under the skin, was also uncertain in action, and gave no fixed incubation period.

Therefore, he argued, as the poison has a selective action on the nerve-cells of the central nervous system, and a sort of natural affinity with them, it must be introduced directly into them, where it will have its proper environment : the emulsion must be put not under the skin, but under the dura mater (the membrane en- veloping the brain). These subdural inoculations were the turning- point of his work. By transmitting the poison through a series of rabbits, by subdural inoculation of each rabbit with a minute quan- tity of nerve-tissue from the rabbit that had died before it, he was able to intensify the poison, to shorten its period of incubation, and to fix this period at six days. Thus he obtained a poison of exact strength, a definite standard of virulence, virus fixe: the next rabbit inoculated wovdd have the disease in six days, neither more nor less. By gradual drying, after death, of the cords of rabid animals, he was able to attenuate the poison contained in them. The spinal cord of a rabbit that has died of rabies slowly loses virulence by simple drying. A cord dried for four days is less virulent than a cord dried for three, and more virulent than a cord dried for five. A cord dried for a fortnight has lost all viru- lence ; even a large dose of it will not produce the disease. By this method of drying, Pasteur was able to keep going one or more series of cords, of known and exactly graduated strengths, accord- ing to the length of time they had been dried, ranging from abso- lute non-virulence through every shade of virulence.

As with fowl-cholera and anthrax, so with rabies : the poison, attenuated till it is innocuous, can yet confer immunity against a stronger dose of the same poison. A man, bitten by a rabid ani- mal, has at least some weeks of respite before the disease can break

out ; and during that time of respite he can be immunized against the disease, while it is still dormant : he begins with a dose of poison attenuated past all power of doing harm, and advances day by day to more active doses, guarded each day by the dose of the day before, till he has manufactured within himself enough anti- toxin to make him proof against any outbreak of the disease. (See Hydeophobia.)

7. Cholera. ??? The specific organism of Asiatic cholera, the "comma-bacillus," was discovered by Koch m 1883 ; but such a multitude of difficulties arose over it, that it was not universally cecognized as the real cause of the disease before 1892, the year of the epidemic at Hamburg. The discovery of preventive inocula^ tion was the work of many men, but especially of Hafikine, one of Pasteur's pupils. Ferran's earlier inoculations in Spain (1885) were a failure. Haffkine's first inoculations were made in 1893. At Agra, in April 1893, he vaccinated over 900 persons ; and from Agra went to many other cities of India. Altogether, in twenty- eight months (April 1893-July 1895) no less than 42,179 persons were vaccinated (many of them twice) in towns, cantonments, jails, tea-estates, villages, schools, &c., " without having to record a single instance of mishap or accident of any kind produced by our vaccines." (See Cholera.)

9. Bubonic Plague. ??? The Bacillus pestis was discovered in 1894 by Kitasato and Yersin, working independently. The preventive treatment was worked out by Haffkine in 1896 : ??? " Twenty healthy rabbits were put in cages. Ten of them were inoculated with Haffkine's plague vaccine. Then both the vaccinated rabbits and the other ten rabbits that had not been vaccinated were infected with plague. The unprotected rabbits all died of the disease, and in their bodies innumerable quantities of the microbes were found. But the vaccinated rabbits remained in good health. Professor Haffkine then vaccinated himself and his friends. This produced some fever, from which, after a day or two, they recovered.

Plague broke out in BycuUa Jail, in Bombay, in January 1897. About half the prisoners volunteered to be inoculated. Of these, 3 developed plague on the day of inoculation, and it is probable that they had already plague before the treatment was carried out. Of the remaining 148 who were inoculated, only 2 were afterwards attacked with plague, and both of them recovered. At the same time, of the 173 who had not been vaccinated, 12 of them were attacked ; and out of these, 6 died." (See Plague.)

10. Typhoid Fever. ??? The Bacillus typhosus was discovered by Klebs, Eberth, and Koch in 1880-81. The first protective inocu- lations in England were made at Netley Hospital in 1896 by Pro- fessor Wright and Surgeon-Major Semple : sixteen medical men and two others offered themselves as subjects. The first use of the vaccine during an actual outbreak of typhoid was in October 1897 at the Kent County Asylum: ??? ???" All the medical staff and a number of attendants accepted the offer. Not one of those vacci- nated??? 84 in number ??? contracted typhoid fever; while of those unvaocinated, and living under similar conditions, 16 were at- tacked. This is a significant fact, though it should in fairness be stated that the water was boiled after a certain date, and other precautions were taken, so that the vaccination cannot be said to be altogether responsible for the immunity. Still, the figures are striking" {Lancet, March 1898).

In 1899 Professor Wright vaccinated against typhoid more than .3000 of the Indian array, at Bangalore, Rawal Pindi, and Lucknow. Typhoid, among the soldiers in India, is on the increase ; and Gov- ernment has now sanctioned voluntary inoculation against typhoid, at the public expense, among the British troops.

Beside the preventive treatment, bacteriology has given us " Widal's reaction " for the early diagnosis of the disease ??? a matter of the very highest practical importance. A drop of blood, from the finger of a patient suspected to be suffering from typhoid fever, is di- luted fifty or more times, that the perfect delicacy of the test may be ensured ; a drop of this dilution is mixed with a nutrient fluid con- taining living bacilli of typhoid, and a drop of this mixture is ob- served under the microscope.

The motility of the bacilli is instantaneously or very quickly arrested, and in a few minutes the bacilli begin to aggregate together into clumps. This ‘ ‘ clumping ‘ ‘ is also made visible to the naked eye by the subsidence of the agglu- tinated bacilli to the bottom of the contaming vessel. The amazing delicacy of ” Widal’s test ” is but a part of the wonder. Long after recovery, a fiftieth part of a drop of the blood will still cause clump- ing : it has even been obtained from an infant whose mother had typhoid shortly before the child was born, A drop of blood from a case suspected to be typhoid can now be sent by post to be tested, a hundred miles away, and the answer telegraphed back.

11. MaltaFever (Mediterranean Pever). ??? The5aci7h(S Melitensis was discovered in 1887 by Surgeon-Major Bruce. The work of discovering and preparing an immunizing serum was done at Nelley Hospital. In this fever, as in typhoid and some others, Widal’s test is of great value : “the diagnosis of Malta fever from typhoid is, of course, a highly important practical matter. It is exceedingly difficult in the early stages” (Manson). Even in a

dilution of 1 in 1000, the blood of Malta fever can give the typical reaction with the Bacillus Melitensis; and this occurred in a case at Netley of accidental innooulation with Malta fever ; one of three cases that have happened there. The case is reported in the British Medicaf Journal, October 16, 1897: ??? “It appears that he had scratched his hand with a hypodermic needle on September 17, when immunizing a horse for the preparation of serum-protec- tive against Malta fever; and his blood, when examined, had a typical reaction with the micrococcus of Malta fever in 1000-fold dilution. The horse, which has been immunized for Malta fever for the last eight months, was immediately bled, and we are in- formed that the patient has now had two injections, each of 30 cub. cm. of the serum. He is doing well, and it is hoped that the attack has been out short.” About fifty cases of the fever, by April 1899, had been

treated at Netley. The Lancet, April 15, 1899, says that the treatment was " with marked benefit : whereas they found that all drug treatment failed, the antitoxin treatment had been generally successful."

12. Yellow Fever. ??? The Bacillus icteroides was discovered by Sanarelli in 1896 during his study of yellow fever in the lazaretto of Flores. By 1897 he had prepared an immunizing serum, which gave excellent results on animals : ??? "This serum was tried on guinea-pigs against a mortal dose of virulent cultures. Half a cubic centimetre of this serum, injected twenty-four hours before the dose of virulent cultures, gave immunity. Two centimetres of it succeeded in saving guinea-pigs already ill, even if it were injected forty-eight hours afterward. . . . The preventive and curative power of the serum of the guinea-pig, the dog, and the horse, vaccinated against the Bacillus icteroides, should be held as absolutely demonstrated in the case of animals." At Rio de Janeiro Sanarelli treated 8 cases of yellow fever, with 4 recoveries: at San Carlos do Pinhal, in January 1898, 22 cases, with 16 re- coveries ; and of the 6 who died, 4 appeared hopeless from the first. The case of two children at the isolation hospital at San Carlos is worth quoting: ??? "La plupart des gens pr^f6raient rester chez eux pour mourir ; les seuls malades k ce moment h I'hOpital Staient deux eufants ramass^s dans la maison oil leur p6re ^tait d6j&, mort de fifevre jaune. Ces deux petits malades pr^sentaient les sympt6mes caract6ristiques de la maladie, y compris le vomito negro. lis furent soumis de suite au traitement, dont les r^sultats furent presque imm^diats ; la fifevre et I'albuminurie disparurent, les symptSmes g^n^raux s'att6nu6rent, et les deux enfants en- trferent en franche convalescence." Sanarelli was careful to se- lect severe cases; and his work was done in a part of the country where the fever was most fatal: ??? " Chaque cas 6tait choisi de commun accord entre nous, dans le but de mettre bien en Evidence Taction th^rapeutique du s^rum, mettant toujours de c6t6 tons les cas qui se pr^sentaient avec des sympt6mes vagues ou att^nu^s ou en forme 16g6re ou fruste." In February 1898 the fever broke out in the jail at San Carlos, with 4 cases and 3 deaths. Prevent- ive treatment was given to all the prisoners, except one who had already had the fever ; and at once the outbreak stopped ; no more cases occurred, though only a weak serum

was used, and though the fever, two months later, was still active in the town.

13. Malaria. ??? Laveran, in 1880, discovered the Plasmodium malarias, an amoeboid organism, in the blood of malarial patients. In 1894 Manson took, as a working theory of malaria, the old belief that the mosquito is the intermediate host of the parasite. In 1895 came MacCuUum's observations on an allied organism, Halteridium. In 1897, after two years' work, Ross found bodies, pigmented like the Plasmodium, in the outer coat of the stomach of the grey or "dapple-winged" mosquito, after it had been fed on malarial blood. In February 1898 he started work in Calcutta : ?? ?" ?? Arriving there at a non-fever season, he took up the study of what may be called ' bird-malaria.' In birds, two parasites have become well known ??? (1) the Halteridium, (2) the Proteosoma of Labb^. Both have flagellate forms, and both are closely allied to the Plasmodium malarice. Using grey mosquitoes and proteosoma- Infected birds, Ross showed by a large number of observations that it was only from blood containing the proteosoma that pig- mented cells in the grey mosquito could be got ; therefore that this cell is derived from the proteosoma, and is an evolutionary stage of that parasite" (Manson, 1898). These pigmented cells give issue to innumerable swarms of spindle-shaped bodies, "germinal rods"; and in infected mosquitoes Ross found these rods in the glands of the proboscis. Finally, he completed the circle of development, by infecting healthy sparrows by causing mosquitoes to bite them. Other workers in this field of science have also infected themselves, from mosquito-bites, with the disease. It would be hard to surpass Ross's work, and that done in Italy by Grassi and others, for fineness and carefulness. He says, for instance, "out of 245 grey mosquitoes fed on birds with proteosoma, 178, or 72 per cent., contained pigmented cells ; out of 249 fed on blood containing halteridium, immature proteosoma, &c., not one contained a single pigmented cell. . . . Ten mosqui- toes fed on the sparrow with numerous proteosoma contained 1009 pigmented cells, or an average of 101 each. Ten mosquitoes fed

on the sparrow with moderate proteosoma contained 292 pigmented cells, or an average of 29 each. Ten mosquitoes fed on the spar- row with no

proteosoma contained no pigmented cells." The destruction of the breeding-puddles of the special mosquito of ma/- laria is therefore the chief thing to be done : and the habits and habitations of Anopheles claviger have become a matter of world- wide Importance. A mass of evidence has also been accumulated which shows that mosquitoes also convey the parasitic organisms that are the cause of filariasis.

The list of diseases studied by the help of bacteriology is not yet complete : nothing has been said of glanders, rinderpest, Texas fever, and other infective diseases. Nothing, again, has been said of the grosser parasites, tape-worms, hydatids, trichina, and the like : whose whole history and life-changes have been worked out by the help of feeding-experiments on animals. Only three more examples need be given of discoveries made by the help of experiments on animals ; and these are the nature and treatment of myxoedema, the actions of certain important drugs, and the serum-treatment of cases of snake-bite.

14. Myxedema. ??? Our knowledge of myxcedema, like our know-ledge of cerebral localization, began not in experimental science but in clinical observation (Gull, 1873; Ord, 1877). In 1882- 1883 Reverdin and Kocher published cases where removal of the thyroid gland for disease (goitre) had been followed by symptoms such as Gull and Ord had described. In 1884 Horsley, by removal of the thyroid gland of monkeys, produced in them a chronic myxoedema, a cretinoid state, the exact image of the disease in man : the same symptoms, ??? course, tissue-changes, mental and physical hebetude, the same alterations of the excretions, the temperature, and the voice. In 1888 the Clinical Society of London published an exhaustive report, of 215 pages, on 119 cases of the disease, giving all historical, clinical, pathological, chemical, and experimental facts ; but out of 215 pages there is but half a page about treatment, of the useless old-fashioned sort. In 1890 Horseley published the suggestion that a graft of thyroid gland from a newly-killed animal should be transplanted beneath the skin in cases of myxoedema : ??? " The justification of this procedure rested on the remarkable experiments of Schifi and von Eisselsberg. I only became aware in April 1890 that this proposal had been in fact forestalled in 1889 by Dr Bircher in Aarau. Kocher had tried to do the same thing in 1883, but the graft was

soon absorbed ; but early in 1889 he tried it again in five cases, and one greatly improved." In 1891 George Murray published his Note on the Treatment of Myxcedema by Hypodermic Injections of an Extract of the Thyroid Gland of a Sheep. Later, the gland was administered in food. At the present time tabloids of thyroid extract are given. We could not have a Isetter ex- ample how experiments on animajs are necessary for the advance- ment of medicine. Now, with little bottles of tabloids, men and women are restored to health who had become degenerate in body and mind, disfigured and debased. The same treatment has given back mental and bodily growth to countless cases of sporadic cretinism. Moreover, the action of the thyroid gland has been made known, and the facts of "internal secretions" have been in part elucidated. (Claude Bernard, speaking of the thy roid, the thy mus, and the suprarenal capsules, said : ' ' We know absolutely nothing about the functions of these organs ; we have not so much as an idea what use and importance they may possess, because experiments have told us nothing about them, and anatomy, left to itself, is absolutely silent on the subject.")

15. The Action of Drugs. ??? Even in the 18th century medicine was still tainted with magic and with gross superstition : the 1721 Pharmacopceia contains substances that were the regular stock-in- trade of witchcraft. Long after 1721 neither clinical observation, nor anatomy, nor pathology brought about a reasonable under- standing of the action of drugs : it was the jihysiologists, more than the physicians, who worked the thing out ??? Bichat, Magen- die, Claude Bernard. Magendie's study of upas and strychnine, Bernard's study of curare and digitalis, revealed the selective ac- tion of drugs : the direct influence of strychnine on the central nerve-cells, of curare on the terminal filaments of motor nerves.

Two instances may be given how experiments on animals have elucidated the action of drugs. A long list might be made ??? aconite, belladonna, chloride of calcium, cocaine, chloral, ergot, morphia, salicylic acid, strophanthus, the chief diuretics, the chief diaphoretics ??? all these and many more have been studied to good purpose by this method ; but it must suffice to quote here Professor Eraser's account

of digitalis, and Sir Thomas Lauder Brunton's account of nitrite of amyl : ???

"1. Digitalis was introduced as a remedy for dropsy; and on the applications which were made of it for the treatment of that disease, a slowing action upon the cardiac movements was observed, which led to its acquiring the reputation of a cardiac sedative. . . . It was not until the experimental method was applied in its investigation, in the first instance by Claude Bernard, and subse- quently by Dybkowsky, Pelikan, Meyer, Boehni, and Schiniede-

berg, that the true action of digitalis upon the circulation was dis- covered. It was shown that the effects upon the circulation were not in any exact sense sedative, but, on the contrary, stimulant and tonic, rendering the action of the heart more powerful, and increas- ing the tension of the blood-vessels. The indications for its use in dis- ease were thereby revolutionized, and at the same time rendered more exact ; and the striking benefits which are now afforded by the use of this substance in most (cardiac) diseases were made available to humanity."

"2. In the spring of 1867 I had opportunities of constantly observing a patient who suffered from angina pectoris, and of obtaining from him numerous sphygmographic tracings, both dur- ing the attack and during the interval. These showed that during the attack the pulse became quicker, the blood-pressure rose, and the arterioles contracted. . . . It occurred to ,me that if it was possible to diminish the tension by drugs instead of by bleeding, the pain would be removed. I knew from unpublished experiments on animals by Dr A. Gamgee that nitrate of amyl had this power, and therefore tried it on the patient. My expectations were per- fectly answered."

15. Snake-Venom. ??? Sewall (1887) showed that animals could be immunized, by repeated injection of small doses of rattlesnake's venom, against a sevenfold fatal dose. Kanthack (1891) immun- ized animals

against cobra-venom : afterward Fraser, Calmette, and many others, worked at the subject. Fraser's work on the antidotal properties of the bile of serpents is of the very highest interest and value, both in physiology and in sero-therapy. Calmette's work is an admirable instance of the delicacy and accuracy of the experi- mental method. The different venoms were measured in decimal milligrammes, and their action was estimated by the body ~~weights of the animals inoculated ; but of course this estimate of viru~~ lence was checked according to the susceptibility of the animals ; guinea-pigs, rabbits, and especially rats, being more susceptible than dogs : ???

" The following table gives the relative toxicity, for 1 kilogramme of rabbit, of the different venoms that I have tested " : ???

1. Venom of Naja 0-25 milligramme per

kilogramme of rabbit. One gramme of this venom kills 4000 kilogrammes of rabbit: activity =4,000,000

2. Venom of Hoplocephalus . . . 0-29 . . 3,450,000

3. Venom of Pseudechis .... 1-25 . . 800,000

4. Venom of Pelias herns . . . 4-00 . . 250,000

By experiments in vitro Calmette studied the influence of heat and chemical agents on these venoms ; and,working by various methods, was able to immunize animals : ???

" I have got to immunizing rabbits against doses of venom that are truly colossal. I have several, vaccinated more than a year ago, that take without the least discomfort so much as 40 milligrammes of venom of Naja tripudians at once. Five drops of serum from these rabbits wholly neutralize in vitro the toxicity of one milli- gramme of Naja venom. . . . It is not even necessary that the serum should come from an animal vaccinated against the same sort of venom as that in the mixture. The serum of a rabbit immunized against the venom of the cobra or the viper acts indifferently on all the venoms that I have tested."

In 1895 he had prepared a curative serum : "If you first inocu- late a rabbit with such a dose of venom as kills the control-animals in three hours ; and then, an hour after injecting the venom, inject under the skin of the abdomen four to five cubic centimetres of serum, recovery is the rule. When you interfere later than this, the results are uncertain ; and out of all my experiments the delay of an hour and a half is the most that I have been able to reach."

In 1896 four successful cases were reported in the British Medi- cal Journal. In 1898 Calmette reports : ???

" It is now nearly two years since the use of my antivenomous serum was introduced in India, in Algeria, in Egypt, on the West Coast of Africa, in America, in the West Indies, Antilles, &c. It has been very often used for men and domestic animals (dogs, horses, oxen), and up to now none of those that have received an in- jection of serum have succumbed. A great number of observations have been communicated to me, and not one of them refers to a case of failure " {Brit. Med. Journ., May 14, 1898 ; see also Boston Med- ical and Surgical Journal, April 7, 1898).

It is of course impossible that "antivenene" should be always at hand, or that it should bring about any great decrease in the number of deaths from snake-bite, which in India alone are 30,000 annually ; but at least something has been accomplished with it.

The account given above of the chief discoveries that have been made by the help of experiments on animals, in physiology, pa- thology, bacteriology, and therapeutics, might easily have been lengthened if we added to it other methods of treatment that owe less, but yet owe something, to these experiments : for example.

transfusion of saline fluid, hypodermic medication, torsion of arte- ries, grafting of skin, transplantation of bone, the absorbable ligature, the diagnostic and therapeutic uses of electricity. JJevertheless, the facts quoted in this article are sufficient to indicate the great debt that medicine owes to the experimental method. (g. P.)

Explosives. ***Explosives are substances capable of producing, under certain circumstances, a more or less violent action. This action may be very local or may extend to some distance around the place where it happens. It is generally accompanied by an aerial disturbance or noise. Sometimes this action results in the propulsion of solids, or liquids, to some distance, or in a local disruption of matters in the immediate vicinity. Where the second action is very pronounced and projection is at a minimum, the term detonation is applied to the action, to distinguish it from explosion, and detonator or " disruptor " explosive to the substance. Explosives may be classified under these two headings. An explosive of the projecting, or propul- sive, class generally acts by burning in a more or less rapid and regular manner, and producing from a comparatively small volume of solid (liquid or gas) a much larger volume of gases, and at the same time much heat may be evolved, which further expands the gases. Time is an important factor. Many ordinary combustion actions can be so accelerated as to become explosive, and this effect can be determined by increasing the area of contact between combustible and oxygen or oxygen-producers. Quantity of heat-energy alone does not necessarily give an explosive action. Some metals burn with extreme vigour, as indi- cated by the temperatures produced, but unless the pro- duets be gaseous, no real explosive action results.***

Explosives may by mixtures of combustible matters with oxygen or suppliers of oxygen, or chemical compounds. All chemical compounds may be classified under one of two headings,being either "endothermic"or "exothermic." The former term means that in the construction or building up of the compound some amount of energy becomes latent or potential. This is the case where any two elementary substances unite only under the compulsion of a high temperature, an electric current, or while some other re- actions are proceeding. For example, oxygen and nitrogen unite only under the influence of an electric spark ; simi- larly with carbon and nitrogen and carbon and hydrogen. In some complex chemical reactions what are known as secondary products appear. In some of these the main reaction is one of running down of energy, and the second- ary one a piling up of energy in the form of a complex and relatively unstable compound. The formation of chlorates is a good example of this, five-sixths of the reaction repre-

senting the running down of energy, and only one-sixth the formation of an " endothermic " compound. A further meaning of endothermic will be apparent from facts about acetylene, a compound of carbon and hydrogen. When 26 parts, by weight, of acetylene are burnt, the heat produced will warm up 310,450 parts of water one degree centigrade. Twenty -four of the 26 parts are carbon, and when this quantity in the form of pure charcoal is burnt, only 192,000 of these heat-units are produced, and from two parts of hydrogen 68,000 units, in all 256,000 units. Therefore 60,450 units of heat are given by the compound over the heat given by its constituents burning to the same end-products. This excess of heat-energy is supposed to be due to a form of latent or potential, perhaps chemical, energy in the compound, which becomes actual energy in some form ^ or other when the compound is broken up or resolved.

The manner in which a substance is endothermic is of importance as regards the practical employment of explos- ives. Some particular endothermic state or form evidently

1 Not necessarily heat. Silver acetylide, nitrogen chloride or iodide, and other compounds decompose with great violence, but very little heat is evolved.

results from the mode of formation, and the consequent internal structure as a chemical or physical molecule. Physical structure alone is certainly answerable for a de- cidedly endothermic condition in some materials, as, for instance, the chilled glass bulbs or drops known as Bo- logna phials and Euperts drops. They are made by suddenly cooling glass from a melted state. They explode on scratching or cutting to a certain depth. The cause is probably that the glass is occupying at the ordinary temperature the same, or nearly the same, volume it occupied when in a melted state, so that all the particles are in a state of strain, tending to revert to an easier relative position. " Superf used " substances are probably in a similar physical state of potential. Acetate of soda melts

when heated a little above 56 C, and if kept melted for some time and then cooled in a clean atmosphere, can be kept for any length of time in a fluid condition. On contact with a crystal of the same substance the whole will rapidly solidify, at the same time becoming heated to about 66 C. again. Among endothermic substances may be included almost all carbon compounds, with the exception of carbon dioxide ; and many, if not all, compounds of nitrogen. As substances can be endothermic in more than one way, it is not at present possible to arrange the known examples in a strict order. Most explosives contain nitrogen in some form. It may be stated, generally, that all explosive com- pounds, whatever be the manner of their explosion, are endothermic, and all endothermic substances should be explosible under some circumstance.

The detonating explosives may be termed "disruptors" in distinction to propellants, because their effect is to break up immediately surrounding matter into very small particles to pulverize them in fact rather than to throw them any distance. Some few substances are so nearly purely " disruptors " that their action on explosion is always of this nature : for instance, silver acetylide, silver fulminate, chloride of nitrogen, some diazo compounds, &c. They cannot be used as propellants under any known conditions. Some substances can behave in both ways under certain circumstances and within limits. Gun-cot- ton, for instance, can be really detonated and also burnt quietly. Nitro-glycerine burns quietly as a constituent of cordite, but, as dynamite, detonates and " disrupts " in a typical manner.

Exothermic compounds are in a certain sense the reverse of endothermic. They are relatively dead or exhausted, and will do but little except when energy is expended upon them from the outside. Water and the ordinary minerals of the earth's crust belong to this class; they are the end products of the running down of energy.

Gunpowders are mechanical mixtures of a nitrate ' with compounds of carbon (charcoal) and sulphur. The me- chanical operations of manufacture are all to the end of producing an intimate mixture. The action on explo- sion is combustion only, and it is doubtful if gun-powders can be detonated by ordinary friction or per- cussion. Black

powder contains 76 per cent, potassium nitrate, 10 per cent, sulphur, and 16 per cent, charcoal, which again may contain about 10 per cent, oxygen and nearly 3 per cent, hydrogen. As these proportions are not in any simple chemical relation, it is not easy to express the explosion by an equation. Debus thinks that at least two actions occur ??? first, 16K]Sr03-|-13C-|-6S= 3K2G03 + 6K2S04-f-9C02-|-CO-l-8ISr2. These products again interact; thus with carbon, 4K2S04-|-7C=2K2C03 +2K2S2-I-5CO2, and with sulphur 4K2S04-|-7S=K2S04 -I-3K2S2-I-4C02- The main products are carbon dioxide.

1 Potassium nitrate only can be employed ; all others are either deliquescent, decompose too easily, or have other objectionable qualities.

nitrogen, a little carbon monoxide and steam as gases, and potassium carbonate, sulphate, and sulphide as solids.

The difference between black and brown powders lies in the nature of the carbonaceous material and in the amount of sulphur. In formulae it may be represented

C 17-39 carbon 1 as I6KNO3] 12-62 hydrogen Uharcoal, 1-52 sulphur.

I 12-0 oxygen J The combustion products are carbon dioxide, riitrogen, much steam, and a very little carbon monoxide as gases ; potassium carbonate, sulphate, and a little nitrite as solids. Brown powders burn slower than black, and, even under great pressures, the rate of burning is not appreciably quicker than when under moderate pressures. Black powder when burnt in large charges gives a sharp pres- sure curve somewhat approaching the character of a de- tonation. The reason for the slow burning of brown powder is that the cellulosic material (brown charcoal) requires to be further decomposed before it actually burns, as in the case of the wax of a candle, which only burns as vapour, not as wax.

Chlorates cannot be used in mixtures containing sul- phur, being far too sensitive to friction. With organic materials, as sugar, it is possible to use them, but even such compounds are unsafe against percussion, and the

way in which they develop pressure on explosion renders them dangerous for artillery purposes ; in fact, they are only suitable for blasting powders.

Gun-cotton was the earliest-discovered explosive com- pound, from a practical point of view. It is produced by the action of nitric acid on cotton, paper, or wood-fibre (Pelouze, 1838). Starch yields a similar substance. The product from cotton-wool was investigated in. 1846 by Schonbein, who proposed its use as a substitute for gun- powder. Gun-cotton contains the elements of nitric acid combined in the whole cellulose molecule, no doubt in the form of an ester or nitrate. The precise constitution of this substance is still a matter of some controversy.

The smallest formula for cellulose is CsHioOj, but the substance is probably more complex. Four of the oxygen atoms are supposed to be present in the hydroxy lie form (□□□OH) , as they are replaceable by some acids, such as acetic. The constitution may be therefore

H HO□□□C. HO□□□a

HO□□□C-H Cv

I HO□□□C-H c/

HO-d/ H

HO□□□C

H2

I

or, HO□□□C 0=0 HO□□□c/

On contact with strong nitric acid at the ordinary temperature a reaction□□□probably C6Hio064-2HN03=2HoO-|-C6H80s(NOs)2□□□takes place. Analyses of the product do not quite bear out this equation, but it is probably what would happen if the correct condition of temperature and strength of acid could be found and

maintained. The product, after washing and drying, ignites at about 150 C. It is very soluble in a mixture of alcohol and ether, and is the main constituent of collodion. A mixture of nitric and sulphuric acids produces, under the same conditions, a more highly nitrated product, the sulphuric acid for the most part acting only as a dehydrating agent in taking up the water eliminated by the action of the nitric acid on the cellulose.

C6Hio06-|-3HN08=3H20 + CeH702(N08)3

I

- *3H2SO4*

II

3(H2S04H20).

- *The sulphuric acid does not appear in the final product, aud may be omitted from the equation, but it is doubtful whether its action is confined to dehydration only.*

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As with nitric acid alone, this action takes some time at the ordi- nai-y temperature, depending on the fineness of the cotton employed. The product is unchanged in appearance, but shows a difference from cotton when examined by polarized light. It has gained in weight, but not up to the extent required by the equation. It is insoluble in alcohol and ether, singly or mixed, and its igniting point is about 180 C. It is very doubtful whether the formula C6H7O2 (N03)8 is not much too simple, but serious difficulties occur in the investigation of this substance (and cellulose compounds generally) owing to its insoluble nature. Gun-cotton is certainly a nitrate. Alkalies and alkaline sulphides act somewhat readily upon it, tending to reproduce cellulose. The artificial silk process depends upon this circumstance. Ammonia is particularly active in decomposing

it. Dilute acids have little or no action. Several substances, as acetone and acetic ether, dissolve or gelatinize gun- cotton, and on the solvent evaporating away, the gun-cotton is left in what is known as a colloidal state. The employment of gun-cotton as the basis or main ingredient of smokeless gunpowder depends entirely on this gelatinizing action, and all attempts to employ gun-cotton before this was discovered were failures. Fibrous gun-cottou may burn or explode at any rate, and under a little pressure detonation almost always takes place. In the colloid form burning can only take place at the outer surface, as gases are quite unable to penetrate a colloidal substance. Assuming gun-cotton to be a cellulose trinitrate, there is enough contained oxygen for a partial combustion without external air. The products of burning are steam, carbon monoxide, and dioxide (CO and CO2), nitrogen, nitric oxide (NO), and sometimes methane (CH4). The relative amounts of these vary considerably with the conditions of firing. There is some dispute and controversy about the matter, but prob- ably nitric oxide is always one product. Dry gun-cotton can be detonated by a charge of fulminate or by a smart blow on an anvil, though the explosion seldom spreads from the piece struck. Wet gun-cotton can be detonated by the shock of the dry substance detonating. Starches, sugars, and many similar substances can be converted into nitrates of a similar type to gun-cotton, but some are soluble in water, and all have some objectionable properties which unfit them for practical use as explosives.

Nitro-glycerine, or glycerine nitrate, is the product of the action of a mixture of nitric and sulphuric acids on glycerine at temperatures below 20 C.

Its chemical constitution may be said to be accurately known.

CH2OH Glycerine has the composition and constitution shown by CHOH,

CH2OH as proved by synthetic methods. The action of the mixed acids is to replace the three hydroxyl groups (OH) by NOs, so that nitro- glycerine is represented as CsHs (N08)8, or a trinitrate of the gly- cerine radical C3H5. Nitric acid alone does notform thiscompound. Sulphuric is, in addition, necessary, and probably exerts the same function here as in

the case of gun-cotton formation. In making nitro-glycerine the glycerine is carefully added to the cooled acid mix- ture, a great excess of acids being employed. The reaction is com- pleted within about one minute of contact, a slight rise in temperature taking place. The product is separated from the acids and washed repeatedly by water, and finally with an alkaline solution. Nitro- glycerine is an oily liquid heavier than water, and almost insoluble therein. It boils at about 120 ►► C, and begins to decompose at the same time, generally detonating very violently at about this temperature, though when rapidly heated in very small quantity it may simply fiash off quietly. Soaked into a porous substance, as blotting-paper, a little may be burnt quietly, as also when in- corporated into a jelly of gun-cotton, as in cordite. Its combustion is more complete than is the case with gun-cotton, since it contains relatively more oxygen. Under atmospheric pressure the products are the same as with gun-cotton, but the quantity of carbon dioxide is greater in proportion. A probable equation is ►►►

2(C3H68)=5H20-|-5C02-(-CO-f2N2-|-2NO.

Detonation may be brought about by a shai-p blow on a hard sur- face, more completely when the nitro-glycerine is soaked into some porous material, as kieselguhr, or even sawdust, when almost any form of "detonator," as fulminate of mercury, will bring about a complete detonation. This is the essential condition in the various forms of dynamite. Nascent hydrogen, from almost any source, or alkaline sulphides will reduce nitro-glycerine to glycerine, and convert the N08 portion of the substance into ammonia; hence alkaline sulphides are well adapted for the quiet destruction of nitro-glycerine or dynamite. Glycerine belongs to a class of compounds known as alcohols. All these substances contain one or more groups of ►►►OH, and in conse- quence of this react with nitric acid under certain circumstances, to produce nitrates with properties more or less resembling nitro- glycerine as to their explosiveness. Ordinary alcohol (CzHsOH),

for instance, will form a nitrate C2H6NO3, the vapour of which explodes with considerable violence. The volatile nature of this and several similar compounds preclude any practical employment as explosives.

Fulminates. ❖❖❖ The first of the fulminates was discovered by Howard in 1800, as a product of the action of alcohol on a solution of mercury in nitric acid.

The only fulminate of practical importance is the mercury com- pound HgC2N202. The essential condition for formation is that the nitrate of mercury solution shall contain some nitrous acid. The probable constitution of mercury fulminate may be

Hg< >0,

\0-C❖❖❖N/

but several other formulae have been proposed. Its explosiveness no doubt depends for the most part on its structure. It is a white crystalline solid, only slightly soluble in water. Small quantities, when heated in air, bum very rapidly. Slight friction or percussion will cause violent detonation. Its rate of burning is too high to allow it time to ignite common powder. In igniting and firing compositions, therefore, for which it is mostly employed, it is mixed with certain quantities of inert substances, as glass-powder, &c., which reduce the rate of burning or explosion. The products of its burning are : mercury, carbon, and carbon dioxide and nitrogen. Other metallic fulminates are known, but they are either too sensitive when in a dry state, ❖❖❖ as silver fulminate, which when dry will explode if shaken on paper, ❖❖❖ or decompose in solu- tion. Alkaline sulphides act very rapidly on fulminate of mercury, decomposing it into quite non-explosive compounds. Fulminate of mercury is largely employed both as an igniting and detonating material for other explosives.

Nitro Explosives from Benzene. ❖❖❖ Benzene, CeHg, is a hydrocarbon extracted from coal-tar. Nitric acid forms with it a number of derivatives called nitro compounds, most, if not all, of which are explosives under certain conditions.

The simplest is nitro-benzene, CsHcNOa, a liquid ; then comes dinitro-benzene, C6H4^ known in three modifications, all of which are solids ; then trinitro and tetra-nitro compounds, of which little is known. Dinitro-

benzene can actually be employed as a constituent of blasting ejcplosives, and to a small extent is also used in some sporting-powders. All these compounds are difficult to explode as compared with gun-cotton or nitro-glycerine.

Picric Acid. ??? Coal-tar contains some benzene compounds in addition to benzene itself. One of these is phenol or carbolic acid, CeHjOH, a hydrate of benzene. When this substance is brought in contact with nitric acid several products are formed, depending on strength of acid and temperature, the final stage being a trinitro derivative known as picric acid or trinitro-phenol, C6H230H. The action is too violent to allow of this direct process of manufacture being employed on a large scale. Asa matter of fact several physical modifications of trinitro-phenol are formed by the direct action of nitric acid on phenol, and some of these are very easily decomposed.

The usual method of manufacture is to act on phenol with hot sulphuric acid, which forms a phenol sulphonic acid of a particular

kind, C6H60H-)-H2S04=C6H4g^H+H20. This sulphonic acid,

when heated with dilute nitric acid, gives a very perfect yield of the particular variety of ti-initro-phenol known as picric acid. This is pictured in structural formula as

OH NO2I6 ^ 2NO2

hI<^h

NO2

The other trinitro-phenols alluded to have a different structure, and in consequence differ in properties. Picric acid is a yellow crystal- line solid, soluble in hot, but very slightly in cold, water. Metallic oxides combine with it to form picrates, as C6H230K, the

potassium salt. All its metallic compounds are very sensitive to heat or friction, and detonate very vigorously. When hurnt in a vacuum vessel, the products from picric acid agree very closely with the equation: 2(C6H280H}=3H20 + 3N2 + 5C02+CO+6C, tut pressure exerts much influence on the relative amounts of these products. Many substances belonging to the class phenols vrill similarly form explosive nitro compounds.

Picric Acid melts at 122-5 C. to a pale yellow liquid, at which temperature a little vapour is formed, which can be ignited, and the substance then burns quietly, with a very smoky flame. When rapidly heated above its melting-point it may undergo internal decomposition and, depending on the quantity and pressure developed, either burn rapidly or detonate violently.

After melting and again solidifying, picric acid becomes some- what denser, although still crystalline.

Lyddite is picric acid that has been melted. Owing to its more compact state, resulting from fusion, it is much easier to detonate by means of exploders of the fulminate class or, better, with some metallic compounds of picric acid itself (picrates) or even by rapidly heating in a confined space. Compared with gun-cotton or nitro-glycerine, and many other explosives, picric acid is difficult to detonate.

Melinite may consist of picric acid alone or mixtures of that substance with certain picrates or nitrates, as ammonium nitrate, which increase its sensibility to percussion or heat, and may add to the violence of explosion.

Diazo Compounds. ??? From the nitro-benzene compounds substances known as amino compounds, of wliicli aniline, CeHj-lSrHj, is an example, may be obtained. Many of these react in a certain way with nitrous acid, producing diazo compounds, of which diazo-benzene, CeHj-NN-OH, is an example. In a dry state these substances are gener- ally not only very explosive but very sensitive to either heat or friction. They are scarcely practical explosives at present.

Amino explosives are becoming a large class. Amino acetic acid, CHjlSrHjCOOH, combines with nitric acid and is known as glycocoll nitrate. It burns rapidly and quietly when ignited, or will detonate under pressure.

Hydrazoic acid, N3II, is possibly the most powerful explosive known. It was discovered by Curtius. It is a gaseous substance which forms salts with metals, ??? as silver and sodium, ??? which explode with extreme violence on heating to a little above the boiling-point of water. The ammonia compound NgNH^ gives, according to Berthelot, 1148 cubic centimetres of gases for 1 gram weight of substance, ??? a greater change of volume than in any other known case.

See also Peopbllants, Oednance (Ammunition), and Mining. (w. e. e. h.)

Exterritoriality is a term of international law, used to denominate certain immunities from the application of the rule that every person is subject for all acts done within the boundaries of a state to its local laws. It is also employed to describe the quasi-extraterritorial posi- tion, to borrow the phrase of Grotius, of the dwelling- place of an accredited diplomatic agent, and of the public ships of one state while in the waters of another. Latterly its sense has been extended to all cases in which states refrain from enforcing their laws within their territorial jurisdiction. The cases recognized by the law of nations relate to : (1) the persons and belongings of foreign sovereigns, whether incognito or not ; (2) the persons and belongings of Ambassadors, Ministers Plenipotentiary, and other accredited diplomatic agents and their suites (but not Consuls, except in some non-Christian countries, in which they sometimes have a diplomatic character) ; (3) public ships in foreign waters. Exterritoriality has also been granted by treaty to the subjects and citizens of con- tracting Christian states resident within the territorry of certain non-Christian states. Lastly, it is held that when armies or regiments are allowed by a foreign state to cross

its territory, they necessarily have exterritorial rights. " The ground upon which the immunity of sovereign rulers from process in our courts," said Mr Justice Wills in the case of Mighell v. Sultan of Johore, 1894, "is recognized by our law, is that it would be absolutely inconsistent with the

status of an independent sov- ereign that he should be subject to the process of a foreign tribunal, unless he deliberately submits to its jurisdiction." It has, however, been held where the foreign sovereign was also a British subject (Duke of Brunswick v. King of Hanover, 1844), that he is amenable to the jurisdiction of the English Courts in respect of transactions done by him in his capacity as a subject. A "foreign sovereign" may be taken to include the President of a Eepublic, and even a potentate whose independence is not complete. Thus in the case, cited above, of Mighell v. the Sultan of Johore, the Sultan was ascertained to have abandoned all right to contract with foreign states, and to have placed his terri- tory under British protection. The Court held that he was, nevertheless, a foreign sovereign in so far as immunity from British jurisdiction was concerned. The immunity of a foreign diplomatic agent, as the direct representative of a foreign sovereign (or state), is based on the same grounds as that of the sovereign authority itself. The international practice in the case of Great Britain was confirmed by an Act of Parliament of the reign of Queen Anne, which is still in force. The preamble to this Act states that " turbulent and disorderly persons in a most outrageous manner " had insulted the person of the then Ambassador of his Czarish Majesty, Emperor of Great Kussia, by ar- resting and detaining him in custody for several hours, " in contempt to the protection granted by Her Majesty, contrary to the law of nations, and in prejudice of the rights and privileges which Ambassadors and other public Ministers, authorized and received as such, have at all times been thereby possessed of, and ought to be kept sacred and inviolable." This preamble has been repeat- edly held by our Courts to be declaratory of the English common law. The Act provides that all suits, writs, processes, against any accredited Ambassador or public Minister or his domestic servant, and all proceedings and judgments had thereupon, are " utterly null and void," and that any person violating these provisions shall be punished for a breach of the public peace. Thus a for- eign diplomatic agent cannot, like the sovereign he repre- sents, waive his immunity by submitting to the British jurisdictioti. The diplomatic immunity necessarily covers the residence of the diplomatic agent, which some writers describe as assimilated to territory of the state repre- sented by the agent ; but there is no consideration which can justify any extension of the immunity beyond the needs^of the diplomatic mission resident within

it. It is different with public ships in foreign waters. In their case the exterritoriality attaches to the vessel. Beyond its bulwarks captain and crew are subject to the ordinary jurisdiction of the state upon whose territory they happen to be. By a foreign public ship is now understood any ship in the service of a foreign state. It was even held in the case of the Parlement Beige (1880), a packet be- longing to the Belgian Government, that the character of the vessel as a public ship was not affected by its carrying passengers and merchandise for hire.

Writers frequently describe the exterritoriality of both embassies and ships as absolute. There is, how- ever, this difference, that the exterritoriality of the latter not being, like that of embassies, a derived one, there seems to be no ground for limitation of it. It was, neverthe- less, laid down by the arbitrators in the Alabama case (Cockburn dissenting), that the privilege of exterritoriality accorded to vessels had not been admitted into the law of

nations as an absolute right, but solely as a proceeding founded on the principle of courtesy and mutual deference between different nations, and that it could therefore " never be appealed to for the protection of acts done in violation of neutrality."

The exterritorial settlements in the Far East, the privileges of Christians under the arrangements made with the Ottoman Porte, and other exceptions from local jurisdictions, are subject to the conditions laid down in the treaties by which they have been created. There are also cases in which British communities have grown up in barbarous countries without the consent of any local authority. All these are regulated by Orders in Council, issued now in virtue of the Foreign Jurisdiction Act, 1890, an Act enabling the Crown to exercise any juris- diction it may have " within a foreign country " in' as ample a manner as if it had been acquired "by cession or conquest of territory." A very exceptional case of exterritoriality is that granted to the Pope under a special Italian enactment. (t. ba.)

Extradition. ◆◆◆ (1) United Kingdom. The Extras dition Acts, 1870-73 (33 and 34 Vict. cc. 62 and 36, and 37 Vict. c. 60), and the Fugitive Offenders Act, 1881 (44 and 46 Vict. c. 69), deal with different branches of the f same subject, the recovery and surrender of fugitive criminals. The Extradition Acts apply in the case of countries with which Great Britain has extradition treaties. The Fugitive Offenders Act applies ◆◆◆ (1) as between the United Kingdom and any British possession, (2) as between any two British possessions, and (3) as between the United Kingdom or a British possession and certain foreign countries, such as Turkey and China, in which the Crown exercises foreign jurisdiction. Most of the extradition treaties and the Fugitive Offenders Act are of later date than the article on Exteadition in the ninth edition of this work ; and it appears desirable to present a general view of the law governijig the recovery and surrender of fugitive criminals, including, for the sake of completeness, the case of fugitives from one part of the United Kingdom to another.

Conditions of Surrender. ◆◆◆ In spite of some earlier authorities it has long been settled that in English law there is no power to surrender fugitive criminals to a foreign country without express statutory authority. Such authority is now given by the Extradition Acts, 1870-73, but only in the case of the offences therein specified, and with regard to countries with which an arrangement has been entered into, and to which the Acts have been applied by Order in Council. The Acts are further to be applied, subject to such "conditions, exceptions, and qualifications as may be deemed expe- dient " (s. 2) ; and these conditions, &c., are invariably to be found in the extradition treaty which is set out in the Order in Council applying the Extradition Acts to a particular country. To support a demand for extradition from Great Britain it is therefore necessary to show that the offence is one of those enumerated in the Extrsr dition Acts, and also in the particular treaty, and that the acts charged amount to the offence according to the laws both of Great Britain and of the state demanding the surrender.

Surrender of Subjects. ◆◆◆ A further question arises where a state is called on to surrender one of its own subjects. Some of the treaties, such as those with France and Germany, stipulate that neither contracting

party shall surrender its own subjects, and in such cases a British subject cannot be surrendered by his own country. The treaties with Spain, Switzerland, and Luxembourg provide for the surrender by Great Britain of her own subjects, but there is no reciprocity. Other treaties, such as those

with Austria, Belgium, Eussia, and the Netherlands, give each party the option of surrendering or refusing to sur- render its own subjects in each particular case. Under such treaties British subjects are surrendered unless the Secretary of State intervenes to forbid it. Lastly, some treaties, such as that with the United States, contain no restriction of this kind, and the subjects of each Power are freely surrendered to the other. Surrender by Great Britain is also subject to the following restrictions con- tained in s. 3 of the Extradition Act, 1870 : ??? (1) that the offence is not of a political character, and the requisi- tion has not been made with a view to try and punish for an offence of a political character ; (2) that the prisoner shall not be liable to be tried for any but the specified extradition offences ; (3) that he shall not be surrendered until he has been tried and served his sentence for offences committed in Great Britain; and (4) that he shall not be actually given up until fifteen days after his committal for extradition, so as .to aUow of an application to the courts.

The question as to what constitutes a political offence is one of some nicety. It was discussed In re Castioni (1890, 1 Q.B. 149), where it was held, following the opinion of Mr Justice Stephen in his His- ofjea^i tory of the Criminal Law, that to give an offence a political character it must be " incidental to and form part of political disturbances." Extradition was accord- ingly refused for homicide committed in the course of an armed rising against the constituted authorities. In the more recent case of In re Meunier (1894, 2 Q.B. 415), an Anarchist was charged with caiising two explosions in Paris ??? one at the Cafe Very resulting in the death of two persons, and the other at certain barracks. It was not contended that the outrage at the Cafe was a political crime, but it was argued that the explosion at the barracks came within the description. The Court, however, held that to constitute a political offence there must be two or more parties in the state, each seeking to impose a government

of its own choice on the other, which was not the case with regard to Anarchist crimes. The party of anarchy was the enemy of all governments, and its effects were directed primarily against the general body of citi- zens. The test applied in the earlier case is perhaps the more satisfactory of the two.

With regard to the provision that surrender shall not be granted if the requisition has in fact been made with a view to try and punish for an offence of a political character, it was decided in the recent case of Arton (1896, 1 Q.B. 108) that a mere suggestion, that after his sur- render for a non-political crime, the prisoner would be interrogated on political matters (his alleged complicity in the Panama scandal), and punished for his refusal to answer, was not enough to bring him within the provision. The Court also held that it had no jurisdiction to entertain a suggestion that the request of the French Government for his extradition was not made in good faith and in the interests of justice.

Extradition Offences. ??? The following is a list of crimes in respect of which extradition may be provided for under the Extradition Acts, 1870-73, and the Slave Trade Act, 1873. Extradition Act, 1870 : ??? (1) Murder ; (2) Attempt to murder ; (3) Conspiracy to murder ; (4) Manslaughter ; (5) Counterfeiting and altering money, uttering counterfeit or altered money ; (6) Forgery, counterfeiting, and altering and uttering what is forged or counterfeited or altered ; (7) Embezzlement and larceny; (8) Obtaining money or goods by false pretences ; (9) Crimes by bankrupts against bankruptcy law ; (10) Fraud by a bailee, banker, agent, factor, trustee, or director, or member or public officer of any company made criminal by any law for the time being in force; (11) Eape; (12) Abduction; (13) Child-

stealing ; (14) Burglary and housebreaking ; (15) Arson ; (16) Robbery with violence; (17) Threats by letter or otherwise with intent to extort ; (18) Crimes committed at sea, (a) Piracy by the law of nations, (6) Sinking or destroying a vessel at sea, or attempting or conspiring to do so, (c)

Assault on board a ship on the high seas, with intent to destroy life or to do grievous bodily harm, (d) Eevolt, or conspiring to revolt, by two or more persons on board a ship on the high seas against the authority of the master. Extradition Act, 1873: ??? (19) Kidnapping and false imprisonment ; (20) Perjury and subornation of perjury. This Act also extends to indictable offences under 24 and 25 Vict. cc. 96, 97, 98, 99, 100, and amending and substituted Acts. Among such offences in- cluded in various extradition treaties are the following : ??? (21) Obtaining valuable securities by false pretences ; (22) Eeceiving any money, valuable security, or other property, knowing the same to have been stolen or unlawfully obtained ; (23) Falsification of accounts (see In re Arton, 1896,1 Q.B. 509); (24) Malicious injury to property, if such offence be indictable ; (25) Knowingly making, with- out lawful authority, any instrument, tool, or engine adapted and intended for the counterfeiting of coin of the realm ; (26) Abandoning children ; exposing or unlaw- fully detaining them ; (27) Any malicious act done with intent to endanger the safety of any person in a railway train ; (28) Wounding or inflicting grievous bodily harm ; (29) Assault occasioning actual bodily harm ; (30) Assault- ing a magistrate or peace or public ofl&cer ; (31) Indecent assault ; (32) Unlawful carnal knowledge, or any attempt to have unlawful carnal knowledge, of a girl under age ; (33) Bigamy ; (34) Administering drugs or using instru- ments with intent to procure the miscarriage of women ; (35) Any indictable offence under the laws for the time being in force in relation to bankruptcy. Slave Trade Act, 1873 (36 and 37 Vict. c. 88, s. 27) : ??? (36) Dealing in slaves in such manner as to constitute a criminal offence against the laws of both states.

The Act of 1873 provides for the surrender of accessories before and after the fact to extradition crimes, and most of the treaties contain a clause by which extradition is to be granted for participation in any of the crimes speci- fied in the treaty, provided that such participation is punishable by the laws of both countries. Several of the treaties also contain clauses providing for optional surrender in respect of any crime not expressly mentioned for which extradition can be granted by the laws of both countries.

Extradition Treaties. ??? The extradition treaties now in force, with their dates, and the dates of the Orders in Council applying them, are shown in the table below. The Orders in Council setting out the treaties will be found in the London Gazette. Extradition between Cape Colony and the Orange Free State and South African Republic was till the outbreak of war in 1899 regulated by the Cape Act, No. 22, of 1882.

It is not practicable to state which of the statutory extradition crimes are included in each of the treaties. It appears, however, from an examination kindly per- mitted of tables prepared for official use that the later treaties include nearly all the crimes in the above list. Rumania, however, reserves the right to refuse surrender for a crime punishable with death, and Portugal will not surrender in such a case. Of the earlier treaties, that with the United States, even as amended by the Convention of 1889, is much the most restricted, omitting crimes 8, 9, 17, 21, 24, 29, 30, 31, 32, 33, 34, 36 in the above list. It may be said generally that crimes 1 to 17 inclusive are covered by all the other treaties.

It is further to be noted that the restrictions on

Dates.

Countries-

Treaties.

Orders in Council.

Argentine Republic .

22 May 1889

29 January 1894.

Austria .

3 December 1873

17 March 1874.

Belgium .

20 May 1876

21 July 1876.

Do. Declaration .

23 July 1877

13 August 1877.

Do. do.

21 April 1887

13 May 1887.

Bolivia

22 February 1892

20 October 1898.

Brazil

13 November 1872

20 November 1873.

Chile

26 January 1897 .

9 August 1898.

Colombia .

27 October 1888 .

28 November 1889.

Denmark .

31 March 1873 .

26 June 1873.

Ecuador .

20 September 1880

26 June 1886.

France

14 August 1876 .

16 May 1878.

Do. Declaration as

to Tunis

31 December 1889

Germany .

14 May 1872

25 June 1872.

Guatemala

4 July 1885

26 November 1886.

Hayti

7 December 1874

5 February 1876.

Italy ‘ . . .

5 February 1873

24 March 1873.

Do. Declaration .

7 May 1873

Liberia

16 December 1892

10 March 1894.

Luxembourg

24 November 1880

2 March 1881.

Mexico

7 September 1886

6 April 1889.

Monaco .

17 December 1891

9 May 1892.

Netherlands

26 September 1898

2 February 1899.

Orange Free State

20 & 25 June 1890

20 March 1891.

Portugal .

17 October 1892 .

3 March 1894.

Rumania .

21 March 1893 .

30 April 1894.

Russia

24 November 1886

7 March 1887.

Salvador .

23 June 1881

16 December 1882.

San Marino

16 October 1899 .

Spain

4 June 1878

27 November 1878.

Do. Declaration .

19 February 1889

28 May 1889.

Sweden and Norway

26 June 1873

.30 September 1873.

Switzerland

26 November 1880

18 May 1881.

9 August 1842 ,

No Order in Coun-

United States .

cil. See Extra- dition Act, 1870,

sec. 27.

Do. Convention

12 July 1889

21 March 1890.

Uruguay .

26 March 1884 .

5 March 1885.

surrender in the Extradition Acts apply only to surrenders by Great Britain. Foreign countries may surrender fugitives to Great Britain without any treaty, if they are willing to do so and their law allows of it, and such surrenders have not infrequently been made. But when surrendered for an extradition crime, the prisoner cannot be tried in England for any other crime committed before such surrender, until he has been restored, or has had an opportunity of returning, to the foreign state from which he was extradited.

To obtain from a foreign country the extradition of a fugitive from the United Kingd om , it is necessary to procure a warrant for his arrest, and to send it, or a certified copy, to the Home Secretary together with such further evidence as is required by the treaty with the country in question. In most cases an infor- mation or deposition containing evidence which would justify a committal for trial in Great Britain will be required. The Home Secretary will then communicate through the Foreign Secretary and the proper diplomatic channels with the foreign authorities, and in case of urgency will ask them by telegraph for a provisional arrest. For the arrest in the United Kingdom of fugitive criminals, whose extradition is requested by a foreign state, two procedures are provided in ss. 7 and 8 of the Act of 1870: ??? (1) On a diplomatic re- quisition supported by the warrant of arrest and docu- mentary evidence, the Home Secretary, if he thinks the crime is not of a political character, will order the chief magistrate at Bow Street to proceed ; and such magistrate will then issue a warrant of arrest on such evidence as

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would be required if the offence had been committed in the United Kingdom. (2) More summarily, any magistrate or justice of the peace may issue a provisional warrant of arrest on evidence which would support such a warrant if the crime had been committed within his jurisdiction. In

practice a sworn information is required, but this may be based on a telegram from the foreign authorities. The magistrate or justice must then report the issue of the warrant to the Home Secretary, who may cancel it and discharge the prisoner. When arrested on the pro- visional warrant, the prisoner will be brought up before a magistrate and remanded to Bow Street, and will then be further remanded until the magistrate at Bow Street is notified that a formal requisition for surrender has been made ; and unless such requisition is made in reason- able time the prisoner is entitled to be discharged. The examination of the prisoner prior to his committal for extradition ordinarily takes place at Bow Street. The magistrate is required to hear evidence that the alleged offence is of a political character, or is not an extradition crime. If satisfied in these respects, and if the foreign warrant of arrest is duly authenticated, and evidence is given which according to English law would justify a committal for trial, if the prisoner has not yet been tried, or would prove a conviction if he has already been convicted, the magistrate will commit him for extra- dition. Under the Extradition Act, 1895, the Home Secretary, if of opinion that removal to Bow Street would be dangerous to the prisoner's life, or prejudicial to his health, may order the case to be taken by a magistrate at the place where the prisoner was apprehended, or then is, and the. magistrate may order the prisoner to be detained in such place. After committal for extradition, every prisoner has fifteen days in which to apply for habeas corpus, and after such period, or at the close of the habeas corpus proceedings if they are unsuccessful, the Home Secretary issues his warrant for surrender, and the prisoner is handed over to the of&cers of the foreign government.

The Extradition Acts apply to the British colonies, the Governor being substituted for the Secretary of State. Their operation may, however, be suspended by Order in Council, as in the case of Canada, where the colony has passed an Extradition Act of its own (see Statutory Rules and Orders).

Fugitive Offenders Act. ??? There are no extradition treaties with certain countries in which the Crown exercises foreign jurisdiction, such as Cyprus, Turkey, Egypt, China, Japan, Corea, Zanzibar, Morocco, Siam, Persia, Somali, &c. In these countries the Fugitive Offenders Act,

1881 (44 and 45 Vict. c. 69), has been applied, pursuant to s. 36 of that statute, and the measures for obtaining surrender of a fugitive criminal are the same as in a British colony. The Act, however, only applies to persons over whom the Crown has jurisdiction in these territories, and generally is expressly restricted to British subjects.

Under this Act a fugitive from one part of the King's dominions to another, or to a country where the Crown exercises foreign jurisdiction, may be brought back by a procedure analogous to extradition, but applicable only to treason, piracy, and offences punishable with twelve months' imprisonment with hard labour, or more. The original warrant of arrest must be endorsed by one of several authorities where the offenders happen to be, ??? in practice by the Home Secretary in the United Kingdom, and by the Governor in a colony. Pending the arrival of the original warrant a provisional arrest may be made, as under the Extradition Acts. The fugitive must then be brought up for examination before a local magistrate, who, if the endorsed warrant is duly aiithenticated, and evidence is produced " which, according to the law

administered by the magistrate, raises a strong or probable presumption that the offender committed the offence, and that the Act applies to it," may commit him for return. An interval of fifteen days is allowed for habeas corpus proceedings, and (s. 10) the court has a large discretion to discharge the prisoner, or impose terms, if it thinks the case frivolous, or that the return would be unjust or oppressive, or too severe a punishment. The next step is for the Home Secretary in the United Kingdom, and the Governor in a colony, to issue a warrant for the return of the prisoner. He must be removed within a month, in the absence of reasonable cause to the contrary. If not prosecuted within six months after arrival, or if acquitted, he is entitled to be sent back free of cost.

In the case of fugitive offenders from one part of the United Kingdom to another, it is enough to get the warrant of arrest backed by a magistrate having juris- diction in that part of the United Kingdom where the offender happens to be. A warrant issued by a metro- politan police magistrate may be executed, without backing, by a metropolitan police officer anywhere, and there are certain other exceptions, but as a rule a

warrant cannot be executed without being backed by a local magistrate. (j. e. p. w.)

(2) United States. Foreign extradition is purely an affair of the United States, and not for the individual states themselves. Upon a demand upon the United States for extradition, there is a preliminary examination before a commissioner or judge before there can be a surrender to the foreign government (Revised Statutes, Title LXVI. ; 22 Statutes at Large, 215). It is enough to show probable guilt (Omelas v. Buiz, 161 United States Reports, 502). An extradition treaty covers crimes pre- viously committed. If a Power, with which the United States have such a treaty, surrenders a fugitive charged with a crime not included in the treaty, he may be tried in the United States for such crime. Inter-state extradition is regulated by Act of Congress under the Constitution of the United States (Article LV. s. , 2 ; United States Revised Statutes, s. 6278). A surrender may be demanded of one properly charged with an act which constitutes a crime under the laws of the demanding state, although it be no crime in the other state. A party improperly surrendered may be released by writ of habeas corpus, either from a state or United States court {Robb V. Conolly, 111 United States Reports, 624). On his return to the state from which he fled, he is subject to prosecution for any crime, though on a foreign ex- tradition the law is otherwise (Lascelles v. Georgia, 148 United States Reports, 537). (s. e. b.)

Eye. See Physiology (Special Senses), and Patho- logy (Eye).

Eyemouth, a police burgh and fishing town of Berwickshire, Scotland, situated at the mouth of the river Eye, 5| miles north-north-west of Berwick-on-Tweed by rail. The bay is easily accessible and affords good anchor- age. The harbour was increased in 1887. It is the centre of one of the Scottish fishery districts. The fish lauded in 1898 was valued at ►►24,366. (See Berwickshike for statistics of district.) There are a town hall and a library, and Established, two United Free, Congregational, and Primitive Methodist churches. The public school had an average attendance of 467 in 1898-99. The population in 1881 was 2825, and in 1901, 2377.

Eyre, Edward John (1815-1901), colonial gov- ernor, the son of a Yorkshire clergyman, was born on 6th August 1815. He was intended for the army, but delays having arisen in procuring a commission, went out

to New SoTitli Wales, where he engaged in the difficult but very necessary undertaking of transporting stock westward to the new colony of South Australia, then in great distress, and where he became magistrate and protector of the aborigines, whose interests he warmly advocated. Already experienced as an Australian travel- ler, he undertook the most extensive and difficult jour- neys in the desert country north and west of Adelaide, and after encountering the greatest hardships proved the possibility of land communication between South and West Australia. In 1845 he returned to England, and published the narrative of his travels. In 1846 he was appointed lieutenant-governor of New Zealand, where he served under Sir George Grey. After successively gov- erning St Vincent and Antigua he was in 1862 appointed acting-governor of Jamaica, and in 1864 governor. In October 1865 a negro insurrection broke out, and was

*repressed with laudable vigour, but the unquestionable severity and alleged illegality of Eyre's subsequent pro- ceedings raised a storm at home which induced the Gov- ernment to suspend him and to despatch a special commis- sion of investigation, the effect of whose inquiries, declared by his successor, Sir John Peter Grant, to have been "admi- rably conducted," was that he should not be reinstated in his office. The Government, nevertheless, saw nothing in Eyre's conduct to justify legal proceedings; indict- ments preferred by amateur prosecutors at home against him, and military officers who had acted under his direc- tion, resulted in failure, and he retired upon the pension of a colonial governor. As an explorer Eyre must be classed in the highest rank, but opinions are always likely to differ as to his action in the Jamaica rebellion. He died 30th November 1901. *

Fabre, Ferdinand (1830-1898), French novelist, was born at Bedarieux, in Herault, a very picturesque division of the south of France, which he made completely his own in literature. He was the son of a local archi- tect, who failed in business, and Ferdinand was brought up by his uncle, the Abb6 Fulcran Fabre, at Camplong among the mulberry woods. Of his childhood and early youth he has given a charming account in Ma Vocation. He was destined to the priesthood, and was sent for that purpose to the seminary of St Pons de Thomiferes, where, in 1848, he had, as he believed, an ecstatic vision of Christ, who warned him " It is not the will of God that thou shouldst be a priest." He had now to look about for a profession, and, after attempting medicine at Montpellier, was articled as a lawyer's clerk in Paris. In 1863 he published a volume of verses, broke down in health, and crept back, humble and apparently without ambition, to his old home at Bedarieux. After some eight or nine years of country life he reappeared in Paris, with the MS. of his earliest novel, Les Oourbezon (1862), in which he treated the subject which was to recur in almost all his books, the daily business of country priests in the Ge- vennes. This story enjoyed an immediate success with the literary class of readers ; George Sand praised it, Sainte- Beuve hailed in its author " the strongest of the disciples of Balzac," and it was crowned by the French Academy. From this time forth Fabre settled down to the produc- tion of novels, of which at the time of his death he had published about twenty. Among these the most import ant were Le Glievrier (1867), unique among his works as written in an experimental mixture of Cevenol patois and French of the 16th century ; L'Abbd Tigrane (1873), by common consent the best of all Fabre's novels, a very powerful picture of unscrupulous priestly ambition ; Mon Oncle G&estin (1881), a study of the entirely single and tender-hearted country abbd; and Lucifer (1884), a mar- vellous gallery of serious clerical portraits. In 1883 Fabre was appointed curator of the Mazarine Library, with rooms in the Institute, where, on 11th February 1898, he died after a brief attack of pneumonia. Ferdi- nand Fabre occupies in French literature a position somewhat analogous to that of Mr Thomas Hardy amongst English writers of fiction. He deals almost exclusively with the population of the mountain villages of Herault, and particularly with its priests. He loved most of all to treat of the celibate virtues, the strictly ecclesiastical pas- sions, the enduring tension of the young soul drawn be- tween the spiritual vocation

and the physical demands of nature. Although never a priest, he preserved a compre- hension of and a sympathy with the clerical character, and he always indignantly denied that he was hostile to

the Church, although he stood just outside her borders. Fabre possessed a limited and a monotonous talent, but within his own field he was as original as he was whole- some and charming. (e. g.)

Fabrizi, Nicola (1804-1885), Italian patriot, was born at Modena, 4th AprU 1804. He took part in the Modena insurrection of 1831, and attempted to succour Ancona, but was arrested at sea and taken to Toulon, whence he proceeded to Marseilles. Afterwards he or- ganized with Mazzini the ill-fated Savoy expedition. Tak- ing refuge in Spain, he fought against the Carlists, and was decorated for valour on the battlefield (18th July 1837). At the end of the Carlist war he established a centre of conspiracy at Malta, endeavoured to dissuade Mazzini from the Bandiera enterprise, but aided Crispi in organizing the Sicilian revolution of 1848. With a company of volunteers he" distinguished himself in the defence of Venice, afterwards proceeding to Eome, where he took part in the defence of San Pancrazio. Upon the fall of Rome he returned to Malta, accumulating arms and stores, which he conveyed to Sicily, after having, in 1859, worked with Crispi to prepare the Sicilian revolution of 1860. While Garibaldi was sailing from Genoa towards Marsala Fabrizi landed at Pizzolo, and, after severe fighting, joined Garibaldi at Palermo. Under the Garibaldian Dictator- ship he was appointed Governor of Messina and Minister of War. Eeturningto Malta after the Neapolitan plebiscite, which he had vainly endeavoured to postpone, he was re- called to aid Cialdini in suppressing brigandage. While on his way to Sicily in 1862, to induce Garibaldi to give up the Aspromonte enterprise, he was arrested at Naples by Lamarmora. During the war of 1866 he be- came Garibaldi's chief of staff, and in 1867 fought at Mentana. In parliament he endeavoured to promote agreement between the chiefs of the Left, and from 1878 onwards worked to secure the return of Crispi to power, but died on 31st March 1885, two years before the real- ization of his object. His whole life was characterized by ardent patriotism and unimpeachable integrity.

(h. w. s.)

Factors. ??? A. factor is a mercantile agent (of the class known as " general " agents) employed to sell for a com- pensation, commonly called factorage or commission ; but he differs from a broker {q.v.) in two respects ??? firstly, he has possession of the goods or the documents of title to them, and secondly, he may sell in his own name. A factor may also be employed to buy goods.

The main source of the law on the subject is now to be found in the Factors Act, 1889, where all previous enact-

ments were repealed and their provisions consolidated and amended. But before discussing the Act it will be necessary to describe briefly what a factor is, and what are his duties and his authority.

I. Factor and Principal.

A factor is appointed or dismissed in the same way as any other agent. He may be employed for a single transaction or to transact all his principal's business of a certain class during a limited period or till such time as his authority may be determined. A factor's duty is to sell or buy as directed; to carry out any instructions he may receive with care, skill, and good faith ; to re- ceive or make payment; to keep accounts, and to hand over to his principal the balance standing to his principal's credit, without any deduction save for commission and expenses. All express instructions he must carry out to the full; and on any point not covered by his express instructions he must follow the usual practice of his particular business if not inconsistent with his instructions or his position as factor. Many usages of businesses in which factors are employed have been proved in court, and may now be regarded as legally established. For instance, he may, unless otherwise directed, sell in his own name, give warranties as to goods sold by him, sell by sample (in most businesses), give such credit as is usual in his busi- ness, receive payment in cash or as customary, and

give receipts in full discharge, sell by indorsement of bills of lading, and insure the goods. It is his duty to clear the goods at the customs, take charge of them and keep them safely, give such notices to his principal and others as may be required, and if necessary take legal proceedings for the protection of the goods. On the other hand, he has not authority to delegate his employment, or to barter ; and it was decided long ago that to pledge the goods is not within his authority. It is, moreover, inconsistent with his employment as agent that he should buy or sell on his own account from or to his principal. A factor has no right to follow any usage which is incon- sistent with the ordinary duties and authority of a factor unless his principal has expressly or impliedly given his consent.

On the due performance of his duties the factor is entitled to his commission, which is usually a percentage on the value of the goods sold or bought by him on account of his principal, regulated in amount by the usages of each business. Sometimes the factor makes himself personally responsible for the solvency of the persons with whom he deals, in order that his principal may avoid the risk entailed by the usual trade credit. In such a case the factor is said to be employed on del credere terms, and is entitled to a higher rate of commission, usually 2\ per cent, extra. Such an arrangement is not a contract of guarantee within the Statute of Frauds, and therefore need not be in writing. Besides his remuneration, the factor is entitled to be re- imbursed by his principal for any expenses, and to be indemnifiied against any liabilities which he may have properly incurred in the execution of his principal's in- structions. For the purpose of enforcing his rights a factor has, without legal proceedings, two remedies. Firstly, by virtue of his general lien (q.v.) he may hold any of his principal's goods which come to his hands as security for the payment to him of any commission, out of pocket expenses, or even general balance of account in his favour. Although he cannot sell the goods, he may refuse to give them up until he is paid. Secondly, where he has consigned goods to his principal but not been paid, he may "stop in transit" subject to the same rules of law as an ordinary vendor ; that is to say, he must exercise

his right before the transit ends ; and his right may be defeated by his principal transferring the document of title to the goods to some third

person, who takes it in good faith and for valuable consideration (Factors Act 1889, section 10). If the factor does not carry out his principal's instructions, or carries them out so negligently or unskU- f ully that his principal gets no benefit thereby, the factor loses his commission and his right to reimbursement and indemnity. If by such failure or negligence the principal suffers any loss, the latter may recover it as damages. So too if the factor faUs to render proper accounts his prin- cipal may by proper legal proceedings obtain an account and payment of what is found due; and threatened breaches of duty may be summarily stopped by an in- junction. Criminal acts by the factor in relation to his principal's goods are dealt with by section 78 of the Larceny Act 1860.

II. Principal and Third Party.

(a) At Common Law. ??? The actual authority of a factor is defined by the same limits as his duty, the nature of which has been just described; i.e., firstly, by his principal's express instructions ; secondly, by the rules of law and usages of trade, in view of which those instructions were expressed. But his power to bind his principal as regards third parties is often wider than his actual authority; for it would not be reasonable that third parties should be prejudiced by secret instructions, given in derogation of the authority ordinarily conferred by the custom of trade ; and, as regards them, the factor is said to have " apparent " or "ostensible" authority, or to be held out as having authority to do what is customary, even though he may in fact have been expressly forbidden so to do by his principal. But this rule is subject to the proviso that if the third party have actual notice of the factor's instruc- tions, the " apparent " authority will not be greater than the actual. " The general principle of law," said Lord Black- burn in the case of Cole v. North-Western Bank (L. E. 10 C. P. at p. 363), " is that when the true owner has clothed any one with apparent authority to act as his agent, he is bound to those who deal with the agent on the assumption that he really is an agent with that authority, to the same extent as if the apparent authority were real." Under such circumstances the principal is for reasons of common fairness precluded, or, in legal phraseology, estopped, from denying his agent's authority. On the same principle of estoppel, but not by reason of any trade usages, a course of dealing which has been followed between a

factor and a third party with the assent of the principal will give the factor apparent authority to con- tinue dealing on the same terms even after the principal's assent has been withdrawn ; provided that the third party has no notice of the withdrawal.

Such apparent authority binds the principal both as to acts done in excess of the actual authority and also when the actual authority has entirely ceased. For instance, A. B. receives goods from C. D. with instructions not to sell below Is. per lb ; A. B. sells at lO^d., the market price ; the buyer is entitled to the goods at lO^d., because A. B. had apparent authority, although he exceeded his actual authority. On the same principle the buyer would get a good title by buying from A. B. goods entrusted to him by C. D., even though at the time of the sale C. D. had revoked A. B.'s authority and instructed him not to sell at all. In either case the factor is held out as having authority to sell, and the principal cannot afterwards turn round and say that his factor had no such authority. As in the course of his business the factor must necessarily make representations preliminary to the contracts into which he enters, so the principal will be bound by any such representations as may be within the factor's actual

or apparent authority to the same degree as by the factor's contracts.

(&) Under the Factors Act 1889. ⁇ ⁇ ⁇ The object of the Factors Acts (which deal with other persons as well as factors) has been to add to the number of cases in which third parties honestly buying or lending money on the security of goods may get a good title from persons in whose possession the goods are with the consent, actual or apparent, of the real owners, thus calling in aid the principle of French law that "possession vaut titre" as against the doctrine of the English common law that " nemo dat quod non habet." The chief change in the law relating specially to factors has been to put pledges by factors on the same footing as sales, so as to bind a principal to third parties by his factor's pledge as by his factor's sale. The Factors Act 1889 in part re-enacts and in part extends

the provisions of the earlier Acts of 1823, 1825, 1842, and 1877; and is, so far as it relates to sales by factors, in large measure merely declaratory of the law as it previously existed. Its most important pro- visions concerning factors are as follows : ???

Section I., s.s. 1. The expression mercantile agent .sliall mean a mercantile agent having in the customary course of his business as such agent authority either to sell goods, or to consign goods for the purpose of sale, or to huy goods, or to raise money on the security of goods ;

(2) A person shall be deemed to be in possession of goods or of the documents or title to goods when the goods or documents are in his actual custody or are held by any other person subject to his control or for him or on his behalf.

(4) The expression "document of title" shall include any bill of lading, dock warrant, warehouse-keeper's certificate, and warrant or order for the delivery of goods, and any other document used in the ordinary course of business as proof of the possession or control of goods, or authorizing or purporting to authorize, either by endorsement or by delivery, the possessor of the document to transfer or receive goods thereby represented.

Section II., s.s. 1. Where a mercantile agent is, with the consent of the owner, in possession of goods or of the documents or title to goods, any sale, pledge, or other disposition of the goods made by him when acting in the ordinary course of business of a mercantile agent, shall, subject to the provisions of this Act, be as valid as if he were expressly authorized by the owner of the goods to make the same : provided that the person taking under the disposition acts in good faith, and has not at the time of the disposition notice that the person making the disposition has not authority to make the same.

(2) "Where a mercantile agent has, with the consent of the owner, been in possession of goods or of the documents of title to goods, any sale, pledge, or other disposition, which would have been valid if the consent had continued, shall be valid notv?ith- standing the determination of the

consent : provided that the per- son taking under the disposition has not at the time thereof notice that the consent has been determined. /

(3) Where a mercantile agent has obtained possession of any documents of title to goods by reason of his being or having been, with the consent of the owner, in possession of the goods repre- sented thereby, or of any other documents of title to the goods, his possession of the first-mentioned documents shall, for the purposes of the Act, be deemed to be with the consent of the owner.

III. Enforcement of Contracts.

(1) Where a factor makes a contract in the name of his principal and himself signs as agent only he drops out as soon as the contract is made, and the principal and third party alone can sue or be sued upon it. As factors usually contract in their own name this is not a common case.

(2) Where a factor makes a contract for the principal without disclosing his principal's name, the third party may, on discovering the principal, elect whether he will sue the factor or his principal; provided that if the factor contract expressly as factor, so as to exclude the idea that he is personally responsible, he will not be liable. The principal may sue upon the contract, so also may the factor, unless the principal first intervene.

(3) Where a factor makes a contract in his own name

without disclosing the existence of his principal the third party may, on discovering the existence of the principal, elect whether he will sue the factor or the principal. Either principal or factor may sue the third party upon the contract. But if the factor has been permitted by the principal to hold himself out as the principal, and the person dealing with the factor has believed that the factor was the principal and has acted on that belief before ascertaining his mistake, then in an action by the principal the third party may set up any defences he would have had against the factor if the factor had brought the action on his own account as principal.

(4) Where a factor has a lien upon the goods and their proceeds for advances made to the principal it will be no defence to an action by him

for the third party to plead that he has paid the principal, unless the factor by his conduct led the third party to believe that he agreed to a settlement being made with his principal.

(5) The factor who acts for a foreign principal will always be personally liable unless it is clear that the third party has agreed to look only to the principal.

(6) If a factor contract by deed under seal he alone can sue or be sued upon the contract ; but mercantile practice makes contracts by deed uncommon.

Stoet. Commentaries on the Law of Agency. Boston, 1882. ??? BoTD AND Pearson. ITie Factors Acts (1SS3 to 1877). Lon- don, 1884. ??? Blackwell. The Law relating to Factors. Lon- don, 1897. (l. f. S.)

Factory Acts. See Labour Legislation.

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Faenia, a town and episcopal see of Italy (Emilia, prov. Eavenna), 31 miles S.E. from Bologna by rail. The picture gallery, the technical school, the school of design (1879), and the fountain (1621) deserve mention. The fayence industry is still carried on. Population about

18,600.

Faidherbe, Louis Leon Cesar (1818-1889), French general, born on 3rd June 1818 at Lille, was educated at the Polytechnic schools at Paris and Metz, and entered the Engineer Corps in 1840. From 1844 to 1847 he served in Algeria, then two years in the West Indies, and again in Algeria, taking part in many expeditions against the Arabs. In 1852 he was trans- ferred to Senegambia as sub-director of engineers, and in 1854 was promoted major and appointed governor of the colony. His eleven years' administration was notable for a number of successful expeditions and several large annexations (major-general, commander Legion of Honour). From 1867 to the early part of 1870 he com- manded the subdivision of Bona in Algeria, when he became general of division, and

was commanding the Constantine division at the commencement of the Franco- German war. Appointed by the Government of National Defence on 23rd November 1870 to be commander-in- chief of the Army of the North, he succeeded Bourbaki early in December, and proved himself an able general, although unable to relieve Paris. He fought several hotly contested but indecisive battles, such as Pont Noyelles and Bapaume against Manteuffel, but having been seriously defeated by Goben on the 19th January 1871 at St Quentiu, he retired on Cambrai and Lille, where he remained until the armistice stopped opera- tions. Elected to the National Assembly for the depart- ment of the North, he resigned his seat in consequence of its reactionary proceedings. For his services he was decorated with the Grand ("ross, and made chancellor of the order of the Legion of Honour. In 1872 he was sent on a seientiiic mission to Upper Egypt, where he studied the monuments and inscriptions. An enthusiastic geographer and archajologist, he wrote numerous works on

his favourite subject, among which may be mentioned Collection des Inscriptions Numidiques (1870) and Epi- graphie PMnicienne (1873). He also wrote on the Senegal and the Sahara, and La Campagne de I'Armie du Nord (1871). He was elected a senator in 1879. He died on 29th September 1889, and his remains received a public funeral. (k. h. v.)

Failsworth, a suburban township of Manchester, 4 miles to the N.E. by rail, in the Prestwich parliamentary division of Lancashire, England, on the Manchester and Leeds canal. The industries are mainly cotton-spinning, silk-weaving, and the manufacture of hats. Area of town- ship (an urban district), 1073 acres. Population (1881),

7912; (1891), 10,425; (1901), 14,152.

Fairhaven, a city of Whatcom county, Washing- ton, U.S.A., on Bellingham Bay, on the east coast of Puget Sound, 3 miles south of New Whatcom, and on a line of the Great Northern railroad. Like most of the smaller places on Puget Sound, it^s chief industry is the manufacture of

lumber, and it contains several saw and shingle mOls. Population (1890), 4076; (1900),

4228.

Fairmont, capital of Marion county. West Virginia, U.S.A., on the Monongahela river, at the intersection of two railways. Population (1890), 1023 ; (1900), 6656.

Fair Oaks, a station on a branch of the Southern railroad, 6 miles east of Richmond, Virginia, U.S.A. It is noted as the site of one of the great battles of the Civil War, fought 31st May and 1st June 1862, between McClellan and Johnston, in command of the Union and Confederate forces respectively. The result was indeci- sive, the Union troops having, however, rather the best of it. The Union losses were 5031 in killed, wounded, and missing; those of the Confederates were 6134. The battle is sometimes known as the Battle of Seven Pines.

Fajardo, a small city and port of entry at the north-east end of Porto Rico, in the province of Humacao. Population (1899), 3414.

Falk, Paul Ludwig Adalbert (1827-1900), German politician, was born at Matschkau, Silesia, 10th /August 1827. In 1847 he entered the Prussian State service, and in 1863 became public prosecutor at Lyck. In 1858 he was elected a deputy, joining the Old Liberal party. In 1868 he became a privy-councillor in the ministry of justice. In 1872 he was made minister of education, and in connexion with Bismarck's policy of the Kultur-kampf he was responsible for the famous May Laws against the Catholics (see Germany, May Laws, and Vaticanism). In 1879 his position became un- tenable, owing to the death of Pius IX. and the change of German policy with regard to the Vatican, and he re- signed his office, but retained his seat in the Reichstag till 1882. He was then made president of the supreme court of justice at Hamm, where he died in 1900.

Falkirk, a parliamentary burgh (Falkirk group) of Stirlingshire, Scotland, is 25^ miles W. by N. of Edin- burgh by rail. In recent years the iron trade has greatly increased, and the town is the chief seat of the light-cast- ing trade in Scotland. There now are in the burgh and immediate

neighbourhood 23 foundries ; and brewing, dis- tilling, and the manufacture of dynamite and chemicals are all carried on. The cattle " trysts," or open markets, though still among the largest in the kingdom, have greatly diminished in importance, owing to the common preference for auction marts. There are county buildings, burgh buildings, a town hall, a free library and institute, parish council chambers, and a new post office. Water- works have been opened, and the parish church has been

renovated and a hall added to it. There are two United Free churches. A high school and a science and art school are under the School Board. Population of parliamentary burgh (1881), 13,170; (1901), 20,503; of burgh and suburbs (1881), 15,599; (1891), 19,769; (1901),

29,271.

Falkland Islands, a group of islands in the South Atlantic, belonging to Great Britain, lie about 250 miles east of the nearest point in the mainland of South America. The area of the islands is about 6600 square miles, of which the two main islands. East and West Falkland, take up 5300. The soil is well adapted for sheep-farming, which is the main industry. "Practically the entire acreage of the colony is sold or leased to some thirty-six farmers for pastoral purposes, the leased lands giving a total rental to the crown of aoout ££5000." The revenue and expenditure were (1880), ££5519 and ££5607; (1890), ££9492 and ££9456; (1899), ££13,219 and ££13,314. There is no public debt. The imports and exports were (1880), ££33,503 and ££88,564; (1890), ££67,182 and ££115,846; (1899), ££73,978 and ££139,203. The main export-is naturally wool. The population was (1881), 1414; (1897), 2060. The large majority are found in the East island, and the predominating element is Scotch £££ Scotch shepherds having superseded the South American Guachos. Edu- cation has been made compulsory, "with the best results." The climate is healthy. The temperature is normally low, always cold, without either the extreme frosts or summer heats of England. The prevailing winds, from west, south-west, and south, which blow continuously, make the cold more penetrating. "At the same time they contribute largely to the healthy condition which prevails in the absence of organized sanitation." The

rainfall is not great, about 20 inches in the year, but slight rain is very frequent, and November is the only dry month. The mails are de- livered by a German line of steamers once in every three weeks. The average length of the journey to England is about five weeks.

The Falkland Islands are a crown colony, with a governor and executive and legislative councils. The legislative council consists of the governor and two official and two unofficial nominated members.

Sistorical Geography of the British Colonies, vol.ii., "The West Indies," Lucas, 1890, and Colonial Beports Annual, (s. e. eg.)

Fall River, a city of Bristol county, Massar chusetts, U.S.A., situated in 41 ́ 30′ N. and 71 ́ 09′ W. on Hope Bay, at the mouth of the Taunton river, and at the terminus of a branch of the New York, New Haven, and Hartford railway. Its plan is irregular ; it has an excellent water supply, pumped fromWatuppa Lake, east of the city; it is well sewered; the streets are macada- mized or gravelled, and there are nine wards. Its public library contains 55,000 volumes. Fall River is a port of entry, with a good harbour and considerable commerce, and is the eastern terminus of the Fall River Line of Sound steamers to New York. But it is as a manufactur- ing city that Fall River is pre-eminent. In 1895 there were 571 establishments, with an aggregate capital of $43,850,962, employing 28,703 hands. The value of the product was $38,934,678. Of this, $26,403,043, or more than two-thirds, consisted of cotton goods; several of the other industries, such as dyeing and finishing establish- ments, are accessory to this. Formerly the water power of Taunton river was largely used, but at present steam power is in general use. The assessed valuation of pro- perty, real and personal, was, in 1899, $71,601,670, the net debt of the city was $3,688,434, and the rate of taxar tion was $17.80 per $1000. Population (1880), 48,961;

(1890), 74,398 ; (1900), 104,863. Of the total population in 1890, 60,042 were foreign-born, and 324 negroes. There were 35,632 persons of school

age (6 to 20 years inclusive). Of 26,842 males of voting age, 4168 were illiterate (unable to write). The death-rate was 22-4.

Falmouth, a municipal and contributory parlia- mentary borough (returning with Penryn one member), seaport, and market-town of Cornwall, England, on Fal- mouth Bay, 306 miles S.W. of London by raU. Eecent erections are an Established church, new buildings of the Meteorological and Magnetic Observatory, a submarine mining establishment, a Seamen's 'Bethel and Institute, a hospital, a cottage hospital, and a free library. The defences of Pendennis and St Mawes Castle have been reconstructed. Engineering and shipbuilding are carried on. There are also oyster and trawl fisheries. The registered shipping at the end of 1898 consisted of 134 vessels of 18,531 tons. In 1888, 1707 vessels of 209,938 tons entered, and 1760 of 212,468 tons cleared. In 1898, 1825 vessels of 347,434 tons entered, and 1749 of 353,750 tons cleared. Population (on the unextended area of 617 acres), (1881), 5973 ; (1891), 4737 ; (on the area extended in 1892 to include the whole of Ealmouth parish, 643 acres, and part of an adjoining parish),

(1891), 12,791 ; (1901), 11,773.

False Bay. See Simons Town.

Falticeni, chief town of the district of Suceava, Eumania, 266 miles from Bucarest. It is a place of some commercial standing. An important fair is annu-' ally held there, commencing on the 20th of July and lasting for five weeks, the chief trade being in cattle, horses, and carriages. The population, about one-half Jews, is 9643.

Falun, a town of Sweden, capital of the province of Kopparberg (or Dalecarlia), 57 miles by rail W. from Gefle, famous for its copper mines. In 1896 the yield was 15,985 tons of ore, from which were extracted 1506 tons of sulphate of copper and 112 tons of iron pyrites ; other products, 2400 oz. gold, 9684 oz. silver, 66 tons of sulphur, 2267 tons of sulphuric acid, and 706 tons of red ochre. The mines belong to the Kopparberg Mining Company, the largest joint stock concern in Sweden, many of the shares, since the reorganization of the company in 1888, being held by the crown, by philanthropic institutions, and by other public bodies. The

company also owns iron mines, limestone quarries, and quartz quarries, some 36 hundred acres of forests, two large ironworks, steam and water-driven sawmills ; and, besides the output of the copper mine, they produce manufactured iron and steel, bricks, timber, wood-pulp, and charcoal. Besides the mining establishments there are railway engine and waggon works. Population (1880),

7305 ;<1898), 9115.

Famagusta (Greek, Ammochostos), a town and harbour on the east coast of Cyprus, about 2|- miles south of the ruins of Salamis. About 800 Moslems live within the walls of the fortress ; the Christian population has migrated to a suburb called Varosia. The foundation of Salamis was ascribed to Teuoer : it was probably the most important town in early Cyprus. St Barnabas, it is said, was born and buried there. The revolt of the Jews under Trajan, and earthquakes under Constantius and Con- stantine the Great, helped in turn to destroy it. It was restored by El. Constantius II. (a.d. 337-361) as Con- stantia. The ruins were partially explored in 1890. The sites of two temples, the agora, and a remarkable reser- voir (loutron, castellum, or piscina) were disclosed, and a fine bull's head capital of Ptolemaic date secured for the British Museum (Journal of Hell. Studies, vol. xii., 1891).

More valuable antiquities were unearthed by Dr A. S. Murray in 1896 from a Mycenean necropolis at Encomi. Another town a little to the south, built by Ptolemy Philadelphus in 274 B.C., and called Arsinoe in honour of his sister, received the refugees driven from Constantia by the Arabs under Mu'awiyah, became the seat of the orthodox archbishopric, and was eventually known as Eamagusta. This received a large accession of popula- tion at the fall of Acre in 1291 ; was coveted and annexed by the Genoese in 1373 ; reunited to the throne of Cyprus in 1464; and surrendered, after an investment of more than a year, to the Turks in 1671. The fortifications, remodelled by the Venetians after 1489, the castle, the grand cathedral church of St Nicolas, and the remains of the palace and many other churches make Eamagusta a place of unique interest. Acts ii. and v. of Othello pass there. It is melancholy to add that its charm is threatened under a scheme to spend part of a sum of

<u>314,000, ad- vanced by the Colonial Loans Act 1899, on railway and harbour works, which would destroy a great part of the sea front.</u>

<u>Fano, a town and episcopal see of Italy (the Marches, prov. Pesaro and Urbino), on the Adriatic coast, 8 miles S.E. from Pesaro by rail. It has important silk industries, and makes bricks. There is also a technical school. In 1899 several Roman statues and other remains of a large building were discovered in the former convent of St Philip. Population about 11,260.</u>

<u>Fano, an island of Denmark, off the west coast of Jutland, 2 miles south from Esbjerg, the northernmost of the ISTorth Frisian Islands, is in great part (75 per cent.) covered with drift-sand, dunes, and barren heath. Area, 20 square miles. Population, 3202. Chief town, ISTordby (population 2600), on the east coast, which has recently acquired repute as a summer seaside resort, and possesses a school of navigation. There is another village, Sonderho, near the south extremity, which also attracts visitors for the sea-bathing. The inhabitants, who are Frisians, support themselves by seafaring and fishing. In 1897 they owned a fleet of 109 vessels of 40,450 tons.</u>

<u>Fargo, capital of Cass county, North Dakota, XJ.S.A., on the west bank of the Bed river, which is here not navigable, at an altitude of 902 feet. It lies in the rich wheat region of the Red river valley, and is a very important market for wheat, farm implements, and machinery. It is entered by the Northern Pacific, the Great Northern, and the Chicago, Milwaukee, and St Paul railways. Fargo College is a Congregational in- stitution, founded in 1887. In 1893 a large part of the town was destroyed by fire, at an estimated loss of $3,000,000. Population (1880), 2693; (1890), 6664; (1900), 9589, of whom 2564 were foreign-born.</u>

<u>Faribault, capital of Rice county, Minnesota, U.S.A., on the Cannon river, and the Chicago, Milwaukee, and St Paul, and the Chicago Great Western railways, at an altitude of 1000 feet. It contains the State schools for the blind, deaf, and feeble-minded. Its manufactures consist largely of flour and furniture. Population (1880), 5415; (1890), 6620; (1900), 7868, of whom 1586 were foreign-born.</u>

Faridkot, a native state of India within the Pun- jab. It ranks as one of the Cis-Sutlej states which came under British influence in 1809. Its area is 643 square miles. In 1881 the population was 97,034, and in 1891 it was 116,040, giving an average density of 178 persons per square mile. In 1901 the population was 124,912, showing an increase of 9 per cent. The esti- mated gross revenue is Rs.3,66,000; the military force

numbers 571 men; there is no tribute. The territory is traversed by the Rewari-Ferozepore railway, and also crossed by the Fazilka line, which starts from Kotkar pura, the old capital. It is irrigated by a branch of the Sirhind canal. In 1896-97 there were seven schools at- tended by 262 pupils ; the proportion of boys at school was as low as one in 243 of the total male population. The town of Faeidkot has a railway station, 84 miles from Lahore.

Faridpur, or Furreedpore, a town and district of British India, in the Dacca division of Bengal. The town, which has a railway station, stands on an old channel of the Ganges. Population about 10,500. There are a Baptist mission, a Government high school, attended in 1896-97 by 277 pupils, and three printing presses, with two vernacular newspapers. The Distbict comprises an area of 3267 square miles. Population (1881), 1,636,785 ; (1891), 1,797,320, showing an average density of 792 persons per square mile. Classified according to religion, Hindus numbered 699,307; Mahommedans, 1,120,612; Christians, 3539, of whom 99 were Europeans ; "others," 85. In 1901 the population was 1,937,922, showing an increase of 6 per cent. The land revenue and rates were Ks. 6,47,392 ; the number of police was 433 ; there were 37,980 boys at school in 1896-97, being 27-9 per cent, of the male population of school-going age ; the registered death-rate in 1897 was 39-45 per thousand, a high mor- tality attributed to the contamination of drinking-water by the steeping of jute. The north of the district is crossed by the line of the Eastern Bengal railway to Goalundo, the port of the Brahmaputra steamers, and a branch runs to Faridpur town. But most of the trade is conducted by river.

Faringdon, Great, a market-town and railway station in the Abingdon parliamentary division of Berk- shire, England, 17 miles S.W. by W. of Oxford. Edward the Elder died in a royal palace there in 925. All Saints' church has an Early English tower, and contains memo- rials ; there are an ancient town-hall, a corn exchange, with a library and reading-room, a cottage hospital, and Faringdon House, built by Henry James Pye, poet lau- reate from 1790 to 1813. About 6|- miles to the S.E. is the White Horse, a figure dug in the slope of a chalk hill. Area of civil parish, 5897 acres ; population (1881),

3141; (1901), 2900.

Farnborough, a parish in the Basingstoke parlia- mentary division of Hampshire, England, 2^ miles N. of Aldershot by rail. The parish church is ancient ; St Michael's Catholic memorial church, erected in 1887 by the ex-Empress Eugenie, contains the remains of Napoleon III. and the Prince Imperial. An adjoining priory is occupied by Benedictine fathers ; the convent is a ladies' boarding school. Aldershot north camp is within the parish. Area of civil parish (an urban district), 2331 acres ; population (1881), 6266 (including 2840 military) ; (1901), 11,499 (including 5070 military).

Farnborough, Thomas Erskine May, 1st

Baeon (1815-1886), was born in 1815, and educated at Bedford Grammar School under Dr Brereton. In 1831 he was nominated by Mr Manners Sutton, speaker of the House of Commons, to the post of assistant librarian, so that his long connexion with parliament began in his youth. He studied for the bar, and was called at the Middle Temple in 1838. In 1844- he published the first edition of his Treatise on the Law, Privilege, Proceedings, and Usage of Parliament. This work, which has passed through "many editions, is not only an invaluable mine of information for the historical student, but it is known as the text-book of the law by which parliament governs its

proceedings. It has been observed that " since its first publication the f ramers of constitutions have found in it the groundwork of their various systems ; and while colonial legislatures have been modelled on the lines

laid down in it, its translation into more than one foreign language has extended its influence beyond the English-speaking race." In 1846 Mr Erksine May was appointed examiner of petitions for private bills, and the following year taxing- master of the House of Commons. He published his Remarks to Facilitate Public Business in Parliament in 1849 ; a work On the Consolidation of Election Laws in 1850; and his Pules, Orders, and Forms of the House of Commons was printed by command of the House in 1854. In 1866 he was appointed clerk assistant at the table of the House of Commons. He received the Companionship of the Bath in 1860 for his parliamentary services, and became a Knight Commander in 1866. His important work, Tlie Constitutional History of England since the Accession of Oeorge III. (1760-1860), was published in 1861-63, and it received frequent additions in subsequent editions. In 1871 Sir Erskine May was appointed clerk of the House of Commons. His Democracy in Europe : a History, appeared in 1877, but it failed to take the same rank iu critical esteem as his Constitutional History. He retired from the post of clerk to the House of Commons in April 1886, having for fifteen years discharged the oner- ous duties of the office with as much knowledge and energy as unfailiag tact and courtesy. Shortly after his retirement from office he was raised to the peerage under the title of Baron Farnborough of Farnborough, in the county of Southampton, but he only survived to enjoy the dignity for a few days. He died 10th May 1886, and as he left no issue the title became extract. (g. b. s.)

Farnworth, a town in the Radcliff-cum-Famworth parliamentary division of Lancashire, England, on the Irwell, 3 miles S.E. of Bolton by rail. The churches and chapels are four parish, a chapel of ease, Eoman Catholic, Baptist, four Congregational, three Wesleyan, Catholic- Apostolic, &c. There are a grammar-school, market-place, public baths, recreation ground, a fever hospital, and a theatre. A public park of 16 acres was opened in 1864. Cotton mills, iron foundries, brick and tile works, and collieries supply industries. Area of urban district, 1502 acres ; population (1881), 50,708 ; (1901), 25,927.

Faroe Islands, in Danish F.□□;e6eene □□□ ^that is, "the Sheep Islands," □□□ belonging to Denmark, between Iceland (260 miles to the N.W.) and the Shetland Islands (180 miles to the S.E.), on the

submarine ridge which separates the Atlantic from the Norwegian Sea. Stromo has an area of 144 sq. miles. Total population (1880), 11,220; (1900), 15,230. Chief town, Thorshavn; popu- lation, 1666. The loftiest elevations are Slattaretinde (2894 ft.) in Ostero and Kopende (2692 ft.) and Skelling- fjeld (2520 ft.) in Stromo. The cultivation of the soil (which belongs for the most part to the Danish state) is extremely primitive, and the cultivated area only about 6 per cent. Hay is the principal crop. Coal is mined. In 1897 the islanders owned a fleet of 87 vessels of a total of 6160 tons.

V. TJ. Hammershaimb has published a collection of folk-songs and popular legends (Faeroisk Anthologi, 2 vols., Copenhagen, 1886-91). Engl, version of the Fxreyinga Saga, by F. York Powell (Lond. 1896). The islands are being surveyed by the Danish General Staff. See Geog. Tidskrift, Copenhagen, 1895 (vol. xiii.) and 1897 (vol. xiv.).

Farr, William (1807-1883), English statistician, was born at Kenley, in Shropshire, on 30th November 1807. When nineteen he became the pupil of a doctor in Shrewsbury, also acting as dresser in the infirmary there. He then went to Paris to study medicine, but after two

years returned to London, ???where, in 1832, he qualified as L.S.A. Next year he began to practise, but without very brilliant results, for five years later he definitely aban- doned the exercise of his profession on accepting the post of compiler of abstracts in the registrar-general's office. The commissioners for the 1841 census consulted him on several points, but did not in every case follow his advice. For the next two decennial censuses he acted as assistant- commissioner ; for that of 1871 he was a commissioner, and he wrote the greater part of the reports of all. He had an ambition to become registrar-general ; and when that post became vacant in 1879, he was so disappointed at the selection of Sir Brydges Henniker instead of him- self, that he refused to stay any longer in the registrar's office. He died of paralysis of the brain a year or two later, on 14th April 1883. A great part of Farr's literary production is to

be found in the papers which, from 1839 to 1880, he wrote for each annual report of the registrar- general on the cause of the year's deaths in England. He was also the author of many papers on general statis- tics and on life-tables for insurance, some read before the Eoyal Statistical Society, of which he was president in 1871 and 1872, some contributed to the Lancet and other periodicals. A selection from his statistical writ- ings was published in 1885 under the editorship of Mr Noel Humphreys.

Farrar, Frederic William (1831), English

divine, was born 7th August 1831, in the Fort of Bombay, his father, afterwards rector of Sidcup, Kent, being then a missionary of the Church Missionary Society. While very young he was sent to England, and placed in King William's College, Castletown, Isle of Man, a school whose external surroundings are reproduced in his pop- ular schoolboy tale, Eric; or, Little by Little. In 1847 he entered King's College, London. Through the in- fluence of Maurice he was led to the study of Coleridge, whose writings had a profound influence upon his faith and opinions. He proceeded to Trinity College, Cam- bridge, in October 1851, but while studying here re- turned to take his degree of B.A. at the university of London. He became a foundation scholar at Cambridge in 1852, and two years later he took his degree as fourth junior optime, and fourth in the first class of the classical tripos. In addition to other college prizes he gained the chancellor's medal for the English prize poem on the search for Sir John Franklin in 1852, the Le Bas prize, and the Norrisian prize. He was elected fellow of Trinity College in 1856. On leaving the university, Ivir Farrar became an assistant master under Dr Cotton at Marl- borough College. In November 1855 he was appointed an assistant-master at Harrow; here he remained for fifteen years. He was elected a fellow of the Royal So- ciety in 1864, university preacher in 1868, honorary chap- lain to the queen in 1869, and Hulsean lecturer in 1870. Mr Farrar was appointed headmaster of Marlborough Col- lege in 1871, and in the following year became chaplain-in- ordinary to the queen. In 1876 he was appointed canon of Westminster and rector of St Margaret's, Westminster. He took his D.D. degree in 1874, being the first to take theological degrees in accordance with the new regulations at Cambridge. Dr Farrar began his literary labours with the publication of Eric in 1858,

succeeded in the follow- ing year by Julian Home and Lyrics of Life, and in 1862 by St Winifred's; or the World of School. He had already published a work on Tlie Origin of Language ; and now for a number of years philology took the place of fiction. His series of works on grammar and scholastic philology included Chapters on Language, 1865; Greek Grammar Bules, 1865 ; Greek Syntax, 1866 ; and Families of Speech, 1869. He edited Essays on a Liberal Education in 1868 ;

and published Seekers after God in the Sunday Library, 1869. It was by his theological works, however, that Dr Farrar attained his greatest popularity. His Hulsean lectures were published in 1870 under the title of The Witness of History to Christ. The Life of Christ, which was published in 1874, speedily passed through a great number of editions, and ultimately became one of the most widely-read theological works of the 19th century. It reveals considerable powers of imagination and elo- quence, and was partly inspired by a personal knowledge of the sacred localities depicted. In 1877 appeared In the Days of My Youth, sermons preached in the chapel of Marlborough College; and during the same year his volume of sermons on Eternal Hope ??? in which he called in question the doctrine of eternal punishment ??? caused much controversy in religious circles. In 1879 appeared T!ie Life and Works of St Paul, and this was succeeded in 1882 by Tlie Early Days of Christianity. Then came in order of publication the following works : Every-day Christian Life; or, Sermons by the Way, 1887; Lives of the Fathers, 1888 ; Sketches of Church History, 1889 ; Dark- ness and Dawn, 1891 ; Tlie Voice from Sinai, 1892 ; Tlie Life of Christ as Represented in Art, 1894 ; a work on Daniel, 1895; Gathering Clouds, a tale of the days of Chrysostom, 1896; and TJie Bible, its Meaning and Su- premacy, 1896. In addition to his separate works, Dr Farrar has been a copious contributor of articles to various magazines, encyclopaedias, and theological commentaries. In 1883 he was made archdeacon of Westminster and rural dean; and in 1885 he was appointed Bampton lecturer at Oxford, taking for his subject "The History of Interpretation." Dr Farrar was appointed dean of Canterbury in 1895. From 1890 to 1895 he was chaplain to the speaker of the House of Commons, and in 1894 he was appointed deputy-clerk of the closet to Queen Victo- ria. As a theologian Dean Farrar^occupies a position mid- way between the

Evangelical party and the Broad Church ; while as a rather rhetorical preacher and writer he exerts a commanding influence over wide circles of readers. He is an ardent temperance and social reformer, and was one of the founders of the institution known as the Anglican Brotherhood, a religious band with modern aims and objects.

Farrer, Thomas Henry Farrer (1819-1899), 1st Baron, English civil servant and statistician, was the son of Thomas Farrer, a solicitor in Lincoln's Inn Fields. Born 24th June 1819, he was educated at Eton and Balliol College, Oxford, where he graduated in the second class in classics in 1840. He was called to the bar at Lincoln's Inn in 1844, but retired from practice in the course of a few years. In 1857 he was appointed assist- ant-secretary in the marine department of the Board of Trade, and permanent secretary to the Board of Trade in 1862. His tenure of this office, which he held for up- wards of twenty years, was marked by many reforms and an energetic administration. Not only was he an ad- vanced Liberal in politics, but he was a thorough Free- trader of the strictest school. He was created a baronet for his services at the Board of Trade in 1883, and in 1886 he retired from office. During the same year he published a work entitled Free Trade versus Fair Trade, in which he dealt with an economic controversy then greatly agitating the public mind. He had already written for the Citizen Series a volume on TJie State in its Relation to Trade. In 1889 he was co-opted by the Progressives an alderman of the London County Council, of which he became vice-chairman in 1890. His efficiency and ability in this capacity were warmly recog- nized; but in the course of time divergencies arose between his personal views and many of those of his

colleagues. The tendency towards socialistic legislation which became apparent was quite at variance with his principles of individual enterprize and responsibility. He consequently resigned his position. In 1893 he was raised to the peerage. From this time forward he devoted much of his energy and leisure to advocating his views at the Cobden Club, the Political Economy Club, on the platform, and in the public press.

Especially were his efforts directed against the opinions of the Fair Trade League, and upon this and other controversies on economic questions he wrote able, clear, and uncompromising letters, which left no doubt that he still adhered to the doctrines of free trade as advocated by its earliest exponents. In 1898 he published his Studies in Currency. He died at Abinger Hall, Dorking, 11th October, 1899.

Fars (the name Fabsistan is seldom used), one of the five great provinces of Persia. It has a population of about 750,000, and pays a yearly revenue of about ––140,000. The subdivision of the province in districts, the chief places of the districts and their population, and the number of inhabited villages in each, as they appear in the latest available lists (dated 1884), are shown in the following table : ––

18

19 20 21 22 23

Name of District.

Ab&deh Iklfd AbMeh Tashk . Abarj .... Abbdssi ––

*1. Bender AbbSssi *

and Villages. /

2. Issin and T&zi^n

3. Shamfl

4. Moghist^n

5. Uinih . Abrkuh Afzar . ‘Alamriid Arb’ah (the four)

1. Deh Riid

2. Deh Ram

3. Heng^m

4. RiidbAl ArdakdiQ ArsinjAn Asfr Baiz^ . Bashakerd . Bfdshehr and Juvfm Bovan^t Darab . Dashtl ???

1. Bardistan

2. BuMk .

3. Md,ndistdn

4. Tassiij .

5. Shumbeh Dashtist&n ???

1. Angdli .

2. Ahrom .

3. Borazj^n

4. Bushire

5. Dilikf .

6. GonSivah

7. Hay at Daiid

8. Khurimij

9. Riid Hillah

10. Shabankireh

11. Tanglstd,n

12. Zengeneh

13. Zlr&h . Dizgird Famiir . Farrdshband Fasi . FIriizdbdd .

Chief Place or Seat of Government.

Name.

Abd.deh

Tashk

Dashtek

Bender Abbtai

Issfn

Shamn

ZlArat

Mlndb

Abrkuh

NImdeh

Sabzpush^

Deh Ram

Ardak^n

ArsinjAn

Aslr

Baiz^

Angtirin

Bidshehr

Siirlan

Darib

Bender Dair Bushgan K^kf

Tang BAgh Shumbeh

Haftjiish

Ahrom

Borazjin

Bushire

DAlikI

Gon^vah

Bender Rfg

Khurmiij

KelAt Sukhteh

Deh Kohneh

TangistAn

Samal

Zir&h

Cherkes

Farr^hband

Fasi

FlriizdbM

Popula- tion.

4,000 2,000

10,000

1,000

4,000 10,000

1,000

1,500

6,000

5,000

500

2,000

3,000

500

5,000

1,000

1,500 500

1,500 4,000 25,000 1,500 1,000 1,000 1,000

1,000 750

500

300

1,000

5,000

4,000

Number of In- habited Villages

In District

33 8 6

14

6 18 10 23 22 12 16

19

10 25 10 55 5 23 23 62

28 18 40 11 15

10

5

19

20

7

12

6

5

10

27

31

4

6

6

3

14

40

29

Chief Place or Seat of

Number

Government.

of In-

Name of District.

habited VillagL-s

Name.

Popula- tion.

in District.

24

Gillehd^r .

Gillehdd,r

1,000

43

25

Hiimeh (immed. en- ‘ virons) Shiriz .

Zerkan

1,000

89

26

Istahbondt .

Istahbonit

10,000

12

27

Jahrom

Jahrom

10,000

33

28

Jireh ....

Ishfayikdn

23

29

Kamflniz .

Palangeri

34

30

Kamin

Kalilek

11

31

Kizeriin

Kdzeriin

8,000

46

32

Kavar ....

Kavar

26

33

Kir and Karzin .

Kir

1,000

23

34

Khafr ....

Khafr

1,000

41

35

Khijeh

Zanjirdn

500

15

36

Khisht.

Khisht

2,500

25

37

Khunj ....

Khunj

1,500

27

38

Kongan

Bender Kongan

12

39

Kiih Glliiyeh

Behbahan

10,000

182

40

KurbAl

Gdvkan

600

67

41

Ldristdn ???

1. LAr

L&T

8,000

34

2. Panjeh Ihshdm

Bairam

11

3. Panjeh F41 .

Ishkend,n

10

4. Jehd,ngiriyeh

Bastak

4,000

30

5 ShibKiih .

Bender Chdrek

36

6. Fiimistdn, or Gdv- 1 bandi . . /

G^vbandi

13

7. KauristAn

Kaurlstdn

4

8. Lingah .

Bender Lingah

10,000

11

9.- MazAyijan .

MazAyij4n

6

42

Maimand

Maimand

5,000

14

43

Maliki ....

Bender Assalii

1,000

25

44

Mamasenni (old Shiilis- t^n) ???

1. Bekesh

2. Javidi, or Jdvf

8 6

3. Dushmanzlirf 1

4. Rustami

Kalat Saf id

16 26

5. Fahliin

7

6. KAkin .

5

45

Marvast and Herit

Marvast

14

46

Marvdaslit ??? 1. Upper Khafrek 1

14

2. Lower Khafrek >

FathdbM

1,250

16

3. Marvdasht . j

22

47

MashhadMMar Suli-\ mdn . . J”

Murghdb

800

6

48

Mayin.

M^yin

8

49

Nairiz ....

Nairiz

9,000

24

50

Ramjird

Jashiin

36

51

Rudd,n and Ahmedl .

Dehbdriz

21

52

SaVah (the seven) ???

1. Bivunj .

Durz

14

2. Hassandbid .

Hassandb^

7

3. Tarom .

Tarom

2,000

15

4. Faraghdn

Firaghdn

1,500

13

6. Forg

Forg

3.000

18

6. Fin and Guhreh .

Fin

13

7. Gilch Gdh (aban- 1 doned) . j

53

Sarchahin .

Ziiret

1,000

11

54

Sarhad Chah&rDungeh ???

1. Dasht Ujan .

2. Dasht Khosro va

Shirin

Kiishk Zard

31

3. Dasht Khtingasht

4. Dasht KiishkZard

55

Sarhad Shesh Nahiyeh ???

1. Padina .

Khiir

‘

2. Hennii .

Henni

3. Samiram

Samiram

4. FeMrd .

Feld,rd

24

6. Vardasht

Garmabad

6. Vank .

Vank

56

Sarvistan

Sarvistan

4,500

23

57

Shirdz (town)

53,6071

???

58

Siyakh.

Darinjdn

13

59

Simkdn

Diizeh

38

1 Persian census (1884) : 6327 houses ; 25,284 males, 28,323 females ; total population, 53,607.

The above fifty-nine districts are grouped into eighteen sub-provinces, under governors appointed by the Governor- general of Fars, but the towns of Bushire, Lingah, and Bender Abbassi, together with the villages in their im- mediate neighbourhood, form a separate government known as that of the " Persian Gulf ports " (Benader i Khalij i Fars), under a governor appointed from Teheran. Many districts are fertile, but some, particularly those in the south-eastern part of the province, do not produce sufi&cient grain for the requirements of the. population. In consequence of droughts, ravages of locusts, and misgovernment by local governors, the province has been much impoverished, and hundreds of villages are in ruins and deserted. Turbulent and lawless nomad tribes, when on the march from summer to winter, or from winter to summer camping grounds, frequently render the roads insecure, and occasionally plunder whole districts, leaving the inhabitants without means of subsistence.

The province produces much wheat, barley, rice, and cotton, but the authorities every now and then prohibiting the exportation of cereals, the people only sow just as much as they think will suflS.ce for their own wants. Much tobacco, principally for home consumption, is also grown (specially in Fasa and Darab), and a considerable quantity of opium, much of it for export to China, is produced. Salt, lime, and gypsum are abundant. There are some oil wells at Daliki, near Bushire, but attempts to tap the oil have been unsuccessful. There are no valuable oyster banks in Persian waters, and all the Persian Gulf pearls are obtained from banks on the coast of Arabia and near Bahrain. (a. h.-s.)

Farukhabad, a city and district of British India, in the Agra division of the North- West Provinces. The city is near the right bank of the Ganges,

87 miles by rail from Cawnpore. It forms a joint municipality with Fatehgarh, the civil headquarters of the district, with a military cantonment. Population (1881), 62,437 ; (1891), 78,032; (1901), 62,878. The municipal income in 1897-98 was Es. 53,427 ; the registered death-rate in 1897 was 42 per thousand. At Fatehgarh is the govern- ment gun-carriage factory ; also an American Presbyterian mission, with high school, and a tent factory. The dis- trict of Faeukhabad has an area of 1720 square miles, and had a population in 1881 of 907,608, and in 1891 of 856,687, giving an average density of 499 persons per square mile. In 1901 the population was 924,660, show- ing an increase of 8 per cent. The land revenue and rates were Us. 13,24,696, the incidence of assessment being R. 1-1-8 per acre ; the cultivated area in 1896-97 was 504,976 acres, of which 278,480 were irrigated; the number of police was 2912; the number of ver- nacular schools in 1896-97 was 104, with 3880 pupils; the registered death-rate in 1897 was 43‘42 per thousand. There are eight printing-presses, issuing four vernacular periodicals, and 87 indigo factories, em- ploying 3927 persons, with an out-turn valued at Rs. 2,07,000. Part of the district is watered by distri- butaries of the Ganges canal, and it is now traversed throughout its length by the Agra-Cawnpore line of the Eajputana railway.

Fas hod a. See Egypt (History), and Nile.

Fatehpur (Fathepur), a town and district of British India, in the Allahabad division of the North-West Provinces. The town is 73 miles by rail north-west of Allahabad. In 1881 the population was 21,328, in 1891 it was 20,179; the municipal income in 1897-98 was Ks. 12,191. The district of Fatehpue has an area

of 1633 square miles. It had a population in 1881 of 683,746, and in 1891 of 699,157, giving an average density of 428 persons per square mile. In 1901 the population was 686,411, showing a decrease of 2 per cent. The land revenue and rates were Rs. 11,79,482, the in- cidence of assessment being R. 1-14-1 per acre ; the culti- vated area was 307,439 acres, of which 127,703 were irrigated from wells, &c. ; the number of police was 2370 ; the number of vernacular schools in 1896-97 was 95, with 2952 pupils ; the registered death-rate in 1897 was 64-35 per thousand. There

are three printing-presses, issuing three vernacular periodicals. The district is tra- versed by the main line of the East Indian railway from Allahabad to Cawnpore, 66 miles in length.

Faure, Francois Felix (1841-1899), President of the French Republic, was born in Paris, 30th January 1841, being the son of a small furniture maker. Having started as a tanner and merchant at Havre, he acquired considerable wealth, was elected to the National Assembly in August 1881, and took his seat as a member of the Left, interesting himself chiefly in matters concerning economics, railways, and the Navy. In November 1882 he became under-secretary for the colonies in M. Feny's Ministry, and retained the post till 1886. He held the same post in M. Tirard's Ministry in 1888, and in 1893 was made vice-president of the Chamber. In 1894 he obtained cabinet rank as minister of marine in the administration of M. Dupuy. In the January following he was unexpectedly elected President of the Republic upon the resignation of M. Casimir-Perier. The princi- pal cause of his elevation was the determination of the various sections of the moderate republican party to exclude M. Brisson, who had had a majority of votes on the first ballot, but had failed to obtain an absolute majority. To accomplish this end it was necessary to unite among themselves, and union could only be secured by the nomination of some one who offended nobody. M. Faure answered perfectly to this description. His fine presence and his tact on ceremonial occasions rendered the state some service when in 1896 he received the Tsar of Russia at Paris, and in 1897 returned his visit, after which meeting the momentous Franco-Russian alliance was pub- licly announced. The latter days of M. Faure's presidency were embittered by the Dreyfus affair, which he was de- termined to regard as chose jugie. But at a critical moment in the proceedings his death occurred suddenly, from apoplexy, on 16th February 1899. "With all his faults, and in spite of no slight amount of personal vanity. President Faure was a shrewd political observer and a good man of business. After his death, some alleged extracts from his private journals, dealing with French policy, were published in the Paris press.

), French musical com

Faure, Gabriel (1846- poser, was born at Pamiers on 13th]\Iay 1845. He studied at the school of sacred music directed by Niedermeyer, first under Dietsch, and subsequently under Saint-Saens. He became "maitre de chapelle" at the church of the Madeleine in 1877, and organist in 1896. His works include a symphony in T> minor (Op. 40), two quartets for piano and strings (0pp. 16 and 46), a suite for orchestra (Op. 12), sonata for violin and piano (Op. 13), concerto for violin (Op. 14), berceuse for violin, elegie for violoncello, pavane for orchestra, incidental music for Alexandre Dumas' Caligula and I)e Haraucourt's Shylock, a re

through labyrinthine harmonies. There can be no deny- ing the intense fascination and remarkable originality of his music. He is a composer whose works are more likely to appeal to those of delicate and refined tastes than to the masses. His muse is essentially aristocratic, and suggests the surroundings of the boudoir and the perfuine of the hothouse.

Faversham, a municipal borough, port, and market-town, in the Faversham parliamentary division of Kent, England, on a creek of the Swale, 9 miles W.N.W. of Canterbury by rail. Eecent erections are an Established church, a cottage hospital, and an isolation- hospital. Area, 693 acres : population (1881), 9374 ; (1901),

11,234.

Favre, J.ules (1809-1880), French advocate and statesman, was born at Lyons on 31st March 1809. After a brilliant career as a barrister, especially as council for defendants in political prosecutions, he achieved political importance by his defence of Felice Orsini in 1868, and in 1860 was returned to the Legislative Assembly as one of the miniature but formidable party of five opposed to the Empire. Unlike most of his colleagues, he consistently maintained this hostile attitude, and it was upon his pro- position that the deposition of Napoleon III. was proclaimed after the disaster of Sedan. He naturally obtained a leading

position in the new Government, but the post of Minister of Foreign Affairs was unsuited to him ; his famous declaration, "Not an inch of our territory, not a stone of our fortresses," had to be taken back, and his neglect of Prince Bismarck's advice to disarm the National Guard brought about the horrors of the Com- mune. After this, though still practising with distinction as a pleader, he took little part in political affairs. He died at Versailles on 20th January 1880.

Fawcett, Henry (1833-1884), English politician and economist, was born at Salisbury on 26th August 1833. His father, William Fawcett, a native of Kirkby Lonsdale, in Westmorland, started life as a draper's assistant at Salisbury, opened a draper's shop on his own account in the market-place there in 1825, married a solicitor's daughter of the city, became a prominent local man, took a farm, developed his north-country sporting instincts, and displayed his shrewdness by successful speculations in Cornish mining. His second son, Henry, inherited a full measure of his shrewdness, along with his masculine energy, his straightforwardness, his perse- verance, and his fondness for fishing. The father was active in electioneering matters, and his wife was an ardent reformer. Henry Fawcett was educated locally and at King's College school (1848-51), and proceeded to Peterhouse, Cambridge, in October 1852, migrating in 1853 to Trinity Hall. He was seventh wrangler in 1856, and was elected to a fellowship at his college. He had already attained some prominence as an orator at the Cambridge Union. Before he left school he had formed the ambition of entering Parliament, and, being a poor man, he resolved to approach the House of Commons through a career at the bar. He had already entered Lincoln's Inn. His prospects, however, were shattered by a calamity which befell him in September 1858, when two stray pellets from his father's fowling- piece passed through the glasses he was wearing and blinded him for life. Within ten minutes after his accident he had made up his mind " to stick to his old pursuits as much as possible." He kept up all recreations contributing to the enjoyment of life ; he fished, rowed, skated, took abundant walking and horse exercise, and learnt to play cards with marked packs. Soon after his

accident he established his headquarters at Trinity Hall, Cambridge, entered cordially into the social life of the college, and came to be

regarded by many as a typical Cambridge man. He gave up mathematics (for which he had little aptitude), and specialized in political economy. He paid comparatively little attention to economic history, but he was in the main a devout be- liever in economic theory, as represented by Eicardo and his school. The later philosophy of the subject he believed to be summed up in one book. Mill's Principles of Political Economy, which he regarded as the indis- pensable " vade mecum " of every politician. He was not a great reader, and Mill probably never had a serious rival in his regard, though he was much impressed by Buckle's History of Civilization and Darwin's Origin of Species when they severally appeared. He made a great impression in 1859 with a paper at the British Associar tion, and he soon became a familiar figure there and at various lecture halls in the north as an exponent of orthodox economic theory. Of the sincerity of his faith he gave the strongest evidence by his desire at all times to give a practical application to his views and submit them to the test of experiment. Among Mill's disciples he was, no doubt, far inferior as an economic thinker to Cairnes, but as a popularizer of the system and a demonstrator of its principles by concrete examples he had no rival. His power of exposition was illustrated in his Manual of Political Economy (1863), of which in twenty years as many as 20,000 copies were sold. Alex- ander Macmillan had suggested the book, and it appeared just in time to serve as a credential, when, in the autumn of 1863, Fawcett stood and was elected for the Chair of Political Economy at Cambridge. The ap- pointment attached him permanently to Cambridge, gave him an income, and showed that he was competent to discharge duties from which a blind man is often considered to be debarred. He was already a member of the Political Economy Club, and was becoming well known in political circles as an advanced Eadical. In January 1863, after a spirited though abortive at- tempt in Southwark, he was only narrowly beaten for the borough of Cambridge. Early in 1864 he was adopted as one of the Liberal candidates at Brighton, and at the general election of 1865 he was elected by a large majority. Shortly after his election he became engaged to Millicent, daughter of Mr New- son Garrett of Aldeburgh, Suffolk, and in 1867 he was married.

Fawcett entered Parliament just in time to see the close of Palmerston's career and to hail the adoption by Gladstone of a programme of reform to

which most of the laissez-faire economists gave assent. He was soon known as a forcible speaker, and quickly overcame the imputa- tion that he was academic and doctrinaire, though it is true that a certain monotony in delivery often gave a slightly too didactic tone to his discourses. But it was as the uncompromising critic of the political shifts and expedients of his leaders that he attracted most attention. He constantly insisted upon the right of exercising private judgment, and he especially devoted himself to the defence of causes which, as he thought, were neglected both by his official leaders and by his Eadical comrades. Ee- elected for Brighton to the Parliament of 1868-74, he greatly hampered the Government by his persistence in urging the abolition of clerical fellowships and the pay- ment of election expenses out of the rates, and by opposing the " permissive compulsion " clauses of the Elementary Education Bill, and the exclusion of agricultural children from the scope of the Act. His hatred of weak conces- sions made him the terror of parliamentary wirepullers, and in 1871 he was not undeservedly spoken of in the

Times as the most " thorough Eadical now in the House." His liberal ideals were further shocked by the methods by which Gladstone achieved the abolition of Army Pur- chase. His disgust at the supineness of the Cabinet in dealing with the problems of Indian finance and the growing evil of Commons' Enclosures were added to the catalogue of grievances which Fawcett drew up in a pow- erful article, " On the Present Position of the Govern- ment," in the Fortnightly Bevieiv for November 1871. In 1867 he had opposed the expenses of a ball given to the Sultan at the India Office being charged upon the Indian budget. In 1870 he similarly opposed the taxation of the Indian revenue with the cost of presents distributed by the duke of Edinburgh in India. In 1871 he went alone into the lobby to vote against the dowry granted to the Princess Louise. The soundness of his principles was not impeached, but his leaders looked askance at him, and from 1871 he was severely shunned by the Government whips. Their suspicion was justified when in 1873 Eawcett

took a leading share in opposing Glad- stone's scheme for university education in Ireland as too denominational, and so contributed largely to a conclusive defeat of the Gladstone Ministry.

Prom 1869 to 1880 Pawcett concentrated his energies upon two important subjects which had not hitherto been deemed worthy of serious parliamentary attention. The first of these was the preservation, of commons, especially those near large towns ; and the second was the responsi- bility of the British Government for the amendment of Indian finance. In both cases the success which he obtained exhibited the sterling sense and shrewdness which made up such a great part of Pawcett's character. In the first case Pawcett's great triumph was the enforce- ment of the general principle that each annual Enclosure Act must be scrutinized by Parliament and judged in the light of its conformity to the interests of the community at large. Probably no one did more than he did to pre- vent the disafEorestation of Epping Forest and of the New Porest. Prom 1869 he regularly attended the meetings of the Commons Preservation Society, and he remained to the end one of its staunchest supporters. His intervention in the matter of Indian finance, which gained him the sobriquet of the "" member for India," led to no definite legislative achievements, but it called forth the best energies of his mind and helped to rouse an apathetic and ignorant public to its duties and respon- sibilities. Pawcett was defeated at Brighton in Pebruary 1874. Two months later, however, he was elected for Hackney, and retained the seat during his life. He was promptly replaced on the Indian Pinance Committee, and continued his searching inquiries with a view to promote a stricter economy in the Indian budget, and a more effective responsibility in the management of Indian accounts.

As an opponent of the Disraeli Government (1874-80) Pawcett came more into line with the Liberal leaders. In foreign politics he gave 'a general adhesion to Glad- stone's views, but he continued to devote much attention to Indian matters, and it was during this period that he produced two of his best publications. His Free Trade and Protection (1878) illustrated his continued loyalty to Cobdenite ideas. At the same time, his admiration for Palmerston and his repugnance to schemes of Home Rule show that he was not by any means a peace-at- any-price man. He

thought that the Cobdenites had deserved well of their country, but he always maintained that their foreign politics were biassed to excess by purely commercial considerations. As befitted a writer whose linguistic gifts were of the slenderest, Pawcett's English was a sound homespun, clear and unpretentious. In a vigorous employment of the vernacular he ap-

proached Cobbett, whose writing he justly admired. The second publication was his Indian Finance (1880), three essays reprinted from the Nineteenth Century, with an introduction and appendix. When the Liberal party returned to power in 1880 Gladstone offered Pawcett a place in the new Government as Postmaster-General (without a seat in the Cabinet). On Egyptian and other questions of foreign policy Pawcett was often far from being in full harmony with his leaders, but his position in the Government naturally enforced reserve. He was, moreover, fully absorbed by his new administrative functions. He gained the sympathy of a class which he had hitherto done little to conciliate, that of public officials, and he showed himself a most capable head of a public department. To his readiness in adopting suggestions, and his determination to push business through instead of allowing it to remain permanently in the stage of preparation and circumlocution, the pub- lic is mainly indebted for five substantial postal re- forms: ??? (1) The parcels post, (2) postal orders, (3) six- penny telegrams, (4) the banking of small savings by means of stamps, (5) increased facilities for life-insurance and annuities. In connexion with these last two im- provements Pawcett, in 1880, with the assistance of Mr James Cardin, took great pains in drawing up a small pamphlet called Aids to Tlirifl, of which over a million copies were circulated gratis. A very useful minor innovation of his provided for the announcement on every pillar-box of the time of the "next collec- tion." In the post office, as elsewhere, he was a strong advocate of the employment of women. Proportional representation and the extension of franchise to women were both political doctrines which he adopted very early in his career, and never abandoned. Honours were showered upon him during his later years. He was made an honorary D.C.L. of Oxford, a Fellow of the Royal Society, and was in 1883 elected Lord Rector of Glasgow University. But the stress of departmental work soon began to tell upon his health. In the autumn of 1882 he had a sharp

attack of diphtheria complicated by typhoid, from which he never properly recovered. He resumed his activities, but on the 6th November 1884 he succumbed at Cambridge to an attack of congestion of the lungs. He was buried in Trumpington church- yard, near Cambridge, and to his memory were erected a monument in Westminster Abbey, a statue in Salis- bury market-place, and a drinking fountain on the Thames embankment.

In economic matters Pawcett's position can best be described as transitional. He believed in co-operation almost as a panacea. In other matters he clung to the old laissez-faire theorists, and was a strong anti-socialist, with serious doubts about free education, though he supported the Factory Acts and vrished their exten- sion to agriculture. Apparent inconsistencies were har- monized to a great extent by his dominating anxiety to increase the well-being of the poor. One of his noblest traits was his kindliness and genuine affection for the humble and oppressed, country labourers and the like, for whom his sympathies seemed always on the increase. Another was his disposition to interest himself in and to befriend younger men. In the great affliction of his youth Fawcett bore himself with a fortitude which it would be difficult to parallel. The effect of his blindness was, as the event proved, the reverse of calamitous. It brought the great aim and purpose of his life to maturity at an earlier date than would otherwise have been possible, and it had a mellowing influence upon his character of an exceptional and beneficent kind. As a youth he was rough and canny, with a suspicion of harshness. The

kindness evoked by his misfortune, a strongly recipro- cated family affection, a growing capacity for making and keeping friends ? ? ? these and other causes tended to ripen all that was best, and apparently that only, in a strong but somewhat stern character. His acerbity passed away, and in later life was reserved exclusively for official witnesses before parliamentary committees. Prank, help- ful, conscientious to a fault, a shrewd gossip, and a staunch friend, he was a man whom no one could help liking. Several of his letters to his father and mother at different periods of his career are preserved in Mr Stephen's admirable

Life (1885), and show a goodness of heart, together with a homely simplicity of nature, which is most touching. In appearance Fawcett was gaunt and tall, over 6 feet 3 inches in height, large of bone, and massive in limb. (t. se.)

Fayrer, Sir Joseph, Babt. (1824-

-), English

physician, was born at Plymouth, 6th December 1824, Beginning his medical career in the navy, he was present as a surgeon at the sieges of Palermo and Eome, and then, after a short time in the army, entered the Bengal medical service in 1850. During the next few years he was again actively engaged in the field, for he went through the Burmese campaign of 1862 and was political assistant and Residency surgeon at Lucknow during the Mutiny. From 1859 to 1874 he was professor of surgery at the Medical College of Bombay, and when the Prince of Wales made his tour in India he was appointed to accompany him as physician. Returning from India he acted as president of the Medical Board of the India Office from 1874 to 1895, and in 1896 he was created a baronet. Sir Joseph Payrer, who became a fellow of the Royal Society in 1877, has written much on subjects con- nected with the practice of medicine in India ; but he is especially known for his studies on the poisonous snakes of that country and on the physiological effects produced by their virus.

Fazokl, or FazogI, a town of the Anglo-Egyptian Sudan, on the left bank of the Blue Nile, close to the Tumat confluence, and opposite Eamaka, near the Abys- sinian frontier, formerly the residence of a powerful native king. During the Egyptian rule it was capital of the upper province of the Blue Nile of the same name, but was soon replaced by Eamaka, where Mahomet Ali built a palace in 1839. Then Eazokl dwindled to a mere ham- let, and both places were abandoned at the outbreak of the Mahdi's revolt. It was reoccupied in 1899, and is now a chief station in the reconstituted Equatorial pro- vince under Anglo-Egyptian rule. It is important both as a frontier post towards Abyssinia, and as the nearest station to the auriferous district of the Tumat basin. The chief gold- washings lie on the west slope of the hills draining to the White Nile. Here

is the steep Jebel-Dul, which appears to contain rich gold-bearing reefs, as the precious metal occurs in all the ravines on its flanks.

Fecamp, a town in the arrondissement of Havre, department of Seine Inferieure, 27 miles N.N.E. of Havre by rail. It has a library and museum of painting and objects of art, a hydrographical school, and an estab- lishment for pisciculture. In 1900 1,681,237 bottles of liqueurs were produced. The total value of the imports, in 1900, was ??185,600, and of the exports ??39,934; 120 vessels of 49,516 tons entered and cleared, and 59 ships were engaged in the Newfoundland cod-fisheries. Amongst minor improvements, it may be said that a length of 165 yards of new quay wall was completed in 1900; that the north pier has been lengthened, and that a new lighthouse with powerful light has been

erected on the extremity to replace that on the cliff. Popu- lation (1881), 11,831; (1896), 13,679; (comm.) 14,448.

Fechner, Custav Theodor (1801-1887), the founder of German experimental psychology, was born on 19th April 1801 at Gross-Sarchen, near Muskau, in Lower Lusatia, where his father was pastor. lie was educated at Sorau and Dresden and the university of Leipzig. In this city he spent the rest of his life. In 1834 he was appointed professor of Physics, but in 1839 contracted a disease of the eyes while studying the phe- nomena of colour and subjective light, and, after much suffering, resigned. He now turned to the study of mind and the relations between body and mind, giving public lectures on the subjects of which his books treat. He died on 16th November 1887. Among his works may be mentioned : Das Biichlein vom Lehen tiach dem Tode (1836), which has been translated into English ; Nanna, Oder uber das Seelenlehen der Pflanzen (1848) ; Zenda- vesta, Oder iiber die Dinge des Himmels und des Jenseits (1851) ; Ueber die physiJcaliscJie und philosophiscJie Atom- enlehre (1855) ; Elemente der Psychophysik (1860) ; Vor- schule der Aesthetik (1876) ; Die Tagesansicht gegenuber der Nachtansicht (1876). He also published chemical and physical papers, and translated chemical works by Biot and Th^nard from the French. A different but essential side of his character is seen in his poems and humorous pieces, such as the Vergleicliende Anatomie der Engel (1825), written under the

pseudonym of Dr Mises. Fechner's epoch-making work was his Elemente der Psychophysik. He starts from the Spinozistic thought that bodily facts and conscious facts, though not re- ducible one to the other, are difilerent sides of one reality. His originality lies in trying to discover an exact mathematical relation between them. The most famous outcome of his inquiries is the law known as Weber's or Fechner's law which may be expressed as follows : ??? In order that the intensity of a sensation may increase in arithmetical progression, the stimulus must increase in geometrical progression. Though holding good within certain limits only, the law has been found im- mensely useful. Unfortunately, from the tenable theory that the intensity of a sensation increases by definite additions of stimulus, Fechner was led on to postulate a unit of sensation, so that any sensation s might be re- garded as composed of n units. Sensations, he argued, thus- being represen table by numbers, psychology may become an "exact" science, susceptible of mathematical treatment. His general formula for getting at the number of units in any sensation is s = o log r ; where s stands for the sensation, b for the stimulus numerically estimated, and 0 for a constant that must be separately determined by experiment in each particular order of sensibility. This reasoning of Fechner's has given rise to a great mass of controversy, but the fundamental mistake in it is sim- ple. Though stimuli are composite, sensations are not. " Every sensation," says Professor James, " presents itself as an indivisible unit ; and it is quite impossible to read any clear meaning into the notion that they are masses of units combined." Still, the idea of the exact measure- ment of sensation has been a fruitful one, and mainly through his influence on Wundt, Fechner is the father of that "new" psychology of laboratories which inves- tigates human faculties with the aid of exact scientific apparatus. Though Fechner has had a vast influence in this special department, the disciples of his general philosophy are few. His world-conception is highly animistic. He feels the thrill of life everywhere, in plants, earth, stars, the total universe. Man stands mid- way between the souls of plants and the souls of stars, who are angels. God, the soul of the universe, must

be conceived as having an existence analogous to men. Natural laws are just the modes of the unfolding of God's perfection. In his last ~~work Fechner, aged but full of hope, contrasts this joyous "daylight view" of the world with the dead, dreary "night view" of material~~ ism. Fechner's work in aesthetics is also important. He conducted experiments to show that certain abstract forms and proportions are naturally pleasing to our senses, and gave some new illustrations of the working of aesthetic association. Fechner's position in reference to predecessors and contemporaries is not very sharply defined. He was remotely a disciple of Schelling, learnt much from Herbart and Weisse, and decidedly rejected Hegel and the monadism of Lotze. (h. st.)

Fechter, Charles Albert (1824-1879), actor, was born in London, of French parents, 23rd October 1824. While he was still a child his parents returned to France. He inherited considerable artistic ability from his father (who was a sculptor), and would probably have at once devoted himself to a sculptor's life but for the accident of a striking success made in some private theatricals. The result of this was an en- gagement early in 1841 to play in a travelling company that was going to Italy. The tour was a failure, and the company broken up; whereupon Fechter returned home and worked assiduously at sculpture. At the same time he attended classes at the Conservatoire with the view of gaining admission to the Comedie FrauQaise. Late in 1844 he enjoyed the double success of winning the grand medal of the Academie des Beaux Arts with a piece of sculpture and of being admitted to make his d6but at the Comedie Frangaise. He acquitted himself at the latter with considerable credit; but, tired of the small parts he found him- self condemned to play, returned again to his sculptor's studio in 1846. In that year he accepted an engage- ment to play with a French company in Berlin, where he made his first decisive success as an actor. He there became acquainted with El^onore Eabut, an actress, whom he married on his return to Paris in the following year. Previously to this he appeared for some months in London, in a season of French classical plays given at the St James's Theatre. In Paris for the next ten years he fulfilled a series of engagements at the Ambigu-Comique, Theatre Historique, Porte St Martin, and Vaudeville theatres, his chief successes being his performance of Armand Duval in La Dame aux CamMias. From March

1857 to December 1858 he was manager of the Odeon, where he produced Tartiife and other pieces from the classical repertory. Having received tempting offers to play in English at the Princess's Theatre, London, he made a diligent study of the language, and appeared there in October 1860 in a version of Buy Bias. This was followed by The Corsican Brothers and Don Ccesar de Bazan; and in March 1861 he first attempted Hamlet. The result was an extraordinary triumph, the play running for 115 nights. This was followed by Othello, in which he played at first the character of the Moor, and after- wards that of lago. In January 1863 he became lessee of the Lyceum Theatre, which he opened with Tlie Duke's Motto; this was followed by TJie King's Butterfly, Tlie Mountebank (in which his son Paul, a boy of seven, appeared), The Roadside Inn, The Master of liavenswood, and The Lady of Lyons. After this he appeared at the Adelphi (in 1868) in No Tlioroughfare, Monte Gristo, and Black and White ; and after a tour through the English provinces in 1869, he set sail in 1870 for the United States, where (with the exception of a visit to London in 1872) he remained till his death. He played in the United States between 1870 and 1876 in most of the

parts in which he had won his chief triumphs in England, making at various times attempts at management. As manager, however, he was rarely successful, owing to his imgovernable temper. The downfall of his career began after an accident upon the ice in 1876, which rendered him physically infirm. Ill-health speedily overtook him, and the last three years of his life were spent in practical seclusion on a farm which he had bought at Eockland Centre, near Quakertown, in Pennsyl- vania. He died there, of a painful internal malady, on 5th August 1879, and was buried in Mount Vernon cemetery, Philadelphia. (b. f. s.)

Felanitx, or Felaniche, a town of Spain, in the south-east of the island of Majorca, stands 11 miles from the sea, surrounded by hills. Population, 11,442. It has well-built streets, a good town hall, and a fine parish church. Near at hand are the ruins of a Moorish castle. There is trade in wine, fruit, wheat, cattle, brandy, chalk, and soap.

Felixstowe, a seaside resort of England, strag- gling about 3 miles along the coast of Suffolk, just outside the estuary of the Orwell, 12 miles south-

east from Ipswich. It has good golf-links, and i's much frequented by visitors in the summer for its excellent sea-bathing. Population of Felixstowe and Walton

(1901), 5805.

Fens, a district in the east of England, possessing a distinctive history and peculiar characteristics. It lies west and south of the Wash, and extends over more than 70 miles in length (Lincoln to Cambridge) and some 35 miles in maximum breadth (Stamford to Brandon in Suffolk), its area being considerably over half a million acres. Although low and flat, and seamed by innumerable watercourses, the entire region is not, as the Roman name of Metaris ^stuarium would imply, a river estuary, but is a silted up bay of the North Sea, of which the Wash is the last surviving portion. Hydrographically, the Fens embrace the lower parts of the drainage-basins of the rivers Witham, Welland, Nene, and Great Ouse ; and against these streams, as also against the ocean, they are protected by earthen embankments, 10 to 16 feet high. As a rule the drainage water is lifted off the Fens into the rivers by means of steam-pumps, formerly by - windmills.

General History. ??? According to fairly credible tradition, the first systematic attempt to drain the Fens was made by the Romans. They dag a catchwater drain (as the artificial fenland watercourses are called), the Caer or Car Dyke, from Lincoln to Eamsey (or, according to Stukeley, as far as Cambridge), along the western edge of the Fens, to carry off the precipitation of the higher dis- tricts which border the fenland, and constructed alongside the Welland and on the seashore earthen embankments,^ of which some 150 miles still survive. After the departure of the Romans from Britain in the first half of the 5th century the Fens fell into neglect; and despite the preservation of the woodlands for the purposes of the chase by the Norman and early Plantagenet kings, and the unsuccessful attempt which Richard de Rulos, chamber- lain of William the Conqueror, made to drain Deeping Fen, the fenland region became almost everywhere waterlogged, and re- lapsed to a great extent into a state of nature. In addition to this it was ravaged by serious inundations of the sea, for example, in the years 1178, 1248 (or 1250),

*1288,2 1322, 1335, 1467, 1571. Yet the fenland was not altogether a howling wilderness of reed- grown marsh and watery swamp. At various spots, more particu- larly in the north and in the south, there existed islands of firmer and higher ground, resting generally on the boulder clays of the Glacial epochs and on the inter-Glacial gravels of the Palseolithic Age.^*

1 See, for a full discussion, S. H. Miller and S. B. J. Skertchly, The Fenland, p. 144 et seq. (Wisbech and London, 1878). Mr Miller is disposed to credit the native British inhabitants of the Fens with having executed certain of these works.

- W. Chapman, Facts and Semarks relative to the Witham and the Welland (Boston, 1800), pp. 21-23.

8 Miller and Skertchly, op. cit., pp. 513-551. In Chap. xv. (pp. 492-583) of the same work will be found an exhaustive discussion of the geology of the entire region.

On these isolated localities members of the monastic orders (espe- cially at a later date the Cistercians) hegan to settle after about the middle of the 7th century. At Medeshampstead (i.e., Peter- borough), Ely, Crowland, Ramsey, Thorney, Spalding, Pea- kirk, Swineshead, Tattershall, Kirkstead, Bardney, Sempringham, Bourne, and numerous other places, they made settlements, built churches and monasteries, founded abbeys, and even reared magnifi- cent cathedrals.i And, in spite of the appalling incursions of the predatory Northmen and Danes in the 9th and 10th centuries, and of the disturbances consequent upon the establishment of the Camp of Refuge by Hereward the Wake in the fens of the Isle of Ely in the 11th century, these scattered outposts continued to shed rays of civilization across the lonely Fenland down to the dissolu- tion of the monasteries in the reign of Henry VIII. Then they, too, Were partly overtaken by the fate which befell the rest of the Eens ; and it was only in the end of the 18th century and the be- ginning of the 19th century that

the com- plete drainage and re- clamation of the Fen region was finally ef- fected. Attempts, and on a considerable scale, were indeed made to reclaim them in the 17th century ??? notably the Witham Pens by Sir Anthony Thomas, the Earl of Lindsey, Sir William Killigrew, King Charles I., and others in 1631 and succeeding years ; the Deeping or Welland Fens in 1638 by Sir W. Ayloff, Sir Anthony Thomas, and other "ad- venturers," after one Thomas Lovell had ruined himself in a similar attempt in the reign of Queen Eliza- beth ; and the Fens of the Nene and Great Ouse, known generally as the Bedford Level, by the Dutch engineer Cornelius Vermuyden and the Earls of Bed- ford, in the first half of the century ; although Lord Chief-J"ustice Pop- ham and a Company of Londoners had be- gun the work in 1605. '^ But all these attempts equally failed, owing to the determined op- position^ of the native f e n m e n, whom the drainage and appro- priation of the unin- closed fenlands would deprive of valuable and long – enjoyed rights of commonage, turbary (turf -cutting), fishing, fowling, &o. Holland

1 For complete lists, compiled from Dugdale and Speed, see Thompson, History of Boston, pp. 737-747 (Boston, 1856), and Miller and Skertchly, op. cit., p. 137; consult also G. Oliver, An Account of the Beligious Houses formerly situated on the Eastern Side of the River Witham, pp. 30-SO (London, 1846).

2 Baldwin Latham, Papers on the Drainage of the Fens. Read before the Society of Engineers, 3rd November 1862.

s For the Witham Fens, see Sir William Dugdale, The History of ImbanTcing and Draining, pp. 419 et seq, (2nd ed., London, 1772) ; Marratt, History of Lincolnshire, vol. i. pp. 138-146, and vol. ii. pp. 187-189 (Boston, 1814-16) ; and P. Thompson, History of Boston, pp. 625-636. For the Welland Fens, Dugdale, op. ciJ., pp. 391 eiseg. And for the Bedford Level, see Fenland Notes and Queries, 1894, pp. 355-359; 1895, pp. 8-10, 52-56, 119-122 (Peterborough) ; and M. Noble, Memoirs of the Protectoral House of Cromwell, pp. 107-108 (Birming- ham, 1787).

Map of the Fens.

*and other Fens on the west side of the Witham were finally drained in 1767, although not without much rioting and lawlessness ; * and a striking account of the wonderful improvements effected by a generation later is recorded in Arthur Young's General View of the Agriculture of the County of Lincoln (London, 1709). The East, West, and Wildmore Fens on the east side of the Witham were drained in 1801-7 by John Rennie, who carried off the pre- cipitation which fell on the higher grounds by oatohwater drains, on the principle of the Roman Car Dyke, and improved the outfall of the river, so that it might the more easily discharge the Fen water wliicli flowed or was pumped into it.* The Welland or Deeping Fens were drained in 1794, 1801, 1824, 1837, and other years.* The drainage of the Great Bedford Level between the year 1630 and the end of the 17th century has been treated of in the ninth edition (see Bedford Level, iii. 482).' Almost the only*

portion of the original wild Fens now remain- ing is Wicken Fen, which lies east of the river Cam, and south- east of the Isle of Ely.

*The Fen Bivers. * The preservation of the Fens depends in an intimate and essential manner upon the pre- servation of the rivers, and especially upon the preservation of their banks. The Witham, known originally as the Grant Avon, also called the Lindis,* some 70 miles long, and drain- ing an area of 1070 square miles, owes its present condition to en- gineering works carried out in the years 1762- 64, 1865, 1881, and especially in 1880-84. In 1500 the river was dammed immediately above Boston by a large sluice, the effect of which was, not only to hinder free navi- gation up to Lincoln (to which city sea^ going vessels used to penetrate in the 14th and 15th centuries), but also to choke the channel below Bos- ton with sedimentary matter. The sluice, or rather a new structure made in 1764-66, stiU remains ; but the river below Boston has been very materially im- proved (1880-84), first by the construction of a new outfall, 3 miles In length, whereby the channel was not only straightened, but its current carried directly into deep water, with- out having to battle against the sandbanks, often shifting, of the Wash ; and*

secondly, by the deepening and regulation of the river-bed up to Boston, so

^ See Marratt, loc. cit.

6 See W. H. Wheeler, A History of the Fens of South Lincolnshire, pp. 223 et seq. (Boston, 2nd ed., [1897]).

6 W. H. Wheeler, op. cit., pp. 298 et seq.; and for a list of the Acts of Parliament authorizing the various drainage schemes, see Fenland Notes and Queries, 1894, pp. 366-370.

‘ See also S. Wells, History and Drainage of the Great Level of the Fens, 2 vols. (London, 1828 and 1830) ; W. Elstobb, A Historical Ac- count of the Great Level (Lynn, 1793) ; Moore, Associated Architectural Societies’ Reports and Papers (1893) ; Miller and Skertchly, op. cit., pp. 158 et seq.; and Fenland Notes and Queries (1893 and following years).

8 By Leland {Itinerary, vol. vii. p. 41), and In Jean Ingelow’s High Tide on the Lincolnshire Coast.

that vessels drawing nearly 3000 feet can now steam up to the docks of the town.i The Welland, which is ahout 40 miles long, and drains an area of 760 square miles, was made to assume its present shape and direction in 1620, 1638, 1650, 1791, and 1835 and follow- ing years.2 The most radical alteration took place in 1794, when a new outfall was made from the confluence of the Glen (30 miles long) to the Wash, a distance of nearly 3 miles. The Nene, 100 miles long, and draining an area of some 1005 square miles, was first regulated by Bishop Morton (of Peterborough) between the years 1478 and 1490, and it was further improved in 1631, 1721, and especially, under plans by Eennie and Telford, in 1827-30 and 1832. s The work done in the years last quoted (1721 onwards) consisted in straightening the lower reaches of the stream and in directing and deepening the outfall. The Great Ouse, which has a

*length of over 140 miles, and drains an area of 2605 square miles, seems to have been deflected, at some unknown period, from a former channel connecting vid. the Old Croft river with the Nene, into the Little Ouse * below Littleport ; and the courses of the two streams are now linked together by an elaborate network of artificial drains, the results of the great engineering works carried out in the Bedford Level in the 17th century. The salient features of the plan executed by Vermuyden ‘ for the Earl of Bed- ford in the years 1632-53 were as follows : ??? Taking the division of the area made in 1697-98 into (i) the North Level, between the river Welland and the river Nene ; (ii) the Middle Level, between the Nene and the Old Bedford river (which was made at this time, i.e., 1630) ; and (iii) the South Level, from the Old Bedford river to the south-eastern border of the fenland. In the North Level the Welland was embanked, the New South Eau, Peakirk Drain, and Shire Drain made, and the existing main drains deepened and regulated. In the Middle Level the Nene was embanked from Peterborough to Guyhirn, also the Ouse from Earith to Over, both places at the south-west edge of the fenland; the New Bedford river was made from Earith to Denver, and the north side of the Old Bedford river and the south side of the New Bedford river were embanked, a long narrow “wash,” or over- flow basin, being left between them ; several large feeding-drains were dug, including th^ Forty Eoot or Vermuyden’s Drain, the Sixteen Foot river, Bevill’s river, and the Twenty Foot river ; and a new outfall was made for the Nene, and Denver sluice (to dam the old circuitous Ouse) constructed. In the South Level Sam’s Cut was dug and the rivers were embanked.^ Since that period the mouth of the Ouse has been straightened above and below King’s Lynn (1795 to 1821), a new straight cut made between Ely and Littleport, the North Level Main Drain and the Middle Level Drain constructed, and the meres of Ramsey, Whittlesea (1851-52), &c., drained and brought under cultivation.’ The effect of all these drainage schemes has been to lower the level of the fen- lands generally by some 18 inches, owing to the shrinkage of the peat consequent upon the extraction of so much of its contained water ; and this again has tended, on the one hand, to diminish the speed and erosive power of the fenland rivers, and, on the other, to choke up their respective outfalls with the sedimentary matters which they themselves sluggishly roll seawards.*

The Wash. ??? From this it will be plain that the Wash, although 24 miles long by 12 miles wide, is being slowly but gradually over- taken by the fate which has already come upon the rest of the once- considerably greater bay ; namely, it is being silted up by riverine detritus. Its floor is already thickly beset with sand- banks, many of them fixed and permanent, and showing 8 to 15 feet above low water, but several of them constantly shifting, and so diverting the interlacing and often antagonistic currents of the rivers. Through these sandbanks there are two main channels into deep water ; one, Boston Deeps, is kept open by the conjoint waters of the Witham and the Welland ; the other, Lynn Deeps, gives passage to the waters of the Nene and the Great Ouse. The formation of new dry land, known at first as "marsh," goes on however but slowly. During the sixteen or seventeen hundred years which have elapsed since the Romans are believed to have constructed the sea-banks which shut out the ocean, it is computed that an area of not more than 60,000 to 70,000 acres has been won from the Wash, embanked, drained, and brought more or less under cultivation. The greatest gain has been at the direct head of the bay, between the Welland and the Great Ouse, where the

1 Thompson's Boston, pp. 353-368 ; Wheeler's Fens of South Lin- colnshire, pp. 365-370 ; and Chapman, Fads and Remarks, pp. 8 et seq.

2 Wheeler, pp. 295 et seq.

3 Miller and Skertchly, Fenland, pp. 187-203 ; Wells, History of Great Level, pp. 20 et seq., 682 et seq., and 705 et seq.

4 Dugdale, History of Imhanhing , pp. 394^396.

6 The principles upon which he proceeded are set forth in his Dis- course touching the Draining of the Great Fennes (1642), reprinted in Fenland Notes and Queries (1898), pp. 26-38 and 81-87.

6 See Dugdale, History of Imbanfcmg, p. 410, &c. ; Wells, Great Level, pp. 103 et seq.

' See Wells, pp. 755 et seq.

average annual accretion is estimated at 10 to 11 lineal feet. On the Lincolnshire coast, farther north, the average annual gain has been not quite two feet ; whilst on the opposite, Norfolk coast, it has been little more than 6 inches annually. On the whole some 35,000 acres were inclosed in the 17th century, about 19,000 acres during the 18th, and about 10,000 acres during the 19th century .8

The first comprehensive scheme for regulating the outfall channels and controlling the currents of the Fens rivers seems to be that pro- posed by Nathaniel Kinderley in 1751. His idea^ was to link the Nene with the Ouse by means of a new cut to be made through the marshland, and guide the united stream through a further new out " under Wotten and Wolverton through the Marshes till over against Inglesthorp or Snetsham, and there discharge itself imme- diately into the deeps of Lyn Channel." In a similar way the Witham, " when it has received the Welland from Spalding," was to be carried " to some convenient place over against Wrangle, or Friskney, where it may be discharged into Boston Deeps." This scheme was still further improved upon by Sir John Rennie, who, in a report which he drew up in 1839, recommended that the out^ falls of all four rivers should be directed by means of fascined channels into one common outfall, and that the land lying between them should be inclosed as rapidly as it consolidated. By this means he estimated that 150,000 acres would be won to cultivation. But beyond one or two abortive or half-hearted attempts, e.g,, by the Lincolnshire Estuary Company in 1851, and in 1876 and sub^ sequent years by the Norfolk Estuary Company, no serious effort has ever been made to execute either of these schemes.

Climate. ??? The annual mean temperature, as observed at Boston, in the period 1864-85, is 48-7?? F. ; January, 36-5?? ; July, 62-8?? ; and as observed at Wisbech, for the period 1861-75, 49-1??. The average mean rainfall for the seventy-one years 1830-1900, at Boston, was 22-9 inches ; ^ at Wisbech for the fifteen years 1860-75, 24-2 inches,ii and for the fifteen years 1866-80, 26-7 inches ; and at Maxey near Peterborough, 21-7 for the nineteen years 1882- 1900.12 Previous to the drainage of the Fens, ague, rheumatism, and other ailments incidental to a damp climate were widely pre- valent, but at the present

day the Fen country is as healthy as the rest of England ; indeed, there is reason to believe that it is conducive to longevity, i'

Historical Notes. ??? The earliest inhabitants of this region of whom we have record were the British tribes of the Iceni confederation ; the Romans, who subdued them, called them Coriceni or Coritani. In Saxon times the inhabitants of the Fens were known (e.g., to Bede) as Gyrvii, and are described as traversing the country on stilts. Macaulay, writing of the year 1689, gives to them the name of Breedlings, and describes them as " a half ~~savage populu~~ tion . . . who led an amphibious life, sometimes wading, some- times rowing, from one islet of firm ground to another." In the end of the 18th century those who dwelt in the remoter parts were scarcely more civilized, being known to their neighbours by the expressive term of " Slodgers." And yet these rude fen-dwellers have in all ages been animated by a tenacious love of liberty. Boadicea, queen of the Iceni, the worthy foe of the Romans ; Hereward the Saxon, who defied William the Conqueror ; Crom- well and his Ironsides, are representative of the fenman's spirit at its best. And the Fen peasantry showed a stubborn defence of their rights, not only when they resisted the encroachments and selfish appropriations of the " adventurers " in the 17th century, in the Bedford Level, in Deeping Fen, and in the Whithan Fens, and again in the 18th century, when Holland Fen was finally inclosed, but also in the Peasants' Rising of 1381, and in the Pilgrimage of Grace in the reign of Henry VIII. So long as the Fens were uninclosed and thickly studded with immense " forests " of reeds, and innumerable marshy pools and "rows" (channels connecting the pools) , they were a very paradise of wild fowl, being regularly frequented by various species of wild duck and geese, garganies, polohards, shovelers, teals, widgeons, peewits, terns, grebes, coots, water-hens, water-rails, red-shanks, lapwings, god- wits, whimbrels, cranes, bitterns, herons, swans, ruffs, and reeves."

8 It is interesting to compare with these data the vastly greater reclamations made ui the Netherlands (see article Holland) , and the losses and gains, as betwixt land and sea, which have been made in the Frisian Islands.

0 Set forth in The Present State of the Navigation of the Towns of Lyn, Wisbeach, Spalding, and Boston {2ui ed., London, 1851), p. 82 et seq.

i ⬜⬜ By Mr W. H. Wheeler, in Fenland Notes and Queries, April 1901, p. 47.

11 For fuller particulars see Miller and Skertchly, op. cit., pp. 226-

12 Fenland Notes and Queries, 1901, p. 47. 18 See Wheeler, op. cit., p. 487 et seq.

1 See Thompson's Boston, pp. 675-678, where are further references to Pennant, Drayton, Fuller, and other older writers; Wheeler, pp. 471-475; and Miller and Skertchly, pp. 362-388.*

Vast numbers of these were taken in decoys,^ and sent to the London markets. At the same time equally vast quantities of tame geese were reared in the Fens, and driven by road ^ to London to be killed at Michaelmas. Their down, feathers, and quills (for pens) were also a considerable source of profit. The Fen waters, too, abounded in fresh-water fish, especially pike, perch, bream, tench, rud, dace, roach, eels, and sticklebacks. The Witham, on whose banks so many monasteries stood, was particularly famous for its pike ; as were certain of the monastic waters in the southern part of the Fens for their eels.' The soil of the reclaimed Fens is of exceptional fertility, being almost everywhere rich in humus, which is capable not only of producing very heavy crops of wheat and other corn, but also of fattening live-stock with peculiar ease. Lincolnshire oxen were famous in Elizabeth's time, and are specially singled out by Arthur Young,^ the breed being the shorthorn. Of the crops peculiar to the region it must suffice to mention the old British dye-plant woad, which is still grown on a small scale in two or three parishes immediately south of Boston ; hemp, which was extensively grown in the 18th century , ⬜⬜ but is not now planted; and peppermint, which is occasionally grown, e.g., at Deeping and Wisbech. In the second half of*

the 19th century the Feu country acquired a certain celebrity in the world of sport from the encouragement it gave to speed skating. When- ever practicable, championship and other racing meetings are held, chiefly at Littleport and Spalding. The little village of Welney, between Ely and Wisbech, has produced some of the most notable of the typical Fen skaters, e.g,, "Turkey" Smart and "Fish" Smart.7

Apart from fragmentary ruins of the former monastic buildings of Crowland, Kirkstead, and other places, the Fen country of Lincolnshire (division of Holland) is especially remarkable for the size and beauty of its parish churches, which, in many cases, are ~~crowned by lofty and graceful spires. Amongst the finest of these churches, mostly built of Barnaok rag from Northampton~~ .shire, ijaay be mentioned Boston, Kirton, Donington, Swineshead, ___Gosberton, Pinchbeck, Spalding, Moulton, Holbeach, Gedney, Whaplode, and Long Sutton. 8 Using these fine opportunities, the Fen folk have long cultivated the science of campanology.

Dialect. ___ Owing to the comparative remoteness of their geo-graphical situation, and the relatively late period at which the Fens were definitely inclosed, the Fenmen have preserved several dialectal features of a distinctive character, not the least interesting being their close kinship with the classical English of the present day. 8 It was the late Professor E. Freeman i" who reminded modern Englishmen that it was a native of the Fens, ' ' a Bourne man, who gave the English language its present shape." This was Robert Manning, or Robert of Brunne, who in or about 1.303 wrote The Handlynge Sy.nne. Tennyson's dialect poems. The Northern Farmer, &c., do not reproduce the pure Fen dialect, but rather the dialect of the Wold district of Mid Lincolnshire.

Authorities. ___ In addition to the works already quoted, see the bibliographies printed as an appendix to Lines. N. and Q., vol. ii. pp. 27-31 (1890-91) ; W. H. Wheeler, Fens of South Lincolnshire, Appendix ii. ; and in Fenland N. and Q., vol. iii. pp. 28-29 (1895). For a discussion of the general principles of draining low-lying

1 For descriptions of these see Oldfield, Appendix, pp. 3-4, of A Topographical and Hiitoricul Account of Wainfleet (London, 1829) ;

. and Miller and Skertohly, pp. 369-375.

2 See De Foe's account in A Tour through the Eastern Counties, 1722 ilT24r-25).

8 See, for the fauna generally, Miller and Skertchly, pp. 321-112 and .591-634, and, for the fish, the same work, pp. 391-400 ; and con- : suit Thompson's Boston, pp. 674-683, and Wheeler's Fens of South Lincolnshire, pp. 477-484.

4 See John Fletcher's Fair Maid of the Inn (1616) and Love's Pil-grimage (1618).

6 General View, pp. 174-194 and 288-304.

6 lb., pp. 149-161. For lists of the botanical species found in the

Fens, see Miller and Skertchly, pp. 298-306 ; Thompson's Boston, pp.

684-689; and White's Lincolnshire (Sheffield, 1892-93), pp. 43-63;

and compare Lincolnshire Notes and Queries, Supplements to the

years 1893-97 inclusive.

' See N. and A. Goodman, Handbook of Fen Skating (Loudon,

1882).

8 See Murray's Handbook to Lincolnshire (London, 1890), pp. [17] to [25], by the Rev. G. E. Jeans.

9 Lists o dialect words and provincialisms are printed in Thomp-son's Boston, pp. 698-733 ; Miller and Skertchly, pp. 126-131 ; Fenland N. and Q., vol. 1. pp. 48, 88, 151 (1889-91); vol. ii. pp. 97, 135, 180, 272,

326, 359, 392 (1892-94) ; vol. iii. pp. 21, 78, 167, 201, 248, 258, 347 (1895-97); and vol. iv. pp. 87, 122, 139, 179, 213 (1898-1900); Wheeler, Appendix iv. ; and compare Streatfeild, Lincolnshire and the Danes, pp. 314-377 (Loudon, 1884); E. Peacock, Glossary of Words used in . . . Lincolnshire, 2 vols. (London, 1889) ; R. E. G. Cole, Glossary of Words in Use in South-West Lincoln-

.. shire (London, 1886); J. E. Brogden, Provincial Words current in Lincolnshire (Lincoln, 1866). 1" In Longman's Magazine, 1875.

lands like the Fens, see Rivbb Enginebbino. Various phases of Fen life, mostly of the past, are described in Charles Kingsley's Uereward the Wake (Cambridge, 1866), Baring Gould's Cheap- Jack Zita (London, 1893), Manville Fenn's Dick o' the Fens (London, 1887), and J. T. Bealby's A Daughter of the Fen (Lon- don, 1896). (j. T. BE.)

Fenton, a township adjoining the east side of Stoke- upon-Trent (in ~~which parliamentary division it is included), Staffordshire, England, on the North Stafford~~ shire railway. There is a town hall (1889). The prin- cipal industry is the manufacture of earthenware. Area of urban district, 1748 acres. Population (1881), 13,830 ; (1901), 22,742. The area of the civil parish is 1726 acres ; population (1881), 14,136 ; (1891), 17,323.

Ferdinand, Maximilian Karl Leopold

Maria, Pkince of Bulgaria (1861), fifth and

youngest son of Prince Augustus of Saxe-Coburg and Gotha, was born 26th February 1861. Great care was exercised in his education, and every encouragement given to the taste for natural history which he exhibited at an early age. In 1879 he travelled with his brother Augustus to Brazil, and the results of their botanical observations were published at Vienna, 1883-88, under the title of Itinera Principum S. Coburgi. Having been appointed to a lieutenancy in the 2nd regiment of Austrian hussars, he was holding this rank when, by unanimous vote of the National Assembly, he was elected prince of Bulgaria, 7th July 1887, in succession to Prince Alexander, who had abdicated on the 7th of September preceding. He assumed the government 14th August 1887, but Eussia for a long time

refused to acknowledge the election, and he was ac- cordingly exposed to frequent military conspiracies, due to the influence or attitude of that Power. The firmness and vigour with which he met all attempts at revolution were at length rewarded, and his election was confirmed in March 1896 by the Porte and the great Powers. On 20th April 1893 he married Marie Louise de Bourbon, eldest daughter of Duke Eobert of Parma, and in May following the Grand Sobranje confirmed the title of Royal Highness to the prince and his heir. The prince adheres to the Roman Catholic faith, but his son and heir, the young Prince Boris, was received into the Orthodox Greek Church, 14th February 1896. The latter, who is the godson of Tsar Nicholas III., accompanied his father to Russia in 1898, when Prince Ferdinand visited St Peters- burg and Moscow, and still further strengthened the bond already existing between Russia and Bulgaria. The prince is a widower, having lost his consort 31st January 1899. (See also Bulgaria.)

Fergana, a province of Russian Turkestan, formed in 1876 out of the former khanate of Kokand. It is bounded by the Russian provinces of Syr-daria on the N. and N.W., and Semiryechensk on the N.E., China (Kashgaria) on the E., and the Bokhara and Afghanistan bekdoms of Vakhan, Shngnan, Darvaz, and Karateghin, and the Russian province of Samarkand on the S. Its southern limits, on the Pamirsj were established by an international commission, from Lake Zor-kul (Victoria) to the Chinese frontier, while the Shugnan, the Roshan, and the Vakhan were given, in consequence of an agreement between Great Britain and Russia, to Bokhara, in ex- change for part of Darvaz (on the left bank of the Panj), which was assigned to Afghanistan. The area is about 67,000 square miles, of which about 17,600 square miles are on the Pamirs. It occupies the rich and fertile valley of the upper Syr and Naryn, which opens towards the south- west, and it extends northwards over the mountains of the Tian Shan system, while in the south it spreads over

the Alai and Transalai Mountains, including also a portion of the Pamirs. The valley is thus surrounded by a ling of high mountains, reaching their highest altitude in Peak Kaufmann (23,000 feet).

Two rivers, rising in the mountains, water the valley ... the Naryn and the Kara-daria, which, by their confluence near Namangan, form the Syr. This latter, by the numerous irrigation canals drawn from it, gives life to the valley ; but it receives also many small affluents, which bring down great masses of sand, which is deposited along its banks, especially where it pierces the Khojent-Ajar ridge (Karakchi-kums). Here nearly 750 square miles are covered with moving sands, which invade under the influence of the prevailing south-west winds the agricultural districts.

The climate of the valley is dry and warm. In March the temperature reaches 68 .. F., rapidly rising to 95 .. in June, July, and August. For five months, from May, there is no rain, which begins to fall in October. Sno'w and frosts occur in December and January and occasionally in February. All the fertility of the valley is thus dependent ou irrigation.

The population in 1897 was 1,560,411, of whom 707,132 were women, and 286,369 lived in towns. Two-thirds of the people are Sarts (of Turkish origin), who mostly live in the valley, while Kirghiz, partly nomad and partly agricultural, occupy the slopes of the mountains. Tajiks are not numerous, and are scattered everywhere. There are, besides, some Dungans, Kipchaks, Jews, and Tsiganes. On the Pamirs the population was only 2348. The Russians belong to the ruling, merchant, and artizan class, and have only one agricultural settlement. The mass of the population (1,039,115) are Mussulmans, and only 3985 belong to the Russian Church.

Of the 2,563,100 acres of cultivated land, 1,936,700 acres are under constant and the remainder under partial irrigation. The land is admirably cultivated, and the crops in 1896 were : wheat, 3,223,000 cwts. ; rice, 1,277,000 ; jugara, 2,395,000 ; millet, 388,000 ; various, 1,606,000. Lucerne, tobacco, root plants, and all sorts of vegetables are grown in large quantities. Tobacco is exported. Gardening reaches a high degree of perfection. The number of cattle kept by the agricultural population is

very great (198,530 horses, 266,700 cattle, 402,200 sheep, 7145 camels). More- over, the nomads, who graze their cattle on the alpine meadows, keep 113,600 horses, 122,200 cattle, 626,500 sheep, and 16,000 camels. No less than 17,300 acres are under vineyards (yielding 460,000 cwts. of grapes) and 347,500 acres under cotton, the crop of which in 1896 attained to 2,203,000 cwts. Nearly the whole of this (2,006,200 cwts.) was American cotton, which was mostly cleaned within the province, representing an income of ►►1,300,000. The remainder was transformed into about 660,000 cwts. of cotton wool, worth about ►►200,000. Nearly 150,000 acres are under forests belonging to the Crown. The state keeps at Marghilan a forestry farm, from which from 120,000 to 200,000 young trees are given free every year to the population. The silkworm culture, formerly prosperous, has decayed, notwithstanding the efforts of a state farm at Novo-Marghilan. The total income from this source was estimated at about ►►48,000 in 1896. Naphtha, coal, sulphur, gypsum, rock-salt, and lake-salt are known to exist, but only the latter is extracted. The aggregate production of all factories, chiefly sixty-nine cotton-cleaning works, reached ►►112,500 in 1896, and the small factories and workshops (9000 in number) showed a return of ►►150,000. A considerable trade is carried on with Russia for the export of raw cotton, raw silk, hides, sheepskins, and some cotton apd leather goods, and the import of various manufac- tured goods, which are exported to Kashgaria and Bokhara.

The Transcaspiari railway has given a fresh impetus to trade. As to the routes leading to the Pamirs and Kashgaria they are mere bridle paths crossing the mountains. Two passes, Kara- kazyk (14,400 feet) and Tenghiz-bai (11,200 feet), which are open all tlie year, lead from Marghilan to Karateghin and the Pamirs, while Kashgar is reached from Osh to Gulcha, and then across the passes Terek-da van (13,000 feet; open all the year), Taldyk (11,600), Archat (11,600), and Shart-davan (about 14,000 feet).

Only 347 boys and girls received education in Russian schools in 1896, and 14,072 in the native and Russian-native schools.

A railway now enters the province from Kokand, reaching Andijan, while a branch runs south to New Marghilan and Kuva.

The province is divided into five districts, of which the chief towns are : New Marghilan, capital of the province (8977 inhabit- ants), Andijan (46,680), Kokand (82,054), Namangan (61,906), and Osh (36,474). To these Old Marghilan (36,592) and Chust (13,686) must be added. (p. a. k.)

Fergus Falls, capital of Ottertail county, Minne- sota, U.S.A., on the Red river and on two railways. It

has fine water power, which is utilised for flour mills. Population (1890), 3772; (1900), 6072, of whom 2131 were foreign-born.

Ferguson, Sir Samuel (1810-1886), Irish anti- quarian and poet, vas born at Belfast, 10th March 1810. He went to the bar, and was made Q.C. iu 1859, but in 1867 retired from practice upon his appointment as deputy-keeper of the Irish records, then in a much neglected condition. All causes of complaint were re- moved during his administration. His spare time was given to general literature, and in particular to poetry. He had long been a leading contributor to the Dublin University Magazine and to Blackwood, where he had pub- lished his two literary masterpieces, " The Forging of the Anchor," one of the finest of modern ballads, and the humorous extravaganza of " Father Tom and the Pope." He published volumes of miscellaneous poems in 1865 and 1880, and in 1872 " Congal," a metrical narrative of the heroic 'age of Ireland, and, though far from ideal perfection, perhaps the most successful attempt yet made by a modern Irish poet to revivify the spirit of the past in a poem of epical proportions. Lyrics have succeeded better in other hands ; many of Ferguson's pieces on modern themes are, nevertheless, excellent. He was an extensive contributor on antiquarian subjects to the Transactions of the Royal Irish Academy, and was elected its president in 1882. His manners were delightful, and his hospitality was boundless. He died at Howth on 9th August 1886. (e. g.)

Fergusson, James (1808-1886), an eminent Scottish writer on architecture, was born at Ayr on the 22nd of January 1808. His father was an army surgeon with advanced views (for his day) on the hygiene

and construction of hospitals, and thus the son may have in- herited a capacity for the study of plan and construction. But the bent of his life was probably decided when he went to Calcutta as partner in a mercantile house. Here he was attracted by the remains of the ancient architecture of India, little known or understood at that time. This he studied, illustrating and classifying it in his book on Tlie Hock-cut Temples of India, published in 1845. The task of analysing the historic and eesthetic relations of this type of ancient buildings led him to undertake a historical and critical comparative survey of the whole subject of architecture, a work which first appeared in 1855 under the title of Tlie Handbook of Architecture. Although this was in itself a remarkable survey of so wide and complex a subject, it did not satisfy him, and the work was reissued ten years later in a much more extended form under the title of Hie History of Architecture. The chapters on Indian architecture, which had been considered at rather disproportionate length in the Handbook, were removed from the general History, and the whole of this subject treated more fully in a separate volume. The Histoi-y of Indian and Eastern Architecture, which appeared in 1876, and formed a kind of appendix to The History of Archi- tecture, although complete in itself. Previously to this, in. 1862, he issued his Histoi-y of Modern Architecture, in which the subject was continued from the Renaissance to the present day, " modern architecture " beingdistinguished as the period of revivals and imitations of ancient styles, which began with the Renaissance. The essential differ- ence between this and the spontaneously evolved archi- tecture of preceding ages Fergusson was the first clearly to point out and characterize. His treatise on The True- Principles of Beauty in Art, an early publication which attracted little notice at the time, is nevertheless one of the best and most thoughtful of the class of metaphysical studies to which it belongs. Some of his essays on special

points in archaeology, such as the treatise on Tlie Mode in vhich Light was introduced into Greek Temples, and his Notes on the Site of the Holy Sepulchre, included theories which have not received general acceptance.

His real monument is his History of Architecture, which, for grasp of the whole subject, comprehensiveness of plan, and thoughtful critical analysis, stands quite alone in archi- tectural literature ; nor has any other country produced a book comparable with it. His breadth and impartiality of view are especially remarkable. A French or German treatise on architecture, historical or aesthetic, always represents the subject from a French or German point of view; but Fergusson is absolutely cosmopolitan in his standpoint. He received the gold medal of the Royal Institute of British Architects in 1871. Among his works, besides those already mentioned, are : A Proposed New System of Fortification (1849), Palaces of Nineveh and Persepolis restored (1851), Mausoleum at Halicarnassus restored (1862), Tree and Serpent Worship (1868), Pude Stone Monuments in all Countries (1872), and Temples of the Jews and other Buildings in the Haram Area at Jeru- salem (1878). The sessional papers of the Institute of British Architects include papers by him on Tlie History of the Pointed Arch, Architecture of Southern India, Archi- tectural Splendour of the City of Beejapore, On the Erech- theum (an exceedingly interesting paper), and on the Temple of Diana at Ephesus.

Although Fergusson never practised, he took a keen interest in all the professional work of his time. He was adviser with Mr (afterwards Sir) Austen Layard in the scheme of decoration for the Assyrian Court at the Crys- tal Palace, and indeed assumed in 1856 the duties of General Manager to the Palace Company, a post which he held for two years. Moreover, he was largely instru- mental in establishing the Palestine Exploration Fund. His manifold activities continued till his death, which took place in London on 8th January 1886. (h. h. s.)

Fermanagh, an inland county of Ireland, province of Ulster, bounded on the N. by Donegal and Tyrone ; on the E. by Tyrone and Monaghan ; on the W. by Cavan and Leitrim ; and on the S. by Cavan. The area of the administrative county in 1900 was 417,665 acres, of which 98,287 were tillage ; 249,674, pasture ; 83, fallow ; 5777, plantation ; 18,680, turf bog ; 1774, marsh ; 21,196, bar- ren mountain ; and 22,294, water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, is identical with the old judicial county. The

population in 1881 was 84,879 ; and in 1891, 74,170, of whom 37,344 were males, and 36,826 females, divided as follows among the different religions : Eoman Catholics, 41,102 ; Protestant Episcopalians, 26,869 ; Presbyterians, 1312; Methodists, 4779; and other de- nominations, 108. The decrease of population between 1881 and 1891 was 12-62. The average number of persons to an acre was ~~16. Of the total, 68,600 inhab~~ ited the rural districts, being an average of 127 persons to each square mile under crops and pasture. In 1901 the population was 65,243 (Roman Catholics, 36,066; Protestant Episcopalians, 23,109; Presbyterians, 1269; Methodists, 4702; others, 97), being a decrease of 12-0 per cent.

The following table gives the number of births, deaths, and marriages in various years : ???

Year.

Births.

Deaths.

Marriages.

1881 1891

1899

1569 1392 1306

1203 1246 1095

287 294 270

In 1899 the birth-rate per 1000 was 17-6, and the death-

rate 14‘8; the rate of illegitimacy was 2-9 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1899 was 53,895, of whom 27,642 were males and 26,253 females. Enniskillen (5570 in 1891) is the only town with a population of over 1000.

Education. ??? The following table gives the degree of education in 1891 : ???

Males.

Females.

Total,

Percentage. 1

E.G.

Pr.Ep.

Presb.

Meth.

Read and write Read only – . Illiterate . .

24,723 4,035 5,164

22,980 5,394 5,214

47,703

9,429

10,378

62-9 16-6 20-5

72-2 11-5 10-3

88-1 6-9 5‘0

89-2 7-3 3-5

The percentage of illiterates among Roman Catholics in 1881 was 28-2. In 1891 there was one superior school with 102 pupils (all Protestants except one), and there were 190 primary schools, with 9486 pupils (Roman Catholics 5077, and Protestants 4409). The number of pupils on the rolls of the national schools on 30th September 1899 was 11,352, of whom 6329 were Roman Catholics and 5023 Protestants.

Administration. ??? The county is divided into two parliamentary divisions, north and south, the number of registered electors in 1900 being respectively 6242 and 5622. The rateable value in 1900 was ??241,360. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury and (to a less extent) of other bodies were transferred to a county council ; urban and rural district councUs were established ; and under that Act the county now comprises one urban and five rural sanitary districts.

Agriculture. ??? The following tables give the acreage under crops, including meadow and clover, and the amount of live stock, in 1881, 1891, 1895, and 1900 : ???

Tear.

i

i

1

a

m

i

go

Total.

1881

579

23,252

295

16,353

3097

1788

8328

67,752

106,489

1891

872

19,676

400

15,401

8081

1985

1455

65,088

107,953

1895

491

19,149

226

14,434

3127

1647

1610

64,251

104,986

1900

789

16,120

216

13,056

2718

1694

268

68,531

98,287

In 1899 the total value of the cereal and other crops was esti- mated by the Registrar-General at ??652,280. The number of acres under pasture in 1881 was 235,423 ; in 1891, 239,003 ; and in 1900,

249,574.

Tear.

Horses and Mules.

Asses.

Cattle.

Sheep.

Pigs.

Goats.

Poultry.

1881 1891 1895 1900

7075 8288 8611 7609

4088 4547 4887 4854

91,780 102,731 98,398 98,639

6,691 18,742 11,116 11,942

16,861 24,848 23,981 20,150

4411 6460 4746 4702

890,969 489,611 480.655 517,813

The number of milch cows in 1891 was 41,125, and in 1900, 39,572. It is estimated that the total value of cattle, sheep, and pigs in 1899 was ►►1,290,668. In 1900 the number of holdings not exceeding one acre was 767 ; between 1 and 6, 1047 ; between 5 and 15, 3414 ; between 15 and 30, 4204 ; between 30 and 50, 2328 ; between 50 and 100, 1273 ; between 100 and 200, 356 ; between 200 and 500, 82 ; and above 500, 12 ; ►►► total, 13,482. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1900, was 1785, amounting to ►►531,351. The num- ber of loans for agricultural improvements, sanctioned under sec- tion 31 of the Land Act, 1881, between 1882 and 1900 was 181, and the amount issued was ►►9815. The total amount issued on loan for all classes of works, under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1900, was ►►87,158. (w. H. PC.)

Fernando Po, a Spanish island off the west coast of Africa, about 20 miles from the mainland, facing the Kamerun coast. About 44 miles from N. to S., and 20 miles broad, it has an area of 760 square miles; the population in 1887 was 30,000. The capital, Santa Isabel, was said to have 1284 inhabitants in 1885 : 170 whites, 31 half-breeds, and 1082 negroes. The island is now administered by a governor, generally an oflELcer of

raiLk in the Spanish navy, who is at the same time com- mandant of the naval station in the Gulf of Guinea, as which part of his duty is to superintend the sub-governor of the island of Elobey Chico, and the Spanish agents in Annobon, Elobey Grande, and the mainland between the Campo and Muni rivers. The Spanish claim to rule on the mainland from the Campo to the Gabun has often caused considerable friction between the Spanish and French Governments. After very protracted negotiations on the matter, a mixed delimitation commission was appointed, and the respective territorial rights were partly defined by a

treaty in 1885. The French again began encroaching, despite Spanish protests; but at last the limits of the Spanish sphere of influence were defi- nitely fixed in June 1900, when, in return for conces- sions in the Adrar country, France acknowledged Spain's right to the country from the Campo river and the Cameroon frontier as far south as the Muni river ??? some 75 miles. Inland, Spanish authority is to extend about 110 miles, the eastern boundary being fixed along, roughly, 11?? 30' E. long.

Spain keeps an old and badly-equipped war vessel and a few companies of marines to assert her rights in Fernando Po and its mainland dependencies and other isles. The cost of maintaining her rule is ??20,500 a year, of which three-quarters are assigned to army, navy, and civil ser- vices, barely a quarter going to public works and other useful expenditure. The governor rules the island with a council of officials. Public education is in the hands of the Father of the Immaculate Heart of Mary order. Long neglected by its Spanish rulers, Fernando Po has excited more interest in the peninsula since the Spaniards awoke to the fact that other European nations were cast- ing longing eyes at a colony of strategical, naval, and commercial importance, the latter through an increasing trade in the hands of foreigners. The exports of Fernando Po exceeded ??200,000 in 1899, and the area of cultivation in the island increased from 4190 acres in the seventies to 15,000 acres in 1899. Negro labourers drawn from Lagos and other British West African colonies chiefly contributed to the development of the resources of the island.

Ferozepore, or Firozpur, a city and district of British India, in the Jullundur division of the Punjab. The city is a railway junction connecting the North-Western and Rajputana railways, and is situated about 4 miles from the present south bank of the Sutlej. The popula- tion in 1881 was 39,570, in 1891 it was 50,437; the municipal income in 1897-98 was Es.44,681. The arsenal is the largest in India. The Distbict comprises an area of 4302 square miles. It had a population in 1881 of 747,329, and in 1891 of 886,676, giving an average density of 206 persons per square mile. In 1901 the population was 958,218, showing an increase of 8 per cent. The land revenue and rates were Es.11,34,911, the

incidence of assessment being a little over 8 annas per acre ; the cultivated area in 1896-97 was 1,009,006 acres, of which 766,401 were irrigated, including 536,808 from government canals ; the number of police was 670 ; the number of schools in 1896-97 was 210, with 6337 pupils, the proportion of boys at school to the male population of school-going age being 7-6 per cent. ; the registered death-rate in 1897 was 31-73 per thousand. There are four printing-presses, issuing one vernacular periodical. The district has 117 miles of railway, and the length of metalled roads is 97 miles. Distributaries of the Sirhind canal water the whole.

Ferrara, a fortified city and archiepiscopal see of Italy (Emilia), capital of the province of Ferrara, on a low, marshy site, 7f feet above sea-level, but 3 feet beloio the

level of the Po, 3 miles distant, the town itself being on the Po di Volano, a southern arm of the Po delta. Under modern conditions of warfare the fortifications would count for little. There are fine law-courts (Palazzo della Eagione), a brick building in the Gothic style, dating from the 14th cent., but renewed in the 16th, and again in 1838. There are further statues to Savonarola (1875), who was born here, to Ariosto (1833), also a native, and to Victor Emmanuel (1890). The free univer- sity, with courses in law, medicine, and natural science, was attended in 1898 by 77 students, the number of pro- fessors being 22. Amongst the other educational institu- tions may be mentioned an engineering college, a musical academy, and a school of design (1882). The principal industry is the manufacture of clothing. Population of commune (1881), 75,553; (1901), 87,697; of province

(1881), 230,807 ; (1901), 271,467.

Ferrol, a seaport of Spain, 12 miles north-east of Corunna. Population in 1897, 24,957. Both the arsenal and dockyards have been much improved, and the defences seawards increased and mounted with heavy modern guns. A new dock was constructed in 1879, since when good quays have been constructed for the merchant vessels, and, in the new part of the town called Esteiro, for the coasting and smaller vessels. Private building yards have been recently established near the town, which has, indeed,

been generally improved, notably in its public buildings ??? the town hall, palace of the naval captain-general for Ferrol, Cartagena, and Cadiz ; prison, foundling hospital, theatres, casinos, bull-ring, and excellent schools of primary and secondary instruction. In 1898, 299 vessels of 140,638 tons entered, and the same number cleared. The principal exports were pit-wood, old iron and copper, cotton textiles, salt fish, and pyrites. The principal imports were coal (chiefly from England), cereals, cotton, flour, iron, olive oil, textiles, timber, and wines. The total exports in 1898 were valued at ??48,946, imports at ??273,553, as compared with ??19,240 and ??317,950 respectively in 1897.

An excellent relief plan of the fortifications of Ferrol, ancient and modern, exists in tlie Madrid Royal Engineers' Museum.

Ferry, Jules Francois Camille (1832-1893), French statesman, was born at Saint Die, Vosges, 5th April 1832. In 1851 he went to the bar, and both as advocate and in the press he took an active part in opposition to the Second Empire. In 1869 he was elected for the Seine to the Corps Ugislatif, and fought energeti- cally against Ollivier. He was a member of the Govern- ment of National Defence after the revolution of 1870, and was entrusted by it with the administration of the Seine department ; but, for all his energy, he was powerless against the Communards ; he was even taken prisoner by them, but rescued. In 1872 he was sent by Thiers as minister to Athens, but returned in 1873. He joined the Eepublicau Left, opposed the (Seize Mai, and was a pro- minent and bitter fighter against clericalism. In 1S79, after MacMahon's retirement, he became minister of education in M. Waddington's cabinet ; and besides suc- cessfully reorganizing the Paris University, he brought forward the measure of March 1880, aimed at dis- solving the " Jesuits' unauthorized religious associations." In September 1880 he became prime minister, and undertook an active colonial programme, including the extension of French influence over Tunis; but his ministrj- broke up in November 1881. In 1883, however, he again formed a cabinet, and, pursuing his colonial pro- gramme, authorized campaigns in IMadagascar and Tong- king, the latter of which, owing to the disaster at Langson in 1885, not only brought about his downfall, but ruined his popularity. In future he was to Frenchmen le

Tonkinois, and his influence was permanently damaged. In 1887 he was proposed for the Presidency on Grevy's retirement, but though assisted by the Monarchists, was beaten through M. Clemenceau's tactics in supporting an " outsider " rather than that he should succeed. It was not till 1891 that he recovered his position to some extent, being then elected senator for the Vosges, and two years later became president of the Senate. He died in Paris on 17th March 1893. Jules Ferry was a man of great administrative ability, but his name will inevitably be associated chiefly with his anti-clerical campaign and with the Tongking failure.

Ferto, an extensive lake in the western part of Hungary, between the counties of Moson and Sopron. The Romans knew it under the name of Teiso, and the Germans call it Neusiedler-See. Its surface (335 square kilometres) frequently varies, and the lake is so shallow that it sometimes dries up in parts. Eastwards it is united with a marsh, called the Hansdg. It has only a few tributaries. Its water has a taste of salt and alkali, and is much recommended for bathing. Among the reeds on its banks waterfowl congregate in vast numbers, and the fishing is also considerable. In several places of the dry bed traces of prehistoric lake-dwellings (pile-dwell- ings) have been discovered. Plans for drying up the lake have been proposed.

Festiniog, a town and parish of Merionethshire, Wales, at the head of Festiniog valley, standing at a height of over 600 feet above the sea, near the river Dwyryd, 19 miles W.N.W. of Bala by rail. There are many and large slate quarries in this extensive parish. The extension of the railway from Bettws-y-coed to Blaenau Festiniog in 1879 has given a great accession of life to the latter place, which, the centre of the slate quarries and the nucleus of three railways, is a modern town compared with Festiniog "the original village." The "toy" railway, as it is called, has a length of 13 miles from Portmadoc to Blaenau, with a rise of about 700 feet. Area of urban district, 16,323 acres ; popula- tion (1881), 11,274; (1891), 11,073 ; (1901), 11,435.

Feu i I let, Octave (1821-1890), French novelist and dramatist, was born at Saint-L6, Manche, on the 11th of August 1821. He was the son of a Norman gentleman of learning and distinction, who would have played a great part in politics "sans ses diables de nerfs," as Guizot said. This nervous excitability was inherited, though not to the same excess, by Octave, whose mother died in his infancy and left him to the care of the hypersensitive invalid. The boy was sent to the College de Louis-le-Grand, in Paris, where he achieved high distinction, and was destined for the diplomatic service. In 1840 he appeared before his father at Saint-L6, and announced that he had determined to adopt the profession of literar ture. There was a stormy scene, and the elder Feuillet cut off his son, who returned to Paris and lived as best he could by a scanty journalism. In company with Paul Bocage he began to write for the stage, and not without success ; at all events, he continued to exist until, three years after the quarrel, his father consented to forgive him. Enjoying a liberal allowance, he now lived in Paris in comfort and independence, and he published his early novels, none of which are quite of sufBcient value to retain the modern reader. The health and spirits of the elder M. Feuillet, however, having still further declined, he summoned his son to leave Paris and bury himself as his constant attendant in the melancholy chateau at Saint-L6. This was to demand a great sacri- fice, but Octave Feuillet cheerfully obeyed the summons in 1850, after printing his novel called Bellali. In 1851 he married his cousin. Mile. Valerie Feuillet, who helped*

him to endure the mournful captivity to which his filial duty bound him. Strangely enough, in this exile ren- dered still more irksome by his father's mania for solitude and by his tyrannical temper the genius of Octave Feuillet developed. He wrote books which have held their place for half a century, La Petite Comtesse, Dalila, and in particular that universal favourite, Le Roman d'un jeune Homme pauvre. He himself fell into a ner- vous state in his " prison," but he was sustained by the devotion and intelligence of his wife and her mother. In 1857, having been persuaded to make a play of the novel of Dalila, he brought out this piece at the Vaude- ville, and enjoyed a brilliant success ; on this occasion he positively broke through the consigne and went up to Paris to see his play rehearsed. His father bore the shock of his temporary

absence, and the following year Octave ventured to make the same experiment on occasion of the performance of Uh jeune Homme pauvre. To his infinite chagrin, during this brief absence his father died. Octave was now, however, free, and the family immedi- ately moved to Paris, where they took part in the splendid social existence of the Second Empire. The elegant and distinguished young novelist became a favourite at court ; his pieces were performed at Compifegne before they were given to the public, and on one occasion the Empress Eugenie deigned to play the part of Mme. de Pons in Les Portraits de la Marquise. Feuillet did not abandon the novel, and in 1862 he achieved a great success with Sibylle. His health, however, had by this tune begun to decline, affected by the sad death of his eldest son. He determined to quit Paris, where the life was far too exciting for his nerves, and to regain the quietude of Normandy. The old chateau of the family had been sold, but he bought a house called " Les Paillers " in the suburbs of Saint-L6, and there he lived, buried in his roses, for fifteen years. He was elected to the French Academy in 1862, and in 1868 he was made librarian of Fontainebleau Palace, where he had to reside for a month or two in each year. In 1867 he produced his master- piece of Monsieur de Camors, and in 1872 he wrote Julia de Tricmur, which is hardly less admirable. His last years, after the sale of " Les Paillers," were passed in a ceaseless wandering, the result of the agitation of his nerves. He was broken by sorrow and by ill-health, and when he passed away in Paris on December 29, 1890, his death was a release. His last book was Honneur d^ Artiste (1890). Among the too-numerous writings of Feuillet, the novels have lasted longer than the dramas ; of the former three or four seem destined to retain their charm as classics. He holds a place midway between the romanticists and the realists, with a distinguished and lucid portraiture of life which is entirely his own. He drew the women of the world whom he saw around him with dignity, with indulgence, with extraordinary penetration and clairvoyance. There is little description in his novels, which sometimes seem to move on an almost bare and colourless stage, but, on the other hand, the analysis of motives, of emotions, and of " the fine shades " has rarely been carried further. Few have written French with greater purity than Feuillet, and his style, reserved in form and never excessive in ornament, but full of wit and delicate animation, is in admirable uniformity with his subjects and his treatment. It is probably in Sibylle

and in Julia de Tricaur that he can now be studied to most advantage, though Monsieur de Camors gives a greater sense of power, and though Le Roman d'un jeune Homme pauvre still preserves its popularity, (e. g.)

Fever. See Pathology.

Fez {Fds), the most important city of Morocco, is situated about 150 miles, or six days by caravan, south of Tangier, and contains probably 150,000 inhabitants,

including several thousand Jews. Progress lias shown itself there by the establishment in 1888 of English lady- missionaries, previous to which no foreigners resided in this capital, and subsequently of British and Prench vice- consulates. European visitors are now more frequent.

Fichte, Immanuel Hermann von (1797- 1879), German philosopher, son of the famous J. G. Fichte, was born at Jena on the 18th of July 1796 or 1797 (authorities differ), and began life as a schoolmaster at Saarbriicken and at Dtisseldorf. In 1836, having pub- lished some philosophical writings, he became extra-pro- fessor of Philosophy at Bonn, and in 1839 full professor. In 1842 he received a call to Tubingen ; retired in 1863, when he was ennobled, and died at Stuttgart on the 8th of August 1879. Fichte' s writings cover the whole field of philosophy. The titles of the most noteworthy are : System der Ethik, 2 vols. (1850-53), Anthropologie (1856), Psycho- logie (1864), Die theistische Weltansicht (1873). In 1837 he had founded the still-existing Zeitschrift filr Philoso- phie as an organ of his views, more especially on the sub- ject of philosophy of religion, where he was in alliance with Weisse. The difference between Weisse and Fichte is, that whereas Weisse thought that the Hegelian struc- ture was sound in the main, and that its imperfections might be mended, Fichte held it to be incurably defec- tive, and spoke of it as a " masterpiece of erroneous con- sistency or consistent error." Fichte's general views on philosophy seem to have changed considerably as he advanced in years, and his influence has been impaired by these inconsistencies and an

appearance of eclecticism ; an appearance strengthened by his predominantly his- torical treatment of problems, his desire to include diver- gent systems within his own, and the conciliatory tone of his writing. He is best remembered as an opponent of Hegel in the interests of religion and ethics. He attacks Hegelism for its pantheism, its lowering of human personality, and imperfect recognition of the demands of the moral consciousness. God, he says, is to be regarded not as an Absolute but as an Infinite Person, whose nature it is that He should realize himself in finite persons. These persons are objects of God's love, and He arranges the world for their good. Fichte, in short, advocates an ethical theism, and his arguments might easily be turned to account by the apologist of Christianity. In his con- ception of fi.nite personality Fichte recurs to something like the monadism of Leibnitz. His insistence on moral experience is connected with his insistence on personality. One of the tests by which Fichte discriminates the value of previous systems is the adequateness with which they interpret moral experience. The same reason that made him depreciate Hegel made him praise Krause and Schleiermacher, and speak respectfully of English philo- sophy. It is characteristic of Fichte's almost excessive receptiveness that in his latest published work, Der neuere Spiritualismus (1878), he supports his position by arguments of a somewhat occult or theosophical cast, not unlike those adopted by F. W. H. Myers in his writings for the Psychical Research Society. (h. st.)

Field, Cyrus West (1819-1892), American capi- talist, founder of the first Atlantic cable, was born at Stockbridge, Mass., on the 30th of November 1819. At the age of fifteen he became a clerk in the store of Alex- ander T. Stewart & Co. of New York. Five years later he began to manufacture paper, and by 1853 had accumu- lated a sufficient fortune to retire from the business. The following year, in connexion with Peter Cooper and other capitalists, he organized the New York, Newfoundland, and London Telegraph Company. A submarine cable to Ireland was laid by this company in 1866, but it failed to

work. The same year he organized the Atlantic Telegraph Company, and in 1868 this company laid a cable which transmitted messages successfully, but for only about a fortnight. In 1865 an attempt was made

with the Great Eastern to lay another cable, but the cable parted in mid-ocean. Still another attempt was made in the following year, with the same vessel, and this time his long-continued efforts were crowned with complete success. Mr Field received many honours as a result of his achievement, among others a gold medal and a vote of thanks from the U.S. Congress. Among his other enterprises Mr Field took an important part in the development of the elevated railway system in New York City. He died at New York on 12th July 1892.

Field, Eugene (1860-1895), American poet, was born at St Louis, Missouri, 2nd September 1860. He spent his boyhood in Vermont and Massachusetts ; studied for short periods at Williams and Knox Colleges and the University of Missouri, but without taking a degree ; and worked as a journalist on various papers, finally becoming connected with the Chicago News. A Little Book of ProJitaUe Tales appeared in Chicago in 1889 and in New York the next year ; but Field's place in later American literature chiefly depends upon his poems of Christmas-time and childhood (of which Little Boy Blue and A Dutch Lullaby are most widely known), because of their union of obvious sentiment with fluent lyrical form. His principal collections of poems are : A Little Book of Western Verse (Chicago, 1889 ; New York, 1890) ; A Second Book of Verse (Chicago, 1892; New York, 1893) ; and With Trumpet and Drum (1892). Field died at Chicago, 4th November 1895.

Field, William Ventris, Baron (1813-

-),

English judge, son of Mr Thomas Flint Field of Fielden, Bedfordshire, was born on the 21st of August 1813. He was educated at Burton Grammar School in Somerset- shire, and entered the legal profession as articled clerk to Messrs Terrell, Barton, & Smale, a firm of solicitors at Exeter. He was afterwards in a London office (that of Messrs Price & Bolton in Lincoln's Inn), and from 1840 to 1843 was junior partner in the firm of Thomp- son, Debenham, & Field, of Salter's Hill Court. In 1843, however, he ceased to practise as a solicitor, and entered at the Inner Temple, reading for the bar in the chambers of Mr T. K. Kingdon of the Western circuit. After having practised for a short time as a special

pleader, Mr Field was called to the bar in 1850, and joined the Western circuit, but soon exchanged it for the Midland. He obtained a large business as a junior, and became a Queen's counsel and bencher of his inn in 1864. As a Q.G. he had a very extensive common-law practice, and had for some time been the leader of the Midland circuit, when in February 1875, on the retirement of Mr Justice Keating, he was raised to the bench as a justice of the Queen's Bench, and was knighted. Mr Justice Field was an excellent puisne judge of the type that attracts but little public attention. He was a first-rate lawyer, had a good knowledge of commercial matters, great shrewdness, and a quick intellect, while he was also painstaking and scrupulously fair. When the rules of the Supreme Court 1883 came into force in the autumn of that year, Mr Justice Field was so well recognized an authority upon all questions of practice that the Lord Chancellor selected him to sit continuously at Judges' Chambers, in order that a consistent practice under the new rules might as far as possible be established. This he did for nearly a year, and his name will always, to a large extent, be associated with the settling of the details of the new pro- cedure, which finally did away with the former elaborate

system of " special pleading." When in 1890 Mr Justice Field accepted a life peerage and retired, becoming at the same time a member of the Privy Council, his title and retirement were recognized as well earned by the work that he had done. In the House of Lords he at first took part, not unfrequently, in the hearing of appeals to that chamber, and notably delivered a carefully-reasoned judg- ment in the case of the Bank of England v. Vagliano Brothers (5th March 1891), in which, with Lord Bram- well, he differed from the majority of his brother peers. Before long, however, deafness and advancing years rendered his attendances less frequent. Lord Field married Louisa, daughter of Mr J. Smith, but his wife died in 1880.

Fields, James Thomas (1817-1881), Ameri- can publisher and author, was born in Portsmouth, New Hampshire, 31st December 1817, and at the age of four- teen went to Boston as clerk in a bookseller's. Afterwards

he wrote for the newspapers, and in 1835 he read a poem before the Boston Mercantile Library Association. In 1838 he became junior partner in the publishing and bookselling firm afterwards known as Ticknor & Fields. The first collected edition of De Quincey was due to his efforts. In 1862 he became, editor of the Atlantic Monthly, which had been edited by James Eussell Lowell since its commencement in 1857. In 1871 Fields retired from business and from his editorial duties, and devoted himself to literary work. Of his books the chief were the collection of sketches and essays entitled Underbrush (1877) and the chapters of reminiscence composing Yester- days with Authors (1871), in which he recorded his personal acquaintanceship with Wordsworth, Thackeray, Dickens, Hawthorne, and others. He died in Boston, 24th April 1881.

Fife, a peninsular county of Scotland, bounded I^f. by the Firth of Tay, separating it from Perthshire and Forfar, S. by the Firth of Forth, separating it from the Lothians, E. by the German Ocean, and W. by parts of Kinross, Perth, and Clackmannan.

Area and Population. ??? The area of the county is 314,952 acres, or 492-1 square mUes, with a population in 1881 of 171,931, and in 1891 of 187,346, of whom 89,135 were males and 98,211 females, the number of persons per square mile being 381, and of acres to a person 1-7. In 1881 the town population amounted to 85,973, the village to 46,576, and the rural to 39,382 ; and in 1891 the town population to 98,508, the village to 49,923, and the rural to 38,915. Between 1881 and 1891 the increase in population was 8‘96 per cent. In 1901, the papulation was 218,843, of whom 105,096 were males, and 113,747 females. The following table gives the numbers of marriages, births, and deaths, with the number and percentage of illegitimate births for 1880, 1890, and 1899 : ???

Tear.

Marriages.

Births.

Deaths.

Illegitimate Births. |

No.

Percentage.

1880 1890 1899

987 1181 1524

5307 5346 5895

3099

3477 3334

361 291

277

6-8 6-4 4-7

The percentage of illegitimacy is considerably below the average for Scotland. In 1891 there were in the county 3453 English, 61 Welsh, 1732 Irish, and 103 foreigners.

The following are the most important towns in Fife, from the point of view of population : Kirkcaldy, Dunfermline, St Andrews, Cowdenbeath, and Leven.

Administration. ??? For parliamentary purposes Fife is divided into an eastern and a western division. It also includes the Kirk- caldy district of parliamentary burghs (comprising Burntisland, Uysart, Kinghom, and Kirkcaldy) and the St Andrews district of parliamentary burghs (comprising Anstruther Eastern, Anstruther Western, Crall, Cupar, Kilrenny, Pittenweem, and St Andrews), in addition to which Dunfermline and Inverkeithing are included in the Stirling district of parliamentary burghs. The county town is Cupar.

Education. ❖❖❖ St Andrews, the seat of the oldest university of Scotland, contains also many private boarding schools for boys and

girls. There are in the county five higher class schools in receipt of government grants, and offering various facilities for education : Bell Baxter School, Cupar; High School, Dunfermline; High School, Kirkcaldy ; Madras College, St Andrews ; and Waid Academy, Anstruther. The grant for higher class schools for the year ending 31st March 1900 was ❖❖2446. The total accommodation in elementary schools on 31st September 1899 was 44,797, the average attendance was 31,990, and the average cost per scholar was ❖❖2:6: OJ. The amount of school rates received in 1895-96 was ❖❖31,280, in 1896-97 ❖❖32,993, and in 1898-99 ❖❖36,199, the average rate per ❖❖ on rateable value for these years being 8-lOd., 8-38d., and 8‘48d. respectively.

Communications. ❖❖❖ Within recent years the railway communication has been greatly improved, especially in the eastern portion of the county, the whole of the coast towns being now connected by rail from St Andrews to Burntisland ; and while the Forth Bridge has facilitated traffic both with Edinburgh and Glasgow, the Tay Bridge gives easy access to Dundee and the north. In 1898 a line for goods traffic only was opened, bisecting the eastern portion of the county from Cameron Bridge to Lochty.

Agriculture. ❖❖❖ About four-fifths of the total area of the county is under cultivation, and of this about three-sevenths is in permanent pasture. In addition about 9000 acres are in hill pasturage, and over 24,000 acres under wood. Within the last twenty years the acreage under com crops has considerably diminished, the decrease being mainly in the acreage under barley, which is now about a third less than in 1880 ; there has also been a decrease of about 2000 acres in the wheat area, but almost no decrease in that of oats, which occupy more than half of the com crop acreage. Turnips occupy nearly three- fourths of the acreage under green crops, and potatoes about a third, while over 1000 acres are under other varie- ties of green crops. More attention has lately been given to dairy farming, but cattle are still kept mainly for feeding

purposes. The following table gives the main divisions of the cultivated area at intervals of five years from 1880 : ???

Year.

Total Area under Cul- tivation.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1880 1885 1890 1895 1900

246,480 250,918 253,756 256,060 255,398

86,584 88,752 76,994 74,028 73,282

47,179 43,716 42,782 42,536 41,118

62,033 67,636 68,342 63,125 64,341

48,849 55,524 64,131 75,694 75,878

1835

1267

1409

614

593

The following table gives particulars regarding the principal live stock for the same years : ???

Cows or

Tear.

Total Horses.

Total Cattle.

Heifers in

Milk or in

Calf.

Sheep.

Pigs.

1880

10,202

39,674

9,038

72,783

5229

1885

9,717

44,360

10,347

88,346

6713

1890

9,481

[illegible] 48,004

10,628

105,093

6669

1895

10,535

49,912

11,285

94,578

6532

1899

9,791

47,673

12,186

109,780

5511

Industries and Trade. ??? According to the report for 1898 of the Chief Inspector of Factories (1900) the total number of persons employed in factories and workshops in 1897 was 26,052, as com- pared with 25,871 in 1896. Of these 12,580 were employed in textile factories, 12,481 being employed in the flax, hemp, and jute industries, and nine-tenths of these in the flax or linen industry, which besides having its chief seats in Kirkcaldy and Dunfermline is prosecuted at many of the inland villages, specially those in the neighbourhood of the Eden and Leven. Non-textile factories employed 10,859 persons, of whom 2069 were employed in the manufacture of machines and 1516 in the manufacture of paper, &c. Workshops employed 2613 persons, 1514 of whom were em- ployed in clothing industries. The total number of persons em- ployed in connexion with mines and quarries in 1899 was 14,870. The same year 103,479 tons of sandstone were raised, 83,716 tons of limestone, and 97,355 tons of igneous rocks. The coalfield is one of the largest and richest in Scotland, and while coal mining is being prosecuted with increasing enterprise and success, there are ample possibilities of much greater development of the industry. The following table gives the tonnage and value of fireclay, coal, and iron ore in 1890 and 1899 : ???

Tear.

Fireclay.

Coal.

Iron.

Tons.

Value.

Tons.

Value.

Tons.

Value.

1890 1899

23,618 35,662

__4137

5.349

3,121,646 4,927,489

__1,131,597

1,847,808

4,100 25,269

__1845

9476

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On account of the great extent of its sea coast and its situa- tion between two large firths, both the salmon and deep-sea fisheries of Fife are of great importance. All the deep-sea fishing stations east of Wemyss and round by the north coast to Newburgh are included in the Anstruther district, and Wemyss and the small stations in the western portion of the south coast ___ which together land fish of a total value of less than a twelfth of that of the fish landed in the Anstruther district ___ in the Leith district. The following table gives particulars regarding the Anstruther district at intervals from 1885 : ___

Tear.

Fishermen.

ToUl

Persons

employed.

Value of Boat Lines and Nets.

Value of Fish landed.

1890 1899

3325 1937

5354 2493

* ??151,555 ??156,763*

* ??44,671*

* ??47,272*

Authorities. ??? Chief among later works is A. H. Millar's Fife, Pictorial and Historical (2 vols. Cupar-Fife, 1895) ??? a very minute history of the different parishes with notices of the principal families. Other books are : ??? Babington. Records of the Fife Foxhounds. Edinburgh, 1883. ??? G. G. Our Old Neighbours: Folklore of Fife. Anstruther, 1887. ??? Sheriff ^neas Mackay. Sketch of the History of Fife. Edinburgh, 1890. History of Fife and Kinross (Scottish Country History Series). Edinburgh, 1896. ??? Thomson. History of the Fife Light Horse. Edinburgh, 1892. ??? Geddie. Fringes of Fife. Edinburgh, 1894. ??? Pkyde. The Queer Folk of Fife. Glasgow, 1897.

Figueira da Foz, a tovm of Portugal, at the mouth of the Mondego, in the district of Coimbra, 25 miles west from Coimbra. It is a summer seaside resort, a new villa quarter, Bairro Novo, having grown up to the north-west of the old town. It is connected with Cape Mondego by tramway. Coal is mined, and glass is manufactured. The port is a fishing station. In 1899 it was entered by a total of 322 vessels of 22,995 tons. The custom-

house returns in 1899 showed a total of ►►67,244. The products are corn, fruit, wine, olive oil, and cork. Population, 5676.

Fiji Islands. ►►► The Piji archipelago comprises about 250 islands and islets, lying between 177►► E. and 178►► W. long,, and between 15►► 40' and 22►► S. lat., about 1700 miles north-east of Sydney and 1200 miles north of New Zealand. The colony includes the island of Eotuma (or Eotumah), which lies 300 miles due north, and supports a population of 2219, its people being apparently a cross between the Polynesians and Micronesians. The peculiar formation of Vitilevu, the largest of the group, gives rise to three rivers, the Eewa, Singatoka, and Ba, which are disproportionately large for an island scarcely half the size of Wales. The land is of recent geological formation, the principal ranges being composed of igneous rock, and showing traces of much volcanic disturbance. There are boiling springs in Vanualevu and Ngau, and slight shocks of earthquake are occasionally felt. With few exceptions the islands are surrounded by barriers of coral, broken by openings opposite the mouths of streams. The mean temperature of the group is 80►►, but in the hill sanatorium at Nandarivatu (2000 feet) the thermometer occasion- ally falls below 60►►. Some part of the group is usually visited by a cyclone at intervals of four or five years.

Recent Commercial History. ►►► Piji became a British colony in 1874. At that date the islands were suffering from commercial depression, following a fall in the price of cotton after the American civil war. Coffee, tea, cinchona, and sugar were tried in turn, with limited success. The coffee was attacked by the leaf disease ; the tea could not compete with that grown by the cheap labour of the East; the sugar machinery was too anti- quated to withstand the fall in prices consequent on the European sugar bounties. In 1878 the first coolies were imported from India, and the cultivation of sugar began to pass into the hands of large companies working with the most modern machinery. With the introduction of coolies the Fijians began to fall behind in the development

of their country. Many of the coolies chose to remain in the colony after the termination of their indentures, and these are rapidly displacing the European country traders. The recruiting of kanaka labourers has, with a

regular and plentiful supply of Indian coolies, practically ceased. The settlement of European land claims, and the measures taken for the protection of native institutions, causedlively dissatisfaction among the colonists, who laid the blame of the commercial depression at the door of the Government; but with returning prosperity this feeling has almost dis- appeared. Out of 4,953,920 acres in the colony the natives own over 4,500,000, or 45 acres a head. They are not permitted to sell their lands, but large tracts are leased to European planters at a low rental. In 1882 the capital was transferred from Levuka to Suva, on the south- east coast of Vitilevu, where there is a better harbour, and where a larger area of land was at the disposal of the Government.

Vital Statistics. ??? There has been a steady, if not a very rapid, decrease in the native population since 1875. The terrible epidemic of measles in that year swept away 40,000, or about one- third of the Eijians, and although measles again revisited the group in 1898, out of the 200 cases there were no deaths. There has, however, been a steady leakage, principally among young children, owing to whooping-cough, tuberculosis, and croup. Every Fijian child seems to contract yaws at some time in its life, through the mistaken notion on the part of the parents that it strengthens the child's physique. One per cent, of the natives is a leper. A commission appointed in 1891 to inquire into the causes of the native decrease collected much interesting anthropological information re- garding native customs, and provincial inspectors and medical officers have been specially appointed to compel the natives to carry out the sanitary reforms recommended by the commission. A considerable sum has also been spent in laying on good water to the native villages. The Fijians have shown no disposition to intermarry with the Indian coolies. The European half-castes, who numbered in 1900 1258, are not prolific inter se, and they are subject to a scrofulous taint. The most robust cross in the islands is the offspring of the African negro and the Fijian. Pro- bably the only hope of saving the native population lies in miscegenation with the Micronesians, the only race in the Pacific which is rapidly increasing, but the immigrar tion of the Gilbert and Ellice islanders would have to be undertaken by the Government.

The following table shows the population by census 5th April 1891, and by vital statistics 31st December 1899 : ???

???

Census 1891.

Vital statistics 1899.

Male.

Female,

Total.

Male.

Female.

Tojal.

Europeans

1,273

763

2,0.36

2,759

1,614

4,873

Half-castes .

529

547

1,076

624

634

1,258

Asiatics . .

4,998

2,470

7,468

8,875

4,407

13,282

Polynesians .

1,923

344

2,267

1,672

289

1,961

Rotumans .

1,056

1,163

2,219

1,033

1,138

2,171

Fijians . .

56,446

49,365

105,800

52,354

46,124

98,478

Others . . Grand total

143

171

314

471

679

1,160

121,180

...

122,673

Constitution and Government. ??? There has been no change in the government since annexation. The legis- lative council consists of six official and six non-official members nominated by the crown, and the governor has a casting vote. The New Zealand Government made overtures in 1900 to absorb Fiji. The Aborigines Society sent a protest to the Colonial Office on 3rd April 1901, and the Imperial Government declined to sanction the proposal. As the power of the chiefs has declined, the

FIJI ISLAND S ??? F I N A N C E

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roTco tui, or native lieutenant-governor, has been occar sionally replaced by a European resident commissioner. The native chiefs have shown considerable ability both as administrators and magistrates, but, with some exceptions, they seem unable to withstand the temptation of convert- ing public money to their own uses.

Religion and Instruction. ??? The majority of the natives are Wesleyan Methodists. The Koman Catholic mis- sionaries have about 3000 adherents; the Church of England is confined to the Europeans and kanakas in the towns ; the Indian coolies are divided between Mahomme- dans and Hindus. There are public schools for Europeans and half-castes in the towns, but there is, as yet, no provi- sion for the education of the children of settlers in the out-districts. The missions have established schools in every native village, and most natives are able to read and write their own language. The Government has besides established a native technical school for the teach- ing of useful handicrafts. The natives have shown them- selves very slow in adopting European habits in food, clothing, and house-building. The law of custom has so far decayed as to deprive them of many safeguards to health, and the law of competition

not having yet taken its place, the Fijian is left, as it were, stranded between two tides. Until the custom of kerekere, under which he who has is obliged to give to him who has not, is broken down, the lazy will continue to live upon the industrious, and there will be no inducement to accumulate property.

Finance. ––– The revenue is derived from customs, native taxation, and stamp duties. The customs tariff, formerly about 12J per cent, ad valorem, was in 1897 largely in- creased by specific duties. The native taxes, paid in pro- duce cultivated under European supervision, are assessed annually at about £18,000, any excess being sold to the contractor, and returned to the native in cash. In 1899 some £12,000 was thus returned, and so elaborate is the system of book-keeping, that every individual native receives his share before the close of the year in which the produce was grown. Owing to the freedom from hurricanes for the last five years there has been a steady increase in the revenue, and a surplus varying from £6000 to £7000. The actual revenue for 1898 was £94,165, the expenditure £85,741. There is a debt of £109,500 in H per cent, debentures, which is being gradually paid off by a sinking fund, and a debt of £95,476 advanced by the imperial treasury without interest, which is also being paid off. A reserve of £26,000 is being formed to meet any temporary loss of revenue by hurricanes. A branch of the Bank of New Zealand is the only banking establishment in the colony. The currency and weights and measures are English.

Defence. ––– The armed native constabulary numbers 100 men, and there is a volunteer and cadet corps in Suva and Levuka.

Agriculture and Industries. ––– The principal exports are sugar and copra and bananas. The production of sugar has passed almost exclusively into the hands of one power- ful company, whose plant is one of the largest in the world. As fresh areas of cocoanuts have come into bear- ing the export of copra has much increased. The culti- vation of tea and coffee is now almost abandoned, but sufficient tobacco is grown to supply the local consumption of cigars. Soap made from cocoanut oil also supplies the local market.

Tear.

Imports.

Exports.

Sugar.

Copra.

Total.

1890 1895 1899

* ??206,757*

241,769 263,044

* ??244,655*

208,889 340,602

* ??31,013*

94,084 77,330

* ??364,532*

332,209 481,856

Internal Comviunications. ???Good bridle tracks now exist in all the larger islands, and macadamized roads are being pushed forward from Suva. There is a bi-weekly overland mail service by native runners, and a telephone line connects Suva with Ba and Nandi.

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Filey, a seaside resort and fishing village of England, stands on the north side of a bay on the Yorkshire coast, between Scarborough and Bridlington, 9 miles south-east from the former. It [has firm sands, a golf-course, and mineral springs, now however neglected. Population

(1901), 3004.

Finance. ◆◆◆ The complete alteration of the English financial system involved in the thorough application of a free-trade policy was substantially accomplished in 1860. Since then the history of English finance has been one of normal growth, influenced indeed by new conditions and marked by considerable readjustments, but altogether free from revolutionary change. The repeal of the Is. duty on com (1869), and the abolition of the sugar duty (1874), were in fact the removal of a last trace of Protection, and a continuation of the work of simplifying the taxation of commodities, and reducing the charge on the poorer con- sumers, which was characteristic of the reforms of Peel and Gladstone. In tracing the financial history of the thirty years, 1870-1900, the first noticeable point is the almost continuous growth of expenditure. From being under 70 millions in 1870, it rose to nearly Bxpeadi- 87 millions in 1890 ; it passed the 100 million "sto-iqoo. point in 1897, until in 1901, under the pressure of war, it exceeded 183 millions. The principal element in this movement was obviously the increased demands of both the army and navy. The outlay on the former, which was 15 millions in 1870, came in time of peace to exceed 20 millions. In the case of the navy the increase was from less than 10 millions to 30 millions, or over 200 per cent. The

revival of international ill- feeling, the immense development in implements of war, and the higher rates of pay required, owing to the improvement in the standard of life, were, though in unequal degree, the underlying causes. Civil adminis- tration has also become more costly. The State has undertaken new tasks, and has discharged its older duties with greater vigour. Especially remarkable is the ad- vance of expenditure on education, which was less than 2 millions in 1870, but came to 12^ millions in 1900. One item of increase is, however, rather apparent than real, viz., the post-oflB^ce expenditure, for it is the necessary condition of the more than proportional increase in postal receipts. Up to 1899 a reduction is also found under the head of interest and management of debt, which only amounted to ►►16,200,000 in that year, as against 22|. millions in 1869 ►►► a result due in part to the repayment of principal, in part to the conversion measu.re of 1888. The war loans of 1900 and 1901 seriously increased this item.

This great increase in national expenditure has been

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met by a corresponding growth of revenue, ~~which has enabled the various claims of the State to be satisfied with~~ out undue pressure on the enjoyments or the industries of the people. The great division of taxes on commodities (or indirect taxation) has been strictly confined to a few productive articles ►►► spirits, beer, wines, tobacco, and tea (with its substitutes). The rates of imposition have not seriously altered ►►► the lowering of the tea duty from 6d. to 4d. per lb, small increases on spirits and beer, with some adjustment, of the tobacco duty, being the chief changes ►►► and yet there has been an advance in receipts. The customs, indeed, have not shown much change from the average of 20 millions attained be- tween 1865 and 1900(their yield in 1901 was 26f millions). But this steady return has been secured in spite of the surrender

of the sugar duty (1874), and one-third of the tea duty (1890). The South African War led to the raising of the tea duty to its old level, the reimposition of the sugar duty, and to an export duty on coal. The excise has proved more elastic. From 23^ millions in 1871-72, its return advanced to over 33 millions in 1900-1, together with 6 millions set aside for the purposes of local finance. Thus it appears that nearly 60 millions is the sum obtained by the State from taxation of commodities. From being regarded as a temporary and unsatisfactory resource, the income tax has gained the place of a well-established and important element in the tax system. Placed at the very low rate of 2d. in the ►► in 1874, it was gradually ad- vanced, until in 1894 what since seemed the normal peace rate of 8d. was established. The necessary result has been a great increase in yield. In 1876 the returns were just over 4 millions ; for 1893 they were 13^ millions ; in 1899-1900 they reached ISf millions. These figures show clearly that a considerable part of the burden of growing expenditure has fallen directly on the payers of income tax as such. But there has been also a re- arrangement, which has affected the relations of different classes of payers. In 1870 the limit for exemption from the tax was only ►►100, and incomes of ►►200 paid the full tax without abatement. By a series of changes the exemption point has been raised to ►►160, while all incomes of ►►700 and under are allowed abatements. The practical effect is to throw by far the greater part of the burden on the possessors of incomes over ►►700, leaving moderate incomes unaffected by the increase. The fact that, in spite of so extensive a relief, the yield per penny now amounts to ►►2,300,000 is a good illustra- tion of the growth of wealth in the United Kingdom. The war rates of Is. (1900) and Is. 2d. (1901) proved productive, as the yield for 1900-1 was almost 27 millions.

A still more remarkable feature of modern English finance is the increased rigour of the duties on succession to property ►►► the death duties. Instead of the system in force in 1870, under which real property escaped the general or probate duty, which only amounted to 3 per cent., there has been since 1894 a comprehensive " estate " duty applicable to all property, and so graduated as to levy 8 per cent, on estates of 1 million. By this agency the death duties, which supplied less than 5 millions in 1870, and had not reached 10 millions in 1890, came in 1900-1 to 13

millions (besides over 4 mil- lions for local finance). This group of taxes operates as the complement of the income tax, and taking the two together, it is evident that between 1876 and 1901 the taxation on income and property increased more than fourfold, or from 10 millions to 40 millions. Other items of the tax revenue so-called need only cursory mention. The land tax and house duty have both been recently reduced, and the more productive " stamps " have been somewhat enlarged in order to include commercial trans-

actions, until in 1899-1900 they produced 8^ millions. The industrial departments of the post-office have yielded more than 80 per cent, of the non-tax revenue (over 16|- millions in 1899-1900), subject, however, to a heavy deduction for expenses, which reduces the net revenue to the moderate amoimt of 4 millions, or 1 million more than in 1872.

The avoidance of deficits or undue surpluses has been a cardinal principle of modern English finance ; but the great war period, ending in 1815, bequeathed a heritage of debt, involving heavy interest payments. This charge has (as already mentioned) been reduced by (1) the sub- stitution of terminable annuities for funded debt, (2) the establishment of a fixed annual sum for the debt service ??? the " new sinking fund " (1875) ??? which in 1899 was reduced to 23 millions, and (3) the " old sinking fund," i.e., the application of actual surplus to redemption of debt ??? this last a resource which has in recent years been restricted by the continual introduction of late supple- mentary estimates. The process of reduction has varied in its rate. In 1869 the debt principal was 750 millions, in 1885 it was 740 millions, a trivial diminution of 10 millions. By 1899 more progress had been made, as the total debt was only 635 millions, or 105 millions less than in 1885. The work of redemption, which was aided by the conversion of the 3 per cent, stock into 2| per cent, in 1888, was, broadly speaking, nullified by the war loans of 1900 and 1901, as they added over 100 millions to the capital charge.

The chief changes in the complementary system of local finance since 1870 have been (1) even greater in- crease in expenditure than that of the State ; (2) a con- siderable development of "non-tax " revenue derived from municipal industries ; (3) a great increase in indebted- ness, mainly

the consequence of the preceding process ; (4) the automatic growth of the share of tax-revenue assigned to local purposes. As a whole, the English financial system appears to be based on simple and intelligible principles, and to be extremely productive of revenue without great sacrifice on the part of the tax- payers. Through the movable income tax and the re- serve of untaxed articles it has ample resources for emergencies, while the distribution of burdens is not seriously unjust. Its weakest points are probably the treatment of the classes of (1) the very poor, who con- sume taxed articles, and (2) the possessors of moderate incomes, and also the want of relation between central and local finance. (See also Taxation.)

(For the finance generally of otlier countries than Great Britain, see the articles on those countries.)

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Findlay, capital of Hancock county, Ohio, U.S.A., on the Blanchard river, at an altitude of 778 feet. It is a railway centre of much importance, being at the inter- section of five lines ??? the Cincinnati, Hamilton, and Day- ton; the Cleveland, Cincinnati, Chicago, and St Louis; the Eindlay, Fort Wayne, and Western ; the Lake Erie and Western; and the Ohio Central. About 1886 the de- velopment of a natural gas field in the neighbourhood induced a rapid growth of population and manufactures, especially of iron, steel, and glass. Population (1880), 4633; (1890), 18,553; (1900), 17,613, of whom 1051 were foreign-born and 294 negroes.

Findlay, Sir George (1829-1893), English rail- way manager, was of pure Scottish descent, and was born at Eainhill, in Lancashire, on 18th May 1829. For some time he attended Halifax Grammar School, but left

at the age of fourteen, and began to learn practical masonry on the Halifax railway, upon which his father was then employed. Two years later he obtained a situation on the Trent Valley railway works, and when that line was finished in 1847 went up to London. There he was for a short time among the men employed in building locomotive sheds for the London & North-Western railway at Camden Town, and years afterwards, when he had become general manager of that railway, he was able to point out stones which he had dressed with his own hands. For the next two or three years he was engaged in a higher capacity as supervisor of the mining and brickwork of the Harecastle tunnel on the North Staffordshire line, and of the Walton tunnel on the Birkenhead, Lancashire, and Cheshire Junction railway. In 1850 the charge of the construc- tion of a section of the Shrewsbury and Hereford line was entrusted to him, and when the line was opened for traf&c Mr Brassey, the contractor, having determined to work it himself, installed him as manager. In the course of his duties he was brought for the first time into official relations with the London & North-Western railway, which had undertaken to work the Newport, Abergavenny, and Hereford line, and he ultimately passed into the service of that company, when in 1862, jointly with the Great Western, it leased the railway of which he was manager. In 1864 he was moved to Euston as general goods manager, in 1872 he became chief traffic manager, and in 1880 he was appointed full general manager; this last post he retained until his death, which occurred on 26th March 1893 at Edgware. Sir George Eindlay was the author of a book on the Working and Management of an English Railway, which contains a great deal of information, some of it not easily accessible to the general public, as to English railway practice about the year 1890.

Finistere, the most westerly department of France, washed by the English Channel and the Atlantic Ocean.

Area, 2730 square miles, ~~with 43 cantons and 293 communes. Population, 707,820 in 1886, 739,648 in 1896, and 763,193 in 1901. Births in 1899, 23,884, of which 588 illegitimate ; deaths, 17,108 ; marriages, 6125. The schools numbered (1896) 839, with 113,000 pupils ; 16 per cent, of the population was illiterate. Quimper, the capital, with 19,441 inhabitants, and Brest, a military~~ station, with 81,948 inhabitants, are the chief towns.

The area of cultivated land in 1896 amounted to 1,027,994 acres, of which 773,467 acres were plough-land. In 1899 the produce of wheat was valued at ––638,000 ; of rye, ––237,000 ; of barley, ––180,000 ; of oats, ––340,000 ; potatoes, ––998,000 ; mangold-wurzel, ––130,000 ; natural pastures and grass lands, ––640,000. Finistere cultivates with success flax, which in 1899 returned the value of ––44,000, and hemp, which produced ––46,000. Its main source of prosperity, however, is the rearing of horses, which in 1899 numbered 112,270 head. Its cattle totalled 432,680 ; its sheep, 69,400 ; and its pigs, 112,430. The department is not rich in metals, and its industry is restricted to some cloth factories.

Finland, Grand Duchy of, a part of the Russian empire, situated between the Gulfs of Bothnia and Finland, and including, moreover, a large territory in Lapland. It touches at its south-eastern extremity the government of St Petersburg, includes the northern half of Lake Ladoga, and is separated from the Eussian govern- ments of Arkhangelsk and Olonets by a sinuous line which follows, roughly speaking, the water-parting be- tween the rivers flowing into the Baltic Sea and the White Sea. In the north of the Gulf of Bothnia it is separated from Sweden and Norway by a broken line which takes the course of the valley of the TorneS. river up to its sources, thus falling only 21 miles short of reaching the head of the Norwegian Lyngen-f jord ; then it runs south-east and north-east down the Tana and Pasis-joki, but does not reach the Arctic Ocean, and 13 miles from the Varanger-fjord it turns southwards. Finland in- cludes in the south-west the Aland archipelago ––– its

frontier approaching within 8 miles from the Swedish coast ––– as well as the islands of the Gulf of Finland, Hogland, Tytars, &c. Its utmost limits are : 59––48′ ––– 70––6′ N. lat., and 19––2’ ––– 32––50′ E. long. The area of Finland, in square miles, is as follows (Atlas de Finlande, 1899) : –––

Government.

Continent.

Islands in Laltes.

Islands in Seas.

Lakes.

Total.

Nyland . . . Abo-Bj orneborg Tavastehus . . Viborg . . . St Michel . . Kuopio . . . Vasa .... Uleaborg . . .

Total . .

4,062

7,594

6,837

11,6.30

5,652

13,160

14,527

60,348

24

8

97

362

1018

643

62

171

210 1331

130

203 94

286 400 1,400 4,502 2,149 2,696 1,313 3,344

4,582

9,.333

8,.S34

16,624

8,819

16,499

16,105

63,957

123,810

2385

1968

16,090

144,253

Orography. ??? A line drawn from the head of the Gulf of Bothnia to the eastern coast of Lake Ladoga divides Finland into two distinct parts,

the lake region and the nearly uninhabited hilly tracts belonging to the Kjolen mountains, to the plateau of the Kola peninsula, and to the slopes of the plateau which separates Finland proper from the White Sea. At the head-waters of the Tornea, Finland penetrates as a narrow strip into the heart of the Kjolen highlands, where the Haldef jail (Lappish Hal-ditschokko) reaches 4115 feet above the sea, and is surrounded by other fjalls, or flat-topped summits, of from 3300 to 3750 feet of altitude. Extensive plateaus (1500-1750 feet), into which Lake Enare, or Inari, and the valleys of its tributaries are deeply sunk, and which take the character of a mountain region in the Saariselka (highest summit 2360 feet), occupy the remainder of Lapland. Along the eastern border the dreary plateaus of Olonets reach on Finnish territory altitudes of from 700 to 1000 feet. Quite different is the character of the pen- tagonal space comprised between the Gulfs of Bothnia and Finland, Lake Ladoga, and the above-mentioned line traced through the Lakes XJlea and Piellis. The meri- dional ridges which formerly used to be traced here along the main water-partings do not exist in reality, and the country appears on the hypsometrical map in the Atlas de Finlande as a plateau of 350 feet of average altitude, covered with countless lakes, lying at altitudes of from 250 to 300 feet. The three main lake-basins of Nasi-jarvi, Pajane, and Saima are separated by low ands flat hills only ; but one sees distinctly appearing on the map a line of flat elevations running south-west to north- east along the north-west border of the lake regions from Lauhanvuori to Kajana, and reaching from 650 to 825 feet of altitude. A regular gentle slope leads from these hills to the Gulf of Bothnia (Osterbotten), forming vast prairie tracts in its lower parts.

A notable feature of Finland are the asar or narrow ridges of morainic deposits, more or less reasserted on their surfaces. Some of them are relics of the longi- tudinal moraines of the ice-sheet, and they run north-west to south-east, parallel to the striation of the rocks and to the countless parallel troughs excavated by the ice in the hard rocks in the same direction ; while the Lojo as, which runs from Hangbudd to Vesi-jarvi, and is continued farther east under the name of Salpauselka, parallel to the shore of the Gulf of Finland, are remainders of the frontal moraines, formed at a period when the ice-sheet remained for some time stationary during its retreat. As a rule these forest-clothed asar rise from

30 to 60 and occa- sionally 120 feet above the level of the surrounding country, largely adding to the already great picturesqueness of the lake region ; railways are traced in preference along them.

Lakes and Rivers. ??? A labyrinth of lakes, covering 11 per cent, of the aggregate territory, and connected by short and rapid streams (fjdrden), covers the surface of South Finland, offering great facilities for internal navigation, while the connecting streams supply an enormous amount of motive-power. The chief lakes are: Lake Ladoga, of which the northern half belongs to Finland ; Saima (three and a half times larger than Lake Leman), whose outlet, the Vuoksen, flows into Lake Ladoga, forming the mighty Imatra rapids, while the lake itself is connected by means of a sluiced canal with the Gulf of Finland ; the basins of Pyha-selka, Ori- vesi, and Piellis-jarvi ; Pajane, surrounded by hundreds of smaller lakes, and the waters of which are discharged into the lower gulf through the Kymmene river ; Nasi- jarvi and Pyha-jarvi, whose outflow is the Kumo-elf, flowing into the Gulf of Bothnia ; Uleartrask, discharged by the Ulea into the same gulf ; and Enare, belonging to the basin of the Arctic Ocean. Two large rivers, Kemi and Tornea, enter the head of the Gulf of Bothnia, while the Ulea is now navigable throughout, owing to improve- ments in its channel.

Geology. ??? Finland is nearly entirely built up of oldest crystalline rocks. Cambrian, Silurian, Devonian, and Carboniferous deposits are only found on the coasts of the Gulf of Finland and Lake Ladoga, as also along the coasts of the Arctic Ocean (probably Devonian), and in the Kjolen. Eruptive rocks of Palaeozoic age are met with in the Kola peninsula (nephelin-syenites) and at Kuusamo (syenite). The remainder of Finland is built up of the oldest known crystalline rocks belonging to the Archseozoic or Algonkian period. The eldest of them seem to be the granites of East Finland, whose disaggre- gation gave origin to the Ladoga schists and various depos- its of the same period, whose primitive position was altered by subsequent vigorous foldings. Then the country came once more under the sea, and the ddbris of the previous formation,

mixed with debris of eruptive rocks originated from many volcanoes situated then in West Finland, formed the so-called Bothnian series. New masses of granites protruded next from underneath, and the Both- nian deposits underwent foldings in their turn, while de- nudation was again at work on a grand scale. A new series of Jatulian deposits was formed next, and a new system of foldings followed ; but these were the last in this part of the globe. The Jotnian series of deposits, which were formed next, remain still undisturbed. No marine de- posits younger than those just mentioned ??? all belong- ing to a pre-Cambrian epoch ??? are found in the continental portion of Finland. The plateau character of vast por- tions of the surface must have been acquired during the extremely long period during which the country remained a continent. The whole of Finland is covered with Glacial and post-Glacial deposits, the former of which, represent- ing the bottom-moraine of the ice-sheet, are covered with Glacial and post-Glacial clays (partly of lacustrine and partly of marine origin) only in the peripheral coast-region ??? or in separate areas in the interior depressions. Some Finnish geologists ??? ~~Sederholm for one ??? consider it proba~~ ble that during the Glacial period an Arctic sea (Yoldia sea) covered all southern Finland and Skania (in Sweden), thus connecting the Atlantic Ocean with the Baltic and the White Sea by a broad channel ; but no fossils from that sea have been found anywhere in Finland. On the contrary, quite certain traces of submergence under a post-Glacial Littorina sea (containing shells now living in the Baltic) are found up to 360 feet along the Gulf of Finland, and up to 260, or perhaps 330 feet, in Oster- botten. Traces of a large inner post-Glacial lake, similar to Lake Agassiz of North America, have lately been discovered. The country is still continuing to rise, but

at an unequal rate ; of nearly 3-3 feet in a century in the Gulf of Bothnia (Kvarken), from 1-4 to 2 feet in the south, and nearly zero in the Baltic provinces.

Climate. ??? Owing to the prevalence of moist west and south-west winds the climate of Finland is less severe than it is farther east in corresponding latitudes. The country lies thus between the annual isotherms of 41?? and 28?? Fahr., which run in a W.N.W.-E.S.E. direction. In January the average monthly temperature varies from 9??

Fahr. about Lake Enare to 30 along the south coast ; while in July the difference betvsreen the monthly averages is only eight degrees, being 53 in the north and 61 in the south-east. Everywhere, and especially in the inte- rior, the winter lasts very long, and early frosts (June 12-14 in 1892) often destroy the crops. The amount of rain and snow is from 25|^ inches along the south coast to 13-8 inches in the interior of southern Finland.

Vegetation. The flora of Finland has been most minutely explored, especially in the south, and the Finnish botanists were enabled to divide the country into twenty-eight different provinces, giving the numbers of phanerogam species for each province. These num- bers vary from 318 to 400 species in Lapland, from 508 to 651 in Karelia, and attain 752 species for Finland proper; while the total for all Finland attains 1132 species. Alpine plants are not met with in Finland proper, but are represented by from 32 to 64 species in the Kola peninsula.

Fauna. The fauna has also been explored in great de- tail both as regards the vertebrates and the invertebrates, and specialists will find the necessary bibliographical indications in Travaux giographiques ew Finlande, pub- lished for the London Geographical Congress of 1895.

Forests. The chief forest trees of Finland are the Scotch fir (Pinus sylvestris, L.), the fir (Picea excelsa Link.) ; two species of birch (B. verrucosa, Ehrh., and B. odorata, Bechst.), as well as the birch-bush (jB. nana) two species of Abms (glutinosa and incand) ; the oak (Q, pedunculata, Ehrh.), which grows only on the south coast the poplar {Populus tremula) ; and the Siberian larch, in troduced in culture in the 18th century. Over 6,000,000 trees are cut every year to be floated to thirty large saw- mills, and about 1,000,000 to be transformed into paper pulp. The total export of timber was valued in 1897 at 82,160,000 marks. It is estimated, however, that the domestic use of wood (especially for fuel) represents nearly five times as many cubic feet as the wood used for export in different shapes. The total area under for- ests is estimated at 63,050,000 acres, of which 34,662,000 acres belong to the State.

Popxdation. ??? The population of Finland, which was 429,912 in 1751, 832,659 in 1800, and 1,636,915 in 1850, was on the 31st December 1895, 2,520,437, of whom there were 1,276,586 women, and 272,415 lived in towns. The distribution of population in various provinces was as follows : ???

8l8t December 1896.

Population.

Density per sq. Mile.

Abo-Bjorneborg

Kuopio

Nyland

St Micliel ???

Tavastehus

XJleSiborg .

Viborg

Vasa .

419,369 300,291 264,243 186,098 276,010 260,763 379,115 436,548

47 22 61

28 40 4 33 30

Total

2,520,437

20

The movement of the population varies very much from year to year in accordance with the state of crops, the

number of births having varied in the years 1892-96 from 76,206 to 84,010, the number of deaths from 46,709 to 57,486, and the excess of births over deaths from 18,947 in 1892 to 37,301 in 1895. Emigration proper is esti- mated at a few thousands every year, but increased con- siderably after 1898.

The bulk of the population are Finns (2,169,000 in 1895) and Swedes (341,500), who belong to the peasa,nt class in the coast region and to the artisans ; the. mid- dle class and the nobility elsewhere. Of Russians there were only 7000, chiefly in East Finland (Karelia), and 1160 Laps. Both Finns and Swedes belong to the Lutheran faith, there being only 46,509 Greek Ortho- dox and Easkolniks (Nonconformists) Finns, chiefly in Karelia.

The distribution of population in different classes is as follows : Nobles, 0-1 per cent.; clergy, 0-3 ; burghers, 3-1 ; peasants, 26-1 ; others, 70-4. Of these different classes only the first four elect representatives to the Diet.

The chief towns of Finland are : Helsingf ors, capital of Finland, and chief town of the province ilan) of Nyland, chief seaport (73,820 inhabitants) ; Abo, chief town of the Abo-Bjorneborg province, important seaport (34,339) ; TammerfoTS, manufacturing town of Tavastehus Ian (25,338) ; Viborg, chief town of province of same name, important seaport (23,026) ; Uleaborg, capital of pro- vince (13,770) ; Vasa, or Nikolaistad, capital of Vasa Ian (12,384) ; Bjorneborg (11,669) ; Kuopio, capital of pro- vince (9566) ; and Tavastehus, capital of province (5322). All other towns have less than 5000 inhabitants.

Agriculture gives occupation to 77 per cent, of the inhabitants; however, only 117,704 persons are owners of the soil, and 92,838 out of them own less than 62^ acres, 32,711 less than 12|- acres. There are, besides, 70,444

farmers, mostly paying their rent in labour, and a large number of Ansdssige (inhysingar), i.e., agricul- tural labourers, only casually employed, and various classes of farm-servants. Efforts have lately been made by enlightened Finnish patriots to facilitate the acquisi- tion of land by the labourers.

The crops, which are chiefly rye and oats in the south, and barley in the north, up to 68 30', as also some wheat, vary very much from year to year, and yielded for the twelve years 1884-95 a maximum of 14-4 bushels of all cereals per head of total population, and a minimum (in 1892) of 11 bushels. To these, from 4 to 7 bushels of potatoes per inhabitant must be added. An average crop may be taken at 4,202,000 quarters of all cereals, i.e., twice as much as it was in 1861. Every year grain has, however, to be imported to the amount of about 66 lb per head of population. Agricultural machinery is mostly of the old type.

Dairy farming is on the increase, and the foreign ex- ports of butter attained in 1896 nearly 13,000 tons (12 lb per head of rural population). There were in 1898 1,298,990 head of cattle (fifty-seven head per each 100 of rural population), 302,565 horses, 1,092,420 sheep, 214,946 swine, 114,730 reindeer, and 441,000 poultry.

Measures have been taken since 1892 for the improve- ment of agriculture, and the state keeps now twenty-six agronomists and instructors for that purpose. There are two high schools, one experimental station, twenty-two middle schools, and forty-eight lower schools of agricul- ture ; besides ten horticultural schools are being created. Agricultural societies exist in each province.

Fishing is an important item of income. Over 17,000 tons of different fish (8350 tons of herring) are obtained every year. The value of exports of fish, &c., was 2,909,000 marks in 1898, but from 1,000,000 to 1,800,000 marks' worth of fish is also imported every year.

Industry is of recent origin. There are 91,055 workers.

miners, and artisans engaged in all industries, in 7787 separate industrial establishments, the aggregate produc- tion of which was valued at

283,671,147 marks in 1898. The chief of them are: wood (22,522 workers, 71,216,455 marks of annual production), articles of food (10,099 workers, 54,016,941 marks), metallurgy and mechanical works (17,198 workers, 44,642,832 marks), textiles (9677 workers, 33,147,415 marks), paper (6254 workers, 21,230,147 marks), and leather (3431 workers, 15,974,617 marks).

Some gold is being obtained in Lapland, on the Ivalajoki (4-6 kilogrammes in 1898), some silver on Lake Ladoga (455 kilogrammes), copper (253 tons) and tin (21 tons) at Pitkaranta, and iron. The last is obtained partly from mines (19,145 tons of ore, 20,000 tons more imported from Sweden), but chiefly from the lakes (50,000 to 75,000 tons of ore). In 1898, 26,679 tons of cast iron (32,811 in 1897) were obtained, and while 12,722 tons of it were exported to Russia, 21,702 tons of cast iron and 23,235 tons of iron were imported from Sweden and Great Britain, the total consumption of iron having regularly risen so as to reach 43,872 tons in 1898. The textile industries are making rapid progress, and their produce, notwithstanding the high duties, is exported to Russia. The fabrication of paper pulp out of wood is also rapidly growing, the total annual production being now over 50,000 tons, out of which 38,000 tons are exported. As to the timber trade, there are no less than 120 large saw-mills (eighteen only with water-power) and 370 small ones (215 with water-power), and over 900 carpentry establishments.

Roads, Railways, Canals. ??? The roads, attaining an aggregate length of 27,500 miles, are kept as a rule in very good order. The first railway was opened in 1862, and the next, from Helsingfors to St Petersburg, in 1870 (cost only 113,000 marks per mile). Railways of a lighter type began to be built since 1877, and now Finland has 1560 miles of railways belonging to the state and 160 miles to private companies, the state debt contracted for that purpose being 112,430,000 marks. A new line connects Helsingfors with Abo. The gross income from the state railways is 25,047,000, and the net income 7,544,000 marks. Finland has an extensive and well-kept system of canals, of which the sluiced canal connecting Lake Saima with the Gulf of Finland is the chief one. It permits ships navigating the Baltic to penetrate 270 miles inland, and is passed every year by from 4980 to 5200 vessels. Considerable works have

also been made to connect the different lakes and lake-basins for inland navi- gation, a sum of 25,000,000 marks having been spent for that purpose.

For postal service Finland had in 1898 820 post-offices, the total of letters, papers, &c., transported attaining

34,000,000.

The telegraphs (3300 miles) chiefly belong to Russia, excepting the railway telegraphs (2970 miles). Telephones have taken a wide extension both in the towns and be- tween the different towns of southern Finland, the tele- phone net of the chief society having a length of 3180 miles ; the cost of the yearly subscription varies from forty to sixty marks, and is only ten marks in the smaller towns.

Commerce. ??? The foreign trade of Finland has been steadily growing, reaching in 1899 the following items in marks : ???

From or to Eussia.

From or to other Countries.

Totals.

Imports . . Exports . .

85,100,000 57,300,000

165,900,000 130,000,000

251,000,000 187,300,000

The chief trade of Finland is with Eussia, and next with Britain, Germany, Denmark, France, and Sweden. The main imports are : cereals

and flour (44,449,000 marks), metals (22,774,000), machinery (19,334,000), textiles (19,286,000), raw cotton, wool, and twist (10,742,000). The chief articles of export are : timber and wood articles (93,490,000 marks), butter and other farm produce (28,987,000), paper and paper pulp (17,213,000), some tissues, metallic goods, leather, &c.

The ports of Finland were entered in 1898 by 8566 ships of more than nineteen tons, representing an aggre- gate tonnage of 1,919,000 tons ; 6878 of them (862,000 tons) were Finnish. The chieJE ports are Helsingfors, Abo, Viborg, Haugo, and A^asa. The commercial fleet numbered, in 1898, 1896 sailing ships (271,824 tons) and 236 steamers (41,043 tons).

Education. ??? Great strides have been made since 1866, when the new education law was passed, to spread educa- tion in the country. Rudimentary teaching in reading, occasionally writing, and the first principles of Lutheran faith are given in the maternal house, or in "maternal schools " (235 in number), or by ambulatory schools (951), under the control of the clergy, who make the necessary examination in the houses of every parish. This educa- tion is received by nearly all Lutheran children, i.e., by 404,745 children out of 413,867 of from seven to fifteen years of age, and by 5442 out of 7763 Greek Orthodox children of the same age. All education above that level is in the hands of the Educational Department and School Boards elected in each parish, each rural parish being bound (since 1898) to be divided into a proper number of school districts and to have a school in each of them, the state contributing to these expenses 800 marks a year for each male and 600 marks for each female teacher, or 25 per cent, of the total cost in urban communes. In the towns, 12,725 boys and 13,206 girls received in 1898-99 education in such schools from 795 teachers. In the rural communes there were 1650 schools of that standard, with a staff of 1888 teachers, and with 72,991 pupils (32,769 girls). There are besides twenty-two superior folk-schools (about 8000 pupils), all due to private initiative. Of schools for teachers there are now ten (five male, five female ; eight Finnish, two Swedish). Secondary education, formerly instituted on two separate. lines, classical and scientific, has been reformed so as to give more prominence to scientific education, even in the classical (linguistic)

lyceums or gymnasia. There are now fifteen classical and nine "modern" (scientific) gymnasia (4723 pupils), and six " elementary " schools, containing each the three or four first forms of the gymnasia (431 pupils, of whom 155 are girls). There are besides twelve gymnasia (high schools) for girls, with 1732 pupils, and ninety private secondary schools (2916 boys and 4869 girls). For higher education there is the university of Helsingfors (formerly the Abo Academy), which had, in 1900, 2318 students (363 ladies) and 119 professors and docents. Besides the Helsingfors polytechnic there are a number of higher and lower technical, commercial, and navigation schools. Finland has several scientific societies enjoying a world- wide reputation, as the Finnish Scientific Society, the Society for the Flora and Fauna of Finland, several medi- cal societies, two societies of literature, the Finno-Ugrian Society, the Historical and Archaeological Societies, one juridical, one technical, and two geographical societies. All of these, as also the Finnish Geological Survey, the Forestry Administration, &c., issue publications well known to the scientific world. The numerous local branches of the Friends of the Folk-School and the Society for Popular Education display great activity, the former by aiding the smaller communes in establishing schools, and the latter in publishing popular works, starting their

own schools (twenty-one in 1900) as well as free libraries (in nearly every commune), and organizing lectures for the people. The university students take a lively part- in this work.

Finances. ??? The budget of Finland, in an average for the three years 1895-97, was 59,744,777 marks of revenue, to which an average of 5,850,000 marks obtained by railway loans has to be added. As to the expenditure, it attained during the same three years an average of 46,597,693 marks of ordinary expenditure, and 8,643,843 of extraordinary for new railways. The estimates of expenditure for the following three years were: ordi- nary, 51,863,206 marks; extraordinary, 11,388,333; total, 63,251,539 marks. The public debt (3 and 3^ per cent.) reached, on 1st January 1900, 112,432,178 marks. The expenditure of the towns was 16,122,000, and of the rural communes 6,358,000 marks. The municipal and communal debts attained the sum of 31,162,000 marks.

Government and Administration. ❓❓❓ After the year of annexation to Russia, 1809, up till 1898, Finland was con- sidered as a separate state, the head of which, or grand duke, is the Emperor of Russia, and which is governed by the grand duke and the Diet, composed of repre- sentatives of the four estates ❓❓❓ nobility, clergy, burghers, and peasants (30 per cent, only of the population having the franchise). The finances, the judicial, educational, clerical, and economic administration were entirely in the hands of the Diet and the Finnish senate, nominated by the Emperor (see Ency. Brit., 9th ed.). The minister of war, however, had to be the Russian war minister, and the minister of foreign affairs the Chancellor of the Russian empire. Several encroachments, however, have been made since upon that independent organization : the posts of Finland were brought under the Russian post-administra- tion, and an Imperial decree promulgated in 1898 estab- lished the right of the Imperial power to recognize certain matters (and specially military service) as Imperial mat- ters, and to act accordingly without the consent of the Diet, while the use of the Russian language was to be rendered obligatory in various branches of the administration and the courts. This attempt to Russify Finland led to a serious agitation in protest, but without success ; and many Finns left the country rather than submit.

Ethnology, Ethnography, Archceology. ❓❓❓ Considerable researches have been accomplished since about 1860 in these subjects, on a scale which has no parallel in any other country. The study of the prehistoric population of Finland ❓❓❓ Neolithic (no Palaeolithic finds have yet been made) ❓❓❓ of the Age of Bronze and the Iron Age has been carried on with great zeal. At the same time the folk- lore, Finnish and partly Swedish, has been worked out with wonderful completeness (see L'CEtivre demi-secidaire de la SociSti de Litth-ature Finnoise et le mou vement national Finnoifi, by Dr E. G. Palmen, Helsingfors, 1SS2, and K. Krohn's Report to the London Folk-lore Congress of 1891). The work that was begun by Porthan, Z. Tope- lius, and especially E. Lonnrot (1802-1884), for collect- ing the popular poetrv of the Finns, was continued by Castren (1813-1852), Europaeus (1820-1884), and Y. Porkka (1854-1889), who extended their researches to the Finns settled in other parts of the Russian empire, and collected a considerable number of variants of the Kalevala and other popular poetry and songs. In order to

study the different eastern kinsfolk of the Finns, Sjogren (1792-1855) extended his journeys to North Russia, and Castren to West and East Siberia '(NordiscJie Eeisen und Forschungen), and collected the materials which permitted himself and Sehiefner to pub- lish grammatical works relative to the Finnish, Lappish, Zyrian, Tcheremiss, Ostiak, Samoyede, Tungus, Buryat,

London Fire Brigade, Horsed Escape.

JjONDON Fliil'; JiRRlADIi STATION

F I N M A E K ??? F I R E

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^^^3,gas, Yenisei-Ostiak, and Kott languages. Ahlqvist ?^?6-1889), and quite a phalanx of linguists, continued their work among the Vogules, the Mordves, and the Ubi-Ugrians. And finally, the researches of Aspelin {Foundations of Finno-Ugrian Archoeology, in Finnish, and Atlas of Antiquities) led the Finnish ethnologists to direct more and more their attention to the basin of the Yenisei and the Upper Selenga. A series of expeditions (of Aspelin, Snellman, and Heikel) were consequently directed to those regions, especially since the discovery by Yadrintseff of the remarkable Orkhon inscriptions (see Moxgolia), which finally enabled the Danish linguist, V. Thomsen, to decipher these inscrip- tions, and to discover that they belonged to the Turkish iron Age. (See Inscriptions de I'Mnissei recueillies et publides par la Soci6t4 Finl. d'Archiologie, 1889, and Inscriptions de V Orkhon, 1892.)

See also Russia. Full bibliographical indexes of recent works as well as excellent general descriptions of Finland, will be found 111 Travaux geographiques executes en Finlande, published for the London Geographical Congress of 1895. Other works are Atlas de Finlande, with French Texte, published in 1899 by the

Geographical Society of Finland ; Notices sur la Finlande, published in 1900 for the Paris Exhibition; Finlnnd in the Nineteenth Century, published on the same occasion ; La Constitution du Grand-Duche de

Finlande ; recueil de lois fondamentales, &c. ; and an excellent illustrated and detailed work Finlandia (1898) , in which the country and its life are very well described, and the constitutional ques- tion is documentally dealt with so as to answer the arguments of the Russian imperialists (Ordin, &c.); this work contains a very complete bibliography in all branches. A good English book on the constitutional history is Finland and the Tsars, by Joseph Fisher, 2nd ed., London, 1900. (p. a. K.)

Finmark, in Norway, the regions inhabited by the Lapps, whom the Norwegians call "Finns." (See Lapland.)

Finsterwalde, a town of Prussia, on the Schake- bach, emptying into the Little Elster, 28 miles west-south- west of Cottbus by rail, in the circle of Luckau, govern- ment district of Frankfurt. The town has a Gothic church (1581), a castle, two girls' schools, cloth and cigar factories, iron-foundries, flour and saw mills, machinery factories, screws, &c. Population (1890), 8133 ; (1900),

10,726.

FIRE AITD FIRE EXTII^CTIOK

United Kingdom.

IN England it is only in recent years that the matter of fire protection on what may be termed efficient lines has been seriously considered. A committee of the House of Commons reported in July 1900 that, except in the large cities and towns, the fire arrangements, where any arrangements exist at all, were often inadequate, and that in the majority of places and districts there were

practically no arrangements for protection against fire. The committee accordingly called attention to the need of legislation upon the subject.

Fire arrangements may be regarded from two points of view, i.e., the saving of life, and the preservation of property ; and it is possible for a force to be equipped with greater consideration to the saving of property

than to the saving of life, or vice versd. Eoughly speaking, the appliances for life saving, such as ladders, poles, ropes,

London Fire Brigade Steam-Float Alpha.

&ca., are utilized more or less in saving property, as they enable firemen to get close to a fire, whether life has to be saved or not. On the other hand, in country towns, it may be argued that provision of life-saving appliances niay, to a certain extent, be disregarded, inasmuch as statistics show that very few, if any, deaths result from ►►re. In Great Britain and Ireland the fire service is recognized as a public service, and such questions as those of payments to brigades, of the amount of pecuniary assistance (if any) that insurance companies should con-

tribute to the cost of brigades, of the protection of the fireman's uniform under the Uniforms Act 1894, of the powers given to the officers commanding brigades, &c., will probably be matters of legislation in the near future. There is no general statute, but London and a few of the larger cities work under their special and local Acts of Parliament. The Fire Brigade Act of 1865, a compara- tively short and simple statute, gives the chief officer of the London fire brigade extensive authority to act on the occasion of fire, including powers " to take any measures

that appear expedient for the protection of life and property."

The monthly summary for 1900 and the summary of causes of fire in 1900 (pp. 401-2) give an idea of the work done by the London fire brigade. The county of London, which is about 130 square miles in extent, con- tains sixty-nine stations, each commanded by an oflB.cer, and having life-saving and fire-extinguishing appliances adequate for dealing with a moderate-sized fire in that particular district. When a call is received at one of these stations (which are, generally speaking, about a mile apart) the whole strength of that station attends, and appliances are

sent on from neighbouring stations to reinforce, according to the call received and the risk of

the locality. In London, every machine, whether horsed- eseape, fire-ladder, or steamer, is sent away as a complete unit, with a sufficiency of men, hose, &c., to get to work immediately on arrival. The London horsed-escape carries a 60-feet life-saving ladder, a coachman, and four firemen, and is never sent out of the particular area for the protection of which it is provided.

The London County Council has, in recent years, spent, and continues to spend, large sums of money in im- proving the fire brigade, both on land and on the river, equipping it with the very best machines to suit the peculiarities of the water supply and other circumstances peculiar to London. Illustrations are given of a horsed- escape and a steam engine, and of the fire-float Alpha, the

London Fibe Brigade Steam Engine.

latest addition to London's river service. Improvements, on the lines of the metropolitan fire brigade, with slight variations to suit the local conditions, are being intro- duced in several country towns and districts. In a few cases, where the water supply is bad or difficult to get at, the chemical engine, such as is largely used in 'America, has been tried, but it cannot be said to have found favour generally. The smaller types of this machine, carried and worked by hand, are frequently used for indoor purposes, and it is a matter for the consideration of the householder whether these appliances, or some form of hand-pump, with buckets, afford the best " first aid " for indoor work in fire extinguishing pending the arrival of qualified firemen, who should invariably be promptly called on an outbreak of fire being discovered.

Fire-alarm posts, giving facilities for telephonic com- munication, of the simplest possible pattern are placed at

distances varying from 300 to 800 yards throughout London, so that in few cases, save in the suburbs, has- a person to run more than 400 yards to call the brigade. In addition, calls are received (o) by means of

telephone exchanges, (6) from police stations which are in direct telephonic communication with the brigade, and (c) by persons running to fire stations. We give illustrations of the latest pattern of London alarm posts, and the method of using the telephone attachment.

One of the principal considerations with any brigade is to get the earliest possible call to a fire, and several forms of automatic alarm have been devised. Whether an elec- tric bell be set ringing by the expansion of a thin wire under the influence of the heat produced by the fire, by the rising of mercury in a thermometer, by the melting of some]iarticular compound at a low temperature, or by the fusing or metallic joining of the circuit wires, is a.

matter of choice to the occupier ; but the main objects to him are (1) the reduction of his fire insurance premium, and (2) the reduction of loss to a minimum should an out- break occur. It is pos- sible that considerable advantage would accrue by the installation of an automatic alarm which would, at an early stage, attract the atten- tion of the police on duty, who could verify the existence of a fire and then immediately call the brigade.

The method of insur- ing a deluge of water in the early stages of a fire is also proving itself, in certain cases, of ad- vantage. This system is called the Sprinkler system, and consists of water pipes so travers- ing a building that on the application of heat the valve is automati- cally set free and the water descends in the neighbourhood of the fire. The system, devised in much the same way, of water curtain, or a stream of water strik- ing the side of a buUding, doorway, or lift, has also been frequently installed, but the governing factor in these cases

Fire- Alarm Post.

Fire-Alarm Post: Method of using Telephone Attachment.

usually is the reduction of premium allowed to the occupier

by the company which insures the premises and contents.

Experiments have been carried out in London with a

view to substituting oil for coal used in working steam engines, and some success has been met with. The practicability of substituting motor power for horses used in the traction of fire appliances is also being considered, and it is hoped that the change will result in economy, to say nothing of increased efiiciency.

With a low-pressure water supply the time within which the steam, or other pumping power, can be avail- able is a matter of the greatest importance, especially when coping with an outbreak in high buildings. For such buildings, the system of dry mains is viewed with favour. Under this system pipes to deliver water at suitable points are installed, but are not filled with water until the connexion is made to the water main or pump, as the case may be, outside the building.

The net cost to the ratepayers of the maintenance (including pensions) of the London fire brigade is about equal to a rate of l^d. in the pound, but in the country generally, where first-class volunteer labour can be ob- tained, it is quite possible to get a reasonably efficient brigade for something like a rate of a halfpenny in the pound. If this fact were generally appreciated, and districts could lay aside all municipal jealousies and freely help each other in the case of large fires, as is done by London and the larger towns, the result of the property loss would be far different.

The question has been discussed whether fire insurance companies should be legally required to contribute gener- ally to the cost of maintaining fire brigades on some such system as obtains in London, where they pay ??35 per million per annum on property insured. On the one hand, it is argued that there should be some general and fair system by which insurance companies should contri- bute towards the expenses of fire brigades, which in the ratio of their efficiency do so much for the benefit of the companies' shareholders ; and on the other hand, it is argued that insuring is . an industry of such essential benefit to the community that it is not expedient to tax it. Against the latter view,

however, it is urged that if the industry be so profitable, the ratepayers should get the benefit of it, and this might lead either to municipal insurance or to the example of large railway companies, who are their own insurers, being followed by municipal authorities.

The strength of some of the principal brigades is as follows : ???

London: 1216, including chief, second, and third officers and all ranks, also workshops, stores, and clerical staff.

Glasgow : 116, including chief officer, superintendent, and all ranks.

Manchester : 100, including chief officer and all ranks.

Belfast : 78, including chief officer and all ranks.

Birmingham : 65, including chief officer and all ranks.

Monthly Calls

to Fire in London

1900.

Per Centum.

Total calls

Month.

in each Month.

Serious.

Slight.

January

6-38

93-62

409

February .

3-42

96-58

352

March

3-46

96-54

428

April .

1-70

98-30

387

May .

2-00

98-00

392

June .

3-68

96-32

345

July .

3-13

96-87

432

August

1-90

98-10

360

September .

5-32

94-68

331

October

2-82

97-18

379

November

2-10

97-90

337

December . Total .

4-80

95-20

377

3-40

96-60

4529

S.IV.-si

402

FIEE AND FIEE EXTINCTION

Summary of Causes of Fires, 1900.

Airing bedding

Airing linen

Bisulphide of carbon

Boiler, explosion of .

Boiler, overheat of .

Boiling over chemicals, fat, oil, pitch, spirit, tar, re- sin, varnish, wax, &o.

Burning rubbish

Candle ....

Candle , curtains or windovr blinds coming in con- tact with

Candle, decorations com- ing in contact with

Celluloid film coming in contact with flame

Children playing with fire

Children playing with lucifers

Children playing with gas- light ....

Coke, overheat of .

Copper, overheat of

Ether ....

Electric wires, short cir- cuit of .

Eire, clothes coming in contact with

Eire, curtains coming in contact with

Eire-damp

Eire, falling on

Fireworks, explosion of .

Eireworks, letting off

Elue blocked up

Elue, defect in

Elue, copper, defect in

Tlue, copper, overheat of

Elue, furnace, defect in

E”lue, furnace, overheat of

Tlue, foul

Elue, overheat of

JFlue, adjoining, defect in

Elue, adjoining, foul

E’lue, adjoining, overheat of

Eorge, overheat of .

Eriction of machinery

^Fumigating

J’urnace, overheat of

Gas bracket, swinging

Gas, escape of .

Gas, explosion of

Gasfitters at work .

Gaslight .

Gaslighting

Gaslight, curtains or win- dow blinds coming in contact with .

???Gaslight, decorations com- ing in contact with

Gaslight, goods coming in contact with .

Gaslight, linen coming in contact with . . 3

Gaslight, scenery coming in contact with . . 1

Gas, seeking for an escape of, with light . . 31

Gaslight, overheat of . 4

Gaslight, straw falling on 1

Gas stove ... 24

Gas stove, overheat of . 11

Gas stove, portable . . 5

Gas stove, goods falling on 1

Carried forward . 1130

7 68 1 2 3

44

9

173

37

1 57

116

1 3 2

1

22

3

1

1

1

2

19

115

3

4

1

4

21

12

34

3

4

1

5

6

6

32

12

71

12

Brought forward

Gas stove, clothes cominj in contact with

Hearth, defect in

Hearth, timber under

Hot ashes

Incendiarism .

Incubator, overheat of

Kiln, overheat of

Lamp, mineral oil .

Lamp, mineral oil, curtains or window blinds coming in contact with

Lamp, mineral oil, decora- tions coming in contact with ....

Lamp, mineral oil, clothes coming in contact with

Lamp, mineral oil, explod- ing .. .

Lamp, mineral oil, upset

Lamp, naphtha

Lamp, plumber's, explod- ing .. .

Lamp, spirit

Lamp, spirit, upset .

Lighted taper .

Light thrown down .

Light thrown from street

Lightning

Lime slaked by rain

Lime slaking

Lucifers .

Mineral oil upset

Oven, overheat of

Painters at work

Plumbers at work .

Salvage, overheat of

Smokehole, overheat of

Smoking tobacco

Spark from copper fire

Spark from " devil "

Spark from fire

Spark from flue

Spark from flue adjoining

Spark from furnace .

Spark from locomotive

Spirit upset

Spontaneous ignition

Steam pipe, overheat of

Still, overheat of

Stove, drying, overheat of

Stove improperly set

Stove, overheat of .

Stove, adjoining, overheat of .

Stove, ironing, overheat of

Stove, mineral oil

Stove, mineral oil, over- heat of .

Stove, mineral oil, upset

Stove pipe, overheat of

Stove, mineral oil, explod- ing .. .

Stove, portable

Stove, spirit

Stove, spirit, upset .

Stove, mineral oil, goods coming in contact with

Stove, beeswax upset on .

Unknown

Vapour of spirit coming in contact with flame

Watchman's fire

1130

1

12

1

74

6

1

3

45

18

2

23

157

4

2 12

268

34

1

1 2

7

O fj

5 1 1

2

4

13

4

1

190

11

4

12

16

1

2

3

1

3

38

18

4

2 21

3

23

1

3 3

7 1

1

1

1156

10 2

Total . . 3385

(l. de l. w.)

United States.

The freedom from great fires and conflagrations that has marked the years since 1876 in America is the more notewortliy because of the abnormal growth of large towns and cities, the great increase in number of

extremely high buildings, and the development of great manufacturing establishments, all of which add enor- mously to the danger from fire. The fire-proof construc- tion of buildings (see Building) has been perfected, and many appliances have been invented, especially in the United States, for the prevention and extinction of fires. The fire departments in the large cities of the United States are organized on a semi-military basis, and in each city are under the entire charge of a single com- missioner or board of commissioners. A " chief of de- partment " is the executive officer on all occasions when the force is called into action. Under him are the "battalion" or "district-chiefs," each in command of a district of the city. Each engine company consists of a captain and lieutenant, engineman and assistant engine- men, and eight hosemen. Each ladder company has a captain, lieutenant, and twelve laddermen. The district- chief's driver is a telegraphist, and on reaching a fire stations himself at the nearest alarm box and opens tele- graphic communication with headquarters, thus insuring instant control of the whole department. When the concentration of the force at a large fire leaves the neigh- bouring districts unprotected, outlying companies still in reserve are brought in and take position in the houses of those

already called out, just as regiments in reserve are advanced to support the attacking column. At head- quarters a covering board, or map on which the various engine houses are marked, is made to show by means of movable pegs the position of each company in action and in reserve.

Fire Prevention. ??? The Automatic SprinMer is of con- spicuous value in mills and factories, and similar build- ings where the risks are great. It consists of lines of

Figs. 1, 2, 8. ??? Automatic Sprinkler.

water pipes carried through the building near the ceiling, 8 or 10 feet apart. Sprinkler heads are attached on the upper side of the pipe. The main supply pipe must be large enough to give a discharge at full pressure from all of the sprinklers in the room at once. The sprhikler (Figs. 1, 2, 3) has a half-inch outlet, kept closed by a valve

held in place by a device, an essential feature of which is an easily fusible solder. A fire starts and the heat quickly melts the solder ; the valve is swept away by the water pressure ; the half-inch stream bursts out, and striking against the deflector above is spread in a shower. Under ordinary conditions, from one to four sprinklers will extinguish 'the fire. In extreme eases all of the sprinklers in a room may be called into action. In the record of all of the American Associated Factory Mutual companies for the five and a half years ending 1st January 1900, it appears that of 563 fires where automatic sprinklers were called into play, 129 (60 without loss) were held by one automatic sprinkler, 88 (31 without ioss) by two sprinklers, 61 (21 without loss) by three sprinklers, 44 (10 without loss) by four sprinklers, 40 (6 vnthout loss) by five sprinklers. In the remaining 201 fires held by sprinklers (26 without loss), the sprinklers opening ranged from six to two hundred and fifty. The Dry-Sprinkler System is of value only where the water is liable to freeze. The pipes are filled with air under a pressure of say 10 lb. The opening of the sprinkler head by the heat allows the escape of the compressed air; the consequent

loss of pressure unlocks a simple arrangement of levers and opens the water valve of the main feed pipe ; the water under proper pressure then circulates through all of the sprink- ler pipes.

Automatic Fire Alarm. ??? The system of the Boston Automatic Fire Alarm Company has been perfected during the period 1880-1901, and its efftciency proved. The essential feature is a " thermostat " or heat-detector, contained in a small round box about 2^ inches in diameter with a perforated lid. It consists of a bent spring, made up of a strip of steel and one of brass welded together, the brass upon the outside of the curve. Its action depends on the greater expansion of the brass. One end only of the spring being fast, the heat causes the free end to bend inwards till it closes an electric circuit. These instruments are placed, usually at in- tervals of about 15 feet each way, upon the ceiling of a room, closet, or nook in the building, and are adjusted to act at any desired temperature, ordinarily at 130?? to 150?? F. These are connected with each other and with the " transmitter." The heat from even a very small fire rising to the ceiling quickly causes the thermostat to transmit the exact position of the fire to the of8.ce of the Company. The force of the fire department is usually on its way to the fire about one minute after the ther- mostat acts. The receiving, recording, and transmitting apparatus are the same in principle as the larger ones at the city fire alarm headquarters described below. With so sensitive an instrument a certain number of needless alarms seems inevitable, but its value is beyond question. In 1900 more than 600 buildings in Boston and 2000 in New York were equipped with these automatic fire alarms.

The Fire Alarm System consists (1) of street or signal boxes on a closed electric circuit, from which signals giving automatically the number of the box are sent to headquarters ; (2) various receiving and recording instru- ments at headquarters ; (3) apparatus for transmitting to the several houses of the department the number of the box signalled ; and (4) a battery or other adequate source of electric power. The electric fire alarm telegraph, in- vented by Dr W. F. Channing and Moses G. Farmer, was first adopted in the United States at Boston in 1861. It had then 40 miles of wire in 5 circuits, 45 signal boxes, and 10 bells. In 1899 it had 1500 miles of wire, 624 signal boxes, 20 bells, 104 gongs, 90 tappers, and

35 circuits in use, with equipment for 70 circuits. During the twenty years to 1871 about twenty cities in the United States adopted the fire alarm system. By 1876 the number had

Fig. 4. ??? Alarm Clock.

increased to seventy-five. In the signal box is a clock- work (Fig. 4), which is set in motion by once pulling down the hook that projects through the inner door. This mechanism breaks and closes an electric circuit by means of a wheel, and thus telegraphs to head- quarters four rounds of the number of the box. The box contains a light- ning arrester, which also pro- tects the mecha- nism against the high tension cur- rents of the trolley and the electric-light wires, a telegraph key, and a call- bell for fire department and police signals. Keyless boxes (Fig. 5) have replaced the locked boxes in districts where they are less liable to be mischievously tampered with, and valuable time is thereby saved. To open the outer door the conspicuous handle is turned to the right, which rings the bell inside, and by calling attention to the fact that the box is being opened, acts as a safeguard against malicious false alarms. The alarm is given by pulling the handle projecting through the inner door, as already mentioned. When boxes are placed within short distances of each other, two or more are liable to be pulled at the same moment for the same fire. To obviate confusion in the quarters, contiguous boxes are placed

Fig. 5. ??? Keyless Box.

record at head- are placed on different cir- cuits, so that the number of each is recorded separately.

Fig. 6. ??? Register.

From twenty to twenty-five boxes are usually on a cir- cuit. “Non-interference” boxes are designed to meet the same difficulty ; the first box pulled is however the only one whose number is recorded. They are advis- able when contiguous boxes are cq the same circuit.

FIKE AND FIEE EXTINCTION

” Non-interference-successive ” boxes contain a device whicli holds up all the other boxes until the first has finished its four rounds and then allows each box iu succession to send in its alarm. Boxes in addition to those in the street are now placed in many large public buildings, such as school houses, hospitals, hotels- and

Fig. 7. ??? Transmitter.

theatres, and in many private buildings. Connected with each box small auxiliary boxes may be placed at various points in the buildings. At the fire alarm headquarters are appliances for transmitting the signals to the several houses of the department. The ” register ” (Fig. 6) re- ceives through the relay and records the number of the

Fig. 8. ??? Transmitter.

run

alarm box upon a strip of paper that is automatically

out as soon as the box is started. Simultaneously a vibrating bell connected with the register strikes the same number. The ” transmitter ” (Figs. 7 and 8) is regulated by an arrangement of dials to strike upon the ” tappers ”

in the department houses the combination of blows that makes up the number of the box. On the first inti- mation of an alarm the operators at headquarters take their positions, one at the receiver to observe and call out the number, and the other at the transmitter to set the dials as each figure of the number is called out. As soon as one round has been received the transmitter is released and strikes rapidly but distinctly on the tappers in each house three rounds. Before the alarm box has completed its four rounds the engines are well on their way to the fire. As soon as the tapper- transmitter stops, another similar transmitter on a different circuit strikes the alarm on the large gongs in the houses and on such public bells as may be necessary to notify the call-numbers of the

suburban companies. The time consumed in sounding the alarm ranges from fifteen to thirty seconds, according as the number of the box is low or high. Electric motor generators have taken the place of the old chemical bat- teries to furnish the electric currents for all circuits.

Fire Engines. ❓❓❓ The practical limit in the size of the horse-drawn engine has been reached. Engines of the first order have steam cylinders 9 inches in diameter and pumps 5\ inches in diameter with an 8-inch stroke in each. They are usually run at 120 lb steam pressure, and in practice seldom deliver much over 600 gallons a minute. " Self-propellers " of the latest form have double the capacity of the horse-drawn engine of a few years ago. They have steam cylinders 9-|^ inches in diameter and pumps 5f inches in diameter with an 8-inch stroke in each. At 300 revolutions the pumps will deliver 1036 gallons a minute. They stand in the houses always under a working pressure of steam. They weigh, when fully equipped, a little less than nine tons, but in spite of their great weight thej^ are easily guided, and with an unob- structed roadway can always outstrip the horse-drawn engines. For the protection of shipping and the water front, steam fire boats are necessary. These are always under full steam, and usually lie at their regular dock. Their pumps, 10 inches in diameter with a 10-inch stroke, give at 225 revolutions 6520 gallons a minute. Such a power, the equivalent of nine average engines, makes them a most valuable part of the system.

❓❓❓ In order to extend the radius of action, and more effectively to utilize this great power, Boston has a salt water fire systera,i con- sisting of about .5000 feet of 12-inch cast-iron pipe, 1 inch thick, laid through the business district adjoining the water front. Each end of this pipe is at deep water accessible to the fire boats. At each end the pipe divides into two 10-inch pipes, each of which has a "boat connexion," with six 3J-inch outlets for attachment of hose. Each outlet has a valve opening inwards. One or both boats can connect, using 3J-inch hose in 15 to 30 feet lengths, with the twelve outlets or any less number. The maximum water pres- sure at the boat is 200 lb on the square inch. Hydrants are placed on the pipe 300 feet apart. The hydrants, known as the Bachelor Hydrant, are unusually heavy throughout, with three 3-inch outlets, each controlled by an independent valve. Each hydrant has an electrical

attachment connecting with the fire boat and the head- quarters of the department, so that the district chief, whose tele- grapher-aid accompanies him to every fire, can control by telegraph the action of the boat, and can send and receive messages to and from headquarters. The pipe is kept full of salt water, but if it is found to be liable to excessive corrosion, it can be filled with fresh water immediately after service. One most valuable feature of this system is the concentration upon a given point of enormous streams of water drawn from an inexhaustible supply. In a test at one- half mile from the water front, with one fire boat in service, two streams, each of I'lOO gallons per minute, were played simultaneously through 2i-inoh nozzles with a nozzle-pressure of 50 lb, three lines of 3-inch hose being " Siamesed " for each stream. In Cleveland, Milwaukee, Detroit, and Buffalo, systems largely similar have been in successful operation for several years. The pipes in Boston are empty when not in service, at least during cold weather. The

'"Salt Water Fire System of Boston," by Frank A. Mclnnes. Journal of the New England Water Works Association, vol. xiii No. 4.

Fig. 10. ??? Jumping Net.

Fio. 11. ??? Water Tov

FIRE AND FIRE EXTINCTION

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elimination of the factor of frost in this way permits of shallow ex- cavation, and probably prolongs the life of the pipe. The disad- vantages are loss of time in filling the line, and the possibility of damage from imprisoned air in the operation of filling.

Chemical Engines and Portable Extinguishers^ have proved their value in small fires, and are now largely used both in public and in private service. Of the 2130 fires in Boston reported for 1899, 19 per cent, were put out by chemical engines, and 22 per cent, by portable extinguish- ers. Some modifications in construction have been made, but no change in principle. The claim that the chemical ingredients are in themselves

largely effective in quench- ing the fire has been disputed, but there is no question of the advantages of the instantly generated power. A greater development in the direction of private fire protection for hotels, theatres, and large business establishments, where a competent watchman or attendant is always assumed, is

Fig. 9. ??? Champion Stationary Engine.

shown in the Champion Stationary Engine (Fig. 9). It is placed in the basement, and has special stand-pipe con- nexion with one or more hose-stations on each storey. Each hose-station is covered by a small metal box with glass door. The pulling of the small handle inside re- leases the weights below ; these invert the cylinder, and thereby cause the mixing of the chemicals and the imme- diate development of a heavy pressure. The process is to break the glass door, pull the handle, turn the valve, and reel off the hose, always attached, with its shut-off nozzle. The cylinder contains 500 gallons or less of the bicarbonate of soda solution. The stream is available in one minute. Extension or " Aerial " Ladders are increasingly in use. The ladder is a permanent part of the truck which carries it, and is in two or three lengths ; it is raised unextended to the proper angle by heavy screws worked by hand- cranks requiring six men; the upper lengths are then

1 See Ency. Brit., ninth edition, vol. ix. pp. 235-236.

extended by a wire rope to the height desired ; in use the upper end rests against the building. The details of con- struction and mechanism are varied by different builders, but the essential principle is the same. A line of hose is usually attached to the ladder and raised with it. The length, when fully extended, is from 90 to 100 feet. The truck carries in addition nine or ten separate ladders of different lengths. It weighs about five tons, and is drawn by three horses abreast.

Hose Waggons, drawn by two horses, have replaced the old hose reel. They carry the hosemen, 1000 feet of 2-|-inch hose, a jumping-net, two small portable chemical extinguishers, a door-opener, and the usual tools and minor pieces of apparatus.

The Jumping Net (Fig. 10) is made of stout tarred hemp rope, and is about 10 to 12 feet in diameter. It is essential that it be held firmly and fearlessly by a sufficient num- ber of strong men. Firemen are drilled in its use. It has proved effective in saving life. (See Plate.)

By means of a Water Tower (Fig. 11, Plate) a powerful stream of water may be carried in a hose independent of the building, and delivered with full force at the height of 65 feet from the ground. The tower consists of a slender but stiff lattice iron frame, about 25 feet long, within which slides the extensible 6-inch round iron tube about 30 feet long that contains the hose. It is perma- nently mounted upon the waggon, lying horizontally as it is drawn to fires, and weighs all told about five tons. The waggon has an 8-foot gauge to insure a stable base. On reaching the fire the front axle is securely locked and the wheels are blocked. The tower is raised to the ver- tical by pressure from a carbonic acid gas-generating tank acting upon a piston with a rack geared into a quadrant at the base of the tower. The upper length, the exten- sible tube, is then raised, drawing up the hose with it, by a hand windlass. The tower is firmly locked. The direc- tion of the stream from the movable pipe with its 2^inch nozzle can be controlled from below. The nozzle is rotated horizontally by means of an iron rod reaching from the base to the top, where it is geared into a i^fliall wheel, a part of the nozzle-pipe; it is raised to about 45 ?? by the force of the stream, and lowered by a wire rope from below. The stout 3^inch hose of the tower takes its water from a chamber below, in which as many as six engine streams may be concen- trated ; the maximum volume and pressure are thus insured. The stream delivers upwards of 1000 gal- lons a minute. When a fire reaches a certain size and intensity, the ordinary 1^ or l|-inch streams make little impression on it. To get sufficient concentra- tion three or four lines of 2^inch hose ai'e united or " Siamesed " into one larger one with a 3- or Scinch nozzle, by means of a 3-way or 4-way brass casting to which they are coupled. Each inlet has its separate valve.

The Gorter Battery is convenient for concentrating as many as six ordinary streams into one. It weighs 1650 lb, and is drawn by one horse. When in action the weight is carried forward on to the shafts, which are fitted with spikes that take hold upon the ground and give the machine

stability to withstand a back pres- sure of 1500 lb to the square inch. The nozzle is moved vertically in a ball-and-socket joint, and horizon- tally on a roller bearing. It throws a solid 2- to 3-inch stream 200 to 300 feet according to pressure. One man can easily control it, as the back pressure is taken up by the shafts.

Stand Pipes are used in " elevator buildings," which are too high to be commanded from the street or by dragging up the hose inside. The inside stand pipe is for use on a fire that has been promptly discovered. It is generally

connected with the city water system, and kept full of water under ordinary pressure, suitable lengths of hose ready for service being permanently attached on each floor. The outside stand pipe, from 4 to 6 inches in diameter, is for the use of the fire department ; it stands empty ; it

Pig. 12. ❖❖❖ Baker Cellar Pipe.

has two or more inlets at or near the level of the side- walk, to which hose from as many engines can be coupled, and two outlets on each storey to which short lengths of hose can be coupled and carried in through the adjacent windows. It should be placed in conjunction with a fire escape, if there is one, so that it may be easily reached by the fire-escape ladders.

The Baker Cellar Pipe (Fig. 12) has been found very effective in cellar fires. The pipe is passec through a hole cut ir the floor over the fire the nozzle is fitted wit! a ball-and-socket joint and by means of th(handle above the strean may be turned in nearlj any direction. The Bres nan Nozzle is designee for the same use as th(cellar pipe, and is perhaps equally effective ; it has a revolving collar with i number of ^ and -f-incl outlets, so arranged as t(throw streams in everj direction and reach witl its heavy spray every pari of the cellar.

The Eastman Nozzli Holder (T?ig. 13) dispenses with long play-pipes. I1 clasps the hose just be low the nozzle, and the point, when fully drawi out, is planted in th(ground and .counteracts the back pressure from the nozzles, so that by means of the handles, in- sulated against electricity, one man can easily direct the heaviest stream. When used on a ladder, it may be hung by the hooks on the under side upon a rung or window- sill, and being pivoted at that point, the stream may be turned in any direction inside the window. The nozzle.

Fig. 18. ❓❓❓ Eastman Nozzle Holder.

about 10 inches long, contains in its middle length a short thin tube as a core, the diameter of which is three-fifths that of the nozzle at that point, held centrally by four wings fastened to the nozzle. The effect of this device is to correct the spiral movement of the water as it leaves the hose and to insure a smooth solid stream. By a system of electrical signals the man at the nozzle directs the action of the engine. Two insulated wires pass through the length of the hose, imbedded between two of its layers, and form an electrical circuit connecting a button on the nozzle and a bell and battery on the engine. The circuit is made continuous through the hose by the act of coupling. (^- !❓❓❓❓❓❓ K-)

Firminy, a town in the arrondissement of St ❓❓tienne, department of Loire, Prance, 71 miles S.W. of St ;fitienne by rail. It has important coal mines and extensive manufacture of iron and steel goods, in- cluding railway material, machinery, and cannon. The mines have an annual output of about 92,000 tons, and give employment to about 4000 workmen. The princi- pal textile industry is that of fancy woollen hosiery. Population (1881), 12,182; (1901), 16,903.

Firuzkuh, a very small province of Persia, held in fief by the minister of arsenals. It has a popula- tion of about 5000, and pays a yearly revenue of about ❓❓400. Its capital is the city of the same name, situated about 90 miles east of Tehran, at an eleva- tion of 6700 feet, and in 35❓❓46′ N. lat. and 52❓❓48′ E. long. It has post and telegraph ofiices, and a population of 2600.

Fischer, Ernst Kuno Berthold (1824-

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German philosopher, was born at Sandewalde in Si- lesia, 23rd July 1824. After studying philosophy at Leipzig and Halle, he became a professor at Heidelberg in 1850. His liberal ideas lost him this post, but in 1866 he obtained a professorship at Jena, where his lucid ex- position and the dignity of his personal character soon rendered him highly influential. In 1872 he returned to Heidelberg. His part in philosophy has been that of historian and commentator, for which he was especially qualified by his remarkable clearness of statement. His History of Modern Pliilosojphy (1852-77) is perhaps the most accredited modern book on the subject, and he has made valuable contributions to the study of Kant, Bacon, Spinoza, and Lessing.

Fish, Hamilton (1808-1893), American states- man, was born in ISTew York city on 3rd August 1808. He graduated from Columbia College, and in 1830 was admitted to the bar, but practised for only a short time. In 1842 he was elected a Eepresentative in Congress. In 1847 the Whigs elected him as lieutenant-governor of New York. In 1848 he defeated the Democratic candi- date for the governorship. He was one of the United States Senators from New York from 1851 to 1857. In 1861 he was associated with John A. Dix, Wm.]\I. Evarts, Wm. E. Dodge, A. T. Stewart, and other New Yorkers, on the Union Defence Committee. As secretary of state during Grant's two administrations, 1869-77, he con- tributed to bring about the treaty of ^'i'ashington, in May 1871, which created a basis for the arbitration of the Alabama claims. He was made president of the peace conference between Spain and the allied republics of Peru, Chile, Ecuador, and Bolivia. It was chiefly due to Pish's management in 1873 that the Virginhis aifair did not result in a war between the United States and Spain. He died in Garrison's, New York, on the 7th September 1893.

Fisheries. ❖❖❖ In the last quarter of the 19th cen- tury the sea fisheries of the United Kingdom under- went a great development, principally in consequence of the application of steam power to fishing boats, and especially to trawling vessels. Necessity was in this case especially the mother of invention, for the industry of steam trawling dates its origin from a period of severe stagnation in the shipping trade in the later 'seventies. Some of the steam-tugs plying at the mouths of the Tyne and Wear resorted to trawling in the neighbourhood as an accessory occupation, and met with such success that the practice spread to other parts of the coast. The un- suitability of these "tug-trawlers" for deep-sea work necessarily placed a limit upon their operations, but the success of their experiments was more than enough to demonstrate the many advantages of steam for trawling purposes. A special type of fishing steamer, fitted with a screw instead of paddles, was soon under construction, enabling steam trawling to be prosecuted in distant as well as in home waters. Built at first of wood, but subsequently of iron, the steam trawler has under- gone a continuous series of improvements, which have increased its strength, speed, storage capacity, and sear worthiness to such a pitch that it is now able to under- take the long and hazardous Icelandic voyage with remarkable regularity through winter and summer alike. The substitution of the otter or beamless trawl for the beam-trawl in 1894 also conduced to a great increase in the " catching power " of steam trawlers, especially as regards round fishes, such as cod and haddock, which swim some little distance above the actual sea-bed. The catching power of a modern steam trawler is regarded as equivalent to that of at least eight or ten deep-sea sailing trawlers.

An idea of the development of steam trawling may be gathered from the fact that in 1883 the fishing vessels sailing from the ports of Hull and G- rimsby included less than 20 steamers and about 1000 sailing trawlers; in 1900 the number of steamers had increased to no less than 869, while the number of sailing trawlers had fallen to 4. In Scotland also the quantity of fish annually lauded by trawlers (almost exclusively steam trawlers) has increased from 6 per cent, of the total in 1890 to 20 per cent, in 1900 (c/. Tables IX. and X.). In that country the development of the trawling industry and the prolongation of the herring fishery have brought about a decline of the line fishery, especially in recent years, the annual yield of

the line fisheries having steadily fallen from 80,000 tons in 1890 to 38,000 tons in 1900 (c/. Table X.). In England and Wales it is difficult to say whether there has been any decline in the line fishery or not, owing to the absence of any discrimination between the products of the various modes of fishing in the official returns.^ It has, however, been estimated that the number of first-class sailing liners belonging to the east coast of England fell from about 240 in 1889 to about

1 The need of a properly organized Fishery Department for the United Kingdom has often been urged. If farther evidence were necessary, it might be drawn from the fact that although an Order in Council, dated 1869, provided that a Register of Sea Fishing Boats, subject to annual revision, should be kept, and sliould record among other details the " ordinary mode of fishing " of every vessel, the data under this head have never been published by the Commercial Department re- sponsible for them; and the very existence of the data appears to have been unknown to the Board of Trade Inspectors of Sea Fisheries as late as the year 1899 (of. Thirteenth Annual Report of Inspectors for 1898, p. 10). The matter was investigated the following year at the instance of the writer of this article, with the result that the annual reports of the inspectors now contain a valuable table giving authentic information on this head based on the Register. The regrettable fact was, however, elicited that the " returns prior to 1893 no longer exist" ??? a loss which is irreparable for statistical purposes, and appears to have involved a distinct breach of the Order in Council which estab- lished the Register in the first place.

80 in 1898, while the number of steam liners increased from about 40 in 1889 to 100 in 1896, subsequently falling to 80 in 1898. The evidence of the Fishing Boats Register for 1893, 1899, and 1900 agrees with this estimate in showing a decrease of first-class sailing liners for the whole of England and Wales from 185 to 47, and an increase of steam liners from 66 in 1893 to 67 in 1899, falling to 63 in 1900. Thus if one steam liner be re- garded as equivalent in catching power to four sailing liners, the English line fishery was probably holding its own until the year 1897, when it began to decline, ap- parently owing to the more lucrative character of trawl fishing. But the catch of halibut (an exclusively line-caught fish) has steadily increased throughout this period.

As regards the drift-net fishery, the supply of herrings and mackerel has been well maintained, 1897 having been a record year for mackerel on the south and east coasts of England, 1898 attaining the same distinction for her- ring in Scotland, while the annual catch of herrings in English waters first exceeded two million cwts. in the years 1899 and 1900. On the other hand, the conditions of the herring fishery have changed considerably during recent years. In Scotland the great summer herring fishery of the east coast has been supplemented by a win- ter and spring herring fishery which has attained con- siderable importance both on the east and west coasts, and an immense early summer fishery is now prosecuted on the west coast and in Orkney and Shetland, so tha.t herring fishing is now followed at one part or another of the Scottish coasts during practically every month in the year. Indeed, the crews of many vessels which formerly worked at the herring and line fisheries in alternate seasons of the year now devote their energies almost entirely to the herring fishery, which they pursue in nomad fleets around all the coasts of Great Britain. Scottish crews now attend the English autumn herring fishery in far greater numbers than formerly, and with most successful results. These facts, together with the introduction of steam drift vessels, indicate a marked increase in the aggregate catching power employed in the herring fishery, and go far to explain the exceptionally heavy catches in recent years.

The yield of the Irish fisheries is still unimportant com- pared with that of the Scottish or English fisheries, but since 1887 a great development of the herring fishery has taken place. An increase of a less marked character is also noticeable in the records of the mackerel fishery, but it would be hazardous to draw conclusions from this feature, owing to the variable quantities of Irish mack- erel which have been landed at English ports in the same period.

The total value of the sea fisheries of the United King- dom in the year 1900, according to the official returns was as follows : ???

Fish Landed in

Excluding SlieU-fish.

Including Bliell-fish.

England and Wales .

Scotland

Ireland

Total ....

6,610,000

2,326,000

279,000

6,982,000

2,401,000

295,000

9,215,000

9,678,000

No information is officially collected in England or Ireland as to the value of the vessels and gear employed in the fisheries of these countries, but as data under this head have been collected for some years past by the Fishery Board for Scotland, it is possible to frame a rough, but sufficiently correct, estimate of the total value for the United Kingdom, since the numbers and tonnage of the fishing vessels are known for all three countries.

The subjoined estimate is based on the returns for 1900. It has been presumed that the average value of fishing gear per ton tonnage of fishing vessels is greater in Scot-

land than in England, owing to the greater proportion of trawlers among the English vessels, and the smaller cost of trawling gear as compared with nets and long lines : ???

Estimate of Value of Fishing Boats and Gear employed in 1900

(the values are authenticated for Scotland only).

Number.

Class of Boat,

Tons.

Val

le of Boats.

Value of Gear.

Grand Total.

Per Ton.

Total.

Per Ton.

Total.

England and Wales . |

1,251 8,384

Steamers. Other boats.

67,484 95,009

******

100 8

******

6,748,400

760,792

7,509,192

******

4 5

******

269,936 475,495

745,431

******

8,254,623

Scotland . . . |

262 10,973

Steamers. Other boats.

9,320 108,384

97

7‘7

904,6.30 831,670

4-2 6-9

39,178 749,819

Ireland . . . |

9

7,887

Steamers. Other boats.

95 28,121

100

8

1,736,300

4 5

788,997

380 140,605

2,525,297

9,500 224,968

234,468

140,985

375,453

United Kingdom (total) |

1,512

27,244

Steamers. Other boats.

9,479,960

1,675,413

11,155,373

History. ??? A brief review may now be given of the history of the administration of the sea fisheries since 1877, and of the attainment of scientific and statistical information in relation thereto.

In 1878 a commission was given to Messrs Bucldand and Walpole to inquire into the alleged destruction of the spawn and fry of sea- fish, especially by the use of the beam-trawl and ground-seine.

In 1882 the former Board of British White Herring Fishery was dissolved and the Fishery Board of Scotland instituted, the latter being empowered to talce such measures for the improvement of the fisheries as the funds under their administration might admit of. Under the Sea Fisheries (Scotland) Amendment Act of 1885 the Board closed the Firth of Forth and St Andrews Bay against trawl- ers as an experiment for the purpose of ascertaining the result of such prohibition on the supply of fish on the grounds so protected. The Treasury also, by a further grant of ??3000, enabled the Board to purchase the steam-yacht Garland as a means of carrying out regular experimental trawlings over the protected grounds. Reports on the results of these experiments have been annually published, and were summarized at' the end of-, ten years' closure in the Board's Report for 1895. Dr Fulton's summary showed that "no very marked change took place in the abundance of food-fishes generally, either in the closed or open waters of the Firth of Forth or St Andrews Bay " as a consequence of the prohibition of trawling. Neverthe- less, among flat fishes, plaice and lemon soles, which spawn oH-shore, ???were reported to have decreased in numbers in all the areas inves- tigated,

whether closed or open, while dabs and long rough dabs showed a preponderating, if not quite universal, increase.

The results of this classical experiment point strongly to the presumptions (1) that trawling operations in the open sea have now exceeded the point at which their effect on the supply of eggs and fry for the upkeep of the flat fisheries is inappreciable ; and (2) that protection of in-shore areas alone is insufficient to check the im- poverishment caused by over-fishing off-shore. The importance of these conclusions as regards the future administration of our sea fisheries cannot be too strongly urged. (For critical examinations of Dr Fulton's account see M'Intosh, Besources of the /Sees, London, 1899, and Garstang, "The Impoverishment of the Sea," Journal of the Marine Biological Association, vol. vi., 1900.)

In 1883 a Royal Commission under the chairmanship of the late Earl of Dalhousie, was appointed to inquire into complaints against the practice of beam-trawling on the part of line and drift-net fishermen. A small sum of money (□□200) was granted to the Com- mission for the purpose of scientific trawling experiments, which were carried out by Professor M'Intosh.

The Report of this Commission was an important one, and its recommendations resulted in the institution of fishery statistics for England, Scotland, and Ireland (1885-87).

In 1884 the Marine Biological Association of the United Kingdom was founded for the scientific study of marine zoology and botany, especially as bearing upon the food, habits, and life-conditions of British food-fishes, crustacea, and molluscs. Professor Huxley was its first President, and Professor Ray Lankester, who initiated the movement, succeeded him. A large and well-equipped laboratory was erected at Plymouth, and formally opened for work in 1 888. The Fishmongers' Company contribute □□200 a year to the Association,

and H.M. Government now contribute a sum of □□1000. The Asso- ciation publishes a half-yearly Journal recording the results of its investigations.

In 1886 a Fishery Department of the Board of Trade was organ- ized under the Salmon and Freshwater Fisheries Act of that year. The Department publishes annually a return of statistics of sea-fish landed, a report on salmon fisheries (transferred from the Home Office) , and a report on sea fisheries. It consists of several inspec- tors under ah assistant secretary of the Board ; it has no power to make scientific investigations or bye-laws and regulations affecting the sea fisheries. In 1894 the administration of the Acts relating to the registration of fishing vessels, &c., was transferred to the Fish- eries Department.

In 1888 the Sea Fisheries Regulation Act provided for the consti- tution (by Provisional Order of the Board of Trade) of local Fisher- ies Committees having, within defined limits, powers for the regula- tion of coast fisheries in England and Wales. The powers of District Committees were extended under Part II. of the Fisheries Act, 1891, and again under the Fisheries (Shell Fish) Regulation Act, 1894. Sea fisheries districts have now been created round nearly the whole coast of England and Wales.

In 1893 a Select Committee of the House of Commons took evi- dence as to the expediency of adopting measures for the preservation of the sea fisheries in the seas around the British' Jslands, with especial reference to the alleged wasteful destruction of under-sized fish. They recommended the adoption of a size-limit of 8 inches for soles and plaice, and 10 inches for turbot and brill, below which the sale of these fishes should be prohibited, on the ground that these limits would approximate to those already adopted by foreign coun- tries.

In 1899 the Agriculture and Technical Instruction (Ireland) Act transferred the powers and duties of the inspectors of Irish fisheries to the Department of Agriculture and Technical Instruction for Ireland. The Department is provided with a steam cruiser, the Helga, 375 tons, fully equipped for fishery research, as well as with a floating marine laboratory. Mr Holt, formerly of the Marine Biological Association, was appointed to take charge of the scientific work.

In 1900 another Select Committee of the House of Commons was appointed to consider and take evidence on the proposals of the Sea

Fisheries Bill, which had been framed in accordance with the recom- mendations of the Select Committee of 1893, but had failed to pass in several sessions of Parliament. Owing to marked divergences of opinion on the question whether the low size-limits proposed would be effectual in keeping the trawlers from working on the grounds where small fish congregated, the Committee reported against the Bill, and urged the immediate equipment of the Government Depart- ments with means for undertaking the necessary scientific investiga- tions.

In May 1901 an International Conference of Representatives of the North Sea Powers met at Christiania to draw up final proposals for a scientific exploration of the North Sea in the interests of the fisheries, to be undertaken concurrently by all the countries bordering on the North Sea. The British Government was represented by Sir Colin Scott Moncrieff, K.C.M.G., C.S.I., with Professor D'Arcy Thomson, Mr W. Garstang, and Dr H. R. Mill as advisers. The proposals hav- ing been accepted by the participating Governments, the work of systematic exploration was expected to begin in the course of 1902.

FISHERIES

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Statistics. ??? The following tables summarize tlie ofBcial statistics of fish landed on the coasts of England and Wales, Scotland and Ireland, and give some information relative to tlie numbers of fishing-boats and fishermen in the three countries. The Irish statistics of shell-fish must throughout be treated cautiously, owing to the inadequate means at the disposal of the authorities for col- lecting complete statistics over large sections of the coast.

Table I. ??? Quantity and Average Landing Value of Flat Fishes landed on the Coasts of England and Wales (all caught with trawl-nets, except Halibut).

Tear.

Quantity (In Thousands ofCwts.).

Average Price (per Cwt.).

1^-

S

_?_?_?_^

^

_?_?

i

Sole.

_?_?_?_e p

E-i

Brill.

_?_?_?_a

&

Sole.

B

Brill.

I

a

_?_? 8.

_?_? s.

B.

s.

8.

1890

72-1

51-9

15-4

623

95

6 7

3 13

2 8

0 19

1 10

1895

82-8

77-9

19 0

789

114

6 16

3 17

2 11

1 1

1 15

1900

75-3

60-7

20-7

752

136

7 11

4 3

2 14

1 4

1 14

Table II. ??? Quantity and Average Landing "Value of Bound Fishes, caught with Trawls and Lines, landed on the Coasts of England and Wales.

Year.

Quantity (in Thousands ofOwts.).

Average Price (per Cwt.).

4

0

4

IS

.2

Cod.

4

J.

Hake.

r.ing.

Cod.

1

Hake.

Ling.

a

“9

a

w

s. d.

8. d.

. d.

8. d.

e. d.

1890

363

1685

<

96

1151

1310

9 7

.

14 3

14 0

1891

361

1741

140

94

854

13 9

10 2

1110

13 8

13 9

1895

496

2433

132

114

1013

12 5

9 9

16 2

11 8

13 7

1900

689

2487

233

100

1190

14 8

13 8

1610

1210

1410

Table III. ??? Quantity and Average Landing Value of Sukfacb Fishes landed on the Coa.sts of England and Wales (caught with drift-, seine-, and stow-nets).

Tear.

Quantity (in Thousands of Cwts.).

Average Price (per Cwt.).

i

P

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1

_?_?_?E

s

Sprat.

s

“g

Sprat.

s

. H

s

i

a

S

8. d.

8. d.

8. d.

s” d.

1889

334

1923

108

63

13 9

4 10

6 1

3 6

1890

509

1332

61

99

15 5

7 2

6 10

3 0

1891

368

1206

99

116

19 7

8 4

6 2

2 2

1895

376

1437

66

91

16 3

6 10

5 3

3 1

1900

321

2425

106

73

15 9

7 8

4 6

4 11

Table VI. ??? Total Quantity of the more important Fishes and Shell-fish returned as landed on the Irish Coasts.

Table IV. ??? Quantity and Average Landing Value of Shell-fish landed on the Coasts of England and Wales.

Tear.

Number.

Average Price.

Thousands.

Mflls.

Cwts.

Per Hundred.

Per Cwt.

Crabs.

S

s

CO

???g

1

i

c

a

Crabs.

1

s

>> o

J

1889 1890 1896 1900

6082 4808 4501 5177

720 922

677 654

36-7 47-6

25-3

37-8

460 606 590 539

6.

1 1 1 4 1 4 1 2

8.

4 4 4 18 4 8 4 7

8. d.

6 8 6 1

6 2

7 0

s. d.

5 2 5 0

4 11

5 8

Table V. ??? Total Quantity of the more important Fishes and Shell-fish landed in Scotland.

Tear.

In Thousands of Cwts.

Cwts.

Number j (Thousands).

1

a

O o

1

i

3

1

a

1

00

1

IB

_?_?_?g

1

1889 1890 1896 1900

8718 8980 4077 8520

14-4 16-6 19-8 20-6

74-3

81-8

79-7

102-2

21-1 20-2 28-9

2S-7

604 449 469 484

184 170 166 167

792 754 1001 761

69-7 75-5 43-6 75-0

60 64 59 72

189 181 194 143

2774 2882 2648 3128

676 648 610 680

312 860 289 796

Tear.

In Thousands of Cwts.

Number (Thousands).

i

1

ea

a

a

IS

‘3 02

1

1

a hi

o

1

a

bJD

a

5

a

1 5

1

1

1890 1896 1900

502 339

278

86 171 284

4-6 1-8 3-1

1-4 1-0 1-6

39-6 43-6 33-6

14-8 29-7 119

16 ‘4 30-9 12-4

13-5 11-9 11-9

25-3 18-7 16-3

576 563 236

228 240 202

238 276

286

Table VII. ??? Number of Fishing Boats on the Register for 1900 (excluding vessels navigated by oars only), compared with the average number registered in preceding periods.

Tear.

England and Wales.

Scotland.

Ireland.

United Kingdom

(including Isle of

Man and Channel

Isles).

1st Class.

2nd Class.

1st Class.

2nd Class.

1st Class.

2nd

Class.

l8t

Class.

2nd

Class.

1878-1882

1888-1892

1900

3809 3905 3176

6094 4151 3969

3881 3816 3375

8366 6698 6237

462 443 364

3333 2929 3818

8503 8464 7124

18,160 14,099 14,317

Ifote. ??? 1st Class = boats of 15 tons and upwards ; 2nd Class = boats of less than 15 tons, navigated otherwise than by oars only. In England and Wales, the CJhannel Isles, and Isle ot Man, but not in Scotland or Ireland, undecked boats fishing within territorial limits have been exempted from compulsory registration since 1880.

Table VIII. ??? Number (A) of Men and Boys constantly employed and (B) of other Persons occasionally employed in Fishing.

Tear.

England and Wales.

Scotland.

Ireland.

United Kingdom.

A

B

A

B

A

B

A

B

1890 1896 1900

32,503 32,229 31,589

9312 8996 7994

34,319 31,044

27,288

20,829 12,329 10,288

10,121 8,692 8,677

13,981 18,218 18,982

78,460 73,090 68,708

46,337 41,230 37,814

Note. ??? The above table takes no account of persons employed in unregistered boats, of which there are many in England and Wales.

Table IX. ??? Total Quantity of the more important Bottom Fishes i landed at certain Ports in the North Sea from 1891 to 1900.

N. Shields,

N. Shields,

Sunderland,

Sunderland,

HuU,

Hartlepool,

Hartlepool,

Tear.

Grimsbv, and

Scarborough,

Tear.

HuU,

Scarborough,

Boston.

Yarmouth,

Grimsby, and

Tarmouth,

Lowestoft, &

Boston.

Lowestoft, &

Eamsgate.

Bamsgate.

Cwts.

Cwts.

Cwts.

Cwts.

1891

1,565,165

570,818

1896

2,342,740

563,788

1892

1,639,129

579,538

1897

2,399,706

520,944

1893

1,776,838

625,283

1898

2,609,320

508,940

1894

1,971,508

575,180

1899

2,667,008

534,818

1895

2,193,998

623,743

1900

2,866,172

568,751

iThe Bottom Fishes here included are cod, haddock, hake, ling, soles, turbot, plaice, and halibut, all of which are caught by trawls or lines. The table shows the steady increase of supplies at the ports which are the centres of the steam trawling industry (Hull, Grimsby, and Boston) , and which receive the products of the Icelandic and Faroe fisheries, as contrasted with the declining character of the supplies at other ports (N. Shields, &c.), which depend exclusively on the products of the older fishing grounds in the North Sea.

Table X. ??? Catch and Value of Line-caught and Trawled Fish landed in Scotland in 1890, 1896, and 1900.

Tear.

Line-caught Fish.

Trawled Fish.

Cwts.

??

Cwts.

??

1890

1,677,299

591,059

291,812

203,620

1895

1,479,654

648,629

631,695

291,166

1900

767,416

371,173

1,077,082

703,427

(w. Ga.) S. IV. ??? 52

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FISHERY

Fishery (Law of). ??? This subject has, (1) its Inter- national aspect ; (2) its Municipal aspect ; and each re- quires separate consideration.

On the high seas outside territorial waters the right of fishery is now recognized as common to all nations. Claims were made in former times by single nations to the exclusive right of fishing in tracts of open sea ; such as that set up by Denmark in respect of the North Sea, as lying between its possessions of Norway and Iceland, against England in the 17th century, and against England and Holland in the 18th century, when she prohibited any foreigners fishing within 15 German miles of the shores of Greenland and Iceland. This claim, however, was always effectively resisted on the ground stated in Queen Elizabeth's remonstrance to Denmark on the subject in 1602, that " the law of nations alloweth of fishing in the sea everywhere even in seas where a nation hath propertie of command." The latest enunciation of this

principle is to be found in the award of the Arbi- tration Court which decided the question of the fur- seal fishery in Bering Sea in 1894. (See Aebitkation-, Intbenational.) The right of nations to take fish in the sea may, however, be restrained or regulated by treaty or custom ; and Great Britain has entered into Conventions with other nations with regard to fishing in certain parts of the sea. The provisions of such Conventions are made binding on British subjects by statutes.

Instances of these are the Conventions of 1818 and 1872 between Great Britain and the United States as to the fisheries on the east- ern coasts of British North America and the United States within certain limits, and the award of the Bering Sea arbitration tribunal under the treaty of 1892 ; the Conventions between Great Britain and France in 1839 and 1867 as regards fishing in the seas adjoining these countries, the latter of which will come into force on the repeal of the former ; the Convention of 1882 between Belgium, Denmark, France, Germany, Great Britain, and Holland, regarding the North Sea fisheries ; that of 1887 between the same parties concerning the liquor traffic in the North Sea ; and the Declaration regarding the same waters made between Great Britain and Belgium for the settlement of differences between their fishermen subjects in such extra-territorial waters. At the instance of the Swedish Govern- ment the British Parliament also passed an Act in 1875 to establish a close time for the seal fishery in the seas adjacent to the eastern coasts of Greenland.

Cases have come before British Courts with regard to the whale fishery in northern and southern seas ; and the customs proved to exist among the whaling ships of the nations engaged in a particular trade have been upheld if known to the parties to the action. In territorial waters, on the other hand, fishery is a right exclusively belonging to the subjects of the country owning such waters, and no foreigner can fish there except by convention.

(rt) Tidal Waters. ??? In British territorial waters, it may be stated, as the general rule, that fishery is a right incidental to the soil covered by the waters in which that right is exercised.

The bed of all navigable rivers where the tide flows and reflows, and of all estuaries or arms of the sea, is vested in the Crown : and, therefore, in Lord Chief Justice Hale's words, "the right of the fishery in the sea and the creelcs and arms thereof is origin- ally lodged in the Crown, as the riglit of depasturing is originally lodged in the owner of the waste whereof he is lord, or as the right of fishing belongs to him that is the owner of a private or inland river." "But," he continues, "though the king is tlie owner of this great waste, and as a consequent of his propriety hath the primary right of fishing in the sea and the creeks and arms thereof, yet the common people of England have regularly a lib- erty of fishing therein as a public common of piscary, and may not without injury to their right be restrained of it unless in such places or creeks or navigable rivers where either the king or some particu- lar subject hath gained a propriety exclusive of that common liberty" (De Jure Maris, ch. iv.).

This right extends to all fish floating in the sea or left on the seashore, except certain fish known as royal fish, which, when taken in territorial waters, belong to the

Crown or its grantee, though caught by another person. These are whales, sturgeons, and porpoises; and grampuses are also sometimes added (whales, porpoises, and grampuses being "fishes" only in a legal sense). In Scotland only whales which are of large size can be so claimed ; but the rights of salmon fishing in the sea and in public and private rivers, and those of mussel and oyster fishing, except in private rivers, are inter re- galia, and are only enjoyable by the Crown or persons deriving title under it. As salmon fishery was formerly practised by nets and engines on the shore, and the mussel and oyster fisheries were necessarily carried on on the shore, the opinion was held at one time that angling for sabnon was a public right, but the later deci- sions have established that the right of salmon fishing by whatever means is a jus regale in Scotland. In England, the Crown in early times made frequent grants of fisheries to subjects in tidal waters, and instances of such fisheries belonging to persons and corporations are very common at the present day: but by Magna Carta the Crown declared that "no rivers shall be defended from hence- forth, but such as were in defence in the time of King Henry, our grandfather, by the same places and the same bounds as they were wont

to be in his time : " and thus bound itself not to create a private fishery in any navigable tidal river. Judicial decision and commentators having interpreted this statute according to the spirit and not the letter, at the present day the right of fishery in tidal waters primd facie belongs to the public, and they can only be excluded by a particular person or corporation on proof of an exclusive right to fish there not later in its origin than Magna Carta; and for this it is necessary either to prove an actual grant from the Crown of that date to the claimant's predecessor in title, or a later grant or immemorial custom or prescription to that effect, from which such an original grant may be presumed. This exclusive right of fishing may be either a franchise de- rived from the Crown, or may arise by virtue of owner- ship of the soil covered by the waters.

In Lord Hale's words: "Fishing may be of two kinds ordinarily, viz., fishing with a net, which may be either as a liberty without the soil, or as a liberty arising by reason of and in concomitance with the soil or an interest or propriety of it ; or otherwise it is a local fishing that ariseth by or from the propriety of the soil, ??? such are gurgites, wears, fishing-places, borachioe, stachice, which are the very soil Itself, and so frequently agreed by our books. And such as these a subject may have by usage ; either in gross, as many religious houses had, or as parcel of or ap- purtenant to their manors, as both corporations and others have had ; and this not only in navigable rivers and arms of the sea but in creeks and ports and havens, yea, and in certain known limits in the open sea contiguous to the shore. And these kinds of fishings are not only for small sea-fish, such as herrings, &c., but for great fish, as salmons, and not only for them but for royal fish. . . . Most of the precedents touching such rights of fishing in the sea, and the arms and creeks thereoif belonging by usage to subjects, appear to be by reason of tlie propriety of the very water and soil wherein the fishing is, and some of them even within parts of the sea " (De Jure Maris, ch. v.).

An instance of the former kind of fishery is to be found in the old case of Royal Fishery of the River Bann (temp. James I., Davis 656), and the modern one of Wilson v. Crossfleld (1885, 1 T. L. E. 601), where a right of fishery in gross was established; but the latter kind, as Hale says, is much more common, and the presumption is al- ways in its favour ; d. fortiori

where the fishing is proved to have been carried on by means of engines or structures fixed in the soil. In England the public have not at common law, as incidental to their right of fishing in tidal waters, the right to make use of the banks or shores for purposes incidental to the fishery, such as beaching their boats upon them, landing there, or drying their nets there (though they can do so by proving a custom from which such a

grant may be presumed) ; but statutes relating to particu- lar parts of the realm, such as Cornwall for the pilchard fishery, give them such rights. In Scotland a right of salmon fishing separate from land implies the right of access to and use of the banks, foreshores, or beach for the purposes of the fishing; and so does white fishing by statute. But otherwise there is no right to do so, e.g., in a public river for trout fishing. A similar privilege is given to Irish fishermen for the purpose of sea fishery by special statute. There is no property in fish in the sea, and they belong to the first taker; and the custom of the trade decides when a fish is taken or not, e.g., in the whale fishery the question whether a fish is " loose " or not has come before English Courts.

(&) Fresh Waters. ??? In non-tidal waters in England and Ireland, for the reason given above, the presumption is in favour of the fishery in such waters belonging to the owners of the adjacent lands : " fresh waters of what kind soever do of common right belong to the owners of the soil adjacent, so that the owners of the one side have of common right the property of the soil, and consequently the right of fishing usque ad filum aquae, and the owners of the other side the right of soil or ownership and fishing unto the filum aquae on their side ; and if a man be owner of the land on both sides, in common presumption he is owner of the whole river, and hath the right of fishing according to the extent of his land in length" (Hale, ch. i.). There is a similar presumption that the owner of the bed of a river has the exclusive right of fishery there, and this is so even though he does not own the banks ; but these presumptions may be displaced by proof of a different state of things, e.g., where the banks of a stream are separately owned the owner of one bank may show by acts of

ownership exercised over the whole stream that he has the fishery over it all. The Crown prerogative of fishery never, it seems, extended to non-tidal waters flowing over the land of a subject, and it could not therefore grant such a franchise to a subject, nor has it any right de jure to the soil or fisheries of an inland lake such as Lough Neagh {Bristow v. Cormican, 1878, 3 App. Cas. 641). The public cannot acquire the right to fish in fresh waters by prescription or otherwise although they are navigable ; such a right is unknown to law, because a profit d, prendre in alieno solo is neither to be acquired by custom nor by prescription under the Prescription Act. It has been decided that the " dwell- ers " in a parish cannot acquire such a right, being of too vague a class ; but the commoners in a manor may have it by custom ; and the " free inhabitants of ancient tene- ments " in a borough have been held capable of acquiring a right to dredge for oysters in a fishery belonging to the corporation of the borough on certain days in each year by giving proof of uninterrupted enjoyment of it from time immemorial, on the presumption that this was a condi- tion to which the grant made to the corporation was subject.

In Scotland the law is similar. The right to fish for trout in private streams is a pertinent of the land adjacent, and owners of opposite banks may fish usque ad medium filum aquae; and where two owners own land round a private loch, both have a common of fishing over it. The public cannot prescribe for it, for a written title either to adjacent lands or to the fishery is necessary. A right of way along the bank of a river or loch does not give it, nor does the right of the public to be on or at a navigable but non-tidal river. The right of salmon fishing carries with it the right of trout fishing : and eel fishing passes in the same way.

In England and Ireland private fisheries have been divided into (a) several (separalis), (b) free (libera), (c) common of piscary (communis), whether in tidal or non-

tidal waters. The distinction between several and free fisheries has always been uncertain. Blackstone's opinion was that several fishery implied a fishery in right of the soil under the water, while free fishery was confined to a public river and did not necessarily comprehend the soil. He is

supported by later writers, such as Woolrych and Paterson. On the other hand, the opinions of Coke and Hale are opposed to this view. ” A man may pre- scribe to have a several fishery in such a water, and the owner shall not fish there ; but if he claim to have common of fishery or free fishery the owner of the soil shall fish there ” (Go. Littl. 122 A); ” one man may have the river and others the soil adjacent : or one man may have the river and soil thereof, and another the free or several fishing in that river” (De Jure Maris, ch. i.). Lord Holt, though in one instance he distinguished them, in a later case thought that they were ” all one.” Later decisions have established the latter view, and it is now settled that although the owner of the several fishery is pi~imd facie owner of the soil of the waters, this presumption may be displaced by showing that the terms of the grant only convey an incorporeal hereditament, and that the words ” sole and exclusive fishery ” give a several fishery in alieno solo. In the words of Mr Justice Willes, ” the only substantial distinction is between an exclusive right of fishery, usually called ‘ several,’ and sometimes ‘ free,’ as in ‘ free warren,’ and a right in common with others, usually called ‘ common of fishery,’ and sometimes ‘ free,’ as in ‘ free port.’ A several fishery means an exclusive right to fish in a given place, either with or without the property in the soil” (Malcolmson v. G’Dea, 1863, 10 H. L.). A common of piscary, or ” a right to fish in common with certain other persons in a particular stream,” is usually found in manors, the commoners of which may have the right to enjoy it to an extent suffi- cient for the sustenance of their tenements ; but they can- not, except by immemorial special prescription, exclude the lord of the manor therefrom, and have no rights over the soil itself. Decisions also establish that a grant of ” fishery ” will primd fade pass an exclusive fishery ; a grant of soil covered by water or a lease of lands includ- ing water will pass the fishery therein ; a several fishery will not merge on being resumed by the Crown ; and a fishery situate within a manor is presumed to belong to the owners of adjacent land, and not to the lord. A several fishery, as already seen, being an incorporeal hereditament, can only be transferred by deed, and there- fore cannot be abandoned, and so acquired by the public, even on proof that the public have, as far back as living memory, exercised the right of fishing in the locus in quo to the knowledge of and without interruption from the claimant of the fishery. But to establish a title to a several fishery, a ” paper title,” i.e., one

founded on docu- mentary evidence only, is not sufficient ; it must be sup- ported by evidence of acts of ownership in recent times, for otherwise it will be presumed that a person other than the alleged owner is the real owner. If the waters of a tidal river leave their old channel and flow into another, the owner of a several fishery in the old channel cannot claim to have it in the new one ; but, on the other hand, the owner of a several fishery can take advantage of a gradual encroachment by the river upon and into the land of a riparian owner, the limits of whose lauds are ascer- tained. The owner of an exclusive fishery, whether in tidal or fresh waters, has the right to take as many fish as he can, and may do so by means of fixed engines or dredging, provided that in navigable waters he does not interfere with the right of navigation, and that in navi- gable and other waters he does not interfere with the fishing rights of his neighbours or infringe the provi- sions made by old or modern statutes as to the methods

of taking the fish, e.g., by weirs. These were forbidden in rivers by Magna Carta and later statutes, and on the seashore by a statute of James I. ; but all weirs in navi- gable fresh waters traceable to a date not later than 25 Edward III. are lawful, for the statutes forbidding weirs do not apply to navigable waters. It seems, however, that at common law any fixed structures put up by the owner of a fishery in his part of a river, which at all prevent the free passage of fish to the waters above or below, give the owners of fisheries therein a right of action against him. So the grantee of an exclusive fishery with rod and line in an unnavigable river can prevent any person from pollut- ing the river higher up and so damaging the fishery. At common law there is no property in fish when enjoying their natural liberty ; the taker is entitled to keep them unless they are caught from a tank or small pond ; or except in the case of salmon by statute.

Modern statutes now regulate all fisheries, sea or fresh, in territorial or inland waters. As regards sea fishery in England, the Board of Trade has power by order to create sea fisheries districts, comprising any part of the sea within which British subjects have, by international law, the exclusive

right of fishing, and to provide for the con- stitution of a local fisheries committee to regulate the sea fisheries in such district, which can make bye-laws for that purpose. It appoints fishery officers to enforce them, pre- scribes a close time for sea fish (which does not include salmon as defined in the Salmon Act), has summary jurisdiction over offences committed on the sea coast or at sea beyond the ordinary jurisdiction of a court of sum- mary jurisdiction, can enforce the Sea Fisheries Acts, or regulate, protect, and develop fisheries for all or any kind of shell fish. Special provision is also made by statute for the oyster fishery and herring fishery (applicable also to Scotland), and that of mussels, cockles, lobsters, and crabs (applicable to all the United Kingdom). In Scot- land the Fishery Board can constitute sea fishery districts, and boards with like powers to those in England, and has general control over the coast and deep-sea fisheries of Scotland ; and there are Acts relative to herring, mussel, and oyster fisheries, and allowing the appropriation of money intended to relieve local distress and taxation towards the encouragement of sea fisheries, and marine superintendence and enforcement of Scottish sea fisheries laws. In Ireland the sea fisheries are under the direction of the Inspectors of Irish Fisheries, who have replaced the former Fishery Commissioners and Special Commissioners for Irish Fisheries; special statutes, besides the general ones applying to all the United Kingdom, deal with oyster fisheries (1845-1884), and mussel fisheries (1898) ; and one of 1899 appropriates ►►10,000 for sea fisheries under the head of technical instruction. In all three component parts of the United Kingdom there are also special stat- utes relative to salmon and freshwater fish : for England, the Salmon and Freshwater Fisheries Acts 1861-1891, and the Freshwater Fisheries Acts 1878 to 1886; for Scotland the chief Salmon Acts are those of 1862-1868, and for trout and freshwater fish those of 1845-1860 ; for Ireland, the Salmon and Trout Acts 1845-1870, and one of 1895, and the Eels Acts 1842, 1848. A similar scheme is adopted in each case, namely, fishery districts and dis- trict boards are set up which regulate the fishing by bye- laws and protect the fish by fixing a close time, and prescribing passes, licenses, inspection, and the like, breaches of which are punishable by courts of summary jurisdiction. The supreme authorities in each case are ►►► for England the Board of Trade, for Scotland the Fishery Board, and for Ireland the Inspectors of Fisheries, and in England a certain official number of conservators on such boards

are appointed by the County Councils. There are special Acts dealing with the fishing in certain rivers.

such as the Thames, Medway, Severn, Tweed, and Esk. Throughout the United Kingdom the use of dynamite or other explosive substance to catch or destroy fish in any public fishery is prohibited, as it is also in England in any private waters subject to the Salmon and Freshwater Fisheries Acts 1878, in which it is also forbidden to use poison or other noxious substance for destroying fish. Officers in the army or marines are forbidden (under penalty) to kill fish without written leave from the person entitled to grant it. There are also provisions of the criminal law dealing with the protection of fisheries generally, as well as the provisions of the Acts already mentioned dealing with special kinds of fish.

Special provision is made by the Merchant Shipping Act 1894 for sea fishing boats (except in Scotland and the Colonies), relating to their registration, carrying official papers, carrying boats in proportion to their tonnage, the punishment of offences on board, the wages of their crews, and keeping record of all casualties, punishments, and the like on board. As regards trawlers, especially in the case of those of 25 tons and upwards, a statutory form of agree- ment with the crew is prescribed, as well as accounts of wages and discharges ; and skippers and second hands must have certificates of competency, which are granted under similar conditions to those required in the case of seagoing ships and are registered with the Board of Trade. Scottish fisTiing boats are regulated by a special statute of 1886 (excepts as regards agreements to pay crew by share of profits, dealt with by the above Act) and by the Sea Fisheries Act of 1868, which applies to all British fishing boats. Particular lights must be carried by fishing boats in navigation.

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Fiske, John (1842-1901), American historical, phil- osophical, and scientific writer, was born in Hartford, Connecticut, 30th March 1842, and died at Gloucester, Massachusetts, 4th July 1901. His name was originally Edmund Fiske Green, but in 1855 he took the name of a great-grandfather, John Fiske. His boyhood was spent with a grandmother in Middletown, Connecticut; and prior to his entering college he had read widely in English literature and history, had surpassed most boys in the extent of his Greek and Latin work, and had studied several modern languages. He graduated at Harvard in 1863, continuing to study languages and philosophy with zeal; spent two years in the Harvard law school, and opened an office in Boston ; but soon devoted the greater portion of his time to writing for periodicals. With the exception of one year, he resided at Cambridge, Massa- chusetts, from the time of his graduation until his death. In 1869 he gave a course of lectures at Harvard on the Positive Philosophy ; next year he was history tutor ; in 1871 he delivered thirty-five lectures on the Doctrine of Evolution, afterwards revised and expanded as Outlines of Cosmic Philosophy (1874) ; and between 1872 and 1879 he was assistant-librarian. After that time he devoted him- self to literary work and lecturing on history. Nearly all of his books were first given to the public in the form of lectures or magazine articles, revised and collected under a general title, such as Myitis and Myth-Makers (1872), Darwinism and Other Essays (1879), Excursions of a?i Evolutionist (1883), and A Century of Science (1899). He did much, by the thoroughness of his learning and the lucidity of his style, to spread a knowledge of

Darwin and Spencer in America. His Outlines of Cosmic Philosophy, while setting forth the Spencerian system, made psychological and sociological additions of original matter, in some respects anticipating Spencer's later con- clusions. Of one part of the argument of this work Fiske wrote in the preface of one of his later books {Tlirough Nature to

God, 1899) : “The detection of the part played by the lengthening of infancy in the genesis of the human race is my own especial contribution to the Doctrine of Evolution.” In The Idea of God as affected by Modern Knowledge (1885) Kske discusses the theistic problem, and declares that the mind of man, as developed, becomes an illuminating indication of the mind of God, ???which as a great immanent cause includes and controls both physical and moral forces. More original, perhaps, is the argument in the immediately preceding work, The Destiny of Man, Viewed in the Light of his Origin (1884), which is, in substance, that physical evolution is a demon- strated fact ; that intellectual force is a later, higher, and more potent thing than bodily strength ; and that, finally, in most men and some ” lower animals ” there is developed a new idea of the advantageous, a moral and non-selfish line of thought and procedure, which in itself so tran- scends the physical that it cannot be identified with it or be measured by its standards, and may or must be endur- ing, or at its best immortal.

It is principally, however, through his work as a his- torian that Fiske’s reputation will live. His historical writings, with the exception of a small volume on Ame7-ican Political Ideas (1885), an account of the system of Civil Government in the United States (1890), The Mississippi Valley in the Civil War (1900), a school history of the United States, and an elementary story of the Eevolutionary war, are devoted to studies, in a unified general manner, of separate yet related episodes in Ameri- can history. The volumes have not appeared in chrono- logical order of subject, but form a nearly complete colonial history as follows : The Discovery of America, with some Account of Ancient America, and the Spanish Conquest (1892, 2 vols.) ; Old Virginia and her Neighbors (1897, 2 vols.) ; Tlie Beginnings of New England ; or, The Puritan Theocracy in its Relations to Civil and Re- ligious Liberty (1889) ; Dutch and Quaker Colonies in America (1899); The American Revolution (1891, 2 vols.) ; and The Critical Period of American History, 1783-1789 (1888). Of these the most original and valu- able is the Critical Period volume, a history of the con- solidation of the States into a government, and of the formation of the constitution. (c. f. e.)

Fitch burg, a city of Worcester county, Massachu- setts, U.S.A., in 42 ° 35′ N. and 71 ° 50′ W., on the North Branch of the Nashua river, at an altitude of 433 feet. The site is hilly, and the city is built irregularly ; the waterworks, owned by the city, derive their supply by gravity from Scott brook. It is on the main line of the Fitchburg railroad, and on a branch of the New York, New Haven, and Hartford railroad. Its manufactures are considerable ; in 1895 there were 264 establishments, with a total capital of $8,079,412, employing 6185 hands, and producing goods valued at 110,629,400. The princi- pal items of manufacture were worsted, cotton, iron and steel goods, and paper. Population (1880), 12,429; (1890), 22,037 ; (1900), 31,531, of whom 10,917 were for- eign-born. The death-rate in 1900 was 13-6.

FitzCerald, Edward (1809-1883), the poet of Omar Khayyam, was born, as Edward Pukcbll, at Bredfield House, in Suffolk, on the 31st of March 1809. His father, John Purcell, who had married a Miss Fitz- Gerald, assumed in 1818 the name and arms of his wife's

family. From 1816 to 1821 the FitzGeralds lived at St Germain and at Paris, but in the latter year Edward was sent to school at Bury St Edmunds. In 1826 he proceeded to Trinity College, Cambridge, where, some two years later, he became acquainted with Thackeray and W. H. Thompson. With Tennyson, " a sort of Hyperion," his intimacy began about 1835. In 1830 he went to live in Paris, but in 1831 was in a farm-house on the battle- field of Naseby. He adopted no profession, and lived a perfectly stationary and rustic life, presently moving into his native county of Suffolk, and never again leaving it for more than a week or two. Until 1835 the FitzGeralds lived at Wherstead; from that year until 1853 the poet resided at Boulge, near Wood- bridge; until 1860 at Farlingay Hall; until 1873 in the town of Woodbridge; and then until his death at his own house hard by, called Little Grange. During most of this time FitzGerald gave his thoughts almost without interruption to his flowers, to music, and to literature. He allowed friends like Tennyson and Thackeray, however, to push on far before him, and long showed no disposition to emulate their activity. In 1851 he published his first book, Euphranor, a Pla- tonic dialogue, born of memories of the old happy life at Cambridge. In 1852 appeared Polonius, a collection of " saws and modern instances,"

some of them his own, the rest borrowed from the less familiar English classics. FitzGerald began the study of Spanish poetry in 1850, when he was with Professor E. B. Cowell at Elmsett, and that of Persian in Oxford in 1853. In the latter year he issued Six Dramas of Calderon, freely translated. lie now turned to Oriental studies, and in 1856 he anonymously published a version of the Saldmdn and Absdl of Jdmi in Miltonic verse. In March 1857 the name with which he has been so closely identified first occurs in FitzGerald's correspondence ❓❓❓ "Hafiz and Omar Khayydm ring like true metal." On the 15th of January 1859 a little anonymous pamphlet was published as The Rubdiydt of Omar Khayydm. In the world at large, and in the circle of FitzGerald's particular friends, the poem seems at first to have attracted no attention. 'The publisher allowed it to gravitate to the fourpenny or even (as he afterwards boasted) to the penny box on the bookstalls. But in 1860 Rossetti discovered it, and Mr Swinburne and Lord Houghton quickly followed. The Rubdiydt became slowly famous, but it was not until 1868 that FitzGerald was encouraged to print a second and greatly revised edition. Meanwhile he had produced in 1865 a version of the Agamemnon, and two more plays from Calderon. In 1880-81 he issued privately translations of the two QSdipus tragedies ; his last publication was Readings in Crabbe, 1882. From 1861 onwards FitzGerald's greatest interest had centred in the sea. In June 1863 he bought a yacht, " The Scandal," and in 1867 he became part- owner of a herring-lugger, the " Meum and Tuum." For some years, till 1871, he spent the months from June to Oc- tober mainly in "knocking about somewhere outside of Lowestoft." In this way, and among his books and flow- ers, FitzGerald gradually became an old man. On the 14th of June 1883 he passed away painlessly in his sleep. He was " an idle fellow, but one whose friendships were more like loves." In 1885 a stimulus was given to the steady advance of his fame by the fact that Tennyson dedicated his Tiresias to FitzGerald's memory, in some touching reminiscent verses to " Old Fitz." This was but the signal for that universal appreciation of Omar Khay- yam in his English dress, which has been one of the curious literary phenomena of recent years. The melody of Fitz- Gerald's verse is so exquisite, the thoughts he rearranges and strings together are so profound, and the general atmosphere of poetry in which he steeps his version

is so pure, that no surprise need be expressed at the universal favour which the poem has met with among critical readers. But its popularity has gone much deeper than this ; it is now probably better known to the general public than any single poem of its class published since the year 1860, and its admirers have almost transcended common sense in the extravagance of their laudation. FitzGerald married, in middle life, Lucy, the daughter of Bernard Barton, the Quaker poet. Of TitzGerald as a man practically nothing was known until, in 1889, Mr W. Aldis Wright, his intimate friend and literary executor, published his Letters and Literary Remains in three volumes. This was followed in 1896 by the Letters to Fanny Kemhle. These letters constitute a fresh bid for immortality, since they discovered that FitzGerald was a witty, picturesque, and sympathetic letter-writer. One of the most unobtrusive authors who ever lived, FitzGerald has, nevertheless, by the force of his extraor- dinary individuality, gradually influenced the whole face of English belles-lettres, in particular as it was mani- fested between 1890 and 1900. (e. g.)

Fitzroy, a city of Victoria, Australia, in the county of Bourke, 2 miles north-east of and suburban to Mel- bourne, with which it is connected by rail. It has several churches, a town hall, and public recreation ground, and is well served with tramways. Population (1881), 23,118 ;

(1901), 31,610.

Fiume, a port and municipal town in Hungary. It has a rapidly growing commercial and maritime trade. In 1900 the number of vessels entered and cleared was 21,772, of 3,365,480 tons ; the value of the imports was 90-8 million, that of the exports 165 million crowns. The Government has spent in the construction of the harbour 71-7 millions of crowns, and grants yearly sub- ventions to the Eoyal Hungarian Steamship Navigation Company " Adria," as well as to the other smaller ship- ping enterprises, the registration port of which is Fiume. Population (1900), 38,955.

Fivizzano, a town of Tuscany, Italy, in the province of Massa and Carrara, on the W. slope of the Apennines, 17 miles E.N.E. from Spezia. It has mineral springs, one sulphurous (74 ---7 Eahr.), another saline (54 --5) ; also marble quarries, silk spinning and weaving, lime-kilns, and olive-oil mills. Population about 13,800.

Flanders, two provinces of Belgium. I. West Flanders (Flemish, West-Vlaanderen; French, Flandre occidentale), bordering the North Sea, along a coast-line 42 miles long, France, the provinces of Hainaut and East Flanders, and the kingdom of Holland. The western part of the ancient Countship of Flanders, it was, when under the government of France, called the dipartement de la Lys. Seawards, West Flanders is fringed by a line of dunes, along which, on the inland side, extend polders or alluvial lands. The subsoil of the province is sandy, but the surface has become modified in consequence of excellent cultivation. The land is a low-lying plain, except along the southern frontier, which presents a chain of hills over 300 feet high. The principal crops are cereals, flax, hemp, colza, chicory, tobacco. The live stock feeding on its good pastures numbers 200,000 head. The industries include agriculture, occupying 24 per cent, of the population, flax, cloth, table-linen, and lace, the manufacture of chicory and oils, of linen and colza, searfishing, employing 400 smacks and 2000 men. The coast is dotted with popular bathing-places ---Ostend, Blankenberghe, Heyst, Knocke, Mariakerke, &c. The province is divided into eight administrative arrondisse- ments. The chief towns are Bruges (with 63,000 inhabi-

tants), the capital of the province, Ostend (38,500 inhabitants), Gourtrai (33,500 inhabitants). The pro- vince has an area of 1249 square miles. The arrondisse- ment of Courtrai is the one of densest population, 1134 to the square mile. The population of West Flanders, 696,651 in 1875, had increased by 113,793 in 1899, an increase of 16 per cent. (810,444, or 649 to the square

mile).

II. East Flanders (Flemish, Oost-Vlaanderen ; French, Flandre orientale), bordering on West Flanders, Hainaut, Brabant, and Antwerp,

and the kingdom of Holland. The eastern part of the Countship of Flanders, estab- lished in the 9th century, was under the government of France (1795-1814) known as the departement de I'Escaut. The land spreads out low and flat, rising a little towards the south. Muddy in the south, sandy in the north, the soil, by persistent cultivation, has been rendered fertile, more especially in the land of Waes, situated on the left of the Lower Escaut. The principal crops are cereals, flax, hemp, colza, and hops. The live stock includes 226,000 head of cattle and 200,000 pigs. More than a quarter of the population is engaged in agriculture. Other industries are the cotton manufacture, having Ghent for its principal seat ; the industry in flax, thread, and cloths; the manufacture of woollen textures, pure and mixed with cotton ; and roperies. The province is divided into six administrative arrondisseraents, having for their capitals Ghent (with 163,000 inhabitants), Eec- loo (13,000 inhabitants), St Nicolas (30,300), Termonde (10,000), Alost (29,700), and Audenarde, or Oudenarde (8900). The province has an area of 1158 square miles. The arrondissement of Ghent has the greatest density of population, 1111 to the square mile. The population of the province, 868,228 in 1875, had added to that amount 166,203 by 1899 (1,034,431, or 893 to the square mile), an increase of 19 per cent.

Flatbush, formerly a township on Long Island, New York, near Brooklyn, and annexed to that city, with other parts of King's county, in 1894. (See Brooklyn.)

Flaubert, Custave (1821-1880), French novelist, was born at B,ouen, on the 12th of December 1821. His father, in whom many traits are reproduced in "Charles Bovary," was a surgeon in practice at Rouen ; his mother was connected with some of the oldest Norman families. He was educated in his native city, and did not leave it un- til 1840, when he came up to Paris to study law. He is said to have been idle at school, but to have been occupied with literature from the age of eleven. Flaubert in his youth " was like a young Greek," full of vigour of body and a certain shy grace, enthusiastic, intensely individual, and apparently without any species of ambition. He loved the country, and Paris was extremely distasteful to him. He made the acquaintance of Victor Hugo, and towards the close of 1840 he travelled in the Pyrenees and Corsica.

Returning to Paris, he wasted his time in sombre dreams, living on his patrimony. In 1846, his mother being left quite alone through the deaths of his father and his sister Caroline, Flaubert gladly abandoned Paris and the study of the law together, to make a home for her at Croisset, close to Rouen. This estate, a house in a pleasant piece of ground which ran down to the Seine, became Flaubert's home for the remainder of his life. From 1846 to 1854 he carried on relations with the poetess. Mile. Louise Colet ; their letters have been pre- served, and according to M. Faguet, this was the only sentimental episode of any importance in the life of Flaubert, who never married. His principal friend at this time was Maxime Du Camp, with whom he travelled in Brittany in 1846, and through the East in 1849.

Greece and Egypt made a profound impression upon the imagination of Flaubert. From this time forth, save for occasional visits to Paris, he did not stir from Croisset. On returning from the East, in 1850, he set about the composition of Madame Bovary. He had hitherto scarcely written anything, and had published nothing. The famous novel took him six years to prepare, but y/ns at length submitted to the lievue de Paris, where it appeared in serial form in 1856. The Government brought an action against the publisher and against the author, on the charge of immorality, but both were acquitted ; and when Madame Bovary appeared in book form it met with a very warm reception. Flaubert now

GusTAVE Flaubert. {From a photo, by F. Nadar, Paris.)

settled down to the archseological studies which were required to equip him for Salammbd, which, however, in spite of the author's ceaseless labours, was not finished until 1862. He then took up again the study of contemporary manners, and, making use of many recollections of his youth and childhood, wrote L' Educa- tion Sentimentale, the composition of which occupied him seven years ; it was published in 1869. Up to this time the sequestered and laborious life of Flaubert had been comparatively happy, but misfortunes began to gather around him. He

felt the anguish of the war of 1870 so keenly that the break-up of his health has been at- tributed to it; he began to suffer greatly from a dis- tressing nervous malady. His best friends were taken from him by death or by fatal misunderstanding ; in 1872 he lost his mother, and his circumstances became greatly reduced. He was very tenderly guarded by his niece, Mme Commonville ; he enjoyed a rare intimacy of friendship with George Sand, and occasionally he saw his Parisian acquaintances, Zola, A. Daudet, Tourgenieff, the Goncourts ; but nothing prevented the close of Flaubert's life from being desolate and melancholy. He did not cease, however, to work with the same intensity and thoroughness. La Tentation de St Antoine, which he had begun so long before as 1857, was at length com- pleted and sent to press in 1874. In that year he was subjected to a disappointment by the failure of his drama Le Candidal. In 1877 Flaubert published, in one volume, Un coeur simple, La Ugende de Julien VHospi- talier, and Herodias. After this something of his judg-

ment certainly deserted him ; he spent the remainder of his life in the toil of building up a vast satire on the futility of human knowledge and the omnipresence of mediocrity, which he left a fragment. This is the de- pressing and bewildering Bouvard et Pecuchet, which, by a curious irony, he believed to be his masterpiece. Flaubert had rapidly and prematurely aged since 1870, and he was quite an old man when he was carried off by a stroke of apoplexy at the age of only 58, on the 8th of May 1880. He died at Croisset, but was buried in the family vault in the cemetery of Rouen. A beautiful monument to him by Chapu was unveiled at the Museum of Eouen in 1890. The personal character of Flaubert offered various peculiarities. He was shy, and yet ex- tremely sensitive and arrogant ; he passed from silence to an indignant and noisy flow of language. The same incon- sistencies marked his physical nature ; he had the build of a guardsman, with a magnificent Viking head, but his health was uncertain from childhood, and he was neurotic to the last degree. This ruddy giant was secretly gnawed by misanthropy and disgust of life. His hatred of the " bourgeois " began in his childhood, and developed into a kind of monomania. He despised his fellow-men, their habits, their lack of intelligence, their contempt for beauty, with a passionate scorn which has been compared to that of an ascetic monk. Flaubert's curious modes of com- position favoured and were emphasized by these peculiari-

ties. He worked in sullen solitude, sometimes occupying a week in the completion of one page, never satisfied with what he had composed, violently tormenting his brain for the best turn of a phrase, the most absolutely final adjective. It cannot be said that his incessant labours were not rewarded. His private letters show that he was not one of those to whom easy and correct language is naturally given ; he gained his extraordinary perfection with the unceasing sweat of his brow. One of the most severe of academic critics admits that "in all his works, and in every page of his works, Flaubert may be con- sidered a model of style." That he was one of the great- est writers who ever lived in France is now commonly admitted, and his greatness principally depends upon the extraordinary vigour and exactitude of his style. Less perhaps than any other writer, not of France, but of modern Europe, Flaubert yields admission to the inexact, the abstract, the vaguely inapt expression which is the bane of ordinary methods of composition. He never allowed a cliche to pass him, never indulgently or wearily went on, leaving behind him a phrase which " almost " expressed his meaning. Being, as he is, a mixture in almost equal parts of the romanticist and the realist, the marvellous propriety of his style has been helpful to later writers of both schools, of every school. The absolute exactitude with which he adapts his expression to his purpose is seen in all parts of his work, but particularly in the por- traits he draws of the figures in his principal romances. The degree and manner in which, since his death, the fame of Flaubert has extended, form an interesting chap- ter of literary history. The publication of Madame Bovary in 1867 had been followed by more scandal than admiration ; it was not understood at first that this novel was the beginning of a new thing, the scrupulously truthful portraiture of life. Gradually this aspect of his genius was accepted, and began to crowd out all others. At the time of his death he was famous as a realist, pure and simple. Under this aspect Flaubert exercised an extraordinary influence over E. de Goncourt, Alphonse Daudet, and M. Zola. But even since the decline of the realistic school Flaubert has not lost prestige ; other facets of his genius have caught the light. It has been perceived that he was not merely realistic, but real ; that his clairvoyance was almost boundless ; that he saw

certain phenomena more clearly than the best of observers had done. Flaubert is a writer who must always appeal more to other authors than to the world at large, because the art of writing, the indefatigable pursuit of perfect expression, were always before him, and because he hated the lax felicities of improvization as a disloyalty to the most sacred procedures of the literary artist. (b. g.)

Fleche, La, chief town of arrondissement, depart- ment of Sarthe, France, 27 miles S.S.W. of Le Mans by rail, on a tributary of the Maine. The chief object of interest is the Prytanee, a famous school for the sons of officers, with accommodation for 600 pupils, occupying the buildings of an ancient Jesuit College. It stands in a fine park, and has a library of 20,000 volumes. In the market-place is a bronze statue of Henry IV. Starch, goloshes, sabots, and paper are manufactured. Population

(1881), 6967 ; (1901), 10,519.

Fleetwood, a seaport and watering-place in the Blackpool parliamentary division of Lancashire, England, at the mouth of the Wyre, 8 miles north by east of Blackpool by rail. St Peter's church has been enlarged, and there are now market-buildings, and a free library and public hall. In the neighbourhood are salt works. The dock is provided with railways, and machinery for facilitating traffic; a large grain elevator has been ◆◆◆erected. The shipping traffic is chiefly in the coasting and Irish trade. Regular communication with Scotland ias been established. In 1900 the registered vessels be- longing to the port were 81 sailing vessels of 5142 tons net, and 35 steamers of 4469 tons net ; total, 116 vessels of 9611 tons. In 1900, 2607 vessels of 530,277 tons ◆◆◆entered, and 2614 vessels of 548,698 tons cleared. Value of imports in the foreign and colonial trade (1900), ◆◆879,112 ; of exports of produce and manufactures of United Kingdom, ◆◆14,828. Area of urban district, 2510 acres. Population (1881), 6733; (1891), 9274; (1901),

12,093.

Flemington and Kensington, a borough of Victoria, Australia, in the county of Bourke, 3 miles north-west of and suburban to Melbourne, with one of the finest race-courses in the world. It has the city cattle market and abattoirs, the latter erected at a cost of about ––60,000. Population (1901), 10,947.

Flensburg, a seaport town of Prussia, province of Schleswig-Hol stein, at the head of the Flensburg Fjord of the Baltic, 39 miles by rail north by east from Rendsburg. It is a busy centre of trade and industry, importing coals and other commodities. In 1898 the port was cleared by 2049 vessels of 191,130 tons. The church of St Nicholas, built about 1390, was restored in 1894, and pro- vided with a tower 295 feet high ; the 13th century church of St Mary has also been provided with a tower 230 feet high. There are new law courts (1884) and a new theatre (1894). A technical school of wood-carving, a school of marine engineering, two schools of navigation, an agricul- tural school, and a commercial school are the principal educational adjuncts of a special character. Population

(1885), 33,313 ; (1895), 40,840 ; (1900), 48,907.

Flers, a town in the arrondissement of Domfront, department of Orne, France, 37 miles, in direct line, north- west of AleuQon, on the railway irom Paris, and an affluent of the Noireau. There are a fine Norman church, a castle (restored) founded in the 5th century, a communal college, an industrial school, and a chamber of commerce. Manufactures are very important, and include a variety of cotton and linen fabrics, of which the annual value is about ––1,500,000, also drugs and chemicals; and there are large brick and tile works, flour mills, and dyeworks. Population (1881), 9494 ; (1901), 13,683.

Flint, capital of Genesee county, Michigan, U.S.A., in 43––01′ N. and 83––41′ W., on Flint river, at an altitude of 709 feet. It is on the Grand Trunk and the Flint and Pere Marquette railways. The Michigan Institute for the Deaf and Dumb is situated here. Flint is largely a lumber town. It contains several large saw- mills, and produces much manufactured lumber. Popula- tion (1880), 8409 ; (1890), 9803 ; (1900), 13,103, of whom 2165 were foreign-born, and 257 negroes.

Flint, Austin (1812-1886), American physician, was born at Petersham, Massachusetts, 20th October 1812. He graduated at the medical department of Har- vard University in 1833. He established the Buffalo Medical Journal, was one of the founders of the Buffalo Medical College, and was professor of the Theory and Practice of Medicine in that institution from 1847 to 1853. He was professor of the Theory and Practice of Medicine in the University of Louisville, 1852-56 ; professor of the Principles and Practice of Medicine and Clinical Medicine in Bellevue Hospital Medical College, New York, 1861-86. He wrote many text-books on medical subjects, among these being, Diseases of the Heart (1859-70) ; Principles and Practice of Medicine (1866) ; Clinical Medicine (1879) ; and Physical Exploration of the Lungs by means of Auscultation and Percussion (1882). He died in New York on 13th March 1886.

Fl i nt, Austi n (1836), American physician, son

of the foregoing, was born at Northampton, Mass., on 28th March 1836. He was educated at Harvard Univer- sity and at the University of Louisville, Ky. (1854-56). He graduated at the Jefferson Medical College, Phila- delphia, in 1857. In 1858 he became professor of Physiology and Microscopic Anatomy in the University of Buffalo, and in the year following professor of Physi- ology in the New York Medical College. In 1860 he was appointed professor of Physiology in the New Orleans Medical School ; in 1861 professor of Microscopic Ana- tomy in Bellevue Medical Hospital ; and in 1862 pro- fessor of Physiology in the Long Island College Hospital. He was better known as a teacher and writer on the subject of physiology than as a practitioner of medicine. His most exhaustive work. Physiology of Man (5 vols., 1866-74), never attained the popularity of his Text-hook of Human Physiology (1876), which was for many yejrs a standard text-book in the majority of American medical colleges. Among his other publications, the best known are. Chemical Examination of the Urine in Disease (1870), Effects of Severe and Protracted Muscidar Exer- cise (1871), and Service of Muscular Power (1878).

Flintshire, a maritime county of North Wales, consists of a main and a detached portion. The main portion is bounded N.^Y. by the estuary of the Dee and Cheshire, and S.E., S., and S.W. by Denbigh. The detached portion, 8 miles to the S.E. of the main portion, is sur- rounded by Cheshire, Shropshire, and Denbigh.

Area and Population. ??? The area of the ancient county is 104,050 acres, or 256 square miles. Population (1881), 80,441 ; (1891), 77,277, of whom 38,242 were males and 39,035 females, the number of persons per square mile being 302, and of acres to a person 2-12 ; (1901), 81,725. Tlie area of the administrative county, as given in the census returns of 1891, is 164,051 acres, with the same population as the ancient county ; but in 1896 the part of the parish of Threapwood in Flint was transferred to Chester and in 1897 part of the parish of Llanarmon yn Yale, and part of the parish of Erbistook, were transferred to Denbigh, while part of the parish of Nannerch in Denbigh was added to Flint. The area of the registration county is 73,380 acres, with a population in 1891 of 42,665. Within this area the decrease of population between 1881 and 1891 were 7-01 per cent. The excess of births over deaths between 1881 and 1891 was 4592, but the resident population decreased by 3209.

The following table gives the number of marriages, births, and

deaths, with the number and percentage of illegitimate births for 1880, 1890, and 1898 : ???

s ???

Year.

Marriages.

Births.

Deaths.

Illegitimate births.

No.

Per cent.

1880 1890 1898

241 280 269

1426 1123 1192

877 848 762

80 69 45

5-6 6-1

3-8

In 1891 there were in the county 326 natives of Scotland, 912 natives of Ireland, and 263 foreigners, while 12,862 persons could speak English, 10,484 Welsh, and 16,879 English and Welsh.

Constitution and Government. ??? The county returns one member to parliament, and it also includes the Flint district of boroughs (consisting of Caergwrle, Caerwys, Flint, Holywell, Mold, Overton, Rhuddlan, and St Asaph) and a small part of the parliamentary borough of Chester. There is one municipal borough, Flint. The urban districts are : Buckley, Connah's Quay, Holywell, Mold, Prestatyn, and Rhyl. Flintshire is in the North Wales and Chester Circuit, and assizes are held at Mold. The borough of Flint has a separate commission of the peace, but no separate court of quarter sessions. The ancient county, which is partly in the dioceses of Chester, Lichfield, and St Asaph, contains 46 entire ecclesiastical parishes or districts and parts of eleven others.

Education. ??? The number of elementary schools on 31st August 1899 was 99, of which 15 were board and 84 voluntary schools, the latter including 66 National Church of England schools, 8 Roman Catholic, and 10 " British and other." The average attendance at board schools was 2297, and at, voluntary schools 9877. The total school board receipts for the year ended 29th September 1899, were over ??10,179. The income under the Agricultural Rates Act was over ??617.

Agriculture. ??? About three-fourths of the total area of the county is under cultivation, and of this about three-fifths is in permanent pasture. About one-half of the acreage under com crops is occupied by oats, wheat and barley occupying each less than a fourth. Since 1880 the corn acreage has decreased more than a fourth, the decrease being chiefly in the acreage under wheat, but partly in that under barley, while the acreage under oats has slightly increased. The principal green crops are turnips and potatoes, which occupy respectively a little less than two-sevenths and four-sevenths of the acreage. The following table gives the larger main divisions of the cultivated area at intervals from 1880 ;???

Tear.

Total area

under cultivation.

Com Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1880 1885 1890 1895 1900

128,738 128,346 128,206 126,392 126,662

30,007 28,763 26,712 23,759 22,029

8100 8562 8217 8166 7405

17,095 14,556 16,879 17,485 23,774

70,937

74,978 75,131 76,263 72,812

2599

1487

1221

618

600

The following table gives particulars regarding the principal live stock for the same years : ???.

Year.

Total Horses.

Total Cattle.

Cows or

Heifers in Milk

or in Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1900

5593 5694 5974 6992 6743

28,537 32,130 32,399 33,609 38,426

13,378 14,801 15,392 16,054 17,174

65,561 59,884 71,752 68,744 86,215

11,816 14,734 19,008 19,664 18,124

Industries and Trades. ??? According to the annual report for

1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 4957, as compared with 4463 in 1896. Of these 4152 were employed in non-textile factories. Hardly any fishing is carried on. The total number employed in connexion with mines and quarries in

1899 was 4192. In the same year 181,828 tons of clay were raised, and 40,283 tons of limestone. The following table gives particulars regarding the output of coal, lead, and zinc in 1890 and 1899 : ???

Year.

Coal.

Lead.

Zinc.

Tons.

Talue.

Tons.

??? Value.

Tons.

Value.

1890 1899

754,149 682,630

__311,086 __264,519

5222 7617

__48,419 __79,095

1117

4728

__7,449 __34,693

(t. f. h.)

Floquet, Charles Thomas (1828-1896), French statesman, was born at St Jean-Pied-de-Port (Basses- Pyrenees), on the 2nd October 1828. He studied law in Paris, and was called to the Bar in 1851. The coup d'&tat of that year aroused the strenuous opposition of Floquet, who had, while yet a student, given proof of his Ee- publican sympathies by taking part in the fighting of 1848. He made his name by his brilliant and fearless attacks on the Government in a series of political trials, and at the same time contributed to the Temps and other influential journals. When the Tsar Alexander II. visited the Palais de Justice in 1867, Floquet was said to have confronted him with the cry, "Vive la Pologne, monsieur ! " He delivered a scathing indictment of the Empire at the trial of Pierre Bonaparte for killing Victor Noir in 1870, and took a prominent part in the Revolution of 4th September, as well as in the subsequent defence of Paris. In 1871 he was elected to the National Assembly by the department of the Seine. He opposed the measures of the Government, and formed the Ligue d'uniou ripublicaine des droits de Paris. He was thrown into

prison, but was soon released. He became editor of the Ripuhlique Frangaise, was chosen President of the Mu- nicipal Council, and in 1876 was elected deputy for the eleventh arrondissement by 22,000 votes out of 24,000. He took a prominent place among the extreme Radicals, and became president of the group of the "Union republi- caine." In 1882 he held for a short time the post of Prefect of the Seine. In 1885 he succeeded M. Brisson as President of the Chamber. This difficult position he filled with such tact and impartiality that he was re-elected the two following years. Having approached the Russian Ambassador in such a way as to remove the prejudice ex- isting against him in Russia since the incident of 1867, he rendered himself eligible for office ; and on the fall of the Tirard Cabinet in 1888 he became President of the Council and Minister of the Interior in a Radical ministry, which pledged itself to the Revision of the Constitution, but was forced to combat the proposals of General Boulanger. Heated debates in the Chamber cul- minated on 13th July in a duel between Floquet and Boulanger, in which the latter was wounded. In the following February the Government fell on the question of Revision, and in the new Chamber of November Floquet was re-elected to the presidential chair. The Panama scaiijdals, in which he was compelled to admit his impli- cation, dealt a fatal blow to his career : he lost the Presidency of the Chamber in 1892, and his seat in the House in 1893, but in 1894 was elected to the Senate. He died in Paris on 18th January 1896.

See Discours et opinions de M. Charles Floquet, edited by Albert Faivre (1885). (h. sy.)

Florence (Italian, Firenze; ancient, Florentia), for- merly capital of the Grand Duchy of Tuscany, capital of Italy from 1864 to 1870, and now chief town of the province to which it gives its name, 120 miles north of Rome, on the river Arno. Florence is an archiepiscopal see, and headquarters of the Sixth Italian Army Corps. In 1899 the population was estimated at 216,051. The area of the city has been greatly extended by new quarters which have arisen outside the old octroi circle, and especially towards Porta San Gallo and Porta alia Croce. These new quarters are inhabited both by the population of the old centre of the city, which has been demolished and rebuilt, and the new inhabitants who

come to Florence, especially from the surrounding province. This transformation of the city long preoccupied the municipal council and, the people of Florence. The fate of the centre of Florence became a burning question, in which much interest was taken outside Florence, and especially in England. The problem atthe moment of the reconstruction of the centre in

1888 appeared extremely difficult. The centre had be- come, from a hygienic point of view, almost uninhabitable, and was a nest of the lowest and most corrupted portion of the Florentine populace. It was necessary to execute a sanitary reform, and at the same time to respect as much as possible of the old quarter that possessed a real historical or artistic interest. The solution has been characterized by greater care for sanitary reform than for artistic and historical coneiderations. Unfortunately the new buildings of the centre are, as a rule, ugly, and out of keeping with the historical character of the city. The new quarters outside the gates are better in every respect, and especially the so-called viali or boulevards which surround the city. This part of Florence has the appear- ance of a quiet, well-to-do residential town. The Floren- tine Art Galleries, and in particular the Uffizi and the Galleria d'Arte Antica e Moderna, have undergone several impravements. In the Uffizi the pictures have been re-arranged in strict chronological order. On the first floor four new rooms have been opened for the portraits of famous painters, according to epoch and nationality. A large number of the most celebrated modern painters of all countries have presented their portraits to the gallery. A new stairway has been built from these rooms to the second storey, where the great artistic collections, includ- ing that of Tuscan art, are situated. In the gallery of ancient and modern art in Via Ricasoli, by the side of the Fine Arts Academy, three new rooms have been opened. The Perugino and Botticelli rooms deserve special men- tion, since they contain the principal works of those great masters. The great hall on the first floor has been divided into three rooms, containing the works of the Tuscan masters from the 13th to the 18th centuries chronologically arranged and classified. In the Pitti Gallery a magnificent new stairway and a new vestibule have been constructed by royal munificence.

Florentine artistic treasures have recently been in- creased by the discovery of several old paintings of great importance in the churches and

palazzi of the city and in the neighbouring villas. One of these paint-

‘ ings was a Ghirlandajo, discovered in the church of the Ognissanti. This discovery aroused great interest, both on account of the fame of the master and from the fact that among the figures in the picture is that of Amerigo Vespucci as a young man. By a coincidence the discovery was made shortly before the fourth centenary celebration

- of Vespucci’s discovery of America. Another valuable work came to light in 1899 in the church of the Santissima Annunziata. It is a fresco by Andrea del Castagno, representing St Jerome in the desert. In the famous Villa al Gallo, once occupied by Galileo, several painted figures were discovered, and were first attributed to Botticelli, but after maturer study to Pollajolo. Further, in the Pitti storehouse a painting, also attributed to Botticelli, though possibly the work of one of his pupils, was found in 1899. The important National Library, situated near the Uffizi, has received constant attention. The library, the largest in Italy, is con- stantly increasing in dimensions, and at present con- tains nearly 1,000,000 books and pamphlets, 19,000 manuscripts, 967 parchments, 300,000 letters and auto- graphs, 22,800 musical works, 25,000 portraits, and 1700 maps, besides prints and engravings. This enor- mous accumulation of valuable material outgrew the space at the disposal of the library. A number of Government commissions successively reported in favour of a new library building, for which the Florentine municipality offered the site in the centre of the city. After long delays the offer was accepted, a state subsidy granted, and the construction of the new edifice authorized.

Great care has been bestowed upon the Florentine schools and gymnasia. Besides numerous elementary schools Florence now possesses three lyceums and gym- nasia, named after the three greatest Florentines ??? Dante, Michelangelo, and Galileo Galilei. There are, besides, technical, commercial, and professional schools ; schools for female professional training, an academy of fine arts, a musical conservatory, a school of social science (founded by the late Marquis Alfieri di Sostegno for intending diplomatists), a school of recitation, and an Institute of Superior Studies. This latter institute serves as a univer- sity, although it possesses only the faculties of letters, medicine, and social science.

Nevertheless in regard to philological and philosophical studies it holds the first place in Italy. The Institute of Superior Studies has, in fact, succeeded in reawakening in Italy the love for classical literature, and has taken the initiative in pro- moting public lectures on the Greek Theatre. The professors of the Institute have also displayed praise- worthy activity in promoting the cult of Dante and the study of the Divina Commedia in his native city. The influence of this Florentine initiative has been felt throughout Italy, so that the study of Dante may now be said to be more flourishing in the peninsula than ever before. A society for public art, founded in Florence and extended to other Italian cities, exercises consider- able influence in the aesthetic questions connected with industries and public buildings. The development of painting, sculpture, and architecture has not kept pace with that of literature. The only really important work accomplished during recent years has been the facade of the cathedral (Sta Maria del Fiore), executed by Tuscan artificers from the designs of the architect De Fabris. During the long work the marble masons acquired a skill hardly inferior to that displayed in Renaissance structures. Begun in 1875, the faqade was unveiled in 1888. In other respects Florentine art has declined, as is proved by the new buildings of the centre and by the modern monuments erected in the squares. Industries have not shown any considerable tendency to develop. Florence still feels the effect of the transfer of the capital to Eome. Local trade has increased, but manufactures on a large scale are still lacking. Florence stiU remains the capital of an agricultural district, and the Piazza della Signoria and the Loggie del INIercato Vecchio still serve as the rendezvous for peasants and factors. The deca- dence of the straw-plaiting industry in the surrounding districts has made its effects felt also in the city. Per- haps the only really important Florentine industry is represented by the porcelain works of Signor Cantagalli and by the manufactory formerly belonging to the Mar- chese Ginori di Doccia, but now the property of a Milanese porcelain firm, Richard & Co.

See EuGi)NE Muntz. Florence et la Toscane ; paysages, monu- ments, mosurs et souveniis historiques. Paris. Hachette, 1901. ??? Peerens. L'Histoire de Florence. ??? Bekenson. Tlie Florentine Painters of the Benaissance. ??? Horner. Walks in Florence. ??? Hare. Florence. ??? Gardner. Florence (Dent Collection). ??? CoNTi. Firenze

Vecchia. ◆◆◆ Guido Carocci. / Dintorni di Firenxe; Firenze Scomparsa. ◆◆◆ Isidoro del Lungo. Florentia. Florence, 1899. (e. Co.)

Florence, capital of Lauderdale county, Alabama, U.S.A., on the northern bank of the Tennessee river, at the foot of Muscle Shoals Canal, at an altitude of 563 feet. The Southern and the Louisville and Nashville railways intersect here. It contains several minor educational institutions, the Southern Female University, the Synodical Female College, and the State Normal College. Population (1880), 1369 ; (1890), 6012 ; (1900), 6478, of whom 90 were foreign-born, and 1952 negroes.

F L 0 E E S ◆◆◆ F L 0 E I D A

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Flores, an island of the Dutch East Indies, with an area of 5838 square miles. The coasts have deep bays and extensive rounded gulfs, where are situated the prin- cipal villages (kampongs). On the north coast are Bari, Eeo, Maumer, and Geliting ; on the east, Larantuka ; and on the south, Sikka and Endeh. The existence of slate, chalk, and sandstone, eruptive rock, volcanoes, and heights stretching west and east, indicates a similar structure to that of the other Sunda Islands. Several volcanoes are still active. The rivers, known only at their mouths, seem to be unnavigable. The climate has a mean tem- perature of 77◆◆ to 80◆◆ E. and a yearly rainfall of 43 inches to 47 inches. Eor administrative purposes the island is divided into West Elores (Mangerai), attached to the government of Celebes, and Middle and East Flores (Larantuka and dependencies), attached to the residency of Timor. The population (250,000) live by trade, fishing, salt-making, shipbuilding, and the cultivation of rice, maize, and palms in the plain, but there is little industry.

Veth. Geographische aanteekeningen over Mores. Tijdsohr. Aardr. Gen. i., 1876, p. 180. ◆◆◆ Kleian. Voetreis over het 0. deel van Flores. Tijdschr. Bat. Gen., 1891, p. 485. ◆◆◆ Jaoobsen. Beisen im 0. 1. Archipel. Petermann's Mitteil., 1890, p. 103. ◆◆◆ Wichmann. Bericht iiber eine Beise, &c. Tijdsohr. Aardr. Gen., 1891, p. 188. ◆◆◆ IIoEDT. Verslag der reis naar de noordkust van Mores. Tijd- sohr. Bat. Gen., 1893,

p. 281. ??? Kan. Flores. Enoyclop. v. N. I., with detailed hibliography and full description of the island.

Florianopolis, a city and port of Brazil, formerly called Desterro, capital of the State of Santa Catharina. It is situated on the island of Santa Catharina and has a population estimated at from 22,000 to 27,000. It is an agriculture centre. In 1897 the port was visited by 335 ships of 151,098 tons burden.

Florida, the most southern State of the United States of America, projectijig as a peninsula between the At- lantic Ocean on the east, and the Gulf of Mexico on the west. The chief political event of late years was the framing of a new State constitution by a Convention which assembled at the capital at Tallahassee, in June 1885, with Samuel Pasco as President, and its subsequent ratification by the people. Under the former constitution the State and county ofiicers, with few exceptions, were appointed by the governor ; and the terms of the justices of the Supreme Court were for life. The new constitu- tion made all the principal oflB.cers elective except the circuit judges, and changed the life term to a term for six years. Other fundamental changes were introduced. The governor cannot be immediately re-elected ; in case of a vacancy during his term, the succession falls first upon the President of the Senate, and secondly upon the Speaker of the House of Representatives. The legisla- ture meets biennially, and is composed of thirty-two senators and sixty-eight representatives. The legislature was authorized to make the payment of a poll-tax a pre- requisite for voting, and has exercised this authority. The poU-tax cannot exceed one dollar annually, and is applied towards the support of the public schools. Au- thority was also given to enact laws for the correction of abuses and the prevention of unjust discrimination and excessive charges by common carriers. A Railway Com- mission was accordingly provided for, consisting of three members; who serve for a term of four years, and are elected by the people. The State has been Democratic in politics since 1876.

Population, Taxation, and Indebtedness. ??? The population of the State was, in 1880, 269,493, and in 1890, 391,422. In 1895 it was 464,639, of whom 271,561 were white and 193,078 coloured. In 1900 it was

528,542, an increase during the decade of 137,120, or 35 per cent. The total land surface is approximately 54,240 square miles, and the average number of persons to the square mile was 9-7 in 1900, as compared with 7-2 in 1890. Of the total population 276,246 were males and 253,296 females, 504,710 were native-born and 23,832 foreign-bom, 297,333 white and 231,209 coloured

(including 230,730 negroes, 120 Chinese, 1 Japanese, and 358 Indians). Out of 139,601 males 21 years of age and over, 30,729 were illiterate (unable to write), of whom 6558 were white and 24,171 were negroes. The death-rate of the entire State in 1900, on the basis of the deaths reported to the United States census enumerators in that year, was about 12-2. There were, in 1900, 92 incorporated cities, towns, and villages, of which only 14 had a population of over 2000, and only 4 a population of over 5000. These 4 were: Jacksonville, with 28,429 inhabitants; Pensacola, with 17,747 ; Key West, with 17,114 ; and Tampa, with 15,839. Between 1890 and 1900 the inhabitants in cities of over 8000 increased from 47,031 (12 per cent, of the total population) to 79,129 (15 per cent, of the total population), an increase con- siderably greater than that shown in the rural districts. In 1880 the value of real and personal property was $31,167,846 ; in 1899 it was $93,527,353.79. The rate of State taxation in 1880 was seven mills ; in 1900 it was five mills for all State purposes. There is no floating debt, and the cash on hand belonging to the different State funds, 1st January 1901, was $370,559.46. The total bonded indebtedness is made up of 7 per cent, bonds of 1871 to the amount of $350,000, and 6 per cent, gold bonds of 1873 to the amount of $925,000, giving a total of $1,275,000. Of the bonds of 1871, on 1st January 1901, $82,300 were in the sinking fund ; $255,700 were in the school, seminary, and college funds ; and $12,000 were in the hands of individuals. Of the bonds of 1873, $160,200 were in the sinking fund ; $586,000 were in school, sem- inary, and college funds ; and ^178,800 in the hands of individuals. The total of both issues in the hands of individuals on 1st January 1901 was thus $190,800.

Education. ??? In 1880 there were 1131 schools with 38,415 pupils, and the annual expenditure was $141,934.16. In 1896, out of a total average attendance of 66,1.36, 41,992 were whites and 24,143 were

coloured. In 1900 there were 2443 schools with 108,874 pupils enrolled, and the annual expenditure was $765,777.42. The number of persons of school age (5 to 20 years inclusive) was 197,600. Two normal schools were provided for by the con- stitutional convention of 1885. One of these, for white teachers, has been located at De Funiak, the other, for coloured teachers, at Tallahassee. Both are in successful operation. In 1883 an insti- tute for the deaf and blind was established at St Ar^ustine, with separate departments for the two races. Facilities for advanced education are provided for coloured students at the following insti- tutions : Edward Waters College, Jacksonville ; Florida Baptist Institute, Jacksonville ; Florida Institute, Live Oak ; Coofaman Institute, Jacksonville. There are three educational institutions for advanced students, which owe their origin to the Uberality of Congress ??? the East Florida Seminary at Gainesville, the Sem- inary West of the Suwannee at Tallahassee, and the State Agri- cultural College at Lake City ; the last, in 1898, had 203 students, of whom 150 were males ; and fifteen instructors, of whom thirteen were men. In addition to the proceeds of the funds, and the Con- gressional appropriations from which these derive the larger part of their support, they are aided with annual appropriations from the State treasury. The South Florida Military and Edu- cational Institute at Bartow is partly supported by the State, and has a curriculum equal to that of like institutions in other States. A university and two colleges have been chartered by the State ; the John B. Stetson University (in 1887) at Deland, with a faculty in 1898 of twenty-five instructors, fourteen of whom were men, and 191 students, 115 of whom were men ; Rollins College (in 1885) at Winter Park, with a faculty of twenty instructors ; and the Methodist Conference College, Leesburg, with a faculty of seven instructors.

Beligion. ??? The leading religious denominations are : Methodists, who in 1890 reported 70,458 communicants ; Baptists, 41,647 ; Catholics, 16,867 ; Presbyterians, 4574 ; and Episcopalians, 4225. The total number of communicants was 141,734. There were 1971 Church organizations, with 1793 edifices, valued at $2,424,423.

Bailways. ??? In 1880 there were 518 miles of railway, and in 1900, 3231 miles. Six daily mail trains pass each way along three trunk lines

from New York, through Jacksonville and Live Oak, to their terminal points at Tampa and Miami. During the tourist season an extra train on each line furnishes the most approved conven- iences and facilities of modem travel to those who visit the State. Meanwhile many millions have been expended in the improvement and extension of terminal facilities at Pensacola and Tampa. These outlays are still going on, and are rendered necessary by the increased commercial intercourse with Cuba and Porto Eico, which has resulted from the war with Spain.

Fruits. ❓❓❓ In the closing years of the 19th century Florida was visited by a series of cold winters that did great damage, especially to the orange crops. In December 1894 the ungathered fruit was destroyed as far south as Indian River ; and in the following February, when the sap was rising, the younger trees were killed to the roots, except in the most southern part of the orange belt. In February 1899 snow fell to the depth of several iaches as far

south as Tampa, a novel sight to the native of Florida who had never been out of his State. In spite of these vicissitudes, hovy- ever, such older trees as received proper attention and cultiva- tion recovered. Before these calamitous visitations the record shipment for one year amounted to 5,000,000 boxes. It has been urged that these cold spells are caused by the clearing of forests, vchich has opened a path for the blizzards from the north, and that they thus indicate a permanent change in the climate ; but similar disasters occurred in the earlier days. It seems likely that in the long cycles of meteorological changes citrus fruits may again bloom and bear their golden harvests, even in the northern part of the State. In 1897, 117,910 crates of pine-apples, valued at $160,662, were shipped from the State, and 58,194 barrels of pears, valued at $65,24.3. The northern part of the State is famous for its water- melons, which find a ready market at the north in the early part of the season ; in Jefferson county many acres are planted for the seed, which is in great demand all over the United States.

Tobacco. ❖❖❖ The manufacture of cigars, begun at Key West, has grown to enormous proportions. The cigars there made by Cuban workmen were of such excellent quality that the name of Key West became a valuable trade mark all over the country. Factories were subsequently established at Quincy, Jacksonville, Tampa, Ooala, and other points. In 1897, 261,663,000 cigars were manufactured, with a value of $16,161,310.

Mineral Products. ❖❖❖ The principal mineral products added to the resources of the State in late years are phosphate, fuller's earth, and kaolin. In 1897, 30,000 tons of fuller's earth, of the value of $360,000,were shipped to other markets, and 69,000 sacks of kaolin, valued at $40,800. Phosphate was discovered about 1880, but its value and importance did not attract the attention of capitalists till 1890, when mines were opened at Dunellon and other places. Florida is now one of the large phosphate-producing districts of the world. From January 1891 to January 1899, 3,433,781 tons were mined, and during the fiscal year ending 30th June 1899, 515,498 tons of the crude product, valued at $4,043,775, were shipped from the ports of Florida to foreign countries. (See South Cakohna.)

Other Products. ❖❖❖ In 1900 there were in the State 519,524 acres given up to Indian corn, and producing 4,156,192 bushels, valued at $2,493,715 ; 33,470 acres of oats, yielding 378,211 bushels, valued at $189,106 ; and (in 1899) 149,403 acres of cotton, yield- ing, during the season of 1899-1900, 41,855 bales, valued at $2,189,805. The cotton ginned from the crop of 1900 amounted to 55,696 commercial bales, of a total gross weight of 24,308,127 R). On the 1st of January 1900 the number and value of farm animals in Florida, according to the Year-Book of the United States Department of Agriculture, were as follows : 38,050 horses, $1,776,778; 76,074 sheep, $128,870; 8521 mules, $610,096; 113,108 milch cows, $1,888,904; 299,712 other cattle, $2,512,036. The exports of timber and lumber during the year ending 30th June 1899 were valued at more than $7,500,000. There has been a marked increase in the production of naval stores, and many new turpentine farms and stills are in successful operation. Fleets of schooners and smaller vessels and many thousand men are employed in

the fisheries at the different ports of the State. Many Pensacola vessels are engaged in the snapper fisheries ; they fre- quently sail twenty-five hundred miles in a single trip ; the fish are packed in ice, and shipped to all parts of the United States. In 1890 the value of this industry was $1,339,869, and it has grown largely since then. The sponge fisheries yield a quarter of a million dollars annually.

Commerce. ??? Regular lines of steamers run from Jacksonville to Charleston and New York, from Tampa to Key West and Havana ; from Fernandinato Brunswick, Ga. ; from Key West to New York and Galveston, New Orleans, and Havana, as well as from other ports. The exports of the leading ports have increased as follows : ???

18S4.

1809.

Apalachicola

$230,334

$396,436

Femandina ....

169,457

2,424,296

Jacksonville ....

35,733

176,305

Key West ....

412,318

1,742,313

Pensacola ....

2,581,426

14,214,690

Tampa . . ??? ???

173,496

956,236

???

$3,602,764

$19,910,276

Durmg the decade from 1890 to 1000 Congress authorized the expenditure of $6,800,000 for the improvement and maintenance of rivers and harbours.

Banks. ??? In 1900 there were sixteen national banks, with a capital and surplus of $1,762,600, and deposits of $6,694,036.4.3; twenty- two State banks, with a capital and surplus of $871,086, and depos- its of $2,912,534 ; and one savings bank, with a capital and surplus of $25,000, and deposits of $233,341.

The mild climate of Florida through the winter months has led to the influx of large numbers of tourists, and to the erection since 1885 of mammoth hotels costing millions of dollars, especially at St Augustine, Palm Beach, Ormond, Miami, and Tampa. (s. pa.)

Floridsdorf, or Floeisdoef, chief town in the gov- ernment district of the same name in Lower Austria. It was formerly a village, commune, and station on the Northern railway, about three miles from Vienna. In 1890 it had 6123 inhabitants, but in 1896 it was made the seat of the government

district of the same name, some adjoining villages being incorporated. This raised the population to 23,000, and in 1900 to 36,599, chiefly German and Catholic (estimated at 6 per cent. Czech, 4 per cent. Jewish, and 1-5 per cent. Protestant). In 1866 the Austrians occupied a fortified camp at Florids- dorf in anticipation of the Prussian advance on Vienna' after the battle of Sadowa. The attack was averted, however, by the conclusion of the armistice. Floridsdorf is a busy industrial centre, its principal manufactures being machinery and liqueurs.

Flotow, Friedrich Ferdinand Adolf von,

Fbeiheek (1812-1883), a voluminous and popular Ger- man composer of operetta, was born on his father's estate at Teutendorf, in Mecklenburg, 27th April 1812. Des- tined originally for the diplomatic profession, his passion for music induced his father to send him to Paris to study under Eeicha. But the outbreak of the Revolution in 1830 caused his return home, where he busied himself writing chamber-music and operetta until he was able to return to Paris. There he produced Pierre et Catherine, Bob Roy, La Duchesse de Guise, but made his first real success with Le Naufrage de la Miduse at the Renaissance Theatre in 1838. Greater, however, was the success which attended Stradella (1844) and Martha (1847), which made the tour of the world. In 1848 Flotow was again driven home by the Revolution, and in the course of a few years he produced Die Grossfurstin (1850), Indra (1853), Eubezahl (1854), Hilda (1866), and Albin (1856). I^'rom 1856 to 1863 he was director (Intendant) of the Schwerin opera, but in the latter year he returned to Paris, where in 1869 he produced L' Ombre. From that time to the date of his death he lived in Paris or on his estate near Vienna. He died 24th January 1883. Of his concert-music only the Jubelouvertiire is now ever heard. His strength lay in the facility of his melodies and in their often piquant dress. (e. h. l.)

Flower, Sir William Henry (1831-1899), Eng- lish biologist, was born at Stratford-on-Avon on 30th November 1831. Choosing medicine as his profession, he began his studies at University College, London, where he showed special aptitude for physiology and comparative anatomy, and took his M.B. degree at the age of twenty. He then joined the Army

Medical Service, and went out to the Crimea as assistant-surgeon, receiving the medal with four clasps. On his return to England he became a member of the surgical staff of the Middlesex Hospital, London, but within a few ;^ears gave up his post there in order to succeed Quekett as curator of the Hunterian Museum of the Royal College of Surgeons of England. In 1869 he was chosen Hunterian Professor, and in 1884, on the death of Owen, was appointed to the directorship of the Natural History Museum at South Kensington. He died in London on 1st July 1899. Sir "William Flower's services to science were twofold. In the first place, he made valuable contributions to structural anthro- pology, publishing, for example, complete and accurate measurements of no less than 1300 human skulls. As a comparative anatomist, again, he ranked high, devoting himself especially to the study of the mammalia. In the

second place, he was a leading authority on the arrange- ment of museums. The greater part of his life was spent in their administration, and in consequence he held very decided views as to the principles upon which the speci- mens should be set out. He insisted on the importance of distinguishing between collections intended for the use of specialists and those designed for the instruction of the general public, pointing out that it was as futile to present to the former a number of merely typical forms as to pro- vide the latter with a long series of specimens differing only in the most minute details. His ideas, which were largely and successfully applied to the museums of which he had charge, gained wide approval, and their influence entitles him to be looked upon as a reformer who did much to improve the methods of museum arrangement and management. In addition to numerous original papers, he was the author of several books on zoological subjects, and of one dealing with topics connected with museums; he also wrote many articles for the ninth edition of this Encyclopmdia, that on the Mammalia being the most elaborate. (h. m. e.)

Flushing (Dutch, Vlissingbn), a fortified seaport on the island of Walcheren, in the province of Zealand, Holland, 60 miles south-west of Rotterdam, at the mouth of the estuary of the Western Scheldt. There is

regular steam communication with Queenborough. Its consider- able manufacture of machinery (employing about 1000 workmen), its state railway-workshops, and its depdt of the Krupp iron and steel works (Essen, Prussia) contribute to its prosperity. An aqueduct conveys excellent fresh water for the ships. The navigation of the port, however, is far behind that of Rotterdam and Antwerp, the tonnage in 1899 being 1,870,000 tons, or about 7-9 per cent, of that of the kingdom. The principal imports are now grain, colonial produce, wine, wood, and manufactures for the shipping trade. Of late years Flushing has acquired considerable popularity as a bathing resort, attracting visitors even from Germany. A chamber of antiquities has been opened in the Town Hall. Population in 1900,

18,896.

Flushing (New Yoek). See New York City.

Focsani, chief town of the district of Putna, Ru- mania, 125 miles from Bucarest, on the river Milcov, which formed the ancient frontier of the former princi- palities of Moldavia and Wallachia. It is the seat of a court of first instance, has 27 orthodox churches, 1 Catholic, 2 Armenian churches, and 2 synagogues, and is the headquarters of the 6th Army Corps. Pocsani is a commercial centre of some importance, the chief industries being oil and soap manufacture and tannery. A large and important wine trade is also carried on. The annual fair is held on the 29th of April. There is a Chamber of Commerce. Government explorations in the vicinity of this town show it to be rich in mineral sources, such as iron, copper, coal, and petroleum. Population (1895), 21,000 ; (1900), 23,783, of whom 6000 were Jews. The line Pocsani-Galatz is covered by a very strong line of fortifications of the most modern type.

Fogazzaro, Antonio (1842), Italian novel- ist and poet, was born at Vicenza in 1842. He was a pupil of the Abate Zanella, one of the best of the modern Italian poets, whose tender, thoughtful, and deeply reli- gious spirit has continued to animate his literary produc- tions. He commenced his literary career with Miranda, a poetical romance (1874), followed in 1876 by Valsolda, which, republished in 1886 with considerable additions,

constitutes perhaps his principal claim as a poet, which is not inconsiderable. To the classic grandeur of Carducci and D'Annunzio's impetuous torrent of melody Fogazzaro

opposes a Wordsworthian simplicity and pathos, contri- buting to modern Italian literature wholesome elements of which it would otherwise be nearly destitute. He has, however, attained far more celebrity as a novelist. His novels, Malombra, Daniele Cortis, Mistero del Poeta, obtained considerable literary success upon their first publication, but did not gain universal popularity until they were discovered and taken up by French critics in 1896. The demand ' then became prodigious, and a new work. Piccolo Mondo Antico, which critics far from friendly to Fogazzaro's religious and philosophical ideas have pro- nounced the best Italian novel since I Promessi Sposi, has gone through thirty editions. Fogazzaro's conservative attitude accounts for his success with large classes of Italian society, but there is much in his delicate and graceful talent independent of the controversies of his time. His biography, with essays illustrative of his characteristics, has been written by Signor Molmenti.

Foggia, a growing town and episcopal see of Italy (Apulia), capital of the province of Foggia, an important railway centre 123 miles by rail E.N.E. from Naples. It possesses a botanical garden, a technical school (1872), and a monument to the local patriot Lanza (1784-1860), and has large ironworks and foundries, and manufactures macE roni and liquorice. Population of town (1881), 40,283 ; (1901), 53,351 ; of province (1881), 356,267 ; (1901), 418,510.

Foil (Foley), Allan James (1837-1899), Irish bass singer, was born at Cahir, Tipperary, 7th August 1837 ; originally a carpenter, he studied under Bisaccia at Naples, and made his first appearance at Catania in 1862. From the opera in Paris he was engaged by Mapleson for the season of 1866, and appeared with much success in various parts. He sang in the first performance of The Flying Dutchman (Daland) in England in 1870, and in the first performance of Gounod's Redemption in 1882. He was distinguished in opera and oratorio alike for his

vigorous, straightforward way of singing, and was in great request at ballad concerts. He died 20th October

1899.

Foligno or Fuligno, a town and bishop's see of Italy (Umbria, province of Perugia), 25 miles S.E. from Perugia by rail. There are a picture gallery, with works by the masters of the Umbrian school, an industrial arts school (1873), and numerous private mansions of architectural interest. Population about 19,000.

Folkestone, a parish, municipal borough, and sea- port in the eastern division of Kent, England, 71 miles S.S.E. of London. It is included in the parliamentary borough of Hythe. Recent erections are Established and Roman Catholic churches, a Congregational hall, a Victoria hospital, a free library and museum, the Harveian Institute (for youths), a " Home of Rest " for ladies, a convalescent home, a Masonic hall, public baths, the Victoria pier promenade, and a bronze statue of Harvey (1881). An infectious diseases sanatorium has been enlarged. Radnor park (20 acres) was opened in 1886. Several lifts facilitate intercourse between the beach and the cliffs. The port was made a customs-port in 1882. The registered shipping is unimportant, but in 1888, 1268 vessels of 209,938 tons entered, and 1760 vessels of 212,468 tons cleared, while in 1898, 2420 vessels of 483,626 tons entered, and 2388 of 478,467 tons cleared. Area of urban district, 2321 acres. Population (1881),

18,816; (1891), 23,711 ; (1901), 30,694.

Fond du Lac, capital of Fond du Lac county, Wisconsin, U.S.A., in 43 ° 47' N. and 88 ° 28' W., at the southern end of Winnebago Lake, at the mouth of Fond du Lac river, at an altitude of 770 feet. The city is

regularly laid out on a level plan, is supplied with water from artesian wells, and is served by three railways, the Chicago and North-Western, the Chicago, Milwaukee, and St Paul, and the Wisconsin Central. It has extensive manufactures of lumber and agricultural implements and machines. Population (1880), 13,094; (1890), 12,024;

(1900), 15,110.

Fonsagrada, a town of Spain, in the east of the mountainous province of Lugo, on the river Navia. There is trade in wheat, wine, hemp, potatoes, and fruit. Much live stock is reared in this extensive township. The industries are linen and rough frieze manufacture, and cheese and butter making. The population, which was 17,200 in 1897, shows a tendency to decrease through emigration.

Fonseca, Manoel Deodoro da (1827-1891), first president of the United States of Brazil, born at Alagoas on 6th August 1827, was the third son of Lieut. – Colonel Manoel Mendes da Fonseca (died 1859). He was educated at the military school of Rio de Janeiro, and had attained the rank of captain in the Brazilian arm7 when war broke out in 1864 against Montevideo, and afterwards against Solano Lopez, dictator of Parar guay. His courage gained him distinction, and before the close of the war in 1870 he reached the rank of colonel, and some years later that of general of division. After enjoying several military commands, he was nomin- ated in 1886 governor of the province of Rio Grande do Sul. In this position he threw himself heartily into politics, espoused the republican opinions then becoming prevalent, and sheltered their exponents with his autho- rity. After a fruitless remonstrance, the Government at the close of the year removed him from his post, and recalled him to the capital as director of the service of army material. Finding that even in that post he still continued to encourage insubordination, the minister of war, Alfredo Chaves, dismissed him from office. On 14th May 1887, in conjunction with the Viscount de Pelotas, Fonseca issued a manifesto in defence of the military officers' political rights. From that time his in- fluence was supreme in the army. In DecerOiber 1888, when the Conservative Corread'Oliveira became prime minister, Fonseca was appointed to command an army corps on the frontier of Matto Grosso. In June 1889

the ministry was overthrown, and on a dissolution an enormous Liberal majority was returned to the Chamber of Deputies. Fon- seca returned to the capital in September. Divisions of opinion soon arose within the Liberal party on the question of provincial autonomy. The more extreme desired the inauguration of a complete federal system. Amongst the most vehement was Ruy Barbosa, the journalist and orator, and after some difficulty he per- suaded Fonseca to head an armed movement against the Government. The insurrection broke out on 15th November 1889. The Government commander, Almeida Barreto, hastened to place himself under Fonseca's orders, and the soldiers and sailors made common cause with the insurgents. The affair was almost bloodless, the minister of marine, baron de Ladario, being the only person wounded. Fonseca had only intended to over- turn the ministry, but he yielded to the insistency of the republican leaders and proclaimed a republic. A provisional government was constituted by the army and navy in the name of the nation, with Fonseca at its head. The council was abolished, and both the Senate and the Chamber of Deputies were dissolved. The emperor was requested to leave the territory of Brazil within twenty -four hours, and on 17th November was embarked on a cruiser for Lisbon. On 20th December a decree of

banishment was pronounced against the Imperial family. So universal was the republican sentiment that there was no attempt at armed resistance. The provisional govern- ment exercised dictatorial powers for a year, and on 25th February 1891 Fonseca was elected President of the republic. He was, however, no politician, and possessed indeed little ability beyond the art of acquiring popu- larity. His tenure of office was short. In May he became involved in an altercation with Congress, and in November pronounced its dissolution, a measure beyond his con- stitutional power. After a few days of arbitrary rule insurrection broke out in Rio Grande do Sul, and before the close of November Fonseca, finding himself forsaken, resigned his office. From that time he lived in retire- ment. He died at Rio de Janeiro on 23rd August 1892.

(e. I. c.)

Fontainebleau, chief town of arrondissement, department of Seine-et-Marne, France, 9 miles S. by E. of Melun, on the railway from Paris to Lyons. The palace is now the summer residence of the President of the Republic, and a school of practical artillery is installed in a section of the buildings. The Forest of Fontainebleau covers an area of 42,500 acres. Population (1881), 9621 ; (1896), 10,788 ; (1901), 10,923, or, including military, 14,160.

Fontenay-SOUS-BoJS, a town in the arrondisse- ment of Sceaux, department of Seine, France, 2J miles east of the Outer Circle of Paris, and about half a mile north-west of Fort Nogent, on the railway from Paris to Brie-Comte-Robert. It has a 16th century church, with fine Gothic arches. Population (1881), 3586; (1896),

5992 ; (1901), 9320.

Foochow (or FucHAw), a treaty port in the province of Fuhkien, China. The trade of the port has declined in recent years owing to the falling off in the export of tea. In 1880 the export of this staple article of trade reached 98 million lb, the greater part of which came to England. In 1898 the export had fallen off to 36 million lb, of which only about a quarter came to England. The total value of the trade for 1899, as given in the customs returns, was H. taels 17,352,000 (□□2,603,000). In 1880 the total of the trade was H. taels 15,758,000, equivalent at the then value of the tael to □□3,832,000. The Min river on which Foochow is built has silted up to such an extent that steam-vessels for many years have been compelled to load and discharge their cargoes at a place called Pagoda anchorage, some ten miles below the city. Near this point the Chinese Government established an arsenal and ship-building yard, which between 1870 and 1880 turned out some twenty- five or thirty small gunboats. In 1884 it was partially destroyed in the attack by the French fleet on the Chinese squadron lying in the harbour, and for a number of years after that event the workshops and machinery, which had cost an immense amount of money, were allowed to stand idle and go to decay. An attempt was made after the Japanese war to revive the establishment, a staff of French engineers having again been engaged for the purpose. On the 1st August, 1895, a horrible attack was made on an English

mission station near the inland city of Kucheng, 120 miles west of Foochow. Nine missionaries, of whom eight were ladies, were massacred, and only one or two escaped. Most of the ringleaders in this outrage were brought to justice. The population of Foochow is esti- mated at 1,000,000, and the number of foreign residents, including missionaries in the interior, at about 530.

Football. ❓❓❓ 1. Association. Though the rules govern- ing the actual play have undergone singularly few, and those not very material, variations, the evolution of Association

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*football since 1875 lias brought in its train many im- portant changes. The whole constitution of the Associa- tion itself, in the first place, has been considerably altered. What used to be a purely sporting administration con- trolling the game in the interests of players wholly and solely, for its own sake and as a healthy recreation, has by the force of circumstances become an unwieldy body, with many varied responsibilities involving the control of details quite outside the scope of a legislative tribunal. The institution of the Football Association Cup in 1871 may be held to have been primarily accountable for the conversion. For a time the competition was mostly limited to South of England teams. The game was then an amateur sport. Even at the most important matches spectators were comparatively few, and " gate money," enabling clubs to provide for the payment of the ex- penses of players on the most limited scale, was prac- tically unknown. It was not till the entry of the Lancashire clubs into the competition that the Associa- tion Cup began to arouse any general interest. Until 1881 the final had been *left entirely to southern teams. The excellent form shown by the Blackburn Rovers, who were only beaten, after a hard struggle, by the bare majority of a goal by the Old Etonians at the Oval in 1882, came as something of a revelation. The next year saw the cup won for the first time by a northern team, the Blackburn Olympic, who were able to outstay the Old Etonians and beat them after one and a half hours' play. This was the beginning of a new era. For three years in succession the Blackburn Rovers held the cup ;*

and so complete was the ascend- ancy of the North that it was not till 1900 that a south- ern club got into the final tie, though in 1901 the cup was at last secured for the South by Tottenham Hot- spur. For nineteen years the cup had remained solely in the, hands of northern or Midland clubs. The early triumphs of the Lancashire teams had far-reaching effects. It soon became evident that the spirit of the amateur rules on which the cup competition was based was being violated. Attempts were made by the executive to check the illicit payment of players. When they failed, the only alternative was to recognize professionalism and bring it under adequate control. The advocates of open profes- sionalism had to wait some time before they carried their point. ' Its opponents certainly did not allow it to be legalized without a stubborn fight. Gradually, however, they had to yield before the force of public opinion, and by 1890 the professional player had come to be officially recognized by the Football Association of England. For a time Scotland, Wales, and Ireland refused to acknow- ledge him ; and the Scottish executive unsuccessfully tried to induce the English authorities to agree to his exclusion from the English elevens in international contests. As it was, they were the last to give way, and professional- ism had been recognized in Wales and Ireland before Scotland perforce had to agree to it. Since 1889 the pro- fessional player has played a part, and an increasingly important part, in Association football. Up to 1902 he had been kept well under control, and the forebodings of the evil he was to do to the game had certainly not been realized. A player receiving more than his actual ex- penses for playing in a match is a professional, and must be registered with the Football Association as such. Even wages absolutely lost are not allowed, and no pro- fessional can revert to his old amateurism until he has been properly reinstated by the Football Association, which naturally requires to be thoroughly satisfied of the good faith of every application before it is even consid- ered. How professionalism has developed in the years which have passed since its recognition may be gathered from the fact that in 1899-1900 no fewer than seven

thousand were registered with the Football Association. This, it may be added, refers only to English players, and does not include those who are registered with Scotland, Wales, and Ireland, which may fairly be computed to number several thousands more. The development of the

Association itself between 1875 and 1902 has of course corresponded with the increase in the popularity of the game itself. In 1875 the official register showed only ninety-four clubs under its direct control. In 1900 the managing body consisted of a president, four vice-presi- dents, a treasurer, and sixteen delegates, elected from the various districts into which the Association has been sub- divided for electoral purposes. In addition to representa- tives of every affiliated association having jurisdiction over fifty or more clubs, varying in number according to the numerical strength of the clubs under their control, at its full strength the Council of the Football Associa- tion includes some forty or fifty persons. Such a body as this has proved very cumbersome for practical purposes, and latterly the bulk of the work has been done by a Consultative Committee, composed of the ofiicers and twelve other delegates selected by them. Besides the Cup Competition the Association has latterly had the control of three international matches, those with Scot- land, Wales, and Ireland, of the trial match North v. South, and during the last few years of a Second Cup Competition confined to amateurs alone. The Scottish match has been played uninterruptedly since 1872. That with Wales was not originated till seven years later, while the Irish fixture does not appear on the list until 1882. The Irish and Welsh matches, as well as that between North and South and the Amateur Cup Competi- tion, are all of them essentially the product of the Asso- ciation's work during the last quarter of the 19th century. The whole policy of legislation in Association football of late years has been naturally to make the game faster by bringing every one into full play. The great aim accordingly has been to encourage combination and to discourage purely individual efforts. In the early days, though there was a certain amount of cohesion, a player had to rely mainly on himself. Even up to the middle of the 'seventies dribbling was looked upon as the great desideratum ; it was the essential for a forward, just as long kicks were the main object of a back. The develop- ment of the game was of course bound to change all that. The introduction of passing, long or short, but long in par- ticular, placed the dribbler pure and simple at a discount, and necessitated methods with which he was mostly unac- quainted. Combined play gradually came to be regarded as the keynote to success. Instead of one full back, as was originally the case, and one half-back, the defence gradually developed by the addition first of a second half, then of a second full back, and still

later of a third half- back, until it came to show, in addition to the goalkeeper of course, two full backs and three half-backs. The eight forwards who used to constitute the attack in the earliest days of the Association have been reduced by degrees, as the science of the game became understood, until they now number only five. The effect of the transition has been to put the attack and defence on a more equal footing, and as a natural consequence to make the game more open and thereby generally more interesting and attractive. Association football is indeed, from the standpoint of the spectator, a much brighter game than it was in its infancy, the result of the new methods bringing every one of the eleven players into full re- lief throughout the game. The players who, as a rule, make or mar the success of a side in modern football are the centre forward and the centre half-back. They are the pivot on which the attack and the defence respectively turn. Instead of close dribbling and following up, the

new formation makes for accuracy of passing among the forwards, with intelligent support from the half-backs. The net result is practically the effective combinaition of the whole side. To do his part as it ought to be done every member of an eleven must work in harmony with the rest, and on a definite system, in all cases.subordinating his own methods and personal interests to promote the general wellbeing of the side.

In its main principles the Association game itself has altered very little since 1880. The usual dimensions for a ground are 120 yards long by 80 yards wide, and the goals are still eight yards in width with a cross bar from post to post and eight feet from the ground. The game is started by a place kick from the centre of the field of play, and none of the opposite side is allowed to approach within ten yards of the ball when it is kicked off. When the ball passes over the touch line it has to be thrown in by one of the opposite side, and can be returned into the field of play in any direction. If it passes over the goal line at any time without touching one of the defending side, it has to be kicked out by the goalkeeper or one of the backs from a line marked in front of goal, the spot selected being in

front of the post nearest the point where the ball left the field of play. But should it touch one of the defending side in its transit over the goal line the atta,eking side has the privilege of a free kick from the corner flag (a " corner kick"). This is often a great advantage, but such free kick does not produce a goal unless the ball touches one of the other players on its way to the post. Ordinarily a goal is scored when the ball goes through the post, not being thrown, knocked on, or carried. The regulation duration of a game is an hour and a half, and ends are changed at forty-five minutes. The side winning the toss has the choice of ends or kick-off, and the one obtaining the majority of goals wins. A goal cannot be scored from a free kick unless a player of the defending side wilfully handles the ball, or a player of the attacking side is intentionally tripped, charged from behind, pushed, or held by an opponent within the twelve- yards goal line. The referee in such cases has power to award a free kick within the twelve-yards line of the defending side. In a penalty kick no one but the goal- keeper is allowed to play the ball, so that the result is an almost certain goal. A player is always in play as long as there are three of the opposite side between him and the opposite goal at the time the ball is kicked. This rule gives much trouble to the young player, though why it should do so it is not easy to say. The rule is simple if the words in italics are remembered. The ball must not be carried, knocked, or wilfully handled under any pre- tence whatever, save by the goalkeeper, who is allowed to use his hands in defence of his goal, either by knocking on or throwing, within his own half of the field of play. Thus far he is entitled to go in maintaining his goal, but if he carry the ball, the penalty is a free kick. There are other infringements of the rules which also involve the penalty of a free kick, among them the serious offences of tripping, hacking, and jumping at a player. Players are not allowed to wear nails in their boots (except such as have their heads driven in flush with the leather), or metal plates, or gutta-percha, and any player discovered infringing this rule is liable to be prohibited from taking further part in a match. No player is allowed to play except in practice matches, when no gate money can be taken, from 1st May to 31st August. But in Scotland the "close season" runs from 15th May to 15th August. (c. w. A.)

2. Rugby Union. ??? Prom early times a rudimentary game of football had been a popular form of sport in many

parts of Great Britain, and in the old-established schools football had been a regular game among the boys. In different schools there arose various developments of the original game ; or rather, what, at first, must have been a somewhat rough form of horse-play with a ball began to take shape as a definite game, with a definite object and definite rules. Eugby school had developed such a game, and from football played according to Rugby rules has arisen Eugby football. It was about the middle of the 19th century that football ??? up till that time a regular game only among schoolboys ??? took its place as a regular sport among men. To begin with, men who had played the game as schoolboys formed clubs to enable them to continue playing their favourite school game, and others were induced to join them ; while in other cases, clubs were formed by men who had not had the experience of playing the game at school, but who had the energy and the will to follow the example of those who had had this experience. In this way football was established as a regular game, no longer confined to schoolboys. When football was thus first started, the game was little developed or organized. Rules were very few, and often there was great doubt as to what the rules were. But, almost from the first, clubs were formed to play football according to Rugby rules ??? that is, according to the rules of the game as played at Rugby school. But even the Eugby rules of that date were few and vague, and indeed almost unin- telligible to those who had not been at Rugby school. Still, the fact that play was according to Rugby rules produced a certain uniformity ; but it was not till the establishment of the English Union, and the commence- ment of international matches, that a really definite code of rules was drawn up.

It is an interesting question to ask why it was that the game of Rugby school became so popular in preference to the games of other schools, such as Eton, Winchester, or Harrow. It was probably very largely due to the reputa- tion and success of Rugby school under Dr Arnold, and this also led most probably to its adoption by other schools ; for in 1860 many schools besides Eugby played football according to Rugby rules. The rapidity with which the game spread was remarkable. The Blackheath club, the senior club of the London district, was established in 1860, and Richmond, its great rival, shortly afterwards. Before 1870, football clubs had been started in Lancashire and Yorkshire ; indeed, the Sheffield

football club dates back to 1855. Likewise, in the universities of Oxford and Cambridge, Rugby football clubs had been formed before 1870, and by that date the game had been implanted both in Ireland and South Wales ; while in Scotland, before 1860, football had taken a hold. Thus by 1870 the game had been established thi'oughout the United Kingdom, and in many districts had been regularly played for a number of years. Rapid as, in some ways, had been the spread of the game between the years 1850 and 1870, it was as nothing to what happened in the following t\veiity years ; for by 1890 Rugby football, together with Asso- ciation football, had become the great winter amvxsement of the people, and roused universal interest ; while to-day, though there are no statistics to prove the assertion, it is no exaggeration to say that on any fine Saturday afternoon in winter there are tens of thousands of people playing football, while those who watch the game can be counted by the hundred thousand. The causes that led to this great increase in the game and interest taken in it were, undoubtedly, the establishment of the various national Unions and the international matches; and, of course, the local rivalry of various clubs, together with cup or other competitions prevalent in certain dis- tricts, was a leading factor. The establishment of the

Englisli Union led to a codification of the rules without which development was impossible. The international matches roused patriotic enthusiasm, and club matches roused local rivalries, which have so strong a hold upon the people.

In the year 1871 the English Rugby Union was founded in London. This Union was an association of some clubs and schools which joined together and appointed a com- mittee and officials to draw up a code of rules of the game. From this beginning the English Rugby Union has become the governing body of Rugby football in England, and has been joined by practically all the Rugby clubs in England, and deals with all matters connected with Rugby football, notably the choosing of the inter- national teams. In 1873 the Scottish Eootball Union was founded in Edinburgh on the same lines, and with the same objects, while in 1880 the

Welsh Football Union, and in 1881 the Irish Rugby Eootball Union, were estab- lished as the national Unions of Wales and Ireland, though in both countries there had been previously Unions not thoroughly representative of the country. All these Unions became the chief governing body within their own country, and one of their functions was to make the rules and laws of the game ; but as this had been done to start with by the English Union, the others adopted the English rules, with amendments to them from time to time. This state of affairs had one element of weakness ___ viz., that since all the Unions made their own rules, if ever a dispute should arise between any of them, a dead- lock was almost certain to ensue. Such a dispute did occur in 1884 between the English and Scottish Unions. This dispute eventually turned on the question of the right of the English Union to make and interpret the rules of the game, and to be the paramount authority in the game, and superior to the other Unions. Scotland, Ireland, and Wales, resisted this claim, and finally, in 1889, Lord Kingsburgh and Major Marindin were ap- pointed as a commission to settle the dispute. The result was the establishment of the International Board, which consists of representatives from each Union ___ six from England, two from each of the others ___ whose duties were to settle any question that might arise between the dif- ferent Unions, and to settle the rules under which inter- national matches were to be played, these rules being invariably adopted by the various Unions as the rules of the game.

With the establishment of the International Board, the organization of the game was complete. Still harmony did not prevail, and in 1895 occurred a definite disruption. A number of leading clubs in Yorkshire and Lancashire broke off from the English Union and formed the Nor- thern Union, which since that date has had many acces- sions, and has become the leading body in the North of England. The question in dispute was the payment of players. Football was originally played by men for the sheer love of the game, and by men who were compara- tively well-to-do, and who could give the time to play it ; but with the increasing popularity of the game, it became the pastime of all classes of the people, and clubs began to grow rich by " drawing big gates," ___ that is, large numbers of spectators, frequently many thousands in nr^mber, paid for the privilege of witnessing the match-. In these circumstances the

temptation arose to reimburse the player for any out-of-pocket expenses he might be put to for playing the game, and thus it became universally recognized as legitimate to pay a player's expenses to and from a match. But in the case of working men it often meant that they lost part of their weekly wage when they had to go a distance to play a inatch, or to go on tour with their club ??? that is, go off for a few days and play one or two matches in different

parts of the country ??? and consequently the claim was made on their behalf to recoup them for their loss of wage ; while at the same time rich clubs began to be willing to offer inducements to good players to join their club, and these inducements were generally most acceptable in the form of money. In Association football, professionalism ??? i.e., the hiring and paying of a player for his services ??? had been openly recognized. A large section of the English Union ??? the amateur party ??? would not tolerate anything that savoured of professionalism, and regarded payments made to a player for broken time as illegitimate. The result was the formation of the Northern Union, which allowed such payments, and has practically recog- nized professionalism. This body has also slightly altered the laws of the game, and probably in the future the two games will be widely different. In Scotland and Ireland Rugby footballers are strongly amateur; but wherever Rugby football is the popular game of the artisan, the professional element is strong, and possibly the Northern Union will be joined by clubs in other districts of England and Wales.

Besides legislation, one of the functions of the Unions is to select international teams. On 27th March 1871 the first international match was played between England and Scotland in Edinburgh. This was a match between teams picked from English and Scottish players. These matches from the first roused widespread interest, and were a great stimulus to the development of the game. With the exception of a few years, when there were dis- putes between their respective Unions, all the countries have annually played one another ??? ^England having played Scotland since 1871, Ireland since 1875, and Wales since- 1880. Scotland commenced playing Ireland in 1877 and Wales in 1883, while Ireland and Wales met first in 1882 and then in 1884, and since 1887

have played annually. The qualifications of a player for any country were at first vaguely considered to be birth ; but they were never definitely settled, and there has been a case of a player playing for two countries. In 1894, however, the Inter- national Board decided that no player was to play for more than one country, and this has been the only pro- nouncement on the question; and though birth is still looked upon as the main qualification, it is not essential. Though international matches excite interest throughout the United Kingdom, the matches between two rival clubs arouse just as much excitement in their district, particu- larly when the clubs may be taken as representatives of two neighbouring rival towns. But when to this rivalry there is added the inducement to play for a cup, or prize, the excitement is much more intense. Among Rugby players cup competitions have never been so popular as among Association, but the competition for the York- shire Cup was very keen in the days before the estab- lishment of the Northern Union, and this undoubtedly was the main cause of the popularity of the game in that county. Similarly the competition for the South Wales Cup from 1878 to 1887 did a great deal to estab- lish the game in that cotmtry. The method of carrying on these competitions is, that all the clubs entered are drawn by lot, in pairs, to play together in the first round; the winners of these ties are then similarly drawn in pairs for the next round, until for the final round there is only one pair left, the winner of which takes the cup. An elaboration of this competition is the "League system" of the Association game. This, likewise, has not been popular with Rugby players. Still it is prevalent in many districts, especially where clubs are anxious to draw big gates. In the League system a certain number of clubs form a league to play one another twice each season ; two points are counted for a win, and one for a draw. The club which at the end of the season comes out with most

points wins the competition. The advantage of this sys- tem over a cup competition is, that interest is kept up during the whole season, and one defeat does not debar a club from eventually coming out first.

It is said that wherever Britons go they take their games with them, and this has certainly been the case with Rugby football, for even in India it is played. But it has not yet been firmly established out of Great Britain. In the United States of America there is a form of football ??? a development of football according to Rugby rules, but now totally different from Rugby football (see below). Such, too, is the case in Australia. Still, in 1888, an English team of Rugby players had a tour in Australia and New Zealand, playing matches under both Rugby and Australian rules, and in 1889 a team of New Zealand native football players, popularly called the Maoris, came over to England. In 1891 a team went to South Africa under the auspices of the Rugby Union. It is perhaps in South Africa where Rugby is most likely to flourish out of Great Britain ; but even there the climatic conditions and state of the ground are against the game. In Germany the game has been established, but it has been taken up in Paris with more vigour than in any place on the Con- tinent, and already many matches have been played between British and Parisian clubs.

The game itself is essentially a winter pastime, as two requisite conditions for its enjoyment are a cool atmo- sphere and a soft though firm turf. The field of play is an oblong, not more than 110 yards long nor more than 76 yards broad, and it usually approximates to these dimensions. The boundaries are marked by lines, called touch lines, down the sides, and goal lines, along the ends. The touch lines are continued beyond the goal lines for a distance of not more than 25 yards ; and parallel to the goal line and behind it, at a distance of not more than 25 yards, is drawn a line called the dead ball line, joining the ends of the touch lines produced. On each goal line, at an equal distance from the touch lines, are erected two posts, termed goal posts, exceeding 11 feet in height, and as a rule generally much more ??? averaging perhaps from 20 to 30 feet from the ground, and placed 18 feet 6 inches apart. At a height of 10 feet from the ground they are joined by a cross bar; and the object of the game is to kick the ball over the cross bar between the upright posts, and so obtain a goal. The ball is oval in shape, and the official dimensions are ??? length, 11 to 11|- inches ; length circumference, 30 to 31 inches ; width circumference, 25|- to 26 inches ; weight, 13 to 14-^ ounces. It is made of indiarubber inflated, and covered with a leather case. Half-way between

the two goal lines there is sometimes drawn the half-way line, but more usually it is marked by flags on the touch line ; and 25 yards from each goal line there is similarly marked the 25-yards line. In the original game the side that had gained the majority of goals won the match, and if no goal had been scored, or an equal number, the game was said to be left drawn; but a modification was adopted before long. A goal can be kicked from the field of play ; but from the very first a try at p,oal could be obtained by that side one of whose players either car- ried the ball across his opponents' goal line and then touched it down, or touched it down, after it had been kicked across the goal line, before any of his opponents. The try at goal consisted in one of the successful side attempting to kick the ball over the bar, while the oppo- nents had to take their stand behind their goal line. Prequently a goal was kicked; very often not. "^ The modification, first allowed, was to count that side the winner which had gained the majority of tries, provided no goal or an equal number of goals had been scored ; but

a majority of one goal took precedence of any number of tries. But this, too, was afterwards abolished, and a system of points instituted by which the side with the majority of points wins.

In the game itself, not only may the ball be kicked in the direction of the opponents' goal, but it may also be carried ; but it must not be thrown forward ००० that is, in the direction of the opponents' goal ००० though it may be thrown back. Thus the game is really a combination of football and handball. The main principle in the play is that any one who is onside ००० that is, not offside ००० may take part. A player is offside if he gets in front of the ball ००० ००० that is, on the opponents' side of the ball, nearer the opponents' goal line ; when in this 'position, he must not interfere with an opponent or touch the ball under penalty. The main feature of the game is the scrummage. In old days at Rugby school there was practically no limit to the numbers of players on each side, and not infrequently there would be a hundred or more players on one side. This was never prevalent in club football ; twenty a-side was the usual number to start with, reduced in 1877 to fifteen a-side, the number still maintained. In the old Rugby big sides the ball got settled amidst a mass of players, and each side attempted to drive it through this

mass by shoving, kicking, and otherwise forcing their way through with the ball in front of them. This, then, was the origin of the scrummage, a feature still characteristic of the game.

The game is played usually for one hour, or one hour and ten minutes, sometimes for one hour and a half. Each side defends each goal in turn for half the time of play. Play is started by one side kicking the ball off from the centre of the field in the direction of the opponents' goal. The ball is then caught by one of the other side, who either kicks it, or runs with it. In running he goes on until he is " tackled," or caught, by one of his opponents, unless he should choose to " pass " or throw it to another of his own side, who may either kick, or run, or pass as he chooses. The ball in this way is kept moving untilit crosses the touch line, or goal line, or is tackled. If the ball crosses the touch line, both sides line up at right angles to the point where it crossed the line, and the ball is thrown in straight either by one of the same side whose player carried the ball across the touch line, or, if the ball was kicked or thrown out, by one of the opposite side. If the ball crosses the goal line, either a try is gained, as explained above, or if the defending side touch it down first, the other side retire to the line 25 yards from the goal line, and the defending side kick it up the field. If the ball is tackled, the player carrying the ball gets up as soon as possible, and certain players of each side, called the for- wards, at once form the scrummage, by putting down their heads, and getting ready to shove against one another. They shove as soon as the ball is put down between the two front rows. In the scrummage the object is, by shov- ing the opponents back or otherwise breaking away with the ball in front, to carry the ball in the direction of the opponents' goal line by a series of short kicks in which the players run after the ball as fast as possible, while their opponents lie in wait to get the ball, and either by a kick or other device stop the rush. Instead, however, of the forwards breaking away with the ball, sometimes they let the ball come out of the scrummage to certain of their own side posted outside, called half-backs, who either kick or run with it, or pass it to the three-quarter-backs, and so the game proceeds until the ball is once more "dead" ??? that is, brought to a standstill. The scrummage appears to be an uninteresting manoeuvre, and a strange relic of bygone times ; but it is not merely a mancBuvre in

which weight and strength alone tell ❓❓❓ it also needs a lot of dexterity in moving the ball with the feet applying the

weight to best advantage, and also in outflanking the opposing side, as it were ❓❓❓ usually termed wheeling ❓❓❓ direct- ing all the force to one side of the scrummage, and thus breaking away. Of the fifteen players who compose a side, the usual arrangement is that eight are called for- wards, and form the scrummage ; two half-backs are posted immediately outside the scrummage; and four three- quarter-backs, a little behind the halves, stretch in a line across the field, their duties being mainly to run and kick and pass, and prevent the opponents from doing the same. Behind the three-quarters comes the full back, or back, a single individual to maintain the last line of defence ; his duties are entirely defensive, either to tackle an oppo- nent who has managed to get through, or, more usually, to catch and return long kicks. As a rule the game is a lively one, for the players are rarely at rest ; if there is much scrummaging, it is called a slow game, but, if much running and passing, a fast or an open game. The spec- tator, unless he be an expert, prefers the open game ; but in any case the game is always a hard and exciting struggle, frequently with the balance of fortune swaying very rapidly from one side to the other, so that it is a matter of no surprise to find the British public so ardently attached to it.

Any one interested in the evolution of tlie game must be referred ❓❓❓ if, indeed, such reference is nowadays needed ❓❓❓ to Tom Brown's Schooldays, where he will find a vivid description of the old Rugby game. The ephemeral literature on Football is enormous, but there are not many good works on the game. The best is Football ; The Bugby Union Oame, by Rev. F. Marshall. In the Sncydopmdia of Sport and in the Badminton Library volume on Football there are articles of more than ephemeral interest. (c. J. N. F.)

(3) United States. ??? Football in America has had a peculiar history, and one showing the great tenacity of life possessed by this sport. At first such football as was played consisted merely in kicking the ball, and the play was without system. In the years 1871-72 certain rules were formulated, but they did not correspond to those in any other country, and were not on the whole satisfactory. Some of the colleges (to which the sport, until recently, was largely confined) formed an association, and adopted these rules. In 1875 Harvard and Yale met under rules taken partly from the Rugby Union and partly from the American game. These proved unsatisfactory, and the next year Harvard and Yale adopted the Bugby Union rules in their entirety. This was the foundation of the present American game. The players found that the Bugby Union rules, while much more satisfactory than anything that had been used, depended in a great mear sure upon traditional understanding and interpretations. American players were unwilling to be guided by any- thing except written regulations, and hence it was neces- sary to add to and explain the rules. Annual conventions were therefore held, and the rules were amplified and from time to time altered. Other colleges joined the Association, and the game became well established in the college world. The roughness and brutality displayed in playing were strongly commented upon in the newspapers, and at that time it was diflB.cult to say whether the game would survive or not ; but in another ten years it had made great progress, and then again it became the object of fur- ther newspaper assaults, and the Harvard team, through the action of the University authorities, was withdrawn from participation. This withdrawal lasted, however, for only a year. Prom that time the game has been character- ized by lessening tendencies to roughness, by increasing skill, and by greater satisfaction to players and spectators. For some time past it has been, perhaps, the most popular sport in the college calendar, and has drawn crowds of from 35,000 to 40,000 people at the principal games. The Association disbanded some years ago, but a Eules

Committee, invited by the University Athletic Club of New York, has made the necessary changes in the rules from time to time, and these have been accepted by the country at large. In the West associations have been formed, and still exist; but the game in the East is played principally

under separate agreements between the con- testing universities, all playing, however, under one code ,of rules.

The rules provide for a field 330 feet long by 160 feet wide, upon which teams composed of eleven men each contend for a period of two thirty-five minute halves, the total score at the end of the second half determining the victor. The scoring is by goals, touch-downs, and safety touch-downs. A goal is scored when the ball is kicked through the upright goal-posts and above the cross- bar connecting the posts at a distance of 10 feet above the ground ; a touch-down when the ball is carried and touched to the ground behind the goal line ; a safety touch-down when the opponent is forced to carry the ball across his own goal line. The points and their values are : Goal from touch-down, 6 points ; goal from field- kick, 5 points ; touch-down from which no goal is kicked, 0 points ; safety by opponents, 2 points. Any player when on-side can run with the ball, and his opponent may tackle him ; if stopjped, he must put the ball down, and a line-up or scrimmage is then formed. The ball may also be advanced by kicking. Infringement of the rules constitutes a foul, and various penalties are imposed.

Upon the above simple framework there has been built a most intricate system of play. The principle of the game is absolutely clear to the spectator, and therein lies its especial charm. There stands out boldly one cardinal object, namely, to advance the ball towards the opponent's goal. When this advance is attempted by means of kicking, the ball is usually sent as far as possible down into the opponent's territory, two or three men of the kick- ing side following it, and, in case it is muffed, endeavouring to secure it, or, if it be caught, to prevent the catcher from carrying it back on a run or returning the kick. The kicking game is most employed when the wind favours. It is also used to relieve the running game. A rule of the sport makes it obligatory upon the side which has failed to advance the ball five yards in three run- ning attempts to surrender it. Hence it is usually to the advan- tage of the side in possession of the ball, when they have failed in two running attempts, and it looks unUkely that they would suc- ceed in a third, to kick the ball as far as possible into the oppo- nent's territory rather than to surrender it within a yard or so of its immediate position. The running game is more

involved than the kicking game, it being the object of the captain to use all possible means to assault the opponents at points of weakness, to enable his runner to encircle the ends of the opponent's line, or to pierce that line at points where the attack can gather the most force, and the defence exhibits the least resistance. Certain signals are used which, presumably unknown to the opponents, indicate to the assaulting side just what the method of assault is to be, and thus enable the men to concentrate suddenly at the one point. This concentration is not finally brought about until after the ball has been put in play, so that the opponents have little chance to anticipate it.

The ball is handled with great accuracy, one man being selected to place the ball on the ground in a scrimmage and to snap it back with his hand to another player who delivers it, usually by a hand- pass or a short throw, to such individual as has been selected for the particular play. No man can pass the ball towards his oppo- nent's goal, and any man is off-side and out of the play if he gets between the ball and his opponent's goal. He cannot then touch the ball until it touches an opponent, or until the man of his own side who has kicked it runs up ahead of him.

In order to measure properly the distance gained or lost the field is marked with white lines every five yards.

The of&cials consist of an umpire, whose principal duty it is to decide regarding fouls ; a referee, who decides questions relating to the progress of the ball and the play ; timekeepers and lines- men, who keep the time of the play and mark the exact progress . of the ball for the benefit of the referee. The American game is far more involved and intricate than the Rugby, but offers corre- spondingly greater field for skilful play. Amateur athletic clubs have taken up the sport, and it is now the principal fall game throughout the United States. (w. Ca.)

Forbes, Archibald (1838-1900), British war correspondent, was the son of a Presbyterian minister in Morayshire. He was born 17th April 1838, and educated at Aberdeen University. Entering the Eoyal Dragoons as a private, he gained, while in the service, considerable practical experience of military life and affairs. Being

invalided from his regiment, he settled in London, and adopted the journalistic profession. When the rranco- German war broke out in 1870, Forbes was sent to the front as war correspondent to the Morning Advertiser, and in this capacity he gained valuable information as to the plans of the Parisians for withstanding a siege. Transferring his services to the Daily News, his brilliant feats in the transmission of intelligence drew world-wide attention to his despatches. He was with the German army from the beginning of the campaign, and he after- wards witnessed the rise and fall of the Commune. His war correspondence in the Daily News was republished. Forbes afterwards proceeded to Spain, where he chronicled the outbreak of the second Carlist war ; but his work here was interrupted by a visit to India, where he spent eight months upon a mission of investigation into the Ben- gal Famine of 1874. Then he returned to Spain, and followed at various times the Carlist, the Republican, and the Alfonsist forces. As representative of the Daily News he accompanied the Prince of Wales in his tour through India in 1876-76. Forbes went through the Servian campaign of 1876, and was present at all the important engagements. In the Eusso-Turkish campaign of 1877 he achieved striking journalistic successes at great personal risk. Attached to the Russian army, he witnessed most of the principal operations, and remained continuously in the field until attacked by fever. His letters, together with those of his colleagues, MacGahan and Millet, were republished by the Daily Neivs. On recovering from his fever, Forbes proceeded to Cyprus, in order to witness the British occupation. The same year (1878) he went to India, and in the winter accompanied the Khyber Pass force to Jelalabad. He was present at the taking of Ali Musjid, and marched

with several expeditions against the hill tribes. Burma was Forbes's next field of adventure, and at Mandalay, the capital, he had several interesting interviews with King Thibaw. He left Burma hurriedly for South Africa, where, in consequence of the disaster of Isan- dlwana, a British force was collecting for the invasion of Zululand. He was present

at the victory of Ulundi, and his famous ride of 120 miles in fifteen hours, by which he was enabled to convey the first news of the battle to England, remains one of the finest achievements in journalistic enterprise. Forbes subsequently delivered many lectures on his war experiences to large audiences. His closing years were spent in literary work. He had some years before published a military novel entitled Drawn from Life, and a volume on his experiences of the war between France and Germany. These were now followed by numerous publications, including Glimpses through the Cannon Smoke, 1880; Souvenirs of some Continents, 1885 ; William I. of Germany : a Biography, 1888 ; Eavelock, in the " English Men of Action " Series, 1890 ; Barracks, Bivouacs, and Battles, 1891 ; The Afghan Wars (1839-80), 1892 ; Czar and Sultan, 1895 ; Memories and Studies of War and Peace, 1895, in many respects autobiographic ; and Colin Cam,phell, Lord Clyde, 1896. He died 30th March 1900. (g. b. s.)

Forbes, a town in the county of Ashburnham, Xew South Wales, Australia, about 289 miles west from Sydney, on the Lachlan river, and with a station on the Western railway. Its importance as a commercial centre is increasing owing to its advantageous position between the northern and southern markets. Its altitude is 1120 feet. The mean temperature for the year is 62-2 F. ; that of January is 78-6 ; of July, 47-3 . Population about 3600.

FORESTS AND FORESTRY.

ALTHOUGH most people know what a forest is, a definition of it which suits all cases is by no means easy to give. Manwood, in his treatise of the Lawes of the Forest, 1698, defines a forest as "a certain territory of woody grounds, fruitful pastures, privileged for wild beasts and fowls of forest, chase, and warren, to nest and abide in, in the safe protection of the king, for his princely delight and pleasure." This primitive definition has, in modern times, when the economic aspect of forests came more into the foreground, given place to others, so that forest may, in a general way, now be described as " an area which is for the most part set aside for the production of timber and other forest produce, or which is expected to

exercise certain climatic effects, or to protect the locality against in- jurious influences."

As far as conclusions can now be drawn, it is probable that the greater part of the dry land of the earth was, at some time, covered with forest, which consisted of a variety of trees and shru)js grouped according to climate, soil, and configuration of the several localities. "When the old trees reached their limit of life, they disappeared, and younger trees took their place. The conditions for an uninterrupted regeneration of the forest were favour- able, and the result was vigorous production by the creative powers of soil and climate. Then came man, and by degrees interfered, until in most countries of the earth the area under forest has been considerably reduced. The first decided interference was probably due to the establishment of domestic animals ; men burnt the forest to obtain pasture for their fiocks. Subsequently similar

measures on an ever-increasing scale were employed to prepare the land for agricultural purposes. More re- cently enormous areas of forest were destroyed by reckless cutting and subsequent firing in the extraction of timber for economic purposes.

It will readily be understood that the distribution and character of the now remaining forests must differ enor- mously. Large portions of the earth are still covered with dense masses of tall trees, while others contain low scrub, grass land, or are desert. As a general rule, natural forests consist of a num^ber of different species intermixed ; but in some cases certain species, called gregarious, have succeeded in obtaining the upper hand, thus forming more or less pure forests of one species only. The number of species differs very much. In many tropical forests hundreds of species may be found on a comparatively small area, in other cases the number is limited. Burma has several thousand species of trees and shrubs, Sind has only ten species of trees. Central Europe has about forty species, and the greater part of Northern Russia, Sweden, and Norway contains forests consisting of about half-a-dozen species. Elevation above the sea acts similarly to rising latitude, bu.t the effect is much more rapidly produced. Generally speaking, it may be said that the tropics and adjoining parts of the eartli, wherever the climate is not modified by

considerable elevation, contain broad-leaved species. Palms, Bamboos, &o. Here most of the best and hardest timbers are found, such as Teak, Mahogany, and Ebony. The northern countries are rich in Conifers. Taking a section from Central Africa to North Europe, it will be found that

south and north of the Equator there is a large belt of dense hardwood forest ; then comes the Sahara, then the coast of the Mediterranean with forests of Cork Oak; then Italy with Oak, Olive, Chestnut, gradually giving place to Ash, Sycamore, Beech, Birch, and certain species of Pine; then Switzerland and Germany, where Silver Fir and Spruce gain ground. Silver Fir disappears in Central Germany, and the countries around the Baltic contain forests consisting chiefly of Scotch Pine, Spruce, and Birch, to which, in Siberia, Larch must be added, while the lower parts of the ground are stocked with Hornbeam, Willow, Alder, and Poplar. Australia, again, has its own particular flora of Eucalypts, of which nearly 200 species have been distinguished, as well as Wattles. Some of the Eucalypts attain an enormous height, a tree 472 feet high having been measured. Apart from a limited number of broad-leaved species, the Conjfers have become the most important timber trees in the economy of man. They are found in greatest quantities in the countries around the Baltic and in North America. An endless variety of different types of forest are found in different parts of the earth.

Utility of Forests. ❓❓❓ In the economy of man and of nature forests are of direct and indirect value, the former chiefly through the produce which they yield, and the latter through the influence which they exercise upon climate, the regulation of moisture, the stability of the soil, the healthiness and beauty of a country, and allied subjects. The indirect utility will be dealt with first. A piece of land bare of vegetation is, throughout the year, exposed to the full effect of sun and air currents, and the climatic conditions which are produced by these agencies. If, on the other hand, a piece of land is covered with a growth of plants, and especially with a dense crop of forest vegetation, it enjoys the benefit of

certain agencies, which modify the effect of sun and wind on the soil and the adjoining layers of air. These modifying agencies are as follows : (1) The crowns of the trees intercept the rays of the sun, and the falling rain obstructs the move- ment of air currents, and reduces radiation at night ; (2) the leaves, flowers, and fruits, augmented by certain plants which grow in the shade of the trees, form a layer of mould, or humus, which protects the soil against rapid changes of temperature, and greatly influences the move- ment of water in it ; and (3) the roots of the trees pene- trate into the soil in all directiohs, and bind it together. The effects of these agencies have been observed from ancient times, and widely differing views have been taken of them. Of late years, however, more careful observa- tions have been made at so-called parallel stations, that is to say, one station in the middle of a forest, and another outside at some distance from its edge, but otherwise exposed to the same general conditions, and in this way the following results have been obtained: (1) Forests reduce the temperature of the air and soil to a moderate extent, and render the climate more equable; (2) they increase the relative humidity of the air, and reduce evaporation ; (3) they tend to increase the precipitation of moisture. As regards the actual rainfall, their effect in low lands is nil or very small ; in hilly countries it is probably greater, but definite results have not yet been obtained, owing to the difllculty of separating the effect of forests from that of other factors. (4) They help to regulate the water supply, produce a more sustained feeding of springs, tend to reduce violent floods, and render the flow of water in rivers more continuous; (5) they assist in preventing denudation, erosion, land- slips, avalanches, the silting up of rivers and lowlands, and the formation of sand dunes ; (6) they reduce the velocity of air currents, protect adjoining fields against

cold or dry winds, and afford shelter to cattle, game, and useful birds ; (7) they may, under certain conditions, improve the hesilthiness of a country, or help in its defence; (8) they increase the beauty of a country, and produce a healthy aesthetic infiuence upon the people.

The direct utility of forests is chiefly due to their produce, the capital which they represent, and the work which they provide. The principal produce of forests consists of timber and firewood. Both are necessaries

for the daily light of the people. In modem times iron and other materials have to a consid- erable extent replaced timber, while coal, ligidte, and peat compete with firewood ; nevertheless wood is still indispensable, and likely to remain so. This is borne out by the statistics of the most civilized nations. Whereas the population of Great Britain and Ireland during the period 1880-1900 increased by about 20 per cent., the imports of timber, during the same pe- riod, increased by 45 per cent. ; in other words, every head of population in 1900 used more timber than twenty years earlier. Germany produced in 1880 about as much timber as she required; in 1899 she imported upwards of 4,600,000 tons, valued at ££14,000,000, and her imports are rapidly increasing, although the yield capacity of her own forests is much higher now than it was formerly. Wood is now used for many pur- poses which formerly were not thought of. The manu- facture of the wood pulp annually imported into Britain consumes at least 2,000,000 tons of timber. A texture closely resembling silk is now actually made of wood. The variety of other, or minor, produce yielded by forests is very great, and much of it is essential for the well- being of the people and for various industries. The yield of fodder is of the utmost importance in countries subject to periodic droughts ; in many places field crops could not be grown successfully without the leaf-mould and brush- wood taken from the forests. As regards industries, attention need only be drawn to such articles as commer- cial fibre, tanning materials, dye-stuffs, lac, turpentine, resin, caoutchouc, guttapercha, &c. Great Britain and Ireland alone import every year such materials to the value of more than ££8,000,000.

The capital employed in forests consists chiefly of the value of the soil and growing stock of timber. The latter is, ordinarily, of much greater value than the former wherever a sustained annual yield of timber is expected from a forest. In the case, for instance, of a Scotch Pine forest, the value of the growing stock is, under the above- mentioned condition, from three to five times that of the soil. The rate of interest yielded by capital invested in forests differs, of course, considerably according to circum- stances, but on the whole it may, under proper manage- ment, be placed equal to that yielded by agricultural land ; it is lower than the agricultural rate on the better classes of land, but higher on the inferior classes. Hence the latter are specially indicated for the forest industry, and the former for the

production of agricultural crops. Forests require labour in a great variety of ways, such as (1) general administration, formation, tending, and harvesting; (2) transport of produce; and (3) industries which depend on forests for their prime material. The labour in- dicated under the first head differs considerably according to circumstances, but its amount is always smaller than that required if the land is used for agriculture. Hence forests provide additional labour only if they are estab- lished on surplus lands. Owing to the bulky nature of forest produce its transport forms a business of considerable mag- nitude, the amount of labour being perhaps equal to half that employed under the first head. The greatest amount of labour is, however, required in the working up of the

raw material yielded by forests. In this respect attention may be drawn to the chair industry in and around High Wycombe in Buckinghamshire, where more than 20,000 labourers are employed in converting the Beech, grown on the adjoining chalk hills, into chairs and tools of many patterns. Complete statistics for Great Britain are not available under this head, but it may be mentioned that in Germany the people employed in the forests amount to 2-3 per cent. ; those employed on transport of forest pro- duce, 1-1 per cent. ; labourers employed on the various wood industries, 8-6 per cent. ; or a total of 12 per cent, of the population of the country. An important feature of the work connected with forests aird their produce is that a great part of it can be made to fit in with the re- quirements of agriculture; that is. to say, it can be done at seasons when field crops do not require attention. Thus the rural labourers or small farmers can earn some money at times when they have nothing else to do, and when they would probably sit idle if no forest work were obtainable.

Whether, or how far, the utility of forests is brought out in a particular country depends on its special condi- tions, such as (1) the position of a country, its communi- cations, and the control which it exercises over other countries, such as colonies; (2) the quantity and quality of substitutes for forest produce available in the country; (3) the value of land and labour, and the returns which land yields if used for other pui-

poses ; (4) the density of population ; (5) the amount of capital available for invest- ment; (6) the climate and configuration, especially the geographical position, whether inland or on the border of the sea, &c. No general rule can be laid down, showing whether forests are required in a country,, or, if so, to what extent; that question must be answered according to the special circumstances of each case. The subjoined table shows the forests of various European states : ???

CoTin tries.

Area of

Forests, in

Acres.

Per- centage of Total Area of Country under Forest.

Per- centage of Forest Area be- longing to the State. ,

Forest

per Head of Popula- tion, in Acres.

1. Sweden

2. Norway

3. Eussia, inolud-l

ing Finland)

4. Bosnia and Her- i

zegovina J

5. Bulgaria

6. Spain

7. Hungary .

8. Austria proper .

9. Servia

10. Eumania .

11. Greece

12. Luxembourg

13. Switzerland

14. Germany .

15. France

16. Italy .

17. Denmark .

18. Great Britain .

19. Belgium

20. Portugal .

21. Holland .

22. Turkey

48,000,000 17,000,000

516,000,000

6,790,000

10,650,000

20,960,000

22,420,000

23,990,000

2,390,000

5,030,000

2,030,000

190,000

2,100,000

34,490,000

23,530,000

10,110,000

600,000

3,030,000

1,250,000

770,000

670,000

6,180,000

44 21

40

53

45

17

28

32

20

17

16

30

20

26

18

14

6

4

17

3

7

8

27 12

61

70

84 16

7

47 80

“4

33

12

4

24

3

5

8

8 9 8-4

5-9

4 9

3-2 1-3 13 10

1-0 10

_____9 _____9 _____7 _____7 _____6 _____3 _____2 _____1

1

_____1 _____1

758,080,000

31

2

These data exhibit considerable differences, since the percentage of the forest area varies from 3 to 53 ; and Russia, Sweden, and Norway may as yet have more forest than they require for their own population. On the other hand, Great Britain and Ireland, Denmark, Portugal, Holland, and even Belgium, France, and Italy have not a sufficient forest area to meet their own require- ments ; at the same time, they are all sea-bound countries, and

importation is easy, while most of them are under the influence of moist sea winds, which reduces to a subordinate position the im- portance of forests for climatic reasons.

Intimately connected with the area of forests in a country is the state of ownership ??? whether they belong to the state, corporations, or to private persons. Where, apart from the financial aspect and the supply of work, forests are not required for the sake of their indirect effects, and where importation from other countries is easy and assured, the Government of the country need not, as a rule, trouble itself to maintain or acquire forests. Where the reverse conditions exist, and especially where the cost of transport over long distances becomes prohibitive, a wise administration will take measures to assure the maintenance of a suitable proportion of the country under forest. This can be done either by main- taining or constituting a suitable area of state forests, or by exercising a certain amount of control over corporation and even private forests. Such measures are more called for in continental countries than in those which are sea-bound, as is proved by the above statistics.

The subjoined table shows the net imports and exports of European countries (average data, calculated from the returns of recent years, whenever available) : ???

Quantities in Tons.

Values in

__ sterling.

Countries.

Imports.

Exports.

Imports.

Exports.

Great Britain and Ireland

9,290,000

22,190,000

Germany

4,600,000

14,820,000

France

1,230,000

8,960,000

Belgium

1,020,000

4,100,000

Denmark .

470,000

1,260,000

Italy

420,000

1,250,000

Spain

210,000

1,180,000

Holland .

180,000

720,000

Switzerland

170,000

590,000

Portugal

60,000

200,000

Bulgaria

60,000

60,000

Greece

36,000

180,000

Servia

16,000

15,000

Eumania .

60,000

180,000

Norway

1,040,000

1,870,000

Austria-Hungary, with I Bosnia & Herzegovina f

8,670,000

10,800,000

Sweden

4,460,000

7,980,000

Eussia with Finland

Total T^et Imports

5,900,000

8,900,000

17,750,000

15,180,000

50,445,000

29,680.000

2,620,000

20.“i”15,lHll)

Silpply of Timber ❖❖❖ Imports and Exports. ❖❖❖ The only timber-exporting countries of Europe are Eussia, Sweden, Norway, Austria-Hungary, and Eumania ; all the others either have only enough for their own consumption, or import timber. Great Britain and Ireland import now upwards of 9,000,000 tons a year, Germany about 4,600,000 tons, and Belgium about 1,000,000 tons. Holland, France, Portugal, Spain, and Italy are all im- porting countries, and so are Asia Minor, Egypt, and Algeria. The west coast of Africa exports hardwoods, and imports coniferous timber. The Cape and Natal import considerable quantities of Pine and Fir wood. Australasia ex,ports hardwoods and a little Kauri Pine from New Zealand, but imports far larger (piantities of light Pine and Fir timber. British India and Siam export Teak and small quantities of fancy woods. The West Indies and South America export hardwoods, and import Pine and Fir wood. The United States of America will not much longer be a genuine exporting country, since it imports already almost as much timber from Canada as it exports. Canada exports considerable quantities of timber. The Dominion has still a forest area of 1,250,000 square miles, equal to 38 per cent, of the total area, and giving 165 acres of forest for every inhabitant. Although only about one-third of the forest area can be called regular timber lands, Canada possesses an enormous forest wealth, with which she might supply permanently nearly all other countries deficient in material, if the governing bodies in the

several provinces would only determine to stop the present fearful waste caused by axe and fire, and to intro- duce a regular system of management. As matters

stand, the resources of the most valuable timber of Canada, the White or Weymouth Pine (Pinus Strobus), are nearly exhausted, the great stores of Spruce in the eastern provinces are being rapidly destroyed, and the forests of Douglas Fir in the western provinces have been attacked for export to the United States and else- where.

Taking the remaining stocks of the whole earth to- gether, it may be said that a sufficient quanltity of hard- woods is available, but the only countries which are able to supply coniferous timber for export on a considerable scale are Russia, Sweden, Norway, and Canada. As these countries have practically to supply the rest of the world, and as the management of their forests is far from satisfactory, the question of supplying light Pine and Fir timber, which form the very staff of life of the wood industries, must become a very serious matter before many years have passed. Unmistakable signs of the coming crisis ate everywhere visible to all who wish to see, and it is difficult to overstate the gravity of the problem, when it is remembered, for instance, that 87 per cent, of all the timber imported into Great Britain consists of light Pine and Fir, and that most of the other importing countries are similarly situated. In some of these countries little or no room exists for the extension of wood land, but this statement does not apply to Great ISritain and Ireland, which contain upwards of 12,000,000 acres of waste land, and 12,600,000 acres of mountain and heath land used for light grazing. One-fourth of that area, if put under forest, would produce all the timber now imported, which can be grown in Britain, that is to say, about 95 per cent, of the total. The subjoined table shows the movements of timber within the greater part of the British Empire, based on a few years' average :
____

Annual Average during

Annual Average during

the Tears 1890-94.

the Tears 1895-99.

Countries.

Imports,

Exports,

Imports, value in ??.

Exports,

value in ??.

value in ??.

value in ??.

Great Britain and Ire- (land . . . S

17,595,000

22,190,000

New South Wales

467,000

311,000

Victoria

881,000

2.31,000

Soutli Australia .

260,000

198,000

Ceylon .

23,‘obo

21,000

Mauritius

41,000

87,000

Natal .

99,000

176,000

Cape of Good Hope

160,000

416,000

Jamaica

57,000

55,000

Barbadoes

65,000

88,000

Trinidad

41,000

40,000

British Gniana .

41,000

27,000

Queensland .

iijooo

6000 1

Forest Management. ??? In early times there was practi- cally no forest management. As long as the forests occupied considerable areas, their produce was looked upon as the free gift of nature, like air and water ; men took it, used it, and even destroyed it without let or hindrance. With the gradual increase of population and the consequent reduction of the forest area, proprietary ideas developed ; people claimed the ownership of cer- tain forests, and proceeded to 'protect them against out- siders. Subsequently the law of the country was called in to help in protection, leading to the promulgation of special forest laws. By degrees it was found that mere protection was not sufficient, and that steps must be .taken to enforce a more judicious treatment, as well as to limit the removal of timber to what the forests were capa- ble of producing permanently. The teaching of general science and of political economy was brought to bear upon the subject, so that now forestry has become a special science. This is recognized in many countries, amongst which Germany stands first, closely followed by France, Austria, Denmark, and Belgium. Of non-European

countries the palm belongs to British India, and then follow Ceylon, the Cape of Good Hope, and Japan. The United States of America has also turned its attention to the subject. (See separate section below.) Most of the British colonies are, in this respect, as yet in a back- ward state, and the matter has still to be fought out in Great Britain and Ireland, though many writers have urged the importance of the question upon the public and the Government. There can be no doubt that all civilized countries must, sooner or later, adopt a rational and sys- tematic treatment of their forests. The progress made in this direction up to 1889 was described in the article Forests in the 9th edition of this work {Ency. Brit., vol. ix.). The following additional remarks furnish later information and statistics.

The British Empire.

Great Britain and Ireland. ??? The forests of Great Britain and Ireland, in spite of the large imports of timber, have not been appreciably extended up to the present time because (1) the rate at which foreign timber has been laid down in Britain is very low, thus keeping down the price of home-grown timber ; (2) foreign timber is preferred to home-grown material, because it is of superior quality, while the latter comes into the market in an irregular and intermittent manner ; (3) nearly the whole of the waste lands are private property. As re- gards prices, it can be shown that the lowest point was reached about the year 1888, in consequence of the re- markable development of means of communication, that prices then remained fairly stationary for some years, and that about 1894 a slow but steady rise set in. This was due to the gradual approach of the coming crisis in the supply of coniferous timber to the world. It can be shown that even with present prices the growing of timber can be made to pay, provided it is carried on in a rational and economic manner. Improved sylvicultural methods must be applied, so as to produce a better class of timber, and the forests must be managed according to well- arranged working plans, which provide for a regular and sustained out-turn of timber year by year, so as to develop a healthy and steady market for locally-grown material. Unfortunately the private proprietors of the waste lands are in many cases not in a financial position to plant. Starting forests demands a certain outlay in cash, and the proprietor must forego the income, however small, hitherto derived

from the land until the plantations begin to yield a return. In these circumstances the State may well be expected to help in one or all of the following ways : ??? (1) The equipment of forest schools, where economic forestry, as elaborated by research, is taught ;

(2) management of the Crown forests on economic princi- ples, so as to serve as patterns to private proprietors ;

(3) advances should be made to landed proprietors who desire to plant land, but are short of funds, just as is done in the case of improvements of agricultural hold- ings ; and (4) the State might acquire surplus lands in certain parts of the country, such as congested districts, and convert them into forests. Action in these directions would soon lead to substantial benefits. The income of landed proprietors would rise, a considerable sum of money now sent abroad would remain in the country, and forest industries would spring up, thus helping to counteract the ever-increasing flow of people from the country into the large towns, where only too many must join the army of the unemployed. Even within a radius of 60 miles of London 700,000 acres of land are unaccounted for in the official agricultural returns. In Ireland more than 3,000,000 acres are waiting to be utilized, and it is well worth the consideration of the Irish Land Commissioners, whether the lands re-

maining on their hands, when buying and breaking up large estates, slioUld not be converted into State forests. Such a measure might become a useful auxiliary in the peaceful settlement of the Irish land question. No doubt success depends upon the probable financial results. There are at present no British statistics to prove such success ; hence, by way of illustration, it may be stated what the results have been in the kingdom of Saxony, which, from an industrial point of view, is comparable with England. That country has 432,086 acres of State forests, of which about one-eighth ??? are stocked with broad-leaved species, and seven-

eighths with conifers. Some of the forests are situated on low lands, but the bulk of the area is found in the hilly parts of the country up to an elevation of 3000 feet above the sea. The aver- age price realized of late years per cubic foot of wood amounts to 5d., and yet to such perfection has the management been brought by a well-trained staff, that the mean annual net revenue, after meeting all expenses, comes to 21s. an acre all round. There can be no doubt that, under the more favourable climate of Great Britain, even better results can be obtained, especially if it is remembered that foreign supplies of coniferous timber must fall off, or, at any rate, the price per cubic foot rise considerably.

British India. ??? The history of forest administration in India is exceedingly instructive to all who take an interest in the welfare of the British Empire, because it places before the reader an account of the gradual destruction of the bulk of the natural forests, a process through which most other British colonies are now passing, and then it shows how India emerged triumphantly from the self-in- flicted calamity. As far as information goes, India was, in the early times, for the most part covered with forest. Subsequently settlers opened out the country along fertile valleys and streams, while nomadic tribes, moving from pasture to pasture, fired alike hills and plains. This pro- cess went on for centuries. With the advent of British rule forest ??? destruction became more rapid than ever, owing to the increase of population, extension of cultiva- tion, the multiplication of herds of cattle, and the univer- sal firing of the forests to produce fresh crops of grass. Then railways came, and with their extension the forests suffered anew, partly on account of the increased demand for timber and firewood, and partly on account of the fresh impetus given to cultivation along their routes. Ultimately, when failure to meet the requirements of public works was brought to notice, it was recognized that a grievous mistake had been made in allowing the forests to be recklessly destroyed. Already in the early part of the 19th century sporadic efforts were made to protect the forests in various parts of the country, and these continued intermittently ; but the first organized steps were taken about the year 1855, when Lord Dal- housie was governor-general. At that time conservators of forests were appointed in Bombay, Madras, and Burma. Soon afterwards other appointments followed, and in 1SG4 an organized State department, presided over by

the In- spector-General of Eorests, was established. Since then the Indian Forest Department has steadily grown, so that it has now become of considerable importance for the welfare of the people, as well as for the Indian exchequer.

The first duty of the Department was to ascertain the position and extent of the remaining forests, and more particularly of that portion which still belonged to the State. Then a special forest law was passed, which was superseded in 1878 by an improved Act, which provided for the legal formation of State forests; the determina- tion, regulation, and, if necessary, commutation of forest rights ; the protection of the forests against unlawful acts, and the punishment of forest offences ; the pro-

tection of forest produce in transit ; the constitution of a staff of forest officers, provision to invest them with suitable legal powers, and the determination of their duties and liabilities. The officers who administered the Department in its infancy were mostly botanists and military officers. Some of these became excellent foresters. In order to provide a technically trained staff arrange- ments were made in 1866 by Sir Dietrich Brandis, the first Inspector-General of Forests, for the training of young Englishmen at the French Forest School at Nancy and at similar institutions in Germany. In 1876 the students were concentrated at Nancy, and in 1885 an English forest school for India was organized in connexion with the Eoyal Indian Engineering College at Cooper's Hill. The imperial forest staff of India consists of ??? officers not specially trained before entering the Depart- ment, 43 ; oificers trained in France and Germany, 53 ; officers trained at Cooper's Hill, 102 ??? total, 198.

In 1878 a forest school was started at Dehra Dun, North-Western Provinces, for the training of natives of India as executive officers on the provincial staff. Since then similar schools, though on a smaller scale, have been established at Poona in Bombay and at Tharrawaddy in Burma. A school for Madras will, no doubt, soon follow. Up to date 553 officers of this class have been appointed. In addition, there are about 12,000 subordi- nates, foresters, and forest guards, who form the pro- tective staff.

The progress made since 1864 is really astonishing. According to the latest available returns, the areas taken under the management of the Department are ??? reserved State forests, or permanent forest estates, 79,311 square miles ; other State forests, 34,606 square miles ; or a total of 113,917 square miles, equal to 13 per cent, of the area over which they are scattered. At present, therefore, the average charge of each member of the controlling staff comprises 350,000 acres ; that of each executive officer, 130,000 acres ; and that of each protective official, 6000 acres. It is the intention to increase the executive and protective staff considerably, in the same degree as the management of the forests becomes more detailed. Of the above-mentioned area the Forest Survey Branch, established in 1872, has up to date surveyed and mapped about 25,000 square miles, and the Survey of India 24,000, or a total of about 49,000 square miles. From 1864 on- wards efforts were made to introduce systematic manage- ment into the forests, based upon working plans, but as the management had been provincialized, there was no central or continuous control. This was remedied in 1884, when a central Working Plans Office, under the Inspector-General of Forests, was established. This officer has since then controlled the preparation and execution of the plans, a procedure which has led to most beneficial results. Plans referring to about 16,000 square miles are now in opera- tion, and after a reasonable lapse of time there should not be a single forest of importance which is not worked on a well-regulated plan, and on the principle of a sustained yield. While the danger of overworking the forests is thus being gradually eliminated, their yield capacity is increased by suitable sylvicultural treatment and by fire protection. Formerly most of the important forests were an- nually orperiodically devastated by jungle fires, sometimes lighted accidentally, in other cases purposely. Now, 29,000 square miles of forest are actually protected against fire by the efforts of the Department, and it is the intention gradu- ally to extend protection to all permanent State forests. Grazing of cattle is of great importance in India ; at the same time it is liable to interfere seriously with the repro- duction of the forests. To meet both requirements careful and minute arrangements have been made, according to which at present 32,106 square miles are closed to grazing ;

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41,001 square miles are closed only against the grazing of goats, sheep, and camels ; while 40,810 square miles are open, to the grazing of all kinds of cattle. The areas closed in ordinary years form a reserve of fodder in years of drought and scarcity. During famine years they are either opened to grazing, or grass is cut in them and transported to districts where the cattle are in danger of starvation. The service rendered in this way by a wise forest administration should not be underrated, since one of the most serious calamities of a famine ??? the want of cattle to cultivate the land ??? is thus if not avoided, at any rate considerably reduced.

The financial results of forest administration in India have been as follows : ???

Mean Annual

Perceotage of

Period.

Net Kevenue.

Increase

Eupees.

during Period.

1865-70 .

1,372,733

1870-76 .

1,783,248

30

1875-80 .

2,224,687

25

1880-85 .

3,385,745

52

1885-90 .

5,066,671

50

1890-95 .

7,870,572

45

The revenue since 1886 has been considerably in- creased by the annexation of Upper Burma, still the progress made in the rest of India is highly satisfactory. The highest percentage of increase occurred in the period 1880-85. Apart from the net revenue, large quantities of produce are given free of charge, or at reduced rates, to the people of the country. Thus in 1896-97 the net revenue amounted to E.s. 7,811,360, while the produce given free to the people was valued at Es.3,446,500, making a total benefit derived from the State forests, during that year equal to Es. 11,257,860. The sales dur- ing the same year mounted up to 65 million cubic feet of timber, 150 million cubic feet of fuel, and 172 million bamboos. The receipts from the sale of other forest produce came to 5 million rupees, out of a total gross revenue of Ks. 17,856,510.

These results are highly creditable to the Government of India, which has led the way towards the introduction of rational forest management into the British Empire, thus setting an example which ought to be followed by all the British colonies. Above all, action is most urgently needed in Canada, where an enormous State property is threatened by destruction. Apart from India, Ceylon and Cape Colony are perhaps the only colonies where real and substantial progress has been made.

Beferences. ??? Schlich. A Manual of Forestry. London, 1889-96. Volumes 1., ii., and iii. by W. Schlich, volumes iv. and V. by W. R. Fisher; second edition of volume i., 1896, of volume ii., 1897. ??? Baden-Powell. Forest Law. London, 1893. ??? Bkown. The Forester. Latest edition by Nisbet, Edinburgh and London, 1894. ??? Puton. Traite cVlSconomie Forestiere. Paris, 1888. ??? Broilliaed. Le Traitement des Bois. Paris, 1894. ??? Gayeb. Der Waldbau. Berlin, 1889. ??? Lokey. ‘ Forst- wissenschaft. Tubingen, 1888. ??? Eossmasslek. Der Wald. Leipzig, 1881. (w. Soh.)

United States.

Tlie Forest Regions. ??? According to Mr Henry Gannett, of the U.S. Geological Survey, the wooded area of the United States, exclusive of Alaska, is 1,094,496 square miles, or 37 per cent, of the total area of the country. It is divided by the great treeless region east of the Rocky Mountains into two grand divisions, which may be called the Eastern and the Western forests. The East- ern forest is characterized by the predominance, on the whole, of broad-leafed trees, the comparative uniformity of its general types over wide areas, and its naturally unbroken distribution. In the Western forest conifers

are conspicuously predominant, the individual species often rea??h enormous and even unequalled dimensions, the forest is frequently interrupted by treeless areas, and the transitions from one type to another are often exceedingly abrupt. Both divisions are botanically and commercially rich in species.

The Eastern forest may conveniently be subdivided into three members : ???

(1) The Northern forest, marked by great density and large volume of standing timber, and a comparative immunity, in its virgin condition, from fire. The charac- teristic trees are Maples, Birches, and Beeches among the hardwoods, and White Pine, Spruce, and Hemlock among conifers.

(2) The Southern forest is on the whole less dense than the Northern, and more frequently burned over. Among its characteristic trees are Oaks, Gums, the Long- leaf and other Pines, Bald Cypress, and White Cedar.

(3) The Interior Hardwood forest, which differs com- paratively little from adjacent portions of the Northern and Southern forests except in the absence of the coni- fers, which form the determining (but not the predomi- nant) factors in their composition. Among its trees are the Chestnuts, Hickories, Ashes, and other hardwoods already mentioned.

The Western division has two members : ???

(1) The Pacific Coast forest, marked by the great size of its trees and the vast accumulations of merchantable timber. Devastating fires are frequent, especially to the north. Among its characteristic species are the Redwood and the Big Tree (Sequoia), the Red Eir, Sugar Pine, Western Hemlock, Western Red Cedar {Thuja), and Tideland Spruce.

(2) The Interior Coniferous forest, whose characteris- tic species are the Western Yellow Pine, Engelmann Spruce, and the Lodgepole Pine. This forest is fre- quently broken by treeless areas of greater or less extent, especially towards the south, and it suffers greatly from fire. Subarid in character, except to the north and at high elevations, the vast mining interests of the region and its treeless surroundings give this forest an economic value out of proportion to the quanti- ties of timber it contains.

This distribution of the various forests is indicated in the map on p. 436. The other map shows the situation of the Federal forest reserves hereafter mentioned.

The forests of Alaska are not well known. Of great but undefined area, and containing, it is believed, large amounts of the timber necessary to the development of mineral and other resources, they have hitherto been little impaired except by fire. Spruce, Western Hemlock, and Alaska Cedar are among the characteristic trees.

Tfie National Forest Policy. ??? The forest policy of the United States may be said to have had its origin in 1799 in the enactment of a law which authorized the purchase of timber suitable for the use of the navy, or of land upon which such timber was growing. It is true that laws were in force under the early governments of Massachti- setts. New Jersey, and other colonies providing for the care and protection of forest interests in various ways, but these laws were distinctly survivals of tendencies acquired in Europe, and for the most part of little use. It was not until the apparent approach of a dangerous shortage in certain timber supplies became knovra that the first real step in forest policy was taken by the United States. Successive laws passed from 1817 to 1831 strove to give larger effect to the original enactment, but without permanent influence towards the preservation of the Live Oak (Querciis virginiana Mill.), which was the object in view. A long period of inaction followed these early measures. In 1831 the solicitor of the Treasury assumed

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Map sHOwixd United States Forest Reserves.

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_?_?_?White E. Plateau

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FORESTS AND FOEESTEY

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436

FORESTS AND FORESTRY

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a partial responsibility for the care and protection of the public timber lands, and in 1855 this duty was transferred to the Commissioner of the General Land Office, in the Department of the Interior, upon whom it has rested ever since. The effect of these changes upon forest protection was unimportant. When, however, at the close of the Civil War railway building in the "United States took on an unparalleled activity, the destruction of forests by fire and the axe increased in a corresponding ratio, and public sentiment became alarmed. Action by several of the States slightly preceded that of the Federal Government, but in 1876

Congress, acting under the inspiration of a memorial from the American Association for the Advance- ment of Science, authorized the appointment of an officer (Dr Franklin B. Hough) under the Commissioner of Agriculture, to collect and distribute information upon forest matters. His office became in 1886 the Division (on 1st July 1901 the Bureau) of Forestry in what is now the United States Department of Agriculture.

Forest Reservations. ??? As the railways advanced into the treeless interior public interest in tree-planting became keen. In 1873 Congress passed, and later amended and repealed, the timber-culture Acts, which granted home- steads on the treeless public lands to settlers who planted one-fourth of their entries with trees. Though these measures were not successful in themselves, they directed attention towards forestry. The Act which repealed them in 1891 contained a clause which lies at the founda- tion of the present forest policy of the United States. By it the President was authorized to set aside "any part of the public lands wholly or in part covered with timber or undergrowth, whether of commercial value or not, as public reservations, and the President shall, by public proclamation, declare the establishment of such reservations and the limits thereof." Some eighteen million acres had been proclaimed as reservations at the time when, in 1896, the I^Tational Academy of Sciences was asked by the Secretary of the Interior to make an investigation and report upon "the inauguration of a rational forest policy for the forest lands of the United States." Upon the recommendation of the committee of the Academy President Cleveland established more than twenty-one million acres of new reserves on 22nd February 1897. His action was widely misunder- stood and attacked, but to the public interest which it awakened in forest questions is directly due the rapid progress of forestry in the United States since that time.

The proclamation of the Cleveland forest reserves was followed by the enactment on 4th June 1897 of a law which conferred upon the Secretary of the Interior all the principal powers required for the proper management of the reserves through the General Land Office. This law provides for the designation and sale of mature timber, permits the use of timber free of charge in small quanti- ties by settlers and miners,

authorizes the Secretary of the Interior to " make such rules and regulations and establish such service as will insure the objects of such reservations, namely, to regulate their occupancy and use, and to preserve the forests thereon from destruction," provides for the exchange of private lands within the forest reserve boundaries for vacant public lands outside, establishes criminal and civil jurisdiction within forest reserves, and provides for the modification of their boun- daries. An extremely important provision continues the mining laws of the United States within the reserves. This just and proper clause, which, at the time of its passage, was indispensable for the success of the measure which contained it, must very seriously affect the manage- ment of the national forests, since the mining laws confer

the right to use the timber on any mineral claim for the development of that claim.

Government Forest Administration. ??? Under this law the Department of the Interior has organized in the General Land Office a scheme of forest administration with the protection of the reserves as its chief objective. Some progress in the sale of timber has also been made. The appropriation for the forest work of the General Land Office for the year 1901-1902 was ^300,000. The force employed consists of one inspector, nine superin- tendents, ten to fifteen supervisors in winter and thirty- five to forty in summer, and a varying number of forest rangers, which in summer attains 430 men. Protection against fire is its most important function.

The Act of 4th June 1897, which provided an adminis- tration for the forest reserves, entrusted the surveying and mapping of their topography and forests to the United States Geological Survey, by which the work has since been prosecuted with admirable success. The estimates and descriptions which it is publishing of the amount and character of the forests of the United States are by far the most intelligent and most trustworthy that have been made. The appropriation for work in the forest reserves during the year 1901-1902 was $125,000.

In addition to the General Land Office and the United States Geological Survey, there is a third Federal orga- nization which deals with forest

matters. This is the Bureau of Forestry in the United States Department of Agriculture, to which are assigned all technical forest questions, together with the responsibility for the prog- ress of forestry among private owners of forest lands and among the people at large. It is engaged in the prepa- ration of working plans for the national forest reserves, for the single important State forest preserve, and for private owners (a method of co-operation made necessary by the fact that nearly all the trained foresters in the United States are members of the Bureau), and in assist- ing tree-planters through practical advice expressed in detailed plans for planting. It studies forest fires, the effect of grazing upon the forest, especially in the forest reserves, and the growth and reproduction of commer- cially valuable trees, seeks improvements in methods of lumbering, of advantage both to the forest and to its yield, and conducts other forest investigations. Its appro- priation for the fiscal year 1898-1899, when work of this character was begun, was $28,520 ; for 1901-1902 it was

$18.5,440.

The dispersal of the Federal forest work among the three agencies mentioned above, while inevitable at the time it was brought about, is so no longer. Its consoli- dation under a single head is a necessity of the immedi- ate future. An excellent Forest Fire Law was passed in Congress in 1900.

Forestry among the States. ??? Among the States, forestry has not yet reached the stage of practical application on the ground. New York holds 1,370,928 acres of forest land, but is for the present unable to apply forest man- agement, although the Forest, Fish, and Game Com- mission is engaged in the prepai-ation of working plans for the State forests in co-operation with the Bureau of Forestry. The New York legislature has appropri- ated in all $2,000,000 for the purchase of forest land. A similar policy has been adopted by Pennsylvania, and Minnesota and Michigan have taken steps in the same direction. Altogether fifteen of the States are, or have recently been, directly occupied with forest matters. Laws to prevent damage from forest fires have been enacted by practically all the States, and in general the}' are of a very satisfactory character. Their

enforcement, unfortunately, has been lax. Public sentiment, however, is making very rapid progress. Among the best laws are those of Maine,

states]

New Hampshire, Minnesota, New York, Pennsylvania, and Wisconsin. The New York law, for example, pro- vides for the appointment of one or more fire wardens in each town of the counties in which damage by fire is especially to be feared. In other counties supervisors of towns are ex-officio fire wardens. A chief fire warden has general supervision of their work. The wardens, half of the cost of whose services is paid by the State, receive compensation only for the time actually employed in fighting fires. They may command the service of any citizen to assist them. Setting fire to woods or waste lands belonging to the State or to another, if such fire results in loss, is punishable by a fine not exceeding f 250, or imprisonment not exceeding one year, or both, and damages are provided for the person injured. Since fire is beyond question the most dangerous enemy of forests in the United States, the measures taken against it are of vital importance.

Forest Associations. ??? Public sentiment in favour of the protection of forests is now widespread and increasingly effective throughout the United States. As the general understanding of the objects and methods of forestry becomes clearer, the tendency, formerly very marked, to confound ornamental tree-planting and botanical matters with forestry proper is rapidly growing less. At the same time, the number and activity of associations deal- ing with forest matters is increasing with notable rapidity. There are now some twenty-two such associations in the United States, of which the American Forestry Associar tion is the oldest and most influential. Its objects are, first, to bring about a wiser and more conservative treat- ment of the forest resources of the country, and to promote educational,' legislative, and other measures to that end ; and secondly, the diffusion of knowledge regarding the conservation, management, and renewal of forests, the methods of reforesting waste

lands, the proper utilization of forest products, the planting of trees for ornament, and cognate subjects of arboriculture. This association has been influential in preparing the groundwork of popular interest in forestry, and especially in advocating and securing the adoption of the federal forest reservation policy, the most important step yet taken by the national G-overnment. The Association is growing rapidly in membership and influence. It publishes as its organ a monthly magazine called Tlie Forester. The Pennsylvania Forestry Association has been instrumental in placing that State in the forefront of forest progress. Its organ is a bi-monthly publication called Forest Leaves. Other States which have associa- tions or societies of special influence in forest matters are California, Massachusetts, Minnesota, Colorado, and Oregon. Arbor Day, instituted in Nebraska in 1872 as a means of interesting children in the planting of trees,, has spread until it is now observed in every State and Territory. It continues to serve an admirable purpose.

Forest Instruction. ??? Elementary instruction in forestry has already made noteworthy progress, especially in State agricultural colleges, of which thirty-eight offer instruction in forest subjects. The University of Minnesota and Berea College, Kentucky, deserve special mention among the institutions which do not attempt to graduate fully trained foresters ; of these there are ten in addition to the agricultural colleges. The Biltmore Forest School, in North Carolina, offers a one-year course in technical forestry, and the New York State College of Forestry, organized in 1898 as a part of Cornell University, offers a four-years' undergraduate technical course modelled on German lines and leading to a degree. A tract of thirty thousand acres in the Adirondack Mountains serves as an experimental forest in connexion with the college. The Yale Forest School, which was opened as a department

of Yale University in September 1900, offers a two-years' post-graduate course, with abundant field-work both in the Adirondacks and in Pennsylvania and Connecticut. A summer school of forestry, specially adapted to the train- ing of forest rangers, and for advanced and special students, is conducted at Grey Towers, Milford, Pennsylvania, by the professors of the Yale Forest School.

Forestry on Private Lands. ??? The practice of forestry among private owners is of old date. One of the earliest instances was that of Jared Eliot, who, in 1730, began the systematic cutting of timber land to supply charcoal for an iron furnace at Old Salisbury, Connecticut. The successful planting of waste lands with timber trees in Massachusetts dates from about ten years later. But such examples were comparatively rare until recent times. At present the intelligent harvesting of timber with a view to successive crops, which is forestry, is much more common than is usually supposed. Among farmers it is especially frequent. It was begun among lumbermen by the late E. S. Coe, of Bangor, Maine, who made a practice of restricting the cut of Spruce from his forests to trees 10, 12, or sometimes even 14 inches in diameter, with the result that much of his land yielded, during his life, a second crop as plentiful as the first. Many owners of Spruce lands have followed his example, but until very recently without improving upon it. Systematic forestry on a large scale among lumbermen was begun in the Adirondacks during the summer of 1898 on the lands of Dr W. S. Webb and Hon. W. C. Whitney, of a combined area of over 100,000 acres, under the superintendence of the then Division of Forestry. In these forests Spruce, Maple, Beech, and Birch pre- dominate, but the Spruce alone is at present of the first commercial importance. The treatment is a form of the selection system. Under it a second crop of equal yield would be ripe for the axe in thirty-five years. Spruce and Pine are the only trees cut. The work had been executed, at any rate up to the year 1902, with great satisfaction to the owners and the lumbering contractors, as well as to the decided benefit of the forest. The lumbering is regulated by the following rules, and com- petent inspectors are employed to see that they are rigidly carried out : ??? (I') No trees shall be cut which are not marked. (2) All trees marked shall be cut. (3) No trees shall be left lodged in the woods, and none shall be overlooked by the skidders or haulers. (4) All merchantable logs which are as large as 6 inches in diameter at the small end must be utilized. (6) No stumps shall be cut more than 6 inches higher than the stump is wide. (6) No Spruce shall be used for bridges, corduroy, skids, slides, or for any purpose except building camps, dams, or booms, unless it is absolutely necessary on account of lack of other timber. (7) All merchantable Spruce used for skidways must be cut into logs and hauled out. / (8) Contractors

must not do any unnecessary damage to young growth in lumbering; and if any is done, they must discharge the men who did it.

These are perhaps the most notable instances of forestry in the United States. Their example is decidedly the most useful and effective one among lumbermen, especially in the Spruce regions of New England and New York, but neither one was the first case of systematic forestry under regular working plans. The first instance was begun in 1891 on about 4000 acres of forest land, forming part of the estate of George W. Vanderbilt, at Biltmore, North Carolina. The working plan has been extended until now it covers nearly 100,000 acres. A professional forester, with a corps of trained rangers under him, is in charge of the work. Protection against fire and the plant- ing of groves, wood-lots, and wind-breaks by individual initiative also deserve mention among private activities in

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forestry. The latter^, in spite of the repeal of the timber- culture laws, is prosecuted on a large scale over consider- able portions of the treeless West.

American Practice. ??? The conditions under which for- estry is practised in Europe and in America differ so widely that rules which are received as axiomatic in the one must often be rejected in the other. Among these conditions in America are the highly developed and specialized, methods and machinery of lumbering, the greater facilities for transportation and consequent greater mobility of the lumber trade, the vast number of small holdings of forest land, and the enormous supply of low-grade wood in the timbered regions. High taxes on forest properties, cut-over as well as virgin, notably in the north-western pineries, and the firmly established habits of lumbermen, are factors of great importance. Prom these and other considerations it follows that such generally accepted essentials of Euro- pean methods of forestry as a

sustained annual yield, a permanent force of forest labourers, a permanent road system, and the like, are in most cases utterly inapplicable in the United States at the present day. Methods of forest management, to find acceptance, must there con- form as closely as possible to existing methods of lumber- ing. Rules of marked simplicity, the observance of which will yet secure the safety of the forest, must open the way for more refined methods in the future. Eor the present a periodic or irregular yield, temporary means of transport, constantly changing crews, and an almost total ignorance of the sylviculture of all but a very few of the most important trees ??? -all combine to enforce the simplest sylvicultural treatment and the utmost concentration of purpose on the two main objects of forestry, which are the production of a net revenue and the perpetuation of the forest. Such concentration has been followed in practice by complete success.

The forests with which the American forester deals are rich in species, usually endowed with abundant powers of reproduction, and, over a large part of their range, greatly dependent for their composition and general character upon the action of forest fires. Except in its most obvi- ous manifestations, the sylvicultural character of the larger number even of the commercially valuable trees is unknown. Of these there may be said to be in round num- bers a hundred out of a total forest flora of about 500 species, but many trees not yet of importance in the lum- ber trade will become so hereafter, as has already happened in many cases. In a forest thus constituted and in exist- ing circumstances the attention of the forester must be concentrated upon the growth and reproduction usually of a single species, and never of more than a very few. Thus the sylvicultural problems which must be solved in the practice of forestry in America are fortunately less complicated than the presence of so many kinds of trees in forests of such diverse types would naturally seem to indicate.

Special Problems. ??? It is probable that forest fires have had more to do with the character and distribution of forests in America than any other modifying factor except rainfall. With an annual range over thousands of square miles, in many portions of the United States they occur regularly year after year on the same ground. Trees whose thick

bark or abundant seeding gives them pecul- iar powers of resistance frequently owe their exclusive possession of vast areas purely to the action of fire. On the economic side fire is equally potent. The prob- ability, or often the practical certainty, of fire after the first cut commonly determines lumbermen to leave no merchantable tree standing. The prevalence of forest fires is thus one of the most eifective barriers to the in- troduction of forestry. Excessive taxation of timber land

is another of almost equal effect. Because of it lumber- men hasten to cut, amd afterwards often to abandon, lands which they cannot afford to hold. This evil, which only the progress of public sentiment can control, is especially prevalent in certain portions of the White Pine belt. A third problem of crucial importance to the Western forests, but of a different kind, relates to grazing in the national forest reserves. Much of the early opposition to their establishment came from the grazing interests. Now that the maintenance of the reserves is no longer in question, the discussion hinges chiefly upon the admission of sheep within the reserve boundaries. The trend of public sentiment is against it, but their complete exclusion is both undesirable and unlikely, since there are doubtless considerable portions of the reserves where moderate grazing will do no harm. This question has been officially referred to the Bureau of Forestry, and a thorough investigatibn is in progress.

Lumbering. ??? The importance of the lumber trade to the prosperity and progress of the United States is difficult to estimate. According to the census of 1890, which was the latest available at the time of writing, the capital invested in logging operations was $60,442,226, the number of employees engaged, 174,152, and their wages, $38,991,794; saw-mills represented an invested capital of $121,562,226, and employed 286,197 persons, whose wages were $87,784,433. The industries depend- ent on the forest ranked next to agriculture in their contribution to the national wealth. For 1899 the total consumption of wood for the United States is roughly estimated at 18,307,000,000 cubic feet, divided approxi- mately as follows : ??? Lumber market and manufactures, 2,260,000,000 cubic feet ; fuel, 15,000,000,000 cubic feet ; railroad ties, 27,000,000 cubic feet; fencing, 30,000,000 cubic feet; other items, 1,000,000,000 cubic feet. For purposes of comparison, 110 cubic feet may be taken as approximately

equal to 1000 board feet. All the opera- tions of the lumber trade in the United States are con- trolled, and to no small degree determined, by the peculiar unit of measure which has been adopted. This unit, the hoard foot, is generally defined as a board 1 foot long, 1 foot wide, and 1 inch thick, but in reality it is equiva- lent to 144 cubic inches of manufactured lumber in any form. To purchase logs by this measure one must first know about what each log will yield in 1-inch boards. For this purpose a scale or table is used, which gives the contents of ??? logs of various diameters and lengths in board feet. Under such a standard the purchaser pays for nothing but the saleable lumber in each log, the inevitable waste in slabs and sawdust costing him nothing.

The principal lumber tree of the United States is still the White Pine (Pinus strobus L.), usually known in Europe as the Weymouth Pine. It has an average height of 110 feet when mature, and an average diameter of somewhat less than 3 feet. Throughout the Northern subdivision of the Eastern forest it is, or has been, com- mercially the most important factor. At present it has largely disappeared as an element of the standing forests of New England, New York, and Pennsylvania, and from large portions of its western (and more important) range as well. Trustworthy estimates of the amount of "SAHiite Pine left standing are not available, but it niaj' be ac- cepted that the first grade of virgin timber is very nearly gone. Of late years the size of the merchantable log has rapidly decreased, until at present much of the White Pine brought to the mill is less than ten inches in diameter. A striking and instructive example of the widespread decline of White Pine as a lumber tree, and its gradual replacement by trees formerly of little moment, is afforded by the official figures of production on the

Penobscot river in Maine, which is still called the Pine Tree State. In 1851 the cut of ^Yhite Pine was 144 million feet, of Spruce 48 million, of Hemlock 11 million. Thirty years later the Pine cut had sunk to 23 million, the Spruce had risen to 118 million, and the Hemlock had surpassed the Pine by a million feet. In 1900 the cut of Pine was less than

23 million, that of Spruce was 102 million, and that of Hemlock 17 million. It is certain that a similar decline in White Pine production will become general. The following table gives the cut of the north-western pineries (on the headwaters of the Mississippi) for the years 1873 to 1900 inclusive : ???

1873 .

3,993,780,000

1887

. 7,757,916,784

1874 .

3,751,306,000

1888

. 8,388,716,460

1875 .

3,968,553,000

1889

. 8,183,050,755

1876 .

3,879,046,000

1890

,, 8,597,659,352

1877 .

3,595,333,496

1891

. 7,879,948,349

1878 .

3,629,472,759

1892

8,594,222,802

1879

4,806,943,000

1893

. 7,.326,263,782

1880 .

5,651,295,000

1894

, 6,821,516,412

1881 .

6,768,856,749

1895

. 7,050,669,235

1882

7,552,150,744

1896

. 5,725,763,085

1883 .

7,624,789,786

1897

. 6,233,454,000

1884 .

7,935,033,054

1898

. 6,155,300,000

1885 .

7,053,094,555

1899

. 6,056,508,000

1886 .

7,425,368,443

1900

. 5,485,261,000

Already very many of the White Pine lumbermen and mill-men have removed to the Southern States and the Pacific Coast, driven away by the

exhaustion of their supplies. White Pine, as a rule, is cut in the summer and autumn, skidded (dragged to convenient places and piled along the roads) by horses in the early winter, hauled on sleds over ice-co&,ted temporary roads to the banks of streams in the late winter and early spring, and finally driven (fioated) down to the booms (chains of floating logs firmly anchored to hold the " drive ") near the mill. The mill machinery, as well as the tools and appliances used in felling the trees, and in the various stages of transport from the stump to the mill, and from the mill to the consumer, are usually of the first grade of practical utility.

Second to the White Pine, among the coniferous lumber trees of the Northern forest, is the Spruce (Picea rubens Sargent), now, however, used for the most part in the manufacture of paper pulp, for which purpose Poplar (chiefly Popnlus tremuloides Michx. and P. grandiden- tata Michx.) and several other woods are also employed, but on a less gigantic scale. The total consumption of wood for paper in the United States in 1900 approached closely to the equivalent of one billion board feet, of which amount from 10 to 16 per cent, was imported from Canada.

The hardwood product of the country, including fuel, is enormous, but no accurate figures are available. Derived from each of the great divisions of the Eastern forest, and consumed in vast quantities for domestic purposes, its grand total can only be surmised. It is known, however, that Michigan, Wisconsin, and Minnesota, which are the principal sources of White Pine, produced in 1900 more than 900 million board feet of hardwood. Their output has doubled since 1896.

The most widely known lumber tree of the Southern forest is the Longleaf Pine (Pinus palustris Mill.), mis- takenly called Pitch Pine in Europe, whose timber is probably superior in strength and durability to that of any other member of the genus Pinus. The average size of the mature Longleaf Pine is 90 feet in height and 20 inches in diameter. Other important lumber trees are the Shortleaf, Loblolly, and Cuban Pines, the Bald C!ypress, and the White Cedar (Chamcecyparis thyoides (L.) 15.S.P.) among the conifers, and the Yellow or Tulip

Poplar and various oaks among broad-leafed trees. Ex- cept for the wire cable logging of the Cypress and other swamp trees, the transportation of logs is, on the whole, less highly specialized here than in the Northern forest. The more valuable timber as a rule is in the lower and more level regions, and the proportion of carriage by rail is consequently greater.

Satisfactory statistics of the standing timber or the lumber product of the Southern forest are not available. The report of the Yellow Pine Clearing House gives the total cut of the various Southern lumber Pines by 136 firms in eight States during 1900 at 1,878,831,109 board feet, but these figures are incomplete. The production of naval stores as it is carried on in the forests of Longleaf Pine is rapidly destructive to the standing timber, and is directly responsible for disastrous fires. It supplies, however, an important item in the revenue from the Southern forest. In 1900 the value of the exports to foreign countries, in spite of a notable shrinkage, was $13,030,232. The domestic consumption is very large.

In the Pacific Coast forest the principal lumber trees, among many of great importance, are Eed Eir, sometimes called Douglas Eir (Pseudotsuga taxifolia (Lam.) Britton), in Oregon and Washington, and Redwood in California. The average sizes of these trees when mature are approxi- mately^ for the Red Fir, 200 feet high and 4 feet in diameter, and for the Redwood, 225 feet high and 8 feet in diameter. The annual lumber product of the Coast is difficult to state in exact figures. That of Washington for 1900 exceeded one billion board feet, that of Oregon was 898,160,000, while the Redwood product of three counties in California for the same year exceeded 200 million feet. The timber standing in these States, according to Mr Henry Gannett, is in Washington, upon the present basis of estimate, 114,778 million feet B.M. (board measure), in Oregon 234,653 million feet, in California (Redwood only) 97,505 million feet. California has great bodies of timber outside the Redwood belt.

Logging in the Pacific Coast forest is usually by wire cable. The logs are skidded partly by cables operated by donkey engines, which drag themselves through the forest wherever they are required, partly by stationary donkeys of larger size, the cables of which are often more than half a mile in length. The final journey to the mill is commonly by rail.

Extreme skill in the handling of enormous weights and powerful machinery is a conspicuous characteristic of lumbering in Washing- ton, Oregon, and especially in California, where the logs of Redwood and of Big Tree are often more than 10 feet in diameter. Elumes for the transportation of manu- factured lumber by water are frequent in this region, where some of them attain a length of 40 miles. Mills of great size, built on piles over tide-water, and so arranged that their product is delivered directly from the saws and dry kilns to the lumber vessels moored alongside, supply a rapidly growing coastwise and foreign trade. Certain products of the Coast forest, notably Cedar shingles and Fir timbers, have already made their way overland into the markets of the central and eastern States.

The most important lumber trees of the Interior Coni- ferous forest are the Western Yellow Pine, the Red Fir, and the Engelmann Spruce. The Red Fir, here extremely variable in size and value, reaches in this forest average dimensions of perhaps 70 feet in height and 2 feet in diameter, the Western Yellow Pine 90 feet by 3 feet, and the Engelmann Spruce 60 feet by 2 feet. Mining, rail- road, and domestic uses chiefly absorb the annual timber product, which is considerable in quantity, and of vast importance to the local population.

F 0 R F A R ⬛⬛⬛ F ORFARSHIRE

For the twelve months ending with December 1900, the United States imported wood and manufactures of wood to the value of $20,156,641. The corresponding value of exports for the same period was ⬛⬛52,636,808.

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Forfar, a royal and parliamentary burgh (Montrose group) of Forfarshire, Scotland, is 14 miles N.N.E. of Dundee by rail. The manufactures include jute, linen, and iron-founding. The parish church was renovated in 1900. Eecent erections are a United Free church, an Episcopal church, and a Baptist chapel. Population of royal burgh

(1881), 13,579 ; (1901), 12,061.

Forfarshire, or Angus, a maritime county of East Scotland, bounded N. by Aberdeen and Kincardine, E. by the (Jerman Ocean, S. by the Eirth of Tay, and W. by Perthshire.

Area and Population. ??? la 1891, 568J acres of the Perthshire parish of Caputh were added to three Forfarshire parishes, and the whole parish of Fowlis Easter and the Perthshire part of the parish of Liff, Benvie and Invergowrie, were transferred to Forfar ; and to Perth from Forfar, part of Alyth, Coupar-Angus, and Kettins. The Kincardine part of the parisli of Edzell was transferred to the Kincardine parish of Fettercairn. The area of the county, according to the latest oflScial estimate, is (excluding foreshore) 562,162 acres, or about 878 square miles. The population was in 1881, 266,360 ; in 1891, 277,788 ; in 1891, on the above area, 277,735, of whom 125,414 were males and 152,321 females ; in 1901, 284,078. On the old area, taking land only (560,186 acres, or 875-3 square miles), the number of persons to tlie square mile in 1891 was 317, and the number of acres to the person 2-0. In the registration county the population increased between 1881 and 1891 by 4-3 percent. Between 1881 and 1891 the excess of births over deaths was 31,815, and the increase of the resident population 11,443. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 : ???

Year.

Deaths.

Marriages.

Births.

Percentage of Illegitlinuto.

1880 1890 18,99

5706 5997 5285

1818 1921 2162

8862 7990 7930

9-9

9-62

8-4

1880.

1881-90.

1890.

1891-98.

1899.

Birth-rate . Death-rate . Marriage-rate

33-27

21-42

6-83

30-89

19-30

6-77

28-61

21-47 6-87

28-61

19-27

7-17

27-67

18-44

7-54

The following table gives the birth-rate, marriage-rate, and death-rate per thousand of the population for a series of years : ???

In 1891 the number of Gaelic-speaking persons in the county was 1438, and of foreigners 376. Valuation in 1889-90, ??603,115 ; 1899-1900, ??618,666.

Administration. ??? The county returns a member to Parliament. Dundee (160,871) returns two members, and Montrose, Arbroath, Brechin, and Forfar form, with Bervie in Kincardine, the Montrose group of parliamentary burghs. Dundee is a royal burgh, a city, and (since 1894) a county of a city, and other royal burghs are Montrose (12,401), Forfar, the county town (12,061), Brechin (8941), and Arbroath (22,372). There are 55 civil parishes, forming one combination. The number of paupers and dependents in September 1899 was 5923. Forfarshire is a sheriffdom, and there is a resident sheriff-substitute at Dundee and another at Forfar, and courts are held also at Arbroath.

Education. ??? Sixty school boards manage 148 schools, which had in 1898-99 an average attendance of 38,856, while 23 voluntary schools, of which 8 are Roman Catholic and 4 Episcopal, had 7211. There are 3 secondary schools at Dundee, and one each at Mon- trose, Arbroath, Brechin, and Forfar ; academies with elementary departments at Broughty-Ferry and Kirriemuir, and one other school in Dundee and 12 in the county earned grants for giving higher education in 1898. There are technical schools at Dun- dee and Arbroath. The county council and Dundee and Arbroath town councils expend the "residue" grant in subsidizing science and art and technical schools and classes, including Dundee university college, textile school, technical institute, navigation school, and workshop schools, and Arbroath technical school, and

cookery, dairy, dress-cutting, veterinary science, plumbing, and laundry classes at various centres.

Agriculture. ??? The percentage of land under cultivation in 1898 was 44-8. Oats are the principal but a declining crop, while the barley acreage continues to increase with fair steadiness. The wheat acreage, considerably reduced between 1875-1900, does not show a tendency to fall further ; it was, for instance, 500 acres more in 1898 than in 1897. The following table gives the principal acre- ages at intervals of five years from 1880 : ???

Year.

Area under Crops.

Corn Crops.

Green Crops.

Clover.

Perma- nent Pasture.

Fallow,

1880 1885 1890 1895 1899

253,373 254,012 253,723 252,200 251,276

94,793 93,231 89,817

87,837 88,144

53,439

50,128 49,546 48,624 47,221

81,396 82,965 85,798 84,823 86,634

23,051 27,360 28,328 30,771 28,936

694

328

80

51

108

The following table gives particulars of the live stock during the same years : ???

Year.

Total Horses.

Total Cattle.

Co-ws or

Heifers In

Milk or Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1899

10,443

9,612

9,947

10,663

10,028

46,304 50,406 55,401 49,163 51,668

11,685 12,310 12,397 11,634 12,536

122,856 132,167 152,203 146,329 167,219

5132 6997 7547 7961 6743

Of the 2637 holdings in 1895, the date of the last return, the average size was 96 acres. The percentage under 5 acres was 15-74, between 5 and 50 acres 35-76, and over 50 acres 48-50. The number of farms between 60 and 100 acres was 399 ; between 100 and 300, 687 ; between 300 and 500, 166 ; and over 500 acres, 27. The bothy system of housing farm servants still prevails in this county to a considerable extent, though the farm buildings are equal to any to be found elsewhere in Scotland. In 1898, 31,972 acres were under wood, 2685 having been planted since 1881. At the census of 1891, 9848 men and 579 women were returned as being engaged in agriculture.

Industries and Trade. ??? Shipbuilding (see Dundee) and manu-factures of confectionery, jams, leather, machinery, soap, and chemicals, are all now important industries. In 1891, 52,345 men and 44,208 women were engaged in pursuits connected with industry, and of these 17,015 men and 34,398 women were associated with the manufacture of textiles. There is a number of sandstone quarries ; the output was in 1896, 112,688 tons, valued at .f66,446, and in 1899, 142,948 tons, valued at ??64,990. The fisheries of the county are of considerable importance. All the ports of the county and one or two belonging to Kincardine are included in the

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Montrose fishery district, statistics of which are given in the following table : ???

Year.

Boats.

Talue of Gear.

Resident Fishermen and Hoys.

Total Yaluo of all Fish.

No.

Tons.

Value.

1890 1898 1899

636 667 543

5084 6700 6377

* ??46,449 ??56,331 ??98,581*

* ??29,709 ??32,608 ??30,252*

1254 1140 1201

* ??85,593 ??75,633 ??95,877*

In 1899 the number of persons connected with the various branches of the sea fisheries in the district was 3279. A con- siderable number of new branch railways has been opened since 1876, the total addition to the county mileage being over 60 miles.

AnxHOKiTiEs. ??? Gammack's edition of Jertise's Memorials of Angus and Mearns. Edinburgh, 1895. ??? A. Jekvise. Land of the Lindsays. Edinburgh, 1882. ??? Loud Lindsay. Lives of the Lind- saijs. London, 1858.^A. Jekvise. Epitaphs and Inscriptions. Edinburgh,

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(w. Wa.)

ForIT, a town and episcopal see of Italy (Emilia), capi- tal of the province of Forli, on the Via Emilia, and 40 miles south-east of Bologna by rail. Its principal indus- tries are iron-works, foundries, and silk-factories. Fur- ther, there are an industrial institute and a technical school. Population: of town (1881), 40,934; (1901), 43,457 ; of province (1881), 261,110 ; (1901), 279,072.

Form (in Music). ??? Every work of art possesses, of necessity, some design by means of which a sense of unity and connexion can be imparted to its different features ; the various means by which this sense of unity is arrived at in music are known by the generic name of ” form.” Certain principles of form are common to all music, but the fully developed scheme on which Haydn, Mozart, and Beethoven wrote their symphonies, sonatas, and quartettes, and which is known as ” sonata ” or ” first movement ” form, did not make its appearance until the beginning of the 18th century. Before a form could be invented it was necessary that there should be material worth pouring into the mould. By 1729 the material was ready; Bach had brought melodic and harmonic invention to a pitch which has never been surpassed, and, farther, it was Bach who largely helped to establish our present system of key-centres, which enabled musical movements on a large scale to revolve round a definite pivot. It is, therefore, not surprising to find, coinci- dentally with Bach’s death, a sudden development of the ” sonata ” form.

The origin of this form may be found in the simple formula A, B, A, or statement, variety, and symmetry. Bat these principles of construction are common to all music ; the particular species from which the Beethoven first-movement may be said to have descended is well represented by the tune Barbara Allen. This tune is divided into two halves, and these halves again into two sections. The first section consists of a phrase in the tonic, the second of one in the dominant, the third is a free passage leading back to the tonic, and the last is a repetition of the second in the tonic key. The Italian composers, Corelli (&. 1653) and Domenico Scarlatti (p. 1683); finding the fugue forms of their contemporaries unsuitable to their essentially melodic style, adopted the scheme above described. However, the form of Barbara Allen is obviously unsatisfactory when applied to a more extended movement, for the reason that there is no re-

statement of the first and principal phrase. This defect was remedied by making the third section a repetition, so far as possible, of the first, but modulating from domi- nant to tonic instead of from tonic to dominant. Mean- while another development of the original form was growing up, chiefly among the German successors of Bach, such as Krebs (b. 1713). This scheme repeats the original subject where it will have its greatest effect, namely, at the return to the tonic key ; the third section remains free as in the primitive design, but both first and second sections are repeated in the last quarter of the movement. This scheme was finally established by Emmanuel Bach and perfected by Mozart and Haydn. These two composers are responsible for the development of the third section ; even Haydn often treated this part yof the movement as a mere episode, having no thematic connexion with the rest of the movement. But already the idea of treating this section as an extension of themes already stated was prevalent. When this part of the movement consisted of the repetition of the first section it had been found necessary to alter and extend it so as to compass the altered modulation, so that the " free " section had already come to be considered a period of development rather than of restatement or digression. The following is an analysis of the "first-movement" form as perfected by Mozart.

1. Tonic Section. ??? A subject in the tonic key called the "first subject," either ending with a half close or fol- lowed by a passage

leading to the dominant key (or rela- tive major if the first key is minor). This passage is called the " first episode."

2. Dominant (or relative major) Section. ◆◆◆ A subject in this key called the " second subject," ' followed by the " second episode," usually of a less melodious character, in which transient modulations sometimes occur. The first half of the movement is brought to a full close in the second key by a short phrase called the " cadence figure " or " codetta."

This half of the movement, consisting of sections 1 and 2, is repeated.

3. Development Section, or " Free Fantasia." ◆◆◆ This con- sists of an extension and development of the themes al- ready heard, passing through a definite succession of keys, until the tonic is once more reached.

4. RecapitulatiQn Section. ◆◆◆ The whole or a part of the first subject and first episode is restated, the latter being altered so as to remain in the tonic. The second subject, second episode, and codetta are also restated in the tonic key. These two sections (Free Fantasia and Eecapitula- tion) are also occasionally repeated and a short coda added. This coda was originally introduced only when the second half of the movement was repeated, but it finally became universal.

In Beethoven's hands this scheme ceased to be an aggre- gation of items and became a united whole, in which the various sections are so welded together that it is impos- sible to see the join. He soon discarded the old system of tonic and dominant, and often introduces his second subject in remote keys such as the mediant; further, while he gives each section its relative importance, yet each passage has its own value, and the " padding " of earlier writers disappears. Moreover, though the princi- ple of restatement is still part of his scheme, yet he never degrades it into a mere transcription of notes. But, perhaps, Beethoven's greatest innovation was his extension of the coda. Before his time the coda was little more than a few bars of tonic and dominant to emphasize the key and to avoid the bathos of ending up twice the same way ; Beethoven's codas are long perora^ tions, forming a climax to all that has gone before.

1 Sometimes this is onlv a new version of the first subject.

S. IV. ❓❓❓56

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The last three movements of a sonata are often written in the same form as the first; indeed, the scherzo (or minuet) and trio are always two short movements in this form, alternating with each other. But the slow move- ments and finales are often written in the aria, rondo, or variation forms. The Aria form reproduces the formula A, B, A in its simplest form, consisting of a section in one key, an episode in another, and a restatement of the original section with or without a coda. The Rondo is an extension of the aria. A musical paragraph is re- peated several times, an episode intervening between each repetition. This form remained somewhat bald and obvious until Beethoven took it in hand. He made it approximate to the first-movement form by making the first episode into a regular second subject, the second episode into a development section, and the third episode into a recapitulation of the second subject. The Varia- tion form requires no explanation from the structural point of view.

Beethoven seems to have brought ” sonata form ” to its furthest limits of development; even Brahms’s innovar tions are those of style rather than of structure. The immediate successors of Beethoven gave their attention chiefly to poetic and dramatic expression, and invented new forms to suit their needs, but all these forms, whether exemplified by Schumann’s Kinderscenen or Wag- ner’s prelude to Tristan xind Isolde, will be found to be ultimately built on the same ground-work as Beethoven’s sonatas or Barbara Allen. (e. v. w.)

Formosa. ❓❓❓This island, called Taiwan by the Ja^ panese, into whose possession it came after their war with China in 1895, is 225 miles long by from 60 to 80 miles broad, has a coast-line measuring 731 miles, an area of 13,429 miles ❓❓❓ being thus nearly the same size as Kiushiu, the most southern of the four chief islands forming the Japanese empire proper ❓❓❓ and a population of 2,729,503, and extends from 20❓❓56′ N. lat. to 25❓❓15’, and from 120❓❓E. long, to 122❓❓.

Along the western coast is a low alluvial plain, not exceeding 20 miles in width at its widest part; on the east coast thefe is a rich plain called Gilan, and there are also some fertile valleys in the neighbourhood of Kwarenko and Pinan, but the rest of the island is mountainous and covered with virgin forest.

Mountains. ❓❓❓ Since Formosa has been added, Fuji-yama ceases to be Japan's highest mountain, and sinks to the place of third on the list. Mount Morrison (14,270 feet) ❓❓❓ which the Japanese have re-named Niitake-yama (New High Mountain) ❓❓❓ stands first, and Mount Sylvia (12,480 feet) ❓❓❓ to which they have given the name of Setzurzan (Snowy Mountain) ❓❓❓ comes second.]\Iount Morrison stands nearly under the Tropic of Cancer. It is not volcanic, but consists of argillaceous schist and quartzite. A recent ascent, made by Dr Honda of the Imperial University of Japan, showed that, up to a height of 6000 feet, the mountain is clothed with primeval forests of palms, banyaus, cork trees, camphor trees, tree ferns, in- terlacing creepers and dense thickets of rattan or stretches- of grass higher than a man's stature. The next interval of 1000 feet has gigantic cryptomerias and chamcecyparis ; then follow pines ; then, at a height of 9500 feet, a broad plateau, and then alternate stretches of grass and forest up to the top, which consists of several small peaks. There is no snow. Mount Morrison, being surrounded by high ranges, is not a conspicuous object. Mount Sylvia lies in 24❓❓30' IST. lat. It has not been ascended by persons competent to give any account of its condition. There are many other mountains of considerable elevation. In the north we have Getsur8bi-san (4101 feet) ; and on either side of Setzu-zan, with which they form a range

running due east and west across the island, are Jusampun- zan (4698 feet) and Hari-zan (7027 feet). Twenty-two miles due south of Hari-zan stands Hakumosha-zan (5282 feet), and just 20 miles due south of Hakumosha-zan begins a chain of three peaks, Suisha-zan (6200 feet), Hoo-zan (4928), and Niitake-yama. These five mountains, Hari-zan, Hakumosha-zan, Suisha-zan, Hoo-zan, and Niitake-yama, stand almost exactly under 121❓❓E. long,, and being in the very centre of the island, may be said to form its backbone. Yet farther south, and still lying in line down the centre of the island, are Sankyakunan- zan (3752 feet),

Shur6gi-zan (5729 feet), Poren-zan (4967 feet), and Kado-zan (9055 feet), and, finally, in the south-east we have Arugan-zan (4985 feet). These, it will be observed, are all Japanese names, and the heights have been determined by Japanese observers. In addition to these remarkable inland mountains, Formosa's eastern shores show magnificent cliff scenery, the bases of the hills on the seaside taking the form of almost perpendicular walls as high as from 1500 to 2500 feet.

Bivers and Lakes. ??? Owing to the precipitous character of tne east coast few rivers of any size find their way to the sea in that direction. The west coast, on the contrary, has many streams, but the only two of any considerable length are the Kotansui, which rises on Shurogi-zan, and has its mouth at Toko after a course of some 60 miles, and the Seira, which rises on Hakumosha-zan, and enters the sea at a point 57 miles farther north after a course of 90 miles. So far as is known, there are no lakes, but a great part of the interior of the island remains still unexplored.

Climate. ??? The climate is damp, hot, and malarious. In the north, the driest and best months are Octobers- November, and December; in the south, December, January, February, and March. The sea immediately south of Formosa is the cradle of innumerable typhoons, but the high mountains of the island protect it partially against the extreme violence of the wind.

Townf:. ??? The chief town is Taipeh (called by the Japanese Taihoku), which is on the ' Tamsui-yei river, and has a population of about 118,000, including 5850 Japanese. Taipeh may be said to have two ports ; one, Tamsui, at the mouth of the river Tamsui-yei, 10 miles distant on the north-west coast, the other Kelung (called by the Japanese Kiirun), on the north-east shore, with which it is connected by rail, a run of some 18 miles. The foreign settlement at Taipeh lies outside the walls of the city, and is called Twatutia (Taitotei by the Japanese). Kelung is an excellent harbour, and the scenery is very beautiful. Tamsui (called Tansui by the Japanese) is usually termed Hobe by foreigners. It is the site of the first foreign settlement, has a popu- lation of about 7000, but cannot be made a good harbour without considerable expenditure. On the west coast there

is no place of any im^iortance until reach- ing Anping (23 ⬜⬜ N. lat.), a port where a few foreign merchants reside for the sake of the sugar trade. It is an unlovely place, surrounded by mud flats, and a hotbed of malaria. It has a population of 4000 Chinese aud 200 Japanese. At a distance of some '2\ miles inland is the former capital of Formosa, the walled city of Tainan, which has a population of 100.000 Chinese, 2300 Japanese, and a few British merchants and missionaries. Connected with Anping by rail (26 miles) and lying south of it is Takao, a treaty port. It has a population of 6800, and is prettily situated on two sides of a large lagoon. Six miles inland from Takao is a pros-]ierous Chinese town called Fgngshan (Japanese, Hozan). 'J'he anchorages on the east coast are Suo, Kwarenko, and Pinan, which do not call for special notice. Forty-seven

miles east of the extreme south coast there is a little island called Botel-tobago (Japanese, K6to-sho), which rises to a height of 1914 feet, and is inhabited by a tribe whose customs differ essentially from those of the natives on the main island.

Administration. ⬜⬜⬜ The island is treated as an outlying territory ; it has not been brought within the full purview of the Japanese constitution. Its affairs are administered by a governor-general, who is also commander-in-chief of the forces, by a bureau of civil government, and by four pref ectural governors ; its finances are not included in the general budget of the Japanese empire; it is garrisoned by a mixed brigade taken from the home divisions ; its tribunals of justice are organized inde- pendently of the system followed in Japan proper ; and its currency is on a silver basis. One of the first abuses with which the Japanese had to deal was the exces- sive use of opium by the Chinese settlers. To interdict the importation of the drug altogether, as is done in Japan, was the step advocated by Japanese public opinion. But, influenced by medical views and by the almost in- superable difficulty of enforcing any drastic import veto in the face of Formosa's large commuuications by junk with China, the Japanese finally adopted the middle course of licensing the preparation and sale of the drug, and

limiting its use to persons in receipt of medical sanc- tion. Steps have been taken also to convert the manu- facture and export of camphor into an official monopoly, which is now farmed to a British firm, acting in conjunc- tion with Japanese merchants ; and China's example has been followed in the case of salt, transactions connected Avith that necessary being monopolized by the Govern- ment.

Finance. ??? In 1897, two years after Japan took posses- sion, the revenue collected was 6^ million yen, and the expenditure totalled 16|- millions, independently of mili- tary and naval outlays. The deficiency of 10 millions on the side of revenue had to be defrayed by the imperial treasury. In 1900 the revenue collected was 13 million yen, approximately, and the expenditures aggregated 20 millions, but only 2^ millions of the deficit were furnished by the imperial treasury, the remaining 4^ millions being obtained by floating bonds. Over 7 millions of the ex- penditure was on account of public works, so that the floating of a loan was a legitimate operation. Govern- ment industries ??? that is to say, the monopolies of camphor, salt, and opium, and the working of railways ??? constituted one of the chief sources of revenue increase, the gross earnings under these headings being 9\ million yen, and the expenditures, 5^ millions. There were also consider- able increments in the yield of customs duties and inter- nal taxes, though it may be noted that the whole of the direct taxes levied do not aggregate more than 1| million yen. Up to the close of 1900, the island had cost Japan 100 millions of yen. The Japanese do not show much inclination to emigrate to Formosa. The number of Jap- anese residing there is only 9324, and the number that emigrated thither in 1899 was 3850.

Hallways. ??? An extensive scheme of railway construc- tion has been planned, the four main lines projected being (1) from Takow to Tainan ; (2) from Tainan to Kagi ; (3) from Kagi to Chianghoa; and (4) from Chianghoa to Kelung ; these four forming, in effect, a main trunk road running from the south-west to the north-east, its course being along the foot of the mountains that border the western coast-plains. The Takow-Tainan section (26 miles) was opened to traffic on 3rd November 1900, and work on the other sections is progressing. Harbour im- provements

also are projected, but in Formosa, as in Japan proper, paucity of capital constitutes a fatal obstacle to rapid development.

Foreign Traffic. ??? The following figures show the state of foreign trade during the three years ended 1899 : ???

Exports.

Imports.

Total.

1897 1898 1899

??1,275,929

1,282,718 1,111,492

??1,265,929

1,687,919 1,427,309

??2,541,868

2,970,637 2,538,801

There are thirteen ports of export and import, but 75 per cent, of the total business is done at Tamsui. Tea and camphor are the staple exports. The greater part of the former goes to Amoy for re-shipment to the West, but it is believed that if harbour improvements were effected at Tamsui so as to render it accessible for ocean-going steamers, shipments would be made thence direct to New York. The camphor trade being now a Govern- ment monopoly, the quantity exported is under strict control.

History. ??? The original inhabitants appear to have come from Malay, and to have settled along the western coast. Towards the close of the 17th century a stream of Chinese immigration set in ??? Hakkas from Canton and Hoklas from Fohkien ??? who dispossessing their

semi-savage predecessors, drove them to the thickly wooded hills at the base of the high mountains, or into the still less accessible regions beyond. A more debased population than the peoples thus struggling for supremacy could scarcely be conceived. The aborigines, to whom the Chinese gave the name Sheng-fan, or " wild savages," deserved the appellation in some respects, for they lived by the chase and had little knowledge even of husbandry ; while the Chinese themselves, uneducated labourers, acknowledged no right except that of might. A long era of conflict ensued between the Chinese and the aborigines. The latter were not implacably cruel or vindictive. They merely clung to their homesteads, and harboured a natural resentment against the raiders who had dispossessed them. Their disposition was to leave the Chinese in unmolested possession of the plain. But some of the most valuable products of the island, as camphor and rattan, are to be found in the upland forests, and the Chinese, whenever they ven- tured too far in search of these products, fell into ambushes of hill-men who neither gave nor sought quarter, and who regarded a Chinese skull as a specially attractive article of household furniture. Reconciliation never took place on any large scale, though it is true that, in the course of time, some fitful displays of administrative ability on the part of the Chinese, and the opening of partial means of communication, led to the pacification of a sec- tion of the Sheng-fan, who thenceforth became known as Pepohoan, or " civilized aborigines." In 1874 the island was invaded by the Japanese for the purpose of obtaining satisfaction for the murder of a shipwrecked crew who had been put to death by one of the semi-savage tribes on the southern coast, the Chinese Government being either unable or unwilling to punish the culprits. A war was averted through the good offices of the British minister, and the Japanese retired on payment of an indemnity. In 1884, in the course of belligerent proceedings arising out of the Tongking dispute, the forts at Keelung on the north were bombarded by the French fleet, and the place was captured and held for some months by French troops. An attack on the neighbouring town of Tamsui failed, but a semi-blockade of the island was maintained by the French fleet during the winter and spring of 1884-85. The troops were withdrawn on the conclusion of peace in June 1886. In 1895 the island was ceded to Japan by the treaty of Shimonoseki at the close of the Japanese war. The

resident Chinese officials, however, refused to recog- nize the cession, declared a republic, and prepared to offer

resistance. It is even said they offered to transfer the sovereignty to Great Britain if that Power would accept it. A formal transfer to Japan was made in June of the same year in pursuance of the treaty, the ceremony taking place on board ship outside Keelung, as the Chinese commissioners did not venture to land. The Japanese were thus left to take possession as best they could, and some four months elapsed before they effected a landing on the south of the island. Takow was bombarded and captured on the 15th October, and the resistance collapsed. Liu Yung-fu, the notorious Black Mag general, and the backbone of the resistance, sought refuge in flight. The general state of the island when the Japanese assumed possession was that the plain of G-ilan on the eastern coast and the hill-districts were inhabited by semi-barbarous folk, the western plains by Chinese of a degraded type, and that between the two there existed a traditional and continuous feud, leading to mutual displays of merciless and murderous violence. By many of these Chinese settlers the Japanese conquerors, when they came to occupy the island, were regarded in precisely the same light as the Chinese themselves had been regarded from time im- memorial by the aborigines. Insurrections occurred frequently, the insurgents receiving secret aid from sym- pathizers in China, and the difficulties of the Japanese being increased not only by their ignorance of the country, which abounds in fastnesses where bandits can find almost inaccessible refuge, but also by the unwillingness of ex- perienced officials to abandon their home posts for the purpose of taking service in the new territory. Gradually, however, the various obstacles are being overcome, and though some years must still elapse before the reign of peace and good order is thoroughly established, all the evidences point to ultimate success. v (f. by.)

Formosa, a territory of the Argentine Eepublic bordering Bolivia and Paraguay. The official area at the census of 1895 was 41,402 square miles, and the population in 1895, 4829. The capital, Formosa, founded

in 1879 on the Rio Paraguay, has a population of about 1000. The province is divided into five ad- ministrative divisions. In 1895 only 778 acres of land were planted in cereals, but the territory had 41,424 head of cattle.

Forres, a parliamentary burgh (Inverness group), with the privileges of a royal burgh, near the river Find- horn, in the county of Elgin, Scotland, 12 miles west by south of Elgin by rail. It is one of the healthiest spots in Scotland, and has the lowest rainfall in the country. The chief trade is in cattle. Industries are varied, but xiuimportant. There is a public hall, a museum contain- ing a collection of the Old Red Sandstone fossils of the district, a mechanics' institute, an agricultural hall, market buildings and auction mart, a cottage hospital, and a Nelson Monument (1806). There is a well-endowed secondary school. Population (1881), 4030; (1901), 4313.

Forrest, Sir John (1847), West Australian

statesman and explorer, son of William Forrest, of Bun- bury, West Australia, was born at Bunbury, 22nd August 1847, and educated at]? erth, W.A. In 1865 he became con- nected with the Government Survey Department at Perth, and in 1869 led an exploring expedition into the interior in search of D. Leichardt, penetrating through bush and salt-marshes as far inland as 123 E. long. In 1870 he again made an expedition from Perth to Adelaide, along the southern shores. In 1874, with his brother Alex- ander Forrest (born 1849), he explored eastwards from Champion Bay, following as far as possible the 26th parallel, and striking the telegraph line between Adelaide and Port Darwin; a distance of about 2000 miles

was covered in about five months vdth horses and without carriers, a particularly fine achievement (see Australia, Exploration). John Forrest also surveyed in 1878 the north-western district between the rivers Ashburton and Lady Grey, and in 1882 the Fitzroy district. In 1876 he was made deputy surveyor- general, receiving the thanks of the colony for his services and a grant of 5000 acres of land; for a few months at the end of 1878 he acted as commissioner of Crown lands and surveyor-general, being given the full appointment in 1883, and retaining it till 1890. When

the colony obtained in 1890 its constitution of self- government, Mr Forrest (who was knighted in 1891) became its first premier, and for ten years held that position, his influence in West Australia being one of an almost autocratic character, owing to the robust vigour of his personality and his success in enforcing his views (see West Australia, History). In 1877 he was made a member of the Privy Council. Sir John Forrest married in 1876 Margaret Hamersley. He has published Explora- tions in Australia (1876) and Notes on Western Australia

(1884-87).

Forssell, Hans Ludvig (1843-1901), Swedish historian and political writer, the son of Adolph Forssell, a distinguished mathematician, was born at Gefle, where his father was professor, on 14th January 1843. A.t the age of sixteen he became a student in Upsala Uni- versity, where he distinguished himself, and where, in 1866, having taken the degree of doctor, he was ap- pointed reader in history. At the age of thirty, how- ever, Forssell, who had already shown remarkable busiuess capacity, was called to Stockholm, where he filled one important post after another in the Swedish civil service. In 1875 he was appointed head of the Treasury, and in 1880 was transferred to the department of Inland Revenue, of which he continued to be president until the time of his death. In addition to the responsibilities which these offices devolved upon him, Forssell was con- stantly called to serve on royal commissions, and his political influence was immense. In spite of all these public duties, which he carried through with the utmost diligence, Forssell also found leisure for an abundant literary activity. Of his historical writiugs the most im- portant were Tlie Administrative and Economical History of Sweden after Gfustavus I. (1869-76) and Sioeden in 1571 (1872). He was also for several years, in company with the poet Wirsen, editor of the Swedish Literary Review. He published two volumes of Studies and Criticisms (1875, 1888). In the year 1881, at the death of the historian Anders Fryxell, Forssell was elected to the vacant seat on the Swedish Academy. The energy of Forssell was so great, and he understood so little the economy of strength, that he unquestionably overtaxed his vital force. His death however, which occurred with great suddenness on the 2nd of August 1901, while he was staying at San Bernardino in Switzerland, was

wholly unexpected. There was little of the typical Swedish urbanity in Forssell's exterior manner, which was somewhat dry and abrupt. Like many able men who have from early life administered responsible public posts, there appeared a certain want of sympathy in his demands upon others. His views were distinct, and held with great firmness ; for example, he was a free-trader, and his consistent opposi- tion to what he called " the new system " had a consider- able effect on Swedish policy. He was not exactly an attractive man, but he was a capable, upright, and efficient public servant. In 1867 he married Miss Zalamith Emeroth, a daughter of the well-known pomologist of Upsala; she survived him, with two sons and two daughters. (e. g.)

Forst, a town of Prussia, on the Gorlitzer Neisse, 13 miles east by south of Cottbus by rail, in the circle of Sorau, Government district of Frankfurt. It has 2 Evangelical, an Old-Lutheran, a Catholic, and an Apos- tolic churches, a progymnasium with real progymnasium, a higher-grade girls' and a burgher school, and over 100 woollen cloth and buckskin factories. Population (1890),

23,539; (1900), 32,075.

Forster, John Cooper (1823-1886), British sur- geon, was born in 1823 in Lambeth, London, where his father and grandfather before him had been local medi- cal practitioners. He entered Guy's hospital in 1841 (M.R.C.S., 1844; F.E.C.S., 1849) was appointed de- monstrator of anatomy in 1860, assistant-surgeon 1855, and surgeon 1870. In 1884 he became president of the College of Surgeons. He was a prompt and sometimes bold operator. In 1868 he performed practically the first gastrostomy in England for a case of cancer of the oesophagus. Among his best-known papers were dis- cussions of acupressure, syphilis, hydrophobia, intestinal obstruction, modified obdurate hernia, torsion, and colloid curve of the large intestine ; and he published a book on Surgical Diseases of Gliildren in 1860, founded on his experience as

surgeon to the Hospital for Children and Women in Waterloo Eoad. He died suddenly in the south of France in March 1886.

Forster, William Edward (1818-1886), Brit- ish statesman, was born of Quaker parents at Bradpole in Dorsetshire, 11th July, 1818. He was educated at the Friends' school at Tottenham, where his father's family had long been settled, and on leaving school he was put into business. He declined, however, on prin- ciple to enter a brewery. Becoming in due time a wool- len manufacturer in a large way at Bradford, Yorkshire (from which after his marriage he moved to Burley-in- Wharfedale), he soon made himself known as a practical philanthropist. In 1846^7 he accompanied his father to Ireland, as distributor of the Friends' relief fund for the famine in Connemara, and the state of the country made a deep impression on him. In 1849 he wrote a preface to a new edition of Clarkson's Life of William Penn, defending the Quaker statesman against Macaulay's criticisms. In 1860 he married Jane Martha, eldest daughter of the famous Dr Arnold of Rugby. She was not a Quaker, and her husband was formally excommu- nicated for marrying her, but the Friends who were com- missioned to announce the sentence " shook hands and stayed to luncheon." Forster thereafter ranked himself as a member of the Church of England, for which, in- deed, he was in later life charged with having too great a partiality. There were no children of the mar- riage, but when Mrs Forster's brother, William Arnold, died in 1869, leaving four orphans, the Forsters adopted them as their own. One of these children was Mr H. 0. Arnold-Forster, afterWards M.P. and secretary to the Admiralty.

Mr Forster gradually began to take an active part in public affairs by speaking and lecturing. In 1858 he gave a lecture before the Leeds Philosophical Institution on " How we Tax India." In 1859 he stood as Liberal candidate for Leeds, but was beaten. But he was highly esteemed in the West Riding, and in 1861 he was re- turned unopposed for Bradford. In 1866 (unopposed) and 1868 (at the head of the poll) he was again returned. He took a prominent part in Parliament in the debates on the American Civil War, and in 1868 was made under- secretary for the Colonies in Earl Russell's ministry. It was then that he first became a

prominent advocate of Imperial federation. In 1866 his attitude on par- liamentary reform attracted a good deal of attention.

His speeches were full of knowledge of the real condi- tion of the people, and contained something like an original programme of Radical legislation. “We have other things to do,” he said, “besides extending the franchise. We want to make Ireland loyal and con- tented ; we want to get rid of pauperism in this coun- try ; we want to fight against a class which is more to be dreaded than the holders of a ⍰⍰7 franchise ⍰⍰⍰ I mean the dangerous class in our large towns. We want to see whether we cannot make for the agricultural labourer some better hope than the workhouse in his old age. We want to have Old England as well taught as New England.” In these words he heralded the Education campaign which occupied the country for so many years afterwards. Directly the Reform Bill had passed, the necessity of ” inducing ‘ our masters to learn their let- ters ” (in Robert Lowe’s phrase) became pressing. Mr Forster and Mr Cardwell, as private members in oppo- sition, brought in Education Bills in 1867 and 1868 ; and in 1868, when the Liberal party returned to office, Mr Forster was appointed vice-president of the Council, with the duty of preparing a Government measure for national education. The Elementary Education Bill (see Education) was introduced on 17th February 1870. The religious difficulty at once came to the front. The Manchester Education Union and the Birmingham Edu- cation League had already formulated in the provinces the two opposing theories, the former standing for the preservation of denominational interests, the latter ad- vocating secular rate-aided education as the only means of protecting Nonconformity against the Church. The Dissenters were by no means satisfied with Forster’s ” conscience clause ” as contained in the Bill, and they regarded him, the ex-Quaker, as a deserter from their own side ; while they resented the ” 26th clause,” per- mitting school boards to pay the fees of needy children at denominational schools out of the rates, as an insidi- ous attack upon themselves. By the 14th of March, when the second reading came on, the controversy had assumed threatening proportions ; and Mr Dixon, the Liberal member for Birmingham and chairman of the Education League, moved an amendment, the effect of which was to prohibit all religious education in board schools. The Government made its rejection a ques- tion of

confidence, and the amendment was withdrawn ; but the result was the insertion of the Cowper-Temple clause as a compromise before the Bill passed. Extrem- ists on both sides abused Forster, but the Government had a difficult set of circumstances to deal with, and he acted like a prudent statesman in contenting himself with what he could get. An ideal Bill was impracti- cable ; it is to Forster's enduring credit that the Bill of 1870, imperfect as it was, etablished at last some ap- proach to a system of national education in England without running absolutely counter to the most cherished English ideas and without ignoring the principal agen- cies already in existence.

Forster's next important work was in passing the Ballot Act of 1872, but for several years afterwards his life was uneventful. In 1874 he was again returned for Bradford, in spite of Dissenting attacks, and he took his full share of the work of the Opposition Front Bench. In 1875, when Mr Gladstone " retired," he was strongly supported for the leadership of the Liberal party, but declined to be nominated against Lord Hartington. In the same year he was elected F.R.S., and made Lord Rector of Aberdeen University. In 1876, when the Eastern question was looming large, he visited Servia and Turkey, and his subsequent speeches onthe subject were marked bystudious moderation, distasteful to extremists on both sides. On Mr Gladstone's return to office in 1880 he was made

Chief Secretary for Ireland, ◆◆◆with. Lord Cowper as Lord-Lieutenant. He carried the Compensation for Disturb- ance Bill through the Commons, only to see it thrown out in the Lords, and his task was made more difficult by the agitation which arose in consequence. During the gloomy autumn and winter of 1880-81, Porster's energy and devotion in grappling with the situation in Ireland (see Ieeland) were indefatigable, his labour was enormous, and the personal risks he ran were many; but he enjoyed the Irish character in spite of all obstacles, and inspired genuine admiration in all his coadjutors. On 24th January 1881 he introduced a new Coercion Bill in the House of Commons, to deal with the growth of the Land League, and in the course of his speech declared it

to be "the most painful duty" he had ever had to perform, and one which would have prevented his accept- ing his office if he had known that it would fall upon him. The Bill passed, among its provisions being one enabling the Irish Government to arrest without trial persons "reasonably suspected" of crime and conspiracy. The Irish party used every opportunity in and out of Parliament for resenting this Act, and Porster was kept constantly on the move between Dublin and London, conducting his campaign against crime and anarchy and defending it in the House of Commons. His scrupulous conscientiousness and anxiety to meet every reasonable claim availed him nothing with such antag- onists, and the strain was intense and continuous. He was nicknamed " Buckshot " by the Nationalist press, on the supposition that he had ordered its use by the police when firing on a crowd. On 13th October Mr Parnell was arrested, and on the 20th the Land League was proclaimed. Prom that time Porster's life was in constant danger, and he had to be escorted by mounted police when he drove in Dublin. Early in March 1882 he visited some of the worst districts in Ireland, and addressed the crowd at Tullamore on the subject of outrages, denouncing the people for their want of courage in not assisting the Government, but adding, "whether you do or not, it is the duty of the Government to stop the outrages, and stop them we will." Porster's pluck in speaking out like this was fully appreciated in England, but it was not till after the revelations connected with the Phoenix Park murders that the dangers he had confronted were properly realized and it became known that several plans to murder him had only been frustrated by the merest accidents. On 2nd May, Mr Gladstone announced that the Government intended to release Mr Parnell and his fellow-prisoners in Kilmain- ham, and that both Lord Cowper and Mr Porster had in consequence resigned; and the following Saturday Porster's successor. Lord Prederick Cavendish, was, with Mr Burke, murdered in Phoenix Park. It was charac- teristic of the man that Porster at once offered to go back to Dublin temporarily as Chief Secretary, but the offer was declined. His position naturally attracted universal attention towards him, particularly during the debates which ensued in Parliament on the " Kilmain- ham Treaty." But Mr Gladstone's iniluence with the Liberal party was paramount, in spite of the damaging appearance of the compact made with Parnell, and Porster's pointed criticisms only caused thoroughgoing partisans to accuse him of a desire

to avenge himself. It was not till the next session that he delivered his fiercest attack on Parnell in the debate on the Address, denouncing him for his connexion with the Land League, and quoting against him the violent speeches of his sup- porters and the articles of his newspaper organs. It was on this occasion that Parnell, on Porster's charging him, not with directly planning or perpetrating outrages or murder, but with conniving at them, ejaculated " It's a

lie " ; and, replying on the next day, the Irish leader, instead of disproving Porster's charges, bitterly denounced his methods of administration. Though, during the few remaining years of his life, Porster's political record covered various interesting subjects, his connexion with these stormy times in Ireland throws them all into shadow. He died on 6th April 1886, on the eve of the introduction of the Home Eule Bill, to which he was stoutly opposed. In the interval there had been other questions on which he found himself at variance with Gladstonian Liberalism, for instance, as regards the Sudan and the Transvaal, nor was he inclined to stomach the claims of the Caucus or the Birmingham programme. When the Redistri- bution Act divided Bradford into three constituencies, Porster was returned for the Central division, but he never took his seat in the new Parliament.

Porster, like John Bright, was an excellent representa- tive of the English middle-class in public life. Patriotic, energetic, independent, incorruptible, shrewd, fair-minded, he was endowed not only with great sympathy with pro- gress, but also with a full faculty for resistance to mere democraticism. He was tall (the Ym-kshiremen called him "Long Porster") and strongly though stiffly built, and, with his simple tastes and straightforward manners and methods, was a typical E'orth-country figure. His oratory was rough and unpolished, but full of freshness and force and genuine feeling. It was Porster who, when appealing to the {government at the time of Gordon's danger at Khartum, spoke of Mr Gladstone as able " to persuade most people of most things, and himself of almost anything," and though the phrase was much resented by Mr Gladstone's entourage, the truth that underlay it may be taken as representing the very con- verse of his own character. His personal difficulties with some of his colleagues, both in regard to the Education

Act of 1870 and his Irish administration, must be properly understood if a complete comprehension of his political career is to be obtained. Por an account of them we need only refer to the Life of the Right Hon. W. E. Forster, by Sir T. Wemyss Eeid (Chapman & Hall), an amirable and sympathetic biography. (h. ch.)

Fort Dodge, capital of Webster county, Iowa, U.S.A., on Des Moines river, at an altitude of 1015 feet. It is at the intersection of four railways, the Chicago, Eock Island, and Pacific, the Illinois Central, the Minneapolis and St Louis, and the Mason City and Port Dodge. It is the centre of a rich farming country, and enjoys a large trade as a supply and distributing point. Population (1880), 3586 ; (1890), 4871 ; (1900), 12,162, of whom 1832 were foreign -born, and 112 negroes.'

Fort Donelson, Tennessee, U.S.A., a post erected by the Confederates during the Civil War, on the left bank of Cumberland river, 40 miles above its mouth, for the control of its navigation. It was taken by the Union forces under General Grant, on 16th Pebruary 1862, after a severe battle, in which each side lost about 2000 men. Some 14,000 Confederate troops were surrend- ered, besides large stores and munitions of war.

Fort Fisher, an earthwork constructed during the Civil War by the Confederates to defend the entrance to Cape Pear river below AVilmington, North Carolina, U.S.A. Being the chief defence of the city of Wilming- ton, which was then the principal port of blockade-runners, it was necessary to reduce it. This was finally accom- plished by a combined land and naval attack on 15th January 1865, but at a loss to the Union forces of about 1000 men in killed, wounded, and missing. The Confederates lost about 2500 men, of whom 500 were killed or wounded.

Fort Madison, capital of Lee county,, Iowa, U.S.A., on the western bank of the Mississippi river, at an alti- tude of 622 feet. It has three railways ◆◆◆ the Atchison, Topeka, and Santa ◆◆6 ; the Chicago, Burlington, and Quincy ; and the Chicago, Fort Madison, and Des

Moines. It contains the works of the first named of these lines, besides meat-packing houses and manufactories of agri- cultural implements. The city is on the site of a fort built in the early part of the century. Population (1880), 4679 ; (1890), 7901 ; (1900), 9278, of whom 1025 were foreign-born, and 230 negroes. '

Fort Scott, capital of Bourbon county, Kansas, U.S.A., in 37 50′ N. and 94 42′ W., on the Marmaton river, which here is not navigable, at an altitude of 800 feet. Its site is a level plain, and the plan is regular. It is the point of intersection of the Kansas City, Port Scott, and Memphis, the Missouri, Kansas, and Texas, and the Missouri Pacific railways, and has in consequence great traffic. Population (1880), 5372 ; (1890), 11,946 ; (1900), 10,822, of whom 474 were foreign-born, and 1205 negroes.

Fort Smith, capital of Sebastian county, Arkansas, U.S.A., in 35 23′ N. and 94 26′ W., on the south bank of the Arkansas river, at an altitude of 421 feet. It has a level site on the river bank, but the street plan is irregular. It is divided into five wards, and is on four railways, the St Louis, Iron Mountain, and Southern, the St Louis and San Francisco, the Port Arthur, and the Arkansas Central. It occupies a commanding position for trade, and for a time had a rapid growth. Population (1880), 3099 ; (1890), 11,311 ; (1900), 11,587, of whom 684 were foreign-born, and 2407 negroes.

Fort Sumter, an old military post in the harbour of Charleston, South Carolina, U.S.A. It is on a shoal at the' entrance to the inner harbour, and is famous principally because of the Confederate attack on it, 12th April 1861, which opened the Civil War. It was surrendered to the Confederates on 14th April, the garrison, under the com- mand of Major Eobert Anderson, marching out with the honours of war. It was bombarded and assaulted by the Northern troops later, but was not captured until the fall of Charleston in February 1865.

Fort Wayne, capital of Allen county, Indiana, U.S.A., in 41 05′ N. lat. and 85 04′ W. long., where the junction of the St Mary and the St Joseph form the Maumee, at an altitude of 778 feet. The city is divided into ten wards. Its site is level, the street plan regular, and the streets are

well paved, largely with brick and asphaltum, and there is a good water supply. It is a railway centre of importance, no fewer than seven railways passing through it or terminating here, and giving the city a trade in all directions. Its manufac- tures are in great portion connected with railway transportation, since several of its railways maintain car shops here. The capital invested in manufactures in 1890 was $7,000,000, employing 6000 hands, and with a product valued at $9,300,000. Of this, $1,726,117 consisted of car construction and repair. The value of' foundry and machine shop products was $1,866,467. The assessed valuation of real and personal property, on a basis of about 70 per cent, of the full value, was, in 1900, $23,984,540, the net debt of the city was but $658,165, and the rate of taxation $21.20 per $1000. Population (1880), 26,880 ; (1890), 35,393 ; (1900), 45,115, of whom 6791 were foreign-born, and 276 negroes.

Fort William, the principal town of Thunder Bay district, Ontario, Canada, 426 miles (by rail) E.S.E. of Winnipeg, on the Kaministiquia river, about a mile from

its debouchement into Lake Superior. It will be the eastern terminus of the Canadian Northern transcontinental railway, and is the western terminus of two steamship lines. It contains large grain elevators with a capacity of 5,250,000 bushels, railway repair shops, and docks, and has a large export trade in grain and other farm produce. The total shipping for the year 1899-1900 was 605 vessels, with a tonnage of 757,204 tons ; ex- ports, $3,671,154 ; imports, $1,164,482. Population

(1901), 4800.

Fort Worth, capital of Tarrant county, Texas, U.S.A., in 32 ́́ 45′ N. and 97 ́́ 20′ W., on the south bank of the> West Fork of Trinity river, at an altitude of 600 feet. The site of the city is level, the street plan is regular, and the streets are macadamized. The city is divided into six wards, and has a water supply owned and operated by it. Eight railways enter it from all sides, giving it great commercial importance far be- yond its importance as a manufacturing city. In 1890 there was invested in manufactures a capital of $3,194,032, employing 2743 hands, with products valued at $6,826,083. These are of varied character, the princi-

pal being flour. Fort Worth is the seat of Fort Worth University and of the Polytechnic College, both Methodist- Episcopal institutions. The former, founded in 1881, had, in 1899, 31 instructors and 393 students, the majority of whom were in the pi'eparatory department. The latter, founded in 1891, had, in 1899, 14 instructors and 308 students, also mainly in the preparatory department. The assessed valuation of property, real and personal, was, in 1898, $15,099,720 ; the net debt of the city was $1,969,512; and the rate of taxation was $25.50 per $1000. Population (1880), 6663 ; (1890), 23,076 ; (1900), 26,688, of whom 1793 were JEoreign-born, and 4249 negroes.

Fortaleza, a town of Brazil, known to foreigners as Ceara, and capital of the State of Ceara. Population, 48,000. It is a well laid out and well built city. It is the principal port of export of the products of the State, these consisting principally of rubber, vegetable-wax (camauba), coffee, sugar, cotton, rum, rice, beans, fruits, hides, &c. It has a railway running to Quixeramobim-Quizada, 177 miles.

Forth, The, a river and firth of Scotland, measuring from the confluence of its two sources above Aberfoyle to the German Ocean 103| miles. The steam ferries have been largely superseded by the opening of the Forth Bridge. The fall of the Tay Bridge in 1879 caused the suspension bridge commenced at Queensf erry in 1878 to be abandoned ; but in 1882 the work of spanning the river was again authorized by Parliament, and was undertaken at the same spot by the Forth Bridge Railway Company, formed by the Great Northern, North-Eastern, Midland, and North British companies. The bridge, which is con- structed of Siemens-Martin steel, was built on the canti- lever system. There are three main piers, each having a height of about 360 feet above high water, the small island of Inchgarvie forming the foundation for the central one. The clear distance between the piers is 1710 feet, and a headway at high water of 150 feet for a distance of 600 feet is given at the central portion of each span. The short arms of the cantilevers on the northern and southern shores are 680 feet long, and beyond this the bridge is continued on each side of the river by means of a viaduct. The engineers in chief were Sir John Fowler and Sir Benjamin Baker, and the principal contractor was Sir William Arrol. The work, including the approach rail- ways, cost

approximately ??3,000,000, and the bridge was opened in March 1890. The river is also spanned by a railway bridge at Alloa.

FORTIFICATION

1. Field.

MODERN military history shows clearly the constant increase in the value of extemporized field defences; yet in spite of this, little real interest has been taken in the subject. The lesson of the American Civil War, that a line of trenches defended by two ranks of men with rifles could not be carried by direct attack, seemed to come as a fresh surprise with each succeeding war, until it was finally taught at Plevna. Even after this, although the European nations began to provide their troops with portable entrenching tools, little attempt was made to turn them to practical use. Such attempts would probably have shown that in the endeavour to avoid encumbering armies with transport for entrenching tools, an unsatisfac- tory compromise had been arrived at, since no portable tool, small enough to be constantly carried by the soldier, is of any practical use for entrenching, except in the very lightest soil. In the quiet years which followed 1877, and amid the babel of speculation as to the effect of the constant improvements in firearms, the old lesson began to be forgotten. Many voices were raised against the use of field defences, on the grounds that, as at Plevna, they led to strategical mistakes; that the use of stationary defences could not be reconciled with the rapidity of manoeuvre which had now become the sole essential ; and that troops could not remain in shelter trenches under the fire of modern artillery. Meanwhile, by constant improve- ments, the effectiveness of guns and rifles against troops in the open was steadily being increased. At the same time, on account of flatter trajectories, the increased ten- dency to ricochet, and in the British service the abandon- ment of common shell for field guns, their power against earthworks was if anything diminishing, aud the introduc- tion of smokeless powder gave the advantage of conceal- ment to troops and guns behind cover, as against those advancing across the open. These considerations, added to previous experience, might have made it clear that in future wars field defences

properly conceived and skilfully planned would be more effective than ever.

The South African War should set these questions at rest, and when its lessons have been fully learnt there can be.no doubt that the use of entrenchments will rank as one of the first necessities of warfare. This use will be extended to the attack. The direct attack will seldom be attempted, and the endeavour of the assailant will be to outflank the defender. Since it is clear that a small force entrenched can resist the attack of a stronger one, it is open to the attack to leave a weak force entrenched in front of the enemy's main position, while endeavouring to get round his flank. The defence may reply in the same way, and the question will be which side shall be quickest in extending and pushing forward its flank works. In such a contest, mobility will be of the greatest importance. Such is the disparity of strength between the attack and the entrenched defence, that under certain conditions of ground it is even conceivable that the weaker force might sur- round and imprison the stronger. If a frontal attack is unavoid- able, the assaulting troops, when checked within a certain distance of the position, should not retire, but hold on to what they have gained, extemporizing such cover as they can ; and at nightfall entrench themselves there. By this means a secure position will be established close up to that of the enemy, and more troops can be collected there. It it is not close enough, a further advance may be made by night, or saps may be pushed forward until the distance will allow of a bayonet msh.

The methods of field fortification which prevailed till some years after the Franco- German War were practically those of the beginning of the 19th century. Since then they have been very much simplified. For instance, "lines of redans" or "lines en cremaillere," and redoubts of intricate design, are no longer contemplated in practice, though still found in many text-books. The refinements of these works belonged to the period of short- range weapons.

In order to understand present ideas, it is necessary first of all to know what are the powers of existing guns and rifles.

Artillery. ??? Field artillery projectiles may be roughly divided into two classes : shrapnel and common shell. The bullets of

“r^*”’/^//mmjni)”’-”’^^^.

*”’”“n^*

Kg. 1.

the former depend for their destructive power on the remaining velocity of the shell at the time when it is burst ; the fragments of the latter are driven by the bursting charge of the shell. It follows that shrapnel bullets always fly forward, forming what is called a “cone of dispersion” about the line of flight of the shell. At a long range, when the shell falls at a steep angle, shrapnel bullets have not enough velocity to be effective. It is usually taken that the steepest slope of effec- tive shrapnel is about one in three (J). Thus a man lying behind a boulder 3 feet high (see Fig. 1) would be prO’

W/‘V

Fig. 2.

tected against a shrapnel bullet ; similarly a man in the trench shown in Fig. 2 would be safe.

Common shell, if burst in the air, retain some forward velocity, but have more lateral spread than shrapnel. If burst on the ground the splinters may fly in any direc- tion. They have more searching power than shrapnel, as will be seen from Fig. 3, but it is more difficult to time them properly.

Howitzers usually fire common shell with per- cussion fuse. The ef- fect of a high ex- plosive bursting charge, as compared with gun- powder, is to give a more powerful shook of discharge, to break the shell into more splinters, and drive them harder. It also gives off poisonous fumes. A shell bursting in the trench, as in Fig. 4, would rake it from end to end ; but it will be

Fig. 3.

‘^^”^^^J^f^”-^‘l”^^/////f7>t>///y/V//’////y^M^^^77i

Fig. 4.

observed that, in order to get its effect, it must fall in the trench.

The penetrative power of shrapnel bullets and of splinters is slight ; from 6 inches to 1 foot of earth will sulfice to keep out either.

field]

FOETIFICATION

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reifies. ??? Small-bore rifles depend for effect on their penetration, their trajectory being so flat that at ordinary ranges they have practically no searching power. A penetration table for the Lee- Enfield rifle is given below. It is much the same as that for other small-bore rifles.

Material.

Earth

Un-

rammed.

Sand.

Brick Work.

Soft Wood (Fii-).

Hard Wood (Oak).

Hardened Steel Plate.

Fine Shingle

in Boxes.

Maximum "j observed 1 penetration j (inches). J

22

18

4i

42

24

4

Fig. 5.

Pig. 6.

It follows from the above, that in order to have protection against artillery fire, men must be close behind the covering para- pet ; and the parapet should not be less than 2 feet thick at the top (if of earth) to keep out rifle bullets. Over- head cover, when pro- vided, against shrap- nel and splinters, should consist of 6 Inches to 1 foot of earth. No extem- porized cover will keep out howitzer shell. If time admits, the trench should be deep and wide enough to admit of free passage, without the defenders being seen from the front.

These considerations, together with the time, labour, and tools available, determine the section of shelter trenches. Fig. 2 shows the latest pat- tern of shelter trench adopted in the British service for execution when time presses. It can be made with the small entrenching tool in about three hours in moderately easy soil. 1'his trench might be subsequently enlarged, as shown in Fig. 5.

Fig. 6 shows how overhead cover might be provided. Such cover requires a large quantity of material, but if it can be made it is very use- ful, both for pro- tection and shelter. Splinter-proof parti- tions, as shown in elevation in Fig. 6, are most useful for localizing the effects of shell explosions.

Fig. 7 is a German type of shelter trench.

Fig. 8 shows a pro- tected look-out.

Kg. 9 is a section used by the Boers. It gives excellent cover from view, be- cause the defenders' heads have an im- mediate background, but would not be suita^ ble to most British sites, for want of command.

All these developments of the simple shelter time, and much labour for the collection of it must be remem-

Fig. 8.

trench require materials ; but

*-!35^^^?*w*

*-^*

bered, that though defences have some- times to be extem- porized in face of the enemy, yet all history shows that occasions have been more frequent when one or two days have been available for preparing a posi- tion on some line of advance to which

the enemy is committed. (For instance, Deligrad, 1876, Shipka, Magersfontein, and Colenso.) Also as the enemy seldom abandons the assault of a position after the first trial, there is usually time for improvement of the works.

Trace or Siting of Trenches. The system on which trenches are laid out is now much simplified by the fact that the decisive effect of the defenders' fire is obtained several hundred yards to the front. Thus, short

faces flanking the front of the trench are not required ; though if a cross fire over the front from neighbouring trenches can be arranged, the resistance will be greatly strength- ened. The siting of the trenches will depend on the ground. The position generally should be on high ground, both for the sake of a clear view of the enemy's advance, and for concealment of the dis- positions of the defence. When the high ground slopes steeply to a level plain, the front trenches may be on the level, and the artillery above them. In this way the trenches may be concealed from the enemy's artillery, and will gain the advantage of a grazing fire over the plain. With this arrangement, and for any position on the forward slope of the hill, the supports (which in any case must be entrenched) must either be very close to the front line, or must

c

Fig. 10.

have access to it by a connecting trench, or at all events a screen. The reserves would probably have to occupy a second line of defensible trenches. On ground which has few marked features, to take the extreme case, a long straight ridge, narrow or flat at the top, the typical dispositions of the firing line may be divided into three classes, viz. (1) A

long straight line of trenches on the forward edge, relying for support on the counter stroke of local reserves ; (2)

O

O

Fig. 11.

* *

Fig. 12.

a line of trenches with redoubts among them, as points d' appui ; (3) groups of trenches, with intervals between them to be de- fended by the

flank trenches of the groups. In this case the nucleus of the group will often be a redoubt.

It is considered by the Germans that the redoubt is a form of work which will not often be used in future. The French (Fig. 10), and Austrians (Fig. 11), on the other hand, prescribe redoubts in connexion with wing trenches.

Such simple positions, however, lending themselves to pure theory, will not often occur ; especially as cases where the lie of the country more or less prescribes one line of advance for the enemy, will generally be found in rough ground. In broken and hilly ground there will be little choice of position for the trenches. HUls with convex slopes are not very suitable for defence, because the field of fire on the slope is al- ways limited, sometimes dangerously so. Concave slopes, on the other hand, are generally accompa- nied by very rough ground, which is most suitable for concealment of trenches and reserve troops. They have the drawback that the top of the slope being very steep, troops in that position must expose themselves a good deal in firing upon the attack in its last stages. In defending such ground, the Boers have used trenches in all three of the positions shown at a, 6, and c in Fig. 1-2.

Eedouhts, if used in connexion with trenches, will generally be of very simple trace adapted to the ground, and their parapets will be of shelter-trench section, so that they may be incon- spicuous. In isolated positions, as when they are meant for posts on lines of communication, the parapets must be high enough to screen the interior from view, and a good obstacle must be pro- vided. Guns should not be placed in redoubts. Epaulments may sometimes be provided for them, but concealment is their best protection.

Accidents of Ground. ??? The right use of these demands both judgment and training. Hedges when high and thick enough for concealment will be of great use, especially in connexion with smokeless powder. Walls, though penetrable by shells, afford concealment, and give protection against musketry. They may therefore be occupied. They can be Jnade very strong by adding a bank of earth in front of them. Houses when in the line of battle are of little use for defence. They will attract

artillery fire and become untenable. The ruins may be defended during the last stage of the attack, but it will not be worth while to prepare the house beforehand. The value of woods to the defence has altered little. They will still give a measure of defence against artillery- fire, and they have the great advantage of concealing the disposi- tions of the defence. Villages are not likely to suffer more than

[land

formerly from artillery. High explosive common fihell has more destructive but less incendiary power than the old powder shell.

Invisibility. ??? This is a point to he studied carefully in the arrangement of defence works. Not merely should trenches and other works be concealed by making them like the surrounding ground, with bushes, sods, &c., but marked accidents of the ground should be avoided, such as the meeting line between plough and pasture land, or the meeting of planes of surface of different inclination, where the lights will fall differently. Hedges may be a useful screen for guns, but the guns should be some distance behind them, so that it may be difficult to judge the range.

Obstacles. ??? Those made by digging should, as a rule, be avoided, on account of the labour involved. Abatis are useful where wood is plentiful, but the obstacle of the future is undoubtedly barbed wire.

Fortification in Savage Warfare. ??? This will as a rule be confined to obstacles and parapets for defence of camps, and forts for posts on lines of communication. In the case of camps the obstacle is the chief thing. The parapets of forts should be high enough to conceal the interior from view. As the defenders will probably be few, the old methods of flanking defence, such as bastions and caponiers, are sometimes employed. The

water supply must be accessible and protected, and all other arrangements made for the comfort of the defenders, who may be shut in perhaps for a week at a time, in a tropical climate. (l. j.)

2. Permanent Land.

Recent years have witnessed extensive changes in the art of permanent fortification owing to the great develop- ment of detached forts and entrenched camps. In the early part of the 19th century, detached forts were used to occupy commanding points which were dangerous to the main fortress, but too far from the enceinte to be in- cluded in it. After the Crimean War Great Britain sur- rounded certain fortresses with a ring of detached forts, placed at a sufficient distance to prevent an enemy from bombarding the main position before he had penetrated the line of forts. The fortresses thus became entrenched camps, and the large area thus enclosed was of great value, in giving space to the garrison to manoeuvre, and in increasing the length of the enemy's blockading line. At the time of the Franco-German War some of the prin- cipal Continental fortresses, such as Paris, Metz, and Antwerp, possessed detached forts. These were for the most part small editions of the fortresses, being open works with a single parapet and bastion or caponier defence for the ditches, of the type shown in Eiicy. Brit., 9th ed., vol. ix. pi. 7. The bombardment of the Paris forts gave evidence of the increasing power of artillery, and the distance of the forts from the enceinte was in- creased. At the same time the attention of engineers was concentrated on improving the cover in the interior of the forts. It was sought to accomplish this by making the forts shallower from front to rear, and by making two parapets, one for infantry and one for artillery. In some cases the guns occupied the upper and in some the lower or front parapet. The result of this was to do away with the large open spaces in the interior of the forts, but not much additional cover against descending shells was gained, as the parapets were still open, that is, the guns fired from behind simple parapets without overhead cover.

In 1886, after the introduction of long shells filled with high explosive, some bombarding experiments carried out in France against the old fort of Malmaison made a great impression throughout the Continent. The

effect of the powerful shells upon the old-fashioned slight escarps and the casemates covered with about three feet of masonry was immense. The general result was the formation of two opposite schools of thought, whose differences have not yet been reconciled. Most of the old school decided in favour of bomb-proof cover for the guns in the forts. A few, chiefly of the younger engineers, proposed to take the guns out of the forts and work them from concealed

positions in the intervals. In any case the majority of the guns would have to be in the intervals for want of space in the forts. So far the bomb-proof school decidedly preponderates on the Continent of Europe, both among theorists and in the designs accepted by Governments.

The advocates of the removal of all the guns maintain that there is no necessary connexion between the artillery and the forts. They argue that the object of the forts is to form a series of secure positions supplying pomis d'appui for the entrenchments of the defence, and that their rdle is to maintain themselves, and defend the intervals by flanking fire. It is not necessarily their duty to take part in the distant artillery combat, thereby attracting to them- selves the enemy's fire. It is also contended that unpro-tected guns in concealed positions are safer than protected guns in exposed positions, as being very difficult to locate, and have an equal effect. Thus it is alleged that the money spent in defensive arrangements, such as cupolas, would be better spent offensively, in guns ; that cupola defence requires a much greater number of experts ; and finally, that arrangements of this kind add greatly to the difficulties of command.

The bomb-proof school, on the other hand, declare that it is essential that there should be some guns in the forts to resist the enemy's guns as soon as they open fire, and before the provisional arrangements of the defence are complete ; that the guns in the intervals" will not be safe unless they are surrounded by defended ditches, which is practically putting them in forts ; that cupolas can now be made perfectly bomb-proof at a moderate cost ; and that arrangements for ammunition supply, &c., can he made simpler and more secure in the forts. The latest designs of the German school and of General Brialmont, which are very similar, consist, in their simplest expression, of triangular forts, with ditches flanked by quick-

firing guns in counterscarp galleries, and an open infantry parapet following approximately the line of the ditch. Within the fort are half-ardozen guns and howitzers of 4^ to 6 inches' calibre in a line of cupolas in front of the gorge. At the angles are one or two more guns, and, dispersed in convenient positions, light quick-firing guns to defend the immediate front, all in cupolas. The cupolas are set in heavy masses of concrete. The magazines are under the guns. The infantry casemates are generally placed under the gorge, in rear, and on the flanks of the main line of guns. Germany, Austria, Italy, Belgium, Denmark, and Rumania are all working more or less on these lines. Russia and Japan so far appear to incline towards the other school : so does Holland, on the score of expense, except for coast forts. The latest French designs are not yet published. The most complete examples of recent, designs are to be found among the smaller States, which only lately began to build detached forts. The entrenched camps at Bucarest, Liege and Namur, and Copenhagen are all worth study as complete and recent types. Fig. 1 shows a typical Belgian fort. Rumania has, on the line of the Sereth, another new type of a different nature. There are three entrenched camps which have no forts, but are defended entirelj- by a large number of small groups of batteries. These batteries consist of short lengths of parapet protected by a broad belt of obstacle. Behind the parapets small quick-firing guns are moved about in travelling cupolas (Fig. 2). This system, which has not been favourably received, is known as tire system of " armoured fronts."

In the strategy of fortification, the latest theoretical development is the idea of "fortified regions." These would consist of a quadrilateral of entrenched camps

coast]

FORTIFICATION

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cupola for two 150 mm. guns ;

„ one 57 ??? gun ;

„ „ 210 „ howitzer;

.. 120 ???

„ „ 210 ??? mortar;

(7, armoured searchlight ; A, shelters; i, dynamos; k, coal store; I, embrasure for 57 mm. gun ; m, magazine ; n, latrines.

occupying important points, some 15 to 20 miles apstrt, with a central fortress. There would be room for a large army to mancBuvre in safety within this region, and as blockade would be impos- sible, the army could not be Shut in, as it might be in an entrenched camp. The advantages of " forti- fied regions" can, how- ever, only be realized by powerful field armies ; and the real question is how far permanent forti- fication can aid such armies, and whether ex- penditure should not be devoted to mobile troops rather than to passive ex- pedients. In details of execution, great attention has been paid to various devices for lessening the effect of shells on bomb- proofs. Masonry construc- tions are chiefly in con- crete. The thickness of casemate arches is from 6 to 10 feet. Revetted escarps are not much used on front faces on account of their liability to be breached. Counter- scarps are lower than formerly, and very mas- sive. There is a tendency to do away with deep ditches and substitute broad belts of wire en- tanglement or thorn plan- tations. Electric search- lights and armoured observing stations are generally provided. The distance of the detached forts from the fortress varies from 8000 to as much as 18,000 yards. The distance between forts is laid down as about 3000 yards, but varies very much, according to the ground. (l. j.)

tion usurped a position in the national defences which it had never filled in the past and could not fill in the future. Naval history, naval conditions, and the rich experience

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Fig. 1. ??? ^Plan and Sections of a Belgian Fort.

3. Coast.

Since about the year 1880 the whole question of coast defence has been the subject of much controversy, out of which certain definite principles are beginning to emerge. The mania for fortification, which gained hold upon Great Britain about

the year 1859, produced ^^ Lrv.l.i>?-<'

most unfortunate results. A Eoyal Commission, ap- pointed to consider and report upon an elaborate series of expensive projects, came to the conclusion that an island state was in some respects more exposed to invasion than one with long land frontiers, and 'that naval defence could not be trusted, because fleets were liable to be decoyed away when needed, and to be dispersed or rendered ineffec- tive by storms. As a natural consequence, coast fortifica-

of war being alike ignored by the school which attained power, works were designed, and completed after long delay, which were totally unsuited to the purposes for which they were intended. The plain lessons of the Crimean War were unheeded, and monumentalism became the ideal of coast defences, although the performance of the

Fig. 2.-

Section of Battery for Movable Cupola.

little Telegraph Battery at Sebastopol, confirming much previous experience, should have amply sufficed to moderate the ambitions of military engineers. A false policy having been inaugurated, and the costly erections which it inspired having been begun, it was long before other views could obtain a hearing. Great Britain was thus saddled with

[coast

a large number of works which were obsolete before they were begun, and which have since been obstacles to effective coast defence. The natural tendency to attempt the rehabilitation of an ill-conceived fort in place of demolishing it hindered, and still continues to hinder, progress. Moreover, for some years the ex- altation of fixed defences led to a most dangerous neglect of the navy, which was at length remedied, however, after great efforts.

There has happily been a widespread reaction against the views adopted by the Koyal Commission of 1860, and a timely return to principles evolved in the days of great wars. Those principles may be briefly summed as fol- lows. An empire, composed of widely scattered members, built up and absolutely dependent upon sea-borne com- merce, must maintain a supreme navy or contemplate disruption and ruin. The conditions which alone could render invasion possible must imply that the means of existence of the home population were cut off. On 'the other hand, a fleet able to give effective protection to the ocean communications of the empire would ipso facto guarantee its members against over-sea invasion. The idea of coast defences as a second line providing a sub- stitute for naval force is, therefore, radically false. As history plainly shows, mobile defence is the only effect- ive protection of a long sea-board. Ports upon which the navy and the commercial marine depend, and which contain resources essential to maritime operations, re- quire, however, means of self-defence against raids by which those resources might be destroyed or gravely injured by one or two cruisers. To inflict considerable damage upon a naval port would justify some risk, and at the outset of war, especially, the movements of the individual vessels of an enemy could not with certainty be controlled. If the geographical conditions of a port are favourable, fixed defences can be employed with advantage for its protection against naval raids. Narrow channels of approach can thus be economically secured ; cramped interior waters can be effectually denied to an enemy ; bombardment, rarely an effective method of attack, can be rendered practically impossible. These are the legitimate objects of coast fortification. As a ship offers an enormous target compared with a gun mounted on shore, and as the latter has the immense advantages of a

fixed platform, comparative invisibility, perfect means of obtaining ranges, and an abundant ammunition supply, the inequality of conditions is evi- dent. The first principle in designing coast defences is to mount guns in such a way as to turn these advantages to the utmost account. This in effect is the modern sci- ence of coast fortification. Conspicuous works of the type largely built after the Crimean War and in defiance of its lessons are, therefore, to be avoided. The object should be to give the guns such dispersion that they can be put out of action only by direct hits, to blend the works in which they are mounted as far as possible with the natural features of the coast line, and to utilize high sites, if such are available, even at some sacrifice of range, in order to increase the accuracy of fire, and at the same time to add to the difficulties of the attack. With care and study of the ground, utilizing vegetation, paint, and even screens, coast defence guns can be in most cases rendered almost indistinguishable by the naked eye at a distance of a mile. At the moment of firing, their positions of course ^become defined ; but the difficulty of locating them suffi- ciently for accurate laying on board ship may neverthe- less be considerable. In selecting sites for shore guns, it is necessary not merely to study the chart, but to take practical navigation into account, and to understand thor- oughly what mancBuvres a ship can accomplish and what she must perforce avoid. In discussions of questions of

coast defence, it is sometimes assumed that attack upon fortified ports is the special and peculiar function of ships of war and the delight of naval commanders. Ships are, however, constructed to fight ships on the sea, and the attack of coast defences is a rdle which they may be called upon to play, but for which they are not well fitted. History shows that great naval commanders invariably eschew such attacks, unless either the defences are hope- lessly incompetent, or all chances of being brought to action by the enemy's fleet may be safely dismissed. Only overpowering naval superiority, such as was asserted by the Allies in the Crimean War, can justify naval attacks on fortified ports. The abortive attempt by the American squadron upon San Juan in 1898 would have had serious results if the Spaniards had possessed a few well-handled modern guns.

The object to be attained by coast defences is thus to impose undue risks upon an enemy's ships seeking to use their guns with a view to injure a dockyard, shipping, or any essential national resources. The shore guns must, therefore, be so disposed as to bring their fire upon waters in which an enemy's vessels can take up positions enabling them to inflict really serious damage. Unaimed fire, directed over high intervening ground upon a dock- yard or an anchorage, cannot be effective, and fire deliv- ered from ships in moderately rapid motion is necessarily inaccurate, as was shown at Alexandria in 1882. The disposition of shore guns is thus noted by natural features of ground and their relation to the chart. The best natural sites do not always conform exactly to the re- quirements, and a compromise must then be adopted. For the defence of channels of approach sites would be chosen from which fire can be brought to bear upon a ship where the difficulties of pilotage are greatest. Where, as at Malta or Esquimalt, an easy channel leads into sheltered inner waters, it is desirable to bring the fire of two or three guns to bear upon the latter. The craze for monster guns has happily passed, and the 9-2-inch gun, with a penetration of about 11-5 inches of Harvey ized armour at 2000 yards, is now generally considered as the largest ordnance required for harbour defence. This gun, as now mounted, wiU have a speed of fire of nearly one round per minute. The exceedingly handy 6-inch Q.F. gun, with a rate of about five rounds per minute, is a valu- able addition, and will in some cases suffice as the staple armament. The 12-pr. Q.F. gun, firing ten rounds a minute, is admirably adapted for dealing with torpedo craft, for clearing the decks and tops, and for searching out the unarmoured portions of any ship. Muzzle-loading guns of old type, specially mounted, have been employed in many cases for high angle fire. The deck attack is naturally attractive, and such guns can be so concealed as to be absolutely secure from all injury. On the other hand, their fire must be directed by position-finders, and is slow and somewhat inaccurate. For convenience of working, it is undesirable to group guns of different types together. Eapid and accurate fire, combined with the highest degree of invisibility attainable, is the best protection of the shore guns. Modern mountings (see Ordxance, Carriages) are designed to give the greatest possible ease and convenience of handling and of am- munition supply. The 9'2-inch gun of 28i tons, and even the older 10-inch gun of 32 tons, can be trained and elevated with ease by one man, and in

all recent mount- ings the laying numlaer can work both gears, large move- ments being performed by alternative under-cover gear. The adoption of auto-sights with telescopes has greatly increased both the accuracy and the speed of coast defence guns. There has been a tendency to over-elaborate the tactical manipulation of coast artillery and to centralize the command of guns. The main requirement is to inflict

the maximum number of hits in the shortest time, and auto-sights, together with smokeless powder, enable the gun to resume its individuality of action subject only to general control. Expert gun-layers and well-drilled detachments are thus of cardinal importance, and as a general rule the less interference they receive from any authority other than the battery commander on the spot the better.

Coast defence works are now simple in design, the objects being to merge them in the natural features of the shore line, to protect the vitals of the gun mountings, and to facilitate the supply of ammunition. Great forts, in which it was sought to combine the functions of the coast battery with those of a fortress, are no longer in favour. The self-defence of the coast battery against a landing party must, therefore, depend mainly upon a mobile in- fantry force, while the battery itself is usually protected by entanglements, sunken unclimbable fences, and machine guns. Mobile infantry garrisons of fortified ports are no new requirement, although this need has frequently been too little regarded. A fort is generally useless outside the rayon of its fire, and it may easily become a trap from which escape can be prevented. Even a small landing party, free to act for a short time, can effect much more destruction than any naval fire.

The only effective form of coast protection in the broad sense is that provided by a mobile navy. Naval raids on important harbours must, however, be guarded against by fixed defences, the scale of which can be extremely moderate, provided that guns and works are good, and that

well-trained men are available. With such harbour defences, bodies of mobile infantry must be associated. Small fixed defences, armed with thoroughly effective guns, well manned and maintained in complete readiness for war, can fulfil all the requirements of the British empire. Large and costly schemes defeat their proposed objects, and being generally in an incomplete state and frequently undermanned, they are fertile sources of weakness. (g. s. c.)

4. United States.

The manner in which the fortifications of the United States are planned and constructed is controlled by Congress, and is subject to change at any time. At present the work is under the direction of the Secretary of War, certain definite duties being assigned to the different bureaux of the War Department. The selection of the sites to be fortified, the preparation of plans, including the determination of the number, calibre, and mounts of the guns, the construction and repair of the permanent parts of the works, the provision of torpedo material, and the planting and operation of the mine-fields, are part of the duties of the Corps of Engineers of the army ; the arma- ment, ammunition, and, in general, the instruments needed for the service of the guns, are procured and distributed by the Ordnance Department of the army ; the barracks, quarters, and other buildings needed for the garrison, are supplied by the Quartermaster's Department of the army. The works when finished are turned over to the artillery arm of the service. The selection of the types of guns and other implements to be adopted by the Government is entrusted to the Board of Ordnance and Eortification, acting under the control and supervision of the Secretary of War, and consisting now of the commanding general of the army, one officer each from the Corps of Engi- neers, the Ordnance Department, and the artillery, and one civilian.

The permanent fortifications of the United States have all been built to protect points on the sea-coast or lake frontier against naval attack. The great development on

the coast-line renders it out of the question to protect every point at which a hostile landing is possible. The principles which have been kept in view in the defence of the coast were enunciated in 1820 by a Board of

Engineers appointed in 1816 to examine the sea-coast, and propose plans for defensive works. The Board held that the means of defence consisted of, 1st, a navy ; 2nd, forti- fications ; 3rd, interior communications by land and water; 4th, a regular army and militia. The duty of the navy was regarded as active and offensive, requir- ing the aid of fortifications to secure its bases on the coast. The interior communications were considered necessary as means of concentration and supply. The army and militia were held to be the vital principles of the system, and the objects of the fortifications were stated as follows : ???

" Fortifications must close all important harbours against an enemy, and secure them to our military and commercial marine ; second, must deprive an enemy of all strong positions where, protected by naval superiority, he might fix permanent quarters in our territory, maintain himself during the war, and keep the whole frontier in perpetual alarm ; third, must cover the great cities from attack ; fourth, must prevent, as far as practicable, the great avenues of interior navigation from being blockaded at their entrances into the ocean ; fifth, must cover the coast-wise and interior navigation by closing the harbours and the several inlets from the sea which intersect the lines of com- munication, and thereby further aid the navy in protecting the navigation of the country ; and, sixth, must protect the great naval establishments."

These principles indicate the policy which has been followed by the United States in organizing its coast defences.

The early fortifications of the United States are usually con- sidered by engineers as divided into three systems : the first embracing those built before and during the time of the French Bevolution of 1789 ; the second, those built at the approach of the war of 1812 ; and the third, those built between 1816 and 1866. Works of the first two systems may be found at nearly all of the harbours which were of importance at the beginning of the 19th century. Castle Williams, Fort Lafayette, and others in New York harbour, are examples. Without costly alteration these works would now be useless for purposes of defence. The third system was inaugurated by the Board of Engineers, the report of which has already been quoted. The works belonging to it were of masonry, with exposed scarps on the sea-

fronts, and con- tained usually two tiers of casemates surmounted by an open barbette battery. As examples may be mentioned Fort Warren at Boston, Fort Adams at Newport, and Forts Wadsworth and Schuyler at New York harbour. None of the works of this system as originally constructed could resist naval ordnance of the present day ; but many have been retained as part of the modern defences, usually after extensive remodelling. When work ceased on third system, about a year before the end of the Civil War, it was already out of date. The use of armour on ships of war was recognized at once in the United States, as well as elsewhere, as compelling some corresponding improvement in coast defences. Masonry could no longer be exposed, even on the sea-fronts, and must either be protected or discarded. After the Civil War the construction of a new system of works began, consisting of open barbette batteries, of strong profile, with earth or sand parapets, and thin breast-high walls. The armament was muzzle-loading, and consisted principally of smooth-bore,cast-iron Rodman guns, of 15, 10, and 8 inches' calibre, of 300-pounder, 200-pounder, and 100- pounder rifled Parrot guns, and of 8-inch converted rifles, made from the 10-inch Rodman gun by reboring and inserting a rifled lining tube ; and of mortars of 13-inch and lower calibre. No attempt was made to plate or otherwise reinforce the existing masonry works with iron, this subject being left unsettled, pend-ing further experiment and investigation in the United States and elsewhere. Between 1866 and 1875 Congress appropriated a total sum of nearly $11,000,000 for the construction of new works, this sum being in addition to the cost of the armament. At the same time, the development of a torpedo system, which was regarded as an indispensable adjunct to the shore batteries, was receiving constant attention. In 1875 the work of constructing new bat- teries was suspended. No further funds for this purpose were appropriated until 1890, although the small sums needed for the preservation and repair of the existing works, and for the experi-ments and work in the development of the torpedo system, were available for all except about two years of this interval. In 1885,

[v. S. A.

after repeated warnings uttered by the military authorities who had the subject in charge, Congress and the people at large awoke to the fact that the power of ships of war had again increased to such an extent as to render the existing defences practically use- less. Congress then directed the formation of a Board, to consist of the Secretary of War, two officers each from the Engineer Corps of the army, the Ordnance Corps of the army, and the line of the navy, and two civilians, to examine and report where fortifications were most needed, and what the character of the defences should be. This Board, known as the Endicott Board, sub-

R d ”^ ”^ report in January 1886. It named twenty- co oar . gg^gjj^ localities, some of which included two or more harbours, which demanded particular attention at the time, and indicated the strength of the high-power armament and the general character of the batteries for each. It proposed the use of armoured turrets, armoured casemates and barbette batteries, aided in some harbours by floating batteries, the last being carefully dis- tinguished from the armoured sea^going ships of the navy. Sub- marine mines were regarded as ” not accessories of the defence, but essential features,” and were recommended for use, together with the necessary flanking batteries and search-lights. Movable torpedoes and torpedo-boats were also included in the plans. The guns proposed were 16, 14, 12, 10, and 8 inches in calibre, supple- mented by 12- and 10-inch mortars and smaller rapid-fire guns. All were to be modern breech-loading rifles. These recommenda^ tions have been followed in a general way in the construction of coast defences since the report ; but the details of the work done differ in many respects from those suggested by the board.*

Four years after the report of the Endicott Board had been rendered, Congress began again to appropriate sums for the con- struction of new fortifications. Between the years 1890 and 1899, both included, a total sum of 120,150,923.93 was allotted for the engineering expenses of building new gun and mortar batteries, while additional sums, aggregating about $7,000,000, were allotted for purchase of sites, for preparation of the submarine mine system, and for certain other purposes

connected with the coast defence. The cost of armament and carriages and the necessary ordnance expenses were not included in the amounts named. During the period In question about $26,000,000 was made available for these purposes. The projects in accordance with which the sums thus appropriated have been expended were prepared under the direction of the Chief of Engineers of the army, subject to the approval of the Secretary of War. As a general rule, the prepara- tion of these projects is assigned by the Chief of Engineers to the Board of Engineers, a body composed of officers of the Corps of Engineers, and especially charged, among other duties, with that of planning and revising, as may be directed by the Chief of Engineers, from time to time, projects of permanent fortifications required for the national defence. The annual report for the year 30th June 1899, of the Chief of Engineers, stated that, "Under the general scheme of national defence outlined by the Endicott Board in its report of 16th January 1886, projects for permanent sea-coast batteries have been adopted for thirty localities in the United States, as follows : ???

9. 10. 11. 12. 1.3. 14. 15.

Penobscot River, Maine. Kennebec River, Maine. Portland, Maine. Portsmouth, N.H. Boston, Mass. New Bedford, Mass. Narragansett Bay, R.I. Eastern Entrance to Long

Island Sound. New York, N.Y. Philadelphia, Pa. Baltimore, Md. Washington, D.C. Hampton Roads, Va. Wilmington, N.C. Charleston, S.C.

16. Port Royal, S.C.

17. Savannah, Ga.

18. St Johns River, Fla.

19. Key West, Ela.

20. Tampa Bay, Fla.

21. Pensaoola, Fla.

22. Mobile, Ala.

23. New Orleans, La,

24. Sabine Pass, Texas.

25. Galveston, Texas.

26. San Diego, Cal.

27. San Francisco, Cal.

28. Mouth of Columbia River,

Oregon and Washington.

29. Puget Sound, Wash.

30. Lake Champlain.

" The defence of several additional localities in the United States is now under consideration, for which no formal projects have yet been completed, or approved by the Secretary of War. In addition, considerable study has been given during the year to the subject of coast defences for our insular possessions, resulting in the completion of a project of defence for the harbour of San Juan, Puerto Rico, and of preliminary projects for the defence of Honolulu and Pearl Harbour, Hawaiian Islands. ..."

' ' Existing approved projects for sea-coast defences contemplate the emplacement of about 500 heavy guns of 8, 10, 12, and 16 inches' calibre, of about 800 rapid-fire guns, and of about 1000 mortars, at an estimated approximate cost for the engineering work of $55,000,000. . . ."

The status of emplacements for which funds have thus far

been provided by Congress was as follows at the close of that fiscal year :
_?_?_?_

12-in.

lO-in.

8-in.

Eapid- fire.

12-ili. mortars.

Guns mounted Ready for armament Under construction . Not yet begun .

27 39 19

83

27 8

59 25 10

46 115 122

25

176

60

108

Totals ....

85

118

94

344

The emplacements enumerated in this table are situated at 77 places, in 30 different harbours. Practically all of those ports for which projects have been prepared have received a portion of the proposed defence, while at the greater part of them a sufficient number of heavy guns and mortars was installed on 30th June 1899, to make strong resistance against naval attack. The regular appro- priations made annually during the last few years, and the extra- ordinary appropriations made for the national defence at the outbreak of the war with Spain, have enabled the military authori- ties to make very gratifying progress with the entire scheme, and have encouraged the hope that in a few years it will be complete. The emplacements for which funds were provided on 30th June 1899 will mount guns of six inches' and heavier calibre as shown below : ???

Present state.

12-in. guns on lift mounts 12-in. guns on disappearing carriages . 12-in. guns on non-disappearing carriages 10-in. guns on disappearing carriages . 10-in. guns on non-disappearing carriages

8-in. guns on disappearing carriages .

8-in. guns on non-disappearing carriages

6-in. R. F. guns on disappearing carriages .

6-in. R. F. guns on non-disappearing carriages

2 54 29 108 10 64 30 29 33

The first 12-in. guns to be installed were the two in the lift battery, which was finished in 1895. In this each gun, with its carriage, is mounted on a platform which can be raised and lowered by a direct- acting hydraulic ram. The gun is lowered for loading behind the parapet, which is of sand

and concrete, and is then raised by the ram to the firing position. It is fired in barbette, over the parapet. The operations of hoisting the ammunition to the breech of the piece and of ramming are performed by hydraulic power, the water for all of the cylinders being drawn from an accumulator into which it is pumped by steam. The time of ascent or descent of the gun is from 15 to 20 seconds, including the operation of locking the platform. The ammunition-lift is raised in 7 seconds. In a two-gun lift-battery the accumulators can be worked continuously at the rate of two minutes and thirty seconds' interval between shots, for each lift. The cost of the lift battery, as first built, for two guns, was about $455,000, exclusive of the guns. The remaining batteries, mounting guns in barbette on disappearing and non- disappearing carriages, are all of the same general type. The pro- tection is given by a sand parapet in front of a retaining wall of concrete, behind which the guns are mounted. The thick- ness of the concrete wall in front of the gun is so great that its top forms a sufficient blast slope. Consecutive guns are separated by thick traverses, rising usually only to the level of the interior crest. Ample magazine space is provided, and suitable appliances for hoisting and conveying the ammunition either by hand or by electric power. The guns, as now mounted, are loaded and trained by hand. Experiments have been undertaken to test the advisability of manipulating the gims and carriages by electric power. The batteries are lighted by electricity and have the need- ful provisions for the installation of range-finding instruments, search-lights, and similar accessories.

The service disappearing carriage now adopted is of the well- known Buffington-Crozier type, the invention of two officere of the Ordnance Department, U.S. Army. By far the greater nnnUaer of high-power guns in the United States are thus mounted at present, but there is a strong probability that this type of carriage will be less extensively used in the future. In trials for rapidity of fire these carriages have given results as follows : ???

8-in. gun, 10 rounds in 12 m. 21 sec. 10-in. gun, 10 rounds in 14 m. 42 sec. 12-in. gun, 10 rounds in 16 m. 57 sec.

The guns were operated and loaded by hand. The trials began with the gun empty, the breech block closed, and the ammunition ready to hand. The mortar batteries mount either 16 or 8 mortars in four or two pits, containing each four mortars. The pits are protected by a thick sand parapet, held up on the interior by a concrete wall, and are separated from each other by heavy traverses

containing bomb-proofs and magazines. In addition to the guns and mortars, batteries mounting one or more pneumatic dynamite guns have been established at San Francisco and Sandy Hook, and are to be placed at Fisher's Island and Port Royal. The heavy guns may be fired either by direct laying by the gunners, or by indirect laying, taking the azimuth and elevation from the position- nndmg station. The latter method possesses great advantages for the guns mounted on disappearing carriages, or on the gun lift, since the pointing may be done while the gun and detachment are completely covered by the parapet. The mortars are arranged for indirect laying only, the parapet being so high as to conceal the target from the gunner. The batteries have been built in some cases by hired labour, and in others by contract, the former method having given the more satisfactory results. The cost has varied very much, according to the situation. One of the principal Items is the concrete, of which a single emplacement, as now built for the different high-power guns on disappearing carriages, con- tains approximately the following quantity, including magazine, platform, and all accessories : ◆◆◆

For the 12-in. gun . . . 5300 cubic yards.

For the 10-in. gun . . . 3600 cubic yards.

For the 8-in. gun . . . 3200 cubic yards. The cost of such emplacements, complete, including ammunition lifts and all permanent parts, but not including gun or carriage, may be taken at between $30,000 and $45,000 for one 8-in. gun, between $35,000 and |50,000 for one 10-in. gun, and between $45,000 and $60,000 for one 12-in. gun. There is no marked

difference in the cost of the emplacements as built for the disap- pearing and non-disappearing mounts. Armoured turrets, though contemplated, have not yet been constructed. The torpedo de- fence, which is regarded as an indispensable part of the general plan, is disposed in accordance with projects prepared in the same way as those for the artillery defence. Each harbour which is protected by land batteries has provision made for one or more niine-fields as well, situated in such manner as to be swept to advantage by the guns on shore. (h. f. h.)

Fortrose, a royal and parliamentary burgh (Inver- ness group), market town, and fishing port, Inverness- shire, Scotland, 10-|- miles N.IST.E. of Inverness Ijy rail. A water supply has been introduced, the harbour re- paired, a new pier built, whilst a volunteer drill hall, a new academy, and a new United Eree church have been erected. The schools include an academy. Population

(1881), 874 ; (1901), 1179.

Fortune, Robert (1813-1880), British botanist and traveller, was born in Berwickshire on 16th September 1813. He was employed in the Botanical Garden at Edinburgh, and afterwards in the Eoyal Horticultural Society's Garden at Chiswick, and upon the termination of the Chinese War in 1842 was sent out by the Society to collect plants in China. His travels resulted in the introduction to Europe of many beautiful flowers ; but another journey, undertaken on behalf of the East India Company, had much more important consequences, occar sioning the successful introduction into India of the tea- plant, whose produce now competes so successfully with the tea of China. In subsequent journeys he visited Formosa and Japan, described the culture of the silk- worm and the manufacture of rice paper, and introduced many trees, shrubs, and flowers now generally cultivated in Europe. The incidents of his travels were related in a succession of interesting books. He died in London, 13th April 1880.

Fortuny, Mariano Jose Maria Bernardo (1838-1874), Spanish painter, was born at Ecus on 11th June 1838. His parents, who were in poor circum- stances, sent him for education to the primary school of his native town, where he received some instruction in the rudiments of art.

When he was twelve years old his parents died and he came under the care of his grand- father, who, though a joiner by trade, had made a collection of wax figures, with which he was travelling from town to town. In the working of this show the looy took an active part, modelling and painting many of the figures ; and two years later, when he reached Barcelona, the cleverness of his handiwork made so much

impression on some people in authority there that they induced the municipality to make him an allowance of forty-two francs monthly, so that he might be enabled to go through a systematic course of study. He entered the Academy of Barcelona and worked there for four years under Claudio Lorenzale, and in March 1857 he gained a scholarship that entitled him to complete his studies in Rome. Then followed a period of more than two years, during which he laboured steadily at copies of the old pictures to which he had access at Rome. To this period an end was put by the outbreak of the war between Spain and the emperor of Morocco, as Eortuny was sent by the authorities of Barcelona to paint the most striking incidents of the campaign. The expedi- tion lasted for about six months only, but it made upon him an impression that was powerful enough to affect the whole course of his subsequent development, and to implant permanently in his mind a preference for the glitter and brilliancy of African colour. He returned to Spain in the summer of 1860, and was commissioned by the city of Barcelona to paint a large picture of the cap- ture of the camps of Muley-el- Abbas and Muley-el-Hamed by the Spanish army. After making a large number of studies he went back to Rome, and began the com- position on a canvas fifteen metres long ; but though it occupied much of his time during the next few years, he never finished it. He busied himself instead with a wonderful series of pictures, mostly of no great size, in which he showed an astonishing command over vivaci- ties of technique and modulations of colour. He visited Paris in 1868, and shortly afterwards married the daughter of Erederigo Madrazo, the Director of the Royal Museum at Madrid. Another visit to Paris in 1870 was followed by a two years' stay at Granada, but then he returned to Rome, where he died somewhat suddenly on 21st November 1874 from an attack of malarial fever, contracted while painting in the open air at Naples and Portici in the summer of 1874.

The work which Eortuny accomplished during his short life is distinguished by a superlative facility of execution and a marvellous cleverness in the arrange- ment of brilliant hues, but the qualities of his art are those that are attainable by a master of technical re- source rather than by a deep thinker. His insight into subtleties of illumination was extraordinary, his dexterity was remarkable in the extreme, and as a colourist he was vivacious to the point of extravagance. At the same time, ill such pictures as " La Vicaria " and " Choosing a Model," and in some of his Moorish subjects, like " The Snake Charmers " and " Moors playing with a Vulture," he showed himself to be endowed with a sensi- tive appreciation of shades of character, and a thorough understanding of the peculiarities of a national type. His love of detail was instinctive, and he chose motives that gave him the fullest opportunity of displaying his readiness as a craftsman.

See Davilliek. Fortuny, sa vie, son ceuvre, sa correspondance, &c. Paris, 1876. ❓❓❓ C. Yeiarte. Fortuny (Artistes Oelebres series). Paris, 1889. (a. l. b.)

Fostoria, a city of Seneca county, Ohio, U.S.A., nearly south of Toledo, at an altitude of 773 feet. It has large flour mills and glass-works, the latter being aided by its supply of natural gas. Eostoria is the point of intersection of five railway lines, making it an import- ant railway centre. Population (1880), 3669 ; . (1890), 7070 ; (1900), 7730, of whom 584 were foreign-born, and 168 negroes.

Fougeres, chief town of arrondissement, depart- ment of Ille-et-Vilaine, Erance, 29 miles north-east of Rennes, on railway from Vitre to Mont St Michel. An

equestrian statue of General de la Eiboisiere (died 1812) ❓❓❓\^as erected in 1893, and there is a monument to the soldiers who fell in 1870-71. Population (1881), 13,125 ; ❓❓❓(1891), 16,781 ; (1901), 20,952.

Fourier's Series are those series which proceed according to sines and cosines of multiples of a variable, the various multiples being in the ratio of the natural numbers ; they are used for the representation of a func- tion of the variable for values of the variable which lie between prescribed finite limits. Although the import- ance of such series, especially in the theory of vibrations, had been recognized by D. Bernoulli, Lagrange, and other mathematicians, and had led to some discussion of their properties, Fourier (see Fourier, Jean Baptiste Joseph, Ency. Brit., ninth edition, vol. ix.) was the first clearly to recognize the arbitrary character of the functions which' the series can represent, and to make any serious attempt to prove the validity of such representation ; the series are consequently usually associated with the name of Fourier. More general cases of trigonometrical series, in which the multiples are given as the roots of certain transcendental equations, were also considered by Fourier.

Before proceeding to the consideration of the special class of series to be discussed, it is necessary to define with some precision what is to be understood by the representation of an arbitrary function by an infinite series. Suppose a function of a variable x to be arbitrarily given for values of x between two fixed values a and b ; this means that corresponding to every value of x such that a'^x'Si, with the possible exception of a finite niunber of values of x, a definite arithmetical value of the function is assigned by means of some prescribed set of rules. A function so defined may be denoted by f{x) ; the rules by which the values of the function are determined may be embodied in a single explicit ana- lytical formula, or in several such formulae applicable to different portions of the interval, but it would be an undue restriction of the nature of an arbitrarily given function to assume a priori that it is necessarily given in this manner, the possibility of the repre- sentation of such a function by means of a single analytical ex- pression being the very point which we have to discuss. The variable x may be represented by a point at the extremity of an interval measured along a straight line from a fixed origin ; thus we may speak of the point c as synonymous with the value x=c of the variable, and of /(c) as the value of the function assigned to the point c. For any finite number of points between a and b the function may be discontinuous, i.e., it may at such points undergo abrupt changes of value. The only discontinuities

here considered will be those known as ordinary discontinuities. Such a discon- tinuity exists at the point c if/(c-t-e), f{e-e) have distinct but definite limiting values as e is indefinitely diminished ; these limit- ing values are known as the limits on the right and on the left respectively of the function at c, and may be denoted by /(c -1-0), f(c ⬚⬚⬚ 0). The discontinuity consists therefore of a sudden change of value of the function from /(c-0) to /(c-l-0), as x increases through the value c. If there is such a discontinuity at the point a; = 0, we may denote the limits on the right and on the left respectively by/(+ 0), /(– 0).

Suppose we have an infinite series Ui(x) + v^(x) + . . . + ⬚⬚⬚⬚(⬚⬚') + ⬚⬚⬚ ⬚⬚⬚ ⬚⬚⬚ in which each term is a function of x, of known analytical form ; let any value x = c(a'^c'^b) be substituted in the terms of the series, and suppose the sum of n terms of the arithmetical series so obtained approaches a definite limit as n is indefinitely increased ; this limit is known as the sum of the series. If for every value of c such that aScSb the sum exists and agrees with the value of

oo

/(c), the series

the values a, b of the variable. If this is the case for all points within the given interval with the exception of a finite number, at any one of which either the series has no sum, or has a sum which does not agree with the value of the function, the series is said to represent "in general" the function for the given interval. If the sura of n terms of the series be denoted by S,i©, the condition that Sm© converges to tlie value /(c) is that corresponding to any finite positive number d as small as we please, a value % of n can be found such that if wSni, | /(⬚⬚) – Sn©] < 5.

Functions have also been considered which for an infinite num- ber of points within the given interval have no definite value, and series have also been discussed which at an infinite number of points in the interval cease either to have a sura, or to have one which agrees with the value of the function ; the narrower con- ception above will however be retained in the treatment of the subject in this article, reference to the wider class of cases being

made only in connexion with the history of the theory of Fourier's Series.

Uniform Convergence of Series. ◆◆◆ If the series iii(x) + %h{^) + . . . Un{x) . . . converge for every value of x in a given interval a to b, and its sum be denoted by S{x), then if cor- responding to a finite positive quantity 8 as small as w-e please a finite number ni can be found such that the arithmetical value of S{x) – S◆◆◆(.i'), where ◆◆>◆◆! is less than d, for every value of x within the given interval, the series is said to converge uniformly within that interval. It may however happen that as x approaches a particular value the number of terms of the series which must be taken so that | S{x) – S◆◆◆{x) | may be < S, increases indefinitely ; the convergence of the series is then infinitely slow in the neigh- bourhood of such a point, and the series is not uniforraly con- vergent throughout the given interval. If the number of such points in the neighbourhood of which the series ceases to converge uniformly be finite, they may be excluded by taking intervals of finite magnitude as small as we please containing such points, and considering the convergence of the series in the given interval with such sub-intervals excluded ; the convergence of the series is now uniform throughout the remainder of the interval. The series is said to be in general uniformly convergent within the given interval a to 6 if it can be made uniformly convergent by the exclusion of a finite number of portions of the interval, each such portion being arbitrarily small. It is known that the sura of an infinite series of continuous terms can be discontinuous only at points in the neighbourhood of which the convergence of the series is not uniform, but non-uniformity of convergence of the series does not necessarily imply discontinuity in the sum.

Form of Fourier's Series. ◆◆◆ If it be assumed that a function f{x) arbitrarily given for values of x such that O'Sx'^l is capable of being represented in general by an infinite series of the form

. mrx J T .n.2 "111 1 r . . ◆◆◆ "f An sin V {...,

and if it be further assumed that the series is in general uniformly convergent throughout the interval 0 to 7, the form of the co- efficients A can be determined. Multiply each term of the series

by sin ⬚j⬚, and integrate the product between the limits 0 and I,

/ TtTTX 71 TTSJ

sin ⬚ J ⬚ sin ⬚ j ⬚ dx = 0, or JZ, accord- ing as n^ is not, or is, equal to n, we have iZA⬚ = / f{x) sin ⬚ j- dx, and

. Trx . "iirx

Aj sm f + Ai sm ⬚r +

thus the series is of the form

mrx n

. mrx x)Sin⬚j-dx

(1)

This method of determining the coefficients in the series would not be valid without the tissumption that the series is in general uniforraly convergent, for in accordance with a known theorem the sum of the integrals of the separate terms of the series is otherwise not necessarily equal to the integral of the sum. This assumption being made, the other assumption of the possibility of the expansion insures that /(x) is such that the integral

f{x)sm⬚j-dx have a definite meaning.

/;

Before we proceed to examine the justification for the assump- tions made, it is desirable to examine the result obtained, and to deduce other series from it. In order to obtain a series of the form

TT.r 2irj'

Bo + Bi cos – . + B2 cos ⬚r- + .

nirx + B ❑❑❑ cos ❑❑❑,- +

for the representation of/(x) in the interval 0 to 1, let us apply the

series (1) to represent the function /[❑❑) sin ❑❑❑,- ; we thus find

252. . mrx /”’,.. irx. . nirx If ^❑❑❑ l J /”’^ ‘ T ”’” T’^-”’

(71-

UTX f’ J., > f

~~IV,i~~

*(,n + l)^^x^*

❑❑❑dx.

I -“❑❑❑”’ I On rearrangement of the terms this becomes 1 , irr /”’ , ^, 2 . irx inr.r f’

J ’” r / /()’ + 7< si' ❑❑❑/ “OS ^^ / /(*; ‘^“i’ 7*

licuoe f{x) is represented for the interval 0 to / by the series of

❑❑❑, nirx, (x) cos ❑❑❑^a^.

1 f

jj f{x)dx +

y❑❑ COS ❑❑❑ ^ / /(.v) cos -,-dx . . (2)

We have thus seen, that vnth the assumptions made, the arbi- trary function f(x) may be represented, for the given interval, either by a series of sines, as in (1), or by a series of cosines, sis in (2). Some important differences between the two series must, however, be noticed ; in the first place, the series of sines has a vanishing sum whena! = 0 or x = l, it therefore docs not represent

the function at the point x=0, unless /(0) = 0, or at the point x=l, unless/(Z) = 0, whereas the series (2) of cosines may represent the function at both these points. Again, let us consider what is represented by (1) and (2) for values of a; which do not lie between 0 and I ; a,af{x) is given only for values of x between 0 and I, the series at points beyond these limits have no necessary connexion with/(a;) unless we suppose that/(a;) is also given for such general values of x in such a way that the series continue to represent that function. If in (1) we change x into ???x, leaving the coefficients unaltered, the series changes sign, and if x be changed into x + 2l, the series is unaltered ; we infer that (1) is an odd function of x and is periodic of period 21 ; thus (1) will represent /(k) in general for values of x between + oo, if /(x) is odd and has a period 21. If in (2) we change x into -x, the series is unaltered, and it is also unaltered by changing x into x + 2l ; from this we see that (2) represents /(a:) for values of a; between +o??, only ifyi^a:) is an even function, and is periodic of period 21. In general a function /(ar) arbitrarily given for all values of x between + oo is neither periodic nor odd, nor even, and is therefore not represented by either (1) or (2) except for the interval 0 to I.

From (1) and (2) we can deduce a series containing both sines and cosines, which will represent a function /(ai) arbitrarily given in the interval -I to I, for that interval. We can express by (1) the function i{f(x)-f{-x)} which is an odd function, and thus this function is represented for the interval -I to +1 hj

2 . mrx f',, ???, ???,, . nirx ,

l^ sm ∓ j ^i{.A??) -/(– ??)} sm ~Y dx ;

we can also express i{ f{x) +/{ – x)}, which is an even function, by means of (2), thus for the interval -Z to +1 this function is represented by

r' 2 ??? ???"???"???^ /"'

1 f’

+/(– x)]dx + 7 < cos ^ 1

5 /”’

[x) +f{ – x)] cos –

dx.

It must be observed that f{- x) is absolutely independent of J[x), the former being not deducible from the latter by putting – a: for a; in a formula ; both f{x) and f{-x) are functions given arbitrarily and independently for the interval 0 to I. On adding the ex- pressions together we obtain a series of sines and cosines which represents y(a;) for the interval -I to I. The integi-als

, . nirx , X) sm ,- dx

/ f{-x) cos ┼(&, / /(

are equivalent to

/”“‘j,, > rnrx , T”’ , . mrx ,

I f{x) cos -j-dx, + I f{xj sm r-dx,

thus the series is

21 j

’ 1 .

f{x)dx + J

which may be written

l-lf[/{x^)dx^ +

” nirx /□□□’ .,. mrx , =; cos □□□J- I J\xj cos -y-dx

< . nirx f' .,. . TITX,

-□□i sm □□□ y / f{x) sm -7-cfe,

1 CO /□□□!

*nT{x – x^) , cos ^ dx^*

(3)

The series, (3) which represents a function f{x) arbitrarily given for the interval -I to I, is what is known as Fourier’s Series, the expressions (1) and (2) being regarded as the particular forms which (3) takes in the two cases, in which /(- □□)= -f(x), or f{-x)=f{x) respectively. The expression (3) does not represent /(x) at points beyond the interval -I to I, xmles&fix) has a period 21. For a value of X within the interval, at which f(x) is discontinuous, the sum of the series may cease to represent f[x), but as will be seen hereafter, has the value ^{f{x + Q)+f(x-0)}, the mean of the limits at the point on the right and the left. The series represents the function at aj = 0, unless the function is then discontinuous, in which case the series is 4{yt + 0)+y(- 0)} ; the series does not necessarily represent the function at the points I and – 1, unless fij) =f[– 1), its sum at either of these points, is \{f{l)+f{ – 1)}-

Examples of Fourier’s Series.- □□□ (a) Let /(a;) be given from 0 to i, by f{x)=c, when Oga: □□=c^Z, and by f(x)= -c from \l to I; it is required to find a sine series, and also a cosine series, which shall represent the function in the interval.

We have

/’-,,. mrx r V , nwx , /” ‘ . nwx,

f{x)sin □□□i-dx=cj sm □□□f-dx-cj sm □□□ ^“K

cl = □□□ (cos mr-2 cos J wtt + 1). mr

This vanishes if ___ is odd, and ifn=im, butif ?i=4to + 2 is equal to

i___, the series is therefore mr

*4e/l _____2tx.1 .^ewx^l .IOtx *

___ – sm ___ – + – sm ___ ___ + – sm ___ ; ___ + . . . 1. 7rV2 13 lb I J

For unrestricted values of x, this series represents the ordinates of the series of straight lines in Fig. 1, except that it vanishes at the points 0, JZ, I, ^l . . .

-zl

21

Kg. 1.

We find similarly that the same function is represented by the series

4c /

I

1 3ira: , 1 Sttx

cos___ ___ + -COS — – 3 15 I

during the interval 0 to I ; for general values of x the series re- presents the ordinate of the broken line in Fig. 2, except tliat it vanishes at the points JZ, fZ . . .

-2 1

2l

Fig. 2. (6) Let/(a;)=a; from 0 to \l, and/(a!)=Z-a;, from JZ to Z ; then

I’nx) sin ?^&= l“x sin !i52rfa;+ f \l – x) sin V^I^dx Jo I Jo I J V I

V-

-) cos mr –

mr

hence the sine series is

“2^ ‘=□□□□ T+^V^ ”’”^ T+^ \^^ T

? mr , V- , mr

37ra:

2Z^ . mr □□□s□□□^ sm □□□

4Z/ □□□)ia; 1 .

4^’^^^----)

Fig. 3

For general values of a;, the series represents the ordinate of the row of broken lines in Fig. 3.

The cosine series, which represents the same function for the interval 0 to I, may be found to be

Y%’

Fig. 4.

‘-F-s.”’-?4□□-t”+

□□□)

S. IV. □□□ 58

F 0 U R I E R^S SERIES

This series represents for general values of x the ordinate of the set of broken lines in Fig. 4.

Dirichlet's Integral. ??? The method indicated by Fourier, but first carried out rigorously by Dirichlet, of proving that with certain restrictions as to the nature of the function f(x), that function is in general represented by the series (3), consists in finding the sum of m + 1 terms of that series, and then investigat- ing the limiting value of the sum, when n is increased indefinitely. It thus appears that the series is convergent, and that the value towards which its sum converges is J{/(a;-l-0)-l-/(a;-0)}, which is in general equal to/(a;). It will be convenient throughout to take – TT to X as the given interval ; any interval ???I to I may be re- duced to this by changing x into Ixfir, thus there is no loss of generality.

We find by an elementary process that

J ⊣ cos (a; – a') ⊣ cos 2(a; – x') -H . . . + (x>sn{x-3?)

sm (a;' ??? x)

2 sin {x – x)

hence, with the new notation, the sum of the first' n+1 terms of (3) is

2 ???-t-l,

-{x^-x)

- dx^ ;

2 sin \{x^ ??? x)

if we suppose/(a) to be continued beyond the interval – ir.to tt, in such a way that/(3;)=/(a;-l-2Tr), we may replace the limits in this integral hy x + ir, x-ir respectively ; if we then put x^-x= 2z, and

1 /□□□ ” let/(a;^)=F(z), the expression becomes I

irj –

^,, sm mz ,, i (z) □□□□□□□ dz, where

**□□□ -‘ Gin c ‘*

m=2n + l ; this expression may be written in the form

1

F(.

, sin mz ,, 1 ~~^ dz +~~

*1 r^*

F(-□□)

-dz

(4)

“We require therefore to find the limiting value, when m is

indefinitely increased, of / ‘ F(z)

/;

dz, the form of the second

integral being essentially the same. This integral, or rather the

dz, when 0

slightly more general one / I'(z) ◆◆◆, -'

known as Dirichlet's integral. If we write X(z) = F(z) – ◆◆◆, the

sm a

r "◆◆◆ sm WIS integral becomes | X(z) dz, which is the form in which

the integral is frequently considered.

TJie Second Mean- Value, Theorem. ◆◆◆ The limiting value of Dirich- let's integral may be conveniently investigated by means of a theorem in the integral calculus known as the second mean-value theorem. Let a, h be two fixed finite numbers such that a < 6, and suppose f{x), 4:{x) are two functions which have finite and determinate values everywhere in the interval except for a finite number of points ; suppose further that the functions f(x), (p{x) are integrable throughout the interval, and that as x increases from a to & the function /(k) is monotonous, i.e., either never diminishes or never increases ; the theorem is that

I f{x)

when f is some point between a and i, and f{a), f{b) may be written for/(◆◆-)-0), /{b – 0) unless a or 6 is a point of indetermina- tion for one of the functions /(a), 0(a').

To prove this theorem, we observe that since the product of two

r"

integrable functions is an integrable function, | f(x){x)dx exists,

and may be regarded as the limit of the sum of a series f{x◆◆◆)rj>(xa) {xi – xo) +f{xi)(xi){X'i ~~Xi) + ... 4~~/(a-◆◆◆-i)0(a;◆◆◆ i)(a;◆◆◆ – x◆◆◆-t) where Xo = 'i; -I'n^b, and ,)◆◆◆], x-i . . o:◆◆◆-i are n-1 intermediate points. "We can express 0(x,.)(.r,^.i – :◆◆>) in the form Y,+i-Y◆◆◆ by

K-r

putting Y,= :g (kk-i) [x-XK-i), yo=0.

Writing X, for f(Xr), the series becomes

Xo(Yi-y□□□)-HXi(Y2-Y,)-l- . . . -fX□□□.i(Y□□□-Y□□□-i) or Yi(X□□□-Xi)-fYj(X,-X2)-I- . . . + Y□□□{X□□□-i- X□□□)H-Y□□□X□□□. Now, by supposition, all the numlnira Y], ‘a . . . Y□□□ are finite, and all the numbers X-i – X,. are of the same sign, hence by a known algebraical theorem the scries is equal to M (Xo~“X□□□)-hY□□□X□□□ M’hero M is a number intermediate between the greatest aud the least of the numbers Yi, ^‘2, . . . Y□□□. This remains true however many partial intervals are taken, and therefore when their number is increased indefinitely, aud their

breadths are diminished indefinitely according to any law, hence we have ‘

j^^Jlx)

when M is intermediate between the greatest and least values

which / (p{x)dx can have, when x is in the given interval. Now

this integral is a continuous function of its upper limit x, and therefore there is a value of x in the interval, for which it takes any particular value between the greatest and least values that it has. There is therefore a value | between a and b, such that

M= / (p{x)dx, hence

jy{x){x)dx+f{b)j ^ -f,{x)dx)

=f{a)j ^

It the interval contains any finite numbers of points of discon- tinuity of f(x) or (/)(□□), the method of proof still holds good, provided these

points are avoided in making the subdivisions ; in particular if either of the ends be a point of discontinuity oif{x), we write/(a-f 0) or/(6-0), for /(a) or /(6), it being assumed that these limits exist.

Functions, with Restricted Oscillation. ??? The condition that f{x), in the mean-value theorem, either never increases or never diminishes as x increases from a to b, places a restriction upon the applications of the theorem. We can however show that a function f{x) which is finite and continuous between a and b, except for a finite number of ordinary discontinuities, and which only changes from increasing to diminishing or vice versa, a finite number of times, as x increases from a to b, may be expressed as the diff'erenue of two functions /i(x), fiix), neither of which ever diminishes as x passes from a to b, and that these functions are finite and continuous, except that one or both of them are dis- continuous at the points where the given function is discontinuous. Let a, /3 be two consecutive points at which f(x) is discontinuous, consider any point Xi, such that a-Sxi-^^, and suppose that at the points Ml, M2 . . . Mr between a and Xi, f{x) is a maximum, and at mi, m2 . . . m^ it is a minimum ; we will suppose, for example, that the ascending order of values is a. Mi, TOj, Mo, m2 . . . M ??? m ??? xi ; it will make no essential difierence in the argument if ? ??i comes before Mi, or if M,. immediately precedes xi, rrir, being then the last minimum.

Let \('(a;i) = {/(Mi)-/Ia-)-0)] + [/(M2)-y(m3)~~f . . . + [/(M.)~~/(m,.i)~~H[/(a:i)~~/(??v)l ; now let Xi increase until it reaches the value M^+i at which /(x) is again a maximum, then let

.A(Xl) = {/(Ml)-/(a-^0)~~[/(M2)~~/(m,)]- . . . + [/(M,) -/(mr-i)~~l~~[/(M,.+i) -/(??!,)] ; and suppose as x increases beyond the value Mr+i, i'{xi) remains constant until the next minimum nv-n is reached, when it again becomes variable ; we see that ^pixi) is essentially positive and never diminishes as x increases.

Let x(.'~~i) = [/(Mi)~~/];mi)~~\[/(M2)-/(m,)]-H . . . -f [./'(M,) ~~/(m,)], then let xi increase until it is beyond the next maximum M^j.!, and then let x(??i)=[/(Mi)~~/i;mi)~~l[/(Mo)-/(mi)~~(~~. . .

+ [/(M,) -/(m,)] 1 [/(M,.+,) -/(xi)] thus x{xi) never diminishes, and is alternately constant and variable. We see that ^(.r{) – x(x{) is continuous as x inpreases from a to |8, and that i/'(xi)-x(xi)=/(xi)-/'(a-|-0) and when Xi reaches ft we have vt{/3)-x(□□i)=/(/3-0) -/(a-fO). Hence it is seen that between a and jS, f(x) = [\l/{x)+f{a + 0)'x(x), where V'(□□) +/(" + 0), x(.t) are continuous and never diminish as x in creases ; the same reasoning applies to every continuous portion of /(x), for which the functions yj/(x), xl'-l are formed in the same manner; we now iske fl{:x) = p{x)+.t\a + 0) + Q, Mx)=x{x) + 0, where C is constant between consecutive discontinuities, but may liave differeut values in the next interval between discontinuities ; the C can bo so chosen that neither /i(a!) nor /(x) diminishes as x increases through a value for which /(x) is discontinuous. We thus see that /(x) =/i(x) -/,(x), where /i(x), /aCx) neA-er diminisli as X inereiises from a to b, and are discontinuous only where /{x) is so. The function /(x) is a particular e:ise of a class of functions defined aud discussed by Jordan, under the name "functions with restricted oscillation " (fonctiims <) variation bornie) ; in general such functions have not necessarily only a finite number of maxima and minima.

I'roiif of the Convergence of Fourier's Series. □□□ It will now be assumed that a function /(x) arbitrarily given between the values – 7r and + x, has the following properties : □□□

(a)^ The function is everj'AN here finite, and continuous except for a finite number of values of the variable, for which it may be ordinarily discontinuous.

(6) The function only changes from increasing to diminishing or

vice versd, a finite number of times within the interval ; this is usually expressed by saying that the number of maxima and minima is finite.

These limitations on the nature of the function are known as Dirichlet's conditions ; it follows from them that the function is integrable

throughout the interval.

On these assumptions, we can investigate the limiting value of Dirichlet's integral ; it will be necessary to consider only the case of a function ^(z) which does not diminish as 2 increases from 0 to

-Tr, since it has been shown that in the general case the difference

of two such functions may be taken. The following lemmas will be required : ???

(1) Since

f=iHL^^^2= [M1+2oos2?? + 2cos4z+ . . . + 2 aos 2nz}dz=Z i j 0 sm 2 j 0 ^

this result holds however large the odd integer m may be.

(2) If 0

/???V 1 /????

'^dz = ^^???l siR mxdz+ -. ??? -I am mz dz

i

J a.

sm s sm

where a < 7 < ;8, hence

1 rV 1 f^ ???

???I sin. mzdz+ -. ??? – | sm

j a SI

Sin mz, , 2 dz \ < ???

\8m a sm pj

u, precisely similar proof shows that

I/:

-dz

dz.

hence the integrals / ??? -. ??? ‘ ??? J a sm s

zero, as m is indefinitely increased.

/ sin mz, , ,, ,. .. dz, converge to the imoat

*(3) lfa>0, I j”^*

???

‘ ?? do I cannot exceed -tt. e ‘ 2

Tor by the

sin 8 T

dB

2 , 2

o h’

sin S

de

hence | LA = 00 |

in particular if a>7r | / . ??? — dS \ <-. J ??- 0 ir

, . d [sin 5 , ◆◆◆ sin a . ^^^’““dala ◆◆◆ <^9=- ◆◆◆ ,a>0,

/ ◆◆◆ ^^ ◆◆◆ a dd increases as a diminishes, when 0

but

^J.

sin Bj

1=-, hence

2'

sin 6

d6

where a < tt, and < – where a^Tr.

To find the limit of written in the form

/IT

0

-dz, we observe that it may be

F(0) f’ iMlf &+ 0(2) – F(0)} 5 ◆◆ ^rf2

V 0 sm 2 jo’ ‘ sm z

+ f’{F(2)-F(0)}?H^rf. .’ (1 sm z

where /u is a fixed number as small as we please, hence if we use lemma (1), and apply the second mean-value theorem,

i;

F(2)^‘i^(i2 5F(0) sm 3 2

-i:

{F(2)-F(0)}-

-dz

4F(M) -F(0)} /” ?ilLZl^rf2 + {Ff) – F(0)} r^^^^dz J fi sm z \2J ‘J p sm z

when f ‘ lies between /j. and -tt. When m is indefinitely increased,

the two last integrals have a. zero limit in virtue of lemma (2). To evaluate the first integral on the right – hand side, let

G(2)={F(s)-F(0)} . ~, and observe that G(s) increases as z in- sm z

creases from 0 to /x, hence if we apply the mean- value theorem

TgCz) ?i2-!!L^rfz=G (m) r^^^^dz Jo ^ ‘ z J i z

=G(M)r?i

J me

sin 8

f 9

dd

where 0-=?-=;^, since G(z) has a zero limit when 2=0. It has been shown by Kronecker that f cannot be zero.

As m increases ^ varies, being dependent on m and on the nature of 6(2), and it may happen that as m is increased indefinitely, { may be indefinitely diminished ; if this is not the case the limit

of / dz is zero. If however mf has a finite limit a, we see

J S ” by vii-tue of lemma (3) that the limit of the integral does not

exceed -G(/n). The fixed quantity 11 may be chosen so small that

I o^^’l I ‘=^> if 0

indefinitely increased

*/ ‘F(2)-?^*

j 0 sm 2

‘dz – -iFlO) has a zero limit.

Returning to the form (4), we now see that the limiting value of

-r

“ jo

= F(z):

sm 2 TTj 0 ‘ sm 2

hence the sum of ra Ɨ 1 terms of the series

i A F(– 2) ?!: ?dz is im + 0) + -Fi~ 0)}, irj 0 » ‘

uJ lf(”)’^^+T

21

I

converges to the value \{f{x + Q)+fix-Qi)], or to f(x) at a point where fix) is continuous, provided f{x) satisfies Dirichlet’s condi- tions for the interval from -I to I.

Proof that Former's Series is in General Uniformly Convergent. ⁂ To prove that Fourier's Series converges uniformly to its sum for all values of x, provided that the immediate neighbourhoods of the points of discontinuity of f(x) are excluded, we have from the above,

+,ⁱ(l)-F(0)}

<1 i^MV'(- + 2M)-/W}+ t Wx-f2^) -fix)}

Now as X is excluded from certain portions of the interval in the neighbourhood of discontinuities of /(x), 11 may be chosen so small

that for every value of x,^- {/(a:f2/:4)/(a;)}

arbitrarily small fixed number ; also/(x-l-Tr) -f{x) is never greater than some fixed finite number A, therefore a value of m can be found such that if m equals or exceeds this value,

-F(0) I <⁂^, for all values of x considered,

0 sm z 2

when el is a fixed arbitrarily small number. If x had been allowed to approach very closely a point of discontinuity, a smaller value

of jit would have had to be chosen, so that -⁂ ⁂ \f{x + 2fj.)-f{x)

thus /I would have to be continually diminished for this inequality to hold, and the argument would fail ; thus the convergence is not uniform if x is allowed to move right up to a discontinuity.

Case of a Function with Infinities. ⁂ The limitation that/(a;) must be finite throughout the interval may, under a certain restriction, be removed. Suppose F(z) is infinite at the point z=c, and is such

that the limits of the two integrals I '^{z)dz are both zero, as e is indefinitely diminished, then

I /“‘f(2)[illegible]-1?^^C?Z-

f.

F(2) [illegible], dz denotes the limit when e=0, ei = 0 of

{ ‘ F(z) [illegible]^dz

Jo SI

[illegible]2 + f ” F(z) ?lIL^^(i2, both these Hmits existing : J c+-> sm 2

the first of these integrals has pF(-f 0) for its limiting value when

m is indefinitely increased, and the second has zero for its limit. The theorem therefore holds if F(z) has an infinity up to which it is integrable ; this will, for example, be the case if F(z) near the point G is of the form x(2) {z-c)‘i^ +‘p{z), where x©, >p{c) are finite, and 0

TJie Ultimate Values of the Coefficients in Fourier’s Series. [illegible] If f{x) is everywhere finite within the given interval – x to Ɨ x, it can be shown that [illegible], 6 [illegible], the coefficients of cos ma;, sin na; in the series which represent the function, are such that [illegible]a [illegible], m& [illegible],

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however great n is, are each less than a fixed finite quantity. For writing /(x)=/i(a;)-/2(x:), we have

/ ^/i([illegible])cosma;(ia;=/i(-7r + 0) / jio3nxdx+f,{T-0) cos nxdx hence

/:

/i(a;) cos ra(& =/i(– TT + 0) [illegible] [illegible] +/i(7r – 0) ^

[illegible] with a similar expression, with f^ix) for fi{x), J being between ir and – TT ; the result then follows at once, and is obtained similarly for the other coefficient.

l{f{x) is infinite at a;=c, and is of the form [illegible]^^^4? near the point

(x – c)'^ c, where 0

*/f{x)cosnx dx, contains portions of the form / . Jc {x-r.]^*

0(3;)

cosnxdx

I

it thus becomes

//

/ -saosnxdx \ consider the first of these, and put a;=c + M,

0(c + 'h)

[illegible] w [illegible] cos in,(c + [illegible])&, which is of the form

/[illegible] ^ cos n(c + u) {c + Se) I -g du ; now let nu = v, the mtegral becomes

. /[illegible]. a N f cos [illegible] /""e COS V , stu)jc T" sin 1! , [illegible]>*

f{x) COS Tiada; becomes, as n is indefinitely increased

.^, [illegible], , f /""cost), . f= [illegible]sm.v [illegible]>

01 the form 0© -^ cos m: I i^ dv – sm mc | [illegible] k"""" /

which is finite, both the integrals being convergent and of known value. The other integral has a similar property, and we infer that

n^~^a ◆◆◆, n^~^b ◆◆◆ are less than fixed finite quantities.

The Differerdiaiion of Fourier's Series. ◆◆◆ If we assume that the differential coefficient of a function f{x) represented by a Fourier's Series exists, that function /'{x) is not necessarily representable by the series obtained by differentiating the terms of the Fourier's Series, such derived series being in fact not necessarily convergent. Stokes has, obtained general formulse for finding the series which represent /'(k), f"{x) ◆◆◆ the successive differential coefficients of an everywhere finite function /(a). As an example of such formulae, consider the sine series (1) ; f{x) is represented by

2 ^- . riTTX r' , , . mrx , J 5 sm ◆◆◆7- / /(◆◆) sm ◆◆◆j-dx ;

f(x) sin ◆◆◆j-dx

= ◆◆[/(+ 0)◆◆/(Z-0) + Scos^{/(a + 0)-/(a-0)}]

-4>

mrx (X) cos ◆◆◆, dx

where a represent the points where f{x) is discontinuous, hence

if/(a;) is represented by the series ^ a ◆◆◆ sin ◆◆◆j-, and f'{x) by the

nirx , , .

series :5 "n cos ◆◆◆^, we have the relation

mr 2 I

h ◆◆◆ = '-fa^ – y [/(+ 0) ◆◆/(Z – 0) + ^ cos "^W" + 0) -/(" – 0)}]

hence only when the function is everywhere continaous, and /(+ 0); /(^ ~ 0) ^r ◆◆ both zero, is the series which represents f'{x) obtained at once by differentiating that which represents f{x). The form of the coefficient

a ❑❑❑ discloses the discontinuities of the I function and of its differential coefficients, for on continuing the integration by parts we find

*2^*

[/(+ 0) ❑❑/(Z-0)+ ^003 ^V(<' + 0)-/(a-O)}]

+ ::i=-. I /'(+ 0) + / ❑❑❑'(❑❑- 0) + ❑❑ sin '

❑❑❑ where j3 are the points at which /'(a;) is discontinuous.

- ,1^2 [/'(+ 0) ❑❑/V – 0) + ^ sin ^{/'(/3 + 0) -/'(j9 – 0)}] + &o.

History and Literatukb of the Theory. The history of the theory of the representation of functions by series of sines and cosines is of great interest in connexion with the progressive development of the notion of an arbitrary function of a real variable, and of the peculiarities which such a function may possess ; the modern views on the foundations of the infini-tesimal calculus have been to a very considerable extent formed in this connexion. [See Functions of a Real Variable.] The representation of functions by these series was first considered in the 18th century, in connexion with the problem of a vibrating cord, and led to a controversy as to the possibility of

such expansions. In a memoir published in 1747 (Memoirs of the

Academy of Berlin, vol. iii.) D'Alembert showed that the ordinate

y at any time ❑❑ of a vibrating cord satisfies a differential equation

S-v 5V of the form -^ = a^r2, where x is measured along the undisturbed

length of the cord, and that with the ends of the cord of length I fixed, the appropriate solution is y =f {at + x)-f [at -x), where/ is a function such that/(a;)=/(a; + 2Z) ; in another memoir in the same volume he seeks for functions which satisfy this condition. In the year 1748 (Berlin Memoirs, vol. iv.) Euler, in discussing the

irx . 2irx

problem, gave /(a;) = a sm 7 + j3sin j + ... as a particular

solution, and maintained that every curve, whether regular or irregular, must be representable in this form. This was objected to by D'Alembert (1760) and also by Lagrange on the ground that irregular curves are inadmissible. D. Bernoulli (Berlin Memoirs. vol. ix., 1753) based a similar result to that of Euler, on physical intuition ; his method was criticized by Euler (175.3). The ques- tion was then considered from a new point of view by Lagrange, in a memoir on the nature and propagation of sound (Miscellanea Taurensia, 1759; (Euvres, vol. i.), who, while criticizing Euler's method, considers a finite number of vibrating particles, and then makes the number of them infinite ; he did not, however, quite fully carry out the determination of the coefficients in Bernoulli's Series. These mathematicians were hampered by the narrow conception of a function, in which it is regarded as necessarily continuous ; a discontinuous function was considered only as a succession of several different functions. Thus the possibility of the expansion of a broken function was not generally admitted. The first cases in which rational functions are expressed in sines and cosines were given by Euler (Suhsidium Calculi Sinuum, Novi Comm. Petrop., vol. v., 1754-55) who obtained the formulie

*i0=sin 0-i sin 20-f J sin 30. . . 7r2 0'^*

:r7, – 7 = cos 0 – J COS 20 -f J COS 30 . . .

*In a memoir presented to the Academy of St Petersburg in 1777, but not published until 1798, Euler gave the method afterwards used by Fourier, of determining the coefficients in the expansions ; he remarked that if * is expansible in the form A 4- B cos 0*

*-)-C cos 20-h . ., then A = – f *d0, B = ~ f $ cos tpd(p, &c. ???n-Jo ???n-jo*

The second period in the development of the theory commenced in] 807, when Fourier communicated his first memoir on the Theory of Heat to the French Academy. His exposition of the present theory is contained in

a memoir sent to the Academy in 1811, of which his great treatise the TMorie Analytiqtie de la Chaleur, published in 1822, is, in the main, a reproduction. Fourier set himself to consider the representation of a function given graphi- cally, and was the first fully to grasp the idea that a single function may consist of detached portions given arbitrarily by a graph. He had an accurate conception of the convergence of a series, and although he did not give a formally complete proof that a function with discontinuities is representable by the series, he indicated in particular cases the method of procedure afterwards carried out by Dirichlet. As an exposition of principles, Fourier's work is still worthy of careful perusal by all students of the subject. Paisson's treatment of the subject, which is still adopted in English works (see the Journal de I'ecole Polyteclinique, vol. xi., 1820, and vol. xii., 1823, and also his treatise, TMoric de la Clialeu); 1835),

depends upon the equality j[j(‘ \ .2/, eos"(J- a) + h"

1 /-"❓❓❓ 1 rIT

~2wl /("')'^" + ^ < '' " / /('') cos n(x – a)da

where o < A < 1 ; the limit of the integral on the left-hand side is evaluated when !i = 1, and found to be J{/(.r + 0) +f(x – 0)}, the series on the right-hand side becoming Fourier's Series. The equality of the two limits is then inferred. If the series is as- sumed to be convergent when h = l, by a theorem of Abel's its sum is continuous with the sum for values of /(less than unity, but a proof of the convorgency for A = l is requisite for the validity of Poisson's proof ; as Poisson gave no such proof of convergency, his proof of tlie general theorem cannot be accepted. The deficiency t'iinnot lie removed except by a process of the same nature as that afterwards applied by Dirichlet. The definite integral has been carefully studied by Schwarz (see two memoirs in his collected

works on the Integration of the equation r-j + g-2 = 0), who showed

that the limiting value of the integi-al depends upon the manner in whicli the limit is approached. Investigations of Fourier's Series were also given liy Cauchy (see his ‘ ‘ Mi'iuoire sur les d(5veloppe- nients des fonctions

en series piSriodiques, ” Mim. de I’Inst., vol. vi., also CEuvres computes, vol. vii.) ; his method, which depends upon a use of complex variables, was accepted, with some modification, as valid by Eiemann, but one at least of his proofs is no longer

regarded as satisfactory. The first completely satisfactory in- vestigation is due to Dirichlet; liis first memoir appeared in Crelle’s Journal for 1829, and the second, which is a model of clearness, in Dove’s Mepertorium der Physik. Dirichlet laid down certain definite sufBcient conditions in regard to the nature of a function which is expansible, and found under these conditions the limiting value of the sum of n terms of the series. Dirichlet’s determina- tion of the sum of the series at a point of discontinuity has been criticized by Schlafii (see Crelle’s Journal, vol. Ixxii.) and by Du Bois-Reymond (Mathm. Annalen, vol. vii.), who maintained that the sura is really indeterminate. Their objection appears, how- ever, to rest upon a misapprehension as to the meaning of the sum of the series ; if Xi be the point of discontinuity, it is possible to make x approach Xi, and n become indefinitely great, so that the sum of the series takes any assigned value between the two values /(a;i + 0),/(a;i-0), whereas we ought to make x=xi first and afterwards re=ai, and no other way of going to the double limit is really admissible. Other papers by Dircksen (Grelle, vol. iv.) and Bessel (Astronomische Nachrichten, vol. xvi.), on similar lines to those by Dirichlet, are of inferior importance. Many of the in- vestigations subsequent to Dirichlet’s have the object of freeing a function from some of the restrictions which were imposed upon it in Dirichlet’s proof, but no complete set of necessary and sufficient conditions as to the nature of the function has been obtained. Lipschitz (“De explicatione per series trigonometricas,” Crelle^s Journal, vol. Ixiii., 1864) showed that, under a certain condition, a function which has an infinite number of maxima and minima in the neighbourhood of a point is still expansible ; his condition is that at the point of discontinuity |8, | /0-l-5)-/(/3) |

*Llog5{/(^-^5)-/(**??**}=0, s=o for which Lipsohitz's results would hold. This last condition is adopted by Dini in his treatise {Sopra la Serie di Fourier, &c. Pisa, 1880).*

Tlie modern period in the theory was inaugurated by the publi- cation by Riemann in 4867 of his very important memoir, written in 1854, TJher die Darstellbarkeit einer Function durch eine trigono- metrische Reihe. The first part of his memoir contains a historical account of the work of previous investigators ; in the second part, there is a discussion of the foundations of the Integral Calculus, and the third part is mainly devoted to a discussion of what can be inferred as to the nature of a function respecting the changes in its value for a continuous change in the variable, if the function is capable of representation by a trigonometrical series. Dirichlet and probably Riemann thought that all continuous functions were expansible ; this view was refuted by Du Bois-Reymond (^Abh. der Bayer. Akad., vol. xii. 2). The first to call attention to the im- portance of the theory of uniform convergence of series in con- nexion with Fourier's Series was Stokes, in his memoir " On the critical values of the sums of periodic series ' ' (Camb. Phil. Trans. , 1847 ; Collected Papers, vol. i.). As the method of determining the coefficients in a trigonometrical series is invalid unless the series converges in general uniformly, the question arose whether series with coefficients other than those of Fourier exist which represent arbitrary functions. Heine showed (^Crelle's Journal, vol. Ixxi., 1870, and in his treatise Kugelfunctionen, vol. i.) that Fourier's Series is in general uniformly convergent, and that if there is a uniformly convergent series which represents a function, it is the only one of the kind. G. Cantor then showed {CrelWs Journal, vols. Ixxii., Ixxiii.) that even if uniform convergence be not demanded, there can be but one convergent expansion for a function, and that it is that of Fourier. In the Math. Ann., vol. v., Cantor extended his investigation to functions having an in- finite number of discontinuities. Important contributions to the theory of the series have been published by Du Bois-Reymond (Abh. der Bayer. Akademie, vol. xii., 1875, two memoirs, also in Crelle"s Journal, vols. Ixxiv., Ixxvi., Ixxix.), by Kronecker {Ber- liner Berichte, 1885), by O. HSlder (Berliner Berichte, 1885), by Jordan (Comptes Bendus, 1881, vol. xcii.), by Ascoli {Math. An- nal., 1873, and Annali di Matematica, vol. vi.), and by Genocchi (Atti delta E. Ace. di

Torino, vol. x., 1875). HamUtou's memoir on " Fluctuating Functions " (Trans. B.I. A., vol. xix., 1842) may also be studied with profit in this connexion. A memoir by Bro- d^n (Math. Annalen, vol. lii.) contains a good investigation of some of the most recent results on the subject.

The foregoing historical account has been mainly drawn from A. Sachse's work, " Versuch einer Geschichte der Darstellung willkiirlicher Functionen einer Variabeln durch trigonometrische Reihen," published in Schlomilch^s Zeitschrift fur Mathematik, Supp., vol. XXV., 1880, and from a paper by G. A. Gibson "On the History of the Fourier Series " (Proa. Ed. Math. Soc, vol. xi.). Reiff' s Geschichte der unendlichen Beihen may also be consulted, and also the first part of Riemann's memoir referred to above.

Besides Dini's treatise already referred to, there is a lucid treat- ment of the subject from an elementary point of view in C. Neumann's treatise, Uber die nach Kreis-, Kugel-, und Cylinder- Functionen fortschreitenden Entwickelungen. Jordan's discussion of the subject in his Cours d' Analyse is worthy of attention ; an account of functions with restricted oscillation is given in vol. i. ; see also a paper by Study in the Math. Annalen, vol. xlvii. On the second mean-value theorem papers by Bonnet (Brux. Memoires, vol. xxiii., 1849, Lionville's Journal, vol. xiv., 1849), by Du Bois- Reymond (Crelle's Journal, vol. Ixxlx., 1875), by Hankel (Zeit- schrift fur Math, und Physik, vol. xiv., 1869), by Meyer (Math. Ann., vol. vi., 1872), and by Holder (Gottingen Anzeigen, 1894) may be consulted. On the theory of uniform convergence of series, a memoir by Osgood (American Journal, vol. xix.) may be with advantage consulted. On the theory of series in general, a memoir by Baire (Annali di Matematica, Series III. vol. iii.) is of great importance. (e. w. h.)

Fourmies, a French town, in the arrondissement of Avesnes, department of Nord, 39 miles south-east of Valen- ciennes by rail, on an afl9.uent of the Sambre. It is now one of the chief centres in Trance for wool combing and spinning. Three large establishments have, respectively, about 10,000, 12,000, and 19,000 spindles, while there are several others with upwards of 6000 spindles. A great variety of cloths is produced. The glass- works of Four- mies date from 1599, and were the first established in the

north of France. Iron is worked in the vicinity, and there are important forges and foundries. Population

(1881), 11,016; (1896), 12,957 ; (1901), 13,828.

Fowler, Sir John (1817-1898), English civil en- gineer, was born on 15th July 1817 at Wadsley Hall, near Shefleld, his father being a land-surveyor, who, though living in the neighbourhood of Shefl&eld, was chiefly employed in agricultural matters. At the age of nine John Fowler was sent to Mr Eider's private school near Ecclesfield, where he received a sound elementary education. At sixteen, having always been interested in engineering, he persuaded his father to allow him to go as pupil to John Towlerton Leather, the engineer of the Sheffield water-works. Mr Leather's uncle, Mr George Leather, was engineer of the Great Aire and Calder Navigation Company, of the Goole Docks, and other similar works, and Fowler passed occasionally into his employment, in which he acquired a thorough knowledge of hydraulic engineering. The era of railway construc- tion soon swept both Fowler and his employers into its service, and one of his first employments under Mr G. Leather was to oppose the line of the Midland railway, chosen by the Stephensons, which left Sheffield on a branch line, and was therefore strongly resented by the inhabi- tants. The prestige of the Stephensons carried all before it, but in later life Sir John Fowler had the satisfaction of seeing the opposition of his clients justified, and Shef- field placed on the main line. In 1838 he went into the office of Mr John Urpeth Eastrick, one of the leading railway engineers of the day, where he was employed in designing bridges for the line from London to .Brighton, and also in surveying for railways in Lancashire. In 1839 he went as representative of Mr G. Leather to take charge of the construction of the Stockton and Hartle- pool railway. He remained as manager of this railway after he had superintended its construction, an experience which he afterwards valued highly as being extremely useful as well as probably unique. In 1844 he began his independent career as an engineer, and from the first was largely employed, more particularly in laying out the small railway systems which eventually were amalgamated under the title of the Manchester, Sheffield, and Lincoln- shire. In the course of this work he designed a bridge known as Torksey Bridge, which was disallowed by the Board of Trade inspector,

Captain (afterwards Field- Marshal Sir) Lintorn Simmons, E.E. The engineering profession espoused Fowler's side in the controversy which

followed, and as a result the verdict of the Board of Trade was modified. The episode was the beginning of a warm friendship between these distinguished repre- sentatives of civil and military engineering. Fowler was also engaged in the making of railways in Ireland, and in 1867 he was selected by Mr Disraeli to serve on a commission to advise the Government in respect of a pro- posal for a state-purchase of the Irish railway system. He also carried out considerable works in relation to the Nene Valley drainage and the reclamation of land at the Norfolk estuary. In 1865 he was elected president of the Institution of Civil Engineers, the youngest president who had ever sat in the chair. He was strongly opposed to the project of a Channel tunnel to France, and in 1872 he endeavoured to obtain the consent of parliament to a Channel ferry scheme, whereby trains were to be trans- ported across the strait in large ferry steamers. The proposal involved the making of enlarged harbours at Dover, and Andrecelles on the French coast. The Bill was thrown out by the casting vote of the chairman of a committee of the House of Lords. In 1875 he was enabled to render, in his private capacity, a signal service to the Italian Government, which was much embarrassed by impracticable proposals pressed on it by Garibaldi for a rectification of the course of the Tiber, and other engineer- ing works. Mr Fowler had several interviews with the Italian patriot, and persuaded him of the impracticable nature of his plan, thereby obtaining for the Government leisure to devise a more reasonable scheme. These, how- ever, were minor employments. Fowler will chiefly be remembered as the engineer of the London Metropolitan railway and (along with his partner. Sir Benjamin Baker) of the Forth Bridge, and from his engagement for eight years from 1871 as general engineering adviser to the Government of Ismail, the Khedive of Egypt. The Metropolitan was a pioneer effort in underground rail- ways. The noteworthy point about it is, that it was m.ade not by tunnelling, but by excavating from the sur- face and then covering in the permanent way

with build- ings and roads. Sir John lived to be one of the engineers ofl3.cially connected with the deep tunnelling system ex- tensively adopted in London for deep electric railways. Though his engagement in Egypt resulted in the com- pletion of no great work, it is of considerable historical and economic interest. He projected a railway to the Sudan, and also the reparation of the barrage. These and many other plans came to an end owing to financial reasons. But the maps and surveys for the railway were given to the War OflBce, and proved most useful to Lord Wolseley in his Nile expedition. For this service Fowler was made K.C.M.G. (1885). On the completion of the Forth Bridge he was made a baronet (1890). Sir John Fowler was a great practical rather than a great scientific engineer. He was reaching man's estate when railway construction began, and the hour belonged to the great organizer as well as to the great inventor. He was a man of very catholic powers of enjoyment, his profession, society, sport, and the making of his highland home at Braemore, being all keen sources of pleasure. He died at Bournemouth on 20th November 1898. (t. m.)*

Fox Channel, an inlet separating the southwestern portion of Baifin Land, known as Fox Land, from South- ampton Island and Melville Peninsula, extends from about 64 to 69 N. lat. and from 75 to 81 W. long. It is connected with the Gulf of Boothia by Fury and Hecla Strait.

Fox, Sir William (1812-1893), New Zealand states- man, was the third son of George Townshend Fox, deputy- lieutenant for Durham county. He was born in England on 9th June 1812, and educated at Wadham College, Ox-

ford, where he took his B.A. in 1832, proceeding to his M.A. seven years later. Called to the bar in 1842, he emigrated immediately thereafter to New Zealand, where, on the death of Captain Arthur Wakefield, killed in 1843 in the Wairau massacre, he became the New Zealand Company's agent for the South Island. While holding this position he made a memorable exploring march on foot from Nelson to Canterbury, through Can- nibal Gorge, in the course of which he discovered the fertile pastoral country of Amuri. In 1848 Governor Grey made Fox attorney-general,

but he gave up the post almost at once in order to join the agitation, then at its height, for a free constitution. As the political agent of the Wellington settlers he sailed to London in 1850 to urge their demands in Downing Street. The Colonial Office, however, refused to recognize him, and, after publishing a sketch of the New Zealand set- tlements, Tlie Six Colonies of New Zealand, and travel- ling in the United States, he returned to New Zealand and again threw himself with energy into public affairs. When government by responsible ministers was at last initiated, in 1856, Fox ousted the first ministry and formed a cabinet, only to be himself beaten in turn after holding office but thirteen days. In 1861 he regained office, and was somewhat more fortunate, for he remained premier for nearly thirteen months. Again, in the latter part of 1863 he took office : this time with Sir Freder- ick Whitaker as premier, an arrangement which endured for another thirteen months. Fox's third premiership began in 1869 and lasted until 1872. His fourth, which was a matter of temporary convenience to his party, lasted only five weeks in March and April 1873. Soon afterwards he left politics, and, though he reap- peared after some years and led the attack which over- threw Sir George Grey's ministry in 1879, he lost his seat in the dissolution which followed in that year, and did not again enter parliament. He was made K.C.M.G. in 1880. For the thirty years between 1850 and 1880 Sir William Fox was one of the half-dozen most notable public men in the colony. Impulsive and controversial, a fluent and rousing speaker, and a ready writer, his warm and sympathetic nature made him a good friend and a troublesome foe. He .was considered for many years to be the most dangerous leader of the Opposition in the colony's parliament, though as premier he was at a disadvantage when measured against more patient and more astute party managers. His activities were first devoted to secure self-government for the New Zealand colonists. Afterwards his sympa- thies made him prominent among the champions of the Maori race, and he laboured indefatigably for their rights and to secure permanent peace with the tribes and a just settlement of their claims. It was during his third premiership that this peace, so long deferred, was at last gained, mainly through the influence and skill of Sir Donald M'Lean, native minister in the Fox cabinet. Finally, after Fox had left parliament he devoted himself, as joint-commissioner with Sir Francis Dillon Bell, to the adjustment of the native land>claims on the west coast of the North

Island. The able reports of the commissioners were his last public ser- vice, and the carrying out of their recommendations gradually removed the last serious native trouble in New Zealand. When, however, in the course of the native wars from 1860 to 1870 the colonists of New Zealand were exposed to cruel and unjust imputations in England, Fox zealously defended them in a book. The War in New Zealand (1866), which was not only a spir- ited vindication of his fellow-settlers, but a scathing criti- cism of the generalship of the officers commanding the imperial troops in New Zealand. Throughout his life Fox

was a consistent advocate of total abstinence. It was he who founded the New Zealand Alliance, and hQ undoubt- edly aided the growth of the prohibition movement after- wards so strong in the colony. He died 23rd June 1893, exactly twelve months after his wife, Sarah, daughter of William Halcombe. (w. p. b.)

Fraga, a to-wn of Spain, in the province of Huesca, on the river Cinca, on a high-road from Madrid to Barce- lona. Population in 1897, 6792. There is trade in wheat, oil, hemp, fruit (for which it is famed), pigs, and cattle, and the local manufactures of linen, wool, soap, frieze, and bricks. Its streets are narrow and steep.

The only important buildings are the town hall, the old parish church, formerly a mosque, and several convents.

Framingham, a town of Middlesex county, Massa- chusetts, U.S.A., has an area of 27 square miles of hilly surface, dotted with lakes and ponds. There are included within it three villages ◆◆◆ Framingham Center, Saxonville, and South Eramingham, the last being the most important. In this village intersect the Boston and Albany and a branch of the New York, New Haven, and Hartford railways. Population (1880), 6235; (1890), 9239; (1900), 11,302, of whom 2391 were foreign- born.

FRAJN^OE.

1. Geography and Statistics.

ON the western shore of Europe, between 51 ́́ 5′ and 42 ́́ 20′ N. lat., and 4 ́́ 42′ W. and 7 ́́ 39′ E. long., Erance is bounded on the N. by the English Channel and the Strait of Dover, on the N.E. by Belgium and Luxem- bourg, on the E. by Alsace-Lorraine (Germany), Switzer- land, and Italy, on the S. by the Mediterranean and Spain, and on the W. by the Atlantic Ocean. Its greatest length, from the eastern extremity of the shore of France on the North Sea to the Serre de la Baque de Bor- deillat in the Pyrenees-Orientales, is 605 miles ; its greatest breadth, from the Pointe de Corsen on the west of Brittany to the easternmost point of the crest of the Vosges to the east of the village of Lubine, 552 miles. Total area 204,146 square miles (official sur- vey), 207,081 (revised estimate of the ministry of War), or 207,170 (see table below).

Forests. ́́́ In relation to its total extent, Erance pre- sents but a very limited area of forest land, amounting to only 34,220 square miles. Included under the denomi- nation of “forest” are lands ́́́ surfaces boisies ́́́ whidh are bush rather than forest. The most wooded parts of Erance are the plateaux of the east and of the north-east, comprising the Eorest de Haye, he Eorest of Ardennes, and the Eorest of Argonne. In the Parisian region there are the Forests of Compiegne (66 square miles), of Villers- CotterSts, of Eontainebleau, &c. The Central Mountains and the Jura have still some considerable belts of wood, such as Mercoire, Aubrac, Chaux, no one forest, however, exceeding 45 square miles. The ForSt d’Orleans covers 152 square miles. The Alps and Pyrenees are in large part deforested, but efforts are being made in the way of reafforestation, &c., to minimize the effects of avalanches and sudden floods. Such are the remarkable labours in connexion with the Devoluy and Cauterets. Between 1870 and 1900 more than 1200 square miles were re- planted with various species of trees. The revenue of the forests, public and private, is estimated (1901) at ́́10,000,000. The value of the forest domain of the state exceeds ́́48,000,000. The production of the woods and forests, covering altogether about 17-88 per cent, of the entire surface of the country, is reckoned to amount annually to fully 32 millions of cubic yards ́́́ an amount, however, still short by at least 8 millions of the consumption.

Climate. ❓❓❓ Climatically, France is distinguished into two principal regions ❓❓❓ that of the Atlantic, and that of the Mediterranean climate. It is further subdivided into local climates, generally grouped under the following seven designations: ❓❓❓ (1) Parisian or Sequan climate, with a mean temperature of 50❓❓ F. ; winters cold, summers mild; (2) Breton climate, with a mean temperature of

51-8❓❓ E. ; winters mild, summers temperate, frequent rain ; (3) Girondin climate (characterizing Bordeaux, Agen, Pan, &c.), having a mean of 53-6❓❓ E. ; mild winters and hot summers ; (4) Auvergne climate, comprising Cevennes, Plateau Central, Clermont, Limoges, and Eodez ; mean temperature, 51-8❓❓ F. ; with cold winters and hot summers ; (5) Vosges climate (comprehending ^fipinal, Mezieres, and Nancy), having a mean of 48-2❓❓ E.; long and severe winters, with hot summers; (6) Rhone climate (ex- perienced by Lyons, Grenoble, and Bourg d'Oisans) ; mean temperature, 61-8❓❓ F. ; cold and wet winters, hot summers ; (7) Mediterranean climate, ruling at Valence, Nimes, Nice, and Marseilles ; mean temperature, 57-5❓❓ E.; mild winters and hot summers. This classification of the climate, which is the one of common acceptation, seems more precise and more practical than the old division according to the different zones of vegetation.

*Geology. ❓❓❓ Geologically, France may be distributed as follows : ❓❓❓ (1) Volcanic regions, comprising the mountains of Auvergne, of Cantal, and of Velay ; (2) the regions of Primitive rocks, comprehending the (Jevennes, the Plateau Central, Pyrenees Centrales, the Alpine massifs Oisans, and of Mont Blanc, Vendue, and Brittany ; (3) the regions of Primary rocks in Brittany, Cotentin, the Western Pyrenees, and Ardennes; (4) the regions of coal in the departments of Nord and Pas-de-Calais, in the Lyonese basin, and in patches in the plateaux of Cevennes ; (5) the regions of Jurassic rocks in the Jura, Cote-d'Or, the plateaux adjacent to the Cevennes, Normandy, and the Alps of Vercors and Devoluy ; (6) the regions of Cretaceous rocks in Champagne, Picardy, and Corbiferes ; (7) the regions of Tertiary strata in the lie de France, in the Landes, and in Perigord ; (8) the regions of Quaternary layers in the basins of Paris, of Lyons, and of Toulouse. **

Utilization of the Soil. ??? The entire surface of France measuring 204,092 square miles, the part laid out in agriculture, gardens, and prairies comprises 147,322 square miles, and in forests 34,220 square miles ; the re- mainder, or 22,550 square miles, i.e., about 11 per cent, of the whole surface, lying waste or uncultivated.

Flora and Fauna. ??? The indigenous flora comprises the ash, linden, oak, and chestnut in Northern and Central France ; the yew, plane-tree, &c., in Southern France. The indigenous fauna includes the bear, now very rare, but still found in the Alps and the Pyrenees ; the wolf, harbouring in the Cevennes and the Vosges mountains ; the fox, the marten, the wild boar, the stag, the hare, and the rabbit. Among the birds are the eagle, the kite, the partridge, and the lark. Of the smaller reptiles may be mentioned the viper, the snake, and the lizard.

Geography and Human Culture. ??? The populations of

the high plateaux, of the lands of granitic formation, and of raw climates, such as the people of Limousin or Auvergne in Central France, or of Lorraine in the east, are taller, robuster, ruder, and more weather-beaten, but also less vivacious, less versatile, less disposed to innova- tion, than are the inhabitants of the great plains of the Seine and the Loire, of maritime Languedoc, and the shores of the Mediterranean. This distinction of type and temperament, exemplified in the most striking manner in the contrast between the Vosgian and the Marseillese men, is carried also into the plane of politics, determining the one set of people as Conservatives, the other as Radicals. The great cities have all, or nearly all, arisen at the confluence of rivers, at easy altitudes, or along the sea-coasts where at once the temperature is more moderate and communication with foreign countries of readier and larger attainment. The three great metal- lurgic areas of France ??? those of the Nord and Pas-de- Calais, the Saone-et-Loire, and the Lyonnais ??? are

planted on regions of coal formation, and, on the other hand, the domains on which cattle are reared ??? in Brittany, Lorraine, and the Central Plateau ??? rest on crystalline or Jurassic strata. On the Cretaceous and Tertiary deposits ??? in the lie de Prance, Orleanais, Picardy, the riverine hills of the Garonne and the Gironde ??? is found the fertile land waving in wheat or mantled with vines.

Population. ??? The population of France, 36,905,788 in 1876, numbered 36,672,048 in 1881, 38,218,903 in 1886, 38,342,948 in 1891, 38,617,975 in 1896, and 38,595,500 in 1901. The following table gives the area in English square miles of each of the eighty-seven departments, with its population according to the census returns of 1881, 1896, and 1901 (provisional) : ???

Departments.

11

Population.

lis

y 3

1881.

1896.

1901.

Its

Ain .

2249

363,472

351,569

349,205

156-3

Aisne

2868

556,791

541,613

534,204

188-8

Alller

2899

416,759

424,378

421,074

148-9

Alpes, Basses- .

2699

131,718

118,142

112,763

43-8

Alpes, Hautes- .

2178

121,787

113,229

106,857

52-0

Alpes-Maritiuies

1444

226,621

265,155

320,822

183-6

Ardfeche .

2145

376,867

.363,501

349,961

169-5

Ardennes

2028

.33.3,675

318,865

314,056

157-2

Arifege

189.3

240,601

219,641

202,284

116-0

Aube

2327

255,326

251,436

245,696

108-1

Aude

2448

327,942

310,513

311,386

126-8

Aveyron .

.3386

415,075

389,464

377,559

115-0

Bouches-du- I Rhane . /

2026

589,028

673,820

737,112

332-6

Calvados .

2198

439,8.30

417,176

407,639

189-8

Cantal

2230

23g,190

234,382

218,941

105-1

Charente .

2306

370,822

356,236

344,376

154-5

Charente-IiiK- \ rieure . /

2792

466,416

453,455

446,294

162-4

Cher .

2819

351,405

347,725

342,889

123-4

Corrfeze

2273

317,066

322,393

304,718

141-8

Corse (Corsica).

3368

272,639

290,168

276,829

86-2

Cate-d'Or .

3392

382,819

368,168

358,708

108-5

C8tes-du-Nord .

2787

627,585

616,074

597,032

221-1

Creuse

2164

278,782

279,366

259,138

129-1

Dordogne .

3561

495,037

464,822

448,545

130-5

Doubs

2052

310,827

302,046

296,957

147-2

Dr6me

2533

313,763

303,491

294,704

119-8

Eure .

2331

364,291

340,652

331,184

146-1

Eure-et-Loir

2293

280,097

280,469

272,624

122-3

Finistfere .

2730

681,564

739,648

763,193

270-9

Card .

2270

415,629

416,036

418,470

183-3

Garonne, Haute-

2458

478,009

459,377

439,769

186-9

Gers .

2429

281,532

250,472

236,204

103-1

Gironde

Carry forward

4141

748,703

809,902

820,781 12,251,874

195-6

83,717

12,468,768

12,:!!)8,:-t

Departments.

Brought forward H&ault

Ille-et-A^ilaine . Indre

Indre-et-Loire . Isfere . Jura . Landes Loir-et-Cher Loire

Loire, Haute- . Loire-Inf^rieure Loiret Lot .

Lot-et-Garonne . Lozfere

Maine-et-Loire . Manohe Marne

Marne, Haute- Mayeime . Meurthe – et – 1

***Moselle Meuse Morbihan Nifevre Nord . Oise . Orne. Pas-de-Calais . Puy-de-D6nie PyrfinSes, ***

***Basses- .) Pyr&^es, ***

***Hautes- . / Pyr^nfes – Ori- ***

entales . / Rliin, Haute- “1

(Belfort) (RhSne

Sadne, Haute- . Sa8ne-et-Loire . Sarthe Savoie

Savoie, Haute- . Seine

Seine-Inffirieure Seine-et-Marne . Seine-et-Oise Sfevres, Deux- Somme Tarn

Tarn-et-Garonne Var . Vaucluse . Vendfie Vienne Vienne, Haute- .

^OJ

Yonne

Total

83,717

2403

2699

2666

2377

3180

1951

3615

2479

1853

1931

2695

2630

2018

2079

1996

2812

2475

3168

2416

1987

2037

2409 2739 2659 2229 2272 2372 2606 3090

2978 1750 1599

235

1104 2075 3331 2412 2389 1775 185 2448 2273 2185 2338 2423 2232 1440 2334 1381 2692 2712 2120 2305 2804

Population.

1881.

12,468,768 441,527 615,480 287,705 329,160 580,271 285,263 301,143 275,713 599,836 316,461 625,625 368,526 280,269 312,081 143,565

523,491 526,377 421,800 254,876 344,881

419,317

289,861 521,614 347,576 1,603,259 404,555 376,126 819,022 566,064

434,366 236,474 208,855

74,244

741,470 295,905 625,589 438,917 266,438 274,087 2,799,329

[illegible]^814,068

348,991 577,798 350,103 550,837 359,223 217,056 288,677 244,149 421,642 340,295

349,3:a

406,862 357,029

12,393,384 469,684 622,039 289,206 337,064 568,933 266,143 292,884 278,153 625,3.36 516,699 646,172 371,019 240,403 286,377 1.32,151 514,870 500,052 439,577 232,057 321,187

466,417

290,384 552,028 333,899 1,811,868 404,511 339,162 906,249 555,078

423,572 218,973 208,387

88,047

839,329 272,891 621,.337 425,077 259,790 265,872 3,340,514 837,824 359,044 669,098 346,694 643,279 339,827 200,390 309,191 236,313 441,735 338,114 375,724 421,412 332,656

1901.

12,251,874 488,285 611,477 286,961 334,073 563,813 259,212 291,657 274,836 644,532 306,671 656,998 36,3,812 223,736 276,607 124,049 513,208 488,361 432,850 224,888 311,207

484,002

28.3,136 557,934 319,506 1,877,647 405,642 325,445 949,968 529,181

423,164

212,173 209,447

91,765

835,157 265,179 616,389 422,944 249,460 259,595 3,599,870 843,928 355,638 700,405 339,340 534,101 326,396 194,458 325,490 235,457 439,637 333,896 374,212 419,784 316,047

207,170 37,672,048 38,517,975 38,595,500

p 9^

195-5 230-5 108-5 141-8 178-9 136-4

81-0 112-2 337-5 267-6 239-8 141-1 119-1 137-7

66-2 183-1 202-0 138-8

96-1 161-6

229-0

120-5 201-5 125-6 812-9 178-0 1430 347-8 179-6

142-2 125-1 130-3

387-4

760-3 131-5 186-5 176-2 108-7 149-8 18056-8 342-2 158-0 306-2 148-3 224-2 152-3 139-2 132-5 171-1 164-1 124-7 177-2 182-8 114-9

186-0

The greater number of the French departments showed a decline in their population from 1881 to 1901. Those in which the decrease of population was most marked were: Basses-Alpes (18,955), Ariege (38,317), Aveyron (37,516), Dordogne (46,492), Eure (33,107), Gers (45,331), Lot (56,533), Orne (50,681), Yonne (40,982), departments all of them purely agricultural, lacking large cities as nuclei for population to rally round. The departments, on the other hand, showing an increase in their population were those in which the industries are developed, and in which, consequently, are centres of large population. While 38,517,975 re- presented the legal population (present and absent) of

statistics]

FRANCE

465

France at the census of 1896, the population actually present at that date was only 38,269,011, or 248,964

Of the population in 1896, 18,922,651 were males and 19,346,360 females, an excess of females over males of 423,709, i.e., a little more than 11 per 1000, or about 506 females to every 494 males : a normal population pretty closely exemplified in all past censuses. The departments in which the female surplusage was most notable were Seine, with 151,073, or 9-5 per cent., more females than males out of a population of 3,308,007. Next, in less proportions, were Seine-Inferieure, with a surplus of 28,454 females out of a population of 829,364 ; Somme, with 12,835 females in excess among a population of 540,415 ; Manche, with a female surplus of 11,148 ; Haute- Garonne, 15,325 ; Morbihan, 13,893 ; Orne, 9868 ; Nord, 18,115. On the other hand, the male population pre- dominated in Basses-Alpes to the number of 6981 out of a population of 117,619 ; in Hautes-Alpes, where the males outnumbered

the females by 6113 ; Corsica, with a surplus of 6113 males ; Drome, with 6076 more males than females; Jura, 3139 males in excess; Haute-Ehin (Belfort), 6379 ; Meurthe-et-Moselle, 22,117.

In respect of nationality again, there were among the 38,269,011 inhabitants in 1896, 37,217,104 per- sons of French nationality ; the remainder, 1,051,907, i.e., 27 per 1000, being foreigners. All the departments included foreigners in their population : Calvados, in the north, numbering 1471 ; Cher, in the centre, 628 ; Alpes- Maritimes, in the south-east, 72,265 ; Bouches-du-Ehone, 94,728 ; Nord, 269,916 ; Seine, 191,687. The department having the largest infusion of foreigners is Alpes- Maritimes, in which 72,266, or 25 per cent., of the population is foreign.

The following table shows the dlstrihution of the population according to their condition in respect of marriage : ???

/"Single . J Married j Widowers (.Divorced

j- Single .

T- 1 Married Females j^i^^^g

(.Divorced

In respect of age, there were counted in 1896, 3,302,797 boys and 8,297,879 girls of less than ten years of age ; 4,969,841 males and 5,065,994 females from ten to twenty-five years of age ; and 10,644,687 men and 10,976,426 women from twenty-five years of age upwards. According to another division, there were, in 1896, 6,990,101 males and 7,009,533 females of less than twenty-one years of age ; 1,623,805 males and 1,437,618 females from twenty up to twenty-four years of age; and 10,649,013 males and 10,982,487 females from twenty-five years of age and upwards ; 40 men and 186 women were centenarians.

The following table shows the distribution of the active popula- tion of France according to their occupations in 1896 -. ???

Males

10,195,788, i

7,689,997, 1,011,313, 25,553,

e., 266-6 per

, 201 , 26-35 0-65

1000 inhabitants.

9,465,874,

7,728,854,

2,118,394,

33,238,

, 247-4 , 202 , 55-4 , 0-81

Occupations.

Males.

Females.

Total.

Forestry and agriculture

5,674,713

2,755,346

8,430,059

Manufacturing industries

3,488,077

1,890,292

5,.378,.369

Trade ....

1,030,977

572,840

1,608,817

Domestic service

217,197

751,867

969,064

Transport

551,731

160,880

712,611

Public service

584,134

104,959

689,093

Liberal professions

199,546

189,630

389,176

Mining, &c.

222,040

4,775

226,815

Fishing .

66,388

5,238

71,626

tJnclassed

26,318

20,890

46,708

Grand total

12,061,121

6,406,217

18,467,338

In 1901 there were in France fifteen towns having each more than 100,000 inhabitants. Their growth from 1876 to 1901 is shown in the

following table : ???

1876.

1886.

1901.

Paris . ....

1,988,806

2,344,550

2,660,559

Marseilles

318,868

876,143

494,769

Lyons

342,815

401,930

453,145

Bordeaux

215,140

240,582

257,471

Lille

162,775

188,272

215,431

Toulouse St ^fetienne

131,642

147,617

147,696

126,019

127,482

146,671

Le Havre

92,068

112,074

129,044

Nantes

122,247

122,750

128,349

Nice

63,397

77,278

125,099

Roubaix

83,661

100,299

124,660

Rouen

104,898

107,163

115,914

Rheims .

81,328

97,903

107,730

Nancy .

66,303

79,038

102,463

Toulon

61,382

70,122

101,172

In the same years the following thirteen towns, now from 0,000 to 100,000 inhabitants, each had : ???

1876.

1886.

1901.

Amiens ....

66,896

80,288

90,038

Limoges

59,011

68,477

83,569

Angers

56,846

73,044

82,966

Brest .

66,828

70,778

81,948

Nimes .

63,001

69,698

80,355

Tourcoing

33,895

58,209

79,468

Montpellier

55,258

56,765

76,364

Rennes

63,598

66,232

74,006

Dijon .

45,607

70,428

Grenoble

43,064

52,484

68,052

OrMans

62,157

60,826

67,589

Tours .

48,325

64,448

Le Mans

45,709

59,585

62,948

There were, besides, forty-one towns each having a population in 1901 of more than 30,000. The rural population in 1896 amounted to 23,492,123, or 60-9 per cent, of the entire popula- tion. The rural and urban population in 1872 were, the former 68-7, the latter 31-3 per cent, of the

whole. There has accord- ingly been a very marked withdrawal of population from the country to the cities.

Movement of Population.

There were the following living births in France in the years specified : ???

1874.

1881.

1891.

1899.

954,652

937,057

823,906

847,267

The yearly numerical mean of births for each of the follovring quinquennial periods was : ???

1881-86.

1886-91.

1891-96.

932,000

884,000

877,000

These figures indicate a steady decrease.

The following were the numbers of legitimate and illegitimate births in the years specified : ???

1891.

1899.

Legitimate Illegitimate .

758,969 73,936

772,657 74,970

There were the following number of deaths in the years speci- fied : ???

1881.

1891.

1899.

828,828

876,882

816,233

The quinquennial mean of deaths fell from 841,000 for the period 1881-86 to 836,000 for the period of 1891-96. In 1881 the number of births exceeded the number of deaths by 108,229, and in 1896 by 93,700. The years 1891, 1892, and 1895 yielded an excess in the number of deaths over the number of births. In 1879 the number of still-bom was 39,778 ; in 1882, 44,362 ; in 1886, 43,623 ; in 1891, 42,472 ; in 1896, 42,054 ; in 1899, 39,860. The

[statistics

birth-rate in 1899 was 22-1 per 1000; the death-rate 21-2 per

1000.

Marriage and Divorce. ??? The numher of marriages registered in France amounted to 282,079 in 1881, 285,458 in 1891, and 295,752 in 1899, indicating a slight progress in the number of marriages. The number of divorces, 2950 in 1886, rose to 5752 in 1891, and 7179 in 1899.

Emigration. ??? The following figures of emigration are quoted from the statements of the ministry of the Interior. The statistics of emigration are, however, not drawn up in a strictly regular method, and the figures may therefore be taken with a certain reserve. In 1857-91 there were 285,873 French emigrants : in 1892, 5528 ; in 1893, 5300 ; in 1898, 4400.

Immigration. ??? There are no official annual statistics taken of the immigration into France any more than of the emigration from France. All that can be done is to cite the figures given in the census returns as to the number of foreigners on French territory. The foreigners in France numbered in the years named : ???

13S1.

1886.

1891.

1896.

1,001,090

1,126,531

1,130,211

1,051,907

In explanation of the last figures, it is to be remembered that the law of 1889 providing for automatic nationalization has contri- buted somewhat to the apparent diminution in the magnitude of the figures. In 1891 there were in France 39,687 English, 83,333 Germans, 465,860 Belgians, 286,042 Italians, and 83,117 .Swiss. It is the Belgians and the Italians who have contri- buted the greatest number to the alien population in France since

1870.

Constitution. ??? The constitution of 1875, modified though it was in 1879 and 1884 in certain points, such as the suppression of senatorships which were irremovable and of the election of the Senate itself, has yet in its essential elements remained unchanged. From 1885 to 1889 the election of deputies was made on the plan of the scrutin de liste dipartementale, according to which each elector votes for as many deputies as the entire department returns to the Chamber; but in 1889 the scrutin uninominal, or one elector one vote, was re-estab- lished. In 1880 there were the following ministries, or heads of the great administrative departments ??? the Minis- tries of Justice, of the Interior, of Foreign Affairs, Finance, War, Marine and Colonies, Public Instruction, the Fine Arts and Worship, Agriculture and Commerce, and Public Works. Since then there have been consti- tuted the separate ministries of Agriculture and of the Colonies, ministries which have become of extreme im- portance. France is divided into 87 departments, 360 arrondissements, 2865 cantons, and about 36,000 com- munes. The departmental organization has remained unchanged since 1875. Only one slight modification has been effected, the suppression of the arrondissements of St Denis and of Sceaux in the department of the Seine. The powers of the elected assemblies or general councils (conseils gendraux) and their permanent delegations (com- missions dipartementales) have remained to the present unaltered, though there is a large current of opinion in favour of administrative decentralisation. On the other hand, the communal organization has been very markedly transformed by the law of 1884,

which has increased the prerogatives of the municipal councils. This law, how- ever, does not apply to Paris, which continues to be ruled by the former regulations. The municipal councils, representing the communes, comprise, according to the size of their population, from ten to thirty-six members. They formulate resolutions which either have the execu- tive force of law, or need for their validity the sanction of the prefect. In all towns, whether large or small, the mayors are elected by the minicipal council. The mayors are at once officiers de I'cHat-civil, executors of the decisions of the municipal council, judicial magis- trates, and representatives of the central power. The

number of deputy-mayors (adjoints) has been modified by the law of 1884 : it is one in a commune of 2500 inhabitants, and two in a commune of from 2501 to 10,000. In communes of greater population there is in addition one deputy-mayor for everj^ 25,000 inhabitants beyond that number, but in no case must the total exceed twelve, excepting at Lyons, where as many as seventeen are allowed.

Justice. ??? The judicial organization of France has un- dergone no alteration since the ninth edition of this work was published. According to the Statistics of Justice (1897), justices of the peace had, in 1897, 342,417 causes to hear; the civil tribunals 181,818, of which they settled 142,856 ; while the courts of appeal had to sit in trial on 21,848, of which 12,047 were deter- mined. The number of judicial distraints {ventes judi- ciaires) was 23,988. The petitions for divorce and legal separation reached the number of 11,940. The com- mercial courts, again, had 209,066 disputed causes brought before them for decision, and settled 190,966 of them. The applications for bankruptcy and judicial liquida- tions numbered 17,342. In 1897 there were 3453 per- sons charged before the assize courts, and of them 980 were condemned for crimes against the person, and 1398 for crimes against property. Of these 2378 persons who were condemned, 2139 were males and 239 females. There were, further, 225,013 persons prosecuted for offences before the correctional courts (tribimaux correc- tionnels), and of these 207,926 were condemned to either fine or imprisonment. Theft alone furnished 43,677 charges ; vagrancy and mendicity, 25,783. The common police cases numbered 386,276. The cases of felonious homicide in France throughout the quinquennial

period (1892-97) have averaged 1-26 per 1000 inhabitants. The departments furnishing the smallest contingent of such eases were Jura (0-40 per cent, of the total number), Pyrenees-Orientales (0-31), and Mayenne (0-14). The departments, on the other hand, contributing the largest number of such cases were Bouches-du-Rhone (2 per cent, of the total number), Nord (2), Corsica (8), and Seine (9). Fourteen persons were in 1897 condemned to death, and of this number ten had their sentence commuted. The administration of the prisons is regu- lated by the law of the 9th June 1875, the first article of which enjoins that thenceforth the accused shall be kept separate from one another day and night. The condemned are subjected to individual imprisonment in cases in which the sentence pronounced upon them is for less than a year and a day. In case of the penalty exceeding the term of a year and a day, the condemned may claim the application of the same rigime, and then by law his sentence is reduced by a quarter. The same law of 1875 has ordained the reconstruction of the metropolitan prisons, but the execution of this ordinance is not yet accomplished. Since the passing of the law of 1886, the rdcidivistes, those, namely, who, having been already condemned become guilty of new crimes or offences, are transported to the French colonies. The penitentiary population of the metropolis in both the central and departmental prisons (piaisons) amounted on the 1st of January 1899 to the number of 33,695. The jiroduce of prison labour in 1898 exceeded the value of 4,046,000 francs.

Religion. ??? The total expenditure set down in the state budget towards the support of the four recognized reli- gious confessions (Roman Catholic, Calvinist, Lutheran, and Hebrew), together with the Mussulman confession in Algeria, an expenditure attached sometim es to the ministry of Public Instruction, sometimes to that of the Interior, and sometimes to that of Justice, amounted in 1901 to a little over 43 million francs. In recent years several

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amendments have been laid before the Chamber, aiming at the suppression of this item of the budget, but all have been rejected.

Roman Catholic. ??? The cures, though appointed by the bishops (whose nomination by the President of the Eepublio has to be con- firmed by the canonical institution of the Pope), have also to be accepted by the Government. There are in France 17 archbishops, receiving a salary each of 15,000 francs ; under them are 67 bishops, with a salary each of 10,000 francs. The archbishops and bishops are assisted by 685 vicars, whose stipends range severally from 2500 to 4500 francs. Attached to each cathedral church, more- over, whether episcopal or archiepisoopal, are chapters of canons ??? orders doomed to ultimate extinction. In 1901 they numbered 695. The inferior orders comprise the cures (drawing salaries of from 1200 to 2400 francs each) to the number of 3451, desservants and curates (vicaires) to the number of 38,002. The total strength of the Roman Catholic clergy in France accordingly exceeds 42,000 persons. They are recruited from the seminaries, which are dis- tinguished from one another as great and little, according to the grade of instruction they impart. The total grant made by the State to the Roman Catholic clergy amounts to about 41 mill- ion francs. The regular clergy are subdivided into congregations, recognized and non-recognized, the latter existing onlyMby the tolerance of the Government. According to statistics published in 1900 by the ministry of the Interior, there were 127 congrega- tions of men, 97 of which are not recognized, and 1276 congrega- tions of women, of which 784 are not recognized. No table of the number of members associated with these has been drawn up, but it is estimated that the number of both sexes is about 150,000. The value of the known real estate belonging to convents is 107 1 mill- ion francs, and that of the personal estate is at least 8000 million francs. Lastly, notwithstanding legal proscriptions, the Jesuits, reorganized, have established themselves in forty-eight departments.

Protestants. ??? The two protestant forms of worship figure in the budget together at about 1,500,000 francs. The Reformed or Calvinist confession includes 628 pastors, who are paid salaries of from 1800 to 3000 francs a year. The Augsburg or Lutheran Church counts 62 pastors, paid at the same rate as the Calvinist pastors.

Jews. ❖❖❖ ^The Hebrew Church costs the State yearly about 150,000 francs. Its service is conducted by 10 chief rabbis, receiving from 4000 to 12,000 francs each ; 24 ordinary rabbis, paid from 1750 to 2500 francs each ; and 23 officiating ministers, with salaries of from 600 to 2000 francs each.

Precise statistics are wanting of the number of followers of each confession. The Eoman Catholics of France may be counted at 36 millions, the Protestants at 2 millions. As to the Hebrew Church, its followers are variously esti- mated at 50,000 and 100,000 ; more probably their num- ber will be about 80,000. The Protestants have their chief seat in the departments of the centre and of the south along the range of the Cevennes. In this region Kimes is the most important centre. Considerable sprink- lings of them are also to be found in the two Charentes, in Dauphine, in the Seine, and in Franche-Comte. The localities in which the Jews are most common are Paris, Lyons, and Bordeaux. There are also small groups of them in Provence, Lorraine, and Champagne.

Education. ❖❖❖ Since the 16th May 1877 ❖❖❖ a critical date in the history of the Third Eepublic ❖❖❖ profound changes have been introduced into the organization of public instruction. Along with the colonial expansion of France and the remodelling of its army, this transformation in education is the most considerable enterprise undertaken by the Government. To characterize the new departure in few words, public instruction has been developed in all directions and withdrawn as much as possible from the influence of the Church. Education of a primary kind has been made free and obligatory. Paul Bert and Jules Ferry are names associated with a thorough organic reconstruc- tion which provoked many controversies and commotions.

General Organization. ❖❖❖ At the head of public instruction is the minister of State, entitled the Grand-Master of the University. He is assisted by the Superior Council of Instruction. This body has been reorganized in a lay sense by the law of the 27th February 1880, and comprehends, in addition to the minister-president, five members of the Institute of France, nine persons designated by writ of the President of

the Eepublic, forty professors of the three degrees of public instruction elected by their colleagues, and four

delegates of free education. The whole territory of France is divided into sixteen academical districts, having their centres respectively at the seats of the academies, which by the law of 1896 have been transformed into universities. The capitals of these academic districts are Paris, Atx, Besan9on, Bordeaux, Caen, Chamb^ry, Clermont-Ferrand, Dijon, Grenoble, Lille (formerly Douai), Lyons, Montpellier, Nancy, Poitiers, Rennes, Toulouse. "Within the jurisdiction of each rector of a district are the three orders of instruction. He is assisted by an Academic Council which, like the Superior Council, was reorganized in 1880, and comprises, besides the rector-president, the district inspectors and a variable number of members nominated or elected. The district inspectors are each placed at the educational head of the depart- ments constituting his academic district. Like the Superior Council, the Academic Councils exercise functions consultative and disciplinary. The budget of public instruction amounted in 1901 (in round numbers) to 206^ million francs. In 1847 it stood at 18 millions, in 1877 at 57 millions, in 1886 at 150 millions.

Superior Education. ??? This is given in the first place by the universities, which themselves comprise a variable number of faculties, namely, Law, Medicine, Theology, Letters, and Sciences. The degrees they confer are those of bachelor, licentiate, and doctor. A fellowship (agregation) is a title rather than a degree, giving the right to teach in a secondary State institution. The right of con- ferring these degrees is reserved to the faculties of the State, the higher education being free, as will appear from certain figures below. In 1900 there were 29,377 students in the faculties of the State, of whom over 12,192 were at Paris University, and 1629 in the Roman Catholic institutes. It is mostly in the faculty of Law that these latter draw students, counting 1109 against 9700 of the State institutions. Other free or public establishments imparting higher education are, in the first category, the JScole des Chartes, ??cole des hautes Etudes, &c. ; in the second category, the jScole des Sciences politiques and the College des Sciences sociales.

Secondary Education. ??? This is imparted by the lycfes and colleges of the State and in free institutions. It is subdivided into a classical course, the right of giving instruction in which is earned by the acquisition of the diploma of bachelor in classics (Latin and Greek) ; and a modem course, the right of giving instruction in which belongs to any one having the modem bachelor's diploma (competence in living languages). The professors of public secondary education require to be fellows. They are trained ??? male professors in the Ecole normale supirieure (for the classical branch) or In the ??cole normale de Cluny (for the modem branch) ; female professors in the Mcole normale de Sevres. In 1900 there were 109 lycfes for boys, 13 of them at Paris ; and 229 Colleges Gommunaux ??? a total of 338, against 324 in 1877. The total number of pupils amounted to 85,599. The secondary establishments for girls comprised, in 1900, 41,994 pupils. The first lycfie dates only from 1881. With respect to the free secondary establishments, the lay ones comprised 10,182 pupils, and the clerical 91,825. The total number of young persons receiving secondary instruction amounted in 1900 to 203,838.

Primary Instruction is, by the law of the 16th June 1881, gratuitous, and by the law of the 28th March 1882, obligatory. Since the passing of the law of the 30th October 1886 primary public instruction may, in principle, be committed to the care only of lay masters and mistresses. The secularization of the schools has not yet, however, been universally accomplished, and there still remain 7000 to 8000 teachers belonging to the religious Congregations. From the age of six to that of thirteen a child is bound to attend a school, public or private, primary instruction being free, unless the parents prefer to have the education imparted at home. Permission to adopt this mode of instruction is given in the Certiflcat d"]Studes.

Public Schools. ??? ^Among them are to be distinguished infant schools {Scoles maternelles) ; primary elementary schools receiving children of from six to thirteen years of age ??? the schools which the laws of 1881 and 1882 had more particularly in view ; and the primary upper schools {M coles primaires superieures), designed to supplement the general instruction and prepare pupils for professional instruction.

In 1899 the number of pupils in attendance at the public infant schools amounted to 463,202 ; at the primary elementary public schools, 4,169,578 ; at the primary upper schools, 31,602. Alto- gether, then, these public infant and juvenile educational establish- ments comprised a population of more than 4,650,000 ??? a register for 1899 which compares favourably with that of 1880, 4,200,000, and that of 1875, which hardly reached four millions. The masters and mistresses of the primary schools, elementaiy and higher, are trained in the normal departmental schools (Ecoles normales departementales), which in 1899 counted 8036 male and female student-teachers, pretty equally divided. The professors of the training schools are themselves taken, the men from the higher training primary schools of St Cloud, the women from the schools of Fontenay-aux-Roses.

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The budget of primary education, for which, between 1880 anr' 1901, very remarkable amounts were voted, has risen from 16 million francs in 1875, to 28 millions in 1880, to 86 millions in 1885, to 121 millions in 1890, to 143 millions in 1895, and to 155 millions in 1901.

Free Schools. ??? Before any one can exercise the functions of a male or female teacher in a free school (JScole libre), it is neces- sary for him or her to have a certificate of competency (brevet de capacite). Such certificate is obtained after passing an examina- tion before a departmental commission, the presidency of which belongs to the academic (district) inspector. The certiiicate may be either for an elementary or a higher school. The free schools in 1899 comprised 1624 pupils in the higher primary class, 1,369,721 in the elementary primary class, and 284,042 in the Infant class of schools, giving a total of more than 1,655,000 pupils. Adding this to the iigures of pupils in the public schools, we get, as the sum- total of the infant and juvenile school population of France in 1899- 1900, about 6,300,000. In 1875 the corresponding figures were 4,800,000, and in 1880, 5,600,000.

Uliterate. ??? Owing to the new school laws, the proportion of illiterate persons in France has sensibly declined since 1875, and more especially since 1880. The 20 per cent, of conscripts entered as illiterate in 1875, di-opped to 16 per cent, in 1880, 11-4 per cent, in 1885, thence to 7-7 per cent, in 1890, and to 4-8 per cent, in 1898. The illiterate statistics of the wedded tell pretty much the same tale. In the case of the men there were, in 1870, 27 per cent, of those entering the married state unable to either read or write ; in 1880 the percentage had fallen to 19, in 1885 to 13, in 1890 to 8, and in 1898 to 5. In the case of women entering the married state, the corresponding percentages for 1870, 1880, 1885, 1890, and 1898 were 39, 24, 21, 13, and 8.

Adult or Evening Schools. ??? For some years, more particularly since 1892, a great extension has been given to after-school educa- tion by the establishment of evening classes for adults. This new departure aims at completing the school education, and, while confirming the learning which pupils have already acquired, it is intended further to benefit the youth of from thirteen to eighteen years of age by enabling them to attend classes in a variety of advanced subjects.

Under this category there were in 1899-1900, 38,191 courses of instruction given ??? 27,842 for men and 10,349 for women. To this number have to be added at least 5000 courses provided by societies of popular instruction, syndicates, and labour bursaries 0)ourses de travail). The attendance at these classes exceeded the number of

950,000.

The Academies. ??? This summary review of education would scarcely be complete unless something were said about the In- stitute of France. It consists of five academies ??? the Acadgmie Franjaise, the Acadfimie des Sciences, the Acadfemie des Inscrip- tions et Belles Lettres, the Acad^mie des Beaux-Arts, and the Academic des Sciences, Morales et Politiques. Each of these academies comprises forty titular members, elected by their col- leagues, with the exception of the Academic des Sciences, which has sixty-three members, and the Acad6mie des Beaux-Arts, forty-one. Each academy, moreover, with the exception of the

AcadSmie Fran9aise, nominates free members (membres libres) and foreign correspondents. The Acad^mie de M^decine is a separate scientific institution (with 100 members), as is also the Sooifit^ Nationale d' Agriculture.

Charitable Institutions. ??? The general organization of public charity has undergone no essential alteration. Several new laws, however, have been passed tending to complete the system. As is well known, the giving of re- lief to the needy is in France regarded as a moral but not a legal obligation. A special department of the ministry of the Interior, designated Assistance Puhlique, is charged with the general superintendence of this duty. The costs of relief to the poor devolve on the State or on the de- partments, but, above all, on the communes. Under the present constitution it is the commune in fact, and in- deed of necessity, in which centres all organization of charity : the commune being in immediate touch with the needy, is enabled promptly to appreciate their wants and to render them relief.

Since the enforcement of the law of 1879 the bureaux de bienfaisance are administered by a commission com- posed of the mayor of the commune, acting as president, and six members. Their number in France amounts to about 18,060, and their yearly expenses reach the figure of 60 million francs. The income is drawn from the revenues of the real estate belonging to the bureaux, a

poor-tax on playhouses, and donations and legacies of private persons, the last item amounting in 1897 to 43,650,000 francs. The bureaux de bienfaisance afford outdoor relief. Hospitals and asylums (hospices) receive the sick, and nurse them throughout their period of sick- ness ; infirm and old people and infants are kept as pen- sioners. These, too, are under the administration of the commission. In 1898 there were 1736 hospital estab- lishments, against 1664 in 1884. The staffs consisted of 34,254 persons, of whom 3373 were physicians and sur- geons, and they contained 52,468 inmates. Paris alone has forty-eight such establishments, with 24,278 beds. The revenue of the hospitals and asylums amounted in 1898 to 145,300,000 francs, of which amount 51 millions were derived from their own resources, 32 from com- munal

subventions, and the rest from pure charity. The expenses amounted to 139,233,000 francs.

Charity Children (Enfants Assistes) . ﹾﹾﹾTiaa class is divided into three categories : First, foundlings really abandoned ; second, children receiving help at their homes ; third, children morally abandoned, i.e., children of morally abandoned parents ﹾﹾﹾ a cate- gory dating from the law of 1889. The keeping of these children devolves at once on the State, the departments, and the com- munes. The total number of children of these three categories amounted in 1897 to 120,177, against 98,000 in 1885; and the total outlay on them was nearly 25 million francs, to which amount the contribution of the State was i\ millions.

iMjjafics. ﹾﹾﹾ Although since 1866 no longer legally bound to maintain lunatic asylums, most of the departments have yet kept them. Lunatics are supported either in such departmental asylums, or in the national asylum at Charenton, or in separate quarters of the infirmaries (hospices) set apart for them ; but they may also be kept privately by their own people. The census of lunatics in 1897 figured at 64,639, of whom 30,355 were males and 34,284 females : 608 of them were entered in the national asylum, and 45,914 in the departmental and communal asylums.

Gratuitous Medical Aid. ﹾﹾﹾ This service has been organized and charged to the account of the departments by a law of 1893. By 1895 it had been brought into operation in 83 departments, and is now at work in all of them, more than 20 millions of people profiting by the service. The yearly contribution of the State treasury is 1,450,000 francs.

Old-Age Pensions. ﹾﹾﹾ By the law of 1897 the State has to con- tribute to the old-age pensions, fixed by the departments at not less than 90 and not more than 200 francs per person in favour of people aged seventy and upwards. This contribution must not, however, exceed 50 francs per head, nor be given in more cases than 2 per 1000 of the population. The law remains, then, only an affirmation of principle, which is valued in the budget, to express it in this way, at an inscription of 690,000 francs.

It may be remarked here that the whole contribution of the national treasury to institutions for relief of the poor amounts to only 12,684,000

francs.

Finance. ❓❓❓ The minister of Finance exercises jurisdic- tion over all matters of public finance. He co-ordinates in one general budget the separate budgets prepared by his colleagues of the council of State, and provides ways and means. In principle, the budget of any one financial year has to be laid on the table of the Chamber of Depu- ties in the course of the ordinary session of the previous year, so that the discussion thereon, opening in October, may close before the 31st December. The financial year in France always begins on the 1st January, although various attempts have been made to postpone the initial date to the 1st of July. The projet de loi, laid before the Chamber of Deputies, is submitted to a special com- mission of thirty-three members elected for one year. This commission appoints a general reporter, and one or more special reporters for each of the ministries. The budget having been voted by the Chamber of Deputies and sent to the Senate, this assembly proceeds after the same fashion, but its financial commission numbers only twenty-seven members. When the budget is not voted within a practicable time, namely, before the 31st De- cember, Parliament grants provisional twelfths, that is to

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say, the authorization to incur expenses up to the amount of those of the preceding year for one, two, or three months. This practice has of late years become gene- ralized, and has sometimes been carried to as far as six-twelfths. The taxes authorized by the financial law are gathered by different bodies of agents ; all the sums collected ultimately, however, find their way into the re- spective treasuries of the arrondissements, and thence into the general treasury. The trisorier payeur giniral, almost always resident at the capital of the department, has to give account at the central ofB^ce for all the sums collected in his department, and to pay the charges due by the treasury. To this end he is in correspondence with the general direction of the movement of the funds, which has its seat at the

ministry in Paris, and organ- izes the circulation of the public funds throughout the whole territory of the State. The trisoriers payeurs ge- niraux, whose responsibilities are weighty, receive, in the shape of fixed emoluments and allowances, considerable salaries, up to 120 and 130 thousand francs. These sal- aries have, however, in recent years been sensibly re- duced. The taxes collected and the charges of the services paid, the budget is subjected to a double control, that of the cour des comptes, whose function it is to over- haul the accounts of the State, the departments, and the communes, and that of Parliament, which passes a vote of definitive settlement.

Expenditure. ??? Since 1875 the State budget of expenditure has passed through the most drastic fluctuations. This expenditure reached its maximum in 1883, from which date it descended in 1888 and 1889, to mount once more in an almost continuous ascent, yet by gradations of growth not too severe. The credits voted for the discharge of the public services are ??? at least have been, and may still be ??? classed under the two distinct heads of ordinary and of extraordinary budget. The ordinary budget of expenditure is that which has to be met exclusively by the pro- duce of the taxes ; the extraordinary budget of expenditure is that which has to be incurred in the way either of an immediate loan or in aid of the funds of the floating debt. Under various names it has existed siuce 1871.

The progress in the growth of the expenditure of France is shown in the following summary figures, the figures of expendi- ture for the specified years denoting respectively so many millions of francs : ???

18T5.

1880.

1885. 1890.

1895.

1901.

2980

3412

3472

3400

3510

3554

To these totals of expenditure the ordinary budget contributed : ???

1875.

18S0.

1885.

1890.

1895.

1901.

2670

2912

3293

3130

3430

3532

The figures contributed by the extraordinary budget of expendi- ture were : ???

1875.

1880.

1885.

1890.

1895.

1901.

310

500

179

270

80

22

Although the term budget extraordinaire is no longer the usual one, there still remains in the State expenditure a good 76 millions of francs in excess of what is included in the ordinary budget.

From 1892, the successive ministers have, after the example of M. Rouvier, followed the practice of what has been named a policy of incorporation (la politique des incorporations') ; that is to say, they have entered in the ordinary budget, each under its own head, the expenditure on war, marine, and public works, items formerly figuring under the head of extraordinary expenditure. By this proceeding, country and Parliament have been enabled to obtain a more precise appreciation of the annual

expenditure, a large part being no longer, as before, wrapped up under any disguise.

The following table gives an exact view of the progress of the costs of the principal public services since 1871, the figures repre-) senting so many millions of francs : ???

1876.

1884.

1894.

1901.

Public debt . . . .

928

1048

1127

1133

Guaranteed interests to rail- “1 way companies . . j

47

17-5

109-7

17

Sinking fund ....

164-7

156-5

6.3-8

37

Algeria

32

45-6

70-1

1

Colonies

28

116

73-8

112

Public relief . . . .

15

17-6

17-2

19

Bourses

33

4-8

6

7-5

Subventions ....

47-5

80-7

54-3

64

Maintenance of works and”) new works . . . /

105-7

238-5

92-4

92

K^gie

81-4

101-7

112-7

121

Repayments and restitutions .

36-8

55

43

32-3

Aministration

300

229

231

254

Salaries of the public ofBcers “|

***(President, senators, and ***

11-6

12-9

13-1

13-3

deputies) . . . j

“War

841

690

627-5

691

Marine

164-6

193-8

265-9

327-7

Military pensions .

74-4

115-2

134

141

Instruction ....

51-5

175

181

206

Monopolies ....

141-6

211

215

230

Distributed among the different ministerial departments, the budget of 1901 showed the following figures in millions of francs : ???

Public debt, salaries,

and

Marine

. 327

finance .

. 1520

Instruction and Fine

Justice

. 35

Arts

. 223

“Worship

. 43

Commerce and posts .

. 242

Foreign affairs .

16

Colonies

. 112

Interior

. 78

Agriculture

. 44

“War .

. 691

Public works

. 221

Altogether, the great increase since 1875 in the State expenditure has been incurred chiefly under the heads of debt, which in itself absorbs nearly a third of the budget ; of the colonies, which have more than tripled their burden on the State ; of public works, which are, however, more and more moderating their claims ; of public instruction, which has been entirely reorganized ; and of war.

Debt. ??? The public debt is subdivided into funded debt, termi- nable debt {dette a terms), and annuities. The capital of the public debt may be estimated, at the least, at 30 milliards, or ??1,200,000,000. The Loans contracted hj the Third Republic alone amount to 13 mill- iards, or ??520,000,000. The costs of the war of 1870-71, which de- volved in part on the present regime, are estimated at from 9 to 9J milliards (??.360 to ??380 millions) ; and the charges of the colonial wars at nearly a milliard (??40,000,000) . The interest on the consol- idated debt amounted in 1876 to 743 million francs, in 1884 to 700 millions, in 1894 to 761 millions, and in 1901 to 675 millions. The difference in the amounts for 1894 and 1901 is due to the last con- version, in 1894, of 4J per cents, to 3J per cents. The terminable debt, consisting of 3 per cents, redeemable, was set down in 1876 at 116 million francs, in 1884 at 277 millions, in 1894 at 280 millions, and in 1901 at 324 millions. The annuities {dette viagere) , again, fig- ured in 1869 at 152 million francs,

in 1876 at 158 millions, in 1884 at 176 millions, in 1894 at 187 millions, and in 1901 at 226 millions.

Besides this debt, which may be characterized as fixed, there is a floating debt contracted to meet the daily wants of the Treasury, a debt undergoing continuous extinction and reconstitution. In 1891 this floating debt reached the sum of 1077 million francs ; in 1893, 953 millions ; in 1895, 1282 millions ; in 1900, about 1054 millions. It comprises 200,025 different bills, in particular bons du tresor, amounting to 100 to 250 millions.

Revenue. ??? The following table shows the rapid growth of the State revenue of France during the period 1875-1901, the figures for the specified years representing so many millions of francs : ???

1875.

1880.

1886.

1890.

1895.

1901.

2705

2956

3056

3229

3428

3554

The revenue of 1901 was derived from the following sources (in millions of francs) : ???

Direct contributions . . 482 Taxes assimilated to direct

contributions ... 40 Registration (enj-egristreTOeni) 554 Stamps .... 173 Tax on transferable securi- ties (valeurs mobilieres) 75

Customs .... 438 Indirect contributions . 649 Sugar . . . .200 Monopolies . . . 456 Posts telegraphs, and tele- phones …. 255 Domains 55

1 Since 1st January 1901 Algeria has had a budget of its own.

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The following taWe shows the different parts played by the respective items of taxation in the growth of the State revenue from 1876 to 1901 (in millions of francs) : ???

1676.

18S4.

1894.

1901.

Direct contributions and taxes \ assimilated thereto . j

412

416

501

522

Registration (of transfers of”! properly, &c.) ___ ___ J

470

519

548

556

Stamps

154

155

161

173

Tax on investments in public “|

funds or bonds of private [___

35

46

69

75

companies . . . j

Customs …..

225

304

465

438

Indirect contributions .

603

604

601

649

Sugar

189

171

203

200

Monopolies

352

406

411

456

Posts, &c

133

163

207

255

Domains ....

57

43

47

55

Legislation. ??? During the period between 1875 and 1900 a number of modifications were introduced into the department of taxes. New taxes have been established. By the law of 1889, amended in 1898, a military tax is imposed on young men exempted or partially exempted from military service. This tax has given the revenue an average of 3 million francs yearly. A tax is also levied on velocipedes, yielding, in 1893, 1,350,000 francs. By a law of 1880 a tax, again, is laid on the revenues of religious Congregations, a tax subject to increase. It yields yearly about 3,800,000 francs. Another new tax is that levied, by law of 1893, on bourse operations, bringing to the State revenue some 7 million francs yearly. Then, again, various taxes have been amended in respect of the quotas attached. The assessment on patents was amended in 1889 and 1893, and the big shops have been more heavily taxed than before. The imposts on the revenue from money vested in public funds or private company bonds have been raised from the 3 per cent, fixed by the law of 1872 to 4 per cent, by law of 1890. Succession laws since 1892 have added at least 100 million francs to the yearly proceeds of the customs dues.

Lastly, special mention must be made of the tax laid on house property. From being a distributive impost (impot de repartition, i.e., fixed as a lump sum by Parliament and then distributed among the arrondissements, communes, and the persons affected) this tax was, by

law pf 1890, converted into a rating impost (impot de quotite, i.e., proportional to the revenue estimated to be derived from the buildings).

Projected Meforms. ??? Of late years the financial system of Prance has been much criticized. More particularly, repeated attempts have been made to substitute an income tax for the present direct contributions. A Bill in this sense was even brought forward by the Government in 1895. On the other hand, the laws about succession and the liquor law have been modified by the votes of the Chamber of Deputies ; but these laws were definitely adopted in 1900 and 1901.

Direct Taxes. ??? The direct taxes, properly so called, are four in number: ??? Pirst, the tax on building-property (impot fancier sur la propriete bcltie), amounting in 1889 to 84 million francs; and the tax on property not built on, amounting in 1900 to 100 millions. Second, the tax on house rent (contribution personelle mohiliere), consisting, in fact, of two different contributions, one imposing a fixed charge on all citizens alike of each department, the charge, however, varying, according to the department, from 1 franc 50 cen- times (= ls. 3d.) to 4 francs 50 centimes (=3s. 9d.) ; the other, levied on every proprietor or tenant in proportion to the rent of the house he lives in. The total number of properties in Prance charged in 1900 with the contribution personelle mohiliere was 9,294,525, 9,193,025 being houses and 101,500 factories, and their lump letting value was 2982 million francs, of which sum 2778 millions was to the account of houses. Third, the contributions on doors and windows, levied in each case on the number of openings, a tax which in 1900 yielded 63 millions. Fourth, the license tax affecting industrial and commercial occupations. It consists of a fixed duty on the total value of one occupation, but varying according to the kind of occupation ; and of an assessment in proportion to the letting value of the premises occupied. This tax gave a return in 1900 of 1.34 million francs, affecting as it did 1,728,200 persons. The department of the Seine by itself yielded 20 million francs, contributed by 174,100 persons. LozSre, on the other hand, at the bottom of the list, shows only 3967 licenses, contributing no more than 60,000 francs. The administration of the direct contributions includes, for the duty of determining the individual quotas, a directorto

each department assisted by conSroZewj-s. The direct taxes are collected by &percepteur residing at the chief town of the canton.

Indirect Contributions. ??? Under this head are comprised the taxes on "hygienic drinks" (wines and cider), producing 173 million

francs ; on beer, yielding 27 million francs ; and on alcohol, re- turning to the revenue 300 million francs. There is a whole army of officials employed in the discharge of this service, which is one of the most costly.

Registration. ??? This tax comprises duties charged on the transfers of property in the way of business (a litre onereux) or sales, bringing in to the Government 205 million francs ; on changes in ownership of property effected a litre gratuit, in the way of donation or suc- cession, the succession dues alone yield the Treasury 223 million francs yearly. The functionaries engaged in this service are called eonservateurs des hypotheques and receveurs. Some of them are in receipt of high salaries, reaching in the Seine department to as high as 180 and 244 thousand francs.

Departmental Finances. ??? The French departments, aspersonnes morales, have their (5wn separate budgets. It devolves on them to keep in repair the departmental highways and cross-roads, to sup- portpublio instruction, and take charge of enfants assistes. The departmental expenditure amounts to about 320 million francs, and is met in large part by taxation additional to the four direct contributions.

Communal Finance. ??? The communes, in the matter of finance, enjoy a still larger autonomy than the departments. Their ex- penses in 1900, leaving Paris out of the account, amounted alto- gether to 760 million francs, against 695 millions in 1877. Their indebtedness, moreover, amounts to nearly two milliards. The communal revenue is derived from taxes levied for the superinten- dence of streets, roads, and buildings (yielding in 1900, 207 million francs), various local taxes, and tolls. Nearly 1500 communes were until 1899-1900 in receipt of revenue from tMs last source (octroi), but since 1st January 1901 the octroi has been either finally sup- pressed or else materially reduced. The gross revenues of the communes, Paris not included, was, in 1900, 181 milUon

francs ; with the inclusion of Paris, 333 millions. Next to the capital, the towns drawing the most revenue from the excise imposed on the importation of articles of consumption were Lyons (realizing 11 million francs), Marseilles (11 millions), Bordeaux (6 millions), and LiDe (5 millions).

Army. ??? The recruitment of the army of France is regu- lated by the lavr of the 15th July 1889, which, superseding that of 1872, has on the one hand done away with volun- teering, and on the other has reduced the period of active service from five to three years. According to the enactment in force, every Frenchman owes his country his personal service for the term of twenty-five years (Titre i.). Every year, in each commune, there is drawn up a list of the young men in it who the year before reached the age of twenty. These men have next to appear before a cantonal revising body (conseil de revision cantonal), composed of the prefect or his substitute, a councillor of the prefecture, a councillor-general, a coun- cillor of the arrondissement, a superior officer, a sous-intendant (having direction in affairs of pay, provisions, clothing, &c.), the recruiting commandant, and a military doctor. The revising body decide on cases of exemption, of adjournment, and of dispensation. The exempt are young men who by reason of infirmitj- are unfit either for active or for auxiliary service, to which latter are assigned those in weakly condition included in the yearly contin- gent. The adjourned are those who, being neither infirm nor weakly, are yet not up to the required standard of vigour. The dispensed, that is, those required to serve only one year, are young men who engage to serve for ten years in a public educational institution ; seminarists pre- paring themselves for the ministry of the Church in one of the recognized confessions ; young men who have ob- tained or are prosecuting their studies with a view to obtaining the licentiate degree in letters or in science, a doctor's degree in law or in medicine, a " prix de Rome " or a prize at the eonservatorium of music, or one of various other diplomas specified by the law ; young men the practice of whose avocations is necessary to the sup- port of their families, the dispensed in this last case, however, not to amount to more than 5 per cent, of the contingent enlisted for three years.

The soldier must be at least 1 m^tre fA centimetres (60-631 inches) in height (Titre iii.). The law provides for voluntary engagements, i.e., it authorizes young men to

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anticipate the call to military service, and solicit their incorporation into the army at the age of eighteen years. In such cases, however, they are enrolled for three, four, or five years. The law further provides for the re-enlist- ment of medalled soldiers, corporals, and non-commis- sioned officers. Such re-engagements, covering two, three, or five years' effective service, and capable of extension to fifteen years, date from the time of the legal expiry of active service. Soldiers so re-enlisting are entitled to a bounty, to a high daily pay, and at the conclusion of the service to a pension (Titre iv.). The number of the re- enlisted is 16,000.

Effective Strength. ??? Every French citizen owes his country twenty-five years' service. He passes successively into the active army ; into the reserve of the active army, in which he completes two periods of service of twenty-eight days each ; into the terri- torial army and its reserve, in which he completes two periods of thirteen days each. The total peace strength of the active army provided for in the budget was, in 1898, 567,000 men, as against 608,000 in 1893, and 488,000 in 1888. The number of conscripts who appeared before the conseils de revision was, in 1888, 295,000; in 1893, 330,000 ; in 1898, 331,000. Of these 331,000, 232,000 passed muster as up to the required standard ; 74,000 of them being enrolled for one year, and 158,000 for periods of two and three years. The number of oflScers, on the other hand, slightly exceeded 28,000. The full war strength of the army of France comprises, according to careful estimates, about 4,250,000 men. Under the law of 1872 the utmost effective strength at disposal in cafie of mobilization was 3,800,000 men.

Military Organization. ??? The President of the Republic makes the appointments to all military offices, and may therefore be con- sidered the supreme head of the army, though he does not command it. The command belongs to the Minister of War, who is assisted by the generalissimo, the actual commander on the field ; by the brigade-major {chef Wetat major'), whose business it is to plan the campaign ; and by the superior council of war, composed of nine members. The ministry of War is itself divided into branches cor- responding to the different services ??? infantry, cavalry, engineering, commissariat, ammunition, health.

France is divided into two military governments, Paris and Lyons, and into twenty corps d'aj-mee; Nancy having been created a new district since the ninth edition was published. Each army corps con- sists of two divisions of infantry, one brigade of cavalry, one bri- gade of artillery, one battalion of engineers, and one squadron of the military train, an organization maintained alike in peace and in war.

The active army comprises 163 infantry regiments of the line ; 30 battalions of chasseurs-^-pied, stationed preferably in the Alps and the Vosges ; 4 regiments of Zouaves ; 4 regiments of tirailleurs alg^riens ; 2 rggiments ^trangferes, constituting the legion fitrangfere, recruited by way of enlistment ; 5 battalions of African light in- fantry ; 13 regiments of cuirassiers, 31 of dragoons, 21 of chasseurs, 14 of hussars, 6 of chasseurs d'Afrique, 4 of Spahis ; 16 battalions of foot artillery ; 40 regiments of horse artillery ; 7 regiments of engineers ; and 19 squadrons of train. There is further at Paris the Ifigion de la Garde R^publio'aine, the regiment des sapeurs pompiers, also for the whole of the territory, and 19 legions of gendarmerie.

In 1898 the infantry of the line were numbered at 273,000 men ; the Zouaves at 18,000 ; the tirailleurs alg^riens at 15,000 ; the 16gion 6trang6re at 10,000 ; the chasseurs-^pied at 29,000 ; the light infantry at 8000 ??? or some 348,000 men as the total strength. The dragoons, cuirassiers, chasseurs, and hussars made up 66,000 men ; the chasseurs d'Afrique and Spahis, 9000 ??? or a total of 75,000. The foot artillery mustered 14,000 soldiers, and the horse artillery 64,000, to which had to

be added 4000 artillery artificers ??? a total of 82,000. The engineers were set down (1898) at 15,000, and the train at 13,000. There are various other corps forming the complement.

According to the budget for 1900, the total effective of the French army was 639,515 men, exclusive of 25,693 for the gendarmerie and Garde R^publicaine. The total number of officers was in addition

29,740.

The mean strength of a regiment of the line stands at about 1800 men ; that of a regiment of cavalry at 860 ; that of a regiment of mounted artillery at 1600.

Military schools. ??? The higher military school is intended for the training of staff officers, who are said to be "brevetfis." Itreceives students who have passed a competitive examination at which officers of all arms are represented. It enrols yearly 70 to 90 new officers, whom it keeps in training for two years. The function of the polytechnic school {Mcolepolyteehnique) is to prepare artillery and engineer officers. It admits yearly 225 students, the period of whose training is two years. At the end of this course, those who have gained inclusion in the first class are free to enter the corps

des ing^nieurs de I'gtat (roads and bridges, mines, &c.). The mili- tary school of St Cyr, receiving annually 450 young men, has the task of training infantry and cavalry officers. Its course of study is also for two years. Other military schools are the military pryta- neum of La FI6che, the artillery and engineer school at Fontaine- bleau, the cavalry school at Saumur, an ammunition school, a military medical and pharmaceutical school, at the Val de Grace in Paris, I'^cole du service de sant6 militaire at Lyons, the school of commissariat at Vincennes, an 6cole normale de gymnastique, shooting artillery and pyrotechnic schools, a military infantiy school at St Maixent, a school of artillery at Versailles, and vari- ous preparatory schools for soldiers' children.

Fortified Places. ??? The region of the north of France, along a frontier of 341 miles, is defended by Dunkirk, Calais, Lille, Valen-

ciennes, and Maubeuge, fortresses of the first class ; the en- trenched camp of Laon, first class ; La F6re, second class ; Paris, third class. The Lorraine frontier on the north-east is defended by the entrenched camps of Toul and Verdun, first class ; Reims, second class. The Vosges frontier, 93 miles in length, is protected by the first-class fortresses of ifcpinal and Toul, and the second-class fortification of Langres, on the Plateau de Langres. The Jura frontier, 180 miles long, is guarded by the stronghold of Pontarlier and the entrenched camp of Besan^on, as also by the second-class forts of Dijon, planted on the escarpments of the C6te-d'0r. The frontier at the Alps is 427 miles long. Its fortifications are Albert-ville, Grenoble, Brianjon, and Nice. And an enemy, if he suc- ceeded in forcing the valleys of the Isere and the Durance, would still find himself confronted by the great entrenched camp of Lyons, resting against the mountains of Lyonnais. On the south, the Pyrenean frontier, extending 354 miles, is fortified only at its two extremities ??? Perpignan and Montlouis in the east, Bayonne in the west.

Navy. ??? The personal establishment of the French navy is recruited in part by voluntary enlistment, in part by appropriation to the naval service of a proportion of the yearly army contingent, in part by "maritime inscription," in which are enrolled the names of all lads and men from eighteen to fifty years of age engaged in fishing or in navi-gation. The number thus enrolled was, in 1899, 219,000, of whom the quarter of Marseilles alone furnished 11,800.

Personnel. ??? The officers of the French navy in 1899 included 15 vice-admirals, 30 rear-admirals, 125 capitaines de vaisseau, 215 capitaines defregate, 754 lieutenants, 531 ensigns, and 219 cadets ??? in all 1889 officers. The rank and file was made up in 1899 of 1352 boatswains (premiers ma?ires),4910boatswains' mates {seconds mattres'), 8921 quartiers maitres, and 29,161 sailors ; giving a total of 44,344 men. Lastly, the infantry in the service of the navy con- sists of thirteen regiments, with 1642 officers and 25,110 men ; the artillery of two regiments, with 690 officers and 7411 men.

The French fleet on the 1st January 1899 consisted of ???

34 armoured battleships of 341,747 tons, 274,119 horse-power, and 1425 guns ;

5 armoured cruisers of 29,130 tons, 18,935 horse-power, and

126 guns ;

7 coast-defence vessels of 33,084 tons, 21,513 horse-power, and

68 guns ;

8 armed cruisers (of a different class

from the above, 5) 2 fast cruisers

6 cruisers, 1st class 16 cruisers, 2nd class 18 cruisers, 3rd class

having a total tonu age of 228,000, a total horse- power of 286,000, and 1334 guns.

The navy further included 10 torpedo-boat destroyers, 19 gun- boats, 22 advice boats, 24 transports, 14 sloops, 10 torpedo des- patch boats, 263 torpedoes, and 3 submarine boats.

Altogether, the entire French fleet amounted to 461 vessels of 701,782 tons, 1,025,793 horse-power, with 3766 guns ; and, in process of construction, 1 battleship, 8 cruisers, 5 torpedo-destroyers, &c. The programme of new construction to lie continued or under- taken in 1899 comprised the following ships building in dockyards : ??? 7 battleships, 14 first-class armoured cruisers, 4 fast cruisers, 1 second-class protected cruiser, 2 third-class protected cruisers, 1 first-class sloop, 2 torpedo-gunboats, 2 gunboats, 1 aviso (advice)- transport, 8 submarine boats, 6 first-class torpedo boats, 10 torpedo cruisers, 11 sea-going torpedo boats of 150 tons, 22 first-class torpedo boats of 86 to 90 tons, 11 torpedo boats of 85 tons, and 6 small torpedo boats ??? at an estimated cost, altogether, of ??8,724,247. The expense of naval construction amounted from 1871 to 1880 to 245 million francs ; from 1881 to 1890, to 387 millions ; from 1891 to 1899, to 685 millions.

Naval Schools. ❑❑❑ The Scole superieure de Marine, corresponding to the J^aole superieure de Guerre, was after a short existence sup- pressed. The Ecole Navale is intended for the training of officers.

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Lads from fourteen to seventeen years of age are admitted to this institution, whicli lias its seat at Brest. After completing their course in this school, the young oflBcers go to pass a year on the fregate ^cole. In addition there are schools of naval medicine at Toulon, Brest, and Rochefort, a school of naval warfare at Paris, and a torpedo school {❑❑cole des Torpilles) at Toulon, &c.

Fortifications on the Coast. ❑❑❑ Fortified places on the coast are those on the North Sea, namely, Dunkirk and Calais (extending along 43^ miles) ; those on the English Channel, protecting a stretch of 716 miles ❑❑❑ at Boulogne, le Havre, Cherhourg, Granville, and St Malo ; those extending 535 miles along the Atlantic ❑❑❑ at Brest, Lorient, St Martin de 116, lie d'Aix, Ol^ron, Rochelle, Rochefort, Estuary of the Gironde, Socoa ; those stretching 388 ipiles along the Mediterranean coast ❑❑❑ at Port Vendres, Cette, Toulon, Marseilles, St Tropez, Antibes, Villefranche.

Colonial Bases of Operation. ❑❑❑ Points d^appui in the French colonies, serving as bases of operation for the Atlantic, Pacific, and Indian Ocean divisions of the fleet, have, by decree of 1898, been established at Fort de France (Martinique), Dakar (Senegal), Cape St Jacques (Cochin-China) , Port Courbet (Tongking), Noumea (New Caledonia), Di^go Suarez (Madagascar), Saintes (Guade- loupe), Port Phaeton (Tahiti), Libreville (Congo), and Obock.

2. Production and Industry.

Agriculture. ??? Agriculture figures in the budget at more than 44 million francs, and has been (by decree of 1881 and 1882) distributed into the four divisions of forests, breeding-stud, agriculture, and agricultural hydraulics. Encouragements of every kind, in the shape of premiums, subventions, and indemnities, are given to the rearing of cattle, viticulture, sericulture, the culture of flax and hemp, &c.

The most important movement, however, made in the interest of the agriculture of Erance since 1875 has been the marked growth of agricultural education. Whereas in 1870 there were but sixty institutes of agricultural tuition and fourteen professorial chairs, the number of such institutions in 1900 was 107, and of professorial chairs, 268. Among the schools imparting superior in- struction, there have further to be enumerated an agro- nomic institute, three veterinary schools, and one school of forestry. The secondary agricultural schools include three national schools of agriculture, one dairy school, one school of industrial cultures, and one of horticulture. Third-class schools include forty-eight practical schools (Ecoles pratiques), fourteen femes Ernies, and twenty other establishments. Account has further to be made of five chaires de facuMs, ninety departmental and 131 special professoriates, sixty-six agronomic stations, &c.

Agricultural Area.- ??? According to the decennial official returns of 1892, there were 170,817 square miles laid out in agriculture (crops, grass, forests, and fallow), of which 153,506 square miles denoted private property. The arable land alone amounted to 99,503 square miles.

Cereals. ??? The area laid out in 1899 in cereals amounted to 28 per cent, of the entire territory. The following table shows the different acreages in France laid out in the cereal crops specified in 1888 and 1899 : ???

1888.

1899.

Acres.

Acres.

Wheat .

17,235,991

17,141,806

Mixed Corn .

756,779

653,280

Rye

4,023,240

3,577,683

Barley .

2,207,439

1,990,827

Oats

9,223,666

9,734,334

Buckwheat .

1,501,484

1,447,225

Maize

1,411,494

1,388,481

The mean yearly production of the different cereals for the periods specified was, in millions of bushels : ???

1876-85.

1886-95.

1696-97.

Wheat

279-647

284-563

283-937

Rye .

68-684

64-625

56-925

Barley

50 -586

47-179

42-281

Mixed Com

17-107

12-188

7-370

Oats

221-974

239-992

236-780

Maize

26-816

27-310

29-466

Buckwheat

27-769

26-.340

24-640

The production of wheat in 1899 was 354,433,000 bushels; mixed corn, 11,604,700 bushels; rye, 65,072,500 bushels; bar- ley, 43,060,400 bushels; oats, 263,030,700 bushels; buckwheat, 22,372,500 bushels ; maize, 24,845,500 bushels.

The following table shows in bushels the mean annual produc- tion of the different crops per hectare (2-471 acres) for the periods specified, as also the production for 1898 : ???

1876-85.

1886-95.

1899.

Wheat .

49-44

45-10

53-06

Rye ....

45-04

40-96

42-68

Barley

54-25

50-87

64-64

Mixed Corn

49-14

44-55

48-67

Oats

69-16

62-70

66-79

Maize

49-96

47-85

88-16

Buckwheat

47-54

46-37

37-19

The entire cereal production in 1899 was valued at 3396 million francs, a total much below that of 1882, which was valued at 5362 millions.

Potatoes and Beetroot. ??? The potato crop covered in 1899, 3,863,082 acres, against 3,651,036 acres in 1892. The weight of potatoes raised in 1899 amounted to 241,938,802 cwts., valued at ??24,638,193. Mangold-wurzel covered in 1899, 11,045,213 acres, and its production amounted to 207,252,460 cwts., valued at ??8,504,390. Beetroot (sugar) occupying in 1898 about three- fifths of the ground covered by, and producing about five-sevenths of the amount produced by, mangold-wurzel, yielded the value of ??7,424,593.

Clover, &c. ??? The following table shows the acreages, the amounts produced, and the values of the frames artificielles in 1899: ???

Prairies Artificielles.

Acreage.

Amount

of Produce in

Owts.

Value in ??.

Trefoil Lucerne . Sainfoin .

Meadows and per- "I manent pasture . J

3,041,520 2,221,800 2,504,400

15,842,400

81,099,126 70,234,720 45,678,640

384,200,097

7,714,134 7,737,683 4,638,160

39,480,000

Industrial Cultures. ??? The subjoined table shows the respective averages, amounts produced, and values of the various industrial crops in 1899 : ???

Colza . Rape .

Hemp . Flax . Tobacco Hops .

Acreage.

142,236 14,248

80,061 46,537 42,092

7,728

Bushels of Produce.

2,298,272 208,927

Cwts.

427,8381

432,6151

449,128

76,120

778,661 62,366

630,005

407,875 839,813 166,183

Vineyards. ??? In 1899 there were 4,604,320 acres covered with vineyards, against 4,446,000 acres in 1892, and 6,424,120 acres in 1882. The great invasion of the phylloxera lasted from 1881 to 1892. If the area now planted in vineyards is less by nearly 2 million acres than it was in 1857, viticulture has nevertheless fought a stubborn battle against the scourge. Certain depart> ments, such as Hfirault, Gironde, Aude, and Gard have been under the necessity of completely renewing their plants. The pro- duction of wine in France, 738,782,000 gallons in 1882, 638,814,000 gallons in 1892, 592,174,000' in 1895, 702,746,000 in 1897, amounted to 936,200,000 gallons in 1899. The departments yielding the largest contribution of wine in 1899 were Aude, with 117 million gallons ; Gard, with 79 million gallons ; H6rault, with '264 miUion gallons ; Pyr^nfes-Orientales, with 64 million gallons. Gironde and C6te-d'0r, whose Bordeaux and Burgundy wines are in special request, figure in the list of wine-producing places, the former with only 62 million gallons, the latter with 12 million gallons. The average production of wine per hectare (2-471 acres) reached its maximum in 1899 in the Seine (890 gallons), H^rault (1461 gallons), and Bouches-du-Rh6ne (1740 gallons). The minimum wine production per hectare, on the other hand, was fui-nished by Corrfeze, whose wine contribution was 102 gallons a hectare (or nearly 48 gallons an acre), and Alpes-Maritimes, which yielded 129 gallons per hectare. The average production per hectare throughout France was 578-3 gallons (134-9 gallons an acre).

1 Seed and fibre.

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The total value of the wine production, which amounted to 905 million francs in 1892, 755 millions in 1897, was 1,193,056,820 francs in 1899.

Fruits. ??? The value of the total crop of chestnuts in the country in 1899 -was ??1,450,223; walnuts, ??533,202; olives, ??699,998;

cider-apples, ►►5,190,513; plums, ►►306,758; mulberry leaves, ►►416,014.

Silk Culture,. ►►► The sericultural production in 1898 amounted to 15,385,376 lb of cocoons ; 156,202 lb of cocoons were exported, valued at ►►33,184, and 7,812,867 lb of raw silk, valued at ►►5,.388,860.

Live Stock. ►►► On the 31st December 1899 the number of farm animals was 2,917,160 horses, 204,750 mules, 357,820 asses, 13,550,880 cattle (including bulls, oxen, cows, and calves), 21,357,660 sheep, 6,305,200 pigs, 1,504,390 goats. According to the census of 1892, there were 47,471,178 farm animals of the value of 5200 million francs; viz., 2,794,529 horses, 217,083 mules, 366,895 asses, 13,708,997 cattle, 21,115,713 sheep, 7,421,073 pigs, and 1,845,088 goats. The census of 1892 valued the horses at 1166 million francs, the asses at 34 millions, the mules at 80 millions, the cattle at 3 milliards, the sheep at 466 millions, the pigs at 500 millions, the goats at 28 millions. Poultry in 1897 figured at the number of 85 millions (54 millions cocks and hens), valued at 166 miUion francs. Of the products of farm animals in 1899, the milk was estimated at ►►50,610,409, the wool at ►►2,230,939, the honey at ►►451,201, and the wax at ►►198,030.

Total Agricultural Beturn. ►►► The gross revenue of the entire agriculture of France, without deduction of expenses, rent, in- terest, &c., oscillated in 1899 between 11 and 12 milliards of francs. According to the statistics of 1892, the gross production was valued at 314 francs per hectare for cereals, 627 francs per hectare for industrial cultures, 301 for forage plants, and 222 for grass.

Agricultural Allotments. ►►► The decennial statistics of 1892 gave the number of agricultural allotments of all sorts and sizes at 4,792,814, of which 3,387,245 were in the immediate hands of the proprietors, who accordingly engrossed 71 per cent, of the agricul- tural holdings of France. The remainder, 1,405,569, or 29 per cent, of the total, were cultivated by farmers and metayers, i.e., farmers giving part of the produce as rent. The number of pro- prietary agriculturists in 1892 had decreased by 138,097 from the figure of 1882, which was 3,525,342. The

number of farmers and metayers, on the other hand, had increased by 95,665. Of the agricultural properties, again, the very small ones of less than 1 hectare (2-47 acres) covered, in 1892, 2-67 per cent, of the entire agricultural land. Small properties of 1 to 10 hectares (2-47 to 247 acres) covered 22-80 per cent. Medium properties of from 247 to 988 acres occupied 28 -98 per cent. Large properties (above 988 acres) engrossed 45-55 per cent, of the whole. The figures of 1892 compared with those of 1882, show a slight increase in the number of very small properties (of less than 1 hectare). The small and medium properties, on the other hand, show a decline while the large properties have added to their number.

Agricultural Machines. ??? In 1892 the number of agricultural machines and motors of every kind was 4,321,000.

Value of French Soil. ??? From 1882 to 1892 the market value of land markedly declined. The average price of arable land per hectare fell from 2000 to 1600 francs ; of viticultural land per hectare, from 2300 to 2100 francs; of meadow land, from 2-900 francs to 2 -450 francs.

Sea Fisheries. ??? The products of the fishing industry ???were set down for 1896 at the value of 102 million francs, of which 93 millions was to the account of boat-fishing and 9 millions to the account of fishing from land. The Iceland fishing yielded in 1896, 28,600,000 lb, of the value of 6^ million francs; the Newfoundland fishing yielded 40,865,000 lb, valued at 7 million francs. The herring fishery for 1896 was set down at 100,100,000 lb, valued at 9,300,000 francs; the mackerel fishing at 55 millions lb, of 5 million francs' value; sardines at 39,600,000 ft, of 9 million francs' value; tunny at 112,200,000 lb, and 2^ million francs' value; salmon at 550,000 ft, and 1 million francs' value. The oyster culture yielded 2,378,200 ft of oysters, valued at 13,700,000 francs. The equipment of fishing craft has been encouraged, always with considerable success, by means of bounties, and in the year named 1222 undecked vessels and boats gained bounties for being fitted out as fishing craft.

Mineral Production. ??? The total mineral production,

including the yield of its quarries, amounted in 1898 to 81,407,444 tons, of the value, at the place of production, of 640,659,439 francs.

Coal. ??? The output of combustible material (coal, an- thracite, and lignite) in 1898 amounted to 32,356,000 tons, of the (pit-mouth) value of 363,153,417 francs. To this total (including anthracite) coal contributed 31,826,000 tons; lignite figuring with only 530,000 tons. In 1899 the output of coal amounted to 32,500,000 tons. The increase in the production of coal from 1870 to 1899 is shown by the following figures of output, which denote the number of tons : ???

1870.

1880.

1890.

189T.

1S99.

13,300,000

19,300,000

26,100,000

30,350,000

32,500,000

The output of coal in Prance, accordingly, more than doubled within the period 1870-99. The supply still, however, comes far short of the demands of industry, which in 1898 consumed nearly 43 million tons, valued at 842^ million francs. The import of coal continues therefore to be very considerable, amounting in 1898 to 11,917,000 tons.

The following table shows the respective contributions of the different basius of Prance to the total output of coal in 1898 : ???

Basins.

Mines in Work.

Output in Tons.

Nord and Pas-de-Calais (Valen-1 cienne%, Le Boulonnais) . j

Loire (St ifctienne and Rave-de-Gier)

Bourgogne and Nivemais (Lei Creusot, Blanzy, Epinac, &c.) /

Gard (Alais, Aubenas, Le Vigan)

Aveyron}(-^i“‘Carmaux,&c.)

Bourbonnais (Commentry et Doyet, 1 StEloy) . . . . /

Auvergne (Brassac, Champagnac, &c.)

Alps (le Drac, Maurienne, &c.)

Vosges (Ronchamp)

H^rault (Graissessac)

CreuseandCorr6ze(Ahun,Aublac,&c.)

West (Le Maine, Vouvant, and\ Chantonnay) .... J

35 46 19 21 19

14

13

50

2

6

5

9

19,287,000 3,912,000 2,341,000 1,974,000 1,781,000

1,123,000

464,000 217,000 217,000 201,000 196,000

119,000

The different coal-mining concessions granted by the Government numbered on the 1st January 1899, 634, extending over 1,364,724 acres, comprised in sixty-four departments. The total number of persons (men, women, and young persons from thirteen to sixteen years of age) engaged in the working of the coal mines in 1898 amounted to 148,600. The average daily wage of the miner in 1898 was 4 francs 23 centimes (about 3s. 6d.). The mean price of the (metric) ton of coal at the pit's mouth was, in 1898, 11 francs 22 centimes (9s. 4d.), as against 13 francs 45 centimes (lis. 2^.) in 1877. At the centres of consumption 19 francs 86 centimes (16s. 6^d.) in 1898, as against 22 francs 50 centimes (18s. 9d.) in

1877.

Peat was extracted in 1898 to the amount altogether of 104,000 tons, of the value of 1,507,000 francs, the department of the Somme alone contributing 33,000 tons.

The iron ore yielded by the mines amounted in 1898 to 4,731,000 tons, of the value, at the place of produc- tion, of 16 million francs, against 3,300,000 tons in 1883, and 3,000,000 tons in 1873. The following table shows the departments contributing the greatest quantities to this production, and the respective amounts of their con- tribution in 1897 :

[iNDUSTKY

Tons.

Tons.

Meurthe-et-Moselle

3,804,000

Lot-et-Garonne

33,000

Sa6ne-et-Loire .

146,000

Arifege

26,000

Haute-Marne .

146,000

Cher .

19,000

Calvados .

101,000

Isfere .

15,000

Pyr^n^es-Orientales

75,000

Tarn .

10,000

Gard

61,000

Aude

10,000

Ardfeohe .

46,000

Var .

8,000

Aveyron .

39,000

There were employed 8200 persons in 1898 in iron-mining, at an average daily wage each of 4 francs 34 centimes (3s. 7-|-d.). The ore sold on an average at 3 francs 39 centimes (3s. 8d.) a ton. Other metallic seams yielded in 1898 altogether 468,200 tons, valued at nearly 16 million francs ??? argentiferous lead, 320,000 francs ; zinc, 7 millions ; pyrites, 4 million francs ; maganese, 831,000 francs ; antimony, 325,000 francs ; arsenic, 109,000 francs. The mines of rock-salt, found chiefly in Lorraine and Eranche-Comte, supplied, in 1898, 304,000 tons, valued at 4,371,000 francs.

The French quarries yielded in 1898, 42^ million tons of stone and other material, valued at 231,800,000 francs. Of this total value, 152 millions was to the account of building materials ??? building stone being valued at 49 ; gravel at 7 ; limestone at 30 ; cement, 26 ; plaster, 12 ; slate, 20. The industrial materials supplied by the quarries counted for 9 million francs ; agricultural for 24 (phosphates alone, 16) ; paving materials, 36; and ornamental, 10 (marble, 5). T^e persons engaged in the open-air quarries numbered 108,162, and those in the subterranean quarries, 22,568.

Out of 294,362 persons employed in the coal and other mines and in quarries in 1898, 1722 met with accidents, 342 of them fatal.

Manufactures. ??? The steam apparatus in use in the various industries in 1898 comprised, exclusive of those employed in railways and boats, 70,765 engines, of 1,441,336 horse-power ; 86,839 steam-boilers, and 30,175 receivers.

The increase in the amount of industrial horse-power at work between 1880 and 1898 was as follows : ???

1880.

1885.

1890.

18’.)3.

1897.

1898.

544,000

683,000

852,000

1,163,000

1,330,000

1,441,336

The number of industrial establishments, with the respective amounts of horse-power employed by them, in 1898 was as follows : ???

Branches of Industry.

No. of Estabs.

No. of

Steam-

Engines.

Horse- Power.

Textile and Clothing

Metallurgic

Building ....

Mining and Quarrying

Alimentary

Agricultural

Chemical and Tanning

Paper, Printing, Furniture, &c

State Services .

6,661 5,114 7,440 3,167 9,605 15,976 3,153 3,464 483

7,456 8,454 8,649 5,852 11,183 19,997 3,866 3,862 1,430

315,190

260,811

217,.374

197,262

150,867

120,458

66,447

02,64!)

50,278

Total

55,063

70,755

1,441,336

Metallurgy. ??? The total production of the industry /m metals amounted in 1898 to 4,624,329 tons, valued at 610,680,500 francs (??24,427,220). Of this amount 4,466,000 tons, of the value of 560,615,000 francs (??22,424,620), was on account of iron and steel; and 59,329 tons, of the value of nearly 50 million francs (??2,000,000), on account of other metals. The produc- tion m pig-iron alone amounted to 2,525,000 tons, valued at ??6,371,680; finished iron, 766,000 tons, of the value of ??5,044,360; wrought steel, 1,174,000 tons.

valued at ??11,008,560. The products of the zinc in- dustry amounted in 1898 to 37,166 tons, valued at nearly 18 million francs; lead, 10,920

tons, valued at nearly 3;700,000 francs ; copper, 7834 tons, valued at 11 million francs; nickel, 1540 tons, valued at 4,600,000 francs; aluminium, 665 tons; antimony, 1226 tons. Fine gold was also produced to the amount of 687 lb, and silver to the amount of 199,282 ft.

The following figures show the production in tons of pig-iron for the years specified : ???

1880.

1886.

1890.

1895.

1898.

1,725,000

1,631,000

1,734,000

2,004,000

2,525,000

To the total production of pig-iron in 1898 the de- partment of Meurthe-et-Moselle contributed 1,661,000 tons, more than six-tenths of the whole. The depart- ment producing the next greatest amount of pig-iron, though at a long interval, was Nord, with 277,000 tons; next, with amounts varying from 106,000 to 76,000 tons, come Saone-et-Loire, Pas-de-Calais, Landes, Gard, and Loire-Inferieure. Twenty-two departments had blast-furnaces at work. To the total production of finished iron, amounting in 1898 to 766,000 tons, ISTord alone contributed 297,000 tons ; Ardennes, 90,000 ; Haute- Marne, 68,000; Meurthe-et-Moselle, 45,000; Saone-et-Loire, 47,000. In the total steel production of 1898, Bessemer and Martin steel ingots figured to the amount of 1,433,717 tons, of which Meurthe-et-

Moselle contributed 545,333 tons; Nord, 218,000 tons; Saone-et-Loire, 142,919 tons; Pas-de-Calais, 79,964; Loire-Inferieure, 71,902. The most important departments for the pro- duction of wrought steel were Nord, producing in 1898 263,000 tons, Meurthe-et-jMoselle (233,000), Saone-et- Loire (112,000), Loire (76,000), Pas-de-Calais (64,000). The lead manufactures have been carried on principally in the department of Loire-Inferieure ; zinc manufactures in Nord, Aveyron, and Pas-de-Calais ; copper in Ardennes, Pas-de-Calais, and Vaucluse. The number of workmen engaged in the manufacture of pig-iron in 1898 was 11,400; finished iron, 24,900; wrought steel, 36,000; in the manufacture of metals other than iron and steel, 3400, leaving out of account the much more numerous personnel occupied in secondary elaborations. The iron manufacture has declined since 1878, when it yielded 843,000 tons. In 1882 the iron production reached 1,073,000 tons. Prom 1888 to 1893 its average yield was 825,000 tons a year. The steel production of 1898 (1,174,000 tons) compares favorably with that of 1895 (715,000 tons), that of 1890 (682,000), that of 1885 (554,000), and that of 1880 (389,000).

Textiles. ??? The textile industry engrossed, in 1898, 22 per cent, of the total power of the steam-engines at work. Cotton spinning counts 6,300,000 spindles and more than 100,000 operatives. The consumption, figur- ing at 500,000 quintals (each 220^ ft) in 1877, 676,000 quintals in 1887, amounted to 1,400,000 in 1897. The cotton industry is distributed in three principal groups. The one longest established is that of Normandy, having its centres at Eouen, Havre, Evreux, Falaise, and Piers, comprising 250 factories, 2,200,000 spindles, and 20,000 looms. The group in the north of France sprang up about the middle of the 19th century, and has its centres at Lille, Tourcoing, Eoubaix, St Quentin, which last manufactures cambric muslin, and Amiens, in which the manufacture of fustian is developed. More than 1,600,000 spindles are at work in the departments of Nord, Pas-de- Calais, Somme, and Aisne. Lastly, there is the Yosges group, which has experienced a large extension since the loss of Alsace-Lorraine, and now counts 900,000 spindles

industry]

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around Belfort, i^pinal, St Di^, and Eemiremont. Secon- dary groups are those of Nantes, Cholet, and Laval in the west, Troyes in Champagne (with 80,000 spindles), and Tarare in Lyonnais.

The linen and hemp industry employs 65,000 operatives, working 45,000 looms. It has its seat in the departments of Nord, Somme, Sarthe, and Mayenne.

The woollen industry comprises more than 2000 estab- lishments and 120,000 employees. The number of its spindles exceeds three millions. In consequence of the introduction of steam power the number of persons em- ployed has since 1865 been reduced by 120,000. The woollen manufacture is most extensively carried on in the north, where its centres are Roubaix, Tourcoing, Fourmies, disposing of nearly 1,800,000 spindles. Of second rank are Reims and Sedan in the Champagne group of wool-manufacturing places. The department of Marne alone counts 275,000 spindles. Notable also are Tarn, with 75,000 spindles, Elbeuf and Louviers in Normandy.

The silk industry engages more than 110,000 persons in the south-eastern departments of Drome, Ardeche, Gard, Rhone, Loire, and Isere, and its production amounts to the annual value at least of 600 million francs. Lyons owes its prosperity to its enormous manufactxire of silk stuffs of every kind. According to the Lyons Cham- ber of Commerce, the silk production of Lyons in 1899 amounted to the value of 415 million francs, which was also the value of 1898, while its production of pure silk in 1899 exceeded that of 1898 to the value of 700,000 francs. St ifitienne is specially noted for its manufacture of ribbons.

The sicgar industry has advanced even to the point of over-production. To insure the export of its products, a complicated system of bounties has been instituted. Sugar refineries are naturally to be found in the de- partments of the north, in which the culture of beetroot is general ??? Nord, Pas-de-Calais, Aisne, Gise, Somme. Refineries have also been set up at the seaports of Nantes, Bordeaux, Marseilles, Dunkirk, and Havre, which, how- ever, since 1893 suffered from a severe sugar crisis. The

sugar industry in 1898-99 counted 340 works, employing regularly 42,811 men, 3614 women, and 2186 children, and occasionally over 8000 extra hands. The yield of sugar, 347,785 metric tons in 1887-88, 593,647 tons in 1895-96, and 730,067 tons in 1897-98, amounted in 1898-99 to 737,902 tons, and in 1899-1900 to 805,421 tons.

AlcoJiol. ??? To the substances from which alcohol is distilled, grain contributes 18 per cent, of the total product ; molasses, 32 per cent. ; beetroot, 34 per cent. ; and grapes, 2 per cent. ; the rest being distilled from fruits, &c. The production amounted to 2,068,000 gallons in 1850, 34,782,000 gallons in 1880, 48,708,000 gallons in 1890, and 48,576,000 gallons in 1898. The consumption of alcohol passed from 2-57 pints per head in 1850 to 3-99 pints in 1860, 4-08 pints in 1870, 4-65 pints in 1880, 7-67 pints in 1890, 7-53 pints in 1897, 7-56 in 1898. The departments producing the most alcohol are Nord (16,208,300 gallons in 1898), Pas-de-Calais (7,370,000 gallons), Seine-Inferieure (2,928,000 gallons), Aisne (6,204,000 gallons).

Beer. ??? The most important breweries are in the north, at Lille, Cambrai, and Dunkirk, and in the east, at Nancy. Since 1892 a very considerable number have also been established around Paris, Lyons, and Marseilles. The production, 66 million gallons in 1830, had increased to 264 millions in 1899.

Trade Unions. ??? These associations of workmen, autho- rized in 1884, have since developed very rapidly. In

that year numbering only 68, by 1890 they had grown to the number of 1006, including 139,962 members; in 1895 they counted 2163, with a membership of 419,781 ; and in 1899, 2695, with 492,647 members. These figures refer exclusively to associations of workers. If to them be added the unions of employers, mixed unions, and agricultural unions, the total number of trade unions in 1899 was 7081, with 1,192,260 members. There were in 1899, 65 Bourses du Travail, or Federations of trade unions, with 239,449 members.

Wages. ??? Taking into account all the different indus- tries, the average daily wage per workman was, accord- ing to official returns, in

Paris 2s. lid. from 1840 to 1845, 3s. 9d. from 1860 to 1865, and 5s. Ifd. from 1891 to 1893. In the provinces, the average daily wage per workman for these three periods was respectively Is. 8^d., 2s. 3^d., and 3s. 4d. The average daily wage of the female worker for these periods was respectively in Paris Is. 3|-d., Is. 5d., and 2s. 6d. ; in the provinces, lOd., Is. Id., and Is. lOd.

Commerce. ??? After, in 1860, embarking in free trade to the largest extent, France has gradually turned round towards protectionism ; this system triumphed in the Customs Law of 1892, which imposed more or less con- siderable duties on imports ??? a law associated with the name of M. Meline. While raising the taxes both on agricultural products and manufactured goods, this law introduced, between France and all the Powers trading with her, relations different from those in the past. It left the Government free either to apply to foreign countries the general tariff or to enter into negotiations with them for the application, under certain conditions, of a minimum tariff. The regime of protection was further accentuated by raising the impost on corn from 5 to 7 francs per hectolitre (2|- bushels). This system, however, against which a powerful party wages war, has at various times undergone modifications. On the one hand it became necessary, in face of an inadequate harvest, to suspend in 1898 the application of the law on the import of corn. On the other hand, in order to check the decline of exports and exercise the baleful effects of a prolonged customs war, a commercial treaty was in 1896 concluded with Switzerland, carrying with it a reduction, in respect of certain articles, of the imposts which had been fixed by the law of 1892. An accord was likewise in 1898 effected with Italy, which since 1886 had been in a state of economic rupture with France. Lastly, in July 1899, an accord was concluded with the United States of America. Almost all other countries, moreover, share in the benefit of the minimum tariff, and profit by the modifications it may successively undergo.

The general commerce with foreign countries, namely, of all goods entering and leaving France, amounted in 1861 to the value of 5745 million francs, in 1880 to 10,725 millions, in 1885 to 8886 millions, in 1890 to 10,292 millions, in 1895 to 9508 millions, and in 1897 to 9941 millions. In 1899 the general commerce figured at 11,381 million francs

<u>❓❓❓ an increase of 1440 millions on the amount of 1897, and of 1947 millions on the quinquennial average of 1894-98. Of the 11,381 million francs representing the general trade of France in 1899, the imports engrossed the larger half, namely, 5848 millions, i.e., 710 millions more than in 1897, the exports being valued at 5533 millions, or 990 millions less than in 1897.</u>

<u>The special commerce of France, on the other hand, including, namely, the imports for home use and the exports of home produce, amounted in 1899 to the value of 8670 million francs, against a value of 7354 millions in 1897.</u>

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<u>[commerce</u>

<u>The fluctuations undergone by the special commerce of France in the course of the twenty-three years from 1876 to 1899 are shown in the following table : ❓❓❓</u>

<u>Tear.</u>

<u>Imports for Home</u>

<u>Use (in Millions</u>

<u>of Francs).</u>

<u>Exports of</u>

<u>Home Produce</u>

<u>(in Millions</u>

<u>of Francs).</u>

<u>Imports and lixports.</u>

1876 1880 1885 1890 1895 1897 1898 1899

3988 5033 4088 4437 3720 3956 4472 4518

3575 3467 3088 3753 3374 3598 3511 4152

7563 8500 7196 8190 7094 7554 7983 8670

Divided in three classes, the imports for the years specified were, in millions of francs, as follows : ???

1892.

1895.

1897.

1898.

1899.

Food Products . Raw Products Manufactured Goods .

Total ....

1400

2172

615

1036

2101

583

1029

2319

608

1506

2348

618

951

2839

728

4187

3720

3956

4472

4518

The corresponding exports were : ???

1892.

1895.

1897.

1898.

1899.

Food Products Raw Products Manufactured Goods .

Total ....

759

822

1879

591

874 1909

721

944

1933

663

932

1916

675 1210 2267

3460

3374

3598

3511

4152

The principal articles of import were, in millions of francs : ???

Articles.

1892.

1895.

1897.

1899.

Raw Wool ....

319

308

343-7

467-4

“Wine .

305

212

280-3

267-4

Cereals

487

162

247-4

143-9

Raw Silk .

258

226

266-4

370-6

Coal and Coke .

185

167

189-5

258-2

Timber and Wood

103

130

154-6

157

Raw Cotton

207

167

205-7

177-6

Oil Seeds .

154

157

135-6

166-1

Raw Hides .

147

135

116-5

139-6

Coffee

145

177

105-4

89-6

Ores .

64

49

62-7

87-9

Cattle .

55

112

41-1

32-1

Sugar, Colonial .

37

26

32

32-3

Machinery .

55

59

67-6

103-6

Flax .

61

60

51-4

56-1

Textiles, Woollen

56

42

40

40-7

Textiles, Silk

62

50

52

65-4

Textiles, Cotton .

39

34,

36-3

43-8

Horses

18

38

39-6

28-7

Fish (Sea) .

32

38

32-9

36-6

Leather

24 ‘

28

26

32-9

The principal articles of export for the same years, in millions of francs, were : ???

Articles.

1892.

1S95.

1897.

1899.

Textiles, Woollen

329

323

265-5

264

Textiles, Silk .

249

271

270-9

278-3

Textiles, Cotton .

96

118

119-3

174-3

Wine

214

222

232-5

210-2

Raw Silk and Yarn .

132

126

117-7

179-9

Raw Wool and Yarn .

120

153

172-2

271-7

Small Ware

157

154

160-3

183-7

Leather ....

114

106

102-8

1.30-4

Leather Goods .

112

83

69-4

75-9

Linen and Clothes .

130

96

95-4

142-1

Metal Goods, Tools .

82

68

79-5

91-5

Cheese and Butter

88

61

86-0

76-2

Spirits ....

66

48

51-9

47-6

Raw Sugar ….

36

25

88-6

65-7

Refined Sugar .

55

41

45-4

46-2

Raw Hides

74

94

77-1

122-1

Chemical Products .

58

62

75-4

83-7

Pottery and Glass Ware .

49

49

56-6

65-3

Machinery ....

35

37

43-8

61-5

(_)ils . _?_?_.

39

27

24-2

21-3

The following were the countries from which the imports (special trade) were mostly drawn, with their respective values, in millions of francs, for the years indicated : _?_?

Countries.

1895.

1897.

1^99.

United States ... 283

438

427

United Kingdom .

496

485

590

Germany

310

309

360

Spain

213

247

239

Belgium .

288

288

332

Russia .

195

236

179

Argentine Republic

180

211

291

Algeria .

246

238

271

British India .

: 163

122

179

Italy .

115

132

158

China

137

149

227

Turkey .

92

107

102

Australia

69

80

95

Switzerland .

67

79

93

Brazil .

85

68

72

Austria .

73

65

78

Sweden .

55

63

70

Chile .

55

50

66

Japan .

59

81

93

Netherlands .

46

39

44

Egypt .

30

35

34

Hayti

48

26

31

Uruguay

36

27

27

Rumania

21

25

22

The French colonies, including Algeria, exported altogether into France (special trade) goods to the value of 197 million francs in 1881, 254 millions in 1886, 323 millions in 1891, 331 millions in 1896, 393 millions in 1897, and 461 millions in 1899.

The following are the principal countries receiving the exports of France, with their respective values, in millions of francs, for the years named :

<u>___</u>

<u>Countries.</u>

<u>1895.</u>

<u>1897.</u>

<u>1S99.</u>

<u>United Kingdom .</u>

<u>999</u>

<u>1132</u>

<u>1239</u>

<u>Belgium</u>

<u>497</u>

<u>513</u>

<u>605</u>

<u>Germany</u>

<u>334</u>

<u>380</u>

<u>457</u>

<u>Algeria .</u>

<u>203</u>

<u>216</u>

260

United States

289

242

255

Switzerland .

163

191

216

Italy .

134

151

192

Spain

109

99

148

Brazil

76

61

67

Argentine Republic

44

51

53

Turkey .

51

49

49

Netherlands .

46

46

51

Russia .

22

26

43

Mexico .

24

20

28

Egypt .

19

24

22

Austria .

17

15

20

British India .

12

12

20

Denmark

15

16

14

Colombia

20

22

14

Japan .

13

12

8

The exports from France (special trade) to the French colonies amounted to the value of 238 million francs in 1881, 246 millions in 1886, 280 millions in 1891, 332 millions in 1896, 358 millions in 1897, 477 millions in 1899. Of the goods to the value of 477 millions exported in 1899, 260 millions' worth was destined to Algeria, 46 millions to French Indo-China, 35 millions to Tunisia, 36 millions to Senegal, and 29 millions to Madagascar and de- pendencies.

The respective shares taken by the principal cities in its general trade, imports and exports combined, were, in millions of francs, in 1893 and 1899 : ???

1S93.

1899.

Marseilles

1766

2253

Havre

1646

1905

Paris

706

803

Dunkirk .

519

741

Bordeaux

647

683

Boulogne

416

479

Rouen .

210

262

Calais

175

249

Dieppe .

171

.-542

Belfort, P.C.

178

208

Tourcoing

174

261

money]

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Shipping. ??? Since 1887 the tonnage of steamers has exceeded the tonnage of sailing vessels in the French mercantile service, the latter remaining almost stationary, contrary to what is the case in neighbouring countries, where the tonnage of sailing ships is on the decline. The French mercantile navy numbered in 1880, exclusive of boats engaged in coast-fishing, 15,068 vessels of 919,298 tons, of which 652 were steamers of 277,759 tons ; in 1890, 15,111 vessels of 944,013 tons, of which 1110 were steamers of 499,921 tons ; in 1893, 14,190 sailing vessels of 396,582 tons with 69,302 crews, and 1186 steamers of 498,841 tons and 14,374 crews; and in 1899, 14,262 sailing vessels of 450,636 tons with 68,031 crews, and 1227 steamers of 507,120 tons with 21,229 crews. Of the sailing vessels of 1899, 150 (14,507 tonnage) fre- quented European waters, and 264 (213,078 tonnage) the high seas. Of the steamers of 1899, 237 (197,067 tonnage) frequented European waters, and 173 (274,861 tonnage) the high seas ??? the rest being in the coasting- trade, port-service, and the fisheries. In 1888, 28,176 vessels (13,537,734 tonnage) entered, and 21,319(9,354,225 tonnage) cleared the ports of France; in 1895, 24,374 vessels (13,221,595 tonnage) entered, and 20,032 vessels (9,272,889 tonnage) cleared; and in 1899 the entrances were 26,464 vessels (17,087,465 tonnage), of which 7828 vessels (4,297,444 tonnage)

were under the French flag, while the clearances numbered 21,292 vessels (12,082,903 tonnage), of which 7627 vessels (4,425,880 tonnage) were under the French flag.

For a number of years the state of her mercantile sea-service has keenly engaged the attention of the public authorities of France. In spite, however, of the con- siderable assistance given to this interest by the Treasury in the shape of bounties, its condition is still recognized as open to improvement. The year 1899 may be regarded as exceptional.

Boads. ??? The national roads kept up by the State had altogether a length in 1899 of 24,052 miles. Of these 1466 miles were paved roads. The departmental roads maintained at the expense of the departments covered 19,263 miles. The cross-roads {chemins vidnaux), dis- tinguished into three classes (chemins de grande com- munication, d'interM commun, and ordinaires), extended over 379,043 miles. The roads, national, departmental, and vicinal, have therefore altogether a length of over 422,300 miles.

Bivers and Canals. ??? The internal waterways actually navigated in 1899 had altogether a length of 12,269 kilometres, or 7620 miles, of which 4608 miles were supplied by rivers and lakes, and 3012 miles by canals. There were, besides, 1826 miles of rivers navigable by rafts. The internal waterways, available at all times for boats drawing as much as 5-9 feet of water, had in 1899 a length altogether of 2934 miles ??? 1297 miles river, and 1637 canal.

Railways. ??? The total railway lines measured in 1860, 4000 miles; in 1890, 20,666 miles; in 1899, 23,592 miles, besides 2754 miles of purely local railway. The following table, referring to lines of general interest open for traffic, indicates the development of railways in recent years : ???

Tear.

Length in English Miles.

Construc- tion Cost (??1000).

Receipts (□□1000).

Expenses (□□1000).

Passengers

(100,015).

Goods

Carried

(1000 tons).

1892 1895

1896 1897 1898 1899

21,661 22,505 23,018 23,152 23,324 23,592

594,600 620,840 628,480 635,920 643,121 651,315

47,336 50,542 51,906 53,514 54,375 58,167

26,511 27,362 27,464 27,871 28,301 29,513

288,078 348,852 363,009 374,755 385,222 400,437

95,713 100,834 104,046 108,399 119,719 126,311

The concessions made to the companies ai'e valid for ninety-nine years, and will all terminate at different dates, from 1950 to 1960, when the lines will revert in full right to the State. Under the convention of 1883, the com- panies are bound to construct a certain number of new lines, the Treasury guaranteeing a certain dividend, rang- ing from 35 francs 50 centimes to 56 francs, according to the company, per primary share of 500 francs. The periods of State guarantee close, in the case of four of them, at the end of 1914, of a fifth in 1934, and of the last in 1935.

The receipts of the railways of general interest dropped between 1876 and 1899 from 43,300 francs' to 38,400 francs, in consequence of the creation of numerous secondary lines with light traffic, and the net proceeds per kilometre have likewise fallen from 22,000 to 18,800 francs. The profits of the companies, however, have, on the whole, been sensibly on the increase, amounting in 1899, after deductions of all expenses, to 712 million francs, against 593 millions in 1895. The total railway expenses in 1899 were 737 million francs, covered (with a margin) by 1449 million francs of receipts. The capital of the railways of general interest is estimated at 12 mill- iards of francs.

Narrow-gauge and normal railways of local interest covered on the 1st January 1900, 2759 miles in length, and the tramways, 2317 miles. The receipts of the local lines amounted to ►►868,676, and the expenses to ►►653,- 500. The receipts of the tramways reached ►►2,936,393, and the expenses ►►2,325,988.

Posts and Telegraphs. ►►► The receipts of the post-ofBce in 1899 amounted to ►►10,277,730, and the expenses to ►►7,708,164. The number of letters carried, includ- ing post-cards and printed matter, amounted in 1899 to 2,260,650,992, against 1,825,642,200 in 1892. Of the total carried in 1899, 904,210,126 were letters, and 1,346,440,866 post-cards and printed matter. Post-office orders, inland, were issued to the value of ►►44,280,016 ; international orders were issued for ►►1,940,221, and postal orders for ►►1,616,176. Bills were collected by the post-office for ►►16,345,247. The number of telegrams was 43,626,116, and the number of subscribers to the telephone 46,121, of which 22,468, or nearly a half, fell to the share of]?aris. Of the total of 43,626,116 tele- grams in 1899, 36,065,264 were internal and 7,660,862 international. The pneumatic tubes in Paris measured (1899) 163 miles ; 931 urban telephone systems disposed of 11,521 miles of line and 129,606 miles of wire; 1256 inter-urban circuits had 17,439 miles of line and 46,118 miles of wire.

Banks. ►►► The last renewal of the privilege accorded to the Banque de France was made in 1897. It is the only establishment which, in consideration of a permanent advance to the Treasury, and under certain

*other stipulated conditions, is allowed to issue bank notes of legal tender. Besides its central seat at Paris, the Banque de France has ninety-five branches in im- portant provincial towns. Its total transactions in 1899 amounted to the value of 17,834,031,400 francs, in which the share of Paris was 9,154,741,200 francs, and of the branches 8,679,290,200 francs. The bullion in stock *on the 1st January 1900 amounted to 3030 million francs, 1873 million francs being in gold and 1167 millions in silver. The notes in circulation amounted to the value of 3,983,493,000 francs. The bullion in hand on 1st February 1901 comprised 2,353,-945,593 francs in gold and 1,096,261,297 francs in sil- ver, while the notes in circulation valued 4,445,866,425 francs. The average rate of discount was 3 per cent, in 1899, against 2-70 per cent, in 1892, 3 per cent, in 1887, 3-80 per cent, in 1882. Finally, the shares in the bank*

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in 1899, as at the beginning, numbered 182,500 ; but the number of shareholders tends gradually to increase, the number being 28,299 in 1899, against 26,742 in 1887.

The transactions of tlie Credit Fonder, whioli grants loans on land securities, amounted on the SOth June 1899 to the value of 3,895,081,575 francs. Since it started business in 1853 it has lent money to the amount of 4,406,368,040 francs. In 1897 its loans were 214,812,832 francs, of which 90,510,659 francs were to the communes. Among other banking establishments may be mentioned the Credit Lyonnais, Societe General, and Comptoir d' Escompte.

Savings Banks. ??? Since 1895 savings banks have experienced an enormous development. They are administered either by the national savings bank, which since 1882 has been connected with the post-office, and numbered, in 1897, 7416 branch offices, or by the private savings banks. The funds, however, are centralized in the Caisse des Depots et

Consignations, which had accounts under this head to the value, on the 31st December 1898, of 3478 million francs.

The deposits in the different savings banks amounted to 680 million francs in 1870, 1810 millions in 1880, 3113 millions in 1890, 4080 millions in 1896, 4271 in 1897. The total number of depositors was on the 31st December 1897, 9,265,408, and on the 31st December 1897 the depositors at the private savings banks numbered 6,772,582. In 1897 the deposits at the national savings banks amounted to 366 million francs, and the withdrawals to 327 millions. At the private savings banks the deposits in 1897 amounted to the value of 719 million francs, and the repayments to 774 millions.

Money. ??? Since 1880 there has been but a single mint in France, namely, the Mint in Paris. The last of the provincial mints, that at Bordeaux, was done away with in 1879. The nominal value of the coin minted at Paris for Prance, the colonies, and foreign countries amounted, in francs, to : ???

1880.

1886.

1890.

1896.

1S99.

200,100,000

8,506,000

22,606,000

148,702,000

140,321,212

Prom 1795 to 1899 there were struck for the use of Prance : ???

Yalue in Francs.

60,663,200

46,893,450

. 204,432,360

. 8,000,517,800

1,041,165,620

233,440,130

Gold-Pieces.

100-franc

pieces

50- ???

40- ???

20- ???

10- ???

5- ???

Total

. 9,587,112,560

Prom 1874 to 1899 the coin struck in gold amounted to the value of 1,812,585,560 francs. Since 1839 no 40-franc pieces, and since 1869 no

5-franc pieces, have been struck. The silver coius of Prance struck from 1795 to 1899 were as follows : ???

Silver Coins.

5-franc pieces

1" 15 J??

50-centime pieces

25- ,,,,

20- ???

Total

Value in Francs.

5,060,606,240

184,863,534

235,558,.399

131,620,003 and 50 centimes. 7,671,101 ,, 25 ??? 8,252,720 ??? 60

. 5,628,571,998 and 35 centimes.

Since 1875 silver coins have been struck to the value of 559,326,173 francs. Since 1848 the coinage of 25-cen- time pieces, since 1869 oi 20-centime pieces, and since 1878 of 5-franc crowns {Ecus) has been suspended. But by way of exception 20-franc pieces were put iif circu-lation in 1889.

Since 1852 bronze coins have been struck to the value of 70,549,872 francs, 40 centimes : ???

Bronze Coins.

10-centime pieces 5- ❓❓❓ ❓❓❓ 2- ??)i

Value in Francs.

. 37,266,676 and 40 centimes. . 29,882,989 ❓❓❓ 55 ,, . 2,061,209 ❓❓❓ 52 . 1,33<),096 ❓❓❓ 93

Total .

. 70,549,872 and 40 centimes.

Colonies. ❓❓❓ Since 1880 Prance has been making stren- uous efforts to increase her colonial empire, which then comprised : ❓❓❓ In Asia ❓❓❓ the East-Indian factories of Pondichery, Karikal, Mahe, Yanaon, and Chandernagore ; in Africa ❓❓❓ Algeria, Senegal and Goree, Gaboon, the islands of Eeunion, Ste Marie de Madagascar, Mayotte, and Nossi-Be; in America ❓❓❓ Martinique, Guadeloupe, St Bar- thelemy in the Antilles group of West Indian islands, Guiana on the continent of South America, and St Pierre and Miquelon in the North Atlantic; in Oceania ❓❓❓ the Marquesas islands, Tahiti, and New Caledonia. At the date of 1880, under the influence especially of Jules Perry, who was a prime mover in the policy of foreign expansion, colonial experiments were made by Prance in three different zones of the globe : in Western Africa (in Sudan and Guinea) and in Northern Africa (in Tunis), in the Indian Ocean (in Madagascar), and in the far East (in Annam and Tongking). Following on a short expedition and the treaty of Kasr-es-Said or Bardo, signed on the 12th May 1881, Tunis was placed under the protectorate of France. It has now become one of the brightest gems in her crown. The year 1880, again, dates precisely the beginning of the penetration of the Sudan by French influence. The French possessions in the Senegal then reached no farther eastwards than Medina. In 1883 the French possessions touched the Niger. The long wars waged against Ahmadou and Samory brought with them a still further extension of conquest and territory. In 1894 Timbuctoo was occupied. French Guinea is likewise of recent foundation, as is also its appendage of Futa Jallon, to

which a number of French officers paid a visit between 1881 and 1885. Since the latter year the Ivory Coast has grown French, a result due to the old settlements of Grand Bassam and Assinie. The region of Kong, constituting its hinterland, was explored by Captain Binger, 1887-89. All this ter- ritory was delimited by the Pranco-Liberian convention of the 8th December 1892 and the Franco-British conven- tion of the 12th July 1893. In respect of the zone of French influence in West Africa, it has been traced iu a general manner by the Franco-British convention of 14th June 1898. This convention has at the same time delimited the frontier of Dahomey on the east side, ia completion of the previous accord of August 1889. The western frontier of this colony, on the other hand, has been drawn by the Franco-German convention of the 27th July 1897. Dahomey and its king Behanzin were con- quered in 1892. Senegal, Sudan, and Guinea form the general government of French Western Africa, in commu- nication with which there are also the Ivory Coast and Dahomey.

French Congo was constituted as a result of the explorations of M. Savorgnan de Brazza (1875-82). Its delimitation was fixed by the convention of the 5th February 1885 concluded with the International Congo Association, by the protocol of December 1886 agreed on with Germany, and by the Franco-Portuguese protocol of May 1886. In the train of territorial and diplomatic difficulties with the Free State, an accord between King Leopold and]\I. Hanotaux relative to the region of the upper Ubanghi was signed on the 14th April 1894. The expansion of Prance in this zone, from 1896 to 1897, was crowned by the mission of Marchand, which in 1898 reached the Bahr-el-Ghazal and the Nile. The Franco- British convention of the 21st March 1899 fixed the delimitation of the Congo towards the north-east.

The large island of Madagascar in the Indian Ocean was, after a first expedition, placed in 1885 under the protectorate of Prance. Following a second expedition (1894-95), Madagascar was in August 1896 declared a French colony.

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French Indo-CMna has since 1862 comprised the terri- tory of Cochin-China, and since 1863 the protectorate of Cambodia. In consequence of a prolonged campaign (1883-84) and of treaties with Annam (6th June 1884) and China (9th June 1885), the protectorate of the Republican Government was proclaimed over Annam and Tongking. Cochin-China, Annam, Tongking, and Cambodia are united under the authority of a common governor-general.

The following table shows the extent of France's colonial empire. It should be noted that the figures for area and population are, as a rule, only estimates, a remark which especially applies to the West African possessions. Detailed notices of the separate colonies will be found under their several heads : ‘

Colony.

In Asia India Annam . Cambodia Cochin-China . Tongking and Laos .

Total in Asia

In Africa Algeria . Algerian Sahara Tunis

Sahara, including Tibesti Senegal .

Sudan Military Districts French Guinea Ivory Coast Dahomey

Congo and Gaboon . Bagirmi, Wadai, Kanem Somali Coast . Efiunion . Comoro Isles . Mayotte . Nossi-B^ . Ste Marie Madagascar

Total in Africa .

In America Guiana Guadeloupe Martinique St Pierre and Miquelon

Total in America In Oceania ◆◆◆ New Caledonia and De-\ pendencies . . J Establishments in Oceania

Total in Oceania Grand Total

Year of Acquisi- tion.

1679

1884

1862

1861

1884-93

1830 1873-1900

1881 1875-1900

1637

1880

1843

1843

1893

1884 1896-99

1864

1649

1886

1843

1841

1750

1896

1626 1634 1635 1635

1854-87 1841-81

Area in Square Miles,

197

88,780

40,530

23,160

210,370

.363,037

184,474

123,500

51,000

1,892,000

182,000

183,000

92,000

119,500

59,000

550,000

126,000

14,000

970

620

140

130

64

228,500

3,806,898

46,850

688

380

93

48,011

7,700 1,520

9,220

4,227,166

Population.

1896.

279,100

4,000,000

1,500,000

2,400,000

12,500,000

20,679,100

4,430,000 50,000 1,500,000 1,500,000 1,200,000 2,000,000 1,000,000 2,500,000 1,000,000 8,000,000

22,000

173,200

53,000

11,640

9,500

7,670

2,750,000

26,207,010

22,710

167,100

187,690

6,250

383,750

47,-351,81

Colonial Budget and Administration. ??? Besides their local bud- gets, the French colonies figure in the budgets of the mother- country, with drafts on her Treasury steadily increasing since 1875, and now amounting to more than 106 million francs. Of this amount the expenditure on military occupation accounts for more than three-fifths ??? actually 72 million francs. Neither Tunis nor Algeria figures in these totals. All the expenses of Tunis are com- prised in a budget of its own, dating from 1st of January 1901. Algeria has likewise a budget of its own, dating from the same time ; but the financial charges of the 19th Army Corps (50 million francs), which has its headquarters at Algiers and subdivisions at Oran and Constantine, are always incumbent upon the capital. It should be remembered, however, that her commercial dealings with Algeria repay France in a measure for the sacrifices which she continues to make. Administratively, the foreign possessions of France are divided into two great categories ??? colonies and pro- tectorates. The latter include Tongking, Annam, and Tunis, over whose native administration is placed a staff of French control, con- sisting of a resident-superior at Tunis and a resident at Hu6, under whom are controleurs, vice-residents, chanceliers de residence, &c. Some of the colonies send representatives to Parliament. In the

case of the older colonies, dating from before the constitution of the Third Republic, the departmental organization of France has been applied in whole or in part. The governor of such a colony is as- sisted by a general elective council exercising deliberative power ??? as in Martinique, Guadeloupe, Guiana, &c. In the new colonies the governor is assisted by a consultative assembly, or he may even be left uncontrolled. At the head of every colonial adminis- tration is the Ministry of the Colonies, which was only separately constituted in 1894. The Ministry of the Colonies is assisted by an elective superior council having consultative attributes.

Fuller details respecting the productions, industries, commerce, and shipping of the colonies will be found under the headings of the various colonies. It may here, however, be noted that the greater part of the French foreign possessions lies within the hot zones of the globe, and that accordingly the chief colonial products are tropical ??? cofiee, sugar, ground-nuts, rice.

Except in the case of Algeria and Tunis, the trade of France with her possessions is not as a rule proportionately great. But the proportion is rapidly increasing, and France is quickly gaining a commanding share of the commerce of her colonies. The follow- ing table gives the value of the trade of France vrith her possessions in 1896 and 1898 : ???

From or to

Imports.

Exports,

1896.

1899.

1896.

1S99.

Alg:eria ....

??8,162,000

??11,240,000

??9,780,000

??11,400,000

Tunis

1,044,000

1,898,000

1,640,000

2,160,000

West African Colonies

944,000

1,801,000

1,852,000

1,962,000

Madagascar . ...

168,000

268,000

316,000

1,470,000

Reunion

836,000

918,000

664,000

720,000

French India

196,000

160,000

???28,000

205,000

Indo-China

712,000

1,663,000

1,468,000

2,242,000

Oceania

476,000

780,000

300,000

603,000

Guiana

84,000

11,000

416,000

401,000

Martinique ....

752,000

820,000

540,000

760,000

Guadeloupe

652,000

568.000

628,000

600,000

St Pierre and Miquelon

1,220,000

1,278,000

272,000

801,000

Total

15,286,000

20,300,000

17,804,000

22,714,000

Colonial Defence. France has not yet a colonial army properly so-called, although it is a problem she has had under discussion for many years. She has, however, the elements of an army in her troops of marines, which have hitherto carried on all her foreign campaigns, and in the native regiments she levies on the spot tirailleurs, Sengalese, Sudanese, Congolese, Sakalavese, Tongking- ese, Annamese, Sudanese Spahis, &c.

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Expansion de la France. Paris, 1891. ◆◆◆ Viollet. Histoire des Institutions Politiques et Administratives de la France. PariSj 1898. ◆◆◆ Zevort. Histoire d^ la Troisieme Republique : Presidence de Jules Grevy. Paris, 1898. Among the numerous Official Publications may be noticed the 1896 census volume, the annual tables of customs, the annual statistics published by the Ministry of Commerce, the reports of the administration of Justice, the parliamentary reports on the budget, the decennial and annual statistics of agriculture, the statistics of the mineral and metal- lurgical production published by the Ministry of Public Works, and the results of the inquiry into the congregations published by the Ministry of Finance, 1901. (p. l.)

3. Political History (1870-1900).

On the 8th of May 1870 the doom of the Second Ernpire was determined by an event which was intended to give it a new lease of life ◆◆◆ the plebiscite approving of the reforms introduced by the emperor into ^^J^◆◆JJ'"' the constitution. Napoleon III. had in reality Empire. sealed the fate of his dynasty four years previ- ously when, cajoled by Bismarck, he had made France

look on, a passive spectator of the defeat of Austria by Prussia. After Sadowa France remained the only obsta- cle to the preponderance of Prussia on the European continent, and a German victory over the French was foreseen as the probable means of consolidating a united Germany under the headship of the ambitious House of HohenzoUern. In the face of this external peril, wantonly evoked by his unsagacious diplomacy, Louis Napoleon set about making his position more secure at home, and, always a dreamer, conceived that a liberalized Empire would conciliate the entire population of France to his rule. The rapidly ageing Emperor had thus dis- avowed the principles which in the prime of life he had declared to be essential to the government of the coun- try, and M. Emile Ollivier, an ardent opponent of the autocracy which sprang from the couj) d'dtat of 1851, became Prime Minister of the Liberal Empire in January 1870. Napoleon III. perceived too late that his waning popularity was not to be recovered by such empirical remedies ; so, against the wish of his liberal minister, he had recourse to an appeal to popular opinion, such as eighteen years before had ratified his arbitrary omnipo- tence. The plebiscite gave an overwhelming majority to the Empire, but it brought on its downfall. The popular victory made Louis Napoleon believe that he still pos- sessed the confidence of the country, and that external glory would restore his shaken authority. The candida- ture of a prince of HohenzoUern for the throne of Spain, vacant by revolution, provided a pretext for a quarrel between France and Prussia, which was not unwelcome on either side the Rhine. The French Government declared it would never accept the presence of a German sovereign at Madrid. The king of Prussia announced to the French Ambassador that his cousin had withdrawn his candidature, whereupon Napoleon demanded a promise from William I. never to allow it to be renewed. This the King refused, to the joy of Bismarck, who saw in the unprepared state of France an opportunity for the fulfil- ment of his life-dream. Subsequent revelations indicate that the Prussian chancellor spared no

effort to fan the warlike inclination of the French, which had no need to be stimulated by his unscrupulous provocation. The de- bates in the Corps Legislatif in July 1870 show that the French were bent on war. The voices of MM. Thiers, Buffet, and Jules Favre, united in pleading for delay though they represented widely different schools of poli- tics, were drowned in the clamour for immediate hostili- ties. War was officially declared on the 19th of July 18" ’” amid the acclamations of the capital, which adopted \v ” enthusiasm the unfortunate phrase of the prime minis ifimile Ollivier, that he entered on the campaign with! ” light heart.” Six weeks later France had neither a rule”? nor a regular army nor a government. The Emperor ‘ drifted into war regardless of diplomatic or military pre- cautions, without allies, and without an organized system of national defence. An unbroken series of German vic- tories culminated at Sedan with the surrender of Napoleon III. and of the French army to the king of Prussia. Three days after the battle of Sedan the Parisian populace, which, clamouring^for war, had sent off the troops with joyous cries of ” A Berlin ! ” invaded the Corps Legislatif, and demanded the deposition of the Empire.

The Third Republic may thus be said to date from the revolution of the 4th of September 1870, when the repub- lican deputies of Paris at the Plotel de Ville constituted a provisional government under the presidency of General Trochu, military gov- ernor of the capital. The Empire had fallen, and the Emperor was a prisoner in Germany. As however since the great Revolution regimes in France have been only passing expedients, not inextricably asso-

Oovern- meat ot National Defence,

1870.

Founda- tion of the Third Republic,

1871.

elated with the destinies of the people, but bound to disappear when accounted responsible for national dis- aster, the surrender of Louis Napoleon’s sword to Will- iam of Prussia did not disarm the country.

Hostilities were therefore continued. The provisional government had to assume the part of a Committee of National Defence, and while insurrection was threatening in Paris, it had, in the face of the invading Germans, to send a delegation to Tours to maintain the relations of France with the outside world. Paris was invested, and for five months endured siege, bombardment, and famine. Before the end of October the capitulation of Metz, by the treason of Marshal Bazaine, deprived France of the last relic of its regular army. With indomitable courage the garrison of Paris made useless sorties, while an army of irregular troops vainly essayed to resist the invader, who had reached the valley of the Loire. The acting Government of National Defence, thus driven from Tours, took refuge at Bordeaux, where it awaited the capitulation of Paris, which took place on the 29th of January 1871. The same day the preliminaries of peace were signed at Versailles, which, confirmed by the Treaty of Frankfort of the 10th of May, transferred from France to Germany the whole of Alsace, excepting Belfort, and a large portion of Lorraine, including the fortified city of Metz, in addition to a money indemnity of two hundred millions sterling.

On the 13th of February 1871 the National Assembly, elected after the capitulation of Paris, met at Bordeaux and assumed the powers hitherto exercised by the Government of National Defence. Since the meeting of the States General in 1789 no repre- sentative body in France had ever contained so many men of distinction. Elected to conclude a peace, the great majority of its members were monarchists, Gambetta, the rising hope of the republicans, having dis- credited his party in the eyes of the weary population by his efforts to carry on the war. The Assembly might thus have there and then restored the monarchy had not the monarchists been divided among themselves as roy- alist supporters of the Comte de Chambord, grandson of Charles X., and as Orleanists favouring the claims of the Comte de Paris, grandson of Louis Philippe. The majority being unable to unite on the essential point of the choice of a sovereign, decided to allow the Republic, declared on the morrow of Sedan, to liquidate the disastrous situation. Con- uently, on the 17th of February the National Assembly

‘ M. Thiers as ” Chief of the Executive Power of the Republic,” the abolition of the Empire being for- oted a fortnight later. The old minister of Louis

ipe, who had led the opposition to the Empire, and been the chief opponent of the war, was further ked out for the position conferred on him by his election to the Assembly in twenty-six departments in recognition of his tour through Europe after the first defeats, under- taken in the patriotic hope of obtaining the intervention of the Powers on behalf of France.]M. Thiers composed a ministry, and announced that the first duty of the Government, before examining constitutional questions, would be to reorganize the forces of the nation in order to provide for the enormous war indemnity which had to be paid to Germany before the territory could be liberated from the presence of the invader. The tacit acceptance of this arrangement by all parties was known as the “parte de Bordeaux.” Apart from the pressure of patriotic considerations, it pleased the republican minority to have the government of France ofl&cially proclaimed a Republic, while the monarchists thought that pending their choice of a monarch it might popularize their cause not to have it associated with the imposition of the burden of war taxation. From this fortuitous and informal transaction,

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accepted by a monarchical Assembly, sprang the Third Republic, the most durable regime established in France since the ancient monarchy disappeared in 1792.

The Germans marched down the Champs Elysees on the 1st of March 1871, andoccupiedParisforforty-eighthours. The National Assembly then decided to remove its sittings to Versailles ; but two days before its arrival at the palace, where the king of Prussia had just been proclaimed Ger- man emperor, an insui’rection broke out in Paris. The revolutionary element, which had been foremost in pro- claiming the Eepublic on the

4th of September, had shown signs of disaffection during the siege. On the conclusion of the peace the triumphal entry of the German troops, the threatened disbanding of the national guard by an

Assembly known to be anti-republican, and the Commune, resumption of orderly civic existence after the

agitated life of a suffering population isolated by siege, had excited the nerves of the Parisians, always prone to revolution. The Commune was proclaimed on the 18th of March, and Paris was declared to be a free town, which recognized no government but that chosen by the people within its walls, the communard theory being that the State should consist of a federation of self-governing communes subject to no central power. Administrative autonomy was not, however, the real aim of the insurgent leaders. The name of the Commune had always been a rallying sign for violent revolutiona- ries ever since the Terrorists had found their last support in the municipality of Paris in 1794. In 1871 among the communard chiefs were revolutionaries of every sect, who, disagreeing on governmental and economic princi- ples, were united in their vague but perpetual hostility to the existing order of things. The regular troops of the garrison of Paris followed the National Assembly to Versailles, where they were joined by the soldiers of the armies of Sedan and Metz, liberated from captivity in Germany. With this force the government of the Ee- public commenced the second siege of Paris, in order to capture the city from the Commune, which had estab- lished the parody of a government there, having taken possession of the administrative departments and set a minister at the head of each office. The second siege lasted six weeks under the eyes of the victorious Ger- mans encamped on the heights overlooking the capital. The presence of the enemy, far from restraining the humiliating spectacle of Frenchmen waging war on Frenchmen in the hour of national disaster, seem^” encourage the fury of the combatants. The comm who had begun their reign by the murder of two concluded it, when the Versailles troops were ta city, with the massacre of a number of eminent ci’ including the archbishop of Paris, and with the tion by fire of many of the finest historical buildi including the Palace of the Tuileries and the Hotel de Villa. History has rarely known a more unpatriotic ???crime than that

of the insurrection of the Commune ; but the punishment inflicted on the insurgents by the Ver- sailles troops was so ruthless that it seemed to be a coun- ter-manifestation of French hatred for Frenchmen in civil disturbance rather than a judicial penalty applied to a heinous offence. The number of Parisians killed by French soldiers in the last week of May 1871 was pro- bably 20,000, though the partisans of the Commune de- clared that 36,000 men and women were shot in the streets or after summary court-martial.

It is from this point that the history of the Third Republic commences. In spite of the doubly tragic end- ing of the war the vitality of the country seemed unim- paired. With ease and without murmur is supported the new burden of taxation called for by the war indemnity and by the reorganization of the shattered forces of France.

Repub- licans anil monarch- ists after the war.

M. Thiers was thus aided in his task of liberating the territory from the presence of the enemy. His proposal at Bordeaux to make the " essai loyal " of the Republic, as the form of government which caused the least division among Frenchmen, was discouraged by the excesses of the Com- mune which associated republicanism with rev- olutionary disorder. Nevertheless, the monarchists of the National Assembly received a note of warning that the country might dispense with their services unless they displayed governmental capacity, when in July 1871 the republican minority was largely increased at the bye- elections. The next month, within a year of Sedan, a provisional constitution was voted, the title of President of the French Republic being then conferred on M. Thiers. The monarchists consented to this against their will ; but they had their own way when they conferred constituent powers on the Assembly in opposition to the republicans, who argued that it was a iisurpation of the sovereignty of the people for a body elected for another purpose to assume the power of giving a constitution to the land without a special mandate from the na- tion. The debate gave Gambetta his first opportu- nity of appearing as a serious politician. The "fou furieux" of Tours, whom M. Thiers had denounced for his efforts to prolong the hopeless war, was

about to become the chief support of the aged Orleanist statesman whose supreme achievement was to be the foundation of the Republic.

It was in 1872 that M. Thiers practically ranged him- self with Gambetta and the republicans. The divisions in the monarchical party made an immediate restoration impossible. This situation induced {?fj? ??? some of the moderate deputies, whose tendencies aambetta. were Orleanist, to support the organization of a Republic which now no longer found its chief support in the revolutionary section of the nation, and it suited the ideas of M. Thiers, whose personal ambition was not less than his undoubted patriotism. Having become unex- pectedly Chief of the State at seventy-four he had no wish to descend again to the position of a minister of the Orleans dynasty which he had held at thirty-five. So, while the royalists refused to admit the claims of the Comte de Paris, the old minister of Louis Philippe did his best to undermine the popularity of the Orleans tradition, which had been great among the Liberals under the Second Em- He moved the Assembly to restore to the Orleans inces the value of their property confiscated under Louis .poleon. This lie did in the well-founded belief that the ily would discredit itself in the eyes of the nation by fecepting two millions sterling of public money at a moment when the country was burdened with the war indemnity. The incident was characteristic of his wary policy, as in the face of the anti-republican majority in the Assembly he could not openly break with the Right ; and when it was suggested that he was too favourable to the maintenance of the Repiiblic he offered his resignation, the refusal of which he took as indicating the indis- pensable nature of his services. Meanwhile Gambetta, by his popular eloquence, had won for himself in the autumn a triumphal progress, in the course of which he declared at Grenoble that political power had passed into the hands of "une couche sociale nouvelle," and he ap- pealed to the new social strata to put an end to the comedy of a Republic without republicans. When the Assembly resumed its sittings, order having been restored in the land disturbed by war and revolution, the financial system being reconstituted and the reorganization of the army planned, M. Thiers read to the house a presidential message which marked such a distinct movement towards the Left that Gambetta led the applause. " The Republic

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exists," said the President, " it is the lawful government of the country, and to devise anything else is to devise the most terrible of revolutions."

The year 1873 was full of events fateful for the history of France. It opened with the death of Napoleon III. at Chislehurst ; but the disasters amid which the Second Empire had ended were too recent for the youthful promise of his heir to be regarded as having any con- nexion with the future fortunes of France, except by the small group of Bonapartists. M. Thiers remained the centre of interest. Much as the monarchists disliked him, they at first shrank from upsetting him before they were ready with a scheme of monarchical restoration, and while Gambetta's authority was growing in the land. But when the Left Centre took alarm at the return of radical deputies at numerous bye-elections the reactiona- ries utilized the divisions in the republican party, and for the only time in the history of the Third Republic they gave proof of parliamentary adroitness. The date for the evacuation of France by the German troops had been advanced, largely owing to M. Thiers' successful efforts to raise the war indemnity. The monarchical

majority, therefore, thought the moment had Resigaa- arrived when his services might safely be dis- Thiers. pensed with, and the campaign against him

was ably conducted by a coalition of Legitimists, Orleanists, and Bonapartists. The attack on M. Thiers was led by the Due de Broglie, the son of another minister of Louis Philippe and grandson of Madame de Stael. Operations began with the removal from the chair of the Assembly of M. Jules Grevy, a moderate republican, who was chosen president at Bordeaux, and the substitution of M. Buffet, an old minister of the Second Republic who had rallied to the Empire. A debate on the political

tendency of the Government brought M. Thiers himself to the tribune to defend his policy. He maintained that a conservative Republic was the only regime possible, seeing that the monarchists in the Assembly could not make a choice between their three pretenders to the throne. A resolution, however, was carried which provoked the old statesman into ten- dering his resignation. This time it was not declined, and the majority with unseemly haste elected as Presi- dent of the Republic Marshal MacMahon, Due de

*Magenta, an honest soldier of royalist sympa- A^acMahoa thies, who had won renown and a ducal title President on the battlefields of the Second Empire. In "'ft/f**' *^ ►► ►►y^ ►► ►►^ Europe the curt dismissal of the **" "' aged liberator of the territoi'y was an act of ingratitude. Its justification would have been the'j success of the majority in forming a stable monarchical, government; but the sole result of the 24th of May 18731 was to provide a definite date to mark the opening of the era of anti-republican incompetency in France which has lasted for a generation, and has been perhaps the most effective guardian of the Third Republic.*

The political incompetency of the reactionaries was fated never to be corrected by the intelligence of its princes or of its chiefs, and the year which saw M. Thiers dismissed to make way for a restoration saw also that restoration indefinitely postponed by the fatal action of the Legitimist pretender. The (Jomte de Paris went to Frohsdorf to abandon to the Comte de Chambord his claims to the crown as the heir of the July Monarchy, and to accept the position of dauphin, thus implying that his grandfather Louis Philippe was a usurper. With the "Government of Moral Order" in command the restora- tion of the monarchy seemed imminent, when the royal- ists had their hopes dashed by the announcement that " Henri V." would accept the throne only on the condi- tion that the nation adopted as the standard of France

The Septen-

the white flag ►►► at the very sight of which Marshal Mac- Mahon said the rifles in the army would go off by themselves. The Comte de Chambord's refusal to accept the tricolour was probably only the The

pretext of a childless man who had no wish to chaJbo^td. disturb his secluded life for the ultimate benefit of the Orleans family which had usurped his crown, had sent him as a child into exile, and outraged his mother the Duchesse de Berry. Whatever his motive, his deci- sion could have no other effect than that of establishing the Republic, as he was likely to live for years, during which the Comte de Paris' claims had to remain sus- pended. It was not possible to leave the land for ever under the Government improvised at Bordeaux when the Germans were masters of France ; so the majority in the Assembly decided to organize another provisional Gov- ernment on more regular lines, which might possibly last till the Comte de Chambord had taken the white flag to the grave, leaving the way to the throne clear for the Comte de Paris. On the 19th of November 1873 a Bill was passed which instituted the Septennate, whereby the executive power was confided to Marshal MacMahon for seven years. It also provided for the nomination of a commission of the National Assembly to take in hand the enactment of a ^ate! constitutional law. Before this an important constitutional innovation had been adopted. Under M. Thiers there were no changes of ministry. The President of the Republic was perpetual prime minister, constantly dismissing individiial holders of portfolios, but never changing at one moment the whole council of ministers. Marshal MacMahon, the day after his appointment, nominated a cabinet with a vice-President of the Council as premier, and thus inaugurated the system of minis- terial instability which has been the most conspicuous feature of the government of the Third Republic. Under the Septennate the ministers, monarchist or moderate republican, were socially and perhaps intellec- tually of a higher class than those who governed France during the last twenty years of the 19th century. But the duration of the cabinets was just as brief, thus dis- playing the fact, already similarly demonstrated under the Restoration and the July Monarchy, that in France parliamentary government is an importation not suited to the national temperament.

The Due de Broglie was the prime minister in Mac- Mahon's first two cabinets which carried onthegovernment of the country up to the first anniversary of M. Thiers' resignation. M. de Broglie's defeat by a coalition of Legit- imists and Bonapartists with the Republicans displayed the mutual attitude of parties. The Royalists, chagrined that the fusion of

the two branches of the Bourbons had not brought the Comte de Chambord to the throne, vented their rage on the Orleanists, who had the chief share in the Government without being able to utilize it for their dynasty. The Bonapartists, now that the memory of the war was receding, were winning elections in the provinces, and were further encouraged by the youthful promise of the Prince Imperial. The republicans had so improved their position that the Due d'Audiffret-Pasquier, great- nephew of the chancellor Pasquier, tried to form a coali- tion ministry with INL Waddington, afterwards ambassador of the Republic in London, and other members of the Left Centre. Out of this uncertain state of affairs was evolved the Constitution which has lasted the longest of all those that France has tried since the abolition of the , old monarchy in 1792. Its birth was due to tion voted, chance. Not being able to restore a monarchy, 'srs. the National Assembly was unwilling definitively to establish a republic, and as no limit was set by the law on the duration of its powers it might have continued the

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provisional state of things had it not been for the Bona- partists. That party displayed so much activity in agitat- ing for a plebiscite, that when the rural voters at bye- elections began to rally to the Napoleonic idea, alarm seized the constitutionalists of the Right Centre who had never been persuaded by M. Thiers' exhortations to accept the Republic. Consequently in January 1875 the Assembly, having voted the general principle that the legislative power should be exercised by a Senate and a Chamber of Deputies, without any mention of the executive regime, accepted by a majority of one a momentous resolution proposed by M. Wallon, a member of the Right Centre. It provided that the President of the Republic should be elected by the absolute majority of the Senate and the Chamber united as a National Assembly, that he should be elected for seven years, and be eligible for re-election. Thus by one vote the Republic was formally established, "the Father of the Constitution" being M. Wallon, who began his political experiences in the Legislative Assembly

of 1849, and survived to take an active part in the Senate to the very end of the century.

The Republic being thus established. General de Cissey, who had become prime minister, made way for M. Buffet, but retained his portfolio of War in the new coalition cabinet, which contained some distinguished members of the two central groups, including M. Leon Say. A fort- night previously, at the end of February 1875, were passed two statutes defining the legislative and executive powers in the Republic, and organizing the Senate. These joined to a third enactment, voted in July, form the body of laws known as the " Constitution of 1876," which though twice revised, lasted without essential alteration to the end of the 19th century. The legislative power was conferred on a Senate and a Chamber of Deputies, which might unite in congress to revise the Constitution, if they both agreed that revision was necessary, and which were bound so to Provisions ^^^^ ^o' ^^^ election of the President of the of the Con- Republic when a vacancy occurred. It was stitution enacted that the President so elected should oti87s. retain office for seven years, and be eligible for re-election at the end of his term. He was also held to be irresponsible, except in the case of high treason. The other principal prerogatives bestowed on the presidential office by the Constitution of 1875 were the right of initiating laws concurrently with the members of the two Chambers ; the promulgation of the laws ; the right of dissolving the Chamber of Deputies before its legal term on the advice of the Senate, and that of adjourning the sittings of both houses for a month; the right of pardon; the disposal of the armed forces of the country ; the reception of diplo- matic envoys, and, under certain limitations, the power to ratify treaties. The Constitution relieved the Presi- dent of the responsibility of private patronage, by pro- viding that every act of his should be countersigned by a minister. The Constitutional Law provided that the Senate should consist of 300 members, 75 being nominated for life by the National Assembly, and the remaining 225 elected for nine years by the departments and the colonies. Vacancies among the life members, after the dissolution of the National Assembly, were filled by the Senate until 1884, when the nominative system was abolished, though the survivors of it were not disturbed. The law of 1875 enacted that the elected senators, who were distributed among the departments on a rough basis of

population, should be elected for nine years, a third of them retiring triennially. It was provided that the senatorial electors in each department should be the deputies, the members of the conseil giniral and of the conseils d'arrondissement, and delegates nominated by the municipal councils of each commune. As the muni-

cipal delegates composed the majority in each electoral college, Gambetta called the Senate the Grand Council of the Communes ; but in practice the senators elected have always been the nominees of the local deputies and of the departmental councillors (conseillers g&neraux).

The Constitutional Law further provided that the deputies should be elected to the Chamber for four years by direct manhood suffrage, which had been enjoyed in Prance ever since 1848. The laws J^ron- relating to registration, which is of admirable dissement simplicity in France, were left practically the ^ndscrutin same as under the Second Empire. From 1875 to 1885 the elections were held on the basis of scrutin d'arrondissement, each department being divided into single-member districts. In 1885 scrutin de liste was tried, the department being the electoral unit, and each elector having as many votes as there were seats ascribed to the department without the power to cumulate ❓❓❓ ^like the voting in the City of London when it returned four members. In 1889 scrutin d'arrondissement was re- sumed. The payment of members continued as under the Second Empire, the salary now being fixed at 9000 francs a year in both houses, or about a pound sterling a day. The Senate and the Chamber were endowed with almost identical powers. The only important advantage given to the popular house in the paper constitution was its initiative in matters of finance, but the right of rejecting or of modifying the financial proposals of the Chamber was successfully upheld by the Senate. In reality the Chamber of Deputies has overshadowed the upper house. The Constitution did not prescribe that ministers should be selected from either house of parliament, but in prac-tice the deputies have been in cabinets in the proportion of five to one in excess of the senators. Similarly the very numerous ministerial crises which have taken place under the Third Republic have with the rarest excep- tions been caused by votes in the lower chamber. Among minor differences between the two houses or- dained by the Constitution was the

legal minimum age of their members, that of senators being forty and of deputies twenty-five. It was enacted, moreover, that the Senate, by presidential decree, could be constituted into a High Court for the trial of certain offences against the security of the State.

The Constitution thus produced, the fourteenth since the Revolution of 1789, was the issue of a monarchical Assembly forced by circumstances to establish a republic. It was therefore distinguished from others which preceded it in that it contained no declaration of principle and no doctrinal theory. The comparative excellence of the work must be recognized, seeing that it has lasted. But it owed its duration, as it owed its origin and its character, to the weakness of purpose and to the dissensions of the monarchical parties. The first legal act under the new Constitution was the selection by the expiring National Assembly of seventy-five nominated p^f,l, senators, and here the reactionaries gave a parties crowning example of that folly which has ever under the marked their conduct each time they have had "^^^"" the chance of scoring an advantage against the Republic. The principle of nomination had been carried in the National Assembly by the Right and opposed by the Republicans. But the quarrels of the Legitimists with the Due de Broglie and his party were so bitter that the former made a present of the nominated element in the Senate to the Republicans in order to spite the Orleanists ; so out of seventy ~~five senators nominated by the mon~~ archical Assembly fifty-seven Republicans were chosen. Without this suicidal act the Republicans would have been in a woeful minority in the Senate when parliament met in 1876 after the first elections under the new system of

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parliamentary government. The slight advantage which, in spite of their self-destruction, the reactionaries main- tained in the upper house was outbalanced by the repub- lican success at the elections to the Chamber. In a house of over 500 members only about 150 monarchical deputies were returned, of whom half were Bonapartists. The iirst cabinet under

the new Constitution was formed by M. Dufaure, an old minister of Loiiis Philippe like M. Thiers, and like him born in the 18th century. The premier now took the title of President of the Council, the Chief of the State no longer presiding at the meet- ings of ministers, though he continued to be present at their deliberations. Although the republican victory at the elections was greatly due to the influence of Gam- betta, none of his partisans was included in the ministry, which was composed of members of the two central groups. At the end of 1876 M. Dufaure retired, but nearly all his ministers retained their portfolios under the presidency of M. Jules Simon, a pupil of Victor Cousin, who first entered political life in the Constituent Assembly of 1848, and was later a leading member of the opposition in the last seven years of the Second Empire.

The premiership of M. Jules Simon came to an end with the abortive coup d'itat of 1877, commonly called from its date the Seize Mai. After the election of Mar- shal MacMahon to the presidency, the clerical party, irritated at the failure to restore the Comte de Cham- bord, commenced a campaign in favour of the resti- tution of the temporal power to the Pope. It provoked the Italian Government to make common cause ^"i^j877 "^^^^ Germany, as Prince Bismarck was like- wise attacked by the French clericals for his ecclesiastical policy. At last M. Jules Simon, who was a liberal most friendly to Catholicism, had to accept a resolution of the Chamber, inviting the ministry to adopt the same disciplinary policy towards the Church which had been followed by the Second Empire and the Monarchy of July. It was on this occasion that Gam- betta used his famous expression, " Le clericalisme, voilA Vennemi." Some days later a letter appeared in the Journal Officiel, dated 16th May 1877, signed by Presi- dent MacMahon, informing M. Jules Simon that he had no longer his confidence, as it was clear that he had lost that influence over the Chamber which a president of the Council ought to exercise. The dismissal of the prime minister and the presidential acts which followed did not infringe the letter of the new Constitution ; yet the proceeding was regarded as a coup d'etat in favour of the clerical reactionaries. The Due de Broglie formed an anti-republican ministry, and Marshal MacMahon, in virtue of the presidential prerogative conferred by the law of 1875, adjourned parliament for a month. When the Chamber reassembled the republican majority of 363 denounced the coalition of parties hostile to

the Re- public. The President, again using his constitutional prerogative, obtained the authorization of the Senate to dissolve the Chamber. Meanwhile the Broglie ministry had put in practice the policy, favoured by all parties in France, of replacing the functionaries hostile to it with its own partisans. But in spite of the administrative electoral machinery being thus in the hands of the reac- tionaries, a republican majority was sent back to the Chamber, the sudden death of M. Thiers on the eve of his expected return to power, and the demonstration at his funeral, which was described as a silent insurrection, aiding the rout of the monarchists. The Due de Broglie resigned, and Marshal MacMahon sent for General de Rochebouet, who formed a cabinet of unknown reaction- aries, but it lasted only a few days, as the Chamber refused to vote supply. M. Dufaure was then called

back to office, and his moderate republican ministry lasted for the remainder of the MacMahon presidency.

Thus ended the episode of the Seize Mai, condemned by the whole of Europe from its inception. Its chief effects were to prove again to the country the incompet- ency of the monarchists, and by associating in the public mind the Church with this ill-conceived venture, to pro- voke reprisals from the anti-clericals when they came into power. After the storm, the year 1878 was one of political repose. The first international exhibition held at Paris after the war displayed to Europe how the secret of France's recuperative power lay in the industry and artistic instinct of the nation. Marshal MacMahon pre- sided with dignity over the fStes held in hon- jg^g.j^^^ our of the exhibition, and had he pleased he arevy might have tranquilly fulfilled the term of his President septennate. But in January 1879 he made a J^^ ^ difference of opinion on a military question an excuse for resignation, and M. Jules Grevy, the president of the Chamber, was elected to succeed him by the Na- tional Assembly, which thus met for the first time under the Constitutional Law of 1875.

Henceforth the executive as well as the legislative power was in the hands of the republicans. The new President was a leader of the bar, who had first become known in the Constituent Assembly of 1848 as the advo- cate of the principle that a republic would do better without a president. M.

Waddington was his first prime minister, and Gambetta was elected president of the Chamber. The latter, encouraged by his rivals in the idea that the time was not ripe for him openly to direct the affairs of the country, thus put himself, in spite of his immense influence, in a position of official self-efface- ment from which he did not emerge until the jealousies of his own party colleagues had undermined the prestige he had gained as chief founder of the Republic. The most active among them was M. Jules Ferry, minister of Education, who having been a republican deputy for Paris at the end of the Empire, was one of the members of the provisional Government proclaimed on 4th Sep- tember 1870. Borrowing Gambetta's cry that clericalism was the enemy, he commenced the work of reprisal for the Seize Mai. His educational projects of 1879 were thus anti-clerical in tendency, the most famous being article 7 of his education bill, which prohibited members of any "unauthor- ized " religious orders exercising the profession of teach- ing in any school in France, the disability being applied to all ecclesiastical communities, excepting four or five which had been privileged by special legislation. This enactment, aimed chiefiy at the Jesuits, was advocated with a sectarian bitterness which will be associated with the name of Jules Ferry long after his more statesman- like qualities are forgotten. The law was rejected by the Senate, M. Jules Simon being the eloquent champion of the clericals, whose intrigues had ousted him from office. The unauthorized orders were then dissolved by decree ; but though the forcible expulsion of aged priests and nuns gave rise to painful scenes, it cannot be said that popular feeling was excited in their favour, so griev- ously had the Church blundered in identifying itself with the conspiracy of the Seize Mai.

Meanwhile the death of the Prince Imperial in Zulu- land had shattered the hopes of the Bonapartists, and M. de Freycinet, a former functionary of the Second Empire, had become prime minister at the end of 1879. He had retained M. Jules Ferry at the ministry of Education, but unwilling to adopt all his anti-clerical policy, he resigned the premiership into his hands in September 1880. The constitution of the first Ferry cabinet secured the further exclusion from office of Gambetta. The previous month

Jules Ferry-

he had, as president of the Chamber, accompanied M. Grevy on an official visit to Cherbourg, and the acclama- tions called forth all over France by his speech, which was a hopeful defiance to Germany, encouraged the wily Chief of the State to aid the republican conspiracy against the hero of the Republic. In 1881 the only political question before the country was the destiny of Gambetta. His influence in the Chamber was such that in spite of the opposition of the prime minister he carried his electoral scheme of scrvtin de Uste, descending from the presidential chair to defend it. Its rejection by the Senate caused no conflict between the houses. The check was inflicted not on the Chamber, but on Gambetta, who counted on his popularity to carry the lists of his nominated candi- dates in all the republican departments in France as a quasi-plebiscitary demonstration in his favour. His rivals dared not openly quarrel with him. There was the semblance of a reconciliation between him and Jules Ferry, and his name was the rallying-cry of the Eepublic at the general election, which was conducted on the old system of scrutin d'arrondissement.

The triumph for the Eepublic was great, the combined force of reactionary members returned being less than one-fifth of the new Chamber. M. Grdvy could no longer abstain from asking Gambetta to form a ministry, but he had bided his time till jealousy of the "occult power" of the president of the Chamber had under- oambetta mined his position in paiiiament. Consequently, Minister, when On the 14th of November 1881 Gambetta announced the composition of his cabinet, iron- ically called the " grand minist^re" which was to consol- idate the Eepublic and to be the apotheosis of its chief, a great feeling of disillusion fell on the country, for his col- leagues were untried politicians. The best known was M. Paul Bert, a man of science, who as the " reporter " in the Chamber of the Ferry Education Bill had distinguished himself as an aggressive freethinker, and he inappropri- ately was named minister of Public Worship. All the con- spicuous republicans who had held office

refused to serve under Gambetta. His cabinet was condemned in advance. His enemies having succeeded in ruining its composition, declared that the construction of a one-man machine was ominous of dictatorship, and the " grand ministh-e " lived for only ten weeks.

Gambetta was succeeded in January 1882 by M. de Freycinet, who having first taken office in the Dufaure cabinet of 1877, and having continued to hold office at intervals until 1899, was the most successful specimen of a " mifiistrable" ??? as recurrent portfolio-holders have been called under the Third Eepublic. His second ministry lasted only six months. The failure of Gambetta, though pleasing to his rivals, discouraged the republican party and disorganized its majority in the Chamber. M. Duclerc, an old minister of the Second Eepublic, then became president of the Council, and before his short term of office was run Gambetta died on the last day of 1882, without having had the opportunity of display- ing his capacity as a statesman or an administrator. He was only forty-four at his death, and his fame rests on the unfulfilled promise of a brief career. The men who had driven him out of public life and had shortened his existence were the most ostentatious of the mourners at the great pageant with which he was buried, and to have been of his party was in future the popular trade-mark of his re- publican enemies.

Gambetta's death was followed by a period of anarchy, during which Prince Napoleon, the son of Jerome, king of Westphalia, placarded the walls of Paris with a mani- festo. The Chamber thereupon voted the exile of the members of the families which had reigned in France.

Death of Qambetta.

The Senate rejected the measure, and a conflict arose be- tween the two houses. M. Duclerc resigned the premier- ship in January 1883 to his minister of the Interior, M. Falliferes, a Gascon lawyer, who eventually became pre- sident of the Senate at the end of the century, and he held office for three weeks, when M. Jules Ferry be- came president of the Council for the second '^n??Im. time. Several of the closest of Gambetta's friends accepted office under the old enemy of their chief, and the new combination adopted the epithet "oppor- tunist," which had been invented by Gambetta in 1875 to justify the expediency of his alliance

with Thiers. The Opportunists thenceforth formed an important group standing between the Left Centre, which was now ex- cluded from office, and the Eadicals. It claimed the tradition of Gambetta, but the guiding principle mani- fested by its members was that of securing the spoils of place. To this end it often allied itself with the Ead- icals, and the Ferry cabinet practised this policy in 1883 when it removed the Orleans princes from the active list in the army as the illogical result of the demonstration of a Bonaparte. How needless was this proceeding was shown a few months later when the Comte de Chambord died, as his death, which fijially fused the Eoyalists with the Orleanists, caused no commotion in France.

The year 1884 was phenomenal in the sense that it passed without a change of ministry. M. Jules Ferry displayed real administrative ability, and' as an era of steady government seemed to be commencing, the oppor- tunity was taken to revise the Constitution. The two Chambers therefore met in congress, and enacted that the republican form of government could never be the subject of revision, and that all members of families which had reigned in France were ineligible for the presidency of the Eepublic ??? a repetition of the adventure of Louis Bonaparte in the middle of the century being thus made impossible. It also decided Revision that the clauses of the law of 1875 relating to "/J^^,"' the organization of the Senate should no longer is84. ' have a constitutional character. This permitted the reform of the Upper House by ordinary parliamentary procedure. So an organic law was passed to abolish the system of nominating senators, and to increase the number of municipal delegates in the electoral colleges in proportion to the population of the communes. The French nation, for the first time since it had enjoyed political life, had revised a Constitution by pacific means without a revolution. Gambetta being out of the way, his favourite electoral system of scrutin de Uste had no longer any terror for his rivals, so it was voted by the Chamber early in 1885. Before the Senate had passed it into law the Ferry ministry had fallen at the end of March, after hold- ing office for twenty-five months, a term rarely paralleled in the annals of the Third Eepublic. This long tenure of power had excited the dissatisfaction of jealous politicians, and the news of a slight disaster to the French troops in Tongking called forth all the pent-up rancour which M. Jules Ferry had inspired in various groups. By the exaggerated news of defeat Paris was excited to the brink of a revolution. The approaches "" "^' of the Chamber were invaded by an angry mob, and Jules Ferry was the object of public hate

more bitter than any man had called forth in France since Louis Napoleon on the days after Sedan. Within the Chamber he was attacked in all quarters. The Eadicals took the lead, supported by the Monarchists, who remem- bered the anti-clerical rigour of the Ferry laws, by the Left Centre, not sorry for the tribulation of the group which had supplanted it, and by place-hunting republicans of all shades. The attack was led by a politician who disdained office. M. Clemenceau, who had originally

come to Paris from the Vendee as a doctor, had as a radical leader in the Chamber used his remarkable talent as an overthrower of ministries, and nearly every one of the eight ministerial crises "which had already occurred during the presidency of M. Grevy had been hastened by his mordant eloquence.

The next prime minister was M. Brisson, a radical lawyer and journalist, who in April 1885 formed a cabinet of " concentration " ??? that is to say, it was recruited from various groups with the idea of concentrating all the republican forces in opposition to the reactionaries. M. de Treycinet and M. Carnot, afterwards President of the Eepublic, represented the moderate element in this ministry, which superintended the general elections under scrutin de liste. That system was recommended by its advocates as a remedy for the rapid decadence in the composition of the Chamber. Manhood suffrage, which had returned to the National Assembly a distinguished body of men to conclude peace with Germany, had chosen a very different type of representative to sit in the Chamber created by the Constitution of 1876. At each succeeding election the standard of deputies returned grew lower, till Gambetta described them contemptuously as " sous-vitdrinaires," indicating that they were chiefly chosen from the petty professional class, which repre- sented neither the real democracy.nor the material inter- ests of the country. His view was that the election of members by departmental lists would ensure the candi- dature of the best men in each region, who under

the system of single-member districts were apt to be neglected in favour of local politicians representing narrow interests. When his death had removed the fear of his using scrutin de liste as a plebiscitary organization, parliament sanc- tioned its trial. The result was not what its of^ss”^ promoters anticipated. The composition of the Chamber was indeed transformed, but only by the substitution of reactionary deputies for republicans. Of the votes polled, forty -five per cent, were given to the Monarchists, and if they had obtained one-half of the abstentions the Republic would have come to an end. At the same time the character of the republican deputies returned was not improved ; so the sole effect of scrutin de liste was to show that the electorate, weary of repub- lican dissensions, was ready to make a trial of monarchi- cal government, if only the reactionary party proved that it contained statesmen capable of leading the nation. So menacing was the situation that the Republicans thought it wise not further to expose their divisions in the presi- dential election which was due to take place at the end of the year. Consequently, on the 28th of December 1885 M. Grevy, in spite of his growing unpopularity, was elected President of the Republic for a second term of seven years.

The Brisson cabinet at once resigned, and on the 7th of January 1886 its most important member, M. de Frey- cinet, formed his third ministry, which had momentous influence on the history of the Republic. The new minister of War was General Bou- langer, a smart soldier of no remarkable mili- tary record ; but being the nominee of M. Clemenceau, he began his official career by taking radical measures against commanding officers of reactionary tendencies. He thus aided the Government in its campaign against the families which had reigned in France, whose situation had been improved by the result of the elections. The fStes , given by the Comte de Paris to celebrate his daughter’s marriage with the heir- apparent of Portugal moved the republican majority in the Chambers to expel from France the heads of the houses of Orleans and of Bonaparte, with their eldest sons. The names of all the princes on the army list were erased from

General Boulaager,

it, the decree being executed with unseemly ostentation by General Boulanger, who had owed early promotion to the protection or the Due d'Aumale, and on that prince protesting he was exiled too. Meanwhile General Boulanger took advantage of M. Gravy's unpopularity to make himself a popular hero, and at the review, held yearly on the 14th of July, the anniversary of the fall of the Bas- tille, his acclamation by the Parisian mob showed that he was taking an unexpected place in the imagination of the people. He continued to work with the Radicals, so when they turned out M. de Freycinet in December 1886, one of their group, M. Goblet, a lawyer from Amiens, formed a ministry, and retained Boulanger as minister of War. M. Clemenceau, however, withdrew his support from the General, who was nevertheless loudly patronized by the violent radical press. His bold attitude towards Germany in connexion with the arrest on the German frontier of a French official named Schnaebele so roused the en- thusiasm of the public, that M. Goblet was not sorry to resign in May 1887 in order to get rid of his too popular colleague.

To form the twelfth of his ministries, M. Grevy called upon M. Rouvier, an Opportunist from Marseilles, who had first held office in Gambetta's short-lived cabinet. General Boulanger was sent to command a corps d'armie at Clermont-Ferrand ; but the popular press and the people clamoured for the hero who was said to have terrorized Prince Bismarck, and they encouraged him to play the part of a plebiscitary candidate. There were grave reasons for public discontent. Parliament in 1887 was more than usually sterile in legislation, and in the autumn session it had to attend to a scandal l^^'/'f" which had long been rumoured. The son-in-law of M. Grevy, M. Daniel Wilson, a prominent deputy who had been an under Secretary of State, was accused of trafficking the decoration of the Legion of Honour, and of using the Ely see, the President's official residence, wliere he lived, as an agency for his corrupt practices. The evi- dence against him was so clear that his colleagues in the Chamber put the Government into a minority in order to precipitate a presidential crisis, and on M. Grevy refusing to accept this hint, a long array of politicians, representing all the republican groups, declined his invitation to aid him in forming a new ministry, all being bent on forcing his resignation. Had General Boulanger been a man of resolute courage he might at this crisis

have made a coup d'itat, for his popularity in the street and in the army increased as the Republic sank deeper into scandal and anarchy. At last, when Paris was on the brink of revolu- tion, M. Grevy was prevailed on to resign. The candidates for his succession were two ex-prime ministers, MM. Jules Ferry and de Freycinet, and M. Floquet, a barrister, who had been conspicuous in the early days of the National Assembly for his sympathjr with the Commune. The Monarchists had no candidate ready, and resolved to vote for M. Ferry, because they believed that if he were elected his unpopularity with the democracy would cause an insurrection in Paris and the downfall of the Republic. M. de Freycinet and M. Floquet each looked for the support of the Radicals, and each had made a secret compact, in the event of his election, to restore General Boulanger to the War Office. But M. Clemen- ceau, fearing the election of jM. Jules Ferry, advised his followers to vote for an "outsider," and after some manceuvring the congress elected by a large majority M. Sadi Carnot.

The new President, though the nominee of chance, was an excellent choice. The grandson of Lazare Carnot, the " organizer of victory " of the Convention, he was also a man of unsullied probity. The tradition of his family name, only less glorious than that of Bonaparte in the annals of

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the Eevolution, was welcome to Erance, almost ready to throw herself into the arms of a soldier of for- Presfdeat tune, while his blameless repute reconciled of the some of those whose opposition to the Republic Republic, iia^ heen quickened by the mean vices of M. Grevy. But the name and character of M. Carnot would have been powerless to check the Boulangist movement without the incompetency of its leader, who was getting the democracy at his back without knowing how to utilize it. The new President's first prime minis- ter was M. Tirard, a senator, who had held office in six of M. Grevy's ministries, and he formed a cabinet of politicians as colourless as himself. The early months of 1888 were occupied with the trial of M. Wilson, who was sentenced to two years'

imprisonment for fraud, and with the conflicts of the Government with General Boulanger, who was deprived of his command for coming to Paris without leave. M. Wilson appealed against his sentence, and General Boulanger was elected deputy for the department of the Aisne by an enormous majority. It so happened that the day after his election a presidential decree was signed on the advice of the minister of War removing General Boulanger from the army, and the Court of Appeal quashed M. Wilson's conviction. Public feeling was profoundly moved by the coincidence of the release of the relative of the ex-President by the judges of the Kepublic on the same day that its ministers expelled from the army the popular hero of universal suffrage.

As General Boulanger had been invented by the Radi- cals it was thought that a Radical cabinet might be a remedy to cope with him, soM. Ploquet became President of the Council in April 1888, M. de Freycinet taking the portfolio of War which he retained through many minis- tries. M. Floquet's chief achievement was a duel Bouiaa- -with General Boulanger, in which, though an '"'[illegible] *elderly civilian, he wounded him. Nothing,*

however, checked the popularity of the military politician, and though he was a failure as a speaker in the Chamber, several departments returned him as their deputy by great majorities. The Bonapartists had joined him, and while in his manifestoes he described ' himself as the de- fender of the Republic, the mass of the Monarchists, with the consent of the Comte de Paris, entered the Boulangist camp, to the dismay both of old-fashioned Royalists and of many Orleanists, who resented his recent treatment of the Due d'Aumale. The centenary of the taking of the Bastille was to be celebrated in Paris by an international exhibition, and it appeared likely that it would be inaugu- rated by General Boulanger, so irresistible seemed his popularity. In January 1889 he was elected member for the metropolitan department of the Seine with a quarter of a million votes, and by a majority of eighty thousand over the candidate of the Government. Had he marched on the Elysee the night of his election, nothing could have saved the parliamentary Republic ; but again he let his chance go by. The Government in alarm pro- posed the restoration of scrutin d'arrondissement as the electoral system for scrutin de liste. The

change was rapidly enacted by the two Chambers, and was a signifi- cant commentary on the respective advantages of the two systems. M. Tirard was again called to form a ministry, and he selected as minister of the Interior M. Constans, originally a professor at Toulouse, who had already proved himself a skilful manipulator of elections when he held the same office in 1881. He was therefore given the supervision of the machinery of centralization with which it was supposed that General Boulanger would have to be fought at the general election. That incomplete hero, however, saved all further trouble by flying the country when he heard that his arrest was imminent.

The Government, in order to prevent any plebiscitary manifestation in his favour, passed a law forbidding a candidate to jiresent himself for a parliamentary election in more than one constituency; it also ge”“fffight arraigned the General on the charge of treason before the Senate sitting as a high court, and he was sen- tenced in his absence to perpetual imprisonment. Such measures were needless. The flight of General Boulanger was the death of Boulangism. He alone had saved the Republic which had done nothing to save itself. Its Government had, on the contrary, displayed throughout the crisis an anarchic feebleness and incoherency which would have speeded its end had the leader of the plebis- citary movement possessed sagacity or even common courage.

The elections of 1889 showed how completely the re- actionaries had compromised their cause in the Boulan- gist failure. Instead of 45 per cent, of the votes polled as in 1885, they obtained only 21 per cent., and the Comte de Paris, the pretender of constitutional monarchy, was irretrievably prejudiced by his alliance with the military adventurer who had outraged the princes of his house. A period of calm succeeded the storm of Boulangism, and for the first time under the Third Republic parliament set to work to produce legislation useful for the State, without rousing party passion, as in its other period of activity when the Ferry education laws were passed. Before the elections of 1889 the reform of the army was undertaken, the general term of active compulsory service was made three years, while certain classes hitherto dispensed from serving, including ecclesiastical seminarists and lay professors, had henceforth to undergo a year’s military training. The new parliament turned its

attention to social and labour questions, as the only clouds on the political horizon were the serious strikes in the manufacturing districts, which displayed the growing political organization of the socialist party. Otherwise nothing disturbed the calm of the country. The young Due d'Orleans vainly tried to ruffle it by breaking his exile in order to claim his citizen's right to perform his military service. The cabinet was rearranged in March 1890, M. de Freycinet becoming prime minister for the fourth time, and retaining the portfolio of War. All seemed to point to the consolidation of the Republic, and even the Church made signals of reconciliation. Car- dinal Lavigerie, a patriotic missionary and statesman, entertained the officers of the fleet at Algiers, and pro- posed the toast of the Republic to the tune of the " Marseil- laise " played by his p^res blancs. The royalist Catholics protested, but it was soon intimated that the Archbishop of Algiers' demonstration was approved at Rome. The year 1891 was one of the four in the annals of the Repub- lic which passed without a change of ministry, but the agitations of 1892 were to counterbalance the repose of the two preceding years.

The first crisis arose out of the peacemaking policy of the Pope. Following up his intimation to the Archbishop of Algiers, Leo XIII. published in February 1892 an encyclical, bidding French Catholics accept the Republic as the firmly-established form of government. The papal injunction produced a new political group called the " Rallies," the majority of its members being Monarchists who rallied to the Republic in obedience to the Vatican. The most conspicuous among them was M. de Mun, an eloquent exponent in the Chamber of legiti- ""p' mism and Christian socialism. The extreme Left "["92^'^' mistrusted the adhesion of the new converts to the Republic, and ecclesiastical questions were the con- stant subj ects of acrimonious debates in parliament. In the course of one of themM. de Freycinet found himself in a minority. He ceased to be prime minister, being succeeded

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by M. Loubet, a lawyer from Montelimar, who had pre- viously held oflB.ce for three months in M. Tirard's first cabinet ; but M. de Freycinet continued to hold his port- folio of War. The confusion of the republican groups kept pace with the disarray of the reactionaries, and out- side parliament the frequency of anarchist outrages did not increase public confidence. The only figure in the Republic which grew in prestige was that of M. Carnot, who in his frequent presidential tours dignified his oflfi.ce, though his modesty made him unduly efface his own personality.

When the autumn session of 1892 began, all other questions were overwhelmed by the bursting of the Panama scandal. The company associated for ^►► the piercing of the isthmus of Panama, under-*

scandai. taken by M. de Lesseps, the maker of the Suez canal, had become insolvent some years before. Fifty millions sterling subscribed by the thrift of Prance had disappeared, but the rumours involving political personages in the disaster were so confidently asserted to be reactionary libels, that a minister of the Republic, after- wards sent to penal servitude for corruption, obtained damages for the publication of one of them. It was known that M. de Lesseps was to be tried for misappro- priating the money subscribed ; but considering the vast sums lost by the public, little interest was taken in the matter till it was suddenly stirred by the dramatic suicide of a well-known Jewish financier closely connected with republican politicians, driven to death it was said by men- aces of blackmail. Then succeeded a period of terror in political circles. Every one who had a grudge against an enemy found vent for it in the press, and the people of Paris lived in an atmosphere of delation. Unhappily it was true that ministers and members of parliament had been subsidized by the Panama company. M. Floquet, the president of the Chamber, avowed that when prime min- ister he had laid hands on ►►12,000 of the company's funds for party purposes, and his justification of the act threw a light on the code of public morality of the parliamentary Republic. Other politicians were more seriously impli- cated on the charge of having accepted subsidies for their private purposes, and emotion reached its height when the cabinet ordered the prosecution of two of its members for corrupt traflB.c of their oflfices. These two ministers were afterwards discharged, and they seem to have been

accused with recklessness ; but their prosecution by their own colleagues proved that the statesmen of the Republic believed that their high political circles were sapped with corruption. Finally, only twelve senators and deputies were committed for trial, and the only one convicted was a minister of M. de Freycinet's third cabinet, who pleaded guilty to receiving large bribes from the Panama company. The public regarded the convicted politician as a scape- goat, believing that there were numerous delinquents in parliament, more guilty than he, who had not even been prosecuted. This feeling was aggravated by the sentence passed, but afterwards remitted, on the aged M. de Lesseps, who had involved French people in misfortune only because he too sanguinely desired to repeat the triumph he had achieved for France by his great work in Egypt.

Within the nation the moral result of the Panama affair was a general feeling that politics had become under the Republic a profession unworthy of honest citizens. The sentiment evoked by the scandal was one of sceptical lassitude rather than of indignation. The reactionaries had crowned their record of political incompetence. At a crisis which gave legitimate opportunity to a respect- able and patriotic Opposition they showed that the coun- try had nothing to expect from them but incoherent and exaggerated invective. If the scandal had come to light

in the time of General Boulanger the parliamentary Republic would not have survived it. As it was, the sordid story did little more than produce several changes of ministry. M. Loubet resigned the premiership in December 1892 to M. Ribot, a former functionary of the Empire, whose ministry lived for three stormy weeks. On the first day of 1893 M. Ribot formed his second cabinet, which survived till the end of March, when he was succeeded by his minister of Education, M. Charles Dupuy, an ex-professor who had never held office till four months previously. M. Dupuy, having taken the portfolio of the Interior, supervised the gen- eral election of 1893, which took place amid the profound indifference of the population, except in certain localities where personal antagonisms excited violence. An intel- ligent Opposition would have roused the country at the polls against the regime compromised by the Panama affair. Nothing of the sort occurred, and the electorate preferred the

doubtful probity of their republican repre- sentatives to the certain incompetence of the reaction- aries. The adversaries of the Republic polled only 16 per cent, of the votes recorded, and the chief feature of the election was the increased return of socialist and radical-socialist deputies. When parliament met it turned out the Dupuy ministry, and M. Casimir-Perier quitted the presidency of the Chamber to take his place. The new prime minister was the bearer of an eminent name, being the grandson of the statesman of 1831, and the great-grandson of the owner of Vizille, where the iStats du Dauphine met in 1788, as a prelude to the assembling of the States General the next year. His acceptance of office aroused additional interest because he was a minister possessed of independent wealth, and therefore a rare example of a French politician free from the imputation of making a living out of politics. Neither his repute nor his qualities gave long life to his ministry, which fell in four months, and M. Dupuy was sent for again to form a cabinet in May 1894.

*Before the second Dupuy ministry had been in office a month M. Carnot died by the knife of an anarchist at Lyons. He was perhaps the most estimable politician produced by the Third Republic. tionVf”^’ Although the standard of political life was not President elevated under his presidency, he at all events *”” ”” set a good personal example, and to have filled unscathed the most conspicuous position in the land during a period unprecedented for the scurrility of libels on public men was a testimony to his blameless character. As the term of his septennate was near, parliament was not unpre- pared for a presidential election, and M. Casimir- Perier, who had been spoken of as his possible ^Jr^J^/er successor, was elected by the Congress which President met at Versailles on 27th June 1894, four days of the after M. Carnot’s assassination. The election fg^g”’”” of one who bore respectably a name not less distinguished in history than that of Carnot seemed to ensure that the Republic would reach the end of the century under the headship of a President of exceptional prestige. But instead of remaining Chief of the State for seven years, in less than seven months INI. Casimir-Perier astonished France and Europe by his resignation. Scurrilously defamed by the socialist press, the new President found that the Republicans in the Chamber were not disposed to defend him in his high office ; so, on the 15th January 1896, he seized the occasion of the*

retirement of the Dupuy ministry to address a message to the two houses intimating his resignation of the presi- dency, which, he said, was endowed with too many responsibilities and not sufficient powers.

This time the Chambers were unprepared for a presi- dential vacancy, and to fill it in forty-eight hours was

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necessarily a matter of hap-hazard. The choice of the congress fell on M. Felix Faure, a merchant of Pafrl”’^ Havre, who, though minister of Marine in the President retiring cabinet, was one of the least-known poli- ”’”... ticians who had held office. The selection was I89S. ”’ ^ good one, and introduced to the presidency a type of politician unfortunately rare under the Third Republic a successful man of business. M. Felix Faure had a fine presence and polished manners, and hav- ing risen from a humble origin he displayed in his person the fact that civilization descends to a lower social level in France than elsewhere. Although he was in a sense a man of the people the Radicals and’ Socialists in the Chambers had voted against him. Their candidate, like almost all democratic leaders in France, had never worked with his hands, M. Brisson, the son of an attorney at Bourges, a member of the Parisian bar, and perpetual candidate for the presidency. Nevertheless the Left tried to take possession of President Faure. His first ministry, composed of moderate republicans and presided over by M. Ribot, lasted until the autumn session of 1895, when it was turned out and a radical cabinet was formed by M. L^on Bourgeois, an ex-functionary, who when a prefect had been suspected of reactionary tendencies.

The Bourgeois cabinet of 1895 was remarkable as the first ministry formed since 1877 which did not contain a single member of the outgoing cabinet. It was said to be exclusively radical in its composition, and thus to indicate that the days of “republican concentration” were over, and that the Republic, being firmly established, an era of party government on

the English model had arrived. The new ministry, however, on analysis did not differ in character from any of its predecessors. Seven of its members were old office-holders of the ordinary " ministrable " type. The most conspicuous was M. Cavaignae, the son of the general who had opposed Louis Bonaparte in 1848, and the grandson of J. B. Cavaignae, the regicide member of the Convention. Like M. Carnot and M. Casimir-Perier, he was, there- fore, one of those rare politicians of the Republic who possessed some hereditary tradition. An ambitious man, he was now classed as a Radical on the strength of his advocacy of the income-tax, the principle of which has never been popular in France, as being adverse to the secretive habits of thrift cultivated by the people, which are a great source of the national wealth. The radicalism of the rest of the ministry was not more alarming in character, and its tenure of office was without legislative result. Its fall, however, occasioned the only constitu- tionally interesting ministerial crisis of the twenty-four which had taken place since M. Grevy's election to the presidency sixteen years before. The Senate, disliking the fiscal policy of the G-overnmeut, refused to vote supply in spite of the support which the Chamber gave to the ministry. The collision between the two houses did not produce the revolutionary rising which the Radicals predicted, and the Senate actually forced the Bourgeois cabinet to resign amid profound popular indifference.

The new prime minister was M. Meline, who began his long political career as a member of the Commune in 1871, but was so little compromised in the insurrection that M. Jules Simon gave him an under-secretaryship in his ministry of 1876. After that he was once a cabinet minister, and was for a year president of the Chamber. He was chiefly known as a protectionist ; but it was as leader of the Progressists, as the Opportunists now called themselves, that he formed his cabinet in April 1896, which was announced as a moderate ministry opposed to the policy of the Radicals. It is true that it made no attempt to tax incomes, but otherwise its achievements did not differ from those of other ministries, radical or concentra-

tion, except in its long survival. It lasted for over two years, and lived nearly as long as the second Ferry cabinet. Its existence was prolonged by certain incidents of the Franco-Russian alliance. The visit of the franco-

Tsar to Paris in October 1896, being the first aw/ance. official visit paid by a European sovereign to the Republic, helped the Government over the critical term at which ministries usually succumbed, and it was further strengthened in parliament by the invitation to the Presi- dent of the Republic to return the Imperial visit at St Petersburg in 1897. The Chamber came to its normal term that autumn ; but a law had been passed fixing May as the month for general elections, and the ministry was allowed to retain office till the dissolution at Easter 1898. The long duration of the Meline Government was said to be a further sign of the arrival of an era of party gov- ernment with its essential accompaniment, ministerial stability. But in the country there was no corresponding sign that the electorate was being organized into- two parties of Progressists and Radicals ; while in the Cham- ber it was ominously observed that persistent opposition to the moderate ministry came from nominal supporters of its views, who were dismayed at one small band of fellow-politicians monopolizing office for two years. The last election of the century was therefore fought on a confused issue, the most tangible results being the further reduction of the Monarchists, who secured only 12 per cent, of the total poll, and the advance of the Socialists, who obtained nearly 20 per cent, of the votes recorded. The Radicals returned were less numerous than the Mod- erates, but with the aid of the Socialists they nearly bal- anced them. A new group entitled Nationalist maJde its appearance, supported by a miscellaneous electorate rep- resenting the malcontent element in the nation of all po- litical shades from monarchist to revolutionary-socialist. The Chamber, so composed, was as incoherent as either of its predecessors. It refused to re-elect the radical leader, M. Brisson, as its president, and then refused its confidence to the moderate leader M. Meline. M. Brisson, the rejected of the Chamber, was sent for to form a ministry, on 28th June 1898, which survived till the adjournment, only to be turned out when the autumn session began. M. Charles Dupuy thus became prime minister for the third time with a cabinet of the old con- centration pattern, and for the third time in less than five years under his premiership the presidency of the Republic became vacant. M. F^lix Faure had increased in pomposity rather than in popularity. His contact with European sovereigns seems to have made him over- conscious of his superior rank, and he cultivated j^gg . habits which austere republicans make believe Death ot to be the

*monopoly of frivolous courts. The President regular domesticity of middle-class life may '^"□□□- not be disturbed with impunity when age is advancing, and M. F^lix Faure died with tragic unexpectedness on 16th February 1899. The joys of his high office were so dear to him that nothing but death would have induced him to lay it down before the term of his septennate. There was therefore no candidate in waiting for the vacancy; and as Paris was in an agitated mood the majority in the Congress elected M. Loubet President of the Republic, because Loubet he happened to hold the second place of dig- President nity in the State, the presidency of the Sen- □□"** ate, and was moreover a politician who had *"" " the confidence of the republican groups as an adver- sary of plebiscitary pretensions. His only competitor was M. Meline, whose ambitions were not realized, in spite of the alliance of his Progressist supporters with the Monarchists and Nationalists. The Dupuy ministry lasted till June 1899, when a new cabinet was formed by*

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M. Waldeck-Eousseau, who, having held office under Gambetta and Jules Ferry, had relinquished politics for the bar, of which he had become a distinguished leader. Though a moderate republican, he was the first prime minister to give portfolios to socialist politicians. This was the distinguishing feature of the last cabinet of the century □□□ the thirty-seventh which had taken office in the twenty-six years which had elapsed since the resignation of M. Thiers in 1873.

It is now necessary to go back a few years in order to refer to a matter which, though not political in its origin, in its development filled the whole political atmo- sphere of France in the closing period of the 19th century. Soon after the failure of the Boulangist movement a journal was

founded at Paris called the Lihre Pa- Anti- role. Its editor, M. Drumont, was known as

movement ^^^ author of La France Juive, a violent anti- Semitic work, written to denounce the influ- ence exercised by Jewish financiers in the politics of the Third Republic. It may be said to have started the anti-Semitic movement in France, where hostility to the Jews had not the pretext existing in those lands which contain a large Jewish population exercising local rivalry with the natives of the soil, or spoiling them with usury. That state of things existed in Algeria, where the indigenous Jews were made French citizens during the Franco-Prus- sian war to secure their support against the Arabs in rebellion. But political anti-Semitism was introduced into Algeria only as an offshoot of the movement in continental France, where the great majority of the Jewish community were of the same social class as the politicians of the Ee- publie. Primarily directed against the Jewish financiers, the movement was originally looked upon as a branch of the anti-capitalist propaganda of the Socialists . Thus the Lib)-e Parole joined with the revolutionary press in attack- ing the repressive legislation provoked by the dynamite outrages of the anarchists, clerical reactionaries who sup- ported it being as scurrilously abused by the anti-Semitic organ as its republican authors. The Panama affair, in the exposure of which the Libre Parole took a prominent part soon after its foundation, was also a bond between anti-Semites and Socialists, to whom, however, the Mon- archists, always incapable of acting alone, united their forces. The implication of certain Jewish financiers with republican politicians in the Panama scandal aided the anti-Semites in their special propaganda, of which a main thesis was that the government of the Third Republic had been organized by its venal politicians for the benefit of Jewish immigrants from Germany, who had thus enriched themselves at the expense of the laborious and unsuspect- ing French population. The Libre Parole, which had become a popular organ with reactionaries and with mal- contents of all classes, enlisted the support of the Catho- lics by attributing the anti-religious policy of the Republic to the influence of the Jews, skilfully reviving bitter memo- ries of the enaction of the Ferry decrees, when sometimes the laicization of schools or the expulsion of monks and nuns had been carried out by a Jewish functionary. Thus religious sentiment and race

prejudice were introduced into a movement which was at first directed against capi- tal ; and the campaign was conducted with the weapons of scurrility and defamation which had made an unlicensed press under the Third Republic a demoralizing national evil.

An adroit feature of the anti-Semitic campaign was an appeal to national patriotism to rid the army of Jewish influence. The Jews, it was said, not content with direct- ing the financial, and thereby the general policy of the Re- public, had designs on the French army, in which they wished to act as secret agents of their German kindred. In October 1894 the Libre Parole announced that a Jewish

officer of artillery attached to the general staff, Captain Alfred Dreyfus, had been arrested on the charge of supply- ing a Government of the Triple Alliance with ^^^^ ^ French military secrets. Tried by court-martial, tion oT"^ he was sentenced to military degradation and to captain detention for life in a fortress. He was publicly "'y'"- degraded at Paris in January 1895, a few days before M. Casimir-P^rier resigned the presidency of the Re- public, and was then transported to the lie du Diable on the coast of French Guiana. His conviction, on the charge of having betrayed to a foreign power docu- ments relating to the national defence, was based on the alleged identity of his handwriting with that of an inter-cepted covering-letter, which contained a list of the pa- pers thus treasonably communicated. The possibility of his innocence was not raised outside the circle of his friends ; the Socialists, who subsequently defended him, even complained that common soldiers were shot for of-fences less than that for which this richly-connected offi- cer had been only transported. The secrecy of his trial did not shock public sentiment in France, where all civil- ians charged with crime are interrogated by a judge in private, and where all accused persons are presumed guilty until they have proved their innocence. In a land subject to invasion there was less disposition to criticize the de- cision of a military tribunal acting in the defence of the nation even than there would have been in the case of a doubtful judgment passed in a civil court. The country was practically unanimous that Captain Dreyfus had got his deserts. A few, indeed, suggested that had he not been a Jew he would never have been accused ; but the greater number replied that an ordinary French traitor of Gentile

birth would have been forgotten from the moment of his condemnation. The pertinacity with which some of his co-religionists set to work to show that he had been irregularly condemned seemed to justify the latter propo- sition. But it was not a Jew who brought about the revival of the affair. Colonel Picquart, an officer of great promise, became head of the Intelligence department at the War Office, and in 1896 informed the Minister of his suspicion that the letter on which Dreyfus had been condemned was written by a certain Major Esterhazy. The military authorities, not wisliing to have the case re- opened, sent Colonel Picquart on foreign service, and put in his place ColonSl Henry. The all-seeing press pub- lished various versions of the incident, and the anti-Semitic journals denounced them as proofs of a Jewish conspiracy against the French army.

At the end of 1897 M. Scheurer-Kestner, an Alsatian devoted to France and a republican senator, tried to persuade his political friends to reopen the case; but M. Meline, the prime minister, declared in the name of the Republic that the Dreyfus affair no longer existed. The fact that the senator who championed Dreyfus was a Protestant encouraged the clerical press in oreytus- its already marked tendency to utilize anti-ardsaad Semitism as a weapon of ecclesiastical warfare, anti-orey But the religious side-issues of the question ^^”””^ would have had little importance had not the army been involved in the controversy, which had become so keen that all the population, outside that large sec- tion of it indifferent to all public questions, was divided into ” Dreyfusards ” and ” anti-Dreyfusards.” The strong position of the latter was due to their assuming the position of defenders of the army, which, at an epoch when neither legislature nor Government inspired respect, and when the Church was the object of polemic, was the only institution in France to unite the nation by appeal- ing to its martial and patriotic instincts. That is the explanation of the enthusiasm of the])ublic for generals and other officers by whom the trial of Dreyfus and

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subsequent proceedings had been conducted in a manner repugnant to those who do not favour the arbitrary ways of military dictatorship, which, however, are not unpopular in France. The acquittal of Major Esterhazy by a court- martial, the conviction of M. Zola by a civil tribunal for a violent criticism of the military authorities, and the im- prisonment without trial of Colonel Picquart for his efforts to exculpate Dreyfus, were practically approved by the nation. This was shown by the result of the general elections in May 1898. The clerical reactionaries were almost swept out of the Chamber, but the overwhelming republican majority was practically united in its hostility to the defenders of Dreyfus, whose only outspoken repre- sentatives were found in the socialist groups. The moderate ministry of M. Meline was succeeded in June 1898 by the radical ministry of M. Brisson. But while the new prime minister was said to be personally disposed to revise the sentence on Dreyfus, his civilian minister of War, M. (Savaignac, was as hostile to revision as any of his military predecessors ❓❓❓ General Mercier, under whom the trial took place. General Zurlinden, and General Billot, a republican soldier devoted to the parliamentary regime.

The radical minister of War in July 1898 laid before the Chamber certain new proofs of the guilt of Dreyfus, in a speech so convincing that the house ordered it to be pla- ❓❓❓ . . carded in all the communes of France. The next results of month Colonel Henry, the chief of the Intelli- Dreytus gence department, confessed to having forged agitation. ^i^Qgg jjg-^y proofs, and then committed suicide. M. Cavaignac thereupon resigned ofiB.ce, but declared that the crime of Henry did not prove the innocence of Dreyfus. Many, however, who had hitherto accepted the judgment of 1894, reflected that the offence of a guilty man did not need new crime for its proof. It was further remarked that the forgery had been committed by the intimate col- league of the officers of the general staff, who had zealously protected Esterhazy, the suspected author of the docu- ment on which Dreyfus had been convicted. An uneasy misgiving became widespread ; but partisan spirit was too excited for it to cause a general revulsion of feeling. Some journalists and politicians of the extreme Left had adopted the defence of Dreyfus as an anti- clerical movement in response to the intemperate parti- sanship of the Catholic press on the other side. Other members of the socialist groups, not content with criti-

cizing the conduct of the military authorities in tRe Dreyfus affair, opened a general attack on the French army, ??? an unpopular policy which allowed the anti-Dreyfusards to utilize the old revolutionary device of making the word " patriotism " a party cry. The defamation and rancour with which the press on both sides flooded the land ob- scured the point at issue. However, the Brisson ministry just before its fall remitted the Dreyfus judgment to the criminal division of the Cour de Cassation ??? the supreme court of appeal in France. M. Dupuy formed a new cabinet in October 1898, and made M. de Freycinet minister of War, but that adroit office- holder, though a civilian and a Protestant, did not favour the anti-military and anti-clerical defenders of Dreyfus. The refusal of the Senate, the stronghold of the Eepublic, to re-elect M. Scheurer-Kestner as its vice- president, showed that the opportunist minister of War understood the feeling of parliament, which was soon displayed by an extraordinary proceeding. The divi- sional judges, to whom the case was remitted, showed signs that their decision would be in favour of a new trial of Dreyfus. The republican legislature, there- fore, disregarding the principle of the separation of the powers, which is the basis of constitutional govern- ment, took the arbitrary step of interfering with the judi-

cial authority. It actually passed a law withdrawing the partly-heard cause from the criminal chamber of the Cour de Cassation, and transferring it to the full court of three divisions, in the hope that a majority of judges would thus be found to decide against the revision of the sentence on Dreyfus.

This flagrant confusion of the legislative with the judicial power displayed once more the incompetence of the French rightly to use parliamentary institutions ; but it left the nation indifferent. It was during the passage of the bill that the President of the Republic suddenly died. M. Felix Faure was said to be hostile to the defenders of Dreyfus and disposed to utilize the popular enthusiasm for the army as a means of making the presidential office independent of parliament. The Chambers, therefore, in spite of their anti-Dreyfusard bias, were determined not to relinquish any of their constitutional prerogative. The military and plebiscitary parties were now fomenting the public discontent by noisy

demonstrations. The president of the Senate, M. Loubet, as has been mentioned, was known to have no sympathy with this agitation, so he was elected President of the Eepublic by a large majority at the congress held at Versailles on 18th February 1899. The new President, who was unknown to the public, though he had once been prime minister for nine months, was expected in political circles ; but his elevation to the first office of the State made him the object of that defama- tion which had become the chief characteristic of the partisan press under the Third Republic. He was reck- lessly accused of having been an accomplice of the Panama frauds, by screening certain guilty politicians when he was prime minister in 1892, and because he was not opposed to the revision of the Dreyfus sentence he was wantonly charged with being bought with Jewish money. Mean- while the united divisions of the Cour de Cassation were, in spite of the intimidation of the legislature, reviewing the case with an independence worthy of praise in an ill-paid magistracy which owed its promotion to political influence. Instead of justifying the suggestive interference of parlia- ment it revised the judgment of the court-martial, and ordered Dreyfus to be re-tried by a military tribunal at Rennes. The Dupuy ministry, which had wished to prevent this decision, resigned, and M. Wal- f',")"'! deck-Rousseau formed a heterogeneous cabinet Dreyfus. in which Socialists, who for the first time took office, had for their colleague as minister of War General de Galliffet, whose chief political fame had been won as the executioner of the Communards after the insur- rection of 1871. Dreyfus was brought back from the Devil's Island, and in August 1899 was put upon his trial a second time. His old accusers, led by General Mercier, the minister of War of 1894, redoubled their efforts to prove his guilt, and were permitted by the officers composing the court a wide license according to English ideas of criminal jurisprudence. The published evidence did not, however, seem to connect Dreyfus with the charges brought against him. Nevertheless the court, by a majority of five to two, found him guilty, and with illogical inconsequence added that there were in his treason extenuating circumstances. He was sentenced to ten years' detention, and while.it was being discussed whether the term he had already served would count as part of his penalty, the ministry completed the incon- sequency of the situation by advising the President of the Republic to pardon the prisoner. The result of the second trial satisfied neither the partisans of the

accused, who desired his rehabilitation, some of them reproaching him for accepting a pardon, nor his adversaries, whose vindictiveness was unsated bj^ the penalty he had al- ready suffered. But the great mass of the French people, who are always ready to treat a public ques-

tion with indifference, were glad to be rid of a con- troversy which had for years infected the national life.

The Dreyfus affair was severely judged by foreign critics as a miscarriage of justice resulting from race- prejudice. If that simple appreciation rightly describes its origin, it became in its development one of those scandals symptomatic of the unhealthy political condition

of France, which on a smaller scale had often character Tecurred under the Third Republic, and which of the were made the pretext by the malcontents

of all parties for gratifying their animosities.

That in its later stages it was not a ques- tion of race-persecution was seen in the curious pheno- menon of journals owned or edited by Jews leading the outcry against the Jewish officer and his defenders. That it was not a mere episode of the rivalry between Republicans and Monarchists, or between the advocates of parliamentarism and of military autocracy, was evident from the fact that the most formidable opponents of Dreyfus, without whose hostility that of the clericals and reactionaries would have been ineffective, were republican politicians. That it was not a phase of the anti-capitalist movement was shown by the zealous adherence of the socialist leaders and journalists to the cause of Drey- fus ; indeed, one remarkable result of the affair was its diversion of the socialist party and

press for several years from their normal campaign against property. The Dreyfus affair was utilized by the reactionaries against the Republic, by the clericals against the non- Catholics, by the anti-clericals against the Church, by the military party against the parliamentarians, and by the revolutionary socialists against the army. It was also conspicuously utilized by rival republican politicians against one another, and the chaos of political groups was further confused by it. The controversy was conducted with the unseemly weapons which in France have made parliamentary institutions a by-word and an unlicensed press a national calamity ; while the judicial proceedings arising out of it showed that at the end of the 19th century the French conception of liberty was as peculiar as it had been during the Revolution a hundred years before.

An epilogue to the Dreyfus affair was the trial for treasoa before the Senate, at the end of 1899, of a number of persons, mostly obscure followers either of M. D^roulfede the poet, who advocated a plebiscitary republic, or of the Due d'Orleans, the pretender of the con- Jbe state gtitutional monarchy. On the day of President 1899.►► Faure's funeral M. Deroulede had vainly tried to

entice G-eneral Roget, a zealous adversary of Dreyfus, who was on duty with his troops, to march on the Elysee in order to evict the newly-elected Presi- dent of the Republic. Other demonstrations against M. Loubet ensued, the most offensive being a con- certed assault upon him on the racecourse at Auteuil in June 1899. The subsequent resistance to the police of a band of anti-Semites threatened with arrest, who barri- caded themselves in a house in the Rue Chabrol, in the centre of Paris, and, with the marked approval of the popu- lace, sustained a siege for several weeks, indicated that the capital was in a condition not far removed from anarchy. M. Deroulede, indicted at the assizes of the Seine for his misdemeanour on the day of President Faure's funeral, had been triumphantly acquitted. It was evident that no jury would convict citizens prosecuted for political offences, and the Government therefore decided tomake use of the article of the Lawof 1875, which allowed the Senate to be constituted a High Court for the trial of offences endangering the State. A respectable minority of the Senate, including M. Wallon, the venerable " Father of

the Constitution" of 1875, vainly protested that the framers of the law intended to invest the upper legislative Chamber with judicial power only for the trial of grave crimes of high treason, and not of petty political disorders which a well-organized government ought to be able to repress with the ordinary machinery of police and justice. The outvoted protest was justified by the proceedings before the High Court, which, undignified and disorderly, displayed both the fatuity of the so-called conspirators and the feebleness of the Government which had to cope with them. The trial proved that the plebiscitary faction was destitute of its essential factor, a chief to put forward for the headship of the State, and that it was resolved, if it overturned the parliamentary system, not to accept under any conditions the Due d'Orleans, the only pretender before the public. It was shown that royalists and plebiscitary republicans alike had utilized as an organization of disorder the anti-Semitic propaganda which had won favour among the masses as a nationalist movement to protect the French from foreign competition. The evidence adduced before the High Court revealed, moreover, the curious fact that certain Jewish royalists had given to the Due d'Orleans large sums of money to found anti-Semitic journals as the surest means of popularizing his cause.

The last year of the 19th century, though uneventful for France, was one of political unrest. This, however, did not take the form of ministerial crises, as, for the fourth time since responsible cabinets were introduced in 1873, a whole year, from 1st January to 31st December, elapsed without a change of ministry. The prime minister, M. Waldeck-Rousseau, though his domestic policy ex- asperated a large section of the political world, including one half of the Progressive group which he had helped to found, displayed qualities of statesmanship always respected in France, but rarely exhibited under the Third Republic. He had proved himself to be what the French call " un homme de gouvei"iiiement " ??? that is to say, an authoritative administrator of unimpassioned temperament capable of governing with the arbitrary machinery of Napoleonic centralization. His alliance with the Extreme Left and the admission into his cabinet of socialist deputies, showed that he understood which wing of the Chamber it was best to conciliate in order to keep the government in his hands for an abnormal term. The advent to office of Socialists disquieted the ^^^g^i respectable and prosperous commercial classes, the

cILl which in France take little part in politics, though <>‘ the they had small sympathy with the nationalists, Z%^” who were the most violent opponents of the “Wal- deck-Rousseau ministry. The alarm caused by the hand- ing oyer of important departments of the State to socialist politicians arose upon a danger which is not always understood beyond the borders of France. Socialism in France is not a scientific doctrine propagated by earnest reformers, as it is in some European countries. It is a movement appealing to the revolutionary instincts of the French democracy, advocated in vague terms by the members of rival groups or sects. Thus the increasing number of socialist deputies in parliament had produced no legislative results, and their presence in the cabinet was not feared on that account. The fear which their office-holding inspired was due to the immense administra- tive patronage which the centralized system confides to each member of the Government. French ministers are wont to bestow the places at their disposal on their political friends, so the prospect of administrative posts being filled all over the land by revolutionaries caused some uneasiness. Otherwise the presence of Socialists on the ministerial bench seemed to have no other effect than that of partially muzzling the socialist groups in the Chamber. The Opposition to the Government ???i\as

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heterogeneous. It included the few Monarchists left in the Chamber, the Nationalists, who resembled the Boulangists of twelve years before, and who had added anti-Semitism to the articles of the revisionist creed, and a number of republicans, chiefly of the old Opportunist group, which had renewed itself under the name of Progressist at the time when M. Waldeck-Rousseau was its most important member in the Senate.

The ablest leaders of this Opposition were all malcon- tent Republicans; and this fact seemed to show that if ever any form of monarchy were restored in Prance, political office would probably remain in the hands of the accomplished place-hunters of the Third Republic. Thus the most

conspicuous opponents of the cabinet were three ex-prime ministers, MM. M^line, Charles Dupuy, and Ribot. These and other republican " ministrables " had their normal appetite for office whetted in 1900 by the international exhibition at Paris. It brought the ministers of the day into unusual prominence, and endowed them with large subsidies voted by parliament for official entertainments. The exhibition was planned on too ambitious a scale to be a financial success. It also called forth the just regrets of those who deplored the tendency of Parisians under the Third Republic to turn their once brilliant city into an international casino. Its most satisfactory feature was the proof it displayed of the industrial inventiveness and the artistic instinct of the French. The political importance of the exhibi- tion lay in the fact that it determined the majority in the Chamber not to permit the foreigners attracted by it to the capital to witness a ministerial crisis. Pew strangers of distinction, however, came to it, and not one sovereign of the great Powers visited Paris ; but the ministry remained in office and M. Waldeek-Rousseau had uninterrupted opportunity of showing his governmental ability. The only change in his cabinet took place when General de Galliffet resigned the portfolio of war to General Andre. The army, as represented by its officers, had shown symptoms of hostility to the ministry in eon- sequence of the pardon of Dreyfus. The new minister of War repressed such demonstrations with proceedings of the same arbitrary character as those which had called forth criticism in England when used in the Dreyfus affair. In both cases the high-handed policy was regarded either with approval or with indifference by the great majority of the French nation, which ever since the Revolution has shown that its instincts are in favour of authoritative government. The emphatic support given by the radical groups to the autocratic policy of M. Waldeek-Rousseau and his ministers was not surprising to those who have studied the history of the French democracy. It has always had a taste for despotism since it first became a political power in the days of the Jacobins, to whose early protection General Bonaparte owed his career. On the other hand liberalism has always been repugnant to the masses, and the only period in which the Liberals governed the country was under the regime of limited suffrage ??? during the Restoration and the Monarchy of July.

The most important event in France during the last year of the century, not from its political result, but from the lessons it taught, was perhaps the Paris municipal election. The quadrennial renewal of all the municipal councils of France took place in May 1900. The municipality of the capital had been for many years in the hands of the extreme Radicals and the revolutionary Socialists. The Parisian electors now sent to the Hotel de Ville a council in which the majority were Nationalists, in general sym- pathy with the anti-Semitic and plebiscitary movements. The nationalist councillors did not, however, form one solid party, but were divided into five or six groups.

representing every shade of political discontent, from monarchism to revisionist-socialism. While the elec- torate of Paris thus pronounced for the revision of the Constitution, the provincial elections, as far as they had a political bearing, were favourable to the ministry and to the Republic. M. Waldeek-Rousseau accepted the chal- lenge of the capital, and dealt with its representatives with the arbitrary weapons of centralization which the Republic had inherited from the Napoleonic settlement of the Revolution. Municipal autonomy is un- g^^Jf,,^ known in France, and the town council of Paris provinces. has to submit to special restrictions on its liberty of action. The prefect of the Seine is always present at its meetings as agent of the Government, and the minister of the Interior can veto any of its resolutions. The Socialists, when their party ruled the municipality, clamoured in parliament for the removal of this adminis- trative control. But now being in a minority they sup- ported the Government in its anti-autonomic rigours. The majority of the municipal council authorized its president to invite to a banquet, in honour of the inter- national exhibition, the provincial mayors and a number of foreign municipal magnates, including the Lord Mayor of London. The ministers were not invited, and the prefect of the Seine thereupon informed the president of the municipality that he had no right, with- out consulting the agent of the Government, to offer a banquet to the provincial mayors; and they, with the deference which French ofBcials instinctively show to the central authority, almost all refused the invitation to the H5tel de Ville. The municipal banquet was therefore abandoned, but the Government gave one in the Tuileries gardens, at which no less than 22,000 mayors paid their respects to the

Chief of the State. These events showed that, as in the Terror, as at the coup d'itat of 1851, and as in the insurrection of the Commune, the French provinces were never disposed to follow the political lead of the capital, whether the opinions prevailing there were Jacobin or reactionary. These incidents displayed the tendency of the French democracy, in Paris and in the country alike, to submit to and even to encourage the arbitrary working of administrative centralization. The elected mayors of the provincial communes, urban and rural, quitted themselves like well-drilled functionaries of the State, respectful of their hierarchical superiors, just as in the days when they were the nominees of the Government ; while the population of Paris, in spite of its perennial proneness to revolution, accepted the rebuff inflicted on its chosen representatives without any hostile demonstration. The municipal elections in Paris afforded fresh proof of the unchanging political ineptitude of the reactionaries. The dissatisfaction of the great capital with the government of the Republic might, in spite of the reluctance of the provinces to follow the lead of Paris, have had grave results if skilfully organized. But the anti-republican groups, instead of putting for- ward men of high ability or reputation to take posses- sion of the Hotel de Ville, chose their candidates among the same inferior class of professional politicians as the Radicals and the Socialists whom they replaced on the municipal council.

It is not easy for contemporary spectators to sum up the chief results to France of thirty years of parliamentary Republic. The most striking phenomenon, perhaps, has been the survival of the centralized system of administra- tion with all its arbitrary powers untouched. Its exist- ence side by side with an incompatible parliamentary system has been one of the causes of the failure of the latter. Yet in all the years that the Republicans have been masters of France they have made no effort to

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decentralize or to ???weaken the administrative machinery which jSTapoleon constructed to be manipulated by strong Results ^^^ autocratic hands. One effect of the ill- ofthe assorted union of the two systems has been to

Third aggravate the unsound finance which has marked

Republic, ^j^g parliamentary career of the Third Eepublic. In the Constitution of 1876 there is nothing to prevent private members of parliament from proposing the in- crease of public expenditure. The greatest economic authorities in France, the last survivors of liberalism like M. Leon Say, have vainly advocated the sound English practice which confines financial initiative to the Government of the day. The deputies, especially the Eadicals and the Socialists, have maintained the preroga- tive of private members to increase the estimates. The chief reason for this has been that under the centralized system every French constituency contains an army of functionaries appointed and paid by the State. Under the parliamentary regime the nomination of these offi- cials has fallen into the hands of members of parlia^ ment. Consequently the aim of deputies has been to increase their power of patronage, and to promote the creation of needless posts paid for by the taxpayer, instead of using their influence to cut down expenditure. A less rich and less industrious nation would have suc- cumbed under this wanton drain on its resources. These have been farther reduced by the decrease of population under the Third Eepublic in the majority of the depart- ments, though that of the capital has increased owing to immigration from the provinces. The lack of testa- mentary liberty in France, and the consequent compul- sory division of property, have popularized the principles attributed to Malthus. The decreasing birth-rate, in this period of universal conscription on the Continent, has compromised the security of France, as in a single- handed conflict with Germany her armies would be over- whelmed by mere force of numbers. It is also, according to French pessimists, one of the reasons of the declining influence of France among nations. France contained almost one-fifth of the population of Europe at the beginning of the 19th century, while at its end she had less than one-tenth. The United Kingdom, in spite of its enormous colonial expansion, increased its population between 1800 and

1900 by 156 per cent. The inhabit- ants of France are only 46 per cent, more numerous than at the beginning of the century, and her vast colonies languish for need of a surplus population to develop them.

The alleged decline of the prestige of France under the Third Eepublic is ascribed to a variety of causes. During the first seven decades of the 19th century, whatever her vicissitudes, France exercised in Europe a great influence, which was scarcely checked even after the hour of defeat in 1816. Until the fall of the Second Empire the French used to say with reason : " Quand la France joue du violon, toute I'Europe se met a danser." The insurrection of the Commune in 1871 evoked no echo beyond the frontier. Europe had ceased to follow the lead of France, at all events in her revolutionary movements, which in 1830 and in 1848 had been followed by political commotions all over the Continent, and even in England. If the disasters which the Eepublic at its birth inherited from the Empire were the flrst cause of the depreciated influence of France, it is certain that the Eepublic has done nothing to restore it, and it is not easy to gainsay French critics who complain that their country has lost prestige under that regime. Some of these pessimists say: the Chief of the State at the end of the 17th century was Louis XIV. ; at the end ❓❓❓of the 18th century Napoleon Bonaparte ; at the end of the 19th century M.]6mile Loubet. If it is galling to the pride of the people that France should pass into the 20th

century under the headship of an unknown citizen of no achievement, who represents none of the brilliant qualities of the nation, the contrast with the gorgeous dawns of other centuries supplies one consolation. The presence of M. Loubet and of his predecessors at the head of the French executive, in the place of a more decorative monarch or series of monarchs, has been a great factor in the preservation of the peace of Europe. Under the Second Empire France was not boycotted ❓❓❓ to use a word which has been adopted in the French language ❓❓❓ by the sovereigns of Europe. Under the Third Eepublic the Chiefs of the State have had no personal relations with crowned heads such as had Napoleon III., for even the relations of the Tsar Nicholas II. with the rulers of the Eepublic have been of a somewhat patronizing character. But while France during the Second Empire was flattered at having a

ruler admitted within the hierarchy of monarchs, whose mere word could agitate the bourses and the chanceries of Europe, she had to pay for the prestige of her Emperor by a series of wars, the last of which ended with the invasion and the mutilation of the land. If the monotony of peace be of greater advantage to a country than the varying viscissitudes of war, it cannot be denied that the Third Eepublic compares favourably not only with the Second Empire, but with the age of Louis XIV., or with the epic and reconstructive period of the first Napoleon. It must, however, be said in justice to the Second Empire that its warlike career before its disastrous end was coincident with an epoch of national prosperity ; while under the peaceful Third Eepublic France has lost her commercial supremacy on the Continent, though a con- siderable industrial development has taken place in Paris and in certain populous centres.

The Third Eepublic has not been fruitful in statesmen to raise the renown of the nation. Three chief causes may be suggested for this dearth. First, the failure of the parliamentary system to attract the best or even the second best men of the nation to take part in politics. Next, ministerial instability, which has prevented poli- ticians from having the opportunity essential to developing their administrative powers. Third, the impersonal system of government, which has been carried to such an extent that not only have superior men been discouraged, but it has condemned its possessors to political ostracism, for fear lest their qualities should induce the people to hail a dictator. It was thus that Gambetta's career was cut short. Neither has the Eepublic produced much useful legislation. The French are not a parliamentary nation, and with their confused ideas on the separation of the powers they have never apprehended that the right function of a legislature is to legislate. The two chief reforms accomplished by the parliament of the Eepublic in the 19th century were the reorganization of public education and of the army. The development under the Eepublic of the educational system, already of high excellence in France, would have had better results had not the legislation on the subject been marked with sectarian animosity. The aim of the educational laws associated with the name of Jules Ferry was not only the elevation of the standard of public instruction, which they undoubtedly effected, but also the hindrance of the work of Eoman Catholic schools and colleges. The anti-religious tendency of State eduration in France is exaggerated

by its adversaries ; yet the Ferry laws have never been accepted by the entire nation. A very large minority has refused the advantages offered to its children gratuitously in the primary schools, and for a modest price in the second- ary establishments. So considerable is that minority that at the end of the 19th century the anti-clericals in parliament moved the Government to introduce legislation limiting the ecclesiastical teaching-orders,

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____while they further demanded that education in a State school should be made an essential condition of public employment, civil or military. Thus the dawn of the new century was clouded with reviving controversies be- tween secular and dogmatic education ____which, based on the intolerant pretensions of the extreme Voltairean and Ultramontane schools of thought, have no counterpart in a land of many sects like England. Apart from this question, one disadvantage of the development of educa^ tion in France is connected with the growth of centralized bureaucracy under the parliamentary Eepublic. A new generation of half-educated young men, disdaining manual toil, seek a career in petty official posts, which are often needlessly created for them at the cost of the taxpayer. From the same unsatisfactory class, unfitted for productive labour, come the journalists of mediocre talent who multi-ply in the land. A cheap and unlicensed press has become a national evil in France, since many of the most widely circulated organs of every political shade ____socialist, anti- Semitic, clerical, and anti-clerical ____are merely organs of violence and defamation, propagating in every corner of the territory the spirit of bitterness and dissension which is a deplorable feature of social life under the Third Republic.

The reorganization of the army may be looked upon with more satisfaction. In spite of the excesses of mili- tarism the French army is an admirable institution. The whole manhood of France passes through its ranks. The period of self-denying discipline imposed upon French- men

of all classes after the close of their school-days, which are more laboriously employed than those of the youth of England, has produced a new nation. Com- pulsory military service is accepted, not with enthusiasm, but without murmuring. The working of the system in France, from the point of view of national life, seems to be not less satisfactory than in Germany, and thus to encourage nations which need, but dread, conscription. The composition of the French army, recruited from every social class, has had much to do with the place it has taken in the heart and imagination of the people, similar to that which monarchical tradition occupies in certain other countries. Thus in a land where all the regimes of a century have been only temporary expedients, it is looked upon as a permanent institution handed down from a historical past and superior to party rivalries. This explains the attitude of the nation towards the assailants of the army, even where the latter have had some show of justice in their attacks. The severe training which all Frenchmen have to undergo, in boyhood at school and on the threshold of life in the army, has a two-sided effect. A minority of the nation considers that it has been so hard worked in youth that it is justified in making no further effort in manhood. In the rich re- actionary upper class this feeling takes the form of lives wasted in frivolity. The men of the middle class who have this disposition swell the crowd of State-paid functionaries or take to journalism or to politics. But the great masses of the nation, frugal and industrious by instinct, unconsciously profit from their years of early discipline, in which their natural habits of good order and diligence are developed. The women of France are no less hard-working than the men, and it was the quiet workers of both sexes, of the great class which abstains from politics, who paid the war indemnity to Germany in the first days of the Eepublic. It is their labours which have since counterbalanced the improvident finance of the politicians. Without these qualities, to which are due the industrial enterprises and the artistic creations of the last generation of the 19th century, France would not have remained in the front rank of nations. The poli- tical future of the land was never more uncertain than at

the opening of the 20th century ; but France contains two elements of stability which seem likely to survive all vicissitudes. On the one hand there are the industry and frugality of the people, which, though menaced

by the scourge of intemperance, are still unequalled in Europe. On the other hand is the system of adminis- tration constructed by Napoleon, which, though incom- patible with parliamentary government, may perhaps survive it, as it seems essential to the orderly existence of France, having survived all the changes of regime of a century. (j. e. c. b.)

4. Literature sixce 1880.

The salient feature of the history of French literature from 1880 to 1900 is the progress of a reaction against what was somewhat inaccurately called the Eealistic school. The Eomantic school was paramount during the first half of the 19th century, and it was not until after 1850 that the Naturalistic movement prevailed. This movement derived its origin from the naturalist philosophy, which developed in France under two different forms : ❖❖❖ (1) The simple theory of sensation of Condillac ; (2) the Positivism of Comte. From the first we get the sensuous realism of Gautier and Flaubert ; from the second the naturalism of M. Zola. ❖❖❖ Gautier develops the theory of "art for art's sake " in his Preface to Mademoiselle de Maupin, which was the manifesto of a school represented by Gautier, Flaubert, Bouilhet, and, with certain modifications, by Lecontede Lisle, Theodore de Banville, and the Goncourts. In the period here under consideration the representatives of this school are the " Parnassian " poets ; among the novelists, the Goncourts alone, and they only in a modified degree, belong to this category.

The watchword of the Utilitarian school was " Art for Utility's sake," audits philosophy was that propounded by Auguste Comte in 1830 and popularized by Taine. The doctrine that science, based on the only trustworthy data, those of the senses, should be the sole guide of the human mind was adopted by M. Zola and his disciples. The aim of the school was to do away with all convention; to institute a searching and exhaustive inquiry into human nature ; to discover the human " document " ; to present what they termed a " slice of life " without beginning or end, the personality of the author being eliminated. These theories, however, were never rigidly practised by their propounders. M. Zola himself admitted that " the realistic novel was a corner of nature

seen through a temperament." Not only were the leaders of the school forced to relax the severity of their precepts, but it soon became apparent that the term was in reality a misnomer, and that in many cases the theories of the school were merely confuted by the practice of its disciples. For if Defoe, Lesage, and Tolstoi are realists in the true sense of the word, then assuredly is M. Zola something different. So far from seeing life " steadily " and seeing it " whole," as Matthew Arnold inculcated, Zola confines himself to the study of the baser and the brutal elements in man and nature while he eliminates the soul ; moreover, he saw the elements to which he confined himself through the distorting glass of a pessimistic and imaginative temperament, so that he evokes monstrous and monotonous visions for us, phantasmagorias of ugliness and crime, sordid and sombre panoramas which are impressive from their very size and from the violence and heaviness with which the coarse colours are laid on the canvas. His work, however, is not lacking in an element of grandeur ; thus we get the epic of the train, the mine, the shop, and the battlefield, but never truly realistic studies of contempo- rary life.

The Eealistic school may be said, therefore, to have ra erely succeeded in substituting one convention for another ; but

this is only true so far as concerns the theories of the school and those authors who slavishly adhered to it. Maupassant, for instaiice, who belongs to the Realistic school, was a true Eealist, not because he adopted any particular theories, but because he was enabled by his temperament to look on life with penetrating eyes, and by his talent to depict what he saw with unsurpassed vivid- ness. But both by his clearness of vision and by the lucidity, the purity, and the masculine directness of his style he was a classic ; and this, as we have already said, is the case of all true Realists such as Defoe and Lesage.

The Realistic school did not fail to produce in its turn a reaction and a revolt against its conventions. Authors who have since attained to the fulness of their powers, such as MM. Brunetiere, Lemaitre, Bourget, and Anatole France, protested against the conventions of the Realistic school and strove to counteract its influence. It is this counter-movement which has continued up to the present day. Another important factor in the origin of the new- phase has been the influence of foreign literatures. The novels of George Eliot, Tolstoi, and Tourgeneff exercised a wide influence in France, and helped to reveal the limited range of the French Naturalist school ; for in these foreign novels Nature was depicted in her entirety and not only in her baser aspects. At the same time a revolt arose against the aridity of the Realists, against their inability to look beyond the objects and facts within their immediate ken, and their total elimination of the life of the soul and the region of ideas. This tendency- gave birth to a renascence of idealism. In 1889 M. Bourget wrote in the preface to his novel Le Disciple, after quoting Littre's well-known saying respect- ing the ocean of the unknown and the comparatively infinitesimal results of science : " A ceux qui te diront que derri^re cet ocean il y a le vide, I'abime du noir et de la mort, aie le courage de repondre, vous ne le savez pas. Et puisque tu sais, puisque tu eprouves qu'une 8,me est en toi, travaille a ce que cette ame ne meure pas en toi avant toi-mgme." The younger generation turned once more to the region of ideas, and the tendency of French literature from 1889 up to the present day has been termed Idealist. Again, just as M. Taine's theories were adopted in a distorted form by the Naturalistic school, the philosophy of M. Renan was an important factor in the origin of the new tendency. But since no movement ever stops half- way, but continues naturally until it reaches its extreme limit, this tendency went farther than M. Renan's idealism, and passed on into mysticism; though this movement, as we look at it now, seems to be split up into singularly various elements, for together with the exist- ence of symbolism and mysticism, incredulity and sensual- ism have survived, and a brutally cynical element has appeared which has been christened " rosserie." Doubtless it may be argued that the idealism of the new generation is skin-deep, that it is mystical without being Christian ; it is at the same time probable that when we can look back upon the present period from a standpoint which will enable us to see it in its true perspective and pro- portion, the whole movement will seem to have been

fairly named idealistic. Amidst the restlessness, the mobility, the shifting phases of this generation in France ... the sudden and shortlived enthusiasms, at one time for Norwegian and other Northern literatures, at another for Neo-Hellenism and a Latin Renascence ... there is perhaps a definite trend towards Faith in the largest sense of the word, towards an imperious necessity of believing, to which the thirst of knowledge is subordinated ; and this movement, while to some critics it may have the appear- ance of being retrograde and reactionary, is perhaps in

reality a renascence of the national genius of France, another example of the elasticity of the French tempera- ment. On the one hand we have a young school who feel this necessity of faith in the largest sense ; on the other hand we have writers like M. Bourget and M. Brunetiere appearing as the plain, outspoken champions of Catholicism; writers like MM. Lemaitre and Barres appearing as the prophets of national energy. Again, in works such as Pour la Couronne by M. Coppee, and M. Rostand's Cyrano de Bergerac, we have a renascence of another kind ... a return from the complicated minstrelsy of intimate rhythms and obscure suggestions practised in later years by Symbolists (which has proved to be pro- ductive of some beautiful music and much unintelligible discord), to the simpler and more commonplace song of an earlier day. It is a message that we have heard before ; but it is precisely this message, old and eternally new, which we demand of the poets at perennially recurring intervals, when man is momentarily wearied of writers whose sole aim is to lay stress on the burden of existence and to point out the ugliness of the world.

Poets. ... The progress of French poetry from 1880 onwards can be divided into two main branches : ... (1) The successors of the Parnassians who maintained the Parnassian tradition ; (2) the Symbolists, decadents, &c. Besides these two branches there is a group of poets who, although contemporary with the Parnassians, scarcely belong to them ... we will designate these as the Provincial and Rustic poets, although they do not all hail from the provinces or exclusively confine themselves to pastoral themes ; and finally, there are those contemporary

poets of the present day who cannot yet be classified in any definite manner, since they represent widely varying tendencies and currents.

The Parnassian school was founded by MM. L. Xavier de Ricard (born 1843) and CatuUe Mendes, who chose as their tetrarchs and judges Theophile Gautier, Leconte de Lisle, Baudelaire, and Banville. The Pamasse contem- porain, an anthology of new poetry, was published in instalments. The first appeared on 2nd March 1866, the eighteenth and last in June of the same year. There were thirty-seven contributors, of whom the most important were Gautier, Banville, Heredia, Vacquerie, Baudelaire, Sully Prudhomme. A second Pamasse was published in 1871, a third in 1876. Finally M. Lemerre published a complete anthology in four volumes. Among the members of this brilliant group none was more richly gifted by nature than M. Gatulle Mendes (born 1841). The fairies of litera- ture seem all to have attended his baptism, and each one conferred on him her particular gift ; no wicked fairy was there to confer some saving flaw, some great defect pro- ductive of a correspondingly predominant quality ??? " Master of all styles, he is supreme in none." With Mr Swinburne's power of assimilation, he lacks Mr Swinburne's lyrical genius; his talent is always under perfect control ; he rides Pegasus so well, with such con- summate mastery and ease, that the horse cannot ever escape from the earth and soar into the heavens. His poetry (and he is not only a poet, but a novelist and a writer of short stories) is in turn realistic, romantic, neo- Hollenic, heroic in the vein of Victor Hugo and lyrical in the manner of Heine, appearing under the titles of Philomela, Soirs Moroses, Pantcleia, Contes ipiques, Intenni^de. It is his extreme versatility and power of assimilation which have perhaps prevented him from attaining to greatness or to supreme excellence in any one line ; his poems give one the impression of exquisitely manufactured imitations; parodies in earnest, what the French call pastiches. Tlae work of M. Sully Prudhomme (born 1839) bears far more resemblance to that of Lamartine

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than to that of Leconte de Lisle and his disciples. He might be called a French Matthew Arnold ; his poems have the same charm and dignity, the same accentof stoical resignation, the same pensive note of melancholy as of an ivory lyre ; but although his work is philosophical, he is a poet who thinks and not a philosopher who turns to rhyme for recreation.

M. Francois Copp^e (born 1842) furnishes a signal example of the influence of Eealism on French poetry ; he has proved to be the most popular of the Parnassians ; no sharper contrast could be found to his sentimental realism, his choice of familiar themes and humble subject-matter, than the spirit which inspires the verse of J. M. de Heredia (born 1842), the artificer of sonnets which are unequalled not only for the sweetness of their versification and for the metrical perfection which they exhibit, but also for the wide range of vision which is evoked by their disciplined utterance.

Less celebrated than most of the Parnassians, but equal almost to the greatest in accomplishment, Andre Lemoyne (born 1822) is the poet of landscape. His poems remind us of the painting of Corot. He produces deli- cate and musical pieces, impregnated with a particular atmosphere, which have a charm not unlike that of Collins's Ode to Evening. Side by side with Lemoyne, Andre Theuriet (born 1833), the author of the graceful CJiemin des Bois, deserves to be mentioned. M. Leon Dierx (born 1838), elected at the death of Mallarme to be " Prince of Poets," has published biit little. His verse, which is above all things artistic, and masterly in tech- nique, is essentially characteristic and representative of the true Parnassian school. His Limes closes was pub- lished in 1868.

Guy de Maupassant, Anatole France, and Alphonse Daudet all began their literary careers by a short sojourn among the Parnassians. Another teller of tales ??? and tales as little edifying as it is possible to find ??? who was endowed with true lyrical and imaginative gifts, is Armand Silvestre (1837-1901), the poet of La Chanson des heures (1878), Ailes d'or (1880), Le Chemin des etoiles (1886). His poems are pervaded by a vague pantheism, and seem to be woven out of a rainbow haze of dreams, their chief merit lying in the way in which they seem to flower in

an endless succession of monotonous and sumptuous images. The list of Parnassians would be incomplete without mentioning Jean Cazalis (born 1840), M. Albert Merat (born 1840), and M. Frederic Plessis (born 1861), the classic poet of La Lampe d'Argile.

The influence of the Realistic school, which was at its height in 1880, can be traced in all the productions of this Parnassian school, for while their poetry escaped from the contagion of ugliness and brutality, it was none the less objective in character, and chose for its themes, as the case might be, detailed landscapes, historical scenes accurately reproduced, or realistic studies of modern life. The attention to detail and concision of style which were sought after and attained, left little to individual inter- pretation. A reactionary movement, such as that which arose against the novel, appeared here also, and hence the Symbolist school came into being, which aimed at greater freedom, a less strict prosody, and a more musical poetry. But it must be borne in mind that this Symbolist move- ment was a revolt against the precepts of the Parnassians and the legacy of the Romantic school, and it can only be called a reaction against naturalism, in so far as the in- fluence of naturalism is to be traced in the poetry of the Parnassians. The Parnassians had borrowed from the plastic arts; the Symbolists aimed at the vagueness, mystery, suggestiveness of music, de la musique avanf toute chose. The high priests of this movement were Paul Verlaine (1844-1896), remarkable much less for his theories

than for his exquisite practice, in which he showed him- self a lyric poet of the first order, comparable with Shelley and Heine, and not without certain affinities to the earliest French singers, such as Charles d'Orleans; and St^phane Mallarnie (1842-1898), perhaps less remark- able for his practice than for his theory. He not only advocated vagueness of music and of sound, but misti- ness of imagery and of sense ??? in fact, obscurity. Then followed a riot of rebellious rhymers, for whom sense capitulated unconditionally to sound and sensibility. M. Viele- Griffin (born 1864) and M. Gustave Kahn (born 1859) gave us vers litres which, but for their typograph- ical arrangement, are indistinguishable from prose. In- deed, the extreme limit of this school is reached in the ballades of M. Paul Fort (born 1872), which are actually printed as prose.

In the verse of these disciples of the Symbolist school rhyme is often reduced to assonance, and poetry tends to become less and less subject to any exterior discipline ; it is made instead to depend upon an intimate rhythm, which varies with every different p6et, the result, should the poet have a sen- sitive ear, being often in the highest degree musical. Verlaine and Mallarme can only be said to have exercised a pernicious influence on the least gifted of their disciples, and in many ways their influence was wholly beneficent. The tyranny of the rhyme was broken, prosody became more supple, and a freer rhythm was introduced. The phase must by no meaas be considered an abnormal one. In the Symbolist movement French poetry reverted more or less to what it was in 1820, to the suggestive imagery and musical vagueness of Lamartine. French poetry at that epoch was moving naturally towards the ideal of the Symbolists, when it was deflected from its course by the appearance of Victor Hugo, who fashioned a new in- strument for lyrical poetry to suit his visionary genius and his command of magnificent rhetoric ; and the in- strument subsisted and was played upon by generations of more and more dexterous artists, until the Symbolists shattered it.

By far the most gifted of the disciples of the Symbolist school is M. Henri de Eegnier (born 1864), the singer of Lendemains (1886), Ar6thuse (1895), and Les Jeux rustiques et divins (1897). We find in his work a har- monious combination of old traditions and modern inno- vations. He has adopted and practised the precept of Andre Chenier ???

" Sur des pensers nouveaux faisons des vers antiques,"

and his work, especially his latest volume, testifies more perhaps to the infiuence of Andre Chenier than to that of contemporary writers ; it is, nevertheless, stamped vnth originality. He takes ancient myths and interprets them anew, using mythological symbols as a vehicle for the expression of modern ideas ; he is symbolical without being obscure. He is particularly successful in the choice of an imagery which has a kind of subdued splendour that harmonizes well with the grave music of his dreams ; throughout his poetry there is a vein of impassioned meditation, suggestive, dreamy, and melodious. The melancholy note of his song and the sumptuousness of his imagery remind one of poems such as Mr

Swinburne's Triumph of Time. He presents affinities to Mr Swin- burne and also to Keats, especially to the early poems of Keats, such as the Bacchic song in Canto IV.^ of Endymion. His poems abound with extremely beautiful lines, and Les Medailles d'Argile (1900) showed a great advance on his earlier works, and contained the promise of still finer performance.

M. Albert Samain (1869-1900) was also a dreamer ; he had an exquisite sense for half tones, subtle shades, elusive scents and fugitive murmurs, and he rendered the same in

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musically murmured, verse. M. Francis Viele-Griffin is the boldest among the initiators of the new movement, and his poetry breaks away from all traditions ; but his work, which is not without charm of melody, is almost entirely unintelligible and incoherent. The disciples of the Symbolist school have given most of their work to the world through the medium of a Review entitled Le Mercure de France. The principal contributors to this periodical are MM. Eobert de Souza, Francis Jammes (born 1868), Laurent Tailhade (born 1854 ◆◆◆ author of Jardin des rives, 1880), and M. Jean Moreas (born 1856), the poet of various volumes from Les Syrtes of 1884 to Les Stances of 1901.

Alongside of, and contemporary with, the Parnassians, there flourished what we have called the Provincial poets. Of these the most important are M. Jules Breton (born 1827), author of Les Champs et la Mer ; M. Charles de Pomairols, a disciple of Lamartine (of whom he has given us a fine study) ; and Alfred de Vigny, whose work has some of the gravity and elevation of his masters. M. Gabriel Vicaire (1848-1900), native of Bresse, published his ^rnaux Bressans in 1884, a volume of fresh and delightful and spontaneous lyrics. The Provence pro- duced M. Jean Aicard (born

1848). Finally, in Paris itself we find M. Deroulede, the French Korner, the patriotic singer of Chants du Soldat (born 1846) ; and M. Eichepin (born 1849), author of La Chanson des Gueux, Les Caresses, Les Blasphhnes, La Mer, and several dramas iu verse ??? Nana-Sahib, Par le Glaive, and Le Flibustier. M. Richepin is one of the most interesting and curious figures in contemporary French poetry ; romantic by temperament, he had made no attempt to modify his proclivities ; his dramas might almost have been written in 1830. In La Chanson des Gueux he celebrated the tramps and beggars of Paris ; in Les Caresses he is frankly pagan and sensual, and in these poems as well as in Les BlaspMmes he reminds one of the more extravagant excesses of Mr Swinburne's early work. For sheer virtuosity and skill in versification he can hold his own not only with all his contemporaries, but with the most accomplished French rhymers of the past; his verse has the quality of vigour, sonor- ity, and colour in the highest degree. Like Mr Swin- burne, j\r. Richepin is a scholar, and his erudition is a little too evident ; in his violence and extravagancies there is the same suspicion of insincerity and rhetoric that we find in the more violent poems of Mr Swinburne, and he never attains to Mr Swinburne's purely poetic inspiration. He remains an astonishing versifier rather than a great poet.

We now come to the representative poets of the present day. One of the most notable is certainly M. Maurice Bouchor (born 1865), author of Les Symboles (1888) ; his poetry has a note of high seriousness and religious feeling. Deserving of mention are M. Georges Leygues, author of Le Coffret Brisi (1882) ; M. Edmond Haraucourt, a brilliant disciple of Leconte de Lisle, author of L'Ame Nue (1885) ; M. Jean Rameau, author of Le Chemin des iJtoiles (1888) ; M. Andre Rivoire's poems in the Revue de Paris have attracted attention. The poems of the Vicomte de Borelli, author of Rana and Alain Chartier, performed at the Comedie Francjaise (1889), are particu- larly interesting as being the work not of a professional man of letters, but of a soldier.

The poetry of M. Edmond Rostand (born 1864) is looked upon with scorn by the contributors to the Mercure de France, and, partly perhaps because it so instantaneously and emphatically won the suffrages of the great public, older critics have been chary in their appreciation. Doubtless

M. Rostand is first and foremost a dramatist, and his poetry is better heard than read ; but although

it is neither the poetry of the Parnassians (to which it stands in the same relation that the poetry of Mr Kip- ling holds to the poetry of Tennyson), nor of the Sym- bolists, yet poetry of a kind it is, brilliant, witty, full of fancy, fertile ??? too fertile, perhaps ??? in invention; it assimilates the character of French poetry of many epochs. M. Rostand is an astounding juggler rather than a supreme artist in words ; and although it would be unjust to accuse him of a fatal fluency ??? for while everything that he touches turns into poetry, the result is gold and not tinsel ??? yet this marvellous facility has the danger of turning him from the main road along which he determines to travel, into byways of attractive episodes, or of causing him to forget in ingenious detail the main architectural design of his fabric. As far as largeness of aim and design are concerned, his most important work so far has been L'Aiglon, but it cannot be said to be on the whole so satisfactory as Cyrano de Bergerac, which contains what is without doubt the best verse he has so far given us. M. Rostand's qualities arid defects are equally well displayed, if on a smaller scale, in his earlier plays ??? Les Romanesques, La Princesse Lointaine, and La Samaritaine.

Novelists. ??? Among the novelists of the later half of the 19th century, the only two of importance who may be said to belong to the Idealistic, if not to the Romantic, school are Octave Feuillet (1821-1890) and Victor Cher- buliez (1829-1899). Whatever charges of artificiality or sentimentality may be brought against the work of Feuillet, his novels are likely to survive, owing to the perfection of their construction and the purity and grace of their style. Cherbuliez, who to a greater degree than Feuillet held aloof from the tendencies of the contem- porary novel, was perhaps more of a moralist and a humorist than a novelist. His ingenious and com- plicated stories, although they do not fail to entertain us, betray inexperience of life, and they justify Mau- passant's criticism that Cherbuliez did not deserve to be called an Idealist merely because his observation of life happened to be inaccurate. His best novels are Un Clieval de Phidias, Le Prince Vitale, and Le Grand CEuvre.

Towards the year 1880 the Naturalist movement had reached its zenith, and the inevitable reaction did not fail to set in. But before dealing with it, it will be well to con- sider the work of the Naturalists as it existed in 1880. It can be divided into two branches ??? on the one hand, the Impressionists, whose object it was to interpret nature, and to whom the impressions received from nature were a means of expressing their personality ; and on the other the Naturalists proper, whose aim was to achieve absolute and objective reality, and whose failure to do so was productive of so many curious and interesting results. To the Impressionists belong the two Goncourts, the most literary of all French writers of the century, whose work may be summed up in one word, nervosity, and who, in their determination to render the vibration of their impressions, dared any discord; Alphonse Daudet ; and Pierre Loti, who in reality belongs to a class all by himself, since he is not a novelist at all, but a poet and a painter in words. To the Naturalistic school proper be- long M. Zola, whose L'Assommoir appeared in 1887 ; and Guy de Maupassant, whose masterpiece, Bonle de Suif, appeared in 1880.

J. K. Huysmans (born 1848) began as a Naturalist, and in his work we see more strikingly manifested than else- where not only the tendencies of the Naturalist school and the reaction they produced, but the extreme limit of this reaction ; in fact, the transition from naturalism to mys- ticism. Huysmans' first books appeared in 1878-79, ^1 Rebours in 1884, Ld,-Bas in 1891. In his early stories, Marthe (1876), Les Soiurs Vatard (1879), Sac au Dos

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(1880), the hideousness of hideous things is depicted with Flemish miniateness ; the world seems to reek in his nostrils; he goes out of his way to choose the most repulsive subjects, and seems to enjoy a bitter satisfac- tion in dwelling on the most sordid aspects of his loathsome vision. The extreme sensibility of his temperament, however, led him farther ; his pessimism reaches its lowest degree in a study of Satanism in

Ld,Bas, and from blasphemy to belief the transition is a natural one, since in order to blaspheme it is necessary first to believe. Disgusted with himself and the horror of his life, the author of Ld^Bas seeks refuge in a Trappist convent. We then get an account of this experience in En Route (1895). This is by far his most interesting and important work, remarkable for the ab sence of all literary Catholicism such as that affected by Baudelaire, for the poignant sincerity with which his moral crisis is depicted, and for the sheer beauty of many scenes and passages. La Cathidrcde (1898) consists almost entirely of a description of the Cathedral of Chartres.

The reactionary movement which is illustrated by the career of Huysmans was headed by M. Paul Bourget (born 1852), who deserves the credit of reinstating psy- chology in the position from which it had been ousted by the physiology of the Naturalists. In his critical essays M. Bourget attempts to discover and to define the funda- mental moral idea forming the basis of the work of the writers whom he studies, in his novels his aim is to analyse the soul of man. He chose for his field of observation the fashionable world of Paris, and conse- quently he is the psychologist and novelist of Society. The chief excellence of his work, and at the same time its cardinal defect, lies in his system of explanation. His characters do not reveal themselves to the reader by their acts and words, the author explains them to us himself. If we eliminate the dissertations from his novels, we are left with " novelette " plots of the most commonplace description ; on the other hand, it is pre- cisely in dissertations that his great talents are manifest, when the subject of the book is purely an analytic study which admits of dissertation.

M. Edouard Rod (born 1857) began as a disciple of M. Zola, but was soon, chiefly owing to the influence of foreign literature, led into the current of reaction. His work is widely different in tone from that of any of his contemporaries, and is impregnated with a rarer atmo- sphere. He is in the highest degree preoccupied by moral ideas and questions of conscience, yet he is capable at the same time, in La Vie Privee de Michel Tessier (1893) and Le Menage du Pasteur Naudie (1898), of creating living characters, and of interesting us in their careers. If his work is lacking in the more salient qualities of brilliancy and colour, it is

nevertheless admirable on account of the harmony of its proportions and the delicacy of touch which it manifests. The titles of his remaining works are Le Sens de la Vie, Les Trois Oceurs, La Sacrifice, Le Silence, Les Roches Blanches, Dernier Refuge Ldb-Haut.

M. Paul Margueritte (born 1860) is another instance of a Naturalist converted. He began as a disciple of the Goncourts, and in 1887 signed a manifesto against M. Zola. The work, indisputably his masterpiece, to which he owed his celebrity is La Force des Choses (1891). His other works are Jours d'ipreuve (1889), Ma Grande (1893), La Tourmente (1893), Le Disastre (1898), with its sequel Les Trongons du Glaive (1900), a historical study of the war of 1870, written in collaboration with his brother. He is affiliated to the Goncourts by his nervous temperament, but no novelist of the present day has a more trenchant style, a greater precision of touch. In

La Force des Choses and Ma Grande he has produced two human dramas remarkable for sincerity and truth, and for their poignant simplicity and pathos.

The work of J. H. Rosny (the name stands for two brothers who work in collaboration) has first and foremost the merit of originality. His conception of art is widely different from that of the Naturalistic school, and yet, although he began as a disciple of M. Zola, and later repudiated him, he cannot be said to belong to the reactionary movement. His work stands entirely apart from that of his contemporaries. Science forms his one preoccupation, and it positively overloads his work. His descriptive passages teem with allusions to chemistry, physical science, and natural history. His cult for science forms the basis of his work, the starting-point of his literary theories and of his moral ideas. His moral aim is to replace the Christian precepts of humility by a rational form of altruism, in which virtue is to be a means of developing superior beings to the fullest possible ex- tent, and the effort of this morality is to tend towards the progressive amelioration of this life ; his cult is that of " La bonne humanity." His early works, such as Nell Horn, in which he depicts scenes of London and Parisian life, and even Vamireh (1891), a prehistoric novel, betray the influence of the Naturalist school. Daniel Valgraive (1891), L'Imperieuse

Bonti (1894), L' Indomptable, and Renouveau, U Autre Femme, Resurrection are very different in character. The two first are inspired by the pre- occupation of social and individual morality. Besides Vamireh he has written other prehistoric novels, Erymah and Les Profondeurs de Kyamo. His best work suffers from incoherence, from the neglect of composition, an indulgence in grotesque detail and barbarous verbal in- ventions, and a pedantic use of scientific phraseology. But all his work is redeemed by a certain greatness of soul, by the excellence of "sincerity and strength," by the enthusiasm rising from deep conviction, and by the largeness and nobility of his ideas ; moreover, in spite of all its defects, his style has moments of sim- plicity, freshness, and majesty. His work resembles a rugged mountain on which we struggle over perilous steeps and through dark caverns, rewarded every now and then by intermittent glimpses of snowy splendours and dazzling horizons.

M. Marcel Prevost (born 1862) affords the greatest possible contrast to Eosny ; his talent is vivacious, elegant, and insinuating ; he has confined himself entirely to love stories, and moves on this ground with masterly ease, analysing the subtler shades with a delicate dex- terity. He published Le Scorpion in 1887, Mademoiselle Jauffre in 1889. No wittier book appeared during the period 1880-1900 than the first series of his Lettres de femmes (1892). His particular deftriess and cleverness found perhaps a larger scope in Les Demi-Vierges (1894) ; yet with all his grace and amenity he is a moralist, since in his love stories he strips passion of its poetry and leaves the bare materialism and vanity which lie beneath it ; at the same time his attraction for what he affects to despise and condemn is clearly evident.

M. Paul Ernest Hervieu (born 1857) has of late years entirely devoted himself to the stage, but he made his reputation by two novels, Peints par Eux Mimes (1893) &TidL' Armature (1895). The first of these two is ironical as to matter, and lucid and trenchant as to style ; the second is a novel written with the purpose of showing that in modern society the only solid element is money, and that all other things, such as virtue, affection, &c., are but a brittle ornamentation. He proves himself an accomplished analyst in both these works, and he seems to delight in revealing the sore places which are hidden by the brilliant trappings of the world of fashion.

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M. Maurice Barres (born 1862) began by two books Sous V oe.il des Barbares and JJ)i homme libre, wliicli are devoted to the psychology of his own personality : in both he reveals himself as a writer of exquisite prose; but they suffer from the defect of being almost entirely unin- telligible. In Le Jarclin de Berenice we find the same qualities, and with a considerable attenuation the same defect. In JDu Sang, de la Mort, et de la Volupte, a work of singular inequality, the obscurity has entirely disap- peared ; impressions of certain landscapes and places are rendered with a wonderful delicacy, and the book abounds in passages of great beauty. Les Diracinis (1898) marks a fresh and a greater transformation. The book is a vehement protest against the dangers of individualism ; unfortunately the interest awakened by its social theories is somewhat lessened by a want of cohesion in the con- struction. The book, however, is not only exceedingly interesting, but entirely human.

M. Anatole France (born 1844) has written novels, but can scarcely be called a novelist. He lacks the necessary qualities of invention and logical sequence ; it is repug- nant to his temperament to construct a plot ; his novels follow his wayward fancy, and his characters talk more than they act. In Le Lys Rouge (1894) he attempts the psychological novel, but it differs from other works of the kind ; for while it is perhaps inferior as a novel, it is far superior as a piece of literature ; the characters, who are essentially alive, interest us more by what they say than by what they do. It is the deep philosophy and the liquid and inimitable style which interest and enchant us ??? that is to say, M. France himself, the showman more than the puppets. In 1897 M. France published the first volume of his Histoire Contemporaine, L' Orme du Mail, which has been followed by three other volumes, in which he invented a new form of novel, a novel without a plot, which enables him to study contemporary life from every side and aspect. Each volume of this series (Le Mannequin d' Osier, L'A7ineau d'AmMhyste, Monsieur Bergeret (\ Paris) is a masterpiece of

satire and irony, and exhibits the cunning candour, the captivating ‘grace and witchery which distinguish M. France’s style.

A small group of novelists chose country life as their exclusive field of observation. Of these the most impor- tant are M. Ferdinand Fabre (1830-1898) ; M. L^on Cladel (born 1835), author of Le Bouscassii, La F&te votive de Saint Bartholomie Porie-Glaive, and L’Homme de la Croioo-aux-Boeufs ; M. ??mile Pouvillon (born 1840), a writer of exquisite pastorals {Cisette, Jean de Jeanne, and Petites Ames) ; and M. Andre Theuriet (born 1833), author of Sauvageonne, Les Mauvais Minages, and Dans les Roses, a delicate painter of provincial life and manner.

Among women authors, by far the most talented is the inimitable ” Gyp ” (Countess de Martel de Janville ; born 1850), the modern Lucian, whose dialogues are unsur- passed for lightness of touch and sharpness of observa- tion. Her masterpieces in this form remain Autour dn Mariage (1883) a.nd Autour du Divorce (1886), but she has also shown herself an accomplished novelist in Le Mariage de Chiffon (1894) and in Bijou (1896).

The most notable of the followers of “Gyp” in the line of light dialogue and sharp observation is Marie Anne de Bovet, author of Roman de Femmes (1895) and Petites Rosseries (1898).

M. Eene Bazin (born 1853), who belongs in reality to the old Idealist school, published De toute son Ame (1897). His best work is La Terre qui meurt (1899).

Criticism. ??? In the domain of criticism the period which begins in 1880 is still overshadowed by the great names of Renan, Taine, and in a lesser degree of Edniond Scherer (1815-1889). M. Sarcey continued from the year 1869 to 1900 to contribute his theatrical criticism

to the newspaper Le Temps with unbroken regularity ; but the true representatives of criticism during the period are MM. Brunetiere, Anatole France, P. Bourget, and Jules Lemaitre. M. Lemaitre (born 1853) together with M. France (born 1844) were the initiators of the subjective

Impressionist school of criticism, which must be traced immediately to the influence of Eenan and ultimately to that of Montaigne. MM. France and Lemaitre laid down the principle that impersonal and objective criticism did not exist, and that criticism was nothing else but the record of the adventures of the soul among masterpieces. The value of criticism of this kind varies with the value of the critic who prac- tises it ; in the case of MM. Lemaitre and France it is hardly necessary to say that its value is consequently very great. M. Lemaitre, who was for some time dra- matic critic to the Journal des Dibats, went over in that capacity to the Revue des Deux Mondes in 1895 ; in 1898 he deserted dramatic criticism altogether, and devoted himself to political work. Dramatic criticism was, in the case of M. Lemaitre, a pretext for vn-iting moral essays ; and his collected articles on theatrical matters (published in ten volumes of Impressions de Thidtre) are in reality deeply interesting and subtle studies of contemporary society. His Contemporains (essays on writers who have become famous since 1870) have the same character. The impressions of books and plays which he gives to us with such apparent neg- ligence have a philosophic value which results from the acuteness and subtlety of his intelligence and his incredible agility of mind ; and his style has the su- preme quality of perfect naturalness and ease, where all effort is either absent or concealed. Besides his critical work M. Lemaitre has written plays {Sirinus and Myrrha) and two volumes of exquisitely graceful short stories. M. Anatole France's critical work is contained in the four volumes of La Vie Litteraire. These volumes form in reality a Journal intime ???z, sen- timental journey through the world of books ; they are distinguished by the same intensely personal and magi- cally graceful style that characterizes M. France's work in another field.

M. ??mile Faguet (born 1847), since 1876 professor at the Sorbonue, a disciple of Tame, has written four vol- umes on the four literary centuries of France, in which he reveals a great power of analysis. He succeeded M. Lemaitre as dramatic critic to the Journal des Dibats. He has also published two volumes of Politiques et moralistes des XlXihne siMe.

M. Rene Doumic, the literary critic of the Revue des Deux Mondes, is a polemical writer, endowed with keen intelligence and an incisive style ; he has already pro- duced much brilliant work, notably four volumes of

Etudes siir la littirature Frangaise, 1896, 1897-1900. Por- traits d'JScrivaiiis and Ecrivains d'aujourdhui ___ Les Jeunes

(1895).

History. ___ From 1880 to the present day the three greatest names in French historical writing are Eenan, Taine, and Fustel de Coulanges. The younger gener- ation is divided into two schools: M. Thureau-Dangin remains faithful to classical traditions ; M. Sorel is a dis- ciple of Taine ; the remaining historians seem to aim at a compromise between the two schools. The follow- ing is a list of, the most important : Due de Broglie (1821-1901) ___ L'Eglise ei V Empire Romain an IVihne siMe (1856-66), Le Secret du Roi (1878), Frederic II. et Louis XV. (1884), Marie Therise Imperatrice (1888) ; Gas- ton T.oissier (born 1823) ; __mile Ollivier (born 1825) ___ ie 19 Jqnvier(18G9),LeMinist^re du2 Janvier (1S7 5), L'Eglise et VEtat cm Concile du Vatican (1878), F Empire Liberal (1894) ; Thureau-Dangin (born 1837) ___ Un homme d'autre-

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fois, L'histoiredelaMonarchiedeJuillet (1886-92) ; Ernest Lavisse (born 1843) ___ Etudes sur I'histoirede Prusse (1879), Vue Ohiirale de Vhistoire politique de I'Europe (1890), La Jeunesse du Grand Fridiric (1891), Le Grand Frideric avant Vavinement (1893) ; Albert Sorel (born 1842) ___ Histoire diplomatique de la guerre Franco- Allemande (1876), La question d'Orient au XVIIIi^me siMe (1877), L' Europe et la Revolution Frangaise (1885-92) ; Henry Houssaye (born 1S4:S) ___ Histoire d'Aldbiade (1873) ; I8I4: Histoire de la campagne de France (1888) ; 1815 : &c. (1893) ; Waterloo (1899) ; Gabriel Hanotaux (born 1853) ___ Histoire de Richelieu (1893-96) ; Albert Vandal (born 1853) ___ L' alliance mise sous Napoleon (1891-96).

Le Vicomte Melchior de Vogue (born 1848) must be classed among historians, although he is at the same time an essayist and a philosopher. It was he who revealed the modern Russian novelists (Tolstoi, Tourgeneff, Dos- toiewski) to the French public. His Souvenirs et Visions, Regards historiques, and Devant le Siicle contain brilliant studies of foreign literature, ancient and modern, historical studies, and criticisms of contemporary French literature. He has many points of resemblance to Chateaubriand, both in his imaginative power and his brilliant and poetic style.

Conclusion. ??? French literature in the later half of the 19th century could not boast of a constellation of poets such as those who were the pride and glory of the Romantic period ; on the other hand, the balance is weighed down by two of the greatest men of genius that the century pro- duced in Europe ??? Taine and Renan. Apart from his monumental historical achievement, M. Renan's incom- parable style, with its unstudied grace, its inevitable per- fection, its complete harmony between the idea and the expression, entitles him to the rank of the greatest prose writer of the century. There is nothing in this epoch, it is true, to equal the vast and many-stringed lyre of Victor Hugo, the lyrical passion of Musset, the seraphic organ- music of Lamartine, the great solemn echoes that fell from the ivory tower of Alfred de Vigny. Yet if we review the last half-century we can reckon three great poets ??? Baudelaire, Banville, and Leconte de Lisle ; and in the work of Leconte de Lisle, and in that of his most brilliant disciple, M. de Heredia, we have examples of a lofty poetic vision, combined with an absolute perfection of technique ??? rhymes and verses which truly seem to be of gold. Besides these four prominent names there re- main the delicate poetry of M. Sully Prudhomme, which follows more or less the traditional lines of French poetry, but joins to grace of diction an austere pensiveness, and the genius of Paul Verlaine, a lyric poet of the first order, who departs so far from the path of tradition that, since all things move in a circle, he can only be compared to the earliest French lyrists. In the poetry of Verlaine we are aware of a new note of pure lyricism without any admixture of rhetoric, a note that is like an " unbodied

joy-"

Turning to writers of fiction, if we embrace the period 1850-1900 in our review, the genius of Gustave Flaubert overshadows all other writers ; if we confine ourselves to the Third Republic, we can count at least three writers of genius ??? Zola, Daudet, and Maupassant; and in addition to these, two whom it is impossible to classify in any definite category, so original and so personal is their ex- quisite art ??? M. Pierre Loti and M. Anatole France, who have both of them contributed invaluable jewels to the treasure-house of French literature.

In the region of criticism no period has ever been more fertile, and the historians of the early part of the century have found worthy successors in Fustel de Coulanges, Thureau-Dangin, and Albert Sorel.

In the domain of the theatre we have had a renascence

of poetical drama, of which M, Rostand is the most pro- minent exponent, and the appearance of a whole group of writers of subtle, delicate, and powerful dramas and come- dies, such as Lemaitre, Donnay, Hervieu, Porto-Riche, Lavedan, and Franqois de Curel.

On the whole, the French literature of the second half of the 19th century can be said to rival in greatness and importance that of the first fifty yeats, and to claim a no less close examination from the comparative student of literature.

For French Drama and Art, see Drama and Schools of Painting. (m. Ba.)

France, Anatole (1844-

~~), French critic, es~~ sayist, and novelist (whose real name is Jacques Ana- tole Thibault), was born in Paris on the 16th April 1844. His father was a bookseller, one of the last of the booksellers, if we are to believe the Goncourts, into whose establishment men came, not merely to order and buy, but to dip, and turn over pages, and discuss. M. France himself speaks of the pleasure with which, as a child, he used to listen to the nightly talks on literary subjects which took place in his father's shop. Nurtured in an atmosphere so essentially bookish, he turned naturally to literature. In 1868 his first work appeared, a study of Alfred de Vigny, a

poet whom many lovers of French poetry regard with a quite peculiar affection. A volume of verse followed in 1873, Les Poemes dor&s, dedicated to Leconte de Lisle, and, as such a dedication suggests, an outcome of the " Parnassian " movement ; and yet another volume of verse appeared in 1876, Les Noces Gorinthiennes. But the poems in these volumes, though unmistakably the work of a man of great literary skill and cultured taste, are scarcely the poems of a man with whom verse is the highest form of expression. He was to find his richest vein in prose. And his prose is exquisite. He himself, avowing his preference for a simple, or seem- ingly simple, style as compared with the artistic style, vaunted by the Goncourts ??? a style compounded of neo- logisms and "rare" epithets, and startling forms of ex- pression ??? observes : "A simple style is like white light. It is complex, but not to outward seeming. In language, a beautiful and desirable simplicity is but an appearance, and results only from the good order and sovereign economy of the various parts of speech." And thus one may say of M. France's own style that its beautiful translucency is the result of many qualities ??? felicity, grace, the harmonious grouping of words, a perfect measure. M. France is a sceptic. The essence of his philosophy, if a spirit so light, evanescent, elusive, can be said to have a philosophy, is doubt. He is a doubter in religion, metaphysics, morals, politics, aesthetics, science ??? a most genial and kindly doubter, and not at all without doubts even as to his own negative conclusions. Sometimes M. France's doubts are expressed in his own person ??? as in the Jardin d'Epicure, from which the above extracts are taken, or Le Livre de mon Ami, which may be accepted, perhaps, as partly autobiographical ; sometimes, as in La Rdtisserie de la Reine Pedauque, and Les Opinions de M. Jirome Coignard, or L'Orme du Mail, Le Mannequin d' Osier, and L'Anneau d' Amithyste, he entrusts the expression of his opinions, dramatically, to some fictitious character, ??? the Abbe Coignard, for instance, projecting, as it were, from the 18th century some very effective criticisms on the popular political theories of contemporary France ??? or the M. Bergeret of the three last-named novels, dealing in similar wise with some modern problems, and particularly, in L'Anneau d' Amithyste, with the humours and follies of the anti-Dreyfusards. All this makes a piquant com- bination. Nor should reference be omitted to works

more distinctly of fancy, such as Balthasar, the story of one of the Magi, or Thais, the story of an actress and courtesan of Alexandria, whom a hermit converts, but with the loss of his own soul. Lightly as M. France bears his erudition, it is very real and extensive. As a critic ??? see the Vie Litteraire, reprinted mainly from Le Temps ??? he is graceful and appreciative. Academic in the best sense, he has found a place in the Acadimie Frawpise, taking the seat vacated by Lesseps. He was received into that august body on the 24th December 1896. In the affaire Dreyfus he sided with M. Zola.

Francis Joseph I., Empekoe of Austria, king of Bohemia, &c. &c., and apostolic king of Hungary

(1830), born 18th August 1830, was the eldest son

of the Archduke Francis Charles, second son of the reign- ing emperor Francis I. His mother, the Archduchess Sophie, was daughter of Maximilian I., king of Bavaria. She was a woman of great ability and strong character,

Thk Emi'Eror Fkancis Joseph I.

and during the years which followed the death of the Emperor Francis was probably the most influential personage at the Austrian Court ; for the Emperor Ferdinand, who succeeded in 1835, was physically and mentally incapable of performing the duties of his office ; as he was childless, Francis Joseph was in the direct line of succession. During the disturbances of 1848 he spent some time in Italy, where, under Eadetzky, at the battle of St Lucia, he had his first experience of warfare. At the end of that year, after the rising of Vienna and capture of the city by Windischgratz, it was clearly desirable that there should be a more vigorous ruler at the head of the empire, and Ferdinand, now that the young archduke was of age, was able to carry out the abdication which he and his wife had long desired. All the preparations were made with the

utmost secrecy ; on 2nd December 1848, in the archiepiscopal palace at Olmtltz, whither the Court had fled from Vienna, the emperor

abdicated. His brother, the archduke, resigned his rights of succession to his son, and Francis Joseph was pro- claimed emperor. Ferdinand retired to Prague, where he died in 1876. The new emperor was naturally during the first years of his reign completely in the hands of Prince Felix Schwarzenberg, to whom, with Windischgratz and Eadetzky, he owed it that Austria had emerged from the revolution apparently stronger than it had been before. The first task was to reduce Hungary to obedience, for the Magyars, who refused to acknowledge the act of 2nd December, at which they had not been represented, pro- claimed a republic. In the war which followed the emperor himself took part, but it was not brought to a successful conclusion till the help of the Eussians had been called in. ‘ The new reign began, therefore, under sinister omens, with the suppression of liberty in Italy, Hungary, and Germany. In 1853 a Hungarian named Lebenyi attempted to assassinate the emperor, and suc- ceeded in inflicting a serious wound with a knife. With the death of Schwarzenberg in 1852 the personal govern- ment of the emperor really began, and with it that long series of experiments of which Austria has been the sub- ject. Generally it may be said that throughout his long reign he has been the real ruler of his dominions ; he has kept in his hands not only the appointment and dismissal of his ministers, but has himself directed their policy, and owing to the great knowledge of affairs, the unremitting diligence and clearness of apprehension, to which all who have transacted business with him have borne testimony, has been able to keep a very real control even of the details of government. The in- troduction of parliamentary government in 1866 neces- sarily made some change in his position, and so far as concerns Hungary he fully accepted the doctrine that ministers were responsible to parliament. In the other half of the empire this has not been possible (see the arti- cle on Austria), and the authority and influence of the emperor have been even increased by the contrast with the weaknesses and failures of the parliamentary system. The most noticeable features in his reign have been the repeated and sudden changes of policy, which, while they arise from the extreme difiiculty of finding any system by which the empire can be governed, also are due to the personal idiosyncrasies of the emperor. First we have

autocratic centralization under Bach ; the personal influence of the emperor is seen in the conclusion of the Concordat with Eome, by which the work of Joseph II. was undone and the full power of the Papacy restored. The foreign policy of this period brought about the complete isolation of Austria, and the "ingratitude" towards Eussia, as shown during the period of the Crimean War, which has become proverbial, caused a permanent estrangement between the two great Eastern empires and the imperial families. The system led inevitably to bankruptcy and ruin; the war of 1859, by bringing it to an end, saved Austria. After the first defeat Francis Joseph hastened to Italy ; he commanded in person at Solferino, and by a meeting with Napoleon arranged the terms of the peace of Villafranca. The next six years, both in home and foreign policy, were marked by great vacillation. In order to meet the universal discontent and the financial difficul- ties constitutional government was introduced ; a parlia- ment was established in which all races of the empire were represented, and in place of centralized despotism was established Liberal centralization under Schmerling and the German Liberals. The opposition of the jSLagj'~~ars and Slavs continued, and the emperor had really with~~ drawn his confidence from Schmerling long before the Constitution was suspended in 1865 as a first step to a reconciliation with Hungary. In the complicated German

affairs the emperor in vain sought for a minister on whose knowledge and advice he could depend. He was guided in turn by the inconsistent advice of Schmerling, Rech- berg, Mensdorff, not to mention more obscure counsellors, and it is not surprising that Austria was repeatedly out-matched and outwitted by Prussia. In 1863, at the Flirsten Tag in Frankfurt, the emperor made an interest- ing attempt by his personal influence to solve the German

question. The origin of the plan is still obscure. He invited all the German rulers to meet him in conference, and before them he laid a plan for the reform of the Con- federation. The eifect of the movement was immense ; he seemed for a moment to have regained the position in Germany which

his ancestors had held. He was welcomed to the ancient free city with enthusiasm. He himself presided at the discussions, and all the princes celebrated

Francis I.

Duke of Lorraine and Emperor,

170&-1765.

Maria Theresa,

Archduchess of Austria,

Queen of Hungary,

1717-1780.

Joseph II.,

Emperor,

1741-1790,

o.s.p.

Leopold II., Duke of

Tuscany and Emperor,

1747-1792.

Marie Antoinette,

1755-1793

Louis XVI., King of France.

3 other daughters.

I

Maximilian,

Elector of

Cologne,

1756-1801,

o.s.p.

Ferdinand, = Marie d'Este,

1754-1806.

Duchess of Modena.

Francis IV.,

Duke of Modena,

1779-1846.

Francis I.,

Emperor of

Austria,

1768-1835.

r

Ferdinand

III.,

Grand-Duke

of Tuscany,

1769-1824.

I

Karl,

1771-1847.

Leopold,

1772-1795.

John,

1782-1859.

Joseph,

1776-1847.

Ludwig,

1784-1864,

o.s.p.

Raiuer,

1783-1856.

Rudolf, Archbp. of

Olmiitz,

1788-1831,

o.s.p.

Leopold II.,

Grand-Duke

of Tuscany,

1797-1870.

I

4 sous,

4 daughters.

12 children

Albrecht,

1817-1895.

Karl Ferdinand.

2 sons, 2 daughters.

3 sons, 2 daughters.

2 daughters. 3 sons,

2 daughters.

Henrietta

Leopold II.,

King of the

Belgians.

5 sons, ! daughters.

Maria Christina

Alfonso, King of Spain.

Ferdinand L,

Emperor of

Austria,

1793-1875,

o.s.p.

Francis Charles, = Sophie, 4 daughters. Napoleon

1802-1878,

daughter of

Maximilian I.

of Bavaria.

I. = Marie L(

lOUise, Duchess of

Parma,

1791-1847.

I

Francis V.,

Duke of

Modena,

1819-1875,

o.s.p.

Ludwig,

son 01 Luitpold,

Prince Regent of Bavaria.

Ferdinand,

1821-1849.

= Maria Theresa,

1849 .

Due de Reichstadt, 1811-1832, o.s.p.

3 sons, 7 daughters.

Francis Joseph, = Emperor of Austria,

1830 .

Elizabeth, duchess In Bavaria.

Maximilian, = Charlotte,

Emperor of daughter of

Mexico, Leopold I.,

1832-1867, King of the

o.s.p. Belgians.

Charles Ludwig,

1833-1896.

Ludwig Victor,

1842.

Rudolf,

1858-1889.

= Stephanie,

daughter of

Leopold II.,

King of the

Belgians.

Gisela,

1856.

Elizabeth,

1883.

Leopold, son of

Luitpold, Prince

Regent of

Bavaria.

Marie Valerie, =

1868.

Archduke Franz

Salvator, grandson of Leopold II., Grand-Duke of Tuscany.

I

Franz

Ferdinand,

1863.

Otto, = Maria

1865.

Elizabeth, Augustine, George, Conrad,

1874. 1875. 1880. 1883.

Elizabeth, Francis 1892. Charles

Salvator,

1893.

Josephe

of Saxony.

Ferdi- nand,

1868.

3 daughters.

Hubertus, He(

1894. 1896.

id wig.

Charles Maximilian

Francis Eugen

Joseph, Ludwig,

1887. 1895.

Table showing the Descent op the Habsburg-Lokraine Dynasty.

the skill which he showed in the conduct of the debate ; but the attempt failed, for the king of Prussia refused the invitation. The war with Prussia in 1866 was not of his seeking ; he took no part in the campaign, but by a sud- den resolution after the battle of Koniggratz telegraphed to Napoleon asking for his mediation, and offering him Venetia. The defeat made the reconciliation with Hun- gary, which the emperor had long desired,

necessary. Dedk was summoned to Vienna, and in a personal inter- view with the emperor explained the demands of the

Magyars. At last the mistakes with which the reign was opened were repaired; Beust was appointed minister, and in 1867 the emperor and empress were solemnly crowned at Buda-Pest with the crown of St Stephen. (For the later history we must refer to the article on Austria-Hun gaey.) The influence of the emperor is to be seen first in the loyal adhesion to the constitutional system which he himself in- augurated. There is probably no other instance in history of a ruler, brought up as he was in the strictest school of abso- lute government, accepting without reserve the restrictions

of parliamentary government, notwithstanding the great discouragement caused by the party struggles.

The emperor has also shown his desire to reconcile the Slavs to the crown as he did the Magyars ; but though he has on more than one occasion held out hopes that he would be crowned king of Bohemia, the project has always been abandoned. In 1869 and 1870 he showed his pru- dence by refusing to be led into a war of revenge against Prussia, and in later years he fully accepted the recon- ciliation with Germany and Italy, the two Powers which were built up on the defeat of Austria ??? *~~in this, as in internal affairs, refusing to allow prejudices, which would have been only natural for a man in his position, to influ~~ ence his policy. He has therefore become one of the chief elements in the system on which the peace of Europe depends, just as in the government of his own dominions it is his personal influence which alone is able to main- tain some authority over the parties and races, the discord of which threatens the disruption of the empire.*

In his private life the emperor has been the victim of terrible catastrophes ??? *his wife, his brother, and his only son having been destroyed by sudden and violent deaths. He married in 1854 Elizabeth, daughter of*

Maximilian Joseph, duke in Bavaria, who belonged to the younger and non-royal branch of the house of Wittelsbach. The empress, who shared the remarkable beauty common to all her family, took little part in the public life of Austria. After the first years of .married life she was seldom seen in Vienna, and spent much of her time in travelling. She built a castle of great beauty and magnificence, called the Achilleion, in the island of Corfu, where she often resided. In 1867 she accompanied the emperor toBuda-Pest, and took much interest in the reconciliation with the Magyars. She became a good Hungarian scholar, and spent much time in Hungary. An admirable horsewoman, in later years she repeatedly visited England and Ireland for the hunting season. In 1897 she was assassinated at Geneva by an Italian anarchist; previous attempts had been made on her and her husband's life during a visit to Trieste. There was one son of the marriage, the Crown Prince Rudolph (1857-1889). A man of much ability and promise, he was a good linguist, and showed great interest in natural history. He published two works. Fifteen Days on the Danube, and A Journey in the East, and also promoted the publication of an important illus- trated work giving a full description of the whole Austro- Hungarian monarchy ; he personally shared the labours of the editorial work. In 1881 he married Stephanie, daughter of the king of the Belgians. On 30th January 1889 he committed suicide at Mayerling, a country house near Vienna. He left one daughter, Elizabeth, who was betrothed to Count Alfred Windischgratz in 1901. In 1900 his widow, the Crown Princess Stephanie, married Count Lonyay ; by this she sacrificed her rank and position within the Austrian monarchy. Besides the crown prince, the empress gave birth to three daughters, of whom two survive: Gisela (born 1857), who married a son of the prince regent of Bavaria; and Marie Valerie (born 1868), who married the Archduke Franz Salvator of Tuscany.

Owing to the compo.site nature of the A ustro- Hungarian monarchy the person of the reigning monarch and all questions connected with the succession have a more fundamental importance than in other States, for it is by the dynasty alone that the empire is bound together. The rules of succession are determined by the Pragmatic Sanction and by the family code of the arohducal house of Austria, by which, as in other German princely families, women are excluded from the succession so long as

there are any male heirs. The table on page 50.‘5 shows the descent of the different branches of the family from the Emperor Francis and Maria Theresa, the founders of the present dynasty of Habsburg-Lorraine. In default of heirs- male of the present emperor the succession will go to his brother. The next brother, the Archduke Ferdinand, accepted the position of emperor of Mexico, and was shot by the Mexicans in 1867. The

fourth brother is unmarried. The third brother, Karl Ludwig (died 1895), left three sons. The eldest, Franz Ferdinand, is therefore heir-presumptive. On the death of Francis V., last duke of Modena, without male issue, the emperor assumed the title of duke of Modena, and the Archduke Franz Ferdinand, who inher- ited the great wealth of the family of Este, assumed the style of archduke of Austria^Este. If he succeed to the empire the Este possessions will pass to his second brother. It will be remembered that the duchy of Modena was annexed to the kingdom of Italy in 1859, so that the family is no longer reigning. The title and pos- sessions came into the house of Austria by the marriage of the Archduke Ferdinand with the heiress of the house of Este in 1777. It is Maria of Modena, the only daughter of the last duke of Modena (married to a son of the prince regent of Bavaria) , who is regarded by some as the direct representative of the house of Stewart. In 1900 the Archduke Franz Ferdinand married the Countess Sophie Chotek, who received the title of princess of Hohenberg. As the countess is not of equal birth, the archduke, before the marriage took place, had to take an oath recognizing that, in virtue of the family code, any children of the marriage would be incapable of succession. A large party in the Hungarian parliament contended, however, that the conception of a morganatic marriage was unknown in Hungary, and that therefore this was an arbitrary and illegal alteration in the law of succession. To meet this a special law was carried through the Hungarian Diet declaring the children excluded from the succession to the throne of Hungary.

The grand-duchy of Tuscany, which was originally acquired by the house of Lorraine in exchange for the duchy of Lorraine, which was annexed to France, was generally held by a younger branch of the family. The duchy was in 1859 annexed to the kingdom of Italy. A son of Leopold II., the last reigning duke, was the Archduke JoHANN Nepomuck Salvator (bom

1852). He attained a high position in the Austrian army, and was the author of several works on military affairs. The opinions expressed in these accentuated differences which had arisen between him and the military author- ities, especially the Archduke Albrecht. In 1887 he retired from active service ; in 1889 he resigned all rights and titles which be- longed to him as archduke, and under the name of John Orth as- sumed the command of a sailing-vessel. He was probably lost at sea during a voyage from Buenos Aires to Valparaiso in 1896.

Franck, Cesar (1822-1890), French musical com- poser, was born at Liege, 10th December 1822. Though one of the most remarkable of modern composers, Cesar Franck laboured for many years in comparative obscu- rity. After some preliminary studies at Liege he came to Paris in 1837 and entered the Conservatoire, obtaining the prize for the organ in 1841, after which he settled down in the French capital as teacher of the piano. His earliest compositions date from this period, and include four trios for piano and strings, besides several piano pieces. Ruth, a biblical cantata, was produced with suc- cess at the Conservatoire in 1846. An opera entitled Le Valet de Ferme was written about this time, but has never been performed. For many years Franck led a retired life, devoting himself to teaching and to his duties as organist, first at Saint-Jean-Saint-Franqois, then at Ste Clotilde, where he acquired a great reputation as an improviser. He also wrote a mass, heard in 1861, and a quantity of motets, organ pieces, and other works of a religious character. Franck was appointed professor of the organ at the Paris Conservatoire in 1872, and the following year he was naturalized a Frenchman. Until then he was esteemed as a clever and conscientious musician, but he was now about to prove his title to something more. A revival of his early oratorio, Ruth, had brought his name again before the public, and this was followed by the production of Redemption, a work for solo, chorus, and orchestra, given under the direction of M. Colonne on 10th April 1873. The serious character of the music and its unconventionality perhaps rather disconcerted the general public, but the work nevertheless made its mark, and Franck became the central figure of an enthusiastic circle of pupils and adherents whose devotion atoned for the comparative indifference of the masses. His creative power now manifested itself in a series of works of varied kinds, and the name of Franck began gradually

to emerge from its obscurity. The fol- lowing is an enumeration of his subsequent compositions :

Rebecca (1881), a biblical idyll for solo, chorus, and orchestra ; Les Beatitudes, an oratorio composed between 1870 and 1880, perhaps his greatest work ; the symphonic poems, Les Bolides (1876), Le Chasseur Maudit (1883), Les Djinns (1884), for piano and orchestra; Psyche (1888), for orchestra and chorus ; symphonic variations for piano and orchestra (1885) ; symphony in D (1889) ; quintet for piano and strings (1880) ; sonata for piano and violin (1886) ; string quartet (1889) ; prelude, choral and fugue for piano (1884) ; prelude, aria and finale for piano (1889) ; various songs, notably " La Procession " and " Les Cloches du Soir." Franck also composed two four-act operas, Hulda and Ghiselle, both of which were produced at Monte Carlo after his death, which took place in Paris, 9th November 1890. The second of these was left by the master in an unfinished state, and the instrumentation was completed by several of his pupils. Cesar Pranck's influence on the younger French composers of the present has been very great. Yet it is impossible to accept him as a typical representative of French music. A Belgian by birth, he came of German stock, and heredity in this instance undoubtedly asserted itself. A more sincere, modest, self-respecting composer probably never existed. In the centre of the brilliant French capital he was able to lead a laborious existence conse- crated to his threefold career of organist, teacher, and composer. He never sought to gain the suffrages of the public by unworthy concessions, but kept straight on his path, ever mindful of an ideal to be reached and never swerving therefrom. His compositions are not likely ever to obtain popularity in the widest sense of the word, but their great qualities of originality and nobility will cause them to be more and more prized by musicians. It may be said that several of the more prominent French composers of our day learned the practice of their art under Cesar Franck. (a. he.)

Franeker, a ISTetherlands town, in the province of Friesland, 10 miles west of Leeuwarden, on the Harlingen- Leeu warden railway. It is at the junction of many roads and waterways, and has a considerable market for agri- cultural produce, butter, cheese, and flax. It has also potteries and shipbuilding yards. Population (1900),

7114.

Frankfort, capital of Clinton county, Indiana, U.S.A., 40 miles from Indianapolis, at an altitude of 857 feet. It is at the intersection of the Chicago, Indiana- polis, and Louisville, the Lake Erie and Western, the Toledo, St Louis and Kansas City, and the Vandalia railways. Population (1880), 2803; (1890), 5919; (1900), 7100, of whom 144 were foreign-born, and 90 negroes.

Frankfort, capital of Franklin county, Kentucky, U.S.A., and the capital of the State, on the Kentucky river, at an altitude of 560 feet. It has three railways, the Chesapeake and Ohio, the Louisville and Nashville, and the Frankfort and Cincinnati. Population (1880), 6958; (1890), 7892; (1900), 9487, of whom 266 were foreign-born, and 3316 negroes.

Frankfort-on-Main, a town of Prussia, province Hesse-Nassau, standing on the right bank of the Main, 24 miles above its confluence with the Rhine at Mainz. Since 1899 Frankfort has been the headquarters of the 18th German Army Corps. The restoration of the cathedral, begun in 1869, was finished in 1890. The church of St Leonhard was restored in 1882. The most noteworthy of the new churches are St Peter's (1893-95), in the North German Eenaissance style, with a tower 2o6 feet high, standing north from the Zeil ; Christ church (1883); and the Luther church (1894). A new

synagogue was built in 1881. Several of the old houses incorporated in the Homer, and the Romer itself, were restored during the years 1888-98. The Judengasse, down to 1806 the sole Jews' quarter, has been pulled down, with the exception of the ancestral house of the Eothschild family, which has been restored and retains its ancient facade. The Thurn-und-Taxis Palace is incor- porated with the imposing pile of the post-office, a new building of 1892-94, with a monument of the Emperor William I.

(1895) in front of it. In the same quarter, i.e., north of the Zeil, are the Exchange (1879), with a commercial museum, and the law courts (1884-89), in the German Eenaissance style. The municipal library, which now contains some 215,000 volumes, was enlarged and rebuilt in 1891-93. The fine bridge, originally used by the Main-Neckar railway, has been given over to road traffic, and two new iron bridges at Gutleuthof and Niederrad carry the railway traffic from the south to the north bank of the Main, where all lines con- verge in a central station of the State railways. This station, which was built in 1883-88, and has replaced the three stations belonging to private companies which stood in juxtaposition on the Anlagen near the Mainzer Thor, lies some half-mile to the west. The intervening ground upon which the railway lines and buildings stood was sold for building sites, the sum thus obtained being more than sufficient to cover the cost of the majestic central station, which, in addition to spacious and handsome halls for passenger accommodation, has three glass-covered spans of 180 feet width each. The so-called Leinwand-Haus, a 14th-century building, reconstructed in 1892, contains a valuable historical museum and the town archives. Behind the Goethe ~~Haus was opened in 1897 the Goethe Museum, together with a library of some 20,000 volumes, representative of the Goethe period of German literature. There may also be men~~ tioned the industrial art exhibition of the Polytechnic Association; two conservatories of music; Schopenhauer's house, on the Main side ; monuments to Schopenhauer (1895), the Emperor William I. (1896), and Clemens Brentano; a commercial high school (1901) and a com- mercial museum ; technical improvement, higher in- dustrial, industrial art, commercial, and other schools ; and a large number of banks. In 1891 the International Electro-Technical Exhibition was held here. Of recent years, Frankfort, or rather Sachsenhausen (on the left bank of the Main) and Bockenheim have developed con- siderable industrial activity, especially in publishing and printing, brewing, and the manufacture of quinine. Other sources of employment are the cutting of hair for making hats, the production of fancy goods, type, machinery, soap and perfumery, ready-made clothing, chemicals, electro-technical apparatus, and metal wares. Market-gardening is extensively carried on in the neigh- bourhood, and Frankfort itself is a seat of floriculture. Cider is extensively manufactured. Here is a trade arbitral tion court, for the settlement of

disputes arising out of labour contracts. Since the completion of the canaliza- tion of the Main past the town the trade of Frankfort, especially the transit trade, has largely increased. A total of 4103 vessels of 1,560,700 tons entered and cleared together by river in 1898. Population (1885), 154,513 ; (1890), 179,985; (1895), 229,279; (1900), 288,489. In 1895 the town of Bockenheim was incorporated in Frank- fort-on-Main. Old Frankfort life is described in Goethe's Wahrheit und Dichtung and in Heine's Habbi von JBacharach. See also the series of plates entitled Frank- furt, die freie Stadt, in Bauwerhen und Strassenbildern, by Eeiffenstein (Frankfurt, 1894-98), and Dietz, Frank- furter Biirgerbuch, geschichtliche Mitteilungen (ib. 1896).

(j. T. BE.)

S. IV. ❓❓❓64

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FRANKFOET-ON-ODEE ❓❓❓FRANKLIN

Frankfort-on-Oder, a town of Prussia, on the Oder, 50 miles E.S.E. of Berlin, capital of the govern- ment district of Frankfurt, province of Brandenburg; a railway centre to Berlin, Breslau, Ctistrin, Posen, &c. There are Evangelical, Reformed, and Catholic churches ; and among the schools are a higher grade girls', with a seminary for female teachers, and 9 Evangelical schools. A new stone bridge, 855 feet long, spanning the Oder, connects the town with the suburb of Damm. There is a monument of the Franco-German war (1882), and one to Prince Frederick Charles (1888). A workshop of the Lower-Silesian and Brandenburg railway employs over 800 workmen. Trade has suffered from the decline of the three fairs and the neighbourhood of Berlin. Population

(1890), 55,738 ; (1900), 61,572.

Frankland, Sir Edward (1825-1899), English chemist, was born at Churchtown, near Lancaster, on 18th January 1826. After attending the grammar-school at Lancaster he studied chemistry, first in London and

then in the laboratories of Liebig at Giessen and Bunsen at Marburg. From an early age he engaged in original research with great success, proving himself an experi- mentalist of exceptional brilliancy. Analytical problems, such as the isolation of certain organic radicals, attracted his attention to begin with, but he soon turned to synthetical studies, and he was only about twenty-five years of age when an investigation, doubtless suggested by the work of his master, Bunsen, on cacodyl, yielded the interesting discovery of the organo-metallic compounds which are formed by the direct combination of a metal with a positive organic radical. The theoretical deductions which he drew from the consideration of these bodies were even more interesting and important than the bodies themselves. Perceiving a molecular isonomy between them and the inorganic compounds of the metals from which they may be formed, he saw their true molecular type in the oxygen, sulphur, or chlorine compounds of those metals, from which he held them to be derived by the substitution of an organic group for the oxygen, sulphur, &c. In this way they enabled him to overthrow the theory of conjugate compounds, and they further led him in 1852 to publish the conception that the atoms of each elementary substance have a definite saturation capacity, so that they have only room, so to speak, for the attachment of a certain limited number of the atoms of other elements. The theory of valency thus founded has dominated the whole subsequent development of chemi- cal doctrine, and forms the groundwork upon which the fabric of modern structural chemistry reposes. In applied chemistry Frankland's great work was in connexion with water-supply. Appointed a member of the second Royal Commission on the Pollution of Rivers in 1868, he was provided by the Government with a completely-equipped laboratory, in which, for a period of six years, he carried on the inquiries necessary for the purposes of that body, and was thus the means of bringing to light an enormous amount of valuable information respecting the contaminar tion of rivers by sewage, trade-refuse, &c., and the purifi- cation of water for domestic use. In 1866, when he succeeded Hofmann at the Royal College of Chemistry, he undertook the duty of making monthly reports to the Registrar-General on the character of the water supplied to London, and these he continued down to the end of his life. At one time he was an unsparing critic of its quality, but in later years he became strongly con- vinced of its general excellence and wholesomeness. His analyses were

both chemical and bacteriological, and his dissatisfaction with the processes in vogue for the former at the time of his appointment caused him to spend two years in devising new and more accurate methods. In

1859 he passed a night on the very top of Mont Blanc in company with Tyndall, of whom he was for some years a colleague at the Royal Institution, where he succeeded Faraday as professor of chemistry in 1863. One of the purposes of the expedition was to discover whether the rate of combustion of a candle varies with the density of the atmosphere in which it is burnt, a question which was answered in the negative. Other observations made by Frankland at the time formed the starting-point of a series of experiments which yielded far-reaching results. He noticed that at the summit the candle gave a very poor light, and was thereby led to investigate the effect produced on luminous flames by varying the pressure of the atmosphere in which they are burning. He found that pressure increases luminosity, so that hydrogen, for example, the flame of which in normal circumstances gives no light, burns with a luminous flame under a pressure of ten or twenty atmospheres, and the inference he drew was that the presence of solid particles is not the only factor that determines the light-giving power of a flame. Further, he showed that the spectrum of a dense ignited gas resembles that of an incandescent liquid or solid, and he traced a gradual change in the spectrum of an incan-descent gas under increasing pressure, the sharp lines observable when it is extremely attenuated broadening out to nebulous bands as the pressure rises, till they merge in the continuous spectrum as the gas approaches a density comparable with that of the liquid state. An application of these results to solar physics in conjunction with Sir Norman Lockyer led to the view that at least the external layers, or photosphere, of the sun cannot consist of matter in the liquid or solid forms, but must be composed of gases or vapours. Frankland and Lockyer were also the discoverers of helium. In 1868 they noticed in the solar spectrum a bright yellow line which did not correspond to any substance then known, and which they therefore attributed to a hypothetical element, helium ; this some thirty years afterwards was actually proved by Professor W. Ramsay to exist on this earth. Sir Edward Frankland died on 9th August 1899, while on a holiday in Norway.

A memorial lecture delivered by Professor H. E. Armstrong be- fore the London Chemical Society on 31st October 1901 contained many personal details of Frankland's life, together with a full discussion of his scientific work. (h. m. E.)

Franklin, a town of Norfolk county, Massachusetts, U.S.A., with an area of 29 square miles of rolling surface. The principal village, which bears the same name as the town, is on the New England railway. Population of the town (1880), 4051 ; (1890), 4831 ; (1900), 6017, of whom 1250 were foreign-born.

Franklin, a city of Merrimack county, New Hamp- shire, U.S.A., on the Merrimack river and on the Boston and Maine railroad. It contains numerous small villages in which many minor manufactures are carried on. These villages are Franklin, Franklin Falls, Maplewood, "Webster Place, Shaw Corner, and Lake City. Population of the town (1880), 3265; (1890), 4085; (1900), 6846, of whom 1323 were foreign-born.

Franklin, capital of Venango county, Pennsylvania, U.S.A., on the Allegheny river, at an altitude of 988 feet. Four railways intersect here, the Allegheny Valley, the Erie, the Lake Shore and Michigan Southern, and the Western New York and Pennsylvania. The city is well sewered, and paved with brick. Franklin is in the oil region, and owes its origin and prosperity to that mineral. Among its manufacturing establishments, those for the refining of petroleum are prominent. Population (1880), 5010; (1890), 6221; (1900), 7317, of whom 489 were foreign-born, and 264 negroes.

Franks, Sir Augustus Wollaston (1826- 1897), English antiquary, was born on 20tli March 1826, and was educated at Eton and at Trinity College, Cam- bridge. From his boyhood he evinced a strong predilec- tion for antiquarian pursuits, and in 1 851 was appointed assistant in the Antiquities Department of the British Museum, a line of life in general but little affected by young men endowed like Franks with ample private

means. Here, and as Director of the Society of Anti- quaries, which appointment he received in 1868, he made himself the first authority in England upon mediaeval antiquities of all descriptions, upon porcelain, glass, the manufactures of savage nations, and in general upon all Oriental curiosities and works of art later than the Classi- cal period. In 1866 the British and mediaeval antiquities, with the ethnographical collections, were formed into a distinct department under his superintendence ; and the Christy collection of ethnography in Victoria Street, London, prior to its amalgamation with the British Museum collections, was also under his care. He became a Vice-President and ultimately President of the Society of Antiquaries, and in 1878 declined the Principal Libra- rianship of the Museum. He retired on his seventieth birthday, 1896, and died on 21st May 1897. The British Museum has had oflcers as distinguished in their respect- ive departments as Sir A. W. Pranks, though none more so ; but it was unique good fortune that almost the only officer it has ever had in a position greatly to enrich its collections from his own stores should also have been a man of rare munificence. Sir A. W. Franks's ample fortune was largely devoted to the collection of ceramics and precious objects of mediaeval art, most of which became the property of the nation, either by donation in his lifetime or by bequest at his death. Although chiefly a mediaeval antiquary, Franks was also an author- ity on classical art, especially Eoman remains in Britain : he was also greatly interested in book-marks and playing-cards, of both of which he formed important collections. He edited Kemble's Horce, Ferales, and wrote numerous memoirs on archaeological subjects. Perhaps his most important work of this class is the catalogxie of his own collection of porcelain, which he permitted to be for a long time exhibited at the Bethnal Green Museum in the east of London. (e. g.)

Franz, Robert (1816-1892), German composer, was born at Halle, 28th June 1816. One of the most gifted of German song writers, he suffered in early life, as many musicians have suffered, from the hostility of his parents to a musical career. He was twenty years old when, his father's animosity conquered, he was allowed to live in Dessau to study organ-playing under Schneider. The two years of dry study under that famous teacher were advantageous chiefly in making him un- commonly intimate

with the works of Bach and Handel, his knowledge of which he showed in his editions of the Matthdus Passion, Magnificat, ten cantatas, and of the Messiah and L' Allegro, though some of these editions have long been a subject of controversy among musicians. In 1843 he published his first book of songs, which ulti- mately was followed by some fifty more books, containing in all about 250 songs. At Halle, Franz filled various public offices, including those of organist to the city, con- ductor of the Sing-akademie and of the Symphony con- certs, and he was also a royal music-director, and master of the music at the university. The first book of songs was warmly praised by Schumann and Liszt, the latter of whom wrote a lengthy review of it in Schumann's paper. Die Neue Zeitschrift, which later was published separately. Deafness had begun to make itself apparent as early as 1841, and Franz suffered also from a nervous

disorder, which in 1868 compelled him to resign his offices. His future was then provided for by Liszt, Dr Joachim, Frau Magnus, and others, who gave him the receipts of a concert tour, amounting to some 100,000 marks. Franz died on 24th October 1892. On his seventieth birthday he published his first and only pianoforte piece. It is easy to find here and there among his songs gems that are hardly less brilliant than the best of Schumann's. Certainly no musician was ever more thoughtful and more painstaking. In addition to songs he wrote a setting for doixble choir of the 117th Psalm, and a four-part Kyrie ; he also edited Astorga's Stabat Mater and Durante's Mag- nificat, and published an " open letter " to Hanslick on his methods of editing. (e. h. l.)

Franzensbad, or Kaisbk-Feanzensbad, a well- known Bohemian watering-place in the government dis- trict of Eger. It possesses besides an international hospital for poor patients and four large bathing establish- ments, Eoman Catholic, Protestant, and Russian Churches, a synagogue, and a theatre. The mineral springs, used internally as well as externally, are twelve in number ??? saline, alkaline, and ferruginous ??? and one contains a considerable proportion of lithia salts. The so-called "moor-" or mud-baths, prepared from the peat of the Franzensbad marsh, which is rich in mineral substances, are an important part of the cure. Franzensbad is fre- quently resorted to for an after cure by patients from Marienbad and Karlsbad. There are over 8000 visitors during the

season, and a considerable trade is done in mineral waters, &c. In 1890 the population (mostly German) was 2370; in 1900, 2330.

Franzensfeste, or Feanzbnsveste, a strong Aus- trian fortress in the government district of Brixen, Tirol, on the road from the latter town to the Brenner Pass, at the entrance of the Pusterthal. It is situated on the right bank of the Eisack, about 9 miles north of Brixen, at the mouth of the narrow defile known as the " Brixener Klause," which is the junction of the roads from Botzen, Innsbruck, and the Pusterthal. It thus commands the Brenner road and railway and the entrance to the Puster Valley, with the railway to Villach, Klagenfurt, and Marburg. The latter line passes through the fortifica- tions, crossing the Eisack by an iron bridge, 218 yards in length, and resting upon six granite piers. This bridge, together with the old wooden structure, the Ladritsch Brilcke, is covered by the guns of the fort. Franzensveste station, about a mile north of the fortifi- cations, has about 300 inhabitants.

For tlie strategic value of this fortress, and generally of the Austrian fortifications in Tirol, see articles by Lieut. ~~Col. Herman Frobenius in the Arcliiv fur die Artillerie~~ und Ingenieur-Officiere des deutschen Beichsheeres, June-September 1895. The Austrian Field-Marshal Franz von Kuhn in his Oebirgskrieg (second edition, Vienna, 1878) draws many of his illustrations from Tirol, which he considers of incalculable value to the monarchy, not only in a war against Italy, but also in one with Germany.

Franz Josef Land, an arctic archipelago lying to the east of Spitsbergen and the north of Novaya Zemlya, extending northwards from about 80 N. lat. Petermann has expressed the opinion that Baffin may have sighted the west of Franz Josef Land in 1614, but the first actual discovery is due to Julius Payer, a lieutenant in the Austrian army, who was associated with Weyprecht in the second polar expedition fitted out by Count Wilczek on the ship TegettJwf in 1872. On 13th August 1873, the Tegetthof being then beset, high land was seen to the north-west. Later in the season Payer led expeditions to Hochstetter and Wilczek islands, and after a second winter in the ice-bound ship, a difficult journey was made

northwards through Austria Sound, which was reported to separate two large masses of land, Wilczek Land on the

east from Zichy Land on the west, to Cape Pligely, in 82[illegible]*5' N. lat., where Eawlinson Sound branched away to the north-east. Cape Fligely was the highest latitude attained by Payer, and remained the highest attained in the Old World till 1896. Payer reported that from Cape Pligely, land (Rudolf Land) stretched north-east to a cape (Cape Sherard Osborn), and mountain ranges were visible to the north, indicating lands beyond the 83rd parallel, to which the names King Oscar Land and Peter- mann Land were given. In 1879 De Bruyne sighted high land in the Franz Josef Land region, but otherwise it remained untouched until Leigh Smith, in the yacht Eira, explored the whole southern coast from 42*[illegible] *to 54*[illegible] *E. long, in 1881 and 1882, discovering many islands and sounds, and ascertaining that the coast of Alexandra Land, in the extreme west, trended to north-west and north. In the face of almost insuperable difficulties, including the loss of his ship, Leigh Smith made botan- ical and zoological collections of great value, although he failed to reach high latitudes. After Leigh Smith comes another pause, and no further mention is made of Franz Josef Land till 1894. In that year Mr Alfred Harmsworth fitted out an expedition in the ship Wind- ward under the leadership of Mr P. G. Jackson, with the object of establishing a permanent base from which sys- tematic exploration should be carried on for successive ye*[illegible]*fs, and, if practicable, a journey should be made to the Pole. Mr Jackson and his party landed at " Elm- wood," near Cape Flora, at the western extremity of Northbrook Island, on 7th September. After a prelim- inary reconnaissance to the north, which afterwards turned out to be vitally important, the summer of 1895 was spent in exploring the coast to the north-west by a boating expedition. This expedition visited many of the points seen by Leigh Smith, and discovered land, which it has been suggested may be the Gillies Land reported by the Dutch captain Gillies inl707. In 1896 the Jackson- Harmsworth expedition worked northwards through an archipelago for about 70 miles,*

and reached Cape Eicht- hofen, a promontory 700 feet high, whence an expanse of open water was seen to the northward, which received the name of Queen Victoria Sea. To the west, on the oppo- site side of a wide opening which was called the British Channel, appeared glacier-covered land, and an island lay to the northward. The island was probably the King Oscar Land of Payer. To north and north-east was the land which had been visited in the reconnaissance of the previous year, but beyond it a water-sky appeared in the supposed position of Petermann Land. Thus Zichy Land itself was resolved into a group of islands, and the out-lying land sighted by Payer was found to be islands also. Meanwhile Nansen, on his southward jour- ney, had approached Franz Josef Land from the north- east, finding only sea at the north end of Wilczek Land, and seeing nothing of Payer's Eawlinson Sound, or of the north end of Austria Sound. Hansen wintered near Cape Norway, only a few miles from the spot reached by Jack- son in 1895. The general results of the two explorers agree in the conclusion that Franz Josef Land consists of an archipelago of small islands, which extends west- wards to a distance as yet undetermined, but is probably connected by a continuous chain with Spitsbergen. Nan- sen had of course finally proved that a deep oceanic basin lies to the north. The Windward revisited " Elmwood " in 1896 and brought Hansen home, the work of the Jackson-Harmsworth expedition being continued for an- other year. As the non-existence of land to the north had been proved, the attempt to penetrate northwards was abandoned, and the last season was devoted to a survey and scientific examination of the archipelago, especially to the west ; this was carried out by Jackson, Armitage,

Koettlitz, Fisher, and Bruce. Further light was thrown on the relations of Franz Josef Land and Spitsbergen during 1897 by the discoveries of Captain Eobertson of Dundee, and Wyche's Land was circumnavigated by Mr Arnold Pike and Sir Savile Crossley. The latter voyage was repeated in the following year by a German expedi- tion under Dr Th. Lerner and Captain Eiidiger. In August 1898 an expedition under Mr Wellman, an Ameri- can, landed at Cape Tegetthof. Beginning a northward journey with sledges at the end of the following winter, Wellman met with an accident which compelled him to return, but not before some exploration had been accom- plished, and the eastern

extension of the archipelago fairly well defined. In June 1899, H.E.H. the Duke of Abruzzi started from Christiania in his yacht, the Stella Polare, to make the first attempt to force a ship into the newly- discovered ocean north of Franz Josef Land. The Stella Polare succeeded in making her way through the British Channel to Crown Prince Eudolf Land, and wintered in Teplitz Bay, in 81 33′ N. lat. The ship was nearly wrecked in the autumn, and the party had to spend most of the winter on shore, the Duke of Abruzzi suffering severely from frost-bite. In March 1900 a sledge party of thirteen under Captain Cagni, started northwards. They found no trace of Petermann Land, but with great difficulty crossed the ice to 86 33′ N. lat., 20 miles beyond Nansen's farthest, and 240 miles from the Pole. The party, with the exception of three, returned to the ship after an absence of 104 days, and the Stella Polare re- turned to Tromso in September 1900. (h. n. d.)

Fraser, James (1818-1885), English bishop, was born at Prestbury, in Gloucestershire, on the 18th of August 1818. His father was of Scottish descent; his mother's family lived at Bilston, in Staffordshire, which occasioned him to receive his school education at Bridg- north and Shrewsbury. At Oxford he gained a first-class and an Oriel fellowship, and was for some time tutor of the college, but did not take orders until 1846. He was successively rector of the livings of Cholderton, in Wilt- shire, and of Ufton ISTervet, in Berkshire; but his rise in life was owing to Hamilton, bishop of Salisbury's recommendation of him as an assistant commissioner of education. His report on the educational condition of thirteen poor-law unions, made in May 1859, is described by Mr Thomas Hughes as " a superb, almost a unique piece of work." In 1865 he was entrusted with a com- mission to report on the state of education in the United States and Canada, and his able performance of his mission brought him an offer of the bishopric of Calcutta, which he declmed, but in January 1870 he accepted the see of Manchester. The task before him was an arduous one, for although his predecessor, Dr Prince Lee, had consecrated no fewer than 130 churches, the enormous population was still greatly in advance of the ecclesias- tical machinery. Fraser worked with the utmost energy, and did even more for the Church by the liberality and geniality which earned him the title of " the bishop of all denominations." He was prominent in secular as well as religious works,

interesting himself in every move- ment that promoted health, morality, or education; and especially serviceable as the friendly, unofiicious counsellor of all classes. He was frequently invoked as an arbitrator in trade disputes, and was seldom absent from any im- portant pviblic gathering of a non-political nature. His theology was that of a liberal High Churchman, but his sympathies were exceedingly broad. His death, which occurred unexpectedly on the 22nd of October 1885, evoked the most earnest demonstrations of sorrow from all classes of society. A biography of him was written by Thomas Hughes, author of Tom Brown's School-Days. (b. g.)

F R ASERBURG ??? FEEDERICK CHARLES

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Fraserburg, a town of Cape Colony, on the north- ern slope of the Nieuwveld range, near the sources of the Zak river, which, when flooded, flows northwards to the left bank of the Orange below Upington. Fraser- burg is a thriving agricultural centre, and possesses some importance as the chief dep6t for the distribution of supplies amongst the stock-breeders of the extensive Nieuwveld plains between Carnarvon and Calvinia. Population about 2000.

Fraserburgh, a police burgh and seaport of Aber- deenshire, Scotland, 47^ miles north by east of Aberdeen by rail. The harbour has been enlarged at a total cost, up to 1898, of ??315,000. There were 15 vessels of 3741 tons registered at the port at the end of 1898, and in that year 397 vessels of 63,195 tons entered, and 388 vessels of 61,844 tons cleared. Fraserburgh is the head of a fishery district (for statistics of district, see Abeedeen- shieb). The value of the fish (mostly herrings) landed in 1899 was ??200,604. Besides 161 other boats, there are now 10 steam trawlers, ft has a public hall and a hospital. The Baptist church was built in 1880, and St Peter's Episcopal in 1891. There is an endowed acad- emy. Population (1881), 6583 ; (1901), 8998.

Fraserville (formerly Eivi^iee du Loup en Bas), a town, railway station, and watering-place in Temiseouata county, Quebec, Canada, 107 mUes (by water) north- east of Quebec, on the south shore of Eiver St Law-

rence, and at the mouth of the River du Loup. It contains a convent, boys' college, hospital, several mills, and a number of handsome villa residences. Population

(1881), 2291 ; (1901), 4569.

Fraud, in its widest sense, is a term which has never been exhaustively defined by an English court of law, and for legal purposes probably cannot usefully be de- fined. But as denoting a cause of action for which dam- ages can be recovered in civil proceedings it now has a clear and settled meaning. In actions in which damages are claimed for fraud, the difficulties and obsciirities which commonly arise are due rather to the complexity of modern commerce and the ingenuity of modern swindlers than to any uncertainty or technicality in the modern law. To succeed in such an action, the person aggrieved must first prove a representation of fact, made either by words, by writing, or by conduct, which is in fact untrue. Mere concealment is not actionable unless it amounts not only to suppressio veri, but to suggestio falsi. An expression of opinion or of intention is not enough, unless it can be shown that the opinion was not really held, or that the intention was not really entertained, in which case it must be borne in mind, to use the phrase of Lord Bowen, that the state of a man's mind is as much a matter of fact as the state of his digestion. Next, it must be proved that the representation was made without any honest belief in its truth, that is, either with actual knowledge of its falsity or with a reckless disregard whether it is true or false. It was finally established, after much controversy, in the case of Derry v. Peek in 1889, that a merely negligent misstatement is not action- able, although the fact that a statement is made without reasonable grounds for believing it to be true may be strong evidence tending to show that it was made with- out honest belief in its truth. Further, the person aggrieved must prove that the offender made the repre- sentation with the intention that he should act on it, though not necessarily directly to him, and that he did in fact act in reliance on it. This principle excludes from the region of actionable fraud such "flourishing descriptions " as are common among auctioneers and house-agents, and also misrepresentations of a trifling and unimportant character. But the wrong-doer cannot escape

the consequences of his own mis-statement by contending that the person who relied upon it ought not to have done so, and ought to have made further inquiries ; by contend- ing, in short, that by the exercise of more vigUance his own dishonesty might have been detected. Lastly, the complainant must prove that, as the direct consequence of the misrepresentation, he has suffered actual damage capable of pecuniary measurement.

As soon as the case of Derry v. Peek had established, as the general rule of law, that a merely negligent mis- statement is not actionable, a statutory exception was made to the rule in the case of directors and promoters of companies who publish prospectuses and similar docu- ments. By the Directors' Liability Act, 1890, such per- sons are liable for damage caused by untrue statements in such documents, unless they can prove that they had reasonable grounds for believing the statements to be true. It is also to be observed that, though damages cannot be recovered in an action for a misrepresentation made with an honest belief in its truth, still any person induced to enter into a contract by a misrepresentation, whether fraudulent or innocent, is entitled to avoid the contract and to obtain a declaration that it is not binding upon him. This is in accordance with the rule of equity, which since the Judicature Act prevails in all the courts. Whether the representation is fraudulent or innocent, the contract is not void, but voidable. The party misled must exercise his option to avoid the contract without delay, and before it has become impossible to restore the other party to the position in which he stood before the con- tract was made. If he is too late, he can only rely on his claim for damages, and in order to assert this claim it is necessary to prove that the misrepresentation was fraud- ulent. Fraud, in its wider sense of dishonest dealing, though not a distinct cause of action, is often material as preventing the acquisition of a right, for which good faith is a necessary condition. Also a combination or conspir- acy by two or more persons to defraud gives rise to liabil- ities not at present very clearly or completely defined.

(a. ll. d.)

Frederick Charles (1828-1886), Prussian prince, known as the ” Red Prince ” from the colour of his favour- ite Hussar uniform, was the eldest son of Prince Charles, brother of the Emperor William I. of Germany, his mother being a sister of the Empress Augusta. He was born in Berlin, 20th March 1828, and, like most princes of the House of Hohenzollern, was educated for the army. Chief amongst his various military tutors and governors was Major von Boon, afterwards Prussian minister for war, who attended him during the two years which he spent at the University of Bonn, 1846 ??? 48. In the latter year the prince entered the Foot Guards, and first saw active service under Marshal von Wrangel in the Schles- wig-Holstein war. Shortly afterwards he attended his uncle. Prince William of Prussia, afterwards Emperor, in the campaign against the Free Companies of Baden. He was now a major of Hussars, having changed his branch of the service. He led a brilliant charge of about forty Hussars against the Polish legion at the battle of Wies- enthal, and received two wounds. Temporarily incapac- itated for military duty, he devoted himself to the study of military works. The prince was appointed colonel of the First Dragoon Guards in 1852, and two years later was raised to the command of the First Guards Cavalry Brigade. In 1855 Frederick Charles visited Paris, where he closely studied the French military system, carefully noting its defects. He traced minutely the course of the Franco-Austrian war of 1859, and embodied his conclusions and strictures upon French tactics in a privately-published pamphlet. This pamphlet obtained a wider circulation than was intended, and gave

rise to much indignation in Prance. Other military essays by the prince testified to his ability as a military critic. The prince became a general of cavalry, with the command of the Third Army Corps in 1861, and he commanded the Prussian corps forming the right wing of the allied army in 1864. It was he who had the credit of forcing the Danes to evacuate Schleswig, and also of leading the Prussians in the storming of the lines of Duppel. He ac- quired in this campaign the popular sobriquet of “Prinz Vorwarts.” In the Austrian war of 1866 he commanded the Pirst Army,

numbering aboutl40,000 men. Entering Bohemia, he defeated the Austro-Saxon troops at Lie- benau, Podol, and Gitschin. But his greatest general-ship was displayed at the crowning battle of Koniggratz. The Austrians were commanded by the veteran Marshal Benedek, and the Prussians by their king, William I. Prince Frederick Charles halted at Kammeniz on 2nd July, and his troops commenced their march at midnight, the first shot being fired about 7.30 a.m. on 3rd July. It was alleged afterwards that the prince opened the en- gagement two hours sooner than commanded, in order that he might, if possible, win this decisive victory before the Crown Prince's army arrived. The attack became general at Koniggratz about ten o'clock, and a desperate struggle ensued, the result appearing uncertain until the Crown Prince and his force arrived at half-past twelve. "When Chlum, which had been taken and lost seven times by the Prussians, was taken for the' eighth time, the fate of the day was decided ; and the retreat of the Aus- trians soon became a hasty and disastrous flight. The Austrians lost about 43,000, including 10,000 wounded and 13,000 unwounded prisoners ; the Prussian loss was 10,000 men. When the war with France broke out in 1870, Prince Frederick Charles was appointed to the command of the Second Army. Again and again in the course of the campaign he gave evidence of his superior military abilities. He led his troops to victory in the great battles of Vionville and Gravelotte-St Privat, and compelled Marshal Bazaine to take refuge within the entrenchments of Metz. The prince then began a syste- matic blockade of the fortress, and after a siege of seventy days only, Bazaine surrendered with about 170,000 men. The prince was rewarded for this great feat by his eleva- tion to the rank of field-marshal. From Metz the prince now hastened westwards to check the armies of D'Aurelle de Paladines and Chanzy in their attempts to raise the siege of Paris from the south. The series of battles which ensued, beginning with Beaune-la-Rolande, lasted almost uninterruptedly from the middle of November till the middle of January, when the French army of the West was rendered impotent at the engagement of Le Mans. This was the prince's last action, for Paris capitulated immediately afterwards. After the Franco-German war Prince Frederick Charles was destined to see no further active service, the remainder of his life being spent in studying war, witnessing reviews, and farming his estates at Glienicke, near Potsdam. He made many efforts, some of which were successful, to

reform and render more elastic the military system of the army. In appearance the prince was a model cavalry officer. He was strong and muscular in body, and active in his habits and pursuits. His private character was harsh and unamiable. In March 1879 his third daughter, Louise Margaret, was married to the Duke of Connaught. The prince died suddenly from apoplexy at his chlteau of Glienicke on 15th June 1885.

(g. b. s.)

Frederick, capital of Frederick coimty, Maryland, U.S.A., in 39 25' N. and 77 25' W., in the broad and fertile valley of the Monocacy river, lying between the Catoctin Eange and the Blue Eidge, at an altitude of 323

feet. It is on branches of the Baltimore and Ohio and the Pennsylvania railways. Population (1880), 8669; (1890), 8193; (1900), 9296, of whom 241 were foreign- born, and 1535 were negroes.

Frederick III. (1831-1888), King of Prussia and German Emperor, was born at Potsdam, 18th October 1831, being the eldest son of Prince William of Prussia, after- wards first German Emperor, and the Princess Augusta. He was carefully educated, and in 1849-60 studied at the University of Bonn. The next years were spent in military duties and in travels, in which he was accompanied by Moltke. In 1851 he visited England on the occasion of the Great Exhibition, and in 1855 became engaged to Victoria, Princess Eoyal of Great Britain, to whom he was married in London on 26th January 1858. On the death of his uncle in 1861 and the accession of his father. Prince Frederick William, as he was then always called, became Crown Prince of Prussia. His education, the influence of his mother, and perhaps still more that of his wife's father, the Prince Consort, had made him a strong Liberal, and he was much distressed at the course of events in Prussia after the ap- pointment of Bismarck as Minister. He was urged by the Liberals to put himself into open opposition to the Govern- ment ; this he refused to do, but he remonstrated privately with the King. In June 1863, however, he publicly dis- sociated himself from the Press Ordinances which had just been published. He ceased to attend meetings of the Council of State, and was much away from Berlin. The opposition of the Crown Prince to the

Ministers was increased during the following year, for he was a warm friend of the Prince of Augustenburg, whose claims to Schleswig-Holstein Bismarck refused to support. During the war with Denmark he had his first military experience, being attached to the staff of Marshal von Wrangel ; he per- formed valuable service in arranging the difficulties caused by the disputes between the Field-Marshal and the other officers, and was eventually given a control over him. After the war he continued to support the Prince of Augustenburg, and was strongly opposed to the war with Austria. During the campaign of 1866 he received the command of an army consisting of four army corps ; he was assisted by General von Blumenthal, as Chief of the Staff, but took a very active part in directing the difficult operations by which his army fought its way through the mountains from Silesia to Bohemia, fighting four en- gagements in three days, and showed that he possessed genuine military capacity. In the decisive battle of Konig- gratz the arrival of his army on the field of battle, after a march of nearly twenty miles, secured the victory. During the negotiations which ended the war he gave valuable assistance by persuading the King to accept Bismarck's policy as regards peace with Austria. From this time he was very anxious to see the King of Prussia unite the whole of Germany, with the title of Emperor, and was impatient of the caution with which Bismarck proceeded. In 1869 he paid a visit to Italy, and in the same year was present at the opening of the Suez Canal; on his way he visited the Holy Land.

He played a conspicuous part in the year 1870-71, being appointed to command the armies of the Southern States, General Blumenthal again being his Chief of the Staff ; his troops won the victory of Worth, took an important part in the battle of Sedan, and later in the siege of Paris. The popularity he won was of political service in preparing the way for the union of North and South Germany, and he was the foremost advocate of the Imperial idea at the Prussian Court. During the years that followed, little opportunity for political activity was open to him. He and the Crown Princess took a great interest in art and industry, especially in the Eoyal

Museums ; and the excavations conducted at Olympia and Pergamon with such great results were chiefly due to him. The Crown Princess was a keen advocate of the higher education of women, and it was owing to her exertions that the Victoria Lyceum at Berlin (which was named after her) was founded. In 1878, when the Emperor was incapacitated by the shot of an assassin, the Prince acted for some months as Regent. His palace was the centre of all that was best in the literary and learned society of the capital. He publicly expressed his disapproval of the attacks on the Jews in 1878; and the coalition of Liberal parties founded in 1884 was popularly known as the " Crown Prince's party," but he scrupulously refrained from any act that might embarrass his father's Government. For many reasons the accession of the Prince was looked forward to with great hope by a large part of the nation. Unfortunately he was attacked by cancer in the throat ; he spent the winter of 1887-88 at San Remo ; in January 1888 the operation of tracheo- tomy had to be performed. On the death of his father, which took place on 9th March, he at once journeyed to Berlin ; but his days were numbered, and he came to the throne only to die. In these circumstances his accession could not have the political importance which would otherwise have attached to it, though it was dis-figured by a vicious outburst of party passion in which the names of the Emperor and the Empress were con- stantly misused. While the Liberals hoped the Emperor would use his power for some signal declaration of policy, the adherents of Bismarck did not scruple to make bitter attacks on the Empress. The Emperor's most important act was a severe reprimand addressed to Herr v. Putkamer, the reactionary Minister of the Interior, which caused his resignation ; in the distribution of honours he chose many who belonged to classes and parties hitherto excluded from Court favour. A serious difference of opinion with the Chancellor regarding the proposal for a marriage be- tween Prince Alexander of Battenberg and the Princess Victoria of Prussia was arranged by the intervention of Queen Victoria, who visited Berlin to see her dying son- in-law. He expired at Potsdam on 15th June 1888, after a reign of ninety-nine days.

After the Emperor's death Professor Gefioken, a personal friend, published in the Deutsche Bundsckau extracts from the Diary of the Crown Prince containing passages which illustrated his differ- ences with Bismarck during the war of 1870. The object was to injure Bismarck's

reputation, and a very unseemly dispute ensued. Bismarck at first, in a letter addressed to the new Emperor, denied the authenticity of the extracts on the ground that they were unworthy of the Crown Prince. Geffcken was then arrested and imprisoned. He had undoubtedly showed that he was an injudicious friend, for the Diary proved that the Prince, in his enthusiasm for German unity, had allowed himself to consider projects which would have seriously compromised the relations of Prussia and Bavaria. The treatment of the Crown Prince's illness also gave rise to an acrimonious controversy. It arose from the fact that as early as May 1887 the German physicians recognized the presence of cancer in the throat, but Sir Morell Mackenzie, the English specialist who was also consulted, disputed the correctness of this diagnosis, and advised that the operation for removal of the larynx, which they had recommended, should not be undertaken. His advice was followed, and the digerenoes between the medical men were made the occasion for a considerable display of national and political animosity.

The Empress Victoria, who, after the death of her husband, was known as the Empress Frederick, died on the 5th of August 1901 at the Castle of Friedrichskron, Cronberg, near Homburg V. d. H., where she spent her last years. Of the Emperor's children, two, Prince Sigismund (1864-66) and Prince Waldemar (1869-79), died in childhood. He left two sons, William (q.v.), who succeeded him, and Henry, who adopted a naval career. Of his daughters, the Princess Charlotte was married to the Heredi- tary Prince of Meiningen ; the Princess Victoria to Prince Adolf of Schaumburg-Lippe ; the Princess Sophie to the Duke of Sparta, Crown Prince of Greece ; and Princess Margaretha to Prince Friedrich Karl of Hesse.

AuTHORiTiiss. ❖❖❖ M. VON PoscHiNOER. KaisBT Friedrich. .3 vols. Berlin, 1898-1900, Adapted into English by Sidney Whitman. Life of the Emperor Frederick (Harper), 1901. See also Bismarck. Reflections and Beminiscences. ❖❖❖ Rennell Rodd. Frederick, Crown Prince and Emperor, 1888.' ❖❖❖ Gustav Freytag. Der Kronprinz und die deutsche Kaiserkrone, 1889 ; English translation, 1890, ❖❖❖ For his illness, the ofiicial publications, pub- lished both in English and German : Die Krankheit KiiiHcr Fried- richs III., Berlin, 1888, and Morell Mackenzie,

The Fatal Illness of Frederick the NoUe, 1888. ❓❓❓ Most of the copies of the Deutsche Bundschau containing the extracts from the Crown Prince's Diary were confiscated, but there is an English edition, published in 1889. (j. -^v. he.)

Fredericksburg, a city of Virginia, U.S.A., in 38❓❓18′ N. and 77❓❓27′ W., on the Rappahannock river, at the head of navigation and tide. Though situated within the limits of Spottsylvania county, and containing the court house, it is independent of the county government. It is regularly built, on a succession of benches rising from the river. It is divided into two wards. Upper and Lower, and is on the Potomac, Fredericksburg, and Pied- mont, and the Richmond, Fredericksburg, and Potomac railways. It was the scene of one of the severest battles of the Civil War. General Burnside, in command of the Union forces, attempted to storm the Confederate defences on the banks on which the city is built, but after repeated charges, in which his troops were decimated, he was forced to withdraw. Fredericksburg College had, in 1899, 12 instructors and 114 students. Population (1880),

5010; (1890), 4628; (1900), 5068.

Fredericton, the capital of New Brunswick, on the St John river, 84 miles from its mouth. Among recent improvements are the new parliament buildings, the post-office, the normal school, a neat and well-kept park, and the two bridges, passenger and railway, which unite the city with the towns of St Marys and Gibson on the east side of the river. In 1899-1900 exports were valued at |161,334, imports at $419,441. Population

(1891), 6502 ; (1900), 7000.

Frederikshavn, a seaport of Denmark, county Hjorring, on the Cattegat, 25 miles south of the Skaw, and 50 miles by rail north-north-east from Aalborg. Origin- ally it was a fishing station, known as Fladsteand, but it is now a harbour of refuge (1882-91) for the Cattegat. It is also a fishing centre, especially for plaice, and sends fishing boats to Iceland and to the oyster grounds of the North Sea. In 1899 the port was entered by 1311 vessels of 167,704 tons, and cleared by 1215 of 166,868 tons, the chief

exports being fish, butter, cattle, and bacon ; and the chief imports, coal and butter (this last in transport). Population (1880), 2891 ; (1900), 6338.

Fredrikshald, a seaport town of Norway, county Smaalenene, close to the Swedish frontier, 85 miles south- south-east of Christiania by rail. It is one of the prin- cipal ports of the kingdom for the export of timber. The total trade in 1897 was valued at ►►627,300 (►►344,000 in 1887). Marble of very fine quality and grain is exten- sively quarried and exported for architectural ornamenta- tion and for furniture-making. Wood-pulp is also exported. The industries embrace granite quarries, wood-pulp fac- tories, and factories for sugar, tobacco, curtains, travelling- bags, boots, &c. Population (1875), 9792 ; (1900), 11,936.

Fredrikstad, a rapidly-growing seaport and manu- facturing town of Norway, standing at the mouth of the Glommen, 59 miles by rail south by east of Christiania. The new town, on the right bank, is the centre of the timber export trade, this place being the principal port in Norway for the export of pit-props, planed boards, and other varieties of timber. In the closing years of the 19th century there was an extraordinary development in the

making of red bricks, owing to the great expansion of Christiania, Gothenburg, and other towns. In 1899 the total output of bricks was 160 millions, as compared with 50 millions in 1896. Granite is hewn to a great extent and exported. Besides the large number of saw and planing mills, there are shipbuilding yards, engine and boiler works, cotton and woollen mills, and factories for acetic acid and naphtha. The total trade of the port was valued at ►►996,000 in 1897. The harbour, which can be entered by vessels drawing 14 ft., is kept open in winter by an ice-breaker. In 1899 the port owned a mercantile fleet of 176 vessels of 54,150 tons. In the vicinity is the much-frequented seaside resort of Hanko. Population

(1875), 9616 ; (1900), 14,573.

Free Church Federation. ►►► In the Methodist Times of 20th February 1890 Dr Guinness Rogers sug- gested that there should be a

Nonconformist Church Con- gress as well as an Anglican Church Congress. The first was held in Manchester on 7th November 1892. In the following year it was resolved that the basis of represen- tation should be neither personal (as in the Anglican Church Congress) nor denominational, but territorial. Englandand Wales have since been completely covered with a network of Local Councils, each of which elects its due proportion of representatives to the National gathering. This territo- rial arrangement eliminated all sectarian distinctions, and also the possibility of committing the different Churches as such to any particular policy. The representatives of the Local Councils attend not as Denominationalists, but as Evangelical Free Churchmen. The name of the organiza^ tion was changed from Congress to National Council as soon as the Assembly ceased to be a fortuitous concourse of atoms, and consisted of duly appointed representatives from the Local Councils of every part of England. The Local Councils consist of representatives of the Congrega- tional and Baptist Churches, the Methodist Churches, the Presbyterian Church of England, the Free Episcopal Churches, the Society of Friends, and such other Evan- gelical Churches as the National Council may at any time admit. The constitution states the following as the objects of the National Council : (a) To facilitate fraternal inter- course and co-operation among the Evangelical Free Churches ; (&) to assist in the organization of Local Coun- cils ; (c) to encourage devotional fellowship and mutual counsel concerning the spiritual life and religious activi- ties of the Churches ; (d) to advocate the New Testament doctrine of the Church, and to defend the rights of the associated Churches ; (e) to promote the application of the law of Christ in every relation of human life.

A striking feature of this movement is the adoption of the parochial system for the purpose of local work. Each of the associated Churches is requested to look after a parish, not of course with any attempt to exclude other Churches, but as having a special responsibility for those in that area who are not already connected with some existing Church. In the great cities, especially in London and in the counties, Local Councils are formed into Federa- tions, which are intermediate between them and the Na- tional Council. The Local Councils do what is possible to prevent overlapping and excessive competition between the Churches. Large

circulating libraries are already es- tablished for the benefit of ministers in villages and country districts. A considerable literature has sprung into exist- ence, consisting of numerous periodicals, hymn-books for special occasions, and works of different kinds explaining the history and ideals of the Evangelical Free Churches. These can be obtained from the organizing secretary at the Memorial Hall, Farringdon Street, London, E.C. The primary object of the whole organization is to reach the masses of the people who are not yet attached to any

Church. The Churches represented in the National Council have 9006 separated or ordained ministers, 50,729 local preachers, 388,160 Sunday-school teachers, 3,360,224 Sunday scholars, 1,911,924 communicants, and sitting accommodation in their sanctuaries for 7,993,708.

The most remarkable manifestation of this unprece- dented reunion is the fact that a committee of the associated Churches has already prepared and published a Catechism expressing the positive and fundamental agreement of all the Evangelical Free Churches on the essential doctrines of Christianity. An account of the origin of this Cate- chism, together with the names of the theologians of all Churches who took part in its preparation, wUl be found in the prefatory note to the Catechism. A fuller history of its origin and its striking features was published in the Contemporary Review of January 1899. The Catechism represents substantially the creed of not less than 80,000,000 Protestants. It has been widely circulated throughout Great Britain, in British colonies, and the United States of America. It has also been translated into Welsh, French, and Italian. This movement has spread to all parts of Australia, New Zealand, South Africa, Jamaica, the United States of America, and India. It is perhaps necessary to add that it differs essentially from the Evangelical Alliance, inasmuch as its unit is not an individual, private Christian, but a definitely organized and visible Church. The essential doctrine of the move- ment is a particular doctrine of churchmanship which, as explained in the Catechism, regards the Lord Jesus Christ as the sole and Divine Head of every branch of the Holy Catholic Church throughout the world. For this reason those who do not accept the deity of Christ are necessarily excluded from the National Council and its local constitu- ent councils. (h. p. h.)

Freeland, a borough of Luzerne county, Pennsyl- vania, U.S.A., in the anthracite coal region, on the Lehigh Valley railway. It is a supply- and shipping-point for the coal mines in the neighbourhood. Population (1890), 1730 ; (1900), 6254, of whom 1339 were foreign-born.

Freeman, Edward Augustus (1823-1892), English historian, was born at Harborne, Staffordshire, on 2nd August 1823. He lost both his parents in in- fancy, was brought up by a grandmother, and was edu- cated at private schools and by a private tutor. He was a studious and precocious boy, more interested in re- ligious matters, history, and foreign politics than in boyisTi things. He obtained a scholarship at Trinity Col- lege, Oxford, and a second class in the degree examina- tion, and was elected fellow of his college (1845). While at Oxford he was much influenced by the High Church movement, and thought seriously of taking orders, but abandoned the idea. He married the daughter of his former tutor, the Rev. R. Gutch, in 1847, and entered on a life of study. Ecclesiastical architecture attracted him strongly. He visited many churches and began a practice, which he pursued throughout his life, of making drawings of buildings on the spot and afterwards tracing them over in ink. His first book, save for his share in a volume of English verse, was A History of Architecture (1849). Though he had not then seen any buildings outside Eng- land, it contains a good sketch of the development of the art. It is full of youthful enthusiasm and is written in florid language. After some changes of residence he bought a house called Somerleaze, near Wells, Somerset, and settled there in 1860. His life was one of strenuous literary work. He wrote many books, and countless articles for reviews, newspapers, and other publications, and was a constant contributor to the Saturday Review until 1878, when he ceased to write for it for political reasons. His Satttrday

Review articles corrected many errors and raised the level of historical knowledge among the educated classes, but as a reviewer he was apt to forget that a book may have blemishes and yet be praiseworthy. For some years he was an active county magistrate. He was deeply interested in

politics, was a follower of Mr Gladstone, and approved the Home Rule Bill of 1886, but objected to the later proposal to retain the Irish members at Westminster. To be returned to Parliament was one of his few ambitions, and inl868 he unsuccessfully contestedMid-Somersefc. Foreign rather than domestic politics had the first place with him. Historical and religious sentiment combined with his de- testation of all that was tyrannical to inspire him with hatred of the Turk and sympathy with the smaller and subject nationalities of Eastern Europe. He took a pro- minent part in the agitation which followed the " Bulga- rian atrocities " ; his speeches were intemperate, and he was accused of uttering the words " Perish India ! " at a public meeting in 1876. This, however, was a misrepre-

Edwakd Augustus Freeman. {From a photo, by Ellioii & Fry.)

sentation of his words. He was made a knight com- mander of the order of the Saviour by the king of Greece, and also received an order from the prince of Montenegro. Freeman advanced the study of history in England in two special directions, by insistence on the unity of history, and by teaching the importance and right use of original .authorities. History is not, he urges, to be divided "by a middle wall of partition " into ancient and modern, nor (broken into fragments as though the history of each nation stood apart. It is more than a collection of narratives : it is a science, " the science of man in his political character." 'The historical student, then, cannot afford to be indifferent to any part of the record of man's political being ; but as his abilities for study are limited, he will, while reckoning all history to be within his range, have his own special range within which he will master every detail (JRede Lecture). Freeman's range included Greek, Eoman, and the earlier part of English history, together with some portions of foreign mediaeval history, and he had a schol- arly though general knowledge of the rest of the history of the European world. He regarded the abiding life of Eome as "the central truth of European history," the hond of its unity, and he undertook his History of Sicily (1891-94) partly because it illustrated this unity. IFurther, he urges that all historical study is valueless

which does not take in a knowledge of original authorities, and he teaches both by example and precept what au- thorities should be thus described, and how they are to be weighed and used. He did not use manuscript authori- ties, simply because he had no need to do so. All the authorities which he needed were already in print, and his books would not have been better if he had disinterred a few more facts from unprinted sources.

His reputation as a historian will chiefly rest on his History of the Norman Conquest (1867-76), his longest com- pleted book. In common with his works generally, it is distinguished by exhausti veness of treatment and research, critical ability, a remarkable degree of accuracy, and a cer- tain insight into the past which he gained from his prac- tical experience of men and institutions. He is almost ex- clusively a political historian. His saying that " history is past politics and politics are present history " is significant of this limitation of his work, which left on one side sub- jects of the deepest interest in a nation's life. In deal- ing with constitutional matters he sometimes attaches too much weight to words and formal aspects. This gives certain of his arguments an air of pedantry, and seems to lead him to find evidences of continuity in institutions which in reality and spirit were different from what they once had been. As a rule his estimates of character are remarkably able. It is true that he is sometimes swayed by prejudice, but this is the common lot of great histo- rians ; they cannot altogether avoid sharing in the feel- ings of the past, for they live in it, and Freeman did so to an extraordinary degree. Yet if he judges too favour- ably the leaders of the national party in England on the eve of the Norman Conquest, that is a small matter to set against the insight which he exhibits in writing of Aratus, Sulla, Nicias, William the Conqueror, Thomas of Canterbury, Frederick the Second, and many more. In width of view, thoroughness of investigation, and honesty of purpose he is unsurpassed by any historian. He never conceals or wilfully misrepresents anything, and he reckoned no labour too great which might help him to draw a truthful picture of the past. When a place had any important connexion with his work he invariably visited it. He travelled much, always to gain knowledge, and generally to complete his histori- cal equipment. His collected articles and essays on places of historical interest are perhaps the most pleasing of his writings, but they deal exclusively with historical associations and architectural

features. The quantity of work which he turned out is enormous, for the fifteen large volumes which contain Yas Norman Cojigwesi, his unfinished History of Sicily, his William Rufus (1882), and his Essays (1872-79), and the crowd of his smaller books, are matched in amount by his uncollected contributions to periodicals. In respect of matter his historical work is uniformly excellent. In respect of form and style the case is different. Though his sentences themselves are not wordy, he is extremely diffuse in treatment, habitually repeating an idea in successive sentences of much the same import. While this habit was doubtless aggravated by the amount of his journalistic work, it seems originally to have sprung from what may be called a professorial spirit, which occasionally appears in the tone of his remarks. He was anxious to make sure that his readers would understand his exact meaning, and to guard them against all possible misconceptions. His lengthy explanations are the more grievous because he insists on the same points in several of his books. His prolixity was increased by his unwilling- ness, when writing without prescribed limits, to leave out any detail, however unimportant. His passion for details not only swelled his volumes to a portentous size, but was fatal to artistic construction. The length of his books has hindered their usefulness. They were written for the

public at large, but few save professed students, who can admire and value his exhaustiveness, will read the many- hundreds of pages which he devotes to a short period of history. In some of his smaller books, however, he shows great powers of condensation and arrangement, and writes tersely enough. His style is correct, lucid, and virile, but generally nothing more, and his endeavour to use as far as possible only words of Teutonic origin limited his vocabulary and makes his sentences rather monotonous. While Froude often strayed away from his authorities, Freeman kept his authorities always before his eyes, and his narrative is sometimes little more than a translation of their words. Accordingly, while it has nothing of Fronde's carelessness and inaccuracy, it has nothing of

his charm of style. Yet now and again he rises to the level of some heroic event, and parts of his chapter on the " Campaign of Hastings " and of his rec- ord of the wars of Syracuse and Athens, his reflexions on the visit of Basil the Second to the church of the Vir- gin on the Acropolis, and some other passages in his books, are fine pieces of eloquent writing.

The high quality of Freeman's work was acknowledged by all competent judges. He was made D.C.L. of Ox- ford and LL.D. of Cambridge honoris causd, and when he visited the United States on a lecturing tour was warmly received at various places of learning. He served on the royal commission on ecclesiastical courts appointed in 1881. In 1884 he was appointed regius professor of modern history at Oxford. His lectures were thinly attended, for he did not care to adapt them to the requirements of the university examinations, and he was not perhaps well fitted to teach young men. But he exercised a wholesome influence over the more earnest students of history among the resident graduates. From 1886 he was forced by ill-health to spend much of his time abroad, and he died of small-pox at Alicante on IGth March 1892, while on a tour in Spain. Freeman had a strongly marked personality. Though impatient in tem- per and occasionally rude, he was tender-hearted and generous. His rudeness to strangers was partly caused by shyness and partly by a childlike inability to conceal his feelings. Eminently truthful, he could not under- stand that some verbal insincerities are necessary to so- cial life. He had a peculiar faculty for friendship and his friends always found him sympathetic and affection- ate. In their society he would talk well and showed a keen sense of humour. He considered it his duty to ex- pose careless and ignorant writers and certainly enjoyed doing so; but, merciless as his attacks were, they were not the outcome of personal spite. He worked hard and methodically, often had several pieces of work in hand, and kept a daily record of the time which he devoted to each of them. His tastes were curiously limited. No art interested him except architecture, which he studied throughout his life ; and he cared little for literature which was not either historical or political. In later life he ceased to hold the theological opinions of his youth, but remained a devout churchman.

Authorities. ??? Stephens. Life and Letters of E. A. Freeman, London, 181tr). ??? Harrison. Tennyson, Buskin, Mill, and other Literary Estimates. London, 1899. ??? Bryce. " E. A. Freeman," Eng. Hist. Bev., July 1892. (w. Hu.)

Freeport, capital of Stephenson county, Illinois, U.S.A., on the Pecatonica river, at an altitude of 760 feet. It has a level site, and its plan is fairly regular. Three railways, the Chicago and North-Western, the Chicago, Milwaukee, and St Paul, and the Illinois Central inter- sect here. Population (1880), 8516; (1890), 10,189; (1900), 13,268, of whom 2264 were foreign-born.

Free Ports, strictly speaking, are localities where no customs duties are levied, and where no customs super-

vision exists. In these ports (subject to payment for specific services rendered, wharfage, storage, &c., and to the observance of local police and sanitary regulations) ships load and unload, cargoes are deposited and handled, industries are exercised, manufactures are carried on, goods are bought and sold, without any action on the part of fiscal authorities. Ports are likewise designated "free" where a space or zone exists within which com- mercial operations are conducted without payment of im- port or export duty, and without active interference on the part of customs authorities. The French and Ger- man designations for these two descriptions of ports are ???for the former " La ville franche," " Freihafen " ; for the latter " Le port franc," " Freibezirk " or " Freilager." The English phrase free port applies to both.^ The lead- ing conditions under which free ports in Europe derived their origin were as follows : ??? (1) When public order be- came re-established during the Middle Ages, trading cen- tres were gradually formed. Marts for the exchange and purcliase of goods arose in different localities. Many Italian settlements, constituting free zones, were estab- lished in the Levant. The Hanseatic towns arose in the 12th century. Great fairs became recognized ??? the Leip- zig charter was granted in 1268. These localities were free as regards customs duties, although dues of the na- ture of octroi charges were often levied. (2) Until the 19th century European states were numerous, and often of small size. Accordingly

uniform customs tarifi's of wide application did not exist. Uniform rates of duty were fixed in England by the Subsidy Act of 1660. In France, before the revolution (besides the free ports) Al- sace and the Lorraine Bishoprics were in trade matters treated as foreign countries. The unification of the Ger- man customs tariff began in 1834 vrith the Steuerverein and the Zollverein. The Spanish fiscal system did not include the Basque provinces until about 1850. The uni- form Italian tariff dates from 1861. Thus until verj- re- cent times on the Continent free ports were compatible with the fiscal policy and practice of different countries. (3) Along the Mediterranean coast, up to the 19th century, convenient shelter was needed from corsairs. In other Continental countries the prevalent colonial and mer- cantile policy sought to create trans-oceanic trade. Free ports were advantageous from all these points of view.

In following the history of these harbours in Europe, it is to be observed that in Great Britain free ports have never existed. In 1552 it was contemplated to place Hull and Southampton on this footing but the design was abandoned. Subsequently the bonding and not the free port system was adopted in the United Kingdom.

Austria-Hungary. ??? Fiume and Trieste were respectively free ports during the periods 1722-1893 and 1719-1893.

Belgium. ??? The emperor Joseph II. during his visit to the Austrian Netherlands in June 1781 endeavoured to create a direct trade between that country and India. Ostend was made a free port, and large bonding facilities were afforded at Bruges, Brussels, Ghent, and Louvain. In 1796, however, the revolutionary govern- ment abolished the Ostend privileges.

Denmark. ??? In November 1894 an area of about 150 acres at. Copenhagen was opened as a free port, and greai facilities are afforded for shipping and commercial operations in order that the Baltic trade may centre there.

France. ??? Marseilles was a free port in the Middle Ages, and so was Dunkirk when it formed part of Flanders. In 1669 these privi- leges were confirmed, and extended to Bayotine. In 1784 there was a fresh

confirmation, and Lorient and St Jeande Luz were included in the ordoniiaiice. The National Assembly in 1790 maintained this policy, and created free ports in the French West Indies. In 1795, however, all such privileges were abolished, but large bonding facilities were allowed at Marseilles to favour the Levant trade.

1 In China at the present time (1902) certain ports are designated " free and open." This phrase means that the ports in question ara (1) open to foreign trade, and (2) that vessels engaged in over-sea voyages may freely resort there. Exemption from payment of cus- toms duties is not implied, which is a matter distinct from the per- mission granted under treaty engagements to foreign vessels to carry cargoes to and from the " treaty ports."

The government of Louis XVIII. in 1814 restored, and in 1817 again revoked, tiie free port privileges of Marseilles. There are now no free ports in France or in French possessions ; the bond- ing system is in force.

Germany. ??? Bremen, Hamburg, and Liibeok vfere reconstituted free towns and ports under the treaties of 1814-15. Certain minor ports, and several landing stages on the Rhine and the Neckar, were also designated free. As the Zollverein policy became accepted throughout Germany, previous privileges were gradually lessened, and since 1888 only Hamburg remains a free port. There an area of about 2200 acres is exempt from customs duties and control, and is largely used for shipping and commercial purposes. Brake, Bremen, Bremerhaven, Cuxhaven, Geestemiinde, and Liibeck are now " Freibezirke," and in 1899 free areas were opened under similar conditions at Neufahrwasser (the entrance to Danzig) and at Stettin. Heligoland is outside the Zollverein ??? practically a foreign country.

In Italy free ports were numerous and important, and possessed privileges which varied at different dates. They were ??? Ancona, during the

period 1696-1868 ; Brindisi, 184-5-62 ; Leghorn (in the 17th and 18th centuries a very important Mediterranean harbour), 1075-1867 ; Messina, 1695-1879 ; Senigallia, 1821-68, during the month of the local fair. Venice possessed warehouses, equivalent to bonded stores, for German and Turkish trade during the Repub- lic, and was a free port 1851-7.3. Genoa was a free port in the time of the Republic and under the French Empire, and was con- tinued as such by the treaties of 1814-15. The free port was, however, changed into a " deposito franco " by a law passed in 1865 and only storing privileges now remain.

Bumania. ??? Braila, Galatz, and Kustenji were free ports (for a period of about forty years) up to 1883, when bonded warehouses were established by the Rumanian Government.

Russia. ??? Archangel was a free port, at least for English goods, from 1553 to 1648. During this period English products were admitted into Russia vid, Archangel without any customs payment for internal consumption, and also in transit to Persia. The Tsar Alexis revoked this grant on the execution of Charles I. Free ports were opened in 1895 at Kola, in Russian Lapland, and in 1899 at Dalny, adjoining Port Arthur.

The number of free ports outside Europe has also lessened. The administrative policy of European countries has been gradually adopted in other parts of the world, and customs duties have become almost universal, conjoined with bonding and transhipment facili- ties. In British colonies and possessions, under an Act of Parliament passed in 1766, and repealed in 1867, two ports in Dominica and four in Jamaica were free. Malacca, Penang, and Singapore had been free ports since 1824, and Hong-Kong since 1842. Zanzibar was a free port during 1892-99. Aden, Gibraltar, St Helena, and St Thomas (West Indies) are sometimes designated free ports. A few duties are, however, levied, which are really octroi rather than customs charges. These places are mainly stations for coaling and awaiting orders.

Some harbours in the Netherlands East Indies were free ports between 1829-99 ; but these privileges were withdrawn by laws passed in 1898-99, in order to establish uniformity of customs administration. Harbours where custom houses are not maintained will be practically closed to

foreign trade, though the governor- general may in special circumstances vary the application of the new regulations.

Macao has been a free port since 1845. Portugal has no other harbour of this character.

The American Republics have adopted the bonding system. In 1896 a free wharf was opened at New Orleans in imitation of the recent European plan. Livingstone (Guatemala) was a free port during the period 1882-88.

The privileges enjoyed under the old free port system benefited the tovrns and districts where they existed ; and their abolition has been, locally, injurious. These places ~~were, however, " foreign " to their own country, and their inland intercourse was restricted by the duties levied on their products, and by the precautions adopted to pre~~ vent evasion of these charges. With fiscal usages involv- ing preferential and deferential treatment of goods and places, the drawbacks thus arising did not attract serious attention. Under the limited means of communication within and beyond the country, in former times, these conveniences were not much felt. But when finance de- partments became more completely organized, the free port system fell out of favour with fiscal authorities : it afforded opportunities for smuggling, and impeded uni- formity of action and practice. It became, in fact, out of harmony with the administrative and financial policy

of later times. Bonding and entrepot facilities, on a scale commensurate with local needs, now satisfy trade requirements. In countries where high customs duties are levied, and where fiscal regulations are minute and rigid, if an extension of foreign trade is desired, and the competition which it involves is a national aim, special facilities must be granted for this purpose. In these cir- cumstances a free zone sufficiently large to admit of com- mercial operations and transhipments on a scale which will fulfil these conditions (watched but not interfered with by the customs) becomes indispensable. The German Government, have, as we have seen, maintained a free zone of this nature at Hamburg. And when the free port at Copenhagen was opened, counter measures were adopted at Danzig and Stettin. Proposals are under consideration for establishing free areas at Antwerp and at Wartan, near Stockholm. An agitation has arisen in

France to provide at certain ports free zones similar to those at Copenhagen and Hamburg, and to open free ports in French posses- sions. Resolutions to this effect were brought before the Chamber of Deputies in March 1899, and were referred to- the Commission de Commerce et de I'Industrie : the ulti- mate action of the Legislature and Government is doubt- ful. Colonial free ports, such as Hong-Kong and Singa- pore, do not interfere with the uniformity of the home customs and excise policy. These two harbours in par- ticular have become great shipping resorts and distributing centres. The policy which led to their establishment as free ports has certainly promoted British commercial interests. (c. m. k*.)

Freiberg, a town of Germany, 2 miles west of the Freiberger Mulde, 19 miles by rail south-west of the town and in the circle of Dresden, kingdom of Saxony. There are 5 Protestant churches and 1 Catholic church. The library of the Academy of mines has now upwards of 36,000 volumes, besides MSS. and maps ; and, in addition to a gymnasium and a real school, there are a commercial, a mining, a tanning, and an agricultural school. Population

(1890), 28,965 ; (1900), 30,176.

Freiburg in the Bebisgatj, a town and archiepis- copal see of Germany, grand-duchy of Baden, at the west foot of the Black Forest, 38 miles by rail north-north-east from Basel. A characteristic feature of the town is its numerous fountains. Another conspicuous ornament is the monument (1876) which commemorates the 14th (Ger- man) Army Corps and General von Werder for the part they took in the war of 1870-71. In 1900 the university was attended by 1766 students and had 119 professors. The town possesses further the church of St Martin's (13th century, restored in 1880-81), a synagogue (1871), a museum, the corn market (1876), a theological semi- nary, a technical, an agricultural, and a commercial school. Population (1885), 42,596; (1900), 61,513.

Freiburg, or Feiboueg, one of the Swiss cantons, with an area of 644 square miles, of which 78 square miles may be regarded as " unproductive." Of the rest, 113 square miles are covered by forests, and rather over f square mile by vineyards. There are 281 communes in the

canton, distributed over seven districts. The dis- trict of Sarine in 1900 numbered 33,052 inhabitants, that of the Singine or Sense had 18,800, that of the Gruyere had 22,936, that of the Lake had 16,440, that of the Gltne had 14,298, that of the Broye (capital, Estavayer or Staffis) had 14,780, and that of the Veveyse had 8413. Besides the railway westwards from Freiburg to Estavayer past Payerne, there is another running north- wards from Freiburg to Morat (Murten), while steamers ply on the Lake of Morat. One of the most interesting and most curious points relating to the canton is that the

linguistic frontier between French and German not merely passes through it from north to south, but actually passes through its capital, Freiburg. In 1888 the population of the canton was 119,166, of whom 100,067 were Eoman Catholics, 18,925 were Protestants, and 125 Jews. In 1900 the total population was 127,719, of whom 87,541 were French- speaking folk, while 38,769 spoke German. The cantonal constitution of 1857 still prevails, having been modiiied in only a very few minor respects since that date. It is remarkalDle as containing none of the modern devices (referendum, initiative, proportional representa- tion), save the right of "initiative" of 6000 citizens to demand a revision of the cantonal constitution. In 1897 the state revenue of the canton was 3,544,222 francs (a rise of 12^ per cent, since 1886), and the state expendi- ture 3,476,083 francs (also a rise of 12^- per cent, since 1885), but in 1898 there was a deficit of 6910 francs. In 1897 the public debt was 38,803,600 francs, the largest cantonal debt in Switzerland, save in the case of Bern.

See Daguet. Histoire de la Ville et Seigneurie de Frihourg (to 1481), 1889. ⁂ Dellion. Dictionnaire Mstorique-statistique des paroisses Catholiques du Canton de F.,6 vols. Fribourg, 1884-88. ⁂ Heyck. Cfeschichte d. Herzoge von Zdhringen. Freiburg i/B. 1891. ⁂ Kdenlin. Der Kant. Freiburg. St Gallen and Bern, 1834. ⁂ ZiMMEKLi. Die Deutsch-Franzosische Sprachgrenze in d. Schweiz, vol. ii. 1895. (w. A. b. c.)

Freiburg, or Feiboubg, capital of the above canton, on the railway between Bern (20 miles distant) and Lau- sanne (41 miles distaut). Since 1663 the bishop of Lau- sanne has resided in Freiburg. The cantonal museum contains many antiquities, and also the paintings and statuary left to the town in 1879 by " Marcello," the ar- tistic nom de guerre of the Duchess Adela Golonna, a member of the Fribourg family of d'Affry. In 1889 a Eo- manist University was founded in Freiburg ; during the winter of 1899-1900 it was attended by 373 students. The span of M. Chaley's bridge is 808 feet, and two more wire cables (with 2238 strands) were added in 1880-81. It is 167 feet in height, but the Gotteron bridge is 246 feet high. The Grandfey viaduct is 249 feet high. In 1900 the population was 15,773.

Freienwalde, a town of Prussia, on the Oder, 28 miles north-east of Berlin ; capital of the circle of Ober- Barnim, government district of Potsdam, province of Brandenburg ; on the Frankfurt-Angermiinde railway. Medical springs in the neighbourhood make it a favourite summer watering-place for the people of Berlin. A new tower commands a fine view of the Oderbruch. There are water-glass and brick works. Population (1890), 7259 ;

(1900), 7989.

Freising, a town of Bavaria, Germany, district Up- per Bavaria, on the Isar, 16 miles by rail north-north-east of Munich. The former Benedictine abbey (725-1803) of Weihenstephan is the seat of a royal model farm and brewery, with agricultural, horticultural, and brewing school, and an agricultural museum. Population (1885),

9125 ; (1900), 10,090.

Fremantle, town and chief port of West Australia, at the mouth of the Swan river, 12 miles south-west from Perth, with which it is connected by rail and cargo steamers. There are a town hall, handsome Episcopal church, and various other public buildings, and a recrea- tion ground. The harbour is not naturally a good one, but improvements have been effected, including the construction of two moles. Fremantle is the western terminus of the Eastern railway. The mean temperature for the

year is 63-2 F. ; for January, 73-4 ; for July, 55-0 . Population (1881), 3641; (1900) (with suburbs),

20,369.

Fremont, John Charles (1813-1890), American explorer and politician, was born in Savannah, Ga., 21st January 1813. His father, a native of France, died when he was yet a boy, and his mother, a Virginian, removed to Charleston, S. C. He had a taste for mathematics, but was otherwise far from being a hard-working student ; he was even expelled from Charleston College. Subsequently, however, he was given a degree, and passed an exami- nation for a professorship in the United States navy ; but he declined this appointment to give his attention to civil engineering in connexion with railways. In the spring of 1838 he became assistant to the French ex- plorer Nicollet, whom the War Department employed to make a map of the country extending from the upper waters of the Missouri river to the British boundary line. Fremont showed great talent as an ex- plorer in the five important expeditions he made in the north- west. The object of the first expedition was to obtain accurate knowledge as to the character of the territories of Nebraska and Wyoming, and especially of South Pass, the opening through the mountains on the way to Oregon (1842). The purpose of the second expedition (1843 44) was to explore the possible lines of communication between Missouri, Nebraska, Wyoming, Utah, Idaho, and Oregon, and find a way by land from the lower Columbia river to the Bay of San Francisco. The third expedition, begun in 1846, was designed to explore the great basin and the coast regions of Cali- fornia and Oregon, but it was changed by events con- nected with the Mexican war into a military and political conquest. From Oregon Fremont went to the Mexican province of California, and collected under his standard the scattered settlers who sided with the Americans in opposition to the Mexicans in the war then in progress. In less than thirty days he won the territory from the Mexicans, and, on 4th July 1846, was chosen its governor. A few months later JMexican authority was withdrawn, and California thenceforth belonged to the United States. In 1848, Fremont undertook at his own expense to dis- cover a passage to California vi& the headwaters of the Eio Grande, along a route subsequently followed by the South- ern Pacific railway.

His fifth and last expedition, begun in 1863, was for the purpose of finding the best route for a national railway from the Mississippi valley to the Pacific Ocean. When, in 1860, California was admitted as a state, Fremont became one of her first two senators. But as he drew the short term he had only three weeks of service in the United States Senate, and he failed to obtain re-election on account of his anti-slavery opinions. In 1856 the newlj— formed Eepublican party was in search of a popular anti- slavery man as candidate for the Presidency, and Fremont, then only forty-three years old, was noniinated by both the Eepublicans and the National Americans. It was still too soon, however, for an anti-slavery policy to win the con- fidence of a majority of the voters, and he was defeated by Buchanan. Fremont was in Europe when the Civil War began. He purchased for the Federal Government a large supply of arms from France, and was appointed major- general in the regular army, with headquarters in St Louis. His military training had not been sufficient to fit him for so high a command. He declared martial law, arrested secessionists and muzzled the opposition press ; but as he lacked system and executive ability his affairs soon became badly involved and he was subjected to damaging criticism. In August 1861, he announced his intention to emancipate the slaves of all Missourians in rebellion against the United States ; but as this announcement was in advance of public opinion, President Lincoln decided to annul it. In Nov- ember 1861 Fremont was removed on account of the alleged extravagance and inefficiency of his management of military affairs. In compliance with popular sympathy

he was placed in command of the mountain district south of the Ohio river, but his operations against ” Stonewall ” Jackson were not sufficiently successful to inspire confi- dence. In June 1862, his corps was incorporated in the Army of Virginia, and he asked to be relieved from ser- vice under its commander, General Pope. Thenceforth he held no command. Fremont’s picturesque career and his anti-slavery ideas made him a favourite of the Repub- licans, who were discontented with

Lincoln's administra- tion, and, in May 1864, he was nominated as their can- didate for the Presidency, but he withdrew, lest his ox^position to Lincoln might result in the election of a Democrat. After the war he was interested in the plan for a trans-continental railway between Norfolk, Va., and San Francisco, which proved to be a very unsuccessful financial enterprise. From 1878 to 1881 he was governor of the territory of Arizona. In his last years Congress authorized the President to appoint him major-general and placed him on the retired list. He died in New York on the 13th of July 1890. A volume of his memoirs, covering only the earlier part of his life, was published in 1886.

Fremont, capital of Dodge county, Nebraska, U.S.A., in 41 ° 26′ N. and 96 ° 30′ W., on the north bank of the Platte river, at an altitude of 1200 feet. It is on three railways, the Union Pacific (main line), the Fremont, Elkhorn, and Missouri Valley, and the Sioux City and Pacific. It is regularly laid out, has a good water supply and sewerage, and has stock-yards, packing-houses, and some manufactures. Population (1880), 3013; (1890), 6747 ; (1900), 7241, of whom 1303 were foreign-born.

Fremont, capital of Sandusky county, Ohio, U.S.A., on the Sandusky river, at an altitude of 630 feet. It is on three important railways, the Lake Shore and Michi- gan Southern, the Lake Erie and Western, and the Wheel- ing and Lake Erie. Both petroleum and natural gas are obtained in the neighbourhood. Population (1880), 8446 ; (1890), 7141 ; (1900), 8439, of whom 1074 were foreign-born, and 137 negroes.

French Congo. ° The French colony in Equatorial Africa described by the name of French Congo has a coast-line along the Atlantic extending from 1 ° N. lat. to 6 ° S. lat., and stretching inland up to the 10th north- ern parallel, where it joins on to the French sphere of influence around Lake Chad. As defined by various con- ventions (see History), the limits of this possession are as follows: ° Inland from the Muni estuary, which is the northern extremity on the coast, the boundary marches with that of the Spanish settlements, first east to about 11 ° 30′ E. long., and then north to the frontier of the German colony of Cameroon, in 2 ° N. lat., with which it runs east to the 16th meridian, and then north as far as the French Congo extends. Inland

from the Lueme estuary, which is the southern limit on the coast, the boundary coincides first with that of the disconnected Portuguese territory of Kabinda, and then with that of the Congo Free State, running north-east and east along the Congo, the Ubangi, and the Mbomu. Near the parallel of 5 N. lat., to the south of the Sultanate of Tambura, the boundary turns northwards, and thence skirts the territories of Bahr el Ghazal and Fertit to the 10th parallel.

Physical Feaktres. The principal variations in the coast-line are Cape St John, the Bay of Corisco, the estu- ary of the Gaboon, Cape Lopez, the mouths of the Ogowe, the Bay of Mayumba, the roadstead of Loango, and the Pointe Noire. The coast region is low and marshy. Behind there is a ridge which rises from 3000 to 4500 feet, called the Crystal Mountains, then a plateau with an elevation varying from 1500 to 2800 feet, cleft

with deep river-valleys, the walls of which are friable, almost vertical, and in some places 760 feet high. The coast rivers flowing into the Atlantic cross four terraces. On the higher portion of the plateau their course is over bare sand ; on the second terrace, from 1200 to 2000 feet high, it is over wide grassy tracts ; then, for 100 miles, the course passes through virgin forest, and, lastly, crosses the shore region, which is about 10 miles broad. The river-courses of French Equatorial Africa thus, in some respects, resemble those of Scandinavia. With rare ex- ceptions, they are not navigable. On the north, the Kio Campo, 80 miles long, is unimportant. The San Benito or Eyo, visited by Crampel in 1889, probably descends from Cameroon. The Muni, which runs to the south of Cape St John, is under 40 miles in length. The Gaboon is rather a bay than an estuary ; it is about 10 miles wide and receives the Como and the Rembo. The Ogowe rises near 2 40' S. lat., half-way between the coast and the Congo ; first flowing in a north-westerly direction, forming numerous rapids and receiving the Passa, which waters Franceville, and the Nkoni, it then bends westwards, receives on the north the Ivindo, waters Lop^ and N' Jole near its confluence with the Okano, and thence, after being increased by the Ngunie, flows southwards. After issuing from the mountains it becomes wider for several miles, being fed by the lagoons Anenge and Zonengue,. and divides into several arms round Cape Lopez.

It is navigable from its mouth to N'Jole, a distance of 235 miles. Its whole length is at least 750 miles. Other- rivers are the Nyanga, 120 miles long, and the Kwilu. The latter, 320 miles in length, is formed by the Kiasi and the Lu^te ; it has a very winding course, flowing by turns from north to south, from east to west, from south to north-west, and from north to south-west. It is en- cumbered with rocks and eddies, and is navigable only over 38 miles, and for five months in the year. 450 miles of the Congo are comprised within the boundary-line. The most important French post on the river is Brazza- ville, situated at the lower end of the reach called Stanley Pool. The Ubangi receives from French territory the Ibenga and the Kemo.

Fauna and Flora. ??? The fauna includes the gorilla, the chimpanzee, the elephant, the hippopotamus, the alligator, and numerous serpents. There are few domestic animals, except fowls. As to the flora, it is remarkable for its splendour and variety. The forests contain bamboo, ebony, sandal-wood, baobab, caoutchouc, the castor plant, earth-nuts, &c.

Climate. ??? The climate is everywhere very warm, and dangerous for Europeans. On the coast four seasons are distinguished : the dry season (16th May to 15th Sep- tember), the rainy season (15th September to 15th Jan- uary), then a second dry season (16th January to 1st March), and a second rainy season (1st March to 1st May). The rainfall at Libreville is about 8 feet.

History of Occupation. ??? France acquired the estuary of the Gaboon in 1841-44, by agreement with native chiefs, to serve as a re-victualling station for vessels appointed to watch the coast. In 1849 Libreville was founded by a convoy of slaves taken from a slave-ship. In 1862 Cape Lopez was ceded to France, and the colony extended along the coast, nominally to the length of 200 miles. In the meantime the exploration of the interior had been begun. Du Chaillu penetrated (1856-65) to the south of the Ogowe; Walker, an Englishman, explored the Ngunie, an affluent of the Ogowe, in 1866. In 1872-1875 Marche and Compiegne examined the same river as far as the mouth of the Ivindo. In

1875 de Brazza began his travels, ascending in 1876-78 the Ogowe for more than 400 miles, and thence striking across to the Congo,

which Stanley had just revealed. In a second journey (1879-82) he founded Brazzaville and explored the Kwilu, at the same time carrying on negotiations with the King of the Bateke. Loango was occupied in 1883. In the same year de Brazza set out at the head of the West African Expedition, and in the course of two years acquired new territories for France. The convention of February 1885 determined the frontier of the Congo Free State (then the International Association) ; bound- ary agreements were made with Germany (December 1885) and Portugal (May 1886) ; the zones of the north and south were delimited ; and an arrangement with the Congo Free State in 1887 settled difEiculties relating to the Ubangi, France abandoning the preferential rights which she had received in 1884. By creating the posts of Bangi (1890), Wesso, and Abira (1891), France ex- tended her influence along the Ubangi and the Sanga. But at the same time the Belgians passed the parallel of 4◆◆ N. lat. ◆◆◆ which, after the compromise of 1887, France had regarded as the southern boundary of her possessions ◆◆◆ and, occupying the Sultanate of Bangasso, pushed on as far as 9◆◆ IST. lat. The dispute which thus arose was only settled in 1894 after the Anglo- Congolese Convention of May 12 of that year, against which both the German and the French Governments protested. By a compromise of August 14, the boundary was definitely drawn and, in accordance with this pact, which put the frontier back to about 4◆◆ N. lat., France from 1895 to 1897 took possession of the Upper Ubangi, with Bangasso, Eafai, and Semio. Then began the French encroachment on the Bahr el Ghazal ; the Mar- chand Expedition, despatched to the support of M. Liotard, the Lieutenant-Governor of the Upper Ubangi, reached Tambura in July 1897, and Fashoda in July 1898. A dispute with Great Britain arose, and it was decided that the expedition should evacuate Fashoda. The convention of 21st March 1899 finally terminated the dispute. Thus, after the Franco-Spanish treaty of June 1900, settling the limits of the Spanish

territory on the coast, the boundaries of the French Congo on all its frontiers were determined.

The important places are Libreville, with 3000 inhabit- ants ; Bangi, on the Ubangi ; Brazzaville, on the Congo, which, with the advent of the concessionaires (see below), has made rapid strides forward ; Buensa ; Franeeville, near the Ogowe ; Loango, a port much frequented ; and N'Jole, on the Ogowe.

*Area and Population. ◆◆◆ The area has been estimated at about 550,000 square miles. The population can be even less accurately determined, no kind of census whatever being yet possible. Perhaps 8,000,000 is the nearest approach to the right number. The natives belong either to a negro race (Loanga Bateke, Bubargi) or to a race crossed with red blood (Paheeni). The French Congo is now administered by a governor-general, assisted by a council composed of three official and three civilian members. He bears the title of Commissaii-e-Geii<'ral, and has under his orders a lieutenant-governor for the Congo Proper, and another for the LTpper Ubangi. A Government Commissioner is appointed for the Shari region. The seat of government is at Libreville. There is a tribunal of first instance, a paymaster-general, a vicar-apostolic, and a commandant for the naval station. It was only in 1889 that it became necessary for even the *hief officials for the administration of justice to be legal magistrates. The budget for 1901 balanced at i^2'2i'>,000. In the estimated receipts France figured for ◆◆83,000, in-direct contributions for ◆◆55,000, and returns from the concessions for ◆◆23,500. Of the estimated expenditure ◆◆55,000 was for administration, ◆◆00,000 for the occupa- tion of the Shari.*

For the exploitation of the colony the system has been adopted of farming out large areas to different companies. The terms of land tenure, &c., are mainly regulated by decrees of March 1899. Concessionaires are bound to pay rent, to provide security, and to contribute to the customs stations. Up to 1st September 1899, 37 con- cessions had been made, and it was estimated that 36 of these covered an area of nearly 240,000 square miles, the grants varying from 425 square miles to 54,000 square miles.

The natives cultivate manioc, which is their principal food. Eubber and ivory are as yet the only outstanding sources of wealth. In 1898, out of a total value of ex- ports of ££227,800, the former stood for ££91,000 and the latter for ££61,500. Other considerable exports are timber and palm-tree products. Warnings have been heard that the supply of ivory is likely to run out if the present abusive manner of collecting it be persisted in. On the other hand, the cultivation of the coifee and cacao plants is spreading; on 1st January 1899 there were 300,000 of the former and 200,000 of the latter. The cultivation of vanilla is also receiving considerable attention, and the rearing of zebras may yield good results. France obtained only ££60,000 of the exports. Great Britain was the best customer, taking two-thirds of the rubber and more ivory than either France or Ger- many, which has the next largest share in the trade. The imports in 1898 were valued at ££193,750, of which France sent only ££51,300. Textiles figured in the total for ££76,000. No other import approached this figure ; the chief were hardware, intoxicants, and arms. In 1899 a committee was revived at Libreville by decree to watch over and advise upon all points connected with the economic development of the colony. The improve- ment of the country has already begun, and the planta- tions on the coast, as well as the factories on the Sanga and the Ubangi, are becoming profitable; but satisfac- tory results will only be attained when transport is facilitated, and the produce of the interior, including ivory, gold, copper, and iron, can be easily conveyed to the coast. It should be observed that no imports are charge- able on foreign merchandise conveyed inland, either in the basins of the Congo and Kwilu, in virtue of the Berlin Act of 1885, or in that of the Shari, in virtue of the Anglo- French Convention of 1899. Though internal communica- tions are not organized, the utilization of the valleys of the Ogowe and the Kwilu has for several years been under consideration, and a survey for a railway between the Gaboon and the Sanga was made in 1899 In the mean- time, produce from Brazzaville can be sent by the Bel- gian railway, which passes round the falls of the Congo and rejoins the river at Matadi, where it is navigable. A telegraph line from Loango to Brazzaville is being con- structed. There is telegraphic communication with Europe by a British submarine cable, and steamship communi- cation between Libreville and Marseilles, Bordeaux, Liv- erpool, and Hamburg. The port

of Libreville should be improved and made accessible to the largest vessels.

Authorities. ??? Barret. Sencgambie, Region Gahonnai^e, &e. Paris, 1888. ??? Henrique. Les Colonies Fnin^aises. Paris, 1800. ??? Kkuger. Le Congo. Paris, 1890. ??? Dutreuil he Euyns. Lp Congo. Paris, 1885. ??? Dk Chavanne. La Mission Je Bra::::a, Paris,]880.^Kei,tie. TIw Partition of Africa. London,]80Ci. ??? Lee. French Colonies. Foreign Office Report, 1900. ??? UAtinee GoloniaJc. Paris, 1900. (p. l.)

Frere, Sir Henry Bartle Edward (1815-1884), rUitish administrator, born at Clydach, at Brecknock- shire, on 29th March 1815, was the son of Edward Frere, a member of an old east county family, and a nephew of John Hookham Frere, of Anti-Jacobin and Ari.'ito- phanes fame. After leaving Haileybury, Bartle Frere

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was appointed a writer in the Bombay Civil Service in 1834, and went out to India by the then unfamiliar over- land route. Having passed his examination in the native languages, he was appointed assistant collector at Poona in 1836. There he did valuable work in checking the extortion of the native officials, gained the confidence both of the people and of his superiors, and was in 1842 chosen as private secretary to Sir George Arthur, governor of Bombay. Two years later he became po- litical resident at the court of the Eajah of Sattara, where he did much to benefit the country by the de- velopment of its communications. On the Kajah's death in 1848 he administered the province both before and after its formal annexation in 1849. In 1850 he was ap- pointed chief commissioner of Sind, and took ample ad- vantage of the opportunities afforded him of developing the province. He pensioned off the dispossessed amirs, improved the harbour at Karachi, where he also estab- lished municipal buildings, a museum, and barracks, instituted fairs, multiplied roads, canals, and schools. Returning to India in 1867

after a well-earned rest, Erere was greeted at Karachi with news of the mutiny. His rule had been so successful that he felt he could answer for the internal peace of his province. He therefore sent his only European regiment to Mooltan, thus securing that strong ‘ fortress against the rebels, and sent further detachments to aid Sir John Lawrence in the Punjab. The 178 British soldiers who remained in Sind proved suflS.cient to extinguish such insignificant outbreaks as occurred. His services were fully recognized by the Indian authorities, and he received the thanks of both houses of Parliament, and was made K.C.B. He became a member of the Viceroy’s council in 1859, and was especially ser- viceable in financial matters. In 1862 he was appointed governor of Bombay, where he effected great improve- ments, such as the demolition of the old ramparts, and the erection of handsome public offices upon a portion of the space, the inauguration of the university buildings, and the improvement of the harbour. He established the Deccan College at Poona, as well as a college for instruct- ing natives in civil engineering. The prosperity ??? due to the American civil war ??? which rendered these develop- ments possible brought in its train a speculative mania, which led eventually to the disastrous failure of the Bom- bay Bank (1866), an affair in which, from neglecting to exercise such means of control as he possessed, Prere in- curred severe and not wholly undeserved censure. In 1867 he returned to England, was made G.C.S.I., and received honorary degrees from Oxford and Cambridge ; he was also appointed a member of the Indian Council. In 1872 he was sent by the Foreign Office to Zanzibar to negotiate a treaty with the sultan, Sayyid Burghash, for the suppres- sion of the slave traf&c. In 1875 he accompanied the Prince of Wales to Egypt and India. The tour was be- yond expectation successful, and to Frere, from Queen Victoria downwards, came acknowledgments of the service he had rendered in piloting the expedition. He was asked by Lord Beaconsfield to choose between being made a baronet or G.C.B. He chose the former, but the Queen bestowed both honours upon him. But the greatest service that Frere undertook on behalf of his country was to be attempted not in Asia, but in Africa. Sir Bartle landed at Cape Town as High Commissioner of South Africa on 31st March 1877. He had been chosen by Lord Carnarvon in the previous October as the statesman most capable of carrying his scheme of confederation into effect, and within two years it was hoped that he would be the first governor of the South

African Dominion. He went out in harmony with the aims and enthusiasm of his chief, " hoping to crown by one great constructive effort the work of a bright and noble life."

Discord or a policy of blind drifting seemed to be the alternatives presented to Frere upon his arrival. He chose the former as the less dangerous, and the first year of his sway was marked by a Kaffir war on the one hand and by a rupture with the Cape (Molteno-Merriman) ministry on the other. The Transkei Kaffirs were sub- jugated early in 1878 by General Thesiger and a small force of regular and colonial troops. The constitutional difficulty was solved by Frere dismissing his obstructive cabinet and entrusting the formation of a ministry to Mr Gordon Sprigg. Frere emerged successfully from a year of crisis, but the advantage was more than counterbal- anced by the resignation of Lord Carnarvon early in 1878, at a time when Frere required the steadiest and most unflinching support. He had reached the con- clusion that there was a widespread insurgent spirit per- vading the natives, which it was necessary to put down, and that it should be suppressed speedily and once for all by the direct action of the imperial power ??? not merely scotched by setting Boer against Zulu or Kaffir against Fingo. He became aware that this insurgent spirit had its focus and strength in the celibate military organization of Cetywayo and in the prestige which impunity for the outrages he had committed had gained for the Zulu king in the native mind. That organization and that evil prestige must be put an end to, if possible by moral pressure, but otherwise by force. Frere reiterated these views to the Colonial Office, where they found a general acceptance. When, however, in view of a series of outrages upon the Natal border (not so much serious in themselves as indi- cating a feeling of contempt and defiance), Frere under- took the responsibility of forwarding an ultimatum to the Zulu chief in November 1878, the Home Government abruptly discovered that a native war in South Africa was inopportune, and raised difficulties about reinforce- ments. Having entrusted into Lord Chelmsford's hands the enforcement of the British demands, Frere's imme- diate responsibility ceased. On 10th January 1879 the British troops crossed the Tugela, and fourteen days later the disaster of Isandhlwana was reported ; and Frere, attacked and censured in the House of Commons, was but feebly defended by the Government. Lord

Beaconsfield, it appears, supported Frere; the majority of the cabinet were inclined to recall him. The result was the unsatisfactory compromise by which he was censured and begged to stay on. Frere wrote an elaborate justifi- cation of his conduct, which was adversely commented on by the Colonial Secretary (Sir M. Hicks-Beach), who "did not see why Frere should take notice of attacks ; and as to the war, all African wars had been unpopular." Frere's rejoinder was that no other sufficient answer had been made to his critics, and that he wished to place one on record. "Few may now agree with my view as to the necessity of the suppression of the Zulu rebellion. Few, I fear, in this generation. But unless my countrymen are much changed, they will some day do me justice. I shall not leave a name to be permanently dishonoured." The Government had some excuse for irritation, but the disaster of Isandhlwana ought to have been visited upon the military authorities and not upon Frere.

The Zulu trouble and the disaffection that was brewing in the Transvaal reacted upon each other in the most disastrous manner. Frere had borne no part in the actual annexation of the Transvaal, which was announced by Sir Theophilus Shepstone a few days after the High Com- missioner's arrival at Cape Town. The delay of Shepstone to give the country a constitution gave a pretext to the malcontent Boers, a rapidly increasing minority, while the reverse at Isandhlwana had lowered British prestige. Owing to the Kaffir and Zulu wars Sir Bartle had hitherto been unable to give his undivided attention to the state of

things in the Transvaal. Much had been effected since the annexation by Shepstone and his successor, Owen Lanyon : debts paid, credit restored, the Zulu trouble rolled away. At the same time the grievances of the Boers were genuine. An autocratic regime had been set up, while no signs were forthcoming of the free constitu- tion promised by Shepstone. In April 1879 Sir Bartle ⁄ was at last able to visit the Transvaal, and the conviction ⁄ was forced upon him that the government had been

unsatisfactory in many ways. The country was very un- settled. A large camp, numbering 4000 disaffected Boers, had been formed near Pretoria, and they were terrorizing the country. Frere visited them unarmed and practically alone. Even yet all might have been well, for he won the Boers' respect and liking. On the condition that the Boers dispersed, Frere undertook to represent their com- plaints to the British Government, and to urge the fulfil- ment of the promises that had been made to them. They parted with mutual good feeling, and the Boers did eventually disperse ??? on the very day upon which Frere received the telegram announcing the Government's cen- sure. He returned to Cape Town, and his journey back was in the nature of a triumph. But bad news awaited him at Government House. On 1st June 1879 the Prince Imperial had met his death in Zululand, and a few hours later Frere heard that the High Commissionership, with the care of affairs in the Transvaal and Zululand, had been transferred from him to Sir Garnet Wolseley. When j\Ir Gladstone's ministry came into office in the spring of 1880, Lord Kimberley had no intention of recalling Frere. In June, however, a section of the Liberal party memo- rialized Mr Gladstone to remove him, and the Prime Minister weakly complied (1st August 1880). Upon his return Frere replied to the charges relating to his conduct respecting Afghanistan as well as South Africa, pre- viously preferred in Mr Gladstone's Midlothian speeches, and was preparing a fuller vindication when he died at Wimbledon from the effect of a severe chill, 29th May 1884. He was buried in St Paul's, and in 1888 a statue of Frere upon the Thames Embankment was unveiled by the prince of Wales. His Life and Correspondence, by John Martineau, was published in 1895. Frere himself edited the works of his uncle, Hookham Frere, and the popular story-book. Old Deccan Days, written by his daughter, Mary Frere. He was three times president of the Royal Asiatic Society. (t. se.)

Frere-Orban, Hubert Joseph Walther (1812-

1896), Belgian statesman, was born at Liege on 24th April 1812. His family name was Frere, to which on his marriage he added his wife's name of Orban. After studying law in Paris, he practised as a barrister at Liege, took a prominent part in the Liberal movement, and in June 1847 was returned to the Chamber as member for Liege. In August of the same

year he was appointed Minister of Public Works in the Kogier Cabinet, and from 1848 to 1852 was Minister of Finance. He founded the Banque Nationale and the Caisse d'fipargne, abolished the newspaper tax, reduced the postage, and modified the customs duties as a preliminary to a decided free-trade policy. The Liberalism of the Cabinet, in which Frfere- Orban exercised an influence hardly inferior to that of Eogier, was, however, distasteful to Napoleon III. Fr6re- Orban, to facilitate the negotiations for a new commercial treaty, conceded to France a law of copyright, which proved highly unpopular in Belgium, and he resigned office, soon followed by the rest of the Cabinet. His work La Mainrmrte et la charite (1854-57), published under the pseudonym of Jean van Damme, contributed greatly to restore his party to power in 1857, when he again became Minister of Finance. He now embodied his

free-trade principles in commercial treaties with England and France, and abolished the octroi duties and the tolls on the national roads. He resigned in 1861 on the gold question, but soon resumed office, and in 1868 succeeded Rogier as Prime Minister. In 1869 he defeated the attempt of France to gain control of the Luxembourg railways, but, despite this service to his country, fell from power at the elections of 1870. He returned to office in 1878 as President of the Council and Foreign Minister. He provoked the bitter opposition of the Clerical party by his law of 1879 establishing secular primary education, and in 1880 went so far as to break off diplomatic relations with the Vatican. He next found himself at variance with the Radicals, whose leader, Janson, jnoved the introduction of universal suffrage. Frere-Orban, while rejecting the proposal, con- ceded an extension of the franchise (1883); but the hostility of the Radicals, and the discontent caused by a financial crisis, overthrew the Government at the elections of 1884. Frere-Orban continued to take an active part in politics as leader of the Liberal opposi- tion till 1894, when he failed to secure re-election. He died at Brussels on 2nd January 1896. Besides the work above mentioned, he published La Qxtestion monitaire ,(1874) ; La Question monitaire en Belgique in 1889; Echcmge de cues entre MM. Fr&re-Orban et E. de Laveleye (1890) ; and La Bivision constitutionnelle en Belgique et ses consequences (1894). He was also the author of numerous pamphlets, among which may be mentioned his last work, La Situation prisente (1895).

(h. sy.)

Freshwater, a seaside resort and railway station, in the Isle of Wight parliamentary division of Hamp- shire, England, 9^ miles west of Ne- wport. The parish contains Farringford House, for some time the home of Lord Tennyson the poet, to whom there is a memorial tablet in All Saints' church. Area of parish, 4836 acres. Population about 3000.

Fresno, capital of Fresno county, California, U.S.A., in the San Joaquin Valley, at an altitude of 290 feet. It is surrounded by a rich farming region, which produces especially grain and fruit. One of the most extensive irrigation systems of the West is in operation in the neighbouring country. The city has a regular plan and an excellent water supply and sewerage. It is on the Southern Pacific and the Atchison, Topeka, and Santa Fe railways. Population (1880), 1112 ; (1890), 10,818 ; (1900), 12,470, of whom 3299 were foreign-born, and 1573 were coloured, including 291 negroes.

Freycinet, Charles Louis de Saulces de

(1828), French statesman, was born at Foix on 14th

November 1828. He was educated at the ficole Poly- technique, and entered the Government service as a mining engineer. In 1858 he was appointed traffic manager to the Compagnie de chemins de fer du Midi, a post in which he gave proof of his remarkable talent for organization, and in 1862 returned to the engineering service (in which he attained in 1886 the rank of Inspector- General). He was sent on a number of special scientific jnissions, among which may be mentioned one to England, on which he wrote a notable 3lhnoire sur le travail des femnies et dcs enfaiitf: dans les manufactures de T AngJeterre (1867). On the establishment of the Third Republic in September 1870, he offered his services to Gambetta, was appointed Prefect of the Department of Tarn-et-Garoniie, and in (October became chief of the military cabinet. It was mainly his powers of organization that enabled Gambetta to raise army after army to oppose the invading Germans. He showed himself a strategist of no mean order ; but the policy of dictating operations to the

generals in the field was not attended with happy results. The friction between him and General Aurelle de Pala- dines resulted in the loss of the advantage temporarily- gained at Orleans, and he was responsible for the cam- paign in the east, which ended in the destruction of Bourbaki's army. In 1871 he published a defence of his administration under the title of La Guerre en province pendant le si^ge de Paris. He entered the Senate in 1876 as a follower of Gambetta, and in December 1877 became Minister of Public Works in the Dufaure Cabinet. He carried a great scheme for the gradual acquisition of the railways by the State and the construction of new lines at a cost of three milliards, and for the development of the cinal system at a further cost of one milliard. He retained his post in the Ministry of M. Waddington, whom he succeeded in December 1879 as President of the Council and Minister for Foreign Affairs. He passed an amnesty for the Communists, but in attempting to steer a middle course on the question of the religious Associations, lost the support of Gambetta, and resigned in September 1880. In January 1882 he again became President of the Council and Minister for Foreign Affairs. His refusal to join England in the bombardment of Alexandria was the death-knell of French influence in Egypt. He attempted to compromise by occupying the Isthmus of Suez, but the vote of credit was rejected in the Chamber by 417 votes to 76, and the Ministry resigned. He returned to office in April 1885 as Foreign Minister in the Brisson Cabinet, and retained that post when, in January 1886, he succeeded to the Premiership. He came into power with an ambitious programme of internal reform ; but except that he settled the question of the exiled Pretenders, his successes were won chiefly in the sphere of colonial extension. In spite of his unrivalled skill as a parliamentary tactician, he failed to keep his party together, and was defeated on 3rd December 1886. In the following year, after two unsuc- cessful attempts to construct new Ministries, he stood for the Presidency of the Republic ; but the Radicals, to whom his opportunism was distasteful, turned the scale against him by transferring their votes to M. Sadi Cavnot. In April 1888 he became Minister of War in the Floquet Cabinet ❓❓❓ the first civilian since

1848 to hold that office. His services to France in this capacity were the crowning achievement of his life, and he enjoyed the conspicuous honour of holding his office without a break for five years through as many successive administrations ??? those of Floquet and Tirard, his own fourth ministry (March 1890-February 1892), and the Loubet and Eibot ministries. To him were due the introduction of the three-years' service and the establishment of a general staff, a supreme councU of war, and the army commands. His Premiership was marked by heated debates on the clerical question, and it was a hostile vote on his Bill against the religious Associations that caused the fall of his Cabinet. He failed to clear himself entirely of complicity in the Panama scandals, and in January 1893 resigned the Ministry of War. In November 1898 he once more became Minister of War in the Dupuy Cabinet, but resigned office on 6th May 1899. He has published, besides the works already mentioned, Traite de mecanique rationelle (1858) ; De V Analyse infinitisimale (1860, revised ed. 1881) ; Bes Pentes economiques en chemin de fer (1861) ; Emploi des eaux d'4gout en agriculture (1869) ; Principes de I'assainissement des villes and Trait& d'assainissement industriel (1870) ; Essai sur la philosopliie des sciences (1896) ; besides some remarkable "Pensees" contributed to the Gontemporain under the pseudonym of " Alceste." In 1890 he was elected to the French Academy in succession to !fimile Augier.

Freytag, Custav (1816-1896), German novelist, was born at Kreuzburg, in Silesia, 13th July 1816. He was educated at the universities of Breslau and Berlin, and, settling in the former city, gave lessons in the university as a private tutor, but devoted his principal attention to writing for the stage, without, however, attaining any very prominent position until in after years (1854) he produced his comedy, Die Journalisten. In 1847 he migrated to Berlin, and in the following year of revolution founded at Dresden, in conjunction with Julian Schmidt, i>ie Grenzboten, a monthly periodical which immediately took rank as the exponent of sane and strenuous Liberalism in politics, and was equally distinguished by the general soundness of its criticism. Freytag helped to conduct it until 1861, and again from 1867 till 1870, when for a short time he edited the new periodical, Im Neuen Reich. His literary fame was made universal by the publication in 1855 of his novel, Soil und Haben {Debit and Credit),

which was translated into almost all the languages of Europe. It is certainly the best German novel of its day, impressive by its sturdy but unexaggerated realism, and in many parts highly humorous. Its main purpose is the recommendation of the German middle class as the soundest element in the country, but it also has a more directly patriotic intention in the contrast which it draws between the homely virtues of the Teuton and the shiftlessness of the Pole and the rapacity of the Jew. As a Silesian, Freytag had no great love for his Slavonic rieighbours, and being a native of a province which owed everything to Prussia, he was naturally an earnest champion of Prussian hege-^ mony over Germany. His powerful advocacy of this idea in his Grenzboten gained him the friendship of the Duke of Saxe-Coburg-Gotha, who took him with him in the French campaign of 1870. Before this he had pub- lished (1864) another novel. Die Verlorne Handschrift {Tlie Lost Manuscript), founded on a supposed discovery of the lost history of Tacitus, and dealing in some measure with the inner life of the University of Leipzig. It obtained considerable success, but was less celebrated than Debit and Credit. Between 1859 and 1867 he published in five volumes Bilder aus der deutschen Ver- gangenheit (Pictures from the German Past), a most valu- able work, full of delightful and instructive collections of essays illustrating the history and manners of old Germany. In 1872 he began a work with a similar patriotic purpose. Die AJmen (TJie Ancestors), designed to unfold German history in a series of romances. These continued to appear until 1880, but were not very successful. The author's aversion from the Slav- onic race is again noticeable. In 1887 Freytag pub- lished his Autobiography, more distinguished by elegance of style than by copiousness of information, and died, full of years and honours, at Wiesbaden, 30th April 1895. Among his other works of importance may be noticed his essays, chiefly reprinted from the Grenzboten, an esteemed work on the technique of the drama, and an excellent biography of the Baden statesman Karl Mathy. Freytag had all the qualities most characteristic of a German of the practical type, and his great success in literature and life was largely owing to the fidelity with which he represented his nation. (e. g.)

Friedek, a town in Austrian Silesia, on the Ostra- witza, a tributary of the Oder. It has a chateau of the late Archduke Albrechtof Austria, who was

the proprietor of the two large smelting works in the vicinity; and there is a very old parish church. It has also a considerable textile industry. Friedek, with the Moravian town of Mistek, on the opposite side of the river, forms the station Friedek-Mistek, on the Kaiser Ferdinands Nordbahn.

S. IV. ❓❓❓66

Population (1890), 7374 ; (1900), 9023, estimated to be two-thirds Czech, one-third German and Polish.

Friedrichroda, a favourite summer resort in the grand-duchy of Coburg-Gotha, Germany, at the north foot of the Thuringian Forest, 13 miles by rail south-west from Gotha. It is surrounded by fir-clad hills and pos-sesses numerous handsome villa residences. There are a kurhaus, a sanatorium, and the ducal hunting castle of Reinhardsbrunn, built out of the ruins of a Benedictine monastery (1089-1525) in 1827-35. The people bleach linen on a very extensive scale and manufacture toys. Population (1900), 4397.

Fried richshafen, a town, lake-port, summer resort, and bathing-place of Wilrtemberg, Germany, on the east shore of the Lake of Constance. It consists of the former imperial town of Buchhorn (dating from 837) and the monastery and village of Hofen (dating from 1050), united in 1824-30. The principal building is the royal castle (summer residence), to which is attached the Evangelical parish church. A hydropathic, whey cure, baths, &c., attract visitors in summer. There are also here the natural history and antiquarian collections of the Lake Constance Association. Popxilation (1900), 4627.

Friendly Societies.❓❓❓United Kincidom. ❓❓❓The Priendly Societies Act, 1875, and the several Acts amend- ing it, are still, in effect, the law by which these societies are regulated, though in form they have been replaced by two consolidating Acts, viz., the Friendly Societies Act, 1896, and the Collecting Societies and Industrial Assurance Companies Act, 1896. All that is necessary in the present article, therefore, is to state

the purport of the amendments made since 1876, and to trace to the present time the results of the working of the Act of 1875. That Act, in continuation of an enactment which first appeared in a statute passed in 1829, required every registered society to make quinquennial returns of the sickness and mortality experienced by its members. By the year 1880 ten periods of five years had been com- pleted, and at the end of each of them a number of returns had been received. Some of these had been tabulated by actuaries, the latest tabulation being of those for the five years ending 1855. There remained untabu- lated five complete sets of returns for the five subsequent quinquennial periods. It was resolved that these should be tabulated once for all, and it was considered that they would afford sufficient material for the construction of tables of sickness and mortality that might be adopted for the future as standard tables for friendly societies ; and that it would be inexpedient to impose any longer on the societies the burden of making such returns. This requirement of the Act was accordingly repealed in 1882. The result of the tabulation appeared in 1896, in a blue book of 1367 folio pages, containing tables based upon the experience of nearly four and a half million years of life. These tables show generally, as compared with previous observations, an increased liability to sickness. With regard to the procedure of the registrars some amendments of the law have been made. An appeal to the Chief Registrar in the case of the refusal of an assistant registrar to register a society or an amendment of rules, and in the case of suspension or cancelling of registry, is interposed before appeal is to be made to the High Court. The grounds upon which registry under a particular name may be refused are extended to include the opinion of the registrar, that the name is likely to deceive the members of the public as to the nature of the society, and not merely as to its identity. Authority is given to the Chief Registrar to direct the expense of an inspection or special meeting to be defrayed by the mem- bers or officers, or former members or officers, of a society.

if he does not think they should be defrayed either by the applicants or out of the society's funds. He is also empowered, with the approval of the Treasury, to exempt any friendly society from the provisions of the Collect- ing Societies Act if he considers it to be one to which those provisions ought not to apply. Every society reg- istered after 1896, to

which these provisions do apply, is to use the words " Collecting Society " as the last words of its name.

The law as to the membership of infants has been altered twice. The Act of 1875 allowed existing societies to continue any rule or practice of admitting children as members that was in force at its passing, and prohibited membership under sixteen years of age in any other case, except the case of a juvenile society composed wholly of members under that age. The Treasury made special regulations for the registry of such juvenile societies. In 1887 the maximum age of their members was extended to twenty- one. In 1895 it was enacted that no society should have any members under one year of age, whether authorized by an existing rule or not ; and that every society should be entitled to make a rule admitting mem- bers at any age over one year. The Treasury, upon this enactment coming into operation, rescinded its regulations for the registry of juvenile societies ; and though it is still the practice to submit for registry societies wholly composed of persons under twenty-one, these societies in no way differ from other societies, except in the circum- stance that they are obliged to seek officers and a commit- tee of management from outside, as no member of the committee of any society can be under twenty-one years of age. In order to promote the discontinuance of this anomalous proceeding of creating societies under the Friendly Societies Act, which, by the conditions of their existence, are unable to be self-governing, the Act pro- vides an easy method of amalgamating juvenile societies and ordinary societies or branches, or of distributing the members and the funds of a juvenile society among a num- ber of branches. The liability of schoolboys and young working lads to sickness is small, and these societies fre- quently accumulate funds, which, as their membership is temporary, remain unclaimed and are sometimes misap- plied.

The affiliated orders have strengthened their position ; most of the lodges existing before 1875 have converted themselves into registered branches. The requirement that for that purpose a vote of three-fourths should be necessary was altered in 1895 to a bare majority vote. The provisions as to settlement of disputes were extended in 1885 to every description of dispute between branches and the central body, and in 1895 it was

provided that the forty days after which a member may applj- to the court to settle a dispute where the society fails to do so, shall not begin to run until application has been made in succession to all the tribunals created by the order for the purpose. In 1887 it was enacted that no body which had loeen a registered branch should be registered as a sepa- rate society except upon production of a certificate from the order that it had seceded or been expelled ; and in 1895 it was further enacted that no such body should, after secession or expulsion, use any name or number implying that it is still a branch of the order. The orders generally, especially the greater ones, have carefully supervised the valuations of their branches, and have urged and, as far as circumstances have rendered it prac- ticable, have enforced upon the branches measures for diminishing the deficiencies which the valuations have disclosed. They have organized plans by which branches disposed to make an effort to help themselves in this matter may be assisted out of a central fund.

The establishment of the National Conference of Friendly

Societies by the orders and a few other societies has been of great service in obtaining some of these improvements in the law, and in enabling the societies strongly to repre- sent to the Government and the Legislature any grievance entertained by them. A complaint that membership of a shop club was made by certain employers a condition of employment, and that the rules of the club required the members to withdraw from other societies, led to the appointment of a departmental committee, who recom- mended that such a condition of employment should be made illegal, except in cei-tain cases, and that in every case it should be illegal to make the withdrawal from a society a condition of employment.

The practice among societies of combining together to obtain medical attendance and medicine for their members by the formation of medical associations has increased. In 1895 trade unions were enabled to join in such associa- tions, and it was provided that a contributing society or union should not withdraw from an association except upon three

months' notice. The working of these associa- tions has been viewed with dissatisfaction by members of the medical profession, and it has been suggested that a board of conciliation should be formed consisting of repre- sentatives of the Conference of Friendly Societies and of an equal number of medical men. One of the most im- portant organic reforms introduced by the Act of 1875 was the requirement from every society of a valuation of its assets and liabilities once in every five years. ISTo com- parison of the aggregates of the valuations that have been completed since the passing of the Act could be made, or if made, would be of any service, inasmuch as the elements on which they depend are extremely variable; but a consideration of the successive valuations of indi- vidual societies strongly confirms the conclusion that " nothing is more elastic than the contract made by a friendly society with its members ; no error more easy of remedy if found out in time than one existing in the original terms of such a contract."

The following figures are derived from returns of regis- tered societies and branches of registered societies to 31st December 1899 :

Number of Members.

Amount of Funds.

7,090 Ordinary Friendly Societies . 19,340 Branches of Registered Orders 45 Collecting Friendly Societies 86 Medical Societies 70 Benevolent Societies . 632 Working Men's Clubs . 465 Specially Authorized Societies 55 Cattle Insurance Societies .

2,807,823

2,409,438

5,922,615

298,691

18,363

175,469

114,307

3,424

??

13,747,273

19,004,596

5,207,686

70,027

286,141

209,041

956,256

6,o99

27,783 Societies and Branches .

11,750,130

39,487,619

(e. w. b.)

United States. ??? Under the title of Fraternal Societies are included in the United States what are known in England as friendly societies, having some basis of mutual help to members, mutual insurance associations, and benefit associations of all kinds. There are various classes and a great variety of forms of fraternal associations. It is therefore difficult to give a concrete historical statement of their origin and growth ; but, dealing with those having benefit features for the

payment of certain amounts in case of sickness, accident, or death, it is found that their history in the United States is practically within the last half of the 19th century. The more important of the older orga- nizations are the Improved Order of Red Men, founded in

Member- ship,

1771 and re-organized in 1834; Ancient Order of For- esters, 1836 ; Ancient Order of Hibernians of America, 1836; United Ancient Order of Druids, 1839; Indepen- dent Order of Eechabites, 1842; Independent Order of B'nai B'rith, founded in 1843; Order of the United American Mechanics, 1845 ; Independent Order of Free Sons of Israel, 1849 ; Junior Order of United American Mechanics, 1853. A very large proportion, probably more than one-half, of the societies which have secret organizations pay benefits in case of sickness, accident, disability, and funeral expenses in ease of death. This class of societies grew out of the English friendly societies, and have Masonic characteristics. The Freemasons and other secret societies, while not all having benefit features in their distinctive organizations, have auxiliary societies with such features. There is also a class of secret societies, based largely on Masonic usages, ,that have for their principal object the payment of benefits in some form. These are the Odd-Fellows, the Knights of Pythias, the Knights of Honour, the Royal Arcanum, and some others. Many trade unions have now adopted benefit features, especially the Typographical Union, while many subordi- nate unions and great publishing houses have mutual relief associations purely of a local character, and some of the more important newspapers have such mutual relief or benefit societies. The New York trade unions, taken as a whole, have paid out large sums of money in benefits where members have been out of work, or are sick, or are on strike, or have died. The total paid in a recent year for all these benefits was over $500,000.

It is impossible to give the membership of all the fraternal associations in the United States ; but according to the latest lists, including Odd-Fellows, Free- masons, purely benefit associations, and all the class of the larger fraternal organizations, the membership is nearly 6,600,000. Among the more im- portant, so far as membership is concerned, are the

Knights of Pythias, with a membership of nearly 600,000 ; the Odd-Fellows, with nearly 1,000,000; the Modern Woodmen of America, with nearly 460,000 ; the Ancient Order of United Workmen, with nearly 400,000 ; Im- proved Order of Red Men, with about 215,000; Royal Arcanum, with over 190,000 ; Knights of the Maccabees, with about 190,000 ; Junior Order of United American Mechanics, with nearly 184,000; Foresters of America, with 155,000; Independent Order of Foresters, with 150,000, &c. These and other organizations pay out a vast amount of money every year in the various forms of benefits. At the present time the sum is probably over $40,000,000, while the aggregate paid out by them since their organization would reach very nearly

$500,000,000.

Since about the year 1870 a new form of benefit organization has come into existence. This is a life insurance based on the assessment plan, assessments being levied when- ever a member dies ; or, as more recently, regular Assess- assessments being made in advance of death, as went post-mortem assessments have proved a fallacious lasuraace. method of securing the means of paying death benefits. The importance of this class of insurance is shown by a com- parative statement. On the 1st January 1899 the number of policies in force under regular level premium companies was 11,218,330, the amount of insurance carried by them being $6,825,037,770. The assessment companies and orders, includ- ing industrial insurance, had a membership the year before of 4,039,062, while the amount of insurance in force under them was $7,799,428,000. There are about 200 mutual benefit insurance companies or associations in the United States conducted on the "lodge system" ; that is to say, they have regular meetings for social purposes and for general improvement, and in their work there is found the mysticism, forms, and ceremonies which belong to secret societies generally. These elements have proved a very strong force in keeping this class of associations fairly intact. The " work" of the lodges in the initiation of members and their

passing through various degrees is attractive to many people, and in small places, remote from the amusements of the city, these lodges constitute a

resort where members can give play to their various talents. In most of them the features of the Masonic ritual are prominent. The amount of insurance which a single member can carry in such associations is small. In the Knights of Honour, one of the first of this class, policies ranging from .$500 to to $2000 are granted. In the Royal Arcanum the maximum is 1.3000. This form of insurance may be called co-operative, and has many elements which make the organizations practising it stronger than the ordinary assessment insurance companies having no stated meetings of members. These co-operative insurance so- cieties are organized on the federal plan ??? as the Knights of Honour, for instance ??? having local assemblies, where the lodge room ele- ment is in force ; state organizations, to which the local bodies send delegates, and the national organization, which conducts all the in- surance business through its executive oflBoers. The local societies pay a certain given amount towards the support of the state and national offices, and while originally they paid death assessments, as called for, they now pay regular monthly assessments, in order to avoid the weakness of the post-mortem assessment. The diffi- culty which these organizations have in conducting the insurance business is in keeping the average age of membership at a low point, for with an increase in the average the assessments increase, and many such organizations have had great trouble to convince younger members that their assessments should be increased to make up for the heavy losses among the older members. The ex- perience of these purely insurance associations has not been suffi- cient yet to demonstrate their absolute soundness or desirability, but they have enabled a large number of persons of limited means to carry insurance at a very low rate. They have not materially Interfered with regular level premium insurance enterprises, for they have stimulated the people to understand the benefits of insur- ance, and have really been an educational force in this direction.

A modern method of benefit association is found in the railway relief departments of some of the large railway corporations. These departments are organized upon a different plan o!;/^ from the benefit features of labour organizations and DeMti- secret societies, providing the members not only with meats ‘ payments on account of death, but also with assistance of definite amounts in case of sickness or accident, the railway*

companies contributing to the funds, partly from philan- thropic and partly from financial motives. The principal railway companies in the United States which have established these relief departments are the Pennsylvania, the Philadelphia and Reading, the Baltimore and Ohio, the Chicago, Burlington and Quincy, and the Plant System. The membership of these railway relief departments includes over one-eighth of all the railway employes in the United States, and on the various lines the number enrolled in them varies from 55 to 65 per cent. The Baltimore and Ohio, which organized its department in 1880, paid out a very large amount of money, up to 30th June 1896 the sum being nearly $5,000,000. The Pennsylvania line has paid out a like sum. In one fiscal year this railway paid out nearly $800,000, 18-27 per cent, being paid by the company ; the Pennsylvania lines west distributed over $-300,000, nearly 18 per cent, being paid by the company. The Baltimore and Ohio paid over $434,000, of which nearly 16 per cent, was paid by the company. The balance of the payments was made by the members of the associations through a mutual insurance plan. These data indicate the volume of business of railway relief associations. The relief de- partment benefits the employfe, the railways, and the public, because it is based upon the sound principle that the "interests and welfare of labour, capital, and society are common and har- monious, and can be promoted more by co-operation of effort than by antagonism and strife."

The railway employes support one-twentieth of the entire population, and most of their associations maintain organiza- tions to provide their members with relief and insurance. The Brotherhood of Locomotive Engineers, the Order of Railway Conductors of America, the Brotherhood of Locomotive Firemen, the Brotherhood of Railway Trainmen, the Brotherhood of Rail- way Trackmen, the Switchmen's Union, the Brotherhood of Rail- way Carmen, and the Order of Railway Telegraphers, all have relief and benefit features. The oldest and largest of these is the International Brotherhood of Locomotive Engineers, founded at Detroit in August 1863. Like other labour organizations of the higher class of workmen, the objects of the brotherhoods of rail- way eniployfis are partly social and partly educational, but in addition to these great purposes they seek to protect their members through relief and benefit features. Of course the relief depart- ments of the railway

companies are competitors of the relief and insurance features of the railway employes' Orders, but both methods of providing assistance have proved successful and beneficial.

Authorities. ??? Eor a history of the various organizations, see

Albert C. Stevens, The Cyclopaedia of Fraternities, New York, 1899 ; Facts for Fraternalisis, published by the Fraternal Moni- tor, Rochester, N.Y. ; for annual statements, "The World Almanac," " Railway Relief Departments," " Brotherhood Relief and Insurance of Railway Employ 6s," " Mutual Relief and Benefit Associations in the Printing Trade." "Benefit Features of American Trade Unions." Bulletins Nos. 8, 17, 19, and 22 of the U.S. Department of Labour. (c. D. W.)

Frisian Islands, the chain which stretches from the Zuider Zee eastwards and northwards as far as Jutland, fringing the coasts of Holland, Hanover (East Frieslaud), Oldenburg, Schleswig, and Holstein. The term is, strictly speaking, ethnographical. The chain is divided into three groups : ??? (1) the West Frisian, (2) the East Frisian, and (3) the North Frisian. The first group embraces Texel or Tessel (44,050 acres ; 6000 pop.), Vlieland (12,220 acres ; 700 pop.), Terschelling (26,765 acres ; 3750 pop.), Ame- land (14,360 acres ; 2250 pop.), Schiermonnikoog (12,100 acres ; 900 pop.), Boschplaat, and Eottum or Eottum- meroog (640 acres; 400 pop.). With the exception of Wangeroog, which belongs to the grand-duchy of Olden- burg, the East Frisian islands belong to Prussia (i.e., Hanover). They comprise Borkum (2^milesby 6; 1350 pop.), Memmert; Juist (2\ sq. miles ; 200 pop.), ISTorder- ney (5^- sq. miles ; 3500 pop.), Baltrum (120 pop.), Lange- oog (8 miles by 1 ; 250 pop.), Spiekeroog (4 sq. miles ; 250 pop.), and Wangeroog (4 miles by ^ mile ; 100 pop.). All these islands are visited for sea-bathing in summer. Norderney, which inspired Heine's Nordseehilder, and Bor- kum are visited annually, the one by 24,000 and the other by 14,000 persons, and have been in repute since the begin- ning of the 19th century. In the beginning of the 1 8th cen- tury Wangeroog was eight times its present area. Borkum and Juist are two surviving fragments of the original island of Borkum (380 sq. miles), which was rent asunder by the sea in 1170. The North Frisian group embraces the islands of Nordstrand (11 \ sq.

*miles ; 2300 pop.), Pell worm (16^ sq. miles ; 2000 pop.), Amrum (10^ sq. miles ; 670 pop.), Fohr (32 sq. miles ; 4500 pop.), Sylt (38 sq. miles ; 4000 pop.), Eom (16 sq. miles ; 1150 pop.), Fano (21 sq. miles ; 3000 pop.), and Heligoland {\ sq. mile ; 2300 pop.). Except Fano, all these belong to Prussia (province Schleswig-Holstein). Sylt (Westerland) is one of the most fashionable seaside resorts of Germany. Heligoland was anciently the holy island of the Frisian race. In the North Frisian group there is also a number of smaller islands called halligen, and rising generally only a few feet above the level of the sea, and crowned each by a single house standing on an artificial mound and sur- rounded by a dyke or embankment.^*

The chain of the Frisian Islands, which lies 3 to 20 miles from the existing coastline, marks the outer fringe of the former continental coastline, and is separated from the firm land of the existing continent by shallows, known as wadden or watteii,'- answering to the maria vadosa of the Romans. Notwithstanding the artificial protection which is afforded these islands by earthen embankments, backed by stones and timber, and matted together with long tenacious grass, they are slowly but surely crumbling away under the pei-sistent attacks of storm and flood. But the efforts of man are from time to time stimulated afresh. For instance, in 1873 a strong causeway was built from Ameland to Holwerd on the mainland with the view of promoting the warping of the wadden. In 1896 the Prussian Government voted ►►66,000 for the protection of the North Frisian halUr/en. About the year 1260 the area of the North Frisian islands was estimated at 1005 sq. miles ; by 1850 this had diminished to only 105 sq. miles. The island of Nordstrand has been exceptionally severely visited by storms and inundations, having suffered terribly in 1300, in 1436, and in 1034. But since the 16th century the low-lying sea-

1 See Dr Eitoen Traeger, Die IlaU'igen der Nordsee (Stuttgart, 1892) ; also Globus, vo. Ixxviii. (1900), No. 15.

^ An entire world lies buried underneath the sands and clays of the leatten ; seeC. P. Hansex, Chronlk der friesischen Cthlaiiile. p. 103, footuote (Altoiia, 18511).

marshes of the continent adjacent to the wadden and watten have peen Intermittently but effectually enclosed and drained. For instance, some 66,600 acres have been thus reclaimed to the north of the Ij in Holland; between 1545 and 1877 some 64,850 acres were reclaimed around the Dollart ; and in Dithmarsch accretions were made amounting to 14,600 acres between 1579 and 1873. Ihe view that tlie Dollart and similar indentations of this coast were formed by violent cataclysms is now abandoned by the modern .school of Dutch and continental geographers in favour of the theory that their formation has been gradual, and has resulted more from the permanent subsidence of the coast, assisted more or less by sea-floods and the neglect of the embankments. The lands occupied by the Frisians originally extended across what is now the northern part of the Zuider Zee into the present province of North Holland, the eastern peninsula of which is indeed called West Friesland. The inhabitants of these islands support them- selves by seafaring (they make excellent sailors), pilotage, grazing of cattle and sheep, fishing, and a little agriculture. Dr D. F. Buitenrust Hettema is editing a Fryske ByWeteek (Utrecht, 1895, &c.),. a series of reprints of Middle Frisian literary works of the 16th, 17th, and 18th centuries.

See Staring, De Bodem van Nederland (1856). ◆◆◆ Blink, Neder- Jand en zijne Beiooners (1892). ◆◆◆ P. J. W. Teding van Beriuiout, ~~De Landaanwinning op de Friesche Wadden (1869). ◆◆◆ J. de Vries and T. Focken, Ostfriesland (1881). ◆◆◆ C. P. Hansen, Das JSchles~~ wig'sche Wattenmeer (Glogau, 1865). ◆◆◆ R. Hansen, in Globus (1896) and (1898), and in Petermann's Mitteilungen (1893). ◆◆◆ P. Axelsen, in Beut. Sundschau fur Geog. u. Statistik (1898). ◆◆◆ Christian Jensen, Vom Dunenstrand der Nordsee und vom Wattenmeer, Schlesvi'ig (1901), which has a good bibliography. (j. t. be.)

Frith, William Powell (1819), English

painter, was born at Aldfield, in Yorkshire, on 9th Janu- ary 1819. His parents moved in 1826 to Harrogate, where his father became landlord of the Dragon Inn, and it was then that the boy began his general education at a school at Knaresborough. Later he went for about two years to a school at St Margaret's, near Dover, where he was placed specially under the direction of the drawing-master, as a step towards his preparation for the profession which his father had decided on as the one that he wished him to adopt. In 1835 he was entered as a student in the well- known art school kept by Henry Sass in Bloomsbury, from which he passed after two years to the Eoyal Academy schools. His first independent experience was gained in 1839, when he went about for some months in Lincoln- shire executing several commissions for portraits ; but he soon began to attempt compositions, and in 1840 his first picture, " Malvolio, cross-gartered before the Countess Olivia," appeared at the Koyal Academy. During the next few years he produced several notable paintings, among them " Squire Thornhill relating his town adven- tures to the Vicar's family," and " The Village Pastor," which established his reputation as one of the most pro- mising of the younger men of that time. This last work was exhibited in 1845, and in the autumn of that year he was elected an Associate of the Eoyal Academy. His promotion to the rank of Academician followed in 1853, when he was chosen to fill the vacancy caused by Turner's death. The chief pictures painted by him during his tenure of Assoeiateship were : " An English Merry-making in the Olden Time," "Old Woman accused of Witch- craft," " The Coming of Age," " Sancho and Don Quixote," " Hogarth before the Governor of Calais," and the " Scene from Goldsmith's ' Good-natured Man,' " which was com- missioned in 1850 by Mr Sheepshanks, and bequeathed by him to the South Kensington Museum. Then came a succession of large compositions, which gained for the artist an extraordinary popularity. " Life at the Seaside," better known as " Eamsgate Sands," was exhibited in 1854, and was bought by Queen Victoria; "The Derby Day," in 1868 ; "Claude Duval," in 1860; "The Railway Station," in 1862 ; " The Marriage of the Prince of Wales," painted for Queen Victoria, in 1865 ; " The Last Sunday of Charles II." in 1867; "The Salon d'Or," in 1871; "The Road to Ruin," a series, in 1878 ; a similar series, " The Race for

Wealth," shown at a gallery in King Street, St James's, in 1880 ; " The Private View," in 1883 ; and " John Knox at Holyrood," in 1886. The artist has also painted a considerable number of portraits of well-known people. In 1889 he became an Honorary Retired Academician. His "Derby Day" is now in the National Gallery of British Art. In his youth, in common with the men by whom he was surrounded, he had leanings towards romance, and he scored many successes as a painter of imaginative subjects. In these he proved himself to be possessed of exceptional qualities as a colourist and manipulator, qualities that promised to earn for him a secure place among the best executants of the British School. But in his middle period he chose a fresh direction. Fascinated by the welcome which the public gave to his first attempts to illustrate the life of his own times, he undertook a considerable series of large canvases, in which he commented on the manners and morals of society as he found it. He became a pictorial preacher, a painter who moralized about the everyday incidents of modern existence ; and he sacrificed some of his technical variety. There remained, however, in all his later work a remarkable sense of characterization, and an appreciation of dramatic effect more than ordinarily acute.

See W. P. Frith, R.A. My Autobiography and Eeminiseenees. London, 1887. ??? Further Beminiscences. London, 1889.

Frohschammer, Jakob (1821-1893), German theologian and philosopher, was born at Illkofen, near Ratisbon, on 6th January 1821. Destined by his parents for the Roman Catholic priesthood, he studied theology at Munich, but felt an ever-growing attraction to phil- osophy. Nevertheless, after much hesitation, he took what he himself calls the most mistaken step of his life, and in 1847 entered the priesthood. His keenly logical intellect, and his impatience of authority where it clashed with his own convictions, quite unfitted him for that unquestioning obedience to his superiors which the Church demanded. It was only after open defiance of the bishop of Ratisbon that he obtained permission to continue his studies at Munich. He at first devoted himself more especially to the study of the history of dogma, and in 1850 published his Beitrdge eur Kirchen-geschichte, which was placed on the Index Expurgatorius. But he felt that his real vocation was philosophy, and after holding for a short time an

extraordinary professor- ship of theology, he became professor of philosophy in 1856. This appointment he owed chiefly to his work, Ueber den Ursprung der menschlichen Seelen (1854), ip which he maintained that the human soul was not im- planted by a special creative act in each case, but was the result of a secondary creative act on the part of the parents : that soul as well as body, therefore, was subject to the laws of heredity. This was supplemented in 1855 by the controversial Menschenseele und Physiologie. Un- deterred by the offence which these works gave to his ecclesiastical superiors, he published in 1858 the Einlei- tung in die Philosophie und Orundriss der Metaphysik, in which he assailed the doctrine of Thomas Aquinas, that philosophy was the handmaid of theology. In 1861 appeared Ueber die Aufgabe der Naturphilosophie und ihr Verhdltniss zur Naturwissenschaft, which was, he declared, directed against the purely mechanical conception of the universe, and affirmed the necessity of a creative Power. In the same year he published Ueber die Freiheit der Wissenschaft, in which he maintained the independence of science, whose goal was truth, against authority, and reproached the excessive respect for the latter in the Roman Church with the insignificant part played by the German Catholics in literature and philosophy. He was denounced by the pope himself in an apostolic brief of

11th December 1862, and students of theology were for- bidden to attend his lectures. Public opinion was now keenly excited ; he received an ovation from the Munich students, and the king, to whom he owed his appoint- ment, remained staunch to him. A conference of Catholic savants was held in 1863 under the presidency of Dollin- ger, and decided that authority must be supreme in the Church. When, however, Dollinger and his school in their turn started the Old Catholic movement, Froh- schammer refused to associate himself with their cause, holding that they did not go far enough, and that their declaration of 1863 had cut the ground from under their feet. Meanwhile he had, in 1862, founded the Athencium as the organ of Liberal Catholicism. For this he wrote the first

adequate account in German of the Darwinian theory of natural selection, and drew a warm letter of appreciation from Darwin himself. Excommunicated in 1871, he replied with three articles, which were repro- duced in thousands as pamphlets in the chief European languages ??? Der Fels Petn in Rom (1873), Der Primat Petri und des Papstes (1876), and Das Christentlmm Christi und das Christenthum des Papstes (1876). His later years were occupied with a series of philosophical works, of which the most important were Die Phantasie als Grundprincip des Weltprocesses (1877), Ueher die Genesis der Menschheit und deren geistige EntivicMung in Religion, Sittliclikeit und Sprache (1883), and Ueher die Organisation und Cidtur der menscJdichen Gesellschaft (1885). His system is based on the unifying principle of imagination ("Phantasie"), which he extends to the objective creative force of Nature, as well as to the sub- jective mental phenomena to which the term is usually confined. He died at Bad Kreuth in the Bavarian High- lands on 14th June 1893.

Frohschammer's works, in addition to those already mentioned, include : Beleuchtung der Encyklika (anonymous, 1865) ; Das Christenthum und die moderne NaMirwissensohaft (1868); Das Becht der eigenen Ueherzeugung , Die politische Bedeutung der Unfehlbarkeit des Papstes und der Kirche, and Zur Wiirdigung der Unfehlbarkeit des Papstes und der Kirche (1869) ; Die TJnfeM- barkeit des Papstes (addressed to the archbishop of Munich ??? Freising, 1871), Ueber die religiosen und kirchenpolitischen Fragen der Gegenwart. Gesammelte Abhandlungen (1875); Die wahre Bedeutung des Kulturkampfes (1878); Monaden und Weltplian- tasie and Ueber die Bedeutung der Einbildungslcraft in der Pliilosophie Kant's und Spinoza's (1879) ; Ueber die Principien der Aristotelischen Pliilosophie und die Bedeutung der Phantasie in derselben (1881); Die Philosophie als Idealwissenschaft und System (1884); Die Philosophie des Thomas von Aquino kritiseh geioiirdigt (1889); Ueber das Mysterium Magnum des Daseins (1891); System der Philosophie im Umriss (1892 et seq.); Briefe von und iiher J. Frohschammer, herausgegeben von B. Munz (1897); J. Froh- scliammer's philosophisches System im Grundriss, nacli Froh- schammer's Vorlesungen herausgegeben von A. Attensperger (1899). In

1888 he published a brief autobiography. For his pliilosophy consult F. Friedrich and B. Miinz. (h. Sy.)

Frome (or Feomb Selwood), a market-town in the Frome parliamentary division (since 1885) of Somerset- shire, England, 11 miles south of Bath by rail. There are in all five parish or district churches, a Roman Catholic church, and various Nonconformist chapels. A recreation ground was provided in 1888. Public offices and a Church of England home for boys have been erected ; there is a cottage hospital. Area of urban district, 731 acres ; population (1881), 9377; (1891), 9613. Area of town- ship, 7614 acres; population (1881), 11,304; (1901), 11,055. There is a parish of Frome.

Froude, James Anthony (1818-1894), English historian, son of R. H. Froude, archdeacon of Totnes, was born at Darlington, Devon, on 23rd April 1818. He was educated at Westminster and Oriel (lollese, Oxford, then the centre of the ecclesiastical revival. He obtained a second class and the chancellor's English essay

prize, and was elected a fellow of Exeter College (1842). Though not so conspicuous in the High Church movement at Oxford as his elder brother, Richard Hurrell Froude, he was one of its prominent adherents, and helped J. H. Newman, afterwards cardinal, in his Lives of the English Sairits. He was ordained deacon in 1844. Soon after- wards his religious opinions began to change, he grew dissatisfied with the views of the High Church party, and came under the influence of Carlyle's teaching. Signs of this change first appeared publicly in his Shadows of the Clouds, a volume containing two stories of a religious sort, which he published in 1847 under the pseudonym of " Zeta," and his complete desertion of his party was declared

J. A. Froude. (From a photo, by Ellioii and Fry,)

a year later in his Nemesis of Faith, of which the earlier part seems to be autobiographical. He resigned his fellowship at Oxford, and mainly at least supported himself by writing, contributing largely to Erasers Magazine and the Westminster Review. The excellence of his style was soon generally recognized. The first two volumes of his History of

England from the Fall of Wolsey to the Defeat of the Spanish Armada appeared in 1856, and the work was completed in 1870. As a historian he is chiefly remarkable for literary excellence, for the art with which he represents his conception of the past. He condemns a scientific treatment of history and disregards its philosophy. He held that its office was simply to record human actions and that it should be written as a drama. Accordingly he gives prominence to the personal element in history. His presentations of character and motives, whether truthful or not, are un-deniably fine ; but his doctrine that there should be " no theorizing" about history tended to narrow his survey, and consequently he sometimes, as in his remarks on the foreign policy of Elizabeth, seems to misapprehend the tendencies of a period on which he is writing.

Froude was not a historical scholar and his work is often marred by prejudice and incorrect statements. He wrote with a purpose. The keynote of his History is contained in his assertion that the Reformation was "the root and source of the expansive force which has spread the Anglo-Saxon race over the globe." Hence he overpraises Henry VIII. and others who forwarded the movement, and speaks too harshly of some of its opponents. So too, in his English in Ireland (1871-74), which waswrittentoshowthe

futility of attempts to conciliate the Irish, he aggravates all that can be said against the Irish, and touches too lightly on atrocities on the part of the English. A strong anti-clerical prejudice is manifest in his historical work generally, and is doubtless the result of the change in his views on Church matters and his abandonment of the clerical profession. Carlyle's influence on him may be traced both in his admiration for strong rulers and strong government, which sometimes led him to write as though tyranny and brutality were excusable, and in his inde- pendent treatment of character. His rehabilitation of Henry VIII. was a useful protest against the idea that the king was a mere sanguinary profligate, but his repre- sentation of him as the self-denying minister of his people's will is erroneous, and is founded on the false theory that the preambles of the

Acts of Henry's Parlia- ments represented the opinions of the educated laymen of England. As an advocate he occasionally forgets that sobriety of judgment and expression become a his- torian. He was not a judge of evidence, and seems to have been unwilling to admit the force of any argument or the authority of any statement which militated against his case. In his Divorce of Catherine of Aragon (1891) he made an unfortunate attempt to show that certain fresh evidence on the subject, brought forward by Dr Gairdner, Dr Friedmann, and others, was not inconsistent with the views which he had expressed in his History nearly forty years before. No attempt at thoroughness of investigation appears in any of his books. The manuscript treasures of Hatfield were opened to him, but he is said to have been content witli a single day's examination of them ; and though he visited Simancas, his work there must have been careless. His Life of Ccesar (1879), a glorification of Imperialism, betrays an imperfect acquaintance with the life and writings of Cicero; and of his two pleasant books of travel, Tlie English in the West Indies .(1888) shows that he made little effort to master his subject, and Oceana (1886), the record of a tour in Australia and New Zealand, among a multitude of other blunders, notes the prosperity of the working- classes in Adelaide at the date of his visit, when, in fact, owing to a failure in the wheat-crop, hundreds were then living on charity. He was constitutionally inaccurate, and seems to have been unable to represent the exact sense of a document which lay before him, or even to copy from it correctly. Historical scholars ridiculed his mistakes, and Freeman, the most violent of his critics, never let slip a chance of hitting at him in the Saturday Review. Fronde's temperament was sensitive, and he suffered from these attacks, which were in truth far too savage in tone. The literary quarrel between him and Freeman excited general interest when it blazed out in a series of articles which Freeman wrote in the Contemporary Review (1878-79) on his Short Study of Thomas Becket.

Yet, notwithstanding its defects, Froude's History is a great achievement ; it presents an important and powerful account of the Reformation period in England, and lays before us a picture of the past magnificently conceived, and painted in colours which will never lose their fresh- ness and beauty. As with Froude's work generally, its literary merit is remarkable ; it is a well-balanced and orderly narrative, coherent in

design and symmetrical in ???execution. Though it is perhaps needlessly long, the thread of the story is never lost amid a crowd of details ; every incident is made subordinate to the general idea, appears in its appropriate place, and contributes its share to the perfection of the whole. The excellence of its form is matched by the beauty of its style, for Froude was a master of English prose. The most notable characteristic of his style is its graceful simplicity ; it is aever affected

or laboured ; his sentences are short and easy, and follow one another naturally. He is always lucid. He was never in doubt as to his own meaning, and never at a loss for the most appropriate words in which to express it. Simple as his language is, it is dignified and worthy of its subject. Nowhere perhaps does his style appear to more advantage than in his four series of essays entitled Short Studies on Great Subjects (1867-82), for it is seen there un- fettered by the obligations of narrative. Yet his narrative is admirably told. For the most part flowing easily along, it rises on fit occasions to splendour, picturesque beauty, or pathos. Few more brilliant pieces of historical writing exist than his description of the coronation procession of Anne Boleyn through the streets of London, few more full of picturesque power than that in which he relates how the spire of St Paul's was struck by lightning ; and to have once read is to remember for ever the touching and stately words in which he compares the monks of the London Charterhouse preparing for death with the Spartans at Thermopylae. Proofs of his power in the sustained narration of stirring events are abundant ; his treatment of the Pilgrimage of Grace, of the sea fight at St Helens and the repulse of the French invasion, and of the murder of Eizzio, are among the most conspicuous examples of it. Nor is he less successful when recording pathetic events, for his stories of certain martyrdoms, and of the execution of Mary Queen of Scots, are told with exquisite feeling and in language of well-restrained emo- tion. And his characters are alive. We may not always agree with his portraiture, but the men and women whom he saw exist for us instinct with the life with which he endows them and animated by the motives which he attributes to them. His successes must be set against his failures. At the least he wrote a great history, one which can never be disregarded by future writers on his period, be their opinions what they may ; which attracts an d delights a multitude of readers, and is a splendid example of literary form and grace in historical composition.

The merits of his work met with full recognition. Each instalment of his History, in common with almost every- thing which he wrote, was widely read, and in spite of some adverse criticisms was received with eager applause. In 1868 he was elected Rector of St Andrews University, defeating Disraeli by a majority of fourteen. He was warmly welcomed in

the United States, which he visited in 1872, giving lectures in various places. On the death of his adversary Freeman in 1892, he was" appointed, on the recommendation of Lord Salisbury, to succeed him as regius professor of modern history at Oxford. Except to a few Oxford men, who considered that historical scholarship should have been held to be a necessary qualification for the ofiice, his appointment gave general satisfaction. His lectures on Erasmus and other 16th-century subjects were largely attended. With some allowance for the purpose for which they were originally written, they present much the same character- istics as his earlier historical books. His health gave way in the s\immer of 1894, and he died on 20th October of that year, at the age of seventy-six. His long life was full of literary work. Besides his labours as an author, he was for fourteen years editor of Fraser's Magazine. He was one of Carlyle's literary executors, and brought some sharp criticism upon himself by publishing Carlyle's Reminiscences and the Memorials of Jane Welsh Curlyle, for they exhibited the domestic life and character of his old friend in an unpleasant light. Carlyle had given the manuscripts to him, telling him that he might publish them if he thought it well to do so, and at the close of his life agreed to their publication. Froude therefore declared that in giving them to the world he was carrying out his friend's wish by enabling him to make a posthumous

confession of his faults. But Carlyle did not intend that they should be published without "fit editing," and said so in a passage which Froude omitted to print. Besides publishing these manuscripts, he wrote a Life of Carlyle. His earlier study of Irish history afforded him suggestions for a historical novel entitled Tlie Tim Chiefs of Dunboy (1889). In spite of one or two stirring scenes, it is a tedious book ; it lacks the necessary elements of romance, and its personages are little more than machines for the enunciation of the author's opinions and sentiments. Though Froude had some intimate friends, he was

generally reserved. When he cared to please, his manners and conversation were charming. Those who knew him well formed a high

estimate of his ability in practical affairs. In 1874 Lord Carnarvon, then colonial secretary, sent him to South Africa on a mission of in- quiry, and in 1875 to Cape Town as a member of a pro- posed conference; but his speeches there were rather injudicious, and his mission was a failure. He was twice married. His first wife, a daughter of Mr Pascoe Gren- fell, died in 1860; his second, a daughter of Mr Joha Warre, M.P. for Taunton, died in 1886. (w. hu.)

FRUIT AI^D FLOWER FARMING.

Imports of Feesh Feuit.

THE quantities of apples, pears, plums, cherries, and grapes imported in the raw condition into the United Kingdom in each year, 1892 to 1901, are shown in Table I. Previous to 1892 apples only were separately

Table I. ??? Imports of raw apples, pears, plums, cherries, and grapes into the United Kingdom, 1892 to 1901. Quantities in thou- sands of bushels (thousands of cwt. in 1900 and 1901), values in thousands of pounds sterling.

Quantities.

Tear

Apples.

Pears.

Plums.

Cherries.

Grapes.

1892

4515

637

413

217

762

1893

3460

915

777

346

979

1894

4969

1310

777

311

833

1895

3292

407

401

196

865

1896

6177

483

560

219

883

1897

4200

1052

1044

312

994

1898

3459

492

922

402

1136

1899

3861

572

558

281

1158

1900

2129-

477 ◆◆

423 ◆◆

243"

593"

1901

1830"

349 ◆◆

264 ◆◆

213 ◆◆

680"

Values.

1892

1354

297

200

135

394

189.3

844

347

332

195

530

1894

1389

411

302

167

470

1895

960

167

166

96

487

L896

1582

207

242

106

443

1897

1187

378

498

178

495

1898

1108

222

435

231

550

1899

1186

266

294

154

588

1900

1225

367

393

308

595

1901

1183

296

244

214

695

” Thousands of cwt.

enumerated. Up to 1899 inclusive the quantities were given in bushels, but in 1900 a change was made to hundredweights. This renders the quantities in that and subsequent years not directly comparable with those in earlier years, but the comparison of the values, which are also given in the table, continues to hold good. In some years the value of imported apples exceeds the aggregate value of the pears, plums, cherries, and grapes imported. The extreme values for apples shown in the table are ££844,000 in 1893 and ££1,582,000 in 1896. Grapes rank next to apples in point of value, and over the ten years the amount ranged between ££394,000 in 1892 and ££695,000 in 1901. On the average, the annual outlay on imported plums is slightly in excess of that on pears. The extremes shown are ££166,000 in 1895 and ££498,000 in 1897. In the case of pears, the smallest outlay tabu- lated is ££167,000 in 1895, whilst the largest is ££411,000 in 1894. The amounts expended upon imported cherries varied between ££96,000 in 1895 and ££308,000 in 1900. In 1900 apricots and peaches, imported raw, previously included with raw plums, were for the first time separately enumerated, the import into the United Kingdom for that year amounting to 13,689 cwt., valued at ££25,846; in

1901 the quantity was 13,463 cwt., and the value ££32,350. In 1900, also, currants, gooseberries, and strawberries, hitherto included in unenumerated raw fruit, were likewise for the first time separately returned. Of raw currants the import was 64,462 cwt., valued at ££87,170; of raw gooseberries 26,045 cwt., valued at ££14,626 ; and of raw strawberries 52,225 cwt., valued at ££85,949. In 1901 the quantities and values were respectively £££ currants, 70,402 cwt., ££75,308; gooseberries, 21,735 cwt., ££11,420 ; strawberries, 38,604 cwt., ££51,290. Up to 1899 the im- ports of tomatoes were included amongst unenumerated raw vegetables, so that the quantity was not separately ascertainable. For 1900 the import of tomatoes was 833,032 cwt., valued at ££792,339, which is equivalent to a fraction under 2id. per lb. For 1901 the quantity was 793,991 cwt., and the value ££734,051.

In 1900 the outlay of the United Kingdom upon im- ported raw fruits, such as can easily be produced at home, was ££2,708,512, made up as

follows : ???

Apples . Grapes . Pears Cherries .

??1,224,655

595,000 366,871 308,395

Currants . . . ??87,170

Strawberries . . 85,949

Apricots and peaches 25,846

Gooseberries . . 14,626

In addition, ??289,752 was spent upon "unenumerated" raw fruit, and ??602,130 on nuts other than almonds "used as fruit," which would include walnuts and filberts,, both produced at home. It is certain, therefore, that the expenditure on imported fruits, such as are grown within the limits of the United Kingdom, exceeds three millions sterling per annum. The remainder of the outlay on imported fruit in 1900, amounting to ??3,660,419, was made up of ??2,120,789 for oranges, ??420,857 for lemons,. ??548,966 for bananas, and ??569,817 for almond-nuts ; these cannot be grown on an industrial scale in the British Isles. In 1901 the total expenditure on raw fruit imported, into the United Kingdom was ??7,623,500, the largest items being ??2,119,726 for oranges, ??1,182,798 for apples, ??1,090,477 for almonds and other nuts used as- fruit, ??875,542 for bananas, and ??694,942 for grapes.

Acreages of Orchards and Small Fruit Plantations.

The Board of Agriculture returns concerning the orchard areas of Great Britain show a continuous expansion year by year from 199,178 acres in 1888 to 234,660 acres in 1901, as will be learnt from Table II. There is, it is.

Table II. ??? Extent of Orchards in Great Britain in each year, 1887 to 1901.

Tear.

Acr??s.

Year.

Acres.

Year.

Aeres.

1887

202,234

1892

208,950

1897

224,116

1888

199,178

1893

211,664

1898

226,069

1889

199,897

1894

214,187

1899

228,603

1890

202,305

1895

218,428

1900

232,129

1891

209,996

1896

221,254

1901

234,660

FEUIT AND FLOWEK FAEMING

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true, an exception in 1892, but the decline in that year is explained by the circumstance that since 1891 the agricultural returns have been collected only from hold- ings of more than one acre, whereas they were previously obtained from all holdings of a quarter of an acre or more. As there are many holdings of less than an acre in extent upon which fruit is grown, and as fruit is largely raised also in suburban and other gardens which do not come into the returns, it may be taken for granted that the actual extent of land devoted to fruit culture exceeds that which is indicated by the official figures. Table III. shows that

Table III. ??? Areas under Orchards in England, Wales, and Scotland, in each year, 1896 to 1901, ??? Acres.

Year.

England.

Wales.

Scotland.

Great Britain.

1896

215,642

3677

1935

221,254

1897

218,261

3707

2148

224,116

1898

220,220

3690

2149

226,059

1899

222,712

3666

2225

228,603

1900

226,164

3695

2270

232,129

1901

228,580

3767

2313

234,660

the expansion of the orchard area of Great Britain is mainly confined to England, for it is almost at a stand- still in Wales, and only increases slowly in Scotland. The acreage officially returned as under orchards is that of arable or grass land which is also used for fruit trees of any kind. Conditions of soil and climate determine the irregular distribution of orchards in Great Britain. The dozen counties which possess the largest extent of orchard land all lie in the south or west of the island. Ac- cording to the returns for 1901, they are the following ; ???

County.

Acres.

County.

Acres.

County.

Acres.

Kent

Devon

Hereford

Somerset

27,175 27,161 26,987 24,929

Worcester Gloucester Cornwall Middlesex

21,414

19,806

5,252

4,974

Salop Dorset Monmouth Wilts

4758 4459 4027 3774

Leaving out of consideration the county of Kent, which grows a greater variety of fruit than any of the others, the counties of Devon, Hereford, Somerset, Worcester, and Gloucester have an aggregate orchard area of 120,297 acres. These five counties of the west and south-west of England ??? constituting in one continuous area what is essentially the cider country of Great Britain ??? embrace therefore rather more than half of the entire orchard area of the island. Eight English counties have less than 1000 acres each of orchards, namely, the small counties of Bedford, Huntingdon, and London, and the northern counties of Cumberland, Westmorland, North- umberland, Durham, and the East Eiding of York. Eutland has less than 100 acres. The largest orchard areas in Wales are in the two counties adjoining Hereford ??? Brecon with 1185 acres, and Eadnor with 723 acres; at the other extreme is Anglesey, with an orchard area of only 41 acres. Of the Scottish counties, Lanark takes the lead with 771 acres, Perth and Haddington following with 666 and 126 acres respectively. Ayr, according to the 1901 returns, is the only other county possessing 100 acres or more of orchards, whilst Kincardine, Orkney, Shetland, and Wigtown return no orchard area, and Banff, Bute, Kinross, Nairn, Peebles, and Sutherland return less than 10 acres each. It may be added that in 1901 Jersey returned 1027 acres of orchards ; Guernsey, &c., 209 acres ; and the Isle of Man 307 acres.

Outside the cider counties proper of England, the counties in which orchards for commercial fruit-growing have increased considerably in recent years include Berks, Buckingham, Cambridge, Essex, Lincoln, Middlesex, Monmouth, Norfolk, Oxford, Salop, Sussex, Warwick,

and Wilts. Apples are the principal fruit grown in the western and south-western counties, pears also being fairly common. In parts of Gloucestershire, however, and in the Evesham and Pershore districts of Worcestershire, plum orchards predominate. Plums are likewise largely grown in Cambridgeshire and the neighbouring counties. Large quantities of apples, jjlums, damsons, cherries, and pears are grown for the market in Kent and Middlesex, whilst in many counties damsons are cultivated around fruit plantations to shelter the latter from the wind.

Of small fruit (currants, gooseberries, strawberries, raspberries, &c.) no return was made of the acreage previous to 1888, in which year it was given as 36,724 acres for Great Britain. In 1889 it rose to 41,933 acres. The areas in subsequent years are shown in Table IV. It

Table IV.-

-Areas of Small Fruit in Great Britain in each year, 1890 to 1901.

Tear.

Acres.

Year,

Acres.

Tear.

Acres.

1890 1891 1892 1893

46,234 58,704 62,148 65,487

1894 1895 1896 1897

68,415 74,547 76,245 69,792

1898 1899 1900 1901

69,753 71,526 73,780 74,999

will be observed that, owing to corrections made in the enumeration in 1897, a considerable reduction in the area is recorded for that year, and presumably the error then discovered existed in all the preceding returns. Despite this, however, the area of 74,999 acres in 1901 is double that of 1888, and there has undoubtedly been a consider- able expansion, rather than a contraction, of small fruit plantations since 1896. The acreage of small fruit in Great Britain is about one-third that of the orchards. As may be seen in Table V., it is mainly confined to

Table V. ??? Areas under Small Fruit in England, Wales, and Scotland in 1898, 1899, 1900, and 1901, ??? Acres.

Tear.

England.

Wales.

Scotland.

Great Britain.

1898 1899 1900 1901

63,438 64,867 66,749 67,828

1044 1106 1109 1092

5271 5553 5922 6079

69,753 71,526 73,780 74,999

England, though Scotland has a much larger acreage of small fruit than of orchards. Fully one-third of the area of small fruit in England belongs to Kent alone, that county having returned 22,778 acres in 1901. Middle- sex ranks next with 4524 acres, followed by Worcester- shire with 3851 acres, Cambridge with 3740 acres, Norfolk with 3342 acres, Hants with

2382 acres, and Essex with 1983 acres. The largest county area of small fruit in Wales is 622 acres in Denbighshire, and in Scot- land 2174 acres in Lanarkshire, followed by 348 acres in Haddingtonshire. The only counties in Great Britain which make no return under the head of small fruit are Orkney, Shetland, and Sutherland. It is hardly necessary to say that considerable areas of small fruit, in kitchen gardens and elsewhere, find no place in the official returns, which, however, include small fruit grown between and under orchard trees.

Gooseberries are largely grown in most small fruit districts. Currants are less widely cultivated, but the red currant is more extensively grown than the black, the latter having suffered seriously from the ravages of the black currant mite. Kent is the great centre for raspberries and for strawberries, though, in addition, the latter fruit is largely grown in Middlesex, South Hants, Norfolk, and other counties.

There are no official returns as to the acreage devoted to orchard cultivation in Ireland. The figures relating to small fruit, moreover, extend back only to 1899, when the

area under this head was returned as 4809 acres, which became 4359 acres in 1900 and 4877 acres in 1901. In most parts of the country there are districts favourable to the culture of small fruits, such as strawberries, rasp- berries, gooseberries, and currants, and of top fruits, such as apples, pears, plums, and damsons. The only localities largely identified (in 1900) with fruit culture as an industry were the Drogheda district and the Armagh district. In the former all the varieties named are grown except strawberries, the speciality being raspberries, which are marketed in Dublin, Belfast, and Liverpool. In the Armagh district, again, all the varieties named are grown, but in this case strawberries are the speciality, the markets utilized being Eichhill, Belfast, and those in Scotland. In the Drogheda district the grower bears the cost of picking, packing, and

shipping, but he cannot estimate his net returns until his fruit is on the market. Around Armagh the Scotch system prevails ??? that is, the fruit is sold while growing, the buyer being respon- sible for the picking and marketing.

Feuit-Geowing m Kent.

As by far the largest fruit-growing county in England, Kent may appropriately be dealt with first. For centuries that county has been famous for its fruit, and appears to have been the centre for the distribution of trees and grafts throughout the country. The cultivation of fruit land upon farms in many parts of Kent has always been an important feature in its agriculture. The most recent description of this noteworthy characteristic of Kentish farming is contained in a comprehensive paper on the agriculture of Kent by Mr Charles Whitehead,^ whose remarks, with various additions and modifications, are here reproduced : ???

Where the conditions are favourable, especially in East and Mid Kent, there is a considerable acreage of fruit land attached to each farm, planted with cherry, apple, pear, plum, and damson trees, and with bush fruits, or soft ftuits as they are sometimes called, including gooseberries, currants, raspberries, either with or without standard trees, and strawberries, and filberts and cob-nuts in Mid Kent. This acreage has largely increased, and will no doubt con- tinue to increase, as, on the whole, fruit-growing has been profitable, and has materially -benefited those fortunate enough to have fruit land on their farms. There are also cultivators who grow nothing but fruit. These are principally in the district of East Kent, between Rochester and Canterbury, and in the district of Mid Kent near London, and they manage Lheir fruit land, as a rule, better than farmers, as they give their undivided attention to it and have more technical knowledge. But there has been great improvement of late in the management of fruit land, especially of cherry and apple orchards, the grass of which is fed off by animals having corn or cake, or the land is well manured. Apple trees are grease-banded and sprayed systematically by advanced fruit-growers, to prevent or check the attacks of destructive insects. Far more attention is being paid to the selection of

varieties of apples and pears having colour, size, flavour, keeping qualities, and other attributes to meet the tastes of the public, and to compete with the beautiful fruit that comes from the United States and Canada.

Of the various kinds of apples at present grown in Kent mention should be made of Mr Gladstone, Beauty of Bath, Devonshire Quarrenden, Lady Sudely, Yellow Ingestre, and Worcester Pear- main. These are dessert apples coming to pick in August and September, and not stored. For storing, King of the Pippins, Cox's Orange Pippin (the best dessert apple in existence). Cox's Pomona, Duchess, Favourite, Gasooyne's Scarlet Seedling, Court Pendu Plat, Baumann's Red Reinette, AUington Pippin, Duke of Devonshire, and Blenheim Orange. Among kitchen apples for sell- ing straight from the trees the most usually planted are Lord Gros- venor, Lord Suffield, Keswick Codlin, Early Julian, Eolinville Seedling, Pott's Seedling, Early Rivers, Grenadier, Golden Spire, Stirling Castle, and Domino. For storing, the cooking sorts favoured now are Stone's or Loddington, Warner's King, Welling- ton, Lord Derby, Queen Caroline, Tower of Glamis, Winter Queen- ing, Lucombe's Seedling, Bismarck, Bramley's Seedling, Golden Noble, and Lane's Prince Albert. Almost all these will flourish

^ Jour. Soy. Agric. Soc, 1899.

equally as standards, pyramids, and bushes. Among pears are Hessle, Clapp's Favourite, William's Bon Chrgtien, Beurrg de Capiaumont, Fertility, Beurre' Riche, Chissel, Beurrg Clairgeau, Louise Bonne of Jersey, Doyenne du Comice, and Vicar of Wink- field. Among plums, Rivers's Early Prolific, Czar, Belgian Pui-ple, Black Diamond, Kentish Bush Plum, Pond's Seedling, Magnum Bonum, and Victoria are mainly cultivated. The damson known as Farleigh Prolific, or Crittenden's, is most extensively grown throughout the county, and usually yields large crops, which make good prices. As a case in point, purchasers were offering to con- tract for quantities of this damson at ??20 per ton in May of 1899, as the prospects of the yield were unsatisfactory. On the other hand, in one year recently, when the crop was abnormally abundant, some of the fruit barely paid the expenses of sending to market.

The varieties of cherries most frequently grown are Governor Wood, Knight's Early Black, Frogmore Blackheart, Black Eagle, Waterloo, Amberheart, Bigarreau, Napoleon BigaiTeau, and Turk. A variety of cherry known as the Kentish cherry, of a light red colour and fine subacid flavour, is much grown in Kent for drying and cooking purposes. Another cherry, similar in colour and quality, which comes rather late, known as the Flemish, is also extensively cultivated, as well as the very dark red large Morella, used for making cherry brandy. These three varieties are grown extensively as pyramids, and the last-named also on walls and sides of buildings. Sometimes the cherry crop is sold by auction to dealers, who pick, pack, and consign the fruit to market. Large prices are often made, as much as ££80 per acre being not uncom- mon. The crop on a large cherry orchard in Mid Kent has been sold for more than ££100 per acre.

Where old standard trees have been long neglected and have become overgrown by mosses and lichens, the attempts made to improve them seldom succeed. The introduction of bush fruit trees dwarfed by grafting on the Paradise stock has been of much advantage to fruit cultivators, as they come into bearing in two or three years, and are more easDy cultivated, pruned, sprayed, and picked than standards. Many plantations of these bush trees have been formed in Kent of apples, pears, and plums. Half standards and pyramids have also been planted of these fruits, as well as of cherries. Fruit bushes of gooseberries and currants, and of raspberry canes, have been planted to a great extent in many parts of the East and Mid divisions of Kent, but not much in the Weald, where apples are principally grown. Sometimes fruit bushes are put in alternate rows with bush trees of apple, pear, plum, and damson, or other standards, or they are planted by themselves. The distances apart for planting are generally for cherry and apple trees on grass 30 feet by 30 feet ; for stand- ard apples and pear trees from 20 feet to 24 feet upon arable land, with bush fruit, as gooseberries and currants, under them. These are set 6 feet by 6 feet apart, and 5 feet by 2 feet for raspberries, and strawberries 2 feet 6 inches to 3 feet by 1 foot 6 inches to 1 foot 3 inches apart. On some fruit farms bush or dwarf trees ??? apples, pears, plums ??? are planted alone, at distances varying from 8 to 10 feet apart, giving from 485 to 680 bush trees per acre, nothing being grown between them except

perhaps straw- berries or vegetables during the firat two or three years. It is believed that this is the best way of ensuring fruit of high quality and colour. Another arrangement consists in putting standard apple or pear trees 30 feet apart (48 trees per acre), and setting bush trees of apples or pears 15 feet apart between them ; these latter come quickly into bearing, and are removed when the standards are fully grown. Occasionally gooseberry or currant bushes, or raspberry canes or strawberry plants, are set between the bush trees, and taken away directly they interfere with the growth of these. Half standard apple or plum trees are set triangularly 15 feet apart, and strawberry plants at a distance of IJ foot from plant to plant and 2J feet from row to row. Or currant or gooseberry bushes are set between the half .standards, and strawben-y plants between these.

These systems involve high farming. The manures used are London manure, where hops are not gi-own, and bone meal, super- phosphate, rags, shoddy, wool-waste, fish refuse, nitrate of soda, kainit, and sulphate of ammonia. Where hops are grown the London manure is wanted for them. Fruit plantations are always dug by hand with the Kent spud. Fruit land is never ploughed, as in the United States and Canada. The soil is levelled down with the "Canterbury" hoe, and then the plantations are kept free from weeds with the ordinary or "plate" hoe. The best fruit fanners spray fruit trees regularly in the early spring, and continue until the blossoms come out, with quassia and soft soap and paraffin emulsions, and a very few with Paris green only, where there is no under fruit, in order to prevent and check the constant attacks of the various caterpillars and other insect pests. This is a costly and laborious process, but it pays well, as a rule. The fallacy that fruit trees on grass land require no manure, and that the grass may be allowed to grow up to their trunks I without any harm, is exploding, and many fruit farmers are well

manuring their grass orchards and removing the grass for some distance round the stems, particularly where the trees are young.

Strawberries are produced in enormous quantities in the northern part of the Mid Kent district round the Grays, and from thence to Orpington ; also near Sandwich, and to some extent near Maid- stone. Raspberry canes have been extensively put in during the last few years, and in some seasons yield good profits. There is a very great and growing demand for all soft fruits for jam-making, and prices are fairly good, taking an average of years, notwith- standing the heavy importations from France, Belgium, Holland, Spain, and Italy. The extraordinary increase in the national ???demand for jam and other fruit preserves has been of great benefit to Kent fruit producers. The cheapness of duty-free sugar, as compared with sugar paying duty in the United States and other large fruit-producing countries, afforded one of the very few ad- vantages possessed by British cultivators, but the re-imposition of the sugar duty in the United Kingdom in 1901 has modified the position in this respect. Jam factories were established in several parts of Kent about 1889 or 1890, but most of them collapsed either from want of capital or from bad management. There are still a few remaining, principally in connexion with large fruit farms. One of these is at Swanley, whose energetic owners farm nearly 2000 acres of fruit land in Kent. The fruit grown by them that will not make satisfactory prices in a fresh raw state is made into jam, or if time presses it is first made into pulp, and kept until the opportunity comes for making it into jam. In this f actoi-y there are fifteen steam-jacketed vats in one row, and six others for candied peel. A season's output on a recent occasion comprised about 3500 tons of jam, 8-50 tons of candied peel, and 750 gross (108,000 bottles) of bottled fruit. A great deal of the fruit pre- served is purchased, whilst much of that grown on the farms is sold. A strigging machine is employed, which does as much work as fifty women in taking currants off their strigs or stalks. Black currant pulp is stored in casks till winter, when there is time to convert it into jam. Strawberries cannot be pulped to advantage, but it is otherwise with raspberries, the pulp of which is largely made. Apricots for jam are obtained chiefly from France and Spain. There is another flourishing factory near Sittingbourne worked on the same lines. It is very advantageous to fruit farmers to have jam factories in connexion with their farms, or to have them near, as they can thorouglily grade their fruit, and send only the best to market, thus ensuring a high reputation for its quality. Carriage is saved, which is a serious charge, though

railway rates from Kent to the great manufacturing towns and to Scotland are very much less proportionally than those to London, and conse- quently Kent growers send increasing quantities to these distant markets, where prices are better, not being so directly inter- fered with by imported fruit, which generally finds its way to London.

Kentish fniit-growers are becoming more particular in picking, grading, packing, and storing fruit, as well as in marketing it. A larger quantity of fruit is now carefully stored, and sent to selected markets as it ripens, or when there is an ascertained demand, as it is found that if it is consigned to market direct from the trees there must frequently be forced sales and competition with foreign fruit that is fully matured and in good order. It was customary formerly for Kentish growers to consign all their fruit to the London markets ; now a good deal of it is sent to Manchester, Birmingham, Liverpool, Sheffield, Newcastle, and other large cities. Some is sent even to Edinburgh. Many large growers send no fruit to London now. It is by no means uncommon for growers to sell their fruit crops on the trees or bushes by auction or private treaty, or to contract to supply a stipulated quantity of specified fruit, say of currants, raspberries, or strawberries, to jam manu- facturers. There is a considerable quantity of fruit, such as grapes, peaches, nectarines, grown under glass, and this kind of culture tends to increase.

Filberts and cob-nuts are a special product of Kent, in the neighbourhood of Maidstone principally, and upon the Eagstone soils, certain conditions of soil and situation being essential for their profitable production. A part of the filbert and cob-nut crop is picked green in September, as they do well for dessert, though their kernels are not large or firm, and it pays to sell them green, as they weigh more heavily. One grower in Mid Kent has 100 acres of nuts, and has grown 100 tons in a good year. The average price of late years has been about 5d. per lb, which would make the gross return of the 100 acres amount to ►►4660. Kentish filberts have long been proverbial for their excellence. Cobs are larger and look better for dessert, though their fiavour is not so fine. They are better croppers, and are now usually planted. This cultivation is not much extending, as it is very long before the trees come into full bearing. The London market is supplied entirely with these nuts from Kent, and there is some demand in

America for them. Filbert and cob trees are most closely pruned. All the year's growth is cut away except the very finest young wood, which the trained eye of the tree-cutter sees at a glance is

blossom-bearing. The trees are kept from 5J to 7 feet high upon stems from 1^ to 2 feet high, and are trained so as to form a cup of from 7 to 8 feet in diameter.

There seems no reason to expect any decrease in the acreage of fruit land in Kent, and if the improvement in the selection of varieties and in the general management continues it will yet pay. A hundred years ago every one was grubbing fruit land in order that hops might be planted, and for this many acres of splendid cherry orchards were sacrificed. Now the disposition is to grub hop plants and substitute cherry trees.

Peuit-Geowixg in other Distkicls.

The large fruit plantations in the vicinity of the metropolis are to be found mostly in the valley of the Thames above Loudon, around such centres as Richmond, Hounslow, Cranford, and Southall. All varieties of or- chard trees and small fruit are grown in these districts, the nearness of virhich to the metropolitan fruit market at Covent Garden is of course an advantage. Some of the orchards are old, and are not managed on modern principles. They contain, moreover, varieties of fruit many of which are out of date and would not be employed in establishing new plantations. In the better-managed grounds the antiquated varieties have been removed, and their places taken by newer and more approved types. In addition to apples, pears, plums, damsons, cherries, and quinces as top fruit, currants, gooseberries, and rasp- berries are grown as bottom fruit. Strawberries are ex- tensively grown in some of the localities, and occasionally outdoor tomatoes are ripened and marketed.

Pruit is extensively grown in Cambridgeshire and adjacent counties in the east of England. A leading centre is Cottenham, where the Lower Greensand crops out and furnishes one of the best of soils for fruit-culture. In Cottenham about a thousand acres are devoted to fruit, and nearly the same acreage to asparagus, which is, how- ever, giving place to fruit. Plums and gooseberries are the most largely grown, apples,

currants, and raspberries following. Of varieties of plums the Victoria is first in favour, and then fiivers's Early Prolific, Tsar, and Gis- borne. London is the chief market, as it receives about half the fruit sent away, whilst a considerable quantity goes to Manchester, and some is sent to a neighbouring jam factory at Histon, where also a moderate acreage of fruit is grown. Another fruit-growing centre in Cam- bridgeshire is at Willinghara, where ??? besides plums, gooseberries, and raspberries ??? outdoor tomatoes are a feature. Greengages are largely grown near Cambridge. Wisbech is the centre of an extensive fruit district, situ- ated partly in Cambridgeshire and partly in Norfolk. Gooseberries, strawberries, and raspberries are largely grown, and as many as 80 tons of the first-named fruit have been sent away from Wisbech station in a single day. In the fruit-growing localities of Huntingdonshire plums and gooseberries are the most extensively grown, but apples, pears, greengages, cherries, currants, straw- berries, and raspberries are also cultivated. As illustrat- ing variations in price, it may be mentioned that about the year 1880 the lowest price for gooseberries was ??10 per ton, whereas it has since been down to ??1. Hunt- ingdonshire fruit is sent chiefly to Yorkshire, Scotland, and South Wales, but railway freights are high.

Essex affords a good example of successful fruit- farming at Tiptree Heath, near Kelvedon, where under one management about 260 acres out of a total of 360 are under fruit. The soil, a stiff loam, grows straw- berries to perfection, and 165 acres are allotted to this fruit. The other principal crops are 43 acres of rasp- berries and 30 acres of black currants, besides which there are small areas of red currants, gooseberries, plums, damsons, greengages, cherries, apples, quinces, and black- berries. The variety of strawberry known as the Small

Scarlet is a specialty here, and it occupies 55 acres, as it makes the best of jam. The Paxton, Eoyal Sovereign, and Noble varieties are also grown. Strawberries stand for six or seven years on this farm, and begin to yield

well when two years old. A jam factory is worked in conjunction with the fruit farm. Pulp is not made ex- cept when there is a glut of fruit. Perishable fruit intended for whole-fruit preserves is never held over after it is gathered. The picking of strawberries begins at 4 A.M., and the first lot is made into jam by 6 a.m.

Hampshire, like Cambridgeshire and Norfolk, is one of the few counties in which the area of small fruit exceeds that of orchards, the former in 1901 being returned at 2382 acres, and the latter at 2078 acres. Compared with a dozen years previously, the acreage of small fruit has trebled. This is largely due to the extension of strawberry culture in the Southampton district, where the industry is in the hands of many small growers, few of whom cultivate more than 20 acres each. Sarisbury and Botley are the leading parishes in which the busi- ness is carried on. Most of the strawberry holdings are from half an acre to 5 acres in extent, a few are from 5 to 10 acres, fewer still from 10 to 20 acres, and only half-a-dozen over that limit. Runners from one-year plants are used for planting, being found more fruitful than those from older plants. Peat moss manure from London stables is much used, but artificial manures are also employed with good results. Shortly after flower- ing the plants are bedded down with straw at the rate of about 25 cwt. per acre. Picking begins some ten days earlier than in Kent, at a date between 1st June and 15th June. The first week's gathering is sent mostly to London, but subsequently the greater part of the fruit goes to the Midlands and to Scotland and Ireland.

In recent years frui1>growing has much increased in South Worcestershire, in the vicinity of Evesham and Pershore. Hand-lights are freely used in the market gardens of this district for the protection of cucumbers and vegetable marrows, besides which tomatoes are ex- tensively grown out of doors. The egg plum and the Worcester damson are the chief fruit crops, apples and cherries ranking next, pears being grown to only a mod- erate extent. In a prolific season a single tree of the Damascene or Worcester damson will yield from 400 to 500 lb of fruit. There is a tendency to grow plum trees iu the bush shape, as they are less liable than standards to injury from wind. The manures used include soot, fish guano, blood manure, and phosphates ??? basic slag amongst the last named. In the Pershore district, where there is a jam factory, plums

are the chief tree fruit, whilst most of the orchard apples and pears are grown for cider and perry. Gooseberries are a feature, as are also red and black currants and a feV white, btit rasp- berries and strawberries are little grown, and cherries much less than formerly. The soil, a strong or medium loam of fair depth, resting on clay, is so well adapted to plums that trees live' for fifty years. In order to check the ravages of the winter moth, plum and apple trees are grease-banded at the beginning of October and again at the end of March. The trees are also sprayed when necessary with insecticidal solutions. Pruning is done in the autumn. An approved distance apart at which to grow plum trees is 12 feet by 12 feet. In the Earl of Coventry's fruit plantation, 40 acres in extent, at Croome Court, plums and apples are planted alternately, the bottom fruit being black currants, which are less liable to injury from birds than are red currants or gooseberries. Details concerning the methods of culti- vation of fruit and flowers in various parts of England, the varieties commonly grown, the expenditure involved, and allied matters, will be found in Mr W. E. Bear's

papers in the Journal of the Eoyal Agricultural Society in 1898 and 1899.

The Wobuen Experimental Feuit Faem.

The establishment in 1894 of the experimental fruit farm at Eidgmont, near Woburn, Beds, is likely to exer- cise a healthy influence upon the progress and develop- ment of fruit-farming in England. The farm was founded, and is carried on, by the public-spirited enter- prise of the Duke of Bedford aud Mr Spencer U. Pick- ering, the latter acting as director. The main object of the experimental station is " to ascertain facts relative to the culture of fruit, and to increase our knowledge of, and to improve our practice in, this industry." The farm is 20 acres in extent, and occupies a field which np to June 1894 had been used as arable land for the ordinary rotation of farm crops. The soil is a sandy loam 9 or 10 inches deep, resting on a bed of Oxford Clay. Although it contains a large proportion of sand, the land would gen- erally be termed very heavy, and the water often used to stand on it in places for weeks together in a wet season. The tillage to which the ground was subjected for the purposes of the fruit farm much improved its character, and in dry weather it presents

as good a tilth as could be desired. Chemical analyses of the soil from difi'erent parts of the field show such wide differences that it is admitted to be by no means an ideal one for experimental purposes. Without entering upon further details, it may be useful to give a summary of the chief results hitherto obtained.

Apples have been grown and treated in a variety of ways, but of the different methods of treatment careless planting, coupled with subsequent neglect, has given the most adverse results, the crop of fruit being not 5 per cent, of that from trees grown normally. Of the separate deleterious items constituting total neglect, by far the most effective was the growth of weeds on the surface ; careless planting, absence of manure, and the omission of trenching all had comparatively little influence on the results. A set of trees that had been carelessly planted and neglected, but subsequently tended in the early part of 1896, were in the autumn of that year only 10 per cent, behind their normally-treated neighbours, thus demonstrating that the response to proper attention is prompt. The growth of grass around young apple trees produced a very striking effect, the injury being much greater than that due to weeds. It is possible, however, that in wet years the ill effects of both grass and weeds would be less than in dry seasons. Neverthe- less, the grass-grown trees, after five years, were scarcely bigger than when planted, and the actual increase in weight which they showed during that time was about eighteen times smaller than in the case of similar trees in tilled ground. It is believed that one of the main causes of the ill effects is the large increase in the evap- oration of water from the soil which is known to be pro- duced by grass, the trees being thereby made to suffer from drought, with constant deprivation of other nourish- ment as well. That grass growing round young apple trees is deleterious was a circumstance known to many horticulturists, but the extent to which it interferes with the development of the trees had never before been real- ized. Thousands of pounds are annually thrown away in England through want of knowledge of this fact. Yet trees will flourish iu grass under certain conditions, and there were signs that those on the farm were in 1900 beginning to get over the baneful influence of the grass. Whether the dominant factor is the age (or size) of the tree is being investigated by grassing over trees which have hitherto been in the open

ground, and so far (1901) the results appear to indicate that the grass is as dele-

terious to the older trees as it was to the younger ones. Again, it appears to have been demonstrated that young apple trees, at all events in certain soils, require but little or no manure in the early stages of their exist- ence, so that in this case also large sums must be annually wasted upon manurial dressings which produce no effects. The experiments have dealt with dwarf trees of Bramley, Cox, and Potts, six trees of each variety- constituting one investigation. Some of the experi- ments were repeated with Stirling Castle, and others with standard trees of Bramley, Cox, and Lane's Prince Albert. All were planted in 1894-95, the dwarfs being then three years old and the standards four. In each experiment the " normal " treatment is altered in some one particular, this normal treatment consisting of plant- ing the trees carefully in trenched ground, and subse- quently keeping the surface clean; cutting back after planting, pruning moderately in autumn, and shortening the growths when it appeared necessary in summer; giving in autumn a dressing of mixed mineral manures, and in Pebruary one of nitrate of soda, this dressing being probably equivalent to one of 12 tons of dung per acre. In the experiments on branch treatment, the bad effects of omitting to cut the trees back on planting, or to prune them subsequently, is evident chiefly in the straggling and bad shape of the resulting trees, but such trees also are not so vigorous as they should be. The quantity of fruit borne, however, is in excess of the average. The check on the vigour and growth of a tree by cutting or injuring its roots is in marked contrast with the effects of a similar interference with the branches. Trees which had been root-pruned each year were in 1898 little more than half as big as the normal trees, whilst those root-pruned every second year were about two-thirds as big as the normal. The crops borne by these trees were nevertheless heavy in proportion to the size of the trees. Such frequent root-pruning is not, of course, a practice which should be adopted. It was found that trees which hadbeencarefully lifted every other year and replanted at once

experienced no ill effects from the operation; but in a case where the trees after being lifted had been left in a shed for three days before re-planting ??? which would reproduce to a certain extent tke conditions experienced when trees are sent out from a nursery ??? material injury was suffered, these trees after four years being 28 per cent, smaller than similar ones which had not been replanted. Sets of trees planted re-spectively in November, January, and March have, on the whole, shown nothing in favour of any of these different times for planting purposes. Some doubt is thrown on the accepted view that there is a tendency, at any rate with young apple and pear trees, to fruit in alternate seasons.

Strawberries of eighty ~~five different varieties have been experimented with, each variety being represented in 1900 by plants of five different ages, from one to five years. In 1896 and 1898 the crops of fruit were about twice as heavy as in 1897 and 1899, but it has not been found possible to correlate these variations with the meteorological re~~ cords of the several seasons. Taking the average of all the varieties, the relative weights of crop per plant, when these are compared with the two-year-old plants in the same season, are, for the five ages of one to five years, 31, 100, 122, 121, and 134, apparently showing that the bearing power increases rapidly up to two years, less rapidly up to three years, after which age it remains practically constant. The relative average size of the berries shows a deterioration with the age of the plant. The comparative sizes from plants of one to five years old were 115, 100, 96, 91, and 82 respectively. If the money value of the crop is taken to be directly dependent on its

total weight, and also on the size of the fruits, the relative values of the crop for the different ages would be 34, 100, 117, 111, and 110, so that, on the Eidgmont ground, strawberry plants could be profitably retained up to five years, and probably longer. As regards what may be termed the order of merit of different varieties of straw- berries, it appears that even small differences in position and treatment cause large variations, not only in the features of the crop generally, but also in the relative behaviour of the different varieties. The relative crop- ping power of the varieties under apparently similar con- ditions may often be expressed by a number five or tenfold as great in one case as in the other. A comparison of the

relative behaviour of the same varieties in different seasons is attended by similar variations. The varying sensitiveness of different varieties of strawberry plants to small and undefinable differences in circumstances is indeed one of the most important facts brought to light in the experiments. Manurial experiments upon strawberries, as well as upon raspberries, gooseberries, black, red, and white currants, are not sufficiently ad- vanced to permit the establishment of conclusions of practical value.

The Plowek-Gbowing Industey.

During the last two or three decades of the 19th century a very marked increase in flower production occurred in England. Jfotably was this the case in the neighbourhood of London, where, within a radius of 15 or 20 miles, the fruit crops, which had largely taken the place of garden vegetables, were themselves ousted in turn to satisfy the increasing demand for land for flower cul- tivation. No flower has entered more largely into the development of the industry than the narcissus or daffodil, of which there are now some 600 varieties, fully one- fourth of these being worth cultivating. On some flower farms a dozen or more acres are devoted to narcissi alone, the production of bulbs for sale as well as of flowers for market being the object of the growers.

In the London district the country in the Thames valley, west of the metropolis, is as largely occupied by flower farms as it is by fruit farms ??? in fact, the cultiva- tion of flowers is commonly associated with that of fruit. In the vicinity of Eichmond narcissi are extensively grown, as they also are more to the west in the Long Ditton district, and likewise around Twickenham. Eoses come more into evidence in the neighbourhood of Houns- low, Cranford, and Ealing, and in some gardens daffodils and roses occupy alternate rows. South of London is the Mitcham country, long noted for its production of laven- der. The incessant growth of the lavender plant upon the same land, however, has led to the decline of this industry, which has been largely transferred to districts in the counties of Bedford, Essex, and Hertford. At Mitcham, nevertheless, mixed flowers are very largely grown for the supply of the metropolis, and one farm alone has nearly 100 acres under flowers and

glass-houses.- Chrysanthemums, asters, Iceland poppies, gaillardias, pansies, calceolarias, geraniums, and other plants are cultivated in immense quantities. At Swanley and Eyns- ford, in Kent, flowers are extensively cultivated in asso- ciation with fruit and vegetables. Narcissi, chrysanthe- mums, violets, carnations, campanulas,roses, pansies, irises, sweet peas, and many other flowers are here raised, and disposed of in the form both of cut flowers and of plants.

The Scilly Isles are important as providing the main source of supply of flowers to the English markets in the early months of the year. This trade arose almost by accident, for it was about the year 1870 that a box of narcissi sent to Covent Garden Market, London, realized ??1 ; and the knowledge of this fact getting abroad, the

farmers of the isles began collecting wild bulbs from the fields in order to cultivate them and increase their stocks. Some ten years, however, elapsed before the industry promised to become remunerative. In 1885 a Bulb and Flower Association was established to promote the industrial growth of flowers. The exports of flowers in that year reached 65 tons, and they steadily increased until 1893, when they amounted to 450 tons. A slight decline followed, but in 1896 the quantity ex- ported was no less than 514 tons. This would represent upwards of 3^ million bunches of flowers, chiefly narcissi and anemones. Rather more than 500 acres are devoted to flower-growing in the isles, by far the greater part of this area being assigned to narcissi, whilst anemones, gladioli, marguerites, arum lilies, Spanish irises, pinks, and wallflowers are cultivated on a much smaller scale. The great advantage enjoyed by the Scilly flower-growers is earliness of production, due to climatic causes ; the soil, moreover, is well suited to flower culture, and there is an abundance of sunshine. The long journey to London is somewhat of a drawback, in regard to both time and freight, but the earliness of the flowers more than compensates for this. Open-air narcissi are usually ready at the beginning of January, and the supply is maintained in different varieties up to the middle or end of May. The narcissus bulbs are usually planted in October, 4 inches by 3 inches

apart for the smaller sorts and 6 inches by 4 to 6 inches for the larger. A compost of farmyard manure, seaweed, earth, and road scrapings is the usual dressing, but nitrate of soda, guano, and bones are also occasionally employed. A better plan, perhaps, is to manure heavily the previous crop, frequently potatoes, no direct manuring then being needed for the bulbs, these not being left in the ground more than two or three years. The expenses of cultiva- tion are heavy, the cost of bulbs alone ??? of which it requires nearly a quarter of a million of the smaller varieties, or half as many of the largest, to plant an acre ??? being considerable. The polyanthus varieties of narcissus are likely to continue the most remunerative to the flower-growers of Scilly, as they flourish better in these isles than on the mainland.

In the district around the Wash, in the vicinity of such towns as Wisbech, Spalding, and Boston, the in- dustrial culture of bulbs and flowers underwent great expansion in the period between 1880 and 1900. At Wisbech one concern alone has a farm of some 900 acres, devoted chiefly to flowers and fruit, the soil being a deep fine alluvium. Eoses are grown here, one field containing upwards of 100,000 trees. Nearly 20 acres are devoted to narcissi, which are grown for the bulbs and also, together with tulips, for cut flowers. Carnations are cultivated both in the field and in pots. Cut flowers are sent out in large quantities, neatly and effectively packed, the parcel post being mainly employed as a means of distribution. In the neighbourhood of Spalding crocuses and snowdrops are less extensively grown than used to be the case. On one farm, however, upwards of 20 acres are devoted to narcissi alone, whilst gladioli, lilies, and irises are grown on a smaller scale. Around Boston narcissi are also extensively grown for the market, both bulbs and cut blooms being sold. The bulbs are planted 3 inches apart in rows, the latter being 9 inches apart, and are allowed to stand from two to four years.

The imports of fresh flowers into the United Kingdom were not separately shown prior to 1900. In that year, however, their value amounted to ??200,586, and in 1901 to ??225,011. From the monthly totals quoted in Table VI. it would appear that the trade sinks to its minimum dimensions in the four months July to October inclusive,

Table "VI. ◆◆◆ Values of Fresh Flowers imported into the United Kingdom in each month of 1900 and 1901.

Month.

1900.

1901.

January

◆◆27,991

◆◆26,521

February .

24,888

25,525

March .

34,693

45,655

April .

40,256

45,848

May .

22,.506

22,586

June

12,245

11,483

July .

2,305

2,523

August

821

1,252

September .

632

478

October

3,902

4,026

November .

11,671

17,173

December . Total

18,615

21,991

__200,585

__225,011

and that after September the business continually ex- pands___ excepting in February, for the shortness of which month allowance must be made ___ up to April, subsequent to which contraction again sets in. About one-half of the trade belongs practically to the three months of February, March, and April.

Hothouse Culture of Fkuit anb Flowers.

The cultivation of fruit and flowers under glass has increased enormously since about the year 1880, especially in the neighbourhood of London, where large sums of money have been sunk in the erection and equipment of hothouses. In the parish of Cheshunt, Herts, alone there are upwards of 130 acres covered with glass, and between that place on the north and London on the south extensive areas of land are similarly utilized. At Erith, Swanley, and other places in Kent, as also at Worthing, in Sussex, glass-house culture has much ex- tended. A careful estimate puts the area of industrial hothouses in England at about 1200 acres, representing a tenfold increase within the space of thirty years. The leading products are grapes, tomatoes, and cucumbers, the last-named two being true fruits from the botanist's point of view, though commercially included with vegetables. Peaches, nectarines, and strawberries are largelj" grown under glass, and, in private hothouses ___ from which the produce is used mainly for household consumption, and which are not taken into consideration here ___ pineapples, figs, and other fruit. Conservative estimates indicate the average annual yield of hothouse grapes to be about 12 tons per acre, and of tomatoes 20 tons. The greater part of the space in the hothouses is assigned to fruit, but whilst some houses are devoted exclusively to flowers, in others, where fruit is the main object, flowers are forced in considerable quantities in winter and early spring. The flowers grown under glass include tulips, hyacinths, primulas, cyclamens, spiraeas, mignonettes, fuchsias, cal- ceolarias, lilies,

geraniums, roses, chrysanthemums, and many others. There is an increasing demand for foliage hothouse plants, such as ferns, palms, crotons, aspidistras, and solanums. Tomatoes are grown largely in vineries and in cucumber-houses, as also in houses exclusively occupied by them, in which case two and sometimes three crops can be gathered in the year. In the Channel Islands, where potatoes grown under glass are lifted in April and May, in order to secure the high prices of the early markets, tomato seedlings are planted out from boxes into the ground as quickly as the potatoes are removed, the tomato planter working only a few rows behind the potato digger. The trade in imported tomatoes is so considerable that home growers are well justified in their endeavours to meet the demand more fully with native produce, whether raised under glass or in the open. Tomatoes were not separately enumerated in the imports

previous to 1900. It has already been stated that in 1900 the raw tomatoes imported amounted to 833,032 cwt., valued at ??792,339, and in 1901 to 793,991 cwt., valued at ??734,061. From the monthly quantities given in Table VII., it would appear that the imports are largest

Table VII. ??? Quantities of Tomatoes imported into the United Kingdom in each month of 1900 and 1901.

Mo

ith. 1900.

1901.

Cwt.

Cwt.

January

27,496

37,768

Febraary

38,420

36,310

March

46,888

49,576

April

44,746

67,007

May

47,199

33,590

June

123,032

100,738

July

160,303

186,535

August

115,152

132,786

Septembei

91,468

75,412

October

66,061

37,490

November

36,906

20,924

December

35,361

25,855

Tota

I . . 833,0.32

793,991

Valu

e . . ??792,339

in June, July, and August, about one-half of the year's total arriving during those three months. It is too early in June and July for home-grown outdoor tomatoes to enter into competition with the imported product, but home-grown hothouse tomatoes should be qualified to challenge this trade.

Prospects of the Feuit and Flower-Gbowing Industries.

As regards Open-air fruit-growing, the outlook for new ventures is perhaps brighter than in the hothouse indus- try, not as Mr Bear has pointed out because the area of fruit land in England is too small, but because the level of efficiency, from the selection of varieties to the packing and marketing of the produce, is very much lower in the former than in the latter branch of enterprise. In other words, whereas the practice of the majority of hothouse nurserymen is so skilled, so up-to-date, and so entirely under high pressure that a new competitor, however well trained, will find it difficult to rise above mediocrity, the converse is true of open-air fruit-growers. Many, and an increasing proportion, of the latter are thoroughly efficient in all branches of their business, and are in possession of plantations of the best market varieties of fruit, well cultivated, pruned, and otherwise managed. But the extent of fruit plantations completely up to the mark in relation to varieties and treatment of trees and bushes, and in connexion with which the packing and marketing of the produce are equally satisfactory, is small in proportion to the total fruit area of the country. Information concerning the best treatment of fruit trees has spread widely in recent years, and old plantations, as a rule, suffer from the neglect or errors of the past, however skilful their present holders may be. Although the majority of professional market fruit-growers may be well up to the standard in skill, there are numerous contributors to the fruit supply who are either ignorant of the best methods of cultivation and marketing, or careless in their application. The bad condition of the great majority of farm orchards is notorious, and many landowners, farmers, and amateur gardeners who have planted fruit on a more or less extensive scale have mis- managed their undertakings. For these reasons new growers of

open-air fruit for market have opportunities of succeeding by means of superiority to the majority of those with whom they will compete, provided that they

possess the requisite knowledge, energy, and capital. It has been asserted on sound authority that there is no chance of success for fruit-growers except in districts favourable as regards soil, climate, and nearness to a railway or a good market; and, even under these condi- tions, only for men who have had experience in the industry and are prepared to devote their unremitting attention to it. Most important is it to a beginner that he should ascertain the varieties of fruit that flourish best in his particular district. Certain kinds seem to do well or fairly well in all parts of the country; others, whilst heavy croppers in some localities, are often unsat- isfactory in others.

As has been intimated, there is probably in England less room for expansion of fruit culture under glass than in the open. The large increase of glass-houses in recent years appears to have brought the supply of hothouse produce, even at greatly reduced prices, at least up to the level of the demand ; and as most nurserymen con- tinue to extend their expanse of glass, the prospect for new competitors is not a bright one. Moreover, the vast scale upon which some of the growers conduct the hot- house industry puts small producers at a great disadvan- tage, not only because the extensive producers can grow grapes and other fruit more economically than small growers ??? with the possible exception of those who do all or nearly all their own work ??? but also, and still more, because the former have greater advantages in transport- ing and marketing their fruit. There has, in recent years, been a much greater fall in the prices of hothouse than of open-air fruit, especially under the existing sys- tem of distribution, which involves the payment by con- sumers of 50 to 100 per cent, more in prices than growers receive. The best openings for new nurseries are prob- ably, not where they are now to be found in large groups, and especially not in the neighbourhood of London, but in suitable spots near the great centres of population in the Midlands and the North, or big towns elsewhere not already well supplied with nurseries. By such a selec- tion of a locality the beginner may build up a retail trade in hothouse fruit, or at least a trade

with local fruiterers and grocers, thus avoiding railway charges and sales-men's commissions to a great extent, though it may often be advantageous to send certain kinds of produce to a distant market. Above all, a man who has no knowledge of the hothouse industry should avoid embarking his capital in it, trusting himself in the hands of a foreman, as experience shows that such a venture usually leads to disaster. Some years of training in diiferent nurseries are desirable for any young man who is desirous of be- coming a grower of hothouse fruit.

There can be no doubt that flower-growing is greatly extending in England, and that competition among home growers is becoming more severe. Foreign supplies of flowers have increased, but not nearly as greatly in pro- portion as home supplies, and it seems clear that home growers have gained ground in relation to their foreign rivals, except with respect to flowers for the growth of which foreigners have extraordinary natural advantages. There seems some danger of the home culture of the nar- cissus being over-done, and the chrysanthemum appears to be produced in excess of the demand. Again, in the production of violets, the warm and sunny South of France has an advantage not possessed by England, whilst Holland, likewise for climatic reasons, maintains her hold upon the hyacinth and tulip trade. Whether the production of flowers as a whole is gaining ground upon the demand or not is a difficult question to answer. It is true that the prices of flowers have fallen generally ; but production, at any rate under glass, has been cheap- ened, and if a fair profit can be obtained, the fall in

prices, without which the existing consumption of flowers would be impossible, does not necessarily imply over- production. There is some difference of opinion among growers upon this point ; but nearly all agree that profits are now so small that production on a large scale is necessary to provide a fair income. Industrial flower- growing affords such a wide scope for the exercise of superior skill, industry, and alertness, that it is not sur- prising to find some who are engaged in it doing remark- ably well to all appearance, while others are struggling on

and hardly paying their way. That a man with only a little capital, starting in a small way, has many dis- advantages is certain ; also that his chance of saving money and extending his business quickly is much smaller than it was. To the casual looker-on, who knows nothing of the drudgery of the industry, flower-growing seems a delightful method of getting a living. That it is an entrancing pursuit there is no doubt; but it is equally true that it is a very arduous one, requiring care- ful forethought, ceaseless attention, and abundant energy. Fortunately for those who might be tempted, without any knowledge of the industry, to embark capital in it, flower- growing, if at all comprehensive in scope, so obviously requires a varied and extensive technical knowledge, that any one can see that a thorough training is necessary to a man who intends to adopt it as a business, especially if hothouse flowers are to be produced.

The market for fruit, and more especially for flowers, is a fickle one, and there is nearly always some uncer- tainty as to the course of prices. The perishable nature of soft fruit and cut flowers renders the markets very sensitive to anything in the nature of a glut, the occur- rence of which is usually attended with disastrous results to producers. Foreign competition, moreover, has con- stantly to be faced, and it is likely to increase rather than diminish. French growers have a great advantage over the open-air cultivators of England, for the climate en- ables them to get their produce into the markets early in the season, when the highest prices are obtainable. The geographical advantage which France enjoys in being so near to England is likely, however, to be considerably dis- counted by the increasing facilities for cold storage in transit, both by rail and sea. The development of such facilities will permit of the retail sale in England of lus- cious fruit as fresh and attractive as when it was gath- ered beneath the sunny skies of California. In the case of flowers, fashion is an element not to be ignored. Flowers much in request in one season may meet with very little demand in another, and it is difficult for the producer to anticipate the changes which caprice may dic- tate. Even for the same kind of flower the requirements are very uncertain, and the white chrysanthemum which is all the rage in one season may be discarded in favour of chrysanthemums of another colour in the next. The sale of fresh flowers for church decoration at I^aster has reached enormous dimensions. The irregularity in the date of the festival,

however, causes inconvenience to growers. If it falls very early the great bulk of suitable flowers may not be sufficiently forward for sale, whilst a late Easter may find the season too far advanced. The trade in cut flowers, therefore, is generally attended by uncertainty, and often by anxiety. (w. fb.)

Fryxell, Anders (1796-1881), Swedish historian, was born at Hesselskog, Dalsland, Sweden, on the 7th of February 1795. He was educated at Upsala, took holy orders in 1820, was made a doctor of philosophy in 1821, and in IS'S.i began to publish the great work of his life, the Stories from- Swedish jFIislnr;/. He did not bring this labour to a close until, fifty-six years later, he published the forty-sixth and crowning voluiue of his vast enterprise.

Fryxell, as a historian, appealed to every class by the picturesqueness of his style and the breadth of his re- search ; he had the gift of awakening to an extraordinary degree the national sense in his readers. In 1824 he published his Swedish Grammar, which was long without a rival. In 1833 he received the title of professor, and in 1835 he was appointed to the incumbency of Sunne, in the diocese of Karlstad, where he resided for the remain- der of his life. In 1840 he was elected to the Sweden Academy in succession to the poet Wallin (1779-1839). In 1847 Fryxell received from his bishop permission to withdraw from all the services of the Church, that he might devote himself without interruption to historical investigation. Among his numerous minor writings are prominent his Characteristics of Sweden between 1592 and 1600 (1830), his Origins of the Inaccuracy with which the History of Sweden in Catholic Times has been Treated (1847), and his Contributions to the Literary History of Sweden. It is now beginning to be seen that the abun- dant labours of Fryxell were rather of a popular than of a scientific order, and although their influence during his lifetime was unbounded, it is only fair to later and exacter historians to admit that they threaten to become obsolete in more than one direction. On the 21st of March 1881 Anders Fryxell died at Stockholm, and in 1884 his daugh- ter Eva Fryxell (born 1829) published from his MS. an interesting Histm-y of My History, which was really a literary autobiography and displays the persistency and tirelessness of his industry. (e. g.)

Fuente Ovejuna, a town of Spain, in the province of Cordoba, on a hill near the western limits of the province, in a well-irrigated district. Population about 10,000. Cattle are largely reared in the neighbourhood, which also contains argentiferous lead mines and stone quarries. The local industries are tanning, and the man- ufacture of soap, flour, and preserved meat. There is trade in wheat, wine, pod-fruit, and honey. The parish church is an old palace of the Knights of Calatrava. There are several other churches ??? one, the Assumption, with three fine naves and altars. Many ruins still stand on the hills around the town.

Fuenterrabia, an ancient town of Spain, on the French frontier, near the Bay of Biscay. It has begun to revive from the decay into which it had fallen, having become a summer resort for people from the interior of Spain. Hotels and villas have been built in the new part of the town that has sprung up outside the picturesque walled fortress, and there is quite a contrast between the part inside the heavy, half-ruined ramparts, with its nar- row, steep streets and curious gable-roofed houses, its fine old church and castle, and its massive town hall, and the new suburbs and fishermen's quarter facing the estuary of the Bidassoa. Many local industries are thriving on the outskirts of the town ; rope and net manufactures, flour mills, saw mills, mining railways, paper mills. The population, which is rapidly growing, is over 5000.

Fugue, an exacting and highly organized musical form. It originated in the abundant canonic imitations of early vocal writers, advanced with the growth of instru- mental music (chiefly at the hands of famous organists) duriui? the 17th century, and reached a perfection in the works of I'.aeh (1685-1750) which no subsequent writer has surpassed. Fugue is written for two or more parts, and may be vocal or instrumental. Its chief characteristic lies in the equal interest of all its voices. In other great forms ??? syviphoni/, sonata, and notably soiig ??? one voice is usually important while others are subservient, but in fugue all are equally important ; and since average listeners only attend with ease to one prominent part,

F U K U I ??? F U L H A M

commonly called the tune, fugue is associated with erudition and mental effort, and often dissociated from emotional power, which, however, it can possess to a stupendous degree. Fugue is akin to Canon (see Music, Ency. Brit, vol. xvii. p. 82) ; Albrechtsberger ??? Bee- thoven's master, and an authority ??? even defines canon as " a kind of fugue." But fugue, inferior in its first loose forms, gradually gained upon the older form in artifice and restraint, and far surpassed it in freedom, magnitude, and expressiveness.

The chief parts of a fugue are : ??? Exposition, which begins with the entry of the subject and ends when all the voices have stated it; Counter-exposition (optional), in which the subject is sometimes restated, somewhat differently, but without further modulation; Episode, of which several are possible in one fugue, and in which (under a rather misleading name) fragments of the subject or subsidiary subjects are developed to afford both contrast and illumination ; Stretto, in which interest is heightened by such rapid recurrences of the subject that the succes- sive statements overlap; Stretto maestrale, a rare and difficult stretto, in which all voices, entering closely, still preserve the subject unaltered; and PedaZ, in which the dominant or other note is persistently held through intri- cate melodic or harmonic devices. (For origin, see Faburden in Music, vol. xvii. p. 81). Such a note, acting as guide to the mind, justifies the greatest complexities while it establishes key ; hence its place of importance near the end of a fugue. Other devices common to both fugue and canon are -.^Augmentation, the doubling in duration of every note in the subject ; diminution, the reverse process ; inversion, in which the direction ??? up or down ??? of each interval in the subject is reversed. These devices together give endless, even bewildering, varieties of treatment.

The first statement of the theme is technically the subject ; the second is called answer, and is either an exact or modified transposition of the subject into the dominant key. Strict rules (to preserve a perfect tonic and dominant balance) govern this point, and a fugue is styled real or tonal accordingly. The melody which accompanies the answer is called counter-

subject ; theo- retically important, it is sometimes ignored ; and a real secondary or companion subject appears later to usurp its place. When the counter-subject is actually sounded with the subject itself, and acquires equal importance, the fugue is called a double fugue, or fugue with two subjects. In a most effective variety of double fugue, two subjects receive separate expositions, to be ultimately combined.

The historic connexion of fugue with the development of harmonic resource is shown with striking clearness in the greatest collection of fugues, known as Bach's " Forty- eight " (Wohltemperirte Klavier). These were written to establish equal right of existence for all keys. This fact and the one-fold nature of fugue form caused Bach, with his unerring instinct and great power, to organize and widen the key kingdom of each degree of the scale. He did this so well that his successors, in developing the superior forms of sonata and symphony, found their key heritage too rich ; and only in recent times have composers risen, and that with difficulty, to the intellectual height of the simpler form, perfected nearly two centuries ago. (h. w. d.)

Fukui, a town in the province of Echizen, Nippon, Japan, near the west coast, some miles north by east of Wakasa Bay. It lies in a volcanic district much exposed to earthquakes, and suffered severely during the disturbances of 1891-92, when a chasm over 40 miles long was opened across the Neo valley from Fukui to Katabira. But Fukui has since revived, and is now in a flourishing condition, with several local industries, and a population which in- creased from 37,000 in 1884 to 42,000 in 1898.

Fukuoka, a town on the north-west coast of the island of Kiushiu, Japan, about 60 miles north by east of Nagasaki. AVith Hakata, on the opposite side of a small coast stream, it forms a large centre of population, with an increasing export trade and several local indus- tries. Of these the most important is silk-weaving, and Hakata especially is noted for its durable silk fabrics. Fukuoka was formerly the residence of the powerful daimio of Chikuzen, and played a conspicuous part in the mediaeval history of Japan ; the renowned temple of Yeiyas in the district was destroyed by fire during the revolution of 1868. Population (1892), 56,000; (1898), 66,000.

There are several other places of this name in Japan, the most important being Fukuoka in the province of Mutsu, North Nippon, a railway station on the main line from Tokyo to Aimori Ura Bay. Population (1900) about 6000.

Fulahs. See NiGEEiA.

Fulda, a town and episcopal see of Prussia, province Hesse-Nassau, situated between the Ehon and the Vogel mountains, 69 miles by rail north-east from Frankfort-on- Main. The present cathedral dates from 1704-12, and stands on the site of the former abbey churches, for the first three were all burnt (in 937, 1286, and 1398), and the fourth was pulled down to make room for the existing structure. The interior, which was restored in 1895-96, contains the tomb of St Boniface, the Apostle of the Frisians, and a statue of Charlemagne. The former Benedictine monastery is now used as a theological semi- nary. The former episcopal palace was built in 1710-13, and now serves municipal purposes. There are several interesting churches, including the round church of >St Michael's (822, restored in 1863) ; the parish church (1770-76), and the church of St Severus (15th century, restored in 1899). Amongst the secular buildings and institutions may be mentioned the library, the episcopal residence, town hall, post office, museum of antiquities, house of the Sisters of Mercy (1884), and monument of the war of 1870-71. There are a couple of seminaries and a school of military music. The town, as distinguished from the abbey, dutes from 1208. It is a stronghold of the Ultramontane movement in Germany. Population

(1886), 12,284 ; (1900), 16,903.

Fulham, a metropolitan borough in the county of London, Middlesex, situated on the Thames, 5\ miles south- west of St Paul's, and opposite Putney, with which it is connected by a stone bridge of five arches in place of the old bridge closed in 1886. The new bridge was erected on the site of the aqueduct of the Chelsea Water- works Company between the years 1882 and 1886. Water mains are laid under the footways of the new bridge to obviate the necessity for a separate aqueduct. Fulham and Hammersmith formed one parish down to 1834, in which year the hamlet of Hammersmith was created a district and separate parish. The streets of

Fulham have been largely rebuilt, and the market gardens and open spaces, for which the place was once famous, have been mostly built upon. There is no record of the first ??? erection of a parish church, but the first known rector was appointed in 1242, and probably a church existed a century before this. The earliest portion of the church, which was demolished in 1880-81, did not date farther back than the 16th century. The new church, built from the designs of the late Sir Arthur Blomfield, was consecrated in 1881. The fine old monuments have been preserved and placed in the new church. The Manor House or Fulham Palace is the oldest building in the parish, but much of it has been rebuilt at various times. The oldest portion of the buildin g is the western quadrangle,

"built by Bishop Fitzjames (1506-22). The Manor of Fulham is said to have been given to Bishop Erkenwald about the year 691 for himself and his successors in the see of London, and Holinshed relates that the bishop of London was lodging in his manor place in 1141, when Geoffrey de Mandeville, riding cut from the Tower, took him prisoner. The parliamentary division of Fulham is conterminous ^vith the metropohtan borough. Population (1881), 42,900; (1891), 91,790; (1901), 137,289. An ex- haustive history of the parish by C.J. F^ret was pubhshed in 1900, entitled Fulham, Old and New (3 vols. 4to).

Fulton, capital of Callaway county, Missouri, TJ-S-A., in 38 ?? 51' N. and 91 ?? 56' W., on the Chicago and Alton EaUroad. Its site is hilly and its plan some- what irregular. It has an excellent water-supply from deep wells. Westminster College, situated here, is a Pres- byterian institution, founded in 1853. In 1899 it had 10 instructors and 99 students. The Synodical Female College, founded in 1872, is of the same denomination, and had, in 1899, 11 instructors and 104 students. Popu-

lation (1880), 2409; (1890), 4314; (1900), 4883, of ⁇⁇⁇whom 244 were foreign-born and 1167 negroes.

FUITia,y, a town in the arrondissement of Kocroi, department of Ardennes, France, north of Mezieres by rail, on the river Meuse. There are valuable subterranean slate workings, whence slate was quarried as early as the 12th century. The blocks detached are of immense size, 50 to 80 feet and even more in length, and 3 to 6 feet in thickness. They are afterwards cut up into sizes suitable for roofings. There are also important engineering works and forges, one establishment employing 300 work- men. Population (1891), 4869; (1901), 5667.

Functions, Analytic ⁇⁇⁇ Roughly speaking, the first principles of the theory of analytical functions may be developed either after Cauchy or after Weierstrass. The present article attempts to show the character and applications of the latter or strictly elementary theory. To this end space is saved by the omission of details in regard to which information is easily accessible in the English authorities cited on p. 544.

Every variable which enters is capable of the complex form ^ + iy\, where ^ and tj are real and i= J – 1, and can be represented by a point whose rectangular cartesian co-ordinates are f and r/ ; the positive square root (^ + iff is called the modulus or absolute value of the quantity, and often written | ^ + ⁇⁇i? | ; denoting it by r, the angle determined by ^ = r- cos 6, i; = r sin 0 is called the phase or argument of the quantity, and, without further con- vention, is ambiguous by additive integral multiples of 27I-. A series of positive integral powers of a complex quantity x, shortly called a power series, which converges for a value c of x, converges both absolutely and uniformly for all values of x whose modulus is less than I c 1 ; the region within which the series is intelli- gible is, therefore, that which is interior to a certain circle, called the circle of convergence ; within this circle the series can be differentiated any finite number of times, two series can be multiplied together, &c. If il be a real quantity not exceeded by the modulus of the sum of the series for any value of x whose modulus | ;r | = r is less than the radius of convergence, the coefficient a^ of the term UmX^ of the series is in absolute value less than or equal to Mr””. The series may vanish to order r at a; = 0, in which case the*

lowest power of x which enters is x^ ; but every other point for which the series vanishes must be at a finite distance from a- = 0. Thus if two power series in x are equal to one another for an infinite number of values of X lying near x = 0, and having this as their point of con-

densation, or limiting point, they must agree term by terra ; this is the so-called principle of indeterminate coefficients. A power series may have an infinite number of zeros, that is, points for which it vanishes, lying within its circle of con- vergence, but the point of condensation of these zeros cannot lie actually within the circumference of convergence ; and any two of its zeros are at finite distance from one another. If fi{x) be one of an infinite number of series of positive and negative integral powers of x, all convergent for r<|a;|

r

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if for 1=1, 2,... 00, the infinite series 2 ? ? y be absolutely convergent, the sum of the moduli of its terms being Uj,

and if the sum 2Ui be convergent, then each of the series

i=l

luik is convergent, and their sum S "i.Uik is the same as

t=l J:=li=l

CO .IT

2 Sitii. When a real quantity can assume values exceed-

t = l:=l*

ing by as little as desired a specified value K, but cannot be less than K, we speak of K as the lower outside value, or limiting value, of the quantity ; then a real continuous quantity necessarily arrives actually at its lower outside value, as well as its upper outside value. This fact requires

mention ; it can be applied, for instance, to show that if an infinite series of rational functions of x converge uniformly in the neighbourhood of every point of a finite and connected region, then it converges uniformly over the whole of that region, namely, the least number of terms which must be suppressed that the absolute value of those following may be less than an assigned e can be taken to be the same for the whole region.

Notion of a Monogenic Analytic Function. ??? Denote by f(x) the value represented within its circle of convergence C, whose centre is c, by a power series 'Zam{x ??? a)'" ; let II be the radius of the circle, and c^ a point within the circle at distance D from its centre c. A circle F, of radius R-D, described with c^ as centre will lie entirely within C, except at the point of contact. For values of x within r the series f{x) can be rearranged in powers of

X – Cj, and will take the form f^{x) = 2 ^^ ~ "'^ /""'(c^), where

/"'(cj) is the value at Cj of the Mth dififerential coefficient of f{x). The possibility of this rearrangement, namely, the fact that within F the series f-^{x) is equal to f{x), follows from Weierstrass's double series theorem. Two alternatives are now possible ??? either the radius of the circle of convergence Cj of the series f^{.r) is precisely R-D, or it is greater than R-D. Suppose that it is greater. Then it can be shown that for all points of Cj which lie within C, including those points which lie outside F, the value represented by /j(x) is equal to that represented by /(a-). In this case wo say that the value represented by /i(.r) for points outside C, or upon the circumference of C, is a coiUiiination of f{x). It can then be shown, in part justification of this definition, that if, with a point c, in- ternal to C, as centre, we similarly construct a series /,(a-), in X – Cj, with a circle of convergence C, extending beyond C, and these two circles C^,C2 have a common region both within and without C, then the values fi{x),f.,(x) agree in the common region of Cj and C, lying outside C. It is clear that having once continued the function /(,r) beyond the circle C, it may be possible to continue it beyond the

circle C,. the series f-^{x) being used as basis. We may- then at once make the statement : It is the aggregate of all such possible continuations which we regard as constituting a monogenic analytical function ; the word monogenic iaving reference to the fact that the various series, in x ??? c, x-c-^, a:Cjj,..., which represent the function in different parts of the plane, have a single origin, namely, the series /(a:), and all the properties of the function being virtually contained in this one series ; the word analytical iaving reference to the possibility of obtaining the value of the function in all the region of its existence by the "weU defined analytical operation of summing a power series. But the statement is not yet complete. It is convenient to regard all the points of the plane for which X is of infinite modulus, which are all given by the single equation a;.i = 0, as constituting one point, and to regard & series of ascending positive integral powers of x^ as similar to a power series in a quantity x-c. Such a series will have a region of convergence given by an equation]a;|. In general it will be sufficient to speak of a function, or of an analytic function, the monogenic character being under- stood. It is obvious, however, that the definition can in the first instance be accepted only as a limitation of the class of functions to be investigated and not as an analysis ???of the word function as commonly used to cover any sort of numerical dependence. As a fact it is in the establish- ment of the confidence that the limitation is not too narrow for practical applications that the development of the later theory marks so great an advance. But the leader should consult the earlier parts of Lagrange's Theorie des Fonctions Analytiques, and Le<^ons sur le Calcul des Fonctions (1806).

We return, however, to further consideration of the series f{x), in x-c, with circle of convergence C. When we rewrite this series in the form /j (a;), in powers of {x – Cj), it is not possible that for every point Cj, interior to C, the ???circle of convergence, Cp of f-^lx), should extend beyond the circle C. If for all points a-^ interior to a circle H within which a series <^(a;), va.x-a, converges, the lower outside value of the radii of convergence of the derived series 4>i{x) iax-a.^ be a finite quantity D other than zero, then the true radius of convergence of the series <^{x) can be shown to be greater by D than the radius of the circle H. Hence it follows that there is at least one point upon the circumference of the circle of convergence C of the series f{x) such that as Cj is taken nearer and ???nearer to this point the radius of convergence of the derived

series f-i(x), in x – Cj, approaches indefinitely to zero. Such a point is called a singular point of the function under consideration; at it the function, strictly speaking, is undefined. It may happen that such a singular point is found in every arc of the circumference of convergence, however small the arc. An example is given by either of

the series 2a;"□□, where Un = n\, or □□□□□□ = □□-. In such a case

11=1

the function, so to say, dies out on the circumference, and, as a monogenic function, cannot be continued over the circumference. But in the more common case, when the original circumference of convergence is not the complete boundary of the region of existence of the function, it is

still true that this region has a boundary, that is, cannot consist of all points of the plane (the point a;"'^ = 0 being counted in, as explained above). For if there be an assignable radius for the circle of convergence of a power series there is, as remarked above, necessarily one singular point upon its circumference ; while if the radius of con- vergence is unlimited it is still true that the point a;"i = 0 cannot be regarded as lying within the circle, since this would involve the obvious impossibility of identity in value, for x □□□

2(0;" □□□a;"-) , which for |a;|

and for |a;|>l represents x~^(x □□□ x~^)~^-

Single-valued Functions. □□□ It follows from the definition of singular points which has been given, that if a power series be continued from a point A to a point B by two different paths enclosing a region containing no singular points, the values thus obtained at B will be the same. A function which by all continuations within a certain region always takes the same value at any point, is called

single-valued in that region ; for instance the series 2 □□□

gives a single-valued function in any closed region which does not surround either of the points x=l, x~^ = 0. We consider now briefly functions which are single-valued in the whole plane of x. For such a function f(x) we divide the singular points into two categories : firstly, those which are not singular points of the inverse ljf(x), which we call poles ; secondly, those which are singular points of llf{x), which we call essential singularities. By the definition of a singular point, every point which is not singular is the centre of a circle of finite, though possibly very small radius, within which there is no singular point ; hence if a; = c be a pole, \lf{x) must be capable of being represented near this point by a power series in. x-c, necessarily of the form (x ??? c) ???, where <^ is a power series in a; - c which does not vanish for x = c ; thus (x ??? c) ???'f{x) must, near x = c, be capable of being represented by a power series in x ??? c not vanishing for x = c. The positive integer m is >0 since otherwise x = c would not be a singular point ; thus as we approach a pole, by whatever path, the function always increases indefinitely in absolute value, so that no ambiguity would arise by agreeing to consider the function as having the definite value infinity at the pole ; moreover, the pole can be made the centre of a circle of finite, if small, radius, within which the function has no other singular point ; so that also, in cases where the boundary of the region of existence of the function contains a curve upon every arc of which, however small, there are singular points, no pole of the function can be upon this curve. For such reasons the pole is also called an unessential singularity. Replacing x – c by x~'^ similar remarks apply to the consideration of the case in which a;~i = 0 is a pole. The category of essential singularities, on the other hand, includes very various possibilities. In all cases, if A be a

finite constant, the essential singularity c of the function f{x) is easily seen to be an essential singularity both of f{x) ??? K and of llf{x). If it

be possible to make c the centre of a circle of not zero radius, within which c is the only singularity of f(x), then within this circle, except at

00

c, the function can be represented as a series 2an(a; – c)”,

n= -co

wherein the number of negative terms is infinite (see below, Laurent’s theorem), and the coefficient a , ??? is in absolute value less than M | (?? – c)” |, where M is the greatest modulus of the function for the value of | a; ??? c | . Thence it follows that the function increases indefinitely as x approaches c by a suitable path. If every circle whose centre is c, however small, contains poles of f{x), but no other singularities, the same conclusion follows. In either case c is an essential singularity of the function lj[f{x) – A], and is the centre of a circle within which no other essential singularities of this function are found ; thus this function increases indefinitely as we approach c by a suitable path, and therefore the function f(x) approaches indefinitely to the arbitrary value A as we approach c by a suitable path. Both results may be in-cluded in the statement that near an essential singularity which is isolated from other essential singularities, points can be found at which the function differs as little as desired from any assigned value, or is greater than any assigned value. In fact it can be proved that there are in general points near a; = c, at which the function is actually equal to any assigned value, two values, at most, being ex-*

1

cepted. For instance, the function e”” approaches as near as we please to any assigned value for values of X near c, and becomes equal to any assigned value other than the two 0 and oo. But when the essential singularity is not finitely distant from other essential singularities, as for instance is the case of the essen-*

tial singularities of the function ^x””, the matter is still more

11=1

difficult. Thus the function a; + 2a:”’’7(a ❑❑ l)(a” + 2),

m = l

where a is a positive integer greater than unity, has essential singularities in every arc of the circle |a;| = l, however small, though the series converges for every point on this circle.

A function whose only singularities are poles is easily proved to be a rational function ; if it have one or more essential singularities it is called transcendental; a function which has no singularity for finite values of x is called an integral function, and can then be either rational or tran-scendental. For a rational integral function f{x) a finite E can be assigned, such that for every | x \ >E, the function is in absolute value greater than an assigned value il ; thus fix) must vanish for finite values of x, since otherwise l//(x) can easily be shown to be also a rational integral function, whereas in fact 1 //(❑❑❑’ ❑❑❑) diminishes indefinitely as \x\ increases sufficiently. For a transcendental integral function there are, as follows from the remarks above, points among those for which \x\ is greater than an assigned R, at which the function differs as little as desired from any assigned value, or is greater than any assigned value.

Existence and Methods of Representation of Single- valued Functions of given Descrqition. ❑❑❑ As soon as any considerable number of descriptive properties of .single- valued monogenic analytic functions have been deduced, the question naturally arises how far such properties suffice to identify the functions ; with which is connected the further question of obtaining representations having a more extended validity than usually possessed by a jiower series. We mention the follovdng theorems (1) Laurent’s

Theorem. ❑❑❑ If the annular region between the circles U-c| = r, |x-c| = R lie entirely within the region of existence of a (single-valued monogenic analytic) function, there exists a series, S An(a;-c)”, valid, and giving

%= – CO

the value of the function, for all the points of this region. By definition the function is developable (or holo7>iorphic\ that is, of the form 2 B□□□(□□ – a)", about every point a ia

71=0

its region of existence. (2) Weierstrass's Factor Theorem. □□□If □□!, ftj, a,, ... be an enumerable aggregate of points with □□ = CO as point of condensation, there exists an integral function vanishing to the first order in these and only these points, and expressible by the infinite product

n \(l – -\e'^"\ where ^□□□ is a polynomial consisting of a number, at most n, but often fewer, of terms of the series —H ^ + 5^ + □□□□□□□□□□ Conversely an integral func- tion vanishing in a^, a^,... can be expressed in the form

e^n rfl -□□□)/"T", where r□□□ is a positive integer and

(j) is an integral function. Familiar examples are the

gamma function Vr(l-l-x) = e 11 I (l + □□□)e "Jandthe

elliptic sigma function (see below, Elliptic Functions)

l |jen 202 1^ .^^i^g^g n = -2,1110 + 2m'tv',

and the product extends to all integral values of m and m' other than the one combination m = m.' = 0. It is necessary that w'jia should not be real. (3) Jfiftag- Le filer's Theorem. ~~*li a*~~*, a^, ttj, ... be an enumerable aggregate of points with a; = oo as point of condensation, a,nA. f-^{x), f,Jix), f^{x), . . . be a corresponding set of rational functions of which fn{x) is infinite only at a^, and, when n is finite, vanishes for a; = oo, it is possible to construct a function V{x) infinite only at a-^, a.,, ag, ... and such that in the neighbourhood of a,j the difference F(j") □□□fn{^) remains finite. And a generalization can be made to the case when the functions f^ix),*

f^ix),--- are not rational, and the point of condensation of the points a-^, o ...., ... is not at infinity. A familiar example is furnished by the trigonometrical function cot xtt for which the points flj, a^,... are the points x = m, and the functions f-J^x), f^(x),... are of the form (x ... m)~'^ + m~'^, where m is a positive or negative integer. (4) The consideration of methods of representation by means of an infinite series of polynomials is too large for the present occasion ; Runge has proved that given any connected region, a function can be constructed having this as its region of existence ; more recently ilittag-Leffler has announced a method of representing a given function over the whole of its region of existence by means of a single series. J//s- cellaneous. ... From many general results that must be omitted here, the following may be selected for bare reference : (1) The theorem of Picard as to the values assumed, in its whole region of existence, by a single-valued integral function, or as to the values actually assumed by a function near an isolated essential singularity (see below under Elliptic Finictioiis). (2) The investiga- tions of Darboux, Poincare, Hadamard, Fabry, Borel, and others, as to the positions of the zero and singular points of a function whose value is to be determined from one given Taylor expansion. (3) The theorem of Poincar6 as to the possibility of representing any multiple-valued analytic function by means of single-valued functions.

Algebraic Functions. ... Having explained the notion of a monogenic analytical function, and considered its funda- mental properties, it becomes proper to inquire as to the

scope of the notion. The most natural ways in which a function can enter are perhaps as defined by algebraic equations and as defined by differential equations. Of these the latter belong to another article (Differential Equations). Here we consider briefly the properties that arise when y is determined from x by an equation /(y, x) = 0, wherein / denotes a polynomial rational and integral in both a- and y, which is

incapable of being written as a product of other polynomials of the same rational form. It can be shown that in the neighbour- hood of any finite value of x, say x = a, exception being made (1) of those for which the coefficient of the highest power of y in /(y, x) vanishes, (2) of those for which the

equations /(y, x) = 0, / = 0 are consistent, every value of

y for which /(y, x) = 0 is expressible by a power series in x ??? a. But in order to meet the case of all values of x it is desirable to proceed in the first instance somewhat differently. It can be shown that if a, b, be any finite values of x, y for which /(6, a) = 0, aU. corresponding values of x, y which satisfy the equation /(y, x) = 0, and are sufficiently nearly equal to a, h, can be expressed by a pair of power series in a parameter t of the form a; = a + P(i), y = 6-I-Q(i), or by a finite number of such pairs, where P(≤), Q(≤) vanish for < = 0, the series being such as to give only one value of t within the region of convergence corresponding to specified values of x and y ; and that this is equally true for all infinite values of x or y, or both, which arise by a limiting process as satisfy- ing the equation /(y, x) = 0, provided only it be under- stood that in such a case x-a

the infinitesimal at (a , b), then R is said to become infinite to order r ; similarly if R be equal to C at x = a, y = b, and r is the greatest positive integer for which (R-C) i”””” is finite, then E is said to become r times equal to C. With this language we have the theorem that R becomes equal to every assignable value, finite or infinite, and this the same number of times for every value. This number is called the order of R. There is a lower limit to the number of poles of arbitrary position, for which there exists a rational function infinite to the first order at each; if this number be ^-1-1, the number p is called the class of the algebraic construct, and is of fundamental importance in the developments, ramify- ing into all branches of mathematics, of the theory of an algebraic construct. Historically these developments centre round the theorem of integral calculus known as Abel’s theorem. If, for the algebraic construct, R be a rational function, the integral Jlxdx can, in general, be evaluated in terms of algebraic and logarithmic functions only when the algebraic construct is of class zero, in which case X and y can be expressed as rational

functions of a single parameter. When the construct is of class unity the integral can be expressed in terms of elliptic functions (see below). In general we have, however, this theorem ; let x-y, X,,,... Xk denote the places where any other rational function than E, say Z, vanishes and Cj, ... cj the places where Z is infinite, to the first order ; then the sum of k

like integrals, ^ I Vidx, has a calculable value which we

express by fR^jlogZ ??? where the meaning is that

in the neighbourhood of any place where the integral fUdx becomes infinite we are to substitute for x, y in

Rtt log Z their values in terms of the infinitesimal t at the

place and determine, in the expansion in ascending powers of t, the coefficient of t~', and then form the sum of all these coefficients, the number of which is always finite. This theorem can be proved by means of the following lemma : if K be any rational function on the construct the sum of the coefficients of t~ in the various expansions of

K-7T at the places where the integral yKc^x becomes infinite,

K-jT \, i = 0 ; it

is easily deduced from the corresponding theorem for rational functions of one variable. Abel's theorem leads to the study of single-valued analytic functions of several variables with systems of simultaneous periods, which, apart from their intrinsic interest, are of importance as affording clues for the elucidation of the many initial difficulties presenting themselves in regard to functions of more than one variable. On the other hand, the attempt to resolve an algebraical construct, whose class is greater than unity, in terms of single-valued functions of one variable, leads to the discussion of certain functions, with an infinite number of essential singularities, which are unaltered by a set of linear substitutions of the variable forming an infinite discontinuous group. Of such developments, already of vast extent, only the barest mention can be made here.

Elliptic Functions. ◆◆◆ If w, vl be two fixed quantities whose ratio is not real, i2 = Imw ¦ 1m! w, it can be shown that the doubly infinite sum ◆◆◆B~2^2[(M-(-fl)~2 o-2j^ extending to all positive and negative integer values of m and m' other than the one pair m = m' = 0, is both abso- lutely and uniformly convergent for all finite values of u other than the values ◆◆ = – 0, and represents a single- valued monogenic analytical function ; it is generally

denoted by p{u). It is doubly periodic, satisfying the equations p{u + 2w) =pu, p{u + 2w') =pi'u., and therefore also the equations p{u + Imw + 1m w) =p{u). Thus all the values of which it is susceptible arise for values of M expressed by m = 2xw + 2x'w', wherein x, x are real quantities such that 0 ^a;\ pw + ^io'\ being of the third order. As a rational function of these two functions, pu, p'u, every single-valued analytic function of u, having the periods 2w, 2w' and having no other singularities than poles, can be repre- sented. In particular ^:)(m + v) can be represented rationally by pu, pv, p'u, p'v. Moreover, every single- valued analytic function of u which is periodic, is necessarily either singly periodic, and can then be represented by trigonometric functions, or is doubly periodic. The function pu is the negative of the second differential coefBcient of the logarithm of the integral function (x(ii) which is given by

the doubly infinite product o-(ji) =m H' [^(1 – ^V" ^X

where fi has the same meaning as before ; this func- tion is not periodic, but satisfies such equations as

where -q, if are constants such that i^w' ◆◆◆ r/'w = - ◆◆◆ or

"1^, according as the real part of r is positive or

negative ; we have, in fact, for all values of u and v, the relation (t\u)(t\v) [p(v) – piu)] = ct(u + v){u) = Jpu pw, the sign for all values of u being given by the prescription that the sign for small real positive values of u

~~shall be posi~~ tive, this function satisfies the equations 4>{u + 2w) = {u), cf>(u + 2w') = – <^(m), and has the periods 2w and 4:w' ; it can therefore be rationally expressed by the functions Pj('m), p\{u), formed from the periods 2w, iw as pu, pu were formed from 2w, 2w' ; in fact it is equal to \ {u)-i-[pi{2w') -Pi{uy. The function pu is easily seen, from the series which represents it, to be unaltered if 2iv, 2w' be replaced by 2(o = 2pw ~~f 2yjw\ 2a)' = 2qw 4~~ IqvJ , where p, q, p, q are any integers for which pq -p'q = =t= 1 ; it is, moreover, a homogeneous function of degree – 2 in the three quantities u, v<, w ; more generally if 2(0 = 2pw \ 2p'w', 2pj'q = r, and p {u) denote the function formed with 2a), 2ni as periods, we have pu equal to the sum of p-^(u) and r – 1 terms of the form ^ , ^ w,<.-r -pt \ where I; h are integers

for which ph + qk' and p'h (q'h' are divisible by r. It can be proved that every pair of formulas 2a) = 2/)w ¦ 2p'w', 2a)' = 2fjw + 2(/'a)', in which /), q, pi, q are such integers that pq -pq = ^ can be derived by repetition of the two pairs given by (□□) = – lu, a)' = w), {ia = w, w =w + w') ; these give respectively -p(D'/p(o= -pwjpw', and -pw'jpta = l+ptv'/pw; or, if h= ~~pw'/pw, they change h re~~ spectively into 1/A and 1 – A ; thus by all substitutions 2a)

= 2piv + 2pw', 2oj' = 2qw + 2qio', in which p<^ -p'q = 1, the function h can only take the six values h, Ijh, 1 – A, 1/(1 – h), hl(h-l), (h- I) Ik, which, are the roots of an equation

(1 0 +>)3/e2(l ^)2 = (1 A + /i2)3/A2(l ^)2. ThuS the

function z{t) = ^fjif^o +l)wpw' + p'^w'f lp'^wp^w\pw -Vpw'f, which is clearly a single-valued function of tlie ratio t = vl \w, is unaltered by any transformation t' = {q-^ qT)l{p +p't), in which p, q,p>'-, i are integers for which pq —p'q=. If the imaginary part of T(= p-l-io-) be positive, the imaginary part of t', being equal to iu{pq – p'q) = r(p +p'py^ +p'cr, is also positive ; it can be shown that the upper half of the infinite plane of t can be divided into regions, all bounded by arcs of circles (or straight lines), such that every point of any region other than the so-called fundamental region can be obtained from a definite point of the fundamental region by a definite one of the transformations, that is, as remarked above, by a definite combination of the two primary transformations t'=-1/t, T'=l+r, while every such transformation leads from any point of the fundamental

region to a corresponding point of a different region. If t = -1-ij;, the fundamental region can be taken to be the region for which i<l, together with the points, on the curves limiting this region, for which ^ is negative. Upon the infinite half plane the function z{t) is a single valued monogenic analytical function whose only essential singularities are those arising, by the transformations, from T = 00 , therefore given by all real rational values of T J the equation s(t') = z{t) can be shown to require a relation of the form r' = (q + qT)/{p+p'T), and the function z(t) takes every value just once within the fundamental and therefore within every other

region. Putting J® = .)^ = 4:(p^w + pwpw + p-w'Y ???^ (^piv ??? pw'yi^pw + 2pw'Y{2pw + pw'Y the function J(t)

2irt

is equal to 0 f or t = ?? ^ , is equal to 1 for t = i, and has

an essential singularity for t = 00 ; the inverse function t(J) is infinitely valued, has branch places with connexion of three values for J = 0, the circuit of the branch place leading to a linear substitution of period three (such as t'= (1|-t)~i), branch places with connexion of two values for J = 1, the circuit of the branch place leading to a linear substitution of period two (such as t'= ??? 1/t), and a branch place with connexion of all values for J = 00 , the circuit leading to a non-periodic linear substitution (such as t' = I I r) ; these are the only singularities of the function t(J). Each of the functions "'J('")> J^i'") ~ 1> ^ I pw+'ipw' ^ /2pw+pw' 24 / [pw + 2pw'){2pw+pio') V piv-pw" V piv-pio" 'V {pw-pw'f

besides others, is a single-valued function of t, being expressible without ambiguity in terms of the single func-

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tion 7;(T) = ei- H ^1 g2w>iT\ = g"i2 2 (i\mg(3m2+m)i,rT .

71 = 1 Tt= -00

these functions are not, however, unaltered by all the linear substitutions ; we have in fact -qi) = J – itijIt),

i;(l Ł t) = e^’^rj(T). A more general theorem below.

The aggregate of the substitutions T’ = (q + qT)j{p +p’t), wherein p, q,p’, q are integers for which pq p’q = \, constitutes a

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u’ = u + 2w, u’ = u + 2w’. In tte case of a single- valued analytic doubly-periodic function which has no essential singularity for finite values of the argument u, we have the three fundamental properties : (1) That if the coefficient of the first negative power of u-a in the expansion of the function for the neighbourhood of the pols u. be called the residue of the function for this pole, the sum of the residues of the function at all its poles within any one parallelogram of periods is zero ; (2) That the function takes any specified value A, within the parallelogram, a number of times equal to the aggregate order of its poles, this number being not less than 2 ; this minimum is reached for the function p(u) ; (3) That the sum of the values of u for which the function takes the value A, can diflfer from the sum of the values of u for which the function takes any other valae B, only by an expression of the form 2mw + 2m’w’, where m, m are integers. Analogous properties hold for automorphic functions ; but space prevents further explanation. The elliptic functions pu, p’u enable us to represent the cubic curve y^ = ix^ g^x- g^ in the form x=p{u), y=p’{u), by means of single- valued functions; and a similar representation, by these functions, can be made of any algebraic construct of class unity. In accordance with a theorem of Poincar6, automorphic functions can be constructed whereby a given algebraic construct of any class may ba similarly represented by single-valued functions, in a form valid for all places of the construct.

The modular function J(t) considered above, unaltered by the group of linear substitutions t’ = {qr + q)j{p’T+p), where p, q, p’, q’ are any integers for pq pq = l, may be regarded as the independent variable of a

~~diflferential equa~~ tion (q.v) of the third order of the form s“‘js’ – {s’/sY = l{l-ª)(x-l)-^ + iil- I3^)x-^ + |(a2-f-/32 -y2 1)^-1 (x – l)~i, of which the dependent variable s is equal to t. A function satisfying this equation being denoted by s{a, /3, y, x), we have in fact t = s(J, , 0, J). Putting A = (2pw’ +pw)j(piv’ -pw), wesimilarly haver = s(0, 0, 0, X), and A is a single-valued function of t, unaltered only by the (self-conjugate) subgroup of modular substitutions in which the coefficients q and p are even integers, and there- fore p and q odd integers ; the fundamental region for this subgroup, if t = f -h irj, may be taken to be given by – l. (^ – iY + 1^>h . and may be divided into six regions which are equivalent to one another by the substitutions of the general modular group. Within this fundamental region X. takes every value just once, except the values 0, 1, oo, which can arise only at the angular points (t = 0, oo , – 1 and the equivalent point T=l); these being essential singularities for the func- tion A. For A(t), as for J(t), the region of existence is the upper half plane, every short length of the axis i; = 0 containing essential singularities.

As bare illustrations of the utility of the function t = s (0, 0, 0, A) we refer to the proof of the theorem : (i.) If a single-valued analytic monogenic integral function (t>{x) do not take the values 0 and 1 for finite values of x, then it is a constant ; for in that case the function s[0, 0, 0, {x)’] is a single-valued analytic monogenic integral function; and it is impossible that the imaginary part of such a function should not become negative, as is the case of s(0, 0, 0, A) for all values of A. Hence it follows that for a single-valued monogenic analytic function ►►{x) which has a; = oo as an isolated essential singularity and no other essential singularity, there cannot be three values a h c which the function does not assume for finite values of X ►►► for by taking proper linear function of the function we could then obtain a single-valued analytic monogenic function not taking the values 0, 1, oo for finite values of X. It can further be shown, by using the function

s{\, \, 0, J), that if there be three values a, b, c which, the function does not assume for an infinite number of finite values of x, then F{x) must be a rational function ; (ii.) Any function s(a, j3, y, x) is a single-valued function of

T = s(0, 0, 0, x) ; for putting t’ = Tzl, the values of t whick

T + i

correspond to the singular points a; = 0, 1, ►►► of s(a, fi, y, x),

though infinite in number, all lie on the circumference of

a circle, | t' I = 1, within which ►►►(a, /3, y, x) is expressible in

the form 2 a►►► t'". The same for any function whose only

71 = 0

singularities are branch places ata; = 0, x=l, j- = co.

Functions of Several Variables. ►►► In order to appreciate the power of Weierstrass's methods it is necessary to study their application to the case of functions of more than one independent variable, for which the Cauchy methods are mostly inapplicable. The region of existence of a monogenic analytical function is as in the simpler case to be defined by a succession of power series ; the singular points are either essential or unessential, but there are two sorts of unessential singularities of which only one sort can be called poles. To define an unessential singularity it is necessary to premise that if a power series in the vari- ables X, Xjj.~~.Xn vanish at a point x = 0, x^ = 0,...Xn = 0 it is possible to write the series in the form (x^ + Mja;""~~ + ... + ►►►j;)E, where u-^,...U!; are power series in x-^,...Xn, all vanishing at x-^ = 0,...Xn = 0, and E is a power series in x, x^,...Xn. not vanishing at x = 0, x^ = Q,.. .Xn = 0; from this it is possible, given two power series both, vanishing at a; = 0, x^ = 0,...Xn = Q, to distinguish between the two cases when : (1) The two series have a common factor in the form of a power series vanishing at x = 0, x^ = Q,...Xn---0 ') (2) The two series have no such common factor. Now as we approach to a singular point of a function of several variables, and consequently the range of convergence of the derived power series representing the function diminishes without limit, there may exist a power series <^, with centre at the singular point, such that for the product of the function F, and the series 4>, the point is an ordinary point ; then the function can be represented in the neighbourhood of the point as the quotient, F = j<, of two power series, and the point is said to be an*

un- essential singularity. If now any factor, in the form of a power series vanishing at the point, which is common to ^ and <^, be divided out, the reduced quotient F = 4'\l'i'\ '^"'ll- still be such that <^j vanishes at the point, or the point would be an ordinary point for the function ; if then \}'-^ does not vanish at the point, the function F has the value 00 at the point by whatever path the point is approached, and the point is one which is an ordinary point for 1/F ; this may be called a pole ; if, however, ^^ also vanish at the point the limiting value of the function F as the singular point is approached is entirely indeterminate and depends on the path of approach. For a function of two complex variables such points of indetermination are generally discrete ; for a function of p variables they form a continuum of 2^ ◆◆◆ 4 dimensions ; and the existence of such points constitutes one of the main difficulties of the theory. There exist, however, proofs of the two following propositions, which generalize results for functions of one variable : (1) If a single-valued analytical monogenic function of p variables have no essential singularity, either for finite values of the variables, or at infinity, then it is a rational function of the variables ; (2) If a function known to exist, and to be single-valued, be further known to be expressible in the neighbourhood of ewexj finite point as a quotient of two power series with a presumably limited range of convergence, then the function can be expressed as a quotient of two integral functions, that is, as a quotient of two power series converging for all finite values of the

variables ; and this in such a way that these integral functions have no common zero other than the points of the {2p ◆◆◆ 4)-fold over which the function is essentially in- determinate.

The monogenic analytical single ~~valued functions of several variables other than the algebraic functions in regard to which most definite results have been obtained are those possessing sets of simultaneous periods, and having no essential singularities for finite values of the variables ; if a^,...ap be such a set of periods the property is {x~~^^ + a^,...Xp + ap) = (l> (x-^,...Xp); the greatest possible number of such sets of simultaneous

periods is 2p, but not every 2p sets oi p quantities can be the periods of such a function ; it is necessary, on the contrary, that the 2p^ quantities should be connected by 2p^ – \p{ji +\) relations of a certain form. The main general result for such periodic functions is that, of functions having the same periods, all can be expressed rationally in terms of (p -^ 1) functions chosen of suitable generality, these (pH-1) functions being themselves connected by a rational rela^ tion. So far as is known two main methods are available for the proof of these statements : (1) When by the general theorem quoted above, the periodic function is expressed as a quotient of two integral functions, these are found to be quasi-periodic, having a property expressed by Q(x-^ ❑❑❑ ❑❑!, ❑❑❑❑❑❑❑ x^p ❑❑❑ cip) = e"6(a:j, . . .Xp) where m is a linear func tion of the variables ; these can therefore be expanded, by a theorem not difficult to prove, which is the generalization of Laurent's theorem, in integral powers of quantities e'^^...e^p'P (wherein X^,...\p are constants). On the basis of this expansion the properties of the functions can be developed ; (2) Another method of proof is obtained by directly connecting the periodic functions with an algebraic construct and utilizing the methods (of contour integration, &c.) used with such success by Kiemann in his investigations in regard to Abelian functions. It is, in fact, as Abelian functions that periodic functions of several variables first arise, being introduced to express the solution of the inversion problem, suggested by Abel's theorem, which generalizes the inversion of the elliptic integral from which elliptic functions take their origin ; the quasi-periodic integral functions, denoted above by 6, by which the periodic functions can be expressed, forming an important part of the development. And, as in the case of one variable, the theory is intimately related to that of automorphic functions, that is, of functions of several variables unaltered by groups of linear substitutions of the variables.

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Functions of Real Variables. ???

The idea of functional dependence came into Mathe- matics from analytical geometry; mathematical analysis as founded, and as at first developed, was based on geo- metrical intuition ; a function was some variable length connected with a curve ; an irrational number was the ratio of two incommeasurable geometric magnitudes ; approach to a limit meant tending continually towards it; none of these essential notions ??? number, limit, function ??? was precisely defined. Modern analysis, on the other hand, is throughout arithmetical ; all the essential notions are defined arithmetically ; the arithmetic even on which analysis rests has been reformulated in such a way as to sever the notion of number from that of magnitude. It is the object of this article to give some account of the Theory of Functions of Eeal Variables as it has been remodelled in the process of complete arithmetization. Notations and ideas which have been sufficiently explained in the articles Infinitesimal Calculus (Ency. Brit. 9th ed. vol. xiii.) and Function (vol. ix.), will be utilized without further discussion. Limitations of space prevent the presentation of proofs of theorems.

The landmarks of the theory are the introduction of the system of ordinal numbers and the establishment of the continuum of real numbers ; the definition of the domain of a variable or a system of variables by means of the theory of Aggregates ^ ; the general principle of con- vergence to a limit ; the definition of functional depend- ence; the establishment of the notions of continuity, differentiability, and integrability of functions; the representation of functions by means of the results of limiting processes ; the conduct of operations on functions so represented. The systematic arithmetical development of the theory is mainly due to "Weierstrass.

1. The Continuum of Real Xumhers. ??? The capacity of numbers to answer questions of how many and how much, in other words to express the results of operations of counting and measuring, may be regarded as a secondary property de- rived from the more fundamental one of expressing order. The fact that a formally complete theory of Arithmetic can be based on the notion of order only was pointed out by Dedekind. According to this theory, a natural number is a mark which serves to specify the place of an object in a series or "progression" (see Number), and the essential fact of the theory is the possibility of referring the

objects in one series to the objects in another series one hj one. Natural numbers form a series with a definite order, and the expressions "greater than" and " less than " mean " more advanced " and " less advanced " in this order. Rational fractions are introduced by means of pairs of natural numbers which obey certain defined laws of operation, and for these also the order is defined.

^ The term " Theory of Aggregates " is here used as the equivalent of the German " Meugenlehre " ami the French "theorie des ensembles."

Negative numbers are introduced in a similar way. Tte whole system of rational numbers thus constructed has a definite order. The meanings to be attached to addition, subtraction, multiplication, and division, the commutative, associative, and distributive laws of operation, can all be based on the notion of order and the possibility of one-to- one correspondences. The formal system thus developed can be applied to express the results of counting and measuring. Irrational numbers are introduced by means of "cuts" (see Number). An irrational number is the mark of a cut which separates all rational numbers into two classes, the inferior class having no greatest number, and the superior class no least number. The whole system of rational and irrational numbers possesses a definite order, and forms a continuum. In fact the notion of a one-dimensional continuum first becomes precise in virtue of the establishment of this system.

2. Measurement. ??? It will be sufficient to consider here the measurement of one kind of concrete quantity, viz., the length of a segment of a straight line (produced indefinitely). We choose any other segment of the line, and mark its ends with the numbers 0 and 1 ; then we lay off on the straight line a series of segments with contiguous ends each equal to this " unit " segment, and mark their ends with the numbers 1 and 2, 2 and 3, . . . the points marked 1, or 2, . . . being the same for con-secutive segments ; on the other side of the point marked 0 we lay off segments in the same way as before, and mark their ends with the

numbers 0 and ⬛⬛⬛ 1, ⬛⬛⬛ 1 and ⬛⬛⬛ 2. . . . The first requisite for the measurement is the possibility of equal segments ; the test of equality of length is congruence. The second requisite for the measurement is that, when the process above described is carried far enough, any point of the liue chosen in advance should be found either within a marked segment or at an end of such a segment ; this is the " axiom of Archimedes." We now divide the segment between m and m + \, where m may be zero or any positive or negative integer, into q equal segments, and mark their extremities in order with the numbers

m.

qm + l gm+2

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each fraction being reduced to its lowest terms, and we do the same with any other marked segment and with any other integer in place of q. Thus certain points of the line will be marked with rational numbers, and the correspondence between the points and the numbers has these properties ⬛⬛⬛ (1) the order of the points is the same as that of the numbers ; (2) the difference of the numbers marking two points is the same as the difference of the numbers marking two other points when the distance between the first two is the same as the distance between the second two. The points which can be marked by carrying this process far enough are called rational points. There are points of the line which are not rational points, and the above method of marking the points is completed by marking such points with irrational numbers ; each point of the line may be regarded as effecting a " cut " in the system of rational points, to which there corresponds a definite cut in the system of rational numbers ; if the point is not a rational point it is marked with the irrational number defined by this cut. By this process any chosen point of the line will be marked by a definite number, rational or irrational, and the correspondence between the points and the numbers has the above properties (1) and (2). That, after choice of any irrational number, one point of the line can be found which must, in carrying out the above process, be marked with that number, is a geometrical axiom first recognized

as necessary by Dedekind and G. Cantor ; in accordance with this axiom the process effects a one-to-one corre- spondence of real numbers and points of a straight line, and the length of any segment is measured with reference to the chosen unit segment, by the difference of the numbers that correspond to its ends. On account of this correspondence a real number is frequently referred to as a " point."

3. Domain of a Variable. ??? The notion of an "aggre- gate " or " manifold " in general underlies the system of ordinal numbers (see Nttmbee). An aggregate is said to be "infinite" when it is possible to effect a one-to-one correspondence of all its elements vpith some of its elements. Thus the aggregates of positive integers and of points on a straight line are infinite aggregates. An aggregate whose elements are real numbers is said to " extend to infinite values " if, after any number If, how- ever great, has been specified, it is possible to find in the aggregate numbers which exceed Jf in absolute value ; such an aggregate is always infinite. The "neighbour- hood of a number (or point) a for a positive number h " is the aggregate of all numbers (or points) x for which the absolute value oi x ??? a, denoted by | x-a |, does not exceed h. The idea of a " variable " is that of a number to which we may assign at pleasure any of the values which constitute a definite aggregate, called the " domain " of the variable. This domain may be an "interval," i.e., it may consist of two terminal numbers, all the numbers between them and no others; when the domain of a variable number is an interval the number is said to be " continuously variable," when the domain consists of all real numbers the variable is -said to oe "unrestricted." A domain which consists of all real numbers which are greater than some fixed number will be described as an " interval unlimited towards the right " ; similarly we may have an " interval unlimited towards the left."

4. Domain of a Set of Variables. ??? The numerical con- tinuum of n dimensions (Cn) is the aggregate that is arrived at by attributing simultaneous values to each of n variables x^, x^, . . . Xn, these values being any real numbers. The elements of such an aggregate are called " points," and the numbers ajj, x^, .. . Xn the " co-ordinates " of a point. Denoting in general the points (xj, x.^, . . . Xn) and (x\, x'2 . ??? . x' ???) by x and x', the sum of the differences | i^j – ar'^ | + j a^j ~*

^‘2 I + ❓❓❓ ❓❓❓ ❓❓❓ + \ n ❓❓❓x’n \ may be denoted by | a; – a;’ | and called the ” difference of the two points.” We can in various ways choose out of the continuum an aggregate of points, which may be an infinite aggregate, and any such aggregate can be the ” domain ” of a ” variable point.” The domain is said to “extend to an infinite distance” if, after any number If, however great, has been specified, it is possible to find in the domain points of which one or more co-ordinates exceed If in absolute value. The ” neighbourhood ” of a point a for a (positive) number h is the aggregate con- stituted of all the points x, which are such that the ” difference ” denoted by | a; – a | : A. If an infinite aggregate of points does not extend to an infinite distance, there must be at least one point a, which has the property that the points of the aggregate which are in the neigh- bourhood of a for any number h, however small, them- selves constitute an infinite aggregate, and then the point a is called a ” limiting point ” of the aggregate ; it may or may not be a point of the aggregate. An aggregate of points is ” perfect ” when all its points are limiting points of it, and all its limiting points are points of it ; it is ” connected ” when, after taking any two points a, b of it, and choosing any positive number e, however small, a number m and points x, x”, . . . a;’”*’ of the aggregate can be found so that all the differences denoted by | ss’ ❓❓❓a |,

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I a;” – a;’ |, ... I 6 – a; ‘❓❓❓’ I are less than e. A perfect connected aggregate is a continuum. This is G. Cantor’s definition.

The definition of a continuum in Cn leaves open the question of the number of dimensions of the continuum, and a further explanation is necessary in order to define arithmetically what is meant by a ” homogeneous part ” Hn of Cn- Such a part would correspond to an interval in Cj, or to an area bounded by a simple closed contour in C2 ; and, besides being perfect and connected, it would have the following properties : (1) There are points of Cn which are not points of Hn ; these form a complementary aggregate Hn- (2) There are points ” within ” Hn ; this means that for any such point there is a neighbourhood consisting

exclusively of points of Hn. (3) The points of Hn which do not lie ” within ” Hn are limiting points of H’n ; they are not points of H’n, but the neighbourhood of any such point for any number h, how- ever small, contains points within Hn and points of H’n ; the aggregate of these points is called the ” boundary ” of Hn- (4) When any two points a, b within Hn are taken, it is possible to find a number e and a corresponding number m, and to choose points oc’, sc”, . . . a;’ ‹‹‹’, so that the neighbourhood of a for e contains x’, and consists exclusively of points within Hn, and similarly for x and x”, x and x” , . . . a;’ ‹‹‹’ and h. Condition (3) would exclude such an aggregate as that of the points within and upon two circles external to each other and a line joining a point on one to a point on the other, and condition (4) would exclude such an aggregate as that of the points within and upon two circles which touch externally.

5. General Notion of Functionality. ‹‹‹ The idea of a function was at first geometrical ; the function was re- garded as given graphically ; nevertheless arithmetical notions were almost from the first associated with geometrical ones, the curve which represents the function being determined by an equation. Among early writers on analysis we find the use of the word “function” in the sense of a power or some other analytical ex- pression; and the two notions (1) that which is deter- mined by a curve supposed drawn, and (2) that which is determined by an analytical expression supposed written down, were not for a long time clearly distinguished. It was for this reason that Fourier’s discovery that a single analytical expression is capable of representing (in different parts of an interval) what would in his time have been called different functions so profoundly struck mathematicians (‹‹22). The analysts who, in the middle of the 1 9th century, occupied themselves with the theory of the convergence of Fourier’s series were led to impose a restriction on the character of a function in order that it should admit of such representation, and thus the door was opened for the introduction of the general notion of functional dependence. This notion may be expressed as follows : We have a variable number, y, and a variable number or system of such numbers, x, a domain of the variable or variables x, and a rule for assigning one or more definite values to y when X is any point in the domain ; then y is said to be a “function” of the variable or variables, and

these are called the "argument" of the function. According to this notion a function is, as it were, an indefinitely ex- tended table, like a table of logarithms ; to each point in the domain of the argument there correspond values for the function, but it remains arbitrary what values the function is to have at any such point. For the defini- tion of any particular function two things are requisite ; (1) a statement of the values of the variable, or of the aggregate of variable points, to which values of the function are to be made to correspond, i.e., of the " domain of the argument " ; (2) a rule for assigning the value or

values of the function that correspond to any point in this domain. We may refer to the second of these two essentials as "the rule of calculation." The relation of functions to analytical expressions may then be stated in the form that the rule of calculation is : " Give the function the value of the expression at any point at which the expression has a determinate value," or again more generally, " Give the function the value of the expression at all points of a definite aggregate included in the domain of the argument." The former of these is the rule of those among the earlier analysts who regarded an analytical expression and a function as the same thing, and their usage may be retained without causing confusion and with the advantage of brevity, the analytical expression serving to specify the domain of the argument as well as the rule of calculation, e.g., we may speak of "the function 1/x" But in complicated cases separate state- ments of the domain of the argument and the rule of calculation cannot be dispensed with. In general, when the rule of calculation is determined as above by an analytical expression at any aggregate of points, the function is said to be " represented " by the expression at those points.

When the rule of calculation assigns a single definite value for a function at each point in the domain of the argument the function is " uniform " or " one- valued." In what follows it is to be understood that all the functions considered are one- valued, and the values assigned by the rule of calculation real.

In the most important cases the domain of the argu- ment of a function of one variable is an interval, and that of a function of n variables is a

homogeneous part of the numerical continuum of n dimensions, with the possible exception of isolated points.

6. Limits. ??? Let / (x) be a function of a variable point X, representing a value of one variable number, or simul- taneous values of n variable numbers, and let a be a point such that there are points of the domain of the argument X in the neighbourhood of a for any number h however small. If there is a number L which has the property that, after any positive number e, however small, has been specified, it is possible to find a positive number A, so that I L ???f{x) I

If / {x) is a function of one variable a; in a domain which extends to infinite values, and if, after e has been specified, it is possible to find a number X, so that \f{x')-f{x) 1 < ?? for all values of x and x which are in the domain and exceed N, then there is a number L which has the property that | /(.r) ??? L \ < e for all such values of x. In this case /'(???') ^^^ ^ limit L bX x ??? co . In like manner f{x) may have a limit at x= ??? ca . This statement includes the case where the domain of the argument consists exclusively of positive integers. The values of the function then form a " sequence," ??j, ij ??? . . . Un, ??? . ., and this sequence can have a limit at n = co .

In the case of a function of n variables in a domain which extends to an infinite distance, there is a limit at an infinite distance if, after ??? has been specified, a number If can be found, so that | f{x') ~~f(x) | < e f or all points X and x' of the domain which have one or more co~~ ordinates exceeding iV in absolute value.

The principle common to the above definitions and theorems is called, after P. du Bois Reymond, " the general principle of convergence to a limit."

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A fuBction which has not a limit at a point a may be such that, if a certain aggregate of points is chosen out of the domain of the argument,

and the points x in the neighbourhood of a are restricted to belong to this aggregate, then the function has a limit at a. For ex- ample sin(l/a;) has limit zero at 0 if a; is restricted to the aggregate I/tt, I/Stt, . . . Ijmr, ... or to the aggregate l/27r, 2/57r, . . . nj{n^ + l)7r, . . ., but if so takes all values in the neighbourhood of 0, sin(l/a;) has not a limit at 0. Again, in the case of a function of one variable, there may be a limit at a if the points x in the neighbourhood of a are restricted by the condition that a; ??? a is positive ; then we have a " limit on the right" at a; similarly we may have a " limit on the left " at a point ; in the case of a function of several variables we may have a limit for approach to a point by a particular path. Any such limit is described as a " limit for a restricted domain."

The limit L of f{x) at a stands in no necessary relation to the value of f{x) at a. If the point a is in the domain of the argument, the value of f{x) at a is assigned by the rule of calculation, and may be different from L. In case f{a) = L the limit is said to be "attained." If the point a is not in the domain of the argument, there is no value for f{x) at a. In the case where f{x) is defined for all points in an interval (or in a domain Hn [??4]), containing a, except the point a, and has a limit L at a, we may arbitrarily annex the point a to the domain of the argument and assign to /(a) the value L ; the function is then said to be " extrinsically defined." The so-called "indeterminate forms" (Istfinitesimai Calculus, Ency. Brit. vol. xiii. p. 21) are examples.

7. Superior and Inferior Limits ; Infinities. ??? The value of a function at every point in the domain of its argument is finite, since, by definition, the value can be assigned, but this does not necessarily imply that there is a number iV which exceeds all the values (or is less than all the values). It may happen that however great a number N we take there are among the values of the function numbers which exceed N (or are less than – N).

If a number can be found which is greater than every value of the function, then either (a) there is one value of the function which exceeds all the others, or (/3) there is a number S which exceeds every value of the function but is such that, however small a positive number e we take, there are values of the function which exceed S- e. In case (a) the

function has a greatest value ; in case (/3) the function has a superior limit S, and then there must be a point a which has the property that there are points of the domain of the argument, in the neighbourhood of a for any h, at which the values of the function differ from S by less than e. Thus S is the limit of the function at a, either for the domain of the argument or for some more restricted domain. If a is in the domain of the argument, and if, after omission of a, there is a superior limit S which is in this way the limit of the function at a, if further f{a) = S, then S is the greatest value of the function ; in this case the greatest value is a limit (at any rate for a restricted domain) which is attained ; it may be called a "superior limit which is attained." In like manner we may have a " smallest value " or an " inferior limit," and a smallest value may be an " inferior limit which is attained."

All that has been said here may be adapted to the description of greatest values, superior limits, &c., of a function in a restricted domain contained in the domain of the argument. In particular, the domain of the argument may contain an interval (or a domain Iln [4]), and therein the function may have a superior limit, or an inferior limit, which is attained ; such a limit is a maximum value or a minimum value of the function.

Again, if, after any number N, however great, has been specified, it is jjossible to find points of the domain of the argument at which the value of the function exceeds N, the values of the function are said to have an " infinite superior limit," and then there must be a point a which has the property that there are points of the domain, in the neighbourhood of a for any h, at which the value of the function exceeds N. If the point a is in the domain of the argument the function is said to " tend to become infinite " at a ; it has of course a finite value at a. If the point a is not in the domain of the argument the function is said to " become infinite " at a ; it has of course no value at a. In like manner we may have a (negatively) infinite inferior limit. Again, after any number N, how- ever great, has been specified and a number h found, so that all the values of the function, at points in the neigh- bourhood of a for h, exceed N in absolute value, all these values may have the same sign ; the function is then said to become, or to tend to become, " determinately (positively or negatively)

infinite " ; otherwise it is said to become, or to tend to become, "indeterminately infinite."

All the infinities that occur in the Theory of Functions of Eeal Variables are of the nature of variable finite numbers, with the single exception of the infinity of an infinite aggregate. The latter is described as an " actual infinity," the former as " improper infinities." There is no " actual infinitely small " corresponding to the actual in- finity. The only " infinitely small " is zero. All "infinite values " are of the nature of superior and inferior limits which are not attained.

8. Increasing and Decreasing Functions. ◆◆◆ A function f{x) of one variable x, defined in the interval between a and b, is "increasing throughout the interval" if, whenever x and x are two numbers in the interval and x>x, then /(◆◆') >/(a;) ; the function " never decreases throughout the interval" if, k' and x being as before, f{x')'^f{x) Similarly for decreasing functions, and for functions which never increase throughout an interval. A function which never increases or never diminishes throughout an interval is said to be " monotonous throughout " the interval. Taking in the above definition b>a, the definition may apply to a function under the restriction that x is not 6 and X is not a ; such a function is " monotonous within " the interval. In this fase we have the theorem that the function (if it never decreases) has a limit on the left at h and a limit on the right at a, and these are the superior and inferior limits of its values at all points within the interval (the ends excluded) ; the like holds mutatis mutandis if the function never increases. If the function is monotonous throughout the interval, /(5) is the greatest (or least) value of f{x) in the interval ; and if f{b) is the limit of f{x) on the left at 6, such a greatest (or least) value is an example of a superior (or inferior) limit which is attained. In these cases the function tends continually to its limit.

These theorems and definitions can be extended, with obvious modifications, to the cases of a domain which is not an interval, or extends to infinite values. By means of them we arrive at sufficient, but not necessary, criteria for the existence of a limit ; and these are

frequently easier to apply than the general principle of convergence to a limit, of which principle they are particular cases.

9. Continuity of Functions. ??? A function f{x) of one variable x is said to be "continuous" at a point a if (1)

f{x) is defined in an interval containing a, (2) f(x) has a limit 1 at a, (3) f(a) is equal to this limit. If f{x) has a limit on the left at a and /(a) is equal to this limit, the function is said to be " continuous to the left " at a ; simi- larly the function may be "continuous to the right" at a.

' It must be a limit for continuous variation, not for a restricted domain.

A function is said to be " continuous throughout an interval" when it is continuous at every point of the interval. This implies continuity to the right at the smaller end-value and continuity to the left at the greater end-value. When these conditions at the ends are not satisfied the function is said to be continuous " within " the interval. By a " continuous function " of one variable we always mean a function which is continuous throughout an interval.

The principal properties of a continuous function are :

(1) The function is practically constant throughout sufficiently small intervals ; this means that, after any point a of the interval has been chosen, and any positive number e, however small, has been specified, it is possible to find a number h, so that the diflference between any two values of the function in the interval between a-h and a + h is less than e. There is an obvious modification if a is an end-point of the interval.

(2) The continuity of the function is " uniform " ; this means that the number h which corresponds to any e as in (1) may be the same at all points of the interval, or, in other words, that the numbers A which correspond to e for different values of a have a positive inferior limit.

(3) The function has a greatest value and a least value m the interval, and these are superior and inferior limits which are attained.

(4) There is at least one point of the interval at which the function takes any value between its greatest and least values in the interval.

(5) If the interval is unlimited towards the right (or towards the" left), the function has a limit at co (or at

-00).

10. Discontinuity of Functions. ??? The discontinuities of a function of one variable, defined in an interval with the possible exception of isolated points, may be classified as follows :

(1) The function may become infinite, or tend to be- come infinite, at a point.

(2) The function may be undefined at a point.

(3) The function may have a limit on the left and a limit on the right at the same point ; these may be different from each other, and at least one of them must be different from the value of the function at the point.

(4) The function may have no limit at a point, or no limit on the left, or no limit on the right, at a point.

In case a function f{x), defined as above, has no limit at a point a, there are four limiting values which come into consideration. Taking any positive number h, the values of the function at points between a and a + h {a excluded) have a superior limit (or a greatest value), and an inferior limit (or a least value) ; further, as h decreases, the former never increases and the latter never decreases ; accordingly each of them tends to a limit. We have in this way two limits on the right ??? the inferior limit of the superior limits in diminishing neighbourhoods, and the superior limit of the inferior limits in diminishing neigh- bourhoods. These are denoted by f{a + 0) and f{a + 0), and they are called the " limits of indefiniteness " on the right. Similar limits on the left are denoted

by/(a-0) and f{a – 0). Unless f{x) becomes, or tends to become, infinite at a, all these must exist, any two of them may be equal, and at least one of them must be different from /(a), if /(a) exists. If the first two are equal, there is a limit on the right denoted by f{n H- 0) ; if the second two are equal, there is a limit on the left denoted by f{a – 0). In case the function becomes, or tends to become, infinite at

on the right of a may be negatively infinite ; this happens if, after any number F, however great, has been specified, it' is possible to find a positive number h, so that all the values of the function in the interval between a and a + h (a excluded) are less than -If; in such a case f{x) tends to become negatively infinite when x decreases towards a ; other modes of tending to infinite limits may be described in similar terms.

11. Oscillation of Functions. ❖❖❖ The difference between the greatest and least of the numbers f{a), f{a + 0), f(a + 0), f{a – 0), f(a – 0), when they are all finite, is called the " oscillation" of the function f{x) at the point a. This difference is the Hmit for A = 0 of the difference between the superior and inferior limits of the values of the func- tion at points in the interval between a- A and a + h. The corresponding difference for points in a finite interval is called the " oscillation of the function in the interval." When any of the four limits of indefiniteness is infinite the oscillation is infinite in the sense explained in ❖❖ 7.

For the further classification of functions we divide the domain of the argument into partial intervals by means of points between the end-points. Suppose that the domain is the interval between a and b. Let intermediate points Xj, aJj, . . . a; ❖❖❖ i, be taken so that 6>a; ❖❖❖ i>a; ❖❖❖ 2. . . >Xj^>a. We may devise a rule by which, as n increases indefinitely, all the differences b-Xn-i, Xn i~ Xn^o' ❖❖❖ ❖❖❖ ❖❖❖ ❖❖❖ ^i – ❖❖ tend to zero as a limit. The interval is then said to be divided into "indefinitely small partial intervals."

A function defined in an interval with the possible exception of isolated points may be such that the interval can be divided into a set of finite partial intervals within each of which the function is monotonous (❖❖ 8). When this is the case the sum of the oscillations of the function in

those partial intervals is finite, provided the function does not tend to become infinite. Further, in such a case the sum of the oscillations will remain below a fixed number for any mode of dividing the interval into in- definitely small partial intervals. A class of functions may be defined by the condition that the sum of the oscillations has this property, and such functions are said to have " restricted oscillation." It can be proved that any function with restricted oscillation is capable of being expressed as the sum of two monotonous functions, of which one never increases and the other never diminishes throughout the interval. Such a function has a limit on the right and a limit on the left at every point of the interval. This class of functions includes all those which have a finite number of maxima and minima in a finite interval, and some which have an infinite number. It is to be noted that the class does not include all continuous functions.

12. Differentiahle Function. ??? The idea of the differentia- tion of a continuous function is that of a process for measuring the rate of growth ; the increment of the function is compared with the increment of the variable. If f{x) is defined in an interval containing the point a, and a-h and a + k are points of the interval, the ex- pression

f[a + h)-f(a) ,^.

represents a function of A, which we may call 4>{h), defined at all points of an interval for A between – k and k except the point 0. Thus the four limits i>{ + 0),>(+ 0), 4>{-0), 4>{ – 0) exist, and two or more of them may be equal. When the first two are equal either of them is the " pro- gressive differential coefficient" of f{x) at the point a; when the last two are equal either of them is the "regres- sive differential coefficient " of f(x) at a ; when all four are equal the function is said to be " diffeientiable " at a,

and either of them is the "differential coefficient" off(x) at a, or the "first derived function" oif{x) at a. In this case ^(A) has a definite limit at h = 0, or is determinately infinite at A = 0 (?? 7). The four limits here in

question are called, after Dini, the “four derivates” of f{x) at a. In accordance with the notation for derived functions they may be denoted by

fM, f+jci), fjaj, f_{a).

A function which has a finite differential coefficient at all points of an interval is continuous throughout the interval, but if the differential coefficient becomes infinite at a point of the interval the function may or may not be continuous throughout the interval ; on the other hand a function may be continuous without being differ- entiable. This result, comparable in importance, from the present point of view, with the discovery of Fourier’s theorem, is due to Riemann ; but the failure of an attempt made by Ampfere to prove that every con- tinuous function must be differentiable may be regarded as the first step in the theory. Examples of analytical expressions which represent continuous functions that are not differentiable have been given by Riemann, Weier- strass, Darboux, and Dini.

13. Properties of Derived Functions. ??? In regard to the first derived function we have the “theorem of intermediate value ” : if f’(x) is continuous throughout the interval be- tween a and 6, there is a value of x in the interval for which

nx)=mzM, (i.)

or, in the usual notation, there is a number 6 between 0 and 1 which has the property that

f{b)=f{a) + {b-aY{a + e{h-a)}. This theorem lies at the foundation of the Differential Calculus and of all its applications.

The formation of second and higher differential co- efficients need not be dwelt upon here, but it is to be observed that, when f”{x) exists, we have the relation

f\x) ^jr/i- + km^Hf(-M . (ii.)

h = 0

h?

on the other hand the limit expressed by the right-hand member of (ii.) may exist although f”{x) does not exist. The same remark applies to the relation

fn\x) = Lth-‘^Vfix + nh) – nf{x + {n – l)h}

+ ‘^V{ ►► + (n-2)h} ... + {)nf{x)]. (iii.)

We have the important results (1) that, when f’(x) vanishes throughout an interval, f(x) is constant through- out the interval; (2) when either /”(a;) or the right-hand member of (ii.) can be proved to vanish throughout an interval, f(x) will be proved to be a linear function of x in the interval.

14. Analytic Function. ►►► The theorem of intermediate value may be generalized. If f{x) ^nd its first n differ- ential coefficients are continuous in the interval between a and a + h, then

/(a + h) =f(a) + hf\a) + f/\a) + ...

{A”

2!-‘

-/►►-i’(a) + i?►►►

where Sn may have various forms, some of which have been given in the article Infinitesimal Calcultts, Fncy. Brit. vol. xiii. pp. 19 and 41. This result is known as ” Taylor’s theorem.”

When Taylor’s theorem leads to a representation of the function by means of an infinite series, the function is said to be ” analytic ” (cf. ►► 20).

15. Ordinary Function. ►►► The idea of a curve represent- ing a continuous function in an interval is that of a line

which has the following properties : (1) the co-ordinates of a point of the curve are a value x of the argument and the corresponding value y of the function ; (2) at every point the curve has a definite tangent ; (3) the interval can be divided into a finite number of partial intervals within each of which the function is monotonous ; (4) the property of monotony within partial intervals is retained after interchange of the axes of co-ordinates x and y. Accord- ing to condition (2) y is a continuous and differentiable function of x, but this condition does not include conditions (3) and (4) : there are continuous partially monotonous functions which are not differentiable, there are continuous differentiable functions which are not monotonous in any interval however small ; and there are continuous, differ- entiable, and monotonous functions which do not satisfy condition (4) (cf. ►► 23). A function which can be repre- sented by a curve, in the sense explained above, is said to be "ordinary," and the curve is called the "graph" of the function. All analytic functions are ordinary, but not all ordinary functions are analytic.

16. Integrable Function. ►►► The idea of integration is twofold. We may seek the function which has a given function as its differential coefficient, or we may generalize the question of finding the area of a curve. The first inquiry leads directly to the indefinite integral, the second directly to the definite integral. Following the second method we define "the definite integral of the function f{x) through the interval between a and h " to be the limit of the sum

‹f{x'r){Xr-Xr_-

1

when the interval is divided into ultimately indefinitely small partial intervals by points x-^, x^, . . . a; ►► i; here x',. denotes any point in the rth partial interval, ►►; ►►► is put for a, and Xn for 6. It can be shown that the limit in question is finite and independent of the mode of division into partial intervals and of the choice of the points such as x'r, provided (1) the function is defined for all points of the interval, and does not tend to become infinite at any of them ; (2) for any one mode of division of the interval into ultimately indefinitely small partial intervals,

the sum of the products of the oscillation of the function in each partial interval and the difference of the end- values of that partial interval has limit zero when n is increased indefinitely. When these conditions are satisfied the function is said to be " integrable " in the interval. The numbers a and 6 which limit the interval are usually called the " lower and upper limits." We shall call them the "nearer and further end-values." We have the following theorems : ???

(1) Any continuous function is integrable.

(2) Any function with restricted oscillation is integrable.

(3) A discontinuous function is integrable if it does not tend to become infinite, and if the points at which the oscillation of the function exceeds a given number cr, however small, can be enclosed in partial intervals i the sum of whose breadths can be diminished indefinitely.

(4) The sum or product of two integrable functions is integrable.

As regards integrable functions we have the following theorems : ???

(1) If S and / are the superior and inferior limits (or greatest and least values) oif{x) in the interval between

a and h, j f{x)dx is intermediate between S{b – a) and

I{h – a). "

^ These partial intervals must be a set chosen out of some complete set obtained by the process used in the definition of integration.

(2) The integral is a continuous function of each of the end-values.

(3) Taking the further end-value 6 as variable, and

writing I /{x)dx = F(x), if /(□□) is continuous at 5, F{x) is

differentiable at b, and F'{b) =f{b).

(4) In case/(a;) is continuous throughout the interval F{x) is continuous and differentiable throughout the in- terval, and F'(x) =f(x) throughout the interval.

(5) In case f'{x) is continuous throughout the interval between a and 5,

jf{x)dx=f{b)-f{a).

a

(6) In case f(x) is discontinuous at one or more points of the interval between a and b, in which it is integrable.

f-

f{x)dx

is a function of x, of which the four derivates at any point of the interval are equal to the limits of indefiniteness of f{x) at the point.

(7) It may be that there exist functions which are differ- entiable throughout an interval in which their differential coefficients are not integrable ; if, however, F{x) is a func- tion whose differential coefficient, F'{x), is integrable in an interval, then

F(x) = I F'{x)dx + const.,

where a is a fixed point, and x a variable point, of the interval. Similarly, if any one of the four derivates of a function is integrable in an interval, all are integrable, and the integral of either differs from the original function by a constant only.

The theorems (4), (6), (7) show that there is some dis- crepancy between the indefinite integral considered as the function which has a given

function as its differential coefficient, and as a definite integral vsdth a variable end-value.

We have also two theorems concerning the integral of the product of two integrable functions f{x) and <\>{x) ; these are known as " the first and second theorems of the mean." The first theorem of the mean is that, if (□□) is one-signed throughout the interval between a and 6, there is a number M intermediate between the superior and inferior limits, or greatest and least values, of f(x) in the interval, which has the property expressed by the equation

M I (j>{x)dx = I f{x)4>{x)dx

The second theorem of the mean is that, if f(x) is monotonous throughout the interval, there is a number f between a and b which has the property expressed by the equation

j f{x)4>{x)dx==f{a) j {x)dx+f{b) j ^{x)dx. a a i

(Cf. the article Fotjeiee's Series.)

17. Improper Definite Integrals. □□□ We may extend the idea of integration to cases of functions which are not defined at some point, or which tend to become infinite in the neighbourhood of some point, and to cases where the domain of the argument extends to infinite values. If c is a point in the interval between a and b at which f{x) is not defined, we impose a restriction on the points x'r of

the definition : none of them is to be the point c. This comes to the same thing as defining / f{x)dx to be

a

Lt I 'f{x)dx + Ztf f(x)dx, (1)

where, to fix ideas, b is taken > a, and e and e' are positive. The same definition applies to the case where f{x) becomes infinite, or tends to become infinite, at c, provided both the limits exist. This definition may be

otherwise ex- pressed by saying that a partial interval containing the point c is omitted from the interval of integration, and a limit taken by diminishing the breadth of this partial interval indefinitely ; in this form it applies to the cases -~here c is a or 6.

Again, when the interval of integration is unlimited to the right, or extends to positively infinite values, we have as a definition

.-A

f(x)dx = Lt I f{x)dx, I ??? m J

f

provided this limit exists. Similar definitions apply to I f{x)dx, and to I f(x)dx.

All such definite integrals as the above are said to be

"improper," for ways. It means

example I

-dx is improper in two

Lt Lt j ^^^dx,

in which the positive number e is first diminished in- definitely, and the positive number h is afterwards increased indefinitely.

The "theorems of the mean" (?? 16) require modifica- tion when the integrals are improper (cf. the article Fourier's Series).

When the improper definite integral of a function which becomes, or tends to become, infinite, exists, the integral is said to be "convergent." If fix) tends to become infinite at a point c in the interval between a and b, and the expression (1) does not exist, then the expression

???6

f{x)dx, which has no value, is called a "divergent

/

integral," and it may happen that there is a definite value for

___^ __{ / A^)'^^ + j f{^)d'^ }

a C+e'

provided that e and e are connected by a definite relation, and both, remaining positive, tend to limit zero. The value of the above limit is then called a " principal value " of the divergent integral. Cauchy's principal value is obtained by making e = ___, i.e., by taking the omitted interval so that the infinity is at its middle point. A divergent integral which has one or more principal values is sometimes described as "semi-convergent."

18. Functiotis of several Variables. ___ We have already explained what is meant by the domain of the argument and the rule of calculation of a function of several inde- pendent variables, by the limit of such a function at a point, by a function extrinsieally defined or tending to become infinite. We shall now suppose that the domain of the argument is a homogeneous part of the numerical

continuum of n dimensions, with the possible exception of isolated points. The definition of a continuous function admits of immediate extension to functions of several variables, but then it is to be noted that a function of n variables may be a continuous function of each set of r variables (r < n) when the rest are kept constant, with- out being a continuous function of the n variables ; more generally the function may be continuous in a restricted domain. The definition of partial differentiation presents no difficulty. The extension of the theorem of inter- mediate value (__ 13) leads to the theorem of the total differ- ential ; for two variables x, y the

theorem is that there exist numbers Q and t] between 0 and 1, for which /(a-l-A, 6-f-i)-/(a, l)^hfx{a + eh, b + k) + Jcfy{a, l + qh), provided that the function f{x, y) has continuous partial difi'erential coefficients, /a;(a;, y) and fy{x, y), at all points with a a; in the interval between a and a + h, and a y in the interval between 6 and h + k. In regard to higher difi'er ential coefficients the theorem expressed by ^^ ◆◆◆J^=^ ^

'◆◆◆ dx oy oy ox

holds, provided one of the first partial differential coeffi- cients, say 1^, and also the corresponding second partial

differential coefficient, S- %-, are continuous at the point dy ox

{x, y). Taylor's theorem, with a remainder after n terms, can be extended to a function of several variables, pro- vided all the partial differential coefficients up to the ◆◆.th order inclusive are continuous.

With a view to the establishment of the notion of integration through a domain, we must define the " extent " of the domain. Take first a domain consisting of the point a and all the points x for which | a; – a | ^ JA, where A is a chosen positive number ; the extent of this domain is A", n being the number of variables ; such a domain may be described as " square," and the number h may be called its " breadth " ; it is a homogeneous part of the numerical continuum of n dimensions, and its boundary consists of all the points for which | a; – a | =\h. Now the points of any domain, which does not extend to an infinite distance, may be assigned to a finite number m of square domains of finite breadths, so that every point of the domain is either within one of these square domains or on its boundary, and so that no point is within two of the square domains ; also we may devise a rule by which, as the number m increases indefinitely, the breadths of all the square domains are diminished indefinitely. When this process is applied to a homo- geneous part, H of the numerical continuum Cn, then, at any stage of the process, there will be some square domains of which all the points belong to H, and there will generally be others of which some, but not all, of the points belong to li. As the number m is increased indefinitely the sums of the extents of both these categories of square domains will tend to definite

limits, which cannot be negative ; when the second of these limits is .zero the domain H is said to be "measurable," and the first of these limits is its " extent " ; it is independent of the rule adopted for con- structing the square domains and contracting their breadths. The notion thus introduced may be adapted by suitable modifications to continua of lower dimensions in Cn-

The integral of a function f{x) through a measurable domain H, which is a homogeneous part of the numerical continuum of n dimensions, is defined in just the same way as the integi-al through an interval, the extent of a square domain taking the place of the difference of the end- values of a partial interval; and the condition of integra- bility takes the same form as in the simple case. In par- ticular, the condition is satisfied when the function is continuous throughout the domain. The definition of an

integral through a domain may be adapted to any domam of measurable extent. The extensions to "improper " definite integrals may be made in the same way as for a function of one variable ; in the particular case of a function which tends to become infinite at a point in the domain of integration, the point is enclosed in a partial domain which is omitted from the integration, and a limit is taken when the extent of the omitted partial domain is diminished indefinitely ; a divergent integral may have different (principal) values for different modes of contracting the extent of the omitted partial domain. In applications to mathematical physics great importance attaches to convergent integrals and to principal values of divergent integrals. Delicate questions arise as to the possibility of representing the integral of a function of n variables through a domain Hn, as a multiple integral, of evaluating it by successive integrations with respect to the variables one at a time, and of interchanging the order of such integrations. These questions have been discussed very completely by C. Jordan, and we may quote the result that all the transformations in question are valid when the function is continuous throughout the domain. The same investigations may be applied to answer the questions of the validity of differentiation and integration of an integral with respect to a parameter by performing the like processes on the subject of integration. Taking for simplicity the case of a function of one variable X

integrated in the interval between a and h, the para- meter being allowed to vary in an interval containing the value a, the process of differentiation under the sign of integration certainly succeeds for a, if the function of x involving the parameter a becomes a function of x and y which is continuous in a domain consisting of all points {x, y) for which x lies between a and b, and y lies between a + k and a ??? k, where k may be as small as we please. The corresponding theorem for integration under the sign of integration can be stated vtdthout difficulty. The con- dition of continuity in the domain of the increased number of variables is sufficient though it is not necessary. When the domain extends to an infinite distance additional con- ditions, restricting the manner of approach of the function to zero at infinite distances, are requisite for the validity of the processes.

19. Sepresentation of Functions in general: Series. ??? Rational functions are represented by rational algebraic ex- pressions. Some, but not all, implicit algebraic functions which are not rational can be represented rationally in terms of fractional powers of rational algebraic expressions. For the representation of all other one-valued functions of a real variable recourse must be had to limiting processes. We may have functions represented by infinite series, infinite products, definite integrals, or by limits of rational functions of two or more variables in a domain in which all but one of them vary. As an example of the last-named method

represents a function of x, which vanishes at x = 0, and at all other points has the value of 1 jx. The two definitions of the r function as a definite integral and as an infinite product may serve as examples of the representation of functions by such means. In another method, elaborated by T. Broden, a continuous function is arrived at graphic- ally, by beginning with a function having a graph in the form of a polygon, and interpolating additional angular points in an ordered sequence without limit. But much the most important method is that of series. From a sequence of numbers a,, (r = 0, l, —) we may form a new

sequence s, ??? (re = 0, 1, . . .) by the rule s ??? =

= 0

If the new

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sequence has a limit 5 at ra = oo (□□6), tlie ” infinite series of numbers” 2 a^ “converges,” and s is its “sum.” If the series

r=0

2 I a^ I also converges, the series 2 a, is said to converge ‘□□□=0 r=0

” absolutely ” ; otherwise its convergence is ” conditional.” The importance of this distinction lies in the fact that the sum of an absolutely convergent series is independent of the order of its terms, but this is not the case for a conditionally convergent series (cf. the article Seeies, Ency. Brit. vol. xxi.). The numbers a^ may be the values at a point a of an infinite aggregate of functions of a variable x, represented in a domain containing a by analytical expressions fr{x), (r = 0, 1,...). The analytical expression /g(□□)+/^(a;) + ... is then called an “infinite series of functions,” and the aggregate of the points a at vfhich it converges form the “domain of convergence.” The expression represents a function in this domain.

20. Power Series. □□□ Taylor’s theorem leads in certain cases to a representation of a function by an infinite series. We have under certain conditions (□□14)

r-

aad this becomes

{x □□□ a)’

r!

r'Ha) + Ii□□□:

(a – a)< r!

r\a),

(1)

provided that (a) a positive number h can be found so that at all points in the interval between a and a + k (except these points) f{x) has continuous differential coefficients of all finite orders, and at a has progressive diiferential coefficients of all finite orders ; (yS) Cauchy's form of the

remainder ||5^" (1 – 6l)"-i /'"{a + e{x – a) } has the limit

zero when n increases indefinitely, for all values of 6 between 0 and 1, and for all values of x in the interval between a and a + h, except possibly a + k. When these conditions are satisfied, the series (1) represents the function at all points of the interval between a and a + k, except possibly a + h, and the function is " analytic " (□□ 14) in this domain. Obvious modifications admit of extension to an interval between a and a □□□ k, or between a □□□ k and a + h. When a series of the form (1) represents a function it is called " the Taylor's series for the function."

Taylor's series is a power series, i.e., a series of the form

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2 an{x □□□ a)".

71 = 0

As regards power series we have the following theorems :

(1) If the power series converges at any point except a there is a number k which has the property that the series converges absolutely in the interval between a □□□ k and a + k, with the possible exception of one or both end-points.

(2) The power series represents a continuous function in its domain of convergence (the end-points may have to be excluded).

(3) This function is analytic in the domain, and the power series representing it is the Taylor's series for the function.

The theory of power series has been developed chiefly from the point of view of the theory of functions of com- plex variables.

21. Uniform Convergence. ??? We shall suppose that the domain of convergence of an infinite series of functions is an interval with the possible exception of isolated points. Let/(*) be the sum of the series at any point x of the domain, and fn{^) the sum of the first n+\ terms. The condition of convergence at a point a is that, after any positive number ??, however small, has been

specified, it must be possible to find a number n so that I fJia) -U{??) I < e for all values of m and p which exceed m, and the sum, f(a), is the limit of the sequence of numbers /???(o) at m = 00 . The convergence is said to be " uniform " in an interval if, after specification of e, the same number n suffices at all points of the interval to make | f{x) -fm{x) \ < e f or all values of m which exceed n. The numbers n corresponding to any e are all finite, but, when e is less than some fixed finite number, they may have an infinite superior limit (?? 7) ; when this is the case there must be at least one point, a, of the interval which has the property that, whatever number F we take, e can be taken so small that, at some point in the neighbourhood of u, n must be taken >N' to make I f{x)-fm{??:) I <?? when m>n; then the series does not converge uniformly in the neighbourhood of a. This dis- tinction may be otherwise expressed thus : ??? Choose a first and e afterwards, then the number n is finite ; choose ?? first and allow a to vary, then the number n becomes a function of a, which may tend to become infinite, or may remain below a fixed number ; if such a fixed number exists, however small e may be, the convergence is uniform. As regards series whose terms represent continuous functions we have the following theorenos :

(1) If the series converges uniformly in an interval it represents a function which is continuous throughout the intervaL

(2) If the series represents a function which is dis- continuous in an interval it cannot converge uniformly in the interval.

(3) A series which does not converge uniformly in an interval may nevertheless represent a function which is continuous throughout the interval.

(4) A power series converges uniformly in any interval

contained within its domain of convergence, the end-points

being excluded.

00

(5) If 2 fr{x)=f{x) converges uniformly in the in-

r=0 '

terval between a and h

j f{x)dx= I, j fr{z)dx,

or a series which converges uniformly may be integrated term by term.

m

(6) If 2 f'r{x) converges uniformly in an interval,

r=0

then 2 fr{x) converges in the interval, and represents a

r=0

continuous differentiable function, (x) ; in fact we have '{x)= 2 /V(^),

r=0

or a series can be differentiated term by term if the series of derived functions converges uniformly.

A series whose terms represent functions which are not continuous throughout an interval may converge uniformly

in the interval. If 2 fr(x), =/(a'), is such a series, and

r=0

if all the functions fr{x) have limits at a, then /(a-) has a

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limit at a, which is 2 ij fr{x). A similar theorem

r=0 x=a

holds for limits on the left or on the right.

22. Fourier's Series. ◆◆◆ An extensive class of functions admit of being represented by series of the form

◆◆o + 2 (an cos -~r + bn sm ◆◆◆), %=i ^ " " '

(i-)

and the rule for determining the coefficients ◆◆◆◆◆, 6,i of such a series, in order that it may represent a given function

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f{x) in the interval between – c and c, was given by Fourier, viz., we have

◆◆o = 2c / /(^^y^". ◆◆◆◆ = – (f(x)cos~dx,

^n=\ ff(x)

. nirx ,

Sin ___ ax.

c

The interval between – c and c may be called the ” periodic interval,” and we may replace it by any other interval, e.g., that between 0 and 1, without any restriction of generality. When this is done the sum of the series takes the form

and this is

/-I r=n

I 2 f{z) cos {2rn-(z-x)}dz,

J r= -n

0

n=l J 3m{(z-x)7r}

(ii.)

Fourier’s theorem is that, if the periodic interval can be divided into a finite number of partial intervals within each of which the function is ordinary (__15), the series represents the function within each of those partial in- tervals. In Fourier’s time a function of this character was regarded as completely arbitrary. By a discussion of the integral (ii.) based on the Second Theorem of the Mean (__16) it can be shown that, if f{x) has restricted oscillation in the interval (__11), the sum of the series is equal to H/(”^ + 0) +/(a;- 0)} at any point x within the interval, and that it is equal to |{/(+ 0) +/(1 ___0)} at each end of the interval. (See the article Fouribe’s Series.) It there- fore represents the function at any point of the periodic interval at which the function is

continuous (except possibly the end-points), and has a definite value at each point of discontinuity. The condition of restricted oscillation includes all the functions contemplated in the statement of the theorem and others. Further, it can be shown that, in any partial interval throughout which f(x) is continuous, the series converges uniformly, and that no series of the form (i.), with coefiicients other than those determined by Fourier's rule, can represent the function at all points, except points of discontinuity, in the same periodic interval. The result can be extended to a function f{x) which tends to become infinite at a finite number of points a of the interval, provided {l)f{x) tends to become determinately infinite at each of the points a, (2) the improper definite integral of f(x) through the interval is convergent, (3) f(x) has not an infinite number of discontinuities or of maxima or minima in the interval.

23. Representation of Continuous Functions hy Series. ??? ??? If the series for f{x) formed by Fourier's rule converges at the point a of the periodic interval, and if /(x) is continu- ous at a, the sum of the series is f{a) ; but it has been proved by P. du Bois Keymond that the function may be continuous at a, and yet the series formed by Fourier's rule may be divergent at a. Thus some continuous functions do not admit of representation by Fourier's series. All continuous functions, however, admit of being repre- sented with arbitrarily close approximation in either of two forms, which may be described as "terminated Fourier's series" and "terminated power series," according to the two following theorems ; ???

(1) If f{x) is continuous throughout the interval be- tween 0 and 27r, and if any positive number e however small is specified, it is possible to find an integer n, so that the difference between the value of f{x) and the sum of the first n terms of the series for f{x), formed by Fourier's rule with periodic interval from 0 to 27r, shall be less than e at all points of the interval. This result can

be extended to a function which is continuous in any given interval.

(2) Ii f{x) is continuous throughout an interval, and any positive number e however small is specified, it is pos- sible to find an integer n and a polynomial in x of the nth degree, so that the difference between the value

of f{x) and the value of the polynomial shall be less than c at all points of the interval.

Expansions in series of the kinds described in the above theorems (1) and (2) are called "asymptotic expansions." Suppose th&tfj^x)+f^{x)+ ... is an infinite series of func- tions which does not converge in a certain domain ; it may happen that, after any number t, however small, is specified, an integer n can be found so that, at any point

a of the domain, | f(a) – 2 fr{a) | < ⬜⬜; but it will also

7- = 0

happen that, after any number N, however great, is specified,

m

an integer n\>n) can be found so that | 2 /^(a) | >N

r=0

for all values of m which exceed n'. The divergent series /o(^+/i(^) + ⬜⬜⬜ ⬜⬜⬜ ⬜⬜⬜ is then an asymptotic expans' jn for the function f{x).

Again it can be proved that, if f{x) is continuous throughout a given interval, polynomials in x of finite degrees can be found, so as to form an infinite series of polynomials whose sum is equal to f{x) at all points of the interval. Methods of representation of continuous func- tions by infinite series of rational fractional functions have also been devised.

Particular interest attaches to continuous functions which are not difi'erentiable. Weierstrass gave as an example the

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function represented by the series 2 a" cos (b'^XTr), where

a is positive and less than unity, and b is an odd integer exceeding (l-l-|ir)/o. It can be shown that this series is uniformly convergent in every interval, and that the continuous function f(x) represented by it has the pro- perty that there is, in the neighbourhood of any point x^, an infinite aggregate of points x', having a; ⬜⬜⬜ as a limiting point, for which {f{x') ⬜⬜⬜f{x^]l{x' ⬜⬜⬜ Xi^ tends to become infinite with one sign when x' ⬜⬜⬜ x^ approaches zero through positive values, and infinite with the opposite sign when x – a^Q approaches zero through negative

values. Accord- ingly the function is not difi'erentiable at any point. The definite integral of such a function f{x) through the inter- val between a fixed point and a variable point x, is a con- tinuous difi'erentiable function F{x), for which F'(x) =f(x) ; and, iif{x) is one-signed throughout any interval, F[x) is monotonous throughout that interval, but yet F(x) cannot be represented by a curve ; in any interval, however small, the tangent would have to take the same direction for infinitely many points, and yet there is no interval in which the tangent has everywhere the same direction. Further, it can be shown that all functions which are everywhere con- tinuous and nowhere differentiable are capable of represen- tation by series of the form llan4>n{x), where 2

change is possible under suitable restrictions for a par- ticular class of cases is a theorem to be proved. Among examples of such interchanges we have the differentiation and integration of an infinite series term by term (◆◆ 21), and the differentiation and integration of a definite integral with respect to a parameter by performing the like pro- cesses upon the subject of integration (◆◆ 18). As a last example we may take the limit of the sum of an infinite se- ries of functions at a point in the domain of convergence. Suppose that the series S./'^(◆◆) represents a function / (a;)

in an interval containing a point a, and that each of the functions /,(◆◆) has a limit at a. If we first put x=a, and then sum the series, we have the value f(a) ; if we first sum the series for any x, and afterwards take the limit of the sum at x=a, we have the limit of f{x) at a; if we first replace each function /,.(◆◆) by its limit at a, and then sum the series, we may arrive at a value different from either of the foregoing. If the function f(x) is continuous at a, the first and second results are equal ; if the functions fr(x) are all continuous at a, the first and third results are equal ; if the "eries is uniformly convergent, the second and third results are equal.

This last case is an example of the interchan g J of the order of two limiting operations, and a sufficient, though not always a necessary, condition, for the validity of such an interchange will usually be found in some suitable extension of the idea of uniform convergence.

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Fundy, Bay of, an inlet of the North Atlantic, separating New Brunswick from Nova Scotia. It is 145 miles long, 48 miles wide at the mouth, and gradu- ally narrows towards the head. It is remarkable for the great rise and fall of the tide, which at the head of the bay is about 65 feet. At spring tides the water in the Bay of Fundy is 19 feet higher than it is in Bay Verte, in Northumberland Strait, only 15 miles distant. Large areas of fertile marshes are situated at the head of the bay, and the remains of a submerged forest show that the land has subsided in the latest geological period at least 40 feet.

FUnfhaus, formerly a suburb of Vienna, but, since 1891, incorporated with the Austrian capital, of which it forms the 15th Ward. In 1890 the population was 44,162 ; in 1900, 45,371.

Fui^ai

FUNG-I in the broad sense include all the lower cellular Cryptogams devoid of chlorophyll, which arise from spores, and the thallus of which is either unicellular or composed of branched or- unbranched tubes or cell- filaments, with apical growth (hyphte), or of more or less complex wefted sheets or tissue-like masses of such (mycelium). The latter may in certain cases attain large dimensions, and even undergo cell-divisions in their interior, resulting in the development of true tissues. The spores, which maj^ be uni- or multi-cellular, are either abstricted free from the ends of hyphae (acro- genous), or formed from segments in their course (Chlaviy-

dospores), or from protoplasm in their interior(endogenous). The want of chlorophyll restricts their mode of life ??? which is rarely aquatic ??? since they are therefore unable to decompose the carbon dioxide of the atmosphere, and renders them dependent on other plants or (rarely) animals for their carbonaceous food-materials. These they obtain usually in the form of carbohydrates from the dead remains of other organisms, or in this or other forms from the living cells of their hosts ; in the former case they are termed Sapropliytpst, in the latter Parasitefi. While some moulds (PenicilUum, Afipcnjillitu) can utilize almost any organic food-materials, other Fungi are more re- stricted in their choice ??? e.g., insect-parasites, horn- and feather-destroying Fungi, and parasites generally. It was formerly the custom to include with the Fungi the Schizo-

mycetes or Bacteria, and the Myxomyeetes or Mycetozoa ; but the peculiar mode of growth and division, the cilia, spores, and other peculiarities of the former, and the emission of naked amcsboid masses of protoplasm, which creep and fuse to streaming plasmodia, with special modes of nutrition and spore-formation of the latter, have led to their separation as groups of organisms independent of the true Fungi. On the other hand, Lichens, previously regarded as autonomous plants, are now known to be dual organisms ??? Fungi symbiotic with Alga?.

The number of species in 1889 was estimated by Saecardo at about .S2,000, but of these 8500 were so- called FaiKji i III perfect i ??? i.e., forms of which we only know certain stages, such as conidia, pycnidia, &c., and which there are reasons for regarding as merely the corresponding stau;es of higher forms. Saecardo also in- cluded about 400 species of Myxomyeetes and (ioO of Schizomycetes. Allowing for these and for the cases, undoubtedly not few, where one and the same fungus has been described under different names, we obtain Schroeter's estimate (in 1892) of 20,000 species. In illustration of the -ery different estimates that have been made, however, may be mentioned that of De Bary in 1872 of 160,000 species, and that of Cooke in 1896 of 40,000, and Massee in 1899 of over 50,000 species, the fact being that no sufficient data are as yet to hand for any accurate census. As regards their geographical

distribution,Fungi,like flowering plaiits,have no doubt their centres of origin and of dispersal ; but we must not forget that every exchange of wood, wheat, fruits,plants, animals, or other commodities involves transmission of Fungi from one country to another ; while the migrations of birds and other animals, currents of air and water, and so forth, are particularly eflScacious in transmitting these minute organisms. Against this, of course, it may be argued that parasitic forms can only go where their hosts grow, as is proved to be the case by records concerning the introduc- tion of Puccinia malvacearum, Peronospora viticola, Hemi- leia vastatrix, &c. Some Fungi ??? e.g., moulds and yeasts ??? appear to be distributed all over the earth. That the north temperate regions appear richest in Fungi may be due only to the fact that North America and Europe have been much more thoroughly investigated than other coun- tries ; it is certain that the tropics are the home of very numerous species. Again, the accuracy of the statement that the fleshy Agaricini, Polyporei, Pezizae, &c., are relatively rarer in the tropics may depend on the fact that they are more difiicult to collect and remit for identi- fication than the abundantly recorded woody and cori- aceous forms of these regions. When we remember that practically all Asia with the exception of parts of the Himalaya, Ceylon, and Java, the whole of Africa except the Cape and parts of Egypt and Algeria, and South America except a small stretch of the south-east coast, the Andes, and Brazil, are practically unexplored as regards Fungi, that we know almost nothing of the Fungi of 'New Zealand, Canada, and the Pacific Islands, the West Indies, or even of those of Turkey, the greater part of Russia and Spain, and that new species are constantly being discovered in the United States, Australia, and Northern Europe ??? the best explored of all ??? it is clear that no very accurate census of Fungi can as yet be made, and no generalizations of value as to their geographical distribu- tion are possible.

The existence of fossil Fungi is undoubted, though very few of the identifications can be relied on as regards species or genera. They extend

back beyond the Car- boniferous, where they occur as hyphse, &c., preserved in the fossil woods, but the best specimens are probably those/ in amber and in siliceous petrifactions of more recent origin.

Organs. ??? Individual hyphse or their branches often exhibit specia^ lizations of form. In many Basidiomycetes minute branches arise below the septa, their tips curve over the outside of the latter, and fuse with the cell above just beyond it, forming a. clamp-connexion. Many parasitic hyphee put out minute lateral branches, which pierce the cell- wall of the host and form a peg-like (^Trichosphceria') , sessile (Cystopus), or stalked {Semileia), knot-like, or a more or less branched {Peronospora) orcoiled {Protomyces) haustorium. In Bhizopus certain hyphse creep horizontally on the surface of the substratum, and then anchor their tips to it by means of a tuft of short branches {Appressoriuni) , the walls of which soften and gum themselves to it, then another branch shoots out from the tuft and repeats the process, like a strawberry runner. Appressoria are also formed by some parasitic Fungi, as a minute ilattening of the tip of a very short branch (Erysiphe), or the swollen end of any hypha which comes in contact with the surface of the host (Piptocephalis, Syncephalis) , haustoria piercing in each case the cell- wall below. In Botrytis the appressoria assume the form of dense tassels of short branches. In Arthrobotrys side-branches of the mycelium sling them- selves around the host (Tylenchus) much as tendrils round a support. Many Fungi {Phallus, Agaricus, Fumago, &o.) when strongly growing put out ribbon-like or cylindrical cords, or sheet-like mycelial plates of numerous parallel hyphse, all growing together equally, and fusing by anastomoses, and in this way extend long distances in the soil, or over the surfaces of leaves, branches, &c. These mycelial strands may be white and tender, or the outer hyphse may be hard and black, and very often the resemblance of the subterranean forms to a root is so marked that they are termed Bhizomorphs. The outermost hyphse may even put forth thinner hyphse, radiating into the soil like root-hairs, and the convergent tips may be closely appressed and so divided by septa as to resemble the root-apex of a higher plant {Armillaria mellea).

Sclerotia. ??? Fungi, like other plants, are often found to store up large quantities of reserve materials (oil, glycogen, carbohydrates, &c.) in

special parts of their vegetative tissues, where they lie accumulated between a period of active assimilation and one of renewed activity, forming reserves to be consumed particularly during the formation of large fructifications. These reserve-stores may be packed away in single hyphse or in swollen cells, but the hyphse containing them are often gathered into thick cords or mycelial strands {Phallus, mushroom, &c.), or flattened and anasto- mosing ribbons and plates, often containing several kinds of hyphse {Merulius lacrymans). In other cases the strands \indergo dif- ferentiation into an outer layer with blackened, hardened cell- walls and a core of ordinary hyphse, and are then termed Bhizo- morphs {Armillaria mellea), capable not only of extending the fungus in the soil, like roots, but also of lying dormant, protected by the outer casing. Such aggregations of hyphse frequently become knotted up into dense masses of interwoven and closely packed hyphje, varying in size from that of a pin's head or a pea {Peziza, Coprinus) to that of a man's fist or head, and weighing 10 to 25 lb or more {Polyporus MyliU(B, P. tumulosus, Lentinus Wcermanni, P. Sapurema, &c.). The interwoven hyphse fuse and branch copiously, filling up all interstices. They also undergo cut- ting up by numerous septa into short cells, and these often divide again in all planes, so that a pseudoparenchyma results, the walls of which may be thickened and swollen internally, or hardened and black on the exterior. In many cases the swollen cell-walls serve as reserves, and sometimes the substance is so thickly deposited in strata as to obliterate the lumen, and the hyphse become nodular {Polyporus sacer, P. rhinoceros, Lentinus Wcermanni). The various Sclerotia, if kept moist, give rise to the fructifications of the Fungi concerned, much as a potato- tuber does to a potato-plant, and in the same way the reserve materials are consumed. They are principally Polyporei, Agaricini, Pezizse ; none are known among the Phyoomycetes, Uredinese, or Ustilaginese. The functions of mycelial strands, Rhizomorphs, and Sclerotia are not only to collect and store materials, but also to extend the fungus, and in many cases similar strands act as organs of attack. The same functions of storage in advance of fructification are also exercised by the stromata so common in Ascomycetes.

Tissue Differentiations. ??? The simpler mycelia consist of hyphse all alike and thin-walled, or merely difiering in the diameter of the branches

of various orders, or in their relations to the environment, some plunging into the substratum-lite roots, others remaining on its surface, and others (aerial hyphse) rising into the air. Such hyphse may be multicellular, or they may consist of simple tubes with numer- ous nuclei and no septa {Phy corny cetes), and are then non-cellular. In the more complex tissue-bodies of higher Fungi, however, we find considerable differences in the various layers or strands of hyphse.

An epidermis-like or cortical protective outer layer is very common, and is usually characterized by the close septation of the densely interwoven hyphse and the thickening and dark colour of their outer walls (Sclerotia, Xylaria, &c.). Fibre-like hyphse with the lumen almost obliterated by the thick walls occur in mycelial cords {Merulius) . Latex-tubes abound in the tissues of Lactarius, Stereum, Mycena, Fistulina, filled with white or coloured milky fluids, and Istvanffvi has shown that similar tubes with fluid or oily contents are widely spread in other Hymenomycetes. Some-times fatty oil or watery sap is found in swollen hyphal ends, or such tubes contain coloured sap. Cystidia and Paraphyses may be also classed here. In Merulius lacrymans Hartig has observed thin-walled hyphse with large lumina, the septa of which are per- forated like those of sieve-tubes.

As regards its composition, the cell ~~wall of Fungi exhibits varia~~ tions of the same kind as those met with in higher plants. WMle the fundamental constituent is a cellulose in many Mucorini and other Phyoomycetes, in others bodies like pectose, callose, &c., commonly occur, and Wisselingh's researches show that chitin, a gluco-proteid common in animals, forms the main constituent in many cases, and is probably deposited directly as such, though, like the other substances, it may be mixed with cellulose. As in other cell-walls, so here the older membranes may be altered by deposits of various substances, such as resin, calcium oxalate, colouring matters ; or more profoundly altered throughout, or in definite layers, by lignification, suberization (Trametes, Dcedalia) , or swelling to a gelatinous mucilage (Tremella, Gymnosporangium) , while cutin- ization of the outer layers is common. One of the most striking alterations of cell-walls is that termed carbonization, in which the substance gradually turns black, hard, and brittle, as if charred ??? e.g., Xylaria, JJstulina, some sclerotia. At the other extreme the cell-walls of many Lichen-Fungi

are soft and colourless, but turn blue in iodine, as does starch. The young cell-wall is always tenuous and flexible, and may remain so throughout, but in many cases thickenings and structural differentiations, as well as the changes referred to above, alter the primary wall considerably. Such thickening may be localized, and pits (e.g., Uredospores, septa of Basidiomycetes), spirals, reticulations, rings, &c. (capilUtium

fibres of Podaxon, Colostoma, Battarrea), occur as in the vessels of higher plants, while sculptured networks, pittings, and so forth are as common on fungus-spores as they are on pollen grains.

Cell- Contents. ??? The cells of Fungi, in addition to protoplasm, nuclei, and sap-vacuoles, like other vegetable cells, contain formed and amorphous bodies of various kinds. Among those directly visible to the microscope are oil drops, often coloured (XJredinem) crystals of calcium oxalate (Phallus, Mussula), proteid crystals {Mucor, Pilobolus, &c.), and resin (Polyporei). The oidia of Ery- siphese contain fibrosin bodies and the hyphge of Saprolegnieas cel- lulin bodies, but starch apparently never occurs. Invisible to the microscope, but rendered visible by reagents, are, glycogen {Mucor, Ascomycetes, yeast, &o.). In addition to these cell-contents we have good indirect evidence of the existence of large series of other bodies, such as proteids, carbohydrates, organic acids, alkaloids, enzymes, &c. These must not be confounded with the numerous substances obtained by chemical analysis of masses of the fungus, as there is often no proof of the manner of occurrence of such bodies, though we may conclude with a good show of probability that some of them also exist performed in the living cell. Such are sugars (glucose, mannite, &o.), acids (acetic, citric, and a whole series of lichen-acids), setherial oils and resinous bodies, often combined with the intense colours of Fungi and Lichens, and anumber of powerful alkaloid poisons, such as Muscarin {Amanita) , Ergotin {Claviceps), &c.

Among the enzymes already extracted from fungi are invertases (yeasts, moulds, &c.), which split cane-sugar, and other complex sugars with

hydrolysis into simpler sugars such dextrose and levulose ; diastases, which convert starches into sugars (Aspergillus, &c.) ; cytases, which dissolve cellulose similarly (Botrytis,&c.) ; pep- tases, using the term as a general one for all enzymes which convert proteids into peptones and other bodies (Penicillium, &c.); lipases, which break up fatty oils (Empusa, Phycomyces, &c.) ; and oxydases, which bring about the oxidations and changes of colour observed in Boletus, &c. That such enzymes are formed in the protoplasm is evident from the behaviour of hyphse, which have been observed to pierce cell-membranes, the chitinous coats of insects, artificial col- lodion films and layers of wax, &c. Whether the material which Buchner extracted from yeast-cells, finely ground and subjected to extremely high pressures, and which Is capable of rapidly breaking down sugar to form carbon dioxide and alcohol, is, as he believes, a true enzyme, or merely finely divided protoplasmic remnants, is not yet clear ; if it is an enzyme, its properties are remarkable. That a fungus can secrete more than one enzyme, according to the materials its hyphae have to attack, has been shown by the extraction of diastase, inulase, trehalase, invertase, maltase, raffinase, malizitase, emulsin, trypsin, and lipase from Aspergilhis by Bourquelot, and similar events occur in other Fungi. The same fact is indicated by the wide range of organic substances which can be utilized by Penicillium and other moulds, and by the behaviour of parasitic Fungi which destroy various cell-contents and tissues. Many of the coloured pigments of Fungi are fixed in the cell- walls or excreted to the outside (Peziza ceruginosa). Matruchot has used them for staining the living protoplasm of other Fungi by growing the two together. Striking instances of coloured my celia are afforded by Corticium sanguineum, blood red ; Elaphomyces Leveillei, yellow-green ; Chlorosplenium ceruginosum, verdigris green ; and the Dematei, brown or black.

Nuclei. ❓❓❓ Although many Fungi have been regarded as devoid of nuclei, and all have not as yet been proved to contain them, the numerous investigations of recent years have revealed them in the cells of all forms thoroughly examined, and we are justified in concluding that the nucleus is as essential to the cell of a fungus as to that of other organisms. The Hyphae of many contain num- erous, even hundreds of nuclei (Phycomycetes) ; those of others haveseveral (Aspergillus) in each

segment, or only two (Exoascus), or one (Erysiphe) in each cell. Even the isolated cells of the yeast plant have each one nucleus. As a rule the nuclei of the mycelium are very minute (1-5-2 fi in Phycomyces), but those of many asci and spores are large and easily rendered visible. As with other plants, so in Fungi the essential process of fertilization consists in the fusion of two nuclei, but owing to the absence of sexual organs from all but a very few Fungi, a peculiar interest attaches to certain nuclear fusions in the vegetative cells or in young spores of many forms, the significance of which is by no means clear. Thus in Ustilagineae the Chlamydospores, in Ure- dinese the Uredo-, Teleuto-, and iEcidiospores, each contain two nuclei when young which fuse as the spores mature. In many young asci a similar fusion of two or even four nuclei occurs, and also in basidia, in each case the nucleus of the Ascus or of the Basidium resulting from the fusion subsequently giving rise by division to the nuclei of the asoospores and basidiospores respec- tively. Since this fusion may occur in young asci which have arisen from a fertilized ascogonium (Sphxrotheca) as well as in such as are not developed as the result of such a sexual process (Exoascus), it has been regarded as a secondary phenomenon, the true significance of which is still unexplained, and not as being

itself the sexual act. Nuclear division may be accompanied by all the essential features of Karyokinesis (Peziza Stevensoniana), or may be direct (mushroom) .

Spores. ??? No agreement has ever been arrived at regarding the consistent use of the term spore. This is apparently owing to the facts that too much has been attempted in the definition, and that differences arise according as we aim at a morphological or a physio- logical definition. Physiologically, any cell or group of cells sepa- rated off from a hypha or unicellular fungus, and capable of itself growing out ??? germinating ??? to reproduce the fungus, is a spore ; but it is evident that so wide a definition does not exclude the ordinary vegetative cells of sprouting Fungi, such as yeasts, or small sclero- tium, like cell-aggregates of forms like Coniothecium. Morphologi- cally considered, spores are marked by peculiarities of form, size, colour, place of origin, definiteness in number, mode of preparation, and so forth, such that they can be distinguished

more or less sharply from the hyphae which produce them . The only physiological pecu- liarity exhibited in common by all spores is that they germinate and initiate the production of a new fungus-plant. Whether a spore results from the sexual union of two similar gametes (zygospore) or from the fertilization of an egg-cell by the protoplasm of a male organ (oospore) ; or is developed asexually (gonidium) as a motile (zoospore) or a quiescent body cut off from a hypha (conidium) or developed along its course (oidium or chlamydospore), or in its protoplasm (endospore) , are matters of importance which have their uses in the classification and terminology of spores, though in many respects they are largely of academic interest.

Klebs has recently attempted to divide spores into three categories asfollows : ??? (1) Kinospores, arising by relativelysimple cell-divisions and subserving rapid dissemination and propagation, e.g., zoospores, conidia, endogonidia, stylospores, &c. ; (2) Paulospores, due to simple rearrangement of cell contents, and subserving the persist- ence of the fungus through periods of exigency, e.g., gemmae, chlamydospores, resting-cells, cysts, &c. ; (3) Carpospores, produced by a more or less complex formative process, often in special fructifications, and subserving either or both multiplication and persistence, e.g., zygospores, oospores. Brand-spores, aecidiospores, asoospores, basidiospores, &c. Little or nothing is gained by these definitions, however, which are especially physiological. In practice these various kinds of spores of Fungi receive further special names in the separate groups, and names, moreover, which will appear, to those unacquainted with the history, to have been given without any consistency or regard to general principles ; neverthe- less, for ordinary purposes these names are far more useful in most cases, owing to their descriptive character, than the proposed new names which have been only partially accepted.

Sporophores. ??? In some of the simpler Fungi the spores are not borne on or in hyphse which can be distinguished from the vegeta^ five parts or mycelium, but in the vast majority of cases the sporo- genous hyphae either ascend free into the air or radiate into the surrounding water as distinct branches, or are grouped into special columns, cushions, layers, or complex masses obviously different in colour, consistency,

shape, and other characters from the parts which gather up and assimilate the food-materials. The term "receptacle" sometimes applied to these spore-bearing hyphae is better replaced by Sporophore. The sporophore is obsolete when the spore-bearing hyphae are not sharply distinct from the mycelium, simple when the constituent hyphae are isolated, and compound when the latter are conjoined. The chief distinctive characters of the sporogenous hyphae are their orientation, usually vertical ; their limited apical growth ; their peculiar branching, form, colour, contents, consistency ; and their spore-production. According to the characters of the last, we might theoretically divide them mto Conidiophores, Sporangiophores, Qametophores, Oidiophores, &c. ; but since the two latter rarely occur, and more than one kind of spore or spore-case may occur on a sporophore, it is impossible to carry such a scheme fully into practice.

A simple sporophore may be merely a single short hypha, the end of which stops growing and becomes cut off as a conidium by the formation of a septum, which then splits and allows the coni- dium to fall. More generally the hypha below the septum grows forwards again, and repeats this process several times before the terminal conidium falls, and so a chain of conidia results, the oldest of which terminates the series (Ei-ysiphe) ; when the primary branch has thus formed a basipetal series, branches may arise from below and again repeat this process, thus forming a tuft (Penicillium). Or the primary hypha may firat swell at its apex, and put forth a series of short peg-like branches (sterigmata) from the increased surface thus provided, each of which develops a similar basipetal chain of conidia (Aspergillus), ^nd various combinations of these processes result in the development of numerous varieties of exquisitely branched sporophores of this type (Botrytis.Botryosporium, Verticillium,&c.).

A second type is developed as follows ; ??? The primary hypha forms a septum below its apex as before, and the terminal coni- dium, thus abstricted, puts out a branch at its apex, which starts as a mere point and rapidly swells to a second conidium ; this

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repeats the process, and so on, so that we now have a chain of conidia developed in acropetal succession, the oldest being below, and, as in Penicillium, &c., branches put forth lower dovra may re- peat the process {Hortnodendron). In all these cases we may speak of simple conidiophores. The simple sporophore does not neces- sarily terminate in conidia, however. In Mucor, for example, the end of the primary hypha swells into a spheroidal head (Spo- rangium), the protoplasm of which undergoes segmentation into more or less numerous globular masses, each of which secretes an enveloping cell- wall and becomes a spore (endospore) , and branched systems of sporangia may arise as before (Thamnidium). Such may be termed Sporangiophores. In Sporodinia the branches give rise also to short branches, which meet and fuse their contents to form zygospores. In Peronospora, Saprolegnia, &Cj, the ends of the branches swell up into sporangia, which develop zoospores in their interior (zoosporangia), or their contents become oospheres, which may be fertilized by the contents of other branches (pollinodia) and so form egg-cases (oogonia) . Since in such cases the sporophore bears sexual cells, they are conveniently termed gametophores.

Compound sporophores arise when any of the branched or un- branched types of spore-bearing hyphse described above ascend into the air in consort, and are more or less crowded into deiinite layers, cushions, columns, or other complex masses. The same laws apply to the individual hyphse and their branches as to simple sporophores, and as long as the conidia, sporangia, gametes, &o. , are borne on their external surfaces, it is quite consistent to speak of these as compound sporophores, &c. , in the sense described, how- ever complex they may become. Among the simplest cases are the sheet-like aggregates of sporogenous hyphse in Fuccinia, XJro- myces, &c., or of basidia in Exobasidium, Corticium, &c., or of asci in Exoascus, Ascocortioium, &c. In the former, where the layer is small, it is often termed a iSorus, but where, as in the latter, the sporogenous layer is extensive, and spread out more or less sheet-like on the supporting tissues, it is more frequently termed a Hymenium. Another simple case is that of the columnar aggregates of sporo- genous hyphse in forms like Stilbum, Coremium, &c. These lead us to cases where the main mass of

the sporophore forms a support- ing tissue of closely crowded or interwoven hyphse, the sporogenous terminal parts of the hyphse being found at the periphery or apical regions only. Here we have the cushion-like type (stroma) of Nectria and many Pyrenomycetes, the clavate "receptacle" of Clavaria, &c., passing into the complex forms met with in Spa- rassis, Xylaria, Polyporei, and Agaricini, &c. In these cases the compound sporophore is often termed the Hymenophore, and its various parts demand special names (Pileus, Stipes, Gills, Pores, &c.) to denote peculiarities of distribution of the Hymenium over the surface.

Other series of modifications arise in which the tissues correspond- ing to the stroma invest the sporogenous hyphal ends, and thus enclose the spores, asci, basidia, &c., in a cavity. In the simplest case the stroma, after bearing its crop of conidia or oidia, develops ascogenous branches in the loosened meshes of its interior (e.g., Onygena). Another simple case is where the plane or slightly convex surface of the stroma rises at its margins and overgrows the sporogenous hyphal ends, so that the spores, asci, &c., come to lie in the depression of a cavity ??? e.g., Solenia, Cypkella ??? and even simpler cases are met with in Mortierella, where the zygospore is invested by the overgrowth of a dense mat of closely branching hyphse, and in Cfymnoascus, where a loose mat of simi- larly barren hyphse covers in the tufts of asci as they develop.

In such examples as the above we may regard the hymenium (Solenia, Cypkella), zygospores, or asci as truly invested by later growth, but in the vast majority of oases the processes which result in the enclosure of the spores, asci, &c., in a "fructification " are much more involved, inasmuch as the latter is developed in the interior of hyphal tissues, which are by no means obviously homo- logous with a stroma. Thus in Penicillium, Eurotium, Erysiphe, &c., hyphal ends which are the initials of ascogenous branches, are invested by closely packed branches at an early stage of develop- ment, and the asci develop inside what has by that time become a complete investment. Whether a true sexual process precedes these processes or not does not affect the present question, the point being that the resulting spheroidal " fructification " (Cleisto- carp, Perithecium) has a definite wall of its own not directly com- parable with a stroma. In other cases Hypomyces, Nectria) the perithecia arise on an

already mature stroma, while yet more numerous examples can be given (Poronia, Hypoxylon, Claviceps, &c.) where the perithecia originate below the surface of a stroma formed long before. Similarly with the various types of conidial or oidial " fructifications," termed Pycnidia, Spermogonia, JEcidia, &c. In the simplest of these cases ??? e.g., Fumago ??? a single mycelial cell divides by septa in all three planes until a more or less solid clump results. Then a hollow appears in the centre owing to the more rapid extension of the outer parts, and into this hollow the cells lining it put forth short sporogenous branches, from the tips of which the spores (Stylospores, Conidia, Spermatia) are abstricted.

In a similar way are developed the pycnidia of Cicinnoholus, Fleospora, Cucurhitaria, Leptosphmria, and others. In other cases (Diplodia, ^Eoidium, &c.) conidial or oidial " fructifications " arise by a number of hyphse interweaving themselves into a knot, as if they were forming a sclerotium. The outer parts of the mass then differentiate as a wall or investment, and the interior becomes a hollow, into which hyphal ends grow and abstriot the spores. Much more complicated are the processes in a large series of " fructifica- tions," where the mycelium first develops a densely packed mass of hyphse, all alike, in which labyrinths of cavities subsequently form by separation of hyphse in the previously homogeneous mass, and the hymenium covers the walls of these cavities and passages, as with a lining layer. Meanwhile differences in consistency appear in various strata, and a dense outer protective layer (Peridinm), soft gelatinous layers, and so on, are formed, the whole eventually attaining great complexity ??? e.g., puff-balls, earth-stars, and various Phalloidem.

Spore-distribution. ??? Ordinary conidia and similarly abstricted dry spores are so minute, light, and numerous that their dispersal is ensured by any current of air or water, and we also know that rats and other burrowing animals often carry them on their fur ; simi- larly with birds, insects, slugs, worms, &c., on claws, feathers, pro- boscides, &c. , or merely adherent to the slimy body. In addition to these accidental modes of dispersal, however, there is a series of in- teresting adaptations on the part of the fungus itself. Passing over the locomotor activity of zoospores (Pythium, Peronospora, Saprolegnia), we often find spores held under

tension in sporangia (Filobolus) or in asci (Feziza) until ripe, and then forcibly shot out by the sudden rupture of the sporangial wall under the pressure of liquid behind ??? mechanism comparable to that of a pop-gun, if we suppose air replaced by watery-sap. Even a single conidium, held tense to the last moment by the elastic cell-wall, may be thus shot forward by a spurt of liquid under pressure in the hypha abstrict- ing it (e.g., Empusa), and similarly with basidiospores (Coprinus, Agaricus, &c.). A more complicated case is illustrated by Sphoero- bolus, where the entire mass of spores, enclosed in its own peridinm, is suddenly shot up into the air like a bomb from a mortar by the elastic retroversion of a peculiar layer which, up to the last moment, surrounded the bomb, and then suddenly splits above, turns inside out, and drives the former as a projectile from a gun. Gelatinous or mucilaginous degenerations of cell-walls are frequently employed in the interests of spore dispersal. The mucilage surrounding endo- spores of Mucor, conidia of Empusa, &c., serve to gum the spore to animals. Such gums are formed abundantly in pycnidia, and, absorb- ing water,swell and carry out the spores in long tendrils,which emerge for days and dry as they reach the air, the glued spores gradually being set free by rain, wind, &c. In oidial chains (Sclerotinia) a minute double wedge of wall ~~*substance arises in the middle lamella between each pair of contiguous oidia, and by its enlargement splits the separating lamella. These disjunctors serve as points of appli*~~ *cation for the elastic push of the swelling spore-ends, and as the con-necting outer lamella of cell-wall suddenly gives way, the spores are jerked asunder. In many cases the slimy masses of spermatia (Uredineas), conidia (CTauiceps), basidiospores (Phallus, Coprinus), &c. , emit more or less powerful odours, which attract flies or other insects, and it has been shown that bees carry the fragrant oidia of Selerotinia to the stigma of Vaccinium and infect it, and that flies carry away the foetid spores of Phallus, just as pollen is dispersed by such insects. Whether the strong odour of trimethylamine evolved by the spores of Tilletia attracts insects is not known.*

Classification. ??? Modern workers are agreed that the vast majority of the Fungi proper fall principally into three great groups, the Phycomy eetes, Ascomy cetes, and Basidio- mycetes, the differences of opinion between various autho- rities referring chiefly to the details of

delimitation of subordinate groups within these, and the relations of these to one another. Even the extreme divergence between the views of De Bary and Brefeld permits this statement, since the principal differences between their schemes concern (1) the relations of origin of the Asco-mycetes and Basidiomycetes to the Phycomycetes, (2) the position of the Ustilagineee within the system, (3) the exact rank of the Uredinese and their possible relations to Ascomycetes ??? their alliance with Basidiomycetes not being questioned, and (4) the delimitations of minor groups. Almost all authorities are agreed that Schizomycetes and Myxomycetes are independent groups not coming into the true Fungi at all, a view we adopt here.

When we come to examine the schemes of classification in detail, however, there are many points to be considered. Whether we take the system of Saccardo (1882-92), of

Brefeld and Von Tavel (1892), of Van Tieghem (1893), or of Schroeter (1892), the two former only of which have materially influenced modern mycology, the same truth comes out; each is a purely morphological scheme, and all agree in the main subdivisions, but differ in details as regards the delimitations of frontiers and the inter- relations of the subordinate groups. Saccardo's system is floristic, and designed apart from theory to facilitate the recognition of species, and the recording of synonyms. It has never been drawn up in tabular form, and admits numerous artificial devices to aid in the determination of imperfectly studied forins.

Bref eld's system, which has been more widely accepted than any other since De Bary, is based on (1) the denial of any trace of sexual organs in Ustilagineae, Uredinese, Ascomycetes and Basidiomycetes, or indeed in any fungi outside the group of Phycomycetes ; (2) on the purely morphological interpretation of the homologies of spores, asci and sporangia, and basidia in the various groups ; and (3) on theoretical conclusions from these interpretar tions as to the evolution of the higher

groups from the lower. The following is a brief tabular survey of Bref eld's scheme, though in this form it does not clearly show the cross-connexions he assumes : �с

A. Phycomycetes. ससс Alga^-like Fungi, with unicellular thallus

and sexual organs.

Class 1. OoMTCETES.. ससс Sexual fructification in the form of Oospores ; asexual in that of sporangia and conidia.

1. Antheridia and Oogonia as sporangia ; asexual

reproduction by means of sporangia : ससс Mono- hlepharidece.

2. Antheridia reduced, Oogonia as sporangia ;

asexual reproduction by means of sporangia or conidia : ससс Peronosporece, Ancylistece, Saproleg- niece {? Chytridiacece).

3. Antheridia and Oogonia reduced ; asexual organs

conidia : ससс Entomophthorex. Class 2. Ztgomtcetes. ससс -Sexual fructification in the form of zygospores ; asexual as sporangia and conidia. (o) Exosporangial series : ससс

1. Sporangia only : ससс ससс Mucorinae,

Thamnidem.

2. Sporangia and conidia : ससс Choane-

phorece.

3. Conidia only : ससс ChcEtocladiece,

PiptocephalidecB. (;8) Carposporangial series : ससс Bhizopece, MortierellecB.

B. Eumycetes. ⁃⁃⁃ Higher Eungi, with segmented thallus and no

sexual organs. I. MESOMYCETES. ⁃⁃⁃ Intermediate forms between the Phycomycetes and Ascomycetes (Hemiasci) on the one hand, and between Phycomycetes and Basidiomycetes (Hemibasidii) on the other. Class 3. Hemiasci. ⁃⁃⁃ Fructification in the form of sporangia and conidia ; sporangia asous- Uke.

(a) Exohemiasci : ⁃⁃⁃ Ascoidece, Protomy-

cetes. (/3) Carpohemiasci : ⁃⁃⁃ Tlielebolem. Class 4. Hemibasidii. ⁃⁃⁃ Fructification in the form of conidia, no sporangia ; conidiophores basi- dium-like : ⁃⁃⁃ ⁃⁃⁃ Ustilagem, Tilletice. II. MYCOMYCETES, including the vast majority of higher Eungi. Class 5. AsooMTOETES. ⁃⁃⁃ Fructification as sporangia and conidia ; the sporangia definite, and termed Asci.

(a) Mxoasci. ⁃⁃⁃ Asci free, i.e., exoascous : ⁃⁃⁃ Endomycetes, Taphrinece, Saccha- romycetes. ((3) Carpoasci. ⁃⁃⁃ Asci enclosed in "fructi- fications," i.e., carpoascous.

(1) Angiocarpous : ⁃⁃⁃ Gymnoascece, Perisporiacece, Pyrenomycetes.

(2) Hemiangiocarpous : ⁃⁃⁃ Hyste- riacece, Discomycetes, Helvel- lacecB.

Class 6. Basidiomycetes. ⁃⁃⁃ Fructification as conidia, no sporangia ; Conidiophores definite, and termed Basidia.

(a) Protobasiomycetes. ⁃⁃⁃ Basidia septate, (i) Basidia tranversely septate. (a) Gymnocarpic series : ⁃⁃⁃ UredinecB, Auricu- lariece. (6) Angiocarpic series : ⁃⁃⁃ Pilacreoe. (ii) Basidia vertically septate : ⁃⁃⁃ Tremellineos. ((3) Autobasidiomycetes. ⁃⁃⁃ Basidia without septa. (a) Gymnocarpic series : ⁃⁃⁃ Dacryo-

mycetes. (6) Angiocarpic -. ⁃⁃⁃ Gastromycetes,

Phalloidece. (c) Gymnocarpic and Hemiangio- carpic : ❖❖❖ Hymenomycetes.

Put shortly, Brefeld regards it as proved that the sexual process, so well seen in many Phycomycetes (e.g., Pythium), and confirming their derivation from Algse such as Vaucheria, gradually disappears within the limits of the group (e.g., Peronospora, PhytophtJiord), never to reappear in the Fungi. Contrary to the view of De Bary, who considered the Peronosporeae as the starting-point for the great Ascomycetous series, and saw homologies between the sexual organs of the former and the organs initiating the inception of the cleistocarps of Erysipheae, Brefeld regards the asci of the latter and of other Ascomycetes as simply sporangia which have become definite in shape, size, and the number of their spores, instead of being in- definite in these respects. In this view he is confirmed by his conviction that the sporangia of Ascoidea and Pro- tomyces are on the way to become fixed and definite asci, and that the spore-producing cells of yeast have practi- cally become such, while Thelebolus can be compared to a sporangium of Mortierella with the pedicel suppressed, and with an envelope of barren hyphee comparable to the weft at the base of the latter. The obviously weak point in this argument is that no explanation is left for the difficult cases of Erysiphese, Dipodascus, Eremascus, Eurotium, Pyronema conjluetis, Collema, and Laboul- beniacese, beyond mere denial that the structures observed are sexual organs, a denial which is seriously discounted by the observations of Harper on Splmrotheca. Bauer on Collema, and Thaxter on Laboulbeniacese, observations which in the opinion of many authorities establish beyond reasonable doubt that a sexual process does occur in these Fungi. It is even more difficult to reconcile this view with the facts of conjugation recently discovered in cer- tain yeasts and described by Barker {Proc. M.S., 1901). As regards Dangeard's views, see below. It is impossible in the space at command to do more than call attention to salient features in the principal groups.

A. Phycomycetes. ❖❖❖ Most of the recent work in this group concerns the studies in Cytology by Wager, Dan- geard, &c., and the effect of external conditions on the formation of sporangia and zygotes by Klebs. Bref eld's speculations on the morphology have been referred to.

The Oomycetes are characterized by the general development of oospheres and pollinodia (antheridia), and in the typical cases by the fertilization of the former by motile antherozoids or nuclear contents discharged from the latter, the sexual organs being there- fore dissimilar. Most of them are aquatic or parasitic, and interest- ing series of degenerations, loss of sexuality, motile and non-motile asexual spores occur. The group is of theoretical importance owing to their alga-like characters, and to the fact that De Bary regarded the oogonium with its oospheres and the poUinodium as the starting-point whence could be derived the sexual organs in certain Ascomycetes (e.g., Erysipheae), and thus of the whole Asco- mycetous series of Fungi.

The Saprolegniece comprise about fifty to sixty species of chiefly aquatic Fungi. P//□□AiMm causes the "damping ofi" ofseedlings, its hyphae penetrating the cell- walls and rapidly destroying the watery

tissues of the living plant, and also living on the dead remains. As the free ends emerge again into the air they sv^ell up into spherical bodies, each of which may either fall off as a conidium and germinate by means of a germ tube, which again infects the host ; or the germ tube is put forth while the conidial swelling is still attached and itself swells up into a zoosporangium, the proto- plasm in which develops swarm-spores. In the rotting tissues branches of the older mycelium similarly swell up at the ends (fiogonia) and the contents become an oosphere, into which the proto- plasmic contents of a short branch (^pollinodium or "antheridial branch ") , developed elsewhere on the hypha, are poured and fertilize it; the oosphere thus becomes an oospore. Pythium is of theoretical importance (1) as a fungus where true sexual reproduction is per- fected, (2) as illustrating the dependence of zoospore-formation on the conditions and the indeterminate nature of conidia, and (3) as a case where the saprophytic and parasitic habits are alike practised. Pythium is also (4) the best type of the group, showing possible transition to the rest of the Saprolegnieae, e.g., Saprolegnia, Achlya, &c. , with cylindrical zoosporangia, and usually several oospores in the oogonia, and becoming

parthenogenetic in extreme cases ; the Peronosporinese, distinguished chiefly by the more pronounced coni- diophores and abstriction of conidia ; and the Monoblepharidese. Klebs has shown that the development of zoosporangia or of oogonia and pollinodia respectively in Saprolegnia is dependent on the external conditions ; so long as a continued stream of suitable food- material is ensured the mycelium grows on without forming repro- ductive organs, but directly the supplies of nitrogenous and carbo- naceous food fall below a certain degree of concentration sporangia are developed. Further reduction of the supplies of food efiecta the formation of oogonia. This explains the sequence of events in the case of a Saprolegnia-mycelmm radiating from a dead ily in water. Those parts nearest the fly and best supplied develop barren hyphse only ; in a zone at the periphery, where the products of putrefaction dissolved in the water form a dilute but easily accessible supply, the zoosporangia are developed in abundance ; oogonia, however, are only formed in the depths of this radiating mycelium, where the supplies of available food materials are least abundant. Sapro- legnieae do not form motile spermatozoids, statements alleging their existence not having been confirmed. Nevertheless, the nuclear masses passed over to the oospheres in those species in which fer- tilization is completed are doubtless homologous with spermatozoids. Each zoospore has one nucleus. The oogonia are multinucleate, re- duction occurring before fertilization. The possible origin of this group from Siphonese ??? e.g., Vaucheria-like Algae ??? has been sug- gested, and in connexion with the primitive forms ??? e.g., Pythium ??? there is much to be said in support of the supposition.

Peronosporeoe are a group of endophytic parasites ??? about 100 species ??? of great importance as comprising the agents of the vine mildew (Plasmopara), potato disease (Phytophthora), onion mildew {Peronospora) , and several other epidemic diseases. The mycelium usually sends haustoria into the cells of the host, and puts out sharply marked conidiophores through the stomata, the branches of which abstriot numerous ‘ ‘ conidia ” ; these either germinate directly, or their contents break up into zoospores, which escape and, after swarming for some time, germinate and infect the host- plant. This behaviour of the “conidia,” sometimes as true coni- dial spores, sometimes as

zoosporangia, may occur in one and the same species (Cystopus candidus, Phytophthora infestans), and reminds us of, the similar phenomena in Pythium ; in other cases the direct germination is characteristic for genera ??? e.g., Bremia, Perenospora ??? while others emit zoospores ??? e.g., Plasmopara, &c. In Cystopus the "conidia" are abstricted in basipetal chain-like series from the ends of hyphse, which come to the surface in tufts and break through the epidermis as white pustule-like groups. Each conidium contains numerous nuclei, which do not fuse. The Peronosporineas form oogonia, with one oosphere and poUinodia on the older mycelium, as in Pythium, and in some {Phytophthora omnivora') the fertilizing tube passes its protoplasm into the oosphere; in others no fertilization occurs (parthenogenesis), and in Phytophthora infestans the power of forming oogonia seems to have been lost altogether. Wager has shown that in Cystopus the poUinodium, which contains several nuclei, passes a nucleus into the oosphere, which unites with one of the hundred or more nuclei in the latter ; the other nuclei pass to the periphery and take no part in the process. In the ripe oospore thirty-two nuclei are formed by repeated division. Magnus states that Peronospora parasitica, while unable to infect the older tissues of Capsella, is able to enter the hypertrophied cushions of these tissues infected by Cystopus candidus.

MonoblepharidinecB comprise three species resembling Saproleg- nia, but the oogonium opens and exposes the one oosphere. The antheridial branch also opens and sets free a few amoeboid sperma- tozoids, each with one flagellum. The spermatozoid creeps on the out- side of the oogonium, enters the orifice, and fertilizes the oosphere. Kesemblances between Monoblepharis and CEdogonium are interest- ing, as pointing to another possible origin of Fuaigi from Algse.

Ghytridinem. ??? These parasitic and minute, chiefly aquatic, forms may be looked upon as degenerate Oomycetes, since a sexual process and feeble unicellular mycelium occur in some ; or they may be re- garded as series of primitive forms leading up to higher members. There is no means of deciding the question. Some authorities in- clude them in Oomycetes, but on the whole their simple structure, minute size, usually unioihate zoospores, and their negative charac- ters justify their retention

as a separate group. It contains less than 200 species, chiefiy parasitic on or in Algse and other water-plants or animals, of various kinds, or in other Fungi, seedlings, pollen, and higherplants. They are often devoid of hyphse, or put forth fine pro- toplasmic filaments into the cells of their hosts. After absorbing the cell-contents of the latter, which it does in a few hours or days, the fungus puts out a sporangium, the contents of which break up into numerous minute swarm-spores, usually one-ciliate, rarely two-cili- ate. Any one of these soon comes to rest on a host-cell, and either pierces it and empties its contents into its cavity, where the further development occurs (Olpidium), or merely sends in delicate proto- plasmic filaments {Rhizophydium) or a short hyphal tube of, at most, two or three cells, which acts as a haustorium, the further develop- ment taking place outside the cell-wall of the host (Chytridium) . In some cases resting spores are formed inside the host {Chytridium), and give rise to zoosporangia on germination. In a few species a sex- ual process is described , consisting in the conjugation of similar cells {Zygochytrium) or the union of two dissimilar ones {Polyphagus) . In the development of distinct pollinodial and oogonial cells the allied Ancylistinese show close alliances to Pythium and the Oomycetes. On the other hand, the uniciliate zoospores of Polyphagus have slightly amoeboid movements, and in this and the pseudopodium- like nature of the protoplasmic processes, such forms suggest re- semblances to the Myxomycetes. Opinions differ as to whether the Chytridinese are degraded or primitive forms, and the group still needs critical revision. Many new forms will doubtless be discovered, as they are rarely collected on account of their minute- ness. Some forms cause damping off of seedlings ❑❑❑ e.g., Olpidium SrassiccB; others discoloured spots and even tumour-like swell- ings ❑❑❑ e.g., Synchytium Scabiosce, S. Succisce, Urophlyctis, &c., on higher plants. Analogies have been pointed out between Chytri- diacesB and unicellular Algse, such as Chlorosphaeracese, Protococ- caceae, "Palmellacese," &c., some of which are parasitic, and sugges- tions may be entertained as to possible origin from such Algse.

The Zygomycetes {Mucorini), of which nearly 150 species are described, have become especially important from a theoretical standpoint, since they furnish the series whence Brefeld derives the vast majority of the Fungi. They are characterized especially by the zygospores, but the

asexual organs {sporangia) exhibit in- teresting series of changes, beginning with the typical sporangium of Mucor containing numerous endospores, passing to cases where, as in Thamnidium, these are accompanied with more numerous small sporangia {sporangioles') containing few spores, and thence to Chcetocladium and Piptoeephalis, where the sporangioles form but one spore and fall and germinate as a whole ; that is to say, the monosporous sporangium has become a conidium, and Brefeld regards these and similar series of changes as explaining the re- lation of ascus to conidium in higher Fungi. According to his view, the ascus is in effect the sporangium with several spores, the conidium the sporangiole with but one spore, and that not loose but fused with the sporangiole wall. On this basis, with other interesting morphological comparisons, Brefeld erected his hypo- thesis that the Ascomycetes and Basidiomycetes diverge from the Zygomycetes, the former having particularly specialized the ascus (sporangial) mode of reproduction, the latter having specialized the conidial (indehiscent one-spored sporangiole) mode. In addi- tion to sporangia and the conidial spores referred to, some Mucorini show a peculiar mode of vegetative reproduction by means of GemmcE or Chlamydospores ??? i.e., short segments of the hyphse become stored with fatty reserves and act as spores. The gemmae formed on submerged Muoors may bud like a yeast, and even bring about alcoholic fermentation in a saccharine solution.

The classification of the Mucorini depends on the prevalence and characters of the conidia, and of the sporangia and zygospores ??? e.g., the presence or absence of a columella in the former, the formation of an investment round the latter. Most genera are saprophytes, but some ??? Chcetocladium, Piptoeephalis ??? are parasites on other Mucorini, and one or two are associated casually with the rotting of tomatoes and other fruits, bulbs, &c., the fleshy parts of which are rapidly destroyed if once the hyphse gain entrance. Even more important is the question of mycosis in man and other animals, referred to species of Mucor, and recently investigated by Lucet and Costantin. Klebs's demonstration that transpiration is the important factor in determining the formation of sporangia, while zygote-development depends on totally different conditions, is valu- able, as are also his other researches on Sporodinia and Mucor.

B. EuMTOETES. ??? ^With the exception of Bref eld's re- grouping of the lower forms into Hemi-asei and Hemi-

tasidii (Mesomycetes), it will be noticed that very little alteration has been brought about in the classification of the main groups.

I. Mesomycetes.

Hemi-asci. ??? This name was proposed by Brefeld to include a number of forms which in his opinion exhibit the transition from sporangium-bearing Phycomycetes to the true Asoomycetes. They are all small Fungi with a septate mycelium and no trace of sexual reproduction, the spores being developed in sporangia which re- semble asci in most respects, but differ in being somewhat inde- finite as regards the number of spores produced, and in form, size, and position. The group comprises a somewhat heterogeneous collection of types, and severe criticism may be passed on the re- tention of such genera as Ascoidea, Protomyces, Thelebolus, and (by some authors) Saccharomyces, &c., in one circle of alliance ; the difficulties are evaded in part by Schroeter's device of separating Saccharomycetes and constituting a new group (Protoascinese) of them and a few other forms. In Ascoidea and Protomyces the ascus-like sporangia are exposed (Exo-hemiasci) , but in Thelebolus they are covered in by a vreb of hyphae (Carpo-hemiasci).

Hemi-basidii, Ustilaginex. ??? The Bunts and Smuts which damage our grain and fodder plants comprise about 400 species of internal parasites, found in all countries on herbaceous plants, and especially on Monocotlyedons. They are remarkable for their dark spores de- veloped in gall-like excrescences on the leaves, stems, &c., or in the fruits of the host. The discovery of the yeast-conidia of these Fungi, and their thorough investigation by Brefeld, have thrown new lights on the group, as also have the results elucidating the nature of the ordinary dark spores ??? Smuts, Bunt, &c. ??? which by their mode of origin and development are Clilamydospores. When the latter germinate a slender ' '

promy celium " is put out ; in Ustilago and its allies this is transversely septate, and bears lateral conidia (sporidia) ; in Tilletia and its allies non-septate, and bears a terminal tuft of conidia (sporidia). Brefeld regards the promyoelium as a kind of basidium, bearing lateral or terminal conidia (comparable to basidiospores) , but since the nrtmber of basidiospores is not fixed, and the basidium has not yet assumed very definite morphological characters, Brefeld terms the group Hemi-basidii, and regards them as a sort of half-way stage in the evolution of the true Basidiomycetes from Phycomycetes, the Tilletia type leading to the true basidium (Autobasidium) , the Usti- lago type to that of the Protobasidiomycetes, with lateral spores. The yeast-conidia, which bud ofE from the conidia or their resulting mycelium when sown in nutrient solutions, are developed in suc- cessive crops by budding exactly as in the yeast plant, but they cannot ferment sugar solutions. It is the rapid spread of these yeast-conidia in manure and soil waters which makes it so difficult to get rid of Smuts, &o., in the fields, and they, like the ordinary conidia, readily infect the seedling wheat, oats, barley, or other cereals. Infection in these cases can only occur in the seedling at the place where root and shoot meet, and the infecting hypha having entered the plant goes on living in it and growing up with it as if it had no parasitic action at all. When the flowers form, however, the mycelium sends hyphae into the young ovaries and rapidly replaces the stores of sugar and starch, &c., which would have gone to make the grain, by the soot-like mass of spores so well known as Smut, &c. These spores adhere to the grain, and unless destroyed, by "steeping" or other treatment, are sown with it, and again produce sporidia and yeast-conidia which infect the seedlings. In other species the infection occurs elsewhere, the chief condition apparently being that the vulnerable tissue must be in the embryonic state.

II. Mtcomtcetes.

Ascomycetes. ??? Here the main groups are retained much as in older classifications, but an additional group, not regarded in Brefeld's scheme, the Laboulbeniaceae, must be added owing to the importance they have attained in Thaxter's hands.

The Exoasci are usually regarded as comprising about 100 species of small Fungi, the mycelium of which is obsolete or septate and often breaks up into single cells, with a pronounced tendency to sprouting (yeast-forms). The asci are formed directly on the myce- lium or by the direct conversion of the isolated cells, and are therefore fully exposed and devoid of any investment. They form the simplest of the Ascomycetes, the Endomycetes, comprising the true yeasts and their allies, being mostly ferment-Fungi with isolated four-spored asci, and the Taphrinese, about fifty species of chiefly parasitic forms, having an endophytic mycelium, which develops eight-spored asci in layers breaking through the epider- mis of the host-plant. Many of these Taphrinese are important parasites ??? e.g., Pocket plums and Witches' Brooms on Birches, &c., are due to their action. Exoascus and Ascocorticium present inter- esting parallels to Exobasidium and Corticium among the Basidio- mycetes, the former having asci where the latter have basidia. Schroeter places the Endomycetes in a group by themselves {Pro- toascinece) and the Taphrinese in another, Protodiscinece. Perhaps the term Proto- ascomycetes might be employed for both.

Saccharomyces, the genus into which the true yeasts which ferment various sugars and form endogenous spores are put, has attained an importance of late even beyond that to which it was brought by Pasteur's researches on alcoholic fermentation, chiefly owing to the exact results of the investigations of Hansen, who first applied the methods of pure cultures to the study of these organisms, and showed that many of the inconsistencies hitherto existing in the literature were due to the co- existence in the cultures of several species or races of yeasts morphologically almost indis- tinguishable, but physiologically very different. About fifty species of Saccharomyces are described more or less completely, but since many of these cannot be distinguished by the microscope, and some have been found to develop physiological races or varieties under special conditions of growth, the limits are still far too ill- defined for complete botanical treatment of the genus. A typical yeast is able to develop new cells by budding when submerged in a saccharine solution, and to ferment the sugar ??? i.e., so to break up its molecules that, apart from small quantities Used for its own substance, masses of it out of all proportion to the mass of yeast used become

resolved into other bodies, such as carbon dioxide and alcohol, the process requiring little or no oxygen. Brefeld regards the budding process as the formation of conidia. Under other conditions, of which the temperature is an important one, the nucleus in the yeast-cell divides, and each daughter-nucleus again, and four spores are formed in the mother cell, a process obviously comparable to the typical development of ascospores in an ascus. Under yet other conditions the quiescent yeast-cells floating on the surface of the fermented liquor grow out into elongated sausage- shaped or cylindrical cells and branching cell-series, which mat together into mycelium-like veils. At the bottom of the fermented liquor the cells often obtain fatty contents and thick walls, and behave as resting cells (chlamydospores). The characters employed by experts for determining a species of yeast are the sum of its peculiarities as regards form and size ; the shapes, colours, con- sistency, &c. , of the colonies grown on certain definite media ; the optimum temperature for spore-formation, and for the development of the veils, and the behaviour as regards the various sugars.

The following summary of some of the principal characteristics of half-a-dozen species will serve to show how such peculiarities can be utilized for systematic purposes : ???

Species.

()]itimum Temperature for

Characters of

Sugars Fermented and Products, &c.

Spores.

Veils.

Fermentation.

Cells.

Spores.

S. cerevisece I.

S. Pastorianus I. .

S. ellipsoideus

S. anomalus .

S. Ludwigii .

S. membranxfaciens

30 ◆◆

27 ◆◆-5 ◆◆

26 ◆◆

28 ◆◆-31 ◆◆

30 ◆◆-31 ◆◆

30 ◆◆

20 ◆◆-28 ◆◆ 26 ◆◆-28 ◆◆ 33 ◆◆-34 ◆◆

?

?

?

High Low Low

High

?

High

Rounded Rounded Rounded

Elliptical

Elongated

Elongated

Globoid Globoid Globoid

Hat-shaped

Globoid

Globoid

r Invert maltose and sac- J. charose and form al- (cohol 4-6 vol. per cent. / Ditto, and evolves fra- t grant ether.

Will not invert maltose, f Inverts neither maltose \ nor saccharose.

Two questions of great theoretical importance have been i-aised over and over again in connexion with yeasts, namely, (1) the morphological one as to whether yeasts are merely degraded forms of higher Fungi, as would seem implied by their tendency to form elongated, hypha-like cells in the veils, and their development of ‘ ‘ ascospores ‘ ‘ as well as by the wide occurrence of yeast-like “sproutingforms “in other Fungi (e.g., ilfwcor, Exoasci, Ustilaginese, higher Ascomycetes and Basidiomycetes) ; and (2) the question as to

the physiological nature and meaning of fermentation. With regard to the first question no satisfactory proof has as yet been given that Saccharomycetes are derivable by culture from any higher form, the recent statements to that effect not having been confirmed on re-examination by Klooker and Schionning. At the same time there are strong grounds for insisting on the resemblances between Endo- myces, a

hyphal fungus bearing yeast-like asci, and such a form as Saccharomyces anomalus. Concerning the second question, the

most recent investigations by E. Bucliner show that by means of prolonged grinding, and the use of very high pressures, a some- thing sufficiently soluble in, or miscible with, water to pass through fine filters can be obtained which causes sugar to break up into carbon dioxide and alcohol in the absence of living yeast-cells, and this has been confirmed by Green. The question whether this extracted body, which Buchner calls Zymase, is a true enzyme, or merely finely particulate protoplasm, has been much debated. The strongest arguments in favour of its enzyme nature are its extreme diffusibility or solubility in water, its passage through filters, and the statements that it can be dried and kept for short periods, and still retain its powers of exciting alcoholic fermentation on again distributing in water, and that it will act in presence of chloro-form. In considering the bearing of these facts on the theory of fermentation proposed by Pasteur, and now so widely adopted, it must not be forgotten that although Buchner's discovery disposes of the view that alcoholic fermentation is a vital phenomenon inseparable from the presence of living yeast-cells, it does not pre- clude the reply that the alleged enzyme is a product of the living protoplasm, if not an integral part of it.

Whether Schizo-saocharomyces, a yeast which divides into two cells, which then fuse and produce spores, and Zygo-saccharomyces, a form in which the sporogenous cells conjugate before spore-for- mation, are true Saccharomycetes is still an open question. In any case, the behaviour of these genera reopens the question of the autonomy of the group.

GymnoascecefWhich Fischer proposes to group with AspergiUaoese, Onygenaoese, and the truffle-like Elaphomycetes, &c. , as a separate group, termed PlectascinecB in reference to the occurrence of the asci on irregular branches scattered throughout the interior of the very loose tissue, are kept as a separate group of about twenty species by Brefeld.

They are remarkable for the loose investment of the ascigerous branches, and Otenomyces for its habitat ??? old feathers.

The PerisporiacecB, including the somewhat heterogeneous Erysi- phe??, Perisporese, and Tuberacese, number probably about 1000 species. The interesting points regarding the sexuality of Erysi- pheae are discussed elsewhere. Tuberacese comprises the under- ground truffles, some of which are symbiotic with the roots of trees, on which they form Mycorhiza. Eurotmm {Aspergillus) has become still more classical since Klebs gave us a study of the con- ditions necessary for the development of its reproductive organs. Onygena, a remarkable horn-destroying fungus which long defied cultivation, has been shown by Marshall Ward to require the action of the digestive juices in an animal's stomach in order that the spores may germinate, and its life-history is now worked out. Penicillium, the common mould, which has played for the plant-physiologist the part that the frog does for the animal physiologist, has been shown to grow on the most unlikely poisonous substances ??? e.g., solutions containing arsenic, copper, sulphuric acid, &c. ??? and has been found to form very different enzymes. It is an active agent in the destruction of wood, as shown by Marshall Ward. The significance of the "sexual organs" described by Brefeld and De Bary in this and in Eurotium still requires elucida- tion. Aspergillus Oryzce plays an important part in saccharifying the starch of rice, maize, &c., by means of the abundant diastase it excretes, and, in symbiosis with a yeast which ferments the sugar thus formed, has long been used by the Japanese in the prepara- tion of the alcoholic liquor, sake. The process has now been successfully introduced into European commerce. The Gymno- ascesB, PerisporiaceEe, and Pyrenomycetes are classed as Angio- carpous by Brefeld to emphasize the fact that their asci are developed in permanently closed fructifications (Cleistocarps), or in such as only open by an orifice above (Perithecia).

The Discomyeetes in the wider sense, including the Hysteriacese, Phacidiacese, Helvellacese, &c., comprise not fewer than 4000, and probably nearer 5000 species, of which the well-known Peziza-iorm is the type, though extreme forms of Hysteriacese on the one hand and of Helvellacese on the other depart far from it in shape, &c.

Woronin's continued and beautiful work on Sclerotinia has led to much important information as to the parasitism of this group of PezizsB. The conidia are fragrant, and carried by bees to the stigma of a bilberry; here they germinate with the pollen, and the hyphae race the pollen-tubes down the style, and infest the ovules, where they develop sclerotia and mummify the fruits. From the sclerotium the Peziza-form develops. The conidia have remarkable disjunctors. One species is heteroecious, the only case known of hetercecism outside the Uredineae. The Discomyeetes and their immediate allies are termed Hemiangiocarpous, because however much their fructifications are closed at first, they ultimately open and expose the layers of asci (Apothecia).

Laboulheniaceoe are a group of about 150 species of Fungi found on insects, especially beetles, and principally known in America from the researches of Thaxter. The plant is a small, dark brown, erect structure (receptacle) of a few cells, and 1-10 mm. high, attached to the insect by the lowermost end (foot), and easily mistaken for a hair or similar appendage of the insect. The

receptacle ends above in appendages, each consisting of one or a few cells, some of which are the male organs, others the female organs, and others again may be barren hairs. The male OTgan(anthendium) consists of a few cells, the terminal one of which either abstriots from its end, or emits from its interior the non-motile antherozoids, reminding us of those of the Floridese. The female organ is essentially a flask-shaped structure ; the neck of the fiask growing out as the trichogyne, and the belly composed of an axial carpo- genic cell surrounded by investing cells, and with one cell (tricho- phoric) between it and the trichogyne. These three elements ??? trichogyne, trichophoric cell, and carpogenic cell ??? are regarded as the procarp. The antherozoids have been shown by Thaxter to fuse with the trichogyne, after which the axial cell below (carpo- genic cell) undergoes divisions, and ultimately forms asci contain- ing ascospores, while cells investing this form a perithecinm, the whole structure reminding us essentially of the fructification of a Pyrenomycete. Many modifications in details occur, and the plants may be dioecious. No injury is done to the infested insects, and the importance of the type turns

on the resemblances between the mode of fertilization referred to and that of the Red Seaweeds.

Basidiomycetes. ??? The principal advances in this group concern the discovery of accessory organs of reproduction ??? conidia and chlamydospores ??? and the important work on the Protobasidio-mycetes, both initiated by Brefeld and his co-workers.

Uredinece, of which nearly 2000 species are described, are inter- cellular parasites on higher plants, and so generally of some shade of orange-yellow or rusty-red, owing to oily cell-contents of such colours, that they are termed Rust Fungi, a designation the more apt since the myriads of spores dust off like iron-rust. Of the five different kinds of spores ??? Uredospores, Teleutospores, Sporidia, ./Ecidiospores, and Spermatia ??? ^the Teleutospore is the most con- stant, and the divisions into genera are based chiefly on its char- acters. It may consist of one, two, three, or more cells variously gi'oup'ed, may germinate forthwith or only after a resting period, have specific markings on the walls, and so forth. The subdivisions of the larger genera depend on the co-existence of the Uredo- or ^cidium-form, or both, with the Teleutospores, and on their behaviour. The Teleutospores put forth on germination a pro- mycelium, which is transversely septate and bears lateral conidia (sporidia), and so obviously resemble JJstilago in these respects that Brefeld names them accordingly ??? a, chlamydospore putting forth a basidium which bears basidiospores. The close resemblances to the corresponding organs in Auriculariese have long been noticed, whence some authors regard Uredineae as true protobasidiomycetes; their parasitism and other peculiarities of habit, and the frequent co-existence of other specialized chlamydospores (Uredo, jEcidium) and conidia (Spermatia) sufficiently distinguish them. The re- markable phenomenon of Hetercecism ??? i. e., the development of one or more forms (Uredo- and Teleuto-spores) on one host, and others (.Scidium and Spermatia) on another host distantly related ??? is now known in about fifty species of several genera, of which the following are examples : ???

Species.

Teleutospores on

.(Ecidiuni on

Ooleosporium Senecionis

Pinus

Senecio

Melampsora Betulina

Betula

Larix

Calyptospora Gc^>pertiana

Vaccinium

Abies

Gymnosporium Sahinae

Juniperus

Pyrus

Uromyces Pisi

Pisum, &c.

Euphorbia

Puccinia graminis

Triticum, &c.

Berberis

P. rubigo-vera

Triticum, &o.

Anchusa

P. coronata

Avena

Rhamnus

P. Phalaridis

DigrapMs

Arum

P. Caricis

Oarex

Urtica

Cronartium rihicolum

Bibs

‘ Pinus

Chrysomyxa Bhododendri

Bhododendron

Picea

In some of these the Teleutospores are accompanied or preceded by Uredospores, in others not, and similarly the ^cidia may or may not have accompanying spermogonia. Further, some species may attack several or

even many different genera and species of the same natural order ??? e.g. , Uromyces Pisi on various Vicieae, Puccinia graminis on several Graminese ??? while others seem rigidly confined to one host. But the most remarkable phenomenon is the special- ized parasitism of particular races or varieties of some species of Puccinia, &c., a complex subject which may be illustrated as follows: ??? Under the designation Wheat Rust it was formerly assumed that one species of Puccinia (P. graminis') was indicated. We now know that two or three species, differing in the morpho- logical characters and life-history, were comprised under that name, one only of which is the species P. graminis. The extensive researches of Eriksson have shown, however, that this species occurs on about a hundred different grasses, but, although no visible differences can be detected between these, if we try to infect oat or wheat with the spores from the fungus on barley the results are negative, though they succeed on rye ; similarly

the one on wheat will not infect oat, rye, or barley, and that on oat refuses to infect wheat, rye, or barley, and so on with others. Yet all these forms (races, varieties) are the same species, and their Teleutospores infect the barberry and produce on it the jEcidium-form. The explanation offered is that these are so many specialized or adapted races, so attuned to the particular conditions of life offered by the tissues of a given host-species, or group of such, that the spores evolved in this environment cannot adapt themselves to the conditions presented by another set of host-species.

The Protobasidiomycetes comprise. In addition to the XJredinese, about 150 species, of which Tremella and Auricularia are the principal types, and the union of the groups into one sub-class is based on the long recognized resemblances between the promycelium of Uredineae and the protobasidium of Auricularieee. The very remarkable genus Pilacre also

comes here, and is regarded by Brefeld as the prototype of the angiocarpous Gastromycetes.

The Autobasidiomycetes comprise the Hymenomycetes and Gas- tromycetes of older systematists, and with approximately the same delimitations except that the smaller subdivisions of the Gastro- mycetes are more sharply marked and raised to higher positions by Fischer, the authority on this group.

In the Mymenomycetes, of which 10,000 to 11,000 species are known, several forms have now been cultivated from spore to spore in pure cultures, and no trace of sexual organs has been dis- covered ; the cystidia have quite other functions, as Brefeld showed in Goprinus. In many genera the young mycelia form oidia, and in some {Nyctalis, Fistulina, Polyporus) well developed chlamydo- spores and conidia are found, and even oonldiophores of special forms ___ e.g., Botrytis-Wks ___ occur. Sclerotia are also common, in some oases of large size, and the histological differentiation of tissues is often remarkable. Many Agarics and Polyporei are serious timber-destroying Fungi, even parasitic, or attacking the roots and stems of conifers, &c. ___ e.g., Armillaria mellea, Polyporus annosus, &c. ___ as Hartig first showed. Merulius is the fungus of the "dry-rot" proper, but several others attack and destroy standing and fallen timber, as well as works of construction. For the interesting and important modes of action of these wood- destroying Fungi, the reader must consult the special works.

Physiology. ___ Tiie physiology of the Fungi comes under the head of that of plants generally, and the works of Pfeffer, Sachs, Vines, Darwin, andKlebs may be consulted for details. Space is here permitted only for general re- ference to certain phenomena peculiar to these plants, the life-actions of which are restricted and specialized by their peculiar dependence on organic supplies of carbon and nitrogen, so that most Fungi resemble the colourless cells of higher plants in their nutrition. Like these they re- quire water, small but indispensable quantities of salts of potassium, magnesium, sulphur, and phosphorus, and supplies of carbonaceous and nitrogenous materials in dif- ferent stages of complexity in the different cases. Like these, also, they respire oxygen,

and are independent of light ; and their various powers of growth, secretion, and general metabolism, irritability, and response to external factors show similar specific variations in both cases. It is quite a mistake to suppose that, apart from the chlorophyll function, the physiology of the fungus-cell is fundamentally different from that of ordinary plant-cells. Nevertheless, certain biological phenomena in Fungi are especially pronounced, and of these the following require particular notice.

Sexuality. ??? Until a short time ago all botanists were in agreement that while the Phycomycetes exhibited an undoubted sexual process ??? conjugation of similar organs resulting in the zygospore of Mucorini, &c., and the fertilization of the oosphere in its oogonium by the con- tents of a much smaller pollinodium in the Oosporese ??? the higher Fungi showed no traces of such except in the small group of Erysipheae, where De Bary had shown the existence of an act of fertilization in Sphairotheca and its allies and in certain other Ascomycetes and Lichens : in these latter Stahl and others had described processes which were accepted with more or less reserve as sexual, but in which the organs concerned differed essentially from those in the Erysipheae. In spite of numerous investiga- tions, resulting in several suggestions not borne out by

facts, no trace of sexual organs or of a sexual process could be discovered in the great group of the Basidiomy- cetes, nor in the Uredineae, Ustilagineae, and the vast mass of higher Ascomycetes, and since closer observation showed that even in the Oosporeae, where both the mor- phological structures and physiological processes inter- preted as sexual appear in their most convincing manner, a gradual reduction or abortion of the sexual process and organs can be traced, the conclusion was gained that as we ascend the scale of the Fungi the sexual process is gradually lost, and that these organisms have come to replace it by other physiological processes, possibly nutri- tive, and connected with the large accessions of energy obtained in their highly elaborated food-materials. This conclusion was carried to extremes by Brefeld and the morphological school of which he was the head; they denied the accuracy of the observations which ascribed sexual organs to the Ascomycetes, and pointed out that whereas De Bary had never been able to see a

transmission of the contents of the so-called male organ of SphcBroiheca, &c., to the contents of the so-called female organ, the structures interpreted as sexual were capable of another interpretation ??? viz., as being merely barren branches commencing to envelop the young ascogonium. Mean- while, a criterion of the sexual process had been discovered, principally owing to Strasburger's work. It was found that the essential event is the fusion of two nuclei, and that however closely the fusion of two cells or two masses of protoplasm m.ay simulate a sexual union, it is not such unless this essential event is consummated. As this wasj of course, not shown to occur, the doubts gained ground as failure after failure to find sexuality was reported. With improvements in method, renewed attempts to penetrate the details led to the proof that the sexual process in the typical Oomycetes ??? Peronospora, Cystop)us, &c. ??? is complete in cases where it was claimed to be so by De Bary and his school, as well as in some other members of the Phycomycetes and allies ??? PolypTmgus, Basidioholus ??? and Wager especially has convinced us that the conclusions drawn by De Bary from less complete data were essentially sound. In 1883 Eidam described a simple fusion of the ends of two hyphse as resulting directly in the formation of the ascus in Eremascus, and in 1892 Lagerheim brought forward an equally simple case in Dipodascus; and, quite recently, Barker has shown that even so simple an Ascomycete as a yeast may conjugate previous to the development of spores. These examples lend support to the contention that a sexual process occurs in Penicillium, Eurotium. and Erysi- pJiem. In 1896 the accuracy of De Bary's work on Sphcerotheca was confirmed by Harper's demonstration, that not only does the antheridium fuse with the oogonium, but that two nuclei are found in the latter after the union, and that these two nuclei conjugate to produce an oospore. At this stage Harper's work would appear to support De Bary's conclusions at every point, but he went farther, and showed that when the fertilized oospore of Sphcero- theca develops it puts out an ascogonial filament, des- tined to form the ascus, and that here again two nuclei occur and conjugate in the cell which is to be the future ascus. From the product of their fusion, the nuclei of the ascopores then develop by repeated divi- sions.

Meanwhile Dangeard and his fellow- workers had brought forward a new and startling view of the sexuality of the higher Fungi. These observers

practically confirmed the fusion of nuclei and the truly sexual nature of the pro- cess in Phycomycetes, though the different behaviour of the several, sometimes numerous, nuclei observed in the oosphere and antheridial tube, &c., of these multinucleate plants exhibit many peculiarities, for a description of

which the literature, and especially Wager's works, must be consulted. In the Ascomycetes, however, Dangeard finds that each cell which is to become an ascus contains two nuclei, which fuse and then divide up to form the spores. This is affirmed for Exoascus, Peziza, Aspergillus, SphoBrotheca, and other genera. Moreover, Dangeard and his followers find the same thing in Ustilagineae ; each young spore has two nuclei which fuse before it becomes a resting spore, whereas no such " sexual process " occurs in the yeast-conidia. In Uredineae also each young Moid- iospore, Uredospore, and Teleutospore is initiated by the fusion of two nuclei. Similarly in the Basidiomycetes, each basidium at first contains two nuclei, and these fuse and their product gives rise by division to the nuclei passed into the basidiospores, and since this was found in many examples from Hymenomycetes and Protobasidio- mycetes, Dangeard concludes it is universal in the group, and that the higher Fungi are not devoid of sexuality but that this process here consists in conjugation of nuclei in the initials of the principal sporogenous cells, asci and basidia respectively. Only by further research can the matter be cleared up. Meanwhile it stands somewhat as follows : In Phycomycetes there is an undoubted sexual process, where well developed sexual organs are recogniz- able and fusion of male and female nuclei occurs. The differences in detail concern the number and behaviour of the extra nuclei concerned, and the morphological dif- ferentiation of the sexual organs. In the group itself the process would seem to disappear, at any rate under certain conditions {e.g., in Saprolegniese), in which, as Klebs has shown, both sexual and asexual reproduction are very sensitive to changes in the environment. In the Uredinese, Ustilagineae, Protobasidiomycetes, Basidiomy- cetes, and the vast majority of

Ascomycetes, no organs capable of interpretation as morphologically differen- tiated sexual organs can be discovered, in spite of nu- merous and repeated attempts to find them; but within the initial cells which will become resting spores (Ustila- gineae), jS;cidiospores,Uredospores, or Teleutospores (Ure- dineae), Asci (Ascomycetes) or Basidia (Basidiomycetes), nuclear fusions occur of such a nature that they remind us forcibly of a sexual process. Within the group As- comycetes at least three types of morphologically differ- entiated sexual organs and sexual processes have been described in addition to the foregoing, viz., direct conju- gation of the tips of similar hyphal branches (Eremascus) leading to the direct formation of an ascus from the product of fusion; the fertilization of an oosphere in its oogonium by the contents of an antheridial branch (Sphoe- rotheca) leading to the development of the product of fusion into an ascogonial apparatus, and the much more complex case of Pyronema confluens, which Harper has recently re-investigated, confirming De Bary's results and extending them in a most remarkable manner, and, finally, the case of Collema, and the LaboulbeniacecB, where an ascogenous apparatus is initiated by the form- ation of a trichogyne borne on a group of cells below (the female sexual organ) and minute spermatia (male organs) abstricted or emitted by certain other branches, the sexual process being consummated by the fusion of the contents of the spermatilim with the trichogyne and their transmission to the cells below. The details of this process have not been traced in the latter Fungi, but Bauer's work on the Collemaceae and Oltmann's on the similar organs in Florideae render it impossible to over-look the possibilities here involved. Whether Dangeard's contention that his nuclear fusions are the true sexual process in all cases, and that Harper, Stahl, Thaxter, and others have fallen into error in interpreting their observations, is to be accepted, or whether these nuclear fusions are only secondary phenomena, as has been con-

tended by those who compare them to the fusion of nuclei in the embryo sac of the Phanerogams, cannot as yet be decided, and the whole problem, together with numerous subsidiary matters of homology consequent on its decision, remains for the present a burning question in Mycology. It is not improbable that these nuclear fusions in sporogenous cells merely indicate that nuclear masses are in all cases mutually attractive in a high

degree during a certain, extremely sensitive, phase of their existence : if this is so, the phenomenon may be one of nutrition ??? or, even, parasitism ??? and our ideas as to the sexual significance of such fusions may have to be modified.

Parasitism. ??? Some Fujigi, though able to live as sapro- phytes, occasionally enter the body of living plants, and are thus termed facultative parasites. The occasion may be a wound (e.g.,Nectria, Dasyscypha, &c.),or the enfeeble- ment of the tissues of the host, or invigoration of the Fungus, the mycelium of which then becomes strong enough to overcome the host's resistance (Botrytis). Many Fungi, however, cannot complete their life-history apart from the host-plant. Such obligate parasites may be Epiphytic (ErysiphecB), the mycelium remaining on the outside and at most merely sending haustoria into the epidermal cells, or Endophytic (Uredineoe, Ustilagineoe, &c.), when the mycelium is entirely inside the organs of the host. An epiphytic Fungus is not necessarily a parasite however, as many saprophytes {Moulds, &c.) germinate and develop a loose mycelium on living leaves, but only enter and destroy the tissues after the leaf has fallen ; in some cases, however, these saprophytic epi- phytes can do harm by intercepting light and air from the leaf {Fumago, &c.), and such cases make it difficult to draw the line between saprophytism and parasitism. Endophytic parasites may be intracellular, when the Fun- gus or its mycelium plunges into the cells and destroys their contents directly (OZpidmm, Lagenidium, Sderotinia, &c.), but they are far more frequently intercellular, at any rate while young, the mycelium growing in the lacunae between the cells {Peronospora, Uredineoe) into which it may send short {Cystopus), or long and branched {Peronospora Calotheca) haustoria, or it extends in the middle lamella {Ustilago), or even in the solid substance of the cell-wall {Botrytis). No sharp lines can be drawn however, siace ~~many mycelia are intercellular at first and subsequently become intracellular {Ustilagineoe), and the various stages doubtless depend on the degrees of resistance which the host tissues are able to offer. Similar gradations are observed in the direct effect of the parasite on the host, which may be local {IIe~~ mileia) when the mycelium never extends far from the point of infection, or general {Phytophthora) when it runs throughout the plant. Destructive parasites rap- idly ruin the whole plant-body {Pythium),

whereas re- strained parasites only tax the host slightly, and ill effects may not be visible for a long time, or only when the Fungus is epidemic {Bhytisma). A parasite may be restricted during a long incubation-period however, and rampant and destructive later {Ustilago). The lat- ter fact, as well as the extraordinary fastidiousness, so to speak, of parasites in their choice of hosts or of organs for attack, point to reactions on the part of the host plant, as well as capacities on that of the parasite, which may be partly explained in the light of what we now know regarding enzymes and chemotrop- ism. Some parasites attack many hosts and almost any tissue or organ {Botrytis cinerea), others are restricted to one family {Cystopus candidus) or genus {Phytophthora infestans) or even species {Melampsora Padi), and it is customary to speak of root-parasites, leaf-parasites, &c., in expression of the fact that a given parasite occurs only

on such organs ??? e.g., Dematophora necatrix on roots, Calyptospora Goeppertiana on stems, Ustilago Scabiosce in anthers, Claviceps purpurea in ovaries, &c. Associated with these relations are the specializations which parasites show in regard to the age of the host. Many parasites can enter a seedling, but are unable to attack the same host when older ??? e.g., Pythium, Ustilago, PhytopJithora omnivora.

Chemotropism. ??? Taken in conjunction with Pfeffer's beautiful discovery that certain chemicals exert a dis- tinct attractive influence on Fungus hyphse {chemotropism), and the results of Miyoshi's experimental application of it, the phenomena of enzyme-secretion throw con- siderable light on the processes of infection and parasit- ism of Fungi. Pfeffer showed that certain substances in definite concentrations cause the tips of hyphae to turn towards them; other substances, though not ia- nutritious, repel them, as also do nutritious bodies if too highly concentrated. Marshall Ward showed that the hyphse of Botrytis pierce the cell-walls of a lily by secret- ing a cytase and dissolving a hole through the membrane. Miyoshi then demonstrated that if Botrytis is sown in a lamella of gelatine, and this lamella is superposed on another

similar one to which a chemotropic substance is added, the tips of the hyphae at once turn from the former and enter the latter. If a thin cellulose mem- brane is interposed between the lamellae, the hyphae nevertheless turn chemotropically from the one lamella to the other and pierce the cellulose membrane in the process. The hyphae will also dissolve their way through a lamella of collodion, parafBn, parchment paper, elder- pith, or even cork or the wing of a fly, to do which it must excrete very different enzymes. If the membrane is of some impermeable substance, like gold-leaf, the hyphse cannot dissolve its way through, but the tip finds the most minute pore and traverses the barrier by means of it, as it does a stoma on a leaf. We may hence con- clude that a parasitic hypha pierces some plants or their stomata and refuses to enter others, because in the former case there are chemotropically attractive sub- stances present which are absent from the latter, or are there replaced by repellent substances.

Symbiosis. ??? The remarkable case of life in common first observed in Lichens, where a Fungus and an Alga unite to form a compound organism ??? the Lichen ??? totally different from either, has now been proved to be universal in these plants, and Lichens are in all cases merely Algae enmeshed in the interwoven hyphae of Fungi. Further- more, the species of Algae have been determined, and Lichens artificially synthesized by sowing the Alga and the Fungus together and watching the latter enslave the former. The Fungus concerned is usually an Ascomycete (Ascolichenes), but several Basidiolichenes are now known in which it is a Basidiomycete. This dualism, where the one constituent (Alga) furnishes carbohydrates, and the other (Fungus) ensures a supply of mineral matters, shade, and moisture, has been termed Symbiosis. Since then numerous other cases of Symbiosis have been demon- strated. Many trees are found to have their smaller roots invaded by Fungi and deformed by their action, but so far from these being injurious, experiments go to show that this Mycorhiza (fungus-root) is necessary for the well- being of the tree. This is also the case with numerous other plants of moors and woodlands ??? e.g., Ericaceae, Pyrolaceae, Gentianaceae, Orchidaceee, Ferns, &c. Eecent experiments have shown that the difficulties of getting Orchid seeds to germinate are due to the absence of the necessary Fungus, which must be in readiness

to infect the young seedling immediately it emerges from the seed. The well-known failures with rhododendrons, heaths, &c., in ordinary garden soils are also explained by the need of

the fungus-infected peat for their roots. The role of the Fungus appears to be to supply materials from the leaf- mould around, in forms which ordinary root-hairs are in- capable of providing for the plant ; in return the latter supports the Fungus at slight expense from its abundant stores of reserve materials. Numerous other cases of Symbiosis have been discovered among the Fungi of fer- mentation, of which those between Aspergillus and yeast in sake manufacture, and between yeasts and bacteria in kephir and in the ginger-beer plant are best worked out. For cases of Symbiosis see article Bactebiologt.

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(h. m. w.)

Furnes, a town of Belgium, in the province of "West Flanders, 27 miles south-west of Bruges, near the French frontier, the central point of a system of canals to Nieuport, Dunkirk, Bergues, and Ypres, with a station on the line from Dixmude to Dunkirk. It has tan- yards and a factory for linen goods. Population (1897),

5636.

Furness, Horace Howard (1833 ???), Amer- ican Shakespearean scholar, was born in Philadelphia, 2nd November 1833, being the son of William Henry Furness, minister of the First Unitarian Church in that

city, a powerful preacher and writer. He graduated at Harvard in 1854, and was admitted to the bar in 1859, but soon devoted himself to the study of Shakespeare. He accumulated a collection of illustrative material of great richness and extent, and brought out in 1871 the first volume of a new Variorum edition, designed to represent and summarize the conclusions of the best authorities in all languages ??? textual, critical, and annotative. Twelve volumes had appeared by the year 1900, as follows: Borneo and Juliet, 1871; Macbeth, 1873 ; Hamlet, 2 vols., 1877 ; King Lear, 1880 ; Othello, 1886; The Merchant of Venice, 1888; As You Like It, 1890; The Tempest, 1892; A Midsummer Night's Dream, 1895; T/ie Winter's Tale, 1898; Much Ado about JSfothing, 1899. The edition has been generally accepted as a thorough and scholarly piece of work; its chief fault is that, beginning with Othello (1886), the editor used the First Folio text as his basis, while in others he makes the text of the Cambridge (Globe) editors his foundation.

Furniture. ??? ^A decided effort to inaugurate a re- cognized style in furniture has been made during the last few years, and with the advent of the Paris Exhibi- tion of the year 1900 this effort was called the " New Style," a name first given in France, several years ago, to the work of a number of Paris furniture makers who migrated to Nancy, and who profess to be free from all old traditions, and only to seek inspiration from Nature. How far Nature is likely to inspire an art so essentially utilitarian as cabinet-making is not at once apparent. It is generally admitted that the pioneers of the new style of original thought, as devoted to useful art, were William Morris and his friends about 1860. (See MoEEis, William, and Akts and Cbafts.) That some of the works of Morris and his school were too quaint to become types of the furniture of the future is true enough. But some of the pieces were admirable both for design and execution, and worthy to inspire, as they have inspired, subsequent designers in furniture both in England and on the Continent. The Arts and Crafts Society, founded in 1880 by Walter Crane and others, has carried on the work of producing and ex- hibiting all kinds of "Art allied to Industry," and has fostered originality of design in furniture, and exercised great influence on artists and artist workmen throughout Europe, where many similar associations have been founded. In the Arts and Crafts Exhibition of 1899 were some chairs designed by C. E. Voysey,

which may be noted as having frames of thick square uprights, tapering at the back to high points. By the same artist was a wooden mantel-piece, also of heavy workmanship. The mantel-shelf, instead of the architectonic cornice with its

various members, was of one piece, with slight carving on its ogee surface, upheld by two masses of wood bulging towards their bases. Again, two wooden column sup- ports of a mantel-piece by W. Aumonier were of a novel style; the capitals were groups of leaves and tendrils forming squares, and undercut so that the shaft could be seen through the capital ; a base was formed by carved roots round the bole. ??? The Guild of Handicraft have also carried out some furniture designs of merit by C. R. Ash- bee, notably some writ- ing cabinets. The ar- rangement of them is that of the old-fashioned bureau, the workman- ship is very good, and a pretty and useful feature consists in the place contrived in the upper part of the cabinet for an electric lamp.

Much novel and in- teresting furniture was shown in the Paris Ex- hibition of 1900. These great World's Fairs, or Universal Exhibitions, began in 1851, and have borne good fruit, not only in encouraging com- petition to show the

Carved Wood Columns, by W. Aumonier.

best work in all industries, but also in stimulating the establishment of state museums, where the best models of art designs, both ancient and modern, are permanently on view. The South Kensington Museum in London followed the Exhibition of 1851; the Austrian Museum for Art, &c., was founded after the exhibition of 1863; and in other countries the same useful results followed. The Paris Exhibi- tion was the most extensive of all, and the furniture there, both English and foreign, could be studied as the outcome of all that was newest in de- sign, material, and execution in the world of art and industry. The display of Eng- lish furniture in Paris was in it- self sufficient to prove that the English cabinet- makers are most to be praised for what may be called the general excellence and

suitability of their furniture. No doubt the remarkable exhibition of furniture of the Chippendale and Sheraton period at Bethnal Green in 1896 partly accounts for the continued influence of their patterns and traditions on English furniture.

British manufacturers do not err by losing sight of constructive utility in order to experiment with fanciful

Writing-Desk, by Henry, London.

decoration, and their work is, for the most part, solid and good. The four or iive principal English firms who have shown examples of modern interiors have worthily carried out the traditions of former times : no attempt at mere quaintness spoils the furniture, and the novelties shown of material and workmanship do not detract from the feeling of repose and comfort, which must be considered an essential. The error most common in reproducing set

Chairs, by G. Hulbe.

pieces, such as sideboards, cabinets, &c., from old types, is the disposition to " improve," i.e., add to the carving or other decoration ; as a rule, this has a questionable effect.

The French makers of the new style of furniture seem in some instances to have a positive distaste for straight lines. They delight in strange curves, usually sweeping curves with sudden twists. Wardrobes and china closets

Piano, by Baldwin Piano Co., Cincinnati, U.S.A.

are pyramidal, chairs and seats have raking legs, table-legs are fortified with bronze, &c. One cabinet is made to represent a leaf-clad arbour, with tree-trunks, branches, and boughs entwined to the life. A pianoforte in

the American section of the Exhibition was no less extreme an instance of the new taste, a tree trunk being carved along the front of its bed. Such an instrument as a pianoforte is entirely artificial; the very wood of it is taken from the choicest part of the tree, dried and pre-

pared with the utmost care. How is this symbolized by a stem to imitate nature, however well sculptured ? It is obvious that an interior furnished in this manner must be lacking every desirable qualification for home life. A piece of furniture is not a painting; it has a use, and the use must be kept in sight throughout. The naturalism of the Nancy workers extends to the working of the metal ; the ormoulu lines of flower and leaf-work are fastened along the edge of cabinets and wardrobes, and then carried up to the tops, where they bend over and form a sort of buttress to support a shelf. In chair frames the craftsmen bind all parts of the seat, as if a kind of strap were necessary round a decaying object. As lightness is a merit in chairs, brass bars and straps ought not to be necessary to their security. The marquetry work of this modern school is also purely realistic, and the attempt is made, notably by Galle of Nancy, by various coloured woods to represent

Desk, by Majorelles, Nancy.

nature in colours, a questionable use of that form of decoration when applied to furniture intended for use. A typical work by Majorelles of Nancy, a desk, is much better; the lines give an impression of strength and solidity, and the metal work, handles, &c., although re- presenting water-lilies and their leaves in successful imita- tion, are arranged with some reference to the uses of the object they decorate. A peculiarity of some of the tables of the New Style is the assumed insufiiciency of four or any number short of eight legs. The top boards spread over at the corners, and wherever that occurs an extra leg, sometimes curved, springs from the foot of the corner leg and stretches over to support this extension.

In many of the pieces of furniture, in the Arts and Crafts and other Exhibitions in England and abroad, there has been an effort to make furniture of old types as unlike old furniture as possible, either by a simplicity, sometimes amounting to rudeness of construction, or by exaggeration of some feature of the design. (j. h. p.)

Furnivail, Frederick James (1826), Eng- lish philologist and editor, was born at Egham, 4tli February 1825, being the son of a surgeon. He was called to the bar in 1819, but his attention was soon diverted to philological studies and social problems. He gave Frederick Denisou Maurice valuable assistance in founding the Workingmen's College, and for half a cen- tury indefatigably promoted the study of early English literature, partly by his own work as editor, and still more efficaciously by the agency of the numerous learned societies of which he was both founder and director, especially the Early English Text Society (1864), which has been of inestimable service in promoting the study of early English. He also established and conducted the Chaucer,

Ballad, New Shakspere, and Wyclif Societies ; and at a later period societies for the special study of Browning and Shelley. As an editor he published the Percy Ballads and many other ancient English books ; but his most im- portant laboursvhave been devoted to Chaucer, whose study he has greatly assisted by his " Six-Text " edition of the Canterbury Tales. He laboured much for the Philological Society, and was one of the original promot- ers of its great English Dictionary. The completion of his half century of labour was acknowledged in 1900 by a handsome testimonial, including the preparation of a volume of philological essays by various writers specially dedicated to him. Dr Furnivall has views of his own on phonetic spelling, which have not obtained general ac- ceptance.

Fiirth, a town of Bavaria, Germany, district Middle Franoonia, 6 miles by rail north-west of Nuremberg. It is the seat of several large industries, such as brewing, the production of chromo-lithographs and picture-books, the manufacture of mirror and mirror-frames, bronze and gold-leaf wares, pencils, toys, haberdashery, optical instru- ments, silver-work, turnery, chicory, machinery, fancy boxes and cases, &c., and an extensive trade is carried ou in these goods, and in hops, metals, wool, groceries, coals, &c. Population (1885), 35,455 ; (1900), 53,874.

Fusilier. ◆◆◆ A fusilier was a soldier armed with a fusil. In the early years of the 16th century there ap- peared a small-arm with a lock in which the spark to ignite the charge was obtained by the percussion of a flint and steel. A specimen exists as old as 1500-20. It was called a snaphance (Dutch, s7iap-7jaari=snap-cock),aterm applied indifEerently to the lock and the weapon. The snaphance must have been well known in England in 1594, for it is mentioned in Lilly's Mother Bombie, Act ii. scene 1. After a chequered existence of nearly a century and a half, an improved model of the snaphance (which would now be called " snaphance, Mark II.") was produced about 1670, and drove the old fire-lock and wheel-lock completely out of the field. This arm the French called fusil, and the English afterwards christened it Brown Bess. The French raised a regiment of fusiliers in 1671, and in 1685 England raised the (7th) Eoyal Fusiliers.

Fusion. ◆◆◆ The term Fusion is generally applied to the melting of a solid substance, or the change of state of aggregation from the solid to the liquid. The term " liquefaction " is frequently employed in the same sense, but is often restricted to the condensation of a gas or vapour. The converse process of Freezing or Solidification, the change from the liquid to the solid state, is subject to the same laws, and must be considered together with fusion. The Solution of a solid in a foreign liquid, and the deposition of Crystallization of a solid from a solution, are so closely related to the fusion of a pure substance, that it will also be necessary to consider some of the analogies which they present.

1. General Phenomena. ◆◆◆ There are two chief varieties of the process of fusion, namely. Crystalline and Amor- phous, which are in many ways distinct, although it is possible to find intermediate cases which partake of the characteristics of both. The melting of ice may be taken as a typical case of crystalline fusion. The passage from rigid solid to mobile liquid occurs at a definite surface without any intermediate stage or plastic condition. The change takes place at a definite temperature, the Fusing or Freezing Point (abbreviated F.P.), and requires the addition of a definite quantity of heat to the solid, which is called the Latent Heat of Fusion. There is also in general an abrupt

change of volume at the moment of fusion, which amounts in the case of ice to a contraction

of 9 per cent. Typical cases of amorphous solidification are those of silica, glass, plastic sulphur, pitch, alcohol, and many organic liquids. In this type the liquid gradu- ally becomes more and more viscous as the temperature falls, and ultimately attains the rigidity characteristic of a solid, without any definite freezing-point or latent heat. The condition of the substance remains uniform through- out, if its temperature is uniform ; there is no separation into the two distinct phases of solid and liquid, and there is no sudden change of volume at any temperature.

In the case of crystalline fusion it is necessary to dis- tinguish two cases, the Homogeneous and the Hetero- geneous. In the first case, the composition of the solid and liquid phases are the same, and the temperature re- mains constant during the whole process of fusion. In the second case, the solid and liquid phases differ in com- position ; that of the liquid phase changes continuously, and the temperature does not remain constant during the fusion. The first case comprises the fusion of pure sub- stances, and that of eutectics, or cryohydrates ; the second is the general case of an alloy or a solution. These have been very fully studied and their phenomena greatly elucidated in recent years.

There is also a sub-variety of amorphous fusion, which may be styled Colloid or Gelatinous, and may be illustrated by the behaviour of solutions of water in gelatine. Many of these j ellies melt at a fairly definite temperature on heating, and coagulate or set at a definite temperature on cooling. But in some cases the process is not reversible, and there is generally marked hysteresis, the temperature of setting and other phenomena depending on the rate of cooling. This case has not yet been fully worked out ; but it ap- pears probable that in many cases the jelly possesses a spongy framework of solid, holding liquid in its meshes or interstices. It might be regarded as a case of " hetero- geneous " amorphous fusion, in which the liquid separates into two phases of different composition, one of which solidifies before the other. The two phases cannot, as a rule, be distinguished optically, but it is generally possi- ble to squeeze out some of the liquid phase when the jelly has set,

which proves that the substance is not really homogeneous. In very complicated mixtures, such as acid lavas or slags containing a large proportion of silica, amorphous and crystalline solidification may occur to- gether. In this case the crystals separate first during the process of cooling, the mother liquor increases gradually in viscosity, and finally sets as an amorphous ground- mass or matrix, in which crystals of different kinds and sizes, formed at different stages of the cooling, remain embedded. The formation of crystals in an amorphous solid after it has set is also of frequent occurrence. It is termed Devitrificationj but is a very slow process unless the solid is in a plastic state.

2. Homogeneous Crystalline Fusion.^The fusion of a solid of this type is characterized most clearly by the perfect constancy of temperature during the process. In fact, the law of constant temperature, which is generally stated as the first of the so-called " laws of fusion," does not strictly apply except to this case. The constancy of the F.P. of a pure substance is so characteristic that change of the F.P. is often one of the most convenient tests of the presence of foreign material. In the case of sub- stances like ice, which melt at a low temperature and are easily obtained in large quantities in a state of purity, the point of fusion may be very accurately determined by observing the temperature of an intimate mixture of the solid and liquid while slowly melting as it absorbs heat from surrounding bodies. But in the majority of cases it is more convenient to observe the freezing-point as the liquid is cooled. By this method it is possible to ensure perfect uniformity of temperature throughout the mass by

stirring the liquid continuously during the process of freezing, whereas it is difficult to ensure uniformity of tem- perature in melting a solid however gradually the heat is supplied, unless the solid can be mixed with the liquid. It is also possible to observe the F.P. in other ways, as by noting the temperature at the moment of the breaking of a wire, of the stoppage of a stirrer, or of the maximum rate of change of volume, but these methods are generally less certain in their indications than the point of

greatest constancy of temperature in the case of homogeneous crystalline solids.

3. Superfusion, Supersaturation. ??? It is generally possible to cool a liquid several degrees below its normal freezing-point without a separation of crystals, especially if it is protected from agitation, which would assist the molecules to rearrange themselves. A liquid in this state is said to be " undercooled " or " superfused." The phenomenon is even more familiar in the case of solutions (e.g., sodium sulphate or acetate) which may remain in the " metastable " or " supersaturated " condi- tion for an indefinite time if protected from dust, &c. The introduction into the liquid under these conditions of the smallest fragment of the crystal, with respect to which the solution is supersaturated, will produce immediate crystallization, which will continue until the temperature is raised to the saturation point by the liberation of the latent heat of fusion. The constancy of temperature at the normal freezing-point is due to the equilibrium of exchange existing between the liquid and solid. Unless both solid and liquid are present, there is no condition of equilibrium, and the temperature is indeterminate. The corresponding case of a superheated solid, existing in metastable equilibrium at a temperature above its normal fusing-point might, theoretically occur, but has not as yet been observed.

4. Effect of Pressure on the F.P. ??? ^The effect of pressure on the fusing-point depends on the change of volume during fusion. Sub- stances which expand on freezing, like ice, have their freezing- points lowered by increase of pressure ; substances which expand on fusing, like wax, have their melting-points raised by pressure. In each case the effect of pressure is to retard increase of volume. This effect was first predicted by James Thomson on the analogy of the effect of pressure on the boiling-point, and was numerically verified by Lord Kelvin in the case of ice, and later by Bunsen in the case of paraffin and spermaceti. The equation by which the change of the F.P. is calculated may be proved by a simple appli- cation of the Camot cycle, exactly as in the case of vapour and liquid. (See Thbkmodynamics, ?? 4.) If L be the latent heat of fusion in mechanical units, v' the volume of unit mass of the solid, and b" that of the liquid, the work done in an elementary Carnot cycle of range

*cZ9 willbe dp(i)”***’!)’), if (?p is the increase of pressure required to produce a change d0 in the F.P. Since the ratio of the work-difference or cycle-area to the heat^transferred L must be equal to d9/6, we have the relation*

*de/dp = Biv”-v’)/L .... (1). The sign of d8, the change of the F.P., is the same as that of the change of volume (v”***v’). Since the change of volume seldom exceeds 0-1 c.c. per gramme, the change of the F.P. per atmosphere is so small, that it is not as a rule necessary to take account of variations of atmospheric pressure in observing a freezing-point. A variation of 1 cm. in the height of the barometer would corre- spond to a change of ~~0001**C. only in the F.P. of ice. This is far beyond the limits of accuracy of most observations. Although the effect of pressure is so small, it produces, as is well known, re~~ markable results in the motion of glaciers, the moulding and rege- lation of ice, and many other phenomena. It has also been employed to explain the apparent inversion of the order of ciystalli- zation in rooks like granite, in which the arrangement of the crystals indicates that the quartz matrix solidified subsequently to the crystals of felspar, mica, or hornblende embedded in it, although the quartz has a higher melting- point. It is contended that under enormous pressure the freezing-points of the more fusible constituents might be raised above that of the quartz, if the latter is less affected by pressure. Thus Bunsen found the F.P. of paraffin wax 1-4**C. below that of spermaceti at atmospheric pressure. At 100 atmospheres the two melted at the same temperature. At higher pressures the paraffin would solidify first. The effect of pressure on the silicates, however, is much smaller, and it is not*

so easy to explain a change of several hundred degrees in the F.P. It seems more likely in this particular case that the order of crystallization depends on the action of superheated water or steam at high temperatures and pressures, which is well known to exert a highly solvent and metamorphic action on silicates.

*5. Variation of Latent Seat. *** Person in 1847 endeavoured to show by the application of the first law of thermodynamics that the increase of the latent heat per degree should be equal to the difference*

(□□”□□□□□’) between the specific heats of the liquid and solid. If, for instance, water at 0□□C. were first frozen and then cooled to □□□t□□C, the heat abstracted per gramme would be (i’f s’J) calories. But if the water were first cooled to □□□t□□C., and then frozen at □□□t□□C., by abstracting heat L”, the heat abstracted would be L’i+s”t. Assuming that the heat abstracted should be the same in the two cases, we evidently obtain L’□□□L” = (s”□□□s’)t. This theory has been approximately verified by Petterson, by observing the freezing of a liquid cooled below its normal F.P. (Jour. Chem. Soc. 24, p. 151). But his method does not represent the true variation of the latent heat with temperature, since the freezing, in the case of a super fused liquid, really takes place at the normal freezing-point. A quantity of heat s”J is abstracted in cooling to □□□t, {L’ □□□s”t) in raising to 0□□ and freezing at 0□□, and s’t in cooling the ice to □□□t. The latent heat L” at □□□J does not really enter into the experiment. In order to make the liquid freeze at a different temperature, it is necessary to subject it to pressure, and the effect of the pressure on the latent heat cannot be neglected. The entropy of a liquid 0" at its F.P. reckoned from any convenient zero

4,ii-,j>o=fs’de/e+L/e .... (2).

Since Bd” /dd=s”, we obtain by differentiation the relation

dL/de=s”s’ + L/e .... (3), which is exactly similar to the equation for the specific heat of a vapour maintained in the saturated condition. If we suppose that the specific heats s’ and s” of the solid and liquid at equilibrium pressure are nearly the same as those ordinarily observed at con stant pressure, the relation (3) differs from that of Person only by the addition of the term L/d. Since s” is greater than s’ in aU cases hitherto investigated, and L/d is necessarily positive, it is clear that the latent heat of fusion must increase with rise of temperature, or diminish with fall of temperature. It is possible to imagine the F.P. so lowered by pressure (positive or negative) that the latent heat should vanish, in which case we should prob- ably obtain a continuous passage from the liquid to the solid state similar to that which occurs in the case of amorphous sub- stances. According to equation (3), the rate of change of the latent heat of water is

approximately 0-80 calorie per degree at 0 ◆◆C. (as compared with 0-50, Person), if we assume s”=l, ands’=0‘5. Putting (s”-s’) =0-5 in equation (2), we find i=0 at-160 ◆◆ C. approximately, but no stress can be laid on this estimate, as the variation of (s” ◆◆◆ s’) is so uncertain.

6. Freezing of Solutions and Alloys. ◆◆◆ The phenomena of freezing of heterogeneous crystalline mixtures may be illustrated by the case of aqueous solutions and of metallic solutions or alloys, which have been most widely studied. The usual effect of an impurity, such as salt or sugar in. solution in water, is to lower the freezing-point, so that no crystallization occurs until the temperature has fallen below the normal P.P. of the pure solvent, the depression of F.P. being nearly proportional to the concentration of the solution. When freezing begins, the solvent generally separates out from the solution in the pure state. This separation of the solvent involves an increase in the strength of the remaining solution, so that the tempera- ture does not remain constant during the freezing, but continues to fall as more of the solvent is separated. There is a perfectly definite relation between temperatui’e and concentration at each stage of the process, which may be represented in the form of a curve as AC in Fig. 1, called the Freexwg-Point Ovrve. The equilibrium tem- perature, at the surface of contact between the solid and ◆◆◆ liquid, depends only on the composition of the liquid phase and not at all on the quantity of solid present. The abscissa of the F.P. curve represents the composition of that portion of the original solution which remains liquid at any temperature. If instead of starting with a dilute, solution we start with a ” saturated ” solution of the solid in the solvent at any point D on the diagram, the dissolved substance or “solute ” generally separates out as the solution is cooled, and the concentration diminishes

with fall of temperature in a definite relation, as indicated by the curve CB, which is called the Solubility Curve. Though often called by different names, the two curves AC and GB are essentially of a similar nature. To

take the case of an aqueous solution of salt as an example, along CB the solution is saturated with respect to salt, along AC the solution is saturated with respect to ice. When the point C is reached along either curve, the solution is saturated with respect to both salt and ice.

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iPercentage of Substance B in SotadoTV

Fig. 1. ⬜⬜⬜ F.P. or Solubility Curve : simple case.

The concentration cannot vary further, and the temperar ture remains constant, while the salt and ice crystallize out together, maintaining the exact proportions in which they exist in the solution. The resulting solid was termed a Cryoliydrate by Guthrie, but it is really an intimate mixture of two kinds of crystals, and not a chemical compound or hydrate containing the constituents in chemically equivalent proportions. The lowest tempera- ture attainable by means of a Freezing Mixture is the temperature of the P.P. of the corresponding cryohy- drate. In a mixture of salt and ice with the least trace of water a saturated brine is quickly formed, which dis- solves the ice and falls rapidly in temperature, owing to the absorption of the latent heat of fusion. So long as both ice and salt are present, if the mixture is well stirred, the solution must necessarily become saturated with re- spect to both ice and salt, and this can only occur at the cryohydric temperature, at which the two curves of solu- bility intersect.

The curves in Fig. 1 also illustrate the simplest type of freezing-point curve in the case of alloys of two metals A and B which do not form mixed crystals or chemical compounds. The alloy corresponding to the cryohydrate, possessing the lowest melting-point, is called the Eutectic Alloy, as it is most easily cast and worked. It generally possesses a very fine-grained structure, but is not a chemical compound. (See Allots.)

To obtain a complete P.P. curve even for a binary alloy is a laborious and complicated process, but the informal tion contained in such a curve is often very valuable. It is necessary to operate with a number of different alloys of suitably chosen composition, and to observe the freezing- points of each separately. Each alloy should also be

analysed after the process if there is any risk of its com- position having been altered by oxidation or otherwise. The freezing-points are generally best determined by observing the gradual cooling of a considerable mass, which is well stirred so long as it remains liquid. The curve of cooling may most conveniently be recorded, either photographically, using a thermocouple and galva- nometer, as in the method of Sir W. Roberts-Austen, or with pen and ink, if a platinum thermometer is available, according to the method put in practice by Heycock and Neville. A typical set of curves obtained in this manner are shown in Pig. 2. When the pure metal A in cooling reaches its P.P. the temperature suddenly becomes sta- tionary, and remains accurately constant for a consid- erable period. Often it falls slightly below the F.P.

2 3 ^ ^ <5 Time Scale'. Mmalea.

Fig. 2. ??? Cooling Curves of Alloys : typical case.

owing to superfusion, but rises to the F.P. and remains constant as soon as freezing begins. The second curve shows the cooling of A with 10 per cent, of another metal B added. The freezing begins at a lower tempera- ture with the separation of pure A. The temperature no longer remains constant during freezing, but falls more and more rapidly as the proportion of B in the liquid increases. When the eutectic temperature is reached there is a second F.P. or arrest at which the whole of the remaining liquid solidifies. With 20 per cent, of B the first F.P. is further

lowered, and the temperature falls faster. The eutectic P.P. is of longer duration, but still at the same temperature. For an alloy of the composition of the eutectic itself there is no arrest until the eutectic temperature is reached, at which the whole solidifies without change of temperature. There is a great advan- tage in recording these curves automatically, as the pri- mary arrest is often very slight, and difficult to observe in any other way.

7. Change of Solubility with Temperature. ??? *The lowering of the F.P. of a solution with increase of concentration, as shown by the*

p.p. or solubility curves, may be explained and calculated by equation (1) in terms of the ^' osmotic pressiire" of the dissolved substance by analogy with the effect of mechanical pressure. It is possible in salt solutions to strain out the salt mechanically by a suitable filter or " semi-permeable membrane," which permits the water to pass, but retains the salt. To separate one gramme of salt requires the performance of work PV against the osmotic pressure P, where Fis the corresponding diminution in the volume of the solution. In dilute solutions, to which alone the calculation can be satisfactorily applied, the volume Fis the reciprocal of the concentration C of the solution in grammes per unit volume, and the osmotic pressure P is equal to that of an equal number of molecules of gas in the same space, and may be deduced from the usual equation of a gas,

F=Be/VM=IieC/M . . . (4),

where M is the molecular weight of the salt in solution, e the absolute temperature, and B a constant which has the value 8-32 joules, or nearly two calories, per degree C. It is necessary to con- sider two cases, corresponding to the curves CB and AB in Fig. 1, in which the solution is saturated with respect to salt and water respectively. To facilitate

description we take the case of a salt dissolved in water, but similar results apply to solutions in other liquids, and alloys of metals.

(a) If unit mass of salt is separated in the solid state from a saturated solution of salt (curve CB) by forcing out through a semi- permeable membrane against the osmotic pressure P the corre- sponding volume of water F in which it is dissolved, the heat evolved is the latent heat of saturated solution of the salt Q together with the work done PV. Writing (Q+PV) for L, and Ffor (y”-v’) in equation (1), and substituting P for p, we obtain

Q+PV=redP/de .... (5),

which is equivalent to equation (1), and may be established by similar reasoning. Substituting for P and F in terms of C from equation (4), if Q is measured in calories, iJ=2, and we obtain

QC=2e^dC/de .... (6), which may be integrated, assuming Q constant, with the result

2log,C”/C’=Q/e’-Q/6" . . (7),

where C”, C” are the concentrations of the saturated solution cor- responding to the temperatures d’ and 6”. This equation may be employed to calculate the latent heat of solution Q from two obser- vations of the solubility. It follows from these equations that Q is of the same sign as dC/dff, that is to say, the solubility increases with rise of temperature if heat is absorbed in the formation of the saturated solution, which is the usual case. If, on the other hand, heat is liberated on solution, as in the case of caustic potash or sul- phate of calcium, the solubility diminishes with rise of temperature. (6) In the case of a solution saturated with respect to ice (curve AB), if one gramme of water having a volume u is separated by freezing, we obtain a precisely similar equation to (5) , but with L the latent heat of fusion of water instead of Q, and v instead of F. If the solution is dilute, we may neglect the external work Pv in comparison with i, and also the heat of dilution, and may write P/t for dP/dS, where t is the depression of the P.P. below that of the pure solvent. Substituting for P in terms of F from equation (4), we obtain

t=2eh}/LrM=2e^w/LWM . . . (8), where W is the weight of water and w that of salt in a given volume of solution. If M grammes of salt are dissolved in 100 of water, w=M, and TF=100. The depression of the P.P. in this case is called by van't Hoff the " Molecular Depression of the P.P." and is given by the simple formula

t=-02e^/L . . . . (9).

Equation (8) may be used to calculate L or M, if either is known, from observations of t, $, and w/ W. The results obtained are sufficiently approximate to be of use in many cases in spite of the rather liberal assumptions and approximations effected in the course of the reasoning. In any case the equations give a simple theoretical basis with which to compare experimental data in order to estimate the order of error involved in the assumptions. We may thus estimate the variation of the osmotic pressure from the value given by the gaseous equation, as the concentration of the solution or the molecular dissociation changes. The most uncertain factor in the formula is the molecular weight M, since the molecule in solution may be quite different from that denoted by the chemi- cal formula of the solid. In many oases the molecule of a metal in dilute solution in another metal is either monatomic, or forms a compound molecule with the solvent containing one atom of the dissolved metal, in which case the molecular depression is given by putting the atomic weight for M. In other cases, as Cu, Hg, Zn, in solution in cadmium, the depression of the P. P. per atom, according to Heycock and Neville, is only half as great, which would imply a diatomic molecule. Similarly As and Au in Cd appear to be triatomic, and Sn in Pb tetratomio. Intermediate cases may occur

in which different molecules exist together in equilibrium in pro- portions which vary according to the temperature and concentration. The most familiar case is that of an electrolyte, in which the mole- cule of the dissolved substance is partly dissociated into ions. In such cases the degree of dissociation may be estimated by observing the depression of the P.P., but the results obtained cannot always be reconciled with those deduced by other methods, such as measurement of electrical

conductivity, and there are many diffi- culties which await satisfactory interpretation.

Exactly similar relations to (8) and (9) apply to changes of boiling-point or vapour pressure produced by substances in solution (see Vapokization) , the laws of which are very closely connected with the corresponding phenomena of fusion ; but the considera^ tion of the vapour phase may generally be omitted in dealing with the fusion of mixtures where the vapour pressure of either con- stituent is small.

8. Hydrates. ??? The simple case of a freezing-point curve, illustrated in Fig. 1, is generally modified by the occur- rence of compounds of a character analogous to hydrates of soluble salts, in which the dissolved substance combines with one or more molecules of the solvent. These hydrates may exist as compound molecules in the solu- tion, but their composition cannot be demonstrated unless they can be separated in the solid state. Corresponding to each crystalline hydrate there is generally a separate branch of the solubility curve along which the crystals of the hydrate are in equilibrium with the saturated solution. At any given temperature the hydrate possessing the least solubility is the most stable. If two are present in contact with the same solution, the more soluble will dissolve, and the less soluble will be formed at its expense until the conversion is complete. The two hydrates cannot be in equilibrium with the same solution except at the temperature at which their solubilities are equal, i.e., at the point where the corresponding curves of solubility

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Pig. 3. ___ Solubility Curves of Hydrates.

intersect. This temperature is called the __ Transition Point.” In the case of ZnS04, as shown in Fig. 3, the heptahydrate, vrith seven molecules of water, is the least soluble hydrate at ordinary temperatures, and is generally deposited from saturated solutions. Above 39 __ C, how- ever, the hexahydrate, with six molecules, is less soluble, and a rapid conversion of the hepta- into the hexa- hydrate occurs if the former is heated above the tran- sition point. The solubility of the hexahydrate is greater than that of the heptahydrate below 39 __, but increases more slowly with rise of temperature. At about 80 __ C. the hexahydrate gives place to the monohydrate, which dissolves in water with evolution of heat, and diminishes in solubility with rise of temperature. If intermediate hydrates exist, as is possible, they are more soluble, and cannot be isolated. Both the mono- and hexahydrates are capable of existing in supersaturated equilibrium at ordinary temperatures far below their transition points, provided that the less soluble hydrate is not present in the crystalline form. The solubility

curves can therefore be traced, as in Fig. 3, over an ex- tended range of temperature. The equilibrium of each hydrate with the solvent, considered separately, would present a diagram of two branches similar to Pig. 1, but as a rule only a small portion of each curve can be realized, and the complete solubility curve, as experimentally determined, is composed of a number of separate pieces corresponding to the ranges of minimum solubility of different hydrates. Failure to recognize this, coupled with the fact that in strong and viscous solutions the state of equilibrium is but slowly attained, is the probable explanation of the remarkable discrepancies existing in many recorded data of solubility.

9. Metallic Compounds. ◆◆◆ The F.P. curves of metallic solutions or alloys, which are often very complicated, are most easily understood by the analogy which the crystal- line compounds formed in the process of solidification bear to the familiar aqueous hydrates. For instance, the F.P. curve of solutions of sodium in mercury (Fig. 4) presents seven or more branches, each of which probably corresponds to the separation of a compound of the nature of a hydrate, except the terminal branches AB, HHg, which correspond to the separation of pure Na and pure Hg respectively. The summit F corresponds to the

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Fig. 4. ??? rreezing-point Curve of Alloys of Na and Hg.

compound NaHg^, the F.P. of which, at 360 ◆◆ C, is much higher than that of either constituent.

In cases like this, where a well-marked compound is formed, the portion of the curve between the summit corresponding to the compound and the melting-point of the pure metal, as between the points F and Hg in the F.P. curve of N'aHg, often bears a close resemblance to the simple case represented in Fig. 1. But there is a characteristic difference to be noted. On the analogy of the ideal ease we should expect to find the two branches on either side of a summit like F meeting at a well-defined angle, as indicated by the dotted lines, and not showing continuous curvature. The slope of the curve on one side of the summit should be that corresponding to the depression of the F.P. of the compound F by Na in dilute solution, as calculated by formula (8), the slope on the other side that corre- sponding to dilute solutions of Hg in F. The experi- mental evidence goes, however, to show that in most cases these summits are rounded, and not sharp. This would indicate, according to Neville and Le Chatelier, that the compound is partly dissociated at its melting- point. The observed point of fusion corresponding to the summit of the curve is depressed below the ideal point of fusion by the presence of dissociated atoms of the components. It is highly probable that in many cases these loose chemical compounds, like some aqueous hydrates, are partly dissociated before the true point of fusion is reached.

10. Formation of Mixed Crystals. ◆◆◆ An important ex- ception to the general type already described, in which the addition of a dissolved substance lowers the F.P. of the solvent, is presented by the formation of mixed

crystals, or " solid solutions," in which the solvent and solute occur mixed in varying proportions. This iso- morphous replacement of one substance by another, in the same crystal with little or no change of form, has long been known and studied in the case of minerals and salts, but the relations between composition and melting- point have seldom been investigated, and much stUl remains obscure. In this case the process of freezing does not necessitate the performance of work of separa- tion of the constituents of the solution, the F.P. is not necessarily depressed, and

the effect cannot be calculated by the usual formula for dilute solutions. One of the simplest types of F.P. curve which may result from the occurrence of mixed crystals, is illustrated by the case of alloys of gold and silver, or gold and platinum, in which the F.P. curve is nearly a straight line joining the freezing-points of the constituents. The equilibrium between the solid and liquid, in both of which the two metals are capable of mixing in all proportions, bears in this case an obvious and close analogy to the equilibrium between a mixed liquid {e.g., alcohol and water) and its vapour. In the latter case, as is well known, the vapour will contain a larger proportion of the more volatile constituent. Similarly in the case of the formation of mixed crystals, the liquid should contain a larger pro- portion of the more fusible constituent than the solid with which it is in equilibrium. The composition of the crystals which are being deposited at any moment will, therefore, necessarily change as solidification pro- ceeds, following the change in the composition of the liquid, and the temperature will fall until the last portions of the liquid to solidify will consist chiefly of the more fusible constituent, at the F.P. of which the solidification will be complete. If, however, as seems to be frequently the case, the composition of the solid and liquid phases do not greatly differ from each other, the greater part of the solidification will occur within a comparatively small range of temperature, and the initial F.P. of the alloy will be well marked. It is pos- sible in this case to draw a second curve representing the composition of the solid phase which is in equilibrium with the liquid at any temperature. This curve will not represent the average composition of the crystals, but that of the outer coating only which is in equilibrium with the liquid at the moment. Eoozeboom {Zeit. Phys. Chem., XXX. p. 385) has attempted to classify some of the possible cases which may occur in the formation of mixed crystals on the basis of Gibbs's thermodynamic potential, the general properties of which may be qual- itatively deduced from a consideration of observed phenomena. But although this method may enable us to classify different types, and even to predict results in a qualitative manner, it does not admit of numerical calculation similar to equation (8), as the Gibbs's function itself is of a purely abstract nature, and its form is unknown. There is no doubt that the formation of mixed crystals may explain many apparent anomalies in the study of F.P. curves. The whole subject has been most fruitful of results in recent years, and appears full

of promise for the future. For further details in this particular branch the reader may consult a report by Neville (Brit. Assoc. Bep., 1900), which contains numerous references to original papers by Roberts-Austen, Le Chatelier, Eoozeboom, and others. fn l c")

Fustel de Coulanges, Numa Denis (1830- 1889), French historian, was born at Paris, 18th March 1830, being of Breton descent. After studying at the iScole ISTormale he was sent to the French school at Athens in 1853, and after his return filled various educa- tional offices untU, in 1860, he was appointed professor

of history at the university of Strasburg. After the con- quest of Strasburg by Germany he returned to Paris, and filled a professorship at the ifieole Normale. In 1878 a professorship of mediaeval history was created for him, which, except for a brief period during which he was director of the jficole Normale, he held until his death on 12th September 1889. His principal works are La Cite Antique (1862) and Histoire des institutions politiques de Vancienne France (1875). In the former, which went through a grea.t number of editions, he traces the influ- ence of religion in moulding antique institutions, espe- cially those of prehistoric times ; in the latter, founded on a course of lectures originally delivered to the Empress Eugenie, he investigates the effect of the Ro- man and Frankish conquests upon Gaulish society, which he considers to have been less than usually sup- posed. The continuation of the work was interrupted by the author's death; but the various sections, which had been thoroughly revised by him, were republished as separate books. The eulogium of Fustel de Coulanges has been pronounced by MM. Albert Sorel, Paul Gui- raud, and Jules Simon, whose oration has been repro- duced in his Notices et Portraits. (r. g.)

Fyzabad , or Faizabad, a city, district, and division of British India, in Oudh. The city is on the left bank of the river Gogra, 78 miles by rail east of Lucknow. Population (1881), 71,405 ; (1891), 78,921 ; (1901), 74,076.

The municipal income in 1897-98 was Es.72,678. The registered death-rate in 1897 was 57 per thousand. The cantonments accommodate a battery of artillery, and a European and a native infantry regiment. There is a Government college. The District has an area of 1728 miles. Population (1881), 1,081,419; (1891), 1,216,969, giving an average density of 704 persons per square mile; (1901), 1,298,086, showing an increase of 7 per cent. The land revenue and rates were Es.13,16,316, the incidence of assessment being E.1-1-1 per acre; the cultivated area in 1896-97 was 623,677 acres, of which 313,834 were irrigated from wells and tanks ; the number of police was 3196 ; the number of vernacular schools in 1896-97 was 68, with 4003 pupils ; the registered death- rate in 1897 was 31-67 per thousand. There are six printing-presses, two of which are owned by English firms ; 77 indigo factories, employing 8781 persons, with an out-turn valued at Es.5,65,000. The district is tra- versed throughout its length by the line of the Oudh and Eohilkhand railway from Lucknow to Jaunpur, 66 miles in all, with eight stations. Tanda, with a population in 1891 of 19,724, is the largest producer of cotton goods in Oudh. The Division of Fyzabad has an area of 12,177 square miles, and had a population in 1881 of 6,062,140, and in 1891 of 6,794,272, giving an average density of 657 persons per square mile. In 1901 the pop- ulation was 6,904,315, showing an increase of 2 per cent.

Cablonz (Bohemian or Czech, Jablonec), the chief town of a district in Bohemia, Austria. It possesses sev- eral new technical and special schools and a large hos- pital. It is the chief seat of the glass pearl and imitation jewellery manufacture, and has also an important textile industry, and produces large quantities of papier-mache and other paper goods, hardware, &c. Gablonz has in- creased its population by 345 per cent, since 1867, a rate of progress only surpassed in Bohemia by Prague, Pilsen, and Aussig. Population (1890), 14,663 ; (1900), 21,086.

Gabrovo, a town in the department of Selvi, in the principality of Bulgaria. It is picturesquely situated at the foot of the Balkans near the famous Shipka pass, on the Jantra, an affluent of the Danube, 22 miles south- west of Trnovo. The Jantra in its course through the town breaks into several streams, and is crossed by six bridges. At one point a great rock divides it into two streams and forms a double cascade. Owing to its

fine supply of water-power the town has become an important centre of the cloth industry. Cord spinning is also car- ried on, and there are several tanneries. The population is almost entirely Christian, and there is a large nunnery. The first modern school of Bulgaria, founded in the town in 1835, has become a higher-class school. Population about 8000.

Cadag, or Garag, a town of British India, in the Dharwar district of Bombay, 43 miles east of Dharwar town. It is an important railway junction on the Southern Mahratta system, with a growing trade in raw cotton, and also in the weaving of cotton and silk. There are fourteen factories for ginning and pressing cotton. Population about 24,000.

Cadara, now Umm Keis, altitude 1194 feet, one of the cities of the Syrian Decapolis, a strong fortress, and the political centre of a small district, Gadaris, which possibly extended to the Sea of Galilee. The extensive ruins are now being rapidly destroyed by the natives. In the Yarmiik valley, about 2^ miles north of the town, are

the famous hot sulphur springs of Gadara (Amatha, now el-Hammah), temperature 110 F., and the remains of bath-houses.

History. The firgt historical notice of Gadara is its capture by Antioohus the Great ; but its name and its commanding position in a fertile district seem to indicate a much earlier existence. It was given by Augustus (30 b.c.) to Herod the Great, at whose death it was re-annexed to Syria. In the Middle Ages it was called Kedar by the Crusaders, and Jadar by the Arabs, a name preserved in the modern Jediir Umm Keis. Gadara was a Greek city ; its coins bear Greek legends, and the inscriptions that have been found on its site are Greek. Its governing and wealthy classes were probably of Greek origin, whilst the people, urban and roral, were Hellenized and Judaized Aramaeans. The community was Hellenistioally organized, with a democratic senate at its head, and, whilst dependent on Syria, and acknowledging the supremacy of Rome, it managed its own internal affairs. The city used the era of Pompey (64 B.C.). Gadara, though not mentioned in the Bible, is referred to in the expression "the country of the Gada- renes" (R.V., Matt. viii. 28) ; but the reading is uncertain, and the scene of the miracle was probably on the eastern shore of the lake.

See ScHiJREK. History of the Jewish People in the Time of Christ. English translation, Division II. vol. i. p. 100. ??? Schumacher. Northern 'Ajlun. P. E. Fund. ??? Baedeker. Handbook to Palestine. ??? Warken. " Gadara," in Hastings's Dtci. of the Bible. ??? Wilsox, in Mecovery of Jerusalem (P. E. Fund, 1882) ; " Gadara," in Smith's Diet, of the Bible. (c. w. W.)

Cade, Niels Wilhelm (1817-1890), Danish com- poser, was born at Copenhagen, 22nd February 1817, his father being a musical instrument maker. At first in- tended for his father's trade, his bent for a musician's career, made evident by the ease and skill with which he learnt to play upon a number of instruments, was not to be denied. Yet, though he became proficient on the violin under Wexschall, and in the elements of theory under Weyse and Berggreen, he was to a great extent self- taught. His opportunities of hearing and playing in the great masterpieces were many, since he was a member of the court band. In 1841 his opus 1 ??? the still popular Nachkldnge aus Ossian overture ??? gained the local musical society's prize, the judges being Spohr and Schneider ; and it also attracted the notice of the king to Gade, who received a stipend which enabled him to go to Leipzig and Italy.

In 1844 he conducted the Gewandhaus concerts in Leipzig during Mendelssohn's absence, and at the latter's death Gade became chief conductor. In 1848, on the outbreak of the Holstein war, Gade returned to Copenhagen, where he was appointed organist and conductor of the Musik- Verein, a society which prospered exceedingly under him. He succeeded Glaser as court conductor in 1861, and was pensioned by the Government in 1876 ??? the year in which he visited Birmingham to conduct his Crusaders. This work, and the Fruhlingsfantasie, the Erlkonigs Tochter, Fruhlingsbotschaft, and Psyche (written for Birmingham in 1882), have enjoyed a wide popularity. Indeed, they represent the strength and the weakness of Gade's musical ability quite as well as any of his eight symphonies (the best of which are the first and

fourth, while the fifth has .an obbligato pianoforte part). Gade was distinctly a romanticist, but his music rarely glows with the warmth one finds in Grieg or Sinding, or even J. P. E. Hartmann, Gade's father-in-law. It is highly polished and beautifully finished, lyrical rather than dramatic and effective. But it rarely stirs one's deeper self. Much of the pianoforte music, the "Aquarellen," the " Spring Flowers," for instance, enjoyed a considerable vogue, as did the " Novelletten " trio ; but Gade's only opera. Marietta, never passed beyond the confines of the Copenhagen Opera House. Gade died at his birthplace, 21st December 1890. (k. h. l.)

Gainesville, capital of Cooke county, Texas, U.S.A., near the Eed river, on the Gulf, Colorado, and Sante Pe and the Missouri, Kansas, and Texas railways, at an altitude of 730 feet. Population (1880), 2667; (1890), 6594; (1900), 7874, of whom 269 were foreign- born and 1201 negroes.

Gainsborough, a market-town in the Gains- borough parliamentary division of Lincolnshire, England, on the Trent, 145 miles north of London. There are three parish churches, a Roman Catholic church, and vari- ous Nonconformist chapels. Eecent erections include an Albert Hall, new town hall, and a Church of England Institute. There are agricultural implement and engineer- ing works. Area of urban district, 2118 acres ; population (1881), 10,873 ; (1901), 17,660. Area of civil parish, 3446 acres.

Gaisford, Thomas (1779-1856), English classical scholar, was born at Iford, Wiltshire, on the 22ud of December 1779. Proceeding to Oxford in 1797, he became successively student and tutor of Christ Church, and was in 1811 appointed regius professor of Greek at the University. Taking orders, he held (1815-47) the college living of Westwell, in Oxfordshire, and other ecclesiastical preferments simultaneously with his pro-fessorship. In 1831 he was appointed Dean of Christ Church, and presided over the destinies of his college until his death on the 2nd of June 1856. As curator of the Bodleian and principal delegate of the University Press he was instrumental in securing the co-operation of distinguished European scholars as collators, notably Bekker and Dindorf. Gaisford was a recondite and critical Greek scholar, of

European reputation. Among his numerous contributions to Greek literature may be mentioned, Hephsestion's Encheiridion (Oxford, 1810) ; Poetce GrcBci Minores (ibid., 1814 ___20), Herodotus, cum notis variorum {ibid., 1824), Suidas (ibid., 1834), Ety- mologicum Magnum (ibid., 1848). In 1856 the Gaisford .prize, for Greek composition, was founded at Oxford to perpetuate his memory.

Galapagos Islands, an archipelago of five larger and ten smaller islands, situated in the Pacific Ocean, exactly under the equator, from 600 to 600 miles west of

Ecuador, to which country they belong. The name is derived JErom galapago, a tortoise, on account of the giant species, the characteristic feature of its fauna.

The origin, distribution, and development of the biological con- ditions of islands so distinctly oceanic as the Galapagos have given its chief importance to this volcanic archipelago since it was visited in the Beagle by Darwin. Of the seven species of these giant rep- tiles known to science (although at the discovery of the islands there were probably fifteen) all are indigenous, and each is confined to its own Islet. There also occurs a peculiar genus of lizards with two species, the one marine, the other terrestrial. The majority of the birds are of endemic species peculiar to different islets ___ and their number is greater than was believed ___ while more than half belong to peculiar genera. More than half of the flora is unknown elsewhere. A convict settlement still exists on Chatham, but no longer on Charles Island ; there are nearly 300 inhabitants, living In low thatched or iron roofed huts, under the supervision of a police commissioner and other officials. A Spaniard, with large estates on which sugar was grown and refined for the Guayaquil market, was in 1901 the sole employer of labour on the island. Charles Island, the most valuable of the group, is being cultivated by a small colony under an American. On many of the islets numerous tropical fruits are to be found growing wild, but they are no doubt escapes from cultivation, just as the large herds of wild cattle, horses, donkeys, pigs, goats, and dogs ___ the last large and fierce ___ which occur so abundantly on most of the islands have escaped from domestication. The

shores of the larger islands are fringed with a dense barrier of mangroves, backed by an often impenetrable thicket of tropical un- dergrowth, which, as the ridges are ascended, give place to tallertrees and deep green bushes which are covered with orchids and trailing moss (orchilla), and from which creepers hang down interlacing the vegetation.

Since 1860 several visits have been paid to the group by scientific investigators ??? by Dr Habel In 1868 ; Messrs Baur and Adams, and the naturalists of the Albatross, between 1888 and 1891 ; and in 1897-98 by Mr Charles Harris, whose journey was specially under- taken at the instance of the Hon.Walter Rothschild of Tring. Very complete collections have therefore, as a result of these expeditions, been brought together ; but their examination does not materially change the facts upon which the conclusions arrived at by Darwin ??? from the evidence of the birds and plants ??? were based ; but he " no doubt would have paid more attention to [the evidence afforded by Land-tortoises] , if he had been in possession of facts with which we are acquainted now " (Giintker). These were that the group "has never been nearer the mainland [of America] than-it Is now, nor have its members been at any time closer together " ; and that the character of the flora and fauna is the result of species strag- gling over from the mainland, at long intervals of time, to the dif- ferent islets, where in their isolation they have gradually varied in different degrees and ways from their ancestors. Equally indecisive is the further exploration as to evidence for the opinion held by other naturalists that the endemic species of the different islands have resulted from subsidences, through volcanic action, which have reduced one large island mass into a number of islets, wherein the separated species became differentiated during their isolation. The presence of these giant reptiles on the group, each species on its own islet, is still the chief fact on which a former land connexion with the continent of America may be sustained. " Nearly all autliorities agree that it is not probable that they have crossed the wide sea between the Galapagos Islands and the American continent, although, while they are helpless and quite unable to swim, they can float on the water. If their ancestors had been carried out to sea once or twice by a flood and safely drifted as far as the Galapagos Islands " (Wallace), "they must have been numerous on the continent" {Rothschild and Eartert). No remains, and of course no

living species, of these tortoises are known to exist or have existed on the mainland. Rothschild and Hartert seem to think that "it is more natural to assume the disappearance of a great stock of animals, the remains of which have survived, . . . than to assume the disappearance in comparatively recent times (i.e., in the Eocene period or later) of enormous land masses." Past elevations of land (and doubtless equally great subsidences)have, we know, taken place in South America since the Eocene, and on a somewhat similar dis- tribution of giant tortoises in the Mascarene region has long been based the conclusion that extensive areas of land have subsided in the Indian Ocean. "But so much we may claim at present, that Dr Baur's theory of the origin of the Galapagos fauna, when applied to the problem offered by the tortoises in the Indian Ocean, is actually . . . supported by geological and biological facts " (Gunther). The Galapagos Islands continue to be of some commercial importance to the Government of Ecuador, on account of the guano and the orchilla moss found on them and exported to Europe. Except on Charles Island, where settlement existed longest, little or no influence of the presence of man is evident in the group ; still, the running wild of dogs, cats, and especially goats

as regards the vegetation, must in the course of a comparatively short period greatly modify the biological condition of the islets.

Authorities. ⁂ Solater and Salvin. " Characters of New Species collected hy Dr Habel in the Galapagos Islands," Froc. Zool. Soc. London, 1870, pp. 322-327. ⁂ Theodor Wolf. Ein Besuch der Galapagos Inseln. Heidelberg, 1879. ⁂ W. L. and P. L. Sclater. The Geography of Mammals. London, 1899. ⁂ Eidg- WAT. "Birds of the Galapagos Archipelago," Proc. l/.S. Nat. Mus. vol. xix. pp. 459-670 (1897). ⁂ Baur. "New Observations on the Origin of the Galapagos Islands," Amer. Nat. 1897, pp. 661-680, 864-896. ⁂ Agassiz. "The Galapagos Islands," Bull. Mus. Comp. Zool., vol. xxiii. pp. 56-75. ⁂ Gunthee. Proa. Linn. Soc. London (President's Address), Oct. 1898, pp.

14-29 (with Bibliography from 1875 to 1898 on Gigantic Land-tortoises). ??? Roth- schild and Haetert. "Review of the Ornithology of the Gala- pagos Islands," Novitates Zoologies, vi. pp. 85-205. (h. O. f.)

Galashiels, a parliamentary burgh and manufac- turing town, situated since 1891 wholly in Selkirkshire, Scotland, on the river Gala, 40 miles south-south-west of Edinburgh by rail. There are now 16 woollen mills and

2 hosiery factories, 2 iron foundries, 2 engineering works,

3 dye-works, and a lioot factory. Eecent erections include 2 United Free Churches, St Paul's parish church, a cottage hospital, and a Gala public school. There is a free library, and waterworks have been completed. Population (1881),

15,330; (1901), 13,598.

Calatia. ??? I. Galatia Proper, a large inland district of Asia Minor, which was occupied by Gauls in the 3rd century e.g. Their position was that of a military aristo- cracy dwelling amongst an inferior race. Some of them settled down in the towns, but for the most part they lived in fortiiied villages and led a pastoral life. As the military powers of the Gauls declined, they began to mix with the Phrygian natives and adopt their religion ; but they long retained much of the Gallic character, and their language was still in use in the 4th century of our era. In the 1st century, when St Paul made his missionary journeys, though the townsmen spoke Greek, the rural population was little affected by Greek civilization. But after the foundation of Constantinople the Hellenization of the country was more rapid. Galatia included a great portion of the vilayet of Angora. (See Angoea.) It is a pastoral, agricultural country, and consists of a series of larger or smaller plains lying between bare desolate hills. Its scenery is monotonous ; it is almost devoid of trees, except on its northern frontier ; its cities are far apart, and its climate ??? a long severe winter and short hot summer ??? is trying.

II. The Roman Province was constituted 25 B.C. It consisted of parts of Lycaonia, Phrygia, with Iconium, Derbe, Lystra, Isaura, and Western

Pisidia, to the borders of Pamphylia. The province was enlarged by the addition of the Paphlagonian territories of Deiotarus (who had been called king of Galatia by the Romans, and who died in 40 B.C.), 6 B.C. ; Sebastopolis, 2 b.c. ; Comana, a.d. 35 ; Pontus, A.D. 63 ; and Cappadocia and Armenia Minor, A.D. 72. About 106 Trajan reduced the province by taking away Armenia Minor, Cappadocia, and Pontus, and in 137 the southern and central parts of Lycaonia were attached to Cilicia. Under Diocletian's reorganiza- tion, about 297, Galatia became a province of the Diocesis Pontica, and in 413 this was divided into Galatia Prima and Galatia Salutaris. The question whether the "churches of Galatia," to which St Paul addressed his Epistle, were situated in South Galatia or in North Galatia, has been discussed by Professor W. M. Ramsay, who rightly maintains that they were the churches planted in Derbe, Lystra, Iconium, and Antioch. (See Galatians.)

Authorities. ❓❓❓ Ramsay. Hist. Com. on St PauVs Epistle to the Galatians, 1%^. St Paul the Traveller. London, 1898. ❓❓❓ Perrot et GuiLLAUME. Expn. archeologique de la Galatie. Paris, 1862.

❓❓❓ HuMANN and Puohstein. Meisen in Kleinasien. Berlin, 1890. ❓❓❓ Crowfoot and Anderson. "Expn. in Galatia," in Journal of Hellenic Society, xlx. 1899. (c. w. w.)

Galatians. ❓❓❓ It can no longer be said that " Galatia is never used in the New Testament, except in its older colloquial sense as equivalent to ' Gallogreecia,' or ' Eastern Gaul.' " It is now generally recognized that in 1 Peter Y Galatia is used for the whole Roman province of that name, which in the apostolic age included far more than Gallogreecia. But we are here concerned to consider where "the churches of Galatia" were to which St Paul's Epistle, generally known as the Epistle to the Galatians, was addressed. The contents of the Epistle make it clear that " the churches of Galatia " were of St Paul's own founding. We naturally turn then to the Acts of the Apostles, to inquire whether there is any mention of these churches there. We do not find the word raAaria anywhere in the Acts, but twice the adjective FaXaTiKos is used (xvi. 6, xviii. 23). It has been generally thought until recent years that the first of these two passages gives the occasion of the founding of the churches of Galatia, a

revisit to which is spoken of in the other passage. A careful examination of the passage xvi. 6 ff. has convinced the writer of this article that this view is no longer tenable. His reasons are given at length in the Norrisian Essay for 1898 {Destination and Date of the Epistle to the Galatians').

It is the habit of the author of the Acts of the Apostles, when he is telling of St Paul's missionary work in cities before unvisited by him, to give details of the effect of his preaching and of the events of his stay in those cities. Now we observe that in Acts xvi. 6 there is no detailed account of the Apostle's missionary work, so that, if it be the case that we have here the occasion of the planting of " the churches of Galatia," the general rule observed by the author of the Acts here finds its exception. We read : " But they went through [Si^A^ov] the Phrygo-Galatian region [rijv <^pvyi,av KOI VaXwTiKrjv x'"P""]) forbidden [or being forbidden] by the Holy Ghost to preach the word in Asia." If by " the Phrygo-Galatian region " is intended missionary ground new to the Apostle, we have a very brief record of the founding of chitrches. There is an entire absence of detail. After the Apostle had revisited the churches founded by him on his first mis- sionary journey, the churches of Derbe, Lystra, Iconium, and Antioch (all of which were in the Roman province of Galatia), he would naturally pass on to Asia. But Asia was forbidden him as ground for missionary work. We might then understand Acts xvi. 6 to mean that the travellers went through the Phrygo-Galatian region because they were forbidden by the Holy Ghost to preach the word in Asia. " The Phrygo-Galatian region " would then be new ground, and might include Galatia proper or Gallograecia. This is the interpretation of the participial clause given by supporters of the North-Galatian theory, as distinguished from the advocates of the South-Galatian theory, who hold that "the churches of Galatia" addressed by St Paul in his Epistle were the churches of Derbe, Lys- tra, Iconium, and Antioch, these being, as has been already said, in the jirovince of Galatia. A serious objection to the North-(Talatian interpretation of Acts xvi. 6 is that the preaching to those to whom the Epistle was written becomes due to a prohibition imposed by the Holy Ghost against speaking the word in Asia, whereas in the Epistle St Paul writes as if his first preaching had been due to some sickness or bodily infirmity (Gal. iv. 13). It is recognized by those who hold the North-Galatian theory that the route into Galatia was a very unlikely one for St

Paul to take, and that his course can only be inter- preted as due to some special guidance, such guidance

being intended by the words of Acts xvi. 6, KwXvOivTK vvo

Tov ayLOv irvev/iaTOS XoX^crat Tov Xoyov iv Tij 'Acria. But

this cannot be reconciled satisfactorily with Gal. iv. 13. The present writer is of opinion that the proper way to interpret this KtoXvOivre^ participial clause is not retro- spectively as giving the reason why the travellers went through the Phrygo-Galatian region, but as part of the predicate. They went through the Phrygo-Galatian re- gion forbidden by the Holy Ghost to preach the word in Asia. The Phrygo-Galatian region is then not new ground at all, but that part of the province of Galatia which was Phrygian, where St Paul had already preached on his first missionary j ourney. This interpretation of the phrase " the Phrygo-Galatian region " is due to Professor W. M. Ramsay, who has steadily advocated the South- Galatian theory. In spite of opposition, the theory has been gain- ing adherents in Great Britain, though the opposition to it in Germany can claim some names of repute.

It has been urged as a serious objection to the South- Galatian theory that St Paul in the Epistle addresses his readers as " Galatians " (Gal. iii. 1). This appellation, it has been said, would be extremely inappropriate unless those addressed were nationally Galatians, and not only belonging to the province of Galatia. This objection has been met by Eamsay in Studia Bihlica, vol. iv. {The "Galatia" of St Paul and the " Galatic territory" of Acts), and in his Historical Commentary on the Gala- tians (notes on iii. 1). And we may remark here that this argument might be turned against supporters of the North-Galatian theory, for it is not likely that a large percentage of inhabitants even of Gallogrsecia were Gauls. There would be a mixture of Gaul, Phrygian, and Greek ; thus VaXaTal might be just as inappropriate as an appel- lation of the converts in Gallograecia.

It has been well argued by Professor Eamsay that "the development and importance of the territory on the northern side of the plateau ??? i.e., Northern Galatia and Northern Phrygia ??? belong to the period following after A.D. 292, and result from a transference of the centre of government, first to Nicomedia and afterwards to Constantinople. Under the earlier Roman Empire the southern side of the plateau was far more important than the northern side." This argument is worked out at length in Ramsay's Historical Geography of Asia Minor.

The reader who wishes to explore the subject thoroughly should study Ramsay's The Church in the Boman Empire before A.D. 170, and his St Paul the Traveller and Boman Citizen, with the other works mentioned in this article, also the articles on Galatia, &c., in Hastings's Dictionary of the Sible. (e. h. A.)

Calatz, a town and port of Rujnania, on the left bank of the Danube, about 90 miles from Sulina on the Black Sea, and 130 miles north-east of Bucharest by rail. Its situation on the Danube between the rivers Sereth and Pruth makes it a position of mercantile importance. Great improvements have been carried out ; all the main thoroughfares are paved, and the streets lighted with gas, the fine quays being lighted by electricity. Galatz ceased to be a free port in 1876. Large docks under govern- ment control have been constructed, covering an area of 88,000 square metres at low water. The depth is 5 metres at low water. The dock buildings consist of a grain warehouse with 338 silos constructed of iron and cement, having a total accommodation for about 25,000 tons of grain ; a depot for goods, several sheds for goods in transit, an engine room, and administrative offices with a room for samples. Extensive private grain storehouses are also in proximity to the docks and quays. Much of the grain trade has been absorbed by Braila, but the wood export industry has been much developed, and with the opening of the Galatz-Bgrlad railway, which brings much of the rich agricultural country of the north-west of

Moldavia into direct touch with the former, Galatz will probably regain much of her ascendency. The navigation of the Sulina branch of the Danube has been greatly improved, vessels of 2500 tons being able to ascend to Galatz. There are large steam saw mills, flour mills, a brewery, soap and candle factories, oil works; a fine prison has been built, as well as extensive barracks, and military and civil hospitals. Electric tramways were started in 1900. The total imports amounted in 1898 to ??2,363,595, and the total exports to ??1,013,563. The average annual amount of shipping of all nations clearing from Sulina is 1500 vessels of 1,499,887 tons. Popular tion 62,678, of whom 14,000 are Jews.

Galena, capital of Jo Daviess county, Illinois, U.S.A., on the Galena river, near the Mississippi. Three railways, the Chicago, Burlington, and Quincy, the Chi- cago and North-Western, and the Illinois Central, inter- sect here. The lead and zinc mines, to which Galena owes its existence and former prosperity, now produce but little, and the business of the city has decreased. Population (1880), 6451; (1890), 5635; (1900), 5005, of whom 918 were foreign-born.

Galena, a city of Cherokee county, Kansas, U.S.A., at the intersection of two railways, in the midst of the lead and zinc region. The development of these mines has given the city a rapid growth. Population (1890), 2496; (1900), 10,165, of whom 251 were foreign-born and 680 negroes.

Galesburg, capital of Knox county, Illinois, U.S.A., in a rich agricultural region, on a level site, at an altitude of 756 feet. It has excellent railway connexions by means of the Atchison, Topeka, and Santa Ee, the Chicago, Burlington, and Quincy, and the Fulton County Narrow Gauge railways. There are extensive manufac- tures of agricultural implements, carriages, waggons, &c., and the Chicago, Burlington, and Quincy railway has yards and works here. Knox College and Lombard Uni- versity, both co-educational institutions, are situated here. The former had, in 1899, 39 instructors and 413 students ; the latter, 15 instructors and 116 students. Population (1880), 11,437; (1890), 16,264; (1900), 18,607, of whom 3602 were foreign-born and 738 negroes.

Galicia (German, Galizien ; Polish, Halicz), a Crown land of the Cisleithan part of the Austro-Hungarian mon- archy. Its population in 1880 was 6,968,907, and in 1890 was 6,607,816, equivalent to 218 inhabitants per square mUe ; in 1900 it was 7,295,538. The population grows solely by natural increase, there being practically no im- migration, while there was a loss of 67,400 by emigration in the decade 1880-90. In 1890 the proportion of fe- males to males was 1027 to 1000. Racially, 53‘34 per cent, were Poles, 43-1 Ruthenians, the remainder being made irp of Germans (3-46 per cent.) and about 500 Slovenes and Rumanians. Considered by religions, 45-38 per cent, were Roman Catholic, 42-22 per cent. Greek Catholic (mostly Ruthenians), 11-66 per cent. Jews, the remain- der consisting of Protestants and Armenian Catholics. Provisional returns for 1898 gave a marriage-rate of 7-8, a birth-rate of 37-08, and a death-rate of 24-8. Of the births in 1897, 14-4 per cent, were illegitimate. The marriage, birth, and death rates are diminishing. Galicia sends 78 members to the Reichsrath, of whom 15 are returned by the new universal suffrage curia. The Diet is composed of 1 German, 133 Polish, and 17 Ruthenian members. Apart from the Polish Acad- emy of Science, educational requirements are pro- vided for by the Universities of Lemberg and Cracow

(2852 students), a Poly teclmic (376 students), an Academy of Art, 3 theological seminaries, 30 gymnasia, and real gymnasia, 12 academies of music, 337 commercial, agri- cultural, mining, and other technical and continuation schools, together with 11 intermediate and 3863 element- ary schools. Only 65 per cent, of the children attend school. In 1880 the proportion of illiterates was 77-1, in 1890, 68-2 per cent. ◆◆◆ a degree of illiteracy only ex- ceeded in Austria by Bukovina and Dalmatia. Of the 203 periodicals and newspapers published in 1898, there were 153 in the Polish language, 25 in Kuthenian, 16 in Hebrew, 4 in German, 1 in Russian, and 4 were polyglot. More than three-fourths of the population are engaged in agriculture and forestry, and about 12 per cent, in min- ing, industry, and trade. Although there has been an increase in the

proportion of arable land, Galicia is back- ward in agriculture, as in most other branches of produc- tion. It has the largest area under potatoes and legumes of any Austrian Crown land. The various classes of live stock show a moderate increase, with the exception of sheep, mules, and asses, which have greatly diminished. Its wealth of valuable timber is one of its chief resources. The principal mining products in 1897 were ___ coal (8 mil- lion metric centners), lignite (607,000 m.c), petroleum (2,752,000 m.c), and ozocerite (68,815 m.c.^, in addition to smaller quantities of iron, lead, and zinc ore. The total production of salt in 1897 (34-75 per cent, of the total Austrian production) was 1,438,951 metric centners, value __739,970. Manufactures are still comparatively unimportant, with the exception of spirits, of which Galicia has 36 '75 per cent, of the entire Austrian pro- duction. In 1897 there were 3082 kilometres of railway, 17-70 per cent, of the total length in Austria, 13,769 kms. of roads, and 2102 kms. of waterway, of which 1287 were only available for floating timber. There were 817 post and 351 telegraph offices, with 6168 kms. of line and 15,901 of wire.

This province enjoys a larger degree of autonomy than any other part of the empire. Indeed, owing to the absence of central con- trol, due to the oflficial employment of the Polish language, it may be said to be practically self-governed. Except from the stand- point of international policy ___ the Poles of Galicia are loyal, politi- cally accommodating, and devoted to the dynasty ___ this experiment is not regarded as particularly successful. Nearly every depart- ment of the administration leaves much to be desired ; the material and moral condition of the populace is unsatisfactory, and even that of the large landed proprietors, who have monopolized political power and influence, is less favourable than might fairly be expected, considering the advantages they have secured from the central Parliament. The treatment of the Ruthenians, who form nearly half the population, has excited animosity between the two races, and is considered certain to lead to difficulties if an opportunity offers; while the old feud between the peasant and the noble is as bitter as ever, and has latterly manifested itself in a dangerous form of agrarian socialism.

See SzujSKi, Die Polen und Huthenen in Galizien, Vienna, 1882 ; Jandaurek, Das IConigreioh Oalizien, Vienna, 1884 ; and histories by Hopp, Vienna, 1793, and Engel, 1793. (m. o'lT.)

Galilee. See Palestine.

Galilee, Sea of, the name most frequently used in the New Testament for the lake called in the O.T. the Sea of Chinnereth or Chinneroth, and, once in the N.T., the " lake of Gennesareth," a corruption of the old name, which is commonly used by Josephus and in the Targums. By St John the lake is called the " Sea of Tiberias," and this name survives in the modern Bahr Tabarieh. In the Gospels its shores are closely connected with the Galilean ministry of Christ and the homes of most of the Apostles. The Sea of Galilee is, like the Dead Sea, a " rift " lake situated in the Jordan-'Araba depression. (See Dead Sea.) It has an area of 64 square miles. The maximum depth is 145 to 150 feet. The present level is 682-5 feet below that of the sea, but deposits show that originally

the lake formed part of the inland sea which filled the Jordan valley in Pleistocene times. During the rainy season the surface level rises from 2 to 4 feet. The shores are for the most part formed of fine gravel (lime-stone, basalt, and flint), mixed with fragments of shells. Some yards from the shore the bed of the lake is uni- formly covered with a fine greyish mud. Oleanders fringe the lake, and the large papyrus grows at "Ain et-Tiu, and near the mouth of the Jordan. The heat in summer is tropical, but is relieved after noon by a strong north-west breeze, which causes a fall of 10 to 11 F. The slopes of the surrounding limestone hills, overlain here and there by basalts, which have a bare steppe-like appearance for half the year, are clothed with green in spring. The lake was once surrounded by towns with a large population, but Tiberias and Mejdel (Magdala) alone are now inhabited. The lake, in which Molyneux first took soundings in 1847, was examined in 1890 by M. Barrels. The most interesting features are the great range of the diurnal variations of temperature at the surface, the relatively small depth of the zone (hardly 49 feet) influenced by these variations, the uniform temperature (59 F.) of the deeper zones between 65 feet and 131 feet, and the existence of at least one sub- aqueous hot spring. The water is

generally used for drinking, but it is flat, slightly brackish, and not very clear. The surface is usually placid, but it is liable to be disturbed by short, sudden storms. The lake swarms with fish, which are caught with nets by a guild of fishermen, whose boats are the only representatives of the many ships and boats which plied on the lake as late as the 10th century. Fishing was a lucrative industry at an early date, and the Jews ascribed the laws regulating it to Joshua. The fish, which were classed as clean and unclean, the good and bad of the parable (Matt. xiii. 47, 48), belong to the genera Chromis, Barbus, Capoeta, Dis- cognathus, Nemachilus, Blennius, and Clarias; and there is a great affinity between them and the fish of the East African lakes and streams. There are eight species of Chromis, most of which hatch their eggs and raise their young in the buccal cavities of the males. The Chromis simonis is popularly supposed to be the fish from which Peter took the piece of money (Matt. xvii. 27). The most remarkable fish is the Clarias macracanthus (Arab, Burhur), called coracinus by Josephus, who says that it lived in the Nile and in the spring of Capharnaum. It was found by Lortet in the springs of 'Ain Mudawara, "Ain et-Tin, and 'Ain Tabghah, on the lake shore where muddy, and in Lake Huleh. It is a scaleless, snake-like fish, often nearly 5 feet long, which resembles the 0. angidllaris of Egypt. From the absence of scales it was held by the Jews to be unclean, and some commentators suppose it to be the serpent of Matt. vii. 10 and Luke xL 11. Large numbers of grebes ___ great crested, eared, and little ___ gulls, and pelicans frequent the lake. On its shores are terrapins, crabs, and innumerable sandhoppers ; and at varying depths in the lake several species of Melania, Melanopsis, Neritina, Corbicula, and Un io have been found.

AuTHOBiTiES. ___ Merrill. Oalilee in the Time of Christ. ___ GutRiN. GaliUe. ___ Baedeker. Handbook to Palestine. ___ Frei. " Beobachtung vom See Genezareth," in Zeitschrift d. Deutschen Pnl. Vereins, 188(>. ___ G. A. Smith. Historical Geography of the Holy Land. ___ Lortet. Ln Syrie d^ aujourd' hui ; "Poissons et reptiles du lac de Tibfiriade," in Archives du Mits. d^hist. nat. de Lyon, iii. 1883. ___ Tristram. Flora and Fauna of Palestine (P. E. Fund Memoirs). ___ Barrois, in Bulletin de la Societe de Geographic. Paris, 1893.

Locard. Malacologie des lacs de Tiberiade, <6c. Lyon, 1883. MoLYNEiTx, in B.O.S. Journal, xviii. 1848.

(c. W. W.)

Gallon, a city of Crawford county, Ohio, U.S.A., on the Erie and the Cleveland, Cincinnati, Chicago, and St Louis railways, at an altitude of 1167 feet. It has

‘A Gii’SY Woman. AND her Ciiildken.” By L. (iALLAiT.

railway and iron works. Population (1880), 5635; (1890), 6326; (1900), 7282; 703 foreign-born.

Callait, Louis (1810-1887), Belgian painter, was born at Tournay, in Hainant, Belgium, 9th May 1810. He first studied in his native town under Hennequin. In 1832 his first picture, “Tribute to Caesar,” won a prize at the exhibition at Ghent. He then went to Antwerp to prosecute his studies under Mathieu Ignace Van Bree, and in the following year exhibited at the Brussels Salon “Christ Healing the Blind.” This picture was purchased by subscription and placed in the cathedral at Tournay. Gallait next went to Paris, whence he sent to the Belgian Salons “Job on the Dunghill,” “Mon- taigne visiting Tasso in Prison”; and, in 1841, “The Abdication of Charles V.,” in the Brussels Gallery. This was hailed as a triumph, and gained for the painter a European reputation. Official invitations then caused him to settle at Brussels, where he died on the 20th of November 1887. Among his greater works may be named : ” The Last Honours paid to Counts Egmont and Horn by the Corporations of the Town of Brussels,” now at Tournay ; ” The Death of Egmont,” in the Berlin Gallery ; the ” Coronation of Baudouin, Emperor of Con- stantinople,” painted for Versailles; “The Temptation of St Anthony,” in the Palace at Brussels; “The Siege of Antioch,” “Art and Liberty,” a “Portrait of M. B. Dumortier,” and “The Plague at Tournay,” all in the Brussels Gallery. “A Gipsy Woman and Her Chil- dren ” (see Plate) was

painted in 1852. ” M. Gallait has all the gifts that may be acquired by work, taste, judgment, and determination,” wrote Theophile Gautier ; his art is that of a man of tact, a skilled painter, happy in his dra- matic treatment, but superficial. No doubt, this Walloon artist, following the examples of the Elemings of the Re- naissance and the treatment of Belgian classical painters and the French Romantic School, sincerely aimed at truth; unfortunately, misled by contemporary taste, he could not conceive of it excepting as dressed in sentimentality. As an artist employed by the State he exercised considerable influence, and for a long period he waathe leader of public taste in Brussels.

Teichlin, Louis Gallait und die Malerei in Deutschland, 1853 ; J. DcjARDiN, VAH Flamand, 1899; C. Lemonniee, Histoiredes Beaux Arts en Belgique, 1881. (h. fr.)

Calie, or PoiiirT DE Galle, town and port of Ceylon, on the south-west coast. The opening of the Suez Canal in 1869, and the construction of a breakwater at Colombo, leading to the transfer of the mail and most of the commercial steamers to the capital port of the island, made a great difference to Galle. Although a few steamers still call to coal and take in some cargo, yet the loss of the Peninsular and Oriental and other steamer agencies reduced it to a very subordinate position; nor has the extension of the railway, 70^ miles from Colombo, and beyond Galle 26|- miles to Matara, very much improved matters. The houses occupied by Euro- peans in or near the town are now very few. The tea- planting industry has, however, spread to the neighbour- hood, and a great deal is done in digging plumbago and in growing grass for the distillation of citronella oil. The export trade for 1899 was chiefly repre- sented by cocoanut oil, 47,731 cwt. ; plumbago, 57,549 cwt. ; coir yarn, fibre, and rope, 68,930 cwt. ; while of tea 348,067 lb were shipped. In import trade there was a declared value of about 50,000 rupees (□□3400) of cotton goods in the same year. Both the export and import trade for the district, however, chiefly passes through Colombo. Population (1891), 33,853; (1901),

37,248.

Callenga, Antonio Carlo Napoleone (1810- 1895), Italian author and patriot, born at Parma on 4th November 1810, was the eldest son of a

Pied- montese of good family, who served for ten years in the French army under Massena and Napoleon. He had finished his education at the University of Parma, when the French Revolution of 1830 caused a ferment in Italy. He sympathized with the movement, and within a few months was successively a conspirator, a State prisoner, a combatant, and a fugitive. For the next five years he lived a wandering life in France, Spain, and Africa. In August 1836 he embarked for New York, and three years later he proceeded to England, where he supported himself as a translator and teacher of languages. His first book, Italy; General Views of its History and Literature, which appeared in 1841, was well received, but was not successful financially. On the outbreak of the Italian Revolution in 1848 he at once put himself in communication with the insurgents. He filled the post of Charge d'Afiiaires for Piedmont at Frankfort in 1848-49, and for the next few years he travelled incessantly between Italy and England, working for the liberation of his country. In 1854, through Cavour's influence, he was elected a deputy to the Italian Parliament. He retained his seat until 1864, passing the summer in England and fulfilling his parlia- mentary duties at Turin in the winter. On the outbreak of the Austro-French war of 1859 he proceeded to Lombardy as war correspondent of The Times. The campaign was so brief that the fighting was over before he arrived, but his connexion with Tlie Times endured for twenty years. He was a forcible and picturesque writer, with a command of English remarkable for an Italian. He materially helped to establish that friendly feeling towards Italy which became traditional in England. In 1859 Gallenga purchased the Falls, at Llandogo on the Wye, as a residence, and thither he retired in 1885. He died at this house on 17th December 1895. He was twice married. Among his chief works are a Historical Memoir ofFrd, Dolcino and his Times, 1853 ; a History of Piedmont, 3 vols., 1855, Italian translation 1856 ; Country Life in Piedm,ont, 1858 ; Tlie Invasion of Denmark, 2 vols., 1864; The Pearl of the Antilles [travels in Cuba], 1873; Italy Revisited, 2 vols., 1875 ; Two Years of the Eastern Question, 2 vols., 1877; The Pope [Pius IX.] and the King [Victor Emmanuel], 2 vols., 1879 ; South America, 1880; A Summer Tour in JRussia, 1882; Iberian Reminiscences, 2 vols., 1883; Episodes of my Second Life, 1884 ; Italy, Present and Future, 2 vols., 1887. Gallenga's earlier publications appeared under the pseudonym of Luigi Mariotti. (b. i. o.)

Galleries of Art. See Art Galleries.

Callieni, Joseph Simon (1849), French

soldier and administrator, was born at Saint-Beat, in the department of Haute-Garonne, on 24th April 1849. He left the military academy of Saint-Cyr in July 1870 as a second lieutenant in the Marines, becoming lieutenant in 1873 and captain in 1878. He saw service in the Franco-German war, and between 1877 and 1881 took an important part in the explorations and military ex- peditions by which the French dominion was extended in the basin of the Upper Niger. He rendered a particu-larly valuable service by obtaining, in March 1881, a treaty from Ahmadu, chief of Segu, giving the French exclusive rights of commerce on the Upper Niger. For this he re- ceived the gold medal of the Societe de Geographic. From 1883 to 1886 Gallieni was stationed in Martinique. On 24th June 1886 he attained the rank of lieutenant-colonel, and on 20th December was nominated governor of Haute- Fleuve-(Senegal). He obtained severalsuccesses-against

Ahmadu in 1887, and compelled Samory to agree to a treaty by which he abandoned the left bank of the Niger. In connexion with his service in West Africa Gallieni published two works ??? Voyage au Sudan Franqais, 1879-

1881 (Paris, 1885), and Deux Campagnes au Sudan Frani;ais (Paris, 1891), which, besides possessing great narrative interest, give information of considerable value in regard to the resources and topography of the country. In 1888 Gallieni was made an officer of the Legion of Honour. In 1891 he attained the rank of colonel, and from 1893 to 1895 he served in Tongking, commanding the second military division of the territory. In 1899 he published his experiences in Trois Colonnes au Tonkin. In September 1896 Madagascar was made a French colony, and after the

unsuccessful administration of Laroche, Gallieni was appointed resident-general and connnander-in-chief. By a vigorous military system he succeeded in clearing of brigands the great routes to the capital, and eventually in completing the subjugation of the island. He then turned his attention to the destruction of the political supremacy of the Hovas and the restoration of the autonomy of the other tribes. The execution of the queen's uncle, Ratsimamanga, and of Eainandrianampandry, the minister of the in- terior, in October 1896, and the exile of Queen Eana-valona herself in 1897, on the charge of fomenting rebellion, broke up the Hova hegemony ; but the appli- cation of the tariff of French customs and other like measures were disastrous to British and American trade, and struck a serious blow at the commercial prosperity of the island.

Calliffet, Gaston Alexandre Auguste de,

Marquis, Prince de Maktignes (1830), French

general, was born in Paris on 23rd January 1830. He entered the army in 1848, was commissioned as sub- lieutenant in 1853, and served with distinction at the siege of Sebastopol in 1855 (Legion of Honour), in the Italian campaign of 1859 under General Douay, and in Algeria in 1860. He displayed great gallantry as a cap- tain at the siege and storm of Puebla, in Mexico, in 1863, when he was severely wounded (majority and officer. Legion of Honour). He went again to Algeria in 1864, took part in expeditions against the Arabs, and became colonel in 1867, with the command of the 3rd Eegiment of Chasseurs d'Afrique. In the Franco-German war of 1870-71 he commanded this regiment in the Army of the Ilhine, was promoted to be general of brigade on 30th August,' and commanded the three regiments of Chas- seurs d'Afrique at the battle of Sedan, leading them in person in a splendid charge on the heights of Floing, and winning the admiration of his enemies. Made pris- oner of war at the capitulation of Sedan, he returned to France during the siege of Paris by the French Army of Versailles, and commanded a brigade against the Com- munists. The severity of his methods against the Com-munists came to be permanently associated with his name. In 1872 he took command of the Batna subdi- vision of Algeria, and commanded an expedition against El Golea, surmounting great difficulties in a rapid

march across the desert, and inflicting severe chastisement on the revolted tribes (commander. Legion of Honour). On the general reorganization of the army he commanded the 31st infantry brigade of the 8th Army Corps, and the department Cher. Promoted general of division in 1875, he successively commanded the 16th infantry di- vision at Dijon, the 9th Army Corps at Tours, and in

1882 the 12th Army Corps at Limoges. In 1885 he be- came a jnember of the Supreme Council of War. He conducted the cavalry manoeuvres in successive years, and attained a European reputation on all cavalry ques- tions. Decorated with the Grand Cross of the Legion

of Honour in 1887, he received a military medal for his able conduct of the autumn manoeuvres in 1891, and after again commanding at the manoeuvres of 1894 he retired from the active list. Afterwards he took an important part in French politics, as War Minister (22nd June 1899 to 29th May 1900) in M. Waldeck-Kousseau's Cab- inet, and distinguished himself by the firmness with which he dealt with certain cases of unrest in the army.

Gal I i poll, a fortified seaport town and episcopal see of the province of Lecce, Apulia, Italy, on the east side of the Gulf of Taranto, and 59 miles by rail south from Brindisi. It exports olive oil (□□113,000 to □□236,000 an- nually), wine (□□185,500 in 1899), dried figs (□□12,000 average), &c., to the average value of □□300,000 annually (□□454,500 in 1899); and imports cereals, flour, timber, and other commodities (□□11,000 in 1888, □□153,200 in 1899). The port was cleared by 407 vessels of 188,180 tons in 1888, and by 913 vessels of 338,670 tons in 1899. The harbour was dredged to a depth of 16^ feet in 1884, and further improved at a later date. Population, 11,000.

Call! poll, a seaport of Turkey, on the Thracian Chersonesus, chief town of the sanjak of the same name. Its chief industries consist of two steam flour mills, and a sardine factory which exports 15,000 to 16,000 cases (100 boxes to a case) annually. The sanjak, of which the population is 95,500, comprises four kazas (cantons), namely (1) Maitos, noted for its excellent cotton; (2) Keshan, lying inland north of Gallipoli, noted for its

cattle-market, the district producing also grain, linseed, and canary seed; (3) Myriofyto; and (4) Sharkeui, on the coast of the Sea of Marmora, which once produced wine that was highly esteemed and was largely exported to France for blending. Heavy taxation, however, amounting to 55 per cent, of the value of the wine, broke the spirit of the viticulturists, most of whom uprooted their vines and replanted their lands with mulberry trees, making sericulture their occupation, an industry which is year by year assuming larger proportions. All this region has been depressed by a succession of bad crops, and the people oppressed by excessive taxation rigidly exacted. The country folk have been reduced to indigence, their lands, their cattle, and in many cases their household goods, having been sold by the authori- ties to cover arrears of taxes. (e. w.)*

Galston, a police burgh and manufacturing town of Ayrshire, Scotland, on the river Irvine, 5 miles east by south of Kilmarnock by rail. There is a blanket factory, 2 lace and muslin and 3 hosiery factories, and a paper mill-board factory. There are coal mines in the vicinity. The institute contains a library and recreation rooms. A Eoman Catholic church was erected in 1886 by the marquis of Bute. Galston figures frequently in Burns's poems. Population (1881), 4085 ; (1901), 4876.

Gait, a town in Waterloo county, Ontario, Canada, 23 miles ISI".]Sr."W. of Hamilton, on the Grand river and on the Grand Trunk and Canadian Pacific railways. It has excellent water privileges, which furnish power for flour mills, and axe, machinery, paper, and other manufactories. Exports in 1899-1900 were valued at f 165,913, imports at $729,931. Population (1881), 5187 ;

(1900), 7746.

Galton, Francis (1822), English anthropolo- gist, .son of S. T. Galton, of Duddeston, A'arwiekshire. His grandfather was the poet-naturalist Erasmus Darwin, and his cousin was the famous proponnder of the doc- trine of evolution. Francis Galton was born in 1822, and educated at King Edward VI. 's Grammar School, Binning- ham. Electing to study medicine, he attended classes at Birmingham Hospital, and afterwards " walked " King's College, London. Graduating at Trinity College, Cam-

bridge, in 1844, lie next travelled for two years and ascended the White Nile, thus being a pioneer of the modern explorers of that part of the Dark Continent. In 1850 he made an exploration, with Dr John Anderson, of Damaraland and the Ovampo country in south-west Africa, starting from "Walfisch Bay. These tracts had practically never been traversed before, and on the appear- ance of the published account of his journey and experi- ences under the title of Narrative of an Explorer in Tropical South Africa (1853) Galton was awarded the gold medal of the Eoyal Geographical Society. His Art of Travel; or, Shifts and Contrivances in Wild Countries, was first published in 1855. In 1861 he visited the north of Spain, and published the fruits of his observations of the country and the people in the first of a series of volumes which he edited, entitled Vacation Tourists. He then turned to meteorology, the result of his investiga- tions appearing in Meteorographica, published in 1863. This was the first serious attempt to chart the weather on an extensive scale, and in this work also the author first established the existence and theory of anti-cyclones. Galton succeeded Admiral Fitzroy as a member of the meteorological committee of the Board of Trade, and was appointed one of the committee entrusted with the parliamentary grant for the Meteorological Office. He next devoted himself to the study of heredity, and with his researches on this subject and his anthropological investigations his name will be most closely associated. In 1869 appeared his Hereditary Genius, its Laws and Consequences, a work which excited much interest in scientific and medical circles. This was followed by English Men of Science, their Nature and Nurture, published in 1874 ; and Inquiries into Human Faculty and its Development, issued in 1883. Then followed, in the order named, Life-History Album, 1884 ; Record of Family Faculties, 1884 (tabular forms and directions for entering data, with a preface); Natural Inheritance, 1889 ; Decipherment of Blurred Finger-Prints, 1893 ; and Finger-Print Directories, 1895. Galton is also the author of several memoirs on anthropo- metric subjects, and on new statistical processes applicable to anthropometry, including that of composite portraiture. His writings on

heredity have been especially popular. He has had a long connexion with the leading scientific societies, and in 1886 he received the gold medal of the Eoyal Society.

Galveston, seaport and capital of Galveston county, Texas, U.S.A., on Galveston Island, Gulf of Mexico, at the entrance to Galveston Bay. It is the fourth city of the state in population, and first in commer- cial importance, and it is one of the important com- mercial centres of the South. Six railways meet in it, and its excellent harbour has had its entrance deepened by jetties, at the expense of the United States. Through these agencies Galveston has become one of the largest cotton shipping ports of the country, shipping 90,000 bales of cotton annually. Its exports increased from $15,700,000 in 1888 to $68,428,621 in 1898, placing it second only to New Orleans among the southern ports. Of these exports 70 per cent, consisted of raw cotton. It has regular steamship lines to the ports of the Gulf, Atlantic, West Indies, and Europe. In the autumn of 1900 it was nearly destroyed by a West Indian hurri- cane, but was rapidly rebuilt. Its manufactures are by no means comparable with its commerce. In 1890 the capital invested was $5,122,612, employing 1932 hands and producing $6,724,545 of products. These were of great variety. The assessed valuation of real and personal property, on a basis of about two-thirds of the full value, was in 1899 $26,777,338, the net debt of the

city $2,839,146, and the rate of taxation $26.30 per $1000. Population (1880), 22,248; (1890), 29,084; (1900), 37,789, of whom 6339 were foreign-born and 8291 negroes.

Calway, a maritime county of Ireland, province of Connaught, bounded on the N. by Mayo and Eoscommon ; on the E. by Eoscommon, King's County, and Tipperary ; on the W. by the Atlantic Ocean ; and on the S. by Clare and Galway Bay. The area of the administrative county in 1900 was 1,463,430 acres, of which 196,365 were tillage, 755,888 were pasture, 861 fallow, 25,166 plantation, 141,926 turf bog, 54,876 marsh, 221,259 barren moun- tain, and 67,100 water, roads, fences, &c. The new ad- ministrative county under the Local Government (Ireland) Act, 1898, includes the parliamentary borough of Galway, and the portion of Ballinasloe formerly situated in Eos- common, but is diminished to the

extent of six electoral divisions added to other counties. The population in 1881 was 242,005, and in 1891 214,712, of whom 108,283 were males and 106,429 females, divided as follows among the different religions : Eoman Catholics, 208,364 ; Protestant Episcopalians, 6340 ; Presbyterians, 628 ; Methodists, 324 ; and other denominations, 66. The average number of persons to an acre in the whole county was -14. Of the total population, 191,673 persons inhabited the rural districts, being an average of 134 persons to each square mile under crops and pasture. The population in 1901 was 192,146 (Eoman Catholics, 186,870; Protestant Episcopalians, 4436 ; Presbyterians, 689 ; Methodists, 181 ; others, 71), being a decrease of 10-5 per cent., as compared with a decrease of 11-3 per cent, from 1881 to 1891. The following table gives the number of births, deaths, and marriages in various years : ???

Tear.

Births.

Deaths.

Marriages.

1881 1891 1899

5638 4707 4373

3323 3370 2755

708 651 650

The birth-rate per 1000 in 1899 was 20-7, and the death- rate 13-0 ; the rate of illegitimacy was -9 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1899 was 196,794, of whom 94,295 were males and 102,499 females. The chief towns in the county are Galway, Ballinasloe, and Tuam.

Education. ??? The following table gives the degree of education in 1891 (excluding the town of Galway) : ???

Males.

Females.

Total.

Percentage.

E.‘C.

Pr. Bp.

Presb.

Read and write Kead only Illiterate

51,837

8,358

29,065

47,694

8,792

31,364

99,531 17,150 60,429

55-3

9-8

34-9

91-0 4-0 5-0

94-4

2-8 2-8

In 1881 the percentage of illiterates among Roman Catholics was 47 -S. In 1891 (including the town of Galway) the number of superior schools was 11, with 489 pupils (Roman Catholics 325, and Protestants 164), and the number of primary schools was 445, with 30,743 pupils (Roman Catholics 29,720, and Protestants 1023). The number of pupils on the rolls of the national schools on 30th September 1899 was 39,485, of whom 38,850 were Roman Catholics and 635 Protestants.

Administration. ❑❑❑ The county is divided into four parliamentary divisions, north, south, east, and Connemara, the number of registered electors in 1900 being respectively 10,475, 8148, 8936, and 8423. The rateable value in 1900 was ❑❑472,941. By the Local Government (Ireland) Act, 1898, the fiscal and adminis- trative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under' that Act the county now comprises two urban and ten rural sanitary districts. By the same Act the county of the town of Galway was abolished.

Agriculture. ❑❑❑ The following tables give the acreage under

crops, iaoluding meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900. Tlie figures for 1900 are for the new administrative county.

Year.

1

.a

1

1

o

Ph

- c 5

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c3

Total.

1881

3544

64,852

692.3

50,688

12,807

7066

85,346

220,070

1891

6258

42,962

4542

41,621

12,694

9318

91,220

207,510

1895

‘2766

42,220

4440

88,900

11,789

8185

96,186

203,486

1900

4054

36,710

8615

86,768

11,077

S986

95,1.55

196,866

In 1899 the total value of the cereal and other crops was estimated by the Registrar-General at ??1,366,245. The number of acres under pasture in 1881 was 741,803 ; in 1891, 717,775 ; and in 1900,

755,888.

Year.

Horses .indMules.

Asses.

Cattle,

Sheep.

Pigs.

Goats.

Poultry.

1881 1891 1895 1900

29,070 .32,828 38,666 23,986

14,763 18,873 17,967 18,207

173,445 200,188 190,.562 198,385

530,912 688,560 602,944 663.456

63,768 68,125 63,600 69,874

10,549 14,623 18,207 13,668

757,922 858,609 877,143 924,908

The number of milch cows in 1891 was 44,852 and in 1900 45,170. It is estimated that the total value of cattle, sheep, and pigs in 1899 was ►►3,975,514, the third largest amount in the Irish counties. In 1900 the number of holdings not exceeding 1 acre was 1980 ; between 1 and 5, 45.53 ; between 5 and 15, 11,951 ; between 15 and 30, 8762 ; between 30 and 50, 3498 ; between 50 and 100, 2410 ; between 100 and 200, 1340 ; between 200 and 500, 765 ; and above 500, 222 ►►► total, 35,481. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1900, was 1529, amounting to ►►416,170. The number of loans for agricultural improvements sanctioned under section 31 of the Land Act, 1881, between 1882 and 1900, was 653, and the amount issued was ►►46,323. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations in 1847 to 31st March 1900 was ►►392,919.

Fisheries. ►►► In 1899 1414 vessels, employing 4877 hands, were registered in the deep-sea and coast fishery districts of Galway and Clifden. In the same year 344 persons were employed in the salmon fishery districts of Galway and Connemara. (w. H. po.)

Cal way, a maritime town and parliamentary borough (returning one member), capital of the above county, on the north side of Galway Bay, and on the Midland Great Western railway. The town commissioners were abolished in 1898, and an urban district council sub- stituted. There is an extensive line of quays, and a canal runs from the harbour to Lough Corrib and Lough Mask. In all, 193 vessels of .37,376 tons entered in] 899, and 80 of 16,798 tons cleared. The number of vessels regis- tered in 1899 in the fishery district was 793, and the number of men and boys employed 2503. A light railway now runs from Galway to Clifden. Population (1881),

15,417 ; (1901), 13,414.

Cambetta, Leon (1838-1882), French statesman, was born at Cahors on the 3rd of April 1838. His father, a Genoese, who had established himself as a grocer and had married a Frenchwoman, is said to have been his son's prototype in vigour and fluency of speech. In his six- teenth year young Gambetta lost by an accident the sight of his left eye, which eventually had to be removed. Notwithstanding this privation, he highly distinguished himself at the public school of Cahors, and in 1857 pro- ceeded to Paris to study law. His southern vehemence gave him great influence among the students of the Quar- tier Latin, and he was soon known as an inveterate enemy of the Imperial Government. He was called to the bar in 1859, but, although contributing to a Liberal review, edited by M. Challemel Lacour, did not make much way until, on the 17th November 1868, he was selected to de- fend a journalist prosecuted for having promoted the erection of a monument to the representative Baudin,

killed in resisting the cmq:) d'etat of 1851. Gambetta seized his opportunity, and assailed both the coup d'etat and the Government with an eloquence of invective which made him immediately famous. In May 1869 he was re- turned to the Assembly, both by the first circumscription of Paris and by Marseilles, defeating Hippolyte Carnot for the former constituency and Thiers and Lesseps for the latter. He elected to sit for Marseilles, and lost no opportunity of attacking the Empire in the Assembly. He opposed the war with Germany, but did not refuse to vote supplies when it was determined upon. When the news of the disaster at Sedan reached Paris, Gambetta led

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Leon Gambetta. {From a photograph by Carjat et Cie., Paris,)

the agitation ^vhich substituted the Eepublic for the Em- pire, and was one of the members of the new Government of National Defence. He advised his colleagues to leave Paris and conduct the Government from some provincial city. This advice was rejected from dread of another revolution in Paris, and a delegation to organize resist- ance in the provinces was despatched to Tours ; but when this was seen to be inefficient Gambetta himself (7th October) quitted Paris in a balloon, and upon arriving at Tours took the supreme direction of affairs as Minister of the Interior and of War. Aided by !M. de Freycinet, a young officer of engineers, as his assistant secretary of war, he displayed prodigies of energy and intelligence. He s])epdilY organized an army, which might possiblj' have effected the relief of Paris if Metz had held out. but the treacherous surrender of Bazaine brought the army of the Crown Prince into the field, and success was impossible. After the defeats of the French near Orleans early in December the seat of government had to be transferred to llordeaux, and when Paris sur- rpiulered at the end of January, Gambetta, though re- sisting and protesting, was compelled to submit to the capitulation concluded with Prince Bismarck. He imme- diately resigned his office. Elected by nine departments to the National Assembly meeting at Bordeaux, he chose

to sit for Strasburg, which by the terms of the treaty about to be submitted to the Assembly for ratification was to be ceded to Prussia, and when the treaty was adopted he resigned in protest and retired to Spain. It is difficult to determine whether patriotism or politi- cal calculation had more influence on his conduct. He returned to Trance in June, was elected by three departments in July, and commenced an agitation for the definitive establishment of the Eepublic. In 1871 he established a journal, La Bepubliqiie Frangaise, which soon became the most influential in France. His orations at public meetings were more effective than those delivered in the Assembly, especially that made at Bordeaux on his return, and that at Grenoble on 26th November 1872, in which he spoke of political power having passed to les nouvelles couches sociales. When

Thiers fell from power in May 1873, and a Royalist was placed at the head of the Government in the person of Marshal MacMahon, Gambetta gave proof that the demagogue had ripened into the statesman. He unceasingly urged his friends to a moderate course, and by his tact and parliamentary dexterity, no less than by his eloquence, was mainly instrumental in the voting of the Constitution in February 1876. This policy he continued during the early days of the now consolidated Republic, and gave it the appropriate name of " Opportunism." It was not until 4th May 1877, when the peril from reactionary intrigues was notorious, and the clerical party had begun a campaign for the restora- tion of the temporal power of the Pope, that he delivered his famous speech denouncing " Clericalism " as " the enemy." On 16th May Marshal MacMahon, in order to support the clerical reactionaries, perpetrated his parlia- mentary coup d'itat, and on 15th August Gambetta, in a speech at Lille, gave him the alternative se soumettre ou se d4mettre. This was during the great electoral contest, the result of which left MacMahon, equally unwilling to resign or to provoke civil war, no choice but to dismiss his advisers and form a moderate Republican ministry under the premiership of M. Duf aure. When the resignation of the Dafaure Cabinet brought about the abdication of Marshal MacMahon, Gambetta did not become a candidate for the Presidency, but allowed this to devolve upon M. Grevy ; nor did he attempt to form a ministry, but accepted the office of President of the Chamber of Deputies (January 1879). This position, which he filled with much ability, did not prevent his occasionally descending from the pre- sidential chair to make speeches, one of which, advocating an amnesty to the Communards, was especially memo- rable. He evidently thought that the time was not ripe for asserting his own claims to direct the policy of the Republic, and seemed inclined to observe a neutral atti- tude as far as possible ; but events hurried him on, and early in 1881 he placed himself at the head of a move- ment for restoring scrutin de liste, or the system by which deputies are returned by the entire department which they represent, so that each elector votes for several representatives at once, in place of scrutin d'arrondisse- ment, the system of small constituencies, giving one member to each district and one vote to each elector. A bill to re-establish scrutin de liste was passed by the Assembly on 19th May 1881, but rejected by the Senate on 19th June. The Ferry Cabinet then in office was

un- able to retain its ground, and Gambetta was unwillingly entrusted by M. Grevy with the formation of a ministry in November 1881 ??? known as Le Grand Ministh-e. He now experienced the Nemesis of his over-cautious system of abstinence from office for fear of compromising his popularity. Every one suspected him of aiming at a dictatorship ; attacks, not the less formidable for their injustice, were directed against him from all sides, and his

Cabinet fell ingloriously in February 1882, after an exist- ence of only sixty-six days. Had he remained in office the face of the world might now have been different, for his declarations leave no doubt that he would have culti- vated the British alliance and co-operated with Great Britain in Egypt. It is only surprising that, feeling as he did, he should not have protested against the de- sertion of Great Britain by the Freycinet administra- tion. His fortunes were presenting a most interesting problem when, on 31st December 1882, at his house in Ville d'Avray, near Sevres, he came to a violent end, by a shot from a pistol, in circumstances which have never been fully explained. France awoke to a sense of her obligation to him, and his public funeral on the 6th of January 1883 evoked one of the most overwhelm- ing displays of national sentiment ever witnessed on a similar occasion.

Gambetta is the only politician produced by France between 1870 and 1900 who merits the reputation of greatness. He rendered France three inestimable ser- vices : by preserving her self-respect through the gallantry of the resistance he organized during the German war, by his tact in persuading extreme partisans to accept a Moderate Republic, and by his energy in overcoming the usurpation attempted by the advisers of Marshal Mac- Mahon. Had he remained in power he might have ren- dered yet another by giving a sound direction to her foreign policy. His fall, which could have been but temporary, was not so much owing to popular ingrati- tude as to a serious fault of his own, his want of loyalty to his colleagues, whom' he systematically used for his own purposes, until at length he found himself distrusted and isolated. His death, however, at the early age of forty-four, cut short a career which had given promise of greater things than have been accomplished by any of those who tried to maintain his traditions. In many respects he strikingly resembles Danton,

but he was too humane and good-natured to have participated in a Reign of Terror. (e. g.)

Gambia, the most northerly of the British West African dependencies. The total area of the colony and Protectorate is 3560 square miles, but before the delimita- tion of the frontier in 1891, in accordance with the Anglo-French agreement of 1889, the outside districts which now form the Protectorate constituted a wholly undefined sphere of influence, andthe settlements (including StMary's Island, British Combo, the Ceded Mile, McCarthy's Island, and other islets) had an area of about 69 square miles. The general effect of the delimitation was to recognize as British a narrow strip of land extending for about 6 miles on each side of the river to a distance of about 250 miles from the sea. The land outside these limits and beyond the Barraconda rapid is recognized as French. The breadth of the colony near the coast is somewhat greater. Gambia, as its name implies, derives its character and value from the river, which is navigable throughout the colony, while large ocean-going ships can always cross the bar at its mouth and enter the port of Bathurst (popu- lation about 6000). Steamers already run to McCarthy's Island, and the line will be continued to Yarbutenda (243 miles from Bathurst). The banks of the river, for about 100 miles from its mouth, are fringed with mangrove swamps, behind which are plains densely covered with grass and interspersed with clumps of timber. Beyond this point the banks become steep and thickly wooded, the valley of the river from McCarthy's Island to Barra- conda being enclosed by low rocky hills of volcanic character, surrounded by park-like scenery. Since 1888 the Gambia has been a separate Crown colony, with a governor, still termed administrator, and an executive and

legislative council. The executive council includes one nominated member, and the legislative two unofficial members. The Protectorate is divided into seventeen districts, each placed under a head chief, supervised by travelling commissioners. The population of the settle- ments was returned in 1898 as 14,300, having remained nearly stationary

since 1881. The population of the Protectorate has been estimated at about 200,000. The native tribes are almost exclusively negro: Mandingoes, Jolofs, Jolas, &c. The Europeans in the settlements number about sixty. Education is in a very backward

Anglo-French Boundary Franco-Portuguese ???

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Sketch Map of Gambia.

condition, in spite of mission schools supported by Government. Mahommedanism is reported to be in- creasing, "and with it temperance and decency." The climate of Bathurst is fairly healthy during the dry season. The temperature is subject to great variations, the thermometer sometimes varying from 68?? to 98?? on the same day. It is always warmer by 20?? or more up the river than near the sea coast. The mean temperature at Bathurst at noon in the shade is from 72?? to 82??. The average rainfall is about 50 inches, but, with the exception of a few showers in May and June, there is no rain excepting between July and October. The dry east wind, known as the "harmattan," blows from December to March. The agricultural resources of the colony remain undeveloped. Land can be hired for 2d. an acre per annum for twenty-one years, and there is stated to be an opening for capital in the cultiva- tion of sisal hemp, &c. A botanical station was opened in 1894, but as yet has led to little results. Ground nuts (Arachis hypogcBO) are the staple product, and account for more than four-fifths of the total exports. They go mainly to Marseilles, where the oil derived from them is sold as olive. In 1899 the exports amounted to 34,353 tons of the value of ??210,006, as against about 20,000 tons of the value of about ??127,000 in 1897. Next to ground nuts, but at a long interval, the most important product is india-rubber. Beeswax, palm kernels, and hides are also exported in small quantities. The principal imports are cotton goods, kola nuts (from Sierra Leone), tobacco, and spirits. The revenue for 1899 amounted to nearly ??47,000. Over ??36,000 was derived from

custom duties, of which over ►►11,000 was from ground nuts. There is no public debt, and there was in 1899 an available surplus of more than ►►43,000. The cost of the Protectorate is covered by direct taxa- tion. A hut tax has encountered no opposition from the natives.

See C. P. Lucas. Historical Geography of the British Colonies. Vol. iii. West Africa, 2nd ed. 11)00.►►► A. F. Mookler-Ferky-

MAN. Imperial Africa. Vol. i. British West Africa. 1898.

Colonial Reports, Annual. , (h. e. eg.)

Came Laws. ►►► There have not been any changes since 1879 in the laws affecting winged game, except the alteration of the close season for partridges in Ireland, which is now from 1st February to 31st August, and the passing of a temporary Act, still annually continued, for the protection of that occasional summer visitor, the sand-grouse. The Wild Birds' Protection Acts have not in any district been used to alter the close time for game birds. A measure of protection against the inconsiderate preservation of game has been given by a decision of the High Court, that persons who overstock with game lands over which they have sporting rights are liable for damage thereby caused to the crops of the occupiers. In 1880 the Ground Game Act was passed, at the instance of Sir William Harcourt, "in the interests of good husbandry, and for the better security of capital and labour invested by occupiers of land in the culti- vation of the soil." With these objects the Act gives to the occupier of the land (whether he be also owner or not, and whether his occupation be under lease or only under an agreement for a lease), as incident to and inseparable from his occupation, the right to kill and take hares and rabbits on the land. The right of the occupier is inde- Ox/ard,igot feasible, and he cannot divest himself of it by contract with his landlord, or even by letting his sporting rights over the land; but, where the terms of occupation do not other- wise provide, the landlord, as the lessee of the sport- ing rights, or persons having right of chase or free warren, may take ground game concurrently with the occupier. The mode of exercise of the right is subject to certain limitations. Traps must not be set except in rabbit burrows, nor may poison be used. Firearms may not be used at

night as defined in the Night Poaching Act, nor may they be used at any time except (1) by the occupier himself, and (2) with his authority by some one other person. But the occupier may authorize the taking or capture of hares and rabbits by other means by members of his own household resident on the land, persons in his ordinary service on the land, and persons bond fide employed for reward in taking and destroying ground game. The authority must be in writing, and must be produced on demand to persons who have a concurrent right to take the game, or an authorized agent. No game licence is necessary, and the occupier may sell the hares and rabbits taken.

*There is no close time for hares or rabbits in England or Scotland, except Sundays and Christmas Day. In Ireland there is a close time from 20th April to 12th August. But hares and leverets killed in the United Kingdom may not be sold in JMarch, April, May, June, or July; and occupiers ol moorland and unenclosed land whicli is not arable (except detached portions not exceed- ing 25 acres) may exercise their right to take ground game only from 11th December to 31st March. The terms for which licences to kill game are issued were altered in 1883, and they ai-e now of four kinds :***

*Those taken out after .'^Ist July :***

*To expire on the next 31st July . . .**.3 0 0*

To expire on the next 31st October . .200

*Those taken out after 1st November :***

To expire on the next 31st July . 2 0 0

Those taken out for any continuous period of four- teen days specified in the licence . 10 0

The necessity of licences to deal in game was in 1893 extended to game killed abroad, but the penalties for selling m close time do not extend to such game. Since

1894 the authority of justices of the peace to grant game- dealers' licences has been transferred to borough or district councils in places outside London. The terms on which they may be granted have not been changed, but have been construed so as to preclude their grant to large stores in London which have also a licence for the sale of beer.

See Ore's Game Laws, 4th ed., by Willis Bund, 1897. ??? Warrv. The Game Laws of England, 1897. ??? Marchant and Watkins. The Wild Birds' Protection Acts, 1897. (w. F. c.)

Gaming. ??? There was no new legislation between 1879 and 1902 for the punishment of gaming except the Betting and Loans (Infants) Act, 1892, passed at the in- stance of Lord Herschell, which makes persons guilty of misdemeanour who, with a view to profit, send to any one whom they know to be an infant a document inviting him to enter into a betting or wagering transaction. The Act was intended to protect lads at school and college from temptation by bookmakers. The powers of making bye-laws for the peace, order, and good government of their districts, possessed by municipal boroughs ??? and since 1888 by County Councils ??? and extended in 1899 to the new London boroughs, have in certain cases been exercised by making bye-laws forbidding any person to " frequent or use any street or other public place, on behalf either of himself or any other person, for the purpose of book- making, or betting, or wagering, or agreeing to bet or wager with any person, or paying, or receiving, or settling bets." This and similar bye-laws have been held valid. The police and the Anti-Gambling League have during the last few years shown great activity in the enforcement of the Acts against betting and gaming. Some results of this activity have been to add baccarat banque and cliemin de fer to the list of unlawful games, and to establish that a man cannot be convicted of keeping a common gaming-house because on a single occasion he invites friends in to play an unlawful game; and also to apply to persons found in gaming-houses the provisions of the old Act of Hen. VIII. by binding them over not to

frequent such places. A further result has been to produce a large crop of decisions on the Betting Act of 1863, showing a considerable divergence of judicial opinion. The House of Lords has held that the Tattersall's enclosure or betting ring on a race-course is not a "place" within the statute; and members of a bond fide club who bet with each other in the club are not subject to the penalties of the Act. But the word "place" has been held to include a public- house bar, an archway, a small plot of waste ground, and a bookmaker's stand, and even a bookmaker's big umbrella, and it is difficult to extract from the judges any clear in- dication of the nature of the " places " to which the Act applies. The Act is construed as applying only to ready- money betting when the stake is deposited with the book- maker, and only to places used for betting with persons physically resorting thereto ; so that bets by letter, tele- gram, or telephone do not fall within its penalties. The arm of the law has been found long enough to punish as thieves " welshers," who receive and make off with de- posits or bets which they never mean to pay if they lose.

The construction put by the judges on ►► 18 of the Gaming Act, 1845, which avoids contracts made by way of gaming and wagering, enabled turf commission agents to recover from their principals bets made and paid for them. But the Gaming Act, 1892, rendered null and void any promise, express or implied, to pay any person any sum of money paid by him under, or in respect of, any contract or agreement rendered null and void by the Gaming Act, 1845, or to pay any sum of money by way of commission, fee, reward, or otherwise in respect of any such contract or agreement, or of any services in relation thereto or in 'connexion therewith. By the combined

effect of these two enactments, the recovery by the winner of bets or of stakes on games is absolutely barred ; but persons who have deposited money to abide the event of a wager are not debarred from crying off and recovering their stake before the event is decided, or even after the decision of the event and before the stake is paid over to the winner ; ^ and a man who pays a bet for a friend or customer has now no legal means of recovering the money, unless indeed some actual deceit was used to induce him to pay in ignorance that it was a bet. But a person who has received a bet on account of another can still, it would seem, be

compelled to pay it over, and the business of a betting man is treated as so far lawful that income-tax is charged on its profits, and actions between parties in such a business for the taking of partnership accounts have been seriously entertained by Chancery judges.

The effect of these enactments on speculative dealings in shares or other commodities calls for special considera- tion. It seems to be correct to define a wagering contract as one in which two persons, having opposite opinions touching the issue of an event (past or future), of which they are uncertain, mutually agree that on the determina- tion of the event one shall win, and the other shall pay over a sum of money, or other stake, neither party having any other interest in the event than the sum or stake to be won or lost. This definition does not strike at contracts in " futures," under which the contractors are bound to give or take delivery at a date fixed of commodities not in existence at a date of the contract. Nor are such contracts rendered void because they are entered into for purposes of speculation ; in fact, their legality is expressly recognized by the Sale of Goods Act of 1893. And contracts to buy or sell stocks and shares are not void because entered into by way of speculation and not for purposes of investment. But a transaction in any commodity, though in form com- mercial, falls within the Gaming Acts if in substance the transaction is a mere wager on the price of the commodity at a date fixed by the contract. It does not matter whether the dealing is in stocks or in cotton, nor whether it is entered into on the Stock Exchange, or on any produce ex- change, or elsewhere ; nor is it conclusive in favour of the validity of the bargain that it purports to bind the parties to take or deliver the article dealt in. The courts are en- titled to examine into the true nature of the transaction ; and where the substantial intention of the parties is merely to gamble in differences, the fact that it is carried out by a series of contracts, regular and valid in form, will not be sufficient to exclude the application of the Gaming Acts.

In very many cases transactions with " outside stock- brokers " or " bucket shops " have been held to be mere wagers, although the contracts purported to give options to demand delivery or acceptance of the stocks dealt with ; and the cover deposited by the " client " has been treated as a mere security for performance of the bargain, and recoverable if sued for

in time, i.e., before it is used for the purpose for which it is deposited. There was not up to 1902 any authoritative decision as to the application of the Gaming Act 1892 to transactions on the London Stock Exchange through a stockbroker who is a member of "the House" ; but the same principle appears to be applicable where the facts of the particular deal clearly indicate that the intention was to make a mere time bargain, or to pay or receive differences only. In the event of the bank- ruptcy of a person involved in speculations, the bankruptcy officials exclude from proof against the estate all claims founded on any dealing in the nature of a wager ; and on the same principle the bankrupt's trustee cannot recover sums won by the bankrupt by gaming transactions.

In the United States, many of the states make gaming

1 So held, Surge v. Ashley. 1900; 1 Q.B.,744, May 1900.

a penal offence when the bet is upon an election, or a horse-race, or a game of hazard. Betting contracts and securities given upon a bet are often made void, and this may destroy a gaming note in the hands of an innocent purchaser for value. The subject lies outside the pro- vince of the Federal Government.

Authorities. ◆◆◆ Coldridge and Hawksfoed. The Law of Gambling, 1895. ◆◆◆ Stutfield. Betting, 3rd ed. 1892. ◆◆◆ Brodhurst. The Stock Exchange, 1897. (yf, p. c.)

Candia, a Mediterranean port of Spain, in the province of Valencia. It is a station on the Madrid-Ali- cante railway. There are some modern public build- ings ◆◆◆ schools, a theatre, and several parish churches ◆◆◆ besides the palace of the dukes of Osuna and a Jesuit convent. The principal local industries are manufactures of leather, silks, velvet, and ribbons. In 1898, 348 ves- sels of 142,175 tons entered. The value of the imports, chiefly coal, guano, timber, and flour, was ◆◆147,464 ; of the exports, mainly oranges, tomatoes, wine, raisins, onions, and cloth,

<u>346,471. The greater part of the exports, except cloth and tomatoes, went to England. Population about 10,000.</u>

<u>Cando. See Nigeria.</u>

<u>Canjam, a district of British India, in the extreme north-east of the Madras Presidency. It has an area of 6037 square miles. The population in 1891 was 1,896,803, being 226 persons per square mile. In the hill tracts alone the density is only 88 per square mile ; for the rest of the district it rises to 325. In 1901 the population was 2,011,488, showing an increase of 6 per cent. The total amount of land revenue and rates is returned as Ils.18,45,758, the incidence of assessment per acre being Rs. 2-2-2 in ryotwari and R.0-3-8 in zamindari lands ; the number of police is 1134. In 1897-98, out of a total cultivated area of 479,108 acres 239,443 were irrigated (115,757 from government canals). There are two large systems of government irrigation in the district : (1) the Rushikulya project, upon which E,s.46,44,423 has been spent, and which showed a deficit in 1897-98 of Es.1,42,119 ; and (2) the Ganj am minor rivers system, on which Ks. 44,846 has been spent, and which shows a profit of Es.6,513, or 15 per cent. The principal crops are rice, other food grains, pulse, oil seeds, and a little sugar-cane and cotton. Salt is evaporated, as a government monopoly, along the coast. Sugar is refined, according to German methods, at Aska, where rum also is produced. A considerable trade is conducted at the ports of Gopalpur and Calinga- patam, which are only open roadsteads. In 1897-98 the total sea-borne trade was valued at Rs. 30,55,430, of which more thau half was coasting trade. The district is traversed throughout by the East Coast railway, which was opened from Madras to Calcutta in 1900. There are colleges at Berhampur and Parlakimedi. In 1896-97 the number of schools was 1763, attended by 39,389 pupils. There are eight printing-presses and severallibraries, read-ing-rooms, and literary institutes. The registered death- rate in 1897 was 50-1 per thousand.</u>

<u>Cap, Canal of, or Canal du Drao, a very im- portant Fiench irrigation channel derived from the Drac in the upper Champsaur Valley, at an altitude of 3838 feet. It is thence carried partly by aqueducts to the Puyde Manse, through which a tunnel 3916 yards in length leads it from the</u>

basin of the Isfere to that of the Durance, its course of 10 miles involving the construction of ninety- eight artificial works. Here, at the water-tower, in the valley of the Luye, at a point only about 96 feet lower than its origin, it divides into two branches, the Charance and the Rochette. The former, taking nearly four-fifths of the total volume of water, or 685 gallons per second, goes

west, south-west, and south for a length of 16 miles, and the latter, taking little more than one-fifth of the total, or 195 gallons per second, goes east, south-west, south, and west for about 17 miles. Both branches then give origin to secondary canals, and these again to smaller ones, making a total length of about 445 miles. The area affected by this system of canals is 18,600 acres, of which 16,500 acres are capable of irrigation, but of this only about one-fourth is actually irrigated. Full utiliza- tion of the work has been hindered by want of capital and labour ; nevertheless, the extent to which it has been developed has resulted in great improvements in the dis- trict, and extension of the cultivable area. The work was commenced in 1864; in 1880 irrigation began to be applied, and in 1888 the work was completed.

Capan, a town in the southern part of the province of Nueva Ecija, Luzon, Philippine Islands. It lies at the centre of a rich tobacco-producing region, and the forests in its vicinity contain the finest of hard woods. Its climate is comparatively cool and healthful. The princi- pal languages spoken are Tagalog and Ilocano. Popula- tion, 20,000.

Card, a department in the south of France, bordering on the Mediterranean, and watered by the Rhone, the Gard, and the Herault.

Area, 2270 square miles. From 417,099 in 1886 the population increased to 418,470 in 1901. Births in 1899, 8813, of which 268 illegitimate ; deaths, 9315 ; marriages, 3164. There were in 1898 1020 schools, with 55,000 pupils. Three per cent, of the popula- tion is illiterate. Out of 1,037,879 acres composing the area of the department under cultivation in 1896, 494,229 acres were plough- land and 130,970 acres in vineyards. The cereals yielded in 1899 a value of less than ––500,000. The production of the vines, on the other hand, exceeded the value of ––2,532,000. Gard takes the first rank among the departments of

France for the production of the mulberry, which in 1899 yielded a value of ––132,000, a figure, how- ever, slightly exceeded by the produce of Ard^che in that year, and of silk-worm cocoons, which amounted in 1898 to 35,826 cwts., a figure slightly in excess of the production of Ardfeche. The live stock in 1899 numbered 20,670 horses, 14,480 asses, 8290 cattle, 404, 500 sheep, 43,970pigs, and 27,850 goats. The mining industry pro- duced in 1898 1,974,000 metric tons of coal and lignite, of the value of ––1,036,000, and 113,000 tons of iron, lead, and manganese, valued at ––192,000. The salt-pans yielded in 1898 81,000 metric tons of salt, of the value of ––56,000. Metallurgy is in a very advanced state in the arrondissement of Alais, its total production in 1898 amounting to 58,000 metric tons of cast-iron, 5000 tons of iron, and 40,000 tons of steel. The other industries, textile and paper man- ufactures, are less developed. Nimes, the capital, has a popula- tion of 80,355 (1901).

Carda, a lake of North Italy, partly in Lombardy, partly in Venetia, partly in Tirol. According to]\[arti- nelli, the lake has an area of 143 square miles, a depth of 1135 feet, and it lies at an altitude of 213 feet above sea-level. The mean surface temperature is 66–– Fahr. Be- tween 60 and 100 feet in depth the temperature decreases rapidly from 64–– to 55––, and from the latter level down to the bottom decreases gradually to 45-9––. There are meteorological observatories at Riva, Salo, and Desenzano. The west shore from Gargnano to Salo is known as the Riviera Benacense, and is reputed to be the warmest dis- trict of North Italy.

Cardine’r, a city of Kennebec coimty, Elaine, U.S.A., on the western bank of the Kennebec river, 6 miles below Augusta, on the Maine Central railroad. The city rises somewhat steeply from the river, is laid out with much regularity, with the business streets paved. It has excellent water power in the Cobosseecontee river, which flows through it to the Kennebec, and this has given rise to large and varied manufactures, including several lumber mills. Gardiner has also a brisk business in ice, which is cut mainly from the Kennebec, and shipped to Boston, New York, and southern citie’s. Population

(1880), 4439; (1890), 5491; (1900), 5501, of whom 537 were foreign-born.

Gardiner, Samuel Rawson (1829-1902), Eng- lish historian, son of Kawson Boddam Gardiner, was born near Alresford, Hants, 4th March 1829. He was educated at Winchester and Christ Church, Oxford, where he obtained a first class in literce humaniores. He was subsequently elected to fellowships at All Souls (1884) and Merton (1892). For some years he was professor of modern history at King's College, London, and devoted his life to historical work. He is the historian of the Puritan revolution, and has written its history in a series of volumes, originally published under different titles, beginning with the accession of James I. ; the seven- teenth, the third volume of the History of the Common- wealth and Protectorate, appeared in 1901, and two more were meant to complete the whole work, ending with the Restoration. The series is History of England from the Accession of James I. to the Outbreak of the Civil War, I6OS-I64S, 10 vols. ; History of the Great Civil War, 1643-1649, 4 vols. ; and History of the Commonwealth and Protectorate, 1649-1660. His treat- ment is exhaustive and philosophical, taking in, along with political and constitutional history, the changes in religion, thought, and sentiment during his period, their causes and their tendencies. Of the original authorities on which his work is founded many of great value exist only in manuscript, and his researches in public and private collections of manuscripts at home, and in the archives of Simancas, Venice, Rome, Brussels, and Paris, were indefatigable and fruitful. His accuracy is universally acknowledged. He was perhaps drawn to the Puritan period by the fact of his descent from Cromwell and Ireton, but he has certainly written of it with no other purpose than to set forth the truth. In his judgments of men and their actions he is unbiassed, and his apprecia- tions of character exhibit a remarkable fineness of percep- tion and a broad sympathy. Among many proofs of these qualities it will be enough to refer to what he says of the characters of James I., Bacon, Laud, Strafford, and Crom- well. On constitutional matters he writes with an insight to be attained only by the study of political philosophy, discussing in a masterly fashion the dreams of idealists and the schemes of government proposed by statesmen. Throughout his work he gives a

prominent place to everything which illustrates human progress in moral and religious as well as political conceptions, and especially to the rise and development of the idea of religious tolera^ tion, finding his authorities not only in the words and actions of men of mark, but in the writings of more or less obscure pamphleteers, whose essays indicate currents in the tide of public opinion. His record of the relations between England and other States proves his thorough knowledge of contemporary European history, and is rendered specially valuable by his researches among manuscript sources which have enabled him to expound for the first time some intricate pieces of diplomacy.

Gardiner's work is long and minute ; the fifty-seven years which it covers are a period of exceptional importance in many directions, and the actions and characters of the principal persons in it demand careful analysis. He is perhaps apt to attach an exaggerated importance to some of the authorities which he was the first to bring to light, to see a general tendency in what may only be the expression of an individual eccentricity, to rely too much on ambassadors' reports which may have been written for some special end, to enter too fully into the details of diplomatic correspondence. In any case the length of his work is not the result of verbiage or repetitions. His style is clear, absolutely unadorned, and somewhat lacking

in force ; he appeals constantly to the intellect rather than to the emotions, and is seldom picturesque, though in describing a few famous scenes, such as the execution of Charles I., he writes with pathos and dignity. The minuteness of his narrative detracts from its interest; though his arrangement is generally good, here and there the reader finds the thread of a subject broken by the in- trusion of incidents not immediately connected with it, and does not pick it up again without an effort. And Gardiner has the defects of his supreme qualities, of his fairness and critical ability as a judge of character ; his work lacks enthusiasm, and leaves the reader cold and unmoved. Yet, apart from its sterling excellence, it is not without beauties, for it is marked by loftiness of thought, a love of purity and truth, and refinement in taste and feeling. He wrote other books, mostly on the same period, but his great history is that by which his name will live. It is a worthy result of a life of

unremitting labour, a splendid monument of historical scholarship. His posi- tion as a historian was formally acknowledged : in 1862 he was given a civil list pension of ??150 per annum, "in recognition of his valuable contributions to the history of England" ; he was honorary D.C.L. of Oxford, LL.D. of Edinburgh, and Ph.D. of Gottingen, and honorary student of Christ Church, Oxford ; and in 1894 he declined the appointment of regius professor of modern history at Oxford, lest its duties should interfere with the accom- plishment of his history. He died 24th February 1902.

Among the more notewortliy of Mr Gardiner's separate works are : Prince Charles and the Spanish Marriage, 2 vols., London, 1869; Constitutional Documents of the Puritan Revolution, 1625- 1660, 1st ed., Oxford, 1889, 2nd ed., Oxford, 1899 ; Oliver Crom- loell, London, 1901; What Gunpowder Plot Was, London, 1897; Outline of English History , Isted., London, 1887,2nd ed., London, 1896; and Students History of England, 2 vols., 1st ed., London, 1890-91, 2nd ed., London, 1891-92. He edited collections of papers for the Camden Society, and also the English Historical Peview. (-w. He.)

Gardner, a town of Worcester county, Massachu- setts, U.S.A., at an altitude of 1034 feet. It is on the main line and a branch of the Pitchburg railroad. The town has an area of 23 square miles of hill country, diversified with ponds. The principal village, bearing the same name as the town, is irregular in plan, and has extensive manufactures, largely of chairs, for which it is widely known. Population of the tovra. (1880), 4988; (1890), 8424; (1900), 10,813, of whom 3449 were foreign-born and 63 coloured.

Garfield, James Abram (1831-1881), twentieth President of the United States, was born 19th November 1831, in a log cabin in the little frontier town of Orange, Cuyahoga county, in Ohio. His early years were spent in the performance of such labour as fell to the lot of every farmer's son in the new states, and in the acquisition of such education as could be had in the district schools held for a few weeks each winter. But life on a farm was not to his liking, and at sixteen he left home and set off to make a living in some other way. A book of stories of adventure on the sea, which

he read over and over again when a boy, had filled him with a longing for a seafaring life. He decided, therefore, to become a sailor, and tramping across the country to Cleve- land, he sought employment from the captain of a lake schooner. But the captain drove him from the deck, and, wandering on in search of work, he fell in with a canal boatman who engaged him. During some months young Garfield served as bowsman, deck-hand, and driver of a canal boat. An attack of the ague sent him home, and on recovery, having resolved to attend a high school and fit himself to become a teacher, he passed the next four years in a hard struggle with poverty and in an earnest effort to secure an education. He worked as a

teacher, a carpenter, and a farmer ; studied Greek and Latin, and finally entered Williams College. On gradua- tion, in 1856, Garfield became professor of ancient lan- guages and literature in Hiram College, Ohio, and had risen to the presidency of the institution when the Civil War opened and he joined the army.

Meanwhile his entrance into political life had been made. In the early days of the Eepublican party, when the shameful scenes of the Kansas struggle were exciting the whole country, and during the campaigns of 1857 and 1858, he became known as an effective speaker and ardent

anti-slavery man. His reward for these services was election to the Ohio Senate as the member from Portage and Summit counties. When the cotton states seceded, Garfield appeared as a warm supporter of vigorous measures. He was one of the six Ohio senators who voted against the proposed amendment to the Federal Constitution forbidding Congress ever again to legislate on the subject of slavery in the States; he upheld the right of the Government to coerce seceded states ; defended the

“Million War Bill”; and when the call came for 75,000 troops he moved that Ohio furnish 20,000 soldiers and three million of dollars as her share. He at once offered his services to the governor, and became lieutenant-colonel and then colonel of the 42nd Ohio Volunteers. He served in Kentucky ; was with Grant at Pittsburg Landing ; was under Rosecrans in the Army of the Cumberland, and was his chief of staff; fought at Chickamauga, and was made a major- general of volunteers for gallantry in that great fight. In 1862 he was elected a member of Congress from the Ashtabula district of Ohio, and took his seat in the House of Representatives in December 1863. In Con- gress he joined the Radical wing of the Republican party, advocated the confiscation of rebel property, approved and defended the Wade-Davis manifesto denouncing the tameness of Lincoln, and was soon recognized as a hard worker and ready speaker. Capacity for work

brought him places on important committees, and his ability as a speaker enabled him to achieve distinction on the floor of the House and to rise to leadership. Between 1863 and 1873 Garfield delivered speeches of importance on “The Constitutional Amendment to Abolish Slavery,^’ “The Freedman’s Bureau,” “The Reconstruction of Rebel States,” ” The Public Debt and Specie Payment,” “Reconstruction,” “The Currency,” ” Taxation of United States Bonds,” ” Enforcing the 14th Amendment,” “National Aid to Education,” and “The Right to Originate Revenue Bills.” The year 1874 was one of disaster to the Republican party. The greenback issue, the troubles growing out of reconstruction in the South, the Credit Mobilier, and the ” Salary Grab ” disgusted thousands of independent voters and sent a wave of Democracy over the country. A Republican Convention in his district demanded his resignation and denounced his support of the hated measures, and re-election seemed impossible. But he defended himself in two pamphlets, “Increase of Salaries” and “Review of the Transactions of the Credit Mobilier Company,” made a village-to-village can- vass, and was victorious. In 1876 Garfield for the eighth time was again chosen to represent his district ; and when, in 1877, James G. Blaine was made a senator from Maine, the leadership of the House of Representa- tives passed to Garfield, and he became the Republican candidate for Speaker. But the Democrats had a ma- jority in the House, and he was defeated. Mr Hayes,

the new President, having chosen John Sherman to be his Secretary of the Treasury, an effort was now made to send Garfield to the United States Senate in Sherman's place. But the President needed his services in the House, and he was not elected to the Senate until 1880.

The time had now come (1880) when the Eepublican party must nominate a candidate for the Presidency. General Grant had served two terms (1869-77), and by the unwritten law of custom ought not to be given another. But the "bosses " of the Republican party in three great states ❓❓❓ New York, Pennsylvania, and Illinois ❓❓❓ were determined that Grant should be renominated. These men and their followers were known as the " Stalwarts." Opposed to them were two other factions, one supporting Mr James G. Blaine of Maine, and the other Mr John Sherman of Ohio. When the convention met and the balloting began, the contest along these factional lines started in serious earnest. For eight-and-twenty ballots no change of any consequence was noticeable. Though votes were often cast for ten names, there were but two real candidates before the convention. General Grant and Mr Blaine. That the partisans of neither would yield was certain. That the choice therefore rested with the support- ers of the minor candidates was manifest, and with the cry, " Anything to beat Grant ! " an effort was made to find some man on whom the opposition could unite. Such a man was ^Garfield. His long term of service in the House, his leadership of his party on its floor, his candidacy for the Speakership, and his recent election to the United States Senate, marked him out as the available man. Between the casting of the first and the thirty- third ballot Garfield had sometimes been given two and at others no votes. On the thirty-fourth he received seventeen, on the next fifty, and on the next almost the entire vote hitherto cast for Blaine and Sherman, and was declared nominated. In November Garfield was duly elected, and he was inaugurated 4th March 1881 ; but on 2nd July, while on his way to attend the commencement exercises at Williams College, the new President was shot by a crazy office-seeker named Guiteau, and, after a linger- ing sickness, died from the effects of his wound on 19th September 1881. (j. b. mcm.)

GARHWAL ❓❓❓ GARIBALDI

Carhwal, (1) a district of Britisli India, in the Kumaon division of the North- West Provinces, and (2) an adjoining native state. Both lie among the Himalayas, containing the headwaters of the Ganges. The district of Garhvi^al is exceedingly mountainous. At least two peaks rise above 25,000 feet. Its area is 6629 square miles. In 1881 it had a population of 346,629, and in 1891 of 407,818, giving an average density of 72 persons per square mile. In 1901 the population was 429,892, show- ing an increase of 5 per cent. The land revenue and rates were Iis.1,77,723, the incidence of assessment being just over 8 annas per acre ; the cultivated area in 1896-97 was 262,484 acres, of which 366 were under tea ; the number of police was 130 ; the number of vernacular schools in 1896-97 was 93, with 3937 pupils ; the registered death- rate in 1897 was 23-67 per thousand. It includes Deo- prayag, one of the holiest places of Hindu pilgrimage. The administrative headquarters are at Fauri, but Srinagar is the largest place ; neither of these is a municipality. The State of Gaehwal is also known as Tehri, after its capital. It area is 4164 square miles. In 1891 it had a population of 241,242, being 58 per- sons per square mile. In 1901 the population was 267,608, showing an increase of 11 per cent. The revenue in 1897-98 amounted to Rs.3,21,287, and the expendi- ture to Rs.2,87,328. There is a reserve of more than Es.8,00,000. No tribute is payable.

Garibaldi, Giuseppe (1807-1882), Italian patriot, was born at Nice on 4th July 1807. As a youth he fled from liome to escape a clerical education, but afterwards joined his father in the coasting trade. After joining the Giovine Italia he entered the Sardinian navy, and, with a number of companions on board the frigate Euridice, plotted to seize the vessel and occupy the arsenal of Genoa at the moment when Mazzini's Savoy expedition should enter Piedmont. The plot being discovered. Garibaldi fled, but was condemned to death by default on 3rd June 1834. Escaping to South America in 1836, he was given letters of marque by the Republic of Rio Grande do Sul, which had revolted against Brazil. After a series of victorious engagements he was taken prisoner and sub- jected to severe torture, which dislocated his limbs. Regaining liberty, he renewed the war against Brazil, and took Porto Allegro. During the campaign he met his

wife, Anita, who became his inseparable companion and mother of three children, Anita, Ricciotti, and Menotti. Passing into the service of Montevideo, he was sent to Corrientes with a small flotilla to support the insui'rec- tion, but was overtaken by Admiral Brown, against whose fleet he fought for three days. When his ammuni- tion was exhausted he burned his ships and escaped. Returning to Montevideo, he formed the Italian Legion, with which he won the battles of Cerro and Sant' Antonio in the spring of 1846, and assured the freedom of Monte- video. Refusing all honours and recompense, he prepared to return to Italy upon receiving news of the incipient revolutionary movement. In October 1847 he wrote to Pius IX. offering his services to the Church, whose cause he for a moment believed to be that of national liberty.

Landing at Nice on 24th June 1848, he placed his sword at the disposal of Charles Albert, and, after various difficulties with the Piedmontese War Office, formed a volunteer army 3000 strong, but shortly after taking the field was obliged, by the defeat of Custozza, to flee to Swit- zerland. .Proceeding thence to Rome, he was entrusted by the Roman Republic with the defence of San Pancrazio against the French, where he gained the victory of 30th April 1849, remaining all day in the saddle, although wounded in the side at the beginning of the fight. Prom

3rd May until 30th May he was continuously engaged against the Bourbon troops at Palestrina, Velletri, and else- where, dispersing an army of 20,000 men with 3000 volun- teers. After the fall of Rome he started for Venice across the swamps of the Romagna, hotly pursued by the Aus- trians. Near Ravenna he lost his wife, Anita, who died of fever. Venice having fallen. Garibaldi went to Genoa, where he was arrested and expelled. Emigrating to New York, he, in order to earn a living, became first a chandler, and afterwards a trading skipper, returning to Italy in 1854 with a small fortune, with which he purchased the island of Caprera. On the outbreak of war in 1859 he was

GlTJSEPPE G-AEIBALDI.

(From a photograph by Elliott and Fry, London.)

placed in command of the Alpine infantry, defeating the Austrians at Casale on 8th May, crossing the Ticino on 23rd May, and, after a series of victorious fights, liberating Alpine territory up to Tirol. When about to cross the Austrian frontier he was stopped by the armistice of Villaf ranca. Returning then to Como to wed the Countess Raimondi, by whom he had been aided during the cam- paign, he was apprised, immediately after the wedding, of certain circumstances which caused him at once to abandon that lady and to start for Central Italy. For- bidden to invade the Romagna, he returned indignantly to Caprera, where with Crispi and Bertani he planned the invasion of Sicily. Assured by Sir James Hudson of the sympathy of England, he began active preparations for the expedition to Marsala. At the last moment he hesitated, but Crispi succeeded in persuading him to sail from Genoa on 6th May 1860, with two vessels carrying a volunteer corps of 1070 strong. Calling at Talamone to embark arms and money, he reached Marsala on 11th May, and landed under the protection of the British vessels Intrepid and Argus. On 12th May the dictatorship of Garibaldi was proclaimed at Salemi, on 16th May the Neapolitan troops were routed at Calatafimi, on 25th May Palermo was taken, and on the 6th of June 20,000 Nea- politan regulars, supported by nine frigates and protected by two forts, were compelled to capitulate. Once estab- lished at Palermo, Garibaldi organized an army to liberate Naples and march upon Rome, a plan opposed by the emissaries of Cavour, who desired the immediate an- nexation of Sicily to the Italian kingdom. Expelling Lafarinaand driving out Depretis, who represented Cavour, Garibaldi routed the Neapolitans at Milazzo on 20th July. Messina fell on 20th July, but Garibaldi, instead of cross- ing to Calabria, secretly departed for Aran ci Bay in Sardinia, where Bertani was fitting out an expedition against the Papal States. Cavour, however, obliged the expedition to sail for Palermo. Returning to Messina, Garibaldi found a letter from Victor Emmanuel II. dissuading him from

invading the kingdom of Naples. Garibaldi replied ask- ing ” permission to disobey.” Next day he crossed the Strait, won the battle of Reggio on

21st August, accepted the capitulation of 9000 Neapolitan troops at San Giovanni and of 11,000 more at Soveria. The march upon Naples became a triumphal progress, which the wiles of Fran- cesco II. were powerless to arrest. On 7th September Garibaldi entered Naples, while Francesco fled to Gaeta. On 1st October he routed the remnant of the Bourbon army 40,000 strong on the Volturno. Meanwhile the Italian troops had occupied the Marches, Umbria, and the Abruzzi, a battalion of Bersaglieri reaching the Vol- turno in time to take part in the battle. Their presence put an end to the plan for the invasion of the Papal States, and Garibaldi unwillingly issued a decree for the pUbiscite which was to sanction the incorporation of the Two Sicilies in the Italian realm. On 7th November Garibaldi accompanied Victor Emmanuel during his sol- emn entry into Naples, and on the morrow returned to Caprera, after disbanding his volunteers and recommend- ing their enrolment in the regular army.

Indignation at the cession of Nice to France and at the neglect of his followers by the Italian Government in- duced him to return to political life. Elected deputy in 1861, his anger against Cavour found violent expression. Bixio attempted to reconcile them, but the publication by Cialdini of a letter against Garibaldi provoked a hostility which, but for the intervention of the king, would have led to a duel between Cialdini and Garibaldi. Returning to Caprera, Garibaldi awaited events. Cavour's successor, Ricasoli, enrolled the Garibaldians in the regular army ; Rattazzi, who succeeded Ricasoli, urged Garibaldi to undertake an expedition in aid of the Hungarians, but Garibaldi, finding his followers ill-disposed towards the idea, decided to turn his arms against Rome. On 29th June 1862 he landed at Palermo and gathered an army under the banner "Roma o morte." Rattazzi, frightened at the prospect of an attack upon Rome, proclaimed a state of siege in Sicily, sent the fleet to Messina, and instructed Cialdini to oppose Garibaldi. Circumventing the Italian troops. Garibaldi entered Catania, crossed to Melito with 3000 men on 25th August, but was taken prisoner and wounded by Cialdini's forces at Aspromonte on 27th August. Liberated by an amnesty. Garibaldi returned once more to Caprera amidst general sympathy.

In the spring of 1864 he went to London, where he was accorded an enthusiastic reception and given the freedom of the City. From England

he returned again to Caprera. On the outbreak of war in 1866 he assumed command of a volunteer army and, after the defeat of the Italian troops at Custozza, took the offensive in order to cover Brescia. On 3rd July he defeated the Austrians at Monte Saello, on the 7th at Lodrone, on the 10th at Darso, on the 16th at Condino, on the 19th at Ampola, on the 21st at Bezzena, but, when on the point of invading Trent, he was ordered by Victor Emmanuel to retire. Replying simply, " I obey," he returned to Caprera to mature his designs against Rome, which had been evacuated by the Frencli in pursuance of the Franco-Italian Conveiition of 15th September 1864. Gathering volunteers in the autumn of 1867, he prepared to enter Papal territory, but was arrested at Sinalunga by the Italian Government and conducted to Caprera. Eluding the surveillance of the Italian cruisers, he returned to Florence, and, with the complicity of the second Rattazzi cabinet, entered Roman territory at Passo Corese on 23rd October. Two days later he took Monte- rotondo, but on 2nd November his forces were dispersed at Mentana by French and Papal troops. Recrossing the Italian frontier, he was arrested at Figline and taken back to Caprera, where he eked out his slender resources by writing several romances. In 1870 he formed a fresh

volunteer corps and went to the aid of France, defeating the German troops at Chatillon, Autun, and Dijon. Elected a member of the Versailles Assembly, he resigned his mandate in anger at French insults, and withdrew to Caprera until, in 1874, he was elected deputy for Rome. Popular enthusiasm induced the Minghetti cabinet to propose that a sum of ??40,000 with an annual pension of ??2000 be conferred upon him as a recompense for his services, but the proposal, though adopted by Parliament (27th May 1875), was indignantly refused by Garibaldi. Upon the advent of the Left to power, however, he accepted both gift and pension, and worked energetically upon the scheme for the Tiber embankment to prevent the flooding of Rome. At the same time he succeeded in obtaining the annulment of his marriage with the Coun- tess Raimondi (with whom he had never lived) and con- tracted another marriage with the mother of his children, Clelia and Manlio. In 1880 he went to Milan for the inauguration of the Mentana monument, and in 1882 visited Naples and Palermo, but was prevented by illness from being present at the 600th anniversary of the Sicilian Vespers. A few months

later, on 2nd June 1882, his death at Caprera plunged the whole of Italy into mourning. (h. w. s.)

Carnier, Jean Louis Charles (1825-1898), French architect, designer of the new Opera House in Paris, was born in that city on the 6th of November 1825. He was educated in a primary school, and it was intended that he should pursue his father's craft, that of a wheelwright. His mother, however, having heard that with a little previous study he might enter an architect's office and eventually become a verijicateur (measuring surveyor), and earn as much as six francs a day, and foreseeing that in consequence of his delicate health he would be unflt to work at the forge, sent him to the Petite ificole de Dessin, in the Rue de Medecine, the cradle of so many of the great artists of France, to learn drawing and mathematics. His progress was such as to justify his being sent first into an architect's office and then to the well-known atelier of Lebas, where he began his studies in preparation for the examination of the ??cole des Beaux Arts, which he passed in 1842, at the age of seventeen. Shortly after his admission it became neces- sary that he should support himself, and accordingly he worked during the day in various architects' offices, among them in that of M. Viollet-le-Duc, and confined his studies for the iScole to the evening. In 1848 he carried off, at the early age of twenty-three, the Grand Prix de Rome, and, with his comrades in sculpture, engraving, and music, set off for the Villa de Medicis. His principal works were the measured drawings of the Forum of Trajan and the temx^le of Vesta in Rome, and the temple of Serapis at Pozzuoli. In the fifth year of his travelling studentship he went to Athens and measured the temple at Aegina, subsequently working out a complete restora- tion of it, with its polychromatic decoration, which was published as a monograph in 1877. The elaborate set of drawings which he was commissioned by the due de Luynes to make of the tombs of the house of Anjou were not published, owing to the death of his patron ; and since Garnier's death they have been given to the library of the Ecole des Beaux Arts, along with other drawings he made in Italy. On his returu'to Paris in 1863 he was appointed surveyor to one or two Government buildings, with a vevy moderate salary, so that the commission given him by M. Baltard to make two water-colour drawings of the Hotel de Ville, to be placed in the album presented to Queen Victoria in 185;"), on the

occasion of her visit to Paris, proved very acceptable. These two drawings are now in the library at Windsor. In 1860 came, at last,

Staircase in the Gkand Opeka House, Pakis. Designed by J. L. C. Gaknier.

Garnier's chance : a competition was announced for a design for a new Imperial Academy of Music, and out of 163 competitors Gamier was one of five selected for a second competition, in which, by unanimous vote, he carried off the first prize, and the execution of the design was placed in his hands. Begun in 1861, but delayed in its completion by the Franco-German war, it was not till 1875 that the structure was finished, at a cost of about 35,000,000 francs (◆◆1,420,000). The history of the building is partly that of Paris, for during the war it was utilized as the municipal storehouse of provisions. The building externally is too well known to need any description; of the interior, the staircase and the mag- nificent hall are the finest portion, and alike in conception and realization have never been approached. Of Garnier's other works, the most remarkable are the Casino at Monte Carlo, the Bischoffsheim villa at Bordighera, the Hotel du Cercle de la Librairie in Paris ; and, among tonrbs, those of the musicians Bizet, Offenbach, Masse, and Duprato. In 1874 he was elected a member of the Institute of France, and after passing through the grades of chevalier, officer, and commander of the Legion of Honour, received in 1895 the rank of grand officer, a high distinction that had never before been granted to an architect. Charles Garnier's reputation was not con- fined to France ; it was recognized by all the countries of Europe, and in England he received, in 1886, the royal gold medal of the Eoyal Institute of Architects, given by Queen Victoria. Besides his monograph on the temple of Aegina, he wrote several works, of which Le Nouvel Op&ra de Paris is the most valuable. For the Inter- national Exhibition of 1889 he designed the buildings illustrating the " History of the House " in all periods, and a work on this subject was afterwards published by him in conjunction with M. Ammann. Not the least of his claims to the gratitude of his country were the services which he rendered on the various art

jui'ies appointed by the State, the Institute of France, and the i^cole des Beaux Arts, services which in France are rendered in an honorary capacity. Gamier died on the 3rd of August 1898. (e. p, s.)

Caro Hills, The, a district of British India, in the Hills division of Assam. It takes its name from the Garos, a tribe of doubtful ethnical affinities and peculiar customs, by whom it is almost entirely inhabited. It consists of the last spurs of the Assam hills, which here run down almost to the bank of the Brahmaputra, where that river debouches upon the plain of Bengal and takes its great sweep to the south. The district was first constituted in 1866, and some trouble was experienced in enforcing authority over certain of the villages. The administrative headquarters are at Tura, of which the population in 1891 was 1045. The area of the district is 3270 square miles. In 1881 it had a popu- lation of 109,548, and in 1891 of 121,570, giving an average density of 37 persons per square mile, the high- est in the hills of the province. There were 1184 Christians, of whom 21 were Europeans or Americans. In 1901 the population was 138,289, showing an increase of 14 per cent. The land revenue was Es.63,214, the incidence of assessment being E.0-14-4 per acre; the number of police was 262 ; the number of boys at school in 1896-97 was 773, being 8-41 per cent, of the male population of school-going age; the number of girls at school was 178, or 1-96 per cent. The American mis- sionaries maintain a small training school for teachers. The public biiildings at Tura were entirely destroyed by the earthquake of 12th June 1897, and the roads in the district were greatly damaged by subsidence and fissures.

Garonne, a river of France, rising in the Mala- detta group of the Pyrenees. The total course of the river in the valley of Aran, in Spanish territory, is about 30 miles, and the area drained 135,900 acres. It enters France at an altitude of 1800 feet, supplies motive power to several mills in the vicinity of Fos, and flows through the gorge of St Beat. The Neste, which joins it at the hill of Montrejeau, brings nearly as much water as the main stream. Between this point and Port Ste Maree the river describes a great curve of about 30 miles around the plateau of Lannemezan. At St Martory it gives off the irrigation canal of that name to water the plains of Toulouse, and at Portet, 5 miles above Toulouse, it is

joined on the right bank, at an altitude of 430 feet, by the Ariege. Below Toulouse the Garonne flows through wide plains, accompanied by a lateral canal at a distance varying from half a mile to 3 miles. At Agen the lateral canal passes by a magniflcent bridge aqueduct from the right to the left bank.

This canal extends from Toulouse to Castets, a length of 120 miles, or, including branclies, of 132 miles. The mean depth in. the level stretches is atout 7 feet, and boats drawing 6 feet can navigate it except between Beaurfigard and Laboulbfene, where the depth is only 4| feet. At Toulouse, where the canal leaves the Garonne, it connects with the Canal du Midi. The Tarn and the Avance are each crossed by a bridge aqueduct, and the Bassanne by a siphon aqueduct. Below Castets a dyke, 6 miles long, pro- tects it from river Inundations. The canal was begun in 1838 and finished in 1856, at a cost of ??2,500,000. It is crossed by 139 bridges. The number of boats plying on the canal in 1900 was 6184, mean tonnage 51, total tonnage 317,615, conveying chiefly agricultural produce and provisions, building materials, wood, and industrial products.

The Garonne has a breadth of 130 yards at Toulouse, 160 at Agen, 160 to about 200 to Podensac, where the river begins to widen out; and at Bordeaux, 15 miles from the head of the estuary, it is from 540 to 660 yards wide. The breadth continues to increase, and at its con- fluence with the Dordogne it has a width of nearly 2200 yards, interrupted, however, by the Isle of Cazeau. It is officially divided into six sections. The figures for traffic here given are those for 1900 : ???

1. Pont-du-Roi to Toulouse, 48 miles ; mean depth, 2J feet ; crossed by 5 bridges. Navigable only between Roquefort and Toulouse. Number of boats, 1117 ; total tonnage, 11,737.

2. Toulouse to mouth of Tarn, 50 miles ; mean depth, IJ feet ; crossed by 8 bridges. Number of boats, 27 ; total tonnage, 114.

3. Mouthof Tarn to Agen, 28 miles ; mean depth, 1 J feet ; crossed by 11 bridges. Number of boats, 139 ; total tonnage, 12,238.

4. Agen to Castets, 66 miles ; mean depth, 3J feet ; crossed by 10 bridges. Number of boats, 2435 ; total tonnage, 71,367.

5. Castets to Bee d'Amb^s, 48 miles; mean depth, 9-8 feet; crossed by 3 bridges. Number of boats, 30,841 ; total tonnage,

1,268,489.

6. I5ec d'Ambfes to ocean, 47 miles ; mean depth, 21 feet. Number of boats, 16,159 ; total tonnage, 345,726. (e. j. h.)*

Caronne-Haute, a department in the south of France, watered by the Garonne, and separated from Spain by the Pyrenees.

Area, 2458 square miles. The population diminished from 481,169 in 1886 to 439,769 in 1901. Births in 1899, 7489, of which 675 were Illegitimate ; deaths, 10,023 ; marriages, 2977. There were in 1896 1122 primary schools, with 55,000 pupils, and 3 per cent, of the population was illiterate. Out of 1,423,378 acres under cultivation in 1896, 924,207 acres were plough-land and 118,614 acres vineyards. The wheat crop of 1899 yielded a value of ►►1,530,000 ; oats, ►►380,000 ; rye, ►►20,000 ; barley, ►►46,000 ; vines, ►►550,000 ; the natural pastures and grass lands, ►►1,032,000. The live stock in 1899 included 30,780 horses, 167,080 cattle, 234,710 sheep, and 100,260 pigs. There are marble quarries, and rock-salt was obtained in 1898 to the extent of 8000 metric tons. The industry in metals produced in 1898 only 2475 tons of iron. In 1901 Toulouse, the capital, had 147,696 inhabitants.

Carrucha, a Mediterranean seaport of Spain, in the province of Almeria. An old castle is now used as a carabineer barrack. The bay affords shelter even for large

vessels, and is every year more frec[uented by foreign ves- sels, chiefly British, French, and Dutch, and by coasting vessels, many of which come in ballast and clear with valuable cargoes. In the neighbourhood the rearing of live stock is a thriving industry, and the inhabitants of rural

districts around send large quantities of wheat, fruit, and vegetables to the port. In 1898 the value of the im- ports was ??170,170; of the exports, ??460,670. The imports were chiefly coal and coke from England, lead ore, bar iron, machinery, timber and deals, petroleum, rice, barley, and soap. The exports were iron ore (??95,056), silver, lead, copper mat, esparto, oranges and lemons, dried figs, marble, and lead ore. Almost all the lead and copper mat went to England, and also the esparto. In the coasting trade in 1898, 311 vessels en- tered and 309 cleared. In the foreign trade, 116 vessels

of 125,079 tons entered, and 116 of 147,843 tons cleared. Population over 5000.

Carrus, a small province of Persia, situated between Khamseh and Azerbaijan in the north and Kurdistan and Hamadan in the south. Its population is estimated at 80,000, and its capital, Bijar, has a population of 3000. The province is fief of the chief of the Garrus Kurds, and pays a yearly revenue of about ??3000 and supplies a battalion of infantry (the 34th) to the army.

Carston, a seaport, railway station, and urban dis- trict in the Widnes division of Lancashire, England, 6 miles south of Liverpool, on the Mersey. The docks, belong- ing to the London and North- Western Eailway Company, employ most of the working population. Population

(1891), 13,444; (1901), 17,288.

GAS AJSTD GAS LIGHTIJ^G.

THE last twenty-five years of the 19th century will always be looked back to as the most important epoch in the history of the great gas industry, this period having been marked not only by many improvements in the manufacture of illuminating gas, but by a complete revolution in the methods of enriching it and utilizing it for the production of light. In 1875 the London Argand, giving a duty of 3-2 candles illuminating power per cubic foot of ordinary 16-candle gas, was looked upon as the most perfect burner of the day, and little hope was entertained that any burner capable of universal adoption would surpass it in its power of developing light

from the combustion of coal gas ; but the beginning of the new century found the incandescent mantle and Bunsen burner yielding six times the light that was then pro- duced by the consumption of an equal volume of gas. In this article the chief changes which have taken place in the manufacture of gas, its purification and enrich- ment, since the issue of the ninth edition of this work, will be dealt with, and then the even more important alterations in the methods used for its consumption will be fully discussed.

Gas Manufactuee.

No very radical alterations have taken place in the methods employed in the destructive distillation by which the volatile constituents of the coal are driven off by heat as crude gas and tar vapour, while the residue remains behind as coke. The retorts are made of fireclay, and in all but small country works the old single- Retorts. ended retort, which was about 9 feet in length, has given way to a more economical construction, known as doubles, double-ended, or through retorts, in which a retort 18 to 20 feet long is fitted with a mouthpiece and ascension pipe at each end. The number of " through " retorts in the retort bench varies from three to twelve, the common practice being to place two at the bottom, three in the middle tier, and two above, these being known as bottoms, middles, and tops. Considerable economy has been introduced in the heating of the retorts by the adoption of regenerative furnaces, the use of which on the Continent is universal, and is now fairly general in Great Britain. In this system of firing a mixture of carbon monoxide and nitrogen is produced liy passing air through incandescent gas coke in a generator placed be- low the bench of retorts, and the heating value of the gases so produced is increased in most cases by the ad- mixture of a small proportion of steam with the primary air supply, the steam being decomposed by contact with the red-hot coke in the generator into water gas, a mixture

of carbon monoxide and hydrogen. (See Gaseous Euel.) The gases so formed vary in proportion with the temper- ature of the generator and the amount of steam, but gen- erally contain 32 to 38 per cent, of combustible gas, the remainder being the residual nitrogen of the air and car- bon dioxide. These gases enter the combustion chamber around the retorts at

a high temperature, and are there supplied with sufiicient air to complete their combustion, this secondary air supply being heated by the hot products of eomljustion on their way to the exit flue. This method of firing results in a saving of about one-third the weight of coke used in the old form of furnace per ton of coal carbonized, and also enables higher temperatures to be obtained.

The importance of labour-saving appliances in gas works has been fully realized in recent years, and in the retort-house mechanical charging and drawing machines are now largely used, while by the use of sloping instead of horizontal retorts gravitation is employed to facilitate the same operations. In both arrangements the coal as it is taken from the stores is broken to the size of nuts in a crusher, and elevated to convenient hoppers above the benches. With the horizontal retorts a mechanical charging machine, worked by compressed air, delivers the coal into the retorts, and with the assistance of a drawing machine, using similar motive power, the work of feeding the retorts with raw material and with- drawing the residual coke is performed expeditiously, with considerable economy and less discomfort than was formerly the case. West's compressed-air drawing and charging machines are an example of this system ; they are designed for working retorts in every tier, being pro- vided with mechanism for elevating the charging and drawing frames to the various levels. Por further economy retort benches of four and five tiers are sometimes constructed, and the general practice is to draw and charge all the retorts on one level at the same time, working from end to end of the retort house. In the gravitation method the retorts are inclined to the horizon at an angle to suit the slip of the class of coal used. This angle is between 28 and 34 . The coal, previously t'levated to the hoppers, is dropped into feeding chambers so arranged that they can travel from end to end of the retort house and deposit the coal into the retorts. When the retort is to be charged an iron stop or barrier is placed in the lower mouthpiece and the door closed. The shoot is placed in the upper mouthpiece, and the stop or door which retains the coal in the chamber is released ; the coal is then discharged into the retort, and, running down the incline, is arrested by the barrier, and banks up,

GAS AND GAS LIGHTING

forming a continuous backing to the coal following. By- experience with the class of coal used, and the adjustment of the stops in the shoot, the charge can be run into the retort to form an even layer of any desired depth. For the withdrawal of the residual coke at the end of car- bonization the lower mouthpiece door is opened, the barrier removed, the coke in the lower part of the retort is " tickled " or gently stirred with an iron rod to over- come a slight adhesion to the retort, and the entire mass readily discharges itself. Guides are placed in front of the retort to direct its course to coke hoppers or con- veyers below, and to prevent scattering of the hot material. This system shows the greater economy in the cost of carbonizing the coal, but the large outlay and considerable wear and tear of the mechanical appliances involved have so far prevented a very general adoption of the process.

The increase in the temperature of distillation to which the coal is subjected increases considerably the volume of gas produced per ton of coal carbonized, and at the same time gives a decrease in the candle-power; but as the latter is not as great in proportion as the gain in volume, it is generally found that the candle-feet per ton of coal

vol. per ton x illuminating value\ . , . , , , , r 1 IS higher than when

lower temperatures were used, while the tar is also altered in character, becoming more viscid and rather less in volume as the temperature of distillation in- ❑❑❑creases. In most works the yield of gas per ton of or- dinary gas coal carbonized is from 10,000 to 11,000 cubic feet.

Little or no change has taken place in the treatment of "the crude gas as it flows from the retort up the ascension pipe and through the dip pipe and hydraulic main to the condensers, exhaiister scrubbers, and purifiers ; but a ❑❑❑clearer conception is being gained as to the actions taking place in the latter, and they are now generally so handled as to secure increased purity in the gas. In general practice slaked lime is employed for the removal of carbon dioxide and the greater quantity of sulphur compounds, while a catch-box or purifier of oxide of iron serves to remove the last traces of ❑❑❑sulphuretted hydrogen. Not fewer than

four lime puri- fiers are employed, and as the one which is first in the series becomes exhausted, i.e., begins to show signs of allowing carbon dioxide to pass through it unabsorbed, it is filled with fresh slaked lime, and is made the last of the series, the one which was second becoming first ; and this procedure goes on continuously. This operation is necessitated by the fact that carbon dioxide has the power of breaking up the sulphur compounds formed by the lime, so that until all carbon dioxide is absorbed with formation of calcium carbonate, the withdrawal of sul- phuretted hydrogen cannot proceed, while since it is cal- ~~cium sulphide formed by the absorption of sulphuretted hydrogen by the slaked lime that absorbs the vapour of carbon bisulphide, purification from the latter can only be accomplished after the necessary calcium sulphide has been formed. The foul gas leaving the scrubbers con~~ tains, as a general average, 30 grains of sulphuretted hydrogen, 40 grains of carbon bisulphide, and 200 grains of carbon dioxide per 100 cubic feet. On entering the first purifier, which contains calcium sulphocarbonate and other combinations of calcium and sulphur in smaller quan- tity, the sulphuretted hydrogen and bisulphide vapour have practically no action upon the material, but the ~~carbon dioxide immediately attacks the calcium sul~~ phocarbonate, forming calcium carbonate with the pro- duction of carbon bisulphide vapour, which is carried over with the gas into the second box. In the connexion between the first and second box the gas is found to con-

Parltlca- tloa.

tain 500 grains of sulphuretted hydrogen and 80 grains of carbon bisulphide per 100 cubic feet, but no trace of carbon dioxide. In the second box the formation of calcium sulphocarbonate takes place by the action of car- bon bisulphide upon the calcium sulphide with the libera- tion of sulphuretted hydrogen, which is carried over to the third purifier. The gas in the connecting pipe between the second and third box will be found to contain 400 grains of sulphuretted hydrogen and 20 grains of carbon bisulphide. The contents of the third box, being mostly composed of slaked lime, by the action of sulphuretted hydrogen upon which calcium sulphide is very rapidly formed, will practically remove the remaining impurities, and the outlet gas will show 20 grains of

sulphuretted hydrogen and 8 grains of carbon bisulphide per 100 cubic feet. The catch-box of oxide of iron will then remove all traces of sulphuretted hydrogen. It will be noticed that in the earlier stages the quantity of the sulphur impurities is actually increased between the purifiers ; in fact, the greater amount of sulphiding pro- cures the ready removal of the carbon bisulphide, but it is the carbon dioxide in the gas that is the disturbing element, inasmuch as it decomposes the combinations of sulphur and calcium. Consequently it is a paramount object in this system to prevent this latter impurity finding its way through the first box of the series. The finding of any traces of carbon dioxide in the gas between the first two boxes is generally the signal for a new clean purifier being put into action, and the first one shut off, emptied, and recharged with fresh lime. The impregnated material is sometimes sold for dressing certain soils. The action of oxide of iron in the catch- box depends on its power of combining with sulphu- retted hydrogen to form sulphide of iron. Such is the affinity of the oxide for this impurity that it may contain 50 to 60 per cent, by weight of free sulphur after revivi- fication, and still remain active. Upon removing the material from the vessel and exposing it to the atmo- sphere the oxide undergoes a revivifying process, the oxygen of the air displacing the sulphur from the sulphide as free sulphur, and converting the iron into hydrated oxide of iron. This revivification can be carried on a number of times till the material when dry contains about 50 per cent, free sulphur, and even occa- sionally 60 per cent, and over ; it is sold to manufac- turers of sulphuric acid, to be used in the sulphur kilns of their plant.

The fact that coal gas of an illuminating power of from 14 to 16 candles can be made in ordinary circum- stances at a fairly low rate, while every candle-power added to the gas increases the cost in an enor- mous and rapidly growing ratio, has, from ^^nt!' the earliest days of the gas industry, caused the attention of inventors to be turned to the enrich- ment of coal gas. This up to 1890 had been almost universally carried out in practice by an admixture of rich cannel coal with the ordinary gas coal in the retorts, with a consequent heavy increase in the cost of the gas. But in that year cannel coal, which had been gradually growing dearer and dearer, reached a prohibitive price, with the result that other methods of enrichment were gradually adopted ; and although cannel has fallen in

price, it will never again be used on a large scale for the enrichment of coal gas, as not only are other methods cheaper and more convenient, but the available supplies of cannel are limited, and any large readoption of its use would soon result in increase in price. The methods which have from time to time been advocated to replace the use of cannel in the enrichment of illuminating gas may be classified as follows : ???

1. Enriching the gas by vapours and permanent gases obtained by decomposing the tar formed at the same time as the gas.

2. Mixing with the coal gas oil gas, obtained by de- composing crude oils by heat.

3. The carburetting of low-power gas by impregnating it with the vapours of volatile hydrocarbons.

4. Mixing with coal gas water gas which has been highly carburetted by passing it with the vapours of various hydrocarbons through superheaters in order to give permanency to the hydrocarbon gases. These methods may now be considered in detail.

1. Enrichment by Tar. ??? From the earliest days of the gas industry attempts have been made to utilize tar for the production and enrichment of gas. The patent litera- ture of the 19th century contains many hundreds of such schemes, most of which were still-born ; a few spent a short and sickly existence, but none achieved success. The reason is not difficult to understand. In order to make gas from tar two methods may be adopted ??? (a) Condensing the tar in the ordinary way, and afterwards using the whole or portions of it for cracking into a per- manent gas ; (b) cracking the tar vapours before conden- sation by passing the gas and vapours through superheaters. If thei^rst method be adopted, the trouble which presents itself, and in a few hours brings the apparatus to grief, is that the tar contains 60 per cent, of pitch, which rapidly chokes and clogs up all the pipes. If an attempt be made to use a temperature at which the

pitch is decom- posed, it is found that a uon- or very poorly luminous gas is the result, while a heavy deposit of carbon remains in the superheater or retort ; and even at a high tempera- ture easily condensable vapours escape, which afterwards create trouble in the pipes. In order to get over the difficulties arising from the choking by the pitch, attempts have been made to distil the tar at a low temperature and utilize the 40 to 60 per cent, of oil so obtained for gasifying, but here the small yield of oil and the expense of handling and distilling have prevented tar from com- peting with other processes of enrichment. A more economical way was to distil the tar so as to leave the pitch behind, and then, instead of condensing the vapours to oil, to pass them through a heated chamber, and thus raise their temperature above the critical point. But as soon as this was tried it was foimd that the lighter vapours, which distilled off first, only required a tempera- ture to crack them which was totally inadequate to render the heavier vapours coming off later in the dis- tillation uncondensable ; while if the heat was so arranged as to crack the heavy vapours, it broke up the lighter ones into gases of very poor illuminating power. These troubles of course arise from the same cause as in the earlier experiments on carburetting gas, by passing over or through volatile naphthas ??? viz., that the tar, like the naphthas, is a mixture of many compounds varying in composition and properties. In order (as far as possible) to surmount this trouble, Mr George Davis proposed to distil the tar so as to remove pitch, and then to get rid of the naphthalene and anthracene, using the remainder, four-fifths of which can be gasified, for enriching the gas. He calculated that coal yields 0‘7 per cent, of its weight of tar, 0-4 of which is got rid of as pitch, and the remain- ing 0-28 per cent, can be converted into gas, a gallon of the oil yielding 80 cubic feet of 50-candle gas. He inferred that from a ton of ordinary coal, by utilizing the tar in this way, 10,465 ciibic feet of 18‘4-candle gas could be obtained, instead of 10,000 of 17-candle gas.

The most apparently successful attempt to utilize cer- tain portions of the liquid products of distillation of coal was the Dinsmore process, in which the coal gas and the

vapours which, if allowed to cool, would form tar were made to pass through a heated chamber, and a certain proportion of otherwise

condensable hydrocarbons were thus rendered incondensable. Even with a poor class of coal it was claimed that 9800 cubic feet of 20 to 21 candle gas could be made by this process, whereas by the ordinary process 9000 cubic feet of 15-candle gas would have been produced. This process, although strongly advocated by the gas engineer who experimented with it, could not have been commercially very successful, as nothing has been heard of it for some years. The eventual solution of the question of enrichment of gas by hydrocarbons derived from tar may be arrived at by a process which prevents the formation of part of the tar during the carbonization of the coal, but all experience points to the impossibility of again decomposing tar in such a way as to be economically successful for enrichment when once it has been formed.

2. Enrichment by Oil Gas. ??? The second method by which a coal gas of poor quality may be enriched up to any desired standard is by mixing with it " oil gas," obtained by decomposing crude oil by heat. The earliest attempts in this direction were to spray oil upon the red- hot mass in the retort during carbonization ; but experience soon showed that this was not an economical method of working, and that it was far better to decompose the liquid hydrocarbon in the presence of the diluents which are to mingle with it and act as its carrier, since if this were done a higher temperature could be employed, and more of the heavier portions of the oil converted into gas, without at the same time breaking down the gaseous, hydrocarbons too much. For instance, if a petroleum oil is decomposed by itself, the resulting gas would consist largely of hydrogen and methane, and the heavy hydro- carbons would probably vary from 16 to 26 per cent., a considerable quantity of carbon separating; but if it were decomposed in the presence of a stream of diluting gas, a far larger percentage of illuminants of the higher marsh gas series (ethane, &c.) would be produced, and a compara- tively small quantity of hydrogen and methane. This is due to the fact that when the hydrocarbons are undiluted they can easily be broken down by heat to hydrogen and carbon ; whereas when they are diluted, a far higher tem- perature is necessary to effect this action, and so the degradation of the hydrocarbons is stopped at an earlier

***In carburetting a poor coal gas with paraffin it must be borne in mind that, as the coal is undergoing distillation, m the earlier stages a rich gas is given off, but towards the end of the operation the gas is very poor in illuminants and rich in hydrogen, the methane disappearing with the other hydrocarbons, and the increase in hydrogen being very marked. Mr Lewis T. Wright employed a coal re- quiring SIX hours for its distillation, and took samples of the gas at different periods of the time. On analysis these- yielded the following results : ***

Time after beginning Distillation. |

IHour

8 Hours

5 Hours

30 Minutes.

25 Minutes.

35 Minutes.

Sulphuretted "I hydrogen /

1-30

1-42

0-49

0-11

Carbon dioxide .

2-21

2-09

1-49

1-50

Hydrogen .

20-10

38-33

52-68

07-12

Carbon monoxide

6-19

5-68

0-21

6-12

Marsh gas .

57-38

44-03

33-54

22-58

Illuminants

10-62

5-98

3-04

1-79

Nitrogen

2-20

2-47

2-55

0-78

This may be regarded as a fair example of the changes- which take place in the quality of the gas during the dis-

tillation of the coal. In carburetting such a gas by inject- ing paraifin into the retort, many of the products of the decomposition of the oil being vapours, it would be waste- ful to do so for the first two hours, as a rich gas is being given off which has not the power of carrying in suspen- sion a much larger quantity of hydrocarbons without being saturated with them. Consequently, to make it bear along with it any further quantity, in a condition not easily deposited, the paraffin would have to be broken down to a great extent, and the temperature necessary to do this would seriously affect the quality of the gas given off by the coal. When, however, the distillation had gone on for three hours the rich portions of the coal gas would all have distilled off, and the temperature of the retort would have reached its highest point ; this would be the best time to feed in the oil.

Undoubtedly the best process which has been proposed for the production of oil gas to be used in the enrichment of coal gas is the " Young " or " Peebles "' process, which depends on the principle of washing the oil gas retorted at a moderate temperature by means of the oil which is

afterwards to undergo decomposition, whereby it is freed from all condensable vapours, and only permanent gases are allowed to escape to the purifiers. In doing this very considerable quantities of the defines and other fixed gases are also absorbed, but no loss takes place, as these are again driven out by the heat in the subsequent retort- ing. Two east-iron retorts about 10 feet in length, set so as to incline downwards to the far end, are used at Peebles's. They are fitted with the usual doors and ascension pipes, but in each door there is a small pet-cock, by opening which the colour of the gas can be seen. This should be of the palest lemon, as it is found that if any darker colour or an approach to brown is produced, decomposition of tar (besides other troubles) will begin. The oil is admitted through small cocks about 2 feet up the ascension pipe, and falls down through the ascending gas on to steel plates, which extend 3 feet into the retort, so as to prevent as far as possible the direct impact of the oil upon the bottom of the iron retort. The tempers/- ture of the retorts is from 800 to 900 C. The gas on leaving the retorts passes up the ascension pipes to the hydraulic main and through a coil of horizontal condens- ing pipes to the scrubber, which is of the " Young " pattern, and made in four compartments. The oil cistern is placed on top of the scrubber, and the supply pipe from it is so arranged that the oil can be made to flow into any or all of the sections. After passing through the scrubber the oil flows back along the bottom of the horizontal con- densers in an opposite direction to that in which the gas is passing, and thence into the hydraulic main. Prom the main it passes through a seal into a small cistern con- taining a float connected with an indicator close to the oil feed taps in front of the working bench, so that the supply of oil can be regulated in accordance with the rate of decomposition. The oil used is what is technically known as " blue " oil, and has an average specific gravity of about -850. Each retort will make 500 cubic feet of gas per hour, and 6^ cwt. of a very dense graphitic coke are obtained for each ton of oil decomposed. This coke collects almost entirely at the back of the retorts, and being non-adherent, is readily removed. The surface of the coke is practically horizontal, which suggests that either it has flowed to the back of the retort as pitch and has been there carbonized, or that carbon deposited in the ascension pipes and front of the retort has been washed there by the oil.

The gas obtained by the Young process, when tested by itself in the burners most suited for its combustion, gives on the photometer an illuminating value averaging from 60 to 60 candle-power, but it is claimed that the enriching

power of the gas is considerably greater. The reason is, that the duty obtained from any burner is entirely depen- dent, firstly, on the regulation of the size of the flame, so that the gases as they burn shall get the correct proportion of oxygen within a given distance from the tip of the burner ; and, secondly, upon the temperature of the flame itself. Hence every variety of gas will give different illuminating values according to the burner used, the burner adapted for a poor or medium gas being utterly unfitted for rich gas, a point which is too often over- looked in testing the illuminating power of gases as well as in their practical consumption. A 16-candle coal gas requires a very large biirner to develop its maximum illuminating power as a flat flame, but as the richness of the gas in heavy hydrocarbons increases, the size of the burner has also to be rapidly decreased, in order to allow sufficient air to get to the flame ; and the smaller the flame, the greater will be the cooling influence of the burner and of the nitrogen of the air upon it, with the result that a burner has to be selected for each quality of gas of such size that it will just not smoke. For in- stance : with an oil gas capable of emitting a light equal to 50 candles per 5 cubic feet, it would be found that the No. 2 Bray burner would give a heavy smoky flame, which will become still more smoky with increase in the size of the burner ; but if a No. 0 Bray were employed, a smokeless flame would be obtained which would give an illuminating power equal to slightly under 50 candles per 5 cubic feet of gas consumed ; and as the size of the burner is reduced the illuminating power recorded would, also decrease, until, with a No. 000, it would only record 35 candles per 5 cubic feet, the falling off being due to the cooling of the flame. With such a gas, therefore, the No. 0 burner would give the highest results ; and when experimenting with gases of over 60 candle-power it is impossible to get a burner which will develop the maximum value, as the burner has to be so small, in order to prevent smoking, that cooling destroys a large percentage of the illuminating value. Hence it is frequently found that the enrichment value of a rich oil gas is higher than would be expected from its photo- metric value.

The fundamental objections tooil gas for the enrichment of coal gas are, firstly, that its manufacture is a slow pro- cess, requiring as much plant and space for retorting as coal gas ; and, secondly, that although on a small scale it can be made to mix perfectly with coal gas and water gas,, great difficulties are found in doing this on the large scale, because in spite of the fact that, theoretically, gases of such widely different specific gravities ought to form a perfect mixture by diffusion, it is found that layering of the gases is very apt to take place in the holder, and thus there is an increased liability to wide variations in the illuminating value of the gas sent out.

3. Enrichment by Volatile Hydrocarbons. ––– The carbu- retting of poor coal gas by passing it over or through highly volatile hydrocarbons, such as the lighter naphthas and benzene, has always been a favourite notion, but the great trouble which in the past has presented itself in the various carburetting systems is, that all the commercial samples of naphtha are mixtures of various hydrocarbons, having each their own boiling-point ; therefore, when used in any of the old forms of carburetter they gave up their more volatile constituents very freely at the beginning of the experiment, while the amount rapidly diminished as the boiling-point of the residue became higher. Hence, when 2113 cubic feet of poor coal gas were passed through a naphtha having a specific gravity of ~~869 and a boiling~~ point of 103 –– C, the temperature during the experiment being 22 –– C. (72 –– P.), the first 80 cubic feet of the gas took up 23-2 grains of the naphtha, whilst the last 450

cubic feet took up only 7-3 grains. The increase of evap- oration with increase of temperature presented itself as another diificulty, for, with an ordinary form of carbu- retter exposed to changes of the atmosphere, the enrich- ment of the gas, which reached 44-4 per cent, in the summer, the average temperature being 72 –– F. (22 –– C), fell in winter to only 22 per cent., with an average tem- perature of 37 –– P. (3 –– C). Much,

however, depends on the form of the carburetter. In one experiment, when gas was passed through a box containing a layer of naphtha, it took up only about 3 ‘2 grains, but when the naphtha was sucked up by cotton fibres the gas took up as much as 22 to 23 grains in the same time owing to the large surface exposed, the same naphtha being used in both cases. A most important point is that only a poor gas can be enriched in this manner, a rich gas losing some of its illuminating power. The best method of carburet- ting poor coal gas at the burner is that known as the albo-carbon process, in which solid naphthalene is vaporized in a chamber by means of a strip of metal kept hot by the flame, the vapour mixing with the gas passing through the chamber.

Of recent years the idea of carburetting coal gas in bulk has been revived by the construction of an ingenious apparatus, devised by Messrs Maxim and Clarke, which to a great extent overcomes the difficulties of the old forms of carburetter. This process not only does away with the trouble that the more volatile portion of the naphtha or gasoline used enriches the gas to an undue ex- tent at the beginning of the process, but it also carburets the gas used in large works and establishments, so that each portion obtains its proper share of hydrocarbon. For small installations the apparatus consists of a cir- cular copper retort, which is kept automatically filled to a fixed level with gasoline from a reservoir outside the building. The retort is jacketed, and steam or hot water is passed round it to volatilize the gasoline, which passes over bafile plates in the top of the retort and then through an automatic regulator into a small holder sealed with mercury. The gas to be carburetted has to pass through this holder, and as it does so the gasoline vapour is supplied to it in the following way : ??? The holder works on a vertical spindle which passes down the tube into the gasoline retort, and is so arranged that when no gas is passing through the opening is closed and no gasoline can enter the holder. As gas is admitted the holder rises and lifts the spindle with it, allow- ing the gasoline vapour to rush up through grooves cut in the bottom of it ; the higher the spindle is drawn the larger the openings become, and so the supply of gaso- line increases pari passu with the amount of gas entering the holder.

Since about 1886 the price of benzol has been rapidly falling, owing to the large quantities produced in the coke ovens, which in the old days used to be burnt to waste, but are now recovered in the processes of coking which are becoming more and more widely adopted. The quantity of benzol produced in 1901 in Germany amounted to about 5,000,000 gallons per annum, and this quantity will be increased more than fourfold as the various coke works which do not at present recover the by-products are forced by competition to erect recovery plant. The wonderful carburetting power of benzol is well known, a very large proportion of the total illuminating power of coal gas being due to the presence of a minute trace of its vapour carried in suspension ; with 90 per cent, benzol at a low price it is by far the cheapest enriching material that can be obtained, and at many gas works it is used in various forms of carburetter for enriching poor coal gas up to the requisite illuminating 230wer.

4. Enrichment by Carburetted Water Gas. ??? In the last decade of the 19th century the most successful and most generally adopted method of enrichment was by means of carburetted water gas mixed with poor coal gas. When steam acts upon carbon at a high temperature, the resulting action may be looked upon as giving a mixture of equal volumes of hydrogen and carbon monoxide, both of which are inflammable but non-luminous gases. This water gas is then carburetted, i.e., rendered luminous by passing it through chambers in which oils are decomposed by heat, and the mixture of oil gas diluted with water gas is made of such richness as to give an illuminating value of 24 or 25 candles. This mixed with the poor coal gas brings up its illuminating value to the required limit. Coke or anthracite is heated to incandescence by an air blast in a generator lined with firebrick, and the heated products of combustion as they leave the generator and enter the superheaters are supplied with more air, which causes the combustion of the carbon monoxide present in the producer gas and heats up the firebrick baffles with which the superheater is filled. When the necessary temperature of the fuel and superheater has been reached, the air blasts are cut off and steam is blown through the generator, forming water gas, which meets the enriching oil at the top of the first superheater, called the carburetter, and carries the vapours with it through the main superheaters, where the fixing of the hydrocarbons takes place. The chief advantage of this

apparatus is that a low temperar ture can be used for fixing owing to the enormous surface for superheating, and thus to a great extent the depo- sition of carbon is avoided. This form of apparatus has been very generally adopted in Great Britain as well as in America, and practically all carburetted water gas plants are founded upon the same set of actions. Im- portant factors in the use of carburetted water gas for enrichment are that it can be made with enormous rapid- ity and with a minimum of labour ; and not only is the requisite increase in illuminating power secured, but the volume of enriched gas is increased by the hvlk of car- buretted water gas added, which in usual English practice amounts to from 25 to 50 per cent. The public at first strongly opposed its introduction, on the grounds of the poisonous properties of the carbon monoxide, which is present in it to the extent of about 28 to 30 per cent. Still, when this comes to be diluted with 60 to 75 per cent, of ordinary coal gas, containing as a rule only 4 to 6 per cent, of carbon monoxide, the percentage of poisonous monoxide in the mixture falls to below 16 per cent., which experience has shown to be a fairly safe limit.

The price of oil suitable for carburetting has during the past few years nearly doubled, and this fact has caused the gas industry to consider other methods by which the volume of the gas obtainable from coal can be increased by admixture with " blue " or non-luminous water gas. In Germany, at several important gas-works, non- luminous water gas is passed into the foul main of the gas plant in the desired proportion, and the mixture of water gas and coal gas is then carburetted to the required extent by benzol vapour, a process which at the present price of oil and benzol is distinctly more economical than the use of carburetted water gas. Extensive experiments are also being made on the Continent and in England upon pass- ing water gas in the desired proportion through the crown of the retort in which the distillation of the coal is proceeding so as to prevent overheating of the gas and vapours by too long contact with the crown and sides of the retorts, the water gas so used also holding in sus- pension some of the more volatile hydrocarbons that would otherwise condense in the tar. In 1896 T\Ir Carl

Dellwik introduced a modification in the process of making water gas which entirely altered the whole aspect of the industry. In all the attempts to make water gas up to that date the incandescence of the fuel had been obtained by " blowing " so deep a bed of fuel that carbon monoxide and the residual nitrogen of the air formed the chief products, this mixture being known as " producer " gas. In the Dellwik process, however, the main point is the adjustment of the air supply to the fuel in the generator in such a way that carbon dioxide is formed instead of carbon monoxide. Under these conditions the producer gas ceases to exist as a by-product, and the gases of the blow consist merely of the incombustible products of complete combustion, carbon dioxide and nitrogen, the result being that more than three times the heat is developed for the combustion of the same amount of fuel, and double the quantity of water gas can be made per pound of fuel, than was before possible. The runs or times of steaming can also be continued for longer periods. The possibility of making 70,000 cubic feet of water gas per ton of coke used in the Dellwik generator, as against 34,000 cubic feet per ton made by previous processes, reduces the price of tvater gas to about 3d. per 1000, so that the economic value of using it in admixture with coal gas and then enriching the mixture by any cheap carburetting process is manifest. During the past few years it has become more and more evident that the universal adoption of the incandescent mantle for lighting purposes makes the illuminating value of the gas a secon- dary consideration, and the whole tendency of the future will be the production of low candle-power gas at a cheap rate for fuel purposes and incandescent lighting.

Gas Lighting.

Industrial history shows the great utility of brisk com- petition, and in no case is this more marked than in the utilization of gas for the emission of light. From 1820, when ISTeilson of Glasgow first discovered the principle of the union jet burner, and gave the world an easy and at the same time fairly effective method of consuming the then newly invented illuminant, until quite recent times, coal gas had been consumed by the methods which had suflced for illumination in the early days ; and in all

probability the methods of consumption would have continued to be of the same inefBcient character down to the present time had it not been for the appear- ance of the electric light as a competitor in the latter part of the 'seventies, and the dread which suddenly a,rose in the minds of those interested in gas manufacture as to the effect of this brilliant rival on their commer- cial status. It is true that the germs of important methods of consuming gas had already been sown, but the time had not been ripe for their development, and it was only the absolute necessity of combating the inroads of electricity that caused the adoption of new and improved methods for developing the light latent in coal gas.

In the early 'fifties Sir Edward Frankland had already pointed out that the heating of the air supply to a flame marvellously increased the light which Regener- that flame emitted. He devised a burner which ^'^ners Consisted of an ordinary Argand, having in addi- tion to the usual chimney a second external one which extended some distance below the first, and was closed at the bottom by a glass plate fitted air-tight to the pillar carrying the burner, so that the air needed to support the combustion of the gas had to pass down the .annular space between the two chimneys, and in its pas- sage became highly heated, partly by contact with the hot inner glass and partly by radiation. He claimed that the use of this burner gave an increase of C7 per

cent, in the light over that obtained by the combustion of the same volume of gas in an ordinary Argand. In 1854 the Eev. W. R. Bowditch brought out a burner identical in nearly every respect with the above, and as this was brought prominently forward, it attracted con- siderable attention, with the result that the inception of the regenerative burner has been generally ascribed to Bowditch, whereas this honour was undoubtedly due to Frankland. This burner has been revived from time to time since its first invention, but has always failed, owing to the inner chimney not being able to withstand the intense heat to which it was subjected; it is of interest as being the first inception of the idea of the modern regenerative burner. In 1879 Friedrich Siemens, of Dres- den, brought out his big burner, which, although one of the most effective, was also one of the most unsightly from its big overhead feed pipe. It was really first made for heating purposes, but the light it gave was so far ahead of any effect

which had been obtained up to that time, that, with certain modifications, it was adopted for lighting purposes. In 1881 Mr Thwaite published in the English Mechanic a description of an overhead recuperative burner under the name of the Hygienic lamp ; and from that time up to the present regenerative burners ??? good, bad, and indifferent ??? have increased and multiplied with great rapidity, the chief differences between them being in their names and slight details of design.

The fact that the luminosity of a coal gas flame depends upon the number of carbon particles liberated within it, and the temperature to which these carbon particles can be heated, at once points to the fact that the methods by which the light developed from a flame of coal gas can be augmented are the increase in the number of the carbon particles by increasing the material which will deposit them, and raising the temperature to which the carbon particles already present have been heated. The first process is carried out by enrichment, the second is best obtained by regeneration, the action of which is limited by the power possessed by the material of which burners are composed to withstand the superheating. Although with a perfectly-made recuperative burner it might be possible for a short time to get as high a duty as 16 candles per cubic foot from ordinary coal gas, such a burner constructed of the ordinary materials would only last a few hours, so that for practical use and a reasonable life for the burner 10 candles per cubic foot was about the highest commercial duty that could be reckoned on. This limitation naturally caused inventors to search for methods by which the emission of light could be obtained from coal gas other than by the incan- descence of the carbon particles contained within the flame itself, and the fact that a coal gas flame consumed in an atmospheric burner under conditions necessary to develop from it its maximum heating power could be utilized to raise particles having a higher emissivity for light than carbon to incandescence, led to the gradual evolution of incandescent gas-lighting, which undoubtedly marks another of the most important eras in the history of gas as an illuminant.

Existing systems of lighting by means of incandescent mantles are the result of many years of experimental toil and disappointment, and from the day when Talbot in 1835 first noticed that blotting-paper lacan- soaked in a solution of calcium chloride and mimues. burnt in the flame

of a spirit lamp leaves a white network of ashes, which heated in the feeblest flame emits a brilliant light, down to the latest developments of the Welsbach mantle, there have been many thousands of experimental failures and still-born attempts which have neither seen nor created light. That all solids can be

made to emit light -vvhen heated to a certain temperature has of course always been known. The fact that at any given temperature some substances would emit more light than others gave rise to the Drumniond light, in which a block of lime raised to the highest temperature possible by the intensity of the oxy-hydrogen or oxy-coal gas blast emitted a light which until the advent of the electric arc remained unrivalled. The amount of material which has in this case to be raised to incandescence rendered this very high temperature necessary, and it was gradually recognized that if instead of a block of lime a basket-work of thin filaments made of lime and magnesia could be employed better results would follow, since instead of the costly oxy-hydrogen or oxy-coal gas flame an ordinary gas and air blowpipe working at a slight pressure could be used. This was practically adopted in the Clamond mantle, which was probably the first oxide mantle which had any extended commercial existence. The same prin- ciple was utilized in the Fahnejelm comb, which was heated to incandescence by water gas. The Clamond mantle, as shown at the Crystal Palace Exhibition of 1882-83, consisted of a conical basket composed of threads of calcined magnesia. A mixture of the hydrate and acetate of magnesium, converted into a paste or cream by means of water, was moulded to the required shape, and then ignited ; the heat decomposed the acetate, which in its partial fusing during decomposition formed a luting material which glued the particles of magnesium oxide produced into a solid mass, while the hydrate gave off water and became oxide. The basket was supported with its apex downwards in a little platinum wire cage, and a mixture of coal gas and air was driven into it from an inverted burner above it. Long, however, before this oxide mantle made its appearance Lewis had introduced a

mantle made of fine platinum wire, which, when raised to incandescence by a blast of air and coal gas, gave for a certain period what was then considered a very high duty for gas consumed, but the rapid falling off of its power of emitting light proved a fatal obstacle to its commercial success. This deterioration was partly due to the surface of the platinum becoming corroded by the formation of traces of carbide of platinum from the action of the hydrocarbon in the flame, and partly to the deposi- tion on its surface of traces of foreign metals due to the breaking up of the carbonoxyl compounds, of which the gas contained minute quantities. It was this latter trouble that at a more recent date militated against what at first appeared a very promising attempt to utilize thin platinum-iridium wire for the manufacture of an un- breakable incandescent mantle. The year 1886 marks the first appearance of the Welsbach system of incan- descent mantles, which after many years of struggle and effort at length attained a well-earned success. Dr Auer von Welsbach, whose researches on the rare metals and their compounds had already gained him a great reputation, conceived the idea of making a mantle of refractory oxides by the methods which had been previ- ously shadowed by Talbot and others. His process con- sisted in soaking an open fabric of cotton in a solution of the nitrates of the metals of which he required the oxides, drying it, and burning off the organic matter, the nitrates at the same time becoming converted into their respective oxides, which retained the shape of the original fabric. Various modifications have been introduced in the manufacture of the fabric and in the composition of the dipping material, until at the present time the incandescent mantle is far and away superior in light- emissivity to any other method of producing light from coal gas.

In the system of lighting by means of incandescent mantles the most important feature is the burner, which

*must give a non-luminous flame, else deposition of carbon will soon ruin the mantle as regards its light- ^^^ giving powers. A non-luminous flame can be spheric obtained either by burning a mixture of air and burners for gas, mixed before combustion, or by burning "a""**- the coal gas in so thin a sheet of flame that the air can permeate it with suiiicient freedom to render it non- luminous. The former method is now employed in nearly all systems of incandescent lighting, but the latter is used in*

Paris in one form of the De Mare system, in which a fringe of light-giving oxides is heated by a small flat flame burner burning with a non-luminous flame. The extended use of incandescent mantles has produced many improvements in the atmospheric burners employed in connexion with them, and has led to a study of the factors necessary to obtain the best results. One of the most promising directions in which this has taken place has been the gradual realization of the fact that in order to secure the highest results the mixture of air and gas must not only be in such proportions as to ensure perfect combustion, but that the mixture itself must be so perfect that each molecule of combustible matter shall find itself side by side with the oxygen necessary for its combustion at the burner tip, as it is manifest that the intensity of the flame is greatly in-creased by the proper regulation of this factor. The chemical actions taking place in a Bunsen burner can be divided into two distinct parts : the first occur on the surface of the inner visible cone of the flame, where the hydrogen and hydrocarbons of the gas enter into partial combination with the oxygen of the air which has been previously mixed with the gas, forming a mixture of carbon dioxide and monoxide with some water vapour; and the second takes place in the outer flame, which is produced by the combustion of the hydrogen and carbon monoxide escaping from the inner zone, the products of the completed combustion being carbon dioxide and water vapour. The appearance of the Bunsen flame varies with the amount of air which is drawn in with the gas. Undernormal conditions thezones of the flame havea violet- blue colour, and as more air is admitted the flame grows fiercer and the inner zone acquires a green tint. A still further addition of air causes the mixture to become so highly explosive that it flashes back into the tube of the burner. In the Bandsept and Kern burners the mixture of air and gas can be so regulated that not only is the green cone in the interior of the flame formed, but owing to the explosive point of the mixture being reached it is drawn down on to the surface of the gauze "atomizers" or mixers, through which it cannot pass, so that the flame consists of practically only the outer cone of the ordinary Bunsen, by which method a more even equality in temperature can be obtained than with the ordinary flame.

The most successful form of mantle is made by taking a cylinder of cotton net about 8 inches long, one end of which is sewn together with an

asbestos thread, a loop of the same material or of thin platinum wire being fixed across the constricted portion to Maatie provide a support by which the mantle may be held by the carrying rod, which is either external to the mantle or (as is most often the case) fixed centrally in the burner head. After being sewn, the cotton net is soaked in a solution of the nitrates of the requisite metals until the microscopic fibres of the cotton are entirely filled with liquid. A longer soaking is not. advantageous, as the acid nature of the liquid employed tends to weaken the fabric and render it more delicate to handle. The cotton is then wrung out to free it from the excess of liquid attached to the exterior of the threads, and is stretched over a conical mould and dried. It is.

maau- facture.

then ready for "burning off," a process in which the organic matter is removed and the nitrates are converted into oxides. The flame of an atmospheric burner is first applied to the constricted portion at the top of the man- tle, whereupon the cotton gradually burns downwards, the shape of the mantle to a great extent depending on the regularity with which the combustion takes place. A certain amount of carbon is left behind after the flame has died out, and this is burnt off by the judicious appli- cation of a flame from an atmospheric blast burner to the interior. The action which takes place during the burning off is as follows : ❖❖❖ The cellulose tubes of the fibre are filled with the crystallized nitrates of the metals used, and as the cellulose burns the nitrates decompose, giving up oxygen and forming fusible nitrites, which in their semi-liquid condition are rendered coherent by the rapid shrinkage which takes place. As the action continues the nitrites become oxides, losing their fusibility, so that by the time the organic matter has disappeared a coherent thread of oxide is left in place of the nitrate-laden thread of cotton. The great draw- back in the early days of incandescent lighting was that the mantles had to be sent out unburnt and the consumer had to burn them off when required, as no process was known by which the burnt mantle could be rendered sufficiently strong to bear carriage. As

the success of the mantle depends upon its fitting the flame, and as the burning off requires considerable skill, this was a great difficulty. Moreover, the acid nature of the nitrates present in the fibres rapidly rotted them, unless they had been subjected to the action of ammonia gas, which neutralized- any excess of acid ; but it^was found that treatment with ammonia rendered the mantles after burning off even more fragile than before, as the fusible nitrates were converted into hydrates, which could not be pressed together into a coherent mass during the burning off. It was discovered, however, that the burnt-off mantle could be temporarily strengthened by being dipped in collodion, a solution of soluble gun-cotton in ether and alcohol together with a little castor oil or similar material to prevent excessive shrinkage during drying : when the mantle was removed from the solution a thin film of solid collodion was left on it, and this burned away on the application of a light when required, no bad after-effects being left.

The oxides first used in England for Welsbach man- tles consisted of mixtures of zirconia, lanthania, and yttria, or zirconia and lanthania, but these gave a very fragile mantle, and only yielded 4 to 7 candles per cubic foot of gas consumed. In 1886 the second Welsbach patent was taken out, which covered the use of thoria, either alone or mixed with zirconia, magnesia, yttria, erbia, neodidymia, lanthania, alumina, &c. The idea which was held at that time was that a pure thoria man- tle had a very high power of light emission, but in point of fact really pure thoria emits practically no light at all, although later experience showed that it possessed important properties for mantle-making, its refractory nature giving the mantle a stability unat- tainable by any other known body. The thoria man- tles made under this patent gave a duty of 6 candles per cubic foot of gas consumed, but when made with pure thoria they give a duty of less than 1 candle per cubic foot of gas, and the other mixtures specified in the patent give results which hardly come within the range of practical utility. About 1891, mantles on the Continent began to show a marked improve- ment, and in 1891-92 it was reported that Welsbach had produced new mantles yielding as much as 16 and 17 candles per cubic foot of gas consumed, and the same improvement was manifested in the English man-

ettect of cerla.

ties. The cause was shown in the following year, 1893, in a patent taken out by Mr Moeller, in which protection was sought for a combination of thoria with very small traces ??? not exceeding 1 or 2 per cent. ??? of the oxides of certain other rare metals, such as uranium, cerium, terbium, neodidymium, samarium, prazeodymium, yttrium, and lanthanum. The present mantles nearly all consist of 99 per cent, tlioria with 1 per cent, cerium, this latter oxide having qualities far in advance of any of the others mentioned.

It will be seen from the above description that the mantles of to-day are the outcome of three stages ??? (1) The method of making the mantle, and the use of the oxides of the rare earths ; (2) using thoria instead of zirconia as the basis of the mantle; and (3) the effect of traces of other oxides on the light-emissivity of the thoria. In the days prior to Welsbach's discovery the rare earths had been studied by but few, although several famous chemists, foremost among them Bunsen, had de- voted special attention to them, and no method was known by which they could be obtained in a state of absolute purity. The price of the raw materials being ex- cessive, their purification was not pushed to the extreme limits, and consequently the candle-power of the earlier mantles was more often influenced by the impurities pres- ent in the materials used than by the actual composition of the mantle. Many experiments have been made in order to determine the effect of the percentage of ceria when added to thoria on the light-emissivity of the mantle, and the results obtained show that, starting with a pure thoria mantle giving practically no light, the candle-power rapidly increases as traces of ceria are added to it, until the maximum is reached, when increase in the amount of ceria decreases the light emitted, the colour of the light also acquiring a yellowish tint, which gradually deepens to a reddish char- acter with excess of ceria. These results show such a narrow limit for the production of the highest light-emissivity, that a very careful proportioning of the liquid for soaking the mantle is necessary. The effect of vary- ing proportions of ceria upon the life of the mantle shows that with a Welsbach mantle made in the ordinary man- ner by soaking the fabric in the nitrates solution, the higher the initial illuminating value the greater is the falling off in light

over a given space of time. It is gen- erally found that the light from a Welsbach mantle in- creases for a certain period and then steadily falls, the initial increase being probably due to the mantle shaping itself to the flame, while the subsequent dimintition in power is chiefly due to dust particles containing silica, which are drawn in over the surface of the mantle by the chimney draught and, fusing on the outside of the fine filaments, form silicates which have a much lower power of light-emissivity than the original oxides.

Many theories have been advanced to explain the mar- vellous power possessed by the minute trace of ceria in exciting the light-giving power of the mantle. The ex- planation put forward by Dr Drossbach, that the ceria has some occult power of converting the heat rays into light, is now regarded as untenable. Drs Killing and Moschelles are of opinion that the ceria (CeOj), at a high temperature under the influence of the hydrogen and carbon monoxide, becomes reduced to cerous oxide (Ce203) with liberation of oxygen, which, combining on the surface of the ceria with the combustible gases of the flame, induces a far higher temperature in the ceria than exists in the thoria, the cerous oxide then undergoing oxidation to the higher compound by the action of the excess of air present. This theory, however, would imply that the more ceria were present the greater would be the light-emitting power of the mantle ; but this is not so, as any increase over 1 per

ceut. tends to reduce the light-giving power. In the explanation of Dr Bunte, which is the one most gen- erally accepted, the action is ascribed to a catalysis of the same nature as causes a piece of platinum foil after cleaning to become red-hot when a mixture of coal gas and air is allowed to impinge upon it, the action being due to the power which the platinum possesses of con- densing within its pores both coal gas and air, and rendering them so chemically active that they unite upon the surface of the metal and emit sufficient heat to raise it to a bright red. Dr Bunte found that at 11>00 F. (649 C.) a mixture of hydrogen and oxygen, in the proportion of two to one, when passed through a heated

porcelain tube, combined to form water, and that the presence of thoria in the tube had no influence upon the temperature at which the combination took place. When he passed the same mixture through a tube containing ceria, the action commenced at 600 F. (316-5 C), and his inference was that this catalytic action, by localizing a high temperature in the small particles of oeria spread -over the surface of the inert thoria, is the cause of the high light-emissivity. Proof of Drossbach's theory ought easily to have been obtained by observing the way in which the rare oxides and mix- tures behave when out of contact with air, but Dr Bunte found on experiment that there was very little differ- ence in the noticeable light radiation from bodies of such widely different light-emissivity as carbon, mag- nesia, thoria, or the mixtures used in the Welsbach mantle. In order to prove this fact he used a thick- walled tube of retort carbon, the thickness of the walls of the centre portion of which for a length of 4 inches was reduced to 0-059 inch. When a strong current of electricity was passed through the thin-walled portion it was raised to a white heat, about 3630 F. (1999 C), the tube being protected from burning away at this point by a coating of magnesia covered by an outer wrapper of asbestos paper. In the interior of the tube small square prisms of magnesia were placed, coated with the substance under examination, and each prism compared side by side in the hottest portion of the tube, a small sight-hole being left at the end of the car- bon tube for observation purposes. By using double prisms, one coated with the substance to be tested and the other with a standard material of known composition, it was found that there was practically no difference in the various materials. This was also confirmed by some experiments made by Mr Campbell Swinton, in which various mantle materials were enclosed in a vacuum tube and submitted to cathode rays : he found that although the mixture of 99 per cent, thoria and 1 per cent, cerium in a vacuum heated up to incandescence more rapidly than pure thoria alone and cooled down afterwards more rapidly, its incandescence was only very slightly greater than that of the thoria alone. Many other facts can be adduced to support the theory that the light is due to the particles of ceria being heated to a higher temperature than that of the flame. The luminosity of an ordinary flame has been shown to be due to the splitting up of the molecule of acetylene with the liberation of endotherniic heat, by which the carbon particles are heated to a tem- perature far above that

which exists in the flame. So in the same way the heat of the flame which heats the whole mantle plus the locally intensified points of excessively high temperature, due to the catalytic action of the ceria upon the oxygen, carbon monoxide, and hydrogen, proba- bly accounts for the intense light-emissivity of the mantle. Additional confirmation of the fact is gained from the cir- cumstance that similar results, though not so marked, are obtained by the use of other materials known to have catalytic powers. The quantity of ceria may seem so

small that it does not appear possible for it to play any important part in the light-giving power of the mantle. Dr Bunte, however, points out that in an ordinary gas flame the luminosity is due to liberated carbon particles heated to an intense degree; the carbon is chiefly ob- tained from the decomposition of unsaturated hydro- carbons, which only form about 5 per cent, of the volume of the gas. Supposing all the carbon of the unsaturated hydrocarbons to be liberated, it may be calculated that about 54 milligrams of carbon are separated from a litre of coal gas, or 23-6 grains from 1 cubic foot. Thus 4 per cent, of ethylene and 1 per cent, of benzene give per litre of gas 60 cc. of carbon vapour from the benzene and 40 cc. from the ethylene, in all 100 cc, equal to about 64 milligrams of carbon. The volume of the luminous por- tion of a flame consuming 6-297 cubic feet per hour, with an illuminating power of 17-5 candles, is about 2 cc. at 32 ◆◆ F. (0 ◆◆ C). It therefore contains 2 x 64—1000 mg. or 0-1 mg. (0-0015 grain) of incandescent carbon, and this small quantity is sufficient to yield a light of 17-5 can- dles. In a Welsbach mantle the amount of ceria is about 4 mg., 0-06 grain, or forty times the quantity of incandes- cent carbon in an ordinary flame, and this will explain why the Welsbach mantle gives a light of 80 candles when the Argand burner affords only 16 candles.

Of late years improved methods have arisen in the manufacture of some mantles, the principle of the Clamond mantle being revived. As already mentioned, these Clamond baskets were made improve- by weaving together threads made from a paste m^ties! of magnesia and magnesium acetate, which after baking could be rendered incandescent by means of an ordinary burner. On 4th November 1890 an improve- ment on this method was patented by Lungren. It was found that in the weaving the

threads at the points of intersection did not weld properly, as the first threads laid on the mould dried before the cross threads were put on, so that on pressing them together the dry threads cut through the softer ones and did not unite with them, with the result that it was difficult to get a coherent mantle. Lungren, however, mixed the earths into a paste with a combustible elastic material, formed the thread, and then wove the mantle from it, the binding material being afterwards burnt out. Suitable materials are said to be glue mixed with glycerine, indiarubber dissolved in naphtha, &c. At the present time collodion is being largely used as a vehicle for holding the incandescent oxides. Among numerous other applications it has been employed for the manufacture of artificial silk, and large factories have been erected in Europe for this pur- pose. The usual method is to convert wood pulp into collodion by nitration. This collodion is then dissolved in as little alcohol and ether as possible, and the solution is squeezed under great pressure through capillary glass tubes, the bore of which is less than one-hundredth of a millimetre. The filament dries a few inches from the orifice of the tube, and ten or twelve of them are twisted together and wound on to a bobbin. The twisted thread is then denitrated by dipping the skeins into a solution of ammonium sulphide, by which they are converted into ordinary cellulose and lose their excessive inflammability. After washing and drying the skeins are ready for weaving into fabric. This artificial silk was utilized by De Mare in 1894 for making mantles by adding to the collodion the necessary salts, and in the next year Knofler and then Plaissetty patented the manufacture of mantles by a similar process to De Mare's, the difference between them being that Knofler used ammonium sulphide for denitrat- mg purposes, while Plaissetty employed calcium sulphide, the objection to which is the trace of lime left in the material. Another process is the Lehner, in which the

high pressures employed for the formation of the filameiit in the early processes are done away with, the solution used being of a more liquid character and the thread hardened by passing through certain organic

solutions. This form of silk has been found well adapted for the manufacture of mantles, and the finished mantles are far superior to the older makes.

Mantles made in the above way are evidently develop- ments of the Clamond class, as the filaments are made by squeezing the material through small holes to form rods or threads, leaving a thread of even density when the collodion is burnt off. In the Auer mantle, however, the filaments on burning off each leave a minute rod of oxides having a dense central portion surrounded by a more or less spongy coating, formed by the salts on the exterior of the filament, which are kept in a porous condition by the escape through them of the gases given off during the burning of the organic matter. In the Welsbach mantle this filamentary matter is twisted in the thread into what, after burning off, becomes practically a fluted column of oxides, but in the Clamond mantle each separate filament stands out by itself, so that the complete thread is really a bundle of filaments, the number of which varies accord- ing to the make of the mantle. The Lehner mantle, for instance, contains more filaments than the Knofler or Plaissetty. This difference in structure between the two classes has a very important effect on the life and strength of the mantle. The decrease in light due to the formation of silicates from dust on the surface of the mantle is con- siderably less in the case of the Clamond type than with the ordinary Welsbach mantle ; the Welsbach mantle after 600 to 600 hours' burning becomes but a mere shadow of its former self, and yields only about a third of the original light, whereas mantles such as the Knofler and Lehner keep up their light-emitting power to a much greater extent, more especially in the case of the latter.

In Germany nearly 90 per cent, of the gas lighting is done by the aid of the incandescent mantle, but in England it has only reached to about 30 per cent, of the whole. It is, however, rapidly spreading, and, with improvements in the strength and lasting power of the mantle, and a cheapening in price, must soon pass into general use. Moreover, in spite of the cost of breakages and renewals, the fact that the use of the mantle increases sevenfold the light obtainable from a cubic foot of gas, as

compared with what was possible with the flat flame or Argand, renders gas lighting the cheapest method of obtaining artificial light. (v. b. l.)

Cas Engines. See Engines.

Caseous Fuel. ??? Natural gas (see Ency. Brit, 9th ed. vol. ix. p. 809, and vol. xxiii. p. 813) has become of practical importance only in some states of the United States, especially in Pennsylvania, where it still plays a very great part for both household and industrial purposes, hundreds of gas wells having been bored and long pipe lines having been constructed. The gas, which contains from 68 to 94 per cent, of methane, with a little hydrogen, ethylene, &c., is evidently an accumulation of many ages, and is gradually approaching exhaustion, the maximum yield having been reached in 1890. The gas used in 1899 was valued at 11|- million dollars.

Of much more importance, and that in a constantly increasing proportion, is artificial gas of all kinds. It is necessary to distinguish between the gaseous fuel obtained as a by-product of certain technical operations and that prepared on purpose. In the former case the combustible gases have been and are still frequently wasted, but their utilization is becoming more and more extended. This is true especially of the gases from blast-furnaces and from coke-ovens. Of the gaseous fuel prepared on purpose there

are two different classes. The first comprises combustible gases generated by the destructive distillation of coal, lignite, bituminous schist, cheap oils, and substances of analogous character. By far the most important case of this kind is the manufacture of coal gas, which is primarily made for the purpose of illumination, but which serves also as a fuel for domestic use, for laboratories, and to some extent even for industrial purposes. In all cases belonging to this class only a comparatively small proportion of the heat-value of the coal is obtained in the shape of gaseous fuel, by far the greater portion remaining behind in the shape of coke. Where the latter is the principal object of the operation, as in the manufacture of coke for metallur- gical purposes, the gases necessarily evolved are still wasted in the great majority of cases, although their fuel value is almost equal to that of ordinary illuminating gas.

An entirely different class of gaseous fuels comprises those produced by the incomplete combustion of the total carbon contained in the raw material, where the result is a mixture of gases which, being capable of combining with more oxygen, can be burnt and employed for heating pur- poses. Apart from some descriptions of waste gases be- longing to this class (of which the most notable are those from blast-furnaces), we must distinguish two ways of producing such gaseous fuels entirely different in prin- ciple, though sometimes combined in one operation. The incomplete combustion of carbon may be brought about by means of atmospheric oxygen, by means of water, or by a simultaneous combination of these two actions. In the first case the chemical reaction is

C + 0 = CO

(a);

the nitrogen accompanying the oxygen in the atmospheric air necessarily remains mixed with carbon monoxide, and the resulting gases, which always contain some carbon dioxide, some products of the destructive distillation of the coal, &c., are known as producer gas or Siemens gas. In the second case the chemical reaction is mainly

C + H2O = CO -f H2

(&);

that is to say, the carbon is converted into monoxide and the hydrogen is set free. As both of these substances can combine with oxygen, and as there is no atmospheric nitrogen to deal with, the resulting gas (ivater gas) is, apart from a few impurities, entirely combustible. Another kind of water gas is formed by the reaction

C + 2H2O = CO2 + 2H2

(0),

but this reaction, which converts all the carbon into the incombustible form of CO2, is considered as an unwelcome, although never entirely

avoidable, concomitant of (6).

The reaction by which water gas is produced being endothermic (as we shall see), this gas cannot be obtained except by introducing the balance of energy in another manner. This might be done by heating the apparatus from without, but as this method would be uneconomical, the process is carried out by alternating the endothermic production of water gas with the exothermic combustion of carbon by atmospheric air. Pure water gas is not, there- fore, made by a continuous process, but alternates with the production of other gases, combustible or not. But instead of constantly interrupting the process in this way, a con- tinuous operation may be secured by simultaneously carry- ing on both the reactions (a) and (b) in such proportions that the heat generated by (a) at least equals the heat absorbed by (b). For this purpose the apparatus is fed at the same time with atmospheric air and with a certain quantity of steam, preferably in a superheated state. Gaseous mixtures of this kind have been made, more or less intentionally, for a long time past. One of the best

known of them, intended less for the purpose of serving as ordinary fuel than for that of driving machinery, is the Dowson gas.

An advantage common to all kinds of gaseous fuel, which indeed forms the principal reason why it is inten- tionally produced from solid fuel, in spite of inevitable losses in the course of the operation, is the following. The combustion of solid fuel (coal, &c.) cannot be carried on with the theoretically necessary quantity of atmo- spheric air, but requires a considerable excess of the latter, at least 50 per cent, sometimes 100 per cent, and more. This is best seen from the analyses of smoke gases. If all the oxygen of the air were converted into COj and HjO, the amount of CO2 in the smoke gases should be in the case of pure carbon nearly 21 volumes per cent., as carbon dioxide occupies the same volume as oxygen ; while ordinary coal, where the hydrogen takes up a cer- tain quantity of oxygen as well, should show about 18-5 per cent. COj. But the best smoke gases of steam boilers show only 12 or 13 per cent., much more frequently

only 10 per cent. CO_2, and gases from reverberatory furnaces often show less than 5 per cent. This means that the volume of the smoke gases escaping into the air is from IJ- to 2 times (in the case of high-temperature operations often 4 times) greater than the theoretical minimum ; and as these gases always carry off a considerable quantity of heat, the loss of heat is all the greater the less complete is the utilization of the oxygen and the higher the tem- perature of the operation. This explains why, in the case of the best-constructed steam-boiler fires provided with heat economizers, where the smoke gases are de- prived of most of their heat, the proportion of the heat value of the fuel actually utilized may rise to 70 or even 75 per cent., while in some metallurgical operations, in glass-making and similar cases, it may be below 5 per cent.

One way of overcoming this difficulty to a certain extent is to reduce the solid fuel to a very fine powder, which can be intimately mixed with the air so that the consumption of the latter is only very slightly in excess of the theoretical quantity ; but this process, which has been only recently introduced on a somewhat extended scale, involves much additional expense and trouble, and cannot as yet be considered a real success. Generally, too, it is far less easily applied than gaseous fuel. The latter can be readily and intimately mixed with the exact quantity of air that is required and distributed in any suitable way, and much of the waste heat can be utilized for a prelimi- nary heating of the air and the gas to be burned by means of "recuperators."

We shall now describe the principal classes of gaseous fuel.

A. Ordinary Coal Gas. ??? Although this gas is primarily manufactured for illuminating purposes, it is now exten- sively used for cooking, frequently also for heating domestic rooms, baths, &c., and to some extent also for industrial operations on a small scale, where cleanliness and exact regulation of the work are of particular importance. In chemical laboratories it is preferred to every other kind of fuel wherever it is available. The manufacture of coal gas having been described elsewhere in this work (see Gas and Gas-Lighting), we need here only point out that it is obtained by heating bituminous coal in fireclay retorts and purifying the products of this de- structive distillation

by cooling, washing, and other opera- tions. The residual gas, the ordinary composition of which is given in the table below, amounts to about 10,000 cubic feet for a ton of coal, and represents about 21 per cent, of its original heating value, 56-5])er cent, being left in the coke, 5-5 per cent, in the tar, and 17 per cent, being lost. As we must deduct from the coke that

quantity which is required for the heating of the retorts, and which, even when employing good gas producers, amounts to 12 per cent, of the weight of the coal, or 10 per cent, of its heat value, the total loss of heat rises to 27 per cent. Taking, further, into account the cost of labour, the wear and tear, and the capital interest on the plant, coal gas must always be an expensive fuel in com- parison with coal itself, and cannot be thought of as a general substitute for the latter. But in many cases the greater expense of the coal gas is more than compensated by its easy distribution, the facility and cleanliness of its application, the general freedom from the mechanical loss, unavoidable in the case of coal fires, the prevention of black smoke, and so forth. The following table shows the average composition of coal gas by volume and weight, together with the heat developed by its single constituents, the latter being expressed in kilogram calories per cubic metre (0-262 kilogram calories = 1 British heat unit; 1 cubic metre = 35-3 cubic feet; therefore 04123 calories per cubic metre = 1 British heat unit per cubic foot).

*= s ******

= 33;^ i!

0

S =

^ a

-sg-ga

Constituents.

Is

^1

1 i.”"

corn

Hydrogen, H2 .

47 ???

7-4

2,582

1213

22-8

Methane, CH4 .

34

42-8

8,524

2898

54-5

Carbon monoxide, CO

9

19-9

3,043

273

5-1

Benzene vapour, CsHs

1-2

7-4

33,815

405

7-7

Ethylene, C2H4

3-8

8-4

13,960

530

9-9

Carbon dioxide, CO2

2-5

8-6

Nitrogen, N2

Total .

2-5

5-5

100-0

100-0

5319

100-0

One cubic metre of such gas weighs 568 grams. ” Rich Gas,” viz., such made by the destructive distillation of certain bituminous schists, of oil, ►►&c., contains much more of the heavy hydrocarbons, and its heat-value is therefore much higher than the above. The carburetted water gas, very generally made in America, and sometimes employed in England for mixing with coal gas, is of vary- ing composition ; its heat-value is generally rather less than that of coal gas (see below).

B. Coke-oven Gas. ►►► In the United Kingdom the great bulk of metallurgical coke is still made by the old ” bee- hive ” ovens, in which all the volatile products of the destructive distillation of coal are completely wasted. Only about 5 per cent, of British coke is made in ovens fitted with apparatus for the recovery of the by-products ; in Germany these are employed for nearly half of the coke made, and they are also coming into extensive use in America. The gas drawn awav from these ovens, and remaining after the condensation of the tar and ammonia, is every\here applied to the heating of the coke-ovens themselves, thus effecting a considerable increase in the yield of coke. But in all the better systems there is a considerable surplus of gas applicable to exti-aneoQS purposes. Its composition resembles that of ordinary coal sas, but as it contains less heavy hydro- carlwns (especially when intentionallv deprived of its benzene vapour), its heat-value is much less. Still, being a waste product and costing practically nothing, it is worthy of much more attention than it has hitherto received, especially in Great Britain.

C. Producer Gas, Siemens Gas (see EitC!/. Brit., 9th ed., xxii. 182). ►►► As we have seen above, this gas is made bv the incomplete combustion of fuel. The materials generally employed for its production are anthracite, coke, or other fuels which are not liable to cake during the operation, and thus stop the draught or otherwise disturb the pro-

cess, but by special measures also bituminous coal, lignite, peat, and other fuel may be utilized for gas producers. The fuel is arranged in a deep layer, generally from four feet up to ten feet, and the air is introduced from below, either by natural draught or by means of a blast, and either by a grate or only by a slit in the wall of the " gas producer." Even if the primary action taking place at the entrance of the air consisted in the complete combus- tion of the carbon to dioxide, CO2, the latter, in rising through the high column of incandescent fuel, must be reduced to monoxide : C02+C=2CO. But as the tempera^ ture in the producer rises pretty high, and as in ordinary circumstances the action of oxygen on carbon above 1000 ◆◆C. consists almost entirely in the direct formation of CO, we may regard this compound as primarily formed. It is true that ordinary producer gas always contains more or less CO2, but this is evidently formed higher up by air entering through leakages in the apparatus. If we ignore the hydrogen contained in the fuel, the theoretical com- position of producer gas would be 33-3 per cent. CO and 66-7 per cent. N, both by volume and weight. Its weight per cubic metre is 1-251 grams, and its heat-value 1013 calories per cubic metre, or less than one-fifth of the heat-value of coal gas. Practically, however, producer gas contains a small percentage of gases, increasing its heat- value, like hydrogen, methane, &c., but on the other hand it is never free from carbon dioxide to the extent of from 2 to 8 per cent. Its heat-value may therefore range be- tween 800 and 1100 calories per cubic metre. Even when taking as the basis of our calculation a theoretical gas of 33-3 per cent. CO, we find that there is a great loss of heat-value in the manufacture of this gas. Thermo- chemistry teaches us that the reaction C-|-0 develops 29 '5 per cent, of the heat produced by the complete oxidation of C to CO2, thus leaving only 70-5 per cent, for the stage C0-|-0 = C02. If, therefore, the gas given off in the producer is allowed to cool down to ordinary temperature, nearly 30 per cent, of the heat-value of the coal is lost by radiation. If, however, the gas producer is built in close proximity to the place where the com- bustion takes place, so that the gas does not lose very much of its heat, the loss is correspondingly less. Even then there is' no reason why this mode of burning the fuel, i.e., first with " primary air " in the producer (C -1-0= CO), then with "secondary air" in the furnace (00+0 = 062), should be preferred to the direct complete burning of the fuel on a grate, unless the above-mentioned advantage is

secured, viz., reduction of the smoke gases to a minimum by confining the supply of air as nearly as possible to that required for the formation of CO_2, which is only possible by producing an intimate mixture of the producer gas with the secondary air. The advantage in question is not very great where the heat of the smoke gases can be very fully utilized, e.g., in well-constructed steam boilers, salt-pans, and the like, and as a matter of fact gas producers have not found much use in such cases. But a very great advantage is attained in high-tempera- ture operations, where the smoke gases escape very hot, and where it is on that account all-important to confine their quantity to a minimum.

It is precisely in these cases that another requirement frequently comes in, viz., the production at a given point of a higher temperature than is easily attained by ordinary fires. Gas-firing lends itself very well to this end, as it is easily combined with a preliminary heating up of the air, and even of the gas itself, by means of " recuperators." The original and best-known form of these, due to Siemens Brothers, consists of two brick chambers filled with loosely- stacked fire-bricks in such manner that any gases passed through the chambers must seek their way through the interstices left between the bricks, by which means a

thorough interchange of temperature takes place. The smoke gases, instead of escaping directly into the atmo- sphere, are made to pass through one of these chambers, giving up part of their heat to the brickwork. After a certain time the draught is changed by means of valves, the smoke gases are passed through another chamber, and the cold air intended to feed the combustion is made to pass through the first chamber, where it takes up heat from the white-hot bricks, and is thus heated up to a bright red heat until the chamber is cooled down too far, when the draughts are again reversed. Sometimes the producer gas itself is heated up in this manner (especially whenit hasbeen cooled down by travellingalongdistance) ; in that case four recuperator chambers must be provided instead of two. Another class of recuperators is not founded on the alternating system, but acts continuously; the smoke gases travel always in the same direction in flues contiguous to other flues or pipes in which the air flows in the opposite direction, an interchange of heat taking place through the walls of the flues or pipes. Here the surface of

contact must be made very large if a good effect is to be produced. In both cases not merely is a saving effected of all the calories which are ab- stracted by the cold air from the recuperator, but as less fuel has to be burned to get a given effect, the quantity of smoke gas is reduced and thus a second advantage is secured.

Gas-firing in the manner just described can be brought about by very simple means, viz., by lowering the fire- grate of an ordinary fire-place to at least 4 ft. below the fire-bridge, and by introducing the air partly below the grate and partly behind the fire-place, at or near the point where the greatest heat is required. Usually, however, more elaborate apparatus is employed. Very many " gas producers " or " generators " have been constructed, com- mencing with Faber du Faur in Wasseralfingen (Wlirtem- berg) in 1836, and Bischof of Magdesprung in the Harz in 1839. But the greatest impetus to this mode of firing was given by Siemens Brothers, commencing in 1856, not only by the construction of their gas producers and heat recuperators, but also by the publicity they gave to the advantages of the system. They were followed by many other inventors, and gas-firing-has now become universal in some of the most important industries, and nearly so in others. The present extension of steel-making and other branches of metallurgy is intimately connected with this system, as is the modern method of glass-mak- ing, of heating coal gas retorts, and so forth.

The composition of producer gas differs considerably, principally according to the material from which it is made. Analyses of ordinary producer gas (not such as falls under the heading of " semi-water gas," comp. sub F.) by volume show 22 to 33 per cent. CO, 1 to 7 per cent. CO2, 0-5 to 2 per cent. Hj, 0-5 to 3 per cent, hydro- carbons, and 64 to 68 per cent. N2.

D. Blast-Fimiace Gases. ??? The gases issuing from the mouths of blast-furnaces in composition closely resemble those which are generated in gas producers, but they contain less CO and more COa- They represent an enormous aggregate heat-value, for it may be taken that the volume of gas given off per ton of iron made is about 4500 cubic metres (158,000 cubic ft.), and that each cubic metre is capable of yielding from 800 to

1000 calories. Although some of this heat has been utilized for a long time past (first by Faber duFaur in 1837), and since 1865 or 1870 all blast-furnaces have been provided with gas-collecting apparatus, the gas is mostly only appli^ to the heating of the blast, to the roasting of ore, and to the raising of steam for the blowing-engine, &c., a large proportion still being allowed to go to waste. Quite recently attempts have been made to utilize this gas in

gas engines for the direct production of motive power, which, after providing for all the wants of the blast- furnace itself, is stated to leave an excess of 10 h.p. per ton of pig-iron made in twenty-four hours.

E. Water Gas. ◆◆◆ The reaction of steam on highly heated carbonaceous matter was first observed by Fontana in 1780. This was four years before Cavendish isolated hydrogen from water, and thirteen years before Murdoch made illuminating gas by the distillation of coal, so that it was no wonder that Fontana's laboratory work was soon forgotten. Nor had the use of carburetted water gas, as introduced by Donovan in 1830 for illuminating pur- poses, more than a very short life. More important is the fact that during nine years the illumination of the town of Narbonne was carried on by incandescent platinum wire, heated by water gas, where also internally heated generators were for the first time regularly employed. The Narbonne process was abandoned in 1865, and for some time no real progress was made in this field in Europe. In America, however, Lowe, Strong, Tessie du Motay,and others, took up the matter, the first permanent success being obtained in 1873 by the introduction of Lowe's system at Phcenixville. In the United States the abundance of anthracite, as well as of petroleum naphtha, adapted for carburetting the gas, secures a great com- mercial advantage to this kind of illuminant over coal gas, so that now three-fourths of all American gas-works employ carburetted water gas. In Europe the progress of this industry was naturally much less rapid, but here also since 1882, when

the apparatus of Lowe and Dwight was introduced in the town of Essen, great improvements have been worked out, principally by E. Blass, and by these improvements water gas obtained a firm footing also for certain heating purposes. The American process for making carburetted water gas, as an auxiliary to ordinary coal gas, was first introduced by the London Gas-Light and Coke Company on a large scale in

1890.

Water gas in its original state is called ” blue gas,” because it burns with a blue, non-luminous flame, which produces a very high temperature. According to the equation C-fH□□□0 = CO -fHj, this gas consists theoretically of equal volumes of carbon monoxide and hydrogen. We shall presently see why it is impossible to avoid the presence of a little carbon dioxide and other gases, but we shall for the moment treat of water gas as if it were composed according to the above equation. The reaction C + H2O = CO ⊣ H2 is endothermic, that is, its thermal value is negative. One gram-molecule of carbon produces 97 great calories (1 great calorie or kilogram-calorie =1000 gram-calories) when burning to CO2, and this is of course the maximum effect obtainable from this source. If the same gram-molecule of carbon is used for making water gas, that is, CO-FHj, the heat produced by the combustion of the product is 68-4-|-57’G = 126 great calories, an apparent surplus of 29 calories, which cannot be got out of nothing. This is made evident by another consideration. In the above reaction C is not burned to CO2, but to CO, a reaction which produces 28-6 calories per gram-molecule. But as the oxygen is furnished from water, which must first be decomposed by the expenditure of energy, we must introduce this amount=68-5 calories in the case of liquid water, or 67-6 calories in the case of steam, as a negative quantity, and the difference, viz. 4-28-6 -57-6=29 great calories, represents the amount of heat to be ex- pended from another source in order to bring about the reaction of one gram-molecule of carbon on one gram- molecule of H2O in the shape of steam. This explains why steam directed upon incandescent coal will produce water gas only for a very short time : even a large mass of coal will quickly be cooled down so much that at first a

gas of different composition is formed and soon the process will cease altogether. We can avoid this by carrying it on in a retort heated from without by an ordinary coal fire, and all the early water gas apparatus were constructed in this way ; but such a method is very uneconomical, and was long ago replaced by a process first patented by J. and T. N. Kirkham in 1854, and very much improved by successive inventors. This process consists in con- ducting the operation in an upright brick shaft, charged with anthracite, coke, or other suitable fuel. This shaft resembles an ordinary gas producer, but it differs in being worked, not in a continuous manner, which, as shown above, would be impossible, but by alternately blowing air and steam through the coal for periods of a few minutes each. During the first phase, when carbon is burned by atmospheric oxygen, and thereby heat is pro- duced, this heat, or rather that part of it which is not carried away by radiation and by the products of com- bustion on leaving the apparatus, is employed in raising the temperature of the remaining mass of fuel, and is thus available for the second phase, in which the reaction (6) C-|-H20=CO-|-H2 goes on with the abstraction of a corresponding amount of heat from the incandescent fuel, so that the latter rapidly cools down, and the process must be reversed by blowing in air, and so forth. The formation of exactly equal volumes of carbon monoxide and hydrogen goes on only at temperatures over 1200 ►► C, that is, for a very few minutes. Even at 1100 ►► C. a little CO2 can be proved to exist in the gas, and at 900 ►► its proportion becomes too high to allow the process to go on. About 660 ►► C. the CO has fallen to a minimum, and the reaction is now essentially (c) C-f 2H20=C02-|-2H2; soon after the temperature of the mass vrill have fallen to such a low point that the steam passes through it with- out any perceptible action. The gas produced by reaction (c) contains only two-thirds of combustible matter, and is on that account less valuable than proper water gas formed by reaction (b) ; moreover, it requires the gener- ation of twice the amount of steam, and its presence is all the less desirable since it must soon lead to a total cessation of the process. In ordinary circumstances it is evident that the more steam is blown in during a unit of time, the sooner reaction (c) will set in ; on the other hand, the more heat has been accumrdated in the producer the longer can the blowing-in of steam be con- tinued.

The process of making water gas consequently com- prises two alternating operations, viz., first, " blowing up" by means of a current of air, by which the heat of the mass of fuel is raised to about 1200 ►► C. ; and, secondly, " steaming," by injecting a current of (preferably super-heated) steam until the temperature of the fuel had fallen to about 900 ►► C, and too much carbon dioxide appears in the product. During the steaming the gas is carried off by a special conduit into a scrubber, where the dust mechanically carried away in the current is washed out, and the gas is at the same time cooled down nearly to the ordinary temperature. It is generally stored in a gas- holder, from which it is conducted away as required. It IS never quite free from nitrogen, as the producer at the beginning of steaming contains much of this gas, together with C'() or CO2. The proportion of hydrogen may exceed 50 per cent., in consequence of reaction (c) setting in at the close of the steaming. Ordinary " blue " water gas, if, as usual, made from coke or anthracite, contains 48-52 per cent. H ►►► 40-41 per cent. CO, 1-5 per cent. CO2, 4-5 per cent. Nj, and traces of hydrocarbons, especially methane. If made from bituminous coal it contains more of the latter. If "carburetted" (a process which increases its volume 50 per cent, and more) by the vapours from superheated petroleum naphtha, the proportion of CO

ranges about 25 per cent., with about as much methane, and from 10 to 15 per cent, of " illuminants " (heavy hydrocarbons). The latter, of course, greatly enhance the fuel-value of the gas. Pure water gas woiild possess the following fuel-value per cubic metre : ►►►

0-5 cub. met. Ho = 1291 calories 0-5 ►►►,, CO = 1522 ►►►

2813 ►►►

Ordinary "blue" water gas has a fuel-value of at least 2500 calories. Carburetted water gas, which varies very much in its percentage of hydrocarbons, sometimes reaches nearly the heat-value of coal gas, but such gas is only in exceptional cases used for heating purposes.

We must now turn to the "blowing-up" stage of the process. Until recently it was assumed that during this stage the combustion of carbon cannot be carried on beyond the formation of carbon monoxide, for as the gas producer must necessarily contain a deep layer of fuel (generally about 6 to 10 feet), any CO_2 formed at first would be reduced to CO ; and it was further assumed that hardly any CO_2 would be formed from the outset, as the temperature of the apparatus is too high for this reaction to take place. But as the combustion of C to CO produces only 29-5 per cent, of the heat produced when C is burned into CO, the quantity of fuel consumed for " blowing-up " is very large, and in fact considerably ex- ceeds that consumed in " steaming." There is, of course, a further loss by radiation and minor sources, and the result is that 1 kilogram of carbon yields only about 1-2 cub. met. of water gas. Each period of blowing-up generally occupies from 8 to 12 minutes, that of steam- ing only 4 or 5 minutes. This low yield of water gas until quite recently appeared to be unavoidable, and the only question seemed to be whether and to what extent the gas formed during blowing-up, which is in fact identical with ordinary producer gas (Siemens gas), could be utilized. In America, where the water gas is mostly employed for illuminating purposes, at least part of the blowing-up gas is utilized for heating the apparatus in which the naphtha is volatilized and the vapours are "fixed" by superheating. This process, however, never utilizes anything like the whole of the blowing-up gas, nor can this be effected by raising and superheating the steam necessary for the second operation ; indeed, the employ- ment of this gas for raising steam is not very easy, owing to the irregularities of and constant interruptions in the supply. In some systems the gas made during the blowing-up stage is passed through chambers, loosely filled with bricks, like Siemens recuperators, where it is burned by "secondary" air; the heat thus imparted to the brickwork is utilized by passing through the re- cuperator, and thus superheating the steam required for the next steaming operation. In many cases, principally where no carburetting is practised, the blowing-up gas is simply burned at the mouth of the producer, and is thus altogether lost ; and in no case can it be utilized without great waste. This state of matters was entirely changed by the invention of Dellwik, improved by Fleischer, who found that the view that it is unavoidable to burn the carbon to monoxide during the blowing-up holds good only for the pressure of blast formerly applied. This did not

much exceed that which is required for over- coming the frictional resistance within the producer. If, however, the pressure is considerably increased, and the height of the column of fuel reduced, both of these con- ditions being strictly regulated in accordance with the result desired, it is easy to attain a combustion of the carbon to dioxide, with only traces of monoxide, in spite of the high temperature. Evidently the excess of oxygen

coming into contact with each particle of carbon in a given unit of time produces other conditions of chemical equilibrium than those existing at lower pressures. At any rate, experience has shown that by this process, in which the full heat-value of carbon is utilized during the blowing-up stage, the time of heating-up can be reduced from 10 to 1^ or 2 minutes, and the steaming can be pro- longed from 4 or 5 to 8 or 10 minutes, with the result that twice the quantity of water gas formerly obtained, viz. 2-5 cub. met., is made from 1 kilogram of carbon.

The application of water gas as a fuel mainly depends upon the high temperatures which it is possible to attain by its aid, and these are principally due to the circum- stance that it forms a much smaller flame than coal gas, not to speak of Siemens gas, which contains at most 33 per cent, of combustible matter against 90 per cent, or more in water gas. The latter circumstance also allows the gas to be conducted and distributed in pipes of moderate dimensions. Its application, apart from its use as an illuminant (with which we are not concerned here), was formerly retarded by its high cost in comparison with Siemens gas and other sources of heat, but as this state of affairs has been changed by the invention of the Dellwik- Fleischer process, its use is rapidly extending, especially for metallurgical purposes.

F. Mixed Gas (Semi-Water Gas). ??? This class is some- times called Dowson gas, irrespective of its method of production, although it was made and extensively used a long time before Mr Dowson constructed his apparatus for generating such a gas principally for driving gas engines. By a combination of the processes for generat- ing Siemens gas and water gas, it is produced by inject- ing into a gas producer at the same time a certain quantity of air and a corresponding quantity of steam, the latter

never exceeding the amount which cair be decomposed by the heat-absorbing reaction, C-f-H20 = CO-|-H2, at the expense of the heat generated by the action of the air in the reaction C 4-0= CO. Such gas used to be frequently obtained in an accidental way by introducing liquid water or steam into an ordinary gas producer for the purpose of facilitating its working by avoiding an excessive tempera- ture, such as might cause the rapid destruction of the brickwork and the fusion of the ashes of the fuel into troublesome cakes. It was soon found that by proceed- ing in this way a certain advantage could be gained in regard to the consumption of fuel, as the heat abstracted by the steam from the brickwork and the fuel itself was usefully employed for decomposing water, its en- ergy thus reappearing in the shape of a combustible gas. It is hardly necessary to mention explicitly that the total heat obtained by any such process from a given quantity of carbon (or hydrogen) can in no case exceed that which is generated by direct combustion; some inventors, however, whether inadvertently or intention- ally, have actually represented this to be possible, in manifest violation of the law of the conservation of energy.

Some of the best-known apparatus belonging to this class are the Munich or Schilling-Bunte generator, the Wilson producer, and the Loomis producer. The Dowson producer has been already mentioned. The gas they yield differs very much in composition, but is alwaysmuch richer in hydrogen (of which it contains sometimes as much as 20 per cent.) and poorer in carbon monoxide (sometimes down to 20 per cent.) than Siemens gas ; generally it con- tains more of CO2 than the latter. The proportion of nitrogen is always less, about 60 per cent. It is therefore a more concentrated fuel than Siemens gas, and better adapted to the driving of gas engines. It costs hardly more to make than ordinary Siemens gas, except where the steam is generated and superheated in special apparatus, as is done in the Dowson producer, which, on the other hand,

yields a correspondingly better gas. As is natural, its properties are some way between those of Siemens gas and of water gas ; but they approach more nearly the former, both as to cost and as to fuel-value, and also as to the temperatures reached in combustion. This is easily understood if we consider that gas of just the same de- scription can be obtained by mixing one volume of real water gas with the four volumes of Siemens gas made during the blowing-up stage ??? an operation which is cer- tainly too expensive for practical use.

A modification of this gas is the Mond gas, which is made, according to Mond's patent, by means of such an excess of steam that most of the nitrogen of the coke is converted into ammonia (Grouven's reaction). Of course much of this steam passes on undecomposed, and the quantity of the gas is greatly increased by the reaction C-f 2H20 = COo+2H2; hence the fuel-value of this gas is less than that of gas made in other ways. Against this loss must be set the gain of ammonia which is re- covered by means of an arrangement of coolers and scrubbers, and, except at very low prices of ammonia, the profit thus made is probably more than sufficient to cover the extra cost. But as the process requires very large and expensive plant, and its profits would vanish in the case of the value of ammonia becoming much lower (a result which would very probably follow if it were somewhat generally introduced), it is no matter of surprise that it has hitherto found only a very limited application.

G-. Air Gas. ??? By forcing air over or through volatile inflammable liquids a gaseous mixture can be obtained which burns with a bright flame and which can be used for illumination. Its employment for heating purposes is quite exceptional, e.g., in chemical laboratories, and we abstain, therefore, from describing any of the numerous appliances, some of them bearing very fanciful names, which have been devised for its manufacture. (g. l.)

Cas Plants for Power Purposes. ??? The term Producer Gas, Generator Gas, or Poor Gas (gaz pauvre), as the Prench prefer to call it, is applied to non-luminous heating gas made by passing air, or air and steam together, through incandescent carbonaceous fuel. As is well known, the ordinary town gas used for lighting purposes (see p. 690 ante,

and 9th edition, vol. x. p. 87) is produced by the destructive distillation of bituminous coal in retorts highly heated by external fires. The apparatus in which producer gas is made has no external fire, and the small amount of distillation which occurs is of secondary importance. The producer usually con- sists of a vertical cylindrical or rectangular iron casing, lined with fire-bricks ; on the top there is a feeding hopper and valve, and near the bottom is a grate or hearth on which a fire is built up. In some producers air is drawn into the producer by suction, in some it is forced in by a blower, and in others a jet of steam is used to inject the air. In the latter case the air is mixed with steam when it enters the fire. (See Gaseous Fuel.)

When air alone is used, the oxygen combines with the carbon of the fuel, and either or both of the following reactions occur, accord- ing to the temperature and other conditions in the producer. At first carbon dioxide (CO2) may be formed, and in that case the greater part of this is afterwards reduced to the monoxide (CO), as it ascends the column of heated fuel. The well-known reactions which occur are thus expressed ; C-)-02=C02, and C02-fC = 2CO. If the temperature developed is about 1000 C. or higher, carbon monoxide is probably formed without the intermediate formation of carbon dioxide, but in practice there is always more or less of the dioxide mixed with the monoxide. When bituminous coal is used in the producer some of the hydrocarbons are oxidized, others are decomposed and converted into olefiant gas (C2H4) and marsh gas (CH4), while others leave the producer in the form of condensable vapours which mix with the currents of hot gas. When steam is mixed with the air it is decomposed on coming

in contact with the heated fuel, and the resultant gases are hydro- gen carbon monoxide, and carbon dioxide. The reactions are H20-hC = H2-l-CO and 2H20-f-C = 2H2-t-C02.

The earlier examples of gas-producers were used for furnace work ; and, owing to Sir William Siemens's skilful application of producer gas to the regenerative furnaces which he devised (see GaseodsFuel and Eney. Srit., 9th ed., vol. xxii. p. 37), his system and various modifications of it are

much used in all manu- facturing countries for metallurgical and other work. Fig. 1 repre-

P

I^S^i?^ ◆◆l

*m^m^wm^*

Fig. 1. ◆◆◆ Siemens Gas Producer, a, feeding^ hopper; &, stokiog holes; c, water supply (in some producers steam is introduced instead of water) ; rf, d, horizontal and inclined fire-bars ; e, gas outlet.

sents an ordinary type of Siemens producer. In producers used for furnace work the hot crude gas is taken directly from the pro- ducer to the furnace, and the gas is usually made with bituminous or semi-bituminous coal ; the tarry vapours distilled off in the producer mix with the gas and enrich it, and all are burnt in the furnace.

The chemical composition of ordinary producer gas, as used in furnaces, depends somewhat on the nature of the coal used, but it usually contains about 24 to 27 per cent, of carbon monoxide, and only 5 to 10 per cent, of hydrogen. It is not suitable for driving gas engines, as it is too weak and does not ignite promptly enough in the cylinder. For engine work the gas should contain not less than 15 per cent, of hydrogen, and its calorific power should not be less than 1200 calories per cubic metre, or 140 British thermal units per cubic foot, at 0 ◆◆ C. and 760 mm. ; moreover, it must noi carry tar or other impurities, and it must be cool and fairly con- stant in quality and pressure. It was therefore necessary not only to improve the quality of the gas, but to devise complete apparatus for cooling and cleaning it, and for fulfilling the other conditions required. The first to do this was J. E. Dowson. The Dowson plant was tried for the first time with a small Otto engine in 1871) by Messrs Crossley of Manchester, and in 1881 the same engine and gas plant were tested by Mr T>. K. Clark, on behalf of the com- mittee of the Smoke Abatement Exhibition, South Kensington,, who awarded the inventor a special prize given by Sir William Siemens. As a measure of what this has led to, it may be men- tioned that up to the end of 18W gas engines developing an

aggre- gate of about 60,000 h.p. were working with gas made in "the Dowson plant. From time to time various other gas plants for engine work have been introduced, and broadly they may be di- vided into three types, as follows : ???

A. Producer with jet of superheated steam forcing in air, e.g., the Dowson plant.

B. Producer without steam-jet, and with blower to force in air, e.g., the Lencauche.z and the Jlund plants.

C. Producer without steam-jet and without blower, the air being drawn into the producer by a suction-pump attached to the gas engine, e.g., the Benii-r plant.

The first type, A, is represented in Fig. 2.

The boiler is provided with superheating tubes, and a jet of dry steam is used for the double purpose of supplying the steam to be decomposed, and of carrying an induced current of air into the gas generator to maintain combustion of the fuel and develop the high temperature required for the necessary chemical reactions to take place. In practice about 90 per cent, of the steam produced in the boiler is decomposed in the gas generator, the remainder

being lost ; and it may here be noted that the percentage of hydrogen in the gas is not an exact measure of the quantity of steam decomposed, as some of the hydrogen is derived from the coal in the generator. In practical work, when anthracite is used in the generator, about J lb of steam is decomposed for each

pound of anthracite consumed, and this can be done without having more than about 5 per cent, of carbon dioxide in the resultant gas. The following table gives the results of tests made by different authorities with

the Dowson gas plant, when working with anthracite in the generator :
_?_?_?

Table showing Besults of Tests with Dowson Gas Plant.

o

3

E-i

o

V OS

P

Locality.

a

s

o

Volume ol'ftas pro- duced, at 0 ?? 0. and

T60 mm. per kilo.

of Anthracite con- sumed in Generator

-1-Coke consumed in Boiler.

Volumetric Composition of Gas per cent.

a

Si

1"

a

J' a

IIe.it-valae of One

Cubic Metre of Gas

produced, at (1 C.

and 700 mm.

Authority.

1

3

CD i -IE

5

a o

9

a

a' fcu

1

1

2

3

4

6

6

7 8

9 10

Jan. 1S88

Nov. 1886

July 1889

Jan. 1890

April 1890

Sept. 1890

June 1894 Feb. 1897

April 1898 April 1898

Battersea .

Eouen, France .

Schwabing, Germany

Canale, Italy .

London

Rouen, France .

Sabadell, Spain . Basingstoke

Millwall . Openshaw ,

s

8

60

40

10

100

120 40

250 300

Cubic Metres.

5-00

6-02

4-74

5-34 504

6-07

4-88

18-73

17-00 16-67 24-00

16-50 19-80

15-30 17-60

[illegible]31

2-00

1-00 1-30

1-40 2-10

-31

25-07

23-00 27-50 22-50

25-40 23-80

27-60 26-50

6-57

6-00

8-40 7-50

4-80 6-30

3-90 4-40

-03 -90 1-20

48-98

82-00 46-78 46-00

61-10

4b-8U

51-80 49-50

Calories.

9350

8790 8740

9160 9600

9120 9200

Calories.

7100

7130 6450

7.390 7370

7850 7670

76-9

81-1 73-8

80-7 77-6

80-6 82-3

Calories.

1420

1350*

1420

1360

1430

1457*

1884 1463

1461 1662

Prof. W. Foster, F.C.S., London.

Prof. A. Witz, Lille University.

Mr F. Uppenborn, Munich,

Dr C. Monaco, Turin.

Dr Langer, Lon- don.

Prof. A. Witz, Lille University.

Mr' G. C. Joiies, F.C.S., London.

Average

lS-18

26-17

5-98

49-86

9128

7194

78-9

1432

= By calorimetric bombs.

From this summary it will be seen that the average calorific power of the gas tested is 1432 calories per cubic metre, or 161 B.T.U. per cubic foot, at 0 C. and 760 mm. ; while the average heat-efficiency of the plant is 78-9 per cent., one plant giving as much as 81-1 and another 82-3 per cent. If an efficiency of 80

f^?

Fig. 2. Dowson Gas Plant, a, boiler ; 6, steam superheater ; c, steam pipe ; d, air injector ; e, gas generator ; /, fire-bars ; g, feeding hopper ; h, A, cooling pipes ; i, hydraulic box with water seal ; j, coke scrubber ; ^, washer ; I, sawdust scrubber ; m, inlet of gasholder ; 7i, gasholder ; o, outlet of gasholder ; p, valve with weighted lever to regulate admission of steam to gas generator ; $, weight to actuate lever p by rise or fall of gasholder.

per cent, is assumed, the loss of heat may be accounted for ap-proximately as follows :

Loss in steam boiler ....

Steam not decomposed in generator

Unburnt anthracite lost in ashes .

Sensible heat of gas lost in cooling and scrubbing and in radiation from the generator

7 per cent.

1 1, 11

10

20 per cent.

In the Lenoauchez plant, which is an example of the second type, B, there is no boiler, the gas being made by forcing air from a blower into the gas

generator, and there saturating it with moisture before it enters the fire. When good gas has been made and the engine is running, the blower is driven by the engine, but

when the latter is not working it is driven by hand power. Some of these plants are work- ing in France, and though a few have been tested lor the fuel consumption per h.p., none appear to have been tested thoroughly as to their heat- efficiency, &c. Professor \Vitz of Lille refers to this plant in his Motfiirs a (4az, but seems doubtful about the heat-value of the gas. Dr Ludwig Mond's plant (see also Gaseous Fuel) was devised primarily for the recovery of ammonium sulphate, and the gas produced was of secondary importance. At first all the gas was used for heating furnaces, but afterwards trials with a gas engine showed that it was suitable for such work, and several engines are now working with it at the chemical works of Messrs Brunner, Mond, and Company. To be profitable, a recovery plant of this kind must be worked on a large scale, night and day ; in the existing plant each producer makes gas enough for about 2000 h.p. an hour, and the bulk of the gas is still used for furnace work. The plant is worked with bitumi- nous coal, the tar being removed by an elaborate system of wash- ing and scrubbing. The calo- rific power of the gas, calculated from its published analysis, is 1385 calories per cubic metre, or 155-6 B.T.U. per cubic foot, at 0 ° C. and 760 mm. The per- centage of hydrogen (24-8) is high, but against this the carbon monoxide is only 18-2, while the carbon dioxide is as high as 12-9. It has been proposed to work a plant of this type without the recovery of ammonium sulphate, and if this were done the working would be nearly on the same lines as those of the Lencauchez plant.

In the third type of plant, C, e.(j., B^nier's (Fig. 3), there is no steam boiler or air-blower, the air being drawn into the producer by a suction- pump- attached to the engine. The quantity of aii

'^^*^^^TSB

drawn in varies witli the load on tlie engine ; and, as it is governed by the engine itself, the storage of gas in a holder is dispensed with altogether. The whole plant consists merely of a producer, a washer, and a scrubber. Water is vaporized in the fire-grate, which is of special construction, and the water vapour mixes with the air before the latter enters the fuel column. The idea is ingenious, but the results obtained have not been encouraging. Professor Witz of Lille tested it carefully with an engine of about 15 b.h.p. The first trial was with English anthracite of good quality, and the calorific power of the gas was only 1149 calories per cubic metre, or 129 B.T.U. per cubic foot, at 0 C. and 700

mm. The engine de- veloped 27-6 i.h.p., but only 14-59 b.h.p. ; while the consumption of an- thracite was 714 grams, or 1-67 lb per b.h.p. per hour. A second trial was made with ordinary gas coke in the gener- ator, and the calorific power of the gas was then as low as 1035 calories per cubic metre, or 116 B.T.U. per cubic foot, at 0 C. and 760 mm. The engine developed 14-7 b.hlp., and the con- sumption of coke was 752 grams, or 1-66 lb per b.h.p. per hour. These results were with a full load on the engine, and it is probable that the gas would have been still weaker if the load had been much reduced, as the temperature of the fuel most favourable for making the gas would not have been maintained.

Water gas plants (see Gaseous Foel) are not included among those which are suitable for working with gas en- gines, as they must be worked intermittently, \'ith frequent reversals, and the quality of the gas necessarily varies considerably.

Owing to the difficulty of removing tar from generator gas made with bituminous coal, most of the gas plants in use with gas engines are worked with anthracite (Ency. Brit., 9th Fuel. ed., ii. 106). Formerly it was necessary to use nuts or

cobbles, but with a suitable grate in the generator the size known as peas (which have passed through | inch and over f or f-^ inch openings in the screens at the pit) is extensively employed, being cheaper than the larger sizes. The best an- thracite is found in the Swansea Valley and neighbouring dis- tricts ; and, owing to the development of the gas-power

industry, a new trade has sprung up for suitable anthracite, and a consider- able quantity is exported. Some anthracite is also found in Scot- land, but, with the exception of that from the neighbourhood of Coltness, it is not good ; even the latter is a little more trouble- some to work with than the Welsh for gas engines, as it is more or less mixed with bituminous compounds. On the Continent anthra- cite is found in Belgium, at Kohlsoheid near Aachen(Aix-la-Chapelle) in Germany, and in Russia and Spain ; a charboii niaigre (lean coal) which is anthraoitic, but of inferior quality, is also found in the department of the Nord and elsewhere in France. There are immense beds of excellent anthracite in Pennsylvania ; there is some in Japan, and it is reported that there are large fields of it undeveloped in China. Ordinary gas coke can also be used for generator gas instead of anthracite, provided it is of good quality, clean, and in small pieces; and there are some installations of gas power (e.g., at the Elswiok Works of Messrs Armstrong, Whitworth, and Com- pany) where no other fuel has been adopted, and where the results have been satisfactory. Coke that yields an excessive amount of clinker, as well as much tar and sulphur, should be avoided. With bituminous coal the difficulties are increased when the plant is worked on a comparatively small scale, e.g., 200 b.h.p. ; but promising trials with bituminous coal have recently been made in a modified plant of the type A, and it is expected that plants of moderate size will soon be working with tar - yielding

Fig. 3. ??? B6oier Gas Plant, a, gas generator ; &, feeding hopper ; c, revolving grate with water inside ; d, chamber to receive steam from c ; e, air inlet ; /, mixing chamber for steam and air at atmospheric pressure ; g, inner casing of generator ; h, annular space for steam and air to pass from/ to bottom of fire, the steam and air being heated on the way ; i, i, annular space for hot gas from generator ; .;', cylinder with water inside ; i", inner tube, of which lower end is dipped in water, with overflow leading to tank I ; 7n, annular space for gas to pass from i to interior of X; ; n, chamber for gas.

coal. Dr Mond's large plant is the only one which is worked regularly with bituminous coal and yields a gas suitable for gas engines. . .

Reference to the table will show that m type A the production of o-as at 0 C. and 760 mm. is about 5 cubic metres per kilogram, or 80 cubic feet per lb, of anthracite consumed in the gas generator. When this gas is used for driving an engine the total fuel con- sumption (including anthracite in the generator and coal or coke in the little boiler which supplies it with steam) is about 1 lb (454 grams) per b.h.p. per hour. The consumption of water varies with the size and type of plant used. For type A it is as under, and in order that a comparison may be made with the water required for a steam boiler of the same h.p., the figures for the latter are added on the basis of 20 lb of water per b.h.p.

Pounds of Water per Hour.

Gas Plant.

Steam Boiler.

100 brake h.p. .

200 ,,...

300 . . .

300 400 500

2000 4000 6000

With ordinary care the cost of repairs is moderate. For type A the following averages (based on several years' experience) may be taken as approximately correct, exclusive of painting : For 100 brake h.p. plant about 4 per annum. 200 6

,, 300 ,, ,, ,, 8 ,,

400 12

500 14

The cost of the gas depends somewhat on the price of fuel and wages, and on the scale of production. In a plant of moderate size of type A working with anthracite peas costing r t t 16s. per ton, the gas usually costs from 2d. to 3d. per ^^ ►► 1000 cubic feet filled into the gasholder, including * " fuel, wages, and repairs. Gas of this kind made with anthracite nuts has been used regularly for several years at the Gloucester County Asylum for driving engines, as well as for all the cooking and baking of bread for the staff and inmates. In 1895 the clerk of works made the following report as to the cost of producing the gas for a year, and it is given here because, fortunately, nearly all the gas produced was measured bypassing through a meter : ►►►*

Cubic feet. ' ' Quantity produced as per meter during the

year ending 31st March 1895 . . . 22,211,700 "Estimated quantity used by engine pump- ing three hours a day at 3000 cubic feet per hour (not registered) 3,285,000

" Total quantity produced . . 25,496,700 " Details of material and labour used in the production of 25,496,700 cubic feet of Dowson gas : ►►►

" Anthracite coal [nuts], 124 tons 19 cwts. at

21s. 2d. per ton ►►132 4 10

" One year's repairs to plant at 6d. per day . 9 2 6 " Gasman's wages, making gas only, at 21s.

a week 54 12 0

►►195 19 4

" Thus costing l|d. per 1000 cubic feet, exclusive of slack \ised for steam boiler."

[The small boiler used in connexion with the gas plant is fired with ashes, &c., from the various fires in the asylum ; no account of these is kept, as they are treated as v-aste for any other purpose. Recently the gas

generators have been altered so as to work with anthracite peas, and the cost of the gas has been still further reduced.]

It must be remembered that the calorific power of this gas is only one-fourth that of ordinary town gas ; the cost of the generator gas should therefore be multiplied by 4, so that the quantity equivalent to 1000 cubic feet of town gas usually costs from 8 to 12 pence.

The loss of fuel in a gas generator when standing with a fire in it is much smaller than in a steam boiler of the same h.p. A series of tests extending over several days, made at Messrs Crossley's works with a L'aO-h.p.' generator, showed an average loss of only 5J pounds per standing hour. In smaller plants it is even less.

*The heat-efficiency of the gas plant is a measure of the heat lost in the transformation of the solid fuel into gas suitable for work- ing an engine. To determine this efiiciency, account should be taken of all the fuel consumed in connexion f^^', with the apparatus used for making the gas, and a * c eacy. balance-sheet should be prepared showing what percentage of the heat energy contained in all the fuel consumed is available in the gas finally passed into the holder. This basis of comparison should be adopted for all types of gas plants, since no other can be*

correct. If the steam decomposed in the gas generator is produced in an independent boiler, as in type A, the fuel consumption in the latter should be included ; or if air is forced into the gener- ator by engine power, as in type B, the expenditure of heat- energy which this involves should be included. The heat-value of the fuel, as well as that of the gas, should be determined, also the volume of gas produced per unit of fuel consumed. For practical purposes it is more simple to determine the heat-value of the gas by a calorimeter (Do wson's or Junker's), or by a calorimetric bomb (Mahler's), than by analysing the gas.

The calorific powers given in Table A and elsewhere are based on the following heat-values : ???

Hydrogen Marsh gas, CH4 . defiant gas, C2H4 Carbon monoxide, CO .

3,070 calories per cubic metre.

9,550 14,970 3,070

The calorific power of the fuel, where it was not tested by calori- meter, has been calculated from the formula

80-8 C-l-345

{"-1)

+ 25 S,

vfhere C, H, 0, and S. represent the percentages of carbon, hydro- gen, oxygen, and sulphur in the fuel. One cubic metre of CO, CO2, or CH4 contains 537-6 grams of carbon, and one cubic metre of C2H4 contains 1075-2 grams of carbon. AH the calculations as to calorific power are also based on the standard temperature and pressure of 0 ?? C. and 760 mm., and all the steam derived from the combustion of the fuel or gas is treated as condensed. Some ex- perimenters do not treat the steam as though it were condensed, and deduct its latent heat from the heat-value of the gas. It should, however, be remembered that in considering the produc- tion of gas in a gas plant, and in stating a balance-sheet of the heat units, we should on the one side give all those in the solid fuel consumed, and on the other side the total heat units the gas derived from it is capable of yielding when burnt to the best advan- tage. When the hydrogen in the gas is burnt steam is produced, and the latent heat of this steam is available for heating purposes ; the latent heat of the steam .should therefore be included in the heat units derivable from combustion of the gas. It happens that in the gas engine of to-day the exhaust products leave at a high temperature, so that the steam formed on combustion of the hydrogen in the cylinder is not condensed ; if there were complete expansion the steam would be condensed. The present loss

of the latent heat of the steam is due entirely to the engine, and should not be debited to the process of making the gas.

Theoretically, one volume of generator gas requires little more than one volume of air for its combustion, whereas ordinary town gas requires from 5 to 6 volumes of air to one of gas. For this reason it is possible to get into an engine cylinder of given capa- city four times more of generator gas than town gas, with the pro- portion of air required. In practice the same cylinders are used for both kinds of gas ; but the maximum h.p. obtainable with generator gas is usually from 10 to 12 per cent, less than with town gas. In engines of the Otto type a space is provided in the cylinder in which the charge of gas and air is compressed, and as this remains full of spent products of combustion after the exhaust is closed, it follows that these products mix with and dilute the next ingoing charge of gas. This is disadvantageous for generator gas, as it is already weakened by the presence of about 50 per cent, of nitrogen and carbon dioxide ; and in the early engines, where a compression of only 35 lb per square inch was in vogue, it was difficult to ensure prompt and regular ignition of the charge. When the slide-valve was superseded, it became possible to raise the com- pression before ignition without trouble from excessive friction, and this is now usual. Fig. 4 represents an indicator diagram taken on a Crossley engine working with Dowson gas, and in this

Fia. 4. ??? Indicator diag^m from Crossley engine working with Dowson gas.

(Compression before ignition 90 lb per sq. inch. Pressures^ Maximum after explosion . 890 ,, ???

(Mean ??? ???. 94‘6 ???

the compression is 901b , while the mean pressure is as high as 94 -6 lb per square inch. When running at 170 revolutions per minute the engine developed a maximum of 44-1 i.h.p. and 38-6 b.h.p.; at a speed of 220 revolutions per minute it gave a maximum of 57-3 i.h.p. and 48-8 b.h.p. With the earlier low compression the molecules of oxygen, surrounded more or less by inert gas, were too far apart from those of the hydrogen

and carbon monoxide, and the high compression now used has remedied this defect to a great

extent. A still further improvement is the removal or scavenginc/ of all products of combustion from the compression space in the cylinder. Apart from ensuring a more prompt and more regular ignition of the charge, scavenging reduces the risk of the explosive mixture being fired prematurely. With non-scavenging engines of large size there is often a good deal of trouble owing to the liability of the new charge to be fired by some of the hot residual products in the cylinder. By scavenging, these hot products are displaced by air, which also helps to cool the cylinder and piston. Another consideration is that if, from any cause, the explosive charge in a non-scavenging engine is not fired, there is a much stronger charge to fire after the next intake of gas, because some of the products of combustion from the last charge fired are displaced by new gas and air. After a misfire in a non-scavenging engine of large size the explosive force is excessive, and has to be provided for by specially strengthening the engine. With a scavenging engine this trouble is avoided.

A steam engine is associated with a boiler, which should be able at all times to yield the maximum quantity of steam required ; and in the same way the gas plant should be able to supply the maximum quantity of gas required by the engine or engines associated with it. If the gas generator or generators have ample producing power, there is no need to store much gas in a holder; the gas should be made as quickly as it can be consumed, just as a steam boiler makes steam as quickly as it is wanted. A gas plant need not occupy more ground space than is required for a horizontal boiler of about the same horse-power, and no chimney-stalk is needed. To avoid an over-production of gas when the load on the engine falls off, the rate at which the gas is made should be governed automatically to suit a varying rate of consumption. In the Dowson plant this is done by using the rise and fall of the gasholder to regulate the quantity of steam and air sent into the generator (Fig. 2) ; the maximum production of the latter can be reduced easily by 30 or 40 per cent. , and in some sizes by 50 per cent. , without appreciably affecting the quality of the gas. Two or more gas generators can work together as easily as a bench of retorts in alighting gas plant. Generator gas does not condense or deteriorate by

coolingor storage, or by travelling through long pipes ; on the contrary, for the good working of an engine it is desirable that the charge of gas admitted to the cylinder should be cool, so that a given volume may yield as much energy as possible. Generator gas is made rapidly, and in a plant of moderate size it usually leaves the generator at a temperature of about 900 F. (500 C). Special attention should therefore be given to the cooling of the gas, so that when it leaves the gasholder its temperature should not be higher than that of the surrounding air; it .should also be well washed and scrubbed. The gas plant, as a whole, should be compact and easy to work, and its first cost should not be excessive. As a final note, it is interesting to observe that a modern Dowson gas plant is now working regularly at the historical works of Boulton and Watt, at Soho, Birmingham, and that the holder used for this gas is one which was erected there by William Murdoch, the pioneer of gas lighting (see Ency. Brit., 9th ed., vol. x. p. 88).

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(j. E. DO.)

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GASES ??? GEELONG

See Condensation”

See Diffusion of

Cases, Condensation of.

OF Gases.

Cases, DifTusion of.

CrASES.

Castein, a valley in the Austrian duchy of Salz- “burg, celebrated for its mineral springs. The visitors numlDer about 8000 annually, of whom three-fourths stay at Wildbad (population, 558). There is now a Protestant church belonging to the German Emperor. The mountain torrent, the Ache, supplies motive-power for the electric lighting of the district, which has made considerable pro- gress in the matter of accommodation for its increasing stream of visitors, including a sheltered glass gallery, or turhaus, for rainy weather. It was at Gastein (August- September 1879) that Prince Bismarck negotiated the Austro-German Treaty with Count

Julius Andrassy. In 1890 the population of the entire valley was 4372, and in

1900, 4436.

Cateshead, a municipal, parliamentary, and county borough of Durham, England. It has greatly extended, but although one of the largest towns in the county, neither its streets nor its public buildings, except perhaps its ecclesiastical buildings, make any claim to archi- tectural beautv. The area of the borough is 3300 acres ; population (1881), 65,846 ; (1891), 85,692; (1901), 109,887. Between 1881 and 1899 the rateable value increased from ––220,000 to ––359,562. The birth and death rates, 36-2 and 20-4 per 1000 respectively, show no great change over a series of years. The number of voters for the borough member of Parliament is (1900) 17,065. Por municipal purposes the town is divided into ten wards, each of which returns three members to the Town Council. Thetown pos- sesses a children's hospital, a very efficient school of art, and public library, and a workhouse, built at a cost of ––40,000, providing accommodation for 1000 inmates. The School Board has seventeen schools under its con- trol. Technical education is provided in the Higher Grade School (1891). A large day school for girls has also been established. Steam trams run through the main streets, and the Corporation have built suitable swimming-baths and wash-houses. More than two thousand hands are employed in the North-Eastern locomotive depot. Large gas works of the Newcastle and Gateshead Gas Company are also situated in the borough.

Cauhati, a town of British India, in the Kamrup district of Assam, on the left bank of the Brahmaputra, with a population in 1881 of 11,695, and in 1891 of 8283. The municipal income in 1897-98 was Rs.46,800. It is still the headquarters of the district, though no longer a military cantonment, and is the river terminus of a section of the Assam-Bengal railway. There are a government high school, with 195 pupils in 1896-97, a law class, a training school for masters, and four printing-presses. Gauhati suffered very severely from the earthquake of 12th June 1897.

Caya, a city and district of British India, in the Patna division of Bengal. The city is situated S5 miles south of Patna by rail. Population (1881),

70,415 ; (1891), 80,383; (1901), 71,186. During the Mutiny the large store of treasure here was conveyed safely to Calcutta by Mr Money. The city contains a government high school, with 351 pupils in 1896-97, a hospital, with a Lady Elgin branch for women, and five printing-presses. The district of-GAYA comprises an area of 4712 square miles. It had a population in 1881 of 2,124,682, and in 1891 of 2,138,331, giving an average density of 454 persons per square mile. Classified according to religion, Hindus numbered 1,911,254 ; Mahommedans, 226,705 ; Christians,

174, of whom 74 were Europeans ; " others," 198. In 1901 the population was 2,064,077, showing a decrease of 3 per cent. The land revenue and rates were Rs.17,73,901 ; the number of police was 767 ; the number of boys at school in 1896-97 was 29,015, being 18-5 per cent, of the male population of school-going age ; the registered death-rate in 1897 was 37-07 per thousand. Opium is largely cultivated, indigo hardly at all. There are forty- one lac factories, employing 1200 persons, with an annual out-turn valued at Pis.31,46,000. The district is traversed in the south by the Grand Trunk road, and three branches of the East India railway now run to Gaya city. In 1901 it suffered severely from the plague.

Cayangos y Arce, Pascual de (1809-1897), Spanish scholar and Orientalist, was born at Seville, 21st June 1809. At the age of thirteen he was sent for education to France, where he passed several years, and studied Arabic under Silvestre de Sacy. After a visit to England, where he married, he obtained a post in the Spanish Treasury, and was afterwards translator to the Foreign Office. In 1836 he returned to England, be-came well known in English society, wrote extensively in English periodicals, and translated Almakkari's History of the Maliommedan Dynasties in Spain for the Royal Asiatic Society. In England he also made the acquaint- ance of the American historian of Spanish literature, Ticknor, to whom he was very serviceable. In 1843 he returned to Spain as professor of Arabic at the university of Madrid, which p)ost he held until 1881, when he was made director of public instruction. This oifice he re- signed upon being elected senator for the district of Huelva. His latter years were almost equally divided between Spain and England, where he made a catalogue of the Spanish manuscripts in the British

iluseum : he had previously continued the work commenced by Mr Bergenroth in cataloguing the manuscripts relating to England in the archives of Simancas. His best known original work is his dissertation on Spanish romances of chivalry in Aribau's Biblioteca de Autores EspaUoles. He died in London on 4th October 1897.

Caza, now Ghuzzeh, the most southerly of the five allied Philistine cities, situated, near the sea, at the point where the old trade routes from Egypt and Petra to Syria met. It was always a strong border fortress and a place of commercial importance. The earliest notice of it isiu the Tell el-Amarna tablets, in a letter from the local governor, who then held it for Egypt. The history of Gaza is that of its many sieges from the time of Alexander to that of Richard Cceur de Lion. Lender the Romans it prospered, but under the Moslems it gradually declined, and before the 14th century it had lost all its importance. Christianity made way slowlj-, and paganism was domi- nant until 400, when the temples and statues of Dagon (j\[arnas) were destroyed by imperial edict. The pros- perity of (ihuzzeh has partially revived through the grow- ing of trade in barley, of which the average annual export to Great Britain for"lS97-90 Avas over 30,000 tons. The]>opulation numbers 25,0(10, including 1000 Christians. The dress of the people is Egyptian rather than Syrian. The Church ^lissionary Society maintains a mission, with schools for both sexes, and a hospital.

Ceelong, a seaport town, in the county of Grant, Mctoria, Australia, on the western arm (Corio Bay) of Port Phillip Bay, 45 miles south-west of]\felbourne,Vith which it is connet'ted by rail. Corio Bay is entered by two channels across the bar, one of which ❓❓❓ the New Channel ❓❓❓ has a depth of 23^ feet. The harbour has four jetties, affording extensive quayage, and vessels drawing 17 to 19 feet can lie alongside at low water. The first

woollen mill in the state was established here, and the cloths, tweeds, and woollen fabrics of the town are noted throughout Australia. Extensive

vineyards were de- stroyed under the Phylloxera Act, but replanting has commenced throughout the district. There are three parks and a botanic garden. There are extensive tan- neries and rope works, and at Fyansford, 3 miles distant, is a large paper mill. Five reservoirs for water supply have a capacity of over 500 million gallons. Population of the town of Geelong (1881), 9721 ; (1901), 12,399 ; of the borough of Geelong West (1881), 4845 ; (1901), 6860.

Ceestemunde, a seaport town of Prussia, province of Hanover, on the right bank of the Weser, immediately south of Bremerhaven. It is a centre of the German North Sea fishing and the seat of a superior school of navigation. Since 1888 upwards of ££800,000 has been spent upon harbour works and improvements. In 1899 the port was entered by 2416 vessels of 347,469 tons. Population (1885), 14,200 ; (1900), 20,113.

Cefle, a seaport town of Sweden, on a bay of the east coast, 112 miles by rail north-north-west from Stockholm. It is the chief port of the productive county of Dalecarlia (Kopparberg), with its iron and copper mines and big forests, and the third commercial port of the kingdom. The exports, which totalled ££804,000 in 1886 and ££1,706,400 in 1900, consist almost entirely of timber (££608,700 in 1887 ; ££1,048,300 in 1900), iron and steel (££222,600 in 1888 ; ££381,850 in 1900), and wood- pulp (££50,000 in 1892 ; ££268,460 in 1900). The imports increased from ££366,600 in 1886 to ££678,400 in 1900. In 1900 the port was cleared by 918 vessels of 506,000 tons, of which 83 of 77,606 tons were British. The harbour, which has two entrances of about 20 feet depth, is usually closed for four or five months in the winter. In 1897 the town authorities voted ££60,000 for deepening and improving it. Large vessels usually load in the roads at Graberg, 6 miles distant. In 1898 Gefle pos- sessed a mercantile fleet of 40 to 60 vessels of some 22,000 tons. It is also a place of some industrial activity. At Skutskar (population 2000 in 1897), a new place at the mouth of the river, are a wood-pulp mill and one of the largest sawmills in Sweden. Population (1880), 18,758 ;

(1890), 23,484 ; (1900), 29,622.

Cegenbaur, Carl (1826), German anatomist,

was born on the 21st August 1826 at Wiirzburg, at the university of which he was student (1845) and after- wards docent. In 1852-53 he studied the marine fauna on the Sicilian coast. In 1855 he was appointed to a medical chair at Jena, where after 1865 his fellow- worker, Ernst Haeckel, was professor of zoology ; and in 1858 Gegenbaur became ordinary professor of anatomy. In 1873 he was appointed to Heidelberg, where he becarne professor of anatomy and director of the Ana- tomical Institute. In 1876 he became editor of the MorpJiologisches Jahrhucli, but the work by which perhaps he is best known is his Grundriss der vergleichenden Ana- tomie (1874, 2nd edition 1878) . This was translated into English by W. E. Jeffery Bell (Elements of Comparative Anatomy, 1878), with additions by Professor E. Ray Lankester. While recognizing the importance of com- parative embryology in the study of descent, Gegenbaur lays stress on the higher value of comparative anatomy as the basis of the study of homologies, i.e., of the rela- tions between corresponding parts in different animals, as, for example, the arm of man, the foreleg of the horse, and the wing of a fowl. A distinctive piece of work was effected by him in 1871 in supplementing the evidence adduced by Huxley in refutation of the theory of the origin of the skull from expanded vertebrae, which, formu-

lated independently by Goethe and Oken, had been championed by Owen. Huxley demonstrated that the skull is built up of cartilaginous pieces ; Gegenbaur showed that " in the lowest (gristly) fishes, where hints of the original vertebrae might be most expected, the skull is an unsegmented gristly brain-box, and that in higher forms the vertebral nature of the skull cannot be maintained, since many of the bones, notably those along the top of the skull, arise in the skin." Other publica- tions by Gegenbaur include a Text-Book of Human Anatomy (1883), the Epiglottis (1892), and Comparative Anatomy of the Vertebrates in Relation to the Invertebrates (vol. i., 1898).

Ceibel, Emanuel (1816-1884), German poet, was born at Llibeck, 17th October 1815, and was the son of a pastor in the city. He was originally intended for his father's profession, but, determining to devote himself to philology and literature, accepted in 1838 a tutorship at Athens, where he remained until 1840. In the same year he brought out, in conjunction

with his friend Ernst Curtius, a volume of translations from the Greek. His first poems, the Zeitstimmen, appeared in 1841 ; a tragedy. King Roderick, followed in 1849. In the same year he received a pension from the King of Prussia, which he retained until his invitation to Munich by the King of Bavaria in 1861 as honorary professor at the university. In the interim he had produced Kbnig Sigurds Brautfahrt, an epic, and Juniuslieder, lyrics in a more spirited and manlier style than his early poems. A volume published at Munich in 1857, and principally consisting of poems on classical subjects, denoted a further considerable advance in objectivity, and the series was worthily closed by the Herbstlieder, published in 1877. He had quitted Munich in 1869 and returned to Lilbeck, where he died on the 6th of April 1884. His works further include two tragedies, Brunhild, 1858, and Sophonisbe, 1869, and translations of French and Italian popular poetry. Beginning with writing, as hostile critics affirmed, "for boarding-school misses," Geibel gradually acquired vigour of thought and style, and, after Eilckert and Platen, is perhaps the best representative of the modern German school of the poetry of literary culture. (e. g.)

Ceikie, Sir Archibald (1835), Scottish

geologist, was born at Edinburgh on 28th December- 1835. He was educated at the High School and Uni- versity of Edinburgh, and in 1856 was appointed an assistant on the Geological Survey. Wielding the pen with no less facility than the hammer, he inaugurated his long list of works with The Story of a Boidder ; or, Gleanings from the Note-Book of a Geologist (1858). His ability at once attracted the notice of his chief. Sir Roderick Murchison, with whom he formed a lifelong friendship, and whose biographer he subsequently became. The geological map of Scotland published in 1862 was their joint work. In 1866 appeared Geikie's Scenery of Scotland (3rd edition 1901), which was, he claimed, " the first attempt to elucidate in some detail the history of the topography of a country." At this time the Edin- burgh school of geologists ??? prominent among them Sir Andrew Ramsay, with his Physical Geology and Geography of Great Britain ??? ~~were maintaining the supreme import~~ ance of denudation in the configuration of land-surfaces, and particularly the erosion of valleys by the action of running water. This

view, now universally accepted, met with opposition from the old-fashioned school, who held that the main features of the earth's surface were deter- mined by cataclysms of Nature. Geikie's book was an able contribution, based on extensive personal knowledge of the districts described, to the doctrines of the Edinburgh

scliool, of which he himself soon began to rank as one of the leaders. Two years later, when a sepa- rate branch of the Geological Survey was established for Scotland, he was appointed director. On the founda- tion of the Murchison Professorship of Geology and Mineralogy at the University of Edinburgh in 1871, he became the first occupant of the chair. These two appointments he continued to hold till 1881, when he succeeded Sir Andrew Eamsay in the joint ofSces of Director-General of the Geological Survey of the United Kingdom and Director of the Museum of Practical Geology, London, from which he retired in February 1901. A feature of his tenure of the latter post was the impetus given to microscopic petrography, a branch of geology to which he had devoted special study, by a splendid collection of sections of British rocks. His ofl&cial work on the Geological Survey culminated in his admirable Geological Map of England and Wales, ivith descriptive notes (1897). His intimate acquaintance with the geology of Scotland brought him face to face with, and helped him to solve, some of the most difficult problems of stratigraphy. Here he was greatly aided by his exten- sive travels, not only throughout Europe, but in Western America. In that world, new from the standpoint of geology no less than of civilization, the forces of Nature have acted both on a greater scale and with less compli- cation. While the canons of Colorado confirmed his long-standing views on erosion, the eruptive region of Oregon supplied him with valuable data for that study of volcanic phenomena which has been the chief work of his later years. His researches, first given to the world in his presidential addresses to the Geological Society in 1891 and 1892, were embodied in his great work on The Ancient Volcanoes of Cheat Britain (1897), which sums up the

present state of our knowledge on the whole question of volcanic disturbances. He lays down the two important generalizations, that in the same area the sequence of volcanic matter erupted is constant, and that the composition and structure of lavas of all ages remain the same. Other results of his travels are collected in his Geological Sketches at Home and Abroad (1882). His experience as a field geologist resulted in an admirable text-book. Outlines of Field Geology (5th edition 1900). After editing and practically re-writing Jukes's Student's Manual of Geology in 1872, he published a Text-BooTc and a Class-Book of geology, which have taken rank as standard works of their kind. His writings are marked in a high degree by charm of style and power of vivid description. His literary ability has given him peculiar qualifications as a writer of scientific biography, and his Memoir of his old chief Sir Andrew Crombie Ramsay (1895) is a model of what such a work should be. His Founders pf Geology consists of the inaugural course of Williams Lectures at the Johns Hopkins University, Baltimore, delivered in 1897. In 1898 he delivered the Romanes Lectures, and his address was published under the title of Types of Scenery and their Influence on Literature. The study of geography owes its im- proved position in Great Britain largely to his eftbrts. Among his works on this subject is Tlie Teaching of Geography (1887). He was foreign secretary of tlie Royal Society from 1890 to 1894, president of the Geological Society in 1891 and 1892, and president of the British Association 1892. He received the honour of knighthood in 1891.

Ceikie, James (1839), younger brother of

Sir Archibald, and like him a distinguished geologist, was born at Edinburgh on 23rd August 1839. He entered the Geological Survey in 1861, and in 1882 succeeded his brother as Murchison Professor of Geology and Mineralogy

at the University of Edinburgh. He has taken as his special subject of investigation the origin of surface- features, and in particular the part played in their formation by glacial action. His views are embodied in his chief work, TJie Great Ice Age and its Relation to the Antiquity of Man (1874; 3rd edition 1894). He is the leader of the school that upholds the all-important action of land-ice, as against those geologists who assign

chief importance to the work of pack-ice and icebergs. Continuing this line of investigation in his Prehistoric Europe (1881), he maintained the hypothesis of five inter- Glaoial periods in Great Britain, and argued that the Palaeolithic deposits of the Pleistocene period were not post- but inter- or pre-Glacial. His Fragments of Earth Lore : Sketches and Addresses, Geological and Geographical (1893), and Earth Sculpture (1898) are mainly concerned with the sarrffe subject. Like Forbes, Eamsay, and Tyndall, he has familiarized himself with the Alps, the classic ground for the investigation of the action of land- ice. His Outlines of Geology (1886), a standard text- book of its subject, reached its third edition in 1896. In 1887 he broke fresh ground with a volume of Songs and Lyrics by H. Heine and other German poets, done into English verse. His interest in geography is shown in the fact that since 1888 he has been editor of the Scottish Geographical Magazine.

Ceislingen, a town of Wilrtemberg, Germany, 38 miles by rail east-south-east of Stuttgart. It has shops for the carving and turning of bone, ivory, wood, and horn, besides iron-works, machinery factories, glass- works, brewing, bleaching, &c. The Church of St Mary's contains wood-carving by Jorg Syrlin the Younger (1512). Here are ruins of the castle of Helfenstein (1552), a monument of the Emperor William I., and a drawing and modelling school. Population (1900), 7050.

Cellivare, or Gellivaea, a mining town of Sweden,, county Finmarken, 127 miles by rail north by west from Lulei, at the head of the Gulf of Bothnia. It owes its importance to the iron mines in the mountain i^ miles to the north, situated in 67 11' IST. lat. and rising to 2024 feet above sea-level (830 feet above Gellivare town). During the dark winter months work proceeds by the aid of the electric light. Some 3000 to 4000 men are employed at the mines. The output has increased at an enormously rapid rate namely, from 85 tons in 1885 to 178,000 tons in 1892 and to over 1,000,000 tons in 1900. In 1864 the mines were acquired by an English company, but abandoned in 1867. In 1884 another English company took them up and completed a provisional railway from Lulea to Gellivare, besides executing a considerable por- tion of the preliminary works for the continuation of the line on the Norwegian side from Ofoten Fjord upwards. But this company, after extracting some 150,000 tons of

ore in 1888-89, became bankrupt in the latter year. TwO' years later the mines passed into the hands of a Swedish company, and the railway was acquired by the Swedisk Government (see Lulea). Population of parish (1900),,

Celnhausen, a town of the province of Hesse- Nassau, Prussia, 27 miles by rail east-north-east of Frankfort-on-Main, on the Kinzig. On an island in the river are the ivy-covered ruins of the imperial palace which Frederick (Barbarossa) I. built before 1170, and which was destroyed by the Swedes during the Thirty Years' War. It has an interesting parish church, with three towers, built in the 13th century, and restored in 1876-79 ; also several other ancient buildings, such as the town-hall, the Princes' Court (now administrative oflflces), the "Witches' Tower, &c. Indiarubber and cigars are manufactured, and wine is made. Gelnhau sen" became

an imperial town in 1169, and in 1186 was the scene of a great Diet of the emisire. In 1634 and 1635 it suffered severely from the Swedes. In 1803 the town became the property of Hesse-Cassel, and in 1866 was assigned to Prussia. Population (1900), 4591.

Celsenkirchen, a town of Prussia, province of Westphalia, 19 miles by rail west of Dortmund. It has coal mines, iron furnaces, steel and boiler works, and soap factories. Population (1885), 20,289 ; (1900), 36,937.

Cems, Artificial. ❖❖❖ The term "Artificial Gems" does not mean imitations of real gems, but the actual formation by artificial means of the real precious stone, so that the product is identical, chemically, physically, and optically, with the one found in nature. Por in- stance, in chemical composition the lustrous diamond is nothing but crystallized carbon. Could we take black amorphous carbon in the form of charcoal or lamp-black and dissolve it in a liquid, and by the slow evaporation of that liquid allow the dissolved carbon to separate out, it would probably crystallize in the trans- parent form of diamond. This would be a true synthesis of

diamond, and the product would be just as much entitled to the name as the choicest products of Kim- berley or Golconda. But this is a very different thing from the imitation diamond so common in shop windows. Here the chemist has only succeeded in making a paste or glass having limpidity and a somewhat high refrac- tivity, but wanting the hardness and " fire " of the real stone.

The Diamond. ??? Within the last few years chemists have actually succeeded in making the real diamond by artificial means, and although the largest yet made is not more than one-fiftieth of an inch across, the process itself and the train of reasoning leading up to such an achieve- ment are suflBciently interesting to warrant a somewhat full description. Attempts to make diamonds artificially have been numerous, but, with the sole exception of those of Moissan, all have resulted in failure. The nearest approach to success was attained by Hanuay in 1880 and Marsden in 1881 ; but their results have not been verified by others who have tried to repeat them, and the prob- ability is that what was then thought to be diamond was in reality carborundum or carbide of silicon.

Attempts have been made by two methods to make carbon crystallize in the transparent form. One is to crystallize it slowly from a solution in which it has been dissolved. The difficulty is to find a solvent. Many organic and some inorganic bodies hold carbon so loosely combined that it can be separated out under the influence of chemical action, heat, or electricity, but invariably the carbon assumes the black amorphous form. The other method is to try to fuse the carbon by fierce heat, when from analogy it is argued that on cooling it will solidify to a clear limpid crystal. The progress of science in other directions has now made it pretty certain that the true mode of making diamond artificially is by a com- bination of these two methods. Until recently it was assumed that carbon was non-volatile at any attainable temperature, but it is now known that at a temperature of about 3600 ?? C. it does volatilize, passing without lique- fying directly from the solid to the gaseous state. Very few bodies act in this manner, the great majority when heated at atmospheric pressure to a sufficient temperature passing through the intermediate condition of liquidity. Some few, however, which when heated at atmospheric pressure do not liquefy, when heated at higher pressures in

closed vessels obey the common rule, and first become liquid and then volatilize. Professor Dewar found the critical pressure of carbon to be about fifteen tons on the

square inch; that is to say, if heated to its critical temperature (3600 ° C), and at the same time subjected to a pressure of 15 tons to the square inch, it will assume the liquid form. Enormous as such pressures and tem- peratures may appear to be, they have been exceeded in some of Sir Andrew Noble's and Sir F. Abel's researches ; in their investigations on the gases from gunpowder and cordite fired in closed steel chambers, these chemists obtained pressures as great as ninety-five tons to the square inch, and temperatures as high as 4000 ° C. Here then, if the observations are correct, we have sufficient temperature and enough pressure to liquefy carbon ; and, were there only sufficient time for these to act on the carbon, there is little doubt that the artificial formation of diamonds would soon pass from the microscopic stage to a scale more likely to satisfy the requirements of science, if not those of personal adornment.

It has long been known that the metal iron in a molten state dissolves carbon and deposits it on cooling as black opaque graphite. Moissan has carried out a laborious and systematic series of experiments on the solubility of carbon in iron and other metals, and has come to the conclusion that whereas at ordinary pressures the carbon separates from the solidifying iron in the form of graphite, if the pressure be greatly increased the carbon on separation will form liquid drops, which on solidifying will assume the crystalline shape and become true diamond. Many other metals dissolve carbon, but molten iron has been found to be the best solvent. The quantity entering into solution increases with the tem- perature of the metal. But temperature alone is not enough; pressure must be superadded. Here Moissan ingeniously makes use of a property which molten iron possesses in common with some few other liquids (water, for instance) of increasing in volume in the act of passing from the liquid to the solid state. Pure iron is mixed with carbon obtained from the calcination of sugar, and the whole is rapidly heated in a carbon crucible in an electric furnace, using a current of 700 ajnperes and 40 volts. The iron melts like wax and saturates itself with carbon.

After a few minutes' heat- ing to a temperature above 4000 ◆◆ C. ◆◆◆ a temperature at which the lime furnace begins to melt and the iron volatilizes in clouds ◆◆◆ the dazzling, fiery crucible is lifted out and plunged beneath the surface of cold water, where it is held till it sinks below a red heat. The sudden cooling solidifies the outer skin of molten metal and holds the inner liquid mass in an iron grip. The expansion of the inner liquid on solidifying produces enormous pressure, and under this stress the dissolved carbon sepa- rates out in a hard, transparent, dense form ◆◆◆ in fact, as diamond. The succeeding operations are long and tedious. The metallic ingot is attacked with hot aqua regia till no iron is left undissolved. The bulky residue consists chiefly of graphite, together with translucent flakes of chestnut- coloured carbon, hard black opaque carbon of a density of from 3-0 to 3-5, black diamonds ◆◆◆ carbonado, in fact ◆◆◆ and a small quantity of transparent colourless diamonds showing crystalline structure. Besides these there may be corundum and carbide of silicon, arising from impurities in the materials employed. Heating with strong sulphuric acid, with hydrofluoric acid, with nitric acid and potassium chlorate, and fusing with potassium fluoride ◆◆◆ operations repeated over and over again ◆◆◆ at last eliminate the graphite a,nd impurities and leave the true diamond untouched. The precious residue on microscopic examination shows many pieces of black diamond, and other colourless transparent pieces, some amorphous, others crystalline. Although many fragments of crystals are seen, the writer has scarcely ever met with a complete crystal. All appear broken up, as if, on being liberated from the intense

pressure under which they were formed, they burst asunder. Direct evidence of this phenomenon has been seen. A very fine piece of diamond, prepared in the way just described and carefully mounted on a mieroscoiDic slide, exploded during the night and covered the slide with fragments. This bursting paroxysm is not unknown at the Kimberley mines.

The artificial diamonds, so far, have not been larger than microscopic specimens, and none has measured more than about half a millimetre across. That, however, is quite enough to show the correctness of the train of reasoning leading up to the achievement, and there is no reason to doubt that, working on a larger scale, larger diamonds will result. Diamonds so made burn in the air when heated to a high temperature, with formation of carbonic acid ; and in lustre, crystalline form, optical properties, density and hardness, they are identical with the natural stone.

It having been shown that diamond is formed by the separation of carbon from molten iron under pressure, it became of interest to see if in some large metallurgical operations similar conditions might not prevail. A special form of steel is made at some large establish- ments by cooling the molten metal under intense hydraulic pressure. In some samples of the steel so made Professor Rosel, of the university of Bern, has found microscopic diamonds. The higher the temperature at which the steel has been melted the more diamonds it contains, and it has even been suggested that the hardness of steel in some measure may be due to the carbon distributed throughout its mass being in this adamantine form. The largest artificial diamond yet formed was found in a block of steel and slag from a furnace in Luxembourg ; it is clear and crystalline, and measures about one-fiftieth of an inch across.

A striking confirmation of the theory that natural diamonds have been produced from their solution in masses of molten iron, the metal from which has gradually oxi- dized and been washed away under cycles of atmospheric influences, is afforded by the occurrence of diamonds in a meteorite. On a broad open plain in Arizona, over an area of about 5 miles in diameter, lie scattered thousands of masses of metallic iron, the fragments varying in weight from half a ton to a fraction of an ounce. There is little doubt that these fragments formed part of a meteoric shower, although no record exists as to when the fall took place. Near the centre, where most of the fragments have been found, is a crater with raised edges, three-quarters of a mile in diameter and 600 feet deep, bearing just the appearance which would be produced had a mighty mass of iron ??? a falling star ??? struck the ground, scattered it in all directions, and buried itself deeply under the surface, fragments eroded

from the surface forming the pieces now met with. Altogether ten tons of this iron have been collected, and specimens of the Canon Diablo meteorite are in most collectors' cabinets. Dr Foote, a mineralogist, when cutting a section of this meteorite, found the tools injured by something vastly harder than metallic iron, and an emery wheel used for grinding it was ruined. He attacked the specimen chemically, and soon afterwards announced to the scientific world that the Canon Diablo meteorite contained diamonds, both black and trans- parent. This startling discovery was subsequently verified by Professors Priedel and Moissan, and also by the writer.

Tlie liuhy. ??? It is evident that of the other precious .stones only the most prized are worth producing artifi- cially. Apart from their inferior hardness and colour, the ???demand for what are known as " semi-precious stones " would not pay for the necessarily great expenses of the factory. Moreover, were it to be known that they were

being produced artificially, the demand ??? never very great ??? would almost cease. The only other gems, therefore, which need be mentioned in connexion with their artificial formation are those of the corundum or sapphire class, which include all the most highly prized gems, rivalling, and sometimes exceeding, the diamond in value. Here a remarkable and little-known fact deserves notice. Except- ing the diamond and sapphire, each of the precious stones ??? the emerald, the topaz, and amethyst ??? possesses a more noble, a harder, and more highly-prized counterpart of itself, alike in colour, but superior in brilliancy and hard- ness ; still more strange, the precious stone to which its special name is usually attached is the variety the least prized. The ruby itself might almost be included in the same category. The true ruby consists of the earth alumina, in a clear, crystalline form, having a minute quantity of the element chromium as the colouring matter. It is often called the " Oriental Euby," or red sapphire, and when of a paler colour, the " Pink Sapphire." But the ruby as met with in jewellers' shops of inferior stand- ing is usually no true ruby, but a " spinel ruby " or " balas ruby," sometimes very beautiful in colour, but softer than the Oriental ruby, and different in chemical composition, consisting essentially of alumina and magnesia and a little silica, with the colouring matter

chromium. The colour- less basis of the true Oriental precious stones being taken as crystallized alumina or white sapphire, when the colouring matter is red the stone is called ruby, when blue sapphire, when green Oriental emerald, when orange- yellow Oriental topaz, and when violet Oriental amethyst. Clear, colourless crystals are known as white sapphire, and are very valuable. It is evident, therefore, that who- soever succeeds in making artificially clear crystals of white sapphire has the power, by introducing appropriate colouring matter, to make the Oriental ruby, sapphire, emerald, topaz, and amethyst. All of these stones, even when of small size, are costly and readily saleable, "while when they are of fine quality and large size they are highly prized, a ruby of fine colour, and free from flaws, a few carats in weight, being of more value than a diamond of the same weight.

This being the case, it is not surprising that repeated attempts have been made to effect the crystallization of alumina. This is not a matter of difficulty, but unfortu- nately the crystals generally form thin plates, of good colour, but too thin to be useful as gems. In 1837 Gaudin made true rubies, of microscopic size, by fusing alum in a carbon crucible at a very high temperature, and adding a little chromium as colouring matter. In 1847 Ebelmen produced the white sapphire and rose-coloured spinel by fusing the constituents at a high temperature in boracic acid. Shortly afterwards he produced the ruby by employing borax as the solvent. The boracic acid was found to be too volatile to allow the alumina to crystallize, but the use of borax made the necessary difference. But it was not till about the year 1877 that]M:M. Fremy and Fell first published a method whereby it was possible to produce a crystallized alumina from \- liich small stones could be cut. They first formed lead aluminate by the fusion together of lead oxide and alumina. This was kept hi a state of fusion in a fireclay crucible (in the com- position of which silica enters largelyV Under the in- fluence of the high temperature the silica of the crucible gradually decomposes the lead aluminate, forming lead silicate, which remains in the liquid state, and alumina, which crystallizes as white sapphire. By the admixture of 2 or 3 per cent, of a chromium compound with the original materials the resulting white sapphire became ruby. More recently MM. Fremy and ^'erneuil obtained artificial rubies by reacting at a red heat with bariuiu

fluoride on amorphous alumina containing a small quan- tity of chromium. The rubies obtained in this manner are thus described by MM. Fr^ray and Verneuil : " Their crystalline form is regular; their lustre is adamantine; they present the beautiful colour of the ruby ; they are perfectly transparent, have the hardness of the ruby, and easily scratch topaz. They resemble the natural ruby in becoming dark when heated, resuming their rose-colour on cooling." Des Cloizeau says of them that " under the microscope some of the crystals show bubbles. In con- verging polarized light the coloured rings and the negative black cross are of a remarkable regularity."

Other experimentalists have attacked the problem in other directions. Besides those already mentioned, Eis- ner," De Senarmont, Deville, and Caron and Debray have succeeded with more or less success in producing rubies. The general plan adopted has been to form a mixture of salts fusible at a red heat, forming a liquid in which alumina will dissolve. Alumina is now added till the fused mass will take up no more, and the crucible is left in the furnace for a long time, sometimes extending over weeks. The solvent slowly volatilizes, and the alumina is deposited in crystals, coloured by whatever colouring oxide has been added.

Mention has been made above of a stone frequently substituted for the true ruby, called the " spinel " or " balas " ruby. The spinel and ruby occur together in nature, stones from Burma being as often spinel as true Oriental ruby. In the artificial production of the ruby it sometimes happens that spinel crystallizes out when true Oriental ruby is expected. The fusion bath is so arranged that only red-coloured alumina shall crystal- lize out, but it is difficult to have all the materials of such purity as to ensure the complete absence of silica and magnesia. In this case, when these impurities have accumulated to a certain point they unite with the alumina, and spinel then separates, as it crystallizes more easily than ruby. When all the magnesia and silica have been eliminated in this way the bath resumes its deposition of crystalline ruby. A few years ago rubies of fine colour and of considerable size were shown in London, made on

the Continent by a secret process. The writer has seen several cut stones so made weighing over a carat each, the uncut crystals measuring half an inch along a crystal edge, and weighing over 70 grains, and a clear plate of ruby cut from a single crystal weighing over ten grains. Riiby has lately been made by Sir W. Roberts-Austen as a by-product in the production of metallic chromium. Oxide of chromium and aluminium powder are intimately mixed together in a refractory crucible, and the mixture 'is ignited at the upper part. The aluminium and chromium oxide react with evolution of so much heat that the reduced chromium is melted. Such is the intensity of the reaction that the resulting alumina is also completely fused, floating as a liquid on the molten chromium. Sometimes the alumina takes up the right amount of chromium to enable it to assume the ruby colour. On cooling the melted alumina crystallizes in large flakes, which on examination by transmitted light are seen to be true ruby. The development of the red colour is said by Greville-Williams only to take place at a white heat. It is not due to the presence of chromic acid, but to a reac- tion between alumina and chromic oxide, which requires an elevated temperature.

Tlie Sapphire. ??? Daubree has shown that when a full quantity of chromium is added to the bath from which white sapphire crystallizes the colour is that of ruby, but when much less chromium is added the colour is blue, forming the true Oriental sapphire. The real colouring matter of the Oriental sapphire is not definitely known,

some chemists considering it to be chromium, and others cobalt. Artificial sapphires have been made of a fair size and perfectly transparent by the addition of cobalt to the igmaous bath of alumina, but the writer does not consider them equal in colour to true Oriental sapphire.

TJie Oriental Emerald. ??? The stone known as emerald consists chemically of silica, alumina, and glucina. Like the ruby, it owes its colour to chromium, but in a different state of oxidation. As already mentioned, there is an- other stone which consists of crystallized alumina col- oured with chromium, but holding the chromium in a different state of oxidation. This is called the Oriental emerald, and, owing to its beauty of colour, its hardness, and rarity, it is more highly prized than the

emerald itself, and commands higher prices. The Oriental emerald has been produced artificially in the same way as the ruby, by adding a larger amount of chromium to the alumina bath and regulating the temperature.

The Oriental Amethyst. ??? The amethyst is rock crystal (quartz) of a bluish-violet colour. It is one of the least valuable of the precious stones. The sapphire, however, is found occasionally of a beautiful violet colour; it is then called the Oriental amethyst, and, on account of its beauty and rarity, is of great value. It is evident that if to the igneous bath of alumina some colouring matter, such as manganese, is added capable of communicating a violet colour to the crystals of alumina, the Oriental amethyst will be the result. Oriental amethyst has been so formed artificially, but the stone being known only as a curiosity to mineralogists and experts in precious stones, and the public not being able to discriminate between the violet sapphire and amethystine quartz, there is no demand for the artificial stone.

The Oriental Topaz. ??? The topaz is what is called a semi-precious stone. It occurs of many colours, from clear white to pink, orange, yellow, and pale green. The usual colour is from straw-yellow to sherry colour. The exact composition of the colouring matter is not known ; it is not entirely of mineral origin, as it changes colour and sometimes fades altogether on exposure to light. Chemically the topaz consists of alumina, silica, and fluorine. It is not so hard as the sapphire. There is also a yellow variety of quartz, which is sometimes called "false topaz." The Oriental topaz, on the other hand, is a precious stone of great value. It consists of clear crystalline sapphire coloured with a small quantity of ferric oxide. It has been produced artificially by adding iron instead of chromium to the matrix from which the white sapphire crystallizes.

TJie Zircon. ??? The zircon, jargoon, or hyacinth is a very beautiful stone, varying in colour, like the topaz, from red and yellow to green and blue. It is sometimes met with colourless, and such are its refractive powers and brilliancy that it has been mistaken for diamond. It is a compound of silica and zirconia. H. Sainte-Claire Deville formed the zircon artificially by passing silicium fluoride at a red heat over the earth zirconia in a porcelain tube. Octahedral crystals of zircon are then

produced, which have the same crystalline form, appearance, and optical qualities as the natural zircon. (w. c.)

General Average. See Aveeage, General.

Geneva, a canton and city of Switzerland. It was the last to be admitted into the Confederation (in 1815), and so ranks last. In point of population the city now ranks as the third in Switzerland, being surpassed by both Zurich and Basel. The canton has an area of 107 square miles (88-8 square miles being " productive," 11 -1 square miles of this being covered by forests and 7-4 square miles by vineyards). The population of the

canton in 1900 was 131,714, divided linguistically thus : Prench – speaking, 110,058; German -speaking, 13,766; Italian-speaking, 7300. Tlie population of the city was in 1888 stated at 71,807, and in 1900 it was (with Carouge and other suburbs) 104,044. The canton is divided into three administrative districts, one taking in the town itself, and the two others the regions on the left and right banks of the Ehone respectively. The cantonal constitution of 1847 is still in force, but has been modi- fied in various particulars. Both the legislature (in the proportion of one member per 1000 inhabitants, or a fraction over 500) and the executive (of seven members) are elected by a direct popular vote, while in each case since 1892 the principles of proportional representation have the force of law. Three thousand five hundred citizens have the right of requiring a " facultative refer- endum" as to any legislative projects, while 2500 citizens have the " right of initiative " as to the revision of the cantonal constitution, or as to any legislative projects. At the end of 1897 the G-enevese people refused to adopt the principle of the separation of Church and State, but in some cases the alienated country churches have been restored to the Eomanists, the Old Catholics being there in such small numbers that they could not themselves use these edifices. In the town the monument of the duke of Brunswick now forms a conspicuous feature, while the restored 15th-century "chapel of the Macca- bees," attached to the cathedral, is very interesting to antiquaries. In 1890 the "

Musee Ariana," a magnificent collection of art treasures, was bequeathed to the town by its owner, M. Revilliod, and is now open to the public. The restoration of the cathedral has also proceeded apace. The university of Geneva (founded as an " academic " by Calvin, and raised in 1873 to the rank of a university) was attended in the winter of 1898-99 by 250 matricu- lated students, and in that of 1899-1900 by 773 (besides 280 hearers). In 1900 the State revenue of the canton was 9,100,432 francs, and the State expenditure 8,764,802 francs, but the budget for 1901 reckons a deficit of 463,000 francs. In 1897 the public debt of the canton was 30,945,400 francs.

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Geneva, Lake of, the largest lake of which any portion belongs to Switzerland. According to Professor Torel, its area is 582-36 square kilometres, or 225 square miles, but the Swiss Government estimate of 1898 makes it slightly less, 577-84 .square kilometres, or 223 square miles. The latest estimate allots 123^ square miles of the lake to Vaud, 11-J- square miles to Geneva, 4f square miles to the Valais, and 83-^ square miles to France. The Petit Lac occupies 30^ square miles of M. Forel's area. The length of the entire lake, from Geneva to Chillon, is 39^ miles, but along its axis 45 miles. The maximum depth is 309-7 metres, or 1015| feet, but the mean depth is only 162-7 metres, or 500 feet. Its greatest width (between Merges and Amphion) is 8^ miles (13-8 kilo- metres), but the normal width is 5 miles, or 8-1 kilometres. Its height above the sea-level is estimated at 371 ~~9 metres (1200 feet) by Forel, and at 375 metres (12301~~ feet) by the Swiss Government officials in 1898. Professor F. A. Forel (of Merges) has made a most complete and detailed study of the lake from every point of view. The results of his prolonged investigations

were given to the world in his monumental work, entitled Le Liman. Professor

Forel mentions (vol. i. pp. 17 et seqq.) a curious fact which deserves to be noticed here. Near the Jardin Anglais in Geneva, on the left bank of the Rhone, there are several erratic blocks in the lake, of which one is called the Pierre du Niton (from a popular tradition that it was once an altar of Neptune). Now this rock was taken many years ago as the base of the Gov- ernment survey, known later as the Dufour Map. Its height was then determined at 376-64 metres (1236 feet), or later at 376-84 metres. But Professor Forel found that its true height above the sea was only 373-5 metres (1225^ feet), so that all the heights on the two great Swiss maps are thus nearly 3 metres (nearly 10 feet) too large. (w. a. b. c.)

Geneva, a village of Ontario county. New York, U.S.A., in 42 ́ 52′ N. and 76 ́ 69′ W., at the foot of Seneca Lake, on the Lehigh Valley and the New York . Central and Hudson Kiver railways, at an altitude of 463 feet. The manufactures consist mainly of iron and steel goods. The village is widely known for the nurseries in the surrounding country, the products of which are dis- tributed to all parts of the United States. Hobart Col- lege, situated here, is a Protestant Episcopal institution, founded in 1822. In 1899 it had 15 instructors and was attended by 92 students. Population (1880), 5878 ; (1890), 7557; (1900), 10,433, of whom 1916 were foreign-born and 193 negroes.

Genoa, chief port and commercial city of Italy, seat of a university and of an archbishopric, near the middle of the Gulf of Genoa, 119 miles north-west of Leghorn by rail, in 44 ́ 24′ 16″ N. lat, 8 ́ 54′ 15″ E. long. After the inclusion of Sampierdarena and the suburban com- munes in the city (1872-73) the population numbered 160,000, and was at later periods (1881), 179,515 ; (1890), 206,033; (1901), 234,809, including 11,469 floating popu- lation. The duke of Galliera's gift of ́800,000 to the city in 1875 permitted the enlargement of the harbour, which was begun in 1877 by a Venetian company. The works included the Molo Lucedio, which more than doubled the length of the mole that starts from the lighthouse; the Nuove Calate, and the quays of Paleo- cazia, Sapri, Caracciolo, Biagio Assereto, Cristoforo Colombo, Andria Doria, Federico

Guglielmo (for pas- senger steamers), Adolfo Parodi, Morosini, and Gugli- elmo Embriaco. All these quays were equipped with the most modern sheds and appliances. Towards the west, outside the harbour, near the Calata delle Grazie, was built the Molo Giano, to which docking basins and re- pairing yards were afterwards added. Simultaneously Via Carlo Alberto, skirting the harbour, was enlarged; the porticos with the marble terrace, near Piazza Carica- mento, were demolished ; and under the terrace in Via Milano (formerly Via alia Lanterna) were placed the Magazzini Generali. The opening of the Gothard tunnel (1882), which extended the commercial range of the port through Switzerland to]\Iannheim, necessitated yet fur- ther enlargement of the harbour. In 1897 a convention to this end was agreed to between the municipality and the Italian Government. These new works included the enlargement of the existing railway station at Piazza Principe, and the creation of another ; the cutting of railway tunnels and the widening of the wharf at the Fed- erico Guglielmo bridge. Meanwhile an English company ___ the Customs and Bonded Warehouses Company ___ has cnnstrui^ted two huge groups of parallel buildings, sev- eral storeys high, on the Molo Vecehio. as a ware- house and bonded stores. The neighbouring Mandeaccio, formerly a stagnant pool, has been filled up so as to gain further warehouse room. The total traffic of the port in 1809 was 3,906,493 tons, of which 215,814 tons were exported; 370,697 were goods in transit; duty

was paid on 3,006,092 tons, while 373,890 tons were placed in bond. The port was visited by 12,970 vessels, representing an aggregate tonnage of 9,049,877 tons. The commerce is constantly increasing, and has now attained a greater volume than that of any Mediterra- nean port except Marseilles.

The only new line of local railway is that known as the Succursale dei Giovi, built to relieve the pressure of traffic which the opening of the Gothard tunnel placed upon the old G-iovi line. The new line from Genoa to Eonco Scrivia is 23 miles long. It contains a tunnel quite as difficult as

that of the Giovi at Busalla, and cost more than ??3,000,000. At present surveys are being made for a new line to Piacenza. The first horse tramway was opened in 1878 by a French company, between the Piazza Annunziata and Sampierdarena. A tunnel was bored through the San Benigno Hill for the passage of the line. Subsequently the horse tramway system was extended to Pontedeoimo and along the shore to Pegli and Voltri. The same company has also installed an omnibus service within the city. In 1893 the first electric tramway was opened between Piazza Corvette and Piazza Manin. A German company has since extended the electric tramway service from the central Piazzi dei Ferrari to Staglieno and Nervi. Other lines run from Piazza Eaibetta along Via San Lorenzo, yia Carignano, Via Circonvallazione a Mare and a Monte to the Kighi, which is reached by an electric funicular railway. Towards the west, lines run from Piazza Garicamento to Pontedecimo and Pegli. A non- electric funicular railway belonging to a Genoese company has been built between the central Piazza Portello and the elevated Corso Magenta. A cog-wheel funicular runs from the hill of San Eocco to the summit of Granarolo, whence a magnificent view is to be obtained. An important electric line was in 1901 in course of construction to La- guardia, a famous sanctuary upon a high hill to the west of the city.

Much has been done by the municipality to improve the streets. In Via Roma, which, with the Galleria Mazzini, was planned in 1871 and completed in 1876, a part of the Palazzo Spinola, which formerly obstructed traffic, has been cut away. Piazza Corvette has been laid out between the two sides of the Acquasola Prome- nade. Via Circonvallazione a Monte has been completed and extended. In 1890 Corso Pirenze was begun, and a carriage road built to the Height of Oregona. Behind Via Milano, Via Venezia has been laid out and is now being connected with the magnificent Circonvallazione a Monte. In 1891 Via a Mare, which ran from Piazza Caricamento to the Molo Giano, was ex- tended and enlarged as far as the Bisaguo Esplanade, and named Corso Aurelio SafB. In the Carignano district the grandiose Galliera Hospital has been built, and Via Corsica laid out as far as the Rotonda, the favourite rendezvous of the Genoese. Corso Mentana, Corso Alessandro Volta, and Corso Silvio Pellico were added. Between the monumental bridge, which connects the two divisions of Via Venti

Settembre and Via Corsica, a wide thoroughfare named Corso Andrea Podest^ has been laid out.

The organization of the Italo-American Exhibition in 1892 (fourth centenary of the discovery of America by Columbus) neces- sitated several important works, namely, the opening of a new thoroughfare between Porta d'Arco and Porta Pila, the demoli- tion of the Fronti Bassi, separating the city from the Bisagno quarter, the embankment of the river Bisagno, the reconstruction of the Pila Bridge, and the lowering of Via Minerva, the name of which was changed to Corso Buenos Ayres. New streets have been constructed in the same quarter, namely, Corso Galliera, Via Torino, Via della Libert^,, Via Casa Regis, Via Barabino, Via Volturno, and Via Fermcoio. New streets have also been laid out in the San Fruttuoso and Cavaletto quarters. The road from Piazza Manin to Staglieno has been completed, the colonnades in Via Carlo Alberto and Piazza Caricamento have been restored, Piazza Principe has been reorganized, and the cemetery of Staglieno embellished with a semicircular colonnade. A large new prison has been built by the Government, and a new public market erected in Via Venti Settembre. Several public monuments have been restored, namely, Porta Soprana, Palazzo San Giorgio, the cathe- dral of San Lorenzo (of which the three naves have been restored in Gothic style), the ancient church of San Donato, and the temple

of the Immacolata. A munificent bequest of the duchess of Galliera provided means for the reorganization of the museum in Palazzo Bianco (in Via Garibaldi), which, with the Palazzo Rosso, contain- ing the celebrated picture gallery, has become municipal property. New monuments have been erected to Mazzini, Garibaldi, Nino Bixio, Victor Emmanuel II., Raiiaele Rubatino (founder of the Navigazione Generale), the duke of Galliera (by Monte verde), and to the duchess of Galliera (also by Monteverde). Many new school buildings have been erected since 1875, and those previously exist- ing much enlarged. There are twenty-five boys' schools, with a total of 9120 scholars and 287 teachers ; twenty-four girls' schools, with 8042 scholars and 241 teachers. In addition there are three technical evening and Sunday schools, with 750 pupils, who are instructed in Italian literature, French, English, algebra, geometry,

chemistry, and physics ; a boys' school of arts and crafts, founded in 1892 ; and two superior female schools, one named after Queen Margherita and the other after the duchess of Galliera, with more than 400 pupils. The sums voted by the municipality for educa- tion have increased from ►►33,000 in 1877 to ►►76,000 in 1899. l"urther sums are provided by the provincial council. One of the most important educational institutes is the superior school of practical commerce, founded by private initiative. It has 100 students, who take a three years' course. A new lyceum has been founded by the municipality. The previously existing nautical school is in a flourishing condition. Since 1880 the university has been promoted from secondary to primary status, and now includes the faculties of jurisprudence, medicine, mathematical and natural sciences, and philosophy and letters. The students in 1900 num- bered 1400.

The development of industry has kept pace with that of the harbour. The Ansaldo shipbuilding yards now construct armoured cruisers both for the Italian navy and for foreign governments. The Odero yards, for the construction of merchant and passenger steamers, have been similarly extended. The two docking basins near the Calata delle Grazie are respectively 540 feet and 670 feet long. A number of foundries and metallurgical works supply material for repairs and shipbuilding. The sugar-refining industry has been introduced by two important- companies, and most of the capital employed in sugar-refming in other parts of Italy has been subscribed at Genoa, where the administrative oifioes of the principal companies and individual refiners are situated. The old industries of maccaroni and cognate products maintain their superiority. Tanneries and cotton spinning and weaving mills have considerably extended throughout the province. Cement works have acquired an extension previously unknown, more than thirty firms being now engaged in that branch of industry.

New charitable institutions have arisen. In 1876 the Galliera Asylum for the poor was founded with a capital of nearly ►►80,000. In 1877 the duchess of Galliera gave ►►400,000 for the creation of three hospitals, one known as Sant' Andrea Apostolo (300 beds), in Carignano, for invalids bom in Liguria; a second, for invalid children, at San Bartolomeo degli Armeni ; and a third, for con- valescent patients, at

Cornigliano. These three hospitals now possess an endowment of more that ––1,000,000. In 1881 the ToUot Infant Asylum was founded with a legacy of ––60,000 bequeathed by Giuseppina ToUot. It has accommodation for 300 children. Other infant asylums provide for an aggregate of nearly 1000 chil- dren. The Pammatone Hospital, founded in 1429 by Bartolomeo Bosco, now contains 857 beds. It possesses an endowment of ––580,000. The municipality pays it an annual subsidy of ––7500 as contribution to the expense of nursing indigent patients. The Hospital for Incurables has 650 beds, and receives from the Pamma^ tone Hospital children whose cases are not chronic. The Lunatic Asylum in Via Brera, with a capacity for 600 inmates, has now a capital of ––210,000. A branch asylum has been built near the sea at the expense of the provincial authorities. The Pauper Asylum and Workhouse, situated above Murassi, deals with the fluctuating mendicant population. It receives an annual subsidy of ––320 from the municipality. The Foundling Hospital, dating from the 15th century, has been detached from the Pammatone. It costs ––8000 a year, of which the provincial authorities provide ––7000. A Sailors' Orphan Asylum, a Public Dormitory, a Hospital for Cripples, a Patronato Scholastico, for supplying indigent children with food, have also been founded. A munifi- cent priest, Francesco Montebruno, has established an Artigianelli Institute with a capital of ––40,000, for training foundling children in arts and crafts. Its inmates at present number 150 boys and 80 girls. Altogether, Genoa has 180 bequests and legacies for charitable purposes.

The municipal budget for 1900 showed a revenue of ––708,760 and an expenditure of ––746,760. Taxes and octroi yield about ––500,000 a year. The chief item of expenditure is represented by interest on the municipal debt (––124,600). The present indebted- ness is ––2,280,000, more than ––800,000 of new debt having been incurred since 1890. (h. W". S.)

GEOGRAPHY.

GEOGRAPHY may be defined as the exact and organized knowledge of the distribution of pheno- mena on the surface of the Earth. The fundamental basis of geography is the vertical relief of the Earth's crust, which controls all mobile distributions. TaTscoll The grander features of the relief of the litho- sphere or stony crust of the Earth control the distribution of the hydrosphere or collected waters which gather into the hollows, filling them up to a height corre- sponding to the volume, and thus producing the important practical division of the surface into land and water. The distribution of the mass of the atmosphere over the surface of the Earth is also controlled by the relief of the crust, its greater or lesser density at the surface cor- responding to the lesser or greater elevation of the surface. The distribution of solar energy is entirely altered from the mathematical simplicity of the zones, which would characterize a uniform globe, by the dissimilar action of land and water with regard to radiant heat, and the influ- ence of crust-forms on the direction of the resulting cir- culation. The influence of physical environment becomes clearer and stronger when the distribution of plant and animal life is considered, and if it is less distinct in the case of man, the reason is found in the modifications of environment consciously produced by human effort. Geography is a synthetic science, dependent for the data with which it deals on the results of specialized sciences such as astronomy, geology, oceanography, meteorology, biology, and anthropology, as well as topographical de- scription (which has too long been supposed to be the whole of geography). The physical and natural sciences are concerned in geography only so far as they deal with the forms of the Earth's surface, or as regards the distribution of phenomena. The distinctive task of geography as a science is to investigate the control exercised by the crust-forms directly and indirectly upon the various mobile distributions. This gives to it unity and definiteness, and renders superfluous the attempts that have been made from time to time to define the limits which divide geography from geology on the one hand and from history on the other. It is essential to classify the subject-matter of geography in such a manner as to give prominence not only to facts, but to their mutual relations and their natural and in- evitable order.

The fundamental conception of geography is form, including the figure of the Earth and the varieties of crustal relief. Hence mathematical

geography, including cartography as a practical application, comes first. It merges into physical geography, which takes account of the forms of the lithosphere (geomorphology), and also of the distribution of the hydrosphere and the rearrange- ments resulting from the workings of solar energy through- out the hydrosphere and atmosphere (oceanography and climatology). Next follows the distribution of plants and animals (biogeography), and finally the distribution of mankind and the various artificial boundaries and redistributions (anthropogeography). The applications of anthropogeography to human uses give rise to political and commercial geography, in the elucidation of which all the earlier departments or stages have to be con- sidered, together with historical and other purely human conditions. The evolutionary idea has revolutionized and unified geography as it did biology, breaking down the old hard-and-fast partitions between the various departments, and displacing the discovery and explora- tion of new lands as the central motive by the study

of the nature and influence of actual terrestrial environ- ments.

History of Geogeaphical Thboet.

The earliest conceptions of the Earth, like those held by the primitive peoples of the present day, are difiicult to discover and almost impossible fully to grasp. Gen- eralizations, as far as they were made from known facts, were usually expressed in symbolic language, and for our present purpose it is not profitable to speculate on the underlying truths which may sometimes be suspected in the old mythological cosmogonies.

*The first definite geographical theories to affect the Western world were those evolved, or at least first ex- pressed, by the Greeks.' The earliest theoretical problem of geography was the form of the Earth. ^^ ”’ ***** The natural supposition that the Earth is a flat disc, circular or elliptical in outline, had in the time of Homer acquired a special definiteness by the introduc- tion of the idea of the ocean river bounding the whole, an application of imperfectly under- g'f^g^ stood observations. Thales of Miletus is claimed as the first exponent of the idea of a spherical Earth ; but although this does not appear to be warranted, his disciple Anaximander (c. 580 b.c.) put forward the theory tlaat the Earth had the figure of a solid body hanging freely in the centre of the hollow sphere of the starry heavens. The Pythagorean school of philosophers adopted the theory of a spherical Earth, but from meta- physical rather than scientific reasons ; their convincing argument was that a sphere, being the most perfect solid figure, was the only one worthy to circumscribe the dwelling-place of man. The division of the sphere into parallel zones and some of the consequences of this gen- eralization seem to have presented themselves to Par- menides (c. 450 b.c.) ; but these ideas did not infiuence the Ionian school of philosophers, who in their treat- ment of geography preferred to deal with facts demon- strable by travel rather than with speculations. Thus Hecataeus, claimed by Tozer^as the father of geography on account of his Periodos, or general “‘^’”- treatise on the Earth, did not advance beyond the primi- tive conception of a circular disc. He systematized the form of the land within the ring of ocean ***** the oel-umene, or habitable world ***** by recognizing two continents: Europe to the north, and Asia to the south of the mid- land sea. Herodotus, equally oblivious of the sphere, criticized and ridiculed the circular outline of the oekumeve, which he knew to be longer from ^^’*****’“‘o’”- east to west than it was broad from north to south. He also pointed out reasons for accepting a division of the land into three continents ***** Europe, Asia, and Africa. Beyond the limits of his personal travels Herodotus ap- plied the characteristically Greek theory of symmetry to complete, in the unknown, outlines of lands and rivers analogous to those which had been ex- J”^^*”” plored. Symmetry was in fact the first geo- ^^”””^ ‘^’ graphical theory, and the effect of*

Herodotus's hypothesis that the Nile must fiow from west to east before turning north in order to balance the Danube running from west

1 A concise sketi'Ii of the whole history of geographical method or theory us distinguished from the history of ueographical discovery is only to he found in the introduction to H.'Wiisjuer's Lehrhuch 'der Gmgrnphle (voh i., Leipzig, 1900), which is in 'every way the most ciimplctc treatise on the principles of geography.

^liistunj of Ancient Geography, Cambridge, 1897, p. TO.

to east before turning south lingered in the maps of Africa down to the time of Mungo Park.'

To Aristotle (384-322 b.o.) must be given the distinc- tion of founding scientific geography. He demonstrated

*the sphericity of the Earth by three arguments, aaTth'" *^ ►► ►►^ which could be tested by observation. sphere. These were ►►► (1) that the Earth must be spherical,*

because of the tendency of matter to fall together towards a common centre ; (2) that only a sphere could always throw a circular shadow on the moon during an eclipse ; and (3) that the shifting of the horizon and the appearance of new constellations, or the disappearance of familiar stars, as one travelled from north to south, could only be explained on the hypothesis that the Earth was a sphere. Aristotle, too, gave greater definiteness to the idea of zones conceived by Parmenides, who had pictured a torrid zone uninhabited by reason of heat, two frigid zones uninhabited by reason of cold, and two intermediate temperate zones fit for human occupation. Aristotle defined the temperate zone as extending from the tropic to the arctic circle, but there is some uncertainty as to the precise meaning he gave to the term " arctic circle." Soon after his time, however, this conception was clearly established, and with so large a

generalization the mental horizon was widened to conceive of a geography which was a science. Aristotle had himself shown that in the southern temperate zone winds similar to those of the northern temperate zone should blow, but from the op- posite direction.

While the theory of the sphere was being elaborated the efforts of practical geographers were steadily directed Pitti th o^'^"is ascertaining the outline and configura- oekumeae tion of the oekumene, or habitable earth, the only to the portion of the terrestrial surface known to the

sphere. ancients and to the mediaeval peoples, and still retaining a shadow of its old monopoly of geographical attention, in its modern name of the " Old World." The fitting of the oekrimene to the sphere was the second theoretical problem. The circular outline had given way in geographical opinion to the elliptical with the long axis lying east and west, and Aristotle was inclined to view it as a very long and relatively narrow band almost encircling the globe in the temperate zone. His argument as to the narrowness of the sea between west Africa and east Asia, from the occurrence of elephants at both extremities, is difficult to understand, although it shows that he looked on the distribution of animals as a problem of geography.

Pythagoras had speculated as to the existence of anti- podes, but it was not until the first approximately accurate

measurements of the globe and estimates of the antipodes.' length and breadth of the oekumene were made

by Eratosthenes (c. 250 b.c.) that the fact that, as then known, it occupied less than a quarter of the sur- face of the sphere was clearly recognized. It was natural, if not very logical, that the ocean river should be extended from a narrow stream to a world-embracing sea, and here again Greek theory, or rather fancy, gave its modern name to the greatest feature of the globe. The old instinctive idea of symmetry must often have suggested other oefemewe balancing the known world in the other quarters of the globe. The Stoic philosophers, especially Crates of Mallos, arguing from the love of nature for life, placed an oekumene in each quarter of the sphere, the three unknown world- islands being those of the Antoken,

Perioken, and Anti- podes. This was a theory not only attractive to the philosophical mind, but eminently adapted to promote exploration. It had its opponents, however, for Herodotus showed that sea-basins existed cut off from the ocean, and

1 See Myres, " An Attempt to reconstruct the Maps used by Hero- dotus," GeographicalJounial, yiii. (1896), p. 605.

it is still a matter of controversy how far the pre- Ptolemaic geographers believed in a water-connexion between the Atlantic and Indian oceans. It is quite clear that Pomponius Mela (c. a.d. 40), following Strabo, held that the southern temperate zone contained a habit- able land, which he designated by the name Afntichthones.

Aristotle left no work on geography, so that it is impos- sible to know what facts he would associate with the science of the Earth's surface. The word geo- . , ^ ,, , graphy did not appear before Aristotle, the first rec- use of it being in 'the Peri Kosmon, which is one graphical of the writings doubtfully ascribed to him, and """' ❑❑❑❑❑ Berger considers that the expression was introduced by Eratosthenes.^ Aristotle was certainly conversant with many facts, such as the formation of deltas, coast- erosion, and to a certain extent the dependence of plants and animals on their physical surroundings. He formed a comprehensive theory of the variations of climate with latitude and season, and was convinced of the necessity of a circulation of water between the sea and rivers, though, like Plato, he held that this took place by water rising from the sea through crevices in the rocks, losing its dissolved salts in the process. He speculated on the differences in the character of races of mankind living in different climates, and correlated the political forms of communities with their situation on a seashore, or in the neighbourhood of natural strongholds.*

Claudius Ptolemaeus (c. a.d. 160) concentrated in his writings the final outcome of all Greek geographical learn- ing, and passed it across the gulf of the Middle Ages by the hands of the Arabs, to form the ❑❑ ""'- starting-point of the science in modern times. His geo- graphy was based more immediately on the work of his predecessor, Marinus of Tyre, and on that of Hipparchus, the follower and critic of

Eratosthenes. It was the ambition of Ptolemy to describe and represent accurately the surface of the oekumene, for which purpose he took immense trouble to collect all existing determinations of the latitude of places, all estimates of longitude, and to make every possible rectification in the estimates of dis- tances by land or sea. His work was mainly carto- graphical in its aim, and theory was as far as possible excluded. The symmetrically placed hypothetical islands in the great continuous ocean disappeared, and the oekumene acquired a new form by the representation of the Indian Ocean as a larger Mediterranean completely cut off by land from the Atlantic. The terra incognita unit- ing Africa and farther Asia was an unfortunate hypothesis which helped to retard exploration. Ptolemy used the word geography to signify the description of the whole oekumene on mathematical principles, while chorography signified the fuller description of a particular region, and topography the very detailed description of a smaller locality. He introduced the simile that geography repre- sented an artist's sketch of a whole portrait, while chorography corresponded to the careful and detailed drawing of an eye or an ear.

The Middle Ages saw geographical knowledge die out in Christendom, although it retained, through Arabic translations of Ptolemy, a certain vitality in ,

Islam. The verbal interpretation of Scripture]□□□ the led Lactantius (c. a.d. 320) and other eccle- Middle siastics to denounce the spherical theory of the ^^*□□" Earth as heretical. The wretched subterfuge of Cosmas (c. A.D. 560) to explain the phenomena of the apparent

2 Geschichte der wissenschaftlichen Erdkunde der Griechen, Leipzig, 1891, Abt. 3, p. 60.

8 Bunbury's History of Ancient Geography, 2 vols., London, 1879; MUller's Geographi Grseci Minores, 2 vols., Paris, 1855, 1861; and Berger's Geschichte der wissenschaftlichen Erdkunde der Griechen, 4 vols., Leipzig, 1887-93, are standard authorities on the Greek geographers.

*movements of the sun by means of an earth modelled on the plan of the Jewish Tabernacle, gave place ultimately to the "wheel-maps ??? the T in an 0 ??? which reverted to the primitive ignorance of the times of Homer and Hecatseus.^*

The journey of Marco Polo, the increasing trade to the East, and the voyages of the Arabs in the Indian Ocean prepared the way for the re-acceptance of Ptolemy's ideas when his works became known through the Moors in Spain, and when the sealed books of the Greek original were translated into Latin by Angelus in 1410.

The old arguments of Aristotle and the old measure- ments of Ptolemy were used by Toscanelli and Columbus in urging a westward voyage to India; and geography. ???ainly ou this account did the crossing of the Atlantic rank higher in the history of scientific geography than the laborious feeling out of the coast-line of Africa. But not until the voyage of Magellan shook the scales from the eyes of Europe did modern geography begin to advance. Discovery had outrun theory; the rush of new facts made Ptolemy practically obsolete in a generation, after having been the fount and origin of all geography for a millennium.

The earliest evidence of the reincarnation of theoretical geography is to be found in the text-books by Peter Apian and Sebastian Munster. Apian in his Gosmo- p anus, grapliicus Liber, published in 1524, and subse- quently edited and added to by Gemma Frisius under the title of GosmograpMa, based the whole science on mathe- matics and measurement. He followed Ptolemy closely, enlarging on his distinction between geography and chorography, and expressing the artistic analogy in a rough diagram. This slender distinction was made much of by most subsequent writers until Nathanael Carpenter in 1625 pointed out that the difference between geography and chorography was simply one of degree, not of kind.

Sebastian Munster, on the other hand, in his Gosmo- grapMa Universalis of 1644, paid no regard to the mathe- matical basis of geography, but, following the

uns er. jjjodel of Strabo, described the world according to its different political divisions, and entered with great zest into the question of the productions of countries and into the manners and costumes of the various peoples. Thus early commenced the separation between what were long called mathematical and political geography, the one subject appealing mainly to mathematicians, the other to historians.

Throughout the 16th and 17th centuries the rapidly accumulating store of facts as to the extent, outline, and mountain and river systems of the lands of the Earth were put in order by the generation of cartographers of which Mercator was the chief; but the writings of Apian and Munster held the field for a hundred years without a serious rival, unless the many annotated editions of Ptolemy might be so considered. Meanwhile the new facts were the subject of original study by philosophers and by practical men without reference to classical traditions. Bacon argued keenly on geographical matters and was a lover of maps, in which he observed and reasoned upon such resemblances as that between the outlines of South America and Africa.

Philip Cluver's Introductio in Geographiam universnm trim veterani qiuun noixirn was published in 1624. Geo- graphy he defined as "the description of the ciuverius. j.^jg Earth, so far as it is known to us." It is distinguished from cosmography by dealing with tlie Earth alone, not with the universe, and from chorography and topography by dealing with the whole Earth, not with a country or a place. The first book, of fourteen short

1 The period of the early Middle Ages is dealt with in Beazley's Dawn 0/ Modern Geography, London, 1897.

chapters, is concerned with the general properties of the globe; the remaining six books treat in considerable detail of the countries of Europe and of the other con- tinents. Each country is described with particular regard to its people as well as to its surface, and the prominence given to the human element is of special interest.

A little-known book which appears to have escaped the attention of most writers on the history of modern geo- graphy was published at Oxford in

1625 by Nathanael Carpenter, fellow of Exeter College,
^^□□□‘p^”^’— with the title Geographie deli7ieated forth in Two Bookes, covMining the Sphericall and Topicall parts thereof. ^ It is discursive in its style and verbose ; but, considering the period at which it appeared, it is remarkable for the strong common sense displayed by the author, his comparative freedom from prejudice, and his firm application of the methods of scientific reasoning to the interpretation of phenomena. Basing his work on the principles of Ptolemy, he brings together illustrations from the most recent travellers, and does not hesitate to take as illustrative examples the familiar city of Oxford and his native county of Devon. He divides geography into The Spherical Part, or that for the study of which mathematics alone is required, and The Topical Part, or the description of the physical relations of parts of the Earth’s surface, preferring this division to that favoured by the ancient geographers □□□ into general and special. It is distinguished from other English geographical books of the period by confining attention to the principles of geography, and not describing the countries of the world.

A much more important work in the history of geo- graphical method is the Geographia Generalis of Bernhard Varenius, a German medical doctor of Leyden, who died at the age of twenty-eight in 1650, ^□□□” “’ the year of the publication of his book. It was so highly esteemed that an annotated edition was published in Cambridge in 1672 by Sir Isaac Newton, with the addition of the plates which had been planned by Varenius, but not produced by the original publishers.*

” The reason why this great man took so much care in correcting and publishing our author was, because he thought him necessary to be read by his audience, the young gentlemen of Cambridge, while he was deliver- ing lectures on the same subject from the Lucasian Chair.” ^

The treatise of Varenius is a model of logical arrange- ment and terse expression ; it is a work of science and of genius ; one of the few of that age which can still be studied with profit. The English translation renders the definition thus : ” Geography is that part of mixed mnthematics which explains the state of the Earth and of its parts, depending ou quantity, viz., its figure, place, magnitude, and motion, with the celestial

appearances, &c. By some it is taken in too limited a sense, for a bare description of the several countries ; and by others too extensively, who along with such a description would have their political constitution."

A'arenius was reluctant to include the human side of geography in his system, and only allowed it as a con- cession to custom, and in order to attract readers by imparting interest to the sterner details of the science. I lis division of geography was into two parts ??? (i.) General or universal, dealing with the Earth in general, and ex- plaining its properties without regard to particular coun- tries ; and (ii.) Special or particular, dealing with each country in turn from the ehorographical or topographical point of view. General geography was divided into ??? (1) the Ahsohite part, dealing with the form, dimensions, posi-

" From translator's preface to the English version by Mr Dugdale (1733), entitled A Complete System of General Geographii, revised by Dr Feter Shaw, Loudon, 1756.

tion, and substance of the Earth, the distribution of land and water, mountains, woods, and deserts, hydrography ^including all the waters of the Earth), and the atmosphere; (2) the Belative part, including the celestial properties, i.e., latitude, climate zones, longitude, &c. ; and (3) the Comparative part, which " considers the particulars arising from comparing one part with another " ; but under this head the questions discussed were longitude, the situation and distances of places, and navigation. Varenius does not treat of special geography, but gives a scheme for it under three heads ??? (1) Terrestrial, including position, outline, boundaries, mountains, mines, woods and deserts, waters, fertility and fruits, and living creatures ; (2) Celestial, including appearance of the heavens and the climate ; (3) Human, but this was added out of deference to popular usage.

This system of geography founded a new epoch, and the book ??? translated into English, Dutch, and French ??? was the unchallenged

standard for more than a century. The framework was capable of accommodating itself to new facts, and was indeed far in advance of the know- ledge of the period. The method included a recognition of the causes and effects of phenomena as well as the mere fact of their occurrence, and for the first time the importance of the vertical relief of the land was fairly recognized.

The physical side of geography continued to be elabor- ated after Varenius' s methods, while the historical side was developed separately. Both branches, although enriched by new facts, remained stationary so far as method is concerned until nearly the end of the 18th century. The compilation of " geography books " by uninstructed writers led to the pernicious habit, which is not yet wholly over- come, of reducing the general or "physical" part to a few pages of concentrated information, and expanding the particular or " political " part by including unrevised travellers' stories and uncritical descriptions of the va- rious countries of the world. Such books were in fact not geography, but merely compressed travel.

The next marked advance in the theory of geography may be taken as the nearly simultaneous studies of the physical Earth carried out by the Swedish Bergmana. gjj^gjjr^ig-t^ Torbern Bergmann, acting under the impulse of Linnasus, and by the German philosopher, Immanuel Kant. Bergmann's Physical Description of the Earth was published in Swedish in 1766, and trans- lated into English in 1772 and into German in 1774. It is a plain, straightforward description of the globe, and of the various phenomena of the surface, dealing only with definitely- ascertained facts in the natural order of their relationships, but avoiding any systematic classification or even definitions of terms.

The problems of geography had been lightened by the destructive criticism of the French cartographer D'Anville (who had purged the map of the world of the '^^"^' last remnants of traditional fact unverified by

modern observations) and rendered richer by the dawn of the new era of scientific travel, when Kant brought his logical powers to bear upon them. Kant's lectures on physical geography were delivered in the University of Konigsberg from 1765 onwards.^ Geography appealed to him as a

valuable educational discipline, the joint foundation with anthropology of that " knowledge of the world " which was the result of reason and experience. In this connexion he divided the communication of experience from one person to another into two categories ??? the narrative or historical and the descriptive or geographical ; both history and geography being viewed as descriptions,

1 Printed in Schriften ziir Physischen Geographie, vol. vi. of Soliubert's edition of the collected works of Kant, Leipzig, 1839. First published with notes hy Rink in 1802.

the former a description in order of time, the latter a description in order of space.

Physical geography he viewed as a summary of nature, the basis not only of history but also of " all the other possible geographies," of which he enumerates five, viz., (1) Mathematical geography, which deals with the form, size, and movements of the Earth and its place in the solar system ; (2) Moral geography, or an account of the different customs and characters of mankind according to the region they inhabit; (3) Political geography, the divisions according to their organized governments ; (4) Mercantile geography, dealing with the trade in the surplus products of countries ; (5) Tlieological geography, or the distribution of religions. Here there is a clear and formal statement of the interaction and causal relation of all the phenomena of distribution on the Earth's surface, including the influence of physical geography upon the various activities of mankind from the lowest to the highest. Notwithstanding the form of this classification, Kant himself treats mathematical geography as prelimi- nary to, and therefore not dependent on, physical geo- graphy. Physical geography itself is divided into two parts : a general, which has to do with the Earth and all that belongs to it ??? water, air, and land ; and a particular, which deals with special products of the Earth ??? mankind, animals, plants, and minerals. Particular importance is given to the vertical relief of the land, on which the various branches of human geography are shown to depend.

*Alexander von Humboldt was the first modern geo- grapher to become a great traveller, and thus to acquire an extensive stock of first-hand information on which an improved system of geography might ”” ” *”*** be founded. The impulse given to the study of natural history by the example of Linnaeus ; the results brought back by Sir Joseph Banks, Dr Solander, and the two Forsters, who accompanied Cook in his voyages of discovery ; the studies of De Saussure in the Alps, and the lists of desiderata in physical geography drawn up by that investigator, combined to prepare the way for Humboldt. The theory of geography was advanced by Humboldt mainly by his insistence on the great principle of the unity of nature. He brought all the ” observable things,” which the eager collectors of the previous century had been heaping together regardless of order or system, into relation with the vertical relief and the horizontal forms of the Earth’s surface. Thus he demonstrated that the forms of the land exercise a directive and deter- mining influence on climate, plant life, animal life, and on man himself. This was no new idea ; it had been familiar for centuries in a less definite form, deduced from ct priori considerations, and so far as regards the influ- ence of surrounding circumstances upon man, Kant had already given it full expression. Humboldt’s concrete illustrations and the remarkable power of his personality enabled him to enforce these principles in a way that produced an immediate and lasting effect. The treatises on physical geography by Mrs Mary Somerville and Sir John Herschel (the latter written for the eighth edition of the Encyclopcedia Britannicd) showed the effect pro- duced by the stimulus of Humboldt’s work in Great Britain.*

Humboldt’s contemporary, Carl Eitter, extended and disseminated the same views, and in his interpretation of ” Comparative Geography ” he laid stress on the importance of forming conclusions, not from the study of one region by itself, but from the comparison of the phenomena of many places. Impressed by the influ- ence of terrestrial relief and climate on human move- ments, Eitter was led deeper and deeper into the study of history and archaeology. His monumental ” Vergleichende

Geographie," which was to have made the whole world its theme, died out in a wilderness of detail in twenty-one volumes before it had covered more of the Earth's surface than Asia and a portion of Africa. Some of his followers showed a tendency to look on geography rather as an auxiliary to history than as a study of intrinsic worth.

During the rapid development of physical geography many branches of the study of nature, which had been included in the cosmography of the early writers, the physiography of Oeograpby ijamxas,y and even the Erdkunde of Ritter, had been sc/ei^ """^ ^ ►► much advanced by the labours of specialists that their connexion was apt to be forgotten. Thus geology, meteorology, oceanography, and anthropology developed into distinct sciences. The absurd attempt was, and sometimes is still, made by geographers to include all natural science in geography ; but it is more common for specialists in the various detailed sciences to think, and sometimes to assert, that the ground of physical geography is now fully occupied by these sciences. Political geography has been too often looked on from both sides as a mere summary of guide-book knowledge, useful in the sciioolroom, a poor relation of physical geography that it was rarely necessary to recognize.

The science of geography, passed on from antiquity by Ptolemy, re-established by Varenius and Newton, and systematized by Kant, included within itself definite aspects of all those terrestrial pheno- mena which are now treated exhaustively under the heads of geology, meteorology, oceanography, and anthropology ; and the Inclusion of the requisite portions of the perfected results of these sciences in geography is simply the gathering in of fruit matured from the seed scattered by geography itself.

The study of geography was advanced by improvements in car- tography (see Maps), not only in the methods of survey and pro- jection, but in the representation of the third dimension by means of contour lines introduced by Buaohe in 1737, and the more remarkable because less obvious invention of isotherms and isobars introduced by Humboldt in 1817.

The "argument from design" had been a favourite form of reasoning amongst Christian theologians, and, as worked out by Paley in his Natural Theology, it served the useful pur- The teleo- pose of emphasizing the fitness which exists between logical ar- ^jj jj^g inhabitants of the Earth and their physical rem^aohr environment. It was held that the Earth had been ' created so as to fit the wants of man in every particular. This argument was tacitly accepted or explicitly avowed by almost every writer on the theory of geography, and Carl Eitter distinctly recognized and adopted it as the unifying principle of his system. As a student of nature, however, he did not fail to see, and as pro- fessor of geography he always taught, that man was in very large measure conditioned by his physical environment. The apparent opposition of the observed fact to the assigned theory he overcame by looking upon the forms of the land and the arrangement of land and sea as instruments of Divine Providence for guiding the destiny as well as for supplying the requirements of man. This was the central theme of Ritter's philosophy ; his religion and his geography were one, and the consequent fervour with which he pursued his mission goes far to account for the immense influence he acquired in Germany.

The evolutionary theory, more than hinted at in Kant's " Physical Geography," has, since the writings of Charles Darwin, become the unifying principle in geography. The con- The theory geption of the development of the plan of the Earth ofevola- from the first cooling of the surface of the planet emzraphy throughout the long geological periods, the guiding power of environment on the circulation of water and of air, on the distribution of plants and animals, and finally on the movements of man, give to geography a philosophical dignity and a scientific completeness which it never previously possessed. The influence of environment on the organism may not be quite so potent as it was once believed to be, in the writings of Buckle for instance,! and certainly man, the ultimate term in the series, reacts upon and greatly modifies his environment ; yet the fact that environment does influence all distributions is established beyond the possibility of doubt. In this way also the position of geography, at the point where physical science meets and mingles with mental science, is explained and justified. The change which took place during the 19th century in the substance and style of

geography may be best seen by comparing the eight volumes of Malte-i3run's Geographie Unhcrscllr. (Paris, 1812-21)) with the twenty-one volumes of Reclus's Cfeographie Uiiiverselle (Paris, 1876-95).

In estimating the influence of recent writers on geography it is usual to assign to Peschel the credit of having corrected the pre- ponderance which Ritter gave to the historical element, and

History of Civilization, vol. i., 1857.

restoring physical geography to its old pre-eminence. " As a matter of fact, each of the leading exponents of theoretical geography at the present time such as Richthofen, Wagner, Ratzel, Davis, Penok, De Lapparent, and Reclus has his in- dividual point of view, one devoting more attention to the results of geological processes, another to anthropological conditions, and the rest viewing the subject in various blendings of the extreme lights. The two conceptions which may now be said to animate the theory of geography are the genetic, which depends upon processes of origin, and the morphological, which depends on facts of form and distribution.

The Pkinoiples op Geogkaphy.

As regards the scope of geography, the order of the various departments and their inter-relation, there is little difference of opinion, and the principles of geography' are now generally accepted by modern geographers. The order in which the various subjects are treated in the following sketch is the natural succession from fundamental to dependent facts, which corresponds also to the evolution of the diversities of the Earth's crust and of its inhabitants.

*The fundamental geographical conceptions are mathematical, the relations of space and form. The figure and dimensions of the Earth are the first of these. They are ascertained by a combination of actual measurement of the highest pre- ^athema- oision on the surface and angular observations of the j, *?"' positions of the heavenly bodies. The science of " ' geodesy is pai:t of mathematical geography, of which the arts of surveying and cartography are*

applications. The motions of the Earth as a planet must be taken into account, as they render possible the determination of position and direction by observations of the heavenly bodies. The diurnal rotation of the Earth furnishes two fixed points or poles, the axis joining which is fixed or nearly so in its direction in space. The rotation of the Earth thus fixes the directions of north and south and defines those of east and west. The angle which the Earth's axis makes with the plane in which the planet revolves round the sun deter- mines the varying seasonal distribution of solar radiation over the surface and the mathematical zones of climate. Another important consequence of rotation is the deviation produced in moving bodies relatively to the surface. In the form known as Ferrell's Law this runs : " If a body moves in any direction on the Earth's surface, there is a deflecting force which arises from the Earth's rotation which tends to deflect it to the right in the northern hemisphere but to the left in the southern hemi- sphere." The deviation is of importance in the movement of air, of ocean currents, and to some degree of rivers.

In popular usage the words "physical geography" have come to mean geography viewed from a particular standpoint rather than any special department of the subject. The popular meaning is better conveyed by the word a^~^h physiography, a term which appears to have been in-
"'

troduced by Linnaeus, and was re-invented as a substitute for the cosmography of the Middle Ages by Professor Huxley. Although the term has since been limited by some writers to one particular part of the subject, it seems best to maintain the original and literal meaning. In the stricter sense, physical geography is that part of geography which involves the processes of contemporaiy change in the crust and the circulation of the fluid envelopes. It thus draws upon physics for the explanation of the phenomena with the space-relations of which it is specially concerned. Physical geography naturally falls into three divisions, dealing respectively with the surface of the lithosphere geomorphology ; the hydrosphere oceanography ; and the atmosphere clima- tology. All these rest upon the facts of mathematical geography, and the three are so closely inter-related that they cannot be rigidly

separated in any discussion. Oceanography and climatology are treated in some detail in special articles, the latter forming an essential part of meteorology.

Geomorphology is the part of geography which deals with terrestrial relief, including the submarine as well as the subaerial portions of the crust. The history of the origin of the various forms belongs to geology, and can be com- “^”””“‘P”- pletely studied only by geological methods. But the “*’ ” relief of the crust is not a finished piece of sculpture ; the forms are for the most part transitional, owing their characteristic out- lines to the process by which they are produced ; therefore the

2 See B^ J. Mucldnder in Britixli Axxnciation Report (Ipswich), 1895, p. 738, for ;i summary of (xcrman opiniou, which has been expressed by many writers in a somewhat voluminous literature.

This phrase is old, appearing in one of the earliest English works on geography, William Cuningham’s Oosmograpliical Glasce con- temyiig the pleasant Prhwiiilex ut’ Cosmographie, Geographie, Htidro- graphic, or Navigntion, Lomion, iri.‘il).

See also S. Giinther, Handhuch der Mdthematischen Geographie, Stuttgart, 1890.

Crustal relief.

geographer must, for strictly geographical purposes, take some account of the processes which are now in action modifying the forms of the crust. Opinion differs greatly as to the extent to which the geographer’s work should overlap that of the geologist. The primary distinction of the forms of the crust is that between elevations and depressions. Granting that the geoid or mean sur- face of the ocean is a uniform spheroid, the distribution of land and water approximately indicates a division of the

surface of the globe into two areas, one of elevation and one of depression. The increasing number of measurements of the height of land in all con- tinents and islands, and the very detailed levellings in those coun- tries which have been thoroughly surveyed, enable the average elevation of the land above sea level to be fairly estimated, although many vast gaps in accurate knowledge remain, and the estimate is not an exact one. The only part of the sea-bed the configuration of which is at all well known is the zone bordering the coasts where the depth is less than about 100 fathoms or 200 metres, i.e., those parts which sailors speak of as "in soundings." Actual or pro- jected routes for telegraph cables across the deep sea have also been sounded with extreme accuracy in many cases ; but beyond these lines of sounding the vast spaces of the ocean remain un- plumbed save for the rare researches of scientific expeditions, such as those of the Challenger, the Valdivia, and the Albatross. Thus the best approximation to the average depth of the ocean is little more than an expert guess.

The chief element of uncertainty as to the largest features of the relief of the Earth's crust is due to the unexplored area in the Arctic region and the far vaster regions of the Ant- arctic, of which we know nothing. We know that the Earth's surface if unveiled of water would exhibit a great region of elevation arranged with a certain rough radiate symmetry round the north pole, and extending jjooon southwards In three unequal arms which taper to points in the south. A great depression sur- rounds the unknown south polar region in a continuous ring and extends northwards in three vast hollows lying between the arms of the ele- vated area. So far it is possible to speak with certainty, but it is permissible to take a few steps into the twilight of dawning knowledge and indicate the chief subdivisions which are likely to be established in the great crust-hollow and the great crust-heap. The boundary between these should obviously be the mean surface of the sphere.

Sir John Murray deduced the mean height of the land of the globe as about 2250 feet above sea level, and the mean depth of the oceans as 2080 fathoms or 12,480 feet below sea level.i Calcu- lating the area of the land at 55,000,000 square miles (or 28-6 per cent, of the surface), and that of the oceans as 137,200,000 square miles (or 71-4 per cent, of the surface),

he found that the volume of the land above sea level was 23,450,000 cubic miles, the volume of water below sea level 323,800,000, and the total volume of the water equal to about j^j of the volume of the whole globe. From these data, as revised by A. Supan,^ H. R. Mill calculated the position of mean sphere level at about 10,000 feet or 1700 fathoms below sea level. He showed that an imaginary spheroidal shell, concentric with the Earth and cutting the slope between the elevated and depressed areas at the contour-line of 1700 fathoms, would not only leave above it a volume of the crust equal to the volume of the hollow left below it, but. would also divide the surface of the Earth so that the area of the elevated region was equal to that of the depressed region.'

A similar observation was made almost simultaneously by Komieux, who further speculated on the equilibrium between the weight of the elevated land mass and that of the total waters of the ocean, and deduced some extremely in- teresting relations between them. Murray, as the result of his study, divided the Earth's surface into three zones ??? the continental area containing all dry land, the transitional area including the submarine slopes down to 1000 fathoms, and the abysmal area consisting of the floor of the ocean beyond that depth ; and Mill proposed to take the line of mean- sphere level, instead of the empirical depth of 1000 fathoms, as the boundary between the transitional and abysmal areas. ????? An elaborate criticism of all the existing data regarding the vol-*

1 " Od the Height of the Land and the Depth of the Ocean," Scot. Geog. Mag. iv. (1888), p. 1. Estimates had been made previously by Humboldt, De Lapparent, H. Wagner, and subsequently by Penck and Heiderich, and for the oceans by Karstens.

2 Petermanns Mitteilungen, xxv. (1889), p. 17. s Proc. Roy. Soc. Edin. xvii. (1890), p. 185.

4 Comptes Eendus Acad. Sci., Paris, vol. iii. (1890), p. 994.

ume relations of the vertical relief of the globe was made in 1894 by Professor Hermann Wagner, whose recalculations of volumes and mean

*heights ??? the best results which have yet been obtained ??? led to the following conclusions.^*

The area of the dry land was taken as 28 ~~3 per cent, of the sur~~ face of the globe, and that of the oceans as 71-7 per cent. The mean height deduced for the land was 2300 feet above sea level, the mean depth of the sea 11,500 feet below, ????????< while the position of mean-sphere level comes out as according 7500 feet (1250 fathoms) below sea level. From this ^ Wagaer. it would appear that 43 per cent, of the Earth's surface was above, and 57 per cent, below, the mean level. It must be noted, however, that since 1895 the soundings of Nansen in the north polar area, of the Valdima in the Southern Ocean, and of various surveying ships in the North and South Pacific, have proved that the mean depth of the ocean is very considerably greater than had been supposed, and mean-sphere level must there- fore lie deeper than the calculations of 1896 show ; possibly not far from the position deduced from the freer estimate of 1888. By the device of a hypsographic curve co-ordinating the vertical relief and the areas of the Earth's surface occupied by each zone of elevation, according to the system introduced by Supan,^ Wagner showed his results graphically.*

This curve with the values reduced from metres to feet is repro- duced below.

Wagner subdivides the Earth's surface, according to elevation, into the following five regions : ???

Wagnek's Divisions or the Earth's Crust.

Depressed area . Oceanic plateau Continental slope Continental plateau Culminating area

Per cent, of

Surface.

3

From Deepest. -16,400 feet. – 7,400 ???

3,300

To

-16,400 feet. – 7,400 ??? ??? 660 ???

3,000 ,,

Highest.

The continental plateau might for purposes of detailed study be divided into the continental shelf trom ???660 feet to sea level, and lowlands from sea level to -1-660 feet (corresponding to the mean

‘t%.ilean,h??w)a,of Land-ZSOOft ‘ . ???, ,, . , o \ ^c^j^

i??y. Mean, Level of Vve,]SarWsO-ust;7pO Ofp

-^^:^C PLATEAU

Areas of the crust, according to Murray,

level of the whole globe).’ Uplands reaching from 660 feet to 2300 (the approximate mean level of the land) , and highlands, from 2.300 upwards, might also be distinguished.

A striking fact in the configuration of the crust is that each continent, or elevated mass of the crust, is diametrically opposite to an ocean basin or great depression ; the only partial exception being in the case of southern South America, ‘Arrange- which is antipodal to eastern Asia. Professor Lapworth ’”^“tof has generalized the grand features of crustal relief in ^^^ggggj a scheme of attractive simplicity. He sees throughout j,oiiows. all the chaos of irregular crust^forms the recurrence of a certain harmony, a succession of folds or waves which build up all the minor features.’ One great series of crust waves from east to west is crossed by a

second great series of crust waves from north to south, giving rise by their interference to six great elevated masses (the continents), arranged in three groups, each consisting of a northern and a southern member, separated by a

6 ” Areal und mittlere Erhebung der Landflachen sowie der Erd- kruste” in Gerland’s Beitrage zur Oeophysik,\x. (1895), p. 667. See also Nature, 54 (1896), p. 112.

6 Petermanns Mitteilu7ige7i,xxx-v. (1889), p. 19.

‘ The areas of the continental shell and lowlands are approximately equal, and it is an interesting circumstance that, taken as a whole, the actual coast-line comes just midway on the most nearly level belt of the Earth’s surface, excepting the ocean floor. The detailed configura- tion of some portions of the continental slope has been made the subject of speculation by Hull in Trans. Victoria Inst., London, xxxi. (1899), p. 269, and of discussion by Hudleston in Geological Mag. vi. (1899),pp. 97, 145.

8 British Association Report (Edinburgh) , 1892, p. 699.

Suess’s theory.

minor depression. These elevated masses are divided from one anotlier by similar great depressions.

He says : ‘ ‘ The surface of each of our great continental masses of land resembles that of a long and broad arch-like form, of which we see the simplest type in the New World. The Lapworth’s syj-faoe of the North American arch is sagged down- theory wards in the middle into a central depression which

lies between two long marginal plateaux, and these plateaux are iuially crowned by the wrinkled crests which form its two modern mountain

systems. The surface of each of our ocean floors exactly resembles that of a continent turned upside down. Taking the Atlantic as our simplest type, we may say that the sur- face of an ocean basin resembles that of a mighty trough or syn- cline, buckled up more or less centrally in a medial ridge, which is bounded by two long and deep marginal hollows, in the cores of which still deeper grooves sink to the profoundest depths. This complementary relationship descends even to the minor features of the two. Where the great continental sag sinks below the ocean level, we have our gulfs and our Mediterraneans, seen in our type continent, as the Mexican Gulf and Hudson Bay. Where the central oceanic buckle attains the water-line we have our oceanic islands, seen in our type ocean, as St Helena and the Azores. Al- though the apparent crust- waves are neither equal in size nor sym- metrical in form, this complementary relationship between them is always discernible. The broad Pacific depression seems to answer to the broad elevation of the Old World ??? the narrow trough of the Atlantic to the narrow continent of America."

The most thorough discussion of the great features of terrestrial relief in the light of their origin is that by Professor Suess,i who points out that the plan of the Earth is the result of two movements of the crust ??? one, subsidence over wide areas, giving rise to oceanic depressions and leaving the continents protuberant ; the other, folding along comparatively nar- row belts, giving rise to mountain ranges. This theory of crust blocks dropped by subsidence is opposed to Lapworth's theory of vast crust-folds, but geology is the science which has to decide between them.

Geomorphology is concerned, however, in the suggestions which have been made as to the cause of the distribution of heap and hol- low in the larger features of the crust, ifelie de Beaumont, in his speculations on the relation between the direction of mountain ranges and their geological age and character, was feeling towards a comprehensive theory of the forms of crustal relief ; but his ideas were too geometrical, and his theory that the Earth is a spheroid Ijuilt up on a rhombic dodecahedron, the pentagonal faces of which determined the direction of mountain ranges, could not be proved.^ The theory brought forward by Lowthian Green ^ that the form of the Earth is a spheroid based on a regular tetrahedron is more ser- viceable, because it accounts for three very interesting facts of

the terrestrial plan ??? (1) the antipodal position of continents and ocean basins ; (2) the triangular outline of the continents ; and (3) the excess of sea in the southern hemisphere. Recent investigations have recalled attention to the work of Lowthian Green, but the question is still in the controversial stage. The study of tidal strain in the Earth's crust by Professor G. H. Darwin has led that physicist to indicate the possibility of the triangular form and southerly direction of the continents being a result of the differen- tial or tidal attraction of the sun and moon.^*

In any case it is fully recognized that the plan of the Earth is so clear as to leave no doubt as to its being due to some general cause which should be capable of detection.

If the level of the sea were to become coincident with the mean level of the lithosphere, there would result one tri-radiate land-mass of nearly uniform outline and one continuous sheet of water broken by few islands. The actual position of sea level lies so near the summit of the crust-heap that the varied relief of the upper portion leads to the formation of a complicated coast^line and a great number of detached portions of land. The hydrosphere is, in fact, continuous, and the land is all in insular masses : the largest is the Old World of Europe, Asia, and Africa ; the next in size, America ; the third, possibly, Antarctica ; the fourth, Australia ; the fifth, Greenland. After this there is a considerable gap before New Guinea, Borneo, Mada-

The continents.

^ Das Antlitz der Erde, vols. i. and ii., Leipzig, 1885, 1888. Trans- lated under the editorship of E. de Margerie with much arlditional muttor as La Face de la Terre, vols. i. and ii., Paris, 1897,

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2Elie de Beaumont, Notice sur les Systemes de Montagnes, 3 vols., P;i, ris 1852.

^Vestiges of the Molten Globe, London, 1875.

See J. W. Gregory, " The Plan of the Earth and its Causes," Geog. Journal, xiii. (1899), p. 225 ; Lord Avebury, ibid. xv. (1900), p. 48; Marf.el Bcrtraiirl, "Deformation tetra^drique de la Terre et ddplace- ment du pule," Comptes Revdnx Acad. Sci., Paris, vol. cxxx. (1900), p. 449 ; and A. de Lapparent, ibid. p. (d14.

5 Ency. Brit., 'Jth ed. art. Tides, x. 50.

gascar, Sumatra, and the vast multitude of smaller islands de- scending in size by regular gradations to mere rooks. The con- trast between island and mainland was natural enough in the days before the discovery of Australia, and the mainland of the Old World was traditionally divided into three continents. These ' ' con- tinents," "parts of the Earth," or "quarters of the globe," proved to be convenient divisions ; America was added as a fourth, and subsequently divided into two, while Australia on its discovery was classed sometimes as a new continent, sometimes merely as an island, sometimes compromisingly as an island-continent, accord- ing to individual opinion. The discovery of the insularity of Green- land might again give rise to the argument as to the distinction between island and continent. Although the name of continent was not applied to large portions of land for any physical reasons, it so happens that there is a certain physical similarity or homology between them which is not shared by the smaller islands or penin- sulas.

The typical continental form is triangular as regards its sea level outline. The rehef of the surface typically includes a central plain, sometimes dipping below sea level, bounded by lateral , highlands or mountain ranges, loftier on one side t^ . than on the other, the higher enclosing a plateau shut tjae^ts. in by mountains. South America and North America follow this type most closely ; Eurasia (the land mass of Europe and Asia) comes next, while Africa and Australia are farther re- moved from the type, and the structure of Antarctica and Green- land is unknown.

If the continuous, unbroken, horizontal extent of land in a conti- nent is termed its trunk,^ and the portions cut up by inlets or chan- nels of the

sea into islands and peninsulas the limbs, it is possible to compare the continents in an instructive manner.

The following table is from the statistics of Professor H. Wag- ner,' his metric measurements being transposed into British units : ???

Comparison op the Continents.

Area

Mean

height,

feet

Area

Area

Area

Area

Area

(total) mil.

trunk, mil.

eulas,

islands, mil.

limbs, mil.

limbs, per

sq. m.

sg, m.

sq. m.

sq. m.

sq. m.

cent.

Old World .

35-8

2360

New World .

16-2

2230

Eurasia .

20-85

2620

15-42

4-09

1-34

5-43

26

Africa .

11 -40

2130

11-22

0-24

0-24

2-1

North America

9-26

2300

6-92

0-78

1-56

2 -.34

25

South America

6-84

1970

6-76

0-02

0-06

0-08

1-1

Australia

3-43

1310

2-77

0-16

0-50

0-66

19

Asia

17-02

3120

12-93

3-05

1-04

4-09

24

Europe .

3-83

980

2-49

1-04

0-30

1-34

35

Islands.

The usual classification of islands is into continental and oceanic. The former class includes all those which rise from the continental shelf, or show evidence in the character of their rocks of having at one time been continuous with a neighbouring continent. The latter rise abruptly from the oceanic abysses. Oceanic islands are divided according to their geological character into volcanic islands and those of organic origin, including coral islands. More elaborate subdivisions ac- cording to structure, origin, and position have been proposed.' In some cases a piece of land is only an island at high water, and by imperceptible gradation the form passes into a peninsula. The typical peninsula is connected with the mainland by a relatively narrow isthmus ; the name is, however, extended to any limb pro- jecting from the trunk of the mainland, even when, as in the Indian peninsula, it is connected by its widest part.

Small peninsulas are known as promontories or headlands, and the extremity as a cape. The opposite form, an inlet of the sea, is known when wide as a gulf, bay, or bight, according to size and degree of inflexion, or as a fjord or ria when long and narrow. It is convenient to employ a specific name for a projection of a coast-line less pronounced than a peninsula, and for an inlet less pronounced than a bay or bight ; outcurve and incurve may serve the turn. The varieties of coast- lines were reduced to an exact classification by Richthofen, who grouped them according to the height and slope of the land into cliff-coasts (iSteilk'iMe.n) ??? narrow beach coasts with cliffs, wide beach coasts with cliffs, and low

coasts, subdividing each group according as the coast-line runs parallel to or crosses the line o% strike of the mountains, or is not related to mountain structure.

<> Eumpf, in German, the language in which this distinction was first made.

‘ Lehrbuch der Geographic, Hanover and Leipzig, 1900, Bd. i. S. 245,

249.

8 See, for example, F. G. Hahn’s Insel-Studien, Leipzig, 1883.

Coasts.

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Coast- Jlaes.

A further subdivision depends on the character of the inter-relation of land and sea along the shore producing such types as a fjord- coast, ria-ooast, or lagoon-coast. This extremely elaborate sub- division may be reduced, as Wagner points out, to three types ??? the continental coast where the sea comes up to the solid rock- material of the land ; the marine coast, which is formed entirely of soft material sorted out by the sea ; and the composite coast, in which both forms are combined.

On large-scale maps it is necessary to show two coast-lines, one for the highest, the other for the lowest tide ; but in small-scale

maps a single line is usually wider than is required

to represent the whole breadth of the inter-tidal zone.

The measurement of a coast-line is difficult, because the length will necessarily be greater when measured on a large- scale map where minute irregularities can be taken into account. It is u.sual to distinguish

between the general coast-line measured from point to point of the headlands disregarding the smaller bays, and the detailed coast-line which takes account of every iniiexion shown by the map employed, and follows up river entrances to the point where tidal action ceases. The ratio between these two coast-lines represents the " coastal development " of any region.

While the forms of the sea-bed are not yet sufficiently well known to admit of exact classification, they are recognized to be

as a rule distinct from the forms of the land, and Submarlae jj^g importance of using a distinctive terminology is

felt. Efforts are being made to arrive at a definite international agreement on this subject, i

In our present state of knowledge it would j)robably be sufficient to use depression as the general term for any hollow of the sea-bed, and to distinguish a relatively narrow depression as a furrow if the slope of the sides be gentle, and as a trough if the slope of the sides be steep. A relatively wide depression might be called a basin when the slope is gentle, and a caldron when it is abrupt. The word deep, often used in the general sense of a deep depression, might be reserved to indicate the deepest portion of a basin or caldron. The nearly flat part of the sea-bed in a depression might be termed a floor, and the steeply-sloping side of a depression, or of an elevation, a ivall. The general term elevation might be applied to any inequality rising above the general level of the ocean floor ; if relatively narrow it might be termed a rise, and if relatively wide a banle. For any elevation coming to within five fathoms of the surface, so as to become a danger to navigation, the word shoal should be retained. It is convenient to recognize one other form, the slielf, a nearly horizontal bank attached to land or to a wall, and bordered on the deeper side by an abrupt descent.

The forms of the dry land are of infinite variety, and have been studied in great detail. ^ From the descriptive or topographical

point of view, geometrical form alone should be con- 4^”” sidered ; but the origin and geological structure of

forms. \a,xi(i forms must in many cases be taken into account

when dealing with the function they exercise in the control of mobile distributions. The geographers who have hitherto given most attention to the forms of the land have been trained as geologists, and consequently there is a general tendency to make origin or structure the basis of classification rather than form alone.

The fundamental form-elements may be reduced to the six proposed by Professor Penck as the basis of his double system of

classification by form and origin.^ These may be The six looked upon as being all derived by various modifica- elemeatary jjgjjg q,, arrangements of the single form-unit, the forms slope or inclined plane surface. No one form occurs

alone, but always grouped together with others in various ways to make up districts, regions, and lands of distinctive characters. They are :
* *

(1) The plane or gently inclined uniform surface.

(2) The scarp or steeply inclined slope; this is necessarily of small extent except in the direction of its length.

(3) The valley, composed of two lateral parallel slopes inclined towards a narrow strip of plain at a lower level which itself slopes downwards in the direction of its length. Many varieties of this fundamental form may be distinguished.

(4) The mount, composed of a surface falling away on every side

1 Wagner, Kriimmel, and Mill, in Bericht des VI, Internationalen Geographischen Congresses, Berlin, 1899. See also British Association Report (Dover), 1899, p. 810.

2 The most important works on the classification of land forms are P. von Richthofen, Fiihrer fur Forschungsreisende, Berlin, 1886; G. de la Noe and E. de Margerie, Les Formes dii Terrain, Paris, 1888 ; and above all A.' Penck, Morphologic der Erdoberflache, 2 vols., Stuttgart, 1894. Compare also A. de Lapparent, Le(;ons de G4ographie physique, 2nd ed., Paris, 1898, and W. M. Davis, Physical Geography, Boston, 1899.

3 " Geomorphologie als genetische Wissenschaft," in Report of Sixth International Geog. Congress, London, 1895, p. 735 (English Abstract, p. 748).

from a particular place. This place may be either a point, as in a volcanic cone, or a line, as in a mountain range or ridge of hills.

(5) The hollow or form produced by a land surface sloping inwards from all sides to a particular lowest place, the converse of a mount.

(6) The cavern or space entirely surrounded by a land surface. These forms never occur scattered haphazard over a region,

*but always in an orderly subordination depending on their mode of origin. The dominant forms result from crustal movements, the subsidiary from secondary reactions ^^Z,^j during the action of the primitive forms on mobile forms distributions. The geological structure and the mineral composition of the rocks are often the chief causes deter- mining the character of the land forms of a region. Thus the whole of the scenery of a limestone country depends on the solubility and permeability of the rooks, leading to the typical Karst^formations of caverns, swallow-holes, and underground stream courses, with the contingent phenomena of dry valleys and natural bridges. A sandy beach or desert owes its character to the mobility of its constituent sand-grains, which are readily drifted and piled up in the form of dunes. A region where volcanic activity has led to the embedding of dykes or bosses of hard rock amongst softer strata produces a plain broken by abrupt and isolated eminences.**

It would be impracticable to go fully into the varieties of each specific form ; but, partly as an example of modem geographical classification, partly because of the exceptional importance of mountains amongst the

features of the land, one exception may be made. The classification of mountains into types has usually had regard rather to geological structure than ^lasslflca- to external form, so that some geologists would even ^"J^f^igs apply the name of a mountain range to a region not distinguished by relief from the rest of the country if it bear geological evidence of having once been a true range. A mountain may be described (it cannot be defined) as an elevated region of irregular surface rising comparatively abruptly from lower ground. The actual elevation of a summit above sea level does not necessarily affect its mountainous character ; a gentle eminence, for instance, rising a few hundred feet above a tableland, even if at an elevation of say 15,000 feet, could only be called a hill.^ But it may be said that any abrupt slope of 2000 feet or more in vertical height may justly be called a mountain, while abrupt slopes of lesser height may be called hills. Existing classifications, however, do not take account of any difference in kind between mountains and hills, although it is common in the German language to speak of Hugel- land, Mittelgebirge, and Hochgcbirge with a definite significance.

The simple classification employed by Professor James Geikie ^ into mountains of accumulation, mountains of elevation, and mountains of circumdenudation, is not considered sufficiently thorough by German geographers, who, following Richthofen, generally adopt a classification dependent on six primary divisions, each of which is subdivided. The terms employed, especially for the subdivisions, cannot be easily translated into other languages, and the English equivalents in the following table are only put forward tentatively : ??? ???

Eichthopen's Classiwcation op Mountains.'

I. Tektonische Qehirge ??? Tectonic mountains.

(a) Bruchgehirge oder Schollengebirge ??? Block mountains.

1. JSinseitige Schollengebirge oder Schollenrandgehirge

??? Scarp or tilted block mountains, (i.) Tafelscholle ???Tahle blocks, (ii.) Ahrasionsscholle ??? Abraded blocks, (ill.)

Transgressionsscholle ⁄ Blocks of unconform- able strata.

2. Flexurgebirge ⁄ Flexure mountains.

3. JJorsi^efeiVf/e ⁄ Symmetrical block mountains. (6) Faltungsgehirge ⁄ Fold mountains.

1. Somoomorphe Faltungsgebirge ⁄ Homomorphic fold

mountains.

2. Meteromorphe Faltungsgebirge ⁄ Heteromorphic fold

mountains. II. Eumpfgebirge oder Abrasionsgebirge ⁄ Trunk or abraded mountains.

- *On this subject see J. Geikie, Earth Sculpture, London, 1898; J. E. Marr, The Scientific Study of Scenery, London, 1900 ; Sir A. Geikie, The Scenery and Geology of Scotland, London, 2nd ed., 1887; Lord Avebury (Sir J. Lubbock), The Scenery of Switzerland, London,*

1896.

6 Some geographers distinguish a mountain from a hill by origin ; thus Professor Seeley says " a mountain implies elevation and a hill implies denudation, but the external forms of both are often identical." Report VI. Int. Geog. Congress, London, 1895, p. 751.

6 "Mountains," In Scot. Geog. Mag. ii. (1886), p. 145.

' Fiihrer fiir Forschungsreisende, pp. 652-685.

III. Ausbruchsgebirge ⁄ Eruptive mountains. IV. Aufschuttungsgebirge ⁄ Mountains of accumulation. V.

Flachboden ??? Plateaux.

(a) Abrasionsplatten ??? Abraded plateaux.

(6) Marines Flachland ??? Plain of marine erosion.

(c) Schichtungstafelland ??? Horizontally stratiiied tableland.

(d) Uehergusstafelland ??? Lava plain.

(e) Stromflachland ??? River plain.

(/) Flachboden der atmosphdrischen Aufschiittung ??? Plains of seolian formation. VI. Erosionsgebirge ??? Mountains of erosion.

From the morphological point of vieve it is more important to distinguish the groups of mountain forms, such as the mountain

mass or group of mountains radiating from a centre, Mountain ^j^j^ ^^^ valleys furrowing their flanks spreading arms. towards every direction ; the mountain chain or line

of heights, forming a long narrow ridge or series of ridges separated by parallel valleys ; the dissected plateau or highland, divided into mountains of circumdenudation by a system of deeply-cut valleys ; and the isolated peak, usually a volcanic cone or a hard rock mass left projecting after the softer strata which embedded it have been worn away (Monadnock of Professor Davis) .

The geographical distribution of mountains is Intimately asso- ciated with the great structural lines of the continents of which

they form the culminating region. Lofty lines of fold DIstribu- mountains form the " backbones " of North America in mountains ^^^ Rocky Mountains and the west coast systems, of

South America in the Cordillera of the Andes, of Europe in the Pyrenees, Alps, Carpathians, and Caucasus, and of Asia in the mountains of Asia

Minor, converging on the Pamirs and diverging thence in the Himalaya and the vast mountain systems of Central and Eastern Asia. The remarkable line of volcanoes around the whole coast of the Pacific and along the margin of the Caribbean and Mediterranean Seas is one of the most conspicuous features of the globe.

If land forms may be compared to organs, the part they serve in the economy of the Earth may, without straining the term, be

*characterized as function. The first and simplest P”octlons function of the land surface is that of guiding loose of land material to a lower level. The downward pull of gravity ‘”””**** suffices to bring about the fall of such material, but the*

pa,th it will follow and the distance it will travel before coming to rest depend upon the land form. The loose material may, and in

an arid region does, consist only of portions of the Land higher parts of the surface detached by the expansion

waste. ^^^ contraction produced by heating and cooling due

to radiation. Such broken material rolling down a uniform scarp would tend to reduce its steepness by the loss of material in the upper part and by the accumulation of a mound or scree against the lower part of the slope. But where the side is not a uniform scarp, but made up of a series of ridges and valleys, the tendency will be to distribute the detritus in an irregular manner, directing it away from one place and collecting it in great masses in another, so that in time the land form assumes a new appearance. Snow accumulating on the higher portions of the land, when compacted into ice and caused to flow downwards by gravity, gives rise,

on account of its more coherent character, to oontin- aiaclers. uous glaciers, which mould themselves to the slopes down which they are guided, different ice-streams converging to send forward a greater volume. Gradually coming to occupy definite beds, which are deepened and polished by the friction, they impress a characteristic appearance on the land, which guides them as they traverse it, and, although the ice

melts at lower levels, vast quantities of clay and broken stones are brought down and deposited in terminal moraines where the glacier ends.

Rain is by far the most important of the inorganic mobile dis- tributions upon which land forms exercise their function of guidance

and control. The precipitation of rain from the aqueous

vapour of the atmospliere is dictated by the form and altitude of the land surface and the direction of the prevailing winds, which itself is largely influenced by the land. It is on the windward faces of the highest ground that most rain falls, and all that does not evaporate or percolate into the ground is conducted back to the sea by a route which depends only on the form of the land. More mobile and more searching than ice or rock rubbish, the trickling drops are guided by the deepest lines of the hillside in their incipient flow, and as these lines converge,

*the stream, gaining strength, proceeds in its torrential *"'^" course to carve its channel deeper and entrench itself*

systems. j^ permanent occupation. Thus the stream-bed, from which at first the water might be blown away into a new channel by a gale of wind, ultimately grows to be the strongest line of the landscape. As the main valley deepens, the tributary stream-beds are deepened also, and gradually cut their way headwards, enlarging the area whence they draw their supplies. Thus new land forms

are created ??? valleys of curious complexity, for example ??? by the " capture " and diversion of the water of one river by another, leading to a change of watershed.^ The minor tributaries become more numerous and more constant, until the system of torrents has impressed its own individuality on the mountain side. As the river leaves the mountain, ever growing by the accession of tributaries, it ceases, save in flood time, to be a formidable instru- ment of destruction ; the gentler slope of the land surface gives to it only power sufficient to transport small stones, gravel, sand, and ultimately mud. Its valley banks are cut back by the erosion of minor tributaries, or by rain-wash if the climate be moist, or left steep and sharp while the river deepens its bed if the climate be arid. The outline of

the curve of a valley's sides ultimately depends on the angle of repose of the detritus which covers them, if there has been no subsequent change, such as the passage of a glacier along the valley, which tends to destroy the regularity of the cross-section. The slope of the river bed diminishes until the plain compels the river to move slowly, swinging in meanders proportioned to its size, and gradually, controlled by the flattening land, ceasing to transport material, but raising its banks and silting up its bed by the dropped sediment, until, split up and shoaled, its distributaries struggle across its delta to the sea. This is the typical river of which there are infinite varieties, yet every variety would, if time were given, and the land remained unchanged in level relatively to the sea, ultimately approach to the type. Move- ments of the land either of subsidence or elevation, changes in the land by the action of erosion in cutting ^latot back an escarpment or cutting through a col, changes ',^^ ^ in climate by affecting the rainfall and the volume of ;a ???^ water, all tend to throw the river valley out of harmony with the actual condition of its stream. There is nothing more strik- ing in geography than the perfection of the adjustment of a great river system to its valleys when the land has remained stable for a very lengthened period. Before full adjustment has been attained the river bed may be broken in places by waterfalls or interrupted by lakes ; after adjustment the bed assumes a permanent outline, the slope diminishing more and more gradually, without a break in its symmetrical descent. Excellent examples of the indecisive drain- age of a new land surface, on which the river system has not had time to impress itself, are to be seen in northern Canada and in Finland, where rivers are separated by scarcely perceptible divides, and the numerous lakes frequently belong to more than one river system.

The action of rivers on the land is so important that it has been made the basis of a system of physical geography by Professor W. M. Davis, who classifies land surfaces in terms of the three factors ??? structure, process, and time.- Of eraoMcal these time, during which the process is acting on the cycle. structure, is the most important. A land may thus be characterized by its position in the "geographical cycle," or cycle of erosion, as young, mature, or old, the last term being reached when the base-level of erosion is attained, and the land, however varied Its relief may have been in youth or maturity, is reduced to a nearly uniform

surface or peneplain. By a re-elevation of a peneplain the rivers of an old land surface may be restored to youthful activity, and resume their shaping action, deepening the old valleys and initiating new ones, starting afresh the whole course of the geographical cycle. It is, however, not the action of the running water on the land, but the function exercised by the land on the running water, that is considered here to be the special province of geography. At every stage of the geographical cycle the land forms, as they exist at that stage, are concerned in guiding the condensation and flow of water in certain definite ways. Thus, for example, in a mountain range at right angles to a prevailing sea^ wind, it is the land forms which determine that one side of the range shall be richly watered and deeply dissected by a complete system of valleys, while the other side is dry, indefinite in its valley systems, and sends none of its scanty drainage to the sea. The action of rain, ice, and rivers conspires with the movement of land waste to strip the layer of soil from steep slopes as rapidly as it forms, and to cause it to accumulate on the flat valley bottoms, in the graceful flattened cones of alluvial fans at the outlet of the gorges of tribu- taries, or in the smoothly-spread surface of alluvial plains.

The whole question of the regime of ri\ers and lakes is sometimes treated under the name hydrography, a name used by some writers in the sense of marine surveying, and by others as synonymous with oceanography. For the study of rivers alone the name potamology^ has been suggested by Penck, and the

1 Spo, for a summary of viver-nclion, A. Phillipson, Studien iiber Wasserscheideii, Leipzig, ISSii; also I. C. Russell, Tiivcr Development, London, 1898 (published as The Riverx of Xorth America, New York,]8n8).

*2 W. M. Davis, "The Geographical Cycle," Geoa. Jouni. xiv. (1898), p. 484. ???^*

- *A. Peiii'k, " Potamology as a Branch of Physical Geography," Geog. Journ. x. (1897), p. 619.*

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subject being of much practical importance has received a good deal of attentijon.i

The study of lakes has also been specialized under the name of limnology.'^ The existence of lakes in hollows of the land depends upon the balance between precipitation and evaporation. A stream flowing into a hollow will tend to fill it up, and the water Lakes and ^;)j begin to escape as soon as its level rises high enough draiaaL. *
^ ^ ^ '^ ^^^ lowest part of the rim. In the case of a * large hollow in a very dry climate the rate of evapora^ tion may be sufficient to prevent the water from ever rising to the lip, so that there is no outflow to the sea, and a basin of internal drainage is the result. This is the case, for instance, in the Caspian Sea, the Aral and Balkhash lakes, the Tarim basin, the Sahara, inner Australia, the great basin of the United States, and the Titicaca basin. These basins of internal drainage are calculated to amount to 22 per cent, of the land surface. The percentages of the land surface draining to the different oceans are approximately
Atlantic, 34-3 per cent. ; Arctic Sea, 16-5 per cent. ; Pacific, 14-4 percent. ; Indian Ocean, 12-8 per cent.'

The parts of a river system have not been so, clearly defined as is desirable, hence the exaggerated importance popularly attached to " the source " of a river. A well-developed river system Termlao- j^g^g i^ f^^ many equally important and widely-separated w er sources, the most distant from the mouth, the highest,

systems. ^ ^^^'^ ^^^^ ^ largest initial volume not being neces-sarily of greater geographical interest than the rest. The whole of the land which directs drainage towards one river is known as its basin, catchment area, or drainage area sometimes, by an incorrect expression, as its valley or even its watershed. The boundary line between one drainage area and others is rightly termed the watershed, but on account of the ambiguity which has been tolerated it is belter to call it water-parting, or, as in America, divide. The only other important term which requires to be noted here is thalweg, a word introduced from the German into French

and English, and meaning the deepest line along the valley, which is necessarily occupied by a stream unless the valley is dry.

The functions of land forms extend beyond the control of the circulation of the atmosphere, the hydrosphere, and the water which Is continually being interchanged between them ; they are exercised with increased effect in the higher departments of bio- geography and anthropogeography.

The sum of the organic life on the globe is termed by some geographers the biosphere, and it has been estimated that the whole mass of living substance in existence at one time would cover the surface of the Earth to a depth of one-fifth of an inch. The distribution of living organisms is a com- plex problem, a function of many factors, several of which are yet but little known. They include the biological nature of the organism and its physical environment, the latter involving conditions in which geographical elements, direct or indirect, preponderate. The direct geographical elements are the arrangement of land and sea, continents and islands standing in shaip contrast, and the vertical relief of the globe, which interposes barriers of a less absolute kind between portions of the same land area or oceanic depression. The indirect geographical elements, which, as a rule, act with and inten- sify the direct, are mainly climatic ; the prevailing winds, rainfall, mean and extreme temperatures of every locality depending on the arrangement of land and sea and of land forms. Climate thus guided affects the weathering of rocks, and so determines the kind and ar- rangement of soil. Different species of organisms come to perfection in different climates ; and it may be stated as a general rule that a species, whether of plant or animal, once established at one point, would spread over the whole zone of the climate congenial to it unless some barrier were interposed to its progress. In the case of land and fresh-water organisms the sea is the chief barrier ; in the case of marine organisms, the land. Differences in land forms do not exert great influence on the distribution of living creatures di- rectly, but indirectly such land forms as mountain ranges and inter- nal drainage basins are very potent through their action on soil and climate. A snow-capped mountain ridge or an arid desert forms a barrier between different forms of life which is often more effective than an equal breadth of sea.*

In this way the surface of the land is divided into numerous natural regions, the flora and fauna of each of

Blogeo- grapby.

1 See, for instance, E. Wisotzki, Hauptfluss und Neienfluss, Stettin, 1889. For practical studies, see official reports on the Mississippi, Rhine, Seine, Elbe, and other great rivers.

2 F. A. Forel, Handbueh der Seenkunde : A llgenneine Limnologie, Stuttgart, 1901; F. A. Forel, "La Limnologie, Branche de la Geogra- phie," Report VI. Int. Geog. Congress, London, 1895, p. 593; also Le L4man, Lausanne, 2 vols. , 1892, 1894 ; H. Lullies, " Studien iiber Seen," JuMldumsschrift der Albertiis-Universitdt , Konigsberg, 1894; and G. R. Credner, '"'Die Reliktenseen," Petermanns Mitteilungen, Ergan- zungshefte 86 and 89, Gotha, 1887, 1888.

3 J. Murray, "Drainage Areas of the Continents," Scot. Geog. Mag. ii. (1886), p. 548.

4 Wagner, Lehrbuch der Geographie, 1900, i. 586.

Floral

*which include some distinctive species not shared by the others. The distribution of life is discussed in the various articles in this Encyclopeedia dealing with biological, botanical, and zoological subjects.^*

The classification of the land surface into areas inhabited by dis- tinctive groups of plants has been attempted by many phytogeogra- phers, but without resulting in any scheme of general acceptance. The simplest classification is perhaps that of Drude according to climatic zones, subdivided ac- cording to continents. This takes account of ??? (1) the Arctic-Alpine zone, including all the vegetation of the region bordering on per- petual snow ; (2) the Boreal zone, including the temperate lands of North America, Europe, and Asia, all of which are substantially alike in botanical character ; (3) the Tropical zone, divided sharply into (a) the

tropical zone of the New World, and (fc) the tropical zone of the Old World, the forms of which differ in a significant degree ; (4) the Austral zone, comprising all continental land south of the equator, and sharply divided into three regions the floras of which are strikingly distinct ⬛⬛⬛ (a) South American, {h) South African, and (c) Australian ; (5) the Oceanic, comprising all oceanic islands, the flora of which consists exclusively of forms whose seeds could be drifted undestroyed by ocean currents or carried by birds. To these might be added the antarctic, which is still practically unknown. Many subdivisions and transitional zones have been suggested by different authors.

*From the point of view of the economy of the globe this classifi- cation by species is perhaps less important than that by mode of life and physiological character in accordance with en- vironment. The following are the chief areas of vege- ^^^ *"' tational activity usually recognized ; ⬛⬛⬛ (1) the ice-deserts of the arctic and antarctic and the highest mountain regions, where there is no vegetation except the lowest forms, like that which causes "red snow." (2) The tundra or region of intensely cold winters, forbidding tree-growth, where mosses and lichens cover most of the ground when unfrozen, and .shrubs occur of species which in other conditions are trees, here stunted to the height of a few inches. A similar zone surrounds the permanent snow on lofty mountains in all latitudes. The tundra passes by impercepti- ble gradations into the moor, bog, and heath of warmer climates. (3) The temperate forests of evergreen or deciduous trees, accord- ing to circumstances, which occupy those parts of both temperate zones where rainfall and sunlight are both abundant. (4) The grassy steppes or prairies where the rainfall is diminished and tem- peratures are extreme, and grass is the prevailing form of vegeta- tion. These pass imperceptibly into ⬛⬛⬛ (5) the arid desert, where rainfall is at a minimum, and the only plants are those modified to subsist with the smallest supply of water. (6) The tropical forest, which represents the maximum of plant luxuriance, stimulated by the heaviest rainfall, greatest heat, and strongest light. These divi- sions merge one into the other, and admit of almost indefinite sub- division, while they are subject to great modifications by human interference in clearing and cultivating. Plants exhibit the controlling power of*

environment to a high degree, and thus vegetation is usually in close adjustment to the bolder geographical features of a region.

The divisions of the Earth into faunal regions by Dr P. L. Sclater have been found to hold good for a large number of groups of animals as different in their mode of life as birds and ??? mammals, and they may thus be accepted as based on realms nature. They are six in number : ??? (1) Palcearctic, in- cluding Europe, Asia north of the Himalaya, and Africa north of the Sahara ; (2) Ethiopian, consisting of Africa south of the Atlas range, and Madagascar ; (3) Oriental, including India, Indo-China, and the Malay Archipelago north of Wallace's line, which runs between Bali and Lombok ; (4) Australian, including Australia, New Zealand, New Guinea, and Polynesia ; (5) Nearctic or North America, north of Mexico ; and (6) Neotropical or South America. Each of these divisions is the home of a special fauna, many species of which are confined to it alone ; in the Australian region, indeed, practically the whole fauna is peculiar and distinctive, suggesting a prolonged period of complete biological isolation. In some cases, such as the Ethiopian and Neotropical and the Palaearctic and Nearctic regions, the faunas, although distinct, are related, several forms on opposite sides of the Atlantic being analogous, e.g., the lion and puma, ostrich and rhea. Where two of the faunal realms meet there is usually, though not always, a mixing of faimas. These facts have led some naturalists to include the Palsearotic and Nearctic regions in one, termed Holarctic, and to suggest transitional regions, such as the Sonoran, between Nortli and South America, and the Mediterranean, between Europe and Africa, or to create sub-regions, such as Madagascar and New Zealand. Oceanic islands

5 For details, see A. R. Wallace, Geographical Distribution of Ani- mals and Island Life; A. Heilprin, Geographical and Geological Dis- tribution of Animals ; O.Di-ude, Sandbuch der Pflanzengetigraphie ; A. Engler, Enlwickelungsgeschichte der Fflanzenwelt ; also Beddard, Zoogeography, Cambridge, 1895; and Sclater, The Geography of Mammals, London, 1899.

Biological dlstrlbu' Hon as a means of geo' graphical researcli.

have, as a rule, distinctive faunas and floras which resemble, but

are not identical vpith, those of other islands in similar positions.

The study of the evolution of faunas and the comparison of the

faunas of distant regions have furnished a trustworthy

instrument of pre-historio geographical research, which

enables earlier geographical relations of land and sea to

be traced out, and the approximate period, or at least the

chronological order of the larger changes, to be estimated.

In this way, for example, it has been suggested that a

land, "Lemuria," once connected Madagascar with the

Malay Archipelago, and that a northern extension of

the antarctic land once united the three southern continents.

The distribution of fossils frequently makes it possible to map out approximately the general features of land and sea in long-past geological periods, and so to enable the histoiy of crustal relief to be traced, i While the tendency is for the living forms to come into harmony with their environment and to approach the state of equilibrium by successive adjustments if the environment should Reaction of happen to change, it is to be observed that the action on^enWron- ►►' organisms themselves often tends to change their ment. ' eiivironment. Corals and other quick-growing cal- careous marine organisms are the most powerful in this

respect by creating new land in the ocean. Vegetation of all sorts acts in a similar way, either in forming soil and assisting in break- ing up rocks, in filling up shallow lakes, and even, like the man- grove, in reclaiming wide stretches of land from the sea. Plant life, utilizing solar light to combine the inorganic elements of water, soil, and air into living substance, is the basis of all animal life. This is not by the supply of food alone, but also by the withdrawal of carbonic acid from the atmosphere, by which vegetation main- tains the composition of the air in a state fit for the support of animal life. Man in the primitive stages of culture is scarcely to be distinguished from other animals as regards his subjection to en- vironment, but in the higher grades of culture the conditions of control and reaction become much more complicated, and the department of anthropogeography is devoted to their consideration. The first requisites of all human beings are food and protection, in their search for which men are brought into intimate relations with the forms and productions of the Earth's surface. zeosrrapby "^^^ degree of dependence of any people upon environ- ' ment varies inversely as the degree of culture or civili- zation, which for this purpose may perhaps be defined as the power of an individual to exercise control over the individual and over the environment for the benefit of the community. The develop- ment of culture is to a certain extent a question of race, and al- though forming one species, the varieties of man differ in almost imperceptible gradations with a complexity defying classification (see Anthropology). Professor Keane groups man round four leading types, which may be named the black, yellow, red, and white, or the Ethiopic, Jlongolic, American, and Cauoasic. Each may be subdivided, though not with great exactness, into smaller groups, either according to physical characteristics, of which the form of the head is most important, or according to language.

The black type is found only in tropical or sub-tropical countries, and is usually in a iDrimitive condition of culture, unless educated , by contact with people of the white type. They follow

5^* " the most primitive forms of religion (mainly fetishism), live on products of the woods or of the chase, with the minimum of work, and have only a loose political organization. The red type is peculiar to America, inhabiting every climate from polar to equatorial, and

containing representatives of many stages of culture which had apparently developed without the aid or inter- ference of people of any other race until the close of the 15th cen- tury. The yellow type is capable of a higher culture, cherishes higher religious beliefs, and inhabits as a rule the temperate zone, although extending to the tropics on one side and to the arctic regions on the other. The white type, originating in the north temperate zone, has spread over the whole world. They have attained the highest culture, profess the purest forms of mono- theistic religion, and have brought all the people of the black type and most of those of the yellow under their domination.

The actual number of human inhabitants in the world has been calculated as follows : ???

Asia Europe Africa America . Australia and Polynesia

Total .

By C'ontinents.2

875,000,000

392,000,000

170,000,000

143,000,000

7,000,000

1,587,000,000

By Race,"

White (Caucasic) 770,000,000

Yellow (Mongolic) 540,000,000

Black (Kthiopio) 175,000,000

Red (American) 22,000,000

Total

1,507,000,000

1 See particularly A. de Lapparent, Traits de Otologic, 4th ed. Paris,

1900.

2 Estimate for 1900. H. Wagner, Lehrhuch der Geofiraphle, i. p. C58.

3 Estimate for year not stated. A. H. Keane in International Geog- raphy, p. 108.

In round numbers the population of the world is about 1,600,000,000, and, according to an estimate by Ravenstein, the maximum population which it will be possible for the Earth to maintain is 6000 millions, a number which, if the present average rate of increase continues, will be reached within 200 years.*

While highly civilized communities are able to evade many of the restrictions of environment, to overcome barriers to inter- communication interposed by land or sea, to counteract the adverse influence of climate, and by the development of trade even to inhabit countries which cannot yield a food supply, the mass of mankind is still completely under the control of those conditions which in the past determined the distribution and the mode of life of the whole human race.

In tropical forests primitive tribes depend on the collection of wild fruits, and in a minor degree on the chase of wild animals, for their food. Clothing is unnecessary ; hence there is little occasion for exercising the mental faculties beyond ’”““Bnce the sense of perception to avoid enemies, or the inven- “““fj” tive arts beyond what is required for the simplest weap- ^^^ oijs and the most primitive fortifications.- When the pursuit of game becomes the chief occupation of a people there is of necessity a higher development of courage, skill, powers of ob- servation and invention ; and these qualities are still further en- hanced in

predatory tribes who take by force the food, clothing, and other property prepared or collected by a feebler people. The fruit-eating savage cannot stray beyond his woods, which bound his life as the water bounds that of a fish ; the hunter is free to live on the margin of forests or in open country, while the robber or warrior from some natural stronghold of the mountains sweeps over the adjacent plains and carries his raids into distant lands. Wide grassy steppes lead to the organization of the people as nomads whose wealth consists in flocks and herds, and their dwell- ings are tents. The nomad not only domesticates and turns to his own use the gentler and more powerful animals, such as sheep, cattle, horses, camels, but even turns some predatory creatures, like the dog, into a means of defending their natural prey. They hunt the beasts of prey destructive to their flocks, and form armed bands for protection against marauders or for purposes of aggres- sion on weaker sedentary neighbours. On the fertile low grounds along the margins of rivers or in clearings of forests, agricultural communities naturally take their rise, dwelling in villages and cul- tivating the wild grains, which by careful nurture and selection have been turned into rich cereals. The agriculturalist as a rule is rooted to the soil. The land he tills he holds, and acquires a closer connexion with a particular patch of soil than either the hunter or the herdsman. In the temperate zone, where the seasons are sharply contrasted, but follow each other with regularity, foresight and self-denial were fostered, because if men did not exercise these qualities seed-time or harvest might pass into lost opportunities and the tribes would suffer. The more extreme climates of arid regions on the margins of the tropics, by the unpredictable succession of droughts and floods, confound the prevision of uninstructed people, and make prudence and industry qualities too uncertain in their results to be worth cultivating. Thus the civilization of agricultural peoples of the temperate zone grew rapidly, yet in each community a special type arose adapted to the soil, the crop, and the climate. On the seashore fishing naturally became a means of livelihood, and dwellers by the sea, in virtue of the dangers to which they are exposed from storm and unseaworthy craft, are stimulated to a higher degree of foresight, quicker observation, prompter decision, and more energetic action in emergencies than those who live in- land. The building and handling of vessels also, and the utiliza- tiou of such uncontrollable powers of nature as wind and tide, helped forward

mechanical Invention. To every type of coast there may be related a special type of occupation and even of char- acter ; the deep and gloomy fjord, backed by almost impassable mountains, bred bold mariners wliose only outlet for enterprise was seawards towards other lands ??? the viks created the vikings. On the gently sloping margin of the estuary of a great river a view of tranquil inland life was equally presented to the shore-dweller, and the ocean did not present the only prospect of a career. Finally the mountain valley, with its patches of cultivable soil on the alluvial fans of tributary torrents, its narrow pastures on the uplands only left clear of snow in summer, its intensified extremes of climate and its isolation, almost equal to that of an island, has in all countries produced a special type of brave and hardy people, whose utmost effort may bring them comfort, but not wealth, by honest toil, who know little of the outer world, and to whom the natural outlet for ambition is marauding on the fertile plains. The highlander and viking, products of the valleys raised high amid the mountains or half-drowned in the sea, are everywhere of kindred spirit.

It is in some such manner as these that the natural conditions of regions, wldoh must be conformed to by prudence and utilized

4 In Proc. R. G. S. xiii. (1891), p. 27.

by labour to yield shelter and food, have led to the growth of peoples differing in their ways of life, thought, and speech. The initial differences so produced are confirmed and perpetuated by the same barriers which divide the faunal or floral regions, the sea, mountains, deserts, and the like, and much of the course of past history and present politics becomes clear when the combined results of differing race and differing environment are taken into aocount.i

The specialization which accompanies the division of labour has important geographical consequences, for it necessitates communi- Den itv t '^^^'O'l between communities and the interchange of populZloa.

^^^^^ *products. Trade makes it possible to work mineral resources in localities where food can only be grown with great difficulty and expense, or which are even totally barren and waterless, entirely dependent on supplies from distant sources.*

The population which can be permanently supported by a given area of land differs greatly according to the nature of the resource s and the requirements of the people. Pastoral communities are always scattered very thinly over large areas ; agricultural popula- tions may be almost equally sparse where advanced methods of agriculture and labour-saving machinery are employed ; but where a frugal people are situated on a fertile and inexhaustible soil, such as the deltas and river plains of Egypt, India, and China, an enormous population may be supported on a small area. In most cases, however, a very dense population can only be maintained in regions where mineral resources have fixed the site of great manu- facturing industries. The maximum density of population which a given region can support is very difficult to determine ; it depends partly on the race and standard of culture of the people, partly on the nature and origin of the resources on which they depend, partly on the artificial burdens imposed, and very largely on the climate. Density of population is measured by the average number of people residing on a unit of area ; but in order to compare one part of the world with another the average should, strictly speaking, be taken for regions of equal size or of equal population ; and the portions of the country which are permanently uninhabitable ought to be excluded from the calculation. ^ Considering the average density of population within the political limits of countries, the following list is of some value ; the figures for a few smaller divisions of large countries are added (in brackets) for comparison : ???

AvBKAGE Population on 1 Square Mile. (For 1890 or 1891.)

Country.

Density of population.

Country. Density of population

(Saxony) .

. 650'

Greece . . 95

Belgium .

. 560 3

European Turkey 90

Java

*. 510**

Spain . . 90

(England)

. 500

*European Russia 55 **

(Bengal) .

*. 470**

Sweden . . 30

Holland .

390

United States . 30

United Kingdom 300

Mexico . 15

Japan

. 285

Norway . .15

Italy

. 280

Persia . . 12 (estimate)

China proper

. 270* (estimate)

New Zealand . 7

German Empire 250

Brazil . . 4‘5

Austria .

. 210

Argentina . 2-8

Indian Empire

. 185*

lEastevn States of

Prance

. 185

Australia . 1-7

Switzerland

. 185

Dominion of

Denmark .

*. HO**

Cana,ria. . 1-4

Hungary .

*. 140**

Siberia . . 1

Portugal .

. 135

West Australia 0‘17

Ceylon

*. 120**

*The movement of people from one place to another without the immediate intention of returning is known as migration, and ***. ,, according to its origin it may be classed as centrifugal*

gra on. (~~(jirected/romaparticular area) and centripetal (directed towards a particular area). Centrifugal migration is usually a matter of compulsion ; it may be necessitated by natural causes, such as a change of climate leading to the withering of pastures or destruction of agricultural land, to~~

~~inundation, earthquake, pesti~~ lence, or to an excess of population over means of support ; or to artificial causes, such as the wholesale deportation of a conquered people ; or to political or religious persecution. In any case the people are driven out by some adverse change ; and when the urgency is great they may require to drive out in turn weaker people who occupy a desirable territory, thus propagating the wave

^ On the influence of land on people see Shaler, Nature and Man in America, New York and London, 1892.

2 See maps of density of population in Bartholomew's Atlas of Scotland and his Handy Royal Atlas of England.

8 Almost exclusively industrial.

- Almost exclusively agricultural.

of migration, the direction of which is guided by the forms of the land into inevitable channels. Many of the great historic move- ments of peoples were doubtless due to the gradual change of geographical or climatic conditions ; and the slow desiccation of Central Asia has been plausibly suggested as the real cause of the peopling of modern Europe and of the mediaeval wars of the Old World, the theatres of which were critical points on the great natural lines of communication between east and west.

In the case of centripetal migrations people flock to some par- ticular place where exceptionally favourable conditions have been found to exist. The rushes to goldfields and diamond-fields are typical instances ; the growth of towns on coalfields and near other sources of power, and the rapid settlement of such rich agri- cultural districts as the wheatlauds of the American prairies, are other examples.

There is, however, a tendency for people to remain rooted to the land of their birth, when not compelled or induced by powerful external causes to seek a new home.

*Thus arises the spirit of patriotism, a product of purely geo- graphical conditions, thereby differing from the sentiment of loyalty, which is of racial origin. Where race and .. soil conspire to evoke both loyalty and patriotism in ^"oznoby a people, the moral qualities of a great and permanent * * ^ "❓❓❓ nation are secured. It is noticeable that the patriotic spirit is strongest in those places where people are brought most Intimately into relation with the land ; dwellers in the mountain or by the sea, and, above all, the people of rugged coasts and mountainous archi- pelagoes, have always been renowned for love of country, while the inhabitants of fertile plains and trading communities are frequently less strongly attached to their own land.*

Amongst nomads the tribe is the unit of government, the poli- tical bond is personal, and there is no definite territorial association of the people, who may be loyal but cannot be patriotic. The idea of a country arises only when a nation, either homogeneous or composed of several races, establishes itself in a region the bound- aries of which may be defined and defended against aggression from without. Political geography takes account of the partition of the Earth amongst organized communities, dealing with the relation of races to regions, and of nations to countries, and con- sidering the conditions of territorial equilibrium and instability.

The definition of boundaries and their delimitation is one of the most important parts of political geography. Natural boundaries are always the most definite and the strongest, lending Round- themselves most readily to defence against aggression. arles. ' The sea is the most effective of all, and an island state is recognized as the most stable. Next in importance comes a moun- tain range, but here there is often difficulty as to the definition of the actual crest-line, and mountain ranges being broad regions, it may happen that a small independent state, like Switzerland or Andorra, occupies the mountain valleys between two or more great countries. Rivers do not form effective international boundaries, although between dependent self-governing communities they are convenient lines of demarcation. A desert, or a belt of country left purposely without inhabitants, like the mark, marches, or debatable lands of the Middle Ages, was once a, common means of separating nations which nourished hereditary grievances. The "buffer-state" of modern diplomacy is of the

*same ineffectual type. A less definite though very practical boundary is that formed by the meeting-line of two languages, or the districts inhabited by two races. The line of fortresses protecting Austria from Italy lies in some places well back from the political boundary, but just inside the linguistic frontier, so as to separate the German and Italian races occupying Austrian territory. Arbitrary lines, either traced" from point to point and marked by posts on the ground, or defined as portions of meridians and parallels, are now the most common type of boundaries fixed by treaty. In Europe and Asia frontiers are usually strongly fortified and strictly watched in times of peace as well as during war. In South America strictly defined boundaries are still the exception, and the claims of neighbouring nations continually give rise to wars or arbitrations.^*

The modes of government amongst civilized peoples have little influence on political geography ; some republics are as arbitrary and exacting in their frontier regulations as some ab- solute monarchies. It is, however, to be noticed that Forms of absolute monarchies are confined to the east of Europe ^1%"' and to Asia, Japan being the only constitutional mon- archy east of the Carpathians. Limited monarchies are (with the exception of Japan) peculiar to Europe, and in these the degree of democratic control may be said to diminish as one passes east- wards from the United Kingdom. Republics, although represented

5 For the history of territorial changes in Europe, see Freeman, Historical Geography of Europe, 2 vols., London, 1881; and for the official definition of existing boundaries, see Hertslet, The Map of Europe by Treaty, 4 vols., London, 1875, 1891; The Map of Africa by Treaty, 3 vols., London, 1896.

in Europe, are the pecrfliar form of government of America, and are unknown in Asia.

Tlie forms of government of colonies present a series of transi- tional types from the autocratic administration of a governor appointed by the

home Government to complete democratic self- government. The latter occurs only in the temperate possessions of the British empire, in which there is no great preponderance of a coloured native population. New colonial forms have been developed during the partition of Africa amongst European Powers, the sphere of influence being especially worthy of notice. This is a, vaguer form of control than a protectorate, and frequently amounts merely to an agreement amongst civilized Powers to respect the right of one of their number to exercise government within a certain area at any future time.

The central governments of all civilized countries concerned with external relations are closely similar in their modes of action, but the internal administration may be very varied. In this respect a country is either centralized, like the United Kingdom or France, or federated of distinct self-governing units like Germany (where the units include kingdoms, at least three minor types of mon- archies, municipalities and a crown land under a nominated governor), or the United States, where the units are democratic republics. The ultimate cause of the predominant form of federal government may be the geographical diversity of the country, as in the cantons occupying the once isolated mountain valleys of Switzer-land, the racial diversity of the people, as in Austria-Hungary, or merely political expediency, as in republics of the American type.

The minor subdivisions into provinces, counties, and parishes, or analogous areas, may also be related in many cases to natural features or racial differences perpetuated by historical causes. The territorial divisions and subdivisions often survive the conditions which led to their origin ; hence the study of political geography is allied to history as closely as the study of physical geography is allied to geology, and for the same reason.

The aggregation of population in towns was at one time mainly brought about by the necessity for defence, a fact indicated by the defensive sites of many old towns. In later times, owns. towns have been more often founded in proximity to valuable mineral resources, and at critical points or nodes on lines of communication. These are places where the mode of travelling or of transport is changed, such as seaports, river ports, and

rail- way termini, or natural resting-places, such as a ford, the foot of a steep ascent on a road, the entrance of a valley leading up from a plain into the mountains, or a crossing-place of roads or railways.^ The existence of a good natural harbour is often sufficient to give origin to a town and to fix one end of a line of land communication.

*In countries of uniform surface or faint relief, roads and rail- ways may be constructed in any direction without regard to the configuration. In places where the low ground is nes of marshy, roads and railways often follow the ridge- lines cation. ‘ ►► hills, or, as in Finland, the old glacial eskers, which run parallel to the shore. Wherever the relief of the land is pronounced, roads and railways are obliged to occupy the lowest ground winding along the valleys of rivers and through passes in the mountains. In exceptional cases obstructions which it would be impossible or too costly to turn are overcome by a bridge or tunnel, the magnitude of such works increasing with the growth of engineering skill and financial enterprise. Similarly the obstructions offered to water communication by interruption through land or shallows are overcome by cirtting canals or dredging out channels. The economy and success of most lines of communication depend on following as far as possible existing natural lines and utilizing existing natural sources of power.’^*

Commercial geography may be defined as the description of the

Earth’s surface with special reference to the discovery, production,

transport, and exchange of commodities. The transport

Commer- concerns land routes and sea routes, the latter being

*a a’”” *^^ more important. While steam has been said to *”” ” ►►►” ►►► make a ship independent of wind and tide, it is still true that a long voyage even by steam must be planned so as to encounter the least resistance possible from prevailing winds and permanent currents, and this involves the application of occano- graphical and meteorological knowledge. The older navigation by utilizing the power of the wind demands a very intimate knowledge of these conditions, and it is probable*

that a revival of sailing ships may in the present century vastly increase the importance ot the study of maritime meteorology.

^ For numerous special instances of the determining causes of town sites, see G. G. Chisholm, " On the Distribution of Towns and VillaKf,s in England," Gcurjraphical Jouninl (1897), ix. 76, x. 511.

2 The whole subject ol anthmpogeography i.s treated in a masterly way by F. Ratzel in his Anthrupoc/eographie, Stuttgart, vol. i., 2nd ed., 1899, vol. ii., 1891, and in his PoUtische Geot/ruphic, Leipzig', 1897. The special question of the reaftion of man on his <'nvir(in- ment is handled by G. P. Marsh in Man and Nature, or Physical Geography as modified by Human Action, London, 1864.

The discovery and production of commodities require a know- ledge of the distribution of geological formations for mineral pro- ducts, of the natural distribution, life-conditions^nd cultivation or breeding of plants and animals, and of the labour market. Attention must also be paid to the artificial restrictions of political geography, to the legislative restrictions bearing on labour and trade as imposed in different countries, and, above all, to the incessant fluctuations of the economic conditions of supply and demand and the combinations of capitalists or workers which affect the market.^ The term ' ' applied geography " has been eip ployed to designate com- mercial geography, the fact being that every aspect of scientific geo- graphy may be applied to practical purposes, including the purposes of trade. But apart from the applied science, there is an aspect of pure geography which concerns the theory of the relation of economics to the surface of the Earth.

It will be seen that as each successive aspect of geographical science is considered in its natural sequence the conditions become more numerous, complex, variable, and practically important. From the underlying abstract mathema- elusion tical considerations all through the physical, biological, anthropological, political, and commercial development of the subject runs the determining control exercised by crust-forms acting directly or indirectly on mobile distributions; and this is the essential principle of geography.

Pkogress of Geographical Discovert.

The last quarter of the 19th century witnessed no abate- ment of the spirit of exploration, almost all the remoter parts of the less known continents having been sought out and investigated. The marked lead taken by f^/" , British explorers in the first part of the century has tlon"" ' not been inaintained ; for many travellers from Ger- many, France, the United States, Italy, Austria-Hungary, Eussia, and the Scandinavian countries have shared in the triumphs of discovery. The character of the explorations also has largely altered ; the work has become more scientific, the surveys more exact, and the collections more systematic. The action of the Royal Geographical Society in supplying practical instruction to intending travellers, in astronomy, surveying, and the various branches of science usefvil to collectors, has had much to do with bringing about this change. The great development of photo- graphy has also been a notable aid, by placing at the disposal of travellers a faithful and ready means of recording the features of a country and the types of inhabitants.*

With the exception of the Arctic and the Antarctic regions, very few places now remain absolutely unknown, and these only on account of the severity of natural conditions or the fanaticism of native peoples. The explorer ambitious to fill up a blank space on the map has now to turn his attention to a few comparatively small districts in the sub-arctic lands of Asia and North America, lying remote from the rivers which form the natural lines of com- munication ; or to the highest parts of the great mountain ranges of Asia, the central wilds of the vast tropical forests of the Amazon basin, some corners of the Congo basin, the interior of Borneo and New Guinea ; or to the heart of the arid deserts of the tropical continents. Although the greater part of the world has been ex- plored and mapped, the accuracy of the work varies greatly, and only a small fraction of the land-surface has been surveyed with high precision.' And after the topographical and hypsometrical surveys are completed, much work remains to be done before statistics are available to enable all the distributions with which geography is concerned to be mapped with approximate completeness.

The progress of exploration has been aided by the remarkable development of geographical societies, especially in France and Germany, since the war of 1870. There were in 1896 no fewer than 107 of these societies in the world (83 of oeographl- them in Europe), with a total membership exceed- ca/ socteMes ing 50,000 persons; and In connexion with them, or and publics- appearing separately, there were 153 journals or maga- tions. zines devoted entirely to geographical subjects.^ In (Sermany there are professorships of geography in practically all universities, but the higher study of the subject has not been adequately encouraged hitherto in other countries. The superior quality of the exploring work done by recent travellers trained in Germany cannot be denied, where scientific study in the field, as distinct from mere surveying or the collection of specimens, is taken into account.

8 For C(pmmeri'ial geographv, see G. G. Chisholm, Manual of Com- mercial Orof/niphii, London, 1890.

^ See J. (i. Hartliolomew, "The Mapping of the World," Scottish Gcog. Mug. vi. (1890), 29:i, 575; vii. (1891) 124, ,'i8B.

* Sec H.^ Wagner, Geographisches Jahrbvch, Gotha, 1898. This ycav-book is the best systematic record of geographical progress in all departments.*

Europe. In Europe fhe only region where exploration in the ordinary sense of the term has been carried out is Iceland, which . . . has been very carefully studied from every point of " ^ view by several travellers, pre-eminent amongst whom*

is Dr Thorvald Thoroddsen, a native of the island. In all coun- tries the topographical surveys have been pushed for- ^ "h) ward and, in the United Kingdom, France, Germany,

^“nls Switzerland, and Austria^Hungary, practically com- ”

pleted by the respective governments. Detailed surveys of the coast have been similarly completed by the hydrographic departments of the maritime states, while private effort has been directed towards the sounding of the ^” smaller lakes, many of the larger ones having been*

*surveys. surveyed by national or international organizations. In this respect, Forel in Switzerland, Delebecque and Belloc in France, Ule and Halbfass in Germany, Simony, Penck, and Richter in Austria, Marinelli hi Italy, Anuchin in Russia, Mill in England, and Murray and PuUar in Scotland may be mentioned. Detailed exploration of the Alps, Pyrenees, Carpathi- Mountala ^^^^ ^^^ Norwegian mountains have been made by the Sod” ’ members of numerous Alpine clubs (see Mountain-eering) ; and E. ^. Martel in France has initiated the special study of caverns, a fascinating branch of minor Soeleolomr exploration, to which the name Speleology has been *” applied, and to which attention is now directed in all European countries.*

The regional description of countries has only been carried out with systematic thoroughness in Finland, where the Geographical Society of Helsingfors has produced a remarkable Regional Atlas de Finlande, with a volume of explanatory text, tloas’” ^^ ^ French as well as a Swedish edition. In Germany, under the .stimulus of the German Geographical Con- gress {Deutsche Geographentag), a series of valuable monographs on different parts of the empire has been produced under the title of Forschungen nur Deutsche.n Landes- und Volkskunde, commenced in 1885 under the editorship of Professor A. Kirchhoff. Similar memoirs abound in the geographical journals of France, Austria, Russia, and in the geological publications of the United States aud Canada. A systematic geographical description of the British Isles, based on the one-inch Ordnance Survey map, and utilizing the official statistics of all distributions, was suggested by Dr H. R. Mill in 1896, and a specimen memoir published in 1900.1 x\l these are efforts to bring together synthetically the masses of discrete information accumulated by costly public surveys, which at present convey no definite impression to the

mind, because the facts of the mobile distributions with which many of them deal are treated without reference to the land-forms.

Asia. ??? Although made as long ago as 1864, the journey of Prince

Peter Kropotkin in the Trans-Baikal province of Siberia and north-

??? ... em Manchuria was not generally known in western

topo a. j;^],Qpg j^ntil recently. It supplied him with data which

led to an entire change in the theory of the mountain system of

Asia as a whole, and opened the way to a generation of profitable

exploration. Next in importance come the journeys of Baron von

, Richthofen in China in the years 1868-72, in which the

o en. geological structure and the vast mineral wealth of that

country were first clearly established. It was a purely scientific

journey, and after thirty years led to an important political result,

for it was on Richthofen's recommendation that the bay of Kiao-

chow was selected for the German pied-a-terre in China, and the

province of Shantung as a German "sphere of influence."

During the whole period under consideration Dr Gustav Radde of the Tiflis Museum has been carrying on a series Caucasus ^^ exploring journeys in the Caucasus, where also the sDlaa" Russian surveyors have been at work.

' M. Lessar did valuable service on the Turkestan

frontier, and General Annenkoff succeeded in bridging the Trans-Caspian deserts by the railway which was opened to Samarcand in 1888, and to Tashkent and Ardijan in 1899, thus furnishing ready access to the borders of Chinese Turkestan.

In 1876 M. Potanin settled the question of the eastern extension

of the Altai, and more recently he and other Russian

Russian explorers made important researches on the mountain

Irfh^l^ systems of northern China, the northern buttresses

ia iiaeu ^^ ^^^ ·j^j. pig^^gg^^^ g^^d the Pamirs. The name of

Prjevalsky deserves special distinction in this respect. Commencing his serious explorations in 1871, he rediscovered in 1885 Prjevalsky. ^^^ remarkable lake, Lob-nor, in which the Tarim river terminates, and made numerous attempts to penetrate to Lhasa, both from the north and from the east, on one occasion getting to within 160 miles of the forbidden city before being turned back. He had set out on a fresh expedition in 1888 when he died near Issyk-kul. The expedition was carried on by Pyevtsoff, Roborov- ski, Kosloff, and Bogdanovich, who have since continued to do

___ Geographical Journal, xv. (1900), 205, 353.

valuable work in exploring and surveying the borders of Tibet and Mongolia.

Obrucheff and other Russian explorers in ever-increasing num- bers, in the south of the Russian possessions and in north-western China, have cleared up the orography of that region ; and the surveys of the Russian railway engineers have "____' __" carried the line of exact measurements across the whole ^ c?/'‘? breadth of Eurasia from sea to sea. ^loeria.

The Kurile islands in the north-east of Asia have been carefully charted by Captain H. J. Snow, an old sealing skip- per, whose knowledge of these

little-frequented seas is Snow. unique.

The problems of Tibet and Central Asia have held the first place in the exploration of Asia, and the former has acquired a romantic interest and a quite fanciful importance on account of the determin- ation of the Tibetan authorities that no European shall be permitted to enter Lhasa. Tibetan exploration was for many years promoted by the Indian Government by the training of native surveyors, amongst whom the names of Nain Singh, Krishna or Kishin Singh (known during his service as A-K), Lama ’”‘a” Ugyen Gyacho (known as U-6), and Sarat Chandra Ive ors Das deserve special distinction. The conscientious sur- ; Tibet veys of these men In Tibet, in circumstances of the greatest difficulty, have made it possible to prepare fairly accurate general maps of Tibet, and the long stay in Lhasa of Kishin and Chandra Das has given much information as to that city as it was in 1878 and 1882. Exploration by Europeans in Tibet has not been encouraged by the Indian Government, although British oificers are permitted to make journeys at their own risk. In this way Captain Bower crossed Tibet from west to east in 1891-92, starting from Leh, and Captain Wellby in 1896 British crossed from the same starting-point, but kept farther ^in^Tibet^ north. Both made important route surveys through regions which had never previously been traversed by a European. Neither was allowed to enter Lhasa ; nor was Mr Littledale more fortunate in 1895, when, after a fine journey across Tibet from the north, he came within 50 miles of the capital, but was obliged to turn westwards and leave the country.

*M. Bonvalot and Prince Henry of Orleans crossed Tibet from the north by a different route in 1890, but turning eastwards, they terminated their journey (one of the longest land jour- neys ever made) in French Indo-China. M. Dutreuil Freacb de Rhins, after four years spent in the exploration of / j-ft”/ the northern barrier ranges of Tibet, made a march ” * southwards towards Lhasa, but being turned eastwards, made his way to the neighbourhood of Sining, where he lost his life during an altercation with the Tibetans in 1894.*

The journeys of Mr W. W. Kockhill, of the American diplomatic service, who entered Tibet from China in 1889, although falling short of Lhasa,

have added much to our know- Kockhill. ledge of the Tibetan land and people.

The difficult country of eastern Tibet and western China is stOl but imperfectly known, although many important expeditions have thinned the veil of darkness which covered it before 1875, when Mr Margary made his way across from Explora- China towards Bhamo, but was murdered by the "onln Chinese close to the frontier of Burma. In 1877 Cap- China. tain W. Gill ascended the Yangtse-kiang, and made his way safely across to the Irrawaddy , and during 1877-78 Mr Colborne Baber pursued extensive explorations throughout the provinces of Szechuen and Yunnan. A finely-equipped expedition under the Hungarian Count B^la Szechenyi investigated the whole west of China and east of Tibet from the upper Yangtse to Koko-nor in 1877-80, and, returning southwards, emerged in Burma with a magnificent collection of scientific specimens. In 1883 Mr A. R. Colquhoun crossed from Canton to Bhamo by a new route, and even as late as 1898 Captain Wingate made a similar journey, in which he crossed several considerable areas of Yunnan where no European had been before. Mrs Bishop's travels in the upper Yangtse district in 1896-97, and Dr Jack's in 1901, also touched new ground. In 1895 51. Bonin, working his way up from the French possessions, was able to rectify the maps of the upper course of the Yangtse ; and numerous commercial and missionary journeys have recently contributed to our knowledge.

The problem of the complicated river-system of Indo-China, north-eastern India, and Tibet has been nearly solved by the labours of the native Indian surveyors, the British civil and military officers in Assam and Burma, and by the journeys of several independent travellers. In Indo- China itself the most important recent work is the expedition of M. Pavie to the upper Mekong in 1886-89, wlien his large scientific staff gave an excellent account of the country.

The great deserts of Mongolia and eastern Turkestan and the northern edge of the Tibetan plateau, including the mountain range of the Kuen Lun, have held the persistent attention of Russian government explorers, and occasionally attracted

Tartan oasis.

adventurous students and sportsmen of many nationalities. These have mapped the country in a, preliminary way from the Pamirs to China, leaving, however, many important blanks Explora- between their respective routes. The splendid services Hon in ^^ Prjevalsky, who travelled over most of inner Asia

inner Asia. ^^^ ^^^^ ^^^ ^^^ *source of the Yellow river, have already been referred to. Mr A. D. Carey and Mr Dalgleish, after crossing western Tibet from India in 1885-87, carried their surveys down the Khoten river eastwards, and then south through Tsaidam, and west again to Urumtsi. Captain Frank Younghusband travelled from China to India through Mongolia, Eastern Turkestan, and across the Pamirs in 1886-87, a journey of exceptional interest. In 1890, and again in 1898-99, Captain Deasy conducted an expedition which did much for the exploration of the eastern Pamirs, the Yarkand region, and the regions of the south and south-east as far as the Kuen Lun mountains.*

In 1889-90, after an expedition in the Tian-Shan, the brothers Grum-Grjmailo described the curious oasis of Turfan, in the very centre of Asia, to which a depth of 100 feet below sea- level was subsequently assigned by Pyevtsoff, and as a result of the long-continued meteorological observa- tions, specially established at Lukchun, in the hollow, the depth has been proved to be 56 feet below sea-level. Drs Putterer and Holderer made an important geological journey across Asia, from the Pamirs to China, in 1898-99, following the northern edge of the Tarim basin, crossing the Gobi desert, and entering China from Koko-nor. The most interesting and most fruitful of recent jour- ❓❓❓ neys were undoubtedly those of Dr Sven Hedin, who

He^ln from 1894 to 1897 was engaged in exploring, mapping,

collecting natural history specimens, and studying ethnography in the Pamirs, on Mustagh-ata, which he ascended to nearly 20,000 feet, in the Takla-makan desert, which he was the first to cross, and where he discovered ancient niins of the highest interest, at Lob-nor, and on the northern edge of Tibet, where he traversed an absolutely unknown region south of the Tian-Shan. He again (1899-1902) engaged in explorations in the same region.

All recent travellers in Eastern Turkestan have found no small help and encouragement in Kashgar from the British agent, Mr George Macartney, and the Russian consul-general, Petrovsky, who, by their influence and local knowledge, more than once turned an expedition which threatened to be a failure into a success.

The Pamirs have been carefully studied by the joint British and Eussian Boundary Commissions, by which , from 1 872 to 1895, surveys . were made by special expeditions, and the actual bound-

Pamlrs. ^^ demarcated on the ground by stone pillars. The re- gion no longer exercises the mysterious fascination which attracted the explorers of the 'seventies and 'eighties. Amongst those the names of Ujfalvy, Bonvalot, and Capus (1877), and Severtsoff (1878), may be specially mentioned ; reference must also be made to the later exploring journeys of Mr Littledale, Lord Curzon to the source of the Oxus, Dr Sven Hedin, and the Danish Lieutenant Olufsen.

*Space fails for a record of the adventurous journeys of British and Russian officers through Afghan territory, but the exploration Kafirlstan '^^ *^ mysterious valleys of Kaflristan by Sir George Robertson in 1890-91 must be mentioned. That region was so rigorously guarded by its pagan mountaineers, who had held out successfully for four hundred years against Mahommedan inva- sion, that it was believed by Sir Henry Yule to be the last part of the , world which should remain unknown. Sir Martin Con-*

nimaiaya. ^^^ ^^ jggg^ ^^^ y^^ Douglas Preshfield in 1899, broke new ground in the exploration of portions of the higher Himalaya not previously reached.

Persia has been explored in several directions by British officers, with native surveyors supplied by the Government of India. The work of Colonel Sawyer in the Bakhtiari country in 1890, and of Major Sy^es in Eastern Persia, may be particularly mentioned ; and many others have done good work, which has been ably supplemented by General Houtum Schindler at Tehran and by Russian officers in the north.

The unknown area in the centre of Borneo has been reduced by ex-peditions equipped by the Dutch Government, by the British North Borneo Company, and by the Government of Sarawak, in Malay -whose service Dr C. Hose has done admirable work in the

Baram district. Valuable surveys havebeen completed in Java by the Dutch Government. A considerable area of unknown country remains in Sumatra, in spite of recent expeditions. Arabia has been scarcely touched since the travels of Mr Doughty in the north in 1876-77. The journeys of the French Orientalist M. Huber in the north, and those of Dr E. Glaser, Dr L. Hirsoh, and Mr and Mrs Theodore Bent in the Hadramut in the south, are the most important in recent years. The labours of the Palestine Exploration Fund have resulted in the detailed survey of the whole of Palestine Palestine. ^^ ^^^ scale of one inch to a mile by the British Ordnance Survey.

Persia.

Arclii- peiago.

Arabia.

Congo basin.

Africa. ??? The last quarter of the 19th century has filled the map of Africa with authentic topographic details, and left few blanks of any size, while surveys of high accuracy have been commenced at several points. Practically the whole continent has been parcelled out since 1884 amongst the European Powers as colonies, protectorates, or spheres of influence, within each of which the dominant Power treats exploration as a duty. As the work of exploration and survey has become closer and

more detailed, journeys of startling novelty have become less frequent, and the most solid of the recent accessions to knowledge have resulted from the labours of a succession of hard- working colonial officials toiling individually in obscurity.

The great journey of Sir H. M. Stanley along the Congo from Lake Tanganyika to the sea in 1875-76 initiated a new era in African exploration. The number of travellers soonTje- came so great that the once marvellous feat of crossing the continent from sea to sea has been performed by more than twenty expeditions, some of which have scarcely added to the knowledge possessed before they set out. The branches of the Congo were gradually explored by scientific investigators, missionaries, and the officers of the Congo Free State, which was founded under the sovereignty of the king of the Belgians in 1879. The relation of the Congo basin to the neighbouring river systems was brought out by the journeys of many travellers. Chief among these were the Portuguese Serpa Pinto, who crossed Africa from St Paul de Loando to the east coast in 1877-79 ; Capello and Ivens, who a few years later (1884-86) traced out a great part of the Congo-Zambezi watershed ; the English missionary Grenfell, who discovered the Ubangi in 1884-85 ; the Gennan Major von Wiss- mann, who explored the Kasai river and made his way across Africa more than once (1881-82) ; the Russian Junker, who, in the course of a long sojourn (1879-87) in the Sudan, thoroughly explored the Bahr-el-Ghazal province and the basin of the Welle, a river the relation of which to the Congo drainage was long a subject of controversy ??? settled finally by Van Gfele in 1887. Stanley's Emin Pasha Relief Expedition of 1889 also helped to fill up the map of the northern slopes of the Congo basin by the exploration of the Aruwimi. In 1893-94 Count Gotzen, in the course of a journey across Central Africa, defined the eastern edge of part of the Congo basin, and discovered Lake Kivu in the great rift between Lakes Tanganyika and Albert Edward. The journeys of MM. de Brazza, Crampel, Maistre, Fourneau, and many other officials of French Congo have determined the relations between the Congo, Lake Chad, and the Niger drainage areas. The only portion of the Congo basin which still affords scope for pioneer exploration is in the south-west, where the upper streams descending from the watershed with the Zambezi have not been fully mapped. Some light has been thrown on the south-eastern part

of the basin by the Katanga expeditions of Captains Bia, Delcommune, and Stairs, and by the missionaries Arnot and Coillard ; while in the source-region of the Congo about Lakes Slweru and Bangweolo those of Lieutenant V. Giraud in 1883-84 and of Jlr Poulett Weatherley in 1899 have been important. The whole watershed of the Congo-Zambezi was traced in 1899-1900 by Major Gibbons, who had previously explored the upper Zambezi, and Captain Lemaire, who had ascended one of the upper tributaries of the Kasai.

In East Africa the period of surveys following on exploration has been fairly inaugurated, and the Uganda railway line united Victoria Nyanza and the coast in 1902, not only facili- tating access to the interior, but supplying an invaluable base for surveys to the north and south of the route. In 1879-80 Mr Joseph Thomson crossed East Africa to Lakes Tanganyika and Nyasa, and in 1883 he made a daring journey across the country of the dangerous Masai tribe to Victoria Nyanza, rediscovering Mount Kenya, and getting the first information as to the great Rift Valley containing Lake Naivasha, perhaps the most remarkable feature in the geography of Africa.

The Somali peninsula and its hinterland towards Abyssinia and Uganda was the last part of East Africa to yield up its secrets. It was penetrated from the south by Count Teleki and Lieutenant von Hijhnel in 1887-88, when I^akes Rudolf and Stefanie were discov- ered, and from the north in 1885 by the brothers James, who reached the river Webi, and by Dr Donaldson Smith, who passed right through to Uganda in 1894. Italian explorere. amongst whom Bottego (who traced the Omo to Lake Rudolf in 1897) may be specially mentioned, did much valuable exploring work in this re- gion, and the final problems of its hydrography have been prac- tically solved by the journeys of Mr H. S. H. Cavendish in 1898, Captain Well by , Messrs Grogan and Sharp, and Dr Donaldson Smith in 1899. Mr Grogan's expedition was the first to traverse the whole length of Africa from Cape Town to the Mediterranean by land.

The lofty mountains of East Africa have naturally attracted a good deal of attention, Kilimanjai-o, which is included in German East Africa, was ascended to above the ^^i , ??? snow-line by Sir H. H. Johnston in

1884, and since mounte/os. 1887 it has been repeatedly climbed and the summit attained by Professor Hans Meyer, who has made it the subject of

East Africa.

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a valuable monograph. Kenya, lying farther north, on the equator, in the British sphere, has also been successfully ascended. Count Teleki was the first to get above the forest zone ; Dr J. "W. Gregory, in 1894, made a more complete study, and passed the snow-line ; while Mr H. J. Maokinder, in 1899, reached the summit. The snowy peaks of Ruwenzori, discovered by Sir H. M. Stanley in 1889, have not yet been scaled, although the explorations of this moun- tain group by Mr Scott Elliot in 1894, by Mr J. E. S. Moore in 1900, and especially by Sir H. H. Johnston, who ascended to 14,800 feet in 1900, have added much to our knowledge. The region of the great central lakes, Tanganyika and Nyasa, has been thoroughly explored ; the latter, from the time of Dr Stewart's journey in 1877, has been studied by the missionaries of Nyasaland and the Govern- ment of British Central Africa. The survey of Tanganyika by Mr E. C. Hore in 1878-80 has been completed and extended by subse- quent work, the position of the lake in longitude having been rec- tified by Mr Eergusson on Mr Moore's expedition.

The French, whose sphere of influence in Africa is larger than that of any other Power, have justified their claim to extensive territory by their diligence in exploration. While the Preach ex- ^ustrian traveller Oscar Lenz was successful in cross- "JZ^f^ ing the Sahara from Marocco to Timbuktu in 1880, the AMca Erench Commandant Monteil made the more difficult

journey from the Niger to Tripoli in 1894, and in 1899 M. Eoureau, after twelve years' experience of exploration in the Sahara, succeeded in crossing the desert from Algeria to Lake Chad, after great danger from the Tuareg tribes, who had massacred Colonel Flatters at the oasis of Air in 1880. The western portion of the Sudan, especially the district between

the great bend of the Niger and the Gulf of Guinea, has been thoroughly explored by Captain Binger and other French officials. The lower course of the Niger and its neighbouring lands in the British sphere of influence have also been fully explored by officials of the Royal Niger Company, and later by those of British Nigeria.

The most extensive journey ever made by any French traveller in Africa was that of Commandant Marchand in 1898 from French Congo through the Central Sudan and the Bahr-el-Ghazal province to the upper Nile, and thence through Abyssinian territory to the French Red Sea colony of Jibuti.

In South Africa the most important work has been the extension northwards of accurate triangulations by the Cape Government, and the opening up of the plateau region between the Limpopo and the Zambezi by the British South Africa Company, a work in which the explorations carried on for many years by Mr F. C. Selous were of the greatest value.

Australia. ??? During the last quarter of the 19th century exploration on a large scale in Australia was only possible in the two western states, but surveying has been proceeding steadily in the three eastern states. The chief difficulty explorers have had to contend with has been the extremely arid and capricious climate of the interior, and in a less degree the fierceness of some of the native tribes. The introduction of camels, however, has facilitated desert expeditions.

On the establishment of the overland telegraph from the south to the north coast in 1872, Mr Ernest Giles made an unsuccessful

, attempt to penetrate to the west coast from near Char-

lotte Waters telegraph station ; and in the following

year, starting farther south, he got half-way to the west coast.

He repeated the attempt in 187-5, and then succeeded in passing

from the head of St Vincent Gulf to Perth. In 1876 he returned

by a still more remarkable journey north of the tropic, again

crossing the whole breadth of West Australia. West Australia

had been crossed twice before this, once in 1873 by

Warburtoa. (-.Q^Q^el Warburton travelling with camels from AUce

Springs on thE telegraph line to Oakover river on the west coast,

and again in 1874 by Sir John Forrest with horses

Forrest only, from the Murchison river to near Peake station

on the telegraph line. Between 1885 and 1887 Mr D. Lindsay

explored the interior of South Australia, crossing the

Lindsay. continent twice, from south to north and from north

to south. Again in 1891-92, as leader of the exploring expedition

fitted out by Sir Thomas Elder, he carried out addi-

ditl”” ti ii^l ‘ i” ^^^ interior. Mr E. Favenc in 1888, pea oa. ^^^ jj^ Tietkins in 1889, made important journeys in the interior of West AustraUa. In 1896-97 Mr David Car- negie, starting from Coolgardie, traversed the deserts Carnegie, northwards to Hall’s Creek in the north, and re- turned by a different route, accomplishing important surveys of a very desolate country. The development of the gold-fields of West Australia has led to innumerable journeys of great diffi- culty, comparatively few of which have been described. The scientific exploring expedition fitted out by Mr W. A. ^oj””-” Horn in 1894 included in its staff several biological pedltlon. jj geological professors of Australian universities, and by its thorough exploration of a considerable area about the MaoDonnell Ranges, almost in the centre of the Australian

South Africa,

continent, added much to the accurate knowledge of the desert region.

In New Guinea the most valuable explorations have probably been those made by Sir William Maogregor, when governor of British New Guinea, who, in addition to the survey of parts of the coast, made several expeditions into the British interior, in the course of one of which, in 1889, he Guinea. ascended and named Mount Victoria, the highest summit of the Owen Stanley range. Important journeys have also been made by Messrs Macfarlane, Chalmers, and other mission- aries. Dr Otto Finsch made a journey both in British and German New Guinea in 1884-85, for the purpose of scientific exploration, and in the German colony the officials have made several difficult journeys of exploration, the chief being Qerman perhaps that by Tappenbeck and Lauterbaoh on the aJjaea Ramu or Ottillien river. Few parts of the world out- side the polar circles, however, remain so little knovm as the interior of New Guinea.

*North America. ??? All the great features of this continent were known before 1875, and the explorations since that time have been mainly carried out by the Geological and Land Survey Departments of Canada and the United States. The construction of the. Cana- dian Pacific railway, which was opened from sea to sea in 1886, rendered necessary a careful study of the difficult country between the Rocky Mountains and the Pacific in the search for a practicable route. The geological surveyors of Canada have been unceasingly at work in the detailed mapping of the Bxplora- settled districts, and they have also made many explor- ‘’”” “y ing journeys of great magnitude. Thus, the late Dr Canadian G. M. Dawson explored the upper course of the Yukon geological in 1887, ten years before the gold discoveries at Klon- *”””’*???”””???*??? dike attracted the attention of the world to that difficultly accessible region. Mr MacConnel of the Geological Survey and Mr W. Ogilvie of the Dominion Land Survey extended the work of exploration and survey during the height of the gold fever. Dr R. Bell and the brothers Tyrrell mapped the shores of Hudson Bay and the desolate stretches of the barren grounds between that sea and the Mackenzie river, and Mr A. P. Low made important journeys in the interior of the great peninsula of Labrador.*

Conjointly with delegates from the United States, the Dominion land surveyors have mapped the disputed boundary belt between Alaska and British Columbia. The long-doubtful height of Mount St Elias has been definitely fixed, and the mountain itself was climbed by the duke of the Abruzzi in 1897. The still higher summit of Mount Logan has been trigonometricaUy measured as 19,500 feet. Many expeditions in Alaska have been sent out by the United States Government, and the geography of the interior of the peninsula has been fairly well sketched in as regards its main features.

*The Coast and Geodetic Survey, the United States Geological Survey, and the surveys of many of the individual states, have made great progress in mapping the country. The names of Professor Mendenhall of the Coast and Geo- Explora- detic Survey, and of Mr Clarence King, Major J. W. J}"^ */ Powell, and Mr I. C. Russell of the Geological Survey, states may be specially associated with recent progress. surveyors.*

The peninsula of Lower California was explored between 1885 and 1894 under the auspices of the Califomian Academy of San Francisco, and American travellers, Including Drs Lenk and Felix and Professor A. Heilprin, Mex'co helped forward the exploration of the less known parts of Mexico. In the south of that country, and in northern Guatemala, scientific and archaeological studies were carried out by Messrs Salvin, Godman, and Maudslay, whose results are being published in the magnificent volumes entitled Biologia Centrali- Americana.

Central and South America. ??? South America has always been a continent of uncertain boundaries, and many recent exploring journeys promoted by the governments of South American repub- lics have been carried out with the direct purpose of defining or demarcating frontiers.

In Central America minute surveys were made for the Panama Canal and also for the projected Nicaragua Canal. The independent researches made since 1888 by Dr Carl Sapper of the central Guatemala Geological Survey cleared up the complex America. and ill-understood orography of Central America, and definitely proved that neither the Rocky Mountains nor any other North American range is continuous with the Andes. Dr

Pittier of Costa Rica extended these researches to the borders of South America.

In the West Indies the researches of North American geologists, especially Professor J. W. Spencer and Dr R. T. Hill, enabled the true relation of the island chain to the two continents to be determined.

On the mainland the Sierra Nevada de Santa Marta and the Goajir peninsula were explored for the first time by Sir E. A.

Alaska boundary

surveys.

West Indies.

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Amazon basla.

*A. Simons in 1878-80, and again by Professor W. Sievers in V ezuela ^^^^> *”’^ geologist having already studied and eluci- dated the orography of the Venezuelan Coast Range in 1884-85.*

In the uplands of Guiana Mr Everard F. im Thurn succeeded in reaching the previously inaccessible summit of Roraima In 1884, and the long-continued journeys of M. Coudreau and Ouiaaa. jj Cr^veau in French Guiana and the adjacent parts of Brazil have fully delineated the territory which was long con- tested by the two countries.

The great river Amazon and its branches flow through the least- known part of South America, and although many expeditions have been engaged in tracing the rich ramifications of the river system, the wild woodlands between the con- verging streams are still in large part untrodden by any white man. The earlier work of exploration in the western republics by Drs Reiss and Sttlbel was continued by the latter in the Amazon basin in 1876-77. In 1881 M. Charles Wiener explored the

upper tributaries with the view of finding the best routes across the Andes to navigable waters. Dr A. Hettner between 1882 and 1890 carried on extensive travels in the Andean and Amazonian region of Peru, Bolivia, and Brazil. The problem of the boundary between the Amazonian provinces of Peru and Bolivia has given prominence to the Inambari question, to the solution of which the Bolivian geographers Pando and Ballivian have devoted many journeys on the Madre de Dios and Inambari rivers. Amongst the explorers of South America Colonel G. E. Church takes a high place, his travels in connexion with railway surveys touching al- most every country in the continent. M. Coudreau travelled and mapped new routes in the Rio Negro basin in 1884-85, and the Xingu region was entered by him from the north in 1897, when he was the first to explore the district between the Tooantins and Xingu ; he died on a journey in the Trombetas basin in 1899.

The trackless province of Matto Grosso was explored from the south through the tributaries of the Xingu river by Dr Karl von den Steinen in 1884-88, then by Dr Ehrenreich, and in continuation of the same series of researches by Dr Herrmann Meyer in 1896 and again in 1899. The result has been not only of geographical importance, but has brought in a harvest of new knowledge in all departments of science, especially in ethnography.

The Andes have always invited exploration, but until the assist- ance of professional Alpine guides was called in the highest peaks proved effective obstacles to the mountaineer. In 1880 Anaes. jjj, jj^^a^i-d Whymper climbed Chimborazo and other

great peaks in Ecuador ; in 1897 two members of Mr E. A. Fitz- gerald's expedition reached the summit of Aconcagua, the highest point on the American continents, and in 1898 Sir Martin Conway climbed the highest of the Bolivian Andes, lUimani and lUampu (Sorata). The main geographical interest presented by the Andes in recent years is the definition of the word Cordillera as applied p . to them. By the terms of the treaty of 1881 the boun-

a goa a. jj^j.y between Chile and the Argentine Republic is defined as " the line of the highest crests of the Cordillera of the Andes which divide

the waters." But since the watershed does not coincide with the highest line of the Andes in Patagonia, it has been necessary to make careful surveys of the almost unknown country in the disputed zone. On the Argentine side the work of Dr Francisco Moreno from 1875 onwards has been of the highest importance, including the discovery of several of the great lakes of the Patagonian lake-district ; and on the Chilean side the explora- tions of Professor A. Bertrand, Dr H. Steffen, and Dr Paul Kruger have greatly elucidated the difficult orography of the forest-clad and rain-drenched western slopes of the Patagonian Andes. The mapping of the disputed area was undertaken in 1902 by a British commission under 8ir Thomas Holdich.

The coasts of southern Chile and Magellan Strait have been sur- veyed in parts' by the Chilean navy, and various short journeys have been made in Tierra del Fuego by travellers of all na- Puem tionalities, amongst whom may be mentioned the French

circumpolar observers in 1882, Dr Otto Nordenskjijld in 1895-90, and the scientifio staff of the Belgica in 1897-98.

Arctic Beyions. ___ The last great polar expedition on the old lines was that under Sir George Nares in the Ah-rt and Discovery in 1875-76, on which Lieutenant (afterwards Admiral) A. H. Markham reached the farthest north in 83 __ 20'. Since then small parties, whose leader had generally a special plan of his own to carry out, have been the rule. The voyage of the Vega, under Baron A. E. Nordenskiold, along the north coast of Asia, which was arrested in 1878 not far from Bering Nordea-Strait, was successfully complptod in 1879 ; the North- sklold la East Passage was made for the first time, and Europe the "Vega." and Asia were circumnavigated. Since this achieve- ment scarcely a year has elapsed in which several trad- ing steamers did not make the voyage through the Kara Sea to the mouths of the Ob and Yenisei. In 1879 the New York Herald sent out an expedition under

Captain W. G. de Long on the Jeannette (the Pandora of Sir Allen Young's voyage), which entered Bering Sea and tried 2y,. ___, ___ to reach a high latitude. She was, however, caught in ^^^ ___ the ice-

pack, and after drifting helplessly west and north for 21 months, she was crushed and sunk in 77 15′ N. Her com- pany escaped with difficulty to the New Siberian Islands, and thence to the coast of Siberia, where most of them perished. Some objects from the Jeannette were picked up on an ice-floe off Juliane- haab in Western Greenland three years later, a circumstance which led to some controversy and to a great generalization.

*In 1879 Lieutenant Schwatka, of the United States army, made a remarkable sledge journey from the shore. of Hudson Bay to King William Land, and returned in 1880 with ^l”^f * a collection of relics of Franklin’s expedition recovered from the Eskimo.*

Professor A. G. Nathorst and Baron de Geer commenced in 1882 a series of studies of Spitsbergen and other Arctic islands, which is still being continued by Swedish observers. Sir Martin Conway and Mr Garwood crossed Spitsbergen for the fiero-en first time in 1897, and Professor Nathorst circumnavi- gated that island group and settled its true extent in 1898.

Mr B. Leigh Smith, after several voyages to the far north in his Arctic yacht Eira, had the misfortune in 1881 to lose his vessel, which was nipped in the ice off Cape Flora, Franz Josef Land. His ship’s company passed the winter in a P”az Josef hastily-constructed hut without casualty, and returned J“i in the following year by boat to Novaya Zemlya, as re- s ,f^^ markable and successful a journey as any in Arctic annals. Franz Josef Land was made the base of the Jackon- Harmsworth Polar Expedition in 1894-97, and although jgctson no high latitude was attained, fresh light was thrown on the geography of the Archipelago and valuable scientific observations were secured. Mr Jackson having indicated the impracticability of advancing north by land, the duke of the Abruzzi, on board the Stella Polare, started in 1899 to endeavour ^ ^ , to push his way northwards from Franz Josef Land by sea. The ship was stopped in 82 , and Captain Cagni with two other Italians pushed northwards over the ice with dog-sledges, reaching 86 33′ in 65 E. on 23rd April 1900, the farthest north point yet attained. It was proved that Petermann Land is non- existent. Mr E. B. Baldwin set out in 1901

with a lavishly- equipped American expedition to follow the same route northward.

The year 1882 saw the most strenuous international efforts to obtain trustworthy data as to the meteorology and magnetic condi- tions of the North Polar area. On the initiative of Payer, and by the direct action of the German Govern- inter- ment, twelve stations round the North Pole in high national latitudes wer^ occupied from July 1882 to August 1883 circumpolar by British, United States, German, Russian, Aastro- stations. Hungarian, Swedish, Norwegian, Danish, and Finnish observers. Of these the most remarkable was the American sta- tion under Lieutenant (afterwards General) Greely in ___. Grinnell Land, from which Lieutenant Lockwood sue- reey.

ceeded in reaching a point in 83__24' N., about four miles beyond Admiral Markham's farthest.

*Dr A. Bunge and Baron Toll visited and explored the New Siberian Islands in 1886, and in 1900-02 Baron Toll j.^^*

again undertook a journey thither in the hope of passing beyond them and reaching Sannikofi Land, and also of repeating the North-East Passage.

Baron Nordenskiold in 1883 made a determined effort to pene- trate the interior of Greenland from the west coast, but the two Lapps whom he sent on in advance on ski had to turn at 120 miles from the sea. In 1888 Dr Fridtjof Nausen Oreealand. was landed on the east coast of Greenland with the object of cross- ing the Inland Ice, he having conceived the idea of making a re- treat unnecessary by keeping the one chance of safety in front. He successfully crossed the ice with a small party, the distance by his route being 200 miles.

The next journey of this explorer was the most remarkable polar voyage yet achieved. Dr Nansen again resolved to make a journey on which there should be no question of any line of re- treat. From the drift of the JeannHte relics, and much ^^f^"""^ other evidence which he had carefully collected and f,p ___weighed, he was led to believe that a

current flowed ‘”’ ”” from the neighbourhood of the New Siberian Islands nearly over the Pole towards Grccnlaml, and that a strongly-built ship frozen in at the proper place would be carried into a high latitude by the drifting ice. In June 1893 he set out, allowed his vessel, l\w’ Fram, to be frozen in the pack off the New Siberian Islands, and every goint of his forecast as to the drift of the ship was literally verified. With one companion he left the ship in 84 N. and travelled on snow- shoes to 86 14’, nearly 3" beyond any previous explorer. They returned on foot to Franz .losef Land, wintered in a hut, met Jlr Jackson in the spring of 1890, and arrived in Europe simultaneously with the Fram, a coincidence probably without parallel.

Naasen.

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In northern Greenland Mr Peary set himself in 1891 to a task which he has pursued steadily for ten years in spite of almost over-

whehning diihculties. In 1892 he sledged across the feary. northern ioe-cap from Inglefield Gulf to Independence

Bay on the east coast, a distance of 600 miles, and back again; but though he repeated this achievement on subsequent occasions, he could not advance upon it. In 1898, and again in 1900, accompanied by some Eskimo, he endeavoured to reach the Pole by travelling over the ice and living in ioe-huts, but he was forced to return to his base both times. He was still confident that the plan was practicable, and prepared to start again, resolved not

to leave the work until it was accomplished. Captain Sverdrap, gverdrup, Nansen’s captain in the Fram, took out that vessel in 1898 up Smith Sound, in the hope of being able to explore by sea to the north of Greenland, a voyage very frequently attempted before, and always in vain. No news of Sverdrup was received in 1900 or 1901.

Dr Erich von Drygalski studied the glaciers of Umanak fjord in western Greenland in 1891 and 1892-9-5, and the Danish authorities

have for many years sent vessels to explore and map Drygalski. portions of the still unknown East Greenland coast. Lieutenants Ryder and Amdrup having particularly distinguished themselves in this work.

From the northern point of Spitsbergen the Swedish engineer Andrfee with two companions started in a balloon of novel design

on 11th July 1897, with the hope of being drifted by the Aadree. wind overthe Pole. Messages dated two days later were recovered, and several buoys were found which had been carried in the balloon, but nothing further has been heard of the explorers, whose fate does not admit of doubt.

In 1899 the Russian Admiral Makaroff took the great ice- breaking steamer YermaJc on a trial trip to the Arctic Bxplora- ggg^ north of Spitsbergen, and the results confirmed his Won Ay ice- jgjjgf_tj_^j ^ vessel of this kind can force a way through breaker. ^^^ floe-ice known to exist, although subsequent ex- periments have produced little result.

Antarctic Begions. ??? The greatest unknown area of the Earth lies in the Antarctic regions, access to which is both difficult and dan- gerous. After the voyage of Sir James Ross, thirty years elapsed before a further step was taken. Then in 1873-74 the German Captain Dallman visited the neighbourhood of Grahamland. In

1874 H.M.S. Challenger was the first steam vessel to ” ”^f””’ cross the jVntarctic circle, which she did south of Ker- ‘” ??? guelen Island, but, not being protected against ice, she*

could not enter the pack. In the southern summer of 1892-93 several Scottish and Norwegian whalers visited the seas about

Grahamland and, though they did but little explora^ Whalers. tlon, brought back some definite additions to know- ledge. In 1895 the Norwegian whaler Antarctic was the first steamer to push through the

Antarctic pack, and Captain Kristen- sen with Mr Borchgrevink, who had shipped as a sailor, were the first men to land on the supposed Antarctic continent, which they did at Cape Adare. In 1897 a Belgian expedition

under Captain de Gerlache, with a cosmopolitan ” Belglca.” scientific staff, sailed in the Belgioa, and early in 1898 were caught in the ice-pack west of Grahamland, remain- ing fast, drifting in the ice for rather more than a year. The members of this expedition were the first to winter within the

New ex- peditions.

Antarctic circle, although the farthest point of the drift was only 71 ►► 36′ S.

*In 1898 Mr C. E. Borchgrevink was sent out by Sir George Newnes as commander of an expedition in the Soiitlifni Cross, and succeeded in landing early in 1899 with a competent scientific staff at Cape Adare, where they spent a whole /►►►►►► *’ year. On the return of the ship to Cape Adare in 1900 Mr Borchgrevink proceeded south to the ice-barrier, saw Mount Erebus, and was able to land on the ice in long. 165 ►► W. and march a few miles inland to 78 ►► 60′ S., a little beyond Ross’s farthest point.*

A British expedition under Commander R. F. Scott, R.N., sailed in the Discovery in 1901, leaving New Zealand in December for Victoria Land. A German expedition under Professor E. von Drygalski in the tra^fssmade its departure southward simultaneously from Kerguelen, and a Swedish expedi- tion under Dr Otto Nordenskjold in the Antarctic left Buenos Aires for Weddell Sea. In 1902 Mr W”. S. Bruce sails in command of a Scottish expedition to Weddell Sea ; and the Morning takes out a relief party for the Discovery.

The Oceans. ►►► The exploration of the oceans has gone on without intermission since the great circumnavigation of H.M.S. Challenger in 1872-76, and the simultaneous voyage of the German man- of-war Gazelle. Much valuable information has been obtained in the cable-laying expeditions of telegraph ships, much also from the work of

government surveying vessels, especially those of the British navy, one of which, H.M.S. Penguin, obtained in 1890 the remarkable sounding of 5155 fathoms in tlie South Pacific to the east of the Kermadec Islands, a depth only exceeded by 5269 fathoms found by the U.S. telegraph ship Nero to the east of Guam in 1900. The Norwegian Government sent out an expedition to the North Atlantic on the Voringen in 1876-78, and the Russian frigate Vityaz, in her circumnavigation of the world in 1886-89, carried on much oceanographical work under Admiral Makaroff in the North Pacific.

The prince of Monaco, at first in his sailing yacht Hirondelle, and later in the fine steam yacht Princesse Alice, specially built for oceanographical work, has investigated the currents of the North Atlantic and the physical and biological conditions of several parts of that ocean. The Austrian ship Pola, under the direction of the Vienna Academy of Sciences, exi:)lored the Eastern Mediter- ranean, the Black Sea, and the Red Sea from 1890 to 1896.

The cruise of the German merchant steamer Valdivia in 1898-99, under the scientific direction of Professor Chun, was of more than ordinary importance, and although without the discipline of naval service, and under the sole charge of a scientific man, the expedition led to results greater than had ever before been obtained in so short a time and at such small expense. The voyage was merely a cir- cumnavigation of Africa, but with wide loops, one of which led to the rediscovery of the long-lost Bouvet Island ; another greatly extended our knowledge of the depths of the Southern Ocean towards the Antarctic Circle, and the third enabled a line of sound- ings to be run across a part of the Indian Ocean hitherto blank on the charts. The Pacific Ocean was the field of Professor A. Agassiz's researches in the United States Fish Commission steamer Albatross in 1899-1900, and the Dutch Government vessel Siboga was engaged at the same time in the little-known seas of the Malay Archipelago. (h. e. m.)

GEOLOGY.

DURING the years which have elapsed since the pub- lication of the article on geologyinthe ninth edition of this Encyclopaedia, the science has continued to make advances in every department of its domain, but its principles and broad conclusions remain with but little change. That article, therefore, still gives a fairly accurate and complete presentation of its subject. Innumerable fresh illustrations might now be inserted of the principles of the science, vast numbers of new facts might be cited which have come to light in the interval, many depart- ments of the subject might be greatly expanded in the light of recent research. But in this supplementary article it will be sufficient to call attention only to the more important changes of view and additions to our knowledge of the larger questions with which geology deals.

1. CosMicAL Aspects of Geology.

The astronomical relations of the Earth and their bear- ings on geological speculation have been much discussed in recent years. Of these questions, more particular reference

may here be made to two ??? Croll's doctrines as to the origin of climates in the past, and the contro- versy as to the age of the Earth. The ingenious %mMes. views propounded by James CroU (1821-90) regarding the influence of astronomical causes in deter- mining variations of terrestrial climate were fully stated in the ninth edition article. His teaching was widely accepted by geologists, inasmuch as it seemed to offer a solution of one of the most difficult problems of geology, and to provide a possible basis for computing the absolute value of geological time. More recently his views were adopted with certain modifications, and enforced by Sir Robert Ball with his accustomed vigour.^

1 Croll's original papers will be found chiefly in the Philosophical Magazine between the years 1864 and 1874. They were collected and incorporated with modifications in his volume Climate and Time in their Geological Relations, London, 1875. His views were also elaborated by

him in his subsequently published Discussions on Climate and Cosmology, Edinbursfh, 1885. Sir Robert Ball's work, The Cause of an Ice-Aae, was published in London, 1891.

During his lifetime CroU's doctrine, though, it com- mended itself to geologists, did not make way among physicists and astronomers. In particular, it was criticized by Professor Simon Newcomb, and defended by its author.^ More recently it has been critically examined by Mr E. P. Culverwell, who regards it as " a vague spectxlation, clothed indeed with a delusive semblance of severe numerical accuracy, but having no foundation in physical fact, and builtup of parts which do notdovetail one into the other." ^

This writer affirms that Croll's fundamental assumption that the midsummer and midwinter temperatures are directly proportional to the sun's heat at those seasons is not borne out by an appeal to observation. At Yakutsk, for example, which may be taken as an extreme case of range of temperature, if the excess of its midwinter tem- perature above that of space were due entirely to the mid- winter sun-heat, then the midsummer temperature, also arising solely from direct sun heat, should be 5800◆◆ Pahr. above that of space, or if the midsummer excess were due only to the midsummer sun-heat, then the midwinter temperature ought to be -228◆◆ Fahr. Mr Culverwell has calculated what parallels of latitude now receive the same amount of winter sun-heat as the parallels of 40◆◆, 60◆◆, 60◆◆, 70◆◆, 80◆◆, and 90◆◆ received during a time of high eccen- tricity when winter occurred in aphelion. He finds that the daily average sun-heat received during the winter of high eccentricity by the parallel of 40◆◆ is now received by that of 42-2◆◆, and that the parallel of 64◆◆ at the present time receives the same amount as that of 50◆◆ did then. He concludes that the lowering of the midwinter tempera^ ture from lat. 50◆◆ IST. to 70◆◆ N., due to

diminished winter sun-heat in the epoch of great eccentricity, cannot have been as much as from 3 to 6 Pahr. Such a small decrease could not have been sufficient to produce a glacial period within these latitudes. But it is not certain that the midwinter temperature did really fall during the epoch of maximum eccentricity. This temperature, in the case of the British Isles, depends not on direct sun- heat so much as on the heat transported by the Gulf stream. But during the time of high eccentricity the summer temperature of the regions whence the Gulf stream derives its warmth was far greater than it is now, so that it is conceivable that, instead of being colder in winter, the British climate may actually have been milder than it is now. The failure of the astronomical theory to afford a solution of the problem of the Ice Age leaves geologists once more face to face with one of the most perplexing questions with which they have to deal. At present no satisfactory explanation of it has been offered.

Though the question of the Age of the Earth has con- tinued to engage the attention of physicists, geologists, and palaeontologists since 1880, no general agreement has been reached in regard to it. On the physical side the same three arguments are still adduced which sfrih/”^ were stated in the ninth edition article (p. 227), viz., the secular cooling of the Earth, the retarda- tion of our planet’s rotation by tidal friction, and the age of the sun’s heat. But whereas Lord Kelvin (then Sir William Thomson) was formerly disposed to allow a period of 100 millions of years for the evolution of geological history, he has since maintained that the time ” was more than 20 and less than 40 millions of years, and probably much nearer 20 than 40.”^ On the other hand, several physicists and mathematicians of eminence have expressed themselves less confidently on the validity of these arguments and conclusions, and with more appreciation of the importance of the views brought forward on the

1 See Fhil. Mac/., for the years 1876, 1883, and 1884.

2 Gciloqical Magazine, 1895, pp. 3, 55; Phil. Mag., 1894, p. 541. 8 Phil. Mill)., January 1899.

side of geology and palaeontology. In an address from the chair of the Mathematical Section of the British Asso- ciation in 1886, Professor

George Darwin reviewed the controversy, and pronounced the f oil owing deliberate judg- mentinregard to it: "In considering these three arguments I have adduced some reasons against the validity of the first [tidal friction], and have endeavoured to show that there are elements of uncertainty surrounding the second [secular cooling of the Earth] ; nevertheless, they un- doubtedly constitute a contribution of the first importance to physical geology. Whilst, then, we may protest against the precision with which Professor Tait seeks to deduce results from them, we are fully justified in following Sir William Thomson, who says that ' the existing state of things on the Earth, life on the Earth ??? all geological history showing continuity of life ??? must be limited within some such period of past time as 100 million years.'" Lord Kelvin has never dealt with the geological and palaeonto- logical objections against the limitation of geological time to a few millions of years. But Professor Darwin, in the address just cited, uttered the memorable warning: "At present our knowledge of a definite limit to geological time has so little precision that we should do wrong summarily to reject theories which appear to demand longer periods of time than those which now appear allowable" (ihid. p. 518).*

*In an address to the Mathematical Section of the American Association for the Advancement of Science in 1889, the vice-president of the Section, Mr E. S. Woodward, thus expressed himself with regard to the physical arguments brought forward by Lord Kelvin and Professor Tait in limitation of geological time. " Having been at some pains to look into this matter, I feel bound to state that, although the hypothesis appears to be the best which can be formulated at present, the odds are against its correctness. Its weak links are the unverified assumptions of an initial uniform temperature and a constant diffusivity. Very likely these are approximations, but of what order we cannot decide. Furthermore, if we accept the hypothesis, the odds appear to be against the present attainment of trustworthy numerical results, since the data for calculation, obtained mostly from observations on continental areas, are far too meagre to give satisfactory average values for the entire mass of the Earth."**

Still more emphatic is the protest made from the physical side by Professor John Perry. He has attacked each of the three lines of argument of Lord Kelvin, and has im- pugned the validity of the conclusions drawn from them. The argument from tidal retardation he dismisses as falla- cious, following in this contention the previous criticism of the Rev. Maxwell Close and Professor George Darwin. In dealing with the argument based on the secular cooling of the Earth, he holds it to be perfectly allowable to assume a much higher conductivity for the interior of the globe, and that such a reasonable assumption would enable us greatly to increase our estimate of the Earth's antiquity. As for the third argument, from the age of the sun's heat, he points out that the sun may have been repeatedly fed by a supply of meteorites from outside, while the Earth may have been protected from radiation, and been able to retain much of its heat by being enveloped in a dense atmosphere. Kemarking that " almost anything is possible as to the present internal state of the Earth," he concludes thus : " To sum up, we can find no published record of any lower maximum age of life on the Earth, as calculated by physicists, than 400 millions of years. From the three physical ari^'uments Lord Kelvin's higher limits are 1000, 400, and 500 million years. I have shown that we have

- *Brit. .I.vsoc. Report, l,S,S(i, p. 517. s Smithsonian Report for 1890, p. 194.*

reasons for believing that the age, from all these, may be very considerably under-estimated. It is to be observed that if we exclude everything but the arguments from mere physics, the jn-obable age of life on the Earth is much less than any of the above estimates ; but if the palaeonto- logists have good reasons for demanding much greater times, I see nothing from the physicist's point of view which denies them four times the greatest of these esti- mates." ^

The arguments from the geological side against the physical contention that would limit the age of our globe to some 10 or 20 millions of years

have been repeatedly stated.^ They are based on the observed rates of geolo- gical and biological changes at the present time upon land and sea, and on the nature, physical history, and organic contents of the stratified crust of the Earth. Un- fortunately, actual numerical data are not obtainable in many departments of geological activity, and even where they can be procured they have not yet been based on a suflBciently wide collection of accurate and co-ordinated observations. But in some branches of dynamical geol- ogy materials exist for at least a preliminary computa- tion of the rate of change. This is more especially the case in respect of the wide domain of denudation. The observational records of the action of the sea, of springs, rivers, and glaciers are becoming gradually fuller and more trustworthy. A method of making use of these records for estimating the rate of denudation of the land was referred to in the ninth edition article (p. 278). Taking the Mississippi as a general type of river-action, it was shown that the amount of material conveyed by this stream into the sea in one year was equivalent to the lowering of the general surface of the drainage-basin of the river by ^{t} of a foot. This would amount to one foot in 6000 years, and 1000 feet in 6 million years. So that at the present rate of waste in the Missis- sippi basin a whole continent might be worn away in a few millions of years.

It is evident that as deposition and denudation are simultaneous processes, the ascertainment of the rate at which solid material is removed from the surface of the land supplies some necessary information for estimating the rate at which new sedimentary formations are being accumulated on the floor of the sea, and for a computa- tion of the length of time that would be required at the present rate of change for the deposition of all the strati- fied rocks that enter into the composition of the crust of our globe. If the thickness of these rocks be assumed to be 100,000 feet, and if we teould suppose them to have been laid down over as wide an area as that of the drain- age basins from the waste of which they were derived, then at the present rate of denudation their accumulation would require some 600 millions of years. But, as Dr A. E. Wallace has justly pointed out, the tract of sea-floor over which the material derived from the waste of the terrestrial surface is laid down is at present much less than that from which this material is worn away. We have no means, however, of determining what may have been the ratio

between the two areas in past time. Certainly ancient marine sedimentary rocks cover at the present day a much more extensive area than that in which they are now being elaborated. If we take the ratio postulated by Dr Wallace [1] 1 to 19 [2] the 100,000 feet of sedimentary strata would require 31 millions of years for their accumu- lation. It is quite possible, however, that this ratio may be much too high. There are reasons for believing that

1 Nature, vol. li. p. 585 (18th April 1895).

2 They are briefly given in the original article (pp. 226, 227). See, however, the presidential address to the British Association at the Edinburgh Meeting in 1892, pp. 15-21, and the President's Address to Section C of the Association at the Dover Meeting of 1899.

the proportion of coast-line to land area has been diminish- ing during geological time ; in other words, that in early times the land was more insular, and is now more con- tinental. So that the 31 millions of years may be much less than the period that would be required, even on the supposition of continuous uninterrupted denudation and sedimentation, during the whole of the time represented by the stratified formations.

But no one who has made himself familiar with the actual composition of these formations and the detailed structure of the terrestrial crust can fail to recognize how vague, imperfect, and misleading are the data on which such computations are founded. It requires no prolonged acquaintance with the Earth's crust to impress upon the mind that one all-important element is omitted, and in- deed can hardly be allowed for from want of sufficiently precise data, but the neglect of which must needs seriously impair the value of all numerical calculations made with- out it. The assumption that the stratified formations can be treated as if they consisted of a continuous unbroken sequence of sediments, indicating a vast and uninterrupted process of waste and deposition, is one that is belied on every hand by the actual structure of these formations. It can only give us a minimum of the time required ; for, instead of an unbroken series, the sedimentary formations are full of " unconformabilities " [3] gaps in the sequence of the chronological records [4] as if whole chapters and groups of chapters had been torn out of a historical

work. It can often be shown that these breaks of continuity must have been of vast durar tion, and actually exceeded in chronological importance thick groups of strata lying below and above them. Moreover, even among the uninterrupted strata, where no such unconformabilities exist, but where the sedi- ments follow each other in apparently uninterrupted sequence, and might be thought to have been deposited continuously at the same general rate, and without the intervention of any pause, it can be demonstrated that sometimes an inch or two of sediment must, on certain horizons, represent the deposit of an enormously longer period than a hundred or a thousand times the same amount of sediment on other horizons. A prolonged study of these questions leads to the profound conviction that in many parts of the geological record the time represented by sedimentary deposits must be vastly less than the time which is not so represented.

It has often been objected that the present rate of geolo- gical change ought not to be taken as a measure of the rate in past time, because the total sum of terrestrial energy has been steadily diminishing, and geological processes must consequently have been more vigorous in former ages than they are now. Geologists do not pretend to assert that there has been no variation or diminution in the activities of the various processes which they have to study. What they do insist on is that the present rate of change is the only one which we can watch and measure, and which will thus supply a statistical basis for any com- putations on the subject. But it has been dogmatically asserted that because terrestrial energy has been diminish- ing, therefore all kinds of geological work must have been more vigorously and more rapidly carried oninformertimes than now ; that there were far more abundant and more stupendous volcanoes, more frequent and more destruc- tive earthquakes, more gigantic upheavals and subsidences, more powerful oceanic waves and tides, more violent atmospheric disturbances with heavier rainfall, and more active denudation.

It is easy to make these assertions, and they look plausible; but, after all, they rest on nothing stronger than assumption. They can be tested by an appeal to the crust of the Earth, in which the geological history of our

planet has been so fully recorded. Had such portentous manifestations of geological activity ever been the normal condition of things since the beginning of that history, there ought to be a record of them in the rocks. But no evidence for them has been found there, though it has been diligently sought for in all quarters of the globe. "VVe may confidently assert that while geological changes may quite possibly have taken place on a gigantic scale in the earliest ages of the Earth's existence, of which no geological record remains, there is no proof that they have ever done so since the time when the very oldest of the stratified formations were deposited. There is no need to maintain that they have always been conducted precisely on the same scale as now, or to deny that they may have gradually become less vigorous as the general sum of terrestrial energy has diminished. But we may unhesitatingly afEirm that no actual evidence of any such progressive diminution of activity has been adduced from the geological record in the crust of the Earth : that, on the contrary, no appearances have been detected there which necessarily demand the assumption of those more powerful operations which physicists have postulated, or which are not satisfactorily explicable by reference to the existing scale of nature's processes.

That this conclusion is warranted even with regard to the innate energy of the globe itself will be seen if we institute a comparison between the more ancient and the more recent manifestations of that energy. Take, for example, the proofs of gigantic plication, fracture, and displacement within the terrestrial crust. These, as they have affected the most ancient rocks of Europe, have been worked out in great detail in the north-west of Scotland. But they are not essentially different from or on a greater scale than those which have affected the Alps, and have involved strata of so recent a date as the older Tertiary formations. On the contrary, it may be doubted whether any denuded core of an ancient moun- tain-chain reveals traces of such stupendous disturbances of the crust as those which have given rise to the younger mountain-chains of the globe. It may, indeed, quite well have been the rule that instead of diminishing in

intensity of effect, the consequences of terrestrial contraction have increased in magnitude, the augmenting thickness of the crust offering greater resistance to the stresses, and giving rise to vaster plications, faults, thrust-planes, and metamorphism, as this growing resist- ance had to be overcome.

The assertion that volcanic action must have been more violent and more persistent in ancient times than it is now has assuredly no geological evidence in its support. It is quite true that there are vastly more remains of former volcanoes scattered over the surface of the globe than there are active craters now, and that traces of copious eruptions of volcanic material can be followed back into some of the oldest parts of the geological record. But we have no proof that ever at any one time in geological history there have been more or larger or more vigorous volcanoes than those of recent periods. It may be said that the absence of such proof ought not to invalidate the assertion until a far wider area of the Earth's surface has been geologically studied. But most assuredly, as far as geological investigation has yet gone, there is an over- whelming body of evidence to show that from the earliest epochs in geological history, as registered in the stratified rocks, volcanic action has manifested itself very much as it does now, but on a less rather than on a greater scale. Nowhere can this subject be more exhaustively studied than in the British Isles, where a remarkably complete series of volcanic eruptions has l□□^en clironicled ran,!:;ing from the earliest Pala-ozoic down to older Tertiary time. The result of a prolonged study of British volcanic geology

(of which a summary will be given in pages 641-646) has demonstrated that, even to minute points of detail, there has been a singular uniformity in the phenomena from beginning to end. The oldest lavas and ashes differ in no essential respect from the youngest. Nor have they been erupted more copiously or more frequently. Many successive volcanic periods have followed each other after prolonged intervals of repose, each displaying the same general sequence of phenomena and similar evidence of gradual diminution and extinction. The youngest, instead of being the feeblest, were the most extensive outbursts in the whole of the prolonged series (see p. 638).

If now we turn for evidence of the alleged greater activity of all the epigene or superficial forces, and especially for proofs of more rapid denudation and deposition on the Earth's surface, we search for it in vain among the stratified formations of the terrestrial crust. Had the oldest of these rocks been accumulated in a time of great atmospheric perturbation, of torrential rains, colossal tides, and violent storms, we might surely expect to find among the sediments some proof of such disturbed meteorological and geographical conditions. We should look, on the one hand, for tumultuous accumulations of coarse unworn detritus, rapidly swept by rains, floods, and waves from land to sea, and on the other hand for an absence of any evidence of the tranquil and continuous deposit of such fine laminated silt as could only settle in quiet water. But an appeal to the geological record is made in vain for any such proofs. The oldest sedi- ments, like the youngest, reveal the operation only of such agents and such rates of activity as are still to be wit- nessed in the accumulation of the same kind of deposits. If, for instance, we search the most ancient thick sedi- mentary formation in Britain ??? the Torridon Sandstone of north-west Scotland, which is older than the oldest f ossilif erous deposits ??? we meet with nothing which might not be found in any Palaeozoic, Mesozoic, or Cainozoic group of similar sediments. We see an accumulation, at least 8000 or 10,000 feet thick, of sand, gravel, and mud, such as may be gathering now on the floor of any large mountain-girdled lake. The conglomerates of this ancient series are not pell-mell heaps of angular detritus, vio- lently swept away from the land and huddled promis- cuously on the sea-floor. They are built up of pebbles that have been worn smooth, rounded and polished by prolonged attrition in running water, and they follow each other on successive platforms with intervening layers of finer sediment. The sandstones are composed of well-waterworn sand, some of which has been laid down so tranquilly that its component grains have been separated out in layers according to their specific gravity, in such manner that they now present dark layers in which particles of magnetic iron, zircon, and other heavy minerals have been sifted out together, just as iron-sand may be seen gathered into thin sheets on sandy beaches at the present day. Again the same series of primeval sedi- ments includes intercalations of fine silt, which has been deposited as regularly and intermittently there as it has been among the mos't recent formations. These bands of shale have been

diligently searched for fossils, as yet without success ; but they may eventually disclose organic remains older than any hitherto found in Europe.

We now come to the consideration of the Palseonto- logical evidence as to the value of geological time. Here the conclusions derived from a study of the structure of the sedimentary formations are vastly strengthened and extended. In the first place, the organization of the most ancient plants and animals furnishes no indication that they had to contend with any greater violence of storm, flood, wave, or ocean-current than is familiar to their modern descendants. The oldest trees, shrubs, ferns, and

club-mosses display no special structures that suggest a difference in the general conditions of their environment. The most ancient crinoids, sponges, crustaceans, arachnids, and molluscs were as delicately constructed as those of to-day, and their remains are often found in such perfect preservation as to show that neither during their lifetime nor after their death were they subject to any greater violence of the elements than their living representatives now experience. Of much more cogency, however, is the evidence supplied by the grand upward succession of organic forms, from the most ancient stratified rocks up to the present day. No biologist now doubts for a moment that this marvellous succession is the result of a gradual process of evolution from lower to higher types of organ- ization. There may be differences of opinion as to the causes which have governed this process and the order of the steps through which it has advanced, but no one who is conversant with the facts will now venture to deny that it has taken place, and that, on any possible explanation of its progress, it must have demanded an enormous lapse of time. In the Cambrian or oldest fossiliferous formations there is already a large and varied fauna, in which the lead- ing groups of invertebrate life are represented. On no ten- able hypothesis can these be regarded as the first organisms that came into being on our planet. They must have had a long ancestry, and as Darwin first maintained, the time required for their evolution may have been " as long as, or probably far

longer than, the whole interval from the Silurian [Cambrian] age to the present day." The records of these earliest eras of organic development have un- fortunately not survived the geological revolutions of the past ; at least, they have not yet been recovered. But it cannot be doubted that they once existed and registered their testimony to the prodigious lapse of time prior to the deposition of the most ancient fossiliferous formations which have escaped destruction.

The impressive character of the evidence furnished by the sequence of organic forms throughout the great series of fossiliferous strata can hardly be fully realized without a detailed and careful study of the subject. Professor Poulton, in an address to the Zoological Section of the British Association at the Liverpool Meeting in 1896, showed how overwhelming are the demands which this evidence makes for long periods of time, and how im- possible it is of comprehension unless these demands be conceded. The history of life upon the Earth, though it will probably always be surrounded with great and even insuperable difB.culties, becomes broadly comprehensible in its general progress when suf&cient time is granted for the evolution which it records ; but it remains unintel- ligible on any other conditions.

*Taken then as a whole, the body of evidence, geological and palSeontological, in favour of the high antiquity of our globe is so great, so manifold, and based on such an ever-increasing breadth of observation and reflection, that it may be confidently appealed to in answer to the physical arguments which would seek to limit that antiquity to ten or twenty millions of years. In the present state of science it is out of our power to state positively what must be the lowest limit of the age of the Earth. But we cannot assume it to be much less, and it may possibly have been much more, than the 100 millions of years which Lord Kelvin was at one time willing to concede.^*

1 The subject of the age of the Earth has also been discussed by Professor Joly and Professor Sollas. The former geologist, approacli- ing the question from a novel point of view, has estimated the total quantity of sodium in the water of the ocean and the quantity of that element received annually by the ocean from the denudation of the land. Dividing the one

sum by the other, he arrives at the result that the probable age of the Earth is between 90 and 100 millions of years

2. Geognosy.

In this department of geological inquiry petrographical research has been greatly pursued and extended. The methods of determining the microscopic structure of rocks have been considerably improved. Fresh light has been thrown on the composition, structure, and probable history of many rocks. A considerable number of new varieties of rocks has been added to the already sufficiently numerous list. Various schemes of classifi- cation have been proposed, but petrographers are still far from any general agreement as to a scheme that shall be at once natural and convenient. This subject has en- gaged the attention of the International Geological Con- gress, of which a special committee has been formed for the purpose of considering the question of petrographical nomenclature and classification.

The voluminous recent literature of this branch of geology will be found partly in the form of papers in the scientific serials and in the proceedings of scientific societies, and partly as independent general treatises or text^books. Of the latter the most important are: ??? F. Zirkel, Lehrbuch der Petrographie, 3 vols., 2nd edit., Leipzig, 1893-94 : this is the most comprehensive treatise on rocks ; H. Rosenbusch, Mikroskopische Physiographie der Mineralien und Oesteine, 3rd edit., Stuttgart, 1892-96: translated by Iddings, London, 1888 ; H. Rosenbusch, Elemente der Gesteinslehre, Stuttgart, 1898; A. Barker, Petrology for Students, 2nd edit, Cambridge, 1897.

3. Dynamical Geology.

The hypogene action whereby changes are effected within the crust of the earth manifests itself in volcanoes, earthquakes, secular movements of upheaval and depres- sion, and in alterations of the texture, structure, and composition of rocks. In each of these sections of inquiry progress has been made in the accumulation of fresh facts, if not in the elaboration of a satisfactory hypothesis to account for them. To a few of

the more important addi- tions to our knowledge in some of these departments reference will here be made.

*Volcanoes. ??? A large amount of observation has been devoted to the phenomena of volcanoes. The daily operations of such constantly active vents as Etna, Stromboli, Vesuvius, and Hawaii have been watched and recorded.^*

Several important volcanic eruptions in various parts of the world have been investigated by competent ob- servers, notably the stupendous catastrophe of Krakatoa in 1883 and that of Bandai-san, Japan, in 1888. The circumstances accompanying volcanic explosions have been more fully studied. Attention has been given to the

(Trans. Roy. Dublin Sac, ser. ii. vol. -yii., 1899, p. 23; Geol. Mag., 1900, p. 220) . Professor Sollas believes that this limit exceeds what is required for the evolution of geological history, that the lower limit assigned by Lord Kelvin falls short of what the facts demand, and that geological time will probably be found to have been comprised within some Indeterminate period between these limits. (Address to Section C, Brit. Assoc. Report, 1900.)

2 For recent accounts of Vesuvius see : ??? H. J. Johnstone-Lavis, Spettatore del Vesuvio, Naples, 1887; Nature, vols, xxvi., xliv., pp. 160, 320, 352, lii. p. 342 ; G. Mercalli, Vulcani e Fenomeni Vulcanici in Italia, Milan, 1883; R. V. Manteucci, Rend. R. Accad. Napoli, 1897, 1898, 1899; Boll. Soc. Geol. Ital. vol. xvi. (1898); Boll. Soc. Sismolog. Ital. v. (1899-1900) ; Rend. Accad. Lincei. Roma, viii. (1899). On Etna; ??? S. von Waltershausen, Der Etna, Leipzig, 1880; Mercalli in the work just cited and notices of recent eruptions in Nature, vols. xix. xx. xxi. xxii. xxv. xxvii. xlvi. xlvii. and Iv. On Stromboli: ??? Mercalli, Yulcani, &c., p. 135; Atti. Soc. Ital. Set. Nut., vols. xxii. xxiv. xxvii. xxix. xxxi. ; and notes in Nature, xliv. (1891), p. 280, xlvii. pp. 89, 453. On Hawaii: ??? J. D. Dana, Characteristics of Volcanoes, p. 125, London, 1890; and Amer. Joum. Sci. vols, xxxiii.-xxxvii. (1887-89) ; C. E. Dutton, Amer. .lourn. Sci. vol. xxv. (1883), p. 219; Ann. Rep. U.S. Geol. Survey (1882-83); also

notices in Nature, vols, xlvii. (1893), p. 499; 1. (1894), pp. 91, 483; liii. (1896), p. 490.

of Krakatoa,

phase of fissure eruptions, especially as manifested in recent times in Iceland and in more remote ages in Britain, India, and the western portions of the United States. A large body of evidence has been gathered bearing on the history of vulcanism in the geological past, and many features of the inner mech- ???anism of volcanic vents, as well as of the phenomenon of the subterranean intrusions of igneous material, have been ascertained with a clearness which no modern vol- cano could supply.

VolcariK Explosions. ??? Of recent volcanic eruptions by far the most stupendous was the outburst of Krakatoa in Sunda Strait. It has thrown fresh light on Eruption ^j^g mature and the occarrence of the explo- sions which form so characteristic a feature in the regime of volcanoes. These phenomena have from the earliest times powerfully impressed the human imagination. In a few hours or days a great mountain is eviscerated with the most violent commo- tion, vast clouds of dust are projected high into the air and cover the noonday sky with the darkness of night, while terror, wounds, and death befall vast numbers of the population around. Such catastrophes have taken place at wide intervals since prehistoric times. It was by one of them that the crater of the islands which now form the Santorin group in the Grecian Archipelago was blown out after a human colony had settled around its flanks. Another, likewise older than the times of history, pro- duced the vast chasm of the Val del Bove on the east side of Etna. The first of which any account has been handed down was that which destroyed the southern half of Monte Somma and buried the towns on the shores of the Bay of Xaples in a.d. 79. Since that time other examples of the phenomenon in different degrees of in- tensity have been experienced in various parts of the world. But probably none of them has equalled in vio- lence the great explosion

of Krakatoa. Fortunately the events that preceded, accompanied, and followed that catastrophe were witnessed by many observers whose testimony has been collected and collated, so that the nature and sequence of these events have been recorded with a fulness previously unknown.

At some early period a large volcano rose in the centre of the tract where now runs the Sunda Strait between Sumatra and Java. Long before any European had entered these waters a gigantic explosion took place by which the mountain was so completely blown away that only the outer portions of its base were left as a broken ring of islands. Subsequent eruptions gradually built up a new series of small cones within the great crater ring. Of these the most important rose to a height of 2623 feet above the sea and formed the peak of the volcanic island of Krakatoa. But compared with the great neigh- bouring volcanoes of Java and Sumatra, the islets of the Sunda Strait were comparatively unknown and neglected. Though densely wooded, Krakatoa was uninhabited, and no satisfactory map or chart of it had been made. In the year 1680 it appears to have suffered from a volcanic eruption, when great earthquakes took place and large quantities of pumice were ejected. But the effects of this disturbance had been so concealed by the subsequent spread of tropical vegetation that the very occurrence of the eruption had sometimes been called in question. At last, about the year 1877, earthquakes began to be of frequent occurrence in the Sunda Strait and continued for the next few years, as an indication that the volcanic energy which had been dormant for at least 200 years was once more waking into life. In 1883 the manifestations of subterranean commotion began to be more decided, for in the month of May of that year Krakatoa broke out in eruption. For some time the efforts of the volcano appear

to have consisted mainly in the discharge of pumice and dust, with the usual accompaniment of detonations, tremors, and earthquakes. And so far the type of activity resembled that which had characterized the volcano ever since the time of the great explosion. But at last, on 26th August, a succession of paroxysmal explosions began which lasted till the morning of the 28th, but of which the four most violent took place on the morning of the 27th. The whole of the northern and lower portion of the

island of Krakatoa, lying within the original crater ring of pre- historic times, was blown away ; the northern part of the cone of Eakata almost entirely disappeared, leaving a vertical cliff which laid bare the inner structure of that volcano. Instead of the volcanic island which had previ- ously existed, and rose from 300 to 1400 feet above the sea, there was now left a submarine cavity the bottom of which is here and there more than 1000 feet below the sea-level. This prodigious evisceration was the result of successive violent explosions of the superheated vapour and gas absorbed in the molten magma within the crust of the earth. The vigour and repetition of these explosions, it has been suggested, may have been caused by sudden inrushes of the water of the ocean as the throat of the volcano was cleared and the crater-ring was lowered and ruptured. The access of large bodies of cold water to the top of the column of molten lava would probably give rise at once to some minor explosions and then to a chilling of the surface of the lava and a consequent temporary diminution or even cessation of the volcanic eructations. But until the pent-up water- vapour in the lava below had found relief it would only gather strength until it was able with explosive energy to burst through the chilled crust and overlying water, and to hurl a vass mass of cooled lava, pumice, and dust into the air.

The amount of material discharged during the two days of paroxysmal energy was enormous, though there are no satisfactory data for even approximately estimating it. A large cavity was formed where the island had pre- viously stood, and the sea-bottom around this crater was covered with a wide and thick sheet of fragmentary materials. Some of the surrounding islands received such a thick accumulation of ejected stones and dust as to bury their forests and greatly to increase the area of the land. So much was the sea filled up that a number of new islands rose above its level. But a vast body of the fine dust was carried far and wide by aerial currents, while the floating pumice was transported for many hundreds of miles on the surface of the ocean. At Batavia, 100 miles from the centre of eruption, the sky was darkened by the quantity of ashes borne across it, and lamps had to be used in the houses at mid-day. The darkness even reached as far as Bandong, a distance of nearly 150 miles. It was computed that the column of stones, dust, and ashes projected from the volcano shot up into the air for a height of seventeen miles or more.

The finer pai-ticles coming into the higher layers of the atmosphere were diffused over a large pait of the surface of the earth, and showed their presence by the brilliant sunset glows to which they gave rise. It was computed that within the tropics they wore at first borne along by air-currents at the rate of about seventy-three miles an hour from east to west until within a period of six weeks they were diffused over nearly the whole space between the latitudes 30 N. and 45 S. Eventually they spread northwards and southwards and were carried over North and South America, Europe, Asia, South Africa, and Australasia. In the Old AVorld they spread from the north of Scandinavia to the Cape of Good Hope.

Another remarkable feature of this stupendous volcanic event was the world-wide disturbance of the atmosphere. The culminating paroxysm of Krakatoa on the morning of

27th Avigust gave rise to an atmospheric wave or oscilla- tion, which, travelling outwards from the volcano as a centre, became a great circle at 180 from its point of origin, whence it continued travelling onwards and con- tracting till it reached a node at the antipodes to Krakatoa. It was then reflected or reproduced, travelling backwards again to the volcano, whence it once more returned in its original direction. " In this manner its repetition was observed not fewer than seven times at many of the stations, four passages having been those of the wave travelling from Krakatoa, and three those of the wave travelling from its antipodes, subsequently to which its traces were lost" (Sir E. Strachey).

The actual sounds of the volcanic explosions were heard over a vast area of the earth's surface, especially towards the west. Thus they were noticed at Rodriguez, nearly 3000 English miles away, at Bangkok ip Siam (1413 miles), in the Philippine Islands (about 1450 miles), in Ceylon (2058 miles), and in West and South Australia (from 1300 to 2250 miles). On no other occasion have sound-waves ever been perceived at anything like the extreme distances to which the detonations of Krakatoa reached.

Not less manifest and far more serious were the effects of the successive explosions of the volcano upon the waters of the ocean. A succession of waves were generated which appear to have been of two kinds : long waves with periods of more than an hour, and shorter but higher waves, with irregular and much briefer intervals. The greatest disturbance, probably resulting from a combina- tion of both kinds of waves, reached a height of about 50 feet. The destruction caused by the rush of such a body of sea-water along the coasts and low islands was enor- mous. All vessels lying in harbour or near the shore were stranded, the towns, villages, and settlements close to the sea were either at once, or by successive inunda- tions, entirely destroyed, and more than 36,000 human beings perished. The searwaves travelled to vast distances from the centre of propagation. The long wave reached Gape Horn (7818 geographical miles) and possibly the English Channel (11,040 miles). The shorter waves reached Ceylon and perhaps Mauritius (2900 miles). ^

The eruption of Bandai-san in the north of Japan in the year 1888 was likewise witnessed and chronicled by intelligent observers, whose evidence brings before us some additional particulars regarding the phenomena attendant on volcanic explosions. The ground rocks of the ^f'j?'**??**f , region are various granites, gneisses, and crystal- **??**a**???**. " line schists through which in Tertiary time a series of volcanic eruptions took place. The volcanic energy is said to have gradually declined down to the present day. A line of volcanic mountains runs in a general north and south direction along the axis of the island. Most of them are now extinct. But a few have remained in the solfataric stage ; that is, they have from time to time given vent to explosions of vapour with more or less violence, but without the discharge of true ashes or lava. During a long period of comparative quiescence the cones have been deeply trenched by denu- dation and thickly clothed with forest. Hot springs still rise at many points, but except to a geological eye there is little in the general aspect of the country to suggest that its contours have resulted from former volcanic activity, or that they may be again modified by the same cause. Tradition tells that the volcanic mountain of Bandai-san had its summit burst open by an eruption, which, sending forth fire and smoke, split it into several peaks. The event was accompanied by a memorable*

1 "The Eruption of Krakatoa and subsequent Phenomena." Ee- port of the Krakatoa Committee of the Royal Society, London, 1888.

catastrophe to the inhabitants, whereby fifty villages were buried under the waters which gathered in the hollow now occupied by Lake Inawishiro. But for ten centuries the volcano appears to have remained on the whole in a dormant condition. At last, on the morning of 15th July 1888, rumbling noises like distant thunder began to be heard by the inhabitants, until a tolerably severe earthquake took place that lasted more than twenty seconds and affected an area with a radius of about thirty miles. A quarter of an hour later, after further violent shaking of the ground, and while the commotion was still going on, a great explosion took place on the old volcanic cone of Bandai-san (6036 feet) followed by fifteen or twenty more during nearly two hours. Each of these paroxysms was accompanied by deafening detonations, while steam and dust were shot up into the air to a height of more than 4000 feet. By the last discharge the material is said to have been projected almost horizontally towards the valley on the north. The fine dust and vapour rapidly ascended into the higher regions of the atmosphere, where at a height of some 18,000 feet the material spread out into the usual pine-tree shape, and was gradually carried by the wind in a south-easterly direction, spreading out on its way, and passing out to sea. The area of land over which this fine dust fell was 790 square miles. How far it was carried across the Pacific was not ascertained. So thick was the canopy of dust that immediately around the mountain the day became black as night ; and the vapour condensed into a warm rain which fell with the hot ashes. While the darkness still lasted the whole summit and side of the mountain gave way, and an immense avalanche of earth and rock rushed down the slopes, burying the ISTagase with its villages and people, and devastating an area of 27 square miles. In all seven villages and 461 inhabitants were destroyed.

According to the observations of the Japanese geolo- gists who at once proceeded to the spot to make a detailed investigation of the circumstances of the eruption, the fine dust that accompanied the successive explosions of steam was not pumice such as results from the sudden expansion of the superheated vapour absorbed in a molten

magma, but fine powder of pre-existing andesitic rocks, which had been more or less decomposed by fumarole action. These observers believed that the dust resulted from the explosive force of the steam acting upon the older Solidified lavas, and from the mechanical trituration of the stones against each other in their ascent and descent in the air. Some of it, mingling with the steam, fell as a hot mud that clung to the leaves and branches of the trees. It was estimated that no less an amount than 1687 millions of cubic yards of the mountain had been blown away and reduced to fragments and dust. The uppermost 540 feet of Bandai- san disappeared, and instead of the forest-covered slope on one side of the mountain there was left a vast horseshoe- shaped chasm, at the back of which the inside of the old crater was laid bare in a great ciifi: 1658 feet high, wherein were revealed the successive sheets of lava and fragment-ary materials whereof the cone had been built up. The loosened and dislocated side of the mountain is described as having been launched downwards as a huge landslip that rushed into the plain below with a velocity of about 48 miles an hour. Most of the material that so travelled is spoken of as having been comparatively dry, though no doubt mingled with the hot rain from the condensed steam, and sweeping up the waters of streams and lakes so as to become in some places a pasty mud. The torrent of debris swelled up into great waves 130 to 200 feet high in front of obstructions, and was strewn with enormous blocks of stone ; even at a considerable distance from the crater such blocks measured 16 or 30 feet on the side.

Its surface rose into conical mounds or hills formed of blocks of stone, the cause of which has not been very satisfactorily explained.

Among the most marked circumstances of the explo- sions were the prodigious blasts of wind by which they were accompanied. The sudden radial expansion of the liberated volumes of steam at quick intervals produced violent disturbances of the air. It was estimated from the effects produced that the velocity with which these tornadoes were propagated outwards from the crater could not have been less 4han 90 miles an hour.

The forests that lay in the pathway of the wind were utterly destroyed, only a few stems being left standing, each as bare as a telegraph pole. The trees fell with their heads pointing away from the crater, showing that the blasts radiated in straight lines. Places in the lee of protecting eminences escaped with little damage.

Another feature of the eruption which has given rise to some discussion was the production of numerous conical basin-like holes varying up to 10 feet in diameter and to more than 3 feet in depth. They were found in thousands around the crater, as well as on slopes a mile or moi;e away from it. Three explanations have been proposed for these singular depressions : (1) they may have been caused by the collapse of the walls of under- ground springs, whereby the water was forcibly ejected to the surface ; or (2) by the uprooting and removal of trees, whereby cavities were left in the ground ; or (3) by the projection of stones from the crater and their fall through the loose soil and ashes that covered the surface. It is possible that examples of all of these modes of origin may have occurred. Holes left by the uprooting of trees were undoubtedly noticed. But according to the careful observations of the Japanese investigators, the vast majority of the holes arose from the third cause. Some of the cavities were dug open and the stones that formed them were found lying at the bottom, sometimes with crushed and bruised but still fresh green leaves lying below them, which they had carried with them in their descent from the surface. On rocky places which the stones could not penetrate, they were found in frag- ments scattered all about. This Japanese example is interesting as a well-attested illustration of the nature and effects of a true volcanic explosion from a long- dormant or seemingly extinct crater. It shows the enor- mous disruptivfe force of imprisoned steam even when no lava or true ashes are discharged. Like Vesuvius, Monte Somma, and other vents, it indicates how volcanic energy, which may have been quiescent since beyond the times even of tradition, may suddenly awake with destructive violence, and then relapse into its previous condition of apparent extinction.'

Fissure-eruptions. ??? With regard to fissure-eruptions, so much has been learnt since 1880 that this phase of volcanic action is now recognized as one which, in modern as well as ancient times, has given

rise to the most voluminous outpourings of molten material from the earth's interior. It is from Iceland that the most detailed information has been obtained' regarding recent eruptions of this kind. Mr Thoroddsen, a geologist resident on the island, has explored and mapped its geology and, in anticipation of an ample detailed work on which he is now engaged, has published a number of interesting and important contributions to our knowledge of the subject. He protests against the common miscon- ception that volcanoes of the type of Etna and Vesuvius may be assumed to represent the general character of modern volcanic action. On the contrary, in Iceland,

1 S. Sekiya and Y. Kikuchi, "The Eruption of Bandai-san," Journ. College of Science, Imperial University of Japan, vol. iii. part ii., Tokyo, Japan (1889).

where the most copious lavarfloods of historic times have been discharged, the regular Vesuvian cone, built of successive sheets of lava and ashes, is comparatively infrequent and unimportant among the manifestations of subterranean energy. It appears that the Icelandic eruptions are essentially due to the opening of fissures in the ground and to the outflow of lava from these over the surrounding country. Mr Thoroddsen has traced two systems of such fissures, of which one, developed in the south of the island, trends from south-west to north-east, while the other, in the northern districts, runs from south to north. The famous volcano, Hekla, is situated on a fissure belonging to the first system. Though built up of lavas and tuffs, it does not form a cone, but an oblong ridge, which has been split by a fissure along its length and bears a row of craters along the rent. The produc- tion of these dislocations has been observed in connexion with recent volcanic disturbances. Thus in 1875 a violent eruption took place at Askja, where two lines of fissure crossed each other, while many large rents were opened at the surface, some of which could be followed in a north and south direction for nearly 50 miles. In- tense volcanic activity was displayed along some of these fissures. But in other cases no discharge of either lava or ashes has taken place. When lava is emitted it may flow out from the whole length of a fissure across a plain, without the production of any cones or craters, the molten material welling forth tranquilly either towards one or both sides.

An example of this nature has been observed at the great Eldgja fissure, which runs for more than 18 English miles with a depth of from 420 to 650 feet. Erom three points on this chasm lava spread out quietly, so as to cover an area of 270 English square miles, but without forming any craters or cones of scoriae or ashes, except towards the southern narrowed end, where a row of low slag-cones made its appearance. More usually, however, the line of the fissure is marked by ramparts of slags and lava-blocks heaped up on each side, or by a row of cones immediately over the dislocation. The great Laki fissure of 1783, so well described and mapped by Dr A. Helland, is marked by hundreds of little cones running along the chasm for about 20 miles. From each of these craters two or more streams of lava issued, now to the one side, now to the other, which, uniting and surrounding the cones, formed vast fields of naked and rugged stone. The western stream reached a distance of more than 40 miles, but a lava of prehistoric time from one of the fissures of the OdMahraun flowed for upwards of 60 miles. The lava desert of this locality is formed of lava that has been discharged from about 20 vents, mostly on parallel fissures, and covers an area computed to be about 1700 English square miles. Mr Thoroddsen has estimated that the mass of lava there displayed, if poured out over Denmark, would have covered that country to a depth of 16 feet.

In connexion with the modern volcanic phenomena of Iceland, reference may be made here to a feature which is well illustrated among them ??? the production of what have been called explosion craters, that is, cavities opened m the ground by volcanic explosions, but with little or no surrounding cone of ejected materials. An interesting example of one of these cavities was produced by a violent explosion at Askja on 29th March 1875. Though it measures no more than 280 feet in diameter, so energetic was the explosion which blew it open that the pumiceous stones ejected at the time fell over an area of 468 English square miles, and the finer dust which was propelled into higher layers of the atmosphere was borne by north-westerly air-currents as far as Norway and Sweden. Nine years after the eruption Mr Thoroddsen,

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on visiting the place, found the bottom of the crater covered with bluish-green boiling mud.

These recent fissue-eruptions of Iceland serve to explain the history of some prehistoric and still more ancient areas of volcanic action, wherein extensive sheets of lava have been poured out with no relation to any-great central cone from which they could have issued. Such are the vast lava^fields of Western America. In Idaho, Utah, Nevada, southwards into Arizona and New Mexico, northwards into Montana, and westwards into Oregon, lavas have been piled up into wide plateaux, stretching out as deserts of black verdureless stone. In some cases the molten material has accumulated sheet above sheet to a depth of many hundred feet. Through this thick mass of material rivers have cut their way, forming gorges 700 feet deep or more, along the walls of which the successive beds of lava may be followed for miles. From these comparatively fresh outpour- ings of lava, trenched by winding ravines, it is no great step to the much older development of the same features displayed by the basalt-plateaux of Antrim and the Inner Hebrides, which date from older Tertiary time. There the phenomena of fissure-eruption are revealed in innumerable ranges of picturesque sea- cliff, and denudation has advanced so far as to lay bare much of the inner arrangement of such plateaux, which can never be studied among modern and still undenuded lavarfields. Still more ancient is the Cre- taceous volcanic plateau of the Ghauts in the Bombay Presidency, where the same general phenomena are visible ??? innumerable dykes representing former fissures, widespread sheets of basalt, and an absence of any cen- tral cone from which the eruptions might be supposed to have emanated.

Distribution of Volcanic Action in Time. ??? In no branch of geological inquiry has more progress been made in recent years than in the collection and investigation of proofs that volcanoes were formerly rife in many parts of the Earth where they have long been extinct, and that their relics can be traced back through successive ages of the geological record to the time of the oldest formations of the Earth’s crust. Materials have thus been accumulating for a history of volcanic action

during the past, and though these materials have not yet been gathered from a wide enough area to allow, perhaps, sat- isfactory generalization for the planet as a whole, they are sufficiently ample for a few regions to indicate some of the main conclusions which fuller evidence will prob- ably confirm and extend.

*By far the most complete chronicle anywhere as yet obtained of the volcanic manifestations during the geo- logical past is that presented in the British Isles.' Vari- ous fortunate circumstances have united to ensure this completeness. Few countries of the same size as Great Britain contain so ample and varied a representation of the series of systems and formations from Mstory^of ^^^0^ geological history is compiled. This voicaaic record has been sedulously explored by innum- actioa la erable observers since the first rise of geology ; *^%s' * hence there is hardly any region of which the detailed geological structure and history have been so well ascertained. Each formation has been so fully studied that the various episodes of past time can be accurately assigned to their relative position in the chronological series. Then the peculiar position of Great Britain, along the outer or critical border-line of a conti- nent, while placing it advantageously for witnessing and chronicling the successive revolutions of former ages ??? upheaval, depression, denudation, and deposition ??? has in*

1 This subject will be found fully discussed in the author's Ancient Volcanoes of Britain, 2 vols., London, 1897.

a special measure been favourable for volcanic evolution. It is a familiar fact that at the present day volcanoes tend to group themselves near the sea, either on the edge of a continent, or in lines and groups of oceanic islands. Doubtless the same distribution has also held good in the past. Certainly nowhere can so ample and continu- ous a series of volcanic chronicles be found as in the British Isles, extending from a time earlier than that of the oldest fossiliferous rocks down to so late a period as the older Tertiary formations. This wonderfully full record includes illustrations of all the great types of volcanic activity that have been observed among modern volcanoes. On the one hand we have evidence of colos- sal eruptions, whereby hundreds of square miles of terri- tory were

buried under several thousand feet of lava ; and on the other, of isolated vents with an energy so feeble as to be capable of nothing more than the explo- sion of the steam that produced them. In some parts of the country relics remain of the Vesuvian type of vol- canoes, in others the volcanic materials have been sup- plied from fissures as in Iceland, while in not a few places the vents have the character of the puys of Cen- tral France and the Eifel. The lavas and tuffs of the older volcanic periods have been preserved by being sub- merged and buried under sedimentary accumulations. And they have subsequently been once more exposed to the day, in consequence of those geological revolutions of uplift and denudation whereby so large a part of the terrestrial crust has been made accessible to observation.

The oldest rocks of the British Isles are probably those comprised under the general name of Archaean or Lewisian gneiss, which form the chain of the Outer Hebrides and occupy many detached areas in the west of the counties of Sutherland and Ross. They include masses which recall the deep-seated bosses of eruptive material connected with volcanic discharges. But so extensive has been the de- nudation which they have undergone, even long anterior to Cambrian time, that if they were ever associated with any superficial manifestations of volcanic action, all trace of these has long since disappeared. Yet in the over- lying Torridonian sandstones, which are certainly pre- Cambrian, fragments of lava-like rocks occur, suggestive of superficial eruptions before these sandstones were laid down. Another group of pre-Cambrian rocks rises along the borders of Wales and Shropshire into a chain of heights of which the Wrekin and Caer Caradoc are the most prominent. These rocks include acid tuffs and lavas which point to true volcanic action, and mark the earliest known eruptions in the long volcanic history of England and Wales. Perhaps to the same primeval period should be referred certain relics of volcanic discharges found in the Malvern Hills, and still more remarkably in Charn- wood Forest. One characteristic feature of all these rocks is the prominence of the breccias and tuffs. It would seem that the pre-Cambrian volcanoes of England and Wales were specially remarkable for the vigour and continuance of their explosions and discharges of fragmentary material, rather than for the amount or variety of the lavas that fiowed from them.

The most ancient series of fossiliferous rocks, to which the name of Cambrian is assigned, contains the records that form the first of the long succession of chapters of fairly continuous geological history. In Great Britain they are chiefly developed in Wales and theborder English counties; they occupy a narrow belt 100 miles long in the north-west of Scotland, and certain groups of rock in the south- east of Ireland have been classed with them, though destitute of any of the characteristic Cambrian fossils. The Scottish and Irish developments of these primeval strata have not disclosed any trace of contemporaneous

volcanic action. But both, in South and North Wales a remarkably full chronicle has been preserved of a long series of volcanic eruptions. Around St Davids in Pem- brokeshire a mass of volcanic material, at least 1800 feet thick, forms the lowest visible portion of the Cambrian system. It consists chiefly of tuffs which represent suc- cessive showers of volcanic ashes thrown from sub- marine vents over the floor of the sea in which the earliest fossiliferous sediments were deposited. These tuffs present most of the characteristic features of Palae- ozoic volcanoes. They include both acid and basic varie- ties, which are represented in such a way as to show that both siliceous and basic lavas existed in the vents and were successively blown out in dust and lapilli. The volcanic series also includes some sheets of basic lava which in turn display some of the familiar features of later Palaeozoic eruptions. Their slaggy bottoms, cellular structure, and identity of character with many of the lapilli in the tuffs in which they are intercalated, show them to be true lavas which flowed over the sheets of still unconsolidated ashes lying on the sea-bottom. Various intrusive bosses, sills, and dykes tra- verse the volcanic series of St Davids. Though some of the tuffs pass into coarse agglomerates, no remnant of a true volcanic neck or orifice has yet been noticed in the district. In North Wales relics of at least two distinct Cambrian volcanic centres have been detected. One of these lies in the picturesque district around the lower end of the lake of Llanberis and

stretches thence towards Bangor ; the other extends along the ground to the west of the great range of Cader Idris. We there meet with evidence of abundant volcanic explosions, marked by intercalated tuffs, and including occasional sheets of acid and basic lavas, and we learn that these records of sub- terranean energy ascend up to the very top of the Cam- brian system and beyond it into the overlying Silurian formations. Though less voluminous in their discharges than the Silurian eruptions, those of Cambrian time were perhaps more long-continued over the region of Wales. In the Malvern Hills and in the neighbourhood of Nuneaton traces of other Cambrian volcanic centres have been found.

Unfortunately the Cambrian rocks have been so widely and deeply overspread by later formations that they only appear here and there at the surface where they have been ridged up by subterranean movements and laid bare by prolonged denudation. The next overlying system, known as Silurian, is exposed over a far wider area, and as it also has preserved a long series of volcanic records, we obtain from it a clearer view of the development and character- istics of the older Palaeozoic volcanoes. Of the two sections into which it is divided the Lower is pre-eminently replete with volcanic intercalations which are widely distributed over the area of the British Isles on certain definite strati- graphical platforms. The eruptions appear to have come from many separate vents often placed far apart over the sea-floor. Some of these vents, more particularly in North Wales, were already in activity during the Cambrian period. But in Silurian time a much more vigorous display of volcanic energy took place. Each of the three great divisions of the Lower Silurian period was marked by outbursts of lava and ashes. In each volcanic district during the long intervals of quiescence that separated the several periods of subterranean activity, the ordinary sedi- mentation of the time went on undisturbed, and enclosed and preserved the remains of the organisms that lived on the sea-bottoms. The stupendous piles of material erupted in those ages now form some of the most picturesque mountainous regions in the country. In North AVales they constitute in whole or in great part Snowdon, Moel Siabod, Moel Wyn, the Arans, and Arenig Fawr,

and they are prolonged southwards in Cader Idris. Again they form the material out of which the hills and valleys of part of the Lake District

have been carved. Even where they rise into no conspicuous eminences they may be detected in so many places all over the southern uplands of Scotland as to show that they under- lie the Silurian formations of that region as a great vol- canic floor which, though for the most part concealed, has been brought up to the surface again and again on the crests of anticlinal folds. They reappear in the south- east and south of Ireland, and though it is now ascertained that much of the material which in that region has been considered to be tuff proves to be crushed igneous rocks simulating a pyroclastic structure, and that much of the " felstone " mapped as intercalated lava really occurs as intrusive sills, evidence enough remains that active vents rose over the sea-floor during older Palaeozoic time in that part of Ireland. Far to the west, in the same long section of geological history, a group of submarine volcanoes rose in what is now the hilly district between Lough Mask and Killary Harbour.

But while it is clear that volcanic action was wide- spread over the area of the British Isles in the older half of the Silurian period, there is no less certainty that the volcanic centres often stood far apart from each other, were quite independent in their activity, and were not all, even in a geological sense, contemporaneous. The three great subdivisions of the Lower Silurian rocks ??? Arenig, Llandeilo, and Bala ??? which must represent a vast succession of ages, have each their volcanic .chroni- cles. We thus learn that the eruptive energy shifted from one part of the region to another ; that there were long intervals of quiescence in each district, and that before the close of the period in which the Lower Silu- rian rocks were deposited the whole series of volcanic foci had become extinct. The volcanoes that were active during the oldest or Arenig eruptions have left their memorials in the ranges of Cader Idris, Aran Mowddwy, Arenig, and Moel Wyn. These thick ranges of rock comprise trachytic or andesitic lavas and tuffs, together with sills of dolerite, felsite, and microgranite. It has been noticed that the upper parts of the series are more acid in composition than the lower ??? a chemical and petrographical sequence that reappears again and again all through the geological record in Great Britain. The site of another Arenig volcano is indicated by the ande- sitic tuffs and lavas that rise to the surface in Shropshire between Church Stoke and Pontesbury. To the same geological period we must assign the oldest visible parts of the

volcanic platform which has been above alluded to as underlying the Silurian formations of the south of Scotland. This platform appears to extend over an area of nearly 2000 square miles. Whether the volcanic sheet is continuous underneath over this wide tract or is separated into distinct districts marking local centres of eruption will probably never be ascertained. It is interesting to note that while in Scotland the volcanic activity of Arenig times was prolonged in successive eruptions through the Llandeiloand Bala periods, the great volcano of Merioneth- shire became entirely extinct, and a long interval elapsed in that region when, so far as we know, volcanic action continued quiescent. The Llandeilo rocks of ^^'ales con- tain no remains of any great volcano, but they are not entirely destitute of contemporaneous volcanic records, for numerous small isolated patches of lava and tuff can be traced at wide intervals down the east side of the prin- cipality and across to the coast of Pembrokeshire. Of these the most important is that of Builth ; others make their appearance near St Lawrence, around Fishguard and on Abereiddy Bay. But no trace of Llandeilo eruptions has been detected among the volcanic records of North "Wales.

The long interval of rest that elapsed after the erup- tions of Arenig, the Arans, and Cader Idris, during which Llandeilo volcanoes were active in the southern half of the principality, while no volcanic activity showed itself in the northern half, was at last brought to a close in the north by a renewed and vigorous outburst over the site of Carnarvonshire during the Bala period. To this revival of subterranean energy we owe the mass of Snowdon and the picturesque mountain-groups around it. For a distance of at least 30 miles from south to north the lavas and ashes of this centre of eruption may be traced. Yet there can be no doubt that only a portion of these is now exposed at the surface, and that much of their original mass has been removed by denudation or lies concealed beneath the younger rocks that now form the surface. The mass of ejected material is probably not less than from 6000 to 8000 feet thick ; in Snowdon alone the higher part of it amounts to 3100 feet. The lavas and tuffs are thickest around

the probable centres of discharge, and are intercalated among the ordinary sediment of the Silurian sea-bottom, in such a manner as to demonstrate that they were erupted during the time when the Bala group of rocks was deposited in the form of sand, mud, and calcareous silt. The lavas are chiefly varieties of felsite or rhyolite, with some andesites towards the top. The tuffs largely developed on Snowdon are sometimes fine-grained well-stratified rocks, more or less mingled with ordinary sediment. They contain the fossils of the Bala group, and indeed occasionally become calcareous and pass into the Bala limestone, which is so marked a palaeontological horizon in the Lower Silurian series of North Wales. In other cases the fragmentary materials consist of very coarse agglomerates, including large blocks of felsite and andesite. Some of the vents from which these various lavas, tuffs, and agglomerates were erupted are probably represented by a series of bosses which rise at intervals from Penpiaenmawr into the peninsula of Lleyn ??? a distance of about 60 miles. The latest manifestation of volcanic energy in the dis- trict appears to have been the intrusion of a large number of basic sills both into the sedimentary strata and into the overlying volcanic pile. In a geological sense con- temporaneously with the eruptions of Carnarvonshire, one or more vents were active farther to the east, on the site of the present Berwyn Hills ; others made their appearance where Anglesey now stands. The Lake Dis- trict, during the same period of geological history, became a centre of remarkable volcanic energy. Over an area of not less than 650 square miles the lavas and tuffs can still be traced there, and they probably extended origin- ally far beyond their present visible limits. They were piled over each other to a depth of perhaps as much as 8000 or 9000 feet, and remain as the chronicle of the most prolonged and most continuous display of volcanic energy among the Palaeozoic rocks of Great Britain. The earliest eruptions began in the Arenig period, and they followed each other so uninterruptedly that no marked interval of quiescence separated any of them, at least such as would be indicated by a thick gronp of inter- calated sediments. By one discharge after another, lavas and ashes were heaped upon the sea-bottom until the close of the Bala period.

In southern Scotland and in south-eastern Ireland active vents were scattered over the sea-floor and con- tinued their eruptions until towards

the close of the same period of geological history. But after that time a com- plete quiescence ensued, and continued for a long inter- val. It is a remarkable fact that over England, Wales, southern Scotland, and south-eastern Ireland, where vol- canic action had been so vigorous and prolonged during the Lower Silurian period, no trace has been found of any

eruption during Upper Silurian time, except certain igneous rocks at Tortworth in Gloucestershire which may now be regarded as dating from that later epoch. Another centre of volcanic eruption contemporaneous with the deposition of the Upper Silurian formations lies on the coast of the Dingle promontory in the extreme west of Ireland, where nodular felsites, tuff's, and volcanic breccias are intercalated among highly fossiliferous strata of Wenlock and Ludlow age.

The next great cycle of geological time ??? that of the Devonian and Old Eed Sandstone rocks ??? was marked by a renewal of volcanic energy, more especially over the site of Scotland. The Silurian sea had there given place to land, that enclosed a number of large lakes or inland seas, and it was in these basins that the volcanoes par- ticularly displayed their activity. The largest sheet of water, to which the name of Lake Caledonia has for the sake of distinction been given, seems to have stretched across the midland valley of Scotland between the high- lands and the southern uplands, and to have extended at least as far as Lough Erne in the north of Ireland. In this long and wide trough two lines of volcanoes lay towards the northern margin, where the Ochil and Sidlaw Hills now rise. These vents poured out sheets of ande- sitic and felsitio lavas which, together with abundant showers of ashes and stones, accumulated upon and among the red sandstones and coarse conglomerates that formed the ordinary sediments of the lake. The thick- ness of volcanic material thus discharged amounts in the Ochil chain to more than 6600 feet, but as the bottom of the whole pile is concealed, the total depth may far exceed that amount. The direction of this line of vents coincided with the trend of the long axis of the lake, that is, from north-east to south-west. In the same general direction, at a distance of perhaps 20 miles to the south, another volcanic bank ran from the neighbourhood of Edinburgh south-westwards through the group of the Pentland and

Biggar Hills, by the head of Nithsdale, into the south of Ayrshire. These two chains of eruptive vents are probably prolonged far to the south-west. Traces of the northern series may be observed in the Isle of Arran and at the south end of Kintyre. Beyond the limits of Scotland some of the breccias are well devel- oped on the Irish coast at the Red Bay, Antrim, while still farther to the south-west, between Dungannon and Omagh, numerous sheets of andesitic lava are interstrati- fied among the red sandstones. iNor were the volcanic eruptions confined to this largest of the Lower Old Bed Sandstone basins. They occurred on a considerable scale in the tract of Lome, in the west of Argyllshire. Small scattered vents were opened on the south side of the Moray Eirth, iu the Orkney Isles, and still more conspic- uously among the Shetlands. Possibly while some of these northern volcanoes were active, another group made its appearance in the south of Devonshire, where its lavas and tuffs can be traced in a tolerably continuous belt from Torbay into Cornwall. Long before the time of the Upper Old Eed Sandstone vigorous volcanic activ- ity had ceased over Great Britain. There appears to have been another long interval of quiescence during the deposition of the uppermost subdivision of the Old Eed Sandstone, only broken, so far as we know, by the appearance of a group of small volcanic cones not far to the south of Limerick, and of another in the island of Hoy among the Orkneys.

The Carboniferous period witnessed another revival of volcanic energy and a considerable m edification of the forms in which this energy manifested itself. The volcanoes now belonged to two distinct types, that of plateaux and that of piiys. In the former the lavas and tuffs were discharged over wide areas, generally from small vents or

fissures, and were gradually built up into masses sev- eral hundred feet thick. This type was the older of the two. It made its ai^pearance at, or perhaps even before, the close of the Upper Old Eed Sandstone period; but ceased before the Carboniferous Limestone began to be laid down. The second type showed itself in the appearance of small vents from which sometimes only ashes, and, even in the most vigorous examples,

comparatively limited streams of lava were emitted. The pipes or funnels of these volcanoes are now marked by plugs of tuff or basalt, and are generally the most conspicuous and sometimes the only visible record of the volcanic action that produced them. Both volcanic types are developed almost entirely in the south of Scot- land. The plateaux extend from Stirling, through the Campsie, Dumbartonshire, and Eenfrewshire hills, to the heart of Ayrshire and the borders of Lanarkshire. They form the Garleton hills in Haddingtonshire, and they stretch in an interrupted band from the Merse of Ber- wickshire across the hilly country of the Slitrig and Liddesdale to the southern coast of Kirkcudbrightshire and into the English border. The puys are the more usual and more widespread type of Carboniferous volca- noes. Their chief development is to be found in the Lothians and Fife, where they are so abundant, well-preserved, and clearly exposed that this district may be regarded as classic ground for their study. The puy type is seen among the toadstones of Derbyshire and far to the south in the few scattered vents of West Somerset. It is also exemplified in Ireland by the neck of Croghan Hill, King's County, and by the remarkably interesting volcanic district of Limerick. Carboniferous eruptions began earliest and lasted longest in Scotland. They were feebler than those of the Old Eed Sandstone, as these in turn were less voluminous and widespread than those of older Palaeozoic time. They displayed as large a range of petrographical composition among their materials as those of previous ages, for they included such highly basic rocks as picrite, together with basalts and dolerites, andesites, trachytes, and phonolites, and even more acid rocks containing free quartz. They became extinct in England and Ireland long before the end of the deposi- tion of the Carboniferous Limestone ; in Scotland they likewise ceased generally within the same period, but in Ayrshire they prolonged a diminished activity until the Coal Measures began to accumulate.

The continued enfeeblement of volcanic energy over the area of the British Isles is strikingly displayed by the next group of small scattered vents and occasional sheets of lavas and tuffs, which are probably referable to the Permian period. These remains are almost wholly con- fined to the south of Scotland. In Ayrshire, where they are best developed, a number of "necks" of tuff and agglomerate rise through the Coal

Measures. Erom these, and no doubt other buried vents a thin series of basic lavas and tuffs has been ejected, which overlies the Coal Measures and passes under a group of massive brick-red sandstones which are believed to represent the Permian sandstones of the north of England. Again in Nithsdale small patches of similar volcanic rocks are found inter- calated in the prolongation of the same red sandstones. But for the most part, only the necks of the little volca- noes have been preserved, all trace of any material which may have been thrown out from them having been re- moved by denudation. In the east of Eife, within an area of about 70 square miles, upwards of eighty distinct vents have been counted. In a space of only about one square mile, near St Andrews, some two dozen separate " necks " have been detected, each marking the site of a volcanic orifice. It cannot be affirmed with certainty that all these vents belong to the Permian period, but

some of them which pierce the very uppermost subdivi- sion of the Coal Measures must be later than that group of strata, and may thus be considered as not older than Permian time. If some of the series be so late, there seems a probability that others, perhaps the whole, hav- ing the same general characters and mode of occurrence in the district, may be of similar age. The only other volcanic series that may be referable to the same part of the geological record lies in Devonshire near Exeter and Crediton. Lavas of basic and intermediate character are there intercalated among the presumably Permian red sandstones and breccias.

In our review of the volcanic history of Great Britain we have now arrived at one of its most important stages. The decay of energy traceable among the later Palaeozoic periods becomes strikingly manifest in the scattered little vents of southern Scotland and Devonshire just referred to, which were, so far as yet known, the last Palaeozoic manifestations of the underground fires. Throughout the whole of the Mesozoic rocks not a single trace of any contemporaneous eruption has been met with. And yet these rocks are admirably exposed over hundreds of square miles of inland country and for many miles of coast- sections. Had they contained any record of volcanic eruptions we may conclude that it would ere now have been detected. But this remarkable quiescence of Meso- zoic time was not confined to Great Britain ; we find that throughout the continent

of Europe, with some trifling exceptions, there is a similar absence of any relic of contemporaneous volcanic disturbance. The gradual en- feeblement of energy in the Palaeozoic periods was fol- lowed by a vast interval, in the voluminous sedimentary records of which no trace of volcanic action has for the most part been found.

After this momentous pause, the pent-up internal energy once more broke out with renewed vigour and on a scale not inferior to any of its earlier displays. Over the north of England, the southern half and west coast of Scotland, and the north of Ireland ??? a total area of more than 40,000 square miles, and therefore larger than either Ireland or Scotland ??? the solid crust of the earth was rent by thousands of fissures, having a general parallelism of direction from south-east to north-west. Up these in- numerable dislocations molten rock rose from below, and solidified there in a great system of dykes, for which the British Isles have long been celebrated. So far as the geological record enables us to pronounce an opinion, nothing of the kind on so colossal a scale had taken place in any period in the history of the country since the wonderful dyke-intrusions in the Lewisian gneiss. From the independence of geological structure which the dykes maintain, they are evidently of comparatively late date. They cross indifferently all the various formations up to the Chalk and the volcanic plateaux which, on the strength of imbedded vegetable remains, have been pronounced to be older Tertiary, that is, about the age of the London Clay and other associated deposits in the south of England. When we consider the wide area over which these dykes extend, and reflect that they indicate a connexion with one or more subterranean reservoirs of molten materials which at some unknown, but probably not very great, depth beneath the surface extended over a tract of the terrestrial crust about 40,000 square miles in extent, we may surmise that this upwelling lava would hardly every- where stop short of the surface, but would not improbably break forth here and there, so as to give rise to the ordinary phenomena of volcanic eruptions. In actual fact we see that such outbreaks have taken place on a vast scale in the north of Antrim and along the west coast of Scotland. If any superficial dischai-ges occurred in the south of Scotland or the north of England, all trace of them has

been removed by denudation. Late though the eruptions were in geological history, the time -which separates them from the present day is so vast as to have allowed a stupendous waste of the surface, so that only a series of fragments of this youngest chapter of the volcanic chronicle has come down to us.

The great basalt plateaux of Antrim, Mull, Morven, and Skye consist of successive sheets of basaltic lava with occasional layers of tuff and seams of sediment containing remains of an older Tertiary terrestrial flora. These volcanic piles must originally nave attained a great thick- ness. Their surface has been enormously wasted and lowered, yet even now they are more than 3000 feet thick in Mull. They must have been poured forth like the lava-floods of Iceland and the Snake river, stretching out as a level plain of black basalt and scoriae over areas of many hundred square miles. Vast numbers of sills were injected among the strata beneath the volcanic pile, and likewise between the successive sheets of the pile itself. Huge sills or bosses of gabbro that disrupted the level lavas of the plateaux are now visible in the picturesque mountain-groups of the Cuillin hills, the Isle of Rum, Ben Buy in Mull, and the promontory of Ardnamurchan. Subsequently still more extensive intrusions of granitoid material broke into the basalt and into the gabbro, further disturbing the regularity of the plateaux. And lastly renewed dislocation of the crust and Assuring of all the Tertiary volcanic series led to the uprise of a new series of basaltic dykes. These latest manifestations of subter- ranean energy formed the concluding phase of the Tertiary eruptions, and they close the long record of the volcanic history of Britain. Since their time denudation has been unceasingly at work ; the Tertiary plateaux, with their various invasions of eruptive material, have been dissected in countless valleys and ravines and on long ranges of sea- cliffs, and their structure has thus been revealed with a fulness of detail such as none of the earlier records pre- sents for the consideration of the geologist. It may be remarked, in passing, that the lessons in the history of denudation derivable from the study of these Tertiary volcanic rocks are not less

interesting nor less important than those which relate to vulcanism. Thus, there can be no doubt that the present topography of Scot- land has been mainly carved out by subaerial action since the Tertiary eruptions. It can be demonstrated, for example, that wide and deep glens, such as that in which Loch Lomond lies, and long and deep searlochs and straits like the fjords of Skye and the Sound of Mull, have all been gradually excavated since that time.

From the study of so remarkably varied and complete a chronicle as is found in Great Britain some conclusions of interest may be drawn regarding the history conciu- q►► vulcanism during the geological past. It is ihfhSory evident from the distribution of the British otvaican- volcanic rocks that they have been erupted ''"►►► along the continental border, mostly over the*

sea-bottom and in a general north and south direction. One of the most impressive features of these rocks is their reappearance on different platforms during suc- cessive geological periods, and the persistence of volcanic energy which they thus prove to have been maintained in the British area during so vast a section of geological time. An attentive consideration of the distribution of these rocks furnishes ample proof that, in a number of instances, the same district became, at widely- separated intervals, the theatre of eruptions, while other tracts remained entirely and persistently free from any such manifestations of subterranean activity. The plateau- eruptions were connected with abundant fissures, repre- sented now by multitudes of dykes. On the other hand.

the ordinary volcanic vents, from the earliest times to the latest, do not furnish any evidence of having had their sites determined by important lines of fault or other dominant geological structure. But they do show a frequent preference for lines of hollow rather than hills and ridges. They made their appearance in areas that were subsiding, and the majority of them were submarine. Alike in the nature and composition of the erupted materials, and in the form in which the volcanic activity showed itself, the volcanoes of the geological past have their counterparts in those of recent time. There has been, indeed, a singularly persistent uniformity in the

main characters of vulcanism throughout geological his- tory. The Vesuvian and Icelandic types of volcano can be recognized even among those of the Palaeozoic ages.

Another important fact in the history of vulcanism is clearly deducible from the geological records of Britain. There has been no gradual and progressive diminution in the intensity of the volcanic forces during past time, such as some physicists have asserted to have occurred as a necessary consequence of the slow cooling of the planet and its resultant loss of energy. If we take a broad view of the volcanic chronicle of Palaeozoic time, we find evidence of many successive periods of eruptive activity, differing from one another in vigour and duration, and each showing a time of maximum energy, followed by a time of diminution, and then by a time of absolute quiescence. It is true that the later eruptions of the Palaeozoic ages showed a marked diminution in number and area, as well as in the variety and amount of the igneous material ejected. It is likewise true that this obvious dying out of the subterranean forces was followed by the long and profound calm of Mesozoic time. Never- theless it is no less certain that when these forces reawakened in the older Tertiary ages, they showed them- selves on at least as vast a scale as ever, ranged over a wider region, and poured out more voluminous floods of lava.

Denudation has so extensively laid open the igneous rocks of former ages that innumerable points in the detailed structure of volcanic vents, fissures, and plateaux can be studied to which no access is possible in modern volcanoes. The whole history of a volcano or volcanic epoch, from its beginning to its end, is disclosed. We see that many vents were opened by gaseous explo- sions, without the aid of any concomitant or pre-existing fissure. We can trace the actual walls of a vent, and mark how the materials have been piled up within them. We can follow the effects of the volcanic heat upon the surrounding rocks, and of the uprise of heated vapours through the materials that choked up the orifice. And we discover how important a part in the subterranean operations of volcanoes is taken by the intrusion of sheets of molten material among the sur- rounding rocks.

One of the most interesting results of a study of the vol- canic rocks of Great Britain is the proof thereby obtained of the gradual change in the condition of the molten magma during the course of a continuous volcanic episode. The evidence shows that the reservoirs which supplied the lavas usually began with the emission of material basic or intermediate in composition, which became finally more acid, and even gave forth such rocks as granite and felsite. Moreover, this sequence from basic to acid was repeated in successive geological periods sometimes even in the same region. It thus appears that the magma beneath a volcanic centre, after it has become acid, and after the volcanic activity has ceased, eventually, during the pro- longed interval of quiescence, acquires once more a basic character, and goes through a similar gradual change of composition in the next volcanic cycle.

While the British records of ancient volcanic activity are more complete, and have been more fully explored than those of other countries, the progress of investigation has brought to light many new facts of interest and im- portance in regard to ancient eruptions in regions which have long been unvisited by any such outbreaks. Thus in the north-west of Prance a remarkable succession of four principal periods of eruption has been discovered by Prof. Barrois, who records the existence there of volcanoes in Cambrian and Lower Silurian time, of others in the ages of the Middle and Upper Silurian rocks, of a third series in the Upper Devonian, and a fourth in the Carboniferous period. The Harz supplies volcanic rocks of Silurian, Devonian, Carboniferous, and Permian age. The volcanoes of this last-named period broke out also in Thuringia and Bohemia, and even as far as the shores of the Medi- terranean to the west of Cannes. In Tirol active vents existed in Triassic time. The period of volcanic calm which is so marked in the geological record of the British Isles during Mesozoic times appears to have extended over the site of continental Europe, though some rocks in Portugal may possibly mark Cretaceous eruptions, while others in the Crimea have been cited as of Jurassic age. But it was in Tertiary time that volcanic energy recovered its

ancient vigour over all the European area. The British examples already referred to were accompanied and followed by copious eruptions. During a long suc- cession of geological periods on the Continent, in central Prance, Ehineland, Saxony, Bohemia, Hungary, Wilrtem- berg, Italy, and other parts of Europe, innumerable vents were active from an early part of Tertiary time, and some may not have become extinct until shortly before the dawn of history.

Earthquakes (see also separate article). ??? Much in- formation has been gathered in recent years regarding the movements of the earth's crust. Those of the sudden and paroxysmal kind embraced under the general term earthquakes have been studied by means of self-recording instruments in countries which, like Japan, are specially subject to them ; while in other regions, where no such instruments are established, the phenomena have been subjected to a more exhaustive examination than was formerly attempted. We now know that what we call the "solid earth" is liable to continual vibrations and tremors which, though for the most part inappreciable by the ordinary senses, can be detected by delicate in- struments, and are sufficiently pronounced to have frus- trated observations to determine the lunar disturbance of gravity. Slight movements of this nature arise from changes of atmospheric pressure and temperature, and from movements in the soil caused by heavy rain and by frost. There are likewise slow and periodic changes of level within small limits. Some of these depend on daily, others on seasonal, conditions, such as temperature, moisture, and evaporation. It thus appears that the surface of the laud is in a perpetual state of strain from the influence of forces acting from without.

Though it cannot yet be said that the origin of earth- quakes is quite understood, some appreciable advance has been made towards the comprehension of this geological problem. There can be no doubt that any movement upon or within the earth, sufBciently violent to give a stroke or blow, and thereby generate an elastic wave or series of waves, will produce an earthquake. A sudden rock-fall or landslip from the side of the mountain, if of sufficient magnitude, may give rise to a widespread concussion of the ground. But the phenomena of true earthquakes arise from changes within the earth. In volcanic districts these precede or

accompany the violent explosions by which steam, gases, ashes, and lava are pro-

jected from the earth's interior into the atmosphere. In non-volcanic regions they may arise from the sudden collapse of underground cavities, such, for instance, as has been caused by the solvent action of percolating water. But in none of these instances do earthquakes reach their greatest intensity and widest range of disturbance. It has now been established that earthquakes are most frequent and most violent in regions where there are no active volcanoes. Hence it is reasonably inferred that, although volcanic explosions undoubtedly give rise to severe concussion of the ground, this eifect is compara- tively local, while the more potent earthquakes extend over vast areas of the globe. It has further been noted that earthquakes are specially prevalent in mountain regions, also in tracts that lie along one or more lines of fault, or on the critical line between the continental plateaux and the ocean basins. In all these tracts the crust of the earth is probably in a state of strain and of unstable equilibrium. It has there been bent by tangential pressure and rupture, and has consequently become weakened and ready to give way again under an accumulation of the same cause. For years or centuries no change may take place along one of these lines of weakness, but eventually the strain becomes irresistible, and the crust gives way in a sudden snap. In the case of the more powerful earthquakes, the bending and fracturing, instead of being confined to a mere point, like the focus of a volcano, may stretch for many leagues along the axis of a mountain chain, or along the submarine front of a continent. And thus the cause of the concussion of the ground may be propa- gated through the crust for hundreds of miles beyond the centre at which the beginning of the snap took place.

The phenomena of earthquakes are discussed in the article on this subject. We are concerned only with their immediate geological relations. Though the progress of observation has not materially increased our information regarding the nature of the geological changes brought about by earthquakes, many new and striking illustrations of these changes have been noted. Of the numerous additional examples which have been chronicled of the effects produced upon the soil and general

surface of a country, some of the most remarkable have been observed in Japan. Reference may be specially made to the severe earthquake which convulsed that country on 28th October 1891. By that visitation in 30 seconds 10,000 people were killed and twice that number were wounded ; 128,750 houses were levelled with the ground, besides numerous temples, factories, and other buildings ; railway bridges and viaducts were twisted and ruined, and hundreds of square miles of central Japan were laid waste. Green forest-covered mountains were denuded of their trees and turned into ridges of naked stone. Everywhere land- slips were produced, and the valleys were blocked up with the rubbish, so that lakes were formed by the interrupted drainage. But, besides these superficial and more or less transient effects, others were noted of a more deep-seated and more lasting kind. The surface of the ground under- went a horizontal compression, whereby valleys and river- beds had their sides brought nearer to each other, so that in the reconstruction of the ruined bridges the engineers had to allow for a diminution of from 1 to 3 per cent, in the length required. A rupture of the ground could be traced for 60 miles, showing in many places as a long low cliff. On one side of this dislocation the ground had sunk some I'O feet, and other evidence was obtained of an alteration of the relative levels of the country. These remarkable results confirm observations made in other earthquake countries. They show tlie paramount influence of the rupturing of the terrestrial crust, and they serve to indi-

cate that though no stupendous geological change may be made, even by the most violent earthquake, the repeated recurrence of such events may eventually entirely change the surface of a country.

Further light on the geological results of earthquakes has been obtained from a study of the effects of the great catastrophe which on 12th June 1897 devastated about 150,000 square miles in Assam and the adjacent parts of India, and of which the shock was felt over about 1,750,000 square miles of the earth's surface. A volu- minous report on this event, prepared by Mr R. D. Oldham for the Geological Survey of India, has

more especially added to our knowledge of the fissures in the ground which have so frequently been observed in great terrestrial disturbances. From the detailed narrative in this report, it appears that two distinct types of fissures could be recognized, one of a superficial, the other of a deep-seated origin. The ruptures of the first class probably start at the surface of the ground and descend to variable but, no doubt, shallow depths. They are probably produced by the wave-motion which is propagated outwards from the centre of shock, and are more especially developed in the alluvial plains, where their direction is often determined by that of a river-course, line of embankment, or roadway. The fissures of the second type arise from displacements within the terrestrial crust. They much less frequently appear at the surface, where they not merely affect the alluvial deposits, but even split through hills of crystaUine rock, and where they are accompanied by evidence of great violence of shock. They are regarded by Mr Oldham not as a result of the wave-motion, but as themselves a cause of that motion and as surface manifestations of the deeper-seated fracture of the crust to which the origination of the earthquake wave is to be ascribed. The tract of country within which this type of fissure was displayed extended in an east and west direction through the hills and plains of Assam for a maximum distance of perhaps 200 miles, with a maximum breadth of 50 miles. Along this belt, at a depth of not improbably less than five miles below the surface, a sudden rupture or overthrust of the terrestrial crust is believed to have taken place, accompanied by secondary thrust-planes and faults, some of which actually extended up to the surface of the ground.

Apart from great destruction of life and property, extensive prostration of forests, and other relatively evanescent though lamentable effects, this Indian earthquake of 1897 left many more lasting traces of its passage. The surface of the alluvial plains was thrown into undulations, and after the catastrophe did not return to its previous condition. Some portions remained permanently depressed, and now became receptacles for the interrupted drain- age, which thus gathered In pools and lakes over the sunk land. Moreover, there was a horizontal displacement or torsion amounting sometimes to as much as 10 or 15 feet. River banks were pushed nearer to each other, and the beds of the narrowed streams were ridged up until sometimes they were on a level with the banks on either

side. Vast numbers of landslips took place along the sides of the hills and river-courses, whereby the drainage was seriously affected. One of the most interesting observations contained in Mr Oldham's report has reference to the production of lakes along a river valley. One of the great lines of fault was traced for some 12 miles along the course of the Chedrang river. In some places its throw or vertical displacement amounted to as much as 35 feet, but elsewhere it diminished and disappeared. There was thus a differential movement whereby some portions of the river-bed were pushed up into the air, while other tracts of the valley were de- pressed below the level of the stream. The line of fault, which has an upthrow to the east, repeatedly crosses the river, which is consequently ponded back in a pool when the elevated side faces up stream, and tumbles over a waterfall when that side looks down stream. Wherever the line of fault could be traced in solid rock it was found to be a vertical fissure. A chain of pools and lakes has been formed along the valley. One of these sheets of water is fully half a mile long, between 300 and 400 yards broad, and 18 feet deep. Another of still larger dimensions occurs farther down the stream. Where the fault leaves the hills and runs out Into the plain, much more extensive alterations of the drainage have taken place, wide tracts of ground have been submerged, and the sites of fields and villages are now covered by lakes 12 feet or more in depth. Similar effects have been produced over wide tracts of alluvial country which have not been directly affected by the deep- seated fractures, but have been thrown into undulations and traversed by superficial fissures. Some of the lakes formed by the depression of the ground are upwards of 20 feet in depth.

Secular Upheaval and Depression. ??? It is now- recognized that the surface of the sea preserves no uni- formity in its distance from the centre of the earth, but is liable to wide divergences therefrom. The term " sea-level " is thus apt to be somewhat misleading. The sur- face of the ocean in the equatorial regions must be more

than thirteen miles farther from the centre than it is at the poles, so that any diminution in the rate of rotation would cause the ocean to sink at the equator and rise at the poles. The preponderance of water in the southern hemisphere appears to be due to an exces.s of heavy materials in the

lithosphere imder the Pacific Ocean, so that if any transference of such materials to the northern hemisphere were conceivably possible it would shift the level of the ocean. But these causes of difference in the distance of the surface of the sea from the earth's centre may be regarded as permanent. There are others, how- ever, of a less fixed kind which affect searlevel, and any modification of which may at any time give rise to changes in that level. The attraction of large masses of high land raises the surface of the neighbouring ocean. Thus the influence of the chain of the Himalaya causes that surface to be 300 feet farther from the planet's centre at the mouth of the Indus than it is 1200 miles away in Ceylon. Hence any movement of the crust whereby the bed of the sea is raised into land, and espe- cially into lofty land, will draw the ocean water towards the elevated region. The accumulation of masses of snow and ice, thousands of feet thick, at the pole will attract the oceanic water and lower the sea-level in other parts of the globe. The mere removal of so much snow and ice from the general body of water on the earth's surface must tend to lower the sea-level, so that fluctua- tions in the bulk of the polar ice-cap will be accompanied by corresponding variations in the general surface of the ocean. Any cause which may give rise to an excessive heaping up of ice at one pole, while the opposite pole is relieved of the ice-cap, will tend to shift the centre of gravity of the planet and to raise the level of the ocean where the frozen mat jrial accumulates. Again, in in- land seas considerable variations of the water may arise from meteorological conditions, especially from excessive rain or drought, as has been registered in, the Baltic and Gulf of Bothnia.

That some of these causes of alteration in the relative levels of sea and land are not without influence at present, and have come into play in the past history of the earth, may be freely conceded. We may grant that in various ways the sea may rise and fall even to the extent of hundreds of feet without any change in the position of the surface of the lithosphere. Obviously, it may often be hardly possible to distinguish the effects of such transferences of the oceanic water from those that have been produced by movements of the lithosphere itself. No fact is more abundantly demonstrable in geology than that the searfloor has again and again been ridged up, convoluted, fractured, and elevated not only into land, but into chains of lofty mountains. But besides the more violent

disturbances directly connected with mountain- making, others of a gentler kind appear to take place, not perhaps in any essential point differing from these, save in intensity and duration. These slower and more tranquil alterations of the relative levels of sea and land are some- times in an upward, sometimes in a downward, direction. They must be caused either by a rise or fall of the sea- level or by an upheaval or depression of the surface of the lithosphere. The opinion of geologists is divided as to which of these two causes should be invoked. During most of the 19th century the general belief was that on the whole it is the land rather than the sea that rises and falls. In recent yd^rs, however, this view has been com- bated by Prof. Suess of Vienna, who holds that the limits of the dry land depend upon certain large indeterminate oscillations of the statical figure of the oceanic envelope ; that not only are " raised beaches " to be thus explained, but that there are absolutely no vertical movements of the crust save such as may form part of the plication arising

from secular contraction, and that the doctrine of secular fluctuations in the level of the continents is merely a remnant of the old Elevation-crater theory, destined to speedy extinction.'

Of the fact that within recent times large tracts of land have emerged from the sea, vfhile other tracts have been submerged, there cannot be any question. If these changes arise solely from some alteration of the figure of the ocean, they can hardly be of merely local occurrence, nor can we suppose that they vary in amount within short distances, or change from an upward to a downward direction. Where any such local peculiarities make them- selves manifest we are constrained to regard them as arising from unequal movements of the land and not from an advance or retreat of the sea.

One of the classic regions for the study of this ques- tion is the Scandinavian peninsula, together with the basin of the Baltic and the coast-line of Finland. The earlier observations were hardly precise enough and continued over a suiHciently long time to warrant per- haps

the definite conclusions drawn from them. But since 1875 the investigation has been pursued with great care, and the result has been to afford good ground for the conclusion that, after every allowance has been made for seasonal variations of the sea-level in the Baltic and Gulf of Bothnia, there is trustworthy evi- dence of a gradual elevation of the Scandinavian penin- sula. ??? The axis of movement appears to coincide broadly with that of the peninsula, and to increase towards the interior of the land. In some places, both on the Kat- tegat and on the shores of the Gulf of Bothnia, the rate of rise is estimated at 25 centimetres or nearly 10 inches in a century ; but at Quarken, where the gulf narrows, the rise on the west sidi has been computed at 1 metre or 3 feet 3 inches during the last hundred years. On the coast of Finland the upward movement gradually diminishes and disappears in the Baltic provinces, and at St Petersburg no change of level has been detected."

Important observations have in recent years been made in the region of the Great Lakes of North America, which indicate that a slow elevation of the land is in progress towards the north-east, so that the water of the lakes is being driven towards the south-west. In the latter direc- tion the shores are undergoing submergence, while towards the opposite quarter they are gaining ground. The rate of movement is estimated to be four-tenths of a foot in a hundred miles during a century.'

Much interesting information on this subject has recently been gathered in Japan, where volcanoes, earth- quakes, and slower movements of the ground are devel- oped on so striking a scale. Though volcanic action is abundant and vigorous in that country, observation shows that the most powerful earthquakes are not connected with volcanic eruptions. They originate partly in tracts of old crystalline rocks, but mainly under the sea beyond the eastern coast-line of the islands. W.e have seen that they sometimes give rise to important changes of level in the land. But besides such sudden alterations others have been watched which, while they are in progress, are in themselves inappreciable, and can only be detected after the lapse of more or less time. They are partly of an elevatory and partly of a subsiding nature. In order to obtain more ample and more definite information in regard to these changes. Prof. D. Kikuchi, of the Imperial University of Japan, in the year 1891 issued a circular

1 Antlitz der Erde, Vienna, Band ii. (1888), cliaps. viii. ix. and x.

2 De Geer, Geol. Fiir. Stockholm. ForhandL, 1888, p. 195; R. Sieger, Zeitsoh. Gesellsch. Erdkunde, Berlin, xxviii. (18(i:!) ; E. Briiclciier, Verhand. Neunten Geographentages, Vienna (1891) ; W. Ramsay, Fennia,:sMi. (1898).

8 G. K. Gilbert, 18th Annual Report of the U.S. Geological Survey (1898), part ii. p. 601.

to officials at the principal towns and villages round the coast, requesting them to furnish any evidence they could collect of advance or retreat of the sea. Out of several thousand replies received, very few intimated that there had been no change. During fifty years, and even in some places within ten years, harbours had become shal- low at rates varying from 1 foot in three to 1 foot in ten years. Some of this change must no doubt be attributed to the abundant deposit of sediment brought down by rivers from the land. But no amount of silting up will explain the concomitant uprise of cliffs carrying with them their faces pierced by boring shells, their seaworn caves, and the sea-beaches deposited at their feet. Prof. Milne, who has personally examined the evidence, con- cludes that some portions of the east coast of Japan are, at the lowest estimate, emerging from the sea at the rate of about an inch per annum. Elsewhere the change has been of an opposite kind. Grass and rice fields have disappeared, and have been replaced by beaches of sand or shingle ; rocks have sunk, the height of the tide has increased, and the depth of the sea has augmented at rates varying from 1 foot in sixteen years to 1 foot in five years ; buildings and roads are now threatened, and the sea advances so rapidly that the inhabitants contem- plate removing inland. Maps constructed a century ago show that the sites of former dwelling-places are now beneath the sea. Some of these changes may be ac- counted for by ordinary marine erosion without any change of level either in the sea or on the land. But their general concurrence, taken together with the sub- marine prolongation of land-valleys, seems to show that certain portions of the Japanese coast are actually under- going submergence.*

It is impossible to suppose that within the compass of a limited district the level of the sea can be at the same time both falling and rising. Any simultaneous change of sea-level within such a district must be nearly uniform and in the same direction. The actual observed diver- gences in direction and in rate of change are only expli- cable on the supposition that it is the land which is undergoing distortion, whereby some portions of it are pushed upwards, while others subside. Thus the evidence of recent changes of level in Japan confirms the general belief which has been recently impugned.

A study of the raised beaches of Great Britain affords further support to the view that it is the land rather than the sea that has shifted its level. These evidences of old sea-margins are traceable along the south coast of England at various levels. But it is in Scotland that the former " strand-lines " are most abundantly and most clearly de- veloped. These lines sometimes consist of terraces of deposit, like the sand, gravel, and silt of the present shores, andare then properly described as "beaches." But in other places they are platforms of erosion, which have been cut along the edge of the land when the sea-margin stood at higher levels than it does now. They appear on both sides of the island, but are more especially marked on the west side from the Firth of Clyde to the coast of Eoss-shire, and on the east side in the estuaries of the Forth and Tay and along the shores of the group of northern firths between Inverness and Helmsdale. Where most fully developed, as near Tain, they are at least five in number, and follow each other in successive platforms at heights of about ir>, 25, 60, 76, and 100 feet. It is much to be desired that a careful topographical survey with accurate levellings were made of these terraces on both sides of the country, with the view of determining their variations in level. So far as present information goes, they do not preserve strict uniformity, and their local

- *Professor J. Milne, Seismology, p. 2, London, 1898.*

differences appear to be too great for any variation of sea^ level, and to require irregularities in the uprise of the land. One of the most remarkable peculiarities in their distri- bution is the fact that, although so well developed, up almost to the extreme north of the mainland of Scotland, they cease beyond that point. On the Orkney and Shet- land Islands they have not been detected, although numerous sheltered inlets would have preserved them there had they ever been formed. The "submerged forests " of western Europe, quoted to prove sinking of land, have probably been mostly caused by mere local slipping of peat attacked and overspread by the sea.

One of the proofs formerly relied on in favour of wide- spread sinking of the lithosphere was the structure and

distribution of coral islands. Darwin's striking Evidence hypothesis to account for these oceanic points of reefe. land captifvated the imagination, while at the

same time his explanation of the successive stages by which fringing reefs became barrier reefs, and barrier reefs became atolls, appeared so clear and con- vincing that the conclusion he drew was not only uni- versally accepted, but was regarded as one of the most signal achievements in science ever accomplished by any geographical expedition. It was received as an estab- lished truth in geology that the rings of coral, so widely distributed over the Pacific and Indian Oceans, proved a vast subsidence of the floor of these sea-basins and the gradual submergence of wide tracts of land which once rose on their site. But the progress of investigation has shown that though Darwin's explanation may still hold good in some cases, it cannot be regarded as of universal application, and that more especially it can no longer be held to prove that widespread subsidence which was claimed for it. As far back as the year 1868 C. Semper met with some reefs among the Pelew Islands which he could not explain by Darwin's hypothesis of general sub- sidence, for only 60 miles away from them he found upraised coral reefs and an island entirely without reefs. He therefore concluded that these atolls had grown up upon an area of sear-floor that was rising rather than sink- ing.^ A few years later J. J. Eein brought forward the coral reefs of Bermuda as

examples that could be ex- plained by the accumulation of calcareous organisms upon the bottom, without necessarily requiring subsidence.^ Subsequently the subject was more fully investigated by Mr (afterwards Sir John) Murray, one of the naturalists attached to the GJiallenger expedition. From all that he .had seen of coral reefs he was led to infer that they may arise without any assistance from a sinking of the sear bottom. It appeared to him that they might grow out- wards from the land upon the top of a steep slope of their own debris, broken off by the waves. He thought that this growth might continue seawards until the steep face of calcareous material had advanced into deep water, and thus that while the whole of it might be supposed to be actually coral that had grown upwards from the bottom, only the uppermost 20 fathoms or thereabouts might be coral rock still in situ, all below that upper layer being calcareous debris on which the living corals had built. He pointed out the obvious con- nexion between the distribution of coral reefs and that of volcanoes in the Pacific basin, and showed that the atolls appeared always to have been planted on the tops of submerged volcanic peaks. To the obvious objection that it was difficult to conceive the possibility of so vast a number of volcanic cones coming just up to the level at which coral-building polyps could begin their operations

^ C. Semper, Zeitsch. Wissen. Zool. xiii. p. 558 ; Verhandl. Phys. Med. Gesellsch., Wiirzburg, February 1868; Vie Phillippen und ihre Bewohner, 1869, p. 100.

^Setickenb. Naturforsch. Gesellsch., Wiirzburg, 1869-70, p. 157.

he replied that those which lay too deep might be brought up to the proper level by the gradual deposit of the remains of the organisms that abound in these waters, while those which rose too high might be cut down by the waves to the depth at which the reef-builders could commence.' These views have been further developed by Professor Alexander Agassiz, who has applied them in elucidation of the history of the Florida reefs and those of the West Indian Islands, Hawaii, Fiji, and Australia. He has brought forward abundant evidence, additional to that originally furnished by Semper, that fringing reefs, barrier reefs, and atolls co-exist in the same region, and that no general subsidence can possibly explain*

their association. He has shown that the whole group of the Fiji Islands has been upraised to a height of more than 1000 feet, and he claims that the east coast of Australia, so famous for its great barrier reef, has risen as much as 2600 feet. Dr Guppy has supplied important evidence from the Solomon Islands, where he has found that fringing reefs, barrier reefs, and atolls have been formed in a region that is undergoing upheaval, and that the elevation has amounted to 900 feet or more.

With the view of obtaining accurate information as to the thick- ness of a living coral reef and the nature of its foundations, a committee of the Royal Society was appointed in 1896 to investi- gate the structure of the atoll of Funafuti, one of the group of the Ellice Islands. Professor Sollas, on whose initiative the research was started, was appointed to take charge of it, and he spent some time on the island. Though he made many interesting observa- tions and brought away much valuable material to be worked out in regard to the composition and history of coral reefs, the boring came to a stop before any decisive results had been obtained. Subsequently the investigation was resumed by Professor Edge- worth David, of Sydney, New South Wales, under the auspices of the same committee. The boring was begun again, and continued to a depth of more than 1000 feet without meeting with any other than calcareous and dolomitic material. For a discussion of the results see under Anthozoa ; but suiBcient evidence has now been accumulated to show that coral atolls do not necessarily prove subsidence, and that they can no longer be brought forward as in themselves a demonstration of widespread submergence over the basins of the oceans. '

4. Steuctukal Geologt.

In this division of the science, treating of the arrange- ment of the rocks in the crust of the earth, the chief pro- gress made has been in the department that deals with the curvatures and dislocations which rocks have undergone since their formation. Though such changes of position may almost everywhere be detected, it is in mountain chains that they are most impressively developed and can be most profitably studied. Accordingly the Alps have long been classic ground for the investigation of these problems of geology. Even to the uninstructed traveller the proofs

of gigantic movements are so ~ manifest that he cannot miss them. No one, for instance, can sail up the Lake of the Four Cantons without marvelling at the way in which sheets of solid gray limestone, hundreds of feet in thickness, have been tossed and folded, as if they had been mere piles of carpet, showing their crumpled layers from the level of the water up to the crests of the moun- tains on either side. But when the geologist begins to explore this corrugated structure, he finds it infinitely more complicated than could ever have been anticipated. The oldest rocks have been placed above the youngest, and now cap the summits, while the later formations have been often plunged deep under the valleys. Fortunately the order of succession of the different members of the Alpine stratigraphical series can be satisfactorily deter-

8 J. Murray, Proc. Boy. Soc. Bdin. x, p. 505, xvii. p. 79; Narrative of the Cruise of the " Challenger," vols. i. ii.

^Amer. Acad. xi. p. 107; Bull. Mus. Comp. Zool. Harvard, xvii. No. 3, xxvi. Nos. 1 and 2, xxxiii. (1899, giving his researches in Fiji) ; Three Cruises of the " Blake," Boston, 1888.

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mined, from experience in other lauds which have escaped such intense disturbance. Partly by the evidence of fos- sils, and partly by that of lithological characters, the actual position of the several rocks and groups of rock can be fixed with considerable accuracy. It was indeed only after this knowledge had been laboriously acquired that geologists began to realize how vastly more complex the structure of the Alps is than could otherwise have been suspected.

At the beginning of the 19th century Leopold von Buch and Conrad Escher von der Linth attempted to grapple with the difficulties of Alpine structure. After them Bernhard Studer, Arnold Escher von der Linth, Murchi- son, and Sedgwick attacked the same problems and threw much

light upon them. Studer's life-long devotion to Swiss geology did much to advance our knowledge of mountain-architecture. Arnold Escher carried on with brilliance and success the labours bequeathed to him by his father, and he imbued with his own enthusiasm his pupils Heim, Baltzer, and Mosch. These younger enthu- siasts have thrown themselves with ardour into the study of the questions left to them by their predecessors. Heim has especially gained distinction by his minute and laborious investigations of the Glarnisch, Todi, Windgallen, and other mountain groups, by his un- rivalled drawings of the complicated intricacies of struc- ture in these groups, and by the ample discussion of that structure in his beautifully illustrated volumes published in 1878, Mechanismus der Oebirgshildung. This was by far the most important treatise that had yet appeared on the subject, and marks a great advance in the treat- ment of the problems of mountain-building. Fastening on the evidence of intense plication, Heim followed it up not only into the architecture of great mountain- masses, but downwards step by step in unbroken sequence, till he traced it into such minute details as can be appreciated in hand-specimens. He brought for- ward abundant proofs that the rocks of the Alps had undergone enormous pressure, in virtue of which they had been folded, compressed, and crushed, and had been reduced to a kind of plastic condition. He believed that the Mesozoic strata of the Alps had been thrown over in folds extending with gentle inclinations for many miles across the mountains, the so-called "double fold" of the Glarner Alps being the most conspicuous example. But he found no prominent place in his sections for dis- locations, as important parts of the structure of the ground. It was not difficult to admit that in the deeper portions of the disturbed area of the terrestrial crust, under the vast pressure there existing, movements of the rocks might conceivably take place without faults, by an internal disruption or plasticity. But in the higher parts, where the pressure was greatly diminished, it might be expected that displacement by faulting of some kind would come into play.

That within some indeterminate limits the causes in- voked by Heim were adequate to produce the effects ascribed by him to them, could not be doubted, liut it was difficult to follow him when he applied his exjjlana- tion to account for the disappearance of thick formations by mere plasticity. Thus, in the mountain-group culmi- nating in the Hausstock,

between the valley of the Ijinth and that of the Vorder Rhein, the Jurassic formations are represented by him as thrown into the immense "double fold" just alluded to, the two loops of which are supposed nearly to meet somewhere above the crest of the Hausstock. In the upper limb of the western fold these formations are some hundreds of feet in thick- ness, as shown on the eastern slopes of the Gliirnisch. But only a short way below, on the side of the Linth, they are reduced to a few inches. It was not easy to

see on what evidence such vast overfolding had been postulated, nor how, within a few hundred yards, a group of massive limestones could be rolled out to nearly the vanishing-point. Thus, while fully admitting the last- ing value of Professor Helm's contribution to the un- ravelling of the architectural details of the mountains, geologists who had specially studied the subject could not but hesitate to accept all his deductions, and felt that there might still be some important feature in the structure that had been missed.

In pai-ticular the absence of dislocations in Professor Heim's sections of a region so prodigiously disturbed could not but attract attention. He was well aware that power- ful lines of dislocation had been described by different geologists as existing in the Alps. Studer, for instance, had long before pointed out that along the line of the Lake of Thun there must be a dislocation across the strike, with a horizontal displacement of nearly two miles. Suess had remarked a series of north and south horizontal disloca^ tions in the Alps, by which the eastern side was some- times driven towards the north. Schafha,utl had noticed similar structures among the Bavarian Alps. But though Heim treated skilfully some of the relations between fold- ing and faulting, showing in particular how the rupture of a closely pressed fold might give rise to a reversed fault, it was chiefly on the minute scale that he dealt with these phenomena, as they are developed in the " ausweichungsclivage " of schistose rocks. Of greater ruptures in the Alpine region he remarks : " I may observe in passing that in contrast with the plications, large over- thrust faults are not to be assumed without good reason to exist here and there in the Alps. What we directly see in the Alps are numberless plications which pass into cracks and faults, but true faults affecting the structure of a great mountain

chain are but seldom to be seen ; they appear to occur with extreme rarity in the Alps.” ^

The true reading of the complex structure of the Alps, however, seemed to require that dislocation as well as plication should be recognized as having contributed to the present arrangement of the rocks. The extreme plas- ticity required by Heim appeared to be hardly possible among hard sedimentary strata, lying under no greater pressure than that of the comparatively small depth of younger strata that covered them. It was conceivable that deep down beneath the Alps, where solid rocks had undergone enormous stresses under a great overlying thickness of the terrestrial crust, they would be crushed, and their component particles might be made to move over each other, possibly with an infinity of minute rup- tures, but without any great dislocation. Yet in this mountain chain, where Tertiary strata had been involved in the plication, it could not be supposed that these strata could ever have been buried under more than, at the most, a few hundred or even thousand feet of younger sediments. It was therefore to be expected that at least the uppermost formations, while being driven together, would be not only plicated but disrupted, and that some portions of them would be found to have been pushed horizontally over other portions.

It had, however, become a settled belief among geolo- gists that in the northern Alps dislocations were either entirely non-existent, or at least possessed no tectonic im- portance. They were ignored on the published geological maps of that region ; and in Heim’s beautifully artistic sections and drawings, while full justice is done teethe wonderful plications of the region he discusses, faults are conspicuously absent. The fiVst definite and systematic step in the. inquiry how far dislocation as well as folding entered into the structure of the Swiss Alps was taken by

^ Mechanismus, Baud ii. p. 14.

Dr A. Eothpletz, who, after studying tlie structure of the Oberland and other parts of Switzerland, announced in 1881 to the Helvetian Society of Natural Science that he had been led to conclude that faults take a much more important place in the geological structure of that region than had up till then been supposed. He instanced three large dislocations which he said he had himself traced in the Oberland, and which, with many others observed by him elsewhere, had convinced him that the striking proofs of great plication had misled observers into the belief that dislocations were either entirely absent in the northern Alps, or at least were of no consequence in the general structure.^ With great energy and perseverance he de- voted himself to the further prosecution of an inquiry into the existence and effects of faults in mountain- structure, and traversed a large part of Switzerland in the research. Among the districts specially examined by him was that between the Eeuss and Ehine, including the tract where the " double-fold " of the Glarner Alps was stated to occur. In the year 1883 he communicated to the German Geological Society a remarkable paper on the framework of the Swiss mountains lying on each side of the Ehine.^ He therein proposed a totally different view of the structure which the "double-fold" was proposed to explain. He believed that this fold had no existence, but that the rocks had been brought into their positions by a gigantic horizontal displacement that had pushed up the older masses over the newer. He traced what he regarded as three main lines of these dislocations or overthrust faults, and indicated their trend upon a map. One of them was represented by him as running from the middle of the Lake of Lucerne by the head of the Lake of Zurich across to the Ehine above the Lake of Constance, and thence far to the east by Bolgenach. A second he traced from the head of the Lake of Lucerne, in a great curve through the mountains by the Glarnisch to Glarus, and thence in a very sinuous line across the Sernf valley and the Foo Pass to Sargans and beyond. A third was shown to follow the line of the Ehine valley as far down as Chur. He further pointed out that these gently inclined displacements were cut through and shifted by transverse faults, as in the valleys of the Eeuss, Linth, and Ehine. As a first broad sketch of an altogether new version of mountain-structure, this paper marks a turning-point in the history of this branch of geology. It covered so much ground that it could hardly be free from

imperfections which more detailed observa- tion would correct, but it laid a foundation on which later students could satisfactorily advance.

Dr Eothpletz in successive publications has brought forward much additional detail in support of his views.^ The writer of this article, who has had the great advantage of being conducted by the Bavarian geologist over some of his evidence in the Linththal, and of carefully examining the sections on which he relies, has no hesitation in declar- ing his belief that the horizontal displacements asserted to be there by Dr Eothpletz undoubtedly exist, and pro- duce the effects claimed for them. One of the most notable localities in this district is that at the foot of the Sernf Thai, where the so-called Lochseite limestone occurs. According to the theory of the "double-fold," this limestone represents there the whole Jurassic forma- tion of the region, squeezed out to a thickness of at most two or three feet. It lies between the Verrucano above

^Archives Sciences Phys. et Natur., Geneva, tome tI. (3me Pe'riode 1881), p. 292.

2 A. Rothpletz, " Zum Gebirgsbau der Alpen beiderseits des Rheines," Zeitsch. Deutsch. Geol. Gesell. Band xxxv., 1883, p. 134.

3 Ein Geologischer Querschnitt durch die Ost-Alpen, Stuttgart, 1894 ; Oeotektonisehe Probleme, Stuttgart, 1894; Das geotekto- tiische Problem der Glarner Alpen, Jena, 1898"; Geologische Alpen- forschungen, part i., Munich, 1900.

*and the Tlysch below. But in reality it is not here at least a true limestone, but a band of crushed material permeated by calcite derived from the Flysch. This cmshed calcareous band has resulted from a horizontal or gently inclined dislocation, the plane of which can actually be seen passing through the band. The older reddish brecciated conglomerate (Verrucano) which here lies uppermost has been thrust forward over the dis- turbed Eocene strata, and has had its component mate- rials drawn out and its pebbles rearranged parallel with the plane of movement below.**

While Dr Eothpletz was pursuing his researches in Switzerland, another series of investigations was in pro- gress in the north-west of Scotland, which eventually shed more fresh light on the problems of mountain-making. Working independently of each other. Professor Lapworth and the oflB.cers of the Geological Survey discovered that the geological structure o'f that region was much more complicated than had been supposed, and that it included a series of dislocations of so novel a kind that, although conspicuously visible when once recognized, their existence had never been even suspected by the geologists who fi.rst examined the ground. This complex structure was worked out in great detail by the officers of the Geological Survey between the years 1883 and 1888. They found that the rocks of that region had been ruptured by dislocations which had thrust them horizontally for great distances. The very lowest and oldest rocks had been torn up from below and launched forward in a westerly direction, some- times for a distance of ten miles. Above one of these planes of movement the rocks were found to have been sometimes pushed over each other by small reversed faults, as cards may be slid one upon another. These minor dislocations were then seen to give way to another more nearly hori- zontal plane of intenser movement, whereby another slice of older rock was thrust forward. In this way a succession of thick slices of the more ancient formations may be observed to lie on clean-cut surfaces of much youngerrocks. Such flat, gently inclined, or undulating surfaces of dis- placement have been termed by the Survey officers " thrust- planes." They exactly resemble the " HauptLangsver- werfungsspalten " which Dr Eothpletz has traced through the Swiss Alps. The rupturing has not taken place as a consequence of excessive plication. The rocks appear to have been dislocated as the immediate effect of intense tangential pressure, probably at no very great depth beneath the surface. But curvature has undoubtedly taken place in them during the displacement, particularly in front of a mass of piled-up strata which was being driven forward on a thrust-plane, and the front of which is apt to be dragged in under the advancing pile. Every- where, however, the dominant feature is rupture, traceable from the largest dislocations in the thrust-planes down to the minute puckering and cleavage seen in "ausweich- ungsclivage" and to the crushing of the materials of the rocks and the production of " mylonite." Gradations can thus be traced through successive reversed

faults, so small as to be visible in hand-specimens or only with a lens, up to those which extend from top to bottom of

^The existence of a thrust-plane at this locality is now admitted by Professor Heim, though he adheres to his view of the ” double-fold.” Compare his sections in the Mechanismus, Plate vii. section xiii. and Plate xvi. Fig. 7, with Plate vii. Figs. 2 and 3, in the Livret Guide of the International Geological Congress, 1894, and p. 104 of the text of that book; also Beitrdge zur Geol. Earte Schioeiz, 25th Lielerung (1891), p. 204. A special literature has grown up in reference to this so-called “Lochseiten Kalk.” For the two opposite views re- garding its stratigraphical relations, see Heim, Mechanismus, i. pp. 138-223, where the band is boldly affirmed to have been formed by the rolling out especially of the Jurassic limestone between the Ver- rucano and Flysch; and Rothpletz, Zeitsch. Deutsch. Geol. Gesell. XXXV. p. 165; Ein Geologischer Querschnitt, p. 243; Das geotehto- nische Problem, &c., Plate vii. Fig. 16.

a cliff and onwards to the maximum thrusts which can be followed for scores of miles across mountain and glen.

Each thrust-plane has a sole or floor over which the rock above has been driven. Under favourable conditions this sole is sharply defined from the immediately over- lying material, which often displays evidence of intense crushing even though now in a hard compact condition. Its substance has been ground into powder, and has been made to move along the sole, so that in some cases it has acquired a ” flow-structure ” and might at first be taken for a felsite or rhyolite. Where a conglomerate has been the material driven over the thrust-plane, its pebbles may be observed to have been drawn out in the line of movement. Pegmatite-veins have been broken up and crushed into fine felspathic dust, so that every step may be traced from the obvious vein into a streaky felsite-like substance.

*The major dislocations are usually inclined at a gentle angle in an easterly direction. Hence they behave like nearly horizontal strata, and can be traced winding up the sides of valleys for miles. Not only so, but they have been trenched by denudation in such a way that outliers of them have been left on the tops of hills, affording the singular appearance of a capping of the oldest rock of the district resting apparently quite regularly and conformably upon the newest. The thrust-planes can be followed along the strike for great distances. The most important of these extends for more than 100 miles from the north coast .of Sutherland to Sleat in Skye. They have been shifted by ordinary transverse faults belonging to a much later period of movement. '^*

Similar structures have subsequently been found to play an important part in the geological structure of Scan- dinavia. Tornebohm, Holmquist, and other geologists have traced lines of thrust whereby, as in Scotland, enormous slices of the older rocks have been pushed horizontally over the top of much younger formations. As the most recent example which has been described, reference may be made here to the country lying to the south-east of the mountain Sulitelmaon the confines of Sweden andlSTorway, where Mr P. T. Holmquist has mapped an important thrust-plane over an area of nearly 40 Swedish miles.^ It is so gently inclined that its outcrop winds up the valleys, and portions of the thrust rocks have been left by denudation as outliers. The effect of the dislocation is to place a series of mica-schists and granulitic quartzites (so-called " Algon- kian ") above some of the oldest Cambrian strata which lie immediately on the Archaean gneiss and granite. Thus the same structure which deceived geologists in Scotland is repeated in Arctic Sweden, but the key to it has now been found, and though at first sight it might seem that the Scandinavian Hyolithus series passes upwards into mica-schists and quartzites, the horizontal thrust-plane has been recognized that accounts for the superposition of the older upon the younger rock. There can be little doubt that the same structure pervades a large part of the Scandinavian peninsula. As in Scotland, it chiefly affects there the older formations of the Earth's crust. But in the Alps it has been powerfully developed among the older Tertiary strata. It thus appears to have played an im- portant part in the structure of mountains, and in the general movements of the Earth's crust from early geological time onwards. Nor

is it confined to the more prominent elevations of the Earth's surface. In the, south of England, for example, it may be seen in a feeble de-

1 G. Lapworth, Proc. Oeol. Assoc, vol. viii. p. 4:)8; Oeol. Mag., 1885, p. 97; A. Geikie, B. N. Peach, and .J. Home, Nature, vol. xx.xi. (1884), p. 39; B. N. Peach, J. Home, W. Gunn, C. T. Clough, L. Hinxman, and H. M. Gadell, Quart. Journ. Geol. Soc, 1888, p. 378.

2 G:-ol. For. Stockholm. Fdrhandl. Band xxli. (1900) , p. 72.

velopment in the Chalk of the coast between Weymouth and Studland Bay. There is reason, indeed, to believe that ruptures of the nature of overthrusts have been much more extensively developed throughout the terrestrial crust than has hitherto been supposed.

Various experiments have been made to reproduce arti- ficially and on a small scale the structures displayed in the crust of the Earth. Curvature of strata was studied in this way by Hall, the founder of experimental geology, in the early years of the 19th century.^ Since his day A. Pavre,^ Daubree,' F. Schardt, and others have varied the methods of investigation, and have imitated with more or less success the phenomena exhibited among the rocks. Since the existence and nature of thrust-planes were realized, experimental research in this subject has been resumed by Mr H. M. Cadell ' in Scotland and Mr Bailey Willis in Washington.' Mr Cadell, realizing that the structures which had been worked out by his Survey colleagues and himself in the north-west Highlands of Scotland pointed to the rupture of solid rocks under great stresses, and probably at no great depth beneath the surface, imitated them by placing in a box alternate thin layers of plaster-of-Paris between thicker layers of damp sand or loam. No weight was placed above the layers. The plaster, absorbing moisture from the mate- rials above and below, set into hard brittle laminae. Pressure was then applied to one end of the box, and a series of experiments was carried on with the view of observing the mechanical effects of the pushing of strata over an immovable surface, and of ascertaining the probable origin of thrust-planes. Some of his more interesting results may be here summarized. Horizontal pressure applied at one side is not propagated far forward into a mass of strata which have no great overl3dng cover of rock. The*

compressed mass, in such conditions, tends to find relief along a series of small gently-inclined thrust- planes which dip towards the side from which pressure is exerted. After a certain amount of heaping-up along a series of such minor thrust-planes which thus grow steeper, the heaped mass tends to rise and ride forward bodily along the sole of one or more major thrust-planes. Experiment showed that thrust – planes and reversed faults do not necessarily arise from the rupture of over- folds, but often spring up immediately from the applica- tion of horizontal pressure. What takes the form of a thrust-plane below may pass into an anticline above, and may never reach the surface, while a major thrust-plane above may and probably always does originate in a fold below. A thrust-plane may branch into smaller thrust- planes, or may pass into an overfold along the strike. The front portion of a mass of rock that is pushed forward along a thrust-plane tends to bow forward and roll under the back part. The peculiar arrangement in mountains known as fan-structure may be produced by the continued compression of a simple anticline, and thrust-planes strongly tend to arise at the sides of the fan. The compression that produces the fan imparts a schistose structure to its core.

5 AND 6. Pal.eontological and Stratigraphical Geology.

It is in this department of the science that the largest amount of new material has been collected since 1875. In every one of the various systems of sedimentary f orma-

8 Trans. Roy. Soc. Eilin. vol. vii. (1812), p. 85.

- *Archives Sci. Phys. Nat., Geneva, 1878, No. 246; Nature, vol. xix. p. 103,*

6 Odologie Experimentale, Paris, 1879, pp. 288 et seq.

0 Bull. Soc. Vaudoise Sci. Nut. vol. xk. (1884), p. 143.

‘ Trans. Roy. Soc. Edin. vol. -x.xxv. (1890), p. 337.

8 “The Mechanics of Appalachian Sitnwiuxe,” 13th Annual Report of United States Geol. Survey, Washington, 1894.

tions into which the accessible part of the Earth's crust has been divided vast additions have been made to our knowledge of their fossil contents, geographical distribu- tion, tectonic arrangement, and geological history. But while this mass of infinite detail has been accumulated, the broad outlines traced in the article on Geology in the ninth edition of this work remain, on the whole, not seriously affected. Two sections, however, of this de- partment of the science have more especially advanced. One of these deals with the nature, arrangement, and probable history of the oldest known portions of the terrestrial crust ; the other discusses the principles and methods according to which the investigation of the fossiliferous formations should be conducted.

Pke-Cambeian Geological History. ^No part of the geological record has in recent years been more diligently studied than those earlier chapters which deal with the ages that preceded the deposition of the earliest fossili- ferous formations. More especially has this research been prosecuted in Great Britain and in North America. Though many known problems in the subject remain un- solved, and doubtless many new problems will arise as the investigation is pursued, we are now in possession of a large body of information regarding the primeval parts of geological history, and can carry our eyes backwards into earlier stages of the Earth's progress than were formerly realized.

So far as research has yet gone all over the world, the distinctly fossiliferous formations terminate downwards in the Cambrian system. At the base of that system, strata specially characterized by the presence of the genus of trilobites known as Olenellus are taken as the starting- point of the Palaeozoic series. But the variety of the fauna found in these and the overlying strata may be re- garded as demonstrative proof that this fauna does not represent the first beginning of life on the globe. Some biologists, indeed, following Darwin, maintain that the time required for the evolution of Olenellus and its con- temporaries may have been as long at least as all the ages that have passed since these organisms lived and died. But of earlier types of life than these only scanty traces have yet

been found. By degrees, however, groups of sedimentary rocks are coming to be recognized in many ‘ t different parts of the world below the Olenellus zone, which are not unlikely eventually to yield up some more definite relics of primeval life. In Europe the most com- plete and most unmistakable series of pre-Cambrian for- mations is developed in the north-west of Scotland and in Scandinavia. In North America pre-Cambrian rocks have been largely studied in recent years, and are now known to have a wide extent, vast thickness, and great variety. It will suffice to give here some account of the Scottish and the American groups.

In the west of the counties of Sutherland and Eoss certain thick dolomites and limestones containing Upper Cambrian and possibly Lower Silurian fossils pass down- wards into dolomitic shales and sandstones, with bands of rusty dolomite. These shales, besides being crowded with worm-castings, contain Olenellus, and thus mark the generally accepted base of the Cambrian system. They lie conformably, however, upon, and are closely linked with, white and pink quartzites, from 400 to 600 feet thick, which in some of their bands are crowded with worm-burrows and casts. This arenaceous series, termi- nating downwards in a conglomeratic base and lying unconformably on the rocks below, must clearly be re- garded as part of the Cambrian system, though it lies below the lowest horizon in which Olenellus has yet been detected. Doubtless the quartz-sand, which is now repre- sented by quartzite, did not afford a suitable habitat for trilobite life. If a band of shale or dolomite were met

with in the quartzite, it might be expected to yield speci- mens of the distinctive crustacean.

Below the bottom of the quartzites of the north-west of Scotland lies a series of far more ancient rocks. They are separated from the Cambrian series by an important unconformability which must represent a vast interval of time. They thus constitute a true pre-Cambrian series, and bring before us the very beginnings of geological history in the west of Europe. They include two distinct assemblages of rock. Of these the lower and older consists of gneiss and other crystalline masses, while the upper and younger is composed of a thick mass of red sandstones, shales, and

conglomerates. Between these two formations there is again a violent unconformability which must mark the passing of an enormous interval of time. The older rocks had already acquired their present crystalline struc- tures and arrangement before the younger sediments were derived from their waste and were laid down upon them. Thus while the deposition of these sediments is shown to belong to a period vastly more remote than the Cam- brian, the formation of the underlying crystalline rocks is pushed back into an inconceivably more distant past. Two widely separated periods of pre-Cambrian time can consequently be recognized in the north-west of Scotland. The oldest of these is known as Lewisian, the second as Torridonian.

Lewisian. ❓❓❓ The rocks which contain the records of this earliest stage in the geological evolution of western Europe are well developed in the island of Lewis; hence the name that has been locally applied to them. What are no doubt the same formations cover wide areas in Scandinavia, where they are known as urberget, or primeval rocks. Similar masses reappear in various parts of Europe, repeating the same lithological types, though it cannot always be safely affirmed that they are the true stratigraphical equivalents of the crystalline rocks of the north-west. Again, in Canada and the United States vast tracts of country are occupied by rocks having the same general characters. As a comprehensive designation to embrace all these most ancient rocks the term Archaean is commonly used. But we have at present no means of deciding how far the rocks so designated in one country really belong to the same interval of geological time as those so designated elsewhere. It has been discovered, indeed, that what had been called Archsean formations in some countries are really of Palaeozoic age. Hence there is a cer- tain convenience in the use meanwhile of local names for the types of rock met with in widely separated regions. Such names remain appropriate and useful, even if we have to shift their stratigraphical position backwards or forwards.

The Lewisian rocks of north-west Scotland comprise a series of crystalline gneisses, the great majority of which are undoubtedly of igneous origin, but in one or two dis- tricts include what are probably highly metamorphosed sediments. Here and there among the crystalline gneisses there occur tracts which have more or less completely escaped deformation and wherein the materials are seen to consist of such perfectly recognizable rocks as in younger portions of the terrestrial crust are admitted to be deep- seated intrusions of igneous material. These comparatively uncrushed rocks are often highly basic, for they include gabbros, peridotites, picrites, pyroxene-granulites, and dio- rites. They occur as lenticular zones or belts, running for several hundred yards more or less parallel with the foliation of the gneiss, into which they graduate, and also as irregular patches about a quarter of a square mile in area. They are intersected by veins of gray pegmatite consisting mainly of quartz and felspar. These tracts may represent the original condition of

the gneisses of the surrounding region. Judging from analogy, we may suppose them to be remnants of eruptive

masses wMcli were injected into the primeval crust of the earth and solidified there at some depth below the surface. They have in many respects their counterparts among the deeper-seated intrusions that have invaded the various stratified formations up even to those of Tertiary age. They obviously consist of at least two groups of intrusive material ??? an older and more abun- dant series of basic masses which seem to have risen in extensive bosses, and a later set of acid injections. Whether any of these eruptive materials were connected with superficial discharges remains unknown. They are not essentially different from the masses that are found about the roots of ancient volcanoes. But no trace of any lavas or tuffs in association with them has yet been discovered. For a long time nothing had been detected to show the nature of that part of the terrestrial crust into which these primeval injections had made their way. Obviously they were not themselves masses that had congealed above ground, so that all speculations about their representing a former terrestrial surface were wholly inadmissible. Eventually, however, the officers of the Geological Survey found a group of rocks which may be a portion of the overlying crust in and beneath which the eruptive masses consolidated. These rocks, seen at Loch Maree, Loch Carron, and Glenelg, comprise mica^ schists, graphitic schists, and limestones, probably the remnants of a series of sedimentary formations, and if so, perhaps the oldest yet met with in Europe. The relations of the gneisses and other crystalline rocks to this presumably sedimentary series are somewhat obscure. We may believe, however, that the eruptive masses have been injected into the schists and limestones, and have been the cause of the development of new minerals in the calcareous bands, and of other changes suggestive of contact-metamorphism.

At some time subsequent to the intrusion of the acid pegmatite veins, the rocks were subjected to powerful tangential pressures, whereby they were crushed and sheared so as to acquire a foliated structure. The basic

masses became rudely foliated gneisses, in which plagio- clase felspar, augite, diallage, hornblende, quartz, and magnetite are the predominant minerals, while the acid pegmatites became gray acid gneisses composed mainly of opalescent quartz and felspar. The dip of the foliation- planes of these rocks is usually at gentle angles. The gradation of the non-foliated igneous rocks into the coarse gneisses can often be traced, and it can be seen that ia some cases the foliation passes across the junction lines between the two varieties of original rock. How far there may have been bands of segregation in the eruptive bosses, like those, for instance, in the Tertiary gabbros of Skye, has not at present been determined. But it is quite possible that some at least of the bands of different min- eral constitution, such as those of hornblende or pyroxene and felspar, may belong to the original igneous magma, and not to the time of the foliation. This much may at least be confidently affirmed ??? what has been called " the fundamental complex" of the Lewisian rocks has been formed out of eruptive basic materials and the pegma^ tites introduced into them prior to the first foliation.

But the igneous history does not end here. After the movements that converted so much of the eruptive masses into coarse gneisses, and possibly after an enormous in- terval of unrecorded time, another series of igneous injec- tions took place. A remarkable succession of dykes, of different petrographical characters, invaded the older masses. The most striking of these are the dykes of dolerite and basalt which follow each other in great numbers, having a general north-westerly trend, and run- ning for long distances, sometimes for ten or twelve miles, from the coast- line inland, ixntil they pass under the Tor-

ridonian sandstones. These intrusions present many of the familiar features of the dykes of much later periods. They obviously rose in fissures that had been opened in rocks already cold, for they present the characteristic close-grained or " chilled " margins. After their uprise, a second group of dykes was injected along fissures which ran in a nearly east and west direction. The material of these intrusions consists of peridotites and palseo-picrites, and as they cut the dolerites they are obviously of later date. What length of interval separated these successive up-wellings of molten material in the terrestrial crust must be matter

merely for speculation. Some considerable lapse of time may possibly have followed the appearance of the ultra-basic dykes before a third and decidedly acid group was erupted. Numerous instances have now, however, been observed of a close connexion between granite cores and highly basic peripheral parts of large intrusive bosses. The magma from which such bosses were fed included both acid and basic parts, rising together, but the latter tend- ing to gather towards the outside, while the more volumi- nous acid body occupied the centre. There may therefore have been a closer genetic relation than might at first be supposed between the palaeo-picrites and peridotites of the second series of dykes and the granites and pegmatites of the third series. This third system of dykes has a gen- eral trend towards west-north-west. Its members attain far larger proportions than their predecessors in the other two series, for they sometimes come together so as to form bands more than 600 yards wide. An interestiag parallel presents itself between these various igneous protrusions and those of later geological ages, especially the Tertiary volcanic series of the Inner Hebrides and Antrim. In both cases there are large protrusions of basic material. In the younger example, among the Inner Hebrides, this material has been arranged in bands of different composition according to the original disposi- tion of a heterogeneous magma ; in the older a somewhat similar structure may be partly attributable to the same cause, though subsequent foliation has in some measure obscured its history. The system of basic and acid dykes ranging towards west and north-west is strikingly alike in the operations of two geological periods so infinitely remote from each other. Again, the order of appearance of the igneous materials has followed the same sequence in each case ; the basic intrusions came first, and the acid last.

After these various groups of eruptive rock had been successfully injected, the crust of the earth in the north- west of Scotland, under another series of powerful stresses, was ruptured by thrust-planes and also by more vertical lines of crushing or shearing. Of these dislocar tions, the officers of the Geological Survey have distin- guished three series : one which runs more or less nearly parallel with the basalt and dolerite dykes, one trending nearly east and west, and one which stretches north-east and south-west, or north and south. The first two series are much the most important, and have effected some remarkable transformations both on

the dykes and on the gneiss. AVhere the north-western lines of movement are more or less parallel with the trend of the basic dykes, the dolerites are changed into diorites, without the develop- ment of foliation, but where one of these lines runs along the margin of a dyke, or where several of them traverse it along its length, the basic rock passes into true horn- blende-schist. Lenticles or eyes of uncrushed diorite may be traced, round which the more crushed parts have moved and have assumed the schistose condition. The more basic materials (peridotites, &c.) in the same cir- cumstances have been crushed into soft talcose schists, while the granite of the dykes has been converted into granitoid gneiss. The vertical east and west lines of

movement have had the effect of wrenching the rocks out of their normal course, sometimes for nearly a mile. Dykes fifty or sixty yards broad are crushed and drawn out in these lines, till they are reduced to a width of no more than four feet, while sometimes they are still further attenuated into detached lenticles enclosed in crushed and reconstructed gneiss. Not less decided have been the effects of these lines of movement upon the gneiss. As this rock approaches one of them, its usually gentle inclination becomes steep and the foliation planes are thrown into sharp folds. The folia are drawn out, and sometimes their component minerals are rearranged parallel to those in the hornblende-schist of the adjacent dykes, so that a secondary foliation has been super- induced. There has likewise been a mineralogical recon- stitution of the materials of the gneiss ; the original blue opalescent quartz has been drawn out and in large part changed into the ordinary clear vitreous variety, black mica has been formed out of the hornblende, and white mica out of the felspar, while the hornblende has in part been re-crystallized in needles of actinolite, and new or secondary felspar has been plentifully developed. Lastly, the gneiss has been ruptured by crush-lines and shear- planes, some of which have given rise in one place to coarse breccia, in another to thin schistose bands.

The newer foliation superinduced by these later move- ments has affected considerable areas of the gneiss. It sometimes entirely obliterates the earlier structure of the rock, but where not so well developed it may be seen crossing the bands of that structure, so that the gneiss then presents the curious result of a double foliation. The gentle arches and troughs of the first foliation, striking north-east and south-west, have beenreplaced by sharp folds which, according to the trend of the later movements, vary from west to north-west. In this way the original massive or igneous structure has been so profoundly modified, and over such extensive tracts, that it has survived only here and there in comparatively limited parts of the region. All the geological changes now described ??? the initial uprise of the first basic bosses, the long sequence of igneous invasions, and the successive movements of the crust that produced the first and subsequent foliation ??? took place long before the Torridonian rocks began to be formed. It is obvious that not only the intrusion of the igneous masses, but their subsequent conversion into gneisses and schists, could not have been effected save under the pressure of a considerable depth of overlying rock. We have no means of telling what was the nature or the thickness of that superjacent cover. It had been com- pletely removed by denudation before the earliest of the surviving Torridonian sediments began to be laid down. From the pebbles in these sediments we may form vague conjectures as to the character of the rocks that have disappeared, but there is no proof that these pebbles actually came from the rocks under which the Lewisian gneiss received its complex structure. They may belong to some much younger era. They include pieces of gneiss, jasper, chert, quartzite, quartz-schist, mica^schist, an^ felsite. The quartzites are altered gray, buff, red, or liver- coloured sandstones. The cherts are usually black or yello-v^, which resemble those met with among sedimentary deposits ; they have been searched for Badiolaria, but hitherto without success. The felsites are dark purplish compact rocks with a spherulitic, micro-pegmatitic, micro- poikilitic, or micro-crystalline ground-mass, in which are scattered porphyritic crystals of felspar, often oligoclase. The spherulitic varieties show occasional traces of perlitic structure. 1

Torridonian. ??? It is impossible to form any conjecture

1 Annual Report of Geological Survey for 1895, p. 21.

as to the chronological value of the interval between the close of the Lewisian and the opening of the Torridonian periods in the geological history of the north-west of Scotland. All we can say regarding it is that, even when compared with other geological intervals, it must have been of enormous duration. A great thickness of rock was removed by denudation, and the Lewisian gneiss was exposed to the air. Some fragments of the land-surface thus carved out have been preserved under the Torridonian sediments, and have a singular interest as relics of the earliest known land in Europe. They show the surface of that land to have been in some parts as uneven as that of the Highlands of the present day. There were mountains at least 3000 feet high, separated by wide valleys from other ridges. The ground was worn down into rounded crags and rocky domes on which the gneiss and its dykes stood up bare to the sun and wind. This ancient topo- graphy may be traced among the wild group of mountains between Loch Maree and Loch Broom. It appears behind the hill of Queenaig in Assynt, and it comes out impres- sively along the south side of Loch Torridon. That it has been preserved is due to the deep mass of sediment under which it sank and was buried. This sedimentary accumulation is known as Torridonian from its large development in the district around Loch Torridon, on the west coast of Eoss-shire. It has been subdivided by the Geological Survey into the following groups of strata in descending order : ???

4. Cailleach Head group (1000 to 1500 feet thick) of sandstones, flags, dark and black shales, and calcareous bands.

3. Aultbea group (2000 to 3000 feet) of chocolate-coloured and red sandstones and flags, and gray micaceous flags, with partings of gray, green, and dark shale.

2. Appleoross group (4000 to 5000 feet) of coarse arkose, with pebbles of gneiss, quartzite, quartz-schist, felsite, jasper, &c.

1. Diabeg group (500 feet and upwards, much thicker in Skye). Hard red sandstones and grits, gray graywackes, red mudstones, dark gray and black shales, limestones and calcareous bands, with, at the base, green

epidotic grits, and in some places a band of conglomerate resting on the gneiss.

Where most fully developed the series of sediments ex- ceeds 10,000 feet in thickness. It forms some of the most conspicuous and most peculiarly shaped mountains in Sutherland and Eoss-shire, rising into pyramids and cones, the sides of which have iDeen scarped into precipices and scooped out into cauldron-shaped corries. The nearly level stratification gives a singularly architectural aspect to these huge masses of reddish-brown bare rock, and affords to the eye a ready means of appreciating how potently the forces of denudation have been concerned in developing the present scenery of the region. Several features of interest are presented by this thick mass of sedimentary deposits. The well-rounded pebbles, the regular layers of alternating detritus, the intercalation of coarse and fine materials, the lamination of the shales, the intercalation of calcareous bands and limestones, towards both the top and the bottom of the series, indicate conditions of sedi- mentation in no respect different from those of Palaeozoic and later times. There are no traces of the violent action which, as some physicists have maintained, should have been characteristic of the earliest geological ages. On the contrary, not only do the layers of sediment succeed each other as they do in any series of similar materials in other and later portions of the geological record, but down even to minute details we see examples of the gentle sifting opera- tions of tidal, fluviatile, or lacustrine waters. Thin dark laminae may be noticed intercalated among the paler grits and sandstones, and these on examination prove to consist mainly of magnetic iron ore and other heavy minerals which, as above remarked, have been sorted out by the currents from the lighter quartzose or f elspathic sand, precisely as

grains of similar ore are gathered together by the tides and strewn as a thin layer above the quartz-sand of the beaches of to-day.

No break or unconformability has been detected in any part of this thick mass of stratified deposits. But owing to the remarkably uneven surface of

gneiss on which the sediments were laid down, they are continually overlap- ping each other, so that different members of the series come to lie directly on the older rock. They were prob- ably accumulated in a lake or inland sea, the floor of which was graduaHy sinking. As the hills and valleys were successively submerged, they were buried under a pile of sediment. The actual shore-line during this time of sub- sidence can be followed up the side of a mountain, and the geologist may stand with one foot on the gneiss which formed the dry land and the other on the consoli- dated gravel which was accumulated by the water. Some of this material is excessively coarse, passing indeed into boulder-beds that remind one of the boulder-clay of the Ice Age, or the moraines of the present day. Indeed, some of the rounded contours of gneiss as they pass under the Torridon sandstone, taken together with these overlying masses of boulders, are suggestive of ice action, though it is difficult to suppose that in these remote ages terrestrial climates had become so far differentiated as to include frost, snow, and ice even down to the 57th parallel of north latitude. So regular is the sedimentation of the Torridonian rocks, and so precisely similar to that of Palaeozoic formations, that there seems no reason why fossils should not be looked for and found in these ancient strata. The most likely parts of the series, particularly the shales and the calcareous bands, have been carefully searched by the Geological Survey, but hitherto with only scant success. Various markings have been found which are not impossibly those made by annelids. Certain curi- ous spicular bodies, partly filled with calcite and partly existing as empty casts in the shale, have likewise been obtained, but though they bear some resemblance to magnified sponge spicules, it is by no means certain that they are of organic origin. Quite recently renewed search has been rewarded by the discovery of a number of flattened nodules of dark compact material in the shales, which prove to be phosphatic. It may be suspected that the phosphate of lime in these aggregations was probably derived from organisms. The shells of Lingula and the tests of trilobites and other organisms have supplied materials for phosphatic nodules and layers among the older PalaBozoic rocks, and possibly some such organisms have been concerned in the formation of the nodules in the Torridonian shales. A thin slice of one of the nodules placed under a microscope reveals numbers of thread-like fibres, not improbably of vegetable origin, together with aggregates of what appear to be cells, as if

*some kind of plant had been macerated and broken up into shreds. But this subject is still under investigation, and more definite information may before long be obtained in regard to it.^*

Pre-Cambrian Bocks of North America. ??? In Canada and the United States, from below the lowest Cambrian strata, a vast mass of rocks emerges, presenting a close parallel to those of Scotland, but with an ampler develop- ment and over a far wider region. It consists of two con- trasted groups, the Archaean below and the Proterozoic or Algonkian above. It is most copiously represented in the Lake Superior region, where some of its members were studied long ago by Logan, the pioneer in this branch of geology. The Archaean division of that region consists of massive and gneissoid granites, massive and foliated

1 See J. J. H. Teall in Summary of Progress of the Geological Survey for 1800.

syenites, gabbros and peridotites, and finely laminated or banded gneiss and schists. None of these rocks have been proved to be of sedimentary origin. The great majority, and probably the whole, are igneous masses of deep-seated origin which have had a more or less distinctly foliated structure imparted to them by great mechanical movements within the crust of the earth. But there are proofs that they belong to different periods of intrusion. Thus the massive granites, which show little or no trace of orogenic movements, are of comparatively late date. In short, the geological history of the " basement complex " of Canada and the neighbouring United States appears to have been broadly similar to that of the Lewisian equivalent in Scot- land. Between the Archaean gneiss and the base of the Cambrian system, however, a far more copious strati- graphical series exists in the Lake Superior region than in Scotland. No fewer than three distinct divisions have been determined, each of ample dimensions and great variety, and separated from one another by uncon- formabilities that probably mark protracted intervals of time. These strata form a vast succession of sedi- mentary deposits with igneous intercalations. They have been grouped together under the general name of Proterozoic or Algonkian. In ascending order they consist of (1) Lower Huronian, (2) Upper Hui-onian, (3) Keweenawan.

1. The Lower Huronian (Keewatin) series, about 6000 feet thick, varies considerably in general character as it passes from district to district. It everywhere rests with a strong unconformability upon the gneiss, which must have undergone great denudation before the lowest Huronian sediments began to be laid down upon it. These lowest sediments are conglomerates or quartzites covered by dolomites, sometimes 1000 feet thick. The dolomites pass under slates and quartzites among which an important group of acid and basic volcanic rocks is intercalated. The uppermost subdivision consists of iron ores (siderite, haematitic slates), cherts, and jaspers, and in the Lower Marquette district ranges from 1000 to 1600 feet in thickness. The iron-carbonates suggest an organic origin, and possibly the cherts and jaspers may have been aggregated by marine organisms, like the cherts of the Cambrian, Lower Silurian, and Carbonif- erous formations, and the flints of the Chalk. After the Lower Huronian rocks were accumulated, they suffered from earth-movements by which they were folded, and even, in many places, violently plicated. Raised above sea-level, they underwent prolonged ex- posure and denudation before the next member of the series was deposited. So vast was this interval that it appears to have suflBced for the local removal of the whole depth of the Lower Huronian rocks and the erosion of part of the platform of gneiss below.

2. The Upper Huronian series rests with complete un- conformability on everything older than itself. Where typically developed, in the Penokee district, it consists of three subdivisions. At the base comes a quartz-slate group, about 500 feet thick, with a conglomerate at the bottom and a persistent band of quartzite at the top. The central formation, about 800 feet thick, consists of cherty iron-carbonate, ferruginous slates and cherts, and actjuolitic and magnetitic slates. The upper subdivision is stated to attain the enormous thickness of 12,000 feet. It consists of sedimentary material, ranging from clay-slate through gray wacke and gray wacke-slate to mica-slate. Possibly part of the great apparent thickness of the Upper Huronian series in this district is due to the masses of diabase that have been injected into it. The deposition of this sub-division was followed by another period of disturbance, during which the rocks were tilted, plicated, and raised above the sea. So great were the effects of the movements

that the rocks here and there acquired foliated struc- tures, and were transformed into schists and gneisses. Prolonged and gigantic denudation followed the up- heaval. In some places the whole of the vast thick- ness of the series was eroded down to the underlying rocks before the next series began to be deposited.

*3. The Keweenawan series is in large measure of vol- canic origin. It attains far vaster dimensions than either of the other divisions of the Algonkian rocks ; indeed, it is stated to attain in some places the hardly credible thickness of 50,000 feet. As most of the series consists of igneous rock, it might have been accumulated in a comparatively short time. The local character of its extravasation seems to be indicated by the fact that it rapidly dies out in particular directions. It is divisible into three members ??? (a) a lower mass of gabbros ; (6) a vast succession of great sheets of basic and acid lavas comparable to the extensive basalt-fields of the Far West. With these rocks are intercalated sandstones and con- glomerates, chiefly derived from the waste of the lavas on which they lie; (c) a group of sandstones and con- glomerates, mainly made up of the detritus of the igne- ous rocks below. Again, the accumulation of a division of the Algonkian rocks was followed by terrestrial dis- turbance, by the elevation of the Keweenawan lavas and sediments, and by extensive denudation. Another pro- longed interval ensued, during which what may have been lofty mountains were worn down to mere stumps. It was after this interval that the Cambrian system of North America commenced to be formed.^*

In other portions of North America various different types of pre-Cambrian rocks have been discovered, but they generally consist of a sedimentary series resting upon gneiss. In some places they have yielded a few fossils. Thus in south-eastern Nova Scotia, from a mass of slates, schists, and conglomerates, the obscure form called Eophyton has been obtained. In Newfoundland, below the Olenellus zone at the base of the Cambrian sys- tem, lies uncomformably a series of quartzites, sandstones, conglomerates, and slates more than 11,000 feet thick, in which two

fossils, Aspidella terranovica and ArenicoUtes spiralis, have been found. Ear to the west, in the Grand Canon of the Colorado, two great groups of sedimentary strata, having a united thickness of nearly 12,000 feet, are covered unconformably by Middle Cambrian rocks. They have yielded a larger fauna, including a minute discinoid or patellinoid shell, a small lingula-like shell, a fragment of what appears to be a trilobite, and a Stro- maiqpora-like form, probably organic. It is much to be desired that some more fossiliferous bands may be dis- covered among pre-Cambrian rocks. The definite progress that has been made in the investigation of this subject dur- ing the last few years encourages the hope that further and greater success will before long reward persistent search.

Zonal Steatigbaphy. ??? The most prominent feature in the general progress of combined stratigraphical and palseontological research during the last quarter of the 19th century has been the wide extension of the princi- ple of palaeontological zones in the subdivision of the geo- logical formations, and in their correlation in different countries. This principle was only a further develop- ment of William Smith's famous idea, " Strata identified by Organized Fossils." Several years ago it was carried out in much detail by various palaeontologists in reference to the Jurassic formations, notably by Quenstedt and Oppel in Germany and D'Orbigny in France. The publi- cation of Oppel's classic work Die Juraformation Englands, Frankreichs and des sildwestlichen Deutschlands (1856-58)

1 For a useful summary of the state of our knowledge regarding the pre-Cambrian rocljs of North America, see a memoir by Mr Charles E. van Hise in the 16th Annual Report U. S. Geol. Survey, Part I., 1896.

marked an epoch in the development of stratigraphical geology. Combining what had been done by various observers with his own laborious researches in France, England, AViirtemberg, and Bavaria, he drew up a classi- fication of the Jurassic system, grouping its several for- mations into zones, each characterized by some distinctly predominant fossil after which it was named. Thus the Lower Lias was subdivided by him into zones which re- ceived the following names : (1) Planorbis-bed, zone of Ammonites planorbis ; (2) Angulatus-bed, zone of Amm.

angulatus ; (3) Bucklandi-bed, zone of Amm. BucMandi ; (4) Tuberculatus-bed, zone of Pentacrinus tuberculatum: ; (6) Obtusus-bed, zone of Amm. ohtusus; (6) Oxynotus- bed, zone of Amm. oxynotus; (7) Earicostatus-bed, zone of Amm. raricostatus. Oppel had spent several years among the Swabian Jurassic rocks during his student days at Ttlbingen and Stuttgart. He had passed seven months in France, partly among the collections in Paris, partly mak- ing himself familiar with the localities in the field. In the same way he had devoted four summer months to the classic grounds of the Lias and Oolites of England. He had thus convinced himself that, all over the western half of Europe, the several zones which he had distinguished held their place. His results were speedily confirmed and his classification was adopted by geologists and palaeon- tologists both on the Continent and in England. The method followed by him was eventually applied with suc- cess to other portions of the Mesozoic formations. Nota- bly was this the case with regard to the Cretaceous system, which in France, through the labours of D'Orbigny, Hebert, and others, was partitioned not only into more or less definitely marked formations, but also into zones char- acterized by one or more distinctive species of organism. Thus the whole of the Mesozoic division of the geological recgrd has been subdivided into fossil zones from the Trias up to the top of the Chalk.

Within undefined and no doubt variable geographical limits, these zones have been found to be remarkably per- sistent. They follow each other in the same general order, but not always with equal definiteness. The type fossil sometimes appears on a higher or a lower platform than it does elsewhere. Only to a limited degree is there any coincidence between lithological variations in the strata and the sequence of the fossil zones. In the Jurassic for- mations, indeed, where frequent alternations of different sedimentary materials are to be met with, it is in some cases possible to trace a definite upward or downward limit for a zone by some abrupt change in the sedimenta- tion, such as from limestone to shale. But such a precise demarcation is impossible where no distinct bands of dif- ferent sediment are to be seen. The fossil zones can then only be vaguely determined by finding their characteristic fossils, and noting where these begin to appear in the strata and where they cease. It would seem, therefore, that the sequence of fossil-zones or life-horizons has not

depended merely upon changes in the nature of the con- ditions under which the organisms lived. We should naturally expect that these changes must have had a marked influence ; that, for instance, a difference should be perceptible between the character of the fossils in a limestone and that of those in a shale or a sandstone. The environment when a limestone was in course of deposition would generally be one of clear water favour- able for a more vigorous and more varied fauna than one where a shale series was accumulating, for then the water must have been discoloured, and only such animals would continue living in it or on the bottom as could maintain themselves in the midst of mud. But no such litho- logical reason, betokening geographical changes that would afllect living creatures, can be adduced as a uni- versally applicable explanation of the occurrence and

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limitation of palaeontological zones. One of tliese zones may be only a few inches or feet or yards in vertical extent, and no obvious cause can be seen why its specially char- acteristic fossils should not be found just as frequently in the similar strata above and below. There is often lit- tle or no evidence of any serious change in the condi- tions of sedimentation, still less of any widespread physical disturbance, such as the catastrophes by which the older geologists explained the extinction of succes- sive types of life. It has been suggested that, where the life-zones are well defined, sedimentation has been extremely slow, and that though these zones follow each other with no break in the sedimentation, they were really separated by prolonged intervals of time during which organic evolution could come effectively into play. Bat it is diflS.cult to see how, for example in the Lower Lias, there could have been a succession of prodigious intervals when practically no sediment was laid down, and yet that the strata should show no sign of contem- poraneous disturbance, but succeed each other as if they had been accumulated by one continuous process of deposit. It must be admitted that the problem of life-zones in stratigraphical geology has not yet been solved.

The principle of zonal classification has been extended into the investigation of the Palaeozoic formations, though on the whole it has been less fully applied there than among the Mesozoic systems. Possibly when it is ex- tended in the same detailed and patient way to the older rocks, it may be found not less useful in their elucidation. The Carboniferous Limestone of Great Britain, for in- stance, would be an excellent field for the application of the method of zonal classification. It is a thick mass of calcareous material almost entirely composed of organisms. We know that certain species range throughout its whole extent from bottom to top, but we have still to learn whether it can be subdivided into platforms, each char- acterized by the presence of some distinctive forms of life that are absent or much less frequent on platforms above or below. The most successful use of this method among the Palaeozoic rocks has been made by Professor Lapworth among the Silurian formations. He has found that the species of graptolite have each a comparatively narrow vertical range, and that they may consequently be used for stratigraphical purposes. Applying the method, in the first instance, to the highly plicated Silurian rocks of the south of Scotland, he found that by means of grap- tolites he was able to work out the structure of the ground. Each great group of strata was seen to possess its own graptolitic zones, and by their means could be identified not only in the original complex Scottish area, but in England and Wales and in Ireland. It was eventually ascertained that the succession of zones determined to exist in Great Britain could be recognized on the Conti- nent, in North America, and even in Australia. The brachiopods and trilobites have likewise been made use of for zonal purposes among the oldest sedimentary forma- tions. The most ancient of the Palaeozoic systems has as its fitting base the Olenellus zone. It is doubtless in the further application of zonal stratigraphy that the next important advances will be made in the detailed investi- gation of fossiliferous formations, and of the history of organic life upon the Earth. (a. gb.)

Geometrical Continuity. *In a report of the Institute prefixed to Poncelet's TraiU des x* *-opriitis projecHves des figures (Paris, 1822), it is said that he employed " ce qu'il appelle le principe de conti)tuM." The law or principle thus named by him had, he tells us, been tacitly*

assumed as axiomatic by "les plus savans g^omfetres." It had been enunciated under another name

by Kepler in cap. iv. 4 of his Ad Vitellionem, Paralipomena quihus Astronomioe Pars Optica traditur (Francofurti, 1604). Of sections of the cone, he says, there are five species from the " recta linea " or line-pair to the circle. From the line-pair we pass through an infinity of hyper- bolas to the parabola, and thence through an infinity of ellipses to the circle. Related to the sections are certain remarkable points which have no name. Kepler calls them foci. The circle has one focus at the centre, an ellipse or hyperbola two foci equidistant from the centre. The parabola has one focus within it, and another, the " caecus focus," which may be imagined to be at infinity on the axis within or without the curve. The line from it to any point of the section is parallel to the axis. To carry out the analogy we must speak paradoxically, and say that the line-pair likewise has foci, which in this case coalesce as in the circle and fall upon the lines themselves ; for our geometrical terms should be subject to analogy. Kepler dearly loves analogies, his most trusty teachers, and intimate with all the secrets of nature, "omnium naturce arcanorum conscios." And they are to be espe- cially regarded in geometry as, by the use of " however absurd expressions," classing extreme limiting forms with an infinity of intermediate cases, and placing the whole essence of a thing clearly before the eyes.

Here, then, we find formulated by Kepler the doctrine of the concurrence of parallels at a single point at infinity and the principle of continuity (under the name analogy) in relation to the infinitely great. Such conceptions so strikingly propounded in a famous work could not escape the notice of contemporary mathematicians. Henry Briggs, in a letter to Kepler from Merton College, Oxford, dated " 10 Cal. Martiis 1625," suggests improvements in the Ad Vitellionem Paralipomena, and gives the following construction : ??? Draw a line CBADC, and let an ellipse, a parabola, and a hyperbola have B and A for focus and vertex. Let CC be the other foci of the ellipse and the hyperbola. Make AD equal to AB, and with centres CC and radius in each case equal to CD describe circles. Then any point of the ellipse is equidistant from the focus B and one circle, and any point of the hyperbola from the focus B and the other

circle. Any point P of the parabola, in which the second focus is missing or infinitely distant, is equidistant from the focus B and the line through D, which we call the directrix, this taking the place of either circle when its centre C is at infinity, and every line CP being then parallel to the axis. Thus Briggs, and we know not how many "savans geometres" who have left no record, had already taken up the new doctrine in geometry in its author's lifetime. Six years after Kepler's death in 1630 Girard Desargues, "the Monge of his age," brought out the first of his remarkable works founded on the same principles, a short tract entitled Mithode Universelle de mettre en perspective les ohjets donnes riellement oa en. deris (Paris, 1636). Kepler as a modern geometer is best known by his Xeiv Stereometry of Wine CaKlys (Lincii, 16ir>), in which he replaces the circuitous Archimedean method of exhaustion by a direct "royal road" of infinitesimals, treating a vanishing arc as a straight line and regarding a curve as made up of a suc- cession of short chords. Some 2000 years previously one Antiplio, probably the well-known opponent of Socrates, had regarded a circle in like manner as the limiting form of a many-sided inscribed rectilinear figure. Antipho's notion was rejected by the men of his day as unsound, and when reproduced by Kepler it was again stoutly opposed as incapable of any sort of geometrical demon- stration ??? not altogether without reason, for it rested on an assumed law of continuity rather than on palpable proof.

To complete the theory of continuity, the one thing

needful was the idea of imaginary points implied in the algebraical geometry of Descartes, in which equations between variables representing co-ordinates were found often to have imaginary roots. Newton, in his two sections on " Inventio Orbium " (Principia, i. 4, 5), shows in his brief way that he is familiar with the principles of modern geometry. In two propositions he uses an auxiliary line which is supposed to cut the conic in X and Y, but, as he remarks at the end of the second (prop. 24), it may not cut it at all. For the sake of brevity he passes on at once with the observation that the requu'ed constructions are evident from the case in

which the line cuts the trajec- tory. In the scholium appended to prop. 27, after saying that an asymptote is a tangent at infinity, he gives an unexplained general construction for the axes of a conic, which seems to imply that it has asymptotes. In all such cases, having equations to his loci in the background, he may have thought of elements of the figure as passing into the imaginary state in such manner as not to vitiate con- clusions arrived at on the hypothesis of their reality.

Boscovich (1711-87), a careful student of Newton's works, has a full and thorough discussion of geometrical continuity at the end of his Sectionum Conicarum Elementa, his first principle being that all varieties of a defined locus have the same properties, so that what is demonstrable of one should be demonstrable in like manner of all, although some artifice may be required to bring out the underlying analogy between them. The opposite extremities of an infinite straight line, he says, are to be regarded as joined, as if the line were a circle having its centre at the infinity on either side of it. This leads up to the idea of a veluti plus quam inflnita extendo, a line-circle containing, as we say, the line infinity. Change from the real to the imaginary state is contingent upon the passage of some element of a figure through zero or infinity, and never takes place per saltuni. Lines being some positive and some negative, there must be negative rectangles and negative squares, such as those of the exterior diameters of a hyperbola. Boscovich's first principle was that of Kepler, by whose quantumvis absurdis locutionibus the boldest applications of it are covered, as when we say with Poncelet that all concentric circles in a plane touch one another in two imaginary fixed points at infinity. In G. K. Ch. von Staudt's Geometrie der Lage and Beitrdge zur G. der L. (Nlirnberg, 1847, 1856-60) the geometry of position, including the extension of the field of pure geometry to the infinite and the imaginary, is presented as an independent science, "welche des Messens nicht bedarf." (See Geometby, Peojective, Ency. Brit, 9th ed., vol. X.)

Ocular illusions due to distance, such as Eoger Bacon notices in the Opus Majus (i. 126, ii. 108, 497 ; Oxford, 1897), lead up to or illustrate the mathematical uses of the infinite and its reciprocal the infinitesimal. Specious objections can, of course, be made to the anomalies of the law of continuity, but they are inherent in the higher geometry, which has taught

us so much of the " secrets of nature." Kepler's excursus on the " analogy " between the conic sections hereinbefore referred to is given at length in an article on "The Geometry of Kepler and Newton " in vol. xviii. of the Transactions of the Canv- bridge Philosophical Society (1900). It has been generally overlooked, until attention was called to it by the present writer in a note read in 1880 (Proc. 0. P. S. iv. 14-17), and shortly afterwards in The Ancient and Modem. Geometry of Conies, with Historical Notes and Prolego- mena (Cambridge, 1881). (c. t.)*

Geometry, Line, is the name applied to those geometrical investigations in which the straight line re- places the point as element. Just as ordinary geometry

deals primarily with points and systems of points, this theory deals in the first instance with straight lines and systems of straight lines. In two dimensions there is no necessity for a special line geometry, inasmuch as the straight line and the point are interchangeable by the principle of duality ; but in three dimensions the straight line is its own reciprocal, and for the better discussion of systems of lines we require some new apparatus, e.g., a system of co-ordinates applicable to straight lines rather than to points. The essential features of the subject are most easily elucidated by analytical methods : we shall therefore begin with the notion of line co-ordinates, and in order to emphasize the merits of the system of co-ordinates ultimately adopted, we first notice a system without these advantages, but often useful in special investigations.

In ordinary Cartesian co-ordinates the two equations of a straight line may be reduced to the form y=rx--s, z=tx+u, and r, s, t, u may be regarded as the four co- ordinates of the line. These co-ordinates lack symmetry : moreover, in changing from one base of reference to another the transformation is not linear, so that the degree of an equation is deprived of real significance. For purposes of the general theory we employ homogeneous co-ordinates ; if x^T^w-i and x^^^^ are two points on the line, it is easily verified that the six determinants of the array

I Xciy^^2 I

*are in the same ratios for all point-pairs on the line, and further, that when the point co-ordinates undergo a linear transformation so also do these six determinants. We therefore adopt these six determinants for the co-ordinates of the line, and express them by the symbols I, X, m, ft,, n, v where l=XiW2 ◆◆◆X2Wi, A.=2/] ◆◆2 ◆◆◆ 2/2*i> &c. There is the fur- ther advantage that if aJiiCidi and a^b^fi^^ be two planes through the line, the six determinants*

a-fiiCidi

are in the same ratios as the foregoing, so that except as regards a factor of proportionality we have \=h-fi2 ◆◆◆b^x, l=Cid2 ◆◆◆C2di, &c. The identical relation lX.--miJ.+nv=0 reduces the number of independent constants in the six co-ordinates to four, for we are only concerned with their mutual ratios ; and the quadratic character of this relar tion marks an essential difference between point geometry and line geometry. For elementary analytical investi- gations cf. Cayley, "The Six Co-ordinates of a Line," Camb. Phil. Trans., 1868, or Collected Papers, vol. v. ; for example, the condition of intersection of two liaes is

lX'+r\+miJi'+m'iJi.+nv'+n'v=0

where the accented letters refer to the second line.

Since a line depends on four constants, there are three distinct types of configurations arising in line geometry ◆◆◆ those containing a triply-infinite, a doubly-infinite, and a singly-infinite number of lines ; they are called Complexes, Congruences, and Ruled Surfaces or Skews respectively (see SuKFACES, Theory of). A Complex is thus a system of lines satisfying one condition ◆◆◆ that is, the co-ordinates are connected by a single relation ; and the degree of the complex is the degree of this equation supposing it to be algebraic. The lines of a complex of the nth degree which pass through any point lie on a cone of the nth degree, and those which lie in any plane envelop a curve of the wth class : there are m lines of the complex in any plane pencil, and this statement combines the former two, for it shows that the cone is of the nth degree and the curve is of the nth class. To find the lines common to four

complexes of degrees jij, ng? ⬜⬜3) ⬜⬜4) we have to solve five equations, viz.,

the four complex equations together with the quadratic equation connecting the line co-ordinates, therefore the number of common lines is 2iiin2n^n^. As an example of complexes we have the lines meeting a twisted curve of the nth degree, which form a complex of the nth degree.

A Oongruence is the set of lines satisfying two condi- tions : thus a finite number m of the lines pass through any point, and a finite number n lie in any plane ; these numbers are called the degree and class respectively, and the congruence is symbolically written (m, w). The simplest example of a congruence is the system of lines constituted by all those that .pass through m points and those that lie in n planes ; through any other point there pass m of these lines, and in any other plane there lie n, therefore the congruence is of degree m and class n. It has been shown by Halphen that the number of lines common to two congruences is mm'-f-nn', which may be verified by taking one of them to be of this simple type. The lines meeting two fixed lines form the general (1, 1) congruence ; and the chords of a twisted cubic form the general type of a (1, 3) congruence ; Halphen's result shows that two twisted cubics have in general ten common chords. As regards the analytical treatment, the difficulty is of the same nature as that arising in the theory of curves in space, for a congruence is not in general the complete intersection of two complexes.

A Ruled Surface, Regulus, or Sheio is a configuration of lines which satisfy three conditions, and therefore depend on only one parameter. Such lines all lie on a surface, for we cannot draw one through an arbitrary point ; only one line passes through a point of the surface ; the simplest example, that of a quadric surface, is really two skews on the same surface. The degree of a ruled surface quA line geometry is the number of its generating lines contained in a linear complex. Now the number which meets a given line is the degree of the surface qud point geometry, and as the lines meeting a given line form a particular case of

*linear complex, it follows that the degree is the same from whichever point of view we regard it. The lines common to three complexes of degrees, Wi►►2'*3) form a ruled surface of degree in-in^n^; but not every ru.led surface is the complete intersection of three complexes.*

In the case of a complex of the first degree (or linear complex) the lines through a fixed point lie in a plane called the polar plane or nul-plane of that point, and those lying in a fixed plane pass through a point called the nul-point or pole of the plane. If the nul-plane of A pass through B, then the nul-plane of B will pass through A ; the nul-planes of all points on one line Zj pass through another line l^. The relation be- tween l-i and I2 is reciprocal ; any line of the complex that meets one will also meet the other, and every line meet- ing both belongs to the complex. They are called con- jugate or polar lines with respect to the complex. On these principles can be founded a theory of reciprocation with respect to a linear complex. This may be aptly illustrated by an elegant example due to Voss. Since a twisted cubic can be made to satisfy twelve conditions, it might be supposed that a finite number could be drawn to touch four given lines, but this is not the case. For, suppose one such can be drawn, then its Reciprocal with respect to any linear complex containing the four lines is a curve of the third class, i.e., another twisted cubic, touching the same four lines, which are unaltered in the process of reciprocation; as there is an infinite number of complexes containing the four lines, there is an infinite number of cubics touching the four lines, and the problem is porismatic.

The following are some geometrical constructions relat- ing to the unique linear complex that can be drawn to

Linear complex.

contain five arbitrary lines. To construct the nul-plane of any point 0, we observe that the two lines which meet any four of the given five are conjugate lines of the complex, and the line drawn through 0 to meet them is therefore a ray of the complex ; similarly, by choosing another four we can find another ray through 0 : these rays lie in the nul-plane, and there is clearly a result involved that the five lines so obtained all lie in one plane. A reciprocal construction will enable us to find the nul-

point of any plane. Proceeding now to the met- rical properties and the statical and dynamical applica- tions, we remark that there is just one line such that the nul-plane of any point on it is perpendicular to it. This is called the central axis ; if d be the shortest distance, d the angle between it and a ray of the complex, then d tan 6=p, where p is a constant called the pitch or para- meter. Any system of forces can be reduced to a force R along a certain line, and a couple G perpendicular to that line ; the lines of nul-moment for the system form a linear complex of which the given line is the central axis and the quotient G/E. is the pitch. Any motion of a rigid body can be reduced to a screw motion about a cer- tain line, i.e., to an angular velocity

The following are some properties of a configuration of two linear complexes. The lines common to the two complexes also belong to an infinite number of linear complexes, of which two reduce to single straight lines. These two lines are conjugate lines with respect to each of the complexes, but they may coincide, and then some simple modifications are required. The locus of the central axis of this system of complexes is a surface of the third degree called the cylindroid, which plays a leading part in the theory of screws as developed synthetically by Ball. Since a linear complex has an invariant of the second degree in its co-efficients, it follows that two linear com- plexes have a lineo-linear invariant. This invariant is fundamental : if the complexes be both straight lines, its vanishing is the condition of their intersection as given above ; if only one of them be a straight line, its vanishing is the condition that this line should belong to the other complex. When it vanishes for any two complexes they are said to be in involution ; the nul-points F, Q of any plane then divide harmonically the points in which the plane meets the common conjugate lines, and each com- plex is its own reciprocal with respect to the other. As regards a configuration of these linear complexes, the common lines from one system of generators of a quadric, and the doubly infinite system of complexes containing the common lines, include an infinite number of straight lines which form the other system of generators of the same quadric.

If the equation of a linear complex is AZ-|-Bm+C)i ~~f DA~~|-E/x-f-Fv=0, then for a line not belonging to the complex we may regard the expression

on the left-hand side as a multiple of the moment of oeaerai the line with respect to the complex, the word "^i^L. monient being used in the statical sense; and we infer that when the co-ordinates are replaced by linear functions of themselves the new co-ordinates are multiples of the moments of the line with respect to six fixed com- plexes. The essential features of this co-ordinate system are the same as those of the original one, viz., there are SIX co-ordinates connected by a quadratic equation, but this relation has in general a different form. By suitable choice of the six fundamental complexes, as they may be

called, this connecting relation may be brought into other simple forms of which we mention two : (i.) When the six are mutually in involution it can be reduced to Xi^+X2+x^--Xi'+Xi^+Xg=0; (ii.) When the first four are in involution and the other two are the lines com- mon to the first four it is aji^-f-Kj^+aSj^-f a;/□□□2a;ja;j=0. These generalized co-ordinates might be explained with- out reference to actual magnitude, just as homogeneous point co-ordinates can be; the essential remark is that the equation of any co-ordinate to zero represents a linear complex, a point of view which includes our origi- nal system, for the equation of a co-ordinate to zero repre- sents all the lines meeting an edge of the fundamental tetrahedron.

The system of co-ordinates referred to six complexes mutually in involution was introduced by Klein, and in many cases is more useful than that derived directly from point co-ordinates ; e.g., in the discussion of quad- ratic complexes : by means of it Klein has developed an analogy between line geometry and the geometry of spheres as treated by Darboux and others. In fact, in that geometry a point is represented hj five co-ordinates, connected by a relation of the same type as the one just mentioned when the five fundamental spheres are mutu- ally at right angles and the equation of a sphere is of the first degree. Extending this to four dimensions of space, we obtain an exact analogue of line geometry, in which (i.) a point corresponds to a line ; (ii.) a linear complex to a hypersphere ; (iii.) two linear complexes in involu- tion to

two orthogonal hyperspheres ; (iv.) a linear com- plex and two conjugate lines to a hypersphere and two inverse points. Many results may be obtained by this principle, and more still are suggested by trying to extend the properties of circles to spheres in three and four dimensions. Thus the elementary theorem, that, given four lines, the circles circumscribed to the four triangles formed by them are concurrent, may be extended to six hyperplanes in four dimensions ; and then we can derive a result in line geometry by translating the inverse of this theorem. Again, just as there is an infinite number of spheres touching a surface at a given point, two of them having contact of a closer nature, so there is an in- finite number of linear complexes touching a non-linear complex at a given line, and three of these have contact of a closer nature (cf. Klein, Math. Ann. v.).

Lie has pointed out a different analogy with sphere geometry. Suppose, in fact, that the equation of a sphere of radius r is

3?+y'+z'+2ax->r2hy--2cz-ifd=0,

so t\isA,i^=d?+h"+c'd; then introducing the quantity e to make this equation homogeneous, we may regard the sphere as given by the six co-ordinates a, 6, c, d, e, r con- nected by the equation a+V^+c^'i^d.e=Q, and it is easy to see that two spheres touch if the polar form 2aai -f 2&&1) 2cci 2n\ de^ d^e vanishes. Comparing this with the equation x^+x^+x^+x^ 2x^x^=0 given above, it appears that this sphere geometry and line geometry are identical, for we may write a=Xi, b=X2, c=Xs, r=XiS l, d=Xs, e=^Xe; but it is to be noticed that a sphere is really replaced by two lines whose co-ordinates only differ in the sign of x^, so that they are polar lines with respect to the complex a;4=0. Two spheres which touch correspond to two lines which intersect, or more ac- curately to two pairs of lines (p, p') and (g, q'), of which the pairs {p, q) and (p', q') both intersect. By this means the problem of describing a sphere to touch four given spheres is reduced to that of drawing a pair of lines {t, t') (of which t intersects one line of the four pairs {pp'), (qq'), ()) '), (ss'), and t' intersects the remaining four). We may, however, ignore the accented letters in translat-

ing theorems, for a configuration of lines and its polar with respect to a linear complex have the same projec- tive properties. In Lie's transformation a linear complex corresponds to the totality of spheres cutting a given sphere at a given angle. A most remarkable result is that lines of curvature in the sphere geometry become asymptotic lines in the line geometry.

Some of the principles of line geometry may be brought into clearer light by admitting the ideas of space of four and five dimensions. Thus, regarding the co-ordinates of a line as homogeneous co-ordinates in five dimensions, we may say that line geometry is equivalent to geometry on a quadric surface in five dimensions. A linear complex is represented by a hyperplane section ; and if two such complexes are in involution, the corresponding hyper- planes are conjugate with respect to the fundamental quadric. By projecting this quadric stereographically into space of four dimensions we obtain Klein's analogy. In the same way geometry in a linear complex is equiva- lent to geometry on a quadric in four dimensions ; when two lines intersect the representative points are on the same generator of this quadric. Stereographic projection, therefore, converts a curve in a linear complex, i.e., one whose tangents all belong to the complex, into one whose tangents intersect a fixed conic : when this conic is the imaginary circle at infinity the curve is what Lie calls a minimal curve. Curves in a linear complex have been extensively studied. The osculating plane at any point of such a curve is the nul-plane of the point with respect to the complex, and points of superosculation always coin- cide in pairs at the points of contact of stationary tan- gents. A rational curve of degree w in a linear complex has 2n� � � 6 stationary tangents ; but conversely, when this is the case, the curve may not belong to a linear complex. Examples are afforded by the twisted cubic and the twisted quartic with two stationary tangents.

In giving an account of non-linear complexes we restrict the discussion mainly to the quadratic variety; compara^ tively little is known of those of higher degrees, Non-linear and the known theorems do not differ essentially com- from those referring to the quadratic complex. P'e- � � ^e ﹔﹔- The lines through a given point that belong to a complex of the nth degree lie on a cone of the nth degree : if this cone has a double

line the point is said to be a singular point. Similarly, a plane is said to be singular when the envelope of the lines in it has a double tangent. It is very remarkable that the same surface is the locus of the singu- lar points and the envelope of the singular planes : this sur- face is called the singular surface, and both its degree and class are in general 2n{n-1Y, which is equal to four for the quadratic complex. Following Plticker, we give an account of the lines of a quadratic complex that meet a given line. The cones whose vertices are on the given line all pass through eight fixed points and envelop a surface of the fourth degree ; the conies whose planes contain the given line all lie on a surface of the fourth class and touch eight fixed planes. It is easy to see by elementary geometry that these two surfaces are identical. Further, the given line contains four singular points Ai, Aj, A3, A4, and the planes into which their cones degenerate are the eight common tangent planes mentioned above; similarly, there are four singular planes, a^, a^, u^, at, through the line, and the eight points into which their conies degenerate are the eight common points above. The locus of the pole of the line with respect to all the conies in planes through it is a straight line called the polar line of the given one ; and through this line passes the polar plane of the given line with respect to each of the cones. The name polar is applied in the ordi- nary analytical sense ; any line has an infinite number of polar complexes with respect to the given complex, for

the equation of the latter can be written in an infinite number of ways ; one of these polars is a straight line, and is the polar line already introduced. The surface on which lie all the conies through a line I is called the Pliicker surface of that line : from the known properties of (2, 2) correspondences it can be shown that the Pliicker surface of I cuts l^ in a range of the same cross ratio as that of the range in which the Pliicker surface of li cuts I. Applying this to the case in which Zj is the polar of I, we find that the cross ratios of (Aj, Aj, Ag, A4) and (oj, a^, Oj, a^ are equal. The identity of the locus of the A's with the envelope of the a's follows at once ; moreover, a line meets the singular surface in four

points having the same cross ratio as that of the four tangent planes drawn through the line to touch the surface. The Pliicker surface has eight nodes, eight singular tangent planes, and a double line, which have further properties. The relation between a line and its polar line is not a reciprocal one with respect to the complex ; but Stahl has pointed out that the relation is reciprocal as far as the singular surface is concerned.

The singular lines of a complex P=0 are the lines common to F and the complex

IT ~S\ Em S^ Sn si As already mentioned, at each line Z of a complex there is an infinite number of tangent linear complexes, and

they all contain the lines adjacent to I. If fine"'^" ^ ^ ^ singular line, these complexes all

reduce to straight lines which form a plane pencil containing the line I. Suppose the vertex of the pencil is A and its plane a, then it follows that the cone of any point on I touches a along I, and the curve of any plane through Z touches Z at A. Hence Z is a double line for the cone of A and for the curve of o, so that A is a singular point and a is a singular plane. Conversely, a double line of a cone or curve is a singular line, and a singular line clearly touches the curves of all planes through it in the same point. This is the usual definition. Further, of the singular lines through A two coincide in Z, and of those in a two coincide in I ; and it follows almost at once that the locus of the A's coincides with the envelope of the a's, and forms part of the focal surface of the congruence of singular lines (see "Congruences," infra). Hence when a line touches a complex it touches the singular surface, for it belongs to a plane pencil like (Aa), and thus in Klein's analogy the analogue of a focus of a hypersurf ace being a bitangent line of the complex is also a bitangent line of the singular surface. The theory of cosingular complexes is thus brought into line with that of confocal surfaces in four dimensions, and guided by these principles the existence of cosingular quadratic complexes can easily be established, the analysis required being almost the same as that invented for confocal cy- clides by Darboux and others. Of cosingular complexes of higher degree nothing is known.

To facilitate the discussion of the general quadratic complex we introduce Klein's canonical form. We have, in fact, to deal with two quadratic equations in six variables; and by suitable linear transformations these can be reduced to the form

ai^h^ + " 2 ◆◆"2^ + O'i^i + a^x^ + a^xi + a^ci = 0 x^ + xi + xi + ◆◆/ + x^ + xi =0 subject to certain exceptions, which will be mentioned later.

Taking the first equation to be that of the complex, we remark that both equations are unaltered by changing the sign of any co-ordinate ; the geometrical meaning of this is, that the quadratic complex is its own reciprocal with respect to each of the six fundamental complexes, for

changing the sign of a co-ordinate is equivalent to taking the polar of a line with respect to the corresponding fun- damental complex. It is easy to establish the existence of six systems of bitangent linear complexes, for the complex \xy-l^<^+l^i+hXi-\-\x^-\-hXi=^ is a bitangent when

Zi=0, and 1 :r+:

02 ◆◆◆ fll

-+:

+

3 ◆◆◆ a, 04 ◆◆◆01 05 ◆◆◆01 06 -oi

=0,

and its lines of contact are conjugate lines with respect to the first fundamental complex. We therefore infer the existence of six systems of bitangent lines of the complex, of which the first is given by

a;i=0,

xi'-

xs-

.2 Xi

xi'-

Xe"

=0.

oi a% a\ ai ai os ai aa ai

Each of these lines is a bitangent of the singular surface, which is therefore completely determined as being the focal surface of the (2, 2) congruence above. It is thence easy to verify that the two complexes 2aa^=0 and

2&a^=0 are cosingular if br=-^ r"-

The singular surface of the general quadratic complex is the famous quartio, with sixteen nodes and sixteen sin- gular tangent planes, first discovered by Kilnuner. We cannot give a full account of its properties here, but we deduce at once from the above that its bitangents break up into six (2, 2) congruences, and the six linear com- plexes containing these are mutually in involution. The nodes of the singular surface are points whose complex cones are coincident planes, and the complex conic in a singular tangent plane consists of two coincident points. This configuration of sixteen points and planes has many interesting properties; thus each plane contains six points which lie on a conic, while through each point there pass six planes which touch a quadric cone. In many respects the Kiimmer quartic plays a part in three dimensions analogous to the general quartic curve in two; it further gives a natural representation of certain relations between hyperelliptic functions.

As might be expected from the magnitude of a form in six variables, the number of projectively distinct varieties of quadratic complexes is very great; . . and in fact Weiler, by whom the question catioa 0/ was first systematically studied on lines indi- quadratic cated by Klein,

enumerated no fewer than forty- <=□□□□□P'"e- nine different types. But the principle of the classifica- tion is so important, and withal so simple, that we give a brief sketch which indicates its essential features. We have practically to study the intersection of two quadrics P and F' in six variables, and to classify the different cases arising we make use of the results of Weierstrass on the equivalence conditions of two pairs of quadratics. As far as at present required, they are as follows : □□□ Sup- pose that the factorized form of the determinantal equa- tion Disct (Fh-XF')=0 is*

(\□□□a)'i+'2+'3- □□□□□□□(X-|8)'i+'2+'3+- □□□ □□□

where the root a occurs Si-I-Sj-I-Sa . . . times in the deter- minant, S2+S3 . . . times in every first minor, S3+ . . . times in every second minor, and so on ; the meaning of each exponent is then perfectly definite. Every factor of the type (X□□□a)' is called an elemi'ntartheil (elementary divisor) of the determinant, and the condition of equivalence of two pairs of quadratics is simply that their determinants have the same elementary divisors. We write the pair of forms symbolically thus "[(S1S2…), (tit^...), ...], letters in the inner brackets referring to the same factor. Returning now to the two quadratics representing the complex, the sum of the exponents will be six, and two complexes are put in the same class if they have the same symbolical expression ; ;.e., the actual values of the roots of the deter-

minantal equation need not be the same for both, but their manner of occurrence, as far as here indicated, mast be identical in the two. The enumeration of all possible cases is thus reduced to a simple question in combinatorial analysis, and the actual study of any par- ticular case is much facilitated by a useful rule of Klein's for writing down in a simple form two quadratics belong- ing to a given class □□□ one of which, of course, represents the equation connecting line co-ordinates, and the other the equation of the complex. The general complex is naturally [111111] ; the complex of tangents to a quad- ric is [(111), (111)] and that

of lines meeting a conic is [(222)J. Full information will be found in Weiler's memoir, Math. Ann. vol. vii.

The detailed stvidy of each variety of complex opens up avast subject; we only mention two special cases, the harmonic complex and the tetrahedral complex. The harmonic complex, first studied by Battaglini, is generated in an infinite number of ways by the lines cutting two quadrics harmonically. Taking the most general case, and referring the quadrics to their common self-conjugate tetrahedron, we can find its equation in a simple form, and verify that this complex really depends only on seven- teen constants, so that it is not the most general quadratic complex. It belongs to the general type in so far as it is discussed above, but the roots of the determinant are in involution. The singular surface is the " tetrahedroid " discussed by Cayley. As a particular case, from a metri- cal point of view, we have Painvin's complex generated by the lines of intersection of perpendicular tangent planes of a quadric, the singular surface now being Fresnel's wave surface. The tetrahedral or Eeye complex is the simplest and best known of proper quadratic complexes. It is generated by the lines which cut the faces of a tetrahedron in a constant cross ratio, and therefore by those subtending the same cross ratio at the four vertices. The singular surface is made up of the faces or the vertices of the fundamental tetrahedron, and each edge of this tetrahedron is a double line of the complex. Tiie complex was first discussed by Eeye as the assemblage of lines joining corresponding points in a homographic transfor- mation of space, and this point of view leads to many important and elegant properties. A (metrically) parti- cular case of great interest is the complex generated by the normals to a family of confocal quadrics, and for many investigations it is convenient to deal with this complex referred to the principal axes. For example, Lie has developed the theory of curves in a Eeye com- plex (i.e., curves whose tangents belong to the complex) as solutions of a differential equation of the form (b ??? c)xdydz + (c ???a)ydzdx+{a ???b)zdxdy=0, and we can simplify this equation by a logarithmic transformation. Many theorems connecting complexes with diiferential equations have been given by Lie and his school. A line complex, in fact, corresponds to a Mongian equation having oo^ line integrals.

As the co-ordinates of a line belonging to a congruence are functions of two independent parameters, the theory

of congruences is analogous to that of surfaces, Coagm- g^jjjj ^g jjj^y regard it as a fundamental inquiry

to find the simplest form of surface into which a given congruence can be transformed. Most of those whose properties have been extensively discussed can be represented on a plane by a birational transformation. But in addition to the difficulties of the theory of algebraic surfaces, a subject still in its infancy, the theory of con- gruences has other difficulties in that a congruence is seldom completely represented, even by two equations. A fundamental theorem is that the lines of a congruence are in general bitangents of a surface ; in fact, since the condition of intersection of two consecutive straight lines

is ldX+dmdiJ.+dndi'=0, a line I of the congruence meets two adjacent lines, say l^ and 4- Suppose I, Zj lie in the plane pencil (Ajfti) and I, l^ in the plane pencil (Ajag), then the locus of the A's is the same as the envelope of the a's, but a^ is the tangent plane at Ai and a^ at Aj. This surface is called the focal surface of the congruence, and to it all the lines I are bitangent. The distinctive property of the points A is that two of the congruence lines through them coincide, and in like manner the planes a each contain two coincident lines. The focal , surface consists of two sheets, but one or both may ^ degenerate into curves ; thus, for example, the normals to a surface are bitangents of the surface of centres, and in the case of Dupin's cyclide this surface degenerates into two conies.

In the discussion of congruences it soon becomes neces- sary to introduce another number r, called the rank, which expresses the number of plane pencils each of which contains an arbitrary line and two lines of the congruence. The order of the focal surface is 2m(n ll) 2r, and its class is m(m 1) 27-. Our knowledge of congruences is almost exclusively confined to those in which either m or n does not exceed two. We give a brief account of those of the second order without singular lines, those of order unity not being especially interesting. A congruence generally has singular points through which an infinite number of lines pass ; a singular point is said to be of order r when the

lines through it lie on a cone of the rth degree. By means of formulBs connecting the number of singular points and their orders with the class m of quadratic congruence Kummer proved that the class can- not exceed seven. The focal surface is of degree four and class 2m ; this kind of quartic surface has been ex- tensively studied by Kummer, Cayley, Eohn, and others. The varieties (2, 2), (2, 3), (2, 4), (2, 5) all belong to at least one Eeye complex ; and so also does the most important class of (2, 6) congruences which includes all the above as special cases. The congruence (2, 2) belongs to a linear complex and forty different Eeye complexes ; as above remarked, the singular surface is Kilmmer's sixteen- nodal quartic, and the same surface is focal for six dif- ferent congruences of this variety. The theory of (2, 2) congruences is completely analogous to that of the surfaces called cyclides in three dimensions. Further particulars regarding quadratic congruences will be found in Kilm- mer's memoir of 1866, and the second volume of Sturm's treatise. The properties of quadratic congruences having singular lines, i.e., degenerate focal surfaces, are not so interesting as those of the above class ; they have been discussed by Kummer, Sturm, and others.

Since a ruled surface contains only co^ elements, this theory is practically the same as that of curves. We pass over the point and plane theory of such surfaces with the remark that the degree and class are obviously equal, and deal exclusively with line geometry. Premising that if a linear complex contains more than n generators of a ruled surface of the nth de- gree it contains all the generators, we remark that for n=2 there are three linearly independent complexes, con- taining all the generators, and this is a well-known pro- perty of quadric surfaces. In ruled cubics the generators all meet two lines which may or may not coincide; these two cases correspond to the two main classes of cubics discussed by Cayley and Cremona. As regards ruled quartics, the generators must lie in one and may lie in two linear complexes. The first class is equivalent to a quartic in four dimensions and is always rational, but the latter class has to be subdivided into the elliptic and the rational, just like twisted quartic curves. A quintic skew may not lie in a linear complex, and then it is unicursal, while of sextics we have two classes not in a linear complex, viz.,

the elliptic variety, having thirty-six places where a linear complex contains six consecutive generators, and the rational, having six such places.

The general theory of skews in two linear complexes is identical with that of curves on a quadric in three di- mensions, and is known. But for skews lying in only one linear complex there are diflftculties ; the curve now lies in four dimensions, and we represent it in three by stereographic projection as a curve meeting a given plane in n points on a conic. To find the maximum deficiency for a given degree would probably be difficult, but as far as degree eight the space-curve theory of Halphen and Nother can be translated into line geometry at once. When the skew does not lie in a linear complex at all the theory is more difficult still ; and we conclude by remark- ing that the deficiency of a skew surface, qud line geome- try of course, is equal to that of its line of striction when we deal with Euclidean space.

The earliest works of a general nature are Pluckek, Neue Geometrie des Saumes, Leipzig, 1868; and Kummer, "Ueberdie algebraischen Strahlensy steme, " Berlin Academy, 1866. Sys- tematic development on purely synthetic lines will be found in the three volumes of Sturm, Liniengeometrie, Leipzig, 1892, 1893, 1896 ; vol. i. deals vrith the linear and Reye complexes, vols. ii. and iii. with quadratic congruences and complexes respectively. For a highly suggestive review by Gino Loria see Bulletin des sciences mathematiques, 1893, 1897. A shorter treatise, giving a very interesting account of Klein's co-ordinates, is the work of Koenios, La geometrie reglee et ses applications, Paris, 1898. Many references to memoirs on line geometry will be found in Hagen, Synopsis der hbheren Mathematik, ii., Berlin, 1894; LoEiA, II passato ed il presente delle principali teorie geometriche, Milan, 1897; a clear rfeum6 of the principal results is contained in the veiy elegant volume of Pascal, Bepertorio di mathematiche superiori, ii., Milan, 1900. Another treatise

dealing extensively with line geometry is Lie, Geometrie der Beriihrungstransformationen, Leipzig, 1896. Many memoirs on the subject have appeared in the Mathematische Annalen ; a full list of these will be found in. the index to the first fifty volumes, p. 115. Perhaps the two memoirs which have left most impress on the subsequent development of the subject are Klein, "Zur Theorie der Liniencomplexe des ersten und zweiten Grades," Math. Ann. ii. ; and Lie, " Ueber Complexe, insbesondere Linien- und Kugelcomplexe," Math. Ann. v. (j. h. Gr.)

Geometry, Non- Euclidean. ❓❓❓ Non-Euclidean Geometry, in the narrower sense, may be defined as the study of the consequences which follow from denying Detiaiti a ❓❓"❓❓'^ more of the (explicit or tacit) assump- tions upon which the Euclidean system is founded. In a broader sense, for which the name Pange- ometry is more appropriate, the word is used to describe systems which merely dispense with one or more of Euclid's assumptions, without making any decision as to the truth or falsity of these assumptions. The motives and scope of non-Euclidean Geometry can hardly be grasped without some knowledge of its growth and devel- opment. The present article, therefore, will begin with a historical sketch ; it will then attempt to dispel some common confusions as to the meaning or the assumptions of non-Euclidean systems; and finally, it will briefly indicate the bearing of these systems upon Epistemology and the philosophy of space.

" In pidcherrimo Geometric corpore," wrote Sir Henry Savile, in 1621, " duo sunt neevi, duse labes nee quod Theory of ^ciam plures, in quibus eluendis et emaculendis parallels cum veterum tum recentiorum . . . vigilavit before industria." These two blemishes are the theory Qauss. ^^ parallels and the theory of proportion. The " industry of the moderns," in both respects, has given rise to important branches of mathematics, while at the same time showing that Euclid is more free from blemish than had been previously credible. It was from endeav- ours to improve the theory of parallels that non-Euclidean Geometry arose ; and though it has now acquired a

far wider scope, its historical origin remains instructive and interesting. To Euclid's successors, the axiom, or more properly the postulate, of

parallels had signally failed to appear self-evident, and had failed equally to appear indemonstrable. Without the use of the pos- tulate its converse is proved in Euclid's 28th proposition, and it was hoped that by further efforts the postulate itself could be also proved. The first step consisted in the discovery of equivalent axioms. Clavius in 1674 deduced the axiom from the assumption that a line whose points are all equidistant from a straight line is itself straight. Wallis in 1663 showed that the postulate follows from the possibility of similar triangles on different scales. Saccheri (1733) showed that it is sufficient to have a single triangle, the sum of whose angles is two right angles. Other equivalent forms may be obtained, but none shows any essential superiority to Euclid's. Indeed plausibility, which is chiefly aimed at, becomes a positive demerit where it conceals a real assumption.

A new method, which, though it failed to lead to the desired goal, proved in the end immensely fruitful, was invented by Saccheri, in a work entitled Euclides ab omni ncevo vindicatus (Milan, 1733). If the postulate of parallels is involved in Euclid's other assumptions, con- tradictions must emerge when it is denied while the others are maintained. This led Saccheri to attempt a reductio ad absurdum, in which he mistakenly believed himself to have succeeded. What is interesting, how- ever, is not his fallacious conclusion, but the non-Euclidean results which he obtains in the process. Saccheri distin- guishes three hypotheses (corresponding to what are now known as Euclidean or parabolic, elliptic, and hyperbolic Geometry), and proves that some one of the three must be universally true. His three hypotheses are thus ob- tained : equal perpendiculars AG, BD are drawn to a straight line AB, and CD are joined. It is shown that the angles ACD, BDC are equal. The first hypothesis is that these are both right angles ; the second, that they are both obtuse ; and the third, that they are both acute. Many of the results afterwards obtained by Lobatchewsky and Bolyai are here developed. Saccheri fails to be the founder of non-Euclidean Geometry only because he does not perceive the possible truth of his non-Euclidean hy- potheses. Some advance is made by Lambert (the de- monstrator of the irrationality of tt) in his Tlieorie der Parallellinien (written 1766 ; posthumously published, 1786). Though he still believed in the necessary truth of Euclidean Geometry, he confessed that, in all his attempted proofs, something remained

undemonstrated. He deals with the same three hypotheses as Saccheri, showing that the second holds on a sphere, while the third would hold on a sphere of purely imaginary radius. The second hypothesis he succeeds in condemning, since, like all who preceded Eiemann, he is unable to conceive of the straight line as finite and closed. But the third hypothesis, which is the same as Lobatchewsky's, is not even professedly refuted.'

Non-Euclidean Geometry proper begins with Gauss. The advance which he uiade was rather philosophical than mathematical: it was he (probably) who first ^^^^ recognized that the postulate of parallels is per^ds possibly false, and should be empirically tested otaoa- by measuring the angles of large triangles. %"ometry The history of non-Euclidean Geometry has been aptly divided by Klein into three very distinct periods. The first ??? which contains only Gauss, Lobat-

1 On the theory of parallels before Lobatchewsky, see Stiickel uini Encel, Theorie der Parallellinien von Kiikiid bi.i aiif Gauss, Leipzig, ISSlf). The foregoing remarks are baseil upon the materials collected in this work.

chewsky and Bolyai ??? is characterized by its synthetic method and by its close relation to Euclid. ??? The attempt at indirect proof of the disputed postulate "would seem to have been the source of these three men's discoveries ; but when the postulate had been denied, they found that the results, so far from showing contradictions, were just as self-consistent as Euclid. They inferred that the postu- late, if true at all, can only be proved by observations and measurements. Only one kind of non-Euclidean space is known to them, namely, that which is now called hyperbolic. The second period is analytical, and is characterized by a close relation to the theory of surfaces. It begins with Riemann's inaugural dissertation, which regards space as a particular case of a manifold. The conception of measure of curvature is extended from surfaces to spaces, and a new kind of space, finite but unbounded (corresponding to the second hypothesis of Saccheri and Lambert), is shown to be possible. As opposed to the second period, which is purely

metrical, the third period is essentially projective in its method. It begins with Cayley, who showed that metrical proper- ties are projective properties relative to a certain funda- mental quadric, and that different geometries arise according as this quadric is real, imaginary, or degenerate. Klein, to whom the development of Cayley's work is due, showed further that there are two forms of Riemann's space, called by him the .elliptic and the spherical. Finally, it has been shown by Lie, that if figures are to be freely movable throughout all space in co' ways, no other three-dimensional spaces than the above four are possible.

Gauss published nothing on the theory of parallels, and it was not generally known until after his death that he had interested himself in that theory from a very early date. In 1799, he announces that Euclidean Geometry would follow from the assumption that a triangle can be drawn greater than any given triangle. Though unwilling to assume this, we find him in 1804 still hoping to prove the postulate of parallels. In 1,830 he announces his conviction that Geometry is not an dk priori science ; in the following year he explains that non-Euclidean Geometry is free from contradictions, and that, in this system, the angles of a triangle diminish without limit when all the sides are increased. He also gives for the circumference of a circle of radius r the formula itkifl" – e"'[1]*, where fc is a constant depending upon the nature of the space. In 1832, in reply to the receipt of Bolyai's Appendix, he gives an elegant proof that the amount by which the sum of the angles of a triangle falls short of two right angles is proportional to the area of the triangle. From these and a few other remarks it appears that Gauss possessed the foundations of hyperbolic Geometry, which he was probably the first to regard as perhaps true. It is not known with certainty whether he influenced Lobatchewsky and Bolyai, but the evidence we possess is against-such a view.' The first to publish a non-Euclidean Geometry was a Russian, Lobatchewsky, Professor of Mathe- matics in the new university of Kazan. In the place of the disputed postulate he puts the following : " All straight lines which, in a plane, radiate*

Lobat- chewsky,

1 See Stackel und Engel, op. cit., and " Gauss, die beiden Bolyai, und die nlcht-Euklidische Geometrie," Math. Annalen, Bd. xlix. ; also Eugel's translation of Lobatchewsky (Leipzig, 1898), pp. 378.^.

2 Lobatchewsky's works on the subject are the following: ???" On the Foundations of Geometry," Kazan Messenger, 1829-30 ; " New Foundations of Geometry, with a complete Theory of Parallels," Proceedings of the University of Kazan, 1835 (both in Russian, but translated into German by Engel, Leipzig, 1898); "Geometrie Imaginaire," Crelle's Journal, 1837; Theorie der Parallellinien, Berlin, 1840, 2nd ed., 1887, translated by Halsted, Austin, Texas, 1891. His results appear to have been set forth in a paper (now lost) which he read at Kazan in 1826.

from a given point, can, with respect to any other straight line in the same plane, be divided into two classes, the iiitei-.iecthig and the non-iiUersecting. The boundary line of the one and the other class is called parallel to the given line." It follows that there are two parallels to the given line through any point, each meeting the line at infinity, like a Euclidean parallel. (Hence a line has two distinct points at infinity, and not one only as in ordinary Geometry.) The two parallels to a line through a point make equal acute angles with the perpendicular to the line through the point. If p be the length of the perpendicular, either of these angles is denoted by n(p). The determination of n(p) is the chief problem; it appears finally that, with a suitable choice of the unit of length,

tan I U(p) = e-".

Before obtaining this result it is shown that spherical trigonometry is unchanged, and that the normals to a circle or a sphere still pass through its centre. When the radius of the circle or sphere becomes infinite all these normals become parallel, but the circle or sphere does not become a straight line or plane. It becomes what Lobat- chewsky calls a limit-line or limit-surface. The geometry on such a surface is shown to be Euclidean, limit-lines replacing Euclidean straight lines. (It is, in fact, a surface of zero measure of curvature.) By the help of these propositions Lobatchewsky obtains the above value of n(jp), and thence the solution of triangles. He points out that his formulae result from those of spherical trigo- nometry by substituting ia, ib, ic, for the sides a, b, c.

John Bolyai, a Hungarian, obtained results closely corre- sponding to those of Lobatchewsky. These he published in an appendix to a work by

his father, entitled Appendix Scientiam spatii absolute veram exhi- ⬜⬜ ^^ ‘

hens : a veritate aut falsitate Axiomatis XI. Eudidei {d, priori liaud unquam decidenda) indejjendentem : adjecta ad casum falsitatis, quadratura circidi geometrica.” This work was published in 1831, but its conception dates from 1823. It reveals a profounder appreciation of the import- ance of the new ideas, but otherwise differs little from Lobatchewsky’s. Both men point out that Euclidean Geometry is a limiting case of their own more general system, that the geometry of very small spaces is always approximately Euclidean, that no d, priori grounds exist for a decision, and that observation can only give an approximate answer. Bolyai gives also, as his title indi- cates, a geometrical construction, in hyperbolic space, for the quadrature of the circle, and shows that the area of the greatest possible triangle, which has all its sides parallel and all its angles zero, is iri^, where i’ is what we should now call the space-constant.

The works of Lobatchewsky and Bolyai, though known and valued by Gauss, remained obscure and ineffective until, in 1866, they were translated into French nig⬜⬜⬜^ ⬜⬜⬜⬜⬜⬜ by J. Hotiel. But at this time Riemann’s dis- sertation, Ueber die Hypothesen welche der Geometrie zu Grunde liegen, was already about to be published. In this work Riemann, without any knowledge of his pre- decessors in the same field, inaugurated a far more profound discussion, based on a far more general stand- point ; and by its publication in 1867, the attention of mathematicians and philosophers was at last secured. (The dissertation dates from 1854, but owing to changes which Riemann wished to make in it, it remained un- published until after his deathA*

Riemann’s work contains two fundamental conceptions.

8 Translated by Halsted, Austin, Texas, 4th ed., 1896.

^ Abhandlungen d. Konigl. Ges. d. Wiss. zu Gottingen, Bd. xiii. Ges. Math. Werke, pp. 254-269; translated by Clifford, Collected Mathematical Papers.

that of a manifold, and that of the measure of curvature of a continuous manifold possessed of what he calls flat- ness in the smallest parts. By means of these concep- tions space is made to appear at the end of definition ^ gradual series of more and more specialized manifold. Conceptions. Conceptions of magnitude, he ex- plains, are only possible where we have a general conception capable of determination in various ways. The manifold consists of all these various determina- tions, each of which is an element of the manifold. The passage from one element to another may be discrete or continuous ; the manifold is called discrete or continuous accordingly. Where it is discrete two portions of it can be compared, as to magnitude, by counting ; where continuous, by measurement. But measurement demands superposition, and consequently some magnitude independent of its place in the manifold. In passing, in a continuous manifold, from one element to another in a determinate way, we pass through a series of intermediate terms, which form a one-dimensional manifold. If this whole manifold be similarly caused to pass over into another, each of its elements passes through a one- dimensional manifold, and thus on the whole a two- dimensional manifold is generated. In this way we can proceed to n dimensions. Conversely, a manifold of n dimensions can be analysed into one of one dimension and one of (re⁄⁄⁄ 1) dimensions. By repetitions of this process the position of an element may be at last determined by re magnitudes. Eiemann proceeds to specialize the mani- fold by considerations as to measurement. If measurement is to be possible, some magnitude, we saw, must Measure of ^g independent of position ; let us consider manifolds in which lengths of lines are such magnitudes, so that every line is measurable by every

other. The co-ordinates of a point being x-^, x^, x⁄⁄⁄,

let us confine ourselves to lines along which the ratios dx^ : dx^ : . . . . : dxn alter continuously. Let us also assume that the element of length, ds,

is unchanged (to the first order) when all its points undergo the same infinitesimal motion. Then if all the increments dx be altered in the same ratio, ds is also altered in this ratio. Hence ds is a homogeneous function of the first degree of the increments dx. Moreover, ds must be unchanged when all the dx change sign. The simplest possible case is, therefore, that in which ds is the square root of a quadratic function of the dx. This case includes space, and is alone considered in what follows. It is called the case of flatness in the smallest parts. Its further discussion depends upon the measure of curvature, the second of Eiemann's fundamental conceptions. This conception, derived from the theory of surfaces, is applied as follows. Any one of the shortest lines which issue from a given point (say the origin), is completely deter- mined by the initial ratios of the dx. Two such lines, defined by dx and Sx say, determine a pencil, or one-dimensional series, of shortest lines, any one of which is defined by \dx f fj.Sx, where the parameter k : fi may have any value. This pencil generates a two-dimensional series of points, which may be regarded as a surface, and for which we may apply Gauss's formula for the measure of curvature at any point. Thus at every point of our manifold there is a measure of curvature corresponding to every such pencil j- but all these can be found when re.re- 1/2 of them are known. If figures are to be freely movable, it is necessary and sufficient that the measure of curvature should be the same for all points and all directions at each point. Where this is the case, if u, be the measure of curvature, the linear element can be put into the form

ds= J2d^{l+l'2x^).

If a be positive, space is finite, though still unbounded, and every straight line is closed ❓❓❓ a possibility first recog- nized by Kiemann. It is pointed out that, since the pos- sible values of a. form a continuous series, observations cannot prove that our space is strictly Euclidean. It is also regarded as possible that, in the infinitesimal, the measure of curvature of our space should be variable.

There is one point, at least, upon which this profound work seems open to criticism, namely, as regards ^^^^^^^^ the introduction of co-ordinates. If we are to o//;/emMii. be able, without a vicious circle, to presuppose co-

ordinates in discussing distance, it is evident that our co-ordinates must not presuppose distance. It then re- mains a question how they are to be defined ??? a question satisfactorily answered (as we shall see) by the projective method, but unanswerable from Eiemann's metrical stand-point. Moreover, if our co-ordinates are to represent any kind of spatial magnitudes, we must assume the possibility of equal quantities in different places, and hence, it will be found, we shall be compelled to regard the measure of curvature as constant. Let us examine the consequences of supposing it variable. In the first place, the method of superposition would have become impossible, so that measurements could no longer be effected. As regards areas and volumes this is obvious, since congruent areas or volumes could not, generally speaking, exist in two different assigned regions. As regards lengths, it seems equally true that superposition would be impossible. For straight lines corresponding to different values of the measure of curvature differ, as we shall see later, not only in quantity, but also in quality. Hence two such lines cannot be fitted together, and are, strictly, neither equal nor unequal. Hence it would be impossible, in general, to divide a given length into equal portions, or to compare it numerically with other lengths. Thus a metrical co- ordinate system would become impossible. Moreover, Geometry would become akin to Geography ; it would not consist of general theorems, but of descriptions of various localities. The variation of the space-constant would be not quantitative merely, but qualitative, and quantities in different places would be of different kinds. Thus the constancy of the measure of curvature is a precondition of any metrical co-ordinate system, and cannot be held doubtful while such a system is retained.^ Another respect in which Eiemann's language, though not fallacious, has proved unfortunate, is the use of the word curvature. This has led philosophers, and even mathematicians (e.g'., Newcomb), to suppose non-Euclidean spaces curved, and therefore necessarily contained in Euclidean spaces of more dimensions. So far is this from being the case that there is perfect reciprocity. Parabolic spaces can be contained both in elliptic and in hyperbolic spaces of one more dimension.^ It has, consequently, become customary to speak of the reciprocal of the square root of Eiemann's measure of curvature as the space-constant, in order to avoid all appearance of implying a curvature of non-Euclid- ean spaces.

The publication of Eiemann's dissertation was closely followed by two works of Helmholtz,^ again undertake'}! in ignorance of the work of prede- "□□'"'"" □□□ cessors. In these a proof is attempted that ds must be a rational integral quadratic function of the incre- ments of the co-ordinates. This proof has since been shown by Lie to stand in need of correction {v. infra). Helmholtz's remaining works on the subject are of*

^ See B. Eussell, Foundations of Omvietry, Cambridge, 1897.

See Whitehead, " Geodesic Geometry of Surfaces in non-Euclidean Space, ' Proc. Lnnd. Math. Soc. vol. xxix.

^ Wiss. Abh. vol. ii. pp. 610, 618 (1866, 1868).

Mmd, O.S., vols. i. and iii. ; Vortrage und Reden, vol. ii. pp. 1 256.

almost exclusively philosophical interest. We shall return to them later.

The only other writer of importance in the second Belt I Period is Beltrami, by whom Kiemann's work was brought into connexion with that of Lobatchewsky and Bolyai. As he gave, by an elegant method, a convenient Euchdean interpretation of hyperbolic plane Geometry, his results will be stated at some length, i The Saygio shows that Lobatchewsky's plane Geometry holds on surfaces of constant negative curvature, straight lines being replaced by geodesies. Such surfaces are cap- able of a conformal representation on a plane, by which geodesies are represented by straight lines. Hence if we take, as co-ordinates on the surface, the Cartesian co-ordi- nates of corresponding points on the plane, the geodesies must have linear equations.

Hence it foUowa that

where w^^a^-u^-i

of our surface. The angli

1!= const, is B, where

v^)du'^ + 2'umdudv H- (a^ – v?)dip} and

1/R' is the measure of curvature between two geodesies m= const..

cos e = uvl sj{a?-v?)(a:'-i?), sine=awl {a-u^)(a?-v^).

Thus M=0 is orthogonal to all geodesies ??= const., and vice versd. In order that sin 6 may be real, w^ must be positive ; thus geo- desies have no real intersection when the corresponding straight lines intersect outside the circle

When they intersect on this circle, 8=0. Thus Lobatchewsky's parallels are represented by straight lines intersecting on the circle. Again, transforming to polar co-ordinates M=rcos/i, v=r sin /i, and calling p the geodesic distance of u, v from the origin, we have, for a geodesic through the origin,

dp='Radrj{a'

-r^),/'=2log^3^,r=atanh^.

Thus points on the surface corresponding to points in the plane on the limiting circle r=a, are all at an infinite distance from the origin. Again, considering r constant, the arc of a geodesic circle subtending an angle p, at the origin is

whence the circumference of a circle of radius p is 27rE sinh p/E. Again, if a be the angle between any two geodesies

V-r=m(U-M), V-ii=r8(U-tt),

then tan o = a[n – m)w/ {{1 + mn)a!' {v mu)(v – nu)}.

Thus a is imaginary when ??, v is outside the limiting circle, and is zero when, and only when, u, v is on the limiting circle. All these results

agree with those of Lobatchewsky and Bolyai. The maximum triangle, whose angles are all zero, is represented in the auxiliary plane by a triangle inscribed in the limiting circle. The angle of parallelism is also easily obtained. The perpendicular

to '!) = 0 at a distance S from the origin is u=a tanh =, and the

K

parallel to this through the origin is u=v sinh =. Hence n(S),

the angle which this parallel makes with v=0, is given by

tann(5). sinhg=l, or tan jn(□□)=c-/K*

which is Lobatchewsky's formula. We also obtain easily for the area of a triangle the formula R(7r – A – B – C).*

Beltrami's treatment connects two curves which, in the earlier treatment, had no connexion. These are limit lines and curves of constant distance from a straight line. Both may be regarded as circles, the first having an infinite, the second an imaginary radius. The equation to a circle of radius p and centre UjVq is

This equation remains real when p

cosh^4□□'V=CV K 0

(say), pure imaginary, and

1 His papers are "Saggio di Interpretazione della Geometria non-Euclldea," Oiornale di Matematiclie, vol. vi. 1868 ; " Teoria fonda-mentale degli spazii di curvatura costaute, " Anncdi di Matematica, vol. ii., 1868-69. Both were translated into French by J. Soiiel, AnnaUs Scientijiqwes de V□□cole Normcde supSrieure, vol. vi., 1869.

remains finite when Wq=0, provided p becomes infinite in such a

way that w□□□ cosh ^ remains finite. In the latter case the equation

represents a limit line. In the former case, by giving different values to C, we obtain concentric circles with the imaginary centre Mo%- One of these, obtained by putting 0=0, is the straight line a^-uun-vvQ^O. Hence the others are each throughout at a constant distance from this line. (It may be shown that all motions in a hyperbolic plane consist, in a general sense, of rota- tions ; but three types must be distinguished according as the centre is real, imaginary, or at infinity. All points describe, accordingly, one of the three types of circles.)

The above Euclidean interpretation fails for three or more dimensions. In the Teoria fondamentale, accordingly, where n dimensions are considered, Beltrami treats hyperbolic space in a purely analytical spirit. The paper shows that Lobatchewsky's space of any number of dimensions has, in Riemann's sense, a constant negative measure of curvature. Beltrami starts with the formula (analogous to that of the Saggio)

ds^=^{dx'dx^^-^-dxl ++'^^)

where x' + Xi + ai2+ ... +x=a

He shows that geodesies are represented by linear equations be- tween Xi, X2, ..., x, and that the geodesic distance p between two points X and a/ is given by

a'^ – anix'i – x^' – ... x x'

cosh ^ =

.'^\V2

*Xi-X2-...-Xj{a^-Xi-X2-...-X)} *

(a foi-mula practically identical with Cayley's, though obtained by a very diiferent method). In order to show that the measure of curvature is constant, we make the substitutions

a^=r\, X2=r...Xn=rK, where 2X^=1.

Hence ds^ = (Radr/a^ – r^f ǂ EV(□□A7(a2 – r).*

where dS?=-Zd>?.

Also calling p the geodesic distance from the origin, we have

cosh

, sinh|= ,J1-^.

Hence

Putting we obtain

rfs'=(?p2-l- [r sinh I VdA2.

Zl = pXl, Z2 = p}^, ...Z□□□ = p\n,

rfs2= S(is2 -H i I [– sinh ^ V – 1] 2(□□irf2t – MZi)'. Hence when p is small, we have approximately

Considering a surface element through the origin, we may choose our axes so that, for this element,

Z3 = Z4=...=S□□□ = 0.

(1).

Thus

ds^=dzl + dzl+^,{z,dz^ – z^z^f

(2).

Now the area of the triangle whose vertices are (0, 0), (zj, z^, (dz^, dz^ is 4 (j], dz^-z^z{j. Hence the quotient when the terms of the fourth order in (2) are divided by the square of this triangle is ijSiB? ; hence, returning to general axes, the same is the quotient when the terms of the fourth order in (1) are divided by the square of the triangle whose vertices are (0, 0,

...0), (%, 2, Zj, ... z), (rfzi, dz., dz^ ...dz). But -| of this quotient is defined by Riemann as the measure of curvature.^ Hence the measure of curvature is 1/R^, i.e., is constant and negative. The properties of parallels, triangles, &c., are as in the Saggio. It is also shown that the analogues of limit surfaces have zero curvature ; and that spheres of radius p have constant

positive cui-vature l/R^sinh"^, so that spherical geometry may be

regarded as contained in the pseudospherical (as Beltrami calls Lobatchewsky's system).

*The Saggio, as we saw, gives a Euclidean interpretation confined to two dimensions. But a consideration of the auxiliary plane suggests a diflferent interpreta- Transition tion, which may be extended to any number of to the dimensions. If, instead of referring to the Projective pseudosphere, we merely define distance and * " angle, in the Euclidean plane, as those functions of the*

'^ Beltrami shows also that this definition agrees with that of Gauss.

co-ordinates which gave us distance and angle on the pseudosphere, we find that the Geometry of our plane has become Lobatchewsky's. All the points of the limiting circle are now at infinity, and points beyond it are imaginary. If we give our circle an imaginary radius the Geometry on the plane becomes elliptic. Replacing the circle by a sphere, we obtain an analogous representation for three dimensions. Instead of a circle or sphere we may take any conic or quadric. With this definition, if the fundamental quadric be 'S,xx = 0, and if 'S.^^' he the polar form of "S^x, the distance p between x and x is given by the projective formula

That this formula is projective is rendered evident by observing that e"" is the anharmonic ratio of the range consisting of the two points and the intersections of the line joining them with the fundamental quadric. With*

this we are brought to the third or projective period. The method of this period is due to Cayley ; its applica- tion to previous non-Euclidean Geometry is due to Klein.

The projective method contains a generalization of discoveries already made by Laguerre in 1853 as regards Euclidean Geometry. Metrical properties, in Euclidean space, are projective properties relative, in two dimensions, to the circular points and the line at infinity considered as a degenerate conic, or, in three dimensions, to the circle and the plane at infinity considered as a degenerate quadric. Substituting a proper conic, or quadric, real or imaginary, we obtain the recognized non-Euclidean results. (In three dimensions some restriction as to the kind of quadric is necessary, if the measurement of angles is to be Unchanged, and if a finite rotation is to cause a return to the initial position. Tangent lines from any point to the Absolute or fundamental quadric make an infinite angle with all other lines through the point ; it is therefore necessary that they should be imaginary. Hence the absolute, when expressed as the sum or difference of squares, must have all its signs positive, or three positive and one negative. This excludes the hyperboloid of one sheet.)

This method leads to a discrimination, first made by Klein,! gf two varieties of Eiemann's space ; Klein calls Tbe two these elliptic and spherical. They are also klads of called the polar and antipodal forms of elliptic elliptic space. The latter names will here be used. space. ijjjg difference is strictly analogous to that

between the diameters and the points of a sphere. In the polar form two straight lines in a plane always intersect in one and only one point ; in the antipodal form they intersect always in two points, which are antipodes. Similarly two diameters always determine a plane, but two points on a sphere do not determine a great circle when they are antipodes, and two great circles always intersect in two points. Again, a plane does not form a boundary among lines through a point : we can pass from any one such line to any other without passing through the plane. But a great circle does divide the surface of a sphere. So, in the polar form, a complete straight line does not divide a plane, and a plane does not divide space, and does not, like a Euclidean plane, have two sides. ^ But, in the

antipodal form, a plane is, in these respects, like a Euclidean plane. The polar form alone, among the various spaces, gives absolute duality between points and planes, or, in two dimensions, between

‘ Math. Annalen, iv. vi. 1871-72.

‘ For an investigation of these and similar properties, see White- head, Unwerscd Algebra, Cambridge, 1898, Bk. vi. chap. ii. The polar form was independently discovered by Newconib in 1877.

points and lines. The reason of this is simple. The measurement of angles is always elliptic ; among the lines or planes through a point, those that make an infinite angle with the rest are imaginary, and for real values angles are periodic. Thus it is only where the measure- ment of length is also elliptic that complete duality prevails.

A question, similar to that which arises in connexion with Kiemann, may be asked concerning the nature of the co-ordinates employed in the projective treatment of metrical properties. The co- ‘”’—^^j”^ ordinates of elementary Geometry are always ►►►►► metrically defined. But if metrical properties are to be defined in terms of our co-ordinates, these must be defined in a new way. Anharmonic ratio itself, as commonly defined, involves lengths, and therefore requires a new definition when lengths are to be defined by its means. Klein has shown ^ how to fulfil these require- ments by an appeal to von Staudt’s quadrilateral con- struction. This construction gives a purely projective definition of a harmonic range, and enables us, starting from three given points on a line, to obtain as many other points on the line as we please by successive repetitions of the construction. In this way an order is assigned among the points of a line (or the planes through a line). Our co-ordinates then express the position of our point (or plane) in the series so obtained, and are thus wholly free from metrical presuppositions. In like manner, by two sets of quadrilateral constructions, we can assign the co-ordinates of a point in a plane or a plane through a point ; and by three sets we can assign the co-ordinates of any point or plane in space. Any point whose co- ordinates are given may thus be found, provided these co-ordinates

are rational. If they are irrational, the point can of course be assigned as a limit.

By means of the projective method and the theory of

*continuous groups, Sophus Lie * has been enabled to give*

a complete answer to the question which Helm- . , , 11 1 1 -iTTi SopbtisLle.

holtz attempted to solve, namely : W hat axioms

are involved in the possibility of rigid bodies with six degrees of freedom ? Assuming that any two points have a distance, which is some function of their co-ordinates, the group of motions must be such as to leave this function invariant. Hence it can be proved that ds^ must be an integral quadratic function of the co-ordinates, and that motions are collineations which transform a certain quadric (the Absolute) into itself. In non-Euclidean Geometry this condition is also sufficient ; in Euclidean Geometry it is necessary further to exclude similarity-transformations. The axioms from which Lie starts are the following : Let

^l=/(‘ ‘’/= l“‘2---)

2/i = 0(OT/zaifli ,,)

be an infinite collection of real transformations of the space X, y, z, concerning which we make the following assumptions :

A. The functions/, 0, \j/ are to be analytic functions of the co- ordinates X, y, z, and the pai-ameters ;, a^, a^.

B. In regard to all transformations of the collection, any two points a’l i/j =j, x^y^z^ are to have an invariant

C. There is to be free mobility in the sense of Riemann and Helmholtz ; i.e. (1) the point xi/z can be transformed into any other ; (2) if a point

x^y^z-^ is kept fixed, every other point x-^^ {of general position) can take up oo^ positions, given by the equation

^{xaiZ^x'^y'^z') = Qix^y^z^x^^) ;

(3) if two points are fixed a third can take up oo^ positions,

.ffulh. Annalen, iv. vi. vii. x.Yxvii. ; Vorlesvngm Uber nichi- Euklidisehe Geometric, Gijttingen, 1893, vol. i. pp. 308 f.

- *"Ueber die Giundlagen der Geonietrie," Leipziger Berichte, 1890,*

determined by two such equations as the above ; (4) if three (non-coUinear) points are fixed every point is fixed.

From these assumptions it follows at once that the transformations considered form a six-membered group. By a completely exhaustive method it is shown that, if the assumptions are to hold without exception throughout a certain region, then the group considered can only be the group of Euclidean or non-Euchdean motions, and the invariant fl is the Euclidean or non-Euclidean distance. Helmholtz, in investigating the same problem, required a fourth axiom, which he called Monodromy ; this demands that the curves described in a rotation (i.e., a motion which leaves two points fixed) should be closed. [See Wiss. Ahh. vol. ii. p. 624.] This axiom Lie finds unnecessary if, in three dimensions, free mobility is to hold unreservedly throughout a certain region. But if we admit groups in which, when one point is fixed, a certain straight line also remains fixed, then Helmholtz's axiom becomes necessary, but not suflicient.i In two dimensions the axiom is necessary even if free mobility holds without exception throughout a certain region, but not if it holds throughout the whole two-dimensional space.

Thus if free mobility, in the above sense, be taken to hold universally, the above three axioms suffice to charac- s aces not ^^'-^ space as of one of

four kinds ??? Euclidean, allowing hyperbolic, and the two elliptic varieties. It free mo- has been pointed out by Klein, however, that biiityin there are other possible spaces, allowing free

e s sense. jjjQ]i,jjj|^y j^ g^ wider sense, i.e., permitting trans- formations which leave metrical properties unchanged, and transform a chosen point into any other chosen point, but not containing as many such transformations. Such spaces still have constant measure of curvature, and their infinitesimal geometry belongs to one of the usual types. Their diflferences from these types may be best illustrated by an example, which is important on its own account.

In elliptic space, the locus of points at a constant perpendicular distance from a given straight line is a ruled quadric, any two of Clltt rd's ^hos?? generators of the same set have an infinite surface of ^^^^^^ ??f common perpendiculars, all of equal length, as have also any generator and the axis of the surface. tare and ‘ ””^ surface is of zero curvature, but of finite extent, finite ex- ”” ” ^^ transformed into itself by only oo ^ motions.^ ^ggf Its properties may be developed by elementary con-

siderations, as follows. Let the Absolute be

3,2 + 2,2 + 22 + ^2 = 0,

and let the axis of the surface be 8=0, w=0. The plane through {x, y, i, w) perpendicular to the axis is x’lx=y’ly, which meets the axis in (x, y, 0, 0). The distance oi(x, y, 0, 0) from (x, y, s, w) is p,

where cos2| = (x^ + y^)’^^? + y^^a? + y’ + z’ + w’)

= (x^ + y^)l{a? + y’ + z^ + w^). The surface is defined by p= constant. Hence its equation is

x^ + y^=cof^.{??^ + i^).

Putting cot^=p, the generators of this surface are

x~pz = \(pw-y)\ j^jjj tx-pz=ij.{pw + y) X(x +pz) =pw + y f \ /it(a5 +pz) =pw – y

It is easily shown that the perpendicular to ►► = 0, w=0 from any point of a generator is also perpendicular to the generator. Again if we put

\=tanff, |U = tan0,

we find x:y ►►►.s:w=pcos(8 – 4>) xpsmiB –) ►►►►►►<:os{d + (p): sin (6 + ((>)►►►, whence, on the surface (for which p is constant),

^ i.e., in addition to Euclidean and non-Euclidean motions, there are other groups, of which some satisfy the axiom of Monodromy. See Lie, Theorie der Transformationsgruppen, Leipzig, 1893, vol. iii. p. 470.

^ This surface was discovered by Clifford ; its generators of one set are (in his sense) parallel to each other and to the axis. See Klein, "Zur nicht-Euklidischen Geometric," Math. AnncUen, vol. xxxvii.

+vJ'Xd3!i+diP+di!i+dw'^dwp

lii~ (j^+j2+j2+u;2)2

*=d92+(if,2-2^zld9(J^*

=dm+d4'i

2p

- 2 cos-rd(

This formula shows that the surface has zero measure of curvature, that its geodesies are given by linear equations in 6 and 0, and that any two generators 9 = constant, 0=constant, make an angle 2plk with each other. Hence the whole surface may be divided into similar parallelograms, and since the length of a generator

is ►►►wk, the area of the surface is irVain.►►►^. Again, motions are

coUineations which transform !ji? + y^ + z” + ‘vfi into itself. Those motions which transform the above surface into itself also leave (x^ + y’)/{z^ + vP) unchanged. Hence they leave x’ + y^ and z^ + w^ each unchanged. Hence they are given by

qx! = x cos a ~ J/ sin a qz’= z cos ^ + to sin ^

J2/’ = – x sin a) 2/ cos a. qw’ = -ain^-f) cos ;3 where q is an arbitrary factor. Hence

af :!/’:a’:ii;’=jioos(e-0-(i):psin(9-ifi-a):cos(9-(fi/3):sin(9-f0-3).

Thus generators are transformed into others of the same set ; the transformation is given by

e’ = 9-i(o-l-jS),0′ = 0-|-i(a-^).

If a+/3=0, one set of generators is unchanged, and every point of the surface moves along these generators. The same transforma- tion gives the same result for surfaces corresponding to other values of ^. Thus there are motions of elliptic space in which all points move along parallel lines ; in this respect, also, Clifi’ord’s parallels resemble Euclid’s. The combination of two such motions, one alter- ing S only, the other 0 only, gives the general motion leaving p = const, unchanged ; and thus only oo ^ motions transform this surface into itself. Since, however, the surface is homogeneous, there is a possible two-dimensional space with the same properties. Thus within each type of space we have varieties, differing as regards connectivity and analysis situs. In the case of positive measure of curvature, there are only the two usual varieties ; but in the negative case there is, as Klein has shown, an infinite number.

The philosophical questions raised by non- Euclidean Geometry have been rendered unduly difiicult by some very prevalent misconceptions. Three of these are xbreeore- especially important. The first concerns the valentmls- phrase “measure of curvature,” the second concep- concerns the projective definition of distance “”’ and angle, and the third concerns the relation of the axiom of congruence to rigid bodies.*

There are, as we have seen, two principal types of Euclidean analogues to non-Euclidean spaces. There is the type preferred by Beltrami, and, unfortunately, popular- ized by Helmholtz {Mind, O.S., vol. i.), which compares the non-Euclidean plane to a Euclidean surface of constant curvature. There is, secondly, the type introduced by Cayley and Klein, in which, within Euclidean space, we introduce a new definition of distance. Both are extremely useful as analogies, but both have a tendency to pass for something more.

The confusion resulting from the first of these analogies has led to the view that the surface of a sphere actually is a plane in the antipodal form of elliptic space.^ Similarly it has been supposed {e.g., ^^"f^" by Newcomb) that non-Euclidean spaces of three dimensions should be regarded as figures in a four- dimensional Euclidean space, being related to it as the sphere to ordinary space. This has made it appear to philosophers that they had to do only with an increase in the number of dimensions. The rest of the apparatus seemed a mere wilful change of nomenclature ◆◆◆ a circle ', was to be called a straight line, a sphere was to be called a plane, and so on. The same error underlies all these views. The conception of a space is essentially the con- ception of a totality ; a figure having points external to it must in no circumstances be regarded as itself a space.

' See, e.g., Lechalas, " Identity des plans de Riemann et des spheres d'Euclide," Anwxlesde lasociitS sdentifique de Bruxelles, t. xx. (1896).

Now the important and interesting fact (which Eiemann pointed out) is that we can conceive a point-manifold in which the measure of curvature is not zero, and in which, nevertheless, there is no hint of a reference to elements not contained in this manifold. In the usual theory of Euclidean surfaces there is a perpetual reference to points not on those surfaces ◆◆◆ we have normals, tangent planes, &c. But Eiemann pointed out how, by Gauss's method, such external reference could be avoided, provided we were willing to regard as identical all surfaces having the

same formula for ds\ For, from this formula, the measure of curvature can be found, and thence the geo- desic Geometry of our surface follows. (In the formula for ds^, two co-ordinates should be chosen which have a geometrical meaning on the surface ??? e.g., geodesic polars.) Nevertheless (though Eiemann appears to have over- looked this), the self-dependence of our Euclidean surface is only real when it is possible to effect measurements without leaving the surface, and this requires that the measure of curvature should be constant. When this condition is fulfilled the Geometry of our surface involves no reference to external space. But our surface still has external space outside it, and is thus not a space. T\1iat we have shown is, therefore, that a manifold might exist having the same internal relations as our surface, but destitute of the external relations which our surface also possesses. Such a manifold would be a Euclidean or non-Euclidean space of two dimensions. Such a space is radically different from a plane in three-dimensional space. Thus, e.g., a plane has two sides and has position, while a two-dimensional space has neither. Hence we have three things to distinguish : (1) a sphere or pseudo- sphere in Euclidean space, (2) an elliptic or hyperbolic space of two dimensions, (3) a plane in an elliptic or hyperbolic space of three or more dimensions. Similarity in symbolic treatment does not show identity in the subject-matter treated. But the fact that we can, in treating of surfaces of constant curvature, abstract from relations to external space, shows that there is a logical possibility of a space containing similar internal relations ???without any external spatial relations. And in like manner, the possibility follows of three-dimensional spaces whose planes formally resemble Euclidean surfaces of constant curvature. On this point clearness is very important ; for otherwise there is a danger of losing the essential and interesting point in non-Euclidean Geom- etry. A mere increase in the number of dimensions affords nothing radically novel; what is novel, is the discovery that space of a given number of dimensions may be of various kinds. Indeed, it is the very absence of reference to a higher Euclidean space which is chiefly interesting about the non-Euclidean spaces. From this point of view a direct investigation, starting from axioms like those of Lobatchewsky, Bolyai, and New- comb, is preferable to more powerful but more symbolic methods.

The same reckless reference to spaces of higher dimen- sions, in which a given space may be supposed to be con- tained, has concealed the logical absurdity of regarding the measure of curvature as possibly variable. A figure contained in a space may have variable measure of curva- ture, since spatial quantities may still be equal in differ- ent places. But where a space is supposed to have variable measure of curvature, no such possibility exists. For it follows, in this case, as we saw in connexion with Eiemann, that equal quantities in different places are impossible. Lengths in general differ qualitatively, and are therefore not measurable in terms of each other. Consequently no two quantities in different places can have a numerical ratio, since ratio implies division into equal parts. Hence metrical Geometry would collapse,

and instead of a variable measure of curvature, we should have no measure of curvature. The essential thing about lengths is, that they are divisible quantities of the same kind, and therefore any two are equal or unequal, and have a numerical ratio. But when there is not a constant measure of curvature this essential property is lost ; we can no longer say, of two lengths, that they must be equal or unequal. Hence homogeneity, or constant measure of curvature, is essential to metrical Geometry.

Again, it is important to notice that we cannot appeal to motion in anything concerning the foundations of met- rical Geometry. Motion, as used in Geometry, is not the motion of a single point, but the Motion ir- motion of many points, or even of all points, ae^^^l^ Now, if we ask how a motion is distinguished from other transformations, the only reply is, that it leaves metrical properties unchanged (with the restric- tion, strictly speaking, that it can be generated by infini- tesimal steps). Thus metrical properties are presupposed in the definition of motion, and must not be defined by its means. Thus when Eiemann, for example, assumes that ds is unaltered by the same infinitesimal motion of all the points of the infinitesimal arc, his argument is circular ; for the same infinitesimal motion of a number of points can only be defined in terms of ds. The exist- ence of equal spatial quantities in different places is pre- supposed in the definition of motion, and motion is not presupposed in metrical Geometry.

A somewhat perplexing question arises, in connexion with the necessary all-inclusiveness of a space, as re- gards different values of the *pace-constant. Are there different possible hyperbolic spaces belmsen or elliptic spaces, having different space- con- anfereai stants, or is there only one space of each kind ? space- Considering two spaces each as a whole, there ”’”* ***”- seems no possibility of quantitative comparison between them, and it seems absurd to speak of one as having a greater or smaller space-constant than the other. All lengths in either can only be estimated relatively to the space-constant, which itself, except in relation to those lengths, has no particular magnitude. Nevertheless, we speak of our actual space as approximately Euclidean, and in relation to empirically given lengths we may certainly speak of greater or smaller space-constants. The following account seems to satisfy both these appar- ently opposite requirements. The space-constant of a space is one among lengths in that space, and has mag- nitude accordingly. The question. What is the ratio of the space-constant to some given length? has there- fore a definite answer. But lengths in different spaces (even where both spaces are elliptic or both hyperbolic) differ in quality ??? they differ in the same way as do two shades of red. As is the case with shades of red, the different possible qualities form a continuous series ; and the space-constants, along with all other lengths in their respective spaces, share these qualities, and thus acquire a place in a continuous series. Although each space-constant is a magnitude, each differs in quality from every other space-constant. No length in one space is greater or smaller than a given length in another space, and this extends also to their space-constants.^ But when we ask, in our actual space, what is the ratio of the space-constant to (say) the diameter of the earth’s orbit, the different possible answers correspond to dif- ferent qualities which all our actual lengths may have ???all of them have the same quality, but since the pos- sible qualities form a continuous series (like shades of***

It IS this necessity for a qualitative difference between lengths corresponding to different space-constants which, as we saw, makes impossible the metrical treatment of spaces without a definite space-constant.

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colour), "we do not know exactly which of the possibilities is actual. Thus, though one space-constant is not greater or smaller than another, we may legitimately inquire what is the ratio of our actual space-constant to empirically given lengths.

The second confusion resulting from the undue use of Euclidean analogies has been suggested by the projective treatment. Since all non-Euclidean results can Projective]^q obtained, in Euclidean space, by a new distance, measure of distance and angle, it seems super- fluous to invent new spaces for the interpretation of the results in question. Thus Cayley always maintained the exclusive validity of Euclidean space, holding that, in non-Euclidean Geometry, he had merely substituted new measures in the old space. Against this view much may be said in detail, but the most cogent argument may be briefly stated. If there are such quantities as distance and angle, their measure can only be arbitrary so far as concerns the choice of a unit, and any different measure must be simply false ; while if there are no such quantities, then they can have no measure at all. Thus it is in no case open to us to choose arbitrarily, among several functions diifering by more than a constant factor, which of them shall express distance or angle : either one such choice or none must be correct. Passing to the actual case, we find that, when our co-ordinates express an- harmonic ratios obtained by Staudt's construction, the distance of two arbitrary points on a line is obtained by keeping two of the points required for anharmonic ratio fixed. Thus only two variable points remain, and the logarithm of the anharmonic ratio thus obtained has always, however our fixed points are chosen, a certain resemblance to distance, consisting chiefly in the fact that it is additive. It may then be doubtful what pair of points on our line are to be fixed, but only one such pair can actually give the distance, unless indeed there be no such thing as distance. This may be easily seen by considering that our two fixed points, in virtue of the formula, are at an infinite distance from all other points on the line. If there be such a thing as distance, it is therefore necessary that our fixed points should be at infinity in some not purely conventional sense. The different types of straight line are really, and not merely artificially, distinguished by the property of having their points at

infinity real and distinct, imaginary, or coin- cident. It is true we may take the other alternative, and deny the existence of distance altogether: there is nothing in pure projective Geometry to imply its existence. But then we cannot know that all the points of our line form a series. Only those obtained by successive quadri- lateral constructions will form a series, unless we introduce order by Pieri's method (7 principii della Geometria di Posizione, Turin, 1898 ??? a work which marks a great advance in logical purity). And thus our arbitrary definition does not necessarily give a distance to every pair of points. It should be observed that we cannot, without assuming the metrical order obtained from dis- tance, legitimately ask whether the points obtained by repeated quadrilateral constructions are evenly distributed (uberall dicht), or whether they leave gaps. For such a question implies that our points have an order in- dependent of that obtained by the quadrilateral construc- tion, and this in turn implies distance. We can only ask whether the points we obtain are all the points of the line, but to this question projective Geometry gives no answer. Metrical Geometry, however, gives a negative answer, for the points projectively obtained form a de- numerable series, while all the points form, in Cantor's phrase, a series of the power of the continuum (see Number). Thus only a vanishing proportion of the points of a line form, with three given points, a range

having, in the pure projective sense, an anharmonic ratio. Finally, there is a last curious restriction to the projective method. The uniqueness of the quadrilateral construction cannot be projectively proved without three dimensions, and hence there is no pure projective Geometry of spaces having onlj'- one or two dimensions.

A third confusion remains as regards the relation of the axiom of congruence to rigid bodies. The axiom of congruence is the axiom in virtue of bodies ua- which superposition may be used (as in Euclid's necessary fourth proposition) to prove the equality of '" 9f?? two figures. But there is some difiiculty in " stating precisely the requisite axiom. Helmholtz main- tained {e.g., Wiss. Abh. Bd. ii. pp. 614, 616) that it asserts the actual existence of rigid bodies, and thence inferred that Geometry is dependent upon Mechanics. He supported his view by reference to the process of measurement, in which the measure must be,*

at least approximately, a rigid body. In so far as it is not rigid our results are inaccurate ??? unless, indeed, we know how to allow for its changes of shape, which would imply some still more rigid body by which our measure is itself measured. Thus, in so far as measurement is trustworthy, it implies the existence of bodies which, during the motion required for superposition, do not greatly change in shape. But this is not an analysis of what is meant by spatial equality, and is not relevant to Geometry. The definition of a rigid body, like the definition of geometrical motion, presupposes what is really meant by the axiom of congruence. A rigid body is one which, at different times, occupies equal spaces. Thus equality of spaces is logically prior to rigidity of bodies. How we discover two actual spaces to be equal is no concern of the geometer; all that concerns him is the existence of equal spaces, the fact that two spatial quantities may be equal or unequal. And this is indeed the true meaning of the axiom. Given two points at a certain distance apart, and any third point, the axiom asserts that there are, on any straight line through the third point, two points whose distance from the third point is equal to the given distance ; it makes also similar assertions as regards areas and volumes. This is all that metrical Geometry requires as regards an axiom of spatial equality. The apparent use of motion is deceptive; what, in Geometry, is called a motion, is merely the transference of our attention from one figure or set of elements to another. Actual super- position, which is nominally employed by Euclid, is not required ; all that is required is the transference of attention from the original figure to a new one, defined by the position of some of its elements and by certain properties which it shares with the original figure. This may be enforced by two simple considerations : (1) What is purely spatial cannot move : a given point, line, or plane is what it is in virtue of its place, and can never change that place. It is only what occupies space, i.e., matter, that can move. (2) If rigid bodies formed any part of the meaning of congruence, it would be self- contradictory to assert, as science does assert, that no body is perfectly rigid. For before we can discuss whether or not a body is rigid, we must be able to decide as to its dimensions at different times; and if this means a comparison with a standard body, then it is a logical impossibility that the standard body should itself be supposed changeable. The standard body would be itself the unit, and could no more suffer change than any other absolute unit. The whole confusion appears to be

due to not distinguishing between the process of measurement, which is of purely practical interest, and the meaning of equality, which is essential to all metrical Geometry.

We may now proceed to specify the various stages in the particularization of spaces, pointing out what Pour stages axioms lead to given portions of Geometry. We la specify- may distinguish four stages, each with its lag a space, appropriate axioms. In the first stage we assume only the purely projective properties ; in the second, we further assume distance ; in the third, we assume that, in a space of n dimensions, there are co4”-?-?+i ~~motions (i.e., transformations leaving all distances un~~ changed) ; in the fourth, finally, we distinguish between the four usual types of space, and become confined to one among them. Thus all the axioms of the first three stages are common to Euclidean, hyperbolic, and elliptic spaces.

I. The pure proj ecti ve theory knows nothing of distance,

nor, consequently, of any order among points, fw/!^’’ lines, or planes, except that introduced by the

quadrilateral construction. By means of this construction it defines a harmonic range, pencil, or sheaf; by the series of quadrilateral constructions (where any such series exists) required to reach a given point from three original points in the same straight line, it defuies the anharmonic ratio of a range (with similar definitions for a pencil or sheaf). We can show that, where four elements have an anharmonic ratio at all, this is unaltered by projection ; and we can establish the usual propositions concerning homography. For that (unknown) proportion of elements projectively obtainable from the requisite number of original elements, we can, in short, in a space of three or more dimensions, establish all the usual propositions of projective Geometry. In three dimensions the axioms required for this most general Geometry will be found to be the following : ???

(1) Any two points (planes) in general determine a straight line, and any three which are not coUinear in general determine a plane (point). The same line is determined by an infinite number of other pairs of points (planes), and the same plane (point) by an infinite number of other triplets of points (planes). A plane or line is said to contain any point which is one of those determining it, and a point or line is said to lie on any plane which . is among those determining it.

(2) When two planes (points) both contain (lie on) two points (planes), they contain (lie on) the line determined by the two points (planes).

(3) A plane may also be determined by a determining point and the line joining two others of its determining points ; and conversely, a point is determined by a plane and a line.

In these axioms the dualistic assertions regarding planes and points are not alternatives, but are both necessary. The corresponding axioms for any number of dimensions are of the same form, and are necessary to any Geometry of that number of dimensions ; but in the case of two dimensions, they are not, by themselves, sufficient to found a Geometry. In order to apply the axioms to hyperbolic space it is necessary to take account of ideal elements.'

II. With the assumption of distance a new set of

axioms is introduced, and metrical Geometry d/stance."" becomes possible. Projective Geometry assumes

one relation, the straight line, between any pair of points ; we now introduce another relation, namely distance, which, unlike the straight line, is a quantity. All distances are regarded as quantities of the same kind, and thus the metrical homogeneity of space is involved. We are restricted, therefore, to spaces having a space-constant. In all of these, the angle-sum of a

1 For the way in which this is done, see Pasch, Neuere Geoinetrie Leipzig, 1883, esp. ☐☐☐☐ (y-'X

triangle differs from two right angles by some constant multiple of the area of the triangle. When this multiple is zero, the geometry of figures not exceeding some finite size is always Euclidean. But the space is not yet wholly specified ; it may differ as to connectivity, as to finitude or infinity, and as to the number of degrees of freedom in motions. The axioms by which the nature of distance is specified are the following : ???

(1) Any two points have a quantitative relation called distance, which, if both points are real, only vanishes when they coincide. Any two distances are quantities of the same kind. (Thus, if both are real, either they are equal, or one is greater than the other.)

(2) If 2}, g, r be three points in one straight line, the sum of the distances pq, qr is equal to the distance jjr (distances in different directions being defined to have different signs, so that pq + qp = 0).

*(3) If a, b, c be any three points, and the distances ab, be are finite, then the distance ac is finite. If ab is finite, and be infinite, or vice versd, then ac is infinite. Also if ab, be are real, then ac is real.^*

III. The next step is to introduce free mobility in the sense defined by Lie's axiom C (v. supra).

Free mobility in the general sense was already ^ow/zft- introduced by homogeneity, that is, any figure could be freely moved in oo??-"+i ways (supposing oui space to have n dimensions). But Klein has pointed out that it does not follow from this that a space as a whole can be transformed into itself in the same number of ways. The addition of this further axiom to those given above shows that our space is of one of the four usual types." All the spaces excluded by this axiom differ from those that remain in some dis- continuous respect ??? i.e., as regards their connectivity and analysis situs. The four types which remain, on the other hand, contain Euclidean space as a limiting case between hyperbolic space and either form of elliptic space, and are thus in a different position from the ex- cluded types.*

IV. It remains to specify the differences between the four remaining types. These differences are o/fferences chiefly metrical, but each space may also be among the distinguished by projective properties, provided toarprinci- we exclude ideal elements. Thus (1) in the '^ ”’”’””’’ ??? antipodal form of elliptic space two straight lines m a plane intersect always in two points ; in the other spaces they intersect at most in one point. (2) In the polar form of elliptic space two straight lines in a plane always inter- sect ; in Euclidean and hyperbolic space they may or may not intersect. (3) In hyperbolic space intersection and non-intersection are equally general cases ; in Euclidean space non-intersection is a limiting case. But these pro- jective distinctions are overcome by introducing ideal elements wherever required, and by identifying antipodal points in antipodal elliptic space, and by this means pro- jective propositions become identical for all four spaces. The metrical differences are more serious. In the first place, all non-Euelidean spaces have an absolute unit of length, the space-constant, just as all spaces, including Euclid's, have an absolute unit of angle. Hence lengths, in non-Euclidean geometries as in spherical trigonometry, appear only in their ratios to an absolute unit. The geometrical meaning of the space-constant, in the two forms of elliptic space, is simple : the length of a complete straight line is, in the polar form, -n-A-, in the antipodal form, 2Tvk (where k is the space-constant). (In hyper- bolic space, where the straight line is infinite, the geo- metrical meaning is less simple.) All questions concerning

2 See Whitehead, Universal Algebra, Bk. vi. chap. 1. ' See Kleiu, Math. Annalen, vol. x.xxvii. pp. 554-565.

parallelism are of course metrical, as is the question concern- ing the sum of the angles of a triangle. Thus, speaking broadly, projective theorems are the same in all the spaces, while metrical theorems are different. But the measure- ment of angles and the Geometry in a point {i.e., of lines through a given point) are the same in all spaces, being in fact elliptic. This is due to the fact that angular measurement is determined by those properties of linear measurement which are the same in all spaces. The

circle is always a closed curve, since all lines through its centre always meet it in two points. Hence the lines in a plane through a point form a closed series, and the measurement of angles is elliptic'

The various possibilities which we have reviewed raise two distinct questions. The first of these is philosophical : Have we, as Kant maintained, any d, priori ^^"^ . ground for excluding all or some of the non- questioas. Euclidean spaces ? The second, which pre- supposes a decision that some, at least, of the non-Euclidean spaces are d, priori possible, is scientific : What empirical means have we for deciding which of the possible spaces is actual ? What are the best observations, or are there any observations, upon which we may base an opinion ? These questions are radically distinct, and it is important to discuss them separately.

Kant had contended that space, on grounds independent of Geometry, is an db priori form of intuition, and that Ge- ometry, consequently, has apodeictic certainty ; ^"^fori" ❓❓❓while conversely he inferred, from the then grounds admitted apodeictic character of Geometry, that *"❓❓❓ space must be an d, priori form of intuition.*

aace" These two lines of argument, which supported one another, were called respectively the meta^ physical and the transcendental deductions of space {Critique of Pure Reason, 2nd ed.). Against this theoiy non-Euclidean Geometry has, from the first, been regarded as a very powerful argument, and its promoters ❓❓❓ Gauss, Lobatchewsky, Bolyai, Riemann, Helmholtz ❓❓❓ have all pointed out the supposed refutation of Kant. Riemanu and Helmholtz, who deal explicitly with the philosophical question, consider all geometrical axioms to be empirical,^ though Eiemann, at least, appears to regard arithmetic and algebra as ft priori. It would seem, however, that non-Euclidean Geometry, though it gives Kant's doctrine something of the air of a paradox, cannot, strictly speak- ing, be considered as logically affecting that doctrine. A purely philosophical theory, such as that of Kant, can only be met by purely philosophical arguments ; mathe- matics, though capable of suggesting new views, can hardly be capable of proving them. If the reasons-which Kant adduces, in the metaphysical deduction, for holding space to be an A

priori form of intuition be found valid, they are alone sufBcient to prove his conclusion, and these reasons are wholly unaffected by non-Euclidean Geometry. Even the transcendental deduction, though robbed of most of its plausibility, can hardly be disposed of by mathe- matics alone ??? for mathematics alone, however many new Geometries it may invent, can never prove that the truth of Euclid is uncertain. Indeed, Kant's doctrine, as com- pared with those of the earlier idealists, is peculiarly adapted to meet the opponents of Euclid ??? so much so, indeed, as to suggest a possible influence of Lambert {v. supra), with whom Kant carried on a correspondence. In Kant's first published work (ed. Hartenstein, 1867, vol. i. pp. 21 ff.), he maintained the possibility of space with more than three dimensions, this being the only departure from Euclid with which he was then acquainted.

1 See an article by B. Bussell in the Revue de metaphysique et de morale, November 1899.

2 See also Erdmann, Axioms der Geometrie, Leipzig, 1877.

In the Critique of Pure Reason, on the contrary, it is pre- cisely the axiom of three dimensions which he instances as an example of apodeictic geometrical propositions {ib. vol. iii. p. 61). It was not the logical possibility of other spaces than Euclid's which could shake his doctrine ; in- deed, this was expressly admitted by the theory that all geometrical propositions are synthetic, i.e., can be denied without contradiction. The essence of his answer to scepticism lay in the contention that we may be certain d. priori of some propositions whose contradictory is not logically absurd. Thus Kant must be met, not by a simple appeal to non-Euclidean Geometry, but by the establishment of some philosophical proposition, e.y., by one of the following three : (1) We have an intuition of non-Euclidean spaces; (2) in the sense in which Kant uses the word, we have no intuition of Euclidean space ; (3) our intuitions are irrelevant in a logical inquiry con- cerning space. No one of these three propositions follows from non-Euclidean Geometry alone. Helmholtz main- tained the first, but seems to have misunderstood Kant's ??? meaning.^ Both the second and third seem to be capable of proof ; but their discussion, which

belongs properly to the criticism of Kant, would carry us too far from our subject to be attempted here.

It remains to inquire whether spaces not belonging to the four main types are logically possible, and if so, why they have received so little attention from mathematicians. The reply seems to be, as regards those which have no space-constant, that, though they are logically possible, they differ from Euclidean space so materially as to be destitute of the interest belonging to spaces more akin to that in which we live. The spaces which have a space- constant, but do not fulfil Lie's axiom of free mobility, appear, however, to deserve just as much consideration as the four usual types, and to have failed to receive it only because of their recent discovery.^ These types allow, so far as figures not exceeding a certain size are concerned, the usual kind of mobility throughout a certain region, and this is all that experience can warrant us in demand- ing. But spaces (if so they can be called) which have no space-constant, though possible logically, would be in- capable, as we have seen, of metrical treatment. Although pure projective Geometry would still be possible, we have seen how narrow are the limits of this science. Thus the axioms of distance, as well as the projective axioms, are necessary to any Geometry at all closely resembling the Geometry of our actual space.

The scientific question, as to the best available evi- dence concerning the nature of actual space, is one beset with diflScultifes of a peculiar kind. Admit- ting non-Euclidean spaces to be possible, we %'tj^a^ must also admit, since Euclidean space is as to the merely a limiting case to which other spaces nature of may indefinitely approximate, that the space space. we live in, though approximately Euclidean, may be found, on closer examination, to be of one or other of the non-Euclidean types. But in making this closer examination, we are obstructed by the fact that all existing physical science assumes the Euclidean hypothesis. This hypothesis has been involved in all actual measurements of large distances, and in all the laws of astronomy and physics. The principle of simplicity would therefore lead us, in general, where an observation conflicted with one or more of those laws, to ascribe this anomaly, not to the falsity of Euclidean Geometry, but

” Mind, O.S., vols. i. iii. ; see also Land’s reply, ib. vol. ii.

< One of them, the surface of zero curvature in elliptic space, was discovered by Clifford, and expounded in a paper. at the British Association in 1873, but the first publication on the subject was Klein's in 1890 {Math. Annalen, vol. xxxvii.).

to the falsity of the laws in question. This applies especially to astronomy. On the earth our means of measurement are many and direct, and so long as no great accuracy is sought they involve few scientific laws. Thus we acquire, from such direct measurements, a very high degree of probability that the space-constant, if not infinite, is yet large as compared with terrestrial distances. But astronomical distances and triangles can only be measured by means of the received laws of astronomy and optics, all of which have been established by assuming the truth of the Euclidean hypothesis. It therefore remains possible (until a detailed proof of the contrary is forthcoming) that a large but finite space-constant, with different laws of astronomy and optics, would have equally explained the phenomena. We cannot, therefore, accept the measure- ments of stellar parallaxes, &c., as conclusive evidence that the space-constant is large as compared with stellar distances. Eor the present, on grounds of simplicity, we may rightly adopt this view ; but it must remain possible ◆◆◆ that, in view of some hitherto undiscovered discrepancy, a slight correction of the sort suggested might prove the simplest alternative. But conversely, a finite parallax for very distant stars, or a negative parallax for any star, could not be accepted as conclusive evidence that our space is non-Euclidean, unless it were shown ◆◆◆ and this seems scarcely possible ◆◆◆ that no modification of astronomy or optics could account for the phenomenon. Thus although we may admit a probability that the space-constant is large in comparison with stellar distances, a conclusive proof or disproof seems scarcely possible.

Finally, it is of interest to note that, though it is theo- retically possible to prove, by scientific methods, that our space is non-Euclidean, it is wholly

impossible to prove by such methods that it is accurately Euclidean. Eor the unavoidable errors of observation must always leave a slight margin in our measurements. A triangle might be found whose angles were certainly greater, or certainly less, than two right angles ; but to prove them exactly equal to two right angles must always be beyond our powers. If, therefore, any man cherishes a hope of proving the exact truth of Euclid, such a hope must be based, not upon scientific, but upon philosophical considerations.

If we ask what is, for philosophy, the main value of non-Euclidean Geometry, two points may be mentioned. The first lies in the clear separation of different "'hicai" I ►► ^^ *axioms, and the resulting logical analysis ofnon- of geometrical results. We have seen how Euclidean to Separate clearly the portions of Geometry aeometry. involving any assumption from those which are independent of it, and how to construct a hierarchy of more and more specialized systems, beginning with projective Geometry and ending finally with Euclid. By this means we discover more clearly than was formerly possible whether any two propositions in Geometry are logically connected, or are independent of one another. The attempts which, down to Legendre, occupied a long series of great mathematicians, to deduce the postulate of parallels from the rest of Euclid's assumptions, are now known to be vain; and the same impossibility has gradually appeared in regard to the passage from any one of the four stages enumerated above to a later stage. A restraining influence is thus exercised upon the wholesale deductions of philosophers, and an example is afforded of the synthetic nature of mathematical propositions. The second point which non-Euclidean Geometry elucidates is of more strictly philosophical interest. ^Ve have seen that there are a number of possible Geometries, each of which may be developed deductively with no appeal to actual facts. But no one of them, per se, throws any light on the nature of our space. Thus geometrical*

reasoning is assimilated to the reasoning of pure mathe- matics, while the investigation of actual space, on the contrary, is found to resemble all other empirical investi- gations as to what exists. There is thus a complete divorce between Geometry and the study of actual space. Geometry does

not give us certain knowledge as to what exists. That peculiar position which Geometry formerly appeared to occupy, as an d, priori science giving knowledge of something actual, now appears to have been erroneous. It points out a whole series of possibilities, each of which contains a whole system of connected propositions ; but it throws no more light upon the nature of our space than arithmetic throws upon the population of Great Britain. Thus the plan of attack suggested by non-Euclidean Geometry enables us to capture the last stronghold of those who attempt, from logical ov h prdori considerations, to deduce the nature of what exists. The conclusion suggested is, that no existential proposition can be deduced from one which is not existential. But to prove such a conclusion would demand a treatise upon all branches of philosophy.

In addition to the works already referred to, the following are among the most important for a study of the subject : ___ Flte, Ste Marie. jStudes analytiqties sur la theorie des paralleles. Paris, 1871. ___ rRiscHAUP. Absolute Geometrie nach Johann Bolyai. Leipzig, 1872 ; Memente der absoluten Geometrie, Leipzig, 1876. ___ Clifford. " Preliminary Sketch of Biquatemions," Proc. Land. Math. Soc, 1873 ; and Collected Mathematical Papers. ___ Kil- ling. Die nicht-Uuklidischen Baumformen in analytischer Behand- lung. Leipzig, 1885. ___ Clebsch-Lindemann. Vortrage Uber Geometrie, vol. ii., Leipzig, 1891. ___ Klein. Vorlesungen uber hohere Geometrie. Gottingen, 1893. ___ Veronese. Grundziige der Geometrie, Leipzig, 1894 (translation from the Italian). ___ Lie. Theorie der Transformationsgruppen, Leipzig, 1893 (third section). ___ A bibliography of non-Euclidean literature down to the year 1878 was given by Halsted, American Journal of Mathematics, vols. i. ii. ^ (b. a. W. E.)

George, Friedrich August, King of Sax- ony (1832), the youngest son of King John of

Saxony (died 1873) and the Queen Amelia, was born at Dresden on 8th August 1832. From an early age he received a careful scientific and military training, and in 1846 entered the active army as a lieutenant of artillery. In 1849-50 he was a student at the University of Bonn, but soon returned to military life, for which he had a predilection. In the Austro-

Prussian war of 1866 he commanded the first Saxon cavalry brigade, and in the early part of the war of 1870-71 the first division of the Saxons, but later succeeded to the supreme command of the 12th (Saxon) Army Corps in the room of his brother, Albert (afterwards king) of Saxony. His name is in- separably associated with this campaign, during which he showed undoubted military ability and an intrepidity which communicated itself to all ranks under his com- mand, notably at the battles of St Privat and Beaumont, in which he greatly distinguished himself. On his brother succeeding to the throne he became commander-in-chief of the Saxon army, and was in 1888 made a field-marshal by the Emperor William I. He married in 1859 the Infanta Maria, sister of King Louis of Portugal, and King Albert's marriage being childless, succeeded on his death in 1902 to the throne of Saxony.

George I., King of the Hellenes (1846),

second son of King Christian IX. of Denmark, was born at Copenhagen, 24th December 1845. After the expulsion of King Otho in 1862, the Greek nation, by a])lebiscite elected the British prince, Alfred, duke of Edinburgh (subsequently duke of Coburg), to the vacant throne, and on his refusal the national assembly requested Groat r>ritain to nominate a candidate. The choice of the British Government fell on Prince Christian William

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Ferdinand Adolphus George of Schleswig-Holstein-Son- derburg-Glticksburg, ~~whose election as King of the Hel~~ lenes, with the title George I., was recognized by the Powers 6th June 1863. The sister of the new sovereign, Princess Alexandra, had a few months before (10th March) married the Prince of Wales, afterwards King Edward VII., and his father succeeded to the Crown of Denmark in the following November. Another sister, the Princess Dagmar, subsequently married the Grand Duke Alexander Alexandrovitch, afterwards Emperor Alexander III. of Eussia. On his accession, King George signed an act resigning his right of succession to the Danish throne in favour of his younger brother Prince

Waldemar. He was received with much enthusiasm by the Greeks. Adopting the motto, "My strength is the love of my people," he has always ruled in strict accord- ance with constitutional principles, though not hesitating to make the fullest use of the royal prerogative when the intervention of the Grown seemed to be required by circumstances. His influence with foreign Courts and Governments has been largely instrumental in saving the country from the consequences of political aberrations, and proved invaluable after the misfortunes of 1897. King George married, 27th October 1867, the Grand Duchess Olga Constantinovna of Russia. His surviving children are Prince Constantine, Duke ,of Sparta, born 1868, married in 1889 to Princess Sophia of Prussia, daughter of the Emperor Frederick, and granddaughter of Queen Victoria ; Prince George, born 1869, since Nov- ember 1898 High Commissioner of the Powers in Crete ; Prince Nicholas, born 1872; Prince Andrew, born 1882 ; Prince Christopher, born 1888 ; and a daughter, Princess Marie, born 1876, and married in 1900 to the Grand Duke George Michailovitch of Russia. Queen Olga, who is distinguished for her beneficence, has founded many charitable institutions in Greece. (See also Geebob : Mistory.)

George V., King of Hanovbk (1819-1878), only son of Ernest Augustus, duke of Cumberland, was born at Berlin on the 27th of May 1819. His mother was Princess Frederike of Mecklenburg, sister to Queen Louise of Prus- sia. He was educated partly in Berlin and partly in Eng- land. His father, the ablest of the sons of George III., on the death of William IV. became king of Hanover, which was henceforth separated frorn the British crown. George, while a child, lost the sight of oneeye during an illness, and in 1833, while playing with Prince George of Cam- bridge (the duke of Cambridge) at Kew, struck his other eye with a purse which he was swinging ; the injury, which was increased by an unsuccessful operation, resulted in total blindness. There were doubts whether he was qualified to succeed to the government, but his father decided that he should do so, as the law of the old empire only excluded princes who were born blind. The decision was a fatal one to the dynasty. Both from his father and still more from his uncle, Prince Charles of Mecklenburg, one of the most influential men at the Prussian Court, George had learnt to take a very high view of royal au- thority. His blindness prevented him

from having that shrewdness and knowledge of the world which had been of such assistance to his father, and he easily fell into the hands of unwise, and perhaps disloyal and dishonest, advisers. A man of deep religious feeling, he formed a fantastic conception of the great place assigned to the house of Guelph in the Divine economy. It is therefore not surprising that from the time of his accession (1861) he was constantly involved in constitutional disputes with the Estates of his kingdom. When the crisis of 1866 came the Hanoverian Government had therefore a bad reputation in Germany as being opposed to the Liberal

and National ideals of the time. George, wishing to ad- here to the federal treaties, refused all offers both from Prussia and from Austria to enter into a special alliance, and especially declined to enter into any fresh union with Prussia ia which he would be required to surrender any of his sovereign rights. The outbreak of war therefore found Hanover without allies,, and unprepared. Prussia then, on 16th June, addressed to the king a summary de- mand that within twelve hours he should undertake to disband his army, observe neutrality during the war, and enter into an alliance with Prussia. This the king re- fused to do, contrary to the wishes of the Hanoverian Parliament and the petition of the municipality of the city. The Prussian envoy then declared war, but before he had done so Prussian troops had crossed the frontier. George ordered his army to assemble at Gottingen, and then on 19th June, with a force of 18,000 men, began an adventurous march, hoping to be able to make his way south and join the Bavarians. Owing to the faulty strat- egy of the Prussians this would probably have been pos- sible had not the king allowed himself to be persuaded to enter into negotiations; the delay enabled fresh troops to be brought up. The king, when he was informed of this, broke off the negotiations. The Hanoverians suc- ceeded in inflicting a severe defeat on the Prussian forces which attacked them at Langensalza on 27th June, but before they were able to continue the march so many fresh Prussian troops had come up that they were obliged to capitulate. The terms of the capitulation determined that the king should not return to Hanover, which was now in the hands of the Prussians. After a few days he^ proceeded to Vienna, but when, at the conclusion of the war, he addressed a letter to the king of Prussia request- ing to know the terms of peace, it was not accepted, and on 20th

September a law was introduced in the Prussian Parliament decreeing the annexation of Hanover. It was a step which could only be justified on the gi'ound of po- litical expediency. The king's indignant protest and his appeals for help to France, Great Britain, and Russia were equally in vain. An inquiry whether it would be of any use if the king abdicated in favour of his son was met by the answer that it was too late. His protests were supported by a large party among his subjects, and he began an agitation which for a time caused serious embarrassment to the Prussians. Unfortunately he allowed himself also to be led into fantastic schemes, such as the formation of a Guelph Legion, consisting of Hanoverian officers and soldiers who refused to enter the Prussian service. To the niunber of 1200 they were maintained at the king's expense in France, and his agents also founded a paper, La Situation, and a speculative bank in Vienna. All hopes of being able to bring about a rising in Hanover and recovering the kingdom were destroyed by the war with France, and in 1870 the Guelph Legion was dis- banded. None the less George always refused any recon- ciliation with the Prussian Government. He passed the rest of his life at Gmtlnden in Austria, but in 1876 went to Paris for medical advice, and died there on the 12th of June 1878. He was buried in St George's Chapel at Windsor. He had married in 1843 Marie, daughter of the duke of Saxe-Altenburg. He left one son, Ernest Augustus, duke of Cumberland, who married in 1878 Princess Thyra of Denmark, and still maintains the claims of his house to the kingdom of Hanover. (See GEEMAmr: History.)

By the capitulation of Langensalza the enjoyment of his personal property was secured to the king. A large sum, including nearly ►►1,000,000 In securities, nearly ►►200,000 in specie, and ►►100,000 in bank-notes, was safely removed before the Prus- sians entered Hanover, sent to England, and deposited in the Bank of England. The valuable plate was buried at Her- renhausen, and remained safely hidden tiU the end of 1867,

when it was restored to the king. The Crown jewels were also secretly carried to England during 1866. The rest of the king's property consisted of landed estate. The British Government offered to help in bringing the settlement of his claims to a con- clusion, and in 1867 the king agreed to accept 11 million thalers (□□1,600,000) in 4| per cent. Prussian bonds. After the agreement had been signed the Prussian Government, in consequence of the continued acts of hostility on the part of the king, was obliged to sequestrate this property. It was administered by a special com- mission, and the accounts were not published, and was therefore available as a secret service fund, known as the Welfenfonds, or more colloquially the Beptilienfonds. In 1892, however, the se- quester was removed, and it was arranged to pay the interest derived from the fund to the duke of Cumberland. The palace of Herrenhausen near Hanover is also reserved as the property of the duke, and has been uninhabited since 1866.

See W. V. Hassell. Geschichte des Monigreichs Hannover. Leipzig, 1897-1901. □□□ Meding. Memoiren zur Zeitgeschichte, 3 vols. 1881-84. □□□ 0. Klopp. Konig Qeorg V. (j. w. He.)

George, Henry (1839-1897), American author and political economist, was born in Philadelphia, U.S.A., 2nd September 1839. He settled in California in 1858 ; removed to New York, 1880 ; was first a printer, then an editor, but finally devoted all his life to economic and

Henry Geoege. {From a photograph l}y Sarony, New York.)

social questions. In 1871 he published Our Land Policy, which, as further developed in 1879 under the title of Progress and Poverty, speedily attracted the widest at- tention both in America and Europe. In 1886 he pub- lished Protection or Free Trade. Henry George had no political ambition, but in 1886 he received an independent nomination as Mayor of New York City, and became so popular that it required a coalition of the two strongest political parties to prevent his election. He received 68,000 votes, against 90,000 for the coalition candidate. His death on 29th October 1897 was followed by one of the greatest demonstrations of popular feeling and general respect that ever attended the funeral of any

strictly private citizen in American history. The funda- mental doctrine of Henry George, the equal right of all men to the use of the earth, did not originate with him ; but his clear statement of a method by which it could be enforced, without increasing state machinery, and indeed

with a great simplification of government, gave it a new form. This method he named the Single Tax. His doc- trine may be condensed as follows : The land of every country belongs of right to all the people of that country. This right cannot be alienated by one generation, so as to affect the title of the next, any more than men can sell their yet unborn children for slaves. Private ownership of land has no more foundation in morality or reason than private ownership of air or sunlight. But the private occupancy and use of land are right and indispensable. Any attempt to divide land into equal shares is impossible and undesirable. Land should be, and practically is now, divided for private use in par- cels among those who will pay the highest price for the use of each parcel. This price is now paid to some persons annually, and it is called Bent. By applying the rent of land, exclusive of all improvements, to the equal benefit of the whole community, absolute justice would be done to all. As rent is always more than sufficient to defray all necessary expenses of govern- ment, those expenses should be met by a tax upon rent alone, to be brought about by the gradual abolition of all other taxes. Landlords should be left in undisturbed possession and nominal ownership of the land, with a sufficient margin over the tax to induce them to collect their rents and pay the tax. They would thus be trans- formed into mere land agents. Obviously this would involve absolute free trade, since all taxes on imports, manufactures, successions, documents, personal property, buildings, or improvements would disappear. Nothing made by man would be taxed at all. The right of pri- vate property in all things made by man would thus be absolute, for the owner of such things could not be di- vested of his property, without full compensation, even under the pretence of taxation. The idea of concentrat- ing all taxes upon ground-rent has found followers in Great Britain, North America, Australia, and New Zea- land. In practical politics this doctrine is confined to the "Single Tax, Limited," which proposes to defray only the needful public expenses from ground-rent, leav- ing the surplus, whatever it may be, in the undisturbed possession of land-owners.

The principal books by Henry George are : Progress and Poverty (1879), The Irish Land Question (1881), Social Problems (1884), Protection or Free Trade (1886), The Condition of Labor (1891), A Perplexed Philosopher (1892), Political Economy (1898). The Single Tax theory is fully discussed on the basis of statistics ia Shearman's Natural Taxation (1895). (t. G. S.)

Georgia, one of the south Atlantic states of the American Union, bounded on the N. by Tennessee and North Carolina, on the E. by South Carolina and the Atlantic, on the S. by Florida, and on the W. by Alabama. The period of reconstruction after the Civil War ––– from 1865 to 1870 ––– found everything in an un- settled condition, with the negroes newly enfranchised and the state under military control. The administration of affairs was largely in the hands of "carpet-baggers" ––– new-comers who had either been left in the state as a heritage of war, or were imported to assist in the distri- bution of the political loaves and fishes. Many negroes were elected to the Republican legislature and to the con- stitutional convention which assenibled during that period, and the Democrats were practically eliminated from state affairs. In 1870 by compact organization of the whites the Democrats obtained control, and in 1877 the Eecon- struction constitution of 1868 was superseded by the new state constitution. Since then the average number of Eepublican legislators out of a total of 219 has probably not exceeded half-a-dozen. In handling the racial and political problems introduced by the enfranchisement of the negroes Georgia has been fortunate. While there

have been occasional outbreaks of popular feeling, they have been sporadic, and have only increased the determina- tion of the whites to bring order out of chaos. Georgia has emphatically refused to join in legislation looking to either disfranchisement of the blacks or discrimination against them. The public funds for education are divided between whites and blacks in just proportion, and in the courts absolute

justice prevails. At the same time the whites have upheld Caucasian civilization through moral force, the justice of which has given it victory.

Population. ❓❓❓ Under the new constitution the state has advanced rapidly. In 1890 the population was 1,837,353, of whom 978,367 were whites and 858,996 negroes ; 919,925 were males and 917,428 females; 1,825,216 native-horn and 12,137 foreign-born. In 1900 the population was 2,216,331, showing an increase of 20-6 percent, for the decade. Three-quarters of the growth of population was made up of white immigrants from other states. The land surface of Georgia is approximately 58,980 square miles, so that the number of persons to the square mile was 37‘5 in 1900, as compared with 31 ‘1 ten years before. Of the total population in 1900, 1,103,201 (49-8 per cent.) were males and 1,113,130 (50-2 percent.) females; 2,203,928 were native-born and 12,403 (0-6 per cent.S foreign-born ; 1,181,109 were white and 1,035,222 (46-7 per cent.) coloured, of whom 1,034,998 were negroes, 204 Chinese, 1 Japanese, and 19 Indians. There were 372 incorporated cities, towns, or villages in the state in 1900, of which 13 had a population ex- ceeding 5000, and 3 a population exceeding 25,000. These three are Atlanta with 89,872, Savannah with 54,244, and Augusta with 39,441. In 1890 the urban population ❓❓❓ classing as such all persons in cities of 8000 inhabitants or more ❓❓❓ was 10-8 per cent. ; of the total population in 1900 it was 11 per cent. The death-rate in 1900 was 12-1. The increase of city population in 1900 was due to natural growth, and not to any marked exodus from the country.

Education. ❓❓❓ A fund of $1,900,000 per annum for education, furnished from various sources by the state government, is divided among the counties on the basis of school population between the ages of six and eighteen. .There are special systems in Atlanta, Savannah, Augusta, Macon, Columbus, Borne, Brunswick, and many other cities and towns, so that the aggregate of annual expenditures for public schools may be placed at |3 ,000,000. Throughout the entire state the whites and blacks are educated separately, and there is an ascertained division of the funds be- tween them. The number of persons of school age (5 to 20 years inclusive) in 1900 was 885,725. The number in attendance at the grammar and high schools is 423,467. Of these 251,093 are white and

172,374 black. Of the total of illiterates above ten years of age, 93,614 are white and 331,814 are coloured. Out of 500,752 males of voting age (21 years and over) in 1900, 158,247 were illiterate (unable to write), of whom 32,456 were white and 125,712 were negroes. The University of Georgia, situated at Athens, is the recipient of the United States agricultural fund, besides annual appropriations of from $8000 to |25,000 from the state government, and is the centre of other high institutions. Under its patronage there have been established a state normal school in Athens, a normal technical school at Milledgeville for women, and a school of technology in Atlanta for men, to each of which is appropriated from $20,000 to $30,000 a year. In 1900 the legislature inaugurated a large increase of these appropriations, especially to the cause of technological education. There are branch colleges at DaMonega and Milledgeville for whites, an agricultural college near Savannah for blacks, and a medical college in Augusta of high standing. The Methodist Church South conducts Emory College in Oxford, the Baptist Church maintains Mercer Univer- sity in Macon, and in almost every considerable town there exist flourishing colleges of lesser grade for young men and women. The total number of undergraduate and graduate students in the institutions of higher education in 1898 was 2177, and of in- structors 135. Two-thirds of the religious population, white and black, are about equally divided between Baptists and Metho- dists. The rest are divided between Protestant Episcopal, Roman Catholic, Presbyterians, and others. The Georgia Sanitarium, for the insane, situated in Milledgeville, accommodates white and black separately, and has an average of 2000 patients. The Georgia Academy for the blind is at Macon ; and the Georgia Institute for the deaf and dumb at Cave Spring.

Agriculture. ??? The commercial and industrial development of the state has been very remarkable. During 1893, 1895, and 1896, $8,000,000 a year were spent for commercial fertilizers, most of which were applied to cotton. In 1897-98 (the cotton year ending 1st September) the crop amounted to 1,536,000 bales, the average gross weight per bale being 506 lb. The average price for middling cotton in New York City during the year was 6-22 cents, so the commercial value of that year's "crop was $48,337,920. A steadily increasing crop had the effect of lowering the price ; in

1885 a crop of 950,025 bales brought the farmers $39,413,825, and in 1893 a crop of 1,250,000 bales brought them only $35,386,875. This compelled attention to other crops. Larger areas were planted in wheat, com, and oats, and the raising, and especially fattening, of cattle for market was successfully followed. The cotton crop of 1899-1900 was somewhat smaller (1,345,699 bales), but the prices were much more satisfactory, ranging in New York from 6J cents for middling upland cotton at the beginning of the season to 9f cents at the close. In 1900 Georgia produced 34,119,530 bushels of Indian com worth $19,448,132, with an average yield per acre of 10 bushels ; 7,010,040 bushels of oats worth $3,434,920, with an average yield per acre of 15 bushels ; 5,011,133 bushels of wheat worth $4,760,576, with an average yield per acre of 9-1 bushels. These averages are for the state at large ; throughout the wheat belt the average yield is 25 bushels per acre, with a correspondingly increased percentage for the corn and oat belts. On 1st January 1900 the number and value of farm animals was as follows : 109,935 horses, $6,001,626; 157,008 mules, $10,826,032 ; 294,826 sheep, $518,893 ; 285,431 mUch cows, $6,836,072 ; 380,716 other cattle, $4,216,054.

Manufactures. ??? The following table shows the manufacturing and mechanical industries as returned at the censuses of 1890 and 1900, and the percentage of increase for the decade: ???

Per-

1890.

1900.

centage of In- crease.

Number of establishments

4,285

7,504

75-1

Capital ....

$56,921,580

$89,789,656

57-7

Wage earners, average

number

52,298

83,842

60-3

Total wages

$14,623,996

$20,290,071

38-7

Cost of material used

*** ?????35,774,480***

$68,232,202

62-8

. Value of products

$68,917,020

*** ??106,654,527***

The principal products were textiles, especially cotton goods, valued in 1900 at $20,266,712 ; lumber and timber products, $13,704,923 ; flour and grist mill products, $8,330,439 ; turpentine and rosin, $8,110,468; and cotton-seed oil and cake, $8,064,112. The growth of the cotton manufactures has been remarkable. In 1879 the cotton factories were valued at $1,640,000. The spindles in operation in 1890 numbered 445,452, or 28 per cent, of the total in the south. In 1809 they numbered 926,044, or almost one- fourth of the total in the south, namely, 4,057,244. Of the 251,343 spindles in construction, 152,978, or over half, were in Georgia.

Mineral Resources. ??? Gold occurs in workable quantities in the north-eastern part of the state, usually in belts, from 1 to 5 miles wide, running north-east and south-west. In 1899 a com- pany of capitalists from Ohio erected at Dahlonega a 120-stamp mill, with a capacity of 400 tons of ore per day, and a chlorination plant for treating sulphide ores, which will treat 40 tons of concentrates a day. Magnetic iron ore occurs in several counties. Extensive deposits of aluminum ore, in the form of bauxite, yield a large part of the aluminum produced in the United States. The bauxite is also extensively used for the manufacture of alum. Georgia, is also one of the largest producers of manganese in the Union, the ore occurring in extensive masses as pyrolusite and psilomelane. The manganese ore is of high grade, being generally free from impurities. Corundum has been successfully produced. Bituminous coal has been worked continuously for many years, principally for the manufacture of coke for furnace use. There are extensive and very valuable clay deposits, which investigations by the State Geological Survey show to be second to none in the United States. Their fusion-point is exceptionally high, and the amount of impurities included is generally quite small. Abundance of marl and some phosphate rock are found in the southern part of the state. Beds of white, black-and-white mottled, and white- pink-and-grey mottled marbles, of endless variety, are worked on a large scale in Pickens county. Much of the black-and-white mottled marble is used for monumental work, on account of its richness and the sharp outline and contrast of its eccentric figures ; and as a building stone this marble is probably not

equalled. The Corcoran Art Gallery in the city of Washington, the Rhode Island State Capitol, the Minnesota State Capitol, and many handsome private buildings are constructed of Georgia marble. Large areas of granite and gneiss occur. A dark-green serpentine, of great beauty, has been quarried at Holly Springs, and turned into polished columns, slabs, &c., for interior decoration. A slate of fine texture and easy cleavage has for a long time been quarried at Rookmart. A very good cement has for several years been manufactured from limestone. Yellow ochre, asbestos, pyrite, steatite, and graphite are mined in various parts of the state, and rock crystal, rose quartz, chalcedony, agate, and moonstone exist in consideralDle quantities.

Bail-ways. ❓❓❓ In 1878 a state railway commission was estab- lished with mandatory powers for the settlement of all questions.

Alter consultation the commission fixes tariff, orders betterments, and transacts without appeal all business into which the interests of the public enter. The mileage of the south Atlantic states, consisting of Virginia, "West Virginia, North and South Carolina, Florida, and Georgia, is 20,496, of which Georgia has a mileage of 5414, or more than 25 per cent, of the total. The mileage of the principal lines is as follows: Central railroad, 1581-50; Western and Atlantic, 138 ; Plant system, 1391 ; Georgia Pacific, 557 ; Seaboard Airline, 926 ; Southern railroad, about 1000 miles in Georgia. The gross earnings of the Georgia railways for the year ending 30th June 1899 were $21,087,310.36, leaving net earnings of $6,347,554.39. This gives a gross earning per mile of $3937.85, or a net earning of $1175.85. Per contra, the worlcing expenses absorbed 70-14 per cent, of the gross earnings. There are fifty-one separate companies or systems in the state. During the year ending 30th June 1899 only six companies showed a deficit, the total deficit being $50,962.88. This would make the net earnings $6,296,591.51. Development of railways has resulted in the settlement and building up of considerable towns and manufacturing communities. Along the Georgia and Alabama railway, and especially in the dense pine belt between Montgomery and Savannah, there has been phenomenal growth.

Steamships. ... The Central railway system has a regular tri-weekly steamship service from Savannah to New York and Boston, with well-appointed passenger steamers. Calls are made at Philadelphia. The Merchants and Miners' Line plies regularly between Savannah and Baltimore. There are ship-lines by river : On the Chattahoo- chee, from Columbus to Apalachicola ; on the Coosa, from Rome into the Alabama ; on the Altamaha and the Ocmulgee, to their mouths.

Banking. ... Charters for state banks are granted by the Secretary of State upon the payment of a fee of $50, which is covered into the state treasury ; but $15,000 must first have been subscribed and actually paid, and there must be a capital stock of $25,000. No state banks of issue exist,

because of a prohibitory tax of 10 per cent, on circulation medium by the national government. There were in 1900 171 state banks in operation, with a capital of #9,634,659 ; 22 private banks, with a capital of $605,123 ; and 11 loan and trust companies, with a capital of $1,194,650. There were 27 national banks, with a capital of $3,556,000. There are clearing houses in Savannah, Atlanta, Augusta, and Macon. Their combined clearings in 1899 aggregated $297,763,629.

Finances. ??? ^The total valuation of property in 1880 was $251,424,651 ; in 1890 it was $415,828,945 ; in 1900 it was esti- mated at $435,000,000. Taxation by legislative enactment has been limited to $5 on the thousand, and owing to the absence of a sufficient floating element in all parts of the state, propositions to increase public burdens, by either taxation or bond issues, undergo very strict inquiry. The proceeds of taxation in 1900 were $2,605,569. The state debt amounted to $7,831,500.

Constitutional Reform. ??? Under the constitution of 1877 the term of the governor was shortened from four years to two ; the state was given power to organize a railway commission ; the establish- ment of public schools was made obligatory ; municipalities were restricted in the contracting of public debts to an amount not more than 7 per cent, of the value of assessment ; all issues of bonds were made subject to a vote of the people ; and the power of expend- ing money was limited to certain well-defined public necessities. There are departments of state, treasury, law, agriculture, educa- tion, and accounts and insurance. Of the sub-departments the most important are the state railway commission ; tlie penitentiary commission, which has control of the question of pardons as well as of penal matters ; and a confederate pension bureau, which has the expenditure annually of $700,000 to the needy wounded veterans and their widows. A new department is that of geology. The state supreme court has been increased from three to six members, and the governing authority of the counties, formerly vested in an inferior court, is ijow in the hands of a central officer known as the ordinary.

Liquor Laws. ??? The growth of the anti-liquor sentiment has been marked by the adoption by the counties of local option. Ever since colonial times all matters affecting local government have been referred

to the grand jury of each county ; and, extending the practice to larger questions of public policy, the state adopted a law by which each county, moving for itself, with the power of biennial reconsideration, can take a vote upon the sale of liquors. One hundred and seventeen out of the one hundred and thirty- seven counties have barred the liquor traffic. The other twenty counties are substantially within prohibition ground, because of a general law whicii prohibits the sale of liquor in rural districts within three miles of church or school, so that in effect liquor is only sold in the larger cities. (c. ho.)

Ceorgievsk, a district town of Russia, North Caucasia, province of Terek, 23 miles north-east of Pyatigorsk railway station. Here the Georgian prince, Heraclius, concluded in 1783 a treaty of federation with Eussia. Population in 1897, 10,608.

Ceorgswalde, a town of Northern Bohemia (Austria), on the borders of Saxony. Together with Eumberg, it is one of the principal centres of the Bohemian linen industry. There are also an iron-foundry, cotton-spinning, brick-making, &c. Population (1900), 8131.

Cera, a town of Germany, capital of the principality of Eeuss the Younger, on the White Elster, 46 miles by rail south-south-west from Leipzig. The church of St John's was built in 1886 ; in front of it stands an equestrian statue of the Emperor William I., unveiled in 1894. There is a municipal museum. Wool-weaving and spinning, iron foundries and machine shops, printing (books and maps), and flower gardening are the distinctive industrial features. Population (1885), 34,162 ; (1900), 46,640.

Ceraldton, the chief port of the northern portion of West Australia, in the district of Victoria, in Champion Bay, about 290 miles north-west from Perth. The chief exports are wool, copper, and lead. The harbour is safe and roomy. The town is the centre of a railway system. The mean temperature for the year is 65-6 P. ; for Feb- ruary, 74-6 P.; for July, 57-5 P.; the mean annual rainfall is 17-13 inches. Population (1901), 2693.

Cerasa, now Jerash, one of the cities of Decapolis in Syria, and possibly the Biblical Eamoth Gilead, buUt on both banks of the Kerw^n

(Chrysorrhoas), and called in an inscription repacra 'Avtiox^m. It is now occupied by a colony of Circassians, whose houses have been built with materials from the earlier buildings, and there has been much destruction of the interesting ruins.

Cerman Reed. ??? The dramatic and musical enter- tainment, which for so many years was knovsm in London by the title of " German Eeed," may be mentioned here in connexion with the principal names of those who made it so successful. Mr Thomas Geemast Eeed (born in Bristol in 1817, died 1888) married in 1844 Miss Priscilla Hoeton (1818-1896), and in 1866 they started their entertainment at the " Gallery of Illustration," in Waterloo Place, London. From 1860 to 1877 they were assisted by John Orlando Parry (1810-1879), an accomplished pianoforte player, mimic, parodist, and humorous singer ; and the latter created a new type of musical and dramatic monologue which became very popular. His tradition was carried on after 1870 by Mr CoENEY Grain (1844-1895), who, as a clever, refined, and yet highly humorous society entertainer (originally a barrister), was one of the best-known figures of his day. After the retirement of the elder German Eeeds, their son, Alfred German Eeed (1846-1896), himself a capi- tal actor, carried on the business in partnership with Corney Grain. The "German Eeed Entertainment" ??? which was always patronized by a large class of people, many of whom objected on principle to going or taking their children to a regular theatre or a music-hall ??? re- tained its vogue for forty years at Waterloo Place and at the St George's Hall, Regent Street. But the death of Mr Corney Grain almost simultaneously with Mr Alfred German Eeed, in ISfl."), together with tlie changed public attitude towards the regular theatre, ended its career, though more recently Mr Albert Chevalier has to some extent^ revived this type of entertainment in modified conditions. The success, however, of John Parry and Corney Grain had meanwhile resulted in many others ??? among them Mr George Grossmith, who had made a reputation in the Gilbert and Sullivan operas at the Savoy Theatre ??? starting independently as " entertainers" with what were known as " musical sketches."

Cermantown, Pennsylvania, a residential district in the northern part of the city of Philadelphia, U.S.A.

GERMANY.

I. ??? Geogeaphy and Statistics.

Geography. ??? The present German Empire extends from 47 ?? 16′ to 65 ?? 54′ N. lat., and from 5 ?? 63′ to 22 ?? 63′ E. long., therefore the 15th meridian, fixing Central European time, does not divide it in the middle. The difference in time between the most eastern point and the 15th degree E. is 36^ minutes, and between the most western point and the 16th meridian only 31|- minutes. The empire is bounded on the E. by Russia (736 miles according to Strelbitsky, 1881), on the S.E. and E. by Austria and Switzerland (together 1647 miles), on the S.W. by France (251 miles), and on the W. by Luxem- burg, Belgium, and Holland (together 530 miles). The length of German coast on the North Sea is 460 miles, and on the Baltic (without reckoning the coasts of the " haffs ") 735 miles, the intervening land boundary on the north of Schleswig being only 72 miles. The total area of the empire, including rivers and lakes, but not the " haffs " and lagoons on the Baltic (called Sodden on the coast of Pomerania) nor other coast waters (together 2590 square miles), is 208,790 English square miles, or 540,743 square kilometres, according to the most recent estimates. As regards the physical features, there is little to add to the earlier article (Ency. Brit., x. 447-450).

Area and Population. ??? Since the constitution of the German Empire in 1871 the territory has been enlarged only by the island of Heligoland (about \ square mile), ceded by Great Britain under the treaty of 1st July 1890. The changes in cadastral measurements have been numer- ous in the several German states, but of small amount.

Table I. ??? Population and Growth of the German Umpire 1870 to 1900.

(Population at the beginning of December; 000 omitted.)

Tear.

Population.

Increase Percentage Per Annum.

Tear.

Population.

Increase Percentage Per Annum.

1870 1875 1880 1885

40,818 42,729 45,236 46,858

0-58 0-91 1-14 0-70

1890 1895 1900

49,428 52,280 56,367

1-07 1-12 1-50

The following table gives the area and population of the twenty-six states of Germany, in their official order, as returned at the census of 1st December 1900 : ???

Table II. ??? Area and Population of the German Empire.

States of the Empire.

Area, English Square Miles,

Population.

Kingdoms.

1. Prussia ....

2. Bavaria

3. Saxony

4. Wtirtemberg ....

Grand- Duchies.

5. Baden

6. Hesse . . . ‘.

7. Mecklenburg-Schwerin .

8. Saxe- Weimar

9. Mecklenburg-Strelitz

10. OldenlDurg ....

Duchies.

11. Brunswick ....

12. Saxe-Meiningen 1.3. Saxe-Altenburg

14. Saxe-Coburg-Gotha

15. Anhalt

Carry forward .

134,622

29,295

5,789

7,534

5,823 2,966 5,069 1,397 1,131 2,482

1,418 953 511

764 888

34,472,509 6,176,057 4,202,216 2,169,480

1,867,944 1,119,893 607,770 362,873 102,602 .399,180

464,333 250,731 194,914

229,550 316,085

200,642

52,9.36,137

States of the Empire.

Area, English Square Miles.

Population.

Brought forward Principalities.

16. Schwarzburg-Sondershausen .

17. Schwarzburg-Eudolstadt

18. Waldeck

19. Reuss-Greiz ....

20. Reuss-Gera ....

21. Sohaumburg-Lippe .

22. Lippe

Free Towns.

23. Lubeok

24. Bremen

25. Hamburg ....

Imperial Territory.

26. Alsace-Lorraine

German Empire

200,642

333 363 433 122 319 131 469

115

99

160

5,604

52,936,137

80,898 93,059 67,918 68,396

139,210 43,132

138,952

96,775 224,882 768,349

1,719,470

208,790

56,367,178

The population doubled within the period 1825-1900, but there are great differences in the growth. It ap- pears from the following table that the inhabitants of the kingdom of Saxony and the eight old provinces of Prussia have increased three or four times more than those of the South German States and Hanover since

1836.

Table III. ??? Increase of Population in States or Provinces.

(000 omitted.)

Population Census, 1881-1900.

Total Increase

Provinces or States.

1881-84.

1875.

1900.

1831-76.

‘31-1900.

Saxony .

(‘34)

1,596

2,760

4,202

73

169

The eight old Prus-l sian Provinces : /

(‘31)

13,040

21,116

28,528

62

119

Brandenburg (in-l eluding Berlin) /

H

1,612

3,126

4,997

84

209

Saxony .

))

1,450

2,169

2,832

50

195

Rhineland

2,250

3,804

5,760

70

155

Westphalia .

*** ***

1,270

1,905

3,188

52

151

Silesia .

n

2,461

3,844

4,669

56

90

Pomerania

910

1,462

1,635

63

80

Prussia (E. and W.)

2,015

3,199

3,560

59

77

Posen .

It

1,070

1,606

1,887

50

76

Hanover .

f‘33)

1,663

2,017

2,591

21

56

Baden

(‘34)

1,228

1,507

1,868

23

52

Hesse

750

884

1,120

18

Bavaria .

4,245

5,022

6,176

18

45

Wilrtemberg .

J ??

1,573

1,882

2,169

20

38

Of the total population, the females exceed the males in the ratio of 1032 to 1000, as in most European states of Teutonic origin.

According to the occupation census of 14th June 1895, the distribution as regards conjugal condition was as follows (the regular census of 2nd December 1895 did not give such returns) : ???

Table IV. ??? Conjugal Condition, 1895. (OOO omitted.)

Males.

Females.

Total.

Total.

Per

Cent.

Total.

Per

Cent.

Total.

Per

Cent.

Unmarried

Married ....

Widowed (and Divorced)

15,784

8,849

776

62-1

34-8

30

15,368 8,785 2,209

58-3 33-3

8-4

31,152

17,634

2,985

60-0

33-9

6-1

680

G E E M A N Y

[statistics

Table V.. ??? Marriages, Births, and Deaths, 1871-99. (000 omitted.)

Tear.

Marriages.

Birtlis (including: Still-born).

Deaths.

Still-born.

Surplus of Births.

1871-80

1881-90

1891-99

or

1897 .

1898 .

1899 .

369 368 426

448 459 472

1744 1799 1953

1991 2030 2045

1233 1247 1226

1206 1183 1250

69

67 64

64 65 65

511

551

727

785 847 795

The mean number of marriages for each 1000 persons living was, for the whole period, 8 -2 ; the annual number rose (1872) soon after the great

war to 10-3, and descended in the period of economic depression (1879-81) to 7-5. Regarding the births, the average annual rate was 38-8. The rate per 1000 ascended slowly to 42-6 (1876), but afterwards decreased (37-1 in 1899). The average death-rate was 26-4. In later years the deaths have regularly diminished, the rates per 1000 from 1894 to 1899 being as follows: 23-5, 23-4, 22-1, 22-5, 21-8, 22-7, still-born included; or 22-3, 22-1, 20-8, 21-3, 20-6, 21-5 without reckoning the still- born. This death-rate is not so favourable as that in Great Britain and Ireland. In Germany, as in most European states, the surplus of females is due to their lower death-rate, for more boys are born than girls.

Table Yl.[illegible] *Excess of Boys for 1000 Girls.*

Tear.

Births.

Deaths.

1897 .

1898 .

1899 .

1060 1058

1059

1103 1106 1099

The rate of illegitimacy has generally decreased in the last thirty years from 11 or 12 per cent. (1841-71) to about 9-9J, but it is still higher than in any other European state, except Den- mark, Sweden, and Austria. For the ten years 1889-98 the proportion was 3 to 3-5 per cent, in Western Germany (Rhineland and Westphalia), 6-7 in the north-western and the extreme eastern provinces, 8-10 in the south-western, and 10-12 in most of the provinces round Brandenburg, and 15 per cent, in Bavaria.

The surplus of births over deaths being much greater than the growtli of the population, there is a great loss by emigration. Between 1820 and 1900 about 5 or 5J millions of Germans appear to have emigrated across the sea : ???

Table VII.. ??? Emigration of Germans from German and Foreign Ports.

(000 omitted.)

Tear.

Total.

Average.

1820-70

2770

1871-75

395

79

1876-80

231

46

1881-85

857

171

1886-90

485

97

1891-95

403

81

1896-1900 .

127

22

There have been great oscillations in the actual emigration by sea. It first exceeded 100,000 soon after the war (1872, 126,000), and this occurred again in the years 1880 to 1892. Germany lost during these thirteen years more than 1,700,000 inhabitants by emigration. In recent years the emigration has been insignificant. The total number of those who sailed for the United States from 1820 to 1900 may be estimated at more than 4,500,000. The number of German emigrants to Brazil between 1870 and 1900 was about 52,000. The greater number of the more recent emigrants were from the agricultural provinces of Northern Germany ??? Western Prussia, Posen, Pomerania, Mecklenburg, Sohleswig-Holstein, and Hanover. Sometimes the emigration reaches 1 per cent, of the total population of these provinces.

The number of foreigners naturalized during the years from 1872 to 1885 was 65,931 ; the returns have not been continued. The number of foreign residents in the empire lias considerably increased from one census to the other. In 1871 there were 40,852,000 natives and 206,700 foreigners, or 5 per 1000 ; in 1895, 51, 7!):;, 711 natives, and 486,185 foreigners, or 9-3 per 1000. The census returns of 1896 show that of these foreigners, 222,952 came from Austria-Hungary, 60,743 from the Netherlands, 44,870 from Switzerland, 28,]4(i from Denmark, 26,569 from Russia, 22,693 from Italy, 19,619 from France, 15,788 from the United

States, 16,290 from Great Britain, 11,756 from Luxemburg, 11,091 from Sweden and Norway, 8947 from Belgium, and 7732 from other countries.

The following table [VIII. (a) and (6)] shows the density of population. It is not possible to do this properly for the actual states under Table II., but a fairer estimate is obtained if we take into consideration the leading political or natural subdivisions of the whole country.

Table VIII. ??? Abstracts for the most important Political or

Natural Groups.

(000 omitted in the Population Eeturns.)

(a) Political Groups.

Area. Sq. Miles.

Population,

1900.

Population

per Square Mile.

Prassia, including the minor) States of North Germany J

Saxony

Thuringian States .

Bavaria

Wttrtemberg ....

Baden . ...

Alsace-Lorraine

Hesse

Total (1900) .

147,018

5,789 4,762 29,295 7,534 5,823 5,603 2,966

37,695

4,200 1,420 6,176 2,169 1,868 1,719 1,120

256

725 298 211 288 320 307 378

208,790

56,367

270

1

(6) Natural Groups.

Area. Sq. Miles.

Population,

1895.

Population

per Square Mile.

Baltic Countries Middle East Germany North-western Plains Hills between Weser and) Elbe . . . . i Saxony-Thuringia . Hesse . . . . Lower

Rhineland Western Upper Rhineland Eastern Upper Rhineland Franconia .... Danubian Countries

Total (1896) .

49,624 43,107 17,941

11,446

13,724 5,593 15,756 8,421 12.545 10,042 20,552

7,179

11,128

3,693

3,110

6,018 1,180 7,575 2,730 3,820 2,252 3,693

145 256 205

272

438 228 479 329 306 225 174

208,761

52,278

251

The difference in the density of population is much greater than can be seen from the above table if we take the minor districts into consideration. Without mentioning the true mountain circles belonging to Ihe Bavarian Alps, there are some rural districts in the moorlands of Oldenburg and Hanover where the inhabitants cumber scarcely 50 per square mile. For the purely agricultural districts of the north-eastern lowlands, or those of

the Upper German plateau (Danubian plateau), 150 is the number. It seems that a density of about 250 is the liighest for a truly rural population in Germany. More thickly populated districts are to be found in the Upper Rhine plain, the Neckar valley, and the plains bordering the midland mountains in the north. But the density attains an extreme degree in the difierent coal districts. In the Ruhr basin, a district of about 600 square miles, the population equals that of Lancashire, the mean being not under 2500 per square mile.

The number of inhabited houses in 1890 was 5,791,000 ; in 1871 it was about 5,330,000, so that the average number of inhabitants per house is 8-46 persons. In Great Britain and Ireland in 1891 the average was only 5-28.

Table IX. ???Toxon and Bttral Population.

Classes of Towns.

Number

of T0W]18.

Population. (000 omitted.)

Per Cent, of Total.

Large Towns ot more than \ 1871 100,000 Inhabitants . / 1895

*Middle-sized Towns from i e, 20,000 to 100,000 Inhab-) ??? |^,' i itants .... J 1**"”^*

Small Towns from 5000) 1871 to 2000 Inhabitants . 1 1895

Rural Towns from 2000 \ 1871 to 5000 Inhabitants . / 1896

*Town Population . j^gg^*

Rural Population . l]ll

(1895

8 28

76 150

529

796

1716

2068

1,969

7,277

3,147 6,680

4,688 7,048 6,087 6,158

4-8 13-9

7-7 10-7

11-1 13‘6

12-4 11-8

2328 3042

14,791

26,063

26,219 26,217

36-1 49-9

63-9 50-1

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The differences in the distribution of the population have be- come much greater than they were formerly. The mean density has increased from about 120 inhabitants per square mile in 1820 to 150 in 1840, 200 in 1875, and 270 in 1900. In the same period the population of the cities has greatly risen, the natural increase of the inhabitants in the rural districts from the surplus of births being neutralized by the steady migration to the cities. It must be remembered that the official statistics designate all inhabitants of communes with more than 2000 souls as "town population"; the term " rural population" is applied to those of the smaller places. (For further details see Ency. Brit. x. p. 457.)

The figures exhibit the extremely unequal increase of the differ- ent groups from 1871 to 1895. In the rural towns it was at the rate of 21 per cent., in the small towns 53 '6 per cent., in ►►the middle- sized towns 43-6 per cent., and in the large towns 269 per cent.

The following is a list of the large towns in 1900 ; the total pop- ulation of these 33 towns was 9,108,815 in 1900, or 16'2 per cent, of the total population (000 omitted) : ►►►

Greater Berlin Berlin

Charlottenburg Hamburg

Altona Munich Leipzig Breslau Dresden Cologne Hanover

Linden Frankfurt-on-Main Nilrnberg Magdeburg Dttsseldorf Stettin Chemnitz

2500 1884 189 706 162 500 455 423 395 372 236 51 288 261 230 214 211 207

Charlottenburg, see Berlin.

Kbnigsberg

Stuttgart ....

Bremen ....

Altona, see Hamburg.

Elberfeld

Barmen ....

Halle-on-Saal .

Strassburg

Dortmund

Danzig

Mannheim

Aachen (with Biirtscheid)

Brunswick

Essen ....

Kiel ....

Crefeld ....

Eassel ....

188 176 163

157 157 157 150 142 140 140 135 128 119 108 107 106

Table X. ??? Occupations, 1882 and 1895. (000 omitted.)

Occupations.

Total.

Engaged in the Several Occu- pations.

Total in Per Cent.

1882.

1895.

1882.

1895.

1882.

1895.

A. Agricultural Class .

B. Industrial Class

C. Commercial Class .

D. Domestic andother 1

Service . J

E. Professions

F. Without Profession”)

or Occupation J Total

19,225

16,058

4,531

938

2,223

2,246

18,501

20,253

5,967

887

2,835

3,327

8,236 6,396 1,570

398

1,031

1,354

8,293 8,281 2,339

432

1,426

2,143

42-5 35-5 10-0

2-1

4-9

5-0

35-7 39-1 11-5

1-7

5-5

6-4

45,221

51,770

18,985

22,914

100

100

Germany made a great step in her development as an industrial state between the years 1882 and 1895. The number of persons engaged in agriculture, cattle-rearing, forestry, and fishing was not more in 1895 than the' number of those engaged in mining, metal works, and other industries, but with respect to the atten- dants and other members of families the two branches were in the ratio of 36 to 39 in 1895, while the agricultural class included in 1882 7 per cent, of the total population more than the industrial class.

Constitution and Government. ??? By the law of 19th March 1888, which came into force in 1890, the members of the Reichstag are elected

*for the term of five years (pre- viously for three years). The duration of the legislative period is also five years. The average number of inhab- itants for each of the 397 electoral districts increased from 103,000 in 1871 to 131,600 in 1898. The total number of electors to the Eeichstag inscribed on the lists was 8,523,000 at the general election of 1874 (in 1871 Alsace- Lorraine ,did not take part in the elections) or 20-8 per cent, of the population of 1871. In 1898 the number of electors was 11,441,000, or 21-9 per cent, of the popula- tion according to the census of 1895. In 1874 the num- ber of effective voters was 61*2 per cent, of the whole electoral body, and the rate was about the same in the following elections till 1884. In 1887 the number rose to 78-2 per cent. ; in 1898, with 7,787,000 voters (in the first vote) it was 68-1 per cent. The following table*

shows the number of votes given to the several political parties and the composition of the Reichstag after the elections of 1874, 1887, 1898 :

Table XI. Number of Votes and Deputies.

Parties.

Legal Votes (000 omitted).

Deputies. |

1874.

1887.

1898.

1874.

1887.

1898.i

Conservatives Reichspartei (Liberal-/ Conservatives) . \ National Liberals . Freisinnig ?? (Liberals) . Volkspartei (Democrats) Centrum (Clerical) Poles .... Social Democrats . Anti-Semites "Welfen, Danes Alsatians Other Parties

Total

360 430

1542

447

22

1568 198 352

138 86 46

1147

736

1678 973

89

1516

220

763

12 113 234

60

859

344

971 754 108

1455 244

2107 284 105 107 413

22

36

155

49

1

101

14

9

4 6

80

41

99 32

98

13

11

1

5

15

2

52

22

47 40

7

102

14

57

10

9 10 23

393

5189

7541

7751

397

397

The multiplicity of parties has been a peculiarity of the German Reichstag from the beginning, and has in- creased still more since 1874.

Languages. ??? The number of German-speaking people in the world, including the various branches, such as Dutch and Flemish, may be roughly estimated for the year 1900 at 90,000,000. They are distributed somewhat as follows : ???

Table XII. ??? Distribution of German-,speaking People.

German Empire

Austria^Hungary .

Netherlands .

Belgium

Luxemburg .

Switzerland .

France ....

Other European Countries

America

Asia ....

Africa ....

Australia

51,800,000

11,000,000

5,100,000

3,900,000

200,000

2,300,000

500,000

2 ,300,000

12,000,000

100,000

600,000

100,000

No imperial census relating to the mother tongue yet exists. Apart from the foreigners residing in the various German states, Germans speaking another language than German are found only in Prussia, Saxony, and Alsace- Lorraine. According to the Prussian census of 1st De- cember 1890, there were 29,815,938 persons speaking commonly one language and 137,531 speaking two lan- guages : ???

Table XIII. ??? Languages spoken in Prussia, 1890.

Germans 26,488,070

Poles f 2,816,657

Masurians j 105,765

Cassubians I 55,540

Moravians and Czechs 66,078

"Wends 74,069

Lithuanians 121,345

Danes and Norwegians 139,399

Walloons 11,058

Other Languages, including Frisian (48,828) 125,498

Total

29,953,469

In the kingdom of Saxony, according to the census of 1885, there were 49,916 Wends, most in the Lausitz. With respect to Alsace-Lorraine, detailed estimates (but no census) gave the number of French in the territory of Lorraine at about 170,000, and in that of Alsace at about 46,000. Combining these statistics with those of the foreign residents, it may be estimated that the whole population of the German Empire for 1900 according to language was as follows : ???

1 Composition on 18th January 1900, four seats being vacant.

S. IV. ??? 86

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Table XIV. ??? Languages spoken in Germany, 1900. (000 omitted.)

LaDguag

es. Population.

Per Cent.

Germans .

51,900

92-7

Poles, &c.

3,200

5-7

Wends

120

0-2

Czechs, &c.

70

O'l

Lithuanians

120

0-2

Danes

140

0-3

French

250

0-8

Walloons .

10

All other Peopl Total .

3S . . 190

6-4

56,000

100

The Poles have increased very much, owing to a greater surplus of births than in the case of the German people in the eastern provinces of Prussia, to immigration from Russia, and to the Polonization of many Germans through clerical influence. The Poles are in the majority in Upper Silesia (Government district of Oppeln, 55 per cent.) and the province of Posen (60 per cent.). They are numerous in West Prussia (34 per cent.) and East Prussia (20 per cent.). In recent years, however, there has been a great emigration of Poles to the western industrial provinces of the empire.

Religion. ??? The following table gives the results of the religious census of 1890 compared with previous years : ???

Table XV . ???Beligious Statistics. (000 omitted.)

Creeds.

1871.

1880.

1890.

Protestants .... Roman Catholics . Dissenters . . . Jews . . . Other Creeds or not stated .

Total ....

25,582 14,868

82 512

17

28,331

16,233

78

561

31

31,027

17,675

146

568

13

41,061

45,234

49,429

Table XVI. ??? Beligion. Batio to 1000 Inhabitants.

Year.

Protestants.

Catholics.

Dissenters.

Jews,

1871 1880 1890

623 626 628

362 359

358

2-0 1-7 2-9

12 12 11

Three states in Germany have a decidedly predominant Catholic population ??? namely, Alsace-Lorraine, Bavaria, and Baden. In four states the Protestant element pre- vails, but there are from 23 to 33 per cent, of Catholics ??? ??? namely, Prussia, Wtlrtemberg, Hesse, and Oldenburg. In Saxony and the eighteen minor states the number of Catholics is only from 0‘3 to 3‘3 per cent, of the population.

Table XVII. ??? Protestants and Catholics according to the Census of 1890.

State.

Protestants.

Xloman Catholics,

Bate per 1000 of Population.

Prot.

Cath.

Alsace-Lorraine Bavaria . Baden .

337,476

1,671,863

698,678

1,227,225 3,962,941 1,028,222

210 281 361

765 708 620

Prussia .

Wiirtemberg .

Hesse ....

Oldenburg

Saxony and Minor States

Total .

19,232,449

1,407,176

666,118

274,410

6,938,640

10,252,818

609,794

293,661

77,769

221,521

642 691 671

773 961

342 299 296 219 31

358

31,026,810

17,673,941

628

Table XVIII. ??? Dissenters.

The census of 1890 gives the following details about the "Other Christians" : ???

Herrnhuters (Moravian Brethren) . . 6,716

Mennonites 22,365

Baptists 29,074

Church of England 5,249

Methodists and Quakers 10,144

Apostolics (Irvingites) 21,761

German Catholics 5,714

Freethinkers 14,347

Dissidents 23,698

Other 6,482*

No official return exists as to the Old Cath'blics. They are estimated to have numbered not more than 30,000 in

1890.

Education. ??? School instruction is obligatory upon all, but the administration of all the degrees of instruction is not imperial. An imperial school committee designates those schools which possess the right of granting certifi- cates to pupils entitling them to serve in the army as one- year volunteers.

The number of primary schools is not exactly known ; it is about 60,000. The pupils attending them number about 8,000,000 and the teachers 125,000. There were 184 seminaries for the training of teachers in 1900. The progress in education will be seen from the diminishing number of the illiterate army recruits since 1871 : ???

Table XIX. ??? Decreasing Number of Illiterate Becruits.

Tears.

Number of " Kecruits.

Unable to Eead or Write, 1

Total.

Per 1000 Kecruits.

1875-76 . 1880-81 1885-86 1890-91 1895-96 . 1898-99 .

139,856 151,180 152,933 193,318 250,287 252,382

3311 2406 1657 1035 374 173

23-7

15-9

10-8

5-4

1-6

0-7

Of the 173 illiterates in 1898-99, 64 were in East and West Prussia, 46 in Posen and Silesia, and 12 in Bavaria. Since 1875 many municipalities have founded schools of a somewhat higher rank for the lower classes, called Fortbildungsschulen, or Con- tinuation schools.

The four different classes of schools for higher educa- tion have been augmented since 1880. Exact and viniform statistics of the secondary schools for the whole empire do not as yet exist. In 1879 there were 878 schools with the privilege of furnishing pass certificates for the one-year volunteers; in 1900 there were 1286. There were included in this number 170 public semi- naries for training teachers in 1879, and 184 in 1900. The number of other secondary schools in 1900 was as follows : ???*

Table XX, ??? Xumber of Schools.

Gymnasia (classical) 451

Progymnasia (classical) 90

Realgymnasia 121

Oberrealschulen (without Latin) . . 53

Realschulen 272

Hiihere Burgerschulen . . .2

<)thor Public Schools 33

Private Schools 54

Total . . 1076

The gymnasia, of which the constitution dates back t() very remote times, have in Prussia the privilege of giving iu-ei[)aratory training for the universities. Pupils of the realschulen are only allowed to visit the univer- sities for the study of mathematics, natural science, and

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modern languages. In the southern states the privileges of the upper realschulen are greater. There is now a movement in Germaijy for extending the privileges of the gymnasia to the other niae-years schools, that is to say, the realgymnasia and the oberrealschulen. The total number of teachers and pupils in the German higher schools is not known, but in 1897 the 578 Prussian schools contained 7683 teachers and about 148,500 scholars.

Universities and Higher Technical Schools. ??? The attend- ance of the German youth at the higher schools and the universities has greatly increased since 1880. The num- ber of students at the twenty-one German universities (without taking account of the little academy at Brauns- berg) was 16,000 m 1872, the year in which Strassburg university was founded, and 33,500 in 1898-99. At the same time the total population has only increased from 41,000,000 (1871) to 65,000,000, or 34 per cent. For some years women have been allowed to attend, and in 1899 there were from 450 to 600 women at the various universities.

Table XXI. ??? The Oerman Universities, 1878 and 1899.

Universities.

Professors and Teachers.

Students.

Non- Matriculated Attendants.

1876.

1900.

18T6.

1898-99.

1898-99.

1. Berlin (Pr.) .

193

419

1977

6478

4843

2. Munich (Bav.)

3. Leipzig (Sax.)

114

199

1136

4049

279

155

224

2730

3481

368

4. Bonn (Pr.) .

100

154

751

1886

143

5. Halle (Pr.) .

96

154

882

1636

181

6. Breslau (Pr.)

108

170

1107

1618

131

7. Tubingen (Wurt.)

86

102

1019

1361

30

8. Heidelberg (Bad.)

110

154

735

1250

119

9. Gottingen(Pr.) .

119

127

1040

1238

87

10. Freiburg (Bad.) .

54

118

272

1235

66

11. Wurzburg (Bav.).

66

88

954

1215

23

12. Strassburg (Als.) .

94

132

674

1105

64

13. Marburg (Pr.) .

69

97

440

1040

74

14. Brlangen (Bav.) .

55

71

422

874

20

15. Konigsberg (Pr.) .

82

121

610

940

44

16. Giessen (Hesse) .

59

75

333

802

71

17. Greifswald (Pr.) .

60

96

498

759

15

18. Kiel (Pr.) .

65

101

212

757

54

19. Jena (Thilr.)

77

99

483

655

54

20. Miinster (Pr.)

29

49

409

620

12

21. Rostock (Meckl.). Total .

36

52

141

464

19

1827

2802

16,825

33,463

6697

The number of foreign students is said to have been only 750 in 1860, but in 1899 it was 2092, of whom 126 were from England, 305 from America,

and 81 from Asia. In 1898-99 the students were distributed among the different faculties as follows : ???

Table XXII. ??? Number of Students in the different Faculties.

1876.

1899.

1. Protestant Theology (17 faculties) .

2. Catholic Theology (7 faculties)

3. Laws, Politics, and Forestry (20 faculties)

4. Medicine, Surgery, Pharmacy (20 faculties)

5. Philosophy, Philology, History, Geo-“)

graphy, Mathematics, and Natural V Science J

Total ....

1,595

686

4,862

3, .529

6,153

2,473 1,548 9,814 8,104

11,524

16,825

33,463

The teaching staff was classified in 1899 as follows : ordinary professors, 1089 (1876, 931) ; extraordinary professors, 619 (1876, 371) ; honorary professors, non- salaried, 92 (1876, 46) ; private teachers (privatdo- centen), 841 (1876, 431); teachers of languages, 161

(1876, 90). The expenses of all the universities (Brauns- berg included) in 1891-92 were 19,912,000 marks, of which 4,872,000 marks were covered by their own revenues, and 15,040,000 marks by state or provincial funds.

The Technical High Schools have greatly increased, following on the industrial development of Germany in the last third of the 19th century. The attendance for the winter of 1898-99 is shown in the following table :

Table XXIII. The Technical Sigh Schools.

Technical High School.

students.

Attendants.

Berlin ....

2425

1003

Munich ….

1839

282

Darmstadt .

1302

141

Karlsruhe

884

196

Hanover

858

339

Stuttgart

767

171

Dresden

689

134

Aachen

340

141

Brunswick . Total

276

129

9380

The number of foreign students was about 1600.

Among the remaining higher technical schools may be mentioned the three mining academies, with 645 students in Berlin, Clausthal in the Harz, and Freiberg in Saxony ; the eight academies of forestry, and the high schools of agriculture, most of them affiliated to the universities, have been named in the earlier article (Ency. Brit. vol. X. p. 472).

Finance. ??? The most important expenses, iu addition to those already mentioned, which the budget of the empire has annually to meet, are the interest on the increasing imperial debt, the charges for the colonies, the subven- tions for steamer lines, and the charges for workmen's insurance against old age and infirmity. When the revenue is insufficient, assessments are made upon the various* states. These Matrikular Beitrdge pressed so heavily upon the minor states that, after the reorganiza- tion of the customs and excise duties in 1887, certain assignments {Ueberweisungen) or repayments to the vari- ous states were introduced of the surplus revenue from customs, tobacco, stamps, and spirits above 130,000,000 marks.

The following tables show the increasing require- ments of the empire and the respective receipts (in millions of marks). The figures are to be understood as net, as the gross amount of the receipts from the posts and telegraphs, printing office, and imperial rail- ways is not shown. For the same reason the assign- ments are deducted for the ordinary expenses and also for the contributions: ???

Table XXIV. ??? Development of the Imperial Finances.

Tears.

Expenditure.

Eevenue. 1

Ordi- nary.

Extra- ordi- nary.

Total.

Ordinary (Proper).

Matric. Contri- butions.

Extra- ordi- nai-y.

Total.

1875 1880-81 1885-86 1890-91 1895-96 1900-1

395-8 425-0 458-7 578-5 747-0 862-7

2.38-7 86-8 63-2 396-2 160-1 274-4

634-5 511-8 521-9 974-7 907-1 1137-1

316-7 374-1 453-7 687-6 829-8 1016-1

69-0

43-5

6-6

12-8

185-8 74-6 39-3

186-7 64-2 75-7

571-5 492-2 499-6

‘ 874-3 894-0

1104-6

The imperial budget is voted every year by the Eeichs- tag. The ordinary and extraordinary expenses for the financial year ending 31st March 1901 were distributed as follows : ???

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Table XXV. ??? Expenditure, 1900-1901 (ire thousand Marks).

1. Reichstag

2. Chancellery

3. Foreign Oifice ???

(a) Foreign Service .... (6) Colonial Office ....

4. Home Office ???

(a) General Service . . .] (6) Subventions (Steamer Lines) > (c) Insurance (Old Age and Infirm) J

5. Army ....

6. Navy ....

7. Ministry of Justice

8. Imperial Treasury ???

(a) General Service . (6) Assignments

9. Imperial Railway Office

10. Debt of the Empire

11. Audit Office .

12. General Pension Fund .

13. Invalid Fund (from 1870 to

14. Posts and Telegraphs .

15. Imperial Printing Office

16. Imperial Railways (Alsace-Lorraine)

1871)

Total

Grand Total

Ordinary.

233

11,986 548

9,705 7,500

31,573 541,758

73,939 2,119

5,355

514,940

392

77,701

856

68,164

30,076

342,495

5,305

58,435

Extraordi- nary.

530 19,636

3,396

124,093 88,269

25 2

13,415

2,256

21,096

1,783,779 272,718 . 2,056,497

Table liSYJ. ??? Revenue, 1900-1901 {Budget}.

Customs and Excise (net) ??? Customs

{Beetroot Sugar Tobacco Salt Spirits . Special Duties ??? Malt and Brewing Contributions by Territories outside verein .

the Zoll-

2. Stamps

Playing-Cards 1,471

Exchanges 10,367

Effects, &o 53,708

Statistical Tax 937

3. Posts and Telegraphs "I

4. Imperial Printing Office w Gross Revenue)

5. Imperial Railways J

6. Imperial Bank (Share of Profits)

7. Various Revenues

8. From the Imperial Invalid Fund

9. Balance of Non-Common Revenue

10. Federal Contributions .

11. Extraordinary Supply (Loans, &c.)

Total

1000 Marks.

473,220

102,009

12,143

47,810

124,301

30,165

78

66,483

393,210 7,516 86,175 14,854 18,762 30,076 15,586

527,662 75,620

2,025,670

The chief branches of imperial expenditure, ordinary and extraordinary, have increased as follows (in millions of marks) : ???

Table XXVII. ??? Imperial Expenditure.

Tears.

Army.

Navy.

Per Head (Marks).

Insur- ance.

Debt.

Army,

Navy.

1875

1885-86

1895-96

1899-1900

1901-2

364-9 371-6 562-7 642-9 673-1

48-6

52-0

85-9

133-7

207-5

8-5

7-9

10-8

11-7

11-9

1-1 1-1

1-6 2-4

3-7

15-3 28-9 30-4

17-4

71-7 75-6 89-0

Customs Revenue. ??? The Zollverein or German Customs Union, founded in 1828 between Prussia and Hesse, and with progi-essive

territorial extensions during the succeed- ing fifty years (for details see the earlier article, Ency. Brit., X. 454), had an area of about 209,281 English square miles, with a population of 40,678,000 inhabitants in 1871, when the German Empire was created. The last

important addition was in October 1888, when Hamburg and Bremen were incorporated. Outside the Zollverein there are now only the two little free-port territories at Hamburg and Bremen, and some districts on the frontier between Baden and Switzerland. These had in 1895 an area of 26-3 square miles, and 13,061 inhabitants. The Grand Duchy of Luxemburg is included in the Zollverein, although it is not a part of the German Empire. After having been in general a free-trade country from about 1860 (transit-duties abolished 1861), a more protective system was introduced by the tariff of 15th July 1879, modified to a certain extent by the commercial treaties of 1892. No export duties have been imposed since 1866 ; but in 1879 raw materials were taxed, and in 1885 the duties on cereals and other foods were raised. The gross amount of customs revenues was as follows (in millions of marks) : ???

Table XXVIII

. ??? Growth

of the Customs Bevenue.

Tears.

Total.

Per Head (Marks).

Tears.

Total.

Per Head (Marks).

1878 1880 1885 1890

114-7 182-2 235-0 389-4

2-62 4-08 5-08

7-85

1895 1897 1899

415-4 472-0 494-1

7-94

8-75 8-89

The customs revenue in proportion to the value of the imported taxed merchandise has been calculated as follows (in millions of marks) for 1898 : ???

Table XXIX. ??? Batio of Customs Duties to Imports.

Articles.

Imports (Value).

Castoms Duties.

Per Cent.

of the Supposed

Value.

Raw Materials for Industry Manufactures . . . ‘ . Articles for Consumption (Animals)

513-2

790-2

1594-2

34-1 116-2 355-8

6-6

14-7 22-3

The principal articles from which duties were received in 1898 were the following : Colonial products, 201-4 million of marks ; cereals or agricultural products, 153-7 ; petroleum, 67-8 ; timber, &c., 20-7 ; oils and fats, 20-4 ; iron and iron manufactures, 97 ; cotton and cotton goods, 9 0.

The following table gives the net amount of the four licensed articles of consumption (totals in millions and per head in marks) : ???

Table XXX. ??? Licensed Articles.

Spirits.

Beer.

Tobacco.

Salt.

Total.

Per Head,

Total.

Per Head.

Total.

Per Head.

Total.

Per Head.

1875-76 1885-86 1895-96 1898-99

44-3

50-1

149-1

162-1

1-38 1-35 2-84 2-95

65 -0 87-2 94-5

1-42 1-66 1-73

14-5 38-5 59-9 65-7

0-35 0-84 1-14 1-20

48-8 50-4

0-93 0-92

There is a great difference between the German beer duty and that of the southern states, where the taxation IS much higher. The duty rose in Bavaria to 6-02 marks per head in 1898, in Baden to 4-‘35, in Wurtemberg to 4-27, and in Alsace-Lorraine to 2-05, whereas in the common territory it was only 0-88 mark.

Farwh of the Empire. ??? The Invalid Fund for paying the pensions of the men invalided in the Franco-German war, which amounted originally to 561,000,000 marks, stood at 383,106,600 on 31st March 1900. The imperial war reserve or Reichskriegsschatz in coined gold and bullion m Spandau still amounts to 120,000,000 marks. The imperial

debt, mainly incurred for military expenses, rose from 2,((00,000 marks in 1873 to 2,418,518,000 marks on

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31st March 1900. Of this amount 1,240,000,000 marks was at the rate of 3^ per cent., 1,059,000,000 marks at 3 per cent., and 120,000,000 marks in shares {Eeichs- kassenscheine) paying no interest.

Defence (see also articles Armies and Navies). ??? The strength of the army on a peace footing (Friedensfuss) was fixed by the Army Bill of 1874 at 401,659 men (or say 1 per cent, of the population at the census of 1871) for a term of seven years ending 31st December 1881. Other Bills, of 6th May 1880, 11th March 1887, 15th June 1890, and 3rd August 1893, raised the peace footing to 479,229, and the Bill of 25th March 1899 fixed the number at 502,506 men in 1902. Since 1st April 1900 the imperial army has consisted of twenty-three army corps ??? namely, the Prussian guards corps, sixteen Prussian corps (including the troops of the minor statps in military con- vention with Prussia), three Bavarian corps, tvi^o Saxon corps, and one Wiirtemberg corps. There are now five " army inspections," each comprising from three to five corps. Generally, an army corps consists of two divisions, composed of infantry, cavalry, and artillery, but two corps have three divisions. The guards corps contains two divisions of infantry and one division of cavalry. The army, therefore, has forty-eight mixed divisions and one cavalry division. In 1902 the army consisted of 625 battalions of infantry, 482 squadrons of cavalry, 574 batteries of field artillery, thirty -eight battalions of foot artillery, twenty-six battalions of pioneers, eleven bat- talions of communication troops (railway and balloon), and twenty-three transport battalions.

The following table shows the strength and the organi- zation of the imperial army on the peace footing according to the budget estimates for 1900 : ???

Table XXXI. ??? The German Army.

Peace Footing,

OfBcers.

Rank and File,

Special Service.

Horses.

1 . Staff, Non – Regimental I

Officers . . /

2. Infantry, 216 regiments . Rifies (Jager), 18 battalions Bezirkskommandos (293) 1

(D^pdts of Landwehr) /

3. Cavalry, 93 regiments

***4. Field Artillery, 88 regi- ***

ments . . . j

***Foot Artillery, 17 regi- ***

ments, 1 battalion J

5. Pioneers, 25 battalions

6. Communication Troops'

(Railways, 3 regi- ments, 1 battalion ; Balloon, 2 divisions; Telegraphs, 3 battal- ions) ...

7. Transport, 23 battalions .

8. Special Formations .

Total

2,604

12,056 388

870

2,406

2,980

872 571

237

322 544

169

367,274 11,274

5,757

66,229

64,316

23,297 14,814

6,074

7,963 4,615

212

2473 72

15

817

962

134 99

47

76 67

...

65,135 32,879

43

4,872

23,850

571,692

4974

102,929

Grand Total .

600,516

The special service formation includes 2165 military surgeons, 1044 paymasters, 671 veterinary surgeons, and 1094 gunsmiths.

1^0 official returns of the war strength of the army based upon the new formation are published, but no doubt Germany would be able to call up in the last extremity from 2,800,000 to 3,000,000 trained men.

The length of the frontier lines has been already mentioned. Germany has not good natural frontiers on the east or on the west, but the great rivers crossing the country from south to north constitute good lines of defence. These are strengthened by a system of fortresses. There are at present in Germany, which is divided into

ten fortress districts, six fortresses of the first class, serving as camps (marked). In the east we find *K6nigsberg, with Pillau and Boyen between the lakes in East Prussia; then along the Vistula, Danzig (Weichselmunde),Graudenz, and *Thorn ; and farther south, *Posen, Glogau, and Glatz. In the centre, near Berlin, are situated KUstrin, Spandau, and Magdeburg ; and along the Donau, Ingolstadt and Ulm. The Pranco-German frontier is guarded by Neu-Breisach, *Strassburg, *Metz, and Diedenhofen; and behind by Germersheim, Mainz, Ehrenbreitstein, near Coblenz, *Cologne, and Wesel. Along the coast, besides the great naval ports of *Wilhelmshaven on the North S.eaand *Kiel on the Baltic, many points are fortified.*

The development of the navy has not until recently kept pace with that of the empire's commercial interests beyond the sea. The navy has also remained behind the marine forces of the other Great Powers. The following table gives the number of ships on 1st April 1901 : ???

Table XXXII. ??? The German Navy.

Number.

Displacement.

Indicated Horse-Power.

First – class battleships \ (Linienschiffe) . j Defence armour-clads Gunboats, armour-clad Large cruisers . Cruisers .... Gunboats . School ships Vessels for other purposes .

Total .

15

8 13 11 29

5 15

8

142,503

28,102 1.3,886 79,470 59,895 4,441 29,688 11,239

142,900

38,400

10,700

114,500

139,250

5,800

. 26,000

17,020

104

369,224

494,750

The personnel for 1901 consisted of 1567 officers and surgeons, 526 aspirants, and 29,078 men.

The Navy Bill (Flottengesetz) of 14th June 1900 pro- vides for (a) a battle-fleet of 2 flagships and 4 squadrons, each consisting of 8 first-class battleships, 8 large cruisers, and 24 small cruisers ; (&) an Auslands-FloUe of 3 large cruisers and 10 small cruisers ; (c) a reserve of 4 battle-

ships, 3 large cruisers, and 4 small cruisers. The total is 38 battleships, 38 large cruisers, and 110 small cruisers. During the seven years ending 1907, 17 battleships, 10 large cruisers, and 29 small cruisers were to be laid down.

The Kaiser Wilhelm Canal, which crosses Schleswig- Holstein, and was opened in 1896, facilitates the transfer of naval forces from one sea to the other.

Agriculture. ??? In the last quarter of the 19th century there were three official inquiries into the agricultural im- provement of the soil ??? namely, in 1878, 1883, and 1893. The last one gave the area of the different forms of culti- vation as follows (in hectares, 000 omitted) : ???

Table XXXIII. ??? Area of Different Forms of Cultivation.

1000

Hectares.

Per Cent.

(A) Cultivable area ???

1. Arable lands (including gardens) Vineyards

2. Meadows

Pasture grounds

3. Woods and forests

Total ....

(B) Uncultivable area ???

1. Houses and courtyards

2. Uncultivable land ....

3. Roads and waters (streams, lakes) .

Total .... Grand total

26,243

133

5,916

2,873 13,957

48-6 0-3

10-9 5-3

25-8

49,122

90-9

484 2,061 2,382

0-9 3-8 4-4

4,927

9-1

54,049

100

686

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Since 1878 the ???woodland area has increased by about 20,000 acres. The state forests alone occupy 17,900 square miles, or 33-3 per cent., and are increasing. About 15-6 per cent, of the area belongs to towns or villages, and one-half is in private possession. The greatest atten- tion is paid throughout the empire to forest culture. But the supply of native timber is not sufla.cient, and much has to be imported. On 14th June 1895 the total number of agricultural and forest holdings was 5,580,358, with an area of 49,627,751 hectares ??? namely, 22,041 exclusively forest holdings, with 6,343,000 hectares, and 5,558,317 combined holdings, including orchards and vineyards, with an area of 43,284,751 hectares.

The mean growth of the several agricultural holdings ??? each cultivated by one household ??? is given in the fol- lowing table (holdings and hectares in thousands) : ???

Table XXXIV. ??? Extension of Agricultural Holdings.

Holdings.

Area.

Total.

Per Cent.

Total.

Per Cent.

1. Holdings (under 2

hectares) . . . j

*2. Small farms (from 2 *

to 5 hectares) . . /

***3. Middle – sized farms ***

(from 5 to 20 hectares) j

4. Large farms (from 20 1

to 100 hectares) . j

5. Large properties (1001^

hectares and more) . J

Total 1895 .

„ 1882 .

3,236

1,016

999

282 25

58-2

18-3

18-0

5-1

0-4

1,808 3,286 9,722 9,870 7,832

5-6 10-1 29-9 30-3 24-1

5,558 5,276

100

32,518 31,869

100

This table shows that in Germany the farmers (Nos. 2, 3, 4), who held in 1895 70-3 per cent, of the total agri- cultural area, are still of great importance. There are, besides, many landowners of large estate, but the 4180 holdings of more than 500 hectares each did not cover together more than 4,461,000 hectares, of which there were 572 with more than 1000 hectares (or 2470 acres), holding together 1,169,000 hectares. It appears from the census that 37,270,000 hectares (or 86 per cent, of a total of 43,245,000 hectares) belonged to the holder, and only 14 per cent, was held by tenants. These farms supported in 1895 18,069,000 persons, of whom 8,156,000 were actually working upon the land. If we take the mean of the five years 1895-99, the areas under the principal crops, and the yield of their products, were as follows (in thousands of hectares and thousand metric tons, 1 metric ton or 1000 kilogrammes = 2200 ft or -984 of an English ton) : ???

Table XXXV. ??? Acreage under Crops and Yield per Hectare.

Crops, 1895-99 (Mean).

Area under Crops. 1000 Hectares.

Yield.

1000

Tons.

Tons Per Hectare.

Rye

Wheat ....

***Winter Spelt (Bavaria, ***

WUrtemberg, Baden) /

Oats

Barley .... Potatoes .... Hay

5,932

1,953

328

4,001 1,647 3,076 5,908

8,427 3,502

470

6,314

2,780

35,820

23,982

14-0

17-7

14-3

15-8

16-9

116-4

Though the crops have increased, the yield is not suffi- cient for the supply of the rapidly increasing population. Nearly all kinds of cereals have to be imported. There were in recent years about 150,000 tobacco planters in Germany, the mean area under plantation being 20,000

hectares in 1894-98, and the mean yield 42,200 tons. The culture of hops is important only in Bavaria, Wiir- temberg, Baden, and Alsace. The 40,600 hectares planted on an average in 1894-98 with hops gave 27,000 tons, of which 6500 tons were available for export. The culture of the vine is concentrated in the valleys of the Rhine and its confluents (Neckar, Main, and Mosel). The mean area of the cultivated vineyards was 117,000 hectares in 1894-98. The yield has fluctuated enormously in recent years, from 6-3 hectolitres per hectare in 1891 to 43-4 in 1896; the mean from 1888 to 1897 was 21-1. The total yield in 1891 was 748,000, and in 1896, 6,051,000 hectolitres. The mean yield from 1889 to 1891 was 5,200,000 hectolitres.

The Prussian provinces east of the Elbe, including the province of Saxony and Mecklenburg, with a population of about 19,000,(f00, produced from potatoes in 1898-99 2,800,000 hectolitres of pure spirits, there being 3369 distilleries. The rest of Germany, with a population of 36,000,000, produced only about 1,000,000 hectolitres from 63,500 distilleries, mostly of small size. The mean total annual product of spirits in the twelve years since Bavar ria, Wiirtemberg, and Baden were introduced into the German area of common spirit duty in 1887 was 3,125,000 hectolitres. The number of breweries decreased from 14,000 in 1872 to 7312 in 1898, but they are at present of much larger dimensions. The quantity of beer produced, calculated per head of the population, was enormous in Bavaria and Wiirtemberg in proportion to the other German states; it has increased also in the latter, but not at all in the same degree as in Northern Germany (German Brewery Union) and Baden.

Table XXXVI. ??? Progress of the Production of Beer.

Tear.

Millions of Hectolitres.

Per Head (Hectolitres).

Bavaria.

Wurtem- berg.

German “Union.

Empire. 1

Bavaria.

Wiirtem- berg.

Union.

1872 1882 1892 1899

10-9 12-3 15-1 17-7

4-2 3-2 3-7 4-1

16-1 21-3 33-2 43-2

32-9 38-9 53-6 69-5

256 232 267 292

229 165 183 193

52 62 84 99

The centres of beetroot sugar production are Silesia and Posen, the province of Saxony and Hanover, with Brunswick and Anhalt. But beet is also largely grown in West Prussia, Pomerania, and Mecklenbxirg.

Table XXXVII. ??? Pj-ogii-ess of the Production of Beetroot Sugar.

Year.

Manufac- tories.

Beetroot consumed.

Sugar (Raw).

Molasses.

1000 Tons.

1000 Tons.

1000 Tons.

1876-77

328

3,550

289

1886-87

401

8,307

986

216

1890-97

399

13,721

1,739

342

1897-98

402

13,698

1,755

344

1898-99

402

12,117

1,627

306

Lice Sfocl:. ??? Since 1873 the number of horses and cat- tle has increased nearly in the same proportion as the population. But sheep-breeding has declined enormously, as in almost all European countries (from 25 to 10 mil- lions). On the contrary, pig-breeding has spread much in recent years, and the number has doubled since 1873. Germany is still absolutely dependent on foreign coun- tries for live stock.

1 Including Baden (1872, 927,000 hectolitres; 1898, 2,947,000) and Alsace-Lorraine.

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Table XXXVlU. ???Live Stock.

Year.

Live Stock (in Millions).

Per 100 Inhabitants. 1

Horses.

Cattle.

Sheep.

Pigs.

Horses.

Cattle.

Sheep.

Pigs.

1873 1883 1892 1900

3-35 3-52 3-84 4-18

15-78 15-79 17-56 19 00

25-00

19-19

13-59

9-67

7-12

9-21

12-17

16-76

8-2 7-7 7-8 7-3

38-4 34-5 35-5 34-0

60-9 42-0 27-5 17-3

17-4 20-1 24-6 300

The number of goats was 3,091,000 in 1892, and 2,320,000 in 1873. Not unimportant is the rearing of bees ; there were in 1892 2,034,000 bee-hives.

Fisheries. ??? The occupation census of 1895 showed that 42,000 persons (members of families included) were occu- pied in fisheries on lakes, and 34,500 on shore and on the open sea.

Minerals and Mining. ??? The extraordinary industrial development of the country since 1870 was largely based on its mineral wealth. Having left France much behind in mineral production, Germany now rivals Great Britain and the United States.

Coal.- ??? ^The six large coalfields rank according to production nearly in the same order as in 1878.

Table XXXIX. ??? Number and Production of Collieries in 1900.

Coalfields.

Collieries.

Qnan titles.

Average No. of Hands.

Value.

Ruhr

Upper Silesia .

Saar

Zwickau, Saxony

Lower Silesia .

Aachen

Minor fields

Total .

170 57 25 31 18 13 24

Mill. Tons.

60-2

24-8

11-1

4-8

4-8

1-8

1-8

229,000 70,000 51,000 23,500 23,000 8,000 9,500

Mill. Marks.

614-8 184-5 129-0 60-3 43-8 16-7 17-0

338

109-2

414,000

966-1

The following table shows the rapidly increasing development of the coal production. That of lignite is added, the provinces of Saxony and Brandenburg being rich in this product : ???

Table XL. ??? Production of Coal and Lignite.

Tear.

Coal.

Lignite. 1

Quanti- ties.

Value.

Hands.

Quanti- ties.

Value.

Hands.

1871 1881 1891 1899 1900

Mill. Tons.

29-4

48-7

73-7

101-6

109-3

Mill. Mks.

218-4 252-2 589-5 789-6 906-1

186,000 283,000 379,000 414,000

MiU. Tons.

8.5 12-8 20-5 34-2 40-5

Mill. Mks.

26-2 88-1 54-2 78-4 98-5

25,600 35,700 44,700 50,900

This production permits a considerable export of coal to the west and south of the empire (1900, 15,300,000 tons), but the distance from the coalfields to the German coast is such that the import of British coal cannot yet be dispensed with (1900, nearly 6,000,000 tons). Besides this from 7,000,000 to 8,000,000 tons of lignite come annually from Bohemia.

Iron. ??? The production of iron ores, mostly in Lorraine and Luxemburg, though three time^ greater than in 1871, does not satisfy the increasing demand. Some fine sorts have to be im- ported from Sweden and Spain. The following is the production of pig iron. The figures in (a) relate- to the production exclusive of that of Luxemburg, the figures in (6) include this : ???

Table

XLL ???

Production of Iron Ores and Pig Iron.

Year.

Iron Ores.

Pig Iron. 1

Quantities.

Value.

Quantities.

Value.

(a)

(61

(a)

(??)

(??)

(6)

(a)

(2-)

MiU.

Mill.

Mill.

Mill,

Mill.

Mill.

Mill.

Mill.

Tons.

Tons.

Marks.

Marks.

Tons.

Tons

Marks.

Marks.

1872

4-72

5-90

38-9

42-4

1-82

1-99

211-7

222-3

1881

5-41

7-57

31-1

36-1

2-62

2-91

152-7

164-0

1891

7-55

10-66

33-4

39-4

4-10

4-64

210-1

232-4

1899

11-98

17-99

57-2

70-2

7-15

8-13

410-1

454-7

1900

12-79

18-96

63-8

77-6

7-55

8-62

491-8

551-1

The following table shows the quantities of coal (lignite included) and pig iron which have been produced by the four most important industrial countries of the world (in millions of tons) : ???

Table XLII. ??? Production of Coal and Pig Iron.

States.

Coal.

Pig: Iron.

1871.

1897.

1671.

189T.

Great Britain United States Germany France

Mill. Tons.

125-5

41-5

42-3

15-9

Mill. Tons.

205-4

181-6

120-4

30-7

Mill. Tons.

6-7 1-9 1-7 1-2

Mill. Tons.

8-9 9-7 6-9 2-5

The production of other important minerals or metals is com- bined in a single table, showing similar progress to that of coal and iron (in thousands of tons and millions of marks) : ???

Table XLIIL ??? Production of other Minerals and Metals.

1871.

1899. 1

Quantity.

Value.

Quantity.

Value.

Zinc ore Lead ore Copper ore . Silver and gold ore Iron pyrites

Rook salt . Potassic salt

Mill. Tons.

335

97 217

27-4 140

140 375

Mill. Mks.

5-4 14-4 5-5 5-3 1-5

1-1 3-3

Mill. Tons.

.665

144

774

13-5

145

861

2500

Mill. Mks.

35-4

14-1

20-9

1-9

1-0

3-8 32-2

The total product of the mines, including coal and lignite and iron, and some minor ores, was of the value of 314,000,000 marks in 1871, and of 1,263,000,000 marks in 1900.

Manufactures. ??? The general census of industries, taken on 14th June 1895, gives the following table, showing the number of the different trades and industries and of the persons engaged in them. The census gives twenty-one groups of manufactures combined in three divisions : ???

Table XUY. ??? Industries, 1895.

Groups.

Establish- ments.

Persons Engaged.

1. Horticulturists

2. Fishermen, &c.

24,768 17,553

74,991 28,137

Totals . . . .

42,321

103,128

3. Miners

4. Workersinstone,clay,andglass

5. Workers in metal .

6. Workers in machines, instru- “1

ments, &c. . . . J

7. Chemical industry

8. Workers in lighting materials, “1

soap, fats, oils, &c. . j

9. Textile industry .

10. Workers in paper .

11. Workers in leather

12. Workers in wood .

13. Workers in foods and drinks

14. Workers in dress and washing

15. Workers in building

16. Polygraphic industry .

17. Artistic industry .

4,003

48,229

158,618

87,879

10,385

6,191

205,292

17,631

47,325

219,914

269,971

848,845

198,985

14,193

9,511

536,289 558,286 639,755

582,672

115,231

57,909

993,257

152,909

160,343

598,496

1,021,490

1,390,604

1,045,576

127,867

19,879

Total B ??? Industry includ- \ ing mining and building /

2,146,972

8,000,563

18. Persons in mercantile business

19. Persons in assurance business

20. Persons engaged in conveyance

21. Lodging and boarding .

635,209

7,342

78,696

234,437

1,332,993

22,256

230,431

579,958

Total C ❓❓❓ Commerce, inn-l keeping, &c. . . J

955,684

2,165,638

All industries, incl. commerce, 1895

1882

3,144,977 3,005,457

10,269,329

7,.S40,789

688

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The rate of increase of persons engaged in industries was 40 per cent, from 1882 to 1896. The following table shows the extent of the several establishments (000 omitted) : ❓❓❓

Table '^JjY . ❓❓❓Extent of Industries.

Tear.

Small Bstabllsh-

ments. (1 to 5 Persons.)

Middle-Sized Establishments. (6 to 50 Persons.)

Large Establishments. (More than 50.)

Establs.

Persons.

Establs,

Persons.

Establs.

Persons.

Totallnl895 . Total in 1882 .

2,936

2,883

4,771 4,336

191 113

2,464 1,392

19 10

3,044 1,613

Increase jjer cent.

1-8

10-10

69-7

76-3

90-0

88-7

The number of establishments employing persons in domestic industry was 22,307 in 1896, with 490,711 persons engaged ; 151,695 establishments or factories used steam or water, the horse-power produced amounting to 3,300,000.

Commerce. ??? It has been stated that the Zollverein or German Customs Union does not completely coincide with the frontiers of the empire. Included within it are the Grand Duchy of Luxemburg and some small Austrian communes. The following table shows the special trade. It should be remembered that Hamburg and Bremen were included in the Zollverein in 1888 : ???

Table XT.VI.-

???Special Trade (in millions of marks').

Year.

Imports.

Exports.

Year.

Imports.

Exports.

1880 1885 1890 1895

2869-9 2989-9 4272-9 4246-1

2946-2 2915-3 3409-6 3424-1

1897 1898 1899 1900

4864-6 5439-7 5783-6 6043-0

3786-2 4010-6 4368-4 4752-6

The three principal groups of articles which the official returns distinguish were as follows in 1890 and 1899 (in miDions of marks) :
_?_?_?

Table XL VII. ??? Specification of the Special Trade, 1890 and 1900.

Articles.

1890.

1S99. 1

Imports.

Exports.

Imports.

Exports.

Eaw materials for industry

Manufactures

Articles of consumption .

1767-4

981-1

1397-0

708-3

2147-5

470-7

2803-1 1199-7 1762-8

1111-4

2982-4

617-6

The following table gives further details of the special trade in 1899 (in millions of marks). The official returns distinguish the raw materials from the manufactured articles in respect of certain classes of imports and exports : ???

Table 'SX.Ylll. ??? Classes of Imports and Exports, 1899.

Imports.

Exports,

Living and other Animals Animal Products Seeds and Plants . Fuel .... Railway Waggons, Ships, \ &c. . . . / Machinery, Instruments . Hardware, Toys, Jewels . Literature, Art, &o. Various

186-4 191-2 . 68-6 160-7

12-9

109-3 26-7 45-0

1

19-7

40-6

42-6

235-6

19-1

291-0

122-3

140-3

2-8

Raw and Manufactured

Materials : ??? Articles of Consumption Fats and Oils Chemicals, Drugs Stone, Clay, Glass Metals, Metallic Mann- “1

factures . . J Wood, Wooden Wares Paper Goods Leather, Furs Textiles Indiarubber, &o. .

Total . Gold and Silver

Eaw.

Manu- factured.

Raw.

Manu- factured.

1273-9 165-7 207-5

. 54-3

350-2

162-7

17-8

144-4

802-7

76-7

268-1

140-5

108-8

23-6

62-3

231-9

9-5

106-7

470-5

14-5

109 0 14-7 44-4 51-9

97-2

43-0 22-9 66-2 154-2 24-3

350-1

20-0

365-4

117-6

487-0

105-6

81-6

204-6

880-4

54-1

5483-3 300-3

4207-0 161-4

The principal imports and exports under the above heads were, in millions of marks, as follows. The figures are to be considered

as net, the exports being deducted from the imports, and vice versd, : ???

Table XLIX. ??? Imports (excess over Exports) in 1899.

Articles.

Quantity. 1000 Tons.

Value.

Articles.

Quantity. 1000 Tons.

Yalue.

Raw Materials : ???

Wheat

1871

180-4

Lignite

8696

60-2

1626

186-2

Copper

63

98-6

Barley

Eye

Eice

1104

127-9

Tin . . .

11

27-6

561

64-9

Iron Ores .

1045

59-6

25T

86-1

Pig Iron

480

27-8

Oats .

269

28-9

Petroleum .

909

78-3

Malt

92

20-9

Other Mineral (

104

17-2

Fruits .

882

99-5

Oils . . !

Wine

89

80-8

Oil, Oilseed, &c.

530

94-4

Coffee

156

128-0

Linseed, Eape

363

72-8

Cocoa

18

24-9

Various Fodder .

678

56-a

2-5

4-5

Clover Seed, &c.

20

17-9

Tobacco .

56

88-1

Saltpetre .

600

70-6

Animals : ???

ITuraber.

Horses

119,000

88-8

Cattle .

179,000

55-9

try:- Wool

Swine

70,000

4-9

176

846-7

Animal Products : ???

1000 Tons.

Cotton .

816

212-1

Meat .

71

66-0

Hemp and Flax .

86

42-2

Lard and Tallow

153

91-0

Jute .

81

22-1

Butter .

10

14-4

Silk .

47

12S-4

Cheese

14

17-9

Yarn, all sorts

42

106-5

Poultry

35

87-8

Wood and Timber .

4579

272-3

Fish (including 1 Herrings) i”

112

95-8

Indiarubber .

8

51-8

60-8

Hides .

69

88-4

Table L

_?_?_? Expor

s (excess over Imports)

n 1899.

Articles.

Quantity. 1000 Tons.

Value.

Articles.

Quantity. luOO Tons.

Value.

Articles of Consump-

Instruments, 1 Pianofortes f

16

42-3

tion: ???

Sugar

938

208-2

Flour

141

18-7

Furniture, &c.

11

23-8

Hops .

4

8-4

Paper

75

66.6

Beer .

21

10-1

Chemicals

42

93-4

3oal and Coke

6889

180-2

Textile Manufac-

517

19.5

tures : ???

Iron : ???

Woollen

28

197-8

Angle Iron, &c.

877

48-6

Cotton

81

178-4

Manufactures

711

263-0

Silk .

5

104-7

Telegraph Wire, 1

12

22-2

Cloths, &c.

9

123-9

Leather, &c. .

10

107-6

Machinery .

187

121-0

Indiarubber , (Manufactures j

Ships .

12

4-2

Copper, manufeo- 1 factured . f

19

5-2

Gold and Silver 1 Wares . . (

78

45-2

Zinc, raw and i 1 manufactured f

51

81-6

Toys

Books, printed

28 8

42-6 48-6

Earthen and China [Wares 1

38

48-1

Impressions in |

colour, Litho- V

5

61-8

Slass

102

20-3

graphs, ►►fcc.)

Countries. ►►► The special commerce of the German Zollverein was divided as follows in 1899, according to countries : ►►►

Table LI. ►►► Imports from Different Countries, and Exports to them, 1899 (in millions of marks).

Countries.

Imports.

Exports.

Great Britain

777-1

851-6

Austria-Hungary

730-4

466-0

Russia

715-9

437-3

France ....

303-1

216-7

Ifetherlands

203-3

327-7

Belgium . . . .

246-1

207-1

Switzerland ....

176-3

284-7

Sweden . . . .

104-2

136-1

Denmark . . . .

77-5

125-8

Norway . . . .

24-8

77-0

Italy

197-0

116-0

Spain

69-5

44-0

Portugal . . . .

16-9

18-9

Rumania . . . .

27-1

36-8

Turkey . . . .

28-9

32-6

Hamburg (free port) .

19-3

70-8

United States

907-2

377-6

British North America

4-7

23-7

Mexico . . . .

11-8

22-3

West Indies

30-1

11-0

Central America .

29-6

4-1

Argentine Republic .

194-5

52-3

Brazil

91-0

46-5

Chile

93-4

28-1

Ecuador, Peru, Bolivia

19-7

14-0

Colombia, Venezuela .

17-7

90

Uruguay . . . . Carry forward .

13-1

10-4

6129-2

4048-1

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Table LI. ??? continued.

Countries.

Imports.

Exports.

Brought forward British India

Australasia .... Dutch East Indies China .... Japan

5129-2

230-5

121-1

62-4

29-0

16-5

4048-1 65-3 37-8 19-5 50-6 40-9

Egypt

Transvaal 1 .... British South Africa . West Africa

31-9 39-3 30-0 40-7

9-7 11-3 11-3 19-5

Other Countries . Total

53-4

54-4

5784-0

4368-4

1 Including gold to the value of 3S‘4 millions of marks.

Shipping and Navigation. ??? As with all searf aring nations, the number of sailing vessels in the German merchant service has decreased, but the number and tonnage of steamei-s have greatly increased. The official returns do not include ships of less than 17-| gross tons. Since 1897 a statement of the gross tonnage has taken the place of thenet tonnage returns. The following table shows the rapid increase in the number of steamships since 1871 : ??? Table LII. ??? The Mercantile Marine of Germany.

Year. January 1.

Sailing Vessels.

Steamers.

Total.

Number.

Tonnage.

Number.

Tonnage.

Number.

Tonnage.

1871 1881 1891

1897 -i

1900

4372 4246

2757 2552

2552 2466

Net Tonnage.

900,000 966,000 710,000 598,000

Gross Tonnage.

632,000 632,000

147

414

896

1126

1126 1293

Net Tonnage.

82,000 216,000 723,000 890,000

Gross Tonnage.

1,428,000 1,864,000

4519 4660 3653 3678

3678 3759

. Net Tonnage.

982,000 1,181,000 1,483,000 1,488,000

Gross Tonnage.

2,060,000 2,495,000

The total number of sailors required for manning the ships of the mercantile marine in 1899 was 42,661, of whom 29,111 were on steamers. Of the total number of vessels almost half the tonnage belonged to Hamburg.

Table LIII. ??? Ships according to States.

Total.

Steamers only. 1

Number.

Gross Tonnage.

Number.

Gross Tonnage.

Hamburg .

Bremen

Prussian Ports .

Mecklenburg-Schwerin

Oldenburg .

Lubeck

Total

846

520

2074

65 228

26

1,229,500

723,000

407,500

39,300

81,900

14,100

435

27.3

525

82

14

14

993,700

510,000

314,600

20,200

10,900

14,100

3759

2,495,300

1293

1,863,500

Much progress has been made in shipbuilding since 1890. The numbers and gross tonnage of ships built in German yards in 1899 were as follows : ???

Table LIV. ??? Ships built in 1899.

Total.

Steamers only.

Number.

Gross Tonnage.

Number.

Gross Tonnage.

A ??? Ships Building. Men of War???

For H.M. Navy .

For Foreigners Merchant "Vessels ???

For Home Merchant \ Marine . . J

For Foreigners River Ships ???

For Home Rivers

For Foreigners .

.B??? Ships built in 1899. Men of War . Merchant Vessels . River Ships

24 23

418 69

166 33

9 307 150

65,470 26,143

415,855 54,812

28,687 2,118

3,090

209,901

22,633

24 23

283 58

46 26

9

222

33

65,470 26,143

389,245 52,892

5,404

1,767

3,090

196,738

2,852

The number and tonnage of registered sailing and steam vessels of the German Empire engaged in home and foreign trade during 1898 are given in the following table, the net tonnage being in millions of tons : ???

Table LV. ??? Trade Voyages.

With Cargoes.

In Ballast.

Number.

Tonnage.

Number.

Tonnage.

Voyages between German Ports

Voyages between German and }

Foreign Ports . . |

Voyages between Foreign Ports

Total

42,100 18,541 18,564

3-0 10-2 26-4

9,086 3,398 3,420

0-6 1-5 2-1

79,205

39-6

15,904

4-2

The maritime development of the German ports may be seen from the following table, giving the tonnage of the vessels cleared and entered (in millions of net register tons) : ???

Table LVI. ??? Clearances and Entries of Ships.

Tears.

Entered.

Cleared.

German.

Foreign.

Total.

German.

Foreign.

Total.

1873-75 1880-85

1895

1899

2-97

4-50

7-91

10-25

3-46 4-67 7-28

7-74

6-43

9-17

15-19

17-99

2-94

4-53

8-03

10-31

3-38 4-69 7-25

7-72

6-32

9-22

16-28

18-03

The tonnage of the vessels entered in 1899 under the British flag was 4,353,000 tons. Other countries were as follows : Sweden 958,000 tons, Denmark 925,000, Norway 711,000, Netherlands 285,000, Russia 237,000, France 90,700.

*The principal ports of the German Empire ranked as follows in 1899 as to the tonnage of ships entered and cleared (in millions of tons) : ******

Table LVII.-

-Number of Ships Entered and Cleared in the most important Ports.

Ports.

Entered.

Cleared.

With

In

With

In

Cargoes.

Ballast.

Cargoes.

Ballast.

Hamburg ....

7-17

0-43

5-36

2-36

Stettin

1-43

0-04

0-90

0-65

Bremerhaven .

1-15

0-08

1-04

0-24

Bremen ....

0-80

0-03

0-64

0-20

Danzig ....

0-54

Oil

0-50

0-16

Lubeck ....

0-53

0-01

0-38

0-16

Kiel

0-50

0-02

0-36

0-14

Konigsberg

0-33

0-01

0-37

0-03

Railways. ??? The German railway system nearly doubled from 1866 to 1875. Since that time Prussia has followed the southern states, where the building of railways has from the outset been regarded as a Government duty. To-day the great majority of German railways are owned by the state governments.

Table LVIII. ??? Development of the Bailway System.

Year. January 1.

Leng1;li In Miles.

Total. English MUes.

Government

Lines. English MUes.

Lines belonging to

Private Companies.

English Miles.

1876 1885 1895 1900

7,493 19,823 26,811

28,087

10,019 3,286 2,277 2,510

17,522 23,109 28,088 30,597

Of the total in 1900, 21,050 miles were trunk-lines and 9547 branch lines. Germany possesses the most extensive network of railways of any country except the United States. The United Kingdom has about 22,000 miles. As regards proportion to the area, Germany had in 1899 144 miles for every 1000 English square miles, but in Great Britain and Ireland the proportion is about 180 per 1000 square miles. Narrow-gauge lines, not comprised in the above figures, measured 1075 miles in 1900. The financial condition of the railways shows, as to broad-gauge lines, that the total capital invested was 12,134 millions of marks at the end of the financial year 1898, or 405,503 marks per mile ; the interest is estimated at 6-06 per cent., the excess of receipts (1898, 1840

S. IV. ◆◆◆ 87

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millions) over the expenditure (111 millions) being 723 millions of marks. The number of men employed -was 509,600, including 308,600 workmen. In 1897-98 320-8 millions of metric tons of goods were carried, and the number of passengers conveyed -was 756 millions.

Internal Navigation. ◆◆◆ The length of navigable rivers in Ger- many is 5779 miles, that of canalized rivers 1451 miles, and of canals proper 1551 miles. The construction of canals had almost ceased for a long time, but in recent years the Ruhr and the Ems (Dortmund-Ems Canal) and the Elbe andtheTrave (near Liibeok) have been joined by canals. The number of vessels engaged in internal navigation -was in 1897 22,000, -with a tonnage of 3,370,000 tons. Not included in the above figures is the Kaiser-Wilhelm Canal, joining the Baltic and North Sea and traversing Holstein from Kiel Bay to the mouth of the Elbe. The canal was built between 1887

and 1895. The length is 61 miles, its breadth at the bottom is 72 feet, at the surface 213 feet, and the depth 29,J feet. The number of ships passing through the canal has steadily in- creased from 20,068 vessels of 1,751,000 tons in 1896 to 29,045 of 4,282,000 tons in 1900, men-of-war not included.

Posts and Telegra2:)hs. ??? With, the exception of Bavaria andWlirtemberg, -which have administrations of their own, all the German States belong to the Imperial Postal District {Reichspostgehiet). The folio-wing table shows the extension of the net of post offices for the whole empire, and also the estimated number of letters and packets delivered : ???

Table LIX. ??? Pos{ Office Development.

Tear.

Post Offices.

Men Employed.

Letters Entered.

Packets Entered.

Letters Per Head.

1872 1880 1890 1899

7,518

9,460

24,952

.36,.S88

128,687 206,945

Millions.

501-2

843-2

1634-4

2724-3 ???

Millions.

62-7

86-6

120-8

184-6

12-1 18-7 33-2 40-4

The number of post ofBces was 18 per 100 English square miles in 1899.

Telegraph statistics are given in the subjoined table : ???

Table LX. ??? Imperial Telegraphs.

Tear.

Telegraph Offices.

Length of Lines.

Length of Wire.

Number of Messages Entered.

Total.

Per Head.

1872 1880 1890 1899

2,359

9,980

17,200

23,716

Miles.

23,425

44,011

64,194

79,870

Miles.

78,022 158,986 226,663 294,900

Millions.

9-7 13-5 21-8 37-9

0-24 0-38 0-45 0-69

There were 188 places provided with telephone service in 1888, and 13,175 in 1899 ; the number of towns in telephonic communi- cation with one another was 1964 in 1899. The number of receivers rose from 37,313 in 1888 to 229,391 in 1899, and that of telephonic messages from 155 millions in 1888 to 621 millions in 1899.

The amount of money circulated by means of the post has also much increased.

Table LXI. ??? Money circulated through the Post.

1872,

1899,

Millions of Maries. 1

Value of charged Letters and Parcels Value of Payments through Post OflSce . Value of Money Orders issued

14,096

55

530

17,235

462

8212

Banking and Credit. ??? The amount of money coined from the foundation of the Empire (1871) to the end of March 1900 is shown in the following table (in millions of marks) : ???

Table LXIL ???

Gold Silver . Nickel . Copper .

Total Withdrawn

Surplus

3631-5

543-4

64-6

14-6

4254-1 69-6

4194-5

The total value, of thalers, which are still legal tender, was estimated in 1894 at about 400,000,000 marks.

There are eight note-issuing banks (Notenbanken), that is to say, the Imperial Bank {Beichsbank) in Berlin, the Frankfort Bank, the Bayrisohe Notenbank in Munich, the Sachsische Bank in Dresden, the Wilrtemberger Notenbank in Stuttgart, the Badische Bank in Karlsruhe, the Bank fur Stiddeutschland in Darmstadt, and the Braunschweiger Bank. The total mean amount of notes in circulation (100, 500, and 1000 marks) was 1322 millions of marks in 1899. Beichskassenscheine, or small paper notes for five, twenty, and fifty marks, have been in circulation of recent years to the amount of 120 millions of marks. The following table shows the average financial condition of the above-named eight note-issuing banks in 1899 (in millions of marks) : ???

Table LXIII. ??? Note-Issuing Banks.

Liabilities.

Assets.

Total.

Eeichs- bank.

Total.

Eeichs- bank.

Capital

Reserve Fund .

***Notes in Circu- ***

lation . J

Other Liabilities

Total .

219-7 47-6

1322-2

649-2

120-0 30-0

1141-7

554-9

Coin and Bullion Notes (Empire) and Banks) / Bills Other Assets .

Total .

911-5

50-8

1049-4 229-0

825-5

35-1

817-1 168-9

2238-7

1846-6

2240-7

1846-6

Life Assurance. ??? There were forty-six companies in 1900 for the insurance of life. The number of persons insured was 1,446,249 at the end of that year, the insurances amounting to 6397 millions of marks. Besides these are sixty-one companies ??? of which forty- six are comprised in the above life assurance companies ??? paying subsidies in case of death or of military service, endowments, &c. Some of these companies are industrial. The transactions of all these companies included in 1900 over 4,179,000 persons, and the amount of insurances was 1606 millions of marks.

Instirance for Working Classes. ??? The speech of the Emperor William I. from the throne on 17th November 1881 inaugurated a great system of public care for the working classes, such as is not to be found in any other great state. A series of Acts passed during the years 1883 to 1892 introduced obligatory insurance for all the working classes in case of sickness, accident, or incapacity, so that now only an insurance of the

widows of workmen is required to complete this system. The insurance in case of sickness is carried out by 23,000 local sick funds, and included in 1898 over 9,223,000 workmen. These funds had receipts amounting to 165,800,000 marks in 1898, and possessed property of the value of 163,900,000 marks. The workmen contribute at the rate of two-thirds, the employers at the rate of one-third. The accident insurance embraces 18,246,000 persons, belonging to 5,110,000 establishments, with 522 professional co-operative associations. Contributions are made by employers only. The receipts were 83,380,000 marks in 1898, and the property was valued at 161,500,000 marks at the end of that year. The old age and invalid insurance is carried out by thirty-one large territorial offices, to which must be added nine special unions. The pre- miums are paid half by employers and half by workmen, but the empire contributes 50 marks to every annuity. The income of the forty establishments was 163,564,000 marks in 1898 (includ- ing 24,400,000 marks of imperial contributions). The capital collected was 671,900,000 marks. The number of annuitants ??? the old age annuities beginning at seventy years of age ??? was 512,000 in 1898, and the amount of annuities 68,940,000 marks.

Money, Weight!^, and Meastires. ??? The variety of German coinage was replaced after the creation of the empire by a united one (Act of 4th December 1871, supplemented by that of 9th June 1873). The standard of value is gold. Silver is legal tender only up to 20 marks. One mark of 100 pfennige is equal to 100/279 grammes of fine gold, so that 1 livre gold (500 grammes) has a value of 1395 marks. The gold coins are 20- and 10-mark pieces, called doppelkrone and krone. The small 5-mark pieces in gold have been withdrawn. The 20-mark piece contains 7-16846 grammes of fine gold, the fineness being 900/ 1000. The pound ster- ling is of the value of 20-43 marks. The silver coins are 5-, 2-, and 1-mark pieces and 50-ptennig pieces. The nickel coins are 20-, 10-, and 5-pfennig pieces, and the bronze coins 2- and 1-pfennig pieces.

The metrical system of weights and measures came into force on 1st January 1872, and the people soon became familiarized with it.

AuTHoniTiES. ❖❖❖ General. ❖❖❖ P. E. Eichter. Bibliotheca geographica (tcrmaniae. " Literatur des Landes- und Volkeskunde des Deutschen Reiches," Leipzig, 1896. ❖❖❖ L. Neumann. Berichte nher die Fortschritte der wissenschaftl. Landesktinde Deutschlands, published in the Geographical Year-Book, Gotha, since 1894, every two years. ❖❖❖ A. KiRcnnOFF. Anlcitunq ziir Deutschen Landes- und Volkskuiide, Stuttgart, 1889. Map's. ❖❖❖" Karte des Deutschen.

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covering the whole suite of the Statistik des Deutschen Belches, published by the Imperial Statistical OfSce since 1873, partly periodically as " Monatshette " and (since 1892) as " Vierteljahrshefte." ??? R. Boeck. Der Deutschen Volkszahl und Sprachgebiet, Berlin, 1869. ??? Nabert. Karte der Verbrettung der Deutschen in Europa, 12 sheets (scale 1 : 92o,000), Glogau, 1891, and since. ??? H. Meyer. Das deutsche Volkstum, Leipzig, 1899. ??? ^P. Langhans. All- deutscher Atlas, Gotha, 1900. ??? Census Works : Volkszahlung of 1890; Statistik des Deutschen Reiches, N. P., vol. Ixviii. (1894); for that of 1895 Vierteljahrshefte 1897, for that of 1900 Viertel- jahrshefte 1901. ??? Die Berufs- und Gewerbezahlung vom 14. Jiini 1895 (Statistik des Deutschen Reiches, N. P., vols, cii.~~oxix., particularly vols. cxi. (with 19 maps), cxix. (with 14 maps), and cxii., die Landwirtschaft im Deutschen Reiche (with 8 maps). Atlas der Bodenkultur des Deutschen Reiches (15 maps), Berlin, 1881. Annual publications of the Reiohsstatistik deal with ex~~ ternal commerce, internal shipping, navigation on sea, criminal justice, insurance in case of sickness. Topography. ??? Neumann. Ortslexikon des Deutschen Reiches, 3rd edition, by Keil, Leipzig, 1894. ??? H. Rudolph. VoUstdndigstes geogr.-topogr.~~statist. Orts~~ lexikon von Deutschland, 2 vols., Weimar, 1870 ; though its figures are out of date, it is useful, and not yet replaced in respect of completeness. ??? Brunkow. Die Wohnplatze des Deutschen Reiches, 3 vols., Berlin, 1889. ??? ~~Useful, but not yet complete, is Kijeschner~~ Peip's Deutsches Kartenwerk, 690 sheets (scale 1 : 200,000), with 158-sheet gazetteer for every four neighbouring sheets, Berlin, Eisenach, Leipzig since 1897. (h. Wa.)

II. ??? History, 1870-1900.

*The foundation of the empire in 1871 begins a new- era in the history of Germany. The rivalry of the dynas- ties to which for so long the interests of the The new nation had been sacrificed now ceased. By the **" ' treaties of Versailles the kingdoms of Bavaria and Wiirteraberg, and the grand duchy of Baden, as well as the southern provinces of the grand duchy of Hesse, were added to the North German confedera- tion. Henceforward all the German states that had survived the struggle of 1866, with the exception of the empire of Austria, the grand duchy of*

Luxemburg, and the principality of Liechtenstein, were incorporated in a permanent federal state under the leadership of Prussia. No important alterations were made in the constitution of 1867. The states retained their autonomy except in those matters which were expressly transferred to the imperial authorities ; the princes retained their sovereignty ; the king of Prussia, though he now took the title of German Emperor, vras only primus inter pares ; he was president of the confederation, but had no suze- rainty over the other princes. None the less, from this time the acts of the State Governments and Parliaments have ceased to have more than a local importance ; the history of the nation is centred in Berlin, in the Bun- desrath or Federal Council, in which the interests of the individual states are represented; in the Reichstag, in

which the feelings and wishes of the nation are expressed ; and above all, in the Prussian Government and imperial executive.

The constitution, as established in 1867 and revised in 1871, derives its authority from a double source : the treaties between the sovereign states of which the confederation is com- posed, and the vote of the constituent assembly of 1867. '^ "' It created for federal purposes a Bundesrath or Council, * "i^J' in which Prussia had 17 votes ; Saxony, 4 ; Mecklen- g^pi^e. burg-Schwerin and Brunswick, 2 each ; all the other states, 1. In 1871 Bavaria received 6 votes; Wurtemberg, 4; Baden, 3 ; and Hesse, 2 additional votes. The Council, the meetings of which are private, exercises a general control over the administration, and all laws require its sanction. In legislation it is assisted by the Reichstag, which is elected by universal suffrage. The Federal Budget has to be passed each year in the form of a law. The ofBce of president of the confederation, to which in 1871 the title of German Emperor was attached, is permanently vested in the king of Prussia. The emperor commands the army and navy ; appoints all federal officials ; summons the Council and Reichstag ; publishes the laws and administers them. All his acts (except orders as commander of the army and navy) must be countersigned by the chancellor, who is the only responsible im- perial minister, and is also president of the Council. The federation formed a customs union (except for the free cities of Hamburg and Bremen), and all legislation on customs, as well as excise on salt, tobacco, beer, brandy, and sugar, belongs to the federal*

authorities. Post-office, navy, and consular service are also federal. The states retain the right of diplomatic representation, but there is also a common diplomatic representation appointed by the president. The subjects on which the imperial authorities were qualified to legislate were, besides naval and military matters and customs, the law of domicile, trade, banking, money, weights and measures, patents and copyright, mercantile marine, railways, rivers and canals, posts and telegraphs, the press, the law of association, medical law, criminal law, legal procedure, and commercial law.

The southern states when they joined the confederation reserved certain privileges : the king of Bavaria kept the command of his army in time of peace, and military jurisdiction ; he, as well as the king of Wurtemberg, retains the right of appointing officers. Excise duties on beer and brandy in both kingdoms and in Baden were reserved. Both kingdoms retained the separate administra- tion of their own posts and telegraphs. Bavarian railways were exempt from imperial supervision except for military purposes, and Bavaria kept the right to have its own laws on marriage and domicile.

The constitution has stood the test. No serious changes have been made, no serious constitutional questions have arisen. The number of states of which the empire consists has remained unaltered j"- occasional T^^em- disputes have been settled harmoniously in a the slates. legal manner. The special rights reserved to Bavaria and Wilrtemberg have not proved, as was feared, a danger to the stability of the empire. Much apprehension had been caused by the establishment of a permanent committee for foreign affairs in the Council, over which the Bavarian representative was to preside ; but the clause re- mained a dead letter. There is no record that the com- mittee ever met until July 1900, when it was summoned to consider the situation in China ; and on that occasion it probably formed a useful support to the Government, and helped to still apprehension lest a too adventurous policy should be pursued. Another clause determined that in a division in the Reichstag on any law which did not concern the whole empire, the representatives of those states which were not concerned should not vote. This, had it been retained, would have destroyed the coherence of the Reichstag as representative of the whole

nation. It was repealed in 1873. The permis- sion to maintain diplomatic missions has been equally harmless : most of the states have recalled all their dip- lomatic representatives ; Saxony, Bavaria, and Wurtem- berg have maintained only those at Vienna, the Vatican,

iThe only formal change is that the duchy of Lauenburg, which since 1865 had been governed by the king of Prussia as a separate principality (but without a vote in the Bundesrath), was in 1876 incorporated in the Prussian province of Sohleswig-Holstein.

aad at St Petersburg. Bavaria has even voluntarily adopted many imperial laws from which it was legally exempted; for instance, the laws of settlement.

If the states have been loyal to the empire, the imperial Government has also respected the constitutional privi- leges of the states. The harmonious working ^'dth" of the constitution depends on the union of empire. policy between the empire and Prussia, for it is the power of Prussia which gives strength to the empire. This was practically secured by the fact that the emperor, who is king of Prussia, appoints the chan- cellor, and the chancellor is generally president of the Prussian ministry as well as minister of foreign affairs ??? in his person the Government of the two is identified. Por twenty years the double office was held by Bismarck, who, supported as he was by the absolute coniidence of the emperor, and also of the allied princes, held a position greater than that ever attained by any subject in modern Europe since the time of Eichelieu. Por ten months in 1873 he, indeed, resigned the office of minister president to Roon ; and in the same way Caprivi, during the years 1893-94, held the chancellorship alone; but in neither case was the experiment successful, and Hohenlohe and Bulow adhered to the older plan. So important is the practical co-operation of the imperial administration and the Prussian Government, that it has become customary to appoint to seats in the

Prussian ministry the more im- portant of the secretaries of state who administer imperial affairs under the chancellor. Delbrliek, head of the im- perial chancery, had held this position since 1868 ; in 1877 Billow, secretary of state for foreign affairs, was appointed Prussian minister, and in recent years this has become the ordinary practice. One result of this is to diminish the control which the Prussian parliament is able to maintain over the Prussian ministry.

In the federal council Prussian policy nearly always prevails, for though Prussia has only seventeen votes out of fifty ~~eight, the smaller states of the North nearly always support her ; practically she controls the vote of Waldeck, and since 1885 those of Brunswick. A definite defeat of Prussia on an important question of policy must bring about a serious crisis ; it is generally avoided because, as the meetings are secret, an arrangement or compromise can be made. Bismarck, knowing that nothing would more impede the consolidation of the empire than an out~~ break of local patriotism, always so jealous of its rights, generally used his influence to avoid constitutional dis- putes, and discouraged the discussion of questions which would require an authoritative interpretation of the con- stitution. It was, however, opposition in the Bundes- rath which obliged him to abandon his scheme for imperial railways, and when, in 1877, it was neces- sary to determine the seat of the new supreme court of justice, the proposal of the Government that Berlin should be chosen was outvoted by thirty to twenty- eight in favour of Leipzig. On this occasion Bismarck ac- cepted the decision, but when important interests were at stake he showed himself as ready to crush opposition as in the older days, as in the case of Hamburg and Bremen (see below).

The great personal qualities of the reigning emperors and the widely- extended family connexions of the house of Hohenzollerh have enabled them to hold with ease their position as leaders among the ruling families. So far as is known, with one or two unimportant exceptions, the other princes have loyally accepted their new position. It is only as regards the house of Brunswick that the older dynastic questions still have some political importance.

The other princes who were dispossessed in 1866 have all been reconciled to Prussia. The elector of Hesse and the duke of Nassau have formally relinquished their

claims. In 1883 the daughter of the duke of Augusteu- burg, the former claimant to the duchies of Schleswig and Holstein, married the heir to the Prussian throne, who be- came Wilhelm II. On the other hand, the royal family of Hanover has never ceased to protest "<'' against the acts by which they were deprived of their dominions. King George (q.v.) to the end of his days, whether in Austria or in Prance, still regarded himself as in a state of war with Prussia. As he had used his large personal property to organize a regiment in order to regain his possessions, the Prussian Government had se- questrated that part of his income, amounting to some 50,000, over which they had control, and used it as secret service money chiefly for controlling the pr'ess ; to this fund the name " Welf en-Pond " was commonly given. After 1870 the Hanoverian regiment was dis- banded, but the sequestration continued. The death of the old king in 1878 made no difference, for his son in a letter to the king of Prussia announced that he assumed and maintained all his father's rights, and that he did not recognize the legal validity of the acts by which he was, as a matter of fact, prevented from enjoying them. His protest was supported by a considerable number of his former subjects, who formed a party in the Reichstag. The marriage of the duke of Cumberland (the title by which the king called himself till he could come into his possessions) with Princess Thyra of Denmark in the same year was made the occasion of a great demonstration, at which a deputation of the Hanoverian nobility assured the duke of their continued attachment to his house.

After Bismarck's retirement, the emperor attempted to ' bring about a reconciliation with the duke and the Hano- verians. His attention had been drawn to the bad moral effect of the use to which the Welfen-Pond was applied, and on the duke of Cumberland writing him a letter, in which, while maintaining his claims to the throne of Hanover, he recognized the empire and undertook not to support any enterprise against the empire or Prussia, with the consent of the Prussian parliament the seques- tration of his property was removed. The attitude

of passive resistance is, however, still maintained, and has affected the position of the duchy of Brunswick.

In 1884 William, duke of Brunswick, died after a reign of fifty-four years. The younger son of the duke who fell at Quatre Bras, he had been called to the throne in 1831 to take the place of his elder brother Charles, who had been deposed. Duke Charles had died at Geneva in 1873, and as both brothers were childless, the succession went to the duke of Cumberland as head of the younger branch of the house of Brunswick- Lilneburg. Duke William before his death had "g"^ arranged that the government should be carried wic^"^' on by a council of regency so long as the heir was prevented from actually assuming the government; at the end of a year a regent was to be chosen from among the non-reigning German princes. He hoped in this way to save his duchy, the last remnant of the dominions of his house, from being annexed by Prussia. As soon as he died the town was occupied by the Prussian troops already sta- tioned therein ; the duke of Cumberland published a patent proclaiming his succession ; the council of state, however, declared, in agreement with the Bundesrath, that the rela- tions in which he stood to the kingdom of Prussia were inconsistent with the alliances on which the empire was based, and that therefore he could not assume the gov- ernment. The claim of the duke of Cambridge as the only male heir of full age was referred to the Bundes- rath, but the duke refused to bring it before that body, and after a year the Brunswit'k Government elected as regent Prince Albert of Hohenzollern, to hold office so long as the true heir was prevented from entering on his rights.

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By this arrangement Brunswick, which hitherto had steadily opposed all attempts to assimilate and subordi- nate its institutions to those of Prussia, though it retains formal independence, has been brought into very close dependence upon Prussia, as is the case with all the other northern states. In them the armies are incorporated in the Prussian army

; the railways are generally merged in the Prussian system ; indirect taxation, post-office, and nearly the whole of the judicial arrangements are impe- rial. None, however, has yet imitated the prince of waideck Waldeck, who in 1867, at the wish of his own subjects, transferred the administration of his principality to Prussia. The local estates still meet, and the principality still forms a separate administrative dis- trict, but it is managed by a director appointed by Prussia. The chief reason for this act was that the state could not meet the obligations laid upon it under the new system, and the responsibility for any deficit now rests with Prussia.

A curious difficulty, a relic of an older state of society, recently arose in the principality of Lippe. On the death of Prince Waldemar in 1895 (his brother , . and heir the reigning prince Alexander being

" "' childless and insane) a dispute as to the suc- cession arose. The nearest agnate was a count of Biesterfeld, but Prince Adolf of Schaumburg-Lippe, the representative of a younger line, claimed the suc- cession on the ground that the marriage of Count Biesterfeld's grandfather with Fraillein von Unruh was not valid for the purposes of transmitting rights of succession. Under the old empire this would have been decided by the imperial courts, for the answer depended on very old- established principles concerning the differ- ent grades of nobility. Under the new empire there is no tribunal qualified to give a decision. The estates of Lippe wished to refer it to the Bundesrath, but the coun- cil refused to take the responsibility; at last the two claimants agreed to abide by the arbitration of the king of Saxony. The jurists appointed by him decided in favour of the count, who therefore, as next heir, now acts as regent. Some political importance attaches to the case, for it is not impossible that similar difficulties may occur elsewhere, and the open support given by the emperor to the prince of Schaumburg, who had married his sister, caused apprehension of Prussian aggression. It is pro- bable, in fact, that on the death of the present regent the claims of the prince will again be revived, for the valid- ity of the regent's marriage, and therefore the claim of his children to succeed, is also contested.*

A much more serious question of principle arose from the peculiar circumstances of Mecklenburg. The grand duchies, which, though

*divided between two lines of the ducal house, have a common constitution, are leaburg ‘ the Only state in Germany in which the parlia^ coastitu- ment still takes the form of a meeting of the *”’”’ ◆◆◆ estates ◆◆◆ the nobility and the cities ◆◆◆ and has*

not been altered by a written constitution. Repeated attempts of the grand dukes to bring about a reform were stopped by the opposition of the Eitterschaft. Buffing, one of the Mecklenburg representatives in the Reichstag, therefore proposed to add to the imperial constitution a clause that in every state of the confederation there should be a parliamentary assembly. This was supported by all the Liberal party, and carried repeatedly ; of course it was rejected by the Bundesrath, for it would have estab- lished the principle that the constitution of each state could be revised by the imperial authorities, which would have completely destroyed their independence. It is noticeable that on the last occasion, in 1894, when this motion was introduced it was lost ; a striking instance of the decay of Liberalism.

CooBerva’ tives.

The public political history naturally centres around the debates in the Keichstag, and also those in the Prussian parliament. The table on page 681 pui,iic above shows the position of parties in the affairs: German Reichstag. In the Prussian parlia^ Political ment are discussed questions of education, local parties. government, religion, and direct taxation, and though of course it is only concerned with Prussian affairs, Prussia is so large a part of Germany that its deci- sions have a national importance. The two parliaments sit in Berlin at the same time, an inconvenient arrange- ment which made Bismarck propose the introduction of biennial budgets, a custom which exists in Bavaria and other states. The constitution is very different, for while the Reichstag, which consists of only one House, is elected by universal suffrage, the Prussian parliament (Landtag) consists of two Houses, and the Lower House is chosen by indirect election on a compli- cated system which gives great influence to wealth. One result of this was that the Socialists, so powerful in the Reichstag, until the year 1900 refused even to contest seats in the Prussian parliament. In the Prussian parlia- ment the members receive

payment, but the members of the Reichstag do not. A very large number of the members sit in both, and the parties in the two are nearly identical. In fact, the political parties in the Reichstag are generally directly descended from the older Prussian parties.

The first place belongs to the Conservatives, who for twenty years had been the support of the Prussian Government. The party of the feudal aristocracy in ISTorth Germany, they were strongest in the agricultural districts east of the Elbe; pre- dominantly Prussian in origin and in. feeling, they had great influence at court and in the army, and desired to maintain the influence of the orthodox Lutheran Church. To them Bismarck had originally belonged, but the estrangement begun in 1866 constantly increased for the next ten years. A considerable number of the party had, however, seceded in 1867 and formed a new union, to which was given the name of the Deutsche Reichspartei (in the Prussian House they were called the Frei Conservativen). These did not include any prominent parliamentary leaders, but many of the most important ministers and officials, including Moltke and some of the great nobles. They were essentially a Government party, and took no part in the attacks on Bismarck which came from the more extreme Conservatives, the party of the Kreuzzeitung.

The events of 1866 had brought about a similar division among the Progressives. A large section, including the most important leaders, determined to support Bismarck in his national policy and to subordinate to this, though not to surrender, the struggle after ^^""^is Constitutional development. Under the name of National-liberal-partei they became in numbers as in ability the strongest party both in Prussia and the empire. Essentially a German, not a Prussian, party, they 'were joined by the Nationalists from the annexed provinces of Hanover and Hesse ; in 1871 they were greatly strengthened by the addition of the National representar tives from the southern states ; out of fourteen repre- sentatives from Baden twelve belonged to them, seventeen out of eighteen Wilrtemberger, and a large majority of the Bavarians. It was on their support that Bismarck depended in building up the institutions of the empire. The remainder of the Progressives, the Fortsclirittspartei, maintained their protest against the military and monarchical elements in the state ; they

voted against the Constitution in 1867 on the ground that it did not provide sufficient guarantees for popular liberty, and in

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The Centre,

1871 against the treaty with Bat-aria because it left too much independence to that state. Their influence was strongest in Berlin, and in the towns of East Prussia ; they hate always remained characteristically Prussian.

These great parties were spread over the whole of Germany, and represented the great divisions of political thought. To them must be added others which were more local, as the VolTcsjMrtei or People's party in Wiirtemberg, which kept alive the extreme democratic principles of 1848, but was opposed to Socialism. They had been opposed to Prussian supremacy, and in 1870 for the time completely lost their influence, though they were to regain it in later years.

Of great importance was the new party of the Centre. Till the year 1863 there had been a small party of Catholics in the Prussian parliament who received the name of the Centrum, from the part of the House in which they sat. They had diminished during the years of conflict, and disappeared in 1866. In December 1870 it was determined to found a new party which, while not avowedly Catholic, practically consisted entirely of Catholics. The programme required the support of a Christian-Conservative tendency ; it was to defend positive aud historical law against Liberalism, and the rights of the individual states against the central power. They were especially to maintain the Christian character of the schools. Fifty-four members of the Prussian parliament at once joined the new party, and in the elections for the Reichstag in 1871 they won sixty seats. Their strength lay in Westphalia and on the Rhine, in Bavaria and the Polish provinces of Prussia. The close connexion with the Poles,

the prin- ciple of federalism which they maintained, the support given to them by the Bavarian " patriots," their protest against the " revolution from above " as represented equally by the annexation of Hanover and the abolition of the Papal temporal power, threw them into strong op- position to the prevailing opinion, an opposition which received its expression when Mallincrodt declared that " justice was not present at the birth of the empire." Por this reason they were generally spoken of by the Nationalist parties as Beichsfeindlich.

This term may be more properly applied to those who still refuse to recognize the legality of the acts by which theempire was founded. First amongtheseare the Guelphs, . . or, as they call themselves, HannoveriscJie Beichspartei, members of the old Hanoverian nobility who represent the rural districts of Hanover and still regard the duke of Cumberland as their law- ful ruler. They make no attempt at conspiracy or re- bellion ; that would indeed be useless, but they main- tain a protest against what is still felt to have been an act of injustice. Neither the lapse of time nor the death of King George has seriously affected their numbers. They have repeatedly demonstrated their attachment to the exiled house, and it is noteworthy that in the elections of 1898 nine members of the Guelph party were returned. The attachment of the nobility to the exiled house is a quality which neither the present emperor nor his predecessors could afford to look on with disfavour, for it is at least evidence of that strong mo- narchical sentiment which they value so highly. A pleasant concession to Hanoverian feeling was made in 1899, when the emperor ordered that the Hanoverian regiments in the Prussian army should be allowed to assume the names and so continue the traditions of the Hanoverian army which was disbanded in 1866.

The Government has also not succeeded in reconcil- ing to the empire the alien races which have been incor- porated in the kingdom of Prussia.

From the Polish districts of West Prussia, Posen, and Silesia a number of representatives are sent to Berlin to protest against their incorporation in the p^^^^ empire. Bismarck, influenced by the older Prussian traditions, always adopted towards them an attitude of uncompromising opposition. The growth of the Polish population has caused much anxiety; sup-

ported by the Roman Catholic Church, the Polish lan- guage has advanced, especially in Silesia, and this is only part of the general tendency, so marked throughout Central Europe, for the Slavonians to gain ground upon the Teutons. The Prussian Government has attempted to prevent this by special legislation and severe adminis- trative measures. In 1885 and 1886 large numbers of Austrian and Russian Poles who had settled in these provinces were expelled. Windthorst thereupon raised the question in the Reichstag, but the Prussian Govern- ment refused to take any notice of the interpolation on the ground that there was no right in the constitution for the imperial authority to take cognizance of acts of the Prussian Government. In the Prussian parliament Bismarck introduced a law taking out of the hands of the local authorities the whole administration of the schools and giving them to the central authority, so as to prevent instruction being given in Polish. A further law authorized the Prussian Government to spend ►►5,000,000 in purchasing estates from Polish families and settling German colonists on the land. The commission, which was appointed for the purpose, during the next ten years bought land to the amount of about 200,000 acres, and on it settled more than 2,000 German peasants. It appears doubtful whether this will have any appreciable effect, for the Poles have founded a society to protect their own interests, and have often managed to profit by the artificial value given to their property. It has, however, caused great bitter- ness among the Polish peasants, and the effect on the population is also counteracted by the fact that the large proprietors in purely German districts continue to import Polish labourers to work on their estates.

In the general change of policy that followed after the retirement of Bismarck, an attempt was made by the emperor to conciliate the Poles. Concessions were made to them in the matter of schools, and in 1891 a Pole, Stabelewski, who had taken a prominent part in the Kulturkampf, was accepted by the Prussian Gov- ernment as Archbishop of Posen. A moderate party arose among the Poles which accepted their position as Prussian subjects, gave up all hopes of an imme- diate restoration of Polish independence, and limited their demands to that free exercise of the religion and language of their country which was enjoyed by the Poles in Austria. They supported '.Government Bills in the Reichstag, and won the commendation of the emperor. Unfortunately, for reasons which are

not apparent, the Prussian Government did not continue a course of conciliation ; administrative edicts still further limited the use of the Polish language, even religious instruction was to be given in German, and an old royal ordinance of 1817 was made the pretext for forbid- ding private instruction in Polish. A further sum of ??5,000,000 was voted for the settlement of German colonists, and the whole influence of the law, of education, and of the army is used to compel the Poles to forget their mother-tongue and the traditions of their country. Further measures are promised to meet the danger to (xerman nationality which is anticipated from the fact that numerous Poles have migrated to the more prosperous districts in the west.

Compared with the Polish question, that of the Danes in North Schleswig is of minor importance ; they number

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less than 150,000, and there is not among them, as among the Poles^ the constant encroachment along an extended line of frontier ; there is also no religious question involved. These Danish subjects have elected one member to the Reichstag, whose duty is to demand that they should be handed over to Denmark. Up to the year 1878 they could appeal to the Treaty of Prague ; one clause in it determined that the inhabitants of selected districts should be allowed to vote whether they should be Danish or German. This was inserted merely to please Napoleon ; after his fall there was no one to demand its execution. In 1878, when the Triple Alliance was concluded, Bismarck, in answer to the Guelphic demonstration at Copenhagen, arranged with Austria, the other party to the Treaty of Prague, that the clause should lapse. Since then the Prussian Govern- ment, by prohibiting the use of Danish in the schools and public offices, and by the expulsion from Schleswig of residents of

Danish nationality, has used the customary means for compelling all subjects of the king to become German in language and feeling.

The attempt to reconcile ~~the inhabitants of Elsass~~ Lothringen to their condition has been equally unsuccess- ful. The provinces had been placed under the immediate rule of the emperor and the chancellor, who Eisass- ~~jfas minister for them ; laws were to be passed by the Eeichstag. In accordance with the Treaty of Frankfort, the inhabitants were per~~ mitted to choose between French and German nationality, but all who chose the former had to leave the country ; before 1st October 1872, the final day, some 60,000 had done so. In 1874, for the first time, the provinces were enabled to elect members for the Eeichstag; they used the privilege to send fifteen Elsasser, who, after deliver- ing a formal protest against the annexation, retired from the House ; they joined no party, and took little part in the proceedings except on important occasions to vote against the Government. The same spirit was shown in the elections for local purposes. It seemed to be the sign of a change when a new party, the Autonomisten, arose, who demanded as a practical concession that the dictatorship of the chancellor should cease and local self- government be granted. To some extent this was done in 1879 ; a resident governor or statthalter was appointed, and a local representative assembly, which was consulted as to new laws. All the efforts of Manteuffel, the first governor, to win the confidence of the people failed; the anti-German feeling increased; the party of pro- testors continued in full numbers. The next governor, Prince Hohenlohe, had to use more stringent measures, and in 1888, to prevent the agitation of French agents, an imperial decree forbade any one to cross the frontier without a passport. Since 1890 there has been, espe- cially in the neighbourhood of Strassburg, evidence of a spread of national German feeling, probably to a great extent due to the settlement of Germans from across the Rhine.

The persistence of opposition in these districts is remarkable. In all cases the inhabitants have shared in the great growth of material prosperity; the "Reiehsland has been treated with great generosity; the taxes are very low. Strassburg has grown rapidly in wealth and numbers. The foundation of a new university, and the great impulse given to trade by the opening up of new railway and water communications, have added

greatly to its prosperity. But the national feeling in Germany is so imperious and so intolerant of opposition, it is so con- stantly put forward as the only legitimate basis for the existence of the state, as naturally to arouse opposition among those who do not share it. The presence of these parties, amounting often to one-tenth of the whole, has

Legal reform.

added greatly to the parliamentary difficulties of the Government.

The great work since 1870 has been that of building up the institutions of the empire. For the first time in the history of Germany there has been a strong administration ordering, directing, and arranging the life of the whole nation. The work which in England was done by the Plantagenets, which in France was begun by the House of Bourbon and completed by the Revolution, is now proceeding, and the city of Berlin is rapidly acquiring a position similar to that held by The period London and Paris. The unification of Germany jg^g__" was not ended by the events of 1866 and 1871 : it was only begun. The work has throughout been done by Prussia ; it has been the extension of Prussian prin- ciples and iPrussian administrative energy over the whole of Germany. It naturally falls into two periods; the first, which ends in 1878, is that in which Bismarck depended on the support of the National Liberals. They were the party of union and uniformity. The Conserva- tives were attached to the older local diversities, and Bismarck had therefore to turn for help to his old enemies, and for some years an alliance was maintained, always precarious but full of results.

The great achievement of the first period was legal reform. In nothing else was legislation so much needed. Forty-six districts have been enumerated, each of which enjoyed a separate legal system, and the boundaries of these districts seldom coincided with the frontiers of the states. Everywhere the original source of law was the old German common law, but in each district it had been wholly or partly superseded by codes, text-books, and statutes to a great extent founded on the principles of the Roman civil law. Owing to the political divisions, however, this legislation, which reached back to the 14th century, had always been carried out by local authorities. There had never been any

effective legislation applicable to the whole nation. There was not a state, not the smallest prin- cipality, in which some authoritative but imperfect law or code had not been published. Every free city, even an imperial village, had its own " law," and these exist down to the present time. In Bremen the foundation of the civil code still were the statutes of 1433 ; in Munich, those of 1347. Most of the states by which these laws had been published had long ago ceased to exist ; prob- ably in every case their boundaries had changed, but the laws remained valid (except in those cases in which they had been expressly repealed) for the whole of the district for which they had been originally promulgated. Let us take a particular case. In 1691 a special code was pub- lished for the upper county of Katzellenbogen. More than a hundred years ago Katzellenbogen was divided between the neighbouring states. But till the end of the 19th century (which in Germany meant the end of 1899) this code still retained its validity for those villages in Hesse, and in the Prussian province of Hesse, which in old days had been parts of Katzellenbogen. The law, however, had to be interpreted so as to take into consid- eration later legislation by the kingdom of Westphalia, the electorate of Hesse, and any other state (and they are several) in which for a short time some of these villages might have been incorporated.

In addition to these earlier imperfect laws, three great codes have been published, by which a complete system was applied to a large district: the Prussian Code of 1794, the Austrian Code of 1811, and the Code Napoleon, which applied to all Germany left of the Rhine ; for neither Prussia, nor Bavaria, nor Hesse had ever ventured to interfere with the French law. In Prussia therefore the older provinces came under the Prussian Code, the Rhine

provinces had French law, the newly annexed provinces had endless variety, and in part of Pomerania con- siderable elements of Swedish law still remained, a relic of the long Swedish occupation. On the other hand,

some districts to which the Prussian Code applied no longer belonged to the kingdom of Prussia ??? for instance, Anspach and Bayreuth, which are now in Bavaria. In other parts of Bavaria in the same way Austrian law still ran, because they had been Austrian in 1811. In two states only was there a more or less uniform system : in Baden, which had adopted a German translation of the Code Napoleon ; and in Saxony, which had its own code, published in I860. In criminal law and procedure there was an equal variety. In one district was trial by jury in an open court; in another the old procedure by written pleadings before a judge. In many districts, especially in Mecklenburg and some of the Prussian provinces, the old feudal jurisdiction of the manorial courts survived.

The constant changes in the law made by current legislation in the different states really only added to the confusion, and though imperial laws on those points with which the central government was qualified to deal super- seded the state laws, it is obvious that to pass occasional Acts on isolated points would have been only to intro- duce a further element of complication.

It was therefore convenient, so far as was possible, to allow the existing system to continue until a full and complete code dealing with the whole of one department of law could be agreed upon, and thus a uniform system (superseding all older legislation) be adopted. Legisla- tion, therefore, has generally taken the form of a series of elaborate codes, each of which aims at scientific complete- ness, and further alterations have been made by amend- ments in the original code. The whole work has been similar in character to the codification of French law under Napoleon ; in most matters the variety of the older system has ceased, and the law of the empire is now com- prised in a limited number of codes.

A beginning had been made before the foundation of the empire ; as early as 1861 a common code for trade, commerce, and banking had been agreed upon by the states included in the Germanic Confederation. It was adopted by the new confederation in 1869. In 1897 it was replaced by a new code. In 1869 the criminal law had been codified for the North German Confederation, and in 1870 there was passed the Gewerbeordnung, an elaborate code for the regulation of manufactures

and the relations of masters to workmen. These were included in the law of the empire, and the work was vigorously continued.

In 1871 a commission was appointed to draw up regu- lations for civil and criminal procedure, and also to frame regulations for the organization of the law courts. The draft code of civil procedure, which was published in December 1872, introduced many important reforms, especially by substituting public and verbal procedure for the older German system, under which the pro- ceedings were almost entirely carried on by written documents. It was very well received. The drafts for the other two laws were not so successful. Protests, especially in South Germany, were raised against the criminal procedure, for it was proposed to abolish trial by jury and substitute over the whole empire the Prussian system, and a sharp conflict arose as to the method of dealing with the press. After being discussed in the Eeichstag, all three projects were referred to a special commission, which after a year reported to the diet, having completely remodelled the two latter laws. After further amendment they were eventually accepted, and became law in 1877. By these and other supplementary

laws a uniform system of law courts was established throughout the whole empire ; the position and pay of the judges, the regulations regarding the position of advocates, and costs, were uniform, and the procedure in every state was identical. To complete the work a supreme court of appeal was established at Leipzig, which was competent to hear appeals not only from imperial law, but also from that of the individual states.

By the original constitution, the imperial authorities were only qualified to deal with criminal and commercial law ; the whole of the private law, in which the variety was greatest, was withdrawn from their cognizance. Lasker, to remedy this defect, proposed, therefore, an alteration in the constitution, which, after being twice carried against the opposition of the Centre, was at last accepted by the Bundesrath. A commission was then appointed to draw up a civil code. They completed the work by the end of 1887 ; the draft which they then published was severely criticized, and it was again sub- mitted for revision to a fresh commission, which reported in 1896. In its amended form this draft was accepted by the Reichstag in

1896, and it entered into force on the 1st of January 1900. The new Civil Code deals with nearly all matters of law, but excludes those con- cerning or arising out of land tenure and all matters in which private law comes into connexion with public law; for instance, the position of Government officials, and the police : it excludes also the relations of master and servant, which in most points are left to the control of individual states. It was accompanied by a revision of the laws for trade and banking. This is far the most important measure which has hitherto been carried by the initiative of a private member of the Reichstag, and though Lasker himseK was dead and his party broken up long before the new code became law, and though in many ways the contents of the code did not satisfy the expectations of those who had helped to carry it, it remains a lasting memorial of the reforming zeal and the national enthusiasm of the first years of the empire.

Equal in importance to the legal was the commercial reform, for this was the condition for building up the material prosperity of the country. Germany was a poor country, but the poverty was to a great extent the result of political causes. Communication, trade, manufactures, were impeded by the political divisions, and though the establishment of a customs union had preceded the foun- dation of the empire, the removal of other barriers required imperial legislation. A common system of weights and measures was introduced in 1868. The reform of the currency was the first task of the empire. In 1871 Germany still had seven different systems; the most important was the thaler and the groschen, which pre- vailed over most of North Germany, but even within this there were considerable local differences. Throughout the whole of the south of Germany and in some North German states the gulden and kreuzer ^'"- prevailed. Then there were other systems in ^^l^^. Hamburgand in Bremen. Everywhere, except in Bremen, the currency was on a silver basis. In addition to this each state had its own paper money, and there were over 100 banks with the right of issuing bank-notes accord- ing to regulations which varied in each state. In 1871 a common system for the whole empire was established, the unit being the mark, which was divided into a hundred pfennig : a gold currency was introduced ; no more silver was to be coined, and silver was made a legal tender only up to the sum of twenty marks. The gold" required for" the introduction of the new

coinage was provided from the in- demnity paid by France. Great quantities of thalers, which hitherto had been the staple of the currency, were sold.

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The right of coinage was, howeiier, left to the individual states, and as a special concession it was determined that the rulers of the states should be permitted to have their head placed on the reverse of the coins. All paper cur- rency, except that issued by the empire, ceased, and in 1873 the Prussian Bank was converted into the Imperial Bank.

The Prussian (now the Imperial) Banlc is a society of private capitalists, but the management is in the hands of the State. The The Bank extension of the privilege has always been supported by ??? the Liberals, but in 1891 and again in 1900 unsuccess- ful attempts were made by the Conservatives, supported by the Agra- rians and Anti-Semites, to prevent the renewal of the Bank Act.

The introduction of a gold standard has not been completely carried through. In 1877, owing to the depreciation of silver, the Ri tat. ^^'^ ??^ silver was suspended, and thalers to the value . . ???^ " ??^ about 400 million marks were reserved. About half of these are in circulation, and are full legal tender. The Conservative reaction which followed deprived of their influence the economists who were more strongly in favour of a gold stand- ard, and the fall in prices caused in Germany, as in other countries, a demand for the adoption of a bimetallic standard, especially among agriculturists ; of recent years bimetallism has become one of the chief points in the Agrarian and even in the Conservative programme. In 1895 a motion was carried in the Reichstag re- questing the Governments to summon a conference for an interna- tional regulation of the currency. The Council, however, refused to do this, on the ground that there was no prospect that a discus- sion would

lead to any practical result, unless the Indian Govern- ment would reopen the mints.

Closely connected with the reform of the currency and the codification of the commercial law was the reform of the banking ___. . laws. Here the tendency to substitute uniform imperial

laws "^ ^si,ws for state laws is clearly seen. Before 1870 there had been over 100 banks with the right of issue, and the conditions on which the privilege was granted varied in each state. By the Bank Act of 1875, which is the foundation of the existing system, the right of granting the privilege is transferred from the Governments of the states to the Bundesrath. The exist- ing banks could not be deprived of the concessions they had received, but unless they submitted to the regulations of the new law their notes were not to be recognized outside the limits of the state by which the concession had been granted. All submitted to the conditions except the Brunswick Bank, which still holds a unique position. The experience of Germany in this matter has been different from that of England, for nearly all the private banks have since surrendered their privilege, and there now re- main only six banks (of which only one, the Frankfurter Bank, is in Prussia) which still issue bank-notes. The other five are sit- uated in Bavaria, Saxony, Wiirtemberg, Baden, and Hesse, and the continuance of their privilege is a natural accompaniment of the political importance which still belongs to these states.

The organization of the imperial post-office was carried out with great success by Herr v. Stephan {q.v.), who re- mained at the head of this department from its creation till his death in 1897. Proposals to Bavaria and Wiir- temberg to surrender their special rights have not been accepted.

The unification of the railways caused greater difficulties. Nearly every state had its own system ; there was the greatest variety in the methods of working and Railways. ^^ ^j^g tariffs, and the through traffic, so important for the commercial prosperity of the country, was very in- effective. In Baden, Wiirtemberg, and Hanover the rail- ways were almost entirely the property of the State, but in all other parts public and private lines existed side by side, an arrangement which seemed to combine the

dis- advantages of both systems. In 1871 three-quarters of the railway lines belonged to private companies, and the existence of these powerful private corporations, while they were defended by many of the Liberals, was, ac- cording to the national type of thought, something of an anomaly. Bismarck always attached great import- ance to the improvement of the railway service, and he saw that uniformity of working and of tariffs was very desirable. In the constitution of the empire he had introduced several clauses dealing with it. The independent administration of its lines by each state was

left, but the empire received the power of legislating on railway matters ; it could build lines necessary for mili- tary purposes even against the wish of the state in whose territory they lay, and the states bound themselves to administer their lines as part of a common system.

In order to carry out these clauses a law was passed in 1873 creating an imperial railway office which should have a general control over all the railways. It does not appear, however, that this office has ever been able to acquire any real power or influence ; it has drafted laws on railway management, but they have never been laid before the Reichstag. Bismarck desired to go farther, and acquire all the railways for the empire. He found, however, that it was impossible to carry any Bill en- forcing this. He therefore determined to begin by transferring to the imperial authority the Prussian state railways; had he been able to carry this out the influ- ence of the imperial railways would have been so great that they would gradually have absorbed those of the other states. The Bill was carried through the Prussian par- liament, but the opposition aroused in the other states was so great that he did not venture even to introduce in the Bundesrath a law empowering the empire to acquire the Prussian railways. In many of the state parliaments resolutions were carried protesting against the system of imperial railways, and from that time the preservation of the local railway management has been the chief object towards which, in Saxony, Bavaria, and Wiirtemberg, local feeling has been directed. It was not till a later period that Bismarck was able, though in a modified form, to carry out his plans.

The result of the legal reform and other laws has been greatly to diminish the duties of the State Governments, for every new imperial law permanently deprives the local parliaments of part of their authority. Generally there remains to them the control of education and religion ??? their most important duty ??? police, all questions connected with land tenure, local government, the raising of direct taxes, and, in the larger states, the management of rail- ways. The introduction of workmen's insurance, factory legislation, and other measures dealing with the condition of the working classes by imperial legislation, was at a later period still further to limit the scope of state legislation.

*Meanwhile the Government was busy perfecting the administration of the national defences. Prom the war indemnity large sums had been expended on coast defence, on fortifications, and on replacing the equipment andstores destroyed during the war. A special fund, producing annually about a million pounds, was put aside, from which pensions to the wounded, and to the widows and orphans of those who had fallen, should be provided. It was also desirable to complete the military organization. It must be remembered that technically there is no German army, as there is no German minister of war. Each state, however small, maintains its own contingent, subject to its own prince, who has ~~"" the right and the obligation of administering it "ff^" **' according to the provisions of the treaty by which he entered the federation. Practically they are closely tied in every detail of military organization. The whole of the Prussian military system, including not only the obligation to military service, but the rules for re~~ cruiting, organization, drill, and uniforms, has to be fol- lowed in all the states ; all the contingents are under the command of the Emperor, and the soldiers have to swear obedience to him in addition to the oath of allegiance to their own sovereign. It is therefore not surprising that, having so little freedom in the exercise of their command, all the princes and free cities (with the excep- tion of the three kings) arranged separate treaties with the king of Prussia, transferring to him (except for certain*

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formal rights) the administration of their contingents, which are thereby definitely incorporated in the Prussian army. The first of these treaties was arranged with Saxe- Coburg-Gotha in 1861 ; those with the other North German states followed at short intervals after 1866. The last was that with Brunswick, which was arranged in 1885 ; Duke William had always refused to surrender the separate existence of his army. Owing to the local organization, this does not prevent the contingent of each state from preserving its separate identity; it is stationed in its own district, each state contributing so many regiments.

In 1872 a com.mon system of military jurisprudence was introduced for the whole empire except Bavaria (a revised code of procedure in military courts was accepted by Bavaria in 1898) ; finally, in February 1874, an im- portant law was laid before the Reichstag codifying the administrative rules. This superseded the complicated system of laws and royal ordinances which had accumu- lated in Prussia during the fifty years that had elapsed since the system of short service had been introduced ; the application to other states of course made a clearer state- ment of the laws desirable. Most of this was accepted Tvdthout opposition or debate. On one clause a serious

constitutional conflict arose. In 1867 the tennft" psace establishment had been provisionally

fixed by the constitution at 1 per cent, of the population, and a sum of 226 thalers (□□33, 16s.) had been voted for each soldier. This arrangement had in 1871 been again continued to the end of 1874, and the peace establishment fixed at 401,669. The new law would make this permanent. If this were done the power of the Reichstag over the administration would be seriously weakened ; their assent would no longer be required for either the number of the army or the money. The Government attached great importance to the clause, but the Centre and the Liberal parties combined to throw it out. A disastrous struggle was averted by a com- promise suggested by Bennigsen. The numbers were fixed for the

next seven years (the so-called septennaf) ; this was accepted by the Government, and carried against the votes of the Centre and some of the Progressives. On this occasion the Portschrittpartei, already much diminished, split up into two sections. The principle then established has since been maintained; the peri- odical votes on the army have become the occasion for formally testing the strength of the Government. In 1880 the strength was fixed for the next seven years, 1881-88, at 427,274. The arrangement was revised in 1887, and again in 1893 and in 1898, but on the last two occasions the vote was taken for five instead of seven years.

The influence of Liberalism, which served the Govern- ment so well in this work of construction, brought about

also the conflict with the Roman Catholic Jtam"/' Church which distracted Germany for many

years. The causes were, indeed, partly political. The Ultramontane party in Austria, Prance, and Bavaria had, after 1866, been hostile to Prussia ; there was some ground to fear that it might still succeed in bringing about a Catholic coalition against the empire, and Bismarck lived in constant dread of European coalitions. Tlie Polish sympathies of the Church in Germany made him regard it as an anti-German power, and the formation of the Catholic faction in parliament, supported by Poles and Hanoverians, appeared to justify his apprehensions. But besides these reasons of state there was a growing hostility between the triumphant National parties and the Ultra- montanes, who taught that the Pope was greater than the Emperor and the Church than the nation. The conflict had already begun in Baden. As in every other country, the control of the schools was the chief object of contention,

but the Government alse claimed a control over the educa- tion and training of the clergy. With the formation of the empire the conflict was transferred from Baden to Prussia, where there had been for thirty years absolute peace, a peace gained, indeed, by allowing to the Catholics complete freedom ; the Prussian constitution ensured them absolute liberty in the management of ecclesiastical affairs; in the ministry for religion and education there was a separ rate department for Catholic

affairs, and (owing to the influence of the great family of the Radziwills) they enjoyed considerable power at court.

The latent opposition was aroused by the Vatican decrees. A small number of Catholics, including several men of learning and distinction, refused to accept Papal Infallibility. They were encouraged by ""fto/to. the Bavarian court, which maintained the Josephinist tradition and was jealous of any encroach- ment of the Papacy; but besides this the Protestants throughout Germany and all opponents of the Papacy joined in the agitation. They made it the occasion for an attack on the Jesuits ; even in 1869 there had been almost a riot in Berlin when a chapel belonging to a religious order was opened there. During 1870 and 1871 meetings were held by the Gustavus Adolphus Yerein, and a great Protestant conference was called, at which resolutions were passed demanding the expulsion of the Jesuits and condemning the Vatican decrees. As the leaders in these meetings were men like Virchow and Bluntschli, who had been lifelong opponents of Catholicism in every form, the result was disastrous to the Liberal party among the Catholics, for a Liberal Catholic would appear as the ally of the bitterest enemies of the Church; whatever possibility of success the Old Cath- olic movement might have had was destroyed by the fact that it was supported by those who avowedly wished to destroy the influence of Catholicism. No bishop joined it in Germany or in Austria, and few priests, though the Governments were ready to protect them in the enjoyment of the privileges secured to Catholics, and to maintain them in the use of the tem- poralities. There was no great following among the people ; it was only in isolated places that priests and congregation together asserted their rights to refuse to accept the decrees of the Church. AVithout the help of the bishops, the leaders had no legal basis ; unsupported by the people, they were generals without an army, and the attempt to use the movement for political purposes failed.

None the less this was the occasion for the first pro- ceedings against the Catholics, and curiously enough the campaign began in Bavaria. The archbishop of Munich had published the Vatican decrees without the Eeghim Placet uvi, which was required by the constitution, and the Government continued to treat Old Catholics as members of the Church.

In the controversy which ensued, Lutz, the chief member of the ministry, found himself con- fronted by an Ultramontane majority, and the priests used their influence to stir up the people. He therefore turned for help to the imperial Government, and at his instance a clause was added to the penal code forbidding priests in their ofiicial capacity to deal with political matters. (This law, which still exists, is popularly known as the Kanzlei or Pulpit-paragraph.) It was of course opposed by the Centre, who declared that the Reichstag had no right to interfere in what was after all a religious question, and the Bavarian Opposition expressed much indignation that their Government should turn for help to the Protestants of the North in order to force upon the Catholics of Bavaria a law which they could not have carried in that state.

For twenty years the Old Catholics continued to be a

cause of contention in Bavaria, until the struggle ended in the victory of the Ultramontanes. In 1875 the par- liament which had been elected in 1869 for six years came to an end. In order to strengthen their position for the new elections, the Liberal ministry, who owed their position chiefly to the support of the king, by royal ordinance ordered a redistribution of seats. By the constitution this was within their power, and by clever manipulation of the constituencies they brought it about that the Ultramontane majority was reduced to two. It does not appear that this change represented any change of feeling in the majority of the people. The action of the G-overnment, however, caused great indig- nation, and in a debate on the address an amendment was carried petitioning the king to dismiss his minis- try. They ofEered their resignation, but the king re- fused to accept it, publicly expressed his confidence in them, and they continued in oflB.ce during the lifetime of the king, although in 1881 the growing reaction gave a considerable majority to the Ultramontane party. After the death of the king the prince-regent, Luit- pold, still retained the old administration, but several concessions were made to the Catholics in

regard to the schools and universities, and in 1890 it was de- cided that the claim of the Old Catholics to be regarded ofB-cially as members of the Church should no longer be recognized.

Meanwhile at Berlin petitions to the Reichstag demanded the expulsion of the Jesuits, and in 1872 an imperial law to this effect was carried ; this was again a serious interference with the control over religious matters re- served to the states. In Prussia, the Government having determined to embark on an anti-Catholic policy, sup- pressed the Catholic division in the ministry, and appointed a new minister, Palk, a Liberal lawyer of uncompromising character. A law was carried placing the inspection of schools entirely in the hands of the ???, state : hitherto in many provinces it had be-

longed to the clergy. Catholic or Protestant. This was followed by the measures to which the name KuUurkampf really applied (an expression used first by Virchow to imply that it was a struggle of principle between the teaching of the Church and that of modern society). They were measures in which the State no longer, as in the school inspection law or in the introduc- tion of civil marriage, defended its prerogatives against the Church, but assumed itself a direct control over ecclesiastical matters.

At the end of 1872 and the beginning of 1873 Falk laid before the Prussian Lower House the draft of four laws. Of these, one forbade ministers of religion from abusing ecclesiastical punishment; the second, which was the most important, introduced a law already adopted in Baden, that no one should be appointed to any oflBce in the Church except a German, who must have received his education in a German gymnasium, have studied for three years in a German university, and have passed a State examination in philosophy, his- tory, German literature, and classics ; all ecclesiastical seminaries were placed under the control of the State, and all seminaries for boys were forbidden. Moreover, every appointment to an ecclesiastical benefice was to be notified to the president of the province, and the confirma- tion could be refused on the ground that there were facts which could support the assumption that the appointment would be dangerous to public order. The third law ap- pointed a court for trying ecclesiastical offences, to which

was given the right of suspending both priests and bishops, and a fourth determined the procedure neces- sary for those who wished to sever their connexion with the Eoman Catholic Church.'

As these laws were inconsistent with those articles of the Prussian constitution which guaranteed to a religious corporation the independent management of its own affairs, it was therefore necessary to alter the constitu- tion. This was done, and a later law in 1876 repealed the articles altogether.

The opposition of the bishops to these laws was sup- ported even by many Protestants, especially by the more orthodox Lutherans, who feared the effect of this in- creased subjection of all Churches to the State; they were opposed also by the Conservative members of the Upper House. All, however, was unavailing. Bismarck in this case gave the Liberals a free hand, and the laws eventually were carried and proclaimed on 15th May 1873 ; hence they got the name of the May Laws, by which they are always known. The bishops meanwhile had held a meeting at Fulda, at the tomb of St Boniface, whence they addressed a protest to the king, and declared that they would be unable to recognize the laws as valid. They were supported in this by the Pope, who addressed a protest personally to the Emperor. The laws were put into force with great severity. Within a year six Prussian bishops were imprisoned, and in over 1300 parishes the admini- stration of public worship was suspended. The first sufferer was the cardinal archbishop of Posen, Count Ledochowski. He refused to report to the president of the province appointments of incumbents ; he refused also to allow the Government commissioners to inspect the seminaries for priests, and when he was summoned before the new court refused to appear. He was then deprived of the temporalities of his office ; but the Polish nobles continued to support him, and he continued to act as bishop. Heavy fines were imposed upon him, but he either could not or would not pay them, and in March 1874 he was condemned to imprisonment for two years, and dismissed from his bishopric. The bishop of Treves, the archbishop of Cologne, and other bishops soon incurred a similar fate. These measures of the Government, how- ever, did not succeed in winning over the Catholic popu- lation, and in the elections for the Keichstag in January 1874 the party of the Centre increased in

number from 63 to 91 ; 1,443,170 votes were received by them. In Bavaria the Ultramontanes won a complete victory over the more moderate Catholics. The Prussian Government proceeded to further measures. According to the ordinary practice towards parties in opposition, public meetings were broken up on the smallest pretence, and numerous prosecutions for insult to Government officials were brought against members of the party. The Catholic agitation was, however, carried on with increased vigour throughout the whole empire ; over a hundred newspapers were founded (three years before there had been only about six Catholic papers in the whole of Germany), and great numbers of pamphlets and other polemical works were published. The bishops from their prisons continued to govern the dioceses ; for this purpose they appointed representatives, to whom they transferred their rights as Ordinary and secretly authorized priests to celebrate ser- vices and to perform the other duties of an incumbent. To meet this a further law was passed in the Prussian parliament, forbidding the exercise of ecclesiastical offices by unauthorized persons, and it contained a provision that any one who had been convicted under the law could be deprived of his rights of citizenship, ordered to live in a particular district, or even expelled from the kingdom. The result was that in numerous parishes the police were occupied in searching for the priest who was living there among the people; although his habitation was known to hundreds of people, the police seldom succeeded in arresting him. Bismarck confesses that his doubts as to the wisdom of this legislation were raised by the picture

of heavy but honest gens d'armes pursuing light-footed priests from house to house. This law was followed by- one authorizing the Government to suspend, in every ??? diocese where the bishop continued recalcitrant, the pay- ment of that contribution to the Roman Catholic Church which by agreement had been given by the State since

1817. The only result of this was that large sums were collected by voluntary contribution among the Roman Catholic population.

The Government tried to find priests to occupy the vacant parishes ; few consented to do so, and the Staats- katlioliken who consented to the new laws were avoided by their parishioners. Men refused to attend their ad- ministration; in some cases they were subjected to what was afterwards called boycotting, and it was said that their lives were scarcely safe. Other laws excluded all religious orders from Prussia, and civil marriage was made compulsory ; this law, which at first was confined to Prussia, was afterwards passed also in the Reichstag.

These laws were all peculiar to Prussia, but similar legislation was carried out in Baden and in Hesse, where in 1872 the Ultramontane and Particularist minister, Dalwick, had retired and, after the interval of a year, been succeeded by a Liberal ministry. In Wiirtemberg alone the Government continued to live peaceably with the bishops.

The Government had used all its resources : it had alienated millions of the people ; it had raised up a com- pact party of nearly a hundred members in parliament. The attempt of the Liberals to subjugate the Church had given to the Papacy greater power than it had had since the time of Wallenstein.

The ecclesiastical legislation and other Liberal meas- ures completed the alienation between Bismarck and the Conservatives. In the Prussian parliament seventy-three members broke off from the rest, calling themselves the " old Conservatives " ; they used their position at court to intrigue against him, and hoped to bring about his fall ; Count Arnim (g.v.) was looked upon as his succes- sor. In 1876, however, the party in Prussia reunited on a programme which demanded the maintenance of the Christian character of the schools, cessation of against the Kulturkampf, limitation of economic liberty. Liberal- and repression of social democracy, and this Ism. ^g^g accepted also by the Conservatives in the

Reichstag. This reunion of the Conservatives became the nucleus of a great reaction against Liberalism. It was not confined to any one

department of life, but in- cluded Protection as against Pree Trade, State Socialism as against individualism, the defence of religion as against a separation of Church and State, increased stress laid on the monarchical character of the State, continued increase of the army, and colonial expansion.

The causes of the change in public opinion, of which this was to be the commencement, are too deep-seated to be discussed here. We must note that it was not pe- culiar to Germany ; it was part of that great reaction against Liberal doctrine which marked the last quarter of the 19th century in so many countries. In Germany, however, it more rapidly attained political importance than elsewhere, because Bismarck used it to carry out a great change of policy. He had long been dissatisfied with his position. He was much embarrassed by the failure of his ecclesiastical policy. The alliance with the Liberals had always been half-hearted, and he wished to regain his full freedom of action ; he regarded as an uncontrollable bondage all support that was not given unconditionally. The alliance had been of the nature of a limited co-operation between two hostile powers for a definite object; there had always been suspicion and

jealousy on either side, and a rupture had often been im- minent, as in the debates on the military Bill and the law reform. Now that the immediate object had been attained, he wished to pass on to other projects in which they could not follow him. Political unity had been firmly established ; he desired to use the whole power of the imperial Government in developing the material re- sources of the country. In doing this he placed himself in opposition to both the financial and the economic doc- trines of the Liberals.

The new period which now begins was introduced by some alterations in the official organization. Hitherto almost the whole of the internal business had been concentrated in the imperial chancery ^^^^^ (Reichskanzeramt), and Bismarck had allowed great freedom of action to Delbriiek, the head of the office. Delbrllck, however, had resigned in 1876, justly foreseeing that a change of policy was imminent in which he could no longer co-operate with Bismarck. The work of the office was then divided between several depart- ments, at the head of each of which

was placed a separate official, the most important receiving the title of secretary of state. Bismarck, as always, refused to appoint min- isters directly responsible either to the Emperor or to Parliament; the new officials in no way formed a col- legiate ministry or cabinet. He still retained in his own hands, as sole responsible minister, the ultimate control over the whole imperial administration. The more im- portant secretaries of state, however, are political offi- cials, who are practically almost solely responsible for their department ; they sit in the Bundesrath, and defend their policy in the Reichstag, and they often have a seat in the Prussian Ministry. Moreover, a law of 1878, the occasion of which was Bismarck's long absence from Berlin, empowered the chancellor to appoint a substitute or representative (stellvertreter) either for the whole duties of his office or for the affairs of a particular department. The signature of a man who holds this position gives legal validity to the acts of the Emperor.

This reorganization was a sign of the great increase of work which had already begun to fall on the imperial authorities, and was a necessary step towards the further duties which Bismarck intended to impose upon them.

Meanwhile the relations with the National Liberals reached a crisis. Bismarck remained in retirement at Varzin for nearly a year ; before he returned to Berlin, at the end of 1877, he was visited by Bennigsen, and the Liberal leader was offered the post of vice-president of the Prussian Ministry and -ice-president of the Bundes- rath. The negotiations broke down, apparently because Bennigsen refused to accept office unless he received a guarantee that the constitutional rights of the Reichstag should be respected, and unless two other members of the party, Forckenbeck and Stauffenberg, were given office. Bismarck would not assent to these conditions, and, even if he had been willing to do so, could hardly have over- come the prejudices of the Emperor. On the other hand, Bennigsen refused to accept Bismarck's proposal for a state monopoly of tobacco. Erom the beginning the negotiations were indeed doomed to failure, for what Bismarck appears to have aimed at was to detach Ben- nigsen from the rest of his party and win his support for an anti-Liberal policy.

The session of 1878, therefore, opened with a feeling of great uncertainty. The Liberals were very suspicious of Bismarck's intentions. Proposals for new taxes, especially one on tobacco, were not carried. p'"'"'" Bismarck took the opportunity of avowing that his ideal was a monopoly of tobacco, and this statement was followed by the resignation of Camphausen, minister of finance. It was apparent that there was no*

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Social Demo- cracy.

prospect of Ms being able to carry through the great finan- cial reform ___which he contemplated. He was looking about for an opportunity of appealing to the country on some question which would enable him to free him- self from the control of the Liberal majority. The popular expectations were expressed in the saying at- tributed to him, that he would " crush the Liberals against the wall." The opportunity was given by the Social Democrats.

The constant increase of the Social Democrats had for some years caused much uneasiness not only to the Government, but also among the middle classes. The attacks on national feeling, the protest against the war of 1870, the sympathy expressed for the Communards, had offended the strongest feelings of the nation, especially as the language used was often very violent ; the soldiers were spoken of as murderers, the generals as cut-throats. Attacks on reli- gion, though not an essential part of the party programme, were common, and practically all avowed Social Demo- crats were hostile to Christianity. These qualities, com- bined with the open criticism of the institutions of mar- riage, of monarchy, and of all forms of private property, joined to the deliberate attempt to stir up class hatred,

which was indeed an essential part of their policy, caused a widespread feeling that the Social Democrats were a serious menace to civilization. They were looked upon even by many Liberals as an enemy to be crushed ; much more was this the case with the Government. Attempts had already been made to check the growth of the party. Charges of high treason were brought against some. In 1872 Bebel and Liebknecht were condemned to two years' imprisonment. In 1876 Bismarck proposed to introduce into the Criminal Code a clause making it an offence punishable with two years' imprisonment " to attack in print the family, property, universal military service, or other foundation of public order, in a manner which undermined morality, feeling for law, or the love of the Fatherland." The opposition of the Liberals prevented this from being carried. Lasker objected to these "elastic paragraphs," an expression for which in recent years there has been abundant use. The ordinary law was, however, sufficient greatly to harass the Socialists. In nearly every state there still existed, as survivals of the old days, laws forbidding the union of different political associations with one another, and all unions or associa- tions of working men which followed political, socialistic, or communistic ends. It was possible under these to procure decisions in courts of justice dissolving the Gen- eral Union of Workers and the coalitions and unions of working men. The only result was, that the number of Socialists steadily increased. In 1874 they secured nine seats in the Eeichstag, in 1877 twelve, and nearly 600,000 votes were given to Socialist candidates.

There was then no ground for surprise that, when in April 1878 an attempt was made on the life of the Leeisiaiion Emperor, Bismarck used the excuse for again agaiast bringing in a law expressly directed against the the Socialists. It was badly drawn up and badly

Socialists, defended. The National Liberals refused to vote for it, and it was easily defeated. The Reichstag was prorogued; six days later a man named ISTobiling again shot at the Emperor, and this time inflicted dan- gerous injuries. It is only fair to say that no real proof was brought that the Socialists had anything to do with either of these crimes, or that either of the men was really a member of the Socialist party; nevertheless, a storm of indignation rose against them. The Govern- ment seized the opportunity. So great was the popular feeling, that a repressive measure

would easily have been carried; Bismarck, however, while the excitement was

at its height, dissolved the Eeichstag, and in the elec- tions which took place immediately the Liberal parties, who had refused to vote for the first law, lost a consid- erable number of seats, and with them their control over the Reichstag.

The first use which Bismarck made of the new parlia- ment was to deal with the Social Democrats. A new law was introduced forbidding the spread of Socialistic opinions by books, newspapers, or public meetings, em- powering the police to break up meetings and to suppress newspapers. The Federal Council could proclaim a state of siege in any town or district, and when this was done any individual who was considered dangerous by the police could be expelled. The law was carried by a large majority, being opposed only by the Progres- sives and the Centre. It was applied with great severity. The whole organization of newspapers, societies, and trades unions was at once broken up. Almost every po- litical newspaper supported by the party was suppressed ; almost all the pamphlets and books issued by them were forbidden; they were thereby at once deprived of the only legitimate means which they had for spreading their opinions. In the autumn of 1878 the minor state of siege was proclaimed in Berlin, although no disorders had taken place and no resistance had been attempted, and sixty-seven members of the party were excluded from the city. Most of them were married and had families; money was collected in order to help those who were suddenly deprived of their means of sub- sistence. Even this was soon forbidden by the police. At elections every kind of agitation, whether by meet- ings of the party or by distribution of literature, was suppressed. The only place in Germany where So- cialists could still proclaim their opinions was in the Reichstag. Bismarck attempted to exclude them from it also. In this, however, he failed. Two members who had been expelled from Berlin appeared in the city for the meeting of the Reichstag at the end of 1878. The Government at once asked permission that they should be charged with breaking the law. The Constitution pro- vided that no member of the House might be brought before a court of justice without the permission of the House, a most necessary safeguard. In this case the per- mission was almost

unanimously refused. Nor did they assent to Bismarck's proposal that the Reichstag should assurSe power to exclude from the House members who were guilty of misusing the liberty of speech which they enjoyed there. Bismarck probably expected, and it is often said that he hoped, to drive the Socialists into some flagrant violation of the law, of such a kind that it would be possible for him completely to crush them. This did not happen. There were some members of the party who wished to turn to outrage and assassination. Most, a printer from Leipzig, who had been expelled from Berlin, went to London, where he founded the Freiheit, a weekly paper, inwhich he advocated a policy of violence. He was thereupon excluded from the party, and after the assassination of the Tsar had to leave England for Chicago. A similar expulsion befell others who advo- cated union with the Anarchists. As a whole, however, the party remained firm in opposition to any action which would strengthen the hands of their opponents. They carried on the agitation as best they could, chiefly by distributing reports of speeches made in the Reichstag. A weekly paper, the Social-Democrat, was established at Zurich. Its introduction into Germany was of course forbidden, but it was soon found possible regularly to dis- tribute thousands of copies every week in every part of the country, and it continued to exist till 1887 at Zurich, and till 1890 in London. In August of 1880 a congress of Socialists was held at the castle of Wyden, in Switzerland,

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at which about eighty members of the party met, dis- cussed their policy, and separated before the police knew anything of it. Here it was determined that the mem- bers of the Beichstag, who were protected by their position, should henceforward be the managing com- mittee of the party, and arrangements were made for contesting the elections of 1881. A similar meeting was held in 1883 at Copenhagen, and in 1887 at St Gallen, in Switzerland. Notwithstanding all the efforts of the Government,

though every kind of public agitation was forbidden, they succeeded in winning twelve seats in 1881. The law, which had obviously failed, was renewed in 1881 ; the state of siege was applied to Hamburg, Leipzig, and Stettin, but all to no purpose ; and though the law was twice more renewed, in 1886 and in 1888, the feeling began to grow that the Socialists were more dangerous under it than they had been before.

The elections of 1878, by weakening the Liberal par- ties, enabled Bismarck also to take in hand the great financial reform which he had long contemplated.

At the foundation of the North German Confederation it had been arranged that the imperial exchequer should receive the produce of all customs duties and also of excise. It depended chiefly on the taxes on salt, tobacco, brandy, beer, and sugar. So far as the imperial expenses were not covered by these sources of revenue, until imperial taxes were intro- duced, the deficit had to be covered by contributions paid by the individual states in proportion to their popu- lation. All attempts to introduce fresh imperial taxes had failed. Direct taxation was opposed by the govern- ments of the states, which did not desire to see the imperial authorities interfering in those sources of revenue over which they had hitherto had sole control ; moreover, the whole organization for collecting direct taxes would have had to be created. At the same time, owing to the adoption of free trade, the income from customs was continually diminishing. The result was that the sum to be contributed by the individual states constantly increased, and the amount to be raised by direct taxation, including local rates, threatened to become greater than could conveniently be borne. Bis- marck had always regarded this system with disapproval, but during the first four or five years he had left the care of the finances entirely to the special ofiicials , and had always been thwarted in his occasional attempts to introduce a change. His most cherished project was a large increase in the tax on tobacco, which at this time paid, for home-grown tobacco, the nominal duty of four marks per hundred kilo, (about a farthing a pound), and on imported tobacco twenty-four marks. Proposals to increase it had been made in 1869 and in 1878, and on the latter occasion Bismarck for the first time publicly announced his desire for a state monopoly, a project which he never gave

up, but for which he never was able to win any support. Now, however, he was able to take up the work. At his invitation a conference of the finance ministers met in July at Heidelberg; they agreed to a great increase in the indirect taxes, but refused to accept the monopoly on tobacco. At the beginning of the autumn session a union of 204 members of the Reichstag was formed for the discussion of economic questions, and they accepted Bismarck's re- forms. In December he was therefore able to issue a memorandum explaining his policy; it included a moderate duty, about 6 per cent., on all imported goods, with the exception of raw material required for German manufactures (this was a return to the old Prussian principle) ; high finance duties on tobacco, beer, brandy, and petroleum ; and protective duties on iron, corn, cattle, wood, wine, and sugar. The whole of the ses-

sion of 1879 was occupied with the great struggle between Pree Trade and Protection, and it ended with a decisive victory for the latter. On the one side were p^^^.^^ the seaports, the chambers of commerce, and the city of Berlin, the town council of which made itself the centre of the opposition. The victory was secured by a coalition between the agricultural interests and the manufacturers ; the latter promised to vote for duties on corn if the landlords would support the duties on iron. In the decisive vote the duty on iron was carried by 218 to 88, on corn by 226 to 109.

The principle of protection which was then adopted has been maintained since ; considerable alterations have been made from time to time in the tariff ; in 1885 the duty on corn was raised ; again in 1885 and 1887, considerable duties were levied on most timbers. The finance duties were also with some exceptions adopted, and have since been maintained. The tax on tobacco was increased to 44 marks, and the duty on imported tobacco raised to 85. The monopoly on tobacco was rejected in 1882 by 273 to 43 votes, and in 1886 that on brandy by 181 to 3. In the next year, after the victory of the coalition, an elaborate law imposing fresh duties on brandy was carried, which was of considerable political importance, for it was adopted by the southern states, who thereby gave up one of their chief privileges. AU proposals for a reform of the tax on beer, however, failed. The result of these new taxes was that the income from customs and

excise rose from about 230 million marks in 1878-79 to about 700 millions in 1898-99, and Bismarck's object in removing a great burden from the states was attained.

The natural course when the new source of income had been obtained would have been simply to relieve the states of part or all of their contribution. This, how- ever, was not done. The Reichstag raised difft- ^^r/- culties on the constitutional question. The butions. Liberals feared that if the Government received so large a permanent source of revenue it would be independent of Parliament; the Centre, that if the contributions of the states to the imperial exchequer ceased, the central Government would be completely independent of the states. Bismarck had to come to an agreement with one party or the other ; he chose the Centre, probably for the reason that the National Liberals were themselves divided on the policy to be pursued, and therefore their support would be uncertain ; and he accepted an amendment, the celebrated Franckenstein Clause, proposed by Franckenstein, one of the leaders of the Centre, by which all proceeds of customs and the tax on tobacco above 130 million marks should be paid over to the individual states in proportion to their population. Each year a large sum would be paid to the states from the imperial treasury and another sum as before paid back to meet the deficit in the form of state contributions. This complicated arrangement has since continued.

Prom 1871 to 1879 the contribution of the states had varied from 94 to 67 million marks; under the new system the surplus of the contributions made by the states over the grant by the imperial treasury was soon reduced to a very small sum, and in 1884-85 the payments of the empire to the states exceeded the contributions of the states to the empire by 20 million marks, and this excess continued for many years ; so that there was, as it were, an actual grant in relief of direct taxation. In Prussia, by the Lex Huene, from 1886 to 1895, all that sum paid to Prussia, so far as it exceeded 15 million marks, was handed over to the local authorities in relief of rates. The increased expenditure on the navy since 1897 has again caused the contributions required from the states to exceed the grants to them from the imperial exchequer.

Party changes.

Seces- sionists.

These events -were followed by the disruption of the National Liberal party and a complete change in the parliamentary situation. Already the Liberal ministers, Talk and Hobrecht, had resigned, as well as Forckenbeck the president, and Stauffenberg the vice-president of the Reichstag ; in their place there was chosen a Conserva- tive, and Franckenstein, a Catholic. The whole party had voted against the Franckenstein Clause, but a few days later fifteen of the right wing left the party and transferred their support to the Gov- ernment. For another year the remainder kept together, but there was no longer any real harmony or co-operation; in 1880 nineteen, including most of the ablest leaders, Lasker, Forckenbeck, Bamberger, and Bunsen, left the party altogether. The avowed cause of difference was commercial policy; they were the Free Traders, but they also justly foresaw that the reaction would extend to other matters. They took the name of the Liberals Vereinigung, but were generally known as the Secession; they hoped to become the nucleus of a united Liberal party in which all sections should join together on the principles of Free Trade and constitutional development. At the elections of 1881 they secured forty-seven seats, but they were not strong enough to maintain themselves, and with great reluctance in 1884 formed a coalition with the Progres- sives, who had gained greatly in strength owing to the breach among the Government parties. They did so reluctantly, because they would thereby condemn them- selves to assume that attitude of purely negative criti- cism which, during the great days of their prosperity, they had looked down upon with contempt, and were putting themselves under the leadership of Eugen Eichter, whom they had long opposed. The new party, the Freisinnige, had no success ; at the election of 1884 they secured only sixty-seven seats, a loss of thirty-nine ; they were subjected to all inconveniences

which had belonged to opposition; so- cially, they were boycotted by all who were connected with the Court or Government ; they were cut oif from all hope of public activity, and were subjected to con- stant accusations for Bismarck Beleidigung. Their only hope was in the time when the Crown Prince, who had shown great sympathy with them, should succeed. They were popularly known as the Crown Prince's party. Lasker soon died ; others, such as Forckenbeck and Bunsen, retired from public life, unable to maintain their position at a time when the struggle of class inter- ests had superseded the old conflicts of principle. At the election of 1887 they lost more than half their seats, and, as we shall see, in 1893 the party again broke up.

The remainder of the !N"ational Liberals only won forty- five seats in 1881, and during the next three years they were without influence on the Government ; and even Bennigsen, unable to follow Bismarck in his new pblicy, disgusted at the proposals for biennial budgets and the misuse of Government influence at the elections, retired from political life. In 1884 a new development took place : under the influence of Miquel a meeting was held at Heidelberg of the South German members of the party, who accepted the commercial and social policy of the Government, including the Socialist law ; their pro- gramme received Bismarck's approval, and was accepted by the rest of the party, so that they henceforward were taken into favour by the Government ; but they had won the position by sacrificing almost all the characteristics of the older Liberalism ; the hope of a reunion for all the different sections which had hitherto kept the name of Liberal was at an end.

These events had a very unfortunate effect on the character of the parliament. From 1878 to 1887 there

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was no strong party on which Bismarck could depend for support. After 1881 the parties of opposition were con- siderably strengthened. Alsatians and Poles, Guelphs, Clericals, and Radicals, were joined in a common hostility, to the Government. Parliamentary history took the form of a hostile criticism of the Government proposals, which was particularly bitter because of the irreconcilable op- position of the Free Traders. Few

of the proposals were carried in their entirety, many were completely lost ; the tobacco monopoly and the brandy monopoly were con- temptuously rejected by enormous majorities; even an increase of the tax on tobacco was refused ; the first pro- posals for a subsidy to the Norddeutsche Lloyd were rejected. The personal relations of the chancellor to Parliament were never so bitter. At the same time, in Prussia there was a tendency to make ^^/m. more prominent the power of the king and to diminish the influence of the parliament. A proposal to introduce biennial budgets was for this reason regarded with great suspicion by the Opposition as a reactionaiy measure, and rejected. The old feelings of suspicion and jealousy were again aroused ; the hostility which Bis- marck encountered was scarcely less than in the old days of the conflict. After the elections of 1881 a protest was raised against the systematic influence exercised by Prus- sian officials. Puttkammer, who had now become minister of the interior, defended the practice, and a royal edict of 4th January 1882 affb- med the monarchical character of the Prussian Constitution, the right of the king person- ally to direct the policy of the state, and required those officials who held appointments of a political nature to defend the policy of the government, even at elections.

One result of the new policy was a reconciliation with the Centre. Now that Bismarck could no longer depend on the support of the Liberals, it would be impossible to carry on the Government if the Catholics maintained their policy of opposition to all Government measures. They had supported him in his commercial reform of 1878, but by opposing the Septen- f^f^'."[illegible] nate in 1880 they had shown that he could not tampt depend upon them. It was impossible to con- tinue to treat as enemies of the state a party which had supplied one of the vice-presidents to the Reichstag, and which after the election of 1881 outnumbered by forty votes any other single party. Moreover, the Gov- ernment, which was now very seriously alarmed at the influence of the Social Democrats, was anxious to avail itself of every influence which might be used against them. In the struggle to regain the adherence of the working men it seemed as though religion would be the most valuable ally, and it was impossible to ignore the fact that the Roman Catholic priests had alone been able to form an organization in which hun- dreds of thousands of working men had been enlisted. It was therefore for every reason*

desirable to remedy a state of things by which so many parishes were left without incumbents, a condition the result of which must be either to diminish the hold of Christianity over the people, or to confirm in them the belief that the Government was the real enemy of Christianity. It was not easy to execute this change of front with dignity, and impossible to do so without forsaking the principles on which they had hitherto acted. Ten years were to pass before the work was completed. But the cause of the confiict had been rather in the opinions of the Liberals than in the personal desire of Bismarck himself. The larger political reasons which had brought about the conflict were also no longer valid ; the fears to which the Vatican decrees had given rise had not been fulfilled; the failure of the Carlists in Spain and of the Legitimists in France, the consolidation of the new kingdom in Italy,

and the alliance with Austria, had dispelled the fear of a Catholic League. The growth of the Catholic democracy in Germany was a much more serious danger, and it proved to be easier to come to terms with the Pope than with the parliamentary Opposition. It would clearly be impossible to come to any agreement on the principles. Bismarck hoped, indeed, putting all questions of prin- ciple aside, to establish a modus vivendi ; but even this was difficult to attain. An opportunity was given, by the death of the Pope in 1878. Leo XIII. notified his accession to the Prussian Government in a courteous despatch; the interchange 6f letters was followed by a confidential discussion between Bismarck and Cardinal Franchi at Kissingen during the summer of 1878. The hope that this might bring about some agreement was frustrated by the sudden death of the cardinal, and his successor was more under the influence of the Jesuits and the more extreme party. Bismarck, however, was not discouraged.

The resignation of B”alk in July 1879 was a sign of the change of policy; he was succeeded by Puttkammer, who belonged to the old-fashioned

Prussian Conservar tives and had no sympathy with the Liberal legislation. The way was further prepared by a lenient use of the penal laws. On 24th February 1880 the Pope, in a letter to the ex-bishop of Cologne, said he was willing to allow clerical appointments to be notified if the Government withdrew the obnoxious laws. In 1880 a provisional Bill was submitted to Parliament giving the Crown dis- cretionary power not to enforce the laws. It was opposed by the Liberals on the ground that it conceded too much, by the Clericals that it granted too little, but, though carried only in a mutilated form, it enabled the priests who had been ejected to appoint substitutes, and religious worship was restored in nearly a thousand parishes. In the elections of 1881 the Centre gained five more seats, and in 1883 a new law was introduced prolonging and extending that of 1881. Meanwhile a Prussian envoy had again been appointed at the Vatican ; all but three of the vacant bishoprics were filled by agreement be- tween the Pope and the king, and the sequestrated revenues were restored. Finally, in 1886, a fresh law, besides other concessions, did away with the Kultur Examen, and exempted seminaries from state control. It also abolished the Ecclesiastical Court, which, in fact, had proved to be almost unworkable, for no priests would appeal to it. By this, the real Kulturkampf, the attempt of the state to control the intellect and faith of the clergy, ceased. A further law of 1887 permitted the return to Prussia of those orders which were occupied in charitable work.

As permanent results of the conflict there remain only the alteration in the Prussian Constitution and the ex- pulsion of the Jesuits ; the Centre have continued to demand the repeal of this, and to make it the price of their support of Government measures ; in 1897 the Bundesrath permitted the return of the Kedemptorists, an allied order. With these exceptions absolute religious peace resulted ; the Centre to a great extent succeeded to the position which the National Liberals formerly held ; in Bavaria, in Baden, in Prussia, they obtained a dominant position, and they became a Government party.

Meanwhile Bismarck, who was not intimidated by the parliamentary opposition, irritating and embarrassing though it was, resolutely proceeded with his Natioaaii- (jg^gj^ gf developing the material

resources of nihyays. ^^^ empire. In order to do so the better he undertook, in add.ition to his other offices, that of Prussian minister of commerce. He was now able to carry out, at least partially, his railway schemes, for he could afford to ignore Liberal dislike to state railways.

and if he was unable to make all the lines imperial, he could make most of them Prussian. The work was con- tinued by his successors, and by the year 1896 there remained only about 2000 kilometres of private railways in Prussia; of these none except those in East Prussia belonged to companies of any great importance. More than this, Bismarck was able to obtain Prussian control of the neighbouring states ; in 1886 the Brunswick rail- ways were acquired by the Prussian Government, and in 1895 the private lines in Thuringia. The imperial rail- ways in Elsass-Lothringen are managed in close con- nexion with the Prussian system, and in 1895 an important step was taken towards extending Prussian influence in the south. A treaty was made between Prussia and Hesse by which the two states together bought up the Hesse-Ludwig railway (the most import ant private company remaining in Germany), and in addition to this agreed that they would form a special union for the joint administration of all the lines belong- ing to either state. What this means is that the Hessian lines are now managed by the Prussian department, but Hesse has the right of appointing one director, and the expenses and profits are divided between the two states in proportion to their population. Thus a nucleus and precedent has been formed similar to tiiat by which the Customs Union was begun, and it was hoped that it might be possible to arrange similar agreements with other states, so that in this way a common management for all lines might be established. There is, however, .strong opposition, especially in South Germany, and most of the states cling to the separate management of then- own lines. Fearful that Prussia might obtain control over the private lines, they have imitated Prussian policy and acquired all railways for the state ; there is now a separate railway administration in Saxony, Bavaria, Wlirtemberg, Baden, Mecklenburg, and Oldenburg. The management of the railways plays an important part in local politics, and occupies much of the attention of Parliament ; much of the old opposition to Prussia is revived in defence of the local railways.

Bismarck's policy has been fully justified by results. In nothing has there been so great an increase in practical efficiency as in the working of the railways. And now that the tariffs are fixed by the state, it is possible to use them so as to support the fiscal and commercial policy of the Government. In the early years of the empire it happened that the railway companies fixed the tariffs so as to give an advantage to foreign imports over home industries ; now they can be fixed so as to afford, if de- sirable, an additional protection to home produce.

A natural supplement to the nationalization of railways was the development of water communication. This is of great importance in Germany, as all the chief coalfields and manufacturing districts ??? Silesia, Saxony, Westphalia, and Elsass ??? are far removed from the sea. The most important works which have been executed in recent years are the canal from Dortmund to the mouth of the Ems, and the Jahde 3anal from the Ems to the Elbe, which enables Westphalian coal to reach the sea, and so to compete better with English coal. In addition to this, however, a large number of smaller works have been undertaken, such as the canalization of the Main from Frankfort to the Rhine, and a new canal from the Elbe to Lilbeck. The traffic on the great waterways increased fourfold during the period 1870-1900, and so great has been the growth of industry and enterprise that the in-, creased use of water communication does not prevent the railway traffic from increasing with equal rapidity. The great ship canal from Kiel to the Elbe, which was begun in 1887 and completed in 1896, has perhaps even more importance for naval than for commercial purposes.

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The change which has taken place in the Khine is characteristic of modern Germany. This great river, so long the home of romance, has become one of the great arteries of traffic, and ~~while lines of railways on both sides have caused small villages to become large towns, the river itself is navigated by more than 400 steamers. The Prussian Government~~

also planned a great scheme by which the Westphalian coalfields should be directly connected with the Ehine in one direction and the Elbe in the other by a canal which would join together Minden, Hanover, and Magdeburg. This would give uninterrupted water communication from one end of the country to the other, for the Elbe, Oder, and Vistula are all navigable rivers connected by canals. This project, which was a natural continuation of Bis marck's policy, was, however, rejected by the Prussian parliament in 1894. The opposition came from the Agrarians and extreme Conservatives, who feared that it would enable foreign corn to compete on better terms with German corn; they were also jealous of the atten- tion paid by the Government to commercial enterprise in which they were not immediately interested. The proposal continued to be repeatedly discussed, but with- out success, and it was the rejection of this Bill in 1901 which led to a ministerial crisis and the resignation of Miquel.

Equally important was the action of the Government in developing foreign trade. The first step was the in- clusion of Hamburg and Bremen in the Customs Hamburg Union ; this was necessary if German maritime Bremen. enterprise was to become a national and not merely a local concern, for the two Hansa cities practically controlled the whole foreign trade and owned three-quarters of the shipping ; but so long as they were excluded from the Customs Union their interests were more cosmopolitan than national. Both cities, but especially Hamburg, were very reluctant to give up their privileges and the commercial independ- ence which they had enjoyed almost since their founda- tion. As a clause in the Constitution determined that they should remain outside the Customs Union until they voluntarily offered to enter it, there was some difficulty in overcoming their opposition. Bismarck, with characteristic energy, proposed to take steps, by altering the position of the imperial customs stations, which would practically destroy the commerce of Ham- burg, and some of his proposals which seemed contrary to the Constitution aroused a very sharp resistance in the Bundesrath. It was, however, not necessary to go to extremities, for in 1881 the senate of Hamburg accepted an agreement which, after a keen struggle, was ratified by the citizens. By this Hamburg was to enter the Union ; a part of the harbour was to remain a free port, and the empire contributed two million pounds towards rearranging and enlarging the harbour. A similar treaty was

made with Bremen, the free port of that city being situated near the mouth of the Weser at Bremerhaven ; and in 1888, the necessary works having been completed, the cities entered the Union. They have had no reason to regret the change, for no part of the country profited so much by the great prosperity of the following years, notwithstanding the temporary check caused by the serious outbreak of cholera at Hamburg in

1896.

During the first years of the empire Bismarck had occasionally been asked to interest himself in colonial enterprise. He had refused, for he feared that Colonies, f Qjgjgn complications might ensue, and that the country might weaken itself by dissipation of energy. He was satisfied that the Germans should profit by the com- mercial liberty allowed in the British colonies. Many of

the Germans were, however, not contented with this, and disputes regarding the rights of German settlers in Fiji caused some change of feeling. The acquisition of German colonies was really the logical and almost necessary sequel of a Protective policy. Eor that reason it was always opposed by the extreme Liberal party.

The failure of the great Hamburg house of Godefroy in 1879 threatened to ruin the growing German industries in the South Seas, which it had helped to buUd up. Bis- marck therefore consented to apply to the Reichstag for a state guarantee to a company which would take over its great plantations in Samoa. This was refused, chiefly owing to the influence of the Liberal party. Bismarck therefore, who took this rebuff much to heart, said he would have nothing more to do with the matter, and warned those interested in colonies that they must depend on self-help ; he could do nothing for them. By the support of some of the great financial firms they succeeded in forming a company, which carried on the business and undertook fresh settlements on the islands to the north of New Guinea. This event led also to the foundation of a society, the Deutscher Kolonial Verein, under the presi- dency of the prince of Hohenlohe-Langenburg, to educate public opinion. Their immediate object was the acquisi- tion of trading stations.

The year 1884 brought a complete change. Within a few months Germany acquired extended possessions in several parts both of Africa and the South Seas. This was rendered possible owing to the good understanding which at that time existed between Germany and France. Bismarck therefore no longer feared, as he formerly had, to encounter the difficulties with Great Britain which would be the natural result of a policy of colonial expan- sion.

The first acquisition was made in South-West Africa. On several occasions missionaries had applied to the German Government for protection. In 1883 .

Herr Luderitz, a Bremen tobacco merchant, had acquired by purchase from the natives and half- breed chiefs a trading-station on the Bay of Angra Pequena and considerable territory in the neighbour- hood. He then asked for the protection of the empire. A correspondence between the British and German Foreign Offices showed that the British Government had not hitherto exercised rights of sovereignty over this district, and had refused to undertake the responsi- bility for the protection of German settlers. In the month of June, therefore, the German flag was hoisted at Angra Pequena, and shortly afterwards the whole coast from the river Orange to the Portuguese colonies, with the exception of Walfisch Bay, was taken under German protection. During the same year, in conse- quence of a dispute which had arisen between German traders and natives on the Gulf of Guinea, a gunboat was despatched, and Dr ISTachtigal was instructed to pro- claim a protectorate over Cameroon. Dr ISTachtigal, however, on his own authority, found it desirable to take Togoland also under German rule. Encouraged by this action of the Government, a company, the Gesellschaft fur deutsche Kolonization, was founded by Dr Peters, who at once went off to the east coast of Africa and succeeded in negotiating treaties with twelve chiefs on the coast off Zanzibar; at the beginning of 1885 these also were taken over by the Govern- ment.

Similar events took place in the South Seas. The acquisition of Samoa, where German interests were most extensive, was prevented by the arrangement made in 1879 with Great Britain and the United States. But

in 1884 and 1885 the German flag was hoisted on the north of New Guinea (to which the name Kaiser Wilhelmsland

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has been given), on several parts of the New Britain Archipelago (which afterwards became the Bismarck Archipelago), and on the Caroline Islands. Pacific '^^^ ???'^^^ acquisition was not kept. The Span- ish Government claimed the islands, and Bis- marck, in order to avoid a struggle which would have been very disastrous to monarchical government in Spain, suggested that the Pope should be asked to mediate. Leo XIII. accepted the offer, which was an agreeable reminiscence of the days when Popes deter- mined the limits of the Spanish colonial empire, all the more gratefully that it was made by a Protestant power. He decided in favour of Spain, Germany being granted certain rights in the islands. The loss of the islands was amply compensated for by the political advantages which Bismarck gained by this attention to the Pope, and, after all, not many years elapsed before they became German.

Bismarck in his colonial policy had repeatedly ex- plained that he did not propose to found provinces or take over for the Government the responsibility for their administration ; he intended to leave the responsi- bility for their material development to the merchants, and even to entrust to them the actual government. He avowedly wished to imitate the older form of British colonization by means of chartered companies, which had been recently revived in the North Borneo Com- pany; the only responsibility of the Imperial Govern- ment was to be their protection from foreign aggression. In accordance with this policy, the territories were not actually incorporated in the empire (there would also have been constitutional diflBculties in doing that), and they were ofBcially known as Protectorates (Schutzgehiete), a word which thus acquired a new signification. In 1885 two new great companies were founded to under-

take the Government. The Deutsch Ost Afrika Gesell- schaft, with a capital of ►►200,000, took over the territories acquired by Dr Peters, and for the South Seas the Meu Guinea Gesellschaft, founded by an amal- gamation of a number of firms in 1884, received a char- ter in 1885. It was not, however, possible to limit the imperial responsibility as Bismarck intended. In East Africa the great revolt of the Arabs in 1888 drove the company out of all their possessions, with the exception of the port of Dar-es-Salam. The company was not strong enough to defend itself ; troops had to be sent out by the Emperor under Captain Wissmann, who as im- perial commissioner took over the government. This, which was at first a temporary arrangement, was after- wards made permanent.

The New Guinea Company had less formidable ene- mies to contend with, and with the exception of a period of three years between 1889 and 1892, they maintained a full responsibility for the administration of their terri- tory till the year 1899, when an agreement was made and ratified in the Eeichstag, by which the possession and administration was transferred to the empire in re- turn for a subsidy of ►►20,000 a year, to be continued for ten years. The whole of the colonies have therefore now come under the direct administration of the empire. They are administered under a special department of the Foreign Office, and in 1890 a council of experts on colonial matters was instituted, who should help the director and the chancellor by their advice. It is one of the- complaints of the colonial party that a separate Office for colonial affairs has not been created. In 1X87 the two chief societies for supporting the colonial move- ment joined under the name of the Deutsche Kolonial- gesellschaft. This society, which in 1901 had over 2.’”),000 members, takes a great part in forming public opinion on colonial matters.

This new policy inevitably caused a rivalry of interests with other countries, and especially with Great Britain. In every spot at which the Germans acquired territory they found themselves in opposition to British interests. The settlement at Angra Pequena f^►►►”^^ caused much ill-feeling in Cape Colony, which Britain. was, however, scarcely justified, for it was the reluctance of the Cape ministry to undertake responsibility for the administration of Namaqualand which prevented the British*

Government from anticipating the Germans in the acquisition of this district. In Togoland and Cameroon British traders had long been active, and the proclamation of British sovereignty was impending when the German flag was hoisted. The settlements in East Africa menaced the old-established British influence over Zanzibar, which was all the more serious because of the close connexion between Zanzibar and the rulers of the Persian Gulf; and the colony of Queensland saw with much concern the German settlement so near their shores. As soon as the acquisitions had been made, however, a period followed during which by a series of treaties the boundaries of German, French, and Brit ish possessions were determined in the way of peaceful negotiation. The overthrow of Jules Ferry and the danger of war with France made a good understanding with Great Britain of more importance. Bismarck, by summoning a conference to Berlin to discuss African questions, secured for Germany, though the youngest of colonial powers, a European recognition which was very grateful to the colonial parties ; and in 1888, by lending his support to the anti-slavery movement of Cardinal Lavigerie, he won the support of the Centre, who had hitherto opposed the colonial policy. At the same time the anti-slavery agitation was of use in another way, for the proclamation of a general blockade on the east coast of Africa was of considerable assistance to the Germans in their difficult struggle against the Arabs.

This period is concluded by the general agreement for the demarcation of Africa which was made in 1890. A similar agreement had been made in 1886 regarding the South Seas. It was made after Bismarck had retired from oflfice, and he, as did the colonial party, severely criticized the details ; for the surrender of Zanzibar and Witu cut short the hopes which had been formed of build- ing up a great German empire controlling the whole of East Africa. Many of the colonial party went further, and criticized not only the details, but the principle. They were much offended by Caprivi's statement that no greater injury could be done to Germany than to give her the whole of Africa, and they refused to accept his contention that "the period of flag-hoisting was over," and that the time had come for consolidating their pos- sessions. It must, however, be recognized that a contin- uation of the ambitious policy of the last few years might easily have involved Germany in dangerous disputes.

It appeared a small compensation that Great Britain surrendered to Germany the island of Heligoland, which she had taken from the Danes in the Napoleonic wars. It was annexed to Prussia ; the natives "^d"' born before the year 1880 were exempted from "" ' military service, and till the year 1901 no additional import duties were to be imposed. It has been strongly fortified and made a naval station.

It was easy for the Opposition to criticize the colonial policy. They could point out that in no case had terri- tory been acquired in which any large number of Ger- man emigrants could live and rear families. As late as 1896 the total number of Germans living in the protec- torates was less than 2000, and. of these more than half were ofiicials and soldiers. The colonies are therefore, and will probably continue to be, useless as a means of

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providing homes for surplus population. As in the old days, emigrants go to the United States and South Amer- ica. As markets for German products the colonies still are of the smallest importance ; in 1901 the whole value of the trade, import and export, between Germany and her colonies was less than ??1,000,000, and the cost of administration, including the grant to the shipping com- panies, has often exceeded the total trade. Many mis- takes have been made in the administration, and cases of misconduct by individual officials have formed the text for attacks on the whole system. Dr Karl Peters, one of the founders of the East African dominion, was in 1897 dismissed from the service. It is noticeable that the colonial party complained of what, on the evidence, was a mere act of justice, as a political blunder, and thereby appeared to identify themselves with his offence and justify the criticisms of the Socialists. Generally, however, these criticisms were premature. Many years must elapse before prosperous plantations can be made in new countries. The colonial policy was one essen- tially of the future ; but whatever the issue be, it was surely wiser, while the opportunity was still

open, to take care that Germany, in the partition of the world among European races, should not alone go entirely without a share.

It would be little use acquiring colonies and creating manufactures if the foreign trade was to be in the hands of other nations. As early as 1881 the Government had published a proposal for a subvention to German ship- ping ; it was criticized with peculiar energy by Bamberger and the Free Traders ; a Bill introduced in 1884 was , , abandoned, but in 1885 Bismarck succeeded

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shipping m carrying a vote by which, tor niteen years, com- four million marks could annually be devoted

psaies. ^Q helping a line of mail steamers to the Pacific and Australia and a branch line in the Mediterranean. An agreement was made with the North German Lloyd, one clause of which was that all the new steamers were to be built in Germany; in 1890 a further vote was passed for a line to Delagoa Bay and Zanzibar.

This far from exhausts the external activity of the nation and the Government : the establishment of student- ships for the study of Oriental languages enabled Germans to make their way in the Turkish and Persian empires, and to open up a fresh market for German goods ; by the great excavations at Pergamum and Olympia Germany entered with great distinction on a field in which the way had been shown by France and Great Britain. The progress of technical studies and industrial enterprise enabled Germany to take a leading place in railway and shipbuilding, in the manufacture of military weapons, in chemical experiments, and in electrical work.

It was a part of the new policy not only to combat Social Democracy by repression, but to win the confidence of the working men by extending to them the direct pro- tection of the state. Recent legislation, culminating in the Gewerbeordnung of 1869, had, in accordance with the principles of the Liberal Economists, or, as the Germans called it, the Manchester School, instituted freedom from state control in the relations between

employers and work- men. The old guilds had been destroyed, compulsory apprenticeship had ceased ; little protection, however, was given to the working men, and the restrictions on the employment of women and children were of little use,' as there was no efficient system of factory inspection. It was difficult for the men by their own exertions to improve their condition, for the masters had full liberty of association, which the law refused to the workmen. Even before 1870 a protest was raised against this system among the Eoman Catholics, who were chiefly concerned for the preservation of family

Social reforms,

life, which was threatened by the growth of the factory system and also by the teaching of the Social Demo- crats. Baron von Ketteler, archbishop of Mainz, had maintained that it was the duty of the state to secure to working men work and provision during sickness and old age. The general interest of the Church in the social question was recognized by a congress of the bishops at Fulda. Ketteler's work was continued by Canon Moufang, and Catholics brought forward motions in the Eeichstag demanding new factory legislation. The peculiar importance of the Catholic move- ment is that it alone was able to some extent sgcia/ism. to meet the Socialists on their ovsm ground. The Catholics formed societies which were joined by large numbers of workmen. Originated by Father Kol- ping on the Ehine, they soon spread over the whole of Catholic Germany. Herr von Schorlemer-Ast, a Catho- lic landed proprietor from Westphalia, formed similar associations among the peasants. The result of this has been that the Social Democrats have failed to conquer the Catholic as they have the Protestant districts. A similar movement began among the Protestants after the commercial crisis of 1873, which forms an epoch in German thought, since it was from that year that men first began to question the economic doctrines of Liberalism, and drew attention to the demoralization which seemed to arise from the freedom of speculation and the influence of the stock exchange' ??? a movement which in later years led to some remarkable attempts to remedy the evil by legislation. A minister, Eudolph Todt, and Rudolph Meyer criticized the moral and economic doctrines of Liberalism ; his writings led to the foundation of the ChristlichSocial Arheiter Verein, which for a few years

attained considerable notoriety under the leadership of Adolph Stocker. The Protes- tant movement has not succeeded in attaining the same position as has the Catholic among the working men ; but it received considerable support among the influen- tial classes at court, and part of the programme was adopted by the Conservative party, which in 1876 demanded restriction of industrial liberty and legisla^ tion which would prevent the ruin of the independent artizans.

In a country where learned opinion has so much in- fluence on public affairs it was of especial importance that several of the younger teachers separated themselves from the dominant Manchester School and asserted the duty of the state actively to promote the well-being of the working classes. At a congress held in Erfurt in 1873, Schmoller, Wagner, Brentano, and others founded the Verein fur Social Politik, which by its publications has had much influence on German thought.

The peculiar social conditions brought it about that in many cases the Christian Social movement took the form of Anti-Semitism {q.v.). In Germany nearly all the bankers and stockbrokers are Jews. Many of the leaders of the Liberal parties, e.g., Bam- berger and Lasker, were of Jewish origin ; the doctrines of Liberalism were supported by papers owned and edited by Jews ; hence the wish to restore more fully the avowedly Christian character of the state, coinciding with the attack on the influence of finance, which owed so much to the Liberal economic doctrines, easily degenerated into attacks on the Jews. The leader in this was Stocker. During the years 1879 to 1881 the anti-Semite agitation gained considerable importance in Berlin, Breslau, and other Prussian cities, and it culminated in the elections of that year, leading in some cases to riots and acts of violence.

So long as the Government was under the influence of the National Liberals, it was indifferent if not hostile to these movements. The Peasants' Union had actually been

Anti- Semites,

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forbidden by the police ; Bismarck himself was violently attacked for his reputed connexion with a great Jewish firm of bankers. He had, however, kept himself in- formed regarding these movements, chiefly by means of Hermann Wagener, an old editor of the Kreuzzeitung, and in the year 1878 he felt himself free to return in this matter to his older opinions. The new policy sug- gested in that year was definitely announced at the opening of the session in the spring of 1881, and at the meeting of the new Reichstag in November 1881. It was explained in a speech from the throne, which, as the Emperor could not be present, became an imperial mes- sage. This is generally spoken of as the beginning of a new era. The help of the Reichstag was asked for " healing social evils by means of legislation . . . based on the moral foundation of Christianity." Compulsory insurance, the creation of corporate unions among work- ing men under the protection of the state, and the intro- duction of indirect taxes, were the chief elements in the reform.

The condition of parties was such that Bismarck could not hope to win a majority for his schemes, especially as he could not obtain the monopoly on tobacco on which he depended to cover the expense. The first reform was the restoration of the guilds, to which the Conservatives attached great importance. Since 1869 they continued to exist only as voluntary associations with no public duties; many had been dissolved, and this is said to have brought about bad results in the management of lodging-houses, the condition of apprentices, support dur- ing illness, and the maintenance of labour bureaus. It was supposed that, if they could be restored, the cor- porate spirit would prevent the working men from fall- ing under the influence of the Socialists. The law of 1881, while it left membership voluntary, gave to them many duties of a semi-public nature, especially that of arbitration between masters and men. These were extended by a further law in 1884.

The really important element was the scheme for a great imperial system by which all working men and women should be provided for in case of sick- Compul- ness, accident, or old age. Bismarck hoped by this to relieve

the parishes of the burden of the poor-rate, which would be transferred to the empire ; at the same time the power of the Government would be greatly extended. The first proposal in March 1881 was for compulsory insurance against accidents. Every one employed on railways, mines, and factories was to be insured in an imperial office; the premium was to be divided equally between masters, workmen, and the state. It was bitterly opposed by the Liberals, especially by Bamberger; all essential features were altered by the Reichstag, and it was withdrawn by the Government after it had passed the third reading.

In 1882 a fresh scheme was laid before the newly- elected Reichstag dealing with insurance against accident and against sickness. The two parts were separated by the Reichstag ; the second, which was the necessary prelude to the other, was passed in 1883. The law was based on an old Prussian principle : insurance was made com- pulsory, but the state, instead of doing the work it- self, recognized the existing friendly and other societies ; they were still to enjoy their corporate existence and separate administration, but they were placed under state control, and for this purpose an imperial insurance department was created in the office of the secretary of state for the interior. Uniform regulations were to be followed in all trades and districts ; one-third of the premium was paid by the employer, two-thirds by the workmen.

The Accident Law of 1883 was rejected, for it still

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included the state contribution to which the Reichstag would not assent, and also contributions from the work- men. A new law, drafted according to their wishes, was passed in 1884. It applied only to those occupa^ tions, mines and factories, in which the use of machinery was common ; it threw the whole burden of compensBr tion on to the masters ; but, on the other hand, for the first thirteen weeks after an accident the injured work- man received compensation from the sick fund, so that the cost only fell on the masters in the more serious cases. The masters were compelled to insure themselves against the payments for which they might become liable, and for this purpose had to form trade associa- tions, self- governing societies, which in each district included all the masters for

each particular trade. The application of this law was subsequently extended to other trades.

It was not till 1889 that the greatest innovation, that of insurance against old age, was carried. The obligation to insure rests on all who are in receipt of wages of not more than two pounds a week. Half the premium, which varies according to the wages received, is paid by the master. The pension begins at the age of seventy, the amount varying by very complicated rules, but the state pays 'a fixed sum of two pounds ten shillings annu- ally in addition to the pension.

These measures worked well. They were regarded with satisfaction by masters and men alike. Alterations have been made in detail, and further alterations demanded, but the laws have established themselves in practice. The large amount of self -administration has prevented an undue increase of bureaucratic power. The co-operation of masters and men in the administration of the societies has a good effect on the relations of the classes. The expense of administration is, however, considerable. The existence of the separate funds causes much waste of money and labour. The latest proposals are for simpli- fication by establishing a common administration of the sick funds and the old age pensions, and abolishing the separate administration of the different trade benefit societies. It is to be expected that as time goes on the administration will fall more completely into the hands of the state, and that the authority of the imperial insurance department will absorb the older societies.

So far had the social reform gone during this period ; except in the matter of insurance, the total result was small. The demands repeatedly made by the Centre and the Conservatives for effective factory legislation and prohibition of Sunday labour were not successful. Bismarck did not wish to lay heavier burdens on the capitalists, and it was not till a later period that they were carried out.

During all this period Bismarck's authority was so great, that in the conduct of foreign affairs he was freed from the criticism and opposition which so often hampered him in his internal policy, and he was able to establish that system of alliances on which for so many years the political

system of Europe depended. The close union of the three empires which had existed since the meeting of the Emperors in 1872 did not survive the out- break of disturbances in the East. Bismarck had maintained an attitude of neutrality, but amiS) after the Congress of Berlin he found himself the Triple placed between the alternatives of friendship ‘’”**??**”**?????** with Austria or Russia. Movements of Russian troops on the western frontier threatened Austria, and the Tsar, in a letter to the German Emperor, stated that peace could only be maintained if Germany gave her support to Russia. Bismarck, now that the choice was forced upon him, determined in favour of Austria, and during a visit to Vienna in October, arranged with Count Andrassy an*

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alliance by which in the event of either being attacked, by Russia the other was to assist ; if either were attacked by any Power other than Russia, the other was to preserve benevolent neutrality unless the attacking Power was helped by Russia. The effect of this was to protect Austria from attack by Russia, and Germany from the danger of a combined attack by France and Russia. Bismarck with some difficulty procured the consent of the Emperor, who by arranging a meeting with the Tsar had attempted to preserve the old friendship. From that time the alliance with Austria has continued. In 1883 it was joined by Italy, and was renewed in 1887, and in 1891 for six years, and if not then denounced, for twelve.

In 1882, after the retirement of Gortchakoff, the rela/- tions with Russia again improved. In 1884 there was a meeting of the three Emperors, and at the same time Bismarck came to a close understanding with France on colonial questions. The period of quiet did not last long. The disaster in Tongking brought about a change of ministry in France, and Bulgarian affairs again alienated Austria and Russia. Bismarck with great skill used the growing foreign complications as a means of freeing him- self from

parliamentary difficulties at the same time that he secured the position of Germany in Europe.

To meet the increase in the French army, and the open menaces in which the Russian press indulged, a further increase in the German army seemed desirable. The Septennate would expire in 1888. In the autumn of 1886 a proposal was laid before the Reichstag to increase the peace establishment for the next seven years to 468,409 men. The Reichstag would not assent to this, but the opposition parties offered to vote the required increase for three years. Bismarck refused to accept this compromise, and the Reichstag was dissolved. Under his influence the Conservatives and National Liberals formed a coalition or Cartel by which each

agreed to support the candidates of the other.

The elections caused greater excitement than

any which had taken place since 1870. The niimbers who went to the poll were much larger, and all the opposition parties, except the Catholics, including even the Socialists, suffered severe loss. Bismarck, in order to win the support of the Centre, appealed directly to the Pope, but Windthorst took the responsibility of refusing to obey the Pope's request on a matter purely political. The National Liberals again became a Govern- ment party, but their position was much changed. They were no longer, as in the old days, the leading factor. They had to take the second place. They were sub- ordinate to the Conservatives. They could no longer impose their will upon the Government. In the new parliament the Government proposals were accepted by a majority of 223 to 48 (seven members of the Centre voted for it, the others abstained). The opposition con- sisted chiefly of Socialists and Freisinnige.

The fall of Boulanger removed the immediate danger from France, but for the rest of the year the relations

with Rvissia caused serious apprehensions. Anti- Rei^io"^ German articles appeared in Russian news- Rassia. papers. The growth of the Nationalist party

in Russia led to measures injurious to German trade and German settlers in Russia. German vessels were forbidden to trade on the Niemen. The increase of the duties on iron injured German trade. Stringent measures were taken to stamp out German nationality in the Baltic provinces, similar to those used by the Germans against the Poles. Foreigners were forbidden to hold land in Russia. The German Government retaliated by a decree of the Reichsbank refusing to deal with Russian paper. Large accumulations of

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troops on the western frontier excited alarm in Germany and Austria. During a short visit paid by the Tsar to Berlin in November Bismarck discovered that forged despatches misrepresenting the policy of Germany in the Eastern Question had been communicated to the Tsar. This did not seem to remove all danger, and in February 1888 the Government introduced an amend- ment to the imperial Military law extending the (obli- gation for service from twelve to eighteen years. In this way it was possible to increase the war establish- ment, excluding the Landsturm, by about half a million men without adding to the burden ia time of peace. Another law authorized a loan of ►►14,000,000 for mili- tary equipment. At the same time the text of the Triple Alliance was published. The two laws were adopted without opposition. Under the effect of one of Bismarck's speeches, the Military Bill was unanimously passed almost without debate.

It was probably at the meeting of 1884 that a secret treaty, the existence of which was not known for many years, was arranged between Germany and secret Russia. The full text has never been pub- treaty lished, and the exact date is imcertain. Either ^'‘ state pledged itself to observe benevolent neu- " "►►► trality in case the other were attacked by a third Power. Apparently the case of an attack by France on Germany, or by Austria on Russia, was expressly mentioned. The treaty lapsed in 1890, and owing to Bismarck's dismissal was not renewed. Caprivi refused to renew it because it was doubtful whether by increasing the number of treaties the value of them was not diminished. Under this system it was to be apprehended that if war broke out between Austria and Russia, Austria*

would claim the support of Germany under the Triple Alliance, Russia neutrality under this treaty. The decision of Germany would theoretically have to depend on the question which party was the aggressor ❓❓❓ a question which notoriously is hardly ever capable of an answer. (For this treaty see the debate in the Reichstag of 16th November 1896; the Hamburger Nachrichten of 24th October in the same year ; and Schulthess, Europaisches Geschichts-kalendar, 1896.)

The Emperor William died on 9th March 1888. He was succeeded by his son, who took the title of Frederick III. In Italy, the older title of King of Pied- mont has been absorbed in the newer kingdom p^'fferttk of Italy ; this is not the case in Germany, ///. where the title German Emperor is merely attached to and not substituted for that of King of Prussia. The events of this short reign, which lasted only ninety-nine days, have chiefly a personal interest, and are narrated under the articles Feedeeick and Bismaeok. The illness and death of the Emperor, however, destroyed the last hope of the Liberals that they might at length succeed to power. For a generation they had waited for his accession, and bitter was their disappointipent, for it was known that his son was more inclined to follow the principles of Bismarck than those of his own father. The Emperor, crippled and dying though he was, showed clearly how great a change he would, had he lived, have introduced in the spirit of the Government. One of his first acts was severely to reprimand Puttkammer for mis- using Government influence at elections. The minister sent in his resignation, which was accepted, and this practice, which had been deliberately revived during the last ten years, was thereby publicly disavowed. Bis- marck's own position would naturally have been seriously affected by the fall of a colleague with whom he was closely connected, and another point of internal policy showed also how numerous were the differences between the chancellor and the Emperor. Laws had been passed

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William II.

prolonging the period of both the Prussian and Imperial parliaments from three to five years ; when they were laid before the Emperor for his signature he said that he must consider them. Bismarck then pointed out that the con- stitution of the empire did not authorize the Emperor to withhold his assent from a law which had passed both the Reichstag and the Bundesrath ; he could as king of Prussia oppose it by his representatives in the Council, but when it had been accepted there, it was his duty as Emperor to put the law into execution. The Emperor accepted this exposition of the constitution, and after some delay eventually gave his consent also to the Prussian law, which he was qualified to reject.

He was succeeded by his eldest son, William II. (q.vX The first year of the new reign was uneventful. In his public speeches the Emperor repeatedly expressed his

reverence for the memory of his grandfather,

and his determination to continue his policy ;

but he also repudiated the attempt of the extreme Conservatives to identify him with their party. He spent much time on journeys, visiting the chief courts of Europe, and he seemed to desire to preserve close friendship with other nations, especially with Russia and Great Britain. Changes were made in the higher posts of the army and civil service, and Moltke resigned the office of chief of the staff, which for thirty years he had held with such great distinction.

The beginning of the year 1890 brought a decisive event. The period of the Reichstag elected in 1887 ex- pired, and the new elections, the first for a quinquennial period, would take place. The chief matter for decision was the fate of the Socialist law ; this expired 30th September 1890. The Government at the end of 1889 introduced a new law, which was altered in some minor matters, and which was to be permanent. The Conserva- tives were prepared to vote for it; the Radicals and Centre opposed it ; the decision rested with the National Liberals, and they were willing to accept it on condition that the clause was omitted which allowed the state governments to exclude individuals from districts in

which the state of siege had been proclaimed. m'smarck ^^^ iaial division took place on 26th February

1890. An amendment had been carried omitting this clause, and the National Liberals therefore voted for the Bill in its amended form. The Conservatives were ready to vote as the Government wished; if Bismarck was content with the amended Bill, they would vote for it, and it would be carried; no instructions were sent to the party ; they therefore voted against the Bill, and it was lost. The House was immediately dissolved. It was to have been expected that, as in 1878, the Government would appeal to the country to return a Conservative majority willing to vote for a strong law against the Socialists. Instead of this, the Emperor, who was much interested in social reform, published two proclaitiations. In one addressed to the chancellor he declared his intention, as Emperor, of bettering the lot of the working classes ; for this purpose he proposed to call an international congress to consider the possi- bility of meeting the requirements and wishes of the working men ; in the other, which he issued as king of Prussia, he declared that the regulation of the time and conditions of labour was the duty of the state, and the Council of State was to be summoned to discuss this and kindred questions. Bismarck, who was less hopeful than the Emperor, and did not approve of this policy, was thereby prevented from influencing the elections as he would have wished to do; the coalition parties, in consequence, suffered severe loss ; Socialists, Centre, and Radicals gained numerous seats. A few days after the election Bismarck was dismissed from office. The differ-

ence of opinion between him and the Emperor was not confined to social reform; beyond this was the more serious question as to whether the chancellor or the Emperor was to direct the course of the Government. The Emperor, who, as Bismarck said, intended to be his own chancellor, required Bismarck to draw up a decree reversing a cabinet order of Frederick William IV., which gave the Prussian minister-president the right of being the sole means of communication between the other ministers and the king. This Bismarck refused to do, and he was therefore ordered to send in his resignation.

*Among those more immediately connected with the Government, his fall was accompanied by a feeling of relief which was not confined to the Opposition, for the burden of his rule had pressed heavily upon all. There was, however, no change in the principles of chaacei- Government or avowed change in policy ; some lorship of uncertainty of direction and sudden oscillations Count voa of policy showed the presence of a less experi- *'^'"""- enced hand. Bismarck's successor. General von Caprivi, held a similar combination of offices, but the chief control passed now into the hands of the Emperor himself. He aspired by his own will to direct the policy of the state ; he put aside the reserve which in modern times is gen- erally observed even by absolute rulers, and by his public speeches and personal influence took a part in political controversy. He made very evident the monarchical character of the Prussian state, and gave to the office of emperor a prominence greater than it had hitherto had.*

One result of this was that it became increasingly difficult in political discussions to avoid criticizing the words and actions of the Emperor. Prosecutions for Use-majesti became commoner than they were in former reigns, and the difficulty was much felt in the conduct of parliamentary debate. The rule adopted was that discussion was permitted on those speeches of the Emperor which were officially published in the Reiclis- ameiger. It was, indeed, not easy to combine that respect and reverence which the Emperor required should be paid to him, with that open criticism of his words which seemed necessary (even for self-defence) when the monarch condescended to become the censor of the opin- ions and actions of large parties and classes among his subjects. The attempt to combine personal government with representative institutions was one of much interest ; it was more successful than might have been anticipated, owing to the disorganization of political parties and the absence of great political leaders ; in Germany, as else- where, the parliaments had not succeeded in maintain- ing public interest, and it is worth noting that even the attendance of members was very irregular. There was below the surface much discontent and subdued criticism of the exaggeration of the monarchical power, which the Germans called Byzantinismus ; but after all the nation seemed to welcome the government of the Emperor, as it did that of Bismarck. The uneasiness

which was caused at first by the unwonted vigour of his utterances subsided, as it became ai)parent how strong was his influence for peace, and with how many-sided an activity he supported and encouraged every side of national life. Another result of the personal government by the Emperor was that it was impossible, in dealing with recent history, to determine liow far the ministers of state were really responsible for the measures which they defended, and how far they were the instruments and mouthpieces of the policy of the Emperor.

The first efforts of the " New course," as the new ad- ministration was termed, showed some attempt to recon- cile to the Government those parties and persons whom Bismarck had kept in opposition. The continuation

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of social reform was to ??? win over the allegiance of the working men to the person of the Emperor ; an attempt was made to reconcile the Guelphs, and even the Poles were taken into favour ; Windthorst was treated with marked distinction. The Radicals alone, owing to their ill-timed criticism on the private rela- tions of the imperial family and their continued opposi- tion to the army, were excluded. The attempt, however, to unite and please all parties failed, as did the similar attempt in foreign policy. Naturally enough, it was social reform on which at first activity was concen- trated, and the long-delayed factory legislation was now carried out. In 1887 and 1888 the Clerical and Conservative majority had carried through the Reichstag laws restricting the employment of women and children and prohibiting labour on Sundays. These were not accepted by the Bundesrath, but after the International Congress of 1890 an import- ant amendment and addition to the Gewerbeordnung was carried to this effect. It was of even greater importance that a full system of factory inspection was created. A further provision empowered the

Bundesrath to fix the hours of labour in unhealthy trades ; this was applied to the bakeries by an edict of 1895, but the great outcry which this caused prevented any further extension.

These acts were, however, accompanied by language of great decision against the Social Democrats, especially on the occasion of a great strike in Westphalia, when the Emperor warned the men that for him every Social Demo- crat was an enemy to the empire and country. None the less, all attempts to win the working men from the doctrinaire Socialists failed. They continued to look on the whole machinery of government, emperor and army, church and police, as their natural enemies, and remained completely under the bondage of the abstract theories of the Socialists, just as much as fifty years ago the German bourgeois were controlled by the Liberal theories. It is strange to see how the national characteristics appeared in them. What began as a great revolutionary movement became a dogmatic and academic school of thought; it often almost seemed as though Progress the orthodox interpretation of Marx's doctrine Ism ""^ ' were of more importance ~~than an improvement in the condition of the working men, and the discussions in the annual Socialist Congress resembled the arguments of theologians rather than the practical considerations of politicians. The party, however, pros~~ pered and grew in strength beyond all anticipation. The repeal of the Socialist law was naturally welcome to them as a great personal triumph over Bismarck ; in the elections of 1890 they won thirty-five, in 1893 forty-four, in 1898 fifty-six seats. Their influence was not confined to the artizans ; among their open or secret adherents were to be found large numbers of Government employes and clerks. In the autumn of 1890 they were able, for the first time, to hold in Germany a general meeting of delegates, which has been continued annually. In the first meetings it appeared that there were strong oppos- ing tendencies within the party which for the first time could be brought to public discussion. On the one side there was a small party, die Jungen, in Berlin, who attacked the parliamentary leaders on the ground that they had lent themselves to compromise and had not main- tained the old intransigeant spirit. In 1891, at Erfurt, Werner and his followers were expelled from the party ; some of them drifted into anarchism, others disappeared. On the other hand, there was a large section, the leader of whom was Herr von

Vollmar, who maintained that the social revolution would not coma suddenly, as Bebel and the older leaders had taught, but that it would

be a gradual evolution ; they were willing to co-operate with the Government in remedial measures by which, within the existing social order, the prosperity and freedom of the working classes might be advanced ; their position was very strong, as Vollmar had succeeded in extending Socialism even in the Catholic parts of Bavaria. An attempt to treat them as not genuine Socialists was frus- trated, and they continued in co-operation with the other branch of the party. Their position would be easier were it not for the repeated attempts of the Prussian Govern- ment to crush the party by fresh legislation and the supervision exercised by the police. It was a sign of most serious import for the future that in 1897 the electoral law in the kingdom of Saxony was altered with the express purpose of excluding the Socialists from the Saxon Landtag. This and other symptoms caused serious apprehension that some attempt might be made to alter the law of universal suffrage for the Reichstag, and it was policy of this kind which maintained and justified the profound distrust of the governing classes and the class hatred on which Social Democracy depends. On the other hand, there were signs of a greater willingness among the Socialists to co-operate with their old enemies the Liberals in opposition to the commercial policy of the Government, and every step is welcomed which will break down the intellectual isolation in which the work- ing classes are kept.

In foreign affairs a good understanding with Great Britain was maintained, but the Emperor failed at that time to preserve the friendship of Russia. The close under- standing between France and Russia, and the constant increase in the armies of these states, made a still further increase of the German army desirable. In 1890, while the Septennate had still three more years to run, Caprivi had to ask for an additional 20,000 men. It was the first time that an increase of this kind gi^jo ??? had been necessary within the regular period. When, in 1893, the proposals for the new period were made, they formed a great change. Universal service was to be made a reality ; no one except those absolutely unfit were to escape military service. To make enlistment of so large an additional number of recruits possible, the period of service with the

colours was reduced to two years. The parliamentary discussion was very confused; the Government eventually accepted an amendment giving them 657,093 for five and a half years instead of the 670,877 asked for ; this was rejected by 210 to 162, the greater part of the Centre and of the Ereisinnige voting against it. Parliament was at once dissolved. Before the elections the Ereisinnige party broke up, as about twenty of them determined to accept the compromise. They took the name of the Freisinnige Yereinigung, the others who remained under the leadership of Richter forming the Freisinnige Volkspartei. The natural result of this split was a great loss to the party. The Liberal opposi- tioh secured only twenty-three seats instead of the sixty- seven they had held before. It was, so far as now can be foreseen, the final collapse of the old Radical party. Notwithstanding this the Bill was only carried by six- teen votes, and it would have been thrown out again had not the Poles for the first time voted for the Government, since the whole of the Centre voted in opposition.

This vote was a ~~sign of the increasing disorganization of parties and of growing parliamentary difficulties which were even more apparent in the Prussian Landtag. Miquel, as minister of finance, succeeded indeed in carrying a reform, by which the proceeds of the tax on land and buildings were transferred to the local govern~~ ment authorities, and the loss to the state exchequer made up by increased taxation of larger incomes and

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industry. The series of measures which began in 1891, and "were completed in 1895, won a more general approba- tion than is usual, and Miquel in this successfully car- ried out his policy of reconciling the growing jealousies arising from class interests.

A School Bill for Prussia was less successful, and aroused conflicts of principle, which afterwards divided the coun- try. It is remarkable that up to this time there is no general law existing in Prussia regulating the

manage- ment of the elementary schools. In every province there are different rules as to the age at which attendance is compulsory, as to school management, the regulation of religious education, and the relation of the Church to the

schools. A clause in the Constitution states proposal". ^^ these matters are to be regulated by law,

but no law has yet (1902) been carried. In November 1890 a general law was introduced, but it was opposed by the Centre on the ground that it would ad- versely affect the religious teaching, and Gossler, minister of education, had to resign ; he was succeeded by Count Zedlitz, who, in 1892, introduced a new law so drawn up as greatly to strengthen the influence of the Church. This led to a violent agitation ; all the Liberal parties joined in opposing it ; the agitation spread to the learned classes, and the cry was raised that culture and learning were being handed over to the priests. Caprivi defended the law as part of the great struggle between Christianity and Atheism, but the Ministry was nearly equally divided ; the Emperor was dissatisfied with the manner in which it had been introduced, and on 16th March the law was withdrawn. The next day Zedlitz resigned ; Caprivi also sent in his resignation, but, at the special request of the Emperor, continued in of&ce as chancellor ; he was succeeded by Count Eulenburg as president of the Prussian ministry.

Caprivi's administration was further remarkable for the arrangement of commercial treaties. In 1892 treaties with Austria-Hungary, Italy, Belgium, and Switzerland for twelve years bound together the greater part of the

Continent, and opened a wide market for G-er- Com- man manufactures ; the idea of this policy was

to secure, by a more permanent union of the

middle European states, a stable market for the goods which were being excluded owing to the great growth of Protection in Prance, Russia, and America. These were followed by similar treaties with Rumania and Servia, and in 1894, after a period of sharp customs warfa,re, with

Russia. In all these treaties the general principle was a reduction of the import duties on corn in return for advantages given to German manufactures, and it is this which brought about the struggle of the Government with the Agrarians, which after 1894 took the first place in party politics.

The agricultural interests in Germany had during the middle of the 19th century been in favour of Free Trade. The reason of this was that, till some years after the foundation of the empire, the production of corn and food- stuffs was more than sufficient for the population; as long as they exported corn, potatoes, and cattle, they required no protection from foreign competition, and they enjoyed the advantages of being able to purchase colonial goods and manufactured articles cheaply. Mecklenburg and

Hanover, the purely agricultural states, had. Agrarians, j^j^]^ their entrance into the Customs Union, followed a completely Free Trade policy. The first union of the Agrarian party, which was formed in 1876 under the name of the Society for the Reform of Taxa- tion, did not place protection on their programme ; they laid stress on bi-metallism, on the reform of internal taxation, especially of the tax on land and buildings, and on the reform of the railway tariff, and demanded an

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increase in the stamp duties. These three last points were all to some extent attained. About this time, however, the introduction of cheap corn from Russia began to threaten them, and it was in 1879 that, prob- ably to a great extent influenced by Bismarck, they are first to be found among those who ask for pro- tection.

After that time there was a great increase in the importation of foodstuffs from America. The increase of manufactures and the rapid growth of the popula- tion made the introduction of cheap food from abroad a necessity. In the youth of the empire the amount of corn grown in Germany was sufficient for the needs of its inhabitants ; the amount consumed in 1899 exceeded the amount produced by about one quarter of the total. At the same time the price, making allowance for the fluctuations owing to bad

harvests, steadily decreased, notwithstanding the duty on corn. In twenty years the average price fell from about 235 to 135 marks the 1000 kilo. There was therefore a constant decrease in the income from land, and this took place at a time when the great growth of wealth among the industrial classes had made living more costly. The agriculturists of the north and east saw themselves and their class threatened with loss, and perhaps ruin ; their discontent, which had long been growing, broke out into open fire during the discussion of the commercial treaties. As these would inevitably bring about a large increase in the importation of corn from Rumania and Russia, a great agitation was begun in agricultural circles, and the whole influence of the Conservative party was opposed to the treaties. This brought about a curious situation, the measures being only caxried by the sup- port of the Centre, the Radicals, and the Socialists, against the violent opposition of those classes, especially the landowners in Prussia, who had hitherto been the supporters of the Government. In order to prevent the commercial treaty with Russia, a great agricultural league was founded in 1893, the Bund der Landidrthe ; some 7000 landowners joined it immediately. Two days later the Peasants' Leag^ue, or Deutsche Bauemhund, which had been founded in 1885 and included some 44,000 members, chiefly from the smaller proprietors in Pomerania, Posen, Saxony, and Thuringia, merged itself in the new league. This afterwards gained very great proportions. It became, with the Social Demo- crats, the most influential society which had been founded in Germany for defending the interests of a particular class ; it soon numbered more than 200,000 members, including landed proprietors of all degrees. Under its influence a parliamentary union, the Wirth- schaftsvereinigung, was founded to ensure proper consid- eration for agricultural affairs; it was joined by more than 100 members of the Reichstag ; and the Conser- vative party fell more and more under the influence of the Agrarians.

Having failed to prevent the commercial treaties, Count Kanitz introduced a motion that the state should have a monopoly of all imported corn, and that the price at -which it was to be sold should be fixed by law. On the first occasion, in 1894, only fifty members "were found to vote for this, but in the next year ninety-seven sup- ported the introduction of the motion, and it was con- sidered worth while to call together the Prussian

Council of State for a special discussion. The whole agitation was extremely inconvenient to the Government. The violence with which it was conducted, coming, as it did, from the highest circles of the Prussian nobility, appeared almost an imitation of Socialist methods ; but the Em- peror, with his wonted energy, personally rebuked the leaders, and warned them that the opposition of Prussian

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nobles to their king was a monstrosity. Nevertheless they were able to overthrow the chancellor, who was specially obnoxious to them. In October 1894 he was dismissed suddenly, without warning, and almost without cause, while the Emperor was on a visit to the Eulenburgs, one of the most influ- ential families of the Prussian nobility.

Caprivi's fall, though it was occasioned by a difference between him and Count Eulenburg, and was due to the direct act of the Emperor, was rendered easier by the weakness of his parliamentary position. There was no party on whose help he could really depend. The Mili- tary Bill had offended the prejudices of conservative military critics ; the British treaty had alienated the colonial party; the commercial treaties had only been carried by the help of Poles, Radicals, and Socialists ; but it was just these parties who were the most easily offended by the general tendencies of the internal legislar tion, as shown in the Prussian School Bill. Moreover, the bitter and unscrupulous attacks of the Bismarckian press to which Caprivi was exposed made him unpopular in the country, for the people could not feel at ease so long as they were governed by a minister of whom Bis- marck disapproved. There was therefore no prospect of forming anything like a stable coalition of parties on which he could depend.

*The Emperor was fortunate in securing as his suc- cessor Prince Chlodwig von Hohenlohe. Though the new chancellor once more united with this office that of Prussian minister-president, his age, and perhaps also his character, prevented him from exercising Chancellor that Constant activity and vigilance which his Hobenkihe. *^ ?? predecessors had displayed. During his administration even the secretary of state for foreign affairs, Baron Marschall von Bieberstein, and afterwards Count von Billow, became the ordinary spokesman of the Government, and in the management of other departments the want of a strong hand at the head of affairs was often missed. Between the Emperor, with whom the final direction of policy rested, and his subordinates, the chancellor often appeared to evade public notice. The very first act of the new chancellor brought upon him a severe rebuff. At the opening of the new buildings which had been erected in Berlin for the Reichstag, cheers were called for the Emperor. Some of the Socialist members remained seated. It was not clear that their action was deliberate, but none the less the chancellor himself came down to ask from the House per- mission to bring a charge of Use-majest& against them, a request which was, of course, almost unanimously refused.*

The Agrarians still maintained their prominent posi- tion in Prussia. They opposed all Bills which would appear directly or indirectly to injure agricultural in- terests. They looked with suspicion on the naval policy of the Emperor, for they disliked all that helps industry and commerce. They would only give their support to the Navy Bills of 1897 and 1900 in return for large concessions limiting the importation of margarine and American preserved meat, and the removal of the Indemnitats Nachweis acted as a kind of bounty on the export of corn. They successfully opposed the construc- tion of a canal from Westphalia to the Elbe, on the ground that it would facilitate the importation of foreign corn. They refused to accept all the compromises which Miquel, who was very sympathetic towards them, suggested, and thereby brought about his retirement in May 1901.

The opposition of the Agrarians was for many reasons peculiarly embarrassing. The franchise by which the

Prussian parliament is elected gave the Conservatives whom they controlled a predominant position. Any alteration of the franchise was, however, out of the question, for that would admit the Socialists. It was, moreover, the tradition of the Prussian court and the Prussian Government (and it must be remembered that the Imperial Government is inspired by Prussian tradi- tions) that the nobility and peasants were in a jjeculiar way the support of the Crown and the State. The old distrust of the towns, of manufacturers and artizans, still continued. The preservation of a peasant class was considered necessary in the interests of the army. Be- sides, intellectual and social prejudices required a strong Conservative party. In the south and west of Germany, however, the Conservative party was practically non- existent. In these parts, owing to the changes intro- duced at the revolution, the nobility, who hold little land, are, comparatively speaking, without political importance. In the Catholic districts the Centre had become absolutely master, except so far as the Socialists threaten their position. Those of the great industrialists who belonged to the National Liberals or the Moderate Conservatives did not command that influence which men of their class generally hold in Great Britain, because the influence of Social Democracy banded to- gether the whole of the working men in a solid phalanx of irreconcilable opposition, the very first principle of which was the hostility of classes. The Government, therefore, were compelled to turn for support to the Centre and the Conservatives, the latter being almost completely under the influence of the old Prussian nobility from the northeast. But every attempt to carry out the policy supported by these parties aroused an opposition most embarrassing to the Government.

The Conservatives distrusted the financial activity which centred round the Exchanges of Berlin and other towns, and in this they had the sympathy of Agrarians and Anti-Semites, as well as of the Centre. The Agrarians believed that the Berlin Exchange was partly responsible for the fall of prices in corn ; the Exchange Anti-Semites laid stress on the fact that many J'j;' of the financiers were of Jewish extraction ; the Centre feared the moral effects of speculation. This opposition was shown in the demand for additional duties on stamps (this was granted by Bismarck), in the opposi- tion to the renewal of the Bank Charter, and especially in the new regulations for the Exchange which were carried in

1896. One clause in this forbade the dealing in " fu- tures " in corn, and at the same time a special Prussian law required that there should be representatives of agri- culture on the managing committee of the Exchange. The members of the Exchanges in Berlin and other towns re- fused to accept this law. When it came into effect they withdrew and tried to establish a private Exchange. This was prevented, and after two years they were compelled to submit and the Berlin Bourse was again opened.

Political parties now came to represent interests rather than principles. The Government, in order to pass its measures, was obliged to purchase the votes by class legislation, and it bought those with whom j"–" ‘ it can make the best bargain ??? these being ing. generally the Centre, as the ablest tacticians, and the Conservatives, as having the highest social position and being boldest in declaring their demands. No great parliamentary leader took the place of Windt- horst, Lasker, and Bennigsen; the extrarparliamentary societies, less responsible and more violent, grew in influence. The Anti-Semites gatued in numbers, though not in reputation. The Conservatives, hoping to win votes, even adopted an anti-Semite clause in their pro- gramme. The general tendency among the numerous

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societies of Christian Socialism, which broke up almost as quickly as they appeared, was to drift from the alliance with the ultra-Conservatives and to adopt the economic and many of the political doctrines of the Social Democrats. The National-Socialer Verein defended the union of Monarchy and Socialism. Meanwhile the ex- treme spirit of nationality was fostered by the AllrdeutscJier Verein, the policy of which would quickly involve Ger- many in war with every other nation. More than once the feelings to which they gave expression endangered the relations of Germany and Austria-Hungary. The persecution of the Poles in

Prussia naturally aroused indignation in Austria, where the Poles had for long been among the strongest elements on which the Government depended ; and it was not always easy to prevent the agitation on behalf of the Germans in Bohemia from assuming a dangerous aspect.

In the disintegration of parties the Liberals suffered most. The unity of the Conservatives was preserved by social forces and the interests of agriculture; the decay of the Liberals was the result of universal suffrage. Originally the opponents of the landed interest and the nobility, they were the party of the educated middle class, of the learned, of the officials, and finance. They never succeeded in winning the support of the working men. They had identified them- selves with the interests of the capitalists, and were not even faithful to their own principles. In the day of their power they showed themselves as intolerant as their opponents had been. They resorted to the help of the Government in order to stamp out the opinions with which they disagreed, and the claims of the artizans to practical equality were rejected by them, as in earlier days the claims of the middle class had been by the nobles.

The Centre alone maintained itself. Obliged by their constitution to regard equally the material interests of all classes ??? for they represent rich and poor, peasants and artizans ??? they were the natural support of the Government when it attempted to find a compromise between the clamour of opposing interests. Their own demands were generally limited to the defence of order and religion, and to some extent coincided with the wishes of the Emperor ; but, as we shall see, every attempt to introduce legislation in accordance with their wishes led to a conflict with the educated opinion of the countrj', which was very detrimental to the authority of the Government. In the state parliaments of Bavaria, Baden, and Hesse their influence was very great. There was, moreover, a tendency for local parties to gain in numbers and influence ??? the Volkspartei in Wiirtemberg, the Anti-Semites in Hesse, and the Bauernbund (Peasants' League) in Bavaria. The last demanded that the peasants should be freed from the payment to the state, which represented the purchase price for the remission of feudal burdens. It soon lost ground, however, partly owing to personal reasons, and partly

because the Centre in order to maintain their influence among the peasants adopted some features of their programme.

Another class which, seeing itself in danger from the economic changes in society, agitated for special legis- lation was the small retail traders of the large towns. They demanded additional taxation on the vast shops and stores, the growth of which in Berlin, Munich, and other towns seemed to threaten their interests. As the preservation of the smaller middle class seemed to be important as a bulwark against Socialism, they won the support of the Conservative and Clerical parties, and laws inspired by them were passed in Bavaria, Wiirtemberg, and Prussia. This Mittelstand-politik, as it is called, was very char-

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acteristic of the attitude of mind which was produced by the policy of Protection. Every class appealed to the Government for special laws to protect itself against the effects of the economic changes which had been brought about by the modern industrial system. Peasants and landlords, artizans and tradesmen, each formed their own league for the protection of their interests, and all looked to the state as the proper guardian of their class interests.

After the fall of Caprivi the tendency of the German Government to revert to a strong Conservative policy in matters of religion, education, and in the treatment of political discussions became very ""i^gj^l"/ marked. The complete alienation of the work- poncy. ing classes from Christianity caused much natural concern, combined as it was with that indifference to religion which marks the life of the educated classes in the large towns, and especially in Berlin. A strong feeling arose that social and political dangers could only be avoided by an increase in religious life, and the Emperor gave the authority of his name to a movement which produced numerous societies for home mission work, and (at least in Berlin) led to the erection of numerous churches. Unfortunately, this movement was too often connected with political reaction, and the working classes were inclined to believe that the growth of religion was valued because it afforded an additional support to the social and political order. The situation was somewhat similar to that which existed during the last years

of Erederick William IV., when the close association of religion with a Conservative policy made orthodoxy so distasteful to large sections of society. The Government, which had not taken warning by the fate of the School Bill, attempted to carry other measures of the same kind. The Emperor had returned to Bismarck's policy, of joining social reform with repressive legislation. In a speech at Konigsberg in November 1894, he summoned the nobles of Prussia to support him in the struggle for religion, for morality, for order, against the parties of Umstin-z, or Revolution, and shortly afterwards an amendment of the Criminal Code, commonly called the Umsturz Vorlage, was introduced, containing provisions to check voriag" attempts to undermine the loyalty of the soldiers, and making it a crime punishable with three years' imprisonment to attack religion, monarchy, marriage, the family, or property by abusive expressions in such a manner as to endanger public peace. The discussion of this measure occupied most of the session of 1895 ; the Bill was amended by the Centre so as to make it even more strongly a measure for the defence of religion; and clauses were introduced to defend public morality, by forbidding the public exhibition of pictures or statues, or the sale of writings, which, " without being actually obscene, might rudely offend the feeling of modesty." These Clerical amendments aroused a strong feeling of indignation. It was represented that the free- dom of art and literature was being endangered, and the Government was obliged to withdraw the Bill. The ten- dency towards a stricter censorship was shown by a pro- posal which was carried through the Prussian parliament for controlling the instruction given at the universities by the I 'rivatdocenten. Some of the Conservative leaders, especially Baron von Stunim, the great manufacturer (one of Bismarck's chief advisers on industrial matters), demanded protection against the teaching of some of the professors with whose economic doctrines they did not agree ; pastors who took part in the Christian-Social movement incurred the displeasure of the Government; and Professor Delbrtlck was summoned before a dis- ciplinary court because, in the Preussische JahiinicJwr,

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which he edited, he had ventured to criticize the policy of the Prussian Government towards the Danes in Schleswig. All the discontent and suspicion caused by this policy broke out with greater intensity when a fresh attempt was made in 1900 to carry those clauses of the old Umsturz Vorlage which dealt with offences against public morality. The gross immoralities connected with prostitution in Berlin had been disclosed in the case of a murderer called Heinze in 1891 ; and a Bill to strengthen the criminal law on the subject was introduced but not carried. The measure continued, however, to be discussed, and in 1900 the Government proposed to incorporate with this Bill (which was known as the Lex Heinze) the articles from the Umsturz Vorlage subjecting art and literature to the control of the criminal law and police. The agitation was renewed with great energy. A Ooethe Verein was founded to protect Kultur, which seemed to be in danger. In the end the obnoxious clauses were only withdrawn when the Socialists used the forms of the House to prevent business from being transacted. It was the first time that organized obstruc- tion had appeared in the Reichstag, and it was part of the irony of the situation that the representatives of art and learning owed their victory to the Socialists, whom they had so long attacked as the great enemies of modern civilization.

These were not the only cases in which the influence of the parties of reaction caused much discontent. There was the question of the right of combination. mmbina- ” nearly every state there still existed old tion. laws forbidding political societies to unite with

one another. These laws had been passed in the years immediately after the revolution of 1.848, and were quite out of place under modern conditions. The object of them was to prevent a network of societies from being formed extending over large districts, and so acquiring political power. In 1895 the Prussian police used a law of 1850 as a pretext for dissolving the Social- ist organization in Berlin, as had been done twenty years before. A large majority of the Reichstag demanded that an imperial

~~law should be passed repealing these laws, and establishing the right of combination, and they refused to pass the revised Civil Code until the chancellor promised that this should be done. Instead of this course being adopted, however, special laws were intro~~ duced in most of the states, which, especially in Prussia and Saxony, while they gave the right of combination, increased the power of the police to forbid assemblies and societies. It was apparent that large and influential parties still regarded political meetings as something in themselves dangerous and demoralizing, and hence the demand of the Conservatives that women and young persons should be forbidden to attend. In Prussia a majority of the Upper House and a very large minority of the Lower House (193 to 206) voted for an amendment expressly empowering the police to break up meetings in which anarchistic, socialistic, or communistic doc- trines were defended in such a manner as to be dangerous to society ; the Saxon Conservatives demanded that women at least should be forbidden to attend socialistic meetings, and it remained illegal for any one under twenty- one years of age to be present at a political meeting. In consequence of the amendments in the Upper House the Prussian law was lost ; and at last, in 1899, a short imperial law was carried to the effect that " societies of every kind might enter into union with one another." This was at once accepted by the chancellor ; it was the time when the Navy Bill was coming on, and it was necessary to win votes. The general feeling of distrust which this prolonged controversy aroused was, however, shown by the almost contemptuous rejection in 1899 of

a Bill to protect artizans who were willing to work against intimidation or violence (the Zuchthaus Vorlage), a vote which was the more significant as it was not so much occasioned by the actual provisions of the Bill, but was an expression of the distrust felt for the motives by which the Government was moved and the reluctance to place any further powers in their hands.

In these cases the Government depended on the support of the Conservatives and Clericals, assisted sometimes by a few National Liberals. This combination of the Conservatives, moved by political and ‘“grease ot economic motives, and the Clericals, who wished autocracy. to defend religion and morality, with the Prussian Government, inspired by

its traditional aversion from liberty, introduced into the political situation a line of cleavage which cut across the grouping of parties on commercial questions. The result was an attempt to check by legislation the action of those moral and intel- lectual forces which were embodied partly in the Radical but chiefly in the Socialist party ??? forces which threatened to undermine the authority of Crown and Church, but were vital to the whole intellectual growth of the country. The learned classes still count for much in German life, and it is dangerous to revive that kind of intellectual discontent which prevailed when, in the 'seventies, the Governments were trying in the same way to crush the rising power of Liberalism. A generation earlier, modern thought attempted to use the whole power of the State so as to mould even the teaching of the Church ; now there seemed some danger of an alliance with the Church against modern thought. Politically the power of the Church depends on universal suffrage, and so it came about more than once that an agitation among the intellectual classes was necessary in order to defeat measures inimical to liberty which secured a majority in a parliament elected by universal suffrage. There is no doubt that the restrictive policy of the Government caused much intellectual discontent. When the official teaching is that the maintenance of order and society requires restrictions on thought, and even criminal laws which are repugnant to the general feeling of the community, a moral scepticism is produced which makes a nation restless. The forces of reaction were stronger in Prussia and Saxony than in the south of Germany ; and this undoubtedly strengthened the position of the southern states, for it enabled them to appear to some extent as defenders of liberty. There was therefore some increase in particularism, which during Bismarck's government nearly disappeared, and this was helped by the suspicion with which the great personal activity of the Emperor was regarded. Altogether, a good deal of disappointment and dissatisfaction existed with the management of internal affairs. Between the disintegra- tion of parliamentary parties, the growth of Socialists and Catholics, and the increasing number of small groups, a contrast was inevitable with the state of things during the first years of the empire, when there was a strong party guiding national thought and able by the capacity of its leaders to check and assist the Government. The result, however, was, while diminishing the interest in parliamentary debate, to make the nation look with in- creased interest

and satisfaction at the great advances made in practical affairs ??? commerce and industry, engineering and shipping.

The Emperor set himself the task of doing for the German fleet what his grandfather had done for the army. The acquisition of Heligoland enabled a new naval station to be established off the mouth of the Elbe; the completion of the canal from Kiel to the mouth of the Elbe ??? an old plan of Bismarck's which was begun in 1887 and completed in 1896 ??? by enabling

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sMps of war to pass from the Baltic to the North Sea greatly increased the strategic strength of the fleet. In 1890 a change in the organization separated the command of the fleet from the office of secretary of state, who was responsible for the representation of the Admiralty in the Reichstag, and the Emperor was brought into more direct connexion with the navy. During the first five years of the reign four line-of-battle ships were added and several armoured cruisers for the defence of commerce and colonial interests. With the year 1896 began a period of expansion abroad and great naval activity. The note was given in a speech of the Emperor's on the twenty-fifth anniversary of the foundation of the empire, in which he said, " the German empire has become a world empire." The ruling idea of this new Welt-Politik was that Germany could no longer remain merely a Continental power ; owing to the growth of population she depended for subsistence on trade and exports ; she could not maintain herself amid the rivalry of nations unless the Government was able actively to support German traders in all parts of the world. The extension of German trade and influence has, in fact, been carried out with considerable success. There was no prospect of further territory in

Equatorial Africa, and the hopes of bringing about a closer union with the South African Republic were not fulfilled. On the Pacific, however, there were great gains ; long-established plans for obtaining a port in China which might serve as a base for the growing trade at Tientsin were carried out at the end of 1897 ; the murder of two Catholic mis- sionaries was made the pretext for landing The troops in the bay of Kiao-chow ; and in amends

China granted t]je lease of some fifty square miles of territory, and also a concession for building railways. The Emperor showed his strong per- sonal interest by sending his brother. Prince Henry, in command of a squadron to take possession of this ter- ritory, and the visit of a German prince to the Emperor of China strongly appealed to the popular imagination. The Emperor's characteristically rhetorical speeches on this occasion ___ particularly his identification of his brother with the "mailed fist" of Germany ___ excited considerable comment. In Turkey the Government, helped again by the personal interest of the Emperor, who himself visited the Sultan at Constantinople, gained important conces- sions for German influence and German commerce. The Turkish armies were drilled and commanded by German officers, and in 1899 a German firm gained an important concession for building a railway to Baghdad. In Brazil organized private enterprise established a considerable settlement of German emigrants, and though any political power was for the time impossible, German commerce increased greatly throughout South America.

Encouraged by the interest which the events in China had aroused, a very important project was laid before the Reichstag in November 1897, which would enable Germany to take a higher place among the maritime Powers. A completely new procedure was introduced. Instead of simply proposing to build a number of new ships, the Bill laid down permanently the Navaipro- number of ships of every kind of which the /S9___'"' navy was to consist. They were to be com- pleted by 1904 ; and the Bill also specified how often ships of each class were to be replaced. The plan would establish a normal fleet, and the Reichstag, having once assented, would lose all power of controlling the naval budget. The Bill was strongly opposed by the Radicals ; the Centre was divided ; but the very*

strong personal influence of the Emperor, supported by an agitation of the newly-formed Flatten Verein (an imitation of the English Navy League), so influenced public

opinion that the opposition broke down. A general election was imminent, and no party dared to go to the country as the opponents of the fleet.

Scarcely had the Bill been carried when a series of events took place which still more fully turned public attention to colonial affairs, and seemed to justify the action of the Government. The war between the United States and Spain showed how necessary an efficient fleet was under modern conditions, and also caused some feeling of apprehension for the future arising from the new policy of extension adopted by the United States. The Government was, however, enabled to acquire by purchase the Caroline Islands from Spain. This was hardly accomplished when events in South Africa occurred which made the nation regret that their fleet was not sufficiently strong to cope with that of Great Britain. The Government used with great address the bitter irritation against Great Britain which had become one of the most deep-seated elements in modern German life. This feeling had its origin at ^bobii first in a natural reaction against the excessive admiration for English institutions which distinguished the Liberals of an older generation. This reaction was deliberately fostered during Bismarck's later years for internal reasons ; for, as Great Britain was looked upon as the home of parliamentary government and Free Trade, a less favourable view might weaken German belief in doctrines and institutions adopted from that country. There also existed in Germany a curious com- pound of jealousy and contempt, natural in a nation the whole institutions of which centred round the army and compulsory service, for a nation whose institutions were based not on military, but on parliamentary and legal institutions. It came about that in the minds of many Germans the whole national regeneration was regarded as a liberation from British influence. This feeling was deliberately fostered by publicists and his- torians, and was intensified by commercial rivalry, since in the struggle for colonial expansion and trade Germans naturally came to look on Great Britain, who held the field, as their rival. The sympathy which the events of 1896 and 1899 awakened for the Boers Pro-Boer caused all these feelings,

which had long been ment' growing, to break out in a popular agitation more widespread than any since the foundation of the empire. It was used by the Nationalist parties, in Austria as well as in Germany, to spread the conception of Pan-Germanism ; the Boers as Low Germans were re-garded as the representatives of Teutonic civilization, and it seemed possible that the conception might be used to bring about a closer friendship, and even alliance, with Holland. In 1896 the Emperor, by despatching a telegram of congratulation to President Kruger after the collapse of the Jameson Raid, had appeared to identify himself with the national feeling. When war broke out in 1899 it was obviously impossible to give any efficient help to the Boers, but the Government used the oppor- tunity to make an advantageous treaty by which the possession of Samoa was transferred to Germany, and did not allow the moment to pass without using it for the very practical purpose of getting another J ^"" Bill through the Reichstag by which the navy was to be nearly doubled. Some difficulties which arose regarding the exercise by the British Government of the right of search for contraband of war were also used to stimulate public feeling. The Navy Bill was introduced in January 1900. There were some criticisms of detail, but the passing of the Bill was only a matter of bargain- ing. Each party wished in return for its support to get some concessions from the Government. The Agrarians asked for restrictions on the importation of food; the

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Centre for the Lex Heinze and the repeal of the Jesuit law ; the Liberals for the right of combination.

The murder of the German ambassador, Baron von Ketteler, at Peking in 1900 compelled the Government to take a leading part in the joint expedition of the Powers to China. A force of over 20,000 men was organized by- voluntary enlistment from among the regular army ; and the supreme command was obtained by the Emperor for Count von Waldersee, who had succeeded Moltke as chief of the staff. The

Government, was, however, sharply- criticized for not first consulting the Reichstag in a matter involving the first military expedition since the foundation of the Empire. It was desirable in such circumstances that a younger and more vigorous statesman than Prince Hohenlohe should be placed at the head of affairs before the Reichstag met ; and on 17th October he resigned, and was succeeded as Chancellor by Count von Btllow, the Foreign Secretary.

AnTHOKiTiEs. ??? Das deutsche Reich zur Zeit Bismaroks, by Hans Blum (1893), and Oncken, Das Zeitalter des Kaiser Wilhelm, vol. 2 (Berlin, 1890), give a connected history of tlie empire. ??? ScHni-THEss's Europdischer Geschichtskalendar, Nordlingen (a work similar to the Annual Register) , is invaluable as a book of reference for recent German history ; see also Die politische Geschichte der Gegenwart, by MUller (continued by Wippehmann, 1871-1900). For constitutional questions see the parts dealing with Germany in Maequardsbn's Handbuch des offentlichen Mechts der Gegenwart (Leipzig, 1896, &c.), and Lowell, Governments and Parties in Continental Europe (Longmans, 1896). Tor economic and statistical information the most useful work is the Handworterhuch der Staats- wissenschaften, edited by Conrad and Elster (Jena, 1890-97, new edition, 1898, &c.) ; as also the Statistisches Jahrbuch des deutschen Beichs. For political history and party politics the reader must refer to the special works issued by the different parties as Die National-Liberate Partei, 1867-1892 (Leipzig, 1892) ; Politisches AS G- Buck, by Eugen Riohtek ; Conservatives Handbuch; Geschichte des Kultur-kampfes, by Majunke (Munster, 1896) ; Geschichte der deutschen Social-democratie, by E. Mehking, Part II. (Stuttgart, 1898), See also the biographies of Boetticher, by Eduaed Stephani (Leipzig, 1887) ; Boon, by his son (Breslau, 1892) ; Mallincrodt, by Otto PrnEFF (1892) ; Forckenbeck, by Philippsen (1898) ; and Windthorst, by Keupp (1898), the two latter in the series called Manner der Zeit, and also Windthorst, by MenXenbaoh (1891-92). For the Christian Social movement and social reform, Dawson, Bismarck and State Socialism (Sonnen- scheln, 1891) ; Nitti, Catholic Socialism; Gotau, UAllemagne religieuse (Paris, 1898) ; Kannengiessee, Les Allemands Gatho- liques. See also the list of works appended to the article on

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*I. In the years immediately folio-wing the Eranco- German -war the conditions existing in Germany were unfavourable to literary production, and the re-establish- ment of the German Empire left little or no trace on the national literature. All minds were for a time en- grossed by the " Kulturkampf," which broke out in 1872 between the state and the papal authority ; by the financial difficulties ??? the so-called " Grllndertum " ??? due to unscrupulous speculation in Berlin ; and, finally, by the rapid rise of social democracy as a political force. The first volume of Karl Marx's (1818-1883) Das Kapitcd, the chief text-book of the party, had appeared ifi 1867. But even if these disturbing factors had been wanting, the general atmosphere of German intellectual life PMio- y^^^ jjQ^ buoyant enough to inspire a literary *"" "" revival. The influence of Hegel, and the various schools which had gone out from him, was still paramount, and the "historical" method, which found character- istic expression in D. E. Strauss's (1808-1874) Der alte und der neue Glaube (1872), had spread over all fields of intellectual activity. To many, H. Lotze's (1817-1881) compromise between science and metaphysics was a relief from the oppression of Hegelian tradition, but, in litera- ture and art, the dominant force was still, as before the*

war, the philosophy of Schopenhauer ; and in his Philo- sophie des Unhewussten (1869) E. von Hartmann (born 1842) endeavoured to bring pessimism into harmony with idealism. In lyric poetry the dull monotony was broken by the victory at Sedan, the singers of 'the war. the Revolution of 1848 being among the first to welcome the triumph of German arms and the unifica- tion of the nation. E. Ereiligrath (1810-1876), E. Geibel (1816-1884), 0. von Redwitz (1823-1891), and even G. Herwegh (1817-1875) regarded the establishment of the empire with enthusiasm ; but at the same time these older revolutionists could ill conceal a certain disappointment : the united Germany of 1871 was not what they had dreamed of in their youth, when all hopes were set on the Frank- fort Parliament. Geibel, whose Heroldsrufe appeared in 1871, was a favourite poet with all classes, and his shallow, musical verses are characteristic of the period.

The group of writers whom Maximilian II. of Bavaria gathered round him in Munich, between 1852 and 1860, and of whom Geibel was the centre, gave the tone to German letters at the beginning of the nevr era. J. V. von Scheffel ^ (1826-1886), author of Der Trompeter von Sdckingen school (1854), was the undisputed master of the story in verse, a form of poetry particularly associated with this school. Till Eulenspiegel redivivus (1874), J. Wolff's (bom 1834) first verse- romance, was followed by Der Battenfanger von Hameln (1875), Der Wilde Jager (1877), and Tannhduser (1880) ??? the sentiment of the last-mentioned poem forming a striking contrast to the pes- simism and satire of Der neue Tannhduser (1869), an epic by E. Grisebach (born 1845). "With Wolff it is usual to class R. Baum- baoh (bom 1841), author of a number of charming tales in verse, such as Zlatorog (1877) and Erau Holde (1880). Die Volker- ???wanderung (1866-68) is an ambitious epic by H. Lingg (born 1820), while Dreizehnlinden (1878), by a Catholic poet, F. W. Weber (1813-1894), depicts the struggle between Christianity and Saxon heathendom in the early centuries of German history. R. Hamerling (1830-1889) also gave new vitality to the epic in his grandiose poems, Ahasver in Bom. (1860) and Der Konig von Sion (1869). Among the older lyric poets of the Munich circle, F. von Bodenstedt (1819-1894) , the author of Mirza Schaffy, shared Geibel's popularity, while the pessimism of the age is deeply engrained in the verse of H. Lorm (born 1821), H. Leuthold (1827-1879), andF. von Schmid (pseudonym " Dranmor," 1823-1888). The most important writer of the group is Paul Heyse (bom 1830), who ??? made his reputation with a volume of "Novellen" as ' far back as 1855. Since then Heyse has written more than a hundred short stories, all of which are characterized, if not by invariable truth to nature, at least by beauty of form and grace of style. In 1873 Heyse published his first novel. Kinder der Welt, which is one of the representative works of the period, refiecting admirably the pessimism and religious scepticism on the one hand, and on the other the jubilant hopefulness, of the German capital after the war. Im Paradiese (1875), a romance of artr-life in Munich, was followed in 1876 by Der Boman einer Stiftsdame. Heyse's recent novels, such as ilferKre (1892) and tjber alien Gipfeln (1895), continue the conflict which this author has always carried on against modern realism, but they are inferior to Kinder der Welt. As a lyric poet Heyse also occupies an important place, but his dramas have failed to

maintain a hold upon the stage. The historical plays of Martin Greif (bom 1839) have met with a similar fate, Greif's talents being lyric rather than dramatic.

The novel continued to be what it was before the war, the most vigorous form of German literature, but the novelists who were popular in 1871 were almost all past middle age. H. Laube (1806-1884) ́́́́́́"'́́'́́^- and K. Gutzkow (1811-1878) were still writing fiction, and B. Auerbach (1812-1882) expressed his enthusiasm for German unity in a novel called WaJdfried (1874). Eritz Renter's (1810-1874) masterly " plattdeutsch " stories re- mained universal favourites, while another North German, Theodor Storm (1817-1888), in his Chroniknovellen (1877- 1886), put the cro-wn to his work as a prose-writer. Storm and Heyse were acknowledged masters of the " Novelle " in an age which was not ripe for the manlier art of Gottfried Keller. The most widely read novelists at this time were Spielhagen and Ereytag. Ten years before the war Eriedrich Spielhagen, who was born in 1829, had established himself in the first rank of

German novelists, and in 1876, as a worthy successor to Probleniatische Naturen (1860) and Jre Beih' und GHed (1866), he published Sturmflut, a novel in which the financial instability of Berlin was brought into paral-lelism with a great storm on the Baltic coasts. Among the best of Spielhagen's later books are Plattland (1878), Quisisana (1879), Angela (1881), Noblesse oblige (1888), Sonntagskind (1893), and Freigeboren (1900), but they are not to be compared with the masterpieces of his first period. In 1872 Gustav Freytag flw/on"^' (1816-1884) commenced the most ambitious work which the Franco-German war inspired. Die Ahnen (1872-81), a cycle of romances which follows the fortunes of a German family from prehistoric times to the Revolution of 1848. Generally speaking, how- ever, the historical novel was a weak feature of the literature of this period ; the example set by Scheft'el in Ekkehard (1857)

found no worthy imitators. G. Ebers (1837-1898) made the antiquarian novel fashionable with Eine dgyptische Itonigstochter (1864), which he fol- lowed up with similar works of small literary value ; F. Dahn's (born 1834) historical romances, especially Ein Kampf um Rom (1876), found many readers, though Dahn is a scholar and historian rather than an artist ; and other historical novelists, such as G. Taylor (pseudonym for A. Hausrath, born 1837) and E. Eckstein (born 1845), were hardly more successful than Dahn or Ebers. An original figure in the literature of this period is W. Jordan (born 1819), whose alliterative epic. Die Nibelunge (1867-1874), has a certain rugged grandeur. But although neither poetry nor fiction showed much promise, Ger- many was in those years making solid contri- storiaas. ^j^j^JQj^g ^^q j^gj. intellectual possessions in other fields. L. von Ranke (1795-1886), still the dominant force in German historical science, published between 1881 and 1888 nine volumes of his crowning work, WeltgescJiichte ; whUe H. von Sybel (1817-1895) described Die Begriindung des deutschen Reichs durch Wilhelm I. (1889-1894). But the historian who identified himself most completely with the new order of things, whereby Prussia assumed the leading role in the united empire, was H. von Treitschke (1834-1896) ; the trenchant vigour of Treitschke's lectures and of his Deutsche Geschichte m neunzehnten Jahrhundert (1879-1894) made him one of the most influential teachers of the younger generation. Hardly less important as an educative force was the Swiss historian, J. Burckhardt (1818- 1897), whose masterly Kultur der Renaissance in Italien appeared in 1860. But the determining factor in this essentially unliterary era was Bismarck (1815-1898), the record of whose life and work is to be found in his Reden (16 vols., 1886-1891), his Oesammelte Werke (4 vols., 1890), and Politische Briefe (3 vols., 1890), as well as in the personal records of H. Kohl and M. Busch.

II. Towards the end of the first decade of the period under consideration signs of a change became visible. The philosophy of Schopenhauer, it is true, still Phiio- dominated the intellectual life of the nation, crfticism. but natural science and materialism had many adherents, and were appreciably weakening the influence of Schopenhauer. At the universities Hegelianism was giving way to a new movement, the motto of which -was " Zurilck zu Kant," and on the basis of this movement German theology,

as represented by A. Eitschl (1822-1889) and his disciples ??? notably A. Harnack (born 1851) ??? entered upon a new period of development. Of the older Hegelians, Kuno Fischer (born 1824) was the most eminent, and his Geschichte der neueren Philosophic ??? especially in its latest edition, 1889-1901 ??? is one of the outstanding achievements of recent German philosophy.

People now began to have leisure to revise their opinions of the German classical poets. Schiller, it was found, no longer occupied the place that had once been his, and a number of (mostly unfinished) biographies by J. Minor, 0. Brahm, E. Weltrich, and 0. Harnack endeavoured to form a conclusive estimate of that writer. On the other hand, a marked change came over the nation's attitude towards Goethe, a poet to whom neither the era of Hegel nor that of Schopenhauer had been favourable. Indications of a warmer appreciation of Goethe were the lectures on the poet delivered by Herman Grimm (1828-1901) in 1877, the foundation of the Goethe Archive and the Goethe Society at Weimar in 1885, and the issue of a monumental edition of the poet's works (1887 ff.). The increased attention which has been paid to Goethe in recent years has also resulted in a large number of popular biographies, the best of which are by K. M. Meyer (published 1894) and A. Bielschowsky (vol. i., 1896). In general criticism, the chief writer between 1870 and 1880 was Karl Hillebrand (1829-1884), while, at the universities, Wilhelm Scherer (1841-1886), whose masterly Geschichte der deutschen IJtteratur appeared in 1883, had and still has many followers.

In the summer of 1876 Richard Wagner's (1813-1883) long struggle for his art ended with the inauguration of the " Festspielhaus " at Bayreuth and the first complete representation of Der Ring des Nibe- ??? <'ran??>- lungen ; Tristan und Isolde, it may be noted, was per-formed in 1865, Die Meistersinger von Nurnberg in 1868, while his last work, Parsifal, was produced in 1882. Since about 1880 Wagner's music-dramas, which give artistic expression to the pessimism of the time, have held the chief place in the repertory of the German theatres. To Wagner on the one hand, and to the careful and artistic work of the Court Theatre of Meiningen on the other, was due the revival of German dramatic art which began in the 'eighties. The classical iambic tragedy was cultivated*

*by the Munich School, by A. Wilbrandt (born 1837), whose Arria und Messalina appeared in 1874, and A. Lindner (1831-1888), author of Bi- utus und Collatinus (1867) and Die Bluthochzeit (1871) ; and it was also charac- teristic of the time that Halm was popular, while Hebbel and Grillparzer were neglected. Superior to Wilbrandt's iambic tragedies were his comedies, Die Maler (1872), Jztgendliebe (1873), and his dramas of a later period. Die Tochter des Herrn Fabricius (1883) and Der Meister von Palmyra (1889). The really popular playwrights at this date, however, were R. Benedix (1811-1873) and his successors, A. L'Arronge (born 1833), G. von Moser (born 1825), F. von Schonthan (born 1849), and 0. Blumenthal (born 1852) ; and social dramas on French models, such as P. Lindau's (born 1839) Ein Erfolg (1874) and Griifin Lea (1879), were more to the taste of the public than the verse-dramas of H. Kriise (1818-1902), of the Austrian F. Nissel (1831-1893), or a tragedy like A. Fitger's (born 1840) Die Hexe (1876). Apart" from AVagner, the only German dramatist of importance between 1870 and 1880 was Ludwig Anzengruber (1839-1889), an Austrian, whose first play, Der Pfarrer von Kirchfeld (1870), reflected the liberal ideas i- ???^"??n- that were then in the air ; and this was fol- *^??? "" lowed by a series of masterly dramas, mostly in dialect, such as Der Meineidbauer (1871), Die Kreuzelschreiber (1872), Der G'lcissenswitrm (1875), Der Doppelselbst- mord (1876), and Das vierte Gebot (1878). Compared with the peasant- literature of the middle of the century, Anzengruber marks an advance, in so far as his peasants are less violently adapted to artificial literary ideals ; in this respect he is to some extent a forerunner of the realistic school. The North German theatre had no writer who could be compared with Anzen-*

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gruber, but in 1882 hopes were raised by Ernst von Wildenbruch's historical tragedy, Die Karolinger. Wil-

denbruch, who was born at Beirut in Syria in wiiden- 1845, first attracted attention by two " Helden- bruch. lieder," Vionville (1874) and Sedan (1875), on

the war of 1870-71, in which he had himself taken part. His dramas. Die Karolinger, Harold (1882), Der Menonit (1882), Christoph Marlowe (1884), and Das neue Oebot (1886), were followed in 1888 by Die Quitzows, with which the author touched the height of his popu- larity. This play was the first of a series of dramas, including Der Generalfeldoberst (1889), Der neue Herr (1891), Der Junge von Hennersdorf (1896), on subjects borrowed from the history of Prussia. Wildenbruch has also written Die Hauhenlerche (1891), a realistic drama of modern life, and, more recently, Heinrich und Heinriclis Qeschlecht (1896), a double drama on Emperor Heinrich IV., and Die Tochter des Erasmus (1900). As a dramatist Wildenbruch combines a keen sense of stage effect with strong patriotism and a somewhat efi'u- sive pathos, but higher dramatic or poetic qualities are only sparingly present in his work.

The writers of fiction, who took a leading place before the realistic movement set in, were, like their predecessors, ^ . influenced by mid-century traditions, but, in

the novel as in the drama, the younger gener- ation was beginning to make more exacting artistic demands. Since 1869 the North German, A. Wilbrandt, whose work as a dramatist has already been mentioned, had been known to the public as a novelist, but Adams Sohne, his first book worthy of note, only appeared in 1892. It was succeeded by Hermann Ifinger (1892), Der Dornenweg (1894), Die Osterinsel (1895), Die Botlien- burger (1896), and Hildegard Mahlmann (1897), novels which, although old-fashioned in style and technique, discussed themes of actual interest, such as Bocklin's art and Nietzsche's philosophy. This somewhat factitious interest in Wilbrandt's books is wanting in the novels of Wilhelm Jensen (born 1837) ; it is unfortunate, however, that the delicate poetic talent revealed in some of Jensen's earlier " Novellen " is entirely lost amidst the diffuseness and formlessness of the many volumes he has published since 1866. A novelist whose style is more in accordance with modern taste is Hans Hopfen (born 1835), while the humorist of the

group is Wilhelm Eaabe (born 1831), who wrote his early work under the pseudonym of " Jakob Corvinus." Eaabe combines with a senti- mentalism not unlike Jean Paul's a very modern pessi- mism, and has a clearer sense for the actual aspect of what he describes than either Wilbrandt or Jensen ; his most characteristic novels, however, such as Der Hunger- pastor (1865) and Abu Telfan (1867), appeared before the period under discussion. Other humorous writers are H. Seidel (born 1842), who since 1871 has published a series of charming sketches (LeberecJit HUhnchen, 1880), which are true to the best traditions of German humour, and W. Busch (born 1832), author of Max und Moritz (1868), Die fromme Helene (1871). Hans Hoffmann (born 1848) is seen to more advantage in the Geschichten aus Hinterpommern (1891), in which he is a disciple of Storm and Eeuter, than in his ambitious novels on Prussian his- tory. A humorist who stands somewhat alone is the Hegelian professor of aesthetics, E. T. Vischer (1807-1887), who in 1878 brought out an admirable satirical novel, Auch Einer, and in 1882 his collected lyrics as Lyrische Gdnge. Younger writers of fiction , whose sty] e has more in common with the group of novelists under consideration than with the realistic school presently to be discussed, are Ernst von Wildenbruch, E. Wichert (1831-1902), A. Stern (born 1835), Isolde Kurz (born 1863), and Eicarda Huch (born 1864). The two most eminent Austrian

novelists of the period are Marie von Ebner-Eschenbach (born 1830) and Eerdinand von Saar (born 1833). The former of these wrote in 1876 an excellent novel, Bozena, but her " Novellen " first made her name known outside Austria ; the genial humour and the light ironical touch of Neue Erzdhlungen (1881), Dorf mid ScJiloss- geschicJiteu (1883) ??? above all, of the excellent story, Zivei Gomtessen (1885) ??? are unique of their kind. Erau von Ebner-Eschenbach is also the author ^"/^f" of several longer novels. Das Gemeindehind (1887), Utxsiihnbar (1890), Glaubenslos? (1893), and a col- lection of subtle ApJiorismen (1880) ; she is unquestionably the most gifted woman writer in recent German literature. Ferdinand von Saar has written comparatively little ??? a few dramas, several volumes of short stories (Novellen aus Oesterreich, 1876; Herbstreigen, 1897), a handful of Gedichte (1882), and Wiener Elegien (1892), but his delicacy, his lightness of touch, and

the deep under-current of pessimism in all his work place him in the front rank of modern poets and prose-writers. The story in dialect bulks largely in recent Austrian litera- ture, a typical novelist of this class being Peter Eosegger (born 1843 in Styria). Eosegger's Schriften des Waldschulmeisters appeared in 1876, and have been followed by a large number of similar stories, all senti- mental in tone. An Austrian, too, is K. E. Eranzos (born 1848), whose early novels and sketches describe Galician life (Aus Halbasien, 1876 ; Die Juden von Barnow, 1877), while L. von Sacher-Masoch (1836-1895) has written a series of vivid Galizische Geschichten (1876- 81) and Judengeschichten (1878). But the two masters of German prose at this epoch, Gottfried Keller and Konrad Eerdinand Meyer, were neither Austrians nor Germans.

Gottfried Keller was bom at Zuricli in 1819, and died there in 1890. His ambition was to be an artist, and, with this object, he spent two years in Munich ; in 1848 a bursary ??? w ii allowed him to study at the University of Heidelberg, Keller.

and two years later he went to Berlin with a view to becoming a dramatist. From 1861 to 1876 Keller was town-clerk in his native town. Meanwhile, in 1846 and again in 1851, he pub- lished volumes of poetry, and in 1854, after a protracted delay, his fine autobiographical novel, Der gr'une Heinrich. This work was followed by a volume of short stories, entitled, Die Leitte von Seldwyla (1856). Although both Der grilne Heinrich and the " Novellen " ??? above all, such stories as Borneo und Julia auf dem Dorfe and Die drei gerechten Kammmacher ??? were unrivalled in the literature of their time, Keller's importance was not generally recognized until the appearance of a second edition and an addi- tional volume (1874) of Die Leute von Seldwyla. In 1872 he published a cycle of Siehen Legenden, and in 1879-80 a revised edition of Der griine Heinrich. The Zuricher Novellen, including the masterpieces, Der Landvogt von Gheifensee and Das Fdhnlein der siehen Aufrechten, appeared in 1878, Das Sinngedicht in 1882, and a less successful novel, Martin Salander, in 1886. Original and inspired although much of Keller's lyric poetry is, his genius could only move at ease in prose. He is, without question, the most eminent German novelist of the century. Of all modern German writers, he alone was endowed with that naivete which

Schiller regarded as characteristic of the highest form of genius. (C/. J. Baechtold, Gottfried Kellers Leben, 3 vols., Berlin, 1894-97.)

K. F. Meyer (1825-1898), who turned to literature comparatively late in life, was also a native of Zurich. Two volumes of verse, which appeared in 1864 and 1871, attracted little atten- tion, but his epics, Huttens letzte Tage (1871) and Engelherg (1872), were widely read ; and these were followed by the novels on which his reputation rests ??? Das Amulet (1873), JiXrg Jenatsch (1876), Der Heilige (1880), Plautus im Nonnenkloster (1882), Die Hochzeit des Monchs (1884), Die Ver- suehung des Pescara (1887), Angela Borgia (1890). In the choice of his subjects Meyer shows a preference for the virile personalities of the Renaissance, whom he describes with an objectivity unusual in German writers; above all, his novels are masterpieces in form and style. {Of. A. Frey, K. F. Meyer, Stuttgart, 1900.)

III. The last fifteen years of the 19th century were dis- tinguished in Germany by a remarkable literary activity. Since about 1885 Berlin has unmistakably asserted itself

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as the intellectual and artistic metropolis, and the leader- ship in literature has passed into the hands of a new generation of writers, who have grown up as citizens of the empire. An all-important condition, however, for any healthy revival of literature in Germany was that it should be freed from the clogging elements of mid- century tradition ??? above all, from the levelling influence of Hegelianism and the collective ideals of socialism. The liberator from tradition, the writer who embodies most completely the spirit of the period, is Friedrich Nietzsche.

Friedrich Wilhelm Nietzsche was born at Rooken, near Liitzen, on 15th October 1844. He was educated at Pforta, and subse-

quently studied classical philology at Bonn and Leipzig. yv/etescAe “^ ⬛⬛ T^Slh Nietzsche was appointed professor of classical

literature at Basel, but in 1879 was obliged to resign this position owing to ill-health. The next ten years were spent partly in Italy, partly at high altitudes in Switzerland, until in 1889 he became insane. He died at Weimar on 25th August 1900. Die Geburt der Tragodie aus dem Geiste der Miisik (1872), Nietz- sche’s first book, was written under the influence of Schopenhauer and Wagner, and discussed the Dionysiac origin of the Greek drama. In the Unzeitgemdssen Betrachtungen (4 vols., 1873-76) he laid, in a trenchant, polemical style, a foundation for the new ideas of the time. The first of these Betrachtungen was an attack on Strauss’s Der alte und der neue Glaube ; the second gave definite form to Nietzsche’s attack on the Hegelian ideals of a “historical” culture. The third Betrachtung, Schopen- hauer als Erzieher, expressed the writer’s indebtedness and that of his time to the great thinker of the previous generation ; while the last, devoted to his friend and master, Richard Wagner, was written at a time when Nietzsche was already struggling to free himself from Wagner’s influence. The writings of the next period of Nietzsche’s life, Menschliches, Allzumenschliches (1878- 1880), Morgenrdte (1881), and Die frohliche Wissenschaft (1882), show his philosophic ideas in the process of crystallization ; these books represent a preliminary, positive stage, in which their author was casting aside traditional prejudioies. The full develop- ment of his thought is to be found in Also sprach Zarathustra (1883-91) ⬛⬛⬛ the most original philosophic and poetic masterpiece of modern German literature ⬛⬛⬛ in Jenseits von Gut und Bose (1886), and Zur Genealogie der Moral (1887). Finally, Der Fall Wagner (1888) and Nietzsche contra Wagner (1889), gave full expression to the breach between Nietzsche and Wagner. Of a comprehensive work, Der Wille zur Macht, Versuch einer Um- wertung aller Werle, which was intended to contain a summary of his whole philosophy, only fragments were completed, which have been published in posthumous volumes. So far as it is possible to speak at present, Nietzsche represents the final stage of the revolt against Hegelianism. Individualism here takes the place of

collectivism, and pessimism gives way to a vigorous optimism. The individual, not the race ; the ” Herrenmensch,” not the slave ; self-assertion, not self-less renunciation ??? these are the chief ideas round which Nietzsche’s ethics turn. Above all, he looks forward to the human race emerging from an effete culture, and re-estab- lishing Itself on a new basis, in harmony with primitive instincts. Nietzsche follows in Schopenhauer’s footsteps by being not only a philosopher, but also a stylist ; his musical language and clear, finely balanced sentences are a marked advance on the superficiality and clumsiness that have lain heavy on German prose since the days of ” Young Germany.” (Of. E. Forster-Nietzsche, Das Lehen Friedrich Nietzsche” s, I.-II., Leipzig, 1895-97 ; H. Lichtenberger, La Philosophic de Nietzsche, Paris, 1898 ; T. Ziegler, Friedrich Nietzsche, Berlin, 1900.)

The full import of this individualistic philosophy ??? which was to some extent foreshadowed by a work like Der Wert des Lebens (1865), by E. Dtlhring (born 1833) ??? was not understood until Nietzsche himself could no longer appreciate his recognition; but the antagonism which he expressed to conventional ideals of culture early met with an enthusiastic response. The influence of the Unzeitgemdssen Betrachtungen is to be seen in J. Langbehn’s Rembrandt als Erzieher, a book which, ap- pearing in 1890, was for some years extraordinarily popular. Under the auspices of realism, which had taken root not only in France, but also in Eussia and Scandi- navia, the German people began to take a more serious interest in literature. The inspirers of the German movement were Flaubert, the brothers Goncourt, Zola and Maupassant, Tolstoi and Dostoieffski, while, as regards

the drama, the chief stimulus came from Norway ; plays N3y both Bjornson and Ibsen were seen on the German stage before 1880. The new movement was rhereai- accompanied by a corresponding change in the istic move. spirit of German criticism, which is to be ???en<. observed in the work of 0. Brahm (born 1856), '‘???”’”’“ ??? P. Schlenther (born 1854) ??? both of whom studied under Wilhelm Scherer ??? and the brothers Heinrich and Julius Hart (born 1855 and 1859). M. G. Conrad (born 1846), K. Bleibtreu (born 1859), and Arno Holz (born 1863) formulated the principles of German realism, while, under the

guidance of the Viennese critic, Hermann Bahr (born 1862), contemporary Austrian literature at an early date abandoned realism in favour of symbolism and decadence. Max Nordau (born 1849) has written several volumes of vigorous and independent criticism, while, of the older writers, Spielhagen and Fontane welcomed every new de- velopment with encouragement. The Danish critic, Georg Brandes, who in his own literature created a literary school on the basis of realism, has also exerted very considerable influence on recent German criticism. The new school in German fiction virtually began with Pietioa. the novels of a writer who was well known as poet and journalist long before the Franco-German war; in 1878 Theodor Fontane (1819-1898) brought out his first romance, Vor dem Sturm, and this was followed by several other more or less successful stories, such as Grete Minde (1S80) and Schach von Wuthenow (18S3). Fontane's realism was not, however, pronounced until he wrote L'Adultera (1882) and Graf Petofy (1884). In the following years appeared Irnmgen, Wirrungen (1887), Stine (1890), Frau Jenny Treibel (1892), Effl Briest (1895), and Der Stechlin (1898). Effi Briest, one of the masterpieces of modern fiction, marks the culminating point of Fontane's work. The strictly realistic novels of the period were written by H. Conradi (1862-1890), Max Kretzer (born 1854), M. G. Conrad, H. Heiberg (born 1840), K. Bleibtreu, K. Alberti (born 1862), and H. Sudermann. In his early work, Meister Timpe (1888), Kretzer gave promise of being the leading German realist, but his subsequent books were disappointing. A want of stability was characteristic, however, of the whole movement in Ger- many ; the idealistic trend of the German mind proved ill adapted for the uncompromising realism of the French writers, and the German adherents of the school ulti- mately sought to escape from the consequences of their theories ❓❓❓ Kretzer, for example, in the supernaturalism of his novel. Das Gesicht CJiristi (1897), Hauptmann in Hanneles Himmel/ahrt (1893) and Die versunkene GlocJce (1896). Even Sudermann, whose Frau Sorge (1887), Die Geschwister (1888), Der Katzensteg (1889), and the brilliant, though sensational romance, Es toar (1894), are among the best novels of this period, has never been consistently realistic. Novelists whose work, although popular, has little abiding value, are T. H. Pantenius (born 1843), E. von Wolzogen (born 1855), J. C. Heers (born 1859), G. von Ompteda (born 1863), and F. Hollander (born 1867). Of the large number of women engaged in writing

fiction, the most dis- tinguished are ??? besides Isolde Kurz and Ricarda Huch, already mentioned ??? I. Frapan (born 1852), G. Reuter (born 1859), Clara Viebig (born 1860), and Helene Bohlau (born 1859). The last-mentioned is the author, amongst other works, of an admirable story of Munich art-life, Der Rangierbahnhof (1896), Ratsmadel- geschichten (1888-1897), and Das RecU der Mutter

(1897).

At no period in Germany were literature and the theatre in such close touch as at the end of the 19th and opening of the 20th centuries: more than ever before, the theatre became the arena in which all literary battles

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were fought out. Since about 1875 the German theatre and German acting had undergone a steady drama. improvement, and E. von Wildenbruch has al- ready been mentiond as a pioneer of the new drama. With Wildenbruch is to be associated Eichard Voss (born 1851), who, in such plays as Alexandra (1888), Eva (1889), and Die neue Zeit (1891), stands nearer the younger writers than in his verse tragedy, Luigia San Felice (1882). But, as far as the drama is concerned, the new movement did not set in definitely until the end of 1889. In October of that year G. Haupt- mann's play, Vor Sonnenaufgang, was produced on the recently founded " Freie Billme " in Berlin ; and a month later Die Ehre, by H. Sudermann, met with a more en- thusiastic reception than had fallen to the lot of a German play for many years.

Gerhart Hauptmann, who was born in 1862, at Salzbrunn in Silesia, is the most original modem German writer. His earliest – ??? work was an epic, Promethidenlos (1885), written in

*mana^ ' *^ ?? style popular at the middle of the century ; and in 1889 and 1890 his two first social dramas, Vor Sonnen- aufgang and Das*

Friedensfest ??? both of which show the influence of Holz's realistic theories ??? were performed. They were followed in 1891 by Einsame Menschen, for which Ibsen's later plays served as models. Hauptmann's genius found a more congenial subject in Die Weber (1892) ??? originally in Silesian dialect as De Waber ??? a powerful play on the sufferings of the Silesian weavers in 1844. Slighter pieces were College Crampton (1892), an admirable study of an artist fallen upon evil days, and a "thieves' comedy," Der Biberpelz (1893). In 1893 Hauptmann also brought out another work which attracted general attention, Sanneles Himmelfahrt, in which a sordid i-ealism is contrasted with the poetic mysticism of a child's dream. Florian Geyer (1895) is a tragedy of the 16th century, but on so large a scale and so historically realistic that it found little favour on the stage. Most popular of all Haupt- mann's works is the allegorical dramatic poem, Die versunkene Glocke (1896), which did not, however, afford his peculiar genius the same scope as the plays of actual life, and to this form of drama he returned in his next work, Fuhrmann Henschel (1898), perhaps the finest tragedy that the German realistic movement has produced. A humorous poetic fantasy, iSchluck uni Jau, appeared in 1900, Michael Kramer also in 1900, and in the following year Der rote Hahn, a sequel to Der Biberpelz. (Gf. P. Sohlenther, Gerhart Hauptmann, Berlin, 1898). As a drama^ H g J , tist, Hermann Sudermann has been more influenced niana."" /strong> Hauptmann by the traditions of the German theatre. A native of East Prussia, where he was born in 1857, Sudermann passed through a severe apprenticeship to literature before Frau Sorge, and Die Ehre brought him fame. The popularity of Die Ehre was due partly to its satire on con- ventional ideas of honour, partly to the realism with which the stock figures of the " bllrgerliche Drama " were described. Sodoms Ende (1891), Sudermann's next play, although it met with less success, showed a marked advance in dramatic construction, while Heimat (1893), the theme of which is similar to that of Die Ehre, carried its author's reputation beyond the boundaries of Germany. Since then Sudermann has added to his dramas of contemporary life Schmetterlingsschlacht (1895), Das Gluck im Winkel (1896), Johannisfeuer (1900), and Es lebe das LebenI (1902). Although a keen observer, and never deficient in interesting ideas, Suder- mann is, in the first instance, a practical playwright, and the theatrical element in his work occasionally

overshadows its finer literary qualities. In the one-act plays, grouped under the titles Morituri (1896), in Johannes (1898), and Die drei Beihersfedern (1899), Sudermann has abandoned the drama of modem life for fields in which he is less at home ; most important of these is the second, a prose tragedy on John the Baptist, in which the psycho- logical conilict is treated with a refinement that recalls Hebbel. (^Cf. W. Kawerau, Hermann Sudermann, Magdeburg, 1897).

Since the production of Die Ehre, the drama has occupied the foreground of interest in Germany. It is true that the permanent repertory of the German theatre has, so far, been but little enriched by the activity in this form of literature, but it is at least a healthy sign that German playwrights are unwilling to rest content with their successes, and are constantly experimenting with new forms. Be- sides Hauptmann and Sudermann, the most talented dramatists of the present day are Max Halbe (bom

1865), whose Jugend (1893) and Mutter Erde (1897), are, however, better than any plays he has since published ; 0. E. Hartleben (born 1864), author of Hanva Jagert (1893), Itosenmontag (1900), and other plays ; W. Kirch- bach (born 1857) ; and G. Hirschfeld (born 1873). The most consistently realistic dramatist is Johannes Schlaf (born 1862), whose first drama, Familie Seliche (1889), written in collaboration with Arno Holz, is typical of the movement. E. Eosmer (pseudonym for Elsa Bernstein, born 1866) has written, besides several realistic pieces, a drama in verse, Konigskinder (1895), which may be com- pared with Hauptmann's Versunhene Glocke. A lighter vein is exemplified by the graceful comedies {Der Talisman, 1893 ; Jugendfreunde, 1897, &c.) of Ludwig Eulda (born 1862) ; by the plays of Max Dreyer (born 1862), especially Der Probekandidat (1899), and of Otto Ernst (pseudonym for O. E. Schmidt, born 1862). In Austria the drama still retains the specifically national character it has possessed throughout the century. The most eminent writers for the stage here are Arthur Schnitzler (born 1862), whose Anatol (1893) and Liehelei (1896) show an almost French lightness of touch ; Hermann Bahr and Philipp Langmann (born 1862) ; while J. J. David (born 1859), best known as a novelist, has also written plays. Lastly, Hugo von Hofmannsthal's (born 1874) TJieater in Versen (1899) reveals a poetic talent of extraordinary delicacy.

The most characteristic expression of German litera- ture in every period is to be found in the lyric. The present epoch is no exception, although, apart from Liliencron, it is not possible to point to a e single poet of the first order. But, regarded as TyHc" a whole, the modern German lyric shows a remarkable variety of new tones and pregnant poetic ideas ; it has been more influenced by the individualism and optism of Nietzsche ??? himself a lyric poet of con- siderable gifts ??? than has either novel or drama. Detlev von Liliencron, who, born in 1844, belongs to the older generation, was the first to break with the traditions of the German lyric as handed down from the Eomantic epoch; in his Adjutantenritte (1883) he opposed to the melancholy and sentimentality of the Munich school a vigorous and healthy delight in life. While the lyric of Keller, Meyer, Saar, the Prince of Sehonaich-Carolath (born 1852), Isolde Kurz, and Eicarda Huch is essentially conservative in character, A. Holz, J. Schlaf, and W. Arent (born 1864) made, to some extent under the influence of Walt Whitman, a complete break with the past. Since the appearance of Arent's lyric anthology, Modei-ne Dich- tercharaktere, in 1885, the number of essentially modern poets has greatly increased; among the more character- istic are Eichard Dehmel (born 1863), K. Henckell (born 1864), J. H. Mackay (born 1864, at Greenock), G.Ealke (born 1853), E. Avenarius (born 1856), L. Jacobowski (1868-1900), E. Evers (born 1871), F. Dormann (born 1870), and K. Busse (born 1872). The latest develop- ment of the German lyric ??? a return to the mystic and symbolic ??? is to be seen in the work of Stefan George (born 1865). Epic poetry, although little in harmony with the spirit of the time, is not altogether neglected ; the brothers Hart have published the first volumes of Das Lied der Menschheit (1887 ff.), an epic planned on an ambitious scale; and in Austria Marie delle Grazie (born 1864) has followed in Hamerling's footsteps with Bohespierre (1894), an epic in two volumes. Lastly, the extraordinary popularity of the cabaret, or so-called " Ueberbrettl," in recent years has not been without some effect on literature. Particularly associated with this movement are E. von Wolzogen (born 1885) and 0. J. Bierbaum (born 1865), and it is significant that a collection of Bierbaum's lyrics {Lrgarten der Liebe, 1901)

GEROME ◆◆◆ GHAZIPUR

has been tlie most popular volume of poetry published in Germany since the days of Bodenstedt and Geibel.

Authorities. ◆◆◆ T. Ziegi.ek. Die geistigenund socialen Stromun- gen ties neunzehnten Jahrhimderts, 2ncl edition. Berlin, 1901. ◆◆◆ R. M. Meyer. Die deutsche Litteratur des neunzehnten Jahr- himderts, 2nd edition. Berlin, 1900. ◆◆◆A. Bartels. Die deutsche DicMung der Gegenwart, 4th edition. Leipzig, 1901. ◆◆◆ A. VON Hanstein. Das jilngste Deutschland, 2nd edition. Leipzig, 1901. ◆◆◆ B. Litzmann. Das deutsche Drama in der lit- terarischen Bewegtmgen der Gegenwart, 4th edition. Hamburg, 1887. ◆◆◆ K. Francke. German Literature as determined by Social Forces, 4th edition. New Yorls:, 1901. ◆◆◆ J. G. Eobertson. History of German Literature. Edinburgh, 1902. (j. g. e.)

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Cerome, Jean Leon (1824- painter, was born 11th May 1824 at Vesoul (Haute-Saone) He went to Paris in 1841 and worked under Paul Delar roche, whom he accompanied to Italy (1844-45). On his return he exhibited ” The Cock-fight,” which gained him a third-class medal in the Salon of 1847. ” The Virgin with Christ and St John ” and ” Anacreon, Bacchus, and Cupid ” took a second-class medal in 1848. He exhibited “Bacchus and Love, Drunk,” a “Greek Interior,” and “Souvenir d’ltalie,” in 1851; “Psestum” (1852); and “An Idyll” (1853). In 1854 Gerome made a journey to Turkey and the shores of the Danube, and in 1867 visited Egypt. To the exhibition of 1855 he contributed a ” Pifferaro,” a ” Shepherd,” ” A Russian Concert,” and a large historical canvas, ” The Age of Augustus and the Birth of Christ.” The last was somewhat confused in effect, but in recognition of its consummate ability the State purchased it. Gerome’s reputation was greatly enhanced at the Salon of 1857 by a collection of works of a more popular kind : the ” Duel : after a Masquerade ” (see Plate), “Egyptian Recruits crossing the Desert,” ” Memnon and Sesostris,” and ” Camels Watering,” the drawing of which

was criticized by Edmond About. In ” Caesar ” (1869) Gerome tried to return to a severer class of work, but the picture failed to interest the public. ” Phryne before the Areopagus,” ” Le Eoi Candaule,” and ” Socrates finding Alcibiades in the House of As- pasia” (1861) gave rise to some scandal by reason of the subjects selected by the painter, and brought down on him the bitter attacks of Paul de Saint-Victor and Maxime Ducamp. At the same Salon he exhibited the ” Egyptian chopping Straw,” and ” Rembrandt biting an Etching,” two very minutely finished works. Gerome’s best paintings are of Eastern subjects ; among these may be named the “Turkish Prisoner,” and “Turkish Butcher” (1863) ; “Prayer” (1866) ; “The Slave Market” (1867) ; and “The Harem out Driving” (1869). He often illus- trated history, as in “Louis XIV. and Moli^re” (1863) ; ” The Reception of the Siamese Ambassadors at Eontaine- bleau ” (1865) ; and the ” Death of Marshal Ney ” (1868). Gerome has alsobeen successful as a sculptor ; he executed, among other works, “Omphale” (1887), and the statue of the due d’Aumale which stands in front of the Chateau of Chantilly (1899). His ” Bellona ” (1892), in ivory, metal, and precious stones, which was also exhibited in the Royal Academy of London, attracted great attention. The artist then began an interesting series of “Con- querors,” wrought in gold, silver, and gems ”Bonaparte entering Cairo” (1897); “Tamerlane” (1898); and “Frederick the Great” (1899). Gerome was elected member of the Institut in 1865.

Cerona, a maritime frontier province in the extreme north-east of Spain, with an area of 2272 square miles. The population in 1877 was 299,702, and in 1897 298,497. The proportion of illegitimate births (1-50 per cent.) is the lowest in Spain. The province is divided into six adminis- trative districts and 249 parishes. Its general aspect is

mountainous, especially in the western districts. Most of the lower chains are covered with splendid forests of oak, pine, and chestnut. More than a hundred mineral springs are scattered over the province. The climate is generally temperate and rainy during several months in the valleys and near the coast, cold in the Cerdana and Rivas districts during eight months, whilst Gerona, La Bisbal, and Santa Coloma are quite Mediterranean in their hot summers and mild winters. The principal local

industry is fishing, which in 1898 occupied 2653 hands and 518 boats, the fish being valued at ??28,000 ; there are thirty-one factories for salt- ing fish. Next in importance is the cork industry, occupy- ing 8000 hands at San Eeliu de Guixols, Palafrugell, and Cassa. There are also important hydraulic cement, estealite, and ochre works, and no fewer than twenty ~~*two of the towns are centres of manufactures of linen, cotton, woollen stuffs, paper, ironfoundries, cloth, leather, steel, copper, andfurni*~~ *ture. The commerce of the province is important, Port Bou being, after Irun, the most active outlet for the trade not only with France but with the rest of the Continent by land and railway. The main railway from Barcelona to France runs through the province, and there is another line from Gerona to Olot ; there are besides several good steam tramways connecting industrial centres. There are sixteen productive coal mines, turning out some 40,000 tons a year. Agriculture is in a backward state. Official data (1898) show that 78,000 acres produce wheat; 42,352 acres barley, oats, rye, maize ; 18,000 acres vines ; 38,500 acres olives. The capital, Gekona, has greatly developed its local industries. It is still a fortified and walled town, with a citadel used as a state prison. Popu- lation, 16,000.*

Cers, a department in the south of France, watered by the river Gers.

Area, 2429 square miles. From 274,391 in 1886 the population decreased to 236,204 in 1901. There were in 1896 832 schools, with 27,000 pupils, and 6 per cent, of the population was illiterate. The area under cultivation amounted in 1896 to 1,393,700 acres, 751,200 of which were plough-land and 256,990 vineyards. There are few industries beyond the manufacture of the esteemed brandy of Armagnac, the distillation of which in 1898 amounted to 178,000 gallons. Auch, the capital, has a population of 11,500.

Gettysburg, capital of Adams county, Pennsyl- vania, U.S.A., on the Philadelphia and Reading and the Western Maryland railways. It was the scene of oneof the most important battles in the Civil War. This took place on 1st, 2nd, and 3rd July 1863, between the Union forces, numbering 78,043, under General Meade, and the Con- federates, numbering from 70,000 to 77,000, under General Lee, and resulted in the defeat of the

latter. The former lost in killed, ."072 ; wounded, 14,497 ; missing, 5434 ; total, 23,003. The latter lost in killed, 2592 ; wounded, 12,709 ; missing, 5150 ; total, 20,451. The site of the battle has been acquired by the general Government and made a national cemetery, in which the bodies of 3580 Union soldiers have been buried. It was at the dedication of this cemetery in November 1863 that President Lincoln delivered his celebrated " Gettysburg Oration." Popula- tion (1890), 3221 ; (1900), 3495, of whom 58 were foreign- born and 234 negroes.

Chadames. Chat. See Tripoli.

Chazipur, atown and district of British India, in the Benares division of the North- West Provinces. The town is on the left bank of the Ganges, 44 miles east of Benares. Population (1881), 32,885 ; (1891), 44,970 ; (1901), 39,186. Municii)al income (1897-98), Rs. 38,979. Death-rate (1897), (i0;Uperthousand. The District of Ghazipue has an area of 1462 square miles. It had a population in 1881 of 1,014,099, and in 1891 of 1,077,909, giving an average

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density of 737 persons per square mile. In 1901 the population was 914,148, showing a decrease of 11 per cent. The land revenue and rates were Es. 11, 81, 746, the incidence of assessment being R.1-2-8 per acre ; the cultivated area in 1896-97 was 568,410 acres, of which 188,348 were irrigated, mostly from wells ; the number of police was 2191 ; the number of vernacular schools in 1896-97 was 88, with 4336 pupils ; the registered death- rate in 1897 was 27 per thousand. There are 84 indigo factories, employing 2501 persons, with an annual out- turn valued at Rs.1,55,000, and three printing-presses. The main line of the East Indian railway traverses the southern portion of the district, with a branch to the Ganges bank opposite G-hazipur town, 35 miles in all.*

Chazni, a city of Afghanistan, 78 miles south-west of Kabul. Its position, as determined by recent surveys, is in 33◆◆ 33′ IsT. and 68◆◆ 28′ E., its altitude above sea-level being 7280 feet. It is still in the condition of decay which was described by Yate in 1875, and nothing substantially was added to our information regarding its condition or history by the investigations of the of&cers with Stewart's force, which passed upwards from Kandahar to Kabul in 1879, or with Eoberts's force, which passed downwards in 1880. A very considerable trade in fruit, wool, skins, &c., is carried on between Ghazni and India by the povindah Khafilas, which yearly enter India in the late autumn and pass back again to the Afghan highlands in the early spring. The povindah merchants belong chiefly to Nasir, Suliman Khel, and other Ghilzai clans. They invariably make use of the Gomul pass route which leads to the British frontier at Dera Ismail Khan. The opening up of this pass and the British occupation of Wana, by offering pro- tection to the merchants from Waziri blackmailing, largely increased the traffic. In 1890 the estimated value of imports and exports on the Gomul trade route was about 20 lakhs of rupees annually.

Cheel, a town of Belgium, in the province and 26 miles east of the town of Antwerp, with a station on the railway line between Herenthals and Moll. It is chiefly notable for its unique system of treatment for the insane, which dates from the 13th century. The asylum, a large structure flanked

by the residences of the medical staff, stands in well-kept grounds. The village proper, and each of ten neighbouring villages, is divided into two portions, for each of which a doctor and his assistant (a fully qualified practitioner) are appointed, with four sur- veillants, all being subordinate to the medical director of the colony. Patients on arrival enter the asylum, where for five days they are under observation. If at the end of that time it is judged advisable for them to enter a private family, great care is exercised in choosing a home for them. The local keepers, or nourriciers, are people of known good character, and the sanitary condi- tion of their houses is closely inspected, the surveillants being authorized to enter them at any hour of the day or night. The pensionnaires (private patients) are provided with regular occupation and recreation suited to their tastes and social position. There is an excellent Harmonic Society, in which sane and insane alike take part. 'So person with a tendency to suicide, homicide, or vicious habits is admitted into the colony. The cost of mainten- ance varies from 300 francs per annum for a pauper patient (defrayed by the district or parish to which he belongs), which includes his clothing, to 3000 or 4000 francs for patients of a higher class. The sum paid by patients to the inhabitants amounts to over 800,000 francs a year. Population (communal, 1899), 13,151.

Ghent (Flemish, Qent; French, Gand), capital of the Belgian province of East Flanders, at the confluence of the Lys and the Scheldt, which by their ramifications form many islands, 30 miles west-south-west of Antwerp. Since 1875 the narrow and unhealthy lanes in which the population was crowded together have given way to well- aired streets and elegant squares. Ancient buildings, such as the Hotel de Ville (14th century) and the Cathe- dral of St Bavon (12th century), have been partially restored. The vast ruins of the Count's Castle, of the 9th and the 12th centuries, covering 43,000 square feet, have been cleared of all the houses that abutted on it. The glacis of the citadel, erected by the Dutch in 1822, has been converted into a public park. New public build- ings have been raised, such as the Hotel du Gouverne- ment Provincial and the Institute of Sciences, comprising the laboratories of the Faculte des Sciences and technical schools in connexion with the university. The canal connecting Ghent with Terneuzen, on the Scheldt, in Holland (1827), has been widened and deepened (to a depth of 21-3 feet), and

united with three basins in the city and an outer harbour, to which in 1897 there en- tered as many as 1000 vessels. The two chief branches of industry are, first, textiles ??? cotton and linen spinning and weaving, employing 17,000 workers, 540,232 spindles for cotton, and 196,000 spindles for linen weaving. The second branch is the cultivation of ornamental plants ??? orchids, ferns, azaleas, &c. The grounds of a single establishment of this kind cover 49^ acres. The popu- lation, 131,000 in 1876, amounted to 163,000 in 1899, an increase in twenty -five years of 32,000, or 24 per cent.

Chika, Dimitrie (1816-1897), Eumanian states- man, son of the Wallachian Hospodar (or Prince) Gregor Ghika, was born on 31st May 1816. As a youth he studied at Vienna and Berlin, and obtained a commission in the Eussian Imperial Guard. After extensive travels through Europe he returned to Bucarest, and became a member of the Court of Appeal. He distinguished himself as prefect of police at Bucarest under Prince Stirbei, was a member of the Divan of 1867, and in 1859 had attained pro- minence enough to offer himself as a candidate for the princedom of Wallachia. He retired, however, in favour of Couza, under whom he held, in 1860, the office of minister of public instruction. In the following year he was minister of finance under Catargi, on the fall of whose ministry he became president of the council and minister of the interior. Under the rule of Charles of Hohenzollern, Ghika was soon called to office again as minister of the interior, and in 1868 formed a cabinet in which he held the portfolio of finance, and for a time that of foreign affairs. Going out of office in 1870, he was from 1871 to 1876 president of the Chamber. Hitherto he had been identified with the Conservatives, but he now combined with others to form a "central" party ; and when this was dissolved in 1879, he joined the Liberals, under whom he was president of the Senate till 1888. In that year the Liberal coalition broke up : Ghika made an unsuccessful attempt to form a Liberal and Dissident Liberal cabinet, and held no further office till the return of the Liberals to power in 1896. He then became once more president of the Senate, and held this post till his death, which took place at Bucarest on 27th February 1897. An adroit politician and a capable administrator, he played a leading part in the making of Eumania and in

its development as a constitutional monarchy, but left no great measure to keep alive his reputation as a states- man. (See Eumania.) (h. sy.)

Chika, Helene (1828-1888), Eumanian novelist, better known under her literary pseudonym "Dora

d'lstria," was born at Bucarest on 22nd January 1828, be- ing the daughter of Prince Michael (brother of Gregor) Ghika. Carefully educated under a Greek master, Grigor Pappadopulos, she showed herself such an apt pupil that, at the early age of fifteen, she commenced a translation of the Iliad into German. After continuing her educa- tion in Dresden, Venice, and Berlin, she married, in 1849, the Russian prince Kolzow Massalski, and settled with him in St Petersburg. After a few years of unhappy ◆◆◆ union, however, she separated from him and removed, in 1855, to Florence, which was her home until her death in 1888. During all the years of her residence in that city she was very busy with her pen, and published a number of works characterized by depth of research and brightness of description. Chief among them may be noted La vie monastique dans I'eglise Orientale (1855) ; La Suisse allermande (1856) ; Pilerinage au tomheau du Dante, describing the festival in honour of the anniversary of Dante's birth, to which she received an official invita- tion ; Les Lacs Helvitiques (1864). One of the last, and not least important, of her works was Gli Albanesi in Rumenia, Storia dei principi Ghika nei secoli, xvii., xviii., xix. (Plorence, 1873). She also wrote largely for the Revue des Deux Mondes, and was a contributor to Scrib- ner's Magazine.

Chika, Ion (1817-1897), Eumanian statesman and diplomatist, was born at Bucarest in 1817. From 1837 to 1840 he was a student in Paris, where he fell under the influence of the Liberal and Romantic movement, then at its height. Returning to Bucarest, he joined the ranks of the Opposition, and in 1841 was concerned in the conspiracy of Ibraila. From 1843 to 1845 he was professor of mathematics and political economy in the university of Jassy, and in 1844 helped his lifelong friend Vasilie

Alecsandri to found the Liberal journal Progresul, which was speedily suppressed by the Govern- ment. He took a prominent part in the Revolution of 1848, and was sent by the provisional Government as chargi d'affaires to Constantinople. Here he won the confidence of Lord Stratford de Redcliffe, on whose re- commendation he received from the Sultan in 1854 the appointment of governor of Samos. The neighbouring seas, at that time infested with pirates, were swept clear by the untiring energy of Ghika, who thus rendered an important service to the Allied forces at the time of the Crimean War. He received in 1856 the title of prince of Samos, and continued to rule the island with conspicuous success till 1857. After a brief tenure of ministries in Moldavia and Wallachia, he returned to Bucarest, and became the leader of the Liberal party. As president of the council and minister for foreign affairs in the provisional Government of 1866, he played the chief part in the nomination of Charles of Hohenzollern as prince of Rumania, and became the first prime minister of the new rigime. Forced to resign in 1867 by a vote of want of confidence, he joined the Opposition, and took part in the Republican movement of 1870. In December of that year he again became prime minister, but in the following March, being im- plicated in the attempt to overthrow Prince Charles, was dismissed from office. After repeatedly holding the vice- presidency of the Senate, he was in 1881 appointed Rumanian minister in London, where his brilliant powers of intellect and profound sympathy with Western culture gave him a distinguished place in society. He retired in 1890, and died at his estate GherganI on 4th May 1897. Prince Ion Ghika ranks high among Eumanian authors for his charm of style and power of graphic representa- tion ??? qualities best displayed in his correspondence with Vasilie Alecsandri. Many of these letters are of prime im-

portance to the student of Eumanian economic problems. Equally noteworthy are his Convorbiri Economid, and his work in collaboration with D. Sturza, Ajutorul Co- merciantlui. His position as a writer was recognized by his election to the presidency of the Rumanian Academy. The ability he displayed in so many different fields of activity entitles him to be called the most remarkable man Rumania has yet produced ; and, if he did not al- ways keep clear of the intrigues and inconsistencies of

Balkan politics, he yet was in no small degree the author of his country's prosperity. (See Rumania.) (h. sy.)

Giant's Causeway, a promontory of columnar basalt on the north coast of county Antrim, Ireland. In 1883 an electric railway, the fii'st in the United Kingdom, was opened for traffic, connecting the Causeway with Portrush and Bushmills. After a protracted lawsuit the Causeway, and certain land in the viciaity, have been declared to be private property, and a small charge is now made for admission.

Cibara, one of the old fortified north-coast cities of the eastern province of Cuba, 80 miles north by west of Santiago de Cuba. It has an extensive banana export trade, and lays claim to have been originally discovered by Columbus. Population about 7000.

Gibbons, James (1834), cardinal of the

Roman Catholic Church and American archbishop, was born in Baltimore, Md., 23rd July 1834, and baptized in the cathedral over which he was afterwards destined to preside. Entering St Charles College, Md., he completed there his classical studies in 1867, and passed to St Mary's Seminary, Baltimore, where he finished his theological training and was ordained priest 30th June 1861. After a short time spent on the missions of Baltimore, he was called to be secretary to Archbishop Spalding and assist- ant at the cathedral. When, in 1866, the Second Plenary Council of Baltimore considered the matter of new diocesan developments, he was selected to organize the new Vicariate Apostolic of isTorth Carolina, and was consecrated bishop in August 1868. He devoted four years to missionary work, preaching, lecturing, and organizing with great success. During the years spent in North Carolina he wrote, for the benefit of his mission work, TJie Faith of our Fathers, a simple, scholarly presentation of the doctrines and principles of the Catholic Church. He was transferred to Richmond, Va., in 1872, and in 1877 was made coadjutor to Archbishop Bayley of Balti- more. In October of the same year he succeeded to the archbishopric. Pope Leo XIII. in 1884 selected him to preside over the Third Plenary Council of Baltimore, and in June 1886 created him a cardinal priest, with the title of Santa Maria Trastevere. His simplicity of life, fore- sight, and prudence have made him a power in the

Church. Thoroughly American, and a lover of the people, he is in close touch with all that tends to benefit the nation and to ennoble its citizenship, and his public utterances manifest the true instincts of a popular leader. He has contributed frequently to the leading magazines. As an author he is known principally by his works on religious subjects. The Faith of our Fathers has passed through forty edi- tions; his other books are Our Christian Heritage and Tlie Ambassador of Christ. He had been for many years an ardent advocate for the establishment of a Catholic University, but it was not until the Third Plenary Council of Baltimore, 1884, that he saw the realization of his desires in the establishment of the Catholic University of America at Washington. He enjoyed the distinction of being its first chancellor and president of the board of trustees. (^ t. j. c.)

GIBRALTAE

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Gibraltar, a British fortress and Cro-wn colony at the western entrance to the Mediterranean. The southern point of the rock is known as Europa Point, in longitude 5 21' 0" W., latitude 36 6' 30" N., and 11^ nautical miles distant from the opposite African coast. The town is crowded together at the north-west angle, and covers about one-ninth of the whole area ; a small part only of the town is on level ground, and those of its narrow streets and lanes which run away from the shore of the bay are for the most part little more than ramps and rough stairs formed of rubble stones, which con- tract in places into mere stone steps. The climate of Gibraltar is pleasant, mild in winter and only moder- ately hot in summer ; the heat, however, though not excessive is lasting, and rain seldom falls in the five months from May to September ; from October to May the climate is generally delightful, warm sunshine prevailing, tempered by cool breezes ; the periods of bad weather, although blustering enough at times, are seldom of more than a few days' duration. The thermometer in summer rarely reaches 90 in the shade ; from 83 to 86 may be taken to be the average maximum for July and August, which are the hottest months. The average annual rainfall is 37-56 inches, and in twenty years, from 1880 to 1899, the

heaviest recorded rainfall was 59-36 inches, and the lightest 16-76. Although the number of persons employed in and dependent upon Gibraltar has of late considerably increased, especially since the new dockyard works were begun in 1895, the population actually resident has not grown. As Crown leases, of which there are many, fall in they are often not renewed ; and as houses are rebuilt they are adapted for a better class of tenant, and so the poorer classes are being gradually driven out, and go to live in the adjoining Spanish town of Linea de la Concepcion, which, itself a mere suburb of Gibraltar, is said to contain some 40,000 inhabitants, or nearly twice the population of the mother city. It has been estimated that some ten thousand workers come daily from Linea to Gibraltar. The popu- lation (1900) was estimated at 24,701 ; the garrison and its families account for nearly 6000, the civil population numbers not quite 17,000, and there are about 2400 resi- dent aliens, chiefly working men, domestic servants, and professional men. Aliens, who are not duly accredited consuls, are not allowed to reside without a special permit signed by the chief of police, which has to be renewed every three months ; and by an Order in Council, taking effect from November 1900, like disabilities were extended to British subjects not previously resident. When Gib- raltar was taken by the British most of the Spanish in- habitants left. The bulk of the present inhabitants are of Italian or Genoese descent ; ihere are a fair number of Maltese, and two or three thousand Jews : these never intermarry with other races, and form a society of their own. The language is Spanish, spoken not very cor- rectly. English is in every case an acquired language, and is hardly, if ever, spoken by the people in their own homes.

The recorded births, marriages, and deaths are as follows : ???

Births.

Marriag^es.

Deaths.

1883 .

640

190

525

1888 .

645

163

474

1893 .

651

149

404

1899 .

657

208

511

Gibraltar is a Crown colony. Of local government, properly so called, there is none. There is a sanitary commission, which is vested with large powers over build-

ings and streets, like those of local authorities in England. Its members are for the most part nominees of the Government, with little or no knowledge of the rights of owners of property. An appeal from their decisions lies to the supreme court, but as their decisions are not always made known to those injuriously affected by them within the time limited for appeal, the protection is of no special value. Apart from the garrison and the civil officials, there are comparatively few members of the

Anglican Church ; the great majority of the in- habitants belong to the Roman communion. The Jews have four synagogues. The Protestant dissenters have two places of worship, Presbyterian and Wesleyan. Education is not compulsory for the civil population, but most if not all children receive a fair education at private or private-aided schools. The number of children on the roll of the private-aided schools was, in 1899, 1086 boys and 732 girls ; total, 1818. There is no direct taxation. The main sources of revenue are : (i.) duties upon wines, spirits, malt liquors, and tobaccos; (ii.) port and harbour dues ; (iii.) tavern and other licenses ; (iv.) posts and telegraphs ; (v.) ground and other rents ; (vi.) stamps and miscellaneous. The returns prior to 1898 are given in pesetas (5 = $), which have been converted in the following table into sterling at an average of exchange 30 = ??1.

(i.)

(U.)

(iii.)

(iv.)

(V.)

(vi.)

Total Revenue.

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<u>1883 .</u>

<u>8,092</u>

<u>15,404</u>

<u>4,842</u>

<u>737</u>

<u>7,079</u>

<u>4,479</u>

<u>40,634</u>

<u>1888 .</u>

<u>9,732</u>

<u>18,446</u>

<u>5,288</u>

<u>6,444</u>

<u>6,472</u>

<u>3,004</u>

<u>49,386</u>

<u>1893 .</u>

<u>9,050</u>

12,843

4,474

7,382

6,268

10,745

50,762

1899 .

18,245

6,179

4,053

9,191

6,931

16,.355

59,954

Before 1886 the colony derived no revenue from the post office, which was administered from London as a branch of the General Post Office. The deprecia- tion of the Spanish currency during the war with the United States led, in 1898, to the reintroduc- tion of British currency as the legal tender money of Gibraltar. An indirect result of this was a large increase in the revenue of the post office, the old issues of postage stamps in Spanish currency being largely bought by stamp dealers and collectors. Notwith- standing the legal change of currency, the Spanish dollar still remains the current coin in everyday use; much of the retail business of the town being done with people living in Spain, the dollar more than holds its own.

Great changes have been made in the defences of Gibraltar during recent years. Guns of the older types have been removed and replaced by those of the latest pattern. The heaviest pieces, instead of being at or near the sea-level, are now high up, many of them upon the very crest-ridge of the rock, 1200 or 1300 feet above the sea. Guns so placed have a great advantage over an enemy's ships, the decks, the weakest part of the ship, being exposed to the plunging fire of the higher-placed guns. Guns on the crest-line have the further ad- vantage of being able to fire all round the horizon; an elaborate system of range-finding has been carefully worked out. With the completion of the new docks and works (see Dockyards) the importance of Gibraltar as a naval base will be greatly increased. The new dockyard will be able to undertake all the repairs of a squadron. There will be an enclosed harbour, in which a fleet can anchor secure from the attacks of torpedo boats. As part of the same scheme commercial wharves are being constructed for coaling steamers alongside, and the load- ing and discharging of cargo. There will be from 30 to*

35 feet of water over the enclosed area at low water ordinary spring tides. Three dry docks, from 460 to 850 feet in available length, will provide for the simul- taneous repair of three or four vessels ; these will be at the south eud of the harbour. At the north end will be the commercial wharves, at which a considerable number of vessels will be able to coal or load and unload at one time in 30 feet of water. With the defences the food and water supply is in close connexion. Cold stores have been erected, in which frozen meat can be kept for an indefinite period. The water supply has also been largely increased. There are very few good wells in Gibraltar ; nearly all the water used for drinking and cooking con- sists of rain water stored in tanks underground ; most of the better class of houses have their own rain-water tanks, and there are large tanks belonging to the war department for the supply of the garrison. Large additional storage tanks have been constructed by the sanitary commission, with specially prepared collecting areas high up the rock. The collecting areas have been enlarged from 3 to 16 acres, and the

capacity of the storage tanks from 1-| to 6^ million gallons. The tanks are excavated from the solid rock ; the water will thus be kept in the dark and cool, and secure from the effects of an enemy's fire.

The general trade of Gibraltar has undergone little change of late years : one must go a long way back to find a time when there was much active business. At the point of contact of two continents, on the direct line of ocean trade with the Far East, in regular steam com- munication with Korth and South America, Gibraltar is by its position fitted to be a trade centre of the world ; but the dead hand of Islam upon Morocco and protection in Spain have strangled commerce. There are no trust- worthy statistics of the trade : up to the year 1898 wine, beer, and spirits were the only goods which paid duty. In that year a duty of Id. per pound was for the first time put upon tobacco, and produced ►►1444. This duty was in force during part only of the year 1898 ; in 1899 the duty at the same rate produced ►►7703. The chief business is the coaling of passing steamers ; this gives work to several thousand men. Goods are also landed for re-export to Morocco, but the bulk of the Morocco trade, much of which formerly came to Gibraltar, is now done by lines of steamers trading to and from Morocco direct to British, German, or French ports. A fair amount of retail business is done with the passengers of ocean steamers which call on their way to and from the East and from North and South America. The steam tonnage cleared is shown in the following table : ►►►

BritiBli.

Foreign.

Total.

1883 . 1888 . 1893 . 1899 .

Tons.

3,771,075 5,033,088 3,521,164 3,214,965

Tons.

859,711

876,489

1,036,696

1,048,536

Tons.

4,630,786 5,909,577 4,557,860 4,263,501

The money, weights, and measures in legal use are British. Before 1898 Spanish money only was used, and though no longer legal it keeps its hold on the people, so that there is practically a double coinage.

To the works mentioned in the ninth edition of the Encydopcedia Britannica, vol. x., may be added : ??? Monthrh. Historia de Gibraltar. Cadiz, 1860. ??? Colonel Irby. Ornithology of the iStr

Ciers, Nicholas Karlovitch de (1820-1896), Russian minister for foreign afiiairs, was born on the 21st of May 1820. Like his predecessor, Prince Gortcha- koff, he was educated at the lyceum of Tsarskoe Selo, near St Petersburg, but his career was much less rapid, because he had no influential protectors, and was handi- capped by being a Protestant of Teutonic origin. At the age of eighteen he entered the service of the Eastern department of the ministry of foreign affairs, and spent more than twenty years in subordinate posts, chiefly in South-eastern Europe, until he was promoted in 1863 to the post of minister plenipotentiary in Persia. Here he remained for six years, and, after serving as a minister in Switzerland and Sweden, he was appointed in 1876 director of the Eastern department and assistant minister for foreign affairs under Prince Gortchakoff, whose niece he had married. No sooner had he entered on his new duties than his great capacity for arduous work was put to a severe test. Besides events in Central Asia, to which he had to devote much attention, the Herzegovinian insurrection had broken out, and he could perceive from secret ofi&cial papers that the incident had far-reaching ramifications unknown to the general public. Soon this

became apparent to all the world. While the Austrian officials in Dalmatia, with hardly a pretence of concealment, were assisting the insurgents, Eussian vol- unteers were flocking to Servia with the connivance of the Russian and Austrian Governments, and General Ignatieff, as ambassador in Constantinople, was urging his Government to take advantage of the palpable weak- ness of Turkey for bringing about a radical solution of the Eastern question. Prince Gortchakoff did not want a radical solution involving a great European war, but he was too fond of ephemeral popularity to stem the cur- rent of popular excitement. Alexander II., personally averse from war, was not insensible to the patriotic enthusiasm, and halted between two opinions. M. de Giers was one of the few who gauged the situation accurately. As an official and a man of non-Russian extraction he had to be extremely reticent, but to his intimate friends he condemned severely the ignorance and light-hearted recklessness of those around him. The event justified his sombre previsions, but did not cure the recklessness of the so-called patriots. They wished to defy Europe in order to maintain intact the treaty of San Stefano, and again M. de Giers found himself in an unpopular minority. He had to remain in the background, but all the influence he possessed was thrown into the scale of peace. His views, energetically supported by Count Schuvaloff, finally prevailed, and the European congress assembled at Berlin. He was not present at the congress, and consequently escaped the popular odium for the concessions which Russia had to make to Great Britain and Austria. From that time he was practically minister of foreign affairs, for Prince Gortchakoff was no longer capable of continued intel- lectual exertion, and lived mostly abroad. On the death of Alexander II. in 1881 it was generally expected that M. de Giers would be dismissed as deficient in Eussian nationalist feeling, for Alexander III. was credited with strong anti-German Slavophil tendencies. In reality the young Tsar had no intention of embarking on wild political adventures, and was fully determined not to let his hand be forced by men less cautious than himself. What he wanted was a minister of foreign affairs who would be at once vigilant and prudent, active and obedient, and who would relieve him from the trouble and worry of routine work while allowing him to control the main lines, and occasionally the details, of the national policy. M. de Giers was

exactly what he wanted, and accord- ingly the Tsar not only appointed him minister of foreign

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G I E S S E N ? ? ? G I L B E E T

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affairs on the retirement of Prince Gortchakoff in 1882, but retained him to the end of his reign in 1894. In accordance with the desire of his august master, M. de (iiers followed systematically a pacific policy. Accepting as a fait cuscompli the existence of the Triple Alliance, created by Bismarck for the purpose of resisting any aggressive action on the part of Russia and France, he sought to establish more friendly relations with the cabi- nets of Berlin, Vienna, and Rome. To the advances of the French Government he at first turned a deaf ear, but when the rapprochement between the two countries was effected with little or no co-operation on his part, he util- ized it for restraining France and promoting Russian interests. In private life M. de Giers had none of the brilliancy of his illustrious predecessor. To the outside world he seemed a taciturn, solemn, and rather common- place person, who had few human sympathies, and whose idea of happiness was to sit in his chancellery surrounded with heaps of official documents. Those who knew him well were aware that his somewhat uncouth exterior cov- ered many amiable qualities, and that his habitual care- worn expression concealed a good deal of quiet humour. He died on 26th January 1895, soon after the accession of Nicholas II. (p. m. w.)

Ciessen, a town and important railway jimction of Germany, grand-duchy of Hesse-Darmstadt, on the Lahn, 41 miles by rail north from Frankfort-on-Main. The town hall contains the collections of the Upper Hessian Historical Association ; the Arsenal is now used as bar- racks. There is a new Evangelical church (1891). In 1889 new buildings were erected for the university, and in 1887-90 new medical schools. In 1900 the university was attended by 855 students, and had 82 professors. The old university buildings have been appropriated to the library, containing about 200,000 volumes. Giessen is the seat of an agricultural college. It has also a mon- ument to von Liebig, the chemist, who was professor here from 1824 to 1852. There is a large lignite mine in the vicinity, and large tobacco and cigar factories in the town. Population (1885), 18,836 ; (1900), 25,664.

Cifu, or Imaizumi, a city of Japan, capital of the ken (government) of Central Nippon, which comprises the two provinces of Mino and Hida. It lies east by north of Lake Biwa, on the Central railway, about 172 miles from Tokyo and 64 miles from KyotQ, on a tributary of the Kiso, which flows to the Bay of Mia TJro. Popula- tion (1880), 12,500 ; (1898), 31,000. The ken has an area of about 4000 square miles, and is thickly peopled, with a population of over 1,000,000 in 1900. The whole dis- trict is subject to frequent earthquakes, and Gifu was nearly ruined during the disturbances which lasted from October 1891 to March 1892, when as many as 2588 shocks were registered at this place.

Cijori, a Spanish seaport on the Bay of Biscay, in the province of Oviedo. Population (1897), 43,392. Im- portant works have been in progress since 1892 to create an excellent harbour of refuge at Musel, at the extremity of the bay of Gijon, which will also be a mineral load- ing port, capable of accommodating vessels of any size. More than a quarter of the works have been completed, and they have already attracted much trade. The value of the import trade was ££384,440 in 1898, Great Britain figuring for ££160,743. The principal imports were ma- chinery, iron, and metal work, and iron ore for the works at Mieres, Duro, and Moreda. The exports in 1898 were valued at ££122,200, the United Kingdom taking ££28,349. With the increasing output of coal in the province, Gijon exported 302,217 tons of coal in 1898, being an increase of 26,826 tons

since 1897. The shipping in 1898 num- bered 1980 vessels of 313,000 tons. The town has grown

apace, not only with the movement of the port, but with the summer influx of people, who come for the bathing. New suburbs have sprung into existence, broader streets have been built, the public gardens improved, statues raised to the memory of Jovellanos and Pelayo, duke of Asturias, and a new town hall, theatre, and markets erected. The bull-ring, recently restored, can hold 12,000 persons. Besides the institute, Gijon has a nautical school, a school of arts and handicrafts, and numerous primary schools educating large numbers of children. The glass factory is the best in Spain ; por- celain factories, iron works, and petroleum refineries are in a flourishing condition; manufactures of preserves, soap, candles, chocolate, and liqueurs are among the ris- ing local industries.

Cilan (GMlan), one of the northern provinces of Persia, on the south-west shore of the Caspian, between 36 20' and 38 30' N., and 48 60' and 50 30' E. It is divided into the following administrative districts : Rasht (with the capital of the province and its imme- diate neighbourhood), Fuman (with Tulam and Masulah, where are iron mines), Gesker, T^lesh (with Talesh, Diilib, Shandarman, Asalom, Gil DuMb, Karg^nrud, Masai, Enzeli, the port of Rasht), Sheft, Manjil (with Rahmat^bSid and Amarlii), Langarud (with Riidsar and R^nehkiih), Dilmdln, and Lashtnishah (on the lower Safid riid). Gil^n means " land of the Gil," and the Gil were an old tribe which the ancient Greeks mentioned as the Gelae. A man of GiMn is called a " Gilek," and the dialect which he speaks is " Gileki." The land-tax paid by the province is 48,840, or 14,560 less than in 1876. The value of the exports and imports from and into Gilin, much of them in transit, is about 1,860,000. The Government abolished the farm system in Gilan in March 1900, in the hope that the customs dues would yield a considerably higher revenue. The Crown lands of Gilan have been much neglected, and the revenue de- rived from them is stated to amount to no more than 153,500 krans, or a little over 3000. The fisheries of the whole Persian littoral of the Caspian, having been conceded to a Russian firm for an annual payment of 16,000, which is paid direct into the Treasury, cannot be considered as revenue of Gilan.

Gilbert, Sir John (1817-1897), English painter and illustrator, was one of the eight children of George Felix Gilbert, a member of a Derbyshire family. He was born at Blackheath on the 21st of July 1817,went to school there, and even in childhood, without any instruction what- ever, displayed an extraordinary fondness for drawing and painting. Nevertheless, his father's lack of means com- pelled him to accept employment for the boy in the office of Messrs Dickson & Bell, estate agents, in Charlotte Row, London. It was even then clear that he possessed, as if by nature, an amazing power of dramatically realiz- ing siibjects the pictorial qualities of which he intuitively recognized, and that " the young Gilbert thought in pic- tures." Yielding to his natural bent, his parents agreed that he should take up art in his own way, which included but little advice from others, his only teacher being Haydon's pupil, George Lance, the fruit painter. This artist gave him brief instructions in the use of colour. Gilbert, who studied in none of the schools, worked inde- fatigably, in a somewhat florid mood, from nature, and thus like an old master attained such skill that no artistic methods came amiss to him, while, like Millais, "he thought out his subjects by instinct." In 1836 Gilbert appeared in public for the first time. This was at the gallery of the Society of British Artists, where he sent drawings, the subjects of which were characteristic, being " The Arrest of Lord Hastings," from Shakespeare,

and "Abbot Boniface," from Tlie Monastery of Scott. " Inez de Castro " was in the same gallery in the next year ; it was the first of a long series of works in the same medium, representing similar themes, and was accom panied, from 1837, by a still greater number of works in oil which were exhibited at the British Institution. These included " Don Quixote giving advice to Sancho Panza," 1841 ; " Brunette and Phillis," from Tlie Spectator, 1844 ; " The King's Artillery at Marston Moor," 1860 ; and " Don Quixote comes back for the last time to his Home and Family,"- 1867. In that year the Institution was finally closed. Gilbert exhibited at the Eoyal Academy from 1838, beginning with the " Portrait of a

Gentleman," and continuing, except between 1851 and 1867, till his death to exhibit there many of his best and more ambitious works. These included such capital instances as " Hol- bein painting the Portrait of Anne Boleyn," "Don Quixote's first Interview with the Duke and Duchess," 1842 ; "Charlemagne visiting the Schools," 1846. " Touch-stone and the Shepherd," and " Rembrandt," a very fine piece, were both there in 1867 ; and in 1873 " Naseby," one of his finest and most picturesque designs, was also at the Eoyal Academy. Gilbert was elected A.K.A. 29th January 1872, and E.A. 29th June 1876. Besides these mostly large and powerful works, the artist's true arena of display was undoubtedly the gallery of the Old Water Colour Society, to which from 1852, when he was elected an Associate exhibitor, till he died forty-five years later, he contributed not fewer than 270 drawings, most of them admirable because of the largeness of their style, massive coloration, broad chiaroscuro, and the surpassing vigour of their designs. These qualities won for him the title of "The Rubens of his time," and, taken with the great distinction of his works on larger scales, induced the lead-ing critics to claim for him opportunities for painting mural pictures of great historic themes as decorations of national buildings. " The Trunipeter," " The Standard- Bear er," "Richard II. resigning his Crown" (now at Liverpool), " The Drug Bazaar at Constantinople," " The Merchant of Venice," and " The Turkish Water-Carrier," are but examples of that wealth of art which added to the attractions of the gallery in Pall Mall. There Gilbert was elected a full Member in 1855, and president of the Society in 1871, shortly after which he was knighted. Gilbert, as an illustrator of books, magazines, and periodi- cals of every kind, including newspapers, produced an astounding number of designs, all of which possessed extraordinary value, nor did he repeat himself in any. Energy, abundance of invention, and picturesqueness existed in all of them; yet their multitude did not affect his painting pictures, nor exhaust his powers in the least degree. To the success of the Illustrated London News his designs lent powerful aid, and he was eminently serviceable in illustrating the Shakespeare of Mr Howard Staunton. He illustrated a great proportion of the dra- matic literature and poetry of England, and of other coun- tries besides. Sir John Gilbert died 6th October 1897. He was a member of many artistic societies besides those mentioned above, and was a Knight of the Legion of Honour. (f. g. s.)

Gilbert, Sir Joseph Henry (1817-1901), Eng- lish chemist, was born at Hull on 1st August 1817. He studied chemistry first at Glasgow under Thomas Thomson, then at University College, London, in the laboratory of A. T. Thomson, also attending Graham's lectures, and finally at Giessen under Liebig. On his return to England from Germany he acted for a year or so as assistant to his old master A. T. Thomson at University College, and in 1843, after spending a short

time in the study of calico dyeing and printing near Manchester, accepted the directorship of the chemical laboratory at the famous experimental station established by Sir J. B. Lawes at Eothamsted, near St Albans, for the systematic and scientific study of agriculture. This position he held for fifty-eight years, until his death on 23rd December 1901. The work which he carried out during that long period in collaboration with Sir John Lawes was of a most comprehensive character, involving the application of many branches of science, such as chemistry, meteorology, botany, animal and vegetable physiology, and geology ; and its infiuence in improvLug the methods of practical agriculture extended all over the civilized world. Some account of the results obtained will be found in the article Agbicultueb. Sir Joseph Henry Gilbert was chosen a fellow of the Royal Society in 1860, and in 1867 was awarded a Royal medal jointly with Sir John Lawes. In 1880 he presided over the Chemical Section of the British Association at its meeting at Swansea, and in 1882 he was president of the Chemical Society, of which he had been a member almost from its foundation in 1841. For six years from 1884 he filled the Sibthorpian chair of rural economy at Oxford, and he was also an honorary professor at the Royal Agricultural College, Cirencester. He was knighted in 1893, the year in which the jubilee of the Rothamsted experiments was celebrated.

Gilbert, William Schwenk (1836), Eng- lish playwright and humorist, son of William GUbert (a descendant of Sir Humphrey Gilbert), was born in London on the 18th of November 1836. His father was the author of a number of novels, the best known of which were Shirley Hall Asylum (1863) and Dr Austin's Guests (1866). Several of these novels ??? which were characterized by a singular acuteness and lucidity of style, by a dry, subacid humour, by a fund of humani- tarian feeling, and by a

considerable medical knowledge, especially in regard to the psychology of lunatics and monomaniacs ??? were illustrated by his son, who developed a talent for whimsical draughtsmanship. Young Gilbert was educated at Boulogne, at Ealing, and at King's College, graduating B.A. from the University of London in 1856. The termination of the Crimean war was fatal to his project of competing for a commission in the Royal Artillery, but he obtained a post in the Education Department of the Privy CouncU Office (1857-61). Dis- liking the routine work, he left the Civil Service, entered the Inner Temple, was called to the bar in November 1864, and joined the northern circuit. His practice was inconsiderable, and his military and legal ambitions were eventually satisfied hj a captaincy in the volunteers and appointment as a magistrate for Middlesex (June 1891). In 1861 the comic journal Ftin was started by H. J. Byron, and Gilbert became from the first a valued con- tributor. Palling to obtain an entire to Punch, he continued sending excellent comic verse to Fun, with humorous illustrations, the work of his own pen, over the signature of " Bab." A collection of these lyrics, in which deft craftsmanship unites a titillating satire on the deceptive- ness of appearances with the irrepressible nonsense of a Lewis Carroll, was issued separately in 1869 under the title of Bab Ballads, and was followed by More Bab Ballads. The two collections and Songs of a Savoyard were united in a volume issued in 1898, with many new illustrations. The best of the old cuts, such as those depicting the "Bishop of Rum-ti-Foo" and the "Dis- contented Sugar Broker," were happily preserved intact.

While remaining a staunch supporter of Fun, Gilbert was soon immersed in other journalistic work, and his

position as dramatic critic to the Illustrated Times turned his attention to the stage. He had not to wait long for an opportunity. Early in December 1866 T. W. Robert- son was asked by Mjss Herbert, lessee of the St James's Theatre, to find some one who could turn out a bright Christmas piece in a fortnight, and suggested Gilbert; the latter promptly produced Dulcamara, a burlesque of L'Elisire d'Amore, written in ten days,

rehearsed in a week, and duly performed at Christmas. He sold the piece outright for ►►30, a piece of rashness which he had cause to regret, for it turned out a commercial success. In 1870 he was commissioned by Buckstone to write a blank verse fairy comedy, based upon Le Palais de la VirM, the novel by Madame de Genlis. The result was The Palace of Truth, a fairy drama, poor in structure but clever in workmanship, which served the purpose of Mr and Mrs Kendal in 1870 at the Haymarket. This was followed in 1871 by Pygmalion and Galatea, another three-act " mythological comedy," a clever and effective but artificial piece. Another fairy comedy. The Wicked World, written for Buckstone and the Kendals, was followed in March 1873 by a burlesque version, in collaboration with Gilbert a Beckett, entitled The Happy Land. Gilbert's next dramatic ventures inclined more to the conventional pattern, combining sentiment and a cynical humour in a manner strongly reminiscent of William Gilbert the novelist. Of these pieces, Sweethearts was given at the Prince of Wales's Theatre, 7th November 1874 ; Tom Oobb at the St James's, 24th April 1875; Broken HeaHs at the Court, 9th December 1875 ; Dan'l Druce (a drama in darker vein, suggested to some extent by Silas Marner) at the Haymarket, 11th September 1876 ; and Engaged at the Haymarket, 3rd October 1877. The first and last of these proved decidedly popular. Gretchen, a verse drama in four acts, appeared in 1879. A one-act piece, called Comedy and Tragedy, was produced at the Lyceum, 26th January 1884. Two dramatic trifles of later date were Foggerty's Fairy and Rosenkrantz and Ghiildenstem, a travesty of Ham- let, performed at the Vaudeville in June 1891. Several of these dramas were based upon short stories by Gil- bert, a number of which had appeared from time to time in the Christmas numbers of various periodicals. The best of them have been collected in the volume entitled Foggerty's Fairy, and Other Stories. In the autumn of 1871 Gilbert commenced his memorable col- laboration (which lasted over twenty years) with Sir Arthur Sullivan. The first two comic operas, Thespis; or The Oods grown Old (26th September 1871) and Trial by Jury (Royalty, 25th March 1876) were merely essays. Like one or two of their successors, they were, as regards plot, little more than extended "Bab Ballads." Later (especially in the Yeomen of the Onard), much more elaboration was attempted. The next piece was pro- duced at the Op^ra Comique (17th November 1877) as The Sorcerer. At the same theatre were successfully given H.M.S. Pinafore (25th May 1878), The

Pirates of Penzance; or The Slave of Duty (3rd April 1880), and Patience; or Bunthome's Bride (23rd April 1881). In October 1881 the successful Patience was removed tp a new theatre, the Savoy, specially built for Gilbert and Sullivan by Richard D'Oyly Carte. Patience was fol- lowed, on 25th November 1882, by lolanthe; or TJie Peer and the Peri; and then came, on 6th January 1884, Prin^ cess Ida; or Castle Adamant, a re-cast of a charming and witty fantasia which Gilbert had written some years pre- viously, and had then described as a " respectful perver- sion of Mr Tennyson's exquisite poem." The impulse reached its fullest development in the operas that followed next in order ??? The Mikado; or Tlie Town of Titipu

(14th March 1886) ; Ruddigore (22nd January 1887) ; The Teomen of the Guard (3rd October 1888) ; and Tlie Gon- doliers (7th December 1889). After the appearance of The Gondoliers a temporary misunderstanding occurred between the composer and librettist. Gilbert wrote several more librettos, and of these Utopia Limited (1893) and the exceptionally witty Grand Duke (1896) were written in con- junction with Sullivan. Yet there were many to whom it seemed that the old spell was broken. The plan of para^- dox and musical theme upon which the partners had hith- erto relied was becoming too well worn, and no ingenuity could disguise the repetition of devices and methods, tricks of jest and of rhythm, which they had taught their sincerest admirers to anticipate. As a master of metre Gilbert had shown himself consummate, as a dealer in quips and paradoxes and ludicrous dilemmas, unrivalled. Even for the music of the operas he de- serves some credit, for the rhythms were frequently his own (as in "I have a Song to Sing, 0"), and the metres were in many cases invented by himself. One or two of his librettos, such as that of Patience, are virtually flawless. Enthusiasts are divided only as to the comparative merit of the operas. Princess Ida and Patience are in some respects the daintiest and the most idyllic. There seems a genuine, if limited, vein of poetry in The Yeomen of the Guard. Some of the drollest songs are in Pinafore and Ruddigore. The Gondoliers has the most charming ligh-eti, while with the general public The Mikado proves the most popular.

Cilgit, an outlying province in the extreme north- west of India, over which Kashmir has reasserted her sovereignty. Only a part of the basin of

the river Gilgit is included within its political boundaries. There is an intervening width of mountainous country, represented chiefly by glaciers and ice-fields, and intersected by narrow sterile valleys, measuring some 100 to 160 miles in width, to the north and north-east, which separates the province of Gilgit from the Chinese frontier beyond the Muztagh and Karakoram. This part of the Kashmir borderland includes Kanjut (or Hunza) and Ladak. To the north- west, beyond the sources of the Yasin and Ghazar in the Shandur range (the two most westerly tributaries of the Gilgit river), is the deep valley of the Yarkhun or Chitral. Both Kanjut (or Hunza) and Chitral are included within the sphere of the Gilgit Agency, which, as a branch of the Kashmir Agency, extends British influence over the whole borderland south of Afghanistan and China. Chitral, Yasin, Panyal, the Gilgit valley, Hunza and Nagar, Astor, and the Indus valley from Bunji to Batera, together with the hills of the upper Panjkora and Swat, all fall within the political sphere of the British Agency at Gilgit, although the political boundaries of Kashmir administration only enclose the lower Gilgit valley and a portion of the Indus valley bordering Chilas.

Within these wider limits of the Agency are many mixed races, speaking eleven different languages, which have all been usually classed together under the name Dard. The Dard, however, is unknown beyond the limits of the Kohistan district of the Indus valley to the south of the Hindu Koh, the rest of the inhabitants of the Indus valley belonging to Shin republics, or Shinaka. The great mass of the Chitral population are Kho (speaking Khowar), and they may be accepted as representing the aboriginal population of the Chitral valley. (See Hindu Kush.) Between Chitral and the Indus the "Dards" of Dardistan are chiefly Yeshkuns and Shins, and it would appear from the proportions in which these people occupy the country that they must have primarily moved up from the valley of the Indus in successive waves of conquest, first the

Yeshkuns, and then the Shins. No one can put a date to these invasions, but Biddulph is inclined to class the Yeshkuns with the Yuechi who conquered the Baktrian kingdom about 120 b.c. The Shins are obviously a Hindu race (as is testified by their veneration for the cow), who spread themselves northwards and eastwards as far as Baltistan, where they collided with the aboriginal Tatar of the Asiatic highlands. But the ethnography of " Dar- distan," or the Gilgit Agency (for the two are, roughly speaking, synonymous), requires further investigation, and it would be premature to attempt to frame anything like an ethnographical history of these regions until the neighbouring provinces of Tangir and Dar61 have been more fully examined. No material exists on which even an approximate estimate of the population of that rough tract of country which is comprised within the Gilgit Agency can be based. The area of the Gilgit valley falling directly under Kashmir administration is about 2000 square miles, but the total area of those border dis- tricts over which British political influence extends can- not be less than 30,000.

In general appearance and dress all the mountain-bred peoples extending through these northern districts are very similar. Thick felt coats reaching below the knee, loose " PyJ3-□□□8'S " with cloth " putties " and boots (often of English make) are almost universal, the distingiiishing feature in their costume being the felt cap worn close to the head and rolled up round the edges. They are on the whole a light-hearted, cheerful race of people, but it has been observed that their temperament varies much with their habitat □□□ those who live on the shadowed sides of mountains being distinctly more morose and more serious in disposition than the dwellers in valleys which catch the winter sunlight. They are, at the same time, bloodthirsty and treacherous to a degree which would appear incredible to a casual observer of their happy and genial manners, exhibiting a strange combination (as has been observed by a careful student of their ways) of " the monkey and the tiger." Addicted to sport of every kind, they pursue no manufacturing industries whatsoever, but they are excellent agriculturists, and show great ingenuity in their local irrigation works and in their efforts to bring every available acre of cultivable soil within the irrigated area. Gold washing is more or less carried on in most of the valleys north of the river Gilgit, and gold dust (contained in small packets formed with the petals of a cup-shaped

flower) is an invariable item in their official presents and offerings. Gold dust still constitutes part of the annual tribute which, strangely enough, is paid by Hunza to China, as well as to Kashmir.

Boiites in the Gilgit Agency. ??? One of the oldest recorded routes through this country is that which connects Mastuj in the Chitral valley with Gilgit, passing across the Shandur range (12,250). It now forms the high-road between Gilgit and Chitral, and has been engineered into a passable route. From the north three great glacier- bred afiSluents make their way to the river of Gilgit, joining it at almost equal intervals, and each of them affords opportunity for a rough passage northwards. (1) The Yasin river, which follows a fairly straight course from north to south for about 40 miles from the foot of the Darkot pass across the Shandur range (15,000) to its junction with the river Gilgit, close to the little fort of Gupis, on the Gilgit-Mastuj road. Much of this valley is cultivated and extremely picturesque. At the head of it is a grand group of glaciers, one of which leads up to the well-known pass of Darkot. (2) Twenty- five miles (by map measurement) below Gupis the Gilgit receives the Ashkuman afiluent from the north. The little Lake of Karumbar is held to be its source, as it lies at the head of the river. The same lake is some-

times called the source of the river Yarkhun or Chitral ; and it seems possible that a part of its waters may be deflected in each direction. The Karumbar, or Ashku- man, is nearly twice the length of the Yasin, and the upper half of the valley is encompassed by glaciers, rendering the route along it uncertain and difficult. (3) Forty miles or so below the Ashkuman junction, and nearly opposite the little station of Gilgit, the river receives certain further contributions from the north which are collected in the Hunza and Nagar basins. These basins include a system of glaciers of such gigantic proportions that they are probably unrivalled in any part of the world. The glacial head of the Hunza is not far from that of the Karumbar, and, like the Karumbar, the river commences with a wide sweep eastwards, following a course roughly parallel to the crest of the Hindu Kush (under whose southern slopes it lies close) for about 40 miles. Then striking south for another 40 miles, it twists amidst the barren feet of gigantic rock-bound spurs which reach upwards to the Muztagh peaks on the east and to a mass of glaciers and snow-fields on the west,

hidden amidst the upper folds of mountains towering to an average of 25,000 feet. The next great bend is again to the west for 30 miles, before a final change of direction to the south at the historical position of Chalt and a comparatively straight run of 25 miles to a junction with the Gilgit. The valley of Hunza hes some 10 miles from the point of this westerly bend, and 20 (as the crow flies) from Chalt. Much has been written of the magnificence of Hunza valley scenery, surrounded as it is by a stupendous ring of snow-capped peaks and brightened with all the radiant beauty that cultivation adds to these mountain valleys ; but such scenery must be regarded as exceptional in these northern regions.

Glaciers and Mountains. ??? Con'^^ay and Godwin Austen have described the glaciers of Nagar which, enclosed between the Muztagh spurs on the north-east and the frontier peaks of Kashmir (terminating with Eakapushi) on the south-west, and massing themselves in an almost uninterrupted series from the Hunza valley to the base of those gigantic peaks which stand about Mount Godwin Austen, seem to be set like an ice-sea to define the farthest bounds of the Himalaya. From its uttermost head to the foot of the Hispar, overhanging the valley above Nagar, the length of the glacial ice-bed known under' the name of Biafo is said to measure about 90 miles. Throughout the mountain region of Kunjut (or Hunza) and Nagar the valleys are deeply sunk between mountain ranges which are nowhere less than 15,000 feet in alti- tude, and which must average above 20,000 feet. As a rule, these valleys are bare of vegetation. Where the summits of the loftier ranges are not buried beneath snow and ice they are bare, bleak, and splintered, and the nakedness of the rock scenery extends down their rugged spurs to the very base of them. On the lower slopes of tumbled debris the sun in summer beats with an intensity which is unmitigated by the cloud drifts which form in the moister atmosphere of the monsoon-swept summits of the Himalaya. Sun-baked in summer and frost-riven in winter, the mountain sides are but immense ramps of loose rock debris, only awaiting the yearly melting of the upper snow-fields, or the advent of a casual rain- storm, to be swept downwards in an avalanche of mud and stones into the gorges below. Here it becomes piled and massed together, till the pressure of accumulation forces it out into the main valleys, where it spreads in alluvial fans and silts uji the

plains. This formation is especially marked throughout the high level valleys of the Gilgit basin.

Passes. ??? Each of these northern affluents of the main

stream is headed by a pass, or a group of passes, leading either to the Pamir region direct, or into the upper Yark- hun valley from which a Pamir route diverges. The Yasin valley is headed by the Darkot pass (16,000 feet), which drops into the Yarkhun not far from the foot of the Bar- oghil group over the main Hindu Kush watershed. The Ashkuman is headed by the Gazar and Kora Bohrt passes, leading to the valley of the Ab-i-Punja ; and the Hunza by the Kilik and Mintaka, the connecting links between the Taghdumbash Pamir and the Gilgit basin. They are all about the same height ??? 16,000 feet. All are passable at certain times of the year to small parties, and all are uncertain. In no case do they present insuperable diffi- culties in themselves, glaciers and snow-fields and moun- tain staircases being common to all ; but the gorges and precipices which distinguish the approaches to them from the south, the slippery sides of shelving spurs whose feet are washed by raging torrents, the perpetual weary monotony of ascent and descent over successive ridges multiplying the gradient indefinitely ??? these form the real obstacles blocking the way to these northern passes.

Gilgit Station. ??? The pretty little station of Gilgit (4400 feet above sea) spreads itself in terraces above the right bank of the river nearly opposite the opening lead- ing to Hunza, almost nestling under the cliffs of the Hindu Koh which separates it on the south from the savage mountain wilderness of Darel and Kohistan. It includes a residency for the local political officer, with about half a dozen homes for the accommodation of officials, barracks suitable for a battalion of Kashmir troops, and a hospital. Evidences of Buddhist occupation > are not wanting in Gilgit, though they are few and unimportant. Such as they are, they appear to prove that Gilgit was once a local Buddhist centre, and that the old Buddhist route between Gilgit and the Peshawar plain passed

through the gorges and clefts of the unexplored Darel valley to Thakot under the northern spurs of the Black Moiuitain.

Connexion with India. ??? The Gilgit river joins the Indus a few miles above the little post of Bunji, where an excellent suspension bridge spans the river. The valley is low and hot, and the scenery between Gilgit and Bunji is monotonous; but the road is now maintained in excellent condition. A little below Bunji the Astor river joins the Indus from the south-east, and this deep pine- clad valley indicates the continuation of the high-road from Gilgit to Kashmir vi& the Tragbal and Burzil passes. Another well-known route connecting Gilgit with the Abbottabad frontier of the Punjab lies across the Babusar pass (13,000 feet), linking the lovely Hazara valley of Kaghan to Chilas ; Chilas (4150 feet) being on the Indus, some 50 miles below Bunji. This is a more direct con- nexion between Gilgit and the plains of the Punjab than that afforded by the Kashmir route vid Gurais and Astor, which latter route involves two considerable passes ??? the Tragbal (11,400) and the Burzil (13,500) ; but the inter- vening strip of absolutely independent territory (indepen- dent alike of Kashmir and the Punjab), which includes the hills bordering the road from the Babusar pass to Chilas, renders it a risky route for travellers unprotected by a military escort. Like the Kashmir route, it is now defined by a good military road.

AuTHOKiTiBS. ??? BiDDULPH. The Tribes of the Hindu Kush. Calcutta, 1880.- ??? W. Lawkence. The Kashmir Valley. Lon- don, 1895. ??? Tanner. ” Our Present Knowledge of the Himalaya.” Froc. S.Gr.S., vol. xiii., 1891. ??? Doeand. Making a Frontier. London, 1899. ??? Beport of Lockhart’s Mission. Calcutta, 1886. ??? E. F. Knight. Where Three Empires Meet. London, 1892. ??? F. YonNGHUSBAND. “Journeys in the Pamirs and Adjacent Countries.” Froc. JS.Q.S., vol. xiv., 1892. ??? Cur- zoK. “Pamirs.” Jour. B.G.S., vol. viii., 1896. ??? Leibner. Dardistan. (t. h. h.*)

Cilly, a town of Belgium, in the province of Hainaut, 2 miles north-east of Charleroi by rail. It has coal-pits and numerous factories, which include glass and nail works. Population (communal, 1899), 23,298.

Oilman, Daniel Coit (1831), American

educationalist, was born in Norwich, Connecticut, 6th July 1831. He graduated at Yale in 1852, studied in Berlin, and between 1866 and 1870 was professor of physical geography at Yale, in 1872 becoming president of the University of California, at Berkeley, near San Prancisco. In 1875 he was chosen first president of Johns Hopkins University at Baltimore, a post whic"h he filled until 1901. His influence upon higher education in America has been great. Under his direction Johns Hopkins became the first university in the United States to develop a strong graduate department under competent professors, in which holders of bachelors' degrees pursued non-professional and advanced work (leading to the degree of Doctor of Philosophy) in philology, biology, physics, and other subjects. Johns Hopkins retains its superiority, in this respect, among the institutions of the old southern states ; and its methods have been widely spread by the work of the recipients of its higher degrees. Some of Dr Gilman's papers and addresses are gathered in a volume, entitled University Problems in the United States (1898), representing his mature conclusions on many educational themes. He is also the author of a work on James Monroe in his Relations to the Public Service during Half a Cen- tury (1883) in the American Statesmen Series, and a Life of James I). Dana, the geologist (1899).

~~), He~~

Cinsburg, Christian David (1831- brew scholar, was born at Warsaw, 26th December 1831. Coming to England shortly after the completion of his education in the Kabbinic College at Warsaw, Dr Gins- burg continued his study of the Hebrew Scriptures, with special attention to the Megilloth. The first result of these studies was a translation of the Song of Songs, with a commentary historical and critical, published in 1867, and containing a careful elucidation of the text in accord- ance with the established laws of historico-grammatical exegesis. A similar translation of Ecclesiastes, followed by treatises on the Karaites, on the Essenes, and on the Kabbalah, kept the author prominently before Biblical critics while he was preparing the first sections of his magnum opus, the critical study of the Massorah. Be- ginning in 1867 with the publication of Jacob ben

Chajim's Introduction to the Eabbinic Bible, Hebrew and English, with notices, and the Massoreth Ha-Massoreth of Elias Levita, in Hebrew, with translation and commentary, Dr Ginsburg at once became an authority on Biblical He- brew criticism. In 1870 he was appointed one of the first members of the committee for the revision of the English version of the Old Testament. His life-work culminated in the publication of the Massorah, in three volumes folio (1880-86), followed by the Masoretico-critical edition of the Hebrew Bible (1894), and the elaborate introduction to it (1897). In attempting to appreciate the value of Dr Ginsburg's work, and the vast labour it has entailed, it is necessary to bear in mind the character and peculiarities of the Massorah itself. This elaborate code of marginal references and exhaustive notes, collating and calling attention to the minutest peculiarities of style, grammar, or spelling, originated in the wise forethought of the Jewish scribes, who thus endeavoured to guard against even the most trivial variation in copying the Holy Scriptures. After being, as its name signifies, an oral tradition, the Mas-sorah was reduced to writing, probably about the 3rd century before Christ, by the Jewish scholars of Palestrae.

The growing vastness of the work soon rendered it impos- sible to transcribe the whole of the Massorah in any single manuscript of the Bible, and consequently portions only were copied. Gradually these portions were written in a contracted form and purposely rendered difficult by the copyists, who expended their ingenuity in the fantastical transcription of words which they had long ceased to understand. Such are the MSS. which Dr Ginsburg has deciphered, transcribed, and collated. He had one prede- cessor in the field, the learned Jacob ben Chajim, who in 1624r-25 published the second Rabbinic Bible, contain-ing what has ever since been known as the Massorah ; but neither were the materials available nor was criticism suffi- ciently advanced for a complete edition. It was reserved for Dr Ginsburg to take up the subject almost where it was left by those early pioneers, and to collect portions of the Massorah from the countless MSS. scattered through- out Europe and

the East. Dr Ginsburg's latest contri- bution to the branch of learning which he has made so peculiarly his own is a critical treatise " on the relation- ship of the so-called Codex Babylonicus of a.d. 916 to the Eastern Recension of the Hebrew Text." In this work he proves that the St Petersburg Codex, for so many years accepted as the genuine text of the Baby- lonian School, is in reality a Palestinian text carefully altered so as to render it conformable to the Babylonian recension.

-), Italian statesman.

Ciolitti, Giovanni (1842- was born at Mondovi on 27th October 1842. After a rapid career in the financial administration he was, in 1882, appointed councillor of state and elected to parlia- ment. As deputy he chiefly acquired prominence by attacks on Magliani, treasury minister in the Depretis cabinet, and on 9th March 1899 was himself selected as treasury minister by Crispi. On the fall of the Eudini cabinet in May 1892, Giolitti, with the help of a Court clique, succeeded to the premiership. His term of office was marked by misfortune and misgovernment. The building crisis and the commercial rupture with Prance had impaired the situation of the state banks, of which one, the Banca Eomana, had been further undermined by maladministration. A bank law, passed by Giolitti, failed to effect an improvement. Moreover, he irritated public opinion by raising to senatorial rank the director- general of the Banca Eomana, Signor Tanlongo, whose irregular practices had become a byword. The Senate declined to admit Tanlongo, whom Giolitti, in consequence of an interpellation in parliament upon the condition of the Banca Eomana, was obliged to arrest and prosecute. During the prosecution Giolitti abused his position as premier to abstract documents bearing on the case. Simultaneously a parliamentary commission of inquiry investigated the condition of the state banks. Its report, though acquitting Giolitti of personal dishonesty, proved disastrous to his political position, and obliged him to resign. His fall left the finances of the state dis- organized, the pensions fund depleted, diplomatic rela- tions with Prance strained in consequence of the massacre of Italian workmen at Aigues-Mortes, and Sicily and the Lunigiana in a state of revolt, which he had proved impotent to suppress. After his resignation he was impeached for abuse of power as minister, but the supreme court quashed the impeachment by

denying the competence of the ordinary tribunals to judge ministerial acts. Por several years Giolitti, while retaining his seat in the Chamber, was compelled by public opinion to play a passive part, but later he took the leadership of a group of deputies, with whose help he succeeded by degrees in regaining some portion of his former influence.

Cirgeh, or Giega, a town and former capital of

Upper Egypt, on the left bank of the Nile. It is an imr portant railway station on the Nile valley line, 336 miles from Cairo, with a population in 1900 of about 15,000, and probably occupies the site of This (Tini), one of the oldest places in Egypt. It stood formerly at some dis- tance from the river, but is now on the bank, the inter- vening space having been washed away, together with a large part of the town, by the stream continually encroach- ing on its left bank.

Cirgenti, a town, episcopal see, and capital of the province of Girgenti, Sicily, Italy, about midway on the south coast, but 3 miles from the sea and 58 miles south from Palermo. A new aqueduct from Poltano, 23 miles distant, has been made since 1897. Population (1881),

20,391; (1901), 26,069.

Cironde, a department in the south-west of France, bathed by the Atlantic Ocean, and watered by the Garonne and the Dordogne, which unite under the name of the Gironde.

Area, 4141 square miles. The population increased from 775,845 in 1886 to 820,781 in 1900. Births in 1899, 14,908, of which 1817 were illegitimate ; deaths, 16,216. There were in 1896 1280 schools, with 93,000 pupils, and the illiterate formed 4 per cent, of the population. The area xmder cultivation comprised in 1896 1,974,400 acres, of which 499,000 acres were arable and 336,000 acres vineyard. “Woods and forests occupy more than 740,000 acres, principally in the region of the Landes. In 1899 the produce of wheat amounted to the value of ––980,000 ; rye yielded ––21,000 ; oats, ––38,000 ; maize, ––40,000. The natural pastures returned a value of ––607,000. A little tobacco also is cultivated. The great source, however, of the wealth

of the Gironde is its wine, which in 1899 yielded a value of more than 3J millions sterling. Gironde has no great industries except those connected with alimentation. Gironde in 1899 owned 50,160 horses, 139,330 cattle, 236,710 sheep, and 67,800 pigs. The distilleries of alcohol have, however, assumed large proportions, turning out in 1898 no less than 1,282,000 gallons. Bordeaux, the capital, had in 1901 a population of 257,471.

Cirvan, a police burgh, market and fishing town of Ayrshire, Scotland, at the mouth of the river Girvan, 21^ miles south-south-west of Ayr by rail. The harbour has been improved by the building of a pier and breakwater, and a sewage scheme has been carried out. There is a Eoman Catholic church and convent. Population (1881),

4605; (1901), 4019.

Citschin (Czech, Jicin), the chief town of a govern- ment district in Bohemia, Austria. It has a garrison of 834 men, and an important corn trade, together with lai'ge sugar refineries, and the manufacture of paper, soda-water, beer, &c. Population, mostly Czech (1890), 8457 ; (1900),

9790.

Ciurgevo, or Giurgixt, a town in Eumania, on theleft bank of the Danube opposite Eustchuk in Bul- garia. It is the seat of a court of first instance, has four Rumanian churches, one Greek church, and two syna^ gogues. Its port is at Smarda, 2| miles east of the town. Giurgevo is the terminus of the first railway constructed in Rumania (Bucarest-Giurgiu), and is a town of consider- able commercial importance. The export trade in 1898 was valued at ►►591,660. Population (1900), 13,977.

Civet, a town and important railway junction in the arrondissement of Rocroi, department of Ardennes, Prance, 40 miles by rail north of Mezi^res. The fortifications, with the exception of the citadel of Charlemont, were demolished in 1892. In the new quarter is a statue of the musician Mehul (1892). The town has considerable river traffic ; total tonnage entered 1900, 32,332, consist- ing chiefly of coal, copper, and stones. Population (1881),

4932; (1901), 7011.

GLADBACH ... GLADSTONE

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CI ad bach, or Munchen-G lad bach, a town of Prussia, in the Rhine province, 16 miles by rail west by- south from Diisseldorf. There are monuments to the Emperor William I. (1897) and to Bismarck (1900). The cotton and other industries still flourish vigorously, and there is also manufacture of account books, cloth, stove tiles, paper, hosiery, linen, shoes, and breweries. Popu- lation (1885), 44,230; (1900), 58,014.

Gladstone, John Hall (1827-

-), English

chemist, was born at Hackney, London, on 7th March 1827. Erom childhood he showed great aptitude for science ; geology was his favourite subject, but since this in his father's opinion did not afford a career of promise, he devoted himself to chemistry, which he studied under Graham at University College, London, and Liebig at Giessen. In 1850 he became chemical lecturer at St Thomas's Hospital, and three years later was elected a fellow of the Royal Society at the unusually early age of twenty-six. From 1858 to 1861 he served on the Royal Commission on Lighthouses, and from 1864 to 1868 was a member of the War Office committee on gun-cotton. From 1874 to 1877 he was Fullerian professor of chemis- try at the Royal Institution, in 1874 he was chosen first president of the Physical Society, and in 1877-79 he was president of the Chemical Society. In 1897 the Royal Society recognized his fifty years of scientific work by awarding him the Davy medal. Dr Gladstone's re- searches have been large in number and wide in range, dealing to a great extent with problems that lie on the border-line between physics and chemistry ... with that physical chemistry which was the creation of the latter part of the 19th century. Thus a number of his inquiries, and those not the least important, have been partly chemical, partly optical. He determined the optical constants of hundreds of substances, with the object of discovering whether any of the elements possesses more than

one refractive equivalent. Again, he investigated the connexion between the optical behaviour, specific gravity, and chemical composition of ethereal oils, and the relation between molecular magnetic rotation and the refraction and dispersion of nitrogenous compounds. So early as 1856 he showed the importance of the spectro- scope in chemical research, and he was one of the first to notice that the Fraunhofer spectrum at sunrise and sun- set differs from that at midday, his conclusion being that the earth's atmosphere must be responsible for many of its absorption lines, which indeed have been subsequently traced to the oxygen and water-vapour in the air. Another portion of his work was of an electro-chemical character. His studies, with Hibbert, in the chemistry of the storage battery have added largely to our knowledge, while the " copper-zinc couple," with which his name is associated together with that of Tribe, among other things afforded a simple means of preparing certain organo-metallic compounds, and thus promoted research in branches of organic chemistry where those bodies are especially useful. Mention may also be made of his work on phosphorus, on explosive substances such as iodide of nitrogen, gun-cotton, and the fulminates, on the influence of mass in the process of chemical transforma- tions, and on the effect of carbonic anhydride on the germination of plants. Dr Gladstone has always taken a great interest in educational questions, and from 1873 to 1894 he was a representative for Chelsea on the London School Board, of which for three years he acted as vice-chairman.

Gladstone, William Ewart (1809-1898), British statesman, was born on 29th December 1809 at No. 62 Rodney Street, Liverpool. His forefathers were Gled- stanes of Gledstanes, in the upper ward of Lanarkshire ;

or, in Scottish phrase, Gledstanes of that Ilk. As years went on their estates dwindled, and by the beginning of the 17th century Gledstanes was sold. The adjacent property of Arthurshiel remained in the hands of the family for nearly a hundred years longer. Then the son of the last Gledstanes of Arthurshiel removed to Biggar, where he opened the business of a maltster. His grand- son, Thomas Gladstone (for so the name was modified), became a corn-merchant at Leith. He happened to send his eldest son, John, to Liverpool to sell a cargo of grain there, and the energy and aptitude of the young man attracted the favourable notice

of a leading corn- merchant of Liverpool, who recommended him to settle in that city. Beginning his commercial career as a clerk in his patron's house, John Gladstone lived to be- come one of the merchant-princes of Liverpool, a baronet, and a member of parliament. He died in 1851, at the age of eighty-seven. Sir John Gladstone was a pure Scotsman, a Lowlander by birth and descent. He mar- ried Anne, daughter of Andrew Robertson of Stornoway, sometime Provost of Dingwall. Provost Robertson be- longed to the Clan Donachie, and by this marriage the robust and business-like qualities of the Lowlander were blended with the poetic imagination, the sensibility, and fire of the Gael.

John and Anne Gladstone had six children. The fourth son, William Ewart, was named after a merchant of Liverpool who was his father's friend. He seems to have been a remarkably good child, childhood and much beloved at home. In 1818 or 1819 ?," ???. Mrs Gladstone, who belonged to ^he Evangeli- cal school, said in a letter to a friend, that she believed her son William had been " truly converted to God." After some tuition at the vicarage of Seaforth, a watering-place near Liverpool, the boy went to Eton in 1821. His tutor was the Rev. Henry Hartopp Knapp. His brothers, Thomas and Robertson Gladstone, were already at Eton. Thomas was in the fifth form, and William, who was placed in the middle remove of the fourth form, became his eldest brother's fag. He worked hard at his classical lessons, and supplemented the ordi- nary business of the school by studying mathematics in the holidays. Mr Hawtrey, afterwards headmaster, com- mended a copy of his Latin verses and " sent him up for good " ; and this experience first led the young student to associate intellectual work with the ideas of ambition and success. He was not a fine scholar, in that restricted sense of the term which implies a special aptitude for turning English into Greek and Latin, or for original versification in the classical languages. " His composi- tion," we read, " was stiff," but he was imbued with the substance of his authors ; and a contemporary who was in the sixth form with him recorded that " when there were thrilling passages of Virgil or Homer, or difficult passages in the Scriptores Graeci to translate, he or Lord Arthur Hervey was generally called up to edify the class with quotation or translation." By common consent he was pre-eminently God-fearing, orderly, and conscientious. " At Eton," said Bishop Hamilton of Salisbury, " I was a

thoroughly idle boy, but I was saved from some worse things by getting to know Gladstone." His most intimate friend was Arthur Hallam, by universal acknowledgment the most remarkable Etonian of his day ; but he was not generally popular or even widely known. He was seen to the greatest advantage, and was most thoroughly at home, in the debates of the Eton Society, learnedly called "The Literati" and vulgarly "Pop," and in the editor- ship of the Eton Miscellany. He left Eton at Christmas 1827. He read for six months with private tutors, and in October 1828 went up to Christ Church, where, in the following year, he was nominated to a Studentship.

At Oxford Gladstone read steadily, but not laboriously, till he neared his final Schools. During the latter part of his undergraduate career he took a brief but brilliant share in the proceedings of the Union, of which he was successively Secretary and President. He made his first speech on 11th February 1830. Brought up in the nur- ture and admonition of Canning, he defended Roman Catholic emancipation, and thought the Duke of Welling- ton's Government unworthy of national confidence. He opposed the removal of Jew- ish disabilities, arguing, we are told by a contemporary, " on the part of the Evangeli- cals," and pleaded for the gradual extinction, in prefer- ence to the immediate aboli- tion, of slavery. But his great achievement was a speech against the Whig Reform Bill. One who heard this famous discourse says: "Most of the speakers rose, more or less, above their usual level, but when Mr Gladstone sat down we all of us felt that an epoch in our lives had oc- curred. It certainly was the finest speech of his that I ever heard." Bishop Charles Wordsworth said that his ex- perience of Gladstone at this time " made me (and I doubt not others also) feel no less sure than of my own existence that Gladstone, our then Christ Church undergraduate, would one day rise to be Prime Minister of England." In December 1831 Gladstone crowned his career by taking a double first-class. Lord Halifax (1800-1886) used to say, with

reference to the in- crease in the amount of read- ing requisite for the highest honours : " My double – first

must have been a better thing than Peel's ; Gladstone's must have been better than mine."

Now came the choice of a profession. Deeply anxious to make the best use of his life, Gladstone turned his thoughts to Holy Orders. But his father had deter- mined to make him a politician. Quitting Oxford in the spring of 1832, Gladstone spent six months in Italy, learning the language and studying art. In the follow- ing September he was suddenly recalled to England, to undertake his first parliamentary campaign. The fifth Duke of Newcastle was one of the chief potentates of the High Tory party. His frank claim to " do what he liked with his own " in the representation Batry lata Qf Newark has given him a place in political history. But that claim had been rudely disputed by the return of a Radical lawyer election of 1831. The Duke was anxious to a capable candidate to aid him in regaining his ascendancy over the rebellious borough. His son, Lord Lincoln, had heard Gladstone's speech against the Reform]3ill delivered in the Oxford Union, and had written home that " a man had uprisen in Israel." At his suggestion the Duke invited Gladstone to stand for Newark in the Tory interest against Mr Serjeant

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Wilde, afterwards Lord Chancellor Truro. The last of the Unreformed Parliaments was dissolved on the 3rd December 1832. Gladstone, addressing the elec- tors of Newark, said that he was bound by the opinions of no man and no party, but felt it a duty to watch and resist that growing desire for change which threatened to produce " along with partial good a melancholy pre- ponderance of mischief." The first principle to which he looked for national salvation was, that the " duties

of governors are strictly and peculiarly religious, and that legislatures, like individ- uals, are bound to carry throughout their acts the spirit of the high truths they have acknowledged." The condition of the poor de- manded special attention; lar hour should receive adequate remuneration ; and he thought favourably of the "allot- ment of cottage grounds." He regarded slavery as sanc- tioned by Holy Scripture, but the slaves ought to be educated, and gradually eman- cipated. The contest resulted in his return at the head of the poll.

*The first Reformed Pai-lia- ment met on 29th January 1833, and the young mem- ber for Newark took his seat for the first time in an as- sembly which he was des- tined to adorn, delight, and astonish for more than half a century. His maiden speech was delivered on the 3rd June, in reply to what was almost a personal challenge. The Colonial Secretary, Mr Stanley, afterwards Lord Derby, brought forward a series of resolutions in favour of the extinction of slavery in the first night of the debate Lord Grey, who had been Colonies, and who as proceeding too ^** ’”” gradually towards abolition, cited certain occur- slavery. rences on Sir John Gladstone's plantation in Demerara to illustrate his contention that the system of slave-labour in the West Indies was attended by great mortality among the slaves. Gladstone in his reply ??? his first speech in the House ??? avowed that he had a pecuniary interest in the question, "and, if he might say so much without exciting suspicion, a still deeper interest in it as a question of justice, of humanity, and of religion." If there had recently been a high mor- tality on his father's plantation, it was due to the age of the slaves rather than to any peculiar hardship in their lot. It was true that the particular system of cultiva- tion practised in Demerara was more trying than some others; but then it might be said that no two trades were equally conducive to health. Steel-grinding was iiotoriously unhealthy, and manufacturing processes generally were less favourable to life than agricultural. While strongly condemning cruelty, he declared himself an advocate of emancipation, but held that it should be*

Gladstone (1895). Elliott and Fry, London.)

the British colonies. On Lord Howick, afterwards Under-Secretary for the opposed the resolutions

effected gradually, and after due preparation. The slaves must be religiously educated, and stimulated to profitable industry. The owners of emancipated slaves were entitled to receive compensation from Parliament, because it was Parliament that had established this description of property. " I do not," said Gladstone, " view property as an abstract thing ; it is the creature of civil society. By the legislature it is granted, and by the legislature it is destroyed." On the following day King William IV. wrote to Lord Althorp : " The King rejoices that a young member has come forward in so promising a manner as Viscount Althorp states Mr W. E. Gladstone to have done." In the same session Gladstone spoke on the question of bribery and corruption at Liverpool, and on the temporalities of the Irish Church. In the session of 1834 his most important performance was a speech in opposition to Hume's proposal to throw the Universities open to Dissenters.

On 10th November 1834 Lord Althorp succeeded to his father's peerage, and thereby vacated the leadership of the House of Commons. The Prime Minister, Lord Mel- bourne, submitted to the King a choice of names for the Chancellorship of the Exchequer and leadership of the House of Commons ; but His Majesty announced that, having lost the services of Lord Althorp as Leader of the House of Commons, he could feel no confidence in the stability of Lord Melbourne's Government, and that it was his intention to send for the Duke of Wellington. The Duke took temporary charge of affairs, but Peel was felt to be indispensable. He had gone abroad after the session, and was now in Rome. As soon as he could be brought back he formed an administration, and ap- pointed Gladstone to a Junior Lordship of the Treasury. Parliament was dissolved on 29th December. Gladstone was returned unopposed, this time in conjunction with the Liberal lawyer whom he had beaten at the last election. The new Parliament met on 19th February 1835. The elections had given the Liberals a con- siderable majority. Immediately after the meeting of

Parliament Gladstone was promoted to the Under- Secretaryship for the Colonies, where his offtoial chief was Lord Aberdeen. The administration was not long- lived. On 30th March Lord John Russell moved a resolution in favour of an inquiry into the temporalities of the Irish Church, with the intention of applying the surplus to general education" without distinction of religious creed. This was carried against ministers by a majority of thirty-three. On 8th April Sir Robert Peel resigned, and the Under-Secretary for the Colonies of course followed his chief into private life.

Released from the labours of oflB.ce, Gladstone, living in chambers in the Albany, practically divided his time between his parliamentary duties and study. Then, as always, his constant companions were Homer and Dante, and it is recorded that he read the whole of St Augustine, in twenty-two octavo volumes. He used to frequent the services at St James's, Piccadilly, and Margaret Chapel, since better known as All Saints', Margaret Street. On 20th June 1837 King William IV. died, and Parliament, having been prorogued by the young Queen in person, was dissolved on the 17th of the following month. Simply on the strength of his parliamentary reputa- tion Gladstone was nominated, without his consent, for Manchester, and was placed at the bottom of the poll ;

but, having been at the same time nominated Literary ^^ Newark, was again returned. The year 1838

claims special note in a record of Gladstone's life, because it witnessed the appearance of his famous work on The State in its Relations with the Church. He had left Oxford just before the beginning of that Catholic revival which has transfigured both the inner spirit

and the outward aspect of the Church of England. But the revival was now in full strength. The Tracts for the Times were saturating England with new influences. The movement counted no more enthusiastic or more valuable disciple than Gladstone. Its influence had reached him through his friendships, notably with two Eellows of Merton ??? Mr James Hope, who be- came Mr Hope-Scott of Abbotsford, and the Rev. H. E. Manning, afterwards Cardinal Archbishop. The State in its Belations was his practical contribution to a controversy in which his deepest

convictions were involved. He contended that the Church, as established by law, was to be " maintained for its truth," and that this principle, if good for England, was good also for Ireland.

On 25th July 1839 Gladstone was married at Hawarden to Miss Catherine Glynne, sister, and in her issue heir, of Sir Stephen Glynne, ninth and last baronet of that name. In 1840 he published CJmrch Principles considered in their Results.

*Parliament was dissolved in June 1841. Gladstone was again returned for Newark. The General Election resulted in a Tory majority of eighty. Sir Robert Peel became Prime Minister, and made the member for Newark Vice- President of the Board of Trade. An inevitable change is from this time to be traced in the caWoe/** topics of Gladstone's parliamentary speaking. Instead of discoursing on the corporate conscience of the State and the endowments of the Church, the import- ance of Christian education, and the theological imfit- ness of the Jews to sit in Parliament, he is solving business-like problems about foreign tariffs and the exportation of machinery ; waxing eloquent over the regulation of railways, and a graduated tax on corn ; subtle on the monetary merits of half-farthings, and great in the mysterious lore of quassia and cocculus indicus. In 1842 he had a principal hand in the preparation of the Revised Tariff, by which duties were abolished or sensibly diminished in the case of 1200 duty-paying articles. In defending the new scheme he spoke incessantly, and amazed the House by his mastery of detail, his intimate acquaintance with the commercial needs of the country, and his inexhaustible power of exposition. In 1843 Gladstone, succeeding Lord Ripon as President of the Board of Trade, be- came a member of the Cabinet at the age of thirty-three. He has recorded the fact that "the very first opinion which he ever was called upon to give in Cabinet" was an opinion in favour of withdrawing the Bill providing education for children in factories, to which vehement opposition was offered by the Dissenters on the ground that it was too favourable to the Established Church.*

At the opening of the session of 1845 the Govern- ment, in pursuance of a promise made to Irish members that they would deal with the question of

academical edu- cation in Ireland, proposed to establish non-sectarian colleges in that country and to make a large addition to the grant to the Roman Catholic College of Maynooth. Gladstone resigned ofl&ce, in granu order, as he announced in the debate on the resigna- Address, to form " not only an honest, but like- "'"'''''wise an independent and an unsuspected judgment," on the plan to be submitted by the Government with respect to Maynooth. His subsequent defence of the proposed grant, on the ground that it would be improper and unjust to exclude the Roman Catholic Church in Ireland from a "more indiscriminating support" which the State might give to various religious beliefs, was regarded by men of less sensitive conscience as only proving that there had been no adequate cause for his resignation.

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GLADSTONE, WILLIAM EWAET

Free Trade.

Before he resigned he completed a second Eevised Tariff, carrying considerably farther the principles on which he had acted in the earlier revision of 1842.

In the autumn of 1845 the failure of the potato crop in Ireland threatened a famine, and convinced Sir Robert Peel that all restrictions on the importation of food must be at once suspended. He was supported by only three members of the Cabinet, and resigned on 6th December. Lord John Eussell, who had just announced his conver- sion to total and immediate repeal of the Corn Laws, de- clined the task of forming an administration, and on 20th December Sir Eobert Peel re- sumed ofB.ce. Lord Stanley refused to re-enter the Government, and his place as Secretary of State for the Colonies was offered to and accepted by Gladstone. He did not offer himself for re-election at Newark, and remained outside the House of Commons during the great struggle of the coming year. It was a curious irony of fate which excluded him from Parliament at this crisis, for it seems unquestionable that he was the most advanced Pree Trader in Sir Eobert Peel's Cabinet. The Corn Bill passed the House of Lords on the 28th June 1846, and on the same day the Government were beaten in

the House of Commons on an Irish Coercion Bill. Lord John Eussell became Prime Minister, and Gladstone retired for a season into private life. Early in 1847 it was announced that one of the two members for the University of Oxford intended to retire at the Gen- eral Election, and Gladstone was proposed for the vacant seat. The representation of the university had been pronounced by Canning to be the most coveted prize of public life, and Gladstone himself confess'ed that he " desired it with an almost passionate fondness." Par- liament was dissolved on 23rd July 1847. The nomina- tion at Oxford took place on 29th July, and at the close of the poll Sir Eobert Inglis stood at the head, with Gladstone as his colleague.

The three years 1847, 1848, 1849 were for Gladstone a period of mental growtlj^ of transition, of development. A change was silently proceeding, which was not com- pleted for twenty years. " There have been," he wrote in later days to Bishop Wilberforce, " two great deaths, or transmigrations of spirit, in my political existence ❓❓❓ one, very slow, the breaking of ties with my original party." This was now in progress. In the winter of 1850-51 Gladstone spent between three and four months at Naples, where he learned that more than half the Chamber of Deputies, who had followed the party of Opposition, had been banished or im- prisoned; that a large number, probably not less than 20,000, of the citizens had been imprisoned on charges of political disaffection, and that in prison they were subjected to the grossest cruelties. Having made careful investigations, Gladstone, on 7th April 1851, ad- dressed an Open Letter to Lord Aberdeen, bringing an elaborate, detailed, and horrible indictment against the rulers of Naples, especially as regards the arrangements of their prisons and the treatment of persons confined in them for political offences. The publication of this letter caused a wide sensation in England and abroad, and pro- foundly agitated the Court of Naples. In reply to a question in the House of Commons, Lord Palmerston accepted and adopted Gladstone's statement, expressed keen sympathy with the cause which he had espoused and sent a copy of his Letter to the Queen's representative at every court of Europe. A second Letter and a third followed, and their effect, though for a while retarded was unmistakably felt in the subsequent revolution which created a free and united Italy.

In February 1852 the Whig Government was defeated on a Militia Bill, and Lord John Eussell was succeeded

Naples prisons.

by Lord Derby, formerly Lord Stanley, with Mr Dis- raeli, who now entered office for the first time, as Chan- cellor of the Exchequer and Leader of the House of Commons. Mr Disraeli introduced and carried a make- shift Budget, and the Government tided over the session and dissolved Parliament on 1st July 1852. There was some talk of inducing Gladstone to join the Tory Gov- ernment, and on 29th November Lord Malmesbury du- biously remarked, "I cannot make out Gladstone, who seems to me a dark horse." In the following month the Chancellor of the Exchequer produced his second Budget. The Government redeemed their pledge to do something for the relief of the agricultural interest by reducing the duty on malt. This created a deficit, which they repaired by doubling the duty on inhabited houses. The voices of criticism were heard simultaneously aiaOsUtae on every side. The debate waxed fast and " furious. In defending his proposals Mr Dis- raeli gave full scope to his most characteristic gifts ; he pelted' his opponents right and left with sarcasms, taunts, and epigrams. Gladstone delivered an unpre- meditated reply, which has ever since been celebrated. Tradition says that he "foamed at the mouth."- The speech of the Chancellor of the Exchequer, he said, must be answered " on the moment." It must be " tried by the laws of decency and propriety." He indig- nantly rebuked his rival's language and demeanour. He tore his financial scheme to ribbons. It was the beginning of a duel which lasted till death removed one of the combatants from the political arena. " Those who had thought it impossible that any impres- sion could be made upon the House after the speech of Mr Disraeli had to acknowledge that a yet greater impression was produced by the unprepared reply of Ml- Gladstone." The House divided, and the Govern- ment were left in a minority of nineteen. Lord Derby resigned.

The new Government was a coalition of Whigs and Peel- ites. Lord Aberdeen became Prime Minister, and Glad- stone Chancellor of the Exchequer. Having been returned again for the University of Oxford, he

entered on the active duties of a great office for which he was pre-emi- nently fitted by an unique combination of finan- cial, administrative, and rhetorical gifts. His ChaBceiior first Budget was introduced on 18th April 1853. E^equer. It tended to make life easier and cheaper for large and numerous classes ; it promised wholesale remis- sions of taxation ; it lessened the charges on common processes of business, on locomotion, on postal communi- cation, and on several articles of general consumption. The deficiency thus created was to be met by a "suc- cession-duty,-" or application of the legacy-duty to real property ; by an increase of the duty on spirits ; and by the extension of the income-tax, at 5d. in the pound, to all incomes between .~~yiOO and ❑❑160. The speech in which these proposals were introduced held the House spell~~ bound. Here was an orator who could apply all the re- sources of a burnished rhetoric to the elucidation of figures; who could sweep the widest horizon of the financial future, and yet stoop to bestow the minutest attention on the microcosm of penny stamps and post-horses. Above all, the Chancellor's mode of handling the income-tax at- tracted interest and admiration. It was a searching an- alysis of the financial and moral grounds on which the impost rested, and a historical justification and eulogy of it. Yet, great as had been the services of the tax at a time of national danger, Gladstone could not consent to retain it as a part of the permanent and ordinary finances of the country. Is was objectionable on account of its une- qual incidence, of the harassing investigation into private affairs which it entailed, and of the frauds to which

it inevitably led. Therefore, having served its turn, it was to be extinguished in 1860. The scheme astonished, interested, and attracted the country. The Queen and Prince Albert wrote to congratulate the Chancellor of the Exchequer. Public authorities and private friends joined in the chorvjs of eulogy. The Budget demonstrated at once its author's absolute mastery over figures and the persuasive force of his expository gift. It established the Chancellor of the Exchequer as the paramount financier of his day, and it was only the first of a long series

of similar performances, different, of course, in detail, but alike in their bold outlines and brilliant handling. Looking back on a long life of strenuous exertion, Gladstone declared that the work of preparing his proposals about the succession-duty and carrying them through Parliament was by far the most laborious task which he ever performed.

War between Great Britain and Russia was declared on 27th March 1854, and it thus fell to the lot of the most pacific of ministers, the devotee of retrenchment, and the anxious cultivator of all industrial arts, to prepare a war-budget, and to meet as well as he might the exigencies of a conflict which had so cruelly dislocated all the ingenious devices of financial optimism. No amount of skill in the manipulation of figures, no in-genuity in shifting fiscal burdens, could prevent the addition of forty-one millions to the national debt, or could countervail the appalling mismanagement at the seat of war. Gladstone declared that the state of the army in the Crimea was a "matter for weeping all day and praying all night." As soon as Parliament met in January 1855 J. A. Roebuck, the Radical member for Sheffield, gave notice that he would move for a select committee "to inquire into the condition of our army before Sebastopol, and into the conduct of those depart- ments of the Government whose duty it has been to minister to the wants of that army." On the same day Lord John Russell, without announcing his intention to his colleagues, resigned his office as President of the Council sooner than attempt the defence of the Govern- ment. Gladstone, in defending the Government against Roebuck, rebuked in dignified and significant terms the conduct of men who, "hoping to escape from punish- ment, ran away from duty." On the division on Mr Roebuck's motion the Government was beaten by the unexpected majority of 157.

. Lord Palmerston became Prime Minister. ThePeelites joined him, and Gladstone resumed office as Chancellor of the Exchequer. A shrewd observer at the time pro- nounced him indispensable. " Any other Chancellor of the Exchequer would be torn in bits by him." The Government was formed on the understanding that Mr Roebuck's proposed committee was to be resisted. Lord Palmerston soon saw that further resistance was useless ; his Peelite colleagues stuck to their text, and, within three weeks after resuming office, Gladstone, Sir James

Graham, and Mr Sidney Herbert resigned. Gladstone once said of himself and his Peelite colleagues, during the period of political isolation, that they were like rov- ing icebergs on which men could not land with safety, but with which ships might come into perilous collision. He now applied himself specially to financial criticism, and was perpetually in conflict with the Chancellor of the Exchequer, Sir George Cornewall Lewis.

In 1858 Lord Palmerston was succeeded by Lord Derby at the head of a Conservative administration, and Glad- stone accepted the temporary office of High Commissioner Extraordinary to the Ionian Islands. Returning to Eng- land for the session of 1859, he found himself involved in the controversy which arose over a mild Reform Bill introduced by the Government. They were defeated on

the second reading of the Bill, Gladstone voting with them. A dissolution immediately followed, and Glad- stone was again returned unopposed for the University of Oxford. As soon as the new Parliament met a vote of want of confidence in the ministry was moved in the House of Commons. In the critical division which ensued Gladstone voted with the Government, who were left in a minority. Lord Derby resigned. Lord Palmer- ston became Prime Minister, and asked Gladstone to join him as Chancellor of the Exchequer. To vote confidence in an imperilled ministry, and on its defeat to take office with the rivals who have defeated it, is a manoeuvre which invites the reproach of tergiversation. But Gladstone risked the reproach, accepted the office, and had a sharp tussle for his seat. He emerged from the struggle victorious, and entered on his duties with characteristic zeal. The Prince Consort wrote : " Glad- stone is now the real leader in the House of Commons, and works with an energy and vigour altogether in- credible."

The Budget of 1860 was marked by two distinctive features. It asked the sanction of Parliament for the commercial treaty which Cobden had privately arranged with the Emperor Napoleon, and it fg/^^*"' proposed to abolish the duty on paper. The French treaty was carried, but the abolition of the paper- duty was defeated in the House of Lords. Gladstone justly regarded the refusal to remit a duty as being in effect an act of taxation, and therefore as an infringe- ment of the rights of the

House of Commons. The proposal to abolish the paper-duty was revived in the Budget of 1861, the chief proposals of which, instead of being divided, as in previous years, into several Bills, were included in one. By this device the Lords were obliged to acqtiiesce in the repeal of the paper-duty, or else to incur the responsibility of rejecting the whole financial scheme for the year. The Budget became law, and Gladstone was triumphant.

During Lord Palmerston's last administration, which lasted from 1869 to 1865, Gladstone was by far the most brilliant and most conspicuous figure in the Cabinet. Except in finance, he was not able to accomplish much, for he was met and thwarted at every turn by his chief's invincible hostility to change; but the more advanced section of the Liberal party began to look upon him as their predestined leader. In 1864, in a debate on a private member's Bill for extending the suffrage, he declared that the burden of proof lay on those "who would exclude forty-nine fiftieths of the working-classes from the franchise." In 1865, in a debate on the con-dition of the Irish Church Establishment, he declared that the Irish Church, as it then stood, was in a false position, inasmuch as it ministered only to one-eighth or one-ninth of the whole community. But just in pro- portion as Gladstone advanced in favour with the Radical party he lost the confidence of his own constituents. Parliament was dissolved in July, 1865, and the Uni- versity elected Mr Gathorne Hardy in his place.

Gladstone at once turned his steps towards South Lan- cashire, where he was returned with two Tories above him. The result of the General Election was to retain Lord Palmerston's Government in power, but on the 18th October the old Prime Minister died. He was succeeded by Lord Russell, and Gladstone, retaining the Chancellor- ship of the Exchequer, became for the first time Leader of the House of Commons. Lord Russell, backed by Gladstone, persuaded his colleagues to con- ^^fff"/ sent to a moderate Reform Bill, and the task commons. of piloting this measure through the House of Commons fell to Gladstone. The speech in which he wound up the debate on the second reading was one of

the finest, if not indeed the very finest, whicli he ever delivered. But it was of no practical avail. The Govern- ment were defeated on an amendment in committee, and thereupon resigned. Lord Derby became Prime Minister, with Disraeli as Chancellor of the Exchequer and Leader of the House of Commons. On the 18th March 1867 the Tory Reform Bill, which ended in establishing Household Suffrage in the boroughs, was introduced, and was read a second time without a division. After undergoing exten- sive alterations in committee at the hands of the Liberals and Radicals, the Bill became law in August. Lord Cran- borne (afterwards Lord Salisbury) declared that it had been remodelled at the dictation of Gladstone.

At Christmas 1867 Lord Russell announced his final retirement from active politics, and Gladstone was recog- nized by acclamation as Leader of the Liberal Leader ot party. Nominally he was in Opposition; but party\ ^is party formed the majority of the House of

Commons, and could beat the Government whenever they chose to mass their forces. Gladstone seized the opportunity to give effect to convictions which had long been forming in his mind. Early in the session he brought in a Bill abolishing com- pulsory Church-rates, and this passed into law. On the 16th March, in a debate raised by an Irish member, he declared that in his judgment the Irish Church, as a State Church, must cease to exist. Immediately after- wards he embodied this opinion in a series of resolutions concerning the Irish Church Establishment, and carried them against the Government. Encouraged by this triumph, he brought in a Bill to prevent any fresh appointments in the Irish Church, and this also passed the Commons, though it was defeated in the Lords. Parliament was dissolved on the 11th November. A single issue was placed before the country ???was the Irish Church to be, or not to be, disestablished ? The response was an overwhelming affirmative. Glad- stone, who had been doubly nominated, was de- feated in Lancashire, but was returned for Greenwich. He chose this moment for publishing a Cliapter of Auto-

biography, in which he explained and justified his change of opinion with regard to the Irish Church Establishment.

On the 2nd December Disraeli, who had succeeded Lord Derby as Premier in the preceding Eebruary, announced that he and his colleagues, recognizing their defeat, had resigned without waiting for a formal vote of the new Parliament. On the following day Gladstone was summoned to Windsor, and commanded by the Queen to form an administration. The great task to which the new Prime Minister immediately 'miailter: addressed himself was the disestablishment of Irish the Irish Church. The Queen wrote to Arch-

Charch bishop Tait that the subject of the Irish Church " made her very anxious," but that Mr Glad- stone " showed the most conciliatory disposi- tion." " The Government can do nothing that would tend to raise a suspicion of their sincerity in proposing to dis- establish the Irish Church, and to withdraw all State endowments from all religious communions in Ireland- but, were these conditions accepted, all other matters connected with the question might, the Queen thinks, become the subject of discussion and negotiation." The disestablishing Bill was drawn on the principle, and piloted on the lines, thus indicated. Gladstone brought it in on the 1st March 1869. Its progress through the House of Commons was easy. In committee in the House of Lords there was some risk of serious conflict but moderate counsels prevailed, and the Bill became law on the 26th July. In the session of 1870 Gladstone's principal work was the Irish Land Act, of which the

d/sestab- llshmeat

object was to protect the tenant against eviction as long as he paid his rent, and to secure to him the value of any improvements which his own industry had made. In the following session Religious Tests in the Universities were abolished, and a Bill to establish Secret Voting was carried through the House of Commons. This was thrown out by the Lords, but became law a year later. The House of Lords threw out a Bill to abolish the purchase of commissions in the army. Gladstone found that purchase existed only by royal sanction, and advised the Queen to issue a

royal warrant declar- ing that, on and after 1st November following, all regulations authorizing the purchase of commissions should be cancelled.

In 1873 Gladstone set his hand to the third of three great Irish reforms to which he had pledged himself. His scheme for the establishment of a University which should satisfy both Roman Catholics and Protestants met with general disapproval. The Bill was thrown out by three votes, and Gladstone resigned. The Queen sent for Disraeli, who declined to take office in a minority of the House of Commons, so Gladstone was compelled to resume. But he and his colleagues were now, in Disraelitish phrase, "exhausted volcanoes." Election after election went wrong. The Government had lost favour with the public, and was divided against itself. There were resignations and rumours of resignations. When the session of 1873 had come to an end Gladstone took the Chancellorship of the Exchequer, and, as high authori- ties contended, vacated his seat by doing so. The point was obviously one of vital importance ; and we learn from Lord Selborne, who was Lord Chancellor at the time, that Gladstone " was sensible of the difficulty of either taking his seat in the usual manner at the opening of the session, or letting . . . thenecessary arrangements for business in the House of Commons be made in the Prime Minister's absence. A dissolution was the only escape." On 23rd January 1874 Gladstone announced the dissolution in an address to his constituents, o/^g^^"""" declaring that the authority of the Govern- " ment had now " sunk below the point necessary for the due defence and prosecution of the public interest." He promised that, if he were returned to power, he would repeal the income-tax. This bid for popularity failed, the General Election resulting in a Tory majo- rity of forty-six. Gladstone kept his seat for Green- wich, but was only second on the poll. Following the example of Disraeli in 1868, he resigned without meeting Parliament.

For some years he had alluded to his impending retirement from public life, saying that he was " strong against going on in politics to the end." He was now sixty-four, and his life had been J^^^^ a continuous experience of exhausting labour. " """"" ' ' On 12th March 1874 he informed Lord Granville that he could give only occasional attendance in the House of Commons during the current session, and that he must " reserve his entire freedom to divest himself of all the re- sponsibilities of

leadership at no distant date." His most important intervention in the debates of 1874 was when he opposed Archbishop Tait's Public Worship Bill. This was read a second time without a division, but in com- mittee Gladstone enjoyed some signal triumphs over his late Solicitor-General, Sir William Harcourt, who had warmly espoused the cause of the Government and the Bill. At the beginning of 1875 Gladstone carried into effect the resolution which he had announced a year before, and formally resigned the leadership of the Liberal party. He was succeeded by Lord Hartington, afterwards Duke of Devonshire. The learned leisure which Gladstone had promised himself when released from official responsibility

was not of long duration. In the autumn of 1875 an insurrection broke out in Bulgaria, and the suppression of it by the Turks was marked by massacres and out- rages. Public indignation was aroused by what were known as the " Bulgarian atrocities," and Gladstone flung himself into the agitation against Turkey with characteristic zeal. At public meetings, in the press, and in Parliament he denounced the Turkish Govern- ment and its champion, Disraeli, who had now become Lord Beaconsfield. Lord Hartington soon found himself pushed aside from his position of titular leadership. For four years, from 1876 to 1880, Gladstone maintained the strife with a courage, a persistence, and a versatility which raised the enthusiasm of his followers to the high-

est pitch. The county of Edinburgh, or Midlo- campaiga. ^hian, which he contested against the dominant

influence of the Duke of Buccleuch, was the scene of the m.ost astonishing exertions. As the General Election approached the only question submitted to the electors was ❓❓❓ Do you approve or condemn Lord Beacons- field's foreign policy ? The answer was given at Easter 1880, when the Liberals were returned by an overwhelm- ing majority over Tories and Home Rulers combined. Gladstone was now member for Midlothian, having retired from Greenwich at the dissolution.

When Lord Beaconsfield resigned the Queen sent for Lord Hartington, the titular leader of the Liberals, but he and Lord Granville assured her that no other chief than Gladstone would satisfy the party. Accordingly, on 23rd April he became Prime Minister for the second time. His second administration, of which the main achievement was the extension of the suffrage to the agricultural labourers, was harassed by two controversies, relating to Ireland and Egypt, which proved disastrous to the Liberal party. Gladstone alienated consider- able masses of English opinion by his efforts to reform the tenure of Irish land, and provoked the Irish people by his attempts to establish social order and to repress crime. A Bill to provide compensation for tenants who had been evicted by Irish landlords passed the Commons, but was shipwrecked in the Lords, and a ghastly record of outrage and murder stained the follow- ing winter. A Coercion Bill and a Land Bill passed in 1881 proved unsuccessful. On the 6th May 1882 the newly- appointed Chief Secretary for Ireland, Lord Frederick Cavendish, and his Under-Secretary, Mr Burke, were stabbed to death in the Phoenix Park at Dublin. A new Crimes Act, courageously administered by Lord Spencer and Sir George Trevelyan, abolished exceptional crime in Ireland, but completed the breach between the British Government and the Irish party in Par- liament.

The bombardment of the forts at Alexandria and the occupation of Egypt in 1882 were viewed with great disfavour by the bulk of the Liberal party, and were but little congenial to Gladstone himself. The circumstances of General Gordon's untimely death awoke an outburst of indignation against those who were, or seemed to be, responsible for it. Frequent votes of censure were proposed by the Opposition, and on 8th June 1885 the Government were beaten on the Budget. Gladstone resigned. The Queen offered him the dignity of an earldom, which he declined. He was succeeded 'hy Lord Salisbury.

The General Election took place in the following November. When it was over the Liberal party was

just short of the numerical strength which was ^'"' requisite, to defeat the combination of Tories

^ome ue ^^^ Parnellites., A startling surprise was at

hand. Gladstone had for some time been con- vinced of the expediency of conceding Home Eule to

Ireland in the event of the Irish constituencies giving unequivocal proof that they desired it. His intentions were made known only to a privileged few, and these, curiously, were not his colleagues. The General Election of 1886 showed tha^ Ireland, outside Ulster, was prac- tically unanimous for Home Eule. On 17th December an anonymous paragraph was published, stating that if Mr Gladstone returned to office he was prepared to " deal in a liberal spirit with the demand for Home Eule." It was clear that if Gladstone meant what he appeared to mean, the Parnellites would support him, and the Tories must leave office. The Government seemed to accept the situa- tion. When Parliament met they executed, for form's sake, some confused manoeuvres, and then they were beaten on an amendment to the Address in favour of Municipal Allotments. On 1st February 1886 Gladstone became, for the third time, Prime Minister. Several of his former colleagues declined to join him, on the ground of their absolute hostility to the policy of Home Eule ; others joined on the express understanding that they were only pledged to consider the policy, and did not fetter their further liberty of action. On the 8th April Gladstone brought in his Bill for establishing Home Eule, and eight days later the Bill for buying out the Irish landlords. Meanwhile two members of his Cabinet, feeling themselves unable to support these measures, resigned. Hostility to the Bills grew apace. Gladstone was implored to with- draw them, or substitute a resolution in favour of Irish autonomy; but he resolved to press at least the Home Eule Bill to a second reading. In the early morning of 8th June the Bill was thrown out by thirty. Gladstone immediately advised the Queen to dissolve Parliament. Her Majesty strongly demurred to a second General Election within seven months ; but Gladstone persisted, and she yielded. Parliament was dissolved on 26th June. In spite of Gladstone's skilful appeal to the constituencies to sanction the principle of Home Eule, as distinct from the practical provisions of his late Bill, the General Elec- tion resulted in a majority of considerably over 100 against his policy, and Lord Salisbury resumed office. Throughout the existence of the new Parliament Gladstone never re- laxed his extraordinary efforts, though now nearer eighty than seventy, on behalf of the cause of self-government for Ireland.

The fertility of argumentative resource, the copiousness of rhetoric, and the physical energy which he threw into the enterprise, would have been remarkable at any stage of his public life ; continued into his eighty- fifth year they were little less than miraculous. Two incidents of domestic interest, one happy and the other sad, belong to that period of political storm and stress. On 25th July 1889 Gladstone celebrated the fiftieth anni- versary of his marriage, and on the 4th July 1891 his eldest son, William Henry, a man of fine character and accomplishments, died, after a lingering illness, in his fifty-second year.

The crowning struggle of Gladstone's political career was now approaching its climax. Parliament was dis- solved on 28th June 1892. The General Election resulted in a majority of forty for Home Eule, heterogeneously composed of Liberals, Labour Members, and Irish. As soon as the new Parliament met a vote of want of confidence in Lord Salisbury's Government was moved and carried. Lord Salisbury resigned, and on 15th August 1892 Gladstone kissed hands as First Lord of the Treasury. He was the first English statesman that had been four times Prime Minister. Parliament reassembled in January 1893. Gladstone brought in his new Home Eule Bill on the 13th February. It passed *"^ ;g the House of Commons, but was thrown out biii. by the House of Lords on the second reading on 8th September 1893. Gladstone's political work was*

now, in his own judgment, ended. He made his last speech in the House of Commons on the 1st Marcli 1894, acquiescing in some amendments introduced by the Lords into the Parish Councils Bill ; and on the 3rd March he placed his resignation in the Queen's hands. He never set foot again in the House of Commons, though he remained a member of it till the dissolution of 1895. He paid occasional visits to friends in London, Scotland, and the south of France ; but the remainder of his life was spent for the most part at Hawarden. He occupied his leisure by writing a rhymed translation of the Odes of Horace, and pre- paring an elaborately annotated edition of Butler's Analog!/ and Sermons. He had also

contemplated some addition to the Homeric studies which he had always loved, but this design was never carried into effect, for he was summoned once again from his quiet life of study and devotion to the field of public controversy. The Armenian massacres in 1894 and 1895 revived all his ancient hostility to " the governing Turk." He denounced the massacres and their perpetrators at public meetings held at Chester on 6th August 1895, and at Liverpool on 24th September 1896. In March 1897 he recapitu- lated the hideous history in an Open Letter to the Duke of Westminster, which in its masterly handling of facts and its resonant eloquence may rank with the best of his writings.

But the end, though not yet apprehended, was at hand. Since his retirement from office Gladstone's physical vigour, up to that time unequalled, had shown signs of impairment. Towards the end of the summer of 1897 he began to suffer from an acute pain, which was attributed to facial neuralgia, and in November he went to Cannes. In February 1898 he returned to England and went to Bournemouth. There he was in- formed that the pain had its origin in a disease which must soon prove fatal. He received the information with simple thankfulness, and only asked that he might die at Death home. On 22nd March he returned to Hawarden,

and there he died on 19th May 1898. During the night of 25th May his body was conveyed from Hawarden to London, and the coffin was placed od a bier in Westminster Hall. Throughout the 26th and 27th a vast train of people, officially estimated at 250,000, and drawn from every rank and class, moved in unbroken procession past the bier. On the 28th May the coffin, preceded by the two Houses of Parliament and escorted by the chief magnates of the realm, was carried from Westminster Hall to Westminster Abbey. The Heir- Apparent and his son, the Prime Minister and the Leader of the House of Commons, were among those who bore the pall. The body was buried in the north transept of the abbey, where, on the 19th June 1900, Mrs Gladstone's body was laid beside it.

After a careful survey of Mr Gladstone's life, enlight- ened by personal observation, it is inevitable to attempt some analysis of his character. First among his moral attributes must be placed his religiousness. From those

early days when a fond mother wrote of him as having been "truly converted to God," down to the Character. ^gj.gg ^j ninety years, he lived in the habitual contemplation of the unseen world, and regulated his private and public action by reference to a code higher than that of mere prudence or worldly wisdom. A second characteristic, scarcely less prominent than the first, was his love of power. His ambition had nothing in common with the vulgar eagerness for place and pay and social standing. Rather it was a resolute deter- mination to possess that control over the machine of State which should enable him to fulfil without let or hindrance the political mission with which he believed

that Providence had charged him. The love of power was supported by a splendid fearlessness. No dangers were too threatening for him to face, no obstacles too formidable, no tasks too laborious, no heights too steep. The love of power and the supporting courage were allied with a marked imperiousness. Of this quality there was no trace in his manner, which was courteous, conciliatory, and even deferential ; nor in his speech, which breathed an almost exaggerated humility. But the imperiousness showed itself in the more effectual form of action; in his sudden resolves, his invincible insistence, his recklessness of conse- quences to himself and his friends, his habitual as- sumption that the civilized world and all its units must agree with him, his indignant astonishment at the bare thought of dissent or resistance, his incapacity to believe that an overruling Providence would permit him to be frustrated or defeated. He had by nature what he himself called a " vulnerable temper and im- petuous moods." But so absolute was his lifelong self- mastery that he was hardly ever betrayed into saying that which, on cooler reflection, needed to be recalled. It was easy enough to see the " vulnerable temper " as it worked within, but it was never suffered to find audible expression. It may seem paradoxical, but it is true, to say that Mr Gladstone was by nature con- servative. His natural bias was to respect things as they were. In his eyes, institutions, customs, systems, so long as they had not become actively mischievous, were good because they were old. It is true that he was sometimes forced by conviction or fate or political neces- sity to be a revolutionist on a large scale ; to destroy an established Church ; to add two millions of voters to the electorate ; to attack the parliamentary union of the kingdoms. But these changes were, in their inception, distasteful to

their author. His whole life was spent iu unlearning the prejudices in which he was educated. His love of freedom steadily developed, and he applied its principles more and more courageously to the problems of government. But it makes some difference to the future of a democratic state w^hether its leading men are eagerly on the look-out for something to revolutionize, or approach a constitutional change by the gradual pro-cesses of conviction and conversion.

Great as were his eloquence, his knowledge, and his financial skill, Gladstone was accustomed to say of him- self that the only quality in which, so far as he knew, he was distinguished from his fellow-men was his faculty of concentration. Whatever were the matter in hand, he so concentrated himself on it, and absorbed himself in it, that, for the time being, nothing else seemed to exist for him.

A word must be said about physical characteristics. In his prime Gladstone was just six feet high, but his inches diminished as his years increased, and in old age the unusual size of his head and breadth of his shoulders gave him a slightly top-heavy appearance. His features were strongly marked; the nose trenchant and hawk-like, and the mouth severely lined. His flashing eyes were deep- set, and in colour resembled the onyx with its double band of brown and grey. His complexion was of an extreme pallor, and, combined with his jet-black' hair, gave in earlier life something of an Italian aspect to his face. His dark eyebrows were singularly flexible, and they perpetually expanded and contracted in harmony with what he was saying. He held himself remarkably upright, and even from his school days at Eton had been remarked for the rapid pace at which he habitually walked. His voice was a baritone, singulaj-ly clear and far-reaching. In the ^'averley Market at Edinburgh, which is said to hold 20,000 people, he could be heard without difficulty ;

and as late as 1895 he said to the present writer: "What difference does it make to me whether I speak to 400 or 4000 people ? " His physical vigour in old age earned him the popular nickname of the Grand Old Man.

(g. w. e. e.)

Claisher, James (1809), English meteoro- logist and aeronaut, was born in London on 7th April, 1809. After serving for a few years on the Ordnance Sur- vey of Ireland, he acted as an assistant at the Cambridge and Greenwich observatories successively, and when the department of meteorology and magnetism was formed at the latter, he was entrusted with its superintendence, which he continued to exercise for thirty-four years, until his retirement from the public service. In 1845 he pub- lished his well-known dew-point tables, which have gone through many editions. In 1850 he established the Meteorological Society, acting as its secretary for many years, and in 1866 he assisted in the foundation of the Aeronautical Society of Great Britain. He was appointed a member of the Royal Commission on the Warming a,nd Ventilation of Dwellings in 1875, and for twelve years from 1880 acted as chairman of the executive committee of the Palestine Exploration Fund. But his name is best known in connexion with the series of balloon ascents which he made between 1862 and 1866, mostly in company with Coxwell. Many of these ascents were arranged by a committee of the British Association, of which he was a member, and were strictly scientific in character, the object being to carry out observations on the tempera- ture, humidity, &c., of the atmosphere at high elevations. In one of them, that which took place at Wolverhampton on 5th September, 1862, Mr Glaisher and his companion attained what is probably the greatest height ever reached by a balloon carrying passengers. As no automatically recording instruments were available, and Mr Glaisher was unable to read the barometer at the highest point owing to loss of consciousness, the precise altitude can never be known, but it is estimated at about 7 miles from the earth. An authentic account of this and other ascents undertaken by him may be found in the article Aeronautics {Ency. Brit., 9th edition, vol. i.), which came from his pen.

Glamorgan, a maritime county of South Wales, bounded on the N.W. by Carmarthen, on the N. by Car- marthen and Brecon, on the E. by Monmouth, from which it is separated by the Rhymney, and on the S. and the S.W. by the Bristol Channel.

Area and Population. ??? The area of the ancient county is 516,959 acres, or 808 square miles, with a population in 1881 of 511,433, and in 1891 of 687,218, of whom 360,260 were males and 326,958 females ; the number of persons per square mile being 851, and of acres to the person 0-75. The area of the administrative county, according to the census returns of 1891, was 505,815 acres, with a population of 467,954, or. with the county boroughs of Cardiff and Swansea, 516,966 acres, with a population of 687,218 ; but in 1895 the acreage of the combined area was slightly altered by transferences in the case of the county borough of Cardiff to and from Mon- mouth. The area of the registration county is 576,308, with a population in 1891 of 693,072. Within this area the percentage of increase between 1881 and 1891 was 33-70. The excess of births over deaths between 1881 and 1891 was 97,222, but this was much exceeded by the increase of the population, which was 174,689. In 1901 the population of the ancient county was 860,022. The fol- lowing table gives the number of marriages, births, and deaths, with the number and percentage of illegitimate births, for 1880, 1890, and 1898 : ???

Tear.

Marriages.

Births.

Deaths.

Illegitimate Births.

No.

Per cent.

1880 1890 1898

4088 6575 6112

18,345 24,245 29,347

11,076 13,046 14,732

597 680 812

3-3

2-9 2-8

In 1891 there were in the county 3289 natives of Scotland, 11,256 natives of Ireland, and 5856 foreigners, while 326,481 persons could speak English, 142,346 Welsh, and 177,726 English and Welsh.

Constitution and Government. ??? The county is divided into five parliamentary divisions, and it also includes the Cardiff district of boroughs (consisting of Cardiff, Cowbridge, and Llantrisant) , greater part of the borough of Merthyr Tydfil, and Swansea, comprising Swansea town and Swansea district (consisting of the boroughs of Aberavon, Kenfig, Loughor, and Neath) . There are five municipal boroughs : ??? Aberavon (7553), Cardiff (164,420), Cowbridge (1202), Neath (i;j,732), and Swansea (94,514). Cardiff and Swansea are county boroughs. The following are urban districts: ??? Aber- dare (43,357), Barry (27,028), Bridgend (6063), Briton Ferry (6961), Caerphilly (15,835), Glyncon-wg (6450) , Maesteg (15,013), Margam (9014), Merthyr Tydm (69,227), Mountain Ash (31,093), Ogmore and Garw (19,912), Oystermouth (4483) , Penarth (14,227), Pontypridd (32,319), Porthcawl (1871), and Rhondda (113,735). Glamorganshire is in the South Wales and Chester circuit, and assizes are held at Cardiff and Swansea. The boroughs of Cardiff, Swansea, and Aberavon have separate commissions of the peace, and the former two have also separate courts of quarter sessions. The ancient county ??? which is partly in the diocese of Llandaff and partly in that of St Davids ??? contains 140 entire ecclesiastical parishes and districts and part of five others.

Education. ??? Cardiff is the seat of the University College of South Wales and of a technical school. At Swansea are the Gov- ernment schools of science and art. In connexion with the University College of Cardiff there is a day training college for schoolmasters and mistresses. At Swansea there is a residential college for mistresses (British and

Foreign School Society's) which also takes day students. In Cardiff there are two school board blind schools and one school board deaf school ; in Swansea are the Royal Cambrian Institution for the deaf and the Swansea and South Wales Institution for the blind ; at Pontypridd is a school board deaf school, and there is also one at Ystradyfodwg. The number of elementary schools in the county on 31st August 1899 was 382, of which 253 were board and 129 voluntary schools, the latter including 100 National Church of England schools, 24 Roman Catholic, and 5 " British and other." The average attendance at board schools was 108,320, and at voluntary schools 16,400. The total school board receipts for the year ended 29th September 1899 were over ►►513,702. The income under the Technical Instruction Act was over ►►669, and that under the Agricultural Rates Act over ►►2467.

Agriculture. ►►► More than half of the total area of the county is under cultivation, and of this about seven-ninths is in permanent pasture, cattle, especially cows for milk-selling, and sheep being largely kept. There are in addition over 121,000 acres of mountain pasture, and about 27,000 acres under woods. Since 1880 the acreage under corn crops has decreased by about a third, there being a con- siderable decrease even in the acreage under oats, and a decrease of about two-fifths in the acreage under wheat, and only a little less than two-fifths in the acreage under barley. The acreage under green crojjs has decreased more than a sixth, the decrease being chiefly in that under turnips, which, however, still occupy about three-fourths of the green crop area.

The following table gives the larger main divisions of the culti- vated area at intervals from 1880 : ►►►

Year.

Total area under Cul- tivation.

Corn Crops.

Green

Crops.

Clover.

Permanent Pasture.

Fallow.

1880 1885 1890 1895 1900

272,215 279,659 282,774 279,416 274,410

36,685 31,455 28,661 26,191 25,205

15,013 14,606 14,176 13,299 11,851

26,088 27,570 23,195 21,3.58 21,824

190,514 203,889 215,072 217,149 214,375

3911 2128 1573 1266 1026

The following table gives particulars regarding the principal live stock for the same years : ???

Tear.

Total Horses.

Total

Cattle.

Cows or Heifers

in Milk or in

Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1900

14,206 15,362 16,125 17,284 16,468

51,972 57,256 55,849 52,203 50,485

21,863 23,957 25,1.38 24,285 25,697

253,321 283,939 303,507 292,786 330,060

13,020 17,660 18,024 18,892 16,406

Industries and Trade. ??? According to the annual report for 1898 of the chief inspector of factories (1900), the total numbe.r of persons employed in factories and workshops in 1897 was 54,859,

as compared with 53,313 in 1896. Of these 47,358 persons were employed in non-textile factories, there being an increase of 2-2 per cent, between 1895 and 1896, and of 3-3 per cent, between 1896 and 1897. In metal founding and conversion 19,298 persons were employed, in the extraction of metals 3695, in the manu- facture of machines, appliances, conveyances, and tools 11,846, in pottery, &o., 1684, in the manufacture of paper, &c., 1916 ; there is considerable manufacture of chemicals. Workshops employed 7266 persons, of whom 4430 were employed in clothing industries. The fishing industry is of some importance : by lines, draught nets, dredging, trawling, fixed nets, and hand. The principal fish are cod, herring, pollard, whitings, fluke, brill, plaice, soles, turbot, oysters, mussels, limpets, winkles, cockles, shrimps, crabs, and lobsters. The total quantity landed at the ports of Cardiff and Swansea in 1899 was 29,242 cwts., valued at ??19,983. The total number of persons employed in mines and quarries in 1899 was 96,017, rather more than the number em- ployed in Lancashire, and exceeded among British counties only by the numbers of Durham and Yorkshire. In the same year 681,910 tons of limestone were raised and 292,137 tons of sand- stone. Tin and

copper ore are imported from Cornwall for smelt- ing purposes, and most of the iron for the special industries of the county is also imported. There are many large blast-furnaces ___ at Dowlais, Merthyr Tydfil, Cardiff, Pontypridd, Bridgend, Landore, Port Talbot, and Briton Ferry ___ the amount of pig iron produced in 1885 being 354,692 tons, in 1890 416,874 tons, in

1895 447,715 tons, and in 1899 578,790 tons. The fdllowing table gives particulars regarding the principal minerals in 1890 and 1899 : ___

Tear.

Clay.

Coal.

Iron Ore.

Tons.

Value.

Tons.

Value.

Tons.

Value.

1890 1899

144,767 217,147

__28,804 __23,364

21,426,415 28,116,941

__11,451,913 __10,967,247

21,363

6,817

9613 3068

AviwominiS. Interesting Tour in the County of Monmouth and Part of Glamorgan by a Gentleman. 2nd ed. Halesworth, 1808. ^ Book of Glamorganshire Antiquities, by Rice Mehriok, 1578, ed. Sir T. Phillips. Typis Medio Montano, 1825. HoMFRAY. Castles of the Lordship of Glamorgan. Swansea, 1802. Roberts. Druidical Bemains and Antiquities of the Ancient Britons, principally in Glamorgan. Swansea, 1842. Nicholas. The. History and Antiquities of Glamorganshire and its Families. London, 1874. G. S. Clark. 2he Land of Morgan, 6 pts. London, 1880 ; new ed., London, 1883 ; Genealogies of Families of the Lordship of Morgan and Glamorgan. London, 1886 ; Cartce quce ad Dominium de Glamorgan pertinent, 2 vols. Dowlais, 1885-90. Thomas. Inscribed Stones of Glamorganshire. Cardifi, 1893. See also the guides to South Wales. (t. f. h.)

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JHERING. Philip A. Ashworth, Dr Juris.

JOHNSTON, GENERAL J. E. Major-General Joseph Wheeler,

Senior Cavalry General of the Confederate Armies in the

American Civil War.

JOHOR. Hugh Clifford, C.M.G., British Resident, Pahang.

JOUBERT. J. A. J. de Villiers, British Museum.

JOWETT. The Rev. Lewis Campbell, LL.D., Emeritus Pro-

fessor of Greek, University of St Andrews ; Joint Author of

” Life of Benjamin Jowett.”

PREFATORY ESSAY.

THE APPLICATION OF THE DOCTRINE OF EVOLUTION TO SOCIO-

LOGICAL THEORY AND PROBLEMS.

By Benjamin Kidd.

IN tlie Prefatory Essay to vol. xxvi. of the present edition of the Encyclopcedia Britannica, Mr Edward

Dicey, in reviewing recent political progress, has described the tendencies in thought and statecraft

during the last quarter of the 19th century as, on the whole, most adequately summarized in the phrase

“Conservative reaction.” It is evident that a situation in the public life of a period to which such

an expression can be correctly applied has a significance which extends beyond the conditions of current

politics. Judging from analogies in history, a position of the kind in political life must be taken to

imply that great alterations in the habits of thought and in the opinions of society are in progress beneath

the surface of events. Such changes must arise from causes which are deep-seated, which are possibly

carrying us forward to a new era of reconstruction, and which, therefore, fall to be considered in wide and

general relations.

During the second half of the 19th century the cause which most considerably influenced the

tendencies of thought was the acceptance of the doctrine of organic evolution as based on the principle of

natural selection. As it has come to be understood that it is not so much in the lower animal

world as in human society that we have the highest, most complex, and most characteristic tiuencein

phase of the struggle for existence, a new influence, against which the older tendencies in *** *’”’’■’’

knowledge have continued to struggle with diminishing success, has been felt in all the sciences

dealing with man and the phenomena of his social progress. The leading problems in ethics, in politics,

in economics, in religion, and in philosophy have been brought into direct relationship to principles

universal in reach, which are seen to affect them vitally, but which were, nevertheless, not understood nor

even to anj”^ general extent discussed before the closing decades of the 19th century. The first effect of

the new ideas has been profoundly disintegrating. There has resulted an attitude of doubt, of hesitation,

and of apparent reaction as the tendencies of the less organic views of older schools of thought have

become visible. The process of change in progress is, in short, radical and far-reaching, and the first duty

of the observer is, therefore, to endeavour to see it as a whole.

Although the hypothesis of evolution as applied to the cosmos, and even in a more special and local

sense to forms of life, is not new, the effort to consider it in relation to man himself, and consequently in

its bearings on sociological theories and problems, is of quite recent origin. To understand the nature of

the characteristic difficulties which have presented themselves in this attempt, the conditions prevalent

in Western thought when Charles Darwin published the Origin of Species in 1859 must be recalled.

For a hundred years before Darwin — that is to say, during the last half of the 18th century and the first

half of the 19th century — the general mind had been to some extent familiarized with the conception of

continuous development by many speculations which had begun to be supported by evidence.

^’■”*’’ Kant’s nebular hypothesis, after it had received scientific shape at the hands of Laplace and

theories j r ■> ■■• ... t j j.

leading up Sir W. Herschel, prepared the world for the reception of the theory of evolution as applied to

‘sekMon. the physical universe. In the biological sciences ideas of development and progressive modifica-

tion of forms were also to be found in many quarters. In France by the middle of the 18th

century Buffon had suggested that a succession of nearly related forms was to be traced amongst animals

and plants, likeness of type being held by him to suggest the possibility of the varying forms being con-

sidered as having sprung originally from a single stock. Lamarck and Geoffrey Saint-Hilaire in the

same country had arrived at a similar conclusion, the latter asserting that such divisions as fishes,

amphibians, birds, and mammals were formed on one original type, and that modifications were

still in progress. Lamarck in the PMlosophie Zoologique had held, although in opposition to the

dominant influence of Cuvier, that forms of existing life were descended from one or more original

forms ; the theory being also put forward by him that the action of the physical environment of the

various forms in causing the increasing use or disuse of organs had tended to produce development

in certain directions with divergence of type.

In Germany and England thought had been moving in the same direction. In the former country

Kant’s speculations as to the mode of development of the solar system had been supplemented by a view

of evolution in the organic world which still forms a connecting link between the past and the modern

view. The ideas of Goethe and Oken had tended to strengthen a belief in the theory of progressive

development in life ; and the work of embryologists like Wolff, Meckel, and von Baer had given a

decided impetus to speculations founded on it. Meckel had remarked in 1811 that ” there is no good

physiologist who has not been struck incidentally by the observation that the original form of all

organisms is one and the same,” and von Baer in 1834 had asserted in still more decisive words that

” only in a very childish view of nature could species be regarded as permanent and unchangeable tjrpes.”

In England to a certain class of inquirers a number of causes had long contributed not only to suggest

the idea of continuous development, but to call attention to the character of the forces which might

influence it. As early as 1798 Malthus, confining his attention to human society, had published his

famous Ussay on the Principle of Population, which was afterwards to suggest to Darwin the conception

of natural selection. In geology a group of active minds had been working out the history of life upon

the globe from the stratified rocks. The contributions of Murchison, Buckland, Mantell, Lyell, and others

had helped to familiarize men’s minds with the idea of development, both physical and biological, in the

past history of the earth, Lyell, in particular, seeking to uphold the theory that all the geological

features of the world were to be accounted for by the agency of exactly the same kind of changes as were

taking place upon the earth in the present time.

In spite, however, of all these and other important indications, and of many pregnant suggestions

made by observers like Owen, Wells, Matthew, and others, it must be considered that the conception of

the continuous evolution of life from simpler forms had made surprisingly little impression.

Ism to the It had to contend against a set of conditions which it is important to understand, conditions

7ry”pri’n-‘ t^i^t uot Only retarded its more direct developments, but prevented altogether its application

cipie. ^Q ^\^Q higher problems of biology presented in human society.

In the first place, there was everywhere to be distinguished a strongly entrenched resistance to all

attempts to apply the doctrine of evolution to man himself. The outlying conclusion upon which this

resistance had generally elected to make its decisive stand was a very clear one. It was suggested in

the first instance by the hitherto prevailing interpretation of the Hebrew account of creation contained in

the first book of Genesis. But the principle which it involved was undoubtedly established in its hold

on the more thoughtful minds simply by the absence of any convincing theory of’ the mechanism by

which a process of evolution could be accepted as operating in life. It might be possible, it was reasoned

to accept divergences in forms of life within certain limits (variations). Nevertheless, it was said, species

must, at the same time, be held to be immutable. These it was considered represented acts of creation

(special creations) at various times in the past history of the earth. Buffon's theory of organic evolution

had been hardly more than suggestive. Lamarck had put forward a theory of the accumulation of the

supposed inherited effects of the use and disuse of organs to account for divergence of types. But his

view had not been accepted; and his conception of the transmutation of species was ridiculed in France

by Cuvier, the most influential of the systematic naturalists, who remained to the end an advocate of the

theory of constant cataclysms and recurring creations in the past history of life. Finally, it is on record,

on the authority of Darwin, that down to the publication of the Origin of Species " all the most eminent

living naturalists and geologists disbelieved in the mutability of species." It came to be afterwards

asserted, he said, speaking of the position at the publication of the Origin of Species, that the subject was

in the air, or that men's minds were prepared for it ; but he continued, " I do not think that this is strictly

true, for I occasionally sounded not a few naturalists, and never happened to come across a single one who

seemed to doubt about the permanence of species. Even Lyell and Hooker, though they would listen

with interest to me, never seemed to agree.”

This was the position in thought when Darwin published the Origin of Species. It is necessary

to keep it in view in considering the later applications of the theory of evolution to sociological

problems. At first sight the Origin of Species attempted nothing in itself very remarkable.

It endeavoured to prove an assertion which, as has been said, had been many times put forward signiti-

by naturalists in the past, namely, that species were not fixed groups. In estimating the of tte

nature of the work which he considered he had accomplished in the Origin of Species, species””

Darwin said, ” Hereafter we shall be compelled to acknowledge that the only distinction

between species and well-marked varieties is, that the latter are known, or believed, to be connected at the

present day by intermediate gradations, whereas species were formerly thus connected.” That was all.

Never, however, was a meaning of such far-reaching application hidden in a simpler form of words. It

was by formulating in the conception of natural selection a theory of the mechanism by which he con-

ceived the transmutation of species to be effected, and then, and especially, by supplying the necessary

evidence in support of it, that Darwin advanced the doctrine of evolution beyond the position to which

any of his predecessors had carried it.

The general mind from the beginning, and perhaps in some senses more fully than the workers in

many of the departments of biological science, distinguished the significance of the new departure. It

was not simply that a unifying principle exemplifying the mode of change in the organic world had been

enunciated. What was perceived was that, by implication, the study of man himself had become a

department of higher biology. All the phenomena of his development — physical, mental, and social —

had now been brought within the application of the general causes which were thus asserted to have con-

trolled the evolution of life from lower to higher forms from the beginning of sentient existence.

It will probably be seen much more clearly in the future than it is at present, how great were the

difficulties which at the outset confronted the attempt to apply this theory of evolution to sociological

problems. When the character of our civilization as a whole is considered; when the nature of the

beliefs and of past interpretations of many doctrines intimately interwoven with its history is held in

mind ; when the fact that the acceptance of the theory of evolution has involved the conception of

development as applied to men's fundamental convictions in such matters as ethics, politics, and religion,

is taken into account ; — it will be seen that an enormous and even an unprecedented change in the habits

and modes of thinking of society has been involved. Every allowance must, therefore, be made for

tendencies which have hitherto retarded the legitimate application of the conception of evolution to

sociology. The wonder rather is that so great progress has already been made, and that, as Romanes has

pointed out, we are already, as the result, living in the midst of a revolution in the general tendencies of

knowledge which is without a parallel in the past history of mankind.

Looking at the conception of organic evolution as it was accepted in the period immediately follow-

ing the publication of Darwin's Origin of Species, there are several matters which call for attention in

considering the subsequent history of the attempt to apply the theory to sociological development.

to human

society.

X PREFATORY ESSAY

When the distinctive Darwinian contribution to the doctrine of development is considered, it may be

seen to consist essentially in a chain of evidence brought forward to support a simple theory of the

mechanism of the evolutionary process. It was proved in the first place that every existing

”’”^.f” form of life tends to increase at such a rate as to outrun the conditions of its existence for the

plications

of the time being. There is to be found, said Darwin, “no exception to the rule that every organic

Z7iZiott being naturally increases at so high a rate, that, if not destroyed, the earth would soon be covered

by the progeny of a single pair.” In the second place, it was found that this faculty in life was

coexistent vrith an inherent tendency in every form to variation within narrow limits. These

variations extended to every part, organ, and function, and tended to be transmitted by inheritance.

From these facts, now accepted practically vrithout question, there was deduced the principle of natural

selection. In Darwin’s words, ” As many more individuals of each species are born than can possibly

survive; and as, consequently, there is a frequently recurring struggle for existence, it follows that any

being, if it vary however slightly in any manner profitable to itself, under the complex and sometimes

varying conditions of life, will have a better chance of surviving, and thus be naturalli/ selected. From

the strong principle of inheritance, any selected variety will tend to propagate its new and modified form.”

As Alfred Russel “Wallace put it — the best equipped would have an advantage over their competitors

in the struggle for existence, the fittest would survive. And they would tend to transmit in cumulative

degree the qualities upon which that fitness depended.

The first era of the attempt to apply this conception of evolution by natural selection to society

extends practically over nearly the whole of the second half of the 19th century ; for Herbert Spencer,

who had begun his system of social philosophy before the publication of the Origin of Species, incorporated

in his general system the doctrine of natural selection, which he had himself in some degree foreshadowed

in an essay published as early as 1852 in the Westminster Review. This first stage of the attempt has

gradually brought into view a position of considerable interest in sociological theory, which, as its

bearing becomes understood, is likely, it appears to the present writer, to exercise a not unimportant

influence on the further development of the theory of organic evolution in general.

It is evident that in considering the application of the principle of natural selection to human

society there is a fact, encountered at the outset, which is so fundarnental that it must be held to control

all the phenomena of social evolution. It is nowadays a commonplace of knowledge, that the potential

efficiency of society must always be taken to be greater than the sum total of the potential efficiency

of all its members acting as individuals. This arises from the fact, to be observed every day

acteristic in life, of the effect of organization, of division of labour, of specialization of work, and more

Natural particularly of the opportunity afforded in an organic type of society for the accumulation

Selection a,nd transmission of that knowledge and experience from which power and efficiency in the

struggle for existence in a large degree arise. There follows, however, from this fact,

obvious enough once it is mentioned, an important inference. This is that in the evolution of society

natural selection will, in its characteristic results, reach the individual not directly, but through society.

That is to say, the interests of the individual qud individual must cease to be a matter of first importance.

It is by development in the individual of the qualities which will contribute most to the efficiency of

society, that natural selection will in the long-run produce its distinctive results in human evolution. It

is, in short, about this function of socialization, involving the increasing subordination of the individual,

that the continued evolution of society by natural selection must be held to centre. Societies in which

the individuals were able to resist the process would quickly reach the limits of their progress, and would

have to give way in the struggle for existence before others in which the process of subordination con-

tinued. In the end it would be the social organizations in which the interests of the individual were

most efficiently included in and rendered subservient to the interests of society considered collectively

that, from their higher efficiency, would be naturally selected. In all the first attempts, therefore, tO’

apply the doctrine of evolution to social development it was recognized that society must be considered in

some sense as organic.

One of the earliest attempts to approach the study of social evolution from this standpoint was made

by Herbert Spencer in the middle of the 19th century. It was contained in an article published

in the Westminster Review in January 1860, and was entitled “The Social Organism.” This article is in

many respects one of the most noteworthy documents in the literature of the last half of the

19th century. It is important for two principal reasons. In the first place, it offers the clue speacer’s

to the central principle round which Mr Spencer afterwards constructed his system of social *’”’ ” °^’

philosophy, and round which the thought, and even the political development, of more than half a century

have revolved. In the second place, it clearly expresses the nature of the fundamental difficulty under-

lying Mr Spencer’s attempt to apply the doctrine of evolution to society. It affords, as we read it now,

clear indication of a leading cause which made the last quarter of the 19th century a period of apparent

reaction, but which, as the application of the doctrine of evolution is better understood, is notunlikely to

render the ensuing period one of profound reconstruction in which the science of society may be carried

considerably beyond the position reached by Mr Spencer.

Mr Spencer’s object in the essay in question was suggested by the position which had been reached

in the sciences dealing with life. He set out, therefore, by assuming that in the light of the recent great

generalizations of biology it had become possible to apply the conception of the social organism much

more effectively than was the case in the speculations of Plato and Hobbes. He proceeded accordingly to

examine the analogy which he considered existed between the social organism and a living individual

body. Mr Spencer in the result found societies to agree with individual organisms in four conspicuous

peculiarities, which he enumerated as follows : —

1. ” That commencing as small aggregations, they insensibly augment in mass : some of them

eventually reaching ten thousand times what they originally were.”

2. ” That while at first so simple in structure as to be considered structureless, they assume, in the

course of their growth, a continually-increasing complexity of structure.”

3. ” That though in their early, undeveloped states, there exists in them scarcely any mutual depend-

ence of parts, their parts gradually acquire a mutual dependence ; which becomes at last so

great that the activity and life of each part is made possible only by the activity and life of

the rest.”

4. ” That the life and development of a society is independent of, and far more prolonged than, the

life and development of any of its component units ; who severally are born, grow, work, repro-

duce, and die, while the body politic composed of them survives generation after generation,

increasing in mass, completeness of structure, and functional activity. ”

In the examination of these analogies Mr Spencer, as might be expected, found in society, as in the

individual organism, physiological division of labour ; ” differentiation upon differentiation taking place in

the evolution of a civilized society,” with the development of government, of contrdl, of communication, and

economic activities of all kinds.

Coming then to the differences between societies and individual organisms, Mr Spencer proceeded to

enumerate these also under four heads. The differences under the first three of these need not here be

referred to, as they were in large measure explained away in the essay. But under head 4 a noteworthy

distinction was made. Mr Spencer continued : — ” The last and perhaps the most important distinction,

is, that while in the body of an animal, only a special tissue is endowed with feeling ; in a society, all the

members are endowed with feeling. . . . While in individual bodies, the welfare of all other parts is

rightly subservient to the welfare of the nervous system, whose pleasurable or painful activities make up

the good or evil of life ; in bodies politic, the same thing does not hold, or holds to but a very slight

extent. It is well that the lives of all parts of an animal should be merged in the life of the whole ;

because the whole has a corporate consciousness capable of happiness or misery. But it is not so with a

society ; since its' living units do not and cannot lose individual consciousness ; and since the community

as a whole has no corporate consciousness. And this is an everlasting reason why the welfare of citizens

cannot rightly he sacrificed to some supposed benefit of the State ; hut why, on the other hand, the State is to

he maintained solely for the benefit of citizens. The corporate life here must be subservient to the lives of the

parts; instead of the lives of the parts being subservient to the corporate life."

When the sentences which are here printed in italics are read carefully their importance will be

perceived. They bring clearly into view the nature of the limitation within which Mr Spencer constructed

his system of social philosophy. They afford also the clue to the characteristic conception of

^um”MU>n. socicty which, although it has not been at any time without vigorous opposition, has been in

the ascendant during the whole of the first stage of the attempt to apply the doctrine of

evolution to society.

It has been said that in considering the principle of natural selection as in operation in society there

is a principle to be taken into consideration at the outset which is so fundamental in character that it

ultimately controls all the phenomena of social development. From the fact that the efficiency of

society is always greater than the sum total of the efficiency of all its members acting as individuals,

natural selection, it has been pointed out, must in its characteristic effects in human evolution reach the

individual through society. It must, in short, in the end subordinate the individual and all his interests

to the efficiency of society in this higher sense. But in the passage just quoted from Mr Spencer, as

indeed in the whole of the article in question, two facts, it may be observed, call for attention. The

” social organism ” which he has in view is the State. And the State as he conceives it is subordinate to

the individual, and not the individual to the State. In Mr Spencer's own words, " the corporate life here

must be subservient to the lives of the parts ; instead of the lives of the parts being subservient to the

corporate life."

The difficulty with which Mr Spencer was here confronted may readily be perceived. If natural

selection is conceived as operating on society, and, therefore, as tending to produce the highest efficiency

out of the materials that comprise it, it must, as has been said, produce the subordination of the interests

of its units to that higher efficiency of society which is greater than the sum total of the efficiencies of its

component members. But one 9f only two conclusions could, therefore, result from Mr Spencer's position.

In regarding the " social organism " as an organism in which the corporate life must be subservient to

the lives of the parts, instead of the lives of the parts being subservient to the corporate life, it must be

that the individual had succeeded in arresting the characteristic effects of natural selection on society.

Or else, the result just mentioned being scarcely conceivable, natural selection, whether the individual

be conscious of it or not, must be subordinating individual interests in society to a larger meaning

in the evolutionary process. Society must, in short, be subject to principles which reach farther than

Mr Spencer conceived ; it must be organic in some different and wider sense than he imagined ; and

the analogy of the ” social organism ” as confined within the consciousness of ascendant interests in the

political State must be considered to be a false one.

This may be said to present the crux of the position which slowly developed itself during the first

stage of the attempt to apply the doctrine of evolution to society. The main problem with which the

philosophy of the race has been on the whole always concerned, namely, that the individual in society is

being subordinated to a process the principles of which extend beyond his political interests, and that this

subordination must, nevertheless, be effected in terms of his own mind, had not been touched. Mr

Spencer, notwithstanding the reach of the principle he was stating (see the article in these

Dominant volumes ou SOCIOLOGY), had not in practice got farther than the English Utilitarians, from

influence

ot English Bentham to John Stuart Mill, in regarding the science of society as the science of the ascendant

tarians. interests of the individuals comprised within the consciousness of the political State. As the

19th century reached its closing decade the gradually increasing perception of the difficulties

of such a position is, therefore, to be distinguished in all directions, — in ethics, in economics, in politics,

as well as in general philosophy. The conviction that it was impossible to formulate the principles of

human development in the terms of any theory of the ascendancy of the interests of society as confined

within the consciousness of Mr Spencer's "social organism," had indeed not ceased in the meantime

to be ably and consistently expressed in various idealist and other schools of thought. But what now

began to be clear was that the same conclusion must ultimately prevail in quarters where it was held

that there must be no implication to go a step beyond that firm ground of fact and experience demanded

by the representatives of the characteristic development in English thought which had come down through

Hume. Many of the theories and anticipations of the Utilitarian school in philosophy and politics

were, in short, felt to have no permanent foundation, and their influence began to diminish. The extreme

expression which the Utilitarian position had reached in phases of continental socialism, and in par-

ticular in the theories of Marx, in which the economic factor was asserted to be the ruling factor in

history, were seen to be all involved in a like condemnation. The century, accordingly, approached its

close in a period of apparent reaction. And the chill shadow of the waning credit of the over-confident

ideas of the Utilitarian school which had ruled the development in thought and politics in its middle

decades hung heavily over all the progressive parties which had inherited the traditions to which these

ideas had given rise.

As the general theory of evolution had in the meantime continued to develop, other symptoms of

interest bearing on the position which had been defined in sociological theory had become visible, and call

for notice. The Darwinian doctrine of evolution as a working hypothesis rested on natural

selection as the elficient cause of progress in the development of life. The theory of natural ‘“fiieace

selection which Darwin had formulated had, however, been suggested to him, not so much by

observations of the lower forms of life as by a study of human society. ” Fifteen months after I had

begun my systematic inquiry,” says Darwin, “I happened to read for amusement Malthus On Population,

and being well prepared to appreciate the struggle for existence which everywhere goes on from long-

continued observation of the habits of animals and plants, it at once struck me that under these circum-

stances favourable variations would tend to be preserved, and unfavourable ones to be destroyed. The

result of this would be the formation of new species. Here, then, I had at last got a theory by which

to work." The co-formulator of the principle of natural selection, Alfred Russel Wallace, speaks of his

independent experience in almost the same terms. " I was led to the theory itself," he said, " through

Malthus — in my case it was his elaborate account of the action of ' preventive checks ' in keeping down the

population of savage races to a tolerably fixed but scanty number. This had strongly impressed me, and

it suddenly flashed upon me that all animals are necessarily thus kept down — ' the struggle for existence ' —

while variations, on which I was always thinking, must necessarily often be beneficial, and would then

cause those varieties to increase while the injurious variations diminished."

A truth since in evidence in the development of the theory of organic evolution had here received

exemplification, namely, that it is in human society that there is presented to the inquirer the principal

basis for the study of the phenomena of life. Man is really the animal which has been observed most,

the creature of whom immeasurably more is known than of any other form of existence. Many depart-

ments of knowledge and entire professions are exclusively devoted to the study of the phenomena of his

life, both individual and social ; and all history and literature are but the record of his actions and

emotions in the struggle which he maintains against liis fellows and against the world. It was, there-

fore, but a natural sequence of events that a unifying principle controlling the development of life should

be suggested independently to two observers by a study of the struggle for existence in human society.

The bearing of this fact remained, however, to be seen. The Darwinian doctrine of natural

selection which had been applied to life had been suggested, as has been said, by the theory of population

propounded by Malthus, a theory closely associated in England with the political philosophy of the

Utilitarians. It is accordingly of importance, in view of the developments which were to follow, to

note certain features in which the doctrine of evolution, as it was presented by the early Darwinians,

was related to the Utilitarian position as it was defined at the time in English thought, particularly in the

writings of Bentham and James Mill. The characteristic position of the Utilitarians may be

said to be that, even when all due allowance is made for many suggestive passages of wider view a

implication in their writings, they practically conceived all the principles of the development • ™*’‘«’

of society to be related to the ascendant interests in the struggle for existence of the individuals

comprised within the consciousness of the political State as they saw it around them. They endeavoured,

therefore, as it were, to formulate the principles of human evolution from that cross-section of interests

and motives which they dissected into view on an examination of the principles of the State as thus con-

ceived. In the first statement of the law of natural selection the correlative of this position is apparent.

There is visible a tendency to endeavour to enunciate the laws of organic evolution, in general, from the

principles brought into view by a similarly narrow cross-section of the evolutionary process. It was the

operation of the evolutionary process in adapting the ascendant interests of the individual or the species

to current environment that principally occupied attention.

Could this, however, include the method of the whole process ? For instance, effective adaptation to

existing environment might itself vary. It might, for instance, be adaptation to existing environment so

complete that, as must have happened continually in case of extinct forms, it did not offer a sufficiently

wide basis for change or development as the conditions of competition altered in the future. Or it might

be, as between rival forms, adaptation to current environment which, while rendering the competitors equally

efficient in the present, would also include qualities useless and even burdensome in relation to current

environment, but contributing, though in varying degrees, to higher efficiency in the future. The

evolutionary process would in time, as the future became the present, discriminate between these forms.

Higher efficiency in the future would, of necessity, always include adaptation in the present, but the con-

verse would not follow. With progress in the efficiency of life the evolutionary process would tend to

become increasingly organic, so that it would be in the development of functions of life such as those

associated with the production and organization of variation, the increasing equipment of offspring, and

the propagation in numbers in excess of environment — in the operation of which the present was subordi-

nate to the future — that it would tend to produce the most weighty results. Progress from lower to higher

types would, in short, necessarily follow the line of variations in which present efficiency included more

than adaptation to current environment. It would take place through forms which would bear the

burthen of qualities contributing to higher efficiency in the future in addition to those concerned in adapta-

tion to current environments.

The condition in which such a result could not be conceived as arising would, of course, be that in

which it would have to be accepted that no qualities could exist in life except such as were related, or had

been related by the principle of utility to current environment. This would be the case if the Lamarckian

hypothesis were correct, and all development in life had to be conceived as the result of inherited effects

of use or disuse of organs in direct response to environment. It would also be the case if the action of

the Darwinian principle of natural selection had to be conceived as so stringent that no other qualities

could co-exist with those related by the principle of utility to current environment.

Following the criticisms to which the Darwinian hypothesis in its return influence on the theory

of society became subjected after Darwin’s death, it may be observed, accordingly, to have centred in large

degree round controversies related to these two leading matters. Darwin had retained to the

Darwinian ©ud of his life a partial belief in the Lamarckian conception of evolution in the forms of life,

develop- ^^ ^^g ^q ^}jg transmission to descendants of the effects of use and disuse of organs in the

individual (transmission of acquired qualities). ” I am convinced,” he said, ” that natural

selection has been the most important, but not the exclusive, means of modification.” If the Lamarckian

view were accepted as correct, it would, of course, confine the theory of development to the narrowest pos-

sible theory of Utilitarianism in relation to current environment. For all qualities would have to be ruled

out of life except those produced in ancestors by past environment, plus those which environment might

be producing in existing individuals. A central subject of dispute in the Weismann controversies has,

however, been the sustained challenge, as regards the higher forms of life, of the doctrine of the trans-

mission of acquired qualities (see Heredity), even to the limited extent that Darwin recognized it,

accompanied by a considerable extension of the conception of the method in which the principle of nat-

ural selection operates in life.

The other controversy has centred round the view that the operation of natural selection tended to

be so direct as to rule out, with great stringency, all qualities save those connected by the principle of

utility with current environment. Mr Wallace has been one of the most consistent supporters of this

view. But it has been challenged in turn by many observers, and the strong case against it is effectively

set out by Romanes (although without continuous insight into the significance of the principle for which

he was contending), in his review of the post-Darwinian position in the second volume of Darwin and

after Darwin.

As the doctrine of evolution now came to be applied more directly to human society, the effect of

these positions became visible, and developments followed in rapid succession. Darwin had attempted

no comprehensive or systematic study of human society. But in a few of the chapters of the Descent of

Man he had discussed the qualities of the human mind, including the social and moral feelings, from the

point of view of the doctrine of natural selection enunciated in the Origin of Species. The standpoint

he took up was, as might be expected, practically that of the Utilitarian writers of the period on social

subjects, from whom he quoted freely in support of his views. A certain note of hesitation and contra-

diction is, however, already to be distinguished in this return attempt to fit the facts of human society

into the theory of natural selection as it had so far been developed. Thus at times Darwin appeared to

think that natural selection could effect but comparatively little in advanced society. ” With highly

civilized nations,” he says, ” continued progress depends to a subordinate degree on natural selection.”

While he noted the obvious usefulness of the social and moral qualities in many cases, he at the same

time felt constrained to remark upon their influence in others in arresting, as appeared to him, the

action of natural selection in civilization. ” We civilized men,” he continues, ” do our utmost to check

the process of elimination (of the weak in body and mind) ; we build asylums for the imbeciles, the

maimed,, and the sick ; we institute poor laws ; and our medical men exert their utmost skill to save the

life of every one to the last moment.” The attempt is missing to connect the phenomena here brought

into view with some wider principle of the evolutionary process which evidently must control them.

This aspect of uncertainty is to be noticed in many statements. ” It is impossible,” he says again,

“not to regret bitterly, but whether wisely is another question, the rate at which man tends to

increase.” In these and similar passages Darwin’s attitude of mind is noticeable. An instinctive

searching after a higher organic principle in relation to natural selection in society than is to be got

out of the current Utilitarian doctrine may be said to be distinguishable.

The position was, however, undergoing rapid development. In the year 1889 Mr Wallace, in a

statement of his conception of the doctrine of evolution in his book, Darwinism, brought more clearly

into view the fundamental difficulty of the early Darwinian conception of natural selection

as it began to be applied to society. In the last chapter of the book Mr Wallace maintained ms/um*

that there were in ” man’s intellectual and moral nature . . . certain definite portions . . .

which could not have been developed by variation and natural selection alone.” Certain faculties,

amongst which lie classed the mathematical, artistic, and metaphysical, the latter covering qualities-

with which he considered priests and philosophers to be concerned, were, he asserted, ” altogether removed

from utility in the struggle for life,” and were, therefore, he thought, ” wholly unexplained by the

theory of natural selection.” He, accordingly, proposed to consider man, in respect of these portions

of his mind, as under the influence of some cause or causes wholly distinct from those which had shaped

the development of life in its other characteristics.

The weakness of this position was immediately apparent. To remove man as regards qualities so

directly associated with his social evolution from the influence of the law of natural selection was felt

to be, a step backwards. It is no injustice to Mr Wallace to say that the effect produced on the minds

of the younger school of evolutionists was not so much to convince them that he was right, as to make

them feel that the theory of natural selection which he had endeavoured to apply to human society

was still in some radical respect incomplete. Mr Wallace’s view was severely criticized in many

quarters ; but it followed, it may be pointed out, by strict logical necessity from his position, already

mentioned, as to the supposed stringency of the action of the principle of natural selection in relation to

current environment.

A tendency to arrive at a similar crux to that which Mr Wallace here encountered was also to be

distinguished in the views of other of the early Darwinians. Huxley had been one of the first converts

to a belief in the Darwinian conception of the principle of natural selection. But in the Romanes

lecture delivered in 1893 he had reached a position with regard to the operation of natural selection in

human society logically little different from that in which Wallace found himself. In this lecture

Huxley actually proceeded to place the ethical process in human society in opposition to the

““elusion cosmic process, to which latter he considered the struggle for existence and the principle of

otthe natural selection belonged. “Social progress,” he went on to say, “means a checking of the

ethical ” r (3 ‘ -^ i, n j +1,

from the cosmic process at every step and the substitution for it of another, which may be caliea tne

7nZ’ss. ethical process ; the end of which is not the survival of those who may happen to be the

fittest, in respect of the whole of the conditions which obtain, but of those who are ethically

the best. ‘ It was a fallacy, therefore, he thought, to consider ” that because, on the whole, animals and

plants have advanced in perfection of organization by means of the struggle for existence and the

consequent ‘ survival of the fittest ‘ ; therefore men in society, men as ethical beings, must look to the

same process to help them towards perfection.” The weakness of such a position was scarcely less

apparent than in the case of Mr Wallace. Here, also, the fact really in evidence was that the con-

ception of natural selection that had been applied to society was, in some fundamental sense, insufficient.

Many symptoms of a change in the conception of the conditions in which natural selection

operated in human society were, however, becoming visible. It was evident that society must be

organic in some wider sense than had hitherto been generally conceived, or than was possible

views’’’’^ in the ” social organism ” which Mr Spencer and the Utilitarians had imagined as centred

concerning round the asccudaut interests in the struggle for existence of those comprising the political

nature ot State. Regarding human development in history it did not seem in accordance with evident

‘^^le^. facts to imply that society was nothing more than political. Social progress was, as a rule,

presented in history in association with great types or systems of social order organically related

to certain conceptions and beliefs which had subordinated individual conduct and influenced political

development over prolonged periods of time. At the present day the great majority of the race was

included in a few great systems of the kind, and the fundamental ideas associated with these had influenced

in every detail the moral conceptions, habits of life, standards of conduct, and all the principles of

politics and of social development of the included peoples for hundreds and, in some cases, for thousands

of years. Natural selection, in virtue of the result, was evidently discriminating between these systems,

and, therefore, between the peoples which they included. It would probably continue to do so to an

increasing degree in the future. Even amongst the most advanced peoples of the present day it was

evident that the principles through which political forces were expressing themselves were not really, in

the ultimate analysis, principles of the State or of the ascendant interests of those comprised within its

consciousness. Western civilization, as a whole, was evidently organic in some wider sense than the life

of any of the states included in it. In one sense, and in relation to developments which had influenced

it most, it was to be considered as intimately associated with the life-history of a particular form of

religious belief. Were, therefore, beliefs of this kind to be studied in respect of their organic relations to

the struggle for existence ? Were they after all characteristic phenomena of what must be the central

function of the evolutionary process in its higher phases — the subordination, necessarily in terms of

his own mind, of a reasoning creature to the meaning of an organic process in society, the principles of

which extended far beyond the content not only of his individual, but of his political interests ?

The great difficulties referred to at the beginning as latent in the attempt to apply the doctrine of

evolution to society were, however, now in evidence. The position of these beliefs, and the inflamed

controversies through which they had come in developments which had taken place in the past had left

an atmosphere little favourable at first to the work waiting to be done. Even the attitude of many

claiming to represent the scientific spirit was often far removed from that which such a work required,

as may often be observed in Huxley's polemical writings. The situation was in many respects unique

in the history of thought, and the stage at which the old position begins to be influenced by a new

concept is one of much interest.

The conditions in which the two tendencies meet, and the remarkable and conflicting ideas to which

they give rise at first, are well exemplified in a passage in one of Mr Karl Pearson's free-thought essays

on the subject of Buddhism published in 1888. Writing as an opponent of religious predispositions,

Mr Pearson, nevertheless, felt constrained to ask himself whether a social group possessing such a

predisposition might not in the rivalry of existence be thereby placed in a position of advantage with

regard to other groups having a less definite religion or no religion at all. “A predisposition, or

prejudice having absolutely no rational basis, may,” he continued, ” have a social value and tend to

preserve an individual or group of individuals in the struggle for existence. Do not we here catch a

glimpse of how a nigh universal predisposition may exist without our being able to give it a rational

basis ? We can perhaps trace its historical growth, we may see how it took root, and the mode in

which it has developed ; but the utmost we can assert is, that its origin and permanence are due to the

assistance it gives the human race in the struggle for life. What is true of such predispositions, and the

resulting prejudices or beliefs in the mind of mankind as a whole, applies equally well to the customary

beliefs of smaller sections of human society. Such beliefs may have absolutely no rational basis, may

indeed be demonstrably false, but the race, the tribe, the society may in the long-run force them upon all

or the majority of its members, — those who do not accept the belief being destroyed, expelled, or ostracized.

The deeper knowledge, the clearer insight may show the individual that many beliefs are due only to racial

predispositions ; that they are intellectually false and productive of pain and misery to the individual.

He may go so far as to renounce for himself all the Buddhist delusions, but can such renunciation become

a general rule ? May not the non-renouncing sections of humanity ultimately survive ? ”

The inquiry could not, of course, remain in this stage, though Mr Pearson carried it no farther,

the position of antagonism from which he set out doubtless closing his mind to the application of the

revolutionary concept which had here come into view. As the subject continued, however, to present

itself in its wider bearings, it was evident that a very considerable and far-reaching change was at

hand. The progress of knowledge had destroyed the self-centred Ptolemaic conception of a universe

constructed to revolve round the world on which the observer stood, and to centre in himself. The

doctrine of evolution was now, to all appearance, destined to accomplish a scarcely less significant,

although in many respects an unexpected, transformation in its application to the science of

society. Hitherto in all conceptions of the kind set forth in the passages quoted from Mr widening

Spencer, it will be seen that the science of human development had been made to centre in social

the ascendant interests of those comprised within the consciousness of the political State.

In most of the literature of the French Revolution, in the characteristic principles of the Utilitarian

school of philosophy in England, as in the ideas of those phases of continental socialism in which the

economic factor is regarded as the ruling factor in history, this conception of society had been

fundamental. It may be said to have been in the ascendant during the 19th century. It was evident,

however, that its intellectual basis had been undermined, and that the principles controlling the

evolution of society must be considered from the standpoint of a much wider outlook.

The movement of the period in which we are living may, accordingly, be said to be towards what

may be called a phenomenology of human evolution in its more organic relations. If the evolutionary

process is to be considered as acting on man, through conceptions by which his individual and even

political interests are subordinated over long periods of time to the principles of a larger process of life,

there can be no doubt as to the direction that social development must take under the influence of

natural selection. It must be the social systems which are founded on conceptions rendering society in

the highest sense organic, that is to say, social systems which, while of necessity always remaining

efficient in competition with other societies in the present, will most effectively subordinate current

interests to a higher efficiency in the future, that will be naturally selected.

Looking at the civilization of our current Western era in this light, many of its salient features are

seen to present themselves as those of a process of organic development extending over a long period of

time, and proceeding in the last analysis from fundamental conceptions of the system of stages ot

belief associated with it. In the earliest stages of human society the increased efficiency social de-

velopment

of co-operation over individual effort would be the first principle of development compelling

under the influence of natural selection towards social organization. In a further stage in which the

efficiency of the social aggregate was centred round the personality of a great leader or military chief, its

organic potentiality would be still higher, but liable to be resolved into its component elements on his

death. As society grew still more organic and natural selection continued, society under the influence

of ideas permanently subordinating the individual to military efficiency would have a great advantage

over all others. Great social systems founded on the conception of exclusive citizenship having a

religious significance regarded as proceeding from blood relationship to deified ancestors (Ancestor-Worship)

would in this stage contain the germs of the highest military potentiality.

Where, however, as throughout all this stage of social development, the highest law was always

in the last resort a rule of force, and where, therefore, as in the civilizations of the ancient world, the

subordination of the individual to the life of the State would be the inclusive ideal of all human effort,

the full limits of the organic principle in society would in time be reached. The ultimate ideal of the

State itself must, in such circumstances, be universal military conquest, and all social institutions would

tend to become, as in the case of slavery, closed absolutisms organized round the conception of the

ascendancy of men’s desires in relation to the present.

In the next stage, therefore, the enormously higher organic potentiality of a type of society which,

while preserving in competition with lower forms its defensive military efficiency in the present, would

be influenced by conceptions that would project the sense of human responsibility outside the State and

beyond the present, would be evident. In many of the religions of the East such conceptions were to be

found in various stages of development. But no Eastern people has, down to the present time, been able

to provide for them the permanent military milieu in history in which alone their potentiality in the

evolutionary process could be realized. The significance, therefore, of the culmination of the military

epoch in the ancient classic civilizations of the Western world which preceded the opening of the era in

which we are living, and of the fact that the peoples of the same descent who were destined to carry on

the civilization of the existing era represent the supreme military stock by natural selection not only of

the entire world, but of the evolutionary process itself in human history, will be evident.

With the spread, accordingly, amongst peoples of this origin, and in such a milieu in history, of a

new conviction of responsibility to principles extending beyond the consciousness of the political State,

there would begin a further and more organic stage of the evolutionary process in society. The gradual

dissolution in the era in which we are living of all the closed absolutisms within the State, in which

human action and ideas had hitherto been confined, is apparently the characteristic phenomenon of this

stage. Progress is towards such a free and tolerant, but intense and efficient conflict of forces as Avas

not possible in the world before. It is, it would appear, in this light that we must regard the slow

dissolution of the basis of ideas upon which slavery rested ; the disintegration of the conceptions which

supported the absolute position of the occupying classes in the State ; the undermining of the ideas by

which opinion was supported by the civil power of the State in the religious struggles of the Middle

Ages ; the growth of the conception that no power or opinion in the State can be considered as the

representative of absolute truth ; the consequent development of party government amongst the advanced

peoples, with the acknowledgment of the right of every department of inquiry to carry results up to that

utmost limit at which they are controlled only by the results obtained in other departments of activity

with equal freedom ; the growth of the conception, otherwise absurd, of the native equalitv of men ; the

resulting claim, otherwise similarly indefensible, of men to equal voting power irrespective of status or

possessions in the State, which has been behind the movement towards political enfranchisement ; and,

finally, the development of that conviction which is behind the existing challenge to all absolute

tendencies in economic conditions in the modern world — namely, that the distribution of wealth in a

well-ordered State should aim at realizing political justice. These are all features, as the present writer

has endeavoured to show (^Principles of Western Civilization; see also the article in these volumes on

Sociology), of a developing process in modern history. They must be considered as all related to a

controlling principle which has rendered the evolutionary process in society more organic than in any past

stage — namely, the projection of the sense of human responsibility outside the limits of the creeds and

interests which had in previous stages embodied it in the State.

The increasing intensity and efSciency of the social process amongst the included Western peoples

has now, as current history shows, begun, under the influence of natural selection, to tell to an increasing

degree in competition with other types of society. It must be noticed, however, how the nectar-

characteristic principle of the process from the beginning has been its projected efficiency. The acunstic

principle

peoples included in it have had to maintain themselves at every point in competition with of the

other societies of lower future potentiality (as in the struggle extending over many centuries p™***®-

with Mahommedan civilization) by military efficiency. All the qualities to which future potentiality

was related were not only useless for centuries of time, but, as in the conditions of the evolutionary

process already referred to, they formed a burden that had to be borne in addition to efficiency in relation

to current environment.

Here once more the suggestiveness of a study of human society in bringing into view the

general principles of the evolutionary process in life has to be noted. The law of progress

in life cannot, it would appear, be stated, as was imagined by the early Darwinians, simply in

terms of qualities connected by utility with current environment. In human society the

operation of the qualities which lead the advanced peoples to build hospitals and asylums current

for their weaker members carries us beyond that Utilitarianism in the present in connexion environ-

with which Darwin discussed it. It is, we see, controlled by that higher organic principle of sufficient;

responsibility to life, extending beyond the meaning of the State, with which the virility and tontrowng

superior efficiency of our civilization is identified, and through which natural selection in principle

the end produces higher results, and on a far larger scale. Similarly, the conception of

Mr Wallace that such faculties as those which include the qualities with which he saw priests and

philosophers to be concerned could not be accounted for by the operation of natural selection, is seen to be

incomplete. It proceeds naturally from Mr Wallace's position, already mentioned, as to the supposed

stringency of the action of natural selection in relation to current environment. The qualities which

cannot, on investigation, be connected by the principle of utility with existing environment are those

correlated with the principle of projected efficiency, as the evolutionary process in society grows more

and more organic, and the individualover long periods of time is subordinated to a process, the principles

of which extend far beyond the content, not only of his individual, but of his political interests. So far,

however, from such qualities having no relation to the principle of natural selection, they are, it will be

seen, rather those through which natural selection is producing its largest and most efficient results in

human society.

Similarly, Huxley's conception that the ethical process in human society was to be placed in

opposition to the cosmic process, and was to be regarded as tending to check the struggle for existence

and the operation of natural selection must, it would seem, be taken to belong to that earlier

^ ‘ ‘ & The ethical

stage of the application of the doctrine of evolution when the full reach of the process was process

not perceived, and when all qualities tended to be viewed in their relation to current environ- /” ^^^

ment. So far from it being possible to regard the ethical process as in opposition to the cosmic (^smic

process, it must, it would appear, be taken that the ethical process is the cosmic process, and

that it is through the principles and mechanism of the ethical process that the struggle for existence

and natural selection are producing, on the largest scale, and in the most effective manner, their most

characteristic results in the development of life.

The changes which the doctrine of evolution is thus beginning to effect in its applications to

sociological theory are to all appearance only in their initial stages. In psychology and ethics they can

hardly fail to be as important as they already promise to be in the domain of political

philosophy. The survival in social and political philosophy of the Ptolemaic standpoint, as ™* teaden-

represented in the tendency to conceive the principles of the evolutionary process in society current

as centred in the ascendant interests in the struggle for existence of those comprised within ^^^^

the consciousness of the political State, has still its correlative in psychology and ethics. For

instance, it has been hitherto impossible to fit into any theory of empirical psychology certain qualities

which Kant found in the human mind. But the basis in the evolutionary process of many of the qualities

with which Kant was concerned, and which could not be accounted for in relation to experience, just, as

they could not be accounted for by Mr Wallace in relation to current environment, is now evident. For

when the evolutionary process is considered in the wider and more organic relations that have here been

discussed, it is clear that the peoples who represent the advanced sections of the race at the present day

do so in virtue of qualities in the minds of those who preceded them which had no relationship to current

environment. The peoples amongst them who are destined to inherit the future will similarly do so in

virtue of qualities which have no Utilitarian relationship to existing environment. In the statement

of the principles of the human mind the tendency hitherto in all empirical systems has necessarily been

to endeavour to construct a theory of human society and of human progress from an introspective

examination of the interests and emotions of the individual mind. But this tendency can hardly fail to

be reversed with the continued application of the doctrine of evolution to society. It is the principles of

the evolutionary process in society considered in its more organic aspects that must now be considered

to be the controlling factor ; and it is therefore to be expected that it will be from this wider standpoint

that the study of the content of the individual mind itself will in future be approached.

ENCYCLOPEDIA BRITANNICA.

(NEW VOLUMES.)

GLARUS-GLASGOW.

Clams, one of the Swiss cantons, ranking officially

as the seventh in order. It has a total area of 267 square

miles. Of this 173 square miles are reckoned “productive,” forests covering 41 square miles, vineyards but -07, and land, arable or pasture, 132 square miles. Of the “unproductive” portion 13-9 square miles are occupied by glaciers. A fine carriage road over the Klausen Pass (to Uri) was opened in August 1899, while one is projected over the Praegel Pass (to Schwyz), now crossed by a good mule path. The slate quarries above Elm, at the head of the Sernf valley, were the scene of a great landslip in 1881, when 115 lives were lost. In 1896 there were in the canton of Glarus 10,906 cattle, 3971 pigs, 1237 sheep, and 7037 goats. The mountain pastures number eighty-seven, and are of an estimated capital value of about £250,000. The cotton industry is concentrated in the villages near the chief town. There are eighty factories, employing 10,000 persons, or 56 per cent, of the population. The canton is divided into twenty-eight communes, of which the most populous in 1900 (after the town of Glarus) were Ennenda (2473), Nafels (2527), Schwanden (2400), Netstal (1987), and

Linthal (1896). The population of the canton was 33,825 in 1888, and in 1900 it was 32,349. Glarus is one of the few Swiss cantons in which the population is steadily diminishing. In 1899 there were 126 inhabitants per square mile. The canton is maialy Protestant (in 1900 there were only 8006 Eoman Catholics) and German-speaking (in 1900, 370 Italians represented the largest non-German tongue in the canton). Glarus still preserves its primitive democratic assembly of all men over twenty years of age. The communes (forming eighteen electoral circles) elect for three years a sort of “standing committee” (Landrath), in the proportion of one member for every 500 inhabitants or fraction over 260, but the Landsgemeinde itself names for three years an executive of five members. Owing to the pure democracy in Glarus, no referendum, &c., is required, as that is exercised annually at the meeting of the Landsgemeinde. The present cantonal constitution dates from 1887. In 1897 the state revenue of Glarus was 1,066,959 francs (a rise of 56^ per cent, since 1886), while the state

expenditure was 1,026,375 francs (a rise of 48Jf per cent, since 1885). In 1897 the public debt was 4,210,500 francs. Glaeus, the capital of the canton, is 1678 feet above the sea-level. It is a clean, modern little town, with wide streets. Population (1888), 5367, of whom 1502 were Eoman Catholics and only 100 non-German-speaking: (1900), 4896.

SeeBABLER. Die Alpwirthschaft im Kant. Glarus. Soleure, 1898.

— Heee. Geschichte d. Landes fflarus, 2 yo\s. Glarus, 1898-99.

(w. A. B. c.)

Glasgow, a royal burgh, city, and county of a city (1893), Scotland, on both banks of the river Clyde, 401^ miles north-west by north of London by rail, and 47|- west by south of Edinburgh.

Area and Population. — Under the Local Government Act (Scotland), 1889, the city was placed wholly in the county of Lanark. In 1891 the municipal boundary was extended to include six suburban burghs and a number of suburban districts, the area being increased from 6111 acres to 11,861 acres. The total area of the

city and the coterminous burghs of Govan, Partick, and Kinning Park, which resisted annexation in 1891, is 15,659 acres. In 1893 the municipal burgh was constituted a county of a city. The population was in 1881, 511,415 ; 1891, prior to extension of boundary, 565,839 ; after extension, 668,198 ; 1901, 760,423, the increase since 1891 being nearly 16 per cent., compared with 14 in 1881-91. The birth-rate, 1896-98, was 33-6, against 33-9 in 1891-95, and 35-5 in 1886-90 ; in 1899 it 33-0. The marriage-rate during the years 1896-98 was 9-7 ; in 1899 it was 10-2. Mainly through the vigorous administration of the Public Health Committee of the Corporation the death-rate has been reduced from 30 to 33, at which it stood less than half a century ago, to 21-6 in 1899. Of the population in 1891 the number of Gaelic-speaking persons was 17,925 ; 211,477 were natives of other parts of Scotland, 349,597 of the city itself, and 66,071 of

Ireland. Professional persons numbered 9540 men and

3937 women ; commerce engaged the attention of 39,983 men and 3825 women; industry of 130,160 men and 60,230 women, of whom 15,276 men were concerned with machines and . implements, 1898 men with ships, 9462 men and 19,979 women with textiles, and 29,964 men and 1696 women with minerals. Valuation of the city in 1878-79, £3,420,697 ; in 1899-1900, £4,780,000.

Constitution and Government. — Since 1886 the city has been divided for the purpose of representation in Parliament into seven divisions, each of which returns a member. Under the local Act of 1891 the corporation was increased from 60 to 77 members, with 15 magistrates, including the Lord Provost ; and under the local Act of 1896 all the powers which the Town Council exercised as Police Commissioners, and trustees for parks, markets, water, &c., were consolidated and conferred upon the corporation as such. In 1898 the two parish councils of the city and barony, which, administered the poor law over the greater part of the city north of the Clyde, were amalgamated as the Parish Council of Glasgow, with 31

members. As a county of a city Glasgow has a lieutenancy— successive Lord Provosts having hitherto been appointed Lords-Lieutenant — and a Court of Quarter Sessions, which is the appeal court from the magistrates as licensing authority.

The municipal government of Glasgow is notable for its efficiency in most departments, and the corporation has led the way in several enlargements of the municipal function. New City Chambers in George Square, Venetian in character, which, cost about £600,000, were opened in 1889 ; and since then several additional blocks of buildings have had to be built, acquired, or leased, to house an ever-increasing stafE of officials. Admirably equipped sanitary chambers were opened in 1897 ; they embrace a bacteriological and chemical laboratory. The first part of a scheme for intercepting and purifying the sewage of the city was completed in 1894. Powers were obtained in 1896 and 1898 to treat in the same way the whole sewage emptied into the Clyde and Kelvin by Glasgow, suburban burghs, and adjoining county dis-

tricts, and it is certain that the estimated cost of £1,100,000 will be largely exceeded before the work is completed. Under an Act of 1895, Loch Katrine, from which the city draws most of its water, was raised 5 feet, and Loch Arklet, with a storage of 2,060,000,000 gallons, connected with it by tunnel; the two lochs together will ultimately have a capacity of about 12,000,000,000 gallons. The entire works between the loch and the city have been duplicated over a length of 23|- miles, and an additional reservoir, holding 694,000,000 gallons, has been built, adding 18 to the previous 12|^ days' supply which is held in reserve. Hydraulic power has been supplied to manufacturers and others by the Water Committee since 1896. In 1899 the corporation had under its control five gas-works, with a productive capacity of 35,215,000 cubic feet of gas per day, which is sold to about 200,000 subscribers in and around the city at 2s. 6d. per thousand feet ; and additional works, now being built at a cost of £1,000,000, will add 40,000,000 cubic feet to the daily output. The corporation began to

supply electric light in 1893 ; 75 miles of distributing mains have been laid, and 2,824,350 units were sold to 2000 consumers in 1899. Part of the city is lit by electricity at a charge of £14 per lamp, and two large generating stations are at work, and a third is being built. But the greatest enterprise undertaken by the corporation in recent years is the working of the city tramways. Since the expiry of the lease of the company which used the lines up till 1894 the number of passengers carried has been more than doubled, and the revenue of the tramways department has reached nearly half a million sterling a year. Overhead electric traction is employed. The corporation acquired St Andrew's Halls in 1890, and has since purchased or built six public halls in different parts of the city, and contemplates the erection of more. A new infectious diseases hospital at Euchill, consisting of 33 blocks of buildings, to accommodate 408 patients, was completed in 1900, supplementing the accommodation for 390 which already existed at Belvedere. Vast additions have been made to the

parks and open spaces of Glasgow in recent years.

Queen’s Park was enlarged in 1894 by the enclosure of the grounds of Camphill (68 acres). The Cathkm Braes (49 acres) was presented in 1886, Bellahouston (176) was purchased in 1895, Euchill (53) in 1891, Tollcross (82f) in 1897, Springburn (53^) in 1892, Eichmond Park (44) in 1898, and Maxwell Park became the property of the corporation on the annexation of Pollokshields in 1891. The Botanic Gardens also became public property in 1891, and with subsequent additions now form a combined scientific institution and a public park of 40 acres. In addition there is a large number of open spaces, of which 11, covering a total area of 33,614 square yards, have been acquired since 1889.

A People’s Palace, combining a conservatory and art gallery and museum, was erected on Glasgow Green in 1898, and a winter garden is being built in Springburn Park. New corporation art galleries have been erected in Kelvingrove Park at an estimated cost of £200,000, a considerable proportion of whicb was derived from the

profits of the Exhibition held in 1887. Glasgow Bridge was rebuilt and widened in 1899 at a cost of £100,000. Eutherglen Bridge was rebuilt in 1896, and Dalmarnock Bridge in 1891. A new central station has been erected for the fire brigade, which has nine stations in the city and one sub-station. And a telephone exchange has been opened by the corporation under the Telegraphs Act of 1899.

Streets and Buildings. — Thirty-eight miles of new streets have been laid out since 1880. In the same period authority has been given for the erection of buildings of all kinds costing nearly £18,000,000, of which £6,000,000 were authorized to be spent in the three years 1896-99. The Improvements Act of 1866 was amended by an Act of 1881. Under it the Improvement Trustees (corporation) began in 1888 to build houses for the poor — sanitary dwellings at a rent of £4, 10s. for single-roomed houses and upwards. Then they began to erect lodging-houses for men and women, and ultimately became the owners of seven such houses,

to which was added in 1896 a family home for the accommodation of whole families in certain circumstances. When the powers of the trust were practically exhausted in 1896 it was found that £1,956,650 had been spent in the 29 years in the purchase and improvement of land and buildings, and £231,500 in the erection of tenements and lodging-houses — total,. £2,187,050; and on the other hand, gi-ound had been sold for £1,072,000, and the trust owned heritable property valued at £692,000, showing a deficiency of £423,050. The assessment of the ratepayers for the purposes of the trust had brought in £593,000 in all, and it was estimated that the operations, beneficial to the city in a hundred ways, had cost the citizens about £24,000 a year for 29 years. Under a new Improvements Act obtained in 1897, £560,000 is at present being spent in dealing with other insanitary and congested areas in the centre of the city and on the south side of the river, and in acquiring not more than 26 acres of land, within or without the city, for the erection of

dwellings for the poorest classes.

GLASGOW

In 1891 the Mitchell Library was rehoused in Miller Street in a building formerly occupied by the Water Commissioners. The new post ofBce was commenced in 1876 and completed in its present form in 1896, and already it has been found necessary to erect a new parcels department in another part of the city. Other public buildings dating since 1880 are the Inland Eev-enue Of&ce (1885), Com Exchange (partially rebuilt 1896), Athenaeum (1888 and 1893), Theatre Eoyal (partially after fire in 1896), Y.M.C.A. Club (1897), and Bible Training Institute (1898), both pendicles of the Christian Institute (1879); Victoria Infirmary (1890), Pine Art Institute (1880), two wings of the High School (1887 and 1897), 69 public schools (since 1873), new School of Art (1899), Sick Children's Hospital (1882-^87), Anderson's College Medical School (1887), Conservative Club (1894), Queen Street Station (1880), and a number of district railway stations. Gartloch Asylum was

opened by the City Lunacy Board in 1896 in Cadder parish. The Central and St Enoch's stations are being enlarged, and the Eoyal Infirmary is about to be reconstructed at a cost of £100,000 as a memorial of Queen Victoria's Diamond Jubilee. Langside Battlefield Memorial was erected in 1887, and a Gladstone statue is to adorn George Square. Street architecture has greatly improved in Glasgow, but recently a strong tendency has been manifested to pile up gigantic business premises.

Communications. — The City and District railway (circular), belonging to the North British Company, was opened in 1886. Cathcart District railway (Caledonian) was completed in 1886, and made circular for the south side of the city and suburbs in 1894. In 1896 the Caledonian Eailway Company opened the whole extent of a 6^miles railway, which runs, underground for the most part, through the heart of the city from Maryhill to Dalmarnock. This (central) railway has two junctions in the city with the Lanarkshire and Dumbartonshire railway,

opened in the same year, and at the other extremity it throws off a branch to Tollcross, opened in 1897. Both the Caledonian and Glasgow and South-Western Companies are at present doubling the roads entering their principal stations. The Glasgow Subway — an underground cable passenger line, 6^ miles long, worked in two tunnels and crossing beneath the Clyde twice — was opened in. 1896. Eor tramways, see above. Communication up and down and across the river is provided by small steamers run by the Clyde Trust, which carried 12,000,000 passengers in 1899 ; and it is now proposed to make cross-transit free in default of the provision of bridges across the harbour, which would hamper the shipping. There are two steam ferry boats or floating bridges for vehicular traffic, and there is a subway for foot and wheeled traffic at Stobcross.

Harbour. — Queen's Dock at Stobcross was completed in 1880. Prince's Dock, on the south side of the river, was opened in 1897. It is 72 acres in extent, divided into three basins and a canting basin ; the quayage is 2^

miles long, and the entrance 156 feet wide. It is 20-28 feet deep at low water and 31-39 feet at high water, and is fully equipped with hydraulic and steam cranes, one of which lifts 130 tons. A second graving dock was opened in 1886, and a third in 1897. The three are respectively 551, 576, and 880 feet long, and the third has a width of 83 feet, and can be made at will into two docks of 417 and 457 feet long. The total area of the harbour is now 206 acres, and the length of the quays and wharves is more than S\ miles. The accommodation for mineral traffic has been increased by 64 per cent, since 1884, and the storage and quayage for timber was doubled in 1896. A new mineral dock is to be built by the Clyde Trust at Clydebank. Continuous work had been done at the deepening of the river. The dredging plant now owned by the Trust lifts two million cubic yards of material in the year, double the quantity lifted in 1884, and between 1885 and 1900 the depth of the channel was increased to a minimum of 22 feet, and vessels drawing 26 feet can go up or down on one tide. The debt of the Trust is nearly

6f millions, and the revenue, which was £291,000 in 1884, is now £439,000 a year.

The tonnage registered at the port in 1898 was 1667 vessels of 1,686,743 tons, and the movements of shipping were— 1888, entered 9361 vessels of 2,886,672 tons, cleared 9400 of 2,998,835 tons; 1898, entered 11,091 vessels of 3,710,206 tons, cleared 11,476 of 3,964,108 tons. Imports were valued at £10,864,084 in 1888, and £12,788,374 in 1898 ; exports of the manufactures of the United Kingdom, £14,461,488, and of colonial goods, £523,865 in 1888, and £13,137,276 (United Kingdom) and £462,589 (foreign and colonial) in 1898. The principal article of import is flour, of which £2,168,465 worth was imported in 1898. Animals come next at £978,608; wood imports were valued at £905,190; wheat £636,270; iron ore, £500,375; fruit, the trade in which has reached large dimensions in recent years, £425,465. The chief exports were in 1898 cotton manufactures, valued at £2,608,112 ; manufactured iron and steel, £1,797,395; machinery, £1,785,986; spirits,

£1,038,320; cotton yarn, £837,226; linen fabrics, £719,060 ; coal, £576,327 ; jute yarn and goods, £409,039 ; woollen manufactures, £219,166. The customs revenue of the port rose from £969,339 in 1880 to £1,748,822 in 1898.

Industries. — There are 11 shipbuilding yards within the harbour of Glasgow, and 40 considerable shipbuilding firms operate in the river and firth. The Clyde output for 1899 was 41 sailing vessels of 14,618 tons, and 243 steamers of 476,466 tons — total tonnage, 491,074; the output in 1898 was 466,832; 1897, 340,037; 1896, 410,841; 1895, 360,162; 1894, 340,886; 1890, 349,995; 1880, 241,114. Marine engines of 478,603 i.h.p. were turned out in 1899; 510,805 in 1898; 373,195 in 1897; 295,620 in 1894. The manufacture of steel armour for battleships is the only industry of importance added to the activities of Glasgow of recent years, and it is probable that the making of ordnance wiU presently be associated with it. All trades connected with iron and steel have developed ; textiles have not, mainly owing to

the short supply of female labour. There are in the city 1977 factories and nearly 8000 workshops. There were in 1900 five cotton factories in operation, with a total of 325,000 spindles, and other industries are represented as follows : — Textile factories (including those devoted to cotton and five or six to carpet-weaving), 56 ; engineers and boil ermakers, 186 ; iron foundries, 58 ; brass foundries, 60; chemical works, 20; white lead, 2; bichromate of potash, 1 ; paint and colour works, 30 ; confectioners, 20 ; biscuit makers, 9 ; tobacco factories, 15 ; clothing factories, 91; printers and bookbinders, 231; boot factories, 17; lace curtain factories, 4; printing and bleaching works, 61 ; cabinetmaking works, 61 ; flour-mills, 9 ; distilleries and breweries, 14 ; laundries, 19 ; saw-mills, 65 ; match-making works, 2 ; lead-smelting works, 1 ; indiarubber factories, 2; potteries, 8; aerated water works, 45.

University, Colleges, and Schools. — The university has now 31 professors and 32 lecturers, the latter almost all of recent institution. Queen Margaret College for

women, established 1883, with an endowment of upwards of £26,000, was incorporated with the university in 1893, and is used for the teaching of Women students, who are to a large extent segregated from the men

students. The foundations, scholarships, &c., of the university amount to about £14,000, and the number of matriculated students in 1898-99 was 1647, of whom 306 were women. A Muirhead College for women is in process of establishment. The Glasgow and West of Scotland Technical College was founded in 1886 by a combination of the non-medical part of Anderson's College, the College of Science and Arts, Allan Glen's Institution, and the Atkinson Institution, and is subsidized by Hutcheson's Trust, the City Educational Endowments Board, and the corporation. Anderson's College Medical School was incorporated in 1887, and St Mungo's College, with faculties of medicine and law, in 1889. There are two educational endowments boards, which apply a revenue of about £10,000 a year to the

foundation of bursaries mainly. There are four high schools for boys and two for girls, besides two Eoman Catholic academies for boys and one for girls, and the Glasgow School Board has among its schools 11 equipped with secondary departments or as science schools, and the Govan Board 6. Six School Boards — Glasgow, Govan, Maryhill, Springburn, Eastwood, and Cathcart — ‘ control the elementary education of Greater Glasgow (including Govan and Partick, with a total population in 1891 of about 780,000) ; the public schools number 97, and they had an average attendance of 93,968 in 1898-99. Cliurches. — There are in Greater Glasgow 86 Established churches, 89 Free, 69 United Presbyterian (these and most of the Free churches now belonging to the United Free Church), 3 Original Secession, 1 Eeformed Presbyterian, 2 Free Presbyterian, 26 Congregational Union, 2 Evangelical Union, 14 Baptist, 6 Wesleyan, 2 Swedenborgian, 2 Unitarian, 2 German Protestant congregations, 1 French Protestant, 2 Hebrew, 27 Scottish Episcopal (including missions), 1 English Episcopal, and

21 Roman Catholic. Four orders or congregations of Eoman Catholics are represented in Glasgow — Jesuits, Passionists, Franciscans, and Marists — and there are 8 coivents or conventual institutions.

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Class. — Glass is an amorphous solid substance, formed by the action of heat, and consisting of mixtures of silicates, borates, and phosphates. It may be transparent, translucent, or opaque. Former definitions have been rendered obsolete by recent researches, and the present definition may meet with a similar fate, although a comparison of the analyses of English and foreign staple glasses (soda-lime, potash-lime, and potash-lead glasses) shows that the composition of these glasses is practically constant. The attempts to represent the different varieties of glass as definite chemical compounds have not been attended with success. The knowledge of the chemistry

of glass has been considerably widened by the experiments carried out by Dr Schott at the Jena glassvporks with reference to the manufacture of new kinds of optical glass. The commercial success and extensive development of these works have demonstrated the value of pure science to manufactures. In spite of the example set by Messrs Chance, who secured the services of M. Bontemps and Dr Hopkinson, and encouraged their researches, there has been no marked scientific development in English glass manufacture in recent years. It is doubtful how far State aid can permanently benefit an industry, but it is certain that no institution for aiding scientific industry exists in England comparable to the Imperial Technical and Physical Institute of Charlottenburg ; and Dr Abbe and Dr Schott, the founders of the Jena glassworks, acknowledge their indebtedness to the Prussian Education Bureau and to the Diet for liberal and repeated subsidies, which enabled them to carry out costly investigations on a commercial scale.

In the preparation of the varieties of colourless glass

in general use few new materials have been introduced. Sulphate of soda is now universally used for plate and sheet glass, and carbonate of barium has been substituted for red lead in several manufactories of pressed glass. For rendering the ordinary potash-lead and soda-lime glasses opalescent or opaque, arsenic trioxide, tin oxide, cryolite, and a mixture of felspar and fluor-spar have been employed. (See Mosaic.)

In preparing coloured glasses the chemical nature of the glasses must be considered. Some of the colour-giving metallic oxides develop one tint when mixed with a soda-lime glass, and a quite different tint when mixed with a potash-lead glass. With the latter the oxide of nickel gives a rich purple colour, with the former a reddish brown. The “charcoal” yellow, which so frequently occurs in the mosaic windows of the 13th century, can only be developed with a soda-lime glass. The yellow colour due to silver oxide can only be obtained by applying it to the surface of glass in the form of a pigment and subjecting the glass to a moderate heat in a kiln.

The use of gas furnaces for melting glass has become general. In the new form of Siemens furnace, additional economy of fuel is effected by building the gas producer as part of the furnace, and as the gas regenerators can be omitted the cost of construction is reduced.

In dealing with manufactured glass it will be convenient to adopt the following classification : —

I. Optical Glass.

n. Blown Glass.

III. Glass pressed or

blown mechanically.

Table Glass. Tube. Sheet and Crown Glass.

Coloured Glass for “Windows.

Glass blown by com-

‘ air.

Plate Glass. Pressed Glass.

I. Optical Glass.

The story of the manufacture of optical glass closed in the ninth edition of this Encydopcedia with the purchase in 1867 by the French Government of a pair of crown

and flint discs, 29 inches in diameter, manufactured by Chance Bros, of Birmingham. To understand the subsequent development of the manufacture it is necessary to recall the work of Fraunhofer. Fraunhofer originated the idea of examining the influence exerted by the chemical constituents of glasses on their optical qualities.

Moreover, by his system of spectroscopic

examination, he was the first to denote the optical properties of glasses in exact figures — to measure accurately the refractive index and dispersion, and to demonstrate the disproportionate increase of dispersion in crown and flint glass. Following in Fraunhofer's steps, and with the same object, namely, the elimination of the secondary spectrum, the Eev. W. V . Harcourt and G. G. Stokes carried out a prolonged series of experiments in glass-making, and examined the optical qualities of glasses in which phosphoric anhydride took the place of silica. Similar experiments were also conducted by Dr J. Hopkinson. In 1881 Professor Abbe and Dr Schott commenced their researches. The task they set themselves was to study the influence on refractive index and dispersion of every chemical element Tyhich could be

combined to form an amorphous glass; to these researches, which were at first carried on on the scale of laboratory experiments, the Jena glassworks owe their origin. The example set by Abbe and Schott was closely followed by Messrs Chance of Birmingham and the late M. Mantois of Paris. The problem requiring solution was the removal of the secondary spectrum in combinations of crown and flint glass by the production of crown and flint glass of such quality that when examined spectroscopically the increase of dispersion in the two glasses is proportional in all parts of the spectrum. With reference to this problem, Dr Schott says: “When, in 1881, we began our experiments we had very satisfactory results by using glasses containing borates and phosphates. The great hopes we formed of these were, however, disappointed in so far as these glasses did not prove durable enough for all purposes, and therefore their manufacture had to be discarded to a certain extent.” The following examples show the progress that has been made towards obtaining

a perfect combination (the numbers denote the relative

partial dispersion in different parts of the spectrum) : —

At the present time M. Mantois's successor publishes a list of 110 different optical glasses, and the list of the Jena works contains 76. Messrs Chance's list for 1900 is as follows : —

Ordinary CROfras

AND

Flints

Eefraotire

y=

^

Specific

Kind of Glass.

Dispersion

C-F

n-1

forD

An

C-D

D-F

F-Oi

Gravity.

Hard Crown .

1-6175

0-00856

60-5

0-00262

0-00604

0-00484

2-48

Soft Crown .

1-6152

0-00906

50-9

0-00264

0-00642

0-00517

2-55

Extra Light rUnt .

1-5816

0-01035

49-0

0-00313

0-00772

O-O068O

2-78

”

1-6383

0-01099

48-5

0-00322

0-00777

0-00640

2-80

Light FUnt .

1-.5472

0-01196

45-8

0-00348

0-00848

0-00707

2-98

t» ...

1-5610

0-01299

4S-2

0-00872

0-00927

0-00770

3-06

,,

1-6760

0-01404

41-0

0-00402

0-01002

0-00840

8-22

Dense Flint .

1-6124

0-01650

87-0

0-00474

0-01176

0-01080

8-67

„ ...

1-6214

0-01722

86-1

0-00491

0-01231

0-01046

8-64

)t ...

1-6225

0-01729

86-0

0-00493

0-01286

0-01054

8-66

Extra Dense Flint .

1-6469

0-01917

88-7

0-00.541

0-01376

0-01170

8-88

Double Extra Dense Flint

1-7129

0-02.384

29-9

0-00670

0-01714

0-01661

4-40

Special Glasses.

Kind of Glass.

Refractive

Index

forD

Medinm

Dispersion

m-1

Partial Dispersion.

Specific

Gravity.

C-D

D-F

F-Gl

Are

Boro-Silicate Crown

Baryta Crown

Densest Baryta Crown .

Baryta Light Flint

1-6098

1-5660

1-6099

1-5452

1-5840

0-00788

0-01006

0-01100

0-01020

0-01248

64-6

66-8

55-5

53-5

46-8

0-00236

0-00297

0-00321

0-00298

0-00362

0-00552

0-00709

0-00779

0-00722

0-00886

0-00449

0-00676

0-00629

0-00582

0-00785

2-45

8-17

8-68

2-94

8-29

A’toD

DtoF

FtoG

Early combination \ Light Flint

of Jena glasses J Hard Crown .

0-615

0-643

0-713

0-703

0-600

0-566

1

Eecent combination 1 Flint

of Jena glasses / Crown .

0-635

0-644

0-705

0-707

0-573

0-568

Another problem especially affecting the manufacture

of photographic objectives is the production of glasses

possessing greater variation between refractive index and

medium dispersion, so as to afford a choice of several

glasses of the same refraction but of different dispersion.

The following are examples. D represents refractive

index ; G’-D medium dispersion : —

D

G’-D

Crown glass with high dispersion .

Baryta Flint glass

Baryta Crown glass, densest .

1-5289

1-6235

1-6112

0-01374

0-02107

0-01363

The following are analyses of some of the more interesting of the Jena glasses : —

SiOj

NajO

KjO

AljO,

MgO

PbO

ZnO

BaO

B,Os

PjOs

Light Baryta Flint .

Baryta Silicate Cro-wn

Light Phosphate Crown .

Borate Flint .

65-6

71-4

1-23

3-58

4-i2

6-47

7-78

14-8

11-3

10-0

11-6

1-08

6-87

12-2

4-50

12-6

9-97

9-52

8-27

8-13

4-98

66-3

56-6

M. Mantois, the maker of the 40-inch lenses for the Terkes telescope, and the 49-inch lenses for the great telescope of the Paris Exhibition of 1900, gives the following description of the manufacture of glass discs for large lenses: —

The aim (he says) of the manufacturer is to produce large blocks of glass absolutely homogeneous and physically clear, entirely free from those transparent threads, cords, and striae which are almost invariably found in ordinary glass. The furnaces employed are small, being constructed for a single crucible. The crucibles hold from 10 to 18 cwt. of glass, and are similar in shape to those used for flint glass, except that the mouth is elongated so as to project beyond the wall of the furnace. A crucible is built into a furnace

whilst cold, and the only part which remains visible is the projecting mouth. The temperature is raised slowly, and when the furnace is at a bright red heat the first charge of the raw material is shovelled into the crucible through the mouth. Successive charges are gradually added, until the crucible is full. About ten hours after the last charge has been added the furnace is driven to its highest temperature in order to disengage and expel from the glass all bubbles of air and gas. After the so-called ” plaining ” or refining process has lasted some twenty hours, a specimen of the molten glass is dra-wn from the crucible and examined with a microscopic lens to see if any bubbles remain. After several specimens have been examined and the molten glass is pronounced to be “plain,” the temperature of the furnace is slightly lowered, the stopper and clay are removed from the mouth of the crucible, and the surface of the glass is skimmed to remove all floating impurities. After the glass has been skimmed the “stirring” process is commenced. In molten glass the constituents, silicates, borates, and phosphates, have a tendency to separate, and either to sink or rise in the crucible according to their density. To breai up the threads, cords, or striae produced by this separation, to maintain the intimate mixture of

the constituents, and to render the mass of the glass perfectly homogeneous, constant and prolonged stirring is absolutely necessary. The stirring apparatus is exceedingly simple. A cylinder of fire-clay, closed at one end, which has been raised to a white heat, is gradually lowered into the molten glass. The bent end of a long iron bar is inserted in the mouth of the cylinder, the weight of the bar is supported by a chain, and a long wooden handle is attached to the end of the bar farthest from the furnace. The bar is so poised that a man by moving the handle can direct the cylinder into any part of the crucible, and keep the whole mass of glass in a state of gentle agitation. The work is exceedingly trying, especially during the first few hours, whilst the furnace is almost at its highest temperature. The workmen are dressed in asbestos-cloth, and relieve each other at short intervals. The process requires constant supervision, as different glasses require different manipulation ; moreover, if bubbles are formed hy the stirring, the work must immediately be stopped, the cylinder removed, the crucible closed, and the heat of the furnace increased. If no bubbles are formed the stirring is continued for from ten to

fifteen hours, whilst the temperature of the fur-
nace is allowed steadily to diminish. As the
temperature diminishes the glass becomes more
viscous, until the clay cylinder can only be moved

with difficulty. As there is no longer any danger of the constituents of the glass separating, and of “cords” being formed, the cylinder is drawn carefully to the mouth of the crucible and removed, and the fire is allowed to die down. After an interval of five or six hours, during which the glass has cooled rapidly, the cooling is checked by hermetically closing the crucible and furnace. This is done to prevent the glass from becoming “case-hardened,” like so-called “toughened” glass. The crucible remains untouched for a period, varying from six. days to six weeks, according to the size of the discs required and the nature of the glass. When the furnace is opened the crucible is drawn out, and the walls of the crucible are broken away from the glass. (In the manufacture of large lenses a crucible can only be used for one melting.) The mass of glass is usually found to be broken into

several irregularly-shaped pieces. Each piece is examined microscopically, and by transmitting through the glass a beam of concentrated light, which shows up every imperfection. In spite of prolonged stirring and every precaution, parts of the glass are invariably found defective. These defects are due partly to irregularity of cooling, the exterior layers of the glass having naturally cooled more rapidly than the interior, andpartly tothe disturbance caused by the removal of the clay cylinder. It is rare that more than half of the contents of a crucible is perfectly clear and homogeneous. After the examination, the defective parts are chipped away with a hammer, or ground away by a revolving iron disc fed with emery and water. In order to convert the selected pieces, which are often irregular in form, into discs of regular form, each piece is placed in a mould made of fireclay and subjected to heat, sufficient to cause the glass to take the shape of the mould, but insufficient to produce complete fusion. The moulding process must be conducted with the greatest care, as a slight excess of heat may render useless all the labour previously expended. After the glass has taken the form of the mould the fire is allowed to die out, and the kiln in which the process has been conducted is hermetically closed. By

the first moulding the irregular fragments of glass are converted into discs with parallel faces ; by a second inoulding, and by using moulds possessing various degrees of curvature, the dkcs are caused to assume roughly the form of lenses. Before the last process of moulding, part of the edge or surface of each disc is poflshed and the glass once more examined for defects.

II. BiowN Glass.

Tdble-Glass and Vases. — The following is the composi-
tion of the varieties of glass used : —

SiO,

KjO

PbO

m,o

CaO

MgO

FejO,

and

A1,0,

Potash-lcad (FUnt) glass

Soda-lime (Venetian) glass .

Potash-lime (Bohemian) 1

glass . . . f

68-n

73-40

71-6

13-88

15‘0

82-95

18-58

5-06

lO-Q

1-2

2-48

2-3

Regenerative gas furnaces are being gradually adopted.

In many -works, however, the old-fashioned coal or coke

furnaces, fitted in some cases with mechanical feeders, are

still in use. For potash-lead glass covered crucibles are

used, holding from ^ to f ^^n of molten glass. Open,

basin-shaped crucibles are used for leadless glasses.

Potash-lead glass, although readily fusible, is so viscous and tenacious of gas and air bubbles, that, with the appliances now in use, the raw materials cannot be converted into clear workable glass in less than from fifty to sixty hours. The distinctive qualities of potash-lead glass are its ductility when heated and its brilliancy and colourlessness when cold. Owing, however, to its brilliancy, it is not so well adapted to display niceties of form as a leadless glass, which may be far from faultless -with regard to clearness and colour. All table-glass worthy of the name is blown glass. Every vase, wine-glass, or decanter has commenced its existence in the form of a bubble at the end of a blowing-iron, and owes its form to simple tools guided by delicate touch and trained eyesight. The revival in recent years of the craft of glass-blowing in England must be attributed to William Morris and T. G. Jackson, R.A. They, at any rate, seem to have been the first to grasp the idea that a wine-glass is not merely a bowl, a stem, and a foot, but that, whilst retaining simplicity of form, it may nevertheless possess decorative

effect. They, moreover, suggested the introduction for the manufacture of table-glass of a material similar in texture to that used by the Venetians, both colourless and tinted (see Plate).

In 1870 the colours available and used for English table-glass were ruby, canary-yellow, emerald-green, dark peacock-green, light peacock-blue, dark purple-blue, and a dark purple. About that year the “Jackson” table-glass was made in a light, dull green glass, similar to that used in .stained glass as “white,” containing a wealth of bubbles and interesting irregularities.

Owing to these so-called defects the glass only appealed to a very select circle. The dull green, commonly known as “pale green,” was followed successfully by amber, white opal, blue opal, straw opal, sea-green, horn colour, and various pale tints of soda-lime glass, ranging from yellow to blue. Experiments have also been tried with a violet-coloured glass, a violet opal, a transparent black, and with glasses shading from red to blue, red to amber, and blue to green. Touches of colour have been added to

vessels in course of manufacture by means of seals of molten glass, applied like sealing-wax; or by causing vessels to wrap themselves round with threads or coils of coloured glass. By the application of a pointed iron hook, while the glass is still ductile, the parallel coils can be distorted into bends, loops, or zig-zags (Eigs. 3, 4). The surface of vessels may be rendered lustrous by rolling the hot glass on metallic leaf, or iridescent, by the deposition of metallic tin, or by the corrosion caused by the chemical action of acid fumes. Gilding and enamel decoration are applied to vessels when cold, and fixed by heat. Cutting and engraving are produced by pressing the surface of vessels against the edge of wheels revolving on horizontal spindles. ” Cutting ” wheels range from 18 inches to 3 inches in diameter, and are made of iron for grinding, stone for smoothing, and wood for polishing. “Engraviug ” wheels are small, ranging from 1 inch to J inch, and are made of copper. It is the fashion to run down ” cutting ” as a form of decoration. As, however,

Fig. 1.— Glass mechanically “crimped.

” cutting ” brings out one of the intrinsic beauties of pot-
ash-lead glass, namely, its remarkable power of reflecting
and refracting light, the reason that it is decried must be
on the ground of misapplication, rather than unfitQess.
The fault probably lies in cutting too deeply and too lav-
ishly. When a vessel is smothered with cutting, form dis-
appears in sparkle. The true use of engraving is to add
interest to vessels by means of coats-of-arms, monograms,
inscriptions, and graceful outlines. The improper, but
too common, use of engraving is to hide defective material.

GLASS

The influence exerted by public taste upon glass-
blowing has not always been conducive to the best inter-
ests of the craft. Some instances are sufficiently curious
to deserve notice. Large numbers of shades for gas,

Fig. 2. — Opal Vases : figure on the right has naturally folded edges.

oil, and electric light, as well as bowls for flower-vases,
were rendered decorative by allowing the edges of the
mouths, while still ductile, to arrange themselves in
natural folds. The discriminating public thought these

Fig. 3. — Whitefriars Glass.

natural folds to be too irregular, and certain manufacturers promptly introduced a machine, closely resembling a guillotine, which crimped the folds with mathematical precision (I”ig. 1). This curious distrust of natural irregularity has had the effect of, to a great extent, spoiling opal glass. The beauty of opal glass consists in the wanton irregularity of its shading, no two pieces being precisely similar (Fig. 2). The public asked for regularity, and have been supplied with an insipid milk-and-water material, which is called opal. ” Threading ” has suffered much in the same way. By the old method of hand threading the spaces between the threads or coils of coloured glass are always more or less irregular. A lathe has been introduced which not only winds the glass thread with exasperating exactitude, but renders it possible to cover a vessel with threading from top to bottom. Irides-

cence, when first introduced, was applied delicately to vases of suitable form; it was, however, before long applied to utensils of every description, and the effect, so far from suggesting the actual lightness and brightness of a bubble, is often rather more suggestive of the putrescence of a stagnant pool. Reticence and restraint in decoration have few advocates, and there is a constant demand for any kind of novelty, provided it is highly coloured and exuberantly trimmed. The unfortunate feature of the misuse of processes of decoration is not so much that it offends good taste, but that it brings into disrepute processes which, when properly used, are capable of producing beautiful effects.

In the Paris Exhibition of 1900 surface

decoration was the prominent feature

of all the exhibits of table-glass. The

carved or ” cameo ” glass, introduced by Thomas Webb of

Stourbridge in 1878, had been copied with varying success

Fig. 4. — Whitefriars Glass.

by glass-makers of all nations. Frequently the surface

had been dulled by acid so as to produce a ” satin ” finish.

M. ifimile Gall^ and Daum Freres of Nancy exhibited

specimens of this form of decoration possessing consider-

able beauty. The so-called ” Pavrile ” glass of Messrs

Tiffany of New York owes its effect entirely to surface

colour and lustre (Fig. 6). The vases of Karl Koepping

of Berlin are so graceful and so fragile that they appear to

Fig. 6.— Tiffany Glass Vase.

equally divided. It has been proved that these varia-

tions depend to a great extent on the chemical natiire

of the glass of which the thermometer is made, bpeciai

glasses have therefore been produced, by M. Tonnelot m

France and at the Jena glassworks in Germany, expressly for the manufacture of thermometers for chemical and physical measurements.

The following are the analyses :—

-■Wliitefriais Glass.

be creations of the lamp-worker rather than of the glass-blower (see Plate). Through the absence of exhibits of British table-glass it was impossible to determine the position it occupies in relation to that of other nations.

Ttie existence of the craft of glass-blowing is threatened by three dangers. 1 . There is the difficulty of attracting recruits. Boys are rightly forbidden to commence work at the furnace until they are fourteen. Commencing at this age, only those who are exceptionally quick attain the dex-terity which is essential to a first-class work-man. 2. To meet the demand for regularity

and excessive light-
ness in table-glass,
many of the simpler
articles are now blown
in moulds. The train-
ing which the fashion-
ing of simpler form^
by hand affords is thu~
lost. 3. The demand
for cheap table-glas, .
has encouraged th ■
use of “pressed glass’’
and the introductioi i
of automatic blowiU; ‘
machines from th’ •
United States.
Tube. — In modern
thermometry instru-
ments of extreme ac-
curacy are required,

and researches have
been made, especi-
ally in Germany and
France, to ascertain
the causes of vari-
ability in mercurial
thermometers, and
how such variability
is to be removed
or reduced. In all
mercurial thermometers there is a slight depression of the
ice-point after exposure to high temperatures ; it is also not
uncommon to find that the readings of two thermometers
between the ice- and boiling-points fail to agree at any
intermediate temperature, although the ice- and boiling-
points of both have been determined together with per-
fect accuracy, and the intervening spaces have been
Tonnelot’s
” Verre dur.’
JeDa glass —

xvi-iii .

59-iii

SIO.

71-45

67-5

720

Na.O

11-17

14-0

11-0

KjO

CaO

14-52

7-0

AljOj

12-6

2-5

5-0

Fc.Oi

0-29

B,0:

2-0

12-0

8O3

0-74

Depres-

sion of

Ice-

poiDt.

0-07

0-05

0-02

Since the discovery of the Eontgen rays, experiments have been made to ascertain the efifects of the ditterent constituents of glass on the transparency of glass to X-rays. The oxides of lead, barium, zinc, and antimony are lound perceptibly to retard the rays. The Jena glassworks manufacture two glasses for making X-ray tubes : —

BiOj

B,0,

AljOa

NajO

I. . .

n. . .

71-0

39-6

14-0

30-0

5-0

20-0

10-0

10-0

Sheet Glass.-

glass : —

-The following are analyses of sheet

SiOs

CaO

NajO

AljOa+FejOj

English

Trench

.72-00

71-90

13-00

13-60

13-00

13-10

2-00

1-40

The materials used are sand, chalk or limestone, sul-
phate of soda; a small quantity of powdered anthracite
or charcoal is added.

Eegenerative gas-furnaces with tanks are generally used.
The tanks are provided with one, two, or three floating
bridges, and there are floating fireclay rings, within which
the molten glass is kept clear by skimming, and from the
centre of which the molten glass is gathered for working.
Owing to the high temperature attainable with gas
furnaces, and the greater purity of the materials used, the
scum of ” glass-gall ” or ” sandiver,” which in old times

rose to the surface, and was a constant source of trouble, is almost imknown. In many manufactories a separate furnace is used as a source for the heat required in manipulation. This arrangement prevents loss of heat from the melting furnace, and enables the temperature to be more regularly maintained. A well-regulated temperature improves the quality of the glass, and is sufficient compensation for the extra expenditure on fuel. The regular working of the meltiug furnace adds greatly to the convenience of the workmen, as they can work throughout the week in regular eight-hour shifts.

The use of compressed air for blo-wing the sheet-glass cylinders has been introduced, but has not been generally adopted.

Coloured Glass for Windows. — The production of coloured glass for ” mosaic ” windows has become a separate branch of glass-making. Charles Winston, after prolonged study of the coloured windows of the 13th, 14th, and 15th centuries, convinced himself that no approach to the colour effect of these windows could be made with glass which is

thin and even in section, homogeneous in texture, and made and coloured with highly refined materials. To obtain the effect it was necessary to reproduce as far as possible the conditions under which the early craftsmen

Table Glass. Designed by T. G. Jackson (in 1870)-

Table Glass. Designed by “Wtlliam Moreis (about 1872).

Table Glass. Designed by Koepping of Berlin (1900).

worked, and to create scientifically glass which is impure in colour, n-regular in section, and non-homogeneous in texture. The glass is made in cylinders and in ” crowns ” or circles. The cylinders measure about 14 inches in length by » inches in diameter, and vary in thickness from one-eighth to three-eighths of an inch. The “crowns” are about lo inches in diameter, and vary in thickness from one-eighth to half an inch, the centre being the thickest, ihe glass, thus made, gives all the life and variety that the artist can legitimately require, and coloured glasses are made which are certainly not unequal to the old. Mr h. J. Prior has introduced an ingenious method of mak-

ing small oblong and square sheets of coloured glass, which a,re thick in the centre and taper towards the edges, and which have one surface slightly roughened and one brilliantly polished. Molten glass is blown into an oblong iron mould about 12 inches in depth and 6 inches in width. A hollow rectangular bottle is formed, the base and sides of which are converted into sheets. The outer siirf ace of these sheets is slightly roughened by contact with the iron mould. Small ‘ slabs or sheets with an irregular section are also made by pressing molten glass on to flat moulds marked with slight irregularities. Large sheets of irregularly corrugated glass are made by a rolling machine. The molten glass passes between two rollers, one of which is engraved with sinuous indentations. This rolled and mechanically undulated glass, especially when it is opalescent and streaked with colour, is at the present time popular on the Continent and in the United States. Many of the coloured windows at the Pai-is Exhibition of 1900 were made of this glass, and contained representations by means of streaks of colour of sunset

and sunrise, as well as of fruits, flowers, and trees. There were occasional happy effects of colour, but the style and material are too suggestive of confectionery.

III. Glass Mechanically Pressed oe Blown.

Plate Glass. — The following are analyses of plate

SiOz

CaO

Na,0

AljO,

FejOa

French

English

71-80

70-64

15-70

16-27

11-10

11-47

1-26

0-70

0-14

0-49

The materials used are sand, limestone, sulphate of soda ; a small quantity of powdered anthracite or charcoal is added. Regenerative gas furnaces are almost universally employed. The same crucibles are used both for melting and casting ; they hold from 1 to 1|- tons of molten glass, and weigh from 7 to 9 cwt. Contact with the molten glass causes the tables to expand, and the expansion of the tables gives to the glass plates a curved section. This curvature is reduced by building the casting tables of many comparatively small slabs of iron, instead of two or three, as was formerly the custom.

Pressed Glass. — The following is an analysis of a specimen of English “pressed” glass : —

SiO^

UajO

CaO

BaO

A1,0,

FejOs

English .

70-68

18-38

5-45

4-17

0-33

0-20

The materials used at Gateshead are sand, sulphate of soda, nitrate of soda, lime-spar, and carbonate of barium. The use of red-lead has been discontinued. At Pittsburg, United States, the materials are sand, sodarash, nitrate of soda, and lime (crushed and burnt). At Gateshead the old-fashioned coal furnaces are still used. The moulds are made of cast-iron. Oil furnaces with steam-blast are used for polishing the goods after they have been pressed. The presses are generally worked by hand. Steam power, however, has been applied to some of the heavier ones. The secretary of the National Glassworks at Pittsburg writes : ” Most of the work done in America in table-ware,

tumblers, &c., is produced by hand-presses, as it is necessary for the operator to know by touch whether the plunger has pressed the glass to the proper point in the mould. Natural gas has been very largely used for the past ten years in the manufacture of glass. Continuous tank furnaces are used for the commoner grades of pressed glass.”

Glass Bottles partly Pressed, and partly Blown by Conv-jpressed Air. — The following is an analysis of a specimen of light green English ” bottle” glass : —

SiOj

A1,0,

Fe^Oa

CaOj

Na^O

English

69-15

2-38

0-69

15-38

12-17

The materials used are sand, Derbyshire limestone, chalk, sulphate, and carbonate of soda. Gas regenerative tank furnaces are generally used. Ashley's patent bottle-making machine combines the process of pressing with a

Fig. 7. — Owens's Glass-hlowing Machine,

g. g. g. blowing-irons.

plunger, with that of blowing by compressed air. The neck of the bottle is first formed by the plunger, and the body is subsequently blown out by compressed air admitted through the plunger. A sufficient weight of molten glass to form a bottle is gathered and put

in a funnel placed over and giving access to a mould which shapes the outside of the neck. A plunger is forced upwards into the glass contained in the neck-mould and forms the neck. The funnel is removed, and the plunger, neck-mould, and mass of molten glass attached

to the neck are inverted. A bottle mould rises and envelops the mass of molten glass. Compressed air is admitted through the plunger in the neck, forces the molten glass to take the form of the bottle mould, and completes the bottle. A single machine can be made to produce nine gross of bottles in a day.

Glass Blown by Compressed Air. — Works have been built at West Bromwich for the manufacture of tumblers, chimneys, bottles, and electric lamp bulbs by means of the automatic glass-blowing machine (Fig. 7) patented by Michael Owens of Toledo, U.S.A. These machines take the place of human glass-blowers. The only manual operations are : (1) G-athering the molten glass at the end of a blowing-iron; (2) placing the blowing-iron in the machine so that, whilst the mouth-piece is in contact with an air-jet, the mass of molten glass hangs within the sections of an open mould; (3) removing the blowing-iron with the finished article attached. Each machine consists of a revolving table carrying five or six moulds. The moulds are opened and closed by ” cams ” actuated

by compressed air. As soon as a blowing-iron is in contact with an air-jet, the sections of the mould close upon the molten glass and the compressed air forces the glass to take the form of the mould. A large pipe carrying compressed air runs round the works, and the blowing machines are cormected with the pipe by flexible tubes. It is claimed that these machines can turn out seven tumblers or five lamp chimneys per minute.

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(h. j. p.)

Class, Stained. — The art of what is called glass painting — though in reality a combination of glazing and painting goes to the making of a stained glass window — may be claimed as mediaeval. It arose and was developed in connexion with Gothic architecture ; painted glass, indeed, culminated in the 16th century, but the art throve only so long as artists of the Renaissance worked on the mosaic principle of the Middle Ages. Step by step with their departure from the consideration of a window as primarily stained glass, and their reliance upon painting only, the art declined. Its reawakening in England was part of the Gothic revival ; and the Gothic revival determined the direction which modern glass should take. Early Victorian work was tentative, interesting, not for

its artistic merit, but as marking the steps of recovery — witness the work of Willement, in the choir of the Temple Church; of Ward and Nixon, in the south transept of Westminster Abbey ; and of Wailes, in the House of Lords. The cartoons for this last were drawn by Oliphant from sketches by Pugin, who in his day exercised considerable influence over the art, and by John Powell (Hardman'& Co.), an able artist, who was content to walk, even after his master's death, reverently in his footsteps. Charles Winston, again, whose Hints on Glass Painting was the first real contribution towards the understanding of Gothic Glass, and who, by the aid of Powell's (of Whitefriars), succeeded in getting glass very like the old in texture and colour, was more learned m ancient instances than appreciative of modern design. So from the beginning of its recovery glass fell into the hands of men less in sympathy with art than with archaeology. The artists foremost in the Gothic revival (Butterfield, Street, Surges, &c.) were infected with the same spirit; and, as they had the placing of commissions for

windows, they controlled the policy of glass painters. Thus designers, whatever their originality, were constrained to work in a manner contrary to their individual bias, and to fill churches with mock-mediaeval windows, the interest in which died with the illusion about a Gothic revival. But they knew their trade, and when an artist like John Clayton (Clayton & Bell), master of a whole school of later glass painters, took a window into his hands (St Augustine's, Kilburn ; Truro Cathedral; King's College Chapel, Cambridge) the result was a work of art from which we may gather what such men might have done had they been left to follow the bent of their own genius. It is necessary to refer to this, because it is popularly supposed that whatever is best in recent glass is due to the Eomantic movement. The charms of Burne-Jones's design and of Morris's colour place the windows done by them among the triumphs of modern decorative art. But Morris was neither foremost in the reaction, nor quite such a master of the material he was working in as he showed himself in other crafts. Other

artists to be mentioned in connexion with glass design are — Clement Heaton, Bayne, Westlake, and Henry Holiday.

Foreign work, as compared with modern English, shows a less just appreciation of glass. In Germany, King Louis of BavaTia enlisted Cornelius and Kaulbach as designers for it (Aix-la-Chapelle, Cologne, Glasgow). In France the Bourbons employed Ingres, Delacroix, Vernet, and Flandrin (Dreux). But though the windows they designed were painted with the skill characteristic of Munich and Sevres, the glass, according as it was left bare or laden with paint, was either crude or dull, lacking the character of glass. In Belgium happier results were obtained, Capronnier's window at Brussels being not unworthy of the series by Van Orley, which it supplements ; but foreign artists failed at the best to appreciate the quality of glass ; they put better draughtsmanship into their windows than English designers, and painted them better, but they missed the glory of translucent colour.

In America, John La Farge, finding English material not dense enough, produced pot-metal more heavily charged with coloured oxides, and more wilfully streaked, mottled, and otherwise quasi-accidentally varied than European manufacture — opalescent, too, and more like agate or onyx than jewels. It was also an American idea to make glass in lumps and chip it into flakes, to corrugate it, to blow it into shapes, or to pull molten glass out of shape — to make, in fact, material safely to be trusted only in the hands of an artist of reserve. La Farge and L. Tiffany have turned it to beautiful account ; but even they have put it to more pictorial purpose than it can properly fulfil. The design to which it obviously lends itself is a form of ornament severe even to the verge of the barbaric.

Mere painting, whether on pieces of pot-metal afterwards to be leaded together, or upon single sheets of plate, has been carried as far as it can go. In the one case there is always the discrepancy between delicate painting and

harsh lead lines ; in the other, there is so little of the real quality of glass in the result, that there is no excuse for the production of so fragile a picture, lacking, as it must, the qualities peculiar to painting proper, as may be seen in the wenderful but most unsatisfactory series of pictures painted at Sevres for the chapel at Dreux (sheets of plate each 4 by 2^ feet).

Of late years each country has been learniag from the others, and the newest effort is very much in one direction. It seems to be agreed that a window begins with glazing, that the all-needful thing is beautiful glass, and that painting may be reduced to a minimum, may even (owing to new developments in the making of gla^) be dispensed with altogether.

The present tendency seems to be not merely in the direction of mosaic, but of carrying the glazier’s art further than has been done before, rendering even figure subjects and landscapes ia leaded glass. The limitations of mere glazing are obvious — only a very partial view, for example,

of the human face can be expressed yi this fashion — but a way out of the difficulty was shown at Paris (1900) by M. Tournel, who fused coloured tesserae on to larger pieces of colourless glass, with a flux of powdered glass between them. There would be no advantage in building up whole windows in this way, but for the rendering of the flesh, &c., in a window for the most part leaded, this use of tesserae, and even of small-shaped pieces fused on to white, seems to supply just what is wanted.

A freer hand is given to the glass painter to-day, partly because his work is no longer exclusively ecclesiastical. Domestic glass being now a very important industry, the practices of men employed upon it seriously affect the methods of those engaged upon church work. Moreover, the recognition of the artistic position of craftsmen in general makes it possible for an artist to devote himself to glass without sinking to the rank of a mechanic ; and artists begin to realize the scope glass offers to them. Design is all-important. And design is adequate in pro-

portion as it has nothing to lose and everything to gain by translation into glass. It must necessarily take into account the capacities of the material, asking of it only what it can do, and bringing out the qualities in which it excels — the purity, the brilliancy, the translucency, the beauty of colour in which it is supreme. (l. f. d.)

Glastonbury, a municipal borough and market-town in the eastern parliamentary division of Somerset-shire, England, 5 miles south-west of Wells by rail. The church of St Benedict and St John's Church tower have been restored. In 1892 the remains of a prehistoric marsh village, consisting of sixty mounds within a space of five acres, were discovered close by the town. The relics found there and in other localities in the neighbourhood have been deposited in the Antiquarian Museum, begun in 1887. There are a Eoman Catholic college for mission-aries, a Roman Catholic chapel, and various Noncon-formist chapels. There are manufactures of sheepskin rugs and leather gloves and shoes. Area, 5000 acres. Population (1881), 3719 ; (1901), 4016.

Clatz, a fortified town of Prussia, province of Silesia, on the Neisse, 58 miles by rail south-south-west from Breslau. Breweries and machinery factories have been added to its industries. A bronze statue of the Emperor William I. was unveiled in 1898. The fortifications of the town were razed in 1891. Population (1885), 13,588 ; (1900), 14,918.

Clauchau, a town of Germany, on the Mulde, 17 miles by rail west of Chemnitz, in the circle of Zwickau, kingdom of Saxony. It has important manufactures of woollens and half -woollens, 9 weaving mills, over 20 dye, cloth-dressing, yam-washing, and |)rint works, 2 spinning mills, several pattern-designing works, and a weaving-implement factory. Population (1890), 23,406; (1900),.

Cleichen, two groups of castles in Germany. (1) A group of three, situated each on an isolated hill in Thuringia, between Gotha and Erfurt. Of the three only one is inhabited, namely, Wachsenburg (1358 feet above searlevel), belonging to the duke of Saxe-Coburg-Gotha, and containing collections of weapons, pictures, &c. It

is said to have been founded about 935, and was sold to the landgrave of Thuringia in 1368. The other two, Gleichen (1221 feet) and Muhlberg (1309 feet), are ruins. Both were unsuccessfully besieged by the Emperor Henry IV. in 1088. The former is best known from the romantic legend of the count of Gleichen, a Crusader, who was allowed to live with two wives at the same time (see Musseus, Volksmarchen, “Melechsala”). The castle of Muhlberg existed as early as 704. (2) The other group of two castles, Neu-Gleichen and Alt-Gleiehen, both in ruins, crown two isolated hills (1394 and 1404 feet respectively) about 2 miles south-east from Gottingen.

Cleneig, a South Australian watering-place, 6| miles south-south-west of Adelaide, on Holdfast Bay. It is a popular summer resort, connected by two rail-way lines with Adelaide. In the vicinity is the “Old Gum Tree,” under which South Australia was pro-claimed British territory by Governor Hindmarsh in 1836. Population (1901), 3949.

Clens Falls, a village of Warren county, New York, U.S.A., in 43° 18′ N. and 73° 39′ W., on the Hudson river and on the Delaware and Hudson railway, at an altitude of 343 feet. It has fine water power in the falls, which is utilized in lumber, shingle, and lath mills, paper mills, and iron and steel works. In the immediate neighbourhood are many lime-kilns. Population (1880), 4900; (1890), 9509; (1900), 12,613, of whom 1762 were foreign-born.

Clogau, a fortified town of Prussia, province of Silesia, on the Oder, 59 miles north-west from Breslau by the railway to Frankfort-on-the-Oder. A new quarter has grown up on the south-east of the old fortified enceinte. Population (1885), 20,027; (1900), 22,136.

Ciossop, a municipal borough and market-town in the High Peak parliamentary division of Derbyshire, England, 58 miles north-north-west of Derby by rail. Recent erections are the free library, the public baths, a technical school (1900), and Wood’s Hospital. Howard Park was formed in 1887. Area of borough, 3033 acres.

Population (1881), 19,574 ; (1901), 21,526.

Gloucester, a city and seaport of Essex county, Massachusetts, U.S.A., in latitude 42° 36′ N. and 70° 39′ W., on Cape Ann, and a branch of the Boston and Maine railway. It includes, besides the community of Gloucester, several small places, Annisquam, Bayview, LanesvOle, East and West Gloucester, and Eiverdale. The city includes an area of 34 square miles ; most of this is uneven, and the bordering coast is rocky. Gloucester has an excellent harbour and some commerce, but the principal business is fishing. In this industry it is the most important place in the United States, and most of the adult males are engaged in it. There were employed in it, in 1895, 380 vessels, 2442 boats, and 6500 men. The product was valued at $3,212,985. An industry of secondary importance is the quarrying of the granite with which the city is underlaid. The manufactures are not extensive. In 1896 the capital invested was $3,003,256, employing 1980 hands, with a product valued at $6,590,366. Of this, by far the largest item was canned and preserved fish.

The coast is very picturesque, and it has become a favourite seaside resort, especially for artists, “who prefer the point on the east side of the harbour, in the village of East Gloucester. Population (1880), 19,329; (1890), 24,661 ; (1900), 26,121, of whom 8768 were foreign-born. The death-rate in 1900 was 14-9.

Gloucester, a city of Camden county, New Jersey, U.S.A., in 39° 63′ N. and 76° 07′ W., on the eastern side of the Delaware river, opposite Philadelphia. It is connected with Philadelphia by ferry, and has two railways, the Atlantic City and the West Jersey and Seashore. Population (1880), 6347; (1890), 6564; (1900), 6840, of whom 1094 were foreign-born.

Gloucester, a city, county of itself, municipal and parliamentary borough, port, and county town of Gloucestershire, England, in the Tewkesbury parliamentary division of the county, on the left bank of the river Severn, 33 miles north-east of Bristol by rail. Alternately with

Worcester and Hereford, a triennial musical festival is held here. In recent years the Shire Hall has been enlarged at a cost of £11,750 ; the Guildhall built at a cost of £31,500; the corn exchange enlarged and converted into the post office ; a free library built, and a county council dairy school established. Between the years 1873 and 1890 the sum of £13,000 was expended on the restoration of the cathedral. In 1897 funds, estimated at £10,000, were collected for further expenditure, and the north and west alleys of the cloisters were thoroughly repaired.

Gloucester, declared a port in 1882, is reached from the Severn by a ship canal (the Berkeley) 16^ miles in length. The registered shipping in 1898 consisted of 154 vessels of 7563 tons. In that year 4445 vessels entered the port with 510,874 tons, and 4478 vessels cleared with 493,856 tons. A harbour board was formed in 1890 to maintain, regulate, and light a harbour in the Severn estuary.

Since 1885 the city has returned only one member to Parliament. Area, 1437 acres. Population (1881), 36,513; (1901), 47,943.

Gloucestershire, a west midland county of Eng-
land, bounded on the S.E. by Wiltshire, on the S. by
Somersetshire, on the W. by Monmouthshire, on the
N.W. by Herefordshire, on the N”. by Worcestershire and
Warwickshire, and on the E. by Oxfordshire.

Area and Population. — The area of the ancient connty is 795,734 acres or 1243 square miles, with a population in 1881 of 572,341, and in 1891 of 599,947, of whom 281,012 were males and 318,935 females, the numher of persons per square mile being 483, and of acres to a person 1-32. The area of the administrative county, as given in the census returns of 1891, was 796,731 acres, with a population in 1891 of 645,574 ; but in 1896 considerable additions were made to its area by the transference from Warwickshire of the part of the parish of Batsford in Warwickshire, and by the transference from Wiltshire of the parishes of Kemble, Poole Keynes, and Somerford Keynes. The area of the registration county in 1891 was 714,763 acres, with a population of 548,886, of which 360,705 were urban and 188,181 rural. Within the registration area the increase of population between 1881 and 1891 was 4‘52 per cent. The excess of births over deaths between 1881 and 1891 was

64,020, and the increase of the resident population was 23,717. In 1901 the population of the ancient county was 634,666. The following table gives the numbers of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 : —

Tear.

Marriages.

Birtlis.

Deaths.

Illegitimate Births.

Males.

Females.

1880

1890

1898

4113

4315

4436

16,485

15,723

14,880

9938

9760

9116

423

328

276

892

311

275

The number of marriages in 1899 was 5034 ; of births, 17,309 ; and of deaths, 11,178.

The following table gives the marriage-, birth-, and death-rate per 1000 of the population, with the percentage of illegitimate births, for a series of years : —

1870-T9.

1880.

1880-89.

1890.

188S-9T.

1898.

Marriage-rate

Birth-rate .

Death-rate .

Percentage of Ille-

gitimacy .

17-2

32-6

20-4

4-8

15-7

31-5

190

4-9

15-3

80-1

17-9

4-8

15-8

27-6

17-8

3-9

15-4

27-8

17-4

4-0

15-7

26 ‘4

161

3-7

In 1891 there were in the county 435 natives of Scotland, 735 natives of Ireland, and 392 foreigners.

Constitution and Government.— The ancient county comprises five parliamentary divisions, and it also includes the parliamentary borough of Gloucester, returning one member, part of the borough of Cheltenham, returning one member, and the greater part of the borough of Bristol, which returns four members. The administrative county contains four municipal boroughs : the city of Bristol (328,842), Cheltenham (49,489), Gloucester (47,943), and Tewkesbury (5419). Bristol and Gloucester are county boroughs. The following are the urban districts: Awre (1096), Charlton Kings

(3806), Cirencester (7536), Coleford (2541), Horfield (1485), Kingswood (11,961), Nailsworth (8028), Newnham (1184), Stow-on-the-Wold(1386), Stroud (9188), Tetbury (1989), and Westbury-on-Sevem (1866). The Forest of Dean is for forestry purposes under the jurisdiction of the Crown, and the hundred of the duchy of Lancaster is for some purposes under the jurisdiction of the duchy of Lancaster. Gloucestershire is in the Oxford circuit, and assizes are held at Gloucester. The boroughs of Bristol, Gloucester, and Tewkesbury have separate commissions of the peace and separate courts of quarter sessions. The ancient county— which is chiefly in the diocese of Gloucester — contains 397 ecclesiastical parishes and districts, with parts of ten others.

Education. — Cheltenham is the seat of a famous grammar school. There are a residential training college (Church of England) for schoolmasters, another at Bristol (Diocesan), and two training colleges (Church of England and Ladies' College) for schoolmistresses. There are at Bristol a district institution for deaf and dumb, a school board deaf school, and an asylum and school of industry for the blind. The number of elementary schools on 31st August 1899 was 541, of which 116 were board and 425 voluntary schools,

the latter including 875 national Church of England schools, 11 Wesleyan, 11 Roman Catholic, and 28 “British and other.” The average attendance at board schools was 41,321, and at voluntary schools 61,653. The total school board receipts for the year ending 29th September 1899 were over £212,666. The income under the Agricultural Rates Act was over £1925.

Agriculture. — Nearly seven-eighths of the total area of the county is under cultivation, and of this neai’ly four-sevenths is in permanent pasture, both cattle and sheep being largely raised. A feature of the county is its apple and pear orchards, chiefly for the manufacture of cider and perry, which are attached to nearly every farm, and cover altogether more than 19,000 acres. Nearly 60,000 acres are under wood. The acreage under wheat nearly equals the combined acreages under barley and oats ; and turnips, &c., occupy about three-fourths of the green crop acreage, potatoes occupying only about a twelfth. About 1500 acres are under small fruit.

The following table gives the larger main divisions of the cultivated area at intervals from 1880 : —

Tear.

Total Area

under

Cultiva-

tion.

Corn

Crops.

Green

Crops.

Clover.

Permanent

Pasture.

Fallow.

1880

1885

1890

1895

1900

653,828

659,011

659,336

656,488

661,441

160,852

146,659

135,949

120,608

121,495

60,152

60,610

54,435

50,293

47,035

89,067

98,064

89,869

88,068

89,214

324,908

841,239

869,023

387,092

398,718

18,823

12,408

9,116

8,611

4,431

The following table gives particulars regarding the principal live stock for the same years : —

Tear.

Total

Horses.

Total

Cattle.

Cows or Heifers

in Milk or in

Calf.

Sheep.

Pigs.

1880

1885

1890

1895

1900

25,779

26,455

27,268

27,737

27,530

112,292

129,926

121,3.36

109,786

124,708

36,280

48,506

41,640

88,307

39,068

854,621

893,149

375,712

347,011

864,785

62,171

68,358

81,094

83,619

67,438

Industries and Trade. — According to the annual report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 60,427,

as compared with 59,678 in 1896. Of these 5830 were employed in textile factories, the majority of whom (3539) were engaged in the woollen manufacture carried on at Bisley, Eastington, Edge, Ebley, Minchinhampton, Nailsworth, North Nibley, Stonehouse, Stroud, and Wotton-under-Edge ; the cotton industi-y employed 1355. The number employed in non-textile factories was 43,173, there being an increase between 1895 and 1896 of 10-2 per cent.,

and between 1896 and 1897 of 0-1. Of these 8538 were employed in clothing industries, 7097 in the manufacture of machine appliances, conveyances, and tools, 5752 in food industries, 4370 in the manufacture of paper, &c., and 1497 in furniture-making, &o. ; pottery and glass are also manufactured. Workshops employed 11,424, of whom 6486 were employed in clothing industries and 1316 in those of furniture, &c. For the export and import maritime trade see under Bristol and Gloucestee, city. The total number of persons employed in mines and quarries in 1899 was 8775. In the same year 254,173 tons of clay were raised, 171,270 tons of limestone, and 123,534 tons of sandstone. Strontium sulphate is dug from shallow pits in the red marl in Gloucestershire and Somersetshire, the total quantity obtained in the two counties in 1899 being 12,629 tons, valued at £6314. The following table gives the coal and ironstone produced in 1890 and 1899 :—

1890.

1899. 1

Tons.

Value.

Tons.

Value.

Coal .

Ironstone

1,419,616

65,611

£716,100

26,244

1,528,014

26,101

£789,474

12,516

Authorities. — Among recent works are Legends, Tales, and Songs in the Dialect of the Peasantry of Gloucestershire. London, 1876. — Robertson. Glossary of Dialect and Archaic Words of Gloucester. London, 1890. — Witchell. Fauna and Flora of Gloucestershire. Stroud, 1892. — Bazelet and Htett. Bibliographers^ Manual of Gloucestershire. 3 vols. London, 1895-97. See also Transactions of the Bristol and Gloucestershire Archaeological Society. (t. p. h.)

Cloversville, a city of Fulton county, New York, U.S.A., in 43° 03′ N. and 74° 22′ W., on a small branch of the Mohawk river, and on the Fonda, Johnstown, and Gloversville railway; altitude 1000 feet. Gloversville derives its name from its principal industry, the glove manufacture, for which it is the chief centre in the United States. It was incorporated as a village in 1851, and received a city charter in 1890. Population (1880), 7133 ; (1890), 13,864 ; (1900), 18,349, of whom 2542 were foreign-born and 216 were negroes. The death-rate in 1900 was 11-8.

Cluckstadt, a seaport town of Prussia, province of Schleswig-Holstein, on the right bank of the Elbe, 33 miles north-west from Hamburg by rail. The town hall, built in 1642, was entirely rebuilt in 1873. Here are a school of seamanship, and railway workshops, shipbuilding, &c. The port is free. Population (1885), 6483 ; (1900), 6586.

Cmund, a town of Wurtemberg, Germany, on the river Eems, 32 miles by rail east of Stuttgart. It is a seat of the jewellery and silversmiths’ industries, of

wood-carving and turning, and cotton-weaving, and has a trade in fruit and hops. There are an industrial art museum and several benevolent institutions. Population (1885), 15,321 ; (1900), 18,673.

Cmunden, the chief town of the Salzkammergut, in Upper Austria, and the principal depSt of the State Salt Monopoly, situated at the efSux of the Traun river, from the lake of the same name. It is much frequented as a health and summer resort, and has a variety of lake, brine, vegetable, and pine-cone baths, a hydropathic establishment, inhalation chambers, whey cure, &c. Its principal resource, in addition to the salt industry, is the entertainment of its thousands of visitors. Population (1890), 6476 ; (1900), 7126.

Cneist, Heinrich Rudolf Hermann Friedrich von (1816-1895), German jurist and politician, was born at Berlin on the 13th of August 1816, the son of a judge attached to the ” Kammergericht ” (Court of Appeal) in that city. After receiving his school education at the Gymnasium at Eisleben in Prussian Saxony,

he entered the University of Berlin in 1833 as a student of jurisprudence, and became a pupil of the famous Roman law teacher von Savigny. Proceeding to the degree of doctor juris in 1838, young Gneist immediately established himself as a ” privat-docent ” in the faculty of Law. He had, however, already chosen the judicial branch of the legal profession as a career, and having while yet a student acted as ” auscultator,” was admitted ” assessor ” in 1841. He soon found leisure and opportunity to fulfil a much-cherished wish, and spent the next few years on a lengthened tour in Italy, France, and England. He utilized his ” Wander jahre” for the purposes of comparative study, and on his return in 1844 was appointed extraordinary professor of Roman law in Berlin University; and thus began a professorial connexion which ended only with his death. The first-fruits of his activity as a teacher were seen in his brilliant work. Die formellen Vertrdge des heutigen romischen Obligationen-Rechtes (Berlin, 1845). Pari passu with his academic labours, he continued his judicial ca-

reer, and became in due course successively assistant judge of the Superior Court and of the Supreme Tribunal. But to a mind constituted such as his, the want of elasticity in the procedure of the courts was galling. “Brought up,” he tells, in the preface to his Eng-Usche Verfassungs-Geschichte, ” in the laborious and rigid school of Prussian judges, at a time when the duty of formulating the matter in litigation was entailed upon the judge who personally conducted the pleadings, I became acquainted both with the advantages possessed by the Prussian bureau system as also with its weak points.” Feeling the necessity for fundamental reforms in legal procedure, he published, in 1849, his Trial by Jury, in which, after pointing out that the origin of that institution was common to both Germany and England, and showing in a masterly way the benefits which had accrued to the latter country through its more ex—tended application, he pleaded for its freer admission in the tribunals of his own country. The period of “storm and stress,” in 1848 afforded Gneist an opportunity for

which he had yearned, and he threw himself with ardour into the constitutional struggles of Prussia. Although his candidature for election to the National Assembly of that year was unsuccessful, he felt that “the die was cast,” and deciding for a political career, retired in 1850 from his judicial position. Entering the ranks of the National Liberal party, he began both in writing and speeches actively to champion their cause, now busying himself pre-eminently with the study of constitutional law and history. In 1853 appeared his Adel und Ritterschaft in England, and in 1857 the Geschichte und heutige Gestalt der Aemter in England, a pamphlet primarily written to combat the Prussian abuses of administration, but for which the author also claimed that it had not been without its effect in modifying certain views that had until then ruled in England itself. In 1858 Gneist was appointed ordinary professor of Eoman law, and in the same year commenced his parliamentary career by his election for Stettin to the Abgeordnetenhaus (House of Deputies) of the Prussian Landtag, in which assembly he sat thenceforward

uninterruptedly until 1893. Joining the Left, he at once became one of its leading spokesmen. His chief oratorical triumphs are associated with the early period of his membership of the House; two noteworthy occasions being his violent attack (September 1862) upon the Government budget in connexion with the reorganization of the Prussian army, and his defence (1864) of the Polish chiefsof the (then) GrandDuchyofPosen, who were accused of high treason. In 1857-63 was published I)as heutige

Englische Verfassungs und VerwaltungsrecM, a work which, contrasting English and German constitutional law and administration, aimed at exercising political pressure upon the Government of the day. In 1868 Gneist became a member of the North German Parliament, and acted as a member of the commission for organizing the Federal army, and also of that for the settlement of ecclesias-

tical controversial questions. On the establishment of German unity, his mandate was renewed for the Reichstag, and in this he sat, an active and prominent member of the ISTational Liberal party, until 1884. In the Kulturkampf he sided with the Government against the attacks of the Clericals, whom he bitterly denounced, and whose implacable enemy he ever showed himself. In 1879, together with his colleague, von Hanel, he violently attacked the motion for the prosecution of certain Socialist members, which as a result of the vigour of his opposition was almost unanimously rejected. He was parliamentary reporter for the committees on all great financial and administrative questions, and his profound acquaintance with constitutional law caused his advice to be frequently sought, not only in his own but also in other countries. In Prussia he largely influenced legislation, the reform of the judicial and penal systems and the new constitution of the Evangelical Church being largely his work. He was also consulted by the Japanese Government

when a constitution was being introduced into that country. In 1875 he was appointed a member of the Supreme Administrative Court (” Oberverwaltungsge-richt”) of Prussia, but only held office for two years. In 1882 was published his Englische Verfassungs-Ge-schichte (trans., “History of the English Constitution,” London, 1886), which may perhaps be described as his magnum opus. It placed the author at once on the level of such writers on English constitutional history as Hal-lam and Stubbs, and supplied English literature with a text-book almost unrivalled in point of historical research. In 1888 one of the first acts of the ill-fated Emperor Erederick, who had always, as Crown Prince, shown great admiration for Mm, was to ennoble Gneist, and attach him as instructor in constitutional law to his son, the Emperor William II., a charge of which he worthily acquitted himself. The last years of his life were full of energy, and, in the possession of all his faculties, he continued his wonted academic labours until a short time before his death, which occurred at Berlin on the 22nd of

July 1895.

As a politician, Gneist's career cannot perhaps be said to have been entirely successful. In a country where parliamentary institutions are the living exponents of the popular will he might have risen to a foremost position in the State ; as it was, the party to which he allied himself could never hope to become more than what it remained, a parliamentary faction, and the influence it for a time wielded in the counsels of the State waned as soon as the Social-Democratic party grew to be a force to be reckoned with. It is as a writer and a teacher that Gneist is best known to fame. He was a jurist of a special type. To him law was not mere theory, but living force ; and this conception of its power animates all his schemes of practical reform. As a teacher he exercised a magnetic influence, not only by reason of the clearness and cogency of his exposition, but also because of the success with which he developed the talents and guided the aspirations of his pupils. He was a man of noble bearing, religious, and imbued with a stern sense of duty.

He was proud of being a ” Preussischer Junkei”’ (a member of the Prussian squirearchy), and throughout his writings, despite their liberal tendencies, may be perceived the loyalty and affection with which he clung to monarchical institutions. A great admirer and a true friend of England, to which country he was attached by many personal ties, he surpassed all other Germans in his efforts to make her free institutions, in which he found his ideal, the common heritage of the two great nations of the Teutonic race.

Gneist was a prolific writer, especially on the subject he had made peculiarly his own, that of constitutional law and history, and among his works, other than those above named, may be mentioned the following : Budget und Gesetz nach dem constitutionellen Slaatsrecht Englands (Berlin, 1867) ; Freie Advocatur {ibid., 1867) ; Der Bechtsstaat (ibid., 1872, and 2nd edition 1879) ; Zur Verwaltungsreform in Preussen (Leipzig, 1880) ; Das englische Parlament (Berlin, 1886) ; in English translation, The English Parliament (London, 1886, 3rd edition 1889) ; Die Militar- Vorlage von 1892 und der Preussiche Verfassungsconflikt von 1862 bis 1866 (Berlin,

1893) ; Die nationale Bechtsidee von den Stdnden und das Preus-
sische Dreiklassenwahlsystem (ibid., 1895) ; Die verfassungsmdssige
Stellung des Preussischen Oesammtministeriums (ibid., 1895). See
Gierke, EudolpJi von Gneist, Gedachtnissrede (Berlin, 1895), an
In Memoriam address delivered in Berlin. (p. a. A.)

C n ese n ;^- town and— arehiepisco-
pal see of Prussia, province of Posen, 31 miles north-east
from Posen by the railway to Thorn. It has new (re-
naissance) administrative offices (1898) and a monument
to the Emperor Erederick III. (1895) ; and linen and
woollen weaving, and distilleries. Population (1885),
16,757; (1900), 21,661.

Coa, a territorial possession of Portugal, in India,
bearing the ofiicial title of State of India. It embraces
the three districts of Goa, Damao, and Diu, and stretches
60 miles along the Indian Ocean between 14° 53′ and 16°
44′ N. lat. The mean annual temperature at Panjim is
79-7° E., and at Satari 78-8°. Palms take the first place
amongst the flora, especially the following species : Cocus
nucifera, Areca catechu, Caryota urens, Pluenix silvestris,

Borassus flabellifqrmis, Cucifera thebaica (date-palm), and Corypha umhraculifera. Other noteworthy vegetable products are the mango, three species of bananas, the bamboo, bread-fruit tree, siss6 (Dalbergia sissoides), teak (Tectona grandis), cutch or catechu (Acacia catechu), and maura (Bacia latifolia). Iron exists in various parts of the territory, and is extracted at Embarbacem and Astagraar. Agriculture is the principal occupation, and rice the principal crop ; next comes the cocoanut, both for the nuts and for the juice (sura). Other cultivated products are betel-nut and bananas. Salt is very extensively prepared, and gives employment to nearly 2000 persons, who produce 23,200 tons of salt annually. Large quantities of native spirits are distilled from the palms. The average annual value of the imports for the three years 1894-96 was £216,800, and of the exports £114,800. In 1900 the imports through Marmagao were valued at £53,160 and the exports at £25,700; and in addition there was a transit trade valued at £422,000. Goa imports textiles, cattle, wine, tea, rice, drugs, corn, potatoes and other edible roots,

butter, sugar, oils, and tobacco; and exports cocoanuts, spices, fish, cashew nuts, bamboos, poultry, and timber. Trade is carried on almost entirely with Bombay, Madras, Kathiawar, and Portugal. A line of railway (51 miles) runs from Marmagao to Castle Eock (on the Western Ghats). The area of the territory is estimated at 1400 square miles, and the population is 494,836 (1894), as coBipaEed with 420,868 (1881). The territory is ruled by a governor-general, and forms a separate ecclesiastical province of Portugal. Its capital is Nova Goa or Panjim, where there are a lyceum, normal school, seminary, technical school, ajid experimental agricultural station. For 1900-1901 the estimated revenue was £229,100, and expenditure £228,700.

SeeE. ViLLACA, Belatorio e Propostas de iei, Lisbon, 1899 ; Lopes Mendes, a India Portuguesa, Lisbon, 1886; and E. de Vascon-CBLLos, As Colonias Portuguesas, Lisbon, 1896-97. (e de v)

Coal para, a town and district of British India, m

the Brahmaputra Valley division of Assam. The town (population, 5500) overlooks the Brahmaputra. It has declined in importance since the district headquarters were removed to Dhubri in 1879, and it suffered severely from the earthquake of 12th June 1897. The District comprises an area of 3964 square miles. Its population in 1881 was 446,232, and in 189.1 was 462,304, giving an average density of 114 persons per square mile. Classified according to religion, Hindus numbered 209,925 ; Mahommedans, 124,455 ; hill tribes, 116,112 ; Christians, 1632, of whom 61 were Europeans ; ” others,” 180. In 1901 the population was 462,083, showing an increase of 2 per cent. The land revenue was Es.1,25,383, the incidence of assessment being one pie per acre on the permanently settled portion, and E.1-6 on the rest ; the number of police was 256 ; the number of boys at school in 1896-97 was 5896, being 16-6 per cent, of the male population of school-going age ; the registered death-rate in 1897 was 49-65 per thousand. Tea cultivation does not flourish anywhere in the district. In 1897 there were

three gardens, with 410 acres under tea, yielding 140,-798 lb. Dhubki (population, 6000), the administrative headquarters of the district, stands on the Brahmaputra where that river takes its great bend south. It is the termination of the emigration road from North Bengal and also of the river steamers that connect with the North Bengal railway. In 1897, 66,962 coolie immigrants passed through.

Gobi or Shamo, the name which was formerly given to the whole of the steppes (dry prairies) and the stony or sandy deserts in Central Asia, extending in the form of a large crescent from the Pamirs in the south-west to the eastern corner of Transbaikalia, or Lake Dalai, in the north-east. ‘ In the north-west they are bounded by the highlands of the Eastern Tian-Shan and North-western Mongolia and by the Kentei escarpment, while along their south-eastern border the Kuen-lun, the Altyn-tagh, and the Nian-shan mountains separate them from the still higher and still more dreary plateaus of Northern Tibet, the Nian-shan joining by means of a succession

of not yet explored plateaus and mountains the great Khingan border-ridge which separates the Gobi from Manchuria. Taken in this sense, the Gobi may be regarded as the lower terrace of the high plateau of East Asia. The western portions, however, of this immense region, which are watered by the Tarim, and belong geographically to the basin of Lob Nor (nor meafiing lake), and politically to East Turkestan, may be conveniently considered as a separate region, which is known in Central Asia as the Taklamakan desert, and by geographers as the Tarim basin. The Gobi would thus be that part of the lower terrace which lies to the east of the 92nd degree of E. longitude (Greenwich), and would naturally be divided into two parts, the Western Gobi and the Eastern Gobi. (See Mongolia.)

Coch, a town of Prussia, in the Ehine province, 8 mUes by rail south of Cleves. It manufactures brushes, plush goods, and cigars, and has oil-mills. In the Middle Ages it was the seat of a large trade in linen. Population (1900), 9101.

Codalming, a municipal borough and market-town in the Guildford parliamentary division of Surrey, England, on the Wey, 4 miles S.S.W. of Guildford by rail. Amongst its more recent buildings are a Masonic hall, the Victoria Hall, a home for epileptic women, and the technical institute and school of science and art. A drainage system costing £50,000 has beeif completed. Charterhouse School, originally founded in 1611, was transferred from London to GodaJming in 1872. It stands within grounds 92 acres in extent, about half a mile north of Godalming, and consists of spacious buildings in Gothic style, with a chapel, library, and hall, besides boarding-houses, masters' houses, and sanatoria. The school has 34 masters and about 570 pupils. Area of municipal borough, 708 acres. Population (1901), 8748.

Codard, Benjamin Louis Paul (1849-1895), French composer, was born in Paris, 18th August 1849. He studied at the Conservatoire, and competed for the Prix de Eome without success in 1866 and 1867. He

began by publishing a number of songs, many of which are charming, such as ” Je ne veux pas d’autres choses,” ” Ninon,” ” Chanson de Florian,” also a quantity of piano pieces, some chamber music, including several violin sonatas, a trio for piano and strings, a quartet for strings, a violin concerto, and a second work of the same kind entitled ” Concerto Romantique.” Godard’s chance arrived in the year 1878, when with his dramatic cantata, Le Tasse, he shared with M. Theodore Dubois the honour of winning the musical competition instituted by the city of Paris. From that time until his death Godard composed a surprisingly large number of works, including four operas, Pedro de Zalamea, produced at Antwerp in 1884 ; Jocelyn, given in Paris at the Theatre du Chateau d’Eau, in 1888 ; Dante, played at the Op6ra Comique two years later ; and La Vivandi&re, left unfinished and partly scored by another hand. This last work was heard at the Opera Comique in 1895, and has been played in England by the Carl Rosa Opera Company. His other works include the ” Symphonic L^gendaire,” ” Sym-

phonic Gothique," " Diane," and various orchestral works. Godard's ' productivity was enormous, and his compositions are, for this reason only, decidedly unequal. He was at his best in works of smaller dimensions, and has left many exquisite songs. Among his more ambitious works the " Symphonie Legendaire " may be singled out as being one of the most distinctive. He had a decided individuality, and his premature death at Cannes on 10th January 1895 was a loss to French art. (a. He.)

Codavari, a district of British India, in the north-east of the Madras Presidency, with an area of 7857 square miles. The population in 1891 was 2,078,782, being 264 persons per square mile for the hill-tracts alone, 42 per square mile, but rising to 407, for the rest of the district ; in 1901 the population was 2,303,-495, showing an increase of 11 per cent. The land revenue and rates (1898) were Rs.68,48,232, the incidence of assessment per acre being Es.3-11-4 in 'ryotwari and E.0-13-3 in zamindan lands ; the number of police

was 1416. In 1897-98, out of a total cultivated area of 1,028,646 acres, 616,564 were irrigated from Government canals. The country has always been able to provide a large surplus for export. The principal crops are rice, millet, other food grains, pulse, oil-seeds, tobacco, sugar, and cotton. The cigars known in England as lunkas axe partly made from tobacco grown on lankas or islands in the river Godavari. The administrative headquarters are now at Cocanada, the chief seaport; but Rajahmundry, at the head of the delta, is the old capital. A large and increasing trade is conducted at Cocanada and Coringa, rice being there shipped to the Maldives, Mauritius, and Ceylon. At both these places riee-cleaning mills have been established. In 1897-98 the total sea^-borne trade of the district was valued at Rs.2,07,82,027, of which just half was with foreign countries. The district is traversed by the main line of the East Coast railway, with a branch to Cocanada ; the iron girder bridge of forty-two spans over the Godavari

river near Kajakmundry was opened in 1900. There is a Government college at Eajahmundry, with a training college attached, and an aided college at Cocanada. In 1896-97 there were altogether 1538 schools, attended by 50,945 pupils. There are thirteen printing-presses, issuing three English and three vernacular periodicals, and several libraries, reading-rooms, and literary institutes. The registered death-rate in 1897 was 22-8 per thousand.

Codesberg, a village of Prussia, in the Ehine province, Germany, on the left bank of the Ehine, 4 miles by rail south from Bonn. It is a favourite summer resort, with numerous villas belonging to the manufacturers and merchants of Cologne, Elberfeld, Crefeld, and other towns. There are three churches, including the Ecgnan Catholic, built in the Gothic style in 1862, a famous hydropathic (1869), chalybeate springs (1864-65), a fine park (1892), and on a basalt peak (246 feet above the town) the ruins of Godesberg castle, built by the

Archbishop of Cologne in the 13th and 14th centuries, and destroyed by the Elector of Bavaria in 1583. Population (1900), 8927.

Codhra, a town of British India, administrative headquarters of the Panch Mahals district of Bombay, and also of the Eewa Kantha political agency ; situated in 22° 46′ IST. lat. and 73° 40′ E. long., 52 miles north-east of Baroda. Population, 14,000. It is on the line from Anand to Eutlam, and has a Telang high school, .and a printing-press issuing a vernacular newspaper.

Coding, the chief town of a government district in Southern Moravia, on the right bank of the river March, at this point forming the frontier between Austria and Hungary, and becoming navigable. The old imperial castle is the centre of the Moravian family estates of the Austrian reigning house. The manufactures comprise tobaccs, white-lead, starch, and cloth. Population, half Czech (1890), 8482 ; (1900), 10,231.

Codkin, Edwin Lawrence (1831-1902), American author, was born of English parents in Moyne,

County Wicklow, Ireland, 2nd October 1831, and graduated at Queen's College, Belfast, in 1851. In the Crimean war, from 1854 to 1856, he was correspondent of the London Daily News. In 1856 he made the United States his home, and was admitted to the bar in 1859, but continued his journalistic work. In 1865 — partly because of a scheme on the part of several friends of the lately freed Africans to establish a newspaper to promote the interests of the coloured population — he was enabled to carry out a cherished plan to edit an American political and critical weekly somewhat on the lines of the Lon(ion Spectator; and the Nation was started in New York, with Mr Godkin as its leading spirit. In 1881, with Carl Schurz and Horace White, he acquired control of the New York Evening Post (daily), and the Nation was thence-forward made up of matter appearing in the Post. He retired on account of ill-health in 1899. His principal work was done in advocacy of political independence, free trade, and civil service reform, which he defended with a satirical pen. From his articles in the Nation

and other periodicals he gathered several volumes, of which the chief are Reflections and Comments 1865-95, and Unforeseen Tendencies of Democracy (1898). He died at Brixham, England, on 21st May 1902.

Codollo, a market town of Hungary, 23 miles distant from Budapest, in the county of Pest-Pilis-Solt-Kis-Kun, with 5886 inhabitants in 1900. The king's summer castle, which formerly belonged to the Princes Grassalkovich, was, along with the beautiful domain, presented by the Hungarian nation to King Francis Joseph I. after the coronation in 1867. In its park there are a great number of stags and wild boars. GodoUo is a favourite summer resort of the inhabitants of Budapest. In its vicinity is the famous place of pilgrimage M^riarBesnyo, with a fine Franciscan cloister, wherein lived Fessler, the Hungarian historiographer.

Colccha (Gdk-chai; Armenian, Sevanga; ancient Gohkaruni), the largest lake of Transcaucasia, government Erivan, Eussia, 40° 9′ to 40° 38′ N. and 45° 1′ to 45° 40′ E. Its altitude is 6340 feet ; it is of triangular

shape, and measures from north-west to south-east 45 miles, its greatest width being 27 miles and its maximum depth 57 fathoms. Two peninsulas divide it into two parts, united by a strait 5 miles wide. It lies on a high plateau, surrounded by 12,000 feet of high, barren mountains of volcanic origin, and receives twenty-eight mountain rivers, which mostly dry up in summer. Its outflow is the Zanga, left bank tributary of the Araks {Araxes); it never freezes, and its level undergoes periodical oscillations. It contains four species of SalmonidcB, and two of the Cyprinidce, which are only met with in the drainage area of this lake.

Col car, a township in the Colne Valley parliamentary division of the West Eiding of Yorkshire, England, 3 miles W.S.W. of Huddersfield by rail. It stands on the Colne Valley canal. The chief industry is the manufacture of fancy woollen goods. Area of urban district, 1593 acres. Population (1881), 7653; (1901), 9260.

Cold. — The nature and history of this metal were

fully dealt with in the ninth edition of the Ency. Brit., and the quantities produced in various countries for years ranging from 1875 to 1879 were also given. For many years afterwards the annual production continued to decrease, the average production of the five years 1881-85 being the smallest since the Australian and Californian mines began to be worked in 1848-49. It was not until after 1886 that the annual output of the world began to expand. Of the total production in 1876 almost the whole was derived from the United States, Australasia, and Eussia. Since then the proportion furnished by these countries has been greatly lowered by the appearance of South Africa, Canada, India, and China among the gold-producers. The increase of production has not been uniform, the greater part having occurred most notably since 1895. Among the regions not previously important as gold-producers which now contribute to the annual output, the most remarkable are the goldfields of South Africa (Transvaal), which were discovered in 1885. India likewise has been

added to the list, its active production having begun at about the same time as that of South Africa. The average annual product of India for the period 1886 to 1899 inclusive was £698,208, and its present annual product averages from 450,000 to 500,000 ounces, or about £1,900,000, obtained almost wholly from the free-milling quartz veins of the Colar goldfields in Mysore, Southern India. Canada, too, has assumed an important rank, having contributed in 1900 £5,583,300. This great increase was due to the development of the goldfields of the North-Western Territory, especially British Columbia. From the district of Yukon (Klondike, &c.) £2,800,000 were obtained in 1899, wholly from alluvial workings, but the progress made since has been slower than was expected by sanguine people. It is, however, probable that the North-Western Territory will continue to yield gold in important quantities for

some time to come, though it is impossible to make any

estimate of the future annual output.

The output of the United States increased from 1,678,612 ounces in 1881 to 3,829,897 ounces in 1900. The provisional estimate of the director of the United States Mint for 1901 was for a value of £16,043,800, against £15,864,000 in 1900. This increase was chiefly-due to the exploitation of new goldfields. The fall in the price of silver stimulated the discovery and development of gold deposits, and many States formerly regarded as characteristically silver districts have become important as gold producers. Colorado is a case in point, its output having increased during the period under review from about £600,000 to £6,065,000 in 1900. Somewhat more than one-half of the Colorado gold is obtained from the Cripple Creek district. Other States also showed a largely augmented product. On the other hand, the output of California, which was producing over £3,000,000 per annum in 1876, has fallen off, the average annual output from 1876 to 1900 being £2,800,000. This decrease was largely caused

by the practical suspension for many years of the hydraulic mining operations, in preparation for which millions of dollars had been expended in deep tunnels, flumes, &c., and the active continuance of which might have been expected to yield some £2,000,000 of gold annually. This interruption, due to the practical prohibition of the industry by the United States courts, on the ground that it was injuring, through the deposit of tailings, agricultural lands and navigable streams, was lessened, though not entirely removed, by compromises and regulations which permit, under certain restrictions, the renewed exploitation of the ancient river-beds by the hydraulic method. On the other hand, the progressive reduction of mining and metallurgical costs effected by improved transportation and machinery, and the use of high explosives, compressed air, electric-power transmission, &c., resulted in California (as elsewhere) in a notable revival of deep mining. This was especially the case on the “Mother Lode,” where highly promising results were obtained. Not only is vein-material, for-

merly regarded as unremunerative, now extracted at a profit, but in many instances increased gold-values have been encountered below zones of relative barrenness, and operators have been encouraged to make costly preparations for really deep mining — more than 3000 feet below the surface. The gold product of California, therefore, may be fairly expected to maintain itself, and, indeed, to show an advance. Alaska first appeared in the list of gold-producing countries in 1880, and gradually increased its annual output until the year 1900, when it yielded 375,922 ounces. The Alaska gold is derived at present almost wholly from the large low-grade quartz mines of Douglas Island. But in 1899 another important district was discovered at Cape Nome, on the northwestern coast. The result of a few months' working during that year was more than £500,000 of gold, and a very much larger annual output may reasonably be anticipated in the future. The gold occurs in alluvial deposits designated as gulch-, bar-, beach-, tundrar, and bench-placers. The Tundra is a coastal plain, swampy,

and covered with undergrowth and underlaid by gravel. The most interesting and, thus far, the most productive are the beach deposits, similar to those on the coast of Northern California. These occur in a strip of compara^ tively fine gravel and sand, 150 yards wide, extending along the shore. The gold is found in stratified layers, with ” ruby ” and black sand. The ‘ ‘ ruby ” sand consists chiefly of fine garnets and magnetites, with a few rose-quartz grains. As yet the relative importance of the other placers has not been determined. Further exploration of the interior will probably result in the discovery of additional gold districts. Mexico, from a gold production of £200,000 in 1891, advanced to about £1,881,800 in 1900. Of this increase, a considerable part was derived from gold-quartz mining, though much was also obtained as a by-product in the working of the ores of other metals. The product of Colombia, Venezuela, the Guianas, Brazil, Uruguay, Argentina, Chile, Bolivia, .Peru, and Ecuador amounted in 1900 to £2,481,300, of which Colombia and the Guianas supplied more than one-

half.

In 1876 Australasia produced £7,364,120, of which Victoria contributed £3,984,349. The annual output of Victoria declined until the year 1892, when it began to increase rapidly, but not to its former level, the value for 1900 having been £3,142,400. There has been an important increase in Queensland, which from £1,696,304 in 1876 advanced to £3,248,000 in 1899. There has been no increase and, indeed, no large fluctuation until quite recently in the output of New Zealand, which averaged £1,054,000 per annum from 1876 to 1898, but the production ‘ of the two years 1899 and 1900 rose to £1,472,600 and £1,394,520 respectively. By far the most important addition to the Australasian product has come from West Australia, which began its production in 1887 — about the time of the inception of mining at Wit water srand (“the Eand”) in South Africa — and by continuous increase, which assumed large proportions towards the close of the 19th century, was 1,643,873 ounces, or £6,426,000, in

1899 and 1,580,949 ounces, or £6,179,000, in 1900. For 1901 the yield was returned at 1,869,459 ounces, subject to revision.

Undoubtedly the greatest of the gold discoveries made in the latter half of the 19th century was that of the Witwatersrand district in the Transvaal. By reason of its unusual geological character and great economic importance this district deserves a more extended description. The gold occurs in conglomerate beds, locally known as ” banket.” There are several series of parallel beds, interstratified with quartzite and schist, the most important being the ” main reef ” series. The gold in this conglomerate reef is partly of detrital origin and partly of the genetic character of ordinary vein-gold. The formation is noted for its regularity as regards both the thickness and the gold-tenor of the ore-bearing reefs, in which respect it is unparalleled in the geology of the auriferous formations. The gold carries, on an average, £2 per ton, and is worked by ordinary methods of gold-mining, stamp-milling, and cyaniding. In 1899, 5762 stamps were in

operation, crushing 7,331,446 tons of ore, and yielding £15,134,000, equivalent to 25-5 per cent, of the world's production. Of this, 80 per cent, came from within 12 miles of Johannesburg. After September 1899 operations were suspended, almost entirely owing to the war, but on 2nd May 1901 they recommenced, and some progress had been made by January 1902 towards placing the industry in its former position. The total for the eight months ended 31st December 1901 was 238,991 ounces. So certain is the ore-bearing formation that engineers in estimating its auriferous contents feel justified in assuming, as a factor in their calculations, a vertical extension limited only by the lowest depths at which mining is feasible. On such a basis they arrived at more than £600,000,000 as the available gold contained in the Witwatersrand conglomerates. At the rate of exploitation in 1899 this amount would be extracted in about thirty years, but this period will, it is assumed, be diminished by increase in the magnitude of the exploitar tions. Deposits similar to the Witwatersrand banket

occur in Zululand, and also on the Gold Coast of

Africa ; but these localities have been worked to a small extent only. Considerable mining developments are being made in Khodesia, the country lying north of the Transvaal, where gold occurs in well-defined quartz-veins, and there is unquestionable evidence of extensive ancient workings. The economic importance of the region generally has not been fully proved, mining by modern methods being still in its infancy there. Rhodesia produced 91,940 ounces in 1900 and 172,061 ounces in 1901, in spite of the South African war.

The gold production of Eussia during the period under review was remarkably constant, averaging £4,899,262 per annum ; the gold is derived chiefly from placer workings in Siberia. Gold discoveries have been made in Eastern and Southern Siberia, from which an important output may be expected. The completion of the trans-

Siberian railway will stimulate mining.

The gold production of China was estimated for

1899 at £1,328,238 and for 1900 at £860,000, showing

approximately the average annual production from 1883

to 1900 inclusive. Considerable increase will doubtless

attend the development of the empire.

Table of the Quantities of Gold produced in the Undermentioned Countries in the Years named (in ounces').

Tear.

AustralaBia.

Africa.

Canada.

India.

Mexico.

Russia.

United States.

Other

Countries.

Total.

1881

1,475,161

52,483

41M^

1,181,853

1,678,612

547,326

4,976,980

1882

1,438,067

52,000

45,289

1,154,613

1,572,187

563,638

4,825,794

1883

1,333,849

• t •

46,150

. .’.

46,229

1,132,219

1,451,250

849,805

4,859,502

1884

1,352,761

46,000

57,227

1,055,642

1,489,950

901,309

4,902,889

188S

1,309,804

53,987

46,941

1,225,738

1,538,325

827,789

5,002,584

1886

1,257,670 ■

66,061

29,702.

922,226

1,693,125

1,075,579

5,044,363

1887

1,290,202

1 28^754

59,884

15,403

39,861

971,656

1,596,375

1,059,355

5,061,490

1888

1,344,002

1240,266

53,150

35,034

47,117

1,030,151

1,604,841

821,062

5,175,623

1889

1,540,60-7

1366,023

62,658

78,649

33,862

1,154,076

1,587,000

788,370

5,611,245

1890

1,453,172

497,817

55,625

107,273

37,104

1,134,590

1,588,880

855,505

5,726,966

1891

1,518,690

729^68

45,022

131,776

48,375

1,168,764

1,604,840

1,040,856

6,287,591

1892

1,638,238

1,210,869

43,905

164,141

54,625

1,199,809

1,597,098

1,193,487

7,102,172

1893

1,711,892

1,478,477.

44,853

2207,152

63,144

1,345,224

1,739,323

1,182,520

7,772,585

1894

2,020,180

2,024,164

50,411

210,412

217,688

1,167,455 ■

1,910,813

1,212,725

8,813,848

1895

2,170,505

2,277,640

92,440

257,830

290,250

1,397,767

2,254,760

1,073,313

9,814,505

1896

2,185,872

2,280,892

136,274

328,501

314,437

1,041,794

2,568,132

1,099,959

9,950,861

1897

2,690,278

3,034,679

294,582

390,595

362,812

1,124,511

2,774,935

1,027,506

11,699,898

1898

3,235,638

4,295,609

669,445

418,944

411,187

1,231,791

3,118,398

1,026,250

14,407,262

1899

4,105,526

4,195,961

1,031,563

456,020

450,000

1,072,333

3,437,210

1,001,736

15,750,349

1900

3,764,548

562,307

1,258,000

513,266

8420,000

8 1,100,000

3,837,215

8 1,046,734

4 12,502,070

1 The Chamber of Mines of the late South African Republic iu its report for the year ended 30th December 1899 gives a table from

which it appears that the total output of 1887, 1888, and 1889 was 642,804 ounces, of which 42,000 ounces represent ” estimated unre-

corded production ” for those years. The figures given above show a total of 635,043 ounces, and it is unnecessary to alter them.

2 Incomplete. 8 Estimated. ^ Partly estimated.

Metallurgy. — During the period 1875-1900 no radical

changes were made in the amalgamation of gold ores,

nor was there any great improvement in crushing

the ores. By increased weight of stamps, and by the

use of ” self-feeders,” the capacity of the batteries

has been considerably enlarged. Where conditions are

specially favourable, other classes of pulverizing machines are sometimes used. The cyanide process is the only radically new departure in gold metallurgy proper. It is mainly used in the treatment of battery-tailings, and has been found of advantage. It consists essentially in (1) the solution of the gold in cyanide of potassium ; (2) the precipitation of the dissolved gold by means of ziac (M'Arthur Forrest process), or by electricity (Siemens and Halske, and other modifications); and (3) the fusion and casting into ingots of the precipitated gold. Gold ores, other than tailings, are occasionally cyanided in the raw state, or after the preliminary roasting. The process is applicable also to the recovery of gold from certain classes of auriferous pyrites. To render the process economically successful the gold must be in a fine state of division, and the ores must not carry too great a percentage of deleterious substances, the presence of which necessitates an excessive consumption of cyanide and of zinc. Preliminary roasting may extend the application of the process to the treatment of base

ores. Cyaniding has in many cases superseded the chlorination, process, though in America the latter is still often preferred where a preliminary roasting is required. About 33 per cent, of the gold produced in the Witwatersrand district is extracted by the cyanide process, to which the gold ores of that district are exceptionally adapted. When conducted on a large scale the entire metallurgical treatment of the Witwatersrand ores, i.e., the crushing and amalgamation of the ore and the cyaniding of the tailings and slimes, costs about six shillings per ton, the cost of cyaniding being ■ about two to four shillings per ton. From 90 to 95 per cent, of the assay value of the ore is recovered by these combined processes in the Witwatersrand district.

In the extraction of gold from concentrates by the chlorination process the use of sulphur dioxide or hydrogen sulphide as precipitants is more general now than formerly, these reagents being deemed preferable to ferrous sulphate when time is of importance. Barrel chlorination has to some extent taken the place of

chlorination in vats. The chemical reactions are the same in both, but in the barrel process the agitation of the pulp by revolution, and the generation of chlorine by chemical action throughout the mass, facilitates and hastens the solution of the gold. The most noteworthy improvement in refining is the Wohlevill electrolytic process, which has been successfully employed in the two principal gold refineries of Germany. It is chiefly valuable in cases where the gold is alloyed with a small amount of platinum.

Though revolutionary inventions or improvements in the direct metallurgy of gold have been few, the cost of producing gold has been greatly reduced by causes which have affected other mining and metallurgical industries as well. Among these ai-e to be mentioned the immense increase in the transmission and use of mechanical power, including devices for the handling of large quantities of material with a minimum of manual labour ; the use of

high explosives in mining ; and especially the immense extension of metallurgical enterprises, based on the reduction of lead or copper ores, in which both gold and silver are obtained practically as by-products. It often happens, for instance, in the United States that the miner of a gold-bearing ore desirable to smelters by reason of its other ingredients can realize 90 to 95 per cent, of its gold value without payment of any smelting charges for that metal. These commercial conditions often act as a competitive limit upon such processes as stamp-milling, amalgamation, chlorination, and cyaniding, the whole cost of which must be assessed upon the gold produced.

In working auriferous river-beds, dredges have been used with considerable success in certain parts of New Zealand and on the Pacific slope in America. The field for such operations is, of course, limited. The dredges used in California are almost exclusively of the endless-chain bucket or steam-shovel pattern. Some dredges have a capacity, under favourable conditions, of 2000 cubic yards of gravel daily, which they handle at a cost

of from five to ten cents per cubic yard.

Industrial Consumption. — It is estimated by the director of the United States Mint (Report upon the Production of the Precious Metals in the United States during the calerir dar Tear 1899, p. 50) that the world's industrial consumption of gold for the year 1898 amounted to about £16,000,000, of which about £10,750,000, or about 71 per cent., was taken by the United States, Germany, France, and Great Britain. (j. h. h.*)

Cold Coast. — The name " Gold Coast" denotes geographically that portion of the Guinea coast which extends from Asinie upon the west to the river Volta on the east, but it is now generally restricted to the political colony and protectorate of the Gold Coast, belonging to Great Britain. This extends from about 3 degrees west longitude to about 1-14 degrees east longitude, the length of the coast-line being about 350 miles. It is bounded on the west by the French colony of the Ivory Coast, and on the east by German Togoland. On the north the nominal boundary, as against the nominal boundary of the French

Sudan, extends to the 11th degree of north latitude, but at the present time the actual extent of the colony and protectorate is very much more circumscribed. Inland the breadth of the protectorate, excluding Ashanti and the Northern Territories, varies considerably, but its breadth appears nowhere greatly to exceed 200 miles, and the average breadth is, for the most part, not much more than 50 miles. The total area, including all the hinterland allotted by European conventions, has been estimated at 74,500 square miles ; excluding Ashanti and the Northern Territories, it is about 40,000 square miles, with a population of about li million. The Northern Territories, up to November 1899, were separated from Togoland by a Neutral Zone. The territory thus described was then, however, apportioned between Great Britain and Germany. The river Daka was fixed as the boundary as far north as 9° N. lat., whence it was arranged that the frontier should be so delimited that Gambaga and the territories of Mamprusi fell to the Gold Coast, and Tendi and the territories of Chakosi to Togoland.

The Gold Coast proper possesses no harbours, and bars of sand block the mouths of the rivers. Of the towns, Axim is the port of the gold-mines of Wassau and the outlet of a large timber trade; Elmina has a population of over 11,000, Cape Coast Castle about 12,000, and Accra, the capital, about 20,000. Saltpond, between Cape Coast Castle and Accra, is worthy of notice as the principal centre of the palm oil industry.

For many years the Gold Coast played an important part in the struggle of the various nations for colonial supremacy. Portugal here took the lead, founding San Gorge la Mina (Elmina) in 1470.

The English appeared upon the scene in the middle of the 16th century, and were soon followed by the French. More dangerous rivals arose in the shape of the Dutch, who from the end of the 16th century sought to oust the Portuguese from the Gold Coast, and in whose favour the Portuguese did finally withdraw in 1642, in return for the withdrawal on the part of the Dutch of clairas to Brazil. Inasmuch as the Dutch did not interfere with the country outside their immediate posts, British and other European traders were able to establish settlements along the coast. The troubles Asbantl.

with the powerful native kings of Ashanti, in which the British colony became involved when its importance as a slave-trading centre came to an end, and which latterly were largely due to the acquisition by the British of the territory held by other European Powers, finally culminated (as was shown in the ninth edition under Ashanti) in the capture of Kumasi in 1874, an event which involved consequences unwished for by the home Government. It was followed by the defection of outlying provinces, some of which became absorbed in the British protectorate. Hostile chiefs were pursued by the Ashanti king into British territory, and a state of unrest was generally prevalent. Eemedial measures proved impossible against the obstinacy of KingPrempeh, and it became apparent that a state of things had been brought about which necessitated annexation (see below). Ashanti became British in 1896, and in 1899 the governor was able to report that, “taking it as a whole, the country seemed contented and prosperous, a pauper being unknown.” An organized rebellion in the following year, which at one time seemed likely to involve very grave consequences, showed that there were still serious troubles to be surmounted before the Ashantis settled down under British rule.

The Gold Coast is a Crown colony, with a governor, executive councU, and legislative council. The executive council consists of five members; the legislative of the same, with the addition of the chief justice and three nominated unof&cial members. The supreme court consists of a chief justice and three puisne judges. There are district commissioners, and in the protectorate native chiefs have a limited jurisdiction. There are also travelling commissioners for native affairs, a British resident for Ashanti, and a commissioner for the Northern Territories, as the territories behind the Gold Coast and north of Ashanti are now designated.

The Gold Coast constabulary includes both a military and civil police, the former being mainly recruited from the Hausas.

The following are the figures of the revenue and expenditure during 1896-1900 :—

Tear.

Eevenue.

Expenditure.

1896

1897

1898

1899

1900

£237,460

233,179

268,822

422,796

383,283

£282,277

401,692

377,976

309,656

272,203

The large deficits in 1897 and 1898 were mainly due to punitive expeditions, £147,587 of the expenditure in 1897 being entirely on account of the Ashanti campaign. The revenue is mainly raised by customs duties. There is stUl no standing public debt, but the colony is responsible

for advances to the amount of £435,448, in great part for

the Sekundi-Tarkwa railway.

The trade of the Gold Coast has latterly greatly increased, a& the

following table shows : —

Tear.

Imports.

Exports.

1896

1897

1898

1899

1900

£778,009

784,188

960,336

1,152,478

1,294,963

£792,111

857,793

992,998

1,111,738

885,445

Rubber represents over 50 per cent, in value of the total exports, and palm oil and kernels nearly 20 per cent. Next in importance to these comes gold dust. Cotton goods are the principal import. Of the potential wealth of the country there can be no question. ” Rich in gold, in valuable timber, in soil which will produce almost any commodity of trade value,” the great difficulty in the way of

its development is the difficulty of access to the interior. The colony west of Accra is in the forest belt of Africa, and the rivers, though numerous, abound in rocks and rapids. Although hitherto the output of gold has not been very great, it is believed that with the opening of a railway the gold industry is capable of great developments. The export of gold was valued at £86,186 in 1896, but at only £38,007 in 1900. There are said to be twenty miles of banket reef gold in Wassau, Ashauti, and Kwahu, very similar to that in the Transvaal. A railway, from Sekundi, on the coast, to the mining district of Tarkwa, has been constructed, and railway

surveys have also been made in various directions. Rubber, which at present remains the staple product, is shipped from Cape Coast Castle, Accra, and Quitta. A large amount of rubber comes from Ashanti, and it is estimated that the output could be easily trebled were the transport rendered cheaper. Palm oil and palm kernels come mainly from the districts behind Saltpond, and from the districts of Aquassim and Crobol. Valuable timbers abound in the hinterland. There is a good road from Cape Coast Castle to Prahsu, and from Accra to Aburi, and a road has been constructed for about fifty miles in the Northern Territories. There are about 700 miles of telegraph open. But whatever the improvement in the means of transport, the unhealthiness of the climate must always be a retarding influence upon the development of the Gold Coast. There are at present only about 200 European inhabitants, and the number will probably not greatly increase.

The rainfall averages at Accra 30 inches in the year, but at other places the fall is much greater. There are two wet seasons, April to July, and October and November. Prom December to March the dry Harmattan wind blows.

Under the agency of the Basel, Wesleyan, and Eoman Catholic

missionary societies elementary education is spreading. There are Government schools at Accra, Cape Coast Castle, and Insuaim, and the total number of schools, assisted and not assisted, was, in 1898, 208. Very little has yet been done in the way of secondary education.

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Ashanti Expeditions, 1895-1900.

The treaty arranged between the British authorities and the Ashantis after the expedition of 1873-74 (see Ency. Brit., 9th ed., ii. 682) had remained practically a dead letter. The road from Kumasi to Cape Coast Castle had not been kept open to trade. The indemnity had only been paid in part. Human sacrifices con-

tinued. Under King Prempeh the Ashanti power became more and more a disturbing influence in the hinterland of the Gold Coast colony, and an obstacle to trade and civilization. It was impossible to permit the reign of murder within a short distance of the OU89S-96 British frontier, and demands made for the complete fulfilment of the terms of the treaty produced no result. The king declined to treat with the governor of the Gold Coast, and despatched informal agents to England, w^hom the Secretary of State refused to receive. To put an end to the misgovernment and barbarities carried on at Kumasi, and to establish law, order, and security for trade, an expedition was at length decided upon. The force, placed under Colonel Sir Francis Scott, consisted of the 2nd West Yorkshire Eegiment, a ” special service corps,” made up of detachments from various regiments in the United Kingdom, under specially selected officers ; the 2nd West India Eegiment, and the Gold Coast and Lagos Hausas. The composition of the special service corps was much criticized at the

time ; but as it was not called upon for fighting purposes, no inferences as to its efficiency are possible. The details of the expedition were carefully organized. Before the arrival of the staff and contingent from England the native forces were employed in improving the road from Cape Coast Castle to Prahsu (70 miles), and in establishing road stations to serve as standing camps for the troops. About 12,000 carriers were collected, the load allotted to each being 60 lb. In addition, a force of native scouts, which ultimately reached a total of 860 men, was organized in eighteen companies and partly armed with Snider rifles to cover the advance of the main column and to improve the road. The king of Bekwai having asked for British protection, a small force was pressed forward and occupied this native town, about 25 miles from Kumasi, on 4th January 1896. The advance continued, and at Ordahsu a mission arrived from King Prempeh offering unconditional submission. On 17th January Kumasi was occupied, and Colonel Sir P. Scott received the king. Effective measures were

taken to prevent his escape, and on the 20th Prempeh made submission to Mr Maxwell, the governor of Cape Coast, in native fashion. The king, with the queen mother and the principal chiefs, was then arrested and taken as a prisoner to Cape Coast Castle, where they were embarked on board H.M.S. Racoon for Elmina. The fetish buildings at Bantama were burned, and on 22nd January Bokro, a village 5 miles from Kumasi, and Maheer, the king's summer palace, were visited by the native scouts and found deserted. On the same day, leaving the Hausas at Kumasi, the expedition began the return march of 150 miles to Cape Coast Castle. The complete success of the expedition was due to the excellent organization of the supply and transport services, while the promptitude with which the operations were carried out probably accounts in great measure for the absence of resistance. Although no fighting occurred, a heavy strain was thrown upon all ranks, and fever claimed many victims, among whom was Prince Henry of Battenberg, who had volunteered for the post of military secre-

tary to Colonel Sir P. Scott. (g. s. c.)

In 1900, after four years of peace, a serious rebellion broke out in Ashanti. The tribes involved were the Kumasis, Adansis, and Kokofus ; the other tribes of the Ashanti confederation remained gf^^’”” loyal. The rebels were, however, able to command a force reported to number 40,000. On 28th March the governor of the Gold Coast, Sir P. Hodgson, in a public palaver at Kumasi, announced that the Ashanti chiefs would have to pay the British Government 4000 ounces of gold yearly, and he reproached the chiefs with not having brought to him the Golden Stool — the emblem of sovereignty among the Ashantis — which the Kumasis had kept hidden since 1896. Three days afterwards the Kumasi warriors attacked a party of Hausas sent with the chief object of discovering the Golden Stool. (In the previous January a secret attempt to seize the Stool had failed.) The Kumasis, who were longing to wipe out the dishonour of having let Prempeh be deported without fighting, next threatened the fort of Kumasi. Mr Eam-

seyer and the other Basel missionaries, and Sir P. and Lady Hodgson, took refuge in the fort, and reinforcements were urgently asked for. On 18th April 100 Gold Coast constabulary arrived. On the 29th the Kumasis attacked in force, but were repulsed. The same day a party of 250 Lagos constabulary reached Kumasi. They had fought their way up, and came in with little ammunition. On 15th May Major Morris arrived from the British territory north of Ashanti, also with 250 men. The garrison now numbered 700. The 29 Europeans in the fort included four women. Outside the fort were gathered 3000 native refugees. Pamine and disease soon began to tell their tale. Sir P. Hodgson sent out a message on 4th June (it reached the relieving force on 12th June), saying that they could only hold out to 11th June. However, it was not till 23rd June that the governor and all the Europeans save three, together with

600 Hausas of all ranks, sallied out of the fort. Avoid-

ing the main road, held by the enemy in force, they attacked a weakly held stockade, and succeeded in cutting their way through, with a loss of two British ofl&cers mortally wounded, 39 Hausas killed, and double that number wounded or missing. The governor's party reached Cape Coast Castle safely on 10th July.

A force of 100 Hausas, with three white men (Captain Bishop, Mr Ralph, and Dr Hay), was left behind in Kumasi fort with rations to last three weeks. Meantime a relief expedition had been organized at the Gold Coast by Lieut.-Colonel Willcocks. This oflftcer reached Cape Coast Castle from Nigeria on 26th May. The difficulties before him were appalling. Carriers could scarcely be obtained, there were no local food supplies, the rainy season was at its height, all the roads were deep mire, the bush was almost impenetrable, and the enemy were both brave and cunning, fighting behind concealed stockades. It was not until the 2nd of July that Colonel Willcocks was able to advance to Fumsu. On the next day he heard of the escape of the governor and of the straits of the garrison

left at Kumasi. He determined to relieve the fort in time, and on the 9th of July reached Bekwai, the king of which place had remained loyal. Making his final dispositions, the colonel spread a report that on the 13th he would attack Kokofu, east of Bekwai, and this drew off several thousands of the enemy from Kumasi. After feinting to attack Kokofu, Colonel Willcocks suddenly marched west. There was smart fighting on the 14th, and at 4.30 p.m. on the 15th, after a march since daybreak through roads ” in indescribably bad condition,” the main rebel stockade was encountered. It was carried at the point of the bayonet by the Yoruba troops, who proved themselves fully equal to the Hausas. ” The charge could not have been beaten in Man by any soldiers.” Kumasi was entered the same evening, a bugler of the war-worn garrison of the fort sounding ” the general salute ” as the relieving column came in view. Most of the defenders were too weak to stand. Outside the fort nothing was to be seen but burnt-down houses and putrid bodies. The relieving force that marched into Kumasi consisted

of 1000 fighting men (all West Africans), with 60 white men, two 75-millimetre g^ns, four seven-pounder guns, and six Maxims.

Kumasi relieved, there remained the task of crushing the rebellion. Colonel Willcocks's force was increased by Yaos from Central Africa and by sikhs to a total of 3368 natives, with 134 British oflBcers, and 35 British non-commissioned officers. In addition there were Ashanti levies. On the 30th of September the Kumasis were completely beaten at Obassa. Thereafter many of the rebel chiefs surrendered, and the only two remaining in the field were captured on 28th December. Thus 1901 opened with peace restored. The total number of casualties during the campaign (including those who died of disease) was 1007. Mne British officers were killed in action, 43 were wounded, and six died of disease. The commander, Lieut.-Colonel Willcocks, was promoted colonel, created a K.C.M.Gr., was mentioned in the King's speech 'at the opening of Parliament in 1901, and received the freedom of the City of London, with a sword of honour.

Sir F. Hodgson was appointed Governor of Barbados, and Major Nathan took his place on the Gold Coast. By an Order in Council, dated 26th September 1901, Ashanti was formally annexed to the British dominions.

(f. e. c.)

Coldie, Sir George Dashwood Taubman

(1846), British colonial administrator, was born on 20th May 1846 at the Nunnery in the Isle of Man, being the youngest son of Lieut.~~Colonel John Taub~~ man Goldie-Taubman, Speaker of the House of Keys, by his second wife Caroline, daughter of John E. Hoveden of Hemingford, Cambridgeshire. Sir George resumed his paternal name, Goldie, by royal licence in 1887. He was educated at the Eoyal Military Academy, Woolwich, and for a few months held a commission in the Royal Engineers. He travelled in all parts of Africa, gaining an extensive knowledge of the continent, and first visited the country of the Niger in 1877. He was impressed by the advantage to be gained by uniting all British interests in that region, and in 1879 succeeded in promoting the

United African Company. In 1881 a charter was sought from Government, the capital of the company was raised from £125,000 to £1,000,000, and it was renamed the National African Company. The French traders who established stations on the Lower Niger rendered it difficult to obtain any territorial rights in the country, but in 1884 they were bought out, prior to the meeting of the Berlin Conference, where Taubman was present as an expert on matters relating to the Niger. Through Joseph Thompson, the explorer of MasaUand, treaties were made with over three hundred native chiefs, and in July 1886 a charter was at length granted, the National African Company becoming the Royal Niger Company, with Lord Aberdare as governor and Taubman as vice-governor. In 1887 Goldie was created K.C.M.G., and in 1897 he took part in the successful expedition of the company against the Mahommedan states of Nupe and Ilorin. In the following year the differences with France in regard to the frontier line became acute, and compelled the intervention of the British Government. It was

evidently impossible for a commercial association to hold its own against the State-supported protectorates of France and Germany, and in consequence, on 1st January 1900, the Royal Niger Company transferred its territories to the British Government for the sum of £865,000. The ceded territory was styled the protectorate of Northern Nigeria, and placed under the governorship of Colonel Lugard. Goldie was created a privy councillor in 1898. He is honorary D.C.L. of Oxford University (1897) and honorary LL.D. of Cambridge (1897). He married in 1870 Matilda Catherine (died 1898), daughter of John William Elliott of Wakefield.

Coldingen (Lettish, Kuldigd), a district town of Russia, government of Courland, 40 miles S.E. of Windau, on Windau river. It has woollen mills, needle and match factories, as well as a gymnasium for boys of the Courland nobility, and a college for teachers. Population (1897), 9733.

Coldmark, Karl (1832), Hungarian com-
poser, was born at Keszthely-am-Plattensee, in Hungary,

on 18th May 1832. His father, a poor cantor in the local Jewish synagogue, was unable to assist to any extent financially in the development of his son's talents. Yet in the household much music was made, and on a cheap violin and home-made flute, constructed by Goldmark himself from reeds cut from the river-bank, the future composer gave rein to his musical ideas. This was helped on by the village schoolmaster, by whose aid he was able to enter the music-school of the Oedenburger Verein. Here he remained but a short time, his success at a school concert finally determining his parents to allow him to devote himself entirely to music. In 1844, then, he went to Vienna, where Jansa took up his cause and eventually obtained for him admission to the conservatorium. For two years Goldmark worked under Jansa at the violin, and on the outbreak of the revolution, after studying all the orchestral instruments he obtained an engagement in

the orchestra at Eaab. There, on the capitulation of

Eaab, he was to have been shot for a spy, and was only sared at the eleventh hour by the happy arrival of a former colleague. In 1850 Goldmark left Eaab for Vienna, where from his friend Mittrich he obtained his first real knowledge of the classics. There, too, he devoted himself to composition, and in the course of a short time produced a veritable mountain of music. In 1857, while suffering severely from the prevalent Mendelssohn fever, Goldmark, who was then engaged in the Karl-theatre band, gave a concert of his own works with such success that his first quartet attracted very general attention. Then followed the ” Sakuntala ” and ” Penthesilea ” overtures, in which Goldmark showed how Wagner’s influence had cured his aforesaid fever, and the delightful “Landliche Hochzeit” symphony, which carried his fame abroad. His reputation was now made, and very largely increased by the production at Vienna in 1875 of his first and best opera, Die Konigin von Saba. Over this opera Goldmark spent seven years. Its popularity is still almost as great as ever. It was followed in November 1886, also at Vienna,

by Merlin, much of which has been rewritten since then. A third opera, a version of Dickens's Cricket on the Hearth, was given by the Eoyal Carl Eosa Company in London in 1900. Goldmark's chamber music has not made much lasting impression in England, but the overtures " ImPriihling," " Prometheus Bound," and " Sapho " were given fairly constantly some years ago. In the realms of absolute music Goldmark is often dull. A "programme " seems essential to him. In opera he is most certainly at his best, and as an orchestral colourist he ranks among the very highest.

Coldsboro, capital of Wayne county, North Carolina, U.S.A., on the Neuse river, at an altitude of 110 feet. It is on the Atlanta and North Carolina, the Atlantic Coast, and the Southern railways. Population (1880), 3286; (1890), 4017; (1900), 5877, of whom 76 were foreign-born and 2520 negroes.

Coldschmidt, Madame. See Lind, Jenny.

Coif. — In 1880 the man who travelled about England with a set of golf clubs was an object of some aston-

ishment, almost of alarm, to his fellow-travellers. In those days the commonest of questions in regard to the game was, ” You have to be a fine rider, do you not, to play golf ? ” so confounded was it in the popular mind with the game of polo. At Blackheath a few Scotsmen resident in London had long played golf. In 1864 the Eoyal North Devon Club was formed at Westward Ho, and this was the first of the seaside links dis-covered and laid out for golf in England. In 1869 the Eoyal Liverpool Club established itself in possession of the second English course of this quality at Hoylake, in Cheshire. A golf club was formed in connexion with the London Scottish Volunteers corps, which had its house on the Putney end of Wimbledon Common on Putney Heath ; and, after making so much of a start, the progress of the game was slow, though Progress steady, for many years. A few more clubs ‘game. Were formed ; the number of golfers grew ; but it could not be said that the game was yet in any sense popular in England. All at once, for

no very obvious reason, the qualities of the ancient Scottish game seemed to strike home, and from that moment its popularity has been wonderfully and increasingly great. The English links that have most risen in favour during recent years is the fine course of the St George's Golf Club, near Sandwich, on the coast of Kent. It is a course that has two chief merits — the primary one of excellence for golf, and the secondary one of accessibility. To the London golfer it was the first course of the first class that was reasonably accessible, and the fact made something like an epoch in English golf. A very considerable increase, it is true, in the number of English golfers and English golf clubs had taken place before the discovery for golfing purposes of the links at Sandwich. Already there was a chain of links all round the coast, besides numerous inland courses ; but since 1890 their increase has been extraordinary, so that there are now not much fewer than 1000 golf clubs in Great Britain and Ireland. To compute the average membership of these clubs is very difficult. There is not a little overlapping, in the

sense that a member of one club will often be a member of several others ; but probably the average may be placed at something like 200 members for each club. The immense amount of golf-playing that this denotes, the large industry in the making of clubs and balls, in the upkeep of links, in the actual work of club-carrying by the caddies, and in the instruction given by the professional class, is obvious. Golf has taken a strong hold on the affections of the people in all parts of Ireland, and the fashion for golf in England has reacted strongly on Scotland itself, the ancient home of the game, where since 1880 golfers have probably increased in the ratio of twenty to one. Besides the industry that such a growth of the game denotes in the branches immediately connected with it, as mentioned above, there is to be taken into further account the visiting population that it brings to all lodging-houses and hotels within reach of a tolerable golf links, so that many a fishing village has risen into a moderate watering-place by virtue of no other attractions than those which are offered by its golf course. Therefore

to the Briton golf has developed from something of which he had a vague idea — as of ” curling ” — to something in the nature of an important business, a business that can make towns and has a considerable effect on the receipts of railway companies.

Moreover, ladies have learned to play golf. This is not stating the fact too widely nor too forcibly, for though it is true that before 1885 many played on the short links of St Andrews, North Berwick, Westward Ho, and elsewhere, still it was virtually unknown that they should play on the longer courses, which till then had been in the undisputed possession of the men. At many places women now have their separate links, at others they play on the same course as the men. But even where links are set apart for women, they are far different from the little courses that used to be assigned to them. They are links only a little less formidable in their bunkers, a little less varied in their features, than those of men. The ladies have their annual Championship, which they play on the long links of the men,

sometimes on one, sometimes on another, but always on courses of the first quality, demanding the finest display of golfing skill.

The claim that England has made to a golfing fellowship with Scotland has been conceded very strikingly by the admission of two English greens, those of Hoylake and of Sandwich, into the exclusive list of the links on which the Open Championship of the game is decided. Before England had so fully assimilated Scotland's game this great annual contest was waged at St Andrews, Musselburgh, and Prestwick in successive years. Now the ancient green of Musselburgh, somewhat worn out with length of hard and gallant service, and, moreover, as a nine-holes course inadequately accommodating the numbers who compete in the Championships to-day, has been superseded by the course at Muirfield as a championship arena, and the greens of Sandwich and Hoylake, as just now stated, have been included in the list, which thus contains at present five greens in place of the old

three. The Amateur Championship also has been played on these two greens of England, as well as on the three that are honoured in Scotland as championship courses ; but since this championship of the amateurs is of more modern institution than the Open Championship, and indeed owed its institution chiefly to the initiative of the English club at Hoylake, there is not in this circumstance the same marked proof that Scotland concedes to England share in the general golfing councils.

While golf had been making itself a force in the South-ern kingdom, the professional element — ^men who had learned the game from childhood, had become past-masters, were capable of giving instruction, and also of making clubs and balls and looking after the greens on which golf was played — had at first been taken from the north-ern side of the Border. But when golf had been started long enough in England for the little boys who were at first employed as ” caddies ” — in carrying the players’ clubs — to grow to sufficient strength to drive the ball as

far as their masters, it was inevitable that out of the number who thus began to play in their boyhood some few should develop an exceptional talent for the game. This, in fact, actually happened, and English golfers, both of the amateur and the professional classes, have proved themselves so adept at Scotland's game, that the championships in either the Open or the Amateur competitions have been won more often by English than by Scottish players of late years. Probably in the United Kingdom to-day there are as many English as Scottish professional golf players, and their relative number is increasing.

Golf has also " caught on," to use the American expression, in the United States. To the American of 1890 golf was largely an unknown thing. Since then, however, golf has become a very much greater factor in the life of the upper and upper-middle classes in the United States than it ever has been in England or Scotland. Golf to the English and the Scots meant only one among several of the sports and pastimes that take the man and the

woman of the upper and upper-middle classes into the country and the fresh air. To the American of like status golf came as the one thing to take him out of his towns and give him a reason for exercise in the country. Before golf came to amuse them there were only a very few of the rather Anglicized Americans who in the Eastern States found any active amusements at all out of doors. To-day golf has become an absorbing interest in the Eastern States of America, and indeed all over the Northern Continent, but it is in the Eastern States that it has made most difference in the life of the classes with whom it has become fashionable. The others, the Westerners and Southerners, found more excuses before the coming of golf for being in the open country air. It is in the Eastern States more especially that it has had so much influence in making the people live and exercise out of doors. In a truly democratic spirit the American woman golfer plays on a perfect equality with the American man. She does not compete in the men's championships ; she has championships of her own ; but she plays,

without question, on the same links. There is no sug-

gestion of relegating her, as a certain cynical writer in

the Badminton volume on golf described it, to a waste

s 6 r

Ttpes of Golf Clubs.

10

1, Driver; 2, Brassy ; 3, Cleek ; 4, Driving MasMe ; 5, Iron ; 6, Mashie ; 7, Niblick ; 8, Wooden Putter ; 9, Putter ; 10, Bafflng Spoon.

comer, a kind of ” Jews’ Quarter,” of the links. And the

Americans have taken up golf in the spirit of a sumptuous

and opulent people, spending money on magnificent club-

houses beyond the finest dreams of the Englishman or

the Scot.

So much enthusiasm and so much golf in America

have not failed to make their influence felt in the United

Kingdom. Naturally and inevitably they have created a

strong demand for professional instruction, both by ex-

ample and by precept, and for professional advice and

assistance in the laying-out and upkeep of the many new

links that have been created in all parts of the States,

sometimes out of the least promising material. By the

offer of great prizes for exhibition matches, and of wages that are to the British rate on the scale of the dollar to the shilling, they have attracted many of the best Scottish and English professionals to pay them longer or shorter visits as the case may be, and thus a new opening has been created for the energies of the professional golfing class.

There have been some slight changes of detail and arrangement in the rules of the game. A new class of golfer has arisen, requiring a code of rules Cftaii|es framed rather more exactly than the older and play. code. The Scottish golfer, who was “teethed” on a golf club, as Mr Andrew Lang has de-scribed it, imbibed all the traditions of the game with his natural sustenance. Very few rules sufficed for him. But when the Englishman, and still more the American (less in touch with the traditions), began to play golf as a new game, then they began to ask for a code of rules that should be lucid and illuminating on every point — an ideal perhaps impossible to realize. It was found,

at least, that the code put forward by the Royal and Ancient Club of St Andrews did not realize it adequately. Nevertheless the new golfers were very loyal indeed to the club that had ever of old held, by tacit consent, the position of fount of golfing legislation. The Eoyal and Ancient Club was appealed to by English golfers to step into the place, analogous to that of the Marylebone Cricket Club in cricket, that they were both willing and anxious to give it. It was a place that the club at St Andrews did not in the least wish to occupy, but the honour was thrust so insistently upon it, that there was no declining.

The latest effort to meet the demands for some more satisfactory legislation on the thousand and one points that continually must arise for decision in course of playing a game of such variety as golf, consists of the appointment of a standing committee, called the ” Eules of Golf Committee.” Its members all belong to the Royal and Ancient Club ; but since this club draws its membership from all parts of the United Kingdom, this restriction is quite consistent with a very general repre-

sentation of the views of north, south, east, and west —

from Westward Ho and Sandwich to Dornoch, and all the many first-rate links of Ireland — on the committee. Ireland has, indeed, some of the best links in the kingdom, and yields to neither Scotland nor England in enthusiasm for the game. This committee, after a general revision of the rules into the form in which they now stand, considers every month, either by meeting or by correspondence, the questions that are sent up to it by clubs or by individuals ; and the committee's answers to these questions have the force of law until they have come before the next general meeting of the Eoyal and Ancient Club at St Andrews, which may confirm or may reject them at will. The ladies of Great Britain manage otherwise. They have a Golfing Union which settles questions for them; but since this union itself accepts as binding the answers given by the Eules of Golf Committee, they really arrive at the same conclusions by a

slightly different path. Kor does the American Union, governing the play of men and women alike in the States, really act differently. The Americans, naturally, reserve to themselves freedom to make their own rules, but in practice they conform to the legislation of Scotland, with the exception of a more drastic definition of the status of the amateur player, which seems to be required by the circumstances of the game in the States.

A slight modification has been effected in the implements of the game. The tendency of the modern wooden clubs is to be short in the head as compared with the clubs of, say, 1880 or 1885. The advantage claimed (probably with justice) for this shape is that it masses the weight behind the point on which the ball is struck (see Fig.). Better material, both in the wood of the clubs and in the guttapercha of which the balls are made, is a consequence of the increased demand for these articles and the increased competition among their makers. Whereas, under the old conditions, a few workers at the few greens then in existence were enough to supply the golfing

wants, now there is a very large industry in golf club and ball making, which not only employs workers in the local club-makers' shops all the kingdom over, but is an important branch of the commerce of the stores and of the big athletic outfitters.

With all this growth of interest in golf, it is only natural that more and more attention should have been directed to efforts at discovering its origin, but so far all in vain. One of the most ancient and most interesting of the pictures in which the game is portrayed is the tail-piece to an illuminated Book of Hours, made at Bruges at the beginning of the 16th century. The original is in the British Museum. The players, three in number, have but one club apiece. The heads of the clubs are steel or steel covered. They play with a ball each. That which gives this picture a peculiar interest over the many pictures of Dutch schools that portray the game in progress is that most of them show it on the ice, the putting being at a stake. In this Booh of Hours they are putting at a hole in the turf, as in our modern golf. It

is scarcely to be doubted that the game is of Dutch origin,
and that it has been in favour since very early days.
Farther than that our knowledge does not go. The early
Dutchmen played golf, they painted golf, but they did
not write it.
With our own devotees of golf the case has been very different,
and the literature of the game has grown to some considerable
bulk. Por many years it was practically comprised
Literature in the fine work by Mr Clark, Oolf: A Moyal and
of the Ancient Game, together with two handbooks on the
game. game by Mr Chambers and by Mr Forgan respectively,
and the Qolflana Miscellanea of Mr Stewart. A small
book by the present writer, named Hints on Golf, was very shortly
followed by a much more important work by the late Sir Walter
Simpson, Bart., called The Art of Golf, a title which sufaciently
explains itself. The Badminton Library book on Golf attempted
to collect into one volume the most interesting historical facts
known about the game, with obiter dicta and advice to learners,
and, on similar didactic lines, books have been written by Mr H.
C. S. Everard, Mr Garden Smith, and W. Park, the professional

player. Mr H. J. Whigham, sometime amateur champion golfer of the United States, has given us a book about the game in that country. The Book of Golf and Golfers, compiled, with assistance, by the present writer, is in the first place a picture-gallery of famous golfers in their respective attitudes of play. Much interesting lore is contained in the Golfing Annual, which has now been published yearly for several years, and in the pages of Golf, which has now become Golf Illustrated, a weekly paper devoted to the game. Among works that have primarily a local interest, but yet contain much of historical value about the game, may be cited the Golf Book of East Lothian, by the Rev. John Kerr, and the Chronicle ofBlackheath Golfers, by Mr W. E. Hughes.

By way of amplifying the rather dry definitions given in the rules, it may be said, for the benefit of the unlearned, that the game of golf consists in hitting the ball over a great „^. . , extent of country ,” preferably of that sand-hill nature -j” which is found by the sea-side, and finally hitting or “putting ” it into a little hole of some four inches diameter cut in the turf. The place of the hole is commonly marked by a flag. Eighteen is the recognized number of these holes on a full course,

and they are at varying distances apart, from one hundred yards up to anything between a quarter and half a mile. For the various strokes required to achieve the hitting of the ball over the great hills, and finally putting it into the small hole, a number of different “clubs” has been devised to suit the different positions in which the ball may be found and the different directions in which it is wished to propel it (see Fig.). At the start for each hole the ball maybe placed on a favourable position {e.g., “teed” on a small mound of sand) for striking it, but after that it may not be touched, except with the club, until it is hit into the next hole. A “full drive,” as the farthest distance that the ball can be hit is called, is about two hundred yards in length, of which some three-quarters will be traversed in the air, and the rest by bounding or running over the ground. It is easily to be understood that when the ball is lying on the turf behind a tall sand-hill, or in a bunker, a differently shaped club is required for raising it over such an obstacle from that which is needed when it is placed on the tee to start with ; and again, that another club is needed to strike the ball out of a cup or out of heavy grass. It is this variety that gives the game its charm. Each player plays with his own ball, wi3i no

interference from his opponent, and the object of each is to hit the ball from the starting-point into each successive hole in the fewest strokes. Theplayerwho at the end of the round (i.e., of the course of eighteen holes) has won the majority of the holes is the winner of the round ; or the decision may be reached before the end of the round by one side gaining more holes than there remain to play. For instance, if one player be four holes to the good, and only three holes remain to be played, it is evident that the former must be the winner, for even if the latter win every remaining hole, he still must be one to the bad at the finish.

The Amateur Championship is decided by a tournament in matches thus played, each defeated player retiring, and his opponent passing on into the next round. In the case of the Open Championship, and in most medal competitions, the scores are differently reckoned— each man's total score (irrespective of his relative merit at each hole) being reckoned at the finish against the total score of the other players in the compe- ^^'"P'o"' tition. There is also a species of competition called "' " bogey" play, in which each man plays against a " bogey " score ^a score fixed for each hole in the round before starting — and his

position in the competition relatively to the other players is determined by the number of holes that he is to the good or to the bad of the “bogey” score at the end of the round. The player who is most holes to the good, or fewest holes to the bad, wins the competition. It may be mentioned incidentally that golf occupies the almost unique position of being the only sport in which even a single player can enjoy his game, his opponent in this event being “Colonel Bogey” — more often than not a redoubtable adversary.

The links which have been thought worthy, by reason of their geographical positions and their merits, of being the scenes on which the golf championships are fought out, are, as we have already said, three in Scotland— St Andrews, Prestwick, and IMuir-field— and two in England— Hoy lake and Sandwich. This brief list is very far from being complete as regards links of first-class quality in Great Britain. Besides the five named, there are in Scotland— Carnoustie, North Berwick, Cruden Bay, Nairn, Aber-deen, Dornoch, Troon, Machrihanish, South Uist, Islay, Gullane, Luffness, and many more. In England there are— Westward Ho, Bembridge, Littlestone, Deal, Great Yarmouth, Brancaster, Seaton

Carew, Formby, Lytham, Harlech, Burnham, among the seaside ones ; while of the inland, some of them of very fine quality, we cannot even attempt a selection, so large is their number and so variously estimated their comparative merits. Ireland has Portrush, Newcastle, Portsalon, DoUymount, and many more of the first class ; and there are excellent courses in the Isle of Man. In America many fine courses have been constructed. There is not a British colony of any standing that is without its golf course — Australia, India, South Africa, all have their golf championships, which are keenly contested. Canada has had courses at Quebec and Montreal for many years, and the Calcutta Golf Club, curiously enough, is the oldest established (next to the Blackheath Club), the next oldest being the club at Pau in the Basses-Pyr6n6es.

The Open Championship of golf was started In 1860 by the Prestwiok Club giving a belt to be played for annually under the condition that it should become the property of any who could win it thrice in succession.

The following is the list of the champions : —

1860. W. Park, Musselburgh . . . 174— at Prestwick.

1861. Tom Morris, sen. , Prestwick . 163— at Prestwick.

1862. Tom Morris, sen., Prestwick . 163 — at Prestwick.

1863. W. Park, Musselburgh . . . 168— at Prestwick.

1864. Tom Morris, sen., Prestwick . 160 — at Prestwick.

1865. A. Strath, St Andrews . . . 162— at Prestwiok.

1866. W. Park, Musselburgh . . . 169— at Prestwick.

1867. Tom Morris, sen. , St Andrews . 170 — at Prestwick.

1868. Tom Morris, jun., St Andrews . 154 — at Prestwick.

1869. Tom Morris, jun., St Andrews . 157 — at Prestwick.

1870. Tom Morris, jun., St Andrews . 149 — at Prestwick.

Tom Morris, junior, thus won the belt finally, according to the conditions. In 1871 there was no competition ; but by 1872 the three cluijs of St Andrews, Prestwick, and Musselburgh had subscribed for a cup which should be played for over the course of each subscribing club successively, but should never become the property of the winner. In later years the course at Muirfield was substituted for that at Musselburgh, and Hoylake and Sandwich were admitted into the list of championship courses. Up to 1891, inclusive, the play of two rounds, or thirty-six holes, determined

the championship, but from 1892 onwards the result has been determined by the play of seventy-two holes.

After the interregnum of 1871, the following were the champions : —

1872. Tom Morris, jun., St Andrews . 166 — at Prestwick.

1873. Tom Kidd, St Andrews . . 179— at St Andrews.

1874. Mungo Park, Musselburgh . . 159 — at Musselburgh.

1875. Willie Park, Musselburgh . . 166 — at Prestwick.

1876. Bob Martin, St Andrews . . 176— at St Andrews.

1877. Jamie Anderson, St Andrews . 160 — at Musselburgh.

1878. Jamie Anderson, St Andrews . 157 — at Prestwick.

1879. Jamie Anderson, St Andrews . 170 — at St Andrews.

1880. Bob Pergusson, Musselburgh . 162 — at Musselburgh.

1881. Bob Pergusson, Musselburgh . 170 — at Prestwick.

1882. Bob Pergusson, Musselburgh 171 — at St Andrews.

1883. W. Pemie, Dumfries . . . 159 — at Musselburgh.

1884. Jack Simpson, Carnoustie . . 160 — at Prestwick.

1885. Bob Martin, St Andrews . . 171 — at St Andrews.

1886. D. Brown, Musselburgh . . 157 — at Musselburgh.

1887. Willie Park, jun., Musselburgh . 161 — at Prestwick.

1888. Jack Burns, Warwick . . 171 — at St Andrews.

1889. Willie Park, jun., Musselburgh . 155 — at Musselburgh.

1890. Mr John Ball, jun., Hoylake . 164— at Prestwick.

1891. Hugh Kirkaldy, St Andrews . 166— at St Andrews.

1892. Mr H. H. Hilton, Hoylake . . 305— at Muirfield.

1893. W. Auchterlonie, St Andrews . 322— at Prestwick.

1894. J. H. Taylor, Winchester . . 326— at Sandwich.

1895. J. H. Taylor, Winchester . . 322— at St Andrews.

1896. H. Vardon, Scarborough . . 316— at Muirfield.

1897. Mr H. H. Hilton, Hoylake . . 314— at Hoylake.

1898. H. Vardon, Scarborough . . 307 — at Prestwick.

1899. H. Vardon, Scarborough . . 310 — at Sandvrich.

1900. J. H. Taylor, Richmond . . 309— at St Andrews.

1901. J. Braid, Bomford . . . 309— at Muirfield.

The Amateur Championship is of far more recent institution,

winners have been : —

Its

1886. Mr Horace Hutchinson

1887. Mr Horace Hutchinson

1888. Mr John Ball

1889. Mr J. E. Laidlay .

1890. Mr John Ball

1891. Mr J. E. Laidlay .

1892. Mr John Ball

1893. Mr P. Anderson .

1894. Mr John Ball

at St Andrews,

at Hoylake.

at Prestwick.

at St Andrews,

at Hoylake.

at St Andrews,

at Sandwich,

at Prestwick.

at Hoylake.

1895.

1896.

1897.

1898.

1899.

1900.

1001.

Mr L. Balfour-Melville

Mr P. G. Tait

Mr J. T. Allan .

Mr John Ball

Mr F. G. Tait

Mr H. H. Hilton .

Mr H. H. Hilton .

at St Andrews,

at Sandwich,

at Muirfield.

at Prestwick.

at Hoylake.

at Sandwich,

at St Andrews.

Glossary of Technical Terms used in the Game.

Addressing the Ball. — Putting oneself in position to strike the ball.

All Square. — Term used to express that the score stands level,

neither side being a hole up.

Baff. — To strike the ground with the club when playing, and so loft the ball unduly.

Baffy.—A. short wooden club, with laid-back face, for lofting shots.

Bogey. — The number of strokes which a good average player should take to each hole. This imaginary player is usually known as ” Colonel Bogey,” and plays a fkie game.

Brassy. — A wooden club with a brass sole (see Pig.).

Bulger. — A drver in which the face “bulges” into a convex shape. The head is shorter than in the older-fashioned driver.

Bunker. — A sand-pit.

Caddie. — The person who carries the club (from French cadet).

Cleek. — The iron-headed club that is capable of the farthest drive of any of the clubs with iron heads (see Fig.).

Dead. — A ball is said to be ” dead ” when so near the hole that the putting it in in the next stroke is a, “dead” certainty. A ball is said to ” fall dead ” when it pitches with hardly any run.

Divot. — A piece of turf cut out in the act of playing, which, be it noted, should always be replaced before the player moves on.

Dormy. — One side is said to be “dormy” when it is as many

holes to the good as remain to be played — so that it cannot be beaten.

Driver. — The longest driving club, used when the ball lies very well and a long shot is needed (see Fig.).

Foozle. — Any very badly missed or bungled stroke.

^^Fore!” — A cry of warning to people in front.

Foursome. — A match in which four persons engage, two on each side playing alternately with the same ball.

Green. — (a) The links as a whole ; (6) the ” putting-greens ” around the holes.

Grip. — (o) The part of the club-shaft which is held in the hands while playing ; (6) the grasp itself — e.g., “a firm grip,” ” a loose grip,” are common expressions.

Half-Shot. — ^A shot played with something less than a full swing.

Halved. — A hole is ” halved” when both sides have played it in the same number of strokes. A round is ” halved ” when each side has won and lost the same number of holes.

Hanging. — Said of a ball that lies on a slope inclining down-wards in regard to the direction in which it is wished to drive.

Hazard. — A general term for bimker, whin, long grass, roads, and all kinds of bad ground.

Heel. — ^To hit the ball with a pulling movement, so as to send it too much to the left : in a sense, the opposite of slice.

Honour. — ^The privilege (which its holder is not at liberty to decline) of striking ofi first from the tee.

Iron. — An iron-headed club intermediate between the cleek and lofting mashie. There are driving irons and lofting irons according to the purposes for which they are intended (see Fig.).

Lie. — (o) The angle of the club-head with the shaft {e.g., a ” flat lie,” ” an upright lie “) ; (6) the position of the ball on the ground {e.g., “a good lie,” “a bad lie”).

Like-as-we-Lie. — Said when both sides have played the same number of strokes.

Line. — The direction in which the hole towards which the player is progressing lies with reference to the present position of his ball.

Mashie. — An iron club with a short head (see Fig.). The lofting mashie has the blade much laid back, for playing a short lofting shot. The driving mashie (see Fig.) has the blade less laid back, and is used for longer, less lofted shots.

Match-Flay. — Play in which the score is reckoned by holes won and lost.

Medal-Play. — Play In which the score is reckoned by the total of strokes taken on the round.

Niblick. — ^A short stiff club vrith a short, laid back, iron head, used for getting the ball out of a very bad lie (see Fig.).

Press. — To strive to hit harder than you can hit with accuracy.

Putt. — To play the short strokes near the hole.

Putter. — The club used for playing the short strokes near the hole. Some have a wooden head, some an iron head (see Fig.).

Sub-of-the-Green. — Any chance deflection that the ball receives as it goes along.

Bun Up. — To send the ball low and close to the ground in approaching the hole — opposite to lofting it up.

Scratch Player. — Player who receives no odds in handicap competitions.

Slice. — To hit the ball with a out across it, so that it flies curving

to the right.

Stance. — (a) The place on which the player has to stand when playing — e.g., ” a bad stance,” ” a good stance,” are common expressions ; (6) the position relative to each other of the player’s feet.

Stymie. — When one ball lies in a straight line between another and the hole the first is said to ” stymie,” or ” to be a stymie to ” the other — from an old Scottish word given by Jamiesou to mean “the faintest form of anything.” The idea probably was, the ” stymie ” only left you the ” faintest form ” of the hole to aim at.

Tee. — The little mound of sand on which the ball is generally placed for the first drive to each hole.

Teeing-Ground. — The place marked as the limit, outside of which it is not permitted to drive the ball off. This marked-out ground is also sometimes called “the tee.”

Top. — To hit the ball above the centre, so that it does not rise much from the ground.

Wrist-Shot. — A shot less in length than a half-shot, but longer than a putt.

Bules of Gtolf.

1. Definitions : — (a) The game of golf is played by sides, each playing its own ball. A side consists either of one or of two players. If one player play against another, the match is called “a single.” If two play against two, it is called “a foursome.” A single player may play against two, when the match is called ” a threesome,” or three players may play against each other, each playing his own ball, when the match is called ” a three-ball matcii.”

(6) The game consists in each side playing a ball from a teeing-ground into a hole by successive strokes, and the hole is won by the side which holes its ball in fewer strokes than the opposite side, except as otherwise provided for in the rules, if the sides hole out in the same number of strokes, the hole is halved.

(c) The teeing-ground shall be indicated by two marks placed in a line, as nearly as possible at right angles to the course.

(d) The term “putting-green” shall mean all ground within 20 yards of the hole, except hazards. The hole shall be 4J inches in diameter, and at least 4 inches deep.

(e) A “hazard” shall be any bunker, water (except casual water), sand, path, road, railway, whin, bush, rushes, rabbit

scrape, fence, or ditch. Sand blown on to the grass, or sprinkled on the course for its preservation, bare patches, snow, and ice are not hazards. Permanent grass within a hazard shall not be considered part of the hazard.

(/) The term ” through the green” shall mean all parts of the course except “hazards” and the putting-green which is being played to.

(a) The term ” out of bounds ” shall mean any place outside the denned or recognized boundaries of the course.

(ft) ” Casual water ” shall mean any temporary accumulation of water (whether caused by rainfall or otherwise) which is not one of the ordinary and recognized hazards of the course.

(s) A ball shall be “in play ” as soon as the player has made a stroke at the teeing-ground in each hole, and shall remain in play until holed out, except when lifted in accordance with the rules.

(j) A ball shall be considered to have “moved ” only if it leave its original position in the least degree, and stop in another ; but if it merely oscillate, without finally leaving its original position, it shall not be considered to have “moved.”

(k) A ball shall be considered “lost” if it be not found within

five minutes after the search for it is begun.

(I) A ” match” shall consist of one round of the links, unless it be otherwise agreed.

A match is won by the side which is leading by a number of holes greater than the number of holes remaining to be played. If each side win the same number of holes, the match is halved.

(m) A “stroke” shall be any movement of the ball caused by the player, except as provided for in Rule 4, or any downward movement of the club made with the intention of striking the ball.

(re) A ” penalty stroke ” is a stroke added to the score of a side under certain rules, and shall not affect the rotation of play.

(o) The privilege of playing first from a teeing-ground is called “the honour.”

(p) ” Addressing the ball ” shall mean that a player has taken up his position and grounded his club, or if in a hazard, that he has taken up his position preparatory to striking the ball.

(g) The reckoning of strokes is kept by the terms — ” the odd,” “two more,” “three more,” &c., and ” one off three,” ” one off two,” ” the like.” The reckoning of holes is kept by the terms — so many ” holes up,” or ” all even,” and so many ” to play.”

2. A match begins by each side playing a ball from the first teeing-ground.

The player who shall play first on each side shall be named by his own side.

The option of taking the honour at the first teeing-ground shall be decided, if necessary, by lot.

A ball played from in front of, or outside of, or more than two club lengths behind the two marks indicating the teeing-ground, or played by a player when his opponent should have had the honour, may be at once recalled by the opposite side, and may be re-teed.

The side which wins a hole shall have the honour at the next teeing-ground. If a hole has been halved the side which had the honour at the last teeing-ground shall again have the honour.

On beginning a new match the winner of the long match in the previous round shall have the honour, or if the previous match was halved the side which last won a hole shall have the honour.

3. A player shall not play while his ball is moving, under the penalty of the loss of the hole. But if the ball begin to move while the player is making his upward or downward swing, he shall incur no

penalty, except as provided for in Rules 10, 18, and 27, and a stroke lost under Rule 27 shall not in these circumstances be counted as a stroke of the player.

4. If the ball fall or be knocked ofi the tee in addressing it, no penalty shall be incurred, and it may be replaced, and if struck when moving no penalty shall be incurred.

5. In a threesome or foursome the partners shall strike ofi alternately from the teeing-grounds, and shall strike alternately during the play of the hole.

If a player play when his partner should have done so, his side shall lose the hole.

6. When the balls are in play, the ball farthest from the hole which the players are approaching shall be played first, except as otherwise provided for in the rules. If a player play when his opponent should have done so, the opponent may at once recall the stroke. A ball so recalled shall be dropped as near as possible to the place where it lay, without penalty.

7. The ball must be fairly struck at, not pushed, scraped, nor spooned, under penalty of the loss of the hole.

8. A ball must be played wherever it lies or the hole be given

up, except as otherwise provided for in the rules.

9. Unless with the opponent’s consent, a ball in play shall not be moved, nor touched before the hole is played out, under penalty of one stroke, except as otherwise provided for in the rules. But the player may touch his ball vrith his club in the act of addressing it, without penalty.

If the player’s ball move the opponent’s ball through the green, the opponent, if he choose, may drop a ball (without penalty) as near as possible to the place where it lay, but this must be done before another stroke is played.

10. Any loose impediment (not being in or touching a hazard) which is within a club length of the ball may be removed. If the player’s ball move after any such loose impediment has been touched by the player, his partner, or either of their caddies, the penalty shall be one stroke. If any loose impediment (not being on the putting-green) which is more than a club length from the ball be removed, the penalty shall be the loss of the hole.

11. Any vessel, wheel-barrow, tool, roller, grass-cutter, box, or similar obstruction may be removed. If a ball be moved in so doing, it may be replaced without penalty. A ball lying on or touching

such obstruction, or on clothes, nets, or ground under repair or covered up or opened for the purpose of the upkeep of the Unks, may be lifted and dropped without penalty, as near as possible to the place where it lay, but not nearer the hole. A ball lifted in a hazard, under such circumstances, shall be dropped in the hazard.

A ball lying in a golf hole or flag hole, or in a hole made by the green-keeper, may be lifted and dropped without penalty as near as possible to the place where it lay, but not nearer the hole.

12. Before striking at a ball in play, the player shall not move, bend, nor break anything fixed or growing near the ball, except in the act of placing his feet on the ground for the purpose of address-ing the ball, in soling his club to address the ball, and in his up-ward or downward swing, under penalty of the loss of the hole, except as otherwise provided for in the rules.

13. When a ball lies in or touches a hazard, nothing shall be done to improve its lie; the club shall not tonch the ground, nor shall anything be touched or moved before the player sti-ikes at the ball, subject to the following exceptions :— (1) The player may place his feet firmly on the ground for the purpose of ad-dressing the ball ; (2). in addressing the ball, or in tlie upward

or downward swing, any grass, bent, whin, or other gi-owing substance, or the side of a bunker, wall, paling, or other immovable obstacle may be touched ; (3) steps or planks placed in a hazard by the Green Committee for access to or egress from such hazard may be removed, and if a ball be moved in so doing, it may be replaced without penalty ; (4) any loose impediments may be removed from the putting-green ; (5) the player shall be entitled to find his ball as provided for by Rule

30. The penalty for a breach of this rule shall be the loss of the hole.

14. A player or oaddle shall not press down nor remove any irregularities of surface near a ball in play. Dung, worm-oasts, or mole-hills may be removed (but not pressed down) without penalty. The penalty for a breach of this rule shall be lie loss of the hole.

15. If a ball lie or be lost in water, the player may drop a ball, under penalty of one stroke. But if a ball lie or be lost (1) in casual water through the green, a ball may be dropped without

penalty ; (2) in water in a hazard, or in casual water in a hazard, a ball may be dropped behind the hazard, under penalty of one stroke ; (3) in casual water on a putting-green, a ball may be placed by hand behind the water, without penalty.

16. When a ball has to be dropped, the player himself shall drop it. He shall face the hole, stand erect behind the hazard or casual water, keep the spot from which the ball was lifted (or in the case of water or casual water, the spot at which it entered) in a line between himself and the hole, and drop the ball behind him from his head, standing as far behind the hazard or casual water as he may please. If it be impossible to drop the ball behind the hazard or casual water, it shall be dropped as near as possible to the place where it lay, but not nearer the hole. If the ball so dropped touch the player dropping it, there shall be no further penalty, and if the ball roll into a hazard, it may be re-dropped without further penalty.

17. When the balls lie within six inches of each other on a putting-green, or within a club length of each other through the green or in a hazard (the distance to be measured from their nearest points), the ball nearer the hole may, at the option of either the

player or the opponent, be lifted until the other is played, and shall then be replaced as near as possible to the place where it lay. If the ball farther from the hole be moved in so doing, or in measuring the distance, it shall be replaced without penalty. If the lie of the lifted ball be altered by the player in playing, the ball may be placed in a lie a^ nearly as possible similar to that from which it was lifted, but not nearer the hole.

18. Any loose impediments may be removed from the putting-green, irrespective of the position of the player’s ball. The opponent’s ball may not be moved escept as provided for by the immediately preceding rule. If the player’s ball move after any loose impediment lying within six inches of it has been touched by the player, his partner, or either of their caddies, the penalty shall be one stroke.

19. When the ball is on the putting-green the player or his caddie may remove (but not press down) sand, earth, dung, worm-casts, mole-hUls, snow, or ice lying round the hole or in the line of his putt. This shall be done by brushing lightly with the hand only across the putt and not along it. Dung may be removed by a club, but the club must not be laid with more than its own

weight upon the ground. The line of the putt must not be touched, except with the club immediately in front of the ball, in the act of addressing it, or as above authorized. The penalty for a breach of this rule is the loss of the hole.

20. When the ball is on the putting-green, no mark shall be placed, nor line dravm as a guide. The line of the putt may be pointed out by the player’s caddie, his partner, or his partner’s caddie, but the person doing so must not touch the ground.

The player’s caddie, his partner, or his partner’s caddie may stand at the hole, but no player nor caddie shall endeavour, by moving or otherwise, to influence the action of the wind upon the ball.

The penalty for a breach of this rule is the loss of the hole.

21. When on the putting-green, a player shall not play until the opponent’s ball is at rest, under penalty of one stroke.

22. Either side is entitled to have the flag-stick removed when approaching the hole. If the ball rest against the flag-stick when in the hole, the player shall be entitled to remove the stick, and, if the ball fall in, it shall be deemed as having been holed out at the last stroke. If the player’s ball knock in the opponent’s ball,

the latter shall be deemed as having been holed out at the last stroke. If the player's ball move the opponent's ball, the opponent, if he choose, may replace it, but this must be done before another stroke is played. If the player's ball stop on the spot formerly occupied by the opponent's ball, and the opponent declare his intention to replace, the' player shall first play another stroke, after which the opponent shall replace and play his ball. If the opponent's ball lie on the edge of the hole, the player, after holing out, may knock it away, claiming the hole if holing at the like, and the half if holing at the odd, provided that the player's ball does not strike the opponent's ball and set it in motion. If after the player's ball is in the hole the player neglect to knock away the opponent's ball, and it fall in also, the opponent shall be deemed to have holed out at his last stroke.

23. If a ball in motion be stopped or deflected by any agency outside the match, or by the forecaddie, the ball must be played from where it lies, and the occurrence submitted to as a "rub of the green." If a ball lodge in anything moving, a ball shall be dropped as near as possible to the place where the object was when the ball lodged in it, without penalty. If a ball at rest be

displaced by any agency outside the match, excepting vrind, the player shall drop a baE as near as possible to the place where it lay, without penalty. On the putting-green the ball shall be replaced by hand, without penalty.

24. If the player’s ball strike, or be moved by an opponent or an opponent’s caddie or clubs, the opponent shall lose the hole.

25. If the player’s ball strike, or be stopped by, himself or his partner, or either of their caddies or clubs, his side shall lose the hole.

26. If the player, when making a stroke, strike the ball twice, the penalty shall be one stroke.

27. If the player, when not intending to make a stroke, or his partner or either of their caddies, move his or their ball, or by touching anything cause it to move, when it is in play, the penalty shall be one stroke. If a ball in play move, after the player has grounded his club in the act of addressing it, or, when in a hazard, & he has taken up his stand to play it, he shall be deemed to have caused it to be moved, and shall lose a stroke, which shall be counted as a stroke of the player, except as provided in Kule 3.

28. If a player play the opponent’s baU, his side shall lose the

hole, unless (1) the opponent then play the player’s ball, whereby the penalty is cancelled, and the hole must be played out with the balls thus exchanged, or (2) the mistake occur through wrong information given by the opponent or his caddie, in which case there shall be no penalty, but the mistake, if discovered before the opponent has played, must be rectified by placing a ball as near as possible to the place where the opponent’s ball lay.

If it be discovered before either side has struck ofi from the next teeing-ground (or, after playing the last hole in the match, before any of the players have left the green) that one side has played out the hole with the ball of a party not engaged in the match, that side shall lose that hole.

29. If a baE be lost, except as otherwise provided for in the rules, the player’s side shall lose the hole ; but if both balls be lost, the hole shall be considered halved.

30. If a ball be lost in fog, bent, whins, long grass, or the like, only so much thereof shall be touched as will enable the player to find his ball. The penalty for a breach of this rule shall be the loss of the hole.

31. If a ball be driven out of bounds, a ball shall be dropped at

the spot from which the stroke was played, under penalty of loss of the distance.

32. In a three-ball niatch, if a player consider that an opponent's ball on the putting-green might interfere vrith his stroke, he may require the opponent either to lift or hole out his ball at the opponent's discretion.

If an opponent consider (1) that his own ball, if left, might be of assistance to the player, he is entitled to lift it, or hole out at his discretion ; or (2) that the ball of the other opponent might be of such assistance, he may require that it be either lifted or holed out at the other opponent's discretion.

83. A player shall not ask for advice from any one except his own caddie, his partner, or his partner's caddie, nor shall he willingly be otherwise advised in any way whatever, under penalty of the loss of the hole.

34. If a ball split into separate pieces, another ball may be put down where the largest portion lies, or if two pieces are apparently of equal size, it may be put where either piece lies, at the option of the player. If a ball crack or become unfit for play, the player may change it, on intimating to his opponent his intention to do so.

Mud adhering to a ball shall not be considered as making it unfit for play.

35. If a dispute arise on any point, the players have the right of determining the party or parties to whom it shall be referred, but should they not agree, either side may refer it to the Rules of Golf Committee, whose decision shall be final. If the point in dispute be not covered by the Rules of Golf, the arbiters must decide it by equity.

Special Bules for Stroke Competitions.

1. In stroke competitions, the competitor who holes the stipulated course in fewest strokes shall be the winner.

2. If the lowest scores be made by two or more competitors, the tie or ties shall be decided by another round to be played on the same day. But if the Green Committee determine that to be inexpedient or, impossible, they shall then appoint the following or some subsequent day whereon the tie or ties shall be decided.

3. New holes shall be made for stroke competitions, and thereafter no competitor, before starting, shall play any stroke on a putting-green, under penalty of disqualification.

4. The scores shall be kept by a special inarker, or by the com-

petitors noting each other’s scores.’ The scores marked shall be

checked after each hole. On completion of the round, the score of the competitor shall he signed by the marker, countersigned by the competitor, and handed to the secretary or his deputy, after which, unless it be found that a card returned shows a score below that actually played (in which case the competitor shall be disqualified), no correction or alteration can be made.

5. If a competitor play from outside the limits of the teeing-ground, the penalty shall be disqualification.

6. If a ball be lost (except as otherwise provided for in the Rules of Golf), the competitor shall return as near as possible to the spot from which the lost ball was struck, tee a ball, and lose a stroke. The lost ball shall continue in play, if it be found before the player has struck another ball.

7. If a competitor’s ball strike himself, his clubs or caddie, the penalty shall be one stroke.

8. If a competitor’s ball strike another competitor, or his clubs or caddie, it is a ” rub of the green,” and the ball shall be played

from where it lies. If a competitor's ball which is at rest be moved by another competitor or his caddie, or his club, or his ball, or by any outside agency excepting wind, it shall be replaced as near as possible to the place where it lay, without penalty.

9. A competitor shall hole out with his own ball at every hole, under penalty of disqualification. But if it be discovered before he has struck off from the next teeing-ground, or, if the mistake occur at the last hole, before he has handed his card to the secretary or his deputy, that he has not holed out with his own ball, he shall be at liberty to return and hole out with his own ball, without penalty.

10. A ball may be lifted out of a difficulty of any description, and teed, if possible, behind it, under penalty of two strokes. If it be impossible to tee the ball behind the difficulty, it shall be teed as near as possible to the place where it lay, but not nearer the hole.

11. All balls shall be holed out, under penalty of disqualification. When a competitor's ball is within 20 yards of the hole, the competitor shall not play until the flag has been removed, under penalty of one stroke. If the ball nearer the hole might either

interfere with the competitor's stroke, or in any way assist the competitor, such ball must be holed out or lifted, at the owner's option. Through the green a competitor may have any other competitor's ball lifted, if he find that it interferes with his stroke.

12. A competitor, unless specially authorized by the Green Committee, shall not play with a professional, and he may not willingly receive advice from any one but his caddie, in any way whatever, under penalty of disqualification.

A forecaddie may be employed.

13. Competitors shall not discontinue play on account of bad weather, under penalty of disqualification.

14. Where, in the Rules of Golf, the penalty for the breach of any rule is the loss of the hole, in stroke competitions the penalty shall be the loss of two strokes, except where otherwise provided for in these Special Rules.

15. Any dispute regarding the play shall be determined by the Rules of Golf Committee.

16. The Rules of Golf, so far as they are not at variance with these Special Rules, shall apply to stroke competitions.

Etiquette of Qolf.

1. A single player has no standing, and must always give way to a properly constituted match.

2. No player, caddie, or onlooker should move or talk during a stroke.

3. No player should play from the tee until the party in front have played their second strokes, and are out of range, nor play up to the putting-green till the party in front have holed out and moved away.

4. The player who has the honour should be allowed to play before his opponent tees his ball.

5. Players who have holed out should not try their putts over again when other players are following them.

6. Players looking for a lost ball must allow other matches coming up to pass them.

7. On request being made, a three-ball match must allow a single, threesome, or foursome to pass. Any match playing a whole round may claim the right to pass a match playing a shorter round.

8. If a match fail to keep its place on the green, and lose in distance more than one clear hole on those in front, it may be passed,

on request being made.

9. Turf cut or displaced by a stroke should be at once re-
placed.

10. A player should carefully fill up all holes made by himself
in a bunker.

11. It is the duty of an umpire or referee to take cognizance of
any breach of rule that he may observe, whether he be appealed to
on the point or not. (h. q. h.)

~~),Prus~~

Coltz, Kol mar von der, Baeon (1843-
sian soldier and military writer, was born at Bielkenfeld,
East Prussia, on 12tli August 1843, educated at the
Cadet School at Kulm and Berlin, and received his com-
mission in the infantry in 1861. In 1864 he entered
the Berlin Military Academy, but was temporarily with-
drawn in 1866 to serve in the Austrian war, in which he
was wounded at Trautenau. In 1867 he joined the topo-
graphical division of the general staff, and at the begin-
ning of the Franco-German war of 1870-71 was attached
to the staff of Prince Frederick Charles. He took part

in the battles of Mars-le-Tour and Gravelotte and in the siege of Metz. After its fall he served under the Eed Prince in the campaign of the Loire against the French General Chanzy, including the battles of Orleans and Le Mans and the subsequent six days' fighting. He was appointed in 1871 professor at the Military School at Potsdam, and the same year was promoted captain and placed in charge of the historical division of the general staff. It was then he wrote Tlie Operations of the Second Army to the Capitulation of Metz, and Tlie Seven Days of Le Mans, both published in 1873. In 1874 he was appointed to the staff of the 6th division, and while so employed wrote The Operations of the Second Army of tlie Loire, and Lion Gambetta and his Armies, published in 1875 and 1877 respectively. The latter was translated into French the same year, and both are impartially written. In 1878 von der Goltz was appointed professor of military history at the Military Academy at Berlin, where he remained for five years, and attained the rank of major. He published, in

1883, Bossbach and Jena and The Nation in Arms, and during his residence in Berlin contributed many articles to the military journals. In June 1883 his services were lent to Turkey to organize the military educational establishments of the country, and he was made a pasha. On his return to Germany in 1896 he rose to be lieutenant-general, and was appointed commander of the 5th division in 1898, head of the Engineer and Pioneer Corps and inspector-general of fortifications. He has been a frequent contributor to military periodical literature, and, in addition to the works already named, has published TJie Ttirco-Orecian War and Tlie Conduct of War, the latter of which has been translated into English.

Coluchowski, Agenor, Count (1849),

Austrian statesman, was born in 1849. His father, descended from an old and noble Polish family, was governor of Galicia. Entering the diplomatic service, the son was in 1872 appointed attach^ to the Austrian embassy at Berlin, where he became secretary of legation,

and thence he was transferred to Paris. After rising to the rank of counsellor of legation, he was in 1887 made minister at Bucarest, where he remained till 1893. In these positions he acquired a great reputation as a firm and skilful diplomatist, and on the retirement of Count Kalnoky in May 1895 was chosen to succeed him as Austro-Hungarian minister for foreign affairs. In his speech of that year to the delegations he declared the maintenance of the Triple Alliance, and in particular the closest intimacy with Germany, to be the keystone of Austrian policy ; at the same time he dwelt on the traditional friendship between Austria and Great Britain, and expressed his desire for a good understanding with all the Powers. In pursuance of this policy he effected an understanding with Eussia, by which neither Power was to exert any separate influence in the Balkan peninsula, and thus removed a long-standing cause of friction. Austria's policy in the Balkans, to which he now secured the adhesion of Russia, was, in his words, " the

consolidation of the state of affairs created in the East by international treaties ; the preservation of Turkey ; the independence, strengthening, and free development of the several Balkan states, and of friendly relations with them ; and, finally, the exclusion of the predominant influence of any single great Power to the detriment of the rest." This understanding was formally ratified during a visit to St Petersburg on which he accompanied the Emperor in April 1897. He took the lead in establishing the European Concert during the Armenian troubles of 1896, and again resisted isolated action on the part of any of the Great Powers during the Cretan troubles and the Greco-Turkish war. In November 1897, when the Austro-Hungarian flag was insulted at Mersina, he threatened to bombard the town if instant reparation were not made, and by his firm attitude greatly enhanced Austrian prestige in the East. In his speech to the delegations in 1898 he dwelt on the necessity of expanding Austria's mercantile marine, and of raising the fleet to a strength which,

while not vying with the fleets of the great naval Powers, would ensure respect for the Austrian flag wherever her interests needed protection. He also hinted at the necessity for European combination to resist American competition. Count Goluchowski has devoted much of his energies to the problem of supervising emigration so that the loss of population may be compensated by the opening of new markets across the seas.

Gomel (Homel), a district town of Eussia, 108 miles S.S.E. of Moghilev, on the Sozh, tributary of the Dnieper. It is an important junction of the railways from WUno to Odessa, and Orel to Poland, and is in steamer communication with Kieff and Moghilev. It has gymnasia for boys and girls, and carries on a brisk trade in corn and timber; there are also paper-pulp mills and oil factories. Gomel was founded in the 12th century, and after changing hands several times between Poles and Eussians, was annexed to Eussia in 1772. Population (1897), 35,846, nearly half of whom are Jews.

Gomez, Maximo (1823), Cuban soldier, was

born in San Domingo in 1823. He entered the Spanish army in that island as a lieutenant, and rose to be captain. His family emigrated to Cuba and settled near Santiago. He joined the insurgent army in 1868, and obtained victories at Jiguani and Holguin in the following year. In 1872 the commander-in-chief, General Agramonte, promoted him to the rank of brigadier-general and sent him to command at Puerto Principe, where he increased his reputation. He captured Nuevitas, Santa Cruz, and Cascorra, and fought the battle of Las Guarimas. In 1874 he invaded the province of Santa Clara, defeated General Jovellar, and was made a major-general. On the collapse of the rebellion in 1878 he escaped to Jamaica, and lived as a farmer there and in San Domingo until the renewal of the rising in Cuba in 1895 under Jose Marti. He landed in Cuba on 14th April, and was made commander-in-chief of all the insurgent forces. Eealizing the great strength of the Spanish forces in the island, he avoided serious encounters, and was content to hold areas of tropical wilderness by scattered squads,

with a system of speedy dispersion and concentration. To this policy he added a systematic destruction of the two great Cuban industries — sugar and tobacco production— in order to impoverish the Spaniards and to compel the Cubans to take part in the war. The Spanish general, Campos, failed to make any head against the insurgents, and he was succeeded in February 1896 by Weyler, who strove to quell the rising by extreme severity. Early in 1896 a revolutionary government was formed under the presidency of Salvador Cisneros. In June Gomez defeated General Castillanos near Puerto Principe, and during 1897 he held the field. In October 1897 Weyler was recalled, and the new Spanish ministry under Senor Sagasta resolved to grant autonomy to Cuba, but the offer was rejected by the Cubans. Gomez by no means welcomed the intervention of the United States in 1898, and more than once attacked the President and Government in his public utterances. On the transfer of Cuba to the United States, however, on 1st January 1899, after the conclusion of the war with Spain, he

accepted the terms offered him and promised to assist in disbanding the Cuban army. In consequence he was impeached on 12th March by the Cuban military assembly and removed from his command. On 7th April, however, he was reinstated by a majority of the Cuban generals, and he subsequently concluded the negotiar tions for the disbandment of the Cuban army with General Brooke, the United States military governor. (See Cuba.)

GoncharofF, Ivan Alexandrovlch (1812-1891), Eussian novelist, was born 6/18 July 1812, being the son of a rich merchant in the town of Simbirsk. At the age of ten he was placed in one of the gymnasiums at Moscow, from which he passed, though not without some difficulty on account of his ignorance of Greek, into the Moscow University. He read many Erench works of fiction, and published a translation of one of the novels of Eugfene Sue. During his university career he devoted himself to' study, taking no interest in the political and Socialistic agitation among his fellow-students. He was first em-

ployed as secretary to the governor of Simbirsk, and afterwards in the Ministry of Finance at St Petersburg. Being absorbed in bureaucratic work, Goncharoff paid no attention to the social questions then ardently discussed by such men as Herzen, Aksakoff, and Bielinski. He began his literary career by publishing translations from Schiller, Goethe, and English novelists. His first original work was ObuiJenovennaya Istoria, ” A Common Story ” (1847). In 1856 he sailed to Japan as secretary to Admiral Putiatin for the purpose of negotiating a commercial treaty, and on his return to Eussia he published a description of the voyage under the title of “The Frigate Pallada.” His best work is Oblomoff (1857), which exposed the laziness and apathy of the smaller landed gentry in Eussia anterior to the reforms of Alexander II. Eussian critics have pronounced this work to be a faithful characterization of Eussia and the Eussians. Dobroluboff said of it, “Oblomofka [the country seat of the Oblomoffs] is our fatherland: something of Oblomoff is to be found in every one of us.” Peesareff,

another celebrated critic, declared that ” Oblomoffism,” as Goncharoff called the sum total of qualities with which he invested the hero of his story, ” is an illness fostered by the nature of the Slavonic character and the life of Eussian society.” In 1858 Goncharoff was appointed a censor, and in 1868 he published another novel called Obreev. He was not a voluminous writer, and during the latter part of his life produced nothing of any importance. His death occurred on 15/27 September 1891. (g. d.)

Goncou rt, de, the name of a famous French literary family. Edmond de Goncoubt was born at Nancy, 26th May 1822, and died at Champrosay, 16th July 1896. Jules de Goncoukt, his brother, was born at Paris, 17th December 1830, and died at Paris, 20th June 1870. Writing always in collaboration, until the death of the younger, it was their ambition to be not merely novelists, inventing a new kind of novel, but historians ; not merely historians, but the historians of a particular century, and of what was intimate and what is unknown

in it ; to be also discriminating, indeed innovating, critics

of art, but of a certain section of art, the 18th century, in Prance and Japan ; and also to collect pictures and bibelots, always of the French and Japanese 18th century. Their histories (Portraits intimes du xviW Si^cle, 1857, La Femme au xviW Si^cle, 1862, La du Barry, 1878, &c.) are made entirely out of documents, autograph letters, scraps of costume, engravings, songs, the unconscious self-revelations of the time ; their three volumes on L'Art du xviii' Siicle, 1859-75, deal with Watteau and his followers in the same scrupulous, minutely enlightening way, with all the detail of unpublished documents ; and when they came to write novels, it was with a similar attempt to give the inner, undiscovered, minute truths of contemporary existence, the iiiMit of life. The same morbidly sensitive noting of the inMit, of whatever came to them from their own sensations of things and people around them, gives its curious quality to the nine volumes of the Journal,

1887-96, which will remain, perhaps, the truest and most poignant chapter of human history that they have written. Their novels, Soiur Philom&ne, 1861, Renie Mauperin, 1864, Qerminie Lacerteux, 1865, Nanette Salomon, 1865, Madame Oervaisais, 1869, and, by Edmond alone. La Fille Elisa, 1878, Les Fr&res Zemganno, 1879, La Faustin, 1882, Chirie, 1884, are, however, the work by which they will live as artists. Learning something from Flaubert, and teaching almost everything to Zola, they invented a new kind of novel, and their novels are the result of a new vision of the world, in which the very element of sight is decomposed, as in a picture of Monet. Seen through the nerves, in this conscious abandonment to the tricks of the eyesight, the world becomes a thing of broken patterns, and conflicting colours, and uneasy movement. A novel of the Goncourts is made up of an infinite number of details, set side by side, every detail equally prominent. While a novel of Flaubert, for all its detail, gives above all things an impression of unity, a novel of the Goncourts deliberately dispenses with unity in order

to give the sense of the passing of life, the heat and form of its moments as they pass. It is written in little chapters, sometimes no longer than a page, and each chapter is a separate notation of some significant event, some emotion or sensation which seems to throw sudden light on the picture of a soul. To the Goncourts humanity is as pictorial a thing as the world it moves in ; they do not search further than ” the physical basis of life,” and they find everything that can be known of that unknown force written visibly upon the sudden faces of little incidents, little expressive moments. The soul, to them, is a series of moods, which succeed one another, certainly without any of the too arbitrary logic of the novelist who has conceived of character as a solid or consistent thing. Their novels are hardly stories at all, but picture-galleries, hung with pictures of the momentary aspects of the world. French critics have complained that the language of the Goncourts is no longer French, no longer the French of the past ; and this is true. It is their distinction — the finest of their inventions — ^that, in order to render new

sensations, a new vision of things, they invented a new language. (a. sy.)

Conda, a town and district of British India, in the Fyzabad division of Oudh. The town is 28 miles north-west of Fyzabad, and is an important junction on the Bengal and ISTorth-Western railway. The population in 1891 was 17,430 ; the municipal income in 1897-98 was Rs.16,334. The cantonments were abandoned in 1863. The District of Gonda has an area of 2880 square miles. Its population in 1881 was 1,270,926, and in 1891 was 1,459,229, giving an average density of 507 persons per square mile. In 1901 the population was 1,402,350, showing a decrease of 4 per cent. The land revenue and rates were Es.16,83,221, the incidence of assessment per acre being E.1-6-4 on temporarily settled andE.0-13-11 on permanently settled laud ; the cultivated area in 1896-97 was 1,047,674 acres, of which 186,616 were irrigated from wells, tanks, &e. ; the number of police was 2776 ; the number of vernaxjular schools in 1896-97 was 95, with 3873 pupils ; the registered death-rate in

1897 was 42-67 per thousand. The district is traversed by the main line of the Bengal and North-Western railway, with a branch from Gonda town towards Lueknow.

Condal, a native state of India, within the Gujarat division of Bombay, situated in the centre of the peninsula of Kathiawar. Its area is 1024 square miles ; population (1891), 161,036. The estimated gross revenue is about Es.16,00,000, of which Es.3,26,760 was expended in 1897-98 on public works ; the tribute is Es.1,10,721. The present chief, whose title is Thakor Saheb, is a Jareja Eajput, of the same clan as the Rao of Cutch. He was educated at the Eajkot college, and afterwards graduated in arts and medicine at the University of Edinburgh. He has published a book in English on the medical system of the Hindus. In 1898 he received the insignia of K.C.I.E. from Queen Victoria in person. The state has always been conspicuous for its progressive administrar tion, and was recently raised from the second to the first class. It is traversed by a railway connecting it with Eajkot and with the sea^board. The Town of Gondal

is 23 miles by rail south from Eajkot. It had in 1891 a population of 15,343. It has an Anglo-vernacular school, an iron foundry, and a state printing-press, issuing an official gazette.

Cooch, Sir Daniel, Bart (1816-1889), English mechanical engineer, was born at Bedlington, in Northumberland, on 16th August 1816. At the age of fifteen, having shown a taste for mechanics, he was put to work at the Tredegar Ironworks, Monmouthshira In 1834 he went to Warrington, where, at the Vulcan foundry, under Eobert Stephenson, he acquired the principles of locomotive design. Subsequently, after passing a year at Dundee, he was engaged by. the Stephensons at their Gateshead works, where he seems to have conceived that predilection for the broad gauge for which he was afterwards distinguished, through having to design some engines for a 6-foot gauge in Eussia and noticing the advantages it offered in allowing greater space for the machinery, &c., as compared with the standard gauge favoured by Stephenson. In 1837, on Brunei's recommendation, he was

appointed locomotive superintendent to the Great Western railway. When he accepted this post the engines possessed by the railway were very poor and inefficient ; in fact, there were only about half-a-dozen that could be depended upon at all, and it was not an infrequent thing to send out one of the sounder ones to search for and help home a train which was more than usually unpunctual. Under Gooch, however, this state of affairs was soon remedied, and he gradually provided his employers with a stock of locomotives, many of which have scarcely even now been surpassed for general excellence and economy of working. One of the most famous, the Lord of the Isles, was awarded a gold medal at the Great Exhibition of 1851, and when thirty years afterwards it was withdrawn from active service it had run more than three-quarters of a million miles, all with its original boiler. In 1864 he left the Great Western and interested himself in the problem of laying a telegraph cable across the Atlantic. At this time Brunei's famous steamship, the Great Eastern, was in the hands of the bondholders, of whom he himself was one of the most

important, and it occurred to him that she might advantageously be utilized in the enterprise. Accordingly, at his instance she was chartered by the Telegraph Construction

Company, of which also he was a director, and in 1865 was employed in the attempt to lay a cable, Gooch himself superintending operations. The cable, however, broke in mid-ocean, and the attempt was a failure. Next year it was renewed with more success, for not only was a new cable safely put in place, but the older one was picked up and spliced, so that there were two complete lines between England and America. For this achievement Gooch was created a baronet. Meanwhile the Great Western railway had fallen on evil days, being indeed on the verge of bankruptcy when in 1866 the directors appealed to him to accept the chairmanship of the board and undertake the rehabilitation of the company. He agreed to the proposal, and was so successful in restoring its prosperity that in 1889, at the last meeting over which

he presided, a dividend was declared at the rate of 7| per cent. Under his administration the system was greatly enlarged and consolidated by the absorption of various smaller lines, such as the Bristol and Exeter and the Cornwall railways ; and his appreciation of its strategic value caused him to be a strenuous supporter of the construction of the Severn Tunnel. His death occurred on 15th October 1889, at his residence, Clewer Park, near Windsor. (h. m. k.)

Coole, a market-town and port in the Osgoldcross parliamentary division of Yorkshire, England, at the confluence of the Don and the Ouse, 24 mUes west by south of Hull by rail. Eecent erections are a sailors' institute, court house, cottage hospital, post office, and market-hall. A new dock of 2^ acres was opened in. 1882, and in 1891 one 620 feet long and 260 feet broad, with a depth of 22 feet. There are now in all eight docks supplied with timber ponds, quays, warehouses, and other accommodation. The registered shipping in 1888 consisted of 245 vessels of 24,787 tons ; in 1899, 147 vessels of 26,391

tons. In 1888, 2258 vessels of 530,508 tons entered, and 2597 vessels of 661,616 tons cleared. In 1899, 2641 vessels of 863,440 tons entered, and 2756 vessels of 888,969 tons cleared. Area of urban district, 1441 acres. Population (1881), 10,418; (1901), 16,576.

Corakhpur, a city, district, and division of the North- West Provinces of British India. The city is situated on the river Rapti, and had a population in 1881 of 57,922, and in 1901 of 63,409. The municipal income in 1897-98 was Es.67,294 ; the roistered death-rate in 1897 was 61-37 per thousand. It is the civil headquarters of the district, with a military cantonment, and has nine printing-presses, issuing one vemaxsular newspaper. The DisTKiOT OF GoRAKHPPE has an area of 4576 square miles. It had a population in 1881 of 2,617,120; in 1891 of 2,994,057, giving an average density of 654 persons per square mile ; and in 1901 of 2,955,543, showing a decrease of 3 per cent. The land revenue and rates were Es.31,59,359, the incidence of assessment being just under E.1 per acre ; the cultivated area in 1896-97 was

1,906,024 acres, of which 531483 were irrigated from wells, tanks, &a ; the number of police was 3263; the number of vernacular schools in 1896-97 was 202, with 9069 pupils ; the registered death-rate in 1897 was 35-27 per thousand. The district is traversed by the main line of the Bengal and North-Western railway, and both the Gogra and Eapti are navigable. There are twenty-eight indigo factories, employing 5500 persons, with an out-turn valued at Rs.3,00,000 per annum. The Division has an area of 9491 square miles. The population in 1891 was 6,508,526, giving an average density of 685 persons per square mile, being more than one to every acre, and the highest for any large tract in India ; in 1901 the popular tion was 6,331,356, showing a decrease of 3 per cent. –

Corcum, or Gobkum (Dutch Gorinchem), a town in the Netherlands, province of South Holland, 22 miles E.S.E. of Eotterdam, near the influx of the Linge into the Merwede. EaUway connexions have been established with Geldermalsum, Bois-le-Duc (1883), and Dordrecht (1885). Trade has also been promoted by the opening in

1894 of the Merwede Canal (Amsterdam-Gorcum). Gold and silver working are carried on. Population (1900), 11,855.

Cordium, an ancient city of Phrygia, situated on the Persian ” Eoyal road ” from Pessinus to Ancyra, and not far from the Sangarius. Eamsay identifies it with Tlirme, Humann with Chakmak, and Crowfoot with Pebi.

Cordon, Adam Lindsay (1833-1870), Australian poet, was born at Eayal, in the Azores, in 1833, and was the son of a retired Indian officer who taught Hindo-stanee at Cheltenham College. A youthful indiscretion led to his being sent to South Australia in 1853 with a commission in the mounted police. Here for some years he prospered, married, and obtained a seat in the local parliament. Misfortune, uevei-theless, overtook him, and in 1867 he removed to Victoria, where he published his poems. They brought him more praise than emolument, and, thoroughly discouraged, especially by his failure to make good his daim to some property in Scotland to which he believed himself entitled, he committed suicide

at New Brighton on Port Phillip Bay on the 24th of June 1870. His reputation rose after his death, and he became the best known and most widely popular of Australian poets, although he must undoubtedly some day give place to one tmiting to an equal or superior poetical talent a deeper feeling for Australian scenery and life. Much of Gordon's poetry might have been written in England : when, however, it is really local, it is -vividly so ; his genuine feeling frequently kindles into passion ; his versification is always elastic and sonorous, but sometimes too reminiscent of Swinburne. His compositions are almost entirely lyrical, and their merit is usually in proportion to the degree in which they partake of the character of the ballad.

Cordon, Charles Ceorge (1833-1885), British soldier and administrator, fourth son of General H. W. Gordon, Royal Artillery, was bom at Woolwich on 28tli January 1833. He received his early education at Taunton school, and was given a cadetship in the Eoyal Military Academy, Woolwich, in 1848. He was com-

missioned as second lieutenant in the corps of Eoyal Engineers on 23rd June 1852. After passing through, a course of instruction at the Eoyal Engineers' establishment, Chatham, he was promoted lieutenant in 1854, and was sent to Pembroke Dock to assist in the construction of the fortifications then being erected for the defence of Milford Haven. The Crimean war broke out shortly afterwards, and Grordon was ordered on active service, and landed at Balaclava on 1st January 1855. The siege of Sebastopol was in progress, and he had his full share of the arduous work in the trenches. He was attached to one of the British columns which assaulted the Eedan on 18th June, and was also present at the capture of that work on 8th September. He took part in the expedition to Kinburn, and then returned to Sebastopol to superintend a portion of the demolition of the Eussian dockyard. After peace "with Eussia had been concluded, Gordon was attached to an international commission appointed to delimit the new boundary, as fixed by treaty, between Eussia and Turkey in Bessarabia ;

and on the conclusion of this work he was ordered to Asia Minor on similar duty, with reference to the eastern boundary between the two countries. While so employed

la China,

Gordon took the opportunity to make himself well acquainted with the geography and people of Armenia, and the knowledge of dealing with Eastern nations then gained was of great use to him in after life.

He returned to England towards the end of 1858, and was then selected for the appointment of adjutant and field-works instructor at the Eoyal Engineers' establishment, and took up his new duties at Chatham after promotion to the rank of captain in April 1859. But his stay in England was brief, for in 1860 war was declared against China, and Gordon was ordered out there, arriving at

Tientsin in September. He was too late for the attack on the Taku Forts, but was present at the occupation of Peking and destruction of the Summer Palace. He remained with the British force of occupation in Northern China until April 1862, when the British troops, under the command of General Staveley, proceeded to Shanghai, in order to protect the European settlement at that place from the Taeping rebels. The Taeping revolt, which had some remarkable points of similarity with the Mahdist rebellion in the Sudan, had

commenced in 1850 in the province of Kwangsi. The leader, Hung Seu Tsuen, a semi-political, semi-religious enthusiast, assumed the title of Tien Wang, or Heavenly King, and by playing on the feelings of the lower class of people gradually collected a considerable force. The Chinese authorities endeavoured to arrest him, but the imperialist troops were defeated. The area of revolt extended northwards through the provinces of Hunan and Hupe, and down the valley of the Yangtse-kiang as far as the great city of Nanking, which was captured by the rebels in 1853. Here the Tien Wang established his court, and while spending his own time in heavenly contemplation and earthly pleasures, sent the assistant Wangs on warlike expeditions through the adjacent provinces. For some years a constant struggle was

maintained between the Chinese imperialist troops and the Taepings, with varying success on both sides. The latter gradually advanced eastwards, and, approaching the important commercial city of Shanghai, alarmed the European inhabitants of that place, who subscribed to raise a mixed force of Europeans and Manila men for the defence of the town. This force, which was placed under the command of an American named Ward, took up a position in the country west of Shanghai to check the advance of the rebels. Fighting continued round Shanghai for about two years, but Ward's force was not altogether successful, and when General Staveley arrived from Tient-sin affairs were in a somewhat critical condition. He decided to clear the district of rebels within a radius of 30 miles from Shanghai, and Gordon was attached to his staff as engineer officer. A French force, under the command of Admiral Frotet, co-operated with Staveley,

General Gordon.

(^I'rom a pJwiogra/ph J>y the London Stereoscopic CoTn^an/y.)

and Ward, with his little army, also assisted. Kahding,

Singpo, and other towns were occupied, and the country was fairly cleared of rebels by the end of 1862. Ward was, unfortunately, killed in the assault of Tseki,_and his successor, Burgevine, having had a quarrel with the Chinese authorities, Li Hung Chang, the governor of the Kiang-su province, requested General Staveley to appoint a British officer to command the contingent. Staveley selected Gordon, who had been made a brevet-major in December 1862 for his previous services, and the nomination was approved by the British Government. The choice was judicious, as further events proved. In March 1863 Gordon pro-ceeded to Sungkiang to take command of the force, which had received the name of ” The Ever- Victorious Army,” an encouraging though some-

what exaggerated title, con-
sidering its previous his-
tory. Without waiting to
reorganize his troops he
marched at once to the re-
lief of Chansu, a town 40
miles north-west of Shanghai,
which was iavested by the
rebels. The relief was suc-
cessfully accomplished, and
the operation established
Gordon in the confidence of
his troops. He then reor-
ganized his force, a matter
of no small difBculty, and
advanced against Qninsan,
which was captured, though
with considerable loss. Gor-
don then marched through the
country, seizing town after

town from the rebels, until
at length the great city of
Suchow was invested by his
army and a body of Chinese
imperialist troops. The city was taken on the 29th of
November, and after its capture Gordon had a serious
dispute with Li Hung Chang, as the latter had beheaded
certain of the rebel leaders whose lives the former had
promised to spare if they surrendered. This action, though
not opposed to Chinese ethics, was so opposed to Gordon's
ideas of honour, that he withdrew his force from Suchow,
and remained inactive at Qninsan until February 1864.
He then came to the conclusion that the subjugation
of the rebels was more important than his dispute with
Li, and visited the latter in order to arrange for further
operations. By mutual consent no allusion was made
to the death of the Wangs. This was a good example of
one of Gordon's marked characteristics, that, though a
man of strong personal feelings, he was always prepared
to subdue them for the public benefit. He declined, how-

ever, to take any decoration or reward from the emperor for his services at the capture of Suchow. After the meeting with Li Hung Chang the ” Ever- Victorious Army ” again advanced and took a number of towns from the rebels, ending with Chanchufu, the principal military position of the Taepings. This fell in May, when Gordon returned to Quinsan and disbanded his force. In June the Tien Wang, seeing his cause was hopeless, committed suicide, and the capture of Nanking by the imperialist troops shortly afterwards brought the Taeping revolt to a

conclusion. The suppression of this serious movement was undoubtedly due in great part to the skill and energy of Gordon, who had shown remarkable qualities as a leader of men. The emperor promoted him to the rank of Titu, the highest grade in the Chinese army, and also gave him the Yellow Jacket, the most important decoration in China. He wished to give him a large sum of money, but this Gordon refused. He was promoted lieutenant-

colonel for his Chinese services, and made a Companion of the Bath. Henceforth he was often familiarly spoken of as ” Chinese ” Gordon.

Gordon was appointed on his return to England Commanding Royal Engineer at Gravesend, where he was employed in superintending the erection of forts for the defence of the Thames. He devoted himself with energy to his of&cial duties, and his leisure hours to practical philanthropy. All the acts of kindness which he did for the poor during the six years he was stationed at Gravesend will never be fully known. In October 1871 he was appointed British representative on the international commission which had been constituted after the Crimean war to maintain the navigation of the mouth of the river Danube, with headquarters at Galatz. During 1872 Gordon was sent to inspect the British military cemeteries in the Crimea, and when passing through Constantinople on his return to Galatz he made the acquaintance of Nubar Pasha, prime minister of Egypt, who sounded him as to whether he would take service

under the Khedive. Nothing further was settled at the time, but the following year he received a definite offer from the Khedive, which he accepted with the consent of the British Government, and proceeded to Egypt early in 1874. He was then a colonel in the army, though still only a captain in the corps of Royal Engineers.

To understand the object of the appointment which Gordon accepted in Egypt, it is necessary to give a few facts with reference to the Sudan. That ^ '^^ vast territory, bordering the Nile on both sides Sudan. from the Egyptian frontier to the equator, after a long and varied history, had lapsed into a state of semi-barbarism. Mehemet Ali, the ruler of Egypt, having made himself practically independent of his suzerain, the Sultan of Turkey, conceived the project of founding an African empire, and with this object determined to take possession of the Sudan. An expedition was sent up the Nile in 1820 under the command of Ismail, son of Mehemet Ali. The force reached

Khartum after meeting with considerable opposition, and the province of Sennaar was captured, but in 1822 Ismail was murdered by the inhabitants of Shendy near Berber. Notwithstanding this, the Egyptians pressed southwards and conquered Kordofan and Fazogl. In 1865 Turkey ceded the province of Suakin and Massawa on the Red Sea to the Khedive, thus rounding off the possessions of Egypt in the Sudan. One result of the Egyptian occupation of the country was that the slave trade was largely developed, especially in the White Nile and Bahr-el-Ghazal districts. Captains Speke and Grant, who had travelled through Uganda and came down the White Nile in 1863, and Sir Samuel Baker, who went up the same river as far as Albert Nyanza, brought back harrowing tales of the misery caused by the slave-hunters. Public opinion was considerably moved, and in 1869 the Khedive Ismail decided to send an expedition up the White Nile, with the double object of limiting the evils of the slave trade and opening up the district to commerce. The command of the expedition was given

to Sir Samuel Baker, who reached Khartum in Eebruary 1870, but, owing to the obstruction of the river by the sudd or grass barrier, did not reach Gondokoro, the centre of his province, for fourteen months. He met with great difficulties, and when his four years' service came to an end little had been effected beyond establishing a few posts along the Nile and placing some steamers on the river. It was to succeed Baker as governor of the White Nile province that the Khedive asked for Gordon's services, having come to the conclusion that the latter was the most likely person to bring the affair to a satisfactory conclusion. After a short stay in Cairo, Gordon proceeded to Khartum by way of Suakin and Berber, a route which he ever afterwards regarded as the best mode of access to the Sudan. From Khartum he proceeded up the White Nile to Gondokoro, where he arrived in twenty-four days, the sudd, which had proved such an obstacle to Baker, having been removed since the departure of the latter by the Egyptian governor-general. Gordon remained in the Equatorial Provinces until October

1876, and then returned to Cairo. The two years and a half thus spent in Central Africa was a time of incessant toil. A line of stations was established from Sobat on the White Nile to the frontier of Uganda, and considerable progress was made in the suppression of the slave trade. The river and Lake Albert were mapped by Gordon and his staff, and he devoted himself with wonted energy to improving the condition of the people. Greater results might have been obtained but for the fact that Khartum and the whole of the Sudan north of the Sobat were in the hands of an Egyptian governor, independent of Gordon, and not too well disposed towards his proposals for diminishing the slave trade. On arriving in Cairo Gordon informed the Khedive of his reasons for not wishing to return to the Sudan, but did not definitely resign the appointment of governor of the Equatorial Provinces. But on reaching London he telegraphed to the British consul-general in Cairo, asking him to let the Khedive know that he would not go back to Egypt. Ismail Pasha, feeling, no doubt, that Gordon's resignation would injure

his prestige, wrote to him saying that he had promised to return, and that he expected him to keep his word. Upon this Gordon, to whom the keeping of a promise was a sacred duty, decided to return to Cairo, but gave an assurance to some friends that he would not go back to the Sudan unless he was appointed governor-general of" the entire province. After some discussion the Kiedive agreed, and made him governor-general of the Sudan, inclusive of Darfur and the Equatorial Provinces.

One of the most important questions which Gordon had to take up on his appointment was the state of the political relations between Egypt and Abyssinia, which had been in an unsatisfactory condition for some years. The dispute centred round the district of Bogos, lying not far inland from Massawa, which both the Khedive and King John of Abyssinia claimed atlZai.'" as belonging to their respective dominions.

War broke out in 1876, when an Egyptian expedition was despatched to Abyssinia, and was completely

defeated by King John near Gundet. A second and larger expedition, under Prince Hassan, the son of the Khedive, was sent the following year from Massawa. The force was routed by the Abyssinians at Gura, but Prince Hassan and his staff got back to Massawa. Matters then remained quiet until March 1877, when Gordon proceeded to Massawa to endeavour to make peace with Kiag John. He went up to Bogos, and had an interview with Wadenkal, an Abyssinian chief, who had joined the Egyptians with a view to raiding on his own account. Gordon, with his usual powers of diplomacy, persuaded Wadenkal to remain quiet, and wrote to the king proposing terms of peace. But he received no reply at that time, as John, feeling pretty secure on the

Egyptian frontier after liis two successful actions against the Khedive's troops, had gone southwards to fight with Menelek, king of Shoa. Gordon, seeing tliat the Abyssinian difficulty could wait for a few months, proceeded to Khartum. Here he took up the slavery question, and proposed to issue regulations making the registration of slaves compulsory, but his proposals were not approved by the Cairo Government. In the meantime an insurrection had broken out in Darfur, and Gordon proceeded to that province to relieve the Egyptian garrisons, which were considerably stronger than the force he had availa^ ble, the insurgents also being far more numerous than his little army. On coining up with the main body of rebels he saw that diplomacy gave a better chance of success than fighting, and, accompanied only by an interpreter, rode into the enemy's camp to discuss the situation. This bold move, which probably no one but Gordon would have attempted, proved quite successful, as part of the insurgents joined him, and the remainder retreated to the south. The relief of the Egyptian garri-

sons was successfully accomplished, and Gordon visited the provinces of Berber and Dongola, whence he had again to return to the Abyssinian frontier to treat with King John. But no satisfactory settlement was arrived at, and Gordon came back to Khartum in January 1878. There he had scarcely a week's rest when the Khedive summoned him to Cairo to assist in settling the financial affairs of Egypt. He reached Cairo in March, and was at once appointed by Ismail as president of a commission of inquiry into the finances, on the understanding that the European commissioners of the debt, who were the representatives of the bondholders, and whom Ismail regarded as interested parties, should not be members of the commission. Gordon accepted the post on these terms, but the consuls-general of the different Powers refused to agree to the constitution of the commission, and it fell to the ground, as the Khedive was not strong enough to carry his point. The attempt of the latter to utilize Gordon as a counterpoise to the European financiers having failed, Ismail fell into the hands of his

creditors, and was deposed by the Sultan in the following year in favour of his son Tewfik. After the conclusion of the financial episode, Gordon proceeded to the province of Harrar, south of Abyssinia, and, finding the administration in a bad condition, dismissed Raouf Pasha, the governor. He then returned to Khartum, and in 1879 went again into Darfur to pursue the slave traders, while his subordinate, Gessi Pasha, fought them with great success in the Bahr-el-Ghazal district and killed Suleiman, the leader. This put an end to the revolt, and Gordon went back to Khartum. Shortly afterwards he went down to Cairo, and when there was requested by the new Khedive to pay a visit to King John and make a definite treaty of peace with Abyssinia. Gordon had an interesting interview with the king, but was not able to do much, as the king wanted great concessions from Egypt, and the Khedive's instructions were that nothing material was to be conceded. The matter ended by Gordon being made a prisoner and sent back to Massawa. Thence he returned to Cairo and resigned his Sudan ap-

pointment. He was considerably exhausted by the three years' incessant work, during which he had ridden no less than 8500 miles on camels and mules, and was constantly engaged in the task of trying to reform a vicious system of administration.

In March 1880 Gordon visited the king of the Belgians at Brussels, and King Leopold suggested that he should at some future date take charge of the Congo Free State. In April the Government of the Cape Colony telegraphed to him offering the position of commandant of the Cape local forces, but he declined the appointment. In May the Marquis of Ripon, who had been given the post of Governor-General of India, asked Gordon to go with him as private secretary. This he agreed to do, but a few days later, feeling that he was not suitable for the position, asked Lord Ripon to release him. The jggg,jgg^ latter refused to do so, and Gordon accom-

panied him to India, but definitely resigned his post on Lord Ripon's staff shortly afterwards. Hardly had he resigned when he received a telegram from Sir

Robert Hart, inspector-general of customs in China, inviting him to go to Peking. He started at once, and arrived at Tientsin in July, where he met Li Hung Chang, and learnt that affairs were in a critical condition, and that there was risk of war with Russia. Gordon proceeded to Peking and used all his influence in favour of peace. His arguments, which were given with much plainness of speech, appear to have convinced the Chinese Government, and war was avoided. Gordon returned to England, and in April 1881 exchanged with a brother officer, who had been ordered to Mauritius as Commanding Royal Engineer, but who for family reasons was unable to accept the appointment. He remained in Mauritius until the March following, when, on promotion to the Tank of major-general, he had to vacate the position of Commanding Royal Engineer. Just at the same time the premier of Cape Colony telegraphed to him to ask if he would go to the Cape to consult with the ^Government as regards settling affairs in Basutoland. The telegram stated that the position of

matters was grave, and that it was of the utmost importance that the colony should secure the services of some one of proved ability, firmness, and energy. Gordon sailed at once for the Cape, and saw the governor, Sir Hercules Robinson, and the premier, Mr Merriman, who, for political reasons, asked him not to go to Basutoland, but to take the appointment of commandant of the colonial forces at King William's Town. After a few months, which were spent in reorganizing the colonial forces, Gordon was requested to go up to Basutoland to try to arrange a settlement with the chief Masupha, one of the most powerful of the Basuto leaders. Greatly to his surprise, at the very time he was with Masupha a meraber of the Cape Government was taking steps to induce Lerethodi, another chief, to advance against Masupha. This not only placed Gordon in a position of danger, but was regarded by him as an act of treachery. He advised Masupha not to deal with the Cape Government until the hostile force was withdrawn, and resigned his appointment. He considered that the Basuto

difficulty was due to the bad system of administration by the Cape Government. That Gordon's views were correct is proved by the fact that a few years later Basutoland was separated from Cape Colony and placed directly under the Imperial Government. After his return to England from the Cape, being unemployed, Gordon decided to go to Palestine, a country he had long desired to visit. Here he remained for a year, and devoted his time to the study of Biblical history and of the antiquities of Jerusalem. The king of the Belgians then asked him to take charge of the Congo Pi-ee State, and he accepted the mission, and returned to London to make the necessary preparations. But a few days after his arrival he was requested by the British Government to proceed immediately to the Sudan. To understand the reasons for this, it is necessary briefly to recapitulate the course of events in that country since Gordon had left it in 1879.

After his resignation of the post of governor-general, Raouf Pasha, an official of the ordinary type, who, as

already mentioned, had been dismissed by Gordon for misgovernment in 1878, was appointed to succeed him.

As Eaouf was instructed to increase the receipts and diminish the expenditure, the system of government naturally reverted to the old methods, which Gordon had endeavoured to improve. The fact that justice and firmness were succeeded by injustice and weakness tended naturally to the outbreak of revolt, and unfortunately there was a leader ready to head a rebellion — one Mahommed Ahmed, already known for some years as a holy man, who was insulted by an Egyptian official, and retiring with some followers to the island of Abba on the Nile, proclaimed himself as the Mahdi, a successor of the Prophet. Eaouf endeavoured to take him prisoner, but without success, and the revolt spread rapidly. Eaouf was recalled, and succeeded by Abdel Kader Pasha, a much stronger governor, who had some success, but whose forces were quite insufficient to cope with the rebels.

The Egyptian Government was too busily engaged in suppressing Arabi's revolt to be able to send any help to Abdel Kader, and in September 1882, when the British troops entered Cairo, the position in the Sudan was very perilous. Had the. British Government listened to the representations then made to them that, having conquered Egypt, it was imperative at once to suppress the revolt in the southern provinces, the rebellion could have been crushed, but unfortunately Great Britain would neither take effective steps herself nor allow Egypt to do so. It is unnecessary to follow the sad history. Suffice it to say that in December 1883 the British Government saw that something must be done, and ordered Egypt to abandon the Sudan. But abandonment was a policy most difficult to carry out, as it involved the withdrawal of thousands of Egyptian employes and their families. Abdel Kader Pasha was asked to undertake the work, and he agreed on the understanding that he would be supported, and that the policy of abandonment was not to be announced. But the latter condition was refused,

and he declined the task. The British Government then asked General Gordon to proceed to Khartum to report on the best method of carrying out the evacuation. He received his instructions on the 18th of January 1884, and started at once for Cairo, accompanied by Lieut.-Colonel Stewart.

At Cairo he received further instructions from the British minister, Sir Evelyn Baring, and was appointed by the Khedive as governor-general, with full powers. Travelling by Korosko and Berber, he arrived at Khartum on the 18th of February, and was well received by the inhabitants, who believed that he had come to save the country from the rebels. Gordon at once commenced the task ,of sending the women and children and the sick and wounded to Egypt, and about two thousand five hundred had been removed before the Mahdi's forces closed upon Khar-tum. At the same time he considered what was the best arrangement for the future government of the country, and decided that the only possible man was

Zobeir Pasha, who had formerly had great influence in the Sudan, and had been detained in Cairo for some years. But the British Government refused to sanction the appointment, because Zobeir had been a slave-dealer. The advance of the rebels against Khartum was combined with a revolt in the Eastern Sudan, and the Egyptian troops in the vicinity of Suakin met with constant defeat. At length a British force was sent to Suakin under the command of General Sir Gerald Graham, and routed the rebels in several hard-fought actions. Gordon telegraphed to Sir Evelyn Baring urging that the road from Suakin to Berber should be opened by a small force But this request, though strongly supported by Baring and the British military authorities in Cairo, was refused by the Government in London.

At

Khartum.

In April General Graham and his forces were withdrawn from Suakin, and Gordon and the Sudan were definitely abandoned to their fate. The garrison of Berber, seeing

that there was no chance of relief, surrendered a month later, and Khartum was completely isolated. Had it not been for the presence of Gordon the city would also soon have fallen, but with an energy and skill that were almost miraculous, he so organized the defence that Khartum held out until January 1885. When it is remembered that Gordon was of a different nationality and religion to the garrison and population, that he had only one British officer to assist him, and that the town was badly fortified and insufficiently provided with food, it is just to say that the defence of Khartum is one of the most remarkable episodes in military history. The siege commenced on the 18th of March, but it was not until August that the British Government decided to take steps to relieve Gordon. General Stephenson, who was in command of the British troops in Egypt, wished to send a brigade at once to Dongola, but he was overruled, and it was not until the beginning of November that the British relief force was ready to start from Wadi Haifa under the command of Lord Wolseley. The force reached

Korti towards the end of December, and from that place a column was despatched across the Bayuda desert to Metemmeh on the Nile. After some severe fighting, in which the leader of the column, Sir Herbert Stewart, was mortally wounded, the force reached the river on the 20th of January, and the following day four steamers, which had been sent down by Gordon to meet the British advance, and which had been waiting for them for four months, reported to Sir Charles Wilson, who had taken command after Sir Herbert Stewart was wounded. On the 24th Wilson started with two of the °*^- steamers for Khartum, but on arriving there on the 28th he found that the place had been captured by the rebels and Gordon killed two days before. At one time there was an idea current that Wilson might have started earlier and saved the town, but this was quite groundless. In the first place, Wilson could not have started sooner than he did; and in the second, even if he had been able to do so, it would have made no difference, as the rebels could have taken Khartum

any time they pleased after the 6th of January, when the provisions were exhausted. Another popular notion, that the capture of the place was due to treachery on the part of the garrison, is equally without foundation. The attack was made at a point in the fortifications where the rampart and ditch had been destroyed by the rising of the Nile, and when the Mahdi's troops entered the soldiers were too weak to make any effectual resistance. Gordon himself expected the town to fall before the end of December, and it is really difficult to understand how he succeeded in holding out until the 26th of January. Writing on the 14th of December he said, " Now, mark this, if the expeditionary force — and I ask for no more than two hundred men — does not come in ten days, the town may fall, and I have done my best for the honour of my country." He had indeed done his best, and far more than could have been regarded as possible. To understand what he went through during the latter months of the siege, it is only, necessary to read his own Journal, a portion of which, dating from 10th September

to 14th December 1884, was fortunately preserved and published.

Gordon was not an author, but he wrote many short memoranda on subjects that interested him, and a considerable number of these have been utUized, especially in the work of his brother. Sir Henry Gordon, entitled Events in the Life of Oharles George Gordon, from its Beginning to its End. He was a voluminous letter writer,

and much of Ms correspondence has been published. His character was remarkable, and the influence he had over those with whom he came in contact was very striking. His power to command men of non-European races was probably unique. He had no fear of death, and eared but little for the opinion of others, adhering tenaciously to the course he believed to be right in the face of all opposition. Though not holding to outward forms of religion, he was a truly religious man in the highest sense of the word, and was a constant student of the Bible. To

serve God and to do his duty were the great objects of his life, and he died as he had lived, carrying out the work that lay before him to the best of his ability. The last words of his last letter to his sister, written when he knew that death was veiy near, sum up his character : ” I am quite happy, thank God, and, like Lawrence, I have tried to do my duty.”

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Corgei, Arthur (1818), Hungarian soldier,

was born at Toporcz, in Upper Hungary, on the 6th of]?ebruary 1818. He came of a Saxon patrician family, who were converts to Protestantism. As befitting his rank, he entered in 1837 the Bodyguard of Hungarian Nobles at Vienna, where he combined military service with a course of study at the University. In 1845, on the death of his father, he retired from the army and devoted himself to the study of chemistry at Prague. On the outbreak of the revolutionary war of 1848, Gorgei offered his sword to the Hungarian GoveBnment. Entering the Honved army with the rank of captain, he was almost immediately given the command of the National Garde

Mobile north of the Theiss. Whilst he was engaged in preventing the Croatian army from crossing the Danube, at the island of Csepel, below Pesth, the wealthy Hungarian magnate Count Eugene Zichy fell into his hands, and Gorgei executed summary justice upon the unfortunate noble, who, being arraigned before a court-martial on a charge of treason, was immediately hanged. After various successes over the Croatian forces, Gorgei was appointed commander of the army of the Upper Danube, but, on the advance of Prince Windischgratz across the Leitha, he retreated, in spite of the remonstrances of Kossuth, upon Waitzen. Here, irritated by what he considered undue interference with his plans, he issued a proclamation throwing the blame for the recent want of success upon the Government, and virtually revolting against their authority. Gorgei retired to the Hungarian Erzgebirge and conducted operations on his own initiative. Meanwhile, the supreme command had been conferred upon the Pole, Dembinski, but the latter suffered defeat at Kapolna, and the command again devolved upon Gorgei.

The campaign in the spring of 1849 was brilliantly conducted by him, and in a series-of engagements he defeated Windischgratz at Izsaszeg and Wohlgemuth at Nagy Sarld; had he followed up his successes by taking the offensive against the Austrian frontier, it is quite possible that he might have dictated terms in the Austrian capital itself. As it was, he contented himself with reducing Ofen, and then he remained inactive for some weeks. Meanwhile, at a Diet held at Debreczin, Kossuth had formally proposed the dethronement of the Hapsburg dynasty, and Hungary had been proclaimed a republic. Gorgei, who had refused the field-marshal's baton offered him by Kossuth, now accepted under the ijew Government the portfolio of Minister of War, while retaining the command of the troops in the field. The Russians had, however, intervened in the struggle and made common cause with the Austrians ; they were advancing into Hungary on all sides, and Gorgei was defeated by Haynau at Pered. Kossuth, perceiving the impossibility of continuing the struggle, and being unwilling himself to make terms,

resigned his position as dictator, and was succeeded by Gorgei, who, with his army of 20,000 infantry and 2000 cavalry, surrendered to the Russian general Eiidinger at Vilagos. Gorgei. was not court-martialled, as were his captains, but kept in confinement at Klagenfurt, where he lived until 1867, when he was pardoned, and returned to Hungary. Since then he has not played any role in public life, and though in 1885 an attempt was made to rehabilitate him in public estimation, it was not favourably entertained in Hungary. (See also article Hungary, History, in, Ency. Brit., 9th edition.)

Cori, district town of Russia, Transcaucasia, government and 49 miles by rail N.W. of Tiflis, on the Kura ; altitude 2000 feet. The surrounding country is very picturesque, the climate very mild, and Gori is one of the best smaller towns of Transcaucasia. It has a high school for girls, and a school for Russian and Tatar teachers. Gori is built at the f oot*of the hill upon which stood the Goristsikhe fortress, founded, according to trar dition, by Byzantine emperors. It was founded probably

in the 7th century, and rebuilt in 1123. Population (1897), 10,467.

Corlice, a district town in South-Western Galicia, Austria, on the Ropa river. It is an old and important trading centre for corn, wine, linen, and woollen stuffs, and other local products, such as the naphtha distilled from the asphalt, of which there are large deposits in the vicinity. Population (1890), 6663 ; (1900), 6468.

Corlitz, a town of Prussia, province of Silesia, 66 miles east of Dresden by rail, on the Neisse. It is an important industrial town and railway centre, and ranks as the second town in Silesia. In 1889-91 a tower (276 feet) was built to the church of St Peter and St Paul. The town, which has grown rapidly since the demolition of the former walls, has a handsome appearance, and is adorned with statues to the Emperor ^A'illiam I. (1893), Burgomaster Demiani by Schilling (1876), and (in the town park) to Bohme (1898), Prince Frederick Charles (1891), the War of Liberation of 1813, and (in the town) a monument of Roon (1895) and an ornamental fountain

(1887). The neighbouring hill of Landeskrone (1410 feet) is adorned with a monumental obelisk to Theodor Korner (1896). Amongst the public institutions may be mentioned the Milich Library and the library of the Upper Lusatia Society— both containing valuable MSS.— the municipal museum of Lusatian antiquities, the Emperor William Museum, commercial, agricultural, industrial, and other special schools, and the railway bridge (1650 feet long), of 32 arches, across the river Neisse. Gorlitz is regarded as classic ground for the study of German Renaissance architecture. It also plays a prominent part in the musical world of Silesia. In addition to nearly a

dozen large clotli factories, employing over 2000 hands each, there are factories for the manufacture of alpaca, machinery, gold and silver wares, wirework, chemicals, sausages, railway material, and toys. Population (1886), ,55,702 ; (1900), 80,932.

Cortchakoff, Alexander Michailovitch,

Pkikce (1798-1883), Russian statesman, came of a princely family which claimed descent from Rurik. He was born on the 16th of July 1798, and was educated at the lyceum of Tsarskoe Selo, where he had the poet Pushkin as a school-fellow. He became a good classical scholar, and learnt to speak and write in French with facility and elegance. Pushkin in one of his poems described young Gortchakoff as “Fortune’s favoured son,” and predicted his success. On leaving the lyceum Gortchakoff entered the Foreign OfB.ce under Count Nesselrode. His first diplomatic work of importance was the negotiation of a marriage between the Grand Duchess Olga and the Crown Prince Charles of Wiirtem-berg. He remained at Stuttgart for some years as Russian minister and confidential adviser of the Crown Princess. He foretold the outbreak of the revolutionary spirit in Germany and Austria, and was credited with counselling the abdication of Ferdinand in favour of Francis Joseph. When the German confederation was re-established in 1850 in place of the parliament of

Frankfort, Gortchakoff was appointed Russian minister to the Diet. It was here that he first met Prince Bismarck, with whom he formed a friendship which was afterwards renewed at St Petersburg. The Emperor Nicholas found that his ambassador at Vienna, Baron Meyendorff, was not a sympathetic instrument for carrying out his schemes in the East. He therefore transferred Gortchakoff to Vienna, where the latter remained through the critical period of the Crimean war. Gortchar koff perceived that Russian designs against Turkey supported by Great Britain and France were impracticable, and he counselled Russia to make no more useless sacrifices, but to accept the bases of a pacification. At the same time, although he attended the Paris Conference of 1856, he purposely abstained from affixing his signature to the treaty of peace after that of Count Orloff, Russia's chief representative. For the time, however, he made a virtue of necessity, and Alexander II., recognizing the wisdom and courage which Gortchakoff had exhibited, appointed him minister of foreign affairs in place of

Count Nesselrode. Not long after his accession to office Gortchakoff issued a circular to the foreign Powers, in which he announced that Russia proposed, for internal reasons, to keep herself as free as possible from complications abroad, and he added the now historic phrase, “La Russie ne houde pas ; elle se recueille.” During the Polish insurrection Gortchakoff rebuffed the suggestions of Great Britain, Austria, and France for assuaging the severities employed in quelling it, and he was especially acrid in his replies to Earl Russell’s despatches. In July 1863 Gortchakoff was appointed chancellor of the Russian empire expressly in reward for his bold diplomatic attitude towards an indignant Europe. The appointment was hailed with enthusiasm in Russia, and at that juncture Prince Chancellor Gortchakoff was unquestionably the most powerful minister in Europe.

An ajaprochement now began between the courts of Russia and Prussia ; and in 1863 Gortchakoff smoothed the way for the occupation of Holstein by the Federal troops. This seemed equally favourable to Austria and

Prussia, but it was the latter Power which gained all the substantial advantages ; and when the conflict arose between Austria and Prussia in 1866, Russia remained neutral and permitted Prussia to reap the fruits and establish her supremacy in Germany. When the Franco-German war of 1870-71 broke out Russia answered for the neutrality of Austria. An attempt was made to form an anti-Prussian coalition, but it failed in consequence of the cordial understanding between the German and Russian chancellors. In return for Russia's service in preventing the aid of Austria from being given to France, Gortchakoff looked to Bismarck for diplomatic support in the Eastern Question, and he received an instalment of the expected support when he successfully denounced the Black Sea clauses of the Treaty of Paris. This was justly regarded by him as an important service to his country and one of the triumphs of his career, and he hoped to obtain further successes with the assistance of Germany ; but the cordial relations between the cabinets of St Petersburg and Berlin did not subsist much longer.

In 1875 Bismarck was suspected of a design of again attacking France, and Gortchakoff gave him to understand, in a way which was not meant to be offensive, but which roused the German chancellor's indignation, that Russia would oppose any such scheme. The tension thus produced between the two statesmen was increased by the political complications of 1875-78 in South-Eastern Europe, which began with the Herzegovinian insurrection and culminated at theBerlin Congress. Gortchakoff hoped to utilize the complications in such a way as to recover, without war, the portion of Bessarabia ceded by the Treaty of Paris, but he soon lost control of events, and the Slavophil agitation produced the Russo-Turkish campaign of 1877-78. By the preliminary peace of San Stefano the Slavophil aspirations seemed to be realized, but the stipulations of that peace were considerably modified by the Congress of Berlin (13th June to 13th July 1878), at which the aged chancellor held nominally the post of first plenipotentiary, but left to the second plenipotentiary. Count Schuvaloff, not only the task of

defending Russian interests, but also the responsibility and odium for the concessions which Russia had to make to Great Britain and Austria. He had the satisfaction of seeing the lost portion of Bessarabia restored to his country by the Berlin Treaty, but at the cost of greater sacrifices than he anticipated. After the congress he continued to hold the post of minister for foreign affairs, but lived chiefly abroad, and resigned formally in 1882, when he was succeeded by M. de Giers. He died at Baden-Baden on the 11th of March 1883. Prince Gortchakoff devoted himself entirely to foreign affairs, and took no part in the great internal reforms of Alexander II.‘s reign. As a diplomatist he displayed many brilliant qualities — adroitness in negotiation, incisiveness in argument, and elegance in style. His statesmanship, though marred occasionally by personal vanity and love of popular applause, was far-seeing and prudent. In the latter part of his career his main object was to raise the prestige of Russia by undoing the results of the Crimean war, and it may fairly be said that he in great measure

succeeded.

Corz and Cradisca, a county and crownland of the Cisleithan half of the Austro-Hungarian Monarchy. In conjunction with the peninsula and islands of Istria, and the town and territory of Trieste, they constitute the Austro-Illyrian Kilstenland or littoral. Gradisca is that part of Friuli which remained to Austria after the peace of Nikolsburg in 1866. Population (1880), 211,084; (1900), 232,338. Racially 63 per cent, are Slovenes, 36 per cent. Italians and Ladins, i.e., Friulians who speak the Ladin dialect, and 1 per cent. German. Classified by religions, 99-6 per cent, are Roman Catholic, the remainder being of the Hebrew, Protestant, and Greek Orthodox faiths. In 1896 the marriage-rate was 6-75, the birth-rate

36-40, or, excluding still-births, 35-42, and the death-rate 26-01 per thousand. Of the births 3-38 per cent, were illegitimate, the lowest proportion in Austria. The crown-land is represented in the Reichsrath by five members

(three Italians and two Slovenes). The provincial Diet is composed of twenty-one Italians and twelve Slovenes. Although 70-47 per cent, of the population is still engaged in agriculture and forestry, industry (17-65 per cent.) is progressing, and particularly the manufacture of silk, of which the chief seats are the town of Gorz and the village of Haidenschaft. Viticulture and the cultivation of the silk-worm are the chief agricultural resources. The most important crops are maize, wheat, buckwheat, barley, potatoes, and fruit. A small quantity of rice is also grown. For education, communications, &C., see KtJSTENLAND.

Corz (Italian, Gorizia), chief town of the Austrian crownland and administrative district of the same name. Industry is progressing, particularly the manufacture of silk and cotton yarns and stuffs, candles, liqueurs, &c. The principal trade is in early fruit, grapes, and vegetables. The entertainment of visitors is a resource of growing importance, owing to the increasing popularity of the town as a winter resort. The Due de Chambord,

who died at Gorz in 1883, was buried in the Franciscan monastery outside the town, where also lie the remains of King Charles X. of France. Population (1890), 21,825; (1900), 25,432 ; two-thirds Italians, the rest mostly Slovenes and Germans. There is a garrison of 1761 men. The population is almost entirely Catholic, the Jews, Protestants, and members of the Greek Orthodox Church forming a mere fraction.

Coschen, George Joachim Coschen, 1st Visoou^-T (1831 —), British statesman, son of William Henry Goschen, a London merchant of German extraction, was born in London, 10th August 1831. He was educated at Eugby under Dr Tait, and at Oriel College, Oxford, where he took a first-class in classics. He entered his father's firm of Frtlhling & Goschen, of Austin Friars, in 1853, and three years later became a director of the Bank of England. His entry into public life took place in 1863, when he was returned without opposition as member for the City of London in the Liberal interest, and this was followed by his re-

election, at the head of the poll, in the General Election of 1865. In November of the same year he was appointed Vice-President of the Board of Trade and Paymaster-General, and in January 1866 he was made Chancellor of the Duchy of Lancaster, with a seat in the Cabinet. When Mr Gladstone became Prime Minister in December 1868, Mr Goschen joined the Cabinet as President of the Poor Law Board, and continued to hold that office until March 1871, when he succeeded Mr Childers as First Lord of the Admiralty. In 1874 he was elected Lord Eector of the University of Aberdeen. Being sent to Cairo in 1876 as delegate for the British holders of Egyptian bonds, in order to arrange for the conversion of the debt, he succeeded in effecting an agreement with the Khedive. In 1878 his views upon the County Franchise question prevented him from voting uniformly with his party, and he informed his constituents in the City that he would not stand again at the forthcoming General Election. In the following August he attended the International Monetary Conference at Paris. In 1880 he was

elected for Ripon, and continued to represent that constituency until the General Election of 1885, when he was returned for the Eastern Division of Edinburgh. Being opposed to the extension of the franchise, he was unable to join Mr Gladstone's Government in 1880; declining the post of Viceroy of India, he accepted that of Special Ambassador to the Porte, and was successful in settling the Montenegrin and Greek frontier questions in 1880 and 1881. He was made an Ecclesiastical Commissioner in 1882, and when Sir Henry Brand was raised to the peerage in 1884, the Speakership of the House of Commons was offered to him, but declined. During the Parliament of 1880-85 he frequently found himself unable to concur with his party, especially as regards the extension of the franchise and questions of foreign policy; and when Mr Gladstone adopted the policy of Home Eule for Ireland, Mr Goschen followed Lord Hartington and became one of the most active of the Liberal Unionists. His vigorous and eloquent opposition to Mr Gladstone's Home Eule Bill of 1886 brought

him into greater public prominence than ever, but he failed to retain his seat for Edinburgh at the election in July of that year. On the resignation of Lord Eandolph Churchill in December 1886, Mr Goschen, though a Liberal Unionist, accepted Lord Salisbury's invitation to join his Ministry, and became Chancellor of the Exchequer. Being defeated by Mr Nevill, a Gladstonian Liberal, at Liverpool, 26th January 1887, by seven votes, he was elected for St George's, Hanover Square, on 9th February. His Chancellorship of the Exchequer during the Ministry of 1886 to 1892 was rendered memorable by his successful conversion of the National Debt in July 1889 (see National Debt Conversion). With that financial operation, under which the new 2f per cent. Consols became known as "Goschens," his name will long be connected. Aberdeen University again conferred upon him the honour of the Lord Eectorship in 1888, and he received a similar honour from the University of Edinburgh in 1890. In the Unionist opposition of 1893 to 1895 Mr Goschen again took a vigorous part,

his speeches both in and out of the House of Commons being remarkable for their eloquence and debating power. From 1895 to 1900 Mr Goschen was First Lord of the Admiralty, and in that ojBBce he earned the highest reputation for his businesslike grasp of detail and his statesmanlike outlook on the naval policy of the country. He retired in 1900, and was raised to the peerage by the' title of Viscount Goschen of Hawkhurst, Kent, on 17th December. He married in 1857 Lucy, daughter of Mr John Dalley, but lost his wife in 1898. In educational subjects he had always taken the greatest interest, his best known, but by no means his only, contribution to popular culture being his participation in the University Extension Movement ; and his first efforts in Parliament were devoted to advocating the abolition of religious tests, and the admission of Dissenters to the universities. His published works indicate how ably he combined the wise study of economics with a practical instinct for business-like progress, without neglecting the more ideal aspects of human life. In addition to his well-known work on

The Theory of the Foreign Exchanges, he is the author of several financial and political pamphlets and numerous addresses on educational and social subjects. Among the latter may be mentioned that on Cultivation of the Imagination, Liverpool, 1877, and that on Intellectual Interest, Aberdeen, 1888.

Goshen, capital of Elkhart county, Indiana, U.S.A., on the Elkhart river, and on the Cleveland, Cincinnati, Chicago, and St Louis, and the Lake Shore and ilichigan Southern railways, at an altitude of 800 feet. It has some manufactures, especially of waggons, agricultural implements, flour, &c., and a large lumber trade. Population (1880), 4123; (1890), 6033; (1900), 7810, of whom 462 were foreign-born.

G 0 S L A R— G 0 S P E L S

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Coslar, a town of Prussia, province of Hanover, situated at the north foot of the Harz, 31 miles by rail south by west from Brunswick. The post office (1893), classical school (1888), museum of the Natural Science

Society (especially the collection of Harz minerals), the Fenkner Museum of Antiquities, and the miners' church of St Peter and St Paul (Frankenberg), built originally in 1108, rebuilt in 1225, and restored in 1880, deserve to be mentioned. The emperor's house was restored in 1867-80. Population (1885), 11,736; (1900), 16,403.

Gospels. — In this article a somewhat different order will be followed from that adopted in Ency. Brit., vol. x. Points connected with the external evidence will be treated first for all the Gospels together, and we shall then pass to the evidence supplied by the study of the works themselves and their relations to one another.

I. — External Evidence.

A few statements and conclusions in the earlier article seem to require revision in the light of later investigations.

(1) The three Epistles of Ignatius, as known through the Curetonian Syriac, are there regarded as genuine, while the seven Epistles in the short Greek or Vossian form are supposed to be an unauthentic expansion, and are assigned to A.i). 160. It has now been established,

mainly through the labours of Zahn and Lightfoot, that the latter are genuine, and that their date must be thrown back somewhat. They may be placed between a.d. 110 and 130. This difference of twenty to forty years is not unimportant in relation to the stages in the recognition of the Gospels.

(2) Formerly the view was taken that the first three Gospels were the documents designated by Justin as Apostolic Memoirs, and his chief authorities; but that he made no use at all, or at most an extremely slight one, of the Fourth Gospel, and that his only source besides for the Gospel history was oral tradition. The progress of inquiry has confirmed the opinion that Justin did use the Synoptic Gospels, or at all events, Matthew and Luke, and that they were among the works chiefly referred to by him under the name Memoirs of the Apostles. It has, besides, been decidedly favourable to the belief that he knew and" used the Fourth Gospel also.

The majority of critics, including many who cannot be suspected of conservative bias, now hold this. A. Hilgenfeld, who in 1850

declared it to be “in the highest degree improbable

Did Justin that he was acquainted with it” {Krit. Untersuoh.

‘’”%’ iifcer- die Evang., p. 304), writes in 1875 that “the use

pMira ^^^ Justin] of the Johanniue Gospel would be difficult

Qospel? *° deny” {Einleit., pp. 66, 67) ; compare Keim, Jesus

of Nazara, i. p. 186 ff., English translation ; Thoma,

Genesis des Evang. Johann., p. 824 ; H. Holtzmann, Einleit., 3rd

ed., p. 100; Jiilichev, .Einleit., p. 293; Harnaok, Chronol., i. p.

673 f. At the same time, these writers do not admit that Justin

attributed Apostolic authority to the Fourth Gospel, though they

allow that he did to the others. This is a point to which we shall

return. Among writers who are more unreserved in their admis-

sions as to the testimony borne by Justin’s writings to the Fourth

Gospel, Prof. James Drummond, Theological Review for October

1875, and April and July 1877, and Dr Ezra Abbot, The Author-

ship of the Fourth Gospel, External Evidences, pp. 16-48, may be

specially mentioned.

In judging of the signs of Justin’s use of the Fourth Gospel,

care must be taken not to exaggerate the contrast afforded by his

use of Matthew. This is the Gospel from which he unquestionably

takes most, but he does not ” quote” it in the strict sense of the word. He nowhere refers to it specifically ; with only one or two exceptions he does not give its words exactly ; most often he departs from it considerably, condensing, or combining passages from different parts of it, and from parallels in Luke. To say the least, we cannot expect greater exactness when he reproduces the substance of passages of the Fourth Gospel.

Further, the verdict must depend upon the cumulative force of a number of indications, many of them slight in themselves. The evidence cannot be massed and examined here, but a few illustrations may be given. In Dial. c. 69, in one of his customary summaries of facts which were fulfilments of prophecy, there are no fewer than three traits which forcibly remind us of John. One of these relates to a charge brought by the Jews against .Jesus. There are many other allusions in different places in the Dial, to our Lord’s conflicts with the Jews, which recall this Gospel specially {e.g., comp. turns of expression in Dial. c. 136 with Jn. v. 37, 38, 23, 24). To pass to theological teaching: the correspondence between Justin and the Fourth Gospel in regard to the doctrine of the Person and Mission of Christ is extensive. See, e. g. , iqr several

ppints, Apol. ii. 6, comparing Jn. i. 1, 2, 3, 12, 13. The peculiarly Johannine thoughts, that Christ came from the Father, that the Father sent Him, that He fulfilled the Father's will, that He derived His power from the Father, are prominent in Justin. See, e.g., Apol. i. 0 and Dial. 64, and comp. Jn. i. 9, iii. 31, xii. 46, &c. ; Apol. 14, and comp. Jn. xiv. 6 ; Dial. 140, and comp. Jn. iv. 34, xiv. 10, &c. ; Dial. 30, and comp. Jn. v. 36 ; Dial. 100, and comp. Jn. X. 18. The same types also appear. In addition to "the light" and "the living water," which will be found in passages already referred to, we have the brazen serpent twice {Apol. 60, and Dial. 91 ; see especially the latter).

Among the largely increased number of students who have been convinced that Justin was acquainted with the Fourth Gospel, there are, at the same time, as we have observed, those who hold that it did not in his estimation take rank, like the Synoptics, as a member of the class of Memoirs of the Apostles. The ground for supposing this difference is chiefly his more limited and less distinct use of it. But as regards this, it may well be urged that the contents of the Fourth Gospel were on the whole less suited to the purpose he had in hand. It may be added that there are passages

in which, according to the most natural interpretation of his language, statements taken from the Fourth Gospel are referred to the Memoirs. (See Dial. 105 ; also Apol. 1. 46, where he says that “we were taught” — no doubt he would say on the authority of the Apostles, and probably by means of. their “Memoirs” — that ” Christ was the Word of Whom the whole race of men partook.” Comp. also ihid. c. 66.)

A few words must be added on another point in connexion with Justin, viz., the question whence he derived those traits and incidents in his representation of the Gospel history, which cannot be traced to the Gospels, or to reflexion upon Old Testament prophecies, aided by his own imagination. Here the view adopted in the earlier article is that which ‘ ‘ orthodox ‘ ‘ writers had commonly maintained. The use by Justin, to an appreciable extent, of any written source or sources other than the Gospels is denied. Few critics of any school would now feel able to agree to this. Seeing that Hegesippus, a contemporary of Justin, is said by Eusebius to have quoted from the Gospel according to the Hebrews (jff. E. iv. 22) , and that another contemporary, the author of the Homily commonly called the 2nd Ep. of Clement, also quotes from

an Apocryphal Gospel, apparently that according to the Egyptians, it is in itself probable that Justin may have known some such work or works, and been quite ready to give credence to its or their statements. Some parallels may be noticed between Justin and the recently recovered fragment of the Gospel of Peter, and several critics think that Justin himself refers to this work when he says that a fact about Peter and certain other Apostles, is recorded in his (Peter's) Memoirs {Dial. 106)— hereby assuming that if we had the whole work we should find therein the statement in question. But there is a passage entirely to the purpose in Mark iii. 16, 17, and Justin's words can be satisfactorily explained as an allusion to this Gospel. It should also be observed that in those few particulars in which there Is a measure of resemblance between Justin and the Gospel of Peter, the former (to speak generally) is nearer to the Gospels. In one important respect his language is directly opposed to that of the work in question.

If Justin was not only acquainted with the Gospel of Peter, but believed it to be the composition of that Apostle, or to embody his testimony, he must have regarded it as a high authority. It is contrai-y to the evidence to suppose that he did this. Whether he

included any other writings, afterwards reckoned by the Church as ” apocryphal” among his Apostolic Memoirs, or even while admitting them to this class was conscious of any difference in value and authenticity between them and other members of it to which afterwards a unique position was attributed, are questions which the indications in his writings hardly enable us to decide.

(3) The so-called Muratorian fragment on the Canon would not now generally be placed so early as a.d. 170. Lightfoot in his latest work seems to regard a.d. gg^^,^^^ 185-190 as more probable (Apostolic Fathers, evUenceot Part i. vol, ii. pp. 413 and 496). Zahn arrives grouping at about a.d. 210 as its date {Kanon, ii. 136). ”’ oospeis. The first formal list of the writings of the New Testar ment which we know of must thus be held to belong to a somewhat later time than has often been supposed.

But as regards the evidence of the special recognition of the four Grospels there is an equivalent in the fuller knowledge which has been obtained of Tatian’s Diates-

saron. Little room now remains for doubting that this work was an account of the life of Christ compiled from the Gospels — from these and not in any comparable degree from other sources, and also not more from the Synoptics than from the Fourth Gospel, with the first words of the Prologue to which the work began, ” In the beginning was the Word.” ^ The importance of this fact will be perceived, if we bear in mind that Tatian was at Rome with Justin Martyr, and speaks of him with profound reverence. We may take a.d. 160-180 as the period of his chief literary activity.

(4) In judging of the external evidence as to the authenticity of the Gospels, and in an especial manner of the Fourth Gospel, it is essential that we ti”^” . ^^°^^^<1 t^^^ account of the position held by raiiyf””^’ ^-^le four Gospels in the Church at the end of the second and beginning of the third century, and should endeavour to estimate the age and strength, and to speak generally the trustworthiness, of the traditional beliefs on which it rested. This is a

subject on which some of the chief writers on the Canon in recent times have joined issue. It is admitted on all hands that at this epoch the four Gospels were regarded in the most prominent Churches of the Roman Empire as the embodiment, in an altogether unique sense, of the Apostolic testimony in regard to the life and teaching of Christ. Irenseus (Adv. Hcer. book iii. cc. 1-11) is a witness for ancient Churches on the western coast of Asia Minor and Eome, as well as Southern Gaul ; the Muratorian fragment is another witness as to the Church of Kome, whether it is, or is not, by Hippolytus, as also are the undoubted works of Hippolytus ; Clement of Alexandria (Strom, iii. c. 13) for that great Christian community. TertuUian (Adv. Marcionem, iv. 5), again for Rome as well as for North Africa. It can hardly be doubted that the authority of the fourfold Gospel was equally firmly established in at least some other Churches which are not so directly represented; while soon after this time it had certainly come to be accepted in all parts of the Church. Books which had only lately become

known could not have been regarded as these were in those divers Churches, and by those eminent teachers to whom we have referred. These men themselves had a long and wide experience of Christian tradition. Irenaeus refers in particular to his recollection of what as a boy he had heard Polycarp relate concerning John, by whom he evidently means the Apostle. It has been said that as Irenseus appears to be mistaken when he asserts that Papias was a hearer of John, confusing here between John the Apostle and a certain elder John, so he may be mistaken in the case of Polycarp. His statement, however, in regard to Papias seems to have been founded on what he had read in the latter's book ; and it is one thing that he should have formed and preserved an erroneous impression thus, quite another that he should be at fault in reminiscences of what he had heard in early youth, about the distinctness of which in his own case he is very emphatic. But it is, perhaps, more important to observe that in regard to the tradition of the residence of St John in Ephesus, and all that concerned the recog-

nition of the Fourth Gospel, as well as the other three, there must have been abundant opportunities for his own memory to be corrected by that of many other Christians both of the same age as, and older than, himself. The place which we find the four Gospels occupying at the

1 For a narrative of the literary innds and investigations wliich lead to this conclusion, see The Diatessaron of TiUian, by S. Hemphill; or the introduction to The Diatessaron of Tatian, by J. H. HiU.

epoch we have indicated was due to an appreciation of their value which had grown by degrees; yet at the same time it would seem to have been one which could not have been attained without a long-standing convic-tion as to their pecuHar claim to be trusted. When written accounts of the life of Christ were put forth— which, according both to the view traditional in the Church and other evidence, was not till about or after the close of the lives of St Paul and St Peter— they naturally did not cause the oral method of transmitting the facts, hitherto relied on exclusively, to be at once laid aside. But as those who could themselves remember

the Apostles and their fellow-labourers and the teaching given by them passed away, the importance of documents which came down from the Apostolic age, or its confines, necessarily increased. Ther* are inequalities for a certain period in the signs of their distribution and use. But this is easily understood when it is considered that they appeared in different quarters, and that an interval of about thirty years (again according to both tradition and criticism) elapsed between the publication of the earliest and the Fourth ; and when in addition we remember the labour of copying, and allow for the probability that one rather than another might in a special manner commend itself to various individual minds and Churches. Again, attention was at first fixed upon the substance of the Gospel ; the precise words of the record were comparatively little regarded. Hence there was small reason for indicating particular sources ; and when two or more sources contained parallel passages, there was a disposition. to combine them instead of quoting them in their distinctness. Of these statements

abundant proofs might be adduced from the writings of the sub-Apostolic age and the Apologists of the middle of the 2nd century. With time the distinct value of each of the several records was perceived, and a conception of their relations to one another was attained. Here, as in many other cases, the work of definition was promoted by conflict with heresy. Gnostics, and others who held more or less exaggerated and one-sided views, were wont to exalt one or more of the four Gospels to the disadvantage of the remainder, or to make use of other Gospels.^ Hence arose the need of marking off clearly those which were to be deemed authentic, and of insisting that all these were alike to be reverenced. The intrinsic worth of the four Gospels, their manifest superiority to all other works of the kind, and their agreement with the tradition of Apostolic doctrine, may have had a share in procuring this result. But the conclusion in question seems to have been formulated even more on the ground of the actual history of the Gospels. Indeed, we may say with – confidence that it could not

without this external reason have been arrived at so swiftly and surely, with so little doubt and debate, as it was, when we consider the unfitness of the masses of men at all times, and peculiarly so of the early Christians, for forming a decision on critical grounds. In this connexion it is well to note that, according to the information which we possess, the leading part in framing this Canon of the Gospels was taken by the chief Churches in that Greek-speaking world for which the Gospels (not excepting the First in the form in which we have it) were composed.

II. — Internal Evidence.

1. Tlie Synoptic Problem.— The ” originality of Mark ” is a thesis maintained at the beginning of the article in the ninth edition of this work. It is there argued that the

2 See Iren. Adn. User. iii. xi. 6; and for the attitude of the Alogi to the Fourth Gospel, ib. § 9, and Epiphan. Hxr. li. ; also, for use of Gospel of Peter by Docetae, Eus. H. E. vi. 12.

Second Gospel cannot be derived from the First and Third, and that on the contrary it most nearly represents, for that portion of the Gospel history which it gives, a source used in the First and Third. These are some of the most widely accepted and most secure results of modern criticism as •to the literary relations of the Gospels. It wiU not be Was the necessary here to dwell further upon them. common We go on to ask whether the common source source oral “was Oral Or Written. In judging of this ques- or written ? ^^^^ we must take account not only of the amount of agreement between all three Synoptics, but also of the still fuller agreement between Mark and the two others separately in the same contexts. When, for example, in a passage, the substance and many of the words and phrases of which are common to all three, we find whole sentences and the general structure of the passage identical in Matthew and Mark, though Luke differs more or less, the obvious inference is that the fixity of the common source must at least be meas- ured by the resemblance between the two first, and that

the third has departed from it. But this is the case again and again. In like manner there are numerous instances, though, on the whole, not so many, in which Mark and Luke agree, where Matthew is independent. Nearly the whole of the subject-matter, and to a large extent the phraseology, of Mark reappear in Matthew and Luke taken together. Further^ the correspondence between the Synoptics, not only in regard to language and the form of separate narratives, but also in regard to the sequence of sections, needs to be particularly noted. And the agreement between the pairs Mark and Matthew, Mark and Luke, once more calls for explanation, as well as that between all three. In point of fact, Mark's order is almost invariably supported by one of the others, as well as frequently by both. The amount of agreement of these different kinds is so great that to the majority of students of the subject at the present time it seems impossible to explain it solely by the influence of a common oral tradition, even when every allowance is made for unusual conditions which may have tended to give stability to

such a tradition.

The common source, then, was a document in which almost the whole of the contents of Mark was found, given at least nearly in the same form and arranged in the same manner. Vhateve else we may be able to learn about this document, e.g., as to whether any other matter was included in it, we have thus made a first approximation to a knowledge of its character.

We have traced agreements between Mark and either of the other two Synoptics to a source which was also known to and largely used by the third. May common ^® ^o*) then, also see the same common source toss. revealed in the agreement of the other pair, andil'L. J^atthew and Luke ? The answer is that it would not be unreasonable to do so on the same condition as before, viz., that the agreement occurs as part of a more general parallelism between all three. But while this holds universally in connexion with the coincidences between Mark and one of the others, those of INIatthew and Luke where this requirement

is satisfied are comparatively rare, and they consist for the most part only of isolated words or brief phrases.

An instance in wMch the agreement is more extensive is afforded by a comparison of the passages in the three Synoptics on the preaching of the Baptist. The relations between the three may be satisfactorily explained by the supposition that the inatter which is verbally identical in Matthew and Luke, but omitted by Mark (JIatt. iii. 7-10 and 12; Lu. iii. 7-9 and 17), together with the words given by all three (Matt. iii. 11 ; Mk. i. 7, 8 ; Lu. iii. 16), was taken from the source from which the common elements generally in the three Gospels are derived. There may be one or two other pieces of discourse in regard to which the same view may deserve to be considered. Holtzmann, however, refers a good deal more matter which is not given in Mark to the same source, where there is not the reason which I have indicated, or any other sufficient grounds for doing so (see below).

The greater part of the matter not contained in Mark, which is common to Matthew and Luke, falls into another category. It is introduced into the Synoptic outline

very differently in these two Gospels. This fact clearly suggests that it existed in a separate form, and was independently combined by the first and third Evangelists with the contents of that source which we have hitherto had before us. This matter has also a character of its own ; it consists mainly of pieces of discourse ; and it is not difficult to imagine influences which during the period of oral teaching may have tended to secure the collection of considerable portions of it, at least, in the shape in which we have it. (Comp. Weizsacker, Apost. Age, ii. p. 33 ff., in Eng. trans.) It is, perhaps, most generally believed by critics at the present time that the first and third Evangelists derived it from the same document. But the grounds for supposing a common written source are not so strong in this as in the former case. Some connexion between the source or sources used in the two Gospels must, no doubt, be assumed, for parts of it are reproduced in the two in exactly, or almost exactly, the same form. But in other parts, as pointed out in the earlier article, the agreement is far less close. This

strange variety requires explanation. Further, the arrangement of the whole of this matter in ilatthew and Luke is very different, not only, as we have already noted, with reference to the general plan of the Gospel narrative, but also regarded simply by itself. It is far more broken up in Luke. If, then, its derivation from a single common document in both is assumed, we have to ask in which of the two that document has been most faithfully followed; or, in other words, whether the first Evangelist has brought together what he found dissevered, or the third has scattered what he found united. The former of these processes would seem to have been the easier and the more natural. But this view of the origin of the difference is hard to reconcile with the tradition which, on the strictest grounds of historical criticism, ought to have considerable weight, as to the connexion of Matthew with the First Gospel. It would still be possible, indeed, that the common document might have been his work, but the Third Gospel would, at least in important respects, be the truest representative

of it.

This objection may be avoided, and we shall have a theory which, it would seem, takes account more fully of all the facts, if we suppose that the particular collection of the matter we are considering, which has been embodied in Matthew, was not directly used by the third Evangelist, but that he himself compUed the similar matter which he gives from what he had learnt by oral transmission or obtained in the form of written fragments. Those passages in which the two Gospels agree almost verbally may have been first copied from a Greek version of the Matthew document by some who were making smaller collections of the teaching of our Lord on particular topics for their own use; or, again, they may have been pieces early translated from the Hebrew document, or even portions of Greek oral tradition that had been written down, which were introduced by the editor of the Greek Matthew at the places to which, according to his original, they belonged, but which, as we have supposed before, came independently into the

hands of the third Evangelist. The latter seems expressly to claim that the arrangement of what he related was his own (Lu. i. 3).

St Mark.

It will be desirable now to say a few words on the composition of each of the three Synoptic Gospels individually, taking into account as we do so what we have learnt from comparing them, and also touching upon any other points which need to be considered.

Can we determine somewhat more exactly than we have hitherto done how the Second Gospel was related to the document which was at least most nearly reproduced in it? (a) To what extent did it differ therefrom by abbreviation ? We have seen that the additions to this source which can with any high degree of probability be made on the ground of parallelisms in Matthew and Luke are but scanty. Holtzmann, how-

ever, supposes that it contained, among other things, the Sermon on the Mount. The omission of this sermon, and (with the exception of a couple of sayings) of all parallels to its contents, is a remarkable feature of the Second Gospel. It is impossible to imagine that its author, or editor, could have been ignorant of the whole of this matter. That he should have passed it over entirely, if it was included in his own principal document, would also have been very strange. That he might have thought its inclusion by himself unnecessary would be somewhat more easy to understand, if it had already been set forth in another writing, (b) Scattered throughout Mark there are forcible and vivid touches which do not appear in the parallels in Matthew and Luke. Were these added to the document which lay before them subsequently to.their use of it ? There hardly seems to be good reason for thinking so. Many of the expressions in question appear to be in the style which, to all appearance, belonged to the original document. The third Evangelist often revised, recast, and condensed that

which he took from it. To a more limited degree the first did the same. It is natural that their omissions should in some instances have coincided. That some changes were made in the original work during the earliest period of its circulation is not improbable. But these appear to have been slight. On the whole we are justified in believing that the Second Gospel is substantially the work which, as Papias learned from ” the Elder,” Mark composed from his reminiscences of Peter’s teaching.

The editor who has given us the Eirst Gospel in its present shape in Greek employed mainly, if not exclusively, two documents. Discourses and sayings were the most characteristic contents of one of these, though it is possible that some narTatives may also have been comprised in it. Occasions on which the teaching recorded was given may probably have been indicated in it to some extent ; but words spoken at different times which bore on the same subject would seem not infrequently to have been put

together. This work was originally written in Hebrew (or Aramaic), and if not by the Apostle Matthew, was at least known to represent what he had taught. The editor of the Greek Matthew either himself translated this work, or so much of it as he required for his purpose, or had before him a translation which had already been made. But along with this he used Mark's narrative. Nay, he may without serious exaggeration be said to have incorporated the Matthew document with it. It supplied the framework, while in passage after passage we have virtually a transcript from it, with here and there an abbreviation or the omission of a sentence that may well have appeared redundant, or with some other saying woven in. Additional sayings, in such contexts need not indicate the existence of an account parallel in other respects which contained them. They may have been introduced from some distijict group of sayings in the other document, or be fragments of oral tradition inserted by the St Matthew.

editor of the Greek Gospel. Yet it is in itself probable that the two documents overlapped ; and where sections which have parallels in Mark are not placed in the same connexion as these, or have many marks of an independent origin in their form and substance, or differ in both respects, it is reasonable to see in these variations- the influence of the Hebrew original.

It is especially notewortiiy that where the placing differs, tlie similarity in other ways is also less close than usual. Comp. Matt, viii. 23-34 with Mk. iv. 35-v. 20 ; Matt. ix. 18-26 with Mk. v. 21-43 ; Matt. x. with Mk. iii. 13-19a, and vi. 66-13. (Matt. x. contains much matter which is given in various places in Luke, also six verses (17-22) closely parallel to Mk. xiii. 9-13.) Sometimes, however, Mark's outline seems to have suggested the point for introducing a passage which, though it has a parallel in Mark, seems to have been derived from another source. Thus Christ's answer to the charge of the Pharisees that He cast out devils by Beelzebub occurs in the same general connexion in Matthew as in Mark (Matt. xii. 24 ; Mk. iii. 22) ; but the incident which gave rise to the charge is the same as that in Luke (xi. 15-26), where it

is part of his ” great insertion,” while the language of the answer has also far closer affinities with that in Luke than in Jlark.

Again, a discourse “-concerning offences ” is given in Matt, xviii. 5-35, in a position corresponding to the one in Mk. ix. 42-50, and several of the sentences in Mark are almost verbally reproduced ; but with them we find combined both much that is peculiar and also a short piece on the same topic, which is placed- by Luke (xvii. 1-4) towards the close of his ‘ ‘ great insertion.” Another naiTa-tive occurring in a context which closely resembles Mark, but con-taining itself many signs of independence, is that of the Canaan itish woman (Matt. xv. 21-28 ; Mk. vii. 24-30).

We possess no such specific information from any early writer in regard to the composition of St Luke’s Gospel as we do in the case of Matthew and Mark.

But when we examine it in conjunction with ” *’ the Acts of the Apostles, which is evidently by the same author, we obtain strong confirmation of the tradi-tional view of the authorship, (a) We may indicate first an argument based on literary style and vocabu-lary. As was remarked in the earlier article, there

are variations of style in the Gospel, and so there are in the Acts. Nevertheless characteristic words and phrases, which for convenience we will at once call ” Lucan,” occur throughout, and evidently proceed from the author of the works in their final shape ; though in parts where he is using materials derived from others, or possibly adopting a style suited to a special theme, they are naturally less frequent. Certain sections, however, of the Acts, commonly called the ” we ” sections from the use in them of the first person plural (xvi. 10-17 ; xx. 6-15 ; xxi. 1-18 ; xxvii. 1-xxviii. 16), are generally admitted to be notes of travel by a companion of St Paul. Now it is a remarkable fact that ” Lucan ” words and phrases are specially abundant in these sections. The inference is that the writer of them was the author of the book as a whole and of the Gospel. (6) There are the geographical accuracy and the other elements of historical credibility which have so much impressed Professor W. M. Eamsay and others.

Luke, as well as the editor of the Greek Matthew, used

Mark ; but he revised its language much more freely, and omitted more. He also supplemented it with other material, but this — if arguments which have been briefly urged above are sound — was not taken from a single source, but amassed by himself through personal inquiry and labour.

2. TJie Fourth Gospel. — The special characteristics of the Fourth Gospel have been for the most part sufiiciently brought out in the article in Ency. Brit., vol. x. There would be agreement as to many of them among students who have examined the Gospel from very diverse points of view. The additional remarks here made will mainly have reference to the bearing of those characteristics upon the question of the credibility of the narrative, and their

object will be to direct attention to some points which seem to have been too much disregarded in that article.

(a) The foregoing brief inquiry into the history of the composition of the Synoptic Gospels, while it justifies

us in regarding them as inestimably precious

ei^s’fnm t°^ “^^^^ ^^^^ ^^1^*® ^ to *^® ^^^^ ^^^ Teach-

Syaoptics. i^g of Jesus, should prevent us from erecting

them into a standard by which every other

treatment of the same theme should be tried. There

is good reason to think that the material which has been

preserved in them had been authenticated by eye-

witnesses ; but no one of the authors of the works in

their present form was in a position to furnish an

approximately complete view of their common subject.

In respect of one difference between the Synoptics and

the Fourth Gospel, namely, the mention by the latter of

several visits to Jerusalem at the time of Jewish Feasts,

to which the former make no reference, probability is

overwhelmingly strong on the side of the Fourth Gospel.

In the Synoptic Gospels Jesus is represented as ready to

conform to the requirements of the ancient Law. This

being so, He could not have refrained persistently from

going up to Jerusalem for the great Feasts. Even with-

out this reason He must have been attracted there by

those great gatherings of Jews which afforded such excellent opportunities for the fulfilment of His prophetic Mission. In addition to this, we cannot understand the final catastrophe, apart from such previous conflicts between Jesus and the ruling classes in Jerusalem as are described in the Fourth Gospel. His work in Galilee did not sufS.ciently threaten their authority to have given birth to a settled determination to destroy Him. Nor could their design and plot against Him have taken shape within three or four days after His triumphal entry.^

To turn to the Teaching of Jesus : the thoughts in the Fourth Gospel are less apparently simple, and are less confined within Jewish forms. But ought it to be supposed on that account that they are less likely to have been those of the Master Himself ? Is the matter-of-fact writer always able to give a truer estimate of a great character, or of a. mighty and complex movement, than the man of reflective mind and philosophical bent ? That the latter’s representation is more liable to be coloured by his own individuality is of course to be

admitted. But in spite of this the advantage is not wholly, or even chiefly, on the side of the man of more limited mind and nature. There might well be portions of the teaching of Jesus which the whole body of the Twelve at first, and many of them to the end, understood very imperfectly, which would be little reflected in the ordinary instruction given to Jewish and other converts in Palestine or elsewhere, and the significance of which could only be apprehended by a man of peculiar depth and intensity of mind after long meditation, and when experience had thrown light upon them.

(b) The author of the Fourth Gospel undoubtedly desires not merely to give a faithful record of the deeds and words of Jesus, but to impress upon his readers his own view of the Person and Mission of Jesus ; and with this intention he makes a selection among the facts, relating, or giving special prominence to, those which are suitable for his purpose. Such selection, designed to bring out certain aspects of the truth, may be perfectly legitimate and necessary. But we have to ask whether the

effect which the beliefs of the Evangelist have had upon

i In the ninth edition (see vol. x. p. 832, n. 3) it is allowed only that the Fourth Gospel may possibly be right as to there having been visits to Jerusalem before the last Passover season, and the really strong reasons for believing that there must have been are overlooked. In the case of another difference between the Fourth Gospel and the other three, that in regard to the day of the Crucifixion, it is more decidedly admitted (i5. 828) that the Fourth has the advantage.

his narrative extends farther than this. Has his conception of the Person of Jesus led him to transform the facts so that he is not a trustworthy witness even in what he states ? In this connexion we will consider, first, the question of the influence upon him of Philo's philosophy. That there are points of contact between the thought and language of the Fourth Gospel and those Ij^^'"/'"' of Philo is unquestionable. But was the Evan- nHo. gelist a disciple of Philo, who, after being well grounded in that philosophy, embraced the Gospel, and who, in his later faith, sought for an exemplification of the principles he had before held ? Or was he simply

a thoughtful Christian believer, who, having formed his idea of Christ and His Mission primarily from the utterances of Jesus Himself and all the facts concerning Him', was ready to avail himself of terms and forms of thought taken from Philo, when he met with them, in order to express what was already in his mind ? In the former case there would be far greater danger that his impressions in regard to the facts and his present-ment of them might be affected by philosophy than in the other, and consequently, in judging of his trust-worthiness as a historian, it should make a wide difference whether his relation to Philo was of the one or the other kind. A careful comparison between the Fourth Gospel and the writings of Philo brings out the essential inde-pendence of the Evangelist. Philo's language on the being of the Logos and the relations of the Logos to God and to the world is wavering and contradictory. It is exceedingly difl&cult to obtain a clear idea of his system of thought, and very different judgments have been formed upon it. The Evangelist, on the other hand,

shows a thorough mastery of his subject. In the few verses of his Prologue he gives in firm, strong outlines a majestic view of God and of the whole scheme of creation and human history. He is able to do this because his mind is under the power of certain dominant thoughts, which he did not derive from Philo. The relation of the Father to the Son, and of the Son to the Father, manifested through the Incarnation, have, for him, illuminated the doctrine of the Logos. Nor, on the other hand, are there any signs that the lines of philosophical speculation which commended the great concept of the Logos to Philo were of special interest or significance for the Evangelist. Again, there is evidence of a sense, to say the least, of historic propriety in the fact often noticed, that the use of the term “the Word” to describe the Person of Christ is confined to the Prologue. An instance of a similar kind is the restricted use of fx.ovoyivq epithet applied to the Logos in Philo. It occurs only in the Prologue (i. 14, 18), and in the comment of the Evangelist (iii. 16-21), which is virtually a prolongation

of the last note of the Prologue.

The places after the Prologue in which we have the nearest parallels to the language and thought of Philo are the passages in which Jesus speaks of Himself as the Manna (vi. 26 ff.) and the Light of the World (viii. 12 ; ix. 5). But it should be remembered that there were other associations which might well have suggested the use of these figures ; and further, it should be observed that the whole mode in which they are applied accords with the conditions of His Incarnate state. He is the food of man by that which He communicates through His flesh (vi. 61 ff.). He is the Light to those who mark and follow His human example (viii. 12). The absence, too, of one trait is specially noteworthy. Philo dwells on the high-priestly character of the Logos, whereas the priesthood of Christ is not named or indicated in the Fourth Gospel.^ And yet that it should have been would have been rendered

2 Unguarded expressions in Ency. Brit., vol. x. (pp. 824, 827, 830, n. 2), may be taken to imply the contrary.

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natural even by considerations such as appear in the Epistle to the Hebrews. The fact is also the more striking, because the thought of Christ's death as a propitiation, which is utterly alien to Philo's philosophy, is strongly emphasized. That is, He is set forth as a Sacrificial Victim, but not as the Priest.

It is evident that the author of the Fourth Gospel had a conception of the Mission of Christ which transcended all limits of nationality, and that it is part of his aim to bring out its universal and eternal significance. Yet in connexion with this, again, we have marks of fidelity to the actual history. We gather from this Gospel no less than from the Synoptics that the Ministry of Jesus was exercised primarily, and almost exclusively, towards Jews. There is an exception — His conversation with the Samaritan woman, and preaching in a Samaritan village

— just as there are one or two exceptions also in the other Gospels. It is true the exception is dwelt upon at considerable length, and the occurrence is the occasion for some profound instruction. But it should also be observed that remarks are introduced by the Evangelist which seem expressly designed to show that this labour formed no part of the proper plan of Jesus (iv. 3, 39, 40).

It is said that the human nature of Christ is disre-garded in the Eourth Gospel. This plainly is not true in respect to physical infirmity (iv. 6) or human traiture' emotion (xi. 35, 38). But it is more important of Jesus. to note that we must turn to this Gospel for the fullest and most vivid representation of Jesus as the perfect Son of the Heavenly Eather under the conditions of humanity, living here below a life of dependence upon and submission to the Eather, doing on earth the Eather's Will, not less than for the plainest declaration of the doctrine of His Divine, Eternal Sonship. In reviewing its teaching as a whole, we may be led to

feel that His absolute. Divine Sonship is presupposed even in those passages in which it is not directly suggested. In point of fact He could be perfect even as the human Son only in virtue of His true Divinity. Nevertheless, it is an important point that in many places in this Gospel Jesus speaks so completely from the standpoint of humanity, that the question of His Divinity is not raised, or not necessarily so (e.g., iv. 34 ; vii. 16-18 ; xiii. 16, 20 ; XV. 21).

(c) Some names used, and classes referred to, in the Synoptics do not occur in the Eourth Gospel. We do not hear in it of ” scribes ” and ” elders,” terms f^7t^“‘fd ‘hi’^ would be very misleading to Greek scriptfon.^’ readers; in place thereof we have the easily comprehensible word ” rulers.” The Sadducees — mentioned only once in Mark and Luke, where Christ gives His answer regarding the Resurrection, and the introduction of whose name in Matthew in two other connexions does not further illustrate their doctrines or party-relations — do not appear; nor do the Hero-

dians, named twice in Mark (and in the parallel to one of these places in Matthew). But the character and position of the Pharisees are given far more clearly than in the Synoptics. Their influence is referred to (xii. 42), and their feeling of abhorrence for the people and its ground (vii. 49), both which traits are confirmed by what we know from Jewish sources. The various parts taken by those who brought about Christ's death stand out more distinctly and in a very life-like manner. The Pharisees watch His proceedings and the growth of His influence, carry on the doctrinal controversy with Him, and are the active instigators of measures against Him (vii. 32 ; viii. 13 ; ix. 13, 15, 40, 41; xi. 46, 47; xii. 19). The chief priests come upon the scene when it is a question of official action being taken and of treating with the Eoman governor (vii. 32, 45 ; xi. 47 ff., 57 ; xii. 10 ; and cc. xviii., xix.). The special place assigned to Annas also agrees remarkably with other evidence respecting him (see Westcott's Comm., note on Jn. xviii. 13). Chi-ist's popularity with

the people is noted (vii. 12 ; xii. 12, 19), and we are not left in any danger of thinking that the same ” multitude ” which followed Him with hosannahs clamoured shortly afterwards that Barabbas might be released in place of Him. Those who joined in this cry are ” the Jews,” a designation which includes Pharisees and Chaberim, men who were faithful members of the covenant, and others who desired to be associated with these (xviii. 12-15). The diverse motives which came into play with the conspirators, or were employed by them to induce Pila.te to act, are also touched upon (xi. 48 ; xviii. 30, 31 ; xix. 7, 12, 15, 16).

The Evangelist’s powers of analysis found an opportunity for even more characteristic exercise in marking the various degrees of faith in and loyalty to Christ among those who were attracted to Him. We are told of many who in His early ministry in Judaea believed, but whom He reckoned untrustworthy (ii. 23 ff.) ; of many disciples who turned back (vi. 66) ; of ” Jews and Pharisees ” after this who belonged in some sense to

His following, and yet were ready to take offence at His words (viii. 31 ff. ; ix. 40, 41) ; of men who were convinced, but who were unwilling openly to profess themselves His disciples because they had much to lose thereby (iii. 1 ff. ; xii. 42 ; xix. 38, 39) ; as well as of the faithful few. And that there must have been this diversity we are sure from our knowledge of human nature and experience of Christian missions. And Jesus Himself depicted it in the Parable of the Sower, in which He doubtless describes what He saw beginning to take place around Him.

(d) We have seen in discussing the external evidence in regard to the composition of the Gospels that the tradition which ascribes the authorship of the Eourth Gospel to John the son of Zebedee is sA/p*”””” one which cannot be lightly set aside ; a close connexion of some kind between the work and that Apostle seems to be required to explain it. The state-

ment in the book itself which bears most directly on the question — this is the disciple which beareth ivitness of these things, and wrote these things (Jn. xxi. 24) — has commonly been taken to mean that the disciple referred to was the author of the Gospel as a complete work — saving, perhaps, the immediately foregoing narrative. This is a possible meaning of the words, but hardly a necessary, or the most natural, one. They assert that the particulars were supplied by his oral testimony and by records he had left, but not that the arrangement of this matter and the setting in which it is placed are by him.

We turn to other considerations bearing on the question of authorship. The efforts to convict the writer of this Gospel of errors in regard to topography and Jewish customs have failed. The advantage must be pronounced to have lain very decidedly with the defenders of the Johannine authorship so far as the controversy in respect to it has turned upon signs in the work of acquaintance with the facts. The chief difficulties connected with the

traditional view appear to be that the position of John the son of Zebedee and all the circumstances of his life for many years as one of the ” Apostles of the Circumcision ” (Gal. ii. 9) render it unlikely that he should have attained to the wide outlook of the writer of the Gospel ; and that the Apocalypse, the authenticity of which as a work of the Apostle John is supported by strong external

evidence, is of the character which might be expected if it proceeded from one with those antecedents, while tlie differences between its style and thought and those of the Gospel are incompatible with identity of authorship, even when the longest interval that is at all possible has been assumed between the dates of their composition. It is not easy to gauge the amount of weight which should be allowed to these objections. The extent to which the views of the twelve Apostles were limited by Jewish prejudices must not be exaggerated. In particular, one who, like St John, never took the most lead-

ing part in the Church at Jerusalem, may well have held a larger faith than most of those with whom he associated, without being thereby brought into sharp conflict with them. Moreover, we ought not to set any narrow bounds to the development which might take place in one who, in those days of unexampled spiritual movement, surrendered himself to the Spirit's influence, especially when he found himself amid entirely new surroundings and brought face to face with new needs.

As regards differences between the Apocalypse and the Gospel, a few more years of residence at Ephesus would explain the greater command of Greek shown in the latter. It must also be borne in mind that for the same writer to attempt more than one form of composition, and in doing so to adopt a different style, is nothing strange. And the doctrinal contrasts may be more superficial than real. The visions of the Apocalypse may for the seer himself have been symbolical to a larger extent than we perhaps imagine ; while, on the other hand, we may, through reading modern ideas into the language of

the Gospel, be apt to fancy that the writer had discarded the ordinary conceptions of Christians of his time on such subjects as ” the last things,” far more than he actually had. Striking points of similarity between the Apocalypse and the Gospel have also been pointed out. (See Westcott, Gospel of St John, prolegomena, p. Ixxxiv ff.) These considerations, if they are not thought suf&cient to remove all ground for calling in question the authorship of the Fourth Gospel by the son of Zebedee, serve at least to show that there need not have been any serious inconsistency between the spirit of his teaching and the thought of the Gospel, and that the actual author may well have been one who looked up to him as a master, and who sought to embody in the work what he had received from him. This view of the Apostle’s relation to the Gospel, which we have seen is in harmony with the language of the book itself, appears to be that which does fullest justice to the various items of evidence, external and internal, and to all the probabilities of the case.

The Synoptic Problem. — The importance of mechanical helps by

which the phenomena of relationship between the Gospels can be readily perceived alike broadly and in detail, was rightly insisted on in the earlier article. And the Synopticon by W. 6. Eushbrooke, printed according to the plan there described (vol. x. 790), which was then in preparation, has since been published. Another much less expensive Synopsis, by A. Wright, has also appeared. In this work also the whole of Mark is first given continuously, with the corresponding portions of Matthew and Luke in parallel columns, then the passages parallel in Matthew and Luke only, &c. Various kinds of type are not made use of, as in the former work, except to a veiy limited degree, and so far it is inferior. But it possesses one distinct advantage in the arrangement of successive clauses in separate lines, whereby the remarkable similarities between the Synoptics in the structure of their sentences are clearly shown. No work of first-rate importance on the Synoptic problem has appeared recently either in England or in Germany. It is treated in a condensed form, but often with considerable thoroughness, in the various Introductions to the New Testament, of which several by writers of great learning and ability have appeared in Germany. It will be sufScient to mention

those of H. Holtzmann, B. Weiss, and Th. Zahn. The second of these has been translated into English. The section also of Weizsacker's Apost. Zeitalter on ' ' the Evangelical Tradition ' ' (bk. iv. ch. 2, in Eng. trans.) is valuable. In England there have been signs that interest in the subject has been revived and that it is being studied in various quarters, though as yet little has been published beyond popular accounts and articles in journals and dictionaries. One valuable contribution to the knowledge of the subject, published in a separate forin, has however been made by Sir J. Hawkins in his Horm Synopticce. The " oral theory " still finds somewhat more favour in England than in Germany, and has been defended by the Rev. A. Wright, but it can no longer be said that the division of opinion on the point is " almost national."

St John.—VnAer the head of literature of the Johannine question, the section on " Die Johanneische Schriften " in Harnack's Chron. d. Altchrist. Lit. must be mentioned. It may be well also to name Delff's liahhi Jesu von Nazareth. His position, especially in regard to the Fourth Gospel, is an eccentric one in some respects, but he draws attention to characteristics of this Gospel which ought to be pondered. The general reader will obtain a good idea

of the controversy from the articles by E. Schurer and W. Sanday in the Contemporary Review for September and October 1891. (v. H. s.)

Cosport, a seaport town in the Fareham parliar mentary division of Hampshire, England, facing Ports-mouth, across Portsmouth harbour, on the London and South-Western railway. It is enclosed within a double line of fortifications, consisting of the old Gosport lines, and, about 3000 yards to the east, a series of forts con-nected by strong lines with occasional batteries, forming part of the defence works of Portsmouth harbour. Recent additions to the public buildings are a soldiers' home, a memorial hall, and a public library. Gosport is in the civil parish and urban district formerly called Alverstoke, but since 1891 Gosport and Alverstoke. Population (1881), 21,581 ; (1901), 28,879.

COSS, Sir John (1800-1880), English composer, was born at Eareham, Hampshire, on 27th December 1800. He was elected a child of the Chapel Eoyal in 1811, and in 1816, on the breaking of his voice, became

a pupil of Attwood, through whom he may not impossibly have imbibed some of the Mozartian sweetness which characterizes his best work. A few early compositions, some for the theatre, exist, and some glees, &c., were published before 1825. He was appointed organist of St Luke's, Chelsea, in 1824, and in 1838 became organist of St Paul's in succession to his master, Attwood ; he kept the post until 1872, in which year he officiated at the public thanksgiving for the recovery of the Prince of Wales, and subsequently, on his resignation, received the honour of knighthood. In 1876 he was given the degree of Mus.D. at Cambridge. Though his few orchestral works have very small importance, his Church music contains things that will not be forgotten, such as the anthems, " 0 taste and see," " 0 Saviour of the world," and others. Many anthems were published, as well as collections of chants, &c. He was the last of the great English school of Church composers who devoted themselves almost exclusively to Church music ; and in the history of the glee his is an honoured name, if only on

account of his finest work in that form, the five-part glee, Ossian's "Hymn to the Sun." He died at Brixton, London, 10th May 1880, and was buxied at Kensal Green cemetery, and a tablet to his memory is in the crypt of St Paul's. (j. a. f.-m.)

Cosse, Philip Henry (1810-1888), English naturalist, was born at Worcester on 6th April 1810, his father being a miniature painter. In his youth the family removed to Poole, where Gosse's turn for natural history was noticed and encouraged by his aunt, Mrs Bell, the mother of the zoologist, Thomas Bell. He had, however, little opportunity for developing it until, in 1827, he found himself clerk in a whaler's office at Carbonnear, in Newfoundland, and beguiled the tedium of his life by continual observations, chiefly with the microscope. After

a brief and unsuccessful interlude of farming in Canada, during which he wrote an unpublished work on the entomology of Newfoundland, he travelled in the United

States, was received and noticed by men of science, was employed as a teacher for some time in Alabama, and returned to England in 1839. His Canadian Naturalist (1840), written on the voyage home, was followed in 1843 by his Introduction to Zoology. His first widely popular book was Tlie Ocean (1844). In 1844 Gosse, who had meanwhile been teaching in London, was. sent by the British Museum to collect specimens of natural history in- Jamaica. He spent two years on that island, and after his return published his Birds of Jamaica (1847) and his Naturalist's Sojourn in Jamaica (1851). He also wrote about this time several zoological works for the S.P.C.K., and • laboured to such an extent as to impair his health. While recovering at Ilfracombe, he was attracted by the forms of marine life so abundant on that shore, and in 1853 published A Naturalist's Rambles on the Devonshire Coast, accompanied by a description of the marine aquarium invented by him, by means of which he had for the first time succeeded in preserving zoophytes and other marine animals of the

humbler grades alive and in good condition away from the sea. This was more fully set forth and illustrated in his Aquarium (1854), succeeded in 1855-56 by A Manual of Marine Zoology, in two volumes, illustrated by nearly 700 wood engravings after the author's drawings. A volume on the marine fauna of Tenby succeeded in 1856. In June of the same year he was elected F.R.S. Gosse, who was a most careful observer, but who lacked the philosophical spirit, was now tempted to essay work of a more ambitious order, publishing in 1857 two books, lAfe and Omphalos, embodying his speculations on the appearance of life on the earth, which he considered to have been instantaneous, at least as regarded its higher forms. His views met with no favour from scientific men, and he returned to the field of exact research, which he was better qualified to cultivate with advantage. Taking up his residence at St Marychurch, in South Devon, he produced from 1858 to 1860 his standard work on the sea-anemones, the Actinologia Britannica. The Momance of Natural History and other popular

works followed, until in 1865 he abandoned the field of authorship. His later years were chiefly devoted to the cultivation of orchids and the study of the Eotifera, upon which, with the assistance of Dr C. T. Hudson, he published a monograph in 1886. He died at Torquay on 23rd August 1888. His life has been written by his son, Mr Edmund Gosse. (k. g.)

Cdta. — (1) A river of Sweden, which flows out of the south extremity of Lake Wener, and goes almost due south to the Cattegat, entering it by two arms, one on each side of the island of Hisingen, the east arm flowing past Gothenburg. It is navigable for large vessels throughout its entire course of 47 miles, the famous (four) falls of TroUhatta (108 feet descent in four-fifths of a mile) being avoided by means of the TroUhatta canal, made in 1793-1800, but enlarged and altered in 1838^4. At the village of TroUhatta (population, 5615) there are iron- works, paper and calcium carbide factories, saw-mills, &c. (2) A canal of Sweden, which connects Lake Wener with the Baltic, passing on the way through

Lakes Wetter, Boren, Boxen, and numerous smaller ones, giving a waterway 125 miles long (54 miles of artificial cuttings), 47 feet wide at the bottom and 85^ feet wide at the surface, with a depth of 9 feet 9^ inches, and with 68 locks in all. The canal starts at Sjotorp, on the east side of Wener, enters Lake Wetter at Carlsberg, passes out of it again at Motala, and connects with the Baltic at Mem, 3 mUes below Soderkoping. It was constructed in 1810-32 by B. B. von Platen, with the assistance of Telford, though the idea dated back to the year 1516. The highest point (300 feet above searlevel) of the canal is in Lake Viken, between Lakes Wener and Wetter. The traflic through the canal has increased to such an extent that the question of enlarging it throughout was forced to the front in 1900.

Cotha, a town of Germany, capital of the grand-duchy of Coburg-Gotha, at the north foot of the Thuringian Forest, 17 miles by rail west from Erfurt. It alternates with Coburg as the grand-ducal residence. The town hall, built in 1674, was restored hi 1898. There are

monuments to Arnoldi (1778-1841), a benefactor of the ‘ town, and of the war of 1870-71. Population (1886), 27,802; (1900), 34,648.

Gothenburg (Swedish Goteborg), a seaport town of Sweden, on the east bank of the river Gota, 286 miles south-west from Stockholm by rail. It ranks in respect of industry, commerce, and population^as the second city in the kingdom. The industries of Gothenburg produced 10-3 per cent, of the value of the gross output of the entire kingdom in 1895 (Stockholm=27-4 per cent.). The commerce of Gothenburg in 1896 represented 27-2 per cent, of the aggregate foreign trade of the kingdom, as compared with 19-7 per cent, for Stockholm; the imports amounting to £5,300,000, and the exports to £4,611,000, or an aggregate of £9,911,000. The principal items of export are iron (annual average, nearly 110,000 tons), butter, timber, paper, cereals and flour, matches, wood-pulp, zinc ore,_ joinery, fish, bottles, bacon, bobbins, and cardboard. Of the imports the most important are textiles, raw cotton, grain and flour, sugar

and molasses, coffee, coal, bricks, wines and spirits, and machinery. In 1900 the port was cleared by 2687 vessels of 1,186,500 tons, as compared with 2341 vessels of 845,800 tons in 1886. The harbour in the Gota river is kept open in wiater by ice-breakers. In 1893 a new quay, 1530 feet long, was completed, giving 20 feet depth alongside. In 1902 it was proposed to build a new dry dock, 490 feet long and 26 feet deep, so as to accommodate vessels of 6000 to 8000 tons displacement. The merchant fleet numbers about 200 vessels of some 100,000 tons. Gothenburg is the principal port of embarkation of Swedish emigrants for the United States. During the last years of the 19th century this city expanded at a rapid rate. In 1898 it was decided to equip it with modern fortifications. The old East India Company's house, in which the museum has been sheltered since 1861-63, was restored in 1894-96. A university coUege, with arts faculty, was opened in 1891. Other new buildings are the Oscar Frederick church (1889-93), and an imposing asylum (Gibraltar) for old age (1896). Population

(1880), 76,401 ; (1890), 104,657 ; (1898), 123,105, or including the widespread suburbs, 130,619. If, as is proposed, Lundby (9730), on the island of Hisingen, on the opposite side of the river, were incorporated with the city, the population would exceed 140,000. Gothenburg is famous for the plan of liquor law reform known as the Gothenburg Licensing System. Although first formally adopted in Gothenburg in 1865, modified forms of the system seem to have been in existence earlier at Falun (1850), Jonkoping (1852), and Marstraud. A further modification of the system was adopted in Norway in 1871, but repealed in favour of local option pure and simple in 1894. (See Liquor Laws.) (j. t. be.)

Gothland (Swedish, Gotland and Gotaland), the southernmost of the three territorial divisions of Sweden. It embraces the counties of Malmohus, Christianstad,

Blekinge, Halland, Goteborg and Bohus,,. Kronoberg, Calmar, Jonkoping, Elfsborg, Skaraborg, Ostergotland,

and Gotland (the island of Gothland), with an area of 35,788 square miles. Population (1880), 2,593,621; (1900), 2,696,233. The island of Gothland, between 56° 54′ and 57° 56′ K lat. and 18° 7′ and 19° 22′ E. long., in the Baltic, about 40 miles from the east coast of Sweden, forms, together with the island of Faro (39 square miles), Gotska Sando (about 30 miles north by east, area 14 square miles), and the Charles Islands, a separate county, with an area of 1215 square miles. Population (1880), 54,668 ; (1900), 62,781. It is a level plateau of Silurian limestone, inclined gently eastwards, with steep coasts, fringed with tapering, columnar, free-standing buttresses of limestone (raukar). The climate is mild and the soil fertile. The marshy moorlands {e.g., Martebo) have in recent years been drained and cultivated. In 1897, 19-7 per cent, of the total area was under the plough, 10-7 per cent, meadow land, and 44-5 per cent, forest. There are nearly 80 miles of railway on the island. Perhaps the most characteristic feature of Gothland is the very large number of 13th-century churches,

with massive towers, often standing detached, and generally considered to have been built for defensive purposes. (See WiSBT.)

Goto Islands (Goto Eetto), a group of islands belonging to Japan, lying westward of the province of Hizen, in 33° N. lat. and 129° E. long. The southern of the two principal islands, Fukae-jima, measures 17 miles by 13^; the northern, ISTakaori-jima, measures 23 miles by 7|-. These islands lie almost in the direct route of steamers plying between Nagasaki and Shanghai, and are distant some 50 miles from ISTagasaki. Some dome-shaped hills command the old eastle-town of Eukae. The islands are highly cultivated; deer and other game abound, and trout are plentiful in the mountain streams. A majority of the inhabitants are Christians.

Cottingen, a town of Prussia, province of Hanover, 67 miles south from Hanover by the railway to Cassel. The battlemented town hall, dating from 1369-71, was restored in 1880. There are a natural history museum, municipal collection of antiquities, picture gallery, agri-

cultural institute, physical institute, institute for physical chemistry and electro-chemistry, provincial lunatic asylum, commercial and technical trade schools ; also a monument to the mathematicians Gauss and Weber (1899), and another to the poet Burger (1895). In 1900 the University was attended by 1314 students, and had 131 professors. Population (1886), 21,561; (1900), 30,234.

CottSChee (Slovene, Kocevje), a duchy, government district, and town on the southern border of the Austrian crownland of Carniola — a German enclave in a Slovene province. The duchy has an area of over 270 square miles and a population of about 25,000, of whom the majority are ” Gottscheer,” a people of Franconian and Thuringian origin, who have apparently been settled in the country at least since the 14th century. They have preserved their racial characteristics and dialect, notwithstanding their absolute isolation in a purely Slav country. The duchy lies entirely within the barreii limestone region of the Karst. The government district

has a larger area than the duchy, and a Slovene majority. The cJiief toivn, on the Einsee rivulet, which disappears into the earth in the immediate vicinity, has 2421 German inhabitants and a certain amount of trade and industry (wood-carving, turnery, glass, pottery, &c.). The Fried-richstein ice-cave and numerous other caverns in the neighbourhood, with their singular subterranean fauna, attract many visitors.

Coulburn, a town of New South Wales, 134 miles S.W. of Sydney by the Great Southern railway. It lies in a productive agi-icultural district, and has an ample water supply. There are Church of England and Eoman Catholic cathedi'als. The gaol was erected at a cost of £72,000. Manufactures of boots and shoes, flour, and beer, and tanning are important. The altitude is 2129 feet. Population (1881), 6839 ; (1901), 10,190.

Coulburn, Edward Coulburn (1818-1897), English Churchman, son of Mr Serjeant Goulburn, M.P., Eecorder of Leicester, and nephew of the Eight Hon. Henry Goulburn, Chancellor of the Exchequer

in the Ministries of Sir Eobert Peel and the Duke of Wellington, was born in London, 11th February 1818, and educated at Eton and Balliol, Oxford. In 1839 he became fellow and tutor of Merton, and in 1841 was ordained. In 1850 he was chosen to succeed Tait as headmaster of Eugby, but in 1858 he resigned, and in 1859 became vicar of St John's, Paddington. In 1866 he was made Dean of Norwich, and for twenty-three years exercised a marked influence on Church life in that capacity. A strong Conservative and a Churchman of traditional orthodoxy, he was a keen antagonist of " higher criticism " and rationalism in all its varieties. As an author, his Tlioughts on Personal Religion and Pursuit of Holiness were well-known books ; and he wrote the Life of his friend Dean Burgon, with whose doctrinal views he was substantially in agreement. He resigned the deanery in 1889, and died at Tunbridge Wells on 3rd May 1897.

Could, Benjamin Apthorp (1824-1896), American astronomer, was born in Boston, Mass., 27th Sep-

tember 1824, the son of Benjamin Apthorp Gould (1787-1859), principal of the Boston Latin School and editor of several classical text-books for schools. Young Gould graduated at Harvard in 1844, and afterwards studied mathematics and astronomy at Gottingen. On his return to America he was employed in the astronomical work of the United States Coast Survey, under Superintendents Bache and Pierce, devoting himself chiefly to longitude determinations, and employing land and submarine telegraphs for the purpose. Between' 1849 and 1861 he conducted an Astronomical Journal. From 1856 to 1859 he acted as director of the Dudley Observatory at Albany, New York. During the Civil War of 1861-65 he was for a time in charge of the statistics of the Sanitary Commission; but his most important work was done between 1868 and 1885, when he planned a private astronomical expedition to Argentina, for the purpose of extending to the southern hemisphere zone-observations like those of Bessel and Argelander in the northern. The value of his labours was perceived by the Argentine Government, and

out of them grew the national observatory at Cordoba, which he organized and from which he issued astronomical reports and maps. Of particular importance is a series of sidereal charts, or uranometry, of the southern heavens (1872-77), in which he practically extended Argelander' s scale to the whole heavens. For this service he received the gold medal of the Eoyal Astronomical Society. Gould had been one of the first to see the use of photography in accurate determination of star-places, having, as far back as 1866, co-operated with L. M. Eutherfurd in photographing the Pleiades. Eeturning to America in 1885, here-established his Astronomical Journal and engaged in other similar labours until his death in Cambridge, Massachusetts, 26th November 1896.

Could, Jay (1836-1892), American financier, was born in Eoxbury, Delaware county. New York, 27th May 1836. He was brought up on his father's farm, and

studied in Hobart Academy. After some business experi-

ence in several states, he removed in 1869 to New York City, where he became a broker in railway stocks, and in 1868 was elected president of the Erie railroad. The management of this road under his control led to litigation begun by the English bondholders, and Gould was forced out of the company and compelled to restore securities valued at $7,500,000. He had become interested in other railways, and by means of consolidations, reorganizations, and constructing branch lines, built up the “Gould system” in the south-western states. He also gained control of the Western Union Telegraph Company, and after 1880 of the elevated railways in JSTew York City. He was intimately connected with many of the largest railway and financial operations in the United States for the twenty years following 1868, including the panic in the New York gold market on ” Black Ei^iday.” He was one of the wealthiest men in the United States, and his property aggregated $72,000,000 at the time of his death, which took place in New York City on the 2nd of December 1892.

Counod, Charles Francois (1818-1893), Erench composer, was born in Paris ‘on 17th June 1818, the son of E. L. Gounod, a talented painter. He entered the Paris Conservatoire in 1836, studied under Eeicha, Halevy, and Lesueur, and won the “Grand Prix de Eome ” in 1839. While residing in the Eternal City he devoted ‘much of his time to the study of sacred music,

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Chaeles Gounod.

{From a photograp7i by J£UioU and Fry.)

notably to the works of Palestrina and Bach. In 1843 he went to Vienna, where a ” requiem ” of his composition was performed. On his return to Paris he tried in vain to find a publisher for some songs he had written in Eome. Having become organist to the chapel of the “Missions ![^trangeres,” he turned his thoughts and mind to religious music. At that time he even contemplated the idea of entering into holy orders. His thoughts were, however, turned to more mundane matters when, through the intervention of Madame Viardot, the

celebrated singer, he received a commission to compose an opera on a text by]Smile Augier for the Acad^mie Rationale de Musique. Sapho, the work in question, was produced in 1861, and if its success was not very great, it at least sufficed to bring the composer's name to the fore. Some critics appeared to consider this work as evidence of a fresh departure in the style of dramatic music, and Adolphe Adam, the composer, who was also a musical critic, attributed to Gounod the wish to revive the system of musical declamation invented by Gluck. The fact was that Sapho differed in some respects from the operatic works of the period, and was to a , certain extent in advance of the times. When it was revived at the Paris Opera in 1884, several additions were made by the composer to the original score not altogether to its advantage, and SapJio once more failed to attract the public. Gounod's second dramatic attempt was again in connexion with a classical subject, and consisted in some choruses written for Ulysse, a tragedy by Ponsard, played at the Theatre Erangais

in 1852, when the orchestra was conducted by Offenbach. The composer's next opera. La Nonne Sanglante, given at the Paris Opera in 1854, was a failure.

Goethe's Faust had for years exercised a strong fascination over Gounod, and he at last determined to turn it to operatic account. The performance at a Paris theatre of a drama on the same subject delayed the production of his opera for a time. In the meanwhile he wrote in a few months the music for an operatic version of Moliere's comedy, Le MMecin malgre lui, which was produced at the Theatre Lyrique in 1858. Berlioz well described this charming little work when he wrote of it, " Everything is pretty, piquant, fluent, in this ' opera eomique ' ; there is nothing superfluous and nothing wanting." The first performance of Faust took place at the Theatre Lyrique on 19th March 1859. Goethe's masterpiece had already been utilized for operatic purposes by various composers, the most celebrated of whom was Spohr. The subject had also inspired Schumann, Berlioz, Liszt, Wagner, to mention only a few, and the

enormous success of Gounod's opera did not deter Boito from writing his Meflstofele. Faust is without doubt the most popular Erench opera of the second half of the 19th century. Its success has been universal, and nowhere has it achieved greater vogue than in the land of Goethe. Eor years it remained the recognized type of modern Erench opera. At the time of its production in Paris it was scarcely appreciated according to its merits. Its style was too novel, and its luscious harmonies did not altogether suit the palates of those dilettanti who still looked upon Eossini as the incarnation of music. Times have indeed changed, and French composers have followed the road opened by Gounod, and have further developed the form of the lyrical drama, adopting the theories of Wagner in a manner suitable to their national temperament. Although in its original version Faust contained spoken dialogue, and was divided into set pieces according to custom, yet it differed greatly from the operas of the past. Gounod had not studied the works of German masters such as Mendelssohn and

Schumann in vain, and although his own stjde is eminently Gallic, yet it cannot be denied that much of its charm emanates from a certain poetic sentimentalitj- which seems to have a Teutonic origin. Certainly no music such as his had previously been produced by any Erench composer. Auber was a gay trifler, scattering his bright effusions with absolute insouciance, teeming with melodious ideas, but lacking depth. Berlioz, a musical Titan, wrestled against fate with a superhuman energy, and, Jove-like, subjugated his hearers with his thunderbolts.

It was, however, reserved for Gounod to introduce la note tendre, to sing the tender passion in accents soft and languorous. The musical language employed in Faust was new and fascinating, and it was soon to be adopted by many other Erench composers, certain of its idioms thereby becoming hackneyed. Gounod's opera was given in London in 1863, when its success, at first doubtful, became enormous, and it was heard concurrently at Covent

Garden and Her Majesty's Theatres. Since then it has never lost its popularity.

Although the success of Faust in Paris was at first not so great as might have been expected, yet it gradually increased and set the seal on Gounod's fame. The fortunate composer now experienced no difficulty in finding an outlet for his works, and the succeeding decade is a specially important one in his career.

The opera from his pen which came after Faust was PhiUmon et Baucis, a setting of the mythological tale in which the composer followed the traditions of the Opera Comique, employing spoken dialogue, while not abdicating the individuality of his own style. This work was produced at the Theatre Lyrique in 1860.

It has repeatedly been heard in London. La Heine de Saba, a four-act opera, produced at the Grand Opera on 28th February 1862, was altogether a far more ambitious work. For some reason it did not meet with success, although the score contains some of Gounod's choicest inspirations, notably the well-known air,

” Lend me your aid.” La Heine de Saba was adapted for the English stage under the name of Irene. The non-success of this work proved a great disappointment to Gounod, who, however, set to work again, and this time with better results, Mireille, the fruit of his labours, being given for the first time at the Theatre Lyrique on 19th March 1864. Founded upon the Mireio of the ProVenQal poet Mistral, Mireille contains much charming and characteristic music. The libretto seems to have militated against its success, and although several revivals have taken place and various modifications and alterations have been made in the score, yet Mireille has never enjoyed a very great vogue. Certain portions of this opera have, however, been popularized in the concert-room. La Oolombe, a little opera in two acts without pretension, deserves mention here. It was originally heard at Baden in 1860, and subsequently at the Opera Comique. A suavely melodious entr’acte from this little work has survived and been repeatedly performed.

Animated with the desire to give a pendant to his Faust, Gounod now sought for inspiration from Shakespeare, and turned his attention to Borneo aiid Juliet. Here, indeed, was a subject particularly well calculated to appeal to a composer who had so eminently qualified himself to be considered the musician of the tender passion. The operatic version of the Shakespearean tragedy was produced at the Theatre Lyrique on 27th April 1867. It is generally considered as being the composer's second best opera. Some people have even placed it on the same level as Faust, but this verdict has not found general acceptance. Gounod himself is stated to have expressed his opinion of the relative value of the two operas enigmatically by saying, " Faust is the oldest, but I was younger ; Borneo is the youngest, but I was older." The luscious strains wedded to the love scenes, if at times somewhat cloying, are generally in accord with the situations, often irresistibly fascinating, while always absolutely individual. The success of Borneo in Paris was great from the outset, and eventually this

work was transferred to the Grand Opera, after having for some time formed part of the ripertoire of the Opera Comique. In London it was not until the part of Romeo was sung by Jean de Eeszke that this opera obtained any real hold upon the English public.

After having so successfully sought for inspiration from Moliere, Goethe, and Shakespeare, Gounod now turned to another famous dramatist, and selected Pierre Corneille's Polyeucte as the subject of his next opera. Some years were, however, to elapse before this work was given to the public. The Franco-German war had broken out, and Gounod was compelled to take refuge in London, where he composed the "biblical elegy" Gallia ior the inauguration of the Eoyal Albert Hall. During his stay in London Gounod composed a great deal and wrote a number of songs to English words, many of •which have attained an enduring popularity, such as " Maid of Athens," "There is a green hill far away," "Oh that we two were maying," " The fountain mingles with the river." His sojourn in London was not altogether'

pleasant, as he was embroiled in lawsuits with publishers. On Gounod's return to Paris he hurriedly set to music an operatic version of Alfred de Vigny's Cinq-Mars, which was given at the Opera Comique on the 6th April 1877 (and in London in 1900), without obtaining much success. Polyeucte, his much-cherished work, appeared at the Grand Opera the following year on 7th October, and did not meet with a better fate. Neither was Gounod more fortunate with Le Tribut de Zamora, his last opera, which, given on the same stage in 1881, speedily vanished, never to reappear. In his later dramatic works he had, unfortunately, made no attempt to keep up with the times, prefer.ruig to revert to old-fashioned methods.

The genius of the great composer was, however, destined to assert itself in another field — ^that of sacred music. His friend Camille Saint-Saens, in a volume entitled Portraits et Souvenirs, writes —

"Gounod did not cease all his life to write for the church, to accumulate masses and motetts ; but it was at the commencement

of his career, in the Messe de Sainte Cecile, and at the end, in the oratorios The Redemption and Mors et Vita, that he rose highest." Saint-Saens, indeed, has formulated the opinion that the three above-mentioned works will survive all the master's operas. Among the many masses composed by Gounod at the outset of his career, the best is the Messe de Sainte Cicile, written in 1855. He also wrote the Messe du Sacre Casur, 1876, and the Messe d, la memoire de Jeanne d'Arc, 1887. This last work offers certain peculiarities, being written for solos, chorus, organ, eight trumpets, three trombones, and harps. In style it has a certain affinity with Palestrina. TJie Bedemption, which seems to have acquired a permanent footing in Great Britain, was produced at the Birmingham Festival of 1882. It was styled a sacred trilogy, and was dedicated to Queen Victoria. The score is prefixed by a commentary written by the composer, in which the scope of the oratorio is explained. It cannot be said that Gounod has altogether risen to the magnitude of his task. The music of The Bedemption bears the unmis-

takable imprint of the composer's hand, and contains many beautiful thoughts, but the work in its entirety is not exempt from monotony. Mors et Vita, a sacred trilogy dedicated to Pope Leo XIIL, was also produced for the ' first time ia Birmingham at the Festival of 1886. This work is divided into three parts, "Mors," " Judicium," " Vita." The first consists of a Eequiem, the second depicts the Judgment, the third Eternal Life. Although quite equal, if not superior, to Tlie Bedemption, Mors et Vita has not obtained similar suc-cess.

Gounod was a great worker, an indefatigable writer, and it would occupy too much space to attempt even an incomplete catalogue of his compositions. Besides the works already mentioned may be named two symphonies which were played during the 'fifties, but have long since fallen into neglect. Symphonic music was not Gounod's forte, and the French master evidently recognized the fact, for he made no further attempts in this style. The iacidental music he wrote to the dramas Les deux Beines

and Jeanne d'Arc must not be forgotten. He also attempted to set MoliSre's comedy, Georges Dandin, to

music, keeping to the original prose. This work has never been brought out. Gounod composed a large number of songs, many of which are very beautiful. One of the vocal pieces that have contributed most to his popularity is the celebrated Meditation on the First Prelude of Bach, more widely' known as the Ave Maria. The idea of fitting a melody to the Prelude of Bach was original, and it must be admitted that in this case the experiment was successful.

Gounod died at St Cloud on the 18th of October 1893. His influence on Trench music was immense, though during the last years of the 19th century it was rather counterbalanced by that of Wagner. Whatever may be the verdict of posterity, it is unlikely that the quality of individuality will be denied to Gounod. To be the

composer of Faust is alone a sufficient title to lasting fame. (a. hb.)

Courko, Joseph Vladimirovitch, Count

(1828-1901), Eussian general, was born, of Lithuanian extraction, on the 15th of November 1828. He was educated in the Imperial Corps de Pages, entered the Hussars of the Imperial Body Guard as sub-lieutenant in 1846, became captain in 1867, adjutant to the Emperor in 1860, colonel iu 1861, commander of the 4th Hussar regiment of Mariupol in 1866, and major-general of the Emperor's suite in 1867. He subsequently commanded the grena^ dier regiment, and in 1873 the 1st brigade, 2nd division, of the cavalry of the guard. Although he took part in the Crimean war, being stationed at Belbek, his claim to distinction is due to his services in the Turkish war of 1877. He led the van of the Eussian invasion, took Trnovo on the 7th July, crossed the Balkans by the Hain Bogaz pass, debouching near Hainkioi, and, notwithstanding considerable resistance, captured Uflani,Maglish, and Kezanlyk ; on the 18th July he attacked Shipka,

which was evacuated by the Turks on the following day. Thus within sixteen days of crossing the Danube Gourko had secured three Balkan passes and created a panic at Constantinople. He then made a series of successful reconnaissances of the Tunja valley, cut the railway in two places, occupied Eski and Yeni Saghra, checked the advance of Suleiman's army, and returned again over the Balkans. In October he was appointed commander of the allied cavalry, and attacked the Plevna line of communication to Orkhanie with a large mixed force, captured Gorni-Dubnik, Telische, and Vratza, and, in the middle of November, Orkhanie itself. Plevna was isolated, and after its fall in December Gourko led the way amidst snow and ice over the Balkans to the fertile valley beyond, totally defeated Suleiman, and occupied Sophia, Philippopolis, and Adrianople, the armistice at the end of January 1878 stopping furthet operations. Gourko was made a count, and decorated with the 2nd class of St George and other orders. In 1879-80 he was Governor of St Petersburg, and from 1883 to 1894 Governor-General of Poland.

He died on 29th January 1901. (r. h. t.)

Courock, a police burgh and watering-place of Eenfrewshire, Scotland, on the southern shore of the Pirth of Clyde, 3:^ miles west of Greenock by rail. There is an extensive pier, and the bay affords good anchorage for yachts. The Gamble Institute includes recreation rooms, public library, and baths ; and there are three excellent bowling greens. There is tramway communication with the suburb of Ashton, finely situated on the hillside facing the Firth of Clyde, and commanding magnificent views of the Argyllshire Highlands and the famous salt-water lochs. Population (1881), 3336; (1901), 5244.

Cout. See Pathology (Metabolic Diseases).

Covan, a police burgh of Lanarkshire, Scotland, on the south bank of the Clyde adjacent to Glasgow, and in a parish of the same name which includes a large part of the city. Govan remained little more than a village till about 1860, when the growth of shipbuilding and allied trades on the Clyde gave its development an impetus

which is not yet exhausted. It was formed into a policer burgh in 1864, and the police commission is now in occupation of its third set of municipal chambers (costing £40,000); there are also a theatre (1899) and a combina^ tion fever hospital. The Elder Park, presented to the burgh in 1885, contains a statue of John Elder, the pioneer shipbuilder, the husband of the donor. A statue of Sir William Pearce, another well-known Govan shipbuilder and once M.P. for the burgh, stands at Govan Cross. The Govan Lunacy Board opened in 1896 a new asylum near Paisley. Govan is supplied with Glasgow gas and water, and its tramways are leased by the Glasgow Corporation ; but it has an electric light installation of its own (1899), and performs all other municipal functions quite independently of the city, annexation to which it has always strenuously resisted. Eour of the shipbuilding yards noticed under Glasgow are situated in the burgh, and its other industries are match-making, silk-weaving, hair-working, copper-working, tube-making, weaving, and the manufacture of locomotives and electrical apparatus.

The town forms the greater part of the Govan division of Lanarkshire, which returns a member to Parliament. Area, 1069 acres. Population (1901), 76,351.

Covernment. See Politics.

Cowreeshankar Vodeyshankar (1805-1892), native minister and (during the minority of the prince, Sir Takht Singhji) joint administrator of the State of Bhaunagar in Kathiawar, was born on the 21st August 1805 at the seaport town of Gogo, in a respectable, though not afluent, family of Nagar Brahmans. After receiving the ordinary education of those rude unsettled times, he, in 1822, was appointed to assist Mr Sheva-kram Desai, the vakil or representative of the Bhaunagar State at the Political Agency for Kathiawar, just then established by the Bombay Government. In a short time he became a revenue officer, and successfully resisted some exorbitant claims made against the State in the British courts. In 1847 his services were acknowledged by the Thakoresaheb Vage Singhji, who promoted him to be joint Jcarbhari, or State minister, in association with

Desai Suntokeram Sheorkeram. The reforming hand was soon felt. Old complaints made by the British Agent were disposed of, and the punitive fines called moshul, which then cost the Durbar Es.18,000 a year, were terminated. A claim on seventy-six villages made by the Nawab of Junagarh was settled by a money payment. An Arab Jamedar, a sort of a military commandant, had also a claim for 72 lakhs of rupees as guarantor of debts incurred by a former chief. A^ security for payment this subject had got possession of the fine district of Mahuwa. Colonel Lang, the Political Agent, intervened, au account was taken, and the claim being reduced to 3^ lakhs was paid off, and the territory recovered, not without imminent risk of bloodshed. Gowreeshankar was also the moving spirit of the diplomacy which in 1866 led the British Government to restore to Bhaunagar the jurisdiction over 116 villages which had been treated as British from the year 1816. The tribute also to be paid to the British Government by the State, which was increasing every year, was permanently

settled at Es.52,000. Similar activity was shown in internal affairs. Judicial regulations were passed, public works undertaken, and education was promoted by an

Anglo-vernacular school. Even female education was fostered. The reigning chief, Juswant Singh ji, who had received the honour of K.C.S.I., dying in 1870, Gowree-shankar took charge of the State pending an arrange-ment by which Mr E. H. Percival, chosen from the Bombay civil service on account of his great experience and even temper, was joined with him to exercise the powers of the Chief, then a minor. The experiment was in every respect successful. Under the simple and economical forms used in native States, improvements suggested by British Indian experience were introduced. The land revenue was based on a cash system, the fiscal and customs systems were remodelled, and tree planting was encouraged. The town of Bhaunagar received the great boon of the Gowreeshankar Waterworks, on which

6 lakhs of rupees were spent. The Percival Markets too were built. The Bhaunagar State also warmly pressed for railway communication with the continent of India, and thus began a movement which has spread a network of railway lines over the peninsula of Kathiawar. The British Government rewarded these many services of Gowreeshankar with the distinction of C.S.I, in 1877. He helped to establish the Eajkumar College at Eajkot, for the education of native princes, and also the Rajas-thanik Court, which, after settling almost innumerable disputes between the land-owning classes and the chiefs, has since been abolished. On the 13th January 1879 Gowreeshankar resigned office, after a service of fifty-five years, and devoted himself absolutely to the study of the higher literature of that Vedanta philosophy which through his whole life had been to him a solace and a guide. In 1884 he wrote a work called Svarupanu-sandlian, on the union of the soul with Deity, which led to a letter of warm congratulation and regard from Max Miiller, who also published a short biography of

him. In 1887 he put on the robe of the Sanyasi or ascetic, the fourth stage, according to the Hindu Shastrus, in the life of the twice-born man, and in this manner passed the remainder of his life, giving above ten hours each day to Vedantic studies and holy contemplations. He died, revered by all classes, in December 1892. Born before the first intervention of the British in the affairs of Kathiawar, Gowreeshankar was acquainted with all the events that followed the settleirient made by Colonel A. Walker in 1808. Trained among the Kagar Brahmans, who have supplied many ministers to the princely houses of the peninsula, his career was that of a statesman, devoid of English education and essentially Hindu in mind and tastes and methods. His influence was great with the ministers of the neighbouring States. His advice was at all times valued by the British ofScers, who publicly honoured his ability, his prudence, and his integrity, and ever treated him with the highest consideration and deference.

(n. b. w.)

Coyaz, a state of Brazil, having on the N”. Para and Maranhao, on the W. Matto Grosso and Pard, on the S. Minas Geraes and S. Paulo, and on the E. Maranhao, Piauhy, Minas Geraes, and Bahia. Area, 288,646 square miles. Population (1890), 227,572. The capital, Goyaz, on the Rio Vermelho, has 3000 inhabitants ; other towns are Boa Vista, Bomfim, Entre Rios, Formosa, Porto Nacional, &c.

Craaff Reinet, a town of Cape Colony, on the Upper Sunday river, which rises a little farther north on the southern slopes of the Sneeuwbergen, and here ramifies into several channels flowing through the surrounding flelds and gardens. The town is one of the oldest Dutch settlements in the interior of the colony, dating from the latter part of the 18th century, and is the present inland terminus of a serpentine railway which runs from Port Elizabeth through Uitenhage northwards nearly to the sources of the Sunday river. GraafE Reinet is a flourishing market for the local agricultural produce. Population (1891), 5946.

Crabow, a town of Prussia, province of Pomerania, on the left bank of the Oder, immediately north of Stettin, of which it is now a suburb, with important industries. Its parish church dates from 1890, and it has a school of navigation. Population (1885), 14,541 ; (1900), 22,583.

-), English

Grace, William Gilbert (1848-

cricketer, was born at Downend, in Gloucestershire, on 18th July 1848. He early found himself in an atmosphere charged with cricket, his father (Henry Mills Grace) and his uncle (Alfred Pocock) being as enthusiastic over the game as his elder brothers, Henry, Alfred, and Edward Mills ; indeed, in E. M. Grace the family name first became famous. A younger brother, George Trederick, also added to the cricket reputation of the family. “W. G.” witnessed his first great match when he was hardly six years old, the occasion being a game between W. Clarke’s All-England Eleven and twenty-two of West Gloucestershire. When he grew up, he

was endowed by nature with a splendid physique as well as with powers of self-restraint and determination. At the acme of his career he stood full 6 feet 2 inches, being powerfully proportioned, loose yet strong of limb. A non-smoker, and very moderate in all matters, he kept himself in condition all the year round, shooting, hunting, or running with the beagles as soon as the cricket season was over. He was also a fine runner, 440 yards over 20 hurdles being his best distance; and it may be quoted as proof of his stamina that on 30th July 1866 he scored 224 not out for England v. Surrey, and two days later won such a race in the National and Olympian Association meeting at the Crystal Palace. He speedily made his name a household word wherever the game of cricket was a matter of interest. The title of ” champion ” was well earned by one. who for a space of thirty-Six years (1865-1900 inclusive) was actively engaged in first-class cricket. In no one of these years was he not invited to represent the Gentlemen in their matches against the Players, or, when an Australian eleven

visited England, to play for the mother country against her colony. As late as 1899 he played in the first of the five international contests ; in 1900 he played against the Players at the Oval, scoring 58 and 3. At the age of fifty-three, he scored nearly 1300 runs in first-class cricket, made 100 runs and over on three different occasions, and could claim an average of 42 runs. Moreover, his greatest triumphs were achieved when only the very best cricket grounds received serious attention, when, as some consider, bowling was maintained at a higher standard, and when all hits had to be run out. He, with his two brothers, E. M. and G. F., assisted by some fine amateurs, made Gloucestershire in one season a first-class county ; and it was he who first enabled the amateurs of England to meet the paid players on equal terms, and to beat them. There is hardly a “record” connected with the game which has not at some time or another stood to his credit. Dr Grace did not, however, ” specialize ” in batting ; he was at all times one of the finest fieldsmen in England, in his earlier days generally

taking long-leg and cover-point, in later times generally standing p^nt when he was not bowling. He was, at his best, a fine thrower, fast runner, and safe “catch.” As a bowler he was long in the first flight, originally bowling fast, but in later times adopting a slower and more tricky style, which, from his intimate knowledge of

the game, was frequently very effective. By profession he was a medical man. In later years he became secretary and manager of the London “County Cricket Club. He was married in 1873 to Miss Agnes Day, and one of his sons played for two years in the Cambridge eleven. He has been the recipient of two national testimonials : the first, amounting to £1500, being presented to him in the form of a clock and a cheque at Lord’s ground by Lord Charles Eussell, on 22nd July 1879; the second, collected by the M.C.C., the county of Gloucestershire, the Daily Telegraph, and the Sportsman, amounted to about £1Q,000, and was presented to him in

1896. He visited Australia in 1873-74 (captain), and in 1891-92 with Lord Sheffield's Eleven (captain) ; America and Canada in 1872, with R. A. Fitzgerald's team.

Dr Grace played his first great match in 1863, when, being only-fifteen years of age, he scored .32 against the All-England Eleven and the bowling of Jackson, Tarrant, and Tiuley ; but the scores which first made his name prominent were made in the next year, viz., 170 and 56 not out for the South Wales Club against the Gentlemen of Sussex. It was in 1865 that he "first took an active part in first-class cricket," being then seventeen years of age, 6 feet in height, and 11 stone in weight, and playing twice for the Gentlemen V. the Players, but his selection was mainly due to his bowling powers, the best exposition of which was his aggregate of 13 wickets for 84 runs for the Gentlemen of the South v. the Players of the South. His absolutely highest score was 400 not out, made in July 1876 against twenty-two of Grimsby; but on three occasions he was twice dismissed without scoring in matches against odds, a, fate that never befell him in important cricket.

In first-class matches his highest score was 344, made for the M.C.C. V. Kent at Canterbury, in August 1876 ; two days later he

made 177 for Gloucestershire v. Notts,’ and two days after this 318 not out for Gloucestershire v. Yorkshire, the two last-named opposing counties being possessed of exceptionally strong bowling ; thus in three consecutive innings Dr Grace scored 839 runs, and was only got out twice. His 344 is the third highest individual score made in a big match in England up to the end of 1901.

He also scored 301 for Gloucestershire v. Sussex at Bristol, in August 1896. He made over 200 runs on ten occasions, the most notable perhaps being in 1871, when he performed the feat twice, each time in benefit matches, and each time in the second innings, having been each time got out in the first over of the first innings. He scored over 100 runs on 121 occasions, the hundredth score being 288, made at Bristol, for Gloucestershire v. Somersetshire in 1895. He made every figure from 0 to 100, on one occasion “closing” the innings when he had made 93, the only total he had never made between these limits. In 1871 he made no fewer than ten ” centuries,” ranging from 268 to 116. In the matches between the Gentlemen and Players he scored “three figures” fifteen times, and at every place where these matches have been played. He made over 100 in each of his “first appearances”

at Oxford and Cambridge. Three times he made over 100 in each innings of the same match, viz., at Canterbury, in 1868, for South V. North of the Thames, 130 and 102 not out ; at Clifton, in 1887, for Gloucestershire v. Kent, 101 and 103 not out ; and at Clifton, in 1888, for Gloucestershire v. Yorkshire, 148 and 153. In 1869, playing at the Oval for the Gentlemen of the South V. the Players of the South, Dr Grace and B. B. Cooper put on 283 runs for the first wicket, Dr Grace scoring 180 and Cooper 101. In 1886 he and Scotton put on 170 runs for the first wicket of England v. Australia ; this occurred at the Oval in August, and Dr Grace's total score was 170. In consecutive innings against the Players from 1871 to 1873 he scored 217, 77 and 112, 117, 163, 158, and 70. He only twice scored over 100 in a big match in Australia, nor did he ever make 200 at Lord's, his highest being 196 for the M.C.C. v. Cambridge University in 1894. His highest aggregates were 2789 (1871), 2622 (1876), 2346 (1895), 2139 (1873), 2135 (1896), and 2062 (1887). He scored three successive centuries in first-class cricket in 1871, 1872, 1873, 1874, and 1876. Playing against Kent at Gravesend in 1895, he was batting, bowling, or fielding during the whole time the game was in progress, his

scores being 267 and 73 not out. He scored over 1000 runs and took over 100 wickets in seven different seasons, viz., in 1874, 1665 runs and 129 wickets; in 1875, 1498 runs, 192 wickets; in 1876, 2622 runs, 124 wickets ; in 1877, 1474 runs, 179 wickets ; in 1878, 1151 nms, 153 wickets; in 1885, 1688 runs, 118 wickets; in 1886, 1846 runs, 122 wickets. No one else ifas performed this feat more than twice, except G. Giffen, the Australian. He never captured 200 wickets in a season, though he came very near to the feat in 1875 with 192. Playing against Oxford University in 1886, he took all the wickets in the first innings, at a cost of 49 runs. In 1895 he not only made his hundredth century, but actually scored 1000 runs in the course of the month of May alone, his chief scores in that month being 103, 288, 256, 73, and 169, he being then forty-seven years old. He also made during that year scores of 125, 119, 118, 104, and 103 not out, his aggregate for the year being 2346, and his average 51 ; his innings of 118 was made against the Players (at Lord's), the chief bowlers being Richardson, Mold, Peel, and Attewell ; he scored level with his partner, A. E. Stoddart (his junior by fifteen years), the pair making 151 before a wicket fell, Grace making in all 118 out of

241. This may fairly be considered one of his most wonderful years. In 1898 the match between Gentlemen v. Players was, as a special compliment, arranged by the M.C.C. committee to take place on his birthday, and he celebrated the event by scoring 43 and 31 not out, though handicapped by lameness and an injured hand. In twenty-six different seasons he scored over 1000 runs, in three of these years being the only man to do so, and five times being one out of two. His first three-figure innings was 244 not out, made at the Oval, July 30 and 31, 1866, for England v. Surrey ; his last, 126, made at Lord's, 13th September 1900, for South v. North. Daring the thirty-six years which may be taken as covering his cricket career he scored nearly 51,000 runs, with an average of 43 ;• and in bowling he took more than 2800 wickets, at an average cost of about 20 runs per wicket. He made his highest aggregate (2739 runs) and had his highest average (78) in 1871 ; his average for the decade 1868-77 was 57 runs, a marvellously fine record for so long a period, when the bowling was splendid and grounds were often rough, whUe, boundaries being only occasionally used, the majority of the runs had to be run out. It may be added as a matter of interest that he has thrown the cricket ball more than

116 yards, and has hit it a measured distance of 140 yards from the pitch. This latter distance he has probably exceeded. His style as a batsman was more commanding than graceful, but as to its soundness and efficacy there were never two opinions ; the severest criticism ever passed upon his powers was to the effect that he did not play slow bowling quite as well as fast.

Crafton, a town in the county of Clarence, New South Wales, Australia, on both sides of the Clarence river, at a distance of 45 miles from its mouth, 342 miles IST.E. of Sydney by sea. It comprises two sections. North Grafton and South Grafton, now forming separate municipalities ; communication between the two is maintained by a ferry. The river is navigable from the sea to the town for ships of moderate burden, and for small vessels to a point 35 miles beyond it. Extensive harbour works are now in progress at the river mouth. The dairy interest is of growing importance, and the agricultural prospects are good. In the district are several large sugar mills. The mean rainfall is 33-83 inches. Population (1881), 3891; (1901), 4174; South Grafton, 976.

Crafton, capital of Taylor county. West Virginia, U.S.A., on the Tygart Valley river and on two lines of the Baltimore and Ohio railway. It has large railway shops and several iron foundries. Population (1890), 3159 ; (1900), 6650, of whom 226 were foreign-born.

Graham, Sir Gerald (1831-1899), English soldier, only son of Dr Eobert Hay Graham of Eden Brows, Cumberland, was born on 27th June 1831 at Acton, Middlesex, educated at Dresden and Woolwich Academy, and entered the Eoyal Engineers in 1850. He served with distinction through the Eussian war of 1854 to 1856, was present at the battles of Alma and Inkerman, was twice wounded in the trenches before Sebastopol, and was awarded the Victoria Cross for gallantry at the attack on the Eedan and for devoted heroism on numerous occasions (medal with three clasps, Turkish medal, 5th class Legion of Honour, 5th class Medjidie, and brevet majority). In the China war of 1860 he took part in the actions of Sin-ho and Tang-ku, the storming of the Taku Forts, where he was severely wounded,

and the entry into Pekin (medal with two clasps, brevet lieutenant-colonelcy, and C.B.). Promoted colonel in 1869, he was employed in routine duties until 1877, when he was appointed assistant-director of works for barracks at the War Office, a position he held until his promotion

to major-general in 1881. In command of the advanced force in Egypt in 1882, he bore the brunt of the fighting, was present at the action of Magfar, commanded at the first battle of Kassassin, took part in the second, and led his brigade at the storming of Tel-el-Kebir (medal with clasp, bronze star, 2nd class Medjidie, K.C.B., and thanks of Parliament). In 1884 he commanded the expedition to the Eastern Sudan, and fought the successful battles of El Teb and Tamai, but was forbidden to march to General Gordon's assistance vid Berber, and returned home (two clasps to medal, 1st class Medjidie,thanks of Parliament, lieutenant-general for distinguished service in the field). In 1885 he commanded the Suakin expedition, defeated the Arabs

at Hashin and Tamai, and advanced the railway from Suakin to Otao, when the expedition was withdrawn (thanks of Parliament and G.C.M.G.). In 1896 he was made G.C.B., and in 1899 colonel-commandant Royal Engineers. He died on 17th December 1899. He published in 1875 a translation of Goetze's Operations of the German Engineers in 1870-71, and in 1887 Last Words with Gordon. (r. h. v.)

Graham's Town, a city of Cape Colony, the administrative centre for the Eastern Provinces. It lies 1760 feet above searlevel in a remarkably healthy district, a short distance N. by W. of Port Alfred, and N.E. of Port Elizabeth, with both of which places it is connected by rail. It is one of the earliest English settlements in the colony, dating from the year 1812, and was the chief military station towards Great Pish river during the Kaf&r wars. Owing to the sour quality of the herbage in the surrounding " Zuurveld " district, stock-breeding and wool-growing, formerly the chief occupation of the settlers, have in recent years been largely replaced by

ostrich-farming, for which industry Graham's Town is the most important centre. Its chief seaward outlet is Port Alfred, at the mouth of the little river Kowie, where extensive harbour works now give access to vessels drawing 8 or 10 feet. The great majority of the population is of British descent, and numbered 10,500 in 1891.

Grain Coast. See Liberia.

Grain Trade. — The complexity of the conditions of life at the opening of the 20th century may be well illustrated from the mutations of a penny roll. To think that such a common household necessary as a loaf of bread, which in a simpler state of society each family made at home from grain grown in its own patch of land, should have called into existence fleets of aeaerai ocean and lake steamers, giant railway waggons, masidera- jj^ammoth warehouses, and colossal mills, is a good illustration of the distance which we have travelled ; moreover, when it is considered that all this progress has been made, say, since 1850, it may be seen what giant strides civilization is now taking. Contrast

the cargo of the leviathan ocean tramp of to-day with the freight of a mediaeval coaster; the one carrying in a single voyage the whole crop of an entire English county, such as Derbyshire, the other a load of perhaps a hundred tons. Or compare a modern freight car of North America, with its burden of a thousand or thirteen hundred bushels,' with the farmer's waggon of 1880 ; or the latest American canal barge of 4000 tons capacity with its prototype drawn by a bargee or mule. Or, again, take a farmer's barn of the last generation and place it alongside the grain storage silos in Liverpool, which are capable of holding 3,000,000 bushels, the annual produce of one of the larger English counties. Last, but not least significant, is the wonderful development in the appliances for milling wheat. Think of the ancient quern or the picturesque windmill, and compare it with a modern roller flour mill. with, for instance, a stately building like the Chancellot Mills at Edinburgh, or with one of those colossal fabrics that has an endless series of machines, and miles upon

miles of pipes and elevators, and is equipped with machinery of such scientific accuracy as to be capable of distinguishing between the fineness of two particles of fiour, which together would be barely palpable ; mills with a capacity to produce a million sacks per annum, sufficient to feed a city of 10,000 inhabitants for a hundred years.

The origin of wheat is shrouded in mystery. It is alleged to have been found growing wild somewhere between the Euphrates and the Tigris; but the discovery has never been authenticated, for, unless the plant be sedulously cared for, the species dies out in a surprisingly short space of time. Recent experiments in cross-fertilization in Lancashire by the Garton Brothers have evolved the most extraordinary, not to say monstrous, ” sports,” showing, it is claimed, that in the course of development the plant has probably passed through stages of which until the present day we have not had the slightest conception. The tales that grains of wheat found in the cerements of Egyptian mummies have been

planted and come to maturity are no longer credited, for the vital principle in the wheat berry is extremely evanescent ; indeed, it is doubtful whether wheat twenty years old is capable of reproduction. The Garton artificial fertilization experiments have shown that endless deviations from the ordinary type can be evolved, ranging from minute seeds with a closely adhering husk to big berries almost as large as sloes and about as worthless. The author of the experiment in question is reported to be of the opinion that the wheat plant, as we know it now, is a degenerate form of something much finer which flourished thousands of years ago, and that it is not unreasonable to look forward to a time when it will be restored to its pristine excellence, yielding an increase twice or thrice as large as that to which we are now accustomed, and thus postponing to a distant period the famine doom prophesied by Sir W. Crookes in his presidential address to the British Association in 1898 (see Crookes). It is certainly remarkable what latent possibilities seem to lurk in this seed of the Triticum vulgare, and how readily it yields

them as rewards to man for his research and labour. Contrast the produce of a carelessly tilled Russian or Indian field and the bountiful yield on a good Lincolnshire farm, the former with its average yield of 8 bushels, the latter with its 60 bushels per acre ; or compare the quality, as regards the quantity and flavour of the flour from a fine sample of British wheat, such a,s is on sale at almost every agricultural show in Great Britain, with the produce of an Egyptian or Syrian field ; the difference is so great as to cause one to doubt whether the berries are of the same species.

The ordinary loaf which one sees in a baker’s shop in Great Britain may be said to represent the product of nearly every country in both hemispheres outside of the tropics, each of the five divisions of the world contributing its share. It may be stated roundly that an average quartern loaf in Great Britain is made from wheat grown in the following countries in the proportions named : —

U.S.A.

U.K.

a

■Sa

i

1 ^

§3

fi

11

E?

^.V.

a

s

og

M

<1

M”

^

jv^fq

<

o

Oz.

Oz.

Oz.

Oz.

Oz.

Oz.

Oz.

Oz.

Oz.

26

13

9

5

4

3

2

1

1

Or expressed in percentages as follows

: —

40

20 1 14 1 8 1 6 1 5 1 3

2

2

54

GRAIN TRADE

Wheat, the great staple food of the most progressive portion of mankind, occupies of all cereals the widest region of any foodstuff. Rice, -which shares with millet the distinction of being the principal foodstuff of the greatest number of human beings, is not grown nearly as widely as the white man’s favourite cereal. Wheat grows as far south as Patagonia, and as far north as the edge of the Arctic Circle ; it flourishes throughout Europe, and across the whole of Northern Asia and in Japan ; it is cultivated in Persia, and raised largely in India, as far south as the Nizam’s dominions. It is grown in almost every state of the American Union, from Southern California to the State of Washington. In the Dominion of Canada a very fine wheat crop was raised in the autumn of 1898 as far north as the

mission at Fort Providence, on the Mackenzie river, in a latitude above 62° — the latitude of the Faroe Islands, or less than 200 miles south of the latitude of Dawson City — the period between seed-time and harvest having been ninety-one days. In Africa we hear of it as an article of commerce in the days of the patriarch Jacob, whose son Joseph may be said, in the parlance of the corn market, to have run the first and only successful ” corner ” in the staff of life. For many centuries Egypt was famous as a wheat raiser ; it was a cargo of wheat from Alexandria which the Apostle St Paul helped to jettison on the occasion of one of his shipwrecks, as was also, in all probability, that of the ” ship of Alexandria whose sign was Castor and Pollux,” named in the same narrative. General Gordon is quoted as having stated that the Sudan when properly settled would be capable of feeding the whole of Europe. It is known that the cereal flourishes on all the high plateaux of South Africa, from Cape Town to the Zambezi. Additional land is being rapidly and extensively put

under wheat in the pampas of South America and in the prairies of Siberia. There are tracts along the north coast of Africa which, if properly irrigated, as was done in the days of Carthage, and as is done in India under British rule to-day, could produce a sufficiency of wheat to feed half of the Caucasian race. For an instance, the vilayet of Tripoli, with an area of 400,000 square mUes, or three times the extent of Great Britain and Ireland, according to the opinion of a British consul could raise millions of acres of wheat.

In the raising of the standard of farming to an English level the volume of the world's crop would be trebled, another fact which Sir William Crookes seems to have overlooked. Or, again, take the experiments of the late Sir J. B. Lawes in Hertfordshire, which have proved that the natural fruitfulness of the wheat plant can be increased threefold by the application of the proper fertilizer. A brief digest of the principal results of these most valuable experiments (see also under Agriculture) may not be out of place here. It is taken from a compendium

issued from the Eothamsted Agricultural Experimental

Station.

Experiment on tlie growth of wheat year after year on the same land :

without Tnanure, and vriih different descriptions of mamure.

Average 46 years. 1852 to 1897.

Dressed Grain.

Total Straw.

Quantity.

Bushels per

Acre.

Weight.

Per Bushel,

ft.

Per Acre.

Cwts.

Unmanured continuously

Farmyard manure .

Mixed mineral manure ^

(most successful in- –

stance) . . J

12J

35j

361

m

60i

595

91

33

404

Hxperimemt on wheat alternated wWh fallow and wheat

grown continuously.

(Area under experiment 1 acre.)

Averages — Produce after fallow reckoned at the yield per acre,

of the half in crop, each year.

Yield.

Bushels

per Acre.

Weight

per

Bushel,

, ft.

Total

Grain,

ft.

Total

Straw,

ft.

Total

Grain and

Straw,

ft.

Wheat after ‘l

fallow each j-

Wheat after {

wheat each \

year . J

17i

12f

58-7

58-8

1073

795

1595

1127

2668

1921

It should be noticed that, if after fallow had been reckoned at the yield per acre of the whole area, half in crop and half fallow, the results would of course have been very different. ” The conclusion to be drawn is that although there is an increase of produce after fallow compared with that of wheat grown continuously, it is obtained at the sacrifice of a crop every other year, and that a given area of land yields more when the crop is grown year after year, than when alternated with fallow. The explanation doubtless is, that much of the nitrogen brought into an available condition under the influence of the fallow is lost by drainage during the long period that the land is without a crop.” This conclusion would seem to be in direct conflict with the advice given to the Israelites

of old, and with the practice of many agriculturists abroad at the present time.

As far as can be traced in the report to the Lawes Agricultural Trust Committee by Sir J. H. Gilbert, F.E.S., the highest yield per acre in the twelve years 1871-82 was obtained in the year 1874 with Eivett's (red), the manures used being nitrate after mangels (with dung) were carted off, the jdeld per acre amounting to 67 bushels of dressed grain ; the natural weight, however, was only 58^ lb per bushel, the same class of wheat again in 1878 giving 66^ busiiels of 58| 3b natural weight. But in the wet season of 1879 the same seed gave only 16 bushels, weighing 49 1 B). Taken over an eight years period, 1871 to 1878, some of the best- and worst-yielding sorts were the following : —

(1) Rivett's (red) .

(2) Belgian (white)

(3) Original red Halletts

(4) White Chiddam .

Total

Weight,

ft.

3189

3150

2302

2167

Yield

per Acre.

Bushels.

52i

53|

37J

Weight

per ft.

60f

58|

62

591

The palm for a high natural weight must be awarded to

Red Nursery, which on an eight years average scored

63|^ t), and for a single year as high as 66 S) (in 1876).

In these comparisons of one class of seed wheat with another, we do not purpose drawing invidious distinctions ; indeed, it is by no means the wheat which yields the greatest number of bushels per acre which is the most valuable from a miller’s standpoint, for in his estimation the thinness of the bran and the fineness and strength of the flour are most important considerations, too often overlooked by the farmer when buying his seed. But after all, it is the deficient quantity of the wheat raised of late years in the British Islands, and not the quality of the grain, which has been the cause of so much anxiety to economists and statesmen.

Sir J. Caird, writing as recently as in the year 1880, expressed the opinion that arable land in Great Britain would always command a substantial rent of at least 30s. per acre, for he calculated that the cost of carriage from

abroad of wheat, or the equivalent of the product of an

acre of good wheat land in Great Britain, would not be less than 30s. per ton. , But freights had come down by the year 1900 to half the rates predicated by that authority ; indeed, during a portion of the interval they ruled very close to zero, as far as steamer freights from America were concerned. In 1900 an all-round freight rate for wheat might be taken at 15s. per ton (a ton representing approximately the produce of an rates. ‘^^ o^ good wheat land in England), say from 10s. for Atlantic American and Russian, to 30s. for Pacific American and Australian ; about mid-way between these two extremes we find Indian and Argentine, the greatest bulk coming at about the 15s. rate. Inferior land bearing less than 4J quarters per acre would not of course be protected to the same extent, and moreover, seeing that a portion of the British wheat crop has to stand a charge as heavy for land carriage across a county as that borne by foreign wheat across a continent or an ocean, the protection is not nearly so substantial as Caird would make out. The

compilation showing, the changes in the rates of charges for the railway and other transportation services issued by the Division of Statistics, Department of Agriculture, U.S.A. (Miscellaneous Series, Bulletin No. 15, 1898), is a valuable reference book. From its pages are culled the following facts relating to the changes in the rates of freight up to the year 1900. In Table 3 the average rates per ton per mile in cents are shown since 1846. For the Fitchburg Railroad the rate for that year was 4-523 cents per ton per mile, since when a great and almost continuous fall has been taking place, until in 1897, the latest year given, the rate had declined to ‘870 of a cent per ton per mile. The railway which shows the greatest fall is the Chesapeake and Ohio, for the charge has fallen from over 7 cents in 1862 and 1863 to ‘419 of a cent in 1897, whereas the Erie rates have fallen only from 1-948 in 1852 to -609 in 1897. Lumping the rates of the twelve returning railways

together, we find the average freight in the two years 1859-60 was 3-006 cents per ton per mile, and that in 1896-97 the average rate had fallen to ‘797 of a cent per ton per mile. This difference is very large when the smallness of the unit is borne in mind. Coming now to the raison d’etre of this inquiry, viz., the rates on grain, we find (in Table 23) a record for the forty years 1858-97 of the charge on wheat from Chicago to New York, vid all rail from 1858, and vid lake and rail since 1868, the authority being the secretary of the Chicago Board of Trade. From 1858 to 1862 the rate varied between 42-37 and 34-80 cents per bushel for the whole trip of roundly 1000 miles, the average rate in the quinquennium being 38-43. In the five years immediately prior to the time at which Sir J. Caird expressed the opinion that the cost of carriage from abroad would always protect the British grower, the average all-rail freight from Chicago to New York was 17-76 cents, while the summer rate (partly by water) was 13-17 cents. These rates in 1897, the last year shown on the table, had fallen to 12-50 and

7-42 respectively. The rates have been as foUows in

quinquennial periods, vid all rail : —

Chicago to New York

in Cents

per Bushel.

1858-62.

1863-67.

1S68-72.

1873-77.

1878-82.

1883-87. 1 1888-92.

1893-97.

38-43

31-42

27-91

21-29

16-77

14-67 1 14-52

12-88

Calculating roundly a cent as equal to a halfpenny,

and eight bushels to the quarter, the above would appear

in English currency as foUows : —

Chicago to Nevj York in Shillings and Pence per Quarter.

1868-62.

1863-67.

1868-72.

1S73-77.

1878-82.

1883-87.

i888-92.

1893-97.

s. d.

12 8

B. d.

10 6

s. d.

9 3

8. d.

7 1

s. d.

5 7

s. d.

4 104

s. d.

4 10

s. d.

4 3

Another table (No. 38) is of interest, as showing the average rates from Chicago to New York by lakes, canal, and river. These in their quinquennial periods are given for the season as follows : —

In Cents per Bushel of 60 Ihs.

1857-61. 1 1876-80.

1893-97.

22-15

10-47

4-92

In Shillings and. Pence per Quarter of 480 lbs.

1867-61.

1876-80.

1893-97.

s. d.

7 4

s. d.

3 6

8. d.

1 7

In Shillings and Pence per Ton of 2240 lbs.

1857-61.

1876-80.

1893-97.

s. d.

34 6

s. d.

16 6

s. d.

7 6

This latter mode is the cheapest by which grain can be carried to the eastern seaboard from the American prairies, and, as will be seen from the foregoing, it can

now be done at a cost of 7s. 6d. per ton. The ocean freight has to be added before the grain can be delivered free on the quay at Liverpool. In December 1900 the rate from New York to Liverpool was 2id. per bushel, or 7s. lOd. per ton, a low rate, it is true, in comparison with that which prevailed in former years, but yet sufficiently high, it was claimed, to leave a profit on a modern steam-ship ; indeed, there have frequently been times when the rate was as low as Id. per bushel, or 3s. Id. per ton; and occasionally, in periods of great trade depression, wheat is carried from New York to Liverpool as ballast, actually being paid for by the shipowner. Another route which is also worked more cheaply than formerly is that by river, from the centre of the winter wheat belt, say at St Louis, to New Orleans, and thence by steamer to Liverpool. The river rate is now down below five cents per bushel, or 7s. per ton, 2240 tt). In Table No. 71 the cost of transportation is compared year by year with the export price of the two leading cereals in the States, and as we have not yet shown the annual average rates for the

years severally, we reproduce the whole of this tabular

statement : —

lllieat and Com — Export Prices and Transportalion

Bales Compared.

Wheat.

Com. 1

Rate, Chi-

Bate, Chi-

cago to

New York

Tear.

Export

cago- to

Sew York

of bushels

Export

of bushels

price per

bushel.

hy lake

and canal,

for price

price per

busheL

by lake

and canal,

for price

per

bushel.

busheL

bushel.

bushel.

Cents.

Cents.

1867

10-92

15-95

5-77

SO-72

14-58

4-94

1868

1-36

16-23

8-38

-84-1

13-57

6-20

1869

1-05

17-20

6-10

-72-8

14-98

4-86

1870

1-12

14-85

7-54

-80-5

13-78

5-84

1871

1-18

17-75

6-65

-67-9

16-53

4-11

1872

1-31

21-55

6-08

•61-8

19-62

3-15

1873

1-15

16-89

6-81

•54-3

15-39

3-53

1874

1-29

12-75

10-12

-64-7

11-29

5-73

1875

-97

9-90

9-80

•73-8

8-93

8-26

1876

1-11

8-63

12-86

•60-3

7-93

7-60

1877

1-12

10-76

10-41

•56-0

9-41

5-95

1878

1-33

9-10

14-62

-55-8

8-27 1 6-75

56

GRAIN TRADE

Wheat and Corn — Export Prices and Tra-nsportaiion Rates

Compared (continued).

Year.

Wheat.

Corn.

Export price per bushel.

Rate, Chicago to New York by lalce and canal, per bushel.

Number of bushels carried for price of one bushel.

Export price per bushel.

Rate, Chicago to New York by lake and canal, per bushel.

Number of bushels carried for price of one bushel.

1879

1-07

Cents.

11-60

9-22

0-47-1

Cents.

10-43

4-52

1880

25

12-27

10-19

•54-3

11-14

4-87

1881

11

8-19

13-55

•55-2

7-26

7-60

1882

19

7-89

15-08

■66-8

7-23

9-24

1883

13

8-37

13-50

•68-4

7-66

8-93

1884

07

6-31

16-96

•61-1

5-64

10-83

1885

86

5-87

14-65

-54-0

5-38

10-04

1886

87

8-71

9-99

-49-8

7-98

6^24

1887

89

8-51

10-46

-47-9

7-88

6-08

1888

85

5-93

14-33

•66-0

5-41

10-17

1889

90

6-89

13-06

•47-4

6-19

7-66

1890

83

5-86

14-16

-41-8

5-10

8-20

1891

93

5-96

15-60

-67-4

5-36

10-71

1892

1

03

5-61

18-36

•55

5-03

10-93

1893

80

6-31

12-68

•53

5-71

9-28

1894

67

4-44

15-09

•46

3-99

11^53

1895

58

4-11

14-11

•53

3-71

14-29

1896

65

5-38

12-08

•38

4-94

7-69

1897

•75

4-35

17-24

■31

3-79

8-18

So much improved is the American farmer’s position to-day as compared “with what it was about the year 1870, that the transport companies in 1901 carried 17^ bushels of his grain to the seaboard in exchange for the value of one bushel, whereas in 1867 he had to give up one bushel in every six in return for the service. As regards the British farmer, it does not appear as if he had improved his position at all ; for, in the first

place, he has to send his wheat to greater distances, owing to the collapse of so many country millers or their removal to the ‘seaboard, while railway rates have fallen only to a very small extent ; in the second place, the farmer’s wheat is worth only half of what it was formerly ; so in round numbers, it may be said that the British farmer has to give up one bushel in nine to the railway company for the purpose of transportation, whereas in the ‘seventies he gave up one in eighteen only. Enough has been said to prove that the advantage of position claimed for the British farmer by Caird was somewhat illusory. Speaking broadly, the Kansas or Minnesota farmer’s wheat does not have to pay (1902) for carriage to Liverpool more than 2s. 6d. to 7s. 6d. per ton in excess of the rate paid by a Yorkshire farmer ; this, it will be admitted, does not go very far towards enabling the latter to pay rent, tithes, and rates and taxes, such as obtain in England and in nearly all old countries.

The subject of the rates of ocean carriage at different periods requires consideration if a proper understanding

of the working of the foreign grain trade is to be obtained. Somewhat contrary to general expectations, it will be found that only a very small proportion of the decline in the price of wheat since 1880 is due to cheapened transport rates ; for while the mileage rate has been falling, the length of haulage has been extending, until in 1900 the principal wheat fields of America were 2000 miles farther from the eastern seaboard than was the case in 1870, and consequently, notwithstanding the fall in the mileage rate of 50 to 75 per cent., it still cost the United Kingdom nearly as much to have its quota of foreign wheat fetched from abroad as it did then. The exact difference in the cost of the operation is sho-wn in the following tabular statement, both the cost in the aggregate on a year's imports and the cost per quarter : —

Quantity of Wheat and Wheaten Flour {as wheat) imported into the United Kingdom from various sources during the calendar year 1900, together with the average rate affreight.

1900.

Countries of Origin.

Atlantic America .

South Russia .

Pacific America

Canada .

Rumania

Argentina and Uruguay

France .

Bulgaria and Rumelia

India

Austria-Hungary .

Chile

North Russia .

Germany

Australasia

Minor Countries .

Total .

Quantities.

Qrs. 480 B).

11,171,100

569,000

2,389,900

1,877,100

176,400

4,322,300

25l,9no

30,600

2,200

389,300

600

462,700

438,700

883,900

226,100

23,190,800

Ocean Freight

to United

Kingdom.

Per 480 ab.

3. d.

2 3

2 2

S 1

2 8

2 6

4 10

1 3

Average 3s. 6d.

Total Cost of

Ocean Carriage.

£

1,267,100

62,000

966,000

250,000

22,000

1,046,000

16,000

4,000

400

34,000

36,000

33,000

284,000

28,000

£4,(

i,500

Comparing the foregoing with a similar statement for the year 1872, the most remote year for which similar facts are available, it will be found that the actual total cost per quarter for ocean carriage has not much decreased.

Quantity of Wlieat and Wheaten Flour (as wheat) imported into the United, Kingdom from various sources during the calendar year lS72, together with the average rate of freight.

1872.

Ocean Freight

Countries of Origin.

Quantities.

Qrs.

to United

Kingdom.

Per qr.

Total Cost of

Carriage.

s. d.

£

South Russia .

3,678,000

8 6

1,663,000

United States

.

2,030,000

6 6

659,000

Germany

910,000

2 0

91,000

France .

660,000

3 0

99,000

Egypt .

636,000

4 6

120,000

North Russia

490,000

2 0

49,000

Canada .

400,000

7 6

160,000

Chile

330,000

12 0

198,000

Turkey .

196,000

7 6

72,000

Spain

130,000

3 6

23,000

Scandinavia

160,000

2 0

16,000

Total, Chief

Con:

itrie

9,519,000

Average 6s. 6d.

£3,040,000

N.B. — There was a trifling quantity of Californian and Austra-

lian wheat imported in the period in question, but the Board of

Trade records do not distinguish the quantities, therefore they cannot be given. The freight in that year from those countries averaged about 13s. per quarter.

The exact difference between the average freight for the years 1872 and 1900, it will be seen, amounts to about 2s. lid. per quarter (480 Si), a mere trifle in comparison with the actual fall in the price of wheat during the same years.

The following data bearing upon the subject, for selected periods, are partly taken from the Corn Trade Year-Booh of 1896 :—

United Kingdom

Ocean Freight

Annual Imports.

to United

Aggregate Cost

Wheat and Flour.

Kingdom.

of Carriage.

Qrs.

Per qr.

‘

s. d.

£

1872 .

9,469,000

6 5

3,040,000

1882 .

14,850,000

7 4

5,420,000

1894

16,229,000

3 9

3,041,000

1895

25,197,000

3 0

3,826,000

1896

23,431,000

2 9

3,268,000

1900

23,196,000

3 6

4,036,000

In passing, it may be pointed out that for a period of

four years, from 1871 to 1874, the price of wheat averaged

56s. per quarter (or 7s. per bushel), with the charge for

ocean carriage at 6s. 5d. per quarter, whereas in 1901

we had wheat at 28s. (or 3s. 6d. per bushel), and the

published by Mr T. Smith, Melford, the period covered being from

1666 to 1900 :— ‘ r fa

charge for ocean carriage at 3s. 6d. per quarter; the

ocean transport companies carried eight bushels of wheat

across the seas in 1 90 1 for the value of one bushel, or exactly

at the same ratio as in 1872. The contrast between the case of railway freight and ocean freight is striking, but is to be explained by the greater length of the present ocean voyage, which now extends to 10,000 miles in the case of Europe's importation of white wheat from the Pacific Coast of the United States and Australia, in contrast with the short voyage from the Black Sea or across the -English Channel or German Ocean. It is largely due to the overlooking of this phase of the question that an American statistician has fallen into the error of stating that about 16s. per quarter of the fall in the price of wheat, which happened between 1880 and 1894, is attributable to the lessened cost of transport, he having apparently drawn his deduction from the narrow premises of the American railway and ocean freights. It thus appears to be a fact that, whatever the cause of the decline in the price of wheat may be, it is not due solely to the fall in the rate of rail or ocean freights. Incidental charges, it is true, are lower than they were in 1870; handling charges, brokers' commissions, and in-

surance premiums have been in many instances reduced in recent years. Port dues and charges have occasionally been lowered by Is. to 2s. per ton on each side of the Atlantic ; commissions have been reduced by 1 per cent., or perhaps by a little more; insurance premiums are a trifle lower; but all these economies when combined will only amount to about 2s. per quarter. Now if we add together all these savings in the rate of rail and ocean freights and incidental expenses, we arrive at an aggregate economy of 8s. per quarter, or not one-third of the actual difference between the average price of wheat in 1872 and 1900.

To what the remaining difference was due it is difficult to say with certitude ; there are some who argue that the tendency of prices to fall is inherent, and that the constant whittling away of intermediaries' profits is sufficient explanation, while the bi-metallists maintain that the phenomenon is clearly to be traced to the action of the German Government in demonetizing sUver in 1872.

Wheat Ppjoes foe 246 Yeaks.

The following figures show the fluctuations from year to year,

for 246 years, of English wheat, chiefly according to a record

The World’s Visible Supply of Wheat {in, million bushels) and Average Price, per imperial quarter, of British Wheat in

England and Wales in each mmithfrom August 1891 to July 1901.

Price per

Quarter.

E. d.

6. d.

s. d.

s. d.

s. d.

1656

38 2

1706

23 1

1756

40 1

1806

79 1

1856

69 2

41 6

1707

25 4

1767

53 4

1807

75 4

1857

66 4

1658

57 9

1708

36 10

1768

44 6

1808

84 4

1858

1669

68 8

1709

69 9

1759

35 3

1809

97 4

1859

43 9

1660

60 2

1710

69 4

1760

32 5

1810

106 5

1860

53 3

1661

62 2

1711

48 0

1761

26 9

1811

96 3

1861

65 4

66 9

1712

41 2

1762

34 8

1812

126 6

1862

65 6

1663

60 8

1713

46 4

1763

36 1

1813

109 9

1803

44 9

36 0

1714

44 9

1764

41 6

1814

74 4

1864

40 2

1665

43 10

1715

38 2

1766

48 0

1815

65 7

1865

41 10

1666

52 0

1716

42 8

1766

43 1

1816

78 6

1866

49 11

1667

82 0

1717

40 7

1767

67 4

1817

96 11

1867

64 6

1668

35 6

1718

34 6

1768

63 9

1818

86 3

1868

63 9

1669

39 5

1719

31 1

1769

40 7

1819

74 6

1869

48 2

1670

37 0

1720

32 10

1770

43 6

1820

67 10

1870

46 11

1671

37 4

1721

33 4

1771

47 2

1821

56 1

1871

66 8

1672

36 5

1722

32 0

1772

60 8

1822

44 7

1872

57 0

1673

41 6

1723

30 10

1773

51 0

1823

63 4

1873

68 8

1674

61 0

1724

32 10

1774

52 8

1824

63 11

1874

65 9

1675

67 6

1726

43 1

1776

48 4

1826

68 6

1875

1876

45 2

1676

33 9

1726

40 10

1776

38 2

1826

68 8

46 2

1677

37 4

1727

37 4

1777

45 6

1827

58 6

1877

66 9

1678

62 5

1728

48 6

1778

42 0

1828′

60 6

1878

46 5

1679

63 4

1729

41 7

1779

33 8

1829

66 3

1879

43 10

1680

40 0

1730

32 6

1780

35 8

1830

64 3

1880

44 4

1681

41 6

1731

29 2

1781

44 8

1831

66 4

1881

45 4

1682

39 1

1732

23 8

1782

47 10

1832

58 8

1882

46 1

1683

35 6

1733

25 2

1783

52 8

1833

62 11

1883

41 7

1684

39 1

1734

34 6

1784

48 10

1834

46 2

1884

36 8

1686

41 6

1735

38 2

1786

61 10

1835

39 4

1885

32 10

1686

30 2

1736

86 10

1786

38 10

1836

48 6

1886

31 0

1687

22 4

1737

S3 9

1787

41 2

1837

65 0

1887

32 6

1688

40 10

1738

31 6

1788

45 0

1838

64 7

1888

31 10

1689

26 8

1739

34 2

1789

61 2

1839

VO 8

1889

29 9

1690

30 9

1740

45 1

1790

54 9

1840

66 4

1890

31 11

1691

30 2

1741

41 6

1791

48 7

1841

64 4

1891

37 0

1692

41 6

1’,‘42

30 2

1792

43 0

1842

67 3

1892

30 3

1693

60 1

1743

22 1

1793

49 B

1843

60 1

1893

26 4

1694

66 10

1744

22 1

1794

62 3

1844

51 3

1894

22 10

1695

47 1

1746

24 6

1706

7’; 2

1845

60 10

1895

23 1

1696

63 1

1746

34 8

1796

78 7

1846

64 8

1896

26 2

1697

63 4

1747

30 11

1797

63 9

•■847

69 9

1897

30 2

1698

60 9

1748

32 10

1798

61 10

i848

60 6

1898

84 0

1699

66 10

1749

32 10

1799

69 0

1849

44 3

1899

26 8

1700

35 6

1760

28 10

1800

113 10

1850

40 3

1900

28 11

1701

33 6

1761

34 2

1801

119 6

1851

38 6

1901

26 9

1702

26 2

1752

37 2

1802

69 10

1852

40 9

1703

32 0

1763

39 8

1803

58 10

1853

63 3

1704

41 4

1764

30 9

1804

62 3

1854

72 6

1705

26 8

1766

30 1

1805

89 9

1855

74 8

li’)

1 g 1- 42 10

■5s)

36 0

61 9

65 10

«42 7

” Average for 46 years only.

Dividing the period into ten parts, we have the following as the average prices for each 25 years :

1650-74

1676-99

s. d.

46 0

44 0

1700-24

1726-49

s. d.

37 0

36 0

1750-74

1775-99

s. d.

43 0

48 0

1800-24

1826-49

s. d.

78 0

68 0

1850-74

1 1876-1901

s. d.

63 0

36 6

August.

September.

October.

November.

December.

January.

February.

March.

April.

May.

June.

July.

1891-92 . .|

1892-93 . ./

1893-94 . .|

1894-95 . .|

1895-96 . .{

1896-97 . .1

1897-98 . .{

1898-99 . .|

1899-1900 ./

1900-1901 .|

110

39/9

112

38/5

155

35/0

179

37/10

203

37/6

200

35/4

197

32/6

181

32/11

187

31/2

161

31/5

148

30/1

132

29/2

123

29/7

146

28/11

166

28/2

196

28/1

232

26/3

237

26/3

234

25/9

229

24/10

222

25/1 –

215

26/8

205

27/1

184

26/7

178

26/2

183

26/3

196

27/7

221

27/3

237

26/8

232

26/3

233

25/0

222

24/3

216

24/7

207

24/7

196

23/10

173

24/6

174

24/3

189 ‘

20/7

205

17/8

221

18/10

219

20/7

228

20/7

223

20/0

212

19/11

198

20/5

181

24/10

186

22/5

171

25/9

160

24/9

158

24/2

152

22/10

176

24/6

210

25/9

219

24/11

225

25/7

203

26/2

192

25/2

161

25/6

147

25/1

137

24/4

124

22/11

126

23/9

151

27/10

190

32/4

202

31/8

185

31/2

173

29/4

155

27/11

139

27/3

121

28/0

107

27/3

89

27/9

77

30/3

87

33/7

119

32/5

139

33/9

156

33/11

157

34/9

152

35/1

140

35/7

132

36/0

111

46/0

110

43/7

87

37/5

70

33/1

66

26/5

83

26/6

107

28/1

136

27/2

147

26/11

146

26/2

151

25/8

145

24/8

139

25/3

137

25/6

140

25/5

134

24/8

142

25/3

163

27/4

191

26/4

203

25/6

203

25/10

190

25/11

181

25/11

184

25/11

176

25/8

157

25/9

150

28/8

150

28/8

165

28/6

188

28/5

201-

27/2

203

26/8

200

26/8

198

26/5

193

25/10

188

26/6

172

27/3

153

27/7

136

27/4

S. V. — 8

58

GRAIN TRADE

The World’s Grain Trade.

In the following statistical account of the world’s grain trade, the principal details of each country’s share are shown over a period of ten years or more. The accompanying diagram shows the world’s crop, imports and exports, of the season 1898-99. For the chief

WORLD’S EXPORT

51.300.000 r

w U.X. .

i; IMPORTS

2i:i5bp,000

liargt^^Square^T^ Drld‘5^^ Crop^

?312,00OTS

Ex-Eur:

Import

JCONTlNENT

i IMPORT

mmm

Diagram showing the World’s Crop : Imports and Exports, Season 1898-99.

(The discrepancy between Exports and Imports Is chiefly due to

variations in quantities afloat.)

(FrOTn a drawing by Mr JErnest Procter.)

countries, such as the United Kingdom and the United States, data for longer periods have been set down. The order in which the information is given is, as a rule, according to the importance of the country's contribution to the international trade, the United States claiming attention first of all, as it is facile princess as a producer of foodstuffs.

United States of America (population, 76,303,387 : census 1900). — The record of America's development in this department of human industry is one of triumphant success. Every twenty-five years she doubles the size of her crops, partly owing to the rapid increase of population, but also largely due to improved methods of cultivation ; the extent to which the latter statement is correct will be seen from the following figures : —

Per Capita Production of America duri'ng two Quinquenniuvi^.

Years.

Wlieat.

Maize.

Oats.

Barley.

Rye.

1870-1874

1896-1900

Bushels.

6-3

7-2

Bushels.

24-4

27-2

Bushels.

6-2

9-9

Bushels.

0-7

0-8

Bushels.

0-4

0-3

The consumption per capita of wheat in the United States averages about 41- bushels as compared with about 6 bushels in the United Kingdom and 8 bushels in France. Of late years the discrepancy between the American and European rate has tended to become ; ;reater, and it is often doubted if the American domestic consumption now exceeds 4i bushels. The consumption of maize for all purposes jicr head of the population averages 23 bushels, and of oats 9i bushels.

While it will be seen that America raises enormous crops of grain, yet the rate of yield per acre is relatively very small. Of late years there has been a slight improvement in this respect, but still the average weight of wheat obtained from an American acre is only about one-half of that taken off an English, Scottish, or German area of equal size. The average yield between 1896 and 1900 was in the' United States as follows : —

Wheat.

Maize.

Oats.

Rye.

Barley.

Bushels.

24-3

Bushels.

13-4

Bushels.

25-6

Bushels.

28 2

Bushels.

15-1

Production.

{According to the Year-Book of the Departinent of Agriculture.)

Year

Wheat.

Rye.

Barley.

Oats.

Maize.

Potatoes.

Qrs.

Qrs.

Qrs.

Qrs.

Qrs.

Tons.

8 imp. bush.

8 imp. bus.

Simp.bush.

8 imp.bush.

8 imp. bush.

2240 lb.

1880

60,430,287

2,974,646

5,474,687

60,652,773

208,173,863

4,191,489

1881

46,458,192

2,509,690

4,989,252

60,482,545

144,838,303

2,728,637

1882

61,113,390

3,631,519

5,933,808

59,181,892

196,003,042

4,274,312

1883

51,040,746

3,401,040

6,077,102

69,248,776

188,008,108

5,179,110

1884

62,153,333

3,471,615

7,418,545

70,742,787

217,639,464

4,760,060

1885

43,286,303

2,637,090

7,073,939

76,292,000

234,688,000

4,875,725

1886

55,420,363

2,968,363

7,203,393

75,652,606

201,871,636

4,201,275

1887

65,312,606

2,508,242

6,886,303

79,953,696

176,604,363

3,362,676

1888

50,408,242

3,444,242

7,743,615

85,068,787

240,944,242

6,069,125

1889

69,461,818

3,444,884

9,494,906

91,092,727

256,108,121

6,124,769

1890

48,395,393

3,128,178

8,141,616

63,469,212

180,602,424

3,701,074

18i,l

74,155,161

3,848,711

10,525,967

89,602,303

249,715,636

6,360,674

18a2

62,539,272

3,891,372

9,708,698

80,126,464

197,389,675

3,916,370

1893

48,015,966

3,218,842

8,469,029

77,436,961

196,302,661

4,575,866

1894

55,789,989

2,239,710

7,442,480

80,246,900

147,002,430

4,269,683

1895

56,618,539

3,298,190

10,564,272

99,932,549

260,744,070

7,430,934

1896

61,840,526

2,963,824

8,447,906

85,738,968

270,772,747

6,305,863

1897

64,260,605

3 316,766

8,083,045

84,699,128

230,662,779

4,100,399

1898

81,836,206

3,110,002

6,-762,697

88,594,744

233,234,604

4,807,668

1899

66,300,000

2,910,020

8,963,000

96,600,000

252,000,000

5,701,000

1900

63,000,000

2,900,000

7,060,000

98,000,000

255,000,000

5,200,000

N.B. — The wheat crops of certain years were under-estimated by the Department, as indicated by subsequent distribution. They were estimated by the Corn Trade Kews to be as follows : — 1900, 74,000,000 qrs.; 1899, 72,000,000 qrs.; 1898, 87,000,000 qrs.; 1897, 74,000,000 qrs.; 1896, 59,000,000 qrs.; 1895, 61,000,000 qrs. ; 1894, 66,000,000 qrs. ; 1893, 60,000,000 qrs. ; 1892, 72,000,000 qrs. ; 1891, 86,000,000 qrs.

Note. — In the reduction of the American Winchester bushel we reckon that 33 such bushels are the equivalent of 32 imperial bushels.

Wheat Crops — Acreage and Yield.

The following shows Department of Agriculture estimates of wheat production in 1900 for winter and spring wheat crops : —

States and Territories.

1900.

Acreage.

1900.

Bushels.

Ohio

1,420,646

8,523,876

Michigan

1,219,909

9,271,764

Indiana

1,209,755

6,411,702

Illinois .

1,383,236

17,982,008

Missouri

1,507,737

18,846,713

Kansas ....

4,660,376

82,488,655

Kentucky

957,142

12,442,846

Tennessee .

1,181,423

11,696,088

New York .

367,015

6,496,166

New Jersey

122,753

2,344,582

Pennsylvania.

1,502,321

20,281,334

Delaware

72,864

1,479,139

Maryland

778,864

15,187,848

Virginia

791,759

9,421,932

North Carolina

620,917

5,960,803

South Carolina

238,092

2,142,828

Georgia

550.674

5,011,133

Alabama

96,458

916,351

Mississippi .

4,248

40,781

Texas ....

1,271,517

23,395,913

Arkansas

260,279

2,689,418

West V irginia

454,377

4, -152,895

California

2,771,226

28,543,628

Oregon ....

1,173,769

16,198,012

Oklahoma

Winter Wheat .

981,967

18,657,373

25,605,384

330,883,848

Minnesota

4,905,643

51,509,252

Wisconsin

849,458

13,166,599

Iowa ....

1,397,31:3

21,79S,2‘‘3

Nebraska

2,000,825

24,801,900

North Dakota

2,089,023

13,176,213

South Dakota

2,920,244

20,149,684

Colorado

318,899

7,207,117

Washington .

1,007,943

25,096,661

Nevada

40,457

991,196

Idaho ....

149,201

3,104,629

Montana

72.555

1, ‘.129,963

New Mexico .

183,207

3,847,347

Utah ...

170,895

3,697,106

Arizona

25,045

305,657

Wyoming-

20,819

366,414

Maine ....

2,090

40,755

Now Hampshire .

496

8,085

Vermont

3,487

81,992

Connecticut .

Spring Wheat .

330

6,864

16,889,999

191,.S45,657

Total crop, bushels

522,229,505

Total area, acres .

42,495,383

Yield per acre

12-29

GRAIN TRADE

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Maize Ceops— Acreage and Yield.

Department of Agriculture estimates of production of com

(maize) in 1900 : —

States and Territories.

1900.

Acreage.

1900.

Bushels.

Maine

12,229

440,244

New Hampshire

25,264

934,768

Vermont .

48,477

1,939,080

Massachusetts

40,667

1,545,346

Rhode Island

8,197

262,304

Connecticut

46,610

1,771,180

New York .

538,626

17,236,032

New Jersey

257,364

8,493,012

Pennsylvania

1,308,316

32,707,900

Delaware .

208,763

5,010,312

Maryland .

585,877

15,232,802

Virginia

1,761,485

28,183,760

North Carolina

2,482,515

29,790,180

South Carolina

1,875,591

13,129,137

Georgia

3,411,953

34,119,530

Florida

519,524

4,156,192

Alabama .

2,668,722

29,355,942

Mississippi .

2,293,818

25,231,998

Louisiana .

1,453,094

24,702,598

Texas .

4,553,495

81,962,910

Arkansas .

2,380,313

, 45,225,947

Tennessee .

2,849,894

56,997,880

West Virginia

714,804

19,299,708

Kentucky ,

2,664,124

69,267,224

Ohio .

2,888,924

106,890,188

Michigan .

1,080,235

38,888,460

Indiana

4,031,600

153,200,800

Illinois

7,139,898

264,176,226

Wisconsin .

1,238,681

49,647,240

Minnesota .

963,476

31,794,708

Iowa .

8,048,946

305,859,948

Missouri

6,453,943

180,710,404

Kansas

8,624,770

163,870,630

-Nebraska .

8,093,464

210,430,064

South Dakota

1,200,697

32,418,819

North Dakota .

23,824

381,184

Montana .

1,598

23,970

Wyoming .

2,403 ‘

81,702

Colorado .

167,839

3,188,941

New Mexico

25,216

554,752

Arizona

...

Utah .

8,459

169,180

Idaho

Washington

5,307

106,140

Oregon

13,789

317,147

California .

54,079

1,351,975

Oklahoma .

544,002

14,144,052

Total crop, bushels .

...

2,105,102,516

Total acres .

83,320,872

Yield per acre .

25-3

Average farm price

...

36-0

Exports.

{According to the Year-Book of the Department of AgrUyultv/re.)

In quarters of 8 Winchester bushels.

Year

ending

30th

Wheat.

‘ Eye.

Barley.

Oats.

Maize.

Hour.

June.

Qrs.

Qrs.

Qrs.

Qrs.

Qrs.

Sacks,

8 bush.

8 bush..

8 bush.

8 bush.

8 bush.

280 ,».

1880

17,906,600

362,600

137,600

100,000

12,260,000

4,211,620

1881

18,820,600

237,600

112,600

60,000

11,600,000

6,666,161

1882

11,908,900

125,000

26,000

75,000

5,376,000

4,144,443

1883

13,298,200

271,200

64,100

67,600

6,125,000

6,448,186

1884

8,793,600

27,600

90,000

220,000

6,626,000

6,406,582

1885

10,581,700

368,700

78,600

626,000

6,500,000

7,463,701

1886

7,219,800

26,000

31,200

708,700

8,000,000

6,726,468

1887

12,744,000

37,600

162,600

60,000

6,000,000

8,066,253

1888

8,223,600

9,848

68,600

37,500

3,026,000

8,374,601

1889

6,801,700

35,906

180,000

76,000

8,700,000

6,.562,362

1890

6,798,400

262,600

175,000

1,700,000

12,750,000

8,662,197

1891

6,891,500

37,600

125,000

126,000

3,875,000

7,941,012

1892

19,660,000

1,476,000

3.‘i0,000

1,175,000

9,426,000

10,637,738

1893

14,640,000

184,600

378,700

287,600

6,750,000

11,634,337

1894

11,061,903

28,852

652,425

718,783

8,165,606

11,801,673

1895

9,612,838

1,179

195,469

960,041

71,247

3,461,392

10,688,244

1896

7,681,260

123,668

1,626,673

12,449,104

10,234,604

1897

9,946,252

1,070,034

2,603,787

4,387,092

22,114,646

10,198,681

1898

18,628,907

1,942,697

1,404,636

8,641,286

26,093,117

10,744,960

1899

17,194,834

1,264,482

283,297

3,773,267

21,686,934

12,780,644

1900

12,740,000

296,000

2,960,000

6,171,400

26,170,000

13,087,000

1901

16,300,000

300,000

767,000

i 633,000

22,073,000

12,973,800

It will be noticed that the wheat exports show no particular

growth, but that considerably larger quantities of maize, flour,

oats, and barley are being sent abroad now than in former years.

Impoets.

{According to the Year-Book of the DepartmeiU of Agriculture.)

In quarters ot 8 Winchester bushels.

Year.

Wheat.

Eye.

■ Barley.

Oats.

Maize.

Flour.

Qrs.

Qrs.

Qrs.

Qrs.

Qrs.

Sacks,

8 bush.

8 bush.

8 bush.

8 bush.

8 bush.

280 lb.

1885

25,819

29,876

1,248,313

4,300

563

47,667

21,724

1,274,639

11,306

2,013

1887

34,730

2,308

1,294,449

10,922

3,817

72,889

5

1,353,932

8,479

4,686

16,331

2

1,421,051

2,788

300

..-

1890

19,632

24,699

1,416,668

2,679

203

1891

68,246

17,692

634,841

1,211

264

4,312

1892

199,480

19

260,662

2,111

181

400

1893

138,098

1,063

168,116

2,211

275

266

1894

174,698

1,696

203,636

21,368

673

688

1895

241,142

36

153,178

19,262

1.830

1,626

1896

184,101

12

118,785

9,056

691

1,435

1897

191,700

9

168,900

6,800

785

1,675

1898

248,000

3,992

15,100

1,100

412

1,920

From the foregoing it will be observed that the States have never been importers of cereals excepting on a trifling scale, the only exception being in the case of barley, which during the ‘eighties was freely imported from Canada, a trade which was cut short in the year 1891 by the imposition of prohibitive duties.

DiSTKIBUTION OP WHEAT.

The following table exhibits the production of wheat, quantities required for food, seed, and exports between 1880 and 1899, on the authority of the Department of Agriculture crop returns, compiled by Mr 0. B. Murray : —

Year.

Production.

Bushels.

For Food.

Bushels.

For Seed.

Bushels.

Exportation.

Bushels.

Total

Distribution.

Bushels.

1880

498,649,868

242,086,666

66,663,630

186,321,514

484,971,699

1881

383,280,090

243,000,000

65,215,673

121,892,389

420,107,962

1882

504,185,470

2o0,000,000

52,770,312

147,811,316

460,581,628

1883

421,086,160

256,000,000

64,683,389

111,634,182

422,217,571

1884

612,765,000

261,000,000

66,266,239

132,570,367

448,836,606

1886

357,112,000

267,000,000

61,474,906

94,666,794

413,040,700

1886

467,218,000

271,000,000

61,628,668

163,804,970

476,333,628

1887

456,329,000

277,000,000

63,009,982

119,626,344

449,636,326

1888

416,888,000

283,000,000

64,012,702

88,600,743

426,613,445

1889

490,560,000

289,000,000

63,973,000

109,430,467

462,403,467

1890

399,262,000

296,000,000

66,682,000

102,312,074

453,894,074

1891 ■

611,780,000

302,000,000

64,608,000

226,665,000

582,173,000

1892

616,949,000

304,000,000

54,000,000

191,912,000

649,912,000

1893

396,000,000

310,000,000

49,000,000

164,000,000

623,000,000

1894

460,000,000

■■377,300,000

49,000,000

142,000,000

668,300,000

1895

467,000,000

323,000,000

64,000,000

126,000,000

503,000,000

1896

427,000,000

327,000,000

66,000,000

146,000,000

527,000,000

1897

630,000,000

330,000,000

65,000,000

217,000,000

602,000,000

1898

676,000,000

330,000,000

67,000,000

222,000,000

609,000,000

1899

647,000,000

330,000,000

66,000,000

188,000,000

583,000,000

» Including 60,000,000 bushels fed to live stock.

{Bradstreet’s Seport of Wheat Stocks east of the Rockies on

1st of each month, 1889 to 1900 iiiclusive.)

In hundreds of thousands [00,000 omitted] of bushels.

1900.

1899.

1898.

1897.

1896.

1895.

1894.

1893.

1892.

1891.

47,1

1890.

64,2

1898.

62,7

Jan.

89,2

50,1

64,1

73,2

97,7

113,7

99,5

107,0

69,2

i’eb.

87,4

51,6

61,1

68,0

97,5

106,9

98,8

111,9

66,5

44,2

49,6

47,4

Mar.

a5,6

61,0

45,0

61,6

94,6

98,7

96,2

106,2

64,6

42,4

44,3

44,6

Apr.

79,6

61,2

49,0

65,9

89,1

91,2

89,3

ll)8,3

69,7

4U,6

40,4

39,6

May

70,7

47,2

31,0

49,6

80,3

80,4

82,0

96,7

49,3

33,6

33,3

34,3

June

57,6

42,0

27,4

37,9

68,7

64,3

71,8

86,0

39,2

28,0

30,6

27,0

July

58,5

46,6

18,0

27,0

61,3

63,6

66,2

72,6

33,2

21,0

26,8

20,3

Aug.

60,3

49,1

11,4

23,7

58,4

46,7

66,3

68,6

31,3

23,1

24,0

16.0

Sept.

66,2

48,0

11,4

20,3

67,5

44,7

79,8

64,3

42,8

26,5

22,6

20 8

Oct.

76,0

60,0

22,8

31,5

63,9

66,0

92,1

71,1

69,8

36,6

27,9

26,7

Tfov.

82,2

77,1

33,9

42,8

76,7

76,5

105,8

83,2

78 6

60 6

37,9

46,9

Deo.

86,5

84,6

46,9

49,8

76,4

87,6

113,1

96,6

94,6

62,3

44,8

64,4

{Bradstreet’s Report of Wheat Stocks west of the Rockies on

1st of each -month, 1889 to 1900 inclusive.)

In hundreds of thousands [00,000 omitted] of bushels.

1900.! 1899. ‘1898.1897.

1896.

1896.

1894.

1893.

9.3

1892.

8.8

1891.

12,9

1890.

7,6

1889.

5,7

Jan.

10,0

5,9

6,6

4,1

7,1

13,3

10,7

Feb.

8,9

6,0

5,3

3,0

b.b

13,1

9,8

6.4

6,0

10,6

6.1

4.4

Mar.

7,8

6,1

4,4

1,8

*,2

11,8

9,6

5,4

3.3

8,6

5,0

3,5

Apr.

7,2

4,3

3,4

1,V

3.8

10,4

9,0

4,7

2,6

7.0

*,7

2,1

May

7,0

4,4

3,0

1,6

3.1

10,1

9,3

3,5

2,4

*>2

3,8

1,7

June

6,8

3,6

3,2

1,2

2.6

8,4

8,7

3,0

2,4

2.4

3,1

1.2

July

6,9

3,4

2,9

1.1

1,9

6,6

8,2

2.8

2,3

1,0

2,3

6

Aug.

5,7

<>1

2,6

2,2

1,9

6,8

8,6

4,4

2,7

2,0

2,8

6,9

Sept.

7,4

6,2

3,0

4,6

3,5

8.7

8,5

6,1

3,5

3,4

6,0

7,0

Oct

10,2

8,8

4,6

6,2

64

9,7

9,0

7,1

8,1

9,6

6,7

9,5

Not.

9,9

11,0

6,6

7,3

6.8

9,6

12.0

7.7

8,7

12,7

7,6

9,3

Dec.

10,0

10,6 6,2

6,9

6,6

8,2

14,6

iu,a

10,4

10,6

12,3 8,1 1

60

GRAIN TRADE

(Sradstreet’s Report of Corn Stocks east of the Rochies mi

1st of each month, 1890 to 1900 inclusive.)

In hundreds ot thousands [00,000 omitted] oj bushels.

1900.

1899.

1898.

1897.

1896.

1896.

1894.

1893.

1892.

1891.

1890.

January

19,0

26,9

48,2

26,4

9,1

12,8

11,3

13,6

8 6

6,0

15,4

February

20,1

36,7

b3,5

29,7

17,0

i6,7

18,0

14,4

8,9

47

18,4

March

2S,3

44,7

62,4

33,7

17,0

17,0

21,9

17,6

12,5

5,6

21,3

April

31,8

43,6

62,2

32,6

J9,2

16,3

21,3

17,2

13,2

5,3

27,7

May

30,4

34,2

34,7-

21,7

13,2

13,1

14,8

13,0

8,1

6,0

177

June

18,2

19,0

28,2

16,1

11,2

12,6

9,6

9,4

4,8

7,2

17,9

July

19,0

•il,6

32,9

21,5

11,1

10,7

7,7

10,1

9,4

48,6

19,2

August

18,6

17,6

li5,4

‘20,U

13,2

5,7

4,9

9,9

8,8

4,7

16,1

Septem.

8,V

11,0

24,0

37,5

18,6

6,1

4,2

6,9

8,7

6,6

12,4

October

11,1

16,6

30,1

4b,4

17,8

6,7

6,2

9,9

l?,,?

8,5

12,3

Novem.

11,0

18,7

33,1

62,9

23,9

6,3

3,5

11,3

16,1

4.1

10,0

Decern.

12,7

17,6

25,8

44,5

22,6

7,3

6,3

9,4

12,6

4,0

6,2

The chief customer for the agricultural surplus of America is the United Kingdom, where more than half of her total exports are disposed of. The principal ports of export in the Union are New York, Baltimore, Philadelphia, New Orleans, Boston, Galveston, San Francisco, Williamette, and Puget Sound — ^named in the order of their importance.

Russia (population in Europe, 106,159,141 ; in Asia, 23,051,972 : census 1897). — The Russian empire comes immediately after America as a grower of foodstuff's. As ■wUl be seen, the production of cereals (chiefly rye and oats) amounts roundly to 300,000,000 quarters.

Pkodtjotion.

(From Betums of the Central Statistical Committee and of the Ministry of Agriculture.)

Year.

Wheat

Eye.

Barley.

Oats.

Maize.

Potatoes.

Qrs. of

Qrs. of

Qrs. of

Qrs. of

Qrs. of

8 meas.

8 meas.

S meas.

8 meas.

8 meas.

Tons 2240.

bushels.

bushels;

bushels.

bushels.

bushels.

“1885

21,657,900

84,900,900

12,124,800

47,086,100

2,097,800

6,842,900

•>1886

19,787,000

80,221,400

16,168,600

68,948,600

2,766,100

6,718,800

“IBS?

33,737,600

90,087,700

20,317,900

74,862,200

1,578,700

7,660,100

iilSSS

39,367,200

96,930,400

28,610,200

72,563,500

8,891,700

11,745,600

61889 25,171,600

73,923,000

16,616,800

66,844,900

1,861,200

12,162,600

‘ISOO 28,038,300

87,478,641

21,261,900

70,046,600

2,933,600

12,245,600

‘1891

21,974,600

65,368,600

18,337,900

66,851,300

8,662,700

9,943,300

‘■1892

32,202,800

78,507,700

22,703,600

58,018,200

2,660,300

16,698,600

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Qrs. 480.

=1893

66,448,000

99,095,000

40,949,000

87,782,000

6,276,500

20,514,000

=1894

56,730,000

104,206,000

33,636,000

89,796,000

2,744,200

18,764,000

“1895

51,606,600

93,186,000

30,247,200

82,188,900

3,686,000

21,047,000

n896

46,617,100

90,670,100

30,304,800

84,833,000

2,766,000

23,957,600

«1897

42,875,100

76,065,600

28,550,000

69,986,000

6,044,000

22,669,700

“1898

67,232,300

86,778,400

36,716,700

72,498,700

6,716,400

23,956,300

•>1899

66,691,300

106,024,900

27,144,000

104,962,700

3,698,260

24,668,200

«1900

62,708,000

107,013,000

28,849,000

90,021,000

3,984,000

26,694,000

•1901

63,100,000

88,000,000

28,700,000

61,800,000

8,300,000

° Returns for 50 governments. * Betums for 60 governments.

” Returns for 66 governments. ^ Returns for 69 governments.

” Returns for 71 governments.

In Russia the average yield per acre is, of winter wheat, 12-5 bushels ; of spring wheat, 8 bushels ; rye, 11 bushels ; barley, 13 busliels ; oats, 15 bushels ; maize, 14 bushels.

The proportions of each sort of wheat raised in the different divisions of the empire are as follows, taking the official figures of the year 1899 as an instance : —

Winter

Wheat.

Spring

Wheat.

Total,

European Russia, 50 1

governments . \

Poland, 10 governments

Caucasia, 4 governments

Siberia, 4 governments .

Central Asia, 4 govern-

ments

Qrs.

12,300,000

2,600,000

5,340,000

16,000

15,000

Qrs.

26,960,000

25,000

1,800,000

5,650,000

1,846,000

Qrs.

39,260,000

2,625,000

7,140,000

5,666,000

1,861,000

Total, 72 governments

20,271,000

36,281,000

56,552,000

During the eight years ending 1899 Russia has raised on an average 52,500,000 qrs. of wheat, and exported 13,000,000 qrs., leaving 39,500,000 qrs. for home consumption. Besides the cereal crops enumerated in the tabular statement, Russia annually produces four to iive million qrs. of millet, three million qrs. of pease, and one million qrs. of spelt. In addition to the exports shown in the tabular statement, there were exported in the year 1899 556,000 cwt. of buckwheat, 271,000 cwt. of millet, 3,921,000 cwt. of pease, 1,853,357 cwt. of rye flour, and 7,292,570 cwt. of bran of all kinds. There are also certain quantities of beans and lentils grown and exported ; in 1899 the quantity exported was 1,464,000. The consumption per head of wheat amounts to about 2J bushels for the whole empire ; of rye to 2‘8 bushels per head for European Russia, and for the whole empire to a little over 5 bushels. The rye crop is almost entirely sown in the autumn, as is also half the wheat, but barley, oats, and maize are all spring-sown.

The chief shipping ports are Odessa, Nicolaieff, Taganrog, Rostoff, Novorossiysk for wheat, rye, and barley ; but Libau, St Petersburg, Revel, and Riga ship the bulk of the oats. Odessa, Poti, and Novorossiysk are the chief shippers of maize. The chief cus-

tomers for Russia's wheat exports are Germany, Italy, Belgium, Holland, France, Switzerland, and Spain. Great Britain occasionally takes considerable quantities when American wheat is relatively dear. Great Britain, Germany, and Holland are the principal buyers of Russian barley. Germany takes almost half the rye exports, and Great Britain half the oats and maize.

The effectiveness of Russia as a shipper is largely dependent upon prices, much more so than would seem to be the case with America, the explanation being, it is believed, that when prices are low only that portion of the empire immediately contiguous to the littoral remains operative as a shipper, for railway freights are not so elastic in Russia as they are in America.

ExpOKTs (exolttsive of Finnish).

{From Returns of Exports of Russian Goods to

Foreign Countries.)

Year.

Wheat

Bye.

Barley.

Oats.

Maize.

Flour.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. ■304.

Qrs. 480.

Imperial

bushels.

1890

13,656,400

6,768,000

6,462,400

6,162,100

1,646,600

1,400,000

Sks. 280

1891

13,227,700

6,100,500

4,141,700

5,469,500

2,116,700

480,466

1892

6,116,800

906,000

3,966,100

2,448,000

1,620,600

381,578

1893

11,717,300

2,463,800

10,010,600

6,769,300

1,196,600

410,265

“1894

16,365,425

6,072,760

13,782,510

11,233,000

4,369,425

484,326

«1S96

17,787,075

6,846,976

9,748,710

7,941,941

1,920,900

589,100

“1896

16,469,100

6,944,125

7,344,460

8,038,923

970,125

486,613

‘•1897

15,998,025

6,611,626

8,049,690

6,190,423

1,687,000

484,065

‘1898

12,660,600

4,665,200

8,292,900

2,838,600

2,061,100

679,200

i‘1899

7,399,100

4,272,800

6,451,000

3,249,600

1,676,400

412,800

11900

8,700,000

6,900,000

4,770,000

9,400,000

1,400,000

460,000

=1901

9,600,000

6,108,000

4,853,000

9,180,000

728,000

460,000

” From ” Statistical Abstract for the Principal and other Foreign

Countries.’’

6 From the Journal of Industry and Commerce of St Petersburg.

e Cereal year, commercial return.

Imports.

As might be expected, the imports of agricultural products are

very small. In recent years they have been so insigniiicant that the returns have not been issued through the ordinary channels. Prior to the year 1886 certain quantities of wheat and spelt were imported, the official returns in quarters for the years named being, 160,000 in 1880, 150,000 in 1881, 452,000 in 1882, 306,000 in 1883, 302,000 in 1884, 1,394,000 in 1885, and 604,000 in 1886.

Rumania (population, 5,912,520 ; census 1899). —

This little kingdom has always been a successful raiser of foodstuffs, for as far back as 1862 the records show that substantial crops of wheat, maize, and barley were grown, and indeed the yields of cereals in the year 1868 were as important as they are to-day. Unfortunately the agricultural data between the years 1877 and 1885 are missing, or otherwise we should have a forty years' record, or one twice as old as Great Britain possesses.

Production.

{Returns of the Ifinislri/ of Agriculture ; also from ' ' Recueil de Statistique Roumaine.")

Year.

Wheat

Uye.

Barley.

Oats.

Maize.

Millet

Qrs. of

Qrs. of

Qrs. of

Qrs. of

Qrs. of

Qrs. of

8 bush.

8 bush.

8 bush.

8 bush.

S bush.

8 bush.

1890

6,498,330

672,381

2,000,989

918,662

7,514,491

117,167

1891

5,632,983

470,339

2,686,824

934,904

7,266,974

279,388

1892

7,770,000

661,600

2,493,400

1,333,500

12,821,000

678,210

1893

7,361,220

938,034

4,329,813

1,872,290

8,819,968

349,470

1894

6,288,465

698,899

2,048,111

1,218,802

3,620,966

20,855

1895

8,300,000

1,100,000

2,700,000

1,260,000

8,670,000

95,430

1898

8,624,240

1,479,878

3,850,684

1,783,134

7,925,740

165,790

1897

4,416,228

823,040

2,671,147

1,198,465

9,663,603

378,831

1898

(7,100,000

900,000

3,600,000

2,100,000

12,350,000

309,000

3,160,000

240,000

660,000

760,000

8,400,000

200,000

1900

6,900,000

700,000

1,800,000

1,000,000

10,300,000

■‘300,000

8,800,000

1,100,000

2,500,000

2,000,000

14,000,000

” . Unofficial.

GRAIN TRADE

The average yield per acre of wheat is 14 bushels, barley 16i bushels, oats 19 bushels, rye 15 bushels, maize 17 bushels, and millet 12 bushels. The average rate of consumption per capita in Rumania comprises 5 bushels of wheat and 7 bushels of maize. The present area under wheat is 3,855,000 acres, under maize 5,000,000 acres, under barley 1,500,000 acres, under oats 700,000 acres, under rye 500,000.

Exports.

(From ” Statistique dii Commerce ExUrieur.”)

Year.

Wheat.

Kye.

Barley.”

Oats.

Maize.

Flour.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Qra. 480 lb.

Sacks,

280 ft

1890

4,138,970

397,971

996,421

46,000

3,428,169

69,811

1891

3,039,371

334,992

1,766,059

44,371

3,219,574

87,929

1892

3,541,687

417,305

1,042,994

251,106

3,021,030

136,323

1893

8,328,962

602,708

2,538,891

782,203

6,567,620

160,866

1894

3,140,036

626,449

1,600,770

98,978

3,189,737

246,646

1895

4,462,522

895,059

1,363,728

84,74tf

1,619,665

173,456

1896

5,630,400

1,025,800

2,183,600

134,989

2,037,800

189,000

1897

1,996,400

657,800

1,837,000

236,090

3,697,200

76,000

1898

2,668,000

558,200

1,996,500

538,587

6,147,400

147,000

1899

832,900

140,200

368,200

180,600

2,735,300

183,900

” Including malt from and after 1887.

One often meets with higher estimates of Rumania’s exports, but that is due to the fact that considerable quantities of Bulgarian grain coming down the Danube get mixed up with the quantities actually grown in Rumania. The chief ports of export are Braila and Galatz on the Danube in the summer, and Sulina at the mouth

of the Danube and Constanza on the Black Sea in the winter.

The chief customers for Rumania's wheat are Belgium, Germany, Holland, and Italy, while the Uiuted Kingdom takes the principal share of the maize.

Bulgaria (population, 3,733,189 ; census 1900). — Agricultural statistics are not so readily obtainable from this principality as from the neighbouring kingdom of Eumania, but the Com Trade News has collected returns from various authorities which are believed to be trustworthy. These are given below, in which are also comprised the figures for Eastern Rumelia.

Bulgaria and Eastern Rumelia : Pkoduotion.

[From the Com Trade Year -Book and Commercial Estimates.)

Year.

Wheat.

Bye.

Barley.

Oats.

Maize.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Qrs. 480.

.1890

2,600,000

1891

3,700,000

1,298,000

1,463,000

840,000

1892

3,600,000

850,000

1,688,000

900,000

1893

3,600,000

700,000

2,000,000

600,000

1894

3,100,000

800,000

1,500,000

800,000

1896

3,800,000

900,000

2,000,000

800,000

1896

6,000,000

600,000

2,600,000

700,000

2,800,000

1897

3,400,000

1,200,000

1,400,000

500,000

3,500,000

1898

4,700,000

800,000

1,600,000

1,100,000

4,000,000

1899

2,900,000

600,000

1,260,000

620,000

2,400,000

1900

4,000,000

900,000

1,250,000

600,000

1,600,000

1901

4,100,000

1,000,000

1,600,000

800,000

3,700,000

Eastern Rumelia is credited with raising 700, 000 quarters of soft wheat and 80,000 quarters of hard wheat, which are included in above. The official figures for Bulgaric alone, appearing in the EisuUats des EnsemeTicements et de Mecolte dans la Frindpauti de Bulgarie, are as follows : —

Bulgaria : Acreage under Crops in Statute Acres.

Year.

Wheat.

Bye.

Barley.

Oats.

Maize.

1897-98

1898-99

1,932,763

2,039,444

347,000

366,000

498,900

628,000

346,000

337,000

1,221,000

1,104,000

Bulgaria : Yield of Crops in Imperial Bushels.

Year.

Wheat.

Eye.

Barley.

Oats.

Maize.

1897-98

1898-99

33,983,000

21,623,000

5,072,000

4,343,000

11,712,000

6,382,000

8,746,000

4,731,000

36,224,000

19,092,000

The yield per acre for the two years averaged nearly 14 bushels of wheat, 13 bushels of rye, 17i bushels of barley, 20 bushels of oats, and over 23 bushels of maize.

The consumption per capita of wheat would seem to be about 5 bushels.

Bulgaria: Exports.

{From “Statistique du Commerce de Bulgarie.”)

Year.

1890

1891

1892

1893

1894

1895

1896

1897

1898

1899

1900

Wheat.

Qrs. 480.

1,234,137

1,440,162

1,658,660

1,610,426

1,292,703

1,772,500

2,777,700

1,293,900

856,423

554,200

685,500

Eye.

Qrs. 480.

131,798

374,770

260,102

212,813

135,100

203,269

213,738

77,115

109,440

30,000

112,100

Barley.

Qrs. 400.

161,000

202,422

137,804

226,678

126,253

137,263

127,342

96,771

269,072

56,100

220,000

Oats.

Qrs. 304.

79,970

17,393

48,540

124,628

31,754

2,431

6,240

25,833

32,082

40,600

9,400

Maize.

Qrs. 480.

Sacks,280.

616,902

16,030

199,447

18,637

358,160

32,706

1,473,124

26,126

982,072

35,230

222,873

63,970

495,713

55,923

368,330

27,855

609,501

66,280

722,000

61,500

186,000

70,900

The chief porta from which direct shipments are made are Varna and Baltchick in Northern Bulgaria, but a gi-eat deal of stuff is sent down the Danube and is included in the Rumanian quantities. Bourgas is the port of Southern Bulgaria or Eastern Rumelia.

The imports of agricultural products are trifling.

Servia (population, 2,493,770; census 1900). — Agricultural returns of this kingdom are issued only at long intervals. In 1893, 783,162 aores were credited with producing 8,700,000 bushels of wheat; 227,540 acres with 2,412,000 bushels of barley; 261,735 acres with 2,672,000 bushels of oats ; 147,755 acres with 1,226,000 bushels of rye; and 1,313,562 acres with 16,882,000 bushels of maize; the yields per acre being 11 bushels

of wheat, 10| bushels of barley, 10 bushels of oats,

8^ bushels of rye, and 12f bushels of maize. The total

production of several years, as given by various authori-

ties, is shown below : —

Peoduction.

{British Consular data, excepting 1893, which is official.)

Year.

Wheat.

Eye.

Barley.

Oats.

Maize.

Potatoes.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Qrs. 480.

Tons, 2240

1890

1,275,200

161,600

474,100

616,300

2,986,200

1891

1,331,600

170,800

491,000

526,000

3,167,100

1892

1,256,800

178,800

494,000

518,700

3,284,600

1893

1,081,600

148,400

297,000

363,000

2,110,000

21,800

1894

1,284,400

190,900

512,900

651,800

3,344,300

1896

1,157,800

194,200

455,500

579,300

3,528,800

1896

1,300,300

160,900

508,600

624,400

3,606,000

1897

1,674,100

,222,400

469,000

1,032,200

3,975,200

1898

1,314,200

212,400

640,400

646,100

3,743,800

1899 ■

1,482,000

197,800

474,300

628,400

3,840,600

1900

966,285

102,657

148,234

273,669

1901

1,100,000

The quantities exported are not very important ; such as they are they will be found in the following tabular statement. The consumption per capita in the year 1893 was estimated as follows : — Wheat 5f bushels, and maize 6J bushels, but in subsequent years maize appears to have amounted to 11 bushels and over.

Exports.

{From ” Statistiqu£ du Commerce Fxt^rieur du Eoyaume deSerbie.”)

Year.

Wheat.

Eye.

Barley.

Oats.

Maize.

Hour.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Qrs. 480.

Sacks, 280.

1890

291,000

40,000

31,000

74,000

30,000

1080

1891

396,000

39,000

. 42,700

66,700

182,500

4000

1892

365,000

62,000

49,100

74,600

81,800

SO

1893

403,000

41,000

62,900

95,100

284,200

20

1894

242,300

25,100

52,400

77,600

99,600

6

1895

286,300

9,000

23,200

86,800

17,500

30

1896

473,000

12,600

48,400

121,600

59,700

10

1897

141,700

13,600

19,600

127,900

61,400

100

1898

283,600

16,600

46,100

151,400

9,400

400

1899

356,669

26,422

103,822

83,043

121,160

1900

455,000

21,000

104,000

46,000

286,000

iooo

Austria-Hungary is the chief customer for Servia's exports, but the suspension of the " Mahlverkehr " has seriously curtailed it. The imports, as might be expected, are, as a rule, insignificant ; the only year when they were worth reporting was in 1898, when 105,000 quarters of maize were received from neighbouring countries.

TurTtey in Europe. — No ofiScial returns of production or exportation are published at Constantinople, but in

commercial circles it is known that the country grows just about what it needs for its own consumption. Constantinople imports weekly about 4000 quarters of wheat and 10,000 bags of Eussian flour, but other parts of the empire export small quantities of wheat, and occasionally substantial shipments of maize, barley, and oats are made

at Salonica. The crops of the province of Salonica for the year 1900 were as follows : — Wheat acreage 861,000, yield 800,000 qrs. ; barley acreage 343,000, crop 460,000 qrs. ; oats acreage 104,300, crop 209,000 qrs. ; rye acreage 172,000, crop 117,000 qrs. The port of Dedeagatch also occasionally exports certain quantities of cereals.

Austrior-Hungary (population — Austria, 26,107,304; Hungary, 19,203,531 : census 1900).— The dual monarchy now plays a far less important part in the international grain trade than formerly, as will be seen from the subjoined summary of the exports and imports of the chief cereals. It is not because Hungarian wheat has deteriorated in quality, for it still holds a high place in the estimation of millers everywhere ; but it would seem that it cannot compete in price with the product of the prairies of North and South America. The ordinary area under the premier cereal in Hungary is 7,500,000 acres, in Austria 2,500,000 acres, and in Croatia-Slavonia 600,000 acres ; the yield per acre in Hungary averaging 17 bushels, in Austria 16, and in Croatia-Slavonia 15 bushels. The

annual consumption of wheaten bread stuffs in the empire amounts roundly to 24,000,000 qrs., or 4J bushels per caput. The chief customers for the small quantities of wheat now exported are Germany, Switzerland, and Italy ; but the United Kingdom is the best customer for flour, followed at a great interval by Germany and France. The bulk of the barley exports goes to Germany. The chief ports of shipment are Fiume for Hungarian produce, and Trieste for Austrian. The imports into Austria-Hungary chiefly come from Russia, Rumania, and Servia, mainly by way of the Danube.

It should be noted that for many years a large trade was carried on in manufacturing imported wheat in bond into flour, and exporting it to the United Kingdom, Germany, and other countries ; but at the end of June 1 900 the trade was abolished at the instance of the Austrian millers and the Hungarian agriculturists. The annual exports from bond ranged between 700,000 and 1,000,000 sacks (280 ft).

Pkoduction (including Croatia and Slavonia).

(From ” SlatistiscJies Jahrbuch” of Ministry of Agriculture.)

Year.

Wheat.

Rye and

Spelt.

Barley.

Oats.

Maize.

Potatoes.

Qrs.

Qrs.

Qrs.

Qrs.

Qrs.

Tons,

8 bush.

8 bush.

S bush.

8 bush.

8 bush.

2240 ft.

1885

19,761,100

14,657,800=

12,885,800

18,073,100

16,626,144

11,100,000

1886

17,867,700

13,865,800

11,038,300

‘20,318,900

12,658,600

10,200,000

1887

24,018,000

17,290,900

13,820,000

20,180,300

10,862,600

10,700,000

1888″

22,739,800

16,036,600

12,412,400

19,692,900

13,563,700

10,600,000

1889

16,978,739

13,087,499

9,728,100

15,091,400

14,399,300

11,600,000

1890

23,269,300

15,907,200

13,005,600

19,080,690

13,220,100

10,100,000

1891

21,848,422

13,023,732

13,331,000

21,121,050

19,998,800

8,300,000

1892

24,278,000

16,153,200

14,051,600

22,249,800

18,321,300

12,300,000

1893

25,476,700

16,809,200

14,107,200

19,619,700

20,026,900

11,700,000

1894

24,086,700

17,374,700

14,479,900

22,420,600

11,427,500

12,600,000

1895

25,260,400

13,813,300

13,804,900

22,636,900

21,673,600

16,600,000

1896

24,660,100

15,576,200

14,013,260

21,670,760

19,863,500

16,200,000

1897

15,229,200

12,676,600

11,288,600

18,614,900

16,887,900

11,000,000

1898

23,400,000

15,500,000

14,900,000

23,000,000

19,100,000

16,400,000

18996

23,600,000

14,900,000

13,600,000

22,900,000

12,250,000

14,400,000

19006

24,200,000

12,700,000

14,400,000

21,370,000

17,000,000

lOOlK

22,100,000

16,500,000

12,600,000

20,600,000

18,100,000

” Excluding Croatia and Slavonia.

‘ Commercial estimate.

” Excluding spelt in Austria.

The following statement will show how the export

trade has declined since the years 1887-90, the trade in

barley alone showing any vitality : —

Exports.

(From ” Statistik des auswartigen Sandels des osterreicMsch

ungarischen ZoUgehiets. “)

Year.

Wheat.

Eye.

Barley.

Oats.

Maize.

Flour.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Qrs. 480.

Sks. 280.

1886

732,600

33,200

1,816,100

612,600

89,400

1,180,800

1886

962,600

6,600

1,316,000

461,600

115,600

1,146,000

1887

1,072,600

6,100

2,120,200

286,500

33,600

1,010,600

1888

1,902,300

26,100

2,366,000

253,800

80,600

1,622,800

1889

1,176,700

16,600

1,774,600

219,300

223,800

1,387,600

1890

1,088,000

15,100

2,101,800

70,300

61,600

1,074,800

1891

711,000

171,200

1,831,600

266,600

381,000

782,600

1892

344,700

142,200

1,788,000

782,000

494,600

367,200

1893

360,000

3,200

2,824,000

663,300

166,000

329,200

1894

297,000

1,600

2,303,400

79,100

60,800

206,600

1895

311,700

2,000

1,474,200

18,100

20,500

89,500

1896

258,000

800

2,367,300

9,400

103,800

86,700

1897

129,400

400

1,974,800

11,000

86,600

82,600

1898

13,300

1,800

1,829,500

66,700

13,900

27,300

1899

3,293

2,921

2,278,386

456,632

16,947

864,600

1900

37,600

1,700

1,661,900

241,100

9,800

369,400

1901

97,600

1,100

1,787,900

27,100

59,700

664,600

N.B. — In addition to the above specified exports, the dual

empire sends away annually about 400, 000 quartei’S of beans, and formerly sent away 700,000 to 1,000,000 sacks of flour manufactured in bond. Since the year 1897, when there was a crop failure throughout the empire, the tide has turned, and large quantities of wheat, rye, and maize are being imported.

Impokts.

(From ” Statistik des auswartigen Sandels des osterreichiscTi-ungarischen ZollgeKets.”)

Year.

Wheat.

Eye.

Barley.

Oats.

Maize.

Hour.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Qrs. 480.

Sks. 280.

■1885

634,400

406,600

267,200

360,700

1,347,000

12,000

1886

104,000

348,000

96,200

124,000

483,600

17,700

1887

36,100 .

318,600

63,300

141,600

385,000

6,900

1888

6,200

12,100

21,100

82,200

267,700

500

1889

8,200

16,800

31,800

182,000

216,600

300

1890

19,700^

77,300

71,800

266,200

444,300

400

1891

43,800

10,200

35,200

183,200

233,300

1,000

1892

60,000

33,300

25,300

104,000

249,700

800

1893

96,100

31,500

132,400

350,800

344,000

1,300

1894

128,000

15,300

440,700

1,012,400

1,028,700

2,900

1896

86,300

127,000

194,000

495,000

986,300

6,600

1806

61,000

234,700

63,200

472,000

666,400

6,000

1897

685,400

803,300

241,600

449,600

1,062,000

21,500

1898

876,000

1,034,100

261,600

167,100

3,036,700

26,600

1899

337,630

94,487

67,618

64,256

712,770

8,200

1900

165,000

34,700

120,300

48,800

839,000

3,200

1901

144,500

169,600

116,800

306,300

1,007,100

3,200

The average result of the trading for the three years end-

ing 1899 is shown as follows : —

Imports.

Wheat.

Qrs.

Eye

Qrs.

Barley.

Qrs.

Oats.

Qrs.

Maize.

Qrs.

Flour.

Sacks.

600,000

670,000

186,000 226,000

1,603,000

17,000

Exports.

Qrs.

Qrs.

Qrs.

Qrs.

Qrs.

Sacks.

50,000

1,000

2,000,000

180,000

40,000

324,000

As the provinces of Bosnia and Herzegovina are under

the dominion of Austria, we include their agricultural

statistics in this section.

Production

(From ” Die Landwirtlischaft in Bosnien uvA Herzegovina.”)

Year.

Wheat.

Eye.

Barley.

Oats.

Maize.

Spelt.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Qrs. 480.

Qrs. 480.

1890

370,400

68,900

430,000

200,300

1,076,300

78,100

1891

325,500

47,400

396,900

304,700

1,120,700

6S,S00

441,200

64,200

430,000

279,200

1,236,700

79,000

1893

303,100

49,300

435,600

254,000

1,263,200

64,000

359,000

47,600

462,000

877,300

877,100

55,000

1896

326,000

46,600

398,900

268,400

1,186,600

46,400

303,100

46,900

436,000

276,600

1,272,400

45,900

1897

183,700

37,000

343,000

312,000

960,100

23,000

1899

293,600

260,000

46,900

441,000

440,000

1,378,000

36,000

1900

300,000

•■

Canada (population officially estimated in 1900 at

5,522,500). — The progress of agriculture in the Dominion

seems slow in comparison with that of the United States,

for there are many single states in the Union which alone

GRAIN TRADE

produce a far greater crop than all the provinces of the Dominion combined. The climate and soil are not to be blamed for this state of things, for in many parts of Canada they are magnificent; the real cause being the lack of immigrants of the class which will endure the drudgery of raising crops of wheat and maize in a new and sparsely settled country. Such agricultural progress as is being made seems solid and safe, the cultivation is more careful, thorough, and scientific, with the result that the average product of an acre of land in Canada is at least 25 per cent, higher than in the States. The chief agricultural districts are Ontario and Manitoba. In the former the average yield of winter wheat is 20 bushels; of spring wheat 16 bushels, barley 26 bushels, oats 35 bushels. In Manitoba the average yield is 18 bushels of spring wheat, 30 bushels of barley, and 35 bushels of oats. The average per caput consumption of wheat in the Dominion on the d^ta for 1897-1900 apparently reached 7 bushels, or a mean between the French and English

rate.

Crop of 1901.

Ontario.

Manitoba.

North-West.

Nova Scotia.

Crop.

Bushels.

21,500,000

Bushels.

50,500,000

Bushels.

12,500,000

Bushels.

180,000

The harvest of spring wheat in Canada in 1900 was very deficient, owing to a severe spring drought. The crop of wheat raised in 1901 creates a record.

The following tabular statement gives the production during a number of years : —

Pkodtjction.

{From the Statistical Year-Boole.)

Year.

Wheat.

Bye.

Barley.

Qrs.

Oats.

Pease.

Qrs.

Qrs.

Qrs.

Qrs.

8 bush.

8 bush.

8 bush.

8 bush.

8 bush.

1886

2,069,900

159,000

2,206,000

7,700,000

1,751,000

1886

1,926,500

138,000

2,602,000

7,840,000

2,005,000

1887

4,053,000

112,000

2,382,000

7,139,000

1,622,000

1888

2,635,000

162,000

‘2,920,000

8,183,000

1,783,000

1889

3,240,000

180,000

3,064,000

8,470,000

1,688,000

1890

4,462,000

196,000

2,208,000

7,786,000

1,923,000

1891

6,972,000

142,000

2,420,000

11,222,000

2,300,000

1892

6,404,600

141,600

1,888,200

9,661,600

1,811,800

1893

4,668,400

124,300

1,644,200

8,561,100

1,771,100

1894

4,631,600

173,300

1,746,300

10,260,000

1,762,900

1896

6,175,400

237,600

2,216,900

13,406,700

1,946,000

1896

4,121,200

278,900

1,980,200

11,935,300

2,186,600

1897

6,889,800

422,700

1,900,700

12,118,600

1,733,400

1898

7,986,900

334,200

2,206,000

14,387,600

1,690,200

1899

7,070,000

260,000

2,600,000

14,800,000

1,890,000

1900

4,800,000

298,000

2,610,000

13,100,000

1,710,000

1901

10,600,000

400,000

3,000,000

14,600,000

From 1885 to 1897 inclusive the production of provinces of

Ontario and Manitoba only is given.

Foralongperiod Canada has been a shipper of grain to the mother country, the product of the wheat fields of the North-West being held in high estimation by millers. Pease also are shipped in large quantities. The following tabular statement shows the progress of trade between 1885 and 1899 : —

Exportation (Domestic Produce).

(From Statistical Year-Book.)

Year

ended

Wheat

Eye.

Barley.

Oats.

Pease.

Wheat

June 30.

Qrs.

Qrs.

Qrs.

Qrs.

Qrs.

Sacks,

8 bush.

8 bush.

8 bush.

8 bush.

8 bush.

280 ft.

1885

292,600

35,900

1,133,400

294,900

337,300

86,800

1886

427,400

21,800

1,069,300

618,700

402,400

270,200

1887

704,000

16,600 ,

1,182,100

266,000

497,000

364,000

1888

270,400

1,171,300

70,800

270,600

246,000

1889

61.300

1,243,500

42,100

247,800

91,700

1890

62,800

64,400

1,247,000

94,700

341,000

80,600

1891

263,600

42,600

611,600

32,6&0

344,300

207,900

1892

1,089,300

27,700

660,300

76,800

680,000

266,700

1893

1,159,000

7,400

265,100

909,200

426,800

287,000

1894

1,160,000

7,900

74,700

362,300

422,300

300,000

1896

1,103,200

7,800

213,500

116,800

282,400

166,000

1896

1,239,900

106,100

121,000

219,600

130,700

1897

982,000

27,100

228,900

818,400

501,000

296,000

1898

2,370,400

142,400

66,600

1,234,500

404,500

874,300

1899

1,290,000

40^000

30,000

1,289,000

347,000

654,000

1900

2,100,000

60,000

260,000

86,000

360.000

638,000

Canadian produce during the winter is shipped from

American ports, and American produce during the summer

is shipped through Montreal, so that the trade statistics

of the two countries are rather mixed up.

Importation for Home Consumption.

[From Statistical Year-Booh.)

Year

ended

June 80.

■Wheat.

Hour.

Barley.

Indian

Corn.

All other

Grain.

other

Bread-

stuffs.

Qrs.

8 bushels.

Sacks 280 ft.

Qrs.

8 bush.

Qrs.

8 bush.

Qrs.

8 bush.

ft.

1886

46,600

378,000

1800

187,300

33,700

62,387,360

1886

8,300

140,900

1000

228,200

13,700

51,121,881

1887

2,800

118,700

600

253,600

4,600

68,374,378

1888

1,500

43,800

900

289,000

15,100

53,641,884

1889

1,900

181,300

900

361,900

23,300

61,040,816

1890

23,600

119,000

1600

405,300

46,200

81,499,100

1891

18,400

40,200

348,600

12,300

65,030,624

1892

8,300

25,600

200

210,700

2,600

47,602,608

1893

1,100

24,200

300

, 253,900

8,700

46,646,257

1894

7,600

22,800

400

201,400

24,800

39,313,689

1895

62,600

33,500

1300

186,700

29,900

48,626,402

1898

17,800

29,000

6400

846,600

27,600

48,006,983

1897

10,400

18,500

1600

220,400

10,600

30,931,785

1898

7,300

24,900

1100

25,600

14,100

67,498,966

1899

4,000

40,360

600

82,000

1900

3,500

35,000

60,000

Corn imported free for ensilage not included in 1890-96.

Note. — Flour computed at 4^ bushels of grain to the barrel 1873 to 1897, and 4 bushels and 35 lb in 1898.

British India (including the native states : population, 295,252,700 ; census 1901). — This great dependency, with an area less than half the size of the United States, raises a wheat crop of about 30,000,000 qrs. — of which

10 per cent, is available for exportation to Europe, the remaining 27,000,000 qrs. being consumed, it is estimated, by the 60,000,000 wheat-eating population, at the rate of about 3J bushels per head. Once in every five years since 1885 the crop has proved a failure, more or less complete. The Central Provinces and Sind usually suffer most severely in this respect. The exportation of wheat on a wholesale scale commenced in the year 1873, and by the year 1877 the shipments had assumed material proportions, being returned as 1,500,000 qrs. During the famine of 1878—79 they fell away again, but in the year 1881 they reached the big total of 4,600,000 qrs., and were the means of breaking the level of prices in Europe to the extent of something like 10s. per quarter between the years 1882 and 1884, the old minimum price of 45s. giving place to one of 35s. In 1891 India's exports reached the high-water mark, for not less than 7,000,000 qrs. were shipped to Europe to help fill the gap caused by crop failures in France and Eussia. Since that time India has played a less important part in the in-

ternational grain trade ; but once more, namely in 1898, the year of the Leiter corner and of France’s big requirements, India came opportunely to the rescue and shipped 4,500,000 qrs., the bulk of it in a surprisingly short space of time.

The following shows the normal area, product, and yield per acre of each of the chief provinces : —

Average five years 1896-99.

Yield per

Area in acres.

Product

in tons.

bushels

60 ft.

Punjab ....

7,540,000

2,163,908

10-7

North-West Prov. and Oudh

4,332,252

1,418,972

12-2

Bengal ....

1,513,500

476,400

11-7

Central Province .

2,.846,187

461,492

6-0

Bombay

2,175,523

575,521

9-8

Sind .

503,160

148,311

11-0

Berar .

669,864

52,735

2-9

Nizam’s Territory

1,491,683

93,829

2-3

Rajputana .

1,400,722

331,775

8-8

Central India

1,853,789

316,517

6-3

Mysore

4,556

353

2-8

Average .

24,331,236

6,039,813

GRAIN TRADE

Before the failure of 1899-1900 there had been a constant growth of the area under wheat in the Punjab, the average acreage of the previous five years being 7,540,000, as compared with 7,100,000 acres, the area of the decade 1890-99, and it is probable that a further gi-owth may occur in these parts. On the other hand, it would seem as if wheat-growing were doomed in the Central Provinces, for failure after failure has happened, until we find the acreage for 1898 and 1899 only averaged 2,000,000 in comparison with a mean of 2,800,000 for the five years 1895-99, and 3,400,000 the mean of the ten years 1890-99. In Central India the situation is as bad, for the acreage of 1898 and 1899 only averaged about 1,000,000 compared with 1,850,000, the mean of the preceding five years. The most fertile land is to be found in the north-west parts of Bengal, Punjab, Sind, and Bombay ; but the average yield even in these tracts only amounts to about 11 bushels per acre.

The port of Kurrachee (Karachi) is now far and away the most important wheat port of India, having wrested the palm from

Bombay, which about 1880 wrested it from Calcutta, where the trade originated. The produce of the fields of Bengal, and largely of the ISTorth-West Provinces and Oudh, reaches’the port of Calcutta for shipment by sea. The port of Bombay gets all the produce of the Presidency of Bombay, the Central Provinces, Berar, Rajputana, and Central India, with a share of that from the North-West Provinces and Oudh, and the Punjab. Kurrachee gets the produce of Sind and the bulk of the Punjab surplus.

In the record season of 1891-92 the three ports shipped the quantities placed against their names — Bombay, 3,380,000 qrs. ; Kurrachee, 2,437,000 qr». ; Calcutta, 1,184,000 qrs. In addition to wheat, India ships about 30,000,000 cwt. of rice o^ paddy per annum, 15,000,000 cwt. of oil-seeds, and 2,000,000 cwt. of pulse, &c.

The sowing season in the Punjab may extend from September to late in January ; in the North-West Provinces, Oudh, Bengal, Central Provinces, Berar, and Rajputana from September to December ; in the Nizam’s Territory from September to November ; and in Bombay and Sind from October to December. The harvest usually takes place in the month of March, excepting in the

Punjab and parts of the North-West, where it falls six or eight

weeks later.

PKODircTioN (Wheat).

{From the Reports of the Revenue and Agriculture Departmewl

of the GovemTnent of India.)

(Harvested March/April.)

Year.

Qrs. 480.

Year.

Qrs. 480.

Year.

Qra. 480.

1885

35,900,000

1890

28,778,000

1895’’

29,516,000

1886

36,100,000

1891″

32,317,000

1896

25,897,000

1887

29,800,000

1892

26,014,000

1897

22,992,400

1888

33,100,000

1893′

33,807,000

1898

31,424,000

1889

29,901,000

1894′

31,823,000

1899

1900

29,793,000

22,983,000

” Believed to have been under-estimated by 2,000,000 qrs.

” Believed to have been over-estimated by 4,000,000 qrs.

“^ Believed to have been over-estimated by 3,000,000 qrs.

’’ Subsequently amended to 32,070,000 qrs.

Of rice India produces about 500,000,000 cwt., and of oil-seeds about 40,000,000 cwt.

In the following tabular statement will be found the annual exports of India of grain by sea between 1885 and 1901, the exports by land being inconsiderable : —

Exports by Sea.

{From the Statistical Abstract.)

Grain and

Fiscal year

(April to

March).

Wheat.

Rice and

Paddy.

Pulse, other

than Wheat

or Kice.

Oil Seeds.

Flour.

Qrs. 480.

Cwt.

Cwt

Cwt.

Sks. 280.

1885-86

4,916,079

28,222,000

1,068,334

17,319,000

67,425

1886-87

6,194,840

26,879,000

1,762,226

16,906,000

1887-88

3,168,904

28,533,000

2,463,646

16,081,000

128,865

1888-80

4,109,014

23,144,000

1,805,612

16,672,000

1889-90

3,219,818

27,098,000

1,673,718

15,798,000

173,471

1890-91

3,841,443

34,963,000

1,777,900

14,800,000

167,985

1891-92

7,070,798

33,163,000

2,826,838

19,166,000

1892-93

3,493,805

27,938,000

1,910,061

16,610,000

1893-94

2,836,596

24,747,000

2,139,900

24,238,000

1894-95

1,610,879

34,301,000

2,020,100

20,890,000

1895-96

2,334,010

36,161,000

2,428,000

13,674,000

1896-97

445,795

28,270,000

1,634,000

11,397,000

1897-98

658,271

28,730,000

1,244,800

12,653,000

1898-99

4,665,637

37,930,000

3,275,000

19,280,000

1899-1900

2,283,600

32,271,393

2,138,300

15,876,237

1900-1901

12,000

31,342,000

925,561

10,997,000

199,600

The export of wheat during the season 1900-1 was practically

As would be expected, India imports only trifling quantities of

agricultural products ; even during famines the quantities do not

amount to anything material. In the year 1877, 101,000 qrs. of wheat was entered, and in 1896, 140,000 qrs. of the same cereal was imported, some of which was re-exported in the succeeding season.

Australian Commonwealth, and JVew Zealand (population 4,513,399, estimated 1900).— That wheat raising should be successfully carried on in a country where the average return is so low as in the two chief states, South Australia and Victoria, where the average value per acre is valued at from 8s. to 13s. 6d., compared with 40s. in America and £6 or £7 in England (the straw being included in the latter case), is wonderful. A total area under wheat of 5,884,116 in 1899 giving a total yield of 48,580,000 bushels or 6,070,000 qrs. is from a British standpoint a very poor return for labour and capital, although the season was a highly satisfactory one.

The average yield per acre works out at rather over 8 bushels per acre, ranging from under 5 bushels in South Australia to 32 bushels in New Zealand. The following shows the area, product, and average yield per

acre for the year 1899, the crops being sown in June and reaped in November and December in the Australian Commonwealth, and about two months later in New Zealand.

	Acreage.	Production (bushels).	Yield per acre (bushels):
New South Wales			
Victoria			
Queensland .			
South Australia .			
West Australia .			
Tasmania .			
New Zealand	1,426,166	2,165,693	52,527

1,821,137

84,516

64,328

269,749

13,604,166

15,237,948

641,314

8,453,135

987,329

1,101,303

8,581,898

9-5

7-03

12-2

4-6

11-6

17-1

31-8

Total

5,884,116

48,607,093

8-3 <■

■• Average,

The indicated per caput consumption of the whole of Australasia works out at about 6J bushels for all purposes. The averages for 1890-99 were:— Wheat crop, 4,600,000 qrs.; exports, 1,550,000 qrs.; wheat and flour imports, 250,000 qrs.; net quantities consumed or seeded in the colonies 3,300,000 qrs., or 6 J bushels per head, of which one bushel is used for seeding, and the balance for human food.

Australia anb New Zealand : PRODUCTioiir.

{From Colonial Blue-Books.)

III

III

Wheat.

Kye.

Barley.

Oats.

Maize.

Potatoes.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Qrs. S bush.

Tons.

1885

2,937,825’”

22,000

292,600

1,760,325

900,060

396,000

1886

4,139,175«

22,600

269,400

2,230,660

866,600

458,800

1887

6,794,700«

28,900

228,100

1,948,100

1,021,820

475,300

1888

3,860,800>’

37,300

322,900

1,830,050

1,110,820

399,700

1889

6,300,000

33,400

387,200

2,282,200

1,062,060

475,600

1890

4,100,000

44,800

365,600

2,068,200

1,197,820

647,700

1891

4,490,000

71,700

325,000

2,149,200

1,333,960

642,900

1892

6,100,000

67,700

238,400

2,964,400

1,143,200

401,600

1893

6,200,000

48,800

248,011

2,312,644

1,282,197

474,610

1894

3,930,000

22,600

308,622

2,089,221

1,212,817

641,624

1895

3,160,000

36,800

361,753

2,401,076

1,282,975

482,017

1896

3,373,000

44,000

232,871

2,620,000

1,282,659

497,733

1897

4,240,000

71,800

241,360

2,068,383

1,438,028

388,493

1898

8,778,000

68,600

417,000

8,128,000

1,235,830

646,000

1899

6,410,000

73,300

460,000

3,065,000

1,460,000

629,276

1900

6,638,000

353,500

3,877,600

1,212 170

489,676

1901

8,200,000 1

« Partly estimated.

GRAIN TRADE

65

Australia and New Zealand : Exports.

(From Colonial Blue-Books.)

Year.

Wheat.

Eye.

Barley.

Oats.

Maize.

Potatoes.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Qrs. 8 bush.

Tons.

1885

1,582,066

73,104

30,732

382,232

626,622

288,644

1886

323,562

61,632

28,748

286,422

470,606

279,347

1887

603,732

170,647

27,263

438,898

657,583

338,364

1888

1,716,941

166,230

22,230

361,673

687,002

365,126

1889

637,890

156,171

68,936

395,187

519,277

223,717

1890

1,634,003

200,405

33,717

411,594

614,931

325,201

1891

1,681,411

107,388

17,839

630,361

474,033

384,310

1892

965,370

37,713

18,492

631,206

476,612

238,861

1893

1,486,749

“20,499

10,937

318,792

340,439

809,004

1894

1,514,069

14,964

6,061

294,611

426,094

336,721

1895

875,404

22,004

9,922

867,645

514,954

215,682

1896

205,109

184,223

16,647

386,698

466,627

35,202

1897

286,632

276,026

8,340

262,110

200,066

23,272

1898

413,614

136,634

3,477

224,544

249,007

160,513

1899

1,890,000

1900

“1,500,000

” Approximate.

Australia and New Zealand : Imports.

Year.

Wheat.

Eye.

Barley.

Oats.

Flour.

Sacks.

Potatoes.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Tons.

1885

103,473

10

17,800

290,708

725,917

76,841

1886

202,103

21,384

248,665

809,906

79,394

1887

94,192

6

38,025

360,687

948,042

68,469

1888

235,610

61,400

334,771

668,236

68,141

1889

398,446

75,762

402,668

891,265

77,105

1890

125,681

9,996

292,170

810,488

66,322

1891

190,584

12,010

248,493

809,960

69,100

1892

207,102

16,569

225,936

737,899

70,092

1893

166,601

11,923

199,063

634,362

49,071

1894

160,890

40

9,269

160,678

609,142

47,068

1895

168,179

50

5,103

212,122

407,628

67,570

1896

636,972

2

15,213

298,663

716,288

80,335

1897

480,086

..

32,014

126,172

507,184

76,410

1898

232,991

60,545

131,066

287,619

42,635

1899

“200,000

”

” Partly estimated.

The two foregoing tables include inter-oolonial exchanges.

Xew South “Wales : Production.

{From Victorian Year-Boole.)

Year.

Wheat.

Barley.

Oats.

Maize.

Potatdes.

Qrs. of 8

Qrs. of 8

Qrs. of 8

Qrs. of 8

meas. bush.

meas. bush.

meas. bush.

meas. bush.

1885

341,600

10,700

34,900

542,000

38,700

1886

733,600

16,600

75,100

478,100

45,800

1887

. 586,900

10,500

49,300

619,100

61,500

1888

181,300

4,600

13,700

613,800

36,800

1889

821,300

14,100

67,900

669,300

50,100

1890

456,100

10,100

32,100

714,100

52,800

1891

495,400

11,600

34,500

715,200

61,300

1892

852,100

11,400

58,300

629,600

52,100

1893

812,839

14,284

87,725

883,447

83,838

1894

880,172

22,418

70,340

703,191

86,170

1895

649,414

12,014

46,774

710,878

56,179

1896

1,106,680

13,792

104,329

719,277

84,214

1897

1,320,013

12,488

67,993

839,132

55,332

1898

1,160,700

8,010

34,000

758,000

61,900

1899

1,100,000

16,500

78,000

747,000

81,300

1900

1,700,000

14,000

70,000

767,000

64,337

New South “Wales : Exports.

{From New South Wales Statistical Begister.)

Year.

Wheat.

Flour.

Barley.

Oats.

Maize.

Potatoes.

Qrs. of

8 bush.

Sacks, 280.

Qrs. of

8 bush.

Qrs. of

8 bush.

Qrs. of

8 bush.

Tons.

1885

5,900

73,104

1000

17,400

49,940

7,100

1886

15,000

61,432

700

8,200

24,624

6,200

1887

16,900

169,640

4600

16,300

42,150

9,100

1888

18,700

153,648

9100

19,200

42,761

6,600

1889

17,200

144,496

3700

22,900

45,757

9,900

1890

27,400

164,400

300

5,600

3,851

10,700

1891

40,200

101,896

200

3,900

2,203

6,600

1892

1,000

25,512

80

5,700

2,415

3,700

1893

1,800

14,272

400

6,500

1,533

3,600

1894

750

13,216

250

3,600

1,466

2,900

1895

198

15,224

676

537

5,255

561

1896

40,683

182,416

547

1,617

6,450

1,746

1897

157,518

273,088

657

4,953

11,635

3,620

1898

157,523

124,547

34

918

21,391

7,506

New South “Wales: Imports.

{Same authority as Exports.)

Year.

Wheat.

Flour.

Barley.

Oats,

Maize.

Potatoes.

Qrs. of

8 bush.

Sacks, 280.

Qrs. 400.

Qrs. of

Qra. 480.

Tons.

1885

68,177

427,360

5,500

192,708

14,500

59,848

1886

138,134

491,936

7,600

145,286

11,800

62,923

1887

34,763

547,368

8,500

190,552

34,000

64,140

1888

192,321

527,112

17,700

162,671

19,000

52,239

1889

354,106

526,144

16,600

133,203

29,700

58,933

1890

44,060

441,866

6,000

187,953

70,400

60,200

1891

112,509

511,928

7,700

183,843

36,300

66,678

1892

116,425

390,456

4,300

171,222

40,600

58,316

1893

68,973

214,612

7,700

165,281

20,800

36,181

1894

32,068

266,064

4,500

89,357

7,200

33,346

1895

44,894

154,224

1,479

102,005

311

50,175

1896

312,809

450,328

7,925

123,610

13,877

52,779

1897

113,741

447,952

9,726

103,662

42,455

59,075

1898

65,470

;

146,691

12,092

114,432

28,232

32,344

Victoria : Production.

{From Statistical Abstract of Victoria.)

Years.

Wheat.

Maize.

Barley. ‘

Oats.

Potatoes.

Eye.

Qrs. of

Qrs. of

Qrs. of

Qrs. of

Tons,

2240.

Qrs. of

8 meas.

8 meas.

8 meas.

8 meas.

8 meas.

bush.

bush.

bush.

bush.

buth.

1884-86

1,304,100

22,000

136,300

649,000

161,100

1900

1885-86

1,146,300

22,600

162,800

686,200

163,200

1000

1886-87

1,612,500

28,900

108,400

632,000

170,700

1400

1887-88

1,666,100

87,300

119,600

670,800

198,200

1800

1888-89

1,081,000

33,400

141,400

860,400

131,100

1300

1889-90

1.437,000

44,600

203,900

705,600

157,100

2100

1890-91

1,593,900

71,700

196,400

614,900

204,200

2200

1891-92

1,710,000

67,700

106,600

666,900

200,500

1000

1892-93

1,851,800

46,600

96,700

671,800

142,600

1893-94

1,906,900

22,600

129,200

618,900

144,700

1894-95

1,430,700

36,800

199,600

704,200

196,700

1895-96

708,600

44,000

89,500

360,000

117,200

1896-97

861,400

70,800

102,000

862,100

146,600

1600

1897-98

1,322,600

64,400

94,800

601,200

67,800

2970

1898-99

2,447,000

73,300

139,000

690,000

161,142

3900

1899-1900

1.906,000

78,000

183,000

764,000

173,000

190g-1901

2,230,000

76,000

152,000

1.197,000

123,000

Victoria : Exports.

{Same authority as Production.)

Year.

Wheat.

Eye.

Barley.

Oats.

Maize.

Flour.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Qrs. 480.

Sacks, 280.

1886

272,083

1800

9,207

3,200

267,400

1886

101,031

2900

7,190

100

205,160

1887

263,600

1400

9,769

4,600

313,176

1888

330,900

1200

5,600

1,400

841,888

1889

60,900

1600

2,000

60

192,208

1890

76,200

800

4,600

600

286,624

1891

693,100

7000

7,400

600

843,100

1892

462,400

20

7700

12,400

11,800

205,700

1893

578,800

6300

44,000

13,800

299,600

1894

696,700

8000

30,000

600

331,920

1896

432,600

3700

64,400

6,400

211,008

1896

50,300

6800

10,700

800

29,568

1897

117,800

3100

37,000

1,100

11,800

1898

226,400

400

3000

80,400

23,000

109,600

From the years 1877-90 inclusive, and from the years 1894-97

inclusive for flour ; biscuits are included.

Victoria: Imports.

{Same authority as Production.)

Year.

Wheat.

Maize.

Barley.

Oats.

Flour.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Sks. 280.

1885

2,209

4,100

12,100

91,200

9,785

1886

17,746

10,100

8,400

68,000

8,310

1887

12,100

4,500

26,800

129,400

10,030

1,=88

18,600

7,200

20,200

163,000

10,478

1889

27,200

28,200

66,100

248,000

4,497

1890

17,100

1,600

80

71,000

8.980

1891

88,800

1,000

100

38,000

11,100

1892

24,200

250

76

16,000

11,600

1898

30,800

26

350

600

7,600

1894

49,900

70

3,200

1,600

9,^92

1895

60,000

20

1.700

3,600

14,892

1896

49,700

600

11,000

43,000

14,803

1897

118,000

3,400

10,600

12,000

10,183

1898

83,300

20

2,600

1,000

14,600

S. V.

66

GRAIN TRADE

Queensland

: Production.

{Fr

om Victorian Year-Book.)

Year.

Wheat.

Barley.

Oats.

Maize.

Potatoes.

Qis. o£ 8

Qrs. of 8

Qrs. o£ 8

Qrs. of 8

Tons 2240

meas. bush.

meas.bush.

meas.bush.

meas. bush.

1885

6,400

1,200

125

196,700

19,000

1886

2,600

2,300

150

213,700

27,000

1887

22,800

3,900

1,600

203,900

30,700

1888

1,000

900

450

272,700

20,700

1889

16,800

3,300

1,800

217,800

25,900

1890

25,900

1,500

1,100

296,700

28,800

1891

49,000

2,600

2,100

384,700

26,000

1892

57,800

800

1,600

291,600

20,500

1893

51,636

1,049

1,611

228,013

17,165

1894

68,148

4,728

3,807

335,615

28,185

1895

15,453

909

1,360

298,922

19,027

1896

75,156

2,417

4,022

383,166

18,451

1897

126,161

6,230

3,937

350,396

18,520

1898

75,800

4,358

506

281,560

16,413

1899

76,000

14,800

1,000

246,000

22,675

1900

150,000

15,900

1,000

307,000

20,014

Queensland : Imports.

(From Statistics of the Colony.)

Year.

Wheat.

Flour.

Barley.

Oata.

Beans and

Pease.

Potatoes.

Qrs. 8 bus.

Sks. 280.

Qrs.Sbus

Qrs. 8 bus.

Qrs. 8 bus.

Tons.

1885

1,287

270,660

...

16,993

1886

2,420

291,600

15,339

1887

6,637

353,616

13,025

1888

2,089

319,960

15,902

1889

13,698

330,968

17,372

1890

40,810

328,976

15,186

1891

32,635

267,464

12,421

1892

33,686

290,592

9,697

1893

46,569

273,504

10,843

1894

51,966

272,032

10,513

1895

45,567

262,032

12,454

1896

107,933

263,968

19,271

1897

45.052

253,600

15,756

1898

39,411

2,103

12,679

1,308

10,232

South Australia : Production.

{^rom the Agricultural Returns and Australian Statistics.)

Year.

Wheat.

Barley.

Oats.

Potatoes.

Qrs. 8 bush.

Qrs. 8 bush.

Qrs. 8 bush.

Tons 2240.

1885

645,125

no returns.

no returns.

no returns.

1886

1,354,376

no returns.

no returns.

no returns.

1887

2,376,600

no returns.

no returns.

no returns.

1888

773,300

no returns.

no returns.

no returns.

1889

1,822,000

30,800

16,700

23,900

1890

1,174,900

21,900

14,500

24,000

1891

804,500

13,400

10,100

27,800

1892

1,155,000

21,900

20,800

20,000

1893

1,702,257 «

26,697 «

21,675 »

22,958 «

1894

972,652″

1895

741,162″

1896

350,661

13,474

23,714

16,139

1897

501,866

20,258

26,665

9,308

1898

1,097,362

29,266

38,000

14,445

1899

1,056,000

23,600

27,300

19,716

1900

1,406,000

26,000

45,700

14,566

Estimated.

South Australia : Exports.

(From Statistical Register of South Australia.)

Year.

Wheat.

Maize.

Barley.

Oata.

Flour.

Qrs. 8 bush.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Sks. 280.

1885

1,134,193

651,848

1886

51,078

200

ibo

3,400

414,336

1887

244,466

900

900

8,600

576,144

1888

1,078,846

500

2,000

10,100

529,232

1889

133,023

50

1,900

4,700

430,048

1890

971,976

20

200

5,600

476,962

1891

775,640

447,568

1892

194,074

426,464

1893

577,725

295,704

1894

788,006

366

640

384,376

1895

440,880

94

6,630

466,160

1896

57,006

289

1,180

409,680

1897

2,182

27

110

140,096

1898

12,130

9

190

182,000

South Australia ; Imports.

{From Statistical Register of South Australia.)

Year.

Wheat.

Barley.

Oats.

Maize.

Flour.

Qrs. 480.

Qrs. 8 bush.

Qrs. 304.

Qrs. 480.

Sks. 280.

1885

1886

9,600

6,800

28,900

3,400

1887

500

3,100

23,800

1,500

1888

800

7,400

14,900

700

100

1889

1,500

3,400

14,800

300

1890

30

3,500

20,500

100

...

1891

...

1892

...

1893

...

1894

...

1895

1896

...

...

1897

...

1898

...

1899

West Australia : Production.

{From Victorian Year-Book.)

Year.

Wheat.

Barley.

Oats.

Maize.

Potatoes.

Qrs. of

Qrs. of

Qrs. of

Qrs. of

8 meas.

8 meas.

8 meas.

8 meas.

2240 El

bush.

bush.

bush.

bush.

1885

42,400

11,200

2,900

260

1100

1886

36,100

10,300

3,500

600

1100

1887

33,700

8,700

3,100

220

1100

1888

40,300

9,200

5,200

220

2000

1889

62,100

11,600

5,200

16ft

1400

1890

58,100

11,000

4,700

120

1700

1891

36,900

6,100

2,000

60

1600

1892

53,600

7,100

3,700

100

1600

1893

65,000

5,900

6,000

70

2300

1894

21,300

1,900

2,500

200

2500

1895

23,600

2,300

2,400

76

2300

1896

30,500

1,600

2,400

60

2100

1897

51,100

2,900

3,700

600

4300

1898

108,100

3,700

7,000

170

5700

1899

120,000

7,070

9,200

280

8173

1900

97,000

3,600

10,800

170

4755

West Australia : Imports.

{From Annual Export of the Collector of Customs.)

Flour

Maize

Year.

Wheat

Potatoes.

Barley.

Oats.

(excluding

Meal).

and

Gram.

Qrs. of

Tons,

Qrs. of

Qrs. of

Qrs. of

8 meas.

8 meas.

Sacks, 280.

8 meas.

bush.

busli.

bush.

bush.

1885

13,312

1886

104

1132

584

6,870

11,460

1000

1887

2,986

1294

615

14,235

36,228

396

1888

36,776

1889

1,541

800

652

6,665

29,666

882

1890

381

936

416

12,617

22,276

520

1891

15,288

1892

11,684

2067

1682

28,400

38,656

962

1893

1,469

2047

953

26,982

36,896

66

1894

3,356

3209

869

56,121

68,204

693

1895

14,718

4941

1665

102,377

80,760

800

1896

22,730

8285

1486

124,813

119,108

1668

1897

26,593

127,860

1898

36,446

...

118,928

1899

Tasmania : Production.

{From Victorian Year-Book.)

Year.

Wheat.

Eye.

Barley.

Oats.

Pease.

Potatoes.

Qrs. of

Qrs. of

Qrs. of

Qrs. of

Qrs. of

Tons,

8 meas.

8 meas.

8 meas.

8 meas.

8 meas.

bush.

bush.

bush.

bush.

bush.

1885

68,000

22,000

98,000

53,500

1886

79,000

7,600

70,000

75,800

1887

84,300

6,500

48,100

42,500

1888

102,400

13,700

118,300

66,700

1889

94,600

13,200

131,100

72,300

GRAIN TRADE

Tasmania : Production (continued).

Year.

Wheat.

llye.

Barley.

Oats.

Pease.

Potatoes.

‘

Qrs. of

Qrs. of

Qrs. of

Qrs. of

Qrs. of

Tons,

2240 ft.

8 meas.

8 meas.

8 meas.

8 meas.

8 meas.

bush.

bush.

bush.

bush.

bush.

1890

80,400

...

12,400

64,900

73,200

1891

117,200

...

8,900

109,500

63,000

1892

127,300

10,000

78,900

60,200

1893

104,200

...

13,800

104,800

76,800

1894

109,000

25,300

116,000

90,800

1895

145,600

17,400

113,400

81,500

1896

160,800

9,400

121,500

72,300

1897

208,500

1,000

8,800

137,800

17,600

49,100

1898

287,900

2,100

23,000

283,900

27,000

88,200

1899

137,600

17,800

143,000

101,670

1900

137,900

13,000

168,000

93,862

Tasmania : Exports.

(From Statistics of the Colony of Ta,s7}iania.)

Year.

Wheat

Eye.

Barley.

Oats.

Flour.

Sacks,

Potatoes.

Qrs. of

8 meas.

Qrs. of

8 meas.

Qrs. of

8 meas.

Qrs. of

8 meas.

Tons,

bush.

bush.

bush.

bush.

1885

...

25

3,500

8

21,634

1886

1

7600

27,300

64

31,546

1887

7

3400

5,000

400

35,789

1888

500

400

40

13,003

1889

...

...

33,600

41,390

1890

1,050

2300

18,600

33,386

1891

600

70

4,200

23,213

1892

300

25

140

30,900

35,362

1893

12

130

22,700

29,144

1894

180

15,200

39,520

1895

5

2

2700

42,700

48,068

1896

80

2

3000

38,100

200

48,276

1897

12

160

17,200

160

45,998

1898

16,200

3

100

39,300

11,000

22,535

1899

Tasmania : Imports.

(Savie authority as Exports.)

Year.

Yv’heat.

Eye.

Barley.

Oats.

Hour.

Haize.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 804.

Sacks,

2801b.

Qrs. 480.

1885

31,800

10

200

6,800

4900

100

1886

34,100

600

1600

100

1887

37,200

6

10

2,600

8000

■ 60

1888

26,800

6100

14,200

8600

250

1889

...

...

1890

23,300

5200

200

8400

60

1891

2,200

1800

3,800

3800

200

1892

16,800

900

10

6500

200

1893

5,800

20

100

1200

100

1894

10,900

40

100

...

3200

130

1895

5,900

50

9

140

4700

150

1896

12,200

2

2

40

1400

200

1897

2,200

2400

50

5

250

1898

4

4100

20

150

New Zealand: Exports.

[Fro-m Statistics of Oie Colony of New Zealand.)

New Zealand: Production.

(From Victorian Year-Book.)

Year.

Wheat.

Barley.

Oats.

Maize.

Potatoes.

Qrs. of 8

Qrs. of 8

Qrs. of 8

Qrs. of 8

meas. bush.

meas. bush.

meas. bush.

meas. bush.

1885

530,200

112,100

1,075,400

113,800

1886

787,200

69,800

1,496,600

...

134,900

1887

1,178,000

95,100

1,314,000

27,900

138,100

1888

1,096,200

175,000

1,122,100

25,900

133,700

1889

1,056,100

167,800

1,709,100

33,700

159,700

1890

715,400

94,800

1,243,300

29,800

178,100

1891

1,282,100

86,000

1,376,100

29,800

162,000

1892

1,047,200

81,700

1,234,200

21,400

104,200

1893

611,461

90,581

1,519,133

28,067

126,540

1894

451,629

125,076

1,277,674

29,111

139,869

1895

855,471

129,470

1,532,942

76,400

207,011

1896

740,815

102,688

1,404,100

62,956

157,529

1897

708,752

88,734

1,217,298

81,700

180,333

1898

1,634,000

209,000

2,064,000

101,600

298,561

1899

1,070,000

198,000

2,040,000

83,000

222,124

1900

815,000

128,000

2,385,000

63,000

169,042

Year.

Wheat.

Maize.

Barley.

Oats.

Flour.

Potatoes.

Qrs. of

Qrs. of

Qrs. of

Qrs. of

Qrs. of

Tons,

8 bush.

8 bush.

8 busli.

8 bush.

6 bush.

2240.

1885

169,889

28,307

352,125

14,036

1886

156,452

17,388

240,332

...

7,923

1887

78,776

16,963

398,737

15,688

1888

288,496

2,082

9,430

326,373

606

16,598

1889

336,767

11,625

61,836

331,987

2,022

21,009

1890

558,378

35,985

30,117

377,394

1,242

28,877

1891

181,871

5,427

10,469

506,551

448

35,610

1892

307,596

12,081

5,447

478,805

571

28,961

1893

327,424

6,208

5,067

243,192

258

5,804

1894

28,613

1,740

2,231

245,411

132

1,901

1895

1,821

6,698

2,746

250,408

71

4,023

1896

56,640

1,685

5,500

280,881

821

3,688

1897

■ 9,020

2,337

4,373

200,057

1,227

7,692

1898

1,261

11,384

333

102,026

81

22,507

1899

363,000

23,000

16,000

440,000

12,000

25, .396

Kew Zealand: Imports.

(Same authority as Exports.)

Year.

Wheat.

Potatoes.

Barley.

Oats.

Maize.

Flour.

Qrs. 480.

Tons, 2240.

Qrs. 400.

Qrs. 304.

Qrs. 480.

Sacks, 280.

1891

40

1

10

50

10

380

1892

7

12

2

14

4

80

1893

• •■

1894

■ ■■

• ■•

1895

• •■

>••

,.,

1896

1897

600

589

388

60

15

1898

760

59

3960

35

3800

1899

1000

Argentina (population, 4,794,149; census 1900). —

This South American republic, with an area nine times

that of the United Kingdom, in 1899 took second place

in the international grain trade as a shipper of wheat.

The wheat and linseed crops are mostly grown in the provinces of Santa F^, Buenos Aires, Cordoba, and Entre Rios ; the maize crop being raised chiefly in Buenos Aires, and moderately in Santa F^. The wheat area now amounts to 9,000,000 acres, a growth of 3,000,000 since 1895. The area under maize is given as 2,500,000 acres, against 3,000,000 in 1895. The wheat exports commenced in 1871 with 9 tons ; in 1900 they reached 8,862,300 quarters, besides 403,000 sacks of flour. Maize exports commenced in 1864 with 14 tons, and reached in 1896 a total of 7,214,000 quarters. The exportation of linseed has now reached an annual total of 200,000 tons. The area, production, and yield per acre of the chief provinces was officially estimated as follows for the year 1899 : —

Wheat crop planted about June ; reaped December.

Production.

Acres.

Bushels.

Yield

per Acre.

Santa M

Buenos Aires .

Cordoba .

Entre Rios

Others .

3,991,000

1,849,000

1,154,000

580,000

173,000

45,897,000

29,581,000

12,691,000

6,612,000

. 1,903,000

11-5

16-0

11-0

11-4

11-0

7,747 000

06,684,000

12-5

The average yield per acre for the whole country ranges from 18 bushels in a good year like 1893 to 7 bushels in a bad year like 1896, the highest yield now, as a mle, being obtained in the province of Buenos Aires off virgin soil. The average per caput consumption of wheat during the decade ending the 19th century was nearly 6 bushels for all purposes, of which about IJ bushel was used for seed.

The production of wheat and maize during the period 1887-1901, and of the minor crops for the year 1899, is given in the following tabular statement : —

Peodtjction.

(From the Com Trade Year -Book and other Sources.)

Year.

” Wheat.

Linseed.

» Maize.

Qrs. 480.

Tons.

Qrs. 480.

1887

4,000,000

4,100,000

1888

3,800,000

3,200,000

1899

3,000,000

4,500,000

1890

4,100,000

5,500,000

1891

4,600,000

2,500,000

1892

6,900,000

4,500,000

1893

11,000,000

2,700,000

1894

7,500,000

2,000,000

1895

5,500,000

9,000,000

1896

3,100,000

10,000,000

1897

6,200,000

5,000,000

1898

13,600,000

200,000

7,000,000

1899

12,700,000

200,000

9,000,000

1900

9,000,000

250,000

7,000,000

1901

6,000,000

8,000,000

” Heaped in December. ‘ Reaped in Marcli.

The average yield per hectare of linseed is stated to he 660 kilos, of rye 790, of barley 860 kilos.

Previous to 1899 there were no statistics of the production of rye, barley, and linseed, but in that year the quantities raised were respectively 5000 qrs. (of 480 lb), 30,000 qrs. (of 400 lb), and 200,000 tons.

Exports.

{From ‘ ‘ Anuario de la direcdon general de Estadistica,

BueTws Aires.”)

Year

Wheat.

Eye. 1 Barley.

Linseed.

Maize.

Flour.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Tons,

2240 Si.

Qrs. 480.

Sks. 280.

1885

360,500

11,600

909,000

58,600

1886

174,000

4,800

1,064,200

41,400

1887

1,092,600

4,600

81,200

1,662,100

42,600

1888

822,000

1,300

40,223

744,300

50,300

1889

104,700

1,300

28,200

1,987,000

26,500

1890

1,506,100

7,200

30,700

3,249,000

94,700

1891

1,817,000

700

12,000

302,800

55,200

1892

2,159,500

5,500

43,000

2,050,000

148,400

1893

4,630,300

6,800

6,200

72,100

388,200

298,600

1894

7,387,000

13,700

3,700

104,000

252,100

321,000

1895

4,640,000

13,300

49,600

276,000

3,547,700

424,700

1896

2,402,400

2,400

20,000

229,000

7,214,000

407,300

1897

467,800

100

2,800

164,100

1,722,300

326,300

1898

2,963,500

...

2,400

158,000

3,293,800

251,300

1899

7,880,000

...

220,000

5,130,000

470,000

1900

8,862,300

227,000

3,276,000

403,000

«1901

4,500,000

370,000

5,242,000

679,000

” Cereal year.

The imports of agricultural products are insignificant, but in the year 1897, owing to the crop failure, and for the sake of getting some new seed, a few cargoes of American and Bussiau grain were imported, amounting in all to 66, 000 quarters.

The chief customers for Argentina’s wheat are the United Kingdom, Belgium, France, and Germany ; the last country getting its supply through Hamburg, Eotterdam, and Antwerp. Brazil takes annually about 300,000 qrs. of wheat, 250,000 sacks of flour, and 200, 000 qrs. of maize. Uruguay and Paraguay also take certain quantities when their own crops are.bad. A great deal is described in the official returns as shipped to Portugal, but this means simply that it is shipped to St Vincent for orders, as it is to Las Palmas and Falmouth. The chief wheat ports are Rosario, Buenos Aires, and Bahia Blanca. Maize is shipped chiefly from Buenos Aires and La Plata.

Uruguay (population, 930,680 ; census 1900).— In the early ‘nineties it seemed as if this republic were going to join Argentina in supplying Europe with wheat, but the export proved to be a mere flash in the pan, and

after raising 1,100,000 qrs. in 1894-95, the production fell off. In September 1900 at Montevideo there was issued an official estimate of the production, which gave it as 894,000 quarters grown on an acreage of 836,000, equalling a yield of a fraction over 8 bushels per acre — a great falling off since the previous estimates of 1893 and 1894, when the yields were 11 and 17 bushels respectively. Taken upon a ten years' average, the consumption per caput for all purposes appears to have been nearly 4^ bushels. The chief crop after wheat is maize, of which half a million to a million quarters are raised in good years, the yield per acre in a good season averaging 17 bushels ; the total annual exports amounting to 300,000 or 400,000 quarters. The shipments are made from the port of Monte-video, the principal purchasers being the United Kingdom, Antwerp, and Brazil.

Peoduotion.

{From British Official Returns and other Sources.)

Year.

Wlieat.

Eye.

Barley. Oats.

Maize.

Potatoes.

Harvested

Qrs.

Qrs.

Qrs. Qrs.

Qrs.

Tons,

1st Jan.

8 bush.

8 hush.

8 bush. 8 bush.

8 bush.

2240.

1890

510,000

1891

310,000

...

1892

398,900

16,100

5,800 300

424,000

5000

1893

690,800

13,000

15,500

30

384,700

5500

1894

1,080,000

19,300

14,000 170

636,400

4300

1895

1,100,000

730,000

1896

620,000

700,000

1897

400,000

500,000

1898

500,000

500,000

1899

“894,138

,

500,000

1900

800,000

370,000

1901

600,000

—

870,000

” Official.

EXPOETS.

{From Anuario Estadistico de la Bepublica Oriental

del Uruguay.)

1890

1891

1892

1893

1894

1895

1896

1897

1898

1899

1900

Wheat.

Qrs. 480.

83,963

2,304

5

27,130

509,463

461,039

29,398

57,725

354,700

288,638

184,000

Potatoes. Barley.

Tons, 2240.

19

5

118

86

184

76

57

24

35

Qrs. 400.

16

15

50

9

1265

3613

935

60

1700

2000

1000

Oats.

Qrs. 304.

30

22

7

Maize.

Qrs. 480.

19,927

6,440

2,934

3,795

223,100

311,171

413,521

6,338

57,700

49,000

2,000

Plour.

Sks. 280.

4,384

3,768

1,042

91,150

267,636

152,967

139,940

90,486

88,900

163,200

140,000

Imports.

{Same authority as Exports.)

Year.

Wheat.

Potatoes.

Barley.

Oats.

Maize.

riour.

Qrs. 480.

Tons, 2240.

Qra. 400.

Qrs. 304.

Qrs. 480.

Sacks, 280.

1885

83

1601

135

...

188

1886

6,112

102

2180

226

1887

465

517

83

1888

118

1728

7

1889

170,297

3060

768

300

45,700

29,283

1890

91,247

5168

1566

500

16,100

26,065

1891

6,100

4300

100

80

200

4,500

1892

5,200

7800

15

60

600

1,300

1893

3,300

5400

900

110

100

200

1894

100

800

1700

120

SO

80

1895

150

2400

80

40

5

10

1896

30

2400

1000

10

1,800

10

1897

2,000

3300

200

100

95,800

10

1898

100

4200

1200

100

7,600

30

Paraguay (population, 635,571 ; census 1900).— No

official statements for either acreage or production are

available for this country. The trade is very small.

AVheat Impokts.

1885, 6476 bushels ; 1886, 77,794 bushels ; 1887, 69,760 bushels.

Flour Imports.

1881, 1,290,344 lb; 1882, 1,680,802 B ; 1883, 2,177,016 ft;

1884, 2,047,456 ft ; 1885, 1,908,419 ft ; 1886, 385,225 ft ;

1887, 1,338,862 ft.

In addition, a small trade in maize and potatoes is carried on.

GRAIN TRADE

Chile (population, 3,110,000; census, November 1899). — This country, after being a steady exporter of a moderate quantity of -wheat and barley for many years, seems as if it were being beaten out of the field by other growers. The wheat product formerly was about 2,000,000 qrs., and the annual exportation about 500,000 qrs. ; but the production has now fallen off so seriously that importation of Californian and Australian wheat has commenced on a large scale. The indicated per caput consumption on a ten years' average was 5i bushels for all purposes.

Wheat (Production) Harvested Janfaey-Februakt.

(From the Corn Trade Year-Book.)

Qrs. 480.

1891

1892

1893

1894

1895

1896

Qrs. 480.

2,100,000

1,900,000

2,100,000

1,700,000

1,600,000

1,900,000

1897

1898

1899

1900

1901

1,600,000

1,500,000

1,400,000

1,000,000

1,000,000

There are no oflioial estimates of the area or average yield issued, but there are complete returns of the exports and imports published

regularly, as will be seen from the following : —

Exports.

{From Estadistica Comereial de la BepuUica de Chile.)

Year.

Wheat.

Barley.

Maize.

Flour of all

kinds.

Qrs. 8 bush.

Qrs. 8 bush.

Qrs. 480 lb.

Sacks, 280 B).

1885

493,036

43,872

44,404

1886

560,808

52,921

54,498

1887

572,100

22,200

250

24,000

1888

427,258

133,523

200

24,908

1889

228,574

38,599

500

24,806

1890

133,032

33,891

100

17,103

1891

819,020

76,736

300

45,259

1892

670,689

73,485

1300

30,707

1893

855,429

148,967

17,229

1894

534,681

210,199

24,616

1895

361,468

309,501

...

30,407

1896

632,799

285,048

32,405

1897

332,500

103,985

250

42,040

1898

364,000

101,000

1000

47,800

1899

210,000

143,000

2000

53,000

The imports are only important in the case of flour and maize, and these only occasionally. The great port for wheat shipments is Talcahuano. Almost the entire exportation of wheat and barley comes to the United Kingdom.

Algeria (population, 4,824,000; census 1901). — The progress of agriculture in this part of North Africa, as well as in the neighbouring countries of Tunis and Tripoli, is kept in check by the twin evils, droughts and locusts. The following figures show the average yield per acre of wheat, barley, and oats : —

Acreage.

Product.

Yield per

Acre.

Wheat .

Barley

Oats

3,219,848

3,446,966

209,036

Bushels.

22,240,000

32,000,000

3,600,000

Bushels.

7

9i

» 17i

The general production between 1891 and 1900 was as follows : —

Year.

Wheat

Barley.

Oats.

Maize.

Qrs.

Qrs.

Qrs.

Qrs.

1891

3,270,000

5,009,000

360,000

46,000

1892

2.500,000

4,500,000

275,000

39,000

1893

2,510,000

3,950,000

305,000

40,000

1894

3,880,000

5,750,000

532,000

49,000

1895

3,246,000

4,630,000

533,000

60,000

1896

2,860,000

3,730,000

543,000

54,500

1897

2,470,000

3,004,000

415,000

35,000

1898

3,380,000

4,956,000

630,000

40,000

1899

2,780,000

4,000,000

450,000

40,000

1900

2,200,000

6,600,000

720,000

40,000

1901

2,900,000

4,000,000

470,000

The trade with Algeria in grain is of no consequence to any nation beside France. In the last two years for which official returns are obtainable we have as follows :

Importations.

Exportations. |

1898.

1897.

1898.

1897.

Cereals, grain”!

and flour . j

Rice, its flour, “1

and semolina J

Bran

Quintals.

968,575

6,476,212

Quintals.

722,067

5,381,310

Quintals.

1,558,209

2,770,747

Quintals.

2,108,411

2,869,850

Tunis (population, 1,906,000; estimate 1889).— Of this country very few agricultural or trade statistics are published. The area under crops in 1898 and 1899 was believed to be as follows, in hectares : —

Year.

Wheat

Eye.

Barley.

Maize.

1898

1899

358,462

367,690

370,684

403,409

6933

6480

19,738

6,285

For the year 1898 the following figures represent the imports and exports : —

Wheat

Barley.

Wheat

Flour.

Imports : quintals .

Exports : quintals .

88,750

671,377

137,635

495,181

77,448

146

Tripoli (population, 800,000; estimate 1899). — This vilayet grows certain quantities of barley, and exports, chiefly to the United Kingdom, 20,000 qrs. and occasionally 50,000 qrs. annually. It also imports from Italy and France about 40,000 sacks of flour annually.

Egypt (population, 9,734,405; census 1897).— Not^

withstanding the general prosperity of the Khedive's dominions under British protection, it cannot be said that agriculture is prospering. There are but few data obtainable as to the production, but the record of exports and imports is very complete, and these wiU be found annexed.

Production.

{Commercial estimates.)

Year.

Wheat

Haize.

Beans.

Year.

Wheat.

Maize.

Beans.

Qrs. 480.

Qrs. 480.

Qrs. 480.

Qrs. 480.

Qrs. 480.

Qre. 480.

1890

1,250,000

4,000,000

900,000

1896

900,000

4,250,000

770,000

1891

1,800,000

4,000,000

1,000,000

1897

750,000

4,300,000

725,000

1892

840,000

3,700,000

800,000

1898

1,000,000

4,000,000

650,000

1893

1,000,000

3,800,000

850,000

1899

1,300,000

4,400,000

1894

950,000

4,000,000

980,000

1900

1,200,000

4,300,000

1895

1,000,000

4,200,000

760,000

1901

1,100,000

3,800,000

••

Imports.

{From ” Le Commerce Extirieur.”)

Flour of

Year.

Wheat

Beans.

Barley.

Rice.

Maize.

Wheat and

Maize.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Cwt.

Qrs. 480.

Sacks, 280.

1885

106,200

69

35,200

224,400

12,400

77,900

1886

137,300

165

60,000

298,600

40,300

117,800

1887

32,400

119

7,600

393,000

6,000

76,400

1888

30,300

42,000

21,400

274,300

6,100

69,500

1889

111,200

814

62,800

275,900

109,000

68,200

1890

141,100

473

22,100

310,300

17,300

68,100

1891

26,300

230

1,700

286,900

250

65,900

1892

61,200

262

36,800

319,700

29,500

60,500

1893

111,200

128

36,000

338,600

10,800

145,100

1894

81,400

124

21,000

324,800

600

159,200

1895

59,800

299

72,200

349,800

13,900

287,900

1896

119,400

220

99,100

425,700

174,000

523,600

1897

57,400

179

47,900

353.200

199,400

440,800

1898

33,300

372

.3,100

420,400

284,700

278,600

70

GRAIN TRADE

EXPOKTS.

{From ” Le Commerce Extirieur”)

Tear.

Wheat.

Beaus.

Barley.

Cotton

Seed.

Maize.

Flour of

Wheat

aud Maize.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Tons,

2240 lb.

Qrs.

4801b.

Sacks,

280 lb.

1885

127,200

676,100

17,000

244,800

34,500

8,800

1886

55,200

421,000

200

269,600

1,700

2,100

1887

89,700

466,200

25,200

270,000

8,000

35,000

1888

285,600

453,100

30,000

244,900

126,200

48,000

1889

141,800

296,000

23,200

245,200

2,400

3,100

1890

185,900

707,200

65,200

294,600

27,300

5,000

1891

416,300

793,400

170,300

324,900

490,600

21,400

1892

189,400

642,400

36,900

393,600

147,700

9,600

1893

71,500

671,000

37,300

342,100

6,100

1,800

1894

121,700

855,900

37,900

333,200

106,800

6,300

1895

102,600

660,300

10,200

342,300

185,600

2,000

1896

60,900

473,800

33,700

361,400

6,200

560

1897

26,600

426,400

9,300

444,000

39,600

2,100

1898

37,600

317,300

Qrs. of

8 bush.

48,700

424,100

4,800

8,300

1899

14,000

426,600

90,000

370,900

12,000

7,000

1900

..

194,000

Turkey in Asia and Syria. — The production of cereals in this part of the Sultan's empire has shrunk into insignificance. Small quantities of barley, wheat, beans, and dari are occasionally shipped ; but the only port which

maintains any real importance is Smyrna, whence a considerable quantity of excellent barley is shipped annually, mostly finding its way to the United Kingdom. In 1900 the exports amounted to 974,000 qrs. of barley, 58,000 qrs. of beans, 26,000 qrs. durra ; or of aU cereals, expressed in tons, to 196,756, or 110,000 tons in excess of 1899 ; the increase being due to the exceptionally fine barley crop. The United Kingdom received 188,626 tons, leaving 8130 tons only for all other countries.

Cyprus (population, 227,900; census 1899). — The agricultural and trade statistics are very complete and satisfactory. In the following tabular statements will be found details of exports and imports from 1890 to 1899 :—

Production.

{From, Board of Trade Returns.)

Year.

Wheat.

Barley.

Oats.

8 bush.

8 bush.

8 bush.

1890

233,900

331,900

14,400

1891

267,900

309,000

16,100

1892

258,800

245,400

23,300

1893

173,200

233,700

24,100

1894

291,900

299,600

35,500

1895

295,700

229,100

49,900

1896

222,200

211,800

52,700

1897

260,900

231,300

42,700

1898

166,000

207,700

31,300

1899

269 000

305 000

33,800

ExPOKTS.

{From Statistical Alstractfor the several Oolonial and oth^

Possessions of tlie United Kingdom.)

Year.

Wheat.

Barley.

Oats.

8 bush.

8 bush.

8 bush.

-1890

64,600

115,200

5,800

“1891

50,000

119,000

8,200

‘1892

17,500

41,900

9,400

■■1893

13,500

72,700

13,200

‘1894

50,600

56,800

14,100

‘1895

38,200

65,300

23,100

‘1896

16,200

55,200

14,300

‘1897

6,600

31,300

10,800

‘1898

26,250

97,100

9,700

‘1899

3,000

46,800

7,700

■■ Year ended 31st March.

‘ Year ended 31st December.

The imports of wheat into Cyprus are unimportant, but a small amount of flour and a moderate quantity of rice are landed annually. In 1898, 16,800 owt., and in 1899, 11,800 cwt. of rioe were imported.

Malta (population, 181,648; estimated 1899). —The

area under wheat in 1899 was 8308 acres, and under barley 2771 acres. The yield of wheat was 153,416 bushels, or 18 bushels per acre; and of barley 70,000 bushels, or 24 bushels per acre. The production in 1899 was 19,000 quarters of wheat and 8700 quarters of barley. The imports consist chiefly of flour from France and Italy, and certain quantities from the United Kingdom.

Persia (population estimated at 8,000,000). — This kingdom is credited with raising 2,000,000 quarters of wheat and barley, but the flgures are untrustworthy. Occasionally the United Kingdom gets a few thousand quarters of wheat, and somewhat larger quantities of barley ; but often enough the exportation of foodstuffs is prohibited. The ports from which they are shipped are Bushire, Lingah, Bander Abbdsi, Bahrein, Arab coast ports, and Mohammerah.

Japan (population, 46,540,744, including Formosa and the Pescadores; census, December 1898). — Agricultural and trade statistics are very complete for this kingdom, and go back for a number of years. The figures for

the 1898 crops are as follows : —

Acreage.

Production.

Yield,

per Acre.

Wheat

Barley

Eye .

1,140,740

1,616,255

1,669,342

Bushels.

20,742,164

44,211,258

36,538,361

Bushels.

18

27

22

The production and exports and imports since 1890 are shown

in the following three statements : —

Pkoduction.

Year.

Wheat.

Eye.

Barley.

Beans and

Pease.

Potatoes.

Rice.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qis. 8 bmsh.

Tons,2240.

Cwt. 112 IB.

1890

1,503,000

1,768,000

3,354,000

,,

106,733,000

1891

2,169,000

3,963,000

6,031,000

..

94,546,000

1892

1,883,000

3,766,000

4,221,000

.,

I49V1OO

102,619,000

1893

2,014,000

3,810,000

4,462,000

92,260,000

1894

2,429,000

4,467,00

5,223,000

2,200,000

183,900

102,446,000

1896

2,434,000

4,297,000

6,228,000

2,320,000

163,400

99,804,000

1896

2,175,600

3,629,000

4,808,000

1,859,000

162,900

89,337,000

1897

2,334,600

3,776,000

4,917,000

1,922,000

216,300

81,930,000

1898

2,592,000

4,667,000

6,626,000

116,102,000

1899

2,500,000

4,100,000

6,260,000

•-

97,600,000

N.B. — The sweet potato crop is ten or fifteen times as big as the

other potato crop.

Exports.

{From ike Returns of Foreign Trade.)

Year.

Wheat.

Barley.

Flour.

Pulse.

Eice.

Potatoes:

Qrs. 480.

Qr. 400.

Sacks,

280 lb.

Qrs. 480.

Cwt. 112 lb.

Tons,

2240 B).

1890

18,305

64

6,272

236

466,800

2169

1891

8,241

77

3,000

188

2,374,400

2408

1892

186

63

11,738

703

1,446,400

2400

1893

6,767

659

4,010

1160

1,887,183

2624

1894

6,851

1724

16,720

1106

1,811,847

1771

1895

8,000,000

1896

1,258

9200

15,450

5400

3,070,000

435″

1897

502

2490

14,365

3800

2,039,000

405«

1898

258

160

15,761

4060

1,691,000

880′

” Exported by Japanese merchants alone,

Jf.B.—ln the years 1889, 1892, 1893, and 1894 there were considerable quantities of rye exported.

Imports.

{From the Returns of Foreign Trade.)

Tear.

Wheat.

Barley.

Qrs. 400.

Flour.

Pulse.

Eice.

Qrs. 480.

Sacks,

280 lb.

Qrs. 480.

Cwt 112 lb.

1890

10,213

13,897

31,631

250,040

5,460,764

1891

7,749

27,717

42,870

297,000

1,994,000

1892

6,931

6,146

36,613

429,000

980,000

1893

313

1,468

42,600

466,000

1,662,000

1894

6,146

237

73,634

882,600

8,926,000

1,031

61,600

800,000

1,860,000

1896

10,700

,.

113,900

435,800

2,200,000

44,300

.,

111,200

651,000

7,480,000

1893

13,300

184,500

666,800

18,850,000

The imports of oats and maize are unimportant.

GRAIN TRADE

71

On the average for the ten years ending 1898 the consumption of wheat for all purposes amounted to only 0‘4 of a bushel — rice and sweet potatoes forming the chief food crops of Japan.

United Kingdom (population, 41,454,578; census 1901).

— Eegularofficial estimates of crop production in theUnited Kingdom were first made in 1884. The figures relating to the production of wheat between the years 1884 and 1900 inclusive are from the agricultural produce statistics of Great Britain, with additions from the returns of the registrar-general for Ireland. The statistics for years prior to 1884 are from a statement published by the late Sir J. B. Lawes. The returns of acreage are available for a much longer period from the Board of Agriculture. The trade returns are taken from the statistical abstracts (or

the annual statements) for each year.

The wheat crop of the United Kingdom becomes annually smaller, and consequently of less importance as a factor in the international grain trade. The decline in production is due to the abandonment of wheat growing, and not to a falling off in the productiveness of the soil or to inferior farming. The yield per acre for the whole kingdom during the years 1896-1900 was as follows : —

Bushels per Acre.

1900.

1S99. 1 1898.

1897. 1896. 1

28-61

32-76

34-75

29-07

33-63

Between 1886 and 1899 the respective proportions of native and foreign bread-stuffs consumed for all purposes in Great Britain were as follows, shown in three periods of five years each : —

This gives an average for the quinquennium of 31 -79 compared with 29 -63 bushels per acre for the first five years of the period when official returns were first collected (1884-88). The rise in the acreage yield is probably due to the fact that the less fertile wheat land is being abandoned, and only the better class kept under cultivation. The only other countries, making current returns, which come near the British average are New Zealand, with about an equal return ; Belgium, 28-10; Holland, 28-08; Germany, 24-17; and Sweden, 24-03. All other countries return a yield of less than 20 bushels. Also in the cultivation of barley and oats no other nation raising these cereals on a large scale comes anywhere near the British average yield of 34 bushels of the former and 40 bushels of the latter per acre.

The consumption of wheat per head of the population for all purposes during the period 1891-1900 averaged 5 bushels and 54 lb (or including what has been used for seeding, 6 bushels 2 lb). Taken on a five years' basis, the consumption works out at 5 bushels 51 ft per head ; so that it would appear as if prosperous trade had the effect of lessening the consumption of bread-stuffs.

Production.

(From the AgruyuUural Heturns atid other Sources.)

Year.

Wheat.

Qrs.

8 bush.

Potatoes.

Barley.

Oats.

Beans.

Peas.

Ions 2240.

Qrs.

3 bush.

Qrs.

3 bush.

Qrs.

8 bush.

Qrs.

8 bush.

1870

14,105,464

1871

11,466,644

1872

11,481,438

1873

10,290,417

.,

1874

13,972,926

1875

10,018,418

1876

9,732,984

1877

10,970,633

1878

12,647,213

..

1879

6,906,020

•-

1880

9,364,464

..

1881

8,880,198

1882

10,116,225

..

..

1883

9,477,822

1884

10,258,370

6,783,655

9,989,639

20,175,468

1,467,283

710,037

1885

9,950,000

6,374,242

10,715,000

20,006,600

1,140,000

542,000

1886

7,918,480

5,836,487

9,786,200

21,172,000

1,311,000

734,000

1887

9,628,100

7,134,296

8,743,600

18,848,000

1,069,000

703,000

1388

9,311,600

6,682,331

9,318,000

19,747,000

1,230,000

732,000

1889

9,485,400

6,435,337

9,337,900

20,519,000

1,171,000

740,000

1890

9,499,000

4,622,214

10,099,200

21,412,000

1,432,000

789,000

1891

9,342,800

6,090,047

9,944,000

20,809,000

1,337,000

722,000

1892

7,696,900

6,633,964

9,617,000

21,022,000

381,000

628,000

1893

6,364,000

6,640,693

8,218,000

21,073,000

608,000

594,000

1894

7,638,000

4,662,147

9,825,000

23,867,000

900,000

778,000

1895

4,785,600

7,064,634

9,378,600

21,809,000

703,000

591,000

1896

7,281,000

6,263,235

9,728,000

20,357,000

811,000

622,000

1897

7,037,000

4,106,609

9,077,000

20,444,000

831,000

656,000

1893

9,360,600

6,224,780

9,341,000

21,572,000

908,000

607,000

1899

8,407,600

6,837,387

9,315,700

20,936,600

945,000

553,300

1900

6,790,000

4,576,312

8,570,000

20,640,000

933,000

609,000

1901

6,700,000

8,460,000

20,250,000

English

Wlieat.

Foreign

Wheat.

Foreign Flour.

Total Native

and Foreign.

1885-89

lfe90-94

1895-99

Qrs.

9,260,000

8,840,000

7,360,000

Qrs.

13,100,000

15,200,000

16,200,000

As qrs. Wheat

5,400,000

6,200,000

6,800,000

Qrs.

27,760,000

30,240,000

30,360,000

N.B. — Allowance has not been made for re-exports, which amount to 300,000 quarters annually.

It is worthy of note that the proportion which the flour imports bear to the total quantity of wheat used is growing larger, the percentage in the first period being 24 per cent., in the second 25 per cent., and in the third 29 per cent. Divided up among the population, it appears that the per caput consumption of the manufactured article imported from abroad averaged 1 ‘17 bushels in 1885-89 ; 1-29 bushels in 1890-94 ; and 1-35 bushels in 1895-99.

This is a matter for disappointment to the British millers, who seemed for a while to have stemmed the imports of foreign-made flour ; for after the great importation of the year 1891 the quantity declined steadily, until in 1897 it had fallen off to 16 per cent. ; but only to rise again in 1898 and 1899 to a higher level than ever before : —

Imports.

{From the Stcdistical Abstract.)

From 1870 to 1883 inclusive are nnoificial estimates.

Year.

Wheat.

Beans.

Barley.

Oats.

Maize.

Flour. Potatoes.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Qrs. 480.

Slis. 280. Ions.

1870

7,210,286

351,362

697,840

2,020,863

3,990,232

3,909,916

1,921,663

lj691,176

38,692

1871

9,190,964

2,399,323

1,021,016

3,925,833

42,391

1872

9,829,802

688,080

4,213,038

4,260,693

6,724,289

1,765,254

299,371

1873

10,234,000

662,460

2,687,480

4,887,100

4,392,120

2,484,960

376,830

1874

9,689,782

660,922

3,173,910

4,196,493

4,123,612

2,494,417

199,333

1875

12,104,62C

807,047

3,093,863

4,681,642

4,768,978

2,454,433

234,806

1876

10,372,75a

1,075,096

2,736,424

4,130,376

9,324,786

2,333,923

801,196

1877

12,662,965

1,070,847

3,628,667

4,766,328

7,111,490

2,960,921

898,242

1878

Ll,644,84«

436,842

3,963,937

4,706,366

9,723,911

3,131,231

437,291

1879

13,904,762

640,343

3,232,967

4,963,243

8,434,621

4,291,300

467,868

1880

12,894,448

601,331

3,277,481

6,094,069

8,686,771

4,223,332

487,725

1881

13,334,617

485,980

2,745,664

3,808,632

7,812,197

4,642,961

201,733

1882

14,989,508

487,849

4,351,228

5,021,406

4,264,337

5,222,961

149,686

1883

14,966,680

837,076

4,609,164

6,676,988

7,406,791

6,631,724

267,475

1884

11,038,103

321,466

3,626,840

4,760,687

6,782,108

6,038,120

122,208

1885

14,349,734

820,863

4,302,480

4,810,64!

7,366,238

6,333,137

114,996

1886

11,068,354

666,234

3,839,808

4,968,248

7,286,031

6,876,824

186,394

1887

13,020,587

680,767

3,987,200

6,328,462

7,272,376

7,225,293

138,167

1888

13,360,984

703,261

5,965,400

6,915,616

6,919,70(

6,764,176

119,190

1889

13,662,106

835,235

4,872,280

6,891,261

8,444,876

5,368,832

93,221

1890

14,110,642

730,480

4,669,840

4,688,963

10,168,827

6,309,334

97,005

1891

15,473,024

366,896

4,930,396

6,115,9*

6,269,312

6,689,201

169,641

1892

15,143,753

1,033,651

3,997,644

5:769,987

8,266,618

8,842,403

160i416

1893

16,274,463

920,963

6,396,460

6,141,31(

7,677,260

8,163,267

141,406

1894

16,362,787

1,227,308

8,747,692

6,613, 64(

8,261,843

7,653,842

185,190

1896

19,074,98E

963,792

6,609,320

6,720,966

7,920,348

7,347,364

187,907

1896

16,339,896

724,031

6,293,650

6,479,32:

12,080,166

8,628,080

112,231

1897

14,639,373

662,676

6,308,43«

6,937,772

12,549,922

7,472,264

196,000

1898

16,219,848

635,108

6,847,960

5,739,226

13,839,601

8,406,840

837,600

1899

16,548,824

438,018

4,813,004

6,767,179

14,629,916

9,178,280

257,890

1900

16,009,400

400,804

4,775,400

7,408,400

12,635,100

8,616,400

446,600

1901

16,267,000

436,700

6,124,000

8,280,000

11,986,000

9,029,000

363,800

EXPOETS.

{From the Statistical Aistraet.)

(Including re-exports.)

Year.

Wheat.

Maize.

Barley.

Oats.

Flour.

Potatoes.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304

Sks.280.

Tons 2240.

1870

,

22,428

464,288

6,300

1871

768,460

12,054

32,228

456,071

262,916

33

1872

124,356

6,300

3,780

36,760

15,172

64

1873

263,249

27,590

11,692

19,303

18,484

110

1874

80,416

22,967

91,924

54,800

38,084

40

1875

22,631

5,903

21,140

67,857

10,736

1,188

1876

107,527

66,497

6,944

114,273

10,924

294

1877

48,617

83,797

16,828

32,627

11,600

627

1878

163,366

71,176

25,228

66,963

15,760

876

1879

162,477

174,987

16,156

40,360

26,308

521

1880

157,549

167,856

4,452

103,220

fA^

955

1881

294,864

38,143

22,708

276,097

63,212

1,345

1882

312,788

29,856

66,888

179,515

103,160

30,880

1883

148,981

192,311

14,224

50,063

fl0,216

87,600

1884

28‘6,908

89,040

23,866

84,062

96,120

63,600

1835

182,266

31,752

12,600

63,914

90,656

^?‘3;!2

1386

279,916

68,756

16,436

78,293

112,392

17,060

1887

169,411

17,164

19,712

36,679

130,680

2,438

1888

106,512

12,012

17,192

58,303

151,368

2,610

1889

109,627

77,695

17,500

62,963

154,972

949

72

GRAIN TRADE

Exports — continued.

Year.

Wheat.

Maize.

Barley.

Oats.

Flour.

Potatoes.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 480.

Sks. 280.

Tons 2240.

1890

110,463

110,817

18,984

46,405

161,266

1,118

1891

162,173

66,413

18,480

42,729

168,708

1,996

1892

208,320

62,969

19,644

14,976

171,320

30,887

1893

162,722

17,087

9,800

94,498

183,636

87,622

66,800

1894

86,600

28,000

32,200

102,000

181,000

1895

70,700

14,000

21,400

91,700

191,000

13,800

1896

68,600

142,800

63,200

63,800

280,000

19,000

1897

70,700

172,200

43,800

92,400

240,000

24,000

1898

155,400

241,600

43,600

87,000

322,000

11,900

1899

169,600

178,000

22,800

34,000

367,400

19,800

1900

66,800

123,900

18,900

44,900

448,500

13,900

A reference to the annual statement showing the exportation of grain and flour affords little cause for gratification. There is a steady but small increase in the exports of flour, but they do not yet amount to 5 per cent, of the imports.

The chief ports which handle foreign grain are Liverpool, London, Hull, and Bristol, followed at a considerable distance by Manchester, Cardiff, Gloucester, Plymouth, Newcastle, and Southampton. Of wheat alone Liverpool is far ahead as an importer, followed by Hull and London. The five chief ports importing the largest proportion of each cereal and flour in 1900 were : —

IVheat, quarters.

Liverpool. Hull. London.

4,776,000 2,766,700 2,200,000

Flour, sacks.

London. Liverpool. Glasgow.

3,116,000 1,700,000 1,625,000

Maize, quarters.

Liverpool. London. Bristol.

3,699,000 1,587,000 987,000

Barley, quarters.

Bristol. London. Hull.

988,000 f 55, 000 654,000

Oats, quarters.

London. Hull. Bristol.

4,623,000 645,000 275,000

The favourite wheats imported into Great Britain are North American, Canadian, Argentine, Australian, and Indian ; Russian and Eumaniau sorts being less in demand as a general rule.

Annual Imports in Cereal Years of Different Sorts.

Bristol.

Leith.

909,000

645,000

Belfast.

Leith.

507,000

405,000

Glasgow.

954,000

Belfast.

825,000

Leith.

472,000

Liverpool.

346,000

Liverpool.

268,000

Leith.

231,000

1899-90.

1898-99.

1897-98.

1896-97.

Qrs.

Qrs.

Qrs.

Qrs.

North American

8,763,000

10,232,000

9,403,000

8,450,000

Argentine

3,905,000

1,630,000

898,000

390,000

Australian

930,000

464,000

16,000

Indian .

870,000

2,069,000

1,322,000

160,000

Russian ,

435,000

787,000

2,476,000

3,615,000

Rumanian

8,000

70,000

1,085,000

Other sorts

294,000

201,000

649,000

1,978,000

Total

15,197,000

15,391,000

14,834,000

15,668,000

France (population, 38,595,500; census 1901). — Prior to 1874 France raised the biggest crop of -wheat of any country in the world, but America has now taken the lead, followed by Eussia. There has been very little change in the area under wheat in France. For a long time it has stood at 17,000,000 acres, but of late years there has been a distinct improvement in the standard of farming, with the result that the yield per acre has been increased by 2 bushels. But it is still a long way below the British standard, being about one-third less. The acreage, production, and yield per acre, according to the harvest of 1899, were as follows : —

Acreage.

Total Crop.

Yield

per Acre.

Bushels.

Bushels.

“Wheat and Spelt

17,142,000

353,162,000

20‘6

Barley ....

1,991,000

43,905,000

22-1

Oats ....

9,730,000

262,078,000

27-0

Ryo ....

3,677,000

64,836,000

17-6

Maize , .

1,385,000

24,785,000

10-9

Potatoes ....

3,864,000

485,966,000

126-0

The production over a series of years of tha chief crops was

aa follows : —

Production.

{From the Bulletin du Ministire de V Agriculture.)

Year

Wheat.

Eye.

Barley

Oats.

Maize.

Potatoes.

Maslin.

Qrs. of

Qrs. of

Qrs. of

Qrs. of

Qrs. of

8 meas.

8 meas.

8 meas.

8 meas.

8 meas.

2240 lb.

Qrs. 480.

bush.

bush.

bush.

bush.

bush.

1886

39,128,200 7,987,70016,005,300

29,493,2003,113,100

11,020,937

1,782,600

1886

37,831,000 7,453,700|6,170,100

30,789,2003,072,800

11,002,009

1,761,600

1887

40,005,600 7,782,000

5,830,400

27,625,800 3,681,300

11,471,546

1,746,200

1888

34,438,000 7,266,800

5,448,700

29,295,800,3,403,200

10,1?8,196

1,478,400

1889

38,231,000 7,617,700

6,460,200

29,399,800,3,156,400

10,485,845

1,660,000

1890

41,217,100 7,961,600

5,916,800

32,288,000‘2,894,100

10,819,003

1,620,800

1891

26,669,000 7,072,600

8,765,70C

36,601,800 8,224,200

10,943,813

1,246,200

1892

38,845,0007,827,000

5,602,900

28,962,500 3,232,900

13,264,669

1,403,300

1893

34,722,800 7,608,400

4,221,000

21,678,000 3,167,800

11,604,662

1,268,300

1894

43,027,600 8,740,800

6,887,70C

81,682.800 3,331,900

12,663,692

1,512,200

1895

42,464,300 3,381,600

5,867,200

32,716,600 8,179,200

12,666,416

1,505,000

1896

42,637,600 8,140,600

6,600,600

31,726,300 8,697,200

12,686,432

1,419,000

1897

80,281,200 5,670,000

5,001,200

27,666 600 3,694,200

11,091,262

1,040,000

1898

45,618,400 7,808,400

6,696,400

88,816,200 2,855,200

11,596,617

1,444,000

1899

45,686,000 8,060,000

5,806,000

32,060,000 3,700,000

1,360,000

1900

40,696,00o‘6,930,000

4,963,000

30,461,000|

1,092,000

1901

38,000,0007,300,000

4,700,000 26,000,0001

Average yield crops of wheat in 1898, 1899, 1900, 20 bushels per acre.

The principal wheat port of the republic is Marseilles, for there trade is always active, even when such important ports as Havre and Dunkirk are quite idle. The first mentioned port is the great entrepot for the trade in bonded wheat milling, and all the year round, and every season alike, fifty or sixty thousand quarters per week are taken in at Marseilles and manufactured into ” paste,” or re-exported in the shape of flour to French colonial possessions. When there is a serious crop failure in France such ports as Havre and Dunkirk become of great importance, as it is in the north of France wheat is mainly produced : — ■

Exports (Commerce Special).

(From the Bulletin du Ministire de V Agriculture.)

Year.

Wheat.

Bye.

Barley.

Oats.

Maize, i Flour.

Potatoes.

Qrs.

Qrs.

Qrs.

Qrs.

Qrs.

Sacks,

Tons,

480.

480.

400.

304.

480.

2801b.

2240 lb.

1885

34,100

164,100

642,800

78,500

24,800

68,000

102,200

1886

13,000

121,700

669,100

66,600

37,700

60,200

99,400

1887

4,300

78,100

343,800

61,400

42,800

38,000

99,900

1888

6,200

9,300

211,600

17,100

27,200

72,500

114,100

1889

5,100

28,600

298,600

19,000

60,000

89,400

107,800

1890

2,700

35,100

293,300

21,800

38,300

67,300

118,600

1891

3,300

186,200

677,000

181,400

4,800

62,300

216,200

1892

3,800

376,700

669,500

586,900

2,100

100,400

178,800

1893

8,100

51,000

77,600

24,600

8,400

154,900

116,700

1894

14,600

4,600

123,600

13^800

8,700

198,800

137,000

1895

10,000

13,400

178,100

21,900

900

106,200

166,400

1896

6,100

41,800

113,100

22,600

3,800

141,800

128,600

1897

2,600

700

70,000

18,100

6,400

161,400

137,800

1898

8,000

2,300

189,600

17,700

26,400

320,300

151,600

1899

8,860

37,871

223,600

18,545

1,485

161,763

162,697

1900

7,000

26,800

224,600

20,300

6,400

311,000

198,000

1901

2,900

1,100

189,600

14,600

1,100

146,000

181,200

Imports (Commerce Special).

{Same authority as Exports.)

Year

Wheat

Eye.

Barley.

Oats.

Maize.

Flour.

Potatoes.

Qrs. 480.

Qrs.

4S0.

Qrs. 400.

Qrs. 304.

Qrs. 480.

Sacks

280 lb.

Tons,

2240 lb.

1885

2,966,300

11,700

688,000

1,641,500

1,472,800

234,900

17,700

1886

3,264,800

4,100

369,000

1,048,900

2,204,600

198,900

18,000

1SS7

4,119,000

85,000

766,300

1,539,700

1,687,000

160,100

53,900

1888

5,217,100

219,800

672,800

2,842,000

1,464,100

218,600

66,600

1889

5,245,700

98,300

643,000

1,486,400

2,396,600

241,600

63,700

1890

4,846,600

4,800

937,200

1,083,600

2,978,100

250,800

22,600

1891

9,002,400

1,400

764,200

710,200

289,000

684,200

22,700

1892

8,664,700

300

697,600

286,700

948,700

336,100

12,900

1893

4,607,600

8,700

1,368,700

2,232,000

1,262,800

126,200

25,500

1894

6,740,000

30,900

1,584,000

3,980,400

1,144,300

159,100

35,600

1896

2,070,400

900

791,000

1,916,000

625,200

274,600

35,400

1896

728,000

6,600

768,700

1,404,000

1,514,700

170,900

36,400

1897

2,400,000

220,000

1,063,500

1,430,000

1,821,400

144,700

44,700

1898

8,976,600

198,800

938,200

2,249,700

2,530,700

300,300

70,700

1899

600,281

1,421

748,049

849,627

2,401,489

166,306

46,368

1900

593,400

130

472,100

1,696,600

1,634,600

163,800

64,000

1901

727,000

7,600

1,043,400

8,032,700

1,353,800

147,800

61,200

N.B. — In addition to the above imports there is a substantial quantity taken surreptitiously. France also uses a good deal of foreign wheat in the manufacture in bond of flour, semolina, biscuits and bread for exportation. These figures are shown in the ” TaMeau OSnhal du Commerce, ”

The consumption of wheat for all purposes in France is very great, as will be seen from the following figures, wliich give tha average for the period 1883-

of five years each : —

GRAIN TRADE

9, divided into three equal peiiods

72

1885-89.

1890-94.

1895-99.

Total quarters .

Per caput bushels

41,900,000

8-9

43,400,000

9-0

-44,300,000

“9-1

” Probably an over-estimate.

The favourite foreign wheat in France is Russian, but when a crop failure occurs all sorts are imported — Australian and Califomian being well liked. North African wheat is nearly all taken in at Marseilles.

Germany (population, 56,345,014; census 1901). — The statistics of this country both for production and for exports and imports are from Statistisches Jalxrhach fiir das Deutsche Reich. There has been a rapid growth in thg production of wheat, proceeding from a higher acreage yield and an increasing area. The area under crops, the out-turn, and the yield per acre are shown in the following statement for the year 1900 : —

Acreage.

Total Crop.

Yield.

Bushels

per Acre.

Wheat .

5,061,000

17,645,000 qrs.

27-9

Eye.

14,708,000

39,277,000 „

21-3

Bariey .

4,125,000

16,550,000 „

32-1

Oats

10,183,000

61,466,000 „

40-3

Potatoes .

7,950,000

40,686,000 tons-

5‘1 tons

« 2-205 ».

German agriculture, it will be seen, is now of a high standard, closely resembling the British. During 1885-1900 the total production of wheat and rye in Germany increased 50 per cent. ; barley and oats, 30 per cent. ; and potatoes, 40 per cent. The chief breadstuff in the Fatherland is rye ; the per capita consumption for all purposes amounts to 5‘6 bushels, compared with 3‘1 bushels of

wheat, both taken on a five years’ average. Notwithstanding the increased productiveness of German farms, it is a fact that the importation of foreign grain is becoming yearly more important. During 1885-1900 wheat imports trebled ; barley also ; while at the same time enormous quantities of maize were imported. The following tabular statements show the production, imports, and exports : — „

Production.

Tear.

Wheat.

Eye.

Barley.

Oats.

Spelt.

Potatoes.

Qrs. 480.

Qr.s. 480.

Qrs. 400.

Qrs. 304.

Qrs. 480.

Tons, 2240.

1885

11,980,900

26,838,000

12,484,900

31,626,200

2,142,600

27,466,300

1836

12/249,200

27,987,600

12,884,200

35,238,100

2,027,700

24,640,000

1887

13,003,500

29,287,000

12,158,200

31,214,200

2,099,600

24,767,600

1S88

11,623,800

25,388,500

12,461,700

33,726,300

1,643,600

21,472,800

1839

10,897,700

24,636,300

10,685,700

30,433,100

1,376,600

26,071,800

1890

13,004,000

26,954,800

12,687,800

35,656,500

2,264,400

22,864,600

1891

10,720,100

21,970,400

13,877,300

38,311,200

1,713,700

18,187,200

1892

14,527,800

31,363,300

13,344,700

84,429,100

2,268,800

27,427,800

1893

13,757,700

34,270,400

10,732,700

23,528,400

1,943,700

31,632,300

1894 1 13,836,300

32,500,000

13,432,200

38,099,300

1,969,800

28,468,300

1895 i 12,896,700

30,298,000

13,294,800

38,117,300

1,720,600

31,150,900

1896 ! 18,818,500

33,222,500

12,774,300

36,053,600

1,483,000

28,692,600

1897 13,383,000

31,845,300

12,359,000

36,133,400

1,692,800

29,206,100

1898 14,745,000

34,601,000

13,858,800

41,949,600

1,958,700

31,166,000

1899 17,698,300

39,908,600

16,411,300

49,899,500

2,190,000

38,486,200

1900

17,645,000

39,277,000

16,550,000

61,466,000

2,142,000

39,961,000

1901

11,600,000

37,500,000

18,200,000

62,400,000

1,976,000

47,000,000

Exports of Native Grown and Dutt Paid Foreign Grain.

Tear.

Wheat.

Eye.

Barley.

Oats.

Maize.

Flour.”

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Qrs. 480.

Sacks, 280.

1885

64,700

18,600

136,400

93,000

1,016,100

1886

38,000

14,600

320,000

119,600

1,049,100

1887

13,000

14,400

114,400

60,200

1,040,800

18S8

5,100

10,400

128,100

13,100

1,190,000

1889

3,500

2,800

122,000

2,300

300

1,084,000

1890

1,000

600

36,300

3,300

300

916,000

1891

1,600

600

21,600

2,700

200

820,400

1892

1,100

4,100

62,700

3,400

400

828,300

1S93

1,S00

1,200

45,400

. 2,000

‘166,000

300

1,154,400

1894

363,800

228,400

107,000

500

1,483,300

1895

321,200

165,300

270,000

873,000

300

1,312,800

, 1896

345,500

176,100

116,600

220,500

300

1,180,800

1897

737,300

489,000

102,100

155,000

£00

1,277,300

1898

619,200

696,800

69,800

345,100

200

1,082,200

1899

904,000

666,700

77,540

495,900

133

260,600

1900

1,355,100

349,200

177,000

767.400

196

252,000

1901

426,400

422,900

207,000

1,060,200

300

227,800

Prior to iay9 rye-meal and flour were counted in with the flour

exports.

Imports (Commerce Special).

Year.

Wheat.

Eye.

Barley.

Oats.

Maize.

Flour.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Qrs. 480.

Sacks,

1885

2,629,500

3,635,600

2,414,700

1,582,600

901,700

218,000

1,255,300

2,596,600

1,960,900

688,000

778,000

166,800

1S87

2,513,800

2,933,000

2,819,800

1,216,000

733,200

192,600

1,560,500

2,998,800

2,461,900

1,316,400

433,000

104,100

2,374,000

4,898,000

3,691,200

1,872,300

1,445,000

109,600

1890

3,089,500

4,041,700

4,053,300

1,361,800

2,581,800

112,900

3,870,600

4,005,600

869,900

1,875,700

110,000

2,876,500

3,215,400

637,000

3,296,000

209,600

1893

3,231,300

1,030,000

4,695,200

1,763,200

3,496,000

211,800

1894

5,300,200

3,002,600

6,014,700

2,921,200

2,678,800

242,200

6,146,600

4,630,200

5,121,300

1,732,400

1,487,500

266,200

1896

7,591,000

4,734,000

6,667,300

3,686,400

3,772,800

382,200

3,936,900

6,862,100

3,976,900

5,816,600

303,100

1898

6,786,800

4,198,700

6,356,400

3,310,600

7,260,200

237,700

2,674,600

6,088,100

1,878,800

7,472,200

331,000

1900

5,943,600

4,103,100

4,307,300

3,354,600

6,357,900

266,900

1901

9,803,100

3,967,000

4,969,900

2,993,700

5,481,600

303,000

The chief grain port of Germany is Hamburg, followed at a long interval by Bremen and Stettin. In addition to the imports of foreign grain through these seaports, there is a very large trade carried on at Mannheim — the Rotterdam imports finding their way into Germany by the Rhine and other rivers and canals. German millers are beginning to take to all kinds of foreign wheat, but the most favoured sorts are Russian and Rumanian, red American following next, and sharing third place with Argentine.

Belgium (population, 6,815,504; census 1900). — The acreage and yield are taken from the official annual publi-cation, Annuaire Statistique de la Belgique. The import figures are from the Tableau General du Corrvmerce, &c.

The following statement shows the acreage for 1895, but the crops for 1897 : —

Acreage.

Total Crop.

Yield per

Acre.

Bushels.

Bushels.

Wheat and Spelt .

528.000

15,300,000 ■

‘29-0

Eye . . .

699,939

19,770,400

28-2

Barley

100,000

3,513,000

35-1

Oats

614,000

28,676,000

46-7

Potatoes .

457,187

108,566,000

238-0

Owing to the peculiar method adopted in arriving at the foregoing results, we are inclined to doubt the accuracy of the figures as to the yield per acre. The probability is the acreage was larger upon which the crop of 1897 was grown, and the average yield per acre somewhat less. The total consumption of wheat and rye in Belgium per annum is as follows : — Wheat, 7-1 ; rye, 3-0 bushels per caput.

Production.

{From the Annuaire Slaiistique de la Belgique.)

Year.

Wheat.

Eye.

Barley.

Oats.

Spelt.

Potatoes.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Qrs. 480.

Tone.

1890

2,695,122

2,395,512

534,559

3,734,882

684,888

2,714,637

1891

2,050,692

1,679,169

429,719

3,930,418

498,034

2,439,751

1892

2,348,563

2,695,190

480,639

3,279,493

648,678

4,321,347

1893

2,096,221

2,325,842

403,050

2,510,146

505,447

4,041,733

1894

2,134,161

2,627,218

438,548

3,440,723

630,382

2,923,477

1895

2,268,876

2,517,649

450,495

3,651,696

620,520

4,394,777

1896

2,286,763

2,636,972

463,273

3,183,441

721,609

2,914,438

1897

1,449,667

2,471,304

439,214

3,584,635

441,628

2,938,904

“1898

1,650,000

2,450,000

500,000

3,900,000

600,000

4,400,000

-1899

1,500,000

2,260,000

460,000

3,200,000

600,000

..

“1900

1,600,000

2,375,000

375,000

3,375,000

»1901

1,500,000

2,700,000

, 380,000

3,000,000

” Commercial estimate.

Exports.

(From the Tableau Gineral du Commerce avee les Pays Mr angers.)

Year.

Wheat.

Eye.

Barley.

Maize, Oats,

Buckwheat.

Maize.

Flour and

Meal.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Cwt

Qrs.

Sacks, 280.

1890

1,025,500

266,400

‘198,800

3,641,300

732,000

1891

»2,108,212

340,114

‘248,391

2,136,300

..

870,000

1892

“1,726,000

313,200

‘175,600

2,624,600

..

732,000

1893

•“1,602,300

231,200

‘388,400

2,610,000

147,700

1894

■“1,496,500

134,600

‘306,700

2,303,000

Oats,

Qrs. 304.

176,700

1895

““1,502,898

85,435

‘213,933

80,482

308,810

175,208

1896

““1,311,188

117,083

‘276,661

17,110

657,624

91,766

1897

“1,316,621

174,317

‘409,337

6,626

667,045

128,544

1898

“1,614,876

277,140

‘400,421

7,025

649,805

266,498

1899

■“1,649,077

140,304

‘294,107

6,488

702,203

156,728

1900

■■1,103,000

101,200

‘214,800

3,830

706,800

136,400

1901

“1,646,000

134,200

‘193,700

9,100

639,700

146,400

” Including spelt.

‘ Including winter barley.

S. V. — lo

74

GRAIN TRADE

Imports.

{From the Tableau GSniral du Commerce avec les Pays Etrangers.)

Year.

Wheat,

iucluding

Spelt.

Eye.

Barley.

Maize, Oats,

Buckwheat

Maize.

Flour and

Meal.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Cwt.

Qrs. 480.

Sack8,280.

1890

4,119,300

418,700

1,207,900

7,888,700

749,092

1891

6,516,755

491,744

1,166,818

5,028,900

,,

786,000

1892

4,740,800

172,600

1,003,400

5,191,000

670,000

1893

4,750,000

135,700

1.284,400

6,897,000

457,200

1894

6,674,200

141,700

1,469,600

6,233,000

Oats,

Qrs. 304.

••

571,800

1895

6,244,408

164,905

1,341,169

701,684

948,414

632,758

1898

6,082,814

315,366

1,648,602

484,662

1,621,509

114,196

1897

6,052,189

380,815

1,623,612

495,994

1,812,764

48,960

1898

6,874,940

386,317

1,768,826

207,429

2,110,254

70,926

1899

6,301,885

131,509

1,706,782

333,899

2,387,128

189,829

1900

6,069,500

225,400

1,328,800

625,100

2,318,300

183,000

1901

6,858,600

296,000

1,308,000

327,700

1,743,700

163,000

Antwerp is the one port of Belgium monopolizing the grain trade — Ghent alone getting a little of the oats imported from Libau and Riga. Considerable quantities of grain are exported to the north of France and Germany. Frequently Antwerp has taken the lead of all the wheat-importing centres of the world, receiving

over 6,000,000 quarters of wheat in a twelvemonth, as in 1899, 1895, and 1891.

Holland (population, 5,179,138 ; estimate 1900). — The production of cereals in tlie Netherlands is on a very small scale, and the agricultural statistics are not very closely up to date. Figures for 1897 : —

	Acreage.	Total Crop.	Yield per Acre.
“Wheat and Spelt .	154,000	527,000	90,000
Rye	331,000	373,000	
Barley ….			
Oats			
Potatoes			

Bushels.

4,174,000

11,561,000

3,621,000

15,625,000

75,517,000

Bushels.

27-1

21-9

40-2

47-2

202-0

The consumption of wheat and rye for all purposes during the five years ending 1900 averaged about 4 j bushels of the former and 4i bushels of the latter ; in the five years 1885-89 the quantities averaged 3| bushels of wheat and 4J bushels of rye.

Pkodtjction.

{From Jaareijfers voor Tiet Koningrijlc der Nederlanden.)

Tear.

Wheat

Eye.

Barley.

Oats.

Spelt

Potatoes.

Qrs.

Qrs.

Qrs.

Qrs.

Qrs.

Measured

8 bush.

8 bush.

8 bush.

8 bush.

8 bush.

bushels.

1890

659,000

1,350,000

604,000

1,600,000

3,000

62,087,700

1891

426,000

1,006,000

643,000

2,262,000

700

44,002,800

1892

654,000

1,511,000

606,000

l,S23,e00

1,400

91,205,600

1893

604,000

1,604,000

580,000

1,498,000

2,100

86,838,800

1894

606,000

1,497,000

440,000

1,835,000

2,100

57,359,500

1896

520,000

1,566,000

621,000

1,886,000

2,500

72,341,600

1896

613,000

1,660,000

654,000

1,864,000

2,600

81,312,000

1897

521,000

1,450,000

466,000

1,959,000

2,100

76,517,800

1898″

760,000

1,376,000

625,000

2,125,000

..

1899»

700,000

1,438,000

600,000

2,000,000

..

1900a

700,000

1,876,000

437,000

2,000,000

,.

1901″

600,000

1,300,000

460,000

2,060,080

■■

a Estimated.

The average yield per acre of wheat in 1898-1900 was 287

bushels.

Exports.

(From Koniiigrijk der Nederlanden Statistiek.)

Year.

Wheat

Eye.

Barley.

Oats.

Maize.

Wheaten

Flour.

Qrs.

8 bush.

Qrs.

8 bush.

Qrs.

8 bush.

Qrs.

8 bush.

Qrs. 480.

Sacks, 280.

1890

1,481,800

1,167,000

730,100

1,010,800

132,800

181,100

1891

1,918,800

1,039,800

630,400

669,600

76,800

180,700

1892

1,966,000

611,600

601,700

404,000

313,600

127,700

1893

2,117,800

674,200

982,200

1,111,800

636,800

123,300

1894

1,969,000

948,000

1,247,600

1,704,100

240,000

126,800

1895

8,005,600

1,064,600

980,800

1,368,200

183,100

73,000

1896

2,973,000

1,413,600

1,262,700

2,182,400

646,400

76,700

1897

4,016,600

1,429,000

1,810,800

1,846,000

690,200

1898

6,497,600

1,648,200

1,848,600

2,037,800

1,828,600

119,300

1899

6,780,000

1,155,200

1,710,100

2,048,400

1,964,900

128,400

1900

4,883,800

1,618,800

1,265,800

2,631,800

1,401,800

168,800

1901

6,804,000

1,840,000

1,889,000

2,836,000

1,027,000 1 103,000 1

Imports.

Year.

Wheat

Eye.

Barley.

Oats.

Maize.

Wheaten

Flour.

Sacks,

280 tb.

Qrs.

8 bush.

Qrs.

8 bush.

Qrs.

8 bush.

Qrs.

8 bush.

Qrs. 430.

1890

2,494,900

1,906,200

1,280,700

1,117,000

957,800

697,800

1891

3,417,300

2,144,800

1,221,000

722,600

858,400

1892

3,032,800

884,400

1,043,000

246,200

1,278,000

817,700

1893

3,039,600

1,321,100

1,719,300

1,167,700

1,465,600

854,700

1894

3,732,800

2,201,400

2,442,300

1,768,300

945,800

853,900

1895

4,397,400

2,225,000

1,919,700

1,660,900

896,800

738,600

1896

4,760,400

2,478,000

1,713,400

2,627,800

2,034,400

994,300

1897

6,101,000

2,326,300

1,809,000

2,122,400

2,361,700

904,600

1898

6,285,400

2,262,100

1,886,400

2,263,100

3,647,900

1,033,000

1899

6,464,800

1,896,600

2,094,000

2,343,300

3,846,600

1,366,600

1900

6,873,400

2,349,300

1,694,700

2,864,300

3,165,300

1,207,900

1901

8,091,800

2,432,700

1,891,500

2,462,000

2,464,600

1,369,300

The great wheat port of Holland is Rotterdam, through which and its extensive ramifications of rivers and canals large areas of northern Europe are fed with imported grain. This port, along with Liverpool and Antwerp, disputes the claim for first place as the chief wheat-importing port of the world. Holland, as will be seen from a glance at the foregoing table, re-exported about 12,000,000 quarters of grain out of the 16,000,000 quarters which she imported in 1899. Large quantities of all sorts of grain go up the Maas to the Rhine, to supply Germany and Switzerland.

/ta/y (population, 32,449,754; census 1901). — The statistics as to production are taken from the Annuario Statistico Italiano, and those for the trade in foreign grain from the Movimente Comnierciale del Regno St Italic.

The cidtivation of wheat, in virtue of a high protective duty, is maintained, and indeed slightly enlarged, but not

in proportion to the increase in the population, neither does the importation increase, so that it would appear as if the standard of living was not being raised as it is in most other countries — Germany in particular. The only article which Italy is taking more freely now than in, say, 1890 is maize, of which also more is being produced.

The total amount of wheat and maize used annually in the two periods 1885-89 and 1895-99 was as follows : —

Years.

1885-89

1895-99

Wheat

Qrs.

17,600,000

18,100,000

Maize.

Qrs.

9,300,000

10,000,000

Consumption per Head

of Population.

Wheat

Bushels.

4-6

4-5

Maize.

Bushels.

2-4

2-5

N.B. — A good deal of pulse is consumed in Italy.

The following table shows the present acreage, crop, and yield

per acre : —

Acreage.

Total Crop.

Yield per

Acre.

“Wheat

“Maize .

‘Oats .

“Barley

‘Pulse .

11,315,000

4,831,000

1,171,000

761,000

2,097,000

Bushels.

140,752,000

77,440,000

18,601,000

9,744,000

11,220,000

Bushels.

12-4

16-0

15-9

12-8

5-3

“Year 1896.

‘ Year 1895.

The standard of farming must be very low in Italy, judging from

the poor yields per acre : —

Prodtjction.

{From, Annuario Statistico Italiano.)

Y’ear

Wheat

Rye.

Barley.

Oats.

Maize. | Potatoes.

Qrs.

Qrs.

Qrs.

Qrs.

Qrs. 480.

Tons,

8 bush.

8 bush.

8 bush.

8 bush.

2240 lb.

1890

15,922,000

630,000

1,323,000

2,303,000

9,081,000

739,000

1891

17,137,000

645,000

1,133,000

2,094,000

8,031,000

1892

14,014,000

615,000

961,000

2,088,000

8,738,000

754,000

1893

16,881,000

645,000

959,000

2,210,000

10,026,000

796,000

1894

14,729,000

622,000

1,009,000

2,062,000

7,220,000

611,000

1895

14,265,000

486,000

901,000

2,201,000

8,638,000

690,000

1896

17,594,000

500,000

1,218,000

2,450,000

9,680,000

1897

10,629,000

500,000

962,000

2,375,000

8,004,000

1898

16,689,000

600,000

1,100,000

2,250,000

9,677,000

1899

16,758,000

837,600

1,000,000

2,000,000

10,768,000

..

1900

14,600,000

400,000

812,000

2.000,000

10,600,000

..

“1901

15,700,000

400,000

1,000,000

1,900,000

10,700,000

••

” Unofficial.

GRAIN

ExPOKTS.

{From, Movimente CommeroiaU del Segno St Italic.)

TRADE

75

Coarse

Grains, in-

Year.

Wheat.

cluding

Barley,

Maize,

and Rye,

Barley.

Oats.

Maize.

Flour.

Qrs.

8 bush.

Qrs. 480.

Qrs. 400.

Qrs.

8 bush.

Qrs. 480.

Sacks,

280 lb.

1890

2000

34,800

1700

42,000

2,600

1891

8200

12,200

1000

66,900

4,700

1892

2300

600

200

33,800

1,900

1893

3100

4600»

11,600

4100

60,000

2,300

1894

1700

8800«

66,600

8100

112,000

4,400

1895

1300

llOO”

32,800

900

62,000

76,900

1896

1600

800′

6,300

1100

47,800

63,700

1897

2000

800«

86,000

3000

46,600

71,100

1898

1400

400«

6,600

1800

86,800

68,100

1899

1200

800

800

80,100

91,300

1900

1400

1,900

1000

66,800

80,400

1901

1300

1,100

800

36,200

69,600

« Eye, Qrs. 480.

Impokts.

{Frmn Movimente Commerciale del Regno St Jtalie.)

Tear.

Wheat

Eye.

Barley.

Oats.

Maize.

Flour.

Qrs.

8 bush.

Qrs. 480.

Qrs. 400.

Qrs. 304.

Qrs. 480.

Sacks,

2801b.

1890

8,010,000

, ,

63,800

207,700

783,200

7,400

1891

2,166,000

66,600

87,100

206,700

6,300

1892

3,252,000

85,100

47,300

334,600

7,300

1893

4,018,000

37,700

92,500

19,000

116,000

9,600

1894

2,306,000

26,000

153,000

13,600

29,600

7,300

1895

3,070,000

12,200

248,600

65,000

726,000

10,600

1896

8,267,000

83,700

66,000

43,000

831,000

22,200

1897

2,128,000

47,900

19,200

22,400

689,300

17,600

1898

4,354,400

60,800

38,200

268,000

1,426,000

39,200

1899

2,175,400

2,300

80,000

367,500

1,064,300

17,000

1900

9,162,900

‘20,400

26,900

261,300

381,600

6,600

1901

4,614,600

64,000

32,000

828,400

1,164,900

9,600

The chief grain ports of Italy are Genoa and Venice, the former heing the receiving port for much of the wheat destined for Switzerland. The wheats imported into Italy in greatest quantities are those of Eussia and Eumania, the hard wheat of Taganrog heing in great demand for making maccaroni.

Spain (population, 18,826,000; census 1897).— Only in 1899 for the first time were Spanish agricultural statis-tics issued. Foreign Office returns : —

Acreage

under Crops,

year 1899.

Estimated

Total Crops.

Yield

per Acre.

Wheat

Barley

Oats .

Eye .

Maize

Beans

9,048,662

3,463,710

931,578

1,848,062

1,159,720

633,202

Bushels.

97,680,582

51,796,024

12,386,000

19,891,000

23,913,000

7,032,000

Bushels.

10-8

15-0

13-3

10-8

20-6

11-1

The consamption per head of wheat in the years 1896-97 appears to have been about 54 bushels. During the ten years ending 1899 the gross annual supply of wheat, native and imported, was as follows, in two periods of five years each : —

Period.

Native.

Foreign.

Total.

1890-94

1895-99

Qrs.

10,200,000

11,700,000

Qrs.

1,060,000

700,000

Qrs.

11,260,000

12,400,000

The wheats of which Spain imports most are Eussian and Bumanian, the chief receiving port being Barcelona. Formerly a good trade was done by Spanish millers in exporting flour to Cuba and Costa Eica, but this has now ceased.

Pkoduction.

(From British Board of Agriculture.)

Year.

Wheat.

Kye.

Barley.

Oats.

Maize.

Qrs. 8 bush.

9,000,000

9,000,000

Qrs. 8 bush.

Qrs. 8 bush.

Qrs. 8 bush.

Qra 8 bush.

1891

1892

9,300,000

1893

10,700,000

1894

13,000,000

1896

» 9,842,000

2,126,000

1896

10,600,000

1,876,000

1897

12,600,000

2,260,000

1898

13,600,000

2,750,000

1899

12,210,000

2,486,000

6,474,000

1,648,000

2,989,000

1900

11,200,000

2,700,000

1901

14,500,000

3,000,000

••

••

” Does not agree with the Cmn Trade Year-Book,

Exports.

(From Fstadistica general del comerds eoslerios de FspaHa.)

Year.

Wheat.

Eye.

Barley.

Flour.

Maize.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Sacks,

2801).

Qrs. 480.

1885

..

169,628

,.

1886

2,800

2,100

1,400

166,078

1887

3,459

7,167

1,662

120,317

9

1888

933

8,004

7,023

141,323

142

1889

700

4,200

3,100

184,828

460

1890

3,200

3,000

800

250,769

150

1891

2,500

62,000

20

290,427

200

1892

100

114,400

20

14,101

20O

1893

150

70O

2,900

7,204

150

1894

1,600

1,300

700

104,161

6,200

1895

600

25,100

40O

291,999

4,100

1896

2,300

16,000

200

456,849

86,600

1897

300

1,000

100

392,163

48,700

1898

12,200

1,100

293,300

125,600

2,600

1899

250

6,400

64,700

12,800,

40

1900

250

400

800

13,300

60

1901

40

40

800

3,600

50

Impokts.

Year.

Wheat

Eye.

Barley.

Maize.

Flour.

Qrs. 480.

Qrs. 480.

Qrs. 400.

Tons, 2240.

Sacks, 280.

1885

616,609

1886

689,319

89,300

1887

1,444,818

190,658

1888

1,119,060

281,405

1889

668,435

241,300

1890

737,784

..

200,600

1891

713,469

33,100

1892

638,493

39,800

1893

1,926,868

66,400

1894

1,954,199

69,300

1895

932,305

14,900

1896

862,288

..

2,300

1897

651,963

13,600

1898

273,100

13,200

11,600

469,500

22,000

1899

1,714,600

3,700

3,900

241,500

173,900

1900

1,022,400

3,600

64,600

232.400

39,300

1901

674,100

263,000

77,000

312,000

22.600

Portugal (population, 5,428,800, including the Islands ; census 1900). — Agricultural statistics are not easily obtainable for this country, and we have to take an estimate of M. Louis Grandeau of the year 1892 as our authority for the acreage and the average yield per acre.

Acreage.

Total Crop.

Yield

per Acre.

Wheat .

Maize

Eye.

Barley .

Oats

Potatoes .

642,000

1,285,000

667,000

143,000

30,000

74,000

Bushels.

8,512,000

20,225,000

6,640,000

1,986,000

425,000

8,211,700

Bushels.

13-1

15-9

10-0

13-7

14-1

111-0

All these yields are meagre in comparison with those of Northern Europe, but they seem about correct in relation to Spanish and Italian. The consumption of wheat in Portugal is small, working out at only 2J bushels per head ; the cereal constituting the people's chief food being maize, of which it is estimated that between 6 and 8 bushels per head are used annually. The following tabular state-1 ments show the production, exports, and imports of the chief

cereals for a number of years. The chief ports of entry for wheat are Oporto and Lisbon, and the principal source of supply the United States of America.

Production.

{From the Corn Trade News.)

Year.

Wheat

Year.

Wheat

Qrs. 480.

Qrs. 480.

1890

810,000

1896

750,000

1891

875,000

1897

1,200,000

1892

800,000

1898

1,100,000

1893

750,000

1899

800,000

1894

1,250,000

1900

1,000,000

1895

800,000

The exports of wheat are unimportant, but some flour is shipped

annually.

Impokts.

{From the Eslatistica de Portugal.)

Year.

Wheat

Maize.

Barley.

Flour.

Qra. 480.

Qrs. 480.

Qrs. 400.

Sks. 280.

1890

436,300

75,403

3,982

20,700

1891

517,900 .

162,978

2,007

30,100

1892

516,900

18,064

150

20,100

1893

665,400

33,823

11,300

1894

490,700

72,800

1895

635,400

45,700

...

1896

547,400

28,900

1897

650,600

63,480

10,320

1898

320,620

134,320

10,150

114,000

1899

461,400

376,100

1900

628,700

328,100

Portugal imported of oleaginous seeds 322,400 cwts. in 1900, and 268,500 in 1899 ; besides rice 344,900 cwts. in 1900, and 322,300 owts. in 1899 ; and about 40,000 to 50,000 qrs. beans on an average enter this country.

Sweden (population, 5,136,441 ; census 1900). — Very complete and up-to-date statistics are issued by the Swedish Government, as will be seen from the annexed tabular statements. The acreage under crops is for 1898, the produce statistics being for the following year : —

Acreage.

Total Crop.

Yield

per Acre.

Bushels.

Bushels.

Wheat .

182,000

4,293,000

23-6

Barley

545,000

11,329,000

20-8

Oats

2,033,000

52,038,000

25-6

Rye ....

1,013,000

20,773,000

20-5

Potatoes .

390,000

32,877,000

84-0

The consumption per head of wheat works out at only \^ bushels, but of rye it amounts to almost 5 bushels. The great crop, how-ever, is oats, of which nearly 13 bushels per head are raised. The

following tabular statements show the production of native, and the trade in foreign cereals for certain years. The largest quantities of wheat come from America, Russia, and Germany. The principal ports for grain are Stockholm and Calmar.

Production.

{From the Jordbruk och Boskapsskbtsel.)

Year.

Wheat.

Kye.

Barley.

Oats.

Potatoes.

Qrs. 480.

Qrs. 480.

Qra. 400.

Qrs. 304.

Tons, 2240.

1890

506,000

2,696,000

1,842,000

7,927,000

884,000

1891

551,300

2,754,000

1,681,000

7,164,000

1,279,000

1892

652,400

2,855,000

1,724,000

8,412,000

1,439,000

1893

485,300

2,957,000

1,592,000

6,895,000

1,534,000

1894

541,100

2,301,000

1,788,000

8,469,000

1,092,000

1895

460,000

2,447,000

1,771,000

8,509,000

1,355,000

1896

565,900

2,910,000

1,743,000

6,794,000

1,640,800

1897

553,800

2,858,000

1,732,000

7,083,000

1,369,000

1898

550,100

2,600,000

1,793,000

8,530,000

933,000

1899

500,000

2,375,000

1,625,000

8,125,000

1900

650,000

3,000,000

1,875,000

7,250,000

»1901

550,000

2,760,000

1,660,000

7,100,000

Exports.

{From JJtrikes Handel och Sjofart.)

Year.

Wheat.

Eye.

Barley.

Oats.

Potatoes.

Flour.

Qrs.

8 bush.

Qrs.

8 bush.

Qrs.

8 bush.

Qrs. 8 bush.

Tons.

Sks. 280.

1890

70

480

23,200

586,000

30

20,054

1891

92

694

36,000

1,276,000

90

12,221

1892

179

427

22,400

777,000

. 400

11,698

1893

161

1476

26,100

1,536,000

180

1,394

1894

105

400

22,000

982,000

90

690

1896

40

230

600

645,000

60

746

1896

200

200

30

451,000

200

6,400

1897

60

200

60

149,000

60

17,512

1898

80

200

400

286,900

600

10,880

1899

140

230

870

273,000

3,310

1900

155

126

1,400

90,600

3,800

Imports.

{From JJtrikes Handel och Sjofart.) ‘

Year.

Wheat

Bye.

Barley.

Data.

Potatoes.

Wheat

Flour.

Qrs.

Qrs.

Qrs.

Qrs

8 bush.

8 bush.

8 bush.

8 bush.

1890

263,100

578,300

20,000

37,760

7,680

121,300

1891

330,700

402,500

16,000

14,000

5,300

122,600

1892

543,000

348,200

54,000

10,450

3,400

171,800

1893

557,500

368,900

59,000

11,240

3,600

251,600

1894

708,600

622,000

62,200

20,000

1,760

291,400

1895

494,600

559,000

4,100

23,000

3,200

72,300

1896

661,300

418,800

3,400

41,100

3,400

78,000

1897

509,100

206,100

66,200

101,000

4,020

41,400

1898

608,800

424,800

16,100

60,200

32,200

44,000

. 1899

721,000

615,700

1,820

146,400

83,471

121,000

1900

704,500

619,700

56,800

383,000

50,000

66,700

Norway (population, 2,231,395 ; census 1901). — As

would be expected, this northern kingdom plays but a small part in the international grain trade. In 1890 the areas and pelds of the chief crops were as follows : —

Crop.	Acreage.	Yield per Acre.
Wheat .	10,833	Bushels.
Rye .	33,985	256,800
Barley	127,896	920,800
Oats	256,198	4,104,800
		9,541,000

Bushels.

23-8

27-3

32-0

37-5

The two years for which complete estimates of the produce are available are 1890 and 1900 :—

Wheat and

Uye

combined.

Barley.

Oats.

Potatoes.

Other

Corn.

1890

1900

Qra.

147,000

146,000

Qra.

513,100

475,000

Qrs.

1,192,700

1,154,000

Bushels.

23,212,800

22,216,000

Qrs.

174,600

176,000

The imports comprise substantial quantities of rye, barley, wheat flour, and rye meal, and a little wheat. The exports are small, comprising about 5000 quarters of oats and 6000 sacks of rye meal. The chief ports are, Moss (for Chiistiania), Stavanger, and Bergen. Wheat is imported from Russia and Germany ; rye from Russia, Germany, and United States of America ; flour and rye meal from Germany.

Imports.

<• Commercial estimate.

{From ‘j

^aheller vedkommende Norges Handel.)

Year.

Wheat

Eye.

Barley.

Maize.

Wheat

flour.

Eye Meal.

Qrs.

Qrs.

Qrs.

8 meas.

8 meaa.

8 meas.

Qrs. 480.

Sks. 280.

Sks. 280.

bush.

bush.

bush.

1890

81,724

760,000

281,724

4,000

171,430

194,656

1891

64,483

832,069

833,104

9,300

226,700

143,306

1892

87,686

650,690

426,617

12,400

276,868

167,480

1893

10,000

741,379

480,000

7,300

812,050

193,560

1894

20,000

827,686

476,662

1,900

268,600

274,130

1895

42,768

Qrs. 480.

868,965

Qrs. 480.

427,686

Qrs. 400.

6,000

247,112

248,860

1896

40,400

908,000

478,800

11,600

281,100

345,600

1897

44,600

873,000

496,000

29,000

243,000

829,809

1898

48,200

921,200

470,400

89,700

270,100

220,100

1899

42,000

885,700

627,600

101,000

260,000

860,000

1900

32,000

836,400

643,600

120,000

840,000

427,000

1901

30,000

927,000

607,000

GRAIN TRADE

11

Denmarh (population, 2,464,770; census 1901). — The produce statistics are from Hasten i Danmark, and give the yield for 1900, and acreage and yield for 1896 : —

Acreago.

Crop.

Yield per

Acre.

Bushels.

Bushels.

“Wheat .

84,812

3,550,290

41-9

Barley

689,660

20,453,158

297

Oats

1,083,468

37,078,120

34-2

Kye .

716,648

19,328,472

27-0

Potatoes .

129,185

20,888,942

162-0

This remarkably heavy yield per acre of wheat has always been questioned, for there is no other country in the world that has

succeeded in raising its yield per acre, over a wide area, above 34 bushels ; and it is thought that some mistake has crept in among the area or the produce statistics for the year 1896. The consumption of cereals per head in Denmark during recent years has averaged about 2J bushels of wheat and 8 J bushels of rye.

The following tabular statement shows the production of native, and the trade in foreign, grain and flour for a number of years.

Pkoduotion.

[From Hasten i SanmarJc.)

Year.

Wheat.

Hye.

Barley,

Oats.

Potatoes,

Qrs. of

Qrs. of

Qrs. of

Qrs. of

Tons,

8 bush.

8 bush.

8 bush.

8 bush.

2240 lb.

1890

454,100

2,046,400

2,821,900

4,489,200

299,800

1891

602,000

2,351,600

2,724,700

4,142,800

346,600

1892

612,800

2,452,000

2,974,900

4,902,700

463,600

1893

464,100

2,363,400

2,081,200

3,360,500

618,100

1894

892,600

2,002,000

2,579,100

4,611,300

897,300

1895

417,100

2,213,700

2,622,200

4,841,200

497,200

1896

443,800

2,420,100

2,556,600

4,634,800

622,200

1897

418,000

2,180,000

2,306,000

4,238,000

485,400

1801?

359,000

1,941,000

2,631,000

4,990,000

398,900

1899

439,000

2,250,000

2,626,000

4,376,000

1900

400,000

2,375,000

2,370,000

3,911,000

1901

300,000

2,200,000

2,570,000

4,500,000

Ej

:poets.

{From DanmarTc’s Vareindforsel og udforsel.)

Year.

Wheat.

Eye.

Barlet.

Oats.

Maize.

Flour.

Qrs. 480.

Qrs. 480,

Qrs. 400,

Qrs. 304,

Qrs. 480.

Sacks, 280.

1890

139,800

23,600

202,300

6,200

60,000

■ 139,700

1891

116,200

71,500

227,200

17,900

25,700

137,000

1892

181,000

149,000

175,300

10,800

73,600

118,600

1893

122,000

64,300

206,000

60,100

41,000

82,200

1894

65,600

75,300

297,500

6,600

37,100

67,200

1895

44,400

41,700

123,300

3,800

14,200

33,800

1896

06,700

21,700

223,000

1,800

27,400

38,900

1897

100,400

11,600

204,100

10,800

257,000

47,600

1898

110,600

32,700

204,700

11,000

278,000

53,500

1899

36,400

19,100

283,100

9,500

244,400

20,000

1900

106,500

17,400

233,000

25,000

102,000

61,600

Impokts.

Year.

Wheat.

Eye.

Barley.

Oats,

Maize.

Flour.

Qrs. 480.

Qrs. 480.

Qrs, 400,

Qrs. 304.

Qrs. 480.

Sacks, 280.

1890

188,700

363,200

83,000

201,300

605,700

23,700

1891

358,000

436,000

79,500

183,600

187,700

48,300

1892

218,000

130,000

76,500

172,700

699,600

62,200

1893

331,000

224,400

264,600

126,600

388,000

72,400

1894

367,000

526,800

1,159,700

141,200

278,000

104,000

1895

333,200

638,400

992,100

192,800

226,600

116,600

1896

288,400

440,600

250,900

185,200

1,011,700,

112,400

1897

268,000

349,600

308,200

139,700

2,310,700

97,400

1898

344,000

413,600

300,000

95,200

2,514,200

135,600

1899

344,500

412,600

131,100

99,300

2,362,700

187,000

1900

281,600

429,200

57,000

216,400

2,020,000

145,300

The chief port for grain is Copenhagen, and the principal sources of supply are Germany, Russia, and the United States of America,

for wheat and ‘ flour ; Russia and Germany for rye ; Russia for barley ; and America for maize, of which immense quantities are annually imported.

Switzerland (population, 3,313,817; census 1900). — There are no official returns for the areas under crops, but the trade statistics are quite complete and up to date. The consumption per head of wheat during the period 1896-1900 averaged nearly 6 bushels, and of rye rather over 6 bushels; but probably the great number of tourists who visit Switzerland in the summer disturbs these calculations slightly. The crops of Switzerland are usually estimated at between 500,000 and 600,000 qrs. of wheat, 2,500,000 qrs. of rye, 1,800,000 qrs. of barley, and 8,500,000 qrs. of oats. The exports are only trifling, but the imports are considerable, as wiU be seen from the following statement : —

Impokts.

{From Official Trade Statistics.)

Year,

Wheat,

Eye,

Barley,

Oats,

Maize,

Flour.

Qrs, 480,

Qrs, 480,

Qrs, 400,

Qrs, 304,

Qrs, 480,

Sks, 280,

1890

1,516,924

21,200

79,204

360,905

160,442

165,643

1891

1,674,565

14,700

74,697

402,424

166,050

181,609

1892

1,414,952

11,700

76,262

406,586

178,662

188,226

1,634,652

21,400

91,428

452,789

240,390

219,973

1894

1,661,043

26,800

74,011

455,210

137,932

226,917

1895

1,728,354

36,000

69,273

657,725

127,105

268,005

1896

1,940,367

46,000

62,292

640,003

291,688

343,437

1897

1,622,367

33,100

63,500

642,640

276,703

319,071

1898

1,583,400

27,000

59,100

627,800

292,300

276,700

1899

1,761,100

49,800

675,300

293,300

335,400

1900

1,646,200

49,400

660,600

230,300

234,800

“lOOl

1,700,000

43,000

700,000

220,000

240,000

Cereal year.

As Switzerland has no seaboard, the foreign grain is brought from the ports of other countries in bond, and received at Basel, Ziirich, and other frontier towns from Rotterdam, Marseilles, Genoa, &c. The chief sources of supply are Russia for wheat and oats, and France for flour,

Greece (population, 2,433,806; census 1896), — According to the estimates of the Corn Trade Year-Book, the wheat crop has steadily diminished in size, until it amounted

in 1900 to only about one-third of what it was in 1890 : —

Wheat Crop in Quarters.

1890, 1891, 1892, 1893, 1894, 1895,

850,000 1,000,000 940,000 900,000 620,700 460,000

1896, 1897, 1898, 1899, 1900, 1901.

600,000 400,000 400,000 200,000 300,000 400,000

The imports of wheat now amount to about 700,000 quarters annually, so that the indicated per capita consumption is 3J bushels. The exports are insignificant.

The Piraeus is the port where most of the foreign grain arrives.

The plains of Thessaly are where the major part of the native wheat crop is raised,

Mexico (population, 13,545,462; census 1900). — The production is estimated as follows : —

Phodttction.

Year,

Wheat,

Barley.

Maize.

Year.

Wheat.

Barley.

Maize.

Qrs, 480.

Qrs.

Qrs.

Qrs.

Qrs.

Qrs.

8 bush.

8 bush.

8 bush.

8 bush.

8 bush.

1890

1,500,000

1895

1,700,000

1891

1,600,000

..

1896

1,900,000

Qrs.

1S97

1,212,600

1,074,600

14,812,000

8 bush.

1898

2,000,000

1892

1,706,500

631,700

9,112,600

1809

2,000,000

1393

2,100,000

190O

2,000,000

1894

2,600,000

The imports chiefly consist of maize from America, amounting occasionally to 1,000,000 quarters. The exports are only trifling.

South Africa. — The cultivation of cereals is not carried on in any of the South African colonies with great success.

The statistics for Cape Colony and Natal are as follows : —

Cape Colony (population, 2,265,556 ; estimated December 1899).—

Pkoditotion.

{From Statistical Register of the Colony of the Cape of Good Eope.)

Year.

Wheat.

Eye.

Barley.

Oats.

Maize.

Potatoes,

Qrs. of

Qrs. of

Qrs, of

Qrs. of

Tons,

8 raeas.

8 ineas.

8 meas.

8 meas.

Qrs. 480.

bush.

bush.

bush.

bush.

1893

486,362

68,386

127,886

204,639

341,720

23,489

1894

374,817

70,049

96,360

171,568

201,194

22,703

1895

308,086

83,129

122,168

346,800

20,030

1896

266,463

75,787

82,774

203,667

81,147

17,872

1897

263,223

98,124

113,054

232,648

23,803

“1898

243,853

36,969

113,490

180,919

257,592

27,070

‘1899

277,600

103,800

226,300

357,200

30,000

1900

600,000

“• In this year is included the old colony and native territories.

‘> Estimated,

78

GKAIN TRADE

Natal (population, 902,365 ; census 1898). —

Production.

{From Statistical Year -Book of the Colony of Natal.)

Harvested

Dec. -Jan.

Wheat.

Barley.

Cats.

Maize.

Potatoes.

Qrs. 8 bush.

Qrs. Sbush.

Qrs. Sbush.

Qrs. 8 bush.

Tons, 2240.

1890-91

1,040

250

3,190

88,400

4,910«

1891-92

770

410

2,650

97,040

8,290 »

,1892-93

1,070

290

3,300

104,900

10,000″

1893-94

1,300

460

6,600

73,800

14,100-

1894-95

1,300

570

5,700

96,200

6,600-

1895-96

770

740

3,000

51,200

6,600″

1896-97

1,100

830

5,700

85,000

11,300″

1897-98

760

1,100

4,100

77,600

6,400″

1898-99

...

1899

...

...

‘ ” These figures relate to cultivation by European population only, and include sweet potatoes.

China (population, including dependencies, 400,000,000; estimate). — Very little has ever been published on the agricultural productions of this country. The cereal crops, •whatever their quantity, are sufficient to provide for the populations of most of the Chinese provinces ; but there

are no reserves, and whenever a bad harvest occurs, famine immediately sets in. The following statistics are taken from Beturns of Trade for 1898, printed at Shanghai: — Imports: wheat, 42,412 quarters; flour, 203,773 sacks; beans, 776,000 quarters. Exports : wheat, 40,749 quarters ; flour, 22,778 sacks ; beans, 1,805,781 quarters. In 1897 the imports of beans amounted to 568,611 quarters, but no figures are given for flour or wheat. Hong Kong is credited with importing about 800,000 sacks of flour per annum from America.

Korea (population, 17,000,000; census 1897).— In 1898 the exports amounted to £7000 worth of wheat, £111,000 worth of beans, and £278,000 worth of rice ; the imports to £44,000 worth of millet and £39,000 worth of rice.

Trinidad.

Imports.

‘ {From Statistical Abstract for the several Colonial and other Possessions of the United Kingdom.)

Year.

Flour.

Year.

riour.

Sacks, 280.

Sacks, 280.

1885

75,047

1893

107,273

1886

79,351

1894

116,379

1887

72,902

1895

106,626

1888

78,263

1896

109,239

1889

81,994

1897

102,632

1890

84,816

1898

118,790

1891

86,106

1899

130,100

1892

95,313

1900

128,000

Newfoundland.

Imports.

Year.

Oats.

Hour.

Qrs. of 8

meas. bush.

Sacks, 280 a.

1885

212,585

1886

261,795

1887

239,673

1888

16,900

273,762

1889

12,300

229,877

1890

10,100

221,659

1891

19,800

256,447

1892

Ho returns.

No returns.

1893

22,200

257,564

1894

20,300

236,500

1895

20,500

242,572

1896

18,200

254,046

1897

257,570

1898

...

255,850

1899

290,000

MauritiiLS.

Imports.

{From Statistical Abstract for the several Colonial and other

Possessions of the United Kingdom.)

Year.

Wheat.

Oats.

Wheat

Flour.

Qrs. 8 bush.

Qrs. 8 bush.

Sacks 280.

1885

8,600

34,601

39,582

1886

18,100

41,869

46,755

1887

8,581

27,413

43,576

1888

2,102

21,200

49,000

1889

7,742

43,000

51,500

1890

2,150

32,000

66,800

1891

1,219

32,951

64,140

1892

300

32,190

55,252

1893

644

32,298

83,668

1894

1,300

29,900

77,100

1895

1,700

30,500

73,100

1896

500

55,400

77,300

1897

300

60,000

1898

600

56,000

1899

1,500

53,000

1900

2,300

50,000

Malta {including Gozo and Coniino).

Prodtjction.

{From, Uetums of Board of Agriculture for Great Britain

and Colonies.)

Year.

Wheat.

Barley.

Mixed

Grains.

Beans.

Qrs. of 8

meas. bush.

Qrs. of 8

meas. bush.

Qrs. 480.

Qrs. 480.

1885

14,917

6368

11,200

3800

1886

13,347

4799

11,000

6200

1887

20,148

9688

13,500

5000

1888

20,500

7600

13,900

6800

1889

23,700

9100

12,700

6200

1890

24,000

7600

10,200

5100

1891

20,900

6200

11,100

4700

1892

19,900

6400

9,800

4600

1893

19,400

6500

10,800

4800

1894

21,500

6100

1895

19,000

5700

1896

21,600

6900

1897

16,300

6400

1898

20,800

7900

Jamaica.

Imports.

{From Statistical Abstract for the several Colonial and

other Possessions of the United Kingdom.)

Year.

Flour.

Maize or

Indian Corn.

Sacks, 280,

Qrs. 8 bush.

“1885

89,763

6,100

“1886

93,625

7,800

“1887

80,628

10,400

“1888

93,773

11,300

“1889

107,569

13,500

‘ 1890

125,379

26,600

‘1891

121,651

22,294

‘1892

124,057

23,585

‘1893

118,125

26,859

‘1894

128,956

81,200

‘1895

141,586

38,600

‘1896

120,200

40,100

‘1897

103,331

38,300

‘1898

94,360

36,600

‘1899

107,000

34,000

‘1900

103,000

30,000

° Year ended 80th September.

‘ Year ended 31st March.

GRAIN TRADE

79

Java.

Imports.

(From JaarhoeJc der Kolonier Koningrijk der Nederlcmden.)

Year.

Wheat.

Flour.

Tear.

Wheat.

Flour.

Qra. ot8

bush.

Sacks, 280.

Qrs. of 8

bush.

Sacks, 280.

1885

102

39,147

1893

42

60,000

1886

372

31,029

1894

100

61,700

1887

446

36,761

1895

200

69,700

1888

49

30,840

1896

61,800

1889

49

35,722

1897

70,800

1890

14

39,848

1898

60,000

1891

7

41,000

1899

,.,

71,900

1892

15

60,500

British Guiana.

Impokts.

(Statistical Abstract for the several Colonial amd other

PossessioTis of the United Kingdom.)

Year.

Oats.

Flour.

Potatoes.

Qrs. 8 bush.

Sacks, 280.

Tons, 2240.

1885

12,080

99,160

4518

1886

8,940

87,072

2293

1887

12,700

100,083

3168

1888

9,400

105,179

1889

13,200

116,460

1890

13,000

112,623

1891

15,119

118,882

1892

11,471

135,224

1893

12,647

143,783

1894

15,900

142,355

..>

1895

12,900

122,826

1896

13,800

102,328

1897

10,000

107,919

1898

11,000

124,390

...

1899

11,300

144,000

...

1900

12,700

103,000

Barbadoes.

EXPOETS.

{Statistical Abstract for the several Colonial and other

Possessions of the United Kingdom.)

Flour,

Flour,

Year.

Wheat,

Year.

Wheat,

or Eye.

or Rye.

Sacks, 280.

Sacks, 280.

1885

23,401

1893

13,000

1886

18,605

1894

16,248

1887

21,659

1895

12,635

1888

21,387

1896

9,643

1889

21,737

1897

10,840

1890

14,168

1898

16,240

1891

15,705

1899

14,000

1892

12.705

1900

13,800

IMPOP.TS.

{Same authority as Exports.)

Year.

Oats.

Flour, Wheat,

or Rye.

Grain and

Com.

Qrs. 304.

Sacks, 280.

Qrs. of 8 bush.

1885

18,500

50,697

41,716

1886

17,400

51,851

34,200

1887

19,300

51,672

30,834

1888

14,300

49,587

27,677

1889

21,700

52,511

41,830

1890

17,500

50,747

34,756

1891

24,600

50,173

48,935

1892

20,100

51,989

34,529

1893

21,600

48,762

38,704

1894

25,400

63,690

53,213

1895

16,400

44,090

37,123

1896

19,300

39,557

37,750

1897

...

38,562

38,109

1898

47,390

45,900

1899

50,000

45,000

1900

...

51,000

38,000

Impokt Duties.

Statement showing the rates of import duty levied on grain amd

flour, and in force June 1901, according to the Board of Trade.

Tariff Classification.

RUSSIA—

Cereals of all kinds (except

rice):—

In the grain

Flour (except potato flour)

SWEDEN—

Rye, Wheat, Maize, Bar-“1

ley, not ground .]

Data

Flour of all kinds, not ground

NORWAY—

Cereals not ground : —

Buckwheat ....

Barley

Oats

Wheat

Rye

Cereals ground : —

Oroats; Buckwheat.

Barley, whole or split and \

pearled barley groats /

Oats

Wheat, including Serao-\

lina and Cabanca grits /

Flour of Barley .

„ Buckwheat and Rye

,, Maize, and Maize- \

meal of all kinds . /

Flour of Oats

Wheat .

SPAIN—

Wheat ....

Wheat-flour .

Millet ....

Flour of millet .

Other cereals (except rice)

Flour of the same

SWITZERLAND—

Wheat, Barley, Oats, Rye .

Flour of cereals .

ITALY—

Wheat

Rye

Oats

Barley

Maize

Flour of Wheat .

„ Rye

„ Barley or Oats

„ Maize

AUSTRIA-HUNGARY—

Maize

Barley, Oats.

Wheat, Spelt, and Rye

Flour of cereals .

UNITED STATES—

Barley . . .

Barley pearled, patent or\

hulled . . . (

Buckwheat .

Maize ....

Corn-meal .

Oats ....

Oatmeal and Rolled Oats

Oat hulls

Rye ....

Rye-flour

Wheat ....

Wieat-flour .

GERMANY—

Wheat .

Rye

Oats

Buckwheat

Barley .

Maize .

Flour of cereals

HOLLAND—

Grain and Flour

BELGIUM—

Wheat, Rye, Barley, Buck*

wheat. Maize .

Oats . . . . ,

Flour of Oats .. ,.

„ other . ;

Rates of Import

Duty.

RbLcop.

Free.

Poud gross 8 45

Kron.ore.

100 kilos 3 70

Free.

100 kilos 6 60

Kron.ore.

Free.

100 kilos 0 22

Free.

100 kilos 0 60

Free.

100 kilos

100 kilos

0 60

0 60

0 60

0 15

0 60

»0 30

0 60

2 00

Pes. c.

8 00

13 20

3 20

Frc. c.

100 kilos 0 30

„ 2 00

100 kilos

100 kilos

12 30

6 60

6 GO

9 60

Fl. kr.

0 60

0 75

1 60

3 76

Bus. of 48 D)

lb

Bus. of 48 lb

Bus. of 66 I>

Bus. of 48 !>

Bushel

111

Per 100 B)

Bushel

S>

Bushel

25 per cent, ad. vol.

M. pf.

English Equivalents.

I^ee.

Free.

100 kilos

2 00

2 00

1 60

7 30

Frc. 0.

3 00

4 00

2 00

£ 8. d.

Free.

Cwt 0 2 8

Cwt. 0 2 1

Free.

Cwt. 0 3 8

Cwt.

Cwt

Free.

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Free.

Free.

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0 0 IJ

9 0 4

Cwt

Cwt

Cwt

Bus. of 48 lb

Bus. of 66 B>

Bus. of 48 Si

Bushel

Cwt

Cwt

Bushel

Cwt

Bushel

3

6

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S OJ

1 10

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0 1 ei

0 3 ej

Bus. of 48 lb 0

Cwt. 0

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4

0 7»

0 7J

0 10

0 7J

25 per cent. ad. val.

Cwt

Free.

Free.

Cwt.

0 1

0 1

0 9 91

‘■ Rye flour imported through the custom-houses of Hammerfest,

Yardo, and Vadsii is free.

Impokt Duties {continued).

Tariff Classification.

Eates of Import

Duty.

English Equivalents.

FRANCE—

Wheat, Spelt, and Maslin :—

Fro. c.

Grain

100 kilos, gross 1 00

Owt. gross

0 2 10

Crushed and grist con-

taining more than 10 per

100 kilos, net li 00

Cwt. net

0 4 6

cent, of Flour.

Flour :—

At the rate of extraction t

of TO per cent, and above (

n oo’

0 4 6

At the rate of extraction

”

between 60 and 70 per

18 50

”

05 6

cent.

At the rate of extraction

16 00

0 6 6

of 60 per cent, and below

Oats, Barley, Kye, and

V

Maize :—

Grain . ...

100 kilos, gross 8 00

Cwt. gross

0 1 2J

0 2 0|

Flour

6 00

Buckwheat :—

‘

Grain

2 50

”

0 1 05

Flour

4 00

01 7

Note. — In the case of countries having a differential tariff the rates given are those leviable on imports of British produce from the United Kingdom. (q_ j_ §_ g /)

Cramont, Antoine Agenor Alfred, Due db

(1819-1880), French statesman, was born at Paris on tlie 14tli of August 1819, and came of an old aristocratic family. After the usual educational course he entered upon a diplomatic career. In 1848 he married a Scottish lady.

Miss Mackinnon. After the coup d'etat of 2nd December 1851 he began to rise with the fortunes of Louis Napoleon, who was his personal friend, and he was employed upon various diplomatic missions. In 1857 he was sent as ambassador to Eome. The creation of the kingdom of Italy, as the result of the campaign of 1859, caused his position at the Papal court to become extremely embarrassing. He was consequently recalled to Prance, and from 1861 to 1870 he was ambassador at Vienna. On 16th May 1870 he was appointed minister of foreign affairs in the Ollivier cabinet. In this capacity he incurred much obloquy by forcing on the war with Germany. The due de Gramont first announced to the king of Prussia that the candidature of Prince Leopold of Hohenzollern for the throne of Spain could not be permitted ; and then, after the prince withdrew, he insisted that no member of the Prussian family should be put forward in his stead. Germany refused to give any such pledge, which she described as an utterly unnecessary and humiliating demand, and this led to the declaration

of war by Prance in July. In the French legislative body, on 11th July, the due de Gramont said, ” Up to the present all the European cabinets appear to admit the legitimacy of our complaints.” This was promptly contrar dieted, so far as Great Britain was concerned, by Earl Granville, who added, however, that Great Britain had exerted her influence for the preservation of peace. On 15th July M. Ollivier in the legislative body, and the due de Gramont in the Senate, announced that France was at war. After the revolution of September the due de Gramont fled to England. In 1872 he published a defence of his conduct under the title of La France et la Prusse avant la Guerre. Soon afterwards he returned to France, where he devoted himself to financial undertakings. He died in Paris on 18th January 1880.

(g. b. s.)

Granada, a maritime province of Southern Spain.

Its area is 4937 square miles, divided into fifteen administrative districts and 205 parishes. The province is still badly off for means of communication, having only

one railway from Granada to Bobadilla, the junction with the lines to Cordoba, Malaga and Eonda, Seville and Algeciras, in all 67 miles. The roads also are in a very incomplete and unsatisfactory condition. The sugar-cane and beet-root industries have been developed with excellent results, and they have further increased since the loss of the West Indian colonies and the Philippines. The sugar factories are at Loja, Antequera, Flora, Motril, Salobrena, and the Vega of Granada. There are also tanneries, foundries, and manufactories of woollen, linen, cotton, and rough frieze stuffs, cards, soap, liqueurs, gun-powder, brandy, and machinery. Its ports on the Mediterranean are Motril, Almunecar, Albunol. The official records show forty-three mines productive and 758 unproductive. The former give occupation to about one thousand hands, and in 1898 turned out 49,688 tons of coal. The province is one of the richest in live stock, especially mountain sheep and goats. The figures for 1897 are 10,052 horses, 38,314 mules, 38,630 asses, 18,466 cattle, 328,180 sheep, 108,272 goats, and 51,634 pigs. At

the same time 111,000 acres were devoted to wheat, 76,000 acres to barley, 75,500 acres to rye and oats, 12,000 acres to pod fruit, 35,000 acres to beans and garbanzos, 13,000 acres to vines, and 52,000 acres to olives. Population (1887), 484,341 ; (1897), 477,768.

Granada, the capital of the above province. Few cities in Spain have more educational establishments. Besides the university there are an institute for higher instruction, a training school for teachers, a school of fine arts, and twenty-two primary schools. The provincial library is now practically empty. There are archaeological and painting museums, besides that of the Alhambra; also a royal central seminary, an ecclesiastical college, twelve hospitals and orphanages for both sexes, and in one of the convents a leper hospital. Granada has some thriving local industries — manufactures of liqueurs, paper, soap, and coarse woollen and linen stuff — and an active trade in agricultural products from the fertile Vega. Population (1887), 73,000; (1897), 75,054.

Granada, a city of Nicaragua, Central America.

It is situated on the north-west shore of Lake Nicaragua, 32 miles N.W. of Managua, the capital of the republic, with which it is now connected by rail. The journey to the Pacific port of Corinto now occupies only about twelve hours — by steamer on Lake Managua to Momotombo, and thence to Corinto by rail 68 miles. From the railway station of Granada at the wharves on Lake Nicaragua there is a tramway to the market buildings one mile distant. There is an ice factory established, but the special industry of the city is the manufacture of “Panama chains,” made of gold wire. In the environs are large cacao plantations. Population, 19,000.

Grand Bassa. See Libebia.

Grand Forks, capital of Grand Forks county, North Dakota, U.S.A., on the western bank of the Red river, and on the Northern Pacific and the Great Northern railways, at an altitude of 830 feet. It is in the midst of the great Eed Eiver valley wheat region, and much of its business consists in the handling of wheat Population (1880), 1705; (1890), 4979; (1900), 7662, of

whom 2781 were foreign-born.

Grand Island, capital of Hall county, Nebraska, U.S.A., in 40° 56′ N. and 98° 21′ W., on the broad, level bottom-lands of the Platte river, at an altitude of 1866 feet. The plan is regular, the broad streets running at angles of 45° with the compass points. It has three railways, the Union Pacific, the Burlington and Missouri Eiver, and the St Joseph and Grand Island. It is the seat of Grand Island College, a Baptist co-educational institution, founded in 1892. This had, in 1899, 10 instructors and 125 students. The city is in a rich agricultural region, and its principal business consists in handling grain and cattle. It contains works of the Union Pacific

railway. Population (1880), 2963 ; (1890), 7636 ; (1900), 7564, of whom 1339 were foreign-born and 38 negroes.

Grand Junction, capital of Mesa county, Colorado, U.S.A., in the broad desert valley of Grand Eiver, at the mouth of the Gunnison, at an altitude of 4579

feet. The Grand Eiver valley, when irrigated, is extremely fertile, and produces vast quantities of fruit, which is handled here. It is also the meeting-point of the Colorado Midland, the Eio Grande Western, and two branches of the Denver and Eio Grande railway. Population (1880), 859; (1890), 2030; (1900), 3603, of whom 358 were foreign-born and 52 negroes.

Grand Rapids, capital of Kent county, Michigan, U.S.A., in 42° 68′ N. and 85°40’W., at the rapids in Grand Eiver, at an altitude of 610 feet. The city is regularly laid out, is divided into twelve wards, is well paved, largely with asphalt and wooden blocks, and has a municipal water supply. It is entered by six railways, affording communication in all directions and giving the city a large commerce. Grand Eapids is a manufacturing city of great importance, which is due in no small part to the water power in Grand Eiver. In 1890 there were 869 manufacturing establishments, with a capital of $15,945,947, employing 13,282 hands, and with a product valued at $19,851,181. The leading products were

furniture, valued at $5,638,916 ; flour, $1,568,845 ; and lumber, $2,319,495. In the manufacture of furniture this city is one of the foremost in the United States. The assessed valuation of real and personal property in 1900 was $43,264,021, the net debt of the city $1,889,824, and the rate of taxation $20-42 per $1000. Population (1880), 32,016 ; (1890), 60,278 ; (1900), 87,565, of whom 23,896 were foreign-born and 604 negroes. The death-rate in 1900 was 14-4.

Grangemouth, a police burgh and seaport of south-east Stirlingshire, Scotland, near the confluence of the rivers Carron and Forth, 3 miles east-north-east of Falkirk. Standing at the entrance to the Forth and Clyde Canal, it is one of the most important harbours in Scotland. The docks cover an area of 28 acres, and there are timber basins covering 32 acres, the total quayage being 2290 yards. A large extension is being carried out at an estimated cost of £1,000,000. The new docks will be 200 acres in extent, with an entrance 15 feet deep in the Forth. At the end of 1898. 66 vessels of 15,589 tons

were registered. In 1888, 1962 vessels of 721,724 tons entered ; in 1898, 2389 vessels of 1,089,166 tons entered. Imports rose in value from £1,902,753 in 1888 to £2,416,462 in 1898; and exports from £705,740 in 1888 to £2,163,368 in 1898. Timber, pig-iron, and iron ore are the principal imports, while 662,027 tons of coal were exported in 1888, and 1,479,946 in 1898. There is a shipbuilding yard and various accompanying industries. Grangemouth has regular steamer communication with London, Christiania, Hamburg, Eotterdam, and Amsterdam. There is a ” classic ” town hall, a public institute, a free library, and a public park. Population (1901), 7968.

Grant, Sir Alexander, 8th Baet. (1826-1884), British scholar and educationalist, was born in New York, 13th September 1826. After an early childhood spent in the West Indies, where his father owned property, he was educated at Harrow and Oxford. He entered Oxford as scholar of Balliol, and subsequently held a Fellowship at Oriel from 1849 to 1860. He made a special study of the Aristotelian philosophy, and in 1867 published an

edition of the Ethics (4th ed. 1885) which became a standard text-book at Oxford. In 1855 he was one of the examiners for the Indian Civil Service, and in 1856 a Public Examiner in Classics at Oxford. In the latter year he succeeded to the baronetcy. About the same time he married the daughter of Professor Ferrier of St Andrews, In 1869 he went to Madras with Sir Charles Trevelyan, and was appointed Inspector of Schools ; the next year he removed to Bombay, to fill the post of Professor of History and Political Economy in the Elphinstone College. Of this he became Principal in 1862; and, a year later, Vice-Chancellor of Bombay University, a post he held from 1863 to 1866 and again from 1866 to 1868. In 1866 1* took upon himself also the duties of Director of Public Instruction for Bombay Presidency. In 1868 he was appointed a member of the Legislative Council.

In the same year, upon the death of Sir David Brewster, he was offered and accepted the post of Principal of Edinburgh University, which had conferred an honorary LL.D. degree upon him in 1865. From that time till his

death (which occurred in Edinburgh, 30th November 1884) his energies were entirely devoted to the well-being of the University, his zeal in connexion with which was fully recognized. The institution of the Medical School in the University was almost solely due to his initiative ; and the Tercentenary Festival, celebrated in 1884, was the result of his wisely directed enthusiasm. In that year he published The Story of the University of Edinburgh during its First Three Hundred Years. He was created Hon. D.C.L. of Oxford in 1880, and Hon. Fellow of Oriel College in 1882. (r. f. s.)

Grant, James (1822-1887), British novelist, was born in Edinburgh, 1st August 1822, being the son of a military officer. Between 1832 and 1839 his father was quartered in Newfoundland, and James Grant was with him. In 1839, however, he returned to England and entered the 62nd Foot as an ensign, but in 1843 he resigned his commission and left the service. He then devoted himself to writing, first magazine articles, but soon a profusion of novels, full of vivacity and incident,

and dealing mainly with military scenes and characters.
For many years he was a favourite author in this kind.
His best stories, perhaps, were The Romance of War (his
first, 19ii&), Bothwell (1851), i^ranA Hilton; or, the Queen's
Own (1866), Tlie Phantom Begiment and Harry Ogilvie
(1856), Lucy Arden (1868), TJie White Cockade (1867),
Only an Ensign (1871), Shall I Win Her? (1874). ^Grant
also wrote British Battles on Land and Sea (1873-76),
and other books of general reading, of which one to
which permanent value attaches was his great work, in
three volumes, on Old and New Edinburgh. In 1875 he
became a Eoman Catholic. He died on 5th May 1887.
Grant, James Augustus (1827-1892), British
traveller and explorer, was born at Nairn in 1827.
After a course of study at Marischal College, Aberdeen,
he was appointed to the Indian army in 1846, and
subsequently rose to be lieutenant-colonel. He served
throughout the whole of the Mutiny, and for his services
received the Mutiny medal with Lucknow clasp. From
1860 to 1863 he was in Egypt with Captain Speke,

exploring the sources of the Nile. On his return he was created C.B., in September 1866. Two years later he served in the Intelligence Department of Lord Napier of Magdala's Abyssinian expedition ; for this he was made C.SJ., and was awarded the Abyssinian medal. Shortly after his return from Abyssinia he married. He was awarded the gold medal of the Eoyal Geographical Society in 1884, and, at various times, distinctions from British and foreign learned societies. He was Justice of the Peace and Deputy-Lieutenant of his native county, and the later years of his life were spent at Nairn. He died at Nairn, 11th February 1892. Besides contributions

to the journals of various learned societies, he published A Walk across Africa (1864) and Khartum as I Saw it in 1863 (1885). (e. f. s.)

Grant, Sir Patrick (1804-1895), British field marshal, was the second son of Major John Grant, 97th

Foot, of Auchterblair, Inverness-shire, where he was born on 11th September 1804. He entered the Bengal Native Infantry as ensign in 1820, and became captain in 1832. He served in Oude from 1834 to 1838, and raised the Hariana Light Infantry. Employed ^n the adjutant-general's department of the Bengal army from 1838 until 1854, he became adjutant-general in 1846. He served \inder Sir Hugh Gough at the battle of Maharajpur in 1843 (bronze star and a brevet majority), was adjutant-general of the army at the battles of Mudki in 1845 (twice severely wounded), and of Tirozshah and Sobraon in 1846 (medal with three clasps, a brevet lieutenant-colonelcy, and a C.B.). He took part in the battles of Chilianwala and Gujarat in 1849 (medal with two clasps, colonel, and aide-de-camp to the Queen). He served also in Kohat in 1851 under Sir Charles Napier (medal with clasp). Promoted major-general in 1854, he was commander-in-chief of the Madras army from 1866 to 1861. He was made K.C.B. in 1857, and on General Anson's death was summoned to Calcutta to take su-

preme command of the army in India. From Calcutta he directed the operations against the mutineers, sending forces under Havelock and Outram for the relief of Cawnpore and Lucknow, until the arrival of Sir Colin Campbell from England as commander-in-chief, when he returned to Madras. On leaving India in 1861 he was decorated with the G.C.B., and made colonel of the 104th Foot and later of the Seaforth Highlanders. He was promoted lieutenant-general in 1862, was governor of Malta from 1867 to 1872, was made G.C.M.G. in 1868, promoted general in 1870, field marshal in 1883, and colonel of the Eoyal Horse Guards and gold-stick-in-waiting to the Queen in 1886. He married as his second wife, in 1844, Frances Maria, daughter of Lord (then Sir Hugh) Gough. He was governor of the Eoyal Hospital, Chelsea, from 1874 until his death there on 28th March 1895. (k. h. v.)

Grant, Robert (1814-1892), British astronomer, was born at Grantown, Scotland, on 17th June 1814. In early youth he exhibited marked ability, but at the

age of thirteen the promise of a brilliant career was clouded by a prolonged illness of such a serious character as to incapacitate him from all school-work for six years. At the age of twenty, however, his health greatly improved, and he set himself resolutely, without assistance, to repair the disadvantages of his earlier years, devoting himself to the study of Greejj, Latin, Italian, and mathematics. Astronomy also occupied much of his attention at this time, and he was encouraged in the study of this subject by the interest attaching to the return of Halley's comet in 1835, and the annular eclipse of the sun of 16th May 1836, which he successfully observed. After a short course at King's College, Aberdeen, he obtained employment in his brother's counting-house in London, but still devoted his leisure hours to a systematic study of astronomy and mathematics. It was during this period that the idea occurred to him of writing a history of physical astronomy. For some time he had been accumulating materials suitable for such a history, but before definitely commencing the work he had to search, amongst other

records, those of the French Academy, and for that purpose took up his residence in Paris in 1845, supporting himself by giving lessons in English. Returning to London in 1847, he devoted the next five years to the preparation of his classic work, The History of Physical Astronomy from the Earliest Ages to the Middle of the Nineteenth Century. This was first published in parts in Tlie Library of Useful Knowledge, but after the issue of the ninth part this mode of publication was discontinued, and the work appeared as a whole in 1852. The main object of the work is, as expressed by the author, ” to exhibit a view of the labours of successive inquirers in establishing a knowledge of the mechanical principles which regulate the movements of the celestial bodies, and in explaining the various phenomena relative to their physical constitution which observation with the telescope has disclosed.” The lucidity and completeness with which a great variety of abstruse subjects were treated, the extent of research, and the maturity of judgment it displayed, were remarkable, the more so when

we consider that this was the first published work of one who enjoyed no special opportunities, either of acquiring materials or of discussing the subjects it treats of with others engaged in similar pursuits. The book at once attracted the attention of astronomers, and took a leading" place in astronomical literature. In 1856 the gold medal of the Eoyal Astronomical Society was awarded to Grant for his work. In 1869 he succeeded Nichol as professor of astronomy in the University of Glasgow, and took up his residence at the Glasgow Observatory during the following year. From time to time he contributed astronomical papers to the Monthly Notices, Astronomische Nachrichten, Comptes Rendus, and other scientific serials, but his principal work after his appointment to Glasgow consisted in determining the places of a large number of stars with the Ertel transit-circle of the Glasgow Observatory. The results of these labours, extending over a period of twenty-one years, are contained in the Glasgow Catalogue of 6415 Stars, published in 1883. This was followed in 1892 by the Second Glasgow Catalogue of

2166 Stars, published a few weeks after his death, which took place on the 24th October 1892.

(a. a. r.*)

Grant, Ulysses Simpson (1822-1885), American soldier, and eighteenth President of the United States, was born at Point Pleasant, Ohio, 27th April 1822. He was a descendant of Matthew Grant, a Scotsman who settled in Dorchester, Mass., in 1630. His earlier years were spent in helping his father in the work upon his farm in Ohio. In 1839 he was appointed to a place in the military academy at West Point, and it was then that his name assumed the form by which it is generally known. He was christened Hiram, after an ancestor, with Ulysses for a middle pame ; in those days it was fashionable to call men by Greek and Roman names. As he was usually called by his middle name, the Congressman who recommended him for West Point supposed it to be his first name, and generously added thereto the name of his mother’s family, Simpson. Grant’s career at West Point was not especially brilliant ;

he was the best horseman of his class, and took a re-
spectable place in mathematics, but he only ranked
twenty-first in a class of thirty -nine. In September 1854
he went with his regiment to join the forces of General
Taylor in Mexico ; there he took part in the battles of
Palo Alto, Resaca de la Palma, Monterey, Cerro Gordo,
and Churubusco, and was at the storming of Chapultepec.
He was breveted captain for gallantry. After the close
of the war he married, and was for a while stationed in
California, but in 1854 he resigned his commission. He
had acquired a taste for liquor, which impaired his
usefulness and injured his reputation in the army. For
the next six years he lived in St Louis, earning a scanty
subsistence by dealing in real estate. In 1860 he moved

to Galena, Illinois, and became a clerk in a hardware
store kept by his father. At that time his earning
capacity seems not to have exceeded 800 dollars a year,
and he was regarded by his friends as a broken and dis-

appointed man.

After the outbreak of the Civil War, in the following year, he offered his services to the United States Government, but no heed was paid to him. After some vexatious delay, he obtained from the governor of Illinois a commission as colonel of volunteers, and about the 1st of August he was promoted to the rank of brigadier-general and placed in command of a district of the western department under General John Pope. The Confederate General Polk had occupied the bluffs at Columbus and was threatening to seize the town of Paducah, situated at the confluence of the Tennessee river with the Ohio. It was of the utmost importance

that the latter step should
be prevented, and Grant, act-
ing on his own responsibility,
moved rapidly forward and
seized Paducah, 6th Septem-
ber 1861. In November he
made a demonstration ii
Missouri, and fought at Bel
mont his first battle, ii
which both sides claimed th(
victory. Three months late
came his first great achieve
ment, when he captured For
Henry on the Tennessee
river and Port Donelson on
the Cumberland. This great
victory, in which 15,000
Confederates were taken
prisoners, broke through the
enemy's first line of defence, and compelled them to

fall back upon Corinth in Mississippi. His next military operation was directed against Corinth, where General Sidney Johnston had accumulated an army of about 40,000 men. On arriving at Pittsburg Landing on the Tennessee river, some 20 miles from Corinth, Grant occupied a very strong position on the SMioh' ^®** bank, intending to hold it until the arrival of General Buell with his army from Nashville. After the junction of the two armies, amounting to more than 70,000 men, it was intended to move in overwhelming force on Corinth. When Johnston learned of Grant's presence at Pittsburg Landing with no more than 40,000 men, he decided to advance suddenly and surprise him, in the hope of winning a victory before Buell's arrival. Circumstances so delayed the operation that Buell's advance division had arrived at Savannah, only 9 miles below Pittsburg Landing, on the evening before the attack was made. There has been much discussion as to whether Grant was really surprised on the Sunday morning, 6th April 1862, when the Con-

federates charged upon his camp. It is perfectly clear that he was not aware of the presence of Johnston's force in his neighbourhood, and did not expect any attack to be made before the middle of the week. When the firing began on Sunday morning Grant was 9 miles distant at Savannah. The division of Lew Wallace, 7000 men, was at Crump's Landing, 5 miles

Gbnekal TJ

(From aplioiograph hy F.

below the scene of the battle. The position at Pittsburg Landing, where the principal command was exercised by Generals M'Clernand and Sherman, was a strong one, protected on three sides by creeks, which were swollen with backwater from the great river. The open front towards the south-west, marked by a rude meeting-house known as Shiloh, ought to have been protected by earthworks ; this precaution, however, had been neglected. Johnston's plan was to attack by his right flank and cut off the Union army from Pittsburg Land-

ing, which would involve its

destruction or capture; but
his attack was not correctly
planned for that purpose.
His force was not sufficiently
massed upon his right, and
his main blow was directed
too near the Federal centre.
The attack was conducted
with magnificent gallantry,
but the resistance of the
Federal troops was very ob-
stinate, and although their
organization was much im-
paired, it was with great slow-
ness that they were pushed
back. About the middle
of the forenoon the Union
general, Benjamin Prentiss,
secured a difficult position,
since known as the Hornet's

Nest, and maintained it until
late in the afternoon despite
all the efforts of the Confede-
rates. Early in the afternoon,
while assaulting this position,
Johnston was killed, and
the command devolved upon
General Beauregard. At
nightfall it was manifest that
the Confederate attack had
failed. Lew Wallace's divi-
sion had been greatly delayed
in its march by imperfect information, and Nelson's
division of Buell's army had been equally delayed by
the detestable spring roads, but at nightfall both these
divisions arrived upon the battlefield, adding 15,000
fresh men to the Union force ; and so many steamboats
had now been collected at Savannah tbat two more of
Buell's divisions were comfortably brought up the river
during the night. It was evident on Monday that

Beauregard's battle was fought, not so much in the hope of victory, as in order to secuTC an unmolested retreat. This he accomplished. In the afternoon he withdrew his army with much skill, leaving the Federals too weary to pursue. In this great battle more than 20,000 men were killed and wounded, and the Federals lost besides 3000 prisoners. It was an important victory for the Federals, inasmuch as it decided the fate of Corinth; but those who blamed Grant for the surprise were perhaps quite as many as those who praised him for the victory. His position during the summer was a trying one, since Halleck came and took command of the entire force, thus placing Grant second in command, without assigning him any important duties. The campaign was conducted by Halleck with such feebleness that the advantages hitherto gained were in great part thrown away. For the loss of Corinth the Confederates consoled themselves by fortifying Vicksbufg and Port Hudson on the Mississippi river, and Chattanooga on the mountainous confines of Tennessee and Georgia. The conquest of

. 8. Geant.

Gutekv/tist, Philadelphia.)

these two strongholds employed two great armies during the whole of the year 1863.

In the midsummer of 1862 Halleek was appointed general-in-chief of the armies of the United States, and in that capacity transferred his headquarters to Washington, lea-ving Grant in command at Corinth. His force had been so depleted by Halleck's scattered operations that the Confederates now made an attempt to drive him down the Tennessee river. The result was seen in the battles of luka and Corinth early in October 1862, when the Confederates were defeated by a portion of Grant's force under Eosecrans, for whom the Opera- victory won so much reputation that he was vicksburg. appointed to supersede Buell in command of the army in Tennessee. It was the prelude to Grant's first movement against Vicksburg. That city

had been fortified and guarded by the Confederates in such wise that it was deemed impregnable, and it might well have been thought so. The place is situated on a steep and lofty bluff at the junction of the Yazoo river with the Mississippi. The latter flows in a serpentine course through a low flat basin about 40 miles in width. It is perpetually changing its course, and the land on either side is intersected in all directions by sluggish streams and stagnant lakes, the remnants of its abandoned channels. In such a country operations with an army are impossible. At long intervals, however, the river flows entirely on one side of its basin and washes the foot of the steep hills by which it is bounded. Wherever such a cliff occurred, as at Columbus, Memphis, and other points, it was defended by the Confederates, and when they lost it they lost the river down to the next similar point. Now the combination of circumstances at Vicksburg was peculiar. Its position was too lofty to be taken by the fleet unaided, but the only direction from which it could be safely approached by

an army was from the rear, that is to say, from the east ; and the correct line of approach was that of the Mississippi Central railway, with Memphis for the Federal base of supplies. For an army coming either up or down the Mississippi the problem was almost insoluble. It was impossible to get in the rear of the city by landing to the north of it, for the approaches were there guarded by batteries on Haines Bluff which could shoot down any assailing column faster than it could advance. On the other hand, an army landing to the south of Vicksburg incurred the risk of starvation, since the guns of Vicksburg prevented supplies from passing down stream, while the guns of Port Hudson 200 miles below equally prevented them from passing up. Grant's first movement against Vicksburg was the correct one, along the Mississippi Central railway ; but because of his deficiency in cavalry, his line of communications was cut and he was obliged to retreat upon Corinth. Meanwhile a separate expedition under Sherman had been sent down the Mississippi river. It landed at Chickasaw Bayou,

and attempted to storm the works at Haines Bluff in order to gain a foothold to the north of Vicksburg. This enterprise met with a bloody repulse. A period of intrigue succeeded, the result of which was that Grant felt obliged to abandon his first plan and take his whole army down the river to Vicksburg. After arriving on the west bank of the Mississippi opposite the mighty stronghold, the problem before him was to get his army into its rear. Two fruitless months were spent in attempts to navigate the intricate and tortuous system of bayous, in order either to land the army northwards without encountering the guns of Haines Bluff, or to carry supply-ships' southwards by routes not commanded by the batter! efe of Vicksburg. Meanwhile Grant's popularity greatly declined, and President Lincoln was urged to remove him from command. But Lincoln's, reply was, "I rather like the man ; I guess we will try him a little longer." At this crisis Grant conceived a most daring scheme ; and having heard it condemned by every one of his generals, he proceeded to try it on his own responsibility. On the

16th of April Porter's fleet was taken down the river below the city, sustaining slight damage from its batteries. Peints were made to the northward, while the body of the army was rapidly marched to Bruinsburg, about 25 miles below Vicksburg. A crossing was effected near that place, and the Confederates were defeated in an obstinate battle at Port Gibson. This obliged them to evacuate Grand Gulf, the strongest of the outposts to the southward. From Port Gibson Grant then proceeded to march north-easterly upon the city of Jackson, the capital of the state of Mississippi, intending to find and defeat Joseph Johnston, who was approaching to relieve Vicksburg. Grant's object was to throw himself between Johnston's army and that of Pemberton, the commander at Vicksburg, and to defeat them in detail. In order to do this, it was necessary for him to keep his army concentrated, and he could not spare troops to guard his line of communications with the Mississippi river. He therefore cut loose from his base altogether, and conducted this marvellous campaign upon such, food

as his men could carry in their knapsacks or seize in the course of their march. To avert certain ruin it was necessary that he should be victorious at every point ; and he was. Having defeated Johnston in two battles, at Eaymond and again at Jackson, he instantly faced about to the west and marched against Pemberton, who had come out to intercept his supposed line of communications. In a bloody battle at Champion Hill Pemberton was totally defeated, and his ruin was completed the next day at the Big Black river. Pemberton then retired into Vicksburg with the remnant of his force, while Sherman approached Haines Bluff in the rear and compelled the enemy to evacuate it. The supposed insoluble problem was now virtually at an end, for Grant's line of supplies from the northward was opened and made secure. Mindful of the possibility that Johnston might sufficiently recover strength to interrupt operations. Grant tried to carry Vicksburg by storm, and two assaults were made which were repulsed with great slaughter. He then resorted to siege operations, and by the third day of July

the city was starved into submission. By this brilliant campaign Grant's reputation was at once raised to a very high pitch. He was made major-general in the regular army, and henceforth was allowed to have his own way in most things.

His next field of action was at Chattanooga. The Confederate commander, Braxton Bragg, had been driven out of that place by Eosecrans in a series of skilful manoeuvres ; but, in attempting to pursue Bragg through the difficult mountain country to the south, Eosecrans allowed the two wings and the centre of his army to become too widely separated, thus exposing himself to swift detraction. Bragg failed to seize the opportunity offered him, but nevertheless succeeded in bringing Eosecrans to battle in the valley of Chickamauga. There, in a murderous battle, in which nearly 40,000 men were killed or wounded, the Union right wing and centre were routed ; but General Thomas, with almost incredible skill and bravery, not only saved the left wing, but very nearly retrieved the situation. Eosecrans retired his army into

Chattanooga, but had not sufficient force to hold the crests of Lookout Mountain and Missionary Eidge, which were forthwith occupied by the Confederate army. This operation left the Union army without any good line of communications. The only route by which food could be brought was a long and difficult waggon road over a spur

of the Cumberland Mountains known as Waldron’s Eidge. Drenching rains set in, the mules died on the route and blocked up the way, and presently the Union army suffered for want of food. Indeed, something like a famine set in, and nearly all the horses perished for want of forage. At this crisis Grant was appointed to command all the armies west of the Alleghanies, increased by the transfer of two corps from the army of the Potomac to that of the Cumberland. His first proceedings were to supersede Eosecrans by Thomas, and to order up Sherman from Vicksburg. By a beautiful series of operations an excellent line of communication was opened by General

William Farrar Smith, and the sufferings at Chattanooga were relieved. On the arrival of Sherman's force it was moved by a circuitous and secret route to the north end of Missionary Eidge near Chickamauga station on the Dalton railway, by which Bragg received his supplies. At this time Longstreet, who had been sent from Virginia to Bragg's assistance, and had taken part in the battle at Chickamauga, was engaged in a subsidiary operation. He had been imprudently sent away by Bragg to lay siege to Knoxville, and his line of communications was also the railway from Dalton. Bragg's left wing occupied the summit of Lookout Mountain, while his centre and right stretched along the crest of Missionary Eidge for a space of 5 or 6 miles. Under these conditions Grant's plan of battle was simple. His reinforcements from Virginia, commanded by Joseph Hooker, were in Lookout Valley. He proposed to make a demonstration with these troops which should engross Bragg's attention, while Sherman at the opposite extremity of the field should storm the northern end of Missionary Eidge, cut

off Bragg from the Dalton railway and crush his right wing, thus wrecking his army ; but the battle, as fought, proceeded upon a very different plan. The accidental breaking of a pontoon bridge left in Lookout Valley one division of men which had been destined for Sherman's part of the field. This additional force so far strengthened Hooker that in the course of the fight which ensued upon Lookout Mountain he carried the whole position by storm, driving the Confederates down upon Missionary Eidge. On the other hand, Sherman's enter-
Battie at prise was frustrated by an unforeseen obstacle. Ridge""^^ After he had surmounted the northern extremity of Missionary Eidge he was confronted by a yawning chasm which none of the Federal glasses had been able to detect, and as there were no good topographical maps, its existence was unknown. The crests beyond were crowned with Confederate artillery, and well manned. In these circumstances, the part that Sherman played, though a very useful one, was different from what had been intended. On the second day of

the battle he attacked the heights before him; he was unable to carry them, but his pressure upon that vital point was so strong that it led Bragg to keep on reinforcing it at the expense of his centre, which was confronted by the army of General Thomas. Presently Grant, fearing for Sherman and wishing to stop this northward movement of Confederates, ordered four of Thomas's divisions to make a bayonet charge in front. They were to carry the Confederate works at the foot of Missionary Eidge and then halt and await orders. At that moment Grant was building better than he knew. The line of 20,000 men swept like an avalanche over the works at the foot of the ridge, and then in an uncontrollable spirit of victory kept on without orders, making their way up the perilous height. As they reached the top they broke through the Confederate centre in at least six different places, while at the same moment Hooker, who had come down from Lookout Mountain, overwhelmed Bragg's right and sent it tumbling in upon his routed centre. In a few moments the remnant of the Confederate army was a

disorderly mob fleeing for life. This great victory secured for the northern army the line of the Alleghanies, as the capture of Vicksburg had secured the line of the Mississippi.

Grant's fame was now at its zenith. The rank of lieutenant-general was revived for him, and he was made general-in-chief of the armies of the United States. This appointment gave to the military °a"chief. operations of 1864 a greater coherence than that of former years. The theatre of war was now practically reduced to the seaboard states, Georgia, the two Carolinas, and Virginia. The Confederacy still possessed two formidable armies, one at Dalton in Georgia, commanded by Joseph Johnston, who had superseded Bragg, the other on the river Eapidan in Virginia, commanded by Lee, who seemed unconquerable. Grant's plan was to go directly by the overland route against Lee, while Sherman should advance from Chattanooga against Johnston. In Virginia, Grant took command in person. He now found himself opposed

by a general of far greater calibre than any of those against whom he had contended in the west. The events of this last year added nothing to his military reputation. While they revealed in many ways Grant's fine soldierly qualities, it was nevertheless unquestionable that upon every occasion he was out-generalled by Lee. The first period of the summer's fighting began on 5th May 1864, and lasted until 3rd June. It was marked by the terrible battles of the Wilderness, Spottsylvania, and Cold Harbor, in the course of which Grant lost more than 60,000 men killed and wounded without making any perceptible advance towards the object of the campaign. In one of his despatches in May he had said, "I propose to fight it out on this line if it takes all summer," but after his bloody repulse at Cold Harbor, 3rd June, he abandoned that line and chose a different method of circumventing Lee and approaching Eichmond. He did what M'Clellan was on the point of doing two years before when he was overruled by Halleck. He crossed the James river and moved upon

Petersburg, a point from which he might hope to cut Lee's communications with points to the southward. But this movement was only partially successful ; the Confederates succeeded in reaching Petersburg first, and the affair settled down into a siege which lasted both summer and winter. Meanwhile the ground was being cut from under Lee's feet. In a masterly campaign Sherman pushed Johnston back upon Atlanta. Jefferson Davis superseded Johnston by Hood, a general who believed in hard blows, and soon received some at Sherman's hands. The result was the fall of Atlanta. Hood then made a dash towards Tennessee, hoping to draw Sherman after him, but the force of the latter was sufficiently large to allow of his dividing it. He took 60,000 men with him on a march to the seaboard, there to obtain a new base from which to move to the assist-ance of Grant. The success of this sweeping movement was entirely dependent upon the crushing of Hood when the latter should invade Tennessee. This work was entrusted to General Thomas, who was left with about

20,000 men, while as many more were summoned from different quarters to reinforce him. On the 15th and 16th of December, in a masterly battle before Nashville, perhaps the most brilliant action of the war, Thomas completely annihilated the army of Hoodf A few days later Sherman reached Savannah, and began from that point his northward march against Lee. The Confederates gathered a remnant of about 20,000 men to oppose him, the command being once more entrusted to the sagacious Johnston. In an exciting display of strategy Johnston was driven north-

wards before Sherman until the northern portion of North Carolina was reached. For a moment it seemed that the armies of Johnston and Lee would coalesce, only to be crushed between Grant and Sherman as the upper and the nether millstones, but this wg-s prevented by Sheridan's brilliant victory at Five Forks, which turned Lee's right wing and cut off his southward retreat. Weight of numbers on the northern side at length became irre-

sistible ; Grant, with 100,000 men, broke through Lee's centre at Petersburg, the Confederate Government abandoned Richmond, and in a few days Lee surrendered the remnant of his army at Appomattox Courthouse. A few days later Johnston surrendered his army to Sherman, and the great Civil War was over.

After the assassination of President Lincoln a disposition was shown by his successor, Andrew Johnson, to deal severely with the Confederate leaders, and it was understood that indictments for treason were to be brought against General Lee and others. Grant nipped these proceedings in the bud by insisting that the United States Government was,boundby the terms which he had accorded to Lee and his army at Appomattox. He went so far as to threaten to resign his commission if the President disregarded his protest. This energetic action on Grant's part saved the United States from a foul stain upon its escutcheon. In the summer of 1866 the grade of general was created, and Grant was promoted to that position.

In the course of the following year he became involved in

the deadly quarrel between President Johnson and Congress. In order to tie the President's hands Congress had passed the Tenure of Office Act, forbidding the President to remove any cabinet officer without the consent of the Senate ; but in August 1867 President Johnson suspended Secretary Stanton and appointed Grant secretary of war ad interim until the pleasure of the Senate should be ascertained. Grant accepted the appointment under protest, and held it until the following January, when the Senate refused to confirm the President's action, and Secretary Stanton resumed his office. President Johnson was much disgusted at the readiness with which Grant turned over the office to Stanton, and a bitter controversy ensued between Johnson and Grant. Hitherto Grant had taken but little part in politics. The only vote which he had ever cast for President was in 1856 for James Buchanan ; and sundry leading Democrats, so late as the beginning of 1868, hoped to make him their candidate in the election of 1868; but the effect of the controversy

with President Johnson was to bring Grant forward most conspicuously as the candidate of the Eepublican party. At the convention in Chicago, 20th May 1868, he was unanimously nominated on the first ballot. The Democratic party soon afterwards did all in its power to help his election by nominating as his competitor the one Democrat in the United States who had the smallest chance of beating him — Horatio Seymour, lately governor of New York, an excellent statesman, but at that time quite hopeless as a candidate because of his attitude during the war. The result of the contest was at no time in doubt; Grant received 214 electoral votes, and Seymour 80.

The most important domestic event of Grant's first term as President was the adoption of the fifteenth amendment to the Constitution, 30th March 1870, guaranteeing the right of suffrage throughout the United States without regard to race, colour, or previous condition of servitude. The most important event in foreign policy was the treaty with Great Britain of 8th May 1871, com-

monly known as the Treaty of Washington, whereby several controversies between the United States and Great Britain, including the bitter questions as to damage

Presi-

dency,

1868.

inflicted upon the United States by the Alabama and other Confederate cruisers built and equipped in England, were amicably referred to arbitration. In 1869 the Government of San Domingo expressed a wish for the annexation of that island by the United States, and such a step was favoured by Grant, but it failed to obtain the requisite two-thirds vote in the Senate. In May 1872 something was done towards alleviating the odious Eeconstruction laws for dragooning the South, which had been passed by Congress in spite of the vetoes of President Johnson. The Amnesty Bill restored civil rights to all persons in the South, save some 350 who had held high positions under the Confederacy. As early as 1870 President Grant recommended measures of civil service reform, and suc-

ceeded in obtaining an Act authorizing him to appoint a Civil Service Commission, and to prescribe rules for its proceedings. A commission was accordingly created, but owing to the persistent hostility of the politicians in Congress it accomplished but little. The need for such civil service reform was beginning to be sorely felt by the country. During the fifty years since Crawford's Tenure of Office Act was passed in 1820, the country had been growing more and more familiar with the spectacle of corruption in high places. The evil rose to alarming proportions during Grant's Presidency, partly because of the immense extension of the civil service, partly because of the growing tendency to alliance between spoilsmen and the persons benefited by protective tariffs, and partly because the public attention was still so much absorbed in Southern affairs that little energy was left for curbing rascality in the North. The scandals, indeed, were rife in Washington, and affected persons who were in close relations with the President, so that evil-minded persons were inclined to suspect him of complicity with the

rogues. President Grant was ill fitted for coping with the difficulties of such a situation. Along with high intellectual powers in certain directions, he had a simplicity of nature quite charming in itself, but often calculated to render him the easy prey of sharpers. He found it almost impossible to believe that anything could be wrong in persons to whom he had given his friendship, and on several occasions such friends proved themselves unworthy of him. The feeling was widely prevalent in the spring of 1872 that the interests of pure government in the United States demanded that President Grant should not be elected to a second term. This feeling led a number of high-minded gentlemen to form themselves into an organization under the name of Liberal Republicans. They held a convention at Cincinnati in May with the intention of nominating for the Presidency Charles Francis Adams, who had so ably represented the United States at the Court of St James's during the Civil War. The convention, was, however, captui-ed by politicians who converted the whole affair into a farce by nominating

Horace Greeley, editor of the New York Tribune, who represented almost anything rather than the object for which the convention had been called together. The Democrats had been awaiting the action of this convention; they despaired of electing a candidate of their own, and hoped to achieve success by adopting the Cincinnati nominee, should he prove to be an eligible person. The event showed that while their defeat in 1868 had taught them despondency, it had not taught them wisdom; it was still in their f^‘f^^’ power to make a gallant fight by nominating a person for whom Republican “reformers could vote. But, with almost incredible fatuity, they held a convention and adopted Greeley as their candidate. As a natural result Grant was re-elected by an overwhelming majority.

The most important event of his second term was his

veto of the Inflation Bill in 1874, followed by the passage

of the Eesumption Act in the following year. The country was still labouring under the curse of an inconvertible paper currency created by the Legal Tender Act of 1862. There was a considerable party in favour of debasing the currency indefinitely by inflation, and a Bill with that object in view was passed by Congress in April 1874. It was promptly vetoed by President Grant, and two months later he wrote a very sensible letter to Senator Jones of Nevada advocating a speedy return to specie payments. The passage of the Eesumption Act in January 1875 was largely due to his consistent advocacy, and for these measures he surely deserves as high credit as for any of his victories in the field. In spite of these great services, popular dissatisfaction with the Republican party rapidly increased during the years 1874-76. The causes were twofold: firstly, there was great dissatisfaction with the troubles in the Southern states, owing to the harsh Reconstruction laws and the robberies committed by the carpet-bag governments which those laws kept in power ; secondly, the scandals

at Washington, comprising wholesale frauds upon the public revenue, awakened lively disgust. In some cases the culprits were so near to President Grant that many persons found it difficult to avoid the suspicion that he was himself implicated, and never perhaps was his hold upon popular favour so slight as in the summer and autumn of 1876.

After the close of his Presidency in the spring of 1877 Grant started on a journey round the world, accompanied by his wife and one son. He was received with distinguished honours in England and on the continent of Europe, whence he made his way to India, China, and Japan. After his return to America he went

- ^ ** back to his old home in Galena, Illinois. A

faction among the managers of the Republican party attempted to secure his nomination for a third term as President, and in the convention at Chicago in June 1880 he received a vote exceeding 300 during 36 consecutive ballots. Nevertheless, his opponents made such effective use of the popular prejudice against third terms

that the scheme was defeated, and Garfield was named in his stead. In August 1881 General Grant bought a house in the city of New York. His income was insufii-cient for the proper support of his family, and accord-ingly he had become partner in a banking house in which one of his sons was interested along with other persons. The name of the firm was Grant and Ward. The ex-President invested in it all his available property> but paid no attention to the management of the business. His facility in giving his confidence to unworthy people was now to be visited with dire calamity. In 1884 the firm became bankrupt, and it was discovered that two of the partners had been perpetrating systematic and gigantic frauds. This severe blow left General Grant quite penniless, just at the time when he was beginning to suffer acutely from the disease which finally carried him off. Down to this time he had never made any pre-tensions to literary skill or talent, and had never regarded himself in the light of an author ; but, on being approached by the Century Magazine with a request for some articles,

he undertook the work in order to keep the wolf from the door. It proved a congenial task, and led to the writing of his Personal Memoirs, a frank, modest, and charming book, which ranks among the best standard military biographies. The sales earned for the general and his family something like half a million dollars. The circumstances in which it was written made it an act of heroism comparable with any that Grant ever showed as a soldier. During most of the time he was suffering tortures from cancer in the throat, and it was only four days before his death that he finished the manuscript.

In the spring of 1885 Congress passed a Bill creating him a general on the retired list; and in the summer he was removed to a cottage at Mount M'Gregor, near Saratoga, where he passed the last five weeks of his life, and where he died on the 23rd of July 1885. His mortal remains were deposited in a tomb in Riverside Park, in New York City, overlooking the Hudson river.

As a soldier Grant possessed very high qualities; the combination of self-reliant courage, fertility of resource,

and swiftness in action was perhaps never more perfectly realized than in his wonderful campaign ”"’^’’• in the rear of Vicksburg. He was invariably patient and equable in temper in the most trying circumstances, neither elated by success nor cast down by ill-fortune. For dogged persistency he has never been surpassed. He possessed, in a high degree, that quick and subtle appreciation of topography which is essential to success in great military operations. Though he was slow and deliberate in conversation and in the ordinary movements of his body, his thoughts moved nimbly and his military actions were marked by promptness. Yet, in spite of Vicksburg, one can hardly accord him a place in the first rank of military commanders. He never rose to the grade of Napoleon or Frederick, although in some of his movements we can see Napoleonic touches. When he was pitted against Lee, in the last year of his military life, there could be no doubt as to the superior genius of the Confederate general. In character Grant showed many admirable and lovable traits. There was a charming side

to that trustful simplicity, which was at times almost like that of a sailor set ashore. He abounded in kindliness and generosity, and if there was anything especially difficult for him to endure, it was the sight of human suffering, as was shown on the night at Shiloh, where he lay out of doors in an icy rain rather than stay in a comfortable room where the surgeons were at work. His good sense was strong, as well as his sense of justice, and these qualities stood him in good service as President, especially in his trimnphant fight against the greenback monster. Altogether, in spite of some shortcomings. Grant was a massive, noble, and lovable personality, well fit to be remembered as one of the heroes of a great nation.

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Grantham, a municipal borough, incorporated in the 15th century (extended 1879), parliamentary borough (now returning only one member), and market-town of Lincolnshire, England, on the Witham, 105 miles north of London by rail. Area of municipal borough, 1677 acres. Population (1881), 16,886 ; (1901), 17,593.

Granville, a seaport and bathing resort in the arrondissement of Avranches, department of Manche, France, with terminal station on railway, 204 miles from Paris. Granville ranks next to Bordeaux as a market for cod-fish from Newfoundland. The total number of vessels (not includingthoseengagedincoastingtrade) entered and cleared in 1899 was, respectively, 252 of 43,416 tons, and 260 of 48,160 tons. Population (1881), 9693; (1891), 10,373; (1901), 11,667. In the commune are included the Chausset Islands, which lie 7 miles to the W.N.W. of Granville. They are a group of 52 islands, extending east and

west for a length of 7 miles, and north and southfor 5 miles.

but only Grande (100) is inhabited. It has a fort, lighthouse, and semaphore, and there are important granite quarries.

Cranviile, George Leveson – Cower, 2nd Earl (1815-1891), English statesman, eldest son of the 1st Earl (1773-1846), the friend of Canning and ambassador at Paris (1824-41), was born in London, 11th May 1815. After being at Eton and Christ Church, he was at Paris as attache under his father, until, in 1836, he was returned to Parliament in the Whig interest for Morpeth. For a short time at the end of Melbourne's ministry he was Under-Secretary for Foreign Affairs. Prom 1841 until his father's death in 1846 he sat for Lichfield. In the House of Lords he signalized himself as a Free Trader, but he was regarded as a courtly wit and a dandy rather than as a serious politician, and Lord John Eussell made him Master of the Buckhounds (1846). He was made Vice-President of the Board of Trade in

1848, and in December 1851 succeeded Palmerston at the Foreign Office for a short time ; in 1853 he became President of the Council. He took a prominent part in the promotion of the Exhibition of 1851 abroad, especially at Paris, and w«Q golden opinions from the French. From 1855 Granville led the Liberals in the Upper House, and in June 1859 Queen Victoria, embarrassed by the rival ambitions of Palmerston and Russell, sent for him to form a Ministry, but Russell preferred to serve under Palmerston, and Granville was quite content to be President of the Council; in 1866 he retired with the Ministry, having meantime been appointed Lord Warden of the Cinque Ports. In December 1868 he became Colonial Secretary in Gladstone's first administration. His tact was invaluable to the Government in carrying the Irish Church and Land Bills through the House of Lords. On 27th June 1870, upon the death of Lord Clarendon, he was transferred to the Foreign Office. As Foreign Minister (1870-74 and 1880-85) Lord Granville was amiable but weak, and his periods of office

were marked by a good deal of nerveless diplomacy, for which Great Britain both then and since had to pay dear. The Franco-German war of 1870 broke out within a few days of his pronouncement that not a cloud obscured the political horizon. Russia took advantage of the situation to denounce the Black Sea clauses of the Treaty of Paris (1856), Lord Granville' s protest being entirely reasonable but quite ineffectual. In 1871 an intermediate zone was described by Granville and Gortchakoff between Russia and Afghanistan. When, however, in 1873, Russia took permanent possession of Khiva (within the neutral zone), Granville had to accept Schuvaloff's " assurances " that the advance was temporary. The Conservatives came back to power in 1874, and Granville's part for the next six years was to criticize Disraeli's "spirited" foreign policy, a task which he performed with much graceful irony, and to defend his own more pliant methods. He returned to the Foreign Office in 1880, but his policy remained an ineffectual one. In 1883-84 he was severely rebuffed by Bismarck over the Angra-Pequena question.

With a mind as open as Gladstone's to the reception, even in old age, of entirely new ideas, Granville adhered to his chief in the question of Home Rule (1886), and gave way with his accustomed grace to Lord Eosebery when the latter was preferred to the Foreign Office.

He took charge of the Colonial Office (February-July 1886) for his remaining six months of office, though he was far from being persona grata in the colonies ; and he retired from public life in the summer of 1886.

He died in South Audley Street, London, on 31st March 1891. Lord Granville was an admirable after-dinner speaker and one of the most charming talkers. He spoke French like a Parisian, but with a slight Court accent recalling the ancien regime. He was a master of the art of diplomatic fencing and word-play, but he had no grasp of the really important problems which were gradually coming to the front in the British Empire.

Craslitz, a town in the north-west of Bohemia (Austria), near the Saxon frontier. It has a station on the Falkenau and Buschtiehrader railways. One of the most

important industrial centres of Bohemia, its specialties are the manufacture of musical instruments, carried on both as a factory and domestic industry, and lace-making. Next in importance is cotton-spinning and weaving, machine embroidery, &c., and the mother-of-pearl industry. Graslitz, which is distinguished by its strong German-Nationalist sentiment, was the scene of some violent demonstrations in 1899, which were accompanied by loss of life. Population, all German (1900), 11,803.

Crasse, chief town of arrondissement, department of Alpes Maritimes, France, 30 miles W.S. W. of Nice by rail. About 2,000,000 ft of roses and 4,000,000 ft of orange flowers are annually produced for the distillation of essences. There are also important manufactures of olive and sweet almond oil. Population (1881), 7597 ; (1901), 15,429.

Cratz, or Geaz, capital of the Austrian crownland of Styria. It possesses a number of interesting public monuments, two bridges, a new synagogue, a technical college, a new university building, a town haU (1892), a large

new museum (1895), a court of justice, &c. The univer-
sity is attended by about 1550 students, including Italians
from the Ktistenland and Dalmatia. The polytechnic is
attended by nearly 400 students. There are four gym-
nasia, two realschule, and five other technical and special
high schools. Not only trade, but also industry, has made
great progress in consequence of increased railway facili-
ties and the establishment in the town of the extensive
workshops of the Southern railway. Its manufactures
now include rails, machinery, bicycles, &c., and all kinds
of iron and steel goods; paper, perfumes, leather and
leather goods ; sugar, soap, chemicals, physical and optical
instruments ; and pottery, champagne, beer, flour, and
artistic printing and lithography, &c. Gratz played a
prominent part in the German national agitation under
the Badeni and Thun ministries, and was the scene of

violent demonstrations against the Government, which were repressed with loss of life. The progress of Socialism among the working classes has been as marked among the labourers as that of the Pan-Germanic sentiment among the other sections of the community. The ” Emancipation from Rome ” movement also aroused a strong echo in Gratz, particularly among the students. Population, almost wholly German and Roman Catholic (1890), 112,069 ; (1900), 138,270.

Craudenz, a town of Prussia, province of West Prussia, on the right bank of the Vistula, 37 miles by rail north by east from Thorn. It is a place of considerable manufacturing activity, especially in carriages and carpets, though there are also iron-foundries, flour-mills, breweries, and brick-works, a large trade in corn, cattle, horses, timber, and wool. The town possesses a museum, and a monument (1815) to Courbi^re, the defender of the town in 1807. Graudenz is an important place in the German system of fortifications, belonging to the cluster of forts on the eastern frontier. Population (1885), 17,336 ;

(1900), 32,800.

Crave lines, a town in the arrondissement of Dun-
kirk, department of Nord, France, 48 miles N.W. of Lille,
with station on railway from Calais to Dunkirk. It
is a centre for the cod and herring fisheries, and fish-
salting and fiax- and hemp-spinning are amongst its in-
dustries. The situation of the port is one of the best in

Prance on the North Sea. The harbour has an area of
75 acres ; depth at entrance 18 and 16 feet, high spring
and neap tides ; the Government wet dock covers 6 acres,
and has 1968 feet of quayage ; a channel If mile long
connects with the sea, and inland there is communication
with the northern network of canals. In 1899, 162 vessels
of 21,680 tons entered, and 164 of 21,846 tons cleared.
The total tonnage of river traf&c on the Aa amounted to
88,416 tons in 1900. The export trade is mainly with
England. Population (1881), 3902 ; (1901), 6202.

Cravesend, a municipal and parliamentary borough

of Kent, England, on the Thames, 22 miles east by south of London by rail. Gravesend belongs to the port of London. The hospital has been extended. There is a college for daughters of Congregational ministers, and an industrial school for boys. Eecent erections are a technical school containing a public library, a public hall, and a sanatorium at Cobham. The town pier has been acquired by the Tilbury Railway Company. Area of municipal borough, 1256 acres. Population (1881), 23,302 ; (1901), 27,175.

Cray, Asa (1810-1888), American botanist, was born at Paris, Oneida county, N.Y., on 18th November 1810. He was the son of a farmer, and received no formal education except at a small rural academy and a provincial medical school. From the professor of chemistry and materia medica in the latter he obtained his first instruction in science (1825-26). In the spring of 1827 he first began to collect and identify plants. His formal education, such as it was, ended in February 1831, when he took the degree of Doctor of Medicine.

His first contribution to descriptive botany appeared in 1835, and thereafter an uninterrupted series of contributions to systematic botany flowed from his pen for fifty-three years. In 1836 his first botanical text-book appeared under the title Elements of Botany, followed in 1839 by his Botanical Text-Booh for Colleges, ScJwols, and Private Students. This text-book developed into his Structural Botany, written with a view to interest large numbers of readers. He published later the following smaller books: First Lessons in Botany and Vegetable Physiology, 1857; How Plants Grow, 1858; Field, Forest, and Garden Botany, 1869 ; Botany for Young People, Part II., How Plants Behave, 1872. These books served the purpose of developing popular interest in botanical studies. His most important contribution, however, was his Manual of the Botany of the Northern United States, the first edition of which appeared in 1847. This manual has passed through a large number of editions, is clear, accurate, and compact to an extrar ordinary degree, and within its geographical limits is

an indispensable book for the student of American botany.

Throughout his life Dr Gray was a diligent writer of reviews of books on natural history subjects. Often these reviews were elaborate essays, for which the books served merely as texts ; often they were clear and just summaries of extensive works; sometimes they were sharply critical, though never ill-natured or unfair; always they were interesting, lively, and of literary as well as scientific excellence. The greater part of Dr Gray's strictly scientific labour was devoted to a flora of North America, the plan of which originated with his early teacher and associate, Dr John Torrey of New York. The second volume of Torrey and Gray's Flora was completed in 1843 ; but for forty years thereafter Dr Gray gave up a large part of his time to the prepare^ tion of his Synoptical Flora, the first part of which did not appear till 1878. He lived at the precise period when the flora of North America was being discovered. described, and systematized ; and his enthusiastic labours

in this fresh field placed him at the head of American botanists and on a level with the most famous botanists of the world. In 1856 he published a paper on the distribution of plants under the title Statistics of the Flora of the Northern United States; and this paper was followed in 1859 by a memoir on the botany of Japan and its relations to that of North America, a paper of which Sir J. D. Hooker said that ” in point of originality and far-reaching results [it] was its author’s opus magnum.”

Aba Gbay.

It was Gray’s study of plant distribution which led to his intimate correspondence with Charles Darwin during the years m. which Darwin was elaborating the doctrines that later became known as Darwinism. From 1865 to 1875 Dr Gray was both a keen critic and a sympathetic exponent of the Darwinian principles. His influence on this subject, both in the United States and in England, was due to the candour, clearness, and conservatism of his expositions. Dr Gray’s religious views were those of the Evangelical bodies in the Protestant Church ; so

that, when Darwinism was attacked as equivalent to atheism, he was in position to answer effectively the unfounded allegation that it was fatal to the doctrine of Design. He taught that ” the most puzzling things of all to the old-school teleologists are the principia of the Darwinian.” He openly avowed his conviction that the present species are not special creations, but rather derived from previously existing species ; and he made his avowal with frank courage, when this truth was scarcely recognized by any naturalists, and when to the clerical mind evolution meant atheism.

In 1842 Dr Gray accepted the Fisher professorship of natural history in Harvard University. On his accession to this chair the university had no herbarium, no botanical library, few plants of any value, and but a small garden, which for lack of money had never been well stocked or well arranged. Dr Gray soon brought together, chiefly by widespread exchanges, a valuable herbarium and library, and arranged the garden; and thereafter the development of these botanical resources was part of his

regular labours. The herbarium soon became the largest

and most valuable in America, and on account of the numerous type specimens it contains it is likely to remain a collection of national importance. Nothing of what Dr Gray did for the botanical department of the university has been lost ; on the contrary, his labours were so well directed that everything he originated and developed has been enlarged, improved, and placed on stable foundations. He himself made large contributions to the establishment by giving it all his own specimens, many books, and no little money, and by his will he gave it the royalties on his books. During his long connexion with the university he brought up two generations of botanists, who are now scattered all over the United States. The Gray Herbarium was for years the resort of nearly all the working botanists now in influential positions, and Dr Gray always took a strong personal interest in the re-

searches and the personal prospects of the young men who studied under his eyes. His scientific life was mainly spent in the herbarium and garden in Cambridge; but his labours there were relieved by numerous journeys to different parts of the United States and to Europe, all of which contributed to his work on the Synoptical Elora. Every journey enlarged his experience, increased his resources, and added to his reputation. He lived to a good age — long enough, indeed, to receive from learned societies at home and abroad abundant evidence of their profound respect for his attainments and services. He died at Cambridge, Mass., 30th January 1888. (o. w. e.)

Grays Thurrock, a town and parish in the South-Eastern parliamentary division of Essex, England, on the Thames, 3 miles north-west of Tilbury Eort by rail. There are an endowed and two training-ship schools. Drainage works costing over £40,000 were completed in 1894. The buildings include a public hall and a free library (1894). The town does trade in bricks, lime, and cement. Area of urban district, 1382 acres. Population (1881), 5327 ;

(1901), 13,831.

Great Barrington, a town of Berkshire county, Massachusetts, U.S.A., on the river Housatonic in the Berkshire Hills. It is traversed by a branch of the New York, New Haven, and Hartford railway, and is well known as a summer resort. Population (1890), 4612; (1900), 5854, of whom 1187 were foreign-born and 138 negroes.

Great Britain. See British Empire, England AND Wales, English Histoky, Scotland, United Kingdom.

Great Falls, capital of Cascade county, Montana, U.S.A., in 47° 30′ N. and 111° 17′ W., on the south bank of the Missouri river, opposite the mouth of Sun river, at an altitude of 3331 feet. It is near the great falls of the Missouri, from which it derives its name. It is on a branch line of the Great Northern railway, and is the terminus of the Great Palis and Canada railway, and of a branch line into the mountains to the south. It is a well-built city, founded in 1867. It has smelters for the treatment of silver, lead, and copper ores. Population

(1890), 3979 ; (1900), 14,930, of whom 4692 were foreign-born and 128 negroes.

Great Salt Lake, a large body of water without outlet, in Utah, U.S.A. It lies at the western base of the Wasatch range, from which it receives numerous streams, the principal of which are the rivers Jordan, Weber, and Bear. The inflow to the lake is variable in amount, owing to irregularity in rainfall, and as the only means of discharge— evaporation — is quite uniform, the level of the lake has oscillated greatly in past times, while in recent years, owing to the fact that much of the water of its tributaries has been used for irrigation, the lake level has been considerably lowered. The lake being shallow and its shores quite level, especially on the west, a slight reduction in the water level causes a notable diminution in area. The lake is some 80 miles in length north and south, and on an average 40 miles in breadth. The water contains about 20 per cent, by weight of solid matter, mainly chloride of sodium. The country to the east and south of the lake is well settled by Mormons, and is

highly cultivated, while that on the north and west, since it possesses no water for irrigation, is a desert.

Great Slave Lake (Athapuscow), lake of Mackenzie district, Canada. It is situated between 60° 60′ and 62° 65′ N. lat. and 108° 40′ and 117° W. long., at an altitude of 520 feet above the sea. It is 325 miles long, from 15 to 65 miles wide, and includes an area of 9770 square miles. Its coast-line is very irregular and deeply indented by large bays, and its northern shores are rugged and mountainous. The Yellow-knife, Hoar-frost, Lockhart, discharging the waters of Clinton-Colden and Artillery lakes, the Tchzudezeth, Du Eocher, Hay, and Slave rivers — the last a continuation of the Mackenzie — empty into Great Slave Lake. It is navigable from about 1st July to the end of October. It was discovered in 1771 by Samuel Hearne.

Creathead, James Henry (1844^1896), British engineer, was born at Grahamstown, Cape Colony, on 6th August 1844. He migrated to England in 1869, and in 1864 was a pupil of P. W. Barlow, from whom he

became acquainted with the shield system of tunnelling with which his name is especially associated. Barlow, indeed, had a strong belief in the shield, and was the author of a scheme for facilitating the traffic of London by the construction of underground railways running in cast-iron tubes constructed by its aid. To show what the method could do, it was resolved to make a subway under the Thames near the Tower, but the troubles encountered by Brunei in the Thames Tunnel, where also a shield was employed, made engineers hesitate to undertake the subway, even though it was of very much smaller dimensions (6 feet 7 inches internal diameter) than the tunnel. At this juncture Greathead came forward and offered to take up the contract ; and he successfully carried it through in 1869 without finding any necessity to resort to the use of compressed air, which Barlow in 1867 had suggested might be employed in water-bearing strata. After this he began to practise on his own account, and mainly divided his time between railway construction and taking out patents for improvements in his shield, and for Other

inventions such as the “Ejector” hydrant (see Powek Transmission, Hydraulic). Early in the ‘eighties he began to work in conjunction with a company whose aim was to introduce into London from America the Hallidie system of cable traction, and in 1884 an Act of Parliament was obtained authorizing what is now the City and South London railway — a tube-railway to be worked by cables. This was begun in 1886, and the tunnels were driven by means of the Greathead shield, compressed air being used at those points where water-bearing gravel was encountered. During the progress of the works electrical traction became so far developed as to be superior to cables ; the idea of using the latter was therefore abandoned, and when the railway was opened in 1889, it was as an electrical one. In 1888 Greathead became engineer, together with Sir Douglas Pox, to the Liverpool Overhead Electric railway, and afterwards was engaged in two other important underground lines in London — the Waterloo and City, and the Central London. He lived to see the tunnels of the former completed under the

river, but the latter was scarcely begun at the time of his death, which happened at Streatham, in the south of London, on 21st October 1896.

91

GREECE.

Geography and Statistics.

GREECE has undergone many -vicissitudes in recent years. The natural and excusable desire of the Greeks to bring about the political union of their race has exposed the country to paroxysms of excitement at each successive crisis in the Eastern Question ; a series of costly mobilizations has ruined the national finances, and repeated warlike movements have culminated in a disastrous conflict. Meanwhile the vital interests of the country have been neglected by reckless politicians, bent on acquiring popularity by flattering the national sentiment ; urgent reforms have been postponed or abandoned, the administrative and judicial systems have been demoralized by party influences, and public order has not always been ef&ciently maintained. Notwithstanding these se-

rious drawbacks, Greece has made sensible progress since 1870: commerce has advanced rapidly, agriculture and other industries by slow degrees, education is widely diffused, and though the State is bankrupt, the great mass of the people is well-to-do, if not rich. Owing to the tact and sagacity of King George, the country, amid all the vicissitudes of its recent history, has escaped revolution, and the dynasty may be regarded as firmly established. The acquisition of the fertile province of Thessaly will in course of time add greatly to the resources of the kingdom. The interest of Greece to the scholar, the antiquary, and the student of art has, if possible, been enhanced by recent discoveries, and the peculiar charm of its scenery has received wider appreciation. With improved communications and complete tranquillity in the interior, there will be a constant increase in the number of those who visit this beautiful and interesting country, which may derive no slight material profit from its historic and natural attractions.

No State survey of Greece has ever been undertaken.

The area of the country, according to the ofBcial figures, was 47,516 square kilometres before the acqui-

Areaand gition of the Ionian Islands in 1864, 50,211 square kil. prior to the annexation of Thessaly and part of Epirus in 1881, and 63,606 square kil. in 1896. If we deduct 395 square kil., the extent of territory ceded to Turkey after the war of 1897, the present area of Greece would be 63,211 square kil. Other authorities give 65,194 and 65,119 square kil. as the area prior to the rectification of the frontier in 1898. The population in 1889 was 2,187,208, or 34-38 to the square kil., the population of the territories annexed in 1881 being approximately 350,000 ; and in 1896, 2,433,806, or 38-26 to the square kil. (according to the official estimate of the area), showing an increase of 246,598, or 1-61 per cent, per annum. The population by sex in 1896 is given as 1,266,816 males and 1,166,990 females. This proportion (52 per cent, males to 48 females) corresponds to that found in Italy, Servia, and Bulgaria. The preponderance of males is most marked in the maritime districts, and in

the departments of Larissa and Trikkala. Only in the department of Laconia, in the Cyclades, and in Cephalonia is the female population in excess of the male. Neither the census of 1896 nor that of 1889 gives any classification by professions, religion, or language, but the following figures are derived from unofficial sources : — agricultural and pastoral employments, 444,096 ; industries, 64,211; traders and their employees, 117,979; labourers and servants, 31,321; various professions, 15,735; ofiacials, 12,109; clergy, 10,059; national defence, 34,624. In 1879, 1,635,698 of the population were returned as populw

tlon.

Orthodox Christians, 14,677 as Catholics, 2652 as Jews, and 740 as of other religions. The annexation of Thessaly and part of Epirus is stated to have added 24,165 Mahommedan subjects to the Hellenic kingdom. A considerable portion of these, however, emigrated immediately after the annexation, and although a certain number subsequently returned, the total Mahommedan

population in Greece is estimated to be under 20,000.

The Albanian population still probably exceeds 120,000.

It is gradually being absorbed in the Hellenic population.

The Vlach population was increased by the annexation

of Thessaly ; several thousands of these nomad shepherds

are to be found in the Pindus range ; the greater propor-

tion speak Greek as well as a dialect of Rumanian. By

a law of 27th November 1899 Greece, which had hitherto

been divided into 16 departments (vo/tot) was re-divided

into 26 departments, as follows : —

Population

Population

Department.

according to

Department.

according to

Census of 1896.

Census of 1896.

1. Attica

255,978

15. Arcadia

. 167,092

2. Boeotia

57,091

16. Achaia

. 144,826

3. Phthiotis .

98,764

17. Elis

91,425

4. Phocis

60,472

18. Triphylia .

. 86,471

5. Aoarnania .

126,892

19. Messenia .

. 119,327

6. Euritania .

43,667

20. Laconia

. 62,839

7. Arta

39,144

21. Lacedaemon

. 84,929

8. Trikkala .

96,007

22. Corfu .

. 94,686

9. Karditsa .

80,766

23. Cephalonia.

. 70,077

10. Larissa

86,513

24. Leukas (with.

11. Magnesia .

91,828

Ithaca) .

. 43,178

12. Eutoea

106,777

25. Zante

. 45,032

13. Argolis

80,695

26. Cyclades .

. 134,747

14. Corinth

64,577

The population is densest in the Ionian Islands, exceed-

ing 286 per square mile. The departments of Aoarnania,

Phocis, and EubcBa are the most thinly inhabited (about

54, 57, and 62 per square mile respectively).

The movement of the population since 1881 was as

follows : —

Year.

Births.

Deaths.

Marriages.

Excess of Births.

1882

43,157

32,194

11,186

10,963

1883

43,061

34,619

11,615

8,442

1884

67,995

.35,899

13,657

22,096

1889

74,666

53,512

18,558

21,154

1890

78,226

55,813

19,899

22,443

Both the birth-rate and death-rate are low, being 27-6 and 20-7 per 1000 respectively. Infant mortality is slight, and in point of longevity Greece compares favourably with most other European countries. The number of illegitimate births is 12-25 per 1000. Of the total population 22-3 per cent, live in towns. The population of the principal towns is : —

1889.

1896.

1889.

1896.

Athens

107,251

111,486

Volo

11,029

16,788

Piraeus

34,327

43,848

Larissa .

13,610

15,373

Patras

33,529

37,985

Zante

16,608

14,906

Trikkala .

14,820

21,149

Kalamata

10,696

14,298

Hermopolis

Pyrgos .

12,647

12,708

(Syra) .

22,104

18,760

Tripolis .

10,698

10,465

Corfu

19,025

18,581

No trustworthy information is obtainable with regard to immigration and emigration. In 1889 it was computed that there were 135,466 native-born Greeks in foreign lands, but this figure is probably too low. Every year numbers of young men emigrate to the United States from Arcadia,

Laconia, and Maina; there has been a considerable emigra-
tion to Egypt from the Cyclades. There is an increasing
immigration into the towns from the mountainous districts.

[statistics

In the higher departments of the administration no
important changes have been effected in recent years. In
1898 the number of deputies in the Boule
Mminis- -(^ras increased from 207 to 234. Some years
Justice. previously, a law diminishing the national
representation and enlarging the constituencies
■was passed by Trikoupis, with the object of checking the
local influence of electors upon deputies, but the measure
was subsequently repealed. The practice of bartering
personal favours, known as awaXXay^, still continues, to
the great detriment of public morality. Local administra-
tion is in the hands of some 20,000 oflcials, most of them
inadequately remunerated and liable to removal upon a
change of Government. A proletariat of office-seekers

has thus been created, and large numbers of well-educated persons spend many years in idleness or in political agitation. The administration of justice suffers under the existing system, more especially in the country districts, where the judges, most of whom are removable, must reckon with the influential politicians and their adherents. The pardon or release of a convicted criminal is not infrequently due to pressure on the part of some powerful patron. In the circumstances crime is less rife than might be expected. A serious feature is the great prevalence of homicide, due in part to the passionate character of the people, but still more to the almost universal practice of carrying weapons. The traditions of the vendetta are almost extinct in the Ionian Islands, but still linger in Maina, where family feuds are transmitted from generation to generation.

The brigand of the old-fashioned type (Xt^o-t^s, K\£(j>Trji) has almost disappeared, except in the remoter country districts, and piracy has been practically suppressed, but numbers of outlaws {(j>vy68iKoi) still haunt the mountains,

and the efforts of the police to bring them to justice are far from successful. Their ranks were considerably increased after the war of 1897, when many deserters from the army and adventurers who came to Greece as volunteers betook themselves to a predatory life. On the other hand, there is no habitually criminal class in Greece, such as exists in the large centres of civilization. Professional medicancy is still rare. The system of employing ofiicers and soldiers of the regular army for police duties has proved unsatisfactory, and will soon be abolished. Prison discipline and sanitation are very deficient ; conflicts among the prisoners are sometimes reported, in which knives and even revolvers are employed. A good prison has been built near Athens by Andreas Syngros, the national benefactor. The Greeks, like the other nations liberated from Turkish rule, are somewhat litigious, and numbers of lawyers find occupation even in the smaller country towns. A new civil code, based on Saxon and Italian law, has been drawn up by a commission of jurists. A court of appeal (at Larissa) has been

added to the four already existing; there are now 22 courts of first instance and 237 justices of the peace.

A complete reorganization of the Greek army has been projected under the auspices of the Crown Prince. The experience of the war of 1897 proved the need of far-reaching administrative changes and disciplinary reforms. The existing organization is based on the laws of 1887 and 1896. Military service is obligatory, and liability to serve begins from the 21st year. The term of service comprises 2 years in the active army, 10 years in the active army reserve (for cavalry 8 years), 8 years in the territorial army (for cavalry 10 years), and 10 years for all branches in the territorial army reserve. As a rule, however, the period of service with the colours is considerably shortened. By a law passed in 1900 the army will consist of 3 divisions, each composed of 2 brigades, and other units to be fixed by royal decree. There are 10 regiments

Defence.

of infantry, each of 2 battalions, and 1 battalion-cadre, in addition to 8 battalions of Euzones or highlanders, and 3

regiments of cavalry, each of 4 squadrons. The infantry are armed with the single-loader Gras (-433”) rifle and a bayonet, the cavalry with a Gras carbine and a sword.

The artillery consists of 3 regiments of field artillery of 20 batteries. Twofield batteries are armed with 8-7-cm.Krupp guns, the remaining batteries with 7-6-cm. Krupp guns.

There is 1 regiment of engineers composed of 2 battalions.

The peace strength of the army in 1899 was as follows: —

Officers and
CivUians.
Non-commis-
sioned Officers
and Men.
Horses and
Mules.
“War Office .
Engineers .
Artillery .
Cavalry-
Infantry

Ambulance

General services

Military instruction

Gendarmerie

Total .

62

101

217

96

873

12

390

123

139

l’,381

2,583

1,448

13,180

449

8

10

4,108

20

158

1305

1269

452

51

86

180

395

2013

23,167

3916

In time of war the total strength is 82,125 officers and men, 14,441 horses and mules, and 180 guns. The kingdom is divided into three military districts, Larissa, Missolonghi, and Athens.

The Greek fleet consists of 6 armour-clad vessels — 3 battleships (built 1889-90) of 4885 tons each, and carry-

ing 35 guns, 1 central battery ship (launched 1867), and 1 broadside ship (launched 1869) ; there are further 1 cruiser, 4 gunboats, 2 coast defence vessels, 29 torpedo boats of various types, 1 torpedo gunboat, 3 torpedo ships, 21 vessels used for various services, and 1 royal yacht. The personnel of the navy is composed of 369 officers and cadets, 917 petty officers, 2134 sailors and stokers, 45 boys, and 387 civilians. The navy is manned chiefly by conscription ; the period of service is two years. The Greeks make better sailors than soldiers, and the navy, if reorganized by foreign officers, might be brought to a high state of efficiency.

The Greek branch of the Orthodox Eastern Church is practically autocephalous, like those of Servia, Montenegro, and Rumania, though nominally subject to the Patriarchate of Constantinople. The jurisdic- i^eiigion tion of the Patriarch was in fact repudiated in Vacation. 1833, and the severance was completed in 1850. Ecclesiastical affairs are under the control of the ^Ministry of Education. Church government is vested in the Holy

Synod, a council of five ecclesiastics under the presidency of the Metropolitan of Athens ; its sittings are attended by a royal commissioner. There are nominally 18 arch-bishoprics and 22 bishoprics in Greece, but many of the sees are allowed to remain vacant. The number of priests is very large. They belong for the most part to the poor-est classes, and, having no fixed stipends, often resort to agriculture or to small trading in order to supplement the scanty fees earned by their ministrations. There are 199 monasteries and 6 nunneries in Greece, with about 1650 monks and 250 nuns. The number of Roman Catholics is probably between 25,000 and 30,000; the majority are in the Cyclades. They have 3 archbishoprics (Athens, Naxos, and Corfu) and 6′ bishoprics. There are about 60 Roman Catholic churches. The Greeks, an intelligent people, have always shown a remarkable zeal for learning, and popular education is making great strides. In 1898 there were 2914 ” demotic ’” or primary schools, with 3465 teachers, attended by 129,210 boys (5-38 per cent, of the population) and 29,119 giijls (1-19

per cent, of the population). The expenditure on primary schools, which in 1894 was 3,737,620 drachmae, had risen statistics]

in 1897 to 5,007,440 dr. ; the attendance of pupils in the former year was 144,917, in the latter 158,349. In 1898 there were 243 ” Hellenic ” or secondary schools, with 647 teachers and 13,472 pupils (boys only), maintained by the State at a cost of 1,696,716 dr. ; and 40 higher schools or gymnasia, with 291 masters and 3822 pupils, partly maintained by the State (expenditure, 842,640 dr.) and partly by benefactions. The Polytechnic Institute of Athens affords technical instruction in the departments of art and science to 359 students. There are 7 agricultural colleges, 5 theological seminaries, 5 nautical schools, the military college of the Euelpides at Athens, and many private schools. (For the native and foreign archaeo-logical institutions, see Athens.) The University of Athens in 1899 numbered 57 professors and 2802

students, of whom 815 were from abroad. Of the five faculties theology numbered 65 students, law 1147, medicine 864, arts 289, and pharmacy 121. The university receives a subvention from the State, which in 1899 amounted to 506,040 dr. Higher instruction is practically gratuitous in G-reece, and there is a somewhat ominous increase in the number of educated persons who disdain agricultural pursuits and manual labour.

Owing to the natural aptitude of the Greeks for commerce, and their predilection for a seafaring life, a great portion of the trade of the Levant has fallen

Commerce into their hands. The Greek mercantile marine, ladustry. “^^ich in 1888 consisted of 1362 vessels (70 steamers) with a total tonnage of 219,416 tons, numbered in 1898 1270 vessels (118 steamers) with a total tonnage of 326,041 tons. Almost the whole of the corn trade of Turkey is in Greek hands. A large number of the sailing ships, especially the smaller vessels occupied in the coasting trade, belong to the Heptanesian and Aegean islanders. A considerable portion of the shipping

on the Danube and Pruth is owned by the inhabitants of Ithaca and Cephalonia. There are six principal Greek steamship companies, owning 44 steamers with a total tonnage of 27,251 tons. In 1847 there was but one light-house in Greek waters ; in 1899 there were 110 lighthouses and port-lanterns. Hermopolis (Syra) is the chief seat of the carrying trade, but as a commercial port it yields to Piraeus, which is the principal centre of distribution for imports. Other important ports are Patras, Volo, Corfu, Kalamata, and Laurion. The following table shows the total value of special Greek commerce for the given years : —

1887.

1892.

1897.

1898.

Imports

Exports

131,849,325 fr.

102,652,487 „

119,806,007 fr

82,261,464 „

116,368,348 fr.

81,708,626 „

162,083,684 fr.

89,438,100 „

Variations in the price and quantity of imported cereals and in the sale of currants account mainly for the marked fluctuations in the returns.

The imports and exports for 1897 were distributed as follows : —

Imports from.

Exports to.

Great Britain

Russia

Austria

Turkey

France

Italy .

Germany .

United States

Belgium

Rumania

Egypt .

Holland

Other countries .

Fr.

29,486,910

29,256,722

11,583,956

8,744,476

11,686,838

2,778,.343

7,550,463

3,890,662

2,951,694

568,817

883,575

761,588

6,219,304

26,763,302

2,434,927

8,085,969

4,868,893

7,641,507

5,233,428

4,733,690

3,644,286

7,616,747

841,716

2,147,478

6,459,878

1,236,805

116,363,.348

81,708,626

The principal articles of importation were : —

1896.

1897.

Total TaluG

in Francs.

Imports from the United Kingdom. Total Value in Francs.

Imports from the United Kingdom.

Cereals .

Textiles .

Minerals, metals (raw)

Fish, caviar, &c. .

Raw hides

Wood and timber

Minerals, metals (worked) .

31,010,922

22,769,703

13,158,009

3,654,307

3,333,108

4,491,951

3,643,241

None.

14,259,858

9,123,887

1,677,436

369,614

49,094

1,140,186

33,118,185

21,149,714

12,536,251

4,047,410

3,565,454

3,783,012

2,901,537

None.

13,236,880

9,404,953

1,528,554

250,311

38,658

795,645

The chief articles of exportation were : –

1896.

1897.

Total Value

In Francs.

Exports to

the United

Kingdom.

Total Value

in Francs.

Exports to

the United

Kingdom.

Currants

Ores

Wines .

Cognac .

Figs

Tobacco .

Olive oil

Olives

Valonia .

Sponges .

23,139,527

17,4.33,940

5,094,044

962,157

3,598,068

2,582,708

3,041,161

1,138,462

3,320,636

1,240,400

7,681,585

7,163,705

578,590

1,179

24,862

117,733

13,848

42,527

2,211,682

173,200

33,300,223

19,805,836

6,592,725

1,081,439

2,653,108

1,899,407

4,645,785

684,374

1,965,920

1,040,260

17,280,263

6,385,538

493,308

43,389

16,860

66,861

549,715

19,223

701,667

84,820

Greece does not yet possess manufacturing industries on any large scale. In 1889 there were 146 establishments, employing steam of 6668 indicated horse-power. In 1892 the total horse-power employed in all factories was calculated to have increased to 10,000. Among the factories are flour mills, cloth and cotton mills, shipbuilding and engineering works, oil presses, tanneries, powder and dynamite mills. About 100 are established in the neighbourhood of Athens and Piraeus.

Greece is essentially an agricultural country ; its prosperity depends on its agricultural products, and more than half the population is occupied in the cultivation of the soil. The land 4„-i-,„/*,„„ in the plains and valleys is exceedingly rich, and, wherever there is a sufficiency of water, produces magnificent crops. The country, especially since the acquisition of the fertile province of Thessaly, might under a well-developed agricultural system provide a food supply for all its inhabitants and an abundant surplus for exportation. Thessaly alone, Indeed, could furnish cereals for the whole of Greece. Unfortunately, however, agriculture is still in a primitive state, and the condition of the rural population has received very inadequate attention from successive Governments. As a rule, countries dependent on agriculture are liable to sudden fluctuations in prosperity, but in Greece the diversity of products is so great that a failure in one class of crops is usually compensated by exceptional abundance in another. Among the causes which have hitherto retarded agricultural progress are the ignorance and conservatism of the peasantry, antiquated methods of cultivartion, want of capital, absentee proprietorship, sparsity of population, bad roads, the prevalence of usury, the uncertainty of

boundaries and the land tax, which, in the absence of a survey, is levied on ploughing oxen ; to these may be added the growing distaste for rural life which has accompanied the spread of education. Large estates are managed under the metayer system ; the landlords, who prefer to live in the larger towns, see little of their tenants, and rarely interest themselves in their welfare. A great proportion of the best arable land in Thessaly is owned by persons who reside permanently out of the country. In the Peloponnesos peasant proprietorship is almost universal ; elsewhere it is gradually supplanting the metayer system ; the small properties vary from 2 or 3 to 50 acres. The extensive State lands have been much encroached upon by neighbouring owners ; a considerable portion has also been sold to the peasants. The rich plain of Thessaly suffers from alternate droughts and inundations, and from the ravages of field mice ; with improved cultivation, drainage, and irrigation it might be rendered enormously productive. Usury is,

perhaps, a greater scourge to the rural population than any visi-

tation of nature; the institution of agricultural banks, lending money at a fair rate of interest on the security of their land, would do much to rescue the peasants from the clutches of local Shy locks. The following table gives the approximate yield and acreage of agricultural products for 1893 : —

Crops.

Acres.

Yield.

Cereals

1,111,.500

20,250,000 bushels

Olives ....

432,000

15,000,000 lb

Vineyards .

336,000

66,000,000 gallons

Currants

168,000

350,000,000 a

Pigs ....

52,000

60,000,000 R)

Cotton ….

14,800

Tobacco

12,000

16,000,000 K)

Various

211,400

Fallow.

1,200,000

Forest ....

2,025,400

Total, 5,563,100

In addition to the above there are about 5,000,000 acres of pasture and 3,000,000 acres of waste land. The principal cereals are wheat, barley, maize, oats, sesame, and rye. Eice is grown in the marshy plains of Elis, Boeotia, Marathon, and Missolonghi. The cultivation of vegetables is increasing ; beans, peas, and lentils

are the most common. Of late years market-gardening has been taken up as a new industry in the neighbourhood of Athens. There is a great variety of fruits. Olive plantations are found everywhere ; in 1860 they occupied about 90,000 acres, in 1887 43-3,701 acres. The annual yield of olive oil is estimated at 25,000,000 kilogrammes, and the value of the oil and fruit exported varies from five to ten million francs. Figs are also abundant, especially in Messenia and the Cyclades. Mulberry trees are planted for the purposes of sericulture. Other fruit trees are the orange, citron, lemon, pomegranate, and almond. Peaches, apricots, pears, cherries, &c., abound, but are seldom scientifically cultivated ; the fruit is generally gathered while unripe. Cotton in 1887 occupied 14,984 acres, chiefly near Levadeia. Tobacco plantations in 1893 covered 16,320 acres, yielding 2,840,102 okes (1 oke = 2| lb) ; about half of the annual produce is exported, principally to Egypt, Holland, and Turkey. More important are the vineyards, which occupied in 1887 an area of 306,421 acres. The best wine is made at Patras, on the royal estate at Decelea, and on other estates in Attica ; a peculiar flavour is imparted to the wine of the country by the addition of resin. The foreign de-

mand for Greek wines is rapidly increasing ; 3,770,257 gallons were exported in 1890, 4,974,196 gallons in 1894. There is also a growing demand for Greek cognac.

The currant, by far the most important of Greek exports, is cultivated in a limited area extending along the southern shore of the Gulf of Corinth and the seaboard of the “Western Currao s. peloponnesos, in Zante, Cephalonia, and Leukas, and in certain districts of Akarnania and JEtolia ; attempts to cultivate it elsewhere have generally proved unsuccessful. The history of the currant industry has been a record of extraordinary vicissitudes. Prior to 1877 the currant was exported solely for eating purposes, the amounts for the years 1872 to 1877 being 70,766 tons, 71,222 tons, 76,210 tons, 72,916 tons, 86,947 tons, and 82,181 tons respectively. In 1877, however, the French vineyards began to suffer seriously from the phylloxera, and French wine producers were obliged to have recourse to dried currants, which make an excellent wine for blending purposes. The importation of currants into France at once rose from 881 tons in 1877 to 20,999 tons in 1880, and to 70,401 tons in 1889, or about 20,000 tons more than were imported into England in that year. Meanwhile the total amount of currants

produced in Greece had nearly doubled in these thirteen years. The country was seized with a mania for currant planting ; every other industry was neglected, and olive, orange, and lemon groves were cut down to make room for the more lucrative growth. The currant growers, in order to increase their production as rapidly as possible, had recourse to loans at a high rate of interest, and the great profits which they made were devoted to further planting, while the loans remained unpaid. A crisis followed rapidly. By 1891 the French vineyards had to a great extent recovered from the disease, and wine producers in France began to clamour against the competition of foreign wines and wine-producing raisins and currants. The import duty on these was thereupon raised from 6 francs to 15 francs per 100 kilos, and was further increased in 1894 to 25 francs. The currant trade with France was thus extinguished ; of a crop averaging 160,000 tons, only some 110,000 now found a market. Although a fresh opening for exportation was found in Russia, the value of the fruit dropped from £15 to £5 per ton, a price scarcely covering the cost of cultivation. In July 1895 the Government introduced a measure, since known as the Retention (TapaKpiTrja-ii) Law, by which it was enacted that every ship-

per should deliver into depots provided by the Government a weight of currants equivalent to 15 per cent, of the amount which he intended to export. A later law has fixed the quantity to be retained by the State at 10 per cent., which may be increased to 20 per cent., should a representative committee, meeting every summer at Athens, so advise the Government. The currants thus taken over by the Government cannot be exported unless they are reduced to pulp, syrup, or otherwise rendered unsuitable for eating purposes ; they may be sold locally for wine-making or distilling, due precautions being taken that they are not used in any other way. The price of exported currants is thus maintained at an artificial figure. The Retention Law, which since 1895 has been voted annually, was passed for a period of ten years in 1899. This pernicious measure, which is in defiance of all economic laws, perpetuates a superfluous production, retards the development of other branches of agriculture, and burdens the Government with vast accumulations of an unmarketable commodity. It might excusably be adopted as a temporaiy expedient to meet a pressing crisis, but as a permanent system it can only prove detrimental to the country and the currant growers themselves. In 1889 an agricultural bank was established at

Patras for the purpose of assisting currant growers. The following table gives the annual currant crop from 1877 to 1898, the figures for the last six years, however, being only approximate.

Ex-

Ex-

Ex-

Ex-

Total

ported

Tear.

Total

ported

ported

to Great

to

(Tons).

to Great

to

Britain.

France.

Britain.

France.

1877

82,181

881

1888

152,965

51,856

43,639

1878

100,004

...

9,086

1889

152,256

49,923

70,401

1879

92,311

...

19,087

1890

147,024

56,846

40,018

1880

92,337

...

20,999

1891

153,997

64,050

40,856

1881

121,994

.. .

30,315

1892

122,583

53,957

20,627

1882

109,403

51,933

26,282

1893

170,000

60,694

3,187

1883

114,980

52,099

24,815

1894

135,500

57,559

15,060

1884

129,268

59,629

39,198

1895

151,500

51,645

19,067

1885

113,287

55,765

37,730

1896

132,000

49,676

2,815

1886

127,570

48,892

45,000

1897

107,000

52,318

526

1887

127,160

55,549

37,438

1898

140,000

58,115

892

The ” peronosporos,” a species of white blight, first caused considerable damage in the Greek vineyards in 1892, recurring in 1897 and 1900.

More than half the cultivable area of Greece is devoted to pasturage. Cattle-rearing, as a rule, is a distinct occupation from agricultural farming ; the herds are sent to stock pasture on the mountains in the summer, and return farming. to the plains at the beginning of winter. The larger cattle are comparatively rare, being kept almost exclusively for agricultural labour ; the smaller are very abundant. The native breed of oxen is small ; buffaloes are seldom seen except in north-

western Thessaly ; a few camels are used in the neighbourhood of Parnassos. The Thessalian breed of horses, small but sturdy and enduring, can hardly be taken to represent the celebrated chargers of antiquity. The flocks of long-horned sheep and goats add a picturesque feature to Greek rural scenery. The shepherds' dogs rival those of Bulgaria in ferocity. In 1892 the numbers of the various domestic animals were as follows : — sheep, 2,900,000 ; goats, 2,000,000 ; large cattle, 360,000 ; donkeys, 100,000 ; horses, 100,000 ; mules, 52,000 ; pigs, 25,000 ; and camels, 44.

The forest area (about 2,025,400 acres) is for the most part State property. The principal trees are the oak and the various conifers. In Greece, as in other lands formerly subject to Turkish „ rule, the forests are not only neglected, but often de- * * liberately destroyed ; this great source of national wealth is thus continually diminishing. Every year immense forest fires may be seen raging in the mountains, and many of the most picturesque districts in the country are converted into desolate wildernesses. These conflagrations are mainly the work of shepherds eager to provide increased pasturage for their flocks ; they are sometimes, however, due to the carelessness of smokers, and occasionally, it

is said, to spontaneous ignition in hot weather. Great damage is also done by the goats, which browse on the young saplings ; the pine trees are much injured by the practice of scoring their bark for resin. With the disappearance of the trees the soil of the mountain slopes, deprived of its natural protection, is soon washed away by the rain ; the rapid descent of the water causes inundations in the plains, while the uplands become sterile and lose their vegetation. The climate has been affected by the change ; rain falls less frequently but with greater violence, and the process of denudation is accelerated. The Government has from time to time made efforts for the protection of the forests, but with little success ; a society for the re-afforesting of the country has been formed at Athens under royal patronage.

The chief minerals are silver, lead, zinc, copper, manganese,

statistics]

GREECE

95

Public

works.

magnesia, iron, sulphur, and coal. Emery, salt, millstone, and

Mines gypsum, which are found in considerable quantities, are worked by the Government. The important mines at Laurion, reopened in modern times by a Franco-Italian company, were declared to be State property in 1871 ; they are now worked by a Greek and a French company. The output of marketable ore in 1899 was as follows: — manganese iron ore, 306,625 tons ; hsematite iron ore, 134,381 tons ; calamine or zinc ore, 23,710 tons ; lead ore and galena, 15,749 tons ; blende of zinc and lead ore, 1195 tons ; arsenic lead smokes, 3000 tons, and speiss, 2100 tons: total 486,760 tons, besides 289,292 tons of dressed lead ore, producing 18,360 tons of silver pig lead with about 2000 grams of silver per ton of lead. The total value of the exports from the Laurion mines, which in 1875 amounted to only £150,513, had in 1899 increased to £827,209. The revenue accruing to the Government from all mines and quarries, including those worked by the State, was estimated in the budget for 1900 at 1,115,000 drachmae. The great abundance of marble in Greece has latterly attracted the attention of foreign capitalists. New quarries have been opened by an English company on the north slope of Mount Pentelikon, and are now connected by rail

with Athens and Piraeus. The marble on this side of the mountain is harder than that on the south, which alone was worked by the ancients. The estimated output in 1900 was 10,800 tons.

White marble is also found at Skyros, Tenos, and Naxos ; gray at Stoura and Karystos ; variegated at Valaxa and Karystos ; green on Taygetos ; black at Tenos ; and red in Maina.

The important drainage works at Lake Copais were taken over by an English company in 1890. The lake covered an area of 58,080 acres, the greater part of which is now rendered fit for cultivation. In 1899, 2,400,000 okes of wheat, 900,000 okes of barley, 680,000 okes of hay, and 690,000 okes of maize, besides other produce, were raised oft the reclaimed lands. The drainage works consist of a canal 28 kilometres in length, and a tunnel of 600 metres descending through the mountain to a lower lake, which is connected by a second tunnel with the sea. The canal through the isthmus of Corinth was opened to navigation in November 1893. The total cost of the works, which were begun in 1882, was 70,000,000 francs. The narrowness of the canal, which is only 24 metres broad at the surface, and the strength of the current which passes through it, seriously detract from its utility.

The high charges imposed on foreign vessels have proved almost prohibitive. There are reduced rates for ships flying the Greek flag. Up to February 1899, 15,272 vessels had passed through the canal. In 1898 thereceipts from Greek ships were 241,921 drachmae, from foreign ships 19,382 francs gold. The widening of the Euripus Channel at Chalcis to the eiatent of 21 ~~56 metres was accom~~ plished in 1894. The operations involved the destruction of the Venetian tower which guarded the strait.

Internal communication by roads is improving, though much remains to be done, especially as regards the quality of the roads. A considerable impetus was given to road-making under CommanI- ^^^ Trikoupis administration. In 1878 there were cations. ^^jy ggg ^jjgg ^j ^^^^^ . jjj jggg ^jjgj.g ^gj.g 2398 miles. Railways were open to traffic in 1900 for a length of 598 miles, an increase of 29 miles since 1892 ; some 62 miles, which will complete the circle of the Moi:ea railways, are in course of construction. A very important undertaking is the completion of a line from Piraeus to the frontier, the contract for which was signed in 1900 between the Greek Government and the Eastern Railways Extension Syndicate. A line connecting Pirseus with Larissa was

begun in 1890, but in 1894 the English company which had under-taken the contract went into liquidation. The line will now be carried as far as Demerli, in the south of Thessaly, a distance of 218 miles ; it will subsequently be continued to some point, not yet determined, on the Turkish frontier. There will be branch lines to Lamia and Chalcis. The establishment of a connexion with the continental railway system, by a junction with the line from Belgrade to Salonika, would be of immense advantage to Greece, and Piraeus would become an important place of embarka^ tion for Egypt, India, and the Far East. In 1898 the number of post offices was 372, with 550 employes. The receipts amounted to 1,789,236 francs, the expenditure to 1,870,963 francs. During the year there passed through the post 3,104,050 ordinary letters for the interior, 4,984,902 for foreign destinations ; 225,180 regis-tered letters ; 139,450 post-cards ; 75,712 samples ; 5,620,730 printed papers for the interior, 2,519,067 for foreign destinations. In the same year there were 221 telegraph offices with 394 instruments and 9 telephones, employing 974 clerks, whose duties, however, were in most cases divided between the postal and telegraph services. Telegraph lines extended over 5235 miles, with 6240 miles of wires.

There were despatched during the year 902,872 inland telegrams, 319,048 foreign, and 19,002 service telegrams. Receipts amounted to 1,211,669 francs, expenditure to 779,925 francs.

The financial history of Greece has been unsatisfactory from the outset. Excessive military and naval expenditure (mainly due to repeated and hasty mobilizations), a lax and improvident system of administration, the corruption of political parties, and pittance. the instability of the Government, which has rendered impossible the continuous application of any scheme of fiscal reform — all alike have contributed to the economic ruin of the country.

For a long series of years preceding the declaration of national insolvency in 1893 successive budgets presented a deficit, which in years of political excitement and military activity assumed enormous proportions : the shortcomings of the budget were supplied by the proceeds of foreign loans, or by means of advances obtained in the country at a high rate of interest. The two loans which had been contracted during the war of independence were extinguished by means of a conversion in 1889. Of the existing foreign loans the earliest is that of 60,000,000 fr., guaranteed by the three protecting Powers in 1832 : owing to the payment of interest and

amortization by the Powers, the capital amounted in 1871 to 100,392,833 fr. ; on this Greece pays an annual sum of 900,000 fr., of which 300,000 have been granted by the Powers as a yearly subvention to King George. The only other existing foreign obligation of early date is the debt to the heirs of King Otho (4,500,000 dr.) contracted in 1868. A large amount of internal debt was incurred between 1848 and 1880, but a considerable proportion of this was redeemed with the proceeds of the foreign loans negotiated after this period. At the end of 1880 the entire national debt, external and internal, stood at 252,652,481 dr. In 1881 the era of great foreign loans began. In that year a 5 per cent, loan of 120,000,000 fr. was raised to defray the expenses of the mobilization of 1880. This was followed in 1884 by a 5 per cent, loan of 170,000,000 fr., of which 100,000,000 was actually issued. The service of these loans was guaranteed by various State revenues. A “patriotic loan” of 30,000,000 dr. without interest, issued during the war excitement of 1885, proved a failure, only 2,723,860 dr. being subscribed. In 1888 a 4 per cent, loan of 135,000,000 fr. was contracted, secured on the receipts of the five State monopolies, the management of which was entrusted to a

privileged company. In the following year (1889) two 4 per cent, loans of 30,000,000 fr. and 125,000,000 fr. respectively were issued without guarantee or sinking fund : Greek credit had now apparently attained an established position in the foreign money market, but a decline of public confidence soon became evident. In 1890, of a 5 per cent, loan of 80,000,000 fr. efiective, authorized for the construction of the Piraeus-Larissa railway, only 40,050,000 fr. was taken up abroad and 12,900,000 fr. at home ; large portions of the proceeds were devoted to other purposes. In 1892 the Government was compelled to make large additions to the internal floating debt, and to borrow 16,500,000 fr. from the National Bank on onerous terms. In 1893 an effort to obtain a foreign loan for the reduction of the forced currency proved unsuccessful. (For the events leading up to the declaration of national bankruptcy in that year see below under Becent History.') A funding convention was concluded in the summer, under which the creditors accepted scrip instead of cash payments of interest. A few months later this arrangement was reversed by the Chamber, and on the 13th December a law was passed assigning provisionally to all the foreign loans alike 30 per cent, of the stipulated interest: the

reduced coupons were made payable in paper instead of gold, the sinking funds were suspended, and the sums encashed by the monopoly company were confiscated. The causes of the financial catastrophe may be briefly summarized as follows : — (1) The military preparations of 1885-86, with the attendant disorganization of the country ; the extraordinary expenditure of these years amounted to 130,987,772 dr. (2) Excessive borrowing abroad, involving a charge for the service of foreign loans altogether disproportionate to the revenue. (3) Remissness in the collection of taxation : the total loss through arrears in a period of ten years (1882-91) was 36,549,202 dr., being in the main attributable to non-payment of direct taxes. (4) The adverse balance of trade, largely due to the neglected condition of agriculture ; in the five years preceding the crisis (1888-92) the exports were stated to amount to £19,578,973, while the imports reached £24,890,146 ; foreign live stock and cereals being imported to the amount of £6,193,579. The proximate cause of the crisis was the rise in the exchange owing to the excessive amount of paper money in circulation. Forced currency was first introduced in 1868, when 15,000,000 dr. in paper money was issued ; it was abolished in

the following year, but reintroduced in 1877 with a paper issue of 44,000,000 dr. It was abolished a second time in 1884, but again put into circulation in 1885, when paper loans to the amount of 45,000,000 dr. were authorized. In 1893 the total authorized forced currency was 146,000,000 dr., of which 88,000,000 (including 14,000,000 dr. in small notes) was on account of the Government. The rate of exchange, as a rule, varies directly with the amount of paper money in circulation, but, owing to speculation, it is liable to violent fluctuations whenever there is an exceptional demand for gold in the market. In 1893 the gold franc stood at the ratio of 1-60 to the paper drachma : the service of the foreign

loans required upwards of 31,000,000 dr. in gold, and any attempt to realize tliis sum in tiie market would have involved an outlay equivalent to at least half the budget. With the failure of the projected loan for the withdrawal of the forced currency repudiation became inevitable. The law of the 13th December was not recog-nized by the national creditors : prolonged negotiations followed,

but no arrangement was arrived at till 1897, when the intervention of the Powers after the war with Turkey furnished the opportunity for a definite settlement. It was stipulated that Turkey should receive an indemnity of £T4,000,000 contingent on the evacuation of Thessaly ; in order to secure the payment of this sum by Greece without prejudice to the interests of her creditors, and to enable the country to recover from the economic consequences of the war, Great Britain, France, and Russia undertook to guarantee a 2J per cent, loan of 170,000,000 fr., of which 150,000,000 fr. has been issued. By the preliminary treaty of peace (18th September 1897) an International Financial Commission, composed of six representatives of the Powers, was charged with the payment of the indemnity to Turkey (£T4,000,000), and with “absolute control” over the collection and employment of revenues sufficient for the service of the foreign debt. A law defining the powers of the Commission was passed by the Chamber, 26th February 1898 (o.s.). The revenues assigned to its supervision were the five Government monopolies, the tobacco and stamp duties, and the import duties of Piraeus (total annual value estimated at 39,600,000 dr.) : the coUeotion was entrusted to a Greek society, which is under

the absolute control of the Commission. The returns of Piraeus customs (estimated at 10,700,000 dr.) are regarded as an extra guarantee, and are handed over to the Greek Government ; when the produce of the other revenues exceeds 28,900,000 dr. the “plus value ” or surplus is divided in the proportion of 50-8 per cent, to the Greek Government and 49‘2 per cent, to the creditors. The plus values amounted to 3,301,481 dr. in 1898, 3,533,756 dr. in 1899, and 3,442,713 dr. in 1900. Simultaneously with the establishment of the control the interest for the Monopoly Loan was fixed at 43 per cent., for the Funding Loan at 40 per cent., and for the other loans at 32 per cent, of the original interest. With the revenues at its disposal the International Commission has already been enabled to make certain augmentations in the service of the foreign debt ; since 1900 it has begun to take measures for the reduction of the forced currency, of which 2,000,000 dr. will be annually bought up and destroyed till the amount in circulation is reduced to 40,000,000 dr. On the 1st January 1901 the authorized paper issue Was 164,000,000 dr., of which 92,000,000 (including 18,000,000 in fractional currency) was on account of the Government ; the amount in actual circulation was 148,619,618 dr.

The financial commission retains its powers until the extinction of all the foreign loans contracted since 1881. Though its activity is mainly limited to the administration of the assigned revenues, it has exercised a beneficial influence over the whole domain of Greek finance. No change can be made in its composition or working without the consent of the six Powers, and none of the officials employed in the collection of the revenues subject to its control can be dismissed or transferred without its consent. It thus constitutes an element of stability and order which cannot fail to react on the general administration. It is unable, however, to control the expenditure or to assert any direct inHuence over the Government, with which the responsibility still rests for an improved system of collection, a more efficient staff of function-aries, and the repression of smuggling. The country has shown a remarkable vitality in recovering from the disasters of 1897, and should it in future obtain a respite from paroxysms of military and political excitement, its financial regeneration will be assured. The following table gives the actual expenditure and receipts for the period 1889-99 inclusive : —

Year.

Actual Receipts.

Actual

Expenditure.

Surplus or Deficit.

1889

1890

1891

1892

1893

1894

1895

1896

1897

1898

1899

Drachmm.

83,731,591

79,931,795

90,321,872

95,465,569

96,723,418

102,885,643

94,657,065

96,931,726

92,485,825

104,949,718

111,318,273

Drachmae.

110,772,327

125,932,579

122,836,385

107,283,498

92,133,566

85,136,752

91,641,967

90,890,607

137,043,929

110,341,431

104,586,504

Drachmas.

-27,040,736

-46,000,784

-32,514,513

-11,817,929

~~1~~ 4,589,863

-1-17,749,891

+ 3,016,098

~~1~~ 6,041,119

-44,558,104

- 5,391,713

-f 6,731,769

The budget estimates for 1901 were as follows : — Civil list, 1,-325,000 dr. ; pensions, payment of deputies, &c., 7,433,763 dr. ; public debt, 32,344,624 dr. ; foreign affairs, 2,846,018 dr. ; justice, 6,243,573 dr. ; interior, 15,140,566 dr. ; religion, 6,392,467 dr. ; army, 17,893,014 dr. ; navy, 7,123,947 dr. ; finance, 7,129,947 dr.; collection of revenue, 9,438,235 dr. ; various expenditure, 6,910,628 dr.— total, 118,721,772 dr.

The two privileged banks in Greece are the National Bank, founded in 1841 ; capital, 20,000,000 francs, in 20,000 shares of

1000 francs each, fully paid up; reserve fund, 13,600,000 o.„t,„„ francs ; notes in circulation, 126,900,000 francs ; and «™””^’ the Ionian Bank, incorporated in 1839; capital paid up, £315,500, in 12,620 shares -of £25 each; notes in circulation, about 13,000,000 francs. The National Bank has its central establishment at Athens, with 33 branches throughout the country. The headquarters of the Ionian Bank are in London; it has 5 branches in Greece. The privileged Epiro-Thessalian Bank ceased to exist from 12th January 1900, when it was amalgamated with the National Bank. There are three other banking companies in Athens, and several private banks. Greece entered the Latin Monetary Union in 1868. The monetary unit is the new drachma, equivalent to the franc, and divided into 100 lepta or centimes. There are nickel coins of 20, 10, and 5 lepta, copper coins of 10 and 6 lepta. Gold and silver coins were minted in Paris between 1868 and 1884, but have since practically disappeared from the country. The paper currency consists of 500-dr. , 100-dr., 25-dr. , lO-dr., and 6-dr. notes; there are also fractional notes for ^ dr. and 1 dr. The decimal system of weights and measures was adopted in 1876, but some of the old Turkish standards are still in

general use.

Ionian Islands. — Since their annexation to Greece in 1864, the history of the ” Ionian Islands ” (Corfu, Paxos, Cephalonia, Santa Maura, Ithaca, Zaute, and Cerigo) has been uneventful. Corfu (Kerkyra) with Paxos ; Cephalonia ; Santa Maura (Leukas) with Ithaca (Thiaki) ; and Zante (Zakynthos) each form separate nomarchies or departments, the population of which in 1896 has been given above. Cerigo (Kythera) now forms part of the nomarchy of Laconia. The beautiful island of Corfu has latterly suffered a decline of prosperity. Centralization at Athens has affected some of the local industries and institutions ; the university, founded by Lord Guildford, has been abolished ; commerce has considerably diminished, partly owing to the fact that the neighbouring coasts of Albania and Epirus now trade directly with Trieste, Fiume, and Marseilles, and the number of winter visitors has decreased owing to the growing popularity of Cairo, Algiers, and other health resorts. In recent years the stagnation of trade has been more marked owing to successive

failures in the olive and wine crops, the staple products of the island. The total exports, which in 1895 were valued at £147,200 (£20,579 to the United Kingdom), were estimated in 1898 at only £87,809 (£3754 to the United Kingdom), and in 1899 at £60,815 (£6937 to the United Kingdom). The imports, which in 1896 reached £238,346 (£63,012 from the United Kingdom), were valued in 1898 at £158.426 (£21,326 from the United Kingdom), and in 1899 at £126,471 (£16,833 from the United Kingdom). Corfu and the other Ionian Islands have retained the exemption from direct taxation which they enjoyed under the British protectorate; in lieu of this there is an ad valorem tax of 20^ per cent, on exported oil and a tax of 6 per cent, on wine exported to Greek ports ; these commodities are further liable to an export duty of 1^ per cent., which is levied on all agricultural produce and articles of local manufacture for the maintenance and construction of roads. The excellent roads, which date from the British administration, are kept in fair repair. Agriculture has made little progress

in Corfu ; many of the landed proprietors live in the town, and pay little attention to their estates, which are let out to the peasants on the mitayer system. The un-productiveness of the olive trees in recent years is stated to be largely due to neglect. Among ‘the principal industrial establishments of Corfu are steam oil-presses and flour mills, soap and caudle factories, tanneries, and a playing-cards factory. The substantial residence of the liritish High Commissioners, built in the time of Sir Thomas Maitland, is now a royal palace. In the

histoeyJ

neighbourhood of the town is the Villa Monrepos, built by Sir Frederick Adam, and now occasionally oeciipied by the Greek royal family. The Ionian Academy, founded by Lord Guildford, contains a library and a museum. Near the village of Gastouri is the remarkable Achilleion, once the residence of the Empress Elizabeth of Austria. The house, which is decorated in the Pompeian style, is

said to have cost upwards of 6,000,000 francs ; it commands a magnificent view, and is surrounded by iDeautiful gardens. The small rocky island of Paxos numbers about 5000 inhabitants. Cephalonia, the largest of the Ionian Islands, contains the highest mountain in the group, Mount ^nos or Monte Nero (6300 feet), the slopes of which are still partly covered with beautiful forests of pine (abies Oephalonica). Argostoli (population 9172) and Lixouri (population 6414), the principal towns, stand respectively on the east and west shores of the gulf of Livadi, a long inlet on the western side of the island. Currants, which are not grown in Corfu, form one of the principal products of Cephalonia, Santa Maura, and Ithaca. The total exports from these islands in 1898 were estimated at £161,008 (currants £118,958), in 1899 at £136,935 (currants £94,610). The currants are mainly exported to Holland. The total imports in 1898 were £228,705 (£35,450 from the United Kingdom); in 1899, £222,315 (£33,850 from the United Kingdom). The excess of imports over exports is

covered by remittances from natives trading abroad.

The island of Ithaca is inhabited by an industrious agricultural and seafaring population (11,409 in 1896). The ships of the enterprising islanders appear in every port of the Mediterranean, and carry on a busy trafiic on the rivers Danube and Pruth. , The wine of Ithaca enjoys a high reputation. In latter years the prosperity of the islands has declined, and there has been a considerable emigration to Australia. The remarkable Cyclopean fortress on Mount ^tos, commonly called the Castle of Ulysses, was excavated by Schliemann in 1878. In view of the theory latterly supported by Professor Dorpfeld, that Leukas is the Ithaca of Homer, excavations on the island were carried out by that scholar and Herr Goekup in 1900 and 1901, but without important results.

Leukas, which owes its name to its white limestone cliffs, was formerly connected with the mainland. The intervening lagoon is shallow, but a passage is being opened which will be navigable to ships of considerable tonnage. The population of Leukas, with that of the small adjacent

islands, in 1896 was 31,769. The fertile and beautiful Zante has not recovered its prosperity since the earthquakes of 1893, and many of the public and private buildings remain in a dilapidated condition. The island has also suffered severely from the crisis in the currant trade, hitherto its principal source of wealth. Cerigo, which has no geographical connexion with the other islands, is rocky, and comparatively unproductive. A large proportion of the male population goes abroad for harvest work during the summer. Quails are captured in great numbers in the spring and autumn, and are exported alive. The population in 1896 was 12,306. The small neighbouring island of Cerigotto or Antikythera has latterly been brought into notice, owing to the remarkable discovery of ancient statues at the bottom of the sea near its coast (January 1901). A signal station was established here during the Cretan insurrection of 1897, by which messages were transmitted from Crete to Athens. The total population of the Ionian Islands was 265,279 in 1896.

Cydades and Sporades. — The Cyclades, a compact group of islands in the Greek Archipelago, form a cluster around the island of Syros, the principal town of which, Syra, officially known as Hermopolis, is the capital of a department. Population, 134,747. The islands, though seldom visited by foreigners, are for the most part highly interesting and picturesque, notwithstanding their somewhat barren appearance when viewed from the sea ; many of them bear traces of the feudal rule of Venetian families in the Middle Ages, and their inhabitants in general may be regarded as presenting the best type of the Greek race.

To the student of antiquity the most interesting islands of the group are : Delos (q.v.), one of the greatest centres of ancient religious, political, and coTnmercial life, where an important series of researches has been latterly carried out by French archaeologists ; Melos, where, in addition to various buildings of the Hellenic and Eoman periods, the large prehistoric stronghold of Phylakopi has been excavated by members of the British school at Athens; and TJiera (Santorin), the ancient capital of which

has been explored by Baron Hiller von Gaertringen. Thera is also of special interest to geologists owing to its remarkable volcanic phenomena. Naxos, the largest and most fertile island of the group, contains the highest mountain in the Cyclades (Zia, 3290 feet) ; the island annually exports upwards of 2000 tons of emery, a State monopoly, the proceeds of which are now hypothecated to the foreign debt. The oak woods of Keos (Ze£) and los furnish considerable supplies of valonia. Kimolos, which is absolutely treeless, produces fuUer’s-earth. The famous marble quarries of Paros have been practically abandoned in modern times ; the marble of Tenos is now worked by a British syndicate. The mineral wealth of the Cyclades has hitherto been much neglected ; iron ore is exported from Seriphos, manganese and sulphur from Melos, and volcanic cement (pozzolana) from Santorin. Other articles of export are wine, brandy, hides, and tobacco. Kythnos, Melos, and other islands possess hot springs with therapeutic qualities. The prosperity of Syra, formerly

an important distributing centre for the whole Levant, has been declining for several years.

Of the Sporades, or ” scattered islands,” of the ^gean, only the group known as the North Sporades belongs to Greece, Skiathos, Skopelos, and Ikos being included in the department of Magnesia, and Skyros in that of Euboea. Skiathos is a beautifully wooded and picturesque island ; the town stands on a declivity surrounding an excellent harbour. The larger island of Skopelos is also well wooded. Almost every householder in both these islands is the owner, joint owner, or skipper of a sailing ship. Skyros is fertile, and celebrated for its wheat. The population of the Cyclades and Greek Sporades in 1896 was as follows (the population of small adjacent islands is included in some of the figures) : —

Syros

27,774

Mykonos

4,403

Zea .

5,019

Kythnos

4,353

Seriphos

3,851

Andros

18,809

Tenos

12,300

Naxos

15,608

Paros

8,336

Skopelos

Ikos

Cyclades.

Santorin

Anaphe .

Amorgos .

Melos

Siphnos .

Kimolos .

Pholegandros

Sikinos

los .

Sporades.

5,295 I Skyros .’

653 Skiathos .

Eecent History (1862-1899).

14,472

643

4,286

5,310

4,060

1,655

1,000

697

2,171

. 3,512

. 2,790

(j. D. B.)

Eecent Greek history is little more than a record of successive episodes in the prolonged struggle of the race to attain national unity. The Greeks never acquiesced in the narrow limits assigned to the king-dom in 1832; the exclusion of Crete was regarded as

a special injustice, and Prince Leopold of Saxe-Coburg-Gotha, to whom the throne was then offered, declined to accept it so long as the island was not included in the new realm. At the outbreak of the Eusso-Turkish war in 1854, the Greek army was mobilized, and an insurrec-tion was fomented in Epirus, but the occupation of Piraeus by French troops put an end to the dream of national aggrandizement. It was not till 1864 that an accession of territory was obtained by the acquisition of the seven Ionian Islands, which since 1816 had formed

a separate commonwealth under British pro-
Accession tection. In 1862 King Otho, the first sover-
aeorgei. eign of modern Greece, was deposed by a
revolution, and next year Prince William
George of Schleswig-Holstein-Sonderburg-Glucksburg,
whom Great Britain had designated as a suitable candidate
for the vacant throne, was elected by the National Assem-
bly with the title of ” George I., King of the Hellenes.”
On 29th October 1863 the new sovereign arrived in
Athens, and in the following June the British authori-
ties handed over the Ionian Islands to a Greek com-
missioner. King George thus began his reign under
the most favourable auspices, the patriotic sentiments
of the Greeks being flattered by the acquisition of new
territory. He was, however, soon confronted with con-
stitutional difficulties ; party spirit ran riot at Athens,
the ministries which he appointed proved short-lived,
his counsellor Count Sponneck became the object of
violent attacks, and at the end of 1864 he was compelled
to accept an ultra-democratic constitution, drawn up by

the National Assembly. This, the sixth constitution voted since the establishment of the kingdom, is that which is still in force. In the following year Count Sponneck left Greece, and the attention of the nation was concentrated on the affairs of Crete. The revolution which broke out in that island received moral and material support from the Greek Government, with the tacit approval of Russia ; military preparations were pressed forward at Athens, and cruisers were purchased, but the king, aware of the inability of Greece to attain her ends by warlike means, discouraged a provocative attitude towards Turkey, and eventually dismissed the bellicose Cabinet of Koumoundouros. The removal of a powerful minister commanding a large parliamentary majority constituted an important precedent in the exercise of the royal prerogative ; the king adopted a similar course with regard to Delyannis in 1892 and 1897. The relations with the Porte, however, continued to grow worse, and Hobart Pasha, with a Turkish fleet, made a demonstration off Syra. The

Cretan insurrection was finally crushed in the spring of 1869, and a conference of the Powers, which assembled that year at Paris, imposed a settlement of the Turkish dispute on Greece, but took no steps on behalf of the Cretans. In 1870 the murder of several Englishmen by brigands in the neighbourhood of Athens produced an unfavourable impression in Europe ; in the following year the confiscation of the Laurion mines, which had been ceded to a Franco-Italian company, provoked energetic action on the part of France and Italy. In 1875, after an acute constitutional crisis, Charilaos Trikoupis, who but ten months previously had been imprisoned for denouncing the Crown in a newspaper article, was summoned to form a Cabinet. This remarkable man, the only great statesman whom modern Greece has produced, exercised an extraordinary influence over his countrymen for the next twenty years ; had he been able to maintain himself uninterruptedly in power during that period, Greece might have escaped a long succession of misfortunes. His principal oppo-

nent, Theodore Delyannis, succeeded in rallying a strong body of adherents, and political parties, hitherto divided into numerous factions, centred around these two prominent figures.

In 1877 the outbreak of the Eusso-Turkish war produced a fever of excitement in Greece ; it was felt that the quarrels of the party leaders compromised the interests of the country, and the populace of Athens insisted on the formation of a coalition Cabinet. The “great” or ” oecumenical ” ministry, as it was called, now came into existence under the presidency of the veteran Kanaris ; in reality, however, it was controlled by Trikoupis, who, recognizing the unpreparedness of the country, resolved on a pacific policy. The capture of Plevna by the Eussians brought about the fall of the “oecumenical” ministry, and Koumoundouros and Delyannis, who succeeded to power, ordered the invasion of Thessaly. Their warlike energies, however, were soon checked by the signing of the San Stefano Treaty, in which the claims of Greece to an extension of frontier were altogether ignored.

At the Berlin Congress two Greek delegates g‘J^”’ obtained a hearing on the proposal of Lord Salisbury. The Congress decided that the rectification of the frontier should be left to Turkey and Greece, the mediation of the Powers being proposed in case of non-agreement; it was suggested, however, that the rectified frontier should extend from the valley of the Peneus on the east to the mouth of the Kalamas, opposite the southern extremity of Corfu, on the west. In 1879 a Greco-Turkish commission for the delimitation met first at Prevesa, and subsequently at Constantinople, but its conferences were without result, the Turkish commissioners declining the boundary suggested at Berlin. Greece then invoked the arbitration of the Powers, and the settlement of the question was undertaken by a conference of ambassadors at Berlin (1880). The line approved by the conference was practically that suggested by the Congress ; Turkey, however, refused to accept it, and the Greek army was once more mobilized. It was evident, however, that nothing could be gained by an appeal to

arms, the Powers not being prepared to apply coercion to Turkey. By a convention signed at Constantinople in July 1881, the demarcation was entrusted to a commission representing the six Powers and the two interested parties. The line drawn ran westwards from a point between the mouth of the Peneus and Platamona to the summits of Mounts Kritiri and Zygos, thence following the course of the river Arta to its mouth. An area of 13,395 square kilometres, with a population of 300,000 souls, was thus added to the kingdom, while Turkey was left in possession of lannina, Metzovo, and most of Epirus. The ceded territory was occupied by Greek troops before the close of the year.

In 1882 Trikoupis came into power at the head of a strong party, over which he exercised an influence and authority hitherto unknown in Greek political life. With the exception of three brief intervals Trikoupis (May 1886 to May 1886, October 1890 to Feb- ‘oeiyBunis. ruary 1892, and a few months in 1893), he continued in office for the next twelve years. The reforms

which he introduced during this period were generally of air unpopular character, and were loudly denounced by his democratic rivals ; most of them were cancelled during the intervals when his opponent Delyannis occupied the premiership. The same want of continuity proved fatal to the somewhat ambitious financial programme which he now inaugurated. While pursuing a cautious foreign policy, and keeping in control the rash impetuosity of his fellow-countrymen, he shared to the full the national desire for expansion, but he looked to the development of the material resources of the country as a necessary preliminary to the realization of the dreams of Hellenism.

history]

With this view he endeavoured to attract foreign capital to the country, and the oontidenee which he inspired in financial circles abroad enabled him to contract a number of loans and to better the financial situation by a series of conversions. Under a stable, wise, and economical

administration this far-reaching programme might perhaps have been carried out with success, but the vicissitudes of party politics and the periodical outbursts of national sentiment rendered its realization impossible. In April 1885 Trikoupis fell from power, and a few months later the indignation excited in Greece by the revolution of Philippopolis placed Delyannis once more at the head of a warlike movement. The army and fleet were again mobilized with a view to exacting territorial compensation for the aggrandizement of Bulgaria, and several conflicts with the Turkish troops took place on the frontier. The Powers, after repeatedly inviting the Delyannis Cabinet to disarm, established a blockade of Piraeus and other Greek ports (8th May 1886), France alone declining to co-operate in liiis measure. Delyannis resigned (11th May) and Trikoupis, who succeeded to power, issued a decree of disarmament (25th May). Hostilities, however, continued on the frontier, and the blockade was not raised till 7th June. Trikoupis had now to face the serious financial situation brought about

by the military activity of his predecessor. He imposed heavy taxation, which the people, for the time at least, bore without murmuring, and he continued to inspire such confidence abroad that Greek securities maintained their price in the foreign market. It was ominous, however, that a loan which he issued in 1890 was only partially covered. Meanwhile the Cretan difficulty had become once more a source of trouble to Greece. In 1889 Trikoupis was grossly deceived by the Turkish Government, which, after inducing him to dissuade the Cretans from opposing the occupation of certain fortified posts, issued a finnan annulling many important provisions in the constitution of the island. The indignation in Greece was intense, and popular discontent was increased by the success of the Bulgarians in obtaining the exequatur of the Sultan for a number of bishops in Macedonia. In the autumn of 1890 Trikoupis was beaten at the elections, and Delyannis, who had promised the people a radical reform of the taxation, succeeded to power. He proved unequal, however, to cope with the financial diflS.culty,

which now became urgent ; and the king, perceiving that a crisis was imminent, dismissed him and recalled Trikoupis. The hope of averting national bankruptcy depended on the possibility of raising a loan by which the rapid depreciation of the paper currency might be arrested, but foreign financiers demanded guarantees which seemed likely to prove hurtful to Greek susceptibilities ; an agitation was raised at Athens, and Trikoupis suddenly resigned (May 1893). His conduct at this juncture appears to have been due to some misunderstandings which had arisen between him and the king. The Sotiropoulos-E.halles ministry which followed effected a temporary settlement with the national creditors, but Trikoupis, returning to power in the autumn, at once annulled the arrangement. He now proceeded to a series of arbitrary measures which provoked the severest criticism throughout Europe and exposed Greece to the determined hostility of Germany. A law was hastily passed which deprived the creditors of 70 per cent, of their interest, and the proceeds of the revenues conceded

to the monopoly bondholders were seized (December 1893). Long negotiations followed, resulting in an arrangement which was subsequently reversed by the German bondholders. In January 1895 Trikoupis re-signed office, in consequence of a disagreement with the Crown Prince on a question of military discipline. His popularity had vanished, his health was shattered, and he determined to abandon his political career. His death at Cannes (llth April 1896), on the eve of a great national convulsion, deprived Greece of his masterly guidance and sober judgment at a critical moment in her history.

fiis funeral took place at Athens on 23rd April, while the city was still decorated with flags and garlands after the celebration of the Olympic games. The re-vival of the ancient festival, which drew together g^j^^‘J^ multitudes of Greeks from abroad, led to a lively js96. * .| awakening of the national sentiment, hitherto depressed by the economic misfortunes of the kingdom, and a secret patriotic society, known as the EthniM Hetmria, began to develop prodigious activity, enrolling

members from every rank of life and establishing branches in all parts of the Hellenic world. The society had been founded in 1894, by a handful of young officers who considered that the military organization of the country was neglected by the Government ; its piincipal aim was the preparation of an insurrectionary movement in Macedonia, which, owing to the activity of the Bulgarians and the reconciliation of Prince Perdinand with Russia, seemed likely to be withdrawn for ever from the domain of Greek irredentism. The outbreak of another insurrection in Crete supplied the means of creating a diversion for Turkey while the movement in Macedonia was being matured; arms and volunteers were shipped to the island, but the society was as yet unable to force the hand of the Government, and Delyannis, who had succeeded Trikoupis in 1895, loyally aided the Powers in the restoration of order by advising the Cretans to accept the constitution of 1896. The appearance of strong insurgent bands in Macedonia in the summer of that year testified to the activity of the society and

provoked the remonstrances of the Powers, while the spread of its propaganda in the army led to the issuei of a royal rescript announcing grand military manoeuvres, the formation of a standing camp, and the rearmament of the troops with a new weapon (6th December). The objects of the society were effectually furthered by the evident determination of the Porte to evade the application of the stipulated reforms in Crete; the Cretan Christians lost patience, and indignation was widespread in Greece. Emissaries of the society were despatched to the island, and affairs were brought to a climax by an outbreak at Canea on 4th February 1897. The Turkish troops fired on the Christians, thousands of whom took refuge on the warships of the Powers, and a portion of the town was consumed by fire.

Delyannis now announced that the Government had abandoned the policy of abstention. On the 6th two warships were despatched to Canea, and on the 10th a torpedo fiotilla, commanded by Prince George, ‘^

left Piraeus amid tumultuous demonstrations. isgr.’ The ostensible object of these measures was the protection of Greek subjects in Crete, and Delyannis was still anxious to avoid a definite rupture with Turkey, but the Ethnike Hetseria had found means to influence several members of the ministry and to alarm the king. Prince George, who had received orders to prevent the landing of Turkish reinforcements on the island, soon withdrew from Cretan waters owing to the decisive attitude adopted by the commanders of the international squadron. A note was now addressed by the Government to the Powers, declaring that Greece could no longer remain a passive spectator of events in Crete, and on 13th February a force of 1500 men, under Colonel Vassos, embarked at Piraeus. On the same day a Greek warship fired on a Turkish steam yacht which was conveying troops from Candia to Sitia. Landing

near Canea on the night of the 14th, Colonel' Vassos issued a proclamation announcing the occupation of Crete in the name of King George. He had received orders to expel the Turkish garrisons from the fortresses, but his advance on Canea was arrested by the international occupation of that town, and after a few engagements with the Turkish troops and irregulars he withdrew into the interior of the island. Proposals for the coercion of Greece were now put forward by Germany, but Great Britain declined to take action until an understanding had been arrived at with regard to the future government of Crete. Eventually (2nd March) collective notes were addressed to the Greek and Turkish Governments announcing the decision of the Powers that (1) Crete could in no case in present circumstances be annexed to Greece ; (2) in view of the delays caused by Turkey in the application of the reforms, Crete should be endowed with an effective autonomous administration, calculated to ensure it a separate government, under the suzerainty of the Sultan. Greece was at the same time summoned to remove its

army and fleet within the space of six days, and Turkey was warned that its troops must for the present be concentrated in the fortified towns and ultimately withdrawn from the island. The action of the Powers produced the utmost exasperation at Athens ; the populace demanded war with Turkey and the annexation of Crete, and the Government drew up a reply to the Powers in which, while expressing the conviction that autonomy would prove a failure, it indicated its readiness to withdraw some of the ships, but declined to recall the army. A suggestion that the troops might receive a European mandate for the preservation of order in the island proved unacceptable to the Powers, owing to the aggressive action of Colonel Vassos after his arrival. Meanwhile troops, volunteers, and munitions of war were hurriedly despatched to the Turkish frontier in anticipation of an international blockade of the Greek ports, but the Powers contented themselves with a pacific blockade of Crete, and military preparations went on unimpeded. While the Powers dallied, the danger of war increased ;

on 29th March the Crown Prince assumed command of the Greek troops in Thessaly, and a few days later hostilities were precipitated by the irregular forces of the Ethnike Hetaeria, which attacked several Turkish outposts near Grevena. According to a report of its proceedings, subsequently published by the society, this invasion received the previous sanction of the prime minister. On 17th April Turkey declared war. The disastrous campaign which followed was of short duration, and it was evident from the outset that the Greeks had greatly underrated the military strength of their opponents (see below Greco- Turkish War). Delyannis was invited by the king to resign, but refusing to do so was dismissed (2Sth April). His successor, Ehalles, after recalling the army from Crete (9th May) invoked the mediation of the Powers, and an armistice was concluded on the 19th of that month. Thus ended an unfortunate enterprise, which was undertaken in the hope that discord among the Powers would lead to a European war and the dismemberment of Turkey. Greek

interference in Crete had at least the result of compelling Europe to withdraw the island for ever from Turkish rule. The conditions of peace put forward by Turkey included a war indemnity of £10,000,000 and the reten-tion of Thessaly ; the latter demand, however, was reso-lutely opposed by Great Britain, and the indemnity was subsequently reduced to £4,000,000. The definitive treaty of peace, which was signed at Constantinople on 6th December, contained a provision for a slight modificHr tion of the frontier, designed to afford Turkey certain strategical advantages ; the delimitation was carried out

War with

Turkey.

by a commission composed of military delegates of the Powers and representatives of the interested parties.

The evacuation of Thessaly by the Turkish troops was completed in June 1898. An immediate result of the war was the institution of an international financial commission at Athens, charged with the control of certain revenues assigned to the service of the national debt.

The state of the country after the conclusion of hostilities was deplorable ; the towns of Northern Greece and the islands were crowded with destitute refugees from Thessaly; violent recriminations prevailed at Athens, and the position of the dynasty seemed endangered. A reaction, however, set in, in consequence of an attempt to assassinate King George (28th February 1898), whose great services to the nation in obtaining favourable terms from the Powers began to receive general recognition.

In the following summer the king made a tour through the country, and was everywhere received with enthusiasm.

In the autumn the Powers, on the initiative of Kussia, decided to entrust Prince George of Greece with the government of Crete; on 26th November an intimation that the prince had been appointed High Commissioner in the island was formally conveyed to the court of Athens, and on 21st December he landed in Crete amid enthusiastic demonstrations (see Crete).

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Geeoo-Tuekish Wae, 1897.

This war involved two practically distinct campaigns, in Thessaly and in Epirus. Upon the Thessalian frontier the

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Turks, early in March, had concentrated six divisions (about 68,000 men), 1600 sabres, and 166 guns, under Edhem Pasha. A seventh division was rendered avail-able a little later. The Greeks numbered about 45,000

infantry, 800 cavalry, and 96 guns, under the Crown Prince. On both sides there was a considerable dispersion of forces along the frontier. The Turkish navy, an important factor in the war of 1877-78, had become para^ lytic ten years later, and the Greek squadron held complete command of the sea. Expeditionary forces directed against the Turkish line of communications might have influenced the course of the campaign ; but for such work the Greeks were quite unprepared, and beyond bombarding one or two insignificant ports on the coast-line, and aiding the transport of troops from Athens to Volo, the navy practically accomplished nothing. On the 9th and 10th April Greek irregulars crossed the frontier, either with a view to provoke hostilities or in the hope of fomenting a rising in Macedonia. On the 16th and 17th some fighting occurred, in which Greek regulars took part; and on the ISth Edhem Pasha, whose headquarters had for some time been established at Elassona, ordered a general advance. The Turkish plan was to turn the Greek left and to bring

on a decisive action, but this was not carried out. In the centre the Turks occupied the Meluna Pass on the 19th, and the way was practically open to Larissa. The Turkish right wing, however, moving on Damani and the Reveni Pass, encountered resistance, and the left wiug was temporarily checked by the Greeks among the mountains near Nezeros. At Mati, covering the road to Tyrnavo, the Greeks entrenched themselves. Here sharp fighting occurred on the 21st and 22nd, during which the Greeks sought to turn the right flank of the superior Turkish central column. On the 23rd fighting was renewed, and the advance guard of the Turkish left column, which had been reinforced, and had pressed back the Greeks, reached Deliler. The Turkish forces had now drawn together, and the Greeks were threatened on both flanks. In the evening a general retreat was ordered, and the loose discipline of the Greek army was at once manifested. Rumours of disaster spread among the ranks, and wild panic supervened. There was nothing to prevent an orderly retirement upon Larissa, which had been fortified

and provisioned, and which offered a good defensive position. The general dibdcle could not, however, be arrested, and in great disorder the mass of the Greek army fled southwards to Pharsala. There was no pursuit, and the Turkish commander-in-chief did not reach Larissa till the 27th. Thus ended the first phase of the war, in which the Greeks showed tenacity in defence, which proved fruitless by reason of initially bad strategic dispositions entailing far too great dispersion, and also because there was no plan of action beyond a general desire to avoid risking a defeat which might prevent the expected risings in Macedonia and elsewhere. The handling of the Turkish army showed little skill or enterprise; but on both sides political considerations tended to prevent the application of sound military principles.

Larissa being abandoned by the Greeks, Velestino, the junction of the Thessalian railways, where there was a strong position covering Volo, seemed to be the natural rallying point for the Greek army. Here the support of the fleet would have been secured, and a Turkish advance

across the Othrys range upon Athens could not have taken place until the flanking position had been captured. Whether by direction or by natural impulse, however, the mass of the Greek troops made for Pharsala, where some order was re-established, and preparations were made to resist attack. The importance of Velestino was recognized by sending a brigade thither by railway from Pharsala, and the inferior Greek army was thus split into two portions, separated by nearly 40 miles. On 27th April a Turkish reconnaissance on Velestino was repulsed, and further fighting occurred on the 29th and 30th, in which the Greeks under Colonel Smolenski held their own. Meanwhile the Turks made preparations to attack Pharsala, and on 6th May the Greeks were driven from their positions in front of the town by three divisions. Further fighting followed on the 6th, and in the evening the Greek army retired in fair order upon Domokos. It was intended to turn the Greek left with the first division under Hairi Pasha, but the flanking force did not arrive in time

to bring about a decisive result. The abandonment of Pharsala involved that of Velestino, where the Turks had obtained no advantage, and on the evening of the 6th Colonel Smolenski began a retirement upon Halmyros. Again delaying, Edhem Pasha did not attack Domokos till the 17th, giving the Greeks time to entrench their positions. The attack was delivered in three columns, of which the right was checked and the centre failed to take the Greek trenches and suffered much loss. The left column, however, menaced the line of retreat, and the Greek army abandoned the whole position during the night. No effective stand was made at the Purka Pass, which was evacuated on the following night. Colonel Smolenski, who arrived on the 18th from Halmyros, was directed to hold the pass of Thermopylae. The Greek forces being much demoralized, the intervention of the Tsar was invoked by telegraph ; and the latter sent a personal appeal to the Sultan, who directed a suspension of hostilities. On the 20th an armistice was . arranged.

In Epirus at the outbreak of war about 16,000 Greeks, including a cavalry regiment and five batteries, the whole under Colonel Manos, occupied a line of defence from Arta to Peta. The Turks, about 28,000 strong, with forty-eight guns, under Achmet Hifsi Pasha, were distributed mainly at lannina, Pentepagadia, and in front of Arta. On 18th April the Turks commenced a three days' bombardment of Arta ; but successive attempts to take the bridge were repulsed, and during the night of the 21st they retired on Philippiada, 26 miles distant, which was attacked and occupied by Colonel Manos on the 23rd. The Greeks then advanced to Pentepagadia, meeting with little resistance. Their difBculties now began. After some skirmishing on the 27th, the position held by their advanced force near Homopulos was attacked on the 28th. The attack was renewed on the 29th, and no Greek reinforcements were forthcoming when needed. TheEuzones made a good defence, but were driven back by superior force, and a retreat was ordered, which quickly degenerated into panic-stricken flight to and across the Arta. Rein-

forcements, including 2600 Epirote volunteers, were sent to Arta from Athens, and on 12th May another incursion into Turkish territory began, the apparent object being to occupy a portion of the country in view of the breakdown in Thessaly and the probability that hostilities would shortly end. The advance was made in three columns, while the Epirote volunteers were landed near the mouth of the Luro river with the idea of cutting off the Turkish garrison of Prevesa. The centre column, consisting of a brigade, three squadrons, and two batteries, which were intended to take up and hold a defensive position, attacked the Turks near Strevina on the 13th. The Greeks fought well, and being reinforced by a battalion from the left column, resumed the offensive on the following day, and fairly held their own. On the night of the 15th a retreat was ordered and well carried out. The volunteers landed at the mouth of the Luro were attacked and routed with heavy loss.

The campaign in Epinis thus failed as completely as that in Thessaly. Under the terms of the treaty of peace, signed on 20th September, and arranged by the European Powers, Turkey obtained an indemnity of £T4,000,000, and a rectification of the Thessalian frontier, carrying with it some strategic advantage. History records few more unjustifiable wars than that which Greece gratuitously provoked. The Greek troops on several occasions showed tenacity and endurance, but discipline and cohesion were manifestly wanting. Many of the officers were incapable ; the campaign was gravely mismanaged; and politics, which led to the war, impeded its operations. On the other hand, the fruits of the German tuition, which began in 1880, and received a powerful stimulus by the appointment of General von der Goltz in 1883, were shown in the Turkish army. The mobilization was on the whole smoothly carried out, and the newly completed railways greatly facilitated the concentration on the frontier. The young school of officers

trained by General von der Goltz displayed ability, and the artillery at Pharsala and Domokos was well handled. The superior leading was, however, not conspicuously successful; and while the rank and file again showed excellent military qualities, political conditions and the Oriental predilection for half-measures and for denying full responsibility and full powers to commanders in the field enfeebled the conduct of the Campaign. On account of the total want of careful and systematic peace training on both sides, a war which presented several interesting strategic problems provided warnings in place of military lessons. (g. s. c.)

Modern Greek Literature.

The works of modern Greek poets and prose writers are usually classified according to the form of the language in which they are written. In contemporary literature two distinct forms of the modern language present themselves — the vernacular (ij Kadofi.iXovfi.ivrj) and the purified (17 /ca^apeuoro-a). The former is the oral language, spoken by the whole Greek world, with local

dialectic variations ; the latter is based on the Greek of the Hellenistic writers, modified, but not essentially altered, in successive ages by the popular speech. At the time of the War of Independence the enthusiasm of the Greeks and the Philhellenes was fired by the memory of an illustrious past, and at its close a classical reaction followed : the ancient nomenclature was introduced in every department of the new state, towns and districts received their former names, and children were christened after Greek heroes and philosophers instead of the Christian saints. In the literary revival which attended the national movement, two schools of writers made their appearance — the purists, who, rejecting the spoken idiom as degenerate and corrupt, aimed at the restoration of the classical language, and the vulgarists, who regarded the vernacular or "Romaic" as the genuine and legitimate representative of the ancient tongue. A controversy which had existed in former times was thus revived, with the result that a state of confusion still prevails in the national literature. The classical scholar who is as yet unacquainted with modern

Greek wUl find in the pages of an ordinary periodical or newspaper specimens of the conventional literary language which he can read with ease side by side with poems or even prose in the vernacular which he will be altogether unable to interpret.

The vernacular or oral language is never taught, but is universally spoken. It has been evolved from the ancient language by a natural and regular process, similar to that which has produced the Romajice languages from the Latin, or the Russian, Bulgarian, and Servian from the old Slavonic. In the case of Greek the process has been less complete; the speech of illiterate peasants in Epirus and Asia Minor approximates more nearly to the classical tongue than Italian to Latin. If we except certain peculiar dialects, such as the Tzakonian in the south-eastern Morea, the differences of idiom prevailing among the members of a widely scattered race are surprisingly slight. This comparative uniformity may be attributed to the maritime character of the Greeks, to the intercourse between the great centres of population, such as Constan-

tinople, Smyrna, Salonika, and Alexandria, to the influence of the Church, and still more to that of the schools, which even in the darkest period of the national history were maintained throughout the Greek world. The phonetic modifications which occur in the different dialects are also relatively insignificant. A comparative study of these can hardly fail to suggest the conclusion that the ancient pronunciation is to a large extent represented by the modern. There are, apparently, some important deviations, e.g.f the prevailing itacisra, or use of the ” i ” sound for -q, V, ec, 01, vi, the converse use of the ” u ” sound for ” i,” and the pronunciation of the diphthongs av and ev as “af ” and “ef,” are undoubted corruptions; but in these and other instances the original pronunciation has been retained in various dialects. The arbitrary systems of pronunciation adopted in England, France, and Germany differ from each other in essential particulars. Notwithstanding certain variations in the dialects, the general uniformity in the use of the accents, which rarely deviates from that denoted by the Alexandrine gram-

marians, shows the system of accentuation according to metrical quantity to be erroneous. The spoken Greek, like the other languages of modern Europe, has received an analytic development. The case endings show a tendency to disappear or to assimilate ; the dative is totally lost, the genitive is often replaced by a preposition with the accusative. In the conjugations the perfect and future tenses are formed by the auxiliaries £x ^eX(o; the infinitive has ceased to exist except in a shortened form with the auxiliary. As in the Romance languages, a new nominative is often formed from the accusative: thus b avrip, fj ywq, 7) vv$ become 0 avSpai, ^ yvvaiKa, 17 vvxra; the nominative plural of all feminine nouns ends in -s ; the final nasal in noun and verb forms usually disappears; the final syllable, as well as the first syllable, is sometimes lost, as in <^St, (dSi, XaSi, for 6

passive, which has disappeared in most languages of the Indo-European family, is a peculiar feature. The spoken language contains a large number of foreign

words.

The Greek vernacular has developed on parallel lines with the modern European languages, and in obedience to the same laws; like them, it might have grown into a literary language had any great writers arisen in the Middle Ages to do for it what Dante and his successors of the trecento did for Italian. But the effort to adapt it to the requirements of modern literature will hardly prove successful. In the first place, the national sentiment of the Greeks will always prompt them to imitate the classical writers, and so far as possible to appropriate their diction. The beauty and dignity of the ancient tongue will always possess such an attraction for cultivated writers that they will be led insensibly to adopt its forms and borrow from its wealth of phrase and idiom. In the next place, a certain literary tradition and usage has already been formed which cannot easily be broken down. For more than half a century the generally accepted written language, half modern, half ancient, has been in use in the schools, the university, the parliament, the state depart-

ments, and the pulpit, and its influence upon the speech of the more educated classes is already noticeable. It largely

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owes its present form — though a fixed standard is still lacking — to the influence and teaching of Koraes (1748-1833), whose literary activity was contemporary with the national renascence. As in the time of the decadence a KOLvr] SioXcKTos stood midway between the classical language and the popular speech, so at the beginning of the 19th century there existed a common literary dialect, largely influenced by the vernacular, but retaining the characteristics of the old Hellenistic, from which it was derived by an unbroken literary tradition. This written language Koraes took as the basis of his reforms, purging it of foreign elements, preserving its classical remnants, and enlarging its vocabulary with words borrowed from the ancient lexicon or, in case of need, invented in accordance with a fixed principle. He thus

adopted a middle course, discountenancing alike the pedantry of the purists and the over-confident optimism of the vulgarists, who found in the imcouth popular speech all the material for a langue savante. The language which he thus endeavoured to shape and reconstruct is, of course, conventional and artificial. In course of time it will probably tend to approach the vernacular, while the latter will gradually be modified by the spread of education. The spoken and written languages, however, will always be separated by a wide interval.

Many of the best poets of modern Greece have written in the vernacular, which is best adapted for the natural and spontaneous expression of the feelings. Dionysios Solomos (1798-1857), the greatest of them all, employed the dialect of the Ionian Islands. Of his lyrics, which are full of poetic fire and inspiration, the most celebrated is his " Ode to Liberty." Other poets, of what may be described as the Ionic school, such as Andreas Kalvos (1796-1869), Julius Typaldos (1814-83), John Zampelios (1787-1856), and G-erasimos Markoras (born 1826),

followed his example in using the Heptanesian dialect. On the other hand, Georgios Terzetes (1806-74), Aristotle Valaorites (1824-79), and Gerasimos Mavrogiannes, though natives of the Ionian Islands, adopted in their lyrics the language of the Klephtic ballads — in other words, the vernacular of the Pindus range and the mountainous district of Epirus. This dialect had at least the advantage of being generally current throughout the mainland, while it derived distinction from the heroic exploits of the champions of Greek liberty. The poems of Valaorites, which are characterized by vivid imagination and grace of style, have made a deep impression on the nation. Other poets who largely employed the Epirotio dialect and drew their inspiration from the Klephtic songs were John Vilaras (1771-1823), George Zalokostas (1805-1857) in his lyric pieces, and Theodore Aphentoules, a Cretan (died 1893). With the poems of this group may be classed those of Demetrius Bikelas (born 1835). The popular language has been generally adopted by the younger generation of poets,

among whom may be mentioned Aristomenes Probelegios (born 1850), George Bizyenos (1863-96), George Drosines, Kostes Palamas (born 1859), John Polemes, Argyres Ephthaliotes, and Jacob Polylas (died 1896).

Contemporary with the first-mentioned or Ionic group, there existed at Constantinople a school of poets who wrote in the accepted literary language, and whose writings served as models for the later group which gathered at Athens after the emancipation of Greece.

The literary traditions founded by Alexander Eizos Ehangabes (1810-1892) and the brothers Alexander and Panagiotis Soutzos (1803-63 and 1800-68), who belonged to Phanariot families, were maintained in Athens by Spiridion Basiliades (1843-74), Angelos Vlachos (born 1838), John Karasoutzas (1824-73), Demetrios Paparrhegopoulos (1843-1873), and Achilles Paraschos (born 1838). The last, a poet of fine feeling, has also employed the popular language. In general the practice of versification in the literary language has declined, though sedulously encouraged by the university of

Athens, and fostered by annual poetic competitions with prizes provided by patriotic citizens. Greek lyric poetry during the first half of the century was mainly inspired by the patriotic sentiment aroused by the struggle for independence, but in the present generation it often shows a tendency towards the philosophic and contemplative mood under the influence of Western models. Among recent satirists, George Soures (born 1853) occupies a unique position. He reviews social and political events in the ‘Pcofiijos, a witty little news-paper written entirely in verse, which is read with de-light by all classes of the population.

There has beeu an abundant production of dramatic literature in recent years. In addition to Alexander Khangab^s, John Zampelios, and the two Soutzos, who belong to the past generation, Kleon Ehangabes, Angelos Vlachos, Demetrios Koromelas, Basiliades, and Bema-dakes are the most prominent among modern dramatic writers. Numerous translations of foreign masterpieces have appeared, among which the metrical versions of

Borneo and Juliet, Othello, King Lear, Hamlet, Macbeth, and The Merchant of Venice, by Demetrios Bikelas, deserve mention as examples of artistic excellence. Goethe's Faust has been rendered into verse by Probelegios, and Hamlet, Antony and Cleopatra, Coriolanus, and Julius Caesar into prose by Damiralis.

Almost all the prose writers have employed the literary language. In historical research the Greeks continue to display much activity and erudition, but no great work comparable to Spiridion Trikoupis's History of the Revolution has appeared in the present generation. A history of the Greek nation from the earliest times to the present day, by Spiridion Lampros, and a general history of the 19th century by Karolides, have recently been published. The valuable Mvqii.ua. of Sathas, the fieXeTcu. Bv^avnvrj^ la-TopCa's of Spiridion Zampelios, and Mavrogiannes's History of the loniayi Islands deserve special mention, as well as the essays of Bikelas, which treat of the Byzantine and modern epochs of Greek history. Some of the last-named were translated into English by the

late marquis of Bute. Among the writers on jurisprudence are Peter Paparrhegopoulos, Kalligas, Basileios OSkonomedes, and Nikolaos Saripolos. Brailas-Armenes and John Skaltzounes, the latter an opponent of Darwin, have written philosophical works. The Ecclesiastical History of Diomedes Kyriakos and the Theological Treatises of Archbishop Latas should be noted. The best-known writers of philological works are Constantino Kontos, a strong advocate of literary purism, George Hatzidakes, Theodore Papademetrakopoulos, and John Psichari; in archaeology, Stephen Koumanoudes, Panagiotes Kavvadias, and Christos Tsountas have won a recognized position among scholars. John Svoronos is a high authority on numismatics. The works of John Hatzidakis on mathematics, Anast. Christomanos on chemistry, and Demetrios Aeginetes on astronomy are well known.

The earlier works of fiction, written in the period succeeding the emancipation of Greece, were much affected by foreign influence. Modern Greece has not produced

any great novelist. The Kpr/TiKoi ya.ji.oi of Spiridion Zampelios, the scene of which is laid in Crete, and the Tlianos Blechas of Kalligas are interesting, the former for accuracy of historical detail, the latter as a picture of peasant life in the mountains of Greece. Original novel-writing has not been much cultivated, but translations of foreign romances abound. In later times the short story

has come into vogue through the example of D. Bikelas, whose tales have acquired great popularity ; one of them, Loukis Laras, has been translated into many languages. The example of Bikelas has been followed by Drosinis Karkavitzas, Ephthaliotis, Xenopoulos, and many others. The most distinguished of the writers who adhere to the vernacular in prose is John Psichari, professor of the ;ficole des Hautes iStudes in Paris. He is the recognized leader of the vulgarists. Among the best-known of his works are To Toieihl ixov, a narrative of a journey in Greek lands, Tovapo tov TiavvLprf, ‘H ZovXea, and o Mdyos. The

tales of Karkavitzas and Ephthaliotis are also in the vernacular. Among the younger of M. Psichari's followers is M. Pallis, who has recently published a translation'of the Iliad. Owing to the limited resources of the popular language, the writers of this school are sometimes compelled to employ strange and little-known words borrowed from the various dialects. The vernacular has never been adopted by writers on scientific subjects, owing to its inherent iin suitability and the incongruity arising from the introduction of technical terms derived from the ancient language. ISTotwithstanding the zeal of its adherents, it seems unlikely to maintain its place in literature outside the domain of poetry ; nor can any other result be expected, unless its advocates succeed in reforming the system of public instruction in Greece.

Many periodicals are published at Athens, among which may be mentioned the Athena, edited by Constantine Kontos, the EthniM Agogi, a continuation of the old Hestia, the Harmonia, and the Ata7rAav iraiSav, an educational review. The Parnassos, the Archaeological

Society, and other learned bodies issue annual or quarterly reports. The Greek journals are both numerous and widely read. They contain much clever writing, which is often marred by inaccuracy and a deficient sense of responsibility. Por many years the Ifea Hemira of Trieste exerted a considerable influence over the Greek world, owing to the able political reviews of its editor, Anastasios Byzantios (died 1898), a publicist of remarkable insight and judgment.

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C ree kChurch. See Orthodox Eastern Church.

Green, John Richard (1837-1883), EngUsh his-torian, was born at Oxford on 12th December 1837, and educated at Magdalen College School and at Jesus (Col-lege, where he obtained an open scholarship. On leaving Oxford, he took orders and became the incumbent of St Philip’s, Stepney. His preaching was eloquent and able ; he worked diligently among his poor parishioners,

and won their affection by his ready sympathy. Meanwhile he studied history in a scholarly fashion, and wrote much for the Saturday Review. Partly because his health was weak and partly because he ceased to agree with the teaching of the Church of England, he abandoned clerical life and devoted himself to history ; in 1868 he took the post of librarian at Lambeth, but his health was already breaking down, and he was attacked by consumption. His Sliort History of the English People (1874) at once attained extraordinary popularity, and was afterwards expanded in a work of four volumes (1877-80). Green is pre-eminently a picturesque historian ; he had a vivid imagination and a keen eye for colour. His chief aim was to depict the progressive life of the English people rather than to write a political history of the English state. In accomplishing this aim he worked up the results of wide reading into a series of brilliant pictures. While generally accurate in his statement of facts, and showing a firm grasp of the main tendency of a period, he often builds more on his author-

ities than is warranted by their words, and is apt to overlook points which would have forced him to modify his representations and lower the tone of his colours. From his animated pages thousands have learnt to take pleasure in the history of their own people, but could scarcely learn to appreciate the complexity inherent in all historical movement. His style is extremely bright, but it lacks sobriety and presents some affectations. His later histories. The Making of England (1882) and Ttie Conquest of England (1883), are more soberly written than his earlier books, and are valuable contributions to historical knowledge. Green died at Mentone on 7th March 1883. He was a singularly attractive man, of wide intellectual sympathies and an enthusiastic temperament; his good-humour was unfailing and he was a brilliant talker ; and his work was done with admirable courage in spite of ill-health- It is an open secret that Mrs Humphry Ward's Robert Elsmere was largely a portrait of him. In 1877 J. E. Green married Miss Alice Stopf ord ; and Mrs Green, besides writing a

memoir of her husband, prefixed to the 1888 edition of his Short History, has herself done valuable work as a historian, particularly in her Henry II. in the ” English Statesmen ” series (1888) and her Town Life in the 15th Century (1894). (w. hu.)

See also the Letters of J. R. Green (1901), edited by Leslie Stephen.

Green, Thomas Hill (1836-1882), English philosopher, the most typical English representative of the school of thought called Neo-Kantian, or Neo-Hegelian, was born on 7th April 1836 at Birkin, a village in the West Eiding of Yorkshire, of which his father was rector. On the paternal side he was descended from Oliver Cromwell, whose honest, sturdy independence of character he seemed to have inherited. His education was conducted entirely at home until, at the age of four-

teen, he entered Rugby, where he remained five years. In 1865 he became an undergraduate member of Balliol College, Oxford, of which society he was, in 1860, elected

Fellow. His life, henceforth, was devoted to teaching (mainly philosophical) in the university — first as college tutor, afterwards, from 1878 until his death (at Oxford on the 26th of March 1882), as Whyte's Professor of Moral Philosophy. The lectures he delivered as professor form the substance of his two most important works, viz., the Prolegomena to Ethics, and the Lectures on the Principles of Political Obligation, which contain the whole of his positive constructive teaching. These works were not published until after his death, but Green's views were previously known to the outside world indirectly through the Introduction to the standard edition of Hume's works (by Green and Grose), in which the doctrine of the " English " or " Empirical " Philosophy was exhaustively examined.

Hume's Empiricism, combined with a belief in biological evolution (derived from Herbert Spencer), was the chief feature in English thought during the third quarter of the 19th century. Green represents primarily the reaction against doctrines which, when carried out to their logical

conclusion, not only “rendered all philosophy futile,” but were fatal to practical life. By reducing the human mind to a series of unrelated atomic sensations, this teaching destroyed the possibility of knowledge, and, further, by representing man as a ” being who is simply the result of natural forces,” it made conduct, or any theory of conduct, unmeaning ; for life in any human, intelligible sense implies a personal self which (1) knows what to do, (2) has power to do it. Green was thus driven, not theoretically, but as a practical necessity, to raise again the whole question of Man in relation to Nature. When (he held) we have discovered what Man in himself is, and what his relation to his environment, we shall then know his function — what he is fitted to do. In the light of this knowledge we shall be able to formulate the Moral Code, which, in turn, will serve as a criterion of actual civic and social institutions. These form, naturally and necessarily, the objective expression of moral ideas, and it is in some civic or social whole that the Moral Ideal must finally take concrete shape.

To ask ” What is Man ? ” is to ask ” What is Experi-

ence ? ” for Experience means that of which I am conscious. The facts of consciousness are the only facts which, to begm with, we are justified in asserting to exist. On the other hand, they are valid evidence for whatever is necessary to their own explanation, i.e., for whatever is logically involved in them. Now the most striking characteristic of man, that in fact which marks him specially, as contrasted with other animals, is seZ/-consciousness. The simplest mental act into which we can analyse the operations of the human mind — the act of sense-perception — is never merely a change, physical or psychical, but is the consciousness of a change. Human experience consists, not of processes in an animal organism, but of these processes recognized as such. That which we perceive is from the outset an apprehended fact — that is to say, it cannot be analysed into isolated elements (so-called sensations) which, as such, are not constituents of consciousness at all, but exists from the first as a synthesis of relations in a consciousness which keeps distinct the “self” and the various elements of the ” object,” though holding all

together in the unity of the act of perception. In other words, the whole mental structure we call knowledge consists, in its simplest equally with its most complex constituents, of the ” work of the mind.” Locke and Hume held that the work of the mind was eo ipso unreal because it was ” made by ” man and not ” given to ” man. It thus represented a subjective creation, not an objective fact. But this consequence follows only upon the assumption that the work of the mind is arbitrary, an assumption shown to be unjustified by the results of exact science, with the distinction, im.iversally recognized, which such science draws between truth and falsehood, between the real and ” mere ideas.” This (obviously valid) distinction logically involves the consequence that the object, or content, of knowledge, viz., reality, is an intelligible ideal reality, a system of thought relations, a spiritual cosmos. How is the existence of this ideal whole to be accounted for? Only by the existence of some “principle which renders all relations possible and is itself determined by none of them” ; an eternal self -consciousness which knows

in whole what we know in part. To God the world is, to man the world becomes. Human experience is God gradually made manifest.

Carrying on the same analytical method into the special department of Moral Philosophy, Green held that Ethics applies to the peculiar conditions of Social life that investigation into man's nature which Metaphysics began. The Faculty employed in this further investigation is no " separate moral Faculty," but that same Reason which is the source of all our knowledge — Ethical and other. Self-reflexion gradually reveals to us human capacity, human function, with, consequently, human responsibility. It brings out into clear consciousness certain potentialities in the realization of which man's true good must consist. As the result of this analysis, combined with an investigation into the surroundings man lives in, a " content " — a Moral Code — becomes gradually evolved. Personal good is perceived to be realizable only by making actual the conceptions thus arrived at. So long as these remain potential, or ideal, they form the motive of action ; motive consisting

always in the idea of some “end” or “good” which man presents to himself as an end in the attainment of which he would be satisfied, that is, in the realization of which he would find his true self. The determination to realize the self in some definite way constitutes an ” act of Will,” which, as thus constituted, is neither arbitrary nor externally determined. For the motive which may be said to be its cause lies in the man himself, arid the identification of the Self with such a motive is a /SeZ/-determination, which is at onoe both rational and free. The ” Freedom of Man ” is constituted, not by a supposed ability to do anything he may choose, but in the power to identify himself with that true good which reason reveals to him as his true good. This good consists in the realization of personal character; hence the final good, i.e., the Moral Ideal, as a whole, can be realized only in some Society’ of persons who, while remaining ends to themselves in the sense that their individuality is not lost but rendered more perfect, find this perfection attainable only when the separate indivi-dualities are integrated as parts of a social whole. Society

is as necessary to form persons as persons are to constitute Society. Social union is the indispensable condition of the development of the special capacities of the individual members. Human self-perfection cannot be gained in isolation ; it is attainable only in interrelation with fellow-citizens in the Social Community.

The law of our being, so revealed, involves in its turn civic or political duties. Moral goodness cannot be limited to, still less constituted by, the cultivation of self -regarding virtues} but consists in the attempt to realize in practice that moral ideal which self-analysis has revealed to us as our ideal. From this fact arises the ground of political obligation, for the institutions of political or civic life are the concrete embodiment of moral ideas in terms of our day and generation. But, as Society exists only for the proper development of persons, we have a criterion by which to test these institutions, viz., do they, or do they not, contribute to the development of moral character in the individual citizens ? It is obvious that the final Moral

Ideal is not realized in any body of civic institutions actually existing, but the same analysis ■which, demonstrates this deficiency points out the direction which a true development will take. Hence arises the conception of rights and duties which should be maintained by Law, as opposed to those actually maintained ; with the further consequence that it may become occasionally a moral duty to rebel against the State in the interest of the State itself, that is, in order better to subserve that end or function which constitutes the raison d'Mre of the State. The State does not consist in any definite concrete organization formed once for all. It represents a " general will " which is a desire for a common good. Its basis is not a coercive authority imposed upon the citizens from without, but consists in the spiritual recognition, on the part of the citizens, of that which constitutes their true nature. "Will, not force, is the basis of the State."

Green's teaching was, directly and indirectly, the most potent

philosophical influence in England during the last quarter of the 19th century, while his enthusiasm for a common citizenship, and his personal example in practical municipal life, inspired much of the efiort made, in the years succeeding his death, to bring the universities more into touch with the people and to break down the rigour of class distinctions.

Of his philosophical doctrine proper, the most striking characteristic is Integration, as opposed to Disintegration, both in Thought and in Reality. ” That which Is” is a whole, not an aggregate; an organic complex of parts, not a mechanical mass ; a ” whole ” too not material but spiritual, a ” world of Thought-relations.”

On the critical side this teaching is now admittedly valid against the older Empiricism, and the cogency of the reasoning by which his constructive theory is supported is generally recognized. Nevertheless, Green’s statement of his conclusions presents important difficulties. Even apart from the impossibility of conceiving a whole of relations which are relations and nothing else (this objection is perhaps largely verbal), no explanation is given of the fact (obvious in experience) that the spiritual entities of which the IJniverse is composed appear material. Certain elements present

themselves in Feelmg which seem stubbornly to resist any attempt to explain them in terms of Thought. While, again, legitimately insisting upon Personality as a fundamental constituent in any true theory of Reality, the relation between human individualities and the divine Person is left vague and obscure ; nor is it easy to see how the existence of several individualities — human or divine — in one cosmos is theoretically possible. It is at the solution of these two questions that Philosophy in the immediate future may be expected to work.

Green's most important treatise — fjie Prolegomena to Ethics — practically complete in manuscript at his death — was published in the year following. Shortly afterwards Nettleship's standard edition of his WorJcs (exclusive of the Prolegomena) appeared in three volumes : vol. i. containing reprints of Green's criticism of Hume, Spencer, Lewes ; vol. ii. Lectures on Kant, on Logic, on the Principles of Political Obligation ; vol. iii. Miscellanies, preceded by a full Memoir by the Editor. The Principles of Political Obligation was afterwards published in separate form. A criticism of Neo-Hegelianism will be found in Professor Seth's Hegelianism and Personality, to which may be added articles in Mind (January

and April 1884) by Mr A. J. Balfour and Professor Henry Sidgwick.

(w. H. F.*)

Creenaway, Kate (1846-1901), English artist and book illustrator, was the daughter of John Greenaway, a well-known draughtsman and engraver on wood, and was born in London on the 17th of March 1846. After a course of study at South Kensington, at ” Heatherley’s ” life classes, and at the Slade School, Kate Greenaway began, in 1868, to exhibit water-colour drawings at the Dudley Gallery, London. Her more remarkable early work, however, consisted of Christmas cards, which, by reason of their quaint beauty of design and charm of draughtsmanship, enjoyed an extraordinary vogue. Her subjects were, m the main, young girls, children, flowers, and landscape ; and the air of artless simplicity, freshness, humour, and purity of these little works so appealed to public and artists alike, that the enthusiastic welcome habitually accorded to them is to be attributed to something more than love of novelty. In the line she had struck out Kate Greenaway was encouraged by H. Stacy Marks,

E.A., and she refused to listen to those friends who urged her to return to a more conventional manner. Thence-forward her illustrations for children (such as for Little Folks, 1873, et seq.) attracted much attention. In 1877 her drawings at the Dudley Gallery were sold for £54, and her Eoyal Academy picture for eighteen guineas; and in the same year she began to draw for the Illustrated London News. In the year 1879 she produced Under the Window, of which 150,000 copies are said to have been sold, and of which French and German editions were also issued. Then followed TJie Birthday Book, Mother Goose, Little Ann, and other books for children, which were appreciated not less by adults, and were to be found on sale in the bookshops of every capital in Europe and in the cities of America. The extraordinary success achieved by the young girl may be estimated by the amounts paid to her as her share of the profits : for Under the Windov) she received £1130; for The Birthday Book, £1250; for Mother Goose, £905; and for Little Ann, £667. These four books alone produced a clear return of £8000.

” Toy-books ” though they were, these little works created a revolution in illustration, and so were of real import-ance ; they were loudly applauded by John Ruskin (Art of England and Fors Clavigerd), by Ernest Chesneau and Arsene Alexandre in France, by Dr Muther in Germany, and by leading art-critics throughout the world. In 1890 Kate Greenaway was elected a member of the Eoyal Institute of Painters in Water Colours, and in 1891, 1894, and 1898 she exhibited water-colour drawings (including illustrations for her books) at the gallery of the Fine Art Society (by which a representative selection was ex-hibited in 1902), where they surprised the world by the infinite delicacy, tenderness, and grace which they dis-played. A leading feature in Miss Greenaway’s work was her revival of the delightfully quaint costume of the beginning of the 19th century ; this lent humour to her fancy, and so captivated the public taste that it has been said, with poetic exaggeration, that “Kate Greenaway dressed the children of two continents.” Her drawings of children have been compared with Stothard’s for

grace and with Eeynolds's for naturalness, and those of flowers with the work of even Van Huysum and Botticelli. From 1883 to 1897, with a break only in 1896, she issued a series of Kate Greenaway's Almanacs. Although she illustrated The Pied Piper of Hamelin and other works, the artist preferred to provide her own text ; the numerous verses which were found among her papers after her death prove that she might have added to her reputation with her pen. She was possessed of great charm of character. Extremely shy of public notice, she was not less modest in private life; her friendships, though few, were very cordial. She died at Hampstead on 6th November 1901. (m. h. s.)

Greenbacks, a form of paper currency in the United States, so named from the green colour used on the backs of the notes. They are Treasury notes, and were first issued by the Government in 1862, " as a question of hard necessity," to provide for the expenses of the Civil War. The Government, following the example of the banks, had suspended specie payment. The new

notes were therefore for the time being an inconvertible paper currency, and, since they were made legal tender, were really a form of fiat money. The first Act, providing for the issue of notes to the amount of $150,000,000, was passed on the 25th February 1862; the Acts of 11th July 1862 and 3rd March 1863 each authorized further issues, of $150,000,000. The notes soon depreciated in value, and at the lowest were worth only 35 cents on the dollar. The Act of 12th April 1866 authorized the retirement of $4,000,000 of notes per month, but was repealed two years later. On 1st

January 1879 specie payment was resumed, and the amount of notes then nominally remaining ($346,681,016) was still outstanding on 1st January 1902.

The so-called Greenback party, whioli first came into definite political existence in 1874, was in favour of further increasing the volume of greenbacks. Their candidate for the presidency in 1876 was Peter Cooper, who received 81,740 votes. In 1880 the

party, enlarged by fusion with labour reformers, nominated James B. Weaver, and not only polled 307,306 votes, but elected eight representatives to Congress. In 1884 their candidate was Greneral Benjamin F. Butler (also the candidate of the Anti-Monopoly party), who received 133,825 votes. Since then the party has been merged in the Populists.

Green Bay, capital town of Brown county, Wis-
consin, U.S.A., in 44° 31′ N. and 88° 00′ W., at the iead
of Green Bay, at an altitude of 691 feet. It has four rail-
ways, the Chicago and ISTorth-Westeru, the Chicago, Mil-
waukee, and St Paul, the Green Bay and Western, and
the Kewaunee, Green Bay, and Western. Its excellent
harbour and ample railway facilities give it a large com-
merce. Its manufactures are chiefly of lumber; the city
contains many saw and shingle mills. Population (1880),
7464; (1890), 9069; (1900), 18,684.

Creenbush. See Ebnssblaee, N.Y.

Creencastle, capital of Putnam county, Indiana, U.S.A., at an altitude of 762 feet. It is on the Vandalia, the Chicago, Indianapolis, and Louisville, and the Cleveland, Cincinnati, Chicago, and St Louis railways. It is the seat of De Pauw University, a co-educational Methodist-Episcopal institution, founded in 1832. In 1899 this had 22 professors and instructors and 475 students, about one-third of whom were women. Its property exceed $600,000, and its income for the year was $31,848. Population (1880), 3644; (1890), 4390; (1900), 3661, of whom 143 were foreign-born and 155 negroes.

Greenfield, capital of Franklin county, Massachusetts, U.S.A., including an area of 20 square miles of hill country. The principal village, of the same name as the town, is situated on the northern bank of the Deerfield river, and on the Fitchburg and the Boston and Maine railways, at an altitude of 200 feet. Population of the town (1880), 3903 ; (1890), 6252 ; (1900), 7927, of

whom 1431 were foreign-born.

GREEIN^LAN^D.

SINCE 1880 the unknown parts of the coasts of Greenland have been explored by several expeditions. In 1882 Lieutenant Lockwood and Sergeant (afterwards Captain) Brainard, of the United States expedition to Lady Franklin Bay,^ explored the north-west coast beyond Cape Britannia to a promontory in 83° 24′ N. lat. and 40° 46′ E. long.,, and they saw to the north-east Cape Washington, in about 83° 38′ N. lat. and 39° 30′ E. long., the most northerly point of land hitherto observed. In July 1892 Lieutenant B. E. Peary and E. Astrup discovered Independence Bay, on the north-east coast, in 81° 37′ N. lat. and 34° 6′ W. long.^ In May 1895 it was revisited by Peary, who supposed this bay to be a sound communicating with Victoria Inlet on the north-west coast. To the north Heilprin Land and Melville Land were seen stretching northwards, but the probability seemed to be that the coast soon trended north-west. In 1901 Lieutenant Peary rounded the north point, and penetrated

as far north as 83° 50′ N. The previously little-known east coast has to a great extent teen well explored since 1880. The Danes G. Holm and V. Garde have carefully explored and mapped the coast from Cape Farewell to Angmagssalik, in 66° N. lat.^ Kansen and his companions also travelled along a part of this coast in 1888.^ Nordenskiold visited in the Sophia JLngmagssalik, in 65° 36′ IST. lat., in 1883.’ Captain C. Eyder, in 1891-92, explored and mapped the large Seoresby Sound, or, more correctly, Scoresby Fjord.^ Lieutenant G. Amdrup, in 1899, explored the coast from Angmagssalik north to 67° 22′ IS”, lat.’ A part of this coast, about 67° N. lat., had also been seen by ifansen in

1 A. W. Gbeelt. Report on the Proceedings of the United States Expedition to Lady Franklin Bay, Grinnell Land, vols. i. and ii. Washington, 1885. Three Tears of Arctic Service, 2 vols. Xondon, 1886.

2 R. E. Peaky. Northward over the ” Great Ice,” 2 vols. Jilew York, 1898. — E. Astbup. Blandt Nordpolen’s Naboer. Kristiania, 1895.

8 MeddeleUer om Gronland, Parts ix. and x. Copenhagen, 1888.

- F, Nansen. The First Grossing of Greenland, vol. i. London,

1890.— H. MoHN- and F. Nansen. ” Wisseaschaftliche Ergebnisse von Dr F. Nansen Durchquerung von Gronland, 1888.” Ergdnzvingeheft, No. 105 zu Petermann’s Mitteilungen. Gotha, 1892.

5 A. E. NoBDENSKioi,!). Den andra Dicksonska Expeditionen til Gronland. Stockholm, 1885.

6 MeddeleUer om Gronland, Parts xvii.-xLx. Copenhagen, 1895-96.

‘ Geograflsk Tidskrift, vol. rv. pp. 53-71. lOopenhagen, 1«99.

1882.8 In 1899 Professor Kathorst explored the land between Franz Josef Fjord and Scoresby Fjord, where the large King Oscar Fjord, connecting Davy’s Sound with Franz Joseph Fjord, was discovered.’ In 1900 Lieutenant Amdrup explored the still unknown east coast from 69° 10′ N”. south to 67° N. Only the following portions of the coasts of Greenland stUl remain unexplored : the east coast between Cape Bismarck in 77° N. lat. and Independence Bay, and the north-east and north coast between this and Cape Washington.

Character of the East Coast. — Our ideas of the east

coast of Greenland have been somewhat changed by recent explorations. It is an unusually glaciated coast, evidently owing to the north polar current carrying the ice masses from the north polar basin south-westwards along the land, and giving it an entirely Arctic climate down to Cape Farewell. In some parts the interior ice-covering extends dovm to the outer coast, while in other parts its margin is situated more inland, and the ice-bare coast-land is deeply intersected by fjords extending far into the interior, where they are blocked by enormous glaciers or ” ice-currents ” from the interior ice-covering, which discharge masses of icebergs into them. The east coast of Greenland is in this respect iighly interesting. All coasts in the world which are much intersected by deep fjords have with very few exceptions a western exposure, e.g., TsTorway, Scotland, British ColumHa and Alaska, Patagonia and Chile, and even Spitzhergen and Novaya Zemlya, whose west coasts are far more intersected than their east ones. Greenland forms the most prominent exception, its eastern coast being quite as much intersected as its western. The

reason is to be found in its geographical position, a cold ice-covered polar current running south along the land, while not far outside there is an open warmer sea, a circumstance which, while producing a cold climate, must also give rise to much precipitation, the land being thus exposed to the alternate erosion of a rough atmosphere and large glaciers. On the east coast of Baf&n Land and Labrador there are similar conditions. The fact is, tliat

8 Geograflsk Tidskrift, vol. via. pp. 76-79. Copenhagen, 1884.

8 A. G. Nathobst. The Geographical Journal, vol. xiv. Ifi99, 534; Tol. xvii. 1901, p. 48. Tvd Somrar i Norra Ishafvet. Stockholm, 1901.

the east coast of Greenland, has the largest system of fjords known on the Earth's surface. The Scoresby Fjord has a length of about 180 miles from the outer coast to the point where it is blocked by the glaciers, and with its numerous branches covers an enormous area. Franz Josef Fjord, with its branch King Oscar Fjord, communicating

with Davy Sound, seems to form a system of fjords on a similar scale. These fjords are very deep ; the greatest depth found by Ryder in Scoresby Sound was 300 fathoms, but there are certainly still greater depths. Assuming that the fjords are submerged or drowned valleys, which is most likely, this indicates that the

■B. V.Darbishir€^ 0.7.R Hmvartk, JEn^ Ma ‘oSrioe — «o~Sb5~3o» QS^A ‘SOt

Sketch Map op Greenland.

land was once at least 2000 feet higher, or the sea-level was 2000 feet lower, and probably more. A few-soundings made outside this coast seem to indicate that the fjords continue as deep submarine valleys far out into the sea. Along the east coast there are also many high mountains, exceeding 6000 and 7000 feet in height. One of the highest peaks hitherto measured is at Tiningnertok, on the Lindenow Fjord, in 60° 35′ N. lat., which is 7340 feet high. At the bottom of Mogens Heinesen Fjord, 62° 30′ N. lat., the peaks are 6300 feet, and in the region of Umanak, 63° N. lat., they even exceed 6600 -feet. At Umivik, where

Nansen began his journey across the ” inland ice,” the highest peak projecting through the ice-covering was Gamel’s Nunatak, 6440 feet, in 64° 34′ N. lat. In the region of Angmagssalik, which is very mountainous, the mountains rise to 6500 feet, the riiost prominent peak being Ingolf’s Fjeld, in 66° 20′ N. lat., about 6000 feet, which is seen far off in the sea, and forms an excellent landmark. This is evidently the Blaaserk (i.e., Blue Sark or blue coat) of the old Norsemen, their first landmark on their way from Iceland to the Oster Bygel, the present Julianehaab district, on the south-west coast of Green-land.^ A little farther north the coast is much lower, rising only to heights of 2000 feet, and just north of 67° 10′ N. lat. only to 600 feet or less.^ The highest mountains near the inner branches of Scoresby Fjord are about 7000 feet. The Petermann Spitze, near the shore of Franz Josef Fjord, measured by Payer and found to be 11,000 feet, has hitherto been considered to be the highest mountain in Greenland, but according to Nathorst it ” is probably only two-thirds as high as Payer supposed,”

perhaps between 8000 or 9000 feet.

Along the west coast of Greenland the mountains are generally not quite so high, but even there peaks of 5000 and 6000 feet are not uncommon. As a whole the coasts are unusually mountainous, and Greenland forms in this respect an interesting exception, as there is no other known land of such a size so filled along its coasts on all sides with high mountains and deep fjords and valleys.

Tlie “Inland Ice.” — The whole interior of Greenland is completely covered by the so-called ” inland ice,” an enormous glacier forming a regular shield-shaped expanse of snow and glacier ice, and burying all valleys and mountains far below its surface. It rises in the interior to a level of 9000 feet, and in places perhaps 10,000 feet or more, and descends gradually by extremely gentle slopes towards the coasts or the bottom ‘ of the fjords on all sides, discharging a great part of its yearly drainage or surplus of precipitation in the form of icebergs in the fjords, the so-called ice-fjords,

which are numerous both on the west and the east coast. These icebergs float away, and are gradually melted in the sea, the temperature of which is thus lowered by cold stored up in the interior of Greenland. The last remains of these icebergs are met with in the Atlantic south of Newfoundland. The interior of the inland ice has been explored by several expeditions since 1875. Captain J. A. D. Jensen reached, in 1878, the Jensen Nunataks (5400 feet above the seaV about 45 miles from the western margin, in 62°50'N. lat.' Norden-skiold penetrated, in 1883, about 70 miles inland from its western margin in 68° 20′ N. lat., and two Lapps of his expedition went still farther on skis. Peary and Maigaard reached, in 1886, about 100 miles inland from the western margin a height of 7500 feet, in 69° 30′ N. lat. Nansen with five companions crossed, in 1888, the inland ice from the east coast to the west, in about- 64° 25 ' N. lat., and reached a height of 8922 feet. Peary and As-trup crossed, in 1892, the northern part of the inland ice between 78° and 82° N. lat., reaching a height of about

8000 feet, and determined the northern termination of the ice-covering. Peary made very nearly the same journey again in 1895. Captain V. Garde explored, in 1893, the interior of the inland ice between 61° and 62° N. lat., near its southern termination, and he reached a height of 7080 feet about 60 miles from the margin.*

The surface of the inland ice forms in a transverse section from the west to the east coast an extremely

1 Their second or third landmark was Hvidserk (i.e., white sark or coat), near Hvarf, in the region of Cape Farewell. Hvidserk is one of the moat prominent snow-covered mountains on the east or south coast near Cape Farewell. It is difficult, however, for one who has not seen this part of the coast to decide which mountain it may be.

2 See C. Kruuse in Geografisk Tidskrift, vol. xv. p. 64. Copen-hagen, 1899. See also F. Nansen, ” Die Ostkiiste Gronlands,” Ergdn-zungsheft, No. 105 zu Petermann’ s Mitteilungen (Gotha, 1892), p. 55 and pi. iv. sketch No. 11.

3 J. A. D. Jensen. ” Expedition til Syd-Gronland,” i. 1878. Med-delelser om Griinland, Part i. Copenhagen, 1879.

- T. V. Garde. ” Boskrivelse af Expeditioneu til Sydvestgronland,

1893." Meddelelser om OrSnland, Part xvi. Copenhagen, 1896.

regular curve, almost approaching an arc of a wide circle, which along Nansen's route has its highest ridge somewhat nearer the east than the west coast. The same also seems to be the case farther south. The curve shows, however, slight irregularities in the shape of undulations. The angle of the slope decreases gradually from the margin of the inland ice, where it may be 1° or more, towards the interior, where it is 0°. In the interior the surface of the inland ice is composed of dry snow which never melts, and which is constantly packed and worked smooth by the winds. It extends as a completely even plain of snow, with long, almost imperceptible, undulations or waves, at a height of 8000 to 10,000 feet, obliterating the features of the underlying land, the mountains and valleys of which are completely interred. Over the deepest valleys of the land in the interior this ice-cap must be at least 6000 or 7000 feet thick or more. Approaching the poasts from

the interior, the snow of the surface gradually changes its structure. At first it becomes more coarse-grained, like the Mm Schnee of the Alps, and is moist by melting during the summer. Nearer the coast, where the melting on the surface is more considerable, the wet snow freezes hard during the winter and is more or less transformed into ice, on the surface of which rivers and lakes are formed, the water of which, however, soon finds its way through crevasses and holes in the ice down to its under surface, and reaches the sea as a sub-glacial river. Near its margin the surface of the inland ice is broken up by numerous large crevasses, formed by the outward motion of the glacier covering the underlying land. The steep ice- walls at the margin of the inland ice show, especially where the motion of the ice is slow, a distinct striation, which indicates the strata of annual precipitation with the intervening thin seams of dust (Nordenskiold's kryokonite). This is partly dust blown on to the surface of the ice from the ice-bare coast-land and partly the dust of the atmosphere brought down by the falling snow and

accumulated on the surface of the glacier's covering by the melting during the summer. In the rapidly moving glaciers of the ice-fjords this striation is not distinctly visible, being evidently obliterated by the strong motion of the ice masses.

The ice-cap of Greenland must to some extent be considered as a viscous mass, which, by the vertical pressure in its interior, is pressed outwards and slowly flows towards the coasts, just as a mass of pitch placed on a table and left to itself will in the course of time flow outwards towards all sides. The motion of the outwards-creeping inland ice will naturally be more independent of the configurations of the underlying land in the interior, where its thickness is so enormous, than near the margin where it is thinner. Here the ice converges into the valleys and moves with increasing velocity in the form of glaciers into the f j ords, where they break ofE as icebergs. The drainage of the interior of Greenland is thus partly given off in the solid form of icebergs, partly by the melting of the snow and ice on the surface of the ice-cap, especially near its western

margin, and to some slight extent also by the melting produced on its under side by the interior heat of the Earth.

Glaciers. — After Professor Amund Holland had, in July 1875, discovered the amazingly great velocity, up to 64f feet (19-77m.) in twenty-four hours, with which theglaciers of Greenland move into the sea, the margin of the inland ice and its glaciers was studied by several expeditions. K. J. V. Steenstrup during several years, Captain Hammer in 1879-80, Captain Eyder in 1886-87, Dr Drygalski in 1891-93,' and several American expeditions in later years, 1 E. v. Dktoalski. GrSnland-Expedition der Gesellsekaft fur Erdkunde zu Berlin, 1891-1893, 2 vols. Berlin, 1897. aU examined the question closely. The highest known velocities of glaciers was measured by Ryder in the Upernivik glacier (in 73° IST. lat.), where, between the 13th and 14th August of 1886, he found a velocity of 121 feet in twenty -four hours, and an average velocity during several days of 99 feet (Danish).^ It was, however, ascertained that there is a great difference between the velocities of the

glaciers in winter and in summer. For instance, Eyder found that the XJpernivik glacier had an average velocity of only 33 feet in April 1887. There seem to be periodical oscillations in the extension of the glaciers and the inland ice similar to those that have been observed on the glaciers of the Alps and elsewhere. But these interesting phenomena have not hitherto been subject to systematic observa^ tion, and our knowledge of them is therefore uncertain. Numerous glacial marks, however, such as polished striated rocks, moraines, erratic blocks, &c., prove that the whole of Greenland, even the small islands and skerries outside the coast, has once been covered by the inland ice.

Geology. — It is unnecessary to discuss in detail all the researches into the geology of Greenland during the last quarter of the 19th century : the reader is referred to the excellent series of publications, Meddelelser om Gronland, published in Copenhagen, where much valuable information in this respect may be found. The highly interesting Cretaceous and Tertiary strata with plant fossils at Atanikerdluk and other places on the west coast between 69° 25′

and 72° N. lat. have been carefully investigated by K. J. V. Steenstrup, Nordenskiold, and Nathorst, and valuable memoirs on them have been published by Oswald Heer, Nathorst, and Steenstrup. In the southern part of the explored east coast, south of Angmagssalik, no sedimentary rocks with fossils have been found ; they are all crystalline schists. In Scoresby Fjord the Eyder expedition found Jurassic deposits, besides basalts and crystalline schists. In the Franz Josef Fjord region Nathorst discovered also deposits of the Silurian and Devonian systems. Numerous raised beaches and terraces, containing shells of marine Mollusca, &c., occur along the whole coast of Greenland, and indicate that the whole of this large island has been raised, or the sea has sunk, in post-Tertiary times, after the inland ice covered its now ice-bare outskirts. In the north along the shores of Smith Sound these traces of the gradual upheaval of the land, or sinking of the sea, are very marked ; but they are also very distinct in the south, although not found so high above searlevel, which seems to show that the upheaval has been greater in the north.

In Uvkusigsat Fjord (72° 20′ N. lat.) the highest terrace is 480 feet (150 m.) above the sea.^ On Manitsok (67° 50′ N. lat.) the highest raised beach was 360 feet (108 m.) above the sea.* In the Isortok Fjord (67° 11′ N. lat.) the highest raised beach is 380 feet (119-2 m.) above sea-level.^ In the Ameralik Fjord (64° 14′ N. lat.) the highest marine terrace is about 340 feet (106 m.) above searlevel, and at Ilivertalik (63° 14′ N. lat.), north of Fiskernees, the highest terrace is about 326 feet (101 m.) above the sea. At Kakarsuak, near the Bjornesund (62° 50′ N. lat.), a terrace is found at 615 feet (192 m.) above the sea, but it is doubtful whether this is of marine origin.^ In the Julianehaab district, between 60° and 61° N. lat., the highest marine terraces are found at about 160 feet (50 m.) above the sea.’ The highest marine terrace

2C.H. Ryder. ” Undersogelse af Gronlands Vestkyst fra72°til 74° 35′ N. Br.” Meddelelser om Gronland, Part vlii. (Copenhagen,

i> Meddelelser om Gronland, Part iv. (Copenhagen, 1883), p. 230; see also Part xiv. p. 317 et seq., p. 323.

- Ibid., Part xiv. (Copenhagen, 1898), p. 323.

6 Ibid., Part ii. (Copenhagen, 1881), pp. 181-88.

6 Ibid., Part i. (Copenhagen, 1879) , pp. 99-101.

^ Ibid., Part ii. (Copenhagen, 1881), p. 39; Part xvi. (1896), pp. 150-54.

observed in Scoresby Fjord, on the east coast, was 240 feet above sea-level.^ There is a common belief that during quite recent time the west and south-west coast, within the Danish possessions, has been sioking. Although there are many iudications which may make this probable, none of them can be said to be quite decisive.^ Native iron has been found by K. J. V. Steenstrup in several places ou the west coast enclosed as smaller or larger nodules in the basalt. This iron has very often beautiful Widmannstatten figures like those of iron meteorites.^ In 1895 Peary found native iron at Cape York; since John Eoss's voyage in 1818 it had been known to exist there, and from it the Eskimo got iron for their weapons. In 1897 Peary brought the largest

nodule to New York ; it was estimated to weigh nearly 100 tons. This iron is considered by several of the first authorities on the subject to be of meteoric origiu,* but no evidence hitherto given seems to prove decisively that it cannot be telluric. That the nodules found were lying on gneissic rock, with no basaltic rocks in the neighbourhood, does not prove that the iron may not originate from basalt, for the nodules may have been transported by the glaciers, like other erratic blocks, and will stand erosion much longer than the basalt, which may long ago have disappeared. This iron seems, however, in several respects to be unlike the celebrated large nodules of iron found by Nordenskiold at Uifak on Disco Island, but appears to resemble much more closely the softer kind of iron nodules found by Steenstrup in the basalt ; ^ it stands exposure to the air equally well, and has similar Widmannstatten figures very sharp, as is to be expected in such a large mass. It contains, however, more nickel and also phosphorus.

Climate. — The climate of the interior has been found to be of a continental character, with large ranges of

temperature, and with an almost permanent anti-cyclonic region over the interior of the inland ice, from which the prevailing winds radiate towards the coasts. On the 64th parallel the mean annual temperature at an elevation of 6560 feet is supposed to be ~~13° P., or reduced to sea~~ level 5° P. The mean annual temperature in the interior farther north is supposed to be —10° P. reduced to sea-level. The mean temperature of the warmest month, July, in the interior should be, reduced to sea-level, on the 64th parallel 32° P., and that of the coldest month, January, about -22° P., while in North Greenland it is probably ^0° reduced to sear-level. Here we may prob-ably fijid the lowest temperatures of the northern liemi-sphere. The interior of Greenland contains both summer and winter a pole of cold, situated in the opposite longitude to that of Siberia, with which it is well able to compete in extreme severity. On Nansen's expedition temperatures of about -49° P. were experienced during the nights in the beginning of September, and the minimum during the winter may probably sink to -90° P. in the interior of the

inland ice. These low temperatures are evidently caused by the radiation of heat from the snow-surface in the rarefied air in the interior. The daily range of tempera-ture is therefore very considerable, sometimes amounting to 40°. Such a range is elsewhere found only in deserts, but the surface of the inland ice may be considered to be an elevated desert of snow." The climate of the east

1 Meddelelser om Oronland, Part xix. (1896), p. 175.

2 IMd., Fart i. p. 34 ; Part ii. p. 40; Part xiv. pp. 343^7 ; Part iv. p. 237 ; Part yiii. p. 26.

3 Ibid., Part iv. (Copenhagen, 1883), pp. 115-31.

^ See Peart. Northward over the " Great Ice," vol. ii. p. 604 et seg. New York, 1898.

6 See toe. cit. pp. 127-8.

6 H, MoHN. " The Climate of the Interior o£ Greenland," The Scott. Geogr. Magazine, vol. ix. (Edinburgh, 1893), pp. 142-45, 199.— H. MoHN and F. Nansek". " Wisseuschaftliche Ergebnisse," &c., Ergdn-zungaheft. No. 105 zu Petermann's Mitteilungen (1892), p. 51.

coast is on the whole considerably more Arctic than that of the west coast on corresponding latitudes ; the land is

much more snow-covered, and the snow-line goes considerably lower. The probability also is that there is more precipitation, and that the mean temperatures are lower.'^ The well-known strangely warm and dry /oAw-winds of Greenland occur both on the west and the east coast; they are more local phenomena than was previously believed, and are formed by cyclonic winds passing over local mountains or also passing down the outer slope of the inland ice.^

Fauna and Flora. — It has been a common belief that the fauna and flora of Greenland are essentially European, a circumstance which would make it probable that Greenland has been separated by sea from America during a longer period of time than from Europe. The correctness of this hypothesis may, however, be doubted. The land mammals of Greenland are decidedly more American than European : the musk-ox, the banded lemming (Cuniculus torquatus), the white polar wolf, of which there seems to have been an invasion recently round the northern part ■of the country to the east coast, the Eskimo and the dog, — •

probably also the reindeer, — have all of them come from America, while the other land mammals, the polar bear, the polar fox, the Arctic hare, the stoat (Mustela erminea), are perfectly circumpolar forms. The species of seals and whales are,if anything, more American than European, and so to some extent are the fishes. The bladder-nose seal (Cysr topJiora cn'stota), for instance, may be said to be a Greenland-American species, while a Scandinavian species, such as the grey seal (Halichceiiis grypus), appears to be very rare both in Greenland and America. Of the sixty-one species of birds breeding in Greenland, eight are JEuro-pean-Asiatic, four are American, and the rest circumpolar or North Atlantic and North Pacific in their distribution.^ About 310 species of vascular plants are found, of which about forty species are American, forty-four European-Asiatic, fifteen endemic, and the rest common both to America and Europe or Asia. We thus see that the American and the European-Asiatic elements of the flora are nearly equivalent ; and if the flora of Arctic North America were better known, the number of plants common

to America might be still more enlarged.^”

At Tasiusak (73° 22′ N. lat.), the most northern civilized settlement in the world, gardening has been attempted without success, but several plants do well in forcing frames. At Umanak (70° 40′ N. lat.) is the most northern garden in the world. Broccoli and radishes grow well, turnips (but not every year), lettuce, and chervil succeed sometimes, but parsley cannot be reared. At Jacobshavn (69° 12′ N. lat.), only some 15 miles from the inland ice, gardening succeeds very well ; broccoli and lettuce grow willingly ; the spinach produces large leaves; chervil, pepper-grass, leeks, parsley, and turnips grow very well ; the radishes are sown and gathered twice during

‘ On the climate of the east coast of Greenland see V. Willaume-Jantzen. Meddelelser om GrSnland, Part ix. (1889), pp. 285-310; Part xvii. (1895), pp. 171-80.

8 See A. Paulsen. Meteorolog. Zeilschrift (1889), p. 241.— F. Nansen. The First Crossing of Greenland (London, 1890), vol. ii. pp. 496-97.— H. MoHN and F. Nanskn. ” Wissenschaftliche Ergebnisse,” Stc, Ergdnzungsheft, No. 105 zm Petermann’s Mitteilungen {1W&),^.

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9 H. WiNGE. “Gronlands Fugle,” Meddelelser om GrSnland, Part xxi. pp. 62-63. Copenhagen, 1899.

1″ See J. Lanqe. ” Conspectus Florae Groenlandicae,” Meddelelser om GrSnland, Part iii. Copenhagen, 1880 and 1887.— E. Warming. “Om Gronlands Vegetation,” Meddelelser om GrSnland, Part xii. (Copenhagen, 1888) ; and in Botanische Jahrbiicher, vol. x. (1888-89). —See also A. Blytt. Englers Jahrbiicher, ii. (1882), pp. 1-50.— A. G. Nathorst. btversigt af K. Yetenskap. Akad. Forhandl. Stockholm, 1884. “Kritische Bemerkungen viber die Geschichte der Vegetation. Gronlands,” Botanische Jahrbiicher, vol. xiv. (1891).

the summer (June to August). In the south, in the Julianehaab district, even flowering plants, such as aster, nemophilia, and mignonette, are cultivated, and broccoli, spinach, sorrel, chervil, parsley, rhubarb, turnips, lettuce, and radishes grow very well. Potatoes give fair results when they are taken good care of, carrots grow to a thickness of one inch and a half, while cabbage does poorly. Strawberries and cucumbers have been ripened in a forcing

frame. In the " Kongespeil " (King's mirror) from the 13th century it is stated that the old Norsemen tried in vain to raise barley.

Population. — The Eskimo population of Danish Greenland (west coast) seems to have decreased since the Norwegians came to the country a century and a half ago. Hans Egede estimated the population then at 30,000, but this is probably a large over-estimate. The decrease may chiefly have been due to infectious diseases, especially a very severe epidemic of smallpox. During the last half of the 19th century there was on the whole a slight increase of the native population : in 1855 it was 9648 ; in 1870, 9615; in 1881, 9701; in 1883, 9844; in 1885, 9914; in 1888, 10,221; in 1890, 10,264; in 1895, 10,639; and in 1899, 10,974. The population fluctuates a good deal, owing, to some extent, to an emigration of natives from the east to the west coast.^ The population of the east coast seems on the whole to be decreasing. In the north part of the east coast, in the region of Scoresby Fjord and Franz Josef Fjord, numerous ruins

of Eskimo settlements are found, and in 1823 Sabine met Eskimo there, but now they have either completely died out or have wandered south. In the district of Angmagssalik the population in 1884 was 413 natives, and on the east coast between Angmagssalik and Cape Farewell there were 135, the population of the east coast being all together 648 in 1884.^ In 1892 the population of the Angmagssalik district was only 293, a decrease of 120 since 1884, which is chiefly owing to the fact that a great number of natives (118) had travelled farther south. In 1894* the number had decreased to 247, this decrease being chiefly due to an epidemic of influenza. In 1895 also the population numbered 247, while in 1896 it increased to 372, chiefly owing to 118 individuals having come from the south.^ On 31st December 1899 the population numbered 403. The little tribe of Eskimo living in the region of Cape York near Smith Sound — the so-called “Arctic Highlanders” or Smith Sound Eskimo — numbered in 1895, 253. In 1896 this number

was reduced to 229 by an epidemic of influenza. In 1897 the number was 234.°

Trade. — The chief addition to trading districts since 1880 was made in 1894, when a new trading and missionary station or ” coloni ” was established in Angmagssalik on the east coast, where a missionary and a ” colonibestyrer,” or superintendent of the district, with their families reside. The trade of Greenland has on the whole much decreased during late years, and trading and missions now cost the Danish State a comparer tively large sum (about £11,000 every year), although this is partly covered by the income from the cryolite royalty of the mines at Ivigtut. The Danish Mission* in Greenland has a yearly grant from the Greenland trade of 36,000 kroner (£2000), besides a contribution

1 F. Nansbn. Eskimo Life (London, 1893), p. 331.

2 G. Holm. Meddelelser om Gronland, Part x. (1888), p. 200.

3 C. Rtdbr. Ibid., Partxvii. (1895), p. 143.

< C. Rybekg. " Fra Missions og Haudelsstatiouen ved Angmagssalik,” Geografisk Tidskrift, vol. xiv. (Copenhagen, 1898), p. 117.

5 R. E. Pbakt. Northward over the ” Great Ice ” (New York, 1898), vol. i. p. 480.

6 Ttie Moravian Mission, which had worked in Greenland a century and a half, finally retired from the country in 1900.

of 16,000 (£880) from the Danish State. If these sums be considered, the results of the Greenland trade and missions of late years are the following, according to Mr C. Eyberg, of the Greenland directorate : 1895-96, deficiency 183,699 kroner; 1896-97, deficiency 284,024 kroner; 1897-98, de^cjereci/ 92,420 kroner ; 1898-99, defi-ciency 40,430 kroner; 1899-1900, profit 20,839 kroner; 1900-1, deficiency 106,091 kroner. The mean result of this term of six years is consequently a yearly de-ficiency of 114,304 kroner (£6350). The decline in the value of the trade, which some years ago was very profitable, has to a great extent been brought about by the fall in the price of seal-oil. The exceptional profit in the year 1899-1900 was chiefly due to the extraordinarily high prices of the skins of the blue

fox and polar bear, on account of the Paris Exhibition.

It might be expected that there should be a decrease in the Greenland seal fisheries, caused by the European and American sealers catching larger quantities every year, especially along the coasts of Newfoundland and Labrador, and so actually diminishing the number of the animals in the Greenland seas. The statistics of South Greenland, however, do not seem to demonstrate any such decrease. For North Greenland there is no information at hand for the later years. According to Mr C. Eyberg, there were, in the seventeen years from 1874 to 1890, 32,826 seals caught yearly in South Greenland. In the following years there were caught in the same district : 1891-92, 24,583 seals; 1892-93, 33,338 seals; 1893-94, 29,726 seals; 1894-95, 38,075 seals; 1896-96, 29,964 seals ; and in 1896-97, 41,912. The mean number of seals caught yearly during this period was consequently 32,933 seals, or very nearly the same as during the previous seventeen years.

For further information about Greenland see especially Med-

delelser om Gronland, Parts i.-xxiii. (Copenhagen, 1879-99) ; it is chiefly written in Danish, but each part has a summary in French. In Part xiii. there is a complete list of literature about Greenland up to 1880. The more important literature of later years has already been cited in the footnotes. As to the discovery of Greenland by the Norsemen and its early history see Konrad Maukee's excellent paper in the report of Die zweite Deutsche Nordpol Expedition, 1869-70, vol. ii. — G. Stoem. Studies on the ^^ Vineland" Voyages. Christiania and Copenhagen, 1889 (see also Aarbog fer Nordisk Oldkyndighed pg Historie. Copenhagen, 1888). K. J. V. Steensteup. "Om Osterbgyden," Meddelelser om Gronland, Part ix. (1882), pp. 1-51. — Finnce JdNSSON. " Gronlands gamle Topografi efter Kilderne," Meddelelser om Gronland, Part xx. (1899), pp. 265-329. (p. u.)

Greenock, a seaport town and parliamentary burgh of Kenfrewshire, Scotland, on the south bank of the river Clyde, 21-^ miles west-north-west of Glasgow by water, 23 miles by rail. Public erections since 1880 are the municipal chambers, in the Renaissance style, completed in 1886 at a cost of £225,000; Established, Eoman Cath-

olic (1900), Eeformed Presbyterian, and two United Free churches, a technical college (1900), an eye infirmary, a new post ofiS.ce (1899), a masonic temple, and electric lighting works. Smithston poorhouse and lunatic asylum, which cost £100,000, was erected in 1879. Street tramways connect the town with both Gourock and Port Glasgow. Shipbuilding alone now stands out prominently above other industries; 43,358 tons were launched in 1889, and 41,664 in 1899. Sugar-refining has declined, and in 1900 there were only four refineries at work. Among other industries are boiler and engine making, and an aluminium factory was established in 1898. The dock and quay accommodation now covers 100 acres, and £1,500,000 has been spent on the harbour from first to last. The James Watt dock cost £650,000 in 1886; it is 2000 by 400 feet, and has a depth of 32 feet at low water. Two large tidal harbours cost £500,000. Indeed, the harbour had been improved more

rapidly and more expensively than tlie trade of the port warranted, and in 1887 the trustees found themselves unable to pay the interest on the mortgage bonds. At the end of 1898 there were 267 vessels of 273,964 tons on the register of the port. In 1888, 6630 vessels of 1,379,616 tons entered, and 6903 vessels of 1,528,164 tons cleared. In 1898, 9533 vessels of 1,685,235 tons entered, and 9627 vessels of 1,887,565 tons cleared. The value of the foreign and colonial imports was £3,170,328 in 1888, and £1,341,908 in 1898; of the exports, £225,747 in 1888, and £191,261 in 1898. Fort Matilda, with submarine mines, protects the river at Greenock. The School Board manages an academy. Other educational institutions are a school of art and a school of navigation and engineering. Population (1881), 66,704; (1901), 67,645.

Greensboro, capital of Guilford county. North Carolina, U.S.A., at an altitude of 837 feet. It is on the Southern and the Cape Fear and Yadkin Valley railways. It has cotton and flour mills and blast furnaces. Several

minor educational institutions are situated here. The name comes from General Greene, who in 1781 defeated the British under Cornwallis at Guilford Court House, near this place. Population (1880), 2105 ; (1890), 3317 ; (1900), 10,036, of whom 90 were foreign-born and 4086 negroes.

Creensburg, capital of Westmoreland county, Pennsylvania, U.S.A., at an altitude of 1091 feet, on the Pennsylvania railway. It has manufactures of iron and glass. Population (1890), 4202 ; (1900), 6608, of whom 484 were foreign-born and 128 negroes.

Greenville, capital of Washington county, Mississippi, U.S.A., on the eastern bank of the Mississippi river, in the Yazoo Bottom, at an altitude of 125 feet, on the Southern and Yazoo and Mississippi Valley railways. It is in one of the richest cotton regions of the South, and has a large cotton trade. Population (1880), 2191 ; (1890), 6668 ; (1900), 7642, of whom 249 were foreign-born and 4987 negroes.

Greenville, capital of Greenville county. South

Carolina, U.S.A., at an altitude of 976 feet, on the South-ern and the Charleston and Western Carolina railways. It is in the cotton belt, and handles the crop of an ex-tensive surrounding country. It has some manufactures, especially of cotton goods. It is the seat of Purman University and two colleges for women. Population (1880), 6160 ; (1890), 8607 ; (1900), 11,860, of whom 119 were foreign-born and 5414 negroes.

Greenville, capital of Hunt county, Texas, U.S.A., at an altitude of 552 feet. It is at the intersection of the Missouri, Kansas, and Texas, the Houston and South-western, the Sherman, Shreveport, and Southern, and the Texas Midland railways. It is an important ship-ping point for cotton, and the seat of Burleson College, a Baptist institution, opened in 1893. Population (1890), 4330 ; (1900), 6860, of whom 114 were foreign-born and 1751 negroes.

Greenwich, a municipal and parliamentary borough of England, on the south bank of the Thames, 4 miles E.S.E. of St Paul's, London, on the South-Eastern and

Chatham railway. A new building for the Eoyal Observatory was completed in 1899. About a quarter of a mile to the east is the magnetic pavilion, placed thus far away to avoid the disturbance which would be occasioned by the iron used in the principal building. The Government whitebait dinner was resumed in 1895, after an interval of fifteen years. A stained glass window to the memory of General Wolfe was placed in the parish church in 1896. By the London Government Act of 1899 the borough of Greenwich was taken out of the county of Kent and made one of the twenty-eight metropolitan boroughs of the county of London. Population of the metropolitan borough (1891), 78,514; (1901), 95,770.

Greenwich, a town of. Fairfield county, Connecticut, U.S.A., with an area of 49 square miles of hill country, and containing a borough of the same name. Greenwich borough is on Long Island Sound, and on the New York, New Haven, and Hartford railway. It is a popular summer resort, especially for New York business men. Population of the town (1880), 7892; (1890),

10,131 ; (1900), 12,172, of whom 3271 were foreign-born and 356 negroes.

Greg, William Rathbone (1809-1881), English essayist, the son of a merchant, was born at Manchester in 1809. He became a manufacturer, and entering with ardour into the struggle for free trade, obtained in 1842 the Anti-Corn Law League's prize for the best essay on "Agriculture and the Com Laws." He was too much occupied with political, economical, and theological speculations to give undivided attention to his business, which became unprosperous, and was relinquished in 1850. Greg turned vigorously to authorship; his Creed of Christendom was published in 1851, and in 1852 he contributed no fewer than twelve articles to four leading quarterlies. Disraeli spoke of him eulogistically ; Sir George Cornewall Lewis bestowed a Commissionership of Customs upon him in 1856 ; and in 1864 he was made Comptroller of the Stationery Office. He continued to write, and besides contributions to periodicals produced several volumes of essays on political and social philosophy. The

general spirit of these is indicated by the titles of two of the most celebrated, TJie Enigmas of Life (1872) and Bocks Ahead (1874). They represent a reaction from the high hopes of the author's youth, when wise legislation was assumed to be a remedy for every public ill. Greg in old age went into the opposite extreme ; but his accuracy of thought and deep moral earnestness were always valuable. He died at Wimbledon on the 15th of November 1881.

Gregorovius, Ferdinand (1821-1891), German historiaa and miscellaneous writer, was born at Neidenburg. East Prussia, on the 19th of January 1821. He studied theology and philosophy at Konigsberg University, being intended for the priesthood, but relinquished that project and devoted himself to literary work, his first important publication being a study of Goethe's Wilhelm Meister. In 1862 he travelled, by way of Corsica, to Italy, and the result was a brilliant book (1857) entitled Wanderjahre in Italien, besides a volume on Corsica. He settled at Rome, and between 1859 and 1872

produced his magnum opus, the History of Rome in the Middle Ages, a work steeped in mediseval learning. Gregorovius was a voluminous writer, and his list of publications is a long one, including a tragedy, TJie Death of Tiberias, an epic, Euphorion (1858), and Athens in the Middle Ages, the last a historical work which resulted from his travels in Greece and the East in 1880. He died at Munich, 1st May 1891.

Greifswald, a town of Prussia, province of Pomerania, near the head of Greifswald Bay on the Baltic, oh which, 2\ miles distant, are the little seaside resorts of Wieck (population 800), which is also the port for Greifswald, and Eldena (1050). In front of the university, which had 808 students and 95 professors in 1900, stands a monument commemorative of its four hundredth anniversary. The university institutions embrace a zoological [museum, a gynaecological institute, an ophthalniological I school, a psychological school, physical, physiological, and

pharmaceutical institutes, a botanical garden, and (at Eldena) an agricultural school. Population (1885), 20,346 ; (1900), 22,940.

Creiz, a town of Germany, capital of the principality of Eeuss the Elder, on the White Elster, 66 miles by rail south from Leipzig. It consists of two parts, the old town on the right bank, and the new town on the left bank, rapidly growing and regularly laid out. There are monuments to the Emperor William I. (1888), Bismarck (1895), and the war of 1870-71. Population (1886), 17,288 ; (1900), 22,345.

Grenada, since 1885 the seat of government of the Windward Islands, and the most southerly of the group, situated about 90° N. of Trinidad, between 11° 58′ and 12° 30′ N. lat. and 61° 20′ and 61° 35′ W. long. It is about 21 miles long by 12 miles broad, with an area of 133 square miles. The island is very mountainous, and the hills (the highest of which, Mount Catherine, is 2749 feet), running off in spurs from the centre, form valleys of great beauty and fertility. Included in the

government of the Windward Islands are also a number of small islands called Gkbnadines, some of which are attached to the local government of St Vincent and some to that of Grenada. Of the latter the chief is Carriacou, with an area of nearly 7000 acres and a population of over 6000. Population of Grenada (1877), 41,365 ; (1899), 64,098. The birth-rate per 1000 of the mean estimated population was 42-17, and the death-rate 20-85. The climate. is very healthy, epidemic diseases are rare, and the temperature is equable. The hottest months are August, September, and October. The mean temperature of 1898 at 600 feet above the sea was 79-0° at 9 a.m. The rainfall is very heavy, amounting in some parts to 200 inches a year. During 1898 it was 162-45 inches in the centre of Grenada and 80-28 at Carriacou. The rain lasts, on and off, from May to the end of the year, September and November being especially wet. ‘The island is singularly free from the visitations of hurricanes. It is a favourite health resort for the neighbouring colony of Trinidad. A new sanatorium was opened at Grand

Etang (1800 feet) in 1899. There are practically no Crown lands for disposal. Good roads and by-ways intersect the island in every direction. The value of imports in 1877 was £127,204 ; in 1899 it was £226,828. The value of exports in 1877 was £145,906 ; in 1899 it was £267,738. The imports were derived as follows: — United Kingdom, £101,921 ; British colonies, £64,603 ; foreign countries (mainly United States), £60,303. The exports go in the following proportions : — To the United Kingdom, 94 per cent. ; to the British colonies, 1 per cent. ; to foreign countries (principally the United States), 4 per cent. The chief articles of export in 1898 were cacao (£234,610) and spices (£21,761), with smaller values of cotton, live stock, kola nuts, coffee, and logwood, the sugar-cane being now chiefly prepared for local consumption as sugar, molasses, or rum. An excellent oyster is obtained at Carriacou, and turtle and fresh fish are plentiful. The revenue in 1877 was £29,084 ; in 1899 it was £68,757. The expenditure in 1877 was £29,581 ; in 1899 it was £69,358. The tonnage of vessels entered in

1898 was 216,192, of which 209,455 was British and 6737 foreign. There is no military force, but there is a police force of sixty-five officers and men. The elementary schools were in 1899 partly Government (9) and partly grant-in-aid schools (32) under the management of the ministers of the different religious denominations (Roman Catholics, 19; Anglican, 7; Wesleyan, 4; Church of Scotland, 2), the whole being under a Board of Education nominated by the governor. The 41 schools had 9240 pupils on the roll, with an average daily attendance of about 52 per cent. There are a grammar-school for boys and two high schools for girls in St George (the capital) receiving grants-in-aid. The bishopric of the Windward Islands forms part of the West Indian province of the Church of England. English is universally spoken, but the peasantry speak amongst themselves a French patois, a legacy of French occupation. The Legislative Council consists of the governor with six of&cial and seven unofficial members, all nominated by the crown, (f. cu.) Grenadier, — Grenadiers were soldiers, part of whose

duty it was to throw hand-grenades. Du Bellay says grenades were made in large numbers at Aries in 1536. The Comte de Eendan was killed by one at the siege of Rouen, 1662. They were used at the siege of Famagusta in Cyprus, 1671. Four or five grenadiers were attached to each French company in 1667, and in 1670 they were increased and formed in companies. Evelyn tells us in his Diary that, on 29th June 1678, he saw at the Houns-low camp certain soldiers " called grenadiers, who were dexterous in flinging hand-grenades." Eventually each English battalion had a company.

Two excellent plates of grenadiers of the 2nd Eegiment of Foot (Royal West Surrey), 1714-27, taken from picture-board dummies in the County Hotel, Carlisle, will be found in the Archceological Journal, xlvii. 321, 324, The same journal, xxiii. 222, gives a plate, "Blow your Match," after a sketch by Lens, "limner to His Majesty " George II., which represents a grenadier of the 1st Regi-ment of the Guards in 1735, grenade in hand.

Grenoble, chief town of department Ishve, France, 393 miles south-east of Paris, on the railway from Paris

to Marseilles, at the confluence of the Drac with the Isfere. The city is extending in the direction of the Drac, and in the north-east, enclosed by a bend of the Isfere, is the peninsula of lie Verte, a rapidly growing suburb. The lycee was opened in 1886. There are several monuments, among them one (1890) commemorating the commencement of the Revolution in Dauphine. Grenoble is the headquarters of the 14th Army Corps, is the seat of a Court of Appeal, and has a chamber and a tribunal of commerce, and an assay office. Notwithstanding the application of machinery to many of the processes employed in the glove manufacture, and the consequent reduction of manual labour, the number of the persons engaged in the trade has been more than maintained. Some 4000 men and 21,000 women and children produce annually about 1,200,000 dozen pairs of gloves, valued at from £1,400,000 to £1,440,000. There is a large establishment employing about 360 workpeople in the manufacture of metal buttons, &c. As much as 1,540,000 lb of copper are used in a year, yielding daily about

1,500,000 button pieces, the finished product being 8000 buttons daily. This factory not only supplies buttons for the Grenoble industry, and for export to other glove manufacturing centres, but also the principal machines required in the making of gloves. Other manufactures are silk and linen, hosiery, heavy iron goods, alimentary paste, artificial flowers, and mosaics, and there are coal mines and quarries. Population (1881), 41,154 ; (1901), 68,062.

Grevy, Francois Paul Jules (1807-1891), third President of the French Republic, was born at Mont-sous-Vaudrey in the Jura, on 16th August 1807. He became an advocate in 1837, and, having steadily maintained republican principles under the Orleans monarchy, was elected by his native department to the Constituent Assembly of 1848. Foreseeing that Louis Bonaparte would be elected president by the people, he proposed to vest the chief authority in a president of the Council elected and removable by the Assembly. After the coup d’etat this proposition gained M. Grevy a reputation for sagacity,

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GREY, SIR GEORGE

and upon his return to public life in 1869 he took a prominent place. After the fall of the Empire he was chosen president of the Assembly on the 16th of February 1871, and occupied this position till the 2nd of April 1876, when he resigned on a question of discipline. On the 8th of March 1876 he was elected president of the Chamber of Deputies, a post which he filled with such efficiency that upon the resignation of Marshal MacMahon he seemed to step naturally into the Presidency of the Eepublic (30th January 1879). Quiet, shrewd, attentive to the public iuterest and his own, but without any particular distinction, he would have left an unblemished reputation if he had not unfortunately accepted a second term (18th December 1886). Shortly afterwards the traffic of his son-in-law (M. Wilson) in the decorations of the Legion of Honour came to light. M. Grevy was not accused of personal participation in these scandals,

but he was somewhat obstinate in refusing to realize that he was responsible indirectly for the use which his relative had made of the Elysee, and it had to be unpleasantly impressed upon him that his resignation was inevitable (2nd December 1887). He died at Mont-sous-Vaudrey, 9th September 1891. He owed both his success and his failure to the completeness with which he represented the particular type of the thrifty, generally sensible and patriotic, but narrow-minded and frequently egoistic bourgeois. (See also Eeance, History.)

Grey, Sir George (1812-1898), British colonial governor and statesman, only son of Lieutenant-Colonel Grey of the 30th Foot, was born in Lisbon on 14th April 1812, eight days after the death of his father at the storming of Badajoz. He passed through Sand-hurst with credit, and received his commission in 1829. His lieutenancy was dated 1833, and his captaincy 1839, in which year he sold out and left the army. In the early ‘thirties he was quartered in Ireland, where the wretchedness of the poorer classes left a deep impression

on his mind. In 1836 the B.oyal Geographical Society accepted his offer to explore the north-west region of West Australia, and accordingly he landed at Hanover Bay at the end of 1837. The surrounding country he found broken and difficult, and his hardships were aggravated by the tropical heat and his ignorance of the continent. In a skirmish with the natives, in which he was speared near the hip, he showed great courage, and put the assailants to flight, shooting the chief, who had wounded him. After a brave endeavour to contiaue his journey his wound forced him to retreat to the coast, whence he sailed to Mauritius to recruit. Next year he again essayed exploration^ this time on the coast to the north and south of Shark's Bay. He had three whale-boats and an ample supply of provisions, but by a series of disasters his stores were spoilt by storms, his boats wrecked in the surf, and the party had to tramp on foot from Gantheaume Bay to Perth, where Grey, in the end, walked in alone, so changed by suffering that friends did not know him. In 1839

he was appointed Governor-Eesident at Albany, and during his stay there married Harriett, daughter of Admiral Spencer, and also prepared for publication an account, in two volumes, of his expeditions. In 1840 he returned to England, to be immediately appointed by Lord John Russell to succeed Colonel Gawler as Governor of South Australia. Reaching the colony in May 1841, he found it in the depths of a depression caused by mismanagement and insane land speculation. By rigorously reducing public expenditure, and forcing the settlers to quit the town and betake themselves to tilling their lands, and with the opportune help of valuable copper discoveries. Grey was able to aid the infant colony to emerge from the slough. So striking were his energy and determination that when, in 1845, the little settlements in New Zealand were found to be involved in a native war, and on the verge of ruin, he was sent to save them. The Maori chiefs in open rebellion were defeated, and made their submission. Another powerful leader suspected of fomenting discontent was arrested,

and friendly chieftains were subsidized and honoured. Bands of the natives were employed in making government roads, and were paid good wages. The governor gained the veneration of the Maori tribes, in whose welfare he took a close personal iaterest, and of whose legends and myths he made a valuable and scholarly collection, published ia New Zealand in 1855 and reprinted thirty years afterwards. With peace prosperity came to New Zealand, and the Colonial Office desired to give the growing settlements full self-government. Grey, arguing that this would renew war with the Maori, returned the constitution to Downing Street. But though the Colonial Office sustained him, he became involved in harassing disputes with the colonists, who organized an active agitation for autonomy. In the end a second constitution, partly framed by Grey himself, was granted them, and Grey, after eight years of despotic but successful rule, was transferred to Cape Colony. He had been knighted for his services, and had undoubtedly shown strength, dexterity, and humanity in dealing with

the whites and natives. In South Africa his success continued. He thwarted a formidable Kaffir rebellion in the East Provinces, and pushed on the work of settlement by bringing out men from the German Legion and providing them with homes. He gained the respect of the British, the confidence of the Boers, the admiration and the trust of the natives. The Dutch of the Free State and the Basutos chose him as arbitrator of their quarrels. When the news of the Indian Mutiny reached Cape Town he strained every nerve to help Lord Canning, despatching men, horses, stores, and £60,000 in specie to Bombay. He persuaded a detachment, then on its way round the Cape as a reinforcement for Lord Elgin in China, to divert its voyage to Calcutta. Finally, ia 1859, Grey almost reached what would have been the culminating point of his career by federating South Africa. Persuaded by him, the Orange Free State passed resolutions in favour of this great step, and their action was welcomed by Cape Town. But the Colonial Office disapproved of the change,

and when Grey attempted to persevere with it Sir Edward Bulwer Lytton recalled him. A change of Ministry during his voyage to England displaced Sir Edward Bulwer Lytton. But though the Duke of Newcastle reinstated Grey, it was with instructions to let federation drop. In 1861 the Colonial Office sent him, for the fourth time in succession, to take up a post of exceptional difficulty by again entrusting him with the governorship of New Zealand, where an inglorious native war in Taranaki had just been succeeded by an armed truce. Grey did his best to make terms with the rebels and to re-establish friendship with the Maori king and the land league of tribes formed to stop further sales of land to the whites. But the INIaori had got guns and powder, and were suspicious and truculent. In vain Grey, supported by Bishop Selwyn and by Fox and the peace party among the settlers, strove to avert war. It came in 1863, and spread from province to province. Ten thousand regulars and as many colonial riflemen were employed to put it down. The imperial troops were badly handled, and Grey, losing patience,

became involved in bitter disputes with their commanders, Generals Cameron and Tuke. As an example to the former he himself attacked and captured Weraroa, the strongest of the Maori stockades, with a handful of militia,

a feat which delighted the colonists, but made him as much disliked at the War Office as he now was at Downing Street. Moreover, Grey had no longer real control over the islands. New Zealand had become a self-governing colony, and though he vindicated the colonists generally when libellous imputations of cruelty and land-grabbing were freely made against them in London, he crossed swords with his ministers when the latter confiscated three million acres of tribal land belonging to the insurgent Maori. Yet through all these troubles progress was made ; many successes were gained in 1866, chiefly by the colonial militia, and a condition of something like tranquillity had been reached in 1867, when he received a curt intimation from the Duke of Buckingham

that he was about to be superseded. The colonists, who believed he was sacrificed for upholding their interests and good name, bade farewell to him in 1868 in an out-burst of gratitude and sympathy ; but his career as a ser-vant of the empire was at an end. Returning to England, he tried to enter public life, delivered many able speeches advocating what later came to be termed Imperialism, and stood for Newark. Discouraged, however, by the ofllcial Liberals, he withdrew and turned again to New Zealand. In 1872 he was given a pension of £1000 a year, and settled down on the island of Kawau, not far from Auckland, which he bought, and where he passed his leisure in planting, gardening, and collecting books. In 1875, on the invitation of the Auckland settlers, he became superintendent of their province, and entered the New Zealand House of Representatives to resist the abolition of the provincial councils of the colony, a change then being urged on by Sir Julius Vogel in alliance with the Centralist Party. In this he failed, but his eloquence and courage drew round him a strong Radical following,

and gave him the Premiership in 1877. Manhood suffrage, triennial parliaments, a land-tax, the purchase of large estates, and the popular election of the governor were leading points of- his policy. All these reforms, except the last, he lived to see carried; none of them were passed by him. A commercial depression in 1879 shook his popularity, and on the fall of his Ministry in 1879 he was deposed, and for the next fifteen years remained a solitary and pathetic figure in the New Zealand Parliament, respectfully treated, courteously listened to, but never again invited to lead. In 1891 he came before Australia as one of the New Zealand delegates to the Federal Convention at Sydney, and characteristically made his mark by standing out almost alone for “one man one vote ” as the Federal franchise. This point he carried, and the Australians thronged to hear him, so that his visits to Victoria and South Australia were personal triumphs. When, too, in 1894, he quitted New Zealand for London, some reparation was at last made him by the Imperial Government ; he was called to the Privy Council,

and graciously received by Queen Victoria on his visit to Windsor. Thereafter he lived in London, and died on the 20th of September 1898. He was given a public funeral at St Paul's. Grey was all his life a collector of books and manuscripts. After leaving Cape Colony, he gave his library to Cape Town in 1862 ; his subsequent collection, which numbered 12,000 volumes, he presented to the citizens of Auckland in 1887. In gratitude, the people of Cape Town erected a statue of him opposite their library building. (w. p. e.)

Grey, Henry Grey, 3rd Earl (1802-1894), English statesman, born 28th December 1802, was the fifth son of the Earl Grey who was prime minister at the time of the Reform Bill of 1832. He entered Parliament in 1826 under the title of Viscount Howick as member for Winchilsea, which constituency he left in 1831 for Northumberland. On the accession of the Whigs to power in 1830 he was made Under-Secretary for the Colonies, and laid the foundation of his intimate acquaintance with colonial questions. He belonged at the time to the more advanced

party of colonial reformers, sharing the views of Edward Gibbon Wakefield on questions of land and emigration, and resigned in 1834 from dissatisfaction that slave emancipation was made gradual instead of immediate. In 1835 he entered Lord Melbourne's Cabinet as Secretary at War, and effected some valuable administrative reforms, especially by suppressing malpractices detrimental to the troops in India. After the partial reconstruction of the ministry in 1839 he again resigned, disapproving of the more advanced views of some of his colleagues. These repeated resignations gave him a reputation for crotchetiness, which he did not decrease by his disposition to embarrass his old colleagues by his action on Free Trade questions in the session of 1841. During the exile of the Liberals from power he went still farther on the path of Free Trade, and anticipated Lord John Russell's declaration against the Corn Laws. When, on Sir Robert Peel's resignation in December 1845, Lord John Russell was called upon to form a ministry, Howick, who had become Earl Grey by the death

of his father in the preceding July, refused to enter the new Cabinet if Lord Palmerston were Foreign Secretary. He was greatly censured for perverseness, and particularly when in the following July he accepted Lord Palmerston as a colleague without remonstrance. His conduct, nevertheless, afforded Lord John Russell an escape from an embarrassing situation. Becoming Colonial Secretary in 1846, he found himself everywhere confronted with arduous problems, which in the main he encountered with success. His administration formed an epoch. He was the first minister to proclaim that the colonies were to be governed for their own benefit and not for the mother-country's ; the first systematically to accord them self-government so far as then seemed possible; the first to introduce free trade into their relations with Great Britain and Ireland. The concession by which colonies were allowed to tax. imports from the mother-country ad libitum was not his ; he protested against it, but was overruled. In the West Indies he suppressed, if he could not overcome,

discontent; in Ceylon he put down rebellion; in New Zealand he suspended the constitution he had himself accorded, and yielded everything into the masterful hands of Sir George Grey. The least successful part of his administration was his treatment of the convict question at the Cape of Good Hope, which seemed an exception to his rule that the colonies were to be governed for their own benefit and in accordance with their own wishes, and subjected him to a humiliating defeat. After his retirement he wrote a history and defence of his colonial policy in the form of letters to Lord John Russell, a dry but instructive book. He resigned with his colleagues in 1852. No room was found for him in the Coalition Cabinet of 1853, and although during the Crimean struggle public opinion pointed to him as the fittest man as Minister for War, he never again held office. During the remainder of his long life he exercised a vigilant criticism on public affairs. In 1858 he wrote a work (republished in 1864) on parliamentary reform ; in 1888 he wrote another on the state of Ireland; and in 1892

one on the United States tariff. In his latter years he was a frequent contributor of weighty letters to The Times on land, tithes, currency, and other public questions. His principal parliamentary appearances were when he moved for a committee on Irish affairs in 1866, and when in 1878 he passionately opposed the policy of the Beaconsfield Cabinet in India.

He nevertheless supported Lord Beaconsfield at the dissolution, regarding Mr Gladstone's accession to power with much greater alarm. He was a determined opponent of Mr Gladstone's Home Rule policy. He died on 9th October 1894. None ever doubted his capacity or his conscientiousness, but he was generally deemed impracticable and disagreeable. Prince Albert, however, who expressed himself as ready to subscribe to all Grey's principles, and applauded him for having principles, told Stockmar that, although dogmatic, he was amenable to argument ; and Sir Henry Taylor credits him with "more

freedom from littlenesses of feeling than I have met before in any public man. ” His chief defect was perceived and expressed by his original tutor and subsequent adversary in colonial affairs, Edward Gibbon Wakefield, who wrote, “With more than a common talent for understanding principles, he has no originality of thought, which compels him to take all his ideas from somebody; and no power of working out theory in practice, which compels him to be always in somebody’s hands as respects decision and action. ” (e. g.)

Crieg, Edvard Hagerup (1843), Norwegian musical composer, was born at Bergen, 15th June 1843. In spite of the fact that his family was of Scottish origin, Alexander Greig (sic) and his wife having emigrated from Fraserburgh to Norway more than a century ago, Grieg is the foremost and most typical representative of Scandinavian music. After the completion of his musical studies at the Leipzig Conservatorium, whither he went on the advice of Ole Bull, and where he passed, like all his contemporaries, under the influence of

the Mendelssohn and Schumann school of romantics, he studied for a short time with Gade and Emil Hartmann in Copenhagen. Together with another young Norwegian composer, Eichard Nordraak, Grieg made a kind of crusade in favour of national music, and even his earliest works show his strong afBnity for a style built upon the tradi-tion ballads of his country. He visited Italy in 1865 and 1870, and from 1867 till 1880 conducted a musical union in Christiania. More recently he has appeared in the capital as an orchestral conductor, but the greater part of his life has been spent at Bergen. In 1888 he played his pianoforte concerto and conducted his ” two melodies for strings ” at a Philharmonic Concert in London, and visited England again in 1891, 1894, and 1896, receiving the degree of Mus.D. from the University of Cambridge in 1894. His works include a large mimber of songs, and pianoforte solos of ” lyrical ” form ; three violin sonatas ; a string quartet; a sonata for piano and violoncello; Aus Holherg’s Z^it; a suite for stringed orchestra, and also for pianoforte solo; the pianoforte concerto already men-

tioned; a concert-overture, /m Herbst, and other smaller pieces for orchestra; and several works for chorus and orchestra, with or without solos. His incidental music to Ibsen's Peer Oynt is widely known through the two suites selected from it, the first of which was originally published as a duet for pianoforte, and afterwards scored for full orchestra. Grieg has enshrined the characteristics of Scandinavian music in works of undying beauty, though for the most part of somewhat small calibre. In the use of these elements he departs very far from the recognized rules of form, and he has always succeeded best in the class of compositions where such departure is most readily excused. His songs may be said to be always the more spontaneous the more closely they conform to the simple model of the volkslied; the pianoforte concerto is brilliant and spontaneous, and the first and second of his violin sonatas are perennially agreeable, so free and artless is the flow of their melody. In his numerous piano pieces and in those of his songs where a definitely national style of treatment is avoided, the impression made is less per-

manent, for, apart from the national characteristics which he employs so adroitly, his individuality is not strongly pronounced, and in the rare cases where he has attempted the treatment of subjects not specially national in type on theconventional lines, he has shown himself somewhat of a mannerist.

Griffin, capital of Spalding county, Georgia, U.S.A., 43 miles south of Atlanta, on the Southern and the Central of Georgia railways, at an altitude of 975 feet. It has cotton factories and a large cotton trade. Population (1880), 3620; (1890), 4503; (1900), 6857 of whom 26 were foreign-born and 3258 negroes.

Grimsby, Great, a parliamentary, county, and municipal borough, mercantile and fishing seaport of England, in the county of Lincoln, situated on the east coast, near the mouth of the Humber, and 155 miles north by east from London by the Great Northern railway. It also has a station on the Great Central railway. The port possesses five docks (104 acres) and three graving docks. These are reached through a tidal basin of 15

acres, protected on the east and west by breakwaters. The weight of fish sent from Grimsby by rail increased from 26,324 tons in 1870 to 114,292 tons in 1899. In 1899 the fishing fleet consisted of 522 vessels, mostly steam trawlers, of 31,512 tons, manned by nearly 4650 hands. In 1900 the mercantile fleet belonging to the port numbered 622 vessels of 60,540 tons. The value of the imports increased from £3,544,449 in 1881 to £7,967,414 in 1900; that of the exports from £7,342,468 in 1881 to £11,007,937 in 1900. The most important items amongst the imports are butter, woollens, timber, cereals, eggs, glass, cottons, preserved meat, wool, sugar, and bacon. The exports consist chiefly of woollen yarn, woollens, cotton goods, cotton yarn, machinery, &c., and coal. The port was cleared by 926 vessels of 416,651 tons in 1886, and by 1748 of 960,236 tons in 1899. There is in addition a coasting trade of some 500,000 tons annually. To the industries must be added the manufacture of ship tackle, ropes, ice, turnery, flour, linseed cake, artificial manure, and sawmills, bone and corn

mills, and creosote works. The church of St John the Divine was built, in the Early English style, in 1892; the church of All 'Saints' in 1891; St Barnabas's in 1900; St Paul's in 1884; the Eoman Catholic church in 1883 ; the Sailors' and Fishermen's Harbour of Refuge in 1890; and the Grimsby, Cleethorpes, and East Coast Orphan Home in 1892. The church of St James's was restored between 1882 and 1886. The Wesleyans and Congregationalists have also built new chapels. In 1899-1900 the Mechanics' Institution was converted into the Free Public Library. The Constitutional Club dates from 1892. The Duke of York public gardens were opened in 1894, and a new cemetery in 1889. There has been a technical school since 1893. The sewage works, with a pumping station, were completed in 1896. In 1889 Grimsby was extended by the inclusion of part of the township of Clee with Weelsby, and in 1891 was made a county borough, with a separate court of quarter sessions. It is governed by a mayor, 12 aldermen, and 36 councillors, and is represented in Parliament by one

member. Area, 2832 acres. Population (1891), 51,934; (1901), 63,138. Birth-rate, 30-0 (1898); death-rate, 16-9 (1898). The second half of the year 1901 was marked by a serious wages dispute between the owners and crews of the fishing-vessels of the port, which was eventually settled by the intervention of the Board of Trade and an arbi-tration before Sir Edward Fry.

GRIMTHOEP E — G E I S 0 N S

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Crimthorpe, Edmund Beckett, 1st Bakon (1816), son of Sir Edmund Beckett Denison, was born on the 12th May 1816. He was educated at Doncaster and at Eton, whence he proceeded to Trinity College, Cambridge University, and graduated thirtieth wrangler in 1838. Having adopted . the law as his profession, he was called to the bar at Lincoln's Inn, 1841. Upon succeeding to the baronetcy in 1874 he dropped the name of Denison, which his father had assumed in 1816. From 1877 to 1900 he was chancellor and vicar-general of York, and he was raised to the

peerage in 1886. He was made a Q.C. in 1864, and was for many years a leader of the Parliamentary Bar. He devoted himself to the study of astronomy, horology, and architecture, more especially Gothic ecclesiastical architecture. As early as 1850 he had become a recognized authority on clocks, watches, and bells, and in particular on the construction of turret clocks, for it was well known that he had designed Dent's Great Exhibition clock, and his Rudimentary Treatise was a notable book that went through many editions. It was therefore natural that in 1851 he should be called upon, in conjunction with the Astronomer Royal (Mr, afterwards Sir, G. B. Airy) and Mr Dent, to design a suitable clock for the new Houses of Parliament. The present clock, " Big Ben," was the result. In every burning question during his time, such as marriage with a deceased wife's sister, the revision of the New Testament, or the views of Huxley and the modern school on miracles. Lord Grimthorpe took a prominent part, either in the form of pamphlets or of letters to Tfie Times. It is, however, in connexion with

the restoration of St Albans Abbey that he is most widely known. The St Albans Abbey Reparation Committee, which had been in existence since 1871, and for which Sir Gilbert Scott had carried out some admirable repairs, obtained a faculty from the Diocesan Court in 1877 to repair and restore the church and fit it for cathedral and parochial services. Very soon, however, the committee found itself deeply involved and unable to raise the necessary funds, and it was at this juncture that a new faculty was granted to Lord Grimthorpe (then Sir Edmund Beckett) to "restore, repair, and refit" the abbey at his own expense. Lord Grimthorpe made it an express stipulation that the work should be done according to his own designs and under his own supervision. Lord Grimthorpe's public spirit in undertaking the burden of the work was undeniable, but his treatment of the roof, the new west front, and the windows inserted in the terminations of the transepts, excited a storm of adverse criticism and was the subject of vigorous protests from the professional architectural

world.

Crindelwald, a valley in the Bernese Oberland in Switzerland, and one of the chief resorts of tourists in Switzerland. It is shut in on the south by the precipices of the Wetterhorn, Mettenberg, and Eiger, between which flow two famous glaciers. On the north it is sheltered by the Eaulhorn range, while on the east the Great Scheidegg Pass leads over to Meiringen, and on the south-west the Little Scheidegg or 'Wengern Alp (railway 11^ miles across) divides it from Lauterbrunnen. The main village is connected with Interlaken by a cog-wheel railway (12^ miles). The valley is very green, and possesses excellent pastures, as well as fruit trees, though but little corn is grown. It is watered by the Black Liltsehine, a tributary of the Aar. The height of the church above the sea-level is 3468 feet. The population in 1900 was 3342, practically all Protestant and German-speaking, and shows a slight increase. The glacier guides are the best in the Alps. The valley was originally inhabited by the serfs of various great lords in summer for the sake of pas-

turage. A chapel in a cave was superseded in about 1146 by a wooden church, replaced in about 1180 by a stone church, which was pulled down in 1793 to erect the present building. Gradually the Austin canons of Interlaken bought out all the other owners in the valley, but when that house was suppressed in 1628 by the town of Bern the inhabitants gained their freedom. The church hamlet, with the neighbouring houses, bears the name of Gydisdorf. Grindelwald is very much frequented by visitors in winter.

See W. A. B. Coolidge. Walks and Excursions in the Valley of Grindelwald (also in French and German). Grindelwald, 1900. — E. F. VON MuLiNEN. Beitrage zur Heimathkunde des Kantons Bern, deutschen Theils,Yol. i, (Bern, 1879), pp. 24-26. — G. Strassek. Der Gletschermann. Grindelwald, 1888-90. Scattered notices may be found in the new edition (London, 1899) of the ” General Introduction” (entitled ” Hints and Notes for Travellers in the Alps” to Mr John Ball’s Alpine Guide. (y^. x. B. c.)

Crinstead, East, a market-town and railway station in the East Grinstead parliamentary division of

Sussex, England, 12 miles west of Tunbridge Wells. St Swithin's church has ancient memorials. There are a literary and scientific institution, a cottage hospital, Sackville College (an almshouse founded in 1608), St Margaret's Home and Orphanage, a Roman Catholic church, and an isolation hospital. Brewing and brick and tile making are carried on. In the vicinity (nearest station, Eorest Row) is the golf-course of the Royal Ashdown Forest Golf Club, one of the most beautiful and also one of the most sporting of English inland links. Area of urban district, 6415 acres. Population (1881), 4783; (1901), 6094.

Criqualand. See Kaffbaeia.

Crisons, or Gbaubunden, the largest of the Swiss cantons. It has a total area of 2773 square miles. Of this only 1488 square miles are classed as " productive," forests covering no fewer than 490 square miles, and vine-yards but 1 square mile. Of the " unproductive " area 139 square miles (more than in any other canton save the Valais) are occupied by glaciers, while a good deal

of space is taken up by lakes, though of no great size.

The valley of Juf (6998 feet) is the loftiest permanently inhabited village in the entire chain of the Alps. In 1888 the population was 94,810, or 35 inhabitants to each square mile, the lowest rate of density in the whole of Switzerland. In that year the Protestants numbered 51,937, the Roman Catholics 42,797, and the Jews 13. In 1900 the population was 104,510, of whom 48,937 were German-speaking, 38,677 Rom6nsch- or Ladin-speaking, 13,883 Italian-speaking, and only 535 French-speaking.

The capital of Grisons is Coire or Chur. There are fourteen administrative districts in the canton. The existing cantonal constitution dates from 1892. The legislature (numbers not fixed by the constitution) is elected for two years by a popular vote, by which also the five members of the executive are chosen for three years. For all laws the “obligatory referendum” obtains, while with regard to resolutions and ordinances made by the legislature, 3000 citizens can demand the “facultative referendum.” In 1892 the right of “initiative” as to legislative

projects was given to 3000 citizens, but 5000 are required in the case of a revision of the cantonal constitution. In 1897 the state revenue of the canton was 1,147,679 francs (a rise of 9|^ per cent, since 1885), and the state expenditure 1,935,564 francs (a rise of 20J per cent, since (1885). But in these sums the taxes are not reckoned, which always causes a deficit that is carried to the capital account and is met by the land tax — a complicated system. Really there is thus never a deficit, as the amount of the land tax varies annually according to the amount which must be covered. This singular system of accounts is quite unique in Switzerland, but is prescribed by the cantonal constitution (Article 19). Apart

from the special loan of 10,000,000 francs for the construction of railways, the public debt in 1897 was 5,992,161 francs. There is a railway up the main Rhine valley to Coire and thence to Thusis, and another from Landquart up to Davos, and others are in construction. Davos-Platz (5115 feet) and St Moritz (6089 feet) are the most famous “air cures” in Grisons. A newer resort is Arosa (6108 feet) in the Schaniigg valley, above

Coire.

See Codex Dvplomaikus ad Historiam Haeticam, 4 vols. Coire, 1848-63.— LOKRIA and Martbl. Ze Massif de la Bemina. Zurich, 1894.— Von Planta. Das alto Raetien (Berlin, 1872), and Die Curraetischen Serrschaften in d. FeudaUeit (Bern, 1881), and GeschicMe voii Graubunden (Bern, 1892). — Wagnee and YoN Salis. RecMsquellen d. Cant. Grauliinden. Basel, 1877-92.

(W. A. B. C.)

Grivegfn^Gi a town of Belgium, in the province and 3 miles S.E. of the town of Liege. Tt was in the ironworks of this town that English methods of treating the metal were first introduced into Belgium. Population (1899), 10,565.

Grbdek, the chief town of a government district in Galicia, Aus'ria, aLout 18 miles to the S.W. of Lemberg. It is a station on the railway between the latter town and Cracow. It is an important corn market and centre of the trade in flax, of which large quantities are grown in the district. Population (1890), 10,742 ; (1900), 11,845 (69 per cent. Polish, 30 per cent.

Euthenian, 1 per cent. German ; 36 per cent. Roman Catholic)

Grod no, one of the Lithuanian governments of North-western Russia. It is hilly in the north (highest altitude 924 feet), but otherwise is a vast plain. Granites and gneisses appear on the river Bug; Cretaceous, and especially Tertiary, deposits elsewhere. The soil is mostly sandy, assuming the character of drifting sands in Grodno dis-trict and along the rivers ; the remainder is of moderate fertility, and in places marshy. Great marshes occur in the Byelovyezhsk and Grodno pushchas (forests). Forests cover nearly one-fifth of the total area. Peat-bog, sometimes four to seven feet thick, is viddely met with. The climate is wet and cold, the average temperatures at Grodno being for the year, 42° F. ; for January, 22° ; for July, 73° ; the yearly rainfall is 20 ‘6 inches. The population in 1897 numbered 1,617,859 (789,801 women, 255,946 living in towns), and consists of White and Little Russians (54 per cent.), Poles (a little over 20 per cent., chiefly in south-west), and Jews (19 per cent.). The Lithuanians and

Tatars proper number but a few thousands each. Agriculture is the main occupation. The peasants own 42 per cent, of the land, i.e., 4,046,900 acres, of which 2,327,400 acres are arable. The crops are moderately good. Cattle-breeding is carried on, there being in 1891 176,245 horses, 484,110 horned cattle, and 685,200 sheep. In respect of woollen cloth factories Grodno occupies in Russia the third place ; there are about 150, employing some 4754 persons, with a yearly production of £330,600. Tobacco factories, silk and shoddy mills, and tanneries come next, the total number of factories being 3671, employing over 21,600 persons in 1897, with a yearly return of £1,537,840. There were besides over 25,000 artizans. The annual aggregate tonnage of the navigation in the drainage areas of both the Niemen and the Yistula is 257,450 tons. Grodno is divided into nine districts, the chief towns of which are : Grodno, Brest Litovsk (46,542 inhabitants), Byelsk (7461), Byelostok (63,927), Kobrin (10,365), Pruzhany (7634), Slonim (15,893), Sokolka (7595), and Volkovysk (10,584). Gkodno, capital of the government, is situated on

the right bank of the Niemen, which is spanned by

an iron bridge, 533 miles S.W. of St Petersburg by rail. It is well provided with secondary schools for boys and girls. Only the tobacco factories are of importance ; but there is considerable trade in wood and timber, and various goods are shipped on the Niemen. The population in 1897 was 46,871, of whom nearly two-thirds were Jews. (P- -*-■ ^■)

Groen Van Prinsterer, Guillaume

(1801-1876), Dutch politician and historian, was born at Voorburg, near The Hague, on the 21st of August 1801. He studied at Leyden University, and graduated in 1823 both as Doctor of Literature and LL.D. From 1829 to 1833 he acted as secretary to King William I. of Holland, afterwards took a prominent part in Dutch home politics, and gradually became the leader of the so-called anti-revolutionary party, both in the Second Chamber, of which he was for many years a member, and outside. In Groen the doctrines of Guizot and Stahl found an eloquent exponent. They permeate his controversial and political writings and historical studies, of which his Handbook

of Dutch Histm-y (in Dutch) and Maurice et Barnevelt (in French, 1875, a criticism of Motley's Life of Van Olden-Barnevelt) are the principal. Groen was violently opposed to Thorbecke, whose principles he denounced as ungodly and revolutionary. Although he lived to see these principles triumph, yet he never ceased to oppose them until his death, which occurred at The Hague on the 19th of May 1876. He is best known as the editor of the Archives et Correspondance de la Maison d' Orange (12 vols., 1835-45), a great work of patient erudition, which procured for him the title of the " Dutch Gachard." Itir J. L. Motley acknowledges his indebtedness to Groen's Archives in the preface to his Rise of the Dutch Republic, at a time when the American historian had not yet made the acquaintance of King William's archivist, and also bore emphatic testimony to Groen's worth as a writer of history in the correspondence published after his death. At the first reception, in 1858, of Mr Motley at the royal palace at The Hague, the King presented him with a copy of Groen's Archives as a token of apprecia-

tion and admiration of the work done by the “worthy vindicator of William L, Prince of Orange.” This copy, bearing the King’s autograph inscription, afterwards came into the possession of Sir William Vernon Harcourt, Mr Motley’s son-in-law. (h. Ti.)

Gron i ng^en, a province and town in the Netherlands. Clay, and clay and sand mixed, predominate in the north and north-east part of the province, the high fens of the southern portion lying on diluvial sand. The former is an agricul-tural district, growing wheat and oil-seeds ; on the latter cattle are bred, rye, potatoes, and buckwheat grovni, peat is cut, and industries and shipping flourish. The area of the province is 904 square miles, and its population in 1900 was 299,033. The town of Geoningen is situated 45|-miles east of Harlingen, with which it is connected by rail, at the end of the sandy tongue (the Hondsruf) which stretches from the plateau of Drenthe to tlie clay soil in the centre of the province, while it communicates by rivers and canals with the sea and adjoining provinces. To the advantages of its natural position the town as

capital of the proAince has added those of commercial and political supremacy and monopoly, and this accounts for the fact that the small towns (Winschoten, Appingedam, Delfzijl) of the province are few in number. Considerable trade is done in grain, wood, turf, and cattle with Great Britain, Germany, Scandinavia, and Russia. The industries are unchanged since 1874. The Nordeschool was founded in 1893. There are also a new archseological society and a central bureau for collecting information concerning the province. The university in 1898-99 had 397 students. Population (1874), 39,284: (1900), 66,537.

Gross- Jed lersdorf. See Jedlehsdoef.

Gross-Meseritsch, the chief town of a government district in North-east Moravia, on the Oslawa. It has considerable linen industry and leather manufactures, horse fairs, and important trade in fruit, vegetables, and flax. Population, chiefly Czech (1900), 5236.

Groton, a town of New London county, Connecti-

cut, U.S.A., on the eastern bank of the river Thames, at its mouth. The town has an area of 35 square miles, level near the coast, but rising into hiUs inland. The principal village, of the same name as the town, is situated on the Thames opposite New London, and on the New York, New Haven, and Hartford Kailway. Population of the town (1880), 5128; (1890), 5539; (1900), 5962, of whom 936 were foreign-born and 96 negroes.

Grottagflie, a town of the province of Lecce, Apulia, Italy, 12 miles east by north of Taranto by the railway to Brindisi. It is celebrated for a white -glaze pottery, and has also a ceramic school (1887), and olive-oil presses. Population, about 10,000.

Groups, Theory of.— The conception of an operation to be carried out on some object or set of objects underlies all mathematical science. Thus in elementary arithmetic there are the fundamental operations of the addition and the multiplication of integers ; in algebra a linear transformation is an operation which may be carried

out on any set of variables ; while in geometry a transla-
tion, a rotation, or a projective transformation are operations
which may be carried out on any figure.

In speaking of an operation, an object or a set of
objects to which it may be applied is postulated ; and
the operation may, and generally will, have no meaning
except in regard to such a set of objects. If two opera-
tions, which can be performed on the same set of objects,
are such that, when carried out in succession on any
possible object, the result, whichever operation is per-
formed first, is to produce no change in the object ; then
each of the operations is spoken of as a definite operation,
and each of them is called the inverse of the other. Thus
the operations which consist in replacing x by nx and xjn
respectively, in any rational function of x, are definite
inverse operations, if n is any assigned number except
zero. On the contrary, the operation of replacing x by
an assigned number in any rational function of x is not,
in the present sense, although it leads to a unique result,
a definite operation ; there is in fact no unique inverse

operation corresponding to it. It is to be noticed that the question whether an operation is a definite operation or no may depend on the range of the objects on which it operates. For example, the operations of squaring and extracting the square root are definite inverse operations if the objects are restricted to be real positive numbers, but not otherwise.

If O, O’, O”,.— is the totality of the objects on which a definite operation S and its inverse S’ may be carried out, and if the result of carrying out S on O is represented by O. S, then O.S.S’, O.S’. S, and O are the same object whatever object of the set O may be. This will be repre-sented by the equations SS’ = S’S = 1. Now O.S.S’ has a meaning only if O . S is an object on which 8′ may be performed. Hence whatever object of the set O may be, both O . S and O . S’ belong to the set. Similarly O.S.S, 0 . S . S . S, . . . are objects of the set. These will be repre-sented by O . S^, O.S’,... Suppose now that T is another definite operation with the same set of objects as S, and that T’ is its inverse operation. Then O.S.T is a definite

operation of the set, and therefore the result of carryings

out S and then T on the set of objects is some operation

U with a unique result. Eepresent by U’ the result of

carrying out T’ and then S’. Then

O.UU’ = O.S.T.T’. S’ = O.SS’ = 0,

and

O.U’U = O.T’. S’.S.T = O.T’T = 0,

whatever object O may be. Hence

UU’ = U’U=1;

and U, U’ are definite inverse operations.

If S, U, V are definite operations, and if S’ is the inverse

of S, then

SU = SV

implies S’SU = S’SV,

or U = V.

Simnarly US = VS

implies U = V.

Let S, T, U,...

be a set of definite operations, capable of being carried

out on a common object or set of objects, and Definition

let the set contain — of a group.

(i.) the operation ST, S and T being any two operations of the set ;

(ii.) the inverse operation of S, S being any operation of the set ;

the set of operations is then called a group.

The number of operations in a group may be either finite or infinite. When it is finite, the number is called the order of the group, and the group is spoken of as a group of finite order.

If the number of operations is infinite, there are three possible cases.. When the group is represented by a set of geometrical operations, for the specification of an individual operation a number of measurements will be necessary. In more analytical language, each operation will be specified by the values of a set of j)arameters. If no one of these parameters is capable of continuous variation, the group is called a discontinuous group. If all the parameters are capable of continuous variation, the group is called a continuMis group. If some of the parameters are capable

of continuous variation and some are not, the group is called a mixed group.

If S’ is the inverse operation of S, a group which contains S must contain SS’, which produces no change on any possible object. This is called the identical operation, and will always be represented by 1. Since

SPS2 = SP+«

when p and q are positive integers, and

S2’S’ = S3’-i

while no meaning at present has been attached to S* when q is negative, S’ may be consistently represented by S~^. Since

S, S\ S3,...

all belong to a group which contains S, it follows that for every operation of a group of finite order there must be some smallest integer m such that

S™=1;

m is then called the order of the operation S, which is spoken of as an operation of finite order. Operations of finite order may, of course, occur in groups containing an

infliiite number of operations, but do not necessarily do

so. In any case the set of operations

..., s-2, s-^ 1, s, s^.

obviously constitute a group. Such a group is called a

cyclical group, whether S is of finite order or not.

It will be convenient, before giving some illustrations

Subgroups, °^ ^^^ general group idea, to add a number of

conjugate further definitions and explanations which apply

operations, to all groups alike. If from among the set of

isomorpb- operations

ism.&c ^ S, T, U,...

which constitute a group G, a smaller set

s; T', u',...

can be chosen which themselves constitute a group H,

the group H is called a subgroup of G. Thus, in par-

ticular, if S is an operation of G, the cyclical group con-

stituted by

..., s-2, s-i, 1, S, S2,...

is a subgroup of G, except in the special case when it coincides with G itself.

If H is a subgroup of G, and S an operation of G, which is not contained in H, the totality of the operations formed by combining in every way S and its positive and negative powers with the operations of H necessarily forms a group. This is contained in or coincides with G. By first taking for H the cyclical subgroups of G, and continually building up in this way fresh subgroups, all possible subgroups of G will arise.

If S and T are any two operations of G, the two operations S and T'^ST are called conjugate operations, and T'^ST is spoken of as the result of transforming S by T.

Since

(T-iST)2 = T-iST.T-iST = T-iS2T,

and

(T-iST)« = T-iS"T,

it follows that if S is an operation of finite order, T~^ST is an operation of the same finite order, and conversely.

It is to be noted that since

ST = T-i.TS.T,

ST and TS are always conjugate operations in any group

containing both S and T. If T transforms S into itself,

that is, if

S = T-iSTorTS = ST,

S and T are called permutable operations. A group whose

operations are all permutable with each other is called an

Abelian group. If S is transformed into itself by every

operation of G, or, in other words, if it is permutable with

every operation of G, it is called a self-conjugate operation

of G.

The conception of operations being conjugate to each

other mav be extended to subgroups. If

s’, r, u’,...

are the operations of a subgroup H, and if K is any opera-

tion of G, then the operations

K-iS’R, R-iT’E, R-iU’R,...

belong to G, and constitute a subgroup of G. For if

S’T’ = U’,

then

R-iS’R . R-irE = R-iS’T’E -E-iU’R.

This subgroup may be identical with H. In particular,

it is necessarily the same as H if E belongs to H. If it

is not identical with H, it is said to be conjugate to

H ; and it is in any case represented by the symbol

E-iHE. If

H = E-iHE,

the operation R is said to be permutable with the sub-

group H. (It is to be noticed that this does not imply

that E is permutable with each operation of H.)

If

H = E-iHE,

when for E is taken in turn each of the operations of G,

then H is called a self-conjugate subgroup of G.

A group is spoken of as simple when it has no self- .

conjugate subgroup other than that constituted by the

identical operation alone. A group which has a self-

conjugate subgroup is called composite.

Let G be a group constituted of the operations

S, T, U,...

and g a second group constituted of

s, t, u,...

and suppose that to each operation of G there corresponds

a single operation of g in such a way that if

ST = U,

then

st = u,

where s, t, u are the operations corresponding to S, T, U

respectively. The groups are then said to be isomorphic,

and the correspondence between their operations is spoken

of as an isomorphism between the groups. It is clear that

there may be two distinct cases of such isomorphism. To

a single operation of g there may correspond either a single

operation of G or more than one. In the first case the

isomorphism is spoken of as simple, in the second as

multiple.

Two simply isomorphic groups considered abstractly —

that is to say, in regard only to the way in which their

operations combine among themselves, and apart from any

concrete representation of the operations — are clearly in-

distinguishable.

If G is multiply Isomorphic with g, let

A, B, C,...

be the operations of G which correspond to the identical operation of g. Then to the operations A”^ and AB of G there corresponds the identical operation oi g.; so that A, B, C, ... constitute a subgroup H of G. Moreover, if E is any operation of G, the identical operation of g corresponds to every operation of R^^HE, and therefore H is a self-conjugate subgroup of G. Since S corresponds to s, and every operation of H to the identical operation of g, therefore every operation of the set

SA, SB, SO,...

which may be represented by SH, corresponds to s. Also these are the only operations that correspond to s ; for if there were another such operation T, then T^^S would correspond to the identical operation of g, which is not the case. The operations of G may therefore be divided into sets, no two of which contain a common operation, such that the correspondence between the operations of G

and g connects each of the sets

H, SH, TH, UH,...

with the single operations

1, s, t, u,...

written below them. The sets into which the operations

of G are thus divided combine among themselves by

exactly the same laws as the operations of g. For if

st = u,

then

SH.TH = UH,

in the sense that any operation of the set SH followed by

any operation of the set TH gives an operation of the

set UH.

The group g, abstractly considered, is therefore com-

pletely defined by the division of the operations of G into

sets in respect of the self-conjugate subgroup H. From

this point of view it is spoken of as the factor-group of G

in respect of H, and is represented by the symbol G/BL

Any composite group in a similar way defines abstractly a factor-group in respect of each of its self-conjugate subgroups.

It follows from the definition of a group that it must always be possible to choose from its operations a set such that every operation of the group can be obtained by combining the operations of the set and their inverses. If the set is such that no one of the operations belonging to it can be represented in terms of the others, it is called a set of independent generating operations. Such a set of generating operations may be either finite or infinite in number.

If A, B,...,E are the generating operations of a group, the group generated by them is represented by the symbol {A, B,..., E}. An obvious extension of this symbol is used such that {A, H} represents the group generated by combining an operation A with every operation of a group H; {Hj, Hj} represents the group obtained by combining in all possible ways the operations of the groups Hj and Hj ; and so on. The independent generating operations of a group may be subject to certain relations connecting

them, but these must be such that it is impossible by com-

bining them to obtain a relation expressing one operation

in terms of the others. For instance,

AB = BA

is a relation conditioning the group {A, B} ; it does not,

however, enable A to be expressed in terms of B, so that

A and B are independent generating operations

Let

O, O’, O”,...

‘ be a set of objects which are interchanged among them-

Traasl- selves by the operations of a group G, so that if

tivity and S is any operation of the group, and O any one

prlml- of the objects, then 0 . S is an object occurring in

tivity. j.jjg gg(. j£ jj. jg possible to find an operation S

of the group such that O . S is any assigned one of the set

of objects, the group is called transitive in respect of

this set of objects. When this is not possible the group is

called intransitive in respect of the set. If it is possible

to find S so that any arbitrarily chosen n objects of the

set, Oj, O2,..., On are changed by S into 0\, 0\,...,

0’„ respectively, the latter being also arbitrarily chosen, the group is said to be w-ply transitive.

If

O, O’, 0”,...

is a set of objects in respect of which a group G is transitive, it may be possible to divide the set into a number of subsets, no two of which contain a common object, such that every operation of the group either interchanges the objects of a subset among themselves, or changes them all into the objects of some other subset. When this is the case the group is called irniprimitive in respect of the set ; otherwise the group is called primitive. A group which is doubly-transitive, in respect of a set of objects, obviously cannot be imprimitive.

If G is a group which is transitive in respect of a set of objects

0, 0’, O”,...

no portion of the set less than the whole can be interchanged among themselves by all the operations of G. It may, however, be possible to choose a portion of the set,

such that the objects it contains are interchanged among themselves by some of the operations of G. If S and T are two operations of G which have this property in respect of the portion, then ST has it also. The operations of G, which interchange among themselves the objects forming a portion of the set, constitute therefore a subgroup. In many particular cases, as wiU be seen in the examples presently to be dealt with, this consideration of the in-variance of a, portion of a transitive set of objects lends itself readily to the determination of the subgroups of the group under examination.

The foregoing general definitions and explanations will now be illustrated by a consideration of certain particular groups. To begin with, as the operations involved are of the most familiar nature, the group of rational mustra-arithmetic may be considered. The fundamental tlons ot operations of elementary arithmetic consist in the group the addition and subtraction of integers, and ‘ ‘ multiplication and division by integers, division by zero alone omitted. Multiplication by zero is not a definite

operation, and it must therefore be omitted in dealing with those operations of elementary arithmetic which form a group. The operation that results from carrying out additions, subtractions, multiplications, and divisions, of and by integers a finite number of times, is represented by the relation

X =ax\h,

where a and 6 are rational numbers of which a is not zero, X is the object of the operation, and x is the result. The totality of operations of this form obviously constitutes a group ; for if

x” = a-^x’ (6j

is a second operation of the same kind, the operation that results from carrying out the first and then the second is

x” = aa^x + a^b + bj,

which belongs to the set. Moreover, the inverse of the first operation is

1 5

X =- X —

a

which also belongs to the set.

If S and T represent respectively the operations

x’ = ax + b

and

x’ = cx + d,

then T~^ST represents

x = ax + d – ad + hc.

When a and h are given rational numbers, c and d may be

chosen in an infinite number of ways as rational numbers,

so that d-ad+bc shall be any assigned rational number.

Hence the operations given by

x’ = ax-‘r b,

where a is an assigned rational number and b is any

rational number, are all conjugate; and no two such

operations for which the a’s are dififerent can be conjuga,te.

If a is unity and 6 zero, S is the identical operation which

is necessarily self-conjugate. If a is unity and b different

from zero, the operation

x’ = x + b

is an addition. The totality of additions forms, therefore, a

single conjugate set of operations. Moreover, the totality of additions with the identical operation, i.e., the totality of operations of the form

$x' = x + b$,

where b may be any rational number or zero, obviously constitutes a group. The operations of this group are interchanged among themselves when transformed by any operation of the original group. It is therefore a self-conjugate subgroup of the original group.

The totality of multiplications, with the identical operation, i.e., all operations of the form

$x' — ax$,

where a is any rational number other than zero, again obviously constitutes a group. This, however, is not a

self-conjugate subgroup of the original group. In fact, if the operations

$x' = ax$

are all transformed by

oc’ = cx-- d,

they give rise to the set

x’ = ax + d(]. – a).

When d is 3. given rational number, the set constitutes a subgroup which is conjugate to the group of multiplica-tions. It is to be noticed that the operations of this latter subgroup may be written in the form

x’ — d = a{x — d).

A complete discussion of all the subgroups of the group under consideration is not here called for, as the present object is merely to illustrate the definitions and general properties that apply to all groups alike ; but further sub-groups will immediately suggest themselves to the reader. For instances, all operations of the form

x’ = a“‘x + b,

where a is a given rational number, n a positive or negative integer, and h any rational number, obviously constitute a subgroup which is self -conjugate.

The totality of rational numbers, including zero, forms a

set of objects which are interchanged among themselves by all operations of the group.

If x^ and x^ are any pair of distinct rational numbers, and yj and y^ ^^7 other pair, there is just one operation of the group which changes x-^ and x^ into y^ and [/] respectively. For the equations

y^ = OTj -f h,

determine a and h uniquely. The group is therefore doubly transitive in respect of the set of rational numbers.

If H is the subgroup that leaves unchanged a given rational number x-^, and S an operation changing x-^ into a,,, then every operation of S'[HS leaves x] unchanged. The sub-groups, each of which leaves a single rational number unchanged, therefore form a single conjugate set. The group of multiplications leaves zero unchanged ; and, as has been seen, this is conjugate with the subgroup formed of all operations

X -d = a(x – d),

where o? is a given rational number. This subgroup leaves d unchanged.

The group of multiplications is clearly generated by

the operations

x =px,

where for p negative unity and each prime is taken in

turn. Every addition is obtained on transforming

x =x+l

- by the different operations of the group of multiplications.

Hence

x’ = x +\, and x —px, {p= – 1, 3, 5, 7, . . .)

form a set of independent genergrting operations of the

group. It is a discontinuous group.

As a second example the group of motions in three-

dimensional space will be considered. The totality of

motions, i.e., of space displacements which leave the dis-

tance of every pair of points unaltered, obviously consti-

tutes a set of operations which satisfies the group definition.

From the elements of kinematics it is known that every

motion is either (i.) a translation which leaves no point

unaltered, but changes each of a set of parallel lines into

itself; or (ii.) a rotation which leaves every point of one

line unaltered and changes every other point and line ; or (iii.) a twist which leaves no point and only one line (its axis) unaltered, and may be regarded as a translation along, combined with a rotation round, the axis. Let S be any motion consisting of a translation I along and a rotation a round a line AB, and let T be any other motion. There is some line CD into which T changes AB; and therefore T- 1ST leaves CD unchanged. More-over, T”iST clearly effects the same translation along and rotation round CD that S effects for AB. Two motions, therefore, are conjugate if and only if the amplitudes of their translation and rotation components are respectively equal. In particular, all translations of equal amplitude are conjugate, as also are all rotations of equal amplitude. Any two translations are permutable with each other, and give when combined another translation. The totality of translations constitutes, therefore, a subgroup of the general group of motions ; and this subgroup is a self-conjugate subgroup, since a translation is always conjugate to a translation.

All the points of space constitute a set of objects which are interchanged among themselves by all operations of the group of motions. So also do all the lines of space and all the planes. In respect of each of these sets the group is simply transitive. In fact, there is an infinite number of motions which change a point A to A', but no motion can change A and B to A' and B' respectively unless the distance AB is equal to the distance A'B'.

The totality of motions which leave a point A unchanged forms a subgroup. It is clearly constituted of all possible rotations about all possible axes through A, and is known as the group of rotations about a point. Every motion can be represented as a rotation about some axis through A followed by a translation. Hence if G is the -group of motions and H the group of translations, G/H is simply isomorphic with the group of rotations about a point

The group of rotations round a point is an example of a simple group. To verify this, suppose that a self-conjugate subgroup of the group of rotations round A contains a rotation through an angle a about Aa. Since the group

of rotations round A has operations which change any one line through A into any other, the self -conjugate subgroup contains rotations of amplitude a round every line through A. Now a pair of lines AB, AC can always be chosen so that a rotation of amplitude a round AB followed by one of amplitude – a round AC is equivalent to a rotation of arbitrarily chosen amplitu.de round some other line AD. The self -conjugate subgroup then contains rotations of all possible amplitudes about all possible lines through A. In other words, it coincides with the group of rotations about A.

The totality of the motions which leave a given line unchanged forms a subgroup. It is constituted of all the twists which have the given line for axis, and of rotations through two right angles about all lines which meet the given line at right angles.

Similarly, the totality of motions which leave a given plane unaltered forms a subgroup. It is constituted of all translations parallel to the plane, all rotations about lines perpendicular to the plane, and rotations through two

right angles about all lines in the plane.

The totality of the motions which bring a given solid to congruence \itli itself again constitutes a subgroup of the group of motions. This will in general be the trivial subgroup formed of the identical operation above, but may in the case of a symmetrical body be more extensive. For a sphere or a right circular cylinder the subgroups are those that leave the centre and the axis respectively unaltered. For a solid bounded by plane faces the sub-group is clearly one of finite order. In particular, to each of the regular solids there corresponds such a group. That for the tetrahedron has 12 for its order; for the

cube (or octahedron) 24, and for the icosahedron (or dodecahedron) 60.

The determination of a particular operation of the group of motions involves six distinct measurements ; namely, four to give the axis of the twist, one for the magnitude of the translation along the axis, and one for

the magnitude of the rotation about it. Each of the six quantities involved may have any value whatever, and the group of motions is therefore a continuous group. On the other hand, a subgroup of the group of motions which leaves a line or a plane unaltered is a mixed group.

Continuous Groups.

We shall discuss separately continuous groups, discontinuous groups, and groups of finite order ; and, as they are in a sense the most general, we shall begin with the theory of continuous groups.

The determination of a particular operation of a given, continuous group depends on assigning special values to each one of a set of parameters which are capable of continuous variation. The first distinction regards ithe number of these parameters. If this number is finite, the group is called a finite continuous group ; if infinite, it is called an infinite continuous group. In the latter case arbitrary functions must appear in the equations defining the operations of the group when these are reduced to an analytical form. The theory of infinite continuous groups

has not hitherto received the same amount of attention, nor is it yet so completely developed as that of finite continuous groups. The latter theory will mainly occupy us here, and the former will not be entered upon in any detail. Sophus Lie, to whom the foundation and a great part of the development of the theory of continuous groups are due, undoubtedly approached the subject from a geometrical standpoint. His conception of an operation is to regard it as a geometrical transformation, by means of which each point of (ra-dimensional) space is changed into some other definite point.

The representation of such a transformation in analytical form involves a system of equations,

X g =-f8\Xj, X^,..., Xn),

(s = l, 2,..., ra),

expressing x^', x^,...,x'n, the co-ordinates of the transformed point in terms of x-^, x^,..., Xn, the co-ordinates of the original point. In these equations the functions fs are analytical functions of their arguments. Within a properly limited region they must be one- valued, and the

equations must admit a unique solution with respect to

iCj, x^,..., Xn', since the operation would not otherwise be

a definite one.

From this point of view the operations of a continuous

group, which depends on a set of r parameters, will be de-

fined analytically by a system of equations of the form

X s=j8\^ii X^j.-.j Xn J Clj, Ctg, ..., (Xr^, \^'}

(s = l, 2,. ..,«),

where aj, a^,.—, ar represent the parameters. If this opera-

tion be represented by A, and that in which 6j, b^,...,br

are the parameters by B, then the operation AB is repre-

sented by the elimination (assumed to be possible) of

x\, x'^..., x'n between the equations

(s=l, 2,...,H.),

and

(s = l,2,...,n).

Since AB belongs to the group, the result of the elimina-

tion must be

X g=fs(Xi, X^,..., Xn', Cj, Cj,..., Cx),

where c^, c^,..., c^ represent another definite set of values of

the parameters. Moreover, since A-^ belongs to the group,

the result of solving equations (i.) with respect to x-^,x^..., Xn

must be

“^s =Ja\X J, a; 2, . . ., ^ n ; <^i) <^2′ • • •) 'Ir),

(s= 1,2,. ..,»).

Conversely, if equations (i.) are such that these two con-

ditions are satisfied, they do in fact define a finite contiuuous

group.

It will be assumed that the r parameters which enter in

equations (i.) are independent, i.e., that it is impossible to

choose /(<»•) quantities in terms of which a-^, a^,..., Or can

be expressed. Where this is the case the group will be

spoken of as a ” group of order r.” Lie uses the term

“r-gleidriffe Grwppe.” It is to be noticed that the word

order is used in quite a different sense from that given to

it in connexion with groups of finite order.

As examples of systems of equations thus defining

continuous groups, the following simple instances may be

considered. First

x’ = a-^ + a^

where a^ and a^ are continuously varying parameters,

subject to the condition

a^ + 0.

This equation agrees in form with that already considered

in connexion with the arithmetical group, and does not

require further comment. Its geometrical signification as

defining a projective transformation of a straight line,

which leaves the point at infinity unaltered, will be obvious

to the reader. Secondly,

x’ = x cos fflj – y sin dj ₮ a^

y =x sin a.^ + y cos a-^ + a^,

where a^^, a^, a^ are the parameters.

That these equations actually satisfy the conditions may

be easily verified directly. Their geometrical meaning, as

representing in analytical form the most general ” motion”

in a plane, is again obvious. Thirdly,

, a’^x-a{x’ + y’’)

^ – (x-ay+y^ ‘

y ~{x-ay’+y’^’

where a is the single parameter. It will be found that the

result of combining two pairs of equations of this form, in which the parameters are a and 6, leads to a new pair of equations of the same form in which the parameter is a6/(a Ł h). Also that the result of solving the two given equations with respect to x and y leads agaii; to a pair of equations of the same form with – » for parameter. The equations therefore define a continuous group with a single parameter.

Eeturning now to equations (i.), which define the general operation of the group, it is to be noticed that, since the group contains the identical operation, these i„f,„nggj, equations must for some definite set of values 0,^1 opera- of the parameters reduce to tionsota

continuous

x\ = Wj, x\ = X^,...,x'n = Xn. group.

This set of values may, without loss of generality, be assumed to be simultaneous zero values. For if »j, i^,..., ir be the values of the parameters which give the identical operation, and if we write

at=is-Va-a, (s = l, 2,...,r),

then zero values of the new parameters Oj, a^, . . ., iv gi'^e the identical operation.

To infinitesimal values of the parameters, thus chosen, will correspond operations which cause an infinitesi-mal change in each of the variables. These are called

infinitesimal operations. The most general infinitesimal operation of the group is that given by the system

a/.

(s=l, 2,...,»),

3a,"

where, in ■—, zero values of the parameters are to be taken.

Since a^ a^,...,ar are independent, the ratios of Sctj, &a^, ..., Sa^ are arbitrary. Hence the most general infinitesimal operation of the group may be written in the form

^^' \ "da + **23a2 + • • • + ^'■da.r'**

(s= 1,2,. ..,»),

where e^, e^,---, e^ are arbitrary constants, and St is an infinitesimal.

If F (xj, a;,,..., Xn) is any function of the variables, and

if an infinitesimal operation of the group be carried out on

the variables in F, the resulting increment of F will be

8F s , 3F s ,, 3F s

When in this expression their values are written for Sx^,

Sx^,..., it becomes

g/§i3F 9^3F .f ^K\8t

/3AaF , 9Am:

+ e.

+1

+

+

2\3a2 3a5i B^a ^‘i

-+...+

?A. 3F

da.

3F\

3a!„/

Si

3/n 3F>

ef’SAOT 9^2 3F 3A.3F\

”” \3ar 3a!i Bffir 3×2 •••■!” gd,. 9a;„/

iSi.

If now the differential operator

,+^ —

be represented by

Xi,

(i=l, 2,...,r),

then the increment of F when an infinitesimal operation

of the group is carried out on the variables is given by

{e^X^ + e^J.$^{+...+er}$)¥ St.

When the equations (i.) defining the general operation of

the group are given, the co-efficients J^ which enter in

these differential operators are functions of the variables

which can be directly calculated.

The diflferential operator

e^Xj + 62X2 + . . • + Cj-Xr

may be regarded as defining the most general infinitesimal

operation of the group. In fact, if it be for a moment

represented by X, then (1 + 8

ing out the infinitesimal operation on F ; and by putting

ajj, x^,...,Xn in turn for F, the actual infinitesimal operation

is reproduced. By a very convenient, though perhaps

hardly justifiable, phraseology, this differential operator is

itself spoken of as the general infinitesimal operation of

the group. The sense in which this phraseology is to be

understood will be made clear by the foregoing explana-

tions.

We suppose now that the constants e^, Cgi •••>«)• i^^'^^

assigned values. Then the result of repeating the par-

ticular infinitesimal operation

fjXj Ł e^Xj ł . . . ł fij-Xj-

or X, an infinite number of times is some finite operation

of the group. The effect of this finite operation on F may

be directly calculated. In fact, if St is the infinitesimal

already introduced, then

d¥

Hence

= F-f-

It must, of course, be understood that in this analytical

representation of the effect of the finite operation on F, it is implied that ;; is taken sufficiently small to ensure the convergence of the (in general) infinite series.

When »!, x^,... are written in turn for F, the system of equations

x’s={l+tX + ^-^X.X+...)xs (ii.)

(s = l, 2,...,«.)

represent the finite operation completely. If t is here regarded as a parameter, this set of operations must in themselves constitute a group, since they arise by the repetition of a single infinitesimal operation. That this is really the case results immediately from noticing that the result of eliminating F’ between

F’ = F +

and

F” = F’1<'X. F-(-|^X. X. F't ...

is

r”=F-t-(<-K')^.F-i-^^^x.x.r-f…

The group thus generated by the repetition of an infinitesimal operation is called a cyclical group; so that a con-

tinuous group contains a cyclical subgroup corresponding to each of its infinitesimal operations.

The system of equations (ii.) represents an operation of the group whatever the constants e^, e^,-,.., Cr may be. Hence if e^, e^t,..., ert be replaced by a^, a^,..., equations (ii.) represent a set of operations, depending on r parameters and belonging to the group. They must, therefore, be a form of the general equations for any operation of the group, and are therefore equivalent to the equations (i.). The determination of the finite equations of a cyclical group, when the infinitesimal operation which generates it is given, will always depend on the integration of a set of simultaneous ordinary differential equations.

As a very simple example we may consider the case in which the infinitesimal operation is given by

3

‘X = X’

3x’

The relation

dt

= X

F, ^ = X.X.F,..

so that there is only a single variable,

between x’ and t is given by

dx’ ,2

dt ~^ ‘

with the condition that a;’ = x, when * = 0. This gives at

once

‘__ ^

which might also be obtained by the direct use of (ii.).

When the finite equations (i.) of a continuous group

of order r are known, it has now been seen that the

differential operator which defines the most

general infinitesimal operation of the group can Relations

be directly constructed, and that it contains **f ”**^*”

r arbitrary constants. This is equivalent to tinitelimai

saying that the group contains r linearly in- operations

dependent infinitesimal operations ; and that ”’ •■ ’’’”” «

the most general infinitesimal operation is “gnup”””’

obtained by combining these linearly with

constant coefficients. Moreover, when any r independent infinitesimal operations of the group are known, it has been seen how the general finite operation of the group may be calculated. This obviously suggests that it must

be possible to define the group by means of its infinitesimal operations alone ; and it is clear that such a definition would lend itself more readily to some applications (for instance, to the theory of differential equations) than the definition by means of the finite equations.

On the other hand, r arbitrarily given linear diflferential operators will not, in general, give rise to a finite continuous group of order r; and the question arises as to what conditions such a set of operators must satisfy in order that they may, in fact, be the independent infinitesimal operations of such a group. A system of necessary relations between the infinitesimal operations may be directly deduced from the point of view already taken.

Let X and Y be two infinitesimal operations of a finite

group, and let Xf, Yj,, be finite operations which result

from repeating X and Y an infinite number of times.

Then it has already been seen that

and

H-«X + j^X.X+...

l + <'Y + gY.Y+...

are the differential operators which give the effect of Xe

and Yf on any function of the variables. The differential

operator for XtYt,X tY ei will now be calculated. That

for XtY«, is

(l4-!!‘Y-h^Y.Y-H...)(l-h!;X-Hj^X.X+...)

= l + iX-f-!!‘Y-f-^X.X4-«‘Y.X-hgY.Y-K...

where the unwritten terms are of the 3rd order in t and «’

combined. Similarly that for X (Y «’ is

l-i!X-rY4-j^X.X + «T.X-H^Y.Y-l-...

Hence the differential operator which gives the effect of

X(Y(,X (Y «, is l-«’(X.Y-Y.X)-|-terms of the 3rd

order in t and i. If t and i are here regarded as

infinitesimals of the order \, the unwritten terms vanish

in comparison with that written, and therefore

l-Sr;(X.Y-Y.X)

must give the effect of an infinitesimal operation of the group on any function of the variables. In other words,

X.Y-Y.X

is an infinitesimal operation of the group. That X . Y – Y . X is a linear differential operator is evident when for X and Y their actual values are written. This operator is represented by (XY), and is called the comhinant of X and Y. Lie uses the expression Klammerausdruck. The result thus arrived at may be expressed in words by saying that among the infinitesimal operations of any finite continuous group must be included the combinant of every pair of infinitesimal operations.

Let

Aj, Xj,..., Kr

be a set of independent infinitesimal operations of a continuous group of order r, so that every infinitesimal operation can be represented by combining them linearly with constant coefiicients. Then the above conditions will be expressed by the system of equations

(XjXj) — ^CijsKi,

(iii.)

(j-,/=l, 2,..., r).

In these equations Cyg are constants, among which certain relations hold. In fact, if Xi, X^, Xj are any three linear operators, the identity (known as Jacobi's)

(Xi-(X,Xi)) + (X,(XftXi)) + {XtiXiXj)) = 0

holds among them; while from the definition of the combinant

(XiX,-) + (X^Xi) = 0.

When the values of the combinants are substituted from (iii.) in these relations, it is found that the c's are subject to the relations

and

Cijt + Cjit = 0

^-{ejkifiiBt + Ckiifijgt + CijsCjcst) = 0 I

(iv.)

for all values of i, j, k, and t.

The fundamental theorem of the theory of finite continuous groups is now that these conditions, which have

been shown to be necessary in order that Xj, Xg,..., X,

may generate, as infinitesimal operations, a continuous

group of order r, are also suflacient.

For the general proof of this fundamental theorem the

reader must be referred to Lie's works (cf. Lie-Engel, i.

chap. 9 ; iii. chap. 25 : see Bibliography at the end of

this article), as it would take up more room than can be

spared in this necessarily brief account of group-theory.

The general lines on which the proof runs, and the

essential geometrical ideas which underlie it, can, however,

be made clear to the reader by considering the particular

case ji = 1 and r = 2.

Let

Xi=/i(^)^

and

X2=/2(^)i

be two infinitesimal operations in a single variable. Then if

X = a^X^ + a^X^,

x' = {l+X + ~X.X+...)x

is a set of transformations with two parameters, or a set

of 00^ transformations of the variable x. This set contains the identical transformation corresponding to dj = a, = 0. If T and T' are any two transformations of the set, then the condition that the set shall constitute a group is that TT' shall belong to the set. Now when TT' is actually formed it will in general depend on more than two para^-meters. If, however, the set TT' depends only on two independent parameters, it must coincide with the set T, since for T' the identical transformation may be chosen. Hence the sufficient condition that the set of transformations

x' = {l + X+^X.X+...)x…{a)

should be a group is that the operation, which results from carrying out in succession any two operations of the set, should contain only two independent parameters.

The set of transformations (a) may be regarded geometri-cally as effecting a transformation of the points of a straight line. An arbitrarily chosen point of the line will be changed successively by the operations of the set into ooi new positions. A pair of arbitrarily chosen points mu?t, however, be changed into co^ new positions by the

operations of the set. For if every operation of the set which brings A to a definite new position A' at the same time brings a second arbitrarily chosen point B to a definite new position B', the totality of points on the line only takes up ooi new positions, and the set could only contain a>i distinct transformations. A fortiori three or more arbitrarily chosen points on the line are changed into oo^ new positions by the set of transformations.

Let now x, y, z be the symbols defining a set of three arbitrarily chosen points on the line. These three symbols may also be regarded as the co-ordinates of a point P in three-dimensional space. Hence under the set of transf ormar

tions the point P takes up go^ new positions in space ; in other words, P is displaced on a certain surface. This surface may either be changed into itself by every transformation of the set TT', or it may be changed into 0=1 or into cd2 new surfaces. In the two latter cases the point P will be changed into coS new positions by the transforma-

tions of the set TT'. Hence the set of transformations

TT' win contain just two independent parameters if, and

only if, each of a singly-infinite set of surfaces is changed

into itself by every operation of the set T. Now the

infinitesimal operations of the set, when regarded as

affecting the set of three symbols x, y, z, are

Xj-hYj-l-Zi, orUi;

/2(/2(2')g^/2('

X„-fY„-fZ„ orUo.

or

and

or

Let

where C is an arbitrary constant, be the set of surfaces,

each of which is changed into itself by every operation of

the set, then F must be a common solution of the two

linear partial differential equations

Conversely, by tracing the argument backwards, it follows

that if these differential equations have a common solu-

tion, then the set of operations forms a group.

Now the well-known condition that these equations

should have a common solution is that functions a, /3, of

X, y, z should exist such that

But, by direct calculation

(UiU,) = (X,X,) + (YiY,) + (Z^Z,),

■where (XjXj), (Y^Yj), (ZjZg) contain respectively only

differentiations with respect to », y, and z.

Hence

(X,X,) = aXi + /3X2,

(YiY,) = aY,-f^Y2,

(ZiZ2) = aZi+^Z2.

From the first of these equations it follows that a and /3

do not depend on y or z, and from the second that they

do not depend on z or x. Hence they are constants.

Finally, then, the sufficient condition that X-j and X^

should generate a continuous group of order two is that it

may be possible to find constants a and ^, such that

(X,X2) = aXj+/3X2.

In the more elaborate proof of the general theorem, a

set of (?”+ 1) points in space of n dimensions and a single

point in space of (r-)-l)n. dimensions replace the set of

three points on a line and the one point in three-dimensional

space here considered.

If two continuous groups of order r are such that,

for each, a set of linearly independent infiinitesimal opera-

tions

Xj, X.,,...,Xr,

and

Y Y

Y

Determina'

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distinct

types of

continuous can be ciosen, so that in the relations

groups at a . .

given ^^'A?/ ~ ■^'^ijs-^st

'"■''''■• and

(iii.)

(X i Y j^ — ^Clijs Y a,

the constants ctjs and dyg are the same for all values of

i, J, and s, the two groups are simply isomorpHc, Xg

and Yj being corresponding infinitesimal operations. This

foUovra from noticing that the two groups have neces-

sarily corresponding systems of subgroups. In fact, the

problem of determining all the subgroups of the con-

tinuous group generated by

Xi, Xj, ..., Xr

is clearly the same as that of finding all systems of « (

infinitesimal operations

X j^ = OjjXj + ^12X3 + • • • + fi^irXj-,

X 2 = 21 1 “ *^22 2 + ■ • • “^” 2^’

X g ^ dg-^JL-^ + Cis2^2 “1″ • • ■ ^” ^srX-rs

such that each combinant (X’jX’j), (i,j=l, 2…, s) can be

expressed linearly in terms of X.\, X’g…, X’^. Correspond-

ing to each solution of this problem for the X’s there is

clearly one with the same set of constants for the Y’s.

Two continuous groups of order r, whose infinitesimal

operations obey the same system of equations (iii.), may

be of very different form ; for instance, the .number of

variables for the one may be different from that for the other. They are, however, said to be of the same type, in the sense that the laws according to which their operations combine are the same for both.

The problem of determining all distinct types of groups of order r is then contained in the purely algebraical problem of finding all the systems of r^ quantities c^, which satisfy the relations

2(cysCsj;(Ł CjtsCjjt -F cusC^t) = 0,

for all values of i, j, h, and t. To two distinct solutions of the algebraical problem, however, two distinct types of group will not necessarily correspond. In fact,

Xj, Xj,..., Xr

may be replaced by any r independent linear functions of themselves, and the c's will then be transformed by a linear substitution containing r^ independent parameters. This, however, does not alter the type of group considered

For a single parameter there is, of course, only one type of group, which has been called cyclical..

For a group of order two there is a single relation

(X,X.) = aX, + /3X2.

If u, and ^ are not both zero, let a be finite. The

relation may then be written

Hence if

then

(aXi + ^X2,iX,) = aX,-(-j8X2.

aXi + /3X2 = X'i,

-X, = X',«

(X',x'2)=xv

There are, therefore, just two types of group of order

two, the one given by the relation last written, and the

other by

(X,X2) = 0.

Lie has determined all distinct types of continuous

groups of orders three or four; and all types of non-

integrable groups (a term which will be explained im-

mediately) of orders five and six (cf. Lie-Engel, iii nn

713-744). 6 , • J:!-.

A problem of fundamental importance in connexion

simple

groups.

“with any given continuous group is the determination of

Self-con- *^® self-conjugate subgroups which it contains.

jugate sub- Closely related to this is the determination of

groups. all distinct types of simple groups. We shall

proceed to deal shortly with the first of these

two questions, and to state the results which

have been arrived at with respect to the second.

If A is a given operation of the group, and B any other

operation, the operations B~^AB have been defined as

those which are conjugate to A. The actual form of the

infinitesimal operations which are conjugate to a given

one may be determined thus.

Let X be the differential operator defining an infinitesi-

mal operation A, and let Y be any infinitesimal opera-

tion. If B is the result of repeating Y an infinite number

of times, the differential operator which gives the effect

of B~iAB on any function of the variables is

(1-

t'Y + Ay2. . .) (1 + StX) (1 + t'Y + ^Y2 + .

•)•

On actual calculation this is found to be

1 + 8t[X + t'(XY) + o((XY)Y) + ^-5-3(((XY)Y)Y) +...],

and therefore the general form of the set of infinitesimal

operations which are conjugate to X is

X + t'QLY) + ,2((XY)Y) + J1^(((XY)Y)Y) + . . .

Hence (XY) = 0 is the sufficient condition that B may

be permutable with A ; and when this condition is satisfied

every operation of the cyclical group generated by Y is

permutable vnth every operation of that generated by X.

Now a self-conjugate subgroup which contains X must

contain all the operations conjugate to X, and therefore it

must contain (XY), where Y is any infinitesimal operation

of the group. Hence if X'j, X'j, ..., X'j are s linearly in-

dependent operations of the group which generate a self-

conjugate subgroup of order s, then for every infinitesimal

operation Y of the group relations of the form

(X’jY) = 2 a^X’e

(* = 1, 2,...,^)

must be satisfied. Conversely, if such a set of relations is satisfied, X’j, X’^..., X’« generate a subgroup of order s, which contains every operation conjugate to each of the infinitesimal generating operations, and is therefore a self- conjugate subgroup. A specially important self-conjugate subgroup is that generated by the combinants of the r infinitesimal generating operations. That these generate a self – conjugate subgroup follows from the relations (iii.). In fact,

((XtXj)Xj;) = 2 cijs (XgXi).

s

Of the •|r(r-l) combinants not more than r can be linearly independent. When exactly r of them are linearly independent, the self -conjugate group generated by them coincides with the original group. If the number that are linearly independent is less than r, the self-conjugate subgroup generated by them is actually a subgroup ; i.e., its order is less than that of the original

group. This subgroup is known as the derived group,

and Lie has called a group perfect when it coincides with

its derived group. A simple group, since it contains no

self -conjugate subgroup distinct from itself, is necessarily

a perfect group.

If G is a given continuous group, Gj the derived group

of G, Gj that of Gj, and so on, the series of groups

G, Gj, Gg,...

will terminate either with the identical operation or with

a perfect group ; for the order of Gg+j is less than that

of Gg unless Gg is a perfect group. When the series

terminates vnth the identical operation, G is said to be

an integrable group ; in the contrary case G is called non-

integrable.

If G is an integrable group of order r, the infinitesimal

operations

which generate the group may be chosen so that

Xj, Xj,..., Xr^ (»-i<»")

generate the first derived group,

Xi, X2,..., X^2, (*‘2’=‘“l)

the second derived group, and so on. When they are so

chosen the constants c^g are clearly such that if

then Cijs vanishes unless

In particular the generating operations may be chosen

so that Cijg vanishes unless s is equal to or less than the

smaller of the two numbers i, j ; and conversely, if the c's

satisfy these relations, the group is integrable.

The derived group is not the only self-conjugate sub-

group of a given continuous group whose definition is

independent of the particular type.

If n,. = y.r

a* =

'-'Ckss

the infinitesimal operations

tJjXj + CjXj -f . .. ŧ e^Xr,

where

a^fi]^ Ł a^e^ + ... + a-rSr = 0

generate a self-conjugate subgroup (Lie-Engel, iii. p. 692).

If the a's are not all identically zero, the set of infinitesimal

operations contains r – 1 that are linearly independent, and

therefore r — 1 is the order of the subgroup. If, however, the a's all vanish, there is no relation among the e's, and the subgroup coincides with the original group.

In illustration of the present section, non-integrable groups of order three may be considered. It has been seen that all groups of order two are integrable, and therefore a group of order three must be either integrable or simple. If Xj, X^, Xg arfe the infinitesimal operations,

(Xi, AXj + /iXj) = (Aci21 + /^«13l)Xl + (■^Cl22 + I^IZ2)^2

Hence if

/i(A.Ci22 + A'Ci32) = ^(''^Cl23 + P^lSsX

then Xj and XXj-f/iXg generate a group of order two. New generators may therefore be taken such that

(YjYg) = aYj, where a is 0 or L

If a were zero the order 'of the derived group could not exceed two, as it must if the group is simple.

Now if (YjY2) = Yi,

the identity

((Y,Y,)Y3) + ((Y2Y3)Y,) + ((Y3Y,)Y,) = 0

gives

(Cl31 + «232) Yi + (C233 – l)(YlY3) + Ci33(Y2Y3) = 0.

Hence if

= 0,

then

Now

, = 0.

(Y2 + xY^, mYj ~ vY^ + wYj)

= (XV-U + WC^^^ + fl!M'Ci3i)Yi + W{C2^^ + XC^^^Y^

+ «'(«233 + ^=133)Yr-

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Hence if

then

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^^233 "^ ■'^'^ISS ~ ■■■>

(Y2 + xY^, uY^ + vY^ + wY^ = mYi + vY^ + wY^ ;

and, from the relations obtained above, the equations for

X and for the ratios of «, v, zv are always capable of finite

solution.

If then

Yj = Zi, Y2 + xY^ = Z2, mYj + vY^ + wYg = Z3,

we have

(Z^Z2)=Zj, (Z2Zg) = Z3.

Jacobi's identity then gives

((Z,Z3)Z2) = 0,

or

(ZiZ3) = aZ2.

Moreover, on replacing Zj and Z3 by arbitrary multiples of themselves, a may be made any constant except zero. There is therefore a single type of simple continuous group of order three, and it is defined by

(^1^2) = ^1′ (^2^3) = ^3′ (^1^3) = "^2′

where a is any constant other than zero.

A particular form of the group is given by

X =a;2— .

In regard to the enumeration and classification of simple continuous groups, it is impossible here to do more than to give the results that have been arrived at. It is very remarkable that this enumeration has been completely carried out, for in the case of groups of finite order such

is far from being the case. Lie himself has demonstrated the existence of four great classes of simple groups. These are : —

(i.) The groups simply isomorphic with the general projective group in space of n dimensions. Such a group is defined analytically as the totality of the transformations of the form

(a„ a! + g„ ^^ + . . . + g„ „Xn ≺ “■

. (s=l, 2,..., w),

where the a’s are parameters. The order of this group is clearly n{n + 2).

(ii.) The groups simply isomorphic with the totality of the projective transformations which transform a non-special linear complex in space of 2?i – 1 dimensions with itself. The order of this group is re(2re +1).

(iii.) and (iv.) The groups simply isomorphic with the totality of the projective transformations which change a quadric of non-vanishing discriminant into itself. It is found that these fall into two distinct classes of types according as n is even or odd. In either case the order is

|re(n.+ l). The case » = 3 forms an exception in which the corresponding group is not simple. It is also to be noticed that a cyclical group is a simple group, since it has no continuous self -conjugate subgroup distinct from itself.

‘ Killing and Cartan have separately proved the very remarkable fact that outside these four great classes there exist only five distinct types of simple groups, whose orders are 14, 52, 78, 133, and 248; thus completing the enumeration of all possible types.

To prevent any misapprehension as to the bearing of these very general results, it is well to point out explicitly that there are no limitations on the parameters of a continuous group as it has been defined above. They are to be regarded as taking in general complex values. If in the finite equations of a continuous group the imaginary symbol does not explicitly occur, the finite equations will usually define a group (in the general sense of the original definition) when both parameters and variables are limited to real values. Such a group is, in a certain sense, a con-

tinuous group; and such groups have been considered shortly by Lie (of. Lie-Engel, iii. pp. 360-392), who calls them real continuous groups. To these real continuous groups the above statement as to the totality of simple groups does not apply ; and indeed, in all probability, the number of types of real simple continuous groups admits of no such complete enumeration. The efifect of limitation to real transformations may be illustrated by considering the groups of projective transformations which change

a;2 + y2 + 22 1 = 0

and

respectively into themselves. Since one of these quadrics is changed into the other by the imaginary transformation

x' = x, y' = y, z' = zj^,

the general continuous groups which transform the two quadrics respectively into themselves are simply iso-morphic. This is not, however, the case for the real con-tinuous groups. In fact, the second quadric has two real sets of generators ; and therefore the real group which transforms it into itself has two self-conjugate subgroups,

either of which leaves unchanged each of one set of generators. The first quadric having imaginary generators, no such self -conjugate subgroups can exist for the real group which transforms it into itself ; and this real group is in fact simple.

Among the groups isomorphic with a given continuous group there is one of special importance which is known as the adjunct group. This is a homogeneous linear group in a number of variables equal to the order of the group, whose infinitesimal operations are defined by the relations

■V- V 9

0 = 1, 2,..., r),

where cijs are the often-used constants, which give the combinants of the infinitesimal operations in terms of the infinitesimal operations themselves.

That the r infinitesimal operations thus defined actually generate a group isomorphic with the given group is most readily verified by forming their combinants. “VVe have

The

adjunct

group.

= 2 (cipsCsqt + CqisCspt)xi^-

i, I, s

But the c's are subject to the relation

-(CyjsCsjt + CqisCgpt + CpqsCgn) = 0

for all suffixes /, p, q, and t.

Hence

(\p\q) — ^ CpqsCistXi^t

i, t,s

9

^pqS'

As)

and therefore the r infinitesimal operations actually gener-

ate a group isomorphic with the given group. The X's

however, are not necessarily linearly independent. In

fact, the sufficient condition that

should be identically zero is that

3

should vanish for all values of i and s.

equations

2jajCijg ^ U

Hence if the

for all values of i and s, have / linearly independent

solutions, only r — r' of the X's are linearly independent,

and the isomorphism of the two groups is multiple. If

are the infinitesimal operations of the given group, the

equations

'Zafijs = 0, {s, i=l, 2,.^.,r)

J

express the condition that the operations of the cyclical

group generated by

2ajY,-

J

should be permutable with every operation of the group ;

in other words, that they should be self-conjugate opera-

tions. , In the case supposed, therefore, the given group

contains a subgroup cif order r' each of whose operations

is self-conjugate. The adjunct group of a given group will, therefore, be simply isomorphic with the group, unless the latter contains self -conjugate operations ; and when this is the case the order of the adjunct will be less than that of the given group by the order of the subgroup formed of the self-conjugate operations.

We have been thus far mainly concerned with the Continu- 8’bstract theory of continuous groups, in which ous groups no distinction is made between two simply iso- ot the line morphic groups. It is now time to give some “/ ‘** d account of what has been accomplished in the ot three- classification and theory of groups when their dimen- form is regarded as essential; and this is a sionai return to a more geometrical point of view. space. j^ jg natural to begin with the projective groups, which are the simplest in form and at the same time are of supreme importance in geometry. The general projective group of the straight line is the group of order three given by

/ ax + h

X = r.

cx + l

This group is triply-transitive as regards the points of the line. In fact, if x-^, x^, x^ are the co-ordinates of three points en the line

-jg’.g x’ – x\

is an equation of the above form which changes Xj, iCj, x^

If a; J = ajj and x’^ = «2, the last written transformation is of the form

-. — 5 = a — ^,

and when a is regarded as a parameter, the totality of transformations of this form, x-^ and ajj being given distinct points, forms a cyclical group. The totality of the trans-formations which keep two distinct points fixed constitutes therefore a cyclical subgroup. When the fixed points are 0 and 00, the form of this subgroup is

x’ = ax,

and all such subgroups are clearly conjugate within the general group.

When X2 is infinite and x^ an arbitrarily assigned point,

the form of the subgroup is

x’ = ax + (l -a)xj^;

and if here x-^ approaches 00, and b is written for the

limit of (1 – a)xj^, so that a must approach unity, the

limiting form is

x’ = x+b.

The totality of the transformations which keep two coinci-

dent points fixed forms, therefore, again a cyclical subgroup,

which, when the fixed double point is at infinity, has the

last given form. All such subgroups again are conjugate.

If in

Xz-X^X -X^ X^-XyX-X^

= 00

the transformation has the form

x’ = ax + b,

and transformations of this form, where a and b are

parameters, constitute a group of order two. Hence the

totality of the transformations, which keep a single point

fixed, constitutes a subgroup of order two ; such subgroups

form a single conjugate set ; and when the fixed point is

at infinity the subgroup has the last written form.

A group of order two is not simple, and therefore every subgroup of order two of the general projective group of the straight line must contain a cyclical group as a self-conjugate subgroup. Every subgroup of order two must therefore keep at least one point fixed, namely, the fixed point of its self -conjugate cyclical subgroup. Hence the subgroups above determined exhaust all the subgroups of the projective group of the line.

The analysis of the general projective group must obviously increase very rapidly in complexity, as the dimensions of the space to which it applies increase. This analysis has been completely carried out for the projective group of the plane, with the result of showing that there are thirty distinct types of subgroup. Excluding the general groap itself, every one of these leaves either a point, a line, or a conic section unaltered. For space of three dimensions Lie has also carried out a similar investigation, but the results are extremely complicated. One general result of great importance at which Lie arrives in

this connexion is that every projective group in space of three dimensions, other than the general group, leaves either a point, a curve, a surface, or a linear complex unaltered;

For space of more than three dimensions, it is only certain special types of projective groups which have been hitherto investigated. For instance, Lie has determined those projective groups in n variables whose degree of transitivity is as great as possible.

Returning now to the case of a single variable, it can be shown that any finite continuous group in one variable is either cyclical or of order two or three, and that by a suitable transformation any such group may be changed into a projective group.

The genesis of an infinite as distinguished from a finite continuous group may be well illustrated by considering it in the case of a single variable. The infinitesimal operations of the projective group in one variable are

d .

1) X-y-, X'

dx dx

dx

If these combined with

8 ^

dx

be taken as infinitesimal operations from which to generate

a continuous group among the infinitesimal operations of

the group, there must occur the combinant of x^j- and

Q d

dx

S. V. — 17

This is oc^-r- The combinant of this and x”^^ is

dx dx

130

2^S

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, and so on. Hence x’^-j-i ■where r is any positive

integer, is an infinitesimal operation of the group. The

general infinitesimal operation of the group is therefore

f{oc)-r- where f(x) is an arbitrary integral function of x.

In the classification of the groups, projective or non-projective, of two or more variables, the distinction between primitive and imprimitive groups immediately presents itself. For groups of the plane the question that then arises is the following. Is there or is there not a singly-infinite family of curves

where C is an arbitrary constant such that every operation of the group interchanges the curves of the family among themselves? In accordance with the previously given definition of imprimitivity, the group is called imprimitive or primitive according as such a set exists or not. In space of three dimensions there are two possibilities ; namely, there may either be a singly infinite system of surfaces

V{x,y,z) = G

which are interchanged among themselves by the operations of the group ; or there may be a doubly-infinite system of curves

G<{x, y, z) = a, H(a;, y, z) = h,

which are so interchanged.

In regard to primitive groups Lie has shown that any primitive group of the plane can, by a suitably chosen transformation, be transformed into one of three definite types of projective groups ; and that any primitive group of space of three dimensions can be transformed into one of eight definite types, which, however, cannot all be represented as projective groups in three dimensions.

The results which haive been arrived at for imprimitive groups in two and three variables do not admit of any such simple statement ; but in this case, again, the classification is complete in the sense that all possible types are divided into a number of classes, while methods are given which enable the complete determination of the groups belonging to a given class to be carried out.

No account of the theory of continuous groups would be complete without some reference, however short, to the conception of contact-transformations and

Contact- groups of contact-transformations. This concep-

ations”” ’ ^^°’‘ ■’‘^® ‘-^^ °^ continuous groups, owes its

origin to the genius of Sophus Lie.

From a purely analytical point of view a contact^trans-

formation may be defined as a point- transformation in

2w + 1 variables, z, x^, x.,,..., Xn, p^, p^,.-, pn which leaves

unaltered the equation

d9 – p-^dx-^ —p^dx^ — ... —pndxn = 0.

Such a definition as this, however, gives no direct clue to

the geometrical properties of the transformation, nor does

it explain the name given.

In dealing with contact-transformations we shall restrict

ourselves to space of two or of three dimensions ; and it

will be necessary to begin with some purely geometrical

considerations. An infinitesimal surface-element in space

of three dimensions is completely specified, apart from its

size, by its position and orientation. If x, y, z are the

co-ordinates of some one point of the element, and if

p, q, -I give the ratios of the direction-cosines of its

normal, x, y, z, p, q are five quantities which completely

specify the element. There are, therefore, oo^ surface elements in three-dimensional space. The surface-elements of a surface form a system of oo^ elements, for there are co^ points on the surface, and at each a definite surface-element. The surface-elements of a curve form, again, a system of oo^ elements, for there are ooi points on the curve, and at each ooi surface-elements containing the tangent to the curve at the point. Similarly the surface-elements which contain a given point clearly form a system of 00^ elements. Now each of these systems of co^ surface-elements has the property that if (x, y, z, p, q) and (.r + dx, y + cly, z + dz, p + dp, q + dq) are consecutive elements from any one of them, then

dz – pdx — qdy = 0.

In fact, for a system of the first kind dx, dy, dz are proportional to the direction-cosines of a tangent line at a point of the surface, and p, q, – 1 are proportional to the direction -cosines of the normal. For a system^ of the second kind dx, dy, dz are proportional to the direction-cosines of a tangent to the curve, and p, q, -I give the

direction- cosines of the normal to a plane touching the curve ; and for a system of the third kind dx, dy, dz are zero. Now the most general way in which a system of oo^ surface-elements can be given is by three independent equations between x, y, z, p and q. If these equations do not contain p, q, they determine one or more (a finite number in any case) points in space, and the system of surface-elements consists of the elements containing these points ; i.e., it consists of one or more systems of the third kind.

If the equations are such that two distinct equations independent of p and q can be derived from them, the points of the system of surface-elements lie on a curva

For such a system the equation

dz —pdx — qdy = 0

will hold for each two consecutive elements only when the plane of each element touches the curve at its own point.

If the equations are such that only one equation independent of p and q can be derived from them, the points of the system of surface-elements lie on a surface.

Again, for such a system the equation

dz —pdx — qdy = 0

will hold for each two consecutive elements only when each element touches the surface at its own point. Hence, when all possible systems of oo^ surface-elements in space are considered, the equation

dz —pdx — qdy = 0,

is characteristic of the three special types in which the elements belong, in the sense explained above, to either a point, a curve, or a surface.

Let us consider now the geometrical bearing of any transformation

a;'=/i(a'> y, 2> p, q),—; 2'=M^, y, -% p, q),

of the five variables. It will interchange the surface-elements of space among themselves, and will change any system of oo^ elements into another system of oo^ elements. A special system, i.e., a system which belongs to a point, curve, or surface, will not, however, in general be changed into another special system. The necessary and sufficient condition that a special system should always be changed

into a special system is that the equation

dz -pdx’ – q’dy — 0

should be a consequence of the equation

dz —pdx — qdy — 0 ;

or, in other words, that this latter equation should be

invariant for the transformation.’

When this condition is satisfied the transformation is

such as to change the surface -elements of a surface

in general into surface-elements of a surface, though in

particular cases they may become the surface-elements of

a curve or point ; and similar statements may be made

with respect to a curve or point. The transformation is >

therefore a veritable geometrical transformation in space

of three dimensions. Moreover, two special systems of

surface-elements which have an element in common are

transformed into two new special systems with an

element in common. Hence two curves or surfaces which

touch each other are transformed into two new curves or

surfaces which touch each other. It is this property which leads to the transformations in question being called contact-transformations. It will be noticed that an ordinary point-transformation is always a contact-transformation, but that a contact-transformation (in space of n dimensions) is not in general a point- transformation (in space of n dimensions), though it may always be regarded as a point-transformation in space of 2»n- 1 dimensions. In the analogous theory for space of two dimensions a line-element, defined by {x, y, p), where 1 :p gives the direction-cosines of the line, takes the place of the surface-element ; and a transformation of x, y, and p which leaves the equation

dy —pdic = 0

unchanged transforms the ooi line-elements, which belong to a curve, into ooi line-elements which again belong to a curve ; while two curves which touch are transformed into two other curves which touch.

One of the simplest instances of a contact-transformation that can be given is the transformation by reciprocal polars.

By this transformation a point P and a plane p passing through it are changed into a plane p’ and a point P’ upon it ; i.e., the surface -element defined by P, p is changed into a definite surface-element defined by P’, p’. The totality of surface-elements which belong to a (non-developable) surface is known from geometrical considerations to be changed into the totality which belongs to another (non-developable) surface. On the other hand, the totality of the surface-elements which belong to a curve is changed into another set which belong to a developable. The analytical formulae for this transformation, when the reciprocation is effected with respect to the paraboloid

x^ + y^ -2z = 0, are

’’’=P, y = ?j z’=px + qy-z,p’ = x, q’ = y.

That this is, in fact, a contact-transformation is verified directly by noticing that

dz —p’dx’ — qdy’ = — d(z — px — qy) — xdp — ydq

= — {dz -pdx — qdy).

A second simple example is that in which every surface-element is displaced, without change of orientation, normal

to itself through a constant distance t. The analytical

equations in this case are easily found in the form

X =x +

\/l + p’’ + q^

y =y +

Vn-p^-t-j’-’’

>J\+f+q^’

p=p, q= q.

That this is a contact-transformation is seen geometrically

by noticing that it changes a surface into a parallel surface.

Every point is changed by it into a sphere of radius *.

Also from the analytical form of the transformation, it

follows at once that

dz’ —p’dx’ — ^dy = dz —pdx — qdy.

The symbol of a general infinitesimal operation in the five

variables x, y, z, p, q is

where ^, t}, f, it, k, are functions of the variables.

The increment of

dz- pdx -qdy

given by this infinitesimal operation is

{d^~ -irdx -pid^ – xdy — qdrj)ht.

Hence the necessary and sufficient condition that the

transformation should be a contact – transformation in

space (x, y, z) is

d^—irdx —pd^ – Kdy — qdrj = a(dz -pdx – qdy),

where o- is some function of x, q, z, q, q.

This equation is equivalent to

ri

’’-pi-m)= -f,

Hence if

9m 3w

~ dy ^dz

■^{C-pi-m)=-v-

t 9w 9w 9w 9u

t 9w 9w

where the function (o is quite arbitrary. If w is zero the

transformation is the identical transformation, but for

any value of w other than zero an actual transformation

distinct from identity arises. Every infinitesimal contact-

transformation is thus completely defined by a function (o

of the variables, which is called its characteristic function.

It will be noticed that ^, ij and f are independent of p

and q if, and only if,

cases only is the transformation an ordinary point-trans-

formation.

is an infinitesimal point-transformation in three-dimensional

space, so that £, 77, f are functions of x, y, z only, the

characteristic function for the transformation regarded as

a contact-transformation is

pi+m-i-

EL6I1C6

9f /3f 9A Si; 9i7 oSI

and these expressions give the infinitesimal changes that

arise in p and q from the point-transformation. As a

transformation of the five variables the point-transforma-

tion may be written

.9 9 .9 , 9^ 9

^ + ‘‘9^ + %+’’+”‘

and this is called the extended point-transformation.

Since a contacWransformation in space of n dimensions

may be regarded as a point -transformation in space of 2n+l dimensions, which leaves invariant the equation

dz -pdx, – ... -pndxn = 0,

two contact-transformations carried out in succession give rise to another contact – transformation. Hence arises naturally the conception of a group of contact-transformations. Thus the totality of the transformations that arise on repeating an infinitesimal contact-transformation constitutes a (continuous) cyclical group. For example, if the characteristic function of the infinitesimal transformation is J\ +p^ + q^, the finite equations of the resulting cyclical group are

X =x +

\+p + q-

TsV =y+-

qt

^1+f + f

p’=p>

where t is the arbitrary parameter.

The formal theory of continuous groups of contact-transformations is, of course, in no way distinct from the formal theory of continuous groups in general. On what may be called the geometrical side, the theory of groups of contact-transformations has been developed with very considerable detail in the second volume of Lie-Engel ; and to this work the reader may be referred. As an example of the way in which a continuous group may be defined by a system of differential equations we will conclude the present section by the determination of those contact-transformations in the plane for which the equation

d3?’

= 0

is invariant. Let

be an infinitesimal contact-transformation, and let kt and /3T, where t is infinitesimal, be the increments of t^ and ^, or of q and r. Then

q + KfT =

or

K = 0)^ H- ojyp + la^q – ^^q – ^^q – f ,2,

where the suffixes denote partial differentiation.

dig + kt)

So

and

r + pT =

d{x + ^y

P = K^+Kyp + Kpq + KqV – $a:r – ^yVp – ^pVq.

If the equation

r = 0

is to be invariant for the given infinitesimal transforma-

tion, then p = 0 must be a consequence of r = 0. Hence

•ix+l^yP + K-p1=^-

In this equation the coefficient of each power of q must

vanish. Hence

f pp = 0, (Uaa; + ^P^xy + P'^^yy = 0,

lOy + ^uixp + 2pwyp – ^xx – ^Pixy -P^yy = 0,

iy + '^pp 2£a;p – '^P^yp = 0.

If W is the characteristic function of the infinitesimal

transformation, then

and when expressed in terms of W the four equations

become

„ =0. (|h-4)v=o,

(l-4)l(l^4)^-«-

From the first and third of these equations it immediately

follows that

yf=hp’,±p{,-r^)+f{^,y),

where X^ and Xg are functions of x only. The fourth

equation then gives

and the second equation leads to

di?

= 0,

dK?

= 0,

da?

= 0,

dX, . d’Xn

dx

dx^

= 0.

Hence W contains ten arbitrary constants, and in fact it is found on completing the calculation that W is an arbitrary integral function of the second degree of x, p, and y – \px.

The most general infinitesimal contact-transformation, for which the equation r = 0 is invariant, therefore contains 10 arbitrary constants; and the totality of such operations constitutes a continuous group of order 10. It should be noticed that that part of w which does not contain p^ has 7 arbitrary constants, so that the greatest group of point-transformations in the plane for which r- = 0 is invariant has 7 for its order.

To the manifold applications of the theory of continuous groups in various branches of pure and applied mathematics it is impossible here to refer in ^^p^,.^^. any detail. It must suffice to indicate a few fi„„g „/ of them very briefly. In some of the older theory of theories a new point of view is obtained which ”’”"""" presents the results in a fresh light, and suggests “““P- the natural generalization. As an example, the theory of

the invariants of a binary form may be considered.

If in the form

/= a^x'^ + na^x'^-'y + ...+ any',

the variables be subjected to a homogeneous substitution

d = ax + ^y, y' = yx + dy, (i.)

and if the coefficients in the new form be represented by

accenting the old coefficients, then

a'o = gpa" -f aimg"~^7 + ■ ■ ■ ~ anV , \

a\ = ao""~'|3 + ai(TC – W-^^y +a''^d) + ...+ a„7"^9, I (ii.)

a'„ = a^ + ai»/3"-i9 + . . . ~ a„3″ ; /

and this is a homogeneous linear substitution performed

on the coefficients. The totality of the substitutions (i.),

for which a9 — /3y = l, constitutes a continuous group of

order 3, which is generated by the two infinitesimal trans-

formations

3,3

Hence with the same limitations on a, fS, y, 9 the totality

of the substitutions (ii.) forms a simply isomorphic con-

tinuous group of order 3, which is generated by the

two infinitesimal transformations

and

9

‘*«i95; + “-l«2 9^ + “2«3S^+ +«na^-

The invariants of the binary form, i.e., those functions of the coeflicients which are unaltered by all homogeneous substitutions on x, y of determinant unity, are therefore identical with the functions of the coefficients which are invariant for the continuous group generated by the two infinitesimal operations last written. In other words, they are given by the common solutions of the differential equations

«o| + 2

Both this result and the method by which it is arrived at are well known, but the point of view by which we pass from the transformation group of the variables to the isomorphic transformation group of the coefficients, and regard the invariants as invariants rather of the group than of the forms, is a new and a fruitful one.

The general theory of curvature of curves and surfaces may in a similar way be regarded as a theory of their

invariants for the group of motions. That something more than a mere change of phraseology is here implied will be evident in dealing -with minimum curves, i.e., with curves such that at every point of them

For such curves the ordinary theory of curvature .has no meaning, but they nevertheless have invariant properties in regard to the group of motions.

The curvature and torsion of a curve, which are invariant for all transformations by the group of motions, are special instances of what are known as differential invariants. If is the general infinitesimal transformation of a group of point -transformations in the plane, it has been already seen how to extend the transformation so as to indicate its effect on the successive differential coefiScients y^ y^,... of y. If

.33 3 3

be the extended transformation, it may be regarded as a transformation of the variables

By including a sufficient number of these variables the group must be intransitive in them, and must therefore have one or more invariants. Such invariants are known as differential invariants of the original group, being necessarily functions of the differential coefficients of the original variables. For groups of the plane it may be shown that not more than two of these differential invariants are independent, all others being formed from these by algebraical processes and differentiation. For groups of point-transformations in more than two variables there will be more than one set of differential invariants. For instance, with three variables, one may be regarded as independent, and the other two as functions of it, or two as independent and the remaining one as a function. Corresponding to these two points of view, the differential invariants for a curve or for a surface will arise.

If a differential invariant of a continuous group of the plane be equated to zero, the resulting differential equation remains unaltered when the variables undergo any transformation of the group. Conversely, if an ordinary

differential equation

/(^>2’>2’i>2‘2v) = 0

admits the transformations of a continuous group, i.e., if the equation is unaltered when x and y undergo any transformation of the group, then /(a;, y, y^, y^,..!)ox some multiple of it must be a differential invariant of the group. Hence it must be possible to iind two independent differential invariants a, /3 of the group, such that when these are taken as variables the differential equation takes the form

This equation in a, /? will be of lower order than the original equation, and in general simpler to deal with. Supposing it solved in the form

/? = <^(a),

■where for a, /8 their values in terms of x, y, y-y, y^,... are written, this new equation, containing arbitrary constants, is necessarily again of lower order than the original equation. The integration of the original equation is thus divided into two steps. This will §how how, in the case of an ordinary differential equation, the fact that the

equation admits a continuous group of transformations may be taken advantage of for its integration.

The most important of the applications of continuous groups are to the theory of systems of differential equations, both ordinary and partial ; in fact. Lie states that it was with a view to systematizing and advancing tie general theory of differential equations that he was led to the development of the theory of continuous groups. It is quite impossible here to give any account of all that Lie and his followers have done in this direction. An entirely new mode of regarding the problem of the integration of a differential equation has been opened up, and in the classification that arises from it all those apparently isolated types of equations which in the older sense are said to be integrable take their proper place. It may, for instance, be mentioned that the question as to whether Monge's method will apply to the integration of a partial differential equation of the second order is shown to depend on whether or not a contact-transformation can be found which will reduce the equation to either

= 0.

It is in this direction that further advance in the theory of partial differential equations must be looked for. Lastly, it may be remarked that one of the most thorough discussions of the axioms of geometry hitherto undertaken is founded entirely upon the theory of continuous groups.

Discontinuous Groups.

We go on now to the consideration of discontinuous groups. Although groups of finite order are necessarily contained under this general head, it is convenient for many reasons to deal with them separately, and it will therefore be assumed in the present section that the number of operations in the group is not finite. Many large classes of discontinuous groups have formed the subject of detailed investigation, but a general formal theory of discontinuous groups can hardly be said to exist as /et. For instance, there is in this connexion no system of theorems concerning possible types of simple groups analogous to those stated above for continuous groups. In fact no discontinuous group (with a finite number of inde-

pendent generating operations), whose order is not finite, has yet been recognized as a simple group ; though, on the other hand, the non-existence of such simple discontinuous groups, if true, has still to be demonstrated. It will thus be obvious that in considering discontinuous groups it is necessary to proceed on different lines from those followed with continuous groups, and in fact to deal with the subject almost entirely by way of example. An operation of a discontinuous group must necessarily be specified analytically by a system of equations of the form

(s=l, 2,. ..,»),

and the different operations of the group will be given by different sets of values of the parameters a-^, p .

ttg, ..., ar. No one of these parameters is sus- aadim-

ceptible of continuous variations, but at least one properly must be capable of taking a number of values dlscoatla-

which is not finite,* if the group is not one “^J

of finite order. If h^, b^,.—, br is another set of values of the parameters, then the result of eliminating x\, x\,..., x’n between (i.) and

^ s —fs{^ II X 2,---! ^

{s=l,2,...,n)

must lead to

(s=l, 2,..., «,),

where Cj, c,,,..., c,. is a third set of admissible values of

the parameters. Among the sets of values of the para-

K \,

..., Ir)

meters there must be one ■wMch gives tlie identical trans-

formation. No other transformation makes each of the

diSerences x\ — x-^, x'^ — Xr,,..., x'n — ^n vanish. Let d be

an arbitrary assigned positive quantity. Then if a trans-

formation of the group can be found such that the

modulus of each of these diflferences is less than d when

the variables have arbitrary values within an assigned

range of variation, however small d may be chosen, the

group is said to be improperly discontinuous. In the

contrary case the group is called properly discontinuous.

The range within which the variables are allowed to vary

may clearly affect the question whether a given group

is properly or improperly discontinuous. For instance,

the group defined by the equation

of — ax + h,

where a and b are any rational numbers, is improperly

discontinuous ; and the group defined by

x’ = x + a,

where a is an integer, is properly discontinuous, whatever

the range of the variable. On the other hand, the group,

to be later considered, defined by the equation

, ax + i

cx+d’

where a, b, c, d are integers satisfying the relation

ad—bc = 1,

is properly discontinuous when x may take any complex

value, and improperly discontinuous when the range of x

is limited to real values.

Among the discontinuous groups that occur in analysis,

a large number may be regarded as arising by imposing

limitations on the range of variation of the parameters of

continuous groups. If

! —fsi^ii

n),

r)j

(i-)

(s = l, 2,...

are the finite equations of a continuous group, and if C

with parameters c^, Cj, . . ., Cr is the operation which results

from carrying out A and B with corresponding parameters

in succession, then the c's are determined uniquely by

the a'a and the b's. If the c's are rational functions of

the a's and b's, and if the a's and 6's are arbitrary

rational numbers of a given corpus (see Ntjmbee), the

c's will be rational numbers of the same corpus. If the c's

are rational integral functions of the a's and 5's, and the

latter are arbitrarily chosen integers of a corpus, then the

c's are integers of the same corpus. Hence in the first

case the equations (i.), when the a's are limited to be

rational numbers of a given corpus, will define a discon-

tinuous group ; and in the second case they will define such a group when the a's are further limited to be integers of the corpus. A most important class of Linear dis- discontinuous groups are those that arise in ”’” ”’”’”* this way from the general linear continuous group in a given set of variables. For n variables the finite equations of this continuous group are

a^‘a = as-^x-^ + O-s-fi + • • ■ + tfm^M) (ii-)

(s = l, 2,. ..,»),

where the determinant of the a's must not be zero. In this case the c's are clearly integral lineo-linear functions of the a's and 6's. Moreover, the determinant of the c's is the product of the determinant of the a's and the determinant of the 5's. Hence equations (ii.), where the parameters are restricted to be integers of a given corpus, define a discontinuous group ; and if the determinant of the coefficients is limited to the value unity, they define a discontinuous group which is a (self -conjugate) subgroup of the previous one.

The simplest case which thus presents itself is that in

which there are two variables while the coeflBcients are rational integers. This is the group defined by the equations

a!=^ax + by,\ n^^s

y’ = cx + di/,j

where a, b, c, d are integers such that

ad—bc = 1.

To every operation of this group there corresponds an operation of the set defined by

, az + h

cz + d’

(iv.)

in such a way that to the product of two operations of the group there corresponds the product of the two analogous operations of the set. The operations of the set (iv.), where ad-bc=l, therefore constitute a group which is isomorphic with the previous group. The isomorphism is multiple, since to a single operation of the second set there correspond the two operations of the first for which a, 6, c, d and – a, -b, – c, -d are parameters. These

two groups, which are of fundamental importance in the theory of quadratic forms and in the theory of modular functions, have been the object of very many investigations. From the present point of view they may be used to illustrate how, by further limitations on the parameters, subgroups of a discontinuous group arise.

If a”, b”, c”, d” are the parameters of the operation which results from carrying out in succession those with parameters a, b, c, d and a, b’, c’, d’, then

a” = ad + h’c,

b” = a’b + b’d,

c” = ac’ + cd!,

d”= be +dd’.

Hence if

a = d = a’ =.d’ = 1, mod. n

b = c = b’=c=0,

then

a” = d” = 1, b” = c” = 0, mod. n.

The totality of the operations of either group for which a and d are congruent to unity, while b and c are congruent

to zero, mod. n, therefore constitutes a subgroup ; and it is easy to verify that this subgroup is a self-conjugate sub-group. Again, the totality of the operations for which b is zero constitutes a subgroup ; as also do those for which c is zero. These are not self-conjugate subgroups.

Another point of fundamental importance in connexion with discontinuous groups may be illustrated by the groups here under consideration. For each of them a pair of operations may be found such that every Generating operation of the group can be formed by the combination and repetition of the two. It may, in fact, be easily verified that

—x + y,

and

X = -y,

is such a pair of operations for the first group, while

z’ = 2 + 1, and z — — -,

is the corresponding pair for the second. As has been already stated, such a set of operations is called a set of generating operations for the group ; and when, as

in the present instance, no one of them can be formed from the remaining ones, the generating operations are said to be independent. Such a set of necessity exists for every discontinuQus group, but their number is not necessarily finite. ^Moreover, except in the case of a cyclical group, which is formed by the repetition of a single operation, such a set of generating operations is

never unique; for if A, B, C,... generate the group, so also do either A, AB, AC,...; or S'^AS, S'lBS, S~^CS,... where S is any operation of the group.

The consideration of a discontinuous group as arising from a set of independent generating operations suggests a purely abstract point of view in which any two simply isomorphic groups are indistinguishable. The number of generating operations may be either finite or infinite, but the former case alone will be here considered. Suppose then that

is a set of independent operations from which a group G

is generated. The general operation of the group will be

represented by the symbol

SaS^...S*, or S,

where a, h,..., d are chosen from 1, 2,..., n, and a, /?,..., 8

are any positive or negative integers. It may be assumed

that no two successive suffixes in 2 are the same, for if

6 = a, then S^Sf may be replaced by S^”^^. If there are

no relations connecting the generating operations and the

identical operation, every distinct symbol 2 represents a

distinct operation of the group. For if

S = 2„

then

and unless

this is a relation connecting the generating operations.

Suppose now that Tj, T^,... are operations of G, and that

H is that self-conjugate subgroup of G which is generated

by Tj, Tj, . . . and the operations conjugate to them. Then,

of the operations that can be formed from

the set 2H, and no others, reduce to the same operation

2 when the conditions

T, = l, T2 = l,...

are satisfied by the generating operations. Hence the group which is generated by the given operations, when subjected to the conditions just written, is simply isomorphic with the factor-group G/H. Moreover, this is obviously true even when the conditions are such that the generating operations are no longer independent. Hence any discontinuous group may be defined abstractly, that is, in regard to the laws of combination of its operations apart from their actual form, by a set of generating operations and a system of relations connecting them. Conversely, when such a set of operations and system of relations are given arbitrarily they define in abstract form a single discontinuous group. It may, of course, happen that the group so defined is a group of finite order, or that it reduces to the identical operation only; but in regard to the general statement these will be particular and exceptional cases.

As an example of this abstract mode of defining a group, the group generated by

z =z + \, z = —

may be considered. If these operations are represented

by Si and 83, the operation S^Sa or

is an operation of order three ; while Sg itself is an opera-

tion of order two. Among the relations which Sj and Sj

must satisfy, there must therefore occur

(SiS,)’ = l, S/=l;

and these are in fact sufficient. The proof of this state-

ment will occur more naturally later.

We shall now proceed to consider shortly certain special

classes of discontinuous groups which occur in plane

geometry, and in the theory of functions of a oiscoa-

single variable. In the first place, the properly tinuoa’s

discontinuous groups of motions in a plane wiU groups of

be investigated. motions.

Any set of finite displacements in a plane generate, by

their combination and repetition, a group of motions;

but such a group will in general be improperly discon-

tinuous. If the group leaves one point unchanged it

must consist of rotations round this point ; and it will be

either a group of finite order or improperly discontinuous.

If it leaves no point unaltered it must contain operations arising from equal and opposite rotations about difi'erent points, i.e., it must contain translations. A properly discontinuous group of motions in the plane whose order is not finite must therefore contain translations. If the axis of X be taken parallel to the direction of a translation, and if a be the magnitude of the smallest translation in the group, parallel to the axis of x, then

x' = x + ma, y' = y,

or il = z + ma,

where 2 = « ~~1~~ iy,

represents the cyclical subgroup generated by the translation a.

Suppose first that the group contains no other translations than these. If it contain rotations, the origin may be chosen so as to be the fixed point of a rotation.

If a is the angle, the rotation is represented by

a;' = a; cos a — y sin a, y' = a; sin a ¦ y cos a.

If the translation be represented by T and the rotation

by E, then R-^TE is

z =z + ae^,

a translation in a direction inclined at an angle a to the

axis of a. Hence a must be tt, and the rotation must

be through two right angles. A second rotation E’, with

h, k for a fixed point, contained in the group, is repre-

sented by

z’ — h — ih= -(z — h — ili);

and EE’ is

z’=2-f2(A-i-«Vc).

Hence Tc must be zero, and 2A a multiple of a, or

E’ = T-“ET«

where n is some integer.

It follows that when there is a single set of translations

the group must be either

(i.) . . . z’ = z + ma,,

or

(ii.) . . . 2′ = ±3 -F ma.

Suppose next that the groap contains translations in

more than one direction. It may then be assumed with-

out loss of generality that the subgroup formed of its

translations, since it is properly discontinuous, is generated

by

If

^ = z + a, z =z + 6e*^.

z’ = z + cey

is any other translation of tlie group, it must be possible

to find integers m and n such that

Let R be a rotation of the group whose angle is a, and

whose fixed point may be taken to be the origin. Then

if T is the general translation R-pTEp, or

is a translation belonging to the group. Hence, whatever

integers m and n and p may be, it must be possible to

find two integers m and ra’, such that

A discussion of this relation will show that if a and h are

unequal u. must be tt. , If, however, a and 6 are equal, the

further values /3 = J, a = ^- qJ^JL a = — • B = ‘^— a—,

f” 2′ 2’/^ 3′ 3’^3‘3′

are admissible. It may be shown, as in the former case, that if R' is another rotation of the group, then R' is the result of transforming R (or one of its powers) by a suitable translation. The remaining types of properly discontinuous groups of motions in the plane may now be written down. They are

(iii.) . . «' = 3 + ma + 7i6e*3,

(iv.) . . t =±z + ma + nh&^,

(v.) . . z =e ^ z + {m + in)a,

2ipir / 2iir\

(vi.) . . z' = e ^ z+ ym + ne^)a,

ipir / 2iiT\

(vii.) . . z =e ^ z+ \m + ne ^ J a,

where m, n, p, are any integers.

In connexion with each of these groups the whole plane may be divided into congruent portions which are interchanged among themselves by the operations of the group. In the simpler cases this is obvious. For instance, for the group (iii.) the parallelograms into which the plane is divided by the lines

y = m,b sin ;8,

X sin jS — y cos ji = na sin /3,

m and n taking all integral values, are clearly such a set of regions. In general such regions may be constructed as follows : — Let P be any point in the plane and F, P”, . . . the points to which the various operations of the group displace P. With P, P’, P”,.— as centres, suppose circles to be described with the same radius, this being taken at first so small that no two circles meet. Let the radii increase at the same rate, continuing to do so till the circles begin to meet. Wherever the circles meet let the radii cease increasing. In this way a region will be formed round each of the points P, P’, P”, ... bounded by straight lines. From their mode of formation these regions are necessarily all congruent ; and the operations of the group, which interchange the points P, P’, P”,... among themselves, also interchange the regions. The regions thus constructed are susceptible of an infinite variety of form owing to the arbitrary position of P.

No two points in any one region can be displaced, the

one into the other, by an operation of the group ; and corresponding to any given point within one region there is just one point within any other region to which it may be brought by an operation of the group. Any one region with these properties is called a fundamental region for the group ; and the same phrase is used in connexion with discontinuous groups of plane and space transforma^ tions other than groups of motions. For an improperly discontinuous group no region of finite size exists with the properties of a fundamental region.

As a second class of examples certain groups of the plane .will be considered which arise from the plane trans- formation known as inversion. Let AjAj. ■■■^ q, be a polygon whose sides are circular arcs, and ti„uous suppose that each of the internal angles of the groups polygon is either a submultiple of two right arising angles or zero. If this polygon be inverted at J™”„„„„5. one of its sides AjA^, a new polygon is formed with the same properties as the original, and having the side AjAg only in common with it. The result of inverting at

any one of the sides of the new polygon is equivalent to that of successive inversions at three (properly chosen) sides of the original polygon. Suppose now that new polygons are continually formed by inverting those already constructed at their sides. From the mode of formation, no two polygons thus constructed can have any area in common imless they coincide entirely. The original polygon is therefore a fundamental region for the group generated by inversions at its sides; and this group is therefore a properly discontinuous group. Let the polygons be divided into two sets such that the fundamental polygon and all that are derived from it by an even number of inversions form the first set, while those derived from the fundamental polygon by an odd number of inversions form the second. Then both the first set and the second set of polygons are changed into itself by any operation of the group which is given by an even number of inversions. The totality of the operations which arise from an even number of inversions at the sides of the fundamental polygon therefore constitutes a dis-

continuous group G for which the region formed by the original polygon and its inverse at AjAg is a fundamental region. If

Rj, Rj,.

•J Rji

represent inversions ‘at the sides

AjAj, AjAg, ..., A^Aj

of the original polygon, the group G can be generated by the operations

t^TiRxj RiR2»***> Rn— 2*^— 1)

Bp Sj,.

Sn i

since from these any operation consisting of an even number of inversions can clearly be constructed. Now an inversion at a circle whose centre is (a^, 6j) and radius Cj is given analytically by the equations

x + iy = z, ttj -h t6j = Oj,

x — iy — z, aj — ib^ = 5.^,

these are equivalent to the single equation

2 — a, = :

1

and similarly an inversion at a second circle is given by

a-Oj

Hence the plane transformation that arises from the two

inversions performed successively is

2 = a„ + ■

Oi-d2 + –

ttS-h^

7;-l-5

where a, j3, y, S are constants (in general complex)

depending on the two circles. The generating operations

Sr(r=l, 2,..., re-1) of the group G are therefore n-l

fractional linear substitutions

0′ = “=^, (r=l, 2,. ..,«-!)

performed on the variable z; and since any two linear

substitutions performed successively lead to another linear

substitution, every operation of the group vrill be repre-

sented by a linear substitution. The linear substitution

that results from successive inversions at two circles which intersect at an angle ir/w, where m is an integer, is an operation of finite order m. Hence if

are the internal angles of the original polygon at

Aj, Aj,..., An_j, the generating operations of the group

are subject to the relations

Sj =1, Sj =i,..., S

= 1.

The operation consisting of successive inversions at AmAj and h-n-x^n is represented in terms of the generating operations by SiS2…S«,_j. Hence, if tt/otb is the internal angle of the polygon at A„,

If the fundamental polygon be taken to correspond to the identical operation, then each polygon in the figure will correspond to that operation of the group which transforms the fundamental polygon into it. The polygon which corresponds to any operation S^Sj… of the group may be found by drawing a line from the fundamental polygon to the polygon S^ ; continuing it from the polygon S^ to that into which S^ transforms it, and so on. To any

further relation between the generating operations, such as

SaS!,”-Sa=l,

will correspond a closed path returning to the funda-

mental polygon. But any such closed path may be

continuously deformed, without crossing any of the angular

points, into a series of loops surrounding the angular

points ; and, therefore, any such relation is a consequence

of the relations giving the periods of the generating

operations and of their product SjSj-.-Sn-j. The n

relations

sr’=i, sr^=i,...,s™-i=i, (SA-S«-,r’’=i, •

therefore completely define the group. If one or more of

the internal angles of the polygon are zero, the number of

the relations will be diminished. In the extreme case

when all the angles are zero the figure vrill represent

graphically a perfectly general discontinuous group

generated by m — 1 operations which are subject to no

relations.

As a particular example, the analytical form of the

group will be calculated when the polygon is a triangle

whose angles are 0, ir/2, and tt/S. The sides AjAj, AjA^,

AjAg of such a triangle may be taken to be

2a;+l=0, a; = 0, x^^■y^-\ = Q

respectively. The operations Ej, R2, Eg are then

2 = 0, 2=-, 2 = -l-z;

and the operations Sj, Sj are

2′ = 0-f-l, /=— .

Moreover, the group is abstractly defined by the relations

S/=l, (SiS,)3=l.

It has been already seen that the operations Sj and 83

generate the discontinuous group constituted of all

substitutions of the form

as^-6

where a, 6, c, d are integers for which

ad-hc = .

The geometrical origin now obtained for this group

makes it clear that, when 2 is regarded as a complex

variable, the group is properly discontinuous, and that

the necessary and sufficient defining relations of the grouj)

are those previously stated. The class of properly dis-

continuous groups of linear substitutions here considered is only one from an infinite variety of such classes ; and it has been chosen rather for the extreme simplicity of its geometrical form than for any other reason. For a more complete discussion the reader is referred to the memoirs of Poincar6 and Klein mentioned later.

Eeturning now for a time to the discontinuous groups of motions in the plane, it is to be noticed that each one underlies and, in fact, is fundamental in the theory of a corresponding set of functions. In regard to any group of transformations of a single variable, the question may be asked, “What function of the variable is invariant for all the transformations of the group % ” If the group is continuous or improperly discontinuous the only invariant uniform function is a constant. But if the group is properly discontinuous, invariant uniform functions other than constants will always exist. Thus for the group

^ = z + ma

any simply periodic function of period a is invariant, and for the group

z’ =2 + ma + nbe’^

any doubly periodic function with a and 6e*^ for its periods is invariant. In a similar way, to every properly discontinuous group of fractional linear substitutions there corresponds a class of uniform functions which are invari-ant for all substitutions of the group. These are the so-called automorphic functions. For the particular group generated by

2=0+1, 2= —

the simplest automorphic function is the absolute invariant of a non-singular cubic curve for which 2 represents the ratio of the periods of the associated elliptic functions ; and this group is therefore fundamental in the theory of the modular functions.

For space of three dimensions the theories, analogous to those that have been described for the plane, are, as is to be expected, more complicated. The investigation of the properly discontinuous groups of motions in space has been carried out completely, and forms the mathematical basis for the theory of crystallography. The result arrived

at is that tliere are 65 distinct types of such groups.

In their analytical form these groups must be represented as linear transformations of a set of three real variables ; and they cannot, except in the cases already dealt with, be represented as transformations of one or of two variables.

No detailed account of discontinuous groups of space transformations which arise from inversions can “be entered on here, but their importance may be made clear by a simple illustration. The discontinuous group that arises from inversions at a given set of circles in a plane is simply isomorphic with that which arises from inversions at the spheres which have their centres in the plane and pass through the given circles. Now the group of space transformations arising from the spheres may be properly discontinuous though the group of plane transformations is not. For instance, if the circles in the plane are the threg sides of an equilateral triangle and the circumscribing circle, the group of plane transformations is improperly

discontinuous. Tlie corresponding spheres (three of them being in this case planes) meet in a spherical tetra-hedron all of whose dihedral angles are 5r/3 ; and the group of space transformations is therefore properly dis-continuous.

The special classes of discontinuous groups that have been so far dealt with arise directly from geometrical

Group of a considerations. As a final example we shall

linear an- refer briefly to a class of groups whose origin is essentially analytical. Let

terentiat

equation.

, d'^-'V

d^" + U^ ■■■ -t^n-i^ + i^ny = ^

be a linear differential equation, the coefficients in which are rational functions of x, and let y-^, y^,..., yn be a linearly independent set of integrals of the equation. In the neighbourhood of a finite value x^ of x, which is not a singularity of any of the coefficients in the equation,

these integrals are ordinary power-series in x – x^^. If the analytical continuations of y-^, y,^,---, yn be formed for any closed path starting from and returning to x^, the final values arrived at when x^ is again reached will be another set of linearly independent integrals. When the closed path contains no singular point of the coefficients of the differential equation, the new set of integrals is identical with the original set. If, however, the closed path en-closes one or more singular points, this will not in general be the case. Let y\, y\,..., y'n be the new integrals arrived at. Since in the neighbourhood of Kq every integral can be represented linearly in terms of 2'iJ ^2- • -j Vn, there must be a system of equations

2''i = «iiS'i + «i2y2+'

y'2 = "2l2'l + '^22y2 +

' • + ^inVnj

y'n = an^y-i + O'n'Hi -f . . ■ + annVn,

where the a's are constants, expressing the new integrals in terms of the original ones. To each closed path de-scribed by x^ there therefore corresponds a definite linear

substitution performed on the y's. Further, if Sj and Sj are the substitutions that correspond to two closed paths Lj and L,, then to any closed path which can be continuously deformed, without crossing a singular point, into L, followed by L,, there corresponds the substitution Sj 85. Let Lj, L2, ■ ■ ., Lr be arbitrarily chosen closed paths starting from and returning to the same point, and each of them enclosing a single one of the (r) finite singular points of the equation. Every closed path in the plane can be formed by combinations of these r paths taken either in the positive or in the negative direction. Also a closed path which does not cut itself, and encloses all the r singular points within it, is equivalent to a path enclosing the point at infinity and no finite singular point. If Sj, S2, S3. . ., Sr are the linear substitutions that correspond to these r paths, then the substitution corresponding to every possible path can be obtained by combination and repetition of these r substitutions, and they therefore generate a discontinuous group each of whose operations corresponds to a definite closed path. The group thus

arrived at is called the group of the equation. For a given equation it is unique in type. In fact, the only effect of starting from another set of independent integrals is to transform every operation of the group by an arbitrary substitution, while choosing a different set of patha is equivalent to taking a new set of generating operations.'

The great importance of the group of the equation in connexion with the nature of its integrals cannot here be dealt with, but it may be pointed out that if all the integrals of the equation are algebraic functions, the group must be a group of finite order, since the s§t of quantities y-^, y^,—; yn can then only take a finite number of distinct values. As a simple example of the deter-mination of the group from the differential equation, we may take the equation

There is only one finite singular point, namely x = 0, and therefore the group is cyclical. The determinantal equation at a; = 0 is

(»- 1)3 = 0,

and the form of the three independent integrals must

therefore be

u, v + ulogx, w + 2v log a; + M (log x)^,

where u, v, w are power-series of which u vanishes with x.

If these are represented by y-^, y^, y^, the substitution

given by a closed path surrounding a; = 0 is

y\ = yv y‘2 = ^2 + S’T^Vi, y‘2 =y3 + ^-^m – ^^‘‘vv

and the group of the equation is the cyclical group gener-

ated by this substitution.

Groups of Finite Oedee.

We shall now pass on to the last division of the subject,

that is, to groups of finite order. It is clear that here

we must have to do with many properties which have no

direct analogues in the theory of continuous groups or in

that of discontinuous groups in general ; those properties,

namely, which depend on the fact that the number of

distinct operatioas in the group is finite.

Let

denote the operations of a group G of finite order N, Sj

being the identical operation. The tableau

^1′ ^2′ 3′ — ‘ ^’

bj^bg, b2b2, b3bg, ..., bsb2j

SjSg, SjSg, S3S3,..., SsSj,

SjSs, SjS^ 838^,..., Sj,Sh,

when in it each compound symbol S^Sj is replaced by the single symbol Sr that is equivalent to it, is called the multiplication table of the group. It indicates directly the result of multiplying together in an assigned sequence any number of operations of the group. In each line (and in each column) of the tableau every operation of the group occurs just once. If the letters in the tableau are regarded as mere symbols, the operation of replacing each symbol in the first line by the symbol which stands under it in the ^th line is a substitution performed on the set of N symbols. Thus to the N lines of the tableau there corresponds a set of N substitutions performed on the N symbols, which includes the identical substitution that leaves each unchanged. Moreover, if S^jSj = Sr, then the result of carrying out in succession the substitutions which correspond to the pdh and g'th lines gives the substitution which corresponds to the rth line. Hence the

set of substitutions constitutes a group which is simply

isomorphic with the given group.

Every group of finite order N can therefore be repre

sented in concrete form as a group of substitutions on N

symbols.

The order of any subgroup or operation of G is neces-

sarily finite. If

Tl(= Si), T2,..., T,,, Properties

are the operations of a subgroup H of G, and ”’ ” f:”>“P

if S is any operation of G which is not con-

tained in H, the set of operations

“Vnn Vrri VT

or 2H, are all distinct from each other and from the

wblcb

depend on

tbe order.

operations of H. If the sets H and 2’H do not exhaust

the operations of G, and if 2′ is an operation not belong-

ing to them, then the operations of the set 2'H are distinct from each other and from those of H and 2H. This process may be continued till the operations of G are exhausted. The order n. of H must therefore be a factor of the order N of G. The ratio N/w is called the index of the subgroup H. By taking for H the cyclical subgroup generated by any operation S of G, it follows that the order of S must be a factor of the order of G.

Every operation S is permutable with its own powers. Hence there must be some subgroup H of G of greatest possible order, such that every operation of H is permutable with S. Every operation of H transforms S into itself, and every operation of the set HS transforms S into the same oi^eration. Hence, when S is transformed by every operation of G, just N/re distinct operations arise if n is the order of H. These operations, and no others, are conjugate to S within G ; they are said to form a set of conjugate operations. The number of operations in every conjugate set is therefore a factor of the order of G. – In the same way it may be shown that the number of sub-

groups which are conjugate to a given subgroup is a factor of the order of G. An operation which is permutable with every operation of the group is called a self-conjugate operation. The totality of the self -conjugate operations of a group forms a self-conjugate Abelian subgroup, each of whose operations is permutable with every operation of the group.

An Abelian group contains subgroups whose orders are any given factors of the order of the group. In fact, since every subgroup H of an Abelian group G and the corresponding factor groups G/H are Abelian, this result follows immediately by an induction from the case in which the order contains n prime factors to that in which it contains n+. For a group which is not Abelian no general law can be stated as to the existence or non-existence of a subgroup whose order is an arbitrarily assigned factor of the order of the group. In this con-nexion the most important general result, which is in-dependent of any supposition as to the nature of the group, is known as Sylow's theorem, which states that if p'^

is the highest power of a prime p which divides the order of a group G, then G contains a single conjugate set of sub-groups of order ^», the number in the set being of the form 1 +‘kp. This theorem, which is of fundamental importance, may be established as follows ; —

Let r be the number of distinct sets of conjugate opera-tions in G, and let

Sylow’s h^(= l),h^,h^...,hr,

eorem. ^^ ^j^g numbers of operations in each set, the first set consisting of the identical operation alone. Any operation of the sth set is contained as a self-conjugate operation in a subgroup of order ng, where reA = N, the order of the group.

The order of the group being equal to the sum of the numbers of operations in the different conjugate sets, it follows that

N = l + —I--+ ... + -.

If G contains no self- conjugate operation except the identical operation, no one of the denominators on the right-hand side is N, and at least one of them must

be divisible by p^. In this case, then, G contains a sub-group whose order is divisible by p^. If G has self-conjugate operations, the same result is arrived at by considering the factor group G/H, where H is the sub-group constituted of the totality of the self-conjugate operations ; and G, therefore, in any case contains a sub-group whose order is divisible by p^. The same reasoning may be repeated with this subgroup, and so ultimately a subgroup of order /i” must be arrived at. The existence within G of a subgroup P of order p» is thus demonstrated. If this subgroup is not self-conjugate, let P’ be another subgroup of order p” conjugate to it. When P’ is trans-formed by all the operations of P, the number of distinct groups, including P’, which arise is /i*”, where p is the order of the greatest group common to P and P’. If the \+pc-p groups so obtained do not exhaust all the sub-groups conjugate to P in G, let P” be a new one. On transforming F’ by the operations of P, p^-?’ new groups arise, which are distinct from each other and from the previous \+pf^‘K This process may be continued till the

groups conjugate to P are exhausted. Their number is therefore of the form 1 4- kp. The supposition that G contains a second conjugate- set of subgroups of order pf^ leads by a similar process to the obvious contradiction that the number of subgroups in the set is at once of the forms \ +kp and Ip. The theorem is therefore com-pletely proved. Sylow's theorem may be extended to show that if p^' is a factor of the order of a group, the number of subgroups of order pfl-' is of the form 1 + kp. If, however, p'^' is not the highest power of p which divides the order, these groups do not in general form a single conjugate set.

The importance of Sylow's theorem in discussing the structure of a group of given order need hardly be insisted on. Thus, as a very simple instance, a group whose order is the product p-iP2 of two primes {p-^^p^ must have a self-conjugate subgroup of order ^2> since the order of the group contains no factor, other than unity, of the form 1 + kp^. The same again is true for a group of order p-^p^, unless jBj = 2, and p^ = 3.

There is one other numerical property of a group connected with its order which is quite general. If N is the order of G, and n a factor of N, the number of operations of G, whose orders are equal to or are factors of n, is a multiple of n.

As already defined, a composite group is a group which contains one or more self -conjugate subgroups, whose orders are greater than unity. If H is a self-conjugate subgroup of G, the factor-group G/H °™:“*;es may be either simple or composite. In the ot a group. former case G can contain no self-conjugate subgroup K, which itself contains H ; for if it did K/H would be a self- conjugate subgroup of G/H. When G/H is simple, H is said to be a maximum self-conjugate subgroup of G. Suppose now that G being a given composite group,

G, G-j^, G2, ..-, vjtij ij

is a series of subgroups of G, such that each is a maximum self-conjugate subgroup of the precediog; the last term of the series consisting of the identical operation only.

Such a series is called a composition-series of G. In general it is not unique, since a group may have two or more maximum self -conjugate subgroups. A composition-series of a group, however it may be chosen, has the property that the number of terms of which it consists is always the same, while the factor-groups

G/Gj, Gj/Gj,..., G„,

differ only in the sequence in which they occur. Let Gj and G'j be two maximum self-conjugate subgroups of G, and let H be the common subgroup of Gj and G'j. The group { Gj, G'j } generated by Gj and G\ is contained self-conjugately in G, and must therefore coincide with G, since Gj and G\ are maximum self -conjugate subgroups. Also H, being the common subgroup of two self-conjugate subgroups of G, is a self – conjugate subgroup of G,

Gj, and Q. Now the factor -group {Gj, G\}IG^ ia iden-tical with {g^, g\}lg-^, where g^^ and g\ represent Gj/H and Gyn. But {g^, g'-^}/gi is identical with ^r'j, since ^Tj

and g\ have no common operations. Hence G/Gj is identical with G'j/H ; and similarly G/G'j is identical with Gj/H. Moreover, H is a maximum self-conjugate subgroup of both G^ and G. Suppose now that

G, Gj, Gj,..., 1,

and

G, G'l, G'2,..., 1,

are two composition-series of G. Since H is a maximum self-conjugate subgroup of both Gj and G'j, there must be two other composition-series of the form

G, Gj, H, I, J,..., 1,

and

G, G'l, H, I, J,..., 1 ;

and for these the factor-groups are identical except as regards sequence.

The property stated of the composition-series may now be proved by an induction. Suppose it to have been established for all groups whose order does not exceed n, and let the order of G be not greater than 2n, so that the orders of Gj and G'j do not exceed n. Then the series

Gi, H,..., 1,

have the same number of terms, and apart from sequence

the same factor-groups ; as also have the series

G'j, H,..., 1.

Hence the same is true for the series

G, Gj, Gj,.—, 1,

G, G'l, G'2,..., 1.

For a group of sufficiently small order the property is

obviously true, and it is thus established generally. It

should be noticed that though a group defines uniquely

the set of factor-groups that occur in its composition-series,

the set of factor-groups do not conversely in general define

a single type of group. When the orders of all the factor-

groups are primes the group is said to be soluble.

If the series of subgroups

G, H, K, ..., Ij, 1

is chosen so that each is the greatest self-conjugate sub-

group of G contained in the previous one, the series is

called a chief composition – series of G. All such series

derived from a given group may be shown to consist of

the same number of terms, and to give rise to the same

set of factor-groups, except as regards sequence. The

factor-groups of such a series will not, however, necessarily

be simple groups. From any chief composition-series a

composition-series may be formed by interpolating between

any two terms H and K of the series for which H/K is

not a simple group, a number of terms Aj, h^,---, hr; and

it may be shown that the factor-groups H/Aj, hjh^,.. ., h^/K

are all simply isomorphic with each other.

A group may be represented as isomorphic with itself

by transforming all its operations by any one of them. In

fact, if

Sr,

Isomor-

phism of a

group with then

itself.

SpSg =

S ‘SpS. S ■‘858 = 8 -^s^s.

An isomorphism of the group with itself, established in

this way, is called a cogredient isomorphism. It may be regarded as an operation carried out on the symbols of the operations, being indeed a substitution performed on these symbols. The totality of these operations clearly constitutes a group isomorphic with the given group, and this group is called the group of cogredient isomorphisms. A group is simply or multiply isomorphic with its group of co-gredient isomorphisms according as it does not or does contain self-conjugate operations other than identity. It may be possible to establish a correspondence between the operations of a group other than those given by the cogredient isomorphisms, such that if S' is the operation corresponding to S, then

S pb gr = 0 r

is a consequence of

SpSj = Or-

The substitution on the symbols of the operations of a group resulting from such a correspondence is called a contragredient isomorphism. The totality of the isomor-phisms of both kinds constitutes the group of isomorphisms

of the given group, and within this the group of cogredient isomorphisms is a self-conjugate subgroup. Every set of conjugate operations of a group is necessarily transformed into itself by a cogredient isomorphism, but two or more sets may be interchanged by a contragredient isomorphism. A group which has no self-conjugate operations except identity, and admits of no contragredient isomorphisms, is called a complete group. If a group G has a complete group H as a self-conjugate subgroup, then G contains a subgroup K simply isomorphic with G/H, such that every operation of K is permutable with every operation of H ; and G is said to be the direct product of H and K. A subgroup of a group G, which is transformed into itself by every isomorphism of G, is called a characteristic subgroup. A series of groups such that each is a maximum characteristic subgroup of G contained in the preceding, may be shown to have the same invariant properties as the subgroups of a composition series. A group which has no characteristic subgroup must be either a simple group or the direct product of a

number of simply isomorphic simple groups.

It is an obvious result from Sylow's theorem that,

when a given number is assigned arbitrarily as . .

the order of a group, there is not in general composite

among the possible types of group a simple groups,

group. The examination of successive integers, -So/uA/e

from this point of view, has been carried as far*^™"'*'

as 1092, with the result of showing that 60, 168, 360,

504, 660, and 1092 are the only orders not exceeding 1092

corresponding to which simple groups exist, and that for

each of these numbers as order there is a single type of

simple group. On the other hand, the number of simple

groups known to exist is infinite and is being continually

added to. Thus for every order of the forms

In !, J(5« i)p« andip~~(i'» – l)(iJ»-i X)... {p\

where n is any integer, p a prime, and d the highest

common factor of n and ^ – 1, a simple group is

known to exist; and the same may be stated of several

other forms for the order. Again, a series of forms for

the order of a group are known corresponding to which

there can be no simple group, and these also tend to increase with new investigations. Thus if p, q, r,... denote primes, groups of order ^", p'^q, p'^{q} and pq…r are always soluble ; and a group of order p'^{q}...ry, where none of the indices exceed two, is always soluble unless twelve is a factor of the order. If the number of prime factors in the order of a group does not exceed five, the group is composite unless 60, 168, 660, or 1092 is the order. If the order of a group is twice an odd number, the group is always composite, containing a self-conjugate subgroup of index two. Finally, no simple group of odd order is at present known to exist.

GROUPS, THEORY OF

It has been seen that every group of finite order can be Substitu- represented as a group of substitutions performed tioa- on a set of symbols whose number is equal to groups. the order of the group. In general such a representation is possible with a smaller number of symbols. Let H be a subgroup of' G, and let the operations of G be divided, in respect of H, into the sets

H, SjH, SjH SmH.

If S is any operation of G, the sets

SH, SS^H, SS3H,..., SS™H,

differ from the previous sets only in the sequence in which they occur. In fact, if SS^ belong to the set SgH, then since H is a group, the set SS^H is identical with the set SjH. Hence, to each operation S of the group will correspond a substitution performed on the symbols of the m sets, and to the product of two operations corresponds the product of the two analogous substitutions. The set of substitutions, therefore, forms a group isomorphic with the given group. Moreover, the isomorphism is simple unless for one or more operations, other than identity, the sets all remain unaltered. This can only be the case for S, when every operation conjugate to S belongs to H. In this case H would contain a self-conjugate subgroup.

Hence, if H is a subgroup of G of index m, which contains no self -conjugate subgroup of G, then G can be represented as a group of substitutions performed on m symbols.

The fact that every group of finite order can be

represented,, generally in several ways, as a group of substitutions, gives special importance to such groups. The number of symbols involved in such a representation is called the degree of the group. In accordance with the general definitions already given, a substitution-group is called transitive or intransitive according as it does or does not contain substitutions changing any one of the symbols into any other. It is called imprimitive or primitive according as the symbols can or cannot be arranged in sets, such that every substitution of the group changes the symbols of any one set either among themselves or into the symbols of another set. When a group is imprimitive the number of symbols in each set must clearly be the same. The total number of substitutions that can be performed on n symbols is n !, and these necessarily constitute a group. It is known as the symmetric group of degree n, the only rational functions of the symbols which are unaltered by all possible substitutions being the symmetric functions. When any substitution is carried out on the product of the »(ra— l)/2, differences of the n symbols, it must

either remain unaltered or its sign must be changed. Those substitutions which leave the product unaltered constitute a group of order n !/2, which is called the alternating group of degree re ; it is a self ~~conjugate sub~~ group of the symmetric group. Except when ?i = 4 the alternating group is a simple group ; and except f or w = 6 the symmetric group is a complete group. A substitution group of degree n, which is not contained in the alternating group, must necessarily have a self -conjugate subgroup of index 2, consisting of those of its substitutions which belong to the alternating group. The determination of all possible subgroups of the symmetric group has been carried out for some of the smaller values of n. Of greater interest and importance is the determination of the transitive and in particular of the primitive subgroups. The latter determination has been made for all values of n up to 15. Another form in which every group of finite order can Linear ^^ represented is that known as a linear homo- bomogene- geneous group. If in the equations lr=\,“i,...,m),

which define a linear homogeneous substitution, the co-efficients are integers, and if the equations are replaced by congruences to a finite modulus n, the system of con-gruences will give a definite operation, provided that the determinant of the coefficients is relatively prime to n. The product of two such operations is another operation of the same kind; and the total number of distinct opera-tions is finite, since there is only a limited number of choices for the coefficients. The totality of these operations, therefore, constitutes a group of finite order ; and such a group is known as a linear homogeneous group. If n is a prime the order of the group is

(ti™ – l)(re’” – ra) . . . (re»» – rem-i).

The totality of the operations of the linear homogeneous group for which the determinant of the coefficients is congruent to unity forms a subgroup. Other subgroups arise by considering those operations which leave a function of the variables unchanged (mod. n). AU such subgroups are known as linear homogeneous groups.

When the ratios only of the variables are considered,

there arises a linear fractional group, with which the

corresponding linear homogeneous group is isomorphic.

Thus, if /) is a prime the totaUty of the congruences

~cz + d’

(mod. p)

ad -be 4= 0,

constitu,te3 a group of order p(p^ – 1). This class of

groups for various values of p is almost the only one which

has been as yet exhaustively analysed. For all values of p

except 3 it contains a simple self-conjugate subgroup of

index 2.

The operations of a substitution-group, as defined above,

are linear substitutions of a very special type, orouos ot

where each symbol is replaced by another single linear sub-

symbol. The difference of any two symbols is stltutlons.

also replaced by the difference of some other two. Now

every difference of a pair of the symbols

can be expressed linearly in terms of

Hence the substitution -group of degree n can be

represented as a group of linear substitutions in the more general sense, performed on a set of m – 1 symbols. A group of linear substitutions on m symbols is called irreducible when it is impossible to form m’ { functions of the sjrmbols which are transformed among themselves by every operation of the group. The representation of a given group as a group of linear substitutions in as small a number of symbols as possible, and the determination whether the group so formed is irreducible or not, constitutes one of the main problems of the theory. A simple group when so represented is necessarily irreducible. On the other hand, no Abelian group, other than a cyclical one, can be represented in irreducible form. The only groups of finite order which can be represented as substitution-groups with a single symbol are clearly the cyclical groups. The determination has been made of all t3rpes which can be so represented with two and with three symbols. The difficulties presented by the cases of four symbols are very considerable and have not yet been overcome. That among the latter a group of order 25920

occurs indicates the great number of possibilities.

The chief application of the theory of groups of finite order is to the theory of algebraic equations.

The analogy of equations of the second, third, Applies- and fourth degrees would give rise to the ex- ”””*’ pectation that a root of an equation of any finite degree

could be expressed in terms of the coefficients by a finite number of the operations of addition, subtraction, multi- plication, division, and the extraction of roots; in other words, that the equation could be solved by radicals.

This, however, as proved by Abel and Galois, is not the case : an equation of a higher degree than the fourth in general defines an algebraic irrationality which cannot be expressed by means of radicals, and the cases in which such an equation can be solved by radicals must be regarded as exceptional. The theory of groups gives the means of determining whether an equation comes under this exceptional case, and of solving the equation when it

does. When it does not, the theory provides the means of reducing the problem presented by the equation to a normal form. From this point of view the theory of equations of the fifth degree has been exhaustively treated, and the problems presented by certain equations of the sixth and seventh degrees have actually been reduced to normal form.

Galois showed that, corresponding to every irreducible equation of the nth degree, there exists a transitive substitution-group of degree n, such that every function of the roots which is unaltered by all the substitutions of the group can be expressed rationally in terms of the coefficients, while conversely every function of the roots which is expressible rationally in terms of the coefficients is unaltered by the substitutions of the group. This group is called the group of the equation. In general, if the equation is given arbitrarily, the group will be the symmetric group. The necessary and sufficient conditions that the equation may be soluble by radicals is that its group should be a soluble group. When the coefficients

in an equation are rational integers, the determination of its group may be made by a finite number of processes each of which involves only rational arithmetical operations. These processes consist in forming resolvents of the equation corresponding to each distinct type of subgroup of the symmetric group whose degree is that of the equation. Each of the resolvents so formed is then examined to find whether it has rational roots. The group corresponding to any resolvent which has a rational root contains the group of the equation ; and the least of the groups so found is the group of the equation. Thus, for an equation of the fifth degree the various transitive subgroups of the symmetric group of degree five have to be considered. These are (i.) the alternating group ; (ii.) a soluble group of order 20; (iii.) a group of order 10, self ~~conjugate in the preced~~ ing ; (iv.) a cyclical group of order 5, self -conjugate in both the preceding. If a;,x, x^, Xg, x^ are the roots of the equation, the corresponding resolvents may be taken to be

those which have for roots (i.) the square root of the

discriminant ; (ii.) the function (x^x-^ + x^x^ + x^Xg + x^x^

+ x^^ix^x^ + x^^ + x^x^ -H x^Xg + XgX^ ; (iii.) the function

Xf^x^ 4- x^x^ + x^g + x^x^ + x^Xf^ ; and (iv.) the function

x^x.^ ~~H x~~[x] + x^Xg + x^x^ + x^x^. Since the groups for

which (iii.) and (iv.) are invariant are contained in that

for which (ii.) is invariant, and since these are the only

soluble groups of the set, the equation will be soluble by

radicals only when the function (ii.) can be expressed

rationally in terms of the co-efficients. If

yX^X-, + X-

“T XfX-^ “P XnXn -P “‘3’*’()/

is known, then clearly

can be determined by the solution of a quadratic equation.

Moreover, the sum and product

(aj(i + eKj ~~I~~ e’x^ + e^Xg + e^x^Y

and

(x^ + ftjij + «%2 + e^Xg + €X^Y

can be expressed rationally in terms of x^x-^ + x^x^ + x^^

+ XgX^ + x^x^, e, and the symmetric functions ; « being a

fifth root of unity. Hence (x^ + m^ + x + e^x^ + x^

can be determined by the solution of a quadratic equation. The roots of the original equation are then finally determined by the extraction of a fifth root. To show how the problem presented by an equation of the fifth degree, when not soluble by radicals, can be reduced to a normal form, would go far beyond the limits of the present article. This question forms the subject of Prof. Klein's admirable Vorlesungen iiber das Ikosaeder. Another application of groups of finite order is to the theory of linear differential equations whose integrals are algebraic functions. It has been already seen, in the discussion of discontinuous groups in general, that the groups of such equations must be groups of finite order. To every group of finite order which can be represented as an irreducible group of linear substitutions on n variables will correspond a class of irreducible linear differential equations of the nth order whose integrals are algebraic. The complete determination of the class of linear differential equations of the second order with all their integrals algebraic, whose group has the

greatest possible order, viz., 120, has been carried out by Prof. Klein.

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GROVE— GUADALAJARA

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Grove, Sir Georgre (1820-1900), English writer on music, was born at Clapham, IStt August 1820. At the close of his school days he was articled to a civil engineer, and worked for two years in a factory near Glasgow. In 1841 and 1845 he was employed in the West Indies, erecting lighthouses in Jamaica and Bermuda. In 1849 he became secretary to the Society of Arts, and in 1852 to the Crystal Palace. In this capacity his natural love of music and enthusiasm for the art found a splendid opening, and he threw all the weight of his iniluence into the task of promoting the best music of all schools in connexion with the weekly and daily concerts at Sydenham, which had such a long and honourable career under the direction of Mr Manns. Without Sir

George Grove that eminent conductor would hardly have succeeded in doing what he did to encourage young composers and to educate the British public in music. Grove's analyses of the Beethoven symphonies, and the other works presented at the concerts, set the pattern of what such things should be; and it was as a result of these, and of the fact that he was editor of Macmillan's Magazine from 1868 to 1883, that the scheme of his famous Dictionary of Music and Musicians, published from 1878 to 1889, was conceived and executed. His own articles on Beethoven, Mendelssohn, and Schubert are monuments of a special kind of learning, and the fact that the rest of the book is a little thrown out of balance owing to their gigantic length is hardly to be regretted. Long before this he had contributed to the Dictionary of the Bible, and had promoted the foundation of the Palestine Exploration Fund. On a famous journey to Vienna, undertaken in the company of his lifelong friend, Sir Arthur Sullivan, the important discovery of a large number of compositions by Schubert was made, including the music

to Rosamunde. When the Koyal College of Music was founded in 1882 he was appointed its first director, receiving the honour of knighthood. He fulfilled the duties in such a way as to bring the new institution into line with the most useful European conservatoriums. On the completion of the new buildings in 1894 he resigned the directorship, but retained an active interest in the institution to the end of his life. He died at Sydenham, 28th May 1900. (j. a. f. m.)

Grove, Sir William Robert (1811-1896),

English judge and man of science, was bom on 11th July 1811 at Swansea, in South Wales. After being educated by private, tutors, he went up to Brasenose College, Oxford, where he took an ordinary degree in 1832. Three years later he was called to the bar at Lincoln's Inn. His health, however, did not allow him to devote himself strenuously to practice, and he occupied his leisure with scientific studies. About 1839 he constructed the well-known platinum-zinc voltaic cell that bears his name, and with the aid of a number of these exhibited the electric

arc light in the London Institution, Finsbury Circus. The result was that in 1840 the managers appointed him to the professorship of experimental philosophy, an office which he held for seven years. His researches dealt very largely with electro-chemistry and with the voltaic cell, of which he invented several varieties. One of these, the Grove gas-battery, is of especial interest both intrinsically and as the forerunner of the secondary batteries now in use for the "storage" of electricity. He discovered that a current is produced by a couple of platinum plates standing in acidulated water and immersed, the one in hydrogen, the other in oxygen ; hence a galvanometer connected to the electrodes of an apparatus for the electrolysis of water which has been in operation for a short time indicates the existence of a current passing in the reverse direction to that which has effected the decomposition, and thus there is a return of part of the electrical energy which has been expended. At one of his lectures at the Institution Grove anticipated the electric lighting of to-day by illuminating the theatre with incandescent electric lamps,

the filaments being of platinum and the current supplied by a battery of his nitric acid cells. In 1846 he published his famous book on Tlie Correlation of Physical Forces, the leading ideas of which he had already put forward in his lectures : its fundamental conception was that each of the forces of nature — light, heat, electricity, other, and that where experiment does not give the full equivalent, it is because the initial force has been dissipated, not lost, by conversion into other unrecognized forces. In the same year he received a Koyal medal from the Royal Society for his Bakerian lect-ure on ” Certain phenomena of voltaic ignition and the decomposition of water into its constituent gases.” In 1866 he presided over the British Association at its Nottingham meeting, and delivered an address on the continuity of natural phenomena. But while he was thus engaged in scientific research, his legal work was not neglected, and his practice increased so greatly that in 1853 he became a Q.C. One of the best-known cases in which he appeared as an advocate was that of William Palmer, the

Rugeley poisoner, whom he defended. In 1871 he was made a judge of the Common Pleas in succession to Sir Robert Collier, and remained on the bench till 1887. He died in London on 1st August 1896. A selection of his scientific papers will be found appended to the sixth edition of The Correlation of Physical Forces, published in 1874.

Groznyi, fortress and district town of Russia, North Caucasia, province of Terek, on the Sunzha river, 58 miles north-east of Vladikavkaz, on the railway to Petrovsk. There are naphtha works close by. PoiDulation (1897), 15,599.

Grunbergf, a town of Prussia, province of Silesia, 34 miles by rail north-west from Glogau on the line to Frankfort -on -the -Oder. It has manufactures of straw hats, leather, and tobacco. There is a technical (textiles) school. Population (1885), 14,395; (1900), 20,987.

Gruy^re, a district in the Swiss canton of Freiburg, famous for its cheese. Properly the name belongs to the whole of the upper valley of the Saane above Bulle, but it is

often applied only to the Freiburg portion of this region, from Montbovon to BuUe, its capital. This region now forms the Gruyfere prefecture of the canton of Freiburg, and contained in 1900, 22,936 inhabitants, mainly Romanist and French-speaking. In 1900 the town of Bulle had 3317 inhabitants, while that of Gruyeres (spelt usually with the final ” s ” to distinguish it from the district) had 1383. A railway is projected from Bulle up the valley, and another from Montbovon to the Lake of Geneva^

The county of Gruyfere was seized in 1555 by Berne and Freiburg, the creditors of the last count. The Bernese portion of the upper Saane valley (capital, Chateau d’Oex), known as the ” Pays d’en Haut,” passed in 1798 to the Canton L6man (called Vaud after 1803). In 1893, 50,000 cwts. of cheese were exported from the Gruyere district (see also Daisy Farming).

Guadalajara, a province of Central Spain, with an area of 4869 Engfish square miles, divided into nine

administrative districts and 398 parishes. Its population decreased from 204,984 in 1887 to 199,290 in 1897. Outside agriculture there are no industries of any importance. This province is crossed by the Madrid-Saragossa railway, which has eleven stations and 70 miles of line in the province. There are 175 miles of first-class roads. The province contains 22 productive and 179 unproductive registered mines. The former employ 360 hands. The salt mines have an output of 9382 tons. In 1898 there were 2670 horses, 29,171 mules, 16,643 asses, 8055 cattle, 440,209 sheep, 51,059 goats, 17,330 pigs : 212,500 acres were devoted to wheat; 330,130 acres to other cereals, chiefly oats, rye, barley, maize ; 59,000 acres to vines ; and 45,000 acres to olives.

Guadalajara, capital of the above province.

A few modern buildings have been erected by the local corporations, such as the prison, provincial hospital, foundling hospital, institute for superior education, training schools for teachers of both sexes, and several primary schools. The once famous cloth manufacture has much

decayed. New manufactures of soap, woollens, leather, and bricks have been instituted. Population (1897), 11,075.

Guadalajara, a city of Mexico, and capital of the state of Jalisco. Population (1895), 83,934. It is the principal seat of the cotton and wool manufacturing industries of the country. The public buildings — the cathedral, mint, Degollado theatre, and state Capitol — are splendid specimens of Mexican architecture. The Paseo is a beautiful drive on both sides of the Kio San Juan de Dios. There are numerous parks, and a botanical garden ; the hospicio or home for the poor is a notable building. The town has tramways, electric lighting, &c.

Guadeloupe, a Prench colony in the Lesser Antilles, between Montserrat on the north and Dominica on the south. It has an area of 619 square miles, and consists of two islands, Grande Terre (255 square miles) and Basse Terre (364 square miles), separated by the Eiviere Salee (" Salt Eiver "), 4 miles long. The year is divided into the rainy season (July to November), the cool

season (December to March), and the dry season (April to June). Round Guadeloupe are grouped its dependencies, namely. La Desirade, 6 miles east, with an area of 10 square miles ; Marie Galante, 16 miles south-east, with an area of 55 square miles, traversed by the river St Louis ; Les Saintes, 7 miles south, one of the strategic points of the Antilles ; St Barthelemy, 95 miles north-west, with an area of 8 square miles (retroceded to Prance by Sweden in 1877) ; St Martin, 125 miles north-west, belonging to the extent of two-thirds to Prance, the remainder being Dutch. The population of Guadeloupe and its dependencies in 1887 was 182,000 ; but in 1898 it had fallen to 167,000, in consequence of the crisis in sugar production. In 1898 the men numbered 50,000, the women 63,500, and children 48,000. The immigrants, chiefly from India, numbered 15,500. The towns in the islands are: Basse Terre, the seat of government, with 7762 inhabitants ; Trois Eivi^res (6016), Vieux Habitants (3954), Pointe 4 Pitre (a magnificent port in Grande Terre, with 17,242 inhabit-ants), Laurentin (4355), Le Gossier (4611), Home 4

I'Eau (8442), LeMoule (10,378), Petit Bourg (6110), Petit Canal (6748), Port Louis (4393), Saint Anne (9497), Saint Francis (5265), and others. Grand Bourg, the capital of Marie Galante, has 6901 inhabitants. The administrative authority is vested in a governor, who is assisted by a privy council, and has under his orders a director of the interior, a procurator-general, and a paymaster. There is also an elective general council. The colony is divided into three arrondissements, and comprises thirty-four communes with elective municipalities. Political elections are very eagerly contested, the mulatto or negro element striving more and more to seize the power which has fallen from the hands of the old ruined colonists. The apostolic administrator resides at Basse Terre, where there is an appeal court, on which three civil tribunals are dependent (Basse Terre, Pointe a Pitre, and Marie Galante), besides eleven justices of the peace. The vagrancy problem in the colony is not the least serious which has to be dealt with. There is a lycie at Pointe a Pitre with 256 pupils, and a diocesan college at Basse Terre. One

hundred and one Government primary schools, with (in 1900) 248 teachers and 10,920 pupils, some conducted by the Eoman Catholic orders, are scattered throughout the colony. The budget for 1900 balanced at £198,760, and with the Government grant the expenditure on the colony was brought up to about £260,000. In addition the communes expend about £100,000. Altogether the local administration demands 60 per cent, of the total value of the productions. The garrison consists of only 250 men. About 126,000 acres, or a little more than a fourth part of the area of the colony, is cultivated, against 85,000 acres in 1873. Sugar-cane is still the leading crop, and the other crops are cereals, coffee, cacao, cotton, manioc, yams, and potatoes. The yield of sugar in 1875 amounted to 48,000 tons, in 1888 to 65,000 ; then, in consequence .of the fall in the price, a decadence began, which very seriously affected the prosperity of the colony, and in 1898 the crop only reached 36,000 tons. The importation of coolies from Asia and the concentration of the works in great factories were unable

to retard the crisis. The profit from the sugar industry is scarcely 6 per cent. Its centres are St Anne, Pointe a Pitre, andLe Moule. Coffee has not escaped the general depression, and the export in 1898 (670 tons) was only about half of that in 1878. The tendency, however, is to recover, and in 1899 the export was 780 tons. The export of cacao in 1899 was 410 tons. Worthy of mention also is the banana crop (200 tons). Tobacco culture, after a slight recovery, has again fallen away, as has the cultivation of vanilla. Porests cover 100,000 acres on the hills, but being difficult of access they are not worked. In 1898 the colony possessed 22,000 oxen, 11,000 sheep, 33,000 pigs, 8600 horses, and 11,000 asses and mules. Except sulphur and salt (9,900,000 bushels), no mineral substance is worked in Guadeloupe, but the thermal springs of the colony are regarded as valuable. Besides factories for sugar and distilleries for rum, there are establishments for pickled provisions and for chocolate manufacture. The commerce rose to £2,420,000 in 1878; in 1898 it had fallen to £1,450,000, of which

£744,000 was for imports and £706,000 for exports. Prance's share in the former sum was £365,000, in the latter £700,000. The largest items in the list of imports were, in order, farinaceous foods, animal products (hides, &c.), intoxicants, fish, and textiles. After France the United States, Great Britain, and India are the countries most interested in the import trade. The principal items in the exports — all but minute sums, it will be remembered, to France and her colonies — were: sugar, £468,000 ; coffee, £86,000; cacao, £45,800; rum, £39,500. The totals of the imports and exports in 1899 were almost the same as in 1898 : imports, £758,000 ; exports, £730,000. In 1899, 438′ vessels of 221,303 tons (metric) entered and 419 of 187,911 tons cleared. Eegular steam service is maintained between the colony and France and Great Britain.

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GUAM— GUAEANTEE

Guam (GuAHAN or Guajan), the largest island of the Ladrones or Mariannes, a group of islands in the North Pacific, situated in 13° 26′ N. lat. and 144° 39′ E. long., 1823 miles east by south of Hong-Kong, 1342 nautical miles south by east of Yokohama, and 4470 miles ■west-south-west of San Francisco. It is a United States naval station and port of call, being 1342 miles east of the Philippines and 3337 west by south of the Sandwich Islands (Honolulu). The island is the most southerly of the group, is surrounded by a dozen islets, measures 32 miles from north to south by 9 east to west, and has an area of 224 square miles. In the north it reaches an altitude of 1000 feet in Santa Eosa, and a low ridge runs parallel to the west coast in the southern half of the island. It is wooded in both the north and west. The coast is generally rocky, except in the south-east, where it is coral-built and low. The climate is excellent, with two distinct seasons, and the rainfall is distributed throughout the year. Destructive typhoons sometimes

visit the island, and earthquakes occasionally. The principal products are maize, sugar, potatoes, yams, bananas, oranges, and a few cocoanuts and pineapples. ‘The value of the island lies in its fine harbour of San Luis d’ Apra or Caldera, on the west coast, measuring 3^ miles across, with a depth of from 4 to 27 fathoms, and divided into an inner and an outer harbour by a peninsula and an island. Besides this there are several other coves and bays round the coast. The inhabitants are of the Chamorro stock (Indonesian), strongly intermixed with Philippine Tagals and Spaniards; and their speech is a dialect of Malay, corrupted by Tagal and Spanish. They number in all (1887), 8363; (1900), 9000, of whom 6185 live in the chief town Agana, 10 miles north-east of San Luis d’Apra. The island is administered by a naval governor. It was discovered by Magellan in 1521, occupied by Spain in 1688, and ceded to the United States by the Treaty of Paris on 10th December 1898.

Cuanabacoa, a town in Cuba, about 6 miles east of Havana, of which it is practically a suburb. Popular

tion (1899), 13,966.

Cuanajay, a town in Cuba, 22 miles south-west of Havana. It is situated in the midst of a fertile country, about 12 miles from the north shore of Pinar del Eio province. It has a handsome plaza and some imposing houses. Population (1899), 6483.

Guanajuato, a state of Mexico, bounded on the E”. by the state of San Luis Potosi, on the E. by that of Queretaro, on the S. by Michoacan, and on the W. by Jalisco. Area, 11,374 square miles. Population (1879), 834,845; (1900), 1,065,317. It is one of the most favoured regions of Mexico, its mining resources, fertility of soil, and railway communications bringing it great prosperity. The climate is temperate, the mean temperature being about 70° F. The principal agricultural products are cereals and leguminous plants of all kinds, tobacco, &o. Hogs, sheep, and goats are the principal animals raised. In 1897 the mineral production amounted to 149,507,042 kilograms, worth f 9,026,348. The total trade is about $67,000,000 a year. The Mexican Central

railway traverses the state in three directions. The industries comprise 350 woollen mills, 72 flour mills, distilleries, foundries, tanneries, &c. The state is divided into five departments and thirty-one partidos. The capital, Guanajuato, situated 250 miles by rail from Mexico City, has good public buildings, a mint, state coUege, several churches, two theatres, hospitals, a pantheon, and the castle of Granaditas; population, 39,404. The principal towns of the state are Celaya (21,245), Irapuato (18,593), Silao (15,437), Salamanca (13,121), AUende (12,740), Valle de Santiago (12,671), Salvatierra (11,008), Pozos (9506), Cortazar (8623), La Luz (8318), Penjamo (7658), Santa Cruz (7440), San Francisco del Einc6n (7111), Aoambaro (6958), Gonzalez (6097), Dolores Hidalgo (5949), Yuriria (5789), Moroleon (6716), Comonfort (5260).

Guantanamo, the easternmost town of the south coast of Cuba. It is the shipping port and centre of a coffee-, sugar-, and lime-growing district. Population (1899), 7137.

Guarantee (sometimes spelt “Guarantie” or
” Guaranty “). — This word and the word ” warrant ” are
probably both derived from the Teutonic word wahren,
which signifies to defend or make safe and binding.
” Guarantee ” is, however, a term more comprehensive and
of higher import than either ” warrant ” or ” security,”
and designates either some international treaty whereby
claims, rights, or possessions are secured, or more com-
monly a mere private transaction, by means of which one
person, to obtain some trust, confidence, or credit for
another, engages to be answerable for him.
In English law, a guarantee is a contract to answer for
the payment of some debt, or the performance of some
duty, by a third person who is primarily^iahle to such
payment or performance. It is a collateral contract,
which does not extinguish the original liability or obliga-
tion to which it is accessory, but on the contrary is itself
rendered null and void should the latter fail, as without
a principal there can be no accessory. The liabilities of
a surety are in law dependent upon those of the principal

debtor, and when the latter cease the former do so like-
wise (per Collins, L. J., in Stacey v. Hill, 1901, 1 K.B., at
666). If, therefore, persons wrongly suppose that a
third person is liable to one of them, and a guarantee is
given on that erroneous supposition, it is invalid db
initio, by virtue of the lex contractus, because its founda-
tion (which was that another was taken to be liable) has
failed {per Wills, J., in Mountstephen v. Ldkeman, L.E. 7
Q.B., p. 202).

The giver of a guarantee is called ” the surety,” or
” the guarantor ” ; the person to whom it is given ” the
creditor,” or ” the guarantee ” ; while the person whose
payment or performance is secured thereby is termed
“the principal debtor,” or simply “the principal.” In
America, but not apparently elsewhere, there is a recog-
nized distinction between “a surety” and “a guarantor”;
the former being usually bound with the principal, at
the same time and on the same consideration, while the
contract of the latter is his own separate undertaking, in
which the principal does not join, and in respect of

which he is not to be held liable, until due diligence has been exerted to compel the principal debtor to make good his default. There is no privity of contract between the surety and the principal debtor, for the surety contracts with the creditor,' and they do not constitute in law one person, and are not jointly liable to the creditor (per Baron Parke in Bain v. Cooper, 1 Dowl. E. (N.S.) 11, 14).

No special phraseology is necessary to the formation of a guarantee ; and what really distinguishes such a contract from one of insurance is not any essential difference between the two forms of words insurance and guarantee, but the substance of the contract entered into by the parties in each particular case (per Eomer, L. J., in Seaton V. Heath— Seaton v. Burnand, 1899, 1 Q.B. 782, 792, C.A. ; and see Dane v. Mortgage Insurance Corporation, 1894, 1 Q.B. 64 C.A.). In this connexion it may be mentioned that the different kinds of suretyships have been classified as follows : — (1) Those in which there is an agreement to constitu.te, for a particular purpose, the

relation of principal and surety, to which agreement the

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creditor thereby secured is a party ; (2) those in which there is a similar agreement between the principal and surety only, to which the creditor is a stranger ; and (3) those in which, without any such contract of suretyship, there is a primary and a secondary liability of two persons for one and the same debt, the debt being, as between the two, that of one of those persons only, and not equally of both, so that the other, if he should be compelled to pay it, would be entitled to reimbursement from the person by whom (as between the two) it ought to have been paid {per Earl of Selborne, L.C., in Duncan Fox and Co. y. North and South Wales Bank, 6 App. Cas., at p. 11).

The common-law requisites of a guarantee in no way differ from those essential to the formation of any other contract. That is to say, they comprise the mutual assent

of two or more parties, competency to contract, and, unless the guarantee be under seal, valuable consideration. An offer to guarantee is not binding until it has been accepted, being revocable till then by the party making it. Unless, however, as sometimes happens, the offer contemplates an express acceptance, one may be implied, and it may be a question for a jury whether an offer of guarantee has in fact been accepted. Where the surety's assent to a guarantee has been procured by fraud of the person to whom it is given, there is no binding contract. Such fraud may consist of suppression or concealment or mis-representation. There is some conflict of authorities as to what facts must be spontaneously disclosed to the surety by the creditor, but it may be taken that the rule on the subject is less stringent than that governing assur-ances upon marine, life, and other risks (T7te North British Insurance Co. v. Lloyd, 10 Exch. 523), though formerly this was denied {Owen v. Homan, 3 Mac. and G-. 378, 397). Moreover, even where the contract relied upon is in the form of a policy guaranteeing the solvency of a surety for

another's debt, and is therefore governed by the doctrine of uberrima fides, only such facts as are really material to the risk undertaken need be spontaneously disclosed {Seaton v. Bumand — Bumand v. Seaton, 1900, A.C. 136). As regards the competency of the parties to enter into a contract of guarantee, this may be affected by insanity or intoxication of the surety, if known to the creditor, or by disability of any kind. The ordinary disabilities are those of infants and married women — now greatly mitigated as regards the latter by the Married Women's Property Acts, 1870 to 1893, which enable a married woman to contract, as a feme sole, to the extent of her separate property. Every guarantee not under seal must have a consideration to support it, though the least spark of one suffices {per Wilmot, J., in Pillan v. Van Mierop and Hopkins, 3 Burr, at p. 1666 ; Barren v. Tmssell, 4 Taunt. 117), which, as in other cases, may consist either in some right, interest, profit, or benefit accruing to the one party, or some for-bearance, detriment, loss, or responsibility given, suffered, or undertaken by the other. In some guarantees the con-

sideration is entire — as where, in consideration of a lease being gi-anted, the surety becomes answerable for the performance of the covenants ; in other cases it is fragmentary, i.e., supplied from time to time — as where a guarantee is given to secure the balance of a running account at a banker's, or a balance of a running account for goods supplied {per Lush, L.J., in Lloyd's v. Harper, 16 Ch. Div., at p. 319). In the former case, the moment the lease is granted there is nothing more for the lessor to do, and such a guarantee as that of necessity runs on throughout the duration of the lease, and is irrevocable. In the latter case, however, unless the guarantee stipulates to the contrary, the surety may at any time terminate his liability under the guarantee as to future advances, &c. The consideration for a guarantee must not be past or executed, but on the other hand it need not comprise a direct benefit or advantage to either the surety or the creditor, but may solely consist of anything done, or any promise made, for the benefit of the principal debtor. It is more frequently executory than concurrent, taking the

form either of forbearance to sue the principal debtor, or of a future advance of money or supply of goods to him. Total failure of the consideration stipulated for by the party giving a guarantee will prevent its being enforced, as will also the existence of an illegal consideration. The statutory requisites of a guarantee are, in England, prescribed by (1) the Statute of Frauds, which, with reference to guarantees, provides that "no action shall be brought whereby to charge the defendant upon any special promise to answer for the debt, default, or miscarriages of another person, unless the agreement upon which such action shall be brought, or some memorandum or note thereof, shall be in writing and signed by the party to be charged therewith, or some other person thereunto by him lawfully authorized," and (2) Lord Tenterden's Act (9 Geo. IV. c. 14), which by § 6 enacts that " no action shall be brought whereby to charge any person upon or by reason of any representation or assurance made or given concerning or relating to the character, conduct, credit, ability, trade, or dealings of any other person, to the intent

or purpose that such other person may obtain credit, money, or goods upon " {i.e., "upon credit," see per Parke, B., in Lyde v. Barnard, 1 M. and W., at p. 104), "unless such representation or assurance be made in writing signed by the party to be charged therewith." This latter enactment, which applies to incorporated companies as well as to individual persons {Hirst v. West Hiding Union Banking Co., 1901, 2 K.B. 560 C.A.), was rendered necessary by an evasion of the 4th section of the Statute of Frauds, accomplished by treating the special promise to answer for another's debt, default, or miscarriage, when not in writing, as required by that section, as a false and fraudulent representation concerning another's credit, solvency, or honesty, in respect of which damages, as for a tort, were held to be recoverable {Pasley v. Freernan, 3 T.E. 51). In Scotland, where, it should be stated, a guarantee is called a " cautionary obligation," similar enactments to those just specified are contained in § 6 of the Mercantile Law Amendment Act (Scotland), 1856, while in the Irish Statute of Frauds (7 Will III. c. 12)

there is a provision identical with that found in the English Statute of Frauds. In India a guarantee may be either oral or written (Indian Contract Act, § 126). The Statute of Frauds does not invalidate a verbal guarantee, but renders it unenforceable by action. It may, therefore, be available in support of a defence to an action, and money paid under it cannot be recovered. An indemnity is not a guarantee within the statute, unless it contemplates the primary liability of a third person. It need not, therefore, be in writing when it is a mere promise to become liable for a debt, whenever the person to whom the promise is made should become liable (WUdes V. Dudlow, L.R. 19 Eq. 198; Guild v. Conrad, 1894, 2 Q.B. 885 G.A.). Neither does the statute apply to the promise of a del credere agent, which binds him, in consideration of the higher commission he receives, to make no sales on behalf of his principal except to persons who are absolutely solvent, and renders him liable for any loss that may result from the non-fulfilment of his promise. A promise to give a guarantee is, how-

ever, within the statute, though not one to procure a guarantee.

The general principles which determine what are guarantees within the Statute of Frauds, as deduced from a multitude of decided cases, are briefly as follows : — (1) the primary liability of a third person must exist or be

contemplated as tke foundation of the contract (BirTcmyr V. Darnell, 1 Sm. L.C., 10th. ed., p. 287 ; Mountstephen r. Lakeman, L.E. 7 Q.B. 196 ; L.R. 7 H.L. 17) ; (2) the promise must be made to the creditor ; (3) there must be an absence of all liability on the part of the surety independently of his express promise of guaraaitee; (4) the main object of the transaction between the parties to the guarantee must be the fulfilment of a third party's obligation; and (5) the contract entered into must not amount to a sale by the creditor to the promiser of a security for a debt or of the debt itself (see De Colyar's Law of Guarantees and of Principal and

Surety, 3rd ed., pp. 65-161, where these principles are discussed in detail by the light of decided cases there cited).

As regards the kind of note or memorandum of the guarantee that wUl satisfy the Statute of Frauds, it is now provided by § 3 of the Mercantile Law Amendment Act, 1856, that " no special promise to be made, by any person after the passing of this Act, to answer for the debt, default, or miscarriage of another person, being in writing and signed by the party to be charged therewith, or some other person by him thereunto lawfully authorized, shall be deemed invalid to support an action, suit, or other proceeding, to charge the person by whom such promise shall have been made, by reason only that the consideration for such promise does not appear in writing, or by necessary inference from a written document." Prior to this enactment, which is not retrospective in its operation, it was held in many cases that as the Statute of Frauds requires " the agreement " to be in writing, all parts thereof were required so to be, including the consideration moving to,

as well as the promise by, the party to be charged (Wain V. Walters, 5 East, 10 ; Saunders v. Wakefield, 4 B. and Aid. 595).~ These decisions, however, proved to be burdensome to the mercantile community, especially in Scotland and the north of England, and ultimately led to the alteration of the law, so far as guarantees are concerned, by means of the enactment already specified. Any writing embodying the terms of the agreement between the parties, and signed by the party to be charged, is sufficient ; and the idea of agreement need not be present to the mind of the person signing {per Lindley, L.J., in In re Hoyle — Hoyle T. Hoyle, 1893, 1 Ch., at p. 98). It is, however, necessary that the names of the contracting parties should appear somewhere in writing ; that the party to be charged, or his agent, should sign the memorandum or note of agreement, or else should sign another paper referring thereto ; and that, when the note or memorandum is made, a complete agreement shall exist. Moreover, the memorandum must have been made before action brought, though it need not be contemporaneous with the agree-

ment itself. As regards the stamping of the memorandum or note of agreement, a guarantee cannot be given in evidence unless properly stamped (Stamp Act, 1891). A guarantee for the payment of goods, however, requires no stamp, being within the exception contained in the fijst schedule of the Act. Nor is it necessary to stamp a written representation or assurance as to character within 9 Geo. IV. e. 14, supra. If under seal, a guarantee requires a ten-shilling stamp ; otherwise a sixpenny stamp suffices ; and, on certain prescribed terms, the stamps can be affixed any time after execution (Stamp Act, 1891, § 15, amended by § 18 of the Finance Act, 1896).

The liability incurred by a surety under his.guarantee depends upon its terms, and is not necessarily coextensive Extent of 'with that of the principal debtor. The surety surety's cauuot, howcver, be made liable except for a liability. j^gg gustained by reason of the default guaranteed against. It was formerly considered to be the duty of the party taking a guarantee to see that it was couched in language enabling the party giving it to understand

clearly to what extent he was binding himself (Nichol-
son V. Paget, 1 C. and M. 48). This view, however, can
no longer be sustained, it being now recognized that a
guarantee, like any other contract, must, in cases of
ambiguity, be construed against the party bound thereby,
and in favour of the pai'ty receiving it (Mayer v. Isaac,
6 M. and W. 605 ; Wood v. Priestner, L.E. 2 Exch. 66).
The surety is not to be charged beyond the limits pre-
scribed by his contract, which must be construed so as
to give effect to what may fairly be inferred to have
been the intention of the parties, from what they
themselves have expressed in writing. In cases of
doubtful import, recourse to parol evidence is permissi-
ble, to explain, but not to contradict, the written evi-
dence of the guarantee. As a general rule, the surety
is not liable if the principal debt cannot be enforced,
because, as already explained, the obligation of the
surety is merely accessory to that of the principal
debtor. It has never been actually decided in England
whether this rule holds good in cases where the prin-

cipal debtor is an infant, and on that account is not liable to the creditor. Probably in such a case the surety might be held liable by estoppel (see Kimball v. Newell, 7 Hill (N-Y.) 116). When directors guarantee the performance by their company of a contract which is ultra vires, and therefore not binding on the latter, the directors' suretyship liability is, nevertheless, enforceable against them (Yorkshire Railway Waggon Go. v. Maclure, 21 Ch. D. 309 C.A.).

It is not always easy to determine for how long a time liability under a guarantee endures. Sometimes a guarantee is limited to a single transaction, and is obviously intended to be security against one specific default only. On the other hand, it as often happens that it is not exhausted by one transaction on the faith of it, but extends to a series of transactions, and remains a standing security until it is revoked, either by the act of the parties or else by the death of the surety. It is then termed a continuing guarantee. No fixed rules of interpretation determine whether a guarantee is a continuing one or not, but each

case must be judged on its individual merits; and frequently, in order to achieve a correct construction, it becomes necessary to examine the surrounding circumstances, which often reveal what was the subject-matter which the parties contemplated when the guarantee was given, and likewise what was the scope and object of the transaction between them. Most continuing guarantees are either ordinary mercantile securities, in respect of advances made or goods supplied to the principal debtor, or else bonds for the good behaviour of persons in public or private offices or employments. With regard to the latter class of continuing guarantees, the surety's liability is, generally speaking, revoked by any change in the constitution of the persons to or for whom the guarantee is given. On this subject it is now provided by section 18 of the Partnership Act, 1890, which applies to Scotland as well as England, that "a continuing guarantee or cautionary obligation given either to a firm or to a third person in respect of the transactions of a firm, is, in the absence of agreement to the contrary, revoked g,s to future

transactions by any change in the constitution of the firm to which, or of the firm in respect of the transactions of which the guaranty or obligation was given." This section, like the enactment it replaces, namely, section 4 of the Mercantile Law Amendment Act, 1856, is mainly declaratory of the common law, as embodied in decided cases, which indicate that the changes in the persons to or for whom a guarantee is given may consist either of an increase in tiieir number, of a diminution thereof caused by death or retirement from business, or of the incorpora-

tion or consolidation of the persons to whom the guarantee is given. In this connexion it may be stated that the Government Offices (Security) Act, 1875, which has been amended by the Statute Law Revision Act, 1883, contains certain provisions with regard to the acceptance by the heads of public departments of guarantees given by companies for the due performance of the duties of an office or employment ia the public service, and enables

the Commissioners of His Majesty's Treasury to vary the character of any security, for good behaviour by public servants, given after the passing of the Act.

Before the surety can be rendered liable on his guarantee, the principal debtor must have made default. When, however, this has occurred, the creditor, in the absence of express agreement to the contrary, may sue the surety, without even informing him of such default having taken place, or requiring him to pay, and before proceeding against the principal debtor or resorting to securities for the debt received from the latter. In those countries where the municipal law is based on the Roman civil law, sureties usually possess the right, originally conferred by the Roman law, of compelling the creditor to sue the principal debtor before having recourse to the sureties. This right, according to a great American jurist (Chancellor Kent in Hayes v. Ward, 4 Johns. 'S&w York, Ch. Cas. p. 132), "accords with a common sense of justice and the natural equity of mankind." In England, however, this right has never been fully recognized ; but,

even in England, before any demand for payment has been made by the creditor on the surety, the latter can, as soon as the principal debtor has made default, compel the creditor, on giving him an indemnity against costs and expenses, to sue the principal debtor, if the latter be solvent and able to pay {per A. L. Smith, L. J., in Rouse V. Bradford Banking Company, 1894, 2 Ch. p. 75 ; per Lord Eldon in Wright v. Simpson, 6 Ves. at p. 733).

The usual mode of enforcing liability under a guarantee is by action in the High Court or in the County Court.

It is also permissible for the creditor to obtain redress by means of a set-ofE or counter-claim, in an action brought against him by the surety. On the other hand, the surety may now, in any court in which the action or the guarantee is pending, avail himself of any set-off which may exist between the principal debtor and the creditor. Moreover, if one of several sureties for the same debt is sued by the creditor or his guarantee, he can, by means of a proceeding termed a third-party notice, claim contribution from his co-surety towards the common liability. Independent

proof of the surety's liability under his guarantee must always be given at the trial ; as the creditor cannot rely either on admissions made by the principal debtor, or on a judgment or award obtained against him {ExparteYowng In re Kitchin, 17 Ch. Div. 668). Should the surety become bankrupt either before or after default has been made by the principal debtor, the creditor will have to prove against his estate. This right of proof is now regulated by the 37th section of the Bankruptcy Act, 1883, which is most comprehensive in its terms.

A person liable as a surety for another under a guarantee possesses various rights against him, against the person to whom the guarantee is given, and also against ^areUes' those who may have become co-sureties in respect of the same debt, default, or miscarriage.

As regards the surety's rights against the principal debtor, the latter may, after he has made default, be compelled by the surety to exonerate him from liability by payment of the guaranteed debt (per Sir W. Grant, M.R., in Antrohus v. Davidson, 3 Meriv. 669, 679; per

Lindley, L.J., in Johnston v. Salvage Association, 19 Q.B.D. 460, 461 ; and see Wolmershausen v. Ghdlich, 1893, 2 Ch. 514). The moment, moreover, the surety has himself paid any portion of the guaranteed debt, he is entitled, if the suretyship was undertaken at the principal debtor's actual or constructive request, but not otherwise, to rank as a creditor for the amount so paid, and to compel repayment thereof. In the event of the principal debtor's bankruptcy, the surety can prove against his estate, not only in respect of payments made before such bankruptcy, but also, it seems, in respect of the contingent liability to pay under the guarantee. As regards the rights of the surety against the creditor, they are exercisable even by one who in the first instance was a principal debtor, but has since become a surety, by arrangement with his creditor, duly notified to the creditor, though not even sanctioned by him. This was decided by the House of Lords in the case of Rouse v. The Bradford Banking Co. (1894, A.C. 686), removing a doubt created by the previous case of Swire v. Redman (1 Q.B.D. 636), which must

now be treated as overruled. The surety's principal right against the creditor entitles him, after payment of the guaranteed debt, to the benefit of all securities, whether known to him (the surety) or not, which the creditor held against the principal debtor ; and where, by default or laches of the creditor, such securities have been lost, or rendered otherwise unavailable, the surety is discharged pro tanto. This right, which is not in abeyance till the surety is called on to pay (Dixon v. Steel, 1901, 2 Ch. 602), extends to all securities, whether satisfied or not, given before or after the contract of suretyship was entered into. On this subject the Mercantile Law Amendment Act, 1856, § 5, provides that " every person, who being surety for the debt or duty of another, or being liable with another for any debt or duty, shall pay such debt or perform such duty, shall be entitled to have assigned to him, or to a trustee for him, every judgment, specialty, or other security, which shall be held by the creditor in respect of such debt or duty, whether such judgment, specialty, or other security shall or shall not

be deemed at law to have been satisfied by the payment of the debt or performance of the duty, and such person shall be entitled to stand in the place of the creditor, and to use all the remedies, and, if need be, and upon a proper indemnity, to use the name of the creditor, in any action or other proceeding at law or in equity, in order to obtain from the principal debtor, or any co-surety, co-contractor, or co-debtor, as the case may be, indemnification for the advances made and loss sustained by the person who shall have so paid such debt or performed such duty ; and such payment or performance so made by-such surety shall not be pleadable in bar of any such action or other proceeding by him, provided always that no co-surety, co-contractor, or co-debtor shall be entitled to recover from any other co-surety, co-contractor, or co-debtor, by the means aforesaid, more than the just proportion to which, as between those parties themselves, such last-mentioned person shall be justly liable." This enactment is so far retrospective that it applies to a contract made before the Act, where the breach thereof, and the payment

by the surety, have taken place subsequently. On the principal debtor becoming a bankrupt, the surety who has paid the guaranteed debt has a right to all dividends received by the creditor from the bankrupt in respect thereof, and to stand in the creditor's place as to future dividends. This right is, however, often waived by the guarantee stipulating that, until the creditor has received J^U payment of all sums due to him from the principal debtor, the surety shall not participate in any dividends distributed from the bankrupt's estate amongst his creditors.

As regards the rights of the surety against a co-surety, he is entitled to contribution from him in respect of their common liability. This particular right is not the result of

any contract, but is derived from a general equity, on the ground of equality of burden and benefit, and exists whether the sureties be bound jointly, or jointly and severally, and by the same, or different, instruments.

There is, however, no right of contribution where each surety is severally bound for a given portion only of the guaranteed debt ; nor in the case of a surety for a surety ; nor where a person becomes a surety jointly with another, and at the latter's request. Contribution may be enforced, either before payment, or as soon as the surety has paid more than his share of the common debt (Wolmershausen v. Oullick, 1893, 2 Ch. 514) ; and the amount recoverable is now always regulated by the number of solvent sureties, though formerly this rule only prevailed in equity. The right of contribution is not the only right possessed by co-sureties against each other, but they are also entitled to the benefit of all securities which have been taken by any one of them as an indemnity against the liability incurred for the principal debtor.

The discharge of a surety from liability under his guarantee may be accomplished in various ways, he being regarded as a " favoured debtor " {per Turner, L. J., in Wheatley v. Bastow, 7 De G. M. and G. 279, 280; per Earl of Selborne, L.C., in In re Sherry — Londonand County

Banking Co. v. Terry, 25 Ch. D., at p. 703). Thus, fraud subsequent to the execution of the guarantee (as where, for example, the creditor connives at the principal debtor's default) will certainly discharge the surety. Again, a material alteration made in the instrument of guarantee after its execution may also have this effect. The most prolific ground of discharge, however, is usually traceable to causes originating in the creditor's laches or conduct, the governing principle being that if the creditor violates any rights which the surety possessed when he entered into the suretyship, even though the damage be nominal only, the guarantee cannot be enforced. On this subject it suffices to state that the surety's discharge may be accomplished (1) by a variation of the terms of the contract between the creditor and the principal debtor, or of that subsisting between the creditor and the surety ; (2) by the creditor taking a new security from the principal debtor in lieu of the original one ; (3) by the creditor discharging the principal debtor from liability ; (4) by the creditor binding himself to give time to the principal debtor for payment of

the guaranteed debt ; or (5) by loss of securities received by the creditor in respect of the guaranteed debt. A revocation of the contract of suretyship by act of the parties, or in certain cases by the death of the surety, may also operate to discharge the surety. The death of a surety does not per se determine the guarantee, but, save where from its nature the guarantee is irrevocable by the surety himself, it can be revoked by express notice after his death, or, it would appear, by the creditor becoming affected with constructive notice thereof ; except where, under the testator's will, the executor has the option of continuing the guarantee, in which case the executor should, it seems, specifically withdraw the guarantee in order to determine it. Where one of a number of joint and several sureties dies, the future liability of the survivors under the guarantee continues, at all events until it has been determined by express notice. Moreover, when three persons joined in a guarantee to a bank, and their liability thereunder was not expressed to be several, it was held that the death of one surety did not deter-

mine the liability of the survivors. In such a case, how-
ever, the estate of the deceased surety would be relieved
from liability.

The Statutes of Limitation bar the right of action on
guarantees under seal after twenty years, and on other
guarantees after six years, from the date when the creditor
might have sued the surety.

Authorities. — De Coltak. Law of Guarantees and of Prin-
cipal and Surety, 3rd edition, 1897 ; American edition, by J. A.
Morgan, 1875. — Theoop. Validity of Verbal Agreements.— Fx-lt..
Guarantees, 2nd edition. — Theobald. Law of Principal and
Surety. — Brandt. Law of Suretyships and Guarantee.

(h. a. de C.)

Guard a, a district of Portugal, on the watershed
between the Tagus and the Douro, with an area of 2086
square miles, and a population of 263,292 in 1900. Wine
is the principal product, especially in the communes of
PoscSa, Mgda, Gouveia, and Ceia. Corn, i.e., wheat,
millet, barley, and rye, is also extensively cultivated.
Woollens are made at Gouveia, Manteigas, and Guarda.

The live stock, consisting principally of sheep, are estimated to amount (in value) to 3-4 per cent, of the entire kingdom. The capital, Guarda, an episcopal see, stands on a plateau at the north end of the Serra da Estrella, 81 miles south-east of Oporto. It has a sanatorium for consumptives. Population, 5990.

Guatemala, a country of Central America, lying between 13° 42′ and 17° 49′ N. lat., and 88° 10′ and 92 ° 30′ W. long. The frontier towards Mexico was determined by conventions of 27th September 1882, 17th October 1883, 1st April 1895, and 8th May 1899. Starting from the Pacific, it ascends the river Suchiate, then follows an irregular line towards the north-east, till it reaches the parallel of 17° 49′ N. lat., along which it runs to the frontier of British Honduras. This frontier, by the convention of 9th July 1893, coincides with the meridian of 89° 20′ W. long, till it meets the river Sarstun, which it follows eastwards to the Gulf of Honduras. The climate is healthy, except on the coast lands, where malarial fever is prevalent. The rainy

season in the interior lasts from May to October, but on the coast sometimes continues till December. The coldest month is January, and the warmest is May. The average temperatures for these months at places of different altitudes are given by Dr Sapper as follows : —

Locality.

Altitude

(Feet.)

Fahrenheit Degrees,

January.

May.

Puerto Barrios .

Salami ....

Campur ....

Chimax ....

Guatemala ....

Quezaltenango

6

3020

3050

4280

4870

7710

74

68

64

61

60

50

81

77

73

68

67

62

Area and Population. — The area is calculated at 48,300 square miles, and the population in 1900 was put at 1,674,340.

According to the returns of the census taken 26th February 1893, the population was 1,364,678 (females, 687,206 ; males, 677,472),

of whom 882,733 were Indians : about 60 per cent, of the population are Indians, the rest are Ladinos, people of mixed blood, negToes, mulattoes, zambos, and half-caste Indians, the number of pure whites being very small. The foreign population (1893) numbered ll,331, including 1303 Americans (mostly Jews from the west), 532 Spaniards, 453 Italians, 399 Germans, 349 English, 272 French. By occupation, 327,594 persons were labourers, 46,054 bakers, 21,930 weavers, 13,034 merchants, 9653 seamstresses, 7759 servants and female cooks. The rural population numbered 827,058 ; inhabitants of cities and towns, 526,666 ; and those of special settlements, 1.0,954.

The principal towns, with their populations in 1893, are: Gautemala, 72,000; Quezaltenango, 16,000^; Antigua, 9000 ; AtitMn, 9000 ; San Cristdbal, 9000 ; Momostenango, 8000; Tacana, 7000; Cob^n, 6000; Nebaj, 6000; Totonicapam, 5000 ; Escuintla, 5000.

1 This town was entirely destroyed at the end of April 1902 by an earthquake, hut preparations for its rebuilding were promptly begun.

Oovei-nment. — According to the constitution of 1879, the legislative power is vested in a national assembly of 69 deputies (1 for every 20,000 inhabitants) chosen for 4 years by direct popular vote in 38 electoral districts. The president of the Eepublic is elected in a similar manner, but for 6 years, and he is not eligible for the following term. He is assisted by 6 ministers, heads of Grovernment departments, and by a council of state of 9 members, 4 of whom are appointed by himself and 5 by the national assembly. The two vice-presidents of the Eepublic are elected by the national assembly.

Local Government. — Each of the 22 departments is administered by an of&cial called a Jefe Politico, or political chief, appointed by the president of the Eepublic, and each is subdivided into municipal districts, of which there are altogether 331. These districts are administered by one or more alcaldes or mayors, assisted by municipal councils, both alcaldes and councils being chosen by the people.

Justice. — The judicial power is vested in a supreme court, con-

sisting of a chief-justice and four associate justices, elected by the people ; six appeal courts, each with three judges, also elected by the people ; and twenty -nine courts of first instance, each consists ing of one judge appointed by the president, and two by the chdef-justioe of the supreme court.

Meligion and Instruction. — The prevailing form of religion is the Roman Catholic, but the state recognizes no distinction of creed. The establishment of conventual or monastic institutions is prohibited. Of the population in 1893, 90 per cent, could neither read nor write, 2 per cent, could only read, and 8 per cent, could read and write. Primary instruction is compulsory, and, in Government schools, is provided at the cost of the state. In 1895 there were 1266 Government schools, with a total attendance of 64,015 (39,411 boys and 24,604 girls). But there are, besides, about 50 private (occasionally aided) schools of similar character, owners of plantations on which there are more than 10 children being obliged to provide school accommodation. Higher instruction is given in two national institutes at the capital, one for men with 500 pupils, and one for women with 300. At Quezaltenango there are two similar institutes, and at Chiquimula there are other two. To each

of the six there is a normal school attached, and within the Republic there are 4 other normal schools. Tor professional instruction (law, medicine, engineering) there are 4 schools, supported by private funds, but aided occasionally by the Government. Other educational establishments are a school of art, a national conservatory of music, a commercial college, 4 trades' schools with more than 600 pupils, and a national library. For the year 1901 the expenditure of the state on instruction was put at 1,513,900 pesos.

Defence. — For the white and mixed population military service is compulsory ; from the eighteenth to the twenty-fifth year of age, in the active army, and from the twenty-sixth to the fiftieth, in the reserve. The effective force of the active army is put at 56,900, of the reserve at 29,400.

Finance. — Of the revenue of Guatemala about 36 per cent, is derived from liquor and tobacco taxes ; 28 per cent, from import and export duties; 9 per cent, from property, road, military, slaughter, and salt taxes ; 1-7 per cent, from the gunpowder monopoly ; and the remainder from various taxes, stamps. Government lands, and postal and telegraph services. The spending departments are chiefly those of war, government, and internal

development. The gold value of the currency peso fluctuates between limits so wide that conversion into sterling (especially for a series of years), with any pretension to accuracy, is impracticable. In 1899 the rate of exchange moved between 710 per cent, and 206 per cent, premium on gold. Between 1892 and 1899 the gross revenues collected were as follows in currency pesos : —

Year.

Pesos.

Tear.

Pesos.

1892

1893

1894

1895

8,660,490

10,442,750

11,851,030

14,491,670

1896

1897

1898

1899

15,150,740

12,479,740

9,738,661

8,566,910

The cash receipts and expenditure of the Treasury for 1896-1

ere : — i 1 1 1

were

Tear.

Receipts.

Expenditure.

Pesos.

Pesos.

1896

18,351,900

17,437,450

1897

22,073,590

21,433,190

1898

9,183,340

9,964,830

1899

5,946,120

5,937,281

For the year 1900-1 the revenue was estimated at 9,620,000

pesos, and the expenditure at 9,611,200 pesos.

At the end of 1899 the outstanding debt of the Republic was as

follows : —

Consolidated external debt .

Muller and Thomsen loan

German syndicate loan (1897)

German syndicate loan (1898)

Other gold debts

Silver debt (internal loans, note issue, &c.),

25,763,776 pesos = ...

£1,542,112

39,275

101, -500

24,850

109,745

1,167,000

Total 2,984,482

The amount of the consolidated external debt includes arrears of interest. An agreement made in 1895 for the service of this debt was speedily broken by the Government, and another, made in 1898, fared little better, the funds assigned as security for its service being applied to the reduction of the more recent debts due to the German syndicates. At the end of 1899 the assets of the Republic, including national lands, railways, &c., were put at 32,535,300 silver pesos (£2,400,000).

Production. — The most important products of Guatemala are coffee and sugar, and the richest districts for the cultivation of these crops are on the Pacific slope of the range of volcanic mountains running parallel to the coast. On the Atlantic side of the mountains there are also coffee plantations, but in this region progress has been slower. Both in the west and east the most flourishing are the German plantations, which have a total area of more than 1000 square miles, and yield about one-third of the

total coffee produce of Guatemala. In both regions the uncultivated land is overgrown with dense tropical forest, the area of which has perceptibly diminished only in the west. The extension of coffee cultivation is shown by the increase of the crop at intervals of five years since 1881, as follows : —

Tear.

Lbs.

Tear.

Lbs.

1881

1886

1891

1896

26,037,200

52,975,100

52,449,500

68,773,633

1897

1898

1899

82,475,-585

82,603,283

84,194,460

Sugar, which was largely exported from 1882 to 1890, is now again grown in considerable quantities. In 1898 the area under sugar-cane was 40,768 acres, and the yield amounted to 11,356,900 lb of white sugar, 141,620 bags of brown sugar, 13,494,425 lb of molasses, and 3,482,900 lb of inferior sugar. Cocoa-trees are planted in the lowlands to the number of 1,251,830, on an area of 7504 acres, the yield amounting in 1899 to 187,200 lb. There were 11,872 acres under bananas, yielding 910,500 bunches. Tobacco covered 1680 acres, yielding 935,000 H). Cereals and other agricultural produce grown in small quantities include wheat, potatoes, rice, maize (860,107 bushels on 221,648 acres in 1898), beans (29,310 bushels on 15,456 acres). Rubber-trees are planted in the lowlands, and the production increases. In 1899 the export amounted to 513,800 Jb. The cattle industry is prosperous, and hides and skins are exported. In 1898 the live stock within the Republic consisted of 196,768 cattle, 60,343 horses, 77,593 sheep, and 29,784 swine. Gold washing is carried on by natives in a primitive manner on the banks

of the Motagua river in the departments of Izabal and Baja Verapaz. Salt mines abound in the departments of Alta Verapaz and Santa Rosa. Silver, iron, copper, lead, cinnabar, coal, and mica are found in different localities on the eastern side of the Republic. Mining, however, has not been undertaken on a large scsde, and it is still doubtful whether the minerals known to exist in the country could be obtained in paying quantities. There are no manufactures of any importance. Coarse cotton and woollen stuffs are woven, and hats, shoes, agricultural implements, and other articles are made, but not in sufficient quantities to supply local demands.

Commerce. — The imports into Guatemala consist mainly of cotton goods and yarn, flour, sacks, and iron implements. The exports are coffee, sugar, and a few other products. The imports during the five years 1891-95 were of the average annual value (5 gold pesos = £1) of £1,442,000; in the year 1896, £1,828,670; in 1897, £1,373,600 ; in 1898, £970,160. The exports in the years 1891-95 amounted to the average annual value of (at 13-5 silver pesos=£l) £1,431,700; in 1896, £1,710,000; in 1897, £1,464,800; in 1898, £1,139,000; in 1899, £1,674,000. In 1899 the values of the principal exports were: coffee, £1,478,100; sugar, £50,070;

bananas, £23,610; rubber, £51,380; hides and skins, £53,550; cocoa, £193. Of the imports, about 90 per cent, in value come from the four countries named in the following table, which shows the value imported from each of them in 1898 and 1899. It should be remembered that German trade is much assisted by the numerous German planters within the Republic : —

Countries.	1898.	issia.
United States . .	£309,829	129,689
Great Britain . .	187,568	43,467
Germany	£227,369	
France		

157,429

133,051

35,728

Of the exports, the United States in 1899 took ahout 18 per cent, of the coffee, all the bananas, and 50 per cent, of the rubber ; Great Britain took 22 per cent, of the coffee and 15 per cent, of the rubber ; Germany took 55 per cent, of the cofEee and 33 per cent, of the rubber.

/Shipping and Communications. — The Republic is in regular steam communication on the Atlantic side with New Orleans, New York, and Hamburg, by Tessels which visit the ports of Barrios and Livingston, On the western side the ports of San Jos6, Champerieo, and Oc6s are visited by the Pacific mail steamers, by the vessels of a Hamburg company, and by those of the South American (Chilian) and the Pacific Steam Navigation Companies. In 1898 altogether 825 vessels entered and 845 cleared at the ports of the Republic. The principal towns are connected by waggon roads, towards the construction and maintenance of which each male inhabitant is required to pay two pesos or give four days' work a year. There are coach routes between the capital and

Quezaltenango and Antigua, but over a great portion of the country transport is still on mule-baok. The railways in operation are the Southern (or Central), 75 miles, from the capital to San Jos6, belonging to an American company ; the “Western, 41 miles, from Champerieo to Retalhuleu and San FiLip6, belonging to a Guatemalan company, but largely under German management ; and the Northern, 133 miles, from Port Barrios to El Ranoho, a Government line, which is intended to be continued to Guatemala city (60 miles), so that, with the Southern railway, there may be an interoceanic system. For local traffic there are several lines; one from Iztapa, near San JosS, to Naranjo, and another from Oc6s to the western coffee plantations. On the Atlantic slope transport is efEected mainly by river tow-boats from Livingston along the Dulce Gulf and other lakes, and the Polochie river as far as Panzos. The narrow-gauge railway that serves the German plantations in the Verapaz region is largely owned by Germans.

Post and Telegraph. — Guatemala joined the Postal Union in 1881, but the international postal service has suffered from the financial rottenness of the Government, which was in debt to the

Panama Railway Company and to a New Orleans steamboat company for conveyance of mail packets. The international postal movement in 1899 comprised the despatch of 328,112 and the receipt of 401,598 letters and packets. The total movement in 1898 consisted of the receipt of 2,769,543 and the despatch of 2,771,035 pieces of mail. In 1899 the telegraph lines had a length of 3126 miles, with 148 offices, through which 786,046 messages were sent. In and around the capital and Quezaltenango telephone services have been provided by private companies.

Money and Credit.— Within the Republic there are six banks of issue, to which the Government is deeply indebted. There is practically neither gold nor silver in circulation, and the value of the bank-notes is so fluctuating that trade is seriously hampered. In order to ease its own position and give general relief at a time of financial crisis the Government, on 29th October 1898, empowered a committee of the banks to increase the note circulation by the issue of 6,000,000 pesos of paper money in 1-, 5-, and25-peso notes. This arrangement did not include a supply of fractional money necessary for retail transactions, and during the last six months of 1899 the only notes of smaller denomination than a peso were the

cedulas, issued by municipalities, and current only vrithin their several limits. In the course of 1899 fractional silver coins, -500, •600, and -835 fine, were put in circulation to the nominal value of 346,373 pesos, but these, vanishing as soon as issued, made no appreciable difference. In August 1899 the Government made a further contract by which the banks that were parties to it were each authorized to issue, in addition to their earlier issues, small notes to the amount of 100,000 pesos. Since then other issues of small notes have been authorized to take the place of notes of larger denomination ; and a later measure provided for the coining of 3,000,000 pesos of fractional nickel money, which will be legal tender only for payment of amounts strictly limited. The silver peso, the monetary unit, weighs 25 grammes -900 fine. The metric system of weights and measures has been adopted.

History. — The recent history of Guatemala is mainly a record of political, military, and financial trouble. President Eufino Barrios, elected in 1873, governed the country after the manner of a dictator ; and though he encouraged education, promoted railway and other enterprises, and succeeded in settling dif&culties as to the Mexican

boundary, the general result of his policy was baneful. Conspiracies against him were rife, and in 1884 he narrowly escaped assassination. His ambition was to be the restorer of the federal union of the Central American States, and when his efforts towards this end by peaceful means failed, he had recourse to the sword. Counting on the support of Honduras and Salvador, he proclaimed himself, in February 1885, the supreme military chief of Central America, and claimed the command of all the forces within the five states. President Zaldivar, of Salvador, had been his friend, but after the issue of the decree of union he entered into a defensive alliance with Costa Eica and Nicaragua. In March Barrios invaded Salvador, and on 2nd April a battle was fought, in which the Guatemalan president was killed. He was succeeded as president by General Barillas. No further effort was made to force on the union, and on 16th April the war was formally ended. Peace, however, only provided opportunity for domestic conspiracy, with assassination and revolution in view. In 1892, General Eeina Barrios was elected presi-

dent, and in 1897 he was re-elected ; but on 8th February jl898 he was assassinated. Senor Morales, vice-president, succeeded him ; but in the same year Don Manuel Estrada Cabrera was elected president for the term ending 1905. With the exception of brief intervals of quarrelling with neighbouring states, Guatemalan activity has been chiefly devoted to political disturbance and insurrection.

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Guatemala, or more exactly Guatemala la NuEVA, capital of the Eepublic, situated in the middle of a broad plain. It lies about 5000 feet above sea-level, and is surrounded on all sides by mountains and volcanoes. It is 75 miles N. of San Jose, on the Pacific, with which it is connected by railway, and 190 mUes S.E. of Puerto Barrios, on the Gulf of Honduras, with which also there is railway communication. In preparation for the exhi-bition of 1897 much was done to improve the town. The boulevards, which extend to a distance of 3 miles from

the city, have undergone extensive repairs, and form a fine carriage drive ; a park, La Eeforma, has been laid out, and the presidential palace and other public buildings have been erected. The city has suffered somewhat from a fall in the price of coffee, the depression of silver, and other causes, but with the completion of the railway to Puerto Barrios a rapid increase of prosperity is anticipated. The foreign trade is mainly in the hands of Germans. The population in 1893 was 71,525, five-sixths being of European origin.

Cuayama, a small town of Porto Eico, the capital of a province of the same name, situated about 10 miles fi-om the south coast. The natural port is Arroyo. It is connected by fine highways with San Juan and Ponce. Population (1899), 5334.

Guayaquil, a city and port of Ecuador, and capital of the province of Guayas. Population (1890), 44,772, of whom 4378 were foreigners ; (1900), about 61,000.

There is a weekly service of steamers, British and Chilian, north and south, and nineteen-twentieths of the commerce of Ecuador now passes through the port. The following table shows the number of foreign vessels entered and cleared at the port during the years 1896-98 : —

1896.

1897.

1898.

Ships.

Tonnage.

Ships.

Tonnage.

Ships.

Tonnage.

Entered

Cleared

201

197

267,931

264,240

192

192

265,208

265,208

206

200

298,805

290,855

The value of the exports — chiefly cocoa, coffee, sugar, hides, and fruits— in 1896 was £1,088,919; in 1897, £1,217,628; in 1898, £1,678,170; in 1900, £1,245,531. A railway line runs from Duran on the east bank of the Guayas, opposite Guayaquil, to Chimbo, 60 miles from Duran, and its extension to Quito is now being pushed. After its devastation by fire in 1896 the greater part of the business portion of the city was rebuilt in better style, but on 30th November 1899 a fire broke out in the centre of the city, which in a few hours destroyed some of the most important public buildings, including the theatre, the San Jose Church, the San Vincente Col-

lege, and the main offices of the Custom House. A large brewery has been established, and there are cotton and woollen mills, sugar refineries, soap works, chocolate factories, &c. The city is connected with the telegraph cable, and has several tramway lines, electric lighting and telephone service.

Cuayra, La, or La Guaika, a town and port of Veaezuela, in the province of Caracas, from which it is distant 23 miles by rail ; an important port for foreign trade. In 1898, 325 steamships entered the port, 84 of which were British, 39 American, and 70 Trench. The total shipments of the most valuable exports for the same year were : coffee, 30,256,911 lb ; cacao, 11,466,078 lb ; skins, 89,729 lb ; hides, 2,091,112 tb ; and sabadilla, 171,769 ft) ; and in 1899 the weight of coffee shipped was 18,944,000 ft ; of cacao, 11,399,000 ft ; and of hides, 2,155,000 ft. The total amount of the import duties collected in 1898 was £623,191. One of the most important engineering works in Venezuela is the La Guayra breakwater, built by an English company, over 2000 feet

long and 40 feet deep at the extreme point.

Cubbio, a town and bishop's see of the province of PerHgia, Umbria, Italy, on the Florence-Ancona line, 68 miles west by south from Ancona by rail. Amongst the public buildings may be mentioned the town hall, containing a museum of pictures, wood-carving of the 15th and 16th centuries, MSS., &c., and the famous Eugubine tables. The manufacture of rose-tinted lustred ware is still pursued with success. Silk-throwing and the making of cement are also carried on. Population (1881), 6290 ; (1899), 5500.

Cuelderland, or Gelderland, formerly a duchy, now a province of the Netherlands. It consists of three very distinct regions. The first, formerly the Graafschap Zutphen, lies east of the river Yssel, with diluvial sand and gravel, sloping from east to west (131 to 26 feet, and

with its rivers accordingly flowing in the same direction to join the Yssel. The extreme east is occupied by older Tertiary loam, upon which and on the river banks are the most fertile spots, woods, cultivated land, pastures for the cattle bred in the district, towns and villages, with a population of Saxon origin. Farther from the rivers lie heaths, small fens, and sand. The second region, or the Veluwe (" bad land "), lies west of the Yssel, is varied by hills (164 to 328 feet), and has a soil of sand and gravel, with clay only along the banks of the Yssel and its feeders. Between the Veluwe hUls and the Utrecht ridge the Geldersch valley, formed by the diluvial Ehine, is ill-drained by the Grift into the Zuider Zee. All over the Veluwe are heaths, scantUy cultivated (rye and buck-wheat), cattle of inferior quality, and sheep, and a sparse population. It is only on grounds sloping to the rivers Yssel and Ehiae that large forests have attracted a denser population of mixed origin. The third region, or the Betuwe (" good land "), lies south of the Yssel and Ehine, has a level clay soil, varied by isolated hills and a sandy

stretch hx the direction of Nimeguen. A denser population, mainly of Erankish origin, is occupied in the cultivation of wheat, beetroot, and orchards, the breeding of excellent cattle, shipping, and industrial pursuits. Guelderland is the largest province in the kingdom, having an area of 1906 square mUes. Population (1873), 437,778 ; (1900), 566,649.

Cuelph, a city (1879) of Ontario, Canada, 45 miles W. by S. of Toronto, on the river Speed and the Grand Trunk and the Canadian Pacific railways. It contains, in addition to the county and municipal buildings, the Ontario Agricultural College. The exports in 1899-1900 were valued at $734,346, imports at $869,280. Population (1881), 9890 ; (1900), 11,087.

Guernsey. See Channel Islands.

Guerrero, a state of Mexico, bounded on the IST. by the states of Mexico and Morelos, on the N.E. by that of Puebla, on the E. and S.E. by Oaxaca, and on the S.W. by the Pacific. Area, 25,003 square miles. Population in 1879, 295,590; and in 1900, 474,594. The

state lacks communication facilities, and its territory is mountainous. The principal agricultural products are cereals, coffee, cacao, vanilla, tobacco, textile fibres, &c. These products are valued at about $2,000,000 a year. Gold, silver, mercury, lead, iron, coal, sulphur, &e., are found in the state, but lack of communication retards their working. The capital is Chilpancingo (6312) ; amongst other towns are Chilapa (8266), Iguala (6631), Tixtla (6588), Acapulco (5770).

Guiana, an extensive region in the north-east of South America, divided between Great Britain, France, Holland, Brazil, and Venezuela. British, French, and Dutch Guiana have certain common physical characteristics. In all three countries different regions must be distinguished : the northern plain, consisting of alluvium deposited by the sea and rivers, 18 to 60 miles in breadth; the gneiss and diabase, forming the beds of the rivers ; and the slate formation on the surface, covered in the south by granite. Difference of structure, modified by atmospheric conditions, causes corresponding differences in the

surface relief and in vegetation, forming three natural divisions. (1) The fiat coast region, with reed-bordered marshes, ridges of shells and sand indicating the former shore lines, and, near the rivers, sand and blue clay or humus. Here plantations have been formed on drained and dyked lands. (2) The higher and drier savannahs, in the east much nearer to the coast than in the west, covered with sand, and overgrown with grass, shrubs, and thin forests. (3) The undulating country rising into forest-covered hills and mountains, as the Tumuc-Humac and Acarai mountains on the southern frontier ; the Nassau, Brokopondo, and Mindrineti mountains, respec-tively near the Maroni and the Surinam and between the latter river and the Saramacca. The character of th»

river channels, the rainfall, and tides affect the navi-gability of the waterways. Generally speaking, in the large rivers flowing south to north vessels of 16 feet draught can ascend with the tide three or four hours' sail from the sea, and vessels drawing 6|- to 9^ feet

can ascend still higher in the dry season. The middle stretches up to the rapids or cataracts are navigable for canvas boats.

I. British Guiana, the only British possession in South America, lying between 9° and 1° IST. lat. and between 57° and 62° W. long. Its area is over 110,000 square miles, of which only about 130 square miles are under cultivation. Its coast-line from east to west measures 300 miles, while from north to south there is a lineal depth of more than 550 miles. It is bounded on the N. by the Atlantic! Ocean, on the E. by Dutch Guiana, on the W. by Venezuela, and on the S. by Brazil. The .boundary line between British Guiana and Venezuela was for many years till 1899 the subject of dispute. The Dutch, while British Guiana was in their possession, claimed the whole watershed of the Essequibo river, while the Venezuelans asserted that the Spanish province of Guayana extended up to the Essequibo. In 1886 the British Government declared that it would thenceforward exercise jurisdiction up to and within the

boundary (known as the Schomburgk line) suggested by Sir Robert Schomburgk after his survey of 1842-43. In 1897, in consequence of intervention on the part of the United States, arbitration was agreed upon, and two years later the tribunal gave, in Paris, its decision in favour of a line not greatly differing from the Schomburgk line, though it awarded to Venezuela Point Barima and the immediately adjacent land, and the dis-trfct between the Wenamu and the upper reaches of the Cuyuni. The delimitation of the boundary between British Guiana and Brazil was in 1902 referred to the arbitration of the King of Italy. The physical nature of British Guiana offers, roughly speaking, four different types : first, the seaboard, which, though not swampy, is low, flat, and alluvial; secondly, the basin of the Essequibo river, which traverses the colony from south to due north; thirdly, the savannah, or elevated table-land, averaging 1200 to 1500 feet in height, well watered and treeless ; and fourthly, the mountainous portion of the colony, a sandstone group of mountains reaching

their highest ascertained summit in Eoraima, a remarkable tableland of rock, measuring roughly 4 miles by 8, and rising to a height of 8600 feet above sea-level. The colony is divided into three districts, which take their names from the three principal rivers debouching into the Atlantic — namely, the Demerara, Essequibo, and Berbice, which are navigable for 90, 35, and 150 miles respectively. Other rivers, varying in size and volume from mighty streams to small creeks, intersect the interior. The capital is Gbokgbtown, at the mouth of the Demerara river, with a population of 53,000. New Amsterdam, on the Berbice river, has a population of 8900. Each possesses a mayor and town council, with power to raise local revenues. There are twenty-three villages, with a population of 32,573, the affairs of which are controlled by vUlage councillors. As the climate is not favourable to prolonged physical exertion, and as three days' wage will, as a rule, supply the agricultural labourer's wants for a week, the provision of a trustworthy labour supply for sugar estates is of great im-

portance. For sixty years the labour necessary to carry on the staple industry has been imported under a system of indenture. China helped greatly between 1853 and 1859, and the West Indies and Madeira also contributed, but India has been the only permanent recruiting-ground. A scheme adopted in 1896-97, whereby allotments of

lands are made to coolies wishing to remain at the end of their indentures, in lieii of passage back to India, has worked advantageously. The census of 1891 gave a total population of 278,328. In 1899 the population was estimated as follows: —

Europeans, other than Portuguese . . 4,500

Portuguese . 12,200

East Indians 108,000

Chinese 3,800

Africans (born) 3,300

Creoles 116,000

Aboriginal Indians 7,500

Mixed races 31,200

286,500

English is spoken throughout the colony, but the aboriginal Indians — ^the Warraus, Arawaks, Wapianas, and Caribs — have their own tribal languages, which are divided into many dialects. Many of these Indians are still whoUy uncivilized, although both Roman Catholic and Protestant missionaries have for many generations been working amongst them. The climate is hot, especially from July to October, but not unhealthy. The temperature ranges from 78° to 88°. The rainfall ranges from 75 to 130 inches per annum; earthquakes and violent thunderstorms are of rare occurrence, and the colony is not within the region of hurricanes. Sugar, the cultivation of which is confined to the fringe of the coast lands and to the lower banks of the main rivers, for many years the principal product of British Guiana, has survived, in the face of bounties and other adverse conditions, better than in any other West Indian colony. Attention has, however, latterly been paid to other products, especially to rice, cacao, and kola. Though the lower parts of

the upper reaches of the rivers are not very fertile, there are between the true coast lands and the ranges of sand dunes which occur in Berbice, Demerara, and Essequibo, at varying distances from the mouths of the rivers, great tracts of land of marked fertility formed by the deposition of the sea-borne mud of the Amazon, which vdll produce almost any tropical vegetable and fruit. The timber industry is limited to those regions which lie near the lower stretches of the principal rivers, overland transport of heavy logs being difficult and costly, while on the upper reaches of the rivers are many cataracts and falls. Unalienated Crown lands extend to about 80,000 square miles, largely covered by virgin forest and in need of drainage. This land can be purchased at very cheap rates. Without beneficial occupation, however, the land reverts to the Crown. Licenses to cut timber, to collect ballata gum, indiarubber, &c., and for quarrying, are granted. The gold-producing districts (mainly placer workings) are situated in the forest portion of the colony, i.e., Berbice and Corentyn; Demerara and Essequibo

rivers, Mazaruni and Puruni rivers; Cuyuni river and Groote Creek, Essequibo river ; and Barima, Barama, and Waini rivers. The revival of the industry dates from 1884. Diamonds to the value of £11,210 were exported in 1901, almost all from the Mazaruni district.

During 1900-1, 94,745 tons of sugar (valued at £1,082,400) were exported, besides 4,023,828 gallons of rum (value, £287,400), and gold £377,400, the other exports being molasses, timber, ballata gum, shingles, cattle, and hides. In 1878 the value of the im-ports was £2,150,714 ; that of 1900-1 was £1,311,800. In 1878 the value of the exports was £2,507,571 ; that of 1900-1 was £1,577,400. The average value of the imports in the five years ending 1901 was £1,288,000, as compared with an average of £1,838,400 in the five years 1881-85 inclusive; the averages of the exports for the corresponding periods being £1,815,400 and £2,515,400 respectively. The following shows the direction of the import trade in 1900-1 :— United Kingdom, 48-4 per cent. ; British possessions, 13-7 ; Foreign countries, including the United States (£759,100 in 1899-1900), 31-7. In 1878 the revenue was £405,092 ; in 1898-99 it was £525,865. In 1878 the

expenditure was £417,995; In 1898-99 it was £525,387. The pubUc debt in 1877 was £323,563 ; in 1899 it was £975,791. During 1897-98 the tonnage of vessels entering was 304,428 (steam, 242,571 ; sailing, 61,857), and cleared 316,770 (steam, 253,960 ; sailing, 62,810). After the United Kingdom, Holland sends the most vessels ; then Norway and France. Queen's College, Georgetown, a Government institution, provides secondary education for about 100 boys (mainly English or Creole, but including a fair number of Portuguese, Chinese, East Indian, and others). Secondary teaching for girls is provided at private establishments — Roman Catholic and Wesleyan. The matriculation and other examinations of the University of London and the Cambridge Local Examinations are held in the colony. A scholarship is awarded annually of £200 per annum for three years, or, for medical students, £150 for five years. In 1898-99 there were 210 state-aided elementary schools under the management of ministers of religion, with 28,689 children on the books, and an average daily attendance of 15,959.

Except those belonging to estates, these schools are denominational as follows : — Anglican, 72 ; Church of Scotland, 36 ; Congrega^ tional, 30 ; Wesleyan, 29 ; Roman Catholic, 27 ; Estate, 13 ; Moravian, 2 ; Lutheran, 1. Eour Government primary scholar-ships are given yearly. The bishopric of British Guiana forms part of the West Indian Province of the Church of England.

There are no imperial troops now stationed in the colony. The police, semi-military in character, numbers 806 officers and men, with a rural constabulary numbering 1169. The militia numbers 426, with a reserve of 196. There are 5 public hospitals and lunatic and leper asylums ; 69 post-offices (39 being telegraph stations), and 1157 miles of telegraph lines. There are two lines of railway : from Georgetown to Mahaica (20 miles) ; from Deme-rara river to Essequibo river (18 J miles). The total length of roads in the colony is 264 miles (of which 163 were constructed by Grovemment, and 101 by the proprietors of sugar estates).

The political constitution of the colony is, from a theoretical point of view, a mixture of a Crown colony, a dependency, and an autonomous colony — due to the fact that when Great Britain ac-quired the colony from the Dutch in 1814 she adopted the Dutch-

Roman law bequeathed by Holland, which is still in force in civil cases, modified by Orders in Council and local ordinances ; the criminal law being based on that of England. The Government consists of the governor and the court of policy, which comprises 15 members, 7 ex-officio nominated, and 8 elected. The court acts as a legislative council except for purposes of taxation, which is settled by the " combined court," consisting of the court of policy and 6 elected financial representatives. There is also an executive council, consisting of the governor, 5 official and 3 unofficial members nominated by the Crown, which discharges administrative functions, which until 1891 belonged to the court of policy.

(f. cu.)

II. Dutch Guiana, or Sueiitam, has an area of about 57,900 square miles. The interest taken by the Netherlands in the colony greatly increased during the last twenty years of the 19th century, as shown by the establishment of the Surinam Association, of the Steam Navigation Company's service to Paramaribo, and by the formation of a botanical garden for experimental cultures at that town, as also by geological and other scientific ex-

peditions, and the exhibition at Haarlem, 1898. The most important crops and those supplying the chief exports are cocoa, yielding, in 1899, 9,733,900 lb, coffee 893,100 lb, and sugar, all cultivated on the larger plantations, with rice, maize, and bananas on the smaller or coast lands. The area under sugar in 1899 was 4243 acres, under cocoa 33,536 acres, other cultures 3669 acres ; total, 41,448 acres. Most of the larger plantations are situated on the lower courses of the Surinam, Commewyne, ISTickerie, and Cottica, and on the coast lands, rarely in the upper parts. The goldfields lie in the older rocks (especially the slate) of the upper Surinam, Saramacca, and Maroni, and near these rivers mining concessions had been granted of 968,166 acres in 1899. The production of gold in 1899 amounted to 893,197 grammes, valued at £101,970. Cattle-rearing is a veiy inconsiderable industry, the total live stock of the colony in 1899 being represented by about 6760 cattle and horses, 600 asses and mules, 181 sheep, 1726 goats, and 2627 swine.

During late years meteorological observations have been carried

on at five stations (Paramaribo, Burnside (Coronie), Sommelsdijk, Meuw-Nickerie, and Croningen). The mean range of temperature for the day, month, and year shows little variation, being respectively 77-54°-88-38° F., 76 ■l°-78 -62° P., and 70-52°-90-14° F. The north-east trade winds prevail throughout the year, but the rainfall varies considerably ; for December and January the mean is respectively 8-58 and 9-57 inches, for May and June 11-26 and 10-31 inches, but for February and March 7-2 and 6-81 inches, and for September 2-48 and 2 0 inches. The seasons comprise a long and a short dry season, and a period of heavy and of slight rainfall. The inhabitants of Surinam differ with the soil and the products. The Indians (Caribs, Arawaks, Warrous) live on the savannahs, or on the upper Mckerie, Coppename, and Maroni, far from the plantations, cultivating their fields of manioc or cassava, and for the rest living by fishing and hunting. They number 1000 to 2000. The bush negroes (Marrons) dwell between 3° and 4° N., near the isles and cataracts. They are estimated at 8000, and are employed in the transport of men and goods to the goldfields, the navigation of tiie rivers, in trade with the Indians, and in the transport of wood to Paramaribo ind the plantations. The inhab-

itants of Paramaribo and the plantations comprise a variety of races, represented by 400 Chinese, 600 Javanese, 10,000 coolies from India and the West Indies, 30,000 to 40,000 negroes, and 2000 of the white race ; Jews number about 1200, and there is a floating Dutch population of 600. The total (1899) is about 67,150, of -s^hom nearly one-half are in Paramaribo and one-half in the districts. In 1852 there were 6000 persons in the town and 32,000 in the districts ; thus, while the population has increased but little during fifty years, the movement from the districts to the town has increased. During the same period the number of immi-grants was 29,570. Agriculture is the chief means of subsistence. Of 30,000 persons whose occupation was given in the statistics, close upon 21,000 were engaged in agriculture or on the planta-tions, 2400 in gold-mining, and only 1000 in trade. The exports increased in value from £200,800 in 1875 to £459,800 in 1899, and the export of gold between 1882 and 1899 from £65,350 to £99,600. The imports increased from £260,450 in 1875 to £510,180 in 1899. The growth of the commerce and the countries with which it is chiefly carried on are shown in the following table : —

Tear.

Vessels.

Tonnage.

Value in thousands

of£.

Nether-

lands.

United

states.

Other

Coun-

tries.

Nether-

lands.

United

States.

Other

Coun-

tries.

Nether-

lands.

United

states.

Other

Coun-

tries.

Imports.

1888 30 21 198 5,944 5800 89,410 178 84 i 178

1899 2T 14 190 27,752 7611 100,209 267 111 | 182

1883 15 21 214 3,180 5462 42,323 69 104 166

1899 27 8 197 27,187 3578 106,985 147 267 45

According to statistics compiled by ex-governor Asoh van Wyck, the population in 1898 comprized 29,000 Moravian Brethren, 9000 Protestants, 16,750 Roman Catholics, 1250 Jews, 2700 Mahommedans, and 9700 Hindus. As regards instruction, Paramaribo had in 1899 six government primary schools with 53 teachers and 1612 pupils, besides eighteen private schools with 75 teachers and 3876 pupils. In the districts there were thirteen government schools with 14 teachers and 693 pupils, and sixteen private schools with 21 teachers and 959 pupils.

A0THORITIES. — Kappler. Surinam. Stuttgart, 1887. — Bona-

parte, Prince Roland. Les habitants de Surinam. Paris, 1884.
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Surinam,” Bijdragen v. h. Inst, voor Taal Land en VolJcenkunde,
vol. i. p. 1. The Hague. — Westerouen tan Meeteren. La
Ouyane Neerlandaise. Leiden, 1884. — TENlfAXE. “Eenenander
over Suriname,” Qids, 1888. — Verschuur. “Voyages aux trois
Guyanes,” Tour du Monde, 1893, pp. 1, 49, 65. — Loth. Beknopte
Aardrijkskundige beschrijving van Suriname. Amsterdam, 1898,
and Tijdschr. Aiirdr. Gen., 1878, 79, 93. — Asch t.\x Wyck. “La
Colonie de Surinam,” Les Pays Bas, 1898. Catalogus der Xederi.
W. L ten Toonstelling te Haarlem, 1S99 : Guide a travers }a Section
des Indes Neerlandaises, p. 323. Amsterdam, 1899. (c. M. k.)
III. French Guiana. — This colony is situated between
Dutch Guiana and Brazil. A delimitation of the territory
belonging to France and the Netherlands was arrived at
in 1891, by decision of the Emperor of Eussia. In De-
cember 1900 the Swiss Government fixed as the boundary
between French Guiana and Brazil the river Oyapok
and the watershed on the Tumuc Humac mountains,
thus awarding to France about 3000 of the 100,000

square miles which she claimed. Trench Guiana, according to the most recent official estimate, has an area of 60,030 square miles; but a strange divergence of opinion exists upon this point, and competent authorities variously place it, without the zone whose possession was till recently disputed with BrazH, at 47,000 square miles and 68,000 square miles. M. Coudreau ventured across the immense inland tropical forest in 1887-91, but it is still little known. The population has little altered in numbers, being estimated at about 30,000 in 1898. Of this total 12,350 lived at Cayenne, 10,100 were in the communes, 6700 formed the penal population, 1600 were native Indians (Galibi, Emerillon, Oyampi), and 500 near Maroni were negroes. Apart from Cayenne, which was rebuilt after the great fire of 1888, the centres of population are unimportant : Sinnamary with 1500 inhabitants, Mana with 1750, Eoura with 1200, and Approuague with 1150. In 1892 French Guiana was finally divided into fourteen ■communes, exclusive of the Maroni district. Belonging

to the colony are also the three Safety Islands (Eoyale, Joseph, and Du Diable — the last notable as the island where Dreyfus was imprisoned), the Enfant Perdu Island, and the five Remire Islands. The colony is administered by a governor, assisted by a director of the interior, a chief ■of the judicial service, a director of the penitentiary administration, and by a privy council. In 1879 an elective general council of sixteen members was constituted. There are a tribunal of first instance and a higher tribunal at Cayenne, besides four justices of peace, one of whom has extensive jurisdiction in other places. White convicts are now sent to the settlements ; in 1886 French Guiana was appointed as a place of banishment for confirmed ■criminals and for convicts sentenced to more than eight years' hard labour. Of the £207,000 demanded for the colony in the colonial budget for 1901, £195,000 represented the estimated expenditure on the penal settlement, so that the cost of the colony was only about £12,000. The loca.1 budget for 1901 balanced at £99,000. Instruction is given in the college of Cayenne and in six primary

schools. At the head of the clergy is an apostolic prefect. The armed force consists of two companies of marine infantry, half a battery of artillery, and a detackment of gendarmerie, and comprises about 380 men. A Yerj small portion of the territory is devoted to agriculture, although France has paid some attention to the development of this branch of activity. In 1880 a colonial garden was created near Cayenne; since 1894 an experimental garden has been laid out at Baduel. About 8200 acres are cultivated, of which 5400 acres are under cereals and rice, the remainder being under coffee, cacao, cane, and other cultures. The low lands between Cayenne and Oyapok are capable of bearing colonial produce, and the savannahs from the Oyapok to the Arajovary might support large herds ; cereals, root-crops, and vegetables might easily be grown on the high grounds, and the working of the timber in the forests of the interior should be profitable. As regards gold-mining, placers of very great wealth have been discovered on the Awa, on the Dutch frontier, and at Carsevenne in the territory which formed the subject of the

Franco-Brazilian dispute. The production amounted to £160,000 in 1889, £280,000 in 1892, and to nearly £320,000 in 1899. But wages are high and transport is costly. Silver and iron have been found in various districts; kaolin is extracted in the plains of Montsinery; and phosphates have been discovered at several places. Besides 123 workings for gold, the industries of French Guiana comprise saw-mills, distilleries, brick-works, and sugar-works. The commerce in 1885 amounted to £336,000 for imports, and to £144,000 for exports; in 1897 the values were respectively £373,360 and £286,400. The share of France and her colonies in

the exports was £277,400, and in the imports £253,500. For 1899 imports were valued at £421,000, exports at £270,000. The gold export amounted to £255,000. The imports consist of wines, flour, clothes, &c. The shipping during 1899 numbered 150 vessels of 40,300 tons (metric) entered, and 149 of 39,600 tons cleared. Cayenne is almost the only port. One of the drawbacks to the development

of the colony is the lack of labour. Native labour is most difficult to obtain, and attempts to utilize convict labour have not proved very successful. So far also every effort to supply the need by immigration has proved a failure. The land routes are not numerous. The most important are that from Cayenne to Iracoubo (78 miles), and that from Cayenne to Kaw along the coast to the mouth of the Approuague. Towards the interior there are only foot-paths, badly made. By water, Cayenne is in regular communication with the Safety Islands (35 miles), and the mouth of the Maroni (80 miles), with Fort de France in the island of Martinique, where travellers meet the mail packet for France, and with Boston (United States). There is a French cable between Cayenne and Brest.

See ViALA. Les Trois Guyanes. Montpellier, 1893.— Levasseuk. La France, tome ii. Paris, 1893. (p. ^\

Guildford, a municipal borough, market-town, and county town of Surrey, England, in the Guildford parliamentary division (since 1885) of the county, on the Wey,

30 miles south-west of London by rail. It is the seat of a suffragan bishopric. Guildford Castle has been purchased by the corporation, and the ground about it opened as a public garden (1888). Public baths, a cattle market, and an isolation hospital have been erected, and the Eoyal Surrey Hospital has been enlarged. Area, 607 acres. Population (1881), 11,288 ; (1901), 15,937.

Cuimaraes, a town of Portugal, district Braga, 26 miles S.E. of Braga. It has one of the largest markets in the kingdom, and manufactures cutlery, linen, leather, and preserved fruits. The vineyards cover about 9000 acres. Population (1900), 8863.

Guinea, French, a French colony in West Africa, bounded on the W. by the Atlantic, on the IS", by Portuguese Guinea and Senegal, on the E. by Senegal and the ■ Ivory Coast, and on the S. by Liberia and Sierra Leone. The shore, which extends from the Alcatraz Islands on the north to the Scarcies Islands on the south, is low, monotonous, and bordered with sand-dunes. The islands of Tomba, Laos, Matakong are at various dis-

tances from the coast. The protectorate of Futa Jallon, which commences at a distance of 80 miles from the sea, is high, and possesses well-marked features ; some places have an altitude of 4000 feet, and there is scarcely any more important hydrographic centre in Africa. French. Guinea is watered by the Cogon, the Rio Nunez (70 miles), the Eio Pongo, and the Mellacoree; from the Futa Jallon flow the Gambia, the Faleme, the Bafing, and the Niger. Futa Jallon was annexed after the expeditions of Moustier and Zweifel (1879), Bayol (1881), and Plat (1888). There has never been any difficulty in occupying this region. French Guinea was administered by the governor of Senegal till 1893, when the colony was declared a separate administrative imit. The present limits of the hinterland were fixed by the decree of October 1899, dividing the French Sudan (see Subaij-) among the four French West African colonies, by which French Guinea received the six circles Dinguiray, Siguiri, Kurussa, Kankan, Kissandugu, Beyla, and nearly doubled its area, which is now estimated at 92,000 square miles. The

population on this area numbers about 1,250,000. The

colony is administered by a governor (since 1895 under the governor-general of French West Africa), assisted by a council composed of three official and three civil members. One of the three French colonies allowed to manage their own finances, French Guinea is practically self-supporting. In 1898 the local expenditure was only £53,805 as compared with a revenue of £70,763, and in 1899, though there was a subsidy from the home Government of £12,700, about £4500 of this was voted for military expenditure and £4000 for a road to the Niger. The ‘ inhabitants do not cultivate more than one-tenth of the surface of the country. Cotton textiles are by far the most important import ; in 1898 their value amounted to £153,800 out of a total of £360,800, in 1899 to £253,000 out of a total of £617,700 (including £77,000 specie). The other principal items in 1899 were hardware £36,800, and rice £31,600. Great Britain

and Sierra Leone supply practically all the textiles, and have a commanding share in the other imports. The proportionate share of France itself is small, but increasing : £59,400 in 1898, £166,000 in 1899. Rubber predominates even more among the exports than textiles among the imports, being valued in 1898 at £237,600 out of a total value of exports of £312,000, and in 1899 at £280,000 out of a total of £378,600. Though a source of great prosperity to the colony, the consequences of the supply of rubber coming to an end through abusive exportation are already beginning to be discussed. Of other exports, that of cattle from Futa Jallon is important ; this has had to be curtailed for fear of exhausting the supply. Futa Jallon is also rich in gold. There is thought to be a promising future for the export of groundnuts and wax. Great Britain and Sierra Leone receive most of the exports, but France's share increased from £22,000 in 1898 to £38,500 in 1899. Means of communication are difficult. A railway will connect Konakry with Kurussa on the Niger, so as to bring the produce of

the Sudan to the coast. The inland system of telegraphs was united in 1899 with that of Senegal by a line which brought the total length laid down in three years up to 560 miles. There is telegraphic communication with Europe along an English submarine cable, and steamers call at Konakry from Havre, Bordeaux, and Marseilles, and Liverpool, Antwerp, and Hamburg. The Belgian line has transferred its headquarters to Konakry from Sierra Leone, which, indeed, has in other directions lately lost much of its trade to its French neighbour.

In 1898, 2369 vessels of 263,763 tons entered Konakry, and 2286 of 263,127 tons cleared. The centres of population are Konakry, the capital, on the isle of Tomba, Boke on the Eio Nunez, Dubreka, Beuti, and Timbo in Futa Jallon.

See Henrique. Les Colonies Franqaises. Paris, 1890. — Teotjillet. Les Possesions Frani}aises de Gfuinee. Paris, 1893. — Lee. French Colonies. Foreign Office Report, 1900. — L'Annee Coloniale. Paris, 1900. (p. L.)

Guinea, Portuguese, a colonial province of

Portugal, on the west coast of Africa, between 11° 40′ and 12° 40′ N. and 13° 40′ W. and the Atlantic, with an area of 4394 square miles, and an estimated population of 67,166. It is on the whole a flat region, traversed by an extensive network of rivers, of which the chief are — the Cacheo, navigable to Farim, 105 miles ; the Mansoa, navigable for 44 miles; the Geba; the Corubal; the Grande de Guinala, virtually an inlet of the sea ; the Combidian ; 9,nd the Cacine. It includes the neighlDOuring archipelago of Bissagos. The rainy season lasts from May to November, and is very hot (89-6° F.) and tempestuous. Rice and millet are the principal cultivated crops. The natural products of the soil embrace mancarra (almonds), indiarubber, tobacco, kola nuts, indigo, cotton, coffee, and palm oil ; and of the forests, mahogany, ebony, calabash, and other trees. The total trade (imports and exports) has increased from £111,100 in 1894 to £366,670 in 1899 ; the shipping which entered has likewise increased from 745 vessels of 47,978 tons m 1894 to 1294 vessels of 64,756 tons in 1899. The capital

is Bolama, on the island of the same name in the Bissagos Archipelago, opposite the estuary of the Grande ; but the principal port is Bissao, on the island of the same name. The native inhabitants belong chiefly to the Fulah, Mandingo, and Biafada races. The province is administered by a governor, assisted by a council. The estimated revenue for 1900-1901 was £23,780, and the expenditure £40,670.

See E. DE Vasconcellos, As Colonias Portuguesas. Lisbon, 1896-97. (b- db v.)

Cuines, a town in the interior of Havana province, Cuba. It is in the midst of a rich sugar district. Population (1899), 8149.

Cuipuzcoa, a maritime province of Northern Spain, with an area of only 728 square miles, divided into four administrative districts and ninety parishes. The population was 181,856 in 1887, and 191,822 in 1897, being then surpassed in density only by the provinces of Barcelona and Pontevedra. Of the births 3-42 per cent, were illegitimate. The province loses

large numbers through emigration. The main line of the northern railway from Madrid to France runs through the province for 90 miles, passing one of the most important custom-houses of Spain. This province has 350 miles of first-class roads, kept up at local expense only. It is very rich in mineral springs, having no fewer than two salt, twenty-two sulphurous, and thirty-five ferruginous, much frequented every summer by people from all parts of Spain. The fishing fleet is composed of 350 sailing boats and some small steamers, manned by 1900 men and boys, who secure £80,000 worth of fish annually. The coasting trade exceeds £400,000 a year, and by Irun, Passages, and the frontier roads £4,000,000 of imports and £3,000,000 of exports pass to and from France, partly in transit for the rest of Europe. Apart from the foui Catalan provinces, no province has witnessed such a development of local industries as Guipuzcoa. The principal industrial centres are Irun, Eenteria, Villabona, Vergara, and Azpeitia for cotton and linen stuffs ; Zumarraga for

osier; Eybar, Plasencia, and Elgoibar for arms and cannon, and gold incrustations ; Irun for soap and carriages; San Sebastian, Irun, and Onate for paper, glass, chemicals, and saw-mills ; Tolosa for paper, timber, cloths, and furniture ; and the banks of the bay of Passages for the manufacture of liqueurs of every kind, and the preparation of wines for export and for consumption in the interior of Spain. This last industry occupies several thousand French and Spanish workmen. There are only nineteen productive mines, from which the main outputs in 1898 were 20,582 tons of iron and 20,659 tons of lignite ; and of hydraulic cement 79,064 tons were manufactured. The mines and works connected therewith gave employment to 1300 hands. In 1898 the live stock included 1937 horses, 254 mules, 5492 asses, 60,655 cattle, 119,444 sheep, 1378 goats, 16,840 pigs. Oxen are much used as draught animals on the steep roads of the mountains. “Wheat occupied 30,690 acres, and 31,000 were given to beans.

Cuiraud, Ernest (1837-1892), French com-

poser, was born at New Orleans on 26th June 1837. He studied at the Paris Conservatoire, where he won the "Grand' Prix de Rome." His father had gained the

same distinction many years previously. The fact is worthy of note, as it affords the only instance of both father and son obtaining this much-coveted prize. Ernest Guiraud is the composer of the following operas : — Sylvie (1864), Le Kobold (1870), Madame Turlupin (1872), Piccolino (1876), Galante Aventure (1882) ; also the ballet Gretna Green, given at the Opera in 1873. His opera Frid&gonde was left in an unfinished condition and terminated by Saint-Saens. It was produced at the Paris Opera in 1895. G-uiraud, who was a fellow student and intimate friend of Georges Bizet, was for some years professor of composition at the Conservatoire. He was the author of an excellent treatise on Instrumentation. His music, if not particularly individual, is characteristically Trench, and is invariably scored with consummate art.

He died in Paris, 6th May 1892.

Cujranwala, a town and district of British India, in the Rawalpindi division of the Punjab. The town is situated 40 miles N. of Lahore by rail. The population in 1881 was 22,884, in 1891 it was 26,785; the municipal income in 1897-98 was Es.68,799. There are manufactures of brass-ware, jewellery, silk and cotton scarves. The Distkiot comprises an area of 3017 square miles. The population in 1881 was 616,892, and in 1891 was 690,169, giving an average density of 229 persons per square mile. In 1901 the population was 756,749, showing an increase of 10 per cent. The land revenue and rates were Es.10,95,970, the incidence of assessment being 11.1-9-9 per acre ; the cultivated area in 1896-97 was 675,169 acres, of which 557,452 were irrigated, including 230,685 from government canals. Part of the upland tract has been brought under cultivation by the Chenab canal. The number of police was 603 ; the number of schools in 1896-97 was 320, with 10,137 pupils, the proportion of boys at school to the male population of

school-going age being 15-8 per cent. ; the registered death-rate in 1897 was 27-89 per thousand. There are three printing-presses, issuing one vernacular newspaper, and two factories for pressing cotton. There are 116 miles of railway in all, 82 miles of navigable river, and 64 miles of metalled roads.

Cujrat, a town and district of British India, in the Rawalpindi division of the Punjab. The town stands about 5 miles from the right bank of the river Chenab, and about 70 miles IST. of Lahore by rail. The population in 1891 was 18,050 ; the municipal income in 1897-98 was Rs.31,104. It has manufactures of inlaid work in gold and iron, brass-ware, boots, cotton goods, and shawls, and also one printing-press. The Distkict comprises an area of 2051 square miles. The population in 1881 was 689,1] 5, and in 1891 was 760,875, giving an average density of 371 persons per square mile. In 1901 the population was 752,038, showing a decrease of 1 per cent., compared with an increase of 10 per cent, in the previous decade. The land revenue and rates were

Rs.7,66,520, the incidence of assessment being R.1-2-9 per acre; the cultivated area in 1896-97 was 533,498 acres, of which 184,128 were irrigated, entirely from private wells ; the number of police was 520 ; the number of schools in 1896-97 was 413, with 12,880 pupils, the proportion of boys at school to the male population of school-going age being 17-6 per cent., the highest figure in the province; the registered death-rate in 1897 was 21-89 per thousand. There are 76 mUes of railway in all, 72 miles of navigable river, and 55 miles of metalled roads, but no government canal.

Cull, Sir William Withey, Baet. (1816-1890), English physician, was the youngest son of John Gull, a bargeowner and wharfinger of Thorpe-le-Soken, Essex, and was born on 31st December 1816. He began life as a schoolmaster, but in 1837 Benjamin Harrison, the treasurer of Guy's Hospital, who had noticed his ability, brought him up to London from the school at Lewes where he was usher, and gave him employment at the hospital, where he also gained permission to attend

the lectures. In 1838 he matriculated at the University of London, and graduated M.B. in 1841. Two years later he was made a lecturer in the medical school of the hospital, in 1851 he was chosen an assistant physician, and in 1868 he became full physician. In 1847 he was elected Fullerian professor of physiology in the Royal Institution, retaining the post for the usual three years, and in 1848 he delivered the Gulstonian Lectures, taking for his subject paralysis, the disease of which he afterwards died. At the College of Physicians he filled every of&ce of honour but that of president. He died in London on 29th January 1890 after a series of paralytic shocks, the first of which had occurred nearly three years previously. He was created a baronet in 1872, in recognition of the skill and care he had shown in attending the Prince of Wales during his attack of typhoid in 1871.

Sir William Gull's fame rested mainly on his success as a clinical practitioner ; as he said himself, he was " a clinical physician or nothing." This success must be largely ascribed to his remarkable powers of observation,

and to the great opportunities he enjoyed for gaining experience of disease. He was sometimes accused of being a disbeliever in drugs. That was not the case, for he prescribed drugs like other physicians when he considered them likely to be beneficial. He felt, however, that their administration was only a part of the physician's duties, and his mental honesty and outspokenness prevented him from deluding either himself or his patients with unwarranted notions of what they can do. But though he regarded medicine as primarily an art for the relief of physical suffering, he was far from disregarding the scientific side of his profession, and he made some real contributions to medical science. His papers, which were not very numerous, were printed chiefly in G'wy's Hospital Reports and in the proceedings of learned societies : among the subjects he wrote about were cholera, rheumatic fever, taenia, paraplegia, and abscess of the brain, while he distinguished for the first time the disease now known as myxcedema, describing it as a " cretinoid condition in adult women."

Culpaigan, a district and city in Central Persia, situated north-west of Isfahan and south-east of Irak. Together with Khuns^r it forms a small province, paying a yearly revenue of about £6000. The city of Gulpaigan is situated 87 miles N.W. of Isfahan, at an elevation of 5875 feet, in 33° 24′ N. lat. and 60° 20′ E. long,, and has a population of about 5000. The district is fertile, and produces much grain and some opium. Sometimes it is under the governor-general of the Isfahan province, at others it forms part of the province of Ir^k, and at times it is under a governor appointed from Tehran. It was in 1902 part of Irak.

Cumuljina, a town of European Turkey, in the vilayet of Adrianople. It is situated on the river Karaja, south of the eastern extremity of the Rhodope range of mountains and north-east of the Gulf of Lagos, and is a station on the railway between Salonica and Dede-Agach. It has a population of about 20,000, of whom three-fourths are Turks, and the remainder Greeks, Jews, and Armenians. The district produces hard wheat, equal in

quality to that of Taganrog, maize, barley, and tobacco. Sericulture and viticulture are both practised on a limited scale. The wine of Gximuljina is everywhere highly

esteemed. The most prominent feature in tlie commercial life of the place is its cattle fair, held annually on Greek Palm Sunday.

Ciimush-Khaneh, the chief town of a sanjak of the same name (area, 2365 square miles ; population, 114,800) in the Trebizond vilayet of Asiatic Turkey, altitude 4400 feet, situated on high ground in the valley of the Kharshut Su, about half a mile from the Trebizond-Erzeriim chaussie. The silver mines from which the place takes its name were noted in ancient times, and are mentioned by Marco Polo. The population of the town is 3000, chiefly Greeks.

Cun. — Firearms are said to have been first used in European warfare in the 14th century. The hand gun came into practical use in 1446, and was of very rude

construction. It consisted of a simple iron or brass tube with a touch-hole at the top fixed in a straight stock of wood, the end of which passed under the right armpit when the “gonne” was about to be fired. A similar weapon was also used by the horse-soldier, with a ring at the end of the stock, by which it was suspended by a cord round the neck; a forked rest, fitted by a rfng to the saddlebow, served to steady the gun. ThisK rest, when not in use, hung down in front of the right leg. A match made of cotton or hemp spun slack, and boiled in a strong solution of saltpetre, or in the lees of wine, was an appurtenance of the hand gun. The touch-hole was first placed on the top of the barrel, but afterwards at the side, with a small pan underneath to hold the priming, and guarded by a cover moving on a pivot.

An improvement in firearms took place in the first year of the reign of Henry VII., or at the close of Edward IV., by fixing a cock on the hand gun to hold the match, which was brought down to the priming by a trigger,

whence the term matchlock or arc-h-bouche, a bow with a mouth, subsequently corrupted to harquebus. The harquebus or matchlock was supposed to have been invented in Italy. This weapon is still in use among the Chinese, Tartars, Sikhs, Persians, and Turks. An improvement in the stock was also made during this period by forming it with a wide butt end to be placed against the right breast. Subsequently the stock was bent, a German invention, and the arm was called a haekbutt or hagbut, and the smaller variety a demihague. The harquebus and hackbutt were about a yard in length, including barrel and stock, and the demihague was about half the size and weight, the forerunner of the pistol. The wheel-lock, an improvement on the matchlock, was invented in Nuremberg in 1517; was first used at the siege of Parma in 1521; was brought to England in 1530, and continued in partial use there until the time of Charles II. This wheel-lock consisted of a fluted or grooved steel wheel which protruded into the priming pan, and was connected with a strong spring. The cock, also regulated

by a spring, was fitted with a piece of pyrites (sulphuret of iron). In order to discharge the gun the lock was wound up by a key, the cock was let down on the priming pan, the pyrites resting on the wheel; on the trigger being pressed the wheel was released and rapidly revolved, emitting sparks, which ignited the powder in the pan. The complicated and expensive nature of this lock, with its liability to injury, no doubt prevented its general adoption.

About 1540 the Spaniards constructed a larger and heavier firearm, carrying a ball of 10 to the pound, called a musket. This weapon was introduced into England before the middle of the 16th centviry, and came into general use throughout Europe, having been first extensively used at the battle of I'avia iu 1525.

The snaphaunce was invented about this period in Germany, and from its comparative cheapness was much used in England, France, and Holland. It held a flint instead of the pyrites of the wheel or firelock, which ignited the powder in the pan by striking on a

piece of furrowed steel, when released by the trigger, and emitting sparks.

As a sporting weapon the gun may be said to date from the invention of the wheel-lock in the beginning of the 16th century, though firearms were used for sporting purposes in Italy, Spain, Germany, and to some extent in France, in the 16th century. Before that period the longbow in England and the crossbow on the Continent were the usual weapons of the chase. In Great Britain little use appears to have been made of firearms for garne shooting until the latter half of the 17th century, and the arms then used for the purpose were entirely of foreign make.

The French gunmakers of St ifitienne claim for their town that it is the oldest centre of the firearms industry. They do not appear to have made more than the barrels of the finest sporting arms, and these even were sometimes made in Paris. The production of firearms by the artists of Paris reached its zenith about the middle of the 17th century. The Italian, German, Spanish, and Eussian

gunsmiths also showed great skill in the elegance and design of their firearms, the Spaniards in particular being makers of fine barrels. Pistols are understood to have been made for the first time about 1540 at Pistoia in Italy, from which town they receive their name. About 1635 the modern firelock or flint-lock was invented, which only differed from the snaphaunce by the cover of the pan forming part of the furrowed steel struck by the flint. Originally the priming was put into the pan from a flask containing a fine-grained powder called serpentine powder. Later the top of the cartridge was bitten off, and the pan fllled therefrom before loading. The mechanism of the flint-lock musket rendered all this unnecessary, as, in loading, a portion of the charge passed through the vent into the pan, where it was held by the cover or hammer. The highest development of the flint-lock is found in the fowling-pieces of the end of the 18th and beginning of the 19th centuries, particularly those made by Joseph Manton, the celebrated English gunsmith and inventor. The Napoleonic wars afforded English gun-

makers an opportunity, which they fully utilized, of gaining the supremacy over their foreign competitors in the gunmaking trade. English gunmakers reduced the weight, improved the shooting powers, and perfected the lock mechanism of the sporting gun, and increased the range and efliciency of the rifle. This transference of the gunmaking craft from the Continent to England was also assisted by the tyranny of the foreign gunmaking guilds. In 1637 the London gunmakers obtained their Charter of Incorporation. The important gunmaking industry of Birmingham dates from 1603, and soon rivalled that of London. Double shot-guns do not appear to have been generally used until the 19th century. The first successful double guns were built with the bai-rels over and under, and not side by side, and were invented about 1616 by one Guilliano Bossi of Eome. In 1784 double shot-guns were described as a novelty. Joseph Manton patented the elevated rib which rested on the barrels. The general success of the double gun was eventually due to the light weight which the better material and work-

manship of the best gunmakers made possible, and to the quickness and certainty of ignition of the modern cart-ridge.

The objections to the flint-lock were that it did not entirely preserve the priming from wet, and that the flint sparks sometimes failed to ignite the chai-ge. In 1807

the Eev. Mr Forsytli obtained a patent for priming with a fulminating powder made of chlorate of potash, sul-phur, and charcoal, which exploded by concussion. This important improvement in firearms was not recognized aud adopted by the military authorities until more than thirty years later. In the meantime it was gradually developed, and the copper percussion cap invented, by various gunmakers and private individuals. Thomas Shaw of Philadelphia first used fulminate in a steel cap in 1814, which he changed to a copper cap in 1816. It was not until the introduction of the copper cap that the percussion gun could be considered in every way supe-

rior to the flint. In 1834, in the reign of William IV., Forsyth's invention was tested at Woolwich by firing 6000 rounds from six flint-lock muskets, and a similar number from six percussion muskets, in all weathers. This trial established the percussion principle. The shooting was found to be more accurate, the recoil less, the charge of powder having been reduced from 6 to 4^ drs., the rapidity of firing greater, and the number of miss-fires much reduced, being as 1 to 26 nearly in favour of the percussion system. In consequence of this successful trial the military flint-lock in 1839 was altered to suit the percussion principle. This was easily accomplished by replacing the hammer and pan by a nipple with a hole through its centre to the vent or touch-hole, and by replacing the cock which held the flint by a smaller cook or hammer with a hollow to fit on the nipple when released by the trigger. On the nipple was placed the copper cap containing the detonat-ing composition, now made of three parts of chlorate of potash, two of fulminate of mercury, and one of powdered

glass.

In 1840 the Austrian army was supplied with the percussion musket, and in 1842 a new model percussion musket with a block or back-sight for 150. yards was issued to the British army, 11 lb 6 ozs. in weight, 4 ft. 6| in. in length without bayonet, 6 ft. with bayonet, and with a barrel 3 ft. 3 in. in length, firing a bullet of 14t^ to the R) with 4i- drs. of powder. This musket was larger in bore than that of France, Belgium, Russia, and Austria, and thus had the advantage of being able to fire their balls, while the English balls could not be fired from their barrels. But the greater weight and momentum of the English ball was counteracted by the excess of windage. This percussion musket of 1842, the latest development of the renowned Brown Bess, continued in use in the British army until partially superseded in 1851 by the Minie rifle, and altogether by the Enfield rifle in 1855. (For further information as to the history and development of military, target, and sporting rifles see EirLE.)

Modern Shot-guns. — The modern sporting breech-loaders may be said to have originated with the invention of the cartridge-case containing its own means of ignition. The breech-loading mechanism antedated the cartridge by many years, the earliest breech-loading hand guns dating back to 1537. Another distinct type of breech-loader was invented in France about the middle of the 17th century. During the 17th and 18th centuries breech-loading arms were very numerous and of considerable variety. The original cartridge, a charge of powder and bullet in a paper envelope, dates from 1586. These were used with muzzle-loaders, the base of the cartridge being ripped or bitten off by the soldier before placing in the barrel. It was only when the detonating cap came into use that the paper cartridge answered well in breech-loaders. The modern breech-loader has resulted from a gradual series of improvements, and not from any one great invention. Its essential feature is the prevention of all escape of gas at the breech when the gun is fired by means of an expansive cartridge-case containing its own means of

ignition. The earlier breech-loaders were not gas-tight, because the cartridge-cases were either consumable or the load was placed in a strong non-expansive breech-plug. The earliest efficient modern cartridge-case was the pin-fire, patented by Houiller, a Paris gimsmith, in 1847, with a thin weak shell which expanded by the force of the explosion, fitted perfectly in the barrel, and thus formed an efficient gas check. Probably no invention connected with firearms has wrought such changes in the principle of gun-construction as those effected by the expansive cartridge-case. This invention has completely revolutionized the art of gunmaking, has been successfully applied to all descriptions of firearms, and has produced a new and important industry — that of cartridge manufacture.

About 1836, Lefaucheux, a Paris gunsmith, improved the old Pauly system of breech-loading, but its breech action was a crude mechanism, with single grip worked by a bottom lever. The double grip for the barrels was the subsequent invention of a Birmingham gunmaker.

The central-fire cartridge, practically as now in use, was introduced into England in 1861 by Daw. It is said to have been the invention of Pottet, of Paris, improved upon by Schneider, and gave rise to considerable litigation in respect of its patent rights. Daw, who controlled the English patents, was the only exhibitor of central-fire guns and cartridges at the International Exhibition of 1862. In his system the barrels work on a hinge joint, the bottom lever withdraws the holding-down bolt ; the cartridge is of the modem type, the cap being detonated by a striker passing through the standing breech to the inner face. The cartridge-case is withdrawn by a sliding extractor fitted to the breech ends of the barrels. Daw was subsequently defeated in his control of the patents by Eley Bros., owing to the patent not having been kept in force in France. The modern breech-loading gun has been gradually and steadily improved since 1860. Westley Eichards adopted and improved Matthews' top-lever mechanism. About 1866 the rebounding lock was introduced, and improved in 1869. The treble wedge-fast

mechanism for holding down the barrels was originated by W. W. Greener in 1866, and perfected in 1873. A very important improvement was the introduction of the hammerless gun, in which the mechanism for firing is placed entirely within the gun. This was made possible by the introduction of the central-fire cartridge. In 1862 Daw, and in 1866 Green, introduced hammerless guns in which the cocking was effected by the under lever. These guns did not attain popularity. In 1871 T. Murcott patented a hammerless gun, the first to obtain distinct success. This also was a lever-cocking gun. About the same time Needham introduced the principle of utilizing the weight of the barrels to assist in cocking. In 1876 Anson and Deeley utilized the fore-end attached to the barrels to cock the locks. From this date hammerless guns became really popular. Subsequently W. W. Greener and some other gunmakers unproved the hammerless mechanism. Still greater improvements have since been introduced by Westley Eichards, Purdey, and others, including cocking by means of the mainspring. In 1874

J. Needham introduced the ejector mechanism, by which each empty cartridge-case is separately and automatically thrown out of the gun when the breech is opened. The necessary force is provided by the mainspring of the lock. W. W. Greener and some other gunmakers have since introduced minor modifications and improvements of this mechanism. The latest improvement in the modern breech-loader is the single trigger mechanism introduced by some of the leading English gunmakers, by which both barrels can be fired in succession

by a single trigger. This improvement enables both barrels to be rapidly fired without altering the grip of the right hand.

Repeating or magazine shot-guns on the principle of the repeating rifle, with a magazine barrel below the single firing barrel, are also made by some American and other gunmakers (particularly by the Winchester Small Arms Company), but as yet have not come into general use,

being comparatively cumbersome and not well balanced. The difficulty of a shifting balance as each cartridge is fired has also yet to be overcome. Several varieties of a combination rifle and shot-gun are also made, for a description of which see Eifle. ‘

The chief purposes for which modern shot-guns are required are game-shooting, trap-shooting at pigeons, and wild-fowling. The game gun may be any bore from 32 to 10 gauge. The usual standard bore is 12 gauge. The usual weight of the 12-bore double-barrelled game gun is from 6 to 7 lb with barrels 30 inches long. These barrels are made of laminated steel twisted and welded, and are known as Damascus barrels, or of forged wroiight steel drilled, or more usually of Whitworthfluid-compressed steel. The standard charge is 3 drams of powder and 1\ oz. of No. 6 shot. The ordinary game gun should have a killing circle of 30 inches at 30 yards with the first barrel and at 40 yards with the second. Improved materials and methods of manufacture, and what is known as ” choke ” boring of the barrels have enabled

modern gunmakers to regulate the shooting of guns to a nicety. Choke-boring is the constriction of the diameter of the barrel near the muzzle, and was known in America in the early part of the 19th century. In 1875 Pape of Newcastle was awarded a prize for the invention of choke-boring, there being no other claimant. The methods of choke-boring have since been varied and improved by the leading English gunmakers. The pigeon gun is usually heavier than the game gun, and more choked. It generally weighs from 7 to 8 lb. In England its weight, by club rules, is restricted to 8 ft, and its bore to 12 gauge. The standard wild-fowling gun is a double 8-bore with 30-inch barrels weighing 16 ft, and firing a charge of 7 drams of powder and 2f to 3 oz. of shot. These guns are also made in both smaller and larger varieties, including a single barrel 4-bore, which is the largest gun that can be used from the shoulder, and single barrel punt guns of l|-inch bore, weighing 100 ft. (h. s.-k.)

Cung'l, Josef (1810-1889), Hungarian composer

and conductor, was born, 1st December 1810, at Zs^mbek, in Hungary. After starting life as a school-teacher, and learning the elements of music from Of en, the school-choir-master, he became first oboist at G-raz, and, at twenty-five, bandmaster of the 4th regiment of Austrian artillery.

His first composition, a Hungarian march, written in 1836, attracted some notice, and in 1843 he was able to establish an orchestra in Berlin. With this band he travelled far, even in 1849 to America. It is worth recording that Mendelssohn's complete Midsummer Night's Dream music is said to have been first played by Gung'l's band. In 1853 he became bandmaster to the 23rd Infantry Regi-ment at Briinn, but in 1864 he lived at Munich, and in 1876 at Frankfort, after (in 1873) having conducted with great success a series of promenade concerts at Covent Garden, London. Erom Erankfort Gung'l went to Weimar to live with his daughter, a well-knovm German opera singer and local prima donna. There he died, 31st January 1889. Gung'l's dances number over 300, perhaps the most popular being the " Amoretten," " Hydropaten,"

” Casino,” ” Dreams on the Ocean ” waltzes ; ” Im Stille Mitternaeht ” polka, and ” Blue Violets ” mazurka. His Hungarian march had the honour of being transcribed by Liszt. His music is characterized by the same easy flowing melodies and well-marked rhythm that distinguish the music of Strauss, to whom alone he can be ranked second in this kind of composition. (b. h. l.)

GUN^-MAKIlNa.

THE ninth edition of this Encyclopaedia carried the history of British service guns up to the year 1878. These guns were of a short, muzzle-loading type, and consisted of a steel barrel, over which was shrunk a series of wrought-iron coils. Eorged steel was chosen as the best material for the barrel, on account of the closer nature of its texture and the absence of flaws as compared with wrought iron ; it was therefore far less eroded by the action of the powder gases than the more open fibre of wrought iron, in which streaks of slag, due to the imperfect forging or welding operation, are invariably present. The manufacture of large steel forgings was then practi-

cally in its infancy, and defects which occasionally appeared in the mass of an apparently sound forging — often the result of imperfect annealing — caused the material to be looked upon as somewhat treacherous, and liable to fracture, without warning, under any sudden stress, unless strengthened by surrounding it with coils of wrought iron. Experience gained from the bursting of guns, by accident or design, had shown that this latter material always showed evident signs of distress before finally fracturing. The coiled iron never flew to pieces as the steel of that period occasionally did. These guns were built up of as few coils as possible, and only in the largest guns were two layers of coils superimposed on the barrel. Thick coils were preferred to thin ones, the argument being that one thick coil cost less than several thin ones, and thus one of the principles of the Armstrong construction was rendered inoperative. At the present time the opposite extreme is favoured, and by the use of wire the full benefit is obtained of the ideal thin coil or hoop, without the disadvantage of excessive weight and cost. Wrought iron is

no longer considered the best material ; indeed, so far as structural purposes go, it is non-existent. The steel industry has made so much progress since 1880 that steel is looked upon as one of the most trustworthy metals in use.

The gun steel used in England and most foreign countries is prepared by the open-hearth method in a regenerative gas furnace of the Siemens-Martin type. (For a full description of the arrangement see Eney. Brit, 9th edition, vol. xiii. page 294, and Supp. Ieon and Steel.) The steel is run from the furnace into a large ladle, previously heated by gas, and from this it is poured into a cast-iron ingot mould of from 10 to 12 feet high and 2 feet or more in diameter. The external shape of these ingots varies in different steel works, but they are so arranged that, as the ingot slowly cools, the shrinkage of the ^‘efwre/ metal shall not set up dangerous internal stresses. * ” ‘

The top of the ingot is generally porous, and consequently, after cooling, it is usual for about one-third of the(length of the ingot to be cut from the top and remelted ; a small

part of the botton is also often discarded. The centre of

the larger ingots is also inclined to be somewhat unsound,

and a hole is therefore bored through them to remove this

part. In the ^Vhitworth method of fluid-compressed steel

Fig. 1. — Interior ol a ll(jdeni Gun-making Establishment.

a, Top, as c-iist. x ■ ”.!.

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Vi

J’”^

6, liutLuin, :i5 ca^t. X ‘I’J.

0, Toil, forgf.l. X

%m0

d, Bottom, forged, x 20.

c, Bottom, foi-fii’il X llilill.

Fig. 2. — Effects of Forging on Structure of Metal.

/, Oil-liardened aud .lunealed. x 29.

this porosity at the top and centre of the ingot does not occur

to the same extent, and a much greater portion can there-

fore be utilized. The sound portion of the ingot is heated in a reheating gas furnace, which is usually built in close proximity to a hydraulic forging press. This press is now almost exclusively used for forging the steel in place of the .steam hammers which were formerly an important feature in all large works (Fig. 1, Plate). The largest of these steam hammers could not deliver a blow of more than some 500 foot tons of energy; with the hydraulic press, however, the pressure amounts to, for ordinary purposes, from 1000 tons to 6000 tons, while for the manufacture of armour plates it may amount to as much as 10,000 or 12,000 tons. For 8-inch guns and those of larger calibre the bored-out ingot is forged hollow on a tubular mandrill, kept cool by water running through the centre ; from two to four hours' forging work can be performed before the metal has cooled down too much. Generally, after one end of the ingot has been forged down to the proper size, iifc is then reheated and the other end similarly treated. The forging of the steel and the subsequent operations have a very marked influence on the structure of the metal, as

will be seen from the micro-photographs of Fig. 2 (Plate) ; (a) and (&) show the structure of the cast steel of the actual ingot. From these it will be noticed that the crystals are very large and prominent, but as the metal passes through the various operations they become smaller andless pronounced. Thus (c) and (d) show the metal after forging; (e) shows the pearlite structure with a magnification of 1000 diameters, which disappears on the steel being oil-hardened ; and(/) shows the oil-hardened and annealed crystals. At the Bofors Works in Sweden gun barrels up to 15 centimetres calibre are often formed of an unforged cast steel tube, but this practice, although allowing of the production of an inexpensive gun, is not followed by other nations. After the forging is completed it is annealed by reheat-ing and cooling slowly, and a number of test pieces are cut from each end tangentially to the circumference of the bore. Half the number of these are tested to ascertain the quality of the steel in the soft state, and the remainder are hardened and annealed in the way described hereafter for the treatment of the gun forging, and tested partly for

tensile test and partly for bending. It is found that the quality of the steel is greatly improved by forging, so long as this is not carried so far as to set up a laminar structure in the metal, which is thereby rendered less suitable for gun construction, being weaker across the laminae than in the other directions. It is then termed overforged.

Fig. 3a.

If the tests are satisfactory the forging is rough-turned and bored, and then reheated to a temperature of 1600° F., and hardened by being plunged into a vertical tank of rape oil. This process is a somewhat critical one ; great care must be observed in uniformly heating the whole of the forging in a furnace in close proximity to the oil tank into which it is plunged, and it must be completely submerged as rapidly as possible. In some cases the oil in the tank is circulated by pumping, so that uniformity of cooling is ensured, and in addition the tank is surrounded by a water jacket, which also helps to keep it at a uniform heat. The forging is subsequently again heated to from 900° F. to 1200° F., and allowed to cool slowly

by being placed in warm sand, &c. This last operation is termed annealing, and is intended to dissipate any internal stress which may have been induced in the forging by any of the previous processes, especially that of oil-hardening.

After this annealing process a second set of test pieces, two for tensile and two for bending test, are cut from each end of the forging in the positions above mentioned. For guns of less than S-inch calibre only half this number of test pieces is taken, and with hoops of less than 48 inches in length the test pieces are taken only from the end which formed the upper part of the cast ingot. In all cases of annealed steel the test piece of 2 inches length and 0-533 inch diameter must not break, with less than 34 tons per square inch or more than 44 tons per square

Fig. 3b.

inch ; the elongation must not be less than 17 per cent., nor the elastic limit less than 21 tons per square inch.

For breech screws the steel is made of a harder quality, as

it has to resist a crushing stress. These are the tests required in England, but they differ in different countries; for instance, in France a harder class of steel is employed, and the tensile strength must not be less than 46 tons, nor the elastic limit less than 25 tons per square inch, neither must the elongation fall below 15 per cent.

Steel having about 3 per cent, of nickel is now being used to some extent for the smaller guns, and offers certain advantages. It does not require tempering, and in the soft state has a tensile strength equal to that of ordinary tempered gun steel, with a higher elastic limit and about the same elongation. The structure is of a very uniform and finely crystalline nature.

Assuming that the tests of the annealed forging are satisfactory, the forging, which we will suppose to be a barrel, is tested for straightness, and, if necessary, rectified; it is then bored out to nearly the finished dimension and rough- and afterwards fine-turned in a lathe, on the exterior (Fig. 3a). In the meantime the other portions of the gun are in progress, and as it is far easier to turn down the

outside of a tube than to bore out its interior to the exact

measurements required to allow for shrinkage, the interior of the jacket and other hoops are bored out in a boring-machine and finished before the exterior of the barrel is fine-turned ; and so for any other hoop. The process is illustrated in Pig. 3b. The barrel or hoop A to be bored is passed through the revolving headstock B and firmly held by jaws C, the other end being supported on rollers D. A head E, mounted on the end of a boring-bar F, is drawn gradually through the barrel as it revolves by the leading screw K actuated by the gear G. The boring head is provided with two or more cutting tools, and also with a number of pins of brass or pieces of hard wood to act as guides, in order to keep the boring head central after it has entered the barrel. The revolving headstock B is driven by a belt and worm-gear H.

With wire guns the procedure is somewhat different.

The wire is wound on to its tube, which has been pre-
viously fine-turned ; the exterior diameter of the wire is
then carefully measured, and the interior of the covering
tube or hoop finished to suit. The covering hoop is often
not allowed any shrinkage, as it is simply intended as a
protection to the wire and to give longitudinal strength ;
but in order to place it over the wire it must be heated,
and thus some little contraction always does take place,
as it is found that any hoop on cooling, after being heated,
is somewhat smaller than it was originally. The heat to
Fig. 4.
which these hoops are brought for shrinking never exceeds,
or even approaches, that used in annealing, otherwise the
modifying effects of the annealing process would be
interfered with.
In the earliest modern type B.-L. guns the breech
screw engaged directly with a screw thread cut in the
barrel, which thus had to resist a large portion of, if not
all, the longitudinal stress. This was, until quite
‘^t‘“ctT” recently, the system adopted in Prance, but it

has some serious objections. The principal one is, that the barrel must be made of large external diameter to meet the longitudinal stress, and this in consequence reduces the circumferential strength of the gun. Again, the diameter of the screw is always considerably larger than the breech opening, and so an abrupt change of section takes place, which should always be avoided in structures liable to sudden shocks. The only advantage is, that the thick barrel gives stiffness against bending, but this liability is met in a better manner in all the later patterns of British guns by the long continuous outer tubes which are shrunk over the barrel or wire. In the English system the breech screw is engaged either in the breech piece, i.e., the hoop which is shrunk on over the breech end of the barrel, or in a special bush screwed into the breech piece. The latter method suits the latest system of construction, in which the breech piece is put on the barrel from the muzzle, while with the earlier type it was put on from the breech end.

With the earlier constructions short hoops were used

whenever possible, as, for instance, over the chase of the gun, principally because the steel in short lengths was less likely to contain flaws. But as the metallurgical processes of steelmaking developed the necessity for this dis-appeared, and the hoops have become gradually longer. This has, however, increased correspondingly the difficul-ties in boring and turning, and to a much greater extent those encountered in building up the gun. In this opera-tion the greatest care has to be taken, or warping of the long tubes will occur during heating. The tubes are heated in a vertical cylindrical furnace, gas jets playing on both the exterior and interior of the tube. When sufficiently hot, the tube is raised out of the furnace and dropped vertically over the barrel or other portion of the gun. In cooling it shrinks longitudinally as well as circum-ferentially, and in order to avoid gaps it is, aiter being placed in position, cooled at one end to make it grip by a ring of water jets, while the other portions are kept hot by rings of burning gas flames, which are successively extinguished to allow the hoop to shorten gradually, and

thus avoid internal longitudinal stress. A stream of water is also directed along the interior of the gun during the building-up process, in order to ensure the hoop cooling from the interior. After the building iip has been completed, the barrel is fine-bored and ground, then chambered and rifled. The breech is then screwed either for the bush or breech screw, and the breech mechanism is fitted to the gun.

In order to obtain longitudinal strength, the outer

tubes are so arranged that each hooks on to its neighbour from muzzle to breech. Thus the chase hoop hooks on to the barrel by a step, and the succeeding hoops hook on to each other until the jacket is reached ; this is secured to the breech piece by a strong collar and screwed ring. In some of the later patterns of guns there is usually only a chase hoop covering the forward portion of the gun and a jacket covering the breech portion — an arrangement ■which simplifies the design, but greatly increases the

difficulties of manufacture.

Wire guns are now made of almost all calibres, ranging from 3-inch to 12-inch. Many authorities object to guns of less calibre than 4-7 inch being wound with wire, as they consider that on diameters so small the in-sJruetton.' t^rior surface of each layer of wire is over-compressed, while the exterior is too much extended; but if the thickness of the wire is propor-tioned to the diameter of the tube on which it is wound, there is no reason why this should be the case. The wire is wound on the barrel with a certain tension, ascer-tained by calculation, and varying from about 50 tons per square inch for the layers first wound on the gun to about 35 or 40 for the outer layers. To fasten the wire at the beginning and end, several methods are adopted. In the Woolwich system a narrow annular ring (0 0, Fig. 4), with slots cut into one of its faces, is shrunk on to the gun, and into these slots one end of the wire is inserted and secured in position by a steel-screwed plug, each layer of wire being fastened at the beginning and

end in this way. At Elswick the wire is fastened by bending it into a circular-cut groove in a similar annular ring, but the wire is only fastened off in the same way after several layers have been wound. With each succeeding layer of wire the interior layers are compressed, and these in turn compress the barrel ; it is therefore necessary, in order to prevent the fatigue of the material of the barrel, to make it relatively thick, or, better still, to have an outer barrel superimposed on the inner one. This latter arrangement is now used in all guns larger than 4-7 inch, but it will probably be extended to guns of even 4-inch calibre ; it is not so important with smaller guns, where the barrel is always comparatively thick, and thus meets the conditions. With modern guns the interior of the outer barrel is bored taper, the larger end being towards the breech, and the exterior of the inner barrel or liner is made taper to correspond. The latter is then inserted in the outer barrel while both are cold, and forced into position by hydraulic pressure. The details of the machines for winding on the wire differ

somewhat in different works, but all are arranged so that any desired tension can be given to the wire as it is being wound on to the gun.

The wire is manufactured in much the same way as ordinary wire. A red-hot bar of steel, gradually rolled down between rollers to a section about double that which it is finally intended to have, is annealed and carefully pickled in an acid bath to detach any scale. It is then wound on a drum, ready for the next process, which consists in drawing it through graduated holes made in a hardened steel draw-plate, the wire being often annealed and pickled during this process. The draw-plate holes vary in size from slightly smaller than the rolled bar section to the finished size of the wire, and, as a rule, the sharp corners of the wire are only given by the last draw. It is found that considerable wear takes place in the holes of the draw-plate, and a new plate may be required for each hank of 500 or 600 yards of wire. Great importance is attached to the absence of scale from the wire when it is being drawn, and after pickling, the rolled bar and wire are treated with lime or some similar substance to facilitate the drawing. The tests for the finished wire are as follows: — It has to stand a tensile

stress of from 90 to 110 tons per square inch of section, and a test for ductility, in which a short length of the wire is twisted a considerable number of turns in one direction, then unwound, and re-twisted in the opposite direction without showing signs of fracture. It will be seen that the wire is extremely strong, and the moderate stress of from 25 to 30 tons per square inch, which at most it is called upon to withstand in a gun, is far less than it could endure with perfect safety.

The wire, after manufacture, is made up into hanks for storage purposes, but when required for gun construction it is thoroughly cleaned and wound on a drum E about 3 feet 6 inches in diameter, which is placed in one portion of the machine in connexion with a powerful band friction brake M. The wire is then led to the gun A placed between centres or on rollers BB, parallel to the axis of the wire drum. By rotating the gun the wire is drawn off from the drum against the resistance of the band brake, which is so designed that, by adjusting the weight S, suspended from the brake strap, any desired resistance can be given in order to produce the necessary

tension in the wire as it is being wound on the gun. The stress on the wire is indicated on the dial N. The head-stock, containing the drum of wire, is capable of being moved along the bed G by a leading screw H, driven by a belt through variable speed cones I ; the belt is moved along the cones by forks J, traversed by screws K, which in their turn are actuated by chain belts from the hand-wheel L. The traversing speed is regulated to suit the diameter of winding by moving the belt along the speed cones. The wire is rectangular in section, 0-25 inch wide and 0‘06 inch thick, and after it has been wound on to the gun it presents a very even surface, which does not gen-erally require any further preparation. The diameter over the wire is gauged, and the jacket or other covering hoop is carefully bored equal to this, if no shrinkage is to be allowed, or the dimension is diminished in accord-ance with the amount of shrinkage to be arranged for. The gun is built up, after wiring, in the same manner as a gun without wire, the jacket or other hoop being heated in the vertical gas furnace, and when hot enough dropped

into place over the wire, cooled by the ring of water jets at the end first required to grip, and kept hot at the other, exactly as before described.

Strictly speaking, the description of obturators should be included in that of breech mechanism ; but as there are, at present, two systems of obturation in use in the British service, and as the design of the breech mechanism depends in a large measure on the ‘rs^’ system adopted, we propose to consider this part of the subject separately. The purpose of the obturator is to make the breech end of the gun gas-tight, and

1 ^ ^ V^^^

1 ^^^

” VL

Fig. 5.

to prevent any escape of gas past the breech arrangements. In the first Armstrong B.-L. guns this object was attained by fitting to the breech block a copper ring coned on the exterior ; the cone surface was screwed tightly up, by the breech screw, against a corresponding

copper ring fitted at the breech opening of the gun chamber. This was a positive method, but one which could be used only when it was possible to jam the copper surfaces together by a powerful screw. In the French service B.-L. guns have been in use since about 1863, and one of the first systems of obturation was arranged on the same principle as the leather packing ring of the hydraulic press. On the face of the breech screw a steel ring, A, of a cup form, was fastened by a central screw ; the outer lip of the cup fitted against a slightly coned seating formed in the breech of the gun (Fig. 5). When the gun

Fig. 6.

was fired, the gas pressure expanded the cup ring and forced it into close bearing against the breech screw and the seating in the gun, thus preventing any escape of gas. Very similar to this was the Elswiek cup obturation (Fig. 6), introduced by the Elswiek Ordnance Company, except that its bearing face was slightly rounded, so that on

setting back against the breech screw it became flattened and expanded the lip more than with the French obturator. Besides this, the seating in the gun was formed of a copper ring, let into the gun, which could be renewed when necessary. Both these types of obturators were perfectly efficient if treated with care, and with the Elswiek plan the parts liable to damage could be replaced, though a slight abrasion of the cup or seating allowed the gas to escape, and so accentuated the defect with each round fired ; unless, therefore, the fault was immediately remedied, considerable damage was caused to the gun after a few rounds. The Broadwell gas ring, used in some French B.-L. guns and by Krupp for his guns, and described in the ninth edition of this Encyclopaedia, depends on the same principle, and is open to the same objections. For all his latest pattern guns Krupp uses the metallic cartridge case, to be described lower down.

After this there was introduced into the French service by Colonel De Bange a new form of obturator, which has

since been adopted by the British and other Governments. It consists of a pad (Fig. 8) made up of a strong annular-shaped canvas bag, containing a mixture of asbestos fibre and mutton suet ; the bag with its contents is placed in a properly formed die and subjected to hydraulic pressure. The pad is placed on the front of the breech screw, and it is protected on its faces by discs of metallic tin or copper, having steel wedge rings on the outer edges ; the circumference of the complete pad and discs is slightly coned, and fits into a corresponding seating formed at the breech end of the gun, the canvas of the circumference of the pad being in immediate contact with the gun. In front of the pad is placed a strong steel disc formed with a spindle, and called a mushroom head, the spindle passing through the hole in the pad and through the breech screw, being secured in rear by a nut. The firing vent is generally drilled through the mushroom head and spindle, and is then termed an axial vent, to distinguish it from the radial vent bored through the body of some guns. On the gun being fired the gas exerts a great pressure on the mush-

room head, which compresses the pad and forces it out on the circumference into close contact with the seating, thus forming a perfect gas seal. It is found that this apparently delicate arrangement will stand considerable ill-usage and act perfectly for an indefinite time, and as it is easily replaced, it is looked upon as one of the best forms of obturator. In some countries the Freyre obturator is in use ; this has a somewhat similar axial head to the De Bange, but the asbestos pad is replaced by a single steel wedge ring into which the axial head fits. On firing the gun the head is forced into the wedge ring, and thus expands it against the seating of the gun.

We have now to consider one other means of obturation, viz., metallic cartridge cases. These act on the same principle as the cup obturation, and are extremely efiBcient for the purpose ; moreover, they have certain advantages when used for small guns.

The idea has developed from the use of such cartridges in small arms, and larger

cartridges of the same type were intro-
duced in 3-pounder and 6-pounder guns by
Hotchkiss and Nordenfelt about the year
1880. Then in 1886 the Elswiek Company
produced a 36-pounder (soon converted to
a 46-pounder) of 4-7 inches calibre, with
the powder charge contained in metallic
cases, and about 1888 a 6-inch 100-pounder
gun, using similar cartridges. Metallic
cases of a short pattern were also used
in guns of 8-inch and 10-inch calibre,
and although their action was quite efficient, they were
heavy to manipulate, and it was considered that for guns
above 6-inch calibre the De Bange obturation was the most
advantageous. Krupp, however, uses cartridge cases with
guns even of 12 inches calibre, but this is, in aU proba-
bility, due to the difficulties attending the use of the
Fig. 8.
ordinary forms of obturation with the wedge breech system,
especially now that the use of smokeless powder, which is

exceedingly searching in its action, is almost obligatory. With smokeless powder any small defect in the ring obturators is immediately attacked, and increases with such

rapidity as quickly to render the obturator useless, even if it does not seriously damage the gun. There are, however, certain disadvantages with cartridge cases, such as their weight, the difficulty of stowage, &c., which has caused a reaction in England in favour of the De Bange system, especially for guns of 6-inch and even smaller calibres. Most other nations, however, still retain cartridge cases for guns up to 6-inch calibre. Aluminium

Pig. 9.

cases have been experimented with, but up to the present have not proved satisfactory.

One of the most important parts of the gun is the breech mechanism, and a vast amount of ingenuity is expended in designing this, that it may be as

Breech ^ simple and at the same time as effective and

tem. ^’ quick-acting as possible. In England the inter-
rupted breech screw is used. This is a French
invention, and consists of a strong screwed plug engaging
with a corresponding screw thread cut on
the interior of the breech opening of the
gun. The screw surface of the breech plug
is cut away in sections equally divided and
alternating with the threaded portions. The
screw surface of the breech opening of the
gim is similarly cut away, so that the plug
can be pushed nearly home into the breech
opening without trouble ; by then revolving
the breech screw through a small angle, the
screwed portions of the plug and breech
opening engage. Thus if three sections
are cut away, the angle of revolution neces-
sary to ensure a full engagement of the
screw surfaces will be 60°. A modification
of the cylindrical breech screw (called the
Welin screw), in which the loss of the

threaded surface by the interrupted portion is reduced, has lately been introduced into the English service. In the older types of mechanism the breech was opened in from three to four different operations, which involved considerable loss of time. Thus in the earlier patterns of 10-inch B.-L. gun, to open the breech the cam lever C was folded up so that it engaged the pin J in connexion with the ratchet lever E (Fig. 7). This was then worked, and disengaged the breech screw from the threads cut in the gun ; the cam lever was then folded down so as to start the breech screw, and the winch handle D rotated to withdraw the screw and swing it clear of the breech opening. During these operations the firing lock was actuated and made safe, but the fired tube had to be extracted by hand. To close the gun these various operations were reversed. To open or close the gun would certainly occupy at least half a minute with

trained men. To compare with this a modern 12-inch breech mechanism is shown in Fig. 8. In order to open this breech it is only necessary to turn the hand-wheel continuously in one direction, and to close it again the motion of the hand-wheel has only to be reversed; either closing or opening the breech occupies about six seconds. Supposing the breech closed, the hand-wheel when rotated gives motion to the link G through the worm-wheel E and crank F. By this means the tooth B is moved from its extreme right position to the left, and so disengages the breech screw A from the threads in the gun; the rack A^ on the breech screw then comes into gear with the pinion E, and draws the breech screw out of the gun into the carrier ring C which finally swings on the axis pin EF and clears the breech opening. While the opening is being performed the firing lock K is operated by the cam groove A^, which puts the firing mechanism, either electric or percussion, to safety by withdrawing the firing needle, extracts the fired tube, and leaves the primer chamber

open for a fresh primer. All these operations are performed in the reverse order on closing. With both these types of mechanism the De Bange system of obturation, with the pad only slightly coned, is used. With smaller guns the mechanism is still simpler, as less power is required for opening the breech. Thus with the 6-inch B.-L. gun, Mark IV., date about 1885 (Fig. 9), the breech is opened in three separate operations : — (a) the cam-lever C, which also locks the breech, is raised into the vertical position and pulled over to the left, disengaging the screw threads; (6) the cam lever is folded down, so that the cam acting on the rear face of the gun releases the De Bange obturator, and the screw A is then pulled by hand through the

Kg. 10.

carrier ring B out of the breech; and (c) the carrier ring and breech screw are revolved together to the right, clear of the breech opening. In a modern 6-inch gun fitted with De Bange obturator all these operations are combined, and the mechanism worked by a horizontal

hand lever, which is moved from left to right through an angle of about 200°. The hand lever A (Fig. 10) moves a link B connected to a pin C on the breech screw D, and disengages the screw from the gun ; a small lateral movement is then given to the axis pin of the carrier, so as to allow the obturator pad E to swing out of its seating ; when this is quite free the whole mechanism revolves on the axis pin, and thus clears the breech opening. The

firing lock F is actuated at tlie same time and ejects the fired tube G, and a new tube is inserted while the gun is being loaded, so that immediately the breech is closed the charge can be fired without loss of time. In the old mechanisms the breech had to be closed first and the firing tube inserted afterwards.

The breech mechanism for guns firing metallic cartridge cases is somewhat simpler than that for the De Bange obturation, due principally to the fact of the firing primer being contained in the cartridge case, when this

r 11 i i;

r-

if

E!m)

^^^1 j?

^

Kg. 11.

is introduced into the gun.. In the Hotchkiss and also in the Skoda systems the mechanism is of the vertical breech block type ; the actuating lever F (Fig. 11) is on the right side of the gun, and is connected to a powerful crank arm C working in a groove E cut in the breech lock. By pulling the lever towards the rear the crank arm forces down the block A and extracts the fired case by an extractor X, which in the Hotchkiss gun is actuated by a cam groove Y, also cut on the side of the block. As the mechanism is opened the hammer H is cocked ready for the next round. To close the mechanism the lever is pushed over to the front, and by releasing the trigger sear by pulling the lanyard the hammer

falls and fires the cap of the cartridge case. Automatic gear can be fitted which opens the breech and extracts the fired case by means of a supplementary mechanism and strong spring actuated by the recoil of the gun;

Kg. 12.

when a new cartridge is pushed into the gun the breech, which was retained by the extractor, is teleased, and closes automatically.

The Nordenfelt mechanism (Fig. 12) consists of a breech block B and a wedge 0 to secure it. A hand lever on the shaft C is pulled to the rear, and this works the action cam A, which pulls down the wedge ; the breech block B is then caused to rotate, and falls back to the rear. This motion of the breech block actuates the extractor and extracts the case. While the wedge is being with-drawn the firing pin G is pulled back and cocked for the next round. The mechanism is closed by reversing the hand lever, which rotates the breech block upwards, and pushes home the cartridge case ; the wedge is then forced up, and secures the breech block.

For larger guns the Elswick type of coned screw has found much favour, and has been fitted to guns of all calibres from 3-inch to 6-inch, both for the British and numerous foreign Grovernments. The breech screw is formed partly conical and partly cylindrical, to facilitate its entrance and its exit ; this form, moreover, is taken advantage of by cutting the interruptions in the screwed surface alternately on the coned part and on the cylindrical part, so that there is a screw surface all round the circumference of the breech screw. By this means the stress is taken all round the circumference, both of the breech screw and in the gun, instead of in portions alternately, as with the ordinary cylindrical form of breech screw. This form of breech screw can also be used with De Bange obturation and the actuating mechanism similar to that already described. The breech screw F (Fig. 13) is mounted on a carrier D pivoted on the right side of the gun. On the rear face of the breech screw projects a pin A,

which is connected to the horizontal hand lever E by a block B, sliding in a groove cut in the carrier and link C. When the hand lever is pulled from left to right to open the gun, the link pulls the sliding block across the rear face of the breech screw, and rotates it until the screw threads are disengaged; the sliding block then comes to a stop in the carrier, and the whole mechanism can be revolved on the axis pin G, clear of the breech opening. This then also acts on an extractor H, which extracts the fired cartridge case a short distance, so that it is easily removed by hand ; it would be dangerous to the gun's crew for these heavy cartridge cases to be violently ejected. On first moving the hand lever to open the gun the firing mechanism is put to safety by slightly withdrawing the firing needle, and it is impossible to fire the gun until the lever is quite closed. To fire by percussion, the needle is drawn back by hand until it is cocked ; by then pulling the lanyard attached to the trigger J, the needle is released and

fires the primer.

The rifling of a gun is the term given to the numerous shallow grooves cut spirally along the bore ; the rib left between two grooves is called the “land.” The mar *”””*■• chine used for rifling modern guns is very similar to that employed for the old muzzle-loaders ; but as guns have kept increasing in length, the diificulties of their manufac-ture have increased also, and it has only been by improving the mechanical appliances that the various obstacles have been sur-mounted and a steady progress made possi-ble. The rifling machine (Fig. 14) is a special tool used in gun construction only, and is in reality a copying machine. A steel or cast-iron bar J, which forms the copy of the de-veloped rifling curve, is first made. The copying bar — which is straight if the rifling is to be uniform, but curved if it is to be increasing — is fixed inclined at the

proper angle to standards K on the machine. The cutting tool is cai-ried at one end, C, of a strong hollow cylindrical rifling bar B, the other end of which is fixed to a saddle M. This is moved along the bed of the machine by a long screw N, and the rifling bar is consequently either pushed into the gun or withdrawn by the motion of the saddle along the machine. During this motion it is made slowly to rotate by being connected to the copying bar by suitable gearing, I ; it will thus be seen that the cutting tool will cut a spiral groove along the bore of the gun in strict conformity with the copy. In most English machines the cutting tool cuts only as the rifling bar is drawn out of the gun ; during the reverse motion the cutter F is withdrawn out

of action by means of a wedge arrangement D, actuated by a rod passing through the centre of the rifling bar, which also pushes forward the tool at the proper time for cutting. One, two, or three grooves may be cut at

one time, the full depth being attained by slowly feeding the tool after each stroke. After each set of grooves is cut the rifling bar or the gun is ro-tated, so as to bring the cutters to a new position.

All modem guns are rifled on the poly-groove system, i.e., a considerable number (from four to six per inch of diameter) of shallow grooves are cut all round the bore of the gun ; the stress induced on the rifling, in forcing the projectile to rotate

during its passage along the bore, is thereby distributed around the circumference. In the old muzzle-loaders a few deep and wide grooves only were cut, so that the metal studs fixed in the projectile should not be too numerous, and thus unduly weaken its walls. When the studs were superseded by the copper gas check, more numerous grooves were cut so as to distribute the rotational pressure. This was a great improvement, as the powder gas expanded the edge of the gas check, and so prevented the escape of gas over the projectile, as in the previous systems.

The first type of driving band used in modern breech-loading guns was a broad band of copper fixed to the base of the projectile, but this was expensive, and not altogether satisfactory. Mr Vavasseur then devised the plan of pressing, by hydraulic or other means, a comparar tively narrow band of copper into a recessed groove cut near the base of the projectile ; this proved most satis-factory, and has now been universally adopted. It will be seen that with breech-loading guns the projectile is better centred, and the copper driving band forms a definite stop for the projectile; in consequence, the capacity of the gun chamber is practically constant. In addition, the use of a copper band ensures a uniform resistance while the projectile is being forced through the gun, and it also prevents the escape of gas. These elements have a very great influence on the accuracy of the gun, and fully account for the vastly superior results obtained from breech-loading ordnance as compared with the muzzle-loading type. Many authorities believe that the best results are obtained when the projectile is fitted

with two copper bands, one near the head and the other near the base. Ko doubt it is better centred when so arranged, but such projectiles can only be fired from guns rifled with a uniform twist, and it must also not be forgotten that the groove formed for the front band in the head of the projectile necessarily weakens the part of the shot which should be strongest.

Projectiles with a driving band at the base only can be fired from guns rifled either uniformly or with increasing twist. The pitch of the rifling or the amount of twist depends altogether on the length of the projectile ; if this is short, a small amount of twist only is necessary ; if long, a greater amount of twist must be arranged for in order to spin the shell more rapidly. Professor Greenhill has shown that the pitch of the rifling necessary to keep a projectile in steady motion is independent of the velocity, of the calibre, or of the length of the gun, but depends principally on the length of the shell and on its description, so that for similar projectiles one pitch would do for all guns.

The following table has been calculated from Professor

Greenhill's formula : —

Length of

projectile

in

calibres.

Minimum twist at muzzle of ^n requisite to give stability of

rotation expressed in 1 tarn in n calibres.

ill

“■goo

II

Ed

m 1

5iri

1^^ s

8

n

n

n

n

2 0

21

2-2

63-87

59-84

56-31

71-08

66-59

62-67

72-21

67-66

63-67

84-29

78-98

74-32

2-3

2-4

2-5

53-19

50-41

47-91

59-19

56-10

53-32

60-14

57-00

54-17

70-20

66-53

63-24

2-6

2-7

2-8

45-65

43-61

41-74

50-81

48-53

46-45

51-62

49-30

47-19

60-26

57-55

55-09

29

3 0

31

40-02

38-45

36-99

44-54

42-79

41-16

45-25

43-47

41-82

52-72

50-74

48-82

3-2

3-3

3-4

35-64

84-39

33-22

39-66

38-27

36-97

40-30

38-84

37-56

47-04

45-38

43-84

3-5

3-6

3-7

32-13

31-11

30-15

35-75

34-62

33-55

36-33

35-17

34 09

42-40

41-05

39-79

3-8

3-9

40

29-25

28-40

27-60

32-55

31-61

30-72

33-07

3211

31-21

38-61

37-48

36-43

41

4-2

4-3

26-85

26-13

25-45

29-88

29-08

28-33

30-36

29-55

28-78

35-43

34-49

33-59

4-4

4-5

4-6

24-81

24-20

23-65

27-61

26-93

26-32

28-05

27-36

26-74

32-74

31-94

31-21

4-7

4-8

4-9

23-06

22-53

22-03

25-66

25-08

24-51

26-08

25-48

24-91

30-44

29-74

29-07

50

51

5-2

21-56

21-08

20-64

23-98

23-46

22-97

24-36

23-84

23-34

28-44

27-83

27-24

5-3

5-4

5-5

20-22

19-81

19-42

22-50

22-05

21-61

22-86

22-40

21-96

26-68

26-14

25-63

5-6

5-7

5-8

19-04

18-68

18-33

21-19

20-79

20-40

21-53

21-12

20-73

25-13

24-66

24-20

5-9

60

7 0

18-00

17-67

14-99

20-03

19-67

16-68

20-35

19-98

16-95

23-75

23-33

19-78

8 0

9 0

10 0

13 02

11-50

10-31

14-48

12-80

11-47

14-72

13-00

11-65

17-18

15-18

13-60

In most modem guns the projectile varies in length from 3 ‘5 to 4 calibres, so that the rifling is made to terminate at the muzzle with a twist of 1 turn in 30 calibres, which is found ample to ensure a steady flight to the projectile. With howitzers the projectile may be 4-5 calibres long, and the rifling has to be made of a shorter pitch to suit. The relative merits of uniform and increas-ing rifling depend on the description of gunpowder used in the gun ; for quick-burning explosives most authori-ties favour the increasing twist, while for slow-burning

Fig. 14.

powder it would appear that the uniform twist has the advantage. So many considerations have to be taken

into account in this important question, that it would not be possible to detail them, here. We give, in the following table, the pressures between the rifling and driving band of the projectile, which have been calculated from the experiments carried out by Sir Andrew Noble with some 4-7-inch guns. These results are obtained by using the formulae shown in Etmv. Brit., vol. xi 295 :—

Travel of
shot in
Total thrust,
Uniform Kifling.
Velocity
Parabolic Bifllng.
Total thrust
Total thrust
bore
(fee, on base o£
in tons between
between driving

in feet

shot in tons.

driving surface

of grooves and

ring of projectile.

surface of groove

and ring of

projectile in tons.

0-5

2547

19-9

548

7-9

10

264-0

20-7

849

9-7

1-5

245-0

19-2

1064

10-3

2 0

207-9

16-3

1224

10-5

2-5

175-7

13-7

1343

10-5

30

160-7

11-8

1437

10-4

40

115-2

9-1

1577

10-5

50

94-9

7-4

1680

10-8

6 0

80-6

6-3

1761

11-1

7-0

69-5

5-4

1828

11-4

8 0

60-0

4-7

1884

11-6

9 0

52-1

4-1

1931

11-8

10-0

44-8

3-5

1970

11-9

110

38-4

3-0

2004

12-0

12-0

32-9

2-6

2032

12-0

13-0

28-4

2-2

2056

12-1

140

24-3

1-9

2076

12-1

14-4

22-6

1-8

2084

12-1

In order to understand properly the principles of gun construction, it is necessary to study the theoretical considerations of the

stresses set up in the metal of the

gun by the pressure of the powder

gases, or by the shrinkage of the

tubes in built-up guns or the tension

of the mre in wire-wound guns.

For this purpose take a small brick-

shaped piece of the metal of the tube

(see Fig. 15), and suppose its dimen-

sions to be defined as follows : — ~ T-

(i.) By two adjacent oonoen trie cy-

finders of radii r and r) fr,

(ii.) By two consecutive radial

planes at an angle 59,

(iii.) By two transverse planes at

distances x and x + Sx from Fig. 15.

one end,

so that the width of the lower part of the element will be rS0,

its depth or, and thickness dx.

Let the tube be acted upon by the powder gases, which will

induce in the small piece of metal —

T=a circumferential stress,

P=a radial stress,

E=a longitudinal stress.

and assume by these stresses that the piece is slightly altered in all

its dimensions, so that the radius increases by u and the thickness

by d^, thus —

rSB becomes r56

so that the circumferential extension =-=e,

Sr becomes dr

and the radial extension

Sx becomes ix

and the longitudinal extension

u

i=-=e,

r

(du\

du

~d^^J

= ‘dx=3-

Putting -^ = l^ + ‘g^, the longitudinal dilatation for unit stress,

B = g^ — gT, the transverse contraction for unit stress for

any single force acting alone (see Ency. Brit., vol. -vii. p. 806).

Therefore, when the three forces are acting on the element

together we have

e=AT-B(P-FE))

/=AP-B(T + R)f . . . . (1)

ff=AR-B(P-^T)j

B ^ . ,

or since “T”” Poisson s ratio.

‘+T)J

and putting ^=M, Young’s modulus of elasticity, we have

Me=T-i7(P-|-E)”

M/=P-o-(T-l-I

M?=R-o-(Ph ”

“We have also (see Enay. Brit., vol. xv. p. 745)

T=i(I’’-) . . .

From equations (2) we obtain

M

‘?(~~‘^>+’^C/~~<-?)}

^ = (1-Hcr) (l-2ff)W-‘^)? + °-(«+/)}

(2)

(3)

(4)

(5)

(6)

Now making use of the relation in equation (3) and using

equations (4) and (5) we obtain, by putting the proper values of e

/, and g,

(1 – <^)-^ -i-r (^^^ + ^j =(1 -

ld% d di di\

“Kdr+‘dr-^ + d^)’

or transposing and dividing by r

,, . (dSi Idu u\ d di

^^-”[dr’ + rrr-pj+‘d-r^’^- • • W

Assuming that the longitudinal stress R is constant throuehout

the section, °

dU „

dr ‘

G U N-M A K I N G

169

and from (6)

d rf|

From (7) and (8) we see that

/dhi Idu u\

XdP’^l-dr TV”’’

(8)

and

d!hi Idu u

dr^ rdr~r^~^

. (9)

Integrating (9)

drda:’” . . . .

dii, u

^+ – = 20, a constant,

.(10)

or

rdM + udr=2Grdr,

and again integrating

ur=Cr^ + I)

that is

and

Integrating (10)

. du T)

S’ — ^=o, a constant.

Suppose we are dealing with a single tube of a gun of radii r„ i

and r„ ; then the radial stress varies from P„ i at the interior to

P„ at the exterior of the tube. As the tensional stresses are con-

sidered positive, the pressures must be negative.

Therefore from (5)

D =

l + o- rn~\^rj

M r.

2 ». 2(Pn-l -Pn),

and by putting R=0 or to a constant in (6) and combining the

result with (5) wo obtain the other constants.

Using these values in equations (4), (6), and (6) we find for any

intermediate radius r that

^ P„ ir„-i’’-P„?-„’ ^ n.-iV P«-i-P«

»-n=-r„-i2 ■ r^ r„^-r„-j.’’

P»-i(r-== + r„-^)-P„(r„;J-r-2)

■ (11)

p »-„-iVP„ l – P„ P„-iJ-„.i2- P„r„2

Pn-i(‘-==-r„-2) + P„(r„:r)

. (12)

-2-2

E=0 or a constant

. (13)

Prom the last equation of (2) it will be seen that

T + P=-(R-Mg’), a constant.

Therefore in the same hoop, P being of negative sign,

T„-P„=T-P (14)

Suppose the radii of the barrel to be ro and ri, of the superim-

posed hoop ri and r^, and of the w”” hoop r„ i and r„. Then

from (12) the external pressure of the »”■ hoop is

P r,8^” 1^” ‘-irn-i’-‘P„r„

•r»-r„-i 2 «. ,2 „ 2 „ 2 ■

and from (11) the internal tension of this hoop is

rn “n-l’^n-l “riTn gPn-1 — Pji

^n-1— ^ 2 ^ .2 ”’”’^”«2

Adding, we find

- r„-i’

In in—\

T„-l) Pm= (Pm-1 – P»i)r~2^

‘n ‘n— 1

Therefore the pressure between the ra’” hoop and the {n – 1)”> hoop is

Pn-i — ;

-2(T„-1 + P„)-J-P„

(15)

Tn’ + rn-l’

In the same way the pressure between the (ra – 1)”■ and (m – 2)”” hoops

is

P»-2 =

‘•n-i’

rn-i-‘-fr-n-a-

i(T„ 24-P„ a) + P„ x

. (16) I

So that when P„ and the tensions T,i i, T„.2 ... are known, the

other pressures can be found. It is usual in gun construction to

consider that the proof tension of the barrel should not exceed 15

tons per square inch, and of the outer hoops 18 tons per square inch.

If the m* hoop is the exterior hoop then P,,=0, if we neglect the atmospheric pressure.

The stress obtained by (15) is called the Firing stress, as it is due to the pressure Po of the powder gases produced by the discharge of the gun, Po varying for different positions along the bore (Gunnery : § Interior Ballistics). In order to obtain the full benefit of the hoop system it will be seen that a certain pressure, to be obtamed by shrinkage, should exist at the common surface of each pair of hoops ; this is called the initial stress or stress of repose.

Considering the gun a homogeneous solid block of steel, i.e., by putting n=l in (15) the powder pressure Pq will produce the powder stress ; and the following relation exists : —

(17)

Initial stress ~~I~~ powder stress = firing stress

The method of working will best be seen by a practical example.

Take, for instance, a section across the chamber of a 4‘7-inch Q.-F. gun, in which the diameter of the chamber is 5 inches, that of the barrel 8-2 inches, and the external diameter of the jacket IS inches.

Here ro=2-5 ; ri = 4-l ; and r2=7‘5

To = 15 ; Ti = 18 ; andP2=0.

From (15) we have for the firing stress

■^’”(T^IF+TfTP’^ 18 = 9‘72 tons per square inch.

(4-1)2 (2*5)2

Po=/^Tjw:j772:5y2X (15-f972)4-9”72 = 21 tons per square inch.

By (14) we can obtain the tension T„’ of the outer fibres of the

hoops, thus

T2^ = P2-fTi-Pi= 18-9-72 = 8-28tons,

and Tii = Pi-)-To-Po = 9-72-|-15-21 = 3-72 tons.

For the powder stress (11) and (12) may be used by making

M=l and ^1=0, then

(7-5)2 + (2-5)3

””(7-5)2- (2-5)2 X 21 =26-25 tons,

fei = 26-25-21= 5-25 tons,

for a radius j-=4-l inches

^ = 6-32 tons and

Subtracting the powder stress from the firing stress we obtain

the initial stress, which can be seen at a glance from the following

table : —

Tenaions.

Pressures. 1

At

Hring

Powder

Initial

Firing

Powder

Initial

£adius.

Stress.

Stress.

Stress.

Stress.

Stress.

Stress.

Barrel

>o = 2-5

15 0

26-25

-11-25

21-0

21-0

0

ri=4-l

3-72

11-57

-7-85

9-72

6-32

3-4

Jacket

.v;=4-i

18-0

11-67

6-43

9-72

6-32

3-4

\i-2=7-6

8-28

6-25

3-03

0

0

0

Figure 16, A shows the stress dra-wn to scale.

Denoting by m-‘„ i and tt„ i the radial displacement, from the unstrained position, of the outer and inner circumferential fibres of a tube and the superimposed hoop respectively due to shrinkage, the external radius r„ i -H M„ i’ of the tube -will be diminished by M„ i^ and the internal radius r„-i-‘ii„ i of the hoop will he increased by M„ i.

Since the shi-inkage S is defined as the excess of the external diameter of a tube over the internal diameter of the hoop before shrinkage when both are in the cold state

As

and since i

have

iS = (r„ i-fM„ i’) – (r„ i—a„ i)=M„.i’-l-M„ i

Un-\ denotes an extension it is considered positive in sign, inoe vn\ denotes a compression it is negative. From (2) we

Me=

‘n—i

M-

negatii

Ti„ i<7(P„ i-HE).

-M«=

Therefore subtracting

M(M„ l-^M,

or, denoting the shrinkage between the {n-Vf^ and m” ” hoops by

n-iSm we find that

„ iS„ =(T„ i – T„ i^)

2r„.

M

. (17)

S. V. 2 2

170

G U N-M A K I N G

From (14)

T„-i-T„ ii=T„ i-T„.a + P„ 2-P„ i,

and consequently

„-iS„ ={T„-i-T„.j+^=^^;^^;(T„_,+P„_,)}^' . (18)

Where M can be taken as 12,500 tons per square inch for gun steel.

(See Unwin's Testing of Materials of Construction, p, 249.)

In wire guns, we may regard the tube on which the wire is wound,

as so large, in comparison with the thickness of the wire, that the

compression of the concave surface of the wire and the extension of its

convex surface may be neglected without sensible error. "We may also

neglect any consideration of longitudinal stress in the wire coils.

It is assumed that in the firing stress the tension T, usually taken

at from 25 to 30 tons per square inch, is uniform throughout the

thickness of the wiring. If the wire is wound direct on the ban-el and

is covered by a jacket, then ro, n are the radii of the barrel, ri, rj are

the radii of the internal and external layer of wire, and r^, ra the radii

of the jacket. Then for the firing stress in the wire we have—

T(r2-r) = P?—P2r2 . . . (19)

T(r-n) = Piri-Pr

(20)

The initial tensions of the wire are arranged so that T is uniform

when the gun is fired, and we have now to determine what must

be the winding tensions to produce these conditions.

Denote by 0 the winding tension, by 0 the initial tension, and by a the pressure at any radius r. It is assumed that M is uniform for the gun steel and wire, and that 6, at any radius)•, is equal to 0 increased by the circumferential stress, due to the initial radial pressure m, of the superincumbent layers, acting on the portion of the wire coil and barrel between the radii ro and r. Thus from equation (15) by putting ra=l and Po=0, and consider-ing the barrel and wire homogeneous

r'^ + rt?

^ + <-i. . . . (21)

where E=-(T + P2)r2

F= (T+P2)r2-(T + Po)ro

G= (T + P2)7-2 + (T + P(,)r3.

To compare with the previous example, we will calculate the stresses in a 4'7 Q.-F. wire gun, consisting of a barrel, intermediate layer of wire, and jacket.

Here ?-|,=2-5, ri = 3-75, r2 = 5-5, r3 = 7-5 ;

the tension Ti to 1^ of the wire = 25 tons per square inch, suppose. Take Po = 21 tons per square inch and consider that the jacket fits tightly over the wire, but has no shrinkage. Then for the firing

stresses we have from (12)

P2=2-25 tons,

*and from (19) and (20) Ti(r2 – n) = Pin – V^r^*

Pi= 14-97, say 15 tons;

from (15) we can obtain To and Ts since we know Po, Pa, and Pj

To=0-6 tons, T2=7-5 tons.

From (14) we find

Ti^= —6 ‘4 tons (a compression) and T3” = 5-25 tons.

The powder stress can be obtained in the same way as in the

previous example, and so also the initial stress ; therefore

tabulating : —

Tensions.

Pressures.

At

Firing

Powder

Initial

Firing

Powder

Initial

Badius

Stress.

Stress.

Stress.

Stress.

Stress.

Stress.

Barrel ■

rr„ = 2-5

0-6

■*26-26*

-26-65

21-0

21-0

0

r,=3-‘?5

-6-4

13-126

-18-626

16-0

7-876

7-i-:5

■*VTire •*

rr; = 3-76

25-0

13-125

11-875

15-0

7-875

7-1 La

11-2=6-6

26-0

7-5

17-5

2-26

2-26

0

Jacket –

≥j=6-6

7-6

7-5

0

2-25

2-25

0

r,=1-b

6-26

S-25

0

0

0

0

■*b=li$-!^*

FUU LINES OEHOTE Fmme STRESSES

„ POWDER „.

TffZSSS

For the winding tension of the wire

E= -149-875; F = 34-875; G=264-875;

so that calculating B we find that the -winding

tension must commence 30-3 tons per square

*inch and finish off" at 17*5 tons per square inch.*

It will be noticed that the finishing-off tension

is the same as the initial tension which would

be expected.

Fig. 16, B shows these stresses.

Professor Greenhill has put these formulas,

both for the built-up and wire-wound guns, into

an extremely neat and practical geometrical

form, which could be used instead of the

arithmetical processes ; for these see the Texl-

Book of Gunnery, Treatise of Service Ordnance,

and journal of the United States Artillery,

INITIAL „

WINDING TENSION vol. iv.

In England, as we have before mentioned, the

longitudinal stress at the breech end of the

gun is provided for by the breech piece ; or, in

guns where this is absent, by the jacket. Its

amount is easily calculated on the hypothesis of

uniform stress throughout the thickness of the

breech piece or jacket.

If ro is the largest radius of the gun chamber,

Po the maximum powder pressure, and the radii

of the breech piece or jacket n and ro, then the

tension in tons per square inch

30-3

*l^^^*

T =

*tVV p ro-**

2ir(7-2—i-rj'-')~%2-r/

From (17), (11), and (12), Po being now the powder pressure —

0=T=Po,

-P P""*

ro" rj-'-t-r-'

rs' – ro-

ra" – ro-

(22)

(23)

By means of these equations and by (19) we find that the

expression (21) reduces to

r-ro r + ro

Gunmakers usually arrange that a large factor of safety is observed in providing for this longi-tudinal stress ; and in the larger calibres of guns both the breech piece and jacket may be avail-able for longitudinal strength ; but even in this case tlie jacket is best considered as an auxiliary only, as, owing to the necessary connexions between these two portions, it is possible the jaclcet may not be taking its full share of stress.

The screw thread of the brooch screw and of the breech opening must be so proportioned as to pro-vide for a similar strength ; but in many modem B.-L. guns fitted -with Do Bange obturation the diameter of the seating at the breech opening can be made just large enough to admit the projectile freely. As this would generally be considerably smaller than the maximum diameter of the chamber, a less area is exposed to the gas pressure, and consequently loss thread section is required.

{X. G. H.)

BALLISTICS, the science of throwing warlike missiles or projectiles, is now divided into two parts : Exterior Ballistics, in which the motion of the projectile is considered after it has received its initial impulse, when the projectile is moving freely under the influence of gravity and the resistance of the air, and it is required to determine the circumstances so as to hit a certain object, with a view to its destruction or perforation ; and Interior Ballistics, in which the pressure of the powder-gas is analysed in the bore of the gun, and the investigation is carried out of the requisite charge of powder to secure the initial velocity of the projectile ; also including the calculation of the strength of the various parts of the gun required to withstand the pressure at all parts of the bore.

I. ExTEEioK Ballistics.

In the ancient theory due to Galileo, the resistance of the air is ignored, and, as shown in ordinary treatises on Dynamics, the trajectory is now a parabola. But this theory is very far from being of practical value for most

purposes of gunnery; so that a first requirement is an accurate experimental knowledge of the resistance of the air to the projectiles employed, at all velocities useful in artillery. The theoretical assumptions of Newton and Euler {hypotheses magis mathematicce quam naiurales) of a resistance varying as some simple power of the velocity, for instance, as the square or cube of the velocity (the quadratic or cubic law), lead to results of great analytical complexity, and are useful only for provisional extrapolation at high or low velocities, pending further experiment. The foundation of our knowledge of the resistance of the air, as employed in the construction of Ballistic Tables, is the series of experiments carried out between 1867 and 1879 by the Rev. F. Bashforth, B.D. {Beport on the Experiments made with the Bashforth Chronograph, &c., 1865-1870; Final Report, (fee, 1878-1880; The Bashforth Chronograph, Cambridge, 1890). According to these experiments, the resistance of the air can be represented by no simple mathematical law over a large range of velocity. Abandoning therefore all a priori theoretical

assumption, Bashforth set to work to measure experiment-

ally the velocity of shot and the resistance of the air by

means of equidistant electric screens furnished with vertical

threads or wire, and by a chronograph which measured the

instants of time at which the screens were cut by a shot

flying nearly horizontally. Formulae of the Calculus of

Finite Differences enable us from the chronograph records

to infer the velocity and retardation of the shot, and thence

the resistance of the air. (For practical details refer to

the article Chkonogbaph.)

As a first result of the experiments it was found that the resist-

ance of similar shot was proportional, at tlie same velocity, xo the

surface, or cross section, or square of the diameter. The resistance

R can thus be divided into two factors, one of which is «P, where d

denotes the diameter of the shot in inches, and the other factor is

denoted by f or f^ii), where p is the resistance in pounds at the

same velocity to a similar 1-inch projectile ; thus

R=rf> = cP/(«),

and the value of ‘p, or/(«), for velocities ranging from 100 to 2800

feet per second (f/s) is given in the second column of the extract

from the abridged Ballistic Table.

These values of ^ refer to a standard density of the air, of 634 “22 grains per cubic foot, which is the density of dry air at sea-level in the latitude of Greenwich, at a temperature of 62° F. and a barometric height of 30 inches.

But in consequence of the humidity of the climate of England it is better to suppose the air to he (on the average) two-thirds saturated with aqueous vapour, and then the standard temperature will be reduced to 60° F., so as to secure the same standard density ; the density of the air being reduced perceptibly by the presence of the aqueous vapour.

It is further assumed, as the result of experiment, that the resistance is proportional to the density of the air ; so that if the standard density changes from rmity to any other relative density denoted by t, then

R = ■rd’^p,

and r is called the coefficient of tenuity.

The factor t becomes of importance in long-range high-angle fire, where the shot reaches the higher attenuated strata of the atmosphere ; on the other hand, we must take t = about 800, in

calculations of shooting under water.

The resistance of the air is considerably reduced in modem pro-jectiles by giving them a greater length and a sharper point, and by the omission of projecting studs, and a factor k, called the coefficient of shape, is mtroduced to allow for this change.

For projectiles in which the ogival head is struck with a radius of 2 diameters, Bashforth puts k = 0‘975 ; on the other hand, for flat-headed projectiles, as required at proof-butts, k = 1‘8, say 2 on the average.

For spherical shot k is not constant, and a separate ballistic table must be constructed ; but k may be taken as 1 ‘7 on the average.

Lastly, to allow for the superior centring of the shot obtainable with the breech-loading system, Bashforth introduces a, factor called the coefficient of steadiness.

This steadiness may vary during the flight of the projectile, as the shot may be unsteady for some distance after leaving the muzzle, afterwards steadying down, like a spinning-top. Again, rounds.

Collecting all the coefficients, t, k, c, into one, we put

(1) R = nd^p = nd?f{v)

where

(2)

n = TKa,

and n is called the coefficient of reduction.

By means of a well-chosen value of n, determined by a few experiments, it is possible, with the most recent designs, to utilize Bashforth's experimental results carried out with old-fashioned projectiles, pending further experiments. For instance, m = 0'8 is considered a good average for the modem rifle bullet.

Starting with the experimental values of p, for a standard projectile, fired under standard conditions in air of standard density, we proceed to the construction of the Ballistic Tables ; and first determine the time t in seconds required for the velocity of a shot, d inches in diameter and weighing w pounds, to fall from any initial velocity Vf/s to any final velocity iif/s.

If r denotes the retardation of the shot, in f/s', due to the resistance of R pounds, then by Newton's Second Law of Motion, " Change of Motion is proportional to the Impressed Force."

(3) r R mP

- = – = — P>

g w w

since r varies as R, and r = g when R = «>.

If A.V denotes the loss of velocity in the small interval of time Ai,

(4) Aw

•TT = average retardation in the interval At

R TuiP

where ^ denotes the average value in the interval ; and therefore

(5) A« = 4,^-

na' gp

We put

(6) ^ = C

and call C the iallistic coefficient (driving-power) of the shot ; so

that

(7)

A« = C'

Av

and now if t changes to T for the standard projectile for which

C = l,

(8) A« = CAT.

where

(9)

AT =

Av

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GUNNERY OE BALLISTICS

Since p is tabulated as f{v), a function of v, the velocity v is

taken as the argument of the Ballistic Table ; starting with the

lowest experimental value, say v = 400, the change in velocity Ai) is

taken constantly as 10, and the average value of y in each interval

of velocity between 400, 410, 420, ... is multiplied by g and

divided into Au = 10, to obtain the corresponding value of AT ;

the sum of these values of AT is afterwards made, by an arithmo-

meter, and entered in the column under T.

The number T is also denoted by T(i!), and now

(10) T(V) – TW

is the time taken by the standard projectile for the velocity to fall

from Y to 1) f/s ; while

(11) « = 0{T(V)-T(^)}

is the number of seconds occupied by a projectile whose ballistic

coefficient is C, between the same limits of velocity, V and ii.

Next let As denote the number of feet of advance in the time ht ;

then

(12) As = vbA,

and if s changes to S for the standard projectile,

(13) AS = ■uAT,

where v denotes the mean velocity in the interval ; and AS can be

calculated with sufficient accuracy from AT by taking the mean

velocity in the intervals as 415, 425, 435. . . .

These differences AS are entered in the corresponding column of

the table ; and their sum, obtained by the arithmometer, is entered

in the column headed S.

The number S, also denoted by S(‘»), is such that

(14) S(V) – (S)w

is the number of feet advanced horizontally by the standard pro-

jectile, while the velocity falls from V to v f/s ; and

(15) s = C[S(V)-S(«)]

is the number of feet of advance of any other projectile whose

ballistic coefficient is C, between the same limits of velocity,

V and V.

To save the trouble of proportional parts required -when the velocity proceeds by increments of 10, Bashforth has provided Ballistic Tables which give by interpolation the values of T and S for every unit of velocity, in the region useful in artillery. A third table, due to Mr W. D. Niven, F.K.S., Director of Naval Studies, Green-wich, called the degree table, determines the change of direction of motion of the shot -while the velocity changes from V to v, the shot flying nearly horizontally.

To explain the theory of this table, suppose the tangent at the point of the trajectory, where the velocity is ■», to make an angle i radians with the horizon.

Then, resolving normally in the trajectory, and supposing the resistance of the air to act tangentially,

(1«) D^ = gcosi,

at

■where Ai denotes the infinitesimal decrement of i in the infinitesimal increment of time dt.

In problems of Direct Fire, where the trajectory ia flat enough for cos i to be undistinguishable from unity, ec^uation (16) becomes

(17) v^ = g,OTf = ^

dt ^ dt v'

80 that we can put

(18)

Ai

Lt "

if V denotes the mean velocity during the small finite interval of

time H, during which the direction of motion of the shot changes

through Ai radians.

If the inclination or change of inclination in degrees is denoted

by S or AS,

(19) 8 ^'

180 v'

so that

Ad:

180,. l&OgAt,

: — Ai = — – — ;

IT IT V

and if 5 and i change to D and I for the standard projectile,

(21) ,T .AT

AI = ,

(22)

AD = 1^^.

The differences AD are thus calculated, while the values of D are obtained by summation with the arithmometer ; and they are entered in their respective columns.

For some purposes it is preferable to retain the circular measure, i radians, as being undistinguishable in Direct Fire from sin i and tan i ; and now the differences AI and the sum I are calculated and entered in their columns.

The last function A, called the altitzidefunction, will be explained when High Angle Fire is considered (p. 175).

The annexed scheme of computation shows the method employed, using four-figure logarithms ; and when the significant figures are reduced to three, the work can be shortened still further by the use of the Slide Rule.

"When the values of p are revised in accordance ■with the results of new experiments, a recomputation of the Ballistic Tables in this manner will have to be carried out.

Calculation of

A Ballistic Table.

V

1600-1610.

1610-1620.

1620-1630.

P

logp

log AT

1-4923

11-48

1-0599

11-60

1-0645

11-72

1-0690

2-4324

2-4278

2-4233

^^=*AT*

0-0271

0-0268

0-0265

T

27-5457

27-5728

27-6996

27-6261

log V

log AS

■*!)AT=AS*

S

18587-05

3-2065

1-6379

43-44

18630-49

3-2082

1-6360

43-26

18673-74

3-2109

1-6342

43-08

18716-82

log 180?

3-2658

*log^*

5-2269

6-2196

5-2124

log AD

180?AT_^j5

2-4927

0-0311

2-4854

0-0306

2-4782

0-0301

D

49-7729

49-8040

49-8346

49-8647

log?

logAI

1-5077

4-7346

4-7273

4-7201

‘ AT

0-000643

0-000634

0-000525

I

0-868675

0-869218

0-869752

0-870277

log I

log AS

log AA

IAS = AA

A

8470-30

1-9392

1-6379

1-6771

37-77

8608-13

1-9394

1-6360

1-5754

37-63

8545-76

1-9396

1-6342

1-5738

37-48

8583-24

A.BEIDGED Ballistic Table.

V

P

AT

T

AS

S

AD

D

AI

I

AA

A

f/s

1600

1610

1620

1630

1640

1650

1660

1670

11-416

11-540

11-662

11-784

11-909

12-030

12-150

12-268

-0271

•0268

-0265

-0262

-0260

■*0257*

•*0255*

•*0252*

27-6457

27-5728

27-5996

27-6261

27-6623

27-6783

27-7040

27-7295

43-47

43^27

43-08

42-90

42-72

42-65

42-39

42-18

18587-00

18630-47

18673-74

18716-82

18759-72

18802-44

18844-99

18887-38

-0311

■*0306*

-0301

-0296

-0291

-0287

■*0282*

•*0277*

49-7729

49-8040

49-8346

49-8647

49-8943

49-9234

49-9521

49-9803

•000543

-000634

-000525

-000617

-000608

-000500

-000492

-000484

•868675

■*869218*

■*869762*

•870277

•870794

•871302

•871802

•872294

87^77

37 ■es

87-48

37-35

37-21

37-09

36-96

36-80

8470-36

8608-13

8545-76

8583-24

8620-59

8657-80

8694-89

8731-85

GUNNERY OR BALLISTICS

Abridged Ballistic Table — contimied.

173

V

P

AT

T

AS

S

AD

D

AI

I

AA

A

f/s

1680

12-404

-0249

27-7547

41-98

18929-56

-0273

50-0080

-000476

•872778

36-65

8768-65

1690

12‘636

-0247

27-7796

41-78

18971-64

-0268

50-0363

-000468

•873254

36^50

8805-30

1700

12-666

-0244

27-8043

41-60

19013-32

-0264

50-0621

•000461

•873722

36-35

8841-80

1710

12-801

•0242

27-8287

41-41

19054-92

-0260

60-0885

•000453

■874183

36-21

8878-15

1720

12-900

-0239

27-8529

41-23

19096-33

•0266

50-1145

•000446

•874636

36-07

8914-36

1730

13-059

-0237

27-8768

41-06

19137-56

•0252

50-1401

-000439

•875082

35-94

8960-43

1740

13-191

-0234

27-9005

40-90

19178-62

■0248

50-1653

-000432

•876521

36-81

8986-37

1750

13-318

-0232

27-9239

40-69

19219-52

■0244

60-1901

-000425

■876953

36-65

\JVKJ\J U fl

9022-18

1760

13-466

•0230

27-9471

40-53

19260-21

•0240

50-2145

-000419

■876378

35-53

9057-83

1770

13-591

-0227

27-9701

40-33

19300-74

•0236

60-2385

•000412

•876797

35-37

9093^36

1780

13-733

-0225

27-9928

40-19

19341-07

•0233

60-2621

•000406

•877209

36-26

9128-73

1790

13-862

-0223

28-0153

40-00

19381-26

•0229

60-2854

■000400

■877616

35-11

9163-99

1800

14-002

-0221

28-0376

39-81

19421-26

•0225

50-3083

■000393

■878016

34-96

9199-10

1810

14-149

-0219

28-0597

39-68

19461-07

•0222

60-3308

■000388

■878408

34-86

9234-06

1820

14-269

-0217

28-0816

39-51

19500^76

•0219

50-3530

•000382

■878796

34-73

9268-92

1830

14-414

-0214

28-1033

39-34

19640-26

•0216

50-3749

•000376

■879178 ■

84-59

9303-65

1840

14-552

-0212

28-1247

39-17

19579-60

•0212

50-3965

-000370

•879554

34-46

9338-24

1850

14-696

-0210

28-1459

39-01

19618-77

•0209

50-4177

-000365

•879924

34-33

9372-70

1860

14-832

•0209

28-1669

38-90

19657-78

■0206

60-4386

-000360

•880289

34-25

9407-03

1870

14-949

•0207

28-1878

38-75

19696-68

■0203

50-4692

-000355

•880649

34-14

9441-28

1880

15-090

•0205

28-2085

38-61

19735-43

•0200

50-4795

•000360

•881004

34-02

9475-42

1890

15-224

•0203

28-2290

38-46

19774-04

•0198

60-4995

•000345

•881354

33-91

9609-44

1900

15-364

•0201

28-2493

38-32

19812-50

■0196

60-5193

•000340

•881699

33-80

9543-35

1910

15-496

•0199

28-2694

38-19

19850^82

•0192

60-5388

■000335

•882039

33-69

9577-15

1920

16-656

•0197

28-2893

38-01

19889 •Ol

•0189

60-5580

-000330

•882374

33-55

9610-84

1930

15-809

•0196

28-3090

37-83

19927-02

■0186

60-5769

-000325

■882704

33-40

9644-39

1940

15-968

•0194

28-3286

37-66

19964-85

■0184

50-5955

•000320

■883029

33-26

9677-79

1950

16-127

•0192

28-3480

37-48

20002-51

■0181

50-6139

•000316

•883349

33-12

9711-05

1960

16-302

•0190

28-3672

37-26

20039-99

■0178

50-6320

•000311

•883666

32-94

9744-17

1970

16-484

-0187

28-3862

36-99

20077-25

■*0175*

50-6498

-000306

•*883976*

32-71

9777-11

1980

16-689

-0185

28-4049

36-73

20114-24

■*0172*

50-6673

-000300

■884281

32-48

9809-82

1990

16-888

-0183

28-4234

36-47

20150-97

■0169

50-6845

-000295

•884581

32-26

9842-30

2000

17-096

-0181

28-4417

36-21

20187-44

•0166

50-7014

-000290

•884876

32-05

9874-56

2010

17-306

-0178

28-4598

35-95

20223-65

■0163

50-7180

-000285

•885166

31-83

9906-61

2020

17-515

-0176

28-4776

35-65

20269-60

■0160

50-7343

-000280

■885461

31-57

9938-44

2030

17-752

-0174

28-4952

35-35

20295-25

■0158

50-7503

-000276

■885731

31-32

9970-01

2040

17-990

-0171

28-5126

36-06

20330-60

■0166

50-7661

■000270

•886006

31-07

10001-33

2050

18-229

-0169

28-5297

34-77

20365-66

■0152

50-7816

■000265

•886276

30-82

10032-40

2060

18-463

-0167

22-5466

34-49

20400-43

■0149

60-7968

-000260

•886541

30-68

10063-33

2070

18-706

-0165

28-5633

34-21

20434-92

■0147

60-8117

•000256

•886801

30-34

10093-80

2080

18-978

-0163

28-5798

33-93

20469-13

■0144

60-8264

■000261

•887067

30-10

10124-14

2090

19-227

-0160

28-5961

33-60

20503-06

•0141

60-8408

■000247

•887308

29-82

10164-24

2100

19-504

-0158

28-6121

33-34

20536-66

-0139

50-8649

■*000242*

•*887555*

29-69

10184-06

2110

19-755

-0156

28-6279

33-02

20570-00

-0136

50-8688

•*000238*

•*887797*

29-32

10213-65

2120

20-010

-0154

28-6435

32-76

20603-02

-0134

50-8824

•000234

•888036

29-10

10242-97

2130

20-294

-0152

28-6589

32-50

20635-78

-0132

50-8958

•000230

-888269

28-88

10272-07

2140

20-661

-0150

28-6741

32-26

20668-28

•0129

60-9090

•000226

-888499

28-66

10300-95

2150

20-811

-0149

28-6891

32-00

20700-63

-0127

50-9219

•000222

-888725

28-44

10329-61

In the calculation of Eange Tables for Direct Fire,

defined officially as "fire from guns with full charges at

elevations not exceeding 15°," the vertical component of

the resistance of the air may be ignored as insensible, and

(24)

df

Fig. 1.

the actual velocity and its horizontal component, or com-

ponent parallel to the line of sight, are undistinguishable.

The equations of motion are now, the oo-ordinates x and y being

measured in feet,

(23) (i^x

dfl

9P

■ C

The first equation leads, as hefore, to

(26) t = G{T(V) – T(^)}.

(26) X = C{S(V) – S(i;)}.

The integration of (24) gives

^^”^ ^ = constant – gt = ff(4T – f),

if T denotes the whole time of flight from 0 to

the point B (Fig. 1), where the trajectory cuts

the line of sight ; so that \1 is the time to the

vertex A, where the shot is flying parallel to OB.

Integrating (27) again,

(28) y = ^(4T< – Ifi) = \gt{T! – t) ■

and denoting T – < by i', and taking g = Z2fjs^,

(29) y = IBtf,

Colonel Sladen’s formula, employed in plotting ordinates of a

trajectory.

At the vertex A, where y = H, we have t = t” = JT, so that

(30) H = i!/T%

which for practical purposes, taking (/=32, is replaced by

(31) H = 4T2, or (2T)2.

Thus if the time of flight of a shell is 5 seconds, the height of

the vertex of the trajectory is about 100 feet ; and if the fuse is set

to burst the shell one-tenth of a second shott of its impact at B,

the height of the bui-st is 7 -84, say 8 feet.

The line of sight Oa;, considered horizontal in Eange Table

results, may be slightly inclined to the horizon, as in shooting up

or down moderate slopes, without appreciable modification of (25)

and (26), and y or PM is still drawn vertically to meet OB in M.

Given the ballistic coefficient C, the initial velocity V, and a

range of R yards or X = 3R feet, the final velocity v is first

calculated from (26) by

(”) S(.) = S(V)-|

and then the time of flight T by

(33) T = C{T(V) – T(i.)}.

Denoting the angles of departure and descent, measured in

degrees and from the line of sight OB, by ^ and p, the total

deviation in the range OB is (Fig. 1)

(34) S = 0 + ^ = C{D(y) – D(‘»)}.

To share the S between

point of half-time (and therefore beyond half-ramge, because of the

continual diminution of the velocity), and the velocity «» at A is

calculated from the formula

(35)

T(i;„) = T(V) – ^=

^ =i{T(V)+T(i;)};

and now the degree table gives

(36) 0 = C{D(V) – D(«„)},

(37) p = C{D(«„) – T>{v)}.

This value of tf i^ the tangent elevation (T. E.) ; the quadrant

elevation (Q. E.) is (p – S, where S is the angular depression of the

line of sight OB ; and if O is A feet vertical above B, the angle S

in minutes at a range of R yards is given by

(38) . „ n

“^ = 31

or, for small angle, expressed in minutes.

; = 1146.

£■

So also the angle p must be increased by S to obtain the angle at which the shot strikes a horizontal plane, the water, for instance. The following is a specimen of the calculations required in the compilation of a Range Table for moderate ranges of Direct Fire : — a 6-inch gun has been selected, with increments of range of 500 yards, reaching up to 2000 yards ; the intermediate hundreds of yards can be interpolated, and the results tabulated in the ordinary form of a Range Table (of which a short extract is given), in which vertical columns give the values of v, t, 0, ft &c., corresponding to every hundred yards of range. The discrepancies between the cal-culatedand tabulated results will serve toshowthe influence of a slight change in the coefiioient of reduction n and the muzzle velocity V . The Abridged Ballistic Table has been employed, of which the extract given above covers the extent of velocity required ; to avoid the trouble of proportional parts required for units of velocity with the Abridged Table, extended tables are given in Text-Books of Gunnery, but these are too long for insertion here.

A Slide Rule can be used for tJie computations, instead, of four-figure logarithms, with ample accuracy for practical purposes.

Calcttlation of a Range Table for 6-inch Gun.

«;=100 ft, ^=6”, TO=0-96, 0 = 2-892, «=1500 ft.,

0

= 518, V = 2150 f/s.

Eange.

0

500 Yds.

1000 Yds.

1500 Yds.

2000 Yds.

V

T(i>)

20700-53

2150

28-6891

20182-53

1999

28-4399

19664-63

1862

28-1711

19146-53

1732

27-8815

18628-63

1610

27-5728

t

C

t

■*D(v)*

0-2492

0-5180

0-8076

1-1163

60-9219

0-720

50-6997

1-497

50-4427

2-33

60-1451

3-225

49-8040

s + p

c~ c

0-2222

0-4792

0-7768

1-1179

^ + /3

0-6425

1-384

2-243

3-234

iA

0-1246

0-2590

0-4038

0-5581

T(i'o)

■»o

D(i;o)

28-5645

2071

50-8132

28-4301

1994

50-6913

28-2853

1918

50-5542

28-1310

1843

50-4029

0

c

0-1087

0-2306

0-3677

0-6190

I 0-3145

1 0° 19'

i 0-3280

(0° 20'

0°19'

0-666

0°40'

0-718

0°43'

0°39'

1-062

1°4'

1-181

1° 11'

r 6'

1-5

1°30'

1-734

1°43'

1°26'

1 By Hadcock's Double-Entry Table.

Range Table foe 6-inoh Q.F. Guns, Makks I. to III.

55-01

Tweight, 13 lb 4 oz.

Charge -! gravimetric density,

*[nature, cordite, size 30. ^ "'^^*

T, . ., ., f nature, Palliser shot. Shrapnel shell.

°J<='^^n weight, 100 lb.*

Muzzle velocity, 2154 f/s.

Nature of mounting, pedestals

Jump, nil.

To strike

an object

5 minutes' Elevation

or Depression

alters pointof impact

FUSE

BO per cent, of rounds

10 feet

high

Slope of

ELEVA-

TION.

EANGE.

scale for

T. and P.

middle

should fall in

Time

of

Penetra-

tion into

S'l

Flight.

must be

Laterally

No. 64

Iron.

A>

known

within

Eange.

or

Vertically.

*Marks I.,**

n., or lit.

Length.

Breadth.

Height.

f/a.

yards.

lin

yards.

yards.

• ‘

yards.

yards.

yards.

yards.

sees.

inches.

2122

1145

687

125

0-14

0 4

100

i

0-4

...

0-16

13-4

2091

635

381

125

0-29

0 9

200

S

0-4

...

0-31

13-2

2061

408

245

125

0-43

0 13

300

1

0-4

0-47

13-0

2032

316

190

125

0-68

0 17

400

li

0-4

0-62

12-8

2003

260

156

125

0-72

0 21

500

li

0-5

0-2

0-78

12-6

1974

211

127

125

0-87

0 26

600

2

0-5

0-2

0-95

12-4

1946

183

110

125

1-01

0 30

700

2i

0-5

0-2

1-11

12-2

1909

163

98

125

1-16

0 34

800

2S

0-5

0-2

1-28

12-0

1883

143

85

125

1-31

0 39

900

3

0-6

0-3

1-44

11-S

1857

130

78

125

1-45

043

1000

3i

0-6

0-3

1-61

11-6

1830

118

71

125

1-60

0 47

1100

3S

0-6

0-3

1-78

11-4

1803

110

66

125

1-74

0 51

1200

4

0-6

0-3

1-95

11-2

1776

101

61

125

1-89

0 55

1300

44

0-7

0-4

2-12

11-0

1749

93

56

125

2-03

0 59

1400

45

0-7

0-4

2-30

10-8

1722

86

52

125

2 18

1 3

1500

5

0-7

0-4

2-47

10-6

1695

- 80

48

125

2-32

1 7

1600

54

25

0-8

0-5

2-65

10-5

1669

71

43

125

2-47

1 11

1700

5i

25

0-9

0-5

2-84

10-3

1642

67

40

100

2-61

1 16

1800

H

25

1-0

0-5

3-03

10-1

1616

61

37

100

2-76

1 22

1900

64

25

1-1

0-6

3-23

9-9

1591

57

34

100

2-91

127

2000

7

25

1-2

0-6

3-41

9-7

GUNNERY OR BALLISTICS

175

High Angle

*defined officially, "is fire at elevations greater than 15°," and " Curved Fire is fire from howitzers at all angles of elevation not exceeding 15°." In these cases the curvature of the trajectory becomes considerable, and the methods employed in Direct Fire must be modified; the method generally employed is due to Colonel Siacci of the Italian Artillery. "^*

Starting with the exact equations of motion in a resisting medium

(40)

(«)

and eliminating r,

(42)

cPx

dx

■ r cos I — — r-;-,

-^=-rs.m-g=-T^-i

dx oPy dy cPx

dt de ” di dfi”

and this, in conjunction with

(43)

dx

^dt’

. ■ dy dy jdx

dx~ dtj dt’

(44)

reduces to

(45)

‘^ dt~\dt dH dt dtyl\di) ‘

dt V

COS I, or –

d tan i

dt

(46)

V c

equation (40) becomes

(47)

**?*

dt

and therefore

(48)

dq

the equation obtained, as in (16), by resolving normally in the trajectory, but di now denoting the increment of i in the increment of time dt.

Denoting -n, the horizontal component of the velocity, by q,

so that

r cos r,

di dt di g' ^

by reason of (45).

It is convenient to express ^ as a function of » in the notation

(49) p =f{v),

so that

(50) ^ Av)

r -9 Q ,

and now

(51) dq dv cos i vf(i>)

di°^ di C '

an equation connecting v=q aeo i, or q and i.

Now

(52) ^ p sec ^"

(Is ~ 9/(9. seo i)'

and multiplying by -=r or q,

(63)

q sec %

dx „.

dq" ~ gf{q sec if

and multiplying by -3^ or tan i,

also

(54)

dy „q sec i tan i

ik” 9 f{q sea i) ‘

(55)

di ^ 1

dq q sec if(q sec i)

(56)

d tan i ri sec i

qf{q sect)’

from which the values of t, x, y, i, and tan i are given by integra-

tion with respect to q, when see i is given as a function of q by

means of (48).

Now these integrations are quite intractable, even for very

simple mathematical assumptions of the function /(ii), say the

quadratic or cubic law, f{v) = Icv\ or fa)^

But, as originally pointed out by Euler, the difficulties can be

turned if we notice that in the ordinary trajectories of practice the

quantities i, cos i, and sec i vary so slowly that they may be

replaced by their mean values ■>;, cos 17, and sec i; ; especially if the

trajectory, when considerable, is divided up in the calculations into

arcs of small ourvatiu-e, the curvature of an arc being defined as

the angle between the tangents or normals at the ends of the arc.

Replacing then the angle i on the right-hand side of equations

(52)-(66) by some mean value ij, we introduce Siacci's paeudo-

velocity u defined by

(57) M = J sec 17,

so that M is a quasi-component parallel to the mean direction of

the tangent, sot the direction of the chord of the arc.

Integrating from any initial pseudo-velocity U,

(58) nT" <^"

(69) f udu

a = 0 cos 1; I ^;— r,

J 9fM

(60) „ . f udu

and supposing the incluiatiou i to change from <(>toB radians over

the arc,

(61) ^ a n r "^w

0 – 9 = C cos 7; —f^-^>

J ufW

(62)

tan — tan d = C i

:,]”.

du

u/{uy

But according to the definition of the functions T, S, I, and

D of the Ballistic Table, employed for Direct Fire, with u written

for V,

(63)

(64)

(66)

and therefore

(66)

(67)

(68)

(69)

(70)

ju-m =I(U)-I(«);

t = C [T(U) – T(«)]

2; = C cos 9j [S(U) – S(m)]

y = Gamv [S(U) – S(«)]

0 – « = C cos 1) [I(U) – I(«)]

tan 0 – tan e = C sec r; [I(U) – I(m)],

while, expressed in degrees,

(71) 0° – «° = C cos 1) [D(U) – D(«)].

These (66)-(71) are Siacci's equations, slightly modified by

General Mavevski ; and now in the numerical applications to High

Angle Fire Wo can still employ the Ballistic Table for Direct Fire.

It will be noticed that rj cannot be exactly the same mean angle

in all these equations ; but if 17 is the same in (67) and (68),

(72) y ^

^ ' 2. = tan 77,

X

so that 77 is the inclination of the chord of the arc of the trajectory,

as in Mven's method of calculating trajectories [Froc. M. S., 1877) ;

but this method requires ij to be known with accuracy, as 1 %

variation in 17 causes more than 1 % variation in tan 77.

The difficulty is avoided by the use of Siacci's altitude-function

A or A(m), by which y/x can be calculated without introducing

sin 77 or tan 77, but in wjfiioh 77 occurs only in the form cos 77 or sec 7;,

which varies very slowly for moderate values of 77, so that 77 need

not be calculated with any great regard for accuracy, the arith-

metic mean J((/) ┼ 9) of 0 and 8 being near enough for 77 over any

moderate arc (t> – 0.

Now taking equation (70), and replacing tan S, as a variable final

tangent of an angle, by tan i or -j',

(73)

tan (p ■

-^ = C sec

dx

77[l(U)-I(«)]

and integrating with respect to x over the arc considered,

(74)

X tan ~y

But

(75)

C sec 77 ra:I(U) – ("l{u)dx.

^l{u)dx=J^I(u)^^du

„ /■".,. udu

= C cos 77 (l{u) —TT-.

= C cos 17 [A(TJ) – A(m)]

in Siacci's notation ; so that the altitude-function A must be calca-

lated by summation from the finite differences.

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GUNNERY OR BALLISTICS

(76)

AA=I(tt) — = I(w)AS,

gp

as shown already in the specimen computation of the BaUistio

Table.

Dividing again hy x, as given in (67),

from which yjx can be calculated, and thence y.

In the application of Siacci's method to the calculation of a tra-

jectory in High Angle Fire by successive arcs of small curvature,

*starting at the beginning of an arc at an angle (j> with velocity v^*

the curvature of the arc <(> – 6 is first settled upon, and now

(78) i) = «0 + e)

is a good first approximation for i;.

Now calculate the pseudo-velocity u^ from

(79) u^ = v^ cos 0 sec -q,

and then, from the given values of 4> and 6, calculate v^ from either

of the formula of (70) or (71),

T, , T/ ^ tan^-tand

I(m») = 1{V4)

(80)

(81)

C sec 1?

D(«,)=D(«)-^^^^*

Then with the sufiix notation to denote the beginning and end

of the arc — 0,

(82)

(83)

(84)

f

,j,

iJiKj = C cos 17 [S(m<()) – S(M9)]

(- J = tan 0 – C sec t; I(M) – . o >

A now denoting any finite tabular difference of the function between

the initial and final (pseudo-) velocities.

In Direct Fire the pseudo- velocities U and w, and the real veloci-

ties V and V, are undistinguishable ; so that, putting 2/ = 0 in (77),

(®^) tan 0 = C sec v [l(V) – ^].

in which sec v may be replaced by unity ; or according to Siacoi, sec V being replaced by sec V)

(87)

sin 20=20 [l(V)-|^].

^=c[ff -!(.)}

Fig. 2.

Also the velocity vg at the end of the arc is given by

(86) vg = Ug sec 6 cos 17.

Treating this final velocity vg and angle $ as the initial velocity vtp and angle ip of the next arc, the calculation proceeds as before (Fig. 2).

In long range High Angle Fire the shot ascends to such a height that the correction for the tenuity of the air becomes important, and the curvature 0 – 9 of an arc should be so chosen that height ascended, should be limited to about 1000 feet, equivalent to a change of 1 inch in the barometer or 3 % in the tenuity-factor T.

A convenient rule has been given by Captain James M. Ingalls, U.S.A., for approximating to a high angle trajectory in a single arc, which assumes that the mean density of the air may be taken

as the density at two-thirds of the estimated height of the vertex ; the rule is founded on the fact that in an unresisted parabolic trajectory the average height of the shot is two-thirds the height of the vertex, as illustrated in a jet of water, or in a, stream of bullets from a Maxim gun.

The longest recorded range is that given in 1888 by the 9‘2-inch gun to a shot weighing 380 lb fired with velocity 2375 f/s at elevation 40° ; the range was about 12 miles, with a time for flight of about 64 seconds, shown in Fig. 2.

A calculation of this trajectory is given by Lieutenant A. H.

■*Wolley – Dod, K.A., in the Proceedings R.A. Institution, 1888, employing Siacci’s method and about twenty arcs ; and Captain Ingalls, by assuming a mean tenuity-factor r = 0‘68, corresponding to a height of about 2 miles, on the estimate that the shot would reach a height of 3 miles, was able to obtain a very accurate result, working in a single arc over the whole trajectory (Ingalls, Handlook of Ballistic Problems).*

Siacci’s altitude ~~function is useful in Direct Fire, for giving im~~ mediately the angle of elevation 0 required for a given range of R yards or X feet, between limits V and v of the velocity ; also the

angle of descent j3.

Also

(88) tan 0 – tan ^ = C sec 57 [I(V) – L(m)]

in which sec 77 may be replaced by unity, so that

*(89) f..«=or^*

or, as Siacoi writes it,

(«°) ,i„ 2^=20 [II -I(.)],

the two forms leading practically to the same value of p for

moderate angles. .

To simplify the work, so as to look out the value of sm 20

without the intermediate calculation of the remaining velocity y, a

double-entry table has been devised by Captain Braccialini Scipione

(Problemi del Tiro, Roma, 1883), and adapted to British units by

Mr. A. G. Hadcock, late R.A., and published in the Proc. P.. A

Institviion, 1898 ; and in Gunnery Tables, 1898.

In this table

(91) sin 20= Co,

where as is a function tabulated for the two arguments, V the initial

R

velocity, and p-the rediiced range m yards.

The table is too long for insertion here, but the results for 0 and /S, as calculated for the Range Tables above, are given there for comparison.

After all care has been taken in laying and pointing, in accordance with the rules of theory and practice, absolute certainty of hitting the same spot every time is unattainable, as causes of error exist which cannot be eliminated, such as variations in the air and in the explosion of the powder charge, also in the steadiness of the shot in flight.

To obtain an estimate of the accuracy of a gun, as much actual practice as is available must be utilized, in accordance with the laws of Probability, for the calculation of the 50 per cent, zones shown in the Range Table ; the article Pkobability must be consulted for the theory by which the percentage of hits to be expected on a given object at a known range is calculated, when the gun has been properly laid.

The Perforation of Armour.

The energy in foot-tons

*(92) v^*

2g X 2240

of a shot weighing w tt), striking with velocity v f/s, on a

target composed of iron or steel plates, or other resist-

ing material, is used up in penetrating a certain thickness,

p inches, against some unknown law of resistance of the

material, as shown in the last column of the Eange Table.

Empirical formulse for the calculation of ^, such as those of Fair-

bairn, . Krupp, De Marre, Tressidder, and Gavre, are constructed by

putting

(93)

p=k-, or K-^,

where d denotes the diameter of the shot, and then determining

the best numbers for the indices x, y, & from experiments, plotted

preferably on a logarithmic chart.

Fair-

baim.

Krupp.

i

De

Marre.

Tressid-

der.

Gavre.

X

y

z

1

4

1

I

4

J.S.

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Taking logarithmic differentials,

(94)

A» Aw Av

+ = X — +y — ■

p W V

Arf

or expreaaed in popular language, 1 % increase in w, v, or d, varying one at a time, is such as to cause x, y, or – z % increase in p ; but little reliance can be placed on these formulae for extrapolation beyond the limits of experiments for prediction of results to be expected.

For a full discussion of these empirical formulse, and of the numerical values of the indices x, y, s, with numerous illustrations of actual practice, consult Armour and its Attack by Artillery, by Captain Orde Browne.

II. Interior Ballistics.

The investigation of the relations connecting the pressure, volume, and temperature of the powder gas inside the bore of the gun, of the work realized, by the expansion of the powder, of the dynamics of the movement of the shot up the bore, and of the stress set up in the material of the

gun, constitutes the branch of Interior

Ballistics.

A gun may be considered a simple thermo-

dynamic machine or heat engine which does its

work in a single stroke, and does not act in a series of periodic

cycles as an ordinary steam or gas engine.

An indicator diagram can be drawn for a gun (Fig. 3) as for a

fo

capable of being lengthened to 100 calibres or 50 feet {Proc. S.S., June 1894).

On the assumption of uniform pressure up the bore, practically

realizable in a Zalinski pneumatic dynamite gun, the pressure curve

would be a straight line parallel to AM ; the energy curve AeE

4‘2 ‘ 44 ‘ 46

*HEzzn^^*

Fig. 3.

steam engine, representing graphically by a curve CPD the relation

between the volume and pressure of the powder gas ; and in addi-

tion the curves AQE of energy, AvY of velocity, and AiT of time

can be plotted, or derived.

The velocity and energy at the muzzle B are denoted by V and E, and at any intermediate position M of the base of the shot by v and e. After ascertain discount due to friction in the bore and the energy of rotation and of recoil of the gun, the net work realized by the powder gas is represented by the area ACPM, and this is equated to the energy e of transla-tion of the shot. The mean effective pressure (M.E.P.) in tons/inches", multiplied by lird^ the cross section of the bore in square inches, gives in tons the mean effective thrust X of the powder on the base of the shot ; and, multiplied again by I, the length in feet of travel AM of the shot up the bore, gives the work realized in foot-tons ; so that equating it to the muzzle energy

E = „ "'I!;7^(foot-tons)

14 16 18 ZO 22

TRAVEL of ahot in FEET

Kg. 4.

would be another straight line through A ; the velocity curve AiiV, of which the ordinates v are as the square roots of e, would be a parabola ; and the acceleration of the shot being constant, the time curve A

If the pressure falls off uniformly, so that the pressure curve is a straight line CPD sloping downwards and cutting AM in F, then the energy curve will be a parabola curving downwards, and the velocity curve can be represented by an ellipse, or circle with centre F and radius FA ; while the time curve will be a sinusoid.

But if the pressure curve is a straight line F'CP sloping upwards, cutting AM behind A in F', the energy curve will be a parabola curving upwards, and the velocity curve a hyperbola with centre at F'.

These theorems may prove useful in preliminary calculations where the pressure curve is nearly straight ; but, in the absence of any observable law, the area of the pressure curve must be read off by a planimeter, or, calculated by Simpson's rule, as an indicator diagram. To measure the pressure experimentally in the bore of a gun, the crusher gauge is used (Fig. 6) ; it records the maximum

pressure by the compression of a copper cylinder in its interior ; it may be placed in the powder chamber, or fastened in the base of the shot.

In Sir Andrew Noble's researches a number of plugs were inserted in the side of the experimental gun, reaching to the bore and carrying crusher gauges, and also chronographic appliances which registered the passage of the shot in the same manner as the electric screens in Bashforth's experiments ; thence the velocity and energy of the shot was inferred, to serve as an independent control of the crusher gauge records (Figs. 4 and 5).

It was found that with modem explosives the crusher gauges

(1)

we deduce

(2)

2g X 2240

M V V — —- =, (tons/inches^).

But the maximum pressure may exceed the mean in the ratio of 2 or 3 to 1, as shown in Figs. 4 and 5, representing graphically the results of Sir Andrew Moble's experiments with a 6-inch gun.

ziz ‘ 24 Ze ‘ 2‘8 ■ 30 ‘32 ‘34

TRAVEL oF shof m FEET

Fig. 5.

register a slightly higher pressure than the chronograph records, but

a lower pressure with ordinary powder.

As a preliminary step to the determination of the pressure of

fired gunpowder in the bore of a gun, it is desirable to measure the

pressure obtained by exploding charges of powder in a closed

vessel, varying the weight of the charge, and thereby the density

of the powder gas.

The earliest experiments of this nature are due to Benjamin

Robins in 1743 and Count Rumford in 1792 ; and their methods

have been revived by Dr Kellner, War Department chemist, who

(F) Gasclieck

(A).Cjlindef ,

Kg. 6.

employed the steel spheres of bicycle ball bearings as safety-valves,

loaded to register the pressure at which the powder gas will blow

off, and thereby check the indications of the crusher gauge {Froc. II.S., March 1895).

The Chevalier d'Arcy, 1760, also experimented on the pressure of powder and the velocity of the bullet in a musket barrel ; this he accomplished by shortening the barrel Successively, and measuring the velocity obtained by the ballistic pendulum ; thus reversing Noble's procedure of gradually lengthenmg the gun.

But the most modern results employed with gunpowder are based on the experiments of Koble and Abel (Fhil. Trans., 1875-80-92-94).

Charges of powder, or other explosive, of varying weight P lb, were fired in an explosion chamber (Figs. 7, 8, and 9) of which the The results are also embodied in the following table : —

Table I.

G.D.

G.V.

Pressure in Tons/inches 2. 1

Pebble Powder.

Cordite.

0-05

20-00

0-855

3-00

6

16-66

1-00

3-80

8

12-50

1-36

6-40

0-10

10-00

1-76

7-10

12

8-33

2-06

8-70

14

7-14

2-63

10-50

15

6-66

2-73

11-36

16

6-25

2-96

12-30

18

6-55

3-33

14-29

20

6-00

3-77

16-00

22

4-54

4-26

17-90

24

4-17

4-66

19-80

26

4-00

4-88

20-63

26

3-84

5-10

21-75

30

3-33

6-07

26-00

36

2-85

7-36

31-00

40

2-60

8-73

36-53

46

2-22

10-23

42-20

60

2-00

11-25

48-66

66

1-81

13-62

55-86

60

1-66

15-55

63-33

65

1-54

17-68

...

70

1-43

20-02

80

1-25

25-52

90

1-11

32-46

1-00

1-00

41-48

^

The term gravimetric density (G. D.) is peculiar to artillerists ;

it is required to distinguish between the specific gravity (S. G.) of

the powder filling a given volume in a state of gas, and the specific

gravity of the separate solid grains of powder.

Thus, for instance, a lump of solid lead of given S. G., when

formed into a charge of lead shot composed of equal sphericles

closely packed, will have a G. D. such that

(3) G. D. of charge of lead shot l i^ (^ 74 no

■srcT^f lump of solid lead g-'V' """^ 5*

while in the case of a bundle of cylindrical sticks of

cordite,

(4) G D. of charg^o^corcUt e^l gpgy

S, G. of stick or cordite 6

At the standard temperature of 62° F. the volume

of the gallon of 10 lb of water is 277-3 inches'; or

otherwise, 1 foot' or 1728 inches ' of water at this

temperature weighs 62-35 lb, and therefore 1 lb of

water bulks 1728 ═ 62-36 = 27-73 inches'.

Thus if a charge of P lb of powder is placed in a

chamber of volume C inches ', the

(«)

Fig. 7.

Fig. 8.

G. D. = 27-73^,

G.V. = =

C

A, containing vessel of mild steel ; B, charge ; 0, firing ping ; B, conical plug ; E, escape

screw ‘ F channel of communication with charge chamber ; G, mitred surface ;

H passage for escape of gases when E is withdrawn ; K, crusher apparatus lor

detennining pressure ; S, set screw ; W, ebonite washer.

volume, C inches’, is accurately known, and the pressure p tons/-

iuches ^ was recorded by a crusher gauge.

The results are plotted in Figs. 10 and 11, in curves showing the

relation between p and D the gravimetric density, which is the

EXPLOSION VESSEL.

specific gravity of the Plbofpowderwhenfillingthe volume C inches’

in a state of gas ; or between p and v, the reciprocal of D, which

may be called the gravimetric volume (G. V.), being the ratio of the

volume of the gas to the volume of an equal weight of water.

27-73 P”

Sometimes the factor 27-68 is employed, corre-

sponding to a density of water of about 62 ‘4 ft/foot’,

and a temperature 12° C, or 54° F.

With metric units, measuring P in kg. , and C in

litres or dm.’, the G. D. = P/0, G. V. = 0/P, no

factor being required.

After the explosion of the powder charge P lb, it was found that

PRESSURES OBSERVED IN CLOSED VESSELS WITH

VARIOUS EXPLOSIVES.

GRAVIMETRIC DENSITY OF PRODUCTS OF EXPLOSION

Fig. 10.

a fraction aP remained in a liquid state at S. G. unity, and there-

fore of volume 27-73 a? inches’ ; and the remainder (1 – o)P Hi

was converted into a gas which filled the remaining

(6) 0 – 27-73 aP = 0 (1 – aD) inches ‘ of the chamber ;

GUNNERY OR BALLISTICS

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so that the S. G. of the gas was

(7) 27-73 (1 – a)P (1 – a)D 1 – g

C (1 – oD) ~ 1 – aD ~ ■» – a”

On the assumption that the gas obeyed Boyle’s law, and that

the temperature of explosion was constant,

(8) y (1 – a)D ^ 1 – g

pa~ 1 – aD ~ V – a’

where pa denote the pressure when T) = 1, v = 1 and a may he

called the covolume.

According to Noble and Abel’s experiments, j)o = 43 tons/inches ‘■’,

whEe the liquid residue was 57% of the charge, so that g=0‘57 ;

and this makes

(9)

P ■■

43 X 0-43 D

18-49

1 – 0-57 T> ~ V- 0-57'

and the dotted line in Fig. 11 shows the theoretical curve of relation

between p and v, calculated by this formula ; the actual realized

curve is seen to lie slightly below.

From the Table I., or by quadrature of the curve in Fig. 11, the

work E in foot-tons realized by the expansion of 1 lb of the powder from one gravimetric volume to another is inferred ; for if the average pressure is p tons/inches ^ while the gravimetric volume changes from v – ^Av to v + ^Av, a change of volume of 27-73 Av inches", the work done is 27-73 p Av inch- tons, or

(10) AE = 2-31 pAv foot-tons ;

and the differences AE being calculated from the observed values of p, a summation, as in the Ballistic Tables, would give E, as tabulated in Table II.

Conversely from a table of E in terms of v, we can infer the value of p ; for instance, as v changes from 4-9 to S'l, so that Av = 0-2, then AE = 1-621, making p = S'5 tons/inches^, agree-ing closely with the experimental value in Table I.

Table II.

Work capable of being oUme by Exploding Gunpowder, in Expand-ing from Volume Unity wifh Unit Gravimetric Density.

(See Noble and Abel, "Researches on Explosives," PhU. Tram. Roy. Soc, 29th May 1879.)

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■s

^

^

C

s

1

.a

s

1

■*a*

o

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1

^

I

I’OO

0-000

1-54

33-681

2-95

68-668

610

99-282

13-00

127-036

vm

0-980

1-5«

34-600

3-00

69-347

6-20

99-916

14-00

129-602

102

1-936

1-58

36-301

3-05

70-109

6-30

100-636

15-00

131-970

1-03

2-870

1-60

36-086

310

70-854

6-40

101-145

16-00

134-168

104

3-782

1-B2

36-865

3-15

71-685

6-50

101-744

17-00

136-218

105

4-647

1-64

37-608

3-20

72-301

6-60

102-333

18-00

138-138

100

6-647

1-fifi

38-346

3-25

73-002

6-70

102-912

19-00

139-944

1-07

6-399

1-68

39-069

3-30

73-690

6-80

103-480

20-00

141-647

108

7-234

1-70

39-778

3-35

74-365

6-90

104 038

2100

143-268

1-09

8-051

1-72

40-474

3-40

76-027

700

104-686

2200

144-788

1-10

8-852

1-74

41-156

3-45

75-677

7-10

105-126

23 00

146-242

lU

9-637

1-76

41-827

3-50

76-315

7-20

106-666

24-00

147-629

1-12

10-406

1-78

42-486

3-55

76-940

7-30

106-176

25-00

148-960

1-13

11-160

180

43-133

3-60

77-663

7-40

106-688

26 00

160-232

1-14

11-899

1-82

43-769

3-65

78-166

7-50

107-192

27-00

161-462

1-15

12-625

184

44-394

3-70

78-749

7-60

107-688

28 00

162-622

1-16

13-338

l-8fi

45-009

3-75

79-332

7-70

108-177

29-00

153-743

117

14-038

1-88

45-614

3-80

79-905

7-80

108-669

30-00

154-819

1-18

14-726

1-90

46-209

3-85

80-469

7-90

109-133

3100

155-867

1-19

16 400

1-92

46-796

3-90

81-024

8 00

109-600

32 00

156-866

1-20

16-063

1-94

47-372

3-95

81-670

8-10

110-060

33 00

167-824

1”21

16-716

1-96

47-940

4-00

82-107

8-20

110-614

34-00

158-771

122

17-369

1-98

48-499

4-10

83-167

8-30

110-962

3500

169-678

1-23

17-992

2 00

49-050

4-20

84-176

8-40

111-404

36 00

160-656

1-24

18-614

205

60-383

4-30

85-166

8-50

111-840

3700

161-411

1‘25

19-226

210

61-673

4-40

86-128

8-60

112-270

38 00

162-241

T2«

19-828

2-15

62-922

4-50

87-064

870

112-696

3900

163-046

1-27

1-28

T29

20-420

2-20

54-132

4-60

87-976

8-80

113-114

40-00

163-828

21-001

2-25

66-304

4-70

88-861

8-90

113-528

4100

164-8

21-672

2-30

66-439

4-80

89-724

900

113-937

42 00

166-7

1-30

1-32

1-34

22-133

2-35

67-639

4-90

90-566

910

114-341

43 00

166-3

23-246

2-40

68-606

5-00

91-385

9-20

114-739

4400

367-0

24-324

2-45

69-639

5-10

92-186

9-30

115-133

45-00

167-6

1-36

26-371

2-50

60-642

520

92-968

9-40

116-621

46-00

168-3

1-38

1-40

26-389

2-55

61-616

5-30

93-732

9-50

115-905

4700

169-0

27-380

2-60

62-563

5-40

94-479

960

116-284

48-00

169-6

1-42

28-348

2-65

63-486

5-50

96-210

9-70

116-669

49-00

170-3

1-44

29-291

2-70

64-385

5-60

96-925

9-80

117-029

5000

171-0

1-46

30-211

2-75

65-262

5-70

96-625

9-90

117-395

1-48

31-109

2 80

66-119

5-80

97-310

10 00

117-767

1-50

31-986

2-85

66-965

6-90

97-981

11-00

121-166

1-52

32-843

2-90

67-771

«-oo

98-638

12-00

124-239

On drawing off a little of the gas from the explosion vessel it

was found that ^ gramme of powder gas (or cordite) at 0° C. and

standard atmospheric pressure occupied 280 cm.' (cordite 700

cm.'), while the same gas compressed into 0-43 cm.' at the

temperature of explosion had a pressure of 43 tons/inches", or

43 X 2240 ÷ 14-7 = 6552 atmospheres, of 14-7 lb/inchest

The absolute centigrade temperature T is thence inferred from

the gas equation

(11) T! -^ PoVo

T ~ 273 '

which, with p = 6552, v = 0-43, p„ = 1, d„ = 280, makes T = 2748,

a temperature of 2475° C. or 4487° F.

If the powder charge exploded in the bore of a gun is supposed

PRESSURES IN CLOSED VESSELS OBSERVED AND CALCULATED.

I'm

30

28

a-,.

3^-»

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22

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S‘8

a. le

T>

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I 12 13

- *IS le 17 1*

t la i

GRAVIMETRIC VOLUME

Fig. 11.

to expand according to the ordinary adidbatic law, then equation

(8) must be changed to

(12) p ^ n – a\y

Po \v – a) ‘

where the index y Is the ratio Cp /Gv of Cp the specific heat (S. H.)

at constant pressure to C,, the S. H. at constant volume ; and

7 = 1 -4 on the average.

But, contrary to anticipation based on this adiabatio law. Noble

and Abel found at an early stage of their researches that the pres-

sure observed in a closed vessel as given theoretically at constant

temperature by equation (9) did not differ greatly from the pres-

sure in the bore of the gun itself as deduced from experiments ; so

that the pressure falls off much more slowly than according to the

ordinary adiabatio law ; and they came to the conclusion that this

departure from expectation was due to the heat stored up in the

liquid and solid residue.

Denoting then by ;3 the ratio by weight of the non-gaseous to

the gaseous products of the charge, and by X the S. H. of the non-

gaseous portion, supposed to be- distributed in a finely divided state throughout the gas, the heat dK given out by the non-gaseous part during a small change of temperature dT is such that

(13) dH.= -p\dT.

The gaseous part obeys the gas-equation

(14) ^ p(v – a) ^ Po (1 – a).

To

so that

(15)

T p

dv

and

(16)

*dS. a\(dp , dv *

^ = -^\7 + ^r-gj-

Supposing^ and v to vary one at a time,

(17) dH

SH ,., 5H ,

and p varying while v is constant,

(18) 5H ^ SH 5T ^ (, Bj

Sp iTl Sp ”]

and keepings constant while v varies,

= ai

(19)

so that, in (17)

(20)

oH ^ 5H 5T ^ (. p

Sv 5T Sv

dK pdp

+ C,

dv

T “p

and equating the values of dHjT in (16) and (20),

*(21) (C, + j3X)^ + (Cp-H3X)-*L=0.*

p v — a

180

GUNNERY— GUNTUR

V

n~a

Po

\v~a)

m =

Ogj-iSX

Cv + pi

Integrating

(22) (C« + j3\) log ^ + (Cp + /3X) log (d – o) = constant,

r

(23)

where

(24)

reducing to the ordinary adiabatic law when j3=0.

According to the experiments of Noble and Abel,

o = 0-57, |3 = - = 1-3256, X = 0-45, Cp = 0-2324, C„ = 0-1762,

making to = 1-074.

In metric units, the work done per gramme of powder in the

expansion from unit G. D. or G. V. is

TO – 1 \ \v – a) I

po{l – a) – p{v – g)

m-1

= — -,(T„-T).

TO – 1

In British units this must be multiplied by 2-31 to obtain E, the work iu foot-tons per lb of powder ; and with po = 43 tons/inchest

(26) ^ = 43f »-^^ V'°"-

(27)

E =

2-31×43×0

0-074

-"'■»(' -T.)

^(-y

so that 577 "3 foot-tons is the total amount of work realizable from the infinite expansion from unit G. D. of 1 lb of gunpowder.

If Table II. is calculated from formula (27) the results are not very different from those obtained in the previous manner from the obserred pressure in closed vessels. The table is carried up to V = 50, and can easily be extended by means of formula (27).

In the employment of Table II. to calculate the muzzle energy and velocity to be expected from a given charge of P lb of powder, in expanding from the volume C inches ^ of the chamber to the volume B inches' of the bore, the initial and final gravimetric

volumes (G. V.) are denoted by Vo and v, such that

(28)

C ^ B .

^° 27-73 P ” 27-73 P’

these are calculated, and the difference E(‘w) – E(‘Do) of the corre-

sponding values of E multiplied by the charge P gives the maxi-

mum realizable work in foot-tons.

In practice a, factor of effect f, varying from 0‘9 to 0-7, equivalent

to, a discount of 10 to 30 per cent., is required to obtain the actual

not realized work stored up in the shot on leaving the muzzle.

Thus, for instance, in the 15-pounder B. L. gun, in which G = 117,

B = 647 inches ‘, a charge of 4 ft) of powder expands from ijo = 1 -054

to i» = 5-83, so that

(29) E(t)) – E(«„) = 97-5113 – 5-0232 = 92-4881 ;

and, with a factor of effect 0-7, the net muzzle energy is

(30) 0-7 X 4 ;< 92-4881 = 259 foot-tons ;

and if the shot weighs 15 lb, this makes the muzzle velocity

V = 1578 lb.

Mr Longridge points out the necessity for some such reduction

by a factor of effect/, by reason of tlie time occupied by the charge

in combustion, during which the pressure rises to its maximum ; the direct employment of Table II. assuming that the charge was consumed completely before the shot moved.

Fig. 3 shows the upper theoretical curve of pressure PoPiP, the area of which is tabulated in Table II. ; the shaded portion represents in Longridge's theory the work to be deducted in consequence of the pressure rising gradually to a maximum pi along the curve CPj, while the G. V. increases from Vo to Vi ; and the actual work per lb of powder realized during combustion will be something less than

(31) El = 2-31 (til – %)^i foot- tons.

The maximum pressure pi being supposed known, ana its corresponding «i, then during the subsequent expansion between the G.V.'s Vi and v, the work done in foot-tons per lb of powder is given from Table il. by

(32) E(«) – E(i)i).,

Suppose, for instance, that in the 15-pounder the maximum pressure is^i = 11-25 tons/inches ^ corresponding to vi = 2, then

(33) El = 24-6.

(34) E(d) – E(i;i) = 48-5,

making the theoretical work something under 73 foot-tons per lb ;

so that the factor of effect becomes about 0-9, to be accounted for

by the friction in the bore and the energy of rotation.

With cordite the products of combustion are almost all gaseous,

hence the absence of smoke ; so that we may put a = 0, ^ = 0 in

formula (24) ; a good average value of m is found by experiment

to be

(35) TO = 1-2;

thence a table of the work in foot-tons per B of cordite is easily

calculated when the pressure pi tons/inches* corresponding to a

given Vi has been determined.

Thus the cordite charge of 15 oz. employed with the 15-pounder

gun expands from Vo = 4-45 to « = 25, and gives a muzzle velocity

V = 1576 f/s to a shrapnel shell weighing 14 lb 1 oz. ; so that the

energy realized per lb of cordite is

^^^^ 7r-^^T5 = 258-5 foot-tons.

2g X 2240 P

If the maximum pressure ^ = 14 tons/inches ^ is attained when

Vi = 6, then in accordance with Longridge's theory

and

(37)

(38)

El = 2-31 X 1-55 X 14 = 60 foot-tons,

E(«) – E(«i) = 2-3ip:

dv

= 241 foot-tons,

making the realized work per lb of cordite something under 291

foot-tons ; so that the factor of effect is about

(39) /= 0-89.

This factor / varies appreciably ~~with the temperature, as con~~

duction is very rapid in consequence of the small density and

great heat of the cordite gas.

The discussion of the dynamical phenomena which take place

in the bore during the progress of the shot is so complicated that

much reliance is placed on empirical formulse, resembling those

employed for the perforation of armour plates.

Sarrau's Monomial Formula is much employed, giving the muzzle

velocity

(40)

V = HP wd'

*V(B)^*

where the symbols have their previous meaning, and H is a factor depending on the quaUty and structure of the powder ; and this formula can, as before, be interpreted in popular language as equivalent to saying that 1 % change in P, w, d, D, B/C causes ^, y, i. ?> »■ % change in V.*

In the old rule of Robins and Hutton, that the muzzle energy is proportional to the charge, ignoring the effect of calibre, density of loading, and number of expansions in the bore, we put a: = i, 2/ = – i,P, q,r = 0.

For quick powder, entirely consumed in the bore, Sarrau takes

(41) x = i,y= – i, p = h 1 = h r = i-

For slow powder, some of which is blown out of the muzzle unconsumed, he takes —

(42) x = i,y=-^,p = i,q = i,r = ^.

These indices are readily determined by plotting a few experimental results on a logarithmic chart.

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(a. G. G.)

Gunpowder. See Peopellants.

Guntur, a town of British India, in the Kistna

district of Madras, a station on the branch of the

Southern Mahratta Eailway from Bellary to Bezwara.

Population (1881), 19,646; (1891), 23,267; municipal

income (1897-98), Rs.46,470. It is a centre for trade in

grain and cotton, with five cotton-presses. The American

Lutheran Mission supports a college. There are two high

schools, two printing-presses, and two literary associations.

Gurdaspur, a town (with a population in 1891 of 5189) and district of British India, in the Lahore division of the Punjab. The Disteict comprises an area of 1889 square miles. Population (1881), 823,965; (1891), 943,922, being 500 persons per square mile; (1901), 940,595, showing a shght decrease, compared with an increase of 15 per cent, in the previous decade. The land revenue and rates were Rs. 16,56,082, the incid-ence of assessment being R. 1-4-9 per acre; the number of police was 536; the cultivated area in 1896-97 was 812,760 acres, of which 210,375 were irrigated, including 37,101 from government canals ; the number of schools in 1896-97 was 296, with 9968 pupils, the proportion of boys at school to the male population of school-going age being 12-2 per cent. ; the registered death-rate in 1897 was 24-97 per 1000. There are seven printing-presses, issuing one English and one vernacular newspaper. A branch of the North- Western Eailway runs for.. 48 miles through the district. There are 80 miles of navigable river, and 26 miles of metalled roads. The largest town is Batala. The

sanitarium of Dalhousie, though situated in the native state of Chamba, is attached to Gurdaspur.

Gurgaon, a district of British India, in the Delhi division of the Punjab, comprising an area of 1984 square miles. Population (1881), 641,848; (1891), 668,929, being 337 persons per square mile; (1901), 745,877, showing an increase of 11 per cent. The land revenue and rates were Rs.l3,7l,138, the incidence of assess-ment being R.1-1-11 per acre; the number of police was 520; the cultivated area in 1896-97 was 817,975 acres, of which 217,421 were irrigated, including 92,085 from government canals; the number of schools in 1896-97 was 149, with 4834 pupils, the . proportion of boys at school to the male population of school-going age being 9 per cent. ; the registered death-rate in 1897 was 37”36 per 1000. There are two printing-presses, four factories for cleaning and pressing cotton, seventeen small indigo factories, and two saltpetre refineries. The largest town is Eewari. There are altogether 62 miles of railway, 30 miles of navigable river, and 79 miles of metalled roads.

The district is also traversed by the Agra canal.

Guriev, or Gueiev Goeodok, formerly Yaitskiy

GoEODOK, a district town of Eussia, government of Uralsk,

on the right bank of the Ural, 1 1 miles above its mouth,

in a malarial neighbourhood. It has considerable

fisheries, and is in steamer communication with Astrakhan ;

trade is carried on vrith the Kirghiz, especially at the fairs.

Population, 9320.

Gurney, Edmund (1847-1888), English

psychologist, was born at Hersham, near Walton-on-

Thames, 23rd March 1847. He was educated at Black-

heath and at Trinity College, Cambridge, where he took

a high place in the classical tripos, and obtained a fellow-

ship. His work for the schools was done, says his friend

Mr Myers, " in the intervals of his practice on the piano."

Dissatisfied with his own executive skill as a musician, he

wrote :7%e Power o//SoM?i(^(1880),an essayon the philosophy

of music. He then studied medicine with no intention of

practising, devoting himself to physics, chemistry, and

physiology. In 1880 he passed the second M.B. Cam-

bridge examination in the science of the healing profession. These studies, and his great logical powers and patience in the investigation of evidence, he devoted to that outlying field of psychology which is called "Psychical Research." He asked whether, as universal tradition declares, there is an unexplored region of human faculty transcending the normal limitations of sensible knowledge. That there is such a region it was part of the system of Hegel to declare, and the subject had been metaphysically treated by Hartmann, Schopenhauer, Du Prel, Hamilton, and others, as the philosophy of the Unconscious, or Subconscious. But Gurney's purpose was to approach the subject by observation and experiment, especially in the hypnotic field, whereas vague and ill-attested anecdotes had hitherto been the staple of the evidence of metaphysicians. The tendency of his mind was to investigate whatever facts may give a colour of truth to the ancient behef in the persistence of the conscious human personality after the death of the body. Like Joseph Glanvil's, the natural bent of Gurney's mind

was sceptical. Both thought the current and traditional reports of supernormal occurrences suggestive and worth investigating by the ordinary methods of scientific observation, and inquisition into evidence at first hand. But the method of Gurney was, of course, much more strict than that of the author of Saddvjcismus Triumphatus, and it included hypnotic and other experiments unknown to Glanvil. Mr Gurney began at what he later saw was the wrong end by studying, with Mr Myers, the " stances " of professed spiritualistic "mediums" (1874-78). Little but detection of imposture came of this, but an impression was left that the subject ought not to be abandoned. In 1882 the Society for Psychical Research was founded. (See Psychical Eeseaech.) Paid mediums were discarded, at least for the time, and experiments were made in "thought-transference" and hypnotism. Personal evidence as to uninduced hallucinations was also collected. The first results are embodied in the volumes of Phantasms of the Living, a vast collection (Podmore, Myers, and Gurney), and in Mr Gurney's remarkable essay.

Hallucinations. The chief consequence was to furnish evidence for the process called "telepathy," involving the provisional hypothesis that one human mind can afi'ect another through no recognized channel of sense. The fact was supposed to be established by the experiments chronicled in the Proceedings of the Society for Psychical Research, and it was argued that similar experiences occurred spontaneously, as, for example, in the many recorded instances of " deathbed wraiths " among civilized and savage races. (Tylor, Primitive Culture, i., chapter xi., especially pages 449-450, 1873. Lang, MaJcing of Religion, pages 120-124, 1898.) The dying man is supposed to convey the hallucination of his presence as one living person experimentally conveys his thought to another, by "thought-transference." Mr Gurney's hypnotic experiments, marked by great exactness, patience, and ingenuity, were undertaken in 1885-88. Their tendency was, in Mr Myers's words, " to prove — so far as any one operator's experience in this protean subject cin be held to prove anything — that there is sometimes, in the

induction of hypnotic phenomena, some agency at work which is neither ordinary nervous stimulation (monotonous or sudden) nor suggestion conveyed by any ordinary channel to the subject's mind." These results, if accepted, of course corroborate the idea of telepathy. (See Gurney, " Hypnotism and Telepathy," Proceedings S.P.R., vol. iv.) Experiments by MM. Gibert, Janet, Eichet, H^ricourt, and others are cited as tending in the same direction. Other experiments dealt with " the relation of the memory in the hypnotic state to the memory in another hypnotic state, and of both to the normal or waking memory." All this work has been more appreciated by Continental than by British savants. The result of Mr Gurney's labours, cut short by his early and regretted death, has been to raise and strengthen the presumption that there exists an unexplored region of human faculty which ought not to be neglected by science as if the belief in it were a mere survival of savage superstition. Eather, it appears to have furnished

the experiences wliich, misinterpreted, are expressed in traditional beliefs. That Mr Gurney was credulous, and easily to be imposed upon, those who knew him, and knew his penetrating humour, cannot admit ; nor is the theory likely to be maintained by those whom bias does not prevent from studying with care his writings. In controversy " he delighted in replying with easy courtesy to attacks envenomed with that odium plus quam tlieologicum which the very allusion to a ghost or the human soul seems in some philosophers to inspire." In discussion of themes unpopular and obscure Mr Gurney displayed the highest tact, patience, good temper, humour, and acuteness. There never was a more disinterested student.

In addition to his work on music and his psychological writings, he was the author of Tertium Quid (1887), a collection of essays, on the whole a protest against one-sided ideas and methods of discussion. He died at Brighton on 23rd June 1888, from the effects of an overdose of narcotic medicine. (a. l.)

Cutersloh, a town of the province of Westphalia, Prussia, 11 miles S.W. from Bielefeld by the railway to Dortmund. It is the seat of silk and cotton industries, and has a trade in Westphalian hams and sausages. Printing, brewing, and distilling are also carried on. It is famous for its rye-bread (pumpernickel). Population (1900), 7100.

Guthrie, capital of Logan county, Oklahoma, U.S.A., and the capital of the territory, on the river Cottonwood and the Atchison, Topeka, and Santa Fe railway, at an altitude of 939 feet. The city was founded in 1889, and one year later had a population of 2788. In 1900 the population (including what in 1890 was Guthrie, East Guthrie, and West Guthrie towns) had increased to 10,006, of whom 301 were foreign-born and 3036 negroes.

Cwalior, a native state of India, in the Central Indian Agency, with a total area of about 29,000 miles, and a population in 1881 of 2,951,014, and in 1891 of 3,366,496, giving an average density of 116 persons

per square mile. In 1901 the population of the Gwalior Agency, which is not coextensive with the state of Gwalior, was returned as 2,149,958, showing an increase of 3 per cent. The gross revenue is about Es.1,60,00,000 (say, one million sterling). In 1896-97 the land revenue yielded Es.67,16,700, and Es.38,80,323 was expended on the army. There was an accumulated balance of about Es.10,00,00,000, of which more than half was invested. The number of schools was 261 (including two colleges and three high schools), attended by 13,772 pupils, of whom 1346 were learning English. The present Maharaja, Madhava Eao Sindhia, G.C.S.I., was born in 1877, and succeeded in 1886. During his minority the state was administered for eight years by a council of regency. He was entrusted with ruling powers in 1894, and has in all respects continued the reforming policy of the council, while paying personal attention to every department. A survey has been introduced for land revenue ; large sums have been devoted to railways; active measures have been adopted for the

suppression of dakaiti, or gang robbery — the scourge of Central India ; and roads, bridges, hospitals, and schools have been built. The survey, under an English officer, shows that about one-third of the total area is cultivated, and that one-thirteenth of the cultivated area is irrigated. The assessment ranges from Es.20 to Es.60 per plough. The railways undertaken by the state are — (1) from Bina on the Indian Midland to Goona (74 miles) ; (2) an extension of this line to Bara (74 miles), opened in 1899 ; (3) from BhopaltoUjain (114 miles) ; (4) two light railways, from Gwalior to Sipri and Gwalior to Bhiud (total length, 127 miles), which were opened by the Viceroy in November 1899. On the same occasion the Viceroy opened the Victoria College, founded to commemorate the Diamond Jubilee ; and the Memorial Hospital, built in memory of the Maharaja's father. The northern portion of the state suffered from famine in 1897, and the southern portion in 1900. British currency has been introduced instead of Chandori rupees, which were much depreciated. Two regiments of imperial service cavalry are maintained, and

also a transport corps of ponies and carts, which did good service in the Chitral and Tirah campaigns. In 1900 the Maharaja equipped at his own cost a hospital ship for the China war, and himself accompanied it. The City of GwALioE is 76 miles by rail south of Agra. The population in 1881 was 88,066, in 1891 it was 104,083. It has a college with 400 students, a high school, a girls' school with 115 pupils, a service school to train officials, a law class, hospitals for men and for women, amuseum, apalace, lighted by electricity, a paper-mill, and a printing-press, issuing a state gazette.

GYMNOSPERMS

THE Gymnosperms form with the Angiosperms the great division of seed-bearing plants of Phanerogams. As the name imp'lies, one characteristic is the absence of an ovary or a closed chamber containing the ovules. These naked-seeded plants are of special interest on account of their great antiquity, which far exceeds that of other Flowering Plants, and as comprising different types which carry us back to the Palaeozoic

era and to the forests of the Coal Period. The best known and by far the largest division of the Gymnosperms is that of the cone-bearing trees (pines, firs, cedar, larches, &c.), which play a prominent part in the vegetation of the present day, especially in the higher latitudes of the northern hemisphere ; certain members of this class are of considerable antiquity, but the Conifers as a whole are still vigorous, and show no signs of decadence. The division known as the Cycadales is represented by a few living genera of limited geographical range, and by a large number of extinct types which in the Mesozoic era (see Paleobotany, Mesozoic) played a conspicuous part in the vegetation of the world. Palaeobotanical evidence has rendered it probable that the Cycads sprang from a common ancestry with Ferns. Among the Cycadales we find surviving types which, in their present isolation, their close resemblance to fossil forms, and in certain morpho-logical features, constitute links with the past that not only connect the present with former periods in the eai-th's history, but serve as sign-posts pointing the way back

along one of the many lines which evolution has followed. The Cordaitales (see Paleobotany, Paleozoic) are represented by extinct forms only, which occupied a prominent position in the Palaeozoic period; these plants exhibit certain features in common with the living Araucarias, and others which invite a comparison with the Maidenhair tree {Ginkgo biloba), the solitary survivor of another class of Gymnosperms, the Ginkgoales (see Paleobotany, Mesozoic). The Gnetales are a class apart, including three living genera, of which we know next to nothing as regards their past history or line of descent.

GYMNOSPERMS

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Gymnospermae. — Trees or shrubs ; leaves vary considerably in size and form. Flowers unisexual, except In a few cases (Gnetajes) without a perianth. Monoecious or dioecious. Ovules naked, rarely without carpellary leaves, usually borne on carpophylls, which assume various forms. The single megaspore enclosed in the nucellus is filled with tissue (prothallus) before fertilization, and

contains two or more archegonia, consisting usually of a large egg-cell and a small neck, rarely of an egg-cell only and no neck {Q-netum and Welwitschia). Microspore spherical or oval, with or without a bladder-like extension of the exine, containing a prothallus of two or more cells, one of which produces two non-motile or motile male cells. Cotyledons two or several. Secondary xylem and phloem produced by a single cambium, or by successive cambial zones ; no true vessels (except in the Gnetalea) in the wood, and no companion-cells in the phloem.

I. Cycadalbs. — A. Oycadacece, B. Bennettitacece (extinct).

II. C0RDAITALE8 (extinct).

III. GiNKGOALEs. — A single recent genus, Ginkgo.

IV. Conifer ALES. — A. Taxacem, B. FinaceCB.

V. Gentales. — A. Sphedroideoe, B. Onetoidem, C. Welwitschioi-dece.

Ctcadales. — ^A. Oycadacece. — Stems tuberous or columnar, not infrequently branched, fronds pinnate, bi-pinnate in the Australian genus Bowenia. Dioecious ; flowers in the form of cones, except the female flowers of Gycas, which consist of a rosette of leaf-like carpels at the apex of the stem. Seeds albuminous, with one

integument ; the single embryo, usually bearing two partially fused cotyledons, is attached to a long tangled suspensor. Stems and roots increase in diameter by secondary thickening, the secondary wood being produced by one cambium or developed from successive cambium-rings.

The Cycads constitute a homogeneous group of a few living members confined to tropical and sub-tropical regions. As a fairly typical and well-known example of the Cycadaoese, a species of the genus Oycas (e.g., C circinalis, G. revoluta, &c.) is briefly described. The stout columnar stem (see Uncy. Brit., vol. iv., Plate 15) may reach a height of 20 metres, and a diameter of half a metre ; it remains either unbranched or divides near the summit into several short and thick branches, each branch terminating in a crown of long pinnate leaves. The sur-face of the stem is covered with rhomboidal areas, which represent the persistent bases

of foliage- and scale-leaves. In some species of Gycas there is a well-defined alternation of transverse zones on the stem, consisting of larger areas representing foliage-leaf bases, and similar but smaller areas formed by the bases of scale-leaves (ii'and S, Fig. 1). The scale-leaves clothing the terminal bud are linear-lanceolate in form, and of a brown or yellow colour ; they are pushed aside as the stem-axis elongates, and become shrivelled, finally falling off, leaving projecting bases which are eventually cut ofi at a still lower level. Similarly, the dead fronds fall off, leaving a ragged petiole, which is afterwards separated from the stem by an absciss-layer a short distance above the base. In some species of Gycas the leaf-bases do not persist as a permanent covering to the stem, but the

surface is covered with a wrinkled bark, as in Gycas Siamensis, which has a stem of unusual form (Fig. 2). Small tuberous shoots, compar-able on a large scale with the bulbils of Lycopodium Selago, are occasionally produced in the axils of some of the persistent leaf ~~bases ; these are char~~ acteristic of sickly plants, and serve as a means of vegetative reproduction.

In the genus Gycas the female flower is peculiar among Cycads in consisting of a terminal crown of separate leaf-like carpels several inches in length ; the apical portion of each carpellary leaf may be broadly triangular in form, and deeply dissected on the margins

Tio. 1.— Stem of Or/cas.

F, foliage-leaf bases ;

S, scale-leaf bases.

Fie. 2.—Cyca8 Siamensis.

into narrow woolly appendages like rudimentary pinnae. From the lower part of a carpel are produced several laterally placed ovules, which become bright red or orange on ripening ; the bright fleshy seeds, which in some species are as large as a goose's egg, and the tawny spreading carpels produce a pleasing combination of colour in the midst of the long dark green fronds, which curve gracefully upwards and outwards from the summit of the columnar stem. In Cycas the stem-apex, after , producing a cluster of carpellary leaves, continues to elongate, and produces more bud-scales, which are afterwards pushed aside as a fresh crown of fronds is developed. The young leaves of Cycas consist of a straight rachis bearing numerous linear pinnae, traversed by a single midrib ; the pinnae are ciroinately coiled like the leaf of a fern (Fig. 3). The male flower of Gijcas conforms to the type of structure characteristic of the Gycads, and consists

of a long cone of numerous sporophylls bearing many oval pollen-sacs on their lower faces. The type described serves as a convenient representative of its class. There are eight other living genera, which may be classified as follows : —

Glassiflcation. — A. Gycadece. — Characterized by (a) the alternation of scale- and foliage-leaves (Fig. 1) on the branched or unbranched stem ; (6) the growth of the main stem through the female flower ; (c) the presence of a prominent single vein in the linear pinnae ; {d) the structure of the female flower, which is peculiar in not having the form of a cone, but consists of numerous independent carpels, each of which bears two or more lateral ovules. Eepresented by a single genus, C«/cas. (Tropical Asia, Australia, &c.)

B. ZamieoB. — The stem does not grow through the female flower ; both male and female flowers are in the form of cones, (a) Stangerieae. — Characterized by the fern-like venation of the pinnae, which have "yoiing frond, a prominent midrib, giving off at a wide angle simple

or forked and occasionally anastomosing lateral

veins. A single genus, Stangeria, confined to South Africa, (b)

Euzamiem. — The pinnae are traversed by several parallel veins.

Bowenia, an Australian Cycad, is peculiar in having bi-pinnate

fronds (Fig. 5). The various genera are distinguished from one

another by the shape and manner of attachment of the pinnae, the

form of the carpellary scales, and to some extent by anatomical

characters. Encephalanos (South Africa) . — Large cones ; the car-

pellary scales terminate in a peltate distal expansion. Macrozamia

(Australia). — Similar to ^nc^ftaZartos, except in the presence of a

spinous projection from the swollen distal end of the carpels. Zamia

(South America, Florida, &c.). — Stem short and often divided into

several columnar branches. Each carpel terminates in a peltate head.

Geratozamia (Mexico) . — Similar in habit to Macrozamia, but distin-

guished by the presence of two horn-like spinous processes on the

apex of the carpels. Microcycas (Cuba). — Like Zamia, except that

the ends of the stamens are flat, while the apices of the carpels are

peltate. Dioon (Mexico) . — Characterized by the woolly scale-leaves

and carpels ; the latter terminate in a thick laminar expansion of

triangular form, hearing

two placental cushions, on which the ovules are situated. .Boroera'a (Australia) . —Bi-pinnate fronds ; stem short and tuberous (Fig. 5). The stems of Cycads are often described as unbranched ; it is true that in comparison with Conifers, in which the numerous branches, springing the main stem, give a characteristic form to the tree, the tuberous or columnar stem of the Cycadaceae constitutes a striking distinguishing feature. Branching, however, occurs not infrequently ; in Gycas the tall stem often produces several cande-

labra-like arms ; in Zamia the main axis may break up nearthe base into several cylindrical branches; in species of Z)ioow (Fig. 4), Encephalartos, &c., lateral branches are occasionally produced. The thick armour of petiole-bases enveloping the stem is a characteristic Cycadean feature ; in Oycas the alternation of scale-leaves and fronds is more clearly shown than in other Cycads ; in Encephalartos, Dioon, &c. , the persistent scale-leaf bases are almost equal in size to those of

stem

and

Leaf.

from

Fie. i.—Dioon edule. (From a photograph

of a plant in the Peradeuiya Gardens,

Oeylon, by E. H. Tapp.)

the foliage-leaves, and there is no regular alternation of zones such as characterizes some species of Oycas. Another type of stem is illustrated by Stangeria and Zamia, also by a few forms of Cycas (Fig. 2), in which the fronds fall off completely, leaving a com-

paratively smooth stem. The Cycas type of frond, except as regards the presence of a midrib in each pinna, characterizes the Cycads generally, except Bowenia and Stangeria. In the mono-typic genus Bowenia the large fronds, borne singly on the short and thick stem, are bi-pinnate (Fig. 5) ; the segments, which are

Fig. h,— Bowenia spectaMHs : frond.

broadly ovate or rhomboidal, have several forked spreading veins, and resemble the large pinnules of some species of Adiantum. In Stangeria, also a genus represented by one species ((S. paradoxa of South Africa) , the long and comparatively broad pinnse, with an entire or irregularly incised margin, are very fern-like, a circum-stance which led Kunze to describe the plant in 1835 as a species of the fern Lomaria. In rare cases the pinnae of Cycads are lobed or branched : in Dioon spinulosum (Central America) the margin of the segments bears numerous spinous processes ; in some species of Encephalartos, e.g., E. horridus, the lamina is deeply lobed; and in a species of the Australian genus Macrozamia, M. heteromera, the narrow pinnae are dichotomously branched almost to the base (Fig. 6) , and resemble the frond of some species of the fern Schizaia, or the fossil genus Baiera (Ginkgoales).

In Ceratozamia the broad petiole-base is characterized by the presence of two lateral spinous processes, suggesting stipular appendages, comparable, on a reduced scale, with the large stipules of the MarattiaoesB among Ferns. The vernation varies in different genera ; in Cycas the rachis is straight and the pinnae circinately coiled (Fig. 3) ; in Encephalartos, Dioon, &c., both rachis and segments are straight ; in Zamia the rachis is bent or slightly coiled, bearing straight pinnae. The young leaves arise on the stem-apex as conical protuberances with winged borders, on which the pinnae appear as rounded humps, usually in basipetal order ; the scale-leaves in their young condition resemble fronds, but the lamina remains undeveloped. A feature of interest in

connexion with the phylogeny of Cycads is the presence of long hairs clothing the scale-leaves, and forming a cap on the summit of the stem-apex or attached to the bases of petioles ; on some fossil cycadean plants these outgrowths have the form of scales, and are identical in structure with the ramenta (paleae) of the majority of ferns.

The male flowers of Cycads are constructed on a uniform plan, and in all cases consist of an axis bearing crowded, spirally dis-

Plower posed sporophylls. These are often wedge-shaped and angular ; in some cases they consist of a short, thick stalk, terminating in a peltate expansion, or prolonged upwards in the form of a triangular lamina. (See Ency. Brit., vol iv., Plate 15.) The sporangia (pollen-sacs), which occur on the under-side of the stamens, are often arranged in more or less definite groups or

Fig. 6. — Macroeamda heteromera. A, part of frond ; B, single pinna.

MIcrO’

spores

and

mega-

spores.

sori, interspersed with hairs (paraphyses) ; dehiscence takes place along a line marked out by the occurrence of smaller and thinner-walled cells bounded by larger and thicker-walled elements, which form a fairly prominent cap-like ” annulus ” near the apex of the sporangium, not unlike the annulus characteristic of the Schizaea-ceae among Ferns. The sporangial wall, consisting of several layers of cells, encloses a cavity containing numerous oval spores (poUen-grains). In structure a cycadean sporangium recalls those of certain ferns (Marattiaceae, Osmundacese, and Schizseaceae) , but in the development of the spores there are certain peculiarities not met with among the Vascular Cryptogams. With the exception of Cycas, the female flowers are also in the form of cones, bearing numerous carpellary scales. In Cycas revoluta and C. circinalis each leaf-like carpel may produce several laterally attached ovules, but in C. Normanbyana the carpel is shorter and the ovules are

reduced to two ; this latter type brings us nearer to the carpels of Dioon, in whicli the flower has the form of a cone, and the distal end of the carpels is longer and more leaf-like than in the other genera of the Zamiese, which are characterized by shorter carpels with thick peltate heads bearing two ovules on the morphologically lower surface. The cones of Cycads attain in some cases (e.g., Encephalartos) a considerable size, reaching a length of more than a foot.

The pollen-grains when mature consist of three cells, two small and one large cell ; the latter grows into the pollen-tube, as in the Coniferales, and from one of the small cells two large ciliated spermatozoids are eventually produced. One of the most important botanical discoveries made during the latter part of the 19th century was that by Ikeno, a Japanese botanist, who was the first to demonstrate the existence of motile male-cells in the genus Cycas. Similar spermatozoids have been observed also in some species of Zamia by Webber, an American botanist, and Lang has found traces of ciliated cells in Stangeria. Before following the growth of the pollen-grain after pollination, we will briefly describe the

structure of a cycadean ovule. An ovule consists of a conical nucellus surrounded by a single integument. At an early stage of development a large cell makes its appearance in the central region of the nucellus ; this increases in size and eventually forms three cells ; the lowest of these grows vigorously and constitutes the megaspore (embryo-sac), which ultimately absorbs the greater part of the nucellus. The mega-spore-nucleus divides repeatedly, and cells are produced from the peripheral region inwards, which eventually fill the spore-cavity with a homogeneous tissue (prothallus) ; some of the superficial cells at the micropylar end of the megaspore

increase in size and divide by a tangential wall into two, an upper cell which gives rise to the short two-celled neck of the archegonia, and a lower cell which develops into a large egg-cell. Each megaspore may contain 2 to 6 archegonia. During the growth of the ovum nourishment is supplied from the contents of the cells imme-diately surrounding the egg-cell, as in the development of the ovum of Pinus and other Conifers. Meanwhile the tissue in the apical region of the nucellus has been undergoing disorganization, which results in the formation of a large space or pollen-chamber (Fig. 7, O), situated immediately above the megaspore. The pollen-grains find their way between the carpophylls, which at the time of pollination are slightly apart owing to the elongation of the inter-nodes of the flower-axis, and pass into the pollen-chamber ; the large cell of the pollen-grain grows out into a tube {Ft), which penetrates the nucellar tissue and often branches repeatedly ; the pollen-

grain itself, with the prothallus-cells, projects freely into the pollen-chamber (Fig. 7). The nucleus of the outermost (second) small cell (Fig. 7, Q) divides, and one of the daughter-nuclei passes out of the cell, and may enter the lowest (first) small cell. The outermost cell, by the division of the remaining nucleus, produces two large spermatozoids(Fig. 8, a, a). In the course of this division two bodies make their appearance in the cytoplasm, and behave as centrosomes during the karyokinesis ; they gradually become thread-like and coil themselves round each daughter nucleus. (See Cytology, Vegetable.) This thread gives rise to a spiral ciliated band lying in a depression on the body of each sper-

FiG. 7. — Zatnia : part of ovule in longi-tudinal section. P, prothallus ; A, archegonia ; N, nuceUus ; C, pollen-chamber ; Pt, pollen-tube ; Pg, pollen-grain ; Gy generative cell (second cell of pollen-tube). (After Webber.)

Fig. 8. — Zam4a :

proximal end of

pollen-tube, a,

a,spermatozold8

from O of Fig.

7 ; Pg, pollen-

grain ; c, proxi-

mal cell (ilrBt

cell). (After

Webber.)

matozoid, which ends posteriorly in a short tail formed of cyto-

plasm ; the spermatozoids eventually escape from the pollen-tube,

and are able to perform ciliary movements in the watery liquid

which occurs between the thin papery remnant of nuoellar tissue

and the arohegonial necks. Before fertilization a neck-canal cell

is formed by the division of the ovum-nucleus.

After the body of a spermatozoid has coalesced

with the egg-nucleus the latter divides repeatedly

and forms a mass of tissue which grows more

vigorously in the lower part of the fertilized

ovum, and extends upwards towards the apex of

the ovum as a peripheral layer of parenchyma surrounding a central space. By further growth d this tissue gives rise to a proembryo, which consists, at the micropylar end, of a sac; the tissue at the chalazal end grows into a long and tangled suspensor, terminating in a mass of cells, which is eventually differentiated into a radicle, plumule, and two cotyledons. In the ripe seed the integument assumes the form of a fleshy envelope, succeeded internally by a hard woody shell, internal to which is a thin papery membrane— the apical portion of the nuoellus — which is easily dissected out as a conical cap covering the apex of the endosperm. A central depression occurs in the apex of the endosperm, in which may be seen the remains of additional archegonia. The first leaves borne on the seedling axis are often scale-like, and these are followed by two or more larger laminae, which foreshadow the pinnae of the adult frond.

The anatomical structure of the vegetative organs of recent Cycads is of special interest as affording important evidence of re-, . lationship with extinct types, and with other groups of aa omy. j-ggg^^ plants. Brongniart, who was the first to investi-gate in detail the anatomy of acycadean stem, recognized an agree-ment, as regards the secondary wood, with Dicotyledons and Gym-nosperms, rather than with Monocotyledons. He drew attention also to certain structural similarities between Gycas and Ginkgo. The main anatomical features of a cycad stem may be summarized as follows : The centre is occupied by a large parenchymatous pith traversed by numerous secretory canals, and in some genera by cauline vascular bundles (e.g., Encephalartos and Macrozamia). In addition to these cauline strands (confined to the stem and not connected with the leaves) , collateral bundles are often met with in the pith, which form the vascular supply of terminal flowers borne at intervals on the apex of the stem. These latter bundles may be seen in sections of old stems to pursue a more or less hori-zontal course, passing outwards through the main woody cylinder. This lateral course is due to the more vigorous growth of the lateral vegetative branch formed near the base of each flower,

which is a terminal structure, and, exceptin the female flower of Oj/cas, puts a limit to the apical growth of the stem. The vigorous lateral branch therefore continues the line of the main axis. The pith is encircled by a cylinder of secondary wood, consisting of single or multiple radial rows of tracheids separated by broad medullary rays composed of large parenchymatous cells; the tracheids bear numerous bordered pits on the radial walls. The large medullary rays give to the wood a characteristic parenchymatous or lax appearance, which is in marked contrast to the more compact wood of a conifer. The protoxylem-elements are situated at the extreme inner edge of the

secondary wood, and may occur as small groups of narrow, spirally-pitted elements scattered among the parenchyma which abuts on the main mass of wood. Short and reticulately-pitted tracheal cells, similar to tracheids, often occur in the ciroummedullary

Fi&. 9. — Macrozamia : diagrammatic transverse section of part of stem, pd, periderm in leaf bases ; It, leaf-traces in cortex ; ph, phloem ; lo, xylem ; m, medullary bundles; o, cortical bundles. (After Worsdell.)

region of cycadean stems. In an old stem of Cycas, Encephalartos, or Macrozamia the secondary wood consists of several rather unevenly concentric zones; while in some other genera it forms a continuous mass as in Conifers and normal Dicotyledons.

These concentric rings of secondary xylem and phloem (Fig. 9) afford a characteristic cycadean feature. After the cambium has been active for some time producing secondary xylem and phloem, the latter consisting of sieve-tubes, phloem-parenchyma, and frequently thick-walled fibres, a second cambium is developed in the pericyole ; this produces a second vascular zone, which is in turn followed by a third cambium, and so on, until several hollow cylinders are developed. It has been recently shovm that several cambium-zones may remain in a state of activity, so that the formation of a new cambium does not necessarily mark a cessation of growth in the more internal meristematic rings. It occasionally happens that groups of xylem and phloem are developed internaUy to some of the vascular rings ; these are characterized by an inverse orientation of the tissues, the xylem being centrifugal and the phloem centripetal in its development. The broad cortical region, which contains many secretory canals, is traversed by numerous vascular bundles (Fig. 9, c), some of which pursue a more or less vertical course, and by frequent anastomoses with one another form a loose reticulum of vascular strands ; others are leaf-traces on their way from the stele of the stem to the leaves. Most of these cortical

bundles are collateral in structure, but in some the xylem and phloem are concentrically arranged ; the secondary origin of these bundles from procambium -strands was described by Mettenius in his classical paper of 1860. During the increase in thickness of a cycadean stem successive layers of cork-tissue are formed by phel-logens In the persistent bases of leaves (Fig. 9, pd), which increase in size to adapt themselves to the growth of the vascular zones. The leaf -traces of Cycads are remarkable both on account of their course and their anatomy. In a transverse section of a stem (Fig. 9) one sees some vascular bundles following a horizontal or slightly oblique course in the cortex, stretching for a longer or shorter distance in a direction concentric with the woody cylinder. From each leaf-base two main bundles spread right and left through the cortex of the stem (Fig. 9, It) , and as they curve gradually towards the vascular ring they present the appearance of two rather flat ogee curves, usually spoken of as the leaf -trace girdles (Fig. 9, It). The distal ends of these girdles give off several branches, which traverse the petiole and rachis as numerous collateral bundles. A leaf-trace, as it passes through the cortex, has a collateral structure, the proto-xylem being situated at the inner edge of the xylem ; when it reaches

the leaf-base the position of the spiral tracheids is gradually altered, and the endarch arrangement (protoxylem internal) gives place to mesarch structure (protoxylem more or less central and not on the edge of the xylem strand). In a bundle examined in the basal portion of a leaf the bulk of the xylem is found to be centrifugal in position, but internally to the protoxylem there is a group of centripetal tracheids ; higher up in the petiole the xylem is mainly centripetal, the centrifugal wood being represented by a small arc of tracheids external to the protoxylem and separated from it by a few parenchymatous elements. Finally, in the pinnae of the frond the centrifugal xylem may disappear, the protoxylem being now exarch in position and abutting on the phloem. Similarly In the sporophylls of some Cycads the bundles are endarch near the base and mesarch near the distal end of the stamen or carpel. The vascular system of cycadean

seedlings presents some features worthy of note ; centripetal xylem occurs in the cotyledonary bundles associated with transfusion-tracheids. The bundles from the cotyledons pursue a direct course to the stele of the main axis, and do not assume the girdle-form characteristic of the adult plant. This is of interest from the point of view of the comparison of recent Cycads with some fossil cycadean plants (Bennettiteae), in which the leaf -traces follow a much simpler course than in modem Cycads. The mesarch structure of the leaf-bundles is met with in a less pronounced form in the flower peduncles of some Cycads. This fact is of importance as showing that this type of vascular structure, which characterized the stems of many Palaeozoic genera, has not entirely disappeared

from the stems of modern Cycads ; but the mesarch bundle is now confined to the leaves and peduncles. The roots of some Cycads resemble the stems in producing several cambium-rings ; they possess 2 to 8 protoxylem-groups, and are i^oots. characterized by a broad perlcyclic zone. A common pheno-menon In Cycads is the production of roots which grow upwards (apogeotroplc), and appear as coralline branched structures above the level of the ground ; some of the cortical cells of these roots are hypertrophled, and contain numerous filaments of blue-green

Fig. 1Q.— Ginkgo Mloba : leaves.

Fig. 11. — Ginkgo adiantoides.

Fossil (Eocene) leaf from the island of Mull.

AlgBS (NostocacesB), which live as endoparasites in the cell-cavities.

GiNKGOALEs. — This class-designation has been recently proposed to give emphasis to the isolated position of the genus Ginkgo

(Salisburia) among the Gymnosperms. Ginkgo Mloba, the Maiden-hair tree, has usually been placed by botanists in the Taxe» in the neighbourhood of the Yew {Taxus), but the proposal by Eichler in 1852 to institute a special family, the Salisburiese, indicated a recognition of the existence of special characteristics which distinguish the genus from other members of the Coniferae. The discovery by the Japanese botanist Hirase of the development of ciliated spermatozoids in the pollen-tube of Ginkgo, in place of the non-motile male cells of typical Conifers, served as a cogent argument in favour of separating the genus from the Coniferales and placing it in a class of its own. In 1712 Kaempfer published a drawing of a Japanese tree, which he described under the name Ginkgo ; this term was adopted in 1771 by Linnseus, who spoke of Kaempfer's plant as Ginkgo biloba. In 1797 Smith proposed to use the name Salisburia adiantifolia in preference to the "uncouth" genus Ginkgo and the " incor-

rect" specific term 6i7o6fl!. Both

names are still in common use.

On account of the resemblance of

the leaves to those of some species

of Adiantum, the appellation

Maidenhair tree has long been

given to Ginkgo biloba. Ginkgo is of special interest on account

of its isolated position among existing plants, its restricted

geographical distribution, and its great antiquity (see Pal.^o-

BOTANY, Mesozoic). Thls solitary survivor of an ancient stock

is almost extinct in a wild state, but a few large trees still flourish

in parts of China and possibly in Japan ; it is common as a sacred

tree in the gardens of temples in the Far East, and often culti-

vated in North America and Europe. Ginkgo biloba, which may

reach a height of over 30 metres, forms a tree of pyramidal shape

with a, smooth grey bark. The leaves (Eigs. 10 and 11) have a

long, slender petiole terminating in a fan-shaped lamina, which

may be entire, divided by a median incision into two wedge-

shaped lobes or subdivided into several narrow segments. The

venation is like that of many ferns, e"g., Adiantum; the lowest

vein in each half of the lamina follows a course parallel to the edge, and gives off numerous branches, which fork repeatedly as they spread in a palmate manner towards the leaf margin. The foliage-leaves occur either scattered on long shoots of unlimited growth, or at the apex of short shoots (spurs), which may eventually elongate into long shoots.

The flowers are dioecious, the axil of scale-leaves, consist or a stalked central axis bearing loosely dis-posed sta-mens; each stamen con-sists of a slender fila-ment terminating in a small apical scale, which bears usually two, but not infrequently three or four pollen-sacs (Fig. 12, a). The axis of the

flower is a shoot bear-

ing leaves in the form

of stamens. A mature

pollen-grain contains a

prothallus of 3 to 5 cells

(Fig. 13, Pg) ; the exine

extends over two-thirds

of the circumference,

leaving a thin portion of

the wall, which on col-

lapsing produces a lon-

gitudinal groove similar

to the median depres-

sion on the pollen-grain of a cycad. The ordinary type of female flower has the form of a long, naked peduncle bearing a single ovule on either side of the apex (Fig. 12), the base of each being enclosed by a small, collar-like rim, the nature of which has been variously interpreted. A young ovule consists of a conical nucellus surrounded by a single integument terminating as a two-lipped mioropyle. A large pollen-chamber occupies the apex of

the nucellus; immediately below this, two or more archegonia

(Fig. 13, a) are developed in the upper region of the megaspore,

each consisting of a large egg-cell surmounted by two neck-cells and

The male flowers (Fig. 12), borne in

Flowers.

Fig. Vl.~Oitikgo Mloba. A, male flower ;

S, 0, single stamens ; Z>, female flower.

Fig. 18. — Ginkgo : apex of ovule, and pollen-

grain, p, pollen-tube (proximal end) ; c,

poUen-chamber ; e, upward prolongation

of megaspore ; a, archegonia ; Pff, pollen-

grain ; Ms, exine. (After Hirase.)

a canal-cell which is cut off shortly before fertilization. After the

entrance of the pollen-grain the pollen-chamber becomes roofed

over by a blunt protuberance of nucellar tissue. The megaspore

(embryo-sac) continues to grow after pollination until the greater

part of the nucellus is gradually destroyed ; it also gives rise to a

vertical outgrowth, which projects from the apex of the megaspore

as a short, thick

column (Fig. 13, «) sup-

porting the remains of the nucellar tissue which forms the roof of the pollen-chamber (Fig. 13, c). Surrounding the pitted wall of the ovum there is a definite layer of large cells, no doubt representing a tapetum, which, as in Cycads and Conifers, plays an important part in nourishing the growing egg-cell. The endosperm detached from a large Ginkgo ovule after fertilization bears a close resemblance to that of a cycad ; the

apex is occupied by a

depression, on the floor

of which two small

holes mark the position of the archegonia, and the outgrowth from the megaspore apex projects from the centre as a short peg. After pollination the pollen-tube grows into the nuceUar tissue, as in Cycads, and the pollen-grain itself (Fig. 13, Fg) hangs down into the pollen-chamber ; two large spirally ciliated spermatozoids are produced, their manner of development agreeing very closely with that of the corresponding cells in Cycas and Zamia. After fer-tilization the ovum-nucleus divides and cell-formation proceeds rapidly, especially in the lower part of the ovum, in which the cotyledon and axis of the embryo are differentiated ; the long, tangled suspensor of the cycadean embryo is not found in Ginkgo. It is often stated that fertilization occurs after the ovules have fallen, but it has been demonstrated by Hirase that this occurs while the ovules are still attached to the tree. The ripe seed, which grows as large as a rather small plum, is enclosed by a thick, fleshy envelope covering a hard woody shell with two or rarely three longitudinal keels. A papery remnant of nucellus lines the inner face of the

woody shell, and, as in cycadean seeds, the apical portion is readily separated as a cap covering the summit of the endosperm.

The morphology of the female flowers has been variously interpreted by botanists ; the peduncle bearing the ovules has been described as homologous with the petiole of a foliage-leaf and as a shoot-structure, the collar-like envelope at the base of the ovules being referred to as a second integument or ariUus, or as the representative of a carpel. The evidence afforded by normal and abnormal flowers appears to be in favour of the following interpretation : The peduncle is a shoot bearing two or more carpels.

Each ovule is enclosed at the base by an envelope or collar homologous with the lamina of a leaf ; the fle&y and hard coats of the nucellus constitute a single integument.

The stalk of an ovule, considerably reduced

in normal flowers and much larger in some abnormal flowers, is homologous with a leaf-stalk, with which it agrees in the structure and number of vascular bundles. The facts on which this description is based are derived partly from anatomical evidence, and in part from an account given by a Japanese botanist, Fujii, of several abnormal female flowers ; in some cases the collar at the base of an ovule, often described as an arillus, is found to pass gradually into the lamina of a leaf bearing marginal ovules (Fig. 14, B). The occurrence of more than two ovules on one peduncle is by no means rare ; a particularly striking example is described by Fujii, in which an unusually thick peduncle

FiG. 14. — Ginkgo : abnormal female flowers.

A, peduncle ; 6, scaly bud ; S, leaf bearing

marginal ovule. (After Fujii.)

bearing several stalked ovules terminates in a scaly bud (Fig. 14, A, 6). The frequent occurrence of more than two pollen-sacs and the equally common occurrence of additional ovules have been regarded by some authors as evidence in favour of the view that ancestral types normally possessed a greater number of these organs than are usually found in the recent species. This view receives Aaatomy. support from fossil evidence. Close to the apex of a shoot the vascular bundles of a leaf make their appear-ance as double strands, and the leaf-traces in the upper part of a shoot have the form of distinct bundles, which in the older part of the shoot form a continuous ring. Each double leaf -trace passes through four internodes before becoming a part of the stele ; the double nature of the trace is a characteristic feature. Secretory saos occur abundantly in the leaf-lamina, where they appear as short lines between the veins ; they are abiuidant ajso in the cortex and pith of the shoot, in the fleshy integument of the ovule,

and elsewhere. The secondary wood of the shoot and root conforms in the main to the Coniferous type ; in the short shoots the greater breadth of the medullary rays In the more internal part of the xylem recalls the cycadean type. The secondary phloem contains numerous thick-walled fibres, parenchymatous cells, and large sieve-tubes with plates on the radial walls ; swollen parenchymatous cells containing crystals are commonly met with in the cortex, pith, and medullary-ray tissues. The wood consists of tracheids, with circular bordered pits on their radial walls, and in the late summer wood pits are unusually abundant on the tangential walls. A point of anatomical interest is the occurrence in the vascular bundles of the cotyledons, scale-leaves, and elsewhere of a few centripetally developed tracheids, which give to the xylem-strands a mesarch structure such as characterizes the foliar bundles of Cyoads. The root is diarch in structure, but additional protoxylem-strands may be present at the base of the main root ; the perioycle consists of several layers of cells.

This is not the place to discuss in detail the past history of Ginkgo (see Paleobotany, Mesozoio). Among Palaeozoic genera there are some which bear a close resemblance to the

Oeologlcal j-gcent type in the form of the leaves, and petrified history. Palgeozoio seeds, almost identical with those of the Maidenhair tree, have been described from French and English localities. During the Triassic and Jurassic periods the genus Baiera — no doubt a representative of the Ginkgoales — was widely spread throughout Europe and in other regions ; Ginkgo itself occurs abundantly in Mesozoic and Tertiary rocks, and was a common plant in the Arctic regions during the Jurassic and Lower Cretaceous periods. Some unusually perfect Ginkgo leaves have been found in the Eocene leaf-beds between the lava-flows exposed in the cliffs of Mull (Fig. 11). From an evolutionary point of view, It is of interest to note the occurrence of fllicinean and cycadean characters in the Maidenhair tree. The leaves at once invite a comparison with Ferns ; the numerous long hairs which form a delicate woolly covering on young leaves recall the hairs of certain ferns, but agree more closely with the long filamentous hairs of recent Cyoads. The spermatozoids constitute the most striking link with both Cycads and Ferijis. The structure of the seed, the presence of two neck-cells in the arohegonia, the late development of the embryo, the partially-fused cotyledons and certain anatomical characters, are

features common to Ginkgo and the Cycads. The Maidenhair tree is one of the most interesting survivals from the past ; it represents a type which, in the Palaeozoic era, may have been merged into the extinct class Cordaitales. Through the succeeding ages the Gink-goales were represented by numerous forms, which gradually be-came more restricted in their distribution and fewer in number during the Cretaceous and Tertiary periods, terminating at the present day in one solitary survivor.

CoNiFEEALES. — Tfccs and shrubs characterized by a copious branching of the stem and frequently by a regular pyramidal form. Leaves .simple, small, linear or short and scale-like, usually persisting for more than one year. Flowers monceoious or dicecious, unisexual, without a perianth, often in the form of cones, but never terminal on the main stem.

The plants usually included in the Conlferae constitute a less homogeneous class than the Cycadaceas. Some authors use the term Conif erae in a restricted sense as including those genera which have the female flowers in the form of cones, the other genera, characterized by flowers of a diSerent type, being placed in the Taxaceae, and often spoken of as Taxads. In order to avoid con-

fiision in the use of the term Conrferas, we may adopt as a class-designation the name Coniferales, including both the Conlferae — using the term in a restricted sense — and the Taxaceae. The most striking characteristic of the majority of the Bxtemal Coniferales is the regular manner of the monopodial features. ■branching and the pyramidal shape. Araucaria imbricata, the Monkey-puzzle tree, A. exeelsa, the Norfolk Island Pine, many Pines and Firs, Cedars, and other genera illustrate the pyramidal form. The mammoth Redwood tree of California, Sequoia (Wellingtonia) gigantea, which represents the tallest Gymnosperm, and among the Angiosperms is exceeded only by the Eucalyptus trees of Australia, is a good example of the regular tapering main stem and narrow pyramidal form. The Cypresses afford instances of tall and narrow trees similar in habit to Lombardy Poplars. The common Cypress {Cupressus sempervirens) , as found wild in the mountains of Crete and Cyprus, is characterized by long and spreading branches, which give it a Cedar-like habit. A pendulous or weeping habit is assumed by some Conifers ; e.g., Picea exeelsa var. virgata represents a form in which the main branches attain a considerable horizontal extension, and trail themselves like snakes

along the ground. Certain species of Finns, the Yews (Taxus), and some other genera grow as bushes, which in place of a main mast-like stem possess several repeatedly-branched leading shoots. The unfavourable conditions in Arctic regions have produced a dwarf form, in which the main shoots grow close to the ground. Artificially induced dwarfed plants of Finns, Oupressus, Sciadopitys (Umbrella Pine), and other genera are commonly cultivated by the Japanese. The dying off of older branches and the vigorous growth of shoots nearer the apex of the stem produce a form of tree illustrated by the Stone Pine of the Mediterranean region {Finns Fined), which Turner has rendered familiar in his " Childe Harold's Pilgrimage" and other pictures of Italian scenery. Conifers are not infrequently seen in which a lateral branch has bent sharply upwards to take the place of the injured main trunk. An upward tendency of all the main lateral branches, known as fastigiation, is common in some species, producing well-marked varieties, e.g., Oephalotaxus pedunculata var. fastigiata ; this fastigiate habit may arise as a sport on a tree with spreading branches. Another departure from the normal is that in which the juvenile or seedling form of shoot persists in the adult tree ; the numerous Coniferous

plants known as species of Betinospora are examples of this. The name Betinospora, therefore, does not stand for a true genus, but denotes persistent young forms of Juniperus, Thuja, Cupressus, &c., in which the small scaly leaves of ordinary species are replaced by the slender, needle-like leaves, which stand out more or less at right angles from the branches. The flat branchlets of Cupressus, Thuja (Arbor Vitae), Thnjopsis dolabrata (Japanese Arbor Vitae) are characteristic of certain types of Conifers ; in some cases the horizontal extension of the branches induces a dorsiventral structure. A characteristic feature of the genus Agathis {Dammard), the Kauri Pine of New Zealand, is the deciduous habit of the branches ; these become detached from the main trunk by a well-defined absciss-surface, which appears as a depressed circular scar on the stem.

With a few exceptions Conifers are evergreen, and retain the leaves for several years (10 years in Aranoaria imbricata, 8 to 10 in Ficea exeelsa, 5 in Taxus baccata ; in Finus the needles usually fall in October of their third year). The Larch L.eaves. (Larix) sheds its leaves in the autumn, in the Chinese Larch {Fseudolarix Kaempferi) the leaves turn a bright yellow colour

before falling. In the swamp Cypress {Taxodinm distichiim) the tree assumes a rich brown colour in the autumn, and sheds its leaves together with the branchlets which bear them ; deciduous branches occur also in some other species, e.g., Sequoia semper-virens (Redwood), Thuja occidentalis, &c. The leaves of Conifers are characterized by their small size ; e.g., the needle-form repre-sented by Finus, Cedrus, Larix, &c., the linear flat or angular leaves, appressed to the branches, of Thuja, Cupressus, Libocedrus, &c. The flat and comparatively broad leaves of Araucaria imbricata, A. Bidwillii, and some species of the southern genus Fodocaipus are traversed by several parallel veins, as are also the still larger leaves of Agathis, which may reach a length of several inches.

In addition to. the foliage-leaves several genera also possess scale-leaves of various kinds, represented by bud-scales in Finus, Ficea, &c., which frequently persist for a time at the base of a young shoot which has pushed its way through the yielding cap of protecting scales, while in some Conifers the bud-scales adhere together, and after being torn near the base are carried up by the growing axis as a thin brown cap. The Cypresses, Araucarias, and some other genera have no true bud-scales ; in some species,

e.g., Araucaria Bidwillii, the occurrence of small foliage-leaves, which have functioned as bud-scales, at intervals on the shoots affords a measure of seasonal growth. The occurrence of long and short shoots is a characteristic feature of many Conifers.

In Finus the needles occur in pairs, or in clusters of 3 or 5 at the apex of a small and inconspicuous short shoot of limited growth (spur), which is enclosed at its base by a few scale-leaves, and borne on a branch of unlimited growth in the axil of a scale-leaf. In the CaUfornian Finns monophylla each spur bears usually one needle, but two are not uncommon ; it would seem that rudiments of two needles are always produced, but, as a rule, only one develops into a needle. In Sciadopitys similar spurs occur, each bearing a single needle, which in its grooved surface and in the possession of a double vascular bundle bears traces of an origin from two needle-leaves. A peculiarity of these leaves is the inverse orientation of the vascular tissue ; each of the two veins has its phloem next the upper and the xylem towards the lower surface of the leaf ; this

unusual position of the xylem and phloem may he explained hy

regarding the needle of Sciadopitys as being composed of a pair of leaves borne on a short axillary shoot and fused by their margins (Fig. 15, A). Long andshort shoots occur also in OedrusauA Larix, but in these genera the spurs are longer and stouter, and are not shed with the leaves ; this kind of short shoot, by accelerated apical growth, often passes into the condition of a long shoot, on which the leaves are scattered and separated by comparatively long inter-nodes instead of being crowded into tufts such as are borne on the ends of the spurs. In the genus Phyllocladus (New Zealand, &c.) there are no green foliage-leaves, but in their place flattened branches (phylloclades) borne in the axils of small scale-leaves. The cotyle-dons are often two in number, but sometimes (e.g., Pinus) as many as fifteen ; these leaves are usually succeeded by foliage-leaves in the form of delicate spreading needles, and these primordial leaves are followed, sooner or later, by the adult type of leaf, except in Eetinosporas, which retain the juvenile foliage. In addition to the first foliage-leaves and the adult type of leaf, there are often pro-duced leaves which are intermediate both in shape and structure between the seedling and adult foliage. Dimorphism or heterophylly is fairly common. One of the best known examples is the Chinese

Juniper (J. Ohinensis) , in which branches with spinous leaves,longer and more spreading than the ordinary adult leaf, are often found associated with the normal type of branch. In some oases, e.g., Sequoia sempervirens, the fertile branches bear leaves which are less spreading than those on the vegetative shoots. Certain species of the southern hemisphere genus Dacrydium afford particularly striking instances of heterophylly, e.g., D. Eirkii of New Zealand, in which some branches bear small and appressed leaves, while in others the leaves are much longer and more spreading. A well-known fossil Conifer from Triassic strata — Voltzia heterophylla — also illustrates a marked dissimilarity in the leaves of the same shoot. The variation in leaf-form and the tendency of leaves to arrange them-selves in various ways on different branches of the same plant are features which it is important to bear in mind in the identification of fossil Conifers. In this connexion we may note the striking resemblance between some of the New Zealand Alpine Veronicas, e.g., Veronica Hectori, V. Cupressoides, &c. (also Polycladus cupressinus, a Composite), and some of the Cypresses and other Conifers with small appressed leaves. The long linear leaves of some species of Podocarpus, in which the lamina is traversed by

a single vein, recall the pinnae of Cycas; the branches of some Dacrydiums and other forms closely resemble those of Lycopods ; these superficial resemblances, both between different genera of Conifers and between Conifers and other plants, coupled with the usual occurrence of fossil coniferous twigs without cones attached to them, render the determination of extinct types a very unsatis-factoiy and frequently an impossible task.

A typical male flower consists of a central axis bearing numerous spirally-arranged sporophylls (stamens) , each of which consists of a slender stalk (filament) terminating distally in a more

Flowers. or less prominent knob or triangular scale, and bearing two or more pollen-sacs (microsporangia) on its lower surface. The pollen-grains of some genera (e.g., Pinus") are furnished with blad-der-like extensions of the outer wall, which serve as aids to wind-dispersal. The stamens of Araucaria and Agathis are peculiar in bearing several long and narrow free pollen-sacs ; these may be compared with the sporangiophores of the Horsetails {Equisetum) ; in Taxus (Yew) the filament is attached to the centre of a large circular distal expansion, which bears several pollen-sacs on its under surface. In the Conifers proper the female reproductive

organs have the form of cones, which may be styled flowers or inflorescences according to different interpretations of their morphology. In the Texaoeae the flowers have a simpler structure.

The female flowers of the Abietineae may be taken as representing a common type. A pine cone reaches maturity in two years ; a single year suffices for the full development in Larix and several other genera. The axis of the cone bears numerous spirally disposed flat scales (cone-scales), each of which, if examined in a young cone, is found to be double, and to consist of a lower and an upper portion. The latter is a thin flat scale bearing a median ridge or keel (e.g., Abies), on each side of which is situated an inverted ovule, consisting of a nucellus surrounded by a single integument. As the cone grows in size and becomes woody the lower half of the cone-scale, which we may call the carpellary scale, may remain small, and is so far outgrown by the upper half (seminiferous scale) that it is hardly recognizable in the mature cone.

In many species of Abies (e.g., Ahies pectinata, &c.) the ripe cone differs from those of Pinus, Picea, and Cedrus in the large size of the carpellary scales, which project as conspicuous thin appendages beyond the distal margins of the broader and more woody semini-

ferous scales ; the long carpellary scale is a prominent feature also in the cone of the Weymouth Pine (Pseudotsuga Douglasii). The female flowers (cones) vary considerably in size ; the largest are the more or less spherical cones of Araucaria — a single cone of A. imbricata may produce as many as 300 seeds, one seed to each fertile cone-scale— and the long pendent cones, 1 to 2 feet in length, of the Sugar Pine of California (Pinus Lambertiana) and other species. Smaller cones, less than an inch long, occur in the Larch, Athrotaxis (Tasmania), Fitzroya (Patagonia and Tasmania), &o. In the Taxodieaj and Araucarieae the cones are similar in appearance to those of the Abietineae, but they differ in the fact that the scales appear to be single, even in the young condition ; each cone-scale in a genus of theTaxodiin» (Sequoia, &o.) bears several seeds, while in the Arauoariinae (Araucaria and Agathis) each scale has one seed. The Cupressineae have cones composed of a few scales arranged in alternate whorls ; each scale bears two or more seeds, and shows no external sign of being composed of two distinct portions. In the Junipers the scales become fleshy as the seeds ripen, and the individual scales fuse together in the form of a berry. The female flowers of the Taxaceae assume another form ; in Mierocackrys

(Tasmania) the reproductive structures are spirally disposed, and form small globular cones made up of red fleshy scales, to each of which is attached a single ovule enclosed by an integument and partially invested by an arillus ; in Dacrydium the carpellary leaves are very similar to the foliage leaves— each bears one ovule with two integuments, the outer of which constitutes an arillus. Finally in the Yew, as a type of the family Taxeae, the ovules occur singly at the apex of a lateral branch, enclosed when ripe by a conspicuous red or yellow fleshy arillus, which serves as an attraction to animals, and thus aids in the dispersal of the seeds.

It is important to draw attention to some structural features exhibited by certain cone-scales, in which there is no external sign indicative of the presence of a carpellary and a seminiferous scale. In Araucaria GooTcii and some allied species each scale has a small pointed projection from its upper face near the distal end ; the scales of Cunninghamia (China) are characterized by a somewhat ragged membranous projection extending across the upper face between the seeds and the distal end of the scale ; in the scales of Athrotaxis (Tasmania) a prominent rounded ridge occupies a corresponding position. These projections and ridges may be homologous with the

seminiferous scale of the Pines, Firs, Cedars, &c. The simplest interpretation of the cone of the Abietineae is that which regards it as a flower consisting of an axis bearing Morpbo' several open carpels, which in the adult cone may be ^f^a°e very small or large and prominent, the scale bearing flower. the ovules being regarded as a placental outgrowth from the flat and open carpel. In Araucaria the cone-scale is regarded as consisting of a flat carpel, of which the placenta has not grown out into the scale-like structure. The seminiferous scale of Pinus, &c., is also spoken of sometimes as a ligular o\it-growth from the carpellary leaf. Kobert Brown was the first to give a clear description of the morphology of the Abietineous cone in which carpels bear naked ovules ; he recognized gymnospermy as an important distinguishing feature in Conifers as well as in Cycads. Another view is to regard the cone as an inflorescence, each carpellai-y scale being a bract bearing in its axil a shoot the axis of which has not been developed ; the seminiferous scale is believed to represent either a single leaf or a fused pair of leaves belonging to the partially suppressed axillary shoot. In 1869 van Tieghem laid stress on anatomical evidence as a key to the

morphology of the cone-scales ; he drew attention to the fact that the collateral vascular bundles of the seminiferous scale are inversely orientated as compared with those of the carpellary scale ; in the latter the xylem of each bundle is next the upper surface, while in the

Fig. 15. — Dia^ammatic treatment of : A, double needle of Sciadopitys (a, a, leaves ; 6, shoot ; JBr, bract) ; B, seminiferous scale as leaf of axillary shoot (6, shoot ; So, seminiferous scale ; Br, bract) ; C, seminiferous scale as ftised pair of leaves (P, Z", P, first, second, and third leaves; 6, shoot; 5r, bract) ; D, cone-scale of Araucaria (», nucellus ; i, Integument ; lo, xylem). (C and D after Worsdell.)

seminiferous scale the phloem occupies that position. The conclusion drawn from this was that the seminiferous scale (Fig. 15, B, Sc) is the first and only leaf of an axillary shoot (6) borne on that side of the shoot, the axis of which is suppressed, opposite the subtending bract (Fig. 16, A, B, C, Br) . Another view is to apply to the seminiferous scale an explanation similar to that suggested by von Mohl

in the case of the douhle needle of Sciadopitys, and to consider the seed-bearing scale as being made up of a pair of leaves (Fig. 1 5, A, uj, a)

of an axillary shoot (6) fused into one by their posterior margins (Fig. 15, A). The latter view receives support from abnormal cones in which carpellary scales subtend axillary shoots, of which the first two leaves (Fig. 15, C, P, l^) are often harder and brovmer than the others ; forms have been described transitional between axil-lary shoots, in which the leaves are separate, and others in which two of the leaves are more or less completely fused. In a young cone the seminiferous scale appears as a hump of tissue at the base or in the axil of the carpellary scale, but Celakovsky, a strong sup-porter of the axillary bud theory, attaches little or no importance to this kind of evidence, regarding the present manner of develop-ment as being merely an example of a short cut adopted in the course of evolution, and replacing the original production of a branch in the axil of each carpellary scale. Eichler, one of the chief supporters of the simpler view, does not recognize in the inverse orientation of the vascular bundles an argument in support of the axillary bud theory, but points out that the seminiferous scale, being an outgrowth from the surface of the carpellary scale, would, like outgrowths from an ordinary leaf, naturally have its bundles inversely orientated. In such cone-scales as show little or

no external indication of being double in origin, e.g., Arauoaria (Fig. 15, D), Sequoia, &c., there are always two sets of bundles ; the upper set, having the phloem uppermost, as in the seminiferous scale of Abies or Pinus, are regarded as belonging to the outgrowth from the carpellary scale and specially developed to supply the ovules. Monstrous cones are fairly common ; these in some instances lend support to the axillary bud theory, and it has been said that this theory owes its existence to evidence furnished by abnormal cones. It is difiBcult to estimate the value of abnormalities as evidence bearing on morphological interpretation ; the chief danger lies perhaps in attaching undue weight to them, but there is also a risk of minimizing their importance. Monstrosities at least demonstrate possible lines of development, but when the abnormal forms of growth in various directions are fairly evenly balanced, trustworthy deductions become difficult. The occurrence of buds in the axils of carpellary scales may, however, simply mean that buds, which are usually undeveloped in the axils of sporophylls, occasionally afford evidence of their existence. Some monstrous cones lend no support to the axillary bud theory. In Larix the axis

of the cone often continues its growth ; similarly in Cephalotazus the cones are often proliferous. (In rare cases the proliferated portion produces male flowers in the leaf-axils.) In Larix the carpellary scale may become leafy, and the semi-niferous scale may disappear. Androgynous cones may be produced, as in the cone of Pinus rigida (Fig. 16) , in which the lower part bears stamens and the upper portion carpellary and seminiferous scales. An interesting case has been figured by Masters, in which scales of a cone of Oupressus Lawsoniana bear ovules on the upper surface and stamens on the lower face. One argument that has been adduced in support of the axillary bud theory is derived from the Palaeozoic type Gordaites, in which each ovule occurs on an axis borne in the axil of a bract. The whole question is still unsolved, and perhaps insoluble. Gordaites is an extinct type which in certain respects resembles Ginkgo, Cycads, and the Araucariese, but its agreement with true Conifers

is probably too remote to justify our attributing much weight to the bearing of the morphology of its female flowers on the interpretation of that of the Coniferse. The greater simplicity of the Eichler theory may prejudice us in its favour, but, on the other hand, the arguments advanced in favour of the axillary bud theories are perhaps not sufficiently cogent to lead us to accept an explanation based chiefly on the uncertain evidence of monstrosities.

A pollen-grain when first formed from its mother-ceU consists of a single cell ; in this condition it may be carried to the nucellus of the ovule (e.g., Taxus, Gupressus, &o.), or more usually Micro- (^Pinus, Larix, &c.) it reaches maturity before the dehis- sporesaad ggjjQg gf the microsporangium. The nucleus of the mega- microspore divides and gives rise to a small cell within spores. ^^^ large cell, a second small cell is then produced ; this is the structure of the ripe pollen-grain in some Conifers (Taxus, &c.). The large cell grows out as a pollen-tube; the second of the two small cells (body-cell) wanders into the tube, followed by the nucleus of the first small cell (stalk-cell). In Taxus the body-cell eventually divides into two, in which the products of division are of unequal size, the larger constituting the

male generative cell, which fuses with the nucleus of the egg-cell. In Juniperus the products of division of the body-cell are equal and both function as male generative cells. In the Abietinese cell-formation in the pollen-grain is carried farther. Three small cells

Fig. 16.— Abnormal cone of Pinus ■rigida. (After Masters.)

occur inside the cavity of the microspore ; two of them collapse and the third divides into two, forming a stalk-cell and a larger body-cell. The latter ultimately divides in the apex of the pollen-tube into two non-motile generative cells. The precise method of fertilization has been followed by V. H. Blaokman, who also succeeded in showing that the nuclei of the sporophyte generation in Pinus contain twice as many chromosomes as the nuclei of the gametophyte. The ovule is usually surrounded by one integument, which projects beyond the tip of the nucellus as a wide-open lobed funnel, which at the time of pollination folds inwards, and so assists in bringing the pollen-grains on to the nucellus. In some Conifers (e.g., Taxus, Cephalotazus, Dacrydium, &c.) the ordinary

integument is partially enclosed by an arillus or second integument. It is held by some botanists (Celakovsky) that the seminiferous scale of the Abietineas is homologous with the arillus or second integument of the Taxaceae, but this view is too strained to gain general acceptance. In some species of Araucaria the nucellus itself projects beyond the open micropyle and receives the poUen-grains direct. During the growth of the cell which forms the megaspore the greater part of the nucellus is absorbed, except the apical portion, which persists as a cone above the megaspore ; the partial disorganization of some of the cells in the centre of the nucellar cone forms an irregular cavity, which may be compared with the larger pollen-chamber of Ginkgo and the Cycads. In each ovule one megaspore comes to maturity, but, exceptionally, two may be present (e.g., Pinus sylvestris). The megaspore becomes filled with tissue (prothallus), and from some of the superficial cells archegonia are produced, usually three to five in number, but in rare cases ten to twenty may be present. An archegonium consisting of a large oval egg-ceU surmounted by a short neck composed of one or more tiers of cells, six to eight cells in each tier. Before fertilization the nucleus of the egg-cell divides and cuts off a ventral

canal-cell ; this cell may represent a second egg-cell. The egg-cells of the archegonia may be in lateral contact {e.g., Cupressineae) or separated from one another by a few cells of the prothallus, each ovum being immediately surrounded by a layer of cells distinguished by their granular contents and large nuclei. During the development of the egg-cell food material is transferred from these cells through the pitted wall of the ovum. The tissue at the apex of the megaspore grows slightly above the level of the archegonia, so that the latter come to lie in a shallow depression. In the process of fertilization the two male generative nuclei, accompanied by the pollen-tube nucleu's and that of the stalk-cell, pass through an open pit at the apex of the pollen-tube into the protoplasm of the ovum. After fertilization the nucleus of the egg divides, the first stages of karyokinesis being apparent even before complete fusion of the male and female nuclei has occurred. The result of this is the production of four nuclei, which eventually take up a position at the bottom of the ovum and become separated from one another by vertical cell-walls ; these nuclei divide again, and finally three tiers of cells are produced, four in each tier. In the Abietineae the cells of the middle tier elongate and push the

lowest tier deeper into the endosperm ; the cells of the bottom tier may remain in lateral contact and produce together one embryo, or they may separate (Pinus, Juniperus, &c.) and form four potential embryos. The ripe albuminous seed contains a single embryo with two or more cotyledons ; in some species of Araucaria (sect. Colymbea') the two cotyledons are partially fused, as in Ginkgo. The seeds of many Conifers are provided with large thin wings, consisting in some genera (e.g., Pinus) of the upper cell layers of the seminiferous scale, which have become detached and adhere loosely to the seed-coat as a thin membrane ; this loose attachment may be of use to the seeds when they are blown against the branches of trees, in enabling them to fall away from the wing and drop to the ground. The seeds of some genera depend on animals for dispersal, the carpellary scale (Microcachrys) or the outer integument being brightly coloured and attractive. In some Abietineae (e.g. , Pinus and Picea) — in which the cone-scales persist for some time after the seeds are ripe — the cones hang down and so facilitate the fall of the seeds ; in Gedrus, Araucaria, and Abies the scales become detached and fall with the seeds, leaving the bare vertical axis of the cone on the tree. In all cases, except some species of Araucaria

(sect. Golymbea) the germination is epigean. The seedling plants of some Conifers (e.g., Araucaria imbricata) are characterized by a carrot^shaped hypocotyl, which doubtless serves as a food-reservoir. The roots of many Conifers possess a narrow band of primary xylem-traoheids with a group of narrow spiral protoxylem-elements at each end (diarch). A striking feature in the roots of several genera, excluding the Abietineae, is the occur- '^""'"y-rence of thick and somewhat irregular bands of thickening on the cell walls of the cortical layer next to the endodermis. These bands, which may serve to strengthen the central cylinder, have been compared with the netting surrounding the delicate wall of an inflated balloon. It is not always e&sf to distinguish a root from a stem ; in some cases (e.g., Sequoia) the primary tetrarch struc-ture is easily identified in tlie centre of an old root, but in other

cases the primary elements are very difficult to recognize. Tlie sudden termination of the secondary tracheids against the pith-cells may afford evidence of root-structure as distinct from stem-structure, in which the radial rows of secondary tracheids pass into

the irregularly-arranged primary elements next the pith. The annual rings in a root are often less clearly marked than in the stem, and the xylem-elements are frequently larger and thinner. The primary vascular bundles in a young conifer stem are collateral, and, like those of a Dicotyledon, they are arranged in a circle round a central pith and enclosed by a common endodermis. It is in the nature of the secondary xylemthat the Coniferales are most readily distinguished from the Dicotyledons and Cycadacese ; the wood is homogeneous in structure, consisting almost entirely of tracheids with circular or polygonal bordered pits on the radial walls, more particularly in the late summer wood. In many genera xylem-parencliyma is present, but never in great abundance. A few Dicotyledons, e.g.,Drimys (Magnoliacese), closely resemble Conifers in the homogeneous character of the wood, but in most cases the presence of large spring vessels, wood-fibres, and abundant parenchyma affords an obvious distinguishing feature.

The abundance of petrified coniferous wood in rocks of various ages has led many botanists to investigate the structure of modern genera with a view to determining how far anatomical characters may be used as evidence of generic distinctions. There are a few

well-marked types of wood which serve as convenient standards of comparison, but these cannot be used except in a few cases to distinguish individual genera. The genus Finns serves as an illustration of wood of a distinct type characterized by the absence of xylem-parenchyma, except such as is associated with the numerous resin-canals that occur abundantly in the wood, cortex, and medullary rays ; the medullary rays are composed of parenchyma and of horizontal tracheids with irregular ingrowths from their walls. In a radial section of a Pine stem each ray is seen to consist in the median part of a few rows of parenchymatous cells with large oval simple pits in their walls, accompanied above and below by horizontal tracheids with bordered pits. The pits in the radial walls of the ordinary xylem-tracheids occur in a single row or in a double row, of which the pits are not in contact, and those of the two rows are placed on the same level. The medullary rays usually consist of a single tier of cells, but in the Finns type of wood broader medullary rays also occur and are traversed by horizontal resin-canals. In the wood of Cupressus, Oedrus, Abies, and several other genera, parenchymatous cells occur in association with the xylem-tracheids and take the place of the resin-canals of other

types. In the Araucarian type of wood {Araucaria and Agathis) the bordered pits, which occur in two or three rows on the radial walls of the tracheids, are in mutual contact and polygonal in shape, the pits of the different rows are alternate and not on the same level ; in this type of wood the annual rings are often much less distinct than in Cupressus, Finns, and other genera. In Taxus, Torreya (North America), and Cephalotaxus, the absence of resin-canals and the presence of spiral thickening-bands in the tracheids constitute well-marked characteristics. An examination of the structure of the wood of branches, stems, and roots of the same species or individual usually reveals a fairly wide variation in some of the characters, such as the abundance and size of the medullary rays, the size and arrangement of pits, the presence of wood-parenchyma — characters to which undue importance has often been attached in systematic anatomical work. The phloem consists of sieve-tiibes, with pitted areas on the lateral as well as on the inclined terminal walls, phloem-parenchyma, and, in some genera, fibres. In the Abietineae the phloem consists of parenchyma and sieve-tubes only, but in most other forms tangential rows of fibres occur in regular alternation with the parenchyma

and sieve-tubes. The characteristic companion-cells of Angio-sperms are represented by phloem-parenchyma cells with albumi-nous contents ; other parenchymatous elements of the bast contain starch or crystals of calcium oxalate. When tracheids occur in the medullary rays of the xylem these are replaced in the phloem-region by irregular parenchymatous cells known as albuminous cells. Eesin-canals, which occur abundantly in the xylem, phloem, or cortex, are not found in the wood of the Yew. Cephalotaxus (Taxese) is also peculiar in having resin-canals in the pith (cf. Ginkgo). One form of Cephalotaxus is characterized by the presence of short tracheids in the pith, in shape like ordinary parenchyma, but in the possession of bordered pits and lignified walls agreeing with ordinary xylem-tracheids ; it is probable that these short tracheids serve as reservoirs for storing rather than for conducting water. The vascular bundle entering the stem from a leaf with a single vein passes by a more or less direct course into the central cylinder of the stem, and does not assume the girdle-like form characteristic of the cycadean leaf-trace. In species of which the leaves have more than one vein (e.g., Araucaria imbricata, &c.) the leaf-trace leaves the stere of the stem as a single bundle which

splits up into several strands in its course through the cortex. The leaf-trace in the Coniferales is simple in its course through the stem, differing in this respect from the double leaf ~~trace of Ginkgo. The an~~ atomical characters of leaves most useful for diagnostic purposes are the position of the stomata, the presence and arrangement of resin-canals, the structure of the mesophyll and vascular bundles. The presence of hypodermal fibres is another feature worthy "of note, but the occurrence of these elements is too closely connected with external conditions to be of much systematic value. A pine needle grown in continuous light differs from one grown under ordinary conditions in the absence of hypodermal fibres, in the absence of the characteristic infoldings of the mesophyll cell-walls, in the smaller size of the resin-canals, &c. The endodermis in Finns, Picea, and many other genera is usually a well-defined layer of cells enclosing the vascular bundles, and separated from them by a tissue consisting in part of ordinary parenchyma and to some extent of isodiametric tracheids ; but this tissue, usually spoken of as the pericy cle, is in direct continuity with other stem-tissues as well as the pericycle. The occurrence of short tracheids in close proximity to the veins is a characteristic of coniferous leaves ; these elements assume two distinct

forms — (1) the short isodiametric tracheids (transfusion-tracheids) closely associated with the veins ; (2) longer tracheids extending across the mesophyll at right angles to the veins, and no doubt functioning as representatives of lateral veins. It has been suggested that transfusion-tracheids represent, in part at least, the centripetal xylem, which forms a distinctive feature of cycadean leaf -bundles ; these short tracheids form conspicuous groups laterally attached to the veins in Cunninghamia, abundantly represented in a similar position in the leaves of Sequoia, and scattered through the so-called pericycle in Finns, Picea, &c. It is of interest to note the occurrence of precisely similar elements in the mesophyll of Lepidodendron leaves. An anatomical peculiarity in the veins of Finns and several other genera is the continuity of the medullary rays, which extend as continuous plates from one end of the leaf to the other. The mesophyll of Finns and Cedrns is characterized by its homogeneous character and by the presence of infoldings of the cell-walls. In many leaves, e.g., Abies, Tsuga, Larix, &c., the mesophyll is heterogeneous, consisting of palisade and spongy parenchyma. In the leaves of Araucaria imbricata, in which palisade-tissue occurs in both the upper and lower part of the mesophyll, the resin-canals

are placed between the veins ; in some species of Fodocarpns (sect. Nageia) a canal occurs below each vein ; in Tsuga, Torreya, Cepha-lotaxus, Sequoia, &c. , a single canal occurs below the midrib ; in Larix, Abies, &c., two canals run through the leaf parallel to the margins. The stomata are frequently arranged in rows, their posi-tion being marked by two white bands of wax on the leaf-surface. The chief home of the Coniferales is in the northern hemisphere, where certain species occasionally extend beyond the Arctic circle and penetrate beyond the northern limit of dicotyle-donous trees. Wide areas are often exclusively occu- Dlstrlbu-pied by Conifers, which give the landscape a sombre “”’ aspect, suggesting a comparison with the forest vegetation of the Coal period. South of the tree-limit a belt of Conifers stretches across North Europe, Siberia, and Canada. In Northern Europe this belt is characterized by such species as Ficea excelsa (Spruce), which extends south to the mountains of the Mediterranean region ; Finns sylvestris (Scottish Fir), reaching from the far north to Western Spain, Persia, and Asia Minor ; Juniperus communis, &c. In North Siberia Finns Cembra (Cembra or AroUa Pine) has a wide range ; also Abies Sibirica (Siberian Silver Eir), Larix

Sibirioa, and Juniperus sabina (Savin). In the North American area Ficea alba, F. nigra, Larix Americana, Abies balsamea (Balsam Fir), Thuja Canadensis (Hemlock Spruce), Fitius Strobns (Weymouth Pine), Thuja occidentalis (White Cedar), Taxus Canadensis are characteristic species. In the Mediterranean region occur Cupressus sempcrvirens, Finns Finea (Stone Pine), species of Juniper, Cedrns atlantica, C. Libani, Callitris quadri-valvis, Finns montana, &c. Several Conifers of economic import-ance are abundant on the Atlantic side of North America — Juni-perus Virginiana (Red Cedar, used in the manufacture of lead pencils and extending as far south as Florida), Taxodium distichum (Swamp Cypress), Finns rigida (Pitch Pine), P. mitis (Yellow Pine), F. tceda, F. palustris, &c. On the west side of the American continent Conifers play a still more striking role ; among them are Chamoicyparis nutkaensis, Ficea sitchensis, Libocedrus decnrrens, Fseudotsuga Douglasii (Douglas Fir), Sequoia sempennrens, S. gigantea (the only two surviving species of this generic type are now confined to a few localities in California, but were formerly widely spread in Europe and elsewhere), Finns CouUeri, F. Lam-bertiana, &o. Farther south, a few representatives of such genera

as Abies, Cupressus, Pin ns, and Juniper are found in the Mexican Highlands, tropical America, and the West Indies. In the Far East Conifers are richly represented ; among them occur Finns densiflora, Cryptomeria japonica, Cephalotaxns, species of Abies, Larix, Thujopsis, Sciadopitys verticillata, Pseudolarix Kaempfcri, &c. In the Himalaya occur Cedrus deodara, Taxus, species of Cupressus, Finns excelsa, Abies Webbiana, &c. Libocedrus tetra-gona, Fitzroya patagonica, Araucaria brasiliensis, A. imbricata.

Saxegothcea, and others are met with in the Andes and other regions in South America. Athrolaxis and Microcachrys are characteristic Australian types. Fhyllocladus occurs also in New Zealand, and species of Dacrydium, Araucaria, Agathis, and Fodocarpus are represented in Australia, New Zealand, and the Malay regions.

Gnetales. — These are trees or shrubs with simple leaves. The flowers are dioecious, rarely monoecious, provided with one or two perianths. The wood is characterized hy the presence of vessels in addition to tracheids. There are no resin-canals. The three existing genera usually spoken of as members of the Gnetales differ

from one another more than is consistent with their inclusion In a single family ; we may therefore better express their diverse characters by regarding them as types of three separate families — (1) Ephedroidex, genus Ephedra; (2) Wel'witseliioide(B, genus Welwitschia ; (3) Onetoidece, genus Onetum. Our knowledge of the Gnetales leaves much to be desired, but such facts as we possess would seem to indicate that this group is of special import-ance as foreshadowing, more than any other Gymnosperms, the Angiospermous type. In the more heterogeneous structure of the wood and in the possession of true vessels the Gnetales agree closely with the higher Flowering Plants. It is of interest to note that the leaves of Gnetum, while typically Dicotyledonous in appearance, possess a Gymnospermous character in the continuous and plate-like medullary rays of their vascular bundles. The presence of a perianth is a feature suggestive of an approach to the floral struc-ture of Angiosperms ; the prolongation of the integument furnishes the flowers with a substitute for a stigma and style. The genus Ephedra, with its prothallus and archegonia, which are similar to those of other Gymnosperms, may be safely regarded as the most primitive of the Gnetales. In Welwitschia also the megaspore is

filled with prothallus-tissue, but single egg-cells take the place of archegonia. In certain species of Qnetuin described by Karsten the megaspore contains a peripheral layer of protoplasm, in which scattered nuclei represent the female reproductive cells ; in Gnetum Gnemon a similar state of things exists in the upper half of the megaspore, while the lower half agrees with the megaspore of Welwitschia in being full of prothallus-tissue, which serves merely as a reservoir of food. Lotsy has described the occurrence of special cells at the apex of the prothallus of Gnetum Gnemon, which he regards as imperfect archegonia (Fig. 17, C, a); he suggests they may represent vestigial structures pointing back to some ancestral form beyond the limits of the present group. The Gnetales probably had a separate origin from the other Gymnosperms ; they carry us nearer to the Angiosperms, but we have as yet no satisfactory evidence that they represent a stage in the direct line of Angiospermio evolution. It is not improbable that the three genera of this ancient phylum survive as types of a blindly-ending branch of the Gymnosperms ; but be that as it may, it is in the Gnetales more than in any other Gymnosperms that we find features which help us to obtain a dim prospect of the lines along which the

Angiosperms may have been evolved.

Ephedra. — This genus is the only member of the Gnetales represented in Europe. Its species, which are characteristic of warm temperate latitudes, are usually much-branched shrubs. The finer branches are green, and bear a close resemblance to the stems of Equisetum and to the slender twigs of Casuarina ; the surface of the long internodes is marked by fine longitudinal ribs, and at the nodes are borne pairs of inconspicuous scale-leaves. The flowers are small, and borne on axillary shoots. A single male flower consists of an axis enclosed at the base by an inconspicuous perianth formed of two concrescent leaves and terminating in two, or as many as eight, shortly stalked or sessile anthers. The female flower is enveloped in a closely fitting sac-like investment, which must be regarded as a perianth ; within this is an orthotropous ovule surrounded by a single integument prolonged upwards as a beak-like micropyle. The flower may be described as a bud bearing a pair of leaves which become fused and constitute a perianth, the apex of the shoot forming an ovule. In function the perianth may be compared with a unilocular ovary containing a single ovule ; the projecting integument, which at the time of

pollination secretes a drop of liquid, serves the same purpose as the style and stigma of an angiosperm. The megaspore is filled with tissue as in typical Gymnosperms, and from some of the superficial cells 3 to 5 archegonia are developed, characterized by long multi-cellular necks. The archegonia are separated from one another, as in Pinus, by some of the prothallus-tissue, and the cells next the egg-cells (tapetal layer) contribute food-material to their development. After fertilization, some of the uppermost bracts below each flower become red and fleshy ; the perianth develops into a woody shell, while the integument remains membranous. In some species of Ephedra, e.g., E. altissima, the fertilized eggs grow into tubular proembryos, from the tip of each of which embryos begin to be developed, but one only comes to maturity. In Ephedra helvetica, as described by Jaccard, no proembryo or suspensor is formed ; but the most vigorous fertilized egg, after undergoing several divisions, becomes attached to a tissue, termed the columella, which serves the purpose of a primary suspensor ; the columella appears to be formed by the lignification of certain cells in the central region of the embryo-sac. At a later stage some of the cells in the upper (micropylar) end of the embryo divide

and undergo considerable elongation, serving the purpose of a secondary suspensor. The secondary wood of Ephedra consists of tracheids, vessels, and parenchyma ; the vessels are characterized by their wide lumen and by the large simple or slightly-bordered pits on their oblique end-walls.

Gnetum. — This genus is represented by several species, most of which are climbing plants, both in tropical America and in warm regions of the Old World. The leaves, which are borne in pairs at the tumid nodes, are oval in form and have a Dicotyledonous type of venation. The male and female inflorescences have the form of simple or paniculate spikes. The spike of an inflorescence bears whorls of flowers at each node in the axils of concrescent bracts accompanied by numerous sterile hairs (paraphyses) ; in a male inflorescence numerous flowers occur at each node, while in a female inflorescence the number of flowers at each node is much smaller. A male flower consists of a single angular perianth, through the open apex of which the fiower-axis projects as a slender column terminating in two anthers. The female fiowers, which

Fig. 17. — Gnetwm Gnemon. A, female flower («, nucellus ; pc, pollen-chamber; i, integument; p' , inner perianth; p", outer perianth).

B, C, megaspore \a, imperfect archegonia ; e, partially developed megaspore ; Jp, fertile half; S, sterile half ; pt, polJen-tnbe ; s, zygote ; s', prothallus). (After Lotsy.)

are more complex in structure, are of two types, complete and in-complete ; the latter occur in association with male flowers in a male inflorescence. A complete female flower consists of a nucellus (Fig. 17, A, m), surrounded by a single integument (Fig. 17, A, i), prolonged upwards as a narrow tube and succeeded by an inner and an outer perianth (Fig. 17, A, p' and js"). The whole flower may be looked upon as an adventitious bud bearing two pairs of leaves ; each pair becomes concrescent and forms a perianth, the apex of the shoot being converted into an orthotropous ovule.

The incomplete female flowers are characterized by the almost complete suppression of the inner perianth. Several embryo-sacs (megaspores) are present in the nucellus of a young ovule, but one only attains full size, the smaller and partially developed mega-spores (Fig. 17, B and C, e) being usually found in close associ-ation with the surviving and fully-grown megaspore. In Gnetum Gnemon, as described by Lotsy, a mature embryo-sao contains in the upper part (micropylar end) a large central vacuole and a

peripheral lay^ of protoplasm, including several nuclei, which take the place of the archegonia of Ephedra; the lower part (chalazal end) of the embryo-sac, separated from the upper by a constriction, is full of parenchyma, which may be regarded as a prothallus. The upper part of the megaspore may be spoken of as the fertile half (Fig. 17, B and C, F), and the lower part, which serves only as food-reservoir for the growing embryo, may be termed the sterile half (Fig. 17, B and C, iS). At the time of pollination the long tubular integument secretes a drop of fluid at its apex, which holds the pollen-grains, brought by the wind, or possibly to some extent by insect agency, and by evaporation these are drawn on to the top of the nucellus, where partial disorganization of the cells has given rise to an irregular pollen-chamber (Fig. 17, A, jjc). The pollen-tube, containing two generative and one vegetative nucleus, pierces the wall of the megaspore and then becomes swollen (Fig. 17, B and C, pt) ; finally the two generative nuclei pass out of the tube and fuse with two of the nuclei in the fertile half of the megaspore. As the result of fertilization, the fertilized nuclei of the megaspore become surrounded by a cell-wall, and constitute zygotes, which may attach themselves either to the wall

of the megaspore or to the end of a poUen-tuhe (Fig. 17, C, 0 and a’) ; they then grow into long tubes or proembryos, which make their way towards the prothallus (C, 2’), and eventually embryos are formed from the ends of the proembryo tubes. One embryo only comes to maturity. The embryo of Gnetum forms an out-growth from the hypocotyl, which serves as a feeder and draws nourishment from the prothallus. The fleshy outer portion of the seed is formed from the outer perianth, the woody shell being derived from the inner perianth. The climbing species of Gnetum are characterized by the production of several concentric cylinders of secondary wood and bast, the additional cambium-rings being products of the perioycle, as in Cycas and Macrozamia. The structure of the wood agrees in the main with that of Ephedra.

Welwitschia. — This is by far the most remarkable member of the Gnetales, both as regards habit and the form of its flowers. In a supplement to the systematic work of Engler and Prantl the well-known name Welwitschia, instituted by Hooker in 1864 in honour of Welwitsoh, the discoverer of the plant, is super-

seded by that of Tumhoa, originally suggested by Welwitsoh ; but the more familiar name will, it is hoped, continue in general use as the recognized generic designation. Welwitschia is confined to certain localities in Damaraland on the west coast of tropical South Africa. A well-grown plant projects less than a foot above the surface of the ground ; the stem, which may have a circumference of more than 12 feet, terminates in a depressed crown resembling a circular table with a median groove across the centre and prominent broad ridges concentric with the margin. The thick tuberous stem becomes rapidly narrower, and passes gradually downwards Into a tap-root. A pair of small strap-shaped leaves succeed the two cotyledons of the seedling, and persist as the only leaves during the life of the plant ; they retain the power of growth in their basal portion, which is sunk in a narrow groove near the edge of the crown, and the tough lamina, 6 feet in length, becomes split into narrow strap-shaped qr thong-like strips which trail on the ground. Numerous circular pits occur on the concentric ridges of the depressed and wrinkled crown, marking the position of former inflorescences borne in the leaf-axil at different stages in the growth of the plant. An Inflorescence has the form of a

dichotomously-branched cyme bearing small erect cones ; those containing the female flowers attain the size of a flr-oone, and are scarlet in colour. Each cone consists of an axis, on which numerous broad and thin bracts are arranged in regular rows ; in the axil of each bract occurs a single flower ; a male flower is enclosed by two opposite pairs of leaves, forming a perianth surrounding a central sterile ovule encircled by a ring of stamens united below, but free distally as short filaments, each of which terminates in a trilocular anther. The integument of the sterile ovule is prolonged above the nucellus as a spirally -twisted tube expanded at its apex into a flat stigma-like organ. A complete and functional female flower consists of a single ovule with two integuments, the inner of which is prolonged into a narrow tubular micropyle, like that in the flower of Gnetum. The megaspore of Welwitschia is filled with a prothallus-tissue before fertilization, and some of the prothallus-cells function as egg-cells ; these grow upwards as long tubes into the apical region of the nucellus, where they come into contact with the pollen-tubes. After the egg-cells have been fertilized by the non-motile male cells they grow into tubular proembryos, producing terminal embryos. The stem is traversed by numerous

collateral bundles, which have a limited growth, and are constantly replaced by new bundles developed from strands of secondary meristem. One of the best-known anatomical characteristics of the genus is the occurrence of numerous spindle-shaped or branched fibres with enormously-thickened walls studded with crystals of calcium oxalate.

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Cympie, goldfield municipality, in the county of March, Queensland, Australia, 107 miles north of Brisbane, with -which it is connected by rail, and 61 miles south by rail from Maryborough. Numerous gold mines are worked in the district. The total value of the gold output to the end of 1899 amounted to £8,400,000. It also abounds in copper, silver, antimony, cinnabar, bismuth, and nickel. Extensive coal beds, as yet unworked, lie 40 miles to the north at Miva. Population (1871),

6800 ; (1901), 11,959.

" Cyp." See Maetel, Comtesse de.

Gyroscope and Gyrostat. — The Gyroscope and Gyrostat are scientific models or instruments designed to illustrate experimentally the dynamics of rotating bodies, such as the spinning top, hoop, and bicycle, and also the precession of the equinoxes.

The instruments may be distinguished by calling the one a Gyroscope when the rotating wheel or disc is mounted in gimbals so that the principal axis of rotation always passes through a fixed point "y°^"'P^- (Eig. 1). It can be made to imitate the motion of a spinning top of which the point is placed in a smooth agate cup, as in Maxwell's Dynamical Top (T'igs. 2, 3) (Collected Works, i. p. 248). A bicycle wheel, with one of the ball bearings placed in a cup, can also be made to serve.

The Gyrostat is an instrument designed by Lord Kelvin (Natural Philosophy, § 345) to illustrate the more complicated state of motion of a spinning body when free to wander about on a horizontal plane, like "'^*-

a top spun on the pavement, or a hoop or bicycle on the road. It consists essentially of a massive fly-wheel concealed in a metal casing, and its behaviour on a table, or with various modes of suspension or support, serves to illustrate the curious reversal of the ordinary laws of statical equilibrium due to the gyrostatic domination of the interior invisible fly-wheel, when rotated rapidly (Fig. 4).

The toy shown in Figs. 5 and 6, which can be bought for one shilling, is acting as a gyroscope in Fig. 5 and a gyrostat in Fig. 6.

The Gyroscope, as represented in Fig. 2 by Maxwell's .Dynamical Top, is provided with screws by which the centre of gravity can be brought into coincidence with the point of support. It can then be used to illustrate Poinsot's theory of the motion of a body under no forces, the gyroscope being made kinetically unsymmetrical by a setting of the screws. The discussion of this movement is required for Jacobi's theorems on the allied motion of a top and of a body under no forces (Poinsot, TMorie nouveUe de la rotation des corps, Paris.

1867; Jacobi, Werke, ii., Note B, p. 476).

GTEOSCOPE AND GYEOSTAT

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Kg. 1.

Fig. 2.

^ -^

Mg. 3.

Fig. 4.

Fig. 5.

Fig- 6.

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

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GYROSCOPE AND GYROSTAT

To imitate the movement of the top the centre of

gravity G is displaced from the point of support O so as to

give a preponderance ; and the complete solution of the

dynamical problem can now be carried out by single-valued elliptic functions, but only in the case of the syrrir-metrical top, as it is called when OG is a ^^'?', , principal axis of kinetic symmetry such that the ^op. moment of inertia about any axis OA at right angles to OG is the same. If this condition is not satisfied t]ie top is called the general or unsymmetrical top, and the motion is complicated to such an extent as to have baffled the powers of mathematics, except Unsym- ^^^ some special cases, discussed by Weierstrass, ^op. Kowalevski, Hess, Jukovsky, and others, princi-pally the Russian mathematicians.

The motion of the Gyrostat, even if kinetically sym-metrical, introduces analytical complications similar to those of the general unsymmetrical top, and here, too, we must await mathematical progress for a complete solution. Contrasted mathematically, the motion of the Gyro-scope, if symmetrical, can be expressed completely by the Elliptic Functions, but the Gyrostat and unsymmetrical top require functions of a higher order of complexity for

a complete solution.

1. The physical constants of a given symmetrical top, expressed in o.G.s. units, which are employed in the subsequent formulae, are denoted by M, h, 0, and A. M is the weight in grammes (g) as given by the number of gramme weights which equilibrate the top when weighed in a balance ; h is the distance OG in centi-metres (cm.) between G the centre of gravity and 0 the point of support, and Mfe may be called the preponderance ; thus Mgh (dyne-cm.) is the moment of gravity about 0 when the axis OG is horizontal, Mgh sin ff being the moment when the axis OG makes an angle S with the vertical, and g=9Sl (cm./s^) on the average ; C is the moment of inertia of the top about OG, and A about any axis through 0 at right angles to OG, both measured in g-cm.^.

To measure A experimentally, swing the top freely about 0 in small plane oscillations, and determine the length, I cm., of the equivalent simple pendulum ; then

(1) z=4' ™”-

Next make the top, or this simple pendulum, perform small conical revolutions, nearly coincident with the downward vertical

position of equilibrium, and measure n, the mean angular velocity of the conical pendulum in radians / second ; then

(2) ^'=hnr'

and m/27r is the number of revolutions per second, 27r/m is the period of a revolution, in seconds.

2. In the popular explanation of the steady movement of the top at a constant inclination to the vertical, depending on the composition of angular velocities, such as given in Perry's Steady Spinning Tops, or Worthington's Dynamics of Motation, mo

"■ generating an angular velocity about an axis OB perpendicular to the vertical plane GOG through the axis of the top OC ; and this angular velocity, compounded with the resultant angular velocity about an axis 01, nearly coincident with 00, causes the axes 01 and OC to keep taking up a new position by moving at right angles to the plane GOO, at a constant precessional angular velocity, say yn rad. /sec. , round the vertical OG (Fig. 7). If, however, the axis 00 is prevented from taking up this processional velocity, the top at once falls down ; thence all the in^^enious attempts — for instance, in the swinging cabin of the

Bessemer ship — to utilize the Gyroscope as a mechanical directive agency have always resulted in failure {Engineer, October 1871). An experimental veriiicatiou can be carried out with the Gyroscope in Fig. 1 ; so long as the vertical spindle is free to rotate in its socket, the rapidly rotating wheel will resist the impulse of tapping on the gimbal by moving to one side ; but when the pinch screw prevents the rotation of tlie vertical spindle in the massive pedestal, this resistance to the tapping at once disappears, provided the friction of the table prevents the movement of the pedestal.

*Familiar instances of the same principles are observable in the movement of a hoop, or in the steering of a bicycle ; it is essential that the handles of the bicycle should be free to rotate to secure *.he stability of the movement.*

The bicycle wheel, employed as a spinning top, can also be carried round a room held by the ball bearings, and will thus, wlien rotated rapidly, convey a distinct muscular impression of resistance to change of direction.

3. A demonstration, depending on the elementary Elementary principles of Dynamics, of the exact conditions required demonstra-

for the axis 00 of a spinning top to spin steadily at Hon ot ibe

a constant inclination B to the vertical OG, is given condition

here before proceeding to the more complicated ques- ot steady

tion of the general motion, when B, the inclination of motion.

the axis, is varying by nutation.

It is a fundamental principle in Dynamics that if OH is a vector

representing to scale the angular momentum of a system, and if

Og is the vector representing the axis of the impressed couple or

torque then OH will vary so that the velocity of H is represented

to scale by the impressed couple Og, and if the top is movmg freely

about 0,

n) Og=‘M.gh sin 8.

In the case of the steady motion of the top, the vector OH lies

in the vertical plane GOC, in OK suppose (Fig. 7), and has a

component OG = G about the vertical and a component OC=G ,

suppose, about the axis 00 ; and G’ = GIl, if R denotes the angular

velocity of the top with which it is spun about OC.

If /i denotes the constant precessional angular velocity of the

vertical plane GOC, the components of angular velocity and

momentum about OA are fi sin B and Am sin B, OA being per-

pendicular to OC in the plane GOC ; so that the vector OK has

the components

(2) 00 = G', and CK=Ayn sin 3,

and the horizontal component

(3) GK=OC sin e-CK cos 0

= G' sin 8- Ayii sin 8 cos 8,

The velocity of K being equal to the impressed couple Og',

(4) Ugh sin e=fi . GK=sin 8 (G'h-Aij? cos B),

and dropping the factor sin 8,

(5) All? cos 8 – G'fj. + Ugh = 0,

the condition for steady motion.

Solving this as a quadratic in /i, the roots /ii, /i^ are given by

(6) ^'

W, fH-

2A

[l+V(l-"eos.)];

and the minimum value of G' = CK for real values of /i. is given by

(7) 7^!^ = cos8,~=2 V(oos 8) ;

*^ ' iAi/Lgh 'An ^^*

for smaller values of E the top cannot spin steadily at the inclina-

tion B to the upward vertical.

Interpreted geometrically

Mgh sin 8 CK

(8)

GK ~ A sine'

(9) CK . KG = AMgh sia' 8 ;

and the maximum value of CK. KG is JOC^ sin 8 tan 8.

4. Suppose the top or gyroscope, instead of moving freely about

the point 0, is held in a ring or frame which is com-

pelled to rotate about the vertical axis OG with con- °°"

stant angular velocity /x ; then if N denotes the couple .

of reaction of the frame keeping the top from falling, "" "t.

acting in the plane GOC, equation (4) § 3 becomes ^g^fg

modihed into '

Mgh sin e – N = sin e (G > – A/i^ cos 8),

]Sr = sin 8 {Afi? cos B-G't^ + UgJi)

= A sin B cos B (/x — i) {ij, — /j) ;

and hence, as /i increases through /i^ and juo, the sign of N can be

determined, positive or negative, according as the tendency of the

axis is to fall or rise.

When G'=CR is large, /i^ is large, and

Ugh Aii

~ G' ~CR'

(1)

(2)

(3)

Ml'

the same for all inclinations, and this is the precession observed

in the spinning top and centrifugal machine.

If the axis of the top OC is pointing upwards, the precession is

in the same direction as the rotation, and an increase of /j, from mi

makes N negative, and the top rises ; conversely a decrease of the

precession /j. causes the axis to fall (rcrry, Spinning Tops, p. 48).

If the axis points downwards, as in the centrifugal machine

with upper support, the precession is in the opposite direction to

the rotation, and to make tlie axis approach the vertical position

the precession must be reduced.

This is effected automatically in the AVeston centrifugal machine

(Fig. 9) by the friction of the indiarubber cushions above the

support ; or else the spindle is produced downwards

below the drum a short distance, and turns in a, hole Centrltagal

in a weight resting on the bottom of the case, which «’»’*’”«•

weight is dragged round until the spindle is upright ; this second

arrangement is more effective when liqnids are treated in the drum,

and wave action is set up (The Oenlnfugal Machi-ne, C. A. Matthey).

Similar considerations apply to the stability of the whirling

bowl in a cream-separating machine.

5. If the]irepondorance is absent, by making the C.G ooiaoide

with 0, and if A/i is insensible compared with G’,

(1) N=-GVsin»,

the formula which suifices to explain most gyroscopic action.

Thus a train running round a curve experiences, in consequence

of the rotation of the wheels, an increase of pressure Z on the

outer rail, and a diminution Z on the inner, giving

action ot ^ <;™Pl^' if « i« ^^« g'^^g^' ^,

railway ^^\ Za=GV,

wheels tending to help the centrifugal force to upset the

train ; and if c is the radius of the curve, ft of the

wheels, C their moment of inertiay and v the velocity of the train,

(3)

li=~, G' = Cp

c 0

(4) ^=^aFc (‘y”‘)’

so that Z is the fraction OjMab of the centrifugal force Mv'^lc.

A gyroscope mounted axially in a small truck which runs on

a model switchback road can bo used to illustrate the drift

..J.J tram the vertical plane of fire observed with rifled

*drift)n * “With the right-handed rotation as usually imparted*

artillery, in artillery, the truck drifts to the i . }, V on the

1 concav / ^^^^ “^ ^^^ track, because the couple required for

deflecting the axis of the gyroscope is supplied by the sidelong

fiiction of the track on the witieels ; and the tendency of the truck

is to move against the direction of the applied force.

But the projectile in its trajectory with upward convexity drifts

on the wliole to the right, so that the real dynamical interpreta-

tion of drift in artillery must be sought elsewhere.

The gyroscopic action of dynamos, and other rapidly rotating

machinery on a ship, due to its rolling and pitching, can be

evaluated in a similar elementary manner (Worthington, th/namics of notation).

6. If the axis OG is inclined at an angle o to the vertical, the equation (2) § 4 becomes

(1) N = sin » (A/i2 cos 6 – G V) ɨ Mgh sin (0 – a).

Suppose, for instance, that OG is parallel to the Earth's axis, and that the frame is fixed in the meridian ; then o is the co-latitude, and /iis the angular velocity of the Earth, the square of which may be neglected ; so that, putting !N" = 0, tf-a=E,

(2) Mgh sin E – G V sin (a -h E) = 0,

(3)

tan E = ,

G'/i sin a

GV

Mgh – G'fi cos a Mgh

This is the theory of Gilbert's barogyroseope, described in Ajjpell's Micaniqne rationelle, ii. p. 387 : it consists essentially of a rapidly rotated gyrostat, mounted on knife-edges by

™" an axis perpendicular to its axis of rotation and point-gyroscope. ^^^ ^^^^ ^^^ ^nest ; spun with considerable angular

momentum G', and provided with a, slight preponderance MA, it should tilt to an angle E with the vertical, and thus demonstrate experimentally the rotation of the Earth.

In Foucault's gyroscope (Comptes Eendus, 1852 ; Perry, p. 105) . the preponderance is made zero, and the axis points to Poucault s ^j^g -^o\s, when, free to move in the meridian. gyroscope. Generally, if constrained to move in any other plane, the axis seeks the position nearest to the polar axis, like a dipping needle with respect to the magnetic pole. {A gyrostatic working model of the niagnetie compois, by Sir W. Thomson. British Association Report, Montreal, 1884. A. S. Chessin, St Louis Academy of Science, January 1902.)

A spinning top with a polished upper plane surface will provide an artiiicial horizon at sea, when the real horizon is obscured. The first instrument of this kind was constructed by Gyroscopic gg^gou, and is described in the GeTdleman's Magazine, borlzon. ^^-y^ xxiv., 1754 ; also by Segner in his Specimen theorice turhinum (Halte, 1755). The inventor was sent to sea by the Admiralty to test his instrument, but he was lost in the wreck of the Victory, 1744. A copy of the Serson top, from the royal

collection, is now in the Museum of King's College, London.

Troughton's Nautical Top (1819) is intended for the same purpose.

The instrument is in favour with French navigators ; but it

must be noticed that the horizon given by the top is inclined to

the true horizon at the angle E given by equation (3) above ; and

if /Hi is the precessional angular velocity as given by (3) § 4, and

T=2TJ/i, its period in seconds,

/.N J. -ci / 1 i T cos lat -r, cos lat*

(4) tanE=^coslat= gg^,orE=^ .

if E is expressed in minutes, taking /n=2ir/86400 ; thus making

the true latitude E nautical miles to the south of that given by

the top {Sevue maritime, 1890 ; Comptes Rendns, 1896).

7. in the ordinary treatment of the general theory of the

gyroscope, the motion is referred to two sets of rect- ,

angular axes ; the one Oa;, Gy, Ox fixed in space, with ^"■f """

Oz vertically uijwards ; and the other OX, OY, OZ o™""»»

fixed in the rotating wheel with OZ in the axis of '^«""'

figure 00.

The relative position of the two sets of axes is given by means of

Euler's unsyrametrieal angles 9, 0, ^, such that the successive

turning of the axes Ox, Oy, Oz through the angles (i) ^ about Oz,

(ii) 8 about OE, (iii) ip about OZ, brings them into coincidence

with OX, OY, OZ, as shown in Fig. 10, representing the coricaTO side

of a spherical surface.

The component angular velocities about OD, OE, OZ are

(1) -^ siu 9, e, (li +

so that, denoting the components about OX, OY, OZ by P, Q, K,

(2) P = « sin 0 – ^ sin 9 cos ij>,

Q = ff cos (p+\l; sin 8 sin 0,

E.= (j> + if'cos8.

Consider, for instance, the motion of a fly-wheel of preponderance

MJi, and ecjuatoreal moment of inertia A, of which the axis 00 is

held in a light ring ZC at a constant angle 7 with OZ, while OZ is

held by another xing zZ, which constrains it to move round the

vertical Oz at a constant inclination 8 -vvith constant angular

velocity /n., so that

(3) e=0, vJ=/i;

(4) P= -fi sin 8 COS ip, Q=/i sin S sin 0, B.=(/>+/i cos 8.

The components of angular velocity and momentum about OF,

OY, are

(5) P cos 7 – R sin 7, Q, and A (P cos 7 – R sin 7), AQ,

so that, denoting the components of angular momentum of the

fly-wheel about OG, OX, OY, OZ by K, hi, lui, A3,

(6) Ai = A(P cos 7 – R sin 7) cos 7 ~~I~~ K sin 7,

(7) A2= AQ,

(8) A3= -A(P cos 7-R sin 7) sin ■y+ ‘K. cos 7;

and the dynamical equation

(9) ^-hq + h,7 = S,

with K constant, and

(10) N = – Mg’A sin 7 cos zY =

reduces to

sin 7 sin 6 sin 0,

(H)

sin 7 – All? sin 7 sin^ 9 sin 0 cos 0

+ A./J? cos 7 sin 8 cos 8 sin 4> – (Km – Mgh) sin 8 sm

The positions of relative equilibrium are given by

(12) sin 0=0, and cos A/t c°s 7 cos 9-K^-HMgA.

A/j? sin 7 sin 8

For small values of /t the equation becomes

(13) ~~A~~ j^sin 7 – (Km – Mgh) sin 8 sin. 0 = 0,

so that 0= IT or 0 gives the position of equilibrium, and the period

of a small oscillation is 27r ,J {A sin j/{Kn'~ Mgh) sin d}.

In the general case, denoting the periods of vibration about

0 = 7r, 0, and the sidelong position of equilibrium by 2ir/(ni, n^,

or ns), we shall find

(14)

(15)

«i2= sm g {K/ -MgA-A^^ cos [y-8)].

A sin 7

sin B

-,—. — {Mgh -Kfi, + Au? cos (7 -f 8)},

A sm 7

(16) W3=mi»2//t sin 9.

The first integral of (11) gives

(17) iAr^Vsin 7 + lAfj? sin 7 sin^ 8 cos^ 0

- Ajj? cos 7 sin 8 cos ff cos 0 -H (K/Ji-Mgh) sin S cos 0 – H=0,

and putting tan J0=s, this reduces to

(18) |=«^Z

where Z is a quadratic in z", so that 2 is a Jacobian elliptic function

of t, and we have

(19) tan j0=C(tn, dn, nc, or cn)nt,

according as the ring ZC performs complete revolutions, or oscillates about a sidelong position of equilibrium, or oscillates about the stable position of equilibrium 0=7r, or 0.

Suppose Oz is parallel to the Earth's axis, and /t is the diurnal rotation, the square of which may be neglected, then if Gilbert's barogyroseope of § 6 has the knife-edges turned in azimuth to make

an angle p with E. and W., we must put 7=iir, cos 9 = sin a sin (3 ;

and putting <^ = 5 + E, where 5 denotes the angle between Zs and the vertical plane Zf through the zenith f,

(20) sin d cos 5= cos a, sin S sin 5= sin a cos ;3 ;

so that equations (9) and (10) for relative equilibrium reduce to

(21) – K/i sin fl sin (S + E) + M.gA sin E = 0,

and will change (3) § 6 into

*(22) tanE=,f^/V°°^^*

mgh – Kfi cos a

(Gilbert, Compfes Mendus, 1882, p. 197).

8. In the general motion of the top, when the axis performs

*nutation, the vector OH of resultant angular momentum is no longer compelled to lie in the vertical plane GOC, 00 being placed f ™ *^^ ‘ ^^^ since the axis Og of the torque of gravity Uenera jg always horizontal, H will describe a curve (a Poinsot the too herpolhode) in a fixed horizontal plane, at a height OG ‘^’ above 0, the vertical vector OG representing the constant component G of angular momentum about the vertical. The component G’ of the angular momentum of the top about its axis 00 remains constant also, as there is nothing to alter it in the symmetrical top.*

Expressed by Euler’s angles 8 and \j/, the vector OH has the components (Figs. 7 and 8)

OC = G’, OK = A sin 6^, KH=A^.

at at

The velocity of H is equal to the torque of gravity Mg’A sin d, perpendicular to the plane GOG, so that the hodograpfi of the curve of H (turned backwards through a right angle) is given by the vector Mgh sin 9e , and is therefore similar to the curve of the projection of C on a horizontal plane ; so that, denoting the polar co-ordinates of H in the horizontal plane GHK by p and w,

the associated motion of the axis of the top is given by

.d

(1)

*‘HLgh sin fe**

-dt

(P^’)

and loops in the curve of C correspond to undulations of H.

solving in the radial direction GH for the oiirve of H,

Ee-

(2)

dt

KH

: sin e cos GHK=M9A sin 6

P

dp .-.,,. ,,dB

p£=AMghsme-

“dt

dt’

(3)

and integrating,

(4) ip'= AMgh{E – cos 9).

To make the equations homogeneous, put

(5) 0G = 5, 00 = 5', 4AM(?A=F;

so that

(6) p2 = p'(E-cos«);

and denoting the perpendicular GK on the tangent at H by p,

(7) ^sin9 = 00-OGcos ff=S'-Scos9,

so that, eliminating 8,

, {d'-S cos 8f

(8)

(9)

p'

sin' 8

{5'F-S(E^-'

■2pW

*P'-P^*

tan KGH =

/i^-(EF-2/)2)2

R

'9~(EB-2p-'f'

5’F – d{M^ – 2/)2)’

(10)

where

(11) R =/)2{^ – (EF – 2p^f} – {dV – 5(E/fc2 2p3)}2

and the diameter of curvature

(12) dp“ lkm sin»g

dp S- B’ cos 8

These will be found to be the equations which represent the char-

acteristic geometrical properties of a Poinsot herpolhode, defined

as the trace on a fixed tangent plane of the point of contact of a roll-

ing quadrio surface, moving about a fixed centre.

Thus, if 5 = + 5’, as in Klein’s rosette curves of the spinning top,

in which the axis passes periodically through the highest or lowest

vertical position, the quadric surface reduces to a plate, and the

herpolhode is the projection of a geodesic line on a prolate spheroid.

In the steady motion of § 3 the rolling quadric surface is of

revolution, and the top has a regular precession except when, as

in § 4, the top is spun rapidly and K is close to 0 in Fig. 7 ; the

rolling surface is now an attenuated rod-like figure, not necessarily

of revolution, and a tremulous {pseudo-regular, Klein) precession

of the top can ensue, such as would be generated if the top was spun rapidly and then dropped with its point in the cup 0.

Darboux has shown that the motion of the axis of the top can be realised mechanically by means of an articulated hyperboloid, formed of rods placed along the generating lines and bound to-gether at the points of crossing (Despeyrous, M^canigue, ii. p. 527).

If 0 and H are at opposite ends of a diameter of this hyperboloid, and OG, 00 are the generating lines through 0, then as H is moved on the plane GHK along the herpolhode, keeping OG and the parallel generator through H vertical, the generating line 00 mil follow the motion of the axis of a top.

The curve of H on the rolling quadric is a line of curvature on an ellipsoid and hyperboloid of two sheets, confocal with the defonn-able hyperboloid (Proceedings London Math. Society, xxvi., xxvii.).

Since

KH2 = GH2-GK2

(13)

(G'-Gcos9)°

/(ZS\2 (G'-Gcoi

(14) K'J^) =2AM?A(E – cos 8) – '— -^J

and putting

(S)

(16)

003 e=z, "-i^=n

A

= 2»2Z,

(16)

Z=(E-.)(l-.^)J-^i^'

= (E-8)(l-«=)-2(-j.

Denoting the roots of Z = 0 by si, 2ij, zs, arranged in the order

(17) Si>l>22>»>2S> -1,

d8 ... dz

then with

(18)

,. positive, -r, negative, as in Fig. 7,

z

dz

nt

j n/2Z'

an elliptic integral of the first kind ; and, by inversion, z is am

elliptic function of t.

To make the reduction to Legendre's standard form, put

*(19) z=Z2 sin^*

(20) z – «3 = (^2 – S3) sin" ft

(21) «2 – s= (22 – 23) cos2 ft

(22) zi-z = (:,-Zs)A

(23) «^=^^',.,.'?i.

^ ' =1-23 si-za

Then j,r

(25) F? = K-»rf, mt= js/(~^)nt.

In Jacobi's notation,

(26) (p=a.m(K-mt);

and in Gudermann's notation,

(27) z= z^sn^iK – mt) + 2scn'(K – mi).

Denoting the roots of E=0 in (11) by p-?, pi, p^, then (18)

becomes p

and

(29) f?=pisn%K-'>nt) + picn^{K-mi).

Again, resolving transversely to GH, or rather, taking the

moment of the velocity V of H round G,

(30) pY=p^-~=0g.GK = ‘M.ghsin6.GK,

=Ugh (G’ – G cos «) = Jmi(S’- Sc) ;

so that, from (7)

(31) \=inJc sin 9 = 4^ J{fc* – (EF – 2/)%

‘■ •* dt 2A(E-«)’

,,,,,, Gt , G’ — EG f dt

(33) „=^+ 2^-jEr-^,

c j(E-z)j2Z’

= p« +

=^nt +

‘/

(y — s)jfisp

involving an elliptic integral of»the third kind ; (29) and (33) give

the analytical determination of the curve of H.

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Denoting the angle KGH by %>

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ndB

(34) tan X=gk=GK sin 0= G’ -Gz ‘

(35)

sin «« ”*=- *

+i vaz

v/2(E-^) ‘

and

(36) lA=-=—X,

so that ^ is given by one elliptic integral of the third kind.

But the component of angular momentum round the vertical

(37) 00 cos fl + CK sin e=G’cosB + A. sin^ ^-£ = G>

so that

d

(38)

dt Asin«« A(l-s’)

G-G’ 1 G + G’ 1

2A ‘ 1-s 2A ‘ 1 + 2'

■which gives ^ by the sum of two elliptic integrals of the third kind ;

their addition into a single integral of the third kind (Legendre)

being shown in (33).

The reduction of (18) to the standard form of “Weierstrass is

effected by putting

where X is a homogeneity factor at our disposal ; and now

J’

(40) ni

(39) pu-e^ = s- s. = i^’(2- =J = J^”^^^. »=1> 2. 3,

jeneity factor ai

Si

-Tg, S = 4(s – Si) (s – Si) (s – «s),

8

(41) r2,«=S = J\«Z=X«p,

00 00*2

/ds f ds f ds Tit

If D, (T, S denote the values of m, s, S corresponding to 0=E, p^=0,

(43) J3i,-^«=iX2(E-2)=X2^’

J’-E«

(44)

(45)

pi2< 0

Sl> (T >S2 > S > Ss,

so that

(46) v=ti>i+fu3, where/is a real fniotion.

Then (33) becomes

ip’vdu

(47)

‘“i”* +

ij^v-

with the elliptic integral of the third kind in the standard form.

Darboux puts

8 L y B

(48) jfc=X’ i=X’

so that

(49)

Z=(E-0)(l-0^)-2(^‘y.

Adding equations (43)

(50) 3J9i;=iX”(3E-0i-Z2-2s)=X2E-L2.

(61) \2E=L2+383i;,

(52) \^=\^S,-2(pv-pu) = U+^v+2pu..

Equation (44) becomes

(53) i^‘i>=X2(B-LE)=X2B-L’-3Lp«,

(54) \m=U + 3Lpv+ip’v.

Again

(55) 2p”v = X<{3E2 – 2E(2i + Z2 + 03) + 2aS3 + 2s3i + 0102}

=X<(E2-4E^+4^-l)

=V(E2-1) + 4LX2(B-LE)

=X4(E2-1) + 4L«F'»;

so that

(56) X^ = X^E^ + iUp'v – 2F'«

= (L2 + 3pvf+ iU^'v – If'v,

thus determining the homogeneity factor X, when the data are L

and 11, and now

0 5 L

(57) =

(58)

2^AMgh k '

& y B

2jAM.gh~ Tc ~ X

= J? '

The motion of the centre of a sphere, rolling and spinning

in the interior of a spherical bowl, or on the top of a spnere, is

found to be of the same character as the motion of the axis of a

spinning top.

Suppose the top, spinning upright, receives a small tap, which

imparts an angular velocity u to the axis ; then

S'=S,E = l + ^,02=l;

(59)

and putting

*(60) 1-0=2 sin2je = 2a;^*

(61) 2Z = 16.=' {(x+^^)(l-^^)-g^}

= 16a;2 (a;,2 + 2.2) (2:32 -a^).

We must distinguish three cases :

in'^/XB J'

so that X3 is proportional to u, and the upright position of the

top is stable.

Then ,/S^ – \ ,

x=Xz aosijl p- – 1)nt,

^ 1 I complete oscillations per second.

II.

i=Tc.

and the upright position is still stable ; and now x=X3c\iJ(om)t.

III. 8<>i;.

-J

so that 3=2 cos" Sjk, and the axis falls away to this inclination

however small the tap, so that the upright position is unstable.

Ultimately

x=X3 sech

and

V(1 – ^)nt.

1^= mi -cos”’ Ic

k

s/(l – x-‘)

Pcos(.|»i-^)4

9. Some simple cases will elucidate the preceding theory.

First put ,.,

(1) G’-GE = 0; Simple

cases of

this makes p’v=0, and v a period, isi or W2,/=0, or 1 ; fj,g motion

E-z is now a factor of Z, 01-0 or 02-z; ^/a top.

and pi^=0, ari>^=0, so that

(2) p = psdn(K – trd), or p3cn(K – mi),

while

■a=—nt=pt, suppose.

X

tanx=

X = ~~a~~^=pt-

^{l-02 2g(E-0)}

(3)

(4)

(5)

and

(6) sin e sin {pt – lA) = «/{«2 – «) (2 – zs)}, or ^/{(zi – 2) (0 – 03)},

(7) sin fl cos {pt -^)=\ \/{2(2i – z)}, or ^ ^{2(2= – 2)} !

^s/{2(E-2)}

(8)

P = h= /22 + 23 pj. /zi+23

n 'K V 2 ' V 2 '

?= 21 = 1+^3, or ? = Z2 = i±^'.

L 02 + 03 L 21+Z3

(9)

Next, take

(10) «=wi + iw3,/=i,

and work with the corresponding pseudo-elliptic integral in the form

(11)

r (i-.)(.+.2)

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where

(12)

(13)

=003-1 /(i::^li£±£-‘.

To construct the corresponding herpolhode from (43) and (47)

§ 8, put

(14) p^=a\K-a?),

so that, from (43) § 8,

(15) lc^=a?\%

(16) ps=-p2 =a’x^,

(17) p2 pi^=a\K^-a?),

(18) p2 p^^=^a\l^),

(19)

(20)

and in (47) § 8,

(21)

(22)

where

(23)

»’-«/5'

K-mi), TOi=

X

-K)fe

=I+j(l-.)/^

I =p« – «,

=f™.i(l

K)mt

L-i(l-

A

= {L-i(l-K)}m≤,

and the herpolhode is given by

(24)

(25)

p sin {pt ■zi) = a I

p cos (pt — ■sr) = a

(1 + a) (f-a;)

2

(I-k) (k + k)

This herpolhode becomes a purely algebraical curve by taking

(26) 6=4(1 – /c)as, L = 4(1-k),

making ^ = 0.

In the associated movement of the top we shall have

*(27) X^*

*(28) X4=(L2-1 + 3(c-/c2)2-8/c(1-k)L + 8k(1-k)^*

(29) X2zi = L2 + l+ «r-K2,

(30) \22;2=L2-1+ k-Vk

*(31) X203=L=-1+ ‘f-‘c^*

(32) X2E=L2-1 + 3ic-k2,

and operating as in (1), § 8,

*(33) iX^ sin e cos (^< - if-) = (L - 1 + K - x) f zA-^*

(34) 4×2 sin e sin (^<-i/')=(L-1 + k + x) /(! + '«)(«-'«)

,„.,b-L^-(1-3« + ‘^”)L-2k(1-k).

(35) « jp .

with the two constants L and k at our disposal for the construction

of numerical eases.

In the purely algebraical cases, when^=0, L=i (l-(c),

(36) (2X)” = (1 + k)2(9-14/<: + 9k2),

(37) (2X)%i = (1 + /c)(5-3k),

(38) (2X)2z2=(1+)c)(-3 + 5k),

(39) (2X)2z3=-3 + 2k-3/(2,

(40) (2X)2E=-3 + 10k-3/c2,

(«) 3 3(i-Hy-.).

stereoscopic figures of this case (Fig. 11) were drawn by the

late Mr T. I. Dewar for

(42)

f = j|. |, and I (cusps).

Cusps occur in the general case when

(43) L = l±V(t + «°)-

When L = B = 1, the axis passes periodically through the highest

vertical position ; and there is an intermediate path for L = B= – k.

The axis rasses periodically through the lowest vertical position

when L= – B = 1 – K.

The axis moves like a spherical pendulum when B=0 ; putting

L=c(l-/(),

*(*4) + « = ,_,*

in which c may be taken as an arbitrary parameter for the construc-

tion of numerical cases.

Other cases can be worked out for a parameter v=ai+/as,

where /= J, J, i . . . ; and in this way we can map out the

analytical field of the most general case of motion. ‘

10. So far the motion of the axis OCZ alone has been con-

sidered ; Euler’s third angle must be introduced for the specifi-

cation of the motion of any point of the body.

Now if K denotes the angular velocity of the top about its axis 00,

30 that

(2)

E=:^ + cosr .

dt dt

^=E

dt

.cosff^ = R

dt

G cos e- OR cos^ e

A sin”

CR-Gcos9

- +

G’ + G 1

A sin2 e

c\j, g-g; 1

A/ 2A l-z~^ 2A l+s

which gives 0 by the difference of two elliptic integrals of the third

kind ; but these can be replaced by a single integral, as for \j/ in

3, in the form

(33)1

(3)

where

so that

(6)

0

≡(•

-^“JRii + ^l’tan

2A

G-

2A i D

V2AMg’AZ

G-G’z

dt

*Z={D-z)(l-z^*

= (D-2)(1

*(G-G'a)^*

z2)-2

2AM.gh

S – 5'z

(•^r.

2l + i%+23 = D +

= E +

2AM.gh

*G^*

=D + 2

5/2

= E + 2.

>5?

32

-

*2AM.gh " ' "Ic^*

The result in (3) can be verified by differentiation ; it shows

that H describes in the plane CKH a herpolhode curve, and thus

Jacobi's theorem is established on the allied motion of a top and

two associated Poinsot movements (Werke, ii. p. 480).

It will simplify the formulas with very slight loss of

generality, which can always be restored at any instant,

if the spherical top, so called, is considered, in which

C = A ; this will merely cancel a secular term in , and

make

,,,, dij> G' -G cos B

^ ' dt~ Asin2« '

equivalent to an interchange of G and G' in 1^ ; and now

,,,,,,,,, ^N G + G'/" dt 5 + S' f ' dz

The

spherical

top.

(1 + 0)V2Z

dz

(8)

(1-2)V2Z

introducing two elliptic integrals of the third kind, with poles at

z=+l, corresponding to parameters of the form

(9) l>i=/ias, V2=t»i+f20's,

where /i and/2 are real fractions ; and now, if v and w denote the parameters corresponding to s=E and D, we shall find

(10) V = V2-Vi, W = V2 + Vi.

The most symmetrical treatment of the motion of any point fixed in the top will be found in Klein-Sommerfeld, Theorie des Kreisels, to which the reader i^ referred for details ; four new functions, a, ;8, 7, S, are introduced, defined in terms of Euler's angles, 8, \j/, 0, by

(11) 0= cos 49 exp 4(f + (t>)i,

(12) /3= i sin ^e exp 4(^-)i,

(13) T=i sin 49 exp |(-\J' + 0)!;',

(14) S= cos \e exp |(– i^ – fji.

Next Klein takes two functions or co-ordinates X and A, defined by

(15) X=^±^ = £±f,

r — z X- yi

and A the same function of X, Y, Z, so that X, A play the part of stereographic representations of the same point (a,-, y, 2) or (X, Y, Z) on a sphere of radius r, ydt\ respect to poles in which the sphere

is intersected by Oc and OZ.

These new functions are sho^vn to be connected by the bilinear relation

(16)

7A + 3 '^' '

in accordance with the annexed scheme of transformation of co-ordinatea —

S

H

Z

f.

a?

^

2a;8

V

*7^*

52

275

t

ay

(35

a.S + Py

where

(17) i=x+yi, ri= – x+ yi, f=-z,

S=X + Yi, H=-X + Yi, Z=-Z;

and thus the motion in space of amy point fixed in the body

defined by A is determined completely by means of a, /3, 7, S ;

and in the case of the symmetrical top these functions are elliptic

transeendants, to which Klein has given the name of muUiplwative

elliptic functions ; and

(18) a5=cos2 ie, §y= -sin^ \e,

a5-/37 = l, aS + j37 = oose,

V(-4a/37S) = sin 8;

while, for the motion of a point on the axis, putting A=0, or 00,

(19) '^=f=i ta.ulBe't'i, or \=-= -4 cot Jfffi'Ai,

0 7

and

(20) a/3= J* sin Be'fii, ay=\i sin 8e'l>\

giving orthogonal projections on the planes GKH, CHK ; and

(21)

dS da a p ‘

the vectorial equation in the plane GKH of the herpolhode of H

for a spherical top.

When/i and/2 in (9) are rational fractions, these multiplicative

elliptic functions can be replaced by algebraical functions, qualified

by factors which are exponential functions of the time t ; a series

of quasi-algebraical eases of motion can thus be constructed, which

become purely algebraical when the exponential factors are can-

celled by a suitable arrangement of the constants.

11. Equation (4) § 3 with alight modification will serve with

the same notation for the steady rolling motion on a horizontal

a rosiat P^^”® ° ^ body of revolution, such as a disc, coin,

rolNniria ”•°°P’ ■“‘li^el, cask, wine-glass, plate, dish, bowl, spin-

*steadr “™^ °P’ §7™^**; <"■ Mcycle ; but 0 is now the point*

motion on °^ intersection of the axis GC with the vertical through

a Diane ^^^ centres of the horizontal circles described by G the

centre of gravity, and by P the point of contact, either

with the ground, or any surface of revolution of which Oz is the

vertical axis (Fig. 12).

Denoting by X, Z the horizontal and vertical components in

dynes of the reaction at P,

(1) X = Mm2.GK, Z=M^;

and taking moments round G,

(2) G V sin e – Ayit^ sin » cos 9 = IT

= Z.PH-hX.HG = M^.PH-i-M^2 GK.HG,

where A now denotes the moment of inertia in g-om.^ about an

axis through G perpendicular to the axis of figure.

The term G' must include not only CR, the angular momentum

of the body due to the component angular velocity R above the

axis GG, but also K, the total angular momentum of any fly-wheels

fixed in the body with their axis parallel to GG.

Denoting KG by c, and GN, NP by z, x, the velocity of P

(3) =^c/i+xR – zfi, sin 8.

This is zero if P is the point of rolling contact, so that

(4) x> „2 sin S –

and therefore

E=

-^,

(5)

Ka sin e + &-^^^/j? sin 9

-A/J? sin 8 cos S-Mc(2 cos ff-l-a; sin 8)fi'

- '!Ag(z sin i9 – a; cos e) = 0.

But if the gyrostatic body is swinging round in relative equili-

brium at the end of a thread O'P of length I inclined at an angle

a to the vertical attached to the point P,

*(6) X=M^tana=McM^*

Gyrostat ^ jj^; sin a ŧ z ain 9 – a; cos 8) ;

*swung ' **

*round by "< *'^® ^^'^ "^ resultant angular velocity being verti-*

a threat! '^^^' 1^=/^ '^os 8, so that

(7) K/J. sin ^-l-(C-A)M^3in 8 cos »=N

= T.GL=Mg'seo a.GL,

where GL is the perpendicular from G on the thread.

When a solid of revolution is moving in unlimited frictionless

liquid with axial velocity V and sidelong velocity U, it experiences

a deflecting couple

(8) 'S = (ci-C3)VY, Stability

in accordance with the principles of hydrodynamics, of a

CsV=F cos 8, and (;iU=F sin 8, being the components rotating

of the impulse F required to give the body its actual projectile.

motion ; ao that equation (2) becomes

^^' GV sin 8 – kiJ? sin 8 coa8 = 5(ci – C3)V= tan 8.

Dividing out sin 8, which equated to zero would give perfectly

centred axial motion, the quadratic in /i becomes

^■^°) A/x2 cos 9 – GV -f %i – C3)V2 sec 9=0,

so that the least admissible value of G' = CE for steady motion is

given by

Suppose the solid is an elongated projectile, fired through the

air by a cJ cm. gun, in which the final angle of the rifling at the

muzzle is /3 ; then

(12)

tan /3=

\dM,

"We can put

(13) Ci=M-HM'a, Cs=M-)-M'7, Ci-C3=M'(a-7),

where M, M' denote the weight in grams of the body and of the dis-

placed air or fluid, and a, 7 are functions of the shape of the body ;

also

(14) C = 10;3^ k=Wc-? + Wy-?.

Now in air, the fraction M'/M is so small that the first power

only need be retained, and

(16)

tan2S=^-%-

*t)^*

which determines ^ the angle of rifling suitable for stability in

flight of a projectile for which a and 7 are known.

But if the body is like an automobile torpedo, submerged in

water with zero buoyancy, then M'=M, and the exact expression

must be used

Stability

+^(a-7)M. tuLoblle

The term G' is supplied in the Whitehead torpedo

by the action of a fly-wheel in the interior.

12. In the theoretical discussion of the general motion of a gyro-

stat rolling on a horizontal plane, apparently the simplest plan is

to write down the most general equations of motion,

and afterwards to introduce the special conditions. enera

Drawing through G the centre of gra^aty any ^Zyrostat

three rectangular axes Gx, Gy, Gz, the notation em- ^^i„„oii

ployed is ,,.1 •.• fn ‘P’”^-

u, V, w, the component linear velocities of G,

p, q, r, the component angular velocities above the axes,

Ai, hi, J13, the components of angular momentum,

h, ^2, 63, the component angular velocities of the system of

rectangular axes,

X, y, z, the co-ordinates of the point of contact with the hori-

zontal plane,

X, Y, Z, the components of the reaction of the plane,

a, |8, 7, the direction cosines of the downward vertical

The dynamical equations are

(1)

du

~dt’

V83 + w82= ga +

M’

(2)

|-... + «93=.p4,

(3)

and

5-„.,+..,=,7 4,

(4)

^-he3+hsSi=yZ-zY,

(5)

^-A3»i + AA=2X-a;Z,

at

(6)

^-M8., + }i^8^=xY-yX.

The geometrical equations, expressing that the point of contact

has no velocity, are

(7) u-yr + zq = <),

(8) v-zp +xr=(i,

(9) w-xq+yp=0.

In the special case of the gyrostat, where the surface is of

revolution about G2, and the body is kinetically symmetrical

about Gz, we take Gy horizontal and Gzx through the point of

contact, so that 2/=0 ; and denoting the angle between Gz and the

downward vertical by 6 (Fig. 12),

(10) a=sin 6, ^=0, 7=cos B ;

while denoting the angular velocity of the plane Gzx about the

vertical by 0,

(11)

«i = fi sin 6, 62= -^^, $s=n cos 6.

The components of angular momentum are given by

(12) hi = Ap, 7i2 = Aq,h3=Gr + K,

where K is the angular momentum of interior fiy-wheels whose

axes are fixed parallel to Gz ; and as G2 is fixed in the body

(13) .p=ei = ii sin e, q = e2---^^-

The elimination of the reactions leads to the general equations

of motion, of which one integral can be written down from the

principle of energy.

We shall confine ourselves to the special case in which x and z

are constant, so that the body has a plane circular base, like a disc,

a wine-glass, or Kelvin's gyrostat (Fig. 4).

Now, from (1), (6), with 2/ = 0,

X ^0 , ^ . „ _,„ _„ dfi

^ = z-^-(zS^sm g-xr)il cos e + x-^^-gaiae

Y dfi sin 9 dr dd

M = ^ dr – ‘“11+^^ “ * + ^ °°^ *)“d«

Z

(14)

(15)

(16)

(17)

-zY=A

dt

t

dQ sin d

M~ -^“j7 + “ + (2^ sin 9-xr)fi sinS-jr cos 0

de

dff

dt

+ A-rpoose-{Or + K)^,

dt

(18) zX-a;Z=-A-^-(Cr-l-K)fisin « + Afi^ sin 9 00s $

dr

(19) a;Y=:C^’,, treating K as constant.

The elimination of Y between (15) and (19) leads to

(20)

^^=o§

,, dn sin e „ „dr „ , . „.

: M.XZ — -jT ‘^’“‘Jf + ‘{^ sm 6 –

Ode

dr d^ sin 6

(21) (C + Mx=)^- Mxz — jg — -M(B^sine + aBcos9)n=0;

or putting Q sin^ 9 = 1^, and Cr- + K = G’,

dG’

CMa:z^-CMa;2N=0.

(22) (0 + Mx”) sin 0 ^g

Between (15) and (17) the elimination of Y leads to

‘de

dr

(23)

~~Mxz sin fl^~(Cr + E) sin 9 = 0 ;

so that from (22) and (23) putting (A + Mz^) (C + Mx=)-MV:2=D,

(24)

(25)

r

(26)

(27)

. («N / dG’ „,

d0=\~~d0 + ”’^ j”°’*

ACMa^N = (D^ – GMazG’) sin 6 ;

(C + Mk^)^-‘ sin e = CMra’^ + CMk^N,

du du

(C + Mir2)G’ sin 9 = D ^ + CMxjH”.

With z=0, as in a disc or Kelvin’s gyrostat

*(28) A ^ = Gi’ s’” *> CMaj^N = (C + Mz^)-^ i*

leading to the differential equations of a hypergeometric series for

G’ and N

r\G =0,

(29)

(30)

d^G’ dG’

-T5r + cot9:j5 –

d0 A(G + Ma;2)

*(PIT dN CMo^*

W ”°^^d0~ A{G + Mx^) ‘

of the form of Legendre’s equation for a zonal harmonic of

fractional order n, given by

(31) «(» + l) = A(c + Mx=)

(Appell and Korteweg, Circolo Tnatematico di Palermo, Aug. 1899).

■N = 0.

But in the general case, when z is not zero, the differential

equations become

dK^’ ^dG’ CM(^2+^zoot9)

(32) -^ + «ot«5F D ^=0'

dFn dN CM{x’+xz cot 9)^

(33) rf«5—cot9^ 5

The elimination of X and Z between equations (14), (16), (18),

leads to

d^0

(34) {A + M{x^ + z^)}-^i – (A + Mz2)fi2 gj^ e cos 9

- MxzO^ sin^ 9 + {(C + Ma:^)?- + Kjfi sin 9

+ Mxzrfi cos 9 + Ms’(a! cos 9 – z sin 9) = 0 ;

and this, in conjunction with (20) and (23) will lead to an

equation, the integral of which is the equation of Energy, which

can be written down in the form

(35) lM{u' + v' + v^) + iA(f + q'^

+ \Gr'^ + 'S&.g{x sin 9 + z cos 9)=H,

a constant ; or

(36) 4{A + M(:r^ + 2^)}(^^-j

+ J(A + Mz2)n2sin2 9

- Mxzrfi sin 6

+ i(C + Ma;2)r2

+ Mg{x sin 0 + z cos 9)=H.

Puta;=0 and we fall back on the original equations for a top

spinning witli its point in a small smooth fixed cup, like the

Maxwell top.

13. To find the small oscillations about a state of steady motion

where the axis has a mean inclination a to the vertical, put

(1) e = a + Pe^«, sin 9 = sin a(l + Pe^'i cot a),

cos 9 = cos (al — Pe^'i tan a)

N = H + qe'Mi^ G' = L + Ee^«

where P, Q, R are small, and

^ ' de P d0 p'

to the order considered.

A substitution in (34) § 12 will lead to the condition of steady motion, and a relation between P, Q, R, which in conjunction with equations (24) to (27) will lead on elimination of P, Q, R to the equation which determines X^ ; and if X^ is positive the motion is stable (Routh, Sigid Dynamics, ii., § 241).

Take the case where the gyrostat is performing small nutations about a position of steady motion when the gyrostat proceeds with its axis horizontal in a straight course with velocity v.

Then in (1), with

(3) z=0, o=4ir, sin 9 = 1, cos 6= -PM«»,

and

H:

= 0, L=I + K,

we shall find R=0, and

V

P-

W

A

(A + Ma;')X° + M(7a;

(G + Ma;2)l + K

(5)

A(A + Mx2)X2= |(C + Mx2)Y + KJC c| + K -AUgx,

and X^ must be positive for the motion to be stable.

Thus, putting V = 0, so that

(6) A(A + Ma;=)X2=K2-AM!7.v,

it is possible for the gyrostat to maintain itself upright on its edge

without advance, as in Fig. 6, provided

(7) K^ – AMgx is positive.

In a solid rolling disc, or coin, or symmetrical body rolling on

its edge.

(8)

K = 0, A{A + Ud')'>=0{G + Mx^f^- AMgx,

and the right-hand side must be positive for the straight advance

to be stable.

For further theory and experiments consult Routh, Advanced

Rigid Dynamics, chap, v., and Thomson and Tait, Natural Philo-

sophy, § 345 ; also Bourlet, TraM des Ucyclcs (analysed in Appell,

Micanique rationelle, ii. p. 297, and Oarvallo, Journal de Vicole

polytechnique, 1900); Whipple, QuaHerly Journal of Mailiemaiics,

vol. XXX., for mathematical theories of the bicycle.

In some ex-periments, described by Lord Kelvin in Nature, February 1877 and November 1880, the fly-wheel of the gyrostat 13 replaced by a spheroid of thin copper, filled with water ; if spun rapidly the motion is stable if the spheroid is oblate, but becomes highly unstable for the prolate form, as exemplified by the difficulty

of spinning a raw egg ; but the motion should become stable again when the egg-shaped spheroid is elongated to more than three diameters long {Proc. Cam. PhiZ. Soc, 1882).

If the fly-wheel is fixed symmetrically at the centre of a spherical case which can roll on a horizontal plane, the preceding results can be modified so as to lead to analytical equations comparable in some cases with Kirchhoff s equations for the motion of a solid in unlimited liquid.

14. Lord Kelvin has also studied, theoretically and experimen-tally, the vibration of a chain of stretched gyrostats {Proc. London Math. Society, 1875 ; Perry, Spinning Tops, p. 127, for a diagram). Supposing the gyrostats, each of axial length 2a, connected by light cords each of length 2Z, stretched to a tension T, and sup-

posing X, y denote the component slight displacements from the

central straight line of the centre of a gyrostat, and that p, q, 1

denote the direction cosines of the axis of gyrostat, and r, s, 1

the direction cosines of a cord, distinguishing the diiferent bodies

by sufRxes ; then, as in Routh's Advanced, Rigid Dynam,ics, p. 266,

neglecting the squares of small quantities, we can put

(2) Ai = A«i, ft2=A92,A3=K;

in the dynamical equations

(3) ^^-hies + hse,=L, . . .

at

so that for the k"' gyrostat, these equations reduce to

(4) Attt – Kpk = Ta(si + st+i – 2ft),

(5) Apji + liqi=Ta{n+n+i-2pi).

Also, for the motion of translation

(6) MiZi = T(n+i – n), Mj?s = T(st+i – Si).

The geometrical relations are

(7) X]c+i-Xi=a{pi+i+pt) + 2lr!c+-i

Vk+i – yh=a{qk-n + qui + 2Zsi^.i.

Putting

(8) x + yi=w, p+qi=w, r+si=ff,

these three pairs of equations can be written

(9) AraTi-Kwii-f-2Tawt-Ta((ri4.i +

(10) Mwi-T(

(11) wic+i – W!c-a(-!sric+i + z^ic) – 2Ziri,+i=0.

For circularly polarized vibrations assume a solution

(12) wjc, z^ji, £ri=(L, P, Q) exp (»i – cA)J,

so that njc is the velocity of propagation : then

(13) P(-Am2 + Kw-H2Ta)-QTa(«-rf-l-l) = 0,

(14) -LM?i2-QT(8-«”-l) = 0,

(15) L(e-” – 1) – Pa («-“■ ⊣ 1) – 2Q?e-“= 0 ;

leading on elimination of L, P, Q, to

(-A»2-l-K«-l-2To) (l—^j-Ma%2

(16)

(17)

Put

(18)

so that

then

“”’— -Kn’ + ‘Kn + iTa + M.aV

(– A»2 ⊣ Km ⊣ 2Ta) J ⊣ 2a2

2 sin” 4c=M«^ -A.n’^ + ^n + ^‘Ya+M.aV

‘M. = 2{a + l)p, K=2{a+iy.,

z=2(a + l)k,

c]c=ez,

c=2{a + l)e;

Kin „.

l + -Frr-2i

(19) sm^{a + V)e=p{a + t^n-

Ta~^Ta(a-H;)

T + Kn”^ -■^+ 2pa(a + 1) n^

a a

With a + l infinitesimal, and neglecting the rotary inertia a,

a + l Kn

(20)

^ ,1 KTl

a Y

I — pV+t)-

This agrees with the result obtained by Larmor {Proc. London

Math. Society, 1890) for the propagation of vibrations along a cord

provided with a continuous distribution of gyrostatio momentum ;

the differential equation of vibration is of the form

d?w T! cPw .-.d^w

'^^' d1? " p &2 '■"dM'

so that, for the circularly polarized vibrations

(22) m;=L exp (w<-ez);

(23)

*»2=? e'Jme', "= */(-^™Y*

For circular polarization in the opposite direction

(24) 'u/=x-yi='iJ OL-g {nt-e'x)i,

and now the velocity of propagation

(25) 1= ^(l-hn).

In this way a mechanical analogue is obtained of the action of a

magnetized medium on polarized light (Larmor, Aether and Matter,

Appendix E).

15. In the discussion of the small vibration of a

single gyrostat about the vertical position, when sus- ^,.

pended by a single thread of length 21=1, we can dis- f"^"

pense with the suffix h in the preceding equations (9),.,^,,-j

(10), (11), § 14, and write tareaa.

(1) A;S—K=rt-(-Taw-Ta

(2) M ⊣ To- = 0, with T = M?,*

(3) w-azr -1×1=0.

Putting

(4) «), OT, (r=(L, P, Q) exp «fo'

in these equations, and eliminating L, P, Q,

(5) (– An2 -H Kw ⊣ M^a) {g – W) – UgaV=0,

and the period of a fundamental vibration is 27r/», where « is a

root of this quartic equation (5).

For a gyrostat, spinning upright on its point on a smooth hori-

zontal plane, put 5 = co, and change the sign of a ; then

(6) An'-Kn+M.ga=0,

so that the condition

(7) ' K^>iAM.ga

is required for stability.

Here A denotes the moment of inertia about an axis through

the centre of gravity ; in the same condition required for stability

when the point is held in a small smooth cup (& = 0), A must be

taken to represent the moment of inertia about a parallel axis

through the point.

Spinning upright inside a smooth spherical surface of radius 6,

the sign of a must be changed to obtain the conditions at the lowest point.

For a gyrostat spinning upright on the summit of a smooth sphere of radius b, the sign of a and b must be changed, or else the sign of g, which amounts to the same thing.

Denoting the component horizontal displacements of the point by l> V, then

(8) br=^, bs=ri, Jo- = |H-57i=f, suppose

(9) w=az} + i.

Now if the point is forced to take the motion (f, ri, 0) by component forces X, Y, Z, the equations of motion of the gyrostat become

(10) -Aq + 'K.p=-Zaq + Ya,

(11) +Kp + 'Kii=+Zap-Xa,

(12) X + Yi=M.i!i, Z= -Wg ;

so that

(13) A-»-K-Ai+M.gazsr+'!Aa,'i6=0

or

(14) (A + Ma^)S – Kot» + Mgaw + Maf = 0.

Thus if the point of the gyrostat is made to take the motion given by f = B, exp (nti), the forced vibration of the axis is given

by isr=P exp {nti), where

(15) P{-(A-l-Ma2)»2 + K»-fMg'a}-KM(m2=0.

In Lord Kelvin's experiments the gyrostats are joined up by

equal light rods and short lengths of elastic wire, with rigid

attachment to the rod and the ease of a gyrostat, so

as to keep the system still, and free from entangle- ,. ®

*ment and twisting due to pivot-friction of fly-wheels. lolnt **

When this gyrostatic chain is made to rotate with

angular velocity n in relative equilibrium as a plane polygon pass-

ing through Oz, each gyrostatic case moves as if its axis produced

was attached to Oz by a ilexure joint, so that its instantaneous

axis of resultant angular velocity bisects the angle ir — 0, if the

axis makes an angle 6 with Oz ; and the components of angular velo-

city about Oz being n and about the axis being – n, the resultant

angular velocity is 2» cos J(ff – 5) = 2n sin JS, and the components

of this angular velocity are

(16) -2n sin JS sin J9= -n{l – cos 6), along the axia

(17) -2n sin 1$ cos ^0= ~n sin ff, perpendicular to the axis

of the gyrostat.

The component angular momentum in. the direction Ox is

therefore

(18) L= -A™ sin 9 cos 6-Cn{l-coa 6) sin B + IS. sin 6,

and Ln is therefore the couple acting on the gyrostat.

S. V. — 26

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GYULA-FEHERVAR — HAD DINGTON

If 0 denotes the angle which a rod makes with Oz, and T

denotes the constant component of the tension of a rod parallel to

O2, the couple acting is

(19) Ta cos dk (tan tpjc+i + tan 0i) – 2Tas sin d^,

which is to be equation to Lre, so that

*(20) – A.n- sin djc cos 8^ – Cm(l – cos «i) sin 6^+ Kre sin 6^*

+ 2Tas sin % – Ta cos 0^ (tan ift+\ + tan

In addition

(21) Mm%;i + T(tan 0t+i – tan

with the geometrical relation

(22) scfc+i ~~xt:~~ a(sin $^{t+i + \sin 6}$) – 2L sin 0i+i = 0.

When the polygon is nearly coincident with Oz, these equations

can be replaced by

(23) (– A«.2 + K» + 2Ta)i?it – Ta(0t+i + 0^) = 0,

(24) M«%:i + T(0t+i-0it) = O,

(25) Ki+i – Xi – a(ei+i + 9i) – 2L0i= 0 ;

and the rest of the solution proceeds exactly as before, in § 14.

. The elastic flexure joint is useful for supporting

•" , oP'c ^;jig gyroscopic pendulum, consisting of a rod and a

'^ ■ gyroscope on its axis.

Expressed by Euler's angles the kinetic energy

(26) T=4A(fl2+ sin2 «i^) + iC(l -cos 9) V^ + JC'(^ + v^ cos Bf,

where A refers to rod and gyroscope, C to rod and case, and C to revolving fly-wheel ; and applying Lagrange's equations, the time is given as a function of cos S by a hyperelliptic integral.

A diagi-am is given in Perry's Spinning Tops, p. 126 ; but if the support is a smooth ball-and-socket joint, the motion is given by elliptic functions, as developed previously.

Authorities. — For a complete list of the mathematical works on the subject of the Gyroscope and Gyrostat from the outset, Professor Cayley's Report to the British Association, 1862, on the Progress of Dynamics should be consulted. Modem authors wiU be found cited in Klein-Sommerfeld, Theorie des Kreisels, 1897.

(a. g. G.)

Gyula- FeherVeir (German, Karhhv/rg), a cor-

porate town of Hungary, in the county of Als6-Fel>^ r.

It is the seat of the Transylvanian Roman Catholic

bishop, and contains a royal tribunal, a chamber^ ct

advocates, several schools and important financial institu-

tions, a museum, &c. Its origin dates from theEoman

*period. In the 16th century, -when Transylvania sepa^*

rated from Hungary, it was the residence of the Transyl-

vanian princes, but after that time it decayed. The

fortress was constructed by order of Charles III. between

1715 and 1735; hence the German name of the town.

Population (1891), 8167; (1900), 11,507.

Haarlom, capital of the pro-nnce of North Holland

(Netherlands), 1 1 miles west of Amsterdam by raU, at the

foot of the dunes and near the confluence of the Spaarne

and the Y. Profiting by the advantages of its situation,

the town uses the dune water for bleaching and brewing

purposes, and the fertile Kennemerland for agriculture.

The industrial rise of Leyden, Brabant, Flanders, and the

commercial rise of Amsterdam, have lessened the import

ance of Haarlem, but it is still a considerable market tor agricultural produce (butter and cheese) and cattle, and has a flourishing trade in "Dutch bulbs." More recent industries are the manufacture of tram and railway carriages and machinery, type-founding, bank-note and stamp printing, &c. Here, too, are the works of the Dutch railway. A steam tramway was opened in 1898, and the Colonial museum has been added to that of industrial art, both founded by the Society for Promoting Industry. Population (1900), 64,069.

H£ickensa.ck, capital of Bergen county. New Jersey, U.S.A., in 40° 53' N. lat. and 74° 03' W. long., on the W. bank of the river Hackensack. Its site is level, and it has a regular plan. It is on four railways — the New Jersey and New York ; the New York, On-tario, and "Western ; the New York, Susquehanna, and Western ; and the West Shore. Population (1880), 4248 ; (1890), 6004; (1900), 9443, of whom 2009 were foreign-born and 515 were negroes.

Haddingrton, or East Lothian, a maritime

county of Scotland, bounded on the N. by the Firth of Forth, on the E. by the North Sea, on the S. by Berwickshire, and on the W. by Edinburghshire.

Area and Population. — In 1891 the boundary between Haddington and Midlothian was altered in the parishes of Humble and Fala and Soutra, the whole of the former and part of the latter being transferred to Midlothian, and between Haddington and Berwickshire in the parish of OldUamstocks, which, deprived of its Berwick portion, was placed wholly in Haddington. According to the latest oflicial estimate, the area of the county (foreshore excluded) ia 171,377 acres, or 267-7 square miles. The population was in 1881, 38,502 ; in 1891, 37,485 ; in 1891 on the above area, 37,377, of whom 18,169 were males and 19,208 females ; in 1901, 38,662. On the old area, land only (271 square miles), the number of persona to the square mile in 1891 was 138, and the number of acres to the person, 4-6. In the registration county the decrease of population between 1881 and 1891 was 2-55 per cent. Between 1881 and 1891 the excess of births over deaths was 5001, and the decrease of the resident population was 980. The following table gives particulars of births, deaths, and marriages in

1880, 1890, and 1899 :—

Tear.

Deaths.

Marriages.

Births.

Percentage of

Illegitimate.

1880

1890

1899

627

623

567

175

194

205

1166

968

955

6-1

7-23

6-0

The following table gives the birth-rate, death-rate, and

marriage-rate per thousand of the population for a series of years : —

1880.

lSSl-90.

1S90.

1891-98.

1S99.

Birth-rate .

Death-rate .

Marriage-rate

30-32

16-31

4-55

29-15

15-95

5-39

25-75

16-57

5-16

27-02

16-38

5-79

26-19

15-55

5-62

In 1891 there were 515 Gaelic-speaking persons in the county, and 70 foreigners. Yaluation in 1889-90, £238,715 ; 1899-1900, £278,783.

Constitution and Government. — The county returns one member to Parliament. The principal towns are Haddington (3992), North Berwick (2784), Dunbar (3581), Tranent (2584), and Prestonpans (1721). "There are 24 civil parishes, forming two combinations with Berwick and Midlothian parishes, with poor-house at Prestonkirk and Inveresk ; the nuniber of paupers and dependants in September 1899 was 958. Haddingtonshire forms part of the sheriffdom of the Lothians and Peebles, and there is a resident sheriff-substitute at Haddington, who sits also at Dunbar, Tranent, and North Berwick.

EdvMition. — Twenty -six school boards manage 41 schools, which had an average attendance of 5062 in 1898-99, while three voluntary schools had 187. There are high schools at North Berwick and Haddington, and seven other Echools earned grants in 1898-99 for giving higher education. The County Council spends a proportion of the " Eesidue " grant in supporting short courses of instruction in technical subjects, chieily agi-iculture, in experiments in feeding cattle and growing crops, and in paying the travelling expenses of technical students.

Agriculture. — Though it no longer stands high above the other counties in the kingdom in respect of successful farming on a large scale. East Lothian is still famous for the richness of its corn and root crops, the size of its holdings, and the good housing of its farm labourers. In 1895 the average size of the 558 holdings was 201 acres ; 14-70 per cent, were under 5 acres, 24-55 were between 5 and 50, and 60-75 were over 50 acres. The number between 50 and 100 acres was 36 ; between 100 and 300, 129 ; between 300 and 500, 120 ; between 500 and 1000, 52, and there were two over 1000. In 1898 the percentage of cultivated area was 65-3, a figure exceeded only by Fife and Linlithgow. Among

the grain crops oats are almost a constant. “Wheat is reviving after a steady and prolonged fall in acreage, while barley has varied remarkably little duri’^” the decade ending 1899. The

following table gives the principal acreages at intervals of ten years from 1880 : —

Tear.

Area tmder

Crops.

Com

Crops.

Green

Crops.

Clover.

Perma-

nent

Pasture.

Fallow.

1880

1890

1899

115,804

115,691

111,902

45,299

40,506

39,463

26,163

24,036

24,624

27,088

80,175

27,539

16,242

20,296

19,852

1012

276

44

The following table gives particulars of the live stock at in-

tervals of five years from 1880 : —

.Tear.

Total

Horses.

Total

Cattle.

Cows or

Heifers in

Milk or Calf.

Sheep.

Pigs.

1880

1885

1890

1895

1899

3753

3467

3620

3788

3555

8,237

11,327

12,379

9,506

10,115

1807

1864

1832

1808

2011

111,886

132,447

142,070

127,483

131,221

2490

2583

2220 ,

The acreage under wood in 1895 was 10,472. In 1891, 4132 men and 1654 women were returned as being engaged in agriculture.

Industries and Trade. — The coalfield in Haddington West is 30 square miles in extent, with ten seams. In 1890, 300,159 tons of coal, valued at £101,304, were raised ; in 1899, 450,588 tons, vj.lued at £168,971. Fireclay as well as limestone is worked. Apart from the industries connected with agriculture, there are none of importance. The Haddington coast is embraced in the Leith fishery district, and the ports of the county are Dunbar, North Berwick, Port Seton, and Prestonpans, which had among them in 1899 l79 boats of 2556 tons, and 669 resident fishermen and boys ; and the value of the fish landed — chiefly cod, haddocks, whitings, and crabs — was £17,167. Of 4854 men in industrial employment in 1891, 1531 were engaged in raising minerals.

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M'Neill. Tranent and its Surroundings. Edinburgh, 1883. — John Maetinb. Mem/iniacences of the Oou/nty of Haddington. Haddington, 1890 and 1894. — W. Sinclaie. Pictorial Chiide to Haddington. — Dr Wallace James. Writs and Charters of Haddington. Haddington, 1898. (-W. Wa.)

Haddington, a royal burgh and tie county town of Haddingtonshire, Scotland, on the river Tyne, 17 miles east of Edinburgh by road, the terminus of a branch of the North British Eailway. There are four bridges over the Tyne, and another is in course of construction, and the market cross has been restored. Haddington is the retail centre for a large district, and its grain markets, once the largest in Scotland, are still of considerable importance. The Knox Institute, built in 1880, contains a lecture room, and took the place of the ancient and famous grammar schooL There is, besides, a public school, which had an average attendance of 457 in 1898-99, while a Koman Catholic school had 130. Population (1881), 4043 ; (1901), 3992.

Haeckel, Ernst Heinrich <1834),

German biologist, was born at Potsdam on 16th February 1834. He studied medicine and science at "Wiirzburg, Berlin, and Vienna, having for his masters such men as Johannes MuUer, Virchow, and Kblliker,and in 1857 graduated at Berlin as M.D. and M.Ch. At the wish of his father he began to practise as a doctor in that city, but his patients were few in number, one reason being that he did not wish them to be many, and after a short time he turned to more congenial pursuits. In 1861, at the instance of Gegenbaur, he became privat-docent at Jena ; in the succeeding year he was chosen extraordinary professor of comparative anatomy and director of the Zoological Institute in the same university; in 1865 he was appointed to a chair of zoology which was specially established for his benefit. This last position he continued to retain in spite of repeated iuTitations to migrate to more important centres, such as Strassburg or Vienna, and at Jena he has spent his life, with the exception of the time devoted to travelling in various parts of the world, whence in every case he brought back a rich

zoological harvest.

As a field naturalist Haeckel displayed extraordinary power and industry. Among his monographs may be mentioned those on Radiolaria (1862), Siphonophora (1869), Monera (1870), Calcareous Sponges (1872), and Arabian Corah (1876), as weU as several Challenger reports, viz., Deep-Sea Medusae (1881), Siphonoph/yra (1888), Deep-Sea Keratosa (1889), and Hadiolaria (1887), the last being accompanied by 140 plates and enumerating several thousand new species. This output of systematic and descriptive work would alone have constituted a good life's work, but Haeckel has in addition written cojiiously on biological theory. It happened that just when he was beginning his scientific career Darwin's Origin of Species was published (1859), and such was the influence it exer-

cised over him that he became the apostle of Darwinism in Germany. He was, indeed, the first German biologist to give a whole-hearted adherence to the doctrine of organic evolution and to treat it as the cardinal conception of modern biology. It was he who first brought it prominently before the notice of German men of science in his memoir on the Sadiolaria, which was completely pervaded with its spirit, and later at the Congress of Naturalists at Stettin in 1863. Darwin himself has placed on record the conviction that Haeckel's enthusiastic propagandism of the doctrine was the chief factor of its success in Germany. His book on General Morphology (1866), published when he was only thirty-two years old, was called by Huxley a suggestive attempt to work out the practical application of evolution to its final results; and if it does, not take rank as a classic, it will at least stand out as a landmark in the history of biological doctrine in the 19th century. Although it contains a statement of most of the views with which Haeckel's name is associated, it did not attract

much attention on its first appearance, and accordingly its author rewrote much of its substance in a more popular style and published it a year or two later as the Natural History of Creation (Natwrliche Schopfv/tigsgeschichte), which was far more successful. In it he divided morphology into two sections — tectology, the science of organic individuality ; and promorphology, which aims at establishing a crystallography of organic forms (see Ency. Brit., vol. xvi. pp. 842—844). Among other matters, he laid particular stress on the " fundamental biogenetic law " that ontogeny recapitulates phylogeny, that the individual organism in its development is to a great extent an epitome of the form-modifications undergone by the successive ancestors of the species in the course of their historic evolution {Ency. Brit., xx. p. 422). His well-known " gastraea " theory is an outcome of this generalization. / He divided the whole animal creation into two categories — the Protozoa or unicellular animals, and the Metazoa or multicellular animals, and he pointed out that while the former remain single-celled throughout their existence,

the latter are only so at the beginning, and are subsequently built up of innumerable cells, the single primitive egg-cell (pvwm) being transformed by cleavage into a globular mass of cells (morula), which first becomes a hollow vesicle and then changes into the gastrula. The simplest multicellular animal he conceived to resemble this gastrula with its two primary layers, ectoderm and endoderm, and the earliest hypothetical form of this kind, from which the higher animals might be supposed to be actually descended, he called the " gastraea." This theory was first put forward in the memoir on the calcareous sponges, which in its sub-title was described as an attempt at an analytical

solution of the problem of the origin of species, and was subsequently elaborated in various Studies on the Oastraea Theory (1873-84). Haeckel, again, was the first to attempt to draw up a genealogical tree (Stammbaum) exhibiting the relationship between the various orders of animals with

regard both to one another and their common origin. His earliest attempt in the General Morphology was succeeded by many others, but his efforts in this direction may perhaps be held to culminate in the paper he read before the fourth International Zoological Congress, held at Cambridge in 1898, when he traced the descent of the human race in twenty-six stages from organisms like the still-existing Monera, simple structureless masses of protoplasm, and the unicellular Protista, through the chimpanzees and the Pithecanthropus erectus, of which a feiy fossil bones were discovered in Java in 1894, and which he holds to be undoubtedly an intermediate form counecting primitive man with the anthropoid apes. In 1900 he made a voyage to Java and the East Indies for scientific purposes, and on his return published Aus Insulinde, Malay ische Reisehriefe (1901).

Not content with the study of the doctrine of evolution in its zoological aspects, Haeckel also applied it to some of the oldest problems of philosophy and religion. What he terms the integration of his views on these subjects he

published under the title of Die Welt-rdthsel, which in 1900 appeared in English as The Riddle of the Universe. In this book he displays the courage of his convictions to an extent which the reader may feel ceases to be meritorious in the absence of adequate argument. Adopting an un-compromising monistic attitude, he asserts the essential unity of organic and inorganic nature. According to his "carbon-theory," which has been far from achieving general acceptance, the chemico-physical properties of carbon in its complex albuminoid compounds are the sole and the mechanical cause of the specific phenomena of movement which distinguish organic from inorganic sub-stances, and the first development of living protoplasm, as seen in the Monera, arises from such nitrogenous carbon-compounds by a process of spontaneous generation. Psychology he regards as merely a branch of physiology, and psychical activity as a group of vital phenomena which depend solely on physiological actions and material changes taking place in the protoplasm of the organism in which it is manifested. Every living cell has psychic

properties, and the psychic life of multicellular organisms is the sum-total of the psychic functions of the cells of which they are composed. Moreover, just as the highest animals have been evolved from the simplest forms of life, so the highest faculties of the human mind have been evolved from the soul of the brute-beasts, and more remotely from the simple cell-soul of the unicellular Protozoa. As a consequence of these views Haeckel is led to deny the immortality of the soul, the freedom of the will, and the existence of a personal God,

There is a biography by W. Bolsche (Dresden, 1900).

Hagen, an industrial town of Prussia, province of Westphalia, 15 m iles by rail north-east of Elberf eld Barmen . It is the seat of important iron and cotton industries, and also of paper, cloth, and tobacco factories, tanneries, distilleries, and breweries. Among its principal buildings are the Luther church (1886-89,), the Eoman Catholic church (1896), and the royal engineering school (1891-1894). There are also a municipal park and a bronze statue of the Emperor Frederick III. (1899). Population

(1885), 29,614; (1900), 50,609. In April 1901 the rural commune of Eckesey (12,326) was incorporated with Hagen, making the total population of Hagen and its environs 62,935.

Hagerstown, capital of Washington county, Maryland, U.S.A., west of the Blue Eidge, on the Baltimore and Ohio, the Norfolk and Western, the Western Maryland, and the Cumberland Valley railways, at an altitude of 567 feet. It is the seat of Kee Mar College, a Lutheran institution for women, established in 1852, and having, in 1898, 15 instructors and 110 students. Population (1880), 6627; (1890), 10,118; (1900), 13,591, of whom 394 were foreign-born and 1277 negroes.

Hagonoy, a town in the extreme south-western portion of the province of Bulacan, Luzon, Philippine Islands. It is the centre of a rich agricultural region, producing rice, Indian corn, coffee, and sugar. Alcohol is made in considerable quantities from the fermented juice of the nipa palm, which grows in the neighbouring swamps. The women of this town are very skilful in weaving the

native fabrics. The language is Tagalog. Population, 20,000.

Hague, The (in Dutch ^S Gfravenhage, or den Haag), chief town of the province of South Holland (Nether-lands), 13 miles N.W. of Rotterdam by rail. Its western portion being built upon high, dry, and sandy soil (the south and south-eastern on low-lying moorland), contains the healthiest, pleasantest, and most prosperous quarters, and the parks, gardens, and woods. The museums, libraries, scientific institutions, and art collections, and the attractiveness of the environs (Scheveningen, Wasse-naer, Haagsche Bosch), make the town a popular resort for people of private means, ex-officials, colonials from India, artists, and scientific men, more especially as rents are low. Accordingly it has of late years grown more rapidly than any other in the kingdom, and many new streets and quarters have been built. Its industries have changed little, but the manufacture at Eozenburg of fine earthenware (Eozenburg-Delftsch) must be specially men-tioned. A few buildings have been renewed or restored,

among them the ministry of justice, the town hall, and the railway stations. The new buildings include one for the arts and sciences, a school for imbeciles, and one for technical instruction. A new fishing port is proposed near the end of the Hague-Scheveningen canal. Population (1869), 90,277; (1900), 206,023.

Hahn-Hahn, Ida, Countess (1805-1880), German authoress, was born at Tressow, in Meeklenburg-Schwerin, on 22nd June 1805. Her maiden name was Hahn, but she became Countess Hahn-Hahn on her marriage with her cousin in 1826. In 1829 the husband's irregularities led to a divorce. The countess travelled, produced some volumes of poetry indicating true lyrical feeling, and in 1838 appeared as a novelist with Aus der Gesellschaft, a title which, proving equally applicable to her subsequent novels, was retained as that of a series, the book originally so entitled being renamed Ida Schonholm. Eor several years the countess continued to produce novels bearing a certain subjective resemblance to those of George Sand, but less hostile to social institutions, and deal-

ing almost exclusively with aristocratic society. The authoress's patrician affectations at length drew upon her the merciless ridicule of Eanny Lewald in a parody of her style entitled Diogena (1847), and this and the revolution of 1848 together seemed to have co-operated in inducing her to embrace the Roman Catholic religion in 1850. She justified her step in a polemical work entitled From Babylon to Jerusalem (1851), which elicited a cutting reply from Professor Abeken. In 1852 she retired into a convent at Antwerp, but continued to write ; her later publica-tions, however, passed unnoticed as mere party manifes-toes. Her earlier works do not deserve the neglect into which they have fallen. If their sentimentalism is some-

times wearisome, it is grounded on genuine feeling and expressed with passionate eloquence. Ulrich and Faustine, both published in 1841, mark the culmination of her power; but Sigismwnd Forster (1843), Cecil (1844), and Sihylle (1846) also obtained considerable popularity. She

died at Mainz on the 12th of January 1880. (k. g.)

Haidarabad, or Htdeeabad, a native state of India, also known as the Nizam's Dominions and the Deccan, occupying the eastern portion of the plateau of Southern India. In 1887, on the occasion of Queen Victoria's Jubilee, the Nizam made an offer to the Viceroy of pecuniary aid for frontier defence, which led to the organization of the imperial service troops now maintained by several native chiefs. In 1900 he paid a visit to the Viceroy at Calcutta, being the first Nizam to leave his own dominions. The visit was returned by Lord Curzon in April 1902.

The following table gives the area and population of the several districts of Haidarabad state according to the census of 1901 : —

Area and Population of Haidarabad, 1901,

Divisions.

Districts.

Number

ofTowns

and

Tillagea.

Population, Census of 1901.

Density

of Popu-

lation to

Square

Mile.

Popula-

tion,

Census

of 1891.

Males.

Females.

Total.

Western .

Northern.

North-

western

Eastern .

Southern

Eailways

(Bidar .

< Nander

(Naldrug .

‘Elgandal .

Indor .

■ Mehdak

. Sirpur Tandur .

C Aurangabad

{ Parbhani .

(Birh .

(Warangal .

] Mahbubnagar

(Nalgonda .

‘Gulbarga

Linsugur

Eaiohor

,Atraf-i-Balda .

4,180

8,843

4,010

1,444

1,174

862

352,211

250,481

273,703

867,062

260,796

267,222

“so’fco’fcO

170-

160

186

901,984

632,529

649,272

11,688

8,480

876,895

87.6,080

1,751,475

152

2,183,786

7,207

4,822

2,017

5,029

1,561

1,119

684

946

680,498

318,688

199,940

134,760

545,080

818,789

195,338

188,418

1,125,678

687,272

395,278

268,173

166

132

196

63

1,094,601

689,698

864,736

231,754

19,075

4.260

1,288,731

1,192,570

2,426,801

184

2,330,688

6,176

5,087

4,460

1,836

1,510

1,013

369,364

822,226

287,600

359,696

319,690

288,222

719,049

641,816

470,722

116

126

106

828,976

805,386

642,722

16,723

4,369

919,079

912,507

1,881,586

116

2,277,032

9,779

6,497

4,131

1,519

1,855

961

499,788

860,102

861,664

466,666

860,915

882,667

966,463

711,017

684,231

99

109

166

853,129

674,649

624,617

20,407

3,835

1,211,454

1,150,247

2,361,701

126

2,152,896

4,064

4,907

3,661

1,109

1,278

925

396,451

835,737

257,714

886,078

884,666

261,383

781,529

670,808

509,097

191

186

189

649,268

620,014

512,455

12,682

3,312

989,902

971,027

1,960,929

166

1,781,727

3,828

851

426,126

403,954

880,080

261

804,823

8,086

4,740

. 12,826

6,690

Grand Total .

82,698

20,087

5,684,772

5,610,126

11,174,897

185

11,637,040

The average density is 135 persons per square mile, ranging from 196 in Mehdak, on the west, to 63 in Sirpur Tandur, on the north. Classified according to religion, in 1891 Hindus numbered 10,315,249, or 89 per cent, of the total population. In the west they speak Narathi, in the south and east Telugu. Mahommedans numbered 1,138,666, or 10 per cent., being most numerous in Haidarabad city. Christians numbered 20,429, of whom half were Roman Catholics. Jains numbered 27,845; Sikhs, 4637; Parsis, 1058; Jews, 26 ;> and aboriginal tribes, 29,130. The preliminary returns of the census of 1901 gave the total as 11,174,897, showing a decrease of 362,143, or 3 per cent., compared with an increase of 1,691,446, or 17 per cent., in the preceding decade. In some districts, where the famine of 1900 was most severe, the rate of decrease was as high as 20 per cent.

The yearly revenue of the state is estimated at Es.4,00,00,000, of which about half is derived from the land. The Haidarabad Contingent consists of six regiments of cavalry, four batteries of artillery, and six battalions of infantry — total, 7660 men, all under British officers, maintained at a cost of about Es.40,00,000. The currency is based on the halli rupee, which contains approximately the same weight of silver as the British rupee, but its exchange value has fallen heavily since the closing of the mints. The conventional rate of exchange is 128 halli rupees =100 British rupees. An independent post-office is also maintained. Eailways have been made hj an English company under a guarantee from the state. The main line of the Great Indian Peninsula traverses the south-western corner of the state, whence a branch mns from Wadi to Haidarabad city, now con-tinued through Warangal to Bezwada on the East Coast system. There is also a short branch to the Singareni coalfields. Another line was opened in 1900 in the north-east of the state, from Manmad junction by

Aurangabad along the valley of the Godavery to Hai-
darabad city (386 miles). The total length of railway
open in 1900 was 715 miles, the gross earnings being
£422,102 and the net profits £205,400. The coal mine
at Singareni is worked by an English company, employ-
ing 6800 persons, of whom 4860 are adult males. In
1898 the output was 394,622 tons,
valued at Es.11,83,870. Attempts
to work gold and diamond mines
have not been successful. There
are three cotton mills, belonging
to companies, j at Haidarabad city,
Aurangabad, and Gulbarga, with
623 looms and 52,476 spindles,
employing 2480 hands. The state
has suffered from bad seasons, which
culminated in 1900 in actual famine.
The total number of persons in re-
ceipt of relief rose to nearly 600,000
in June 1900.

The City of Haidakabad is

situated on the river Musi, about

1700 feet above the sea. Popular

tion, together with Seeunderabad

and the suburbs (1881), 367,417;

(1891), 415,039; (1901), 446,291.

Haidarabad is thus the fourth most

populous city in India, being sur-

passed only by the three Presidency

towns, which are all seaports. The

city proper is surrounded by a

stone wall, with a circuit of about

6 miles. Seeunderabad (6 miles)

is the headquarters of a first-class

military district under the Madras command. A little

farther north (9 miles) is Bolaram, another military

cantonment. The old fortress of Golconda, now used

as a state treasury and prison, is about 7 mUes to the

west.

J. B. Gribble. a History of the Deccan. liOndon, 1896.

Haidarabad, or Hydebabad, a city and dis-
trict of British India, in the Sind province of Bombay.
The city is on a hill about 3 miles from the left bank of
the Indus, and had a population in 1881 of 48,163, and
in 1891 of 54,048. An excellent water supply is derived
from the Indus. Communication is maintained with the
railway station of Kotri, on the opposite bank of the river,
by a steam ferry from Gidu-Bandar ; but the stream has
been bridged, and a railway runs thence into Eajputana.
There are manufactures of silk, gold, and silver em-
broidery, lacquered ware and pottery, and three factories
for ginning cotton. It has three high schools, with about
800 pupils, training colleges for masters and mistresses, a
medical school, an agricultural school for village officials,

a technical school, and three printing-presses, each issuing
a vernacular periodical. The city suffered from plague ia
1896-97, but the death-rate for 1897 was only 38-9 per

1000. The District of Haidakabad has an area of 9033 square miles, with a population in 1881 of 754,624, and in 1891 of 918,646, giving an average density of 102 persons per square mile, being the highest in Sind. In 1901 the population was 990,602, showing an increase of 1 per cent., compared with an increase of 16 per cent, in the previous decade. The land revenue was Es.21,46,338, the incidence of assessment being Rs.2-6-6 per acre; the cultivated area in 1897-98 was 942,471 acres, of which 916,669 were irrigated, iucluding 842,445 from Government canals ; the number of police was 1174 ; the children at school in 1897-98 numbered 15,853, being 2-1 per cent, of the total population ; the registered death-rate in 1897 was 14-4 per 1000. The principal crops are millet, rice, oil-seeds, cotton, and wheat. There is a special manufacture at Hala of glazed pottery and striped cotton cloth. A railway crosses the district eastwards from Haidarabad to Shadipalli, which will be extended across the Indus on one side and into Eajputana on the other, thus affording a direct route, on the metre gauge,

from Northern India nearly to Karachi.

Haifa, a coast town of Palestine, situated at the foot of Mount Carmel, on the south side of the bay of Acre. Its roadstead is protected from south and west winds, and the town, from its more favourable position, is attracting much of the trade of Acre. A railway to Damascus has been commenced, and it is proposed to construct a port. If these works are completed, Haifa will become the most important port on the coast of Syria. The German colony of " Templars," established near the town in 1869, has been the means of greatly increasing its prosperity. In 1900 the exports, cereals and oil, were valued at £178,738. The population numbered 12,000 (Germans 500, Moslems 6000, Christians 4000, Jews 1500). About two miles north-west of Haifa is the celebrated Carmelite monastery.

(c. w. w.)

Hainan, a large island off the southern coast of China, forming part of the province of Kwangtung. The trade of Kiungchow, which is the only treaty port in the island, has risen from 1,216,000 Haikwan taels, or

£175,300, in 1878 to 4,647,000 Haikwan taels, or £670,600, in 1899. This trade is almost entirely with the British colony of Hong-Kong, with which the port is connected by small coasting steamers, but since 1893 it has had regular steamboat communication with Haiphong in Tongking. The population of Kiungchow, including its shipping port of Hoihow, is estimated at 52,000. The number of foreign residents in 1900 was about 30, most of them officials or missionaries.

Hainaut (French, Hainaut; Flemish, Henegouwen), a Belgian province bordering on West and East Flanders, Brabant, Namur, and the French department Du Nord. A part of the ancient Countship of Hainaut of the 9th century, it was under the government of France known as the " departement de Jemappes " — the name of a place where the French arms were victorious in 1792. The land rises in a southerly direction up to a height of 1200 feet. The western half of the province belongs to the basin of the Scheldt, the eastern half to the basin of the Meuse. These two basins communicate with one another

by the Charleroi canal. In the way of mineral products, coal is extracted in the three regions of Borinage, Centre, and Charleroi basins, the mining employing 83,000 workers. The province has also quarries of marble, of building-, paving-, and lime-stone, employing 11,000 workers. The crops include cereals, beetroot, flax, hemp, and tobacco. Though agriculture is in a high state of excellence, the province is essentially industrial. The principal industries are: metallurgy in all its branches, employing 24,000 workers — rolling mills, steam engines, railway material, &c. ; glass works, employing 14,000 persons ; numerous sugar refineries, chemical works, &c. The province is divided into six administrative arrondissements. The chief towns are : Mons (66,600 inhabitants), capital of the province; Tournai (36,800); Charleroi (24,400) ; and, among the industrial towns, Jumet (25,000), La Louviere (16,000). The province covers 1437 square miles, with (1899) a population of 1,133,672, or 789 to the square mile. Between 1876 and 1899 the population of the province decreased 177,318, having

been at the former date 966,354.

Haiphong, a town in Tongking, French Indo-China, on one of the branches of the Song-Koi (or Eed Eiver) delta. So recently as 1880 wide marshes and sub-merged rice-fields extended round the junction of the Kwa-Kam and the Song Tam Bac mouths of the Eed Eiver. On the same site to-day stands Haiphong, the largest town of Tongking with the exception of Hanoi. It has a population of about 17,000, of whom 630 are European (exclusive of officials and the garrison) and 5000 Chinese, and is the great port of Tongking. Since 1893 the open-ing of navigation on the Eed Eiver and the establish-ment of regular services to Hong-Kong, Pakhoi, and Hoihow (on Hainan island) has greatly increased the traffic. The steamers to the interior of Tongking num-ber more than 1800 entering and clearing. The excava^ tion of the Kwa-lSTam-Triu, in course of completion, will permit the largest vessels to reach Haiphong without being delayed by the bar. The town was constituted a municipality 19th July 1888. Since 1893 it has been

lighted by electricity. There are extensive artillery work-shops and military stores in the Annamese citadel. Haiphong is a naval station for warships on the reserve and for dismantled gunboats. The streets are regularly laid out and planted with trees. The Boulevard Paul Bert is the finest European street. The most noteworthy buildings are the Residency, the tribunal, the Indo-Chinese Bank, the Treasury, and the mansion of the Governor-General. There are also fine promenades and a race-course, and the town boasts three printing-ofSces and three French newspapers. Fourteen miles from Haiphong, along a fairly good road, lies the bathing resort of Do-Son, the only seaside town in Tongking in which searbathing can be enjoyed. The Governor-General has a villa there. Since 1891 many houses have been built, and the beach has been much frequented. All the great Indo-Chinese banks have branch establishments at Haiphong, and its chamber of commerce is of sufficient importance to en-title its president to a seat upon the superior councU of Indo-China. (j. m. a. de l.)

Hajipur, a town of British India, in the Muzaffarpur district of Bengal, on the Gandak, just above its confluence with the Ganges above Patna. It is the terminus of the branch of the Tirhut railway from Muzaffarpur, and of another branch under construction along the Ganges to Katihar. Population (1881), 25,078 ; (1891), 21,487.

Halcata. See Fukuoka.

Halce, Thomas Cordon (1809-1896), English poet, was born at Leeds in 1809. A physician by profession, he had given up practice for many years before his death, and had devoted himself to a literary life. In 1839 he published a prose epic Vales, which attracted the attention of D. G. Eossetti, and in after years he became

an intimate member of Eossetti's circle of friends and followers. In 1871 he published Madeline, (1873) Parables and Tales, (1883) The Serpent Play, (1890) New Day Sonnets, and in 1892 he published his Memoirs. Dr Hake's works had much subtlety and felicity of ex-

pression, and were warmly appreciated in a somewhat restricted literary circle. He was given a Civil List literary pension in 1893, and died on 11th January 1896.

Hakodate, a town on the south-east of the island of Yezo, Japan, situated in 41° 46′ N. lat. and 140° 44′ E. long., for many years regarded as the capital of the island until Sapporo was officially raised to that rank. It is one of the ports originally opened to foreign trade, and the development of its commerce is exhibited in the following table : —

Tear.	*Exports.*	*Imports.*	*Total.*
1884			
1889			
1893			
1899	*£67,663*	*126,858*	

79,953

211,605

£898

19,105

3,040

172,646

£68,561

145,963

82,993

384,251

The staple exports are beans, pulse, and peas, marine products, sulphur, furs, and timber ; the staple imports, comestibles (especially salted fish), kerosene, and oU-cake. The town is not situated so as to profit largely by the development of the resources of Yezo. The population grew from 55,677 in 1890 to 78,040 in 1899, and its prosperity has increased in a corresponding ratio, but as a port for foreign trade its outlook is indifferent. Good steamers ply between Hakodate and Yokohama twice or thrice a week, and there is daily communication with

Aomori, 56 miles distant, whence train may be taken for Tokyo. Hakodate has now a tramway, and is provided with water-works, the water being carried from the Akar gawa, 7 miles distant. A fort has been constructed near the summit of the Peak, a great rock which has been likened to Gibraltar, and it is consequently no longer accessible to view-gazers.

Hal, a town of Belgium, in the province of Brabant, 10 miles south of Brussels by rail. It has several industries, including the manufacture of beetroot sugar, considerable beer brewing, and the building of canal boats. Population (communal, 1899), 12,026.

Halberstadt, a town of Prussia, province of Saxony, 56 miles by rail N.W. of Halle. Gleim's house became the property of the municipality in 1899. The leading industries are the manufacture of cigars, gloves, and sugar, distilling, brewing, and tanning. There are also large railway workshops. Population (1885), 34,026 ; (1900), 42,644.

Halevy, Ludovic (1834), Prench author,

was born in Paris on the 1st of January 1834. His father, Leon Halevy, was a clever and versatile writer, who tried almost every branch of literature — prose and verse, vaudeville, drama, history — without, however, achieving decisive success in any. His uncle, Promental Haldvy, the celebrated author of La Juive, was for many years directeur du cliant at the Opera ; hence the double and early connexion of Ludovic Halevy with the Parisian stage. At the age of six he might have been seen playing in that Foyer de la danse with which he was to make his readers so familiar, and, when a boy of twelve, he would often, of a Sunday night, on his way back to the College Louis le Grand, look' in at the Odeon, where he had free admittance, and see the first act of the new play. At eighteen he joined the ranks of the French administration and occupied various posts, the last being that of secretaire-redacteur to the Corps L^gislatif. In that capacity he enjoyed the special favour and friendship of the famous duke of Morny, then President of that assembly. In 1865 Ludovic Hal^vy's increasing popularity as an

author enabled him to retire from the public service. Ten years earlier he had become acquainted with the musician Offenbach, who was about to start a small theatre of his own in the Champs i^lysees, and he wrote a sort of prologue, Entrez, messieurs, mesdames, for the opening night. Other little productions followed, Ba^ta-dan being the most noticeable among them. They were produced under the pseudonym of Jules Servi^res. The name of Ludovic Halevy appeared for the first time on the bills on the 1st of January 1856. Soon afterwards the unprecedented run of OrpMe aux Enfers, a musical parody, written in collaboration with Hector Cr^mieux, made his name famous. In the spring of 1860 he was commissioned to write a play for the manager of the Variitis in conjunction with another vaudevillist, Lam-bert Thiboust. The latter having abruptly retired from the collaboration, Halevy was at a loss how to carry out the contract, when on the steps of the theatre he met Henri Meilhac (1831-1897), then comparatively a stranger to him. He proposed to Meilhac the task rejected by Lam-

bert Thiboust, and the proposal was immediately accepted. Thus began a connexion which was to last over twenty years, and which proved most fruitful both for the reputation of the two authors and the prosperity of the minor Paris theatres. Their joint works may be divided into three classes : the opirettes, the farces, the comedies. The op&rettes afforded excellent opportunities to a gifted musician for the display of his peculiar humour. They were broad and lively libels against the society of the time, but savoujed strongly of the vices and follies they were supposed to satirize. Amongst the most celebrated works of the joint-authors were La Belle HeUne (1864), Barbe Bleue (1866), La Orande Duchesse de Gerolstein (1867), and La Perichole (1868). After 1870 the vogue of Parody rapidly declined. The decadence became still more apparent when Offenbach was no longer at hand to assist the two authors with his quaint musical irony, and when they had to deal with interpreters almost destitute of singing powers. They wrote farces of the old type, consisting of complicated intrigues, with which they cleverly

interwove the representation of contemporary whims and social oddities. They generally failed when they attempted comedies of a more serious character and tried to introduce a higher sort of emotion. A solitary exception must be made in the case of Frou-frou (1869), which, owing perhaps to the admirable talent of Aimee Desclee, remains their unique succis de larmes.

Meilhac and Halevy will be found at their best in light sketches of Parisian life, Les Sonnettes, Le Boi Candaule, Madame attende Monsieur, Toto chez Tata. In that intimate association between the two men who had met so opportunely on the perron des Variitis, it was often asked who was the leading partner. The question was not answered until the connexion was finally severed and they stood before the public, each to answer for his own work. It was then apparent that they had many gifts in comm on. Both had wit, humour, observation of character. Meilhac had a ready imagination, a rich and whimsical fancy; Halevy had taste, refinement, and pathos of a certain kind. Not less clever than his brilliant comrade,

he was more human. Of this he gave evidence in two delightful books. Monsieur et Madame Cardinal and Les petites Cardinal, in which the lowest orders of the Parisian middle class are faithfully described. The pompous, pedantic, venomous Monsieur Cardinal will long survive as the true image of sententious and self-glorifying immorality. M. Halevy's peculiar qualities are even more visible in the simple and striking scenes of the Invasion, published soon after the conclusion of the

Pranco-Germaii war, in Criquette and L'AbM Constantin (1882), two novels, the latter of which went through in-numerable editions. Zola had presented to the public an almost exclusive combination of bad men and women ; in L'AbM Constantin all are kind and good, and the change was eagerly welcomed by the public. Some enthusiasts still maintain that the Abbi will rank permanently in literature by the side of the equally chimerical Vicar of WaTceJield. At any rate, it opened for M. Ludovic Halevy

the doors of the French Academy, to which he was elected in 1888.

Hale, Edward Everett (1822--), American author and Unitarian minister, was born in Boston, 3rd April 1822, being the son of Nathan Hale, editor of the Boston Daily Advertiser, and the nephew of Edward Everett, the orator and statesman. He graduated at Harvard in 1839, entered the Unitarian ministry, and, after a pastorate in Worcester, Massachusetts, became minister of the South Congregational (Unitarian) Church in Boston in 1856. There he remained until his resignation in 1899. While he always deemed his life-work to be that of a Christian minister, and his strong personality affected New England life for half a century, he was a constant and voluminous contributor to the periodical press ; he edited many magazines and newspapers, of which the monthly Old and New was the most ambitious ; and is the author or editor of sixty or seventy volumes — fiction, juvenile stories, books of

travel, sermons, biography, and history. His best>known short story is The Man witliout a Country, which, published in the Atlantic Monthly in 1863, at the darkest period of the American Civil War, did much to strengthen the Union cause in the North. In this, and in some of his other non-romantic tales, he employed a minute realism which led many readers to suppose the narrative a record of unaltered fact. The story Ten Times One is Ten (1870), with its hero Harry Wadsworth and its motto, " Look up and not down, look out and not in, look before and not behind, and lend a hand," led to the formation, in many' parts of the United States, of " Lend a Hand Clubs," " Look-up Legions," or " Harry Wadsworth Clubs " ; while out of the romantic Waldensian religious story In His Name (1874) there similarly grew orders of "King's Daughters," "King's Sons," and other organized bodies for religious work. Of his other writings in prose and verse — all marked by abounding vivacity, earnest humanity, and rapidity of workmanship — the most important are the two volumes, largely based

on painstaking original research, in collaboration with his son, Edward Everett Hale, Jun., on Franklin in France (1887-88: Part L "The Alliance"; Part II. " The Treaty of Peace and Eranklin's Life till his Re-turn ") ; the autobiographical record of his own New England Boyhood (1893) in Boston in the 'twenties and 'thirties ; and the account, from first-hand sources and personal knowledge, of James Russell Lowell and his Friends (1899). Dr Hale interested himself successively in the anti-slavery movement, the protective tariff, popular education, and working-men's home life. A collected and revised edition of his writings began to appear in 1899.

Halfaya, a historical town of Anglo-Egyptian Sudan, which gives its name to the district of Khartum. Eor several years after its occupation by the Egyptians (1821) it continued to be the chief station about the con-fluence of the Blue and White Niles. It stands 7 miles above the confluence, and before the Mahdist revolt was the residence of the powerful sheikh of the Jalin Arabs.

But it lost most of its importance when the seat of government was removed by Mehemet Ali to Khartum.

Halicz, a town in the government district of Stanislau, Galicia, Austria, at the confluence of the Luckow with the Dniester. It is commanded by the ruins of the old castle of Halicz, the seat of the ruler of the former kingdom from which Galicia has derived its Polish name. Its principal resources are the recovery of salt from the neighbouring brine wells, soap-making, and the trade in timber. Population (1890), 3887 ; (1900), 4809.

Halifax, a municipal, county (1888), and parliamentary borough of the West Biding of Yorkshire, England, on the Hebble near its influx into the Calder, 7 miles south-west by west of Bradford, 209 miles by rail north-north-west of London. The municipal borough is divided into 15 wards under a mayor, 15 aldermen, and 45 councillors. The corporation possesses waterworks, gas-works, electric works, tramways, a bonding warehouse, two public libraries, an art gallery and museum (1886), a technical school (1895, costing over £26,000), a court

house and police station, erected at a cost of £27,000, a fire brigade station, and six parks. Modern public buildings include the handsome post office (1887), a new infirmary (1896), and a higher-grade board school. There are two newspapers. The manufacture of carpets is a large industry, one establishment employing 6000 hands. In 1891, 2280 persons were employed in the making of machines, 4070 males and 7506 females in the worsted, 1365 males and 965 females in the woollen, 1159 males and 1364 females in the cotton, and 970 persons in the iron and steel manufacture. The municipal and county borough, coextensive with the parliamentary borough till 1892, was extended then, and again in 1900, and now has an area of 13,636 acres. Population (1891), 97,714 ; (1901), 104,933.

Halifax, city and port of entry, the capital of Nova Scotia and of Halifax county, on the south-east coast of the province. Eecent improvements are the new Dalhousie College, the Intercolonial railway station, a dry dock constructed by a company with Imperial,

Dominion, and civic subsidies, having a capacity for ships of 600 feet in length, and used by the Admiralty and by the Government of the United States for repair-ing ships of war ; spacious wharves, wai-ehouses, freight sheds, &c., and a grain elevator with a capacity of some 750,000 bushels, constructed at the deep-water terminus of the Intercolonial railway ; armouries for the militia, and a new building for the school for deaf and dumb. There are twenty-six churches, five banks, and branches of two others. Halifax is the American terminus of the Direct Cable Company. It is one of the termini of the subsidized mail steamers plying between Great Britain and Canada, and secures a portion of the winter trade. The city is lighted by gas and electricity, and an electric street railway traverses the principal streets. In 1900 there were 148 teachers employed and 7988 pupils at-tended the city schools, being 1 in 4-8 of the population. There are two manual training schools, one for boys and one for girls. In 1900 the number of British and foreign vessels entered was 1080, tonnage 866,989 ; cleared 1185,

tonnage 840,796. Moreover, in connexion with the coasting trade 4030 vessels of 495,394 tons entered in 1900, and 3790 of 529,284 tons cleared. The net debt in 1899 was 13,153,516, taxable property $23,260,962. Exports in 1890 were valued at $5,292,498, in 1900 at 16,758,403 ; imports in 1890 at $6,669,858, in 1900 at 16,335,691. Population (1881), 36,100; (1891), 38,496 ; (1901), 40,787. > V y. > .

Hall, a town in northern Tirol, Austria, on the left bank of the Inn, 4 miles east of Innsbruck. Among its new industries are corn-milling, the manufacture of felt hats, bone buttons, and fire-engines. An important

feature of the town is its growing popularity as a health resort, its brine and mineral springs possessing valuable properties. Population, Roman Catholic and German (1890), 5763; (1900), 6191.

Hall, or Bad-Hall, a market-place and spa in the government district of Steyr, Upper Austria. Its saline

springs, strongly impregnated with iodine and bromine, have been known since the 9th century, and have the reputation of being very efficacious in scrofulous affections and venereal skin diseases. There is a kurhaus, a children's hospital, and a bathing establishment for poor patients. It is annually visited by about 3500 patients. Population (1890), 866 ; (1900), 984.

Hall, Christopher Newman (1816-1902), English Congregational divine, son of the proprietor and printer of the Maidstone Journal, was born at Maidstone on 22nd May 1816, and educated at Totteridge and Highbury College. He also attended classes at University College, and took the London B.A. degree. Like the other students of Highbury College, he was often sent to preach at different towns, and had already acquired some practice when he was called (1842) to his first pastorate at the Albion Congregational Church at Hull. During the twelve years of his ministry the membership was greatly increased, and a branch chapel and school were opened. At Hull Newman Hall first began his active

work in temperance reform, and in defence of his position wrote the Scriptural Claims of Teetotalism. In 1854 he accepted a call to Surrey Chapel, London, founded in 1783 by the Rev. Rowland Hill. A consideralDle sum had been bequeathed by the latter for the perpetuation of his work on the expiration of the lease ; but, owing to some legal flaw in the will, the money was not available, and Newman Hall undertook to raise the necessary funds for a new church. By weekly offertories and donations the money for the fine new church at the junction of the Kennington and Westminster Bridge roads was collected, and within four years of opening (1876) the total cost (£63,000) was cleared. In 1892 Newman Hall resigned his post, and afterwards devoted himself to general evangelical work. Most of his writings are small booklets or tracts of a distinctly evangelical character. The best known of these is Come to Jesus, of which no fewer than four million copies were circulated in forty different languages. Newman Hall visited the United States during the Civil War, and did much to promote a friendly understanding

between England and America. A Liberal in polities, and a keen admirer of John Bright, few preachers of any denomination have exercised so far-reaching an influence as " the Dissenters' Bishop," as he came to be termed. He died 18th February 1902.

Halle, a town of Prussia, province of Saxony, 21 miles by rail north-west of Leipzig on the way. to Magdeburg, and on the river Saale. The oldest parts of the town, between the churches of St Mary and St Maurice, have been modernized by driving some new streets through them. The town council assembly rooms were built in 1890-92, the front being adorned with statues of Charlemagne, the Great Elector, King Erederick I., and the Emperor William I. ; and the town hall was in part restored in 1884. Amongst the public institutions should be mentioned the archaeological museum (opened in 1891), the industrial art museum, the provincial museum and mineralogical museum (these two in the former palace of the archbishops of Magdeburg), the numerous medical institutes (which make up a quarter by themselves, on

the east side of the town), the agricultural institute be-
longing to the university — one of the foremost institu-
tions of the kind in Germany — the institute of physics
with a meteorological institute, the convict prison, the
Leopoldine Carolinian Academy, the provincial blind
asylum (brought hither from Barby), the Riebeck old age
asylum (1894-96), the new theatre (1886), the church of
St Stephen's (1894) and the church of St John's (1893),
a monument to the surgeon von Volkmann (1894), and the
Gothic church of St Francis and St Elizabeth (1894-96).
A new building was completed for the university library
in 1880. A handsome new central railway station was
opened on the east of the town in 1890, its cost being
over half a million sterling. In 1900-1 the university
was attended by 1620 students, and had 156 professors.
Of late Halle has assumed the character and appearance of
a manufacturing town, the principal establishments being
sugar and starch factories, engineering works, factories
for making agricultural machinery, printing works,
breweries, distilleries, chemical factories, and salt works

(some 8500 tons of salt being produced annually). In 1900 the town was enlarged by the incorporation of the communes of Giebichenstein "(15,072 in 1895), Trotha (3656), Crollwitz (2861), and Gimritz (90). Giebichen-stein has a saline spring, which is visited by nearly 1000 persons annually, and is a favourite summer resort of the people of Halle,, as is also the green island of Peissnitz, or the Nightingale Island, on the west of the town. Population (1885), 81,982; (1895), 116,304; (1900), 156,611.

Halle, Sir Charles [originally Kabl Halle] (1819-1895), the eminent pianist and conductor, was born at Hagen, in Westphalia, 11th April 1819. He studied under Rink at Darmstadt in 1835, and as early as 1836 went to Paris, where for twelve years he lived in constant intercourse with Cherubini, Chopin, Liszt, and other musicians, and enjoyed the friendship of the great literary lights of the time, such as Alfred de Muss^t and George Sand. He had started a set of chamber concerts with Alard and Eranchomme with great success, and had com-

pleted one series of them when the revolution of 1848 drove him from Paris, and he settled, with his wife and two children, in London. His pianoforte recitals, given at first from 1850 in his own house, and from 1861 in St James's Hall, were an important feature of London musical life, and it was due in great measure to them that a knowledge of Beethoven's pianoforte sonatas became general in English society. At the Musical Union founded by John Ella, and at the Popular Concerts from their be-ginning, Halle was a frequent performer, and from 1853 was director of the Gentlemen's Concerts in Manchester, where, in 1857, he started a series of concerts of his own, raising the orchestra to a pitch of perfection quite un-known at that time in England. Li 1888 he married Madame Norman Neruda, the famous violinist, and in the same year was knighted ; in 1890 and 1891 he toured with his wife in Australia and elsewhere. He died at Manchester, 25th October 1895. Halle was one of the most important influences in the musical education of England; if his pianoforte-playing, by which he was

mainly known to the public in London, seemed remark-
able rather for precision than for depth, for crystal clear-
ness rather than for warmth, and for perfect realization
of the written text rather than for strong individuality,
it was at least of immense value as giving the composer's
idea with the utmost fidelity. Those who were privileged
to hear him play in private, like those who could appre-
ciate the power, beauty, and imaginative warmth of his
conducting, would have given a very different verdict ; and
they were not wrong in judging Halle to be a man of the
widest and keenest artistic sympathies, with an extraordi-
nary gift of insight into music of every school, as well as
a strong sense of humour. He fought a long and arduous

battle for the best music, and never forgot the dignity of
his art. In spite of the fact that his technique was that
of his youth, of the period before Liszt, the ease and cer-
tainty he attained in the most modern music was not the

less wonderful because he concealed the mechanical means so completely. (j. a. f. m.)

Hallgrimsson, Jonas (1807-1844), the chief lyrical poet of Iceland, was born in 1807 at SteinsstaSir in EyjafjartSarsysla in the north of that island, and educated at the famous school of BessastatSr. In 1832 he went to the University of Copenhagen, and shortly afterwards turned his attention to the natural sciences, especially geology. Having obtained pecuniary assist-ance from the Danish Government, he travelled through all Iceland for scientific purposes in the years 1837-1842, and made many interesting geological observations. Most of his writings on geology are in Danish. His renown was, however, not acquired by his writings in that language, but by his Icelandic poems and short stories. He was well read in German literature, Heine and Schiller being his favourites, and the study of the German masters and the old classical writers of Iceland opened his eyes to the corrupt state of Icelandic poetry and showed him the way to make it better. The misuse of the Eddie

metaphors made the lyrical and epical poetry of the day hardly intelligible, and, to make m atter s worse, the language of the poets was mixed up with words of German and Danish origin. The great Danish philologist and friend of Iceland, Rasmus Eask, and the poet Bjarni Thdrarensen had done much to purify the language, but J6nas Hallgrimsson completed their work by his poems and tales, in a purer language than ever had been written in Iceland since the days of Snorri Sturluson. The excesses of Icelandic poetry were specially seen in the so-called rimur, ballads of heroes, &c., which were fiercely attacked by J6nas Hallgrimsson, who at last succeeded in converting the educated to his view. Most of the principal poems, tales, and essays of J6nas Hallgrimsson appeared in the periodical Fjolnir, which he began publishing at Copen-hagen in 1835, together with Konrd,tS Gislason, a well-known philologist, and the patriotic Thdmas Saemundsson. Fjolnir had in the beginning a hard struggle against old prejudices, but as the years went by its influence became enormous ; and when it at last ceased, its programme

and spirit still lived in Ny Filagsrit and other patriotic periodicals which took its place. Jdnas Hallgrimsson, who died in 1844, is the father of a separate school in Icelandic lyric poetry. He introduced foreign thoughts and metres, but at the same time revived the metres of the Icelandic classical poets. Although his poetical works are all comprised in one small volume, he strikes every string of the old harp of Iceland. (s. bl.)

Halliwell-Phillips, James Orchard (1820-1889), English Shakespearean scholar, son of Thomas Halliwell, was born in London, 21st June 1820, and educated privately and at Jesus College, Cambridge. He devoted himself to antiquarian research, particularly in early English literature. In 1839 he edited Sir John Mandeville's Travels; in 184:2 jiublisiied an Account of the European MSS. in the Chetham Library, besides a newly discovered metrical romance of the 16th century {Torrent of Portugal). He became best known, however, as a Shakespearean editor and collector. In 1848 he brought out his Life of Shalcespeare, which passed through several

editions ; in 1853-65 a subscription edition of the works in folio ; in 1863 a Calendar of the Records at Stratford-on-Avon; in 1864 a History of New Place. He was mainly instrumental in the purchase of New Place for the Corporation of Stratford-on-Avon, and in the formation there of the Shakespeare Museum. His publications in all numbered more than sixty volumes. He assumed the name of Phillips in 1872, under the will of the grandfather of his first wife, a Worcestershire heiress. His house, Hollingbury Copse, near Brighton, was full of rare and curious works, and he generously left many of them to the public. He died 3rd January 1889.

Hallstatt, a market-place in the government district of Gmunden, Upper Austria, on the lake of the same name. The salt mine of Hallstatt, which is one of the oldest in existence, was rediscovered in the 14th century. The neighbourhood (evidently an ancient Celtic settlement) is further remarkable for the great number of antiquities of the Roman and still earlier periods which have been found there. These comprise ornaments and other objects

in bronze, iron, gold, pottery, glass, amber, and ivory. (See works by Baron von Sacken, and Meyer on Da^ Gfrdberfeld von Hallstatt.) Some of these relics have been retained in the Hallstatt Museum, but the most important have been removed to the Natural History Museum in Vienna and the provincial museum at Linz. Population (1890), 789; (1900), 737— all German, two-thirds Catholic and one-third Protestant.

Halmahera, or Jilolo, an island in the East Indian Archipelago, east of the north part of Celebes, belonging to the Dutch residency of Ternate. "Without the neighbouring islands its area is 6648 square miles ; with them, 7495 square miles. Of its four peninsulas, the northern and the southern are reckoned to the sul-tanate of Ternate, the north-eastern and south-eastern to that of Tidore ; the former having eleven, the latter three districts. Since 1879, Campen's explorations in the north and Kiikenthal's on the south-eastern peninsula have added to our still very incomplete knowledge of the island. According to Campen, the four peninsulas are

traversed in the direction of their longitudinal axis by mountain chains 3000 to 4000 feet high, covered with forest, without a central chain at the nucleus of the island whence the peninsulas diverge. The mountain chains are frequently interrupted by plains, such as those of Wadyi and Kobee. The northern part of the mountain chain of the northern peninsula is volcanic, its volcanoes, Sallo (better, Tallama Kie^), Onu, Ibu, &c., being a continuation of the volcanoes of Makian, Ternate, and Tidore. Coral formations on heights in the interior would indicate oscillations in several periods, but a detailed geology of the island is still wanting. Besides sago and rice, the island grows dammar and cocoanuts. The sea also yields trepang and pearl shells. A little trade is carried on by the Chinese and Makassars of Ternate, who, crossing the narrow isthmus of Dodinga, enter the bay of Kayu on the east coast. The population is estimated at 30,000, the greater part in the northern peninsula, predominantly Mahommedans.

In a Dutch work, The Century of Missionary Labour in Nether-

lands-India (Utrecht, 1901), Mr Coolsma shows that the Dutch Missionary Society of Utrecht, who have worked in the northern-most peninsula since 1866, have been fairly successful among the savage Alfoors (slave-drivers and head-hunters lilce their Borneo kinsmen), but less so among the Mahommedans, who have often incited the Alfoors against them and their converts. At the end of 1900 the latter numbered 3000. The influence of the Dutch Government over the sultans of Ternate and Tidore has steadily increased. The pirates of Tobl6o have been virtually extirpated since the Dutch expedition of 1878. But slavery still exists in the interior.

Halmstad, a seaport town of Sweden, on the east shore of the Cattegat, 76 miles south-south-east of Gothen-burg by rail. It possesses cloth, jute, hat, wood-pulp, moss litter, and paper factories, in addition to foundries,

engineering shops, shipbuilding yards, glass-works, granite quarries, and breweries ; and is famous for its potatoes and its salmon. It has a growing trade in the export of

granite, timber (1,980,000 cubic feet in 1888, 8,000,000 in 1899), wood-pulp, and hats. The granite goes almost entirely to Germany. Butter is extensively made in the district, but is exported through Gothenburg and Helsing-borg. The imports consist principally of coal (66,000 tons in 1899), machinery, and grain. The port was cleared by 1098 vessels, of an aggregate of 93,600 tons, in 1888; and by 2035 vessels, of 188,600 tons, in 1900. The harbour, which is accessible in all weathers, was widened and deepened in 1888-89. There are an inner harbour, 15 feet deep, an outer harbour, and roads giv-ing anchorage in 24 to 36 feet, but exposed to south and north-west winds. Population (1880), 8505; (1900), 15,362.

Halos. — The refraction of sunlight or moonlight, through ice-crystals forming cirrus clouds, gives rise to coloured Halos, Parhelia, Paraselence, &c. Halos are at once distinguished from rainbows, for they surroimd the luminary, while the primary and secondary rainbows, at least, have their centres opposite to it.

The usual form of ice-crystals in the air is a regular hexagonal prism, terminated by plane ends perpendicular to the axis. Sometimes the prisms are long and narrow, sometimes they are mere hexagonal plates. Two alternate faces of the hexagon give an ice-prism of 60°, a face and an end a prism of 90°. The refractive index of ice is about 1-31. Let us study the effects of innumerable prisms having these angles, and falling in all aspects or positions in the quarter where the sun appears to be situated. The result of an average distribution will, of course, be symmetrical with regard to the line joining the eye and the sun, and the refracted rays will be crowded together in the direction of minimum deviation. The minimum deviation produced by an ice-prism of 60° is the angle 22° very nearly ; and for a prism of 90°, about 46°. This is, of course, on the supposition that the refraction is in a plane perpendicular to the edge of the prism. Hence if we consider one kind of homogeneous light only, the sun should appear to be surrounded by two circular rings of light, each of a breadth equal to the sun's apparent

diameter, and of mean angular radii 22° and 46° respectively. As these are due to the minimum of deviation by each class of prisms, the scattered rays directly refracted by any one of the prisms, as well as the rays which have passed obliquely through it, are seen outside the corresponding halo. The minimum deviation will be least for the least refrangible rays, so that in both these halos the red rays form the interior border. In this respect they resemble the secondary, not the primary, rainbow. The cause which produces impurity of the colours of the rainbow affects those of the halos even more profoundly. In fact, only the red is at all pure, and the overlapping (due partly to the sun's diameter, but still more to oblique refraction) is so great that, as a rule, a mere trace of green and blue can be seen, the external portion of each halo being nearly white. This gives the phenomenon a very singular character.

Let us now take account of the fact that the crystals free in air will, on the whole, tend to fall in one or more particular positions, i.e., the long prisms mainly endwise,

or it may be with their axes horizontal ; the plates flat-wise, or edgewise, as the case may be. The effect will be to intensify those parts of the halo which are due to the maj ority of the crystals. When the sun is near the horizon and the vertical ice-prisms are exceptionally numerous, the parts of the halo of 22° which are at the same level as the sun are coloured spectra, sometimes dazzlLngly bright. and they are called Parhelia, or, vulgarly, Mock-Suns. When the sun is not on the horizon, the paths of the rays through the vertical prisms are no longer ia planes per-pendicular to their edges. Here also there is a position of minimum deviation, but the deviation is greater than before, increasing with the obliquity of the rays. Also a ray, passing anyhow through a prism, makes equal angles with the edge (in this case vertical) before and after passing. This is evident, without calculation, from the principle of reversal. Hence, as the sun rises higher, the parhelia gradually separate outwards from the halo, still keeping, however, at the same apparent altitude as the sun.

If there be an excess of hexagonal prisms, or plates, with their axes horizontal, these also will prodiice parhelia, which will be situated on the halo above and below the sun, if the axes of the prisms are perpendicular to the line joining the sun and the spectator. But as they are as likely to lie in any other (horizontal) direction, there

Diagram of Halos and Mock-Suns. (After Hevelius.)

will be a continuous series of parhelia, forming a new halo, which touches that of 22° externally above and below, and may even, in favourable circumstances (such as the requisite altitude of the sun, &c.), assume a complete quasi-elliptic form. This halo is brightest at its upper and lower portions, which are usually the only parts visible, and they are therefore commonly called the tangent-arcs to the halo of 22°.

Similar remarks apply to the halo of 46°, and the hexagonal pyramids, which sometimes terminate the ice-prisms, produce analogous results. The parhelia, also, are sometimes themselves bright enough to produce secondary halos; the reflection of the sun's rays from

the surfaces of the crystals gives, from an .excess of horizontal prisms, a colourless, vertical, great circle passing through the sun, and from an excess of vertical faces, a colourless, horizontal, small circle at the same altitude as the sun. All the features described, with the exception of the colourless vertical great circle, will be easily recognized in the accompanying diagram, which is reduced from a drawing by Hevelius of a remarkable series of halos and mock-suns seen by him at Danzig in 1661. There is, however, one feature in this figure, namely, the whitish, incomplete circle of about 90° radius surrounding the sun, which has been observed by others than Hevelius,

but is not yet explained. For full details on this very interesting subject see the remarkable memoir by Bravais {Journal de VEcole Polyteclinique, 1847), who studied the phenomena in high latitudes. The general explanation of the production of halos was suggested by Mariotte, but was first accurately given by Young.

Halos must not be confounded with Goronce — those concentric rings which encircle the sun or moon when seen through a mist or cloud. Halos are red inside, coronse outside. Halos have definite radii depending on the definite angles of ice-crystals ; the size of the coronte, whose radii are as 1 : 2 : 3, &c., depends on the size of the drops of water in a mist or cloud, being smaller as the drops are larger. Thus their diminution in radius shows that the drops are becoming larger, and implies approaching rain. They are due to diffraction, and can be explained only by the help of the undulatory theory. (p. g. t.)

Halsbury, Hardinge Stanley Ciffard, 1st Eael of (1825), Lord High Chancellor of England, son of Stanley Lees Giffard, LL.D., was born in London on 3rd September 1826. He was educated at Merton College, Oxford, where he took the degree of B.A. in 1852 and M.A. in 1855. Called to the bar at the Inner Temple in 1850, he joined the North Wales and Chester Circuit. Afterwards he had a large practice at

the Central Criminal Court and the Middlesex Sessions, and he was for several years junior prosecuting counsel to the Treasury. He was engaged in most of the celebrated trials of his time, including the Overend and Gurney and the Tichborne cases. He became Queen's Counsel in 1865, and a bencher of the Inner Temple. Mr Giffard twice contested Cardiff in the Conservative interest, in 1868 and 1874, but he was still without a seat in the House of Commons when he was appointed Solicitor-General by Mr Disraeli in 1875 and received the honour of knighthood. In 1877 he succeeded in obtaining a seat, when he was returned for Launceston, which borough he continued to represent until his elevation to the peerage in 1886. He was then created Baron Halsbury and appointed Lord Chancellor, thus forming a remarkable exception to the rule that no criminal lawyer ever reaches the Woolsack. Lord Halsbury resumed the position in 1886, and again in 1895 and 1900, his tenure of the office, broken only by the brief Liberal ministries of 1886 and 1892-95, being longer than that of any Lord Chancellor since Lord Eldon.

In 1898 he was created Earl of Halsbury and Viscount Tiverton. Among Conservative Lord Chancellors Lord Halsbury must always hold a high place, his grasp of legal principles and mastery in applying them being pre-eminent among the judges of his day.

Halstead , amarket-town in theMaldon parliamentary division of Essex, England, on the Colne, 14 miles north-west by west of Colchester by rail. A new post ofB.ce, a cottage hospital, and a fever hospital have been erected, and there is a town hall. About 1200 hands are employed in the manufacture of silk and crape. The old civil parish of Halstead became divided under the Local Government Act, 1894, into two parishes, Halstead (urban) and Halstead (rural). Area of urban district, 636 acres. Population (1881), 5804; (1891), 6066; (1901), 6072. The urban district is coterminous with the civil parish of Halstead (urban). Population of the rural district of Halstead in 1901, 10,176.

Hamar, or Stoeehammbe (Gebat Hamae), a town of Norway, county Hedemarken, on the east shore of

Lake Mjosen, 78 miles by rail north. of Christiania, on the railway to Trondhjem. The existing town was laid out in 1849, and made a bishop's see in 1864. Near the same site there stood an older town, which, together with a bishop's see, was founded in 1162 by the Englishman Nicholas Breakspeare (afterwards Pope Adrian IV.) ; but both town and cathedral were destroyed by the Swedes in 1567. A few scanty ruins of the latter still remain. Population (1900), 6003.

Hamburg, a seaport town of Germany, capital of the free state of Hamburg, situated on the right bank of the Elbe, 75 miles from the North Sea and 178 by rail west-north-west from Berlin, the largest and most important seaport on the continent of Europe, and (next after London and New York) the third largest port in the world. Probably there is no place which during the last thirty years of the 19th century grew at a faster rate commercially than Hamburg. Its commerce is, however, almost entirely of the nature of transit trade, for it is not only the chief

distributing centre for the middle of Europe of the products of all other parts of the world, but it is also the chief outlet for German, Austrian, and even to some extent Eussian (Polish) raw products and manufactures.

Public Buildings and Institutions. — The centre of the civic life of Hamburg is the new Eathhaus, a huge German Eenaissance building, constructed of sandstone in 1886-97, and richly adorned with sculptures both outside and inside. It is the place of meeting of the civic council and of the senate, and affords accommodation for the town archives. Immediately adjoining it, and connected with it by a couple of wings, is the Borse (1839^1, enlarged 1880-84, and in part restored 1894) ; it shelters the commercial library of nearly 100,000 volumes. A little to the east of them is the Johanneum (1834), in which are preserved the town library of about 600,000 volumes and 6000 MSS., and the collection of Hamburg antiquities. In the courtyard is a statue (1885) of the Eeformer Bugenhagen. In the Eischmarkt, immediately

south of the Johanneum, a handsome fountain was erected in 1890. Directly west of the town hall is the new (rebuilt) Stadthaus, the chief police station of the town, with a bronze statue of the burgomaster Petersen (1898) in front of it. Several new public buildings have been erected along the circuit of the former walls. Near the west extremity, abutting upon the Elbe, the moat was filled in in 1894-97, and some good streets were built along the site, whilst the Kersten Miles Briicke, adorned with statues of four Hamburg heroes, was thrown across the Helgoland Allee. Farther north, along the line of the former town wall, stand the criminal law courts (1879-82, enlarged 1893) and the civil law courts (finished in 1901). Close to the latter will stand a new Supreme Court. Farther on are the chemical and the physical laboratories and the Hygienic Institute. Facing the Botanischer Garten a new central Post Office, in the Eenaissance style, was built in 1887. At the west end of the Lombard Brtlcke (which divides the Aussen from the Binnen Alster) the municipality have erected a monument,

designed by Schilling, to commemorate the war of 1870-71. A few streets south of that is a monument to Lessing (1881). The Kunst-halle (enlarged in 1885-86 faces the east end of Lombard Briicke. The new Natur-historisches Museum, completed in 1891, stands a little distance farther south. Then to the east of it comes the Museum for Art and Industry, founded in 1878, now one of the most important institutions of the kind in Germany ; there is a trades school connected with it. The Hansa fountain (65 feet high), erected in 1878, is close by. On the north-east side of the suburb of St Georg a botanical museum and laboratory have been established. There is

a new General Hospital at Eppendorf, outside the town on the north, built on the pavilion principle, and one of the finest structures of the kind in Europe ; and at Ohlsdorf, in the same direction, a crematorium was built in 1891 in conjunction with the town ceineteries (370 acres). In 1899 a new central railway station was begun

on the Grlockengiesserwall between the Aussen Alster

and the Frei Hafen. It only remains to mention

Scale of One Mile

‘A /2 3/»

London. Stanfbrd’s Geo^! Estabf.

Plan of Hambueg.

Hagenbeck’s zoological garden, the schools of music and

navigation, and the commercial school. In 1900 a high

school for shipbuilding was founded, and in 1901 an

institute for seamen’s and tropical diseases, with a labora-

tory for their physiological study, was opened, and also

the first public Eree Library in the city. The river is

spanned just above the Frei Hafen by a triple-arched

railway bridge, 1339 feet long, made in 1868-73 and

doubled in width in 1894. Some 270 yards higher

up is an iron bridge (1888) for vehicles and foot

passengers. The southern arm of the Elbe, on the

south side of the island of Wilhelmsburg, is crossed by

another railway bridge of four arches and 2050 feet in length.

Harbour. — It was the accession of Hamburg to the German Customs Union in 1888 which gave such a vigorous impulse to her more recent commercial development. At the same time a portion of the port was set apart as a free harbour, altogether an area of 760 acres of water and 1760 acres of dry land. In anticipation of this event a gigantic system of docks, basins, and quays was constructed, at a total cost of some £7,000,000 (of which the imperial treasury contributed £2,000,000), between the confluence of the Alster and the railway bridge (1868-73), an entire quarter of the town inhabited by some 24,000 people being cleared away to make room for these accessories of a great port. On the north side of the Elbe there are the Sandthor basin (3380 feet long, 295 to 427 feet wide), in which British and Dutch steamboats and steamboats of the Sloman (Mediterranean) Line anchor. South of this lies the G-rasbrook basin (quayage of 2100 feet, and 1693 feet alongside), which is used

by French, Swedish, and transatlantic steamers. At the quay point hetween these two basins there are vast state granaries. On the outer (i.e. river) side of the Grasbrook dock is the quay at which the emigrants for South America embark, and from which the mail boats for East Africa, the boats of the Woermann (West Africa) Line, and the Norwegian tourist boats depart. To the east of these two is the small Magdeburg basin, penetrating north, and the Baaken basin, penetrating east, i.e., parallel to the river. The latter affords accommodation to the trans-atlantic steamers, including the emigrant ships of the Hamburg – America Line,^ though their " ocean mail boats " generally load and unload at Brunshausen, 30 miles lower down the Elbe and on the opposite (left) bank, but from 1901 at Cuxhaven. On the south bank of the stream there follow in succession, going from east to west, the Moldau dock for river craft, the sailing vessel dock (3937 feet long, 469 to 886 feet wide, 26^ feet deep), the Hansa dock, India dock, petroleum dock, several swimming and dry docks ; and in the west

of the free port area three other large docks, one of 77 acres for river craft, the others each 56 acres in extent, and one 23f feet deep, the other 2Q\ feet deep, at low water, constructed in 1900-1. In 1897 Hamburg was provided with a huge floating dock, 658 feet long and 84 feet in maximum breadth, capable of holding a vessel of 17,500 tons and draught not exceeding 29 feet, so constructed and equipped that in time of need (war) it could be floated down to Cuxhaven. During the last 25 years of the 19th century the channel of the Elbe was greatly im-proved and deepened. During the last two years of the century some £360,000 was spent by Hamburg alone in regulating and correcting this lower course of the river. (See Elbe.)

Commerce and Shipping. — The details of the commercial devel-opment of the port are set forth in the Bubjoined tables. As will be seen from Table I. , it is with what may be termed the newer countries that the commerce has grown most rapidly ; and this generalization is still further supported by the development of the trade with the South American states, West and East Africa,

and the Par East. The imports from Great Britain more than doubled in annual value between 1851 and 1900 ; but the per-centages which these totals bear to the entire sea-borne trade of Hamburg steadily decreased, e.g., from 60 per cent, in 1851-60,

1 This is the largest steamship company in the world. At the end of 1901 it possessed a fleet of 117 steamboats, with an aggregate of 602,948 tons, 92 per cent, of which was built within the preceding twelve years. In addition it owns a fleet of 25,453 tons of river steamboats. The company in 1900 owned 80 per cent, of the total steam tonnage belonging to Hamburg, and 49 per cent, of the total steam tonnage of aU Germany. In 1900 they launched the Deutschland, of 16,000 net tonnage and 35,000 horse-power, with estimated speed of 23 knots.

and 64 per cent, in 1861-70, to 54 per cent, in 1871-80, to 40 per cent, in 1891-95, and to only 11 per cent, in 1900. Of the trade with older countries, there has been the greatest advance in the relations with Russia : in 1851-60 Hamburg imported less than £50,000 worth of Russian goods, but in 1900 the imports (by sea only) were valued at £4,460,500. The principal imports in the year 1898, and their values, were as follows :— Wool and

woollens, £14,898,000 ; cereals, £11,931,400 ; sugar and molasses, £10,475,700; raw cotton and cottons, £8,706,200; coffee, £8,457,900; metals, £7,070,800; machinery, £6,098,100; skins and hides, £5,338,300; lard, butter, cheese, eggs, and milk, £4,666,200 ; flax, Jute, and hemp, £4,421,300 ; tobacco, £4,287,700 ; iron, £4,101,750 ; chemicals, £3,814,500 ; guttar-percha, india-rubber, and gums, £2,787,900. In 1900 the imports were thus classified :— raw materials and partly manufactured goods, £61,677,400; foodstuffs, £35,137,000; textiles, £3,617,400 ; building materials and fuel, £3,446,600 ; and other industrial products, £7,925,600.

Table I. shows particulars of the average annual imports for the periods specified (bullion and coin not included) : —

Increase

Imports.

1881-90.

1891-95.

190O.«

per cent.

1861-1900.

Total by sea

£62,288,800

£77,949,500

£111,804,000

6013

Total by rail and

nver .

45,103,000

58,090,000

728

Grand Total .

£97,391,800

£186,089,500

645

From Great Britain

£20,924,400

£19,673,200

£22,272,200

223

From Australia . .

438,800

1,458,100

2,440,900

76,160

From British North

America

71,400

272,000

46,300

From Cape Colony .

215,800

412,600

252,400

1,658

From British India

1,174,600

5,825,800

8,219,300

4,406

From the United

States .

6,075,500

9,905,200

23,700,600

3,003

2 In 1899 the imports by rail and river amounted to £66,935,000, and the imports by sea to £99,225,000, or altogether to £166,160,000.

2 These are calculated to 1899.

Table II. shows the average annual value of the exports for the periods specified (bullion and coin excluded) : —

Exports.

1881-90.

1891-96.

1900.

Increase per cent. 1851-1900.

Total by sea

Total by rail and river

£49,070,700

40,298,000

£68,869,600

66,405,500

£88,776,600

..4

751

661

Grand Total .

£89,863,700

£119,765,100

705

To Great Britain .

No returns.

£19,851,400

£19,262,600

463

‘ In 1899 the exports by sea amounted to £80,315,000, and by rail and river to £70,500,000 ; or altogether to £150,815,000.

In 1900 the exports to the United States reached a value of £10,883,200 ; the exports to Brazil a value of £3,088,400 ; to

Sweden and Norway, £6,184,200; to Russia, £3,608,500. The greater portion of the exports (53-5 per cent, of the whole) goes to the German states. The various items are almost the same, and at approximately the same amounts, as the imports.

Table III. shows the average number and aggregate tonnage of the vessels which entered Qie port annually, river craft being distinguished from ocean-going vessels, at the periods specified : —

1851-60.

1881-90.

1891-96.

1899.5

Tonnage,

Increase

per cent.

1861-96.

By- -jKn'nte

Byrf™-]?oTnte

4,649

756,099

4,388

411,669

T,015

8,870,047

10,788

1,SS9,141

8,928

5,964,214

18,967

2,985,541

18,812

7,766,960

17,698

4,268,426

1027

1086

Tot^l .j?oTnte

9,082

1,167,768

17,798

6,759,188

22,895

8,939,756

80,905

12,084,876

1035

From Gt. (Vessels

Britain) Tonnage

2,0.60

447,290

2,891

1,840,297

8,227

2,184,051

S.SBS

2,861,000

628

6 Owing to the introduction of the new measurement system in 1895,

the totals of the tonnage lor the years since then are about 20 per cent,

less than under the old system of measurement.

In 1861-70 38-4 per cent, of the vessels which arrived by sea and

53-8 per cent, of the tonnage fiew the British flag, 45-7 per cent, of the vessels and 33‘6 per cent, of the tonnage the German flag (of which 32-9 per cent, of the vessels belonged to Hamburg and 72-2 per cent, of the tonnage), whereas in 1899 26-1 per cent, of the

vessels which arrived by sea came under the British flag and 38-8 per cent, of the tonnage (29 and 30 respectively in 1900), as compared with 57-1 per cent, of vessels under the German flag and 50-2 per cent, tonnage.

Table IV. shows the average annual number of vessels, and their total tonnage, belonging to the mercantile fleet of Hamburg for the periods specified : —

1881-90.

1891-95.

1900.

Increase per

cent. 1851-1901.

Sea-going vessels .

Tonnage

504

359,697

626

621,482

792

998,854

178

836

Of the 792 vessels quoted for the year 1900, 486 were steamships and 307 sailing vessels. To the sea-going vessels must be added 4700 river boats, aggregating a total of 332,704 tons in 1898 ; also 157 fishing vessels of 4956 tons, of which only 8 of 264 tons were propelled by steam.

Emigration. — Hamburg is one of the principal Continental ports for the embarkation of emigrants. In 1881-90, on an average the number of emigrants was 90,889 a year (to the United States, 59,322). In 1900 the number was 87,153 (to the United States, 64,137). In the period 1891-1900 the total number of emigrants averaged 71,096 annually, of whom about 88 per cent, went to the United States. The emigrants are mostly Germans (30,514 in

1893, 11,582 in 1900), Russians (41,082 in 1900), and Austrian-Hungarians (28,862 in 1900).

Industries. — Of recent years Hamburg has also developed into an important industrial centre, more especially since the year 1882. The branches which are represented on the largest scale are ship-building (employing some 5000 men in 1897); iron and steel indnstries, i.e., iron and copper foundries, iron works, rolUng mills, machinery factories, tin works, lead works, zinc pipe factories, nail factories, tool factories, electrical plant works, &c. ; chemical factories and factories for explosives, employing about 4000 work-people (1300 in 1887); jute mills, employing about 3000 hands ; a wool-oarding factory, with over 1300 hands ; cotton and woollen spinning mills ; indiarubber goods factories (4000 hands); factories for finer leather goods, with about 2000 hands ; sawmills, joinery works, factories for furniture, boxes, &c., and cooperages ; tobacco and cigars (some 3000 hands) ; printing works, with over 2000 work-people ; factories for ready-made clothing ; breweries and distilleries in great number ; flour mUls, steam bakeries, chocolate, sugar, pork-packing, ice, margarine, and other factories connected with the supplying of provisions. Altogether more than 42,400 persons

above 16 years of age were employed in industrial establishments in 1899.

Banking, as might be expected in a city of the commercial magnitude of Hamburg, is carried on on a very extensive scale. Table V. supplies particulars with regard to the five principal banks for the year 1898 :— ,

Hamburg Branch of Imperial Bank.

N. German Bank.

Union Bank.

Commercial and Discount Bank.

German Bank-

Hamburg

Branch.

Capital .

Turnover for

year .

Eeserve

Advances

£7,500,000

(head bank

in 1901)

764,414,900

£2,000,000

832,760,850

83,000

£1,500,000

516,881,500

186,600

£2,500,000

312,669,200

346,500

£7,600,000

(head bank)

687,950,800

2,822,900

(head bank)

upon secu-

Disoount and

bill busi-

ness .

6,262,000

45,170,400

8,426,800

23,732,000

2,065,600

18,614,900

16,444,100

1,775,250

49,847,200

Population. — Including the suburbs (of which there are fifteen, and which were definitely incorporated with the city in 1894), the

population of Hamburg amounted to 471,427 in 1885, to 569,260 in 1890, to 625,552 in 1895, and to 705,738 in 1900. The birth-rate was 34-3 per 1000 in 1899 and 24-1 per 1000 in 1897. The marriage-rate was 9-5 and 8-96 per 1000 in the same two years respectively. Since 1892, the year in which cholera visited Hamburg so fatally, great improvements have taken place in the sanitary arrangements of the city, as well as in the regulations for the water-supply. As a consequence the death-rate shows an excellent improvement, as the following table manifests : —

1887-91.

Average.

1892.

1893.

1894.

1895.

1896.

1897.

1893

and

1899.

Death-rate per 1000

inhabitants .

28-8

89-3

20-1

17-9

18-9

17-5

16-89

17-3

In the year 1895 39 per cent, of the entire population were engaged in occupations on their own behalf, dependants and servants not being counted, or 243,929 persons (of whom 50,307 were women), out of a total of 606,788 employed, whilst the number of dependants was 307,985, and of domestic servants 27,434. The class first named, namely, those working on their own behalf, increased between 1882 and 1895 from 38-1 to 40-2 per cent, of the population engaged in all occupations, whereas the class of domestic servants decreased from 6 to 4-5 per cent. Of the first-named class, again, 38-2 per cent, were engaged in commerce and its ministrant

branches in 1882 and 39-9 per cent, in 1895, whilst 44 per cent, in 1882 and 40-6 per cent, in 1895 were occupied in industrial pursuits. As some evidence of the general condition of prosperity which prevails, it may be mentioned that of those who were liable to pay income-tax in 1894, 26-6 per cent, enjoyed incomes ranging between £30 and £40 per annum, 49‘8 per cent, incomes between £40 and £100, 19-6 per cent, incomes between £100 and £500, 3-6 per cent, incomes between £500 and £1000, and 0‘4 per cent, incomes above £2500.

The Free State oe Hamburg. — A modification of the constitution came into force in 1879, by -wliicli the House of Burgesses was reduced from 196 to 160 members, of whom one-half are elected by the direct votes of all tax-paying citizens, 40 by the owners of house property, and 40 by the members of the guilds, corporations, and courts of justice. A committee of this house, numbering 20 members, is charged with the duty of watching the action of the senate and preserving the integrity of the constitution. In 1900 the state revenue was £4,489,200 and the expenditure £4,373,650. The state contribution to

the revenues of the empire was fixed in 1900 at £343,286, and in 1900 the state debt amounted to £18,776,300. The population increased from 453,869 1^880 to 518,620 in 1885, to 622,530 in 1890, to 681,632 in 1895, and to 768,349 in 1900. The population of the country districts (exclusive of the city of Hamburg) was 62,611 in 1900. In 1895 633,949 of the inhabitants belonged to the Evangelical Lutheran Church, 24,618 were Roman Catholics, and 17,308 were Jews. Of the total population, about 16,200 were engaged in agricultural pursuits, the crops raised being principally vegetables and fruit, potatoes, hay, oats, rye, and wheat. The live stock in 1897 numbered 17,141 horses, 13,949 cattle, 16,602 pigs, and only 2727 sheep. The other industries of importance are sulphuric acid works (25,323 tons of sulphuric acid, valued at £42,540, in 1897), iron foundries (7345 tons, valued at £712,290), sugar refineries, breweries, and distilleries. Apart from the city of Hamburg, the chief centres of population are the tovra. of Bergedorf and the commune of Cuxhaven (6208).

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Hamein, a town of Prussia, province of Hanover, 33 miles S.W. of Hanover by rail and on the river Weser. In 1875 a monument was erected to commemorate the legend of the "Pied Piper." Population (1885), 11,830 ; (1895), 16,508; (1900), 18,966.

Hamerling, Robert (1830-1889), Austiian poet, was born at Kirehberg am Walde in Upper Austria, on the 24th of March 1830, of humble parentage. He early displayed a genius for poetry, and his youthful at-

tempts at drama, Christopher Colombus and Mdrtyrer, excited the interest and admiration of some influential persons. Owing to their assistance young Hamerling

was enabled to pass through a school course at the Gymnasium at Vienna. Proceeding to the university, he entered the Academic Legion, and took part in 1848 in the defence of Vienna, which was being besieged by Windisehgratz ; as a consequence of this action he was obliged to hide for a long time to escape arrest. He diligently pursued his studies in natural science and philosophy, and in 1856 was appointed teacher at the Gymnasium at Trieste. For many years he battled with ill-health, and in 1866 retired on a pension, which in acknowledgment of his literary labours was increased by the Government to a sum which enabled him to live without care until his death at Graz, where he had made his home, on the 13th of July 1889. Among his poetic productions, Ahasver im Rom (1866), his chef d'oeuvre, shows the

author's brilliant talent lor description. Hamerling was one of the most remarkable of the poets of the modern German school; his imagination was rich and his poems full of natural grace. Among his other productions may be mentioned Venus im Exil (1858), Der Konig von Sion (1868), Die Sieben TodrSilnden, Blatter im Winde, Homun-culus, Amor und Psyche, and a novel, Aspasia, which gives a finely-drawn description of the Periclean age.

Hamerton, Philip Gilbert (1834^1894), English artist and author, was born at Laneside, near Shaw, close to Oldham, 10th September 1834. His mother died at his birth, and having lost his father ten years after-wards, he was educated privately under the direction of his guardia^. His first literary attempt, a volume of poems, proving unsuccessful, he devoted himself for a time entirely to landscape painting, encamping out of doors in the Highlands, where he eventually rented the island of Innistrynych, upon which he settled with his wife, a French lady, in 1858. Discovering after a time that his qualifications were rather those of an art critic

than of a painter he removed to the neighbourhood of his wife's relatives in France, where he produced his Painter's Camp in the Highlands (1863), which obtained a great success and prepared the way for his standard work on Etching and Etchers (1866). In the following year he published a book, entitled Contemporary French Painters, and in 1868 a continuation, Painting in France after the Decline of Classicism. He had meanwhile become art critic to the Saturday Review, a position which, from the burden it laid upon him of frequent visits to England, he did not long retain. He proceeded (1870) to establish an art journal of his own. The Portfolio, a monthly periodical, each number of which consisted of a monograph upon some artist or group of artists, frequently written and always edited by him. The discontinuance of his active work as a painter gave him time for more general literary composition, and he successively produced The Intellectual Life (1873), perhaps the best known and most valuable of his writings ; Round My House (1876), notes on French society by a resident ; and

Modern Frenchmen (1879), admirable short biographies. He also wrote two novels, Wenderholme (1870) and Marmorne (1878). In 1884 Human Intercourse, another valuable volume of essays, was published, and shortly afterwards Hamerton began to write his autobiography, which he brought down to 1858. In 1882 he issued a finely illustrated work on the technique of the great masters of various arts, under the title of Tlie Graphic Arts, and three years later another splendidly illustrated volume, Landscape, which traces the influence of land-scape upon the mind of man. His last books were : Portfolio Papers (1889) and French and English (1889). In 1891 he removed to the neighbourhood of Paris, and died suddenly on 4th November 1894, occupied to the last with his labours on The Portfolio and other writings on art. In 1896 was published Philip Oilbert Hamerton : an Autobiography, 1834-58 ; and a Memoir by his Wife, 1858-94.

Hamilton, a police (extended 1878) and parlia-mentary burgh (Falkirk group) of Lanarkshire, Scotland,

10| miles south-east of Glasgow by road, with five stations on two railway systems. The surrounding coalfield is the richest in Scotland, and there is a considerable manufacture of cotton, lace, iron-work, and carriages. The park adjoining the seat of the dukes of Hamilton contains a race-course, and the herd of aboriginal white cattle in Cadzow Chase was in 1901 the only one still extant in Scotland. The town is the depot of the 26th and 71st regimental districts. Various public halls have been erected, and there is a hospital and a fever hospital. A Free church was built in 1882 and a United Presbyterian in 1884 (both now United Free). The academy, with an average attendance in 1898-99 of 559, is the principal secondary school in the middle ward of the county. Population (1881), 18,517; (1901), 32,775.

Hamilton, a city of Ontario, Canada, at the western extremity of Lake Ontario. It is an important centre on the Grand Trunk, Canadian Pacific, and other railways, whilst an extensive system of electric railways connects the different parts of the city with one another

and with the adjacent localities. It has three daily newspapers, an efficient police force and fire brigade, and is lighted by electricity and gas. As an industrial centre it has been called the Birmingham of Canada, containing iron-smelting works, rolling mills, cotton factories, stove, zinc-refining, agricultural implement, bridge, wire, screw and steel works, and pork-packing, tobacco, and canning factories. The extensive water-power at De Cew Falls, 32 miles distant, has been utilized for the generation of electricity, which is supplied for manufacturing purposes. Hamilton is represented in the Dominion Parliament by two members, and by the same number in the Ontario legislature ; its local affairs are administered by a mayor and twenty-one aldermen. The total shipping for 1899-1900 was 1850 vessels, with a tonnage of 412,624 ; exports were valued at $1,808,200, imports at #6,891,149. Area of city m. 1901, 3990 acres ; total assessment, $29,163,050. Population (1881), 35,961 ; (1891), 48,980 ; (1901), 52,550.

Hamilton, capital of Butler county, Ohio, U.S.A.,

in 39° 23' N. lat. and 84° 25' W. long., on the Great Miami, 25 miles north of Cincinnati, at an altitude of 591 feet. It is on the Cincinnati, Hamilton, and Dayton, and the Pittsburg, Cincinnati, Chicago, and St Louis rail-ways, and on the Miami and Erie canal. It has an abundant water-power in the river and canal, which is utilized in varied manufactures. Population (1880), 11,122; (1890), 17,565; (1900), 23,914, of whom 2949 were foreign-born and 347 were negroes.

Hamirpur, a town and district of British India, in the Allahabad division of the North- West Provinces. The town is on a tongue of land at the confluence of the Betwa and the Jumna, 110 miles N.W. of Allahabad. Population about 9000. The District has an area of 2289 square miles. It had a population in 1881 of 507,337, and in 1891 of 513,720, giving an average density of 224 persons per square mile. The land revenue and rates were E.s.8,85,367, the incidence of assessment being E.0-11-7 per acre ; the cultivated area was 600,918 acres, of which 21,633 were irrigated; the number of police

was 1688 ; the number of vernacular schools in 1896-97 was 72, with 2707 pupils ; the registered death-rate was 65-18 per 1000. In 1901 the population was 468,645,

showing a decrease of 11 per cent., due to the famine of 1896-97. The south of the district is traversed by the line of the Indian Midland railway from Banda to Jhausi. The largest place is Eath (13,000).

Hamley, Sir Edward Bruce (1824-1893), British soldier and military writer, youngest son of Vice-Admiral William Hamley, was born on 27th April 1824 at Bodmin, Cornwall, and entered the Eoyal Artillery as second lieutenant in 1843. He was promoted to be captain in 1850, and in 1851 went to Gibraltar, where he commenced his literary career by contributing articles to magazines. He served throughout the Crimean campaign as aide-de-camp to Sir Richard Dacres, commanding the artillery, taking part in all the operations (medal and four clasps, 5th class of Legion of Honour and Med-

jidie, Sardinian and Turkish medals, brevet-majority and lieutenant-colonelcy, and C.B.). During the war he contributed to Blackwood's Magazine an admirable account of the progress of the campaign, which was afterwards republished separately. The combination in Hamley of literary and military ability secured for him in 1859 the professorship of Military History at the New Staff College at Sandhurst, from which, in 1866, he went to the Council of Military Education, returning in 1870 to the Staff College as commandant. From 1879 to 1881 he was British Commissioner successively for the delimitation of the frontiers of Turkey and Bulgaria, Turkey in Asia and Russia, and Turkey and Greece (K.C.M.G., 2nd class of Medjidie). Promoted colonel in 1863, he became a lieutenant-general in 1882, when he commanded the 2nd' division of the expedition to Egypt under Lord Wolseley, and led his troops to the successful storm of Tel-el-Kebir (medal and clasp and star, 2nd class of Osmanieh, thanks of Parliament, and K.C.B.). Hamley considered that his services in Egypt had been insuf-

ficiently recognized in Lord Wolseley's despatches, and expressed his indignation freely. As, however, both he and the other divisional commander, Sir George H. S. Willis, were mentioned in the final despatch and were suitably rewarded, it cannot be supposed that there was any intention to belittle their services. Erom 1885 until his death on 12th August 1893 he represented Birkenhead in Parliament in the Conservative interest. Hamley was a clever and versatile writer. His principal work. The Operations of War, published in 1867, became a textbook of military instruction. He published some pamphlets on national defence, was a frequent contributor to magazines, and the author of several novels, of which perhaps the best known is Lady Lee's Widowhood.

(e. h. v.)

Hamlin, Hannibal (1809-1891), Vice-President of the United States (1861-65), was born in Paris, Maine, on the 27th of August 1809. He studied law, and was admitted to the bar in 1833. Entering politics as a Democrat, he was a member of the Maine legislature 1836-40.

In 1843 he was elected to Congress, where he served in the House of Representatives till 1847, and then in the Senate, with a short interval, till 1861. He opposed the extension of slavery, was concerned in the origination of the Wilmot Proviso, and in 1856, because of the repeal of the Missouri Compromise, he formally abandoned his old party and joined the Republicans. Nominated and elected with Lincoln in 1861, he was set aside at the end of his term through the preference of the party leaders for a Southern Democrat. After two terms more in the Senate (1869-81) and a brief service as minister to Spain (1881-83), he retired from public life in 1883, and died at Bangor (Me.), 4th July 1891.

Hamm, a town of Prussia, province of Westphalia, on the Lippe, 19 miles by rail north-east of Dortmund. It has important iron industries, wire and machinery factories, production of chemicals, varnishes, &c., saw-mills, and distilleries. Population (1885), 22,520; (1900), 31,-369.

Ham me, a town of Belgium, in the province of East

Flanders, 6 miles north of Termonde by rail. Its manufactures include rope, lace, linen, and oil. There are also boat-building workshops. Population (communal) (1899), 13,593.

Hammerfest, a seaport town of Norway, county Finmarken, in 70° 39′ 15″ N., 23° 39′ E. The principal street was rebuilt after a fire in 1890, and the town is lighted by the electric light. As a rule the sun is visible from Hammerfest uninterruptedly from 13th May to 29th July, and is never seen from 20th November to 21st January. Population about 2200.

Hammersmith, a metropolitan borough in the county of London, on the north bank of the Thames, 3-J-miles south-west of Hyde Park Corner. Hammersmith Bridge, designed by Tierney Clark (1824), was the earliest suspension bridge erected near London. The old bridge being found to be in an insecure condition, a new one from the designs of Sir Joseph Bazalgette was erected in 1884-87. The superstructure is carried by steel chains, which are passed over towers formed of a

framing of wrought-iron enclosed in an ornamental cast-iron casing. Down to 1834 Hammersmith formed a portion of Fulham parish. The parish church of St Paul's was built as a chapel of ease to Fulham, and consecrated by Bishop Laud, 7th June 1631. In 1864 it was enlarged and restored. It was subsequently piflled down, and a new church on the old site was completed in 1890. The Godolphin School, founded in the 16th century under the will of William Godolphin, was remodelled as a grammar school, under the approval of the Court of Chancery in 1861. The new buildings were completed in 1862 from the designs of C. H. Cooke. St Paul's School was removed from St Paul's Churchyard to Hammersmith Road, West Kensington, near Addison Road station, in 1883. The Mercers' Company purchased 16 acres of land and erected new buildings from the designs of Mr Barnes Williams. The Mall facing the river still contains many fine houses, but the old mansions of other parts of Hammersmith have mostly been pulled down. The market gardens and farms have been built over, so

that the population has largely increased at each decennial period. Population (1881), 71,939; (1901), 112,245.

Hammond, a city of Lake county, Indiana, U.S.A., 20 miles south-east of Chicago, at an altitude of 590 feet. It is traversed by no fewer than eight railways approaching Chicago from the east. It has a level site on Grand Calumet river, and contains iron and steel works, and slaughter and packing houses. Population (1880), 699; (1890), 5428 ; (1900), 12,376, of whom 3156 were foreign-born.

Hampshire, Hants, or Southampton, a southern county of England, bounded (as regards its mainland portion) on the S. by the English Channel, on the W. by Dorset and Wilts, on the N. by Berks, and on the E. by Surrey and Sussex. The county also embraces the Isle of Wight in the English Channel.

Area and Population. — The area of the ancient and administrative county (including the Isle of Wight, with an area of 93,342 acres and a population in 1901 of 82,387), as given in the census returns of 1891, was 1,039,769 acres or 1622 square miles, with a popular

tion in 1881 of 593,465, and in 1891 of 690,097, of whom 337,546 were males and 352,551 females, the number of persons per square mile heing 425, and of acres to a person 1-50. Excluding the Isle of "Wight and the two county boroughs of Portsmouth and

Southampton, the axea was 938,098 acres, with a population in 1891 of 386,849. In 1895 certain alterations were made in the area of the administrative county. The parish of Combe was transferred from Hampshire to Berkshire, and the parish of Dockenfield to Surrey, and to Hampshire were added from West Sussex the part of the parish of Bramshott in West Sussex, and from Wilts the parishes of Bramshaw, Martin, Melchet Park, Plaitford, South Damerham, Toyd Farm with Allenford, and the part of the parish of Whichbury in WUts. The area of the registration county is 1,047,223 acres, with a population in. 1891 of 666,250, of which 414,600 were urban and 251,650 rural. Within the registration area the increase of population between 1881 and 1891 was 16-08 per cent. The excess of births over deaths between 1881 and

1891 was 80,634, but this was exceeded by the increase in the resi-

dent population, which was 91,073. The population of the ancient

county in 1901 was 798,756. The number of Scots m the county'

in 1891 was 7243, of Irish 11,848, and of foreigners 2954.

The following table gives the numbers of marriages, births, and

deaths, with the number of illegitimate births : —

Tear.

Marriages.

Births.

Deaths.

lUegitimate Births.

Males.

Females.

1880

1890

1898

4209

4578

5591

17,882

17,982

19,126

10,674

10,590

11,374

405

369

439

390

337

393

Marriages in 1899, 5792 ; births, 19,000 ; deaths, 13,207.

The following table gives the marriage-, birth-, and death-rate per 1000 of the population, with the percentage of illegitimate births, for a series of years : —

18I0-T9.

18S0.

1880-89.

1890.

1868-97.

1899.

Marriage-rate .

15-3

14-7

14-6

13-9

14-6

15-1

Birth-rate

32-6

31-5

30-3

27-3

27-3

25-9

Death-rate

18-5

18-6

17-1

16-1

16-0

15-4

Percentage of Ille-

gitimate Births

4-6

4-4

5-3

4-8

4-1

4-4

Constitution and Government. — The ancient county, including the Isle of Wight, is divided into six parliamentary divisions ; and it also includes the parliamentary boroughs of Portsmouth and Southampton, each returning two members, and of Christ Church and Winchester, each returning one. The administrative county includes eleven municipal boroughs : Andover (6509) , Basingstoke (9793), Bournemouth (47,003), Christ Church (4204), Lymington (4165), Newport (10,911), Portsmouth (189,160), Romsey (4365), Ryde (11,042), Southampton (104,911), and Winchester (20,919). Bournemouth, Portsmouth, and Southampton are county boroughs ;

the following are the urban districts: Aldershot (30,974), Alton (5479), Cowes (8654), East Cowes (3180), East Leigh (9317), Eareham (8246), Earnborough (11,499), Gosport and Alverstoke (28,879), Havant (3839), Itchin (13,097), Petersfield (3265), Pokes-down (4930), St Helens (4645), Sandowu (5006), Shanklin (4533), Ventnor (5866), WarbUngton (3639), and Winton (6719). The administrative county is in the Western circuit, and assizes are held at Winchester. The boroughs of Andover, Basingstoke, Lymington, Newport, Portsmouth, Romsey, Ryde, Southampton, and Winchester have separate commissions of the peace, and the boroughs of Andover, Portsmouth, Southampton, and Winchester have in addition separate courts of quarter sessions. The ancient county, which is almost entirely in the diocese of Winchester, has 396 entire ecclesiastical parishes and "part of one other. Education, — There is a day training college (Hartley College) at Southampton for both masters and mistresses. At Portsmouth is the Hants and Isle of Wight school and home for the blind. On 31st August 1898 there were in the county 520 elementary schools, of which 119 were board and 401 voluntary schools, the latter including 358 National Church of England schools, 3 Wesleyan,

19 Roman Catholic, and 21 "British and other." The average attendance at board schools was 48,763, at voluntaiy schools 57,789. The total school board receipts for the year ending 29th September 1899 were over £146,180. The income under the Agricultural Rates Act was over £1620.

Agriculture. — About seven-tenths of the total area of the county is under cultivation, and of this area about two-fifths is in permanent pasture. There are also about 87,000 acres in hill pasture, and over 125,000 acres under woods, much of it ancient forest. The acreage under corn crops has been steadily diminishing, the diminution being chiefly in the acreage under wheat, which has now an average acreage of only about 60,000. Turnips are grown on more than one-half of the green crop acreage. Over 2000 acres are under small fruit, and about 2000 under orchards. The following table gives the larger main divisions of the cultivated area at intervals from 1880 : —

Tear.

Total area under Cul-tivation.

Corn

Crops.

Green

Crops.

Clover.

Permanent

Pasture.

Fallow.

1880

1885

1890

1895

1900

708,144

711,521

775,023

705,969

712,969

238,720

222,226

213,314

184,100

188,208

129,610

133,464

118,742

110,988

108,483

114,689

110,802

109,621

117,674

113,120

192,855

233,751

247,882

266,124

284,103

29,228

17,957

21,716

22,087

14,482

Much attention is paid to the rearing of sheep and cattle, but while the numbers of sheep have diminished, cattle have increased, the increase being wholly in cows for dairy purposes, and chiefly for the supply of mUk. The following table gives particulars regarding the principal live stock : —

Tear.

Total

Horses.

Total

Cattle.

Cows or Heifers

in Milk or in

Calf.

Sheep.

Pigs.

1880

1885

1890

1895

1900

28,761

28,189

28,150

29,101

27,726

66,943

82,561

76,887

76,402

86,666

36,335

42,030

41,757

44,465

48,402

512,796

524,715

443,658

366,004

378,951

56,727

68,591

77,837

82,434

83.302

Industries and Trade.- — According to the report for 1898 of the chief inspector of factories, the total number of persons employed in factories and workshops in 1897 was 44,660, as compared with 44,010 in 1896 ; 29,307 were employed in non-textile factories, there being an increase between 1895 and 1896 of 95 per cent., and between 1896 and 1897 of 3-8. Of these, 14,048 were employed in the manufacture of machines, appliances, conveyances, and tools, many in the Portsmouth dockyards and the carriage works at Southampton ; 3302 in clothing industries, 2976 in the manufacture of paper, &c., and 1750 in that of drink. Workshops employed 15,154 persons, 6098 being employed in clothing industries, 2291 in the manufacture of machines, &c., 1879 in food industries, and

1055 in the manufacture of furniture, &c. While the naval estab-lishments of Portsmouth have undergone gi-eat development, South-ampton has become one of the principal ports of the kingdom for ocean steamers, and Aldershot is now the great military training centre of the empire. In 1899, 224,272 tons of chalk were raised, 64,079 tons of clay, and 13,349 tons of gravel and sand. The amount of fish landed in 1899 was 10,931 cwt., valued at £9683. The value of shell-fish, in addition, was £22,517.

Authorities. — Godwin. Civil War in Hampshire. London, 1882. — TowNSEND. Flora of Hampshire. London, 1883. — Gil-bert and Godwin. Bibliotheca Hantoniensis. Southampton, 1891. — Shore. History of Hampshire (Popular County Series). London, 1892. — History of Hampshire (Victoria History Series), vol. i. 1900. See also The Climate of Hampshire in Climates of Great Britain, vol. i. London, 1895 ; and various papers in Hampshire Notes and Queries. (t. f. h.)

Hampstead, a metropolitan and parliamentary borough, in the county of London, on the southern slope and the summit of Hampstead Hill, 4 miles north-west of the City. Owing to its position on the side of a hill,

Hampstead largely retained its rural character till quite recently, and many of the houses still possess their old-world appearance, but great changes have been made of late years. Some of the old-fashioned houses in Church Row have been pulled down and replaced by flats. A large number of new houses has also been built in various parts. The hill is the highest in the vicinity of London, being 443 feet above the level of the Thames, or 36 feet higher than the cross of St Paul's. A chapel at Hampstead, dedicated to the Virgin Mary, is mentioned in a deed of 1461, and this seems to have stood until 1745, when it was taken down and a new church built from the designs of Henry Flitcroft, which was dedicated to St John, and consecrated in 1747. The church was enlarged in 1844. It is a plain brick structure in the Italian style, with the altar at the west end. The tower is the only picturesque portion of the building. Hampstead Heath is one of

the finest open spaces in the neighbourhood of London, and consists of 240 acres. At one time its permanence was in jeopardy, but attempts were made as early as 1829 to save the Heath from the builder. In 1871 the struggle for the preservation of the Heath was brought to a satisfactory conclusion by the agreement of Sir Thomas Maryon Wilson and his son, Mr Spencer Wilson, to give up all the rights in the Heath of the Lord of the Manor of Hampstead for the sum of £46,000. An Act of Parliament was passed transferring the owner-ship to the Metropolitan Board of Works, now repre-sented by the London County Council. Golders Hill, to the north-westward of the West Heath, now under the control of the London County Council, was until 1898 in the occupation of the late Sir Spencer Wells, Bart. It consists of a house and 36 acres of land. The estate was purchased for £38,500, to which amount the County Council contributed £12,000. Hampstead has long been a favourite place of residence for lawyers, artists, poets and other men of letters, and the number

of great names associated with the place is very large. It is also remarkable for its charitable institutions, one of the most important being the North London Consumptive Hospital. The sub-manor of Belsize and the hamlet of Kilburn are included in the borough of Hampstead. Population (1881), 45,462; (1901), 81,942. See Caroline A. White. Sweet Hampstead, its Associations. London, 1901. — Records of the Manor, Parish, and Borough of Hampstead, edited by T. E. Baines. London, 1890.

Hampton, a parish and town of England, on the Thames, 12 miles W.S.W. of Hyde Park Corner, in the Uxbridge parliamentary division of Middlesex; station on a branch of the London and South- Western railway. Included in the parish is Hampton Court, the Home Park of which was thrown open to the public in 1893. Garrick, Sir Christopher Wren, and Sir Eichard Steele were residents of Hampton. The area of the civil parish and urban district is 2036 acres. Population (1881), 4776; (1891), 5822; (1901), 6812. Hampton Wick is a parish and urban district on the Thames,

about a mile to the east of Hampton Court. Area, 1316 acres. Population (1881), 2164; (1901), 2606.

Hampton, Wade (1818-1902), American general, was born on the 28th of March 1818 at Columbia, South Carolina. He graduated at South Carolina University, and was trained for the law. Though national in early leanings, he threw himself with energy into the Southern cause in 1861, raising a mixed command known as "Hampton's Legion," which he led at Bull Eun. He rose from brigadier to lieutenant-general in the course of the Civil War, serving chiefly in Stuart's cavalry. When General Sherman advanced northwards from Savannah, and Columbia, S.C, was burned, Hampton's command formed the rearguard of the Confederate retreat. He was chosen in 1876 governor of his state, and installed after a memorable contest; he served in the United States Senate 1879-91, and was United States commissioner of railways in 1893. He died 10th April 1902.

Hanau, a town of Prussia, province of Hesse-Nassau,

on the right bank of the Main, 14 miles by rail east of Frankfort. In 1896 a monument to Jakob and Wilhelm Grimm was unveiled. There is a royal academy of industrial art design. Population (1886), 24,377 ; (1900), 29,846.

Hancock, Winfield Scott (1824^1886), American general, was born, 14th February 1824, in the village of Montgomery Square, Montgomery county. Pa. He was educated in the public schools and at West Point, his career at the latter being creditable but not distinguished. On the 1st of July 1844 he was breveted, and on the 18th of June 1846 commissioned second lieutenant. He took part in the later movements under Scott against the city of Mexico, and was breveted first lieutenant for " gallant and meritorious conduct." After the Mexican war he served at various places in the West, in Florida, and elsewhere ; was married in 1850 to Miss Almira Eussell of St Louis; became first lieutenant in 1863, and assistant-quartermaster with rank of captain in 1866. The outbreak of the Civil War

found him in California. At his own request he was ordered East, and on 23rd September 1861 was made brigadier-general of volunteers and assigned to command a brigade in the army of the Potomac. He took part in the Peninsula campaign, and the handling of his troops in the engagement at Williamsburg, 5th May 1862, was so brilliant that McClellan reported " Hancock was superb," an epithet always afterwards applied to him. At the battle of Antietam he was placed in command of the fijst division of the second corps, and on 30th November of the same year was promoted from captain to major and assistant-quartermaster in the regular army. In the disastrous battle of Fredericksburg, Hancock's division was on the right among the troops that were ordered to storm Marye Heights. Out of the 6006 men in his division 2013 fell, among them not less than 156 commissioned ofiicers. At Chancellorsville his division received both on the 2nd and the 3rd of May the brunt of the attack of Lee's main army. Soon after the battle he was appointed commander of the second corps. The battle of

Gettysburg began 1st July in the defeat of the left wing of the army of the Potomac under General Eeynolds. About the middle of the afternoon Hancock arrived on the field with orders from Meade to assume command and to decide whether to continue the fight there or to fall back. He decided to stay, rallied the retreating troops, and held Cemetery Hill and Eidge until the arrival of the main body of the Federal army. During the second day's battle he commanded the left centre of the Union army, and after the fall of Sickles the left wing. In the third day's battle he commanded the left centre, upon which fell the full brunt of Longstreet's attack, the most famous charge in the whole war. Hancock's superb presence and power over men never shone more clearly than when, as the 160 guns of the Confederate army opened upon the left centre, he calmly rode along the front of his line to show his soldiers that he shared the dangers of the can-nonade with them. His corps lost in the battle 4360 out of less than 10,000 fighting men. But it had captured twenty-seven C onf ederate battle flags and as many prisoners

as it had men when the fighting ceased. Just as the Confederate troops reached the Union line Hancock was struck in the groin by a bullet, but continued in command until the repulse of the attack. The wound proved a severe one, so that some six months passed before he resumed command. In the battles of the year 1864 Hancock's part was as important and striking as in those of 1863. At the Wilderness he commanded, during the second day's fighting, half of the Union army ; at Spottsylvania he had charge of the fierce but successful attack on the " salient " ; at Cold Harbor his corps formed the left wing in the unsuccessful assault on the Confederate lines. In August he was promoted to brigadier-general in the regular army. In November, his old wound troubling him, he obtained a short leave of absence, expecting to return to his corps in the near future. He was, however, detailed to raise a new corps, and later was placed in charge of the " Middle Division." It was expected that he would move towards Lynchburg, as part of a combined movement against Lee's communications. But before he

could take the field Eichmond liad fallen and Lee had surrendered. It thus happened that Hancock, who for three years had been the most conspicuous single figure in the army of the Potomac, did not take part in the final triumph.

After the assassination of Lincoln, Hancock was placed in charge of Washington, and it was under his command that Booth's accomplices were tried and executed. In July 1866 he was appointed major-general. A little later he was placed in command of the department of the Missouri, and the year following assumed command of the fifth military division, comprising Louisiana and Texas. His policy, however, of discountenancing military trials and conciliating the late rebellious states did not meet with approval at Washington, and he was at his own request transferred. Hancock had all his life been a Democrat. His splendid war record and his personal popularity caused his name to be considered as

a candidate for the Presidency as early as 1868, and in 1880 he was nominated for that ofB.ce by the Democrats ; but he did not prove a strong candidate, and was defeated by General G-arfield, though by the small popular plurality of a few thousand votes. He died at Governor's Island, near New York, on 9th February 1886. Hancock was in many respects the ideal soldier of the Northern armies. His large frame and majestic carriage helped him to look every inch the soldier that he was. He was quick, energetic, and resourceful, reckless of his own safety, a strict disciplinarian, a painstaking and hard-working of&cer. It was on the field of battle, and when the fight-ing was fiercest, that his best qualities came to the front. He was a bom commander of men, and it is doubtful if any other oflBoer in the Northern army could get more fighting and more marching out of his men. Grant said of him, " Hancock stands the most conspicuous figure of all the general officers who did not exercise a separate command. He commanded a corps longer than any other, and his name was never mentioned as having

committed in battle a blunder for which he was responsible." A biography of him has been written by General Francis A. Walker. (r. h. h.)

Hangchow, the capital city of the province of Chekiang, at the head of Hangchow Bay, China, 110 miles south-west of Shanghai. It was declared open to foreign trade in 1896, in pursuance of the Japanese treaty of Shimonoseki. It is connected with Shanghai by inland canal, which is navigable for boats drawing up to four feet of water, and which might be greatly improved by dredging. The cities of Shanghai, Hangchow, and Soochow form the three points of a triangle, each being connected with the other by canal, and trade is now open by steam between all three under the inland navigation rules. These canals pass through the richest and most populous districts of China, and in particular lead into the great silk-producing districts. They have for many centuries been the highway of commerce, and afford a cheap and economical means of transport. Hangchow lies at the head of the large estuary of that name, which

is, however, too shallow for navigation by steamers. The estuary or bay is funnel-shaped, and its configuration produces at spring tides a " bore " or tidal wave, which is perhaps unequalled in any other part of the world. The inflowing tide becoming more and more concentrated as it advances, and being checked at its foot by the friction of the downrush of the river, gradually assumes the formation of a wall of water, the upper part being raised higher and higher by the augmenting flood from behind. At its maximum the wave reaches a height of 15 to 20 feet, and rushes past with a roar like thunder and the speed of a railway train. The population of Hangchow is estimated at 500,000. It is the great seat of the silk-weaving industry, and is celebrated for the production of fans, "joss paper," drugs, lacquer, &c. The volume of trade passing through the customs in 1899 was 11,501,000 H. (Haikwan, or customs) taels, equal to £1,729,000, which, however, was only a small part of the total trade.

Hankow, a treaty port on the north bank, and

700 miles from the mouth, of the Yangtse, China. Within recent years it has made rapid advance in wealth and importance. The opening up of the upper waters of the Yangtse to steam navigation has made it a commercial entrepdt second only to Shanghai. It is the terminus of the Belgian railway now in course of construction between Peking and the Yangtse, being the northern half of the grand trunk line from Peking to Canton. The southern half has been contracted for by an Anglo-American syndicate. There is daily communication by regular lines of steamers with Shanghai, and smaller steamers ply on the upper section of the river between Hankow and Ichang. The principal article of export continues to be black tea, of which staple Hankow has always been the central market. The bulk of the leaf tea, however, now goes to Russia by direct steamers to Odessa instead of to London as formerly, and a large quantity goes overland vid Tientsin and Siberia, in the form of brick tea. The quantity of brick tea thus exported in 1898 was upwards of 60 million ft . The exports which come next in value are opium, wood-

oil, hides, beans, cotton yarn, and raw silk. The popular tion of Hankow, together with the city of Wuchang on the opposite bank, is estimated at 800,000, and the number of foreign residents is about 500. Large iron-works have been erected by the Chinese authorities at Hanyang, a couple of miles higher up the river, and at Wuchang there are two official cotton mills. The British concession, on which the business part of the foreign settlement is built, was obtained in 1861 by a lease in perpetuity from the Chinese authorities in favour of the Crown. Sub-leases for a term of years are granted by the Crown to private individuals ; local control, including the policing of the settlement, is managed by a municipal council elected under regulations promulgated by the British minister in China, acting by authority of the Sovereign's Orders in Council. Foreigners, i.e., non-British, are admitted to become lease-holders on their submitting to be bound by the municipal regulations. The concession, however,, gives no territorial jurisdiction. All foreigners, of whatever nationality, are justiciable only before their

own consular authorities by virtue of the extra-territorial clauses of their treaties with China. In 1895 a concession on similar terms to that under which the British is held was obtained by Germany, and this was followed by concessions to France and Russia. These three concessions all lie on the north bank of the river and immediately below the British. An extension of the British concession backwards was granted in 1898. The total trade in 1900 was valued at £13,248,100 (£6,582,050 being exports and £6,666,050 imports), as compared with a total of £17,183,400 in 1900 and £11,628,000 in 1880.

Hanley, a municipal (1857), county (1888), and parliamentary (1885) borough and market town of Staffordshire, England, often styled "the metropolis of the Potteries," 150 miles by rail north-north-west of London. The adjoining municipal borough of Burslem is included in the parliamentary borough, which returns one member. The schools include a higher-grade elementary and science school, built in 1894, and a school of art. Other buildings include the free library (1887); a technical and art

museum, transferred to the corporation in 1891; and a

theatre, reconstructed in 1894. Hanley Park, opened in 1894, covers 80 acres. In 1891 there were 5815 males and 4588 females employed in the manufacture of earthen-ware, china, and porcelain, and 2305 persons in coal-mining. There is a daily newspaper. Area of municipal borough, 1768 acres ; population (1881), 48,361 ; (1901), 61,524.

Hannen, James Hannen, 1st Bakon (1821-1894), English judge, son of a London merchant, was born in 1821. He was educated at St Paul's School, and then proceeded to Heidelberg University, which was famous as a school of law. Called" to the bar at the Middle Temple in 1848, he joined the Home Circuit. At this time he also wrote for the press, and supplied special reports for the Morning Chronicle. Though not eloquent in speech, he was clear, accurate, and painstaking, and soon advanced in his profession, passing many more bril-

liant competitors. He appeared for the claimant in the Shrewsbury peerage case ; was principal agent for Great Britain on the mixed British and American Commission for the settlement of outstanding claims, 1853-55 ; and assisted in the prosecution of the' Fenian prisoners at Manchester. In 1868 Hannen was appointed a judge of the Court of Queen's Bench. In many cases he took a strong position of his own, notably in that of " Farrar V. Close," which materially affected the legal status of trade unions and was regarded by unionists as a severe blow to their interests. Hannen became judge of the Probate and Divorce Court in 1872, and in 1875 he was appointed President of' the Probate and Admiralty Division of the High Court of Justice. Here he showed himself a worthy successor to Cresswell and Penzance. Many important causes came before him, but he will chiefly be remembered for the manner in which he presided over the Parnell Special Commission. His influence pervaded the whole proceedings, and it is understood that he personally penned a large part of the voluminous report.

Hannen's last public service was in connexion with the Bering Sea inquiry at Paris, when he acted as one of the British arbitrators. In January 1891 he was created a life peer and appointed a Lord of Appeal, but in that capacity he had few opportunities for displaying his powers, and he retired at the close of the session of 1893. He died in London, after a prolonged illness, on 29th March 1894.

(g. b. s.)

Hannibal, a city of Marion county, Missouri, U.S.A., in 39° 44′ N. lat. and 91° 23′ W. long., on the west bank of the Mississippi, at an altitude of 473 feet. The business part is in the level bottom lands of the river, while the residence portion spreads up the banks, which afford fine building sites. It has four railways — the Chicago, Burlington, and Quincy ; the Missouri, Kansas, and Texas ; the Wabash ; and the St Louis and Hannibal. It has a large lumber trade, and manufactures of railway cars, machinery, and other iron and steel goods. Population (1880), 11,074; (1890), 12,857; (1900), 12,780, of whom 925 were foreign-born and 1836 were negroes.

Hannington, James (1847-1885), bishop of Eastern Equatorial Africa, was born at Hurstpierpoint, in Sussex, on the 3rd of September 1847. From earliest childhood he displayed a love of fun, adventure, and natural history. At school he made little progress, and left at the age of fifteen for his father's counting-house at Brighton. He had no head for office work, and much of his time was occupied in commandilig a battery of volunteers and in charge of a steam-launch. At twenty-one he resolved to prepare for the ministry, and in 1868 entered St Mary's Hall, Oxford, and soon exercised a remarkable influence over his fellow-students. His studies, however, did not make much progress, and in 1870 he was advised to repair to the little village of Martinhoe, in Devonshire, for quiet reading, but distinguished himself more by his daring climbs after seargulls' eggs and his engineering skill in cutting a pathway along precipitous cliffs to some caves. In 1872 the death of his mother, whom he dearly loved, made a deep impression upon him, and after studying hard he took his B.A. degree, and in the following

year was ordained deacon and placed in charge of the small country parish of Trentishoe. Here his spiritual life underwent a great change. After ministering at Hurstpierpoint, his thoughts were turned by the murder of two missionaries on the shores of Victoria Nyanza to mission work. Accordingly he offered himself to the Church Missionary Society, and sailed on 17th May 1882 at the head of a party of six for Zanzibar, and thence set out for Uganda ; but, prostrated by fever and dysentery, he was obliged to return to England in 1883. On his recovery he was consecrated bishop of Eastern Equatorial Africa, and in 1885 started again for the scene of his mission, and occupied himself on his arrival at Freretown in visiting many stations in the neighbourhood. Then, filled with the idea of opening a new route to Uganda, he set out and reached a spot near Victoria Nyanza in safety. His arrival, however, roused the suspicion of the natives, and under King Mwanga's orders he was lodged in a filthy hut swarming with rats and vermin. After eight days his men were murdered, and on the 29th of October

1885 he himself was speared in both sides, his last words to the soldiers appointed to kill him being, " Go, tell Mwanga I have purchased the road to Uganda with my blood." (g. f. m.)*

Hanoi, capital of Tongking, French Indo-China, on the right bank of the Song-Koi or Ked river, 60 miles in a direct line from the sea. It is the ancient Ke-Sho (" great market "), and few towns have undergone greater changes. Between 1892 and 1895 M. de Lanessan, the then Governor-General, completely altered its appearance. The old Annamese town has almost entirely disappeared, giving place to a magnificent city possessing all the improvements and comforts of European civilization. The Annamese citadel has been razed, and the town now covers over 2470 acres. The population, formerly not exceeding 50,000, now comprises more than 100,000 Annamese, besides 1700 Chinese and 1000 Europeans, almost exclusively French. For several years, especially from 1881 to 1895, Hanoi was regarded as the capital of Indo-China. Wide streets have been opened up, boule-

vards, squares, and promenades laid out, and a theatre and new Government offices built. A system of drains has been constructed and is being extended ; the town is lighted by electricity, and there is a good water-supply. A fine botanical and zoological garden has been laid out, and the Lanessan Hospital was opened in 1894. Im-portant works (embankments and quays) were under-taken in 1894 along the Eed river for a distance of 2|-miles, and a commercial port to which the largest vessels can ascend is under construction. On the completion of the great bridge across the Eed river three railway lines will cross at Hanoi — the lines from Hanoi to Haiphong, from Hanoi to Yenbai vid Sontai (about to be extended to Laokai), and from Hanoi to Ninhbinh, which is ulti-mately to be prolonged to Thanh-hoa and Hue. The approaching connexion between Haiphong and Phu-Lang-Thuong will place Hanoi in communication with the Chinese frontier as far as the Canton river. Eiver and sea communication are secured to Hanoi by the Messageries Maritimes, which run in conjunction with boats between

Haiphong, Hong-Kong, and Saigon. The Messageries MuTiales ply regularly between Haiphong, Hong-Kong, and Pakhoi, and also up the B,ed river to Laokai. Horse-racing is much enjoyed, and the town is at all times very animated. The course is 1420 yards long. Hanoi has a chamber of commerce, the president of which is entitled to a seat on the Superior Council of Indo-China. It has also a court of appeal, a tribunal of general commerce, and a civil tribunal of the first order. The great Indo-China Exhibition of 1902 was held in buildings specially erected on the race-course. (j. m. a. de l.)

Hanotaux, Albert Auguste Gabriel (1853--), ^French statesman and historian, was born at Beaurevoir, in the department of Aisne, France, on the 19th]S”ovember 1853. After successful studies at the]ficole des Chartes, which made him an expert in historical research, he obtained a connexion with journalism. An article in the Bepublique Frangaise procured him the

notice of Gambetta, who brought him into the Ministry of Foreign Affairs, where, but for one brief excursion into parliamentary life, he continued until 1894, filling successively several important posts, and obtaining so much distinction that, with scarcely any political claim excepting his eminence as a civil servant, he was raised to the post of Minister on M. Dupuy's accession to power in May of that year. With one brief interruption, M. Hanotaux retained his position amid changing Miais-tries, until the resignation of the Meline Cabinet in June 1898. After his retirement M. Hanotaux devoted himself chiefly to literature. His Histoire de Richelieu (1893-96) made his reputation as a historian, and he was elected a member of the French Academy in 1897.

Hanover, a province of Prussia, with an area of 14,869 square miles and population of 2,590,939 (1900). The miaes in 1898 gave an output of 629,925 tons of coal, valued at £221,000, and 90,643 tons of lignite, val-ued at £14,000 ; 730,045 tons of iron ore, valued at £138,700 ; 17,197 tons of zinc, valued at £87,800 ; 48,197

tons of lead, valued at £134,100 ; and 25,623 tons of copper, valued at £26,700: total value of minerals, £534,500. The output of the salt works and smelting furnaces consisted of 117,761 tons of salt, valued at £121,900 ; 7618 tons of Glauber salts, valued at £8500 ; 217,804 tons of iron, valued at £420,600 ; 11,008 tons of lead, valued at £139,350 ; 1,087,450 oz. of silver, valued at £163,500; and 27,954 tons of sulphuric acid, valued at £35,450 : total value, £889,300. The produce of the iron-foundries amounted to 344,316 tons, estimated to be worth £2,331,000. In 1897 the live stock consisted of 1,314,762 pigs,. 1,064,586 cattle, 971,669 sheep, and 234,604 horses. In 1899-1900 the sugar factories and refineries yielded 142,340 tons of sugar ; the breweries, 36,630,000 gallons of beer ; and the distilleries, 2,356,500 gallons (1897-98) of pure alcohol. In 1899 the mercan-tile marine numbered 843 sea-going vessels of 82,626 tons. The principal ports are Harburg, Emden, Papen-burg. Leer, Geestemilnde, Norderney, and Borkum. (See also Germany, Prussia.)

Hanover, a town of Prussia, capital of the province of Hanover, 163 miles by rail west of Berlin, at the crossing of the Berlin-Cologne and Hamburg-Prankfort lines, and headquarters of the 10th German Army Corps. In the old town the more noteworthy recent buildings are the Kestner (archaeological) Museum (1888), containing also the municipal library, the administrative offices (finished in 1878), the garrison church (1891-93), the new provincial museum (1900-1901), the Imperial Bank (1895-96) in the Italian Renaissance style, the industrial exhibition, industrial art school, large covered market (1890-92), and Gutenberg fountain (1890). The industrial art museum is now lodged in the house of Leibnitz. The new town hall was designed by Eggers. In the eastern quarters, which are half encircled by the Eilenriede woods and parks (1650 acres), there are the hall of the provincial estates, the Garden church (1887-91), a sandstone structure in the early Gothic style, with a tower 289 feet high and some good stained glass; the law courts (1880-82), the large convict prison (1865-76), Holy

Trinity church (1881-83), a fine war monument (1884), and the veterinary high school. The old provincial museum (1853-54) in this part of the town now includes a variety of collections, such as natural history, ethnography, and modern paiatings, besides the Cumberland gallery and the Guelph Museum. Here, too, is the zoological garden. On the north of the old town are the technical high school (1878-80), now in the Guelph Castle (1857-66) ; the riding and fencing school of the army ; the Eoman Catholic church of St Mary's, with a tower 302 feet high, and the grave of "His Little Excellency" Windthorst, for many years leader of the Ultramontane (Centre) party in the Imperial Diet ; the Luther church (1898), the Apostles' church (1883), and Herrenhausen Castle, with its fine gardens, theatre, museum, orangery, &c., and the magnificent avenue (2200 yards long, 187 feet wide) which leads to it. Other public institutions comprise a high school for girls (1899), commercial school, blind asylum, cripples' home, military school, various seminaries for teachers, industrial art

school, mint, &c. Hanover occupies a leading place amongst the industrial and commercial towns of the king-dom. Its staple industries are the manufacture of india/-rubber and gutta-percha (1400 operatives), machinery (1100 men), iron-founding, and brewing. Besides these, hardware, liuens, chemicals, tobacco, pianos, books, fur-niture, and various other articles are produced. The commerce is principally in the home manufactures, and in wine, chocolate, groceries, hides, horses, coal, wool, and cereals. In the industrial sister town of Linden (50,623), to the south-west, there are a new town hall, a church (1722), and the Alten Park. Population of Hanover (1886), 139,731 ; (1900), 235,666.

Hanover, a town of Grafton county, New Hamp-shire, U.S.A., on the east bank of the Connecticut, 55 miles north-west of Concord. It is connected by bridge with Norwich, and with the Boston and Maine railway on the opposite bank of the river. It is the seat of Dart-mouth College, a non-sectarian institution founded in 1796, and having in 1899, in all departments, 65 instructors

and 694 students. Its endowment and the value of its plant amounted to two and a half million dollars, its library numbered 80,000 volumes, and its income for the year was $103,000. Population (1880), 2147; (1890), 1817; (1900), 1884.

Hanover, a borough of York county, Pennsylvania, U.S.A., at the intersection of a line of the Pennsylvania railway with the Western Maryland railway. Population (1890), 3746 ; (1900), 5302, of whom 133 were foreign-born.

Hansi, a town of British India, in the Hissar district of the Punjab, on a branch of the Western Jumna canal, with a station on the Eewari-Eerozepore railway, 16 miles east of Hissar by rail. The population in 1881 was 12,656, in 1891 it was 16,190 ; the municipal income in 1897-98 was Es.18,320. It is the ancient capital of the tract called Hariana, and was the headquarters of the Irish adventurer George Thomas at the end of the 18th century ; from 1802 to 1857 it was a British cantonment, and the scene of a murderous outbreak during the Mutiny.

It is still surrounded by a high brick ~~wall, with a dis~~ mantled fortress, and is the centre of local trade, with four factories for ginning and pressing cotton. There is an annual horse fair, and a municipal school.

Hanthawaddy, a district in the Pegu division of Lower Burma, the home district of Rangoon, from which the town was detached to make a separate district in 1880. It has an area of 3023 square miles, with a population in 1891 of 396,887, living in 1313 villages, and paying in 1898-99 a revenue of Es.31,99,729. The population was made up of 371,308 Buddhists and Jains, 16,032 Hindus, 6236 Mahommedans, and 4311 Christians, many of whom were Karens. In 1901 the population was 484,847. The total area is 1,934,720 acres, of which, in 1898-99, 1,027,027 acres were cultivated, 167,723 were cultivable, 31,155 acres were lying current fallow, and 489,030 acres were not available for cultivation, while 219,785 acres were under forests. The rainfall in

1898-99, taken at Hmawbi, was 105-8 inches. The headquarters of the district are in Eangoon, which is also the sub-divisional headquarters. The second sub-division has it headquarters at Insein, where there are large railway works. There are nearly 200 schools in the district, with about 7000 pupils. Cultivation is almost wholly confined to rice, but there axe many vegetable and fruit gardens.

Han well, a parish of England, on the Brent, 10 miles west of St Paul's, London, and in the Brentford parliamentary division of Middlesex; station on the Great Western railway. St Mary's, the parish church, was built in 1841, and St Mark's in 1883. In the parish there are also a Catholic chapel (1864) and Baptist and Methodist chapels. In the neighbouring parish of Norwood is the Hanwell lunatic asylum of the county of London. Since its erection in 1831 it has been much extended, and can now accommodate over 2600 inmates. Its chapel was built in 1880. In Han-well a Roman Catholic convalescent home was erected in

1865. Area of urban district, 1067 acres. Population (1881), 5178 ; (1901), 10,437.

Haparanda, a small town of Sweden, on the right bank of the Tornei,, 1^ miles from its issue into the north extremity of the Gulf of Bothnia, immediately opposite to the Finnish town of Tornei,, though, owing to the river having shifted its course, both towns stood in 1899 on the Swedish side of the stream. It has an important meteorological station ; annual mean temperature, 32° Pahr. ; February, 10-5° ; July, 58-8°. Rainfall, 16-5 inches annually. Sea-going vessels load and unload at Salmis, 7 miles distant. Population (1880), 1039 ; (1900), 1568.

Harburg, a seaport town of Prussia, province of Hanover, 6 miles by rail south of Hamburg. A new bridge has been built (1899) across the south arm of the

Elbe, on which Harburg stands, thus connecting it by means of the island of Wilhelmsburg with Hamburg on the north arm of the river. The port is accessible to vessels drawing 18 feet and measuring 4600 tons. Owing to its geographical position and cheap storage, Harburg is a distributing centre of not a little importance, despite its proximity to Hamburg. It is the chief mart in the empire for palm oil and resin ; and in 1901 the Prussian Government contemplated converting it into a free port, and enlarging it relatively on the lines of Hamburg. The shipping entering has decreased from 636 vessels of 77,676 tons in 1888 to 428 vessels of 75,746 tons in 1899 ; in addition to which there are inland (river) entries of approximately 13,090 vessels of nearly three-quarters of a million tons. The leading industries are the crushing of palm kernels and linseed, and the manufacture of india-rubber, phosphates, starch, nitrate, and jute. Population (1885), 26,320; (1900), 49,155, the area of the town having been increased since 1895.

Harcourt, Sir William George Granville

Venables Vernon (1827), English states-
man, second son of William Vernon Harcourt, of
Nuneham Park, Oxford, was born 14th October 1827.
He was educated at Trinity College, Cambridge,
graduating with first-class honours in the classical
tripos in 1851. He was called to the bar at the Inner
Temple in 1854, became a Q.C. in 1866, and was ap-
pointed Whewell professor of international law, Cam-
bridge, 1869. It was in these years that he contributed
largely to journalism and wrote letters to Tlie Times
over the signature of " Historicus," which were published
in book form in 1863. He entered Parliament as Liberal
member for Oxford, and sat from 1868 to 1880, when, upon
seeking re-election after acceptance of ofBce, he was
defeated by Mr Hall. A seat was, however, found for him
at Derby, by the voluntary retirement if Mr PlimsoU, and
he continued to represent that constituency until 1895,
when, having been defeated at the general election, he
found a seat in West Monmouthshire. He was appointed
Solicitor-General and knighted in 1873 ; and, although he

had not shown himself a very strenuous supporter of Mr Gladstone during that statesman's exclusion from power, he became Secretary of State for the Home Department on the return of the Liberals to office in 1880. His name was connected at that time with the passing of the Ground Game Act (1880), the Arms (Ireland) Act (1881), and the Explosives Act (1883). As Home Secretary at the time of the dynamite outrages he had to take up a firm attitude, and the Explosives Act was passed through all its stages in the shortest time on record. Moreover, as champion of law and order against the attacks of the Parnellites, his vigorous speeches brought him constantly into conflict with the Irish members. In 1884 he introduced an abortive Bill for unifying the miinicipal administration of London. He was indeedatthattime recognized as one of the ablest and most effective leaders of the Liberal party ; and when, after a brief interval in 1885, Mr Gladstone returned to ofSce in 1886, he was made Chancellor of the Exchequer, an office which he again filled from 1892 to 1895. Between 1880 and 1892 Sir

William Harcourt acted as Mr Gladstone's loyal and indefatigable lieutenant in political life. A first-rate party fighter, his services were of inestimable value ; but in spite of his great success as a platform speaker, he did not impress the country as possessing much depth of conviction. It was he who coined the phrase about " stewing in Parnellite juice," and, when the split came in the Liberal party on the Irish question, even those who gave Mr Gladstone and Mr Morley the credit of being convinced Home Rulers could not be persuaded that Sir William had followed anything but the line of party expediency. In 1894 he introduced and carried a memorable Budget, which equalized the Death Duties on real and personal property. After Mr Gladstone's retirement in 1894 and Lord Rfosebery's selection as Prime Minister Sir William became, the leader of the Liberal party in the House of Commons, but it was never probable that he would work comfortably in the new conditions. His title to be regarded as Mr Gladstone's successor had been too lightly ignored, and from the first it was evi-

dent that Lord Rosebery's ideas of Liberalism and of the policy of the Liberal party were not those of Sir William Harcourt. Their differences were patched up from time to time, but the combination could not last. At the

general election of 1895 it was clear that there were divisions as to what issue the Liberals were fighting for, and the effect of Sir William Harcourt's Local Veto Bill on the election was seen not only in his defeat at Derby, which gave the signal for the Liberal rout, but in the set-back it gave to temperance legislation. Though re-turned for West Monmouthshire (1895, 1900), his speeches in debate only occasionally showed his characteristic spirit, and it was evident that for the hard work of Opposition he no longer had the same motive as of old. In 1898 the crisis arrived, and with Mr John Morley he definitely retired from the councils of the party and resigned his leadership of the Opposition, alleging as his reason, in letters exchanged between Mr Morley and

himself, the cross-currents of opinion among his old supporters and former colleagues. The split excited considerable comment, and resulted in much heart-burning and a more or less open division between the section of the Liberal party following Lord Eosebery and those who disliked that statesman's Imperialistic views. Though now a private member, Sir William Harcourt still continued to vindicate his opinions in his independent position, and his attacks on the Government were no longer restrained by even the semblance of deference to Liberal Imperialism. He actively intervened in 1899 and 1900, strongly condemning the Government's financial policy and their attitude towards the Transvaal ; and throughout the Boer war he lost no opportunity of criticizing the South African developments in a pessimistic vein. One of the readiest parliamentary debaters, he savoured his speeches with humour of that broad and iEamiliar order which appeals particularly to political audiences. In 1898-1900 he was conspicuous, both on the platform and in letters written to

The Times, in demanding active measures against the Ritualistic party in the Church of England; but his attitude on that subject could not be dissociated from his political advocacy of Disestablishment. Sir William Harcourt married, first, in 1859, Therese, daughter of Mr T. H. Lister ; and secondly, in 1876, Elizabeth, widow of Mr T. Ives, and daughter of Mr J. L. Motley, the historian.

Harderwyk, a small town in the province of Gelder-land, Netherlands, on the coast of the Zuider Zee, 28 miles north-east of and on the railway to Utrecht from Zwolle (Central railway). It has a colonial recruiting office. As a seaport its trade is exclusively confined to the Zuider Zee. Population (1900), 7327.

Hardingstone, a parish in the Mid division of Northamptonshire, England, 2 miles south-south-east of Northampton. In it stands one of the original Eleanor Crosses, of which only three out of twelve remain, erected by King Edward I. to mark the resting-places of his queen's body on its way from Harby (Nottinghamshire)

to burial at Westminster. Population about 3000.

Hardoi, a town and district of British India, in the Lucknow division of Oudh. The town is 63 miles north-east of Lucknow by rail. The population in 1881 was 10,026, in 1891 it was 11,152 ; the municipal income in 1897-98 was E,s.l0,797 ; the registered death-rate in 1897 was 108 per thousand. The District of Haedoi has an area of 2324 square miles; the population in 1881 was 987,630, in 1891 it was 1,113,211, giving an average density of 479 persons per square mile. In 1901 the population was 1,093,201, showing a decrease of 2 per cent. The land revenue and rates were Rs.9, 79,534, the incidence of assessment being a little over R.l per acre ; the cultivated area in 1896-97 was 905,405 acres, of which 209,042 were irrigated from tanks, wells, &c. ; the number of police was 2273; the number of ver-nacular schools in 1896-97 was 92, with 4219 pupils; the registered death-rate in 1897 was 60-57 per 1000. There are three printing-presses, one of which issues a vernacular periodical. The district contains a larger

urban population than any other in Oudh, the biggest town being Shahabad, with in 1891 a population of 20,153. It is traversed by the Oudh and Rohilkhand railway from Lucknow to Shahjahanpur, with six sta^ tions ; 62 miles in all.

Hard war, a town of British India, in the Saharanpur district of the North- West Provinces, on the right bank of the Ganges, 17 miles north-east of Roorkee, with a railway station. The population of the municipal union in 1891 was 29,125; the municipal income in 1897-98 was Rs.39,246. It has an annual religious fair. The Ganges canal here takes off from the river. A branch railway to Dehra was opened in 1900.

Hardy, Thomas (1840), English novelist,

was born in Dorsetshire, 2nd June 1840. His family was one of the branches of the Dorset Hardys, formerly of influence in and near the valley of the Frome, claim- ing descent from John Le Hardy of Jersey (son of Clement Le Hardy, lieutenant-governor of that island in 1488), who settled in the west of England. His

TnOMAB Hakdt.

(From a photograph by Elliott and Fry, London.)

maternal ancestors were the Swetman, Childs or Child, and kindred families, who before and after 1635 were small landed proprietors in Melbury Osmond, Dorset, and adjoining parishes. He was educated at local schools, 1848-54, and afterwards privately, and in 1856 was articled to Mr John Hicks, an ecclesiastical architect of Dorchester. In 1859 he began writing verse and essays, but in 1861 was compelled to apply himself more strictly to architecture, sketching and measuring many old Dorset churches with a view to their restoration. In 1862 he went to London (which he had first visited at the age of nine) and became assistant to the late Sir Arthur Blomfield, R.A. In 1863 he won the medal of the Royal Institute of British Architects for an essay on Coloured Brick and Terra-cotta Architecture, and in

the same year won the prize of the Architectural Associar

tion for design. In March 1865 his first short story was published in Chambers's Journal, and during the next two or three years he wrote a good deal of verse, being somewhat uncertain whether to take to architecture or to literature as a profession. In 1867 he left London for Weymouth, and during that and the following year wrote a " purpose " story, which in 1869 was accepted by Messrs Chapman and Hall. The manuscript had been read by Mr George Meredith, who asked the writer to call on him, and advised him not to print it, but to try another, with more plot. The manuscript was withdrawn and re-written, but never published. In 1870 Mr Hardy took Mr Meredith's advice too literally, and constructed a novel that was all plot, which was published in 1871 under the title Desperate Remedies. In 1872 appeared Under the Greenwood Tree, a " rural painting of the Dutch school," in which Mr Hardy had already "found himself," and which he has never surpassed in happy and delicate perfection of art. A Pair of Blue Eyes, in which tragedy and irony come into his work together, was published

in 1873. In 1874 Mr Hardy married Emma Lavinia, daughter of the late T. Attersoll Gifford of Plymouth. His first popular success was made by Far from the Madding Crowd (1874), which, on its appearance anonymously in the Cornhill Magazine, was attributed by many to George Eliot. Then came Tlie Hand of Ethelherta (1876), described, not inaptly, as "a comedy in chapters" ; Tlie Return of the Native (1878), the most sombre and, in some ways, the most powerful and characteristic of Mr Hardy's novels ; Tlie Trumpet-Major (1880); A Laodicean (1881); Two on a Tower (1882), a long excursion in constructive irony ; Tlie Mayor of Casterbridge (1886); The Wbodlanders (1887); Wessex Tales (1888) ; A Group of Noble Dames (1891) ; Tess of the D' Urbervilles (1891), Mr Hardy's most famous novel; Life's Little L-onies (1894) ; Jude the Obscure (1896), his most thoughtful and least popular book ; Tlie Well-Beloved, a reprint, with some revision, of a story originally published in the Illustrated London News in 1892 (1897) ; Wessex Poems, written during the previous thirty years,

with illustrations by the author (1898). In 1894 Mr Hardy was appointed a magistrate for Dorsetshire. In all his work Mr Hardy is concerned with one thing, seen under two aspects ; not civilization, nor manners, but the principle of life itself, invisibly realized in humanity as sex, seen visibly in the world as what we call nature. He is a fatalist, perhaps rather a determinist, and he studies the workings of fate, or law (ruling through inexorable moods or humours), in the chief vivifying and disturbing influence in life, women. His view of women is more French than English ; it is subtle, a little cruel, not as tolerant as it seems, thoroughly a man's point of view, and not, as with Mr Meredith, man's and woman's at once. He sees all that is irresponsible for good and evil in a woman's character, all that is untrust-worthy in her brain and will, all that is alluring in h^r variability. He is her apologist, but always with a reserve of private judgment. No one has created more attractive women of a certain class, women whom a man would have been more likely to Ibve or to regret loving.

In his earlier books he is somewhat careful over the reputation of his heroines ; gradually he allows them more liberty, with a franker treatment of instinct and its con-sequences. Jude tlie Obscure is perhaps the most unbiassed consideration in English fiction of the more complicated questions of sex. There is almost no passion in his work, neither the author nor his characters ever seeming able to pass beyond the state of curiosity, the most intellectu-ally interesting of limitations, under the influence of any emotion. In his feeling for nature, curiosity sometimes seems to broaden into a more intimate communion. The heath, the village with its peasants, the change of every hour among the fields and on the roads of that English countryside which he has made his own — the Dorsetshire and Wiltshire " Wessex " — mean more to him, in a sense, than even the spectacle of man and woman in their blind, and painful, and absorbing struggle for existence. His knowledge of woman confirms him in a suspension of judgment ; his knowledge of nature brings him nearer to the unchanging and consoling element in the world. All

the entertainment which he gets out of life comes to him from his contemplation of the peasant, as himself a rooted part of the earth, translating the durfibness of the fields into humour. His peasants have been compared with Shakespeare's ; he has the Shakespearean sense of their placid vegetation by the side of hurrying animal life, to which they act the part of chorus, with an unconscious wisdom in their close, narrow, and undistracted view of things.

See Annie Macdonell. Thomas Hardy. London, 1894. — Lionel P. Johnson. The Art of Thomas Hardy. London, 1894.

Harfleur, a town in the arrondissement of Havre, department of Seine-Inf erieure, Erance, 42 miles, in direct line, west by north of Eouen, on the railway from Paris to Havre. Principal industries are the founding of various metals, oil-refining, and the manufacture of soap. The port, which had been rendered almost inaccessible owing to the deposits of the Lezarde, has again become avail-able since the opening, in 1887, of the Tancarville canal, connecting it with the Seine. The new port is half a mile

from the old, and vessels drawing 18 feet can moor along-
side its quays. Population (1901), 2686.

Harlingen, important trading town and seaport
in the province of Friesland, Netherlands, 17 miles west
of Leeuwarden by rail. Owing to the improvement of
the port (Willem sport), and the railway and steamship
connexion with Amsterdam, Bremen, and the southern
provinces, trade with Great Britain (imports — coal, cotton,
and jute for the manufacturing district of Twenthe ;
exports — cattle, butter, cheese, fish, potatoes, and wood)
has much increased. Among the industries is the manu-
facture of margarine. A steam tramway has been opened
to Sneek. Population (1900), 10,267.

Harmonic Functions. See Spherical Har-
monics.

Harnack, Adolf (1851), German theologian,
was born on 7th May 1861 at Dorpat, in Eussia, where
his father held a professorship of pastoral theology.
The son pursued his studies at this university and at
Leipzig, where he took his degree ; and immediately after-

wards began lecturing as a privat-docent. These lectures, which dealt with such special subjects as gnosticism, the Apocalypse, &c., attracted considerable attention, and in 1876 he was appointed " extraordinary " professor. Three years later he was called to Giessen, where he became professor of Church history. There he collaborated with Von Gebhardt in Texte und Untersuchungen zur Geschichte der altcliristlichen Litteratur, an irregular periodical, containing only essays in New Testament and patristic fields. In 1885 he published the first volume of his great work, the History of Dogma. In it Harnack traces the rise of dogma, by which he understands the authoritative doctrinal system of the 4th century and its development down to the Eef ormation. He considers that in its earliest origins Christian faith and the methods of Greek thought were so closely intermingled that much that is not essential to Christianity found its way into the resultant system. Therefore Protestants are not only free, but bound to

criticize it ; indeed for aProtestant Christian dogma cannot be said to exist. In 1886 Harnack was called to Marburg ; and in 1889, in spite of violent opposition from the conservative section of the Church authorities, to Berlin. Here, somewhat against his will, he was drawn into a controversy on the Apostles' Creed, in which the party-antagonisms within the Prussian Church had found expression. Harnack's view is that the creed contains both too much and too little to be a satisfactory test for candidates for ordination, and he would prefer a brief er symbol which could be rigorously exacted from all. At Berlin Harnack continued his literary labours. He undertook an edition of the Greek Fathers down to Eusebius, and a history of early Christian literature. He is one of the most prolific and most stimulating of modern Church historians, and has trained up in his " Seminar " a whole generation of teachers, who are carrying his ideas and methods throughout the whole of Germany and even beyond its borders. Harnack's own point of view is the

historico-critical. His distinctive characteristics are : his claim for absolute freedom in the study of Church history and the New Testament ; his distrust of speculative theology, whether orthodox or liberal ; his interest in practical Christianity as a religious life and not a system of theology. His writings are remarkable for their clearness combined with picturesque grace of style.

Haro, a town of Northern Spain, in the province of Logrono. It has increased in importance with the development of viticulture in its neighbourhood, and become the centre of a large export trade in wine. It has also manufactures of soap, liqueurs, brandy, preserves, candles, chalk, hats, and leather. Several casinos, a theatre, and various promenades have been constructed by the local authorities since 1880. Population (1897), 7976.

Harpenden, a village and urban district, Hertfordshire, England, in the Mid or St Albans division of the county, 5 miles south by east of Luton by rail, with stations on the Midland and Great Northern railways. In

the Lawes Testimonial Laboratory there is a collection of over 60,000 bottles of samples of experimentally-grown produce, annual products, ashes, and soils. The late Sir John Bennet Lawes provided an endowment of £100,000 for the perpetuation of the agricultural experiments which he inaugurated here. The success of his association of chemistry with botany is shown by the fact that one field has grown wheat without intermission for 65 years without manure. Area of urban and rural districts combined, 5111 acres. Population (1891), 3603 ; (1901), 4725.

Harrisburg, capital of Dauphin county and of the state, Pennsylvania, U.S.A., in 40° 16′ N. and 76° 53′ W., on the east bank of the Susquehanna, at an altitude of 317 feet. Its site is level and the street plan regular. It derives an excellent water-supply from the river, and is well paved and sewered. It is on four railways — the Pennsylvania, the Northern Central, the Philadelphia and Reading, and the Cumberland Valley. The state capitol was destroyed by fire in

1897, and has since been rebuilt, greatly enlarged, and improved. The manufacturing establishments in 1890 numbered 475, with $6,716,074 capital, and employed 6898 hands. Their products were valued at $10,538,444 ; of these nearly one-third in value were of iron and steel goods, the only prominent single item. The assessed valuation of real and personal property in 1890, on a basis of about two-thirds of the full value, was $26,631,875; the net debt was $1,183,234, and the rate of taxation was $17 per $1000. Population (1880), 30,762; (1890), 39,385; (1900), 50,167, of whom 2493 were foreign-born and 4107 were negroes. The death-rate in 1900 was 17-8.

Harrison, a town of Hudson county. New Jersey, U.S.A., on the Delaware, Lackawanna, and Western, the Erie, and the Pennsylvania railways, at an altitude of 32 feet. Population (1880), 6898; (1890), 8338; (1900), 10,696, of whom 3633 were foreign-born.

Harrison, Benjamin (1833-1901), the twenty-third president of the United States, was born at North

Bend, Ohio, 20th August 1833. His great-grandfather, Benjamin Harrison of Virginia, was a signatory of the Declaration of Independence. His grandfather, William Henry Harrison, who emigrated to Ohio, was in 1840 elected President of the United States. His father, John Scott Harrison, represented his district in the Benjamin Harrison.

Congress of the United States. Benjamin's youth was passed upon the ancestral farm, and as opportunity afforded he attended the log school-house near his home. He was prepared for college by a private tutor at his father's house, and at the age of eighteen he graduated from Miami University, at that time the leading educa-tional institution in the state of Ohio. From his youth he was diligent in his attention to his studies, and showed an avidity for the writings of Scott, Gibbon, and other classic English authors ; and during his college life he showed a mai'ked talent for extemporaneous speaking. He pursued the study of law, partly in the office of Bel-lamy Storer, a leading lawyer and judge of Cincinnati,

and partly at his father's farm. At the age of twenty-one, having previously married, he went to Indianapolis. He had but one acquaintance in the place, the clerk of the Federal Court, who permitted him to occupy a desk in his office and place at the door his sign as a lawyer. Waiting for professional business, he was content to act as court crier for two dollars and a half a day ; but he soon gave indications of his talent, and his studious

habits and attention to his cases rapidly brought him clients. Within a few years he took rank among the leading members of the profession at a bar which in-cluded some of the ablest lawyers of the country. His legal career was early interrupted by the Civil War. His whole heart was enlisted in the anti-slavery cause, and during the second year of the war he accepted a commission from the governor of the state as second lieutenant, and speedily raised a regiment. He was appointed its colonel, and as such continued in the

Union army until near the close of the war, when he was breveted, a brigadier-general for gallantry in the field. He participated with his regiment in various engagements during Buell's campaigns in Kentucky and Tennessee in 1862 and 1863 ; in Sherman's march on Atlanta in 1864; in the Nashville campaign; and was transferred early in 1865 to Sherman's army in its march through the Carolinas.

Allowing for this interval of military service, he applied himself exclusively for twenty-four years to his legal work, and became recognized as among the first lawyers of his state. The only office he held was that of reporter of the Supreme Court for two terms, which was strictly in the line of his profession. He was a devoted member of the Republican party, but not a politician in the strict sense. Once he became a candidate for Governor, in 1876, but his candidature was a forlorn hope, undertaken from a sense of duty, after the regular nominee had been forced to withdraw. He took a deep interest in the campaign which resulted in the election of Garfield as President,

and was offered by him a place in his cabinet ; but this he declined, having been elected a member of the United States Senate. He was chairman of the Committee on Territories, and took an active part in the admission of the new states of the north-west, especially of North and South Dakota. He served also on the Committee of Military and Indian Affairs, on Foreign Eolations and others, was prominent in the discussion of matters brought before the Senate from these committees, ad-vocated the restoration or enlargement of the navy, the reform of the civil service, and opposed the pension veto messages of President Cleveland. Mr Harrison was nominated by the Republican party for the Presidency in 1888, and successfully opposed Mr Cleveland, the candidate of the Democratic party. Among the measures and events distinguishing his term as President were the following : — The meeting of the Pan-American Congress at Washington ; the passage of the McKinley Tariff Bill ; the law suppressing the Louisiana lottery ; the enlarge-ment of the navy ; further advance in civil service reform ;

the convocation by the United States of an international monetary conference; the establishment of commercial reciprocity with many countries of America and Europe ; the peaceful settlement of the controversy with Chile; the Hawaiian annexation treaty; and the adjustment by arbitration with Great Britain of the Bering Sea fur-seal question. His administration was marked by a revival of American industries and a reduction of the public debt, and at its conclusion the country was left in an un-exampled condition of prosperity and on friendly terms with foreign nations. He was nominated by his party in 1892 for re-election, but was defeated by Mr Cleveland, this result being due to the labour strikes which occurred during the Presidential campaign and arrayed the labour unions against the tariff party.

In 1898 Mr Harrison was retained by the government of Venezuela as its leading council in the arbitration of its boundary dispute with Great Britain. In charge of this duty he appeared before the international tribunal of arbi-tration at Paris in 1899, worthily maintaining the repu-

tation of the American bar. He occupied a portion of his leisure after leaving public life in writing a book, entitled This Countrij of Ours, treating of the organization and administration of the government of the United States. He died at Indianapolis, Ind., on the 13th of March 19^01. Mr Harrison's distinguishing trait of character, to which his success is to be most largely attributed, was his thoroughness. He was somewhat reserved in manner, and this led to the charge in political circles that he was cold and unsympathetic ; but no one gathered around him more devoted and loyal friends, and his dignified bearing in and out of office commanded the hearty respect of his countrymen. (j. w. fo.)

Harrison, Frederic (1831), English jurist and author, was born in London, 18th October 1831. He was educated at King's College School and at Wadham College, Oxford, where, after taking a first-class in Literce. Humaniores in 1863, he became fellow and tutor. He was called to the bar in 1858, and, in addition to his practice in Equity cases, soon began to distinguish him-

self as an effective contributor to the higher-class reviews. Two articles in the Westminster Review, one on the Italian question, which procured him the special thanks of Cavour, the other on Essays and Revieivs, which had the probably undesigned effect of stimulating the attack on the book, attracted especial notice. A few years later Mr Harrison worked at the codification of the law with Lord Westbury, of whom he contributed an interesting notice to Nash's biography of the chancellor. His special interest in legislation for the working classes led him to be placed upon the Trades Union Commission of 1867-69; he was secretary to the Commission for the Digest of the Law, 1869-70; and was from 1877 to 1889 professor of Jurisprudence and International Law under the Council of Legal ^Education. A follower of the Positive philosophy, he was one of the founders of Newton Hall in 1881; and he was editor and part author of the Positivist Ifew Calendar of Gh-eat Men (1892). Of his separate publications, the most import-ant are his lives of Cromwell (1888) and of William the

Silent (1897), his Historical Pieces (1894), and Meaning of History (1862) ; his essays on Early Victorian Literature (1896) and The CJioice of Books (1886) evince a rare faculty for generous admiration tempered by sound common-sense. An advanced Radical in politics and Progressive in municipal affairs, Mr Harrison in 1886 stood unsuccessfully for Parliament against Sir John Lubbock for London University. In 1889 he was elected an alderman of the London County Council, but resigned in 1893. In 1870 he married Ethel Berta, daughter of Mr William Harrison.

Harrogate, a municipal borough (incorporated 1884, extended 1900) and inland watering-place in the Ripon parliamentary division of Yorkshire, England, 16 miles north of Leeds by rail. Recent erections are Royal Baths, seven Established churches, Wesleyan and Baptist chapels ; new buildings of the Harrogate Cottage Hospital, the Royal Bath Hospital, and the Rawson Convalescent Home ; a Jubilee memorial statue of Queen Victoria (1887), Primitive Methodist

chapel. Home for Incurables, Grand Opera House, and new Kursaal in course (1901) of erection. Public gardens were opened in 1888, and 36 acres of open ground, apart from the common (200 acres) are the property of the corporation, which also owns the Spa Concert Rooms and grounds, Harlow Moor, Crescent Gardens, Royal Bath Gardens, and other large open spaces, as well as Royal Baths, Victoria Baths, and Starbeck Baths. The mineral springs are vested in the corporation. Area (1891), 1287 acres; (1900, after extension), 3297 acres. Population (1881), 9482 ; (1891), 13,917; (1901), 28,414.

H A R E 0 W-0 N-T H E-H I L L— H ART

Harrow-on-the-Hill, a parish and town of England, 11 miles W.N.W. of St Paul's, London, in the Harrow parliamentary division of Middlesex, with stations on the London and North- Western and the Metropolitan Extension railways. Besides the tfhnrch of St Mary's, which contains ancient brasses and other memorials, there are Roman Catholic (1894), Baptist, andWesleyan places of

worship. Harrow is celebrated for its School, founded in 1571 by John Lyon, and during the latter half of the 19th centuiy frequently enlarged. Of recent additions the most important are the building which contains, besides school-rooms, the Butler Museum (1886), the music school (1891), and a new drawing school (1897). The Harrow Technical School is under the control of the Middlesex County Council. The civil parish has an area of 10,027 acres, with a population of 13,000. The urban district popula-tion is (1901) 10,220.

Hart, Sir Robert, Baet. (1835), Inspector-General of Chinese Customs, was born at Portadown, in Ulster, on 20th February 1835. He was educated at Taunton, Dublin, and Belfast, and graduated at Queen's College, Belfast, in 1853. In the following year he re-

SiE Egbert Hart.

{From a phoiograph by the London Siereoacopic Company.)

ceived an appointment as student-interpreter in the China consular service, and after serving for a short time at the Ningpo vice-consulate, he was transferred to Canton,

where after acting as secretary to the allied commissioners governing the city, he was appointed the local inspector of customs. There he first gained an insight into custom-house work. One effect of the Taiping rebellion was to close the native custom-house at Shanghai; and as the corrupt alternatives proposed by the Chinese were worse than useless, it was arranged by Sir Rutherford Alcock, the British consul, with his French and American col-leagues, that they should undertake to collect the duties on goods owned by foreigners entering and leaving the port. Sir T. Wade was appointed to the post of collector in the first instance, and after a short tenure of of&ce was succeeded by Mr H. N. Lay, who held the post until 1863, when he resigned owing to a disagreement with the Chinese Government in connexion with the Lay-Osborn fleet. During his tenancy of office the system adopted at Shanghai was applied to the other treaty ports, so that when on Mr Lay's resignation Mr Hart was appointed inspector-general of foreign customs, he found himself at the head of an organization which collected a revenue of

upwards of eight million taels per annum at fourteen treaty ports. From the date when Mr Hart took up his duties at Peking, in 1863, he unceasingly devoted the whole of his energies to the work of the department, vrith the result that the revenue grew from upwards of eight million taels to nearly twenty-seven million, collected at the thirty-two treaty ports, and the customs staff, which in 1864 numbered 200, reached in 1901 a total of 6704. From the first Mr Hart gained the entire confidence of the members of the Chinese Government, who were wise enough to recognize his loyal and able assistance. Of all their numerous sources of revenue, the money furnished by Mr Hart was the only certain asset which could be offered as security for Chinese loans. For many years, moreover, it was customary for the British minister, as well as the ministers of other Powers, to consult him in every difiiculty ; and such complete confidence had Lord Granville in his ability and loyalty, that on the retirement of Sir T. Wade he appointed him minister plenipotentiary at Peking (1885).

Sir Robert Hart, however — who was made a K.C.M.G. in 1882 — recognized the anomalous position in which he would have been placed had he accepted the proposal, and declined the proffered honour. On all disputed points, whether commercial, religious, or political, his advice was invariably sought by the foreign ministers and the Chinese alike. Thrice only did he visit Europe between 1863 and 1902, the result of this long comparative isolation, and of his constant intercourse with the Peking officials, being that he learnt to look at events through Chinese spectacles ; and his work, TJiese from the Land of Sinim, shows how far this affected his outlook. The faith which he put in the Chinese made him turn a deaf ear to the warnings which he received of the threatening Boxer movement in 1900. To the last he believed that the attacking force would at least have spared his house, which contained official records of priceless value, but he was doomed to see his faith falsified. The building was burnt to the ground with all that it contained, including his private diary for forty years. When the stress came,

and he retreated to the British Legation, he took an active part in the defence, and spared neither risk nor toil in his exertions. In addition to the administration of the foreign customs service, the establishment of a postal service in the provinces devolved upon him, and after the signing of the protocol of 1901 he was called upon to organize a native customs service at the treaty ports. Both the Chinese and the British Governments from time to time conferred honours upon him. By giving him a Red Button, or button of the highest rank, a Peacock's Feather, the Order of the Double Dragon, a patent of nobility to his ancestors for three generations, and the title of Junior Guardian of the Heir apparent, the Chinese showed their appreciation of his manifold and great services ; while under the seal of the British Government there were bestowed upon him the Orders of C.M.G. (1880), K.C.M.G. (1882), G.C.M.G. (1889), and a baronetcy (1893). He has also been the recipient of many foreign orders. Sir Robert Hart married in 1886 Hester, the daughter of Alexander Bredon, Esq., M.D.,

of Portadown, his family consisting of one son and two daughters.

Harte, Francis Bret (1839-1902), American author, was born at Albany, New York, 25th August 1839. His father, a teacher in the Albany Female Academy, died during his boyhood. After a common-school education he went with his mother to California at the age of seventeen, afterwards working in that state as a teacher, miner, printer, express-messenger, secretary of the San Francisco mint, and editor. His first literary venture was a series of Condensed Novels (travesties of well-known works of fiction, somewhat in the style of Thackeray), published weekly in The Californian, of which he was editor, and reissued in book form in 1870. The Overland Monthly, the earliest considerable literary magazine on the Pacific coast, was established in 1868, with Harte as editor. His sketches and poems, which appeared in its pages during the next

few years, attracted wide attention in the eastern states and in Europe. " The Luck of Roaring Camp " (1868), « The Outcasts of Poker Flat " (1869), the later sketch " How Santa Claus came to Simpson's Bar," and the verses entitled " Plain Language from Truthful James," combined humour, pathos, and power of character portrayal in a manner that indicated that the new land of mining-gulches, gamblers, unassimilated Asiatics, and picturesque and varied landscape had found its best delineator ; so that Harte became, in his pioneer pictures, a sort of later Fenimore Cooper. Forty-four volumes were published by him between 1867 and 1898. After a year as professor of recent literature in the University of California, Harte lived in New York, 1871-78 ; was United States consul at Crefeld, Germany, 1878-80; consul at Glasgow, 1880-85; in 1885 he took up his residence in London, and devoted himself to literary work. He died at Camberley, England, May 5, 1902.

Hartford, capital of Hartford county and of the

state, Connecticut, U.S.A., on the western bank of the Connecticut river. It is well laid out, is divided into ten wards, has an excellent system of water-works, constructed by the city at a cost of $2,800,000, is well sewered, and is paved mainly with macadam. Its death-rate was 17-91 per 1000 in 1900. The New York, New Haven and Hartford, and the Central of New England railways enter the city, and, with steamboats on the river, which is navigable to this point, give it a large commerce. In 1900 there were 888 manufacturing establishments, having a total capital of $30,500,047, and employing an average number of 13,363 wage-earners. The total products were valued at $31,145,715, among which the most important were bicycles and tricycles ($2,472,446) and foundry and machine shop products ($3,718,608). Hartford has also a large business in the printing and publishing of books. Among its newspapers should be mentioned the Hartford Courant, one of the oldest and best-known papers of New England. The chief business is in life and fire insurance. In 1890 the

ofiices of six stock and five mutual-aid life insurance companies were situated here. The former had a capital exceeding $12,000,000 and assets exceeding $111,000,000. There were seven fire insurance companies, with a capital of over $10,000,000. Hartford is the seat of Trinity College, a Protestant Episcopal institution, founded in 1824, which in 1900 had 25 instructors and 128 students. The assessed valuation of real and personal property in 1900 was $69,760,630. The net debt was $3,641,971, and the rate of taxation was $17-50 per $1000. Population (1880), 42,015; (1890), 63,230; (1900), 79,850, of whom 23,768 were foreign-born and 1887 were negroes. The death-rate in 1890 was 24-4 ; in 1900 it was 19-4.

Hartford City, capital of Blackford county, Indiana, U.S.A., at the intersection of the Lake Erie and Western and the Pittsburg, Cincinnati, Chicago, and St Louis railways. Population (1890), 2287; (1900), 5912, of whom 572 were foreign-born.

Hartlepool (sometimes fcalled East Haetlepool)

and West Hartlepool, twin seaports on the coast of Durham, England, the latter 12 miles, the former 15 miles, north-east from Stockton-on-Tees. The harbour, which embraces two tidal basins and six docks aggregating 83^ acres, in addition to timber docks of 67 acres, covers altogether 350 acres, and stretches between the two Hartlepools. The depth of water on the dock sills varies from 17-|- feet at neap tides to 26 feet at spring tides. A breakwater three-quarters of a mUe long protects the entrance to the harbour. Officially the two Hartlepools are considered as one port. They carry on an important trade in the export of coal, ships, machinery, iron and other metallic ores, woollens and cottons, and in the import of timber, sugar, iron and copper ores, and eggs. The exports increased from a total value of £624,531 in 1896 to £1,491,346 in 1900, and the imports from £1,630,486 to £2,004,481 in the same two years. Timber makes up 69 per cent, of the imports, and coal and ships each about 30 per cent, of the exports. The foreign trade employs about 800 vessels of 411,600 tons cleared annually,

and the coasting trade some 1660 vessels of 530,700 tons. The port owns about 260 vessels of 380,000 tons, and a small fishing fleet. The principal industries are shipbuilding (iron), boiler and engineering works, iron and brass foimdries, steam saw and planing mills, flour-mills, paper and paint factories, and soapworks. There are five graving docks, admitting vessels of 650 feet length and 10 to 21 feet draught. In 1889 a promenade, f mile long, was made from the Heugh lighthouse to Throston. In East Hartlepool there are a new chapel of ease (St Andrew's) to the parish church, and a new United Presbyterian church ; and in addition a Roman Catholic church and haK-a-dozen Nonconformist chapels. The area of the municipal borough is 552 acres, and its population (1891) 21,288, and (1901) 22,737.

West Haetlepool, which is of quite modem growth, but now the larger, was only incorporated in 1887. Its municipal area is 2464 acres, and its population (1891) 42,815, and (1901) 62,614. The municip^ area embraces the three townships of Seaton Carew, Stranton, and

*Throston. There are severaj, new churches, e.g., St Aidan's and St Paul's, both in the Early English style, the Roman Catholic church (1893-94), the Swedish church, and the Presbyterian church; and conspicuous amongst the older sacred edifices are Christ Church, in the Gothic style, and St James's, Early Decorated. There are, further, several Nonconformist chapels. Stranton parish church dates from the middle of the 14th century, but was restored in 1889. The more important of the recent secular buildings are the municipal oflftces (1889), the free public library (189*5), the technical institute and public hall (1896), and the market hall (rebuilt). The town possesses three clubs, three theatres, and the Ward-Jackson Memorial Park, opened in 1883.*

Hartley, Sir Charles Augustus (1825), English engineer, was born in 1826 at Heworth, in Durham. Like most engineers of his generation he was engaged in railway work in the early part of his career, but subsequently he devoted himself to hydraulic engineering and the improvement of estuaries and harbours

for the purposes of navigation. His services were em-

ployed in connexion with some of the largest and most

important waterways of the world. After serving in the

Crimea as a captain of engineers in the Anglo-Turkish

contingent, he was in 1856 appointed engineer-in-chief

for tlie works carried out by the European Commission of

the Danube for improving the navigation at the mouths

of that river, and that position he retained till 1872,

when he became consulting engineer to the Commission.

In 1875 he was one of the committee appointed by the

authority of the U.S.A. Congress to report on the works

necessary to form and maintain a deep channel through

the south pass of the Mississippi delta ; and in 1884 the

British G-overnment nominated him a member of the In-

ternational Technical Commission for widening the Suez

Canal. In addition he was consulted by the British and

other Governments in connexion with many other river

and harbour works, including the improvement of the

navigation of the Scheldt, Hugli, Don, and Dnieper, and of the ports of Odessa, Trieste, Kustendjie, Burgas, Varna, &c. He was knighted in 1862, and became K.C.M.G. in 1884.

Hartmann, Karl Robert Eduard von (1842--), German philosopher, son of a general officer in the Prussian army, was born in Berlin on 23rd February 1842. He was educated for the army, and entered the artillery of the Guards as an officer in 1860, but a malady of the knee, which crippled him, forced him to quit the service in 1865. After some hesitation between music and philosophy he decided to make the latter the serious work of his life, and in 1867 the University of Rostock conferred on him the degree of doctor of philosophy without requiring residence. His reputation as a philosopher was established by his first book, Tlie Philosophy of the Unconscious, which was published in 1869 and had by 1890 reached its tenth edition (in three volumes). This success, which was not rivalled by any of his subsequent writings, was largely due to the origi-

nality of its title, the diversity of its contents (von Hartmann professing to obtain his speculative results by the methods of inductive science, and making plentiful use of concrete illustrations), the fashionableness of its pessimism, the vigour and lucidity of its style ; and these qualities will probably continue to give it the preponderance over its author's later and maturer works, in spite of all his protests. The conception of the Unconscious, by which von Hartmann describes his ultimate metaphysical principle, is not at bottom as paradoxical as it sounds : it is merely a new and mysterious designation for the Absolute of German metaphysicians, which lends itself to much manipulation by reason of its manifold ambiguities. This fact von Hartmann tardily recognized in an article in the Archiv fur systematische Philosophie (August 1900), in which he distinguished nineteen different senses of the " unconscious," and confessed to great imperfections in his earlier treatment, but nevertheless maintained the validity of his metaphysical principle. Shorn in this way of the illusory

empirical illustrations which rendered it interesting, the Unconscious appears as a combination of the metaphysic of Hegel with that of Schopenhauer. The Unconscious is both Will and Reason and the absolute all-embracing ground of all existence. Von Hartmann thus combines "pantheism" with" panlogism" in a manner adumbrated by Schelling in his "positive philosophy." Neverthe-less Will and not Reason is the primary aspect of the Unconscious, whose melancholy career is determined by the primacy of the Will and the subservience of the Reason. I'recosmically the Will is potential and the Reason latent, aud the Will is void of reason when it passes from potentiality to actual willing. This latter is absolute misery, and to cure it the Unconscious evokes its Reason and with its aid creates the best of all possible worlds, which contains the promise of its re-demption from actual existence by the emancipation of the Reason from its subjugation to the Will in the con-scious reason of the enlightened pessimist. When the greater part of the Will in existence is so far enlightened

by reason as to perceive the inevitable misery of existence, a collective effort to will non-existence will be made, and the world will relapse into nothingness, the Unconscious into quiescence. It is apparent from the above that although von Hartmann is a pessimist, and ably continues the tradition of Schopenhauer, his pessimism is by no means unmitigated. The individual's happiness is indeed unattainable either here and now or hereafter and in the future, but von Hartmann does not despair of ultimately releasing the Unconscious from its sufferings. He differs from Schopenhauer in making salvation by the " negation of the Will-to-live " depend on a collective social effort and not on individualistic asceticism. The conception of a redemption of the Unconscious also supplies the ultimate basis of von Hartmann's ethics. We must provisionally affirm life and devote ourselves to social evolution, instead of striving,after a happiness which is impossible ; in so doing we shall find that morality renders life less unhappy than it would otherwise be. Suicide, and all other forms of selfishness, are highly reprehensible.

Epistemologically von Hartmann is a transcendental realist, who ably defends his views and acutely criticizes those of his opponents. His realism enables him to maintain the reality of Time, and so of the process of the world's redemption.

*Von Hartmann is a very voluminous writer, his collected works extending to more than 12,000 pages. They may be classified into — A. Systematical, including * Grundprohleme der Mrkenntnisstheorie; * Kategorienlehre ; * Das siitUche Bewusstsein ; *Die Philosophie des Schonen; *Die Beligion des Geistes; * Die Philosophie des Unbewussten (3 vols., which now include his, originally anonymous, self-criticism, Das Unbewusste vom Standpunkte der Physiologie und Descendenztheorie, and its refutation). B. Historical and critical — * Das religiose Bewusstsein der Menschheit ;*

- *Geschichte der Metaphysik (2 vols.) ; Kanfs Erkenntnisstheorie ;*
- *Kritische Grundlegung des transcendentalen Mealismus ; Uber die dialektische Methode ; studies of Schelling, Lotze, von Kirchmann ; Zur Geschichte des Pessimismus ; Neukantianismus, Schopenhauerismus, Megelianismus ; * Geschichte der deutschen Aesthetik seit Kant; Die Krisis des Ghristentums in der modernen Theologie ;*

*Philosophische Fragen der Gegenwart ; Ethische Studien ; *Moderne Psychologie. C. Popular — Soziale Kernfragen ; Moderne Probleme ; Tagesfragen ; Zwei Jahrzehnte deutscher Politik ; Das Judentum in Gegenwart und Zukunft ; t Die Selbstzersetzung des Christentums; Gesammelte Studien; Der Spiritismus and Die Geisterhypothese des Spiritismus. Of these, those marked * have been included among his selected works, while those marked t have been translated into English.*

Harvard College, founded in 1636 at Cambridge, Massachusetts. It is the oldest and largest university in the United States. Since the election of Charles William Eliot as President in 1869 the standard both in the college and professional schools has been raised to the university level, and there have been founded the Graduate School, the Veterinary School, the Bussey Institution for Agriculture, and the School of Comparative Medicine. The Dental School (founded in 1867) has been organized on a sound basis, and the Lawrence Scientific School (founded in 1847) has been quickened into vigorous activity. In administration and in the life of its students

Harvard has developed the characteristics of the older American colleges under the guiding principle of liberty : the free election of studies has been extended to the fresh-man class ; compulsory attendance at religious exercises has been' abolished (1886) ; the general government, and even the Divi nity School, have been purged of sectarianism , and freedom is accorded to instructors . In scholarship, Ger-many has furnished the model. The range of studies has been widened to keep pace with the immense extension of

knowledge, and the scientific method, -which exacts of the student a large share of observation and research, pre-vails in all departments. With Johns Hopkins Univer-sity, Harvard led the movement that has transformed higher education in the United States. In the college proper the requirements for entrance and for graduation have been raised, although many candidates complete in three years the number of courses requisite for the degree. The professional schools have systematized and length-

ened their work, most of which is prescribed. The Law School, where instruction by the " case " method was introduced by Professor C. C. Langdell, Dean from 1870 to 1895, and the Divinity School, already require of their matriculants the degree of A.B. or its equivalent ; and the Medical School now does the same ; the Dental School likewise looks forward to becoming a graduate school.

At the Law School and Dental School the course is three years; at the Medical School, four years. Each school has a separate faculty for internal administration, but in 1890 the College, Graduate School, and Scientific School were placed under the general control of the Faculty of Arts and Sciences, and in 1899 the Faculty of Medicine Avas created for the Medical, Dental, and Veterinary Schools.

Connected with the university are the Botanic Garden (founded 1807) and Gray Herbarium (1864) ; the university museum of natural history (founded, 1859, by Louis Agassiz, and largely supported by his son, Alexander Agassiz) ; the Peabody Museum (founded, 1860, by George Peabody), devoted to American archse-

ology ; the Fogg Art Museum (erected 1895) ; the Semitic Museum ; chemical, physical, and metallurgical laboratories ; the astronomical observatory (founded in 1843), which has maintained since 1891 a station at Arequipa, Peru ; the Arnold Arboretum, for the study of arboriculture, forestry, and dendrology. The college and departmental libraries contain 577,000 bound volumes and as many pamphlets. The college has twelve large dormitories, two dining halls, a theatre for public ceremonies, a chapel, Phillips Brooks House for religious societies, an infirmary, a gymnasium, and large playgrounds and boat-houses. On 31st July 1900 the invested capital was $12,614,448 ; the lands and buildings were worth about $12,250,000 more ; the receipts for the year were $2,071,308, and the payments $1,584,123 ; the gifts and bequests of the preceding twelve months amounted to $835,101. In 1901 there were 496 teachers and 4297 students, the latter being distributed as follows : College, 1992 ; Scientific School, 507 ; Graduate School, 341 ; Divinity School, 28 ; Law School, 647 ; Medical School, 605 ; Dental School, 126 ; Veterinary School, 18 ; Bussey Institution, 33. In addition, the Summer School of 1900 had 987 students ; Radclifie College for women had in 1901,

449. The alumni of the university number 27,477 (15,76.3 A.B.‘s, 4085 M.D.‘s, 3291 LL.B.‘s). (See also Universities and Education.)

Authorities. — Benjamin Pbirce. A History of Harvard University, 1636-1775. Boston, 1833. — Joshiah Quincy. A History of Harvard University, 2 vols. Boston, 1840. — Samuel A. Eliot. Harvard College and its Benefactors. Boston, 1848. The Harvard Booh, 2 vols. Cambridge, 1874. — G. Birkbeck Hill. Harvard College, by an Oxonian. New York, 1894. — William R. Thayer. History and Customs of Harvard Xfniversity (in Universities and their Sons, vol. i.). Boston, 1898. — Official Guide to Harvard. Cambridge, 1899. (y/^^ K. T.)

Harvesting Machines. See Agricultural Machinery.

Harvey, a city of Cook county, Illinois, U.S.A. It is a manufacturing town of growing importance, south of and close to Chicago. Population (1900), 6396, of whom 982 were foreign-born.

Harwich, a municipal borough and seaport in the Harwich parliamentary division (since 1886) of Essex,

England, on the Stour, 7 miles north-east of London by rail. A quay was opened by the Great Jlastern Railway Company at Parkeston, 1 mile up the river, in 1883. The port is also the headquarters of the Eoyal Harwich Yacht Club. The registered shipping in 1899 consisted of 121 vessels of 14,096 tons. In 1888, 3170 vessels of 686,775 tons entered and 2962 of 670,924 tons cleared ; in 1899, 3860 vessels of 916,371 tons entered and 3639 of 893,281 tons cleared. Area, 1526 acres. Population (1881), 7842; (1901), 10,019.

Harz Mountains, one of the systems which border the great North German plain on the south, between the Saale and Leine. Owing to its position, as the first range of altittides which the northerly winds strike after crossing the North German plain, the climate on the summit of the Harz is generally raw and damp, even, relatively speaking, in summer. In 1896 an observatory was opened on the top of the Brocken, and the results of the first five years (1896-1900) showed a July mean of 60° Fahr., a February mean of 24-7°, and a yearly mean

of 36‘6° (an admittedly imperfect series of older records between 1836 and 1867 gave a yearly mean of 34-5°). During the same five years the rainfall averaged 64^ inches annually. But whilst the summer is thus relatively ungenial on the top of the Harz, the usual summer heat of the lower-lying valleys is greatly tempered and cooled; so that, superadding this to the natural attractions of the scenery, the deep, dark forests, and the crowd of legendary and romantic associations which cling to every fantastic rock and ruined castle, the Harz is a favourite summer resort of the German people. Amongst the more popular places of resort are Harzburg, with the Canossa obelisk (60 feet high), dedicated to Bismarck and put up in 1877 ; Thale and the Bodethal, with the rock scenery of the Eosstrappe and the Hexentanzplatz ; Blankenburg, with the Teufelsmauer and the Hermannshohle; Wernigerode, Ilsenburg, Grund, Lauterberg, Hubertusbad, Alexisbad, and Suderode. Some of these, and other places not named, add to their natural attractions the advantage of mineral springs and baths, pine-

needle baths, whey cures, &c. In spite of the mountainous nature of the region, the Harz is penetrated by some half-a-dozen railways, amongst them being a rack-railway up the Brocken, opened in 1898. The Harz is one of the richest mineral storehouses in Germany. Here silver and lead, to say nothing of other ores, have been mined for several hundred years, principally at Klausthal and St Andreasberg in the Upper Harz. Near the latter town is one of the deepest mining shafts in Europe, namely, the Samson, which goes down 2790 feet, or 720 feet below the level of the sea. For the purpose of getting rid of the water, and obviating the flooding of such deep workings, it has been found necessary to construct drainage works of some magnitude. As far back as 1777-99 the Georgsstollen was cut through the mountains from the east of Klausthal westwards to Grund, a distance of 4 miles or so ; but this proving insufficient, another sewer, the Ernst- AuguststoUen, no less than 14 miles in length, was made from the same neighbourhood to Gittelde, at the west side of the Harz in 1851-64.

See Ber Harz, by various writers, edited by Hans Hoffmann (Leipzig, 1899) ; Von Groddeck, Abriss der Geognosie des Harzes (2nd edition, Klausthal, 1883) ; Gijnther, Ver Harz in Geschichts-Kultur- und Landschafts-bildern (Hanover, 1886) ; Peohle, Harz-sagen (2nd edition, Leipzig, 1886) ; Zeitschrift des Harzvereins (annual since 1868, Wernigerode) .

Haslemere, a town of England, in the south-west corner of Surrey, with a station 12 niiles south-west from Guildford. It stands at an altitude of over 600 feet, be-tween the bold hills (900 feet) of Hindhead and Black-down. The invigorating air and fine scenery of the place, with its copses and abundance of heather and gorse, have made the district round Haslemere a favourite place of residence in recent years, particularly for literary and artistic society. Lord Tennyson spent most of his time at Aldworth, his property on Blackdown ; Professor Tyndall

built a house on Hindhead, and thereby set an example which was followed by many others ; George Eliot stayed

for some time at Shottermill, 2 miles from Haslemere ; and since about 1880 the number of new houses has gone on increasing, till the aspect of the neighbourhood has been completely changed. The town too has been modernized. The principal mansion in the district is Lythe Hill, built by the late Mr J. Stewart Hodgson. The population of Haslemere itself is 2613, and of Hindhead 666, but the number of people for whom Haslemere station is the railway centre is very much larger.

Haslingden, a municipal borough (1891) and market-town in the Kossendale and Heywood parliamentary divisions of Lancashire, England, 4 miles south-south-east of Accrington by rail. Two Established churches have been recently erected. The town, steadily increasing in importance, has cotton, woollen, and engineering works ; quarrying and brickmaking are carried on in the neighbourhood. Area, 8196 acres. Population (1881), 16,298 ; (1901), 18,543. The borough, as incorporated, comprised several townships and parts of townships, but under the Local Government Act of 1894

these were united into one civil parish.

Haspe, a town of Prussia, province of Westphalia, 10 miles north-east of Barmen by rail. It has various iron-works, boiler-works, chemical factories, &c. Population (1885), 8903 ; (1900), 16,040.

Hasselt, a town of Belgium, capital of the province of Limburg, 47 miles east of Brussels, at an important junction of railway lines connecting it with towns in Holland and with the other principal places of Belgium. Its gin is reputed the finest distilled in the country. Its manufactures include oil, tobacco, and chemical and non-chemical manures. Population (communal, 1899), 15,002.

Hastings, one of the Cinque Ports, a municipal, county (1888), and parliamentary borough, and market-town of Sussex, England, 60 miles south-south-east of London by rail. The limits of the municipal and county borough were in 1897 extended, and now exceed those of the parliamentary boroiigh. In 1885 the parliamentary representation was reduced to one member. Among the

churches may be noted Christ Church (1876), costing over £23,000, and the church of St John the Evangelist (1881), All Souls' (1890), and a Catholic church (1882). Educational institutions include the grammar school (1883), school of science and art (1878), technical schools, and numerous board schools. The town hall, costing £20,000, dates from 1880. Other buildings are a theatre (1882), a music hall (1899), baths (1897), costing £60,000; convalescent home (1886), and hospital (1887). A second pier, that of St Leonards, 950 feet long, with a large pavilion, was opened in 1891. Alexandra Park, 76 acres, laid out at a cost of about £35,000, was opened in 1882. Population of municipal and county borough on unextended area (2194 acres) (1881), 42,268 ; (1891), 52,223. Extended area, 4769 acres; population (1891), 63,072; (1901), 66,628.

Hastings, capital of Adams county, Nebraska, U.S.A., at an altitude of 1933 feet. It has a regular plan, the water-supply and sewerage systems are excellent, and four railways enter it — the Burlington and Missouri

Eiver, the Fremont, Elkhorn, and Missouri Valley, the Missouri Pacific, and St Joseph and Grand Island. It is the seat of Hastings College, a Presbyterian institution, founded in 1882, which in 1899 had 10 instructors and 149 students, 68 of whom were women. Population (1880), -2817 ; (1890), 13,584; (1900), 7188, of whom 1253 were foreign-born.

Hatch, Edwin (1835-1889), English theologiaa, was born at Derby, 4th September 1835. He was educated at King Edward's School, Birmingham, under Dr James Prince Lee, afterwards Bishop of Manchester, the preceptor of Archbishop Benson and Bishops Lightfoot and Westeott. Hatch became scholar of Pembroke College, Oxford, took a second-class in Classics in 1867, and was Pusey and Ellerton Scholar in 1858. For some time he was professor of Classics in Trinity College, Toronto, but returned to Oxford in 1867, and was made Principal of St Mary's Hall, a post which he held until 1885. In 1883 he was presented to the living of Purleigh in Essex, and in 1884 was appointed University reader in ecclesias-

tical history. He had many struggles to pass through in early life, which tended to discipline his character and to form the habits of severe study and the mental independence of view for which he was afterwards distinguished. He was the first editor of the University ofBlcial Gazette, and of the Student's Handbook to the University. He took a principal part in the preparation of a concordance to the Septuagint, 'published after his death. But he established his reputation chiefly by his treatises On the Organization of the Early Christian Churches (the Bampton Lectures for 1880), and on the Influence of Greek Ideas and Usages on the Christian Church (the Hibbert Lectures for 1888). These works attracted much attention, and provoked no little criticism on account of the challenge they appeared to throw down to the traditional views in vogue at the time of their appearance. But the research and fairness displayed were admitted on all hands. Hatch died, worn out with labour and greatly regretted, on 10th November 1889. He was a contributor of some important articles to the ninth edition

of the Encyclopoedia Britannica. (j. j. l.)*

Hatfield, or Bishop's Hatfield, a market-town and railway station in the St Albans parliamentary division of Hertfordshire, England, 7 miles W. by S. of Hertford. Hatfield forms part of a rural district. Partly in consequence of the increased importance of Hatfield House in recent years, as the residence of the 'Marquis of Salisbury, the station has become a more important one for purposes of the Great Northern system, and the town has spread out. Area of the parish, 12,884 acres. Population (1891), 4330; of the rural district (1891), 6963; (1901), 7651.

Hatherley, William Page Wood, Barox (1801-1881), Lord Chancellor of Great Britain, son of Sir Matthew Wood, a London alderman and lord mayor who became famous for befriending Queen Caroline and braving George IV., was born 29th November 1801. He was educated at Winchester, Geneva University, and Trinity College, Cambridge, where he became a fellow after being 24th wrangler in 1824. He entered Lincoln's Inn, and

was called to the bar in 1824, studying conveyancing in Mr John Tyrrell's chambers. He soon obtained a good practice as an Equity draughtsman and before parliamentary committees, and in 1830 married Miss Charlotte Moor. In 1845 he became Q.C., and in 1847 was elected to Parliament for the city of Oxford as a Liberal. In 1849 he was appointed Vice-Chancellor of the County Palatine of Lancaster, and in 1851 was made Solicitor-General and knighted, vacating that position in 1852. When his party returned to power in 1853, he was raised to the bench as a Vice-Chancellor. In 1868 he was made a lord justice of appeal, but before the end of the year was selected by Mr Gladstone to be Lord Chancellor, and was raised to the peerage as Lord Hatherley of Down Hatherley. He retired in 1872 owing to failing eyesight, but sat occasionally as a law lord. His wife's death in

1878 was a great blow, from which he never recovered, and he died 10th July 1881. Dean Hook said that Lord

Hatherley — who was a sound and benevolent supporter of the Church of England — was the best man he had ever known. He was a particularly clear-headed lawyer, conscientious and industrious, and his judgments — always delivered extempore — commanded the greatest confidence both with the public and the legal profession.

Hathras, a town of British India, in the Aligarh district of the North-West Provinces, 29 miles north of Agra. Population (1881), 25,656; (1901), 41,849. The municipal income in 1897-98 was Es.32,670. It is an important centre of local trade in sugar and graia, and is connected by a light railway with Muttra, and by a branch (6 miles, opened in 1898) with Hathras junction, on the East Indian main line.

Hatton, John Liptrot (1809-1886), English musical composer, was born at Liverpool, 12th October 1809. He was virtually a self-taught musician, and besides holding several appointments as organist in Liverpool, appeared as an actor on the Liverpool stage, subsequently finding his way to London as a member of

Macready's company at Drury Lane in 1832. Ten years after this he was appointed conductor at the same theatre for a series of English operas, and in 1843 his own fiist operetta. Queen of the Thames, was given with success. Staudigl, the eminent German bass, was a member of the company, and at his suggestion Hatton wrote a more ambitious work, Pascal Bruno, which, in a German translation, was presented at Vienna, with Staudigl in the principal part; the opera contained a song, "Eevenge," which the basso made very popular in England, though the piece as a whole was not successful enough to be produced here. ' Hatton's excellent pianoforte-playing attracted much attention in Vienna; he took the opportunity of studying counterpoint under Sechter, and wrote a number of songs, obviously modelled on the style of German classics. In 1846 he appeared at the Hereford Festival as a singer, and also played a pianoforte concerto of Mozart. He undertook concert tours about this time with Sivori, Vieuxtemps, and others. Erom 1848 to

1850 he was in America; on his return he became con-
ductor of the Glee and Madrigal Union, and from about
1853 was engaged at the Princess's Theatre to provide
and conduct the music for Charles Kean's Shakespearean
revivals. He seems to have kept this appointment for
about five years. In 1866 a cantata, Robin Hood, was
given at the Bradford Festival, and a third opera. Rose, or
Love's Ransom, at Covent Garden in 1864, without much
success. In 1866 he went again to America, and from
this year Hatton held the post of accompanist at the
Ballad Concerts, St James's Hall, for nine seasons. In
1875 he went to Stuttgart, and wrote an oratorio,
Hezekiah, given at the Crystal Palace in 1877 ; like all
his larger works, it met with very moderate success.
Hatton excelled in the lyrical forms of music, and, in
spite of his distinct skill in the severer styles of the
madrigal, &c., he won popularity by such songs as " To
Anthea," "Good-Night, Beloved," and "Simon the
Cellarer," the first of which may be called a classic in
its own way. His glees and part-songs, such as "When

*Evening's Twilight," are still reckoned among the best of their class ; and he might have gained a place of higher distinction among English composers had it not been for his irresistible animal spirits and a want of artistic reverence, which made it uncertain in his younger days whether, when he appeared at a concert, he would play a fugue of Bach or sing a comic song. He died at Margate, *20th September 1886. (j. A. p. m.)*

Hatvan, a market-town of Hungary, in the county of Heves. Being situated at the junction of the railway lines leading from Budapest to the northern and north-eastern parts of the country, it carries on a very lively trade. Its industry is considerable, its sugar factory affording employment to about 500 workmen, and producing 60,000 metric centners of refined sugar a year. Population (1900), 9707.

Haubourdin, a town in the arrondissement of Lille, department of Nord, France, 4 miles south-west of Lille by rail, situated on the canalized Haute Deule, and commanded by a fort and a battery. Public buildings of

interest include the fine castle of Beaupre, built by the Spaniards in the 16th century; a hospital of the 15th century, and the chapel of the Cr^pins, built in 1347. The principal industries are starch, and glucose, textile fabrics, oil and oil-cake, distilling, potash-refining, and dyeing. Port trafBc (1900), 70,835 tons. Population (1876), 5115; (1901), 8485.

Haugesund, a seaport town of Norway, county of Stavanger, on the west coast, 34 miles north by west of Stavanger, an important fishing centre. Herrings are exported to the annual value of £100,000 to £200,000, also mackerel and lobsters. The total trade was valued at £460,250 in 1900. The Vigsnas iron-mines were closed in 1896. The principal imports are coal and salt. There are factories for woollen goods and a margarine factory. Haugesun'd is the reputed death-place of Harold Haarfager, to whom an obelisk of red granite (45 feet high) was erected in 1872, 1^ miles north of the town. Population (1875), 4102 ; (1900), 7935.

Hausa, sometimes incorrectly written Haussa,

HoussA, or Haoussa, a numerous and important "people inhabiting about half a million square miles in the western and central Sudan. Their country, roughly speaking, extends from 8° N. to 14° N., and from 4° E. to 11° E. By the terms of a proclamation dated 1st January 1901 a British protectorate was declared over the whole of this immense territory, including also the province of Bornu, which borders on Lake Chad. Since then British ofiicers in charge of Hausa troops have had frequent fights with the slave-raiders of the interior. A considerable time must, however, elapse before slave-raiding can be extinguished and the protectorate be rendered effective. The Hausa people are believed to number altogether fifteen millions. They are quite distinct from all the tribes by whom they are surrounded, and in physical development far superior. Though their skin is as black as that of any African native, their lips are not so thick nor their hair so curly as those of the ordinary negro. They excel in physical strength. The average Hausa will carry on his head a load of ninety or a hundred pounds without showing the

slightest signs of fatigue during a long day's march. When carrying their own goods it is by no means uncommon for them to take double this weight. Their general look of intelligence cannot but strike the traveller as he meets with them in their capacity of traders in all the surrounding districts. Their food consists chiefly of guinea corn (sorghum vulgare), which is ground up and eaten as a sort of porridge mixed with large quantities of red pepper. The Hausas attribute their superiority in strength to the fact that they live on guinea corn instead of yams and bananas, which form the staple food of the tribes on the river Niger. The Hausas carry on agriculture chiefly by slave labour ; they are themselves born traders, and as such are to be met with in almost every part of Africa north of the equator. Small colonies of them are to be found in towns as far distant from one another as Lagos, Tunis, Tripoli, Alexandria, and Suakio.

The chief articles of trade are cloth, salt, kola nuts, ivory, leather, and spices. The centre of the cloth manufacture is the town of Kano, which has a population of at least 100,000, and the market-place of which has an average daily attendance of from 20,000 to 25,000. The cloth is made of cotton grown in the country, woven on small handlooms, and dyed either with indigo or with a scarlet dye obtained from the bark of a tree. If the Hausa history, which now exists in written form, be correct, the manufacture of this cloth has been carried on in Kano for 950 years. Kano and the district around it clothes half the population of the Sudan. The kola nut, which is chewed by almost every native of Hausaland, is brought from the country which lies at the back of the Gold Coast Colony. In taste it is almost as bitter as quinine. It takes the place of any other stimulant, and by keeping.off the pangs of hunger enables the Hausas to work for a long time without food. The Hausas, though not a military race at all, nevertheless make exceedingly good soldiers when drilled and led by

European officers. Their value was discovered in the first Ashanti war, and by the year 1902 there were over 5000 employed either as soldiers or police on the west coast or on the river l^iger. They have been employed by the Trench as far away as in Madagascar.

Government. — Hausaland consists of a large number of nearly independent states owing a nominal allegiance to the sultan of Sokoto. The various kings are for the most part uncontrolled despots. The tribute which is paid by the smaller towns to the larger, and by the larger to Sokoto, consists almost entirely of slaves. In order to obtain the required number, which in the case of a large town comes to several thousands, the more powerful kings are constantly engaged in raiding the less powerful. In the Kano market there are usually not less than 500 slaves on sale. Most of the kings and of the ruling class are not Hausas, but belong to a tribe variously called Fulah, Fulani, Fulbe, or FuUatah. Whilst the Hausas are a quiet commercial people, the Fulahs are a race of soldiers and rulers. They have been tlie ruling class in Hausaland for about two centuries. They were in former time a race of herdsmen, and practically all the cattle in the country

round belong to them. They are responsible for most of the slave raiding. At least a third of the inhabitants of the country are in a state of slavery. ,

The language is the lingua franca over practically all Africa north of the equator and west of the valley of the Nile. It is a rich sonorous language, with a vocabulary containing perhaps 10,000 words. About a third of the words which the language contains are connected with Arabic roots, nor are these words which the Hausas could well have borrowed in anything like recent times from the Arabs. Many words representing ideas or things with which the Hausas must have been familiar from the very earliest time are obviously connected with Arabic or Semitic roots. There is a certain ambunt of resemblance between the Hausa language, and that spoken by the Berbers to the south of Tripoli and Tunis. This language, again, has several striking points of resemblance with Coptic. If, as seems likely, it should prove possible in the future to demonstrate the connexion between these three languages, such connexion would serve to corroborate the Hausa tradition that their ancestors came from the very far east away beyond Mecca. The Hausa language has been reduced to

writing for at least a century, possibly for very much longer. It is the only language in tropical Africa which has been reduced to writing by the natives themselves, the character used being a modified form of Arabic. Some fragments of literature exist, consisting of political and religious poems, together with a limited amount of native history. A volume, consisting of history and poems reproduced in facsimile, with translations, has been published by the Cambridge University Press.

Eeligion. — About one-third of the people are professed Mahommedans, one-third are heathen, and the remainder have apparently no definite form of religion. Mahommedanism as a dominant power only dates from the beginning of the lOth century. In 1802 the Mahommedan Fulah sheik Othman proclaimed a sort of religious war, and after suffering many defeats, at length succeeded in establishing himself at Sokoto as ruler over the greater part of the Hausa states. Ever since then the ruler of Sokoto has been acknowledged as the religious head of the whole country, and tribute has been paid to him as such. The Hausas who profess Mahommedanism are extremely ignorant of their own faith, and what little religious fanaticism exists is chiefly confined to the

Fulahs. Large numbers of the Hausas start every year on the pilgrimage to Mecca, travelling sometimes across the Sahara desert and by way of Tripoli and Alexandria, sometimes by way of Wadai, Darfur, Khartum, and Suakin. The journey often occupies five or six years, and is undertaken quite as much from trading as from religious motives. Mahommedanism is making very slow, if any, progress amongst the Hausa people. The greatest obstacle to its general acceptance is the institution of the Ramadan fast. In a climate so hot as that of Hausaland, the obligation to abstain from food and drink from sunrise to sunset during one month in the year is a serious difficulty. No important attempt had, up to 1902, been made to introduce Christianity, but the fact that the Hausas are fond of reading, and that native schools exist in all parts of the country, should greatly facilitate the work of Christian missionaries.

The greater part of Hausaland consists of thinly wooded country, with towns and villages scattered at frequent intervals. Every village is fortified in order to resist sudden attack from slave raiders. The largest towns are Kano, Yakoba (often called Garim Bauchi), Zaria, Katsena, Zinder, Gando, and Sokoto. The last

two are of no great size, but are regarded as the centres of the whole couDtry from a religious and political point of view. The country rises very slowly from the coast. Three hundred miles inland, at Lokoja, it is about 280 feet above the sea. The level of Kano, which is about 750 miles inland, is 1425 feet. One of the highest towns is Kachia, which is 2440 feet above the sea. It lies on a range of hills which attain an altitude of about 3800 feet, running from east to west at about 10° N. The rivers are small, and many of them cease running during the dry season, which lasts from December to June or July. During the wet season the grass, except in the densest parts of the forest land, grows to a height of about ten feet, but dies down entirely when the dry season begins. In the southern part of the country baggage animals are not available, except to a limited extent during the dry season. In the northern part horses, donkeys, and mules are used, and in the extreme north camels. There are no roads other than narrow paths about a foot wide. Hills similar in shape to the Table Mountain at Cape Town are a feature of the country. On the hilly country round Kachia are found several pagan tribes who wear no clothes and whose bodies are covered

with hair. These were probably the original inhabitants of the Hausa country, and were driven by the Hausa people into the hills on their advance from the north, which, according to their tradition, occurred 950 years ago. The climate is very trying to the European, though it is perhaps slightly better than that of the river Niger and the West Coast. The natives do not sufier to any extent from fever unless they move from one part of the country to another at some distance from their own home. Leprosy is very common, especially in the inland towns. The chief currency of the country, except when slaves are used, consists of cowry shells, the average value of which is about the two-hundredth part of a penny.

Authorities. — Babth. Travels in North and Central Africa, 2 vols. London, 1857 ; Central-Africanische Vokabularien. Gotha, 1867. — Robinson. Hausaland, or Fifteen Hundred Miles through the Central Soudan, 1896 ; Specimens of Hausa Literature, 1896 ; Hausa Grammar, 1897 ; Hausa Dictionary, 1899. — Monteuil, St Louis a Tripoli par le Tchad, 1895. (c. H. E.)

Haussmann, Georges Eugene, Basojst (1809-1891), the famous aedile of modern Paris, was the

son of Nicolas Valentin Haussmann, a publicist and statistician, who rose in the public service under Louis Philippe. This Nicolas Valentin was the son of Nicolas Haussmann (1761-1846), an Alsatian who established himself at Versailles as a linen-draper and became one of the commissaries of the Convention in 1793, and the nephew of Jean Michel Haussmann (1749-1824), a distinguished chemist of Colmar who inaugurated an important chintz manufactory at Rouen and did much to advance the colour printing of textiles in Normandy. Born in Paris 27th March 1809, Georges Eugene first studied for the profession of a vocalist at the Conservatoire, but then entered a notary's office and qualified for the bar with a view to some administrative office. His advancement was accelerated by that of Louis Napoleon, and by 1851 he had risen to be Prefect of the Gironde. In 1862 Louis Napoleon visited Bordeaux, and was greatly struck by the adroitness with which the prefect had organized the demonstrations in his honour. In intercourse with Haussmann he was still further impressed by his graardiose

schemes for municipal improvements. In the following year he sent for him to Paris and made him Prefect of the Seine. With the aid of a very able engineer named Alphand, Haussmann in the course of the next twelve years completely transformed the ground plan of intra-mural Paris. It is not possible to do more than barely indicate a few of his most daring conceptions. In the forefront of these stand the design of the Place du Carrousel, the junction of the Louvre and the Taileries by means of two monumental galleries, the building of the Halles Centrales, of a number of pretentious churches, and of a group of theatres, including the Nouvel Opera. Passing by the external boulevards, which were almost entirely of his planning, he designed the boulevards Strasbourg, Sebastopol, Malesherbes, and St Michel, besides improving and greatly enlarging the Boulevard St Germain: Even more striking still, perhaps, is the series of arterial streets which he cut through

the tortuous thoroughfares of central Paris. Such were the Rue de Kivoli, the Eue La Fayette, the Rue de Rennes, the Rue Bonaparte, and the Rue des Ecoles, in the construction of which the Donjon de St Jean de Latran was destroyed. The present H5tel Dieu is merely one of the structures which he entirely rebuilt. His reforming zeal was directed with equal energy to the drainage, the water supply, the cemeteries, and the plantations of Paris. Among- the metropolitan parks, for the present arrangement and dimensions of which he was mainly responsible, are the Bois de Vincennes, the Pare Monceau, the Pare Montsouris, the Buttes Chaumont, and the Bois de Boulogne, which he extended to the Seine in 1854. The Champs]filysees in its present form, and the avenues which radiate from the Arc de Triomphe, owe much to the hand of the same master designer ; and the present Hotel Carnavalet with its collections is due primarily to his initiative. To finance these stupendous schemes the municipality of Paris effected loans of between one and two million francs an-

nually. Haussmann carried matters with a high hand, and assured the Parisians that the investment was a profitable one — nor has his prediction been altogether falsified. On the other hand, speculation in land was stimulated to an unwholesome degree, rents were enormously inflated, and malpractices of various, kinds are said to have been prevalent. Great bitterness was caused by the transplantation of poor families and by encroachments upon certain outlying portions of the Luxembourg gardens, while no little political capital was made out of the multiplication of wide avenues, unsuitable for the erection of barricades, but admirably fitted for the operations of artillery.*

Under the effective burlesque title of Contes Fantastiques de Haussmann a scathing attack was made upon Haussmann's methods in 1868 in a mordant pamphlet by Jules Ferry. Similar attacks were made in other quarters, and received semi-of&cial sanction from the Cour des Comptes (Board of Audit), which in a special report describe some of Haussmann's expedients as ingenious

rather than strictly legal. He retained the confidence of the Emperor, but this availed less in 1869 than in 1853. He had to bend to the storm by submitting the Paris budget to the Chamber. OUivier's attempt to liberalize the Government involved his fall on 2nd January 1870. He had been made a Senator (1857), Grand Cross of the Legion of Honour (1862), and Member of the Academy of Fine Arts (1867). Napoleon wished to retain his services, and offered him, it was rumoured, the title of Due de Paris. He preferred a complete retirement at Nice on a small annual pension of 6000 francs. Subsequently he made several attempts to re-enter politics, and managed to secure a seat in the Chamber as Bonapartist deputy for Ajaccio from 1877 to 1881. He died at Paris on 11th January 1891, surviving by only a few weeks his wife, and leaving issue one daughter, wife of M. Camille Dollfus. He is commemorated in Paris street termin-ology by the Boulevard Haussmann, a name which the Municipal Council very nearly succeeded in altering in 1879 ; but Haussmann's real montiment is modern Paris,

of which he inaugurated, as wasi, said, a new Stone Age. Old landmarks disappeared as if by magic under the stroke of his crayon, and new structures sprang up like the palaces of an Arabian tale. As Louis XIV. set the fashion to palace-builders with Versailles, so Haussmann, by the creation of a new Paris, excited to emulation the shapers of cities, and to " Haussmannize " has come to mean the substitution of monotonous avenues and rectilinear spaces for the crooked ways and irregular boundaries dear to the archaeologist and the historian. To form any adequate conception of the extent of Hauss-mann's activities in these directions it is necessary to go through his somewhat dull Memoires (1893), the third (and posthumous) volume of which bears the well-deserved sub-title, bfrands Travaux de Paris.

(t. SB.)

Hautmont, a town in the arrondissement of Avesnes, department of Nord, France, 44 miles in direct lines south-east of Lille ; a junction on the railway from Paris to Brussels, and on the Sambre. There are very

important forges, foundries, and iron-rolling mills, and various kinds of iron goods are extensively produced. Population 10,000.

Havana, the capital of Cuba, the largest city of the West Indies, situated on the north coast of the island. The bay is capacious and land-locked, and on the town side is sea-walled and lined by handsome parks. At the southern end of the bay, at the old fort of Atares, the American Crittenden and others of the insurrectionary expedition of 1851 were shot. Regla, on the east side of the bay, contains the sugar-shipping wharves and the terminus of the railways leading to the eastern end of the island ; it is connected with Havana by large ferry-boats. The older main portion of the city is on a low plain, once enclosed by a mediaeval wall. It occupies a septagonal peninsula lying between the river Almendaris on the west, the sea on the north, and Havana harbour on the east. On the south and west it is .backed by an amphi-theatre of hills, 150 feet high, crowned by the conspicuous fortifications of Castillo de Principe. The principal busi-

ness streets, Calle Obispo and Calle O'Reilly, are narrow and closely built. Elsewhere wider avenues are found. There are many beautiful parks and drives, including the fine avenue known as the Prado. There are also many surburban pleasure resorts, and pretty villages such as Guines, Guanabacoa, Marianao, and Puentes Grandes. Throughout the city, and especially the more modern portion, there are many elaborate structures. The Havanese boast that the Teatro Taqon is the largest theatre in the world. Other notable buildings are the markets, the opera-house, the captain-general's palace, the hospitals, the university, the ciliy prison, several churches (including the cathedral), and many club-houses. The many immense cigar factories are by no means unattractive features. Some of the houses of the wealthy, scattered throughout the city, are very hand-some. They have always an inner courtyard, or patio, surrounded by tall stuccoed columns and ornamented with plants around a central fountain. The large industrial population lives mostly in densely crowded houses. The

principal institutions of learning are the University of Havana and the large Jesuit College de Belen for boys. The latter has a museum and an observatory, where most

of the important astronomical and climatological data concerning Cuba have been collected ; its library is especially rich in old volumes pertaining to Cuban life from the 16th century to the present. Among the numerous benevolent institutions are the Casa de Beneficencia, founded by Las Casas as an asylum for infants and the aged ; hospitals for the sick of all classes, and an immense lazaretto for lepers in the western p^-t of the city. A hospital for the insane is maintainea a few miles south of Havana. Until recently the city was badly supplied with water, and its sewerage is still abominable. In 1895 a modern system of waterworks was installed by New York engineers, who also prepared plans for the solution of the sewerage problem. The city is well policed. Street railways radiate in several directions from the Paseo. The

tramcars are worked by electricity. An extensive system of railways radiates from Havana, extending east to Santa Clara, west to Pinar del Eio, and south to Batabano and Cienfuegos. Coasting vessels from Havana ply round the island, and lines of steamers afford close connexion with the United States. Many European lines also sail to the city. The chief industry is the manufacture of tobacco. There are also manufactories of sweetmeats, candles, carriages, soap, perfumery, and glycerine, and breweries, rum distilleries, tanneries, and gas works. Havana commands the wholesale trade of all the western half of Cuba, including the provinces of Matanzas, Havana, and Pinar del Eio, and is the headquarters of all the commercial and banking interests of the island. The foreign and coastal shipping trade is extensive, the American tonnage alone amounting to 1,000,000 per annum. About 1200 ocean vessels, steam and sail, annually clear from Havana, while the sugar crop finds an outlet at all the principal ports. Population (1899), 235,981. (See Cuba.)

(b. t. h.)

Havel, a river of Prussia, having its origin in Lake Dambeck (223 feet) on the Mecklenburg high grounds, a few miles north-west of ISTeu-Strelitz, and after threading several lakes flowing south as far as Spandau. Thence it curves south-west, west, and north-west past Potsdam and Brandenburg, traversing another chain of lakes, and finally continues north-west until it joins the Elbe from the right some miles above Wittenberge after a total course of 221 miles and a total fall of only 158 feet. Its banks are mostly marshy or sandy, and the stream is navigable from the Mecklenburg lakes downwards. Several canals connect it with these lakes, as well as with other rivers — e.g., the'Finow canal with the Oder, the Euppin canal with the Ehin , the Berlin-Spandau navigable canal (6^ miles) with the Spree, gnd the Plaue-Ihle canal with the Elbe. The Sakrow-Paretz canal, 11 miles long, cuts off the deep bend at Potsdam. The most notable of the tributaries is the Spree (227 miles long), which bisects Berlin and joins the Havel at Spandau. Area of river basin, 10,159 square miles.

Haverfordwest, a municipal and county borough (with its own lord-lieutenant), market-town, and railway station, Pembrokeshire, Wales, 63 miles west by north of Swansea. Since 1885 it has united with Pembroke, Fish-guard, Milf ord, Narberth, Tenby, and Wiston to return one member to Parliament. The old grammar-school has been provided with new buildings, a temperance hall erected, and a high-class school for girls established. There are a shire hall. Masonic hall, two market buildings, a reading-room, and an infirmary. The charities belonging to the borough are considerable. Area, 1382 acres. Population (1881), 6398 ; (1901), 6007.

Haverhill, a city of Essex county, Massachusetts, U.S.A., in 42° 47′ N., 71° 40′ W., on the Merrimack at the head of tide, and on the Boston and Maine railway. Its area of 28 square miles is divided into seven wards ; its plan is irregular ; it has a good water-supply, pumped from neighbouring lakes ; it is sewered, and the streets are paved, mainly with macadam. It is essentially a manufacturing city. In 1890 its manufacturing estab-

lishments numbered 734, with an invested capital of $8,084,272; 15,200 hands were employed, and the product was valued at $25,394,536. Of this not less than four-fifths consisted of boots and shoes. The assessed valuation of real and personal property in 1900 was $26,443,933, the net debt was $1,486,622, and the rate of taxation was $17-40 per $1000. Population (1880), 18,472; (1890), 27,412; (1900), 37,176, of whom 8530 were foreign-born, and 373 were negroes. The death-rate in 1900 was 16-1.

Haverstraw, a village of Eockland county, New York, U.S.A., in 41° 03′ N. and 73° 58′ W., on the west shore of Haverstraw Bay, an enlargement of the Hudson. It is on three railways — the New York, Ontario, and Western, the New Jersey and New York, and the West Shore. Its chief industry is brickmaking. Population (1880), 3506; (1890), 5070; (1900), 5936.

Havre, Le, a town and seaport of France, on the English Channel at the mouth of the Seine, department of Seine-Inferieure, 142 miles from Paris by rail, with

a population in 1886 of 109,199, in 1896 of 117,009, and in 1901 of 129, 044. Its trade has been estimated at one-fifth or one-sixth of that of all France. The annual movement of the port amounts to nearly 13,000 ships, approaching 6,000,000 tons, and producing more than £3,200,000 duty at the custom-house. In 1899, 6348 vessels entered the port and 6414 cleared, with a total of 5,837,997 tons ; the value of exports reached £37,024,000, that of imports, £39,208,000. Fifty-one yachts, eleven of over 100 tons, belong to the port.

Le Havre owes its prosperity mainly to its advantageous situation. At each tide the water level does not vary more than 1 foot for three hours, thus permitting vessels to enter and clear freely during that interval. The appliances and resources of the port are constantly being improved. It now includes 9 wet docks, with an area of nearly 200 acres, and more than 8 miles of quays. The great transatlantic pactet-boats berth in the Eure basin, into whicl. the TanoarviUe canal (15^ miles long) enters, permitting river boats which could not attempt the estuary of the Seine to make the port direct. It is also between the same basin

and the canal that the three dry docks (460, 500, and 600 feet long respectively, and from 65 to 130 feet wide) for the accommodation of large vessels are situated. There is a petroleum dock for the sole use of vessels carrying this dangerous commodity. The fortifications on the southern sea-front will be done away with, and on the west of the present jetties an area of about 120 acres will be surrounded by new piers and added to the present outer port. The channel directed towards the west will be equally accessible from the south-west and west-north-west. It will be excavated 15 feet below the zero level of the charts. The direction adopted will, as far as possible, remove the entrance to the port from the sand deposits in the bay of the Seine. The lock leading from the outer port into the Eure basin will have its flood-gate 13 feet below the zero level of the charts, and will allow large vessels to pass for six hours every tide. In the outer port itself the depth alongside the quay accessible to railway trains is to be deepened for a length o£ 1300 feet, so that the great transatlantic liners can regularly lie under conditions which will permit of their leaving at fixed hours.

The embellishment of the town corresponds with these

improvements to the port. The boulevards which have replaced the ancient ramparts are lined with fine buildings. To the Hotel de Ville and Palais de Justice, of comparatively recent date, is now added the Bourse. Among the large manufactories those producing war material have increased greatly in importance — founding cannon, and building gun-carriages and warships as well as merchant vessels. To these may be added a refinery

of argentiferous lead, a sugar refinery, petroleum, oil, soap, rice, and nickel works, a copper wire-drawing mill, and a manufactory of dye-stuffs. Important electrical works furnish the town with light and its trams with motive power. Le Havre also builds electric motors. Its entrepdt for tobacco leaf is the most important in Prance. England, Germany, and the United States of America are the countries with which the city holds most intercourse. There is weekly communication between Le Havre and JSTew York by the magnificent steamships of theCompagnie

Transatlantique Franqaise.

Hawaiian or Sandwich Islands. — The treaty of commercial reciprocity with the United States, which took effect in 1876, has been justly called the most important event in Hawaiian history since 1843. It ushered in an era of unexampled prosperity, and set in motion a series of momentous changes. In the early part of Kalakaua's reign (1874-91) a political struggle began which culminated in the overthrow of the monarchy. It had been the aim of Kamehameha III. and his advisers to combine the native and the foreign elements under one government; to make the king the sovereign not of one race or class, but of all ; and to extend equal and impartial laws over all inhabitants of the country. Kalakaua, however, seemed to regard himself as merely sovereign of the aboriginal Hawaiians, and residents of European ^1 J or American descent as alien invaders. It appeared to be his chief aim to restore, to a great extent, the ancient system of personal government, under which he should have control of the public treas-

ury. Thus he took it upon himself, on the 2nd of July

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Sketch Map of the Hawaiian Islands.

1878, and again on the 14th of August 1880, to dismiss a ministry without assigning any reason, after it had been triumphantly sustained by a test vote of the legislature. On the latter occasion be appointed Mr C. C. Moreno, who had come to Honolulu in the interest of a Chinese steamship company, as Premier and Minister of Foreign Affairs. This called forth the protest of the representatives of Great Britain, France, and the United States, and aroused such opposition on the part of both the foreigners aiid the better class of natives, that the king was obliged, after four days of popular excitement, to remove the obnoxious minister. On the 20th of January 1881 the king set out upon a tour around the world. He was received with royal honours in Japan, Siam, and

Johore, and he then crossed British India by rail and visited the Khedive of Egypt. The royal party visited nearly all the capitals of Europe, and returned by way of Washington, arriving in Honolulu on the 29th of October 1881. During his absence his sister, Mrs Lydia Dominis, also styled Liliuokalani, acted as regent.

After the king's return the contest was renewed between the so-called National party, which favoured absolutism, and the Reform party, which sought to establish parliamentary government. The king took an active part in the elections, and also used his patronage to the utmost to influence legislation. For three successive sessions a majority of the legislature was composed of office-holders, dependent on the favour of the executive. Among the measures urged by the king and opposed by the Reform party were the project of a ten million dollar loan, chiefly for military purposes; the removal of the prohibition of the sale of alcoholic liquor to Hawaiians, which was carried in 1882; the licensing of the sale of opium; the chartering of a

lottery company ; the licensing of Icahunas, or medicine men, &o. Systematic efforts were made to turn the constitutional question into a race issue, and the party cry was raised of "Hawaii for Hawaiians." Adroit politicians were not wanting to flatter the king's vanity, defend his follies, and teach him how to violate the spirit of the constitution while keeping the letter of the law. From 1882 till 1887 his prime minister was Walter Murray Gibson, a singular and romantic genius, at once a visionary adventurer and a shrewd politician, who had been imprisoned by the Dutch Government in Batavia in 1852 on a charge of inciting insurrection in Sumatra, and who had arrived at Honolulu in 1861 with the intention of leading a Mormon colony to the East Indies. To exalt his royal dignity, which was lowered by the fact that he was only an elected king, Kalakaua caused himself to be crowned with imposing ceremonies on. the ninth anniversary of his election (12th February 1883). He was now no longer satisfied with being merely king of Hawaii, but aspired to what was termed

the " Primacy of the Pacific." Accordingly Mr Gibson addressed a protest to the Great Powers, deprecating any further annexation of the islands of the Pacific Ocean, and claiming for Hawaii the exclusive right "to assist them in improving their political and social condition." In pursuance of this policy, two commissioners were sent to the Gilbert Islands in 1883 to prepare the way for a Hawaiian protectorate. On the 23rd of December 1886 Mr J. E. Bush was commissioned as minister plenipotentiary to the king of Samoa, the king of Tonga, and the other independent chiefs of Polynesia. He arrived in Samoa on 3rd January 1887, and remained there six months, during which time he concluded a treaty of alliance with Malietoa, which was ratified by his Government. The Explorer, a steamer of 170 tons, which had been employed in the copra trade, was purchased for f 20,000, and refitted as a man-of-war, to form the " nest-egg " of the future Hawaiian navy. She was re-named the Kaimiloa, and despatched to Samoa on 17th May 1887 to strengthen the hands of the embassy. As R. L. Stevenson wrote,

” The histoi-y of the Kaimiloa is a story of debauchery, mutiny, and waste of Government property.” At length the intrigues of the Hawaiian embassy gave umbrage to the German Government, and it was deemed prudent to recall it to Honolulu in July 1887. Meanwhile a reform league had been formed for the purpose of putting an end to the prevailing misrule and extravagance, and had the support, of the volunteer military force known as the ” Honolulm Rifles.” The king had succeeded in carrying through the legislature of 1886 a Bill providing for an opium licence, as well as a Loan Act, under which a million dollars was borrowed in London. After this he went from one folly to another until his acceptance of two bribes— one of $76,000 and another of $80,000 for the assignment of an opium licence — precipitated the revolution of 1887. An immense mass meeting was held on 30th June, from which a committee was sent to the king with specific demands for radical reforms in the methods of administering the government. Overawed by the unanimity of the movement, and finding himself without

support, he yielded without a struggle, dismissed his ministry, and signed a new constitution on the 7th of July 1887, revising that of 1864, which was intended to put an end to personal government and to make the cabinet responsible only to the legislature. By its terms office-holders were made ineligible for seats in the

legislature, and no member of the legislature could be appointed to any civil oiiice under the Government during the term for which he had been electedi

The members of the Upper House, instead of being appointed by the king for life, were henceforth to be elected for terms of six years by electors possessing a moderate property qualification. The remainder of Kalakaua's reign teemed with intrigues and conspiracies to restore autocratic rule. One of these came to a head on the 30th of July 1889, but the insurrection was promptly suppressed. Seven of the insurgents were killed and a larger number- wounded. There

can be little doubt that the late king and his sister, who succeeded him, were accessory to this ill-advised outbreak. In order to recruit his failing health, the king visited California in the U.S. cruiser Charleston in November 1890. In spite of the best medical attendance he continued to fail, and breathed his last on the 20th of January 1891 in San Francisco. His remains were brought to Honolulu in the Charleston, arriving there on the 29th of January, when the decorsr tions for his welcome were suddenly changed into the emblems of mourning. On the same day at noon his sister, the regent, took the oath to maintain the constitution of 1887, and was proclaimed queen, under the title of Liliuokalani.

The history of her short and troubled reign shows that it was her constant purpose to restore autocratic government, and to govern as well as to reign. Passing over minor events, the legislative session of 1892, during which four changes of ministry took place, was protracted to eight months chiefly by her determination to

carry through the opium and lottery Bills and to have a cabinet in sympathy with her views in regard to the constitution. Meanwhile she had caused a new constitution to be secretly drawn up, which would practically have transformed the Government from a limited to an absolute monarchy, besides disfranchising a large class of citizens who had voted since 1887. This constitution she undertook to spring upon the country by a coup d'etat, immediately after proroguing the legislature on the 14th of January 1893. At the critical moment, when her preparations were complete, her ministers shrank from the responsibility of so revolutionary an act, and with diflBlculty prevailed upon her to postpone the execution of her design. In such undertakings to hesitate is fatal. Again there was an uprising of the conservative part of the community similar to that of 1887. But this time the prevailing opinion condemned all half-way measures, and declared the monarchy to be forfeited by its own act. A third party proposed a regency during the minority of the heir-apparent, Princess Kaiulani, but in her absence this

scheme found few supporters. A Committee of Safety was appointed at a public meeting, which proceeded to form a Provisional Government and to reorganize the volunteer military companies, which had been disbanded in 1890. It also called a mass meeting of citizens, which met on the afternoon of the 16th and ratified its action. The U.S. steamer Boston, which had unexpectedly arrived from Hilo on the 14th, landed a small force on the evening of the 16th, at the request of the U.S. minister, Mr •J. L. Stevens, and a committee of residents, to protect the lives and property of American citizens in case of riot ■or incendiarism. The next day, the 17th, the Committee .of Safety took possession of the Government Building, and issued a proclamation declaring the monarchy to be abrogated, and establishing a Provisional Government, to exist " until terms of union with the United States of America shall have been negotiated and agreed upon." Meanwhile two companies of volunteer troops arrived and occupied the grounds. By the advice of her ministers, and to avoid bloodshed, the queen surrendered under

protest, in view of the landing of United States troops, appealing to the Government of the United States to reinstate her in authority. A treaty of annexation was negotiated with the United States during the next month, but it was withdrawn on 9th March 1893 by President Cleveland, who then despatched Mr J. H. Blount of Macon, Georgia, as his special commissioner, to investigate the situation in the Hawaiian Islands. On receiving Mr Blount's report to the effect that the revolution had been accomplished by the aid of the U.S. minister and by the landing of troops from the Boston, President Cleveland sent the Hon. A. S. Willis of Kentucky to Honolulu with secret instructions as U.S. minister. Accordingly, Mr Willis, having with much difiieulty and delay obtained the queen's promise to grant an amnesty, made a formal demand on the Provisional Government for her reinstatement on the 19th of December 1893. On the 23rd President S. B. Dole, of the Provisional Government, sent a reply to Minister Willis, declining

to surrender its authority to the deposed queen. The U.S. Congress declared against any further intervention. On the 30th of May 1894 a convention was held to frame a constitution for the republic of Hawaii, which was proclaimed on the 4th of July following, with S. B. Dole as its first President. Towards the end of the same year a plot was formed to overthrow the republic and to restore the monarchy. A cargo of arms and ammunition from San Francisco was secretly landed at a point near Honolulu, where a company of native royalists were collected 6th January 1895, intending to capture the Government Buildings by surprise that night, with the aid of their allies in the city. A premature encounter with a squad of police alarmed the town and broke up their plans. There were several other skirmishes during the following week, resulting in the capture of the leading conspirators, with most of their followers. The ex-queen, on whose premises a large quantity of arms and ammunition, together with a number of incriminating documents, were found, was arrested and imprisoned for nine months in

the former palace. On the 24th of January she formally renounced all claim to the throne and took the oath of allegiance to the republic. The ex-queen and forty-eight others were granted conditional pardons on the 7th of September, and on the following New Year's Day the remaining prisoners were set at' liberty.

On the inauguration of President McKinley, in March 1897, negotiations with the United States were resumed, and on the 16th of June a new treaty of annexation was signed at Washington. As its ratification appeared to be uncertain, a j oint resolution to the same effect was introduced, which passed the Senate by a vote of 42 to 21 and the House of Eepresentatives by a vote of 209 to 91, and was signed by the President on the 7th of July 1898. The formal transfer of sovereignty took place on 12th August 1898, when the flag of the United States was raised over the Executive Building with impressive ceremonies. The public debt of the republic of Hawaii was assumed by the United States, with a limit of four million dollars. The existing laws of Hawaii were to continue in force until

Congress should pass laws organizing the future govern-
ment of the islands. In 1900 Congress passed an Act,
approved by the President 30th April, by which the
Territory of Hawaii was organized and a territorial govern-
ment was established, with its capital at Honolulu. This
Act declared all persons who were citizens of the Republic
of Hawaii on 12th August 1898 to be citizens of the
United States and of the Territory of Hawaii, and
provided that the constitution and, except as specially
provided, all the laws of the United States not locally

inapplicable should have the same force and effect within
the Territory as elsewhere in the United States.
Under this Act the legislature meets biennially, and
consists of a Senate of 15 members holding office for four
years, and a House of Eepresentatives of 30
meat!" members holding office for two years. ' In order
to vote for representatives or senators, the
elector must be a male citizen of the United States who

has attained the age of twenty-one years, has resided in the Territory not less than one year preceding, and is able to speak, read, and write the English or Hawaiian language. No person is allowed to vote who is in the Territory by reason of being in or attached to the army or navy. The executive power is vested in a governor, appointed by the President and holding office for four years. He must be not less than thirty-five years of age and a citizen of the Territory. The secretary of the Territory is appointed in like manner for the same length of term. The governor appoints, by and with the consent of the Senate of the Territory, an attorney-general, treasurer, commissioner of public lands, commissioner of agriculture and forestry, superintendent of public works, superintendent of public instruction, auditor and deputy auditor, surveyor, high sheriff, members of the board of health, commissioners of public instruction, board of prison inspectors, board of registration, and inspectors of election, &c. All such officers are appointed for four years except the commissioners of public instruction and the members of the

said boards, whose terms are as provided by the laws of the Territory ; all must be citizens of the Territory. The judicial power of the Territory is vested in one supreme court, circuit courts, and such inferior courts as the legislature may establish. One delegate is elected to the United States House of Eepresentatives, and there is also established a United States district court. The Territory is also constituted an internal-revenue district and a customs district. The Act further provides that no Chinese labourer shall be allowed to enter any state, territory, or district of the United States from the Hawaiian Islands; and the Act of Congress of 26th February 1886, " To prohibit the importation and migration of foreigners and aliens under contract or agreement to perform labour in the United States, its territories, and the District of Columbia," and the amending and supplementing Acts, are extended to Hawaii.

The President appointed Sanford B. Dole Governor of the Territory, and on 14th June 1900 the new territorial government was

formally instituted. The first elected legislature met on the 20th February 1901. The majority proved hostile to the Governor, passed a resolution asking the President to remove him, and adjourned without making appropriations. An extra session in May was no more harmonious. Matters went so far that the Governor was brought before a grand jury ; but no indictment was found, and the President declined to remove him.

Immigration and Population. — The pressing demand for labour created by the Eeciprocity Treaty has led to great changes in the population of the Hawaiian Islands. It has been the policy of the Government to assist immigrants from widely different countries, not pnly as labourers but also as prospective citizens. In the year 1877 arrangements were made for the importation of Portuguese families fyom the Azores and Madeira, and during the next ten years about 7000 of these people were brought to the islands. Others have since been added to their number, and their natural increase has been very rapid. In 1900 the total number of Portuguese in the islands, including those born there, was not far from 16,000, about

2400 of whom were employed in sugar plantations. They have shown themselves to be industrious, thrifty, and law-abiding. Persistent efforts have also been made to introduce Polynesian islanders, as being of a cognate race with the Hawaiians, but the results have been wholly unsatisfactory. About 2000 of these people, mainly from the Gilbert Islands, were brought in at the expense of the Government between 1878 and 1884 ; but they did not give satisfaction either as labourers or as citizens, and most of them have been returned to their homes. There has never existed any treaty or labour convention between the Government of Hawaii and the empire of China. In early days a limited number of Chinese settled in the islands, intermarried with the natives, and by their industry and economy were generally prosperous. About 750 of them were naturalized under the monarchy. The first importation of Chinese labourers into the country took place in 1852. In 1878 the number of Chinese had risen to 5916. During the next few years there was a steady influx of Chinese free immigrants, which finally reached

alarming proportions. In the spring of 1881 the Hawaiian Government was obliged to send a dispatch to the Governor of Hong-Kong to stop this invasion. Again, in April 1883, it was suddenly renewed, and within twenty days five steaniers arrived from Hong-Kong bringing 2263 Chinese passengers, followed the next month by 1100 more, with the news that several thousand more were ready to embark. Accordingly the Hawaiian Government sent another dispatch to the Governor of Hong-Kong, refusing to admit any further immigration of male Chinese from that port. Various regulations restricting Chinese immigration were enacted from time to time, until in 1886 the landing of any Chinese passenger without a passport was prohibited. The number of Chinese in the islands had then risen to 21,000, and in 1900 they were estimated to be 27,000, of whom 6000 were employed on sugar plantations. The consent of the Japanese Government to the emigration of its subjects to Hawaii was obtained with difficulty in ‘ 1884, and in 1886 a labour convention was ratified. Since then the increase of the

Japanese element in the population has been constant and rapid. It rose from 116 in 1884 to 12,360 in 1890, and 24,400 in 1896. In 1900 it was 61,111, of whom 26,000 were employed in sugar plantations. They have for the most part been recruited from the lowest classes in Japan. Unlike the Chinese, they show no inclination to intermarry with the Hawaiians. The effect of making Hawaii a territory of the United States was to put an end to all assisted immigration, of whatever race, and to exclude all Chinese labourers. But under the recent treaty between the United States and Japan there is nothing to limit the free immigration of Japanese, and several companies have been formed to promote it. The system of contract labour, which was abolished by Act of Congress in 1900, concerned but a small minority of the labourers other than Japanese. Various methods of co-operation or profit-sharing are in successful operation on some plantations.

The excessive preponderance of males over females in Asiatic immigration constitutes a serious menace to the

morals and health of the commonwealth. The decrease of the aboriginal population has still continued, from 44,088 in 1878 to 40,014 in 1884, 34,436 in 1890, and 31,019 in 1896, the rate of decrease being about 1-j-^^ per cent, a year. At the same time the part>Hawaiians, the offspring of intermarriage between Hawaiian women and men of other races, have been constantly increasing from 3420 in 1878 to 4218 in 1884, 6186 in 1890, and 8485 in 1896. All these facts point to the gradual extinction of the full-blooded Hawaiians, and the absorption of the remnant of the race by the European and Asiatic population. The scourge of leprosy, which is almost confined to the native Hawaiians, is being gradually extinguished by segrega-tion. The number of cases at the Molokai settlement has been reduced from 1200 to about 900.

The population in 1900 was 164,001, distributed as follows: — Hawaii, 46,843; Kaiiai and Mihau, 20,734; Maui, 25,416; Molokai and Lanai, 2504; Oahu, 58,504.

Of the total population, 106,369 (69-1 per cent.) were males and 47,632 (30-9 per cent.) females; 63,221 (41-1 per cent.) were native-born and 90,780 (58-9 per cent.) foreign-born ; 66,890 (43-4 per cent.) were white and 87,111 (66-6 per cent.) were coloured. Under the heading white are classed 37,656 Hawaiians or parU Hawaiians, 28,819 Caucasians, and 415 South Sea Islanders. The class coloured included 25,767 Chinese, 61,111 Japanese, and 233 persons of negro descent. Of the white population, 54,141 were native-born and 12,749 (8-3 per cent. Of total population) foreign-born, largely Portuguese. The number of males of voting age (21 years and over) was 79,607, of whom 13,064 were native-born and 66,543 (83-6 per cent.) were foreign-born, principally Chinese and Japanese ; and 60,031 (75-4 per cent.) were coloured, of whom 93 were persons of negro descent and the remainder Chinese and Japanese. Of the total number of males of voting age, 27,363 were illiterate (unable to write), of whom 26,641 were foreign-born and 24,028 were coloured (including 16,723 Japanese, 7276 Chinese, and 29 negroes). The urban population in 1900, classing as such all persons in cities of 8000 inhabitants or over (i.e., in Honolulu), was 39,306, or 25-5 per cent, of the total population — which was

exactly the same percentage as in 1890.

Land. — The total area of the inhabited islands slightly exceeds four million acres. The tenure by which these lands were held before 1840 was strictly feudal, haying probably been evolved out of a prehistoric communal system. In the great division which took place in 1848, and which forms the foundation of land titles, about one million acres were set apart for the king and his successors, a million and a half acres for the Government, and an equal amount for the several chiefs, while the common people were granted fee simple titles for their house lots and the pieces of land which they had cultivated for themselves. As the chiefs generally ran into debt, and died in many cases without heirs, their lands have largely passed into the hands of foreigners. About half of the original Government land has been sold. The census of 1896 showed that there were at that time 3995 landowners of pure Hawaiian blood out of 31,019 men, women, and children. At the abolition of the monarchy in 1893 the crown domains were declared to be public lands, and, together with the other

Government lands, were turned over to the United States. Taken together, these lands now comprise a million and three-quarter acres, valued at seven and a half million dollars. A carefully-drawn Land Act, embodying many of the provisions of the New Zealand system, was passed in 1895, and was to be continued in force by the CuUom Bill. It was intended to promote the sub-division of the Government land into small holdings for actual settlers, and to discourage mere speculators. The crown lands, which were made by law inalienable in 1865, have hitherto been held for the most part under long leases. As these leases expire from time to time, it is the policy of the Government to break up gradually the large holdings into homesteads, and thus to encourage the growth of an agricultural population.

Commercial Progress. — Under the stimulus of the Ee-ciprocity Treaty, the production of sugar, the principal staple of the islands, had increased twenty-fold in 1897, and in 1900 the value was $19,254,773. In 1900 there were 395 manufacturing establishments, with a total cap-ital of $11,541,655, employing 4587 hands, and producing goods valued at 124,992,068. The total value of the

domestic exports of the islands rose from $1,835,382 in 1875 to $22,628,741 in 1899 ; and the total value of the imports rose from $1,682,471 to $19,059,605.79, including $2,990,000 in specie. The number of vessels employed in the foreign carrying trade in 1898 was 481.

During 1899, 655 merchant vessels (of which 447 were American), with a tonnage of 788,842, entered at the ports of Hawaii. During the same year, 32,726 passengers (of whom 4705 were from San Francisco and 27,078 from China and Japan) arrived at Honolulu, and 9065 passengers departed (of whom 4011 sailed for San Francisco and 4398 to China and Japan). From 1843 to 1900 (14th June) inclusive the imports of Hawaii amounted to $184,278,309 and the exports to $286,483,219. During the year ending 30th June 1901 the imports of Hawaii amounted to $2,835,278 and the exports to $120,211— of course exclusive of commerce with the United States. During the same period the merchandise shipped from Hawaii to the United States amounted to $27,903,058, of which a part, valued at $4,293,009, was carried in American steam vessels, and the balance, valued at $23,610,049, in American sailing vessels.

Pitblic Revenue. — The total revenue for the biennial period rose from $877,791 in 1874-75 to $5,913,720 in 1898-99. This latter amount was derived from the following sources :— Customs, $2,192,604 ; direct taxation, $1,879,935; postal bureau, $206,663; public lands, $316,256; licences, $333,994; besides sums received from fines and penalties, fees, waterworks, &c. The total expenditure for 1898-99 was, from current receipts, $4,740,005, and from loan fund for public improvements, $756,504. The total national debt, January 1900, was $4,890,351.

Material Improvements. — Under the monarchy much was done for the improvement of the city of Honolulu, but the outlying districts were neglected and the country roads were mere bridle-paths. Among the public improvements executed since 1878 may be mentioned the palace, now styled the Executive Building, erected in 1878-81 at a cost of $360,000 ; the marine railway, completed in 1882, at a cost of $90,000; and the police station, built in 1885, at a cost of $91,000. Lighthouses

were placed at Barber's Point and at the south-west point of Molokai in the same year. Under the republic great attention has been paid to roads, and more has been accomplished in this direction since 1890 than during the entire previous history of the country. The entrance to the harbour of Honolulu was deepened to 30 feet in 1892, and a complete system of sewerage for the city was begun. The United States Congress has set aside $100,000 for deepening the entrance of Pearl Lochs, 7 miles west of Honolulu, which will open for commerce one of the finest harbours in the Pacific Ocean. Private enterprise has done still more to develop the re-sources of the islands and to improve the communications. The number of inter-island steamers has increased from two to twenty-two, besides twenty inter-island sailing vessels. The first railway built in the islands was the Kahului railway on Maui, which was begun in 1879, and is 15 miles long. The Kohala railway, which was built two years later, is 20 miles long. The Oahu railway, begun in 1888, has been completed from Honolulu around

the western and northern sides of the island to Kahuku, a distance of 70 miles. Street tramways run in Honolulu. Each of the four principal islands is now encircled by telephone lines.

Agricultural Progress. — The immense increase in the production of sugar is due not only to the increase of the area planted with cane, but also to the scientific use of fertilizers, to more extensive irrigation, to improved machinery in mills, and to improved processes for the treatment of the juice. In several localities extensive irrigation canals have been constructed, which have brought into cultivation large tracts of land which had formerly lain barren. The first artesian well in the islands was bored at Honouliuli in July 1879, and met with unexpected success. Since then more than two hundred artesian wells have been sunk around the island of Oahu. Many of the plantations are now supplied with water for irrigation by pumping works, drawing their supply from wells. The crop of sugar has risen in some plantations to 10 and even 14 tons per acre, two crops being taken off in about three

years. The average annual production for all the islands is about 6 tons per acre. The total number of labourers employed in the sugar plantations is about 40,000. The cultivation of rice, which was begun in 1860 with Carolina seed, has passed entirely into the hands of the Chinese.

The annual production is estimated to be about ten million pounds, most of which is consumed in the islands. The Kona coffee has established a reputation for quality equal to that of any in the world, and readily brings twice the price of the Brazilian product. Its culture is particularly adapted to farmers of moderate means, and tends to promote the multiplication of home-steads and the employment of a better class of labour. In 1898, 733,285 pounds of coffee were exported, valued at $132,347. The bananas exported in 1899 were valued at $84,268. There are many other kinds of fruits, as well as of fibre plants, such as sisal, ramie, &c., which can be successfully cultivated in the islands.

Educational Progress. — Education is universal, compulsory, and free. Every child between the ages of six and fifteen must attend either a public school or a duly authorized private school. Consequently the percentage of illiteracy is extremely low. English is by law the medium of instruction in all schools, both public and private, although other languages may be taught in addition. The schools are in session forty weeks during the year. The school system is essentially American in its text-books and its methods. A normal school has been established at Honolulu, with a practice school attached to it. The Honolulu High School is justly the pride of the department, both for the beauty of its buildings and grounds and the excellence of its work. Industrial training is as yet in its infancy. The Lahainaluna Seminary, founded in 1831, furnishes instruction to Hawaiian boys in agriculture, carpentry, printing, and mechanical drawing. The boys in the Reformatory School are taught iisef ul trades. The teaching of sewing in the public schools has met with great success, and a simple form of the Swedish

Sloyd has been introduced into many of the schools. But the best instruction of this kind is furnished by the independent schools, among which the Kamehameha Schools take the first place. They were founded by the late Mrs Bernice Pauahi Bishop, the last lineal descendant of Kamehameha I., who left her extensive landed estate in the hands of trustees for their support. They furnish a good manual and technical training to Hawaiian boys and girls, in addition to a primary and grammar school course of study, and exert a strong religious influence. There are six boarding schools for Hawaiian girls, supported by private resources. The most advanced courses of study are offered by Oaliu College, which occupies a beautiful site east of Honolulu. It is well equipped with buildings and apparatus, and has an endowment of about $300,000.

During the biennial period ending 31st December 1899 the expenditure of the Hawaiian Government for the support of public schools was 1569,188, of which sum $428,862 was paid for teachers' salaries. The average salary paid to public school teachers is 1645 per annum. In 1899 there were 142 Government schools, with

344 teachers and 11,436 pupils ; 55 independent schools, with 200 teachers and 4054 pupils, giving a total of 197 schools, with 544 teachers and 15,490 pupils. Of these pupils 5043 were Hawaiian, 2721 part-Hawaiian, 1314 Chinese, 1141 Japanese, 2767 Portuguese, and 2504 other foreigners. In 1900 the number of persons of school age (5 to 20 years inclusive) was 33,774, of whom 8489 (25-1 per cent.) were foreign-born.

Seligion. — There are Protestant, Roman Catholic, and Mormon teachers, and recently Buddhist priests have been sent from Japan. The Roman Catholics comprise the bulk of the Portuguese population and about one-third of the natives. Perhaps three-fifths of the Hawaiians, and nearly all of British, American, or Northern European race, are Protestants. There are flourishing Protestant missions among the Portuguese, Chinese, and Japanese. The Mormons claim over 4000 adherents, nearly all native Hawaiians.

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(w. D. A.)

Haweis, Hugh Reginald (1838-1901), English preacher and writer, was bom at Egham, Surrey, 3rd April 1838, his father and grandfather having both been clergymen. On leaving Trinity College, Cambridge, he took orders in the Church of England and held various curacies in London, becoming in 1866 incumbent of St James's, Marylebone. His unconventional methods of conducting the service, combined with his dwarfish figure and lively manner, soon attracted crowded congregations, particularly of people who liked a little " sensation." He married Miss M. E. Joy in 1866, and both he and Mrs Haweis (died. 1898) contributed largely to periodical literature and travelled a good deal abroad. Mr Haweis was much interested in music, and wrote books on violins and on church bells, besides contributing an article to the

9th edition of the Encyclopaedia Britannica on bell-ringing. As a lecturer also he was very successful, in America as well as in England. His best-known book was Music and Morals; and for a time he was editor of Cassell's Magazine. He died on 29th January 1901.

Hawick, a parliamentary burgh (Border group) of Roxburghshire, Scotland, on the Teviot, 63 miles south-south-east of Edinburgh by rail. There are now 20 hosiery factories and 7 tweed merchants, owning several spinning mills. Twelve of the hosiery factories and 9 of the tweed factories each employ several hundred women. About 200 hand-frames for knitting are still in use ; iron-founding, engineering, and dyeing are carried on. There are five large nursery gardens. Great lamb, sheep, and cattle sales are held periodically. Recent erections are a cottage hospital, municipal buildings (including a free library), and a new post office ; there is also a science and art institute. The academy furnishes both secondary and technical education. Population (1881), 16,184 ; (1901), 17,303.

Hawkins, Caesar Henry (1798-1884), British

surgeon, son of the Rev. E. Hawkins and grandson of the Sir Caesar Hawkins who was serjeant-surgeon to Kings George II. and George III., was born 19th September 1798, educated at Christ's Hospital, and entered St George's Hospital, London, in 1818 (M.R.C.S. 1821, E.R.C.S. 1843). He was surgeon to the hospital from 1829 to 1861, and in 1862 was made serjeant-surgeon to Queen Victoria. He was president of the College of Surgeons in 1852, and again in 1861 ; and he delivered the Hunterian oration in 1849. His success in complex surgical cases gave him a great reputation. For long he was noted as the only surgeon who had succeeded in the operation of ovariotomy in a London hospital. This occurred in 1846, when anaesthetics were unknown. He did much to popularize colotomy. A successful operator, he nevertheless was attached to conservative surgery, and was always more anxious to teach his pupils how to save a limb than how to remove it. He reprinted his contributions to the medical journals in two volumes, 1874, the more valuable papers being on Tumours, Excision

of the Ovum, Hydrophobia and Snake-bites, Stricture of the Colon, and The Relative Claims of Sir Charles Bell and Majendie to the Discovery of the Functions of the Spinal Nerves. He died 20th July 1884. His brother, Edward Hawkins (1789-1882), was the well-known Provost of Oriel, Oxford, who played so great a part in the Tractarian movement.

Hawkshaw, Sir John (1811-1891), English en-

gineer, was born in Yorkshire in 1811. What scholastic education he received was imparted to him at Leeds

Grammar School, but Ms real education was gained in the school of practical experience. Before he was twenty-one he had been engaged for six or seven years in railway engineering and the construction of roads in his native county, and in the year of his majority he obtained an appointment as engineer to the Bolivar Mining Association in Venezuela. But the climate there was more than

his health could stand, and in 1834 he was obliged to return to England. He soon obtained employment under Jesse Hartley at the Liverpool docks, and subsequently was made engineer in charge of the railway and navigation works of the Manchester, Bury, and Bolton Canal Company. In 1845 he became chief engineer to the Manchester and Leeds railway, and in 1847 to its successor, the Lancashire and Yorkshire railway, for which he constructed a large number of branch lines. In 1860 he removed to London and began to practise as a consulting engineer, at first alone, but subsequently in partnership with Harrison Hayter. In that capacity his work was of an extremely varied nature, embracing almost every branch of engineering. He retained his connexion with the Lancashire and Yorkshire Company until his retirement from professional work in 1888, and was consulted on all the important engineering points that affected it in that long period. In London he was responsible for the Charing Cross and Cannon Street railways, together with the two bridges which carried them over the Thames ; he was en-

gineer of the East London railway, which passes under the Thames through Brunei's well-known tunnel ; and jointly with Sir J. Wolfe Barry he constructed the section of the Underground railway which completes the " inner circle " between the Aldgate and Mansion House stations. In addition, many railway works claimed his attention in all parts of the world — Germany, Russia, India, Mauritius, &c. One noteworthy point in his railway practice was his advocacy, in opposition to Robert Stephenson, of steeper gradients than had previously been thought desirable or possible, and so far back as 1838 he expressed decided disapproval of the maintenance of the broad gauge on the Great Western, because of the troubles he foresaw it would lead to in connexion with future railway extension, and because he objected in general to breaks of gauge in the lines of a country. The construction of canals was another branch of engineering in which he was actively engaged. In 1862 he became engineer of the Amsterdam ship-canal, and in the succeeding year he may fairly be said to have been the

saviour of the Suez Canal. About that time the scheme was in very bad odour, and the Khedive determined to get the opinion of an English engineer as to its practicability, having made up his mind to stop the works if that opinion was unfavourable. Hawkshaw was chosen to make the inquiry, and it was because his report was entirely favourable that M. de Lesseps was able to say at the opening ceremony that to him he owed the canal. As a member of the International Congress which considered the construction of an interoceanic canal across Central America, he thought best of the Nicaraguan route, and privately he regarded the Panama scheme as impracticable at a reasonable cost, although publicly he expressed no opinion on the matter and left the Congress without voting. Sir John Hawkshaw also had a wide experience in constructing harbours {e.g., Holyhead) and docks {e.g., Penarth, the Albert Dock at Hull, and the south dock of the East and West India Docks in London), in river-engineering, in drainage and sewerage, in water-supply, &e. He was engineer, with Sir James Brunlees, of the

original Channel Tunnel Company from 1872, but many years previously he had investigated for himself the question of a tunnel under the Strait of Dover from an engineering point of view, and had come to a belief in its feasibility, so far as that could be determined from borings and surveys. Subsequently, however, he became convinced that through railway communication with the Continent would not be to the advantage of Great Britain, and thereafter would have nothing to do with the project. He was also engineer of the Severn Tunnel, which, from its magnitude and the difficulties encountered in its construction, must rank as one of the most notable engineering undertakings of the 19th century. He died at his London residence on 2nd June 1891. (h. m. b.)

Hawksley, Thomas (1807-1893), English engineer, was born on 12th July 1807, at Arnold, near Nottingham. He was at Nottingham Grammar School till the age of fifteen, but was indebted to his private studies for his knowledge of mathematics, chemistry, and geology. In 1822 he was articled to an architect in

Nottingham, subsequently becoming a partner in the firm, which also undertook engineering work; and in 1852 he removed to London, where he continued in active practice till he was well past eighty. His work was chiefly concerned with water and gas supply and with main-drainage. Of water-works he used to say that he had constructed 150, and a long list might be drawn up of important towns that owe their water to his skill, including Liverpool, Sheffield, Leicester, Leeds, Derby, Darlington, Oxford, Cambridge, and Northampton in England, and Stockholm, Altona, and Bridgetown (Barbados) in other countries. To his native town of Nottingham he was water engineer for fifty years, and the system he designed for it was noteworthy from the fact that the principle of constant supply was adopted for the first time. The gas-works at Nottingham, and at many other towns for which he provided water supplies, were also constructed by him. He designed main-drainage systems for Birmingham, Worcester, and Windsor, among other places, and in 1857 he was called in, together with Bidder and

Bazalgette, to report on the best solution of the vexed question of a main-drainage scheme for London. In 1872 he was president of the Institution of Civil Engineers— an office in which his son succeeded him, in 1901. He died at his residence on Campden Hill, Kensington, on 23rd September 1893.

Haworth, parish and village, in the Keighley division of the West Riding of Yorkshire, England, 10 miles north-west of Bradford, with a station on a branch of the Midland railway. Since 1894 it has been governed by an urban district council. The Reverend Patrick Bronte was incumbent here for forty-one years, and a memorial near the west window of St Michael's Church bears his name and the names of his gifted daughters upon it. The grave of Charlotte and Emily Bronte is also marked by a brass. In 1895 a museum was opened by the Bronte Society. A cemetery was formed in 1891. Population' of the parish and urban district (1901) 7492.

Hay, John (1838), American statesman and

author, was born at Salem, Indiana, on the 8th of October 1838. He graduated from Brown University in 1858. Admitted to the bar in Springfield, Illinois, in 1861, he was at once selected by President Lincoln as assistant private secretary, in which capacity he served till the President's death. Erom 1865 to 1870 Mr Hay filled various posts in the U.S. legations at Paris, Vienna, and Madrid, and later, under President Hayes,' he was first assistant Secretary of State (1879-81). In the interval he was for a time an editorial writer on the New York Tribune, and he also produced his Pike County Ballads (1871) and Castilian Days (1871). His most important

literary work was a monumental biography of Lincoln in collaboration with Mr Mcolay, which was published in book form in 1890. Upon the inauguration of President McKinley in 1897, Mr Hay was appointed ambassador to Great Britain, from which post he was transferred in 1898 to that of Secretary of State. Thus it fell to him to

direct the peace negotiations with Spain after the war of 1898, and to secure American interests in the imbroglio caused by the Boxers in China. When President McKinley was murdered, and President Roosevelt succeeded, Mr Hay remained in of&ce. It was largely due to his tact and good management, in concert with Lord Pauncefote, the British Ambassador, that negotiations for abrogating the Clayton-Bulwer treaty and making a new treaty with G-reat Britain regarding the Isthmian Canal were success-fully concluded at the end of 1901.

Haydock, parish and township, in the Newton division of Lancashire, England, 7 miles north-west of Warrington, 3 miles from Newton-in-Makerfield, station on the London and North-Western railway. Since 1894 it has been governed by an urban district council. The church of St James's was rebuilt in 1891, a handsome Congrega^ tional chapel has been erected, and there are a cottage hospital and a large private lunatic asylum. There are extensive coal mines in the district. Population of the urban district (1901), 8575.

Hayes, Rutherford Birchard (1822-1893), nineteenth President of the United States, was born in Delaware, Ohio, 4th October 1822. He received his first education in the common schools, then passed through the ordinary academic course at Kenyon College, and was a student at the law school of Harvard University from 1843 to 1845. He practised law, first at Upper Sandusky and then at Cincinnati, Ohio, where he won a very respectable standing. As a politician he supported the Whig party, but, having always cherished anti-slavery sentiments, he joined the Republican party in 1854. After the breaking out of the Civil War the governor of Ohio, on 7th June 1861, appointed him a major of a volunteer regiment, and in July he was ordered to West Virginia for active service. His military career was uncommonly creditable, and he attained by his meritorious conduct the rank of brevet major-general. While still in the field he was elected a member of Congress, and took his seat in December 1865. He was re-elected in 1866, and supported the reconstruction measures advocated by

his party. In 1867 he was elected governor of Ohio, and was re-elected in 1869. In 1873 he transferred his residence from Cincinnati to Fremont, a small town in the northern part of Ohio, his intention being to withdraw from public life; but in 1875 the Republican party in Ohio once more selected him as its candidate for the governor-ship. He accepted the charge with great reluctance. The opposition party, the Democrats, adopted a platform de-claring in favour of indefinitely enlarging the volume of the irredeemable paper currency which the Civil War had left behind it. Hayes stoutly advocated the speediest practicable resumption of specie payments, and carried the election. The " sound-money campaign " in Ohio having attracted the attention of the whole country, Hayes was marked but as a candidate for the Presi-dency, and he obtained the nomination of the Republican National Convention of 1876. The candidate of the Demo-cratic opposition, Samuel J. .Tilden, by his reputation as a statesman and a reformer of uncommon ability drew many Republican votes. An excited controversy having arisen

about the result of the balloting in the States of South Carolina, Florida, and Louisiana, to allay a crisis dangerous to public peace the two parties in Congress agreed to pass an Act referring all contested election returns to an ex-traordinary commission. This commission decided each contest by eight against seven votes in favour of the Republican candidates, and Mr Hayes was accordingly declared duly elected.

During his administration President Hayes devoted his efforts mainly to civil service reform, resumption of specie payments, and the pacification of the States recently in rebellion. In order to win the co-operation of the white people in the South in maintaining peace and order, he put himself in communication with their leaders. He then withdrew the Federal troops which since the Civil War had been stationed at the southern State capitals.

An end was thus made of the so-called " Carpet-bag governments " conducted by Republican politicians from the North, some of which were very corrupt, and had been upheld mainly by the Federal forces. This policy found

much favour with the people generally, but displeased many of the Republican politicians, because it loosened the hold of the Republican party upon the Southern States. Though it did not secure to the negroes sufficient protection in the exercise of their political rights it did much to extinguish the animosities still existing between the two sections of the Union, and to promote the material prosperity of the South. President Hayes endeavoured in vain to induce Congress to appropriate money for a CivU. Service Commission ; and whenever he made an effort to restrict the operation of the traditional " spoils system," he met the strenuous opposition of a majority of the most powerful politicians of his party. Nevertheless the system of competitive examinations for appointments was introduced in some of the great executive departments in Washington, and in the custom-house and the post-of&ce in New York. Moreover, he ordered that "no officer should be required or permitted to take part in the management of political organizations, caucuses, conventions, or election campaigns," and that "no assessment for

political purposes on officers or subordinates should be allowed " ; and he removed from their offices the heads of the post-office in St Louis and of the custom-house in New York — influential party managers — on the ground that they had misused their official positions for partisan ends. While these measures were of limited scope and effect, they served greatly to facilitate the more extensive reform of the civil service which subsequently took place. Although the resumption of specie payments had been provided for to begin at a given time by the Resumption Act of January 1876, opposition to it did not cease. A Bill went through both Houses of Congress providing that a silver dollar should be coined of the weight of 412|- grains, to be full legal tender for all debts and dues, public and private, except where otherwise expressly stipulated in the contract. President Hayes returned this Bill with his veto, but the veto was overruled in both Houses of Congress. Meanwhile, however, the prepara- tions for the return to specie payments were continued by the Administration with unflinching constancy, and

on 1st January 1879 specie payments were resumed without difficulty. None of the evils predicted appeared. A marked revival of business and a period of general prosperity ensued. In his annual message of 1st December 1879 President Hayes urged the suspension of the silver coinage and also the withdrawal of United States legal tender notes, but Congress failed to act upon the recommendation. His Administration also did much to ameliorate the condition of the Indian tribes and to arrest the spoliation of the public forest lands.

Although President Hayes was not popular with the professional politicians of his own party, and was exposed to bitter attacks on the part of the Democratic opposition

on account of the cloud ■which, hung over his election, his conduct of public affairs gave much satisfaction to the people generally. In the Presidential election of 1880 the Republican party carried the day after an unusually quiet canvass, a result largely due to popular contentment

with the then existing state of public affairs. On 4th March 1881 President Hayes retired to his home at Premont, Ohio. Various universities and colleges conferred honorary degrees upon him. His remaining years he devoted to active participation in philanthropic enterprises. He died after a short illness, 17th January 1893.

See Life, Public Services, and Select Speeches of Butherford B. Hayes, by James Gray Howard, Cincinnati, 1876. Life of R. B. Hayes, by William D. Howells, New York, 1876 ; and by Russell H. Conwell, Boston, 1876. (c. S.)

Hayti, or Santo Domingo, a West Indian island, comprising the two republics of Hayti and Santo Domingo, or the Dominican Eepiiblic. I. The Hayti Republic has an area of about 10,000 square miles, with a population of about 800,000. There are a President and two Chambers, the members of which hold ofilce according to a Constitution dating from 1889. The army numbers about 7000 men, nominally, and the republic owns six third-class cruisers. Owing to

the excessive customs duties, caused by the financial difficulties of the republic, coupled with the lack of capital and enterprise, trade has for some years been in a very depressed condition. At the end of 1899 the liabilities of the republic amounted to 19,076,733 dollars gold and 9,372,183 dollars paper (gourdes), as compared wifh a total (gold and paper) of 16,261,657 dollars in 1892. The amount of duties received from ex-ports in 1899 was 2,816,902 dollars gold, as compared with 3,442,114 dollars in 1896 ; the import duties in the same years amounting in Haytian currency to 2,618,869 dollars and 4,107,989 dollars respectively. Imports were valued at 6,232,335 dollars in 1895, and exports at 13,788,562 dollars. Though showing a decided tendency to decline in 1896, they were about the same in 1897. Owing to the fall of prices in Europe and America, small coffee planters find it almost impossible, with the heavy export duties, to earn a living by this industry, and are beginning instead to raise plantains, yams, bananas, &c. The other chief products are logwood, mahogany, honey,

wax, hides, and goatskins. Owing to the depression of trade, imports are confined to bare necessaries — the cheapest sort of dry goods and fancy goods, empty bags, lumber, matches, &o. Plour, salt pork, salt beef, codfish, lard, butter, and similar provisions continue to be im-ported, but in reduced quantities. Unable to purchase foreign rice, the natives now grow their own supplies. Considerable attention is devoted to the cultivation of tobacco, for which, as well as for sugar-cane, soil and climate are both admirably adapted. Indeed, the country is one of the most fertile in the world, and it is supposed to possess, in addition, valuable deposits of coal, copper, mercury, and other minerals. A railway from Cap-Haitien to La Grande Riviere (15 miles) was completed in 1900, and a concession has been granted for branch lines to Quanaminte (36 miles) and Limb^ (19 miles). In 1900 a further concession was granted for a line from Port-au-Prince to Salt Lake (50 miles). This railway is intended to connect ultimately the capitals of Hayti and the Dominican Republic. The depression in trade rather

increased in 1899, but in the spring of 1900 a proposal was brought forward for the consolidation of the debt, the creditors relinquishing the guarantee of a percentage of the revenue collected, and accepting a gold-bearing bond, augmented 10 per cent, in value, with interest at the rate of 1 per cent, in gold per month, and payable in fourteen years, the expectation being that the consequent great revival of trade on the conclusion of this arrangement would enable the Government within that period to meet amply their obligations. Still it is to be feared that the country can be saved from ultimate disaster only by the more direct intervention and guidance of the white man. The religion is nominally Roman Catholic, but the bulk of the black population are becoming more and more demoralized by secret addiction to pagan practices, including Vaudoux worship, the horrid rites of which imply human sacrifice. The chief towns are Port-au-Prince (61,000), Cap-Haitien (29,000), Les Cayes (25,000), Gonaives (18,000), and Port de Pain (10,000). They are practically stationary as regards all signs of improve-

ment. II. Santo Domingo, or the Dominican Repub-
lic, with an area of about 20,000 square miles, has a
population of about 500,000. Government is in the
hands of a JSTational Congress of 24 Deputies, a President
with executive power elected by an electoral college, and
an administrative Ministry appointed by the President.
Por several years this part of the island has been
in a very perturbed political condition, and this cul-
minated in July 1899 in the assassination of President
Heureaux. The incoming Government found it neces-
sary to demonetize the paper currency, and the incon-
venience caused by this measure to the foreign merchants
in the country, who are the chief holders of the paper,
was but slightly remedied (October 1900) by certain
temporary expedients. The revenue in 1898 amounted
to 1,550,294 dollars gold. The foreign debt is about
£4,350,000, exclusive of arrears of interest, and the
internal about 2,850,000 dollars gold and 10,125,000'
dollars silver. There is a small army, and the republic
owns three small gunboats. The total value of the imports

in 1897 was 1,702,568 dollars gold, and of the exports 4,675,939 dollars ; and in 1899 the values were 1,669,994 dollars and 4,166,617 dollars. The sugar-cane is being-more and more cultivated, there being now eighteen large plantations. Tobacco, coffee, bananas, and cocoa are the other chief products. Large quantities of mahogany, cedar, and satinwood are also exported ; and other exports are honey, wax, gums, hides, lignum vitse, and logwood. There are deposits of iron, gold, copper, salt, and other minerals, but no attempt has been made to exploit them. In 1899 162 vessels of 167,106 tons entered the port of Puerto Plata. Internal communication is mostly of a primitive kind, and there is a lack of good roads. The capital is Santo Domingo, with a population of about 25,000. A railway extends from Sanchez, on the bay of Samana, to La Vega (62 miles), and further extensions-are in progress or projected.

See Where Black Sules Wliite, by Hesketh Pkichaed. London, 1900.

Hayward, Abraham (1801-1884), English man

of letters, son of Joseph Hayward, of an old Wiltshire family, was born at Wilton, near Salisbury, on 22nd November 1801. After education at Blundell's School,. Tiverton, he entered the Inner Temple in 1824, and was-called to the bar in June 1832. He took part as a Conservative in the discussions of the London Debating-Society, where his opponents were' Roebuck and John Stuart Mill. The editorship of the iaw Magazine; or. Quarterly Review of Jurisprudence, which he held from 1829 to 1844, brought him into connexion with John Austin, G. Cornewall Lewis, and such foreign jurists as Savigny, whose tractate on contemporary legislation and jurisprudence he rendered into English. In 1833 he travelled abroad, and on his return printed privately a

translation of Goethe's Faust into English prose (pronounced by Carlyle to be the best version extant in his time). A second and revised edition was published after another visit to Germany in January 1834, in the course

of which Hayward met Tieck, Chamisso, De La Motte Fouque, Varnhagen von Ense, and Madame Goethe. In 1878 he contributed the rather colourless volume on Goethe to Blackwood's Foreign Classics. A successful translation was in those days a first-rate credential for a reviewer, and Hayward began contributing to the New Monthly, the Foreign Quarterly, the Quarterly Review, and the Ediri-burgh Review. His first successes in this new field were won in 1835-36 by articles on Walker's " Original " and on " Gastronomy." The essays were reprinted to form one of his best volumes. The Art of Dining, in 1852. In February 1835 he was elected to the Athenaeum Club under Rule II., and he remained for nearly fifty years one of its most conspicuous and most influential members. He was also a subscriber to the Carlton, but ceased to frequent it when he became a Peelite. At the Temple, Hayward, whose reputation was rapidly growing as a connoisseur not only of a bill of fare but also (as Swift would have said) of a bill of company, gave recherchi dinners, at which ladies of high rank and elegance appre-

ciated the wit of Sydney Smith and Theodore Hook, the dignity of Lockhart and Lyndhurst, and the oratory of Macaulay. At the Athenaeum and in political society he to some extent succeeded to the position of Croker. He and Macaulay were commonly said to be the two best-read men in town. Hayward got up every important subjectof discussion immediately it came into prominence, and concentrated his information in such a way that he habitually had the last word to say on a topic. When Rogers died, or when Vanity Fair was published, when the Greville Memoirs was issued, or a revolution occurred on the Continent, Hayward, whose memory was as retentive as his power of accumulating documentary evidence was exhaustive, wrote an elaborate essay on the subject for the Quarterly or the Edinburgh. He followed up his paper by giving his acquaintances no rest until they either assimilated or undertook to combat his views. Political ladies first, and statesmen afterwards, came to recognize the advantage of obtaining Hay ward's good opinion. In this way the " old reviewing hand " became an acknow-

ledged link between Society, letters, and politics. As a professional man he was less successful ; his promotion to be Q.C. in 1845 excited a storm of opposition, and, disgusted at not being elected a Bencher of his Inn in the usual course, Hayward virtually withdrew from legal practice. In February 1848 he became one of the chief leader-writers for the Peelite organ, the Morning Chronicle. The morbid activity of his memory, however, continued to make him many enemies. He alienated Disraeli by tracing a purple patch in his official eulogy of Wellington to a newspaper translation from Thiers's funeral panegyric on General St Cyr. His sharp tongue made an enemy of Roebuck, and he disgusted the friends of Mill by the stories he raked up for an obituary notice of the great economist {The Times, 10th May 1873). He broke with Henry Reeve in 1874 by a venomous review of the Greville Memoirs, in which Reeve was compared to the beggarly Scot deputed to let off the blunderbuss which Bolingbroke (Greville) had charged. His enemies pre-vented him from enjoying a well-selected gMasi-sinecure,

which both Palmerston and Aberdeen admitted to be his due. Warren attacked him (very unjustly, for Hayward was anything but a parasite) as Venom Tuft in Ten Tliousand a Year; and Disraeli aimed at him partially in Ste Barbe (in Endymion), though the satire here was directed primarily against Thackeray. After his break with Reeve, Hayward devoted himself more exclusively to the Quarterly. His essays on Chesterfield and Selwyn were reprinted in 1854. Collective editions of his articles appeared in volume form in 1858, 1873, and 1874, and Selected Essays in two volumes, 1878 In his useful but far from flawless edition of the Autobiography, Letters, and Litera')~y Remains of Mrs (Thrale) Piozzi (1861), he again appears as a supplementer and continuator of J. W. Crgker. His Eminent Statesmen and Writers (1880) commemorates to a large extent personal friendships with such men as Dumas, Cavour, and Thiers, whom he knew intimately. As a counsellor of great ladies and of politicians, to whom he held forth with a sense of all-round responsibility surpassing that of a cabinet minister, Hayward retained

his influence to the last years of his life. But he had little sympathy with modern ideas. He used to say that he had outlived every one that he could really look up to. He died, a bachelor, in his rooms at 8 St James's Street (a small museum of autograph portraits and reviewing trophies) on 2nd February 1884.

Two volumes of Hayward's Correspondence (edited by H. E. Carlisle) were published in 1886. In Vanity Fair (27th November 1875) he may be seen as he appeared in later life. (xi se.)

H^lTAX^^ a district of British India, in the Peshawar division of the Punjab, with an area of 2991 square mUes. The population in 1881 was 407,075, and in 1891 was 516,288, giving an average density of 173 persons per square mile; in 1901 it was 710,668, showing an increase of 38 per cent. The land revenue and rates were Rs.2,90,495, the incidence of assessment being R.O— 4^ per acre; the cultivated area in 1896-97 was 419,540 acres, of which 55,674 were irrigated, mainly from private canals ; the number of police was 487 ; the number of schools in 1896-97 was 458, with 8086 pupils, the pro-

portion of boys at school to the male population of school-going age being 7-8 per cent. ; the registered death-rate in 1897 was 23-30 per 1000. There are no railways, navigable rivers, or government canals in the district, and only 44 miles of metalled roads. There is one printing-press.

Hazaribagh, a town and district of British India, in the Chota Nagpur division of Bengal. Population (1881), 15,306; (1891), 16,672. There are a government high school, with 175 pupils in 1896-97, a central jail, with a daily average of 932 convicts, and a reformatory school, with 342 boys. It has ceased to be a military cantonment since the European penitentiary was abolished. Dublin University Mission maintains an English high school, with 139 boys. The District comprises an area of 7021 square miles, with a population in 1881 of 1,104,742, and in 1891 of 1,164,315, giving an average density of 166 persons per square mile. Classified according to religion, Hindus numbered 960,187; Mahommedans, 114,773; aborigines, 87,866;

Christians, 889, of whom 223 were Europeans; Jains, 600. In 1901 the population was 1,178,301, showing an increase of 1 per cent. The land revenue and rates were Rs.1,76,877 ; the number of police was 493 ; boys at school in 1896-97 numbered 14,252, being 16-7 per cent, of the male population of school-going age ; the registered death-rate in 1897 was 48-12 per 1000, this great mortality being due to drouth and high prices of grain. The dis-trict contains an important coalfield at Karharbari, which supplies the East Indian railway. There" are altogether six mines, employing 10,000 persons, with an out-turn of about 660,000 tons a year. There are also ten mica mines, which are gaining in importance, with an annual out-turn of 10,000 mauuds, valued at Es.l, 74,000. Tea cultivation does not flourish. For 1897 four gardens

furnished returns, T,ritli 611 acres under tea, producing 36,200 lb . The only railway is the branch of the East Indian to the coalfield at Giridhi, where there is a technical school maintained by the railway company ; but the district is traversed by the Grand Trunk road.

Hazleton, a city of Luzerne county, Pennsylvania, U.S.A., in 40° 57′ N. and 76° 58′ W., on Hazle Creek and on the Lehigh Valley railway. It is in a level valley, and its plan is regular. It is situated within the anthracite coal district, and its industries are largely connected with coal-mining. Population (1880), 6935; (1890), 11,872; (1900), 14,230, of whom 2732 were foreign-born.

Heanor, a parish and village in the Ilkeston division of Derbyshire, England, 10 miles north-west of Nottingham, with a station, opened in 1890, on the Midland railway. The church is an ancient edifice, in great part rebuilt, and there are several other places of worship. A technical school is installed in Heanor Hall. Large hosiery works employ over 1000 persons, and collieries are worked in the parish. Population of the

urban district, which includes Codnor-cum-Loseoe (1901), 16,249.

Heat. See separate articles Calokimetry, Conduction, &c.

Hebburn, a town and railway station in the Jarrow parliamentary division of county Durham, England, on the Tyne, 4 miles east-north-east of Gateshead. The churches are — three Established, Eoman Catholic, Presbyterian, and Methodist (various). There are also a mechanics' institute, a drill-hall, and a theatre. It has extensive shipbuilding and engineering works, rope and sail factories, and chemical, colour, and cement works. Area of urban district, 1180 acres. Population (1881), 11,802 ; (1901), 20,901.

Hebden Bridge, a town and railway station in the Sowerby parliamentary division of Yorkshire, England, on the Calder and Hebden, 7 miles west by north of Halifax. There is a parish church, and two Wesleyan and three Baptist chapels. The town has cotton factories, dye-works, foundrieSj and manufactories of shut-

tles. There is fine scenery in the neighbourhood. Area of urban district (a civil parish), 478 acres; population (1881), 5007 ; (1901), 7536.

Hebrides, The, or Western Isles, a large group of islands off the west coast of Scotland, between 56° 35' and 58° 30' N. and 6° 40' and 8° 40' W. They consist of two chief groups, the Outer Hebrides — comprising, amongst others, Lewis, Harris, North and South Uist, Benbecula, Barra — and the Inner Hebrides, which are more scattered, and the principal of which are Skye, Kum, Eigg, Canna, Coll, Tiree, Mull, lona, Colonsay, Jura, and Islay. The former group is attached to the counties of Eoss and Inverness, the latter to the shires of Inverness and Argyll. Lewis and Harris, Skye, and North and South Uist are noticed under separate headings.

Hebron, now el-Khalil, some 20 miles S. by S.W. of Jerusalem, in 31° 32' N. and 35° 6' E., with an altitude of 3040 feet. There are a British medical mission, a German Protestant mission with church and schools, and, near Abraham's Oak, a Russian mission. Since 1880

several notices of the Haram, within which are the tombs of the Patriarchs, have appeared.

See CoNDER. Pal. Exp. Fund, Memoirs, iii. 83.S, &o. — Cte. Riant. Archives de V Orient Latin, li. 411, &c. — Dalton and Chaplin. P. E. F. Quarterly Statement, 1897. — Goldziehek. "Das Patriarchengrab in Hebron," in Zeitschrift d. Dn. Fal-Vereins, xvii.

Hefele, Karl Josef von (1809-1893), German theo-logian, was born in Wilrtemberg on 15th March 1809. In 1839, after his ordination to the priesthood, he became professor of the Catholic Faculty of Theology at Tubingen. In 1842 he became a member of the National Assembly of Wlirt«mberg. In 1869 he was made bishop of Eotten-burg. His literary activity, which had been considerable, was in no way diminished by his elevation to the episco-pate. Among his numerous theological works may be mentioned his well-known edition of the Apostolic Fathers, issued in 1839 ; his Life of Cardinal Ximenes, published in 1844 ; and his still more celebrated History of the Gouncils of the Church, in seven volumes, which appeared between

1865 and 1874. His theological opinions inclined towards the more liberal school in the Eoman Catholic Church, but he nevertheless received considerable signs of favour from its authorities. He was made one of the special advisers of the Pope. When the Vatican Council of 1870 was about to assemble he published at Naples his Causa Honorii Papae, which aimed at demonstrating the moral and historical impossibility of Papal infallibility. About the same time he brought out a work in German on the same subject. He took rather a prominent part in the discussions at the council, associating himself with Dupan-loup and Darboy in his opposition to the doctrine of In-fallibility, and supporting their arguments from his large stores of knowledge of ecclesiastical history. In the pre-liminary discussions he voted against the promulgation of the dogma. He was absent from the important sitting on 18th June 1870, and did not send in his submission to the decrees until 1871. But in 1872 he took part in the congress summoned by the Ultramontanes at Eulda, and by his judicious use of minimizing tactics he kept his

diocese free from any participation in the Old Catholic schism. The last four volumes of the second edition of his History of the Councils have been described as skilfully adapted to the new situation created by the Vatican decrees. During the later years of his life he undertook no further literary efforts on behalf of his Church, but retired into comparative privacy. He died on 6th June 1893. (j. J. L.)*

Heidelberg, a town of Germany, grand-duchy of Baden, on the river Neckar, 13 miles by rail south-east of Mannheim. The town has continued to grow towards the south-west, a new villa quarter having been built there, partly on the slopes of the Geisberg, partly in the plain at its foot. At the same end of the town the "new" bridge (1877) connects the Bismarck Square or Gardens with Neuenheim on the opposite bank of the Neckar, but now really an integral part of Heidelberg. A little lower down, and on the Heidelberg side of the river, are the botanical gardens of the university. A wire-rope railway runs from the Corn Market up to the level of the castle,

and is continued thence to the Molkenkur (348 feet above the castle), a favourite point of view for seeing the beauties of the neighbourhood. In 1894 a double observatory was founded on the Geisberg, above the castle hill, and on the " great terrace " of the castle a monument to Viktor von Scheffel, unveiled in 1891, testifies the town's gratitude to the poet's praise of her. The university was frequented by 1653 students in 1900, and had 149 professors. Its library numbers 400,000 volumes and 4500 MSS. The university buildings were restored in part in 1886. Its institutions embrace a children's hospital, zoological and mineralogical museums, and a botanical garden, all connected with the university ; also a technical school and Dr Schweninger's sanatorium. Population (1885), 29,364; (1900), 40,119.

Heidenheim, a town of Wurtemberg, in Germany, 31 miles by rail north by east of Ulm. It is the seat of cotton and woollen, tobapco, machinery, and chemical

factories, bleaching-grounds, dyeworks, and breweries, and corn and cattle markets. It is overlooked by the ruins of the castle of Hellenstein. Population (1885), 6709; (1901), 10,439.

Heilbronn, a town of Wurtemberg, Germany, 33 miles by rail north of Stuttgart, and on the river Neckar. The church of St Kilian's was thoroughly restored in 1886-95. The town possesses a historical museum, a fine synagogue, and monuments to the emperors William I. and Frederick III. and to Schiller, as well asi to Robert Mayer (1814-78), a native of the town, whose name is associated with the discovery of the mechanical theory of heat. Population (1885), 27,758; (1901), 37,883.

Helder, or Den Hbldbk, a town in the province of North Holland, Netherlands, 40 miles north by west of Amsterdam, on the Marsdiep, the old sea road to Amsterdam. Before the construction of the North Sea Canal its harbour, the Nieuwe Diep, and the North Holland Canal served as an outer port to Amsterdam. It is now a fortified maritime station of the first class, with numerous

batteries and forts, an arsenal, docks, and a state wharf. The garrison and marine establishments sustain the industries of the town, which has a zoological station. Population (1900), 25,159.

Helena, capital of Phillips county, Arkansas, U.S.A., on the west bahk of the Mississippi, at an altitude of 193 feet. It is on the Arkansas Midland, the St Louis, Iron Mountain and Southern, and the Yazoo and Mississippi Valley railways. Situated in the alluvial region of the lower Mississippi, the richest cotton-producing region on earth, it is an important compressing and shipping point for cotton. It contains also cotton-seed oil and lumber mUls. Population (1880), 3652 ; (1900), 5550, of whom 265 were foreign-born and 3400 were negroes.

Helena, capital of Lewis and Clark county and of the state, Montana, U.S.A., in 46° 37′ N. and 112° 03′ W., at the eastern base of the Rocky Mountains, at an altitude of 4009 feet. It was founded as a mining camp in 1864, in Little Prickly Pear Gulch, but has now spread down the narrow gulch and over the broad

valley below. Most of its site is level, but its plan is irregular. It is entered by the Northern Pacific and the Great Northern railways, with several branches connecting it with neighbouring mining districts. It is said to be the wealthiest city in the United States in proportion to its population, and it is the financial centre of Montana, as Butte is the mining centre. It is the seat of the Montana Wesleyan University, a Methodist Episcopal institution, founded in 1890, which in 1899 had 15 instructors and 77 students. Population (1880), 3624; (1890), 13,834; (1900), 10,770, of whom 2793 were foreign-born and 228 were negroes.

Helensburgh, a burgh of barony and police burgh of Dumbartonshire, Scotland, on the north shore of the Firth of Clyde, opposite Greenock, 23 miles west-north-west of Glasgow by rail. Most of the inhabitants are Glasgow business men. Numerous villas have sprung up ; Eoman Catholic, Congregational, and Baptist chap-els, and Victoria Halls have been erected. There are also a fever hospital and a monument to Henry Bell,

the pioneer of steam navigation, who died here. Population (1881), 7693 ; (1901), 8654.

Heller, Stephen (1815-1888), Austrian pianist and composer, was born at Pesth, 15th May 1815. (Fetis's dictionary says 1814, but this is almost certainly wrong.) He was at first intended for a lawyer, but at nine years of age performed so successfully at a concert that he was sent to Vienna to study under Czerny. Halm was his principal master, and from the age of twelve he gave concerts in Vienna, and made a tour through Hungary, Poland, and Germany. At Augsburg he had the good fortune to fall ill and to be befriended by a wealthy family, who practically adopted him and gave him the opportunity to complete his musical education. In 1838 he went to Paris, and soon became intimate with Liszt, Chopin, Berlioz, and the set of romantics, among whom was Halle, throughout his life an indefatigable performer of Heller's music. In 1849 he came to England and played a few times, and in 1862 he appeared with Hall^ at the Crystal Palace. He outlived the great reputation he had

enjoyed among cultivated amateurs for so many years, and was almost forgotten when he died at Paris on 14tli January 1888. His pianoforte pieces, almost all of them published in sets and provided with fancy names, do not perhaps show very startling originality, but their grace and refinement could not but make them popular with players and listeners of all classes. He was by far the best of the composers who wrote nothing but what is called " drawing-room " music. (j. a. f. m.)

Heligoland, in German Helgoland, one of the Frisian Islands, belonging to Prussia, to which it was ceded by Great Britain in 1890, situated in the. North Sea^ 28 miles north-west from the mouth of the Elbe, in 64° 10' N. and 7° 53' E. Since its cession by Great Britain (see Germany : History) the island has been strongly fortified, the old English batteries having given place to armoured turrets mounting guns of the heaviest calibre. It has thus become an important strategical base for the German navy. Inside the Dllneninsel the largest ships can ride safely at anchor and take in coal

and other supplies. In 1892 a biological institute, with a marine museum and aquarium (1900) attached, was opened. It now claims to be the most fashionable watering-place in Germany, and during the season — ‘ June to October — it is largely resorted to by visitors from Hamburg and other German towns for sea-bathing. In 1899, 854 vessels of 161,723 tons cleared the island. Since 1891 it has been attached to the province of Schleswig-Holstein. Population (1900), 2307.

Helmholtz, Hermann Ludwig Ferdinand von (1821-1894), German philosopher and man of science, was born on 31st August 1821 at Potsdam, near Berlin. His father, Ferdinand, was a teacher of philology and philosophy in the Gymnasium, while his mother was a Hanoverian lady, a lineal descendant of the great Quaker William Penn. Delicate in early life, Helm-holtz became by habit a student, and his father at the same time directed his thoughts to natural phenomena. He soon showed mathematical powers, but these were not fostered by the careful training mathematicians usually

receive, and it may be said that in after years his attention was directed to the higher mathematics mainly by force of circumstances. As his parents were poor, and could not afford to allow him to follow a purely scientific career, he became a surgeon of the Prussian army. In 1842 he wrote a thesis in which he announced the discovery of nerve-cells in ganglia. This was his first work, and from 1842 to 1894, the year of his death, scarcely a year passed without several important, and in some cases epoch-making, papers on scientific subjects coming from his pen. He lived in Berlin from 1842 to 1849, when he became professor of physiology in Konigsberg. There he remained from 1849 to 1865, when he removed to the chair of physiology in Bonn. In 1858 he became professor of

physiology in Heidelberg, and in 1871 he was called to occupy the chair of physics in Berlin. To this professorship was added in 1887 the post of director of the physio-technical institute at Charlottenburg, near Berlin,

and he held the two positions together until his death on the 8th of September 1894.

His investigations occupied almost the whole field of science, including physiology, physiological optics, physiological acoustics, chemistry, mathematics, electricity and magnetism, meteorology, and theoretical mechanics. At an early age he contributed to our knowledge of the causes of putrefaction and fermentation. In physiological science he investigated quantitatively the phenomena of animal heat, and he was one of the earliest in the field of animal electricity. He studied the nature of muscular contraction, causing a muscle to record its movements on a smoked glass plate, and he worked out the problem of the velocity of the nervous impulse both in the motor nerves of the frog and in the sensory nerves of man. In 1847 Helmholtz read to the Physical Society of Berlin a famous paper, Ueber die Erhaltung der Kraft (on the conservation of force), which became one of the epoch-making papers of the century ; indeed, along with Mayer, Joule, and Thomson (Lord Kelvin), he may be regarded as one

of the foimders of the now universally received law of the Conservation of Energy. The year 1851, while he was lecturing on physiology at Konigsberg, saw the brilliant invention of the ophthalmoscope, an instrument which has been of inestimable vakie to medicine. It arose from an attempt to demonstrate to his class the nature of the glow of reflected light sometimes seen in the eyes of animals such as the cat. When the great ophthalmologist, von G-raefe, first saw the fundus of the living human eye, with its optic disc and blood-vessels, his face flushed with excitement, and he cried, " Helmholtz has unfolded to us a new world ! " Helmholtz's contributions to physiological optics are of great importance. He investigated the optical constants of the eye, measured by his invention, the ophthalmometer, the radii of curvature of the crystalline lens for near and far vision, explained the mechanism of accommodation by which the eye can focus within certain limits, discussed the phenomena of colour vision, and gave a luminous account of the movements of the eyeballs so as to secure single vision with

two eyes. In particular he revived and gave new force to the theory of colour-vision associated with the name of Thomas Young, showing the three primary colours to be red, green, and violet, and he applied the theory to the explanation of colour-blindness. His great work on Physiological Optics (1856-66) is by far the most important book that has appeared on the physiology and physics of vision. Equally distinguished were his labours in physiological acoustics. He explained accurately the mechanism of the bones of the ear, and he discussed the physiological action of the cochlea on the principles of synipathetic vibration. Perhaps his greatest contribution, however, was his attempt to account for our perception of quality of tone. He showed, both by analysis and by synthesis, that quality depends on the order, number, and intensity of the over-tones or harmonics that may, and usually do, enter into the structure of a musical tone. He also developed the theory of differential and of summar tional tones. His work on Sensations of Tone (1862) may well be termed the principia of physiological acoustics.

He may also be said to be the founder of the fixed-pitch theory of vowel tones, according to which it is asserted that the pitch of a vowel depends on the resonance of the mouth, according to the form of the cavity while singing it, and this independently of the pitch of the note on which the vowel is sung. For the later years of his life his labours may be siimmed up under the following heads : (1) On the conservation of energy ; (2) on hydro-dynamics ; (3) on electro-dynamics and theories of elec-tricity; (4) on meteorological physics; (5) on optics; and (6) on the abstract principles of dynamics. In all these fields of labour he made important contributions to science, and showed himself to be equally great as a mathematician and physicist. He studied the pheno-mena of electrical oscillations from 1869 to 1871, and in the latter year he announced that the velocity of the propagation of electromagnetic induction was about 314,000 metres per second. Faraday had shown that the passage of electrical action involved time, and he also asserted that electrical phenomena are brought about

by changes in intervening non-conductors or dielectric substances. This led Clerk Maxwell to frame his theory of electro-dynamics, in which electrical impulses were assumed to be transmitted through the ether by waves. Fitzgerald was the first to attempt to measure the length of electric waves ; Helmholtz put the problem into the hands of his favourite pupil, Heinrich Hertz, and the latter finally gave an experimental demonstration of electromagnetic waves, the " Hertzian waves," on which the invention of wireless telegraphy depends, and the velocity of which is the same as that of light. The last investigations of Helmholtz related to problems in theoretical mechanics, more especially as to the relations of matter to the ether, and as to the distribution of energy in mechanical systems. In particular he explained the principle of least action, first advanced by Maupertuis, and developed by Hamilton, of quaternion fame. Helmholtz also wrote on philosophical and aesthetic problems. His position was that of an empiricist, denying the doctrine of innate ideas and holding that all know-

ledge is founded on experience, hereditarily transmitted or acquired.

The life of Helmholtz was uneventful in the usual sense. He was twice married, first, in 1849, to Olga von Velten (by whom he had two children, a son and daughter), and secondly, in 1861, to Anna von Mohl, of a Wtirtemberg family of high social position. Two children wete born of this marriage, — a son, Robert, who died in 1889, after showing in experimental physics indications of his father's genius, and a daughter, who married a son of Werner von Siemens. Helmholtz was a man of simple but refined tastes, of noble carriage, and somewhat austere manner. His life from first to last was one of devotion to science, and he must be accounted, on intellectual grounds, one of the foremost men of the 19th century. (j. g. m.)

Helmond, town of the province of North Brabant, Netherlands, on the canal between Bois-le-Duc and Maas-tricht (ZuidrWillems vaart), and on the railway from Boxtel to Venlo, 21 miles south-east of Bois-le-Duc. It is one of the industrial centres of the province, and has

twenty-two factories, employing 3000 workpeople in weaving, dyeing, and printing cotton, engine works, a margarine manufactory, &c. There is an art school. Population with suburbs (1900), 11,436.

Helmstedt, a town of Germany, duchy of Brunswick, 30 miles west by north of Magdeburg by rail. The Walpurgis church was restored in 1893-94. There is a new classical school (1880-82). The agricultural school is quartered in the Marienberg nunnery (1176). Coal is mined in the vicinity. Population (1885), 9794 : (1900), 14,259.

Helsingborg, a growing seaport town of Sweden, on the east side of the Sound, opposite to Elsinore (Helsingor) in Denmark, 56 miles by rail west-north-west of Malmo. The harbour, which is of artificial construction, was deepened in 1888-89, and subsequently enlarged to

2200 feet by 450 feet, with 24 feet depth. The export of agricultural produce has steadily declined since 1888, but

other exports have increased. The chief exports are timber (nearly 2 million cubic feet), butter, andiron. In 1900, 4620 vessels of 756,300 tons cleared, as compared with 3749 vessels of 228,600 tons in 1886. The merchant fleet numbers 110 vessels of nearly 51,000 tons. There are several handsome new buildings, chief amongst them being the town hall (1894-96) and the church of Gustavus Adolphus (1897). Population (1880), 11,550: (1900), 24,670.

Helsingfors (Finnish, Helsinki), a seaport and the capital of Finland and of the government of Nyland, centre of the administrative, scientific, and industrial life of Finland. The fine harbour is divided into two parts by a promontory, and is protected at its entrance by a group of small islands, on one of which stands the fortress of Sveaborg. A third harbour is situated on the west side of the promontory, and all three have granite quays. Near the southern harbour is the market square, upon which stands the imperial palace. The finest street, the Esplanade, leads from it, and has a monument to Rune-

berg, two theatres (Swedish and Finnish), an athenaeum (drawing and professional school), and other important buildings. There are also two excellent parks, many museums of natural sciences, antiquities, and art, several large libraries, and a " people's palace," founded by Miss Ally Trugg. Some of its scientific societies have a wide repute, such as the academy of sciences, the geographical, historical, Finno-Ugrian, biblical, medical,' law, arts, and forestry societies, as also societies for spreading popular education, of arts and crafts, for the study of the flora and fauna, and so on. Five daily papers and a great number of other periodicals are published, in addition to admirable works of the geological survey, the land survey, the administration of roads and water communication, forestry, and other departments of government. The population, which was 32,113 in 1870, has rapidly grown since the construction of railways, and in 1899 was, with Sveaborg, 73,820. Nearly 55 per cent, speak Swedish and 36 Finnish, the remainder being Russians and Germans. The aggregate yearly production

of all manufactories is about £1,000,000. The trade is important, Helsingfors being the chief port of Finland for imports (customs duties, £248,020), the total returns of foreign and coasting trade reaching about £2,000,000. It is visited every year by 760 vessels, 253,000 tons. It is connected by rail with St Petersburg (263 miles, vid the Rihimaki junction) and Hango (138 miles, at the entrance into the Gulf of Finland), as also with all the chief towns of Finland as far north as Uleiborg, Kuopio, and loensuu.

Helvoetsluys (Dutch, Hellevoetsluis) , town, Nether-lands, province of South Holland, 17 miles W.S.W. of Rotterdam. Formerly an outer port to Rotterdam, it is since the construction of the new waterway from Rotter-dam to the sea, only a fortified marine station and port. Population (1900), 4293.

Hemichorda. — This zoological term was intro-duced by Bateson in 1884, without special definition, as equivalent to Enteropneusta, which then included the single genus Balanoglossus. It has since been extended

so as to embrace some other forms, the anatomy of which was at that time imperfectly known. The special attention which has of fate years been devoted to these animals is due to the fact that they are generally considered to lie near the base of the Vertebrata, and may eventually throw some light on the origin of that great stem from invertebrate ancestors. The relations of the Hemichorda and allied groups may be represented by the following table : —

I. Hemichokda. Bateson.

1. Vermiformia, Lankester

2. Pterobranchia, Lankester .

3. Enteropneusta, Gegenbaur .

n. Peotochorda, Balfour.

1. Urochorda, Lankester .

Phoronis.

f Cephalodisous.

\ Ehabdopleura.

f Balanoglossus

\ and others.

f Ascidlans or

\ Tunicata.

f Amphioxus

\ and others.

III. Vektebeata zz Craniata, Euchorda, Holochorda, &o.

2. Cephalochorda, Lankester

The external features of Phoronis and of its larva were

described and figured in Ency. Brit., vol. xix. pp. 433,

434. Internally the body cavity is divided by a septum

into an anterior lophophoral ("collar") cavity and a

posterior ("trunk") cavity. The alimentary canal is

U-shaped, bent dorsally, and supported in the trunk

Fig, 1. — Anterior end of Phoronis austraMs, the tentacles cut off

short at their origins, a, anus ; D, dorsal surface ; ^, epistome ;

gl, supposed glandular pit ; i,i., bases of inner series of tentacles ;

971, mouth; n.o., nephridial opening; o.i., bases of outer series of

tentacles ; V, ventral surface. {After Senham.)

cavity by mesenteries ; the chambers between these latter

are not completely separated from one another. The

blood system is complex. There is a pair of typical

nephridia, each with two funnels, which open on opposite sides of a mesentery ; they appear to serve also as genital ducts. The nervous system lies immediately below the ectoderm ; there is a nerve band along the spiral lophophore, with nerves to the tentacles and elsewhere ; a slight concentration of nerve-cells between mouth and anus may represent an indefinite central ganglion (Figs. 1, 2). Two ectodermal pits, containing specialized cells, lying dorsally to the inner series of tentacles, have been variously interpreted as glands and as sense-organs. Segmentation is holoblastic and sub-equal; the blastula undergoes an embolic gastrulation. According to Masterman, the blastopore persists as the mouth. The larva is known as ActinotrocJia. Its body cavity is divided into three sections : a protoccele (head or proboscis cavity), which is formed as a two-horned archenteric diverticulum, similar to those of Amphioxus and of the directly developing Balanoglossus ; a mesocoele (collar cavity), arising as a pair of at first solid masses of cells, probably by proliferation of endoderm cells outwardly ; and a metacoele

(trunk cavity), formed as a pair of endodermal outgrowths, which may possibly have been originally archenteric diverticula. The anatomy of the larva is represented in Figs. 3, 4, and will be further discussed later. In metamorphosis

the prse-oral lobe (proboscis or hood) is apparently absorbed or swallowed, carrying with it the central nervous system ; the adult thus has no protocoele. According to Ikeda, the mesocoBle of the larva becomes a vascular space; that of the adult is a new formation.

The external characters of Cephalodiscus a;nd Rhahdopleura, with figures, will be found in Ency. Brit., vol.

Fig. 2. — Diagram of the anterior and posterior ends of Plioronia, the left half of the body-wall cut away : in the upper half, the left lateral mensentery cut away, but the left nephridium untouched ; in the lower half all mesenteries omitted, a, cesophageal mesentery ; a

right lateral mesentery; a", rectal mesentery; <(f, afferent vessel ; an, anus ; D, dorsal side ; d.v., right vessel supplying tentacles ; e/, efferent vessel ; ep, epistome; gl, "glandular" pit ; iwi., intestine ; i.i., bases of inner whorl of tentacles ; m, mouth ; N, nerve-band ; ne. d., nephridial duct ; ne./.y large nephrldial funnel, opening into rectal chamber ; the smaller funnel, which opens into the cesophageal chamber, is to the left of the top of the larger ; ne. 0., nephridial opening to the exterior; o, ovary; (b, oesophagus; o.i., bases of outer whorl of tentacles ; p, posterior pit ; B, rectum ; r.v., right vessel receiving blood from tentacles ; s, septum between mesoccecle and metacoecle ; si, stomach ; T, testis ; V, ventral side. (Modified from drawings lyy Benhatn.)

xix. pp. 434-436. In addition to, or in correction of, the information there given, the following points should be noted: — The pree-oral lobe or buccal shield of Cephalodiscus corresponds, not to the little epistome of PJioronis, but to the prse-oral lobe of Actino-

troclia. Protocoele, mesocoele, and metaccele are well marked. The protocoele opens by two pores to the exterior, through the front part of that concentration of nerve matter which appears to represent a cerebral ganglion or brain ; the mesocosle, which is continued into the lophophore and tentacles, opens also by two "collar pores." The alimentary canal is U-shaped, flexed dorsally; it has a pair of gill slits, and gives off an anterior caecum (notochord, stomochord) . A pair of ovaries, formerly regarded as eyes, lie in the metaccele, and open by oviducts to the exterior; the male organs have not been seen. A stalk or stolon, on the ventral side of the body posteriorly, contains a portion of the metaccele

divided into two by a mesen-

tery, a ventral nerve, and spaces

interpreted by Masterman as

blood sinus ; from this pedicle

are developed the buds, of which

the whole alimentary canal is

formed by an invagination of

ectoderm at the site of the

mouth. The buds become

detached from the stolon,

and free in the coenoecium

(Figs. 6, 6).

Bhabdopleura has been shown

to possess protocoele, meso-

coele with collar pores (the

" ciliated patches " of the

earlier article), and metaccele ;

a stomochord, and nerve gan-

glion, all as in Cephalodiscus.

Proboscis pore and gill slits have not been detected,

possibly owing only to the minuteness of the animal. There is a stolon of similar structure and position to that of Cephalodiscus, but each individual budded from this remains permanently attached at the end of his branch of the adherent ramifying stolon, which unites all the individuals into a true colony. Nothing is known of the embryology of Rhabdopleura,

■~dfdv. ^^‘i practically

nothing of that of

Cephalodiscus.

The Entero-

pneusta are de-

scribed in a

separate article,

BaLAXOCtLOSSUS.

The reader can only estimate the homological value of

the various internal structures of forms, at first sight so

Fig. 3. — Lateral view of a late

Actinoiroclia larva of Plioro-

tUs. {After Maste-rman.)

■plch.

o^s-

do.?-.

vdv

Fio. 4.— Anterior part of a dorso-ventral section

of Jcihwtrocha (not exactly median) : dc\

protocQBle; rfc*, mesoccele ; rfc”, metacrele;

dbv, dorsal blood-vessel; ft.gr., nerve ganglion;

OSS., fflsophagus; ploh, pleurochord of one side;

«, septum between mesocoele and metac(Ble;

sich, stomochord ; 'vbv, ventral blood-vessel,

{Modified from a drawing bi/ ^fasten7la■n.)

distinct from one another, after a careful study of the memoirs cited below ; the most that can be done here is to point out the more salient features which have led to the association of those animals as Hemichorda.

Tlie Notochord. — This structure, which occurs in the embryos of all Vertebrata, and persists in many of them throughout life, has always been recognized as one of their chief morphological characters. It is not disputed that this is homologous with the notochord of AmpMoxus, and only a few authorities refuse to admit some relationship between the latter and the "notochord" of Enteropneusta, for which Willey's term " stomochord " will here be used. The stomochord is a forward dorsal diverticu-

lum of the gut in the collar region, which pushes before

it the wall of the prse-oral body cavity or protoccele.. Ac-

cording to Willey, its completest development is repre-

FiG. 5. — ^Dorao-ventral section of an adult Cephalodiecun (not exactly me-

*dian): rt, anus; 6g^ protoccele; ftc^, mesocrele ; &c8, metacoele ; int^*

intestine; m, mouth; nch, stomocliord ; w.s., nervous system; (»«., oesophagus ; op, operculum ; ov, ovary ; ovd, oviduct ; ph, pharynx ; p.p., proboscis pore; p.s., proboscis stalk; s^, stomach; fli&, cut origin or stolon or pedicle. {After Nartner.)

sented in Fig. 1 ; the cells of which it is composed

frequently exhibit that vacuolation which is generally

associated with a stiffening function, and is particularly

well developed in Vertebrate notochords. In CepJialo-

discus and Rhahdopleura there exists a simpler divertic-

lum or stomochord, with the same general relations, but

not exhibiting vacuolation.

As regards Actinotrocha, we suffer from a multiplicity

of so-called "notochords." Masterman describes in .4c-

tinotrocha and Cephalodiscus a pair of " pleurochords," lateral evaginations of the gut in the collar region, the

cells of which are vacuolated ; these lie farther back than the Enteropneustan stomochord, and do not project into the protoccele. Eoule in the Actinotrocha of another species of Phoronis, and Ikeda in Japanese species, de-scribe not two, but a single diverticulum of vacuolated cells in the collar; this projects, however, not dorsaUy towards the protoccele, but ventrally, not above but below the cesophagua. On the other hand, Masterman, and mM.

v.mes.

Fig. 6. — Nearly transverse section of Cephalodis-cus: &c8, metacrele; c.p., collar pore; d&v, dorsal blood-vessel ; tf.m^s., dorsal mesentery ; ep, epistome; g.s., gill slit; ini^ intestine; l.o.c.^ left mesoctEle ; in, mouth ; ov, ovary ; plchf pleurochord ; r.c.c, right mesoccele ;

■v.wea., ventral mesentery. The distribution of the " chordold " tissues on gill slits and pleuro-chords is shown by reticulations. (Jk from a drawing hy Masterman.)

(more recently) Menon in Indian species, describe a me-
dian dorsal nou-vacuolated diverticulum ; this, although
formed just outside what he describes as the mouth,
shifts inwards, and comes to have the topographical
relations of a stomochord. He formerly regarded
this and the stomochord of Cephalodiscus as homologous
with the subneural
gland of Uro-
chorda, refusing
to recognize it as
of notochordal sig-
nificance on the
grounds of its
structure, of its
relations to other
organs, and of his
preference for re-
garding the pleuro-
chords as the
paired homologues

of the Entero-

pneustan stomo-

chord. As regards

the question of

histological struc-

ture, it is not wise

to lay too much

stress on this evi-

dence ; the vacuo-

lated cells of

Cephalodiscus and

Actinotrocha are

not particularly

chordoid – looking,

and there is no evidence of their being stiffer than sur-

rounding tissues ; there appear to be gland cells among

them. Further, Spengel, Hill, and Willey have shown

that " pygochordal " vacuolated tissue occurs on the

ventral side of the caudal gut in various Enteropneusta ;

again, chordoid tissue of a stiffening nature is widely

distributed in the animal kingdom, from the tentacles of Hydromedusee upwards. The general topographical relations of the organ are those of the stomochord of Enteropneusta, although in details of this as of other portions of their anatomy the three smaller members differ from Enteropneusta. On the whole, there seems little reason at present to deny to this median stomo-chord in Actinotrocha, Rliab-dopleura, and Cephalodiscus a homology with at any rate some part of the sto-mochord of Enteropneusta. This would agree with the

homologies suggested by

Willey, that the pleuro-

chords are homologous

with the lateral pouches,

and Eoule's ventral diverticulum with the ventral caecum,

of such an Enteropneustan stomochord as is represented

in Eig. 7.

The Coelom and its Openings. — In all the Hemichorda

the ccelom exhibits three well-defined regions separated

from one another by septa : (1) An impaired prse-oral

protoccele (head or proboscis cavity), which is present in

Fig. T.— Complete Enteropneustan

stomochord («/ter Willey): e.g.,

collar gut; l.p., lateral pouch;

■*p.c, ventral cEecum*,

Actinotrocha, but lost in adult Phoronis, and persists in

the other three; (2) a mesocoele (collar or lophophoral

cavity), first paired, then single, in Actinotrocha; paired

in the remainder, and continued into the lophophore and tentacles when they occur ; (3) a paired metacoele or trunk cavity. It is interesting to note that these three are present in the development of Amphioxus (MacBride, Quart. Journ. Micr. Science, xl. 689). The protoccsle and mesocoele communicate with the exterior by pores or canals, presumably for excretory functions; the proto-coele by two pores in Actinotrocha and Cephalodiscus, by two or one in Enteropneusta, but none have been observed in Rhahdopleura ; the mesocoele opens by a pair of pores in all cases.

Gill-slits. — ^While the Enteropneusta have numerous gill-slits, Cephalodiscus has but a single pair, and none have been detected in Wiabdopleura or Actinotrocha; it is less remarkable that two such small animals as the latter should lack them, than that Cephalodiscus should possess them. The pleurochords of Cephalodiscus and Actinotrocha, as Willey suggests, are possibly vestiges of a lost pair of gill-slits; their size, shape, and position, and the presence of vacuolated tissue in the walls of both

(Pig. 6), render this homology probable.

These points are enough to show that the marked morphological similarities justify the inclusion of these three forms among the Hemichorda. But how they stand phylogenetically to each other and to Huchorda, whether they or any of them represent in any sense an ancestral phase, a blind side-path, or a degradation of structure, there is at present no adequate evidence to show.

The three forms, treated here are sessUe, and in this point bear to the Enteropneusta a relation analogous to that between many Ascidians and the Cephalochorda, an analogy the more striking if that interpretation be accepted which assigns to the Ascidians a single pair of gill-slits, greatly enlarged and subdivided.

Mention should be made here of a curious resemblance in many anatomical points between Phoronis and the Sipunculoidea (Oephyrea inermia), but our knowledge of the development of the latter group does not at present tend to show any intimate relationship between the two.

Authorities. — Phoronis — ^Benham, Quart. Journ. Micr. Sci., XXX. 125 ; CoRi, Zeit. wiss. Zool., li. ; Masteeman, Quart. Journ. Micr. Sci., xl. 281, and xliii. 375; Ikeda, Journ. Coll. Tokyo, xiii. ; Menon, Quart. Journ. Micr. Sci., xlv. — Cephalodiscus — Haemer, appendix to "Challenger" Beport on Cephalodiscus; Mastebman, Quart. Journ. Micr. Sci., xl. 281 ; and Trans. Boy. Soc. JEdin., xxxix. 507. — Rhabdopleura — Fowlek, Festschrift fur LeueJcart, 1892. — General — Willey, Quart. Journ. Micr. Set, xlii. 223 ; Masterman, ibid., xliii. 375. (g. h. fo.)

Hems, or Hums, ancient Emessa, a town of Syria, on the right bank of the Orontes. After its capitulation it became the capital of ajund, or military district, which under the Omeiyad Caliphs extended from Palmyra to the sea. Under the Arabs it was one of the largest cities in Syria, with walls and a strong citadel, which stood on a hill. Its men were noted for their courage in war, and its women for their beauty. The climate was extolled for its excellence, and the land for its fertility. A succession of gardens bordered the Orontes, and the vineyards were remarkable for their abundant yield of grapes. When it

capitulated the great church of St John was divided between the Christians and Moslems, an arrangement which apparently lasted until the arrival of the Turks. Its decay probably dates from the invasion of the Mongols (1260), who fought two important battles with the Egyptians (1281 and 1299) in its vicinity. The construction of a carriage road to Tripolis has led to a partial revival of prosperity and to an export of cereals and fruit. The population numbers 30,000 (Moslems 20,000, Christians 10,000). About 7 miles above Hems is the mediaeval Lake Kedes, in the vicinity of which was the Hittite city Kedesh.

GnT LE Strange. Palestine under the Moslems. — Condek. Heth and Moab. — Baedeker. Handbook to Syria and Palestine.

(c. w. W.)

Henderson, capital of Henderson county, Kentucky, U.S.A., on the south bank of the Ohio river, at an altitude of 370 feet. It has three railways— the Louisville and Nashville, the Illinois Central, and the Louisville, Henderson, and St Louis. It has tobacco and cotton

factories. Population (1880), 6365; (1900), 10,272, of whom 341 were foreign-born and 4029 were negroes.

Hendon, a suburb of London, in the Harrow parlia^ mentary division of Middlesex, England, on the Brent, 7 miles north-west of St Pancras. The churches are— three Established (St Mary's is old), a Koman Catholic, and several chapels ; at Mill Hill also are a Roman Catholic college for the training of missionaries and the well-known grammar school. The Brent reservoir for the Eegent Canal occupies 360 acres. Area of civil parish (an urban district), 8382 acres. Population (1881), 10,484 ; (1901), 22,460.

Hendricks, Thomas Andrews (1819-1885), Vice-President of the United States, was bom at Zanes-ville, Ohio, on the 7th of September 1819. He received a college education, and began in 1843 a successful career at the bar. Identifying himself with the Demo-cratic party, he was sent to Congress in 1861, and from that time till his death was active and prominent in politics. His official service included two terms as

representative (1861-56), one as head of the General Land Office (1856-59), one as senator (1863-69), and one as governor of Indiana (1872-76). Prom 1868 he was put forward for nomination for the Presidency at every Democratic convention save that of 1872. His defeats in 1876 and 1884 by Tilden and Cleveland re-spectively were followed in each case by his nomination for Vice-President, and in the latter year he was elected ; but before the year in which he assumed office (1886) was ended he died at Indianapolis, 26th November.

Henle, Friedrich Custav Jakob (1809-1885), German pathologist and anatomist, was born on 9th July 1809 at Eiirth, in Franconia. After studying medicine at Heidelberg and at Bonn, where he took his doctor's degree in 1832, he became prosector in anatomy to Johannes Miiller at Berlin. During the six years he spent in that position he published a large amount of work, including three anatomical monographs on new species of animals, and papers on the structure of the lacteal system, the distribution of epithelium in the

human body, the structure and development of the hair, the formation of mucus and pus, &c. In 1840 he accepted the chair of anatomy at Zurich, and in 1844 he was called to Heidelberg, where he taught not only anatomy, but physiology and pathology. About this period he was engaged on his complete system of general anatomy, which formed the sixth volume of the new edition of Sommering's treatise, published at Leipzig between 1841 and 1844. While at Heidelberg he published a zoo-logical monograph on the sharks and rays, in conjunction with his master Miiller, and in 1846 his famous Mamial of Rational Pathology began to appear ; this marked the beginning of a new era in pathological study, since in it physiology and pathology were treated, in Henle's own words, as "branches of one science," and the facts of disease were systematically considered with reference to their physiological relations. In 1852 he moved to Gbttingen, whence he issued three years later the first

instalment of his sT69.t 'HandJ^oQk'of Systematic Human Anatomy, the last volume of which vas not published till 1873. This work was perhaps the most complete an^ comprehensive of its kind that had so far, appeared, and it was remarkable not only for the fulness and minuteness of the anatomical descriptions, but also for the number and excellence of the illustrations with which they were elucidated. During the latter half of his life Henle's researches were Uaainly histological in character, his investigations embracing the minute anatomy of the blood vessels, serous menibranes, kidney, eye,, nails, central nervous system, &c. He died at Gottingen on 13th May 1885.

Henley-on-Thames, a municipal borough (incorporated 1883, extended 1892) and market-town in the Henley parliamentary division of Oxfordshire, England, 36 miles to London by rail. The grammar school has been reorganized, and the Henley Blue Coat school incorporated- with it. Recent erections are a new town-hall and an isolation hospital. Area, 571 acres. Population

(1881), 4601; (1901), 5984. For the regatta, see Rowing.

Henner, Jean Jacques (1829), French painter, was born 6th March 1829 at Dornach (Alsace). At first a pupil of Drolling and of Picot, he entered the]Scole des Beaux Arts in 1848, and took the Prix de Rome with a painting of "Adam and Eve finding the Body of Abel" (1858). At Rome he was guided by Elandrin, and, among other works, painted four pictures for the gallery at Colmar. He first exhibited at the Salon in 1863 a " Bather Asleep," and subsequently contributed " Chaste Susanna " (1865) ; " Byblis turned into a Spring " (1867) ; " The Magdalene " (1878) ; " Portrait of M. Hayem " (1878) ; " Christ Entombed " (1879) ; " Saint Jerome" (1881); "Herodias" (1887); "A Study" (1891); "Christ in His Shroud," and a "Portrait of Carolus-Duran " (1896) ; a " Portrait of Mile. Eouquier " (1897) ; " The Levite of the Tribe of Ephraim " (1898), for which a first-class medal was awarded to him (see Plate) ; and " The Dream " (1900). Among other pro-

fessional distinctions Henner also took a Grand Prix for painting at the Paris International Exhibition of 1900. He was made Knight of the Legion of Honour in 1873, Officer in 1878, and Commander in 1889. In 1889 he succeeded Cabanel in the Institut de Prance.

E. Bricon. Psycfiolo.gie d? Art. Paris, 1900. — C.Phillips. Art Journal, 1888. — F. Wbdmoke. Magazine of Art, 1888.

Henry Maurice, Prince of Battenbbeg (1858-1896), was the third son of Prince Alexander of Hesse and his morganatic wife, the beautiful Countess Julia von Hauke, to whom was granted in 1858 the title of Princess of Battenberg, which her children inherited. He was born at Milan 5th October 1858, was educated with a special view to military service, and in due time became a lieutenant in the first regiment of Rhenish hussars. By their relationship to the grand dukes of Hesse the princes of Battenberg were brought into close contact with the English Court, and Prince Henry paid several visits to England, where he soon became popular both in public and in private circles. It there-

fore created but little surprise when, towards the close of 1884, it was announced that Queen Victoria had sanctioned his engagement to the Princess Beatrice. The wedding took place at Whippingham on the 23rd of July 1885, and after the honeymoon the prince and princess settled down to a quiet home life with the queen, being seldom absent from the Court, and accompanying her Majesty in her annual visits to the Continent. Three ;sons and a daughter were the issue of the marriage. On 31st July 1885 a Bill to naturalize Prince Henry was passed by the House of Lords, and he Teceived the title .of Royal Highness. He was made , 3, Knight of the Garter and a member of the Privy Council, and also appointed a colonel in the army, and afterwards captain-general and governor of the Isle of Wight and governor of Caripbrooke. Castle. He adapted himself very readily to English country life, for he was an , excellent shot and an enthusiastic yachtsman. Coming of a martial race, the .prince would gladly have embraced an active military career, and when the Ashanti expedition was organized in

November 1895 he volunteered to join it. But when the expedition reached Prahsu, about 30 miles from Kumassi, he was struck down by fever, and being promptly conveyed back to. the coast, was placed on board H.M.S. Blonde. On 17th January he seemed to recover slightly, but a relapse occurred on the 19th, and he died on the evening of the 20th off the coast of Sierra Leone.

Henselt, Adolf von (1814-1889), German composer, was born at Schwabach, in Bavaria, 12th May 1814. At three years old he began to learn the violin, and at five the pianoforte under Frau v. Fladt. On obtaining financial help from Ludwig I. he went to study under Hummel in Weimar, and thence in 1832 to Vienna, where, besides studying composition under Sechter, he made a great success as a concert pianist. In order to recruit his health he made a prolonged tour in 1836 through the chief German towns. In 1837 he settled at Breslau, where he had married, but in the following year he migrated to St Petersburg, where previous visits had made him persona grata at Court. He then became

Court pianist and inspector of musical studies in the Imperial Institute of Fernale Education, and was ennobled. In 1852 and again in 1867 he visited England, though in the latter year he made no public appearance. St Petersburg was his home practically until his death, which took place at Warmbrunn on 10th October 1889. The characteristic of Henselt's playing was a combination of Liszt's sonority with Hummel's smoothness. It was full of poetry, remarkable for the great use he made of extended chords, . and for his perfect technique. He excelled in his own, works and in those of Weber and Chopin. His concerto in F minor is frequently played on the Continent ; and of his many valuable studies. Si oi.teau fetais is almost hackneyed. His A minor trio deserves to be better known. At one time Henselt was second to Rubinstein in the direction of the St Petersburg Conservatorium. (e. h. l.)

Henzada, a district of Lower Burma, formerly in the Pegu, but now in the Irrawaddy division. Area, 2886 square miles. Population (1891), 438,131 ; (1901),

484,774. There were, in 1899, 1329 villages, which paid a revenue of Rs.15,06,83,4. Of the population 419,639 were Buddhists and Jains, 2781 Hindus, 2364 Mahommedans, and 13,372 Christians, 13,234 of whom were natives, chiefly Karens, besides 4 Parsis and 9 non-Christian Karens. Of a total area of 1,847,040 acres, 469,870 acres were cultivated in 1899, 989,314 acres were not available for cultivation, and 182,829 acres other than fallow were , cultivable, but not cul-tivated. The rainfall in 1898-99, taken at Henzada, was 77-96 inches. The bulk of the cultivation is rice, but 6179 acres were under tobacco. The chief town of the district is Henzada, which had in 1899 a population of 19 762. It is a municipal town, with ten elective and three ex-officio members. It has a third-class district jail, capable of holding 311 prisoners. Other niunicipal towns in the district are Zalun, with a population of 6006; Myanaung, with a population of 5489; and Kyangin,

with, a population of 8116, according to the 1891 census. The village of Lemyethna had a population of 6614. The steamers of the Irrawaddy Flotilla Company call at Henzada and Myanaung. (j. g. sc.)

Heppenheim, a town of Germany, grand-duchy of Hesse-Darmstadt, on the Bergstrasse, between Darmstadt and Heidelberg;, 21 miles north of the latter by rail. It possesses a parish church which is reputed to have been built originally by Charlemagne about 806, a large lunatic asylum, and an interesting town hall. On an isolated hill close by stand the extensive ruins of the castle of Starkenburg, built by the abbot of Lorsch in 1064. Hops, wine, and tobacco are grown, and there are large stone quarries. Population (1900), 6777.

Herat. — The Afghan province of Herat, including the valley of the Heri (or Hari) Rud, was carefully surveyed during the progress of the Russo-Afghan Boundary Commission in 1884-85-86, when the dominating fortress of Herat was strengthened and extended for possible defence against Russia. The position of the city was then

found to be a little to the south and east of the point previously assigned to it. It lies in 34° 20′ 30″ N. and 62° 11′ 0″ E., at an altitude of 2500 feet above sea-level. The long narrow valley of the Heri Rud, starting from the western slopes of the Koh-i-Baba, extends almost due west for 300 miles before it takes its great northern bend at Kuhsan, and passes northwards through the broken ridges of the Siah Bubuk (the western extremity of the range which we now call Baropamisus) towards Sarakhs. For the greater part of its length it drains the southern slopes only of the Paropamisus and the northern slopes of a parallel range called Koh-i-Safed. The Paropamisus forms the soutbern face of the Turkestan plateau, which contains the sources of the Murghab river; the northern face of the same plateau is defined by the Band-i-Turkestan. On the south of the plateau we find a similar succession of narrow valleys dividing parallel flexures, or anticlinals, formed under similar geological conditions to those which appear to be universally applicable to the Himalaya, the Hindu Kush, and the

Indus frontier mountain systems. From one of these long lateral valleys the Heri Rud receives its principal tributary, which joins the main river below Obeh, 180 miles from its source ; and it is this tributary (separated from the Heri Rud by the narrow ridges of the Koh-i-Safed and Band-i-Baian) that offers the high, road from Herat to Kabul, and not the Heri Rud itself. From its source to Obeh the Heri Rud is a valley of sandy desolation. There are no glaciers near its sources, although they must have existed there in geologically recent times, but masses of melting snow annually give rise to floods, which rush through the midst of the valley in a turbid red stream, frequently rendering the river impassable and cutting off the crazy brick bridges at Herat and Tirpul. It is impossible, whilst watching the rolling, seething volume of flood-water which swirls westwards in April, to imagine the waste stretches of dry river bed which in a few months' time (when every available drop of water is carried off for irrigation) will represent the Heri Rud. The soft shales or clays of

the hills bounding the valley render these hills espe-
cially subject to the action of denudation, and the result,
in rounded slopes and easily accessible crests, determines
the nature of the easy tracks and passes which intersect
them. At the same time, any excessive local rainfall
is productive of difficulty and danger from the floods
of liquid mud and loose boulders which sweep like an
avalanche down the hill sides. It was a sudden storm
of this nature which led to the disaster on the Chashma
Sabz pass in April 1886, when the British Boundary
Commission lost a company of mule-drivers and much
valuable property. The intense cold which usually ac-
companies these sudden northern blizzards of Herat and
Turkestan is a further source of danger.

From Obeh, 60 miles east of Herat, the cultivated
portion of the valley commences, and it extends, with
a width which varies from 8 to 16 miles, to Kuhsan,
60 miles west of the city. But the great stretch of
highly irrigated and valuable fruit-growing land, which
appears to spread from the walls of Herat east and

west as far as the eye can reach, and to sweep to the foot of the hills north and south with an endless array of vineyards and melon-beds, orchards and villages, varied with a brilliant patchwork of poppy growth bright-ening the width of green wheat-fields with splashes of scarlet and purple — all this is really comprised within a narrow area which does not extend beyond a ten-miles' radius from the city. The system of irri-gation by which these agricultural results are attained is most elaborate. The despised Herati Tajak, in blue shirt and skull-cap, and with no instrument better than a three-cornered spade, is as skilled an agricul-turist as is the Ohilzai engineer, but he cannot effect more than the limits of his water-supply will permit. He adopts the Karez (or, Persian, Kandt) system of imderground irrigation, as does the Ghilzai in Afghan-istan, and brings every drop of water that he can find to the surface; but it cannot be said that he is more successful than the Ghilzai. It is the startling contrast of the Herati oasis with the vast expanse of comparative

sterility that encloses it which has given such a fictitious value to the estimates of the material wealth of the valley of the Heri Rud.

The valley about Herat includes a flat alluvial plain which might, for some miles on any side except the north, be speedily reduced to an impassable swamp by means of flood-water from the surrounding canals. Three miles to the south of the city the river flows from east to west, spanned by the Pal-i-Maliin, a bridge possessing-grand proportions, but which was in 1886 in a state of grievous disrepair and practically useless. East and west stretches the long vista of the Heri Rud. Due north the hills called the Koh-i-Mulla Khwaja appear to be close and dominating, but the foot of these hills is really about 3 miles distant from the city. Under the shadow of them stands the world-famed Ziarat of Gazargarh, the last resting-place of the greatest of Afghan rulers. Dost Mahomed Khan. This northern line of barren, broken sandstone hills is geographically no part of the Paropamisus range, from which it is separated by

a stretch of sandy upland about 20 miles in width, called the Dasht-i-Hamdamao, or Dasht-i-Ardewan, formed by the talus or drift of the higher mountains, which, washed down through centuries ^ of denudation, now forms long sweeping spurs of gravel and sand, scantily clothed with wormwood scrub and almost destitute of water. Through this stretch of dasJit the drainage from the main water-divide breaks downwards to the plains of Herat, where it is arrested and utilized for irrigation purposes. To the north-east of the city a very considerable valley has been formed between the Paropamisus and the subsidiai-y Koh-i-Mulla Khwaja range, called Korokh. Here there are one or two important villages and a well-known shrine marked by a group of pine trees which is unique in this part of Afghanistan. The valley leads to a group of passes across the Paropamisus into Turkestan, of which the Zirmast is perhaps the best known.

Paropamisus. — The main water-divide between Herat and the Turkestan Choi (the loess district) has been called Paropamisus for want of any well-recognized general

name. To the north of the Korokh valley it exhibits something of the formation of the Hindu Kush (of which it is apparently a geological extension), but as it passes westwards it becomes broken into fragments by processes of denudation, until it is hardly recognizable as a distinct range at all. The direct passes across it from Herat (the Baba and the Ardew^n) wind amongst masses of disintegrating sandstone for some miles on each side of the dividing water-shed, but farther west the rounded knolls of the rain-washed downs may be crossed almost at any point without diflftculty. The names applied to this debris of a once formidable mountain system are essentially local and hardly distinctive. Beyond this range the sand and clay loess formation spreads downwards like a tumbled sea, hiding within the folds of its many-crested hills the twisting course of the Kushk and its tributaries.

Kushk. — The exact position of Herat, with reference

to the Russian station of Kushk (now the terminus of a branch railway from Merv), is as follows : — From Herat, a gentle ascent northwards for 3 miles reaches to the foot of the Koh-i-Mulla Khwaja, crossing the Jui Nao or " new " canal, which here divides the gravel-covered foot hills from the alluvial flats of the Heri Rud plain. The crest of the outer ridges of this subsidiary range is about 700 feet above the city, at a distance of 4 miles from it. For 28 miles farther the road winds first amongst the broken ridges of the Koh-i-Mulla Khwaja, then over the intervening dasht into the southern spurs of the Paropar misus to the Ardewdln pass. This is the highest point it attains, and it has risen about 2150 feet from Herat. From the pass it drops over the gradually decreasing grades of a wide sweep of Choi (which here happens to be locally free from the intersecting network of n^irrow ravines which is generally a distinguishing feature of Turkestan loess formations) for a distance of 35 miles into the Russian railway station, falling some 2700 feet from the crest of the Paropamisus.

Oity and Fortress of Herat. — The city and fortress of Herat were found in 1885 to differ in no very material degree from the city and fortress of 1845, and the description given in the ninth edition of this work is still fairly accurate. The bazaar was poor in 1885, and trade was slack. Even in the streets converging on the Charsu lines of shops were closed and business was at a standstill ; but never, in the most flourishing circumstances, could the markets of Herat have ever rivalled those of Kandahar or Kabul. Within the walls of the city there is not a building which can claim any architectural distinction; the streets are narrow, closed in with high walls, and unutterably filthy ; many of the highways are but tunnels, with roofs sagging beneath a weight of overcrowded mud tenements. So poor was the trade of the Herat bazaar that the business introduced by the Afghan Boundary Commission made a most appreciable difference in its appearance. By the spring of 1886 the shops were gay with Bokhara embroideries and silks and the carpets of Adraskand and Turkestan; the roof of the Charsu

was almost in a state of repair, whilst a whole streetful of shopkeepers had again taken down their shutters and resumed business.

When the Royal Engineers of the Russo-Afghan Boundary Commission entered Herat in 1885 they found its defences in various stages of disrepair. The gigantic rampart was unflanked, and the covered ways in the face of it subject to enfilade from end to end. The ditch was choked, the gates were unprotected ; the tumbled mass of irregular mud buildings which constituted the city clung tightly to the walls ; there were no gun emplacements. Outside, matters were almost worse than inside. To the north of the walls the site of old Herat was indicated by a vast mass of debris — mounds of byicks and pottery intersected by a network of shallow trenches, where the only semblance of a protective wall was the irregular line of the Tal-i-Bangi. South of the city was a vast area filled in with the graveyards of centuries. Here the trenches dug by the Persians during the last siege were still in a fair state of preservation ; they were

within a stone's-throw of the walls. Round about the city on all sides were similar opportunities for close approach ; even the villages stretched out long irregular streets towards the city gates. To the north-west, beyond the Tal-i-Bangi, the magnificent outlines of the Mosalla filled a wide space with the glorious curves of dome and gateway and the stately grace of tapering minars, but the impressive beauty of this, by far the finest archi-tectural structure in all Afghanistan, could not be per-mitted to weigh against the fact that' the position occupied by this pile of solid buildings was fatal to the interests of effective defence. By the end of August 1885, when a political crisis had supervened between Great Britain and Russia, under the orders of the Amir the Mosalla was destroyed; but four minars standing at the corners of the wide plinth still remain to attest to the glorious proportions of the ancient structure, and to exhibit samples of that decorative tilework, which for intricate beauty of design and exquisite taste in the blending of colour still appeals to the memory as

unique. At the same time the ancient graveyards round the city were swept smooth and levelled ; obstructions were demolished, outworks constructed, and the defences generally renovated. Whether or no the strength of this bulwark of North-Western Afghanistan should ever be practically tested, the general result of the most recent investigations into the value of Herat as a strategic centre has been largely to modify the once widely-accepted view that the key to India lies within it.

Since the Afghan Boundary Commission visited Herat very little has been written about it. Major C. E. Yate's Northern Afghanistan (London, 1888) contains much general information ; but the exhaustive reports of the Boundary Commission have not been published. The above description is compiled from unpublished notes. (t. h. h.)*

Herault, a department in the south of France, washed by the Mediterranean and traversed by the Cevennes mountains.

Area, 2403 square miles. The population increased from 439,044 in 1886 to 469,684 in 1896, and to 488,285 in 1901. Births

in 1899 numbered 10,357, of which 526 were illegitimate, against 10,517 deaths ; marriages numbered 3646. The department had in 1896 989 schools, with 56,000 pupils, and its illiterates form less than 1 per cent, of the population. The surface under cultivation amounts to 1,008,226 acres, of which 306,420 acres are arable and 415,150 acres vineyards. Herault takes the first place among the departments for the manufacture of wine, as well for the abundance of its production, exceeding in 1899 12,300,000 hectolitres (270,600,000 gallons), as for its quality, which gave to the production the value of £9,393,000. Cereals and grass lands, on the other hand, give a very poor return, the olive yielding in 1899 £66,000, and the mulberry £7300 ; both thrive in this department, which also in 1898 produced 2451 owts. of silk-worm cocoons. The live stock includes 22,130 horses, 10,610 mules, 6300 asses, 8360 cattle, 349,170 sheep, 20,000 goats, and 17,000 pigs. The mining industry in 1898 produced 201,000 metric tons of coal, 4000 tons of iron, and the salt-pans yielded 40,000 tons of salt. The industry in metals has, however, no large establishments. The distilleries manufactured in 1898 438,000 gallons of alcohol. The most populated places

are Montpellier, the capital, with 76,364 inhabitants in 1901 ; B^ziers, 52,077 ; and Cette, 33,065.

Heredia, Jose Maria de (1842), the modern master of the French sonnet, was born at Fortuna Cafeyere, near Santiago de Cuba, on the 22nd November 1842, being in blood part Spanish Creole and part French. At the age of eight he came from the West Indies to

France, returning thence to Havana at seventeen, and finally making France his home not long afterwards. For some time he studied at the ificole des Chartes. In the later ‘sixties, with M. Copp^e, M. Sully-Prudhomme, Ver-laine, and others less distinguished, he made one of the band of poets who gathered round Leconte de Lisle and took, or accepted, the name of Parnassiens. To this new school, form — the technical side of their art — was of supreme importance, and, in reaction against the influence of Musset, they rigorously repressed in themselves all personal feeling and emotion. ” True poetry,” said M. de

Heredia in his discourse on entering the Academy — " true poetry dwells in nature and in humanity, which are eternal, and not in the heart of the creature of a day, however great." M. de Heredia's place in the movement was soon assured. He wrote very little, and published even less, but his sonnets circulated in MS., and gave him a reputation before they appeared in 1893, together with a few longer poems, as a volume, under the title of Les TrnpMes. He was elected to the Academy on the 22nd February 1894, in the place of Mazade, the publicist. Few purely literary men can have entered the Academy with credentials so small in quantity. A small volume of verse — a translation, with introduction, of Diazdel Castillo's History of the Conquest of New Spain (1878-81) — a translation of the life of the nun Alferez (1894), De Quincey's " Spanish Military Nun " — and one or two short pieces of occasional verse, and an introduction or so — this is but small literary baggage, to use the French expression. But the sonnets are of their kind among the most superb in modern literatare. " A L4gende des silcles in sonnets " M. Coppee has

called them. Each presents a picture, striking, brilliant, drawn with unfaltering hand — the picture of some characteristic scene in man's long history. The verse is flawless, polished like a gem ; and its sound has distinction and fine harmony. If oue may suggest a fault, it is that each picture is sometimes too much of a picture only, and that the poetical line, like that of M. de Heredia's master, Leconte de Lisle himself, is occasionally overcrowded. M. de Heredia is none the less one of the most skilful craftsmen who have ever practised the art of verse.

Heredity. — Heredity is the name given to the generalization, drawn from the observed facts, that animals and plants closely resemble their progenitors. (That the resemblance is not complete involves in the first place the subject of Variation {q.v.) ; but it must be clearly stated that there is no adequate ground for the current loose statements as to the existence of opposing " laws " or " forces " of heredity and variation.) In the simplest cases there seems to be no separate problem of heredity. When a creeping plant propagates itself by runners, when a Nais

or Myrianida breaks up into a series of similar segments, each of which becomes a worm like the parent, we have to do with the general fact that growing organisms tend to display a symmetrical repetition of equivalent parts, and that reproduction by fission is simply a special case of metamerism. When we try to answer the question why the segments of an organism resemble one another, whether they remain in association to form a segmented animal, or break into different animals, we come to the conclusion, which at least is on the way to an answer, that it is because they are formed from pieces of the same protoplasm, growing under similar conditions. It is apparently a fundamental property of protoplasm to be able to multiply by division into parts, the properties of which are similar to each other and to those of the parent.

This leads us directly to the cases of reproduction where there is an obvious problem of heredity. In the majority of cases among animals and plants the new organisms arise from portions of living matter, separated from the parents,

but different from the parents in size and structure. These germs of the new organisms may be spores, reproductive cells, fused reproductive cells, or multicellular masses (see Kbpeoduction). For the present purpose it is enough to state that they consist of nucleated masses of protoplasm known as cells. These pass through an embryological history, in which by growth, multiplication, and specialization they form structures closely resembling the parents. Now, if it could be shown that these reproductive masses arose directly from the reproductive masses which formed the parent body, the problems of heredity would be extremely simplified. If the first division of a reproductive cell set apart one mass to lie dormant for a time and ultimately to form the reproductive cells of the new generation, while the other mass, exactly of the same kind, developed directly into the new organism, then heredity would simply be a delayed case of what is called organic symmetry, the tendency of similar living material to develop in similar ways under the stimulus of similar external conditions. The cases in which this happens are

very rare. In the Diptera the first division of the egg-cell separates the nuclear material of the subsequent reproductive cells from the material that is elaborated into the new organism to contain these cells. In the Daphnidae and in Sagitta a similar separation occurs at slightly later stages ; in Vertebrates it occurs much later ; while in some Hydroids the germ-cells do not arise in the individual which is developed from the egg-cell at all, but in a much later generation, which is produced from the first by budding. However, it is not necessary to dis-miss the fertile idea of what Nussbaum and Weismann, who drew attention to it, called '■' continuity of the germ-plasm." Weismann has shown that an actual series of organic forms might be drawn up in which the formation of germ-cells begins at stages successively more remote from the first division of the egg-cell. He has also shown evidence, singularly complete in the case of the Hydroids, for the existence of an actual migration of the place of formation of the germ-cells, the migration reaching farther and farther from the egg-cell. He has elaborated

the conception of the germ-track, a chain of cell genera-
tions in the development of any creature along which
the reproductive material saved over from the develop-
ment of one generation for the germ-cells of the next
generation is handed on in a latent condition to its
ultimate position. And thus he supposes a real con-
tinuity of the germ-plasm, extending from generation to
generation in spite of the apparent discontinuity in the
observed cases. The conception certainly ranks among
the most luminous and most fertile contributions of the
19th century to biological thought, and it is necessary to
examine at greater length the superstructure which
Weismann has raised upon it.

Weismann' s Tlieoi-y of the Germ-plasm. — A living being
takes its individual origin only where there is separated
from the stock of the parent a little piece of the peculiar
reproductive plasm, the so-called germ-plasm. In sexless
reproduction one parent is enough; in sexual reproduc-
tion equivalent masses of germ-plasm from each parent
combine to form the new individual. The germ-plasm

resides in the nucleus of cells, and Weismann identifies it with the nuclear material named chromatin. Like ordinary protoplasm, of which the bulk of cell bodies is composed, germ-plasm is a living material, capable of growing in bulk without alteration of structure when it is supplied with appropriate food. But it is a living material much more complex than protoplasm. In the first place, the mass of germ-plasm which is the starting-point of a new individual consists of several, sometimes of many, pieces named "idants," which are the chromosomes, into

a definite numlDer of "which, the nuclear material of a dividing cell breaks up. These idants are a collection of "ids," which Weismann tentatively identifies with the microsomata contained in the chromosomes, which are visible after treatment with certain reagents. Each id contains all the possibilities — generic, specific, individual — of a new organism, or rather the directing substance which in appropriate surroundings of food, &c., forms a

new organism. Each id is a veritable microcosm, possessed of a historic architecture that has been elaborated slowly through the multitudinous series of generations that stretch backwards in time from every, living individual. This microcosm, again, consists of a number of minor vital units called "determinants," which cohere according to the architecture of the whole id. The determinants are hypothetical units corresponding to the number of parts of the organism independently variable. Lastly, each determinant consists of a number of smaller JLgpothetical units, the " biophores.") These are adaptations of a conception of De Vnes, and are supposed to become active by leaving the nucleus of the cell in which they lie, passing out into the general protoplasm of the cell and ruling its activities. Each new individual begins life as a nucleated cell, the nucleus of which contains germ-plasm of this complex structure derived from the parent. The reproductive cell gives rise to the new individual by continued absorption of food, by growth, cell-divisions, and cell-specializations. The theory sup-

poses that the first divisions of the nucleus are " doubling," or homogeneous divisions. The germ-plasm has grown in bulk without altering its character in any respect, and, when it divides, each resulting mass is precisely alike. From these first divisions a chain of similar doubling divisions stretches along the "germ-tracks," so marshalling unaltered germ-plasm to the generative organs of the new individual, to be ready to form the germ-cells of the next generation. In this mode the continuity of the germ-plasm from individual to individual is maintained. This also is the immortality of the germ-cells, or rather of the germ-plasm, the part of the theory which has laid so large a hold on the popular imagination, although it i« really no more than a reassertion in new terms of biogenesis. With this also is connected the celebrated denial of the inheritance of acquired characters. It seemed a clear inference that, if the hereditary mass for the daughters were separated off from the hereditary mass that was to form the mother, at the very first, before the body of the mother was formed,

the daughters were in all essentials the sisters of their mother, and could take from her nothing of any characters that might be impressed on her body in subsequent development. In the later elaboration of his theory Weismann has admitted the possibility of some direct modification of the germ-plasm within the body of the individual acting as its host.

The mass of germ-plasm which is not retained in unaltered form to provide for the generative cells is supposed to be employed for the elaboration of the individual body. It grows, dividing and multiplying, and forms the nuclear matter of the tissues of the individual, but the theory supposes this process to occur in a peculiar fashion. The nuclear divisions are what Weismann calls "differentiating" or heterogeneous divisions. In them the microcosms of the germ-plasm are not doubled, but slowly disintegrated in accordance with the historical architecture of the plasm, each division differentiating among the determinants and marshalling one set into one portion, another into another portion. There are

differences in the observed facts of nuclear division which tend to support the theoretical possibility of two sorts of division, but as yet these have not been correlated definitely with the divisions along the germ-tracks and the ordinary divisions of embryological organogeny. The theoretical conception is, that when the whole body is formed, the cells contain only their own kind of determinants, and it would follow from this that the cells of the tissues cannot give rise to structures containing germ-plasm less disintegrated than their own nuclear material, and least of all to reproductive cells which must contain the undisintegrated microcosms of the germ-plasm. Cases of bud-formation and of reconstructions of lost parts (see Eegbnbeation) are regarded as special adaptations made possible by the provision of latent groups of accessory determinants, to become active only on emergency.

It is to be noticed that Weismann's conception of the processes of ontogeny is strictly evolutionary, and in so far is a reversion to the general opinion of biologists of

the 17th and 18th centuries. These supposed that the germ-cell contained an image-in-little of the adult, and that the process of development was a mere unfolding or evolution of this, imder the influence of favouring and nutrient forces. Hartsoeker, indeed, went so far as to figure the human spermatozoon with a mannikin seated within the " head," and similar extremes of imagination were indulged in by other writers for the spermatozoon or ovum, adcording to the view they took of the relative importance of these two bodies. Wolff, in his Theoria Generationis (1769), was the first distinguished anatomist to make assault on these evolutionary views, but his direct observations on the process of development were not suf-ficient in bulk nor in clarity of interpretation to convince his contemporaries. Naturally the improved methods and vastly greater knowledge of modern days have made evo-lution in the old sense an impossible conception ; we know that the egg is morphologically unlike the adult, that vari-ous external conditions are necessary for its subsequent prepress through a slow series of stages, each of which is

unlike the adult, but gradually approaching it until the final condition is reached. None the less, Weismann's theory supposes that the important determining factor in these, gradual changes lies in the historical architecture of the germ-plasm, and from the theoretical point of view his theory remains strictly an unfolding, a becoming manifest of hidden complexity.

Hertwig's View. — The chief modern holder of the rival view, and the writer who has put together in most cogent form the objections to Weismann's theory, is Oscar Hertwig. He points out that there is no direct evidence for the existence of differentiating as opposed to doubling divisions of the nuclear matter, and, moreover, he thinks that there is very generally diffused evidence as to the universality of doubling division. In the first place, there is the fundamental fact that single-celled organisms exhibit only doubling division, as by that the persistence of species which actually occurs alone is possible. In the case of higher plants, the widespread occurrence of tissues with power of reproduction, the occurrence of bud-

ding in almost any part of the body in lower animals and in plants, and the widespread powers of regeneration of lost parts, are easily intelligible if every cell like the egg-cell has been formed by doubling division, and so contains the germinal material for every part of the organism, and thus, on the call of special conditions, can become a germ-cell again. He lays special stress on those experiments ‘ in which the process of development has been interfered with in various ways at various stages, as showing that the cells which arise from the division of the egg-cell were not predestined unalterably for a particular r81e, accord-ing to a predetermined plan. He dismisses Weismann's suggestion of the presence of accessory determinants which remain latent unless they happen to be required,

as being too complicated a supposition to be supported without exact evidence, a view in which, he has received strong support from those who have worked most at the

experimental side of the question. From consideration of a large number of physiological facts, such as the results of grafting, transplantations of tissues, and transfusions of blood, he concludes that the cells of an organism possess, in addition to their patent microscopical characters, latent characters peculiar to the species, and pointing towards a fundamental identity of the germinal substance in every cell.

The Nuclear Matter. — Apart from these two characteristic protagonists of extreme and opposing views, the general consensus of biological opinion does not take us very far beyond the plainest facts of observation. The resemblances of heredity are due to the fact that the new organism takes its origin from a definite piece of the substance of its parent or parents. This piece always contains protoplasm, and as the protoplasm of every animal and plant appears to have its own specific reactions, we cannot exclude this factor; indeed many, following the views of Verworn, and seeing in the specific metabolisms of protoplasm a large part of

the meaning of life, attach an increasing importance to the protoplasm in the hereditary mass. Next, it always contains nuclear matter, and, in view of the extreme specialization of the nuclear changes in the process of maturation and fertilization of the generative cells, there is more than suf&cient reason for believing that the nuclear substance, if not actually the specific germ-plasm, is of vast importance in heredity. The theory of its absolute dominance depends on a number of experiments, the interpretation of which is doubtful. Nussbaum showed that in Infusoria non-nucleated fragments of a cell always died, while nucleated fragments were able to complete themselves ; but it may be said with almost equal confidence that nuclei separated from protoplasm also invariably die — at least, all attempts to preserve them have failed. Hertwig and others, in their brilliant work on the nature of fertilization, showed that the process always involved the entrance into the female cell of the nucleus of the male cell, but we now know that part of the protoplasm of the spermatozoon also enters.

Boveri made experiments on the cross-fertilization of non-nucleated fragments of the eggs of Sphoerechinus grann-laris with spermatozoa of Echinus microtuherculatus, and obtained dwarf larvae with only the paternal characters ; but the nature of his experiments was not such as absolutely to exclude doubt. Finally, in addition to the nucleus and the protoplasm, another organism of the cell, the centro-some, is part of the hereditary mass. In sum, while most of the evidence points to a preponderating importance of the nuclear matter, it cannot be said to be an established proposition that the nuclear matter is the germ-plasm. Nor are we yet definitely in a position to say that the germinal mass (nuclear matter, protoplasm, &c., of the reprodiictive cells) differs essentially from the general substance of the organism — whether, in fact, there is continuity of germ-plasm as opposed to continuity of living material from indi-vidual to individual. The origin of sexual cells from only definite places, in the vast majority of cases, and such phe-nomena as the phylogenetic migration of their place of origin among the Hydromedusse, tell strongly in favour

of Weismann's conception. Early experiments on dividing eggs, in which, by separation or transposition, cells were made to give rise to tissues and parts of the organism which in the natural order they would not have produced, tell strongly against any profound separation between germ-plasm and body-plasm. It is also to be noticed that the failure of germ-cells to arise except in specific places may be only part of the specialized ordering of the whole body, and does not necessarily involve the interpretation that reproductive material is absolutely different in kind.

Amphiviixis. — Hitherto we have considered the material bearer of heredity apart from the question of sexual union, and we find that the new organism takes origin from a portion of living matter, forming a material which may be called germ-plasm, in which resides the capacity to correspond to the same kind of surrounding forces as stimulated the parent germ-plasm by growth of the same fashion. In many cases (e.g., asexual spores) the piece of germ-plasm comes from one parent, and f-rom an organ

or tissue not associated with sexual reproduction ; in other cases (parthenogenetic eggs) it comes from the ovary of a female, and may have the apparent characters of a sexual egg, except that it develops without fertilization. In such cases the problem of heredity does not differ fundamentally from the symmetrical repetition of parts. In most of the higher plants and animals, however, sexual reproduction is the normal process, and from our present point of view the essential feature of this is that the germ-plasm which starts the new individual (the fertilized egg) is derived from the male (the spermatozoon) and from the female parent (the ovum). Although it cannot yet be set down sharply as a general proposition, there is considerable evidence to show that in the preparation of the ovum and spermatozoon for fertilization the nuclear matter of each is reduced by half (reducing division of the chromosomes), and that fertilization means the restoration of the normal bulk in the fertilized cell by equal contributions from male and female. So far as the known facts of this process of union of germ-plasms go, they take us no farther than

to establish such, a relation between the offspring and two parents as exists between the offspring and one parent in the other cases. Amphimixis has a vast importance in the theory of evolution (Weismann, for instance, regards it as the chief factor in the production of variations) ; for its relation to heredity we are as yet dependent on empirical observations.

Heredity and Development. — The actual process by which the germinal mass slowly assumes the characters of the adult — that is, becomes like the parent — depends on the interaction of two sets of factors : the properties of the germinal material itself, and the influences of substances and conditions external to the germinal material. Naturally, as Naegeli and Hertwig in particular have pointed out, there is no perpetual sharp contrast between the two sets of factors, for, as growth proceeds, the external is constantly becoming the internal; the results of influences, which were in one stage part of the environment, are in the next and subsequent stages part of the embryo. The differences between the exponents of evolution and epi-

genesis offer practical problems to be decided by experiment. Every phenomenon in development that is proved the direct result of epigenetic factors can be discounted from the complexity of the germinal mass. If, for instance, as Driesch and Hertwig have argued, much of the differentiation of cells and tissues is a function of locality and is due to the action of different external forces on similar material, then just so much burden is removed from what evolutionists have to explain. That much remains cannot be doubted. Two eggs similar in appearance develop side by side in the same sea-water, one becoming a mollusc, the other an Amphioxus. Hertwig would say that the slight differences in the original eggs would determine slight differences in metabolism and so forth, with the result that the segmentation of the two is slightly different; in the next stage the differences in metabolisms and other relations will be increased, and so on indefinitely. But in such cases c'est le premier 2^08 qui coitte, and the absolute cost in theoretical complexity of

the germinal material can be estimated only after a prolonged course of experimental work in a field which is as yet hardly touched.

Empirical Study of Heredity. — The fundamental basis of heredity is the separation of a mass from the parent (germ-plasm) which under certain conditions grows into an individual resembling the parent. The goal of the study of heredity will be reached only when all the phenomena can be referred to the nature of the germ-plasm and of its relations to the conditions under which it grows, but we have seen how far our knowledge is from any attempt at such references. In the meantime, the empirical facts, the actual relations of the characters in the offspring to the characters of the parents and ancestors, are being collected and grouped. In this inquiry it at once becomes obvious that every character found in a parent may or may not be present in the offspring. When any character occurs in both, it is generally spoken of as transmissible and of having been

transmitted. In this broad sense there is no character that is not transmissible. In all kinds of reproduction, the characters of the class, family, genus, species, variety, or race, and of the actual individual, are transmissible, the certainty with which any character appears being almost in direct proportion to its rank in the descending scale from order to individual. The transmitted characters are anatomical, down to the most minute detail; physiological, including such phenomena as diatheses, timbre of voice, and even compound phenomena, such as gaucherie and peculiarity of handwriting ; psycjiological ; pathological ; teratological, such as syndactylism and all kinds of individual variations. Either sex may transmit characters which in themselves are necessarily latent, as, for instance, a bull may transmit a good milking strain. In forms of asexual reproduction, such as division, budding, propagation by slips, and so forth, every character of the parent may appear in the descendant, and apparently even in the descendants produced from that descendant by the ordinary sexual processes. In repro-

duction by spore formation, in parthenogenesis and in ordinary sexual modes, where there is an embryological history between the separated mass and the new adult, ir is necessary to attempt a dif&cult discrimination between acquired and innate characters.

Acquired Characters. — Every character is the result of two sets of factors, those resident in the germinal material and those imposed from without. Our knowledge has taken us far beyond any such idea as the formation of a germinal material by the collection of particles from the adult organs and tissues (gemmules of Darwin). The inheritance of any character means the transmission in the germinal material of matter which, brought under the necessary external conditions, develops into the character of the parent. There is necessarily an acquired or epigenetic side to every character ; but there is nothing in our knowledge of the actual processes to make necessary or even probable the supposition that the result of that factor in one generation appears in the germ-plasm of the subsequent generations, in those cases where an embryological

development separates parent and offspring. The development of any normal, so-called " innate," character, such as, say, the assumption of the normal human shape and relations of the frontal bone, requires the co-operation of many factors external to the developing embryo, and the absence of abnormal distorting factors. When we say that such an innate character is transmitted, we mean only that the germ-plasm has such a constitution that, in the presence of the epigenetic factors and the absence of abnormal epigenetic factors, the bone will appear in due course and in due form. If an abnormal epigenetic factor be applied during development, whether to the embiyo in utero, to the developing child, or in after life, abnormality of some kind will appear in the bone, and such an abnormality is a good type of what is spoken of as an "acquired" character. Naturally such a character varies with the external stimulus and the nature of the material to which the stimulus is applied, and probability and observation lead us to suppose that as the germ-plasm of the offspring is similar to that of the

parent, being a mass separated from the parent, abnormal epigeneticinfluences would produce results on the offspriug similar to those which they produced on the parent. Scrutiny of very many cases of the supposed inheritance of acquired characters shows that they may be explained in this fashion — that is to say, that they do not necessarily involve any feature different in kind from what we understand to occur in normal development. The effects of increased use or of disuse on organs or tissues, the reactions of living tissues to various external influences, to bacteria, to bacterial or other toxins, or to different conditions of respiration, nutrition, and so forth, we know empirically to be different in the case of different individuals, and we may expect that when the living matter of a parent responds in a certain way to a certain external stimulus, the living matter of the descendant will respond to similar circumstances in a similar fashion. The operation of similar influences on similar material accounts for a large proportion of the facts. In the important case of the transmission of disease from parent to offspring it is plain

that three sets of normal factors may operate, and other cases of transmission must be subjected to similar scrutiny : (1) a child may inherit the anatomical and physiological constitution of either parent, and with that a special liability of failure to resist the attacks of a widespread disease ; (2) the actual bacteria may be contained in the ovum or possibly in the spermatozoon; (3) the toxins of the disease may have affected the ovum, or the sper-matozoon, or through the placenta the growing embryo. Obviously in the first two cases the offspring cannot be said in any strict sense to have inherited the disease ; in the last case, the theoretical nomenclature is more doubtful, but it is at least plain that no inexplicable factor is involved.

It is to be noticed, however, that " Lamarckians " and "Keo-Lamarckians" in their advocacy of an inheritance of " acquired characters " make a theoretical assumption of a different kind, whichapplies equally to " acquired " and to " innate " characters. They suppose that the result of the epigenetic factors are reflected on the germ-plasm in such

a mode that iu development the products would display the same or a similar character without the co-operation of the epigenetic factors on the new individual, or would display the result in an accentuated form if with the renewed co-operation of the external factors. Such an assumption presents its greatest theoretical dif&culty if, with Weis-mann, we suppose the germ-plasm to be different in kind from the general soma-plasm, and its least theoretical difficulty if, with Hertwig, we suppose the essential matter of the reproductive cells to be similar in kind to the essen-tial substance of the general body cells. But, apart from the differences between such theories, it supposes, in all cases where an embryological development lies between parent and descendant, the existence of a factor towards which our present knowledge of the actual processes gives us no assistance. The separated hereditary mass does not contain the organs of the adult; the Lamarckian factor would involve the translation of the characters of the adult back into the characters of the germ-cell in such a fashion that when the germ-cell developed these characters would

be re-translated again into those which originally had been produced by co-operation between germ-plasm characters and epigenetic factors. In the present state of our

knowledge the theoretical difficulty is not fatal to the Lamarekian supposition ; it does no- more than demand a much more careful scrutiny of the supposed cases. Such a scrutiny has been going on since Weismann first raised the diificulty, and the present result is that no known case has appeared which cannot be explained without the Lamarekian factor, and the vast majority of cases have been resolved without any difficulty into the ordinary events of which we have full experience. Taking the empirical data in detail, it would appear first that the effects of single mutilations are not inherited. The effects of long-continued mutilations are not inherited, but Darwin cites as a possible case the Mahommedans of Celebes, in whom the prepuce is very small. Brown-Sequard thought that he had shown in the case of guinea-

pigs the inheritance of the results of nervous lesions, but analyses of his results leave the question extremely doubtful. The inheritance of the effects of use and disuse is not proved. The inheritance of the effects of changed conditions of life is quite uncertain. Naegeli grew Alpine plants at Munich, but found that the change was produced at once and was not increased in a period of thirteen years. De Candolle starved plants, with the result of producing better blooms, and found that seedlings from these were also above the average in luxuriance of blossom, but in these experiments the effects of selection during the starvation, and of direct effect on the nutrition of the seeds, were not eliminated. Such results are typical of the vast number of experiments and observations recorded. The empirical issue is doubtful, with a considerable balance against the supposed inheritance of acquired characters.

Empirical Study of Effects of Amphimixis. — Inheritance is theoretically possible from each parent and from the ancestry of each. In considering the total effect it

is becoming customary to distinguish between " blended " inheritance, where the offspring appears in respect of any character to be intermediate between the conditions in the parents ; " prepotent " inheritance, where one parent is supposed to be more effective than the other in stamping the offspring (thus, for instance, Negroes, Jews, and Chinese are stated to be prepotent in crosses) ; " exclusive " inheritance, where the character of the offspring is definitely that of one of the parents. Such a classification depends on the interpretation of the word character, and rests on no certain grounds. An apparently blended character or a prepotent character may on analysis turn out to be due to the inheritance of a certain proportion of minuter characters derived exclusively from either parent. De Vries, arguing from experiments on plant hybrids, declares that no real mingling exists, but that the hybrids possess, in a simple form, some of the characters of each. He believes that characters must be analysed into ultimate units, and that when this is done the hybrid will be found never to exhibit the character of one parent (absent

in the other) in a reduced form, but simply to have it or not to have it, and he obtained extremely interesting experimental results in support of his view. (For further details as to inheritance in crosses see Hybeidism.)

Even leaving out of the question the actual interpretation of " character," there is a still greater difficulty, a fundamental one, in making empirical comparisons between the characters of parents and offspring. At first sight it seems as if this mode of work were sufficiently direct and simple, and involved no more than a mere collection of sufficient data. The cranial index, or the height of a human being and of so many of his ancestors being given, it would seem easy to draw an inference as to whether or no in these cases brachycephaly or stature were inherited. But our modern conceptions of the individual and the race make it plain that the problems are not so simple. With regard to any character, the race type is not a particular measurement, but a curve of vai-iations derived from statistics, and any individual with regard to the particular character may be referable to any point of the

curve. A tall race like the modern Scots may contain individuals of any height within the human limits ; a dolichocephalic race like the modern Spaniards may contain extremely round-headed individuals. What is meant by saying that the one race is tall or the other dolichocephalic, is merely that if a sufficiently large number be chosen at random, the average height of the one race will be great, the cranial index of the other low. It follows that the study of variation must be associated with, or rather must precede, the empirical study of heredity, and we are beginning to know enough now to be certain that in both cases the results to be obtained are practically useless for the individual case, and of value only when large masses of statistics are collected. No doubt, when general conclusions have been established, they must be acted on for individual cases, but the results can be predicted not for the individual case, but only for the average of a mass of individual cases. It is impossible within the limits of this article to discuss the mathematical conceptions involved in the formation and

applications of the method, but it is necessary to insist on the fact that these form an indispensable part of any valuable study of empirical data. One interesting conclusion, which may be called the " ancestral law " of heredity, with regard to any character, such as height, which appears to be a blend of the male and female characters, whether or no the apparent blend is really due to an exclusive inheritance of separate components, may be given from the work of Galton and Pearson. Each parent, on the average, contributes \ or (0-5)^ each grandparent -^ or (O-S), and each ancestor of -n!^ place (0-5)'^. But, this, like all other deductions, is applicable only to the mass of cases and not to any individual case.*

Regression. — An important result of the quantitative work brings into prominence the steady tendency to maintain the type which appears to be one of the most important results of amphimixis. In the tenth generation a man has 1024 tenth grandparents, and is thus the product of an enormous population, the mean of which can hardly

differ from that of the general population. Hence this heavy weight of mediocrity produces regression or progression to type. Thus in the case of height, a large number of eases being examined, it was found that fathers of a stature of 72 inches had sons with a mean stature of 70-8 inches, a regression towards the normal stature of the race. Fathers with a stature of 66 inches had sons with a mean of 68-3 inches, a progression towards the normal. It follows from this that where there is much in-and-in breeding the weight of mediocrity will be less, and the peculiarities of the breed will be accentuated.

Atavism. — Under this name a large number of ordinary cases of variation are included. A tall man with very short parents would probably be set down as a case of atavism if the existence of a very tall ancestor were known. He would, however, simply be a case of normal variation, the probability of which may be calculated from a table of stature variations in his race. Less marked cases set down to atavism may be instances

merely of normal regression. Many eases of more ab-

normal structure, which are really due to abnormal em-

bryonic or post-embryonic development, are set down to

atavism, as, for instance, the cervical fistulae, which have

been regarded as atavistic persistences of the gill clefts.

It is also used to imply the reversion that takes place

when domestic varieties are set free and when species or

varieties are crossed (see Hybridism). Atavism is, in fact,

a misleading name covering a number of very different

phenomena.

Telegony is the name given to the supposed fact that

offspring of a mother to one sire may inherit characters

from a sire with which the mother had previously bred.

Although breeders of stock have a strong belief in the

existence of this, there are no certain facts to support it,

the supposed cases being more readily explained as in-

dividual variations of the kind generally referred to as

" atavism." None the less, two theoretical explanations

have been suggested: (1) that spermatozoa, or portions of spermatozoa, from the first sire may occasionally survive within the mother for an abnormally long period ; (2) that the body, or the reproductive cells of the mother, may be influenced by the growth of the embryo within her, so that she acquires something of the character of the sire. The first supposition has no direct evidence to support it, and is made highly improbable from the fact that a second impregnation is always necessary. Against the second supposition Pearson brings the cogent empirical evidence that the younger children of the same sire show no increased tendency to resemble him. (See Telegony.)

Authorities. — The following books contain a fair proportion of the new and old knowledge on this suhject :— Bateson. Materials for the Study of Variation. 1894. — Delaoe. La Structure du Protoplasma et les Theories sur VHeredite (a very full discussion and list of literature). — Eimer. Organic Evolution. English translation by Cunningham. 1890. — Ewaet. The Penycuik Experiments. 1899. — Galton. Natural Inheritance. 1887. — HertwiG. Evolution or Epigenesis ? English translation by Chalmers

Mitchell. 1896. — Pearson. The Qrammar of Science. 1900. — Verworn. General Physiology. English translation. 1899. — Weismann. T%e Germ Plasm. English translation by Parker. 1893. — Lists of separate papers are given in the annual volumes of the Zoological Becord under heading " General Subject."

(p. 0. M.)

Hereford, a municipal and parliamentary borough, railway station, ancient city, and county town of Hereford-shire, England, on the river Wye, 144 miles from London by rail. Since 1885 its parliamentary representation has been reduced to one member. A musical festival of the choirs of Hereford, Gloucester, and Worcester cathedrals is held annually in rotation at these cities. The new gardens and public walk were opened in 1893. A suspension bridge for foot passengers across the river Wye was opened in 1897 as a memorial of Queen Victoria's Diamond Jubilee. The corporation commenced the supply of electricity in 1899. Area of borough, 5037 acres. Population (1881), 19,821; (1900), 21,382.

Herefordshire, a west midland county of England,

bounded on the W. by Brecknock and Eadnor in Wales, on the N. by Shropshire, on the W. by Worcester, and on the S. by Gloucester and Monmouth.

Area and Population. — The area of the ancient and administrative county, as given in the census returns of 1891, is 537,363 acres, or 840 square miles, with a population in 1881 of 121,249, and in 1891 of 115,949, of whom 56,090 were males and 59,859 females, the number of persons per square mile being 138, and of acres to a person 4-63. In 1894 the boundary of the administrative county was altered by a transference from Worcester, and a transference to Monmouth ; in 1895 the parts of the parish of Leintwardine in Salop were transferred to Hereford ; and in 1897 the parishes of Acton, Beauchamp, and Mathon Rural were transferred from Worcester to Hereford, and part of the parish of Cradley and the parish of Stoke Bliss from Hereford to Worcester. The area of the registration county is 535,846 acres, with a population in 1891 of 113,346, of which 32,427 were urban and 80,919 rural. Within the registration area the decrease of population between 1881 and 1891 was 3-93 per cent. Between 1881 and 1891 the excess of births over deaths was 11,374, but the decrease in population was 4642. In

1901 the population of the ancient county was 114,401.

The following table gives the num'bers of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 :—

Tear.

Marriages.

Births.

Deaths.

Illefentimato Births.

Males.

Females.

1880

1890

1898

673

708

691

3420

2998

2814

2084

1943

1895

136

106

117

116

93

102

The number of marriages in 1899 was 759, of births 2808, and of deaths 1881.

The following table gives the marriage-, birth-, and death-rates per 1000 of the resident population, with the percentage of illegitimate births, for a series of years : —

1870-79,

1880.

1880-89,

1890.

1888-97.

1898.

Marriage-rate .

11-6

11-3

11-6

12-4

12-9

12-6

Birth-rate

28-9

28-8

27-3

26-3

26-8

25-7

Death-rate

18-6

17-5

17-3

17-1

17-6

17-3

Percentage of Ille-

gitimacy

7-3

7-4

7-7

6-6

7-2

7-8

The marriage-, birth-, and death-rates are all much below the average, but the percentage of illegitimate births is much above it, as is usually the case in rural counties. In 1891 the natives of Scotland in the county numbered 2610, the natives of Ireland 4409, and foreigners 1717.

Constitution and Government. — The ancient county is divided into two parliamentary divisions, and it also includes the parlia-mentary borough of Hereford, returning one member. There are two municipal boroughs : Hereford (21, .382) and Leominster (5826). The urban districts are Bromyard (1663), Kington (1953), Ledbury (3259), and Ross (3302). The county is in the Oxford circuit, and

assizes are held at Hereford. The boroughs of Hereford and Leominster have separate commissions of the peace, and the borough of Hereford has in addition a separate court of quarter-sessions. The ancient county, which is almost entirely in the diocese of Hereford, contains 200 entire ecclesiastical parishes or districts, and parts of 20 others.

Education. — The number of elementary schools on 31st August 1899 was 191, of which 30 were board and 161 voluntary schools, the latter including 150 National Church of England schools, 4 Roman Catholic, and 7 " British and other." The average attendance at board schools was 3203, and at voluntary schools 12,432. The total school board receipts for the year ended 29th September 1898 were £11,160. The income under the Agricultural Rates Act was over £1041.

Agriculture. — About four-fifths of the total area of the county is under cultivation, and about two-thirds of this is in permanent pasture. Nearly 27,000 acres are under orchards — chiefly of apples and pears — the county, notwithstanding its much smaller area, ranking in this respect next to Devon. Over 40,000 acres are under woods, much of which is oak, and about 600 acres are under

small fruit. About three-eighths of the total acreage under com crops, which has largely diminished, is still occupied by wheat, but since 1880 its acreage has diminished by more than one-third ; barley has decreased in acreage almost in proportion to the increase of the acreage under oats, which now occupies second place. Turnips occupy about three-fourths of the acreage under green crops, and both mangolds and vetches are also largely grown. About 7000 acres are under hops. The following table gives the main divisions of the cultivated area at intervals from 1880: —

Tear.

Total area under Cul- tivation.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1880

1885

1890

1895

1900

443,854

446,621

444,974

445,306

447,974

100,315

89,377

85,690

73,665

76,575

31,114

33,106

30,928

27,569

25,406

38,429

43,126

37,313

42,871

38,237

255,693

267,364

278,542

288,565

297,421

12,302

6,936

5,785

4,795

2,355

The following table gives the numbers of the principal live stock

*for the same years :^*

Tear.

Total

Horses,

Total

Cattle.

Cows or Heifers

in Milk or in

Calf.

Sheep.

Pigs.

1880

1885

1890

1895

1900

21,326

23,114

22,203

24,144

23,357

75,221

90,713

87,911

88,632

96,603

24,829

32,293

30,577

29,413

32,374

260,099

315,068

.326,347

318,593

330,270

21,054

27,275

30,040

33,626

24,286

262

H E E F 0 E D — H E E 0 D A S

Industries and Trade. — There are no signs of any revival of manufacturing enterprise. According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in fac^iories and workshops in 1897 was 2428, as compared with 2192 in 1896 ; of these 1710 persons were employed in non-textile factories. Paper is manufactured. Limestone was raised in 1899 to the amount of 13,646 tons.

AuTHOKiTiES. — Notes on the Birds of Hereford (published by the Woolhope Field Club). Hereford, 1888 ; Flora of Herefordshire. Hereford, 1889. — Cooke. Visitation of Herefordshire, 1569. Exeter, 1886. — Havekgal. Herefordshire Words and Phrases. Walsall, 1887. — ^HuTCHiNsoN. Herefordshire Biographies. Hereford, 1890. — TiMMiNS. Nooks and Corners of Hereford. London, 1892.

(t. f. h.)

Herford, a town of Prussia, province of Westphalia, on the Werra, 60 miles by rail ■west-south-west of Hanover and 9 miles north-east of Bielefeld. It is the seat of considerable linen, cotton, sugar, furniture, carpet, and other industries. It has an agricultural school. Population (1885), 16,902 ; (1900), 25,120.

Hergenroether, Joseph von (1824-1890),

German cardinal, was born at Wiirzburg, in Bavaria, 15th September 1824. He studied at Wtlrzburg and at Rome. He afterwards became parish priest at Zellingen near his native city, in 1851 teacher, and in 1855 professor of Common Law in the University of Munich. Here he gained the reputation of being one of the most learned theologians on the Ultramontane side of the Infallibility question, which had begun, to be discussed. In 1868 he was sent to Rome to arrange the proceedings of the Vatican Council. In 1870 he wrote AntirJanus, an answer to the celebrated Letters of Janus, which made a great sensation at the time of the council. In 1877 he was made prelate of the Papal household ; he became cardinal deacon in 1879, and was afterwards made curator of the Vatican archives. He wrote a standard and highly important life of Photius, Patriarch of Constantinople (1866-69), and he was also the author of a work on the Roman Catholic Chtirch and the State in their historic development (Pribourg, 1872), a manual of Church history (1876), a sketch of the history

of the Popes (Wiirzburg, 1879), and a life of Cardinal Maury (1878). He died in 1890. (j. j. l.)*

Heringsdorf, a seaside resort of Prussia, province of Pomerania, on the north coast of the island of Usedom, and 6 miles by rail north-west of Swinemlinde. It is surrounded by beech woods, and is perhaps the most popular seaside resort on the German shore of the Baltic, being frequented by some 12,000 visitors annually.

Heri Rud. See Herat.

Herisau, the largest town in the Swiss half-canton of Appenzell-Ausser-Rhoden, on the railway between Winkeln (2^ miles distant) and Appenzell (13| miles distant). Its population (mainly Protestant and German-speaking) in 1901 was 13,518. It stands 2546 feet above the searlevel. Its church was built in 1516-20. The chief manufacture is that of muslins, and the town is by far the largest and most important in the entire canton.

Herkimer, capital of Herkimer county. New York, U.S.A., on the river Mohawk, on the Erie canal, and on the New York Central and Hudson River railway. It is

in a farming and dairy region. Population (1900), 6555, of whom 724 were foreign-born.

Herne, a town of Prussia, province of Westphalia, 15 miles by rail north-west of Dortmund. It has coal mines, boilerworks, gunpowder mills, &c. It was made a town in 1897. Population (1885), 9906 ; (1900), 27,999.

Herne Bay, a seaside resort of England, on the north coast of Kent, 62 miles by rail east from London, visited in summer by large numbers of London families. It has grown up since 1830, and has a somewhat pebbly beach, a pier nearly a mile long, and an esplanade. It has communication with London by steamboat, and in the season coaches run to Canterbury (7^ miles inland). Three miles to the east is Reculvers, the Roman Eegul-hium, a fortified camp for the protection of the Isle of Thanet. Its twin church towers are conspicuous objects, though the chui'ch was taken down, owing to the encroach-ments of the sea, in 1804. Bishop Ridley was at one time (16th century) vicar of Herne, the village behind Heme Bay. Population (1901), 6688.

Herndsand, a seaport town, on the east coast of Sweden, 3 miles south of the Angerman river, connected by a branch line (70 miles) at Langsele with the main railway to the north of Sweden. It has an export trade in timber (33^ million cubic feet annually), iron, and wood-pulp. In 1900 the port was cleared by 783 vessels of 410,700 tons, but is, as a rule, closed by ice from the beginning of December to the beginning of May. Population (1890), 5789; (1900), 7890.

Herodas, or Hekondas (for the name is spelt differently in the few places where he is mentioned), is the author of short humorous dramatic scenes in verse, written under the Alexandrian empire in the 3rd century B.C. Apart from the intrinsic merit of these pieces, they are interesting in the history of Greek literature as being a new species, illustrating Alexandrian methods. They are called Mi;itta/u,/3ot, "Mime-iambics." Mimes were the Dorian product of South Italy and Sicily, and the most famous of them — ^from which Plato is said to have studied the drawing of character — were the work of Sophron.

These were scenes in popular life, written in the language of the people, vigorous with racy proverbs such as we get in other reflections of that region — in Petronius and the Pentamerone. Two of the best known and the most vital among the " Idylls of Theocritus," the 2nd and the 15th, we know to have been derived from mimes of Sophron. What Theocritus is doing there, Herodas, his contemporary, is doing in another manner — casting old material into novel form, upon a small scale, under strict conditions of technique. The method is entirely Alex-andrian : Sophron had written in a peculiar kind of rhythmical prose ; Theocritus uses the hexameter and Doric, Herodas the " scazon " or " lame " iambic (with a dragging spondee at the end) and the old Ionic dialect with which that curious metre was associated. That, however, hardly goes beyond the choice and form of words ; the structure of the sentences is close-knit Attic. But the grumbling metre and quaint language suit the tone of common life Herodas aims at realizing ; for, as Theocritus may be called Idealist, Herodas is a Realist

unflinching. His persons talk in vehement exclamations and emphatic turns of speech, with proverbs and fixed phrases; and occasionally, where it is designed as proper to the part, with the most naked coarseness of expression.

The scene of the second and the fourth (and presumably of all) is laid at Cos, and the speaking characters in each are never more than three. In Mime I. the old nurse, now the professional go-hetween or bawd, calls on Metriche, whose husband has been long away in Egypt, and endeavours to excite her interest in a most desirable young man, fallen deeply in love with her at first sight. A.fter hearing all the arguments Metriche declines with dignity, but consoles the old woman with an ample glass of wine, this kind being always represented with the taste of Mrs Gamp. II. is a monologue by the nopvo/Soo-Kos (whoremonger) prosecuting a merchant-trader for breaking into his establishment at night and attempting to carry off one of the inmates, who is produced in court. The

vulgar blackguard, who is a stranger to any sort of shame, remarking that he has no evidence to call, proceeds to a peroration in the regular oratorical style, appealing to the Coan judges not to be unworthy of their traditionary glories. In fact, the whole oration is also a burlesque in every detail of an Attic speech at law; and in this case we have the material from which to estimate the excellence of the parody. In III. a desperate mother brings to the schoolmaster a truant urchin, with whom neither she nor his incapable old father can do anything. In a voluble stream of interminable sentences she narrates his misdeeds and implores the schoolmaster to flog him. The boy accordingly is hoisted on another's back and flogged ; but his spirit does not appear to be subdued, and the mother resorts to the old man after all. IV. is a visit of two poor women with an offering to the temple of Asclepius at Cos. While the humble cock is being sacrificed, they turn, like the women in the Ion of Euripides, to admire the works of art ; among them a small boy strangling a

vulpanser — doubtless the work of Boethus that we know — and a sacrificial procession by Apelles, " the Ephesian," of whom we have an interesting piece of contemporary eulogy. The oily sacristan is admirably painted in a few slight strokes. V. brings us very close to some unpleasant facts of ancient life. The jealous woman accuses one of her slaves, whom she has made her favourite, of infidelity; has him bound and sent degraded through the town to receive 2000 lashes; no sooner is he out of sight than she recalls him to be branded " at one job." The o^ly pleasing person in the piece is the little maidservant — permitted liberties as a verna brought up in the house — whose ready tact suggests to her mistress an excuse for postponing execution of a threat made in ungovernable fury. VI. is a friendly chat or a private conversation, the nature of which must be found out from the original. It is an ugly subject ; but allowance being made for it, this dialogue between two women is as clever and amusing as the rest, with some delicious touches. Our interest is engaged here

in a certain Kerdon, the artistic shoemaker, to whom we are introduced in VII. (the name had already become generic for the shoemaker as the typical representative of retail trade), a little bald man with a fluent tongue, complaining of hard times, who bluffs and wheedles by turns. VIII. opens with a mistress waking up her maids to listen to her dream ; but we have only the beginning, and all the other fragments are too small to speak of here.

Within the limits of 100 lines or less Herodas presents us with a highly entertaining scene and with characters definitely drawn. Some of these had been perfected no doubt upon the Attic stage, where the tendency in the 4th century had been gradually to evolve accepted types — not individuals, but generalizations from a class, an art in which Menander's was esteemed the master-hand. The IIopvo/8o(r/cos and the Maa-Tpom-o'; we Can piece together from succeeding literature, and see how skilfully the established traits are indicated here. This is achieved by true dramatic means, with touches never wasted and

the more delightful often because they do not clamour for attention. The execution has the qualities of first-rate Alexandrian work in miniature, such as the epigrams of Asclepiades possess, the finish and firm outlines ; and these little pictures bear the test of all artistic work — they do not lose their freshness with familiarity, and gain in interest as one learns to appreciate their subtle points.

The papyrus MS., obtained from the Fayyiiin, is in the possession of the British Museum, and was first printed by Mr Kenyon in 1891. The best text now is by Professor Crusius (Teubner) , and there are convenient French versions (with introductions) by MM. Dalmeyda (Hachette), Ristelhueber (Delagrave), and Boisacq (Thorin). There is a complete edition, with commentary and translation by the writer of this article.

(W. G. H.)

Herschell, Farrer Herschell, 1st Baron (1837-1899), Lord High Chancellor of England, was born 2nd November 1837. His father was the Eev. Ridley Haim Herschell, a native of Strzelno, in Prussian

Poland, who, when a young man, exchanged the Jewish faith for Christianity, took a leading part in founding the British Society for the Propagation of the Gospel among the Jews, and, after , many journeyings, settled down to the incumbency of a Nonconformist chapel near the Edgware Eoad, in London, where he ministered to a large congregation. His mother was a daughter of Mr William Mowbray, a merchant of Leith. Foreign travel, a love for which he derived from his father, and music, which he learnt from his mother, were throughout Herschell's life his chief, if not his only, recreations. In 1854 young Herschell went to a grammar school at Denmark Hill, and shortly afterwards became a student at University College, Gower Street. In 1857 he took his B.A. degree at the University of London. He was reckoned the best speaker in the school debating society, and he displayed there the same command of language and lucidity of thought which were his characteristics during his ofS-cial life. His early interest in oratory was so keen that when the debate on the seizure of the lorcha Arrow

was announced to come on in the House of Commons, he spent six or seven hours in the dismal little room appropriated in those days to strangers, in order to secure a front seat in the gallery. The reputation which Herschell enjoyed during his school days was maintained after he became a law-student at Lincoln's Inn. In 1858 he entered the chambers of Mr Thomas Chitty, the famous common-law pleader, father of the late Lord Justice Chitty. His fellow pupils, amongst whom were A. L. Smith, afterwards Master of the Rolls, and Arthur Charles, afterwards judge of the Qneen's Bench Division, gave him the sobriquet of " the chief baron " in recognition of his superiority. He subsequently read with Mr Hannen, afterwards Lord Hannen. In 1860 he was called to the bar and joined the northern circuit, then in its palmy days of undividedness. For four or five years he did not obtain much work. Fortunately, he was never a poor man, and so was not forced into journalism, or other paths of literature, in order to earn a living. Two of his contemporaries, each of whom achieved great eminence, found themselves in like

case. One of these, Charles Russell, became Lord Chief-Justice of England; the other, William Court Gully, Speaker of the House of Commons. It is said that these three friends, dining together during a Liverpool assize some years after they had been called, agreed that their prospects were anything but cheerful. Certain it is that about this time Herschell meditated quitting England for Shanghai and practising in the consular courts there. Herschell, however, soon made himself useftd to Edward James, the then leader of the northern circuit, and to John Richard Quain, the leading stuff-gownsman. For the latter he was content to note briefs and draft opinions, and when, in 1866, Quain donned " silk," it was on Herschell that a large portion of his mantle descended.

The first occasion on which Herschell greatly distinguished himself in court was as counsel for a young woman who was indicted at Carlisle for the murder of her illegitimate child, aged some two years, by drowning it in the Eden. The trial took place before Baron Bramwell, and at his request Herschell defended the accused. He

did not succeed in obtaining an acquittal, the evidence

against his client being too strong, but he made so

powerful a speech to the jury, that the learned baron

commenced his summing up as follows : — " Gentlemen,

there is one aspect of this trial which makes me proud

of the profession to which I belong. The prisoner at

the bar has apparently not a friend nor a shilling in the

world, but no wealth or position could possibly have

bought a more able, more eloquent, or more zealous

defence than that which has been made on her behalf."

This piece of " luck " (if that is the right word) became

the opportunity which, being taken advantage of to the

full, brought other opportunities in its train. Business

began to flow in gradually, but not in any rushing stream.

On the promotion of Quain' to the bench in 1872, Herschell

applied to be made a queen's counsel, an application

which was granted as a matter of course. He had all

the necessary qualifications for a leader — a clear, though

not resonant voice ; a calm, logical mind ; a sound know-ledge of legal principles; and (greatest gift of all) an abundance of common-sense. He never wearied the judges by arguing at undue length, and he knew how to retire with dignity from a hopeless cause. His only weak point was cross-examination. In handling a hostile witness he had neither the insidious persuasiveness of a Hawkins nor the compelling, dominating power of a Eussell. But he made up for all by his speech to the jury, marshalling such facts as told in his client's favour with the most consummate skill. He very seldom made use of notes, but trusted to his memory, which he had carefully trained. By this means he was able to conceal his art, and to appear less as a paid advocate than as an outsider interested in the case anxious to assist the jury in arriving at the truth. By 1874 Herschell's business had become so good that he turned his thoughts to Parlia-ment. Again his " luck " did not desert him. In Feb-ruary of that year there was a general election, with the result that the Conservative party came into power with

a majority of fifty. The usual crop of petitions followed. The two Radicals (Thompson and Henderson) who had been returned for Durham City were unseated, and an attack was then made on the seats of two other Radicals (Bell and Palmer) who had been returned for Durham county. For oue of these last Herschell was briefed. He made so excellent an impression on the local Radical leaders that they asked him to stand for Durham City ; and after a fortnight's electioneering, he was elected as junior member. Between 1874 and 1880 Herschell was most assiduous in his attendance in the House of Commons. He was not a frequent speaker, but a few great efforts sufficed in his case to gain for him a reputation as a debater. The best examples of his style as a private member will be found in Hansard under the dates 18th February 1876, 23rd May 1878, 6th May 1879. On the last occasion he carried a resolution in favour of abolishing actions for breach of promise of marriage except when actual pecuniary loss had ensued, the damages in such cases to be measured by the amount of such loss.

The grace of manner and solid reasoning with which he acquitted himself during these displays obtained for him the notice of Mr Gladstone, who in 1880 appointed Herschell Solicitor-General.

Herschell's public services from 1880 to 1886 were of great value, particularly in dealing with the " cases for opinion" submitted by the Foreign Office and other departments. He was also very helpful in speeding Government measures through the House, notably the Irish Land Act 1881, the Corrupt Practices and Bankruptcy Acts 1883, the County Franchise Act 1884, and the Redistribution of Seats Act 1885. This last was a bitter pill for Herschell, since it halved the representation of Durham City, and so gave him statutory notice to quit. Reckoning on the local support of the Cavendish family, he contested the North Lonsdale division of Lancashire; but in spite of the powerful influence of Lord Hartington, he was badly beaten at the poll, though Mr Gladstone again obtained a majority in the country. Herschell now thought he saw the Solicitor-Generalship

slipping away from him, and along with it all prospect of high promotion. Lord Selborne and Sir Henry James, however, successively declined Mr Gladstone's offer of the Woolsack, and in 1886 Herschell, by a sudden turn of fortune's wheel, found himself in his forty-ninth year Lord Chancellor. This event had been neatly fore-shadowed in a song written for some theatricals which took place at Christmas 1886 at Whitburn Hall, coimty Durham, the country house of the late Sir Hedworth Williamson, and sung in a burlesque by Sir Hedworth's eldest son, who was supposed to have met with a similar rebuff in a neighbouring constituency. The author of the song was Herschell's friend, Mr Hugh Shield, Q.C., " the poet of the northern circuit." One of its stanzas ran thus —

I then threw up the sponge — ^reflecting

How oft electors judgment lack,

And felt less sore on recollecting ■

That e'en Sir Farrer gets the sack.

Oh yes — he'll get the Sack again, too,

In spite of North Lonsdale's defeat,

A worthier honour he'll attain to.

And on the "Woolsack find a seat.

Herschell's Chancellorship lasted barely six months,

for in August 1886 Mr Gladstone's Home Rule Bill was

rejected in the Commons and his Administration fell.

In August 1892, when Mr Gladstone returned to power,

Herschell again became Lord Chancellor. In September

1893, when the second Home Rule Bill came on for

second reading in the House of Lords, Herschell took

advantage of the opportunity to justify the " sudden

conversion " to Home Rule of himself and his colleagues

in 1886 by comparing it to the Duke of Wellington's

conversion to Catholic Emancipation in 1829 and to that

of Sir Robert Peel to Free Trade in 1846. In 1895,

however, his second Chancellorship came to an end with

the defeat of the Rosebery Ministry.

Whether sitting at the Royal Courts in the Strand,

on the judicial committee of the Privy Council, or in

the House of Lords, Lord Herschell's judgments were

distinguished for their acute and subtle reasoning, for their grasp of legal principles, and, whenever the occasion arose, for their broad treatment of constitutional and social questions. He was not a profound lawyer in the sense in which that term was applied to Lord Blackburn or Mr Justice Willes, but his quickness of apprehension was such that it was an excellent substitute for great learning. In construing a real property will or any other document, his first impulse was to read it by the light of nature, and to decline to be influenced by the construction put by the judges on similar phrases occurring elsewhere. But when he discovered that certain expressions had acquired a technical meaning which could not be disturbed without fluttering the dovecotes of the conveyancers, he would yield to the established rule, even though he did not agree with it. He was perhaps seen at his judicial best in Vagliano v. Bank of England (1891) and Allen v. Flood (1898). Latterly-he showed a tendency, which seems to grow on some judges, to interrupt counsel overmuch. The case last mentioned furnishes an example

of this. The question involved was what constituted a molestation of a man in the pursuit of his lawful calling. At the close of the argument of counsel, whom he had frequently interrupted, one of their lordships, noted for his pretty wit, observed that although there might be a doubt as to what amounted to such molestation in point

of law, the House could well understand, after that day's proceedings, what it was in actual practice. In addition to his political and judicial work, Herschell rendered many public services. In 1888 he presided over an inquiry directed by the House of Commons with regard to the Metropolitan Board of Works. He acted as chairman of two royal commissions, one on Indian currency, the other on vaccination. He took a great interest in the National Society for the Prevention of Cruelty to Children, not only promoting the Acts of 1889 and 1894, but also bestowing a good deal of time in sifting the truth of certain allegations which had been brought against the

management of that society. In June 1893 he was appointed chancellor of the University of London in succession to the Earl of Derby, and he entered on his new duties with his usual thoroughness. " His views of reform," writes Mr Victor Dickins, the accomplished registrar of the university, " were always most liberal and most frankly stated, though at first they were not altogether popular with an important section of university opinion. He disarmed opposition by his intellectual poyer, rather than conciliated it by compromise, and sometimes was perhaps a little masterful, after a fashion of his own, in his treatment of the various burning questions that agitated the university during his tenure of office. His characteristic power of detachment was well illustrated by his treatment of the proposal to remove the university to the site of the Imperial Institute at South Kensington. Although he was at that time chairman of the Institute, the most irreconcilable opponent of the removal never questioned his absolute impartiality." With the Imperial Institute Herschell had been officially connected from its

inception. He was chairman of the provisional committee appointed by the Prince of Wales to formulate a scheme for its organization, and he took an active part in the preparation of its charter and constitution in conjunction with Lord Thring, Lord James, Sir Frederick Abel, and Mr John Hollams. He was the first chairman of its council, and, except during his tour in India in 1888, when he brought the Institute under the notice of the Indian authorities, he was hardly absent from a single meeting. For his special services in this connexion he was made G.C.B. in 1893, this being the only instance of a Lord Chancellor being decorated with an order.

In 1897 he was appointed, jointly with Lord Justice Collins, to represent Great Britain on the Venezuela Boundary Commission, which assembled in Paris in the spring of 1899. So complicated a business involved a great deal of preparation and a careful study of maps and historic documents. Not content with this, he accepted in 1898 a seat on the joint high commission

appointed to adjust certain boundary and other important questions pending between Great Britain and Canada on the one hand and the United States on the other hand. He started for America in July of that year, and was received most cordially at Washington. His fellow commissioners elected him their president. In February 1899, while the commission was in full swing, he had the misfortune to slip in the street, and in falling to fracture a hip bone. He bore his confinement to bed with stoic fortitude, and no word of complaint escaped his lips. But his constitution, which at one time was a robust one, had been undermined by constant hard work, and proved unequal to sustaining the shock. On 1st March, only a fortnight after the accident, he died at the Shoreham Hotel, Washington, a. post-mortem examination revealing disease of the heart. Mr Hay, Secretary of State, at once telegraphed to Mr Choate, the United States ambassador in London, the " deep sorrow " felt by President McKinley ; and Sir Wilfred Laurier said the next day, in the Parliament Chamber at Ottawa, that he regarded Herschell's

death ” as a misfortune to Canada and to the British Empire.” A funeral service held in St John’s Episcopal Church, Washington, was attended by the President and Vice-President of the United States, by the cabinet ministers, the judges of the supreme court, the members of the joint high commission, and a large number of senators and other representative men. The body was brought to London in a British man-of-war, and a second funeral service was held in Westminster Abbey before it was conveyed to its final resting-place at Tincleton, Dorset, in the parish church of which he had been married. Herschell left a widow, granddaughter of Vice-Chancellor Kindersley ; a son, Eichard Farrer, who succeeded him. as second baron ; and two daughters.

AuTHOKiTiEs. — In the above article use has been made mainly of private information and personal knowledge. A “reminiscence” of Herschell by Mr Speaker Gully will be ‘found in The Law Quarterly Review for April 1899. The Journal of the Society of Comparative Legislation (of which he had been president from its formation in 189.3) contains, in its part for July of the same

year, notices of him by Lord James of Hereford, Lord Davey, Mr Victor Williamson (his executor and intimate friend), and also by Mr Justice Brewer and Senator Fairbanks (both of the United States). (m. h. c.)

Hersfeld, a town of Prussia, province of Hesse-Nassau, 26 miles north of Fulda by rail, and on the river Fulda. The parish church was restored in 1899. Here is a military school. Population (1886), 7262 ; (1900), 7908.

Herstal, a town of Belgium, in the province and 3 miles by rail N.E. of the town of Li^ge, of which it is almost a suburb. In 1889 a syndicate of Liege gun-makers, having received an order from the Government for 150,000 military repeating rifles, founded " La Fabrique Nationale d'Armes de Guerre" here. It is the second ^ largest private factory of military repeating rifles in Europe. The motive power of the works is supplied by electricity. About 1000 workmen and 900 workwomen are employed. They are capable of turning out 250 com-pletely finished repeating rifles and 25,000 cartridges a

day. Population (1899), 17,655.

Hertford, a municipal borough (extended, 1892), market-town, and county town in the Hertford parliamentary division (since 1885) of the country of Hertfordshire, England, on the Lea, 23 miles north of London by rail. The old church of All Saints' was burned in 1891 ; a new one has been erected, in the Perpendicular style, of red Euncorn stone. Other recent erections include a public library and school of art, a Congregational hall, a Volunteer drill-hall and armoury, and a joint hospital (Hertford and Ware) for infectious diseases. The shire hall or town-hall and the general infirmary have been enlarged. Works for Oriental printing have been introduced. Population, on 816 acres (1881), 7714; (1891), 7548; (1891), on the area as afterwards extended (1136 acres), 9023 ; (1901), 9322.

Hertfordshire, a south midland county of England, bounded on the S. by Middlesex, on the S.W. by Buckingham, on the N.W. by Bedford, on the N. by Cambridge, and on the E. by Essex.

Area and Population. — The area of the ancient country is 406,161 acres, or 635 square miles, with a population in 1881 of 203,140, and in 1891 of 220,162, of whom 106,471 were males and 113,691 females ; the number of persons per square mile being 347, and of acres to a person 1-84. The area of the administrative county, as given in the census returns, is 406,932 acres, with a population in 1891 of 224,532 ; but several alterations in the area have since taken place. In 1895 the parish of Nettleden and

parts of the parish of Ivinghoe were transferred from Buokingham ; in 1896 additions were made by the transference from Cambridge of the parish of Royston, and the part of each of the parishes of Bas-singbourne, Kneesworth, and Melbourn, which is included in the North Royston special drainage district, and by the transference from Middlesex of part of the rural district and parish of South Mimms ; and in 1897 part of the parish of Caddington, and the parishes of Kensworth and Studham were transferred to Bedford, while the hamlet of Humbershoe, part of the parish of Houghton

Regis, the parish of Holywell, and parts of the parish of Shillington were transferred from Bedford. The area of the registration county is 443,787 acres, with a population in 1891 of 215,179, of whom 68,118 were urban and 147,061 rural. Within the registrar lion area the increase of population between 1881 and 1891 was 6-29 per cent., the increase being due chiefly to the erection of villas in the districts adjoining London. Between 1881 and 1891 the excess of births over deaths was 25,361, and the actual increase in the resident population was 1233. The population in 1901 was 250,350.

The following table gives the number of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 :—

Tear.

Marriages.

Birtlis.

DeathB.

lUegitimate Births. |

Males.

Females.

1880

1890

1898

1093

1228

1545

6254

5722

5680

3567

3579

3446

161

161

138

172

117

106

The number of marriages in 1899 was 1615, of births 5701, and of deaths 3673.

The following table gives the marriage-, birth-, and death-rates per 1000 of the population, with the percentage of illegitimate births, for a series of years : —

1870-79.

1880.

1880-39.

1890.

1889-98.

1899.

Marriage-rate

11-8

10-8

10-7

11-5

11-9

13-8

Birth-rate

32-2

30-9

29-5

26-7

26-7

25-4

Death-rate

18-7

17-6

17-0

16-7

16-0

15-4

Percentage illegi-

timate births

5-9

5-3

4-4

4-2

4-8

4-3

In 1891 there were in the county 1344 Scots, 841 Irish, and 525

foreigners.

Constitution and Government. — ^The ancient county is divided into four parliamentary divisions, and has no parliamentary borough. The administrative county contains three municipal boroughs: Hemel Hempstead (11,264 in 1901), Hertford (9322), and St Albans (16,019). The following are urban districts : Baldock (2057), Bamet (7876), Bishop's Stortford (7143), Cheshunt (12,288), Bast Bamet Valley (10,094), Great Berkhampstead (5219), Harpenden (4725), Hitchin (10,072), Hoddesdon (4711), Riokmansworth (5627), Royston (3517), Stevenage (3957), Tring (4368), Ware (5573), and Watford (29,023). The county is in the home circuit, and assizes are held at Hertford. Tlie boroughs of Hertford and St Albans have separate commissions of the peace. All the civil parishes within 12 miles of, or of which no portion is more than 15 miles from, Charing Cross, are included in the metropolitan police district. The ancient county, which is chiefly in the diocese of St Albans, contains 159 entire ecclesiastical parishes or districts and parts of 5 others.

Education. — There is a residential college for schoolmistresses (St Albans Diocesan) at Bishop's Stortford. The number of elementary schools on 31st August 1899 was 241, of which 39 were

board and 202 voluntary schools ; the latter including 183 National Church of England schools, 4 Roman Catholic, and 15 "British and other." The average attendance at board schools was 9405, and at voluntary schools- 27,633. The total school board receipts for the year ended 29th September 1898 were over £46,224. The income under the Technical Instruction Act was over £171, and that under the Agricultural Rates Act was over £857.

AgricAiUure. — There is an increasing London trade in corn, malt, vegetables, and fruit. More than three-fourths of the total area is under cultivation, and more than one-third of this is in permanent pasture. Over 1700 acres are under orchards, chiefly of apples and cherries ; and strawberries also are largely grown. Wheat still occupies nearly one-half of the total area under corn crops, but its acreage is gradually diminishing ; oats and barley occupy each about one-fourth. About two-thirds of the area under gi-een crops is occupied by turnips, swedes, and mangolds, many cows being kept for the supply of milk and butter to London. The following table gives the larger main acreages of the cultivated area at intervals of five years from 1880 : —

Tear.

Total Area under Cultiva-tion.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1880

1885

1890

1895

1900

340,117

341,381

341,782

336,147

332,187

144,038

137,062

133,122

120,130

121,498

40,436

43,787

36,349

34,415

32,425

37,445

39,793

41,483

45,804

45,667

98,765

106,812

116,134

118,126

120,687

19,430

13,924

14,394

16,957

11,289

The following table gives particulars regarding the principal live stock for the same years : —

Tear.

Total

Horses.

Total

Cattle.

Cows or Heifers

in Milk or in

Calf.

Sheep.

Pigs.

1880

1885

1890

1895

1900

14,846

13,975

14,425

15,554

15,023

33,032

37,731

.33,009

30,068

35,732

12,125

13,708

13,036

12,734

14,681

155,011

169,507

146,848

121,480

112,413

27,975

32,464

33,103

33,689

24,424

Industries and Trade. — According to the annual report for 1898 of the inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 11,770, as compared with 10,418 in 1896. Non-textile factories employed 8503 persons, of whom 2953 were employed in the manufacture of paper. Watford is famed for its ales. Of the 2990 persons employed in workshops, 2003 were employed in clothing industries.

In 1899, 46,888 tons of chalk were raised, 105,142 tons of gravel and sand, and 59,760 tons of clay.

Authorities. — J. E. Cussan. History of Hertfordshire. 3 vols. London, 1870-81. — Ilswick. Nonconformity in Hertfordshire. London, 1884. — Visitation of Hertfordshire 1572-1634 in Harleian Society^s Publications, vol. xvii. London, 1886. — Andrews. Memorial Brasses in Hertfordshire. London, 1886. — North. Church Bells of Hertfordshire, Hertford, 1886. — Petoe. Flora of Hertfordshire. Hertford, 1887. — ^Kingston. Hertfordshire during the Civil War. London, 1894. — See also various papers in Middlesex and Hertfordshire Notes and Queries (1895-98), which in January 1899 was incorporated in the Home Counties Magazine. (t. F. H.)

Hertz, Heinrich Rudolf (1857-1894), German physicist, was born at Hamburg on 22nd February 1857. On leaving school he determined to adopt the profession of engineering, and in pursuance of this decision went to study in Munich, in 1877. But soon coming to the conclusion that engineering was not his Tocation he abandoned it in favour of physical science, and in October

1878 began to attend the lectures of Kirchhoff and Helm-
holtz at Berlin. In preparation for these he spent the
winter of 1877-78 in reading up original treatises like
those of Laplace and Lagrange on mathematics and
mechanics, and in attending courses on practical physics
under Jolly and Bezold ; the consequence was that within
a few days of his arrival in Berlin in October 1878 he
was able to plunge into original research on a problem
of electric inertia. Tor the best solution a prize was
offered by the philosophical faculty of the University,
and this he succeeded in winning with the paper which
was published in 1880 on the " Kinetic Energy of
Electricity in Motion." His next investigation, on " In-
duction in Eotating Spheres," he offered in 1880 as his
dissertation for his doctor's degree, which he obtained
with the rare distinction of summd cum lande. Later
in the same year he became assistant to Helmholtz in
the physical laboratory of the Berlin Institute. During
the three years he held this position he carried out
researches on the contact of elastic solids, hardness,

evaporation, and the electric discharge in gases, the last earning him the special commendation of Helmholtz. In 1883 he went to Kiel, becoming privat-docent, and there he began the studies in Maxwell's electro-magnetic theory which a few years later resulted in the discoveries that rendered his name famous. These were actually made between 1885 and 1889, when he was

professor of physics in the Carlsruhe Polytechnic. He himself has recorded that their origin is to be sought in a prize problem proposed by the Berlin Academy of Science in 1879, having reference to the experimental establishment of some relation between electromagnetic forces and the dielectric polarization of insulators. Imagining that this would interest Hertz and be successfully attacked by him, Helmholtz specially drew his attention to it, and promised him the assistance of the Institute if he decided to work on the subject; but Hertz did not take it up seriously at that time, because he could not think of

any procedure likely to prove effective. It was of course well known, as a necessity of Maxwell's mathematical theory, that the polarization and depolarization of an insulator must give rise to the same electromagnetic effects in the neighbourhood as a voltaic current in a conductor. The experimental proof, however, was still lacking, and though several experimenters had come very near its discovery. Hertz was the first who actually succeeded in supplying it, in 1887. Continuing his inquiries for the next year or two, he was able to discover the progressive propagation of electromagnetic action through space, to measure the length and velocity of electromagnetic waves, and to show that in the transverse nature of their vibration and their susceptibility to reflection, refraction, and polarization they are in complete correspondence with the waves of light and heat. The result was, in Helmholtz's words, to establish beyond doubt that ordinary light consists of electrical vibrations in an all-pervading ether which possesses the properties of an insulator and of a magnetic medium. Hertz him-

self gave an admirable account of the significance of his discoveries in a lecture on the relations between light and electricity, delivered before the German Society for the Advancement of Natural Science and Medicine at Heidelberg in September 1889. Since the time of these early experiments, various other modes of detecting the existence of electric waves have been found out in addi-tion to the spark-gap which he first employed, and the results of his observations, the earliest interest of which was simplythat theyaifordedaconfirmationof an abstruse mathematical theory, have been applied to the practical purposes of signalling over considerable distances (see Tblegkaphy, Wibeless). In 1889 Hertz was appointed to succeed Clausius as ordinary professor of physics in the University of Bonn. There he continued his re-searches on the discharge of electricity in rarefied gases, only just missing the discovery of the X-rays described by Eontgen a few years later, and produced his treatise on the Principles of Mechanics. This was his last work, for after a long illness he died at Bonn on 1st January

1894. By his premature death science lost one of her most promising disciples. Helmholtz thoughthim the one of all his pupils who had penetrated farthest into his own circle of scientific thought, and looked to him with the greatest confidence for the further extension and development of his work.

Hertz's scientific papers have been translated into English by- Professor D. E. Jones, and published in three volumes : Electric Waves (1893), Miscellaneous Papers (1896), and Principles of Mechanics (1899). The preface contributed to the first of these by Lord Kelvin, and the introductions to the second and third by Professors Lenard and Helmholtz, contain many biographical details, together with statements of the scope and significance of his investigations. A book by Dr Oliver Lodge on Hertz and Ms Work (London, 1895) may also be consulted.

(h. m. e.)

Herzegovina. See Bosnia astd Hebzegoviita.

Hesse- Darmstadt, a grand-duchy of G-ermany, situated partly on the Ehine and Main, and partly sur- rounded by the province of Hesse-Nassau. Of the total

area (2966 square miles), 64 per cent, is under cultivation, whilst forests cover over 31 per cent. The total number of farms in 1895 was 133,840, and of these 59,043 were less than 2^ acres each, 65,419 between 2^ and 25 acres (93 per cent, imder 25 acres each), 9255 between 25 and 250 acres, and 123 exceeding 250 acres. In 1898 vines covered 30,840 acres, and produced 2,791,320 gallons of wine, valued at £225,000. The live stock in 1897 numbered 324,626 cattle, 271,595 pigs, 86,731 sheep, and 56,002 horses. In 1898 mineral products yielded 159,430 tons of iron ore, valued at £61,200; 218,384 tons of lignite, valued at £30,000; 37,916 tons of sulphuric acid, valued at £40,300 ; and 16,680 tons of salt, valued at £15,400. The smelting furnaces produced 19,868 tons of iron, valued at £188,500. In 1898-99 the sugar refineries yielded 14,000 tons of sugar ; the breweries, 31,037,800 gallons of beer ; and the distilleries, 398,100 gallons of pure alcohol. The grand-dachy is divided into three pro-vinces, with area and population as follows : —

Provinces.

Area.

Pop. 1886.

Pop. 1890.

Pop. 1895.

Density

Mile, 1895.

Upper Hesse

Rhenish Hesse .

Starkenburg

Totals .

1269

531

1166

263,044

291,142

402,370

265,912

307,329

419,642

271,524

322,934

444,562

213-9

608-1

381-3

2966

956,556

992,883

1.039,020

350-3

In 1900 the population of the grand-duchy was 1,120,426, of whom 558,962 were males and 561,464 females. The number of emigrants who left the country decreased from 2503 in 1885 to 333 in 1899. In 1895 the Protestants numbered 694,962, or 67 per cent, of the whole ; Roman Catholics 305,906, or 30 per cent. ; and there were 24,618 Jews. Por the year 1900-1 the ordinary revenue was estimated at £1,871,400, and the ordinary expenditure at £1,868,600; in addition there was an extraordinary revenue estimated at £602,600, and an extraordinary

expenditure estimated at £483,700. In 1900 the public debt amounted to £13,373,200; and in 1900 the state contribution to the empire was fixed at £523,270. Hesse-Nassau, a province of Prussia, with an area of 6060 square miles and a population of 1,897,981 (1900). The principal crops are potatoes and hay, oats, rye, and beetroot (for sugar), wheat, and barley. The vine was cultivated on 7490 acres in 1898, 97 per cent, of which were in the district of Wiesbaden; the yield of wine being 272,700 gallons, valued at £27,540, and including such brands as Johannisberg, Rtldesheim, Marcobrunner, Rauenthal, Assmannshausen, &c. But the year 1898 was a bad year for wine, the average yield for the years 1888-1897 having been 167 gallons annually per acre, as against 36^ gallons in 1898. Tobacco and hops are also gro-wn, though not on an extensive scale. Gardening, and the cultivation of fruit and vegetables, thrive in certain favoured localities. This province is an important pastoral region, and in 1897 possessed 565,303 cattle, 464,479 pigs, 390,790 sheep, and 80,644 horses. It has also one of the

relatively largest forest areas (40 per cent, of province) in the kingdom of Prussia. Mining is one of the chief industries of the province. The production in 1898 amounted to 614,409 tons of iron, valued at £243,400 ; 380,275 tons of lignite, valued at £73,300 ; 9983 tons of lead, valued at £66,800 ; 12,197 tons of zinc, valued at £45,100 ; further, manganese, salt, and copper. The furnaces and smelting- works produced 24,637 tons of lead, valued at £312,900 ; 778,320 ounces of silver, valued at £113,400; 79,318 tons of iron, valued at £802,660; and 81,026 tons of sulphuric acid, valued at £98,900. In 1898-99 the sugar refineries yielded 10,370 tons of sugar ;

the breweries, 46,666,800 gallons of beer; and the distilleries, 364,000 gallons of pure alcohol. There are numerous sandstone, slate, and clay quarries. The province is famous for its mineral springs, which abound specially in the Taunus region ; the best known of the spas are Wiesbaden, Ems, Homburg, Schlangenbad,

Schwalbach, Soden, &c. (For further particulars, see under Prussia.)

Hewett, Sir Prescott Gardner, Baet. (1812-1891), British surgeon, was born 3rd July 1812, being the son of a Yorkshire country gentleman. He lived for some years in early life ia Paris, and started on a career as an artist, but abandoned it for surgery. He entered St George's Hospital, London (where his half-brother, Dr Cornwallis Hewett, was physician from 1826 to 1833), becoming demonstrator of anatomy and curator of the museum. He was the pupil and intimate friend of Brodie, and helped him in much of his work. Eventually he rose to be anatomical lecturer, assistant-surgeon, and surgeon to the hospital. In 1876 he was President of the College of Surgeons ; in 1877 he was made serjeant-surgeon extraordinary to Queen Victoria, in 1884 serjeant-surgeon, and in 1882 he was created a baronet. He was a very good lecturer, but shrank from authorship ; his lectures on Surgical Affections of the Heart were, however, embodied in his treatise on the subject in

Holmes's System of Surgery. As a surgeon he was always extremely conservative, but hesitated at no operation, however severe, when convinced of its expediency. He was a perfect operator, and one of the most trustworthy of counsellors. He died 19th June 1891.

Hexham, a market-town and parish of England, county of Northumberland, on the south bank of the Tyne, 20 miles west of Newcastle, on the railway to Carlisle. In the neighbourhood there are barytes and coal mines. Since 1882 the town has belonged to the diocese of Newcastle. During the Middle Ages Hexham enjoyed peculiar rights of sanctuary, and the district around, known as Hexhamshire, formed a separate liberty down to the close of the 16th century. The Lancastrians were defeated by the Yorkists near here in 1463. Dr Joseph Parker, the well-known London preacher, was born at Hexham in 1830, and gives particulars of his early life there in his book, A Preacher's Life. Hexham gives its name to one of the four parliamentary divisions of the county. Area of urban sanitary

district, 6136 acres. Population (1891), 6945; (1901), 7071.

Heyse, Johann Ludwig Paul (1830- -),

German novelist and poet, was born at Berlin on 15th March 1830, being the son of the distinguished philologist. After producing in 1848 Der Junghrunnen, a fanciful little tale entirely in the spirit of the romantic school, and in 1861 a tragedy on the story of Francesca da E-imini, he turned his attention to novel-writing, and published at Munich in 1855 four novelettes in one volume, two of which at least were absolute masterpieces. These were the precursors of a series of similar volumes, necessarily imequal at times, but on the whole constituting such a mass of highly complex miniature fiction as perhaps never before proceeded from the pen of a single writer. Heyse works in the spirit of a sculptor : he seizes upon some picturesque incident or situation, and chisels and polishes until all the effect which it is capable of producing has been extracted from

it. The success of the story usually depends upon the merit of the theme, for the artist's skill is generally much the same, and the situation usually leaves a deeper impression than the characters. Heyse is also the author of several novels on a larger scale, all of which have gained success and provoked abundant discussion. The more important are Kinder der Welt (1873), dealing with general, Im Paradiese (1875), with artistic society, and Merlin (1892), a defence of the idealism of life. He has also been a prolific but not a very successful dramatist, and has produced masterly translations of Leopardi, Giusti, and other southern poets.

Hey wood, a municipal borough (1881), in the Hey-wood parliamentary division of Lancashire, England, 3 miles east of Bury and 9 miles north of Manchester, on the Lancashire and Yorkshire railway. A technical school was opened in 1894. Heywood is a manufacturing town with an increasing population. Area, 3628 acres. Population (1881), 22,979 ; (1901), 25,461.

Hicks-Beach, Sir Michael Edward, Babt.,

(1837), English statesman, son of the 8th baronet, whom he succeeded in 1854, was born in London in 1837, and educated at Eton and Christ Church, Oxford, where he graduated with a first-class in the school of-law and modern history. In 1864 he was returned to Parliament as a Conservative for East Gloucestershire, the county in which his estates of Williamstrip Park were situated ; and during 1868 he acted both as Parliamentary Secretary to the Poor Law Board and as Under-Secretary for the Home Department. In 1874 he married the daughter of the 3rd Earl Fortescue. In the same year he was made Chief Secretary for Ireland, and was included in the Cabinet in 1877. From 1878 to 1880 he was Secretary of State for the Colonies. In 1885 he was elected for West Bristol, and the Conservative party having returned to power, became Chancellor of the Exchequer and leader of the House of Commons. After Mr Gladstone's brief Home Eule Ministry, in 1886 he entered Lord Salisbury's next Cabinet again as Irish Secretary, making way for Lord Randolph Churchill as leader of the House ; but troubles

with his eyesight compelled him to resign in 1887, and meanwhile Mr Goschen replaced Lord Randolph as Chancellor of the Exchequer. From 1888 to 1892 Sir Michael Hicks-Beach returned to active work as President of the Board of Trade, and in 1896 — Mr Goschen being transferred to the Admiralty — he again became Chancellor of the Exchequer. As a Finance Minister he showed himself not only a vigorous guardian of the public purse, but also a particularly lucid expositor of his Budgets. In 1899 he lowered the fixed charge for the National Debt from twenty-five to twenty-three millions — a reduction imperatively required, apart from other reasons, by the difiiculties found in redeeming Consols at their then inflated price. When compelled to find means for financing the war in South Africa, he insisted on combining the raising of loans with the imposition of fresh taxation ; and besides raising the income-tax each year, up to Is. 3d. in 1902, he introduced taxes on sugar and exported coal (1901), and in 1902 proposed the reimposition of the registration duty on corn and flour which had been abolished in 1869 by Mr Lowe.

The sale of his Netheravon estates in Wiltshire to the War Office in 1898 occasioned some acrid criticism concerning the valuation, for which, however. Sir Michael himself was not responsible.

Hidalgo, a state of Mexico, bounded on the N. by the states of San Luis Potosi and Veracruz, on the E. by Puebla, on the S. by Mexico and Tlaxcala, and on the W. by Queretaro. Area, 8920 square miles. Population (1879), 427,350 ; (1900), 603,074. The agricultural products comprise cereals, coffee, sugar, cotton, tobacco, and maguey. Mining is the most important industry, the chief products being gold, silver, mercury, copper, iron, lead, zinc, antimony, manganese, and plumbago. The

state is divided into fifteen districts. The capital is Pachuca (40,487;), and among other towns are Tulancingo (8303), Ixmiquilpan (7079), and Actopan (6635).

Hiel, Emmanuel (1834-1899), Belgian-Dutch poet and prose writer, was born at Dendermonde, in

Flanders, May 1834. He acted in various functions, from teacher and government official to journalist and bookseller, busily writing all the time both for the theatre and the magazines of North and South Nether-lands. His last posts were those of librarian at the Industrial Museum and professor of declamation at the Conservatoire in Brussels. Among his better-known poetic works may be cited Looverkens (" Leaflets," 1857); MeuweLiedekens{"l^ew'Poesies,"1861); Gedichten ("Poems," 1863) ; Psalmen, Zangen,en Oratorios ("Tsalma, Songs, and Oratorios," 1869) ; De Wind (1869), an in-spiriting cantata, which had a large measure of success and was crowned ; De Liefde in 't Leven (" Love in Life," 1870) ; Elle and Isa (two musical dramas, 1874) ; Liederen voor Qroote en Kleine Kinderen ("Songs for Big and Small Folk," 1879) ; Jakdba van ieieren (" Jacquelein of Bavaria," a poetic drama, 1880) ; Mathilda van Dene-marken (a lyrical drama, Ghent, 1890). His collected poetical works were published in three volumes at Eousselaere in 1885. Hiel took an active and prominent

part in the so-called " Flemish movement " in Belgium, and we therefore find his name constantly associated with those of Jan van Beers, the Willems, and Peter Benoit. The last wrote some of his compositions to Kiel's verses, notably to his oratorios Lucifer (performed in London at the Eoyal Albert Hall and elsewhere) and De Schelde (" The Scheldt ") ; whilst the Dutch composer, Eichard Hoi (of Utrecht), composed the music to Hiel's " Ode to Liberty," and Van Gheluwe to the poet's "Songs for Big and Small Folk" (second edition, much enlarged, 1879), which has greatly contributed to their popularity in schools and among Belgian choral societies. Hiel also translated several foreign lyrics. His rendering of Tennyson's Dora appeared at Antwerp in 1871. For the national festival of 1880 at Brussels, to commemorate the fiftieth anniversary of Belgian independence, Hiel composed two cantatas, Belgenland ("The Land of the Belgians ") and Eer Belgenland (" Honour to Belgium "), which, set to music, were much appreciated. He died at Schaerbeek, near Brussels, on the 27th of August 1899.

Hiel's efforts to counteract Walloon influences and bring about a rapprochement between the Netherlanders in the north and the Teutonic racial sympathizers across the Ehine made him very popular with both, and a volume of his best poems was in 1874 the first in a collection of Dutch authors published at Leipzig. (h. ti.)

Hierapolis (1), Arabic Manhij or Membij, Turkish Bembij, occupying one of the finest sites in Northern Syria, in a fertile district, with an abundant water supply from large springs. In 1879, after the Eusso-Turkish war, a colony of Circassians from Widin was planted in the ruins. (2) A Phrygian city, altitude 1100 feet, on the right bank of the Churuk Su (Lycus), about 8 miles above its junction with the Menderez (Maeander), situated on a broad terrace, 200 feet above the valley and 6 miles north of Laodicea. On the terrace rise warm, calcareous springs, that have deposited the vast incrustations of snowy whiteness from which the place gets its name, Pambiik Kalesi, " Cotton Castle. " To these springs, which are slightly sulphureous, and to the Plutonium — a hole reaching deep into the

earth, from which issued a mephitic vapour — the place owed its celebrity and sanctity. Here, at an early date, a religious establishment (hieron) existed, and the town which gradually grew round it became one of the greatest centres of Phrygian life. The chief religious festival was the Letoia, named after the goddess Leto, a local variety of the Mother Goddess (Cybele). Hierapolis was the seat of an early church (Col. iv. 13), with which tradition closely connects the Apostle Philip. It has been suggested by Professor Eamsay that the Plutonium, which had disappeared in the 4th century, was filled up and covered over by the Christians about a.d. 320.

Ramsat. Cities and Bishoprics in Fhrygia, i. p. 84, &o. 1895. — HuMANN. Alt'ertiimer von Hierapolis. 1898.

(c. w. w.)

Higginson, Thomas Wentworth (1823-■), American author, reformer, and soldier, was born in Cambridge, Massachusetts, 22nd December 1823, being a descendant of Francis Higginson, minister of the church of Salem, Massachusetts, in 1629. He graduated

at Harvard in 1841, and at the Harvard divinity school in 1847 ; entered the Unitarian ministry, and was pastor of churches in Newburyport and Worcester, Massachu-setts, but left the ministry in 1858. Identifying himself with the anti-slavery movement, he was indicted for participation in the attempt to release Anthony Bums, a fugitive slave, in Boston in 1863 ; engaged in the effort to make Kansas a free state in 1856 ; sympathized with the abolitionist schemes of John Brown in 1869; and during the Civil War became colonel of the First South Carolina Volunteers, the first regiment recruited from former slaves who had been declared "contraband of war" by the Northern authorities. His army service continued until October 1864, when he resigned on account of a wound. His Army Life in a Black Regiment (1870) narrates his career and observations during his service in the field. At the conclusion of the war he devoted himself to literary work, first in Newport, Ehode Island, and then in his native place. His connexion with the periodical press has been constant. Many of

his articles have been reissued in volumes. Of his books the best are Out-Door Papers (1863), a Larger History of the United States (1885), and Cheerful Yesterdays (autobiographical, 1898). During his whole life Colonel Higginson has been an ardent advocate of woman suffrage and " free religion," and in his later years left the Eepublican party, but continued to take part in politics as an Independent, and afterwards as a Democrat.

Highgate, a parish and district partly in the county of Middlesex and partly in the county of London, chiefly in the metropolitan borough of St Pancras. Highgate is situated on a hill (which reaches a height of 426 feet) on the Great North Eoad, 5J miles north-west of the General Post Office.- There are two- chief ascents from London to the village of Highgate, viz., the West Hill and Highgate Hill, leading to the High Street. Holly Lodge, the residence of the Baroness Burdett Coutts, is on West Hill. Highgate is famous for mansions of historical interest, but several of them have been destroyed, such as Arundel House, where Bacon died in 1626, pulled down in 1826,

and Andrew Marvell's cottage, cleared away in 1869. Cromwell House still exists, although a fire on 3rd January 1865 destroyed the upper floors. This mansion was presented by Oliver Cromwell to his eldest daughter, Bridget, on her marriage, 16th January 1646^7, with Henry Ireton. Lauderdale House, after many vicissitudes, is now the refreshment house of Waterlow Park. The site of the Grove was originally occupied by Dorchester House, the mansion of the marquis of Dorchester, a loyal adherent of Charles I. At No. 3, The Grove (the house of the late Mr James Gillman, surgeon), the poet Coleridge lived for eighteen years. The old burial ground (in which lie the remains of Coleridge) is under the college chapel. Highgate Archway, constructed in 1812 in order to make some

improvement in the roadway for the coaches travelling the Great North Road, has been rebuilt, and a new archway to carry a roadway 50 feet wide was completed in 1900. Near Whittington Stone, at the foot of High-

gate Hill, are Whittington's Almshouses, removed from College Hill by the Mercers' Company. The association of Whittington with Highgate has, however, no authority in the original legend, for Bonehill or Bunhill is there designated as the place where he " turned again." High-gate can scarcely be said now to have any individual existence, and there are therefore no official statistics of the population of the place as a whole.

Highlands, formerly a city of Arapahoe county, Colorado, U.S.A., now a part of the city of Denver, on the west bank of the South Platte river, opposite Denver. Population (1890), 5161.

Higinbotham, George (1827-1893), Chief Justice of Victoria, sixth son of T. Higinbotham, of Dublin, was born on the 19th of April 1827, and educated at the Royal School, Dungannon, and at Trinity College, Dublin. After entering as a law student at Lincoln's Inn, and being engaged as reporter on the Morning Chronicle in 1849, he emigrated to Victoria, where he contributed to the Melbourne Herald and practised

at the bar (having been "called" in 1863) with much success. In 1850 he became editor of the Melbourne Argus, but resigned in 1859 and returned to the bar. He was elected to the Legislative Assembly in 1861 for Brighton as an independent Liberal, was rejected at the general election of the same year, but was returned nine months later. In 1863 he became Attorney-General. Under the influence of Mr Higinbotham measures were passed through the Legislative Assembly of a somewhat extreme character ; completely ignoring the rights and power of the Legislative Council, and the government was carried on without any Appropriation Act for more than a year. Mr Higinbotham, by his eloquence and earnestness, obtained great influence amongst the members of the Legislative Assembly, but his colleagues were not prepared to follow him as far as he desired to go. He contended that in a constitutional colony like Victoria the governor held the same position as the Sovereign in Great Britain, and that the Secretary of State for the Colonies had no right to fetter the discretion of the Queen's repre-

sentative by any counsel or interference. Mr Higin-botham did not return to power with his chief. Sir James M'Culloch, after the defeat of the shor1>lived Sladen administration ; and being defeated for Brighter^ at the next general election by a comparatively unknown man, he retired from politics and devoted himself to his large and lucrative practice at the bar. Amongst his other labours as Attorney-General he had codified all the statutes which were in force throughout the colony. In 1874 he was returned to the Legislative Assembly for Brunswick, but after a few months he resigned his seat. In 1880 he was appointed a puisne judge of the Supreme Court, and in 1886, on the retirement of Sir William Stawell, he was promoted to the office of Chief Justice. Mr Higinbotham was appointed president of the Inter-national Exhibition held at Melbourne in 1888-89, but did not take any active part in its management. One of his latest public acts was to subscribe a sum of £10, 10s. a week towards the funds of the strikers in the great Australian labour dispute of 1890, an act which

did not meet with general approval. He died in 1893.

(g. c. l.)

Hijar, a town of Eastern Spain, in the province of Teruel, on the right bank of the liver Martin, situated in a plain. The neighbouring country produces wheat, wine, oils, fruit, and vegetables. The industries of Hijar are chiefly silk, linen, cotton, soap, and bricks. The principal structures are the parish church, the palace of the dukes of Hijar (title dating from 1268), and the town hall. Population (1897), 11,571.

Hilden, a town of Prussia, in the Ehine province, 9 miles south-east of Dtlsseldorf by rail. It has manufactures of silk, velvet, carpets, artificial wool, machinery, calico printing, and brickmaking. Population (1885), 7947; (1900), 11,301.

Hildesheim, a town and episcopal see of Prussia, province of Hanover, at the north foot of the Harz Mountains, 19 miles south-east of Hanover by electric railway. The 14th-century town hall was restored in 1 883-92. The Knochenhauer House (1529), one of the finest examples

of wooden architecture not only in Hildesheim, but in all Germany, was burnt in 1884, but has since been repaired. The Eomer Museum, the geological section of which is especially noteworthy, is housed in the former church of St Martin's. New administrative offices were finished in 1888. Hildesheim is the seat of considerable industry, the chief productions being sugar, tobacco, vehicles, agricultural implements, gutta-percha wares, and bricks, and gardening is extensively carried on. Population (1885), 29,386; (1900), 42,973.

Hill, Octavia (1838) and Miranda (1836-), English philanthropic workers, were born in London, being daughters of Mr James Hill and grand-daughters of Dr Southwood Smith, the pioneer of sanitary reform. They were brought up to take an interest in social problems, and Miss Octavia HUl's attention was early drawn to the evils of London housing, and the habits of indolence and lethargy induced in many of the lower classes by their degradiag surroundings. As a result she conceived the idea of trying to free a few

poor people from such influences, and Mr Buskin, who sympathized with her plans, supplied the money for starting the work. For £750 Miss Hill purchased the 56 years' lease of three houses in one of the poorest courts of Marylebone. Another £78 was spent in building a large room at the back of her own house where she could meet the tenants. The houses were put in repair, cleansed, and let out in sets of two rooms. At the end of eighteen months it was possible to pay 5 per cent, interest, to repay £48 of the capital, as well as meet all expenses for taxes, ground rent, and insurance. What specially distinguished this scheme was that Miss Hill herself collected the rents, thus coming into contact with the tenants and helping to enforce regular and self-respecting habits. The success of her first attempt encouraged her to continue. Six more houses were bought and treated in a similar manner. A yearly sum was set aside for the repairs of each house, and whatever remained over was spent on such additional appliances as the tenants themselves desired. This encouraged them to keep their tenements in good repair.

By the help of friends Miss Hill was now enabled to enlarge the scope of her work. In 1869 eleven more houses were bought, and gradually a band of helpers was trained to assist her. The plan was to set a visitor over a small court or block of buildings, to do whatever work in the way of rent collecting, visiting for the School Board, &c., was required. As years went on Miss Octavia Hill's work largely increased. Numbers of her friends bought and placed under her care small groups of houses, over which she fulfilled the duties of a conscientious land-lord. Several large owners of tenement houses, notably the Ecclesiastical Commissioners, entrusted to her the management of such property, and consulted her about

plans of rebuilding ; and a number of fellow-workers were trained by her in the management of houses for the poor. The results in Southwark (where Red Cross Hall was established) and elsewhere were very beneficial. Both Miss Miranda and Miss Octavia Hill have taken an in-

terest in the movement for bringing beauty into the homes of the poor, and the former was practically the founder of the Kyrle Society, the first suggestion of which was contained in a paper read to a small circle of friends. Both sisters have worked for the preservation of open spaces, and helped to promote the work of the Charity Organization Society, and for several years Miss Miranda Hill has done admirable work in Marylebone as a member of the Board of Guardians.

Hiller, Ferdinand (1811-1885), German composer, was born at Frankfort-on-Main, 24th October 1811. Hiller was a link between the past era of great masters and the present. His first master was Aloys Schmitt, and when he was ten years of age his compositions and talent were so evidently above the average that his father, a well-to-do man, determined to send him to Hummel in Weimar. There he devoted himself to composition, among his work being the entr'actes to Maria Stuart, through which he made Goethe's acquaintance. Under Hummel, Hiller made great strides as a pianist, so much so that

early in 1827 he went on a tour to Vienna, where he met Beethoven and produced his first quartet After a brief visit home Hiller went to Paris in 1829, where he lived till 1836. His father's death necessitated his return to Frankfort for a time, but on 8th January 1839 he produced at Milan his opera La Romilda, and began to write his oratorio Die Zerstorung Jerusalems, one of his best works. Then he went to Leipzig, to his friend Mendelssohn, where in 1843^4 he conducted a number of the Gewaudhaus concerts, and produced his oratorio. After a further visit to Italy to study sacred music, Hiller produced two operas, Ein Traum and Conradin, at Dresden in 1846 and 1847 respectively ; he went as conductor to Dlisseldorf in 1847 and Cologne in 1850, and conducted at the Op6ra Italien in Paris in 1851 and 1852. At Cologne he became a power as conductor of the Gtirzenich concerts and head of the Conservatorium. In 1884 he retired, and died 12th May in the following year. Hiller frequently visited England. He composed a work for the opening of the Royal Albert Hall, his Nala and Dama-

yanti was performed at Birmingham, and he gave a series of pianoforte recitals of his own compositions at the Hanover Square Rooms in 1871. He had a perfect mastery over technique and form in musical composition, but his works are generally dry. He was a sound pianist and teacher, and occasionally a brilliant writer on musical matters. His compositions, numbering about two hundred, include six operas, two oratorios, six or seven cantatas, much chamber music, and a once-popular pianoforte concerto. (b. h. l.)

Hillsboro, capital of Hill county, Texas, U.S.A., on the Missouri, Kansas, and Texas, and the St Louis South- Western railways. It is in the cotton region, and has local importance as a shipping and supply point. Population (1890), 2541 ; (1900), 5346, of whom 128 were foreign-born and 1751 were negroes.

Hilton, John (1804-1878), British surgeon, was born at Castle Hedingham, in Essex, in 1804, and was educated at Chelmsford, Boulogne-sur-Mer, and in Guy's Hospital, which he entered in 1824 (M.R.C.S. 1827, F.R.O.S. 1843).

He was appointed demonstrator of anatomy in 1828, assistant-surgeon 1845, surgeon 1849. In 1867 he was President of the Royal College of Surgeons, and delivered the Hunterian oration. He was also surgeon-extraor-dinary to Queen Victoria. As Arris and Gale professor (1859-62) he delivered a course of lectures on " Rest and Pain," which have become classics. Hilton was the greatest anatomist of his time, and was nick-named "Anatomical John." It was he who, with Towne the artist, enriched Guy's Hospital with its unique collection of models. In his grasp of the structure and functions of the brain and spinal cord he was far in advance of his contemporaries. As an operator he was more cautious than brilliant, and this was doubtless due partly to his living in the pre-ansesthetics period, and partly to his own consummate anatomical knowledge, as is indicated by the method for opening deep abscesses which is known by his name. But he could be bold when necessary ; he was the first to reduce a case of obdurate hernia by abdominal section, and one of the first to practise

lumbar colotomy. He died at Clapham on 14th September 1878.

Hilversum, a prosperous town in the province of North Holland, Netherlands, 10 miles north by east of Utrecht by rail. Formerly a small village with a Saxon population engaged in agriculture and linen-weaving (home industry), since 1848 it has become an industrial commune with thirty factories employing 800 workmen, mainly in the manufacture of floorcloths. It is a favourite place of residence for wealthy citizens of Amsterdam and Utrecht. In the vicinity are the Trompenberg sanatorium and the villages of Baarn and Soestdyk (with a royal summer palace). There are middle-class and technical schools. Population (1870), 6000 ; (1900), 19,442.

Himalaya. — Modern geographers restrict the term Himalaya to that portion of the mountain region between India and Tibet which is enclosed within the arms of the Indus and the Brahmaputra. From the bend of the Indus southwards towards the plains of the Punjab to the

bend of the Brahmaputra southwards towards the plains of Assam, through a length of 1600 miles, is Him^leh or Himalaya. Beyond the Indus, to the north-west, the region of mountain ranges which stretches to a junction with the Hindu Kush south of the Pamirs is usually known as Trans-Himalaya. Thus the Himalaya represents the southern face of the great central upheaval — the plateau of Tibet — the northern face of which is represented by the Kuen Lun.

Throughout this vast space of elevated plateau andmountain face geologists now trace a system of main chains, or axes, extending from the Hindu Kush stricture to Assam, arranged in approximately parallel Himalaya. lines, and traversed at intervals by main lines of drainage obliquely. Godwin-Austen indicates six of these geological axes as follows : —

(1) The main Central Asian axis, the Kuen Lun forming the northern edge or ridge of the Tibetan plateau.

(2) The Trans-Himalayan chain of Muztagh (or Kara-“boram), which is lost in the Tibetan uplands, passing to

the north of the sources of the Indus.

(3) The Ladak chain, partly north and partly south of the Indus — for that river breaks across it about 100 miles above Leh. This chain continues south of the Tsanpo (or Upper Brahmaputra), and becomes part of the Hima-layan system.

(4) The Zaskar, or main chain of the Himalaya, i.e., the " snowy range " pa7- excellence, indicated by Nanga Parbat (overlooking the Indus), and passing in a south-east direction to the southern side of the Deosai plains. Thence, bending slightly south, it extends to the line of snowy peaks which are seen from Simla and other hill stations. It leads past Chini . to the famous peaks of Gangotri and Nanda Devi. This is the best known range of the Himalaya, and although its course eastwards to

the north of Nepal is not accurately traced, it probably includes Everest and Kanchinjunga in its stupendous array of snow-bound peaks ere it is merged in the

mountains to the north of Assam.

(5) The outer Himalaya or Pir Panjal-Dhaoladhar ridge.

(6) The Sub-Himalaya, which is " easily defined by the fringing line of hills, more or less broad, and in places very distinctly marked off from the maia chain by open valleys (dhuns) or narrow valleys, parallel to the main axis of the chain." These include the Siwaliks.

Interspersed between these main geological axes are many other minor ridges, on some of which are peaks of great elevation. In fact, the geological axis seldom coincides with the line of highest elevation, nor must it be confused with the main lines of water-divide of the Himalaya.

Accepting this general definition of the structure of the Himalaya, there is a certain amount of fresh matter of interest to be noted about many of these dominant features.

The relation of the central Himalayan range (through which some of the most important rivers of the Indo-

Preseat Gangetic plain force their way southwards) to knowledge that northern watershed of India which is lost of

™ ^^ *article Himalaya in the ninth edition of this Encyclopaedia. South of this great central line of snowy peaks there is little to add to the information of twenty years ago, when the Dhiins and the Tarai and the valleys intersecting the outer Himalaya had been already examined so far as they lay within reach of examination. There were then wide Himalayan tracts which were not open to European exploration. Those tracts are for the most part still closed. Nepal, Bhutan, and the wild Mishmi and Abor hills to the north of the Assam valley are but partially mapped. On the other hand, Kashmir and the Kumaon and Garwhal districts have been closely surveyed, and the physiography of the little state of Sikkim is now well known. It is beyond the line of highest altitudes, to the eastern and western flanks of the great highlands of Tibet, that geographical exploration has lately been chiefly directed ; and it is the physical*

relation between the Himalaya and these mountain border-lands enclosing the central plateau that still chiefly de-mands further elucidation.

*On the north and north-west of Kashmir the great water-divide which separates the Indus drainage area from The great ^^^^ '^^ *^® Yarkand and other rivers of Chinese northern Turkestan has been explored by Younghusband, watershed and, more recently, by Deasy. The general " " ^- result of their investigations has been to show that the Muztagh range, as it trends south-eastwards and finally forms a continuous mountain barrier together with the Karakoram, is the true water-divide west of the Tibetan plateau. Shutting off the sources of the Indus affluents from those of the Central Asian system of hydrography, this great water-parting is distinguished by a group of peaks of which the altitude is hardly less than that of the Eastern Himalaya, culminating in Mount Everest. Mount Godwin-Austen (28,278 feet high), only 730 feet lower than Everest, affords an excellent example in Asiatic geography of a dominating, peak-crowned*

watershed. From Kailas on the far west to the extreme north-eastern sources of the Brahmaputra, the great northern watershed of the Indo-Tibetan highlands has only been occasionally touched. Littledale, Du Khins, and Bonvalot may have stood on it as they looked south-wards towards Lhasa, but for some 500 or 600 miles east of Kailas it appears to be lost in the mazes of the minor ranges and ridges of the Tibetan plateau. Nor can it be said to be as yet well defined to the east of Lhasa, in spite of the enormous accession of information from Russian, American, Erench, and English sources which was gathered during the last twenty years of the 19th cen-tury concerniag the northern face of the Tibetan plateau and the Tibeto-Chinese borderland.

The Tibetan plateau, or Chang, breaks up about the meridian of 92° E., and to the east of this meridian the affluents of the Tsanpo (the same river as the Dihong and subsequently to be known as the riLt" Brahmaputra) drain no longer from the elevated plateau, but from the rugged slopes of a wild region of

mountains (of systematic conformation where its succes-
sive ridges are arranged in concentric curves around the
great bend of the Brahmaputra), wherein are hidden the
sources of all the great rivers of Burma and China.
Neither immediately beyond this great bend, nor within
it in the Himalayan regions lying north of Assam and
east of Bhutan, have scientific investigations yet been
systematically carried out ; but we know that the largest
of the Himalayan afluents of the Brahmaputra west of
the bend derive their sources from the Tibetan plateau,
and break down through the containing bands of hills,
carrying deposits of gold from their sources to the plains,
as do all the rivers of Western Tibet.
Although the northern limits of the Tsanpo basin are
not sufficiently well known for us to locate the Indo-
Tibetan watershed even approximately, there
*exists some scattered evidence of the nature of ™™'o/^*
that strip of Northern Himalaya on the Tibeto- the central
Nepalese border which lies between the line chain of
*of greatest elevation and the trough of the p^^^*

Tsanpo. Eecent investigations show that all the chief rivers of Nepal flowing southwards to the Tarai take their rise north of the line of highest crests, the " main range " of the Himalaya ; and that some of them drain long lateral high-level valleys enclosed between minor ridges whose strike is parallel to the axis of the Himalaya and, occasionally, almost at right angles to the course of the main drainage channels breaking down to the plains. This formation brings the southern water-shed of the Tsanpo to the immediate neighbourhood of the banks of that river. It also affords material evidence of that wrinkling or folding action which accompanied the process of upheaval, when the Central Asian high-lands were raised, which is more or less marked through-out the whole of the north-west Indian borderland. North of Bhutan, between the Himalayan crest and Lhasa, this formation is approximately maintained; farther east, although the same natural forces first resulted in the same effect of successive folds of the earth's crust, forming extensive curves of ridge and furrow, the abun-

dant rainfall and the totally distinct climatic conditions which govern the processes of denudation subsequently led to the erosion of deeper valleys enclosed between forest-covered ranges which rise steeply from the river banks.

It may be noted that, although suggestions have been made from time to time of the existence of higher peaks north of the Himalaya than that which domi-

nates the Everest group, there is no satisfac- Height ot tory evidence to support any such suggestion. “^I’^g. Everest stands surrounded by pinnacles of such an altitude as make it difficult to detect its actual summit, which stUl ranks as the highest in the world. No satisfactory comparison of altitude can possibly be made except from a distance by means of trigonometrical observations. The mean of many such observations from the south-east has determined the height of Everest to be rather above 29,000 feet, and there is nothing to be seen beyond the group of pinnacles immediately sur-

rounding that peak which can compare with this altitude. Similar observations from the Tibetan plateau have hitherto been wanting ; but recent travellers in Central Tibet have recorded nothing of greater altitude above the general level of the plateau (which may be taken at 15,000 feet) than 5000 or 6000 feet; and, looking southwards, have observed no distant peaks on the Nepal frontier which appeared to rival Everest. It is true that local native tradition, which regards Everest as a sacred mountain, seems to recognize some hitherto unmeasured higher peak in its neighbourhood ; but it is obviously impossible that any conclusion could be formed as to the relative altitude of two unapproachable peaks from any position near the base of them. Such traditions are valueless.

If the period 1880-1900 did not add much to our geographical knowledge of the Himalaya in those uncertain spaces where European exploration is impossible on account of Oeological political obstruction or the savjige nature of the in-o/°Ae *”’ habitants, it led to much careful geological survey

Himalaya, resulting in clearly-expressed opinions as to the con-
ditions under which the mountain masses were evolved
and their primary relations with the peninsula of India. The
peninsula, which has been through countless ages of the past (since
the close of the Palaeozoic era) a land area, is now recognized as
having included the Eastern Himalaya and the Assam hills in
its periods of geological evolution ; whilst the "Western Himalaya
belongs to that extra-peninsular area which has been repeatedly
depressed beneath the sea up to the commencement of the Tertiary
age. The older rocks of the Assam ranges are found to be closely
related to those of the peninsula, and coal-bearing sandstones identi-
cal in character with those of the Bengal coalfields are found along
the Himalaya from Sikkim eastwards.
In a remote geological age, at the commencement of the
Cretaceous period, when a land connexion existed between South
Africa and India, and the Maldive and Laccadive islands were
prominent peaks defining a mountain range, the Eastern Himalaya
appears to have been directly connected with the peninsular area
without the intervening depression caused by the Gangetic plain.
So far as we know, there are no marine deposits in the Eastern

Himalaya, and it was part of the ancient Indian peninsula throughout the Palseozoio and Mesozoic ages, when all beyond the Aravalli range to the north-west was part of an ocean floor. The close of the Cretaceous period was the termination of a long period of repose and the commencement of another period of great earth movements which, gradually increasing in intensity, reached their maximum in the Pleiocene age, and are even now in process of reshaping the earth's surface, though with greatly diminished activity and force. The result of these movements was to drive back the sea, which covered all the north-western and northern trans-frontier of India, and to crush and fold the rocks, forcing them up into mountain ranges till marine limestones of nummulitic age have been raised to heights of 20,000 feet above the sea on the Himalaya ; and sea-formed rocks of the trans-Indus frontier were compressed and crushed into jagged parallel lines of anticlinals, fringing a comparatively level surface of upheaved plateau. But there is direct evidence in the older composition of the rocks that the Himalayan upheaval was the result of a longer period of action and of earlier date than that of the Tertiary trans-Indus frontier hills. The immense mass of the Himalaya apparently precludes

the possibility of elevation within the Tertiary period, and it seems probable that even so far back as the Pleiocene age it formed a mountain range not greatly inferior to that which now exists, and with the main drainage features marked out as at present. In those Tertiary beds, originally formed of river deposits and then tilted and compressed into the form of the Siwalik range flanking the foot of the Himalaya, are found beds of conglomerate and boulders close to the outlet of the modern rivers, proving that the ancient beds were not far from the modern channels, and that the rivers flowed much where they do now in the days when the gigantic mammals of Siwalik age roamed through the forests and plains that skirted the Himalayan foothills.

Another result of those earth-movements which upheaved the Himalaya was the formation of the great parallel depression of the Indo-Gangetic plain. At first this depression had Indo-aaa-]3^t one outlet, viz., by the Indus valley to the sea, but getic de- j^^gj jjjg depression deepened between the Assam and pression. jjajmahal hills, and through this channel Himalayan drainage was gradually diverted until, almost within historic times, the Jumna broke away eastwards instead of wandering in count-

less channels to the south and west, and established for ever the present water-divide between the Indus and Ganges. Such, briefiy, is the general outline of Himalayan evolution as now understood, and the process of it has led to certain marked features of scenery and topography, to some of which allusion is made in the ninth edition of the Eneyclopoedia Britannica. The vast area of western trans-Indus hills has been raised above sea^level within the Tertiary period. Here we have beds of hard limestone or sandstone alter-nating with soft shales, which leads to the scooping out by erosion of long narrow valleys where the shales occur, and the passage of the streams through deep rifts or gorges across the hard limestone anticlinals, which stand in regular series of parallel ridges with the eroded valleys between.

The great mass of the Himalaya exhibits the same structure, due to the same conditions acting for a much longer period and on a much larger scale ; but the structure is varied in the eastern por-tions of the mountains by the efiect of different climatic conditions, and especially by the greater rainfall. Instead of wide, barren, windnswept valleys, we here discover fertile alluvial plains — such as Manipur, for instance — ^but for the most part the erosive action of

the river has been able to keep pace with the rise of the river bed, and we have deep, steep-sided valleys arranged between the same parallel system of folds as we see on the western frontier, connected by short transverse gaps where the rivers cross the folds, frequently to resume a course parallel to that originally held. An instance of this occurs where the Indus suddenly breaks through the well-defined Ladakh range in the North-west Himalaya to resume its north-westerly course after passing from the northern to the southern side of the range. The reason assigned for these extra-ordinary diversions of the drainage right across the general strike of the ridges is that it is antecedent — i.e., that the lines of drainage were formed ere the folds or anticlinals were raised ; and that the drainage has merely maintained the course originally held, by the power of erosion during the gradual process of upheaval.

In the outer valleys of the Himalaya the sides are generally steep, so steep as to be liable to landslip, whilst the streams are still cutting down the river beds and have not yet reached the stage of equilibrium. Here and there the valley has become filled with alluvial detritus owing to some local impediment in the drainage, and when this occurs there is usually to be found a fertile and

productive field for agriculture. The straits of the Jhelam, below BaramuUa, probably account for the lovely vale of Kashmir, which is in form (if not in principles of construction) a repetition on grand scale of the Maiden of the Afridi Tirah, where the drainage from the slopes of a great amphitheatre of hills is collected and then arrested by the gorge which marks the outlet to the Bara.

Other rivers besides the Indus and the Brahmaputra commence by draining a considerable area north of the snowy range — the Sutlej, the Kosi, the Gandak, and the Sabansiri, for example. All these rivers break through the main S””?’ snowy range ere they wind and twist their way through ’”’y” the southern hills to the plains of India. Here the iffypi^, “antecedent” theory will not suffice, for there is no sufficient catchment area north of the snows to support it. Their formation is explained by aprocessof ” cutting back, ” by which the heads of these streams are gradually eating their way northwards owing to the greater rainfall on the southern than on the northern slopes. The result of this process is well exhibited in the relative steepness of slope on the Indian and Tibetan sides of the passes to the Indus plateau. On the southern or Indian side the routes to

Tibet and Ladakh follow the levels of Himalayan valleys with no remarkably steep gradients till they near the approach to the water-divide. The slope then steepens with the ascending cmve to the summit of the pass, from which point it falls with a comparatively gentle gradient to the general level of the plateau. The Zoji La, the Kashmir water-divide between the Jhelam and the Indus, is a prominent case in point, and all the passes from the Kumaon and Garwhal hills into Tibet exhibit this formation in a marked degree. Taking the average elevation of the central axial line of snowy peaks as 19,000 feet, the average height of the passes is not more than 10,000 owing to this process of cutting down by erosion and gradual encroachment into the northern basin.

In comparison with the extent of geographical information which has been gained in the trans-frontier regions of the north-west of India, that which has been acquired during the period 1875-1900 about the Himalayan regions Ls i^?”^’ small. The trans-Himalayan mountains about the ”””^’y head of the Gilgit valley, the sources of the Oxus, of the Kunar (or Chitral) river, and of the rivers of the Kashgar depression, have all been mapped, their glaciers and snowfields explored, and the

difficult tracks and-passes which intersect them examined ; but in the Himalayan region, between the Indus and the Brahmaputra, it is, doubtful if we know of a single new pass or mountain peak. From the western frontier of Nepal bordering Kumaon to Sikkim, for a distance of 180 miles along the length of the Nepal state, no fresh information has been gathered. Then Sikkim intervenes, and here for a short space we have extended geographical recon-naissance into surveys ; but beyond Sikkim eastwards through Bhutan to the wild Assamese border hUls we have nothing new to

record — not a new pass opened, nor a rudimentary exploration accomplished. This is due partly to the jealous watchfulness of the Nepalese authorities against the intrusion of strangers, which is maintained with rather increasing vigilance than otherwise, and to the wild and savage nature of the Assamese border tribes, who have not as yet been touched by civilizing influences. Conse-quently much of the Himalaya is stiU to us a region of conjecture, but of conjecture which is based on most careful study of neigh-

bouring districts.

The northern tributaries of the Gilgit river, which joins the Indus near its south-westerly bend towards the Punjab, take Glaciers ^^^”^ ™e from a glacier system which is probably unequalled in the world for its extent and magnificent proportions. Chief amongst them are the glaciers which have formed on the southern slopes of the Muztagh mountains below the group of gigantic peaks dominated by Mount Godwin-Austen (28,278 feet high), the Golden Throne, and Masharbrum. The Biafo glacier system, which lies in a long narrow trough extending south-west from Nagar on the Hunza to near the base of the Muztagh peaks, may be traced for 90 miles between mountain walls which tower to a height of from 20,000 to 25,000 feet above sea^level on either side. The glaciers of the Himalaya have not yet been brought under systematic observation, but it is clear that there are no glaciers in the Himalaya to rival the trans-Indus group of the Muztagh. Griesbach’s investigations of the chief glaciers of the Kumaon group show them to be of great extent. Nearly all the high valleys of the Himalaya possess glaciers. Near the Niti Pass leading from Almora into Tibet there is a glacier 8 miles

long ; and Nanda Devi, one of the best known of the Central Himalayan group of snowy mountains, is surrounded by them. A glacier on the north side of Nanda Devi is 14 miles in length. The Gangotri group of peaks heading the Ganges sources are all surrounded with glaciers. Griesbach points out that the glaciers of the Central Himalaya are receding, and that they once extended to a much lower level than at present. This gradual diminution of glacial surface is equally apparent in trans-Himalayan regions. Much has been written about the impressiveness of Himalayan scenery, and there is no need to repeat the observations of travellers who have described the countless phases of mountain landscape that are to be found within so vast a region subject to such variations of climatic influence. It is but lately, however, that any adequate conception of the magnitude and majesty of the most stupendous of the mountain groups which mass themselves about the upper tributaries and reaches of the Indus has been presented to us in the works of Younghusband, Conway, and Tanner. It is not in comparison with the picturesque beauty of European Alpine scenery that the Himalaya appeals to the imagination, for amongst the hills of the

outer Himalaya — ^the hills which are known to the majority of European residents and visitors — there is often a striking absence of those varied incidents and sharp contrasts which are essential to picturesqueness in mountain landscape. Too often the brown, barren, sun-scorched ridges are obscured in the yellow dust haze which drifts upwards from the plains ; too often the whole per-spective of hiU and vale is blotted out in the grey mists that sweep in soft, resistless columns against these southern slopes, to be con-densed and precipitated in ceaseless monotonous rainfall. Few Europeans really see the Himalaya; fewer still are capable of translating their impressions into language which is neither exaggerated nor inadequate.

Some idea of the magnitude of Himalayan mountain construction — a magnitude which the eye totally fails to appreciate — may, however, be gathered from the following table of comparison of the absolute height of some peaks above sea^level with the actual amount of their slopes exposed to view :• —

Belative Extent of Snow Slopes Visible.

Mountain

scenery.

Name of Mountain.

Place of Observation.

Height

above Sea.

Amount of

Slope ex-

posed.

Everest or Gaurisankar

Dewanganj

29,000

8,000

i» ‘)

Sandakphu

,,

12,000

Kg or Godwin-Austen .

Between Gilgit and

Gor, 16,000 feet .

28,278

Pk. XIII. or Makalu .

Purnea, 200 feet

27,800

8,000

»» »,

Sandakphu, 12,000 feet

9,000

Nanga Parbat

Gor, 16,000 feet

26,000

28,000

Tirach Mir .

Between Gilgit and

Chitral, 8000 feet

25,400

17-18,000

Eakaposhi

Chaprot (Gilgit), 18,000

feet ....

25,560

18,000

Kanehinjunga

Dariillng, 7000 feet

28,160

16,000

Mont Blanc

Above Chamounix, 7000

feet

1.5,781

11,500

It will be observed from this table that it is not often that a

greater slope of snow-covered mountain side is observable in the

Hill

stations.

Himalaya than that which is afforded by the familiar view of Mont

Blanc from Chamounix.

As regards the scenery surrounding the highest mountain in the

world, Tanner says that the finest view of it which is obtainable

from British territory is that which may be gained from San-

dakphu, 35 miles from Darjiling. " The outline of Everest is

rather tame, though fairly sharp, and a long snowy slope rests on

its north-east flank. Peaks of 22,000 feet and thereabouts encircle its southern base, and below them are seen many dark mountain masses without snow. From due south, near the Kosi river in the Bhagalpur district, Everest is by no means a marked feature in the landscape ; although from a near point of view its face is wild, and the cliff must be very lofty. . . . Though rising to a height of 29,000 feet, it only towers 12,000 feet above its fellows, and is thus relatively commonplace." He further points out that the Tibetans probably refer to Peak T 45 of the Indian Survey to the north-west of Everest, which rises to 27,000 feet, when they claim a higher peak than Everest. Its comparatively isolated position would produce the impression of greater altitude.

For the picturesque beauty of its natural setting in the midst of tropical mountain scenery, no less than for grandeur of outline and profound impression of majestic predominance, there is probably no" rival in the world to Kanchin- la^g^ junga as seen from Darjiling. Here the forest splen- dours of the south combine with the ice-bound majesty of the north, and the two are linked by 16,000 feet of cloud-woven wreaths resting on the successive steps of the grandest mountain

staircase that nature has ever fashioned.

The development of the ‘ ‘ hiU stations ‘ ‘ of the Himalaya is naturally a point of interest in connexion with the general economic progress of India. Great efforts have been made since 1875 to render these stations, or towns, more accessible from the plains, with the result of an increasing population during those months of the year when the heat of the plains drives Europeans to the cool atmosphere of the mountains. It does not appear that the fixed and permanent population of hill stations is largely on the increase, although there is a distinct tendency towards native concentration in the neighbouring villages, and a visible spread of local cultivation in adjacent valleys. No marked increase of European colonists in the Himalaya, east of Kashmir, is recognizable, although the growing intermittent condensation of official society in the hill stations has called for increased house accommodation for temporary occupation. Indeed, the habitations of many of those European settlers who existed in days when communication with Europe was a matter of months now know them no more, and as a rule they have not been reoccupied. In the sheltered valley of Kulu,

and on the outer slopes below Darjiling, fruit plantations and tea cultivation have been largely developed under European management ; but with few exceptions the successful prosecution of agriculture does not lead to permanent settlements in the Hima^ laya. But the increased facilities for exchanging the close sultry atmosphere of the Indian plains in summer for the more invigor-ating (though frequently more humid) climate of " the hiUs " have developed a temporary European population of thousands in places (as in Simla) where there used to be hundreds not so very long ago, and have demanded still further efforts towards facilitating communications.

*At Darjiling a mountain railway of 51 miles in length already connects that station with the Bengal railway system, but this is the only hill station of the Himalaya which in the year 1900 enjoyed such facilities of approach. RaUway '**<"l'>tain projects are already sanctioned for connecting Srinagar '–"-"y^- in Kashmir with the Punjab, and Simla with the head of the Delhi-Kalka line ; and the road to Mussoorie will be shortened by a line which will connect Dehra-Dun at the foot of the Mussoorie hills with the sanitarium on their summits. These short local*

mountain lines would have been constructed earlier had the trade from the hill regions to the plains been sufficient to justify them, but trade with the interior across the Himalayan passes has shown little signs of development. Trade from High Asia across the group of passes which head the rivers of Kumaon and Garwhal, as well as that by the Sutlej river route through Simla, has rather diminished than increased of late years. In Kashmir alone there has sprung up a considerable local traffic (chiefly in frait), and between Tibet and Kashmir viQ, Ladak there seems to be promise for the future.

AuTHORiTJES.— Our old authorities on the Himalaya (notably the Stracheys, Hooker, and Blanford) are still the best, but we have had a good many popular contributions to the subject since 1875, amongst which the following are the best known : — Drew. Jammu and Kashmir. London, 1875. — Leitner. Dardistan. — BiDDULPH. Tribes of the Hindu Kush. Calcutta, 1880.— Lydekker. "Geology of Kashmir, &c." Vols. xiii. and xiv. Geological Survey of India. — Godwin-Austen. "Mountain Systems of the Himalaya." Vols. v. and vi. Proc. B. O. S.,

1883-8-1. — Ujpalvt. Aus dem westUchen Himalaya. Leipzig, 1884. — Tanner. “Our Present Knowledge of the Himalaya.” A’ol. xiii. Proc. S. G. S., 1891.— Geiesbach. “Geology of Central Himalaya.” Geological Survey Memoirs. Calcutta, 1891.— Oldham. ” The Evolution of Indian Geography.” Vol. iii. Jour. S. G. ;S.— Lawrence, W. Kashmir. Oxford, 1895.— Conway. Climbing and Exploring in the Karakoram. London, 1898. (t. h. h.*)

Hindley, a township in the Ince parliamentary-division of Lancashire, England, 2 miles east-south-east of Wigan, on the Lancashire and Yorkshire and the London and North-Western railways. It has a free library and museum. Area of township (an urban district), 2611 acres. Population (1881), 14,715 ; (1901), 23,604.

Hindu Kush, a range of mountains, throughout 600 miles of its length, from its roots in the Pamir regions till it fades into the Koh-i-Baba to the west of Kabul, forming the water-divide between the Kabul and the Oxus basins, and, for the first 200 miles, reckoning westwards,

the southern boundary of Afghanistan. It may be said to spring from the head of the Taghdumbash Pamir, where it unites with the great meridional system of Sarikol stretching northwards, and the yet more impressive mountain barrier of Muztagh, the northern base of which separates China from the semi-independent territory of Kanjut. The Wakhjir pass, crossing the head of the Taghdumbash Pamir into the sources of the river Hunza, almost marks the tri-junction of the three great chains of mountains. As the Hindu Kush strikes westwards, after first rounding the head of an Oxus tributary (the Ab-i-Panja, which Curzon considers to be the true source of the Oxus), it closely overlooks the trough of that glacier-fed stream under its northern spurs, its crest at the nearest point being separated from the river by a distance which cannot much exceed 10 miles. As the river is here the northern boundary of Afghanistan, and the crest of the Hindu Kush the southern boundary, this distance represents the width of the Afghan kingdom at that point.

Physiography. — For the first 100 miles of its length the Hindu Kush is a comparatively flat-backed range of considerable width, permitting the formation of small lakes at intervals on the crest, and possessing no considerable peaks. It is crossed by many passes, varying in height from 12,500 feet to 17,500 feet, the lowest and the easiest being the well-known group about Baroghel, which has from time immemorial offered a line of approach from High Asia to Chitral and Jalalabad. As the Hindu Kush gradually recedes from the Ab-i-Panja and turns south-westwards it gains in altitude, and we find prominent peaks on the crest which measure more than 24,000 feet above sea-level. Even here, however, the main central water-divide, or axis of the chain, is apparently not the line of highest peaks, which must be looked for to the south, where the great square-headed giant called Tirach Mir dominates Chitral from a southern spur. Eor some 40 or 50 miles of this south-westerly bend, bearing away from the Oxus, where the Hindu Kush overlooks the mountain wilderness of

Badakshan to the west, the crest is intersected by many passes, of which the most important is the Dorah group (including the Minjdln and the Mandal), which rise to about 15,000 feet, and which are, under favourable conditions, practicable links between the Oxus and Chitral basins.

Kafiristan Section. — From the Dorah to the Khawak pass (or group of passes, for it is seldom that one solitary line of approach only is to be found across the Hindu Kush), which is between 11,000 and 12,000 feet in altitude, the water-divide overlooks Kafiristan and Badakshan. Here its exact position is matter of conjecture.

It lies amidst a wild, inaccessible region of snow-bound crests, and is certainly nowhere less than 15,000 feet above sea-level. There is a tradition that the great Timur attempted the passage of the Hindu Kush by one of the unmapped passes hereabouts, and that, having failed, he left a record of his failure engraved on a rock in the pass.

Passes. — The Khawak, at the head of the Pan j shir

tributary of the Kabul, leading straight from Badakshan to Charikar and the city of Kabul, is now an excellent khafila route, the road having been engineered under the Amir's direction, and it is said to be available for traffic throughout the year. From the Khawak to the head of the Ghorband (a river of the Hindu Kush which, rising to the north-west of Kabul, flows north-east to meet the Panjshir near Charikar, whence they run united into the plains of Kohistan) the Hindu Kush is intersected by passes at intervals, all of which were surveyed, and several utilized, during the return of the Eusso-Af ghan Boundary Commission from the Oxus to Kabul in 1886. Those utilized were the Kaoshan (the " Hindu Kush " pass par excellence), 14,340 feet ; the Chahardar (13,900 feet), which is a link in one of the Amir of Afghanistan's high roads to Turkestan; and the Shibar (9800 feet), which is merely a diversion into the upper Ghorband of that group of passes between Bamiin and the Kabul plains which are represented by the Irak, Hajigak, Unai, &c. About this point it is geographically correct to place

the southern extremity of the Hindu Kush, for here commences the Koh-i-Baba system into which the Hindu Kush is merged.

General Conformation. — The general conformation of the Hindu Kush system south of the Khawak, no less than such fragmentary evidence of its rock composition as at present exists to the north, points to its construction under the same conditions of upheaval and subsequent denudation as are common to the western Himalaya and the whole of the trans-Indus borderland. Its upheaval above the great sea which submerged all the north-west of the Indian peninsula long after the Himalaya had massed itself as a formidable mountain chain, belongs to a comparatively recent geologic period, and the same thrust upwards of vast masses of Cretaceous limestone has disturbed the overlying recent beds of shale and clays with very similar results to those which have left so marked an impress on the Baluch frontier. Successive flexures or ridges are ranged in more or less parallel lines, and from between the bands of hard, unyielding rock of

older formation the soft beds of recent shale have been washed out, to be carried through the enclosing ridges by rifts which break across their axes. The Hindu Kush is, in fact, but the face of a great upheaved mass of plateau land lying beyond it northwards, just as the Himalaya forms the southern face of the great central table-land of Tibet, and its general physiography, exhibiting long, narrow, lateral valleys and transverse lines of "ante-cedent" drainage is similar. There are few passes across the southern section of the Hindu Kush (and it should be noted that this section is, from the politico-geographical point of view, more important to India than the whole Himalayan system) which have not to surmount a suc-cession of crests or ridges as they cross from Afghan Turkestan to Afghanistan. The exceptions are, of course, notable, and have played an important part in the military history of Asia from time immemorial. From a little ice-bound lake called Gaz Kul, or Karambar, which lies on the crest of the Hindu Kush near its northern origin at the head of the Taghdumbash Pamir, two very important

river systems (those of Chitral and Hunza) are helieved to originate. The lake really lies on the watershed between the two, and is probably a glacial relic. Its contribution to either infant stream appears to depend on conditions of

overflow determined by the blocking of ice masses towards one end. It marks the commencement of the water-divide which primarily separates the Gilgit basin from that of the Yashkun, or Chitral, river, and subseqnently divides the drainage of Swat and Bajaor from that of the Chitral (or Kunar). The Yashkun-Chitral-Kunar river (it is called by all three names) is the longest affluent of the Kabul, and it is in many respects a more import-ant river than the Kabul. Throughout its length it is closely flanked on its left bank by this main water-divide, which is called Moshabar or Shandur in its northern sections, and owns a great variety of names where it divides Bajaor from the Kunar valley. It is this range, crowned by peaks of 22,000 feet altitude and

maintaining an average elevation of some 10,000 feet throughout its length of 250 miles, that is the real barrier of the north — not the Hindu Kush itself. Across it, at its head, are the glacial passes which lead to the foot of the Baroghel. Of these Darkot, with a glacial staircase on each side, is typical. (See Gilgit.) Those passes (the Kilik and Mintaka) from the Pamir regions, which lead into the rocky gorges and defiles of the upper affluents of the Hunza to the east of the Darkot, belong rather to the Muztagh system than to the Hindu Kush. Other passes across this important water-divide are the Shandur (12,250 feet), between Gilgit and Mastuj ; the Lowarai (10,450 feet), between the Panjkora and Chitral valleys ; and farther south certain lower crossings which once formed part of the great highway between Kabul and India.

Chitral. — Deep down in the trough of the Chitral river, about midway between its source and its junction with the Kabul at Jalalabad, is the village and fort of Chitral. The village is insignificant, and the fort derives

its notoriety from the siege of 1895, when it proved to be defensible with difficulty against an undisciplined high-land rabble who were without artillery. Facing Chitral, on the right bank of the river, and extending for some 70 miles from the Hindu Kush, is the lofty snow-clad spur of the Hindu Kush known as Shawal, across which one or two difficult passes lead into the Bashgdl valley of Kafiristan. This spur carries the boundary of Afghan-istan southwards to Arnawai (some 60 miles below Chitral), where it crosses the river to the long Shandur watershed. South of Arnawai the Kunar valley becomes a part of Afghanistan (see Kunae). Chitral can be reached either by the long circuitous route from Gilgit, involving 200 miles of hill roads and the passage of the Shandur pass (12,250 feet), or (more directly) from the Peshawar frontier at Malakand by 100 miles of route through the independent territories of Swat and Bajaor, involving the passage of the Lowarai (10,460 feet). It is held at present by a small force as a British outpost. The district of Chitral is called Kashkar (or Kashgar) by

the people of the country; and as it was once under Chinese domination, and was regarded as a Buddhist centre of some importance by the Chinese pilgrims in the early centuries of our era, it is possible that it then existed as an outlying district of the Kashgar province of Chinese Turkestan, where Buddhism once flourished in cities that have been long since buried beneath the sand-waves of the Takla Makan. The aboriginal population of the Chitral valley is probably to be recognized in the people called Kho (speaking a language called Khowar), who form the majority of its inhabitants. It is from this Kho community that Sir H. Yule considered it likely that the ancient classical name of Khoaspes for the river of Chitral was derived. Upon the Kho a people called Ronas have been superimposed. The Ronas, who form the chief caste and fighting race of the Chitral districts, originally came from the north, but they have adopted the 'language and fashions of the conquered Chitrali. Chitral may be regarded as an outlying branch of the Gilgit political agency, which is itself a branch of Kashmir

administration, its political status being " independent." The value of Chitral as an outpost of British India may be best gauged by its geographical position. It is about 100 miles (direct map measurement) from the outpost of Russia at Langar Kisht on the river Panja, with the Dorah pass across the Hindu Kush intervening. The Dorah may be said to be about half-way between the two outposts, and the mountain tracks leading to it on either side are rough and difficult. The Dorah, however, is not the only pass which leads into the Chitral valley from the Oxus. The Mandal pass, a few miles south of the Dorah, is the connecting link between the Oxus and the Bashg61 valley of Kafiristan ; and the Bashgdl valley leads directly to the Chitral valley at Arnawai, about 50 miles below Chitral. Nor must we overlook the connexion between north and south of the Hindu Kush which is afforded by the long narrow valley of the Chitral (or Yashkun) itself, leading up to the Baroghel pass. This is the route which was once made use of by the Chinese for purposes of pil-grimage, if not for invasion. Access to Chitral from the

north is therefore but a matter of practicable tracks, or passes, in two or three directions, and the measure of practicability under any given conditions can best be reckoned from Chitral itself. By most authorities the possibility of an advance in force from the north, even under the most favourable conditions, is considered to be exceedingly small; but the tracks and passes of the Hindu Kush are only impracticable so long as they are left as nature has made them. (See Chitkal.)

Our information about the Hindu Kush and Chitral is now comparatively exact. The Russo-Afghan Boundary Commission of 1884 and the Chitral Expedition of 1895 opened up a vast area for geographical investigation, and the store of information collected is to be found in the reports and gazetteers of the Indian Government. The following are the chief recent authorities : — Report of the Russo-Afghan Boundary Commission, 1886 ; Report of Lookhart's Mission, 1886 ; Report of Asmar Boundary Commission, 1895 ; Report of Pamir Boundary Commission, 1896. J. BiDDULPH. Tribes of the Hindu Kush. Calcutta, 1880. — W. M'Naik. "Visit to Kafiristan." Vol. vi. B. G. S. Froc, 1884.

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(t. H. H.)*

Hindu Law, — The Hindu law is that body of law which is administered by the courts of British India when they are dealing with Hindus. It is not a territorial law applicable to all persons in British India, but a personal law applicable to Hindus only. And even for Hindus the Hindu law which is administered to-day does not cover the whole field of jurisprudence. There are many laws, some made by the British Parliament, some by the legislative bodies in India, and some which have grown up under the decisions of the courts, which are applicable to Hindus as well as to other British subjects in India.

The extent to which Hindu law is administered by the British courts in India, and the circumstances by which

that extent has been determined, can onl}'- be explained by a short recapitulation of the events which led to these courts being established. Prior to 1771 the only British courts in India were those in Calcutta, Bombay, andMadras, established by royal charter and administering English law. In 1772, Warren Hastings, as Governor-General in council, acting, not under any authority derived from the British Government, but under the authority conferred upon the East India Company by the Mogul emperor, drew up a series of regulations for the administration of civil justice in Bengal, Behar, and Orissa. At that time the

law which prevailed in those districts in civil matters was as regards Hindus the Hindu law, as regards Mahom-medans the Mahommedan law. The criminal law as rega,rds all persons was the Mahommedan law, but juris-diction in criminal matters was reserved by the emperor to his own officers, and did not pass to the East India Company until later. The form in which the authority of

the emperor was granted was that of appointing the East India Company to be the " Dewan," or chief civil officer, in Bengal, Behar, and Orissa. This authority was, of course, exercised by the Company through the Governor-General in council. What were the exact limits of this authority it would not be very easy to determine, for though in theory the East India Company were the servants of the emperor, all the substantial power lay with the Company, and probably Hastings did not consider very closely what the exact limits of his authority were. What he actually announced in the Eegulations by which he constituted the courts in the above districts, was that " in all suits regarding inheritance, marriage, caste, and other religious usages and institutions, the laws of the Koran with respect to Mahommedans and those of the Shasters with respect to Gentoos [i.e., Hindus] shall be invariably adhered to." What law was to be applied in other cases the Eegulations did not say, but it must be remembered that the topics of litigation at that time were very few.

Shortly after this, namely, in 1773, the Supreme Court was established in Calcutta under the authority of Parliament. There arose out of this a conflict between the Governor-General in council and the Supreme Court, on account of the latter claiming jurisdiction outside Calcutta, to which the officers of the East India Company refused to submit. This dispute was settled by the statute 21 Geo. III. c. 70, which confined the jurisdiction of the Supreme Court to Calcutta, and declared that the "inheritance and succession to lands, rents, and goods, and all matters of contract and dealing between party and party, shall be determined in the case of Mahommedans by the laws and usages of the Mahommedans, and in the case of Gentoos [i.e., Hindus] by the laws and usages of Gentoos." In matters of contract the native laws have never been much regarded, and, except where any special custom can be proved, the whole matter is now governed by the Contract Act. The old legislative enactments have also been superseded. By Act 111 of 1887, § 37, the law to be administered in the civil courts in

Bengal, the North- West Provinces, and Assam is laid down in these terms : — " Where in any suit or other proceeding, it is necessary for a civil court to decide any question regarding succession, inheritance, marriage, or caste, or any religious usage or institution, Hindu law in cases where the parties are Hindus shall form the rule of decision, except in so far as such law has by legislative enactment been altered or abolished " ; and there are statutory provisions in similar terms for other parts of India. The interpretation put upon the provisions of the Indian Eegulations quoted above, the British Act of Parliament, and the later Indian Acts have been substantially the same.

Sources of Hindu Law. — The Hindu law is in theory of divine origin, and therefore unchangeable by human authority. Ask a Hindu where his law is to be found, and he will reply " In the Shasters." The Shasters are certain books supposed to be divinely inspired, and all of great antiquity. They contemplate a state of society very unlike that of the present day, or that of many centuries

back. It follows that these sacred writings, whilst they leave many of the legal requirements of the present day wholly unprovided for, contain many provisions which no Hindu even would now think of enforcing. C on sequently, in spite of the theory, the law had to be changed. Legislation, which with us is the most potent as well as the most direct instrument of change, has had scarcely any effect on the Hindu law. Probably it never entered into the head of any Hindu before British rule was set up in India that any human agency could be entrusted with the power of making or changing the law ; and although both the Indian Legislatures and the British Parliament have full power to legislate for Hindus upon all matters without any exception, they have, in fact, hardly ever exercised this power as regards the Hindu law. Custom is a less direct instrument of change than legislation, and operates more slowly and secretly, but its influence is very great. The custom which supplants the sacred law may indeed be as old as or older than the sacred law, and its existence may be due to the divinely inspired law having

failed to displace it ; or the habits and necessities of the people may have engrafted the custom upon the sacred law itself. In either view there has been no difficulty in accepting custom where it varied from the sacred law. Indeed, the sacred books themselves recognize to some extent the operation of custom. Thus we find it said in the Laws of Manu (viii. 4, 1), " the king who knows the sacred law must inquire into the laws of castes, of districts, of guilds, and of families, and thus settle the peculiar law of each." It is to the influence of custom that the divergence between the Hindu law of to-day and that of the Shasters is largely due. Another method by which law is developed, and one more subtle still, is interpretation ; and it is one which in skilful hands may be used with considerable effect. Without any dishonesty, people very often find in the language of the law words sufficiently vague and comprehensive to cover the sense which they are looking for. The action of interpretation upon Hindu law differs accordingly as it took place before or after the British occupation. Formerly

the only persons whose interpretation was accepted as authoritative were the writers of commentaries. But the Indian courts are very sparing in accepting modern commentaries as authoritative, though nevertheless they carefully record their own interpretations of the law, and these are always treated as authoritative. It follows, from the very nature of the influences thus brought to bear upon law, that not only have the sacred books been departed from, but that different results have been arrived at in different parts of India. The differences have led recent writers to speak of five schools of Hindu law, called respectively the Benares school, the Bengal or Gaiiriya school, the Bombay school or school of Western India, the Dravida school or school of Southern India, and the Mithila school — the district last named being a very small one to the south of and adjoining Nepal. But it would be a great mistake to suppose that the differences between these so-called schools are comparable to each other in importance. As will appear presently, it would be much more correct to speak of two schools, that of

Benares and that of Bengal — the other three being sub-divisions of the first.

Sacred Books. — It will be convenient to give a short description of those of the sacred books which are actually in use in the Indian courts when they desire to ascertain the Hindu law. Of these by far the first in importance, as well as the first in date, is the one which we call the Laws of Manu. It has been translated by Professor Buhler, and forms vol. xxv. of the " Sacred Books of the East," edited by Professor Max Mtiller. If we examine it, we find that only about one-fourth of the book deals with matters which we should call legal, the rest being concerned with topics either purely religious or ceremonial. And of these topics only one, that relating to partition of family property, belongs to that portion of

the Hindu law which is administered in the courts, and, as one would expect, what is said on this topic has been largely departed from under the influences above de-

scribed. Very little is known as to the date of the Laws of Manu. They are probably much older than their present form, which Buhler places somewhere between 200 B.C. and a.d. 200. Of more interest than the exact date is the state of society which they disclose. The tribal and nomadic stage had passed away. Society had so far settled down as to possess a regular form of government under a king. The people were divided into four great castes, representing religion, war, commerce and agriculture, and servitude. Justice is spoken of as administered by the king. Provision is made for the recovery of debts and the punishment of offences. There are rules relating to the pasture of cattle, trespass by cattle, and the enclosure of cultivated fields. There was evidently considerable wealth in the shape of horses, carriages, clothes, jewellery, and money. There is no mention of land in general as the subject of permanent private property, though no doubt the homestead and the pasture land immediately adjoining were permanently owned. The (so-called) Smriti of Yajnavalkya was, no doubt, a

work of considerable importance in its day, and is still sometimes referred to. It shows a somewhat more advanced state of society than the Laws of Manu. The occupier of land has a firmer hold upon it, and there seems to be even a possibility of transferring land by sale. The date of it has not been fixed, but it is thought to be later than the Laws of Manu.

The Smriti of Narada belongs to a still later period, perhaps to the 6th or 6th century of our era. It goes more into detail than the other two books just mentioned. But far more important for practical purposes than these sacred books are the commentaries. These are not sacred. The most important of them all is that known as the Mitacshara. The author of it was named Vijnaneswara. His work is a commentary on the Smriti of Yajnavalkya, and it is supposed to have been written in the latter half of the 11th century. Only a portion of it is used by the law courts — ^that portion which relates to the partition of family property. It is easy to see that in the eight or ten centuries which had elapsed

since the date of the Laws of Manu, society had considerably advanced, and that the law has undergone great changes. The Mitacshara is an important authority for Hindus all over India, and in the greater part its authority is supreme. But there is one very important exception. In the district which is sometimes called Bengal Proper (from its correspondence with the ancient kingdom of Bengal, of which Gaur was the capital), and may be roughly described as the valley of the Ganges below Bhagalpur, the prevailing authority is a treatise called the Dayabhaga. It is, like the Mitacshara, as its name imports, a treatise on partition. The author of it was Jimutavahana. There does not appear to be any more distinct clue to its date than that this author wrote after the 12th century and before the 16th. The very important points of difference between the two commentaries will be stated hereafter. In Western India there is a commentary of authority called the Vyavahara Mayukha. It belongs to the 16th century. Generally its authority is secondary to that of the

Mitacshara, but in Gujrat its authority is to some extent preferred. In the south of India the Smriti Chandrika is a work of importance. It belongs to the 13th century. It generally follows the Mitacshara, but is fuller on some points. The Vivada Chintamani is used in the small district of Mithila. It is said to belong to the 15th century.

The Joint Family. — The joint family is by far the most important institution of Hindu society, and it is only through the joint family that we can form a proper conception of the Hindu law. It is the form in which the patriarchal system has survived in India. There is nowhere in Hindu literature, ancient or modern, a description of it as it has existed at any time. In its general features it has always been too universal and too well known to be described. In the Laws of Manu we find very little about it, but what we do find is of great interest. The subject is taken up with reference to a question which in every patriarchal system imperatively requires an answer. What is to be done when

a break-up of the family is threatened by the death of the common ancestor ? Upon this subject the author of the Laws of Manu says in chap. ix. v. 104 : " After the death of the father and the mother, the brothers being assembled, may divide among themselves in equal shares the paternal estate, for they have no power over it while the parents live." Then in v. 105, " or the eldest son alone may take the whole paternal estate ; the others shall live under him just as they lived under the father." And in v. Ill, "Either let them thus live together, or apart if each desires to gain spiritual merit, for by their living separate merit increases, hence separation is meritorious."

We may put aside what is said about the mother, which is probably a survival of polyandry, and is now obsolete, and fix our attention upon three important points : — (1) Authority is attributed to the father during his life ; (2) the same absolute authority is attributed to the eldest son upon the father's death, if the family remains undivided; (3) the sons are at liberty, are

indeed recommended, to divide the property. Ifow, though there may be doubts as to how far this type of family was at any time the universal one, there cannot be any doubt that in those early times it largely prevailed, and that the modern Hindu joint family is directly derived from it. Moreover, it must be remembered that what is here discussed is not ownership, but managership. If the family remained undivided, the eldest son did not take the family property as owner ; he only became the uncontrolled manager of it. So far as there was any notion of ownership of the family property, and it was in those early times quite rudimentary, it was in the nature of what we call corporate ownership. The property belonged not to the individual members of the family collectively, but to the family as a whole ; to use a modem illustration, not to the members of a family as partnership property belongs to partners, but as collegiate property belongs to fellows of a college. Probably, however, in early times it never occurred to any one to look very closely into the

nature of ownership, for until the question of alienation arises the difference between managership and ownership is not of very great importance ; and this question did not arise until much later. When and under what circumstances Hindus first began to consider more carefully the nature of ownership we have no means of ascertaining. But we have very clear evidence that there was at one time a very warm controversy on the subject. Each of the two leading commentaries on Hindu law, the Mitacshara and the Dayabhaga, opens with a very long discussion as to when and how a son becomes entitled to be called an owner of the family property. Two conflicting theories are propounded. One is that the sons are joined with the father in the ownership in his lifetime ; the other is that they only become owners when he dies, or relinquishes worldly affairs, which, according to Hindu ideas, like taking monastic vows, produces civil death. The author of the Mitacshara adopts the first of these views ; the author of the Dayabhaga adopts the second ;

and this radical difference led to the great schism in the Hindu law. It follows that, according to the Dayabhaga view, the sons not being owners, the father is sole owner. He is both sole owner and uncontrolled manager. According to the Mitacshara view the father and the sons together are the owners, not as individuals, but as a corporation. But even this is not inconsistent with the father retaining his absolute control as manager. How far he has done so will be considered presently.

Hitherto, for the sake of simplicity, the position of father and son has alone been considered ; but now take the case of several brothers living together with sons and grandsons. What is the nature of the ownership in this case, and in whom is it vested? Neither in the Dayabhaga nor in the Mitacshara is this question discussed directly, but each of these commentaries discloses the answer which its author would give to this question. According to the Mitacshara, of however many different

branches, and of however many different members, a family may consist, they all form a single unity or corporation to which the family property belongs. Not that this is asserted in so many words ; there is probably no Sanskrit word corresponding at all nearly to our word corporation. But this is the only language in which a modern lawyer can describe the situation. The members of the family are not partners; no one can separately dispose of anything, not even an undivided share. It is quite otherwise under the Dayabhaga. The property belongs to the members of the family, not as a corporation, but as joint owners or partners. Each is the owner of his undivided share ; but not all the members of the Dayabhaga family have a share in the ownership ; the sons whose fathers are alive are entirely excluded: the owners are those members of the family of any age who have no direct living ancestor.

This was the nature of family ownership in its two principal forms, but the possibility that an individual member of the family could have something exclusively

his own is clearly recognized in the Laws of Manu. Thus in chap. ix. v. 206, it is said, " Property acquired by learning belongs solely to him to whom it was given, likewise the gift of a friend, a present received in marriage, or with the honey mixture." And again- in V. 208, " What the brother may acquire by his labour without using the patrimony, that acquisition made solely by his own effort he shall not share, unless by his own will, with his brothers"; and these texts, as we shall see presently, are still of practical application. Nowhere has a strict family system prevailed without some analogous measure of relief. In E.ome we find the peculium. In England, as late as the 13th century, lawyers speak of the allod, or ancient inalienable family domain, sometimes called hereditas, side by side with the questum, or acquired property. And Sir Henry Maine considers that there is something analogous in the ancient Brehon law (see Early History of Institutions, 110).

The modern Hindu joint family is a community the

members of which are all descended from a common ancestor, and the wives and unmarried daughters of those who are married. Perhaps the wives and daughters might more correctly be said to belong to the family than to be members of it. In its complete form the family is said to be joint in food, worship, and estate; and not-withstanding the divergence between the Mitacshara and Dayabhaga systems, the main external features of such a family are the same all over India. Every Hindu family has a common home. This does not mean that there is a single house in which all the members of the family continuously reside, but there is one house where the family gods remain, where the wants of all the members of the family are provided for, where the family worship is conducted, and to which every mem-ber of the family is at any time at liberty to resort. This is the real home of a Hindu. Any other residence, however long it may last, is looked upon as temporary. Here also the wives and children remain whilst the men are employed at a distance. With regard to the

enjoyment of the family property there is no distinction, except such as the members of the family themselves choose to make. Everything is enjoyable in common. This is the same all over India. It is very necessary to distinguish between ownership and enjoyment. Although the ownership of the family property under the Mitacshara differs very materially (as explained above) from that under the Dayabhaga, the enjoyment in both cases is the same. There is one common fund out of which the wants of the family are supplied. No one is dependent upon his own contribution to the family fund. No one member can say to another, " You have consumed more than your share, and you must make it good." On the other hand, whatever is earned goes into the common stock. Though separate acquisition is possible, it is exceptional, and there is always a presumption that the earnings of all the members belong to the common fund, so that if any member claims property as self-acquired he must establish his assertion by evidence as to how he acquired it, and that he did so "without using the

patrimony." The accounts of the family are kept by the manager, who is usually the eldest male, and he also generally manages the property. But he is assisted and controlled by the other members of the family. No separate account is kept of what each member contributes or receives. The expenditure on behalf of the various members of the family is scarcely ever equal, but this inequality creates no debt between the members of the family. If any one is dissatisfied he can protest, and if his protest is not listened to, there is only one remedy — he can demand a partition. The powers of the manager are those of an agent : it is very rare to find them formally expressed, and they must be gathered from the usual course of dealing, either amongst Hindus generally, or in the particular family to which the manager belongs ; and it is the custom for all the adult male members of the family to be consulted in matters of serious importance. The alienation of land is always looked upon as a matter of special importance, and, except in cases of urgent necessity, requires the express

assent of all the members of the family.

Partition. — If any member of a Hindu family who is one of the co-owners wishes for a partition, he can demand one, there never having been any compulsion on the members of a Hindu family to live in common. Of course in a Dayabhaga family there can only be a partition as between brothers, or the descendants of brothers ; between a father and his sons there can be no partition, the sons not being owners. The father may, if he chooses to do so, distribute the property amongst his sons, and he sometimes does so ; but this is a distribution of his own property, and not a partition. The father can distribute the property as he pleases. But the absolute power of the father in this respect has only been recently established. It used to be thought that, if the father made a distribution, he must give to each of his sons an equal share. It is now settled that the father is absolute. Under the Mitacshara, the ownership being vested in the father and sons, there can be a partition between father and sons, and the sons can always insist that, if a partition is made,

their rights shall be respected. Whether, under the Mitacshara law, the sons have the right to demand a partition in opposition to their father has been much

disputed. It is now generally considered that the sons have such a right.

In modern times if a partition takes place everything belonging to the family in common must be divided, even the idols. If there is only one idol, then each member of the family will be entitled to a " turn of worship," as it is called. It is, however, open to the members of the family to make any special arrangements either for retaining any portion of the property as joint, or as to the mode of carrying out of the partition, provided they can all agree to it. It is remarkable that in the Laws of Manu no such complete partition as can now be required is prescribed. A list of articles is given of considerable importance of which no partition could be claimed. In chap. ix. v. 219,

it is said, " A dress, a vehicle, ornaments, cooked food, water, and female slaves, property destined for pious uses and sacrifices, and a pasture ground," are all declared to be indivisible. Land and the right of way to the family house were also at one time indivisible. These things, therefore, must have been used in common after partition had taken place, which looks as if the family were not entirely broken up ; and it is possible that they inhabited several houses within the same enclosure, as is sometimes seen at the present day. It is not always easy to sub-divide property amongst the sharers, especially where they are numerous; and cases occur where a better division could be made by selling the whole or a por-tion of the property, and dividing the proceeds. This could always be done with the consent of all the sharers ; and now by Act IV. of 1893 of the Governor-General in council it can be done with the consent of a moiety in value of the sharers.

Eulers in India are apt to look upon their territories as private property, but there is no instance on record of

the succession to the throne being considered as partible. On the contrary, in the families which now represent the small mediatized princes, the family property is frequently, by a special custom, considered to be impartible. The property descends to the eldest male, the younger members of the family getting allowances, generally in the form of temporary assignments of portions of the family property.

Persons who in ordinary circumstances would be entitled to claim a share in the family property may be disqualified from doing so by certain specified imperfections. According to the Laws of Manu (ix. 201), " Eunuchs, outcasts, persons born blind or deaf, madmen, and such as have lost the use of a limb," are excluded. According to Yajnavalkya, a person afiiicted with an incurable disease is excluded. The leaning of the courts is against such exclusions. Outcasts have been relieved by Act XXI. of 1860, which expressly repeals the disqualification ; and probably the only disease which would now exclude is the worst form of lep-

rosy. Persons so excluded are not left unprovided for. Though excluded from partition, they can always claim a suitable maintenance.

Of course only the family property can be divided, and if any of the members make a claim on the ground of self-acquisition to exclude anything from partition, this claim must be considered; and if it is upheld, that portion of the property must be excluded from partition. These claims sometimes give rise to a good deal of litigation, and are not always easy to determine. It must be borne in mind, however, that self-acquired property becomes family property as soon as it has once descended. Thus if a man by a separate trade earns Rs.10,000, and dies leaving two sons and the son of a third son, these persons form a joint family, and the Rs.10,000 is family property. So also family property which has been partitioned remains family property still. Thus if A, a bachelor, gets on partition a piece of land and afterwards marries and has sons, under the Mitacshara law the father and sons form a joint family as soon as the sons

are born, and to this family the land belongs.

Inheritance. — When we come to deal with the question of what shares are taken on partition, it is convenient to follow the example of the Hindu commentators, and to treat the subject of inheritance in conjunction with it. The relative importance of these two subjects has not always been perceived, particularly by the early English writers on Hindu law. Colebrooke, the learned and accom-plished translator of the Mitacshara and the Dayabhaga, published the two treatises together in one volume which he called Tlie Law of Inheritance. But these treatises, although they deal incidentally with inheritance, are both described by their authors as treatises on partition only; and this, no doubt, is because the subject of inheritance, apart from partition, is of comparatively small importance. Inheritance is the transfer of ownership which occurs at and in consequence of a death. It follows from this that in a Mitacshara joint family there is no inheritance. The death of a member of the family makes no change in the ownership ; not any more than the death of a fellow in the

ownership of a college, or of a shareholder in the owner-ship of a railway company. In a Dayabhaga family there is a case of inheritance whenever a member dies. The share of that member descends to his heir. But here, again, no perceptible change in the affairs of the family is occasioned thereby. The enjoymentof the family property is no more affected thereby than by a death in a Mitac-shara family. It is only when a partition takes place that the devolution of the shares by inheritance has to be traced. Inheritance, therefore, apart from partition, has not to be considered when we are dealing with family property under either system.

Let us now consider partition in a Mitacshara family. Of course the only persons who can claim a share are the members of the family. These, as has been said, are the male descendants of a common ancestor through males, their wives and daughters. But the females are entirely excluded from any share on a partition, and we have to consider the males only. The rule for ascertaining the share to which each member of the family is entitled can

be best explained by the following diagram, which repre-

sents the male members of a Mitacshara family of whom

A is the common ancestor : —

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L

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C

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1

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G

1

H

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I

1

K L

i

M

1

N

OP Q

X Y

U

W

The whole family may be considered as forming one group, which may conveniently be called the group A ; and it is evident on inspection that the family may be sub-divided into a number of smaller groups each similarly organized, each group consisting of a man and his own male descendants. Thus besides the group A we have the group B, consisting of B and his descendants ; the group C, consisting of C and his descendants ; and so on. A group may die out altogether, as if U and W were to die child-less, E and M being alre:ady dead. The rule of partition proceeds upon the supposition — not an unnatural one — that a family, when it breaks up, separates always into groups, and that the shares are moulded accordingly. For

example, suppose that when the partition is made the surviving members of the family are N, 0, S, T, X, Y, Z ;

then to find the shares we must go back to the common ancestor and reconstruct the pedigree. There were at first four groups, but at some time, it is immaterial when, by the death of E and all his descendants the groups have been reduced to three ; hence the first step is to divide the property into thtee equal parts, assigning one to each group. The group B was originally represented by three smaller groups, but now by only two, the groups F and G, and to each of these we assign ^ of \, or ^. And, of the ^ assigned to the group F, N will get ^ and 0 will get ■j^. The other ^ is divided between the groups P and Q, each group getting ^^. Then in the group P, X and Y will each get t^, while Z, as the sole representative of the group Q, will get J|. It may be noted in passing that this principle of division survives in the succession per stirpes of which we find so many examples in other

systems of law which had their origin in the patriarchal system. By a similar process we should find that S and T each got i of the property, they being the sole representatives of the groups C and D respectively. For the sake of simplicity we have taken a case where no example occurs of a father and son being both alive at the time of partition. But suppose P to be alive in addition to the persons mentioned above ; then the group P gets ^, and that group consists of three persons, P, X, and Y. There is no precise rule as to how the partition was to be made in such a case in the older Hindu law, and it is rarely that a partition takes place between father and sons, but if there should be one it is always assumed that the shares are equal, i.e., in the case under consideration each would take jig.

Turning now to a Dayabhaga family, we find that the property is vested, not in the family as a whole, but in certain individual members of it — ^that is to say, in those male members of the family who have no ancestor alive. And inasmuch as the undivided share of each member is

his own, it follows that at his death inheritance will operate, and it goes to his heirs. In order, therefore, to find what share each member takes on partition under the Dayabhaga, we must inquire into the history of the family and ascertain what share has become vested in each member of the family by the ordinary rules of inheritance. The rules of inheritance, as laid down in the Dayabhaga, are not very dissimilar to those which we find in other parts of the world. Everywhere we find that a man's property is taken by his nearest relatives, but there are differences in the way in which proximity is reckoned. Everywhere, also, there is a preference given to males and the relatives through males over females and the relatives through females, but there are differences in the extent to which this preference is carried. The relatives of a man through males are called his agnates ; the relatives of a man through females are called his cognates. In the Hindu law as at present administered there is no primogeniture, and a decided preference of males over females, and of agnates over cognates. With regard to the question

of proximity, the Dayabhaga lawyers deal with the matter in a very curious way. All Hindus, as is well- known, offer some sort of sacrifice to their deceased relatives, and the person by whom the sacrifice is to be offered as well as the nature of the offering are very carefully prescribed. These sacrifices are said to confer a " spiritual benefit " upon the deceased, and this spiritual benefit is greater or less according to the nature of the offering and the person who offers it. Now the Dayabhaga lawyers say that the person whose offering confers the greatest spiritual benefit is entitled to succeed as heir. This being the theory, we must see what rules govern in India the offering of sacrifices to the dead.

The most important offering is that of the pinda, or rice cake, and the persons who are entitled to make this offering to the deceased are called his sapindas. The offering next in importance is that of the lepa, or fragments of the cake, the crumbs as we might call them, and the persons who make this offering are called sakulyas. The offering of least importance is the simple libation of water, and

persons connected by this offering are called samonadacas. But who are sapindas, sakulyas, and samonadacas respectively, and of each class whose offering is most efficacious ? Practically we shall find that this question is solved by rules of consanguinity not unlike those which we meet with elsewhere. First of all come the sons ; their offering is most efficacious, so that they are the nearest heirs and all take equally. Then come the sons' sons ; then the sons' sons' sons. Here we break off. The line of inheritance is not continued beyond the great-grandsons. There are other cases in which, as we shall see, there is a similar break when we get three degrees away from the propositus : nor is this -peculiarity confined to the Hindu law. We find traces of a similar break in the Roman and in the Teutonic law. After the great-grandson comes the widow. It is difficult to establish her claim on the ground of spiritual benefit, and it rests upon authority rather than principle. The opinions of ancient writers on the subject are very conflicting. They are set forth at great length in the Dayabhaga, with a conchision in favour of the

widow. Probably the intrusion of the widow is connected with the fact that she could in early times by cohabitation with a brother, and in later times by adoption, procure an heir to her sonless husband. Next to the widow come the daughters, and then the daughters' sons. Their position, again, may be referred to the notion which prevailed in early times, that a Hindu who had no son of his own might take one of his daughters' sons and make him his own. Then comes the father, then the mother, then the brothers, then the brothers' sons, and then the brothers' sons' sons. The sisters are excluded, but their sons succeed after the brothers' sons' sons ; then come the brothers' daughters' sons. Then, leaving this generation, we go a step back-ward, and proceed to exhaust the previous generation in precisely the same way. It is only necessary to enumerate these in their order: — ^father's father, father's mother, father's brothers, father's brothers' sons, father's brothers' sons' sons, father's sisters' sons, father's brothers' daugh-ters' sons. Then going another step backwards we get father's father's father, father's father's mother, father's

father's brothers, father's father's brothers' sons, father's father's sisters' sons, father's father's brothers' daughters' sons.

So far the line of succession is confined either strictly to male agnates, or to persons who may restore the broken line of male agnate relationship. But at this point, under the Dayabhaga, instead of exhausting the male agnates still further, as we might expect, we turn now to the cognates, i.e., the relatives of the deceased through the mother. It is said that these are also in some way sapindas. They are generally called bandhus. There is some difficulty in finding out the order in which they succeed, and since it is rare that an heir has to be sought outside the father's family, the question has not been much discussed. The question would have to be decided by the religious doctrine of spiritual benefit, and it is not improbable that Hindus who are accustomed to keep up the sacrifices which confer the benefit would be able to say whose sacrifice was most efficacious. When all the sapindas both on the father's and mother's side are ex-

hausted, we then go to the sakulyas, and practically these are found by continuing the enumeration of agnates upon the same principle as that already indicated through three generations lower and three generations higher. On failure of the sakulyas we should have to fall back upon the samonadacas, but probably all that can be said with

certainty is that the sakulyas and samonadacas between them exhaust entirely the male agnates of the deceased. Where there are several persons whose offerings are equally eflfi-cacious, i.e., who stand in the same relationship to the deceased, they all take : the male descendants per stirpes, and the other relatives of the deceased per capita. These, then, are the rules which govern theascertainment of the shares of the members of a family on a partition. ISTeither in a Mitacshara family nor in a Dayabhaga family have they any effect so long as the family remains joint : it is partition, and partition only, which brings them

into play, and it is to this event rather than death that Hindu lawyers attach the greatest importance. Nevertheless all property in India is not joint property. Under the Mitacshara as well as under the Dayabhaga separate property may be acquired, and then, of course, we have true inheritance, for which the law must provide. So far as regards the Dayabhaga, the rules which govern the inheritance of separate property are (as we should expect) precisely the same as those which govern the inheritance of a share, and it is therefore unnecessary to restate them. But it remains to lay down the rules of inheritance for separate property under the Mitacshara law. They are not based by Mitacshara writers upon any religious principle, as under the Dayabhaga, yet the result is not widely different. First come the sons, then the sons' sons, and then the sons' sons' sons. Then the widow, whose right has been disputed, but was long ago established ; then the daughters, and then the daughters' sons. After these come the parents, and it is peculiar that of these the mother comes before the father, then the

father's sons, and then the father's sons' sons. Then we go back to the preceding generation, and follow the same order — ^the father's mother, the father's father, the father's father's sons, the father's father's sons' sons. After this we go back another generation, and again follow the same order — father's father's mother, father's father's father, father's father's brother, father's father's brother's son. Prom this point the statements of Hindu lawyers as to the order of succession are very scanty and vague. One thing is certain, that under the Mitacshara law no cognates (relations through females) are admitted until all the agnates (relations through males) are exhausted.

Wills. — So far we have considered intestate succession only, and the power of testamentary disposition is unknown to the true Hindu law. It was introduced by the decisions of the British courts of justice. By a will is meant a declaration by a man of his wishes as to the disposition of his property after his death, taking no effect during his life. A will is therefore by its very nature

revocable. The general question whether a Hindu could dispose of his property by will arose in Bengal when Hindus began to attempt to dispose of their property after their death according to the English method. At that time there was a doubt whether the father was so completely absolute that he could dispose of his property to the exclusion of his sons, even in his lifetime. As soon as it was settled that he could do so, it was assumed that he could also make a will. It seems never to have been asked why it was that up to this time no Hindu had ever made a will, or to question the radically false assumption that the power of alienation inter vivos and the power of testamentary alienation necessarily go to-gether. A long series of decisions confirmed by the legislature has, however, established that a Hindu in modern times can dispose of any property of which he is the sole owner. In other words, a Hindu can dispose by will of his self-acquired property, and under the Dayabhaga a Hindu can dispose by will of his share in family property. But the courts which created the

testamentary power have also limited it to disposition in favour of persons living at the time of the testator's decease, thus avoiding many of the fanciful dispositions of property to which testators in all countries are so prone. But, curiously enough, this restriction, salutary as it is, has also been based on the notion that a testamentary disposition is a gift from the testator to the object of his bounty.

Bebts.—ln almost all countries at an early stage of civilization some legal provision exists by which debtors can be compelled by their creditors to pay their debts, and by which, if they fail to do so, their property can be seized and applied to this purpose. But the extent to which this can be done varies very considerably. So long as the family system exists in its primitive vigour it acts as a protection to the family property against the extravagance of a single mejnber, and we often find that even when the family system has almost, or completely, disappeared, there is an unwillingness to deprive the future representatives of the family of their land and houses. Doubts, too, have arisen

as to whether the same right which a creditor has against his living debtor can be exercised after the debtor's death against those who have succeeded to his property. In India these two considerations have been deeply affected by a principle enunciated by Hindu lawyers (traces of which we find in many Eastern countries), that a man who dies in debt suffers cruel tortures in a future state, and that it is the imperative duty of his own immediate dependants to deliver him from these tortures by discharging his liabilities. Whether this should be looked upon as a legal, or only as apurely religious duty, might be questionable: the courts have seized upon it as a basis for laying down in the broadest manner the just rule that those who take the benefit of succession must take the burdens also. The subject is one which has caused a great deal of litigation in India, and whilst some points have been clearly settled, others are still being slowly worked out. As the matter stands at present, it may be safely said that all separate property is liable for the debts of the owner, both in his lifetime and after his death in the hands of his heirs. The same

may be said of the share in the family property of the member of a Dayabhaga family, of which share he is the owner. So also the family property under both the Daya-bhaga and Mitacshara is liable, as a whole, for the debts incurred on behalf of the family as a whole. As regards the question of the liability of the family property for the separate debts of the members of a Mitacshara family, the courts have held that the sons must pay their father's debts. Of coiTrse illegality would bean answer to the claims of the creditors against the heirs, jiTst as it would be an answer to the claim against the original debtor ; but there is some authority for saying that a debt contracted for an immoral though not an illegal purpose would not be enforced against the heir. According to modern decisions also, if judgment and execution on a separate debt are obtained against the member of a Mitacshara family, the share which would fall to him upon a partition may by process of law be set apart and sold for the benefit of the creditor.

Maintenance. — The doctrine of what is called mainten-ance plays an important part in the Hindu law, and as we

shall see, it modifies considerably the rigour of the Hindu law in excluding from the succession females or persons suffering from mental or bodily infirmity. The right of maintenance under the Hindu law is the right which certain persons have to be maintained out of property which is not their own. The persons who in certain circumstances have this right are sons, widows, parents, and unmarried daughters and sisters. The claim of the widow arises at the death of her husband ; of a child at the death of its parent, and so forth. The claim is not for a bare subsistence only, but to such a provision as is suitable to the claimant having

regard to his or her position in life. Of course the sons are generally heirs, and an heir can have no claim to maintenance ; but a son excluded by any mental or bodily defect would have a right to maintenance. The girls are generally married in infancy, and after marriage they have no claim to maintenance from their own family. The most frequent claim is by the widow ; and it is a

very important one, because she can sometimes, through the assertion of this claim, put herself almost in the position of an heir. If a Hindu under the Dayabhaga dies leaving sons and a widow, the widow is entitled to maintenance, and whilst the family remains joint she can claim to be suitably maintained, in the family if she remains in her husband's house, or out of it if she goes elsewhere. But if a partition takes place she is entitled to have a share equal to that of the sons set aside for her use. She can even, if she thinks that the sons do not treat her properly, apply to the court to compel the sons to give her a separate share. This, of course, gives her a very strong position. Whether in a Mitacshara joint family the widow enjoying maintenance can in any case claim a share on partition is doubtful.

Women's Property. — In some respects, and as regards some kinds of property, the ownership of women under the Hindu law differs from that of men. These differences depend on the source from which the property is derived. If a woman has inherited property from a male, or as a

gift by her husband, or has obtained it as a share on partition, she does not own it in the same way as a man would do; she obtains only a kind of restricted ownership. She has the full enjoyment and management of it, but she cannot sell it, or give it away, or dispose of it by will ; and at her death it goes, not to her heirs, but to the heirs of the person from whom she obtained it ; her ownership simply comes to an end. If she obtained it by inheritance from a male, it will go on her death to the heirs of that male ; if as a share on partition, it will be divided amongst the other sharers ; if as a gift from her husband, to the heirs of the husband. As regards property otherwise obtained she is in the same position as any other owner, but the rules of inheritance applicable to it are somewhat peculiar. It would be a mistake to look upon the restricted owner-ship of a woman as what the English lawyers call a life estate. There is no such thing as a remainder or reversion. The whole estate is vested in her. If we endeavoured to describe the position of affairs at her death in the technical language of the English law of real property, it would be

more correct to say that there was a shifting use. The restriction on alienation is sometimes removed where there is a danger that the property might otherwise be lost, as, for example, when the property is likely to be sold for non-payment of Government revenue, in which case a portion may, if necessary, be sold by the woman so as to save the remainder. So also a woman who has no other means of maintaining herself, or of providing for the performance of religious duties which are incumbent upon her, may sell so much of the property as will produce the necessary funds. It would be difficult for a purchaser to know whether he would be safe in purchasing from a widow selling under necessity, and more difficult still to preserve evidence of the necessity in case the necessity were disputed. Of course the woman herself could not dispute the validity of the sales, but those who take after her might do so. Consequently it is not unusual to obtain the concurrence of the person who at the time of the purchase is entitled to succeed if the widow were dead, and it has been held that, if this person concurs in the sale,

no one else can dispute it on the ground that it was unnecessary.

Husband and Wife. — The subject of marriage is dealt with at considerable length in the Laws of Manu, and it is clear that, as originally conceived, marriage under the Hindu law consisted in nothing more than the mere possession of the woman, however obtained, by the man with the intention of making her his wife. Eight kinds of marriage are enumerated, and to each kind is assigned a separate name. The first four kinds are merely different forms of gift of the girl by her father to the husband. The other four kinds are — obtaining possession of a girl by purchase, fraud, ravishment, or consent of the girl herself. But the simple gift of the girl by her father without any bargain or recompense was even then considered the most reputable form of marriage, and it is now the only one in common use amongst orthodox Hindus. The sale of the daughter was even in those early times stigmatized as disgraceful, but it was valid ; and even now, if there were an actual transfer of the girl by the father, it is scarcely probable

that the courts would inquire whether any inducement was given for the transfer. The transaction takes place entirely between the father of the girl and the future husband ; the girl has nothing to do but to obey. If the girl has no father, then it will be the duty of her nearest male relatives to dispose of her in marriage. If, however, the girl is not married when she attains puberty (which is very rare) then she may choose a husband for herself.

The father cannot dispose of his son in marriage as he can of his daughter, nor is anything said about his consent in the matter ; though in the case of a very young boy there can be no doubt that the consent of one or both parents is obtained. The marriage of very young boys is very common, and is certainly valid.

The cer em onies which precede and accompany a marriage are very numerous. By far the most important is that which consists in the bridegroom taking the bride's hand and walking seven steps. Amongst Hindus generally the performance of this ceremony following upon a betrothal would be treated as conclusive evidence of a marriage,

whilst the omission of it would, amongst orthodox Hindus, be almost conclusive that no marriage had yet taken place- But still any particular customs of the tribe or caste to which the parties belonged would always be considered, and it cannot be said that the completion or non-completion of this ceremony is universally conclusive as to the existence of a marriage. There may be communities of Hindus which require something more than this ; there are certainly some which require something less, and others which require something altogether different. There are lower castes in some parts of India calling themselves Hindus in which the only ceremony accompanying a marriage is giving a feast to which the members of the two families are invited.

The marriage of Hindus is complete without consummation; and as girls are almost invariably married before the age of puberty, and sometimes long before, consummation is generally deferred, it may be, for several years. But all this time the parties are husband and wife, and if the husband dies the child becomes a widow. The con-

dition of these child widows in India is certainly not an enviable one, for practically they can never hope to many again. Whether the second marriage would be lawful was a disputed point in Hindu law, until an act of the Indian Legislature (Act XV. of I860) declared in favour of the opinion that the vsddow might remarry. But the social prejudice against remarriage is still very strong, and such a marriage rarely takes place. If the widow has inherited any property from her husband, she loses it by contracting a second marriage. There is no legal restraint upon the number of vrives that a Hindu may marry, but polygamy is not practised so largely as is sometimes supposed. Members of the three higher castes are forbidden to marry a woman of the same gotra as themselves. Literally a gotra means a cattle-yard, and the prohibition is con-

sidered to exclude marriage between all those who are descended from the same male ancestor through an unin-terrupted line of males. This rule is said not to apply to

Sudras. But there is another rule which applies to all Hindus, and prohibits the marriage of a man with a girl descended from his paternal or maternal ancestors within the sixth degree. The working out of the rule is a little peculiar, but the result is to give a rather wide rule of exclusion of both agnates and cognates. There is, how-ever, this important exception to these rules of exclusion — that if a fit match cannot otherwise be procured, a man may marry a girl within the fifth degree on the father's side and the third on the mother's. Practically this reduces the limit of exclusion to that last stated, because no one but the parties themselves with whom the choice rested could say whether or no any other suitable wife was available to the husband.

A Hindu must also marry within his caste: a Brah-min must marry a Brahmin, a Eajput must marry a Eajput, and a Sudra must marry a Sudra. Whether there are any other representatives of the four original castes is very doubtful, and even the claim of the Eaj-puts to represent the military caste is "disputed. Still

the rule of prohibition is so far clear. But there are innumerable subdivisions of Hindus which are also called castes, and as a matter of fact these minor castes do not intermarry. How far such marriages would be lawful it is difficult to say. The matter is entirely one of custom. The ancient Hindu law furnishes no guide on the subject, because under the ancient law the intermarriages of persons of different castes, even the highest, though they were considered undesirable, were recognized as legal. Modern Hindus seem disposed to deny the validity of marriages between persons of diiferent castes in either sense of the term.

Divorce, in the sense of a rupture of the marriage tie, is not known to the true Hindu law. But unchastity deprives a wife of all her rights except to a bare maintenance, and this without any legal proof. She cannot succeed her husband as his heir, and of course she cannot remarry. A little confusion has been caused by the fact that a Hindu husband sometimes goes through a private ceremony which is erroneously called a divorce. But this

is only done in order more effectually to bar an unchaste wife from succeeding to his property. Some very low castes are, however, said to allow a husband to divorce his wife, and even to allow the divorced wife to marry again. The single case in which a Hindu marriage can be dissolved by a court of law is by a proceeding under Act XXI. of 1860, which was passed to meet the difficulties which arise when one of the parties to a Hindu marriage becomes a Christian. In this case, if the convert after deliberation during a prescribed time refuses to cohabit any longer with the other party, the court may declare the marriage tie to be dissolved, and a woman whose marriage has been thus dissolved is declared capable of marrying again.

Suttee. — An interesting chapter in the history of the modern development of Hindu law is that of the practice of what we call Suttee, though, properly speaking, the native term {Sati) denotes, not a practice, but a person, i.e., a faithful wife. The practice in question is that of the widow burning herself with her husband when his body is burned after his death. This, according to Hindu

ideas, is a laudable act of devotion on the part of the widow, and when Great Britain first began to administer the law in India it was not uncommon. The new-comers had not as yet taken upon themselves the responsibility of altering the law, but, of course, British offtcers did what they could to discourage the practice, and especially to prevent any pressure being put upon the widow to perform the sacrifice. They could also take advantage of any circumstance which would render the case an improper one for the performance of the sacrifice, as, for example, that compulsion had been put upon the widow, or that the burning did not take place with the body of the husband. But if the proceedings were according to Hindu notions regular, it was contrary to the principles on which the Governor-General then acted to interfere, and British officers had frequently to stand by, and, by not interfering, to give a sort of sanction to the sacrifice. When later the servants of the East India Company began to assume a more direct responsibility for the government of the country, many suggestions were made for

legislative interference. But, acting on the salutary principle that it was unwise to interfere in any way with the religion of the people, the Government abstained from doing so. In the meantime a considerable body of opinion against the practice had grown up amongst Hindus themselves, and at length the Government thought it safe to interfere. By Eegulation XVII. of 1829 widow-burning was declared to be a criminal offence. The measure produced no serious opposition. There was hardly a single prosecution xmder this Eegulation ; and from this time the practice of widow-burning has entirely disappeared from that part of India which is under British rule.

Father and Son. — There are certain peculiarities in the relation of father and son in India which have given rise to the suggestion that there is no relationship between sonship and marriage, and that the notion of sonship in India is founded entirely on that of ownership — ownership of the mother and a consequent ownership of the child. But the arguments by which this view is supported do not appear to be sufficient. The rights of a father over his

son, and of a husband over his wife, are, it is true, so far like the rights of ownership that both are in the nature of rights in rem, — that is, they are available against any person who infringes them ; but it is contrary to established usage to speak of rights over a free person as rights of ownership, and no one is prepared to say that the wife or child are slaves of the father. There is no reason for abandoning in India the ordinary view, that sonship depends on marital cohabitation between the father and mother. There are undoubtedly in certain special and exceptional cases methods of acquiring sons otherwise than by marital cohabitation. But these contrivances can only be resorted to when there is no son by marriage, and the fiction which, as we shall see, is resorted to to conceal the true nature of these contrivances, would be entirely meaningless, as would most of the rules which regulate them, if sonship in general was based entirely on ownership. There were at one time more contrivances than there are now for supplying the want of male issue by marriage. At one time a son could be begotten for a man who was dead

by cohabitation of his widow with a member of his family, or perhaps even with a stranger. This is generally looked upon as a survival of polyandry. But this practice, though alluded to in the Laws of Manu as still subsisting, is now entirely obsolete. So there was a custom at one time by which a father could appoint a daughter to raise up male issue for him. The head of the family could also, if he had no son born in wedlock, accept as his own any child born in his house whose mother was not known or not married. So he could accept as his own the son of his wife born before marriage, or the son of his concubine. In the three last cases he may have been, and probably was, himself the father. But none of these contrivances for procuring a son is now in use. The only contrivance now employed for procuring a son, in the absence of one born in wedlock, is by taking into the family the son of another man who is willing to part with him. This is called adoption. There are two kinds of adopted sons : one called dattaka, and the other kritrima. The former

is in use all over India ; the latter only in Mithila. The following rules apply to the dattaka born of adoption : — A man can only adopt who is without issue capable of inheriting his property, of performing the funeral ceremonies for himself, and of making the necessary offerings to his ancestors. A woman cannot adopt. But by the authority of her husband, and acting on his behalf, she may select a son and receive him into the family. A man can adopt a son without his wife's assent ; nevertheless, the son when adopted becomes the son of both parents. Hindus consider it a grievous misfortune that the line of male descent should be broken. The due performance of the sacrificial offerings to the dead is thereby interrupted. Probably this explains the great latitude given in some parts of India to the widow to adopt a son on behalf of her husband in case he has died sonless. There is a text which says, " Nor let a woman give or accept a son unless with the assent of her lord." But the lawyers of Western India do not consider that any express per-

mission to adopt is necessary, and take it for granted that she always has that permission. In Southern India, also, the widow may adopt without express permission, but the sapindas must give their sanction to make the adoption valid. Elsewhere the words have received their natural interpretation, namely, that the husband must in some way indicate his intention that his widow should have authority to adopt. The only person to whom an authority to adopt can be given is the wife or widow ; and no widow can be compelled to exercise her power to adopt if she does not wish to do so. The father has absolute power to give away his son in adoption even without the consent of his wife. But her consent is generally asked and obtained before the son is given. After the father's death the widow may give a son in adoption. The rule which in former times rendered it necessary that the nearest male sapinda should be adopted is obsolete, and the adoption of a stranger is valid, although nearer relatives otherwise suitable are in existence. A man may adopt any child whose mother he

could have married if she had been single; if he could not have done so, then he cannot adopt her child. The reason given in the text is that the adopted son must bear the resemblance of a son. This recalls the dictum of the Koman law — adoptio naturam imitatur. The adopted son and the adopting father must be of the same caste. The period fixed for adoption by the three higher castes is before the ceremony of upandyana, or investi-ture of the child with the thread which these castes always wear over the left shoulder. For Sudras, who have no thread, the period is prior to the marriage of the child. There has been much difference of opinion as to whether an only son can be given and received in adop-tion. It is now settled that the texts which discounte-nance this adoption do not constitute a prohibition which the law will enforce.

There is sometimes a difSculty in ascertaining whether or no an adoption has actually taken place. There must be a final giving and receiving of the child in adoption, and for Sudras nothing more is required. For the twice-

born classes it is not finally settled whether any religious ceremony is actually necessary in order to render the adoption valid. But some religious ceremony in almost all cases accompanies the adoption, so that the absence of any such ceremony will always raise a suspicion that the adoption, though it may have been contemplated and some steps taken towards it, had not been finally completed. If an adoption were in itself invalid, no acquiescence and no lapse of time could make it valid — ^just as an invalid marriage could not be similarly validated.

But acquiescence by the family would be strong evidence of the validity of an adoption, and the rules of limitation by barring any suit in which the question could be raised might render the adoption practically unassailable.

The kritrima adoption is altogether different ; although the adopted son performs the ceremonies for his adopting father's family, and has a right to succeed, he is nevertheless not cut off from his own family. A person of any age may be adopted, and he must be old enough to be able to consent to the adoption, as without this consent it

cannot take place. In this form a female can adopt, and no ceremonies are required.

Authorities. — J. D. Matne. Hindu Law. London, 1892. — Coleerooke's Treatises on the Hindu Law of Inheritance. Calcutta, 1810. — Stokes's Hindu Law Books. Madras, 1865. — West and Buhlek. A Digest of the Hindu Law of Inheritance, Bombay, 1878. — Jogendra Nath Bhattacharya. A Commentary on Hindu Law. Calcutta, 1894. — Rajkhmar Sarvadhikari. Principles of the Hindu Law of Inheritance. Calcutta, 1882. — GooROODAss Banerjee. The Hindu Law of Marriage and Stridhana. Calcutta, 1896. (-w. ma.)

Hindu sta n . See India.

Hingham, a town of Plymouth county, Massar chusetts, U.S.A., on Massachusetts Bay, contains the villages of Hingham Centre and South Hingham. Population (1890), 4664; (1900), 5069, of whom 969 were foreign-born.

HiogO, or Htogo, a Japanese town, situated in 34° 41' N. and 135° 11' E., in the province of Settsu, on the western shore of the bay of Osaka, adjoining the foreign

settlement of Kobe. The growth of its prosperity has been very remarkable. Its population, including tha.t of Kobe, was 135,639 in 1891, and 215,780 in 1898, and it thus stands fifth on the list of Japan's towns, being preceded only by Tokyo, Osaka, Ky5t5, and Nagoya. From the following figures the development of Kobe's foreign trade may be seen : —

Exports.

Imports.

Total.

1884

1889

1894

1899

£1,180,490

3,300,576

3,679,764

7,532,088

£1,391,166

4,226,514

7,113,813

12,028,952

£2,571,656

7,527,090

10,793,577

19,561,040

This increase — nearly eightfold in fifteen years — has not been confined to a few staples of commerce, but has been spread over almost the whole trade, especially silk and cotton fabrics, floor-mats, straw-plaits, matches, and cotton yarns. Kobe owes much of its prosperity to the fact that it serves largely as the shipping port of Osaka, which has become the chief manufacturing town in Japan. The citizens of Osaka, however, are engaged upon a large work of harbour construction, which, when completed, wiU probably divert a considerable part of the business now flowing to Kobe. But Kobe now ranks as the premier port of Japan. Its foreign community, however, has not grown in the same ratio, the figure at present — exclusive of Chinese — being only 1060 of all nationalities. Kobe is

considered the brightest and healthiest of all the places assigned as foreign settlements in Japan, its pure dry air and granite subsoil constituting special advantages. It is in railway communication with all parts of the country, and wharves admit of steamers of large size loading and discharging cargo without the aid of lighters. The area originally appropriated for a foreign settlement soon proved too restricted, and foreigners received permission to lease lands and houses direct from Japanese owners beyond the treaty limits, a privilege which, together with that of building villas on the hills behind the town, ultimately involved some diplomatic complications. Kobe has a good shipbuilding yard, and

commodious docks will soon be constructed in its immediate neighbourhood.

Hiogo's original name was Bako. Its position near tlie entrance of the Inland Sea gave it some maritime importance from a very early period, but it did not become really prominent until the 12th

century, when Kiyomori, chief of the Taira clan, transferred the capital from Ky6t6 to I'ukuhara, in Hiogo's immediate neighbourhood, and undertook various public works for improving the place. The change of capital was very brief, but Hiogo benefited permanently from the distinction thus conferred on it. (f. by.)

H i ppolytus. — Hippolytus, a presbyter of the Church in Rome, was exiled to Sardinia in a.d. 235 with Pontianus, bishop of Rome. Eusebius {H.E. vi. 20) represents him as a bishop without mentioning his see. Apollinaris of Laodicea calls him "the most holy bishop of Rome." In the 4th century he was regarded, probably rightly, as a martyr, and the Roman Church commemorates him on 13th August, on which day his remains were buried on the Via Tiburtina. He was a writer of the first importance. In 1551 a marble statue of Hippolytus, now in the Vatican, was discovered. The figure is clad as a philosopher; the chair contains a list in Greek of his writings, and reproduces part of the cycle for calculating Easter which he invented. This was the first attempt made by the Church to calculate the date of Easter by a

cycle. The exegetical works of Hippolytus embraced all, or nearly all, the Bible. The only book that remains is that on Daniel (Greek and Slavonic). Hippolytus favours allegory, but is more sober than the Alexandrine writers. He wrote against heathens (-Trpos cAAT/ras koX Trpos HXaTuiva) ; also a treatise to the Empress Julia Mammaea; against heretics (o-wray/xa irpos dTraeras ra^ alpeareis) ; against Marcion, &c. ; also on the incarnation (wepl oiKovojutas), on the origin of evil, and irepi Xpto-Tov Koi avTi^iaTov. the last still remains.

Hippolytus was a preacher, and some genuine fragments which remain apparently were homilies. He has been the subject of modern controversy. In 1842 books iv.-x. of a work (Kara TracrSiv alpea-ewv eXeyxos) were discovered. They were found to fit with a work known as the i\ocro wrongly attributed to Origen. The whole must have had two more books, ii. and iii., which are still missing.

Book i. attacks Greek philosophers, iv. treats of astrology. Books v.-x. contain accounts of Christian heresies, partly based on earlier authorities ; ix. tells of dissensions at

Rome, and is of peculiar interest. It accuses Callistus, the bishop, of teaching Sabellianism. This fact has made some Roman Catholics desirous of proving that the book is not by Hippolytus, while some Protestants assert that Hippolytus was a rival Roman bishop or anti-pope. Some have even suggested that the Roman Church canonized him in spite of his schism, because his name gave occasion to continue the heathen festival of Virbius. The truth lies between these extreme theories. The (f)LXo(TO(j>ovfieva is shown by abundant internal evidence to be by Hippolytus. It refers to his a-vvTayfm, and is connected with his works on Antichrist and Noetus. The question as to the episco-pate of Hippolytus is obscure. It is hard to accept the story that he was bishop of Pontus. This apparently arose in the 7th century from the fact that Pontus contained a church having his name. The Liberian Catalogue, a.d. 364, probably quoting a 3rd-century notice, calls Hippolytus a presbyter. This document makes it certain that he died as a presbyter and in union with the Roman see. It is possible that he did for a time exercise episcopal functions,

and that Pontianus and he were exiled while rivals. Pontianus resigned his bishopric 28th September 235, and perhaps Hippolytus resigned his claim at the same time, and so was reconciled with the Church. Apparently they were both alive when Anteros was consecrated pope, 21st November 235. They probably died in Sardinia, and their relics were brought to Rome under Pope Eabian. The history of Hippolytus has been obscured by the fact that Pope Damasus, followed by the poet Prudentius (Peristeph. 11, 17), speaks of a Hippolytus who had supported the schism of ISTovatus c. a.d. 251. Dam asus was either writing of another Hippolytus, or confused the story. (For the Church Order bearing his name see Canons of Hippolytus.)

See also G. KRiJGEE, History of Early Christian Literature (English trans., published by Macmillan, 1897) ; Ehehard u. MuLLER in Strassburger Theologische Studien (Herder, Freiburg, 1900) ; Batiffol, Anciennes Litleratures Chretiennes (Paris, Lecofire). (l. p.)

Hirado, an island belonging to Japan, 19^ miles long and 6 miles wide, lying off the west coast of the province

of Hizen, in 33° 16' N". and 129° 26' E. It is celebrated as the site of the original Dutch factory — often erroneously written Firando — and as the place where one of the finest blue-and-white porcelains of Japan (Hirado-yaki) was produced in the 17th and 18th centuries. The kilns are still active.

Hirosaki, a town in the province of Mitsinoku or Rikugo, ISTorth Nippon, Japan, 22 miles south-west of Aomori, on the route to Niigata. Population (1892), 28,000 ; (1898), 35,000. It is a very old place, f ormerly residence of a great daimio and capital of a vast principality, and still seat of a high court with jurisdiction over the surrounding provinces of Aomori and Akita. Like most places in North Nippon, it is built with continuous verandas extending from house to house, and affording a promenade completely sheltered from the snows of winter. Apples of fine flavour grow in the district, which also enjoys some reputation for its peculiar green lacquer-ware.

Hiroshima, a city and seaport of Japan, capital of

the ken of like name in Central Nippon. In its general aspect it resembles Osaka, and is, next to that place and Hiogo, the most important commercial centre in the Inland Sea. Population (1892), 90,000 ; (1898), 122,000. The ken has an area of about 3000 square miles, with a population (1898) of nearly 1,500,000. Hiroshima is famous all over Japan owing to its association with the neighbouring islet of Itaku-Shima, "Island of Light," which is dedicated to the goddess Bentin and regarded as one of the three wonders of Japan. The chief temple dates from the year 587, and the island, which is inhab-ited largely by priests and their attendants, is annually visited by thousands of pilgrims. But the hallowed soil is never tilled, so that all provisions have to be brought from the surrounding districts.

Hirsch, Maurice de, Bakon Hirsch auf Geeeuth, in the baronage of Bavaria (1831-1896), capitalist and philanthropist (German by birth, Austro-Hungarian by domicile), was born at Munich, 9th December 1831. His grandfather, the first Jewish land-

owner in Bavaria, was ennobled with the pradikat " auf Gereuth" in 1818; his father, who was banker to the Bavarian king, was created a baron in 1869. The family for generations has occupied a prominent position in the German Jewish community. At the age of thirteen young Hirsch was sent to Brussels to school, but when seventeen years old he went into business. In 1855 he became associated with the banking house of Bischoffsheim & Goldschmidt, of Brussels, London, and Paris. He amassed a large fortune, which he increased by purchasing and working railway concessions in Austria, Turkey, and the Balkans, and by speculations in sugar and copper. While living in great splendour in Paris and London and on his estates in Hungary, he devoted much of his time to schemes for the relief of his Hebrew

co-religionists in lands where they were persecuted and oppressed. He took a deep interest in the educational work of the Alliance Israelite Universelle, and on two

occasions presented the society with gifts of a million francs. For some years he regularly paid the deficits in the accounts of the Alliance, amounting to several thousand pounds a year. In 1889 he capitalized his donations and presented the society with securities producing an annual income of £16,000. On the occasion of the fortieth anniversary of the Emperor Francis Joseph's accession to the Austrian throne he gave £500,000 for the establishment of primary and technical schools in Galicia and the Bukowina. The greatest charitable enterpfise on which he embarked was in connexion with the persecution of the Jews in Eussia (see Anti-Semitism) . He gave £10,000 to the funds raised for the repatriation of the refugees in 1882, but, feeling that this was a very lame conclusion to the efforts made in Western Europe for the relief of the Russian Jews, he offered the Russian Government £2,000,000 for the endowment of a system of secular education to be established in the Jewish pale of settlement. The Russian Government was willing to accept the money, but declined to allow any foreigner to

be concerned in its control or administration. Thereupon Baron de Hirsch resolved to devote the money to an emigration and colonization scheme which should afford the persecuted Jews opportunities of establishing themselves in agricultural colonies outside Russia. He founded the Jewish Colonization Association as an English society, with a capital of £2,000,000, and in 1892 he presented to it a further sum of £7,000,000. This enormous fund is now managed by delegates of certain Jewish societies, chiefly the Anglo-Jewish Association of London and the Alliance Israelite Universelle of Paris, among whom the shares in the association have been divided. The association, which is prohibited from working for profit, possesses large colonies in South America, Canada, and Asia Minor. Besides this great organization. Baron de Hirsch founded a benevolent trust in the United States for the benefit of Jewish immigrants, which he endowed with a sum of £493,000. His minor charities were on a princely scale, and during his residence in London he distributed over £100,000 among the local hospitals. It

was in this manner that he disposed of the whole gross proceeds derived from his successes on the English turf, of which he was a lavish patron. He raced, as he said himself, "for the London hospitals," and in 1892, when his filly. La Elgche, won the Oaks, St Leger, and One Thousand Guineas, his donations from this source amounted to about £40,000. Baron de Hirsch married on 28th June 1855 Clara, daughter of Senator Bischoffsheim of Brussels, by whom he had a son and daughter, both of whom predeceased him. He died at Ogyalla, near Komorn, in Hungary, 21st April 1896. (l. -w.)

Hirsch berg, a town of Prussia, province of Silesia, 48 miles south-east of Gorlitz by rail. The linen industry is now of minor importance, though it is still carried on, as are also the manufactures of yarn, paper, cement, cigars, cardboard, machinery and iron wares, and wood-carving. Here is the Riesengebirge Museum. Population (1886), 15,622; (1900), 17,867.

Hirson, a town in the arrondissement of Vervins, department of Aisne, France, 35 miles by rail north-east

of Laon, on the Oise. It occupies an important strategic position close to the point of intersection of several railway lines, and not far from the Belgian frontier. For its defence there are a permanent fort and two batteries, near the railway junction. It is noted for basket-work, and there are manufactures of glass bottles, and iron and tin wares, and wool-spinning. The town had a communal charter in the 12th century. Population (1881), 4531 ; (1901), 7461.

Hissar, a town and district of British India, in the Delhi division of the Punjab. The town is situated on the Rajputana railway and Western Jumna canal, about 102 miles W.N.W. of Delhi. Population (1881), 14,138; (1891), 16,854. The municipal income in 1897-98 was Rs.30,043. It is now chiefly known for its cattle and horse fairs. The District comprises an area of 5163 square miles, with a population in 1881 of 672,569, and in 1891 of 776,006, giving an average density of 150 per square mile. In 1901 the population was 781,576, show-ing practically no increase, whereas in the previous decade

there had been an increase of 15 per cent. The land revenue and rates we're Rs.10,23,852, the incidence of assessment being R.0-3-9 per acre ; the cultivated area in 1896-97 was 380,671 acres, of which 180,204 were irrigated, almost entirely from government canals ; the number of police was 681 ; the number of schools in 1896-97 was 141, with 4734 pupils, the proportion of boys at school to the male population of school-going age being 6-7 per cent., or little more than half the average for the province ; the registered death-rate in 1897 was 45-31 per 1000. There are a printing-press, and nine factories for clean-ing and pressing cotton. Hissar suffered severely in the recent famines. A section of the Rajputana rail-way, 147 miles in all, now traverses the district. There are 95 miles of metalled roads. The largest town is Bhiw£,ni. ^

Hitch in, a market-town in the Hitchin parliamentary

division of Hertfordshire, England, 32 miles north-north-west of London by rail. The grammar school (1632) has been reconstituted for boys and girls. George Chapman, the translator of Homer, was born here, as were also Sir Henry Bessemer in 1813 and Sir Henry Hawkins (Baron Brampton) in 1817. The most notable industry is the cultivation and distillation of lavender and peppermint. Area of urban district, 2624 acres. Population (1881), 8434; (1901), 10,072.

Hjelmar, a lake of Sweden, lies south-west from Lake Malar, and 67 feet higher. Area of the lake, 186 square miles'; of its drainage basin, 1625 square miles. Length of lake, nearly 40 miles ; breadth, 2^ to 12 miles ; depth, 69 feet. Its shores are flat, and subject to inundation. With the view of preventing this evil the level of the lake has been sunk 5| feet below its former mean level. This was effected by deepening the navigable channel through the lake (1878-84), by clean-ing out the Hjelmar canal (1879-80) to 6| feet, and reconstructing the dam at the head of the Eskilstuna

river and cleaning out that river (1880), and by draining the lake of Qvismare by means of a canal 12| miles long, alongside the river Telje (one of the chief feeders of the lake), in 1879-87. By this means an area of 45,000 acres was won to cultivation.

Hl(amti L5ng (called Kantigyi by the Burmese, and Bor Hkampti by the peoples on the Assam side), a Shan state tributary to Burma, but at present be-yond the administrative border. It lies between 27° and 28° N. and 97° and 98° E., and is bordered by the Mishmi countiy on the N., by the Patkoi range on the W., by the Hukawng valley on the S. and on the E., and indeed all round by various Chingpaw or Kachin communities. The country is little known . It was visited by T. T. Cooper, the Chinese traveller and Political Agent at Bhamo, where he was murdered ; by the late General Woodthorpe and Colonel Maegregor in 1884, by Mr Errol Grey in the

following year, and by Prince Henry of Orleans in 1896.

All of these, however, limited their explorations to the valley of the Mali-hka, the western branch of the Irrawaddy river. Hkamti has shrunk very much from its old size. It was no doubt the northernmost province of the Shan kingdom, founded at Mogaung by Sam L6ng-hpa, the brother of the ruler of Kambawsa, when that empire had reached its greatest extension. The irruption of Kachins or Chingpaw from the north has now completely hemmed the state in, and the only hope of its Shan, or Tai, inhabitants of escape from extinction rests in support from the British Government. Lao Hkun, the present chief, has paid homage and tribute at Bhamo. Prince Henry of Orleans described it as " a splendid territory, fertile in soil and abundant in water, where tropical and temperate culture flourish side by side, and the inhabitants are protected on three fronts by mountains." According to him the Kiutze, the people of the hills between the Irrawaddy and the Salween, call it the kingdom of Moam. (j. g. sc.)

Hoar. — The name of a father and two sons dis-

tinguished in American politics and jurisprudence. Samuel Hoae (1788-1856), like his two sons a graduate of Harvard, and trained to the practice of law, was for a generation a leading member of the Massachusetts bar, and served in the National Congress, 1835-37. In 1844, having been sent to Charleston, S.C, on a mission touching the treatment of free negroes iu that port, he was forced by demonstrations of popular hostility to leave the city without completing his work. He married the daughter of Eoger Sherman, the Connecticut statesman, and lived at Concord, Mass., where his two sons were born. The elder of these, Ebbnbzee Kockwood Hoab (1816-1895), after attaining the highest judicial honours of his state, held for a short time (1869-70) the position of Attorney-General in the cabinet of President Grant, and was a member of Congress, 1873-75. The younger son, Geoege Peisbie Hoae (1826), devoted himself to his profession at Worcester, with two short terms in the state legislature, till in 1869 he was elected to Congress by the

Republicans. After two successive re-elections he declined to be again a candidate, and was thereupon, in 1877, chosen to represent Massachusetts in the Senate. Senator Hoar's legal learning gave him from the outset a high position among his colleagues. In 1891, upon the retirement of Senator Edmunds, he became Chairman of the Judiciary Committee, and this influential position he continued to hold whenever his party was in control. He has made a distinguished reputation in scholarship as well as in law and politics, and in 1895 he was President of the American Historical Association.

Hobart, the capital of Tasmania, in the south of the island, at the mouth of the river Derwent. It has been so called since the 1st of January 1881, when its name was changed from Hobart Town. It returns three members out of eighteen to the Legislative Council of the State, and six to the House of Assembly out of thirty-seven members. It has an incorporated area of 1270 acres, and its population in 1901 numbered approximately 34,604; namely, 25,076

in Hobart proper and 9528 in the remainder of the metropolitan area. The principal suburbs are Newton, Sandy Bay (Queensborough), Wellington, Glenorchy, Eisdon, Bellerive, and Beltana. The total length of streets is 38 miles, and the annual value of ratable property £175,500; in 1899 the rates yielded a revenue of £33,360, and from other services the municipality obtained £10,242, making a total of £43,602. Por public works the sum of £231,000 has been borrowed. against which there is a sinking fund, which at the begin-ning of 1899 amounted to £18,150. The water supply, which is under municipal control, is obtained from streams on Mount Wellington, and collected in reservoirs with a capacity of 120,000,000 gallons ; the cost of constructing the works was £163,877. Gas is supplied by a private company, and the city is partly lighted with electricity, while electric tramways run through the niain streets. It has four banks with branches and two public markets (one for fish), is well supplied with public baths, and has an efficient fire brigade, and is the seat of an Anglican

bishopric and a Roman Catholic archbishopric; there are some thirty-five or forty churches of all denomina^ tions. Cemeteries now number only three, several old ones having been closed in recent years. The National Gallery contains some fine paintings, and in respect of parks and public spaces the city is exceptionally fortu- nate ; the Queen's Domain, the principal park, has an area of 1000 acres; and there are also the Royal Society's Gardens, with an area of 25 acres ; PrankUn Square, a pleasant garden on the site of old Government House ; Barrack Square, Prince's Square, which commands a beautiful view of the river and the lower part of the city; and Parliament House reserve, besides extensive recreation grounds at North Hobart, and a fine racecourse and a general recreation reserve at Risdon, close to the main line railway. The Theatre Royal is one of the best-appointed theatres in the Commonwealth, and there are many halls where entertainments are sometimes given, and four clubs. The chief monuments in the city consist of statues of Sir John Pranklin and Dr Crowther, the

Meredith fountain, the Syme memorial, and, at the barracks, a column erected to the memory of the soldiers killed in the New Zealand war. Hobart Hospital is maintained by the Crown, and though hospitals generally and charitable institutions are not numerous, they are well equipped and sufficient for the wants of the city. At the Newton Charitable Institution the average daily number of inmates is about 470 ; and there are a boy's home, an industrial school for girls, and a Roman Catholic orphanage for girls. There are eight state schools, with 38 teachers and an average attendance of 1600; also a technical school and a large number of private schools, both primary and secondary. For the university, which was established in 1890, and is mainly supported by the state, the Government endowment in 1898 was £2900 out of a total revenue of £3436 ; it has three professors and four lecturers and 38 students, and up to the close of 1898 had conferred 129 degrees. During 1899, 265 vessels entered the port, with a tonnage of 383,354 ; in 1890 the number was 292 and the tonnage

273,494. Imports were valued at £682,498 in 1899, and exports at £846,342. During the fruit season Hobart is a place of call for the P. and 0. Company and the Orient Company's boats, and a regular port of call for two other lines running between London and New Zealand. Several lines of steamers run to Sydney and Melbourne, and there is direct communication with New Zealand, whilst vessels are constantly plying all round the coast. As to its manufactures, there are three breweries, five tanneries, five sawmills, four jam factories, two steam flour-mills, two woollen mills, an important iron foundry, and many small engineering establishments. It is the centre of an important horticultural district, in which over 70,000 acres are under crops ; of these about 9000 acres are devoted to orchards. The fruit export trade has reached very considerable dimensions ; the production in 1899 was 364,000 bushels of apples, 33,738 bushels of pears, and 98,000 bushels of other kinds of fruit, and nearly all this was exported, chiefly to Sydney and London. (t. a. c.)

Hobart Pasha, Augustus Charles Hobart-Hampden (1822-1886), English naval captain and Turkish admiral, was born in Leicestershire on the 1st of April 1822, being the third son of the 6th Earl of Buckinghamshire. In 1835 he entered the Eoyal Navy and served as a midshipman on the coast of Brazil in the suppression of the slave trade, displaying much gallantry in the operations. In 1855 he took part, as captain of the Driver, in the Baltic Expedition, and was actively engaged at Bomarsund and Abo. In 1862 he retired from the navy with the rank of post-captain ; but his love of adventure led him, on the outbreak of the American Civil War, to participate in that struggle in the character of blockade-runner. In command of a swift cruiser he succeeded in eluding no less than eighteen times the ironclad blockade squadron of the North, conveying war material to Charleston and returning with a cargo of cotton. In 1867 Hobart entered the Turkish

service, and was immediately nominated to the command of that fleet, with the rank of " Bahrie Limassi " (rear-admiral). In this capacity he performed splendid service in helping to suppress the insurrection in Crete, and was rewarded by the Sultan with the title of Pasha (1869). In 1874 Hobart, whose name had, on representations made by Greece, been removed from the British Navy List, was reinstated; his restoration did not, however, last long, for on the outbreak of the Eusso-Turkish war he again entered Turkish service. In command of the Turkish squadron he completely dominated the Black Sea, blockading the ports of South Russia and the mouths of the Danube, and paralysing the action of the Russian •fleet. On the conclusion of peace Hobart still remained in the Turkish service, and in 1881 was appointed JVIushir, or marshal, being the first Christian to hold that high office. His achievements as a blockade-runner, his blockade of Crete, and his handling of the Turkish fleet against the torpedo-lined coasts of Russia showed him to be a daring, resourceful, and skilful commander,

worthy to be ranked among the illustrious names of British naval heroes. He died at Milan, 19th June 1886.

Hobart, Garret Augustus (1844-1899), Vice-President of the United States 1897-99, was born at Long Branch, N.J., in 1844. Having graduated from Rutgers College, he practised law at Paterson, N.J., and rose to prominence in the state. In politics he was long conspicuous in the state Republican organization. He served several terms in both the lower and the upper house of the legislature, and was presiding officer of each. Though he never aspired to national office, he accepted the nomination as Vice-President in 1896, on the ticket with President McKinley, and was elected. At Washington his force of character won for him more influence than is generally exerted by a Vice-President ; but he was seized with a fatal illness, and was taken to his home at Paterson, N.J., where he died 21st November 1899.

Ho bo ken, a city of Hudson county. New Jersey, U.S.A., in 40° 44' N. and 74° 01' W., on the west bank

of the Hudson river, just north of Jersey City, with which it is connected by lines of steam and street ears, and opposite New York, of which it is a suburb, and with which it is connected by ferries. It has a large ocean commerce, the docks of several steamship companies being situated here. It is also an important manufacturing centre; in 1890 it contained 289 establishments, with a capital of f 3,948,782, employing 3347 hands, and with a product valued at $7,151,391. It contains the Stevens Institute of Technology, which was founded in 1871, and which has a high rank among technical schools. In 1899 it had 30 professors and instructors and 361 students. Its property was valued at $823,000, and its income was $57,000. The total assessed valuation of real and personal property in 1900, on a basis of about 70 and 50 per cent, of the full value respectively, was $27,790,930 ; the net debt was $1,292,113, and the rate of taxation was $24.20 per $1000. Popular tion (1880), 30,999; (1890), 43,648; (1900), 69,364, of whom 21,380 were foreign-born and only 101 were

negroes. The death-rate in 1890 was 25-9; in 1900 it was 214.

Ho bo ken, a town of Belgium, in the province and 4 miles south of the town of Antwerp. It contains numerous villas of Antwerp merchants, and has a large shipbuilding yard. Population, 9623.

Hochst, a town of Prussia, province of Hesse-Nassau, on the Main, 6 miles by rail west of Erankfort-on-Main. It is a busy industrial town, with large dyeworks and manufacture of snuff, tobacco, waxcloth, gelatine, furniture, &c. It has a fine 9th-century basilica in the church of St Justinus. AU that survives of the castle of the Electors of Mainz from the destruction in 1634 is a single fine tower. There is a statue of Bismarck (1899). Population (1885), 6517 ; (1900), 14,123.

Hochstadt, a town of Bavaria, Germany, district of Swabia, on the left bank of the Danube, 34 miles north-east of Ulm by rail. It has been a place of battles. Here Frederick of Staufen, vicegerent of the empire for Henry IV., was disastrously defeated by Henry's rival

in 1081 ; in 1703 the Imperialists were routed by Marshal Villars in command of the Erench ; and in 1704 Marlborough and Prince Eugene defeated the French and Bavarians commanded by the Elector of Bavaria and Marshal Tallard. This last event is better known in English history and English poetry (Southey) as the battle of Blenheim, more correctly Blindheim. Population (1900), 2246.

Hodgson, Brian Houghton (1800-1894), English ethnologist and naturalist, was born at Lower Beech, Prestbury, Cheshire, on 1st February 1800. His father was a country gentleman, his mother being a sister of Bishop Porteus. In 1816 he obtained an East Indian writership. After passing through the usual course at Haileybury, he went out to India in 1819, and after a brief service at Kumaon was in 1822 appointed assistant to the resident at Katmandu, the capital of Nepal. In 1822 he obtained an under-secretaryship in the Indian Foreign Office, which seemed to open the most brilliant prospects, but his health failed in the climate of Calcutta,

and in 1824 he returned to Nepal, to which the whole of his life, whether in or out of India, may be said to have been thenceforth given. He devoted himself in an especial manner to the collection of Sanskrit MSS. relating to Buddhism, and hardly less so to the natural history and antiquities of the country, and by 1839 had contributed eighty-nine papers to the Transactions of the Asiatic Society of Bengal. His investigations of the ethnology of the aboriginal tribes were especially important. In 1833 he became Resident, and passed many stormy years in conflict with the cruel and faithless Court to which he was accredited. He succeeded, nevertheless, in concluding a satisfactory treaty in 1839 ; but in 1842 his policy, which involved an imperious attitude towards the native government, was upset by the interference of Lord Ellenborough, but just arrived in India, and, not unnaturally, anxious to avoid trouble in Nepal during the conflict in Afghanistan. Hodgson took upon himself to disobey his instructions, a breach of discipline justified to his own mind by his superior knowledge of the situation, but

which the Governor-General could hardly be expected to

overlook. He was, nevertheless, continued in office for a time, but was recalled in 1843, and resigned the service. In 1845 he returned to India and settled at Darjiling, where he devoted himself entirely to his favourite pursuits. In 1858 he returned to England, and lived successively in Cheshire and Gloucestershire, occupied with his studies to the last. He died at his seat at Alderley Grange in the Cotswold Hills, 23rd May 1894. No man has done so much to throw light on Buddhism as it exists in Nepal, and his collections of Sanskrit manuscripts, presented to the East India Office, and of natural history, presented to the British Museum, are unique as gatherings from a single country. He wrote altogether 184 philological and ethnological and 127 scientific papers, as well as some valuable pamphlets on native education, in which he took great interest. His principal work, Illustrations

of the Literature and Religion of Buddhists (1841), was republished with the most important of his other writings in 1872-80. His life was written by Sir W. W. Hunter in 1896. (k. g.)

Hof, a town of Bavaria, Germany, district Upper Eranconia, on the river Saale, 103 miles south by west of Leipzig by the railway to Eatisbon. The seat of various flourishing industries, notably the manufacture of woollen and cotton goods, dye-works, calico printing, chemicals, machinery, iron and copper wares, breweries, and limestone quarries. Population (1885), 22,257 ; (1900), 32,782.

Hofmann, August Wilhelm von (1818-1892), German chemist, was born at Giessen on 8th April 1818. Not intending originally to devote himself to physical science, he first took up the study of law and philology at Gottingen, and the general culture he thus gained stood him in good stead when he subsequently began to study chemistry in Liebig's laboratory. When, in 1846, a school of practical chemistry was started in London,

under the style of the Eoyal College of Chemistry, Hofmann, largely through the influence of the Prince Consort, was appointed its first director. It was with some natural hesitation that he, then a privat-docent at Bonn, accepted the position, which may well have seemed rather a precarious one ; but the difficulty was removed by his appointment as extraordinary professor at Bonn, with leave of absence for two years, so that he could resume his career in Germany if his English one proved unsatisfactory. Fortunately the college was more or less successful, owing largely to his enthusiasm and energy, and many of the men who were trained there subsequently made their mark in chemical history. But in 1864 he returned to Bonn, and in the succeeding year he was selected to succeed Mitscherlich as professor of chemistry and director of the laboratory in Berlin University. In leaving England, of which he used to speak as his adopted country, Hofmann was probably influenced by a combination of causes. The public support extended to the college of chemistry had been dwindling for some

years, and before he left it had ceased to have an independent existence and had been absorbed into the School of Mines. This event he must have looked upon as a curtailment of its possibilities of usefulness. But, in addition, there is only too much reason to suppose that he was disappointed at the general apathy with which his science was regarded in England. No man ever realized more fully than he how entirely dependent on the advance of scientific knowledge is the continuation of a country's material prosperity, and no single chemist ever exercised a greater or more direct influence upon industrial development. In England, however, people cared for none of these things, and were blind to the commercial potentialities of scientific research. The college to which Hofmann devoted nearly twenty of the best years of his life was starved ; the coal-tar industry, which was really brought into existence by his work and that of his pupils under his direction at that college, and which with a little intelligent forethought might have been retained in England, was allowed to slip into

the hands of Germany, where it is now worth millions of poiinds annually ; and Hofmann himself was compelled to return to his native land to find due appreciation as perhaps the foremost chemist of his time. The rest of his life was spent in Berlin, and there he died on 5th May 1892. That city possesses a permanent memorial to his name in Hofmann House, the home of the German Chemical Society (of which he was the founder), which was formally opened in 1900, appropriately enough with an account of the latest triumph of German chemical enterprise, the industrial manufacture of synthetical indigo. Hofmann's work covered a wide range of organic chemistry, though with inorganic bodies he did but little. His first research, carried out in Liebig's laboratory at Giessen, was on coal-tar, and his investigation of the organic bases in coal-gas naphtha established the nature of aniline. This substance he used to refer to as his first love, and it was a love to which he remained faithful throughout his life. His perception of the analogy between it and ammonia led to his famous work on the

amines and ammonium compounds and the allied phos-
phorus derivatives, while his researches on the colouring
matters obtained from it, beginning with rosaniline in
1862, only ended with quinoline red in 1887. But in
addition to these and numberless other investigations for
which he was responsible — ^his last communication from
the Berlin University laboratory bears the number 888—7
the influence he exercised through his pupils must also
be taken into account. As a teacher, besides the power
of accurately gauging the character and capabilities of
those who studied under him, he had the faculty of
infecting them with his own enthusiasm, and thus of stimu-
lating them to put forward their best efforts. In the
lecture-room he laid great stress on the importance of
experimental demonstrations, paying particular attention
to their selection and arrangement, though, since he
himself was a somewhat clumsy manipulator, their
actual exhibition was generally entrusted to his assistants.
He was the possessor of a clear and graceful, if some-
what florid, style, which showed to special advantage

in the obituary notices or encomiums he wrote of such men as Liebig, or Dumas, or Wohler. He also excelled as a speaker, particularly at gatherings of an international character, for in addition to his native German he could speak English, French, and Italian with fluency. (h. m. r.)

Hofmeister, Wilhelm Frledrich Benedict (1824-1877), German botanist, was born at Leipzig, 18th May 1824. He came of a family engaged in trade, and after being educated at the realschule of Leipzig he entered business as a music dealer ; much of his botanical work was done while he was so employed, till in 1863 he was nominated, without intermediate academic steps, to the chair in Heidelberg ; thence he was transferred in 1872 to Tubingen, in succession to von Mohl. His first work was on distribution of the Coniferse in the Himalaya, but his attention was very soon devoted to studying the sexuality and origin of the embryo of Phanerogams ; his contributions on this subject extended from 1847 till 1860, and they finally settled the

question of the origin of the embryo from an ovum, as against the prevalent pollen-tube theory of Schleiden : he showed that the pollen-tube does not itself produce the

embryo, but only stimulates the ovum already present in the ovule. He soon turned his attention to the embryology of Bryophytes and Pteridophytes, and gave continuous accounts of the germination of the spores and fertilization in Pilularia, Salvinia, Selaginella. Some of the main facts of the life of Perns and Mosses were already known ; these, together with his own wider observations, were worked into that great general pronouncement published in 1851 under the title, Vergleichende Uhtersuchungen der Keimung, Entfaltung und Fruchtbildung holier er Kryptogamen und der Samenbildung der Coniferen. This work will always stand in the first rank of botanical books. It antedated the Origin of Species by eight years, but contained facts and comparisons which could only become intelligible on some theory of descent.

The plan of life-story common to them all, involving two alternating generations, was demonstrated for Liver-worts, Mosses, Ferns, Equiseta, Ehizocarps, Lycopodiar cese, and even Gymnosperms, with a completeness and certainty which must still surprise those who know the botanical literature of his time. The conclusions of Hofmeister rem.ain in their broad outlines unshaken, but rather strengthened by later-acquired details. In the light of the theory of descent the common plan of life-history in plants apparently so diverse as those named acquires a special significance; but it is one of the re-markable features of this great work that the writer himself does not theorize : with an unerring insight he points out his comparisons and states his homologies, but does not indulge in explanatory surmises. It is the typical work of an heroic age of plant-morphology. Prom 1857 till 1862 Hofmeister wrote occasionally on physiological subjects, such as the ascent of sap, and curvatures of growing parts, but it was in morphology that he found his natural sphere. In 1861, in conjunc-

tion with other botanists, a plan was drawn up of a handbook of physiological botany, of which Hofmeister was to be editor. Though the original scheme was never completed, the editor himself contributed two notable parts, Die Lehre von der Pflanzenzelle (1867) and Allgemeine Morphologie der Gewdclise (1868). The former gives an excellent summary of the structure and relations of the vegetable cell as then known, but it did not greatly modify current views. The latter was notable for its refutation of the spiral theory of leaf arrangement in plants, founded by Schimper and Braun. Hofmeister transferred the discussion from the mere study of mature form to the observation of the development of the parts, and substituted for the " spiral tendency " a mechanical theory based upon the observed fact that new branchings appear over the widest gaps which exist between next older branchings of like nature.

With this important work Hofmeister's period of active production closes; he fell into ill-health, and retired from his academic duties some time before his death at

Lindenau, near Leipzig, on the 12th of January 1877.

(f. o. b.)

Hofmeyr, Jan Hendrik (1845), South African politician, was born at Cape Town on 4th July 1845. He was educated at the South African College, and at an early age entered the profession of journalism. He was editor of the Zuid Afrikaan till its incorporation with 0ns Land, and of the Zuid Afrikaansche Tidjschrift. By birth, education, and sympathies a typical Dutch Afrikander, he became, almost from his first entrance into the Cape Parliament in 1879, the real leader of the Dutch party. Yet he only held office for six months — as minister without portfolio in the Scanlen ministry from May to November 1881. He held no subsequent official post in the colony, though he shared with Sir Thomas Upington and Sir Charles Mills the honour of representing the Cape at the Intercolonial Conference of 1887. Here he supported the proposal for .entrusting the defence of Simonstown to Cape Colony, leaving only the armament to be provided by the Imperial Govern-

ment, opposed trans-oceanic penny postage, and moved a resolution in favour of an Imperial customs union. At the Colonial Conference of 1894 at Ottawa he was again one of the Cape representatives. But his chief im-portance as a public man is derived from his connexion with the Afrikander Bond. (See Cape Colony.) His control over this organization enabled him for many years, while free from the responsibilities of office, to make and unmake ministers at his will, and earned for him the name of " Cabinet-maker of South Africa." Although ofBcially the term " Afrikander " has been explained by Mr Hofmeyr to include white men of whatever race, yet in practice the influence of the Bond was always exerted in favour of the Dutch language, or rather the local dialect of Dutch known as " the Taal," and its power was drawn from the Dutch districts of Cape Colony. The sympathies of the Bond were thus always strongly with the Transvaal, as the chief centre of Dutch influence in South Africa ; and Mr Hofmeyr's position might in many respects be compared with that

of Pamell at the head of the Irish Nationalist party in Great Britain. In the Bechuanaland difficulty of 1884 Mr Hofmeyr threw all the influence of the Bond into the scale in favour of the Transvaal. But in the course of the next few years he began to drift away from President Kruger. He resented the reckless disregard of Cape interests involved in Kruger's fiscal policy; he feared that the Transvaal, after its sudden leap into prosperity upon the gold discoveries of 1886, might overshadow all other Dutch influences in South Africa; above all he was convinced, as he showed by his action at the London Conference, that the protection of the British navy was indispensable to South Africa, and he set his face against Kruger's intrigues with Germany, and his avowed intention of acquiring an outlet to the sea in order to get into touch with foreign Powers. In 1890 he joined forces with Mr Cecil Ehodes, who became premier of Cape Colony with the support of the Bond. Mr Hofmeyr's influence was a powerful factor in the conclusion of the Swaziland Convention of 1890,

as well as in stopping the "trek" to Banyailand in 1891 — a notable reversal of the policy he had pursued seven years before. But the reactionary elements in the Bond grew alarmed at Mr Ehodes's Imperialism, and in 1895 Mr Hofmeyr resigned his seat in Parliament and the presidency of the Bond. Then came the Jameson Eaid, and in its wake there rolled over South Africa a wave of Dutch and anti-British feeling such as had not been known since the days of Majuba. Once more Mr Hofmeyr became president of the Bond. By an alteration of the Provincial Constitution, all power in the Cape branch of the Bond was vested in the hands of a vigilance committee of three, of whom Mr Hofmeyr and his brother were two. As the recognized leader of the Cape Dutch, he protested against such abuses as the dynamite monopoly in the Transvaal, and urged Kruger even at the eleventh hour to grant reasonable concessions rather than plunge into a war that would involve Cape Afrikanderdom and the Transvaal in a common ruin. In July 1899 he journeyed with Mr Her-

holdt to Pretoria, and vainly supported the proposal of a satisfactory franchise law, combined with a limited representation of the Uitlanders in the Volksraad, and in September urged the Transvaal to accede to the proposed joint inquiry. During the negotiations of 1899, and after the outbreak of war, the official organ of the Bond,

Ons Land, was conspicuous for its anti-British attitude, and its violence forced Lord Eoberts to suppress it in the €ape Colony district under martial law. Mr Hofmeyr never associated himself publicly with the opinions ex-pressed by Ons Lmid, but neither did he repudiate them. The tide of race sympathy among his Dutch supporters made his position one of great difficulty, and shortly after the outbreak of war he withdrew to Europe, and refused to act as a delegate, with Messrs Merriman and Sauer, to England in 1901.

Hogarth, William (1697-1764). To the account of Hogarth given in the ninth edition of this Encyclopaedia

the following additions require to be made in view of more recent contributions to our knowledge concerning him. The precise place of Hogarth's birth was Bartholomew Close, where, two years later, his sister Mary was born. He had a second sister, Ann, who was born in 1701. Eichard Hogarth, his father, died in May 1718. By the earlier commentators " A Harlot's Progress " was dated 1733-34 (vol. xii. p. 48). It has now been ascertained that Hogarth must have begun to engrave this series — a task which he had at first intended to leave to others — shortly after the conclusion of the last picture in 1731. From an advertisement in the Country Journal ; or, the Craftsman, 29th January 1732, the pictures were then being engraved ; and from later announcements it seems clear that they were delivered to the subscribers earlyinthe following April, on the 21st of which month an unautho-rized prose description of them was published. From the MSS. of George Vertue in the British Museum (Add. MSS. 23069-98), it appears that, during the progress of the plates, Hogarth was domiciled with his father-in-law, Sir

James ThornhUl, in the Middle Piazza, Covent Garden (the " second house eastward from James Street ") ; and the "Five Days' Peregrination" (May 27-31) must have followed " A Harlot's Progress " instead of preceding it. What Hogarth did to decorate Vauxhall beyond the picture of Henry VIII. and Anne Boleyn is not clear, as the " Four Times of the Day " are said to have been copies by Hayman ; but Jonathan Tyers certainly presented him with a gold pass ticket In perpetuam Beneficii memoriam, which was lately in the Forman Collection, and now belongs to Mr Fairfax Murray. Mr Warwick Wroth (Numismatic Chronicle, vol. xviii.) doubts if Hogarth designed this himself, as generally stated, but he probably did design some of the silver passes to Vauxhall which are figured in WUkinson's Londina Illustrata. Of late years several valuable pictures by Hogarth have passed into the possession of the National Gallery. In July 1895 the Duke of Westminster presented " The Gates of Calais " ; and the Trustees have also purchased " Lavinia Fenton as Polly Peachum "

(1884), "The Shrimp Girl" (1884), Hogarth's "Six Servants" (1892), and "Mrs Salter," Hogarth's sister Ann (1898). To the National Portrait Gallery was added in 1892, by the gift of the Earl of Carlisle, « The House of Commons examining Bambridge" (vol. xii. p. 47). The Print Room at the British Museum also acquired in July 1896, from Mr E. Cheney, a very interesting set of sixteen designs for the series called " Industry and Idleness," the majority of which formerly belonged to Horace Walpole. Hogarth's house at Chiswick (vol. xii. p. 60), of which he was admitted copyholder in September 1749, and which he left at his death to his widow, is still in existence. In December 1901 it was sold by its owner, Mr Alfred Dawson of Chiswick, to Lieutenant-Colonel Shipway for £1500. A life of Hogarth, together with a copious bibliography of books, pamphlets, &c., relating to the painter and his work, and detailed catalogues of his prints and paintings, was issued in 1891 by the present writer. In 1897 it was followed by a new and greatly enlarged edition. It should be added that " Sloane

Museum" (vol. xii. p. 60) is a misprint for Soane Museum ; and that the National Portrait Gallery is now at St Martin's Place. (a. d.)

Hohenelbe (Bohemian or Czech, Vrchlabi), chief town of a government district, Bohemia, Austria, at the source of the Elbe, 14 miles W.N. W. of Trantenau. Its industries now include iron-foundries and the manufacture of machinery, pottery, brewing and milling, and marble works, in addition to its staple trade in textiles. It is the starting-point for excursions in the Eiesengebirge. Population, mostly German and Eoman Catholic (1900), 6597. The adjoining village of Ober-Hohenelbe has a' population of 2420, with bleaching works and linen and jute manufactories.

Hohenems, or Hohenembs, a market-place in the government district of Dornbirn,Vorarlberg, Austria, situated on the right-hand slope of the Upper Eheinthal and on the Feldkirch-Bregenz section of the Austrian State raihVay. Population (1900), 5662. The chief industries are cotton spinning, weaving, printing, and dyeing, manu-

factures of yarn, ribbons, and machine embroidery, and there is considerable trade in timber. It is inhabited by the only Jewish community in Vorarlberg, which numbers 118 souls, and has a synagogue. The village has two chg,teaus, that of Neu-Hohenems and one belonging to Count Waldburg-Zeil. The Hohenembs family became extinct in the male line in the latter half of the 18th century. The title is included in the full list of those borne by the Austrian Emperor, who occasionally uses it when travelling incognito. The late Empress Elizabeth of Austria usually travelled as Countess of Hohenembs.

Hohenheim, a village of Wlirtemberg, Germany, 5 miles south of Stuttgart by rail. It is the seat of the most important agricultural college in Germany. The college was founded in 1818, and established in a royal pleasure castle, built in 1782 by Duke Karl Eugen. To it have since been added a forestry college (1820), a farming school for peasants' sons, a horticultural and a viticultural school, a technological institute, an institute for testing agricultural seeds (1877), an institute for

testing agricultural machinery (1883), a model steam dairy and butter and cheese factory (1883), a fisheries institute and fish-breeding station (1886), a fowl-breeding establishment (1890), a bacteriological institute, a chemical laboratory, botanical gardens of 16 acres, a herbarium of 27,000 plants, an agricultural estate of 800 acres, an orchard, a vineyard, experimental fields, a forest of 6500 acres, experimental stations for testing various processes, a library, physical laboratories, mineralogical, geological, veterinary, and zoological museums, a museum of agricultural implements and various collections of objects connected with farming, a meteorological station ; also, in connexion with the technological institute there are a distillery, a brewery, a vinegar factory, and a sugar factory. The college was raised to the position of a high school in 1865, and now ranks with the technical high schools, and consequently has university status. The course is for three years, and there are 27 professors and teachers, and usually rather more than 100 students, including several foreigners. Population, about 280.

See British Diplomatic and Consular Reports, Miscellaneous series, No. 452, Agriculture in (fennany (1898), p. 14, &c. : and No. 566, Wiirtemberg Schools (1901), p. 32, &c.

Hohenlimburg, a town of Prussia, province of Westphalia, 30 miles by rail S.E. of Dortmund. It is the seat of various iron and metal industries. A castle overlooks the town. Population (1900), 8111.

Hohenlohe-Schillingsfurst, Chlodwig Karl Victor, Prince of (1819-1901), German states-man, was born 31st March 1819. He belonged to a Cath-olic branch of one of the most widely extended of German princely families, which until 1806 ruled over considerable dominions in Swabia, and still possesses all the social privileges secured to the mediatized princes. He studied at the universities of Heidelberg, Gottingen, and Bonn, and entered the Prussian civil service. In the year 1845, large estates in Prussia having been left to the family by the Landgraf of Hesse-Eothenburg, a connexion of his mother's. Prince Victor, the eldest brother, took them as

his share, and received the title of duke of Eatibor from the king of Prussia ; Prince Chlodwig received the Bavarian estates, and became a hereditary member of the Bavarian Upper House, while he also had the title prince of Eatibor. In 1849 he held for a few months a diplomatic post in England, but for the next fifteen years he took little part in public affairs. His attachment to Prussia threw him into opposition to the prevalent opinion in Bavaria. With all his family he belonged to the party of Liberal Catholics ; the duke of Eatibor was one of the few Eoman Catholics who supported Bismarck in his struggle with the Church, and a younger brother, the Cardinal Hohenlohe, was the leader of the opposition to the Ultramontanes in the Vatican Council. In 1872 Bismarck proposed to appoint Cardinal Hohenlohe Prussian envoy at the Vatican, but the Pope refused to accept a cardinal in this position. After the crisis of 1866, when it was desirable to form a ministry in Bavaria which would carry out the new alliance with Prussia, the king entrusted Hohenlohe with the task. He was minister-

president for three years ; he took a leading part in arrang-
ing the customs parliament, which was the first step to-
wards a closer union of I^orth and South Germany, and he
carried out a reorganization of the Bavarian army on the
Prussian system ; he also brought about a military union of
the southern states. During these years he was the most
important German statesman next to Bismarck, for he
made possible the union of Bavaria with Prussia in 1870.
He also issued a celebrated despatch in which he invited
the Catholic Powers to interfere at the Vatican Council
and prevent the declaration of Papal infallibility; but
the greater Powers were too much occupied to venture
on so serious a step, and Bavaria was too weak to act
alone. His policy was, however, bitterly attacked by
the " patriotic " party, who accused him of betraying the
independence of Bavaria; they were supported by the
Ultramontanes, and when Hohenlohe brought in a Bill
for the reorganization of the schools, by which the
influence of the Church would be diminished, it was lost.
His followers were twice defeated in the elections of 1869,

and, notwithstanding the support of the king, he had to resign. He supported and helped to carry the treaty of 1870 with North Germany, and was elected a member of the German Eeichstag. In 1873 Bismarck chose him to succeed Count Arnim as ambassador in Paris. In 1879, on the death of Biilow, he acted for some time as secretary of state for foreign affairs, and was the third German representative at the Congress of Berlin. In 1885 he was chosen to succeed Manteuffel as governor of Elsass-Lothringen. Here he had to carry out the strict measures which became necessary in 1887-88, but he succeeded in laying the foundation of a Nation-alist party. In 1894, notwithstanding his advanced years, he was appointed Prussian minister-president and chancellor of the empire in succession to Caprivi. (For the events connected with his administration see Geemany.) He took a less active part in public business than either of his predecessors; his appearances in the Prussian and German parliaments were rare, and great independence was allowed to the secretaries of state.

On more than one occasion the want of a strong control-
ling force was felt, especially in the management of
Prussian affairs. He resigned in August 1900, and died
6th July 1901.

Prince Hohenlohe married in 1851 Marie, princess of
Sayn-Wittgenstein-Berleburg, by whom he had several
children. On the death of Prince Peter of Sayn-Witt-
genstein in 1887 the princess succeeded to his very
extensive possessions in Eussia. A recent law, however,
forbade foreigners to hold land in Eussia, and all the
influence of the prince was unable to procure an
exemption.

Other members of the family of Hohenlohe who have attained
distinction in recent years are Pkince Adolf ton Hohenlohe
Ingelfingen (1797-1873), a son of the general who commanded
at Jena ; he was minister-president of Prussia for a few months in
1862. His son, Peince Kkaft von Hohenlohe (1827-1892), Prus-
sian general, was the author of a numher of important military
works, most of which have been translated into English. A cousin
of his was Prince Friedrich Wilhelm ton Hohenlohe, duke

of Ujest (1816-1897), one of the wealthiest of the I'russian nobility. These all belong to the Protestant branch, as do the family of Hohenlohe-Langenburg, to which belongs Prince Hermann vox Hohenlohe, general in the Prussian army, founder and president of the German Colonial Society, and after 1894 governor of Elsass-Lothringen, in which post he succeeded Prince Chlodwig von Hohenlohe. His son, the Hereditary Pkince of Hohenlohe-J ANGENBURG, married a daughter of Alfred, Duke of Saxe-Coburg-L.otha, and became regent of the principality during the minority of the present duke. The family of Hohenlohe-Langenburg hold also the title of Count Gleichen. Through the mother of the present prince, a princess from Leiningen, they are closely connected with the English Royal family.

See Rust. Beiohskamler Furst Hohenlohe und seine BriXder. Dusseldorf, 1897. (j. w. He.)

Hohenmauth (Czech, Vysoke Myto), chief town of a government district in Bohemia, Austria. It has now a communal Czech gymnasium, and among its new industries are the manufacture of musical instruments, artificial manure, and pottery. Population, almost wholly Czech*

(1900), 9473, including a garrison of 1452 men.

Hohenzollern, a bailiwick of the kingdom of Prussia, on the Danube, and almost entirely surrounded by Wiirtembefg and Baden, with an area of 441 square miles, and population (1900) of 66,780, of whom 95 per cent, are Eoman Catholics. Agriculture and a little mining, fruit-growing, and manufacture of iron-ware and cottons are the principal industries.

Hokkaido, the Japanese name for the northern division of the empire (BbA;i4= north, A;ai=sea, and do= road), including Yezo, the Kuriles, and their adjacent islets.

Holbeach, a market-town and railway station in the Spalding parliamentary division of Lincolnshire, England, 17 miles south of Boston. All Saints' Church (14th century), with a spire 180 feet high, has been restored; there are Congregational, Baptist, Wesleyan, and other chapels; the grammar school, founded in 1669, has an endowment of about £220 a year, and occupies a building erected in 1877. Other public buildings are the

assembly rooms and a market house. Eoman and Saxon remains have been found. Area of parish (an urban district), 21,469 acres. Population (1881), 5190; (1901), 4752.

Holden, Hubert Ashton (1822-1896), English scholar, was born, of an old Staffordshire family, in 1822, and educated at King Edward's School, Birmingham, and Trinity College, Cambridge. He was Bell University Scholar (1842) and senior classic (1845), besides being a junior optime in the mathematical tripos, and was elected a fellow of his college, where he remained for some time as tutor. In 1848 he was ordained. Erom

1853 to 1858 lie was vice-principal of Cheltenham College, and from 1858 to 1883 headmaster of Queen Elizabeth's School, Ipswich. He took his Cambridge LL.D. in 1863, and in 1893 was given by Dublin the degree of Litt.D. Dr Holden was one of the finest classical scholars of his time ; in 1848 he produced an

edition of Aristophanes, and in subsequent years edited various works of Plutarch, Xenophon, Thucydides, and Cicero. His chief title to remembrance, however, rests on his FoUoi-um Silvula (1852), a collection of English poetry and prose for translation into Greek and Latin ; Folia Silvvlm (the translations), which ran through many editions; and Foliorum Centurice. In English schools these books became household words, and were indis-solubly connected with the writing of Latin and Greek verse. He died in London, 1st December 1896.

Holden, Sir Isaac (1807-1897), English inven-tor and manufacturer, was the son of Isaac Holden, a miner of Cumberland, and was born at Hurlet, a village between Paisley and Glasgow, 7th May 1807. His early life was passed in very straitened circumstances, but his father spared no pains to give him as much elementary education as possible. Necessity, however, compelled the boy to seek employment, and he obtained work for two years as weaver's draw-boy, and afterwards in a cotton mill. Meanwhile his education was continued at the

night schools, and from time to time, as funds allowed, he was taken from work and sent to the grammar school, to which he at last went regularly for a year or two until he was fifteen, when his father removed to Paisley and apprenticed him to an uncle, a shawl-weaver there. This proved too much for his strength, and he became assistant teacher to Mr John Kennedy until January 1828, when he was appointed mathematical teacher in the Queen's Square Academy, Leeds. At the end of six months he was transferred to Lingard's Grammar School, near Huddersfield, and shortly afterwards became classical master at Castle Street Academy, Eeading. It was here that in the course of chemical experiments he invented a lucifer match by adopting sulphur as the medium between the explosive material and the wood, but he refused to patent the invention. In 1830 his health again failed, and he returned to Scotland, where a Glasgow friend set up a school for him. After six months, however, he was recommended for the post of bookkeeper to Messrs Townend Brothers, of Cullingworth, where his interest in

machinery soon led to his transfer from the counting-house to the mill. Here he pursued a series of experiments in wool-combing, which ultimately led to the foundation of the firm of Lister & Holden, whose wool-combing business Was also established successfully in France. Owing to Holden's devotion to the improvement of his machinery, and his special success in the " square motion " principle, the business grew rapidly, and several branches were established. In January 1859 Mr Lister retired, and the firm of Isaac Holden & Sons was established, which became the largest wool-combing business in the world, employing upw9,rds of 4000 work-people. In 1865 Holden's medical advisers insisted on complete change of occupation, and he entered upon a parliamentary career in the Liberal interest, and was elected for Knaresborough in July of that year. In 1868 he resigned his seat, and unsuccessfully contested the Eastern Division of the West Eiding, the Northern Division in 1872, and again the Eastern Division in 1874. But on the death of Lord Frederick Cavendish in

1882 he was elected for the Northern Division, and returned in 1885 for Keighley. He was created a baronet in 1893, and continued to represent Keighley until his death in 1897.

Holguin, a town in the interior of Santiago province, Cuba, 65 miles N.N. W. of Santiago de Cuba. It was noted as a revolutionary centre. It is connected by rail with Gibara. Population (1899), 6045.

Holl, Frank (1845-1888), English painter, was born in London on 4th July 1846, and was educated chiefly at University College School. He was a grandson of William Holl, an engraver of note, and the son of Francis Holl, A.R.A., another engraver, whose profession he originally intended to follow. Entering the Eoyal Academy schools as a probationer in painting in 1860, he rapidly progressed, winning silver and gold medals, and making his debut as an exhibitor in 1864 with "A Portrait," and "Turned out of Church," a subject picture. "A Fern Gatherer," 1865 ; " The Ordeal," 1866 ; "Con-valescent " (the somewhat grim pathos of which attracted

much attention), and " Faces in the Fire," 1867, succeeded. Holl gained the travelling studentship in 1868 ; the successful work was characteristic of the young painter's mood, being " The Lord gave, and the Lord hath taken away." His insatiable zeal for work of all kinds began early to undermine the artist's health, but his position was assured by the studentship picture, which created a sort of furore, although, as with most of his works, the blackness of its coloration, probably due to his training a an engraver, was even more decidedly against it than uhe sadness of its theme. Otherwise, this painting exhibited nearly all the best technical qualities to which he ever attained, except high finish and clearness, and a very sincere vein of pathos. Holl was much below Millais in portraiture, and far inferior in all the higher ways of design; in technical resources, relatively speaking, he was but scantily provided. The range of his studies and the manner of his painting were narrower than those of Josef Israels, with whom, except as a portrait-painter, he may better be compared than with Millais. In 1870 he

painted "Better is a Dinner of Herbs where Love is, than a Stalled Ox and Hatred therewith " ; " No Tidings from the Sea," a scene in a fisherman's cottage, in 1871 — a story told with breath-catching pathos and power; " I am the Eesurrection and the Life," 1872 ; " Leaving Home," 1873, " Deserted," 1874, both of which had great success ; " Her First-born," girls carrying a baby to the grave, 1876 ; and " Going Home," 1877. In 1877 he painted the two pictures shown in our Plate, " Hush " and "Hushed." "Newgate, Committed for Trial," a very sad and telling piece, first attested the breaking down of the painter's health in 1878. In this year he was elected A.E.A., and exhibited "The Gifts of the Fairies," " The Daughter of the House," " Absconded," and a very fine portrait of Samuel Cousins, the mezzotint engraver. This last canvas is a masterpiece, and deserved the success which attended the print engraved from it. Holl was overwhelmed with commissions, which he would not decline. The consequences of this strain upon a constitution which was never strong were more or less,

though unequally, manifest in " Ordered to the Front," a soldier's departure, 1880; "Home Again," its sequel, in 1883 (after which he was made E.A.). In 1886 he produced a portrait of Millais as his diploma work, but his health rapidly declined, and he died at Hampstead, 31st July 1888. Holl's better portraits, being of men of rare importance, attest the commanding position he occupied in the branch of art he so unflinchingly followed. They include likenesses of Lord Eoberts, painted for Queen Victoria, 1882 ; the Prince of Wales, Lord Dufferin, the Duke of Cleveland, 1885 ; Lord Overstone, ilr Bright, iVli-Gladstone, Mr Chamberlain, Sir J. Tenniel, Earl Spencer, Viscount Cranbrook, and a score of other important subjects. (p. G. s.)

'Hush." By Fkank Holl, E.A.

"Hushed." Bt Fkank Holl, E.A.

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HOLLAI^D.

Geography and Statistics.

HOLLAND, as the Kingdom of the Netherlands

is generally termed in English, is a maritime country of North-West Europe, bounded on the E. by Germany, on the S. by Belgium, and on the W. and N.by the North Sea. Since 1880 the dykes and dunes have been considerably strengthened by the erection of new breakwaters, walls, &c., at several places, more particu-larly at West Kappel, near Domburg (Walcheren), along the coast of Delftland and Scheveningen (since the storms of 1894-95), at Petten and the Hondsbossche in North Holland (1884-88), around the shores of Ameland and Vlieland (1880-97), islands which protect the entrance to the Zuyder Zee, and along the coast of the northern provinces. Taking the division of the country into Low-lands, lying below the Amsterdam zero (or mean high-water level in front of that city), and HigJdands (lying above that level), the former may be considered to occupy 38 per cent, of the surface and the latter 62 per cent. A more detailed classification, however, distinguishes seven zones, running roughly from west to east : —

Zone.

1

2

8

-

5

6

7

Mean Altitude between j

(metres) . . .1

Percentage of Total Area .

-2-5

and

0

25

0

and

1

13

1

and

5

12

5

and

10

12

10

and

25

24

25

and

50

12

50

and

10

2

The figures indicate the mean height of the zones; the

height of the hills is greater : near Vaals (Limburg) the

extreme altitude of 1057 feet is reached.

Climate. — The following table supplies data respecting the cli-

mate on an average of fifty years : —

Month.

Mean Monthly-

Temperature.

Mean Monthly

Barometric

Height.

Average

Rainfall.

Average

Evaporation.

January .

February .

March

April

May.

June .

July .

August

September

October .

November .

December .

Fahr.

34-64°

37-22°

40-73°

48-85°

56-48°

62-40°

65-10°

64-40°

59-25°

50-65°

41-32°

36-70°

Inches.

29-93

29-45

29-90

29-90

29-92

29-95

29-94

29-93

29-94

29-88

29-89

29-93

Inches.

1-93

1-75

1-75

1-49

1-94

2-16

2-97

3-19

2-60

2-87

2-34

2-41

Inches.

0-46

- *1-23*

2 12

3-12

5-91

6-88

6-53

3-45

2-07

1-20

0-73

0-59

The mean annual temperature is 49-8° Fahr.; the maximum, 93-9° Fahr. ; the minimum, -5-8° Fahr. The mean annual baro-metric height is 29-98 inches ; the mean annual moisture, 81 per

cent. – the mean annual' rainfall, 27 -99 inches. The mean annual number of days with rain is 204, with snow 19, and with thunder-storms 18. The increased rainfall from July to December (the summer and autumn rains), and the increased evaporation in sprino' and summer (5-2 inches more than the rainfall), are of importance as regards "poldering" and draining operations. The prevalence of south-west winds during nine months of the year and of north-west during three (April-June) has a strong influence on the temperature and rainfall, tides, river mouths, and outlets, and also geologically, on dunes and sand drifts, and on fens and the accumulation of clay on the coast.

Area and Population.— In 1889 the area showed a slight diminution as compared with that of 1877, being calculated to be 12,558 square miles. Including the Zuyder Zee and sand islands (2027 square miles) and the Dutch portion of the DoUart (23 square miles) , the total area was returned as 14,613 square miles. About 38 square miles have been reclaimed since 1877 from the Y, Groningen (the DoUart), Zeeland, and the Legmeer. The following table shows the area and population of the provinces severally :—

Province.

Area in

Square Miles.

Population

1889.

Population

1900.

Density per

Square Mile

in 1900.

North Brabant

Gelderland .

South Holland

North Holland

Zeeland

Utrecht

Friesland .

Overyssel .

Groningen .

Drenthe

Limburg .

Total .

1,980

1,965

1,166

1,070

690

534

1,282

1,291

790

1,030

850

509,628

512,202

949,641

829,489

199,234

221,007

335,558

295,445

272,786

1,30,704

255,721

553,842

566,549

1,144,448

968,131

216,295

251,0.34

340,262

333,338

299,602

148,544

281,934

280

288

981

905

313

470

265

258

379

144

332

12,648

4,511,415

5,104,1311

404

^ This total includes 158 persons assigned to no province.

The divergence between the density in North and South Holland and that in Drenthe has become more marked than ever. On 1st January 1900 there were twenty-two cities with a- population of over 25,000, as compared with only nine thirty years earlier, since when the populations of even the largest had almcst, and in some cases more than, doubled. The eight largest were : Amsterdam (510,850), Rotterdam (318,500), The Hague (206,020), Utrecht (102,080), Groningen (66,530), Haarlem (64,080), Arnhem (56,810), Leyden (53,650). The following table gives particulars of the births (living), deaths, and marriages for the whole country in

1889, 1899, and 1900 :—

Tear.

Births.

Deaths.

Marriages.

Number.

Per

Thousand.

Number.

Per

Thousand.

Number.

Per

Thousand.

1889

1899

1900

150,529

163,289

162,611

33-2

32-0

31-8

91,135

87,319

92,043

20-1

17-1

18-3

31,494

37,990

39,419

7-0

7-4

7-7

The illegitimate births in 1900 numbered 4247, as compared with an annual average of 4264 for the years 1879-84, and an annual average of 4529 for the period 1879-1900. There is but little emigration ; the number of emigrants annually in 1887-91 was 5271, but this fell in 1896-1900 to 1255.

Changes in Government. — Since 1878 the number ol members in the First Chamber has been increased from 39 to 50, So.ith Holland sending 10, North Holland 9, North Brabant and Gelderland each 6, Friesland 4, Overyssel, Limburg, and Groningen each 3, Zee-land, Utrecht, and Drenthe each 2. According to the fundamental law of 1887, they are chosen by the provincial states not only from amongst those who bear the greatest burden of direct taxa^ tion in each province, but also from amongst great functionaries and persons of high rank. The members of the Second Chamber number 100. The franchise has been extended until the number of electors — only 3-02 per cent, of the population in 1880— formed 11-19 per cent, in 1900.

Religion.— M, the census of 1900 the population was classified thus as regards religion : —

Provinces.	*Dutch Reformed.*	*Other Protes-tants.*

Roman

CathoUcs.

Jan-

senists.

Jews.

Other

Creeds &

Unknown.

N. Brabant

Gelderland

S. Holland

N. Holland

Zeeland .

Utrecht .

Friesland .

Overyssel .

Groningen

Drenthe .

Limburg .

Total .

50,626

314,414

683,664

444,334

127,147

134,647

204,902

196,497

199,070

112,193

3,459

13,362

38,951

140,533

142,705

28,959

27,637

83,653

37,768

60,218

22,600

712

486,847

201,939

277,442

266,356

54,456

83,069

24,831

89,845

19,624

9,242

276,452

12

365

1,994

4,589

12

1,737

7

6

24

7

1

2,108

5,160

17;406

61,960

426

1,435

1,545

4,507

6,038

2,292

1,111

887

5,720

23,409

48,187

5,295

2,509

25,324

4,715

14,628

2,210

199

2,470,953

597,098

1,790,103

8,754

103,988

143,083

The state contributes annually about £164,000 towards the funds

of the various denominations.

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Education.-

tion : —

~~*The following tables show the progress of educa*~~

Primary Education.

HOLLAND

[statistics

Tear.

1-

•§■8

u

Pupils.

3|

If

11

St

I-H O

Boys.

GWs.

1875

1898

3,817

4,544

11,975

23,532

55,485

379,622

67,912

351,066

1,626

845

73,018

115,985

£

514,480

1,349,473

1?3

2-8

Secondary Education.

Tear.

High Burgher Schools. 1

Boys.

Girls.

a,

1

H

i

1

1

1

8

1875

1898

78

126

8,087

17,217

521

1,226

51

63

3,847

8,143

581

839

9

12

691

1,586

101

174

1 For drawing and industrial art ; technical schools for workmen.

In 1900 the elementary schools numbered 4569, the teachers 24,222, and the pupils (boys and girls) 539,810 ; the burgher schools 137, the teachers 1225, and the pupils 18,478 ; the high burgher schools 75, the teachers 1024, and the pupils (boys and girls) 10,299. Of the total number of children of school age (six to twelve years) about 8J per cent, receive no education. Besides the universities mentioned below, there is the "free (Reformed) university " of Amsterdam, attended in 1900 by 126 students.

In 1900 the Polytechnic School numbered 714 pupils, the National School of Agriculture nearly 200, and eleven schools of navigation 1564, with 71 instructors. In 1899 the state spent £883,330 upon education, and the communes an additional £1,003,583. The following universities provide for — ■

Higher Education.

Tear.

Leyden.

Utrecht.

Groningen.

Amsterdam.

Amsterdam

Free.

Prof.

Stud.

Prof.

Stud.

Prof.

Stud.

Prof.

Stud.

Prof.

Stud.

1898-99

50

792

39

775

38

397

50

929

6

128

Gymnasia (including Latin or Grammar Schools) .

Tear.

Number.

Teachers.

Pupils.

1899-1900 .

‘ 29

426

2259

The expenditure of the universities and gymnasia amounted in 1877 to £88,141, in 1898 to £253,715. Since 1870 there have been instituted schools of cookery and domestic economy, a technical

school for engineers at Amsterdam, schools of commerce and administration, schools for instruction in horticulture and dairy work, for the training of teachers (for primary schools), for the blind, deaf, and mute, for drawing and industrial art, and for music, dramatic study, painting, and architecture. The number of museums and collections of antiquities, engravings, &c., has also been increased.

Crime and Pauperism. — There are a high court, 5 courts of justice, 23 district tribunals, 106 cantonal courts. Trial by jury is unknown. In 1900, 96,869 persons altogether were convicted by the cantonal courts, and 13,236 males and 1254 females at the district tribunals. The number of inmates In prison at the end of 1898 was 2123 males and 156 females ; in houses of detention 712 males and 58 females. There are three state workhouses for drunkards, beggars, and vagabonds ; the number of inmates at the end of 1898 was 3759. Children under sixteen years of age placed in the three state reformatories in 1898 numbered 593 boys and 98 girls. The relief of the poor is largely eBected by religious societies and organized private charities. The state does not interfere except when private charity fails ; in that case the

pauper must be supported by the commune. The number of poor relieved during 1898 was 235,295, or 4-69 per cent, of the total population.

Finance. — The following statement shows the revenue and expenditure of the kingdom for 1889 and 1900-1 : —

l-levenue.

Expenditure. 1

Source.

ISSi).

1901.

Object.

1SS9.

1901.

£

£

£

£

Excise

3,678,075

4,042,500

National Debt ....

2,727,591

2,906,214

Direct Taxation ....

2,300,865

2,900,175

Department of War

1,798,698

1,893,036

Indirect Taxation ....

2,004,745

1,805,583

Department of Waterstaat

1,790,291

2,448,389

Post Office ...

539,405

865,750

Department of Finance .

1,537,404

2,092,343

Government Telegraphs .

106,970

187,375

Department of Marine .

1,038,536

1,388,141

Export and Import Duties

440,247

801,500

Department of Interior .

815,188

1,380,563

State Domains

213,186

147.000

Department of Justice .

426,343

529,159

Pilot Dues

106,079

191,667

Department of Colonies .

93,829

109,768

State Lotteries

54,609

54,250

Department of Foreign Afiairs

57,312

71,101

Gold and Silver Wares .

19,496

25,908

Royal Household ....

54,166

66,667

Game and Fisheries

11,660

11,000

Superior Authorities of the State .

52,476

56,792

Railways

Totali

361,512

Unanticipated Expenses .

Total 2

1,745

4,166

9,475,337

11,394,220

10,393,579

12,896,289

‘ Including the ordinary revenue (the Indian contributions ceased in 1ST8), balances from previous budgets, proceeds of sale of domains, &c., which are not specified

in details.

2 Including, besides the ordinary budget, the outlays in payment of annuities, in funding and discharging debt, in railway extension, &c.

The total debt in 1901 amounted to £96,561,287, the annual

interest amounting to nearly 3 millions sterling. During the years 1850-1900, £26,034,422 has been devoted to the redemption of the public debt. The total wealth of the kingdom is estimated at 888 millions sterling.

The following table gives a statement of tlie provincial and communal finances : —

Kevenue.

Expenditure.

1889.

1900.

1889.

1900.

Provincial

Communal

£

722,583

6,132,000

£

445,333

9,311,666

Provincial

Communal

740,333

5,683,800

£

445,333

8,503,250

Defence.— Thfi standing army in 1898-99 formed a force of 69,316, as compared with 60,000 in 1878. Of these 3253 were raised by voluntary enlistment, 11,773 were conscripts in arms, 54,290 conscripts not in arms. Personal service has been compulsory since 1898. There are 43,690 in the militia " train – bands " or schuttery. The strength of the navy in 1899 consisted of 741 officers and 10,601 men, including marine infantry. The fleet was composed on 1st January 1900 of 32 armour-plated and (18 non-armour-plated ships, with 39 ships for general purposes. The guns numbered about 650, Both seamen and marines are recruited by enlistment.

Agriculture.— T!\^ following statement shows the uses to which the land was put in 1899 :— Arable land, 26 per cent. ; pasture and

hay fields, 34 per cent, ; market and flower gardens and orchards, 1‘65 per cent.; woodland, 6-8 per cent.; waste lands (in 1876, 23 per cent.), 18 per cent.; the remainder is occupied by water, roads, dykes, buildings, &c. Both the diluvium (sandy soil) and the alluvium (marine and fluvial clay) are adapted for agriculture and grazing ; the orchards, &c., are principally on the gecst or higher grounds on the border of the dunes, or skirting the sand and clay strata. The area of waste land has been lessened by the plantation of woods, cultivation of heaths and fens, improved irrigation and statistics]

means of communication, and a reduction in the number of sheep. The following table shows the areas under cultivation in grain and other marketable crops in 1899 : —

Crops.	*Acres.*	*Mean Production per Acre.*
	1876-80.	

1898-99.

Wheat

Rye .

Potatoes

Oats .

Buckwheat .

Beans and Pease .

Barley

Rape Seed .

Beetroot

Flax .

178,153

530,383

385,727

317,993

71,989

147,416

88,117

11,815

115,233

19,840

Bushels.

23-61

19-38

124-78

41-23

17-37

22-84

30-21

23-51

Cwt.

183-8

3-40

Bushels.

28-3

24-4

204-9

50-0

17-1

28-9

41-0

28-9

Cwt.

254-0

4-8

In addition, over 470,000 acres are annually planted with fodder plants. Notwithstanding the improved production per acre and the progress of agricultural science (promoted by the Government, societies, schools, settlements, winter courses, inspectors, and a special department for agriculture under the minister of the interior), the market value of grain has decreased by about one-half since 1875. Permanent pasture in 1900 extended to close upon 3,000,000 acres. The number in 1876 and 1899 respectively of horses was 268,000 and 284,900 ; of cattle, 1,439,257 and 1,646,500 ; of sheep, 891,090 and 755,400 ; of goats, 150,000 and 177,200 (1898) ; of pigs, 352,000 and 1,384,500. The value of the live stock was estimated in 1897 at about £14,473,200. Stock-breeding, like agriculture, has considerably improved under the care of the Government (state and provincial), which grants subsidies for breeding, irrigation of pasture-lands, the importation of finer breeds of cattle and horses, the

erection of factories for dairy produce, schools, &c.

Fisheries. — The position of the fishing industry in the four great fishing areas in 1899 was : —

A'essels.

Men.

North Sea Fishery (Salt Herring, Cod and Flat Fish)

1,459

10,632

Zuyder Zee Fishery .

3,511

7,492

Groningen and Friesland Fishery

98

288

Zeeland Fishery

1,072

2,383

The herring exported from the North Sea fishery in 1898 amounted to 354,333 tons, value £530,878 ; the herring exported from the

Zuyder Zee fishery amounted to 71,380,000 fish — various fresh sea-fish, 89,027 cwt. ; salt cod, 728 cwt. ; stockfish, 63,718 cwt. ; anchovies, 43,300 ankers (an anker contains 1500-^000 fish, according to their size) ; oysters, 50,819 cwt. ; shrimps, 60,943 cwt. The great advance in the activity of the fisheries must be attributed to the use of better nets and vessels {loggers), improved laws and international treaties, the scientific study of ichthyology, and the connexion of the chief ports with the various railways.

*Industries. — The following are the statistics of the occupations of the people :^*

Industries.	*Total Number of*	■*Workers.*	*Number of Women Workers.*
Earthenware, Diamonds, Glass, Mortar, and Stone .			
Printing and Lithography .			

Building

Chemical Industry .

Wood, Cork, and Straw .

Dress and Dyeing

Handicrafts ....

Leather, Oilcloth, Indiarubber

Coal, Salt, Turf ....

Metallurgy

Papermaking ....

Ship and Carriage Building

Steam and other Engines .

Textile

Lighting, Oils, Varnish

Food and Narcotics .

Total . . “. .

28,572

12,105

120,975

3,509

37,387

75,645

1,598

37,422

15,371

41,633

2,923

13,516

6,456

44,455

6,332

84,327

2,354

88

343

565

521

43,014

221

624

2,088

457

595

71

56

10,833

485

3,355

532,226

65,670

About a third of the productive population of 1,658,000 find their means of subsistence in factories or workshops or as odd workmen. The number gaining a living from agriculture, live stock, garden-ing, &c., is 525,000. The factories are very unequally distributed amongst the different provinces. South and NortlS Holland, Bra^ bant, Gelderland, Overyssel, and Groningen combined have 3340 out of 4089 factories, 3978 out of 4812 engines, 56,968 out of the 68,278 total horse-power. Among industrial products the export of margarine represents a value of £3,725,400 ; sugar, £4,482,000 ; textiles, raw and manufactured, £7,338,300; paper, £3,636,000; vegetables, fresh and dried, £3,951,300 ; butter, £1,881,000 ; iron

and steel goods, £11,877,000 ; cheese, £1,339,000 ; cereals and flour (wheaten, rye, potato, &c.), £15,996,400. By means of national and international exhibitions, museums, and schools, including those for women, the Government and various societies have considerably promoted industry.

Trade. — In 1900 the value of the imports for home consumption was estimated at £164,000,000, and the exports of home produce at £141,250,000. The following table shows the value of the imports and exports of the great classes of products for 1900 : —

Imports.

Exports.

Food Products .

Raw Materials .

Manufactured Products .

Miscellaneous .

42,497,000

38,568,000

20,325,000

29,668,000

£

40,906,000

28,022,000

20,002,000

25,109,000

*Of the exports, 48-8 per cent, go to Prussia, 22-7 per cent, to Great Britain, 13 per cent, to Belgium, 4-4 per cent, to Java, 3-2 per cent, to the United States. Of the imports, 18-9 per cent, come from Pi-ussia, 16-5 per cent, from Great Britain, 11-5 per cent, from Belgium, 13-7 per cent, from Russia, 14 percent, from Java, 7-7 per cent, from the United States. In the total value of the imports, grain and rice represent 22-44 percent.; drugs, 12-96 per cent. ; iron and iron goods, 5*97 per cent. ; coals, 2-89 per cent. ; yam, 2-43 per cent. ; coffee, 2-50 per cent. In the value of the exports, grain and rice represent 16-22 per cent. ; drugs, 14-65 per cent. ; iron and iron goods, 5-10 per cent. ; sugar, 3-72 per cent. ; butter and margarine, 3-64 per cent. ; manufactured goods, 3-44 per cent.; coffee, 1-82 per cent., &c.*

Shipping and Navigation.- — The access to river-mouths and sea^ ports has been improved by the new waterways to Amsterdam and Rotterdam (and in the case of the former town by the use of

ice-breakers), by the new sluice at Ymuiden (1892-96), and by the new faciUties for communication with the sea at Terneuzen (1882), Stavoren (1883-88), Harlingen (1894), Lemmer (1886-88), and Z woUe (1878) . From £585,000 to £665,000 was expended between 1872 and 1897 on the building of lighthouses and lightships, in addition to £8,335,000 upon the improvement of waterways and seaports. The depth in the chief sea outlets and river-mouths is : — For the northern {Friesche zeegat, that for Terschelling, Texel, and Oude Vlie) 7-9-19-4 feet, for the southern (that for Goeree, Brouwershaven, the Krammer, Volkerak, HoUandsch Diep, and West Scheldt) 9-8-27-2 feet. The number of vessels belonging to the mercantile navy at the end of 1900 was 638 of 348,174 tons, of which 425 of 78,588 tons were sailing vessels and 213 of 269,586 tons steamers. In 1900 the total number of vessels which entered the ports was 12,307 of 9,475,164 tons, and cleared 12,367 of 9,449,676 tons. Of the total number entered, 3335 of 2,381,358 tons were Dutch vessels. Of the total entered, 6401 vessels of 5,816,928 tons were at the port of Rotterdam and 1884 of 1,453,170 tons at Amsterdam. About 70 Dutch steamers give passage to the colonies and other parts of the world.

Inland Communication — Railways. — Since 1890 the Rhine rail-

way, and'since 1898 the railway between Maestricht and Lifege and

the portion of the Central Belgian railway on Dutch ground,

have been worked by the state. The following table gives the

railway statistics for 1899 : —

Miles.

Traffic (1899).

18T6.

1898.

Passengers.

Tons of Goods.

State Railways

Railway of Holland

Central Railway .

North Brabant^German

Railway

Total .

528

147

63

32

972

796

69

63

11,733,000

14,463,000

1,123,000

545,000

7,060,000

3,425,000

394,000

322,000

770

1900

27,864,000

11,201,000

The revenue of the railways was in 1900 £3,554,350, and expenditure £2,969,850. Since 1877 communication has been greatly improved by the construction of tramways (61, of which 36 are

steam). Their total length was 927 miles in 1899, when they transported 53,697,000 passengers and 520,535 tons of goods. Their chief importance consists in the connexion they form

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between rail- and water-ways, and the opportunity tliey give the working-classes of living outside the great towns. Altogether, Holland has 9821 miles of roads and dykes ; these last being the embankments which shut out the sea and protect the low-lying country against the rivers.

Inland Communication — JRivers and Canals.— The corrected figures, showing the breadth and depth of the rivers in recent years, are very interesting. The expenditure upon their improvement, which from 1844 to 1861 amounted only to £791,600, rose, for the years 1862 to 1898, to £10,416,600. The normal breadth (minimum) of the fairway and depth (on the shallowest part at lowest tide) of the chief rivers are respectively as follows : — Upper Rhine, 657 feet and lOJ feet; Waal, 1017 feet and 8-9 feet; Lek,

453-738 feet and 6-6 feet ; Meuse, 109-131 feet and 8-3-5-4 feet. Consideraiile sums hjve also been spent since 1874 on the improvement of small rivers such as the Dommel, Old Yssel, Berkel, Vecht, and Regge, to make them available for irrigation and canalization, and to prevent inundations. The chief canals constructed since 1877 are the Deurne canal (1876-92), depth 5-9 feet, from the Meuse to the Helena Fen (North Brabant); the Merwede canal (1881-93), depth 10-2 feet, from Amsterdam to Gorkum; the Overyssel (1884-88), depth 5-2 feet, in the province of Overyssel ; the Stieltjes and Orange canals, in the province of Drenthe, depth 6-6 feet, and constructed respectively in the years 1880-84 and 1881-89; and the Groningen (1877-81), depth, 3-3 feet. The total length of navigable river channels in 1898 was 860 miles, of canals 2082 miles. The latter vary in depth from 33 to 3 feet, according to their importance as highways to the North Sea, the Scheldt, the great rivers Rhine and Waal, or as waterways between the greater towns, and as provincial canals to the fens. The inland traffic cannot be tabulated in definite figures, but its extent may be estimated by the quantity of produce brought to the public markets and the number of ships employed on rivers and canals.

Of late years there has been annually brought to the market of Alkmaar about 13 million lb of cheese ; to that of Sneek (Fries-land) about 4J million lb of butter ; to the market of the small town of Purmerend 80,000 sheep and 50,000 head of cattle ; to Leeuwarden 163,000 head of cattle ; to Rotterdam more than 200,000 head of cattle, sheep, &c. The foreign shipping on the rivers in 1897 consisted of 68,712 vessels. Lobit on the Rhine was passed in 1898 by 58,546 vessels. But for inland traffic there are thousands of other large and small vessels passing the canals and sluices. Between Amsterdam and Rotterdam 26,812 ships passed in 1898 ; St Andries, the sluice between the Waal and Meuse, was passed by 4719 ships; 5841 ships traversed the Walcheren canal; 41,161 the South Beveland canal (Zeeland) ; 37,252 the Merwede canal ; Zwartslnis, on the Meppeler Diep, was passed by 16,990 ships; the total inland traffic amounting to about 1,700,000 tons.

Money and Banking.- — Since 1875 there has been an unrestricted coinage of ten-guilder (guilders Is. 8d.) pieces in gold. There are no State banks. The Bank of the Netherlands is the only one having the right to issue bank-notes for a period of fifteen years from 1888, the contract being renewable for

ten years. Two-fifths of the paper money must be covered.

In 1901 the notes in circulation amounted to £19,322,400 ; total exchanges, £40,360,900; stock of gold, £6,191,700; stock of silver, £5,670,000. The capital amounts to £1,666,666 ; the reserve fund to £458,333. The bank keeps the State treasure and the cash of the post office savings bank. There are many savings banks, all private. Besides these there is a post office savings bank, established in 1881. The total deposits of the private banks in 1900 amounted to £6,405,600, and of the post office savings bank to £7,058,100 ; the number of depositors in the former was 420,885, in the latter 764,201.

Post Office and Telegraphs. — The following table shows the progress made since 1875 ; —

Tear.

Letters.

Printed Matter.

Postcards.

Letters and

Cards per

Head of the

Population.

Telegraph.

Miles of

Line.

Miles of

Wire.

Messages. –

Inland.

Foreign.

Inland.

Foreign.

1875

1900

35,581,000

74,800,000

10,344,000

28,112,000

50,000,000

156,063,000

7,545,000

46,613,860

259,000

9,193,400

14-3

30-8

2,138

3,831

6,341

14,210

2,500.000

5,303.870

The receipts of the post office in 1900 amounted to £845,800, and expenses £645,200 ; of the state telegraphs, receipts £178,450, and expenses £227,250.

Colonies. — The Dutch colonies in the East Indian Archipelago cover an. area of 740,193 square miles, or an area sixty times that of the mother country, with a population in 1897 of about 63,315 Europeans, 469,534 Chinese, 24,410 Arabs, 11,625 other foreigners, and 34,000,000 natives. For the West Indian colonies the area of Surinam is 57,917 square miles, with a population in 1898 of

65,168. The West Indian Islands — Curagao (212 square miles), Bonaire (129 square miles), Aruba (64 square miles), St Martin (17 square miles), St Eustatius (8 square miles), Saba (4 square miles) — had a combined population in 1900 of 51,693. The East Indian possessions no longer (since 1893) yield an annual contribution. Their expenditure exceeded their revenue in the three years 1897-99 by the respective amounts of £1,500,000, £1,415,000, and £415,000 ; but in 1900 and 1901 there were surpluses of £386,656 and £4213 respectively. The West Indian colonies require aid to the extent of £15,000 to £32,000 annually.

Authorities. — Statistical : Jaarcyfers voor het koningryk der Nederlanden (annually). — Dr Blink. Nederland en zijne bewoners (1887-92), and Tegenwoordige Staat van Nederland (1897). — R. ScHciLiNG. Aardrykskunde van Nederland (1897) ; Eene halve .EeMW (1848-98) ; Sistorisch Gedenkboek (1898), containing a series of articles on all subjects connected with the kingdom during the latter half of the 19th century, written by specialists. Les Pays Bas (1898), a work of the same class as the preceding. Gedenkboek uitgegeven ter gelegenheidvan het bOjarig bestaanvan het Koninklyk Instituut van Ingenieurs, 1847-97 (1898)— an excellent aid in study-

ing technically the remarkable works on Dutch rivers, canals, sluices, railways, harbours, drainage and irrigation works, &o. A special manual on the characteristic hydrography of the Netherlands is Bbkkman's De Stryd om het bestaan (1887). Amongst the publications not written in Dutch, and therefore more accessible to foreigners, maybe mentioned: Rifecms, Nouvelle Geographie (1879, vol. iv.). — KiRciiiioFF. Ldnderkunde von Europa (1889, vol. i.). — Blok. History of the People of the Netherlands, 1898-99. — Ditcii-FEED. The Church in the Netherlands, 1892. — ^Doughtt. Neerland Meres, 1890. — Topographische Atlas van het Koningryk der Nederlanden, 1892; the new edition of the Waterstaats!caart van Nederland, of the Bivierkaart van Nederland (1883), and of the Geologische Kaart van Nederland (1889). A new edition (1895, Arnheim) of Witkamp's Aardrykskundig Woordenboek has been published. Of much higher rank are the Nomina geographica Neerlandica (for the history of geographical names) and the Algemeene aardrykskundig e bibliographic van Nederland, giving the literature for the kingdom, the provinces, and the towns, both published by the Royal Geographical Society at Amsterdam. — D. S. Meldrum. Holland and the Hollanders.

London, 1899. (c. M. K.)

Eecent Histoet.

The writer of the history of Holland in the earlier vol-

umes of this Encyclopaedia (9th ed.) broke off his narrative

practically at the most critical juncture of modern Dutch

political affairs in 1850. From that date the newest, and

in many respects the most important, stage in the history

of Holland in the 19th century may be said to have begun.

When King William the Second died at Breda in ilarch

1849, a remarkable Prince of Orange had passed away — ■

a man of singular purpose and force of character. A born

soldier, he had developed, upon Wellington's

battlefields in the Peninsula, in the Pyrenees, —"" "' "■

and around Waterloo, some rare tactical gifts, and a

personal valour which commanded the admiration and

the lifelong friendship of the Iron Duke himself; and

he enjoyed a popularity, both in Holland and in Bel-

gium, which survived even after the Belgians had

risen against the unwise and intolerant rule of King

William the First, which the narrow-minded Congress

of Vienna had imposed upon them. But the second King

"William of Holland was not a politician. He showed his

lack of political wisdom in acting diametrically against

the positive instructions of his royal father, who had sent

him to the south with a mission which he openly ignored

by issuing a manifesto to the Belgians in which he

professed to recognize their independence. The king

immediately repudiated that manifesto, which, without

adding to his son's popularity in the Southern Netherlands,

seriously jeopardized his prestige and prospects in the

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north. Indeed, the -wrath of the Dutch people, then

highly incensed at what they branded as Belgian

treason, became so violent that it was publicly proposed

to exclude him from the throne. Nor was his conduct

in London, whither his father sent him on another

political mission, which proved as futile as his previous

errand to obtain the hand of Princess Charlotte had

been, calculated to regain for him the hold he had lost upon his future Dutch subjects. Not even the brilliant military campaign which he undertook in Belgium at the head of the Dutch army could, fruitless as it turned out to be, entirely restore confidence in him. So when King William the Second ascended the throne of Holland on the abdication of his father in 1840 his position could hardly be called satisfactory or secure.

Peace with Belgium had, it is true, at last been made, but that more or less beneficial settlement of the Dutch crisis abroad was perhaps more than counterbalanced by threatening internal complications. The finances had become disordered, if not critical, in consequence of the Belgian troubles ; taxes had been rapidly increasing, and with them popular discontent and disgust against a regime which failed to grasp the fact that the flimsy reforms, grudgingly bestowed in 1840, were wholly unavailing to stem the current of national feeling which set in stronger and swifter as the fateful year 1848 approached. A wise and statesmanlike ruler would not have resisted the

popular demand for a thorough remodelling of Holland's Constitution upon an enlightened basis so long movem°e^. ^^ ^^^S William the Second did. But he was a soldier, not a statesman. Married to Anna Paulowna, a Eussian grand duchess, he seemed to have abandoned the liberal traditions of his predecessors and of his people for the autocratic tendencies of Muscovite rule. For eight years the king withstood the efforts of the Dutch reform party, who in Johan Eudolf Thorbecke, the foremost statesman of Holland in the 19th century, and "too great a man for so small a country" (as a British statesman is said to have characterized him), had found a leader and a soul. Already in 1844 Thorbecke, with eight other members of the Dutch Chamber, had elaborated a reform Bill. Thorbecke, a student, after-wards a professor in the law faculty of Leyden University, was strongly supported by the vast mass of his educated and enlightened countrymen, then mostly unrepresented in the legislature. Yet for a time all his endeavours were bafiled by the powerful court party, and Thorbecke

even failed to obtain re-election as a member of the Second Chamber in 1846. His time, however, was coming rapidly. In 1847 serious riots occurred at various places, even at The Hague, and notably at Groningen. The king at last saw the danger of further delay, and, prompted maybe by the warnings of coming crisis all over Europe, he promised reforms when opening the States-General in the autumn of the same year. There is no doubt that this timely resolve warded off from Holland the threatening revolution which had broken out in neighbouring states. In March 1848 a royal commission was appointed to elaborate a new Constitution. Of that royal commission Thorbecke was much more than a member. The commission was virtually his commission, and the project it presented to the king his life-work. Its main features having been fully discussed and accepted beforehand, its progress was swift. In October following it became law, and an interim cabinet was appointed to carry out its provisions. The king's signature was practically his last political act. He died at Breda on the 17th of March

1849, and his son William, born at Brussels on the 19th of February 1817, ascended the throne (on the 21st of March) as King William the Third. But for these events, it is probable that the first ministry of Thorbecke would have been formed at an earlier date than the end of October 1849.

The Prince of Orange who now mounted the throne was, in character, tastes, and ambitions, essentially different from his predecessors. During his protracted reign, extending over more than forty jj^'™""" years, he never displayed any lofty and ambitious statecraft which might have endangered the international position of Holland, except perhaps in 1867 by the proposed sale of Luxemburg to Prance, and three years later when some court leanings towards Napoleon III., fostered by the anti-Prussian feelings of his first wife. Queen Sophie, a Wilrtemberg princess whom as crown prince he had married in 1839, threatened to embroil his kingdom in the Pranco-German conflict. With the Russian blood of his mother in his veins. King

William III. had inherited an autocratism ill befitting a constitutional monarch, an abrupt frankness that sometimes amounted to absolute brutality, a punctiliousness in matters political, military, and even social, not unfrequently embarrassing and humiliating to those to whom the king addressed his curt remarks. But he never could forfeit his hold upon the popular mind. The people knew that their priace meant well, that he had a kindly heart — evidenced by his noble self-sacrifice in the calamitous floods of 1855 and 1861 — a sort of magnificent instinct which prevented him from acting against the interests of the nation and prompted him to follow in times of temptation and crisis the advice of his constitutional counsellors. So they readily forgave his several domestic blunders which estranged him from his first queen and drove his eldest son William Prince of Orange (born in 1840), a young man of extraordinary promise, into exile at Paris, where he died on 11th June 1879. The king did not like the austere Thorbecke, yet recognized in him a superior mind and political

wisdom, born of thought, learning, and experience, and he yielded to Thorbecke's influence whenever it became absolutely necessary to do so, though not always willingly.

The preponderance of Thorbecke in Dutch political life during the latter half of the 19th century was such that the modern history of the Netherlands may be j-j,^^. safely divided into two periods : the Thorbecke tecke's period, and the period after Thorbecke's death. ”

The first Thorbecke ministry, formed as the nat- “^ y- ural outcome of the triumph of his efforts and principles, lasted only till 1853, but was marked by extraordinary activity. During that comparatively speaking brief period many fundamental laws were passed for which the Constitution had already provided — such as a new electoral law ; a law to regulate the responsibility of ministers ; another, to settle the rights and duties of provincial governments and councils, and of communal governments and councils, together establishing, in large measure, a complete system of decentralization — thus practically .introducing a kind

of local government in Holland half a century before it was attempted in Great Britain, but within well-defined limits and safeguards; an act to regulate the rights and duties of Dutch citizenship ; another, to settle the parliar mentary prerogative of inquiry, &c. In Van Bosse, Thor-becke had secured the services of an able and energetic minister of finance, who raised the state credit, abolished several irksome and oppressive taxes, and established free trade, Holland being the only Continental state that after-wards remained faithful in the main to free trade principles. The postal and telegraph services were reorganized, and the great work of draining the Haarlem Lake was com-pleted. The first Thorbecke cabinet came to an untimely end in 1863, in consequence of what was called "The April Movement," because it had originated in that

month. Article 165 of the Constitution had recognized, in a country where there was no state Church, the equality

of all religious bodies, subject to governmental control. The Pope and the Militant Clerical party in Holland perceived in that article an opportunity to re-establish in the Low Countries the ancient bishoprics of Utrecht, Haarlem, Bois-le-Duc, Breda, and Eoermond, the bishop of Utrecht becoming an archbishop. This measure — coupled, it must be confessed, with some unfortunate reflections on Dutch Protestantism by the Pope in his decree on that occasion — revived all the anti-Catholic prejudices of former days. Some political enemies of Thorbecke, who could not forgive him his triumphs, were not loth to fan the flames, and a veritable No Popery storm swept over the country, which Thorbecke resisted but could not withstand, he himself being accused of trea^ sonable " Papism." Por several years to come Thorbecke was compelled to relinquish the active duties of leadership, and not until 1862 did he regain it. The intervening years form a sort of interregnum in modern Dutch history. Pour cabinets followed each other at about equal intervals, the most important among them

being the ministry of Dr Justinus Van der Brugghen.

It was during his premiership in 1867 that the Primary Education Law was passed, which established neutral (non-sectarian) state schools, and afterwards largely became the pattern of similar legislation in foreign countries, notably of the Education Act of 1870 in England.

The Dutch law, however, did not as yet provide for compulsory education.

It is curious to note that an article in Van der Brugghen's Educational Bill, in which it was proposed to grant Government subsidies to denominational schools if parents wished it, was defeated by the Catholic and anti-Eevolutionary parties, acting in conjunction with a section of Liberals — that is to say, by the action of the very people who afterwards demanded the abrogation of the same article. The preceding cabinet of Dr Van Hall, an opportunist statesman of considerable ability, was chiefly remarkable for the passing of a statute providing for the better administration of the Dutch East Indies. This is the so-called S&glement of 1854, or Rules of Government,

which practically inaugurated a new era in Netherlands India. (See, for further particulars, Malay Archipelago, History.)

The subsequent cabinet of Dr Van Hall carried in 1860 a most important law, directing the construction of a vast system of state railways, connecting the Railways. a^]^j,ga,dy existing private lines, and involving the building of very costly bridges over the broad rivers in the south. The first State Eailways Act of Holland was carried, after much strenuous opposition in both branches of the Dutch legislature, very shortly after the rejection by the Pirst Chamber of another Government scheme, which x^rovided for the construction of certain railway lines by a private company, the state guarantee-ing the capital required for construction. The defeat of the Government led to a ministerial crisis, and the new cabinet immediately took up the railway question, mak-ing it the chief plank of its platform. That the Dutch Chambers adopted the principle of state railways in 1860 was largely due to Thorbecke's influential advocacy. He

pointed out that Holland was still very backward in this respect, and that the country could not successfully cope with foreign states whilst this condition prevailed. Thorbecke's main proposition was indeed self-evident. Up to 1860 only a small number of private railway companies were at work, chiefly in the central provinces, and the aggregate length of their systems did not amount to 300 English miles. Moreover, they were handicapped by the Government having too long maintained an antiquated gauge, which precluded all connexion with foreign railways having a narrower one. The State Eailways Act of 1860 provided that ten million guilders per annum would have to be applied to the construction of the lines decided upon, and by 1872 the whole first network of Dutch state railways was at last completed. It is noteworthy that the cost of building ' them was almost entirely furnished by the surplus funds accruing annually (up to the year 1877) from the administration of the Dutch East Indies under the "culture system." Consequently the Dutch state railways are

the only ones in existence not burdened with debt.

The state, however, did not undertake their working.

This was entrusted to a private company, founded in 1863 under the title of the Dutch State Eailways (Working) Company, the state merely receiving a share in the net profits.

The important statute, constituting the " State (Privy) Council," and regulating its functions, as prescribed by the Grondwet, dates from the same legislative period, and was the work of the minister of justice, Dr Godefroi, with Thorbecke's assistance.

Thorbecke came back to power in January 1862. His second term of office was marked by the same reforming energy as the first, in spite of a strenuous y.^^^ and somewhat personal opposition, which dis- becke's gusted even some of his more fair-minded second adversaries. In the four years that it lasted ■^'"^^^rr- Thorbecke had the Secondary Education Act passed (1863), completing the work of 1857 ; contributed to the legislation by virtue of which the great canalization works

at Amsterdam and Rotterdam were sanctioned (1863) ; carried his Bill emancipating upwards of 30,000 slaves in the Dutch West Indies, at the cost of ten million guilders in compensation, paid by the state ; and, last though not least, brought about the Pinancial Administration Act for the Dutch East Indies, which determined the right of the Dutch Chambers to control Dutch-Indian ways and means, thus consolidating the R^glement of 1854. A dispute with the colonial minister, Mr Pranssen van de Putte, led to a fresh cabinet crisis, and to the advent of Mr Heemskerk, the leader of the Conservative party. Heemskerk was Thorbecke's great antagonist, the two Dutch statesmen playing in the political arena parts somewhat resembling those of Gladstone and Disraeli in England. Heemskerk, who died in 1880, and who stood three times at the head of affairs, was a politician of talent, though of less calibre and moral fibre than Dr Van Hall, his greater predecessor, and his reaction-ary tendencies and views found favour at court and led to legislative proposals and measures which were

not always in accord with the spirit at least of the 1848 Constitution. A real constitutional crisis of some duration ensued, a struggle between the Government and the Second Chamber, during which Heemskerk attempted to shield himself behind the Crown, but in vain. There is little doubt that the king's proposal, in 1867, to transfer Luxemburg to Prance, if it did not emanate from Heemskerk, had his warm approval. It was none the less dangerous, especially as it came after Sadowa, which had settled the German question in a manner not at all favourable to Napoleonic ambitions. It was perfectly well known that Prance had coveted the grand duchy for some time as a sort of compensation for loss of prestige on the Ehine. Equally notorious was it that Bismarck, the arbiter of Germany's destinies, had no backing for his methods and aspirations from the king and queen of Holland. The Iron „"«ona/ Chancellor was, indeed, well aware that Queen difficulties, Sophie's former feelings of friendship and ad- '^^^■^'>- miration towards him had greatly changed since the days

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of 1866. It was to her animosity that he ascribed both the hostile attitude of the South Germany States (particularly Wlirtemberg, her native kingdom), when they combined with Austria against Prussia, and their previous coquettings with Napoleon III. In his Reminiscences, published after his death, Bismarck refers to the " relations between Stuttgart and France, which were chiefly maintained by the partiality of the queen of Holland, a Wlirtemberg princess," and he goes on to declare that he also traced her "evil" influence in Napoleon's foreign policy of 1867, especially in the speech Eouher made in the French Senate, March 16, when the latter announced that France would never tolerate Prussia's advance towards the Zuyder Zee. Rouher, said Bismarck, could not have spoken as he did on that occasion without some inspiration from The Hague ; before receiving it, the French Minister probably did not even know of the existence of

a Zuyder Zee !

Queen Sophie, then, belonged to the most unflinching and ablest opponents of Bismarck's policy. She corresponded much with Napoleon III., and wrote articles in the Revue des Deux Mondes against it. In 1871, after the sacking of the Tuileries, among many documents discovered were a large number of the queen's letters to Napoleon. Some were subsequently published, and demonstrate that she repeatedly warned him against the designs and armaments of Prussia. "But," says Lord Malmesbury in his Memoirs (ii. 370), "her warnings and counsels were laid aside and unheeded, like those of StofEel, the French military attach^ at Berlin." " The queen," he adds, " was a very clever woman, and knew all the affairs of Europe better than most ministers."

Nor was Queen Sophie loth to reveal her antipathies towards Greater Prussia, at least among her English friends, who were both numerous and influential. Henry Reeve was one of them, and his Memoirs (published in 1898) contained some remarkable letters from the queen.

In answer to Reeve's request for some Luxemburg papers. Queen Sophie wrote (in English) : " Such is the fear of the kingdom of the Netherlands to be involved in any of the impending Luxemburg difiS-Culties, that everything relating to that part of the world is scrupulously ignored ; and if the papers are not claimed at Luxemburg, where the most jealous of men, Prince Henry, governs, you cannot obtain the real truth. The fact is, M. de Bismarck a chercM une querelle d'AUemand, first to obtain a free passage through the Luxemburg railroads ; in the future, to annex the little grand duchy, to close the frontier on that side entirely. This, however, is still kept for a few months hence, as M. de B. would not be put quite on the same line with Prince Gortchakoff, though they are perfectly of the same opinion. It is a sad time, a very bad symptom, when principles, engagements, treaties, are all d, la merci of two or three unscrupiilous men."

The dangers foreshadowed or undergone in 1866-67 were accentuated four years later, during the Franco-German complications, ending in the downfall of the French

empire. Like Belgium, Holland was put upon her trial in guarding her frontiers and her neutrality between two powerful neighbours engaged in a deadly struggle with a court notoriously, if not openly, inimical to one of them, at least during the early stages of the contest. Fortu-natelya Liberal cabinet had succeeded, with some difficulty and not without struggle, to the perilously reactionary ministry of Heemskerk and Van Zuylen in 1868. It had carried through some useful reforms, such as uniform inland postage and the abolition of the newspaper stamp duty — the abolition of the death penalty in Holland belongs to the same legislative period — and the Foek cabinet succeeded in keeping the Netherlands outside the war arena. Sedan, needless to say, profoundly affected Queen Sophie, even apart from the great triumph of Bis-marck ; but, staunch in her friendships and antipathies alike, she never forsook the fallen emperor. Henry Reeve again records this in his Memoirs. When the Edinburgh Review had published in January 1871 an article severely condemning the Second Empire, Queen

Sophie sent Reeve from The Hague a dignified protest, in which she observes : ” AUow me to regret the great severity with which you treat the fallen empire. I put aside every personal feeling, but I remain convinced that posterity will be more lenient. There were faults in the system inherent and inherited. As to the head of the system, few men have been more naturally kind and good. He had the weakness of these natures — wishing to content every one. No question of principle seemed to him worthy of the inestimable enjoyment of peace. Avec les differents partis il se laissait aller d, des paroles, d des engagements contradictoires ; de Id, une apparence de dissimulation, bien iloignie de sa nature. The prisoner of Wilhelmshohe belongs to the past. To those that have known and loved him falls the task of obtaining justice for him. I cannot talk of the present events, of the destruction of Paris. I bow my head and I hope in God’s justice.”

The king sent for Thorbecke again in January 1871, in this instance for the third and last time. He succeeded

in forming another ministry, but he was no longer the Thorbecke of yore. Much aged, and feeble in health, soured by continued strife and opposition, he found the state of afi'airs in his country materially altered. The Liberal party, once all-powerful under his guidance, was no longer so compact, so obedient to his directive im-pulses, his masterful discipline. Many years had passed, many changes had occurred, since the Constitution of 1848 was enacted, and even among Thorbecke's admirers and followers there were not a few who felt that it had served its purpose, and required enlargement of scope to suit the needs of a new generation. Thorbecke him-self, indeed, had recognized this only three years before his death. Yet many doubted his power to carry through that revision of the Constitution which experience had taught to be necessary, whilst others derided even the breadth of his views and the generosity of his policy, contending that Thorbecke had become at heart a Tory, autocratically narrow in his opinions, particularly upon matters religious, colonial, domestic, and artistic. It was

a curious spectacle to see those who in 1853 had denounced Thorbecke as a Papist bitterly attacking him in 1871 as an enemy of the Roman Church, because he defended the recall of the Dutch minister at the Vatican when the Italians had taken possession of Rome. The groups in Holland, acting in opposition to Thorbecke's cabinet from various motives, had latterly grown more powerful, some demanding an extended suffrage, others the revision of the Education Act, factory laws, and other reforms. Each faction, in truth, was not strong ?^^°^ enough to work much mischief, but, supported by the Extreme Liberals, or united with the so-called anti-revolutionary party of Mr Groen Van Prinsterer and the Roman Catholics, against the statesman who had refused to admit the clerical grievances against the non-sectarian state schools, it undoubtedly ceased to be a quantitS nigligeable. At any rate, before Thorbecke died, in June 1872, he must have been conscious that his death might mean the partial disruptisn of the party he had created, as well as the shattering of the edifice he had been

instrumental in building up. His cabinet did not survive for long under the leadership of his successor, Dr Geert-sema, and finally disappeared in August 1874, after having had its Income Tax Bill rejected. Its most important measures had been the further extension of state railways

[history in Holland (1873) and her colonies, the abolition of differential import duties in the Dutch East Indies, and the transference of the remaining Dutch portion of the Gold Coast to the British Government for a sum of money and certain British " concessions " in the Eastern Archipelago. This transaction, which shortly afterwards resulted, on the one hand, in the Ashanti expedition, and on the other in the disastrous war of the Dutch against the Achinese, had been one of the many weapons used by the opposition against Thorbecke.

Thorbeeke's last illness would have commanded a keener national interest than it did but for the fact that it was

thrust into the background by the festivities to celebrate the three hundredth anniversary of the capture of Briel on 1st April 1672, which signalized the commencement of the great struggle against Spain. In the spring of 1874 festivities on a much larger scale than those at Briel took place all over Holland when King William celebrated the twenty-fifth anniversary of his accession to the throne. They were particularly brilliant at The Hague and Amsterdam, and the enthusiasm of the people was as genuine as it was unbounded. It was the last time that the nation saw the whole royal family of the Netherlands together, apparently happy and in good health. Many knew that Queen Sophie had latterly suffered from illness, but few suspected her end to be so near. " Eull of charity, constantly occupied with thoughts of others, forgetful of self, and deeply interested in all great subjects which occupy the attention of the more elevated intellects," as the historian i^Qaeea. Motley described her, Queen Sophie died at The Hague in June 1877. As far as the Dutch

royal family were concerned, the effect of Queen Sophie's decease was absolutely disastrous. The quarrels between the king and the Prince of Orange, who had inherited the wit and the mind of his royal mother, and who if he had lived might have proved one of the most distinguished of his race, became aggravated when the wife and the mother was no longer there to conciliate and pacify. Father and son parted, never to see each other again. So estranged had he and his father become, that the prince was even absent from the king's wedding in January 1879 at Arolsen.

It is at least probable that the departure of the Prince of Orange for Paris, and the unlikelihood of his return to Holland during the lifetime of his father, may

The King have had as much bearing on the king's decision to re-marry as the circumstance that his second son Alexander, who succeeded to the title and presump-tive rights of the Prince of Orange after the decease of his elder brother, but who died in 1884, was then in very bad health. The direct Nassau line was threatened unless

King William were to marry again and had further issue. His bride was Princess Emma of Waldeck-Pyrmont, and by the marriage King William consolidated his popu-larity. Popular rejoicings greeted the birth, on the last day of August 1880, of a princess, who received the name of Wilhelmina Sophia Prederika and the title of Princess of Orange. Two years later the king, accompanied by his queen, went over to England to attend the marriage of Queen Emma's sister to the Duke of Albany.

The second ministry of Dr Heemskerk had terminated in November 1877, and was succeeded by that of Dr Kappeyne van de Copello, who in the following March was able to persuade the Chambers to adopt his Primary Education Bill, strengthening the Act of 1857, despite the violent opposition offered by the reactionary parties, who continued it even after the Bill had passed, petition-ing the king (but fruitlessly) to veto it.

Up to the year 1880 Dutch politics, externally, were largely domiaated by events in Achin, where the new Political

progress.

arrangements with Great Britain, materially modify-

ing the treaty of 1824, had given Holland a free

hand, of which she had not failed to avail herself,

although the subjugation of that sultanate proved much

more difficult and more costly — especially in its after

results, an endless and wasteful warfare — ^than

had been anticipated. Internally, the second

ministry of Heemskerk, succeeding that of

Geertsema, had to cope with a hostile Liberal majority

in both Chambers, which hampered it gi-eatly, and

it was not able to do much more than add the Higher

Education Act to the statute-book. But that measure

was very comprehensive and important. It regulated

and equalized in 1876 the three state universities of

Leyden, Groningen, and Utrecht, enabling Amsterdam

to establish a communal university with equal rank in

1877, and the anti-revolutionary party to found a free

university of its own in 1880. Not much progress

had, however, been made with two other reforms of

great national importance : first, a new codification of the criminal law — the old Napoleonic Penal Code introduced in 1810 being still the law of the land; second, the framing of a new Constitution, to replace Thorbeeke's Grondwet of 1848. Although the former reform was carried in 1881, it did not come into operation tUl January 1886. Professor Modderman of Leyden, head of the department of justice, was largely instrumental in the passing of the measure during the ministry of Count van Lynden, who had succeeded Kappeyne van de Copello as premier; and his friend and colleague, Dr Vissering, the minister of finance, carried through the Bill establishing post ofl&ce savings banks.

The revision of the old Constitution, which had been prepared by a royal commission, proved an even more arduous and more laborious task than that of the penal code. Thorbecke had, perhaps wisely, constita- made the tampering with the Eundamental rtvtsion. Law of 1848 as difficult an undertaking as

possible ; one of the final clauses provided, for instance, that proposals affecting succession to the throne, and the modification of the Constitution, could not be entertained during a regency — ^the very thing that was likely to happen in Holland if the king died during the minority of the Princess of Orange. The alteration of this clause had therefore to be undertaken first (1884) before the revision proper could be made. The death of the Prince of Orange (1879) and the birth of a daughter to the king had for the moment brightened the chances of such revision. Seeing that it had become a national necessity, Dr Kappeyne van de Copello, when prime minister, had made revision a plank of his platform, but by a curious freak of fate it was not he, but his reaction-ary successor Heemskerk, who carried the revision scheme through in 1886.

The new Grondwet, or Fundamental Law, came into force in 1887. This statute comprises eleven chapters, apart from some "additional clauses" concern-ing the method of carrying it into effect. The ™« ^"-

first chapter treats of the kingdom and its of^s's"

inhabitants, and declares that the Fundamental

Law is applicable to the Netherlands alone, and not

to the Dutch colonies. Dutch citizens only may hold

appointments; but liberty of speech, of the press, of

meeting, and of petition, and the rights of property,

are guaranteed to all residents. Chapter ii. (Succes-

sion to the Throne) declares that the crown may pass

to a female, who, however, will forfeit the crown if she

marry without the consent of the States-General. The

latter may, in default of any heirs, elect a king (or

queen) in an extraordinary combined session of the two

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Chambers. No king is allowed to wear a foreign crown,

and the seat of government may not be established out-

side Holland. The civil list for each reign must be fixed

by a special law. During a minority of the king or

queen, or should he or she become unable to govern, the

two Chambers may appoint a regent. The oath to be taken by each king or queen on ascending the throne is given in the Fundamental Law, and shows that the regal rights in Holland are conferred by special contract between the people and the crown, and not inherited of divine right. The king is inviolable, but his ministers are responsible. The king declares war, makes and ratifies treaties with foreign Powers, and has the general direction of foreign affairs, but no treaties with foreign Powers, involving territorial changes, or affecting public rights as established by statute, are valid unless sanctioned by the States-General. The king also has the supreme control of the state finances. He confers ranks and titles ; has the right of pardon, of initiative of Bills in the Second Chamber, and may sanction or reject measures passed by both Chambers; he also possesses the power of dissolving the latter, and nominates the members of the Council of State, to which he submits all Bills intended to be presented to Parliament. He also appoints and dismisses all ministers whose responsibility

is regulated by special statute. According to the third chapter, the States-General represent the whole people, being divided into a First and a Second Chamber, the former consisting of fifty, the latter of one hundred members — Amsterdam returning nine, Rotterdam five. The Hague three, Groningen and Utrecht two each. This was an important addition of strength, the old Second Chamber having had at most eighty members, one for every 45,000 of the inhabitants. The basis of the franchise was at the same time materially altered and much enlarged, the effect being to add some 200,000 male voters of the age of twenty-three to the electorate, the rights of the latter being afterwards settled in a special statute. For the First Chamber, however, the old basis (election of delegates by the provincial states from among the highest taxed or otherwise prominent burghers in each province) was maintained, each member being elected for nine years, one-third retiriag every three years. The members of the , Second Chamber are elected for four years, when the whole retire in a body.

The members of both Houses receive certain allowances from the Treasury to meet the expenses of their journeys to and from The Hague, and of their residence there during the session. The Second Chamber alone has the right to initiate legislation, and the First Chamber does not possess the right of amending any Bill sent up to it by the other Chamber. Ministers may attend the sittings of each Chamber, but are not allowed to vote unless they are members themselves ; no one can be a member of both Chambers simultaneously. No male person is eligible who has not attained the age of thirty. The fourth chapter deals with the provincial states, elected by the people directly in the eleven provinces, in each of which there is a royal commissioner who presides over the provincial assemblies. The communal councils, with presidents (burgomasters) nominated by the king, are also elected by the people of each commune, but are under the control of the provincial states. The fifth chapter treats of the administration of justice, and the sixth of public worship. The latter

guarantees freedom and equality of rights to all religions bodies, the clergy receiving a salary and a pension from the State. The seventh chapter deals with the national finances ; the eighth with national defence, declaring all able-bodied citizens liable to serve in the army, reserve, or militia ; and the ninth with the waterstaat (dykes, roads, bridges, dunes, &c.). The tenth chapter, dealing with public education and poor law administration, sets forth that both are a constant concern of the Government. Although the clauses of this chapter are seemingly the same as the corresponding clauses in Thorbecke's Grondwet, yet it was perfectly well understood, when the Constitution Bill was passed, that they must be interpreted in a sense widely different from that which the legislators of 1866 had imparted to the Primary Education Act of the following year ; for that Act established, as we have seen, primary State schools upon a non-sectarian basis, and this led to a bitter campaign on the part of the Church parties, which was renewed in 1878 against Dr Kappeyne's even more

stringent educational policy. They maintained that the State had no right to " withhold the Bible " from the school children, or, by refusing State aid to private (denominational) schools, starve the latter out in order to promote a "neutral" instruction of which they could not conscientiously approve. The Roman Catholics and the orthodox Protestants had therefore insisted upon the abrogation of the Education Act of 1878, and the passing of another statute to remedy their grievances. With the aid of a section of the Liberal party which sympathized with their anti-revolutionary and Catholic countrymen in this respect they ^were able to enforce their views, and the introduction of a new Education Bill, which under the ministry of Baron ^neas Mackay became law in 1889, was in the nature of the redemption Education of a pledge. In accordance therewith the Act ^^gf of 1889 was a virtual reversal of the Liberal education policy adopted in 1857-78, for it contained the following important provision : " The State will, in each

governmental budget, allocate to the private primary schools subventions proportionally equal to those granted to the communal [public primary] schools." Thus it not only placed the sectarian lower schools upon a basis of equality with the public primary schools, but might even be regarded as favouring the former at the expense of the latter. It is fair to add, however, that the effect of what was virtually a compromise was to set at rest for some time to come a long and bitter controversy. Another important clause in the Act of 1889 was to the effect that gratuitous instruction was no longer possible, except in the case of pauper children.

The necessity of the new Constitution had already been demonstrated early in 1889, when the king's alarming condition, physical and mental, had compelled the appointment of a regent. In Luxemburg, in- Death ot deed, where, owing to the Salic Law, a queen wfifiam. could never reign, the heir-apparent to the grand duchy, the Duke of Nassau, had already assumed the re-

gency, in the general expectation that King William would not recover. But by May 1889 the king recovered as suddenly as he had collapsed, and his physicians having reported that his Majesty was again in a fit state to govern, the Duke of Nassau took a somewhat hasty departure from Luxemburg, whilst the States-General of Holland resolved to invite King William to resume the government, the services of a regent be;ing no longer required. This was accordingly done, and shortly afterwards the fortieth anniversary of his accession to the throne was celebrated with some pomp. But the king's restoration to health proved of short duration. In September 1890 the ministry reported a recurrence of the alarming symptoms of the year before. A consultar tion of physicians again took place in October, and they reported that the king could no longer perform his regal duties. The prime minister thereupon introduced, and

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The

Regency.

carried, a Bill vesting the royal power for the time being in the Council of State. The king growing steadily-worse, and the end, to all appearances, rapidly approach-ing, a further Bill was introduced and passed, appoint-ing Queen Emma regent of the Netherlands during the minority of the Princess of Orange, a councU of guardians for the latter being also nominated. One of the guardians was Baron von Goltstein, who afterwards became the Dutch minister in London, a post he was holding when the young queen, then (1895) still in her teens, visited London, accompanied by her royal mother and by more than one of her tutors.

On 23rd November 1890 King William died. In different circumstances the death of the king might have been productive of serious and even critical results to the Dutch people. As it was, the event did not occur unexpectedly, and there had been ample time to prepare fully for all

emergencies, while it brought at least one unmistakable advantage — namely, the complete severance of the connexion with Luxemburg. Yet at the end of 1890 Queen Wilhelmina was a mere child, and although the queen-regent and the council of guardians could be trusted to perform their duty to the new sovereign and her people conscientiously, still a dif&cult period was before the nation until the young queen should ascend the throne, upon her attaining her majority eight years later. That critical time, however, was passed without serious disturbance. Queen Wilhelmina's health remained good, and through Queen Emma's untiring devotion she received a good education, and gave gener^ pleasure by her simplicity of manner, natural charm, intelligence, and force of character.

One of the chief legislative events of the year 1890 was the purchase by the State of the Dutch-Khenish railway, the working of its lines, leading from the chief coast towns to the German frontier, being entrusted to the States Eailway (Working) Company. That

purchase was followed by the so-called railway agreement, dividing the whole railway network into two chief systems of State railways and of the lines of the Holland Eailway Company. The effect has therefore been to centralize the working of the Dutch lines in the hands of two powerful companies, subject of course to a rigid Government supervision. This arrangement only leaves out a few minor railways, but it has been largely supplemented by a growing network of canals, light railways, ordinary, steam, and electric tramways, the vast extent of which is indicated in the statistical article above. The international railway relations of Holland, whose railway companies formed part of the Continental Eailway Union before 1890, were satisfactorily settled by the Convention of Bern signed in October of that year.

In August 1891 an apparently strong Liberal cabinet had been formed under the leadership of Dr van Tienhoven. Its moving spirits were the distinguished economist and financier, Dr Pierson, and Dr Tak van Poortvliet,

a former minister of commerce, who had shown great ability in promoting railways and canals, and who was a staunch supporter of national steamship lines to England and the Dutch colonies. Dr Tak was an advanced Liberal, and had a fair majority at his back in the Second Chamber, but his franchise proposals in 1894 led to a ministerial crisis and his own downfall. Undoubtedly they were too drastic, practically involving universal manhood suffrage, which by many of Dr Tak's own followers was considered un-constitutional, i.e., in conflict with the Fundamental Law. Dr Tak tried to gain his ends by an appeal to the electors, the Second Chamber having been dissolved in March 1894 ; but a portion of the Liberal party combining with the anti-Liberals, and being supported by the most influential Liberal daily paper of Holland, the Government was defeated at the polls, and Dr Tak, finding himself in a minority, h^A. to resign. Electoral reform was then taken up by Dr van Houten, his successor as minister for home affairs in the Eoell cabinet. „^';^. He succeeded in carrying his measure, which

was, however, conceived on much more modest lines than the ambitious attempt of Dr Tak. Van Houten's Bill, which abolished the scrutin de liste, introduced the lodger franchise, and virtually made every male citizen capable of supporting himself and family a qualified voter, passed the Second Chamber in June 1896, and the First Chamber in the following September. It was the most far-reaching electoral reform yet attempted in the Low Countries, as it not only largely increased the number of voters, but extended the suffrage to social strata hitherto deprived of all franchise rights. Nevertheless many reformers still demand, if not universal suffrage for men and women alike, at least a large service franchise, proportional representation, and reform in the election of the First Chamber. They ask also for a new revision of the Fundamental Law, without which, it is admitted, such reforms could not be obtained.

In the concluding years of the 19th century the ministerial efforts in Holland, under the influence of Dr

N. G. Pierson, formerly president of the Nether-

lands Bank, and a distinguished professor of '"/"^' ^

political economy, mainly consisted of financial retotms.

and labour legislation. The state finances,

much improved by the first conversion of the 4 per cent.

state debt into 3-|- per cent., which was carried through in

1886 with the assistance of the house of Eothschild in

London, underwent a further amelioration in 1893 and

1894 by the imposition of taxes on capital and on in-

dustrial, commercial, and professional incomes not derived

from capital ; and in 1896 by a fresh conversion of the

3^ per cent, state debt into 3 per cent. The Dutch state

debt was in 1902 composed mainly of 2\ and 3 per cent,

consols, the only exception being about 3,000,000 guilders

of bonds, bearing 5 and 6 per cent, interest, a responsi-

bility which the Government acquired when it took over

the old Dutch-Ehenish railway. Dutch labour legislation,

tentatively commenced in 1874 by Dr van Houten's mild

Factory Law, which prohibited child labour in factories

for children under twelve years of age, has taken great

strides. In 1889 the Factory Law was much enlarged. Women, and children under the age of sixteen, are not allowed now to work at night or on Sundays, nor more than eleven hours in the daytime, with one hour's interval for meals. Mothers are not allowed to work in factories until four weeks after their confinement. State inspection of factories and workshops has been made much more stringent by a special statute, passed in 1895, which in matters of ventilation, light, hygiene, &c., seems moulded after an English pattern. Agricultural labourers and servants are not yet in possession of similar protection, but some have already commenced to agitate for it. Compensation to workmen in factories and workshops, to be paid by their employers, has also been enacted, and old age pensions have been discussed. Moreover, an important law has been added to the statute-book, institutingchambers of labour in all the more considerable industrial centres, composed of an equal number of masters and men, elected as delegates in each trade or industry. These bodies act as advisory boards in ordinary times, and as

conciliation boards in the case of disputes, strikes, or lock-outs, but they have no power to enforce their decisions.

Holland's foreign relations between 1850 and 1880 were histoet]

not always of a smooth and pleasant nature, and if peace remained undisturbed, at least in Europe, it Poreiga -^^as not because there never arose any dangers i8so-80^' to threaten it, but because a skilful diplomacy succeeded in avoiding them. We have seen the perilous complications of the Luxemburg question, in "which a European war was, as we now know, merely averted because Germany was not ready to strike in 1867. But the Limburg question, dating from a still earlier period, had its pitfalls too, though these were of a dissimilar nature. They were the outcome of one of the many mistakes of King William I. In 1839 he joined the Germanic Confederation for Limburg only.

The hazards of this dual position for that province might have been terminated in 1848, when the Germanic Confederation ceased to exist, but the Dutch Government deliberately chose to renew them in 1849, by joining, again for Limburg alone, the federation of German States which had then been formed. While peace lasted the Limburg dangers remained in abeyance, but they became apparent in 1859, when France and Italy were at war with Austria, and when the German Confederation decided to mobilize a portion of its troops. Limburg — that is, Holland for her province — was then called upon to furnish a contingent, and this was kept in readiness for all emergencies. If a war had then ensued between Germany and France, Dutch troops might have been fighting on the German side, thus embroiling Holland in a quarrel which did not concern her. Fortunately, when the German Confederation came to an end in 1866, Holland did not join the North German Confederation, and thus the anomalous position of Limburg disappeared. When the Luxemburg and Limburg

questions had been finally disposed of, Holland's inter-
national status was materially strengthened as a result
of the war of 1870, and the ground was cleared for a
political role in Europe, if less ambitious, certainly
more congenial to a people so essentially peace-loving
as the Dutch.
So far as foreign relations since 1880 are concerned,
these have been cordial with Germany, neither the
opinions of some Germans, that Holland ought
Foreign to be annexed or acquired, nor the efforts of
%80-wo'o. isolated Dutchmen to bring about a federation
with Germany finding much favour. The
question of the navigation of the Ehine had been solved
by the abolition of tolls along the whole course of the
river from Basel to Krimpen and Gorkum (1867), and by
the appointment of an International Board w'hich should
settle all disputes arising from the interpretation of the
Ehine Navigation Act (1868) and subsequent regular-
tions and enactments. Upon more than one occasion
this Board rendered useful services, notably in 1893,

when it decided in favour of Holland concerning the long-disputed claims of Rotterdam in the matter of its harbour dues. The Ehine fisheries difficulty was terminated much later, in 1885, by the Salmon Fishery (Ehine) Convention, signed at Berlin. Its main provisions, which are equally applicable on the Moselle, provide a close time for salmon, which varies according to locality, and forbid Sunday fishing altogether. The relations of Holland and Belgium had been occasionally strained, particularly before 1863, owing to Holland's maintenance of tolls on the river Scheldt, which was of course detrimental to Antwerp, and owing also to the building of a Dutch state railway to Flushing, which involved the laying of a dam across one of the branches of the same river. Belgium contended that Holland had not the right to dam up the eastern Scheldt, which must in course of time unfavourably affect the navigable channel in the western Scheldt, and an acrimonious international controversy ensued. But in both cases Holland gained her point. The Scheldt tolls were abolished in 1863,

but Holland received £750,000 in compensation, paid by the states whose ships used the Scheldt most, Great Britain contributing £175,650. In the case of the western Scheldt the protests of Belgium remained unavailing. These questions and quarrels removed, the relations with Belgium became more than cordial, both nations realizing that together they might offer a more effective barrier against the encroachments of strong neighbours than separately. What has probably contributed to this rapprochement is the miscalled "Flemish" movement in the Dutch provinces of Belgium, which is really a revulsion of feeling among the Dutch-speaking Belgians against the French usurpations and encroachments of the Walloon minority, all of which having been gradually swept away, Dutch is now as much the official language as French in the Belgian parliament, law courts, and government offices. The scheme, however, of many enthusiasts for a zoUverein, or even for a political federation, between Holland and Belgium has not yet taken practical shape. With England re-

lations were not always of an entirely amicable nature. Friction occurred in the Eastern Archipelago — not easily preventible perhaps in so vast an area, with rival interests and tendencies everywhere side by side. The most formidable case arose in Borneo, caused by the British Government, in the autumn of 1881, granting a royal charter to the British North Borneo Company, which had taken over certain territorial concessions given by the Sultan of Brunei on the north-western coast to Mr (afterwards Sir) Alfred Dent and other British merchants of Singapore and Hong-Kong. The Dutch Government protested against the charter, founding its protest, as in the case of Sarawak, on the Anglo-Dutch treaty of 1824, contending that this treaty placed Borneo outside the sphere of British interests in the Malayan Archipelago. Some correspondence ensued, the British Government arguing that territorial acquisition by a chartered company did not imply territorial acquisition by the British Government. The Dutch Government

would not admit this, but had finally to acquiesce ; and subsequently a British protectorate was declared (in 1888) over the entire northern portion of Borneo not previously claimed by the Dutch, a British resident was appointed in Brunei, and Labuau was transferred (two years later) to the control of the British North Borneo Company. In June 1891 a treaty was concluded between Great Britain and Holland, whereby the new boundaries of their respective possessions in Borneo were definitively settled. The partition of New Guinea between Great Britain, Germany, and Holland was accomplished in 1896. A similar friction more than once arose in Sumatra over Achin, the contention of the Dutch being that the tough opposition to their rule was encouraged and fed by certain parties at Singapore, despite the action of the British authorities there, who maintained for many years a prohibition of all export of arms to Achin. The difficulties assumed a critical character in November 1883, when the British merchant vessel the Nisero was wrecked off the coast of Tenom, and her

captain and crew captured and taken into the interior by the raja. Some died, and the remainder were only rescued some months afterwards by the payment of a ransom and compensation, but not before a somewhat heated correspondence had passed between London and The Hague. A similar thing happened again in 1894, when in another part of the Malay Archipelago Mr Carpenter, the captain of the British merchant vessel the Costa Mica Packet, was detained and punished by

the authorities of Macassar. But this incident was closed in 1895 by arbitration and an award in favour of Great Britain. The issue was the more satisfactory, because arbitration had been resisted in this instance by an influential party in Holland. The advocates of international arbitration, however, pointed out with truth that this principle had been admitted in many of the Dutch

treaties with foreign Powers, notably with Italy (1884) and Belgiu.m (1892), concerning actions at law, pro Deo, by the subjects of either country in the other; with Portugal (1893) relating to boundary questions in Timor, &c. Moreover, the policy of Holland, steadily pursued ever since Baron van Goltstein, the minister of foreign affairs, circularized her representatives abroad in 1860 in support of the policy of the United States, which pro-posed great reforms in maritime law, has always tended towards minimizing the risks of international strife by substituting the pacific adjustment of disputes for the arbitrament of the sword. -That policy culminated in 1899 in the Peace Conference at The Hague and the formation of a permanent international court of arbitrar tion, Holland taking a prominent part in both. Of course a small country cannot wield the influence of a great Power, yet the example and the policy of Holland left a distinct impression on international politics in more directions than one during the second half of the 19th century. Thus she played an important r61e in the

Congo Conference at Berlin (1885), which resulted in the creation of the Congo Pree State ; and it was mainly due to her eiforts that the conference, in the interest of the Dutch settlements on the Congo, decided that for twenty years no import duties were to be levied in the new Pree State. It is true that Holland was unable to resist the reversal of these free-trade principles which the Brussels Conference enacted in 1890. The magic of a great name, and the respect which her historic traditions inspired, were not less conspicuous at the Suez Canal International Conference in 1885 at Paris, convened for settling the future status of that waterway. Holland had not originally been invited, but, consider-ing that the number and the tonnage of her ships passing through the canal were only less than those of two other European Powers, it was ultimately decided that she had a right to be represented. During the proceedings her two delegates were able to influence the decisions in matters of great political and commercial moment to the nations interested in the Suez Canal, and

Holland is one of the states charged with the joint control instituted by the Conference and the signatories of the 1888 treaty.

Within a more restricted sphere of international politics the influence of Holland made itself equally felt. In 1880 special inquiry instituted by the British Government revealed an extraordinary state of lawlessness among the fishermen of various nationalities on the North Sea. By its invitation a conference of the Powers interested met at The Hague (October 1881), and the result was a treaty, signed in the following May, chiefly remarkable as the first attempt at an international police on the high seas, in which all the Powers interested (except Sweden and Norway) afterwards participated. The new system worked very well, but it did not include the control of the liquor traffic, the abuses of which had been mainly responsible for the lawlessness. That traffic was regulated by another treaty, signed in November 1887, after a second conference at The Hague of delegates of the same Powers.

Another source of diplomatic and popular friction between London and The Hague was furnished by the Transvaal question in 1881. The Boer war of that year roused extraordinary interest and excitement among the Dutch, who somewhat suddenly remembered that the Boers were their descendants and had a claim on their admiration, if not their affec- q„l^,l^a, tion, as kinsmen. Under pressure the Dutch Government offered to mediate between Great Britain and the Boers, but its services proved unnecessary, as Mr Gladstone had determined to restore the indepen- dence of the Transvaal. The Jameson Eaid (1896) and the second Boer war (1899) again caused intense excite- ment and pro-Boer enthusiasm in Holland, coupled with a growing resentment against the British Government. No doubt circumstances had much changed since 1881, but that did not make Dutch feelings less keen, for after 1881 Holland had acquired important material interests in the South African Eepublic, especially in its railways, banks, and several industries, though not

in its gold mines. Dutch pro-Boerism had therefore ceased to be purely sentimental, albeit it had latterly done much to promote Dutch emigration and education in the Transvaal. Holland, however, maintained a strict neutrality, and it is upon record that the Dutch Government, in the autumn of 1899, advised President Kruger not to enter upon the war with Great Britain. An attempt at mediation, based partly upon the provisions of the Peace Conference, failed; and a renewed offer at. the beginning of 1902 to institute peace preliminaries — without, however, any authority from the Boer leaders — was politely declined by Great Britain.

The young queen attained her majority in 1898, and was solemnly enthroned in the so-called New Church in Amsterdam, taking her oath of fidelity to the Constitution in the presence of the States – General on 6th September, in accordance with the ceremonial prescribed, amid national festivities and rejoicings which lasted several days and concluded with a naval review

on the Hollandsch Diep. In October 1900 the an-
nouncement that the young sovereign was betrothed
to Duke Henry of Mecklenburg-Schwerin, a Prussian
officer of the guard, four years her senior, was well
received. The approval of the States ~~General, pre~~
scribed by the Constitution, was therefore readily ob-
tained, and the marriage was solemnized with
great pomp in the Great Church at The Hague o/ouefo
on 7th February 1901, Duke Henry having wiihei-
been created a prince and a general in the ‘”’™-
Dutch army for the occasion, under the title of Prince
Henry of the Netherlands, thus happily reviving the
popular title of a popular prince. King William’s brother,
which threatened to be extinguished with his demise
in 1879.

The June elections for the States -General proved
disastrous to the Liberal ministry of Dr Pierson, owing
to dissensions among his following anent several im-
portant points of home policy. The combined Clericals
(Catholics and Ultra -Protestants, or so-called Anti-

Eevolutionists) gaining a decisive victory at the polls, the Pierson cabinet tendered its resignation. Queen Wilhelmina then sent for Dr Abraham Kuyper, for many years the leader of the Anti-Revolutionary party in Holland, who succeeded in forming a ministry, in which representatives of that and the Roman Catholic party held office together. Its programme, as reflected in the speech from the throne in September, was a "Christian-National" policy, both at home and in the colonies. It has merely to be added that amongst the last achievements of the Pierson cabinet were the enactment of compulteory education (1900) and the introduction of obligatory military service consequent upon the reorganization of the Dutch army (1901).

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This survey of Dutch history indicates the enormous strides that have been made in every direction since 1850. The population of the kingdom, which stood at only 3,000,000 in 1849, had advanced to over 6,000,000 by January 1900. In the provinces of North and South Holland the population has indeed almost doubled in half a century. The population of Amsterdam, The Hague, and Utrecht more than doubled, whilst that of Rotterdam shot up from 90,000 to 318,000. In 1850, 30,396 depositors had £317,580 in the private savings banks; in 1898 their number had increased to 361,509, and their claims to £6,512,000, notwithstanding the competition of the post office savings bank, which had, in 1898, 693,228 depositors, with a balance to their credit of £5,834,330. The imports for consumption, which were valued at £16,052,012 in 1849, had grown to £136,241,666 in 1896 ; the exports having increased in the same period from £10,634,128 to £111,708,333. The spending powers of the nation naturally kept pace with these increases, and the total budget expenses, which were

£5,803,678 in 1860, had grown in 1897 to £11,560,737. It is true that the cessation of yearly contributions from the Dutch Indian revenues since 1878, and the constant enormous outlays for railways, canals, other public works, education, &c., caused in later years a material increase in the national debt, which stood at over £83,300,000 in 1898, but this increase was more than balanced by rapid decreases in the course of years. These aggregate about £91,660,000, whereas the increases were only £80,500,000 ; while by the repeated conversions, rendered possible by the steady rise in national credit, the annual debt charges were considerably lessened. On the other hand, it should be borne in mind that the national assets had been enormously strengthened since 1860, no less than £20,830,000 having been invested in the state railways alone by 1897, besides large investments in canals, the total length of which reached nearly 3000 English miles in 1898, and was constantly increasing. Among the greatest canals was the North Sea Canal at Amsterdam, originally constructed by a private company, but taken

over in 1882 by the State. The dues were abolished in 1890, and this waterway considerably improved in 1896. Next in importance is the new waterway between Rotterdam and the German Ocean, which was completed in 1872, but has been improved since, allowing the largest ocean vessels to enter the Mouse, and making Rotterdam one of the greatest Continental ports. A further comparison of the State budgets for 1849 and 1897 shows that the advance was as marked in matters intellectual as in the material departments of national life. Thus education expenses in 1901 absorbed £833,000, against £43,600 fifty years before ; the postal and telegraph services as much again, against £39,100 in 1849 ; in 1898, £2,000,000 was spent for public works and industries, against barely £166,000 in 1849 ; £70,460 for arts and science, against £9656 in 1849; and £115,700 for the colonies, which fifty years before yielded a revenue and cost nothing. Yet, by this immense material improvement in every department the burghers were at the end of the 19th century better able to pay £8,833,000 of taxes than

those of 1849 to pay half that amount ; their wealth had enormously grown, and the bulk of the national debt was held in Holland. Two principal conditions accompanied and dominated the great progress of these fifty years — the uninterrupted maintenance of peace, and the upholding of the principles of free trade, in which the Low Countries stood absolutely alone on the Continent of Europe.

For literature concerning this period of Dutch political history, see also the Staatsalmanak (official annual), the Annual Register, and similar publications in Holland and England ; Motley's Correspondence (2 vols.) ; Henry Eeeve's Memoirs (2 vols.) ; Earl of Malmeshury, Memoirs of an Ex-Minister (1884, 2 vols.) ; Bismarck, the Man and the Statesman (English translation, 1898, 2 vols.) ; Les Pays Bas, a sumptuous and full compendium of the Netherlands, privately printed and distributed by the Dutch Press Club of Amsterdam upon the occasion of Queen Wilhelmina's enthronement in 1898. There were also at that time numerous other publications of a similar character, mainly in the Dutch language, the principal among them being, perhaps, Eene halve Eeuw (" Half a Century," in 2 vols.), a comprehensive survey of modern Holland, historical,

political, commercial, industrial, artistic, and literary, published at Amsterdam. (h. ti.)

Recent Dutch Litbeatuee.

The recent literature of Holland presents the interesting phenomenon of an aesthetic revolution, carefully and clev-erly planned, crowned with unanticipated success, and dying away in a langour encouraged by the complete absence of organized resistance. It would perhaps be difficult to point to another European example so well defined of the vicissitudes which keep the history of literature varied and fresh. For the thirty or forty years preceding 1880 the course of belles-lettres in Holland was smooth and even sluggish. The Dutch writers had slipped into a conventionality of treatment and a strict limitation of form from which even the most striking talents among them could scarcely escape. At the period of which we are about to speak, the most eminent authors of this early period were ready to pass away, and they appeared to be preparing no successors to take their place. The greatest humourist of Holland,. Nicolaas Beets (bom 1814) (q.v.),

had drawn his works together. The most interesting novelist, Mrs Gertrude Bosboom-Toussaint (1812-1886) (q.v.), had in her last psychological stories shown an unexpected sympathy with new ideas. A very remarkable genius, of whom we write elsewhere, was Edward Douwes Dekker, " Multatuli" (1826-1887). The two other leading Dutch men of letters were critics, Conrad Busken-Huet (1826-1886) (q.v.) and Carel Vosmaer (1826-1888) (q.v.). In Huet the principles of the 1840-80 period were summed up ; he had been during all those years the fearless and trusty watchdog of Dutch letters, as he rmderstood them. He lived just long enough to become aware that a revolution was approaching, not to comprehend its character ; but his accomplished fidelity to literary principle and his wide knowledge have been honoured even by the most bitter of the younger school. Vosmaer, although in certain directions more sympathetic than Huet, and himself an innovator, has not escaped so easily, because he has been charged with want of courage in accepting what he knew to be inevitable. We have

now, however, mentioned the leaders of the old guard, and must proceed to sketch the course of the movement which replaced them.

In November 1881 there died a youth named Jacques Perk (1860-1881), who had done no more than publish a few son-nets in the Spectator, a journal published by Vosmaer. He was no sooner dead, however, than his posthumous poems, and in particular a cycle of sonnets called Mathilde, were published (1882), and awakened extraordinary emotion. Perk had rejected all the formulas of rhetorical poetry, and had broken up the conventional rhythms. There had been heard no music like his in Holland for two hundred years. A group of young men, imited in a sort of esoteric adoration of the memory of Perk, collected around his name. They joined to their band a man somewhat older than themselves, Marcellus Emants (born 1848), who had come forward in 1879 with a symbolical poem called Lilitli, which had been stigmatized as audacious and meaningless : encouraged by the admiration of his juniors, Emants published in 1881 a treatise on Young Holland, in which the first open attack

was made on the old school. The next appearance was that of Willem Kloos (born 1867), who had been the editor and intimate friend of- Perk, and who now undertook to

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lead the army of rebellion. His violent attacks on recog-nized authority in aesthetics began in 1882, and created a considerable scandal. For some time, however, the new poets and critics found a great difficulty in being heard, since all the channels of periodical literature were closed to them. But in 1883 Emants expressed his intellectual aspirations in his TioiligM of the Gods, and in 1884 the young school founded a review, De Nieuwe Gids, which was able to offer a direct challenge to De Gids, the ultra^respeet-able Dutch quarterly. In this year a new element was introduced : hitherto the influences of the young Dutch poetry had chiefly come from England ; they were those of Shelley, Mrs Browning, the Eossettis. In 1884 Erans Netscher began to imitate with avidity the Erench

naturalists. Eor some time, then, the new Dutch litera-
ture became a sort of mixture of Shelley and Zola, very
violent, heady, and bewildering. In 1885 the Persephone of
Albert Verwey and the Hovering Butterflies of Pol de Mont
(born 1869) introduced two lyrical poets of real merit
to Holland ; Emants published his GondakJcer's Illusions.
This was the great flowering moment of the new school.
It was at this juncture that the principal recent writer of
Holland, Louis Couperus (born 1863), made his first definite
appearance. Born in The Hague, the opening years of his
boyhood were spent in Java, and he had preserved in all
his nature a certain tropical magnificence. In 1884 a little
volume of lyrics, and in 1886 the more important Orchids,
showed in Couperus a poet whose sympathies were at first
entirely with the new school. But he was destined to be
a novelist, and his earliest story, Eline Vere (1889), already
took him out of the ranks of his contemporaries. In 1890
he published Destiny (known as Footsteps of Fate in the
English version), and in 1892 Ecstasy. This was followed
in 1894 by Majesty, in 1896 by World-ioide Peace, in 1898

by Metamorphosis, a delicate study of character, in 1899 by Fidessa, and in 1901 by Quiet Force. Of all these later books by Couperus, it is perhaps Ecstasy in which the peculiar quality of his work is seen at present to the greatest advantage. This is an extreme sensitiveness to psychological phenomena, expressed in terms of singular delicacy and beauty. The talent of Couperus is like a rich but simple tropical flower laden with colour and odour. He separated himself, as he developed, from the more fanatical members of the group, and addressed himself to the wider public. Another writer, of a totally different class, resembling Couperus only in his defiance of the ruling system of esthetics, is the prominent Ultramontane politician, E. J. A. M. Schaepmann (born 1844), whosepoem of Aja Sofia originally appeared in 1886. B,ecent novelists of some polemical vigour are H. Borel and van Hulzen. A very delightful talent was revealed by Erederick van Eeden in Little Johnny (1887), a prose fairy-tale; in Ellen (1890), a cycle of mysterious and musical elegies ; and in From the Cold Pools of Death

(1901), a very melancholy novel. Another poet of less refinement of spirit, but even greater sumptuousness of form, appeared in Hel6ne Swarth-Lapidoth (born 1859), whose Pictures and Voices belongs to 1887. In that year also, in which Dutch literature reached its height of fecundity, was published the powerful and scandalous naturalistic novel, A Love, by L. van Deyssel, who^ had hitherto been known chiefly as a most uncompromising critic. Since 1887 the condition of modern Dutch litera-ture has been comparatively stationary, and even within the last decade of the 19th century definitely declining. In 1889, it is true, a new poet, Herman Gorter, made his appearance with a volume of strange verses called May, eccentric both in prosody and in treatment. He held his own without any marked advance towards lucidity or variety. Since the recognition of Gorter, however, no really remarkable talent has made itself prominent iuDutch poetry, unless we except P. C. Boutens, whose Verses in 1898 were received with great respect. Willem Kloos, still the acute and somewhat turbulent leader of the school,

collected his poems in 1894 and his critical essays in 1896. L. van Deyssel, though an effective reviewer, continued to lack the erudition which years should have brought to him. Among the pure poets, the Fleming, Pol de Mont with his Glaribella (1893) and his Iris (1894), possibly showed the most definite advance. Gorter remained tenebrous, Helene Swarth-Lapidoth still gorgeous ; the others, with the exception of Couperus, showed symptoms of sinking into silence. The entire school, now that the struggle for recognition is over, and its members are accepted as little classics and the tyrants of taste, rests on its triumphs and seems to limit itself to a repetition of its old experiments. In drama almost the only notable products are those of De Koo, whose Tobias Bolderman (1900) and Vier Ton (1901) are effective comedies. Dutch literature presented features of remarkable interest between 1882 and 1888, but since that time the general heightening of the average of merit, the abandonment of the old dry conventions, and a recognition of the artistic value of words and forms, are more evident to a foreign

observer than any very important single expression of the national genius in literary art. An exception should be made in favour of the powerful peasant-stories of Steijn Streuvels, a young baker by trade, whose Summer Land (1901) is a most promising production.

Interesting observations on the development of the new school in Dutch literature will he found in "Willem Kloos, Veertien Jaar Literatuur-Geschiedenis, 2 vols., 1896, and in L. van Deyssel, Verzamelde Opstelen, 4 vols., 1890-97. (b. g.)

Holland, ISTorth and South, two adjoining provinces of the Netherlands, between the Zuyder Zee, the most southerly branch of the Meuse, and the North Sea. The surface is mostly beneath searlevel, but is protected by dykes ; the soil is fertile and diligently cultivated. The chief towns in North Holland are Amsterdam, Haarlem, Alkmaar, Heeder, Hoorn, and Zaandam. In South Hol-land the principal towns are Eotterdam, The Hague, Leyden, Delft, Schiedam, and Gouda. The Hook of Holland, the new approach to Central Europe from Harwich, occupies almost the extreme south-western

point of a promontory of South Holland. (Eor statistics see Holland : Geography.)

Holland, a city of Ottawa county, Michigan, U.S.A., on a navigable inlet at the mouth of the Black river, and on the Chicago and West Michigan railway, at an altitude of 609 feet. It is a summer resort, and the seat of Hope College, founded in 1866, which in 1899 had 16 instructors and 214 students, of whom 27 were women. Population (1880), 2620 ; (1890), 3945 ; (1900), 7790, of whom 2075 were foreign-born.

Holland, Josiah Gilbert ^819-1881), Ameri-can author and editor, was born in Belchertown, Massa-chusetts, 24th July 1819. He studied medicine in the Berkshire Medical College (no longer in existence) at Pittsfield, in the same state ; was for a brief period super-intendent of schools in Vicksburg, Mississippi; but in 1849 became one of the editors and owners of the Spring-field (Massachusetts) Republican, with which he retained his connexion for seventeen years. In 1870, having resigned his position upon that journal and travelled in

Europe, he removed to New York and established Scrih-

ner's Monthly (the title of which was later changed to

Tlie Century) by developing an earlier magazine of more

limited scope, and gave it a character of its own, in which

were combined readableness, literary tone, and social help-

fulness. Dr Holland's numerous books, partly reprints

of his contributions to the Republican and Scribner's

Monthly, long enjoyed a wide popularity. These writings

fall into four classes : history and biography, represented

by a Life of Abraham Lincoln (1865), of which more

than 100,000 copies were sold soon after the assassina-

tion of the President; fiction, of which Miss Gilbert's

Career (1860) and Tlie Story of Sevenoaks (1875) remain

faithful pictures of village life in Eastern America;

poetry, of which the easily-moving narratives, Bitter-Sweet

(1858) and Kathrina, Her Life and Mine (1867), were

widely read ; and a series of homely and suggestive essays

on the art of living, of which the most characteristic were

Letters to Young People, Single and Married ^1858), Gold Foil, hammered from Popular Proverbs (1859), Letters to the Joneses (1863), and Every-Day Topics (two series, 1876 and 1882). While a resident of New York, where he died 12th October 1881, Dr Holland identified himself with measures for good government and school reform, being at one time president of the Board of Education.

Holloway, Thomas (1800-1883), English patent-medicine vendor and philanthropist, was born at Devon-port, 22nd September 1800, of humble parents. Until his twenty-eighth year he lived at Penzance, where he assisted his mother and brother in the baker's shop which his father, once a warrant officer in a militia regiment, had left them at his death. On coming to London he made the acquaintance of Eelix Albinolo, an Italian, from whom he obtained' the recipe for the oint-ment which was to carry his name all over the world. The secret of his enormous success in business was due almost entirely to advertisement, in the efficacy of which

he had great faith. He soon added the sale of pills to that of the ointment, and began to devote the larger part of his profits to advertising. Holloway's first newspaper announcement appeared on 15th October 1837, and in 1842 his yearly expenses for publicity had reached the sum of £5000 ; this expenditure went on steadily increasing as his sales increased, until it had reached the figure of £50,000 per annum at the time of his death. It is, however, chiefly by the two princely foundations — the Sanatorium and the College for Women, endowed by Holloway towards the close of his life — that his name will be perpetuated, more than a million sterling having been set apart by him for the erection and permanent endowment of these institutions. In the deed of gift of the college the founder credited his wife, who died in 1875, with the advice and counsel that led him to provide what he hoped might ultimately become the nucleus of a university for women. The Holloway Sanatorium was the first to be opened, in June 1885, eighteen months after the founder's death. It is an asylum for patients

*of the middle class, of both sexes, afflicted with mental disorders, and is intended to be to a considerable extent self-supporting, a moderate charge being made for the reception of inmates whose families can afford to pay. The institution and the surrounding grounds include some forty acres situated at St Anne's Heath, near Virginia Water, the building containing about 600 rooms, disposed on four floors, and capable of accommodating about 250 patients. All the structural and decorative features are on a grand scale and of a highly artistic nature, devised with the purpose of giving wearied brain-workers an opportunity of recovering their faculties. The Royal Holloway College for Women at Mount Lee, Egham, was opened by Queen Victoria in July 1886. The building, surrounded by grounds 95 acres in extent, stands on a picturesque wooded slope, commanding a splendid view; it contains nearly a thousand rooms, and has accommodation for 250 students and an ample staff. The recreation hall is an art gallery, containing pictures which cost upwards of £90,000. Like the sana^*

torium, it was furnished throughout in the most sumptuous manner, and, also like that institution, it is mainly self-supporting. It is unsectarian, the management being vested in a representative body of governors. The philanthropic and somewhat eccentric donor (he had an unconcealed prejudice against doctors, lawyers, and parsons) died of congestion of the lungs on 26th December 1883.

Holmes, Oliver Wendell (1809-1894), American writer and physician, was born 29th August 1809 at Cambridge, Massachusetts. His father, Abiel Holmes, was a Calvuiist clergyman, the writer of a useful history, Annals of America, and of much very dull poetry. His . mother (the second wife of Abiel) was Sarah Wendell, of a distinguished New York family. Through her Dr Holmes was descended from Governors Thomas Dudley and Simon Bradstreet of Massachusetts, and from her he derived his cheerfulness and vivacity, his sympathetic humour and wit. From Phillips Academy he entered Harvard College in the "famous class of '29," made

further illustrious by the charming lyrics which he wrote for the anniversary dinners from 1851 to 1889, closing with the touching " After the Curfew." After graduation he studied law perfunctorily for a year and dabbled in literature, winning the public ear by a spirited lyric called forth by the order to destroy the old frigate Constitution. These verses were sung all over the land, and induced the Navy Department to revoke its order and save the old ship. Turning next to medicine, and convinced by a brief experience in Boston that he liked it, he went to Paris in March 1833. He studied industriously under Louis and other famous physicians and surgeons in Prance, and in his vacations visited the Low Countries, England, Scotland, and Italy. Eeturning to Boston at the close of 1835, filled with a high professional ambition, he sought practice, but achieved only moderate success. Social, brilliant in conversation, and a writer of gay little poems, he seemed to the grave Bostonians not sufficiently serious. He won prizes, however, for professional papers, and lectured on anatomy at Dartmouth

College. He wrote two papers on homoeopathy, which he attacked with trenchant wit ; also a valuable paper on the malarial fevers of New England. In 1843 he published his essay on the Contagiousness of Pueiperal Fever, which stirred up a fierce controversy and brought upon him bitter personal abuse ; but he maintained his position with dignity, temper, and judgment; and in time he was honoured as the discoverer of a beneficent truth. The volume of his medical essays holds some of his most sparkling wit, his shrewdest observation, his kindliest humanity. In 1840 he married Amelia Lee Jackson, daughter of the Hon. Charles Jackson, Associate Justice of the Supreme Judicial Court of Massachusetts, a lady of rare charm alike of mind and character. She died in the winter of 1887-88. Their first-born child, Oliver Wendell Holmes, afterwards became Chief Justice of that same bench on which his grandfather sat. In 1847 Dr Holmes was appointed Professor of Anatomy and Physiology in the Medical School of Harvard University, the duties involving the giving of instruction also in kindred depart-

ments, so that, as he said, he occupied "not a chair, but a settee in the school." He delivered the anatomical lectures until November 1882, and in later years these were his only link with the medical profession. They were fresh, witty, and lively ; and the students were sent to him at the end of the day, when they were fagged, because he alone could keep them awake. In later years he made few finished contributions to medical knowledge ;

his eager and impetuous temperament caused him to leave more patient investigators to push to ultimate results the suggestions thrown out by his fertile and imaginative mind.

In 1836, being in that year the Phi Beta Kappa poet at Harvard University, he published his first volume of poems, which afterwards reached a second edition. Among these earlier lyrics was " The Last Leaf," one of the most delicate combinations of pathos and humour in literature.

His collected poetry fills

three volumes. In 1856-57

a Boston publishing house i

(Phillips, Sampson, and Co.)

invited James Eussell Lowell '

to edit a new magazine,

which he agreed to do

on condition that he could

secure the assistance of

Dr Holmes. By this urgent

invitation the Doctor was ;

*equally surprised and flat- |^*

tered,, for heretofore he had

stood rather outside the

literary coterie of Cam-

bridge and Boston. He ac-

cepted with pleasure, and

at once threw himself into

, the enterprise with zeal.

He christened it The Atlantic ;

Monthly ; and, as Mr Howells

afterwards said, he ” not ;

only named but made ”

it, for in each number of its

first volume there appeared

one of the papers of the

Autocrat of the Breakfast Table.

The opening of the Auto- \j-;,

*crat — ” I was just going to 1*11*

say when I was inter- pf|:

rupted” — is explained by =|ft

the fact that in the old ‘■- ‘

New England Magazine (1831

to 1833) the Doctor had pub-

lished two Autocrat papers,

which, by his wish, have

never been reprinted. In the commercial panic of

1857 the new magazine would inevitably have failed

had it not been for these fascinating, essays. Their origin-

ality of conception, their wit and humour, their suggestions

of what then seemed bold ideas, and their expression of New Englandism, all combined to make them so popular that the most harassed merchant in that gloomy winter pur-chased them as a dose of cheering medicine. Thus Dr Holmes made TJie Atlantic Monthly, which in return made him. A success so immediate and so splendid settled the rest of his career ; he ceased to be a physician, and became an author. These twelve papers were immediately (1858) published as a volume. No sooner was the Autocrat silent than the Professor (1859) succeeded him at the breakfast table. The Professor was preferred by more thoughtful readers, though it has hardly been so widely popular as the Autocrat. Its theology, which seemed in those days audacious, frightened many of the strict and old-fashioned religionists of New England, though to-day it seems mild enough. Twelve years later, in 1871, the Landlady had another boarder, who took the vacant chair — the Poet (published 1872). But here Holmes fell a little short.

In these three books, especially in the Autocrat and the Professor, the Doctor wrote as he talked at many a dinner

table in Boston, but less well. The animation and clash

Oliver Wendell Holmes.

{From a photograph by Elliott and Fry, London.)

of talk roused him. The dinners of the Saturday Club

are among Boston's proudest traditions, as they were

the chief pleasure of Dr Holmes's life. There he met

Emerson, Longfellow, Whittier, Lowell, Sumner, Agassiz,

Motley, and many other charming talkers, and among them

all he was admitted to be the best.

There were characters and incidents, but hardly

a story, in the Autocrat and the Professor. Holmes

had an ambition for more sustained work, and in

1861 his novel, Elsie Venner,

at first called The Professor's

Story, was published. The

book was illuminated through-

out by admirable pictures

of character and society

in the typical New England

town. But the rattlesnake

element was unduly extrav-

agant, and in other respects

the book was open to criti-

cism as a work of art.

It was written with the

same purpose which informed

the greatest part of the

Doctor's literary work, and

which had already been

scented and nervously con-

demned by the religious world.

By heredity the Doctor was

a theologian; no other

topic enchained him more

than did the stern and merci-

less dogmas of his Calvinist

I forefathers. His humanity

;^3 revolted against them, his

^i reason condemned them, and

he set himself to their de-

struction as his task in litera-

ture. The religious world

of his time was still so

: ^i- largely under the control of

^ ■ old ideas that he was as-

sailed as a freethinker and

a subverter of Christianity ;

though before his death

opinions had so changed

that the bitterness of the attacks upon him seemed in-

credible even to some of those who had most vehemently

made them. None the less, undaunted and profoundly

earnest, he returned, six years later, to the same line of

thought in his second novel, !Z7te Guardian Angel (pub-

lished 1867). This, though less well known than Elsie

Venner, is in many respects better. No more lifelike

and charming picture of the society of the New England

country town of the middle third of the 19th century has

ever been drawn, and every page sparkles with wit and

humour. In 1884 and 1886 it was followed, still in the

same line, by A Mortal Antipathy, a production inferior to its predecessors.

Holmes generally held himself aloof from politics, and from those " causes " of temperance, abolition, and woman" s rights which enthralled most of his contemporaries in New England. The Civil War, however, aroused him for the time ; finding him first a strenuous Unionist, it quickly converted him into an ardent advocate, of emancipation. His interest was enhanced by the career of his elder son, who was three times severely wounded, and finally rose to the rank of lieutenant-colonel in the Northern army. He wrote some ringing war lyrics, and in 1863 delivered the Fourth of July oration in Boston, which showed a masterly appreciation of the stirring public questions of

the day. In 1878 Dr Holmes -wrote a memoir of the historian John Lothrop Motley, an affectionate tribute to one who had been his dear friend. In 1884 he contri-buted the life of Emerson to the American Men of

Letters Series. He admired the " Sage of Concord," but was not quite in intellectual sympathy with him. Both were Liberals in thought, but in widely different ways. But in spite of this handicap, the volume proved very popular. In 1888 he began the papers which he happily christened Over the Tea Cups. As a tour de force on the part of a man of nearly fourscore years they are very remarkable.

After his return from Paris in 1835 Dr Holmes lived in Boston, with summer sojournings at Pittsfield and Beverly Farms, and occasional trips to neighbouring cities, until 1886. He then undertook a four months' journeyinEurope, and in England had a sort of triumphal progress. On his return he wrote Our Hundred Days in Europe (1887), a courteous recognition of the hospitality and praise which had been accorded to him. During this visit Cambridge University made him Doctor of Letters, Edinburgh University made him Doctor of Laws, and Oxford University made him Doctor of Civil Law. Already, in 1880, Harvard University had made him Doctor of Laws. He

died on 7th October 1894, and was buried from King's Chapel, Boston, in the cemetery of Mount Auburn.

(j. T. MO.)

Holmflrth, a town in the Holmfirth parliamentary division of Yorkshire, England, on the Holme and Eibble, 6 miles south of Huddersfield and on the Lancashire and Yorkshire railway. There are a town-hall, a drill-hall, and a technical institute, three churches, and several chapels. Woollen manufactures form the principal industry. In the neighbourhood there is picturesque scenery. Area (urban district), 7094 acres. Population (1901), 8976.

HoltzendorfT, Joachim Wilhelm Franz Philipp von (1829-1889), German jurist, born at Vietmannsdorf, in the Mark of Brandenburg, on 14th October 1829, was descended from a family of the old nobility. He was educated at Berlin and at Pforta, afterwards studying law at the universities of Bonn, Heidelberg, and Berlin. He saw the struggles of 1848 with youthful enthusiasm, and remained for the rest of

his life a strong advocate of political liberty. In 1852 he graduated LL.D. at Berlin; in 1867 he became a privat-docent, and in 1860 he was nominated a professor extraordinary. The predominant party in Prussia regarded his political opinions with mistrust, and he was not offered an ordinary professorship until February 1873, after he had decided to accept a chair at the University of Munich. At Munich he passed the last nineteen years of his life. During the thirty years that he was professor he successively taught several branches of jurisprudence, but he was chiefly distinguished as an authority on criminal and international law. He was especially well fitted for organizing collective work, and he has associated his name with a series of publications of the first value. While acting as editor he often reserved for himself, among the independent monographs of which the work was composed, only those on subjects distasteful to his collaborators on account of their obscurity or lack of importance. Among the compilations which he superintended may be mentioned his Encyclopddie der Bechtswissenschaft

(Leipzig, 1870-71, 2 vols. ; fifth edition, 1890), his Hand-bucli des deutschen Strafrechts (Berlin, 1871-77, 4 vols.), and his Handhuch des VoIkerrecMs auf Orundlage Euro-j^aiscAer/S'toafspraaas (Berlin, 1885-90, 4 vols.). Among his many independent works may be mentioned: Das irische Gefdngnisssystem (Leipzig, 1859), Franzosische Reclits-zustdnde (Leipzig, 1859), Die Deportation als Strafmittel (Leipzig, 1859), Die Kiirzungsfdhigkeit der Freiheitsstra-fen (Leipzig, 1861), Die lieform der Staatsanwaltschaft in DeutscMand (Berlin, 1864), Die Umgestaltung der Staatsanwaltschaft (Berlin, 1865), Die Frincipien der Politik (Berlin, 1869), Das Verbrechen des Mordes und die Todesstrafe (Berlin, 1875), Bumaniens Uferrechte an der Donau (Leipzig, 1883 ; French edition, 1884). He also edited or assisted in editing a number of periodical publications on legal subjects. From 1866 to the time of his death he was associated with Eudolf Ludwig Carl Virchow in editing Sammlung gemeinverstdndlicher ivis-senschaftlicher Vortrdge (Berlin). Von Holtzendorff died at Munich on 4th February 1889. (e. i. c.)

Holyhead, a seaport and naval station on the north-east shore of an island of the same name lying off the west coast, and part of the county, of Anglesea, Wales. In 1885 its parliamentary representation was merged in that of the county. There are a hospital, a sailors' home, and almshouses. Area of urban district, 732 acres. Population (1881), 8680 ; (1901), 10,072. The island is about 7| miles long, with a breadth varying from 4 miles to half a mile. On the north-west is the " head," a serpentine mass 719 feet high, and off this are two rocks, the North and South Stacks, with lighthouses.

-), English

Holyoake, George Jacob (1817-

secularist and co-operator, was born at Birmingham, 13th April 1817. At an early age he became an Owenite lecturer, and in 1841 was the last person convicted for blasphemy in a public lecture, though this had no theological character and the incriminating words were merely a reply to a question addressed to him from the body of the meeting. He nevertheless underwent six months'

imprisonment, and upon his release invented the inoffensive term "secularism" as descriptive of his opinions, and established The Beasoner in their support. He was also the last person indicted for publishing an unstamped newspaper, but the prosecution dropped upon the repeal of the tax. His later years were chiefly devoted to the promotion of the co-operative movement among the working classes. He wrote the history of the Eochdale Pioneers (1867), the History of Co-operation in England (1875), and The Co-operative Movement of To-day (1891). He also published (1892) his autobiography, under the title of Sixty Years of an Agitatoi-'s Life.

Holyoke, a city of Hampden county, Massachusetts, U.S.A., on the west bank of the river Connecticut, 8 miles north of Springfield, at an altitude of 114 feet. The plan of the city is regular and divided into seven wards. It derives its water supply by gravity from lakes in the adjacent hills. It is on the Boston and Maine, and the New York, New Haven, and Hartford railways.

Hadley Falls, in the Connecticut, have a fall of about 60 feet, and furnish valuable water-power, the utilization of which has made Holyoke an important manufacturing city. In 1900 it had 433 manufacturing establishments, employing 13,454 hands, and producing goods valued at $26,283,964. Of these, paper and wood pulp were the most important products, having a value of $8,109,485. Cotton goods to the value of $3,764,848, and woollen goods valued at $1,424,897, were also produced. The assessed valuation of real and personal property in 1900 was $39,735,580 ; the net debt of the city was $1,739,868 ; and the rate of taxation was $16.40 per $1000. Population (1880), 21,915; (1890), 35,637; (1900), 45,712, of whom 18,921 were foreign-born and 40 negroes. The death-rate in 1890 was 22-8 ; in 1900 it was 17-9.

Homburg vor der Hohe, a famous watering-place of Prussia, in the province of Hesse-Nassau, at the south-east foot of the Taunus Mountains, 12 miles by-

rail north-north-west of Prankf ort-on-Main, frequented by more than 10,000 visitors annually. In 1897 a Russian (Orthodox Greek) chapel was built, and in 1892 a marble bust of the Emperor Frederick III. was unveiled. A new bath-house was built in 1887-90, and a new salt spring bored in 1898. There is also a new Roman Catholic church (1896). In 1900 the ancient Roman castle of the Saalburg was converted into an imperial museum. Population (1885), 8857 ; (1900), 9636.

Homer, Winslow (1836 ^), American painter, was born in Boston, U.S.A., 24th February 1836. At the age of nineteen he was apprenticed to a lithographer. Two years later he opened a studio in Boston, and devoted much of his time to making drawings for wood-engravers. In 1859 he removed to New York, where he studied in the night-school of the National Academy of Design. During the American Civil War he was with the troops at the front, and contributed sketches to Harper's Weekly. The war also furnished him with the subjects for the first two pictures which he exhibited

(1863), one of which was "Home, Sweet Home." His "Prisoners from the Front" — perhaps his most generally popular picture — was exhibited in New York in 1865, and also in Paris in 1867, where he was spending the year in study. Among his other paintings in oil are "Snap the Whip" (which was exhibited at the Philadelphia Centennial Exposition of 1876, and, in company with "The Country Schoolroom," at the Paris Salon the following year), "Eating Water-melon," "The Cotton Pickers," "Visit from the Old Mistress, Sunday Morning," "The Life-Line," and "The Coming of the Gale." His genius, however, has perhaps shown better in his works in water-colour, among which are his marine studies painted at Gloucester, Mass., and his "Inside the Bar," "The Voice from the Cliffs" (pictures of English fisher-women), "Tynemouth," "Wrecking of a Vessel," and "Lost on the Grand Banks." His work, which principally consists of genre pictures, is characterized by strength, rugged directness, and unmistakable freshness and originality, rather than by technical excellence, grace of line,

or beauty of colour. He was little affected by European influences. His types and scenes, apart from his few English pictures, are distinctly American — soldiers in blue. New England children, negroes in the land of cotton, Gloucester fishermen, and stormy Atlantic seas. Besides being a member of the Society of Painters in Water-colour, New York, he was elected in 1864 an associate and the following year a member of the National Academy of Design.

Homestead, a borough of Allegheny county, Pennsylvania, U.S.A., on the river Monongahela, 8 miles south-east of Pittsburg, at an altitude of 759 feet. It is on the Pennsylvania and the Pittsburg and Lake Erie railways. It is known chiefly as the site of the great iron and steel works of the Carnegie Company, and as the scene, in 1892, of a serious labour strike, which was quelled only by the calling out of the National Guard of the state. Population (1880), 592 ; (1890), 7911 ; (1900), 12,554, of whom 3604 were foreign-born and 640 were negroes.

Homceopathy. — The system of therapeutics which bears the name of Homoeopathy is based upon the law similia sirailibus curentitr, the originator of which was Hahnemann, a native of Meissen in Germany, who discovered his new principle while he was experimenting with cinchona bark in 1790, and announced it in 1796. The essential tenets of homoeopathy are that the cure of disease is effected by drugs that are capable of producing in a healthy individual symptoms similar to those of the disease to be treated, and that to ascertain the curative virtues of any drug it must be " proved " upon healthy persons — that is, taken by individuals of both sexes in a state of health in gradually increasing doses. The manifestations of drug action thus produced are carefully recorded, and this record of " drug-diseases," after being verified by repetition on many "provers," constitutes the distinguishing feature of the homoeopathic materia medica, which, while it embraces the sources, preparation, and uses of drugs as known to the orthodox pharmacopoeia, contains, in addition, the various "provings" obtained

in the manner above described. Within the past few years an interesting controversy has been carried on between the members of the homoeopathic school as to the proper construction of the Latin motto which constitutes its acknowledged basis. For many years the verb at the conclusion of the sentence was used in the indicative mood, curantur, thus making the sentence a positive one. After extended research it has been discovered that Hahnemann himself never employed the word curantur as descriptive of his law of cure, but always wrote curentur, which greatly modifies the meaning of the phrase. If the subjunctive mood be used, the motto reads, "Let similars be treated by similars," or " Similars should be treated by similars." The reading similia similibus curentur was officially adopted as the correct reading of the sentence by the American Institute of Homoeopathy at its session held in Atlantic City, N. J., 20th June 1899 ; and the words are so inscribed on the monument erected to the memory of Hahnemann and unveiled in Washington, D.C., on 23rd June 1900, and also are those carved upon

the tomb of Hahnemann in Pere-la-Chaise, Paris.

Besides the promulgation of the doctrine of similars, Hahnemann also enunciated a theory to account for the origin of all chronic diseases, which he asserted were derived either directly or remotely from psora (the itch), syphilis (venereal disease), or sycosis (fig-wart disease). This doctrine, although at first adopted by some of the enthusiastic followers of Hahnemann, was almost immediately discarded by very many who had a firm belief in his law of cure. In the light of advancing science such theories are entirely untenable, and it was unfortunate for the system of medicine which he founded that Hahnemann should have promulgated such a hypothesis. It served as a target for the shafts of ridicule showered upon the system by those who were its opponents, and even at the present time there still exists in the minds of many misinformed persons the conviction that homoeopathy is a system of medicine that bases the origin of all chronic disease on the itch or on syphilis or fig-warts.

Another peculiar feature of homoeopathy is its posology

or theory of dose. It may be asserted that homoeo-

pathic posology has nothing more to do with the original

law of cure than the psora (itch) theory has, and that

it was one of the later creations of Hahnemann's mind.

Most homoeopathists believe more or less in the action of

minute doses of medicine, but it must not be considered

as an integral part of the system. The dose is the

corollary, not the principle. Yet in the minds of many,

infinitesimal doses of medicine stand for homcBopathy

itself, the real law of cttre being completely put into

the background. The question of dose has also divided

the members of the homoeopathic school into bitter fac-

tions, and is therefore a matter for careful consideration.

Many employ low potencies, ' i.e., mother tinctures, first,

1 Two methods of preparing medicines are recognized, one on the

decimal, the other on the centesimal scale. The pure tinctures are de-

nominated "mother tinctures," and represented by the Greek

make a first decimal dilution or first decimal trituration, 10 drops of

second, sixth dilutions, &c., while others use hundred-thousandths and millionths.

Some homoeopath ists of the present day still believe ■frith Hahnemann that, even after the material medicinal particles of a drug have been subdivided to the fullest extent, the continuation of the dynamization or tritura-tion or succession develops a spiritual curative agency, and that the higher the potency, the more subtle and more powerful is the curative action. Hahnemann says (Organon, third American edition, p. 101), "It is only by means of the spiritual influence of a morbific agent that our spiritual vital power can be diseased, and in like manner only by the spiritual operation of medicine can health be restored." This is absolutely denied by others. Thus at the present time there exist two schools among the adherents of homoeopathy. On the one hand there are the Hahnemannians, the "Purists" or " High Potency " men, who still profess to regard the Organon as their Bible, who believe in all the teachings of Hahnemann, who adhere in their prescriptions to the single dose, the

single medicine, and the highest possible potency, and regard the doctrine of the spiritual dynamization acquired by trituration and succession as indubitable. On the other side there are the "Rational" or "Low Potency" men, who believe in the universality of the law of cure, but think that it cannot always be applied, on account of an imperfect materia medica and a lack of knowledge on on the part of the physician. They believe that in many cases of severe and acute pain palliatives are required, and that they are free to use all the adjuvants at present known to science for the relief of suffering humanity — massage, balneology, electricity, hygiene, &c. The American Institute of Homoeopathy, the national body of the United States, has adopted the following resolution and ordered it to be published conspicuously in each number of the Transactions of the society : — " A homoeopathic physician is one who adds to his knowledge of medicine a special knowledge of homoeopathic therapeutics. All that pertains to the great field of medical learning is his by tradition, by inheritance, by right."

The effect produced upon both the laity and the general profession of medicine by the introduction of homoeopathy was salutary in many ways. It diminished the quantity of medicine that was formerly considered necessary for the eradication of disease, and thus revealed the fact that the vis medicatrix naturae is often sufScient, with occasional and gentle assistance, to cure many diseases, especially those fevers that run a definite and regular course. In addition it prepared the medical mind for the reception of truths soon to be revealed by the aid of the microscope by Schwann, Pasteur, Chevreul, Davine, and Lister. The trend of the belief in the law similia similibus curantur is now forcibly shown by the rapidly increasing adoption of the serum therapy, which consists in the treatment of the most malignant diseases (diphtheria, lock-jaw, typhoid fever, tuberculosis, bubonic plague) by introducing into the system a modified form (similar) of those poisons that produce them in the healthy individual. Progressive physicians at the present time do not hesitate to acknow-

the mother tincture, or 10 grains oi a crude substance, are mixed with

90 drops of alcohol, or 90 grains of saccharum lactis (sugar of milk) respectively. The liquid is thoroughly shaken, or the powder carefully triturated, and the bottles containing them marked 1 X, meaning first decimal dilution or trituration. To make the 2X potency, 10 drops or 10 grains of this first dilution or trituration are mixed with 90 drops of pure alcohol, or 90 grains of milk sugar, and are succussed or triturated as above described and marked 2 X dilution or trituration. This subdivision of particles may be continued to an indefinite degree. On the Hahnemannian or centesimal scale the medicines are prepared in the same manner, the difference being that 1 drop or grain is mixed with 99 drops or grains, to make the first centesimal, which is marked 1 c or 1 simply, and so on for the second and higher dilutions.

ledge the homoeopathic doctrine as true under certain conditions, their only objection to it being that it is " sectarian." It has been publicly announced that if the homceopathists would abolish the name " homoeopathy," and remove it from their periodicals, colleges, hospitals, dispensaries, and asylums, they would be received withia the fold of the regular profession. These conditions have

been accepted by a few homceopathists who have become members of the most prominent medical association in the United States.

Homoeopathy as it exists to-day can, in the opinion of its adherents, stand by itself, and its steady progress for a century in face of prolonged and determined opposition appears to its upholders to be evidence of its truth.

There are still, indeed, in both schools of medical thought, men who stand fast by their old principles.

There are homceopathists who can see nothing but evil in the practice of their brothers of the orthodox school, as there are allopathists who still regard homoeopathy as a humbug and a sham. There are, however, liberal-minded men in both schools, who look upon the adoption of any safe and efficient method of curing disease as the birthright of the true physician, and who allow every man to prescribe for his patients as his conscience may dictate, and, provided he be educated in all the collateral branches of medical science, are ready to exchange views for the good of suffering humanity.

Great Britain. — Homoeopathy is not rapidly extending in Great Britain, and its recognition has been slow. The first notice taken of the new system of therapeutics was by the Medical Society of London in 1826. In 1827 the physician of Prince Leopold of Saxe-Coburg, Dr Quin, who had previously studied homoeopathy in Germany and practised it in Italy, came to England, and it was through his efforts that the system was Introduced. Three other physicians, Dr Belluomini, Dr Romani, and Dr Tagliani, claimed priority, but careful research established Dr Quin's title. Quin was a successful man professionally and socially, and brought upon himself in a short time the anathema of the Royal College of Physicians. In 1844 Dr Henderson, professor of pathology in the University of Edinburgh, embraced the Hahnemannian system. A storm of opposition arose, and Professor J. Y. Simpson (the discoverer of chloroform ansesthesia) published a volume, with the alliterative title, Somosopathy, its Tenets and Tendencies, Theoretical; Theological, and Therapeutical. This brochure was answered by Professor Henderson, the title of his book being Homoeopathy Fairly Bepresented. Erom 1827 to 1837 there were but a dozen practitioners of homoeopathy in London, but during 1837 to 1847

the number increased to between seventy and eighty. In 1857 there were upwards of two hundred practitioners in the kingdom, with thirty-three institutions in which the law of similars was used as a basis of practice. In 1867 the increase was not so rapid, the number being 261. A society was formed about this period for "the protection of homoeopathic practitioners and students," which proved of great value in binding the sect together. In 1870 congresses were established and annual meetings held, which have continued to the present time. In 1901 there were over three hundred homoeopathic physicians in the British Isles, of whom between seventy and eighty were in London alone. There were seventy-nine chemists, of whom seventeen were located in London, and eighty-two towns and cities in the country contained from one to ten homoeopathic practitioners each, together with many established chemists for dispensing homoeopathic medicines. The British Homoeopathic Medical Society, founded by Quin in 1844, is in a flourishing condition, having two hundred and eight members, thirty-four fellows, and thirty-one corresponding members in all portions of the world, including Australia, India, and Tasmania. The London Homoeopathic Hospital was founded in 1850, and a few

years afterwards moved to Great Ormond Street. During the cholera epidemic of 1854 the statistics of this hospital showed a mortality of 16-4 per cent., against 51-8 per cent, of other metropolitan charities. The London Homoeopathic Hospital has a convalescent home under its management at Eastbourne. There are also dispensaries in Ealing and West Middlesex, Kensington, Notting Hill, and Bayswater. Similar institutions, all in a flourishing condition, are located in Bath, Birkenhead, Birmingham, Bootle, Bourne-mouth, Brighton, Bristol, Bromley, Cheltenham, Cheshire, Croy-don, Dublin, Eastbourne, Edinburgh, Folkestone, Hastings and St Leonards, Ipswich, Leeds, Leicester, Liverpool, Newcastle, Northampton, Norwich, Oxford, Plymouth, Torquay, Tunbridge

Wells, Weston-super-Mare. The journals now in existence are the Hommopathic World, the Monthly HoriKfopathic Bemeio, the Lon-don Homeopathic Hospital Beports, and the Journal of the Brit-ish Homoeopathic Society. There are also several of lesser note. The British Journal of Homoeopathy was first published in 1843,

and was edited by Drs Drysdale, Russell, and Black. For many years it was the foremost homceopathic journal in the world. Its motto was In certis unitas, in dubiis Ubertas, in omnibus charitas. One reason why homcBopathy has not advanced as rapidly in the British Isles as in America is said to be the discrimination exercised against it by the General Medical Council, and another is want of cohesion amongst the homoeopaths themselves. An effort is, how-ever, being made to obtain an independent license-conferring school. Canada. — The early history of homoeopathy can be traced back nearly to 1850 in the province of Quebec. In the Dominion of Canada the various provinces control the licensing of physicians, excepting in Quebec, which is the only province having a separate homoeopathic hoard of examiners. This is under the control of the Montreal Homoeopathic Association, and is known as the College of Homceopathic Physicians and Surgeons of Montreal. Three examiners are annually appointed by the association. Suc-cessful candidates receive the diploma of the college, and are en-titled to add to their degree the letters M.C.H.P.S. A certificate of successful examination is forwarded to the lieutenant-governor at Quebec, who, " if satisfied of the loyalty, integrity, and good

morals of the applicant, may grant him a license to practise surgery, physic, and midwifery, or either of them, in the province of Quebec." The word " loyalty " has been decided by the provincial secretary to mean a British subject. This is the only Government medical license now issued in the British empire, the others being by provincial boards or colleges of physicians and surgeons. In this province there are seventeen active practitioners of homoeopathy. In 1894 there was no homoeopathic institution in the province ; at present the Montreal Homoeopathic Hospital, valued at ^20,000, and possessing already an endowment fund of $11,000, is in active operation. The hospital has forty beds, is well equipped for surgical and medical work, and has maternity and nurses' home annexes. The revenue is derived from the private rooms, which are extensively used by both schools for the treatment of patients. The facilities for surgical work in this hospital are superior to those of others in the city. The PhiUips Training School of the hospital has about twenty graduates. New Brunswick, Nova Scotia, and Halifax have each two representatives of the system. In British Columbia there are four homosopathists, and in Manitoba four. Two homoeopathic papers are published monthly — the Hom-

oeopathic Beeord in Montreal, and the Homoeopathic Messenger in Toronto.

In 1870, in the province of Ontario, the three schools, allopathic, homceopathic, and eclectic, united for examining purposes into one board called the medical council, seventeen members representing the old school and five the two other systems. Besides these, the medical colleges sent eight representatives. Finally the eclectics were merged in the old school, the board appointing five of Hahnemann's followers for examining purposes ; these designate two examiners in the branches of medicine bearing especially upon the homoeopathic doctrine. There are eighty homoeopathic physicians, in the province, twenty of whom reside in Toronto. The homoeopathic physicians are appointed on the staffs of the different allopathic hospitals and other public charities. There are homoeopathic eye and ear specialists in London, Hamilton, and Toronto. Grace Hospital, with a capacity of 120 beds, is an imposing structure, and was begun as a dispensary in 1887. The hospital was incorporated in 1890, and in 1892 the present structure was erected.

Into Newfoundland, Prince Edward's Island, and the Labrador coast the system of Hahnemann has not penetrated.

Australia. — Homoeopathy has been practised in Victoria since 1850 at least. It was introduced by a layman, who afterwards emigrated to India, there also to introduce the doctrine. The system is very popular in Adelaide, where there are at present eight homoeopathic physicians. At Melbourne there are nine physicians of the new school, and a homoeopathic hospital. In Sydney there are a dozen doctora practising the system, and ten chemists who dispense homceopathic medicines. Albury has one physician; Bendigo, one, and a chemist ; Brisbane, one ; Casino, one ; Geelong, one, a dispensary, and a chemist ; Maitland, one ; and Freemantle, one. There are also homoeopathic physicians in Christchurch and Dunedin in New Zealand. In the towns of Tasmania there are five.

United States. — Homoeopathy was introduced into the United States by Dr Hans Birch Gram, who was born in Boston. His father being Danish, Gram in his eighteenth year went to Copenhagen, where he graduated in 1814. In 1823 he became acquainted with homceopathy, and brought a knowledge of it to America in 1825 when he settled in New York. The first homoeopathic association was formed in 1833 in Philadelphia, the second in New

York, 1834, and homoeopathy became known in the different states somewhat in the following order :— New York, 1825 ; Pennsylvania, 1828 ; Louisiana, 1836 ; Connecticut, 1837 ; Massachusetts, 1837-38 ; Maryland, 1837 ; Delaware, 1837 ; Kentucky, 1837 ; Vermont, 1838 ; Rhode Island, 1839 ; Ohio, 1839 ; New Jersey, 1840 ; Maine, 1840 ; New Hampshire, 1840 ; Michigan, 1841 ; Georgia, 1842 ; Wisconsin, 1842 ; Alabama, 1843 ; Illinois, 1843 ; Tennessee, 1844 ; Missouri, 1844 ; Texas, 1848 ; Minnesota, 1852 ; Nebraska, 1862 ; Colorado, 1863 ; Iowa, 1871. After 1871 the spread of the system was rapid throughout every state in the Union. In the United States there are to-day 12,000 homceopathic physicians, of whom 1158 are women. Their numerical relation to all other sects is about 12-51 per cent. There are nine national societies, of which the American Institute of Homoeopathy is the largest, having 1900 members. There are two sectional societies, composed of members from four to eight states, 33 state societies with an aggregate of 4000 members, 88 local organizations with 4500 members, 22 medical colleges with alumni numbering nearly 14,000 (six having connected with them alumni associations numbering 4711), 42 clubs with 659 members, 90 general hospitals, 50 general private hospitals,

45 special public hospitals, 36 special private, and 50 other eleemosynary institutions. Of the hospital capacity, 195 contain 16,037 beds, or 6735 more than was reported in 1895. There are 58 dispensaries, treating 287, -507 persons with 740,319 prescriptions annually, being 61,782 patients and 245,521 prescriptions more than in 1895. It is safe to say that the patrons of the system amount to several millions. Besides these it may be noted that departments of homoeopathy are ccjnnected with the universities of Boston, Michigan, Iowa, Minnesota, and Kansas City. There are 33 medical journals in active operation, and text-books and monographs for homoeopathic students in all departments of medicine and surgery, written by members of the homoeopathic school.

Germany. — In 1810 Hahnemann published his Organon, which was the starting-point of homoeopathy in Germany. In 1811 an endeavour was made to found an institution in Leipzig in which practitioners might learn the new method of treatment theoretically and practically, but it was not a success, as the entire tide of professional opinion was against the system. In 1829, at the celebration of the fiftieth anniversary of Hahnemann's doctorate, the German Central Society was organized, holding its first meeting in

1830. In the university hospital of Munich some experiments were made to test the efficacy of homoeopathic medicines, but these were not successful. In 1831 the Government prohibited homoeopathists from dispensing their own medicines ; this was a severe blow to the system. In 1834 there was a division among the homoeopathists themselves, which much retarded the progress of the school. A homoeopathic hospital was established about this time (January 1833) in Leipzig, but there was such constant wrangling among the physicians connected with it that its sphere of usefulness was curtailed, and it was finally converted into a dispensary. The Baden Homoeopathic Society was established in 1834. The homceopathic hospital in Munich was established in 1836, but suffered a similar fate to that of Leipzig, and was converted into a dispensary. The rather equivocal success of these hospitals in Saxony and Bavaria was in direct contrast to the fate of two newly established hospitals in Austria, one in Vienna and the other in Linz, which were very successful, and aroused great interest both among physicians and laymen. During the political confusion of 1846 and 1849 there was complete stagnation of everything medical in Germany. But during all these years, though

the public institutions were few, the literature on homosopathio subjects became very extensive, and exercised a significant influence upon the system in all parts of the world. Hahnemann died in 1843, and on the 10th of August 1851 a bronze monument to him was unveiled at Leipzig. The Leipzig dispensary lived thirty-three years. From 1842 to 1874 there were treated in this institution 65,106 patients. In 1901 there were about 260 homosopathio physicians in Germany; they appeared to be strongest at Berlin, in the province of Brandenburg, in Pomerania and Westphalia, Saxony, Hessen, and in Wtirtemberg. The homceopathic hospital at Leipzig, which was reorganized some years ago, is in successful operation ; its patronage is large, its polyclinics are well attended, and its dispensaries good. At Berlin ground has been purchased upon which to erect a magnificent hospital. The polyclinic at Charlottenburg is well directed, and is under the patronage of distinguished personages. Homceopathic physicians give instruction in homoeopathy to medical students during the various semesters, and have published a large volume on homceopathic materia medica. There is also issued at Berlin Die Zeitschrift des Berliner ^'crcins homoopatischer Aerzte, and at Leipzig Die Allgemeine Homoo-

patische Zeitung, besides several popular homceopathic newspapers for laymen. There is a homoeopathic hospital in JIunich, sup-poi-ted by the Homoeopathic Hospital Society (comprising 86 members) and by small fees charged for treatment at the clinics. Neither the state of Bavaria nor the city contributes to the main-tenance of this institution. There are eight homoeopathic physi-cians in JIunich, four in Augsburg, two in Nuremberg, and one

each in Regensburg, Landshut, Gassan, Rosenheim, XJlm, and FUrth, making a total of twenty. There is one homoeopathic central pharmacy in Munich, two in Augsburg, one in Regensburg, and one in Metzingen, where there is also a homceopathio institution for poor patients. Homoeopathy is patronized in most of the cities as well as in the country among the peasantry, especially in the Alpine regions. Since the death of the last holder, the professor-ship of homoeopathy at Munich has been abolished.

Belgium. — In Antwerp there are three homceopathic physicians, and it is the only city in Belgium where there is an official homoeopathic dispensary for the poor. This institution was founded

by the municipality in 1891, and the physicians are paid from the public funds. In 1892 the annual prescriptions numbered 2922 ; in 1899 they had increased to 11,224. In Brussels there are fifteen homoeopathic physicians. In 1897 a homoeopathic polyclinic was founded, which in 1898 issued 7673 prescriptions, and in 1899 the number increased to 9128. In Ghent there are six homoeopathic physicians and a private dispensary. In all the other cities of Belgium there are one or more physicians of the new school, their number being thirty-five. There are two homoeopathic societies in Belgium, and an excellent medical journal.

Austria-Hungary. — Homoeopathy was introduced Into Austria about 1817, and in 1819 its practice was forbidden by law. Shortly afterwards the physician attending the Archduke John became a homoeopath. In 1825 the doctrine was introduced into Vienna. To test the efficacy of the system Francis I. ordered that experiments be made with homcEopathio medicines, and for this purpose a ward furnished with twelve beds was allotted. The results were satisfactory to the new system, and it made gigantic strides in Vienna. During the cholera epidemic of 1836 an increased impetus was given to the new school by the reported brilliant successes of the treat-

ment. Societies were founded and journals published. In 1846 a second hospital was founded. In 1850 a third hospital was opened, and clinical lectures upon the system were delivered. In 1873 the Society of Homoeopathic Physicians was formed. Between the years 1873 and 1893 homoeopathy declined. In 1901, in thirty-seven cities and towns there were to be found about fifty physicians and two hospitals, and it was estimated that about seventy-five more were scattered in Moravia, Bohemia, Tirol, Salzburg, and the coast provinces. 'In Hungary the situation remains about the same as in former years. There is still a professorship of homoeopathy at the University of Budapest, now held by Dr Bakody, and homoeopathic clinics are held at the new Rochus Hospital in tlUoi Street, and also in the homoeopathic department of the Hospital Bethesda of the Reformed Communiiy. The Elizabeth Hospital, exclusively homoeopathic, has existed for many years. There are societies of homoeopathic physicians in successful operation, but on the whole the people appear to be much more indifferent to the system than in Germany, where a great number of societies and laymen interest themselves in homoeopathy, and where homoeo-pathic physicians deliver popular lectures upon their creed. The

members of such societies in case of illness procure homoeopathic remedies from the pharmacies of their respective organizations. There is a homoeopathic hospital of some importance and also a children's hospital flourishing in Vienna. The physicians of the new school number less than a dozen.

Mussia. — The homoeopathic system of medicine was introduced into Russia in 1823. In 1825 great impetus was given to the new doctrine by the conversion of Dr Bigel, physician to the Grand Duke Constantino. In 1829 the grand duke ordered a series of experiments to be conducted to prove the truth or fallacy of homoeopathy, and they demonstrated the success of the new school. In 1841 a hospital was established in Moscow, and inl849 similar institutions were founded in Nijni-Novgorod. In St Petersburg from 1835 to 1845 there were sixteen homceopathic physicians. From ld45 to 1855 there was neither increase nor decrease in the number. From 1855 to 1865 the number had decreased to thirteen. In Moscow about the year 1875 there were thirty physicians practising homoeopathy. In 1901 there were seventeen physicians in St Petersburg, three pharmacies, three dispensaries, and twelve hospitals. Homoeopathy, it is said, continues to gain

credit, penetrating to the remoter corners of the empire, while the number of its followers increases amongst all classes ; but as will be seen by the foregoing figures, the number of homceopathic physicians rather decreases. There are at present 73 doctors who are practising the homoeopathic method : In St Petersburg 17, Moscow 7, Odessa 7, Warsaw 6, Kiew 3, Riga 3, Charkow 2, Vilna 3, Tiflis 3, Dwinsk 2, Jitomir 2, and 1 each in Lodz, Lublin, Tilsit, Viatka, Yalta, Astraohan, Ekaterinoslaw, Goro-disohtche. Gory, Gotopulow, Grodno, Insar, Kamenetz-Podolsk, Kanzeropol, Maikop, Pensa, Rostov, Saratow, Schidlovietz, Simferopol, Taganrog, Trostianetz. The number of medical men not being sufficient to satisfy the demand, in many places apothe-caries and amateurs are acting as -physicians ; indeed, in many portions of Russia, especially in the villages, the followers of homoeopathy are thrown upon thtirown resources. The number of homceopathic pharmacists has increased since 1896 from 17 to 26, i.e., at St Petersburg 5, Moscow2, Warsaw 2, Odessa 2, Charkow 2, Riga 2, Vilna 2, Rostow on Don 1, Novotcherkaosk 1, Taganrog 1, Kiew 1, Berditetew 1, Tiflis 1, Jitomir 1, Taratars 1, Viatka 1. Homceopathic societies are iu more or less successful operation in

the following cities : St Petersburg 3, Odessa 2, Charkow, Warsaw, Kiew, Moscow, Tiflis, Vilna, Stavropol, Jalta, Poltawa, and Thsemigow each 1. Two of the societies in St Petersburg, the " Hahnemann " in Odessa, and those in Warsaw and Charkow, possess pharmacies of their own, yielding fair profits and affording the possibility of increasing their means independently of private charity. There are two homceopathic journals, one of them published at St Petersburg and the other at Charkow. St Petersburg counts five dispensaries and one hospital. In 1881 the civil engineers proposed to commemorate the virtues of the Emperor Alexander II. by the erection of a hospital ; a committee for collecting funds was created, r.nd 58,064 roubles were handed to the Charity Society of the followers of homceopathy at St Petersburg for the erection and founding of a homoeopathic hospital. The foundation stone of the edifice was laid on 19th June 1893, the Emperor Alexander III. giving 5000 roubles. The inauguration of a new dispensary and a pharmacy took place on the 19th of April 1898, and the hospital itself, intended originally for fifty beds, was opened on the 1st of November 1898. There are sixteen free beds, three of them being in the name of the Emperor Nicholas, the Empress Maria Feodorovna,

and the Emperor Alexander III. On the 28th of January 1899 an imperial edict was issued granting the rights of public service to the doctors of the hospital and dispensaries of the Charity Society, thus placing them on an equality with the doctors of the prevailing medical school.

France. — Homoeopathy was first introduced into France in 1830 by Count de Guidi, doctor of medicine, doctor of science, and inspector of the university, who practised in Lyons. About the same year Dr Antoine Petroz, widely known by his Gfrand Dictionnaire des Sciences Medicates, began practising homoeopathy in Paris, and his establishment became the headquarters of the new system there. In 1835 Hahnemann himself came to the capital. In 1832 the homoeopathic method of treating disease was introduced into the Hospice de Choisy, and in 1842 into the hospital of Carentan. Tessier practised the new doctrine in his wards in the Hospital St Marguerite, and in the Children's Hospital up to the year 1862, when he retired. The first homoeopathic society was established in 1832 (the Soci6t6 Gallicain), Hahnemann becoming president in 1835 ; in 1845 the Soci6t6 de MMicine Homgopathique was organized ; and in 1860 the two were united

for the better interests of the school. This society is still in existence. The first public lecture in the new system was given in January 1835, the course being continued annually to 1869, when it was suspended. In 1901 there were at Paris three hospitals— the Hospital St Jacques with fifty-five beds, the Hahnemann Hospital with thirty-five beds, and the new Protestant Hospital for Children with twenty-five beds. The number of patients treated during the year 1900 at the three hospitals united averaged 630. At Lyons there is the Hospital St Luc, which is in a prosperous condition. The free consultations at the numerous dispensaries have remained stationary for the past few years. The medical journals published in French are VArt Medical, La Mevue Homeopathique Beige, Journal Beige d" Homeopathie, La Therapeutique Integrale, La Mevue Homeopathique Frangaise. Important scientific works have appeared on pathology and materia medica and tuberculosis. There are 66 physicians now practising homoeopathy in Paris, and 151 in the provinces, making a total of 207. There are 22 dispensaries scattered through the republic. Pharmacies are numerous in all the larger cities and towns. In the year 1900 the medical officers of the republic

having supervision over the medical department of the International Exhibition officially recognized the members of the homceopathic school, and arranged for the proper accommodation and reception of the International Congress of Homoeopathic Physicians held in June. On the 30th of that month, with appropriate ceremonies, the remains of Hahnemann were removed from the cemetery of Montmartre and deposited in P6re-la-Chaise, and a monument bearing a suitable inscription was erected to the memory of the founder of homceopathy.

Italy.— The Austrians when they entered Naples in 1821 brought homceopathy into Italy, the general in command of the army being a devoted friend of Hahnemann. In 1828 Dr Count Sebastian de Guidi came from Lyons and assisted in spreading the doctrine. During the period from 1830 to 1860 many physicians practised homceopathy, and the literature on the subject became extensive. A homceopathic clinic was established and a ward opened in Trinity Hospital at Naples, and a homoeopathic physician was appointed to the Count of Syracuse. During the severe cholera epidemics of 1854, 1855, 1865, the success of homoeopathic treatment of that disease was so marked under the care of Dr

Rubini that the attention of the authorities was directed to the

system. In 1860 the homcBopathic practice was introduced into the Spedale della Cesarea, and since that period homoeopathy has been recognized with more or less favour in most of the cities. In the villages and smaller towns it is practically unknown, as indeed is all advanced medical therapeutics. At the present time the Italian Homoeopathic Institute is recognized by royal warrant as an established institution, and its regulations are approved by the Government. It is composed of about iifty members, the greater part of whom are physicians and the remainder laymen, representing the majority of those following homoeopathy in Italy. In Turin, the legal seat of the Homoeopathic Institute, there is a hospital under the management of the State Association. A ,bequest of 150,000 francs has been made to the town of Verona for the establishment of ten charity beds in the general hospital for special homoeopathic treatment, and Genoa also has obtained 20,000 francs as the nucleus of a fund for a similsir purpose. Free dispensaries are now in operation in Rome, Florence, Naples, Milan, and Turin. The

Academy of Medicine at Palermo provides a good dispensary for the care of the sick. The number of physicians who practise homoeopathy has not increased for some years, but the former opposition and ridicule of the old-school physicians have entirely ceased. Apart from the allo-homoeopathic pharmacies, which generally do not inspire great confidence, there are homoeopathic pharmacies in Rome (1), Naples (4), Palermo (1), and Florence, Milan, and Turin (each 1). In Rome there are 5 practitioners; Naples, 12 ; Turin, 6 ; Milan, 3 ; Bologna, 1 ; Palermo, 3 ; Messina, 1 ; Florence, 1 ; Bavagua, 2 ; Casale, 1 ; Laloggia, Bellante, Noto, Melitello, Vittoria, Senorbi (Sardinia), each 1. The homoeopathic medical press consists of the Eevista Omiopatica, established in 1855, and i' Omiopatico in Italia, which is the organ of the Italian Homoeopathic Institute, and first appeared in 1884. At Turin there is a small hospital with ten beds tmder the direction of homoeopathic physicians.

Spain. — Homoeopathy was introduced into Spain in 1829 by a physician to the Royal Commission sent by the king of Naples to attend the luarriage of Maria Christina with Don Ferdinand VII. Shortly after this, a merchant of Cadiz visited Hahnemann in

Coethen, and was cured of a serious disorder ; he returned to Spain with a supply of homoeopathic literature, and immediately sent a medical student to Leipzig to study the new system. In 1843 many cases of cholera were treated homoeopathically in Madrid. The civil war, which did not terminate until 1840, arrested all medical investigation in Spain, but in 1843 there still existed in Madrid five pharmacies and a number of homoeopathic physicians. About this time Dr Tosi Nuflez returned from an investigation of the new system with Hahnemann, and owing to his success in the treatment of disease was created one of the physicians of the bedchamber to the queen, who soon afterwards conferred upon him the title of marquis, with the grand crosses of the Charles in. and of the Civil Order of Beneficiencia. This recognition by high authority gave an impetus to homoeopathy which has continued ever since. In Barcelona to-day there are no fewer than 44 homoeopathic physi-cians and 3 pharmacies. The public institutions are the Academia Homoeopatica, the Clinica Homoeopatica, and the Dispensario Homoeopatica, the last being under the supervision of the Academy. There are 3 veterinary surgeons in the city. In Madrid there are 10 physicians of the new school, 3 homoeopathic chemists, and 2

homoeopathic hospitals. In Valencia there are 7 physicians who practise the system. In Seville the Institut del Dessert is exclusively homoeopathic, while there are between 60 and 70 physicians scattered throughout the provinces. In the Balearic Islands a journal devoted to the interests of the school was published, and in the Antilles the system is known and practised.

Denmark. — Homoeopathy was unknown in Denmark until the year 1821, when Hans Christian Lund, a medical practitioner, adopted it. Hahnemann, however, had been both before and after that time consulted by Danes, and consequently homoeopathic therapeutics was recognized in different parts of the country. Lund translated many of Hahnemann's works into Danish, as well as those of other eminent members of the new school. The spread of the system, however, has been very slow, and in many portions of the country it is unheard of. There are 8 homoaopathic physicians in Denmark, 5 being in Copenhagen, 1 in Aarhus (in Jutland), 1 in Vester Broenderslev (.Jutland), and 1 on the island of Bornholm. There is at present no hospital wherein homoeopathy is practised, but £15,000 has already been subscribed for the purpose of erecting one, which will be built when the fund reaches

£20,000 or £25,000. There is no special homoeopathic pharmacy in Copenhagen, as all the chemists dispense homoaopathic medicines. There are two homoeopathic veterinary surgeons in Copenhagen.

Holland. — In Holland homoeopathy makes but little progress, but there are now In every large town at least one homcsopathic practitioner and several dispensaries. One homoeopathic newspaper is published at Rotterdam. Amsterdam, Alfen, Apeldoorn, Haarlem, Nimeguen, Utrecht, Zaandam, and Zwolle have each a homoeopathic physician. At The Hague there are two, and at Rotterdam two. At Utrecht the Society for the Propagation of Homoeopathy in the Netherlands is in a flourishing condition.

Sweden and Norway.— In Sweden and Norway but little is known of the new system at present. It was introduced into Sweden in 1826. In 1855 an attempt was made to open a homoeopathic polyclinic in Stockholm, which was unsuccessful. In 1865 an American physician settled in NorrkSping and expounded Hahnemann's doctrine, and in 1868, after considerable opposition, a polyclinic was opened at Stockholm, but it was -not of long continuance.

Sioitzerland can boast of but few physicians espousing the doc-trine of Hahnemann. In the late 'fifties it excited some attention, and polemic articles were published in 1864 and 1865 to defend it from attacks by the professors of the university at Bern. A society was also established in the latter city, and a second in Aarau for the promulgation of homoeopathy. A work on materia medioa was issued in 1866, and in 1868 a journal devoted to the interests of the new system was issued. Since that period the system has seemed to stagnate. In Basel there is a small homeo-pathic hospital containing twelve beds. According to the latest information, the physicians of the new school are distributed as follows : — Aarau, 1 ; Basel, 4 ; Bonne, 4 ; Biel, 1 ; Geneva, 2 ; Grundelwald, 1 ; Mouthey, 1; Mithlenen (Bernese Oberland), 4; St Gallen, 1 ; Hun, 1 ; Zurich, 3.

South America. — In South America the system of Hahnemann is best known in Brazil, although there are homo3opathic physicians scattered throughout the different states. It was introduced in 1818, and for a long time had a precarious existence. The Homoeo-pathic Institute of Brazil was founded in 1842, with 56 members ; and soon afterwards a special school for homoeopathic instruction

was opened, with a scheduled course of lectures. In 1847 dissen-
sion among the professors of homoeopathy divided the old society,
and a new organization was formed by the seoeders, called the
Academia Medico Homoeopatha, but the record reads, ‘ ‘ like nearly
all the other institutions and societies in Brazil, it died of the
chronic maladies of selfishness and envy.” Bahia and Rio de
Janeiro have witnessed many struggles in their efforts to place
homoeopathy on a sound footing in South America. Among the
periodicals published representing the new school methods were the
Sciencia and the Hahnemannesta, in d846 ; the Homxopatha, in
1850 ; the Medico Populao, in 1851 ; and the Athleta, in 1852. In
1873 cholera raged in Rio, and the Government organized tem-
porary infirmaries for the treatment of the disease. Some of these
were placed under homoeopathic supervision, and their work was
fairly commendable. Of late years there has been little extension
of the homoeopathic principle in South America. There are at
present homoeopathic physicians in Amazonas, Pard-Belem, Mar-
anhao, Pernambuoo, Bahia, Rio de Janeiro (Campos) , Maje, Marica,
Sao Joao da Barra Nictheroy , Rio de Janeiro (capital) , Sao Paulo,
Campinas, Sao Paulo-Capital, Rio-Claro Tatuhij, Santos, Santa

Catharina, Sao-Pedro, Pelotas, Porto Alegre, Rio Grande, and San Gabriel.

West Indies. — In Barbados there are five homoeopathic physicians, an oculist, and an aurist.

Cuba. — Homoeopathy was brought into Havana in 1842. In 1856 there was a weekly journal published in that city and also one in Santiago. In 1876 there were sixteen homoeopathic physicians practising in Havana. There were also a Casa de Salud, or private hospital, where the system was practised, and one special homoeo-pathic pharmacy. Homoeopathy has declined in Cuba. In 1901 there were only four homoeopathic physicians in Havana.

India. — Homoeopathy is practised in Calcutta, and has a moderate clientele. In that city alone are thirty homoeopathic physicians and seven chemists. There are two journals published in the in-terests of the school, one the Indian Seview, the other the Calcutta Journal of Medicine. A school of homoeopathy and a hospital are in full operation. The Maitra Homceopathic Dispensary is doing serviceable work. Books have been published on the treatment of cholera, on the therapeutics of the plague, besides several homoeo-pathic works in the Bengali language. There ai-e homoeopathic

physicians in a few of the large towns, and a number of native-born Indians have at different times been sent to the homoeopathic colleges in the United States to obtain medical degrees.

China. — There are two homoeopathic physicians at Ningpo, where there is also a hospital and medical school, but it is impossible to obtain accurate information on the status of homoeopathy in the various sections of the vast Chinese empire.

Cape Colony. — In Cape Town there are three physicians practising homoeopathy, and in Kimberley one. (y?, i. H.)

Honduras, a country of Central America, lying between 1,3° 10' and 16° 2' K., and 83° 20' and 89° 30' W. Here, as in other Central American states, there are but two seasons, the wet, from May to

November, and the dry, from November to May. On the moist lowlands of the Atlantic coast the heat is oppressive, but on the highlands of the interior the climate is delightful. At Tegucigalpa, on the uplands, a year's observations showed the maximum temperature to be 90°

F. in May, and the minimum to be 60° F. in December, the range of variation during the whole year being within 40° F. The area is estimated at 46,250 square mUes, and the population in 1900 was 587,600. The population of each of the fifteen departments was as follows in 1895 : Tegucigalpa, 58,984; El Paraiso, 31,246; Choluteca, 33,665; Valle, 24,133; La Paz, 20,616; Comayagua, 21,713; Yoro, 16,424; Cortez, 13,665; Santa Barbara, 26,008; Cop^n, 44,798 ; Gracias, 35,633 ; Intibuc^, 18,967 ; Olancho, 35,737 ; CoWn, 13,409; Bay Islands, 3990. The number of foreigners within the Republic was put at 6021. The European element in the population is small, the mass of the inhabitants being of Indian and mixed blood. The chief towns, with their populations in 1895, are: Tegucigalpa, the capital, 18,000; Juticalpa, 8000; Choluteca, Nacaome, and Santa Eosa, 7000 each ; Gracias, 6000; Yoro, Yuscaran, and Comayagua, 5000 each; Truxillo, 3000.

The constitution, as amended in 1880, provides for a Legislative Chamber, consisting of deputies chosen for

four years by direct popular vote. The number of deputies should be in the proportion of one for every 10,000 inhabitants, but, pending the formation of electoral districts, each department returns three, except the Islands, which return one. The President of the Eepublic is chosen for four years by direct popular vote, but failing an absolute majority, the Legislative Chamber chooses one of the three that received most votes. The President is eligible for a second, but not for a third consecutive term. The members of the cabinet are appointed by the President ; they may take part in the discussions of the Chamber, but have no vote. The governors of the fifteen departments are appointed by the President.

Justice. — Justice is administered by a supreme court of five judges at Tegucigalpa, four appeal courts, courts in the departmental capitals, and subordinate local tribunals.

Meligion and Instruction. — Though the prevailing faith is Roman Catholic, all forms of religion are free, and the State does not contribute to the support of any.

Primary instruction is obligatory, gratuitous, and secular. In

1898-99 there were within the Republic 627 primary schools, with 29,690 pupils. For secondary instruction there are 23 schools, with in all 718 pupils, and for manual and technical instruction there is a school directed by European masters at Tegucigalpa. In the capital there is also a central university, with faculties of law, medicine, science, and political science ; at Comayagua there is a second faculty of law. In the year 1898-99 the sum of 110,060 pesos (£10,560) was devoted to instruction.

Defence. — Military service is obligatory from the twentieth to the thirtieth year of age in the active army ; from the thirtieth to the fortieth in the reserve. The total force in 1898 amounted to 36,686 men. The Republic possesses two small steam revenue cutters.

Finance. — Of the revenue, 42 per cent, is derived from customs, and 34 per cent, from spirit and gunpowder monopolies, while war, finance, and public works demand the largest share of the expenditure. The revenue and expenditure for the years ending 30th June 1895, 1897, and 1899 were as follows (conversion being made at the rate of 23d. to the peso) : —

1895.

1897.

1899.

Revenue .

Expenditure

£208,584

120,185

£229,296

330,426

£225,720

228,340

For the year 1900-01 (at the same conversion rate) the revenue was estimated at £232,610 and the expenditure at £232,015.

The existing external debt was contracted by a conversion loan in 1867, and three railway loans, 1867, 1869, and 1870, the total outstanding principal amounting in 1900 to £5,398,570. No interest has been paid since 1872, and the principal and arrears of interest together in 1900 amounted to £18,298,268. The official statement respecting the public debt on 31st July 1899 put its amount at 1,800,812 pesos, or £172,880, the entire external debt being simply ignored.

Production. — ^Bananas are the principal agricultural produce of

Honduras. This fruit is easily, cheaply, and quickly grown, and its cultivation is steadily extending on the northern coast. Coffee is also grown, but as the bushes require some time to come to maturity, and the market prices of the product have for some years been low, coffee-planting does not extend. The high prices obtained for rubber have aroused interest. Tobacco of fine quality is grown, but in such small quantities that there is none for export. Other products are cocoa-nuts, furniture wood, and sarsaparilla. The cattle industry is usually prosperous, large numbers of living animals and of hides being exported. Gold and silver mining are carried on successfully, but the annual output is not on the increase. Of local industries, the manufacture of straw hats is the most conspicuous.

Commerce. — The imports consist mostly of articles of common use or consumption — cotton goods, hardware, flour, provisions, with agricultural implements and mining machinery ; while the exports consist of agricultural and mineral products. In 1898 the tdtal imports amounted to the value of £273,080 ; in 1899, to £280,804. In 1898 the exports were valued at £257,572 ; in 1899, at £231,014. The exports in 1899 comprised bananas, £89,068 ; coffee, £10,644 ;

coooanuts, £13,181 ; cedar and mahogany, £8652; cattle, £26,136; mineral products, £67,696. The exports of gold in the year 1897-98 amounted to the value of £2780 ; in 1898-99, £2310 ; of bar silver in 1897-98, £92,860 ; in 1898-99, £55,466. The trade is mostly with the United States, which in 1899 sent 73 per cent, of the imports and took 83 per cent, of the exports. Germany sent 12 per cent, of the imports and Great Britain 8 per cent. In 1900 the British exports to Honduras amounted to £52,205, and the imports into the United Kingdom from Honduras to £2967.

Communications. — Means of communication are very defective. The only railway in the country is that from Puerto Cortez to La Pimienta, a distance of about 68 miles. This is a section of the proposed inter-oceanic railway for which the external debt of the Republic was incurred. For the completion of the line concessions, one after another, were granted, and expired, or were revoked. The contract now in force (ratified 26th May 1900) grants a twenty-five years' lease of the already constructed line at an annual rent of 15,000 pesos gold (£3000) to an American syndicate, which undertook to complete the railway to the Pacific within seven years. Other railways, including one along the Atlantic coast, are

projected. The capital is connected with other towns by fairly well-made roads, which, however, are not kept in good repair. To Tegucigalpa from San Lorenzo the journey takes about three days, and from San Pedro Sula about seven days. Other roads have been contracted for, but at present in the country generally all travelling and transport are by mules and ox-carts over roads which defy description.

Honduras joined the Postal Union in 1879. In the year 1898 there were 241 post offices, and 1,106,034 pieces were handled.

The telegraph lines, which are Government property, had in 1899 a length of 3186 miles, and were served by 155 telegraph offices, through which 538,941 messages passed in the course of the year.

Money and Credit. — ^There is at present only one bank, the Banco de Honduras at Tegucigalpa. It has the privilege of issuing biUs, which are legal tender for all duties, taxes, and debts due to the Government ; but there is no paper currency. The monetary unit is the silver peso, weighing 25 grammes, -900 fine, and worth about 22d.

The metric system of weights and measures was introduced by law 1st April 1897, but the old Spanish system continues in general

use.

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(w. w. E.)

Honduras, British, a British colony in Central America, on the eastern side of the base of the peninsula

of Yucatan, with an area, including owtlying cays, of

7562 square miles, lying between 18° 29' and 15° 64' N., and 89° 10' and 87° 50' W. It consists of a low-lying coast-line, intersected by rivers and lagoons, and fringed by cays, rising to higher ground in the interior, the Cockscomb mountains reaching a height of 4000 feet. The characteristic soils of the colony are known as Gaboon ridge (the vegetable alluvium along the river valleys), the Pine ridge (sandy tracts covered with pines, scrub, and wire grass), and Broken ridge (intermediate between these two). Besides these, there are swamp, savannah, and mountain. The Pine and Cahoon ridges afford abundant pasturages for cattle. Of the land in the colony, 50,000 acres are returned as cultivated and 4,573,-870 as uncultivated. About 3,102,843 acres of land are in private ownership, and 1,736,565 remain ungranted — the latter area including lagoons, &c. Population (1900), 36,998 ; death-rate per thousand, 24-055. The population

consists of (1) native Indians, to be found chiefly in for-
est villages in the west and north of the colony away
from the sea-coast ; (2) descendants of the English buc-
caneers, mixed with Scottish and German traders ; (3)
the wood-cutting class known as " Belize Creoles," of
more or less pure descent from African negroes imported,
as slaves\or as labourers, from the West Indies ; (4) the
Caribs of the southern districts, descendants of the
population deported in 1796 from St Vincent, who were
of mixed African and Carib origin; (5) a mixed popular
tion in the south, of Spanish-Indian origin, from Guate-
mala and Honduras ; and (6) in the north another
Spanish-Indian group which came from Yucatan in 1848.
The mean maximum summer temperature is 90°. The
maximum in 1900 was 94-8 (in May) and the minimum
51-8 (in February). The rainiest months are generally
those from June to November. The average annual rain-
fall at Belize is about 80 inches. The value of the imports
in 1900 was £239,754, and of the exports £260,113.
The following are the principal articles of export, and

their values in that year : mahogany, £87,717 ; logwood, £86,507; bananas, £18,221; cocoa-nuts, £5209; cedar, £3943 ; plantains, £3599.

Belize, the capital, at the mouth of the river of the same name, with a good roadstead for ships, is situated in 17° 29' K and 88° 8' W.

The colony has fine soil, adapted to many kinds of tropical products, but most of it is covered by primeval forest or bush. There are no good roads, but there is excellent river and sea-coast communication. No minerals exist in sufficient quantities to justify mining, and an attempt made to develop a sponge industiy was abandoned. The chief industry (now 200 years old) is the catting of mahogany and logwood ; other woods are cedar, rosewood, bullet-tree, fustic, lignum vitas, santa maria, ironwood, &c. After timber, the principal products are bananas (exported to the United States), sugar, and rum (for home consumption only), Indian corn, cocoa-nuts, plantains, and cacao. The revenue in 1900 was £57,-945 (of which £34,050 came from customs), and the expenditure was £49,240. The public debt was £33,763. The standard of currency is the gold dollar of the United States, British gold being

legal tender. Subsidiary silver and bronze currency is coined specially for the colony, and there is a Government note issue. The tonnage of vessels (nearly all British, American, or Norwegian) entered during 1900 was 170,917 (sailing 24,371, steam 146,-546), and cleared 169,180 (sailing 22,919, steam 146,261). The churches represented are Roman Catholic, Anglican, Wesleyan, Baptist, and Presbyterian; but none of them receives assistance from public funds. The bishopric of British Honduras is part of the West Indian Province of the Church of England. School-fees are charged at and grants-in-aid are made to elementary schools, which since 1804 have been under the control of a board, on which the religious bodies managing the schools are i-epresented. In 1900 there were 38 schools, with 3391 children on the books and 2383 in average daily attendance. There are two police forces, the British Honduras constabulary consisting of 50 ofBcers and men (of whom 18 are mounted), all stationed in the northern district ; and the British Honduras police (an unmounted force) distributed in the other districts, consisting of 75 officers and men. There is a volunteer force (the Belize Light Infantry Corps) of 177 officers and men, and a volunteer fire brigade of 335 officers and men. There are

no railways or telegraphs ; in 1900 the revenue from the post office was £2211, and the number of mail pieces 254,451; the money order system is in force. In 1884 letters patent were proclaimed constituting the office of governor and commander-in-chief of British Honduras, which rendered the colony independent of Jamaica, to which it had been attached since its development from a settlement into a colony in 1862. The Legislative Council consists of the governor, with three official and five unofficial members nominated by the Crown. The Executive Council consists of the governor and five members (three ea; officio and two nominated). The English common law extends to the colony, subject to modification by local ordinances. (p. cu.)

Honfleur, French town, in the arrondissement of Pont' l'^v§que, department of Calvados, north-east of Caen, with terminal station on railway 124 miles from Paris. The port comprises the tidal harbour, floating basin of the west, basin of the centre, basin of the east, and fourth basin. The depth of water, ordinary spring tide, on the bar of the tidal harbour is 21 feet, and on the sill of the three first-named basins, respectively, 16-7, 20,

and 22 feet. The total length of quayage is 10,915 feet. There entered in 1899 348 vessels of 146,646 tons (from England 260, of 76,097 tons), and cleared 352, of 150,993 tons ; besides which there entered, in connexion with the coasting trade, 357 vessels of 16,724 tons, and cleared 354, of 16,730 tons. Population (1881), 9012; (1901), 9610.

Hong-Kong, an important trading centre and military and naval position, belonging to Great Britain, situated on the south side of the Chinese province of Kwang-Tung. It is separated from the mainland by a narrow pass of about a quarter of a mile. A good military road, about 22 miles long, encircles the island. Hong-Kong or Victoria harbour constantly presents an animated appearance, as many as 240 guns having been fired as salutes in a single day. Its approaches are strongly fortified. The steaming distance from Singapore is 1520 miles. Victoria, the capital, often spoken of as Hong-Kong (population over 166,000, of whom about 6000 are European or American), stretches for about 4 miles along the

north coast. Its breadth varies from half a mile in the central portions to 200 or 300 yards in the eastern and western portions. The town is built in three layers. The " Praya " or esplanade, 50 feet wide, is given up to shipping. Under the Praya reclamation scheme the land frontage will be extended by 250 feet and a depth of 20 feet secured at all states of the tide. A further extension of the naval dockyard was begun in 1902, and a new commercial pier was opened in 1900. The main commercial street runs inland parallel with the Praya. Beyond the commercial portion, on each side, lie the Chinese quarters, wherein there is a closely packed population. In 1888, 1600 people were living in the space of a single acre, and over 100,000 were believed to be living within an area not exceeding half a mile ; and the overcrowding does not tend to diminish, for in one district, in 1900, it was estimated that there were at the rate of 640,000 persons on the square mile. The average, however, for the whole of the city is 126 per acre, or 80,640 per square mile. The second stratum of the town lies

ten minutes' climb up the side of the island. Government House and other public buildings are in this quarter. There abound " beautifully laid out gardens, public and private, and solidly constructed roads, some of them bordered with bamboos and other delicately-fronded trees, and fringed with the luxuriant growth of semi-tropical vegetation." Finally, the third layer, known as "the Peak," and reached by a cable tramway, is dotted over with private houses and bungalows, the summer health resort of those who can afford them ; here a new residence for the governor was begun in 1900. Excellent water is supplied to the town from the Pokfolun and Tytam

reservoirs, the former containing 68 million gallons, the latter 390 millions.

Climate. — The temperature has a yearly range of from 45° to 99°, but it ocoasionally falls below 40°, and ice occurs on the Peak. In January 1893 ice was found at sea-level. The wet season begins in May, after showers in March and April, and continues until the

beginning of August. During this period rain falls almost without intermission. The rainfall varies greatly, but the mean is about 90 inches. In 1898 only 57-025 inches fell, while in 1897 there were 100-03 inches; in 1899, 72-7 inches, and in 1900, 73-7 inches. The damp is extremely penetrating. During the dry season the climate is healthy, but dysentery and intermittent fever are not uncommon. Bilious remittent fever occurs in the summer months, and smallpox prevails from November to March. The death-rate for 1899 was 23-8 per thousand, but the average was raised by an outbreak of plague, which caused 1428 deaths, and in 1900 it was 23-9 ; the birth-rate in the same years being 4-3 and 3-3 per thousand respectively.

Population, &e. — The following table shows the increase of population ; —

Tear.'

Eur. and

Amer. Civil.

Chinese Civil.

Total (inc. Mil. and

Naval Establish-

ments and

Indians, &o.).

1881

1891

1897

3040

4195

5532

148,850

208,383

233,280

160,402

221,441

246,880

The floating population' was in 1897 given as 31,752, a slight reduction since 1891. In 1901 the population, including 13,237 on the military and naval establishment, amounted to 297,212. This is exclusive of 100,000, all Chinese, in the new territory. There were, in 1900, 104 schools open (13 Government and 91 grant-in-aid), with an avex-age attendance of about 6000 scholars.

The Queen's College provides secondary education for about 135 boys. There are several hospitals, one of which is a Government institution. There were in 1899 over 3000 accounts in the Hong-Kong Savings Bank, with deposits amounting to about $1,100,000. The total strength of the police force in 1899 was 827 (114 European, 350 Indian Sikhs, and 221 Chinese). In 1899 the strength of the military garrison was 3226.

Industries. — Beyond the cultivation of vegetable gardens there is practically no agricultural industry in the colony. But although only 400 acres are cultivated on Hong-Kong island, and the same number of acres in Kowloon, there are 90,000 acres under cultivation in the new territory, of which over 7000 acres were in 1900 planted with sugar-cane. Granite quarries are worked. The chief industries are sugar-refining, the manufacture of cement, paper, bamboo and rattan ware, carving in wood and ivory, working in copper and iron, gold-beating and the production of gold, silver, and sandal-wood ware, furniture-making, umbrella- and jinricksha-making, and Industries connected with kerosene oil and matches. The manufacture of cotton has been introduced, and 12,000 spindles are already at work. Ship- and boat-building, together

with subsidiary industries, such as rope- and sail-making, appear less subject to periods of depression than other Industries.

Trade. — Hong-Kong being a free port, there are no ofiScial figures as to the amount of trade ; but the value of the exports and imports is estimated as about £50,000,000 in the year. Among the principal goods dealt with are tea, silk, opium, sugar, flax, salt, earthenware, oil, amber, cotton and cotton goods, sandal-wood, ivory, betel, vegetables, live stock, and granite. The following are the figures of ships cleared and entered : —

Year.

Tonnage.

British.

1880

1890

1898

1899

1900

8,359,994

13,676,293

17,265,780

18,101,309

18,445,133

3,758,160

6,994,919

8,705,648

8,665,828

9,155,198

The Chinese junks rank next to British ships in the amount of trade. In 1899, 77,722 of these represented a tonnage of 4,664,162, and in 1900 their tonnage was 3,500,128. German and Japanese ships followed next, the former with 1,917,744 tons in 1900.

Finance. — The revenue and expenditure are given below : —

Tear.

Revenue.

Expenditure.

1880

$1,069,948

$948,014

1890

1,995,220

1,915,350

1898

2,918,159

2,841,805

1899

3,610,143

3,162,792

1900

4,202,587

3,628,447

The main sources of revenue are licences, rent of government property, the post-ofBoe, and land sales. The light dues were reduced in 1898 from 2\ cents to 1 cent per ton. There is a public debt of about £340,000, borrowed for public works, which is being paid off by a sinking fund. The only legal tender is the Mexican dollar, and the British and Hong-Kong dollar, or other silver dollars of equivalent value duly authorized by the governor. There are small silver and copper coins, which are legal tenders for amounts not exceeding two dollars and one dollar respectively. There is also a large paper currency in the form of notes issued by the

Chartered Bank of India, Australia, and China, the Hong-Kong and Shanghai Banking Corporation, and the National Bank of China, Limited. The foundation of new law courts was laid in 1900.

Administration. — Hong-Kong is a Crown colony, administered by a governor, executive council, and legislative council. The executive council consists of the holders of certain offices and of such other members as the Crown may nominate. In 1890 there were nine members. The legislative council consists of the same officials and of six unofficial members. Of these three are appointed by the governor (of whom one must be, and two at present are, members of the Chinese community) ; one is elected from the chamber of commerce, and one from the justices of the peace.

Under the Peking Treaty of 1860 the peninsula of Kowloon (about 5 miles in area) was added to Hong-Kong. The population is about 27,000. There are several docks and warehouses, and manufactures are being developed. Granite is quarried in the peninsula.

Neio Territory. — An agreement -was entered into in 1898 whereby China leased to Great Britain for ninety-nine years the territory behind Kowloon peninsula up to

a line drawn from Mirs Bay to Deep Bay, and the adjoining islands, including Lantao. The new district, which extends to 376 square miles in area, is mountainous, with extensive cultivated valleys of great fertility, and the coast-line is deeply indented by bays. The alluvial soil of the valleys yields two crops of rice in the year. Sugar-cane, indigo, hemp, peanuts, potatoes of different varieties, yam, taro, beans, sesamum, pumpkins, and vegetables of all kinds are also grown. The mineral resources are as yet unknown. The population was estimated at about 100,000 in 1899. It consists of Puntis (or Cantonese), Hakkas (" strangers "), and Tankas. The Puntis are agricultural and inhabit the valleys, but they make excellent traders. The Hakkas are a hardy and frugal race, belonging mainly to the hill districts. The Tankas are the boat people or floating population. In the government of the new territory the existing organization is being as far as possible utilized.

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Sea Directory, vol. iii., 3rd edition. 1894. — Henry Nokman. The Peoples and Politics of the Far Fast. London, 1895. — Sir E. Hektslet. Treaties between Great Britain and China and China and Foreign Powers. London, 1896. — A. R. Colquhoun. China in Transformation. London, 1898. Treaty Series, No. 16. 1898. — The Chronicle and Directory for China, Japan, &c. Hong-Kong, 1899. — Colonial Possessions Report, No. 84; and other Colonial Annual Beports. (h. e. eg.)

Honiton, a municipal borough, market-town, and railway station, in the Honiton parliamentary division of Devonshire, England, 16 miles east-north-east of Exeter. The old church has been restored. An attempt has been made to revive the lace industry, in which only about 250 women and children are now engaged, as compared -with some 2000 employed in 1880. , There is an important trade in butter. Area, 3134 acres. Population (1881), 3358; (1901), 3271.

Honolulu, the capital of the Hawaiian Islands, situated on the south-eastern coast of Oahu, at the mouth of the valley of Nuuanu, which runs back 6 miles to the

famous pass in the Koolau range of mountains known as the "Pali." It has a small but safe harbour, and its central position at the "Cross-roads of the Pacific" makes it an important port of call. It is connected by lines of steamers with San Francisco, Vancouver; Japan, Manila, and the Australian states, and by lines

of sailing vessels with Hamburg, Bremen, and Liverpool, as well as with Boston, New York, and other American ports. In the year 1899 its exports were valued at $16,369,664, and its imports at $16,709,634, so that the total foreign commerce of this port amounted to 132,079,198. In 1900 the population was 39,306, in-cluding some 10,000 Hawaiians, upwards of 16,000 Asiatics, nearly or quite 5000 Portuguese, and 8000 other whites. The taxable property of the city is assessed at twenty-four million dollars, but its actual value is probably 50 per cent, greater than this. There are five banks, several hotels, two theatres, and many substantial

buildings of brick and stone in the business quarter. The public buildings would do credit to any civilized country. It possesses a well-equipped paid fire department, public water-works, and both public and private electric light works. There are also a telephone system with 1200 subscribers, and a system of street tramcars. The city contains fifteen churches, the services in which are conducted in five different languages. It also maintains several hospitals, a maternity home, the Lunalilo Home for aged Hawaiians, and an asylum for the insane. It is the chief educational centre of the islands, having more than sixty schools, public and private, attended by 6000 pupils of all nationalities. The admirable Bishop Museum of Polynesian ethnology and the Honolulu Public Library of 14,000 volumes deserve special mention. The city also boasts a flourishing Art League, which exhibits twice a year, and a long list of benevolent, literary, social, and political societies. Numerous publications are issued daily, weekly, and monthly in five different languages. Honolulu combines the conveniences of a progressive

American city with the charms of a mild and equitable climate and a tropical flora.

(w. D. A.)

Hood of Avalon, Arthur William Acland Hood, Baron (1824-1901), English admiral, born on 14th July 1824, was the younger son of Sir Alexander Hood of St Andries, Somerset, 2nd baronet, and grand-son of Captain Alexander Hood, E.N., who, when in command of the Mars, fell in action with the French 74-gun ship Hercule, 21st April 1798. At the age of twelve Hood entered the navy, and whilst still a boy saw active service on the north coast of Spain, and afterwards on the coast of Syria. After passing through the established course of gunnery on board the Excellent in 1844-45, he went out to the Cape of Good Hope as gunnery mate of the President, the flag-ship of Rear- Admiral Dacres, by whom, on 9th January 1846, he was promoted to be lieutenant. As gunnery lieutenant he continued in the President till 1849 ; and in the following year he was appointed to the Aretliusa frigate, then commissioned for the Medi-

terranean by Captain Symonds, afterwards the well-known admiral of the fleet. The outbreak of the Russian war made the commission a very long one; and on 27th November 1854 Hood was promoted to be commander in recognition of his service with the naval brigade before Sebastopol. In 1855 he married Fanny Henrietta, daughter of Sir C. F. Maclean. In 1856 he commissioned the Acorn brig for the China station, and arrived in time to take part in the destruction of the junks in Fatshan creek on 1st June 1857, and in the capture of Canton in the following December, for which, in February 1858, he received a post-captain's commission. From 1862 to 1866 he commanded the Pylades on the North American station, and was then appointed to the command of the Excellent and the government of the Eoyal Naval College at Ports-mouth. This was essentially a gunnery appointment, and on the expiration of three years Hood was made Director of Naval Ordnance. He was thoroughly acquainted with the routine work of the office and the established armar ment of the navy, but he had not the power of adapting

himself to the changes which were being called for, and still less of initiating them ; so that during his period of office the armament of the ships remained sadly behind the general advance. In June 1874 he was appointed to the command of the Monarch in the Channel Fleet, from which he was relieved in March 1876 by his promotion to flag rank. From 1877 to 1879 he was a junior lord of the Admiralty, and from 1880 to 1882 he commanded the Channel Fleet, becoming vice-admiral on 23rd July 1880. In June 1885 he was appointed first sea lord of the Admiralty. The intense conservatism of his character, however, and his antagonistic attitude towards every change, regardless of whether it was necessary or not, had much to do with the alarming state of the navy towards 1889. In that year, on attaining the age of sixty-five, he was placed on the retired list and resigned his post at the Admiralty. After two years of continued ill-health, he died on 15th November 1901, and was buried at Butleigh on the 23rd. He had been promoted to the rank of admiral on 18th January 1886; was made

K.C.B. in December 1885; G.C.B. in September 1889; and in February 1892 was raised to the peerage as Lord Hood of Avalon, but on his death the title became extinct. (j. k. l.)

Hood, John Bell (1831-1879), American soldier, was born in Owingsville, Bath county, Kentucky, on 1st June 1831, and graduated at the U.S. Military Academy in 1853. Transferred to the cavalry service in 1856, he fought the Indians, and while first lieutenant was (1859-60) cavalry instructor at West Point. In 1861 he resigned to enter the Confederate service, and was rapidly promoted from colonel to lieutenant-general, serving throughout the Virginia campaigns of 1862 and 1863. He was severely wounded at Gaines's Mills and Gettysburg. With a great reputation for fighting, he was next sent to Tennessee to reinforce General Braxton Bragg, and at the battle of Chickamauga, September 1863, he lost a leg. Six months later he returned to duty undaunted, and in the spring of 1864 led a corps under General Joseph E. Johnston, whom he was selected to succeed when that prudent officer was

relieved by President Jefferson Davis. General Sherman compelled his retreat from Atlanta, after several days of stubborn fighting ; and when Sherman's march to the sea followed, Hood undertook a counter-movement into Tennessee. On the 30th of November Hood was repulsed with heavy loss at Franklin, but still pushing on, he was disastrously defeated by General George H. Thomas at Nashville on 16th December, and relieved of command. Hood was a bold and valiant officer, but too rash and wasteful of strength to command discreetly at this declining stage of the Confederacy. After the war he engaged in business in New Orleans, where he died of yellow fever on 30th August 1879.

Hoogeveen {i.e., high fen or moor), a village and commune in the Dutch province of Drenthe, 12 miles north-east of Meppel. Among numerous other colonies for the culture of the moorlands of Holland, one was established here in 1772. The industries include factories for the cutting of peat by machinery. The supply of peat is, however, becoming exhausted, and the population

(11,924) is beginning to decline.

Hooghly, or Hugli, a town and district of British India, in the Burdwan division of Bengal, taking their name from the river. The town, situated on the right bank of the Hooghly, 24 miles above Calcutta by rail, forms one municipality with Chinsura, the old Dutch settlement, lower down the river. Population

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(1881), 31,177; (1891), 33,060. It contains a Government college with 181 students in 1896-97, two high schools with 575 pupils, a Mahommedan college with 66 pupils, a hospital with a Lady Dulferin branch for female patients, and twelve printing-presses, issuing one English and two vernacular periodicals. The District comprises

an area of 1223 square miles, with a population in 1881 of 1,016,005, and in 1891 of 1,076,710, giving au average ■density of 880 per square mile. Classified according to religion, Hindus numbered 842,077; Mahommedans, 189,469 ; Christians, 633, of whom 162 were Europeans ; " others," 2117. In 1901 the population was 1,050,365. Land revenue and rates (including Howrah) were Ils.15,39,805 ; the number of police was 837; the number of boys at school in 1896-97 was 43,764, being 67-2 per cent, of the male population of school-going age; the registered death-rate in 1897 was 32-87 per thousand. The district is traversed for 40 miles by the main line of the East Indian railway, with a branch of 22 miles to the pilgrim resort of Tarakeswar, whence a steam tramway has been constructed for a farther distance of 31 miles. The Eden canal irrigates about 6000 acres, and there are several embankments and drainage works. Silk and indigo are both decaying industries, but the xaanufacture of brass and bell-metal ware is actively carried on at several places, to the estimated value of

Es.2,56,000 a year. There are several jute mills, a large flour mill, two bone-crushing mills, and a brick and tile works, with an annual out-turn valued at Es. 1,78,000.

Hook, James Clarke (1819), English painter, was born in London, 21st November 1819. His father, James Hook, a Northumbrian by descent. Judge Arbitrator of Sierra Leone, married the second daughter •of Dr Adam Clarke, the renowned commentator on the JBible, who gave to the painter his second name. Young Hook's first taste of the sea was on board the Berwick .smacks which took him on his way to Wooler. He drew with rare facility, and determined to become an artist ; and accordingly, without any supervision, he set to work for more than a year in the sculpture galleries of the British Museum. In 1836 he was admitted a student of the Eoyal Academy, where he worked for three years, and elsewhere learned a good deal of the scientific tech-nique of painting from a nephew of Opie. His first picture, called " The Hard Task," was exhibited in 1837, and represented a girl helping her sister with a lesson.

Unusual facility in portraiture and a desire to earn his

■own living took the student into Ireland to pamt like-

nesses of the Waterford family and others : here he pro-

duced landscapes of the Vale of Avoca, and much devel-

■oped his taste for pastoral art ; later, he was similarly

■engaged in Kent and Somersetshire. In 1842 his second

exhibited work was a portrait of "Master J. Finch

•Smith " : in this year he gained silver medals at the

Eoyal Academy, and in 1843 he was one of the com-

petitors in the exhibition of cartoons in Westminster

Hall, with a 10 by 7 feet design of " Satan in Paradise."

.In 1844 the Academy contained a picture of a kind

■with which his name was long associated, an illustration

■ of the Decameron, called " Pamphilius relating his Story,"

;a meadow scene in bright light, with sumptuous ladies,

:richly clad, reclining on the grass. The British Institu-

subjects taken from Shakespeare and Burns, which, with

the above, showed him to be cultivating those veins of

.romantic sentiment and the picturesque which were then

iin vogue, but in a characteristically fresh and vigorous

manner. ” The Song of Olden Time ” (Eoyal Academy, 1845) marked the artist’s future path distinctly in most technical respects. It was in this year Hook won the Academy gold medal for an oil picture of ” The Finding the Body of Harold.” The travelling studentship in painting was awarded to him for ” Eizpah watching the Dead Sons of Saul,” in 1846; and he went for three years to Italy, having married Miss Eosalie Burton before he left England. Hook passed through Paris, worked diligently for some time in the Louvre, traversed Switzerland, and, though he stayed only part of three years in Italy, gained much from studies of Titian, Tintoret, Carpaccio, Mansueti, and other Venetians. Their influence thenceforth dominated the coloration of his pictures, and enabled him to apply the principles to which they had attained to the representation (as Bonington before him had done) of romantic subjects and to those English themes of the land and sea with which the name of the artist is inseparably associated. “A Dream of Ancient Venice” (E.A., 1848)— the first fruit of these Italian

studies — “Bayard of Brescia” (E.A., 1849), “Venice” (B.I., 1849), and other works assured for Hook the Assoeiateship of the Eoyal Academy in 1851. Soon afterwards an incomparable series of English subjects was begun, in many pastorals and fine and brilliant idylls of the sea and rocks. ” A Eest by the Wayside ” and ” A Few Minutes to Wait before Twelve o’clock ” proved his title to appear, in 1854, as a new and original painter. After these came ” A Signal on the Horizon,” 1857 ; ” A Widow’s Son going to Sea,” ” The Ship-Boy’s Letter,” “Children’s Children are the Crown of Old Men,” “A Coast-Boy gathering Eggs,” a scene at Lundy ; the perfect “Luff, Boy!” (1859), about which Euskin broke into a dithyrambic chant ; ” The Brook,” ” Stand Clear ! ” ” 0 Well for the Fisherman’s Boy ! ” (1860), ” Leaving Cornwall for the Whitby Fishing,” ” Sea Urchins,” and a score more as fine as these. The artist was elected a full Academician on the 6th March 1860, in the place of James Ward.

See A. H. Palmek. “J. C. Hook, E.A.,” Portfolio, 1888.—

F. G. Stephens. " J. C. Hook, Royal Academician : His Life and Work," Art Annual, London, 1888. — P. G. Hamekton. Etching and Etchers, London, 1877.

Hooker, Sir Joseph Dalton(1817), English botanist and traveller, son of the famous botanist Sir W. J. Hooker, was born on 30th June 1817, at Hales-worth, Suffolk. He was educated at Glasgow Univer-sity, and almost immediately after taking his M.D. degree there in 1839 joined Sir James Eoss's Antarctic expedition, receiving a commission as assistant-surgeon on the Erebus. The botanical fruits of the three years he thus spent in the Southern Seas were the Flora Antarctica, Flora Novae Zelandice, and Flora Tasmanica, which he published on his return. His next expedition was to the northern frontiers of India, and the expenses in this case also were partially defrayed by the Government. The party had its full share of adventure. Hooker and his friend Dr Campbell were detained in prison for some time by the raja of Sikkim, but nevertheless they were able to bring back important results, both geographical

and botanical. Their survey of hitherto unexplored regions was published by the Calcutta Trigonometrical Survey Office, and their botanical observations formed the basis of elaborate works on the rhododendrons of the Sikkim Himalaya and on the flora of India. Among other journeys undertaken by Hooker may be mentioned those to Palestine (1860), Morocco (1871), and the United States (1877), all yielding valuable scientific information. In the midst of all this travelling in foreign countries he quickly built up for himself a high scientific reputation at home. In 1855 he was appointed assistant-director of Kew Gardens, and in 1865 he succeeded his father as full director, holding the post for twenty years. At the early age of thirty he was elected

a fellow of the Eoyal Society, and in 1873 he was chosen its president ; he received three of its medals — a Eoyal in 1854, the Copley in 1887, and the Darwin in 1892.

He acted as president of the British Association at its Norwich meeting of 1868, when his address was remarkable for its championship of Darwinian theories. Of Darwin, indeed, he was an early friend and supporter : it was he who, with Lyell, first induced Darwin to make his views public, and the author of The Origin of Species has recorded his indebtedness to Hooker's wide knowledge and balanced judgment. Sir Joseph Hooker is the author of numerous scientific papers and monographs, and his larger books include, in addition to those already mentioned, a standard Student's Flora of the British Isles and a monumental work, the Genera Plantarum, based on the collections at Kew, in which he had the assistance of Bentham. On the publication of the last part of his Flora of British India in 1897 he was created G.C.S.I., having been created a knight commander of that order twenty years before.

Hoorn, a town in the Dutch province of North Holland, on the Hoornsch Hop, an inlet of the Zuyder Zee, 27 miles by rail north-north-east of Amsterdam. Though

in a decadent state, the town has erected a museuia and (1893) a statue of Jan Pietersz Koen, the founder of Batavia, and has tramways to Alkmaar and Medemblik. The port owns seventy-nine vessels engaged in the fisheries of the Zuyder Zee. Population (1900), 10,714.

Hoosick Falls, a village of Eensselaer county, New York, U.S.A., on the river Hoosick and the Pitch-burg railway, at an altitude of 425 feet. It has a hilly site, and its plan is irregular. Its chief industry is the manufacture of agricultural implements. Population (1880), 4530 ; (1890), 7014 ; (1900), 6671, of whom 1092 were foreign-born.

Hopkins, Mark (1802-1887), American education-alist and writer on Christian ethics and evidences, was born in Stockbridge, Massachusetts, 4tli February 1802. He graduated at Williams College, 1824, where, six years later, he became Professor of Moral Philosophy and Rhetoric. In 1832 he was licensed to preach in Congre-gational churches, and was President of Williams College from 1836 until 1872, when he resigned, but continued

to teach moral philosophy in the college. As a teacher and a writer he was fresh, clear, and stimulating, and his volume of lectures on 27(6 Evidences of Christianity (1846) was long a favourite text-book in American colleges. Of his other writings, the chief were Lectures on Moral Science (1862), and The Law of Love and Love as a Law (1869), a pleasant and suggestive compendium of Christia,n ethics. His general tone of thought and line of argument are at once optimistic and transcendental. Dr Hopkins took a lifelong interest in Christian missions, and was for many years President of the American Board of Commissioners for Foreign Missions (the American Congregational Mission Board). He died at Williamstown, 17th June 1887.

Hopkinson, John (1849-1898), English engineer and physicist, was born in Manchester on 27th July 1849. Before he was sixteen he attended lectures at Owens College, and at eighteen he gained a mathematical scholarship at Trinity College, Cambridge, where he graduated in 1871 as senior wrangler and first Smith's

prizeman, having previously taken the degree of D.Sc. at London University and won a Whitworth Scholarship. Although elected a fellow and tutor of his college, he stayed up at Cambridge only for a very short time, preferring to learn practical engineering as a pupil in the works in which his father was a partner. But there his stay was equally short, for in 1872 he undertook the duties of engineering manager in the glass manufactories of Messrs Chance Brothers and Company at Birmingham. Six years later he removed to London, and while continuing to act as scientific adviser to Messrs Chance, established a most successful practice as a consulting engineer. His work was mainly, though not exclusively, electrical, and his services were in great demand as an expert witness in patent cases. In 1890 he was appointed director of the -Siemens laboratory at King's College, London, with the title of professor of electrical engineering. His death occurred prematurely on 27th August 1898, when he was killed, together with one son and two daughters, by an accident the nature of which

was never precisely ascertained, while climbing the Petite Dent de Veisivi, above Evolena. Dr Hopkinson presented a rare combination of practical with theoretical ability, and his achievements in pure scientific research are not less intrinsically notable than the skill with which he applied their results to the solution of concrete engineering problems. His original work is contained in more than sixty papers, all written with a complete mastery both of style and of subject-matter. His name is best known in connexion with electricity and magnetism. On the one hand he worked out the general theory of the magnetic circuit in the dynamo (in conjunction with his brother Edward), and the theory of alternating currents, and conducted a long series of observations on the phenomena attending magnetization in iron, nickel,- and the curious alloys of the two which can exist both in a magnetic and non-magnetic state at the same temperature. On the other hand, by the application of the principles he thus elucidated he furthered to an immense extent the employment of electricity for the

purposes of daily life. As regards the generation of electric energy, by pointing out defects of design in the dynamo as it existed about 1878, and showing how important improvements were to be effected in its construction, he was largely instrumental in converting it from a clumsy and wasteful appliance into one of the most efficient known to the engineer. Again, as regards the distribution of the current, he took a leading part in the development of the three-wire system and the closed-circuit transformer, while electric traction had to thank him for the series-parallel method of working motors. During his residence in Birmingham, Messrs Chance being makers of glass for use in lighthouse lamps, his attention was naturally turned to problems of lighthouse illumination, and he was able to devise improvements in both the catoptric and dioptric methods for concentrating and directing the beam. He was a strong advocate of the group-flashing system as a means of differentiating lights, and invented an arrangement for carrying it into effect optically, his plan being first adopted for the

catoptric light of the lioyal Sovereign lightship, in the English Channel off Beachy Head. Moreover, his association with glass manufacture led him to study the refractive indices of different kinds of glass ; he further undertook abstruse researches on electrostatic capacity, the phenomena of the residual charge, and other problems arising out of Clerk Maxwell's electro-magnetic theory. His original papers were collected and published, with a memoir by his son, in 1901.

Hopkinsville, capital of Christian county, Kentucky, U.S.A., on the Louisville and Nashville and the Illinois Central railways. It contains a state hospital for the insane, and South Kentucky College, a Christian, institution. Population (1890), 6833; (1900), 7280, of whom 103 were foreign-born and 3243 were negroes.

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Acreage, Pkoductiojt, and Consumption.

THE cultivation of hops in the British Isles is re-

stricted to England, where it is practically confined

to half-ardozen counties — four in the south-eastern and two

in the west-midland districts. In 1901 the English crop

was reported by the Board of Agriculture to occupy 61,127

acres. The official returns as to acreage do not extend back

beyond 1868, in which year the total area was reported

to be 64,488 acres. The largest area recorded since

then was 71,789 acres in 1878 ; the smallest was 49,735

acres in 1898. The difference is 22,054 acres, which

represents the considerable proportion of nearly one-third of the maximum- acreage. The extent to which the areas of hops in the several hop-growing counties vary from year to year is suflELciently indicated in Table I., which shows the

Table I. — Hop Areas of England, 1895 to 1901. — Acres.

County.

1895.

1896.

1897.

1898.

1899.

1900.

1901.

Kent

35,018

38,800

81,661

80,941

81,988

31,614

31,242

Hereford .

7,663

6,895

6,542

6,651

7,227

7,287

7,497

Sussex

7,489

5,908

6,174

4,829

4,949

4,828

4,800

Worcester

4,024

8,800

3,591

3,667

8,788

8,964

4,029

Hants

2,875

2,494

2,306

2,263

2,319

2,281

2,133

Surrey-

1,788

1,623

1,416

1,813

1,888

1,800

1,232

Salop

150

140

129

126

138

188

144

Gloucester

88

49

40

40

42

47

46

Suffolk .

10

4

2

8

4

4

4

Monmoutli

2

2

Berks

Total area .

4

58,940

54,217

60,868

49,735

51,S48

51,308

51,127

annual acreages over a period of seven years, 1895 to

1901. The proportions in which the acres of hops are

distributed amongst the counties concerned vary but little year by year, and as a rule over 60 per cent., or nearly two-thirds, belongs to Kent. Of the total acreage in 1901, for example, 61-1 per cent, was returned by Kent, 14-7 by Hereford, 9-4 by Sussex, 7 9 by Worcester, 4-2 by Hants, 2-4 by Surrey, and the residual 0-3 percent, jointly by Salop, Gloucester, and Suffolk. Arranging the counties in two geographical groups, it is found that 77-1 per cent, of the hop acreage of 1901 was in the south-eastern counties, and 22-9 per cent, in the west-midland counties. Whilst the official figures concerning acreage are available as far back as the year 1868, those relating to production were not collected for the first time till 1885. The official estimators appointed for the purpose send in estimates of the total production of hops in their several districts, and these, divided by the number denoting the acreage cultivated, give the estimated average yield per acre. The home production of hops is always supplemented by imported produce, so that, in order to arrive at the actual quantities available for consumption, the two

must be added together. These various details as far back as the whole of the data are obtainable, form the subject of Table II. The quantities available for home consumption are not shown with complete accuracy in the last column of this table, as the exports have not been deducted. These, however, are relatively very small, and only amounted in 1901, for example, to 22,702 cwt., of which 17,796 cwt. were home-grown and 4906 cwt. im-ported. The wide fluctuations in the home production of hops are worthy of note, as they exercise a powerful influence upon market prices. The largest crop tabulated is that of 776,144 cwt. in 1886, and the smallest is that of

Table II. — Acreage, Estimated Home Produce, and Tm-ports of Hops into the United Kingdom in each Year, 1885 to 1901.

Tear.	*Area.*	*Estimated Home Produce.*

Yield per

Acre.

Imports.

Home

Produce

plus

Imports.

1885

1886

1887

1888

1889

1890

1891

1892

1893

1894

1895

1896

1897

1898

1899

1900

1901

■

Acres.

71,327

70,127

63,706

58,494

57,724

53,961

56,142

56,259

57,564

59,535

58,940

54,217

50,863

49,735

51,843

51,308

51,127

Cwt.

509,170

776,144

457,515

281,291

497,811

283,629

436,716

413,259

414,929

636,846

653,396

453,188

411,086

356,816

661,373

347,894

649,387

Cwt.

7-14

11-07

7-18

4-81

8-62

5-26

7-78

7-35

7-21 ■

10-70

9-39

8-36

8-08

7-17

12-76

6-78

12-70

Cwt.

266,952

153,759

145,122

216,606

199,384

188,028

195,266

187,507

204,392

189,155

217,161

207,041

164,154

244,136

180,233

198,494

116,042

Cwt.

776,122

929,903

602,637

497,897

697,195

471,657

631,982

600,766

619,321

826,001

770,557

660,229

575,240

600,952

841,606

546,388

765,429

Average 1

17 years j

57,228

478,850

8-40

192,555

671,405

281,291 cwt. in 1888, the former being more than 2|.

times the size of the latter. The crop of 1899, estimated

at 661,373 cwt., was so large that prices receded to such

an extent as to leave no margin of profit to the great body

of growers, whilst some planters were able to market the

crop only at a loss. The calculated annual average yields

per acre over the seventeen years 1885 to 1901 are seen to

range between 12-76 cwt. in 1899 and 4-81 cwt. in 1888,

the former being 60 per cent, more and the latter nearly

60 per cent, less than the seventeen years' average of 8-4

cwt. jSTo other staple crop of British agriculture under-

goes such wide fluctuations in yield as are here indicated.

How great may be the variation even in two consecutive

years is shown in Table III., which sets out, county by

Table III. — Estimated Total Produce of Hops in England

in 1901 and in 1900.

County.

1901.

1900.

Increase

in 1901.

Proportion of Crop. 1

1901.

1900.

Cwt.

Cwt.

Cwt.

Per cent.

Per cent.

Kent .

390,429

230,028

160,401

60-0

66-1

Hereford

93,988

32,680

61,308

14-5

11-4

Sussex .

65,396

39,717

25,679

10-1

9-4

Worcester

50,392

26,935

23,457

7-8

7-7

Hants .

31,320

12,229

19,035

4-8

3-5

Surrey .

15,918

5,311

10,607

2-5

1-6

Others, three

Total

1,938

932

1,006

0-3

0-3

649,381

347,894

301,487

100-0

100-0

county, the estimated production in 1900 and 1901, and

the percentage which the several counties contributed to each year's crop. As a matter of fact, the size of the crop produced bears no relation to the acreage under cultivation. For example, the 71,327 acres in 1885 produced only 609,170 cwt., whereas the 51,843 acres in 1899 produced 661,373 cwt. — 19,484 acres less under crop yielded 162,203 cwt. more produce.

Comparing the quantities of home-grown hops with those of imported hops, the figures at the foot of Table II. indicate that, of the total available for consumption, about 70 per cent, on the average is home produce and about 30 per cent, is imported produce. The imports, however, do

not vary so much as the home produce. The latter has ranged ,between 776,144 cwt. in 1886 and 281,291 cwt. in 1888 ; whilst the highest and lowest imports were 266,952 cwt. in 1885 and 145,122 cwt. in 1887, the latter in the year following the biggest home-grown crop on record. Of the imports of 198,494 cwt. in 1900, as much as 147,-

378 cwt., or 73 per cent., came from the United States, where the crop is chiefly grown in the states of California, Oregon, Washington, and New York. Since 1895, however, the production in the last-named state has steadily declined, whilst the Pacific coast production has increased.

During the twenty years 1881-1900 the annual values of the hops imported into England fluctuated between the wide limits of £2,962,631 in 1882 and £427,753 in 1887. In five other years besides 1882 the value exceeded a million sterling, the amounts being £1,615,309 in 1884, £1,141,294 in 1893, £1,089,246 in 1883, £1,030,140 in 1898, and £1,001,728 in 1885. Next to 1887, the lowest annual sums were £447,253 in 1886, J3524,297 in 1897, £591,582 in 1896, and £644,505 in 1895. The annual average value over the whole period was £944,062, whilst the annual average import was 200,562 cwt., consequently the average value per cwt. was £4 : 14s. The quantities and values of English-grown hops exported in the five years 1897 to 1901 were the

following : —

Tear.

Quantity.

Cwt.

Value.

1897

1898

1899

1900

1901

10,779

12,955

11,310

14,999

17,796

£43,841

71,321

65,325

63,526

78,034

These figures represent an annual average export of 13,668 cwt., valued at £64,409, which is equivalent to £4 : 15s. per cwt. The quantities and values of the imported hops that are again exported are almost insignificant. Thus, in the three years 1899-1901 the re-exports were : —

1899.

1900.

1901.

Quantity .

Value

3297 cwt.

£16,715

3686 Gwt.

£10,005

4906 owt.

£8305

Cultivation.

As the county of Kent has always taken the lead in hop-growing in England, and as it includes about two-

thirds of the hop acreage of the British Isles, the recent developments in hop cultivation cannot be better studied than in that county. They have been well summarized by Mr Charles Whitehead in his sketch of the agriculture of Kent,^ wherein he states that the hop grounds — or hop gardens, as they are called in Kent — of poor character and least suitable for hop production have been gradually grubbed since 1894, on account of large crops, the im-portation of hops, and low prices. At the beginning of the 19th century there were 290 parishes in Kent in which hops were cultivated. A century later, out of the 413 parishes in the county, as many as 331 included hop plantations. The hops grown in Kent are classified in the markets as "East Kents," "Bastard East Kents,"

” Mid Kents,” and ” Wealds,” according to the district of the county in which they are produced. The relative values of these four divisions follow in the same order, East Kents making the highest and Wealds the lowest rates. These divisions agree in the main with those defined by geological formations. Thus, ” East Kents ” are grown upon the Chalk, and especially on the outcrop of the soils of the London Tertiaries upon the Chalk. ” Bastard East Kents ” are produced on alluvial soil and soils

formed by admixtures of loam, clay loams, chalk, marl, and clay from the Gault, Greensand, and Chalk formations. ” Mid Kents ” are derived principally from the Greensand soils and outcrops of the London Tertiaries in the upper part of the district. ” Wealds ” coine from soils on the Weald Clay, Hastings Sand, and Tunbridge Wells Sand. As each ” pocket ” of hops must be marked with the owner’s name and the parish in which they were grown, buyers of hops can, without much trouble, ascertain from which of the four divisions hops come, espe-

cially if they have the map of the hop-growing parishes of England, which gives the name of each parish. There has been a considerable rearrangement of the hop planta^ tions in Kent within recent years. Common varieties, as Colegate's, Jones's, Grapes, and Prolifics, have been grubbed, and Goldings, Bramlings, and other choice kinds planted in their places. The variety known as Fuggle's, a heavy-cropping though slightly coarse hop, has been much planted in the Weald of Kent, and in parts of Mid Kent where the soil is suitable. In very old hop gardens, where there has been no change of plant for fifty or even one hundred years in some instances, except from the gradual process of filling up the places of plants that have died, there has been replanting with better varieties and varieties ripening in more convenient suc- cession; and, generally speaking, the plantations have been levelled up in this respect to suit the demand for bright hops of fine quality. A recent classification^ of the varieties of English hops arranges them in three groups — (1) early varieties (e.g., Prolific, Bramling,

Amos's Early Bird) ; (2) mid-season or main-crop varieties (e.g.. Earnham Whitebine, Fuggle's, Old Jones's, Golding) ; (3) late varieties (e.g., Grapes, Colgate's).

The cost of cultivating and preparing the produce of an acre of hop land tends to increase, on account of the advancing rates of wages, the intense cultivation more and more essential, and the necessity of freeing the plants from the persistent attacks of insects and fungi.

In 1893 Mr Whitehead estimated the average annual cost of an acre of hop land to be £36 : 10s., the following being the items : —

Manure (winter and summer) £6 10 0

Digging 0 19 0

Dressing (or cutting) 0 6 0

Poling, tying, earthing, ladder-tying, stringing, lewing . 2 8 0

Shimming, nidgeting, digging round and hoeing hills 300

Stacking, stripping, making bines, &e. . . . 0 17 0

Annual renewal of poles 2 10 0

Expense of picking, drying, packing, carriage,

sampling, selling, &c., on average crop of, say,

7 cwt. per acre 10 5 0

Kent, rates, taxes, repairs of oast and tacks, inter-

est on capital 6 0 0

Sulphuring 10 0

Washing (often two, three, or four times) . .200

Total

.£35 10 0

Seven years later the average cost per acre in Kent had

risen to quite £37.

The hops in Kent are usually planted in October or

November, the plants being 6 feet apart each way, thus

giving 1210 hills or plant centres per acre. Some planters

still grow potatoes or mangels between the rows the first

year, as the plants do not bear much until the second

year ; but this is considered to be a mistake, as it en-

courages wire-worm and exhausts the ground. Many

planters pole hop plants tlie first year with a single short

pole, and stretch cocoanut-fibre string from pole to pole.

2 J. Percival, "The Hop and its English Varieties," Jour. Roy. Agric. Soc. 1901.

and grow many hops in the first season. Much of the hop land is ploughed between the rows, as labour is scarce, and the spaces between are dug afterwards. It is far better to dig hop land if possible, the tool used being the Kent spud. The cost of digging an acre ranges from 18s. to 21s. Hop land is ploughed or dug between November and March. After this the plants are " dressed," which means that aU the old bine ends are cut off with a sharp curved hop-knife, and the plant centres kept level with the ground.

Manuring. — Manure is applied in the winter, and dug or ploughed in. London manure from stables and cow-houses is used to an enormous extent. It comes by barge or rail, and is brought from the wharves and stations by traction engines; it costs from 7s. 6d. to 9s. per. load. Rags, fur waste, sprats, wool waste, and shoddy are also

put on in the winter. In the summer, rape dust, guano, nitrate of soda, and various patent hop manures are chopped in with the Canterbury hoe. Fish guano or desiccated fish is largely used; it is very stimulating, and more lasting than some of the other forcing manures.

The latest investigations into the subject of hop-manuring are those made by Dr Bernard Dyer and Mr F. W. E. Shrivell, at Golden Green, near Tonbridge, Kent. In the 1901 report ^ it is stated that the object in view is to ascertain how far nitrate of soda, in the presence of an abundant supply of phosphates and potash, is capable of being advantageously used as a source of nitrogenous food for hops. An idea long persisted among hop-growers that nitrate of soda was an unsafe manure for hops, being likely to produce rank growth of bine at the expense of quality and even quantity of hops. During recent years, however, owing very largely to the results of these experiments, and of corresponding experiments based upon these, which have been carried out abroad, hop farmers have much more freely availed themselves of the aid of this useful manure ;

and there is little doubt that the distrust of nitrate of soda as a hop manure which has existed in the past has been largely due to the fact that nitrate of soda, like many other nitrogenous manures, has often been misused (1) by being applied without a sufficient quantity of phosphates and potash, or (2) by being applied too abundantly, or (3) by being applied too late in the season, with the result of unduly delaying the ripening period. . On most of the experimental plots nitrate of soda (in conjunction with phosphates and potash) has been used as the sole source of nitrogen ; but it is, of course, not to be supposed that any hop-grower would use year after year, as is the case on some of the plots, nothing but phosphates, potash, and nitrate of soda. Miscellaneous feeding is probably good for plants as well as for animals, and there is a large variety of nitrogenous manures at the disposal of the hop farmer, to say nothing of what, in its place, is one of the most valuable of all manures, namely, home-made dung. These experiments were begun in 1894 with a new garden of young Fuggle's hops. A series of experimental

plots was marked out, each plot being one-sixth of an acre in area. The plots run parallel with one another, there being four rows of hills in each. The climate of the district is very dry.

The subjoined statement shows the annual yield of hops per acre on each plot, and also the average for each plot over the five years 1896-1900 :—

Weight of Kiln-dried Fuggl

e's Hops

per

Acre

Average

Plot.

Annual Manuring per Acre.

1896.

1897.

1698.

1899.

1900.

of 5

Tears.

Cwt.

Cwt.

Cwt

Cwt.

Cwt.

Cwt.

A.

Phosphates and potash .

*13**

n

8}

20}

8

IH

H.

Phosphates, potash, and

2 cwt. nitrate of soda .

16i

H

m

22}

9f

13i

C.

Phosphates, potash, and

4 cwt. nitrate of soda .

*16**

12

*12**

23

11

15 •

D.

Phosphates, potash, and

•■

6 cwt. nitrate of soda .

15|

13

13

*22**

*10**

14i

E.

Phosphates, potash, and

8 cwt. nitrate of soda .

15

*13**

15}

*23**

11

15i

*J^*

Phosphates, potash, and

10 cwt. nitrate of soda

15

13

15

*24**

*10**

15J

X.

30 loads (about 15 tons)

London dung

13

8

9}

24i

lOJ

131

In only one year did the very large dressing of 10 cwt. of nitrate of soda per acre afford any better result than was produced by the less heavy dressing of 8 cwt. per acre, and this was in 1899, a season of siTch abundance and such low prices that it may be regarded as an abnormal season. If the effect of this one season on the average be eliminated, the best results, as regards quantity, were obtained on plot E, receiving 8 cwt. of nitrate of soda per acre. But plot C, with 4 cwt. only of nitrate of soda per acre, has been on the average not more than ^ cwt. per acre behind plot E.

Valuations of the hops made by merchants and factors show that, on the whole, the market quality of the produce is very little affected by manuring. Moreover, chemical investigation of the hops appears to indicate that the brewing quality is not in any constant or definite way influenced by the manuring, except where the quantity of nitrate of soda has amounted to the large dressing of 8 cwt. or more per acre, a quantity which in some seasons would seem to have been prejudicial, although in one season it happened that the highest brewing value appertained to a sample grown with as much as 10 cwt. per acre.

The results of modern investigation show that it is very largely to the presence and proportion of soft resin that hops owe their preservative value, although the quality of hops is by no means wholly dependent on this one feature. The resin percentages in the samples grown on the several plots in 1898, 1899, and 1900 were the following :—

Plot.

189S.

1899.

1900.

Total Eesin.

Soft PLOsin.

Total Eesin.

Soft Eesin.

Total Eesin.

Soft Eesin.

A.

B.

C.

D.

E.

F.

X.

Phosphates and potash

Phosphates, potash, and 2 cwt. nitrate of soda

Phosphates, potash, and 4 cwt. nitrate of soda

Phosphates, potash, and 6 cwt. nitrate of soda

Phosphates, potash, and 8 cwt. nitrate of soda

Phosphates, potash, and 10 cwt. nitrate of soda

30 loads (about 15 tons) London dung .

Per Cent.

14-15

14-30

14-06

13-57

14-11

12-21

13-93

Per Cent.

9-21

9-20

9-04

8-60

8-85

7-91

8-66

Per Cent.

15-07

16-59

15-87

14-90

14-49

15-47

14-92

Per Cent.

8-60

8-83

9-27

8-70

8-96

9-41

8-80

Per Cent.

14-53

15-09

14-46

13-46

13-30

12-77

14-78

Per Cent.

8-90

8-51

8-16

7-62

7-18

6-77

9-07

The general results so far seem to show that the purchase of town dung for hops is not economical, unless under specially favourable terms as to cost of conveyance, and

1 Six Years' Experiments on Hop Manuring. London, 1901.

that it should certainly not be relied upon as a sufficient manure. Home-made dung is in quite a different position, as not only is it richer, but it costs nothing for railway carriage. As a source of nitrogenous manure, purchased

dung is on the whole too expensive. There is a large variety of other nitrogenous manures in the market besides nitrate of soda, such, for instance, as Peruvian and Damaraland guano, sulphate of ammonia, fish guano, dried blood, rape dust, furriers' refuse, horn shavings, hoof parings, wool dust, shoddy, &c. All of these may in turn be used for helping to maintain a stock of nitrogen in the soil ; and the degree to which manures of this kind have been recently applied in any hop garden will influence the grower in deciding as to the quantity of nitrate of soda he should use in conjunction with them, and also to some extent in fixing the date of its application.

Dressings of 8 or 10 cwt. of nitrate of soda per acre, such as are applied annually to plots E and F, would be larger than would be put on where the land has been already dressed with dung or with other nitrogenous manures ; and even, in the circumstances under notice, although these plots have on the average beaten the others in weight, the hops in some seasons have been

■*distinctly coarser than those more moderately manured — though in the dry season of 1899 the most heavily dressed plot gave actually the best quality as well as the greatest quantity of produce.*

With regard to the application of nitrate of soda in case the season should turn out to be wet, present experience indicates that, on a soil otherwise liberally manured, 4 cwt. of nitrate of soda per acre, applied not too late, would be a thoroughly safe dressing. In the case of neither dung nor any other nitrogenous fertilizers having been recently applied, there seems no reason for supposing that, even in a wet season, 6 cwt. of nitrate of soda per acre applied early would be otherwise than a safe dressing, considering both quantity and quality of produce. In conjunction with dung, or with the early use of other nitrogenous manures, such as fish guano, rape dust, &c., it would probably be wise not to exceed 4 cwt. of nitrate of soda per acre.

As to the date of application, April or May is the latest time at which nitrate of soda should, in most

circumstances, be applied, and probably April is preferable to May. The quantity used should be applied in separate dressings of not more than 2 cwt. per acre each, put on at intervals of a month. Where the quantity of nitrate of soda used is large, and constitutes the whole of the nitrogenous manure employed, the first dressing may, on fairly deep and retentive soils, be given as early as January ; or, if the quantity used is smaller, say in February ; while February will, in most cases, probably be early enough for the first dressing in the case of lighter soils. The condition of the soil and the degree and distribution of rainfall during both the previous autumn and the winter, as well as in the spring itself, produce such varying conditions that it is almost impossible to frame general rules.

The commonly accepted notion that nitrate of soda is a manure which should be reserved for use during the later period of the growth of the bine appears to be erroneous. The summer months, when the growth of the bine is most active, are the months in which natural

nitrification is going on in the soil, converting soil nitrogen and the nitrogen of dung, guano, fish, rape dust, shoddy, or other fertilizers into nitrates, and placing this nitrogen at the disposal of the plants ; and it aj)pears reasonable, therefore, to suppose that nitrate of soda will be most useful to the hops at the earlier stages of their growth, before the products of that nitrification become abundant. This would especially be so in a season immediately fol-lowing a wet autumn and winter, which have the effect of washing away into the drains the residual nitrates not utilized by the previous crop.

The necessity, whether dung is used or not, and what-ever form of nitrogenous manure is employed, of also supplying the hops with an abundance of phosphates, cannot be too strongly urged. The use of phosphates for hops was long neglected by hop-planters, and even now there are many growers who do not realize the full importance of heavy phosphatic manuring. On soils con-taining an abundance of lime, no better or cheaper phosphatic manure can be used than ordinary supei'-

phosphate, of which as much as 10 cwt. per acre may be applied without the slightest fear of harm. But if the soil is not decidedly calcareous — that is to say, if it does not effervesce when it is stirred up with some diluted hydrochloric (muriatic) acid — bone dust, phosphatic guano, or basic slag should be used as a source of phosphates, at the rate of not less than 10 cwt. per acre. On medium soils, which, without being distinctly calcareous, nevertheless contain a just appreciable quantity of carbonate of lime, it is probably a good plan to ixse the latter class of manures, alternately with superphosphate, year and year about ; but it is wise policy to use phosphates in some form or other every year in every hop garden. They are inexpensive, and without them neither dung, nitrate of soda, ammonia salts, nor organic manures can be expected to produce both a full vigorous growth of bine and at the same time a well-matured crop of full-weighted, well-conditioned hops.

The use of potash salts on most soils is probably not

needed when good dung is freely used ; but where this is not the case it is safer in most seasons and on most soils to give a dressing of potash salts. On some soils their aid should on no account be dispensed with.

Experiments in hop-manuring have also, for some years past, been conducted in connexion with the South-Eastern Agricultural College, Wye, Kent. The main results have been to demonstrate the necessity of a liberal supply of phosphates, if the full benefit is to be reaped from applications of nitrogenous manure.

Tying, Poling, and Picking. — Tying the bines to the poles or strings is essentially women's work. It was formerly always piecework, each woman taking so many acres to tie, but it is found better to pay the women Is. 8d. to 2s. per day, that they may all work together, and tie the plants in those grounds where they want tying at once. The new modes of poling and training hop plants have also altered the conditions of tying. Many improvements have been made in the methods of poling and training hops. Formerly two or three

poles were placed to each hop-hill or plant-centre in the spring, and removed in the winter, and this was the only mode of training. Kecently systems of training on wires and strings fastened to permanent upright poles have been introduced. One arrangement of wires and strings much adopted consists of stout posts set at the end of every row of hop-hills and fastened with stays to keep them in place. At intervals in each row a thick pole is fixed. From post to post in the rows a wire is stretched at a height of half a foot from the ground, another about six feet from the ground, and another along the tops of the posts, so that there are three wires. Hooks are clipped on these wires at regular intervals, and cocoa-nut-fibre strings are threaded on them and fastened from wire to wire and from post to post, to receive the hop-bines. The string is threaded on the hooks continuously, and is put on those of the top wire with a machine called a stringer. There are several methods of training hops with posts or stout poles, wire, and string, whose first cost varies from £20 to £40 per acre. The system

is cheaper in the long run than that of taking down the poles every year, and the wind does not blow down the

poles or injure the hops by banging the poles together. In another method, extensively made use of in Kent and Sussex, stout posts are placed at the ends of each row of plants, and, at intervals where requisite, wires are fastened from top to top only of these posts, whilst cocoanut-fibre strings are fixed by pegs to the ground, close to each hop-stock, whence they radiate upwards for attachment to the wires stretching between the tops of the posts. This method is more simple and less expensive than the system first described, its cost being from £24 to £28 per acre. In this case the plants require to be well " lewed," or sheltered, as the strings being so light are blown about by the wind. These methods are being largely adopted, and, together with the practice of putting cocoanut-fibre strings from pole to pole in grounds poled in the old-

fashioned manner, are important improvements in hop culture, which have tended to increase the production of hops. Where the old system of poling with two or three poles is still adhered to they are always creosoted, most growers having tanks for the purpose ; and, in the new methods of poling, the posts and poles are creosoted, dipped, or kyanized.

At Wye College, Kent, previously mentioned, different systems of planting and training have been tried, the alleys varying in width from 10 feet down to 5 feet, and the distance between the hills varying quite as widely, so that the number of hills to the acre has ranged from 1210 down to 660. The biggest crop was secured on the plot where the hills were 8 feet apart each way. As a rule, indeed, a wide alley and abundant space between the plants, thus allowing the hops plenty of air and light, produced the best results, besides effecting some saving in the cost of cultivation, as there were only 660 or 680 hills per acre. Of the various methods of training, the umbrella system gave the biggest crop in each of the

three years 1899, 1900, 1901 ; and it seemed to be the best method, except in seasons when washing was required early, in which case the plants were not so readily cleared of vermin.

Much attention is required to keep the bines in their places on the poles, strings, or wire, during the summer. This gives employment to many women, for whose service in this and fruit-picking there is considerable demand, and a woman has no trouble in earning from Is. 6d. to Is. lOd. per day from April till September at pleasant and not very arduous labour. The hop-picking follows, and at this women sometimes get 4s. and even 6s. per day. This is the real Kent harvest, which formerly lasted a month or five weeks. Now it rarely extends beyond eighteen days, as it is important to secure the hops before the weather and the aphides, which almost invariably swarm jvithin the bracts of the cones, discolour them and spoil their sale, as brewers insist upon having bright, "coloury" hops. Picking is better done than was formerly the case. The hops are

picked more singly, and with comparatively few leaves, and the pickers are of a somewhat better type than the rough hordes who formerly went into Kent for "hop-ping." Kent planters engage their pickers beforehand, and write to them, arranging the numbers required and the date of picking. Many families go into Kent for pea- and fruit-picking, and remain for hop-picking. Without this great immigration of persons, variously estimated at between 45,000 and 65,000, the crops of hops could not be picked ; and fruit-farmers also would be unable to get their soft fruit gathered in time without the help of immigrant hands. The fruit-growers and hop-planters of Kent have greatly improved the accom-modation for these immigrants.

Concerning the general question as to the advisability or otherwise of cutting the hop bine at the time of picking. Principal A. D. Hall, of Wye College, has ascertained experimentally that if the bine is cut close to the ground at a time when the whole plant is unripe there are removed in the bine and leaves considerable

quantities of nitrogen, potash, and phosphoric acid which would have returned to the roots if the bine had not been cut until ripe. The plant, therefore, would retain a substantial store of these constituents for the following year's growth if the bine were left. Chemical analyses have shown that about 30 lb of nitrogen per acre may be saved by allowing the bines to remain uncut, this representing practically one-third of the total amount of nitrogen in the hops, leaf, and bine together. There are also from 25 lb to 30 lb of potash in the growth, of which nine-tenths would return to the roots, with about half the phosphoric acid and a very small proportion of the lime. It has been demonstrated that by the practice of cutting the bines when the hops are picked the succeeding crop is lessened to the extent of about one-tenth. As to stripping off the leaves and lower branches of the plant, it was found that this operation once reduced the crop 10 per cent, and once 20 per cent., but that in the year 1899 it did not affect the crop at all. The inference appears to be that when there is a good crop it is not reduced by

stripping, but that when there is less vigour in the plant it suffers the more. Hence, it would seem advisable to study the plant itself in connexion with this matter, and to strip a little later, or somewhat less, than usual when the bine is not healthy.

Drying. — After being picked, the hops are taken in pokes — ^long sacks holding ten bushels — to the oasts to be dried. The oasts are circular or square kilns, or groups of kilns, wherein the green hops are laid upon floors covered with horsehair, under which are enclosed or open stoves or furnaces. The heat from these is evenly dis-tributed among the hops above by draughts below and round them. This is the usual simple arrangement, but patent processes are adopted here and there, though they are by no means general. The hops are from nine to ten hours drying, after which they are taken off the kiln and allowed to cool somewhat, and are then packed tightly into " pockets " 6 feet long and 2 feet wide, weigh-ing one and a half cwt., by means of a hop-pressing machine, which has cogs and wheels worked by hand. Of

late years more care has been bestowed by some of the leading growers upon the drying of hops, so as to preserve their qualities and volatile essences, and to meet the altered requirements of brewers, who must have bright, well-managed hops for the production of light clear beers for quick draught. The use, for example, of exhaust fans, recently introduced, greatly facilitates drying by drawing a large volume of air through the hops ; and as the temperature may at the same time be kept low, the risk of getting over-fired samples is considerably reduced, though not entirely obviated. The adoption of the roller floor is another great advance in the process of hop-drying, for this, used in conjunction with a raised platform for the men to stand on when turning, prevents any damage from the feet of the workmen, and reduces the loss of resin to a minimum. The best results are obtained when exhaust fans and the roller floor are associated together. In such cases the roller floor, which empties its load automatically, pours the hop cones into the receiving sheets in usually as yhole and unbroken a condition as

that in which they went on to the kiln.

Pests of the Hop Crop. — In recent years the difficulties attendant upon hop cultivation have been aggravated, and the expenses increased, by regularly recurring attacks of aphis blight — due to the insect Aphis (Phorodon) humuli — which render it necessary to spray or syringe every hop

plant, every branch and leaf, witli insecticidal solutions three or fonr times, and sometimes more often in each season. Quassia and soft-soap solutions are usually employed; they contain from 4 lb to 8 lb of soft soap, and the extract of from 8 lb to 10 lb of quassia chips to 100 gallons of water. The soft soap serves as a vehicle to retain the bitterness of the quassia upon the bines and leaves, making them repulsive to the aphides, which are thus starved out. Another pest, the red spider, Tetranychus telarius — really one of the " spinning mites " — is most destructive in very hot summers. Congregating on the under surfaces of the leaves, the red spiders exhaust

the sap and cause the leaves to fall, producing the effect known in Germany as " fire-blast." The hop-wash of soft soap and quassia, so effective against aphis attack, is of little avail in the case of red spider. Some success, how-ever, has attended the use of a solution containing 8 lb to 10 lb of soft soap to 100 gallons of water, with three pints of paraffin added. It is necessary to apply the washes with great force, in order to break through the webs with which the spiders protect themselves. Hop-washing is done by means of large garden engines worked by hand, but more frequently with horse engines. Eesort is some-times had to steam engines, which force the spraying solution along pipes laid between the rows of hops.

Mould or mildew is frequently the source of much loss to hop-planters. It is due to the action of the fungus Podosphoera castagnei, and the mischief is more especially that done to the cones. The only trustworthy remedy is sulphur, employed usually in the form of flowers of sulphur, from 40 lb to 60 lb per acre being applied at each sulphuring. The powder is distributed by means of

a machine drawn by a horse between the rows. The sul-
phur is fed from a hopper into a blast-pipe, whence it is
driven by a fan actuated by the travelling wheels, and
falls as a dense, wide-spreading cloud upon the hop-
bines. The first sulphuring takes place when the plants
are fairly up the poles, and is repeated three or four
weeks later ; and even again if indications of mildew are
present. It may be added that sulphur is also success-
fully employed in the form of an alkaline sulphide, such
as solution of " liver of siilphur," a variety of potassium
sulphide. (w. fr.)

Horitz (the " Oberammergau of the Bohemian
Forest "), a commune in the district of Krumau in the
Bohemian Forest, South Bohemia, Austria, noted for the
periodical performances of passion-plays by the peasantry,
which attract as many as 20,000 visitors. Population
(1890), 1094 ; (1900), 1232, all German.

HoNtz, a town in the government district of Konig-
gratz, Bohemia, Austria. Sugar refining is now carried on,
in addition to its older textile, brewing, and milling indus-

tries. It possesses a monument to Ziska, the Hussite leader, who obtained a victory over the Bohemian nobles here in 1423. Population (1890), 6910; (1900), 7771, all Czech.

Hornby, Sir Geoffrey Thomas Phipps (1825-1895), British admiral of the fleet, son of Admiral Sir Phipps Hornby, the first cousin and brother-in-law of the 13th Earl of Derby, by a daughter of Lieutenant-General Burgoyne, commonly distinguished as " Saratoga" Burgoyne, was born on 20th February 1825. At the age of twelve he was sent to sea in the flagship of Sir Eobert Stopford, with whom he saw the capture of Acre in November 1840. He afterwards served in the flagship of Rear- Admiral Josceline Percy at the Cape of Good Hope, was flag-lieutenant to his father in the Pacific, and came home as a commander. When the Derby ministry fell in December 1852 young Hornby was promoted to be a captain. Early in 1853 he married, and as the Derby connexion put him out of favour with the Aberdeen ministry, and especially with Sir James Graham, the first

lord of the Admiralty, he settled down in Sussex as manager of his father's property. He had no appointment in the navy till 1858, when he was sent out to China to take command of the Tribune frigate and convey a body of marines to Vancouver Island, where the dispute with the United States about the island of San Juan was threatening to become very bitter. As senior naval officer there Hornby's moderation, temper, and tact did much to smooth over matters, and a temporary arrangement for joint occupation of the island was concluded. He after-wards commanded the Neptune in the Mediterranean under Sir William Fanshawe Martin, was flag-captain to Eear-Admiral Dacres in the Channel, was commodore of the squadron on the west coast of Africa, and, being promoted to rear-admiral in January 1869, commanded the training squadron for a couple of years. He then commanded the Channel Fleet, and was for two years a junior lord of the Admiralty. It was early in 1877 that he went [out as commander-in-chief in the Mediterranean, where his skill in manoeuvring the fleet, his power as a

disciplinarian, and the tact and determination with which he conducted the foreign relations at the time of the Russian advance on Constantinople, raised his reputation to a very great height and won for him the K.C.B. He returned home in 1880 with the character of being perhaps the most able commander on the active list of the navy. His later appointments were to the Eoyal Naval College as president, and afterwards to Portsmouth as commander-in-chief. On hauling down his flag he was appointed G.C.B., and in May 1888 was promoted to be admiral of the fleet. From 1886 he was principal naval aide-de-camp to Queen Victoria, and in that capacity, and as an admiral of the fleet, was appointed on the staff of the German Emperor during his visits to England in 1889 and 1890. He died, after a short illness, on 3rd March 1895. By his wife, who predeceased him, he left several children, daughters and sons, one of whom, a major in the artillery, won the Victoria Cross in South Africa in 1900. His life has been written' by his daughter, Mrs Fred. Egerton. (j. k. l.)

Horncastle, a market town and railway station in the Horncastle parliamentary division of Lincolnshire, England, on the Bain and Waring, 21 miles east of Lincoln. There are large horse, cattle, and sheep markets. Area of parish (an urban district), 1421 acres. Population (1881), 4818 ; (1901), 4038.

Home, Richard Hengist (1803-1884), English poet and critic, was born in London on New Year's Day 1803. He was intended for the army, and entered at Sandhurst, but receiving no commission, he left his country and joined the Mexican navy. He served in the war against Spain, and underwent m any adventures. Returning to England, he started upon aliterary career, and in 1836-37 edited Tlie Monthly Repositoi-y. In the latter year he published two tragedies, Cosmo de' Medici and Tlie Death of Marlowe, and in 1841 a. History of Napoleon. The book, however, by which he alone lives in memory is his epic of Orion, which appeared in 1843. It was published originally at a farthing, was widely read, and passed through many editions. In the next year he set forth a volume of critical

essays called A New Spii-it of the Age, in the composition of which he was assisted by his friend Elizabeth Barrett, with whom, from 1839 to her marriage in 1846, he conducted a voluminous correspondence. In 1862 he went to Australia in company with William Howitt, and was away from England for seventeen years. On his return in 1869

he continued an industrious literary career, but none of his later works can be considered important. He died at Margate 13th March 1884. Home's extraordinary versatility resulted in a lack of concentration in performance : he was industrious and talented, but, except in the case of Orion, he neverattainedto a very high degree of distinction. That poem, indeed, has much of the quality of fine poetry ; it is earnest, vivid, and alive with spirit. But Horne early drove his talent too hard, and continued to write when he had little left to say. In criticism he had insight and quickness. He was one of the first to appreciate Keats and Tennyson, and he gave valuable encouragement

to Elizabeth Barrett. His old age was rich in memories of the beginnings of the leading spirits of Victorian poetry. (a. wa.)

Hornellsville, a city of Steuben county, New York, U.S.A., on the river Canisteo, at an altitude of 1161 feet. It is on the Erie and the Pittsburg, Shawmut and JSTorthern railways. The car works of the Erie railway are located here. Population (1880), 8195 ; (1890), 10,996; (1900), 11,918, of whom 1230 were foreign-born.

Horodenka, a district town and manufacturing centre in eastern Galicia, on a southern tributary of the Dniester. It has considerable corn trade, and manufacture ■of soap, candles, potash, &c. Population, chiefly Euthen-ians (1890), 11,162 ; (1900), 11,615.

Horowitz, the chief town of a government district in West Bohemia, Austria, a station on the railway between Prague and Pilsen. It has manufactures of enamelled wares and matches, corn-milling and brewing. Population, Czech (1900), 3570.

Horse-breeding. See Ageicultuke.

Horse-racing. — Gebat Britain. Horse-racing, usually described as " the national sport," has greatly advanced in general popularity. The effect of this is not virhoUy satisfactory, because of the large amount of gambling thus encouraged, with its inevitable evils ; but there is no doubt that the best specimens of the English thoroughhred horse are the finest animals of their kind in existence. The value of an infusion of the blood for chargers, hunters, hacks, and other varieties is scarcely to be overestimated ; and the only way of ascertaining what animals may be most judiciously employed for breeding purposes is to submit them to the tests of preparation for and performance on the Turf. Kacing is therefore a practical necessity. On some accepted authority, the origin of which is not to be traced, five races run each season by three-year-olds are distinguished as "-classic." Of these the chief. Classic \yy universal consent, is the Derby, which takes ^ng^nd. plaice at Epsom during the week which includes the 31st May. The Epsom course, on which the

Derby has been run since its origin in 1780, is by no means a good one, in consequence of the abrupt turn at Tattenham Corner ; and the severe descent after this turn is made is also held to be a disadvantage, though a really good horse should be able to act on ascents, descents, and level ground with equal facility. In many respects the St Leger, run at Doncaster about the middle of September, is a better test, as here colts and fillies meet when both are presumably able to do themselves the fullest justice. September, indeed, has been called " the Mares' Month," for though fillies are eligible to run in the Derby, they are very frequently out of sorts and always more or less uncertain in their performances during the summer — only three have been successful in 121 contests for the stake — whereas in the autumn their numerous victories in the St Leger prove them to be at their best. During the period 1884-94 fillies, who now carry 3 ft less than colts, won the St Leger on twelve occasions — an undue proportion, as not 15 per cent, of the runners were mares, — and it was the recognition of this fact which induced

an alteration of the weights in the year 1882, previously to which fillies had carried 5 ft less than colts. The Doncaster course is superior for racing purposes to that at Epsom, where the Oaks, another of the " classic races," is run on the Friday following the Derby ; the other two contests which come into this category being the Two Thousand Guineas for colts and fillies, and the One Thousand Guineas for fillies only. These races take place at Newmarket during the First Spring Meeting, the former always on a Wednesday, the latter on Friday. The expression " a Derby horse " is common, but has no precise significance, as the three-year-olds vary much in capacity from year to year. It is generally understood, for instance, that Ormonde, who won the Derby in 1886, must have been at least 2 stone superior to Sir Visto or Jeddah, who were successful in 1895 and 1898. By their ability to carry weight the value of horses is estimated on the Turf. Thus one horse which beats another by a length over a distance of a mile would be described as a 5-ft better animal.

The term "handicap horse" once had a significance which it does not now possess. In handicaps horses carry weight according to their presumed capacity, as calculated by handicappers who are orsJs" licensed by the Jockey Club and employed by the directors of different meetings. The idea of a handicap is to afford chances of success to animals which would have no prospect of winning if they met their rivals on equal terms ; but of late years the value of handicaps has been so greatly increased that few owners resist the temptation of taking part in them. Horses nowadays which do not run in this kind of contest are very rare, though a few, such as Ormonde, Isinglass, and Persimmon, never condescended to what may be regarded as an inferior class of sport. The late duke of Westminster did not hesitate to put his Derby winner Bend Or into some of the chief handicaps ; and it is, of course, a great test of merit when horses run in these contests, and, carrying heavy weights, show marked superiority to rivals of good reputation more lightly burdened. St Gatien, who won the

Derby in 1884 ; Eobert the Devil, who won the St Leger in 1880 and on several occasions beat the Derby winner Bend Or ; and La Fleche, who won the Oaks and the St Leger in 1892, added to the esteem in which they were held by their successes under heavy weights, the colts in the Cesarewitch, the filly in the Cambridgeshire. Of the chief handicaps of the year, special mention may be made of the City and Suburban, run at the Epsom Spring Meeting over a mile and a quarter ; the Kempton Park Jubilee, over a mile ; the Ascot Stakes, two miles, and the Eoyal Hunt Cup, one mile; the Stewards' Cup at Goodwood, six furlongs; the Cesarewitch Stakes, and the Cambridgeshire Stakes at Newmarket, the former two miles and a quarter, the latter 2000 yards, otherwise described as " a mile and a distance " — a distance on the Turf being a fixed limit of 240 yards. The cups at Man-chester and Liverpool are also handicaps of some note, though it may be remarked that the expression " a cup horse" is understood to imply an animal capable of dis-tinguishing himself over a long distance at even weights

against the best opponents. There are many other valu-

able stakes of almost equal importance, diminishing to

what are known as " selling handicaps," the winners of

which are always put up for sale by auction immediately

after the race, in the lowest class of them the condition

being that the winner is to be offered for £50. No stake

of less than £100 can be run for under Jockey Club rules,

■*which govern all reputable flat racing in England, nor is any-*

horse ever entered to be sold for less than £50. As horses

mature they are naturally able to carry heavier weights.

Scale of Weight for Age.

The following scale of weight for age is published under the

sanction of the Stewards of the Jockey Club as a guide to managers

of race meetings, but is not intended to be imperative, especially

as regards the weights of two- and three-year-olds relatively to the

old horses in selling races early in the year. It is founded on the

scale published by Admiral Rous, and revised by him in 1873, but

has been modified in accordance with suggestions from the principal trainers and practical authorities.

Age.

Mar. &

April,

May.

June.

July.

August.

Sept.

Oct. &

Nov.

St. lb.

St. ft.

St. ft.

St. ft.

St. ft.

St.

ft.

St. ft.

Five Furlongs.

Two years

6 0

6 2

6 7

6 9

7 0

7

4

7 7

Three years .

8 2

8 3

8 5

8 7

8 9

8

10

8 11

Four years .

9 0

9 0

9 0

9 0

9 0

9

0

9 0

Five, six, and

aged

9 1

9 0

9 0

9 0

9 0

9

0

9 0

Six Furlongs.

Two years

6 0

6 4

6 7

6 11

7 0

7

5

7 7

Three years .

8 4

8 6

8 8

8 10

8 12

9

0

9 2

Four years .

9 7

9 7

9 7

9 7

9 7

9

7

9 7

Five, six, and

aged .

9 9

9 8

9 7

9 7

9 7

9

7

9 7

One Mile.

Two years

...

...

6

5

6 7

Three years .

7“‘9

7 11

7' 13

8 2

8 4

8

5

8 6

Four years .

9 0

9 0

9 0

9 0

9 0

9

0

9 0

Five, six, and

aged .

9 4

9 3

9 2

9 0

9 0

9

0

9 0

One Mile and a Half.

1

Two years

...

...

6

0

6 4

Three years

i”i

7“‘9

7”il

7 13

8 1

8

3

8 5

Four years

9 0

9 0

9 0

9 0

9 0

9

0

9 0

Five, six, and

aged .

9 5

9 4

9 3

9 2

9 1

9

0

9 0

Two Miles.

Two years

...

...

...

6

0

6 2

Three years .

7 8

7 11

7' “12

8 0

8 3

8

4

8 5

Four years .

9 4

9 4

9 4

9 4

9 4

9

4

9 4

Five, six, and

^

aged .

9 10

9 9

9 8

9 7

9 6

9

5

9 4

Three Miles.

Three years .

7 1

7 4

7 5

7 7

7 9

7

11

7 13

Four years .

9 0

9 0

9 0

9 0

9 0

9

0

9 0

Five years

9 8

9 7

9 6

9 5

9 5

9

4

9 3

Six and aged .

9 10

9 8

9 7

9 6

9 5

9

4

In the year 1884 the managers of Sandown Park formulated the scheme of a race for a prize of £10,000, to be called the Eclipse Stakes, and to be run over £10,000 ^ distance of a mile and a quarter. In order to secure a large entry, horses were to be nominated soon after their birth ; owners who perceived the hopelessness of their nomination could withdraw at stated intervals by the payment of increasing forfeits ; if their animals finally went to the post a stake amounting in all to £115 would have to be paid for them ; and thus it will be seen that owners were really running for their own money, though if there were an insufficient number of entries the funds of the club might be taxed to supply the deficiency. The scheme was found to be attractive, and the example was followed at Leicester and at Manchester, at both of which places, however, it lapsed. At Newmarket, under the immediate auspices of the Jockey Club, the £10,000 races succeeded, and there are two of them each year. The Princess of Wales's Stakes was run

for the first time in 1894 at the First July Meeting, and the Jockey Club Stakes at the First October. These three events, the Eclipse, Princess of Wales's, and Jockey Club Stakes, appear to be well established. In the year 1900 a fourth race of similar character, the Century Stakes, was originated at Sandown, but the experiment proved a failure, and the contest was discontinued.

The age of the thoroughbred horse is always dated from the 1st January. Foals are generally born in February, March, or April, though not a few good horses have been born in May ; they become yearlings, „,,a^^^s. therefore, on the 1st January following, two-year-olds twelve months later, and many of them begin to race in the following March, for flat racing always starts during the week which contains the 25th, except when Easter falls unusually early. In France no two-year-olds run until the 1st August, and discussion is frequently raised as to the respective wisdom of the English and French systems. It happens, however, that some young horses "come to hand" soon, and deteriorate with equal

rapidity. They are, in fact, able to win races at the beginning of the season, and fail to hold their own later in the year against larger and more powerful animals of their own age who have taken longer to mature ; so that there is some argument in favour of the earlier date. The first noteworthy two-year-old race is the Brocklesby Stakes, run at Lincoln during the first week of the season. Sometimes the winner of the Brocklesby is really a good animal, as was the case with The Bard in 1885 and Donovan in 1888, but as a general rule when the autumn comes he is found to be far inferior to the winners of subsequent two-year-old races of good class. It is seldom that a first-class two-year-old appears before the Ascot Meeting about the middle of June, though horses of character sometimes run for the Woodcote Stakes at Epsom and in other contests elsewhere. The names of many of the most famous horses on the Turf are found in the list of winners of the New Stakes at Ascot, which was first run in 1843 and maintains its character. In 1890 the Coventry Stakes was originated,

and is regarded as a race of practically equal importance. The July Stakes at Newmarket is the oldest of existing two-year-old races, having been first run in 1786. The list of winners is a brilliant one. The Chesterfield Stakes ranks with it. The best two-year-olds are usually seen out at Goodwood, and as a general rule those that have chiefly distinguished themselves during the year, and are to make names for themselves later in life, are found contesting the Middle Park Plate at the Newmarket Second October Meeting and the Dewhurst Plate at the Newmarket Houghton. The Middle Park Plate is usually worth over £2000, the other races named are between £1000 and £2000 in value; but these are not the richest two-year-old prizes of the year, the value of the National Breeders' Produce Stakes at Sandown, run on the day following the Eclipse, being between £4000 and £5000, and the Imperial Stakes at Kempton Park being usually worth close on £3000. As a rule, a colt which has been specially successful as a two-year-old maintains his capacity later in life, unless it be found that he cannot " stay "

— that is to say, is unable to maintain his best speed over more than five or six furlongs ; but it is very frequently the case that fillies which have won good races as two-year-olds entirely lose their form and meet with little or no success afterwards.

Newmarket is called with reason " the headquarters of the Turf." There are about forty training establishments in the town, each trainer having under his charge an average of some forty horses, irrespective of mares, foals, and yearlings. During the year eight race meetings are held on the Heath : the Craven ; the First and Second Spring; the First and Second October — the First October usually occurring at the. end of September ; and the Houghton. These are contested on " the Flat," the course which includes the Rowley Mile.

New-

market.

It is said that the Eowley Mile is so called from the fact

of its having been a favourite race-ground with Charles II. The First and Second July Meetings take place on another course, known as " Behind the Ditch," the Ditch being the huge embankment which runs through several counties and has existed from time immemorial. The Craven Stakes for three-year-olds is an event of some importance at the first meeting of the year, and this race finishes on an ascent at what is called the " Top of the Town," a course over which the handicap for the Cambridgeshire used to be run, though only some half-dozen races are now contested up this hill. At the First Spring Meeting the Two Thousand Guineas and the One Thousand Guineas occur, as already stated, but the names do not represent the values of the stakes, which are, in fact, usually worth close on £5000 each. The July Stakes and the Princess of Wales's Stakes are run at the First July Meeting. The Jockey Club Stakes is the leading event of the First October; the Cesarewitch and the Middle Park Plates follow in the Second October ; the Criterion Stakes, another of the few races that finish at

the "Top of the Town," the Cambridgeshire and the Dewhurst Plate take place at the Houghton Meeting. The majority of races finish at the Eowley Mile post; but there are three other winning-posts along the Eowley Mile, and there is, of course, another at the " Top of the Town." " Behind the Ditch " races finish at two different posts, one of which enables horses to avoid the necessity of galloping up the severe ascent of the " Bunbury Mile." Although, as a rule, there is no better racing to be seen than the best events at jSTewmarket, the Ascot and programmes are often spun out by selling plates "meMogs. ^^d paltry handicaps, and a high level is nowhere so consistently maintained as at Ascot.

The Ascot meeting is distinguished by the entire absence of selling plates, and much more " added money " is given than on any other course. Added money is the sum supplied by the liiTeetors of a race meeting, derived by them from the amounts paid for entrances to stands and enclosures ; for in many races — the Ten Thousand prizes, for instance — owners run mainly or entirely for

sums which they have themselves provided. The Ascot Cup is generally spoken of as a race success in which sets the seal to the fame of a good horse. It is a prize of the highest distinction, and of late years has been of considerable value, the winner in 1901 having gained for his owner £3560. That the number of runners for this race should be invariably small — the average for many years past has been under five — is not a matter of sur-prise to those who are familiar with the Turf. There are very few horses possessing sufiicient speed and stay-ing power to make it worth the while of their owners to submit them to the exceedingly severe test of a preparar tion for this race, which is run over two and a half miles of ground at a time of year when the turf is almost always extremely hard everywhere, and harder at Ascot than almost anywhere else. There is no course on which more good horses have hopelessly broken down. The prizes there are handsome, and success at Ascot confers much prestige, for the reason that the majority of horses that run are good ones ; but annually there is a list of

victims that never recover from the effects of galloping on this ground. Goodwood also attracts horses of high character, though some unimportant races fill out the programme. Formerly there were many meetings around London, which fell into disrepute in consequence of the manner in which they were conducted. These have been replaced by well-managed gatherings in enclosed parks, and here the value of the prizes is often so high that the best horses in training are attracted. These meetings include Sandown, Kempton, Gatwick, Lingfield and Hurst Parks. Liverpool, Manchester, Birmingham, Brighton, York, and various other towns have race meetings twice or oftener in the course of each year. At the various fixtures over half a million of money is annually given in stakes. The largest sum ever won by a horse was the £57,185 gained by Isinglass in 1892-95. Donovan follows with £54,935. In all probability these large totals would have been considerably exceeded had not Flying Fox — who had won in his first two seasons £40,090 — been disqualified by the death of his owner,

the duke of Westminster, as this colt was engaged in the four £10,000 races of 1900, in which to all appearance he could not have been beaten, so much was he superior to his contemporaries. The death of an owner of horses disqualifies the animals he has entered — a necessary regulation, as otherwise an heir might be burdened with a stable of horses the possession of which would entail heavy expense and serious responsibility on a person who perhaps had no knowledge of or taste for racing.

The value of an unquestionably good horse is enormous. It has been seen what handsome prizes are offered for competition, and when withdrawn from the Turf the horse may secure a large in- ^torsetl come to his owner at the stud. A stallion's fee of 600 guineas (as in the case of St Simon) should mean well over £20,000 a year; and fees of 100 guineas and more are common. Proved merit on the Turf is considered essential in a sire, though there have been instances of horses, unsuccessful during their racing career,

who have distinguished themselves at the stud: Wisdom, sire of the Derby winner Sir Hugo, and several notable examples might be cited. Mares are much more uncertain in this respect. On the whole, the famous mares that have won the Oaks, the St Leger, and other leading races have been apt to fail in the paddocks ; but there is always a hope of success with them, and the large sum of 12,600 guineas was paid for La Flfeche when she had ceased from active service on the Turf. For None-the-Wiser 7200 guineas was given ; and 4600 guineas for Wedlock when well advanced in years, on the strength of her having been the dam of a good horse called Best Man. Well-bred mares that have shown no capacity for racing are, however, frequently the dams of good winners. Breeding is a lottery. An Australian enthusiast some years since published a book the object of which was to enable breeders to produce good horses by a species of mathematical calculation ; but the fallacy of the "Figure System" was at once proved by the simple circumstance that in very many cases the own brothers

and sisters of good winners, whose breeding conformed entirely to the system, proved to be utterly worthless for racing purposes. It is a fact difficult of explanation • that the majority of famous winners have been privately bred by their owners. Many persons breed for sale, in some cases sparing no expense or trouble in the endeavour to secure good results, and yearlings sold by auction have fetched prices of from 10,000 guineas (paid for Sceptre, a daughter of Persimmon and Ornament, in 1900) downwards ; sums of over 1000 guineas being frequently given. That so large a proportion of high-priced yearlings should turn out failures is not at all a matter for surprise, considering the uncertainties of the Turf, but it by no means follows that a high-priced yearling is necessarily an expensive animal ; 5500 guineas was, for instance, given for La Fleche, who won for her owner £34,585 in stakes, and, as already observed, was subsequently sold for 12,600 guineas. The principal yearling sales take place during the July meeting at Newmarket and the Doncaster meeting in September. There are also

sales at Ascot and elsewhere. The Eoyal Stud at Bushey

Park, where Memoir, La Fleche, Best Man, and other

good, animals were bred, has now been abandoned.

In many cases trainers have graduated from jockeys.

The usual charge to an owner is 50s. a week per horse,

but, as regards the cost of a horse in train-

amt”” ” ing, to this there are various additions irre-

lockeys. spective of entrances to races, forfeits, travel-

ling, jockeys’ fees, &c. The recognized sum paid

to a jockey is 3 guineas for a losing mount, 5 guineas

for winning. In many cases special terms are made ;

the principal owners usually have a claim on a rider’s

services, and for this call as much as £6000 per

annum, exclusive of the usual riding fees, has been

given.

From time immemorial until within a very recent period

jockeys rode in much the same style, though, of course,

with varying degrees of skill. Many hundreds of boys

exercise daily at Newmarket and other training grounds, all of them necessarily having a tight seat in the saddle, for the thoroughbred horse is, as a rule, high-couraged and apt to play violent tricks ; but though most of these lads find chances to distinguish themselves in trials and races for apprentices, probably not five per cent, grow into professional jockeys, increasing weight keeping many from the business, as a jockey has few chances unless he can ride well under 9 stone. Knowledge of pace is a rare gift or acquisition which is essential to successful jockeyship. The rider must also be quick to perceive how his own horse is going — what he has " left in him " ; he must understand at a glance which of his rivals are beaten and which are still likely to be dangerous ; must know when the moment comes for the supreme effort to be made, and how to balance and prepare the horse for that critical struggle. At the beginning of the race the jockey us«d to stand in his stirrups, with the idea of removing weight from the horse's back and preserving perfect steadiness ; towards the end of the race, if it were neces-

sary to drive the animal home, he sat down " to finish." This method used to be adopted in all countries, but recently a new system came into practice in America. Instead of putting the saddle in the middle of the horse's back, where it had always been placed previously, it was shifted forward on to the animal's withers. The jockey rode with very short stirrups, leaning forward overthe neck and grasping the reins within a few inches of the horse's mouth. The appearance of this was ungainly in the extreme and an entire departure from ancient ways (though Fordham and a few other riders of great reputation had always sat much more forward than their contemporaries), but it was found to be remarkably effective. From the position thus adopted there was less resistance to the wind, and though the saving in this respect was largely exaggerated, in racing, where success or failure is frequently a matter of a very few inches, every little that helps is to be considered. The value of the discovery lay almost entirely in the fact that the horse carries weight better — and is therefore able to stride out more freely —

when it is placed well forward on his shoulders. With characteristic conservatism the English were slow to accept the new plan. Several American jockeys, how-ever, came to England. In all the main attributes of horsemanship there was no reason to believe that they were in the least superior to English jockeys, but their constant successes required explanation, and the only way to account for them appeared to be that horses derived a marked advantage from the new system of saddling. A number of English riders followed the American lead, and those that did so met with an unusual degree of success. Kace-riding, indeed, was in a very great measure revolu-tionized in the closing years of the 19th century.

In the ninth edition of the Encyclopaedia Britannica it was noted of American horses that " on the whole they have not been very successful." This can ^ ^ be said no longer. Of late years American bZsfs" horses — bred, it must always be remembered, from stock imported from England — have won many races in England. Australian horses have also been sent to

the mother country, with results remunerative to their owners, and the intermixture of blood which will necessarily result should have beneficial consequences. French horses — i.e., horses bred in France from immediate or from more or less remote English parentage — have also on various occasions distinguished themselves on English racecourses. That coveted trophy, the Ascot Cup, was won by a French horse. Elf II., in 1898, it having fallen also to the French-bred Verneuil in 1878, to Boiard in 1874, to Henry in 1872, and to Mortemer in 1871. In the Cesarewitch Plaisanterie (3 yrs., 7 st. 8 lb) and Tenebreuse (4 yrs., 8 st. 12 lb) were successful in 1885 and 1888; and Plaisanterie also carried off the Cambridgeshire as a three-year-old with the heavy weight of 8 st. 12 lb in a field of 27 runners. In not a few respects racing in France is conducted with praiseworthy discrimination. There are scarcely any of the five- and six-furlong scrambles for horses over two years old which are such common features of English programmes.

That the horses which have covered various distances

in the shortest times on record must have been exception-

ally speedy animals is obvious. The times of

races, however, frequently form a most deceptive “■*

basis in any attempt to gauge the relative capacity of horses.

A good animal will often win a race in bad time, for the

reason that his opponents are unable to make him exert

himself to the utmost. Not seldom a race is described as

havingbeen “won in a canter,” and this necessarily signifies

that if the winner had been pressed to gallop he would

have completed the course more quickly. The following

figures (from the Sjoortsman) show the shortest times that

have been occupied in winning over various distances : —

One mile ....

Rowley Mile (1 m. 11 yds.)

One mile and a quarter .

One mile and a half

One mile and three-quarters . ‘

Five furlongs ....

Six furlongs ....

One mile and three furlongs .

1 33J

1 404

2 3i

*. 2 40^*

2 401

2 40

2 34

. 2 871

2 31

. 2 30f

2 31f

*2 59^*

*0 57^*

1 7i

*2 \^*

. Previous

aCaiman .

6Galtee More .

cFancy Man .

dVolodyovski .

eMemoir .

/Bend Or

giLandrail

/iCarbiston

iSantoi

jAvidity .

^King's Courier

morizel II

mOthery .

n Master Willie

oFatherless

a. At Lingfield, 13th July 1900. 6, Two Thousand.

fastest, 1 min. 42^ sees, by Marco in Payne Stakes, Newmarl;et,

16th May 1895; 1 min. 42 g sees, by Kirkoonnel and Isinglass;

and 1 min. 42f sees, by Amphion, wlio carried 10 st. 1 lb, in tlie

March Stakes in 1891. c. At Manchester, in Prince Edward

Handicap, 28th September 1901. d, The Derby, 1901. e, The

Oaks, 1890. /, At Epsom, in the Gold Cup, 1881. g, At Don-

caster, 8th September 1899. h, At York, in Duke of York

Stakes, 23rd August 1899. i. At Hurst Park, in Great Whitsun-

tide Handicap, 27th Jlay 1901. j. At Doncaster, in Alexandra

Plate, 13th September 1900. k, At Hurst Park, in September

Handicap, 22nd September 1900. I, At Manchester, in the Cup,

7th June 1896. m, At Ep.som, 19th April 1898. n, At Epsom, in

Royal Stakes, tith June 1901. o. At Nottingham, 1st October 189r>.

As regards time in famous races, Ormonde, perhaps

the best horse of the 19th century — one, at any rate, that

can scarcely have had a superior — occupied 2 minutes

45f seconds in winning the Derby ; and Lonely, one of

the worst mares that have won the Oaks, galloped the

the same mile and a half in 2 seconds less. Ormonde's

St Leger time was 3 m. 21| s., and Sir Visto, prob-

ably the poorest specimen of a winner of the great

Doncaster race, took 3 m. 18f s. Weight " brings horses

together," as the phrase runs — ^that is to say, equalizes

their chances ; hence handicaps, the carrying of penalties

by winners, and " maiden allowances " : a horse that has

never won, and is therefore known as a " maiden," often

has an allowance of 7 lb.

Sport is carried on under the auspices of the. Jockey Club, a self-elected body of the highest standing, whose powers are absolute and whose sway is judici-CTif/.”””*”” °” ^^ *beneficent. Three stewards, one of whom retires each year, when a successor is nominated, govern the active — and extremely arduous — work of the Club. They grant licenses to trainers and jockeys and all officials, and supervise the whole business of racing. The stewards of the Jockey Club are ex officio stewards of Ascot, Epsom, Goodwood, and Don-caster. All other meetings are controlled by stewards, usually well-known patrons of the Turf invited to act by the projectors of the fixture, who settle disputed points, hear and adjudicate on objections, &c., and, if special difficulties arise, report to the stewards of the Jockey Club, whose decision is final.*

Steeplecliasing. — Steeplechasing has altered entirely since the first introduction of this essentially British sport. In early days men were accustomed to match

*their hunters against each other and ride across country to a fixed point near to some steeple which guided them on their way ; and this is no doubt, in several respects, a class of sport superior to that now practised under the name of steeplechasing; for it tested the capacity of the horse to jump fences of all descriptions, and pro- vided the rider with opportunities of showing his readi- ness and skill in picking the best line of country. But racing of this kind afforded spectators a very small chance of watching the struggle; and made-up steeplechase courses, the whole circuit of which could be viewed from the enclosures, came into existence. The steeplechase horse has also changed. The speed of the thoroughbred is so much greater than that of all other breeds that if one were in the field, if he only stood up and could steeple- jump a little, his success was certain; eonse- hwses. quently, except in " point-to-point " races, organ- ized by various hunts, where a qualification is that all starters must have been regularly ridden with hounds, none other than thoroughbred horses are nowa^*

days ever found in races run under the rules of the National Hunt Committee, the body which governs the sport of steeplechasing. A considerable proportion of existing steeplechase horses have done duty on the flat. Members of certain equine families display a special aptitude for jumping; thus the descendants of Hermit, who won the Derby in 1867, are very frequently successful in steeplechases — Hermit's son Ascetic, the sire of Cloister, Hidden Mystery, and other good winners, is a notable case in point. The sons and daughters of Timothy and of several other Hermit horses often jump well. When a flat-race horse appears to have comparatively poor prospects of winning under Jockey Club rules, he is frequently, if he "looks like jumping," schooled for chasing, usually in the first place over hurdles, and subsequently over what is technically called "a country," beginning with small fences, over which he canters, led by some steady animal who is to be depended on to show the way. A great many steeplechase horses also come from Ireland. They are usually recognizable as thorough-

bred, though it is possible that in some cases the name of an ancestor may be missing from the Stud Book. Irish horse-masters are for the most part particularly skilful in schooling jumpers, and the grass and climate of Ireland appear to have beneficial effects on young stock ; but as a rule the imported Irish horse improves considerably in an English training-stable, where he is better fed and groomed than in most Irish establishments. All steeple-chase courses must at the present time contain certain regulation jumps, the nature of which is specified in the National Hunt rules : —

44. In all steeplechase courses there shall be at least twelve fences (exclusive of hurdles) In the first 2 miles, and at least six fences in each succeeding mile. There shall be a water jump at least 12 feet wide and 2 feet deep, to be left open, or guarded only by a perpendicular fence not exceeding 2 feet in height. There shall be in each mile at least one ditch 6 feet wide and 3 feet deep on the taking-off side of the fence, which ditch may be guarded by a single rail, or left open, and which fence must be 4 feet 6 inches in height, and, if of dead brushwood or gorse, 2 feet in width.

45. In all hurdle-race courses there shall be not less than eight flights of hurdles in the first 2 miles, with an additional flight of hurdles for every quarter of a mile or part of one beyond that distance, the height of the hurdles being not less than 3 feet 6 inches from the bottom bar to the top bar.

Natural fences would no doubt be desirable if they could be utilized ; but it is obvious that fences must be made up, because when the same hedge is jumped frequently, and for the most part in the same place — as it is the object of riders to go the shortest way round — gaps would necessarily be made. The use of these made courses naturally renders the sport somewhat artificial, but under existing conditions this is unavoidable ; and as a matter of fact, by reason of the conformation of the ground, the arrangement and make of the fences, courses do vary in no small degree. The steeplechase horse differs from the hunter in his method of jumping. In riding to hounds a man usually steadies his horse at a fence, and in almost “ ” ” “ ^’ every case the animal ” dwells ” more or less after the

leap. In a steeplechase, where speed is everything, horses must be taught to dash resolutely at their jumps without hesitation, and to get away with no pause on the other side ; as a rule, therefore, an old steeplechase horse who is employed as a hunter is rarely a pleasant mount for any but a bold rider. It has been remarked that steeplechase horses are usually in the first place schooled over hurdles, and many anim als remain hurdle racers till the end. More speed is required for hurdles than for a steeplechase course, and there is more money to be won over hurdles than over " a country." No hurdle race is worth so much as the Grand National or the Lancashire Handicap Steeple-chase, the two richest prizes now offered; but, with the exception of these, hurdle-race stakes are as a rule of greater v'alue. Except as a spectacle, there is little to be said in defence of this mongrel business, which is neither one thing nor the other ; but hurdle races are popular, and are therefore likely to continue. A few years ago an attempt was made to discriminate between what were called " hunters " and handicap steeplechase horses, and

certain races were only open to the former class.

*It proved, however, to be a distinction without ^j" **"*

a difference; thoroughbred horses crept into steeple-

the ranks of the so-called hunters, and when cbase

nominal hunters began to be entered for, and in

some cases to win, the Grand National and other important

steeplechases, for which they could be nominated by

abandoning their qualification of hunter, the meaningless

title was relinquished. Still more absurd were the hunters'

flat races of a former day. In order to compete in these

the rule was that an owner must produce a certificate from

a master of hounds to the effect that his horse had been

hunted. Thoroughbreds who lacked speed to win under

Jockey Club rules used to be ridden to a meet, perhaps

cantered across a field or two, and were then supposed to

have become hunters. Animals which were genuinely and

regularly utilized for the pursuit of foxes had of course no

chance against these race-horses in shallow disguise. What

are called National Hunt flat races still exist, the qualifica-

tion being that a horse must have been placed first, second, or third in a steeplechase in Great Britain or Ireland, after having jumped all the fences and completed the whole distance of the race to the satisfaction of at least two of the stewards, to whom previous notice must have been given in writing. There are no handicaps for such animals, and none is allowed to carry less than 11 stone. No race under National Hunt rules can be of a shorter distance than 2 miles, and the lowest weight carried can never be less than 10 stone except in a handicap steeplechase of 3J miles or upwards, when the lowest weight may be 9 st. 7 ft.

Horses are ridden in these races either by gentlemen, or qualified riders, or jockeys. The first of these classes comprises officers on full pay in the army or navy, persons holding commissions under the Crown, bearing titles either in their own right or by courtesy, or members of certain social and racing clubs.

Qualified riders may be farmers holding at least a hundred acres of land, their sons if following the same occupation, and persons elected by members of the National Hunt Committee, a proviso being that they must never have ridden for hire, but it is feared that this rule is in not a few cases evaded. Professional jockeys are paid £5 for each mount, or £10 if they win. The sport is governed by the National Hunt Committee, a body which receives delegated powers from the Jockey Club, and six stewards are elected every year to supervise the business of the various meetings. Steeplechases and hurdle races are either handicaps or weight-for-age races according to the following scale : —

For Steeplechases ofS miles and upwards,

From the 1st of Januaiy to the 30th of June, both inclusive : —

4 yrs. 5 yrs. 6 and aged

10 St. 3 ft 11 St. 8 lb 12 St. 3 ft

From the 1st of July to the 31st of December, both inclusive : —

4 yrs. 5 yrs. 6 and aged

11 St. 11 St. 12 ft 12 St. 3 ft

For Steeplechases of less than 3 miles.

Prom the 1st of January to the 30th of June, both inclusive : —

4 yrs. 5 yrs. 6 and aged

10 St. 10 ft) 11 St. 10 ft 12 St. 3 ft

From the 1st of July to the 3 1st of December, both inclusive ; —

4 yrs. 5 yrs. 6 and aged

11 St. 6ft 12 St. 12 St. 3 ft

For Hurdle Baces.

Prom the 1st of January to the 31st of August, inclusive : —

4 yrs. 5 yrs. 6 and aged

11 St. 6ft 11 St. 10 ft 12 St. 0 ft

Prom the 1st of September to the 31st of December, inclusive : —

3 yrs. 4 yrs. 5, 6, and aged

10 St. 7ft 11 St. 12 ft 12 St. 3 ft

The great test of merit in a steeplechase horse is

success in the Grand National, which is always run at

Liverpool during the first week of the flat-racing

Natioaa”^ season. The course is 4|- miles, and includes

thirty jumps, the fences being for the most part

larger than are found elsewhere. The average time occu-

pied is about ten minutes. The stake has varied in value since the race was originated in 1839 ; it now amounts to close on £2000. Only a very small percentage of steeplechase horses possess the speed and staying power to give them a chance in this race, and the number of entries year by year falls considerably short of a hundred, the prospects of many of these usually appearing hopeless to all but unduly sanguine owners. The average number of starters during the period 1860-1901 was rather over twenty. As many as thirty competed in 1866, when Salamander won ; in 1883, when Zoedone, ridden by her owner, Count Kinsky, was successful, only ten went to the post. Mishaps are almost invariably numerous ; in 1890, of sixteen starters no fewer than eleven fell. So severe is the task that for a long time many good judges of steeplechasing believed that no horse with nuore than 12 stone on his back could possibly win. In 1893, however, Cloister won in a canter by forty lengths carrying 12 St. 7 ft, and with the same weight Manifesto also won in 1899. The race which most nearly approaches

the Grand National in importance is the Lancashire Handicap Steeplechase, run at Manchester over Si-miles early in April. The stake is worth about £1750. An interesting steeplechase called the Grand Sefton takes place at Liverpool about the middle of November ; the distance is 3 miles. During the winter, and extend-ing into the spring, steeplechasing and hurdle racing are carried on at Sandown, Kempton, Gatwick, Lingfield, and Hurst Park ; at Ludlow, Newmarket, Aldershot, Birmingham, Manchester, Windsor, and other places. A race called the National Hunt Steeplechase, under the immediate patronage of the National Hunt Committee, takes place annually ; it is run over a 4-mile course, the stake being £1000. Managers of various courses bid for the privilege of having the race on their ground, and it is therefore run in different localities. A condition is that no horse who has ever won a race can compete ; and, as few owners are willing to keep their animals with a view to success in this event, the field consists either of unknown horses or of those that have been beaten.

Australia. — Kacing in Australia has its headquarters at Sydney, under the government of the Australian Jockey Club, the principal course being at Eanwick; and at Melbourne, where the Victoria Jockey Club is supreme, the principal course being at Flemington. In New Zealand sport is carried on under the authority of delegates from^ the chief racing clubs, who meet in conference. There is a Sydney Derby and a Victoria Derby, and a notable event at Flemington is the Champion Eace, weight-for-age, for three-year-olds and Tipwards, which, usually attracts the best horses in training, as the fee at which a sire stands depends in a great measure on his success in this contest. This race is over a distance of 3 miles, and to ensure a good pace there is a regulation that the time in which it is run must not exceed 5 minutes 40 seconds, though the stewards have power to extend this in case the ground should be made exceptionally heavy by rainy weather. The Melbourne Cup is regarded as one of the most important races in the state. This is a handicap, and in comparison with

English races may perhaps be ranked with the Cesare-witch. The birth of horses dates from the 1st of August, which corresponds as nearly as possible to the 1st of February in England, so that the Australian horses are practically seven months younger than the English — a matter of some importance in the case of those sent to run in England. There are few races which close long before the date of decision, and practically all the good animals run in handicaps. The five- and six-furlong races for other than two-year-olds, so common in Great Britain, are extremely rare ; and it is asserted by colonial sports-men that their horses stay better than those bred in England, a circumstance which is largely attributed to the fact that mares and foals have much more liberty and exer-cise than is the case in the mother country. Horses brought to England from the colonies have certainly had a con-siderable share of success in recent years, though of course it must be assumed that only specially good ones, which have seemed likely to distinguish themselves, have been sent. The chief courses are carefully tended, the crowd

not being permitted to stray upon them, and some distance from the members' stands is erected what is called a •■' silence post," beyond which the bookmakers are not

allowed to ply their calling. An electric timing clock is fixed on the judge's box, set in motion when the starter's flag falls, and stopped as the winner passes the post, for the edification of those who wish to know the precise duration of the contest. The steeplechase and flat race-courses run side by side at lianwick and at most other places, separated by double rails, between which police patrol. The outer rail leans towards the horses, and is so shaped that a jockey can hardly meet with injury by having his leg crushed against it, and the steeplechase fences are high and strong ; indeed, their strength is so considerable that many spectators are in the habit of sitting on them to watch the flat racing. Logs, palings, posts and rails, and other severe jumps occur, and as the going is usually very hard, falls are frequently attended

by serious consequences.

Canada. — Canada is independent, and the racing there is in a very heterogeneous condition, though the Ontario Jockey Club leads the way and gives an excellent meeting every spring at Toronto.

United States. — Eacing in the United States, though in a transitory condition, has gradually been assuming definite and coherent form. Owing to the vast size of the country, there are various centres of sport, which can be classified with reasonable accuracy as follows : — the Eastern States, dominated by the Jockey Club, founded in 'New York in 1894, and recognized by a state law in 1895 ; the Middle Western States, under the control of the Western Jockey Club, whose headquarters are in Chicago; the Pacific Coast, with San Francisco for its centre ; and the Southern and South-Western States, with Louisville as the most important centre. The passage of the racing law in New York State marked the opening of a new era. Supreme even over the Jockey Club is a State Eacing Commission of three, appointed

by the governor of the state. While the Jockey Club is only recognized by law in its native state, it has assumed and maintains control of all racing on the eastern seaboard, within certain lines of latitude and longitude, extending as far north as the Canadian border and south to Georgia. There is small question that other states, both east and west, will follow suit and enact similar laws. The Western Jockey Club, though not recognized by law, controls practically all the racing through the middle west, south-west, and south ; but the racing asso-•ciations of the Pacific Coast have maintained a position of independence.

What New York is to the east, Chicago is to the middle west, and a very large proportion of American racing is ■conducted close to these centres. In New York State the Coney Island Jockey Club, at Sheepshead Bay ; the Brook-lyn Jockey Club, at Gravesend ; the Westchester Eacing Association, at Morris Park ; the Brighton Beach Eacing Association, at Brighton Beach; the Queen's County Jockey Club, at Aqueduct; and the Saratoga Eacing

Association, at Saratoga, are the leading organizations; and all these racecourses, with the exception of Saratoga, are within a radius of 20 miles of the city. The Empire City Jockey Club, near Yonkers, and a new club with headquarters near Jamaica, Long Island, are likely to be prominent in the near future. The Washington Park Club, at Chicago, is the leading Turf body of the West, and the only one on an equal footing with the prominent .associations of New York State. With this single exception the most important and valuable stakes of the American Turf are given in the East ; and so great has the prosperity of the Turf been since the Jockey Club came into existence, that the list of rich prizes is growing at a surprising rate. In this respect the principal fault is the undue encouragement given to the racing of two-year-olds. At the winter meetings held at New Orleans and San Francisco, two-year-olds are raced from the very beginning of the year; and under the rules of the Jockey Club of New York they run as early as March. The Westchester Eacing Association, with which are closely

identified some of the principal members of the Jockey Club, gives valuable two-year-old stakes in May. The Futurity Stakes, the richest event of the year — on one occasion it reached a value of f 67,676 — ^is for two-year-olds, and is run at Sheepshead Bay in the autumn. The institution of races, either absolutely or practically at weight-for-age, and over long courses, has engaged much attention. The Coney Island Jockey Club has the leading three-year-old stake in the Lawrence Eealization, over 1 mile 5 furlongs, with an average value of about $30,000. The Westchester Eacing Association's two principal three-year-old stakes, the Withers, over a mile, run in May, and the Belmont, 1 mile and 3 furlongs, run later in the same month, are of less value, but are much older-established and have a species of " classic " prestige, dating from the old Jerome Park racecourse in the 'sixties. The Coney Island Jockey Club's Century and the Annual Champion Stakes, both for three-year-olds and upwards, over a mile and a half and two miles and a quarter respectively, are fair specimens of the races the associations are

now founding. At Saratoga a stake of $50,000 for three-year-olds and upwards, distance a mile and a quarter, has been opened, to be run for first in 1904. The hope is to wean owners from the practice of overtaxing their two-year-olds, which has resulted practically in a positive dearth, almost a total absence, of good four-year-olds and upward of late years. Handicaps play a more important part than in England. The principal events of this character, such as the Brooklyn Handicap at Gravesend and the Suburban at Sheepshead Bay, have for years drawn the largest attendances of the racing season.

Practically all flat racing in the United States is held on " dirt-tracks," i.e., courses with soil specially prepared for racing, instead of turf courses. At Sheepshead Bay there is a turf course, but it is only used for a minority of races. Dirt-tracks, which are, like many other things in American racing, a legacy from the once hugely popular harness-racing, are conducive to great speed, but are costly in the extreme strain on horses' legs. Steeplechases are

run on turf. This branch of the sport in the East is now flourishing under the administration of the National Steeplechase and Hunt Association, a sister body of the Jockey Club. Comparatively few races are, however, run under these rules, as the weather conditions render it impossible to have a separate season for cross-country sport and steeplechases, and hurdle races are incorporated in programmes of flat racing held through the spring, summer, and autumn, though the ground is frequently so hard as to be unsafe. Since the National Steeplechase and Hunt Association assumed control, regulation courses, practically similar in every respect to those used in England, have been insisted upon in the East, the " open ditch " figuring under the name of the " Liverpool." In the West and South there is not the same uniformity, and so far the sport has not flourished.

The American thoroughbred blood of to-day, of course, originally came from England. Unfortunately but little is known of what was done in the way of racing in the colonial days, and the present era can only be traced

practically back to the importation into Virginia of Diom ed, winner of the first English Derby. In spite of his advanced age, he was a prolific stock-getter, and the old American pedigrees abound in his name, his descendants being inbred continuously. Since Diomed's day the importation of English stock has been constant. St Blaise, another Derby winner, had a brilliant success for a while.

but failed later in other hands when mated with mares of less fashionable family. Ormonde, bought for $150,000 to go to California, was a total failure ; but prior to these horses were many that built the American thoroughbred up to his present standard. Leamington was sent to America to race, but at the stud won undying fame, his blood " nicking " exactly with that of the American Lexington. Then there was Glenelg, the horse whose gameness until death " The Druid " told. His stock, in the female line especially, are invaluable. The French horses, Mortemer and Eayon d'Or, ended their days in the United

States, and the former did grand service. From Australia Sir Modred, Darebin, Maxim, Cheviot, and others came, especially to California. The recruits drawn from England have been practically numberless. Blue Gown, Ossory, and some more died on the way ; but American pedigrees are full of imported horses. Buckden was one of the comparatively early importations, and left a great mark. Galore, Meddler, and Atheling are among the later, and Meddler promises to be one of the great sires of the country. Many English horses of small reputation, such as Esher, or horses that were never raced in England, like Eothen, have done well when mated with American blood.

For the most part the betting system adopted in the United States is the same as in England. In New York State what are described as " personal wagers," i.e., bets between individuals on racecourses, are legal so long as no odds are displayed. Through the western states and in Canada odds are displayed on small blackboards, which are part of the appurtenances of stands, each occupied by

a bookmaker and his clerks. The pari-mutuel system was used, but is now practically abolished, being specifically named as illegal in the State of New York. The selling of pools at auction, which was once the medium of most of the big betting in America, is also discontinued ; and this too is illegal in New York. There is not a weekly settling day, as in England, but accounts are usually settled within twenty-four hours, unless by special arrangement.

In the United States interest in trotting races rivals that felt in the contests of thoroughbred horses. In the year 1834 a horse called Andrew Jackson trot-

"' ted a mile in 2 m. 42 s., that being the fastest time which had then ever been accomplished. This was regarded as something very remarkable, and when eleven days later, on 27th October, the horse improved the time by 4 seconds, some followers of the sport appear to have supposed that finality was reached. It was not until 1858 that any considerable reduction was made in the record,, in that year Ethan Allen having trotted a mile in 2 m.

28 s. In August 1874 Mambrino Gift was credited with 2 m. 20 s. For a time Goldsmith Maid held prominence with figures which she reduced in 1874 from 2 m. 16 s. to 2 m. 14 s., and in 1878 came Earns, who went a mile in a quarter of a second less, the small fraction being esteemed a great thing. Other notable performances reducing the record were St Julian in 1879, 2 m. 11| s. ; Maud S., 1881, 2 m. 10^ s. ; Jay-Eye-See, in 1885, 2 m. 8| s. ; Sunol in 1891, 2 m. 8|- s. ; Nancy Hanks in 1892, 2 m. 4 s. ; and Alix in 1894, 2 m. 3f s. The record at the beginning of 1902 is the 2 m. 2\ s. made by Cresceus in 1901. Improved times have doubtless been the result of improved methods, as well as of care in the breeding of the trptter. Some very severe training rules used to be sedulously observed ; about 1870, for instance, a horse never had water the night before a race, and the system generally appears to have overtaxed the animals' strength. A prominent consideration in trotting races is the adjustment of toe-weights, which are fastened on to the horses' feet to equalize their action, and it is found that horses

improve their time to the extent of several seconds when properly shod. The American trotter is declared to be practically a thoroughbred. Pacing races are also frequent in the United States. In trotting the action may be described as diagonal ; the pacer moves both legs on the same side at the same time, and both feet stride as one. A similar ” gait,” to employ the American term, was called in England some centuries ago an ” amble.” The pacer moves more easily and with apparently less exertion than the trotter, and the mile record (made byA-naconda in 1901) stands at 2 m. If s. Trotting and pacing races are sometimes contested in the saddle, more frequently in wheeled vehicles of the lightest possible description specially constructed for the purpose.

France. — Racing in France as conducted on modern lines may be said to date from the year 1833, when the French Stud Book was originated, and a body formed, somewhat after the model of the English Jockey Club, under the title of the Societe d’Encouragement pour 1' Amelioration des Eaces de Chevaux en France. Eaces

took place in the Champs de Mars, and an unsuccessful attempt was made in 1834 to arrange for a course, or " hippodrome " as it is termed in France, at Maisous Lafiite. Chantilly was, however, fixed upon as the principal racing centre ; on the 22nd April 1836 the first meeting was held there, with five races on the card, the principal being the Prix d'Orleans, a stake of 3500 francs, named after the due d'Orleans, one of the chief promoters of the fixture. Next day the first race for the Prix du Jockey Club was run, and won by Frank, the property of Lord Henry Seymour, who was then taking a very active part in French sport. The Prix du Jockey Club was then worth 6000 francs ; the value has since increased to 200,000 francs. This race occupies in France the place of the English Derby. The Prix de Diane, which corresponds to the English Oaks, was first run in 1843. Chantilly still continues an important centre of the French Turf, and a great many horses are trained in the district. Attempts had been made to popularize racing at Longchamps prior to the year 1856, when

the Societe d'Encouragement obtained a lease, erected stands, laid out the course, and held their first meeting on the 27th August 1857. Next season two meetings were held, one of four days in the spring and another of three in the autumn ; at the present time the sport is vigorously carried on from March to the end of October, except during a summer recess. In 1857 meetings under the auspices of the Societe d'Encouragement began to take place at Amiens, Caen, Nantes, Versailles, Moulins, and other towns ; and there were stakes for two-year-olds in the spring, though of late years the appearance of the young horses has been postponed to the 1st of August. Progress was rapid, and in 1863 two important events were contested for the first time, the Prix du Prince Imperial, which was designed to balance the English St Leger, but for obvious reasons faded out of the programme, and the Grand Prix de Paris, an international race for three-year-olds, run at Longchamps over a distance of 1 mile 7 furlongs, and now the most valuable stake in Europe. In 1901 the prize was £10,812. The first Grand Prix

fell to an English horse, Mr Savile's The Eanger ; two years later it was won by Gladiateur, winner of the English Derby and the property of the comte de Lagrange who raced equally in France and in England ; the duke of Beaufort's Ceylon was successful in 1866, and the marquis of Hastings' Earl in 1868. Mr Savile's Cremorne followed up his Derby victory by a victory at Longchamps in 1872, as did Mr Baltazzi's Kisber four years later. English horses were also victorious in 1874 (Mr W. E. Marshall's Trent), in 1878 (Prince SoltvkofE's Thurio), in 1880 (Mr C. Brewer's Eobert the Devil), in

1881 (Mr Keene's Foxhall, who, however, should rather rank as an American horse), in 1882 (Mr Rymill's Bruce), in 1885 (Mr Cloete's Paradox), and in 1886 (Mr Vyner's Minting). During the first 23 years of the Grand Prix (owing to the war, the race did not take place in 1 871) the stake fell to English horses — if Kisber and Foxhall be included — on twelve occasions, and generally to English

jockeys. In recent years, however, French owners have held their own. In not a few respects racing is managed more judiciously than in England. The courses, for one thing, are better tended and maintained. At Epsom and Ascot, for instance, the trampling of the multitude beats down and destroys the herbage, making the ground cruelly hard for the horses to gallop over ; in France the crowd is not allowed to wander about the course, and in the hot-test summer weather the circuit of Longchamps is never hard and always refreshingly green. The five- and six-furlong races for others than two-year-olds, which are so common at English meetings, are comparatively rare in France, and the value of the prizes in an average day's racing is considerably higher across the Channel than in England. A very large percentage of trainers and jockeys are English, and the former are, as a rule, quite as expert as at Newmarket and elsewhere, though the average seems somewhat lower in France than in England. Transat-lantic methods have been introduced by American jockeys since 1899. From the middle of February until the mid-

dle of December a race meeting within easy reach of Paris ■ takes place almost every day, except during August, when the sport is carried on in the provinces, notably at Deauville. Near Paris, the chief centre after Longchamps is Maisons Laffite. At Longchamps, early in October, a race called the Prix du Conseil Municipal, worth £4000, for three-year-olds and upwards, over a mile and a half, was organized in 1893, and has usually attracted English horses, Mr Wallace Johnstone's Best Man having been successful in 1894, and Mr Sullivan's Winkfield's Pride the following year. Except when the Whip is challenged for and the challenge decided over the Beacon Course at Newmarket, no race is run in England over a longer distance than two miles and a half ; but in France the Prix Gladiateur, of £1200 and a work of art value £100, 3 miles 7 furlongs, creates considerable interest at Longchampsin theautumn. The pari-mutuel, by which most of the betting is carried on in France, though bookmakers pursue their business there as in England, except that they are relegated to the backs of the stands, is described under the head of

Betting.

The first recognized steeplechase in France took place on 1st April 1884, at Croix de Berny, and was won by the comte de Vaublanc's May-fly, all the steeple- horses at that time being ridden by gentlemen. ftafl'^ " Sport does not seem to have been carried on with much spirit, for it is said that the death of an animal called Barcha, in 1839, nearly led to the abandonment of the meeting ; and it was not till 1863, when the Societe des Steeplechases de France was founded, that the business was resolutely taken in hand. Gravelle and Vincennes were the principal centres until 1873, when the Socie'te obtained possession of the ground at Auteuil, where the excellent course now in use was laid out. In 1874 twelve days' racing took place here, the card each day including three steeplechases and a hurdle race, the " hurdles," however, being small fences, as they are at present. The Grand Steeplechase d' Auteuil was then for a stake of 30,000 francs, at the time the most valuable offered in any country ; but, as in racing on the flat, the

stakes have enormously increased in value, and in 1901 the Paris Grand Steeplechase, as the chief event is now called, credited the winner with £6020, the hurdle race being worth rather more than half as much. In England there is scarcely any steeplechasing between March and November, except at hunt meetings, but in Paris cross-country sport is pursued almost all through the year, the chief races at Auteuil taking place in June, about the time of the Grand Prix, which is always run between the English Epsom and Ascot meetings. The Auteuil course is laid out in the shape of the figure 8, with varied fences, several of which reallytestahorse's jumping capacity ; and variety is further obtained by starting the fields in different places and traversing the course in different ways. St Ouen, a meeting within half an hour's drive of the Louvre, is entirely devoted to steeplechasing ; and jumping is also carried on at Vincennes, Colombes, Enghien, and elsewhere near Paris, as also at Nice in January, at Dieppe and other places in August. As a rule, the stakes run for, especially at Auteuil, are very much larger than in Eng-

land. There are none of the clubs and special enclosures such as at Sandown, Kempton, Hurst, Lingfield, Gatwick, &c., though portions of the stand are set apart for privileged persons. A fee of 20 francs is charged for admission to the chief French racecourses, with half as much for a lady's voucher, and the tickets give access everywhere but to the very few reserved portions. At Vincennes, St Cloud, and some other courses trotting races are also contested.

Other Countries. — Racing in Gennany is mainly conducted under the authority of the Union Club of Berlin, the principal course being the Hoppegarten. Two-year-olds do not run until the 1st of June, except in Saxony, where they appear a month earlier. During the month of August there are several days' racing at Baden-Baden, steeplechases as well as flat-races being run. Some of the more valuable stakes are usually contested by a proportion of horses from France and other countries, a few being occasionally sent from England. For years past blood-stock has been imported from England. In Austria the two centres of racing are Vienna and Budapest, each of which has its Jockey Club. Kacing in Belgium derives no little support from the contiguity of the country

to France. The headquarters of the Belgium Jockey Club are in the Bois de la Carabre at Boisfort, and meetings are held at Ostend, Antwerp, Spa, Bruges, and elsewhere. Steeplechases take place at Groenenval and on other Belgian courses, but are not of high class. Racing has not reached a great degree of excellence in Italy, though attempts have been made to improve competitors by the purchase of Melton, who won the Derby of 1885, and of other notable animals. Meetings take place at Florence, Padua, Bologna, and other places, but the stakes are usually small. (a. e. t. w.)

Horsens, a market town of Denmark, at the head of Horsens Fjord, on the east side of Jutland, 32 miles by rail south-west of Aarhus. In 1899 it was entered by 668 vessels of 71,704 tons, and cleared by 695 of 74,679 tons. The exports are chiefly bacon and butter ; the im-ports, iron, yarn, coal, and timber. Population (1880), 12,654 ; (1901), 22,243.

Horsforth, a township in the Pudsey parliamentary division of Yorkshire, England, on the Aire, 5 miles north-west of Leeds by rail. The church of St Mary was

built in 1883, and there are Baptist, Wesleyan, Friends', and other places of worship. Public buildings include a temperance hall and a mechanics' institute. There are extensive woollen manufactures, and in the neighbourhood quarries. Area of urban district, 2801 acres. Population (1881), 6346 ; (1901), 7785.

Horsham, a market town and railway station in the Horsham parliamentary division (since 1885) of Sussex, England, 18 miles north-north-west of Brighton. The town-hall and grammar-school have been rebuilt, and a cottage hospital established. Population of urban district (1881), 6874; (1901), 9446.

Horsley, John Callcott (1817), English painter, son of William Horsley, the musician, and grand-nephew of Sir Augustus Callcott, was born in London, 29th January 1817. He studied painting in the Academy

schools, and in 1836 exhibited " The Pride of the Vil-

lage" (Vernon Gallery) at the Eoyal Academy. This was followed by numerous genre pictures at subsequent exhibitions up to 1893, the best known of these being "Malvolio," " L' Allegro and il Penseroso" (painted for the Prince Consort), " Le Jour des Morts," " A Scene from Don Quixote," &c. In 1843 his cartoon of "St Augustine Preaching" won a prize in the Westminster Hall competition, and in 1844 he ■was selected as one of the six painters commissioned to execute frescoes for the Houses of Parliament, his " Eeligion " (1845) being put in the House of Lords ; he also painted the "Henry V. assuming the Crown" and " Satan surprised at the Ear of Eve." In 1864 he became R.A., and in 1882 was elected treasurer, a post which he held till 1897, when he resigned and became a " retired Academician." Mr Horsley had much to do with organizing the winter exhibitions of "Old Masters " at Burlington House after 1870. When, during the 'eighties, the example of the French Salon began to affect the Academy exhibitors, and paintings of the nude

became the fashion, he protested against the innovation, and his attitude caused Punch to give him the punning sobriquet of " Mr J. C(lothes) Horsley." His son, Victor Horsley (born 1857), is one of the leading neuropathologists, and a prominent supporter of the cause of experimental research.

Hort, Fenton John Anthony (1828-1892), English theologian, was born on 23rd April 1828, and was the great-grandson of Josiah Hort, archbishop of Tuam in the 18th century. At the age of thirteen he was sent to Eugby, where he soon distinguished himself. In 1846 he went to Trinity College, Cambridge, where he was the contemporary of Benson, afterwards archbishop of Canterbury, and of Westcott and Lightfoot, who later became successive bishops of Durham. Like Lightfoot, he read with Westcott for his degree, and thus began the close connexion between the four which was only to end with their lives. In 1850 he took his degree, being third in the Classical Tripos, and in 1862 he became Eellow of his college. In 1854,

in conjunction with J. E. B. Mayor and Lightfoot, he established the Journal of Classical and Sacred Philology, and plunged with the utmost ardour into theological and patristic study. He had been brought up in the strictest principles of the Evangelical school, but at Eugby he fell under the influence of Arnold and Tait, and though he was by no means unaffected by the Tractarian movement, his acquaintance with Maurice and Kingsley finally gave his opinions a direction towards Liberalism. In 1857 he married, and accepted the college living of St Ippolyt's, near Hitchin, in Hertfordshire, where he remained for fifteen years. During his residence there he took some part in the discussions on university reform, continued his studies with unabated diligence, and wrote essays for various periodicals. But already he began to display that sensitive distrust of himself which prevented him from publishing, and this period of his life is marked by a considerable variety of projects which came to nothing. In 1870 he was appointed a member of the committee for revising the translation of the New Testa-

ment. In the next year he delivered his Hnlsean Lectures before the University. Their title was The Way, the Truth, and the Life. Consistently, however, with Hort's usual diffidence, they were not prepared for publication until many years after their delivery. In 1872 he accepted a fellowship and lectureship at Emmanuel College, which brought him back to his natural sphere — university life. In 1878 he was made Hulsean Professor of Divinity, and he was advanced to the Lady Margaret Professorship in 1887.

In the meantime the text of the New Testament, the joint work of Professors Westcott and Hort, had appeared. The Eevision Committee had very largely accepted this text, even before its publication, as a basis for their version of the New Testament. The work on its appearance created an immense sensation among scholars, and was vehemently attacked in many quarters. But on the whole it was received as much the nearest approximation yet made to the original text of the New Testament.

The introduction was the work of Dr Hort, and though its style was not unfrequently difficult to follow, its

depth and fulness convinced all who read it that they were under the guidance of a master. One other feature of the work commanded respect — the practical unanimity, on a subject of great intricacy, of two scholars of European renown, of the utmost independence of character and of the highest reputation for minute accuracy. Hort did not long survive his election to the Lady Margaret Professorship. He died on 30th November 1892, worn out by his intense mental labour. His over-sensitiveness deterred him from publication, and even from putting his ideas into shape. But if he did not publish himself, he gave the utmost assistance in his power to those who on this point were more venturesome than himself. He was continually in communication with Professor Harnack and other distinguished Continental scholars, and not unfrequently consented to read and revise their proofs for them. By the younger generation of Cambridge scholars he was absolutely idolized, and his acute and luminous criticisms of their work, which were not untempered by a generous encouragement, stimulated

and cheered them in their efforts. His two Dissertations, on the reading /j.ovoyevrj'; dtos in St John i. 18, and on TJie Constantinopolitan and other Eastern Creeds in the Fourth Century, remain models of exact scholarship and skilful use of materials ; and the worth of his personal character may be appreciated in his Life and Correspondence, edited by his son. (j. j. l.)*

Horten, a seaport town of Norway, 66 miles south by west of Christiania by rail. The headquarters of the Norwegian navy are no longer at Horten, but at Karl Johans Veern, immediately adjoining. Population (1891), 6536 ; (1900), 8460.

Horwich, a township and urban district in the Westhoughton parliamentary division of Lancashire, England, 15 miles north-west of Manchester by rail. It has extensive locomotive works, and there are large stone quarries in the district. Bleaching and cotton-spinning and the manufacture of fire-bricks and tiles are carried on. Population (1901), 15,084.

Hoshangabad, a town and district of British

India, iu the Nerbudda division of the Central Provinces. The town is on the left bank of the Nerbudda, 1009 feet above the sea, and has a railway station. The population in 1881 was 15,863; in 1891 it was 13,495. It has a government high school, with 473 pupils in 1896-97, and two printing-presses, one of -n-hich issues a weekly news-paper in English and Hindi. The District of Hoshax-gauad has an area of 4594 square miles, with a popu-lation in 1881 of 488,787, and in 1891 of 529,945, giving an average density of 115 persons per square mile. In 1901 the population was 449,197, showing a decrease of 10 per cent., due to famine. The land revenue was Rs.7,78,916, the incidence of assessment being Rs.0 : 7 : 9 per acre; the cultivated area in 1897-98 was 857,227 acres, of which 3143 were irrigated from wells; the number of police was 590 ; the boys at school in 1896-97 numbered 7146, being 16-1 per cent, of the male popula-tion of school-going age ; the registered death-rate in 1897 was 63-43 per thousand. The principal crops are wheat,

HOSHIARPU R — H 0 S P I T A L S

millet, and oil-seeds. The district is traversed through-
out its length by the Great Indian Peninsula rail-
way, with sixteen stations; it is also crossed by
the Bhopal State railway : total length of line, 175
miles. It suffered very seriously from the famine
of 1896-97 : the famine of 1900 was less severely
felt. ^

Hoshiarpur, a town and district of British India,
in the JuUundur division of the Punjab. The population
of the town in 1891 was 21,552 ; the municipal income in
1897-98 was Rs.43,059. There are manufactures of
cotton goods, inlaid woodwork, lacquered ware, shoes, and
copper vessels. The District comprises an area of 2244
square miles, with a population in 1881 of 901,381, and
in 1891 of 1,011,659, giving an average density of 451
persons per square mile. In 1901 the population was
989,176, showing a decrease of 2 per cent., compared
with an increase of 12 per cent, in the previous decade.
The land revenue and rates were Es. 15,58,993, the in-

cidence of assessment being just E.l per acre; the cultivated area in 1896-97 was 829,953 acres, of which 79,950 were irrigated, including 10,801 from government canals ; the number of police was 480 ; the number of schools in 1896-97 was 265, with 9527 pupils, the proportion of boys at school to the male population of school-going age being 11-2 per cent. ; the registered death-rate in 1897 was 24-67 per thousand. There are two printing-presses, issuing one vernacular periodical. The district has no railway nor any navi-gable river, and the total length of metalled roads is 34 miles.

Hospitals. — Great changes have taken place since 1880 in the construction and administration of hospitals for the sick. Many of the older hospital buildings have been reconstructed or rebuilt and enlarged. Quite £1,600,000 has been spent in this way during the last ten years upon the metropolitan hospitals alone. The same work has been proceeding in the provincial hospitals also. The system of treatment known after its originator

Lord Lister as the Listerian method has revolutionized the management of large buildings for the accommodation of the sick. At the time Professor de Chaumont wrote his article in the ninth edition of the Encyclopaedia Britannica, it was held to be unwarrantable to deal with confinement cases in hospitals, at any rate in large numbers ; and this view was justified by the experience of the terrible mor-tality which had resulted froin the presence of these cases in wards connected with general hospitals, as well as in hospitals devoted entirely to maternity cases. At the present time the reception of such cases in large numbers in hospital buildings under proper hygienic regulations is extending. One of the most recent and most important hospitals in ISTew York City is a maternity hospital with some hundreds of beds, which has been erected at the expense of Mr J. Pierpont Morgan. Listerism means devoted and continuous attention to the details of clean-liness, and its effect is well illustrated by the fact that the adoption of the aseptic or Listerian treatment of wounds had reduced to 4-3 per cent, in 1880 in Ger-

many a mortality of 41-6 per cent, in 1868, and a mortality in 1872, according to Sir John Erichsen, of 37-8 per cent, in the larger metropolitan hospitals, and of 25-7 per cent, in University College Hospital. According to Schade's Antiseptic Statistics, this mortality has been further reduced to 2-9 per cent, in all uncomplicated amputations for disease from injury, and is still falling. These figures are very striking when read in conjunction with the statement as to Mr Cadge and the Norwich Infirmary on page 303 of de Chaumont's article in the ninth edition (vol. xii.). It is interesting to note that Lord Lister was passing through the medical schools and qualifying for the practice of his profession about the time Miss Nightingale was training as a nurse at Kaiserswerth, and afterwards giving her object lesson in impi'oved methods for the care of the sick in hospitals in the Crimea. Three years after peace had been declared Lord Lister published his paper on " Early Stages of Inflammation," followed in 1875 by " The Germ Theory of Fermentative Changes," which was to bring about an even greater revolution in

hospital treatment and the improved hygienic condition of the sick in hospitals. Previous to his investigations, and during the period in which they were being followed out to the evolution of the aseptic system, a few zealous men of various professions, who were interested in hospitals, had been reaching step by step an improved plan of hospital construction and a perfected system of hospital drainage and hygiene. Thus year by year, with slow but devoted labour, a small number of scientific men and hospital experts have brought hospital construction and the treatment of the sick in hospitals to the state of perfection which they have attained to-day.

The argument formerly advanced that by distributing infectious cases there is less danger of concentration of poison than when they are congregated by themselves is now condemned in practice. In all large cities and in crowded communities, both in England and on the Continent, great hospitals for infectious cases have been erected upon extensive sites, which are so planned as to constitute, in fact, a village with many hundreds of in-

habitants. This type of modern hospital has common characteristics. A multitude of separate buildings are dotted over the site, which covers 20 acres or upwards. In one such institution, within an area of 20 acres there are 6 miles of drains, 29 miles of water and steam pipes, 3 miles of roof gutters, 42 miles of electric wires, and 42 separate buildings, which to all intents and purposes constitute a series of distinct isolated hospitals, in no case containing more than 46 patients. On the continent of Europe buildings of this class are usually of one storey, but in England the majority have two storeys, each containing a ward for twenty beds and two isolation wards for one and two beds respectively. The two storeys, however, are absolutely distinct — that is, there is no internal staircase going from one ward to the others, but each is entered separately from the outside. This system carries to its extreme limits the principle of separating the patients as much as possible into small groups. The acute cases are usually treated in the upper ward, and as they become convalescent are removed downstairs. In this way the

necessity for entirely separate convalescent blocks is done away with, and the patients are kept under the same charge-nurse, an arrangementwhich promotes necessary discipline. The unit of these hospitals is the pavilion, not the ward, and consists of an acute ward, a convalescent ward, separation wards, nurses' duty rooms, store-rooms for linen, an open-air balcony upstairs into which beds can be wheeled in suitable weather, and a large airing ~~*ground for con*~~ *valescent patients directly accessible from the downstairs ward. Each of the pavilions is raised above the ground level, so that air can circulate freely underneath. The wall, floor, and air spaces in the scarlet fever wards of one of these hospitals are respectively 12 feet, 166 feet, and 2028 feet ; and in the enteric and diphtheria wards they have been increased to 15 feet, 196 feet, and 2635 feet respectively. The provision of so large a floor and linear space, especially in the diphtheria wards, is an experiment the effect of which will be watched with considerable interest. A building of this type is a splendid example of the separate pavilion hospital, and is doing great service*

in the treatment of fevers wherever it has been introduced. Some idea of a hospital village, some of the wards of

which we have been describing, may be gathered from the circumstances that it costs from £300,000 to £400,000, that it usually contains from 500 to 700 beds, and that the staff numbers from 350 to 500 persons. The medical superintendent lives in a separate house of his own. The nurses are provided with a home, consisting of several blocks of buildings under the control of the matron : the charge-nurses usually occupy the main block, where the dining and general sitting-rooms are placed; the day assistant-nurses another block: and lastly, by a most excellent arrangement, the night-nurses, 80 to 120 in number, have one whole block entirely given up to their use. The female servants have a second home under the control of the housekeeper, and the male servants occupy a third home under the supervision of the steward. The Iwo main ideas aimed at are to disconnect the houses

occupied by the staff from the infected area, and to place the members of each division of the staff together, but in separate buildings, under their respective heads. These objects are highly to be commended, as they have important bearings upon the well-being and discipline of the whole establishment, and constitute a lesson for all who have to do with buildings where a great number of people are constantly employed.

The circular ward is growing in favour. At the Great Northern Central Hospital, Holloway, where the site in a crowded district was most awkward, it fulfils a useful purpose, for by making some of the wards rectangular and others circular, the hospital was so planned as to give the same amount of cubic, wall, and superficial space per bed throughout the institution, irrespective of the shape of the wards. The first circular wards actually occupied by hospital patients were those of the Miller Hospital, Greenwich, shortly followed by the Municipal Hospital, Antwerp, the Victoria Hospital, Burnley, the Infirmary of the Hampstead Workhouse, two small military hospitals at Milton near Gravesend and Seaford near Liverpool, the Royal Infirmary at Liverpool, the Northern Hospital, Liver-

pool, and elsewhere. An important feature of this form of ward is its attachment to the main building, which should be by covered bridges with open spaces between the roof of one bridge and the floor of the one above. The centre space has been utilized as a nurses' room, as a ventilating shaft, or as a shaft for a spiral staircase leading to a flat roof used as a sun-room, but all these schemes are objectionable and often unsightly. A circular ward to be typical must be award only. To contain 12 beds it should have a diameter of about 42 feet, and in the centre there should be ventilators and flues with fireplaces, while for 20 beds the following should be the approximate dimensions : — Height, average, 13 feet (ceiling sloping up from periphery to centre) ; diameter, 57J feet ; wall space, 8-50 feet per bed ; area, 128 feet per bed ; cubic space, 1665 feet per bed ; window area, 26-8 feet per bed. An octagonal ward has been tried at the Johns Hopkins Hospital, Baltimore, but has not proved satisfactory ; it does not lend itself conveniently to the arrangement of the beds, and the dust catches the angles where the sides of the octagon join, so that the walls become speedily discoloured and unsightly. Electricity is now a favourite agent for lighting hospital wards, but for many reasons it is desirable that it should always be sup-

plemented by gas. In 1889, surgeons were on more than one occa-sion left in total darkness when performing an operation by electricity in a London hospital. As a system of illumination for hospitals it has great advantages, for it is cleanly, convenient, portable, and enables the surgeon to bring the light exactly where he wants it without moving his patient. Teak and maple are found to be the best wood for the floors. Wood has been superseded by terrazzo, but this in practice proves to be unsatisfactory, owing to its liability to crack when used for hofspital purposes. These cracks may be seen in the terrazzo floors introduced into several of the recently erected modern hospitals. Very marked improvement has taken place in regard to hospital furniture. The bedsteads are ornamental, simple, and specially constructed for hospital purposes (Guy's Hospital pattern). Ward tables and lockers are glass-topped ; and invalid chairs and ambulance litters have been gen-erally adopted for ward use. The number of operations in a modern hospital in existing circumstances is at least four times as great as it was a few years ago. In consequence a demand has grown up for a large number of small operating theatres 6f new and aseptic types, which cost prodigious sums.

Persistent efforts have been made in favour of the plenum system of ventilation (seeEncy. Brit., 9th ed., vol. xxiv. p. 160) for British hospitals. Of the necessity for ventilation there can be no doubt, and upon the fundamental principles which determine the quantity of air to be supplied, the temperature it is to be supplied at, and the rate at which the air is to be changed, authorities are practically agreed. In the United States, and in most Continental countries, more especially in France, it is deemed necessary to adopt mechanical means for renewing the air of wards. In Great Britain, notwithstanding some instances of a contrary practice, or probably because of such instances, it is held that the most efficient ventilation is to be obtained by the use of the simplest means. Having regard to the temperate character of the English climate, artificial ventilation, whatever be the plan adopted, is not desirable, if it even be permissible, especially when entire reliance is placed upon such a system for the whole ventilation of the sick wards of any British hospital which is constantly filled with surgical and other cases requiring abundance of fresh air. The question is exhaustively treated in Burdett, Hospitals and Asylums of the World, vol. iv. pp. 43 et seq. The plenum system may be

a necessity in operating theatres and in outr-patient departments, but its application to English wards is neither necessary, nor desirable, nor economical.

The cottage hospital movement has spread to all parts of the United Kingdom, and is now making its way in the United States, and especially in New England. There are upwards of three hundred cottage hospitals in the United Kingdom at the present time. Everywhere they are becoming most eflicient and complete hygienically ; indeed, many are now as perfect as a single pavilion of a great modern hospital. The amount of good they have conferred upon residents in rural districts is very great. They benefit the community by affording all classes the best kind of skilled medical attendance, and so they attract the wealthy to out-of-the-way places by ensuring adequate treatment by skilled practitioners for operation, accident, and other cases. Thanks to them, residents, in the country can nowadays obtain most of the medical advantages of residents in cities.

The attempt to introduce the pay hospital into England has proved successful, and since the Home Hospitals Association opened the first of these establishments at Eitzroy House, Fitzroy Square,

in 1880, it has proved a boon to hundreds of surgeons and their middle-class patients. The St Thomas's Home, a wing of St Thomas's Hospital, has been given up to the accommodation of paying patients for several years, though the authorities, for some reason not very apparent, are desirous of discontinuing the system. The pay ward, though a common feature of Continental and American hospitals, has been adopted in a tentative way at Guy's Hospital and the Great Northern Central Hospital, where there is a separate wing set apart for paying patients. It is most desirable that pay wards should be erected in connexion with every general hospital of importance throughout the United Kingdom, but the medical staff should be paid for attendance on such cases. In that way hospital abuse would be abolished, and every patient would enjoy the right, which is undoubtedly his, to be attended by his own doctor, and to pay according to his means for the treatment he receives during his residence in hospital.

A revolution has taken place in nursing, which, once a calling, is now denominated a "profession." The duties of nurses are confined to attendance on the sick. They are housed in separate pavilions, have many fewer hours' work in the wards than formerly,

and are allowed a reasonable time for recreation, longer holidays, and much better food. Their training extends over three years at least, and during their course they attend lectures and practical classes on bandaging, dressing, cooking, the elements of hygiene, practical surgery, and the elements of anatomy and physiology. The menial work of a hospital, such as scrubbing flooi-s and house-work generally, is entrusted to a stafi of servants or ward maids employed exclusively for such purposes. Practical instruction is also made available for nurses in midwifeiy, fever nursing, the attendance on patients in private families, and mental nursing. The remuneration has increased quite 30 per cent., and private nurses sometimes earn as much as from £100 to £130 a year. The number, too, in hospitals has been enormously increased, the pro-portion in a well-regulated hospital now being one nurse to every four patients. In some hospitals there is one nurse to every two. occupied beds, but this number is disproportionate if due regard be had to economical considerations.

Authorities. — Complete and statistical information in every form will be found in ; Bdrdett. Cottage Hospitals, General Fever and Convalescent, their Construction, Management, and Work.

London, 1877, 1880, and 1896.— Tollet. Les Edifices Hospitallers depuis leur Origine jusqu'a nos Jours. Paris, 1892.— Burdett. Hospitals and Asylums of the World, with large portfolio of plans to a uniform scale. London, 1893. A supplement to this book is published every year, bringing the information up to date, entitled BurdeWs Hospitals and Charities. London, 1901-02. — Billings. The Principles of Ventilation, Heating, and their Practical Application. New York, 1893. — Galton. Healthy Hospitals. London, 1893. — Tollet. Les Hbpitavtx au XIX

iSiecle. Pans, 1894.— Billings and Hcrd. Suggestions to Jdospital and Asylum Visitors. Philadelphia, 1895.— Oswald KuHN. " Hospitals," Handbuch der Architektur, 4th part, 5th half-Tolume, part 1. Stuttgart, 1897. (h. bt.)

Hot Springs, capital of Garland county, Arkansas, U.S.A., on the Hot Springs railway, at an altitude of 576 ieet. The city was originally situated in a narrow water :gap in one of the ridges of the Ozark Mountains, whence It has spread into the valleys north and south. Its plan

IS very irregular. The springs from which the city de-
lives its name, and which have made it famous, are very
numerous on the ridge on the east side of the gap, whence
the water is piped into the town. They are of value in
Theumatic, syphilitic, and cutaneous diseases, and thou-
sands of sufferers visit the place yearly for relief. For
their accommodation many large hotels have been con-
structed, and the United States has an army and navy
liospital here. Population (1880), 3564; (1890), 8086;
(1900), 9973, of whom 661 were foreign-born and 3102
were negroes.

Hottentots. — In recent years these aborigines have
been carefully studied by Fritsch, Shrubsall, Hamy, and
several other leading anthropologists, whose researches
tend to show that they are not " totally distinct from all
other African races," as was formerly generally supposed
{Ency. Brit. vol. xii. p. 309). They are, on the contrary,
now- held to be, not so much a distinct or independent
variety of mankind as the result of a very old cross be-
tween two other varieties — the Bantu Negro and the

pigmy Negrito-Bushman. (See Bushmen.) Hamy calls them simply "Bushman-Bantu half-breeds," the Bushman element being of the two the more pronounced, as seen in the leathery colour, compared with that of the "sere and yellow leaf"; in the remarkably prominent cheek-bones and pointed chin, giving the face a peculiarly triangular shape ; and lastly, in such highly specialized characters as the tablier and the steatopygia of the women, constant in the Bushman from infancy, but developed only in the adult Hottentot woman, and that not universally. The cranial capacity is also nearly the same (1331 c.c. in the former, 1366 c.c. in the latter), and on these anatomical grounds Shrubsall concludes that the two are essentially one race, allowing for the undeniable strain of Bantu blood in the Hottentot.

This view is further strengthened by the vast range in prehistoric times of the Hottentot variety, which, since the time of Lichtenstein' (1800-04), was known to have comprised the whole of Africa south of the Zambezi, but has recently been extended as far north as the equatorial

lake region. This important fact in African ethnology is due to the explorations of Oskar Neumann in the district between Lake Victoria and Mount Kilimanjaro, where this traveller came upon the Wasandawi people, a sort of Hottentot enclave in the midst of the Negroid-Bantu populations, speaking a non-Bantu language full of clicks like that of the Bushman-Hottentots, and presenting cranial characters — projecting upper jaw, orthodolicho head and low capacity — exactly like those of the Namas and other full-blood Hottentots.'

But very few of these full-blood Hottentots now survive even in their present restricted domain south of the Zambezi. Of the half-dozen groups that still call themselves Khoi-Klioin ("Men of Men") the Namas alone of Great and Little Namaqualand preserve the racial type and speech in tolerable purity. All the others are more or less degraded Hottentot-Dutch or Hottentot-Bantu

1 Dr E. Virchow, Verhandl. Berl. Ges. f. Anthrop. 1895, p. 59, and Dr Mies, Centralbl. f. Anthrop. 189(i, p. 50, Of a Hottentot skull from a cave on the Orange-Transvaal frontier, Dr Mies states that " its form

is orthodoliehoeephalic, as with the Wasandawi " (ib.).

half-breeds, mainly of debased Dutch speech, although the Koi'anas of the Upper Orange, Vaal, and Modder rivers still here and there speak a moribund Hottentot jargon flooded with Dutch and English words and expressions. This Korana jargon, like the " English " of the Liberian negroes, is so corrupt that it has become quite useless for any literary purposes, and is now no longer employed by the missionaries in their intercourse with the natives. But Hottentot speech still survives in a tolerably pure state, not only amongst the Namas, but also in Damara-land, where it has long been spoken by the so-called " Hill Damaras " of the north-eastern uplands. These Hau-Khoin ("True Men"), or Sau-Damop ("True Damas"), as they call themselves, are not " true " Hottentots at all, but a Bantu people with a slight admixture of Hottentot blood, who were at some unknown period assimilated in speech to their Dama^ conquerors. The fundamental con-nexion of this language with that of the Bushmen, already suggested by Bleek, is supported by further evidence ad-

vanced by the late G. Bertin. But its relation to ancient Egyptian, a view at one time generally accepted on the authority of Dr E. Lepsius, rests on no solid grounds, and indeed is now shown to be untenable. In Egyptian, a Hamitic tongue with remote Semitic afiinities, there are no clicks, which form an essential element of Hottentot phonetics, and the two languages differ also fundamentally in their lexical and structural characters.

Subjoined is a tabulated statement of the surviving Hottentot groups, all of whom, except perhaps the Namas, are disappearing by a slow process of extinction or absorption amongst the surrounding Boer and native populations. No Hottentot-English half-breeds are yet spoken of in any part of South Africa : —

Tribal Groups.	*Domain.*	*Population (1890-99).*
Northern Namas .	*Great Namaqualand .*	*12,000*

Oerlams

6,000

Southern Namas .

Little Namaqualand .

3,000

Hill Damaras

N.E. Damaraland .

26,000

Koranas

Upper Orange, Vaal, and

Modder rivers

15,000

Griquas

Griqualand East

4,000

Gonaquas .

Kaffre Borderlands .

35,000 ?

Dispersed .

Total full-blood and

Cape Colony .

half-castes ....

80,000?

180,000

Some of these terms still need explanation. The Oerlams of Great Namaqualand came originally from Little Namaqualand in Cape Colony, whence perhaps their name, which is said to be a corruption of the Dutch Oberlanders. All now speak Dutch, have given up the tribal system, and form semi-civilized Christian communities, differing little from those of the other settled populations, from whom they will scarcely be distinguishable in a few generations.

The Griquas, called by the Dutch Baastards, are a cross between the early Boer settlers and their female Hottentot slaves. After forming a semi-independent state on the Roggeodde uplands about 1800, most of them were driven (1815) by the whites across the Orange to the district from them named Griqualand, now Griqualand West. Here they again set up for themselves till the discovery of diamonds, when the territorial rights of their chief, Waterboer, were surrendered to the Colonial Government for a

Sum of money and compensation elsewhere (1871). Thereupon the bulk of these Western Griquas joined their eastern kindred in the district which was formerly known as Noman'sland, but took the name of Adam Kok's Land in 1862, when it was assigned by the British Government to this Griqua chief and his people, refugees from their Boer oppressors in the Orange Free State. Later Adam Kok's Land was incorporated in Cape Colony as a separate administrative division, and re-named Griqualand East to distinguish it from the diamantiferous Griqualand West, which had already been annexed to Cape Colony in 1880. The great majority of the Griquas are now settled in the eastern division, where they live in harmony with the surrounding Basuto and

2 The dual fem. form Damara (" Two Dama Women "), whence the geographical term "Damaraland" (the Hereroland of the Germans), was due to a misapprehension, for which see A. H. Keane's Africa, vol. ii. p. 176.

white populations. Many, however, have sold their lands, and thus sunk to the position of proletariates.

The Qonaquas, i.e., " Borderers," are descendants of a very old cross between the Hottentots and the Kaffres, which sprang up on the " ethnical divide " between the two races apparently before the advent of the whites. They have always been treated with contempt, and regarded as outcasts by the Ama-Xosa Bantus, and would have been exterminated during the Kaffre wars but for the intervention of the British. At present they live in settled communities under civil magistrates without any tribal organization, and in some dis-tricts could scarcely be -distinguished from the other natives but for their broken Hottentot-Dutch-English speech.

All the other natives to whom the term Hottentot can be in any way applied are now dispersed throughout Cape Colony, where they find employment about the farmsteads and in the households in various menial services. They generally speak a Dutch jargon, ■*which in some places is being replaced by an equally debased " pidgin English."*

Authorities.— G. M'Call Theal. History of South Africa, 1888-91. — ^E. T. Hamt. " Les Races N6gres," in L'Anthropologie, 1897, pp. 257 et seqq.—F. Shrubsall. " Crania of African Bush Races," in Jour. Anthrop. /nsf. November 1897. — W. H. J. Bleek.

A Comparative Grammar of South African Languages, 1862 ; and "Die Hottentoten Stamme," in Petermann's Mit. 1858, pp.49 et seqq.—G. Fritsch. Die Eingehorenen Siid-Afrikas, 1872 ; and " Schilderungen der Hottentoten," in Globus, 1875, pp. 374 et seqq. — G. Bektik. " The Bushmen and their Language," in Jour. a. Asiat. Soc. xviii. Part I., and reprint. (a. h. k.)

Houghton, Richard Monckton Milnes, 1st Baron (1809-1885), English poet and man of letters, son of Eobert Pemberton Milnes, of Fryston Hall, York-shire, by the Hon. Henrietta Monckton, daughter of the fourth Lord Galway, was born in London, 19th June 1809. He was educated privately, and entered Trinity College, Cambridge, in 1827. There he was at once drawn into a literary set, and became a member of the famous " Apostles " Club, which then included Tennyson, Hallam, Trench, Blakesley, and other men of uncommon promise. He took his M.A. degree in 1831, and travelled abroad, spending some time at Bonn University. Thence he went to Italy and Greece, and published in 1834 a volume of Memorials of a Tour in some Parts of Greece,

describing his experiences. He returned to London in 1837, and was in that year elected to Parliament as member for Pontefract. His parliamentary career was marked by much strenuous activity. He interested himself particularly in the question of copyright and the conditions of reformatory schools. He left Peel's party over the Corn Law controversy, and was afterwards identified with Palmerston's politics. Church matters had always a claim upon him : he wrote a striking tract in 1841, which was praised by Newman ; and took part in the discussion about "Essays and Reviews." His literary career was industrious and cultured, without being exceptionally distinguished. He published two volumes of verse in 1838, Memorials of Residence upon the Continent and Poems of Many Years, Poetry for the People in 1840, and Palm Leaves in 1844. He also wrote a Life and Letters of Keats in 1848, and contributed largely to the reviews. His poetry is meditative and delicate ; some of his ballads were among the most popular of their day, and all his work was marked by refinement.

But his chief distinctions were his keen sense of literary merit in others, and the judgment and magnanimity with which he fostered it. He was surrounded by the most brilliant men of his time, many of whom he had been the first to acclaim. He secured a pension for Tennyson, pressed the claims of Emerson in Great Britain, and was one of the earliest champions of Mr Swinburne. He was, in the old sense of the word, a patron of letters, and one who never abused the privileges of his position. Milnes married in 1851 the Hon. Arabella Crewe (who died in 1874), and was made a peer in 1863. He died at Vichy on the 11th of August 1885, and was buried at Fryston. (a. wa.)

Houghton-le-Spring, a township in the Houghton-le-Spring parliamentary division of county Durham, England, 6 miles north-east of Durham city. St Michael's church is ancient, of Early English and Decorated styles, and has been recently restored. St Andrew's, built in 1876, was enlarged in 1883. There are also a Eoman Catholic and various Nonconformist

chapels. Bernard Gilpin, " the Apostle of the North," was rector of this parish from 1556 to 1583, and the founder of the grammar-school. There are almshouses, church institutes, and a town-hall and market-place. The Durham to Sunderland main road here passes through a romantic limestone rock cutting 80 feet deep. The district affords frequent evidence of ice activity in the Glacial Period. The town is the radiating centre of a large projected scheme of electrical tramways. The population is mainly dependent on the neighbouring collieries, but limestone quarrying is carried on to some extent. Area of township (an urban district), 1551 acres. Population (1881), 6041 ; (1901), 7858.

Hounslow, a town of England, 12 miles west by south of St Paul's, London, in the Brentford parliamentary division of Middlesex ; stations on the London and South-Western and the Metropolitan District railways. The town has two parish churches, Holy Trinity (1835) and St Paul's (1874), and a district church, St Stephen's (1876). A Eoman Catholic church was built in

1886 ; there are Congregational, Baptist, Methodist, and other places of worship. The town hall was built in 1857, and the Urban District Council offices in 1889. The Middlesex County Council has here a polytechnic institute (1892). Hounslow Hospital (1881) was enlarged in 1893. HouCslow is partly in Isleworth parish and partly inHestou. Population (1881), 10,459; (1901), 11,377.

Houston, c'apital of Harris county, Texas, U.S.A., on Buffalo Bayou, at the head of navigation, at an altitude of 53 feet. The site of the city, which is the second in size in the state, is level, and the plan fairly regular. With its navigable bayou, giving water communication with the Gulf of Mexico, and ten railways communicating with all parts of the state, it has a very large trade, especially in cotton, cotton-seed oil, and lumber. It is a commercial rather than a manufacturing city. In 1890 its manufactures had a capital of $3,509,434, employed 3009 hands, and produced goods valued at $6,832,943. The assessed valuation of real and personal property in 1900 (on a basis of assessment of about two-thirds

of the full value) was $27,480,898; the tax-rate was $29.47 per $1000, and the net debt was $2,785,721. Population (1880), 16,513 ; (1890), 27,557 ; (1900), 44,633, of whom 4415 were foreign-born and 14,608 were negroes.

Hovas. See Madagascar.

Hove. See Brighton.

How, William Walsham (1823-1897), English bishop, son of a Shrewsbury solicitor, was born 13th December 1823, and was educated at Shrewsbury School and 'Wadham College, Oxford. He was ordained in 1846, and for upwards of thirty years was actively engaged in parish work. He refused preferment on several occasions, but his energy and success made him well known, and in 1879 he became a suffragan bishop in London, under the title of bishop of Bedford, his province being the East End. He became the inspiring influence of a revival of Church work in that district. He founded the East London Church Fund, and enlisted a large band of enthusiastic helpers, his popularity among all classes being

immense. He was particularly fond of children, and was commonly called "the children's bishop." In 1888 he was

made bishop of Wakefield, and in the north of England he continued to do valuable work. His sermons were straightforward, earnest, and attractive; and besides publishing several volumes of these, he was a vigorous and elegant writer of hymns and other verses. In the movement for infusing new spiritual life into the Church services, especially among the poor. Bishop Walsham How was a great force, his tact and geniality being of particular value. He died 10th August 1897. He had married Miss Frances A. Douglas in 1849, and his wife was of much assistance to him in his work, but she died in 1887.

Howard, Oliver Otis (1830--), American soldier, was born in Leeds, Me., on 8th November 1830. He graduated at Bowdoin College in 1850, and at the U.S.

Military Academy in 1854. Resigning from the regular army in 1861 to take command of the 3rd Maine Eegi-ment, he became, in September 1861, a brigadier-general of volunteers, and major-general in November 1862. He was twice wounded at Fair Oaks, 1st June 1862, losing his right arm; fought in 1863 at Chancellorsville and Gettysburg, and, transferred to the west, served at Chatta^ nooga and during Sherman's operations (1864-65). He became a brigadier in the United States army on the 21st December in 1864, was major-general in 1886, and retired in 1894. Howard University, established at Washington for the education of the negro race, was named in his honour.

Howe, Julia Ward (1819), American poet and reformer, daughter of Samuel Ward, was born in New York, 27th May 1819. In 1843 she married Dr Samuel Gridley Howe (1801-1876), a pioneer in the education of the blind and of blind deaf-mutes, whose success in the instruction of Laura Bridgman attracted the attention of Charles Dickens and of many philanthropists.

Mrs Howe wrote several volumes of poems, her best-known piece being the " Battle-Hymn of the Kepublic," which, set to the music of " John Brown's body lies a-mouldering in the grave," had great vogue in the Northern States of America during the war of 1861-65. She has engaged actively in movements on behalf of the anti-slavery cause and of woman-suffrage.' Her poems were published under the titles of Passion Flowers (1854), Words for the Hour (1856), and Later Lyrics (1866) ; and she has also written Sex in Education (1874), Modern Society (1880), and Margaret Fuller (1883).

Howeils, William Dean (1837), American novelist, was born at Martinsville, Ohio, 1st March 1837. His father, William Cooper Howeils, a printer-journalist, moved in 1840 to Hamilton, Ohio, and here the boy's early life was spent successively as type-setter, reporter, and editor in the ofiices of various newspapers. In the midst of routine work he contrived to familiarize himself with a wide range of authors in several modem tongues, and to drill himself thoroughly

in the use of good English. In 1861, as assistant editor of the leading republican newspaper in Ohio, he wrote — in connexion with the Presidential contest — ^the campaign life of Lincoln ; and in the same year he was appointed consul at Venice, where he remained till 1865. On his return to America he joined the staff of the Atlantic Monthly, and from 1871 to 1881 he was its editor-in-chief. Since 1885 he has lived in New York. For a time he conducted for Harper's Magazine the department called " The Editor's Study," and in December 1900 he revived for the same periodical the department of " The Easy Chair," which had lapsed with the death of George William Curtis. Of Mr Howells's many novels, the following may be mentioned as specially noteworthy : Tlieir Wedding Journey, 1871 ; The Lady of the Aroostook, 1879; A Modern Instance, 1882; Tlie Rise of Silas Lapham, 1885 ; TJie Minister's Charge, 1886 ; A Hazard of New Fortunes, 1889 ; Tlie Quality of Mercy, 1892 ; Tlie Landlord at Lion's Head, 1897. Mr Howeils is by general consent the foremost representative of the realistic

school of indigenous American fiction. From the outset his aim has been to portray life with entire fidelity in all its commonplaceness, and yet to charm the reader into a liking for this commonplaceness and into reverence for what it conceals. Though in his earliest novels his method was not consistently realistic — he is at times almost as personal and as whimsical as Thackeray — yet his vivid impressionism and his choice of subjects, as well as an occasional explicit protest that "dulness is dear to

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William Dean Howells.

{From a photograph &y C. F. Conby, Boston.)

him," already revealed unmistakably his realistic bias. In Jl Modern Instance (1882) he gained complete com-mand of his method, and began a series of studies of American life that are remarkable for their loyalty to fact,

their truth of tone, and their power to reveal, despite their strictly objective method, both the inner springs of American character and the sociological forces that are shaping American civilization. Mr Howells's method, as finally developed in his more serious fiction, is noteworthy for its restraint and its conscientious impersonality. He refuses to over-sophisticate or to over-intellectualize his characters, and he is very sparing in his use of psycho-logical analysis. He insists on seeing and portraying American life as it exists in and for itself, under its own skies and with its own atmosphere ; he does not scruti-nize it with foreign comparisons in mind, and thus try to find and to throw into relief unsuspected configurations of surface. He keeps his dialogue toned down to almost the. pitch of everyday conversation, although he has shown in his comedy sketches how easy a master he is of adroit and witty talk. His style is in general trans-parent and rigorously plain, and his humour impersonal and dramatic. That he is at times the victim of a superstition for the commonplace even his warmest ad-

mirers can hardly deny. Life in America has, after all, greater charm of manner and greater intellectual and social refinement than he seems willing to admit. He has

the air of obstinately choosing sordid material, as if he ■were ambitious to outdo the gods themselves in creating beauty. Yet, on the other hand, he has been again and again justified of his ambition, and has compelled some apparently quite prosaic bit of life to exhale a quaint poetic fragrance or to reveal a poignant tragic quality. Taken altogether, his novels doubtless offer a more penetrating and comprehensive interjiretation of American life than can be found in the works of any other writer of fiction.

Howitt, Mary (1799-1888), English writer, daughter of Samuel ietham, was born at Coleford, Gloucestershire, 12th March 1799. She began to write verse when quite young, and in 1821 married William Howitt (see Ency. Brit. vol. xii. p. 324). She and her husband collaborated

throughout a long literary career, Mrs Hewitt's own contributions being of a varied and voluminous description, consisting of poems, songs, stories, &o. A month after her husband's death in 1877, Mrs Howitt was given a Civil List pension of £100 a year. Mary Howitt died 30th January 1888. Brought up as a Quaker, she left the Society of Friends in 1847 ; and after passing through a stage of spiritualism, she joined the Church of Rome in 1882.

Howrah, a city and district of British India, in the Burdwan division of Bengal. The city is situated opposite Calcutta, with which it is connected by a floating bridge. The municipal area is about 11 square miles ; the population in 1881 was 105,628, in 1891 it was 116,606, and in 1901 it was 157,847, showing an increase of 35 per cent. Howrah is the terminus of the East Indian railway, and of the Bengal-Nagpur and East Coast lines. A project has been under consideration for carrying all these railways into Calcutta by a permanent bridge across the river. Howrah is also the centre of two steam tramways, which

run for 29 and 19 miles into the country. Further, it is the headquarters of the jute-manufacturing industry, with many steam presses and steam mills, and there are four cotton mills (see Bengal). There is a paper mill, employing 1000 hands, with an annual out-turn valued at Es.14,00,000 ; six flour mills, employing 300 hands, with a yearly out-turn valued at Es.30,00,000 ; several foundries and iron-works, one of which alone employs more than 3000 hands, with an annual out-turn valued at Es.24,00,000 ; two oil mills; two large ropeworks; and factories of safety matches and umbrellas. Sibpur Engineering College lies on the outskirts of the town. There is a hospital, with a department for Europeans. The District of Howrah extends southwards down the right bank of the Hooghly to the confluence of the river Damodar. For revenue purposes it is included within the district of Hooghly. Its area is 476 square miles ; the population in 1881 was 635,381, in 1891 it was 721,211, giving an average density of 1615 persons per square mile. In 1901 the population was 852,008. The number of

police was 667 ; the number of boys at school in 1896-97 was 31,777, being 55 per cent, of the male population of school-going age ; the registered death-rate in 1897 was 29-32 per thousand. In addition to the two steam tram-ways and the East Indian railway, the district is crossed by the high-level canal to Midnapur, which communicates with the Hooghly at Ulubaria. The manufacturing in-dustries of Howrah extend beyond the town into the district. One or two systems of draining low-lying lands are maintained by the Government.

Hdxter, a town of Prussia, province of Westphalia, on the Weser, 32 miles north of Cassel. The town-house dates from 1466 and 1613, and there are churches of the 11th and 14th centuries, as well as numerous houses of the 16th. The town possesses various industries — cement, paper, gutta-percha, &c. — and an architectural school. It grew out of a royal estate which dates from 823, and eventually became a free imperial town and a member of the Hanseatic League, with a mint and staple of its own. Population (1885), 6046 ; (1900), 7625. Close

to Hoxter is the abbey of Corvey, one of the most famous Benedictine monasteries in Germany, founded in 822 and secularized in 1803; the "castle" contains a valuable old library of some 55,000 volumes. Hoffmann von Fallersleben, who was librarian from 1860 to 1874, is buried behind the abbey church.

Huallaga. See Amazon.

Huancavelica, an interior department of Central Peru. It has an area of 10,814 square miles, and (1896) a population of 223,796, or 20 persons to the square mile. It contains the four provinces of Tayacaja, Huancavelica, Angaraes, and Castrovireyna. The capital, Huancavelica, has a population of 8000.

Huanuco, an interior department of Central Peru. It has an area of 14,023 square miles, and a population (1896) of 145,309, or 10 persons to the square mile. It is divided into the three provinces of Huamalies, Dos de Mayo, and Huanuco. Its capital, Huanuco, is 170 miles north-north-east of Lima.

Hubli, a town of British India, in the Dharwar dis-

trict of Bombay, 15 miles south-east of Dharwar town. Population (1881), 36,677 ; (1891), 52,595 ; (1901), 58,149. It is a railway junction on the Southern Mahratta system, where the lines to Bangalore and Bezwara branch off south and west. It is an important centre of trade and of cotton and silk weaving, and has a cotton mill with 18,880 spindles, employing 725. hands, eleven factories for ginning and pressing cotton, and a printing-press, issuing a newspaper in vernacular and English.

Hubner, Joseph Alexander,CoTTNT (1811-1892), Austrian diplomatist, was born in Vienna on 26th November 1811. His real name was Hafenbredl, which he afterwards changed to Hubner. He began his public career in 1833 under IMetternich, whose confidence he soon gained, and who sent him in 1837 as attache to Paris. In 1841 he became secretary of embassy at Lisbon, and in 1844 Austrian consul-general at Leipzig. In 1848 he was sent to Milan to conduct the diplomatic correspondence of Archduke Kainer, viceroy of Lombardy. On the outbreak of the revolution he was seized as a hostage, and

remained a prisoner for some months. Eeturning to Austria, he was entrusted with the compilation of the documents and proclamations relating to the abdication of the Emperor Ferdinand and the accession of Francis Joseph. His journal, an invaluable clue to the compli-cated intrigues of this period, was published in 1891 in French and German, under the title of Une Annie de ma Vie, 1848-1840. In IMarch 1849 he was sent on a special mission to Paris, and later in the same year was appointed Ambassador to France. To his influence was in large measure due the friendly attitude of Austria to the Allies in the Crimean War, at the close of "W'hich he represented Austria at the Congress of Paris in 1856. He allowed himself, however, to be taken by sur-prise by Napoleon's intervention on behalf of Italian unity, of which the first public intimation was given by the French Emperor's cold reception of Hubner on New Year's Day, 1859, with the famous words: "I regret that our relations with your Government are not so good as they have hitherto been." He did not return to Paris

after the war, and after holding the ministry of police in the Goluchowski cabinet from August to October 1859,

lived in retirement till 1865, when he became ambassador at Rome. Quitting this post in 1867, he undertook extensive travels, his descriptions of which appeared as Pro7nenade autour du Monde, 1871 (1873; English translation by Lady Herbert, 1874), and Through the British Empire (1886). Written in a bright and enter-taining style, and characterized by shrewd observation, they achieved considerable popularity in their time. A more serious effort was his ^iKfe-Qwini (1870 ; translated into English by H. E. H. Jerningham under the title of The Life and Times of Sixtus the Fifth, 1872), an original contribution to the history of the period, based on unpublished documents at the Vatican, Simancas, and Venice. In 1879 he was made a life-member of the Austrian Upper House, where he sat as a Clerical and Conservative. He had received the rank of Baron

(Freiherr) in 1854, and in 1888 was raised to the higher rank of Count (Graf). He died at Vienna on 30th July 1892. Though himself of middle-class origin, he was a profound admirer of the old aristocratic rigime, and found his political ideals in his former chiefs, Metternich and Schwarzenberg. As the last survivor of the Metternich school, he became towards the close of his life more and more out of touch with the trend of modern politics, but remained a conspicuous figure in the Upper House and at the annual delegations. That he possessed the breadth of mind to appreciate the working of a system at total variance with his own school of thought was shown by his grasp of British colonial questions. It is interesting, in view of subsequent events, to note his emphatic belief in the loyalty of the British colonies — a belief not shared at that time by many statesmen with far greater ex-perience of democratic institutions. With strange incon-sistency, he refused to apply these conclusions to the internal politics of his own country. (h. sy.)

Huddersfleld, a municipal, county (1888), and

parliamentary borough and market town in the West Riding of Yorkshire, England, on the Colne, 190 miles by rail north-north-west of London. The municipal borough was extended in 1890, and is now distributed into 13 wards under a mayor, 15 aldermen, and 45 councillors. St Mark's Church was erected in 1887, and Longwood Grammar School (1731) reorganized in 1892. There are now 18 board schools (the college higher grade having been acquired by the school board in 1893), 22 national, and 2 Roman Catholic schools. The reservoirs of the water-works will hold 1,159,000,000 gallons, and two other reser-voirs, now in course of construction, about 460,000,000 gallons. These works have cost over a million sterling. A new theatre was built in 1881. In 1891, 6258 males and 4845 females were employed in the manufacture of woollen cloth, 1295 males and 2195 females in the manu-facture of worsted stuff, and 1144 males and 1252 females in the manufacture of cotton goods. There are two daily newspapers. Area, 11,852 acres. Population (1881), 86,502; (1901), 95,008.

Hudson, a town of Middlesex county, Massachu-
setts, U.S.A., on the Boston and Maine and the Fitchburg
railways. It has an area of 13 square miles of hilly sur-
face, containing a village of the same name, situated on
the Assabet, at an altitude of 226 feet. Population
(1880), 3739; (1890), 4670; (1900), 5464, of whom
1225 were foreign-born.

Hudson, capital of Columbia county, New York,
U. S. A., on the east bank of the Hudson river. It has three
railways — the Boston and Albany, the New York Central
and Hudson River, and the Kinderhook and Hudson — as
well as steamboat lines on the river connecting it with New
York and Albany. It has manufactures of varied character.
Population (1880), 8670; (1890), 9970; (1900), 9528, of
whom 1155 were foreign-born and 424 were negroes.

Hue, capital of Annam, near the mouth of Hue
river, on the coast of Cochin-China, French Indo-China.
Formerly closed to Europeans, French enterprise is now
active in its midst. The royal palace, once forbidden
ground, is to-day open to foreigners, and the citadel is

occupied by French troops. The palace of the French resident-general, opposite the citadel on the right bank of the Hue — the Song-Huon-Oiang — is connected with the citadel by a stationary bridge 1160 feet in length. A glass factory has been established, and a frequent service of steam launches connects the town with the ports of Tuan-an and Tourane. The population (1901) includes twenty-three Europeans (exclusive of officials), 60,000 Annamese, and 300 Chinese. Important suburbs have gathered round the official town, the villages of D6ng-Bo, Bo-vinh, GiarHo, and Kim-Long forming a sort of commercial belt about the governmental city. The apostolic vicariate of northern Cochin-China is established near Kim-Long. (j. m. a. de l.)

Huehuetenango, a city of Guatemala, capital of a department of the same name. It is situated in a fertile plain, watered by the Chiapas, a tributary of the Rio Grijalva, 106 miles north-west of Guatemala. In the neighbourhood there are lead mines, and at a short distance from the city, on a terrace surrounded by

ravines, are important remains of an ancient Indian capital. Population, 12,000.

Huelva, a maritime province of south-western Spain. The area is 4122 square miles, divided into six administrative districts and seventy-seven parishes. The means of communication have been very much improved. A broad-gauge railway, 68 miles in length, has been opened between Seville and Huelva, and another, 112 miles long, from Huelva to Zafra, and other lines are in course of construction. There are, besides, 135 miles of narrow-gauge lines, connecting Huelva with the mines of Rio Tinto, Tharsis, Buitron, and Zalamea, and minor branches from Tharsis to La Zarza, and Cuervo to Sotul mines. There are 98 miles of first-class state roads, and very many useful provincial second- and third-class roads. Apart from vines, which cover 23,600 acres, the agricul-ture of the province is not very important, though 46,600 acres were devoted in 1898 to the culture of wheat, 26,000 to oats, rye, barley, 56,000 acres to pod fruit, and 37,000 to olives. Orange groves yield a good crop.

In some parts of the province are pine, cork trees, oaks, chestnuts, and beeches. In 1898 there were 7796 horses, 7963 mules, 13,650 asses, 11,897 cattle, 82,612 sheep, 55,125 goats, and 28,011 pigs. The local industries in-clude 241 manufactories of brandy {aguardiente), 78 brickworks, 152 oil mills, 12 soapworks, 18 candle factories, and 360 flour mills. The fisheries also afford a thriving industry, and there are 27 establishments for salting. The principal industry, however, is mining, 307 mines being productive and 717 unproductive. The pro-ductive mines, which include 288 copper mines, employed, in 1898, 9108 hands (7876 in the copper mines), and the works connected therewith employed 6078 additional hands. The output included 70,814 tons of sulphur, 16,829 tons of iron ore, 2,229,695 tons of copper ore, 70,000 of iron pyrites, 101,861 of manganese, and 1494 of argentiferous lead. Population (1887), 254,831; (1897), 253,970.

Huelva, capital of the above province. It is a rising and important port, and, with Bilboa and Barcelona,

has an increasing trade with Great Britain. There are

few buildings of artistic merit, and the most notable public works are the port improvements, the splendid piers and quays, a bull-ring, the stations, and one of the business offices. The river has a deep channel, but the sandbanks in the river and estuary are serious draw-backs. The shipping returns for 1898 show 1257 vessels of 806,439 tons, 615 of 657,356 tons being British. The export trade in ores is most prosperous, but the wine export has decreased since France raised her scale of duties, the figures for 1898 being 119,836,400 pints, chiefly shipped to France. Among the exports Great Britain took, in 1898, 612,911 tons of cupreous sulphur ore pyrites, 5820 tons of washed ore, 29,972 tons of precipitate of copper, 16,919 of copper mat, 44,924 of iron pyrites, 4179 of manganese, and a considerable amount of corks. Great Britain stands at the head of

the imports of manufactured goods, machinery, and bread-stufEs, and in 1898 sent 66,768 tons of coal and 13,454 tons of coke. The total of imports during 1899 was 96,508 tons (of 1000 kilos), of which 33 per cent, came from Great Britain, whilst the total of exports for the same period amounted to 1,490,869 tons, 636,431 tons (42 per cent.) being shipped to Great Britain. In 1900 the total of imports was 111,360 tons, 99,262 of which (89 per cent.) were imported from Great Britain. The total of exports amounted to 1,671,267 tons, the total shipped to Great Britain being 622,208 tons (39 per cent.). Population (1887), 18,195; (1897), 19,423.

Huercal-Overa, a town of south-east Spain, in the province of Almeria, not far from the coast. The streets are broad, and there are three fine squares. The parish church has a fine nave and handsome altars. Near Huereal-Overa is the important mining district of Sierra Almagrera. Apart from the product of the mines, the local trade is chiefly agricultural. Population (1887), 15,631 ; (1897), 16,266.

Huesca, a frontier province of north-east Spain.

Its area is 7530 square miles, divided into 8 adminis-

trative districts and 362 parishes. The railway from

Saragossa to Barcelona runs through the province, and

has branches from Tarelimta to Huesca and from Seigna

to Barbastro. The Central Pyrenean railway starts from

Zuera on the SaragossarBarcelona line by the valley of

the Gallego, and has been extended to Canfranc, from

which it will run to the Somport, the site of the tunnel

through the Pyrenees, when Prance and Spain are in a

position to carry out this railway and the Catalonia,

Noguera, Pallares, and Arifege line which they undertook

to execute simultaneously in 1882. The province of

Huesca has 128 miles of first-class roads, and some good

provincial and parish roads kept up at local expense.

Trade is most active with France, where are sent timber,

millstones, cattle, leather, brandy, and, above all, wine.

The vineyards were quickly developed from 1882 to

1892, in the heyday of the exports of common red wines

to France, but have much declined since. The forests of

the Pyrenean region afford one of the most flourishing local industries, pine, fir, oak, and beech forests giving annually £160,000 worth of excellent timber. In some districts irrigation fertilized many thousand acres. The mineral resources remain almost entirely undeveloped. In 1898 there were 4864 horses, 44,170 mules, 30,796 asses, 46,611 cattle, 443,517 sheep, 83,348 goats, and 43,868 pigs. Agriculture is progressing owing to the enterprising spirit of the inhabitants. No less than 352,000 acres were devoted in 1898 to wheat, 30,000 acres to rye, oats, barley, and maize, 14,000 acres to pod fruit, 141,000 acres to vines, and 39,000 acres to olives. There is some emigration. Population (1897), 247,317.

Huesca, the capital of the above province. Considerable attention is paid to public education, and there are not only several good primary schools, but normal schools for teachers, an institute, a seminary, an artistic and archaeological museum, and an economical society. A few manufactures and an active trade in agricultural products and wines have kept up its importance, despite

the decline of its population consequent on emigration to France. Population (1887), 13,043 ; (1897), 11,204.

Huet. See Busken-Huet.

-), English

Muggins, Sir William (1824-

astronomer, was born in London on 7th February 1824, and was educated first at the City of London School and then under various private teachers. Having determined to apply himself to the study of astronomy, he built a private observatory for that purpose at Tulse Hill, in the south of London, about 1866. At first he occupied himself with routine work on the ordinary lines followed by astronomers of the day, but he was far from satisfied with the scope which this afforded, and therefore seized eagerly upon the opportunity for research in a new direction which was offered by Kirchhoff's discoveries in spectrum analysis. The chemical constitution of the stars was the problem to which he turned his attention, and his first results, obtained in conjunction with Professor W. A. Miller, were presented to the Eoyal Society in

1863, in a preliminary note on the " Lines of some of the fixed stars." At the same time, by making use of photography, he introduced into the methods of astronomy an innovation which was destined ultimately to exert as potent an influence on the progress of the science as spectroscopy itself. Wet collodion was, however, the only process at first available, and the difficulties involved in its application to astronomical purposes were so enormous that it was used only to a very limited extent; the real triumphs of photographic astronomy began about 1875 with the invention of the gelatine dry plate. This enabled the observer to make his exposures as long as he might desire, and, through the cumulative action of light on his extremely sensitive surfaces, to obtain permanent accurate pictures of celestial objects which are so faint as to be completely invisible to the eye, even when aided by the most powerful telescopes. In the last quarter of the 19th century spectroscopy and photography together worked a revolution in the science of observational astronomy, and in the

utilization of both Huggins acted as pioneer. Besides these new methods, many results of great importance are associated with his name. Thus in 1864 the spectroscope yielded him evidence that the planetary nebula in Draco consists of luminous gas — a conclusion confirming the nebular hypothesis and supporting the belief that such nebulse are surviving relics of the mass of glowing gas from which Laplace supposed the solar system to have been formed by condensation. Four years afterwards the same instrument enabled Huggins to prove the existence of carbon in comets ; and about the same time he showed how by the application of Doppler's principle it can be used not only to detect the motion of stars moving in the line of vision, but even to measure its amount with more or less accuracy. Such data, which the astronomer can scarcely gain in any other way, are obviously indispensable to any adequate conception of the arrangement of the stars in space. In solar physics Huggins suggested a spectroscopic method by which the red prominences of the sun may be viewed at any time, even when it is not

eclipsed, and one of his experiments went far towards settling a much-disputed question regarding the solar distribution of calcium. In the general solar spectrum

this element is represented by a large number of lines, but in the spectrum of the prominences and chromosphere only one pair of these can be detected. This circumstance has seemed so anomalous to some astronomers that they have doubted whether the pair of lines in question is due to calcium at all, but Sir William and Lady Huggins (who, after their marriage in 1875, actively assisted her husband in his scientific work) dispelled this doubt by demonstrating in the laboratory that calcium vapour, if at a sufl8.ciently low pressure, gives under the influence of the electric discharge precisely these lines and no others. Sir William Huggins, who was made K.C.B. in 1897, has received many honours, academic and other. He presided over the meeting of the British Association in 1891, and in 1900 was chosen president of the Eoyal

Society, from which he has at different times received a Royal, a Copley, and a Eumford medal. He is the author of many scientific papers and (with Lady Huggins) of a magnificent Atlas of Representative Stellar Spectra, published in 1900, which gained the Actonian prize of the Eoyal Institution.

Hughes, David Edward (1831-1900), Anglo-American electrician, was born on 16th May 1831 in London, but the earlier part of his life was spent in America, whither his parents emigrated when he was about seven years old. In 1850 he became professor of music at the college of Bardstown, Kentucky, and soon afterwards his attainments in physical science procured his appointment as professor of natural philosophy at the same place. His professorial career, however, was brief, for in 1864 he removed to Louisville to supervise the manufacture of the type-printing telegraph instrument which he had been thinking out for some time, and which was destined to make both his name and his fortune.

The patent for this machine was taken out in the United

States, in 1855, and its success was immediate. (Tor a description, see Enoy. Brit. vol. xxiii. p. 121.) About the period when it was invented the Morse system, under the control of the American Telegraph Company, held the field in the United States, and the new instrument was promptly taken up as a means to fight what were regarded as the excessive rates charged by that company. After seeing it well established on one side of the Atlantic, Hughes in 1857 brought it over to his native country, where, however, the telegraph companies did not receive it with any favour. Two or three years afterwards he introduced it to the notice of the French Grovernment, who, after submitting it to severe tests, ultimately adopted it, and in the succeeding ten years it came into extensive use all over Europe, gaining for its inventor numerous honours and prizes. In the development of telephony also Hughes had an important share, and the telephone has attained its present perfection largely as a result of his investigations. The carbon transmitters which in various forms are in almost universal use are modifications of a simple device

which he calledamicrophone, and which consists essentially of two pieces of carbon, one resting lightly on the other. The arrangement constitutes a variable electrical resistance of the most delicate character ; if itis included in an electric circuit with a battery and subjected to the influence of sonorous vibrations, its resistance varies in such a way as to produce an undulatory current which affords an exact representation of the sound waves as to height, length, and form. These results were published in 1878, but Hughes did much more work on the properties of such microphonic joints, of which he said nothing till many years afterwards. When towards the end of 1879 he found that they were also sensitive to " sudden electric impulses, whether given out to the atmosphere through the extra current from a coil or from a frictional machine," he in fact discovered the phenomena on which depends the action of the so-called "coherers" that form an indispensable ad-junct to wireless telegraphy. But he went further and practised wireless telegraphy himself, surmising, moreover, that the agency he was employing consisted of true electric

waves. Setting some source of the " sudden electric impulses " referred to above into operation in his house, he walked along the street carrying a telephone in circuit with a small battery and one of these microphonic joints, and found that the sounds remained audible in the telephone until he had traversed a distance of 500 yards. This experiment he showed to several English men of science, among others to Sir G. G. Stokes, to whom he broached the theory that the results were due to electric waves. That physicist, however, was not disposed to accept this explanation, considering that a sufficient one could be found in well-known electromagnetic induction effects, and Hughes was so discouraged at that high authority taking this view of the matter that he resolved to publish no account of his inquiry until further experiments had enabled him to prove the correctness of his own theory. These experiments were still in progress when Hertz settled the question by his researches on electric waves in 1887-89. Hughes, who is also known for his invention of the induction balance and for his con-

tributions to the theory of magnetism, died in London on 22nd January 1900. As an investigator he was remarkable for the extraordinary simplicity of the apparatus which served his purposes, domestic articles like jam-pots, pins, &c., forming a large part of the equipment of his laboratory. His manner of life, too, was simple and frugal in the extreme. At his death he was possessed of property worth not much less than half a million sterling, and the whole of this immense sum, with the exception of some bequests to the Eoyal Society, the Paris Academy of Sciences, the Institution of Electrical Engineers, and the Paris Societe Internationale des filectriciens, for the establishment of scholarships and prizes in physical science, was left to four London hospitals, subject only to the payment of life annuities to certain of his relatives. (h. m. e.)

Hughes, Thomas (1822-1896), English lawyer and author, second son of John Hughes of Donnington Priory, editor of The Boscobel Tracts (1830), was born at Uffington, Berks, on 20th October 1822. In February

1834 he went to Eugby School, to be under Dr Arnold, a contemporary of his father at Oriel. He rose steadily to the sixth form, where he came into contact with the head-master whom he afterwards idealized; but he excelled rather in sports than in scholarship, and his school career culminated in a cricket match at Lord's. In 1842 he proceeded to Oriel, Oxford, and graduated B.A. in 1845. He was called to the bar in 1858, became Q.C. in 1869, a bencher in 1870, and was appointed to a county court judgeship in the Chester district in July 1882. While at Lincoln's Inn he came under the dominating influence of his life, that of Frederick Denison Maurice. In 1848 he joined the Christian Socialists, under Maurice's banner, among his closest allies being Charles Kingsley. In January 1854 he was one of the original promoters of the Working Men's College in Great Ormond Street, and whether he was speaking on sanitation, sparring, or singing his favourite ditty of " Little Billee," his work there continued one of his chief interests to the end of his life. After Maurice's death he held the principalship of the

college. His Manliness of Christ (1879) grew out of a Bible-class which he held there. Hughes had been influenced mentally by Arnold, Carlyle, Thackeray, Lowell,

and Maurice, and had developed into a liberal ehurcliman, extremely religious, with strong socialistic leanings ; but the substratum was still and ever the manly country squire of old-fashioned, sport-loving England. In Parliament, where he sat for Lambeth (1865-68), and for Frome (1868-74), he reproduced some of the traits of Colonel Newcome. Thrice he visited America and received a warm welcome, less as a propagandist of social reform than as a friend of Lowell and of the North, and an author. In 1879, in a sanguine humour worthy of Mark Tapley, he planned a co-operative settlement, " Eugby," in Tennessee, over which he lost money. In 1848 Hughes had married Trances, niece of Kichard Ford, of Spanish Handbook fame. They settled in 1853 at Wimbledon, and there was written his famous story,

Tom Brown's School Days, " by an Old Boy " (dedicated to Mrs Arnold of Fox Howe), which came out in April 1857. It is probably impossible to depict the schoolboy in his natural state and in a realistic manner ; it is extremely difficult to portray him at all in such a way as to interest the adult. Yet this last has certainly been achieved twice in English literature — by Dickens in Nicholas Nicklehy, and by Hughes in Tom Brown. In both cases interest is concentrated upon the master, in the first a demon, in the second a demigod. Tom Brown did a great deal to fix the English concept of what a public school should be. Hughes also wrote The Scouring of the White Horse (1859), Tom Brown at Oxford (1861), Religio Laid (1868), and the Memoir of a Brother. The brother was George Hughes, who was in the main the original " Tom Brown," just as Dean Stanley was in the main the original of "Arthur." Hughes died at Brighton, on 22nd March 1896. He was English of the English, full of "muscular Christianity," straightforward and unsuspicious to a fault, yet attaching a somewhat exorbi-

tant value to "earnestness" — a favourite expression of Doctor Arnold. (t. se.)

Hugo, Victor Marie (1802-1885), the great French poet, dramatist, and romance-writer, was born at Besanqon on the 26th of February 1802. The all but still-born child was only kept alive and reared by the indefatigable devotion of his mother, a royalist of La Vendee married to a general in the service of Napoleon. Educated first in Spain and afterwards in France, the boy whose infancy had followed the fortunes of the imperial camp grew up a royalist and a Catholic. His first work in poetry and in fiction was devoted to the passionate proclamation of his faith in these principles. The precocious eloquence and ardour of these early works made him famous before his time. The odes which he published at the age of twenty, admirable for their spontaneous fervour and fluency, might have been merely the work of a marvellous boy; the ballads which followed them two years later revealed him as a great poet, a natural master of lyric and creative song. In 1823, at the age of twenty-

one, he married his cousin Adfele Foucher. In the same year his first romance, Han d'Islaiide, was given to the press ; his second, Bug-Jargal, appeared three years later. In 1827 he published the great dramatic poem of Crom-well, a masterpiece at all points except that of fitness for the modern stage. Two years afterwards he published Les Orientales, a volume of poems so various in style, so noble in spirit, so perfect in workmanship, in music, and in form, that they might alone suffice for the foundation of an immortal fame. In the course of nine years, from 1831 to 1840, he published Les Feuilles d'Automne, IjCS Chants du Onpuscule, Les Voix Intirieures, and Les Rayons et les Ombres. That their author was one of the greatest elegiac and lyric poets ever born into the world, any one of these volumes would amply suffice to prove. That he was the greatest tragic and dramatic poet born since the age of Shakespeare, the appearance of Hernani in 1830 made evident for ever to all but the meanest and most perverse of dunces and malignants. The earlier and even greater tragedy of Marion de Lorme had been pro-

scribed on the ground that it was impossible for royalty to tolerate the appearance of a play in which a king was represented as the puppet of a minister. In all the noble and glorious life of the greatest poet of his time there is nothing on record more chivalrous and characteristic than the fact that Victor Hugo refused to allow the play which had been prohibited by the G-overnment of Charles X. to be instantly produced imder the Government of his supersessor. Le Roi s'amuse, the next play which Hugo gave to the stage, was prohibited by order of Louis Philippe after a tumultuous first night — to reappear again fifty years later on the same day of the same month, under the eyes of its author, with atoning acclamation from a wider audience than the first. Terror and pity had never found word or expression on the stage which so exactly realized the ideal aim of tragic poetry among the countrymen of .zEschylus and Sophocles since the time or since the passing of Shakespeare, of Marlowe, and of Webster. The tragedy of Jjucrice Borgia, coequal in beauty and power with its three precursors, followed

them next year in the humbler garb of prose ; but the prose of Victor Hugo stands higher on the record of poetry than the verse of any lesser dramatist or poet. Marie Tudor, his next play, was hardly more daring in its Shakespearean defiance of historic fact, and hardly more triumphant in its Shakespearean loyalty to the everlasting truth of human character and passion. Angela, Tyran de Padoue, the last of the tragic triad to which their creator denifed the transfiguration of tragic verse, is inferior to neither in power of imagination and of style, in skill of invention and construction, and in mastery over all natural and noble sources of pity and of terror. La Esmeralda, the libretto of an opera founded on his great tragic romance of Notre-Dame de Paris, is a miracle of lyric melody and of skilful adaptation. Ruy Bias, his next play, was written in verse, and in such verse as none but he could write. In command and in expression of passion and of pathos, of noble and of evil nature, it equals any other work of this great dramatic poet; in the lifelike fusion of high comedy with deep tragedy

it excels them all. Les Burgraves, a tragic poem of transcendent beauty in execution and imaginative audacity in conception, found so little favour on the stage that the author refused to submit his subsequent plays to the verdict of a public audience. His first mature work in prose fiction, Le Dernier Jour d'un Condamne, had appeared thirteen years earlier. As a tragic monodrama it is incomparable for sustained power and terrible beauty. The story of Claude Gueux, published five years later, another fervent protest against the infliction of capital punishment, was followed by many other eloquent and passionate appeals to the same effect, written or spoken on various occasions which excited the pity or the indignation of the orator or the poet. In 1831 appeared the greatest of all tragic or historic or romantic poems in the form of prose narrative, Xotre-Dame de Paris. Three years afterwards the author published, under the title of Litterature et Philosophie mkUes, a compilation or selection of notes and essays ranging and varying in date and in style from his earliest effusions of religious royalism to

the magnificent essay on Mirabeau which represents at once the historical opinion and the critical capacity of Victor Hugo at the age of thirty-two. Next year he published Le Rhiii, a series of letters from Germany, brilliant and vivid beyond all comparison, containing one of the most splendid stories for children ever written, and

followed by a political supplement rather pathetically un-pi'ophetic in its predictions. At the age of thirty-eight he honoured the French Academy by taking his place among its members ; the speech delivered on the occasion was ■characteristically generous in its tribute to an undeserving memory, and significantly enthusiastic in its glorification of Napoleon. Idolatry of his father's hero and leader had Jiow superseded the earlier superstition inculcated by his mother. In 1846 his first speech in the chamber of peers — Louis Philippe's House of Lords — was delivered on be-half of Poland ; his second, on the subject of coast defence, is memorable for the evidence it bears of careful research

and practical suggestion. His pleading on behalf of the exiled family of Bonaparte induced Louis Philippe to •cancel the sentence which excluded its members from Prance. After the fall and flight of the house of Orleans, Ms parliamentary eloquence was never less generous in aim and always as fervent in its constancy to patriotic and progressive principle. When the conspiring forces of clerical venality and political prostitution had placed a putative Bonaparte in power attained by perjury after perjury, and supported by massacre after massacre, Victor Hugo, in common with all honourable men who had ever taken part in political or public

life under the government

superseded by force of treason

and murder, was driven from

his country into an exile

of well-nigh twenty years.

Next year he published

NapoUon le Petit; twenty-

five years afterwards, Histoire

d'un Grime. In these two

books his experience and his

opinion of the tactics which

founded the second French

empire stand registered for

^11 time. In the deathless

volume of Chdtiments, which

appeared in 1853, his indig-

nation, his genius, and his

faith found such utterance

and such expression as must

recall to the student alternately the lyric inspiration of

Coleridge and Shelley, the prophetic inspiration of Dante and Isaiah, the satiric inspiration of Juvenal and Dryden. Three years after Les Chdtiments, a book written in lightning, appeared Les Gomtemplations, a book written in sunlight and starlight. Of the six parts into which it is divided, the first translates into m.any-sided music the joys and sorrows, the thoughts and fancies, the studies and ardours and speculations of youth; the second, as f uU of light and colour, grows gradually deeper in tone of thought and music; the third is yet riper and more various in form of melody and in fervour of meditation ; the fourth is the noblest of all tributes ever paid by song to sorrow — a series of poems consecrated to the memory of the poet's eldest daughter, who was drowned together with her husband by the upsetting of a boat off the coast of Normandy, a few months after their wedding-day, in 1843; the fifth and the sixth books, written during his first four years of exile (all but one noble poem which bears date nine years earlier than Victor Hugo.

{From a photograph hy P. Nadar^ Paris.)

its epilogue or postscript), contain more than a few poems unsurpassed and unsurpassable for depth and clarity and trenchancy of thooght, for sublimity of inspiration, for intensity of faith, for loyalty in translation from nature, and for tenderness in devotion to truth; crowned and glorified and completed by their matchless dedication to the dead. Three years later again, in 1869, Victor Hugo gave to the world the first instalment of the greatest book published in the 19th century. La Ligende des SiMes. Opening with a vision of Eve in Paradise which eclipses Milton's in beauty no less than in sublimity — a dream of the mother of mankind at the hour when she knew the first sense of dawning motherhood, it closes with a vision of the trumpet to be sounded on the day of judgment Which transcends the imagination of Dante by right of a realized idea which was utterly impossible of con- ception to a believer in Dante's creed: the idea of

real and final equity ; the concept of absolute and abstract righteousness. Between this opening and this close the pageant of history and of legend, marshalled and vivified by the will and the hand of the poet, ranges through an infinite variety of action and passion, of light and darkness, of terror and pity, of lyric rapture and of tragic triumph. After yet another three years' space the author of La Ligende des SiMes reappeared as the author of Les Misirables, the greatest epic and dramatic work of fiction ever created or conceived : the epic of a soul

transfigured and redeemed,

purified by heroism and glori-

fied through suffering ; the

tragedy and the comedy of

life at its darkest and its

brightest, of humanity at its

best and at its worst. Two

years afterwards the greatest

man born since the death of

Shakespeare paid homage to

the greatest of his predeces-

sors in a volume of magnifi-

cent and discursive eloquence which bore the title of

William Shakespeare, and might, as its author admitted

and suggested, more properly have been entitled A

propos de Shake^eare. It was undertaken with the

simple design of furnishing a preface to' his younger

son's translation of Shakespeare; a monument of perfect

scholarship, of indefatigable devotion, and of literary

genius, which eclipses even Urquhart's Rabelais — its

only possible competitor ; and to which the translator's father prefixed a brief and admirable note of introduction in the year after the publication of the volume which had grown under his hand into the bulk and the magnificence of an epic poem in prose. In the same year Les Gliansons des Hues et des Bois gave evidence of new power and fresh variety in the exercise and display of an unequalled skill and a subtle simplicity of metre and of style employed on the everlasting theme of lyric and idyllic fancy, and touched now and then with a fire more sublime than that of youth and love. Next year the exile of Guernsey published his third great romance, Les Travailleurs de la

Mer, a work unsurpassed even among the works of its author for splendour of imagination and of style, for pathos and sublimity of truth. Three years afterwards the same theme was rehandled with no less magnificent mastery in IJ Homme qui Bit; the theme of human hero-ism confronted with the superhuman tyranny of blind

and unimaginable chance, overpowered and unbroken, defeated and invincible. Between the dates of these two great books appeared La Voix de Guernesey, a noble and terrible poem on the massacre of Mentana which branded and commemorated for ever the papal and imperial infamy of the colleagues in that crime. In 1872 Victor Hugo published in imperishable verse his record of the year which followed the collapse of the empire, L' Annie Terrible. All the poet and all the man spoke out and stood evident in the perfervid patriotism, the filial devotion, the fatherly tenderness, the indignation and the pity, which here find alternate expression in passionate and familiar and majestic song. In 1874 he published his last great romance, the tragic and historic poem in prose called Quatrevingt-treize ; a work as rich in thought, in tenderness, in wisdom and in humour and in pathos, as ever was cast into the mould of poetry or of fiction. The introduction to his first volume of Actes et Paroles, ranging in date from 1841 to 1851, is dated in June 1875 ; it is one of his most earnest and most

eloquent appeals to the conscience and intelligence of the student. The second volume contains the record of his deeds and words during the years of his exile ; like the first and the third, it is headed by a memorable preface, as well worth the reverent study of those who may dissent from some of the writer's views as of those who may assent to all. The third and fourth volumes preserve the register of his deeds and words from 1870 to 1885 ; they contain, among other things memorable, the nobly reticent and pathetic tribute to the memory of the two sons he had lost since their common return from exile. In 1877 appeared the second series of La Legende des Slides; and in the same year the author of that colossal work, treating no less of superhuman than of human things, gave us the loveliest and most various book of song on the loveliest and simplest of subjects ever given to man, L'AH d'etre Orandpire. Next year he published Le Pape, a vision of the spirit of Christ in appeal against the spirit of Christianity, His ideal follower confronted and contrasted with His nominal vicar ; next

year again La Pitii Supreme, a plea for charity towards tyrants who know not what they do, perverted by omnipotence and degraded by adoration; two years later Religions et Religion, a poem which is at once a cry of faith and a protest against the creeds which deform and distort and leave it misshappen and envenomed and defiled; and in the same year L'Ane, a psean of satiric invective against the past follies of learned ignorance, and lyric rapture of confidence in the future wisdom and the final conscience of the world. These four great poems, one in sublimity of spirit and in supremacy of style, were succeeded next year by a fourfold gift of even greater price, Les Quatre Vents de I' Esprit : the first book, that of satire, is as full of fiery truth and radiant reason as any of his previous work in that passionate and awful kind; the second or dramatic book is as full of fresh life and living nature, of tragic humour and of mortal pathos, as any other work of the one great modern dramatist's; the third or lyric book would suffice to reveal its author as incomparably and immeasurably the greatest poet of his

age, and one great among the greatest of all time ; the fourth or^epie book is the sublimest and most terrible of historic poem^— a visionary pageant of French history from the reign and the revelries of Henry IV. to the reign and the execution of Louis XVI. Next year the great tragic poem of Torquemada came forth to bear witness that the hand which wrote Ruy Bias had lost nothing of its godlike power and its matchless cunning, if the author of Le Roi s' amuse had ceased to care much about coherence of construction from the theatrical point of view as compared with the perfection of a tragedy designed for the devotion of students not unworthy or incapable of the study ; that his command of pity and terror, his powers of intuition and invention, had never been more absolute and more sublime ; and that his infinite and illimitable charity of imagination could transfigure even the most monstrous historic representative of Christian or Catholic diabolatry into the likeness of a terribly benevolent and a tragically magnificent monomaniac. Two years later Victor Hugo published the third and concluding series of

La Ligende des SiMes. On the 22nd of May 1885 he died. The first volume published of his posthumous works was the exquisite and splendid TJiidtre en Liberie, a sequence if not a symphony of seven poems in dramatic form, tragic or comic or fanciful eclogues, incomparable with the work of any other man but the author of ITie Tempest and Tlie Winter's Tale in combination and alter-nation of gayer and of graver harmonies. The unfinished poems, Dieu and La Fin de Satan, are full to overflowing of such magnificent work, such wise simplicity of noble thought, such heroic and pathetic imagination, such reverent and daring faith, as no other poet has ever cast into deathless words and set to deathless music. Les Jumeaux, an unfinished tragedy, would possibly have been the very greatest of his works if it had been completed on the same scale and on the same lines as it was begun and carried forward to the point at which it was cut short for ever. His reminiscences of " Things Seen" in the course of a strangely varied experience, and his notes of travel among the Alps and Pyrenees,

in the north of France and in Belgium, in the south of France and in Burgundy, are all recorded by such a pen and registered by such a memory as no other man ever had at the service of his impressions or his thoughts. Toute la Lyre, his latest legacy to the world, would be enough, though no other evidence were left, to show that the author was one of the very greatest among poets and among men ; unsurpassed in sublimity of spirit, in spontaneity of utterance, in variety of power, and in perfection of workmanship ; infinite and profound beyond all reach of praise at once in thought and in sympathy, in perception and in passion ; master of all the simplest as of all the subtlest melodies or symphonies of song that ever found expression in a Border ballad or a Pythian ode. (a. c. s.)

Hulke, John Whitaker (1830-1895), British surgeon and geologist, was born 6th November 1830, being the son of a well-known medical practitioner at Deal. He was educated at King's College School and Hospital (M.R.C.S. 1852, F.R.C.S. 1857). After the

death of the duke of Wellington in 1854, young Hulke, who had attended with his father on the occasion, wrote the official description for the newspapers. In the Crimean War he volunteered, and was appointed assistant-surgeon at Smyrna, and subsequently at Sebastopol. On returning home he became medical tutor at his old hospital, and afterwards assistant-surgeon. Hulke was an excellent general surgeon, but made his special mark as an ophthalmologist, and as a geologist he had a European reputation. He was president of both the Geological and Pathological Societies in 1883, and president of the Royal College of Surgeons from 1893 until his death on 19th February 1895.

Hull, or KiNGSTON-uPON-HuLL, a municipal borough (extended 1882 and 1897), city, county, and parliamentary

borough and seaport of Yorkshire, England, a county in itself, at the influx of the Hull into the estuary of the Humber, 174|- miles by rail north of London. The cor-

poration consists of a mayor, 16 aldermen, and 48 coun-
cillors. There are also a high steward, a recorder, and a
sheriff. In 1885 the parliamentary representation was
increased from 2 to 3 members, and the municipal and
the parliamentary boroughs were made co-extensive. In
1888 Hull became a county borough, and in 1891 the
seat of a bishop-suffragan to the archdiocese of York.
There are over 20 parish and district, and 4 Roman
Catholic churches, and numerous Nonconformist chapels.
Erections since 1881 include the pier (reconstructed), the
new river wall, a promenade pier, a technical school, a
municipal crematorium, 4 public libraries, a market hall,
a dispensary, a sanatorium, a smallpox hospital, municipal
almshouses, 2 theatres, Hymer's College, comprising classi-
cal, modern, and junior departments, and a grammar
school. Among the many board schools are 3 of higher
grade, one of them accommodating 600 boys and 520
girls. The West Park was opened in 1886, the East
Park in 1887. There are 3 daily newspapers. In 1888
the ports of Hull and Goole were administratively com-

bined, the Hull docks measuring about 186 acres, the Goole docks 30 acres. Docks more recently opened are the Alexandra dock (1883), with 63^ acres of water area, 160 acres of quayage, and 2 graving docks ; St Andrew's (1883), the fish dock, since extended. The railway to near Barnsley (1885) gives Hull direct communication with the South Yorkshire coal-fields. The registered shipping in 1889 was 835 vessels of 220,923 tons; in 1899, 867 of 228,396 tons. Entrances in 1889 numbered 5414 vessels of 2,439,617 tons ; clearances, 6224 vessels of 2,401,391 tons : entrances in 1899 numbered 6246 of 3,116,748 tons; clearances, 6086 vessels of 3,046,991 tons. Imports of foreign and colonial merchandise were valued in 1899 at £28,822,898, against £26,288,229 in 1889. Exports of the produce and manufactures of the United Kingdom were valued in 1899 at £16,648,793, against £16,768,144 in 1889. Area, 8172 acres. Population (1891), 200,472 ; (1901), 240,618.

Hull, a city (1876) and railway junction of Quebec, Canada, and the capital of Wright county, opposite the

city of Ottawa. The Chaudifere Ealls of the Ottawa furnish magnificent water-power, which is utilized by the extensive saw-mills, pulp, paper, and match manufactories. Hull contains a convent, three churches, a court-house, and a town hall. Population (1881), 6890; (1901), 13,988.

Hullah, John Pyke (1812-1884), English composer and teacher of music, was born at Worcester, 27th June 1812. He was a pupil of William Horsley from 1829, and entered the Eoyal Academy of Music in 1833. He wrote an opera to words by Dickens, Hie Village Coquettes, produced in 1836 ; The Barbers of Bassora in 1837, and The Outpost in 1838, the last two at Covent Garden. Prom 1839, when he went to Paris to investigate various systems of teaching music to large masses of people, he identified himself with Wilhelm's system of the "fixedDo,"and his adaptation of that system was taught with enormous success from 1840 to 1860. In 1847 a large building in Long Acre, called St Martin's Hall, was built by subscription and presented to Hullah. It was inaugurated

in 1860 and burnt to the ground in 1860, a blow from which Hullah was long in recovering. He had risked his all in the maintenance of the building, and had to begin the world again. A series of lectures was given at the Eoyal Institution in 1861, and in 1864 he lectured in Edinburgh, but in the following year was unsuccessful in his application for the Reid professorship. He conducted concerts in Edinburgh in 1866 and 1867, and the concerts of the Eoyal Academy of Music from 1870 to 1873 ; he had been elected to the committee of management in 1869. In 1872 he was appointed by the Council of Education musical inspector of training schools for the United Kingdom. In 1878 he went abroad to report on the condition of musical education in schools, and wrote a very valuable report, quoted in the memoir of him published by his wife in 1886. He was attacked by paralysis in 1880, and again in 1883. His compositions, which remained popular for some years after his death, consisted mainly of ballads of a fairly artistic order ; but his importance in the history of music is owing to his exertions

in popularizing musical education, and his persistent opposition to the Tonic Sol-Fa system, which had a. success he could not foresee. His objections to it were partly grounded on the character of the music which was in common use among the early teachers of the system. While it cannot be doubted that Hullah would have won more success if he had not opposed the Tonic Sol-Ea movement so strenuously, it must be confessed that his work was of great value, for he kept constantly in view and impressed upon all who followed him or learnt from him the supreme necessity of maintaining the artistic standard of the music taught and studied, and of not allowing trumpery compositions to usurp the place of good music on account of the greater ease with which they could be read. (j. a. f. m.)

Humacao, a small city near the south-east corner of the island of Porto Eico, 31 miles south-east of San Juan. It is the capital of a province of the same name. Population, 4428.

Humbert, Ranieri Carlo Emanuele Gio-

vanni Maria Ferdinando Eugenio, Kin&

OF Italy (1844-1900), son of Victor Emmanuel II. and

of Adelaide, archduchess of Austria, was born at Turin,

capital of the kingdom of Sardinia, on 14th March 1844.

His education was entrusted to the most eminent men

of his time, amongst others to Massimo d'Azeglio and

Pasquale Stanislao Mancini. Entering the army on 14th

March 1858 with the rank of captain, he was present at

the battle of Solferino in 1859, and in 1866 commanded

a division at Custozza. Attacked by the Austrian cavalry-

near Villafranca, he formed his troops into squares and

drove the assailants towards Sommacampagna, remaining

himself throughout the action in the square most exposed

to attack. With Bixio he covered the retreat of the

Italian army, receiving the gold medal for valour. On

21st April 1868 he married his cousin, Margherita Teresa

Giovanna, princess of Savoy, daughter of the duke of

Genoa (born at Turin on 20th November 1851). On

lith November 1869 Margherita gave birth to Victor

Emmanuel, prince of Naples, afterwards Victor Emmanuel

III. of Italy. Ascending the throne on the death of his father (9th January 1878), Humbert adopted the style "Humbert I. of Italy" instead of Humbert IV., and consented that the remains of his father should be interred at Rome in the Pantheon, and not in the royal mausoleum of Superga. Accompanied by the premier, Cairoli, he began a tour of the provinces of his kingdom, but on entering Naples (17th November 1878), amid the acclamations of an immense crowd, was attacked by a fanatic named Passanante. The king warded off the blow with his sabre, but Cairoli, in attempting to defend him, was severely wounded in the thigh. The would-be assassin was condemned to death, but the sentence was by the king commuted to one of penal servitude for life. The occurrence upset for several years the health of Queen

Margherita. In 1881 King Humbert, again accompanied by Cairoli, resumed his interrupted tour, and visited Sicily and the southern Italian provinces. In 1882 he took a

prominent part in the national mourning for Garibaldi, whose tomb at Caprera he repeatedly visited. When, in the autumn of 1882, Verona and Venetia were inundated, he hastened to the spot, directed salvage operations, and provided large sums of money for the destitute. Similarly, on 28th July 1883, he hurried to Ischia, where an earth-quake had engulfed some 5000 persons. Countermanding King Humbert.

{JFrom a photograph by Giacomo Srogi, Florence.)

the order of the minister of public works to cover the ruins with quicklime, the king prosecuted salvage opera-tions for five days longer, and personally saved many victims at the risk of his own life. In 1884 he visited Busca and Naples, where cholera was raging, helping with money and advice the numerous sufferers, and raising the spirit of the population. Compared with the reigns of his grandfather, Charles Albert, and of his father, Victor Emmanuel, the reign of Humbert was tranquil. Scrupu-lously observant of constitutional principles, he followed, as far as practicable, parliamentary indications in his choice

of premiers, only one of whom — Kudini — was drawn from the Conservative ranks. In foreign policy he approved of the conclusion of the Triple Alliance, and, in repeated visits to Vienna and Berlin, established and consolidated the pact. Towards Great Britain his attitude was invar riably cordial, and he considered the Triple Alliance imperfect unless supplemented by an Anglo-Italian naval entente. Favourably disposed towards the policy of colonial expansion inaugurated in 1885 by the occupa-tion of Massawa, he was suspected of aspiring to a vast empire in North-east Africa, a suspicion which tended somewhat to diminish his popularity after the disaster of Adowa on 1st March 1896. On the other hand, his popu-larity was enhanced by the firmness of his attitude towards the Vatican, as exemplified in his telegram declaring Eome "intangible" (20th September 1886), and affirming the permanence of the Italian possession of the Eternal City. Above all King Humbert was a soldier, jealous of the honour and prestige of the army to such a degree that he promoted a duel between his

nephew, the count of Turin, and Prince Henry of Orleans (15th of August 1897) on account of the aspersions cast by the latter upon Italian arms. The claims of King Humbert upon popular gratitude and affection were enhanced by his extraordinaiy munificence, which was not merely displayed on public occasions, but directed to relieve innumerable private wants into which he had made personal inquiry. It has been calculated that at least £100,000 per annum was expended by the king in this way. The regard in which he was universally held was abundantly demonstrated on the occasion of the unsuccessful attempt upon his life made by the anarchist Acciarito near Eome on 22ud April 1897, and still more after his tragic assassination at Monza by the anarchist Bresci on the evening of 29th July 1900. Good-humoured, active, tender-hearted, somewhat fatalistic, but, above all, generous, he was spontaneously called "Humbert the Good." He was buried in the Pantheon in Rome, by the side of Victor Emmanuel II., on 9th August 1900.

(h. w. s.)

Hungary (Magyarorszag), one of the two states constituting the monarchy of Austbia-Hungaet (g.w.).

The kingdom includes Hungary proper and the province of Croatia-Slavonia, the latter enjoying to a large extent autonomy, granted by the so-called compromise of 1868, which regulated the legal relation of Croatia-Slavonia-Dalmatia to the mother-country. The town and district of Fiume, though united with Hungary proper in respect of administration, enjoys autonomy to a greater extent than the other cities endowed with municipal rights. In the present article the kingdom will be treated of mainly as a whole, as statistics of many of the subjects dealt with cannot be obtained for the separate divisions. In 1873 part of the " Military Frontier " mentioned in the ninth edition of the Encydopcedia Britannica was united with Hungary proper and part with Croatia-Slavonia. As Transylvania is a mere historical expression, it will always be included in the territory of Hungary proper, as will Fiume also.

Climate. — With only a very small strip of coast-line,

Hungary has a continental climate — cold in winter, hot in summer. The rainfall is in general low, except in the mountainous districts. The following table gives the mean temperature (centigrade), relative humidity, and rainfall (including snow) at a series of meteorological stations during the years 1896-1900 : —

Metros

Mean Temperature.

Relative

Eainfall

stations.

above

Humid-

in Milli-

Sea.

Annual.

ary.

July.

ity.

metres,

Selmeczbdnya

02 1

7-9

-2-3

18-2

79

905

Budapest

153

10-5

-0-7

20-4

76

616

Keszthely

133

11-4

-1-1

21-9

78

684

ZdgrAb .

163

11-3

1-3

21-4

72

880

Fiume .

6

13-8

6-4

22-6

75

1805

Debreczen

129

10-1

-1-9

21-1

79

571

Szeged .

05

10-9

-0-5

21-7

80

656

Nagyszeben .

4U

94

-3-4

20-6

79

735

Except at Fiume, the temperature at all these stations in the winter is below freezing-point, and the mean rainfall below 900 millimetres. The mountain-stations, Selmecz-bfCnya in the northern and Nagyszeben in the south-eastern

Carpathians, enjoy a more humid and, in the summer, a more temperate climate than the large plain called Alfold, statistics]

of which. Debreczen and Szeged may be regarded as repre-sentative towns.

Area and Population. — The area of the kingdom of Hungary is : —

English Square MUes.

Hungary proper 108,982

Croatia-Slavonia 16,420

Total . . 125,402

Por administrative purposes the territories belonging to the Hungarian Crown (St Stephen's Crown) are divided into municipalities (counties) endowed with a certain amount of self-government. Hungary proper is now sub-divided into sixty-three rural and — Tiume included — twenty-six urban municipalities, whereas in Croatia-Slavonia there are eight rural and four urban.

The population of the country at the censuses of 1881,

1891, and 1901 was :—

1881.

1891.

1901.

Hungary proper

Croatia-Slavonia

Total .

13,749,603

1,892,499

15,261,864

2,201,927

16,838,255

2,416,304

15,642,102

17,463,791

19,254,559

T"rom 1870 to 1881 there was but little increase of popu-

lation, owing to the great cholera epidemic of 1872-73,

and to many epidemic diseases among children towards

the end of the period. More normal conditions having prevailed from 1881 to 1891, the yearly increase rose from 0-13 per cent, to 1-09 per cent., declining in the decade 1881-1901 to 1-03.

If compared with the first general census of the country, decreed by Joseph II. in 1785, the population of the kingdom shows an increase of nearly 108 per cent, during these 116 years. Recent historical research, the results of which have been published by the Central Statistical Office, has ascertained that the country was densely peopled in the 15th century. Estimates, based on a census of the tax-paying peasantry in the years 1494 and 1495, give five millions of inhabitants, a very respectable number, which explains fully the predominant position of Hungary in the east of Europe at that epoch. The disastrous invasion of the Turks, incessant civil wars, and the devastation of the country by foreign armies and pestilence, caused a very heavy loss both of population and of prosperity. Several censuses in different counties of the country attest the enormous depopulation. In 1715 and 1720, when the land was again free from Turkish hordes and peace was restored, the population did not exceed three millions. Then immigration began to

ill the deserted plains once more, and by 1785 the population had trebled itself. But as the immigrants were of very different foreign nationalities, the country became a collection of heterogeneous ethnical elements, amid which the ruling Magyar race, which had lost its best elements in the preceding wars, formed only a minority.

■*Owing, however, to the mental gifts and political genius of the Magyars, their supremacy was never seriously disputed by any of the numerous nationalities of the country.*

The density of population, according to the census of 1901, was 153-7 inhabitants to the square mile. The great Alfold and the western parts are the most densely popu-lated, whereas the northern and eastern mountainous -counties are but sparsely inhabited. But if the acreage of arable land, which yields much greater resources than the other kinds of land, and is capable of sustaining more hands, be taken as a basis of coinparison, then it is found that the scanty average population of the northern and eastern mountainous counties is really denser than that of the western and middle counties. The one marked char-.acteristic of all modern civilization — ^the agglomeration of

population in towns— prevails in Hungary also, though there is but one really large city, Budapest, the political capital of the kingdom and the principal manufacturing town in the country. The population of the towns having in 1901 more than 40,000 inhabitants at three censuses is shown in the following table : —

Town.

1S81.1

1891.

1901.

Budapest

360,531

505,823

732,322

Szeged

73,675

87,410

102,991

Szabadka (Maria-Theresiopel)

61,367

73,526

82,122

Debreczen ....

51,122

59,552

75,006

Pozsony (Pressburg)

48,006

56,048

65,867

Hodmezo-VAsirhely

52,424

55,626

60,883

Z&gr&b (Agram)

29,218

41,481

61,002

Kecskemet ....

44,887

50,600

57,812

Arad

35,556

43,682

56,260

TemesvAr ....

33,694

43,738

53,033

Nagyv^rad (Grosswardein)

KolozsvS,r (Klausenburg)

F6cs (Flinfkirohen) .

Miskolcz

31,324

70,750

50,177

30,363

37,957

49,295

28,702

35,449

43,982

24,319

32,288

43,096

Kassa

26,097

32,165

40,102

The number and aggregate population of all towns and boroughs in Hungary proper having in 1891 more than 10,000 inhabitants was at the censuses of 1881, 1891, and 1901 : —

Census.

Towns.

Inhabitants.

Percentage of

Total Population.

1881

1891

1901

93

106

122

2,191,878

2,700,852

3,525,377

15-94

17-81

21-58

Thus the relative increase of the population living in urban dis-

tricts of more than 10,000 inhabitants amounted in 1901 to nearly

4 per cent, of the total population. In Croatia-Slavonia only 5-62

per cent, of the population was concentrated in such towns in 1901.

In the total population the two sexes were divided (1901) thus : —

Males.

Females.

Females to

1000 Males.

Hungary proper (including

Flume) ....

Croatia-Slavonia .

8,372,839

1,209,333

8,465,416

1,206,971

1010-8

998-0

The excess of females over males, which may be considered as a general feature of European civilization, is great in the western and northern counties of the kingdom, whereas in the eastern parts and in the province of Croatia-Slavonia there is a preponderance of males. Thus Hungary shows the transition from "Western to Eastern distribution of sexes.

One of the prominent features of Hungary being the great complexity of the races residing in it, the census returns of 1881, 1891, and 1901, exhibiting the numerical strength of the different nationalities, are of great interest. Classifying the population according to the mother-tongue of each individual, there were, in the civil population of Hungary proper, including Fiume : —

so

g

a

6

ss

IS

in

Ii

1^

11

SO

& —

M

■1?

1

O

1881

1891

1901

6,404,070

T,35T,986

8.B88.884

1,870,772

1,990,084

1,980,428

1,855,451

1,896,665

1,991,402

2,408,041

2,589,079

2,784,726

358,269

879,786

423,159

228,054

269,893

829,887

689 986

194,412 496,133

188,652 484.641

i.e., in percentages of the total population : —

1881

1891

1901

46-58

48-53

61-38

18-61

13-12

11-88

18-49

12-51

11-88

17-48

17-08

16-62

2-67

2-60

2-52

4-

1-28

‘1-17

65

8.27

2-60

1-62

1-71

1-95

The results of the three censuses recorded show a decided tend-

ency of change in favour of the dominating nationality, the

Magyar. The relative importance of the other nationalities is

decreasing from census to census. Thus the preponderance of the

Magyars is growing. They reached an absolute majority in the

decade 1891-1901. This is also shown by the data relating to

the percentage of members of foreign nationalities speaking this

language. This percentage was among the

Census.

Ger-

mans.

Slovaks.

Ruma-

nians.

Ruthe-

nians.

Croa-

tian a.

Servians.

others.

1881

1891

20-16

25-15

9-52

12-00

5-71

6-95

5-52

7-33

10-26

16-51 1 11-12

18-64

21-39

1901 16-8

No other means being used to diffuse the knowledge of the official language of the Hungarian state than elementary instruction, and iFor 1881 only the civil population can be given.

S.V.-4S

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to some extent military service, the growth of the Hungarian-speaking elements shows the slow but steady advancement of general instruction and the effect of the internal migrations, which bring into contact with the Hungarian majority the isolated masses of foreign nationalities inhabiting the mountains in the north and east of the country. In the province of Croatia-Slavonia the language of instruction and administration being exclusively Croatian, the other races are converted to this nationality. The Hungarians form but 3-15 per cent., the Germans 5-37 percent, of the population, according to the census of 1891.

Movement of the Population. — The following table shows the average number of marriages, births, and deaths in the kingdom per annum between 1881 and 1901 : —

HuMGAitY Proper.

Tear.

Marriages.

Births

(Living).

Deaths.

Natural Increase

(Surplus of Births).

1881-85

142,391

626,488

467,621

158,867

1886-90

131,642

646,764

478,340

168,424

1891-95

139,064

648,300

492,753

155,547

1896

126,956

647,977

455,969

192,008

1897

131,045

651,667

453,715

197.952

1898

134,541

614,255

456,736

157,519

1899

147,912

644,577

448,756

195,821

1900

178,629

655,674

449,742

205,932

1896-1900

137,816

642,830

452,984

1.89,846

CnOATt -8l,A.V0NIA.

1881-85

21,960

87,578

61,971

25.607

1886-90

19,194

94,062

64,868

29,193

1891-95

20,893

95,009

75,433

19,576

1896

20,521

94,959

74,399

20,560

1897

20,131

96,397

75,252

21,145

1898

21,667

92,578

67,654

24,924

1899

22,914

98,695

65,528

33,117

1900

21,058

97,044

65,492

31,552

1896-1900

21,257

95,935

69,675

26,259

The

marriage-rate per 1000 varied as follows

Division.

‘81-85.

‘86-90.

‘91-95.

1896.

1897.

1S9S.

1899.

19U().

17-S

17-6

‘9{;-190:i.

Hungary proper

Croatia-Slavonia

20-2

22-4

17-8

18-0

18-0

18-8

16-0

18-0

16-2

17-4

16-0

186

18-0

18-4

17-0

18-2

Corresponding to the high marriage-rate, the average number of

births per annum to 1000 living is also high. It was (exclusive of

still-born) : —

Division.

‘SI-S5.

‘86-90.

‘91-96.

1896.

1S97.

1898.

1899.

1900,

‘90-1900.

.tlungary proper

Croatia-Slavonia

44-6

44-7

48-7

44-0

41-9

42-7

40-7

41-6

40-S

41-8

87-8

89 S

39-2

42-0

89-4

40-7

89-5

41-2

Average .

44-6

48-7

42-0

40-8

40-6

88;0

.39-6

39-6

39-7

The figures for 1898 were quite abnormal, and must be attributed to the complete failure of the crops in 1897 and the consequent low marriage-rate. The figures for 1900 were nearly the same as

for 1899. The proportion of still-born children to 100 births was, in the fifteen years from 1881 to 1895,]‘92 per cent. There is an increase in recent years owing to more trustworthy statistics, the proportion reaching 2-20 per cent, in 1896-1900. The percentage of illegitimate births to the total number of living births was : — ISbl-S”>.

1886-90.

1891-95.

1896.

1897.

1898.

1899.

1900.

1896-1900.

7-86

8-16

8-75

8-80

9-28

9-15

9‘28

9-72

9-19

The most favourable feature in vital statistics for recent years is the constant decrease of the death-rate, shown by the following figures, for each 1000 of population per annum : —

Division.

‘81-W.

‘86-90.

‘91-95

1896.

1897.

1898.

1899.

1900.

‘96-1900.

Hungary proper

Croatia-Slavonia

88-8

81-7

82-8

80‘6

81-8

88-9

28-6

82-5

28-1

82‘6

28‘0

29-1

27-8

27-9

27-0

27-5

27-8

29-9

Average .

88-1

82-1

82-1

29-1

28-7

28-2

27-4

27-1

28-1

The improvement is most conspicuous in the case of Hungary proper, and is accounted for by the growth of economic prosperity as well as the advancement in sanitary administration. As a net result the natural increase per 1000 in the population was : —

Division.

‘81-85.

‘86-90.

‘91-95.

1896.

1897.

1898.

1899.

1900.

‘96-1900.

Hungary proper

Croatia-‘Slavonla

11-8

18-1

11-4

18-8

10-1

8-8

12-1

9-1

12-4

9-2

9-8

10-7

11-9

14-1

12-4

18‘2

11-7

11-8

There is an excess of emigration over immigration. In the decades 1881-1891 and 1891-1901 for the whole kingdom it amounted to 182,000 and 185,000 persons respectively. Croatia-Slavonia alone has a surplus of immigration, owing to Hungarian emigration there. The main stream of emigration fiows in the direction of the United States of America. The statistics of that country gave as the number of immigrants from Hungary : — Yearly Average.

1881-S5.

18SC-90.

]sni-9s.

1896.

isn7.

1898.

10,111

17,201

23,827

25,879

13,791

20,920

The data collected at the German and Dutch emigration ports vary somewhat, but the averages for longer periods do not considerably differ. The emigration to America affects principally the mountainous couJities of the north, and the majority of emigrants are of Slovak origin. Many of the emigrants return as well-to-do men, and the movement has caused a noteworthy increase of wages in these counties. From the south-eastern (once Transylvanian) counties there is an emigi'ation to Rumania and the Balkan territories of 4000 to 5000 persons yearly.

Beligion.— At, the censuses of 1881, 1891, and 1901 the civil population in Hungary proper was divided as follows : —

Eeligion.

1881.

1891.

1901.

Roman Catholics .

6,503,207

7,267,695

8,198,497

Greek Catholics .

1,489,849

1,658,308

1,841,272

Greek Orientals

1,937,144

2,064,889

2,199,195

Evangelicals —

Augsburg Confession i

1,107,608

1,180,714

1,258,860

Helvetian Confession ^

2,023,360

2,212,761

2,427,232

Unitarians .

55,787

61,618

68,551

Jews

624,826

707,961

831,162

Others ....

7,822

9,042

13,486

The corresponding percentages are as follows : —

llellgion.

1831.

1891.

1901.

Roman Catholics

47-30

47-93

48-69

Greek Catholics

10-83

10-94

10-93

Greek Orientals

14-09

13-62

13-06

Evangehcals of Augsburg Con-

fession

8-06

7-78

7-48

Evangelicals of Helvetian Con-

fession

14-71

14-59

14-41

Unitarians ....

0-41

0-41

0-41

Jews ....

4-54

4-67

4-94

Others

0-06

0-06

0-08

The relative decrease in the number of those adhering to Pro-

testant churches is caused by the low birth-rate among them, whereas the Greek Orientals suffer heavy loss by reason of the great mortality. The rapid growth in the number of Jews is owing partly to immigration, partly to economic prosperity, which latter is also manifest in the peculiarly low death-rate of the Jews (generally 18 per 1000).

Education. — Apart from the infant schools for children under six years of age (2570 in 1900), Hungary has a series of elementary schools of various kinds, numbering in 1900 (inclusive of those in Croatia-Slavonia) 18,4.“i5 ; Hungary proper possessed 17,048. Of this latter number 1631 were maintained by the state, 1747 by communes, and 13,S57 by the different churches. The language

employed in 60-6 per cent, of these schools was exclusively Hungarian, in 19-9 per cent, it was mixed. The number of teachers in the scholastic year 1800-1900, including those in the schools of Croatia-Slavonia, was 31,213 ; the total number of pupils was 3,255,982. The number of middle-class schools, called gymnasia (giving instruction in Latin and Greek), and of j-ea^schools (without such courses), as well as the number of teachers and pupils, is shown by the following table for the year 1899-1900 : —

Division.

(lymnasia.

Keal-schools.

Teachers.

Pupils.

Hungary proper

CroatiarSlavonia

Total .

165 32

3673

401

61,943

6,575

19

216

7074

68,618

The Hungarian language was exclusively used in 180, i.e., in 91

per cent, of the 197 middle-class schools in Hungary proper. In

1 Lutherans.

^ Helvetians, or Reformed.

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9 instruction -was given in the German tongue, in 5 in Rumanian.

The mother-tongue of pupils was in 1891 and 1900 :—

Mother-tongue,

1891.

1900.

Total.

Per cent.

Total.

Per cent.

Hungarian

German

Slovak

Rumanian

Ruthenian

Croatian or Servian .

30,480

6,213

1,577

2,704

92

797

72 ‘4

14-7

3-7

6‘4

0-2

1-9

44,130

7,066

1,853

3,482

89

1,185

76-1

12-1

3-2

6-0

0-2

2-0

The increase in the numher of Hungarian pupils is shown very clearly. These schools are maintained partly by the state — in 1900, 59 were so maintained in Hungary proper — and partly by ecclesiastical foundation, with or without a subsidy from the state. There are also a few gymnasia and real-schools, founded by communes and by private persons. The total expenditure on middle-class schools in 1899-1900 was 16,386,000 crowns (a crown = 10d.). There are two universities in Hungaiy proper, one at Budapest and one at KolozsvAr ; in Croatia-Slavonia there is a university at

Zkgrkh. The latter has faculties of theology, law, and philosophy ; the two former have in addition a faculty of medicine. The number of professors (ordinary and extraordinary), lecturers, and undergraduates in 1899-1900 is shown by the following table : —

University.

Professors.

Lecturers.

Undergraduates.

Budapest

KolozsvAr

Z&grib .

119

51

35

182

44

31

5546

1210

770

There are 10 high schools of law, called academies, with, in 1899-1900, 80 professors, 40 lecturers, and 1569 pupils. The number of high theological colleges in Hungary is 49 — 29 Roman Catholic, 5 Greek Catholic, 4 Greek Oriental, 10 Protestant, and 1 Jewish ; in 1899-1900 there were 1599 pupils. The polytechnicum at Budapest, with 34 professors and 74 lecturers, had 1772 pupils in that year ; the number of art-schools was 45, with 337 teachers and 5139 pupils. The percentage of illiterates (analphabeta) , which was 59-7 in 1881, had by 1891 decreased to 57-8, and in 1901 to 50-4. The percentage for Hungary proper only is more favourable (in 1891, 55-5, and in 1901, 48-6 per cent.). Omitting children under six years of age, 55 per cent, of the population could read and write. In Croatia-Slavonia only 33-4 per cent, could do so. The average number of periodicals in 1881-85 was 672 ; in 1900 there were 1.396. Of this latter number 938 appeared in Hungarian, and 209 were political papers.

Pauperism. — There is no government system of poor relief in Hungary, Private beneficence and ecclesiastical charity assist the poor, and if these sources fail the commune has to supplement them. Thus the total amount expended on the poor cannot be ascertained. But the XXI. Art. of 1898 assures to the sick gra-

tuitous medical help and total maintenance to deserted children under seven years of age, and for these purposes a special tax, which cannot exceed 3 per cent, of the direct taxes, is levied.

Crime. — The Penal Code of 1878 divides criminal offences into two classes — the more and the less serious ; there are also misdemeanours punishable by fines andimprisonment. The total number of convicted persons in each of these three categories was, in Hungary proper : —

Tear.

Criminal Oifences.

Misdemeanours.

More Serious.

Less Serious,

1894

1898

1900

10,198

11,169

4,035

75,846

84,360

64,641

299,501

368,796

335,231

Crimes of the gravest nature, those against life and property, are diminishing, but political misdemeanours increase rapidly, owing to new laws creating new offences. The only important change of a judicial character since 1871 has been the decentralization of the "Kirfilyi it61bt4bia.k " (1891). Their number now amounts, in Hungary proper, to eleven. For most cases they are the highest courts of appeal, but there is a still higher tribunal for cases of the first importance. The new Code of Procedure (XXXIII. Art. of 1896) and the Law on Juries (XXXIII. Art. of 1897) have been in force since 1st January 1900. These laws extended the jurisdiction of juries to the gravest crimes and introduced great reforms, conforming to modern principles of criminal procedure.

Constitution and Government. — There has been only one reform in the composition of parliament since 1867, namely, that regarding the House of Lords (Forendihdz). Art, VII. of the year 1885 ordered that this House should consist of — (1) all the archdukes

who have attained their majority (eighteen years) ; (2) hereditary peers (that is, princes, counts, and barons) above twenty-four years of age, provided that the title was in the family before 1885, and that the peer is personally charged with a land-tax of 3000 fl. (£250) ; (3) Hungarian peers obtaining this right by order of his Majesty ; (4) other citizens named by the king, up to a maximum number of fifty ; (5) members by virtue of of&oe, i.e., thirty-two archbishops and other dignitaries of the Roman Catholic Church, ten dignitaries of the Greek Church, thirteen representatives of the three Protestant confessions, a few state dignitaries, and five high judges ; (6) three delegates of the Croatian-Slavonian Parliament. The total number of members in 1900 was 398. The number of electors to the House of Commons (Kepvislohdz) in 1879 was 824,602 ; in 1887, 847,216 ; in 1900, 989,009, or 2395 electors for one deputy. The percentage of electors to the total population was 6 per cent, in 1879 and 5-95 per cent, in 1900. A thorough reform of the local administration has been prepared by the Government. Finance. — The total annual revenue and expenditure of the state — deducting merely transitory items of credit operations and con-versions— were, in millions sterling : —

Tear.

lievenue.

Expenditure.

Surplus,

1891-95

42-1

39-4

2-7

1896

43-2

43-0

0-2

1897

46-4

45-6

0-7

1898

43-8

43-7

02

1899

42-9

42-8

01

1900

45-4

45-2

0-2

The total debt at the end of each of the following years was, in millions sterling : —

1891.

1895.

1898.

1899.

1900.

171-9

181-3

184-3

184.6

192-8

The ordinary revenue of the state is derived chiefly from direct and indirect taxation, including monopolies. In 1900 direct taxes amounted to £9,410,000, indirect to £17,048,000. Among the indirect taxes, that on alcoholic drinks, yielded £5,201,000, the monopoly of tobacco £4,767,000 (of which £2,565,000 is net revenue). State forests gave £795,000. The growth in the revenue derived from state railways is shown by the following table (amounts in millions sterling) : —

Year.

Total Eeeeipts.

Expenditure.

Net Revenue.

1881

1-5

1-0

0-5

1890

3-5

2-1

1-4

1898

8-4

5-6

2-8

1899

8-5

5-6

2-9

1900

9-1

6-7

2-4

Already the net revenue corresponds to nearly 4 per cent, of the capital invested, and the prospects of increase may be regarded as very favourable.

Production and Industry. — Though the mineral resources of the country are very great, mining and smelting works only employed 70,476 persons in 1900. This, however, shows an increase compared with the average of 1881-85, which was 47,817, and with that of 1886-90, which was 49,178 persons, whereas the average of

1891-95 was 60,456. The principal products of mining are re-

turned as follows : — ■

Mineral.

Yearly Average Quantities in Cwts.i

1831-85.

lSSG-90.

1891-95.

1896-99.

1900,

Gold 2 . .

Silver .

Pig iron

Coal . .

82

825

8,650,118

45,095,866

88

883

4,604,078

54,823,882

42

390

6,850,687

77,.597,908

61

488

8,900,560

107.465,681

64

897

8,967,678

127,898,942

The growth in the production of iron and coal is shown more clearly if the quantities raised in the first and last years of the period are compared. The following are, then, the figures in English tons (1 metric ton=1000 kg. =0-984 Eng. ton) :—

Mineral,

1831,

1899,

1900,

Pig iron .

Coal

161,376

1,929,774

478,941

6,098,412

462,952

6,602,913

Thus the production of iron, as well as that of coal, was trebled

in nineteen years. There are excellent iron ores in the north-

ern and south-eastern counties, but the quality of coal raised

1 Calculated in this proportion : 1 metric centner equal to 100 kilo-

graras=220-6 ft av.

2 Each kilogram ha-vlng a value of £136.56 ; a metric centner is

worth £13,656.

[statistics

is rather unsatisfactory, the greater part of it being only brown

coal, which cannot be transformed into coke. The number of blast-furnaces, which was 106 in 1881, only amounted to 68 in 1900.

Agriculture. — The pre-eminence of agriculture as the chief economic resource of Hungary is shown by the high percentage which the agricultural class forms of the total population. In 1891 this was 75‘1 per cent, in Hungary proper and 85-2 per cent, in Croatia-Slavonia. The agricultural inquiry of 1896 showed an increase in the area of arable land, but a diminution in the area covered by vineyards, which had suffered greatly from the%evastations of the phylloxera. The main varieties of land are distributed as follows : —

By Area in Acres.

Country.

Arable

Land.

Gar-

dens.

Mea-

dows.

Vine-

yards.

Pas-

tures.

Forests.

Marshes.

Hungary-

proper .

Croatia-

Slavonift .

29,714,382

3,870,540

928,063

136,354

7,075,888

1,099,461

482,801

65,475

9,042,267

1,465,930

18,464,396

8,734,094

199,685

7,921

By Percentage of the Total Area.

Hungary

proper

42-81

1-34

10-19

0-69

18-03

26-60

0-28

Croatia-

Slavonia .

32-26

1-31

10-52

0-63

14-03

86-74

0-08

The remainder, such as barren territory, devastated vineyards, water, and area of buildings, amounts to 5-1 per cent, of the total. The progress of agriculture is shown by the increase of arable land, the diminution of bare fallow land, and the growth of the average production, which may be regarded as a proof of increasing intensity, improvements, and technical progress. The chief agricultural products of Hungary are wheat, rye, barley, oats, and maize, and the annual crops of these for a period of nineteen years aie shown in the following tables : —

Area in Acres in Hungary Proper.

connected with mills. The number of steam-mills was 147 (about) in 1863, 492 in 1873, 910 in 1885, and 1723 in 1895, when the total horse-power of the steam-engines was 68,929. There are 2,952,000 English tons of wheat-flour produced annually. The number of breweries decreased down to 1890, when there were 95 in the whole kingdom. But production on a large scale survived the competition of the Austrian breweries, and the average annual production of beer increased from 11,019,280 gallons in the decade 1881-90 to 34,820,936 gallons in the years 1894-98. There were 99 breweries

in 1900, and they produced 31,862,900 gaUons of beer. The same tendency to production on a large scale prevails in the alcohol and sugar industries. But whereas in the former production is rather on the decline owing to the heavy taxes on alcohol, the sugar industry is advancing with rapid strides. The more equal rate of taxation, which made possible the competition of Hungarian with Austrian factories, though the latter had better raw material and more capi-tal, increased the production in a few years. The growth is shown by the fact that the average annual weight of beet used increased sixfold from 1880-88 to 1896-98 ; in the last of these years 3,996,959 owts. of sugar were produced, 20 large factories sharing in the yield. In the season of 1898-99 the produce increased to 4,857,897 cwts., in 1899-1900 to 4,936,419 cwts. The tobacco industry is a monop-oly, and the factories are under the state. The increase in the annual production of cigars, cigarettes, snuff, and other kinds of tobacco ready for consumption is shown by the following table :—

Year .

1881-85.

1886-90.

1891-95.

1896-99.

1900.

Cwt. .

277,158

312,380

389,472

432,594

411,490

Cereal.

Average per Annum.

1896.

1898.

1899.

1900.

1831-85.

1886-90.

1891-95.

Wheat .

Eye

Barley .

Oats

Maize .

6,483,876

2,476,301

2,420,893

2,460,080

4,567,186

7,014,891

2,727,078

2,491,422

2,546,682

4,681,376

7,551,584

2,610,093

2,407,469

2,339,297

5,222,538

7,751,566

2,725,166

2,876,105

2,484,805

5,098,213

6,866,390

2,468,283

2,886,853

2,215,672

4,909,809

7,798,000

2,696,500

2,608,200

2,880,500

5,257,600

8,142,803

2,546,738

2,486,117

2,824,992

6,469,050

Having renewed with Austria treaties of commerce, which now constitute a customs union, Hungary cannot protect industry by duties. To encourage the investment of capital in industrial es-

tablishments, several Acts exempt from taxation new branches of manufactures and those factories provided with the best modem machinery. This has led to several factories being es-tablished with the aid of national and foreign — including English — capital.

Commerce.— The foreign trade of Hungary, including Croatia-Slavonia, is shown by the following table, in millions sterling : —

Produce in Millions of Bushels.

Cereal.

Average per Annum.

1896.

1898.

1899.

1900.

1881-86.

1886-90.

1891-95.

Wheat .

Eye .

Barley

Oats .

Maize

99-8

41-8

46-2

53-9

92-4

121-3

42-1

43-7

52-3

86-4

144-9

46-5

53-6

64-9

118-0

118-6

33-6

86-6

29-7

91-6

96-0

80-0

84-4

61-6

89-1

136-4

44-0

62-7

64-8

108-0

187-8

39-2

49-7

63-6

121-7

In Croatia-Slavonia no crop statistics were compiled before 1885.

Eeoent returns for maize and wheat show an increase both in the

area cultivated and quantity yielded. The former is the principal product of this province. The number of live stock in Hungary proper in two different years is shown in the following table : —

Animal.

1884.

1895.

Horses .

Cattle .

Sheep .

Pigs .

1,749,302

4,879,334

10,594,867

4,803,777

1,972,930

5,829,483

7,526,783

6,447,134

Year.

Imports.

Exports.

1886-90

37-3

37-5

1891-95

43-7

44-1

1896

45-6

45-3

1897

46-1

45-0

1898

49-7

46-0

1899

■*49-7*

50-0

1900

46-3

55-3

Of the merchandise entering i the country, 75-80 per cent. comes from Austria, and exports go to the same country to the extent of 75 per cent, (in 1900 only 71-6 per cent.). Next comes Germany with about 10 per cent, of the value of total exports and 5 per cent, of that of imports. The neighbouring Balkan states — Rumania and Servia — follow, and the United Kingdom receives somewhat more than 2 per cent, of the exports, while supplying. about 1-5 per cent, of the imports. The value of the principal articles of import and export is shown in the following tables, in thousands of pounds sterling : —

In Croatia-Slavonia the live stock was numbered in 1895 at : horses, 309,098 ; cattle, 908,774 ; sheep, 595,898 ; pigs, 882,957. But the improved quality of the live stock is more worthy of notice than the growth in numbers. And the increasing area devoted to the cultivation of clover and nutritious grasses, the improvement in the breed of horses and cattle, procured by administrative measures and fiscal protection, the prizes and other encouragements offered, are all features which ensure a still further development in this important

branch of production.

Industry. — The number of persons employed in the various manufacturing industries in 1891 was 831,172 in Hungary proper and 81,838 in Croatia-Slavonia. The total number of those dependent on manufacturing industries formed 13 per cent, of the population in Hungary proper and only 8-3 per cent, in Croatia-Slavonia. In 1891 there were in Hungary proper 1134 establishments employing more than twenty hands ; in 1898 the number was 1626. Thus in seven years there was an increase of 43-4 percent. The number of factories with more than 1000 workmen was 11 in 1891 and 27 in 1898. The industry in the highest state of development is that imports.

1897.

1898.

1899.

1900.

Cotton goods

5882

6941

6787

5933

Woollen manufactures

3797

4200

4520

3730

Apparel, haberdashery, and

linen ....

2398

2564

2780

2837

Silk manufactures

1832

2186

2437

2024

Leather, raw

1361

1253

1277

1276

Leather manufactures

1199

1274

1205

1048

“Wine in barrels .

1265

1236

1005

Exports.

1897.

1S98.

1899.

1900.

Flour

6994

6906

6123

6526

Wheat

3081

2635

2925

3527

Beef .

3176

3051

3589

3848

Barley

2602

2144

2544

2363

Pigs .

1.390

1590

2072

2478

Wine in barrels .

1419

1265

1103

1347

Horses

1295

1182

1279

1192

Maize .

1340

1166

1396

1322

1 Merchandise passing the boundaries is subject to declaration ; the respective values are stated by a special commission of experts residing in Budapest.

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The above figures plainly show the prevailing agricultural character of the country, grain, flour, and animals, including dead meat, being the chief articles of export, whereas textile manufactures supply by far the most important item in the imports. But coal, of the value of nearly twenty millions of crowns, tobacco, rice, iron, and especially iron goods, are also imported in large quantities of great value.

Navigation. — The shipping of Piume, the chief port of Hungary, shows great progress. The following table gives statistics of the vessels with cargoes which entered and cleared ; —

Tear.

Entered.

Cleared. 1

Vessels,

Tonnage.

Vessels.

Tonnage.

1881-85

1891-95

1896

1897

1898

1899

1900

2,505

5,091

6,336

9,620

9,893

10,006

10,739

401,714

721,456

912,338

1,151,194

1,283,425

1,291,531

1,681,151

3,010

4,604

6,120

9,397

9,767

9,930

10,733

523,623

772,433

963,117

1,193,859

1,289,594

1,425,533

1,684,329

At all ports in 1900 there entered 19,233 vessels of 2,223,302 tons ; cleared, 19,218 vessels of 2,226,733 tons. The tonnage of British steamers amounted to somewhat more than 11 per cent, of the total tonnage of steamers entered and cleared.

Bailwatjs. — The total length in English miles of the railways open is shown in the following table : —

1875.

1885.

1895.

1896.

1S9T.

1898.

1899.

1900.

3985

5601

8644

9236

9778

10,161

10,513

10,624

The principal lines, extending to a length of 4756 miles, are owned by the Hungarian state, and important sections of private railway lines are also administered by the state, only 1835 miles being possessed and controlled in 1900 by private railway companies. The

total capital invested amounted at the end of 1900 to £136,078,000, the state's share of which was no less than £91,106,000. The number of passengers conveyed yearly is shown in the following table : —

1886-90.

1891-95.

1896.

189T.

1898.

1899.

1900.

17,928,442

45,061,000

57,452,000

56,982,000

60,812,000

61,581,000

64,412,000

The receipts from passengers and from goods traffic amounted to-

Tear.

Passengers.

Goods Traffic.

Total (including

miscellaneous).

1880

1890

1898

1899

1900

£1,000,000

1,600,000

2,600,000

2,700,000

2,799,000

£3,300,000

5,400,000

7,400,000

7,600,000

8,216,000

£4,300,000

7,100,000

10,600,000

10,800,000

11,471,000

Thus the receipts from passengers nearly trebled during two decades, and those from the goods traffic increased 150 per cent., though the tariffs were much reduced. (See Finance.)

Post and Telegraphs. — The number of post-offices at the end of 1900 was 4923. The total number of letters, post-cards, news-papers and other papers delivered was (in millions) —

Average of

Millions.

Tear.

Millions.

1886-90

230-4

1896

350-9

1897

372-7

1891-95

284-5

1898

400-6

1899

440-8

1896-1900

414 ■§

1900

508-7

The number of letters and cards only in 1900 was 260 millions ;

of newspapers only, 116 millions.

The total length of telegraph lines was, in 1900, 22,824 kilo-

metres ; of wires, 114,831 kilometres. The number of messages

forwarded amounted in the same year to 7,573,200.

Banks. — The total number of joint^stock banks and others in

Hungary proper is shown by the following table : —

Tear.

1868.

1878.

1888.

1895.

1898.

1899.

1900.

Banks

156

663

11.30

1841

2329

2363

2623

In 1900 Croatia-Slavonia had 253 banks. The value of deposits (savings included) in the whole kingdom at the end of 1900 was 2,088,500,000 crowns (24 crowns=£l). In the postal savings department 32,674,000 crowns were deposited.

Authorities. — The various statistical reports of the Central Statistical Office include all the material available. A summary of them is annually published under the title, Magyar Statisztikai iSvkonyv {Statistical Year-Book of Hungary). — Matlekovics.

Magyarorszdg KozgazdasAga es Kozmuvelodes llapota ezereves fendlldsakor. Budapest, 1897-98 (9 volumes, German edition 2 vols.). — The Hungarian part of the Az Osztrdk-magyar monarchia Irdsban es kepben. — Chelahd. La Hongrie millenaire. Paris, 1896. (z. B.)

*Eecbnt Histoet.^*

The occupation in 1878 of Bosnia and Herzegovina by AustriarHungary in accordance with article 23 of the Treaty of Berlin was from the first unfavourably viewed in the Hungarian kingdom. There were various reasons for this attitude on the part of the Hungarians ; they were jealous of Austrian interference south of their own territory, partly out of fear of the encroachments of Pan-Germanism, and partly because of the friendly feelings they entertained for Turkey, which had welcomed their refugees in the rev-olution year of 1848. Moreover, the Hungarian finances, which at last, after many years of careful management, seemed to be established on a firm basis, would not, it was apprehended, stand the prolonged strain of a military inter-vention with all the concomitant hazards. In October 1878

the minister of finance, Koloman Szell (b. 1843), resigned, and the whole cabinet with him, but it was almost immediately modified and reconstituted under Tisza (q.v.). At the head of the strong Liberal party he succeeded in allaying the popular indignation, which had found vent in revolutionary meetings, and even excesses, and in persuading the chamber to vote the supplies and continue the military establishment for a further period of ten years. In return for these sacrifices Austria allowed Hungary a freer hand in her policy of Magyarization.

During the next few years various reforms were carried through ; the municipal administration was reorganized, instruction in the Hungarian language was made obligatory in the popular and intermediate schools, and the reconstitution of rthe House of Magnates, which had long been a burning question, passed into law in 1885. In the lower house the period for which deputies were elected was extended from three to five years. The general state of unrest culminated in 1883 in anti-Jewish riots ; but this was only a passing storm, and the national exhibition held in

Budapest in 1885 concentrated the public mind upon the economic possibilities of the country and the potentialities of the capital city. In the ensuing year Tisza enunciated in parliament the Austro-Hungarian Balkan policy, declaring for the Treaty of Berlin and the independence of Bulgaria. His utterances, though welcomed in the sister state and in Europe at large as a weighty and valuable pronouncement and an earnest of peace, gave umbrage in Hungary itself. The increase in the military budget necessitated by the general state of disquietude in Europe, and a new Army Bill, providing for the reconstitution of the Landsturm, introduced in 1889, added to the public indignation, and rioting in Pesth and other large centres was only suppressed by military intervention. Tisza, however, firmly stood his ground, and again, as in 1878, asked the house to vote the Army Bill (Wehrgesetz), providing for the continuance of the military establishment at the same strength for a further period of ten years. Certain clauses of the Bill, rather than its general policy, aroused opposition, notably that requiring volunteers of one year's service

to pass their examination in German. This clause was bitterly assailed as a retrograde movement and a menace to the Magyarization of the country. Tisza eventually carried his points, but he had to resort to all the devices of constitutional procedure open to him to compass his ends. Thwarted on the Army BUI, the Eadical wing

1 See also Austria-Hungabt, History.

next turned its attention to the domicile law (Heimaths-gesetz), demanding its amendment so as to permit of the return of Kossath (q.v.), who by voluntary self-banish-ment for more than ten years had ipso facto ceased to be a Hungarian citizen. The cabinet, with the exception of Tisza, who favoured this step, declined to identify itself with the motion, and Tisza accordingly resigned (1890) ; yet the ex-minister, after taking this step, retained his seat in parliament, and was still regarded as the head of the party. The fifteen years (1875-90) during which

Tisza held undisputed sway mark the creation of modern Hungary, and as long as his counsels were available the nation looked to him to direct its policy.

Count Julius Szap^ry (b. 1832) undertook the presidency of a new ministry, and expressly declared that the Government would adhere to the lines of the policy pursued by Tisza, who, in his turn, loyally promised his support. One of the first acts of the new minister was to revive his predecessor's measure of administrative reform. This, the so-called Verstaatlichung der Verwaltung, was in effect the withdrawing from the countries of their elective and autonomous administration, and the substitution of a centralized or state administration. Introduced in 1892, the Bill, owing to the sustained obstruction of the Opposition, had to be abandoned. A short measure, accepting the principle of state organization, was substituted and carried, but the main measure remained in abeyance, the old provincial autonomy persisting in full force.

In this year (1892) new currency reforms were intro-

duced, and a Bill establishing a gold standard became law. With the removal of the Calvinist Tisza, whom they regarded as their most dangerous enemy, the militant clerical element considered the opportunity favourable for entering an energetic protest against the measures of ecclesiastical reform which formed the Government programme. The Civil Marriage Bill, which, though a separate measure, formed part of this grand scheme of reform, was specially singled out for attack, and the remonstrances of the clergy culminated in a conference of bishops in the autumn, at which the pope's support of the clerical opposition was made known. Another quoestio vexata was that of the baptism of the children of mixed marriages. The law of 1868 provided that of the issue of such marriages the males should be brought up in the religion of the father and the females in that of the mother, and imposed upon the clergy baptizing a child not of their confession the duty of communicating the fact to the clergy of the other confession. This law, it was notorious, had for a long time past been evaded by the Roman Catholic clergy, who had been in

the habit of claiming and baptizing all children of mixed marriages. The antagonism between the Government and the Catholic clergy now became so intense that, on the return of the old Liberal majority to power by the elections of the autumn of 1892, Alexander Wekerle (b. 1844), who had succeeded Szapary as premier, at once laid before the Diet a sweeping schemeof reform, consisting of Bills for the introduction of civil marriage, civil registration, and the education of children of mixed marriages. The House of Magnates at first rejected the Civil Marriage Bill, but eventually all these Bills composing the scheme of ecclesiastical-political reform were carried through the two houses together.

In 1892 the Rumanian party in Transylvania had begun a serious agitation against the inequality with which they alleged they were treated, and they attempted in vain to go behind the Government and obtain personal redress from the king. At a Pan-Rumanian congress at Hermannstad in July 1893, a memorandum of their grievances was formulated, and Wekerle seized the opportunity to prose-

cute the leaders for treason. Twenty of them were sentenced (May 1894) to imprisonment ; but the king was by no means satisfied either with Wekerle's action in this matter or with his encouragement of the popular demonstrations after Kossuth's death in March 1894, and in December 1894 Wekerle's ministry was dismissed. The year 1894 was remarkable for the jubilee of the literary career of Maurus Jdkai (q.v.), and the celebrations held throughout the length and breadth of the land showed the strength and depth of the Magyar feeling of nationality. In January 1896 Baron Desider BinSj (b. 1843) formed a new Government, and began by completing two of Wekerle's measures, that sanctioning .the Jewish religion and that establishing freedom of worship. In this he was successful in spite of the bitter opposition of the clericals backed by Mgr. Agliardi, the papal nuncio. The interference of the latter led to a serious disagreement between the premier andCountKalnoky (the Federal minister for foreign affairs, q.v.), with the result that Kalnoky was forced into resignation. Banffy's first great task was

the renewal of the Ausgleicli (see Austeia-Hungaey), and to this he addressed himself with vigour. It was owing to his conciliatory policy that the Austrian monarchy was won over to a complete recognition of the equality of Hungary ; Hungarian state officials were appointed to the king's court on the monarch being resident in Hungary, and ministers of the imperial house became known by the title "imperial and royal" {kaiserlich-koniglicli). The millennium exhibition held at Budapest in the summer of 1896 was a complete success, being especially favoured by the royal house, which in its turn was loyally received by the Hungarian people and houses of legislature. In view of the enhanced prosperity of the country as evidenced by the exhibition, Austria now demanded that the Hungarian subvention to the common expenses (quota) should be considerably increased ; the current saying in Austria being that "Hungary enjoys 70 per cent, of the power in the dual monarchy for 30 per cent, of the cost." But the proposal to raise the quota from 311 per cent, to 34 per cent, met with much opposition, the Government being

unwilling to make even this concession, and at the same time Badeni's endeavours to gain over the Czechs to the Ausgleicli drove the Germans in the Austrian parliament to opposition, and the further discussion of the measure was accordingly postponed and parliament dissolved. The new elections resulted in a magnificent triumph for the Government, but as it was impossible, owing to the shortness of the session, to renew the attempt to pass the Ausgleicli, a provisional arrangement for a year was proposed. But the obstruction of the Germans in the Austrian parliament still continued and prevented the passing of the Ausgleiclis provisorium, and the whole of the year 1897 was practically taken up with the discussion of this measure and that of the broad lines of the economic policy of the dual monarchy. It was not until January 1898 that the Ausgleicli with Austria was, at the instance of the Hungarian Government and with the consent of the parliament, prolonged until the following May. The discussions in parliament gave B^nffy an opportunity of declarii^ his unalterable allegiance to the dual

monarchy, and of enunciating the policy of his Govern-

ment, which was not merely that of preserving the status

quo with Austria, but of binding that country by still

closer ties to the Hungarian kingdom. The emperor-

king, grateful for these evidences of loyalty, gave his

assent to a new law for the Magyarization of names of

places in Transylvania. This gave rise to a vehement

protest on the part of the various nationalities in those

districts, especially the Saxon element, whose representa-

tives, as a demonstration against this measure, withdrew

from the ranks of the Liberal majority. Among other

disquieting symptoms of trouble during the summer of

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1898 was the spread of agrarian socialism in the country,

which was intensified by a bill regulating the relations

between landowners and their labourers. Meanwhile

the discussion of the Ausgleich roused public feeling to

a fever pitch. The assassination of the empress-queen in

September 1898 had for the moment a sobering effect, and the proposal of the emperor-king to give the site in Ofen, occupied by the Hentzi monument, which had ever been an eyesore to patriotic Hungarians, for the monument to her memory to be erected by public subscription was enthusiastically received. But an order for the re-erection of the Hentzi statue in the barrack-yard of the cadet school gave rise to fresh obstruction, and led to stormy scenes in the chamber ; and the mutual recriminations of parliamentarians resulted in a crop of duels, among which that between Banffy and Horansky, the premier's bitterest assailant, was conspicuous. The new year (1899) brought no cessation of the obstruction, and it soon became evident that nothing less than the resignation of Banffy would satisfy the obstructionist group,

whose tactics threatened to be subversive of constitutional government in Hungary. In February the crisis culminated in the resignation of the Bd,nffy ministry, Koloman Szell being entrusted with the formation of a new cabinet.

Thus closed for Hungary a most momentous period in her modern political history. With the new premier's accession to power the parliamentary deadlock came to an end, and a compromise having been effected with the three opposite groups, the Ausgleich, embodied in a series of bills, was carried through both houses of legislature in July. Between then and the end of 1901, Hungarian politics was only disturbed by the periodical outbursts of anti-Magyar feeling in Austria, where the tension between the two countries as the outcome of commercial jealousy made itself acutely felt at times. Thus, with regard to the Bosnian railway question, the Hungarians, who had a monopoly of railway connexion with Bosnia, were accused of placing impediments in the way of the construction of the short lines intended to connect the Bosnian state

railway with Croatia and Austria on the one side, and with the Dalmatian coast at Spalato on the other. Undoubtedly the feelings aroused in Austria were natural enough. As it was the ambition of the Magyars to make of their country a "model industrial state, the Government left no stone unturned in its endeavour to attain this end. Austrian competition was successfully combated by a system of bounties to Hungarian manufactures which, while affording the necessary protection, ran counter to the spirit, if not to the letter, of the customs union. The result was that Austrian manufacturers and traders were attracted in large numbers to Hungary, while Austrian industries were dealt a correspondingly heavy blow. But in the distracted state of parliamentary politics in Austria (q.v.), no remedy for this was discernible.

The political situation between the years 1870 and 1902 was largely dominated by the conflict between the Catholic and Protestant interests. Beginning in 1867 with Dedk, it found its culminating point in the ultra-Calvinist, Koloman Tisza, while in the last years of the century an extraordinary development took place.

Tisza, with the Government party, endeavoured to realize Protest-
ant aims, whilst an independent Protestant party became a thorn
in the side of the Government. At the beginning of the 'nineties
a Catholic reaction set in with Szap^ry, but he, after a short term
of office, was forced by Desider Szilflgyi (q.v.), the relentless champion
of Calvinism, to resign. His successor, Wekerle, was dismissed
largely as a result of Catholic influence in Vienna. In Banffy, again,
is found a Protestant of extreme Calvinistic leanings, who carried
on his high-handed policy by uniting the forces of Judaism and
Protestantism, and whose questionable methods at the elections of
1897 left a blot upon the escutcheon of Hungarian statesmanship.
After his fall, Szell, a Catholic, undertook the formation of a
ministry, and this party, victorious in Hungary, occupied in 1902
the position formerly filled by the Protestant party.

HUNGAEIAN LiTEEATUEB.

The number of Magyar writers has since 1880 in-
creased to an extent hardly expected by the reading
public in Hungary itself. In 1830 there were only 10
Magyar periodical publications ; in 1880 we find 368 ;
in 1886 their number rose to 494; in 1890 to 636;

and at the beginning of 1895 no less than 806 period-
ical publications, written in the Hungarian language,
appeared in Hungary. Since that time (1895) the
number of periodical as well as of non-periodical literary
works has been constantly rising, although, as in all
countries with a literature of rather recent origin, the
periodical publications are, in proportion to the whole
of the output, far more numerous than the non-period-
*ical.^*
This remarkable increase in the quantity of literary
work was, on the whole, accompanied by a fair advance
in literary quality. It cannot be said that a new literary
generation had arisen, since many of the shining lights of
the 'sixties and 'seventies still remained in the field in 1901.
In lyrical poetry, among the poets who first came to the
fore in the 'sixties several were still activebetween 1880 and
1901, such as Joseph Komdcsy (d. 1894), whose Szerelem
Konyve {" Book of Love ") has become a pojmlar classic ;
Victor Dalmady , who published in the 'nineties his Hazafias
Kolteminyek (Patriotic Poems) ; and Ladislas Arany, son

of the great John. Among the prominent lyrists whose works, although partly published before 1880, belong largely to the later period, the^ following deserve special mention : — The poetry of EmilAbr^nyi (born 1850) is filled with the ideas and ideals of Victor Hugo. Abranyi excels also as a translator, more particularly of Byron. Julius Eeviczky (1855-1899) also inclined to the Occidental rather than to the specifically Magyar type of poets ; his lyrics are highly finished, aristocratic, and pessimistic {Pdn Jialdla, "The Death of Pan"). Count Geza Zichy (born 1849) published his lyrical poems in 1892. Joseph Kiss (born 1843) is especially felicitous in ballads taken from village and Jewish life, and in love-songs ; Alexander Endrodi (born 1850), one of the most gifted modern lyrical poets of Hungary, has the charm of tenderness and delicacy together with that of a peculiar and original style, his Kurucz ndtdk being so far his most successful attempt at romantic lyrics. Louis Bartdk (born 1851) is a remark-able satirist and epigrammatist {Kdrpdti emUkek). Odon Jakab (born 1850) leans towards the poetic manner of

Tompa, with perhaps a greater power of expression than the author of the Virdgregek (" Plower-f ables ") ; Jakab wrote Hangok az ifjusdgbdl ("Sounds of Youth"), Wydr ("Summer"), both collections of lyrical poems. LouisPdsa (born 1850) has made a sphere of his own in his charming poems for and about children, Edes anydm ("My dear Mother"). In Andor Kozma (born 1860), author of Ategnap is a ma ("Yesterday and To-day," 1889), Versek (Poems, 1893), &c., there is undoubted power of genuine satire and deep humour. Michael Szabolcska (born 1864), author of Hangulatok ("Moods," 1894), showed great promise ; Julius Vargha (born 1853) cultivates the nipies or folk-poetry as represented by Hungary's two greatest poets, Petofi and Arany; Vargha has also published excellent translations of Schiller and Goethe. Perhaps scarcely less remarkable are the modern Magyar lyrists, such as, of the older set, John Bulla (born 1843), J. D.

1 This will appear even more striking by a consideration of the number of periodical publications published in Hungary in languages other than Magyar. Thus, while of German periodicals appearing in

Hungary there were in 1871 only 85, they increased in 1880 to 114, in 1885 to 141 ; and they were, at the beginning of 1895, still 128, in spite of the constant spread of that process of Magyarization which has, since 1880, considerably changed the linguistic habits of the people of Hungary.

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Temerdeb, Gustavus Csengey (born 1842), Paul Koroda (bom 1854), E. Julius Kovacs (born 1839, Poems, 1892), Ladislas Inczedi, Julius Ndgradi Pap, Julius Szavay (born 1860), John Dengi (born 1853) ; among the juniors, Anton Eadd (also an excellent translator), Louis Palagyi (Magdnyos uton, " On Lonely Way," &c.), G-eza G^rdonyi (born 1863, Aprilis, 1894), Zoltan Pap, Eugen Heltai (ignotus), Julius Eudnyanszky , (born 1860, Szerelem, "Love"; Nydr, "Summer"), Arpad Zemplenyi, Julius Szentessy, Emil Makai (born 1870), Cornelius G^sp^r, Julius Varsanyi (born 1863, Mulanddsdg, "The Un-stableness of Things"), Alexander Luby {Vergodis,

” Striving “), Eugen V. SzaszvSirosi, Endre Szabd (born 1849), political satirist. In the most recent lyrics of Hungary there is a growing tendency to socialistic poetry, to the ” poetry of misery ” (A nyomor holUszete). In epic poetry Josef Kiss’s Jelwva is the most popular work. Amongst rhymed novels — novels in verse form — the best is the DilibdboJc hose (” The Hero of Mirages “), in which Ladislas Arany tells, in brilliantly humorous and cap-tivating fashion, the story of a young Magyar nobleman who, at first full of great ideals and aspirations, finally ends as a commonplace country squire.

Among Hungarian novels we may distinguish four dominant genres or tendencies. The first is represented almost exclusively by Maurus J6kai, who has gratified his countless admirers, both in Hungary and abroad, with numerous new manifestations of his inexhaustible verve and genius. The national festivities instituted in Jdkai’s honour in 1894, culminating in his being made, in 1897, a member of the Hungarian House of Magnates (the House of Lords in Hungary), publicly recognized the

obligation under which Jdkai's works had laid the Magyar nation. Amongst Jdkai's later novels are : A Tcik kitszer halnak meg (" Those who die Twice ") ; Szeretve mmd a virpadig (" Loving to the very Scaffold ") ; A locsei feMr asszony (" The White Lady of Loose ") ; A Kis Kirdlyoh (" The Little Kings ") ; A tengerszemii holgy (" The Lady with the Searsyes"); Frdter Gfyorgy ("Prater George"); De kdr megvinillni (" What a pity to grow old ") ; ^letembol (Memoirs) ; poems, dramas, &c. To the school so perfectly represented by Jdkai belong ArpM Kupa (A napszdmosok, " The Labourers " ; Kepzelt kirdlyok, "Imaginary Kings") ; Eobert Tabori (Nagy jdtik, " Great Game " ; A negy-venives ferflu, "The Man at Forty") ; and Julius Werner {Kendi Imre hdzassdga, "The Wedding of Emericus Kendi" ; Olga; Megvirrad mig vcdalia, "Dawn will come in the End"). The second class of Hungarian modern novelists is led by the well-known Koloman Mikszath, a poet endowed with originality, a charming naiveti, and a freshness of observation from life. A close observer of the multifarious low life of Hungary, Mikszath has, in his

short stories, given a delightful yet instructive picture of all the minor varied phases of the peasant life of the Slavs, the Paldcok, the Saxons, the tovm artisan. Amongsthis numerous works may be mentioned A j6 paldczoJc (" The Good Paldczok," Slav peasants) ; Egy vdlasztds Magyarorszdgon (" An Election in Hungary ") ; Pipacsok a buzdban (" Wild Poppies in the Wheatfield ") ; A tekintetes vdrmegye (" The Worshipful Coanty ") ; Ne okoskodj Pista (" Don't reason, Pista"); Szent Piter esernyoje ("St Peter's Umbrella," translated from the original into English by Miss B. W. Worswick), &c. Mikszath has had considerable influence upon other writers. Such are Victor E^kosi {Sipulus tdrcdi, " The Essays of Sipulus " ; Bejtett fdszkek, " Hidden Nests ") ; Stephen Mdra {Atydnkfiai, " Our Compatriots"); Alexius Benedek, the author of numerous distinctly sympathetic and truly Magyar tales, fables, and novels, one of the most gifted and deserving literary workers of modern Hungary (Huszdr Anna, "Anna Huszar"; Egy szalmaozvegy levelei, "Letters of a grass-widow " ; A sziv konyve, " The Book of the Heart " ;

Katalin, "Catherine"; Gsendes 6rdk, "Quiet Hours"; Testamentum h Jiat levM, " Last Will and Six Letters," translated into German by Dr W. Schdnwald, &c.) ; Geza Gardonyi (several novels containing the adventures, observations, &c., of Mr Gabriel Gore; A Mkszemu Davidkdni, " Blue-eyed Mrs Davidka " ; A Kdtsa, scenes from gypsy life); Charles Murai (Vig tortinetek, "Jolly Stories " ; Bandi, a collection of short tales) ; Stephen Barsony (Csend, "Silence"; A Kameleon-ledny, "The Chamseleon Girl, and other Stories" ; Erdon-mezon, "In Wood and Field "). The third class of Magyar novelists comprises those cosmopolitan writers who take their method of work, their inspiration, and even many of their subjects from foreign authors, chiefly French, German, Eussian, and also Norwegian. A people with an intense national sentiment, such as the Hungarians, do not as a rule incline towards permanent admiration of foreign-born or imported literary styles ; and accordingly the work of this class of novelists has frequently met with very severe criticism on the part of various Magyar critics.

Yet it can scarcely be denied that several of the " foreign " novelists have contributed a wholesome, if not quite Magyar, element of form or thought to literary narrative style in Hungary. Probably the foremost among them is Sigismund Justh, who died prematurely in the midst of his painful attempt at reconciling French "realistic" modes of thought with what he conceived to be Magyar simplicity {A puszta konyve, " The Book of the Puszta, " prairie of Hungary ; A Pinz legenddja, " The Legend of Money " ; Gdnyd Julcsa, " Juliet Ganyd " ; Fuimus). Other novelists belonging to this school are : Desiderius Malonyai (Az utolsd, " The Last " ; Judith konyve, " The Book of Judith " ; Tanulmdnyfejek, " Typical Heads ") ; Julius Pekar (Dodo Johadnagy probM-mdi, " Lieutenant Dodo's Problems " ; Az aranykesztyus kisasszony, "The Maid with the Golden Gloves"; A szoborszip asszony, " The Lady as Beautiful as a Statue " ; Az esztendo legenddja, " The Legend of, the Year ") ; Thomas Kobor (Aszfalt, " Asphalt " ; O akarta, " He Wanted It " ; A csillagok fele, " Towards the Stais ") ;

Stephen Szomahazy {Huszonnigy 6ra, " Twenty-four Hours " ; A Clairette Keringo, " The Clairette Valse " ; Pdratlan szerddk, " Incomparable Wednesdays " ; Nydri felhok, "Clouds of Summer"); Zoltan Thury {Ullrich fohadnagy ds egy&b tortinetek, "Lieutenant Ullrich and other Tales " ; Urak is parasztok, " Gentlemen and Peasants ") ; also Desiderius Szomory, Odon Gero, Arpad Abonyi, Koloman Szd^ntd, Edward Sas, Julius Vertesi, Tibor Ddnes, Akos Pinter, the Misses Janka and Stephanie Wohl, Mrs Sigismund Gyarmathy, and others. In the fourth class may be grouped such of the latest Hungarian novelists as have tried, and on the whole succeeded, in clothing their ideas and characters in a style peculiar to themselves. Besides Stephen Petelei (Jetti, a name — "Henrietta" — Felhok, "Clouds") and Zoltan Ambrus {Pdkhdld Kisasszony, " Miss Cobweb " ; Chjanu, " Suspicion "), must be mentioned especially Francis Herczeg, who has published a number of very interesting studies of Hungarian social life (Simon Zsuzsa, " Susanna Simon" ; Fenn is lenn, " Above and Below " ; Egy ledny tortinete,

“The History of a Girl”; Idegenek khzott, “Amongst Strangers”); Alexander Brddy, who brings a delicate yet resolute analysis to unfold the mysterious and fascinating inner life of persons suffering from overwrought nerves or overstrung mind (A kitlelkil asszony, ” The Double-Soul ed Lady”; Don Quixote kisasszony, “Miss Don Quixote”; Faust orvos, ” Faust the Physician ” ; Tundir Bona, Rejtel-mek, ” Mysteries ” ; Az ezUst kecske, ” The Silver Goat “) ;

and Edward Kabos, whose sombre and powerful genius has already produced works, not popular by any means, but full of great promise. In him we may trace the in-fluence of Nietzsche’s philosophy {Koldusok, ” Beggars ” ; Vdndorok, ” Wanderers “). To this list we must add the short but incomparable feuilletovs (tdrczalevelek) of Dr Adolf Agai (writing under the nom de plume of Porzd), whose influence on the formation of modern Hungarian literary prose is hardly less important than the unique esjmt and charm of his writings.

Dramatic literature, liberally supported by the king and the government, and aided by magnificent theatres in the capital and also in the provinces (the finest provincial theatre is in Kolozsvar, in Transylvania), has developed remarkably. The Hungarians have the genuine dramatic gift in abundance; they have, moreover, actors and actresses of the first rank. In the modern drama three great and clearly differentiated groups may be distinguished. First the neo-romantic group, whose chief representatives are Eugen Eakosi, Louis Ddczi (born 1846), who, in addition to Csdk (" The Kiss "), has written Utolsd szerelem ("Last Love"), Szichy Mdria ('■'Maria Szechy"), Vegyes Pdrok ("Mixed Couples"). In these and other dramatic writings, more remarkable perhaps for poetic than for stage effects, D6czi still maintains his brilliancy of diction and the delicacy of his poetic touch. To the same school belong Louis Bartdk, Anton V^radi, and Alexander Somld. The next group of Hungarian dramatists is dominated by the master spirit of Gregor Csiky (1842-1891), who

in his short but very active life furnished his country with a great number of society dramas, some gay, others semi-serious, but nearly all of them eminently dramatic, caustic, presenting real types of character in language incisive and moderate. In addition to his Proletdrok (perhaps his masterpiece), Csiky wrote: Czifra nyomo-rusdg (" Sham Splendour "), A Stomfay-csaldd (" The Stomfay Family"), Mukdnyi, Nora, Bozdti Mdrta, J6 Fiilop (" Good Philip "), A Kavidr, Ket szerelem (" Two Loves "), drok torv&ny (" Eternal Law "), Petnehdzy, &c. Among Csiky' s most promising disciples is Francis Herczeg (already mentioned as a novelist), author of the successful society comedy, A Oyurkovics lednyok (" The Misses Gyurkovics "), Hdrom tesotr (" Three Guardsmen"), Honty hdza ("The House of Honty"). A.v^i,di Berczik's Nizd meg az anyjdt ("Look at her Mother"), A protekczid ("Patronizing"), also followed on the lines of Csiky. The third group of dramatic writers take their subjects, surroundings, and diction from the folk-life of the villages (ndpszinmii, "folk-

drama”). The greatest of these dramatists has so far been Edward TMth {Tolonez, “The Ousted Pauper”). Amongst his numerous followers, who have, however, sometimes vulgarized their figures and plots, may be mentioned Tihamer Almasi (Milimdri, A Miniszterelnok bdlja, ” The Ball of the Premier “) and Alexander Soml6. In philosophy there has been a remarkable increase of activity, partly assimilative or eclectic, and partly original. Peter Bihari and Maurice Karm^n have in various writ-ings spread the ideas of Herbart. After the school of Comte, yet to a large extent original, is the Az ember 6s vildga (” Man and his World “) of Charles Bohm, who in 1881 started a philosophical review {Magyar Filozofiai Szemle), subsequently edited by Joseph Bokor, a vigorous thinker. Eealism, more particularly of the Wundt type, is represented by Emericus Pauer, As ethikai determinismus (“Ethical Determinism”), and Eugen Posch {Az idorol “On Time”). On a Thomistic basis John Kiss edits a philosophical review {Bolcseleti Folydirat) ; on similar lines have been working AkosMih^lyfi,Eepassy,Augustin

Lubrich, and others. Neo-Hegelianism is cultivated by Eugen Schmitt, efficiently assisted by Joseph Alexander Simon {Az egysiges is redlis termeszet filozofia alapvonalai, " Outlines of a Uniform and Realistic Philosophy of Nature"). F. Medveczky (formerly a German author under the name of Fr. von Barenbach) espouses Neo-Kantism {Tdrsadalmi elmiletek 6s eszm&nyek, 1887, " Social Theories and Ideals "). The Hungarian scholar Samuel Brassai published, in 1896, Az igazi pozitiv filozojia ("The True Positive Philosophy"). Amongst the ablest and most zealous students of the history of philosophy are Bernhard Alexander, under whose editorship, aided by Joseph Banoczi, a series of the works of the world's great thinkers has appeared; Andrew Domanovszky, author of an elaborate History of Philosophy ; Julius Gyomlai, translator of Plato; Eugen Peterfy, likewise translator of philosophical works, &c.

Juristic literature has been stimulated by the activity in positive legislation. On 1st January 1900 a new criminal code, thoroughly modem in spirit, was put in

force ; and in 1901 a Civil Code Bill, to replace the old Hungarian customary system, was introduced. Among the newer writers on common and commercial law may be mentioned Wenczal, Zlinsky, Zogod, Gustave Schwarz, Alexander Pldsz, Francis Nagy, and Neumann ; on constitutional law, Korbuly, Boncz, Stephen Kiss, Ernest Nagy, Kmety, Arthur Balogh, Ferdinandy, Bela Grtinwald, Julius Andr^ssy, and Emeric Hajnik; on administration, George Fesiis, Kmety, and Csiky; on finance, Mariska, Exner, and L^szld. Among the later writers on statistics, moreover, have been Konek, Keleti, Lang, Foldes, Jekelfalussy, Vorgha, Kdrosy, Eath, and Vizaknai. On subjects of politics, amongst the more important works are the various monographs of Gustavus Beksics on the Dualism of Austriar Hungary, on the " New Foundations of Magyar Politics " {A magyar politika uj alapjai, 1899), on the Rumanian question, &c. ; the writings of Emericus Balint, Akos Beothy, Victor Concha (systematic politics), L. Ecsery, ^Geza Ferdinandy (historical and systematic politics), Arpad Zig^ny, Bela Foldes (political

economy), Julius Mandello (political economy), Alexander Matlekovics (Hungary's administrative service ; Allam-Jidztartds, 3 vols.), J. Pdlya (agrarian politics), M. Somogyi (sociology), and the late Augustus Pulszky.

In history there has been great activity. The millennial festivities in 1896 gave rise to the publication of what was then the most extensive history of the Hungarian nation {A magyar nemzet torUnete, 1895-1901), ten large and splendidly illustrated volumes, edited by Alexander Szilagyi, with the collaboration of the best specialists of modern Hungary, Robert Frdhlich, B. Kuzsinszky, Geza Nagy, H. Marczali, Anton P6r, Schdnherr, V. Frakndi, Arp^d Karolyi, David Angyal, Coloman Thaly, Geza Ballagi.

Literary criticism is actively pursued. Among the more authoritative writers Paul Gyulai and Zsolt Beothy represent the conservative school ; younger critics, like Bela Lazar, Alexander Hevesi, H. Lenkei, Zoltan Ferenczy, Aladar Ballagi, Ladislas Negyessy, have shown themselves somewhat too ready to follow the latest Norwegian

or Parisian sensation.

AuTHOEiTiES. — Zsolt Beothy. A magy. nemz. irod. tort. — S. BodnAe. a magy. irod. tort. — Bela LAzAr. A tegnap, a ma, es a holnap (Budapest, 1896-1900) . — Joseph Szinntei. Magy. ir6k elete es munk&i (an extensive tiiographioal dictionary of Hungarian autliors, in course of publication) . — Irodalom torteneti Kozlemenyeh (a period-ical edited by Aeon SzilAdy, for the history of literature). — Emil Reich. Hungarian Literature (London, 1898). (e. ee.)*

Hunstanton, a seaside resort of England, on the east shore of the Wash, in Norfolk, 15 miles by rail north by east from King's Lynn. It has a good beach, a golf-course, a fine Decorated 14th-century church, the (Tudor)

hall of the L'Estrange family, a convalescent home (1871), a pier, and a lighthouse, 109 feet high, casting its beams 16 miles. Nine miles to the south is Sandringham, the country seat of King Edward VII. when prince of Wales. Population (1901), 1893.

Hunt, Alfred William (1830-1896), English painter, son of Andrew Hunt, a landscape painter, was born at Liverpool in 1830. He began to paint while he was still a boy at the Liverpool Collegiate School; but as the idea of adopting the artist's profession was not favoured by his father, he went in 1848 to Corpus Christi College, Oxford. His career there was distinguished; he won the Newdigate Prize in 1861, and became a Fellow of Corpus in 1858. He did not, however, abandon his artistic practice, for, encouraged by Eustin, he exhibited at the Royal Academy in 1854, and thenceforward regularly contributed landscapes in oil and water-colour to the London and provincial exhibitions. In 1861 he married, gave up his Fellowship, and was elected an Associate of the Royal Society of Painters in Water-Colours, receiving full membership three years later. His work is distinguished mainly by its exquisite quality and a poetic rendering of atmosphere. Hunt died on 3rd May 1896. Mrs A. W. Hunt {nie Margaret Eaine) is the writer of several works of fiction ; and one of her daughters.

Miss Violet Hunt, has also won distinction as a novelist.

See Frederick Wedmore. "Alfred Hunt," Magazine of Art, 1891 ; Exhibition of Drawings in Water Colour by Alfred William Sunt, Burlington rine Arts Club (1897).

Hunt, Henry Jackson (1819-1889), American artillerist, was born in Detroit, Mich., on 14th September 1819, graduated at the U.S. Military Academy in 1839, and became an expert in light artillery. When he was promoted to the rank of major, in May 1861, he was made chief of artillery in the Washington defences, and commanded the artillery reserve in the Virginia operations (1862-66), his services at Gettysburg being of the utmost value. He rose to be major-general of volunteers. By writing reports and papers and serving on various boards he was the foremost contributor to the effective use of artillery during the Civil War. He retired in 1883, and served as governor of the Soldiers' Home, Washington, D.C., until his death, on 11th February 1889.

Hunt, Richard Morris (1828-1895), American ar-

chitect, was born in Brattleboro, Vermont, 28th October 1828. He studied in Europe between 1843 and 1854, mainly in the Nicole des Beaux Arts at Paris. In 1864 he was appointed on the architectural staff of the Louvre, and under Hector Lefuel designed the Pavilion de la Biblioth^que, opposite the Palais Royal. Next year he returned to New York, where he followed his profession until his death. In 1855 he was employed on the extension of the Capitol at Washington. He built the Lenox Library, the Stuy vesant and the Tribune buildings in New York. For the Administration Building at the World's Columbian Exposition at Chicago in 1893 he received the gold medal of the Institute of British Architects. Among the most noteworthy of his domestic buildings are the residences of Mr W. K. Vanderbilt and Mr Henry G. Marquand in New York City; Mr George W. Vanderbilt's palatial residence at Eiltmore, North Carolina; and Mr Cornelius Vanderbilt's "The Breakers " at Newport, R.I. He was one of three foreign members of the Ita,lian Society of St Luke's, an honorary

and corresponding member of the Academic des Beaux Arts and of the Royal Institute of British Architects, and a Chevalier of the Legion of Honour. He was the first to command respect in foreign countries for American architecture, and was the leader of a school that has established in the United States the manner and the traditions of the Beaux Arts. He took a prominent part in the founding of the American Institute of Architects. His talent was eminently practical ; and he was almost equally successful in the ornate style of the early Renaissance in France, in the picturesque style of his comfortable villas, and the monumental style of the Lenox Library. He died 31st July 1895.

Hunt, William Holman (1827), English artist, was born in London on 2nd April 1827. An ancestor on his father's side bore arms against Charles I., and went over to Holland, where he fought in the Protestant cause. He returned with William III., but the family failed to recover their property. Holman Hunt's father was the manager of a City warehouse,

with tastes superior to his position in life. He loved books and pictures, and encouraged his son to pursue art as an amusement, but not as a profession. At the age of twelve and a half young Holman Hunt was placed in a City office, but he employed his leisure in reading, drawing, and painting, and at the age of sixteen began an independent career as an artist. When he was between seventeen and eighteen he entered the Royal Academy schools, where he soon made acquaint-ance with his lifelong friend John Everett Millais, then a boy of fifteen. In 1846 Holman Hunt sent to the Royal Academy his first picture (" Hark ! "), which was followed by "Dr Rochecliffe performing Divine Service in the Cottage of Joceline Joliffe at Woodstock," in 1847, and « The Flight of Madeline and Porphyrio " (from Keats's Eve of St Agnes) in 1848. In this year he and Millais, with the co-operation of Dante Gabriel Rossetti and others, initiated the famous Pre-Raphaelite movement in art, which aimed at the exact imitation of nature and perfect sincerity of workmanship. Typical

examples of the new creed were furnished in the next year's Academy by Millais's "Isabella" and Holman Hunt's " Rienzi vowing to obtain Justice for the Death of his Young Brother." This last pathetic picture was sold to Mr Gibbons for £106, and was succeeded in 1860 by "A Converted British Family sheltering a Christian Mission-ary from the Persecution of the Druids " (bought by Mr Combe, of the Clarendon Press, Oxford, for £l60), and in 1861 by " Valentine protecting Sylvia from Proteus." This scene from Tlie Two Gentlemen of Verona was very warmly praised by Ruskin (inletters to The Times), who de-clared that as studies both of drapery and of every minor detail there had been nothing in art so earnest and com-plete since the days of Albert Durer. It gained a prize at Liverpool, and is reckoned as the finest of his earlier works. In 1852 he exhibited " A Hireling Shepherd," a picture of an English " hireling " sporting with a pretty country girl in a sunny meadow while the sheep break into the corn. " Claudio and Isabella," from Measure for Measure, and a brilliant study of the Downs near Hastings, called

in the catalogue " Our English Coasts, 1852 " (since gener-
ally known as " Strayed Sheep "), were exhibited in 1853.
For three of his works he was awarded prizes of £60
and £60 at Liverpool and Birmingham, but in 1851 he
had been so much discouraged by the difficulty of selling
his pictures, that he had resolved to give up art and learn
farming with a view to emigration. In 1854 he achieved
his first great success by the famous picture of " The Light
of the World," an allegorical representation of Christ
knocking at the door of the human soul. This work
produced what was perhaps the greatest effect of any
religious painting of the century. " For the first time in
England," wrote William Bell Scott, " a picture became

a subject of conversation and general interest from one
end of the island to the other, and indeed continued so
for many years." "The Awakening Conscience," ex-
hibited at the same time, depicted a tragic moment in
a life of sin, when a girl, stricken with memories of

her innocent childhood, rises suddenly from the knees of her paramour. The inner meaning of both these pictures was explained by Euskin in letters to The Times in May 1854. “The Light of the World” was purchased by Mr Combe, and was given by his wife to Keble College.

In January 1854 liolman Hunt left England for Syria and Palestine with the desire to revivify on canvas the facts of Scripture history ” surrounded by the very people and circumstances of the life in Judaea of old days.” The first fruit of this idea, which may be said to have dominated the artist’s life, was ” The Scapegoat,” a solitary outcast animal standing alone on the salt-encrusted shores of the Dead Sea, with the mountains of Edom in the distance, seen under a gorgeous effect of purple evening light. It was exhibited at the Eoy al Academy in 1856, together with three Eastern landscapes. His next picture (1860), one of the most elaborate and most successful of his works, was ” The Einding of our Saviour in the Temple ” (see Plate). Like all his important pictures, it was the work of years.

Many causes contributed to the delay in its completion, including a sentence of what was tantamount to excommunication (afterwards revoked) passed on all Jews acting as models. Thousands crowded to see this picture, which was exhibited in London and in many other of the principal towns of England. It was purchased by a dealer named Gambart for £5500, and was engraved in line by Monsieur Blanchard. It is now in the Art Gallery at Birmingham, the gift of Mr Middlemore, M.P. Holman Hunt's next great religious picture was "The Shadow of Death" (exhibited separately in 1873), an imaginary inciden| in the life of our Lord, who, lifting His arms with weariness after labour in His workshop, throws a shadow on the wall as of a man crucified, which is perceived by His mother. This work was presented to Manchester by Sir William Agnew. Meanwhile there had appeared at the Royal Academy in 1861 "A Street in Cairo: The Lanternmaker's Courtship," and in 1863 " The King of Hearts," and a portrait of the Right Hon. Stephen Lushington, D.C.L. In 1866 came " Isabella and the Pot of Basil," " London Bridge on

the Night of the Marriage of the Prince of Wales," and "The Afterglow," which were exhibited together in a private gallery and drew great attention. In 1867 Holman Hunt sent a charming head of " A Tuscan Girl " to the Grosvenor Gallery and two pictures to the Royal Academy. These were " II dolce far niente " and a lifelike study of pigeons in rain called " The Festival of St Swithin," now in the Taylor Building, Oxford, with many others of this artist's works. After two years' absence Holman Hunt returned to Jerusalem in 1876, where he was engaged upon his great picture of " The Triumph of the Innocents," which proved to be the most serious labour of his life. The subject is an imaginary episode of the flight into Egypt, in which the Holy Eamily are\ attended by a procession of the Holy Innocents, marching along the waters of life and illuminated with unearthly light. Its execution was delayed by an extraordinary chapter of accidents. Eor months he waited in vain for the arrival of his materials, and at last he unfortunately began on an unsuitable piece of linen procured m despair at Jerusalem.

Other troubles supervened, and when he arrived in England he found his picture in such a state that he was compelled to abandon it and begin again. The new version of the work, which is somewhat larger and changed in several points, was not completed till 1885. In the meanwhile the old picture was relined and so skilfully treated that th,e artist was able to complete it satisfactorily; so that now there are two pictures of "The Triumph of the Innocents," one of which is in the Art Gallery at Liverpool and the other in that at Birmingham. The pictures exhibited between 1875 and 1885 included " The Ship," a realistic picture of the deck of a passenger ship by night (1878), and portraits of his son (1880), Sir Richard Owen (1881), and Dante Gabriel Rossetti (1884). All of these were exhibited at the Grosvenor Gallery, where they were followed by "The Bride of Bethlehem" (1885), "Amaryllis," and a portrait of his son (tracing a drawing on a window) in 1886. In 1880 Holman Hunt delivered a lecture at the Society of Arts on the preparation of artists' materials, and in 1886 a

collection of thirty-two of his works was exhibited at the Fine Art Society. His most important later work is " May-Day, Magdalen Tower," a record of the service of song which has been held on the tower of Magdalen, Oxford, at sunrise on May-Day from time immemorial.

William iroi.MAN Hunt.

{From a photograpk by Elliott and Fry, London.)

The subject had interested the artist for a great many years, and, after " The Triumph of the Innocents " was completed, he worked at it with his usual devotion, climbing up the tower for weeks together in the early morning to study the sunrise from the top. This radiant poem of the simplest and purest devotion was exhibited at the Gainsborough Gallery in Old Bond Street in 1891. He continued to send occasional contributions to the exhibitions of the Royal Water-Colour Society, to the New Gallery, and to the New English Art CJub. One of the most remarkable of his later works (New Gallery, 1899) is "The Miracle of Sacred Eire in the Church of the Sepulchre, Jerusalem," which takes place on

the morning of the Greek Easter Eve, in a rotunda round the shrine. The picture is crowded with pilgrims, who, wild with religious excitement, improvise scenes from the Passion while waiting for the miraculous burst of flame.

By his strong and constant individuality, no less than by his peculiar methods of work, Mr Holman Hunt holds a somewhat isolated position among artists. He remained entirely unaffected by all the various movements in the art-world after 1850, without budging one iota fromhis early principles and practice. His ambition was always "to serve as high priest and expounder of the excellence of the works of the Creator." The list of his works is a short

one ; lie spent too much labour on each work to com-plete many ; but perhaps no painter of the 19th century has produced so great an impression by a few pictures as the painter of " The Light of the World," " The Scapegoat," " The Finding of our Saviour in the Temple," and " The

Triumph of the Innocents." In 1856 he executed six designs for the illustrated edition of Tennyson's poems, and has made many illustrations for other works. As a writer Mr Holman Hunt is known by articles in the Contemporary Review on "The Pre-Raphaelite Brother-hood," another on " The Proper Mode and Study of Drawing " in the Magazine of Art, and one on " Pre-Eaphaelitism " in Chambers's Encyclopmdia. He was engaged in 1901 on a History of Pre-Baphaelitism.

See Archdeacon Farkae and Mrs Alice Metnell. "William Holman Hunt, his Life and Work" (^Art Annual). London, 1893. — John Ruskin. Modern Painters; The Art of England (Lecture) [consult Gordon Ceaufokd's Muskin's Notes on the Pictures of Mr Holman Hunt, 1886]. — Robert de la Sizeranne. La Peinture Anglaise Contemporaine. Paris, 1895. — W. B. Scott. Autobiographical Notes. — W. M. Rossetti. Pre-Baphaelite Diaries and Letters. — Percy H. Bate. T/ie Pre-Baphaelite Painters, 1899. (c. Mo.)

Hunter, William Alexander (1844-1898), Scottish jurist and politician, was born in Aberdeen, 8th

May 1844, and educated at the local grammar school and university, where he carried off the highest honours and many prizes. He entered the Middle Temple, and was called to the English bar in 1867, but then was occupied mainly with teaching. In 1869 he was appointed Professor of Roman Law at University College, London, and in 1878 Professor of Jurisprudence, resigning that chair in 1882. His name became well known during this period as the author of a standard work on Roman law, together with a smaller introductory volume for students. After 1882, however. Hunter took up politics, in which he held Radical views. He was elected to Parliament for Aberdeen in 1885, and in the House of Commons was a prominent supporter of Charles Bradlaugh. He was the first to advocate old age pensions, and in 1890 carried a proposal to free elementary education in Scotland. In 1896, however, his health broke down ; he retired from Parliament in 1896, and died 21st July 1898.

Hunter, Sir William Wilson (1840-1900),

British publicist, son of Andrew Galloway Hunter, a

Glasgow manufacturer, was born at Glasgow on 15th July 1840. He was educated at Glasgow University (B.A. 1860), Paris, and Bonn, acquiring a knowledge of San-scrit, and passing first in the competition for the Indian Civil Service in 1861. Posted in the remote district of Birthum, in the lower provinces of Bengal, he began collecting local traditions and records, which formed the materials for his novel and suggestive publication, entitled The Annals of Rural Bengal, a book which did much to stimulate public interest in the details of Indian adminis-tration. He also compiled A Comparative Dictionary of the Non-Aryan Languages of India, a glossary of dialects based mainly upon the collections of Brian Houghton Hodgson, which testifies to the industry of the writer but contains much immature philological speculation. In 1872 he brought out two attractive volumes on the pro-vince of Orissa and its far-famed temple of Jagannath. In 1869 Lord Mayo asked Hunter to submit a scheme for a comprehensive statistical survey of the Indian empire. The work involved the compilation of a number of local

gazetteers, in various stages of progress, and their consolidar tion in a condensed form upon a single and uniform plan. The conception was worthy of the gigantic projects formed by Arthur Young and Sir John Sinclair at the close of the 18th century, and the fact that it was successfully earned through between 1869 and 1881 was owing mainly to the energy and determination of Hunter. The early period of his undertaking was devoted by Hunter to a series of tours which took him into every corner of the peninsula and pat him into direct communication with the local ofacials. He himself undertook the supervision of the statistical accounts of Bengal (20 vols. 1875-77) and of Assam (2 vols. 1879). The various statistical accounts, when completed, comprised no fewer than 128 volumes. The immense task of condensing this mass of material proceeded con-currently with their compilation, an administrative feat which enabled The Imperial Gazetteer of India to appear in 9 volumes in 1881 (second edition in 14 volumes, 1885-87). Hunter adopted a transliteration of verna,cular place-names, by which means the correct pronunciation is

ordinarily indicated ; but hardly sufficient allowance was made for old spellings consecrated by history and long usage. Hunter's own article on India was published in 1880 as A Brief History of the Indian Peoples, and has been widely translated and utilized in Indian schools. A revised form was reissued in 1895, under the title of The Indian Empire : its People, History, and Products. In 1882 Hunter, as a member of the Governor-General's council, presided over the Commission on Indian Education; in 1886 he was elected Vice-Chancellor of the University of Calcutta. In 1887 he retired from the service, was created K.C.S.I., and settled at Oaken Holt, near Oxford. He arranged with the Clarendon Press to publish a series of Rulers of India, to which he himself contributed volumes on Dalhousie (1890) and Mayo (1892). He had previously, in 1875, written an official Life of Lord Mayo, in two volumes. He also wrote a weekly article on Indian affairs for Tlie Times. But the great task to which he applied himself on his settlement in England was a history upon a. large scale of the British Dominion in India,

two volumes of which only had appeared when he died, carrying the reader barely down to 1700. He was much hindered by the confused state of his materials, a portion of which he arranged and published in 1894 as Bengal Manuscript Records, in three volumes. A delightful story, TJie Old Missionary (1895), and Tlie Thackeray s in India (1897), a gossipy volume which appeals to all readers of Tlie Neivcomes, may be regarded as the relaxations of an Anglo-Indian amid the stress of severer studies. In the winter of 1898-99, in consequence of the fatigue incurred in a journey to the Caspian and back, on a visit to the sick-bed of one of his two sons. Hunter was stricken down by a severe attack of influenza, which affected his heart. He died at Oaken Holt on 6th February 1900. (t. se.)

Hunting. — When railways were first started in England, dismal prophecies were made that the end of hunting would speedily be brought about. The result on the whole has been the reverse. In some counties, of course, the sport has suffered. On the other hand, townsmen who formerly would have been too far from a meet can now

*secure transport for themselves and their horses in all directions ; and as a consequence, meets of certain packs are not advertised because of the number of strangers who would be induced to attend. The sport has never been so vigorously pursued as it is at the beginning of the 20th century, 19 packs of staghounds being kept in England and 4 in Ireland, 162 packs of foxhounds in England, 10 in Scotland, and 23 in Ireland, with packs of harriers and beagles too numerous to be counted. The chase of the wild stag is now carried on in the Pac**-west country by the Devon and Somerset hounds, which hunt three or four days a week from kennels at Dunster ; by Sir J. Amory, Bart. ; by the Quantock ; and by a fourth pack started in 1902. The other staghound packs*

are devoted to the capture of the carted deer, a business which is more or less of a parody on the genuine sport, but is popular for the reason that whereas with foxhounds men may have a blank day, they are practically sure of a

gallop when a deer is taken out in a cart to be enlarged before the hounds are laid on. Complaints are often raised about the cruelty of what is called tame stag hunting, and it was a special subject of criticism that a pack should be kept at the Royal kennels at Ascot (abolished in 1901) and hunted by the Master of the Buckhounds; but it is the constant endeavour of all masters and hunt servants to prevent the infliction of any injury on the deer. Their efforts in this direction are seldom unsuccessful ; and it appears to be a fact that stags which are hunted season after season come to understand that they are in no grave danger. Packs of fox-hounds vary, from large establishments in the " Shires," the meets of which are attended by hundreds of horse-men, some of whom keep large stables of hunters in constant work — for though a man at Melton, for instance, may see a great deal of sport with half-a-dozen well-seasoned animals, the number is not sufficient if he is anxious to be at all times well mounted — to small kennels in the north of England, where the field follow on foot.

The " Shires " is a recognized term, but is nevertheless somewhat vague. The three counties included in the expression are Leicestershire, Rutlandshire, and North-amptonshire. Several packs which hunt within these limits are not supposed, however, to belong to the " Shires," whereas a district of the Belvoir country is in Lincolnshire, and to hunt with the Belvoir is certainly understood to be hunting in the " Shires." The Shire hounds include the Belvoir, the Cottesmore, the Quorn, and the Pytchleys ; for besides the Pytchley proper, there is a pack distinguished as the Woodland. It is generally considered that the cream of the sport lies here, but with many of the packs which are generally described as " Pro-vincial " equally good hunting may be obtained. Round about London a man who is bent on the pursuit of fox or stag may gratify his desire in many directions. The Essex and the Essex Union, the Surrey and the Surrey Union, the Old Berkeley, the West Kent, the Burstow, the Hertfordshire, the Crawley and Horsham, the Pucke-ridge, as regards foxhounds ; the Berkhampstead, the

Enfield Chase, Lord Rothschild's, the Surrey, the West Surrey, and the Warnham, as regards staghounds, as well as the Bucks and Berks, which was substituted for the Royal Buckhounds, under the mastership of Sir R. Wilmot, Bart., are within easy reach of town.

Questions are constantly raised as to whether horse and hounds have improved or deteriorated of recent years. It is probable that the introduction of scientific Modern agriculture has brought about an increase of pace. hounds." Hounds hunt as well as ever they did, are probably faster on the whole, and in the principal hunts more thoroughbred horses are employed. Eor pace and endurance no hunter approaches the English thoroughbred ; and for a bold man who " means going," a steeplechase horse is often the best animal that could be obtained, for when he has become too slow to win races " between the flags," he can always gallop much faster, and usually lasts much longer, than animals which have not his advantage of blood. The quondam " 'chaser " is, however, usually apt to be somewhat impetuous at his

fences. But it must by no means be supposed that every man who goes out hunting desires to gallop at a great pace and to jump formidable obstacles, or indeed any obstacles at all. A large proportion of men who follow hounds are quite content to do so passively through gates and gaps, with a canter along the road whenever one is available. A few of the principal packs

Hunt

servants.

hunt five days a week, and sometimes even six, and for such an establishment not fewer than seventy-five couples of hounds are requisite. A pack which hunts four days a week will be well supplied with anything between fifty and sixty couples, and for two days a week from twenty-five to thirty will suffice. The young hound begins cub-hunting when he is some eighteen months old, and as a rule is found to improve until his third or fourth season, though some last longer than this. Often, how-ever, when a hound is five or six years old he begins to lack speed. Exceptional animals naturally do ex-

ceptional things, and a famous hound called Potentate is recorded by the eighth Duke of Beaufort to have done notable service in the hunting field for eleven seasons.

Servants necessary for a pack include the huntsman, the duties of whose office a master sometimes fulfils himself ; two whippers-in, an earth-stopper, and often a kennel huntsman is also employed, though Lord Willoughby de Broke^ an unimpeachable authority, lays it down that " the .man who hunts the hounds should always feed them." In all but the largest establishments the kennel huntsman is generally called the " feeder." It is his business to look after the pack which is not hunting, to walk them out, to prepare the food for the hunting pack so that it is ready when they return, and in the spring to attend to the wants of the matrons and whelps. A kennel huntsman proper may be described as the man who does duty when the master hunts his own hounds, undertaking all the responsibilities of the huntsman except actually hunting the pack. It

may be said that the first duty of a huntsman is to obtain the confidence of his hounds, to understand them and to make himself understood ; and the intelligence of hounds is remarkable. If, for example, it is the habit of the huntsman to give a single note on his horn' when hounds are drawing a covert, and a double note when a fox is found, the pack speedily understand the significance. The mysteries of scent are certainly no better compre-hended now than they were more than a hundred years ago when Peter Beckford wrote his admirable book, Tlwuglits on Hunting, a work from which a student of the sport may still learn practically all that is to be learnt. The subject of scent is full of mysteries. The great authority already quoted, the eighth Duke of Beaufort, noted as a very extraordinary but well-known fact, for example, " that in nine cases out of ten if a fox is coursed by a dog during a run all scent ceases afterwards, even when you get your hounds to the line of the fox beyond where the dog has been." This is one of many phenomena which have always remained inexplicable. The duties of

the whipper-in are to a great extent explained by his title. Whilst the huntsman is drawing the cover the whipper-in is stationed at the spot from which he can best see what is going on, in order to view the fox away, and it is his business to keep the hounds together when they have found and got away after the fox. There are many ways in which a whipper-in who is not intelligent and alert may spoil sport; indeed, the Duke of Beaufort actually went so far as to declare that " in his experience, with very few exceptions, nine days out of ten that the whipper-in goes out hunting, he does more harm than good." In woodland countries, however, a good whipper-in is really of almost as much importance as the huntsman himself ; if he is not alert the hounds are likely to divide, as when running a little wide they are apt to put up a fresh fox. The earth-stopper "stops out" and "puts to" — ^the first expression signifying blocking, during the night, earths and drains to which foxes resort, the second performing the same duties in the morning so as to prevent the fox from getting to ground when he has

been found. In the interests of humanity care should be taken that the earth-stopper always has with him a small terrier, as it is often necessary to " stop-out " per-manently ; and unless a dog is run through the drain some unfortunate creature in it, a fox, cat, or rabbit, may be imprisoned and starved to death. This business is frequently performed by a gamekeeper, a douceur being paid him for any litter of cubs or fox found on his beat. With regard to the expenses of hunting, it is calculated that a master of hounds should be prepared to spend at the rate of £500 a year for every day in the bunting. "^^^ tliat tis hounds are supposed to hunt. Taking one thing with another, this is probably rather under than over the mark, and the cost of hunting three days a week, if the thing be really properly done, will most likely be nearer £2000 than £1600. The expenses to the individual naturally vary so much that no figures can be given. As long ago as 1826 twenty-

seven hunters and hacks were sold for 7500 guineas, an average of over £290 ; and when Lord Stamford ceased to hunt the Quorn in 1853, seventy-three of his horses fetched at auction an average of close on £200. Early in the 19th century, when on the whole horses were much cheaper than they are at present, 700 and 800 guineas are prices recorded as having been occasionally paid for hunters of special repute. A man may see some sport on an animal that cost him £40; others may consider it necessary to keep an expensive establishment at Melton Mowbray or elsewhere in the shires, with a dozen or more 500-guinea hunters, some covert-hacks, and a correspond-ing staff of servants. Few people realize what enormous sums of money are annually distributed in connexion with hunting. Horses must be fed ; the wages of grooms and helpers be paid ; saddlery, clothing, shoeing, &c., are items ; farmers, innkeepers, railway companies, fly-men, and others benefit more or less directly. (a. b. t. w.)

Huntingdon, a municipal borough and market-town of England, capital of the county of Huntingdon,

on the Ouse, and on the Great Northern, Great Eastern, and Midland railways, 59 miles north from London. The recent buildings include the Montagu Institute (1897), in which are held the county council technical education classes, and which also shelters a working men's club. A new red-brick building, in the Elizabethan style, was erected in 1890 to accommodate the Archdeaconry Library (founded in 1716). The town and county hospital was enlarged in 1897, and an isolation hospital built in 1898. The large Early Decorated Trinity Union church (1868) serves both Baptists and Congregationalists. There are also a Wesleyan chapel (1878) and Salvation Army barracks. Amongst the industries should be mentioned the manufacture of carriages and perforated bricks. The town is governed by a mayor, 4 aldermen, and 12 councillors. Population (1901), 4261.

Huntingdon, capital of Huntingdon county, Pennsylvania, U.S.A., on the Juniata river, the Pennsylvania canal, and the Pennsylvania and the Huntingdon and Broad Top Mountain railways, at an altitude of 621

feet. It contains car works and varied manufactures.

Population (1880), 4125 ; (1890), .‘5729 ; (1900), 6053, of whom 225 were foreign-born and 122 were negroes.

Huntingdonshire, one of the south midland counties of England, bounded on the N. by Northampton, on the W. by Northampton and Bedford, and on the remaining sides by Cambridge.

Area and Population. — In 1891 the area of the ancient (geographical) county was 234,218 acres, and the population 57,761, of whom 28,419 were males and 29,342 females, showing a decrease of 1730, or at the rate of 2-9 per cent., since 1881 (59,491), as compared with a decrease at the rate of 6-6 per cent, in the ten years 1871-81 ; and in 1901, 57,773, or an increase of 12 since 1891. The returns of 1891 give 0-25 persons to an acre and 4-05 acres to a person. In 1891 the area of the registration county was 207,569 acres, and the population 50,289, of whom 24,750 were males and 25,539 females.

Particulars of the birth-rate, death-rate, and illegitimacy-rate, and the number of persons married per 1000 inhabitants are given in the subjoined table : —

1871-80.

1881-90.

1889-98.

1899.

Birth-rate .

31-6

27-9

26-0

25-4

Death-rate .

18-5

16-4

16-0

16-6

Illegitimacy – rate

(per 1000 births)

52

50

52

61

Marriage-rate

13-3

12-6

13-1

14-2

In 1891 the county contained 129 persons of Scottish birth, 140 of Irish birth, and 48 foreigners. At the same date there were 45 blind, 19 deaf and dumb, and 68 insane.

Administration,

county is divided into two divisions (Southern or Huntingdon and Northern or Ramsey), each returning one member, and part of the parliamentary borough of Peterborough (Northamptonshire). The administrative county includes the three municipal boroughs of Godmanchester, Huntingdon, and St Ives. There is one court of quarter sessions and five petty sessional divisions. The adminis-•trative county contains 99 entire civil parishes and parts of 8 others. The ancient county contains 79 ecclesiastical parishes or districts and parts of 8 others, most of them in the diocese of Ely. It is also traversed by the London and North-Western railway.

Education. — The number of elementary schools in the county on 31st August 1900 was 88, of which 24 were board schools and 64 voluntary schools, these latter embracing 60 national Church of England schools, 1 Wesleyan school, and three British and other schools. The total school board receipts for the year ending 29th September 1900 amounted to £6262, inclusive of £548 income under the Agricultural Rates Act.

Agriculture. — There has been a large decrease in the areas of corn crops and of fallow since 1880, and an increase in both the permanent grass and the meadow land. The area of orchards was nearly doubled between 1885 and 1900, and the area of market gardens more than trebled between 1885 and 1895. In 1889 168,575 acres were farmed by tenants and 41,966 acres by the owners ; the corresponding figures for 1895 being 177,238 and 33,412 acres, and for 1900, 179,890 and 28,461 acres respectively.

Good drinking water is deficient in many parts of the county.

Willows are the commonest trees.

The following table shows the areas under the different kinds of crops at the periods named : —

Tear.

Area in

Cultivation.

Area under

Corn Crops.

Area under

Green Crops.

Area of

Bare Fallow.

Area under

Permanent

Grass.

1880

1885

1890

1895

1900

209,262

210,628

210,821

210,650

208,351

95,806

88,503

81,946

71,413

74,359

20,223

21,326

19,905

20,173

20,410

15,757

15,689

13,535

11,863

8,902

65,462

76,562

86,043

84,151

The next table shows the number of live stock at the periods

named : —

Year.

Cows and

HL-ifers.

Othor

Cattle.

Total

Cattle.

Horses.

Sheep.

Pigs.

1880

1885

1890

1895

1900

7499

7268

7895

7124

7642

20,814

22,817

24,056

20,802

23,104

28,313

30,085

31,951

27,986

30,746

10,969

10,1.39

11,004

11,393

11,027

155,059

131,128

118,208

101,110

96,459

17,475

19,816

20,997

21,728

17,443

Authorities.— S. H. Miller and S. B. J. Skertohlt. The Fenland. Wisbech, 1878. — A. Kingston. East Anglia and the C-rivat Civil War. London, 1897. — Catalogue of Huntingdonshire Books collected by H. E. Norris (1610-1895), privately printed, 1885. (j. T. BE.)

Huntington, capital of Huntington county, Indi-ana, U.S.A., on the Little river, on the Wabash and Erie canal, and on the Wabash and the Erie railways, at an altitude of 743 feet. It has water-works, natural gas, the car works of the Erie railway, and manufactures of

woodeD ware. Population (1880), 3863; (1890), 7328;

(1900), 9491, of whom 621 were foreign-born.

Huntington, capital of Cabell county. West Virginia, U.S.A., on the south bank of the Ohio river, just below the mouth of the Guyandot, on the Chesapeake and Ohio and the Ohio Eiver railways, at an altitude of 667 feet. It possesses a level site and a regular plan. It is the division headquarters of the Chesapeake and Ohio railway, has car and machine works, and a large trade in coal, iron ore, and lumber. Population (1880), 3174 ; (1890), 10,108 ; (1900), 11,983, of whom 242 were foreign-born and 1212 were negroes.

Huntington, Daniel (1816), American artist, was born in New York, 14th October 1816. In 1835 he studied with S. F. B. Morse, and produced "A Bar-Eoom Politician " and " A Toper Asleep." Subsequently he painted some landscapes on the river Hudson, and in 1839 went to Rome. On his return to America he painted portraits and began the illustration of TJie Pilgrim's Progress, but his eyesight failed, and in 1844 he went back to Eome. Returning to New York in 1846, he devoted

his time chiefly to portrait-painting, although he has painted many genre, religious, and historical subjects. He was president of the National Academy from 1862 to 1869, and was re-elected in 1877. Among his principal works are : " The Florentine Girl," " Early Christian Prisoners," " The Shepherd Boy of the Campagna," " The Roman Penitents," " Christiana and Her Children," " Queen Mary signing the Death- Warrant of Lady Jane Grey," and " Feckenham in the Tower " (1850), " Choeura" (1860), " Republican Court in the Time of Washington," containing sixty -four careful portraits (1861), " Sowing the Word" (1869), "St Jerome," "Juliet on the Balcony" (1870), "The Narrows, Lake George" (1871), "Titian," "Clement VIL and Charles V. at Bologna," "Philosophy and Christian Art" (1878), "Goldsmith's Daughter" (1884). His principal portraits are: President Lincoln, in Union League Club, New York ; Chancellor Ferris of New York University ; Sir Charles Eastlake and the Earl of Carlyle, the property of the New York Historical Society ; President Van Buren, in the

State Library at Albany ; James Lenox, in the Lenox Library; Louis Agassiz (1856-57), William Cullen Bryant (1866), John A. Dix (1880), and John Sherman (1881).

Huntly, a police burgh and bitrgh of barony of Aberdeenshire, Scotland, at the confluence of the rivers Deveron and Bogie. It is a market town and the centre ■of a large agricultural district, 40| miles north-west of Aberdeen by rail. Its industries are agricultural imple-ment-making, hosiery weaving, weaving of woollen cloth, and the manufacture of lamps and of boots. There are an .ancient castle, a public hall, a hospital for aged persons, a public library, and a cottage hospital. The public schools have a secondary department. Population (1881), 3519 ; <1901), 4136.

Huntsville, capital of Madison county, Alabama, U.S.A., on a plain ten miles north of the Tennessee river, 'On the Nashville, Chattanooga, and St Louis, and the Southern railways, at an altitude of 617 feet. It contains several institutions for higher education, also railway

works and cotton mills. Population (1880), 4977; (1890), 7995; (1900), 8068, of whom 143 were foreign-born and 3709 were negroes.

Hunza. See Gilgit.

Hurlford and Crooitedholm, a mining town of Ayrshire, Scotland, on the river Irvine, 2 miles east-,south-east of Kilmarnock by rail. It has extensive ironworks and fireclay works. There is an institute, with a hall and reading-room. Two public schools had an average attendance of 685 in 1898-99, and a Roman Catholic school, 77. Population (1881), 4385; (1891), 4205 ; (1901), 5246.

Husi (Hvsch or Hushi), chief town of the district of Falciil, Rumania, on the right bank of the river Pruth, about 40 miles south-east of Jassy. It is the seat of a court of first instance, and residence of a bishop. The principal commerce is in wine. A fair is held on the 14th of September. The town is said to have been founded by the Hussites in the 15th century. The cathedral (Biserica Domnesca) was built in 1491 by Stephen the Great. The

Treaty of the Pruth between Russia and Turkey was signed at Husi in 1711. Populatiouj 15,404, of whom about one-fourth are Jews.

Husum, a small seaport town of Prussia, province of Schleswig-Holstein, near the coast of the North Sea, the port for the North Frisian Islands, 99 miles by rail north-north-west of Hamburg. In 1898 a bronze bust of Theodor Storm, who was born in this " grey town by the sea " in 1817 and died in 1888, was unveiled in the park. Husum has large cattle markets, especially for fat cattle. Population (1885), 6267 ; (1900), 8268.

-), English

Hutchinson, Jonathan (1828-

surgeon and pathologist, was born 23rd July 1828 at Selby, Yorkshire, his parents belonging to the Society of Friends. He entered St Bartholomew's Hospital, and became a member of the Royal College of Surgeons in 1860 (F.R.C.S. 1862), and rapidly came to the front as a skilful operator and a scientific inquirer. He was president of the Hunterian Society in 1869 and 1870,

professor of surgery and pathology at the College of Surgeons from 1877 to 1882, president of the Patho-logical Society, 1879-80, of the Ophthalmological Society, 1883, of the Neurological Society, 1887, of the Medical Society, 1890, and of the Royal Medical and Chirurgical in 1894-96. In 1889 he was president of the Royal College of Surgeons. He was a member of two Royal Commissions, that of 1881 to inquire into the provision for smallpox and fever cases in the London hospitals, and that of 1889-96 on vaccination and leprosy. He also acted as honorary secretary to the Sydenham Society. A progressive and a reformer, his activity in the cause of scientific surgery and in advancing the study of the natural sciences was unwearying. His lectures on neuropathogenesis, gout, leprosy, diseases of the tongue, &c., were full of original observation ; but his princi];ft,l work was connected with the study of syphilis, on which he became the first living authority. He was the founder of the London Polyclinic or Postgraduate School of Medicine ; and both in his native town of Selby and at

Haslemere, where he acquired a good deal of land and built several houses, he started (about 1890) educational museums for popular instruction in natural history. He has published several volumes on his own subjects, was editor of the quarterly AivJiives of Surgery, and holds the Hon. LL.D. degree of both Glasgow and Cambridge.

Hutchinson, capital of Reno county, Kansas, U.S.A., in the broad bottom-land of the Arkansas river, on the north side, at an altitude of 1533 feet. It is on four railways — the Atchison, Topeka and Santa Fe, the Missouri Pacific, the Chicago, Rock Island and Pacific, and the Hutchinson and Southern. Its site is level, the plan of the city regular, and the water-supply excellent. Near by is a large deposit of rock-salt, and the chief industry is mining and shipping this commodity. Popula-

tion (1880), 1540; (1890), 8682; (1900), 9379, of whom 414 were foreign-born and 442 were negroes.

Hutton, Richard Holt (1826-1897), English

writer and theologian, son of Joseph Hutton, Unitarian minister at Leeds, was born at Leeds on 2nd June 1826. His family removed to London in 1835, and he was educated at University College School and University College, where he began a life-long friendship with Walter Bagehot, of whose works he afterwards was the editor ; he took his degree in 1845, being awarded the gold medal for philosophy. Meanwhile he had also studied for short periods at Heidelberg and Berlin, and in 1847 he entered Manchester New College with the idea of becoming a minister like his father, and studied there under Martineau. He did not, however, succeed in obtaining a " call " to any ministry, and for some little time his future was unsettled. He married in 1851 his cousin, Anne Roscoe, and became joint-editor with J. L. Sanford of the Inquirer, the principal Unitarian organ. But his innovations and his unconventional views about stereotyped Unitarian doctrines caused alarm, and in 1853 he resigned. His health had broken down, and he visited the West Indies, where his wife died of yellow

fever before he returned. In 1855 Hutton anid Bagehot became joint-editors of the NatioTial Review, a new monthly, and conducted it for ten years. During this time Hutton's theological views, influenced largely by Coleridge, and more directly by F. W. Robertson and F. D. Maurice, gradually approached more and more to those of the Church of England, which he ultimately joined. His interest in theology was profound, and he brought to it a spirituality of outlook and an aptitude for metaphysical inquiry and exposition which added a singular attraction to his writings. In 1861 he joined Mr Meredith Townsend as joint-editor and part proprietor of the Spectator, then a well-known Liberal weekly, which, however, was not remunerative from the business point of view. Hutton took charge of the literary side of the paper, and by degrees his own articles became and remained up to the last one of the best-known features of serious and thoughtful English journalism. The Spectator, which gradually became a prosperous property, was his pulpit, in which unwearyingly he gave expression to his

views, particularly on literary, religious, and philo-
sophical subjects, in opposition to the agnostic and
rationalistic opinions then so current in intellectual
circles, as popularized by Huxley. A man of fearless
honesty, quick and catholic sympathies, broad culture,
and many friends in intellectual and religious circles, he
became one of the most influential journalists of the day,
his fine character and conscience earning universal
respect and confidence. He was an original member of
the Metaphysical Society (1869). He was an anti-
vivisectionist, and a member of the Royal Commission
(1875) on that subject. In 1858 he had married again,
his second wife, Eliza Roscoe, being a cousin of his first ;
she died early in 1897, and Hutton's own death followed
quickly, on 9th September of the same year. Among
his other publications may be mentioned Essays, TJieo-
logical and Literary (1871 ; revised 1888), and Criticisms
on Contemporary TJiought and Tliinhers (1894) ; and his
opinions may be studied compendiously in the selec-
tions from his Spectator articles published in 1899 under

the title of Aspects of Religious and Scientific Thought.

(h. Ch.)

Huxley, Thomas Henry (1825-1895), the most distinguished English biologist (if in a different field we except Charles Darwin) of the 19th century, was born on the 4th of May 1825 at Ealing, where his father, George Huxley, was senior assistant-master in the school of Dr Nicholas. This was an establishment of repute, and is at any rate remarkable for having produced two men with so little in common in after life as Huxley and Cardinal Newman. The cardinal's brother, Francis William, had been "captain" of the school in 1821. Huxley was a seventh child (as his father had also been), and the youngest who survived infancy. Of Huxley's ancestry no more is ascertainable than in the case of most middle-class families. He himself thought it sprang from the Cheshire Huxleys of Huxley Hall. Different branches migrated south, one, now extinct, reaching London, where its members were apparently engaged in commerce. They estab-

lished themselves for four generations at Wyre Hall, near Edmonton, and one was knighted by Charles II. Huxley describes his paternal race as "mainly Iberian mongrels, with a good dash of Norman and a little Saxon." ' From his father he thought he derived little except a quick temper and the artistic faculty which proved of great service to him and reappeared in an even more striking degree in his daughter, the Hon. Mrs Collier. " Mentally and physically," he wrote, " I am a piece of my mother." Her maiden name was Rachel Withers. " She came of Wiltshire people," he adds, and describes her as "a typical example of the Iberian variety." He tells us that "her most distinguishing characteristic was rapidity of thought. . . . That peculiarity has been passed on to me in full strength" (Essays, i. 4). One of the not least striking facts in Huxley's life is that of education in the formal sense he received none. " I had two years of a pandemonium of a school (between eight and ten), and after that neither help nor sympathy in any intellectual direc-

tion till I reached manhood" (ii/e, ii. 145). After the death of Dr Nicholas the Ealing school broke up, and Huxley's father returned about 1835 to his native town, Coventry, where he had obtained a small appointment. Huxley was left to his own devices; few histories of boyhood could offer any parallel. At twelve he was sitting up in bed to read Hutton's Geology. His great desire was to be a mechanical engineer ; it ended in his devotion to "the mechanical engineering of living machines." His curiosity in this direction was nearly fatal; a post-mortem he was taken to between thirteen and fourteen was followed by an Ulness which seems to have been the starting-point of the ill-health which pursued him all through life. At fifteen he devoured Sir William Hamilton's Logic, and thus acquired the taste for metaphysics, which he cultivated to the end. At seventeen he came under the influence of Carlyle's writings. Fifty years later he wrote : " To make things clear and get rid of cant and shows of all sorts. This was the lesson I learnt from Carlyle's books when I was a

boy, and it has stuck by me all my life " (Life, ii. 268). Incidentally they led him to begin to learn German ; he had already acquired French. At seventeen Huxley, with his elder brother James, commenced regular medical studies at Charing Cross Hospital, where they had both obtained scholarships. He studied under "VMiarton Jones, a physiologist who never seems to have attained the reputation he deserved. Huxley said of him : " I do not know that I ever felt so much respect for a teacher before or since " (Life, i. 20). At twenty he passed his first M.B. examination at the University of London, winning the gold medal for anatomy and physiology; Ransom, the well known Nottingham physician, obtaining the exhibition. In 1845 he published, at the suggestion of Wharton Jones, his first scientific paper, demonstrating the existence of a hitherto unrecognized layer in the inner sheath of hairs, a layer that has been known since as " Huxley's layer."

1 Nature, Ixiii. 127.

Something had to be done for a livelihood, and at the suggestion of a fellow-student, Mr (afterwards Sir Joseph) Fayrer, he applied for an appointment in the navy. He passed the necessary examination, and at the same time obtained the qualification of the Eoyal College of Surgeons. He was " entered on the books of Nelson's old ship, the Victory, for duty at Haslar Hospital." Its chief. Sir John Richardson, who was a well-known Arctic explorer and naturalist, recognized Huxley's ability, and procured for him the post of surgeon to H.M.S. Rattlesnake, about to start for surveying work in Torres Strait. The commander. Captain Owen Stanley, was a son of the bishop of Norwich and brother of Dean Stanley, and wished for an officer with some scientific knowledge. Besides Huxley the Rattlesnake also carried a naturalist by profession, John Macgillivray, who, however, beyond a dull narrative of the expedition, accomplished nothing. Hux-

ley's future life-long friend.

Sir Joseph Hooker, might

have been his shipmate, but

was tied by other plans. The

Rattlesnake left England on

3rd December 1846, and was or-

dered home after the lamented

death of Captain Stanley

at Sydney, to be paid off at

Chatham on 9th November

1850. The tropical seas teem

with delicate surface-life, and

to the study of this Huxley

devoted himself with unre-

mitting devotion. At that

time no known methods existed

by which it could be preserved

for study in museums at home.

He gathered a magnificent

harvest in the almost unreaped

field, and the conclusions he drew from it were the beginning of the revolution in zoological science which he lived to see accomplished.

Cuvier (1769-1832), whose classification still held its ground, had divided the animal kingdom into four great embrancJiements. Each of these corresponded to an independent archetype, of which the " idea " had existed in the mind of the Creator. There was no other connexion between these classes, and the " ideas " which animated them were, as far as one can see, arbitrary. Cuvier's groups, without their theoretical basis, were accepted by Von Baer (1792-1876). The "idea" of the group, or archetype, admitted of endless variation within it ; but this was subordinate to essential conformity with the archetype, and hence Cuvier deduced the important

principle of the " correlation of parts," of which he made such conspicuous use in palaeontological reconstruction. Meanwhile the " natur-philosophen," with Goethe (1749-1832) and Oken (1779-1851), had in effect grasped the underlying principle of correlation, and so far anticipated evolution by asserting the possibility of deriving specialized from simpler structures. Though they were still hampered by idealistic conceptions, they established Morphology. Cuvier's four great groups were Vertebrata, Mollusca, Articulata, and Eadiata. It was amongst the members of the last class that Huxley found most material ready

Thomas Heney Huxley.

(From- a pThOtograph J>y ElUoit and Fry, ZoTidon.)

to his hand in the seas of the tropics. It included organisms of the most varied kind, with nothing more in common than that their parts were more or less distri-buted round a centre. Huxley sent home " communica^ tion after communication to the Linnean Society," then a somewhat somnolent body, " with the same result as that obtained by Noah when he sent the raven out

of the ark" (Essays, i. 13). His important paper, On tJie Anatomy and the Affinities of the Family of Medusm, met with a better fate. It was communicated by the bishop of Norwich to the Royal Society, and printed by it in the Philosophical Transactions in 1849. Huxley united, with the Medusae, the Hydroid and Sertularian polyps, to form a class to which he subsequently gave the name of Hydrozoa. This alone was no inconsiderable feat for a young surgeon who had only had the training of a medical school. But the ground on which it was done has led to far-reaching theoretical developments. Huxley realized that something more than superficial characters were necessary in determining the

affinities of animal organisms. He found that all the members of the class consisted of two membranes enclosing a central cavity or stomach. This is characteristic of what are now called the Coelenterata. All animals higher than these have been termed Coelemeta; they Ijossess a distinct body-cavity in addition to the stomach. Huxley went farther than this, and the most profounCt sugges-tion in his paper is the com-parison of the two layers with those which appear in the germ of the higher animals. The consequences which have flowed from this prophetic generalization of the ectoderm

and endoderm are familiar to every student of evolution. The conclusion was the more remarkable as at the time he was not merely free from any evolutionary belief, but actually rejected it. The value of Huxley's work was immediately recognized. On returning to England in 1850 he was elected a Eellow of the Royal Society. In the following year, at the age of 26, he not merely received the Royal medal, but was elected on the council. With absolutely no aid from any one he had placed himself in the front rank of English scientific men. He secured the friendship of Hooker and Tyndall, who remained his life-long friends. The Admiralty retained him as a nominal assistant-surgeon, in order that he might work iip the observations he had made during the voyage of the Rattlesnake. He was thus enabled to produce various important memoirs, especially those on certain Ascidians, in which he solved the problem of Appendicularia — an organism whose place in the animal kingdom

Johannes Milller had found himself wholly unable to assign — and on the morphology of the Cephalous Mollusca.

Owen, who was then the leading comparative anatomist in Great Britain, was a disciple of Cuvier, and adopted largely from him the deductive explanation of anatomical

fact from idealistic conceptions. He superadded the evolutionary theories of Oken, which were equally ideal-istic, but were altogether repugnant to Cuvier. Huxley would have none of either. Imbued with the methods of Von Baer and Johannes Miiller, his methods were purely inductive. He would not hazard any statement beyond what the facts revealed. He retained, however, as has been done by his successors, the use of archetypes, though they no longer represented fundamental " ideas " but generalizations of the essential points of structure common to the individuals of each class. He had not

wholly freed himself, however, from archetypal tram-

mels. "The doctrine," he says, "that every nattiral

group is organized after a definite archetype . . . seems

to me as important for zoology as the doctrine of definite

proportions for chemistry." This was in 1853. He

further stated : — " There is no progression from a lower

to a higher type, but rqerely a more or less complete

evolution of one type" {Phil. Trans. 1853, 63). As

Chalmers Mitchell points out, this statement is of great

historical interest. Huxley definitely uses the word

"evolution," and admits its existence within the great

groups. He had not, however, rid himself of the notion

that the archetype was a property inherent in the group.

Herbert Spencer, whose acquaintance he made in 1862,

was unable to convert him to evolution (Life, i. 168). He

could not bring himself to acceptance of the theory —

owing, no doubt, to his rooted aversion from ci priori

reasoning — without a mechanical conception of its mode

of operation. In his first interview with Darwin, which

seems to have been about the same time, he expressed

his belief " in the sharpness of the lines of demarcation between natural groups," and was received with a humorous smile (Life, i. 169).

The naval medical service exists for practical purposes. It is not surprising, therefore, that after his three years' nominal employment Huxley was ordered on active service. Though without private means of any kind, he resigned. The navy, however, retains the credit of having started his scientific career as well as that of Hooker and Darwin. Huxley was now thrown on his own resources, the immediate prospects of which were slender enough. As a matter of fact, he had not to wait many months. His friend Edward Forbes was appointed to the chair of Natural History in Edinburgh, and in July 1854 he succeeded him as lecturer at the School of Mines and as naturalist to the Geological Survey in the following year. The latter post he hesitated at first to accept, as he " did not care for fossils " (Essays, i. 16). In 1856 he married Miss H. A. Heathorn, whose acquaintance he had made in Sydney. They were engaged when Huxley

could offer nothing but the future promise of his abil-
ity. The confidence of his devoted helpmate was
not misplaced, and her affection sustained him to the
end, after she had seen him the recipient of every
honour which English science could bestow. His most
important research belonging to this period was the
Croonian Lecture delivered before the Eoyal Society in
1858 on " The Theory of the Vertebrate Skull." In this
he completely and finally demolished, by applying as
before the inductive method, the idealistic, if in some
degree evolutionary, views of its origin which Owen had
derived from Goethe and Oken. This finally disposed
of the " archetype," and may be said once for all to have
liberated the English anatomical school from the deduc-
tive method.

In 1869 The Origin ofS'pories was]niblished. This was a
momentous event in the history of science, and not least
for Huxley. Hitherto he had turned a deaf ear to
evolution. " I took my stand," he says, " upon two
grounds : firstly, that . . . the evidence in favour of

transmutation was wholly insufficient ; and secondly, that no suggestion respecting the causes of the transmutation assumed, which had been made, was in any way adequate to explain the phenomena " (Life, i. 168). Huxley had studied Lamarck "attentively," but to no purpose. Lyell "was the chief agent in smoothing the road for Darwin. Eor consistent uniformitarianism postulates evolution as much in the organic as in the inorganic world " (J.c.) ; and Huxley found in Darwin what he had failed to find in Lamarck, an intelligible hypothesis good enough as a working basis. Yet with the transparent candour which was characteristic of him, he never to the end of his life concealed the fact that he thought it wanting in rigorous proof. Darwin, however, was a naturalist; Huxley was not. He says : — " I am afraid there is very little of the genuine naturalist in me. I never collected anything, and species-work was always a burden to me ; what I cared for was the architectural and engineering part of the business " (Essays, i. 7). But the solution of the problem of organic evolution must work upwards from

the initial stages, and it is precisely for the study of these that " species-work " is necessary. Darwin, by observing the peculiarities in the distribution of the plants which he had collected in the Galapagos, was started on the path that led to his theory. Anatomical research had only so far led to transcendental hypothesis, though in Huxley's hands it had cleared the decks of that lumber. He quotes with approval Darwin's remark that "no one has a right to examine the question of species who has not minutely described many " (Essays, ii. 283). The rigorous proof which Huxley demanded was the production of species sterile to one another by selective breeding (Life, i. 193). But this was a misconception of the question. Sterility is a physiological character, and the specific differences which the theory undertook to account for are morphological ; there is no necessary nexus between the two. Huxley, however, felt that he had at last a secure grip of evolution. He warned Darwin : — " I will stop at no point as long as clear reasoning will carry me farther" (Life, i. 172). Owen, who had some evolu-

tionary tendencies, was at first favourably disposed to Darwin's theory, and even claimed that he had to some extent anticipated it in his own writings. But Darwin, though he did not thrust it into the foreground, never flinched from recognizing that man could not be excluded from his theory. " Light will be thrown on the origin of man and his history" (Origin, ed. i., 488). Owen could not face the wrath of fashionable orthodoxy. In his Eede Lecture he endeavoured to save the position by asserting that man was clearly marked off from all other animals by the anatomical structure of his brain. This was actually inconsistent with known facts, and was effectually refuted by Huxley in various papers and lec-tures, summed up in 1863 in Man's Place in Nature. This " monkey damnification " of mankind was too much even for the " veracity " of Carlyle, who is said to have never for-given it. Huxley had not the smallest respect for authority I as a basis for belief, scientific or otherwise. He held that scientific men were morally bound "to try all things and hold fast to that which is good" (Life, ii. 161). Called*

upon in 18612, in the absence of the president, to deliver the presidential address to the Geological Society, he disposed once for all of one of the])rinciples accepted by geologists, that similar fossils in distinct regions indicated that the strata containing them were contemporary. All that could be concluded, he pointed out, was that the general order of succession was the same. In 1854 Huxley had refused the post of paleeontologist to the Geological Survey; but the fossils for which he then said that he " did not care " soon acquired importance in his eyes as supplying evidence for the support of the

evolutionary theory. The thirty-one years during which he occupied the chair of Natural History at the School of Mines were largely occupied with palaeontological research. Numerous memoirs on fossil fishes estab-lished many far-reaching morphological facts. The study of fossil reptiles led to his demonstrating, in the course of lectures deliyered at the College of

Surgeons in 1867, on birds, the fundamental affinity of the two groups which he united under the title of Sauropsida. An incidental result of the same course was his proposed rearrangement of the zoo-logical regions into which Sclater had divided the world in 1857. Huxley anticipated, to a large extent, the results at which botanists have since arrived: he proposed as primary divisions, Arctogsea — to include the land areas of the northern hemisphere — and Notogaea for the remainder. Successive waves of life originated in and spread from the northern area, the survivors of the more ancient types finding successively a refuge in the south. Though Huxley had accepted the Darwinian theory as a working hypothesis, he never succeeded in firmly grasping it in detail. He thought " evolution might con-ceivably have taken place without the development of groups possessing the characters of species " (Essays, v. 41). His palaeontological researches ultimately led him to dis-pense with Darwin. In 1892 he wrote : — " The doctrine of evolution is no speculation, but a generalization

of certain facts . . . classed by biologists under the heads of Embryology and of Palaeontology" {Essays, V. 42). Earlier in 1881 he had asserted even more emphatically that if the hypothesis of evolution " had not existed, the palaeontologist would have had to invent it " (Essays, iv. 44).

From 1870 onwards he was more and more drawn away from scientific research by the claims of public duty. Some men yield the more readily to such demands, as their fulfilnient is not unaccompanied by public esteem. But he felt, as he himself said of Priestley, " that he was a man and a citizen before he was a philosopher, and that the duties of the twof ormer positions are at least as imperative as those of the latter" (Essays, iii. 13). Prom 1862 to 1884 he served on no less than ten Eoyal Commissions, dealing in every case with subjects of great importance, and in many with matters of the gravest moment to the community. He held and filled with invariable dignity and distinction more public positions than have perhaps ever fallen to the lot of a scientific man in England. Prom

1871 to 1880 he was a secretary of the Eoyal Society. Prom 1883 to 1886 he was president. For honours he cared little, though they were within his reach ; it is said that he might have received a peerage. He accepted, how-ever, in 1892, a Privy Councillorship, at once the most democratic and the most aristocratic honour accessible to an English citizen. In 1870 Huxley was president of the British Association at Liverpool, and in the same year was elected a member of the newly constituted London School Board. He resigned the latter posi-tion in 1872, but in the brief period during which he acted, probably more than any man, he left his mark on the foundations of national elementary edu-cation. He made war on the scholastic methods which wearied the mind in merely taxing the memory; the children were to be prepared to take their place worthily in the community. Physical training was the basis ; do-mestic economy, at any rate for girls, was insisted upon, and for all some development of the aesthetic sense by means of drawing and singing. Heading, writing, and

arithmetic were the indispensable tools for acquiring knowledge, and intellectual discipline was to be gained through the rudiments of physical science. He insisted on the teaching of the Bible partly as a great literary heritage, partly because he was " seriously perplexed to know by what practical measures the religious feeling, which is the essential basis of conduct, was to be kept up, in the present utterly chaotic state of opinion in these matters, without its use" (Essays, iii. 397). In 1872 the School of Mines was moved to South Kensington, and Huxley had, for the first time after eighteen years, those appliances for teaching beyond the lecture room, which to the lasting injury of the interests of the biological science of Great Britain had been withheld from him by the short-sightedness of Government. Huxley had only been able to bring his influence to bear upon his pupils by oral teaching, and had had no opportunity by personal intercourse in the laboratory of forming a school. He was now able to organize a system of instruction for classes of elementary teachers in the gen-

eral principles of biology, which indirectly affected the teaching of the subject throughout the country.

The first symptoms of physical failure to meet the strain of the scientific and public duties demanded of him made some rest imperative, and he took a long holiday in Egypt. He still continued for some years to occupy himself mainly with vertebrate morphology. But he seemed to find more interest and the necessary mental stimulus to exertion in lectures, public addresses, and more or less controversial writings. His health, which had for a time been fairly restored, completely broke down again in 1885.

In 1890 he removed from London to Eastbourne, where after a painful illness he died on 29th June 1895.

The latter years of Huxley's life were mainly occupied with contributions to periodical literature on subjects connected with philosophy and theology. The effect produced by these on popular opinion was profound. This was partly due to his position as a man of science, partly to his obvious earnestness and sincerity, but in the main to his strenuous and attractive method of exposition.

Such studies were not wholly new to him, as they had more or less

engaged his thoughts from his earliest days. That his views exhibit some process of development and are not wholly consistent was, therefore, to be expected, and for this reason it is not easy to summarize them as a connected body of teaching. They may be found perhaps in their most systematic form in the volume on Hume published in 1879.

Huxley's general attitude to the problems of theology and philosophy was technically that of scepticism. " I am," he wrote, " too much of a sceptic to deny the possibility of anything " (Life, ii. 127). "Doubt is a beneficent demon" (Essays, ix. 66) . He was anxious, nevertheless, to avoid the accusation of Pyrrhonism (Life, ii. 280), but the 'Agnosticism which he defined to express his position in 1869 suggests the Pyrrhonist Aphasia. The only approach to certainty which he admitted lay in the order of nature. " The conception of the constancy of the order of nature has become the dominant idea of modem thought. . . . Whatever may be man's speculative doctrines, it is quite certain that eveiy intelligent person guides his life and risks his fortune upon the belief that the order of nature is constant, and that the chain of natural causation is never broken." He adds, however, that "it

by no means necessarily follows that we are justified in expanding this generalization into the infinite past" (Essays, iv. 47, 48). This was little more than a pious reservation, as evolution implies the principle of continuity (I.e. p. 55). Later he stated his belief even more absolutely : "If there is anything in the world which I do firmly believe in, it is the universal validity of the law of causation, but that universality cannot be proved by any amount of experience" (Essays, ix. 121). The assertion that "There is only one method by which intellectual truth can be reached, whether the subject-matter of investigation belongs to the world of physics or to the world of consciousness" (Essays, ix. 126) laid him open to the charge of materialism, which he vigorously repelled. His defence, when he rested it on the imperfection of the physical analysis of matter and force (I.e., p. 1.31), was irrelevant ; he was on sounder ground when he contended with Berkeley "that our certain knowledge does not extend beyond ourstates of consciousness " (I.e. p. 130). " Legitimate materialism, that is, the extension of the conceptions and of the methods of physical science to the highest as well as to the lowest phenomena of vitality, is neither more nor less than a sort of shorthand

idealism" (Essays, i. 194). While "the substance of matter is a metaphysical unknown quality of the existence of which there is no proof . . . the non-existence of a substance of

mind is equally arguable ; . . . the result ... is the reduction of the All to co-existences and sequences of phenomena beneath and beyond which there is nothing cognoscible" (Essays, ix. 66). Hume had defined a miracle as a "violation of the laws of nature." Huxley refused to accept this. While, on the one hand, he insists that " the whole fabric of practical life is built upon our faith in its continuity" (Hume, p. 129), on the other "nobody can presume to say what the order of nature must be" ; this " knocks the bottom out of all a priori objections either to ordinary ' miracles ' or to the efBoacy of prayer " (Essays, v. 133). "If by the term miracles we mean only extremely wonderful events, there can be no just ground for denying the possibility of their occurrence " (Hume, p. 134). Assuming the chemical elements to be aggregates of uniform primitive matter, he saw no more tlieoretical difficulty in water being turned into alcohol in the

miracle at Cana, than in sugar undergoing a similar conversion (Essays, v. 81). The credibility of miracles with Huxley is a question of evidence. It may be remarked that a scientific explanation is destructive of the supernatural character of a miracle, and that the demand for evidence may be so framed as to preclude the credibility of any historical event. Throughout his life theology had a strong attraction, not without elements of repulsion, for Huxley. The circumstances of his early training, when Paley was the " most interesting Sunday reading allowed him when a boy" (Life, ii. 57), probably had something to do with both. In 18(i0 his beliefs were apparently theistic : " Science seems to me to teach In the highest and strongest manner the great truth which is embodied in the Christian conception of entire surrender to the will of God " (Life, i. 219). In 1885 he formulates " the perfect ideal of religion "^in a passage which has become almost famous: "In the 8th century B.C., in the heart of a world of idolatrous polytheists, the Hebrew prophets put forth a conception of religion which appears to be as wonderful an inspiration of genius as the art of Plieidias or the science of Aristotle. ' And what doth the Lord require of thee, but

to do justly, and to love mercy, and to walk humbly with thy God'" (Essays, iv. 161). Two years later he was writing: "That there is no evidence of the existence of such a being as the God of the theologians is true enough" (Life, ii. 162). He insisted, however, that "atheism is on purely philosophical grounds untenable " (I.e.). His theism never really advanced beyond the recognition of ' ' the passionless impersonality of the unknown and unknowable, which science shows everywhere underlying the thin veil of phenomena" (Life, i. 239). In other respects his personal creed was a kind of scientific Calvinism. There is an interesting passage in an essay written in 1892, "An Apologetic Eirenicon," which has not been republished, which illustrates this : " It is the secret of the superiority of the best theological teachers to the majority of their opponents that they substantially recognize these realities of things, however strange the forms in which they clothe their conceptions. The doctrines of predestination, of original sin, of the innate depravity of man and the evil fate of the greater part of the race, of the primacy of Satan in this world, of the essential vileness of matter, of a malevolent Demiurgus subordinate to a benevolent Almighty, who has only lately revealed*

himself, faulty as they are, appear to me to be vastly nearer the truth than the 'liberal' popular illusions that babies are all born good, and that the example of a corrupt society is responsible for their failure to remain so; that it is given to everybody to reach the ethical ideal if he will only try ; that all partial evil is universal good, and other optimistic figments, such as that which represents ' Providence ' under the guise of a paternal philanthropist, and bids us believe that everything will come right (according to our notions) at last." But his "slender definite creed," R. H. Hutton, who was associated with him in the Metaphysical Society, thought — and no doubt rightly — in no respect "represented the cravings of his larger nature."

From 1880 onwards till the very end of his life, Huxley was continuously occupied in a controversial campaign against orthodox beliefs. As Professor Weldon justly says of his earlier polemics : — "They were certainly among the principal agents in winning a larger measure of toleration for the critical examination of fundamental beliefs, and for the free expression of honest reverent doubt." He threw Christianity overboard bodily and with little apprecia^ tion of its histoi'ic effect as a civilizing agency. He thought that

“the exact nature of the teachings and the convictions of Jesus is extremely uncertain ” (Essays, v. 348). ” What we are usually pleased to call religion nowadays is, for the most part, Hellenized Judaism” (Essays, iv. 162). His final analysis of wliat, “since the second century, has assumed to itself the title of Orthodox Christianity” is a “varying compound of some of the best and some of the worst elements of Paganism and Judaism, moulded in practice by the innate character of certain people of the Western world ” (Essays, v. 142). He concludes “That this Christianity is doomed to fall, is, to my mind, beyond a doubt ; but its fall will neither be sudden nor speedy ” (I.e.). He did not omit, however, to do justice to ” the bright side of Christianity,” and was deeply impressed with the life of Catherine of Siena. Failing Christianity, he thought that some other ” hypostasis of men’s- hopes ” wDl arise (Essays, v. 254). His latest speculations on ethical problems are perhaps the least satisfactory of his writings. In 1892 he wrote:— “The moral sense is a very complex affair— dependent in part upon associations of pleasure and pain, approbation and disapprobation, formed by education in early youth, but in part also on an innate sense of moral beauty and ugliness (how originated need not be

discussed), which is possessed by some people in great strength, while some are totally devoid of it " (Life, ii. 305). This is an intuitional theory, and he compares the moral with the sesthetio sense, which he repeatedly declares to be intuitive; thus:— "All the understanding in the world will neither increase nor diminish the force of the intuition that this is beautiful and this is ugly " (Essays, ix. 80). In the Romanes Lecture delivered in 1894, in which this passage occurs, he defines "law and morals" to be " restraints upon the struggle for existence between men in society." It follows that "the ethical process is in opposition to the cosmic process," to which the struggle for existence belongs (Essays, ix. 31). Apparently he thought that the moral sense in its origin was intuitional and in its development utilitarian. " Morality commenced with society " (Essays, v. 52). The " ethical process " is the "gradual strengthening of the social bond" (Essays, ix. 35). "The cosmic process has no sort of relation to moral ends" (I.e. 83) ; " of moral purpose I see no trace in nature. That is an article of exclusive human manufacture" (Life, ii. 268). The cosmic process Huxley identified with evil, and the ethical process with good ; the two are in necessary conflict. " The reality at the

bottom of the doctrine of original sin " is the "innate tendency to self-assertion " inherited by man from the cosmic order (Essays, ix. 27). "The actions we call sinful are part and parcel of the struggle for existence " (Life, ii. 282). " The prospect of attaining untroubled happiness" is "an illusion" (Essays, ix. 44), and the cosmic process in the long run will get the best of the contest, and " resume its sway " when evolution enters on its downward course (I.e. p. 45). This approaches pure pessimism, and though in Huxley's view the "pessimism of Schopenhauer is a nightmare" (Essays, ix. 200), his own philosophy of life is not distinguishable, and is often expressed in the same language. The cosmic order is obviously non-moral (Essays, ix. 197). That it is, as has been said, immoral is really meaningless. Pain and suffering are affections which imply a complex nervous organization, and we are not justified in projecting them into nature external to ourselves. Darwin and Wallace disagreed with Huxley in seeing rather the joyous than the suffering side of nature. Nor can it be assumed that the descending scale of evolution will reproduce the ascent, or that man will ever be conscious of his doom.

As has been said, Huxley never thoroughly grasped the

Darwinian principle. He thought ‘ ‘ transmutation may take place without transition ” (Life, i. 173). In other words, that evolution may be accomplished by leaps and not by the accumulation of small variations. IJe recognized that the ‘ ‘ struggle for existence ” had not the gradual adjustment of the organism to its environment which is implied in “natural selection.” In highly civilized societies he thought that the former was at an end (Essays, ix. 36) and had been replaced by the ” struggle for enjoyment ” (I.e. p. 40). But a consideration of the stationary population of Prance might have shown him that the effect in the one case may be as restrictive as in the other. So far from natural selection being in abeyance under modern social conditions, “it is,” as Professor Karl Pearson points out, ” something we run up against at once, almost as soon as we examine a mortality table” (Biometrilca, i. 76). The inevitable conclusion, whether we like it or not, is that the future evolution of humanity is as much a part of the cosmic process as its past history, and Huxley’s attempt to shut the door on it cannot be maintained scientifically.

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Huy, a town of Belgium, in the province and 21 miles south-west of the town of Li^ge by rail. It is in the chief vine-growing district of the country, and the town does an important trade in wine and corn. Popular tion (1900), 14,644.

Hwang Ho, or Hoang Ho, the second largest river in China. It is known to foreigners as the Yellow river — a nam e which is a literal translation of the Chinese. It rises on the eastern slopes of the Kuen-lun mountains in Central

Asia, its head- waters beingin close proximity to those of the Yangtse. It has a total length of about 2400 miles, and drains an area of approximately 400,000 square miles. The main stream has its source in two lakes named

Charing -nor and Oring-nor, in 34° 60' N. lat. and 98° E. long., and after flowing a south-easterly course it bends sharply to the north-west and north, entering China in the province of Kansu in lat. 36°. After passing Lanchau-fu, the capital of this province, the river takes an immense sweep to the north and north-east, until it encounters the rugged barrier ranges that here run north and south through the provinces of Shansi and Chihli. By these ranges it is bent back on its course and forced due south for 600 miles, forming the boundary between the provinces of Shansi and Shensi, until it finds an outlet eastwards at Tung Kwan — a pass which for centuries has been renowned as the gate of Asia, being indeed the sole commercial passage between central China and the West. -At Tung Kwan the river is joined by its only considerable affluent in China proper, the Wei, which drains the whole of the large province of Shensi, and the combined volume of water continues its way nearly due east across the great plain to the sea. The quantity of water discharged varies very greatly at different times of

the year. At low water in the winter season the dis-
charge is only about 36,000 cubic feet per second, whereas
during the summer flood it reaches 116,000 feet or more.
The amount of sediment carried down is very large, though
no accurate observations have been made. In the account
of Lord Macartney's embassy, which crossed the Yellow
river in 1792, it was calculated to be 17,520 million cubic
feet a year, but this is considered to be very much over
the mark. Two reasons, however, combine to render it
probable that the sedimentary matter is very large in pro-
portion to the volume of water : the first being the great
fall, and the consequently rapid current over two-thirds of
the river's course ; the second that the drainage area is
nearly all covered with deposits of loess, which, being very
friable, readily gives way before the rainfall and is washed
down in large quantity. The ubiquity of this loess or
yellow earth, as the Chinese call it, has in fact given its
name both to the river which carries it in solution and to
the sea (the Yellow Sea) into which it is discharged. It
is calculated by Dr Guppy {Journal of Cliina Branch

of Boyal Asiatic Society, vol. xvi.) that the sediment brought down by the three northern rivers of China, viz., the Yangtse, the Yellow river, and the Peiho, is 24,000 million cubic feet per annum, and is sufBcient to fill up the whole of the Yellow Sea and the Gulf of Pechili in the space of about 36,000 years.

Unlike the Yangtse, the Yellow river is of no practical value for navigation. The silt and sand form hanks and hars at the mouth, the water is too shallow in winter and the current is too strong in summer, and, further, the bed of the river itself is continually shifting. It is this last feature which has given the Yellow river the notoriety it has unhappily obtained, and earned for it the name " China's sorrow." As the silt-laden waters debouch from the rocky bed of the upper reaches on to the plains, the current slackens, and the coarser detritus settles on the bottom. By degrees the bed rises, and the people build embankments to prevent the river from overflowing. As the bed rises the embankments must be raised too, until the stream is flowing many feet above the level of the surrounding country. As time goes on the situation becomes more and more dangerous ; finally, a breach

occurs, and the whole river pours over the country, carrying destruction and ruin in Its wake. If the breach cannot be repaired the river leaves its old channel entirely, and finds a new exit to the sea along the line of least resistance. Such in brief has been the story of the Yellow river since the dawn of Chinese history. At various times it has discharged its waters alternately on one side or the other of the great mass pf mountains forming the promontory of Shantung, and by mouths as far apart from each other as 500 miles. At each change it has worked havoc and disaster by covering the cultivated fields with two or three feet of sand and mud. Ruthless as it may seem, the river is only completing the geological task which nature has set it to do, viz., building up the great plain by adding a few feet here and there whenever it gets a chance. But the swarming inhabitants, driven from their homes for the time being, set to work to repair the disaster, and confine the giant river in its new course by new embankments. The waters dry up, the fields are again cultivated, until in the next cycle the like causes produce the like results.

The most recent great change in the river's course occurred in 1851, when a breach was made in the north embankment near

!Kaifungfu in Honan. At this point the river bed was some 25 feet above the plain ; the water consequently forsook the old channel entirely and poured over the level country, finally seizing on the bed of a small river called the Tsing, and thereby finding an exit to the sea. Since that time the new channel thus carved out has remained the proper course of the river, the old or southerly channel beiilg left quite dry. It required some fifteen or more years to repair damages from this outbreak, and to confine the stream by new embankments. After that there was for a time comparative immunity from inundations, but in 1882 fresh out-bursts again began. The most serious of all took place in 1887, when it appeared probable that there would be again a permanent change in the river's course. By dint of great exertions, however, the Government succeeded in closing the breach, though not till January 1889, and not until there had been immense destruction of life and property. The outbreak on this occasion occurred, as all the more serious outbreaks have done, in Honan, a few miles west of the city of Kaifungfu. The stream poured itself over the level and fertile country to the southwards, sweeping whole villages before it, and converting the plain into one vast lake. The area affected

was not less than 50,000 square miles, and the loss of life was computed at over one million. Since 1887 there have been a series of smaller outbreaks mostly at points lower down and in the neighbourhood of Tsinanfu, the capital of Shantung. These perpetually occurring disasters entail a heavy expense on the Government ; and from the mere pecuniary point of view it would well repay them to call in the best foreign engineering skill available, an expedient, however, which has not yet recommended itself to the Chinese authorities. (q. j.)

Hybridism. — ^Professor Eomanes represented contemporary opinion well by making his article on Htbeidism, in the ninth edition of this Encyclopaedia, an annotated summary of Darwin's, views. Darwin had shown that there was no foundation in nature for the supposed fixed law that hybrids were infertile. Some mongrels are infertile or sterile ; some crosses are quite fertile ; there are many curious phenomena connected with the susceptibility of the reproductive functions which make it probable that the common intersterility of species is ati accidental result ; as domestic animals

must often have been chosen on account of a relative stability of their reproductive capacities, it is not surprising that domestic varieties should be fertile so frequently; there is no reason to suppose that natural hybridism has played any considerable part in the evolution of new species. Eomanes afterwards developed his theory of physiological selection, in which he supposed that the appearance of differential fertility within a species was the starting-point of new species ; certain individuals by becoming fertile only inter se proceeded along lines of modification diverging from the lines followed by the other niembers of the species, and thus mutual infertility was the starting-point, not the result, of specific modification. Eomanes, however, did not associate his interesting theory with a suflScient number of facts, and it has left little mark in the development of the subject. A. E. Wallace, on the other hand, has argued that sterility between incipient species may have been increased by natural selection in the same fashion as other favourable variations are supposed to have been accumulated. He

supposed that some " slight degree of infertility was a not infrequent accompaniment of the external differences which always arise in a state of nature between varieties and incipient species."

There are many new records as to the production of hybrids. Horticulturists have been extremely active and successful in their attempts to produce new flowers

or new varieties of vegetables by seminal or graft-hybrids, and any florist's catalogue or the account of any special plant, such as is to be found in Foster-Melliar's Book of the Rose, is in great part a history of successful hybridization. Much special experimental work has been done by botanists, notably by de Vries, to the result of whose experiments we shall recur. Experiments show clearly that the obtaining of hybrids is in many cases merely a matter of taking sufficient trouble, and the successful crossing of genera is not infrequent.

Focke, for instance, cites cases where hybrids were obtained be-

tween Brassica and Saphanus, Galium and Asperula, Campanula and Phyteuma,Verbascum and Celsia. Among animals, new records and new experiments are almost equally numerous. Boveri has crossed Echinus microtuberculatus with Sphcerechinus granulans. Morgan even obtained hybrids between Asterias, a Starfish, and Arbacia, a Sea-urchin, a cross as remote as would be that between a fish and a mammal. Vernon got many hybrids by fertilizing the eggs of Strongylocentrotus lividus with the sperm of Sphcerech-inus granularis. Standf uss has carried on an enormous series of experiments with Lepidopterous insects, and has obtained a very large series of hybrids, of which he has kept careful record. Lepidoterists generally begin to suspect that many curious forms offered by dealers as new species are products got by crossing known species. Apellb has succeeded with Teleostean fish ; Gebhardt and others with Amphibia. Elliot and Suchetet have studied carefully the question of hybridization occurring normally among birds, and have got together a very large body of evidence. Among the cases cited by Elliot the most striking are that of the hybrid between Golaptes cafer and 0. auratus, which occurs over a very wide area of North America and is known as O. hybridus, and the hybrid

between Euplocamus Uneatus and E. horsfieldi, which appears to be common in Assam. Among Mammals the most noteworthy results have been obtained by Professor Cossar Ewart, who has bred nine zebra hybrids by crossing mares of various sizes with a zebra stallion, and who has studied in addition three hybrids out of zebra mares, one sired by a donkey, the others by ponies.

The causes militating against the production of hybrids have also received considerable attention. Delage, discussing the question, states that there is a general proportion between sexual attraction and zoological affinity, and in many cases hybrids are not naturally produced simply from absence of the stimulus to sexual mating, or because of preferential mating within the species or variety.

In addition to differences of habit, temperament, time of maturity, and so forth, gross structural differences may make mating impossible. Thus Escherick contends that among insects the peculiar structure of the genital appendages makes cross-impregnation impossible, and there is reason to believe that the specific peculiarities of the modified sexual palps in male spiders have a similar result.

The difficulties, however, may not exist, or may be overcome by experiment, and frequently it is only careful management that is required to produce crossing. Thus it has been found that when the pollen of one species does not succeed in fertilizing the ovules of another species, yet the reciprocal cross may be successful; that is to say, the pollen of the second species may fertilize the ovules of the first. Vernon, working with Sea-urchins, found that the obtaining of hybrids depended on the relative maturity of the sexual products. The difficulties in crossing apparently may extend to the chemiotaxio processes of the actual sexual cells. Thus when the spermatozoa of an Urchin were placed in a drop of sea-water containing ripe eggs of an Urchin and of a Starfish, the former eggs became surrounded by clusters of the male cells, while the latter appeared to exert little attraction for the alien germ-cells. Finally, when the actual impregnation of the egg is possible naturally, or has been secured by artificial means, the development of the hybrid may stop at an early stage. Thus hybrids between the Urchin and the Starfish, animals belonging to different classes, reached only the stage of the pluteus larva. Apello, experimenting with Teleostean fish, found that very often impregnation and

segmentation occurred, but that the development broke down immediately afterwards. Gebhardt, crossing Bana esculenta with B. arvalis, found that the cleavage of the ovum was normal, but that abnormality began with the gastrula, and that development soon stopped. In a very general fashion there appears to be a parallel between the zoological affinity and the extent to which the incomplete development of the hybrid proceeds.

As to the sterility of hybrids inter se, or with either of the parent forms, information is still wanted. Delage, summing up the evidence in a general way, states that mongrels are more fertile and stronger than their parents, while hybrids are at least equally hardy but less fertile. While many of the hybrid products of horticulturists are certainly infertile, others appear to be indefinitely fertile.

Fooke, it is true, states that the hybrids between Primula auricula and P. hirsuta are fertile for many generations, but not indefinitely so ; but, while this may be true for the particular case, there seems no reason to doubt that many plant hybrids are quite fertile. In the case of animals the evidence is rather against

fertility. Standfuss, who has made experiments lasting over many years, and who has dealt with many genera of Lepidoptera, obtained no fertile hybrid females, although he found that hybrid males paired readily and successfully with pure-bred females of the parent races. Elliot, dealing with,birds, concluded that no hybrids were fertile with one another beyond the second generation, but thought that they were fertile with members of the parent races. Wallace, on the other hand, cites from Quatrefages the case of hybrids between the moths Bombyx cynthia and B. arrindia, which were stated to be fertile inter se for eight generations. He also states that hybrids between the sheep and goat have a limited fertility inter se. Cornevin and Lesbre state that in 1873 an Arab mule was fertilized in Africa by a stallion, and gave birth to female offspring which she suckled. All three were brought to the Jardin d'Acclimatation in Paris, and there the mule had a second female colt to the same father, and subsequently two male colts in succession to an ass and to a stallion. The female progeny were fertilized, but their offspring were feeble and died at birth. Cossar Ewart gives an account of a recent Indian case in which a female mule gave birth to a male colt. He points out, however, that many

mistakes have been made about the breeding of hybrids, and is not altogether inclined to accept this supposed case. Very little has been published with regard to the most important question, as to the actual condition of the sexual organs and cells in hybrids. There does not appear to be gross anatomical defect to accou:it for the infertility of hybrids, but microscopical examination in a large number of cases is wanted. Cossar Ewart, to wliom indeed much of the most interesting recent work on hybrids is due, states that in male zebra-hybrids the sexual cells were immature, the tails of the spermatozoa being much shorter than those of the similar cells in stallions and zebras. He adds, however, that the male hybrids he examined were young, and might not have been sexually mature. He examined microscopically the ovary of a female zebra-hybrid and found one large and several small Graafian follicles, in all respects similar to those in a normal mare or female zebra. A careful study of the sexual organs in animal and plant hybrids is very much to be desired, but it may be said that so far as our present knowledge goes there is not to be expected any obvious microscopical cause of the relative infertility of hybrids.

The relative variability of hybrids has received con-

siderable attention from many writers. Horticulturists, as Bateson has written, are "aware of the great and striking variations which occur in so many orders of plants when hybridization is effected." The phrase has been used " breaking the constitution of a plant " to indicate the effect produced in the offspring of a hybrid union, and the device is frequently used by those who are seeking for novelties to introduce on the market, it may be said generally that hybrids are variable, and that the products of hybrids are still more variable. Delage states that in reciprocal crosses there is always a marked tendency for the offspring to resemble the male parents ; he quotes from Huxley that the mule, whose male parent is an ass, is more like the ass, and that the hinny, whose male parent is a horse, is more like the horse. Standfuss found among Lepidoptera that males were produced much more often than females, and that these males paired readily. The freshly -hatched larvae closely resembled the larvee of the female parent, but in the course of growth the resemblance to the male increased, the extent of the

final approximation to the male depending on the relative phylogenetic age of the two parents, the parent of the older species being prepotent. In reciprocal pairing, he found that the male was able to transmit the characters of the parent in a higher degree. Cossar Ewart, in

relation to zebra hybrids, has discussed the matter of resemblance to parents in very great detail, and fuller information must be sought in his writings. He shows that the wild parent is not necessarily prepotent, although many writers have urged that view. He described three hybrids bred out of a zebra mare by different horses, and found in all cases that the resemblance to the male or horse parent was more profound. Similarly, zebra-donkey hybrids out of zebra mares bred in France and in Australia were in characters and disposition far more like the donkey parents. The results which he obtained in the hybrids which he Ijred from a zebra stallion and different mothers were more variable, but there was

rather a balance in favour of zebra disposition and against zebra shape and marking.

"Of the nine zebra-horse hybrids I have bred," he says, "only two in their make and disposition take decidedly after the wild parent. As explained fully below, all the hybrids differ profoundly In the plan of their markings from the zebra, while in their ground colour they take after their respective dams or the ancestors of their dams far more than after the zebra — the hybrid out of the yellow and white Iceland pony, e.g., instead of being light in colour, as I anticipated, is for the most part of a dark dun colour, with but in-distinct stripes. The hoofs, mane, and tail of the hybrids are at the most intermediate, but this is perhaps partly owing to reversion towards the ancestors of these respective dams. In their disposition and habits they all undoubtedly agree more with the wild sire."

Ewart's experiments and his discussion of them also throw important light on the general relation of hybrids to their parents. He found that the coloration and pattern of his zebra hybrids resembled far more those of the Somali or Gravy's zebra than those of their sire — a Burchell's zebra. In a general discussion of the stripings

of horses, asses, and zebras, he came to the conclusion that the Somali zebra represented the older type, and that therefore his zebra hybrids furnished important evidence of the effect of crossing in producing reversion to ancestral type. The same subject has of course been discussed at length by Darwin, in relation to the cross-breeding of varieties of pigeons.

Other writers, in particular Weismann, Bateson, and de Vries, have discussed the phenomena of hybridism for their bearing on the general questions of inheritance, and of the nature of characters and of variations. Gaertner and Naegeli had declared that the farther apart the parents, the more definite and intermediate the hybrids; the nearer the parents, the more variable the hybrids. Weismann concludes, from examination of a series of plant hybrids, that, from the same cross, hybrids of different character may be obtained, but that the charac-ters are determined at the moment of fertilization; for he found that all the flowers on the same hybrid-plant resembled one another in the minutest details of colour

and pattern. Bateson approaches the subject chiefly as a means of studying the nature of variations, and has found a series of important pieces of evidence that variations of large magnitude (discontinuous variation) are produced by hybridization. He cites in this connexion the cases of narcissus, begonia, pelargonium, gladiolus, streptocarpus, a great number of orchids, rhododendron, cineraria, and others. Miss Saunders, working in association with him, has found three important cases of discontinuity in hybrid offspring. Bateson urges forcibly the necessity of detailed observation and experiment in this direction, and particularly insists on the necessity of rearing and noting the characters of all the seedlings obtained from hybridization. Horticulturists for the most part have been content to pick out the most striking forms and to keep no record of the others. De Vries has obtained results of very great interest, and has formulated from them what he calls the " Law of disjunction of hybrids." He supposes speciiic characters to be distinct units (or composed of distinct units), and finds the best mode of studying them

in cases where species are distinguished by a single character. Hybrids are described vaguely as mingling the characters of father and mother. What really happens, he thinks, is that they have in a simple form some of the characters of each. When father and mother are distinguished by one character, this cannot happen ; such a,monohybrid never shows the character of one parent (absent in the other) in a reduced form ; it possesses it, or it does not possess it. He found on sowing seeds of monohybrids that always about 25 per cent, of the seedlings showed one character (the latent, or recessive character), while 75 showed the other (dominant character). On sowing the seeds of these latter, self-fertilized and kept separate in plots, 25 of them gave the dominant character pure, the others were mixed in the proportion of 37-5 with the dominant to 12-5 with the recessive character. Thus he crossed poppies with a black spot on base of petals (B) with poppies with a white spot (W). On sowing the seeds of these hybrids 75 per cent, were B (dominant) and 25 were W (latent). On sowing the seeds of the 75 B's, 25 gave pure B's, while

the others gave mixed results in the proportion of .37-5 B to 12-6 W. The second sowing was needed to distinguish among the 75 B's the 25 which, like the 25 Ws, were not hybrids, but had inherited similarly from father and mother. He thinks that all hybrids when studied with reference to single characters will give similar results.

The interesting experiments and conclusions of de Vries appear to be strictly derivative from older work published by Gregor Mendel in 1865. The law of the disjunction of unit characters in hybrids, including the distinction between dominant and recessive, and the numerical distribution of these, must be called Mendel's Law. Much experimental work is required to elaborate it, but it appears to be a fundamental principle of biology, and it is a curious circumstance that such a principle, as striking as the law of combining proportions m chemistry, should have remained unnoticed for so many years after it had been clearly formulated and supported by abundant experimental evidence.

Authorities. — Apello. "TJeber einige Eesultate der Kreuz-

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Hyde, a municipal borough (1881), railway station, and market-town, in the Hyde parliamentary division of Cheshire, England, 4 miles north-east of Stockport. Eecent erections include the town-hall (1885), the public baths (1887), new technical school and free library (1899), and new post office (1900). Area, 3072 acres. Population (1881), 28,630; (1901), 32,768.

Hyde Park, a town of ISTorfolk county, Massa-chusetts, U.S.A. It lies immediately south-west of Boston, of which it is a residential suburb, on the New England and the New York, New Haven and Hartford

railways. Population (1880), 7088; (1890), 10,193; (1900), 13,244, of whom 3805 were foreign-born and 116 were negroes.

Hydraulic Power.

{Hydraulic).

See PowBE. Transmission

Hydrophobia. — Two new points of interest have arisen in connexion with this rare disease. One is the Pasteur treatment by inoculation with rabic virus, and the other was the attempt of the Government to exterminate rabies in the British Isles by muzzling dogs. The Pasteur treatment was first applied to human beings in 1885 after prolonged investigation and experimental trial on animals. It is based on the fact that a virus, capable of giving rabies by inoculation, can be extracted from the tissues of a rabid animal and then intensified or attenuated at pleasure. It appears that the strength of the rabic virus, as determined by inoculation, is constant in the same species of animal, but is modified by passing through another species. For instance, the

natural virus of dogs is always of the same strength, but when inoculated into monkeys it becomes weakened, and the process of attenuation can be carried on by passing the virus through a succession of monkeys, until it loses the power of causing death. If this weakened virus is then passed back through guinearpigs, dogs, or rabbits, it regains its former strength. Again, if it be passed through a succession of dogs it becomes intensified up to a maximum of strength, which is called the virus fixe. Pasteur further discovered that the strength can be modified by temperature and by keeping the dried tissues of a rabid animal containing the virus. Thus, if the spinal cord of a rabid dog be preserved in a dry state, the virus loses strength day by day. The system of treatment consists in making an emulsion of the cord and graduating the strength of the dose by using a succession of cords, which have been kept for a progressively diminishing length of time. Those which have been kept for fourteen days are used as a starting-point, yielding virus of a minimum strength. They are followed by preparations of

diminishing age and increasing strength, day by day, up to the maximum, which is three days old. These are successively injected into the circulatory system. The principle is the artificial acquisition by the patient of resistance to the rabic virus, which is presumed to be already in the s^'^stem, but has not yet become active, by accustoming him gradually to its toxic effect, beginning with a weak form and progressively increasing the dose. It is not exactly treatment of the disease, because it is useless or nearly so when the disease has commenced, nor is it exactly preventive, for the patient has already been bitten. It must be regarded as a kind of anticipatory cure. The cords are cut into sections and preserved dry in sterilized flasks plugged with cotton-wool. Another method of preparing the inoculatory virus, which has been devised by Tizzani and Centanni, consists in subjecting the virus fixe to peptic digestion by diluted gastric juice for varying periods of time.

The first patient was treated by Pasteur's system in July 1885. He was successively inoculated with emul-

sions made from cords that had been kept fourteen and ten days, then eleven and eight days, then eight, seven, six days, and so on. Two forms of treatment are now used — (1) the " simple," in which the course from weak to strong virus is extended over nine days ; (2) the " intensive," in which the maximum is reached in seven days. The latter is used in cases of very bad bites and those of some standing, in which it is desirable to lose no time. Two days are compressed into one at the commencement by making injections morning and evening instead of once a day, so that the fifth-day cord is reached in four days instead of six, as in the " simple " treatment. When the maximum— the third-day cord — is reached the injections are continued with fifth-, fourth-, and third-day cords. The whole course is fifteen days in the simple treatment and twenty-one in the intensive. The doses injected range from 1 to 3 cubic centimetres. Injections are made alternately into the right and left flanks. The number treated in each year since 1885, with the mortality, is given in the following table : —

Year.

Futient3

Treated.

Deaths.

Mortality

per cent.

1886

2671

25

■*94*

1887

1770

14

•*79*

1888

1622

9

•*55*

1889

18-30

7

■*38*

1890

1540

5

■*32*

1891

1559

4

■*25*

1892

1790

4

■*22*

1893

1648

6

•*36*

1894

1387

7

■*50*

1895

1520

5

■*33*

1896

1308

4

■*30*

1897

1521

6

■*39*

1898

1465

3

•*20*

1899

1614

■25

These figures do not include cases which develop hydrophobia during treatment or within fifteen days after treatment is completed, for it is held that persons who die within that period have their nervous centres invaded by virus before the cure has time to act. The true mortality should therefore be considerably higher. For instance, in 1898 three deaths came within this category, which just doubles the mortality ; and in 1899 the additional deaths were six, bringing the mortality up to two and a half times that indicated in the table. When, however, the additional deaths are included the results remain sufficiently striking, if two assumptions are granted — (1) that all the persons treated have been bitten by rabid animals ; (2) that a large proportion of persons so bitten usually have hydrophobia. Unfortunately, both these assumptions lack proof, and therefore the evidence of the efficacy of the treatment cannot be said to satisfy a strictly scientific standard. With regard to the first

point, the patients are divided into three categories — (1) those bitten by an animal the rabidity of which is proved, by the development of rabies in other animals bitten by it or inoculated from its spinal cord; (2) those bitten by an animal pronounced rabid on a veterinary examination ; (3) those bitten by an animal suspected of being rabid. The number of patients in each category in 1898 was (1) 141, (2) 855, (3) 469 ; and in 1899 it was (1) 152, (2) 1099, (3) 3C3. As might be expected, the vast majority come under the second and third heads, in which the evidence of rabidity is doubtful or altogether lacking. With regard to the second point, the proportion of per-sons bitten by rabid animals who ordinarily develop hydrophobia has only been "estimated" from very inadequate data; but if the number of rabid dogs be compared with the deaths from hydrophobia in any year or series of years, it can hardly be very high. For instance, in 189,-), 668 dogs, besides other animals, were killed and certified to be rabid in England, and the deaths from hydrophobia were twenty. Of course

this proves nothing, as the number of persons bitten is not known, but the difference between the amount of rabies and of hydrophobia is suggestively great in view of

the marked propensity of rabid dogs to bite, nor is it accounted for by the fact that some of the persons bitten were treated at the Institut Pasteur. A comparison of the annual mortality from hydrophobia in Prance before and after the introduction of the treatment would afford decisive evidence as to its efficacy ; but unfortunately no such comparison can be made for lack of vital statistics in that country. The experience of the Paris hospitals, however, points to a decided diminution of mortality. On the whole it must be said, in the absence of further data, that while the Pasteur treatment probably diminishes the danger of hydrophobia from the bites of rabid animals, the extent to which it does so is at present uncertain.

Some attempt has been made to argue that the treat-

ment is itself dangerous, and that persons have died from it, not from the bites they had received. Colour was given to the suggestion by the case of a man named O'Leary, who was bitten in the right leg by a dog at Lahore on 22nd August 1898. He was treated at the Institut Pasteur from 12th September to 26th October, and died of hydrophobia in India on 22nd November. The dog could not be traced, but it bit another dog which remained quite well ; and the inference was drawn that the first dog was not rabid at all. The facts are not sufficiently explicit to warrant the conclusion that the man died from the effects of the treatment ; and even if he did, it is clear, from the very large number of persons treated year by year with good results, that any risk there may be is very small. More recently treatment with an anti-rabic serum has been suggested.

The attempt to stamp out rabies in Great Britain was an experiment undertaken by the Grovernment in the public interest. The principal means adopted were the muzzling of dogs in infected areas, and prolonged quaran-

tine for imported animals. The efficacy of dog-muzzling in checking the spread of rabies and diminishing its prevalence has been repeatedly proved in various countries. It is probable that all carnivorous animals are subject to rabies, and its occurrence in wolves, cats, and foxes is common. Horses, cows, sheep, pigs, and deer have also been known to take it, but in England at least the dog is pre-eminently the vehicle of contagion and the great source of danger to human beings. There is a difference of opinion on the way in which muzzling acts, though there can be none as to the effect it produces in reducing rabies. Probably it acts rather by securing the destruction of ownerless and stray — which generally includes rabid — dogs than by preventing biting ; for though it may prevent snapping, even the wire-cage muzzle does not prevent furious dogs from biting, and it is healthy, not rabid, dogs that wear the muzzle. It has therefore been suggested that a collar would have the same effect, if all collarless dogs were seized ; but the evidence goes to show that it has not, perhaps because rabid dogs are more likely to stray

from home with their collars, which are constantly worn, than with muzzles which are not, and so escape seizure. Moreover, it is much easier for the police to see whether a dog is wearing a muzzle or not than it is to make sure about the collar. However this may be, the muzzle has proved more efficacious, but it was not applied system-atically in England until a late date. Sometimes the regulations were in the hands of the Government, and sometimes they were left to local authorities ; in either case they were allowed to lapse as soon as rabies had died down. In April 1897 the Board of Agri-culture entered on a systematic attempt to exterminate rabies by the means indicated. The plan was to enforce muzzling over large areas in which the disease existed, and to maintain it for six months after the occurrence of the last case. In spite of much opposition and criticism, this was resolutely carried out, and met with great success. By the spring of 1899 — that is, in two years — the disease had disappeared in Great Britain, except for one area in Wales ; and with this exception, muzzling

was everywhere relaxed in October 1899. It was taken off in Wales also in the following May, no case having occurred since November 1899. Eabies was then pronounced extinct. During the summer of 1900, however, it reappeared in Wales, and several counties were again placed under the order. In December 1901 the United Kingdom was declared free from rabies, and all restrictions, save quarantine for dogs imported from abroad, were removed. According to the Government theory, the disease should never reappear, but the hope is hardly justified by present knowledge. The history of rabies shows that it is endemic in Britain and other populous countries, while in some it is wholly unknown, and that from time to time it assumes epidemic proportions and then dies down again quite independently of muzzling or any such measure. Judging by analogy, we should rather regard it as a disease which is spread by contagion, but does not depend for its existence on contagion, as it may remain latent, becoming active periodically under favourable conditions. The assumption that

it exists only in the persons of rabid dogs is highly improbable, and cannot be accepted on the evidence available. We may expect, therefore, that it will re-appear from time to time with greater or less diffusive force, but that the measures adopted will be efficacious in checking its spread and keeping it down to insignifi-cant proportions when it does appear. In other words, experience justifies the hope that hydrophobia may be abolished in Great Britain, whether rabies is " stamped out " or not.

See Annales de V Institut Pasteur, 1886-1900 ; Journal of the Board of Agriculture, 1899. — -Makins, " HydrophoMa," in Treves's System of Surgery. — Woodhead, "Rabies," in Allbutt's System of Medicine. (a. sl.)

Hyeres, a winter health resort, arrondissement of Toulon, department of Var, Prance, 11 miles east of Toulon by rail. Numerous villas have been erected in recent years on the beach, about two miles from the town. Port Pothuau, so named in 1881, is the port of the Salins d'Hyeres. The salins yield annually about 20,000 tons of

salt. Flowers and fruits are extensively cultivated for the London and Paris markets, and cork-cutting is a considerable industry. Strawberries alone are said to be exported to the value of £20,000 annually. In 1899, 209 vessels of 27,741 tons entered and cleared from Port Pothuau, almost entirely engaged in coasting trade. Population (1881), 6918 ; (1891), 8292 ; (1901), 17,669.

Hygiene. — The science of practical hygiene aims at " rendering growth more perfect, decay less rapid, life more vigorous, death more remote." The subject involves an acquaintance with such diverse sciences as physics, chemistry, geology, engineering, architecture, meteorology, epidemiology, bacteriology, and statistics. To these may be added the study of the law or those legal enactments which concern the sanitary well-being of the community. In this article it is proposed to refer only to the more important questions in respect to which recent scientific researcli has led to a better conception of the cause of diseases and methods for their prevention.

The influence of different kinds of soil as a factor in the

production of disease requires to beconsidered, in regardnot only to the nature and number of the micro-organisms they contain, but also to the amount of moisture and air in them and their capacity for heat. The moisture in soU is derived from two sources — the rain and the ground water. Above the level of the ground water the soil is kept moist

by capillary attraction aad by evaporation of the water below, by rainfall and by movements of the ground water ; on the other hand, the upper layers are con-stantly losing moisture by evaporation from the surface and through vegetation. When the ground water rises it forces air out of the soil ; when it falls again it leaves the soil moist and full of air. The nature of the soil will largely influence the amount of moisture which it will take up or retain. In regard to

water all soils have two actions, namely, permeability and absorbability. Permeability is practically identical with the speed at which percolation takes place ; through clay it is slow, but increases in rapidity through marls, loams, limestones, chalks, coarse gravels, and fine sands, reaching a maximum in soil saturated with moisture. The amount of moisture retained depends mainly upon the absorbability of the soil, and as it depends largely on capillary action, it varies with the coarseness or fineness of the pores of the soil, being greater for soils which consist of fine particles. The results of many analyses show that the capacity of soils for moisture increases with the amount of organic substances present : decomposition appears to be most active when the moisture is about 4 per cent., but can continue when it is as low as 2 per cent., while it appears to be retarded by any excess over 4 per cent. Above the level of the ground water all soils contain air, varying in amount with the degree of looseness of the soil. Some sands contain as much as 60 per cent, of air of nearly the same

composition as atmospheric air. The oxygen, how-
ever, decreases with the depth, while the carbon dioxide
increases.

Among the most noteworthy workers at the problems involved in the question of the influence of soil in the production of disease, we find von Foder, Pettenkofer, Levy, Fleck, von Naegeli, Schleesing, Muntz, and Warrington. The study of epidemic and endemic diseases generally has brought to light an array of facts which very strongly suggest that an intimate association exists between the soil and the appearance and propagation of certain diseases ; but although experiments and observations allow this view to be looked upon as well established, still the precise role played by the soil in an setiological respect is by no means so well under-stood as to make it possible to separate the factors and dogmatize on their effects. The earliest writers upon cholera emphasized its remarkable preference for particular places ; and the history of each successive epidemic implies, besides an importation of the contagion, certain local conditions whicli may be either general sanitary defects or peculiarities of climate and soil. The general evidence indicates that the specific bacteria of cholera discharges

are capable of a much longer existence in the superficial soil layers than has hitherto been supposed ; consequently, it is specially necessary to guard against pollution of the soil, and through it against the probable contamination of both water and air. The evidence, however, is not sufficiently strong to warrant a universal conclusion, the diffusion of cholera appearing to be largely dependent upon other factors than soil states. Again, all accounts of diphtheria show a tendency on the part of the disease to recur in the same districts year after year. The questions naturally suggest themselves — Are the reappearances due to a revival of the contagion derived from previous outbreaks in the same place, or to some favouring condition which the place offers for the development of infection derived from some other quarter ; and have favouring conditions any dependence upon the character and state of the soil ? Greenhow in 1858 stated that diphtheria was especially prevalent on cold, wet soils ; and Airy in 1881 describes the localities affected as " for the most part cold, wet clay lands." An analysis of the innumerable outbreaks in various parts of Europe indicates that the geological features of the affected districts play a less important part in the incidence of the disease

than soil dampness. In this connexion it is interesting to note the behaviour of the diphtheritic contagion in soil. We have no actual proof that the bacillus is either an ordinary or an occasional resident of the soil, or that it becomes a.ir-borne in sewer-gas or soil emanations. But experiments show that pure cultures, when mixed with garden soil constantly moistened short of saturation, and kept in the dark at a temperature of 14° C, will retain their vitality for more than ten months ; from moist soil kept at 26° C. they die out in about two months ; from moist soil at 30° C. , in seventeen days ; and in dry soil at the same temperature, within a week. In the laboratory absolute soil dryness is as distinctly antagonistic to the vitality of the diphtheria bacillus as soil damp-ness is favourable. Both statistically and experimentally we find that a damp soil favours its life and development, while prolonged submersion and drought kill it. We may consider that, in country districts, constant soil moisture is one of the chief factors ; while in the case of urban outbreaks mere soil moisture is subsidiary to other more potent causes.

Again, many facts in the occurrence and diffusion of enteric fever point to an intimate connexion between its origin and certain con-

ditions of locality. Epidemics rarely spread over any considerable tract of country, but are nearly always confined within local limits. Observations made at the most diverse parts of the globe, and the general distribution area of the disease, show that mere questions of elevation or even configuration of the ground have little or no influence. On the other hand, the same observations go to show that the disease is met with oftener on the more recent formations than the older, and this fact, so far as concerns the physical characters of the soil, is identical with the questions of per-meability to air and water. Robertson has shown that the typhoid bacillus can grow very easily in certain soils, can persist in soils through the winter months, and when the soil is artificially fed, as may be done by a leaky drain, or by access of filthy water from the surface, the micro-organism will take on a fresh growth in the warm season. The destructive power of sunlight is only exercised on those organisms actually at the surface. Cultures of the typhoid organism planted at a depth of 18 inches were found to have grown to the surface. In the winter months the deeper layers of the soil act as a shelter to the organism, which again grows towards the surface during the summer. The typhoid organism was not found

to be taken oH from the decomposing masses of semi-liquid filth largely contaminated with a culture of bacillus typhosus; but, on the other hand, it was abundantly proved that it could grow over moist surfaces of stones, &c. Certain disease-producing organisms, such as the bacillus of tetanus and malignant oedema, appear to be universally distributed in soil, while others, as the bacillus typhosus and spirillum chloerce, appear to have only a local distribution. The conditions which favour the vitality, growth, and multiplication of the typhoid bacfllus are the follow-ing : — The soil should be pervious ; it should be permeated with a sufficiency of decaying — preferably animal — organic matters ; it should possess a certain amount of moisture, and be subject to a certain temperature. Depriving the organism of any of these essential conditions for its existence in the soil will secure our best weapon for defence. The optimum temperature adapted to its growth and extension is 37°C. = 98°-4 F. Sir Charles Cameron attributes the prevalence of typhoid in certain areas in Dublin to the soil becoming saturated with fsecal matter and specifically infected. The ratio of cases to population living in Dublin on loose porous gravel soil for the ten years 1881-91 was 1 in 94,

while that of those living on stiff clay soil was but 1 in 145. " This is as we should expect, since the movements of ground air are much greater in loose porous soils than in stifi clay soils." A foul gravel soil is a most dangerous one on which to build. For warmth, for dryness, for absence of fog, and for facility of walking after rain, just when the air is at its purest and its best, there is nothing equal to gravel ; but when gravel has been rendered foul by infiltration with organic matters it may easily become a very hot-bed of disease.

The first practical attempt to purify sewage by a biological process was made by Scott Moncrieff in Great Britain in 1891. The State Board of Health of Massachusetts had previously made a series of experiments upon downward filtration, which showed that the same process that occurred in soils could be carried on in artificial filters. The biological treatment of sewage may be conveniently divided into two stages : (1) the breaking down or liquefying of the organic matter; (2) the nitrifying of the results of the first stage. The changes produced

in these stages are effected by means of micro-organisms existing either in the sewage to be treated or in its surroundings. Both aerobic and anaerobic organisms share in the work of breaking down the organic matter, but the former alone are capable of producing nitrification. Scott Moncrieff' s system consists of allowing the sewage to enter from below a tank, filled with stones, sufficiently slowly to be acted upon by the anaerobic organisms which form dense colonies in the nidus formed by the stones : the result being that the solid organic matter is liquefied, and a liquid free from suspended matters passes on. The nitrifying chamber is filled with a series of trays containing filtering media, placed one above the other,

■*with intervening spaces of a few inches between them. The liquid passes slowly downwards through the various trays, meeting under favourable conditions aerobic micro-organisms, and finally passes away to the stream or out-*

fall.

In the "Sutton" system the sewage, after rough straining, is run on to coarse-gi'ain filter beds of burnt ballast, the outlet of each of which is closed in turn and the bed rapidly filled up ; the sewage is allowed to remain for about an hour, when it Is quickly drawn off and passed on to fine-grain filters as a second or completing stage. The object of the coarse-grain filter bed is to admit ttie particles of suspended matter contained in the crude sewage into the interior of the bed, where they are subjected to the action of the anaerobic organisms. If the first bed were made of fine material the suspended matter would collect on the surface and have to be dealt with at frequent intervals, and in this case the problem of sludge disposal would again arise. The size of filter material which Dibden has found most suitable is, in the case of a coarse bed, that which will pass through a two-inch ring and be totally rejected by a screen having a half-inch mesh ; and, for a fine bed, that which will pass a screen of three-eighths or quarter-inch mesh, and be rejected by one having a mesh of one-sixteenth of an inch.

The "septic tank-system" was devised by Cameron of Exeter

in 1896. It consists in providing (1) a closed chamber or tank through which the sewage passes and in which the organic matters in the sewage are brought into solution by anaerobic organisms, and (2) a series of filters worked on the " Sutton " principle, i.e., filling, remaining full, emptying, and resting. The septic tank is constructed to hold about one day's average flow, so that the sewage takes twenty-four hours to pass through it. The flow through the tank is continuous, and the effluent passes oH at the same level as the sewage passes in, i.e., to a depth of about 5 feet below the surface. The object is to avoid disturbance of the scum which forms on the surface of the fluid in the tank, and also to prevent the passage of air with the sewage and the reflux of gases from the tank into the sewers. The deposit which forms on the bottom of the tank consists of road grit, together with the insoluble residue from the decomposition of the sewage solids, and is made up of about 8 per cent, of mineral matter, 4 per cent, of organic matter, and 88 per cent, water. The clear water, which forms between the scum on the surface and the deposit at the bottom of the tank, passes out through a cast-iron pipe fifteen inches below the surface of the scum to distributing wells. In these wells valves are

placed which control the flow to the distributing channels on the surface of the filters. Each filter is filled to a depth of 4J feet with crushed furnace clinker resting on 6 inches of coarse gravel. The filters are filled and discharged automatically by means of alternating gear. The bacteriology of the sfiptic-tank process has been investigated by Sims Woodhead, who found that the crude sewage contained the largest number of anaerobic organisms ; fluorescing and gas-producing varieties were also numerous. In the septic tank the number of anaerobic organisms did not appear to increase, but the varieties which rapidly liquefied gelatine were found in greater numbers than in crude sewage. In the tank efiluent and the filtrate from the beds the number of liquefying anaerobic organisms was found to have fallen consider-ably. As regards aerobic organisms, the liquefying varieties were in greatest number in the crude sewage and tank contents. Non-liquefying organisms were also present in greater numbers than after the sewage had passed the filters. The organisms in the filter beds are chiefly aerobic, but the anaerobic species which have made their way from the septic tank are undoubtedly present, ready to commence work whenever the conditions become favour-

able. This system gives excellent results and has already been largely adopted.

At Manchester very successful experiments have been made with an open septic tank and double filtration in bacterial filter beds. Kaw sewage is allowed to run from the main sewer through a large open tank. "The contents of the tank soon became black, and bubbles of gas began to rise, often accompanied by masses of sludge from the bottom, on still days forming a scum, which gradually completely covered the surface of the liquid." The gas evolved was found to be largely composed of marsh gas, showing that resolution of organic matter was taking place. Nine months after the open tank was placed in operation a flow of 2,500,000 gallons was allowed to pass through in twenty-four hours. About the same time garbage collected from the mechanical screens at the entrance to the works was tipped into the tanks, and a gradual disintegration of the garbage ensued. The efiluent from the open septic tank is then treated by double contact on bacteria beds. ' In every case the effluent from the second filter bed was found non-putrescible.

An important point in connexion with the biological process is

that, by the adoption of it, sludge may be looked upon as a practically negligible quantity. The small amount of road grit and other mineral matter mixed up with sewage can easily be eliminated by ordinary grit chambers provided in front of the installation. It may safely be said that the average results by the biological treatment are quite as good as those given by well-managed sewage farms, while the best results are far beyond them.

Boiling is perhaps the oldest method in practice for the purification of water. The objection to this procedure is that the dissolved gases are driven off, and unless the water is again aerated during the process of cooling it will be found flat and insipid to taste. Special sterilizers have been introduced in order to overcome this difiiculty. The best machines are ^u^tion. those invented by Desmaroux, Maiche, and Waterhouse-Forbes. In all these machines there is the same principle — an exchange heater by means of which the

incoming cold water receives heat from the outgoing hot water, and in this way the fuel required to raise the water to the required temperature is much lessened and the efiluent from the machine is almost as cold as the supply.

In Desmaroux's machine the water retains its gases and is quite cool at the exit. The machine is arranged to work at any temperature between 100° C. and 120° C. The requisite head to cause the water to pass through the apparatus is obtained by means of a pump, when pressure from a public supply is not available. Maiche's apparatus is also provided with a boiler, exchange heater, and pressure regulators. The water is heated to 109° C. for four minutes, and is delivered from the exchange heater as cool sterile water ready for use. The apparatus delivers about 22 gallons per hour at an expenditure of 6 cubic feet of gas. In the Waterhouse-Forbes sterilizer the water is only boiled for a few seconds, and it is claimed for it that the dissolved gases are not driven off. An apparatus weighing 25 lb is capable of delivering 5 gallons of sterihzed water per hour. Careful experiments showed that when rich emulsions of B. coli or B. prodigenns

were passed through these machines not a single organism could be detected in the sterilized water.

The addition of bromine to water has been suggested by Dr Pehlumberg. Experiments have proved that 0-06 gramme of bromine per litre, after five minutes' exposure, will render most surface waters safe for drinking purposes. The colour and taste of the bromine are readily removed after the five minutes' treatment by adding 0-095 gramme of sodium hyposulphite and 0-04 gramme of anhydrous sodium carbonate to each litre of water.

Peiftee was the first to show that sand alone could not remove micro-organisms from water. Filters made of sterilized sand were found actually to increase the number of bacteria during the first few days of working, but with the formation of a slimy layer on the surface and in the body of the filter bed the true filtering action commenced. This slimy layer, to which the greatest importance is now attached, consists of zoogloea of bacteria, combined with suspended materials in the water. It is very friable and readily broken up by excessive pressure on the surface or disturbance of the body of the filter beds. Hence the extreme care now taken to fill the filter beds from below, so as to prevent the zooglcea

masses from being broken up by the pressure of the air and to control the rate of filtration and limit the pressure of water on the surface. The degree of fineness of the sand grains is also of importance in securing a good filtrate. Hence the work of a filter bed is partly mechanical and partly vital. By the growth of bacteria in the bed, food material is used up and the products of bacterial life are eliminated, so that the growth of bacteria through the filter is arrested. But a sand filter will not arrest all the micro-organisms contained in a water applied to the surface, nor can it give absolute protection against water-borne disease : if the rate of filtration is properly controlled it can give such a protection that in practice we have every reason to be satisfied with it (Koch). Reservoirs to store filtered water should always be covered, so as to avoid contamination with dust, &c.

The sterilization of water by ozone has been proposed by Ohmuller, Suidal, and other workers. In 1898 Marinier and Abraham devised an apparatus for the treatment on a large scale of water supplied to the town of Lille. When the water is treated with ozone, equal to 6 mgms. per litre of air, all pathogenic and saprophytic microbes are destroyed. The ozone treatment increases

the aeration of the water and diminishes the organic matter : the nitrates are unaffected. Weyl of Berlin has also reported very favourably on the ozone treatment established at the waterworks at Charlottenburg : the results obtained were the same as those met with when water is purified by careful sand filtration.

The principal methods for effecting the preservation of foods are by (a) drying, (6) smoking, (c) salting, (d) sugar and vinegar, (e) exclusion of air, (/) cold, (gr) se^aifves. mineral or organic antiseptics. The preserva-tion of milk is exceedingly dif&cult, because the liquid is particularly liable to infection by hardy germs. Even -when yielded by a healthy cow, the milk on issuing from the udder is already iufested with bacteria. When milking is ended, a small quantity of milk is left behind in the lacteal ducts, and in it there settle a number of bacteria, which, making their way from the outside, are favoured by a high temperature and become incorporated with the subsequent flow of milk. In addition to these

there are innumerable bacteria originating in the dung and adhering to the udder. The air in the cowhouse is laden with germs, and yields up no small quantities of these to the milk. The germs present in freshly-drawn milk increase very rapidly during transit to the centres of consumption, as also during storage in milk-shops. The reproduction can be moderated by cold, but not arrested, because milk contains several species of bacteria capable of developing at 0° C. Diseased cows yield milk containing pathogenic organisms. Martin shows that 1 in every 13 samples of milk exposed for sale in Paris contained tubercle bacilli, and Dr Schroeder in Washington found that 1 in every 19 samples contained a sufl&cient number to produce infection. Milk also is often the carrier of the specific organisms of typhoid, cholera, scarlet fever, and foot-and-mouth disease.

Milk. — By treating milk to a temperature of 60° C. for one hour, 70° C. for ten minutes, and 95° C. for one minute, tubercle bacilli, if present, will certainly be killed. Cholera and typhoid organisms are less resistant, and are killed more quickly than tubercle bacilli

at the above temperatures. Only a single pathogenic species can withstand the short boiling to which milk is ordinarily treated in domestic management, and this is the anthrax bacillus containing spores. The danger from this source is remote, as the microbe does not form spores within the animal body. Even in the worst cases, therefore, only vegetable forms, easily destroyed by boiling, can find their way into the milk from the body of the cow.

The lactic acid bacillus, always present in unboiled milk (to which the souring of milk is due) , is easily destroyed by heat ; but the bacillus mesenericus, often found in it, forms spores, which are not destroyed by ordinary boiling, and germinate when the milk is kept at a moderately warm temperature, producing a brisk fermentation whereby a large volume of gas is liberated. The fundamental idea of Soxhlet's method for sterilizing milk is to boil it for forty minutes in small bottles holding just enough for one meal, and closing the same with an impervious stopper, which is only removed just before use. Milk so treated will keep at the ordinary room temperature, as the spores of the B. mesentericus do not develop below 15° C. ; but if it be introduced into the alimentary canal of a child the spores will rapidly multiply, and

in such cases large quantities of gas, giving rise to flatulency, will be formed, and possibly also poisonous decomposition products of albuminoid matter. To render milk sterile in the strict sense of the word it is necessary to raise it to a temperature of about 120° C. for twenty minutes. Under these conditions the lactose decomposes into dark-brown fission products, the fat loses its emulsified condition and separates out as cream which cannot be made to diffuse again even by shaking, and the albuminoids are converted into a form very difficult of digestion.

In short, there is at the present time the greatest difiSculty in freeing milk on a large scale from germs without at the same time seriously prejudicing its fiavour and nutritive value. Since, then, the destruction of the hardy germs is so difficult, the greater care should be taken, by washing the udder, hands, and milk vessels, to secure extreme cleanliness in the preparation of milk intended for infant consumption. Sterilization then becomes an easier task, the milk drawn under these conditions being very poor in spore-forming bacteria. It is imperative that cream destined for butter-making should be free from pathogenic organisms. The organisms of cholera, typhoid fever, and tuberculosis present in butter retain

their vitality lor a long time. As butter is consumed in the raw state, a trustworthy preliminary treatment of the cream is in the highest degree desirable. Schuppan has shown that it is possible to produce good butter from Pasteurized or even sterilized cream, and Weigmann introduced the plan of artificially souring cream by means of pure cultures of B. acidi lactici. Boracic acid, salicylic acid, and even benzoic acid have been used as milk preservatives. The influence of small doses of boracic acid is still sub judice ; it is hardly possible for so much as three or four grains a day to produce any deleterious effect. One objection to allowing boracic acid to be added to milk is that it enables the milkman to palm off stale milk as fresh. It would seem advisable to prohibit chemical preservatives altogether. In condensed milk many of the bacteria present are killed by the preliminary heating and the subsequent concentration at 50° to 60° C. A few survive and are still alive in the finished product, but not in a condition to do any damage, since the high concentration plasmolyses the germs, retarding their development and so preventing decomposition.

Meat. — In the preservation of meat we know that the blood and flesh of healthy animals are entirely free from bacteria, but, on the

other hand, the contents of the digestive tract are extremely rich in microbes. If the carcase of a slaughtered animal be left without being disembowelled, these saprophytes will make their way through the capillary vessels of the intestinal wall into the general blood-system, so that the entire carcase quickly begins to undergo decomposition. This can be prevented by the excision of the entire length of the alimentary canal ; and if this be practised the remaining flesh will be perfectly free from fungi. Any subsequent danger can only be due to gradual penetration from the surface. Since these sources of bacterial infection cannot be entirely cut off, attempts are made to prevent the increase of these parasites in the flesh. The oldest known remedy is cold, but the temperature must be kept several degrees below zero (C). The freezing of meat does not kill the germs present, but only hinders their development. If the meat be not stored at low temperatures, but merely put in the ice-chest, whereby it only attains a temperature of 0° C, an increase of germs ensues. These cold-supporting organisms produce the disagreeable taste and smell acquired by edibles remaining in the ice-chest for a few days. Actual putrefaction is not produced by these bacteria. Food-stuffs should not be brought into actual contact with natural

ice, since this substance contains not only putrefactive organisms, but also under certain conditions pathogenic organisms. Frozen meat when thawed undergoes rapid decomposition, because the cellular tissue is loosened by freezing, and access to the interior is facilitated for any organisms present on the surface.

In dried and salted meat the development and activity of the organisms can be prevented by depriving them of the water necessary for metabolism. In salting and pickling, it is only the hygroscopic power of the salt which comes into play ; the germs are plasmolysed and so their activity is prevented. Tubercle bacilli are not killed by a concentrated solution of salt after two months' and typhoid bacilli after three months' action. Smoking forms a more certain means of preserving meat, the active agents being the vapours of phenol, creosote, &c., present in the smoke. These antiseptics do not penetrate far into the flesh, therefore smoking can only preserve the fresh meat taken from healthy animals.

Disinfection by means of sulphur dioxide is now looked upon as quite inefScient, even when used in large amount, ' and has given place to formaldehyde, which is regarded as a powerful germicide. Schlossman

states that there are two chief methods of carry-
ing out this disinfection. In Trillat's method an attempt
is made to prevent the formation of polymers of formal-
dehyde by adding calcium chloride, whereas in Schering's
apparatus para-formaldehyde is converted into gas, and
this is again changed into formaldehyde by means of the
water produced by the burning of a certain amount of
spirit. The probability is that in both methods the
greatest part of the formaldehyde escaping into the air
is converted into polymers. In the method introduced
by Schlossman and Wallten polymerization is prevented
by the use of glycerine.

Lingun has constructed an apparatus consisting of a vessel in
which the water is boiled. The steam rises into a reservoir which
contains 4 per cent, of formaldehyde and 10 per cent, of glycerine.
From the reservoir four pipes pass into the room. A room with a
cubic capacity of 2000 cubic feet is filled with vapour in ten
minutes. All microbes are destroyed in three hours at the latest.
The advantages claimed by Schlossman are : (1) Sterilization is
absolute ; (2) the closure of all cracks and clefts is not necessary ;

(3) the procedure requires only three hours ; (4) there is no danger of explosions ; (5) the method is cheap ; (6) the glycoformal vapour is heavier than air, and therefore sinks ; (7) the total disinfecting powers of the gas are obtained. The windows are thrown open for half an hour after the disinfection. Liquor ammonia is placed in the room in an amount proportional to the formaldehyde used. The windows are again opened, and thus all smell is got rid of. With Schering's method it has been found that rapid volatilization

Is necessary to prevent the polymerization of the greater part of the formaldehyde vapour. Five tablets per 100 cubic feet appear to destroy anthrax cultures containing spores when smeared on linen and exposed in the room: pieces of linen soaked in broth cultures of B. diphtherial and B. typhosus were rendered sterile when five tablets in 100 cubic feet were rapidly converted into formaldehyde vapours by the heat and moisture derived from a large flame of Schering's lamp.

The first suggestion of an international conference on quarantine vras made by the French Government in 1838, but so diverse were the views held on the sub-uluT" 3°' " ^^^ enforcement at stations and ports on the Mediterranean was so capricious, that various difl&eulties arose and the proposals fell through. In 1843 the British Government suggested a further con-ference; but this again was opposed as premature, since there was no foundation on which to base any regulations which would be acceptable to the Powers. In 1849-50 the wave of cholera which passed over Europe brought the subject again under notice, and a conference assembled in Paris in 1851 to consider the question of quarantine in relation to cholera, yellow fever, and plague, the only diseases for which this means of prevention was to be employed. The results were unsatisfactory ; there was little unity of opinion, and no system of international control was possible in the circumstances. It rested with the chief medical officer of the Privy Council (Sir John Simon, K.C.B.) to raise the question of international con-*

trol, and it was chiefly owing to the strong expression of his opinion that a scientific inquiry began, which ultimately led step by step to the almost total abolition of quarantine not only in Great Britain, but in countries under international control. Writing in 1865, Sir John Simon said, " There are two kinds of precautious which may be used against quarantine : first, if possible, to prevent the entrance of the contagion ; secondly, if the contagion be present, to annihilate as far as possible the circumstances which favour its spread. Subject to one qualification, which is not an important one for the present argument, it may, I think, be accepted as certain that quarantine, conducted with extreme rigour and with the precision of a chemical experiment, will keep cholera out of every part of Europe in which the extremely difficult conditions can be absolutely fulfilled ; and thus, if I speak to the dry question of medical practice, I have no hesitation in saying that England ought to resist cholera by quarantine. On the other hand, though I cannot pretend to discuss with any kind of authority the non-medical aspects of the

question, it would be mere pedantry for me to ignore that facts which are of common notoriety and considerations which are of common sense conflict with that medical conclusion. A quarantine which is ineffective is a mere irrational derangement of commerce, and a quarantine which ensures success is more easily imagined than realized. Only in proportion as a community lives apart from the great highways and emporia of commerce, or is ready and able to treat its commerce as a subordinate political interest, only in such proportion can quarantine be made effectual for preventing it. In proportion as these circumstances are reversed, it becomes impossible to reduce to practice the paper plausibilities of quarantine. The conditions which have to be fulfilled are conditions of natural seclusion, and fulfilment of such conditions by England would involve fundamental changes in the most established habits of the country."

The next international conference was held in Constantinople in 1866. This conference came to the conclusion that cholera had always its origin in India, and that its extension followed the lines

of human intercourse. They were of opinion that quarantine was capable of arresting the disease. There should be quarantine of observation and quarantine of rigour. Strict quarantine was to be applied to all ships from an infeoteU port with a foul bill of health, as well as to any vessel which had cases on board during the voyage although provided with a clean bill of health. The term fixed was ten days from the time of entering any port, to recommence if any case occurred thereafter. Quarantine of observation was to consist of keeping isolated and under observation for an indefinite time- to be fixed by the local authority — a vessel with crew and passen- gers, with free ventilation but no disinfection. Strict quarantine was defined as isolation for a fixed time of a ship and persons on board, with disinfection of all that might contain the germs of dis- ease. The whole of the cargo was to be landed and the passengers disembarked at a lazaret. In 1873, so far as cholera was concerned, quarantine was ofBcially abandoned by order of the Local Govern- ment Board. In 1874 an international sanitary conference was held at Vienna, the object being to arrange among the Powers interested compulsory regulations having for their object to bring about a perfect uniformity in the measures to be adopted against

the common danger. This conference was the first which in any form gave sanction to the principle of medical inspection taking the place of quarantine. France was the only one of the Great Powers that still adhered to quarantine. The conference reaffirmed the decision as to the place of origin and transmission of cholera arrived at in Constantinople. Another international conference was held in Rome in 1885. In the matter of disinfection it was for the first time distinctly laid down that it is not necessary to consider articles as infected merely because they came from a country where cholera prevailed ; that only persons or articles that have been actually soiled by choleraic discharges, and articles that have been worn by persons suffering from cholera, ought to be subjected to such a process ; and that, in the case of individuals, disinfection by means of baths ought alone to be resorted to, fumigation being thus incidentally condemned as useless. But in the conclusions of this conference medical inspection finds no place, except in so far as this term may stand for a formal preliminary (1) to a detention of twenty-four hours in cases where the sea voyage has lasted less than ten days, and (2) to the imposition of quarantine detention varying from three to six days on sick and healthy alike. An in-

ternational sanitary conference met again at Venice in 1892. It dealt solely with the question of cholera. It was convened to consider the regulations then existing relative to transit in quarantine by the Suez Canal. The delegates were asked to notify what modifications should be introduced into the constitution of the Sanitary Council of Marine and Quarantine of Egypt, and generally the constitution of that council.

There has always been a considerable divergence between the view held by medical authorities and accepted by public opinion in England and in India, and that prevailing on the Continent, as to the ef&cacy of quarantine against the contagion of cholera and some other infective diseases. The tendency of British opinion throughout this long controversy has been to look to measures of sanitary improvement as the best prophylactic against cholera, and to rely on the application of quarantine for that purpose only to a very small degree, whereas on the Continent the belief in quarantine, though apparently diminishing, retains still much of its actual force. The conclusions of the Venice conference briefly were as follows. Instead of a prescribed five days' detention of all passengers, other than those sick of cholera, at Moses Wells, in

the case of vessels without a doctor or a disinfecting stove on board, the detention will vary according to a sliding scale from forty -eight hours to five days. In case of a vessel carrying a doctor and a dis-infecting stove, it is the doctor on board who is to decide what per-son or persons are to be landed, on the ground that they are suffering from cholera. Thus there is a guarantee against British subjects suffering from dysentery being landed compulsorily. If any landing of a limited number of such passengers or crew does take place, it will only occur when it is necessary for the purpose of disinfecting a portion of the vessel. Even then there is an alternative of removal to a vessel moored alongside, and any such removal is for a limited number of hours only, after which the persons in the vessel have a right to return to the ship. Thus no compulsory landing of any healthy persons can take place. It will be seen that the Venice conference only dealt with the transmission of cholera hy sea into Europe.

A conference was held in Dresden in 1893 to complete, so to speak, the work of the previous conference. It was convened to consider (1) the precautions to be adopted on land and seaports against cholera, (2) the special conditions affecting the Danube, and

(3) the organization of the board of health at Tehran ; but these last two points were apparently not raised or discussed. The convention provided a minimum and a maximum precaution. The minimum is obligatory. It corresponds closely with the provisions of the cholera regulations in Great Britain. Practically the only difference is that the medical supervision of persons landing from an "infected" ship is in Great Britain carried out at their own homes, whereas under the convention such persons are to be detained for a period not exceeding five days from the date of the last case on board. By the Dresden convention no ship will be

detained in any port where there is a hospital for the sick, and all other persons are, if possible, to be disembarked. The maximum of precautions laid down by the convention constitutes a limit which no state may exceed. The most important difference between minimum and maximum occurs in the treatment of healthy ships coming from cholera-infected ports. Such ships are always to receive immediate pratique. As a minimum of precaution, bilge- and drinking-water must be evacuated, and persons landed

from such ships may be subjected to medical supervision at home without any detention. With regard to disinfection also, there is a difference between the minimum and maximum in the case of infected ships, the minimum being that part of the ship actually contaminated shall be disinfected ; the maximum, that the whole ship may be disinfected. Under the convention all goods are freed from restrictions, except fresh rags and things believed to be "contaminated," i.e., fouled with cholera matters. The measures to be applied to land frontiers are analogous to those for seaports, with the important exception that only those persons suffering from cholera may be detained on land frontiers. The greater precaution taken in seaports than on land frontiers was due to the opinion that risk of infection on board ship is far greater than in a train. If a case of cholera occurred in a train, the healthy would leave the carriage at the next station, or would even stop the train, and therefore would be exposed to the risk of infection for a very short time only. The conclusions adopted by this conference embody the principle of notification of cholera, and aim at preventing certain unreasonable measures of restriction against countries in which cholera has appeared.

The next international conference was convened under the auspices of the French Government at Paris in 1894, with a view of devising measures for preventing the spread of cholera by way of the Eed Sea and the Persian Gulf. At Venice in 1892, and at Dresden in 1893, sanitary conventions were concluded to the effect that precautions must be taken on the accepted basis that cholera is communicated by human agency and on lines of human inter-course. The Paris conference really began where the two previous ones left off. The first point discussed was as to the necessity of requiring a medical inspection of all persons on board a pilgrim ship before embarkation. The conference was assured that this was strictly carried out by Great Britain and British India not only as to cholera, but as to all infectious diseases, and the proposal of the requirement was unanimously accepted. A second proposal related to the disinfection of all articles deemed " contaminSes " or "suspect" in accordance with the Venice convention; and, subject to the understanding that the medical officer of health of the port was to be the judge as to what articles came under these definitions, the proposition was carried. A third proposal for-bidding the embarkation of any passengers deemed to be infected

or suspected of being so was also unanimously agreed to. At a full meeting of the conference the heads were arrived at: — (1) Sanitary police at the ports of departure ; (2) Measures to be adopted on board pilgrim ships ; (3) Sanitary surveillance over pilgrimages in the Red Sea ; (4) Surveillance over the pilgrims going by land to Mecca and Medina. In this, as in all previous conferences, vessels were classified as follows : {a) "indemnes" ; (6) "suspects"; (c) "infectfis." " Navires indemnes " are those ships in which no case of cholera has existed before starting or during the voyage. These receive immediate pratique whatever their bill of health may be. " Navires suspects " are those in which any case of cholera has arisen within seven days. These receive medical visits, and are subjected to disinfection, &o., and there is a recommendation (1) as to maintaining the passengers under observation for five days from the date of leaving the port of departure ; and (2) as to preventing the landing of the crew except in case of necessity. "Navires infectfis " are those in which any case of cholera has arisen within seven days before arrival. The sick and remainder of the passengers are obliged to disembark and to undergo detention under observation for a period of five days at

the outside, to date from the occurrence of the last case of cholera. Disinfection of clothing is also compulsory.

In 1897 an international conference assembled at Venice. This was in connexion with the outbreak of plague in the East, and the conference met to settle on an international basis the steps to be taken to prevent, if possible, its spread into Europe. One of the first points to be dealt with was to settle the incubation period for this disease, and the period to be adopted for administrative purposes. It was admitted that the incubation period was, as a rule, a comparatively short one, namely, of some three or four days. After much discussion ten days ‘oTmr”’^ was accepted by a very large maj ority. The principle of notification was unanimously adopted.

Each Government is to notify to other Governments the existence of plague within their several jurisdictions, and at the same time state the measures of prevention which are being carried out to prevent its diffusion. The area deemed to be infected is limited to the actual district or village where the disease prevails, and no locality is

deemed to be infected merely because of the importation into it of a few cases of plague while there has been no diffusion of the malady. As regards the precautions to be taken on land frontiers, it was decided that during the prevalence of plague every country had the inherent right to close its land frontiers against traffic. As regards the Eed Sea, it was decided after discussion that a healthy vessel may pass through the Suez Canal, and continue its voyage in the Mediterranean during the period of incubation of the disease the prevention of which is in question. It was also agreed that vessels passing through the Canal in quarantine might, subject to the use of the electric light, coal in quarantine at Port Said by night as well as by day, and that passengers might embark in quarantine at that port. Infected vessels, if these carry a doctor and are provided with a disinfecting stove, have a right to navigate the Canal in quarantine, subject only to the landing of those who are suffering from plague, and of such persons as have been in actual contact with the sick or with infected articles, together

with the disinfection of the infected compartment of the vessel. Passing on to the conclusions dealing with regular tions to be imposed " in Europe," the following are the chief points to be noted: — As regards measures to be adopted at ports of arrival, the conclusions of the Dresden convention were as far as practicable adhered to. In the case of healthy vessels, i.e., those on board of which there is no illness, though they have sailed from an infected port, it was decided that they should at once have ivee pratique, but at the option of the local authority certain measures of disinfection of soiled articles may be required. For suspected vessels, viz., those on board of which there has been plague, but no fresh case within twelve days, some limited processes of disinfection, &c., as defined, having been complied with, it is recommended that the crew and passengers should be subject to surveillance for a period of ten days from the date of the arrival of the vessel. In the case of infected vessels, viz., those on which plague is actually present, or on which that disease has occurred ten days before arrival, the sick are to be landed and isolated,

and the remainder of those on board are to be subjected, at the discretion of the local authority, to " observation " or "surveillance" for a period not exceeding ten days from the date of the occurrence of the last case of plague. In this convention the terms " observation " and " surveillance" are for the first time clearly defined; the definition as to the latter stating that under that system passengers are not to be isolated, but are to be allowed at once to proceed to their homes, where they can remain under medical supervision so long as may be deemed necessary by the local authority. The results of this conference indicated a great advance on the part of the nationalities represented , towards a liberal and truly scientific conception of the means to be adopted by their respective Governments for the prevention and control of infective diseases. (j. l. n.)

Hypnotism. — Under the name of hypnotism a remarkable revival of what used to be called mesmerism or animal magnetism has taken place. It began in France about 1880, and has attracted much scientific

and popular interest. It is a common experience that when the attention of persons is for the first time drawn to a thing, they are apt to regard what is new to themselves as altogether new. This has conspicuously happened in regard to hypnotism. Extravagant claims of novelty and utility have been made on its behalf, but

there is really nothing new either in the phenomena or in the hopes founded on them. All that has been added to previous experience is the investigation of certain aspects of the subject in a somewhat more systematic manner and in the light of somewhat fuller knowledge. This has resulted in establishing the reality of the main phenomena on a firm basis of accurate observation, but no substantial advance has been made in the explanation of their nature or in their application to medical practice. Any belief to the contrary is founded on ignorance of what has been done in the past. In order to make clear the precise

value of the recent revival, a brief historical retrospect is necessary. (See also Magnetism, Animal, Ency. Brit. vol. XV.)

In a sense the phenomena of hypnotism have probably" been known from time immemorial. They appear to form part of certain traditional practices of great antiquity in the East, and traces of them may be found in classical and mediaeval times, but they were first brought forward ' in a systematic way by Friedrich Anton Mesmer, a Viennese physician who flourished in the latter half of the 18th century. He stumbled across them accidentally in the year 1774, while treating a young woman for hysteria by the application of metal plates. In 1778 he came to Paris, where he soon attracted attention and acquired a vogue which his professional colleagues could not forgive and have not to this day forgiven. No doubt he practised in a highly theatrical and unorthodox manner, and made a great deal of money by doing so, but he did not profess to cure everything, as some modern hypnotists do, and expressly disclaimed any value for his treatment in

organic disease. The methods of producing the mesmeric " crisis " were essentially the same as those used to-day for putting persons into the hypnotic state, namely, various ways of fixing the visual and mental attention. "His usual method was to seat himself opposite the patient with knees touching, the patient regarding him fixedly." The effects were also essentially the same — trance, somnambulism, subordination of the will, and impressibility. Mesmer called it animal magnetism, and formulated an elaborate theory on the subject, but most of his propositions are fantastic and unintelligible, though some of his speculations have been curiously confirmed in later years. He had many followers, who carried on the practice after his retirement in 1785, and notably the marquis de Puysegur, who anticipated nearly everything that has been done since. After the Eevolution, which put a temporary stop to animal magnetism, it was taken up again and flourished widely on the Continent. The Berlin Academy of Science offered a prize for the best essay on the subject. Mesmerism was practised in the

hospitals, and minor operations were performed under mesmeric anaesthesia. That was about 1820. In 1831 a commission, appointed by the Academie de Medecine, issued a very favourable report after an inquiry lasting five years. The reality of the phenomena, including somnambulism and its effects, was declared to have been proved, but a second commission in 1837 reversed the decision and threw the whole thing into discredit. The next phase was the re-discovery of what had been discovered before, with the addition of a new name and a new theory. This was the work of James Braid of Manchester, who invented the word Hypnotism, and maintained that the mesmeric phenomena were not caused by a magnetic fluid, but depended on the " physical and psychical condition of the patient, irrespective of any agency proceeding from or excited into action by another." He was led to take up the study in 1841 by witnessing the public performance of a mesmeric entertainer. Neither his methods nor his results differed essentially from those of earlier mesmerists,

but he undoubtedly put the thing on a more rational and more scientific basis. He himself suggested that hypnotism might be called "rational" as opposed to " transcendental mesmerism." His success in the therar peutic application of hypnotism was not conspicuously greater than that attained many years before in France. He published his Neurypnology in 1843. The word was coined to signify the science of " nervous sleep," but it is not a good one. Natural sleep is "nervous," and hypnotism is not sleep. Braid, in fact, made very much the same mistake as Mesmer in adopting an in-adequate or erroneous theory, and viewing all the facts in the light of it. About the same time, but quite inde-pendently, a Scots surgeon named Esdaile was practising > mesmerism in India, chiefly for producing anaesthesia, which he succeeded in doing with natives to an extent never since approached. He performed upwards of 300 major operations under mesmeric anassthesia in the Indian hospitals, and otherwise showed a complete mastery of the art. On one occasion he hypnotized a man behind

his back and without his knowledge in open court. The affections treated by Braid included various forms of paralysis, neuralgia, nervous headache, hysteria, epilepsy, defects of sight, hearing, smell, and speech, palpitation of the heart, dyspepsia, spinal irritation, clubfoot, curvature of the spine, some skin diseases, and rheumatism. He disclaimed any wish " to hold it [hypnotism] up as a universal remedy," nor did he profess to understand fully how the effects were produced, but he held that " besides the peculiar impression directly made on the nervous centres, by which the mind is for the time thrown out of gear, and which enables us to localize or concentrate the nervous energy or sensorial power to any particular point or function, we have also an extraordinary power of acting on the capillaries and of increasing and diminishing the force and frequency of the circulation, locally and generally." Experience led him to modify his earlier opinion that the hypnotic state is quite independent of the agency of the operator, and he himself made use of mesmeric " passes." Braid's investigations attracted a good

deal of attention, but were not favourably received in scientiflc and orthodox circles, with some exceptions ; and they excited the hostility of the mesmerists, who did not like to see their theory of a magnetic fluid overthrown. Throughout the history of the subject — indeed, from Mesmer dovm to the Nancy school — exponents and oppo-nents alike have been more given to controversy over theories than to the patient investigation of facts. Braid, however, made some distinguished converts among un-prejudiced men to whom the facts appealed, and they seem to have realized the bearing of certain phenomena better than he did himself. Notably they developed the importance of suggestion, and fully anticipated the Nancy school of modern hypnotists. Suggestion was nothing new, having been known to Mesmer, but its significance had been missed by the earlier mesmerists, who believed in a magnetic fluid. Braid appreciated it better, and pointed out that "the sleeper" exhibits "physical manifestations of the suggestion received through words or excited by sensible impressions which thereby direct his current of

thought," and also that " deflnite physical changes could be excited and regulated and controlled at will, according to the suggestion of another person " ; but it was more clearly and more fully recognized by Dr Gregory, professor of chemistry at Edinburgh. In a book on mesmerism, published in 1851, he says, "It must be at once obvious to every person acquainted with physiology that the peculiar phenomena now under consideration depend on the principle of suggestion," and further, "it is self-evident that the power of suggestion may be usefully

applied in medicine." Professor Hughes-Bennett, a physi-cian of high standing, said in his lectures about the same time that it was clear " that the effect is produced by-operating on the mind of the individual, and through that on his bodily powers. In short, predominating ideas, whether originating spontaneously or suggested by the words and actions of others, seem to be the exciting cause in individuals affected with a peculiar condition of the

cerebral functions. The labours of Dr Esdaile in India and Mr Braid of Manchester exhibit a worthy commencement in the rational treatment of disorders by the means alluded to, and there can be little doubt that in no long time its influence, when further studied, will be acknowledged." Hypnotic suggestion was used in medicine in the manner indicated, also for the production of anaesthesia and the treatment of dipsomania ; but its value was not generally acknowledged, and it gradually dropped out of sight. Evidently it did not fulfil expectations ; it ceased to attract public or scientific attention, and fell into disuse. This fact, after the complete recognition of its nature just quoted, and the sanguine hopes entertained of its utility, is of the greatest significance. For some thirty years mesmerism or hypnotism was dormant, save for the travelling showman and a few adherents in France, who readily embraced the opportunity of practising the tabooed art under a new name, and even succeeded in smuggling it into the Academic des Sciences. But it excited only a brief spasm of

interest, and the subject dropped until the revival initiated by Charcot. In the year 1877 he was nominated to investigate and report on the treatment of nervous diseases with metal discs, introduced by Burq. He found the phenomena genuine, and continued the study in his own wards. Experimenting on cases of hysteria, he soon came across the hypnotic or mesmeric condition, and recognized its reality. In short, by the irony of fate the most distinguished of French physicians, treading exactly in the steps of Mesmer, who also began by experimenting on hysterical patients with metal plates, once more re-discovered the whole thing just a hundred years later. His name soon gave an impetus to the study, and an extensive revival followed. Hypnotism became orthodox, and the few French physicians who had been practising it quietly came out into the light of day. Among them was Dr Liebeault of Nancy, who had been using hypnotism for twenty years. His academic colleagues in that city, who had ignored him hitherto, now sought inspiration from his experience, and he became the father

of what was called the Nancy school of hypnotism. Its distinguishing mark was the supreme importance attached to suggestion. According to the most advanced exponents of the Nancy school, there is nothing in hypnotism except suggestion, which is a universal therapeutic agency or " cure all " — if, indeed, all treatment is not a form of suggestion. On the other hand, the " Paris school," following Charcot, regarded hypnotic susceptibility as a morbid condition allied to hysteria. The rise of these rival schools dates from about 1880. At the same time Heidenhain of Breslau embarked independently on the study of mesmerism from a physiological point of view, obtaining his first instruction from a travelling mesmerist, as Braid did. Heidenhain fully established the reality of the phenomena, and formulated a theory that they are due to inhibition of the higher centres in the brain, caused by rhythmical stimulation of the senses. One of his experiments is particularly interesting, because it proves that persons can be hypnotized against their will, and that the condition is not, therefore, purely " subjective." Prussian

soldiers were mesmerized and sent to sleep upon parade, though they had the strongest reasons for not committing such a serious breach of discipline. From 1880 onwards the vogue of hypnotism increased rapidly, until it culminated in 1889, when an International Hypnotic Congress was held in Paris. It was attended by representatives from every European nation and from North and South America, and among the honorary presidents were Charcot, Brown-Sequard, Brouardel, Eichet, and Lombroso. For two or three years after this hypnotism continued to excite great interest, and sanguine expectations were entertained of its future usefulness in medicine, but the excitement did not last long. Interest once more began to languish, and at present the practice, which never obtained a general hold upon the medical profession, appears to be falling again into neglect.

The foregoing summary will sufB.ce to show that animal magnetism, mesmerism, and hypnotism have a continuous history, and are essentially one and the same thing, which

has undergone a series of revivals under different names and in connexion with different theories. The service rendered by the latest revival is not that it has introduced anything new, but that it has established the existence of the hypnotic or mesmeric condition with an authority which must carry conviction to all minds capable of judging evidence. The same phenomena have been re-discovered again and again since Mesmer's time. If they are not real, then it must be supposed that a vast number of persons of all classes and nationalities, including the most ignorant peasants and Orientals, have entered into a conspiracy to deceive for more than a century past, with no real object in view, and often at the cost of great pain to themselves, and have learnt their lesson so well that they all behave in the same way and reproduce the same symptoms so skilfully as to delude hundreds of the most acute and most sceptical observers. This is too large a draft upon the credulity of any one. Scepticism is justified in the case of all exhibitions and paid subjects, who have repeatedly been convicted of trickery, and should

never be trusted. But the investigations of medical men and physiologists, carried out upon genuine hospital patients and other subjects of unimpeachable honesty in all classes of life, stand on a different footing. Nor should the phenomena be confounded with the theories invented to explain them. This was the mistake made by the earlier critics of mesmerism ; with the exception of the French commission of 1825, and a few other clear-headed observers, they devoted their attention to the supposed magnetic fluid and, ignoring the phenomena, pronounced the whole thing a delusion because the existence of the magnetic fluid was not proved to their satisfaction.

The main facts established may be summarized as follows: — (1) The hypnotic state may be induced in various ways. The most usual are fixation of the gaze on some object; gentle monotonous stimulation of any of the senses; a sudden flash of light or loud noise ; passes by the hand ; a command or suggestion to go to sleep. Some of these may be combined.

Occasionally subjects pass spontaneously into the state. Return to the normal is effected by the command to wake up, which may be assisted by a slight physical stimulus, such as a light tap or blowing in the face. When left to themselves subjects awake spontaneously after a time. Natural susceptibility varies greatly. Some persons are affected at once, and even against their will. Others remain wholly refractory, though willing and even anxious to be hypnotized. Susceptibility is always increased by practice. Some operators are more successful than others. Certain races appear to be far more susceptible than others,— the French, for instance, more than the English. In Paris hypnotization has been effected by a revolving instrument resembling that used to attract larks. The

clinique of patients at the Charity Hospital gazing at this object and falling into trances exactly recalls Mesmer's baqv^t. (2) Subjects are very variously affected, but the commonest effects are conditions resembling sleep, trance,

or catalepsy, and somnambulism, in which ordinary con-
sciousness is lost, and the subject renders implicit obedi-
ence to the operator, remembering nothing on waking up.
Certain physiological phenomena have been observed.
The muscles contract on being stroked, and the whole
body may be rendered rigid; the senses may be enor-
mously heightened, so that sounds can be heard and
odours smelt at far greater distances than in the normal
state, and print can be read through layers of cotton-wool
or a wooden screen; the circulation may be affected by
modifying the action of the heart and by causing the
blood-vessels, especially the capillaries, to contract or
dilate ; according to Charcot, it has been ascertained by
exact observation with instruments of precision that the
blood-vessels undergo regular changes in certain hypnotic
states, contracting in some and dilating in others ; the
respiration may be slowed or quickened ; regular changes
also take place in the secretions, and the action of various
glands may be modified at pleasure ; anaesthesia and para-
lysis may be produced. The psychological phenomena

occur in the somnambulistic state, and are mostly mani-

festations of an extreme susceptibility ^ aiJ^festions,

which may be conveyed by word of mouth, by gestures

and signs, or by some other agency acting through one of

the senses. The mind and will of the subject are blank,

ready to receive and act upon any idea impressed upon

them. This phase of hypnotism is the basis of mesmeric

exhibitions on the one hand, and of its therapeutic appli-

cation on the other. There seems hardly any limit to the

obedience of susceptible subjects in the somnambulistic

state, but the fears that it might be used to procure the

commission of crime have not been realized. One of the

most striking phenomena produced is that of "post-

hypnotic suggestion," in which the subject on awaking

executes an order previously given during the somnambu-

listic condition without any recollection or consciousness

of the source of the impulse, and it may be after the lapse

of a considerable interval of time. The effects of sug-

gestion are greatly heightened in some subjects by a

marked increase of intellectual and emotional power, ana-

logous to the exalted capacity of the special senses, which enables them to perform feats of which they are totally incapable in their ordinary condition.' A peculiar relation is established between the operator and the subject, who ignores every one else.

Such are the principal phenomena of hypnotism, but it must be understood that some of them are rather rare, and only produced in specially susceptible subjects. The still rarer effects described by the older mesmerists, such as clairvoyance, telepathy, and " presensation," have not been observed by recent investigators, but Charcot de-scribes some very similar phenomena, and it would be highly unscientific to pronounce them impossible merely because they are outside the range of ordinary experience. Theories of hypnotism are legion. Some are discussed elsewhere (see Physiology, Nerve and Muscle). They have only an academic or controversial interest. Until the normal working of the brain is better understood, it is futUe to speculate on such an abnormal condition as the hypnotic.

There remains the practical application of hypno-
tism in medicine. Modern experience has not materi-
ally enlarged its utility. It has been used for the
most part in the same class of cases as during pre-
vious flourishing periods — namely, in functional disorders
of the nervous system and for the relief of pain. The
only distinctively novel application is that attempted
by the Nancy practitioners, who professed to find a
sovereign remedy in suggestion, and used it in every class
of disease, including the specific fevers. The success of
this new departure has been less conspicuous than its
boldness. Speaking generally, the sanguine hopes of
enthusiastic hypnotizers have not been realized, and the
attitude of the bulk of the profession in holding aloof
from the practice while admitting the reality of the
hypnotic phenomena has been fuUy justified. Charcot
himself abandoned the use of hypnotism because he found
that it did more harm than good and merely added to the
disorder of already disordered nervous systems. Others
have followed his example ; and though a faithful few

may still remain constant to their faith in the virtues of suggestion, it cannot be said that their number or their credit is increasing. This is precisely what might have been expected. History is only repeating itself once more. Had there been any real value in the thing, it would never have fallen into neglect in the 'thirties and again in the 'fifties. Its successive revivals have been due ' to the reality of the phenomena, which continually re-assert themselves with all the indestructible force of truth ; its successive periods of decline have been due to inherent weakness and therapeutic inutility. The hypnotic state and its effects are too uncertain, too capricious, and too dangerous for general use in medicine. (a. sl.)

Hythe, a municipal borough of Kent, England, 67 miles south-east of London by rail. Eecent erections include a sessions hall and an institute. The sea-wall and parade, belonging to the South-Eastern and Chatham railway, and the buildings of the Eoyal School of Mus-ketry, have been extended. There is constant communica-tion with Sandgate by means of a tramway along the

front, and an excellent golf-course has been laid out on the downs. Area, 2620 acres. Population (1881), 4173 ; (1901), 5557.

Ibague, or San Bonifacio de Ibagub, chief town in the department of Tolima, in the Eepublic of Colombia, South America. It is picturesquely situated on a beautiful plain 4300 feet above searlevel, between the rivers Chipalo and Combeimna, affluents of the Cuello, about 18 miles north-west of the Nevada del Tolima. With the Magdalena river it is connected by rail to Girardot, and it is the entrepot of the valleys of Mag-dalena and Cauca. There are two thermal springs in the environs, and unexploited mines of sulphur and silver. The chief productions of the district are cacao, tobacco, rice, and sugar-cane. The city dates from 1550. In 1854 it was for a short time the capital of the Eepublic. Population, about 13,000.

Ibsen, Henrik (1828), Norwegian dramatic and lyric poet, eldest son of Knud Ibsen, a merchant of the small Norwegian seaport of Skien, and of his wife, Maria

Cornelia Altenburg, was born at Skien, in a house on the market-place now destroyed, on the 20th of March 1828. Eor five generations the family had consisted on the father's side of a blending of Danish, German, and Scottish races, with little intermixture of pure Norwegian ; this last element was contributed by the mother. In 1836

Knud Ibsen became insolvent, and the family withdrew, in great poverty, to a cottage in the outskirts of the town. After brief schooling at Skien, Ibsen was sent, towards the close of 1843, to be apprenticed to an apothecary in Grimstad; here he remained through seven dreary years of drudgery, which set their mark upon his spirit. In 1847, in his nineteenth year, he began to write poetry. He made a gloomy and almost sinister impression upon persons who met him at this time, and one of his associates of those days has .recorded that Ibsen " walked about Grimstad like a mystery sealed with seven

seals." He had continued, by assiduous reading, his self-education, and in 1860 he contrived to leave his narrow conditions and come up as a student to Christiania. In the same year he published his first work, the blank-verse tragedy of Gatilina, under a pseudonym. A second drama, The Viking's Grave, was acted (but not printed) a few months later; he was at this time entirely under the influence of the Danish poet Oehlenschlager. During the next year or two Ibsen made a very precarious livelihood in Christiania as a journalist, but in November 1851 he had the good fortune to be appointed " stage-poet " at the little theatre of Bergen, with a small but regular salary. He was practically manager at

this house, and he also re-
ceived a travelling stipend.
In 1852, therefore, he went, to
study the stage, to Copenhar
gen and to Dresden. Among
many dramatic experiments
which Ibsen made in Bergen,
the most considerable and
most satisfactory is the saga-
drama of Mistress Tnger at
Ostraat, which was produced
in 1855 ; here are already
perceptible some qualities of
his mature character. Much
less significant, although at
the time more successful, is
The Banquet at Solhaug, a
tragedy produced in Bergen
in the first days of 1856;
here for a moment Ibsen

abandoned his own nascent manner for an imitation of the popular romantic dramatist of Denmark, Henrik Hertz. It is noticeable that Ibsen, by far the most original of modern writers for the stage, was remarkably slow in discovering the true bent of his genius. His next dramatic work was the romantic tragedy of Olaf lAljekrans, performed in 1857, but unprinted until 1898. This was the last play Ibsen wrote in Bergen. In the summer of the former year his five years' appointment came to an end, and he returned to Christiania. Almost immediately he began the composition of a work which showed an extraordinary advance on all that he had written before, the beautiful saga-drama of The Warriors in Helgeland, in which he threw off completely the influence of the Danish romantic tragedians, and took his material directly from the ancient Icelandic sources. This play marks an epoch in the development of Norwegian literature. It was received by the managers, both in Christiania and Copenhagen, with contemptuous disapproval, and in the autumn of 1857 Ibsen could not con-

Henrik Ibsen.

(From aphotograph by JNyblin, Christiania.)

trive to produce it even at the new theatre of which he was now the manager. The Warriors was not acted anywhere until 1861. During these years, Ibsen, in constant opposition, suffered many reverses and humiliations, but he persisted, in the face of all, to pursue his own line in art. Some of his finest short poems, and amongst others the admirable seafaring romance of Terje Vigen, belong to the year 1860. The annoyances which Ibsen suffered, and the retrograde and ignorant conditions which he felt around him in Norway, developed the ironic qualities in his genius, and he became an acid satirist. The brilliant rhymed drama, Love's Comedy, a masterpiece of lyric wit and incisive vivacity, belongs to 1862. This was a protest against the official conventionality which deadens the beauty of all the formal relations between men and women, the pettiness, the publicity, and the prosiuess of betrothed and married life among the middleclasses inNorway. It showed how society

murders the poetry of love.

For some-time past Ibsen had been meditating another of his saga-dramas in prose, and this appeared in 1864 as Kong-semnerne (" The Pretend-ers "). These works, how-ever, now so universally admired, contained an ele-ment of strangeness which was not welcome when they were new. Ibsen's position in Christiania grew more and more disagreeable. He had positive misfortunes which added to his embarrassment. In 1862 his theatre became bankrupt, and he was glad to accept the poorly-paid post of " aesthetic adviser " at the

other house. An attempt to obtain apoet's pension (digter-gage) was unsuccessful ; the Storthing, which had just voted one toBjornson, refused to do the same for Ibsen. His cup was full of disillusion and bitterness, and in April 1864 he started, by Berlin and Trieste, ultimately to settle inRome. His anger and scorn gave point to the satirical ar-rows which he shot back to his thankless fatherland from Italy in the splendid poem of Brand, published in Copenhagen in 1866, a fierce attack on the Laodicean state of religious and moral sentiment in the Norway of that day ; the central figure, the stern priest Brand, who attempts to live like Christ and is snubbed and hounded away by all his latitudinarian companions, is one of the finest conceptions of a modern poet. Ibsen

had scarcely closed Brand before he started a third lyrico-dramatic satire. Peer Qipit (1867), which remains, in a technical sense, the most highly finished of all his metrical works. In Brand the hero had denounced certain weaknesses which Ibsen saw in the Norwegian character, but these and other faults are personified in the hero of Peer Ghjnt; or rather, in this figure the poet has pictured, in a type, the Norwegian nation in all the egotism, vacillation, and lukewarmness which he believed to be characteristic of it. Ibsen, however, acted better than he preached, and he soon forgot his abstraction in the portrait of Peer Gynt as a human individual. In this magnificent work modern Norwegian literature first rises to a level with the finest

European poetry of the century. In 1869 Ibsen wrote the earliest of his prose dramas, the political comedy of The Young Men's League, in which for the first time he exercised his extraordinary gift for perfectly natural and yet pregnant dialogue. Ibsen was in Egypt, in October

1869, when his comedy was put on the stage in Christi-
ania, amid violent expressions of hostility ; on hearing
the news, he wrote his brilliant little poem of defiance,
called At Port Said. By this time, however, in spite of
the antagonism of the critics and of certain sections of the
public, Ibsen had become a successful author; Brand
sold largely, and has continued to be the most popular
of Ibsen's writings. In 1866, moreover, the Storthing
had at last been persuaded to vote him a " poet's pension,"
and there was now an end of Ibsen's long struggle with
poverty. In 1868 he left Eome, and settled in Dresden
until 1874, when, after a voluntary exile of ten years, he
returned to Norway. But after a short visit he returned
to Germany, and lived first at Dresden, afterwards at
Munich, and did not finally settle in Christiania until
1891. His shorter lyrical poems were collected in 1871,
and in the course of that year his name and certain of
his writings were for the first time mentioned to the
English public. During these years, however, he was
engaged on no new work, but was very carefully revising

the old ones, which were now oiit of print, and which he would not resign again to the reading world until he had subjected them to what in some instances (for example. Mistress Inger at Ostraat) amounted to practical recom-position. In 1873 he published a huge double drama, each part of which was of unusual hal^, the whole forming the tragedy of Emperor and Galilean ; this is Ibsen's latest historical play, and has for subject the unsuccessful struggle of Julian the Apostate to hold the world against the rising tide of Christianity. This work is of an experimental kind, and takes its place between the early poetry and the later prose of the author, with-out properly belonging to either class. Compared with the series of plays which Ibsen was now about to begin, which indeed he had already inaugurated with The Young Men's League, Emperor and Galilean preserves a colour of idealism and even of mysticism which was for many years to be absent from Ibsen's writings, and to reappear in his old age with The Master-builder. There is some foundation for the charge that Ibsen has made

his romantic Greek emperor needlessly squalid, and that he has robbed him, at last, too roughly of all that made him a sympathetic exponent of Hellenism. Ibsen was now greatly occupied by the political spectacle of Germany at war in Denmark, then at war in Erance, and he believed that all things were conspiring to bring the old order of national ideas to a close in Europe, and to start a new epoch of individualism. He was therefore deeply disgusted by the Paris commune, and disappointed by the conservative reaction which succeeded it. This disillusion in political matters had a very direct influence upon Ibsen's literary work. It persuaded him that nothing could be expected in the way of reform from democracies, from large blind masses of men moved capriciously in any direction, but that the sole hope for the future must lie in the study of personality, in the development of individual character. He set himself to diagnose the conditions of society, which he had convinced himself lay sick unto death. Hitherto Ibsen had usually employed rhymed verse for his dramatic com-

positions, or, in the case of his saga-plays, a studied and artificial prose. In spite of the surprising achievements of his poetry, he determined to abandon versification altogether for the future, and to write only in the language of everyday conversation. In the first drama of this his new period, Tlie Pillars of Society (1877), he dealt with the problem of hypocrisy in a small commercial centre of industry, and he drew in the Bernick family a marvellous picture of social egotism in a prosperous seaport town. There was a certain similarity between this piece and A Doll's House (1878), although the latter was much the more successful in awakening curiosity. Indeed, no production of Ibsen's has been so widely discussed as this play, which is nevertheless not his most coherently conceived. Here also social hypocrisy, the convention which goes on covering up and patching together the rotten texture of life instead of rending it away, was ' the object of the playwright's satire, but this time mainly in relation to marriage. In A Doll's House Ibsen first developed his views with

regard to the individualism of woman. In his previous writings he had depicted woman as the devoted and willing sacrifice to man ; here he begins to explain that she has no less a duty to herself, and must keep alive her own conception of honour and of responsibility. The conclusion of A Doll's House was violently and continuously discussed through the length and breadth of Europe, and to the situation of Nora Helmer is probably due more than to anything else the long tradition that Ibsen is "immoral." He braved convention still more audaciously in Ghosts (1881), which is perhaps the most powerful of the series of plays in which Ibsen is occupied in diagnosing the diseases of modern society. It was received in Norway with a tumult of ill-will, and the author was attacked no less venomously than he had been twenty years before. Ibsen was astonished and indignant at the reception which was given to Ghosts, and at the insolent indifferentism of the majority to all ideas of social reform. He wrote, more as a pamphlet than as a play, what is yet one of the most effective of his come-

dies. An Enemy of the People (1882). Dr Stockmann, the hero of that piece, discovers that the drainage system of the bathing-station on which the little town depends is faulty, and the water impure and dangerous. He supposes that the corporation will be grateful to have these deficiencies pointed out; on the contrary, they hound him out of their midst as an " enemy of the people." In this play occurs Ibsen's famous and typical saying, " a minority may be right — a majority is always wrong." This polemical comedy seemed at first to be somewhat weakened by the personal indignation which runs through it, but it has held the stage. Ibsen's next drama. The Wild Duck (1884), was written in singular contrast with the zest and fire which had inspired An Enemy of the People. Here he is squalid and pessimistic to a degree elsewhere unparalleled in his writings ; it is not quite certain that he is not here guilty of a touch of parody of himself. The main figure of the play is an unhealthy, unlucky enthusiast, who goes about making hopeless mischief by exposing weak places in the sordid

subterfuges of others. This drama contains a figure, Hjalmar Ekdal, who claims the bad pre-eminence of being the meanest scoundrel in all drama. The Wild Duck is the darkest, the least relieved, of Ibsen's studies of social life, and his object in composing it is not quite obvious. With Bosmersholm (1885) he rose to the height of his genius again; this is a mournful, but neither a pessimistic nor a cynical play. The fates which hang round the contrasted lives of Eosmer and Rebecca, the weak-willed scrupulous man and the strong-willed unshrinking woman, the old. culture and the new, the sickly conscience and the robust one, create a splendid dramatic antithesis. Since that time, Ibsen has written a series of dramas, of a more and more symbolical and poetic character ; the earliest of these was the mystical The Lady from the Sea (1888). At Christmas 1890 he brought out Hedda Gahler; two years later The Master-

builder, in whicli many critics see the highest attain-

ment of his genius ; at the close of 1894 Little Eyolf ; at Christmas 1896 John Gabriel Borkman ; and in January 1900 Wlieyi We Dead Awaken. On the occasion of his seventieth birthday (20th March 1898), Ibsen was the recipient of the highest honours from his own country and of congratulations and gifts from all parts of the world. A colossal bronze statue of him was erected outside the new National Theatre in September 1899. No recent writer belonging to the smaller countries of Europe has had so widely spread a fame as that of Ibsen, and although the value of his dramatic work is still occasionally contested — at least in England — it has received the compliment of vivacious discussion in every part of the world. There would, perhaps, have been less violence in this discussion if it had been perceived that the author does not pose as a moral teacher, but as an imaginative investigator. He often and with much heat has insisted that he is not called upon as a poet to suggest a remedy for the diseases of society, but to diagnose them. In this he is diametrically opposed to Tolstoi, who admits that he writes

his books for the healing of the nations. If the subjects which Ibsen treats, or some of them, are open to controversy, we are at least on firm ground in doing homage to the splendour of his art as a playwright. He has re-introduced into modern dramatic literature something of the velocity and inevitability of Greek tragic intrigue. It is very rarely that any technical fault can be found with the architecture of his plots, and his dialogue is the most lifelike that the modern stage has seen. His long apprenticeship to the theatre in his early days was no doubt of immense service to him in this respect. In every country, though least perhaps in England, the influence of Ibsen has been marked in the theatrical productions of the younger school. Even in England, on the rare occasions when his dramas are acted, they awaken great interest among all intelligent playgoers.

lea, a coast department of Peru. It has an area of 6295 square miles, and the population in 1896 was 90,962, or 14 to the square mile. It is divided into two provinces, Chindia and lea. The vine is extensively

cultivated, in addition to sugar-cane, tobacco, and rice, and the mineral waters have some repute. There is a railway from lea, the capital of the province and department (about 12,000), to Pisco.

lOELAJ^D.

Geogeapht and Statistics.

ICELAND has an area of 40,437 square miles. Its length is 298 miles, and breadth 194 miles. The most extensive development of the coast-line is on the north-west, where a peninsula, diversified by a great number of fjords, projects outwards from the main portion of the island. The total length of the coast-line is about 3730 miles, of which approximately one-third belongs to the north-west peninsula. The great bays on the west of the island (Eaxafl6i and Brei6ifj6rSur), as well as the many bays on the north, which are separated from one another by rocky promontories, appear to owe their origin to subsidences of the surface ; whereas the fjords of the north-west peninsula, which make excellent harbours, and those of the east coast, seem to be

the result chiefly of erosion.

The Tablelands. — Iceland is a plateau or tableland, built up of volcanic rocks of older and younger formation, and pierced on all sides by fjords and valleys. As compared with the tableland, the lowlands have a relatively small area, namely, one-fourteenth of the whole ; but, on the other hand, they are of vastly the greater importance, for the low-lying coasts and valleys are almost the only parts of the island which are inhabited. In consequence of the rigour of its climate, the central tableland is absolutely uninhabitable. At the very outside, not more than one-fourth of the area of Iceland is inhabited ; the rest consists of elevated deserts, lava streams, and glaciers. The north-west peninsula is separated from the main mass of the island by the bays Hunafldi and BreiSif jortSur, so that there are really two tablelands, a larger and a smaller. The isthmus which connects the two is only 4J miles across, but has an altitude of 748 feet above sea-level. The mean elevation of the north-west peninsula is 2000 feet. The numerous fjords and glens which cut

into it from all sides are shut in by precipitous walls of basalt, which plainly shows that they have been formed by erosion right through the mass of the plateau. The surface of this tableland is also bare and desolate, being covered with gravel and fragments of rock. There is scarcely a vestige of vegetation ; but here and there are large straggling snowfields, the largest being Glima and Drangajokull, on the culminating points of the plateau. The only districts which are inhabited are the shores of the fjords, where grass grows capable of supporting sheep ; but a large proportion of the population gain their live-lihood by fishing. The other and larger tableland, which constitutes the substantial part of Iceland, reaches its cul-minating point in the south-east, in the gigantic snowfield of Vatnajokull, which covers an area of 3300 square miles. The axis of highest elevation of Iceland stretches from north-west to south-east, from the head of Hvammsf j6r8ur to HornafjorSur, and from this water-parting the rivers descend on both sides. The crest of the water-parting is crowned by a chain of snow-capped mountains, separated

by broad patches of lower ground. In fact, they are really a chain of minor plateaux, which rise to an altitude of from 4600 to 6260 feet above sea-level and 2000 to 3000 feet above the tableland itself. In the extreme east is Vatnajokull, which is separated from TungnafellsjokuU by Vonarskard (3300 feet). Between TungnafellsjokuU and HofsjokuU lies the broad depression of Sprengi-sandur (2130 feet). Between HofsjokuU — still going north-west — and the next snow-capped mountain, Langjokull, lies Kjolur (2000 feet) ; and between Langjokull and Eiriksjokull, Flosaskard (2630 feet). To the north of the joklar last mentioned there are a number of lakes, all well stocked with fish. Numerous valleys or glens penetrate into the tableland, especially on the north and east, and between them long mountain spurs, sections of the tableland which have resisted the action of erosion, thrust themselves out towards the sea. Of these the most considerable is the mass crowned by Myrdalsjokull, which stretches towards the south. The interior of the tableland consists for the

most part of barren, grassless deserts, the surface being covered by gravel, loose fragments of rock, lava, driftsand, volcanic ashes, and glacial detritus.

The Lowlands cover, as already mentioned, a relatively small area. With the exception of the lower parts of the larger glens, there are no lowlands on the north and east ; they are confined entirely to the south and west. The south coast is flat next the sea ; but immediately under-neath Vatnajokull there is merely a strip of gravel and sand, brought down and deposited by the glacial streams.

The most extensive low-lying plain of Iceland is that which lies between M^rdalsjokull and Eeykjanes, with an area of about 1550 square miles. In its lowest parts this plain barely keeps above sea-level, but it rises gradually towards the interior, finally terminating in a ramification of valleys. Its maximum altitude is attained in 381 feet, near Geysir. On the west of Hekla this lowland plain connects by a regular slope directly with

the tableland, to the great injury of its inhabited districts, which are thus exposed to the clouds of pumice dust and driftsand that cover large areas of the interior. In this way a considerable portion of this region has been devastated by the north-east storms. Nevertheless the greater part of this lowland plain produces good grass, and is relatively well inhabited. The plain is drained by three rivers — Markarflj6t, Thj6rs4 and OelfusEt — all of large volume, and numerous smaller streams. Towards the west there exist a number of warm springs. There is another lowland plain around the head of Faxafldi, nearly 400 square miles in extent. This, like the former plain, is encircled by mountains. As a rule the surface of this second plain is very marshy. ‘ Several dales or glens penetrate the central tableland; the eastern part of this lowland is called BorgarfjorSur, the western part Myrar.

Glaciers. — An area of no less than 5170 square mUes is covered with snowfields and glaciers {joklar). This extraordinary development of ice and snow is due to the

raw, moist climate, the large rainfall, and the low summer temperature. The snow-line varies greatly in different parts of the island, its range being from 1300 to 4260 feet. It is highest on the tableland, on the north side of Vatnajokull, and lowest on the north-west peninsula, to the south of North Cape. Without exception the great n^ves of Iceland belong to the interior tableland. Interiorly they consist of slightly rounded domes or billowy snowfields of vast thickness. In external appear-ance they bear a closer resemblance to the glaciers of the Polar Regions than to those of the Alps. The largest snowfields are Vatnajokull (3280 square miles), Hofsjokull (620), LangjokuU (500), and Myrdalsjokull (390). The glaciers which stream off from these snowfields are often of vast extent, e.g., the largest glacier of Vatnajokull has an area of 160 to 200 square miles, but the greater number are of course small. Altogether, at the present time more than 124 glaciers are known in Iceland. It is on the south side of Vatnajokull that they descend lowest ; the lower end of BreidamerkurjokuU was in the

year 1894 only 30 feet above sea-level. The glaciers of the north-west peninsula also descend very nearly to sea^ level. The great number of streams of large volume is due to the moist climate and the abundance of glaciers, and the milky white or yellowish-brown colour of their waters is due to the glacial clays. The majority of them change their courses very often, as well as vary greatly in volume; frequently they are impetuous torrents, hampered by numerous waterfalls. Iceland also possesses a great number of lakes, the largest being Thingvallavatn and Thorisvatn, each about 27 square miles in area. My vatn, in the north, is well known from the natural beauty of its surroundings. Above its surface tower a great number of volcanoes and several craters, and its waters are alive with waterfowl, a multitude of ducks of every species breeding on its islands. The lakes of Iceland owe their origin to different causes, some being due to glacial erosion, others to volcanic subsidence. Myvatn fills a depression between lava streams, and has a depth of not more than 8f feet. The group of lakes called

Fiskivotn (or Veidivotn), which lie in a desolate region to the west of Vatnajokull, consist for the most part of crater lakes. The groups of lakes which lie north-west from LangjokuU occupy basins formed between ridges of glacial gravel ; and in the valleys numerous lakes are found at the backs of the old moraines.

Geology. — Iceland is built up almost entirely of volcanic rocks, none of them older, however, than the middle of the Tertiary period. The principal varieties are basalt and palagonitic breccias, the former covering two-thirds of the entire area, the latter the remaining one-third. Compared with these two systems, all other formations have but an insignificant development. The palagonitic breccias, which stretch in an irregular belt across the island, are younger than the basalt. In the north-west, north, and east the coasts are formed of basalt, and rise in steep, gloomy walls of rock to altitudes of 3000 feet and more above the level of the sea. Deposits of clay, with remains of plants of the Tertiary period, lignite, and tree-trunks pressed flat, which the Icelanders

call surtarbrandur, occur in places in the heart of the basalt formation. The region in which these fossiliferous strata are developed in greatest thickness is the north-west peninsula. Indeed, in some few places well-marked impressions of leaves and fruit have been discovered, proving that in Tertiary times Iceland possessed ex-tensive forests, and its annual mean temperature must have been at least 48-2° Fahr., whereas the present mean is 35-6°. The palagonitic breccias, which attain their greatest development in the south of the island and on the tableland, consist of reddish, brown, or yellowish rocks, tuffs and breccias, belonging to several different groups or divisions, the youngest of which seems to be of a date subsequent to the Glacial epoch. All over Iceland, in both the basalt and breccia formations, there occur small intrusive beds and dykes of liparite, and as this rock is of a lighter colour than the basalt, it is consequently visible from a distance. In the south-east of the island, in the parish of Ldn, there exist a few mountains of gabbro, a variety of rock which does not occur in any

other part of Iceland. In the neighbourhood of Hiisavik in the north there have been found marine deposits containing a number of marine shells ; they belong to the Eed Crag division of the Pliocene. In the middle of Iceland, where the geological foundation is tuff and breccias, large areas are buried under ancient outflows of lava, which bear evidences of glacial scratching. These lava streams, which are of a doleritic character, flowed before the Glacial age, or during its continuance, out of lava cones with gigantic crater openings, such as may be seen in some places even at the present day. During the Glacial epoch the whole of Iceland was covered by a vast sheet of inland ice, except for a few small isolated peaks rising here and there along its outer margins. This ice-cap had on the tableland a thickness of 2300 to 2600 feet. Eocks scored by glacial ice and showing plain indications of striation, together with thousands of erratic blocks, are found scattered all over Iceland. Signs of the coast having receded subsequent to the Glacial epoch are very common all round the island, especially

on the north-west peninsula. There we find strikingly developed marine terraces of gravel, shore lines, and surf beaches marked on the solid rock. In several places, too, there are traces of shells ; and sometimes skeletal remains of whales and walruses, as well as ancient driftwood, have been discovered at tolerable distances from the present coast. The ancient shore-lines occur at two different altitudes. Along the higher, 230 to 260 feet above the existing searlevel, shells have been found which are characteristic of high Arctic latitudes and no longer exist in Iceland ; whereas on the lower shore-line, 100 to 130 feet, the shells belong to species which occur amongst the coast fauna of the present day.

Volcanoes. — Iceland is one of the most volcanic regions

on the face of the earth; volcanic activity has gone on continuously from the first formation of the island in the Tertiary period down to the present time. So far as is known, there have in historic times been eruptions from

twenty-five volcanic vents. Altogether 107 volcanoes are known to exist in Iceland, with thousands of craters, great and small. Prom all these there has issued a vast quantity of lava. The lavarstreams which have flowed out since the Glacial epoch now cover an area of 4650 square miles. They are grouped in dense masses around the volcanoes from which they have flowed. The majority of them are the accumulated result of several outflows which have taken place at different periods ; but the bulk of the lava dates from outbreaks which occurred in prehistoric times. The largest volume of lava which has issued at one outflow within historic times is the stream which came from the craters of Laki at Skapta. This belongs to the year 1783, and covers an area of 218 square miles, and amounts to a volume represented by a cube each of whose sides measures 7^ miles. The largest unbroken lavarfield in Iceland is OdatSahraun, upon the tableland north from Vatnajokull (2000 to 4000 feet above sea-level). It is the accretion of countless eruptions from over twenty volcanoes, and covers an

area of 1300 square miles (or, including all its ramifica-
tions and minor detached streams, 1700 square miles),
and its volume would fill a cube measuring 134 miles in
every direction. As regards their superficies, the lavar
streams differ greatly. Sometimes they are very uneven
and jagged (apalhraun), consisting of blocks of lava
loosely flung together in the utmost confusion. The big
lava^fields, however, are composed of vast sheets of lava,
ruptured and riven in divers ways (Jielluhraun). The
smooth surface of the viscous billowy lava is further
diversified by long twisted " ropes," curving backwards
and forwards up and down the undulations. Moreover,
there are gigantic ' fissures, running for several miles,
which have been caused by subsidences of the underlying
sections. The best-known fissure of this character is
Almannagj^ at Thingvellir. On the occasion of out-
breaks the fine ashes are scattered over a large portion
of the island, and sometimes carried far out across the

Atlantic. After the eruption of Katla in 1625 the ashes were blown as far as Bergen in N"orway, and when Askja was in eruption in 1875 a rain of ashes fell on the west coast of Norway 11 hours 40 minutes later and at Stockholm 15 hours afterwards. The volcanic ash frequently proves extremely harmful, in that it destroys the pastures, so that the sheep and cattle die of hunger and disease. The outbreak of Laki in 1783 occasioned the loss of 11,500 cattle, 28,000 horses, and 190,500 sheep—that is to say, 53 per cent, of all the cattle there were in the island, 77 per cent, of the horses, and 82 per cent, of the sheep. After that the island was visited by a famine, which destroyed 9500 people, or one-fifth of the total population.

The Icelandic volcanoes may be divided into three classes : (1) cone-shaped, like Vesuvius, built up of alternate layers of ashes, scoriae, and lava ; (2) cupola-shaped, with an easy slope and a vast crater opening at the top — these shield-shaped cupolas are composed entirely of layers of lava, and their inclination is seldom steeper

than 7°-8° ; (3) long chains of craters running close alongside a fissure in the ground. For the most part the individual craters are low, generally not exceeding 300 and 500 feet. These crater chains are both very common and often very long. The chain of Laki, which was formed in 1783, extends to 20 miles, and embraces about one hundred separate craters of different sizes. Some-times, however, the lava-streams are vomited straight out of gigantic fissures in the earth without any crater being formed. Many of the Icelandic volcanoes are during their periods of quiescence covered with snow and ice. Then when an outbreak occurs the snow and ice melt, and in that way they sometimes give rise to serious catastrophes (jokulhlaup), through large areas of the country being suddenly inundated by great floods of water, which bear masses of ice floating on their surface. Katla caused very serious destruction in this way by converting several cultivated districts into barren wastes. In the same way in the year 1362 Oeraefajokull, the -loftiest mountain in Iceland (6424 feet), annihilated two entire parishes by

sweeping forty farms, together with their inhabitants and live stock, bodily into the ocean. The best-known of the volcanoes is Hekla, which has been in eruption eighteen times within the historic period, the last in 1845. Katla during the same period has been active thirteen times, the last occasion being in 1860. The largest volcano is Askja, situated in the middle of the lava-field of OdaSahraun. Its crater measures 34 square miles in area, and its latest outburst was in 1875. At Myvatn there are several volcanoes, which were particularly active in the years 1724-30. On several occasions there have been volcanic outbreaks under the sea outside the peninsula of Eeykjanes, islands appearing above the waves and afterwards disappearing again. The crater chain of Laki has only been in eruption once in historic times, namely, the violent and disastrous outbreak of 1783. Iceland, however, possesses no constantly active volcano, such as, e.g., Stromboli. There are often long intervals between the successive outbreaks, and the outbreaks are wont to be exceedingly violent.

Indeed, many of the volcanoes, and this is especially true of the chains of craters, have only vented themselves in a solitary outburst.

Earthquakes are a phenomenon of frequent occurrence, especially in the districts which are peculiarly volcanic. Historical evidence goes to show that they are closely associated with three naturally defined regions — (1) the region between Skjalfandi and Axarf jorSur in the north, where violent earth tremblings are extremely common; (2) at Faxafl6i, where minor vibrations are frequent; (3) the southern lowlands, between Eeykjanes and Myrdals-jokull, have frequently been devastated by violent earth-quake shocks, with great loss of property and life, e.g., on 14th-16th August 1784, when 92 farmsteads were totally destroyed, and 372 farmsteads and 11 churches were seriously damaged; and again in August and Sep-tember 1896, when another terrible earthquake visited this region, completely destroying 161 farmsteads and doing injury to 155 others. Hot springs are found in every part of Iceland, both singly and in groups ; they are more

particularly numerous in the western portion of the southern lowlands, where amongst others is the famous Geysir. Sulphur springs and boiling mud lakes are also general in the volcanic districts ; and in places there are carbonic acid springs, these more especially on the penin-sula of Snaefellsnes, north of Faxafldi.

Climate. — Considering its high latitude and situation, Iceland has a relatively mild climate. The meteorological conditions vary, however, greatly in different parts of the island. In the south and east the weather is gene-rally changeable, stormy, and moist; whilst on the north the rainfall is less. The climate of the interior tableland approximates to the continental type, the thermometer sometimes falling to the levels of extremely bitter cold. The mean temperature of the year is 37-2° Fahr. in Stykkish61mur on BreiSifj6r«ur, 38-3° at Eyrarbakki in the south of Iceland, 41° at Vestmannaeyjar, 36° at Akureyri in the north, 36-7° on Berufj6rt5ur in the east, and 30-6° at Modrudalur on the central tableland. The range is great not only from year to year, but also from

month to month. For instance, at Stykkish61mur the highest annual mean for March -was 39-7°, and the lowest 8°, during a period of thirty-eight years. Iceland lies contiguous to that part of the north Atlantic in -which the shifting areas of low pressure prevail, so that storms are frequent and the barometer is seldom firm. The barometric pressure at sea-level in the south-west of Iceland during the period 1878-1900 varied between 30-8 and 27-1 inches. The climate of the coasts, which is closely dependent upon the oceanic currents, is relatively mild in summer, but tolerably cold in winter. The winter means of the north and east coasts average 31-7° and 31-3° Fahr. respectively; the summer means, 42-8° and 44-6° ; and the means of the year, 334° and 36-6°. On the other hand, the winter means of the south and west coasts average 32° and 31-7° respectively; the summer means, 48-2° and 60° ; the annual means, 37-4° and 39-2°. The rainfall on the south and east coasts is considerable,

e.g., at Vestmannaeyjar, 49-4 inches in the year; at BerufjorSur, 43-6 inches. On the west coast it is less, e.g., 24-3 inches at Stykkishdlmur ; but least of all on the north coast, being only 14-6 inches on the island of Grimsey, which lies off that coast. Mist is commonly prevalent on the east coast ; at Beruf jorSur there is mist on no less than 212 days in the year. The south and west coasts are washed by the Gulf Stream, and the north coast by an Arctic current, which frequently brings with it a quantity of drift-ice, and thus exercises a considerable effect upon the climate of the island; sometimes it effectually blocks the north coast in the summer months. On the whole, during the 19th century, the north coast has been free from ice on an average of one year in every four or five.

Flora. — The vegetation presents the characteristics of an Arctic-European type, and is tolerably uniform throughout every part of the island, the differences even on the tableland being but slight. At present 435 species of Phanerogams and Vascular Cryptogams are

known ; the lower Orders have been but little investigated. The grasses are of the greatest importance to the inhabi-tants, for upon them they are dependent for the summer and winter keep of their live stock. Heather is also extensively prevalent, and plays a prominent part in the feeding of the sheep. The development of forest trees is insignificant. Birch woods still exist in a good many places, especially in the warmer valleys, which penetrate considerable distances inland ; but the trees are very short, scarcely attaining to more than 3 to 10 feet in height. In a few places, however, they reach 13 to 20 feet ; and the highest birch-tree in Iceland (at Hallormstadaskdgur in East Iceland) reaches 28 feet. A few mountain ash or rowan trees (Sorbus aucuparia) are found growing singly here and there, and attain to 30 feet in height. Willows are also pretty general, the highest in growth being Salix phyllicifolia, 7 to 10 feet.

Fauna. — The Icelandic fauna is of a sub- Arctic type. But while the species are few, the individuals are often numerous. The land mammals are very poorly repre-

sented ; and it is doubtful whether any species of those that do exist is indigenous. The polar bear is an occasional visitant, being brought to the coast by the Greenland drift-ice. Foxes are common; mice and the brown rat have been introduced, though one mouse variety is possibly indigenous. Reindeer were introduced in 1770. The marine mammalia are very numerous. The walrus is now seldom seen, although in prehistoric times it was very common. There are numerous species of seals ; and the seas abound in whales, and a considerable whaling industry thrives on the north-west coast. Of birds there are over 100 species, more than one-half of them being aquatic. In the interior the whistling swan is common, and numerous varieties of ducks are found in the lakes. The eider duck, which breeds on the islands of BreiSifjorSur, is a source of livelihood to the inhabitants, as are also the many kinds of searfowl which breed on the sea-cliffs. Iceland possesses neither reptiles nor batrachians. The fish fauna is abundant in individuals, some sixty-eight species being

found off the coasts. The cod fisheries are amongst the most important in the world. Large quantities of herring, plaice, and halibut are also taken. Many of the rivers abound in salmon, and trout are plentiful in the lakes and streams.

Population and Occupations. — The census of 1890 gave a total population of 70,927, and this number had by the end of 1899 increased to 76,383. The increase during the 19th century was 27,000; to whom must be added at least 15,600 more, who have emigrated to America, chiefly to Manitoba, since 1872. The principal occupation of the Icelanders is breeding of cattle, more particularly the breeding of sheep, although during the last few years the fishing industries have come rapidly to the front. In 1860, 82 per cent, of the population were dependent upon cattle-breeding and 7 per cent, upon fishing; in 1890 the numbers were 64 per cent, and 18 per cent, respectively. Agriculture is, however, not now practised in Iceland; all bread-stuffs are imported. In ancient times barley was grown in some places, but it

never paid for the cost of cultivation. The moist insular climate and the coolness of the summers are inimical to the cultivation of crops and the growth of forests. The breeding of cattle has declined in importance. In 1703 there were 36,860 head of cattle; in 1898, 21,982 head. On the other hand, the number of sheep has increased from 278,994 in 1703 to 735,442 in 1898. In the latter year there were 44,134 horses, relatively a large number, but then all travelling is done on horseback, and by the same means all goods are conveyed. Formerly garden-ing was of no importance, but considerable progress has been made in this branch of late years, especially in the cultivation of potatoes and turnips. In 1895 the harvest amounted to 67,400 bushels of potatoes and 61,750 bushels of turnips. Fruit-trees will not thrive ; but black and red currants and rhubarb are grown, the last-named doing excellently well. Iceland possesses four agricul-tural schools, one agricultural society, and small agri-cultural associations in nearly every district. The fisheries give employment to about 12,000 people. For the most

part the fishing is carried on from open boats, notwith-standing the dangers of so stormy a coast, especially in winter, and many lives are lost every year. But during recent years the fishermen have begun to use larger decked vessels, and these boats are increasing in number every season. In summer the waters are visited by a great number of foreign fishermen, inclusive of about 300 fishing-boats from French ports, manned by about 6000 men, as well as in the last years by fishing-boats from the Faroes and Norway and steam trawlers from England. Excellent profit is made in certain parts of the island from the herring fishery; this is especially the case on the east coast. Marine insurance societies and a school of navigation have been founded at Reykjavik. The export of fish and fish products has greatly increased. For instance, in 1849-65 the annual average exported was 1480 tons ; in 1891-94 it was 10,800 tons, valued at £215,000; and in 1899 amounted to 11,339 tons and 68,079 barrels of oil, valued at £276,596.

Commerce. — From the first colonization of the island down to the 14th century the trade was in the hands of native Icelanders and Norsemen ; in the 15th century it was chiefly in the hands of the English, in the 16th of

Germans from the Hanse towns. From 1602 to 1786 commerce was a monopoly of the Danish Government ; in the latter year it was declared free to all Danish subjects, and in 1864 free to all nations. Since the year 1874, when Iceland obtained her own administrar-tion and the arrangement of her own finances, both the general comfort of the people and the commerce have in-creased considerably. The total value of the imports and exports together amounted in 1849 to not more than £170,000 ; in the years 1881-86 the annual average value of the imports alone amounted to £340,000, and of the exports to £310,000 ; whilst in 1891-96 the imports aver-aged £366,000, and the exports £340,000. In the year 1899 the ~~imports were valued at £458,500, and the ex~~

ports at £426,900, or a total of £885,400. That is to say, since 1849 the value of the aggregate trade has increased by £715,400, and is now more than five times greater than when free trade was introduced. The principal native products exported are live sheep, horses, salt meat, wool and woollen wares, and hides, to which must be added the fish products — cod, train-oil, herring, and salmon — and eiderdown feathers, &c. The imports consist principally of cereals and flour, coffee, sugar, ale, wines and spirits, tobacco, manufactured wares, iron and metal wares, timber, salt, coal, &c. In the year 1898 there were in Iceland 204 merchants' businesses, of which 166 belonged to Icelanders, and 48 to Danes and foreigners ; in addition several co-operative societies buy considerable quantities of goods in England through commission agents. In 1899 the shipping which entered at Icelandic ports was represented by 380 vessels of 70,369 tons (199 steamships of 54,228 tons and 181 sailing vessels of 16,131 tons) ; of which 82 of 18,357 tons came from Denmark, 179 of 30,000 tons from Great Britain, and 69

of 10,726 tons from Norway. The money, weights, and measures in use are the same as in Denmark. The National Bank in Reykjavik issues bank-notes, though not beyond £41,670 in value.

Communications. — In so sparsely inhabited a country the means of communication have always been primitive. All land journeys are made on horseback, and in the remoter parts all goods have to be transported by the same means. Throughout the greater part of the island there exist no proper roads even in the inhabited districts, only bridle-paths. In the uninhabited districts there are not even bridle-paths. Nevertheless a good deal has been done to improve such paths as there are, and even several miles of driving roads have been made, more particularly in the south. Since 1888 many bridges have been built; previous to that year there were none at all. The larger rivers have been spanned by iron swing bridges, as, for example, Oelfus^ and Thj6rs^, and Blanda is now crossed by a fixed iron bridge. Great progress has also been made in the

steamboat services round the coasts and with foreign countries. Postal connexion is maintained with Denmark by steamboats, which sail from Copenhagen eighteen times a year, and put in at Leith on the way. Besides, steamers go all round the island, touching at nearly every port.

lieligion. — The Icelanders are Lutherans. For ecclesiastical purposes the island is divided into 20 deaneries and 142 parishes, and the affairs of each ecclesiastical parish are administered by a parish council, and in each deanery by a district Qijerad) council. When a living falls vacant, the governor-general of the island, after consultation with the bishop, selects three candidates, and from these the congregation chooses one, the election being subsequently confirmed by the governor-general. In the case of certain livings, however, the election requires confirmation by the Crown. In 1847 a theological seminary was founded at Reykjavik, and there the majority of the Icelandic ministry are educated ; some, however, are graduates of the University of

Copenhagen.

The public health has shown great improvement ; the death-rate of little children has in especial diminished very appreciably. This improvement is due to greater cleanliness, better dwellings, better nourishment, and the increase in the number of doctors and midwives, who are now scattered all over the country, whereas formerly there was scarcely a doctor to be found from one end of the island to another. A new asylum for leprosy has been erected at Laugarnes near Reykjavik. There is a medical school at Reykjavik, opened in 1876. The general sanitary affairs of the island are under the control of a chief surgeon (national physician), who lives in Reykjavik, and also has the superintendence over the doctors and the medical school. There are at the present time twenty permanently appointed district surgeons, besides sixteen assistant surgeons, a state oculist, four small hospitals, and four dispensaries. Midwives are required to attend a course of lectures at the medical school.

Administration and Finances. — There was no change

of any importance in the administrative relations during the last twenty-five years of the 19th century. But in 1902 it was arranged that the minister for Iceland should transfer his office from Copenhagen to Reykjavik. Iceland has her own budget, the Althing having, by the constitution of 1874, acquired the right to vote its own supplies. The Althing only meets every other year, and the budget is consequently passed for two years at once. In the financial period 1896-97 the total income was £67,200, the expenditure £67,300. There is a national reserve fund of about £60,000, but no public debt ; nor is there any contribution for either military or naval purposes. Iceland has her own customs service, but the only import duties levied are upon spirits, tobacco, coffee, and sugar, and in each case the duties are fairly low. During recent years one-quarter of the national income has been spent upon the means of communication — subventions to the steamboat service round the coasts, and for the building of bridges and the making of roads. In Reykjavik there is a national bank, and there are numerous small

savings banks in various parts of the island.

^dwcaiion. —Notwithstanding that there are still only a few elementary schools in the towns, in the fishing villages, and in certain more densely inhabited parts of the island, education is pretty widespread amongst the people. Very often the children are instructed at home ; in some places by peripatetic teachers. It is incumbent upon the clergy to see that all children are taught to read, and write, and "sum." The people are great readers ; considering the number of the inhabitants, books and periodicals have a very extensive circulation. At the present time eighteen newspapers are issued (once and twice a week), besides several journals. Iceland has always been distinguished for her native literature. At Reykjavik there are a Latin school, a medical school, and a theological school ; at Modruvellir and HafnarfjorSur, modern high schools {realschulen) \ and in addition to these there are four agricultural schools, a school of navi-gation, and three girls' schools. The largest collection of books is the national library at Reykjavik, containing

some 40,000 volumes and 3000 MSS. At the same place there is also a valuable arch^ological collection. Amongst the learned societies may be mentioned the Icelandic Literary Society (Bokmentafjelag) and the Society of the Friends of the People, as well as the Archaeological Society of Reykjavik.

Towns. — There are several small towns scattered along the coasts. The largest is Reykjavik on Faxafldi, with

6700 iniabitants (1900), the capital of the island, and the place of residence of the governor-general and the bishop. ThQfe, too, the Icelandic Parliament (Althing) meets ; and there, further, are the principal public institutions of the island (library, schools, &c.). The town is adorned by a statue to Thorvaldsen, the famous sculptor, who was of Icelandic descent. The remaining towns embrace IsafjorSur (1000) on the north-west peninsula, Akureyri (1000) on the north, and SeydisfjorSur (800) in the east. The total urban population was 14,705 in-

habitants in 1899. (th. t.)

LiTEKATUBE.

The literature of Iceland since 1874 has been in a more flourishing state than ever before since the 13th century. Lyrical poetry is by far the largest and the most interesting portion of it. The great influence of J6nas Hallgrimsson (1807-1845) is still felt, and his school was the reigning one up to the end of the 19th century, although then a change seemed to be in sight. The most successful poet of this school is Steingrfmr Thorsteinsson (born 1830). He is specially famous for his splendid descriptions of scenery (T7ie Song of GUsbakki), his love-songs, and his sarcastic epigrams. As a translator he has enriched the literature with The Arabian Nights, Sakuntala, King Lear, and several other masterpieces of foreign literature. Equal in fame is Matthias Jochumsson (born 1835), who, following another of J6nas Hallgrimsson's many ways, has successfully revived the old metres of the classical Icelandic poets, whom he resembles in his

majestic, but sometimes too gorgeous, language. He is as an artist inferior to Steingrimr Thorsteinsson, but surpasses him in bold flight of imagination. He has successfully treated subjects from Icelandic history {Qrettisljd'd, a series of poems about the famous outlaw Grettir). His chief fault is a certain carelessness in writing; he can never write a bad poem, but rarely a poem absolutely flawless. He has translated Tegn^r's Frithiofs Saga, several plays of Shakespeare, and some other foreign masterpieces. The great religious poet of Iceland, Hallgrimr Petursson, has found a worthy successor in Valdimar Briem (born 1848), whose Songs of the Bible are deservedly popular. He is like Matthias Jochumsson in the copious flow of his rhetoric ; some of his poems are perfect both as regards form and contents, but he sometimes neglects the latter while polishing the former. An interesting position is occupied by Benedict Gr5ndal (born 1826), whose travesties of the old romantic stories,' and his truly Aristophanic drama GandrevSin ("The Magic Eide") about contemporary

events, are among the best satirical and humorous productions of Icelandic literature. Most of his works belong, however, to the period before 1874 ; after that time he is chiefly known as a miscellaneous writer.

Influenced by J6nas Hallgrimsson with regard to language and poetic diction, but keeping unbroken the traditions of Icelandic mediaeval poetry maintained by SigurSr BreiSfjortS (1798-1846), is another school of poets, very unlike the first. In the middle of the 19th century this school was best represented by Hj^lmar Jdnsson from Bdla (1796-1876), a poor farmer without any education to speak of, but endowed with great poetical talents, and the author of satirical verses not inferior to those of Juvenal both in force and coarseness. In the last decades of the 19th century this school produced two poets of a very high order, both distinctly original and Icelandic, and comparatively free from any foreign influence. One is Pall Olafsson (born 1827). His songs are mostly written in '^E.g., "The Battle of the Plains of Death," a burlesque on the battle of Solferino.

the mediaeval quatrains (ferskeytla), and are generally of a humorous and satirical character ; his convivial songs are known by heart by every modern Icelander ; and although some of the poets of the present day are more admired, there is none who is more loved by the people at large. The other is porsteinn Erlingsson (born 1868). His exquisite satirical songs, in an easy and elegant, but still manly and splendid language, have raised much discussion. Of his poems may be mentioned The Oath, a series of most beautiful ballads, with a tragical love-story of the 17th century as their base, but with many and happy satirical allusions to modern life; Jorundr., a long poem about the convict king, the Danish pirate Jorgensen, who nearly succeeded in making himself the master of Iceland, and TJie Fate of the Gods and Tlie Men of the West (the Americans), two poems which, with their anti-clerical and half-socialistic tendencies, have caused strongprotestsfrom some of the orthodox Lutheran clergy. Near to this school, but still standing apart, is Grimur Thomsen (born 1820). In the beginning of the 'eighties a new school arose —

having its origin in the colony of Icelandic students at the University of Copenhagen. They had all attended the lectures of Georg Brandes, the great reformer of Scandinavian literature, and, influenced by his literary theories, they chose their models in the realistic school, which then gradually was becoming the reigning one in all the Scandinavian countries. This school is very dissimilar from the half-romantic school of Jdnas Hallgrimsson ; it is nearer the national Icelandic school represented by Pall Olafsson and porsteinn Erlingsson, but differs from those writers by introducing foreign elements hitherto unknown in Icelandic literature, and — especially in the case of the prose-writers — ^by imitating closely the style and manner of some of the great Norwegian novelists. Their influ-ence brought the Icelandic literature into new roads, and it is interesting to see how the tough Icelandic element gradually assimilates the foreign. Of the lyrical poets, Hannes Hafsteinn (born 1861) is by far the most import-ant. In his splendid ballad. The Death of Skarphedinn, and in his beautiful series of songs describing a voyage

through some of the most picturesque parts of Iceland, he is entirely original; but in his love-songs, beautiful as many of them are, a strong foreign influence can be observed. Among the innovations of this poet we may note a predilection for new metres, sometimes adopted from foreign languages, sometimes invented by himself, a thing practised rarely and generally with small success by the Icelandic poets, who as a rule are extremely conservative in that respect, and generally keep to the metres used by their predecessors.

No Icelandic novelist has as yet equalled J6n Thdroddsen (1819-1868). The influence of the realistic school has of late been predominant. The most distinguished writer of that school has been Gestur PfClsson (1862-1891), whose short stories, with their sharp and biting satire, have produced many imitations in Iceland. The best are A Home of Love and Captain Sigurd. J6nas Jdnasson (born 1866), a clergyman of northern Iceland, has, in a series of novels and short stories, given accurate, but somewhat dry, descriptions of the more gloomy sides of Icelandic country

life. His best novel is Bandi'drfrom Hvassafell, a historical novel of the Middle Ages. Besides these we may mention Torfhildur H<51m, one of the few ladies who have distinguished themselves in Icelandic literature. Her novels are mostly historical.

The drama is still in its infancy, but the last decade of the 19th century saw the establishment of a permanent theatre at Reykjavik. The poet Matthias Jochumsson has written several dramas, but their chief merits are lyrical. The most successful of Icelandic dramatists as yet is IndritSi Einarsson, whose plays, chiefly historical, in spite

of excessive rhetoric, are very interesting, and possess a true dramatic spirit.

In geography and geology porvaldr Thoroddsen has acquired a European fame for his researches and travels in ' Iceland, especially in the rarely- visited interior. Of his numerous works in Icelandic, Danish, and German,

we may mention the History of Icelandic Geography, a monumental work. In history Pall Melste^'s (born 1812) chief work, the large History of the World, belongs to this period, and its pure style has had a beneficial influence upon modern Icelandic prose.

Of the younger historians we may mention porkell Bjarnason (History of the Beformation in Iceland). J6n Porkelsson (born 1822), inspector of the archives of Iceland, has rendered great services to the study of Icelandic history and literature by his editions of the Diplomatarium Islandicum and Obituarium Islandicum, and by his Icelandic Poetry in the 15th and 16th Century, written in Danish, an indispensable work for any student of that period. A leading position among Icelandic lexicographers is occupied by J6n porkelsson, formerly head of the Latin school at Reykjavik, whose Supplement til islandske Ordboger, an Icelandic-Danish vocabulary (three separate collections), has hardly been equalled in learning and accuracy. Other distinguished philologists are his successor as head of the Latin school, Bjorn Magniisson Olsen {Researches on Sturlunga,

Ari the Wise, TJie Runes in the Old Icelandic Literature — the last two works in Danish) ; Finnur J6nsson, professor at the University of Copenhagen {Histwy of the Old Norwegian and Icelandic Literature, in Danish, andN excellent editions of many old Icelandic classical works) ; and Valty'r GuSmundsson, lecturer at the University of Copenhagen (several works on the old architecture of Scandinavia) and editor of the influential Icelandic literary and political review, EimreiMn (" The Locomotive "). The English reader can be referred to no authorities on recent Icelandic literature in his own language, but he will find interesting information in the following German works : — J. C. Poestion. Isldndische Dichter der Neuzeit. Leipzig, 1897.— C. Kuchlee. Geschichte der islandischen Dichtung der Neuzeit. Leipzig, 1896. — Ph. Schweitzek. Island; Land und Leute. Leipzig, 1885. — Alexander Baumgaetner. Island und die Faroer. Freiburg-im-Breisgau, 1889. (s. Bl.)

Ichang, a treaty port in the province of Hupeh, China, on the left bank of the Yangtse, of which it is the present upper limit of steam navigation. It is

distant 400 miles from Hankow, and consequently about 1000 miles from Shanghai. All cargo to or from Szechuen is here transhipped from steamer to junk, or vice versd. About 10 miles above Ichang the famed scenery of the Yangtse gorges begins. Through these the great river runs in a series of rapids, which make navigation by vessels of any size extremely diflicult and even dangerous. A very large trade, nevertheless, is carried on by this route between Chungking and Ichang. As a local centre of distribution this port is of no great consequence, the transhipment trade with Szechuen being almost its sole business. The population is estimated at 36,000. The number of foreign residents is very small, trade being carried on by Chinese agents. The total trade of the port amounted in 1899 to £4,675,000, and in 1900 to £3,741,600, as compared with £1,026,800 in 1891, the principal import being cotton yarn and the principal export opium.

ICHTHYOLOaY.

THE activity that prevailed in the field of ichthy-

ology during the last two decades of the 19th century has not been surpassed in any of the other branches of zoology. In those contributions which were of a systematic or descriptive character so many additions have been made to the list of generic and specific forms that the number of known species of living fishes, which in the year 1870 was stated to have been about 8625, has since then been nearly doubled. Our acquaintance with the fish-faunas of all the geographical regions has made proportionate progress, especially in the case of North America and tropical Africa, while the use of the deep-sea trawl, with its many improvements, as well as of other instruments of capture, partly in previously unexplored oceans, has brought to light an astonishing number of new forms of oceanic fishes. There is scarcely any part of the organization of fishes which has not been made the subject of investigation by the morpho-logist with the view of clearing up the genetic relations of the various types. Eesearches into the development of the ova, and of the larval and post-larval stages, particu-

larly of economic and oceanic fishes, have been stimulated by their important bearing upon the interests of the fishing industries. Finally, palaeontological inquiries, undertaken with due reference to living forms, have resulted in important discoveries, filling up gaps in the imperfect geological record, and leading towards a better understanding of the line of evolution of certain types. In this supplementary article only some of the most important results can be dealt with, and they will be referred to in the same sequence which was adopted for the article in the earlier volumes (xii.) of the Ency. Brit, (ninth edition).

The systematic arrangement under -which the class of fishes was presented to the student at the end of the historical sketch in the former article, and which is chiefly based on the anatomical characters eatf.' demonstrated by Johannes Mliller, has met with scanty acceptance from ichthyologists. It ceased to satisfy the demands of the morphologist when it was found that the heart of Albula and the intestine of Chirocentrus showed conditions capable of being inter-

preted as transitional characters connecting Ganoids with Teleosteans. To the palaeontologist a wide separation of these two types was still less acceptable, since it was made dependent on soft structures not capable of f ossiliza-tion, and therefore not available in the study of fossils. Moreover, palaeontology claims to be able to demonstrate from fossil remains a continuity of the series from Ganoid to Teleostean, or, in other words, a direct genetic relation-ship of these types. Thus the view taken by Owen in 1866, and yet more distinctly expressed by Liltken in 1868, has been resuscitated in the most recent classifica-tion, even with the term proposed by the former for the assemblage of Ganoids and Teleosteans, viz., Teleostomi. The separation of Branchiostoina into a class distinct from that of Pisces — Acrania — which has been proposed by Haeckel, is a view now generally adopted. Cope has gone a step farther, and similarly separated the Cyclostomi and the extinct Ostracoderms in a class of vertebrates which he has named Agnatha, and which would be charac-terized by the want of paired fins and the supposed total

absence of a lower jaw. In the class of fishes proper four types are distinguished by the presence or absence of a suspensorium, and by the development of cranial dermal ossifications and of an osseous gill-cover. Weighty objections against the class Agnatha have been raised by several

ichthyologists, especially by E. H. Traquair, but the Copean arrangement has been adopted in the main by Smith Woodward. These palseichthyologists are also agreed as to the Chondropterygian affinities of the AcantJiodii, which formerly had been provisionally placed among the Ganoids, or were regarded as an annectent type between Ganoids and Chondropterygians. As far as the main divisions of extinct and living Cydostomi and PalceichtJiyes are concerned, the systematic arrangement, modified by Traquair's recent researches into the Ostracoderms, appears as follows : —

Class : Agnatha.

I. Subclass : Cyclostomi.

With three Orders : (a) Hyperoartia (Lampreys) ; (6) ffyperotreti (Myxmoids) ; {c)Gyclim (Palssospondylus).

II. Subclass : OSTKACODEEMI.

With four Orders : (a) Heterostraci (Ccelolepidse, Psammosteidsß, Drepanaspidae, Pteraspidae) ; (6) Osteostraci (Cephalaspidse, Ateleaspidse, &o.) ; (c) Antiarchi (Asterolepidse, Pterichthys, Bothrolepis, &c.) ; (d) Anaspida (Birkeniidss).

Class: Pisces.

I. Subclass : Elasmobkanohii.

With four Orders : (a) Pleuropterygii (Cladoselache) ; (6) Ichthyotomi (Pleuracanthidse) ; (_c)Acanthodii (Diplacanthidse and AcanthodidEe) ; (d) Selachii (divided from the structure of the vertebral centres into Asterospondyli and Tectospondyli).

II. Subclass : HOLOCEPHALI.

With one Order : Ghimoeroidei.

III. Subclass : Dipnoi.

With two Orders : (a) Sirenoidei (Lepidosiren, Ceratodus, UronemidsB, Ctenodontidse) ; (6) Arthrodira (Homosteus,

Ooccosteus, Dinichthys) .

rV. Subclass : Teleostomi.

A. Order : Grossopterygii.

With four Suborders : Q) JSaplistia (Taxassius) ; (2) Bhipidistia (Holoptyohiidse, Ehizodontidse, Osteolepidse); (3) Actinistia (Coelacanthidss) ; (4) Gladistia (Polypterus).

J5. Order: Actinopterygii.

■ *With about twenty Suborders : (1) Ghondrostei (Palseoniscidae, Platysomidse, Chondrosteidse, Sturgeons); (2) Protospondyli (Semionotidse, Maorosemiidae, Pycnodontidse, EugnathidEe, Amiidse, Pachycormidae) ; (3) Aetheospondyli (Aspidorhynchidse, Lepidosteidse^ ; (4) Isospondyli (Pholidophoridse, Osteoglossidae, Clupeidse, Leptolepidse, &c.) ; (5) Plectospondyli (Cyprinidae, Characinidse) ; (6) Nematognathi ; (7) Apodes ; and the other Xeleosteans.*

Morphological and Anatomical Work.

Of the contributions to our knowledge of the morphology of fishes, none perhaps claim'a higher interest than

those dealing with the origin and evolution of ^’”®” the paired fins. Guided by the hypothetical analogy to the origin of the median fins, some morphologists (Thacker, Mivart, Dohrn, Wiedersheim) maintained that the paired fins were similarly evolved out of a lateral skin-fold, a theory which, from a palseontological point of view, has found strong support in the discovery of the structure of the paired fins of Oladoselache (B. Dean and S. Woodward) from the Upper Devonian, the most primitive type of shark as yet known. Also the paired series of abdominal spines of the Aeanthodian, Climatius, is referred to as strongly suggesting an originally continuous fin-fold. The lateral fold is supposed to have been the continuation of the embryonic median fold, which on reaching the vent split into a right and left branch, and was supported by short parallel cartilaginous rods extending outwards from the body-wall. In the post-branchial and pelvic regions the fold with its cartilages broadened into fin-like flaps, while the intermediate portion disappeared. Such, indeed, is the condition of the fins in

Cladoselache, in which these organs would not have served in locomotion, but had merely the function of " balancers " {Ptychopterygium) (Dean). In the further course of evolution, the archipterygial stage is reached by the fusion and shortening of the endoskeletal parts, the area of the fin being increased by the development of dermal rays, while, finally, the endoskeletal elements become correlated with the dermal rays, instead of with the axial skeleton. This view of the origin of the paired fins has been criticized by Semon and Gegenbaur, and certainly it has not been supported by the former's researches into the development of the fins in embryonal Ceratodus. According to Gegenbaur, the archipterygium is the most primitive form of fin. " An archipterygium has been the starting-point for the Crossopterygian fin as well as that of Selachians and Dipnoans ; and each of these three divisions shows a modification of its own of a primitive condition which is now no more in existence, and of which palaeontological evidence has hitherto not been forthcoming." According to Gegenbaur, the paired

fins took their origin from the fusion of the cartilages of

the posterior gill-bars, but he admits this to be merely a

hypothesis (Morpliol. jahrbuch, xxii., 1895, pp. 119-160).

Dipnoi. — Owing to the supposed great rarity of Lepidosiren

paradoza, no advance was made in our knowledge of its morphology

for some time after its first discovery. Many specimens, however,

have more recently been obtained from Paraguay and the basin of

the river Amazon, by which we have become acquainted with

many new facts of its organization. J. Graham Kerr has studied

the development of the ova and larvje ; he found the ova coated

Fig. 1. — A, Young Ceraiodue four weeks old, four times natural size. B, Mouth

of young Ceratodus ; it^, anterior ; ri?, posterior nostril ; «, vomerine \ p, pala-

tine teeth. C, Young Lepidosiren. four weeks old, two and one-third times

natural size; c, cement organ. (A. and B, after Semon; C, after Graham

Kerr.)

with a gelatinous substance as in Batrachians and (as previously

shown by Gunther) in the ova of Ceratodus. The young possesses

four external gills, which are lost about six weeks after hatching,

and a "cement" organ corresponding to the sucker of Anura

(Fig. 1, C). In the adult male bundles of long filaments are developed on the pelvic limbs ; their function is not quite clear, but evidently has some relation to the reproduction, as they appear and disappear with the breeding season. The morphology of the skull, and its comparison with that of other Dipnoi, is the subject of an elaborate paper by T. W. Bridge. Ceratodus also has received due attention on the part of morphology. W. Baldwin Spencer has examined in detail the arterial and venous system, pointing out its agreement in some respects with the Piscine, in others with the Batrachian type. E. Semon has collected valuable materials, and completed his researches into the external portion of the development, and into the development of the paired fins. The young of Ceratodus do not possess either external gills or a cement organ. In a larva four weeks old the pectoral limk projects as a short button-like flap, and the pelvic limb makes its first appearance fully a fortnight later. At that age the vomerine and palatine teeth commence to show as rounded tubercles, the latter about six in number on each side, quite distinct from one another, but corresponding to the prongs of the fully-developed tooth (Fig. 1, A, B).

Amia. — The morphology of Amia, particularly with regard to its cranial osteology, has been made the subject of detailed investigation by T. W. Bridge (1877), J. van Wijhe (1882), M. Sagemehl (1883), E. W. Shufeldt (1885), L. Schmidt (1892), and E. P. Allis (1897-1898). Sagemehl views the skull of Amia as a direct advance of conditions which already obtain in the Selachian skull, more especially in that of the Notidanidce, the least differentiated type of sharks. Speaking of the skeleton generally, Shufeldt maintains that although it possesses many of the characters in common with Teleosteans, it Is, on the other hand, still stamped with characters.

more partioulaxly in its vertebral colTuim, of a veritaWe palseo-ichtliyic type.

Ostariophysi. — ^The peculiar commumcation between the auditory organ and the air-bladder, which from its discoverer has been named "Weber's Apparatus," is considered by Sagemehl {Morphol. Jahrb.-i 1884) to indicate a genetic relationship of the four families which possess it {Siluridx, Cyprinidm, CharacinidcB, Gymnotidce). They constitute a separate division among Teleosteans, for which

he proposes the name Ostariophysi. He also points out the many resemblances of the Erythrinina to Amia, from which he draws the inference that the ancestor of the Characines could not have been very remote from that Ganoid.

The results of the morphological researches into the structure of the brain may be summarized thus : — The brain of fishes is characterized (1) by its relatively small size ; (2) by the

Brain. *thinness of the walls of the neural tube, with tumour-like swellings of certain parts, and, accordingly, by the great width of the ventricles ; (3) by greatly developed Lohi inferiores; and (4) by extensive areas of the neural tube retaining their epithelial condition, for instance, the median zone of the cerebeUum. Lampreys possess a brain of the lowest type : the butbi olfactorii are sessUe, and pass directly into the prosencephalon, no lohi optici or cerebellam have been difierentiated, and the roof of the brain has retained its purely epitheUal character. This low condition is approached by the lowest forms of sharks and the sturgeons, although it shows in these fishes an advance by the differentiation of a cerebellum without folds. In the higher forms of sharks the ventricles are much reduced and the cerebellum shows an asym-*

metrical and much complicated structure. The differences which are to be observed in the various types are due to the varying position of the eyes and nostrils {Chimcera., Cestracion, Haja) or to the general configuration of the head {Zygcena, Myliobatis). Brains like that of Isistius represent by the form of their prosen-cephalon a transition to the cerebrum of Acipenser, i.e., that of Teleosteans (Burckhardt). Whilst the brain of the Holocephali is only a Selachian brain slightly modified, that of Dipnoi approaches closely the brain of Polypterus. The brain of the Ganoidei ossei shows different grades of development, and Goronowitsch has demonstrated that they gradually lead to the Teleostean brain. In the latter only a few characters can be recognized as common to all the members of the subclass : the centres of the prosencephalon are greatly reduced and covered by a purely epithelial layer (Rabl-Riickhard) ; the optic lobes, on the other hand, are highly differentiated, and the cerebellum, although unpaired externally, is paired in internal structure and in development (Schafer). Folds of the cerebellum lead to the formation of the so-called va'vula cerebeUi, which is homologous to a portion of the Sela-chian cerebellum. The Scombridm, Siluridae, Gymnotidx, and

Mormyridae are families in which the brain shows a particularly high grade of development. In Pleuroneotidce the brain takes no part in the asymmetry of the head.

The lateral line system has been examined by many morphologlsts, from its most primitive condition in certain Selachians to its most highly specialized forms in bathybial Teleosteans, viz., Lateral bySolger (1880), G.Fritsch (1886), and Garman (1888) in Plagiostomes and ChimEera; by Allis (1889) and CoUinge (1894) in Ganoids ; by S6Ae de Licoux (1884) and Guitel (1891) in Teleosteans ; and finally by Garman (1899) in deep-sea fishes. The last-named author comes to the con-clusion that although in its inception the lateral canal system was tactile in function, and continues to be so In its primitive forms, the additional and very complex apparatus present in many bathybial fishes has assumed other functions ; in them it acts as an illuminating and electrical organ, as an organ by means of which "the species or the sex of the individual is recognized, the members of the school are kept together, the prey is captured, and the enemy avoided," probably acting also as an organ of taste. Morphologlsts seem now to be agreed as to the physiological

function of the so-called phosphorescent or luminous organs. They prove to be more generally distributed among oceanic fishes than was previously known. Johann and Burckhardt have demonstrated their presence in a number of sharks, all of which, however, belong to the family Spinacidce. These organs are extensively distributed over the lower half of the body, similar in structure in all the various species, and exhibit a primitive type of development. Singularly, they are found in the pelagic genera of Spinacidce, and seem to be absent in the bathybial (Centrophorus).

In some viviparous Chondropterygians (Spinax niger, Scymnus lichia, Oentrina, Acanthias vulgaris, Torpedo ocvlata, Trygon pastinaca, Myliobatis aqidla)

Tropbone- the mucous membrane of the uterine dilatation of the oviduct has been observed to be beset with glandular villi, which in some cases "were supposed to bear a relation to the nutrition

line

system.

maious

gestation,

Fig. 2. — Gravid uterus of PtaropUiiea micrwra ;

a, bundles of trophonemata. (After Alcock.)

of the embryo. However, views on this matter were

very vague until Wood-Mason and Alcock obtained

in India fresh specimens in sufficient number to follow

up the whole course of gestation. Their observations

were made on species of Pteroplatea, Ti-ygon, and Mylio-

batis. In these genera the embryo (or embryos) is

destitute of any enveloping membrane, and is free

in the uterus. At the earlier stage of development

the embryo is attached to a large yolk-sac over which

a cloud of delicate

branchial filaments is

spread; issuing from

the gill-slits (not

the spiracles). These

filaments assist in

absorbing the nutri-

tive yolk. As this

source of nutrition is

consumed the yolk-

sac and the branchial

filaments disappear,

but in their place

there arise from the

whole surface of the

mucosa of the uterus

those glandular villi

which are now

destined to supply

a new nutriment to

the embryo, and

which have been

named trophonemata

(Fig. 2). Only those

situated opposite to

the spiracles of the

embryo attain to full

functional development, growing in a bunch into these

openings. They secrete a milky fluid which reaches the

pharynx through the spiracles. During this stage the stomach is not differentiated structurally or functionally; the milk passes through it, and is assimilated in the spiral gut.

Beproduction of Cyclostomes. — The difference which obtains between Hyperoartia and Hyperotreti as regards their generative products has been known for a long time, but it has only recently been shown to extend also to the mode of their reproduction. Both Myxine and Bdellostoma are hermaphrodites, and, according to Nansen and J. T. Cunningham, the ova and sperm of Myxine ripen at different periods of life, each individual being a male first, and being transformed into a female at a more advanced age (protandric condition). The fertilization is not known.

Leptocephali. — The larval forms which are known under the name of Leptocephalus have been the subject of investigation by several Italian naturalists (Bellotti, Calandruccio, Facciola, Grassi) ; they generally confirm Gill's statement that the Leptocephali proper represent normal stages of development of Murmmdce. Those investigators claim to have demonstrated the Leptocephalid stage of nearly all the Mediterranean Mursenoids, besides the Common

Eel, the larva of which had been described as Leptocephalus brevi-

rostris. It seems that the fishes of some of the other oceanic families

of Teleosteans go through a similar Leptocephalid stage with the

same embryonic characters. (See Eel.)

Favnistic Work.

Of the contributions by which our knowledge of the

fish-fauna of certain regions has been advanced, the follow-

ing may be specially referred to : —

In the Equatorial Zone two sections have been distin-

guished, one of the chief characteristics being the presence

or absence of Cyprinoid fishes. The two sections

*are termed accordingly Cyprinoid and Acyprinoid JJ^””**’**

divisions, the former including the African and

Indian, the latter the Pacific and tropical American regions.

As for other classes of animals, so for fresh-water fishes,

the so-called Wallace’s line was regarded as a sharp line

African

region.

of demarcation between, the two divisions, or more especially between the Indian and tropical Pacific faunas. Max Weber has now shown that, although the Cyprinoids offer a sufficiently distinctive character for those two faunas, Wallace's line has no significance in determining the boundary between them. The islands west of it owe the great variety of their truly Indian fish-fauna to their large size and to their longer connexion with the Indian continent, whence they also derived their Cyprinoids. On the other hand, the islands east of the line were separated at an earlier geological period, before Cyprinoids could reach them, and on account of their small size did not offer hydrographic conditions similarly favourable for the differentiation of a variety of forms. Celebes, the largest of these eastern islands, which at present would seem to be well adapted for the production of a rich fish-fauna, was formerly divided into several smaller islands, with short and insignificant rivers. Its fish-fauna is still very poor, but such as it is, and as Weber's collections have shown it to be, it

bears the character of an impoverished Indian fauna, and therefore it cannot be referred to the Australian region. With the opening up to civilization of the interior of tropical Africa many additions have been made to our knowledge of its fresh-water fishes ; the list of described species has been nearly trebled. Differentiation, as far as specific, and even generic, characters are concerned, obtains in a high degree, and does not depend merely on locality. A surprising number of allied but clearly distinct species of the same genus may occur in the same river or lake, under identical physical conditions, as is shown in Boulenger's recent contributions on the fauna of Lake Tanganyika and the river Congo. This great variety is apparent especially in the families of Mastacembelidce, Chromides, Siluridoe, and Mormyri, and reminds us of a similar abundance of fish life in the fresh waters of tropical America. However, numerous as these accessions to the fauna are, they have given no reason for modifying our views as to its general character, with one remarkable exception, viz.,

the occurrence in the extreme south of the continent of a species of the characteristically Antarctic genus Oalaxias. The discovery even of a single representative of a genus limited to the Tasmanian, New Zealand, and Patagonian subregions is most significant, although it cannot affect our view that in all other respects the fish-fauna of South Africa is an impoverished branch of the African fauna generally.

The deep-sea explorations which were undertaken subsequently to the Ohallenger expedition have largely extended our knowledge of the oceanic fish-buna”” fauna. Their results have been published in the magnificent works mentioned in the biblio-graphical notes. More than 600 true bathybial fishes are now known from depths of 1000 fathoms and more. Garman’s list includes the names of about 1060 species of fishes that have been found below the 100-fathoms line, but this number seems to be excessive, since this author considers that individuals apparently identical, but cap-tured at widely distant localities, should be specifically

separated, although this " could hardly be done by the characters ordinarily used in specific diagnoses." Of the new forms many show points of special interest, but all are more or less nearly related to previously known types. A great deal of evidence (if such was needed) has been accumulated to show the gradual transition of the surface fauna into the bathybial. A much larger number of surface fishes than were known before have been met with in deep water (from 100 to 500 fathoms), Pleuronectidae peculiar to deep water have been discovered, and in the Arctic regions certain bathybial types seem frequently to appear close to the surface. This intermingling of surface with bathybial fishes obtains chiefly on the slopes in the neighbourhood of land. As to the truly oceanic areas, Alexander Agassiz's experience is distinctly against the supposed existence of a "mid-water" fauna; he considers the zones intermediate between the 200-fathoms line and the bottom to be azoic. With regard to fishes, however, there is no reason why certain forms should not permanently inhabit inter-

mediate zones, as pelagic fishes are free swimmers for nearly the whole of their life without being tied to the proximity of terra Jirma. The results of more recent explorations are not confirmatory of Agassiz's view. The surmise that the depths of the ocean have been gradually peopled from the surface is supported by palaB-ontology, and it is evident that this process continues to the present time. The Chalk and other Upper Cretaceous formations have yielded a number of deep-sea Teleos-teans, such as Berycidm, Scopelidce, Bathythrissidoe, Clu-peidce, Halosauridce. At the period when Physostomous fishes predominated we find that families of that type composed the fossil bathybial fauna ; a few Anacanths were added to it when this type appeared in the early Tertiary period, and the highly modified eels were a still later immigration. In connexion with these notes on the bathybial fish-fauna, it should be mentioned that Alcoek has found among the collections of the Investigator a Brotuline Ophidiid (Saccogaster), which is evidently viviparous, and naturally we may suppose that this

peculiar form of propagation obtains also in other bathy-

bial members of this group.

Systematic Work.

Gyclostomi. — Among the multitude of new forms discovered in

recent years the most remarkable is a small fossil from the Lower

Old Red Sandstone of Scotland, which has been recognized by

R. H. Traquair as the sole representative that has been preserved

from geological times of the subclass Cyclostomata, and described

by him under the name of Palceospon-

dylus gunni (Fig. 3). It differs from

all the other Cyclostomes by the calci-

fication of its skeleton. The body is

spindle-shaped, naked ; the vertebral

column formed by numerous ossified

rings ; abdominal portion with short

nenrals, caudal with long neurals and

hsemals ; brain-case complete, with a.

pair of trabeculo-palatine enlarge-

ments, and posterior (parachordal)

auditory capsules of enormous size,

terminating in front in a ring of cal-

cified cirri which surround a large

single nasal opening. The list of

living Cyclostomes has also been en-

riched by the discovery on the coast

of Chile of a remarkable form which

differs from all the other known Lam-

preys in possessing large, well-devel-

oped, functional eyes. It has been

described by L. Plate, and named

Macrophtha Imia.

Ostraeodermata. — In another recent

contribution by B. H. Traquair our

knowledge of the Ostraeodermata is

much advanced, certain genera which

rested hitherto on very fragmentary

evidence being made more fully known

(Thelodus, Drepanaspis) , while others

{Lanarhia, Ateleaspis, Birkenia, and

Lanasius) are new additions to this '^f-^—Pamolspondylwgurmi

subclass. The last two prove to be i^e^'^g ^^u^ded^by'^iS

types of a distinct order of Ostraco- ‘/del> — “^■ • ■■

derms, Anaspida ; they comprise small,,

laterally compressed fishes without

paired fins, but with a single small

dorsal and a heterocercal tail (Fig. 4). Both these genera are

armed with a median ventral series of large spines. Their associa-

tion with the Ostracoderms, however, is provisional, as they differ

with regard to the structure of their dermal scutes (which are

(o) ; a, trabeculo-palatine part ;

p, pai'achordal part ; po, post-

occipital plates.

developed in Birkenia at least) from the other members of this

subclass. All these fossils belong to the fauna of the Scottish

Silurian rocks.

Tie. 4.-

(After Traquair.)

In the marl-shales of Grothland (Sweden) a form of Cyathaspis

occurs, for which G. Lindstrom claims that it is not only the oldest fish, but the oldest vertebrate known ; he refers that formation to the Lower Silurian.

Plagiostomata. — Among the Plagiostomes the genus Cladoselache (Fig. 5) from the lower Carboniferous shales of Ohio claims special attention ; it is one of the few fossil sharks whose structure is fairly-well known, thanks to the labours of Dean and Smith Woodward, who consider it to be, with regard to its paired fins, the most

Fio. 5.—Oiadoaeluche/yl6ri. (After Dean.)

primitive form of shark known, and the type of a separate "order," Pleuropterygii. The general form of the body is shark-like, but the mouth and nostrils are terminal ; two dorsal fins, without spine ; no claspers are developed in the ventral fins, which, like the pectorals, are believed to have had the merely initial function of " balancers " ; notochord without calcification ; teeth upon broad, multicuspid bases, several series functional at the same time.

The genus Pleuracanthus {Xenacanthus), although named from fragments long ago, is now loiown almost in its entirety, so that A. Fritsch has been enabled to represent it in a nearly complete restoration (Fig. 6). It proves to be one of the most important

ing to Rose, the cusps represent separate teeth in the embryo, subsequently coalescing into a single tooth with broad bases. This shark has been associated with several extinct types, chiefly on account of its dentition. Its frilled gill-coverings remind one of a similar condition in Cladoselache and Acanthodes ; but while it must be admitted to possess, like the other Notidanidce, certain primitive features, it cannot be traced back farther than to teeth found in Pliocene strata of Tuscany. The history of its discovery is perhaps unique in ichthyology. Discovered first in a Japanese collection as a unique specimen in 1884, it was claimed to be a deep-sea shark in 1887 — a surmise which proved to be correct when it was re-discovered off Madeira in 1889, and finally in the Varanger fjord in 1896. The habits of Notidanus are likewise bathybial.

A genus belonging to the family Lamnidm, having the dentition of, and being generally closely allied to, Odontaspis, has been described from European Chalk formations and the Chalk of Mount Lebanon under the name of Scapanorhynchus (Fig. 7). It is distinguished

Fig. 7. — 8capa/norhynchu8 owatoni, from Japan. (After Jordan.)

by a peculiar prolongation of the rostrum into a long, pointed

blade ; it possesses distinct spiracles. This genus seems to have been a dominant type among the sharks of the Cretaceous seas, and scientific interest in it is increased by the fact that a species generically not separable from the fossil forms has recently been discovered living in Japanese seas.

JSolocephali. — The small number of living Chimseras has received an addition by the discovery in the depths of the North-western Atlantic and the Japanese Sea of a form which has been described under the name of JSarriotta (Fig. 8), and which is characterized

FiG. 6. — Xenacanthus decheni. d, Dorsal ; c, caudal ; a\ a^^ anal fins. (After Fritaoh.)

types connecting sharks with the Dipnoi, its pectoral fin being a transitional stage from the biserial archipterygium of the latter into the monoserial of recent sharks. The general form of the body is shark-like, but the mouth is lateral and the tail diphycercal. An isolated, long, barbed spine is inserted on the occiput, and followed by a long, low, dorsal fin ; two short anals ; ventral fins with claspers ; all the fins with dermal filaments clustering round the distal parts of the cartilaginous supports ; notochord with insignificant calci-fications ; hardly any dermal skeleton, but the roof of the skull is covered with dermal bones (?) symmetrically arranged ; teeth tri-

cuspid, the middle cusp smallest.

Chlamydoselache, a genus of the family of Notidanidm, is the most remarkable addition to our knowledge of living sharks. It has greatly excited the attention of some naturalists, one regarding it as the oldest living type of vertebrata, another making it the representative of a distinct suborder (Selachophichthyoidei) , while to a third it has revealed the nature of the mysterious " sea-serpent."

The gill-slits, six in number, are protected by broad dermal frills.

The teeth are similar in both jaws, each consisting of three slender, curved cusps, separated by a pair of rudimentary denticles. Acoord-

FiG. 8. — Harriotta raleighana. (After Goode and Bean.)

by a greatly elongated snout, the absence of a prehensile cephalic appendage, and very small rudimentary claspers. It should be remembered, however, that the two latter are secondary sexual characters, which are likewise in an undeveloped condition in the young stage of Chimsera.

Arthrodira. — The systematic position of the family Coccosteidoe is still rather doubtful. While Smith Wood-ward, with Cope, is inclined to refer them as a "suborder" to the Dipnoans, Dean considers

that the existing evidence is equally in favour of their relationship to the sharks. However, much has been done towards a better knowledge of their organization. Traquair has worked out the details of the cranial, dorsal, and ventral armature of Coccosteus (Fig. 9) and Homosteus (Fig. 10) from the Old Red Sandstone of Scotland, while Newberry and Claypole have described a number of forms from passage beds between the Devonian and Carboniferous systems of North America, in which this type reached a gigantic size and development {Dinichthys, Titanickthys, Mylostoma, &c.). All these fishes seem to have been autostylic. The dorsal shield was so articulated with the cephalic as to admit of a considerable extent of vertical

Fig. S.—Coccosiems decipiens. (After Traquair.)

motion of the head (Arthrodira). Pectoral fins unknown, if present ; tail probably diphycercal. Some of the American genera show a very distinct pineal foramen.

Chondrostei. — The structure of the Liassic genus Chondrosteus has been more completely made out, and its position more clearly

defined. Traquair, who has paid much attention to this type.

considers that its affinities seem to radiate towards Acipenser, Polyodon, and the Palxoniscidcz, the distance from Acipenser being the least. It is confined to the Lias, while Acipenser and a fish allied to Polyodon (Grossopholis') have not yet been found in earlier than Eocene formations.

New BathyUal Fishes.— The following genera belong to the most striking additions to the fauna of the deep sea : —

Lopholatilus, a genus of Trachinidce, distinguished by a large adipose flap on the nape in front of the dorsal fin, and a fleshy prolongation of the labial fold, extending beyond the angle of \ the mouth. Discovered in 1879,

in from 70 to 130 fathoms of

water, on the Atlantic coast of

the United States, it attracted con-

siderable attention by its sudden

temporary disappearance, an im-

mense number of individuals having

been destroyed by climatic causes.

Fio. lO.~~CrauM buckler of ffomo~~ Jihodichthys a, genus of Ophi-

steuamilleri. (After Traquair.) dltdcB. Head thick, body or tail

Strongly compressed, the latter ta-

pering, enveloped in a thin, transparent, scaleless skin ; vent

immediately behind the humeral symphysis ; snout swollen, over-

lapping the wide mouth ; teeth in the jaws weak, none on the

palate ; eye of moderate size ; ventrals reduced to two filaments,

each bifid, and inserted on the hyoid ; vertical fins continuous,

but with caudal rays differentiated ; gill-openings very wide ;

uniform bright red. Discovered by the Norwegian Expedition in

the Arctic Ocean in 1280 fathoms.

Lamprogrammus, a genus of Ophidiidm distinguished by the

extraordinary development of the lateral canal system. A series

of luminous organs runs along the lateral line, each organ resting upon a very large scale, the whole being covered by the skin and a band of small scales much smaller than those of the body. No ventral fins. Three species are known, from depths of 400 to 700 fathoms, two being taken in the Indian Ocean by the Investigator, the third in the Gulf of Panama by the Albatross.

Sciadonus, a curious, Leptocephalus-like genus of Ophidiidce. Snout very blunt ; no eyes ; vertical fins united at their bases, ventrals small, filaments close together, below the humeral sym-physis ; no cephalic spines ; teeth small, in villif orm bands ; abdominal cavity long, with the veirt far .behind the head ; bones of the head thin and soft. Obtained by the Albatross east of the Cocos Islands in 1010 fathoms.

Bondeletia, a scaleless genus of Alepocephalidce. Body oblong, compressed ; head very large ; mouth wide ; eyes of moderate size ; teeth in the jaws in bands, coarsely granular ; palate toothless ; supra-occipital bones, with a pair of strong spines projecting for-ward over the orbits ; dorsal and anal opposite ; pectorals and ventrals small ; no adipose fin ; no lateral line ; gills wide. Taken by the Albatross off the east coast of the United States in 960 to

1640 fathoms.

Oetomimus, another genus of Alepocephalidce. Body moderately compressed, scaleless ; mouth very wide ; eyes very small ; teeth in granular bands on all the bones of the mouth, tongue, and throat ; dorsal and anal opposite ; no adipose fin ; pectorals short, ventrals none ; lateral line consisting of two canals connected vertically by numerous transverse grooves ; gills wide. Taken by the Albatross off the east coast of the United States in 1040 to 1530 fathoms.

Halimochirurgus (Fig. 11), a genus of Scleroderms, distinguished

Fig. 11. — ffaMmochirwrgus centriscoidea. (After Alcock.)

by its exceedingly long snout, which forms a curved tube with a short terminal mouth opening upwards. Tail short ; a row of minute conical teeth in each jaw ; eye large ; two large dorsal spines, each ventral consisting of a huge spine articulating with the pelvic bone. This remarkable form is almost the only representative of the Scleroderms in the deep sea. It was captured by the Investigator off Cape Comorin in 143 fathoms.

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Idaho, one of the north-western states of the American Union, lying in the northern part of the inner mountain region of the Rocky Mountains and Cascade Eange. Large tracts are still unexplored, and only a small portion of the land belonging to the United States has been surveyed.

The Bitter Root and Priest River forest reserves occupy

parts of the state. Lying wholly or partially in the state are the Fort Hall, Duck Valley, Lemhi, CcEur d'Alene, and Fort Lapwai (school) Indian reservations. United States land offices are situated at Boise, Hailey, Blaekf oot, Lew-iston, and CcBur d'Alene; federal military posts are at Boise, Fort Hall, and Cceur d'Alene (Fort Sherman). The climate is diverse and changeable. The mean annual temperature at Lewiston is 56°, at Boise 51°. In the lower valleys the temperature is seldom below zero in winter, but temperature of 100° is not unusual in sum-mer ; dark or cloudy days are exceptional. The annual rainfall in southern, Idaho varies from 11 to 16 inches ; in the summer months it is iusufftcient for most crops. Population. — The population in 1890 was 84,386 (51,290 males and 33,095 females; 66,929 native and 17,456 foreign-born ; 4223 Indians). The population in 1900 was 161,772, showing an increase of 91-7 per cent, for the decade. The total land surface is approximately 84,290 square miles, and the density per square mile was 1-9 in 1900, as compared with 1-0 ten years earlier.

There were thirty-three incorporated cities, towns, or villages in 1900, of which five had a population exceeding 2000. These five were Boise with 5957, Pocatello with 4046, Lewiston with 2425, Moscow with 2484, and Wallace with 2265 inhabitants. Of the total population in 1900, 93,367 (67-7 per cent.) were males and 68,405 (42-3 per cent.) females ; 137,168 native-born and 24,604 (15-2 per cent.) foreign-born; 154,495 were white and 7277 (4-5 per cent.) coloured, of whom 293 were negroes, 1467 Chinese, 1291 Japanese, and 4226 Indians.

Education. — The public educational system includes the University of Idaho at Moscow (389 students and 23 teachers) ; two normal schools, at Lewiston and Albion ; the common schools of the 760 districts (31,884 students and 793 teachers) ; and the graded schools of about 25 "independent" districts. The percentage of illiterates is 6-14. In 1900 the number of persons of school age (5 to 20 years) was 54,964. Out of 53,932 males of voting age 2936 were illiterate (unable to write), of whom 781 were Chinese and Japanese and 970 were

Indians. A few colleges and schools are maintained by religious denominations. Schools for the education of Indians are supported and administered by the Federal Government. The state penitentiary and a soldiers' home are situated at Boise, and an asylum for the insane at Blackfoot. Of eighty newspapers and periodicals published in 1899 in Idaho, five were daily, four semi-weekly, sixty-six weekly, one semi-monthly, and four monthly.

Religion. — In 1900 it was estimated that an aggregate of 35,000 communicants included 22,000 Mormons, 8000 Catholics, 1700 Methodists, 1200 Presbyterians, and 1000 Baptists.

Mining. — Mining, stock-grazing, and agriculture are the chief industries, though manufacturing, fisheries, and lumbering have been somewhat developed. Placer mining has been prosecuted profitably in the river valleys of every county in the state, and has been succeeded by extensive quartz-mining as the parent ledges of the placer deposits have been discovered. Though gold and silver are most

mined, copper, lead, and iron constitute a large part of the mineral output. Opals and sapphires are the most common of the precious stones found in various parts of the state. Deposits of coal, mica, marble, sandstone, salt, and sulphur are also worked. Of lead, 61,239 tons were produced in 1898 ; of copper, 36,367 pounds were produced in 1893. The gold produced in 1895 was of the value of $1,779,600, in 1898, $1,895,566 ; silver in 1895, $4,021,780, in 1898, $6,796,641. In 1899 Idaho yielded more than one-fifth of the total lead product of the United States, and ranked fourth among the states in the production of silver.

Agriculture. — Next to raining, the most important industry is the grazing of horses, cattle, and sheep. The grazing lands amount to not less than 25,000,000 acres. The cultivable area of about 15,000,000 acres is utilized for a variety of crops, according to altitude and humidity or aridity of climate. Wheat, oats, barley, and other grains, and turnips, potatoes, and other vegetables are supplemented with a large yield (especially in the lower valleys) of many kinds of fruits and berries. Forage crops, chiefly

of timothy, clover, and alfalfa, are almost universal. In the southern part of the state agriculture is dependent on irrigation. The acreage, production, and value of the principal crops in 1900 were as follows : Wheat, 149,261 acres, yielding 3,104,629 bushels, valued at $1,428,129 ; oats, 36,881 acres, yielding 1,349,845 bushels, valued at $539,938 ; barley, 12,165 acres, yielding 399,012 bushels, valued at $199,606 ; potatoes, 6030 acres, yielding 684,080 bushels, valued at $321,518 ; hay, 235,394 acres, yielding 659,103 tons, valued at $4,284,170. In the case of the last three crops the value is the farm value 1st December. On the 1st January the number and value of farm animals were as follows: 127,821 horses, $2,863,604; 2,658,662 sheep, $7,444,254; 33,075 milch cows, $1,055,092; 364,853 other cattle, $8,672,748.

IDA R — I G L A U

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Assessment and Banks. — The assessed valuation of property for taxation in 1889 was 146,719,990. The amount of the bonded and other indebtedness in 1900

was $427,500. There are ten national banks, with an aggregate capital of $600,000, an aggregate surplus of $275,374, and aggregate deposits of $1,829,286; there are also eighteen state banks and private banks, with an aggregate capital of $366,550.

Railways. — The railways operated in the state are the Oregon Short Line (765 miles), the Northern Pacific (188 miles), the Great Northern (83 miles), the Oregon Railway and Navigation lines (87 miles), the Boise, Nampa, and Owyhee and Idaho Northern (40 miles), and the Pacific and Idaho Northern (40 miles), with a total mileage of 1203 miles.

Manufactures. — According to the U.S. census of 1900, the number of manufacturing establishments in the state (excluding 75 having an annual product of less than $500 each, and one Government establishment) was 591, with a total invested capital of $2,941,524. There were 97 salaried employees and an average number of 1477 wage-

eamers. The added values of the products in the differ-
ent establishments amounted to $4,020,532. There were
34 establishments devoted to flouring and grist mill
products, with a capital of $569,107 and annual products
of $832,207; and 117 establishments devoted to lumber
and timber products, with a capital of $913,352 and an-
nual products of $937,665.

Settlement. — From 1848 to 1853 the territory comprised in the
state was a part of the territory of Oregon ; from 1853 to 1859 it
was partly in the territory of Oregon and partly in the territory of
Idaho (including part of Montana until 1864 and part of Wyoming
until 1868) until 1890, when the state was organized with its pre-
sent boundaries. The permanent settlement of the territory dates
from the discovery of gold in 1860, though a few trading-posts and
Indian missions had been established earlier. The capital of the
territory of Idaho was at first at Lewiston, but was removed to
Boise in 1863. Two uprisings of the Indians in the Nez Perc6s
war of 1877 and the Shoshone war of 1878 occasioned much loss of
life and property to settlers.

Administration. — The legislature consists of twenty-one senators

and forty-nine representatives, serving for terms of two years, and its sessions are biennial. The governor exercises a qualified veto on legislation. The lieutenant-governor presides over the Senate, and a speaker over the House of Kepresentatives. The governor and other executive of&cers are elected by popular vote for terms of two years. The Australian ballot is prescribed by law, and the suffrage in all elections may be exercised by both men and women, citizens of the United States, after six months of residence in the state. In taxation the chief reliance is placed on the general property tax, licenses, and poll taxes. State aid to persons (except paupers or other dependents) or corporations is prohibited. Corporations, whether public or private, may be created only by general laws. Impeachments are made by the House of Representatives and tried by the Senate.

Justice. — The supreme court consists of a chief justice and two associate justices, elected biennially for terms of six years. Five district courts in the state are held by judges elected for terms of four years. Probate judges and justices of the peace are elected in the counties and precincts. Idaho is in the Eighth Federal Circuit, and the entire state constitutes one Federal district. In legal

procedure it is a "code" state as distinguished from "common-law" states. (See Law: United, States.) In a civil action three-fourths, and in a criminal action for a misdemeanour five-sixths, of a jury may render a verdict. The pardoning power is reposed in a Board of Pardons, consisting of the governor, secretary of state, and attorney-general.

Politics. — Before 1897 all the governors, senators, and representatives of the state had been Republicans, though the electoral vote had been cast for the candidate of the Populists for President in 1893. Since 1896, however. Democrats, Silver Republicans, and Populists, by the "fusion" of their parties, have been elected to the oflBces of governor, senator, and representative, while the electoral vote of the state has been cast in favour of a fusion candidate for President. (j. p. d.)

Idar, or Edae, a native state of India, forming part of the Mahi Kantha agency, within the Gujarat division of Bombay. It has an area of 1900 square miles, and had a population in 1881 of 258,429 and in 1891 of 302,134. The estimated gross revenue in 1897-98 was Es.6,28,670, of which Es.27,065 was expended on public

works ; there is a tribute to the Gaekwar of Baroda of Es.30,340. The line of railway from Ahmedabad through Parantij to Ahmednagar (55 miles) runs mainly through this state. Much of the territory is held by kinsmen of the Eaja on feudal tenure. The town of Idar is 64 miles north-east of Ahmedabad. Population (1891), 7086.

Iddesleigh, Stafford Henry Northcote, 1st Eael of (1818-1887), British statesman, was born in London, 27th October 1818. His ancestors had long been settled in Devonshire. After a successful career at Balliol College, Oxford, he became in 1843 private secretary to Mr Gladstone at the Board of Trade. He was after-wards legal secretary to the Board ; and, after acting as one of the secretaries to the Great Exhibition of 1851, co-operated with Sir Charles Trevelyan in framing the report which revolutionized the conditions of appoint-ment to the Civil Service. He entered Parliament in 1855 as Conservative M.P. for Dudley, and was elected for Stamford in 1858, a seat which he exchanged in 1866 for North Devon. Steadily supporting his party, he be-

came President of the Board of Trade in 1866, Secretary of State for India in 1867, and Chancellor of the Exchequer in 1874. In the interval between these last two appointments he had been one of the commissioners for the settlement of the Alabama difficulty with the United States, and on Mr Disraeli's elevation to the House of Lords in 1876 he became leader of the Conservative party in the Commons. As a finance minister he was largely dominated by the lines of policy laid down by Mr Gladstone ; but he distinguished himself by his dealings with the Debt, especially his introduction of the New Sinking Eund (1876), by which he fixed the annual charge for the Debt in such a way as to provide for a regular series of payments off the capital. His temper as leader was, however, too gentle to satisfy the more ardent spirits among his own followers, and party cabals (in which Lord Eandolph Churchill — ^who had made a dead set at the " old gang," and especially Sir Stafford Northcote — took a leading part) led to Sir Stafford's transfer to the Lords in 1885, when Lord Salisbury be-

came Prime Minister. Taking the title of Earl of Iddes-
leigh, he was included in the Cabinet as First Lord of the
Treasury. In Lord Salisbury's 1886 ministry he became
Secretary of State for Foreign Affairs, but the arrange-
ment was not a comfortable one, and his resignation had
just been decided upon when on 12th January 1887
he died very suddenly at Lord Salisbury's official resi-
dence in Downing Street. Lord Iddesleigh was elected
Lord Eector of Edinburgh Universify in 1883, in which
capacity he addressed the students on the subject of
" Desultory Eeading." He had little leisure for letters,
but amongst his works were Twenty Years of Financial
Policy (1862), a valuable study of Gladstonian finance,
and Lectures and Essays (1887). His biography, by Mr
Andrew Lang, appeared in 1890.

Idle. See Bkadfokd.

Idria, a mining town in the Austrian duchy of
Carniola. In 1892 there were 1116 miners employed in
the quicksilver mines and 224 labourers in the smelting
works. In 1898, 4913 metric centners of refined mercury

were recovered, amounting in value to over £96,700. It is calculated that the state monopoly has had a clear profit of £2,000,000 from these mines in the period 1814-80. Population (1890), 4906 ; (1900), 5772.

iglau (Czech, Jihlava), an autonomous town in Moravia, Austria. It is second only to the capital, Briinn,

in size and population, and is a G-erman enclave. It has the principal tobacco and cigar factory of the state monopoly (which gives employment to 2600 hands), and has, besides, a large and important textile and glass industry, steam corn- and saw-mills, pottery and brewing. Population, mostly Germans and Eoman Catholic, but with a sprinkling of Czechs (1890), 23,700 ; (1900), 24,387.

Ignatief, Nicholas Pavlovitch, Count

(1832), Russian diptomatist, was born at St Petersburg on the 29th of January 1832, and became at the age of seventeen an officer of the Guards. His diplomatic career began at the Congress of Paris, after the Crimean

war, where he took an active part as military attache in the negotiations regarding the rectification of the Russian frontier on the Lower Danube. Two years later he was sent with a small escort on a dangerous mission to Khiva and Bokhara. The khan of Khiva laid a plan for detaining him as a hostage, but he eluded the danger, and returned safely, after concluding with the khan of Bokhara a treaty of friendship. His next diplomatic exploit was in the Far East, as plenipotentiary to the court of Peking. When the Chinese Government was terrified by the advance of the Anglo-Prench expedition of 1860 and the burning of the Summer Palace, he worked on their fears so dexterously that he obtained for Russia not only the left bank of the Amur, the original object of the mission, but also a large extent of territory and searcoast south of that river. This success was supposed to prove his capacity for dealing with Orientals, and paved his way to the post of ambas-sador at Constantinople, which he occupied from 1864 till 1877. Here his chief aim was to liberate from Turkish domination and bring under the infiuence of Russia the

Christian nationalities in general and the Bulgarians in particular. His restless activity in this field, mostly of a semi-ofiicial and secret character, culminated in the Russo-Turkish war of 1877-78, at the close of which he negotiated with the Turkish plenipotentiaries the treaty of San Stefano. As the war which he had done so much, to bring about did not eventually secure for Russia advantages commensurate with the sacrifices involved, he fell into disfavour, and retired from active service. Shortly after the accession of Alexander III. in 1881, he was appointed minister of the interior on the understanding that he would carry out a nationalist, reactionary policy, but his shifty ways and his administrative incapacity so displeased his imperial master that he was dismissed in the following year. After that time he exercised no important influence in public affairs.

Ignatius, Epistles of. — If the Epistles ascribed to Ignatius of Antioch are genuine, they are of the greatest importance both for their Christology and for their evidence as to the early growth of ecclesiastical

organization ; and the subject has risen to such importance in recent years, and has been so carefully studied, that it calls for fresh treatment. The subject is complicated by the fact that the so-called Acts of his Martyrdom, for-merly much relied upon, are now acknowledged on all hands to be spurious, and by the fact that the letters have come down to us in three different forms : (1) The shorter Greek recension (known as G^), consisting of letters to the Ephesians, Magnesians, Trallians, Romans, Philadel-phians, Smyrneans, and to Polycarp ; it is known to us in one codex only, the Medicean MS. at Florence, from which it was published by Vossius in 1664. There is also a very exact Latin version (made in England, by Robert Grosseteste or one of his scholars, and published by Usher in 1644), fragments of a Syriac translation, a complete Armenian version from the Syriac, and fragments of a Sahidic version first published by Lightfoot. The Epistle to the Romans is found also (apart from the other epistles) with the Martyrdom, both in Greek and Syriac. (2) The longer Ch-eek recensio7i (G^), consisting of the

seven letters above mentioned with additions, and also letters from Mary to Ignatius, Ignatius to Mary, to the Tarsians, Philippians, Antiochenes, and to Hero. This exists in several MSS. and in a Latin version (to some copies of which are appended three additional letters known only in Latin, and apparently composed in that language : to St John, to the Blessed Virgin, and from the Blessed Virgin to Ignatius); whilst the Armenian version mentioned above contains also renderings of the additional letters of this recension. G^ was published in 1657 by Pace, and two years later, independently, by Gessner. (3) The shorter Syriac recension (S), containing three letters (to the Ephesians, Romans, and to Poly-carp) in a form much shorter than that of G^ It was published in 1846 by Cureton from two MSS. brought from the Nitrian desert. Another MS. was found in 1847 and used by Cureton for his Corpus Ignatianum (1849), and additional fragments have been published subse-quently by Lands and Mosinger.

Which, then, of these three forms, if any, is genuine ?

The criticism falls into three main periods : (a) Down to the finding of G^. During this period the three letters only extant in Latin were given up, but otherwise opinion was divided. Baronius and other Roman Catholics accepted G^, subject to possible interpolations, whilst the Madgeburg Centurators and others recognized only the first seven (as being mentioned by Eusebius, H E. iii. 36), and held that these were interpolated. (&) Since the publication of G^, few attempts have been made to defend G^; the additional matter has by degrees been entirely discarded, and it has been shown by Zahn and Lightfoot that G^ was composed after the middle of the 4th century, in all probability by the redactor of the Apostolical Constitutions (q.v.). Opinions differed as to G-‘: Pearson defended it against Daille and Salmasius in the 17th century, whilst in the 19th Baur held that it was forged after a.d. 160 to uphold the “theory of the Catholic Church” as then recently invented, (c) The publication of S reopened the whole question. Cureton unhesitatingly accepted it and rejected G^; so did Bunsen,

and many other English and German scholars, including Ritschl and Lipsius ; on the other hand, Baur held that S was derived from G^ and not vice versa, whilst Hefele, Denzinger, Uhlhorn, Jacobson, and others declared for the genuineness of G^ Little by little S was rejected, mainly because its contents lacked anything like internal unity. Lipsius and Lightfoot, amongst others, gave it up in favour of G^ ; and the question, so far as it concerns S, may now be said to be closed. Meanwhile, fresh critical examin ation has resulted strongly in favour of G'. The opinion of Renan and others, that the Epistle to the Romans is of different origin from the other epistles has been disproved by Harnack. Zahn, Funk, and other German scholars have vindicated the genuineness of the whole seven. Above all, the case has been exhaustively studied by Bishop Lightfoot. His careful comparison of the Greek of the portions of G^ which exist also in S with that of those which do not, shows conclusively that they are one in origin ; whilst a similar comparison in the case of G^ and G'^ leads to the

opposite conclusion. There is no longer any doubt, then, that, of the forms which we possess, G^ is the original, and that it shows no sign of compilation, the style of the letters being the same throughout. Further, after a study of the whole question which for minuteness and accuracy is unequalled, he unhesitatingly decides that the seven letters are the genuine epistles of Ignatius. In England at the present time the matter is generally regarded

as settled ; in Grermany, too, these conclusions are very widely though not universally accepted, and Harnack, who formerly dated the epistles about 140, now agrees that a date in the lifetime of Trajan is possible. Objections are indeed raised against this date, and against the genuine-ness of the letters, on the ground that they show signs of having been written with a definite theological motive ; that they deal with heresies of a date later than that of Ignatius ; that the ecclesiastical order disclosed in them is also of a later date, and that the same thing is true of

the title KoQoXiKrj iKK\rj<7ia (ad Smyrn. viii.). But such objections are not hard to answer. It is d.oubtless true, although the fact used to be denied, that Ignatius writes with the definite aim of exalting the episcopal office as the guarantee of the unity of the Church, but nevertheless it occupies in his letters a much less developed position than, e.g., in the writings of Irenaeus. The heresies referred to in the letters have at least as much analogy with those of earlier date as with those of later. And although Ignatius uses the title KaOoXiKt] €KK\ria-ca, he does so from a point of view different from that which is involved in the later use of the title.

On the whole it is safe to say, with Uhlhorn, that the objections to the genuineness of the letters from internal evidence are so flimsy that they cannot stand against any real external evidence ; and this is supplied by the abundant use of the letters which is made by Polycarp in his Epistle to the Philippians, witnessed to in turn by Irenaeus. Until it is proved that Polycarp's epistle is interpolated throughout, the genuineness of the

seven letters cannot reasonably be impeached again.

The known facts with regard to Ignatius rest almost entirely upon the Letters, for, as we have said, the Acts of his Ma'rtyrdom are spurious. He was bishop of Antioch ; he was condemned to death, and conveyed from Antioch to Rome by a guard of soldiers, to be put to death by beasts in the amphitheatre. The letters to the Ephesians, Magnesians, Trallians, and Romans were sent from Smyrna, where Ignatius was able to be in communication with Polycarp, the bishop of Smyrna. Thence he passed on to Alexandria Troas, where the other three letters were written. Thence, it is to be presumed, he crossed to Europe, and suffered martyrdom in Rome ; but of this we have no evidence of early date.

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Igualada, a town of Spain, in the province of Barcelona. The local industries have developed since 1880, especially the manufactures of cotton, linen, wool, ribbons, cloth, chocolate, soap, brandies, leather, cards, and nails. The surrounding districts, though hilly, are well cultivated, and send many products of agriculture to the fairs in the town. There is a narrow-gauge rail-way connecting Martorell, Barcelona, and Tarragona. Little has been done even for primary education. Population (1887), 10,201 ; (1897), 10,419.

Iki, an island belonging to Japan, lying off the north-western coast of Kiushiu, in 33° 46' N. lat. and 129° 40' E. long. It has a circumference of 86 miles, an area of 51 square miles, and a population of 36,530. The island is, for the most part, a tableland about 600 feet above sea-level. The anchorage is at Gonoura, on the south-west. A part of Kublai Khan's Mongols landed at Iki when about to invade Japan in the 13th century, for it lies in the direct route from Korea to Japan vid 'Tsushima. In the immediate vicinity are several rocky islets.

Iletsk, formerly Eokt Iletskaya Zaschita, a town of Russia, government and 45 miles south of Orenburg, near the Ilek river, a tributary of the Ural. A large bed of excellent rock-salt of great thickness, representing the richest rock-salt deposit known, is worked here to the extent of from 16,000 to 24,000 tons annually. The place is resorted to for its salt, mud, or brine baths and koumiss cures. Population, 11,802.

Ilford, or Gkeat Ilford, a town in the Romford parliamentary division of Essex, England, on the Roding, 7 miles east-north-east of London by rail. A portion of Hainault Eorest lies within the parish. There area library and reading-room, a drill hall, and swimming baths. The Hospital of St Mary and St 'Thomas, founded in the 12th century as a leper hospital, now contains almshouses and a chapel, and belongs to the marquis of Salisbury, who as " Master " is required to maintain a chaplain and six aged inmates. Claybury Hall is a lunatic asylum (1893) of the London County Council. There are large photo-graphic dry-plate works, and paper mills. Area of civil

parish (an urban district), 8493 acres. Population (1881), 7645; (1901), 41,240. Little Ilford is a parish on the west side of the Roding, with an area of 768 acres. Population (1891), 3969 ; (1901), 17,915.

Ilfracombe, a watering-place in the Barnstaple parliamentary division of Devonshire, England, on the Bristol Channel, 225 miles west of London, on the London and South- Western railway. The town has advanced in favour as a popular seaside resort, and the number of winter visitors has also steadily increased. It has been connected with the Great Western railway system by coach from Minehead, and in the summer the Midland]failway run handsome steamers from Sharpness in con-nexion with their system. A Victoria Promenade for inclement weather was erected in 1888 on the townward base of the Capstone Rock, and a Baptist chapel in 1891, whilst the town and harbour have been generally im-proved. Area of parish (an urban district), 6627 acres. Population (1881), 6266; (1901), 8567.

Ilhavo, a town of Portugal, district Aveiro, 3 miles

south-west of Aveiro. It has a fine parish church, and is famous for the beauty of its women. Wheat, millet, vegetables, fruits, and wine are cultivated. Nearly 2000 of the people, using 560 boats, are engaged in fishing, the annual value being about £12,200. It was founded by a colony of Pelasgic Greeks. Population (1890), 10,762 ; (1900), 12,545.

1 1 ion, a village of Herkimer county, New York, U.S.A., on the river Mohawk, the Erie canal, and the New York Central and Hudson River railway. It has manufactures of agricultural implements, small-arms, sewing-machines, and typewriters. Population (1900), 5138, of whom 755 were foreign-born.

Ilkeston, a municipal borough (1887) and market town in the Ilkeston parliamentary division of Derby-shire, England, 9 miles east-north-east of Derby by rail. Recent structures include two Established churches, a large Wesleyan church, and a hospital. Area, 2526 acres. Population (1881), 14,122; (1891), 19,744; (1901), 25,383.

Ilkley, a town and railway station in the Otleyparliar mentary division of Yorkshire, England, on the Wharfe, 10 miles north by west of Bradford. The neighbour-hood is famous for its romantic scenery, and the town has become a favourite health resort. All Saints' Church, restored in 1860, is mostlj' ancient, and contains interest-ing memorials ; there are also another church, a Roman Catholic and other places of worship. Here and at Ben

Ehydding, 1 mile to the east, there are nearly a dozen hydropathics, all built since the middle of the 19th century. The oldest and largest of these stand high up amongst the grouse moors, and thus derive the full benefit of the bracing air. The place occupies the site of an old Eoman station. Its institutions embrace a museum of local antiquities, a grammar school, the Siemens Convalescent Home, the Ilkley Bath Charitable Institution, a golf course ; andfivemileshigherupthevalleyisBoltonAbbey. Area of civil parish (an urban district), 3822 acres. Popu-

lation (1851), 811 ; (1881), 4736; (1901), 7455.

Ill, a river of Germany, entirely -within the imperial territory of Alsace-Lorraine. It rises on a north foot-hill of the Jura, south-west of Basel, flows north-north-east parallel with the Rhine, which it enters from the left 11 miles below Strasburg. Its course lies for the most part through low meadowland; and tjie stream, which is 130 miles long, receives numerous small afBLuents, which pour out of the short, narrow valleys of the Vosges. It is navigable as far as Colmar, a distance of 60 miles. It is on this river, and not on the Ehine, that the principal towns of Upper Alsace are situated — e.g., Millhausen, Bnsisheim, Colmar, Schlettstadt, and Strasburg. The 111 feeds two important canals, the Rhine and Marne canal and the Rhine-Rhone canal, both starting from the neigh-bourhood of Strasburg.

Ilie-et-Vllaine, a department in the north-west of France, bordering on the English Channel.

Area, 2699 square miles. The population increased from 621,384 in 1886 to 622,039 in 1896, but decreased to 611,477 in 1901.

Births In 1899, 14,893, of which 722 were illegitimate; deaths, 13,916 ; marriages, 4834. There were in 1896, 921 schools, with 96,000 pupUs. The illiterate composed 6 per cent, of the population. Of the cultivated land in 1896, amounting to 1,472,801 acres, 1,114,485 acres are plough-land and almost all the rest grass land. Of the cereals, wheat in 1899 yielded the value of £1,460,000; barley, £260,000 ; buckwheat, £490,000 ; oats, £378,000. Green crops amounted to the value of £190,000 ; natural pasture and grass lands, £860,000. The department produces a little linen, hemp, and colza ; and its apples for cider yielded the value of £749,000 in 1899. The department owned in 1899, 69,340 horses, 352,890 cattle, 30,480 sheep, and 107,980 pigs. The value of milk products in 1899 was £1,880,000. The mining industry produces only a little iron, but other minerals to the value of about £112,000. The other industries are in a backward state. Rennes, the capital, had 74,006 inhabitants in 1901.

I Her, a river of Bavaria, rising in the south-west extremity of the kingdom, among the Algauer Alps, and flowing north past Kempten and Memmingen, forming for some distance the boundary between Bavaria and

WUrtemberg, and eventually striking the Danube (right bank) just above Ulm. It is in character a mountain torrent, and causes frequent inundations. Its total length is 103 miles ; between Kempten and Ulm it has a fall of over 2000 feet.

Illinois, a state of the United States of America, bounded on the N. by Wisconsin, on the E. by Indiana and the Wabash and Ohio rivers, on the S. by the Ohio, and on the W. by the Mississippi. It was named after its principal river, which had itself been named from a confederacy of North American Indians who once occupied the territory. The state was admitted into the Union, 3rd December 1818. Its capital is Springfield, and the existing constitution was adopted in 1870. Under the law of 1901 the state has twenty-seven votes in the electoral college. Its representation in Congress, dating from 1903, consists of two senators and twenty ~~five repre~~ sentatives. Prior to 1860 the Democratic party prevailed in Illinois in every Presidential election. Prior to 1857 the Democrats always elected the Governor. Since that

time the Republicans have carried the state, except in 1890, when the Democrats elected their state ticket and obtained a majority in the General Assembly, and in 1892, when they again carried the state for their state and national tickets. In 1889^ the Republicans passed an obnoxious compulsory school law, which alienated the German Lutheran vote and was in some degree responsible for these defeats. In 1900 the popular vote for Presidential electors was : Republican, 697,985 ; Democratic, 503,061 ; Prohibition, 17,626.

Administration. — The executive department consists of a governor, lieutenant-governor, secretary of state, auditor of public accounts, treasurer, superintendent of public instruction, and attorney-general. Each holds ofBce for four years, except the treasurer, who holds for two. The governor receives a salary of $6000 per annum, and has in addition the use and occupation of the executive mansion.

The law-making power is vested in a General Assembly, composed of a Senate and House of Representatives.

The Senate consists of 51 members, elected for four

years, and the House of 153 members, elected for two years. A senator must have attained the age of twenty-five years, and a representative twenty-one years. The legislature meets biennially in odd years ; the elections are held in even years. Since 1895 members receive $1000 for regular sessions, and $5 a day for special sessions. They are allowed f 50 a session for stationery, and 10 cents a mile to and from the seat of government. A two-thirds vote of each House is necessary to pass a Bill over the governor's veto. Minority representation in the House is secured by the constitution.

Justice. — The Supreme Court consists of seven judges, elected in judicial districts. They hold office for nine years. Under the law of 1897 they receive a salary of $7000 per anniim. They must be thirty years of age. Since 1897 the law requires the Supreme Court to meet at Springfield only. The circuit and superior court judges hold office for six years, and the county court judges for four years. The legislature is authorized to create in districts appellate courts, from which appeals lie to the Supreme Court. Four such courts have been established. The appellate courts are

held by judges of the circuit courts. The judges of the circuit and superior courts of Cook (Chicago) county receive under a law of 1901 a salary of $10,000 a year. The legislature may provide for a probate court in counties having a population of over 50,000. Education. — The state has made a great advance in its educa-tional institutions since 1890. It has twenty-five colleges and universities. The more important of these are the University of Chicago, in Chicago ; Northwestern University, having departs ments in Chicago and Evanston ; and the State University in Champaign. These institutions have a large attendance of students, satisfactory standards and equipment. The property of the University of Chicago amounts to §12,000,000, and that of Northwestern to $5,000,000. The State University is supported by state funds. Mention should be made, among others, of Lake Forest University at Lake Forest, Knox College at Galesburg, Illinois College at Jacksonville, Wheaton College at Wheaton, the Illinois Wesleyan University at Bloomington, and the Female College at Rockford. The Armour Institute of Technology in Chicago is one of the best endowed institutions of its kind in the United States. In 1897 George M. Pullman l^t 81,200,000 to

establish a manual training school in the town of Pullman. The Lewis Institute in Chicago has property in excess of §1,000,000. In Chicago are flourishing schools of law, medicine, theology, dentistry, and pharmacy. The state maintains out of the public funds 4 normal schools. There are 311 high schools, in which, 30th June 1900, 38,620 students were enrolled, 14,934 males and 23,686 females. The number graduated from the high schools that year was 4708—1578 males and 3130 females. The number of high schools having a course of study of three years was 88 ; a course of four years, 218 ; and a course of five years, 5. The number of school districts in 1900 was 11,771, and the number of teachers employed 26,313—6950 men and 19,363 women. The whole number of public schools was 12,762. The number of private schools was 785, the number of teachers 3908—1842 men and 2566 wonien. The number of children of school age, six to twenty-one yeai-s, was 1,588,895, and of this number 958,911 were enrolled in the public schools and 142,496 in private; the total attendance being 1,101,407. The average daily attendance was 737,576. The average school year was 142-8 days. The highest monthly salary paid to male teachers in the public

schools was $300, and to female teachers S28. The average monthly salary paid to male teachers was $60.42, and to female

teachers $53.27. The total amount of public money expended for the year ending 30th June 1900 was $18,167,219.32. Since 1873 there has been an annual state tax for school purposes of $1,000,000. The school district tax levy for 1899 was $15,850,804, or $16.53 per pupil enrolled. The permanent school funds, the income alone being available, amount to $17,429,569. The estimated value of the school property in 1900 was $51,403,089. This is exclusive of the property under private control. In 1899 a law was passed providing free text-books for children in public schools. The constitution prohibits the appropriation of any public fund in aid of any educational institution under sectarian control. Under the census of 1900 the percentage of males of voting age who were illiterate was 4-8.

Military. — In the war against Spain in 1898 the state rendered prompt and efficient service. The Pifth Illinois regiment was the first volunteer regiment in the United States to be mustered into

the Federal service in that war. The total number of men furnished to the army was 13,647, divided as follows : infantiTr, 12,194 ; cavalry, 1275 ; light artillery, 178. The state had in its military service, 1st January 1901, 7122 officers and men. These were divided into eighty-six companies of infantry, eight of cavalry, two of artillery, one of engineers, and one signalling corps. The total number of officers and men in the naval militia was 631: 56 officers, 99 petty officers, and 476 enlisted men. During the war of the Rebellion the state furnished to the army of the United States 259,092 men ; the quota demanded by the President was 244,496.

Prisons. — The appropriation for 1900 for the ordinary expenses of each of the two prisons was $90,000. The prison at Joliet returned unexpended to the treasury $25,000. The appropriation for the reformatory at Pontiac was $266,100. This provided for improvements and running expenses ; $60,000 was returned to the treasury. The number of prisoners in confinement in the state prisons on 1st January 1901 was as follows : at Joliet, 1198 males and 61 females; at Menard, 866 males; at Pontiac, 1282 males. A law of 1895 established the parole (ticket-of-leave)

system in the punishment of adult criminal ofienders, except in cases of treason, murder, and rape. No prisoner is eligible to go upon parole until he has served the minimum term provided by law for the crime of which he was convicted. Each paroled prisoner must report once a month to the prison authorities, and six months of good behaviour secures final release. For 1900 there were 1662 applications for parole, and 631 were granted.

Charities. — A Board of State Commissioners of Public Charities has supervision of the charities and correctional institutions, state prisons excepted. The following are the institutions maintained : Northern Hospital for Insane, Elgin ; Eastern Hospital for Insane, Kankakee ; Western Hospital for Insane, Watertown ; Central Hospital for Insane, Jacksonville ; Southern Hospital for Insane, Anna ; Asylum for Incurable Insane, Peoria ; Asylum for Insane Criminals, Chester ; Soldiers' and Sailors' Home, Qaincy ; Soldiers' Widows' Homes, Wilmington ; Charitable Eye and Ear Infirmary, Chicago ; State Home for Female Juvenile Offenders, Geneva ; Institution for Education of Deaf and Dumb, Jacksonville ; Institution for Education of the Blind, Jacksonville ; Asylum for Feeble-minded Children, Lincoln; Soldiers' Orphans' Home,

Normal. Under the law governing commitment and detention of lunatics 4846 insane cases were tried in the courts during the biennial period ending 30th June 1900. Of this number 2669 were males and 2177 females ; 3451 were tried by jury, and 1395 by commission. The number of inmates in asylums for the insane on 30th Jane 1900 was 6438. For the two years beginning 1st July 1899 the General Assembly appropriated to state charitable institutions $4,350,161 ; for ordinary expenses .$3,163,520, and for special purposes $1,196,641. The total valuation of the property belonging to the fifteen state charitable institutions as reported on 80th June 1900 was $7,400,000. In 1899 "An Act to establish the Illinois State Colony for Epileptics " was passed. The state Board of Charities estimated the number of epileptics in 1900 as 5000.

Agriculture. — Illinois occupies a leading position among agricultural states. In the value of its farms, at the census of 1890, it stood first among the states of the Union. The state lies in the centre of a great agricultural valley, and the diversity of soil and climate enables it to produce a great variety of cereals, vegetables, and fruits. Its black soil has great fertility. Since September

1895 a permanent state fair has been maintained at Springfield, chiefly for the benefit of the agricultural and horticultural interests. The fair grounds contain 156 acres, and the buildings were erected at great expense. The Dome Building, which is used for agricultural exhibits, has the dome from the Horticultural Hall of the World's Fair at Chicago in 1893. According to the census of 1890, the total acreage of farms in the state was 30,498,277 ; 25,669,060 were improved, and 4,829,217 unimproved. The number of farms cultivated by the owners was 158,848 ; the number rented for money was 29,182 ; the number rented for a share of the products was 52,661. The number of families occupying farms was 252,963, and of this number 160,066 owned their farms. The number of farms under 50 acres was 49,448; 50 and under 100, 68,746 ; 100 and under 500, 119,684 ; 500 and under 1000, 2420 ; 1000 and over, 383. The value of farm lands, fences, and buildings was $1,262,870,687 ; of farm implements and machinery, $34,456,938 ; of live stock, $180,431,662 ; of farm products, $184,759,013. The cost of fertilizers purchased, $124,977.

The United States Department of Agriculture gave the following statistics of the grain production of the state for 1900 :—

Wheat.

Oats.

Corn.

Baric 1

Eye.

Buckwheat.

Potatoes.

Hay.

Acreage ....

1,383,236

3,616,918

7,139,898

13,365

73,877

4,476

166,262

1,668,834

Number of bushels .

17,982,068

133,642,884

264,176,226

342,144

1,270,684

67,140

16,296,104

2,119,4191

Average yield per acre .

13-0

38-0

37-0

26-6

17-2

15-0

92

1-271

Average value per acre .

$8.32

$8.74

$11.84

.‘512.03

$8.08

#9.75

$37.72

$10.66

Value of crop .

$11,508,524

$30,737,863

$84,536,392

$160,808

$597,221

$43,641

$6,271,403

$17,803,120

The figures in the following table are of 1st January 1900 : —

Numher.

Value.

Average Price

per Head.

Milch cows .

Other cattle

Sheep .

1,021,236

1,303,018

637,719

$37,070,867

41,197,518

2,532,383

$36.30

81.62

3.97

The beet-sugar crop is estimated at 1800 tons. The state is first among the states in the Union for the value of the crops of corn and oats, and of milch cows, and in the number of sheep and swine. It holds second place as to horses and meat cattle. Chicago is the greatest live-stock market in the world.

Manufactures. — In 1900 the state held third place in the Union as respects alike the value of its manufactured products, the cost of materials used, and capital invested. The following are the general statistics for 1890 and 1900 :—

1890.

1900.

Per cent,

of Increase.

Number of establish-

ments .

Capital .

Wage-earners, average

number .

Total wages

Cost of materials used

Value of products

20,482

$502,004,612

280,218

$142,873,265

$529,019,089

$908,640,280

38,360

$776,829,598

395,110

$191,610,962

$739,754,414

$1,259,571,105

87-3

54-7

41-0

34-0

39-8

88-6

The most important of the diSerent manufacturing industries was that of slaughtering and meat-packing, with 64 establishments, an aggregate capital of $71,229,262, 27,861 wage-earners (besides salaried officials, clerks, &c.), and products valued at $287,922,277. The size of other leading industries in 1900 is shown by the following table : —

Industry.

Establish-

ments.

"Wage-earners.

Value of

Products.

Agricultural imple-

ments .

94

18,231

$42,033,796

Cars, steam railway .

17

9,314

24,845,606

Clothing, men's

900

14,977

37,378,717

Flouring and grist

mill products

871

2,111

81,006,294

Foundry and machine-

shop products

758

31,851

63,878,352

Iron and steel .

26

16,642

60,144,081

Liquors, distilled and

malt

114

3,607

57,941,897

Eailways. — Illinois holds first place in railway mileage. The

State Railway and Warehouse Commission reported, 30th June

1900, for steam railways in Illinois a total mileage of 10,817-10

main line and branches ; total capital per mile, $63,172 ; total

income of passenger department, including mails and express,

$26,468,160 ; freight income, $69,510,827 ; total earnings and

1 Number of tons.

income, 8107,806,152 ; total expenditures, $93,072,220 ; passengers carried, 42,153,557 ; passenger earnings per mile of road, $2914 ; tons of freight carried, 83,667,441 ; freight earnings per mile, $5990 ; railway employees, 88,047 ; aggregate amount paid to employees, $51,360,689 ; tons of steel rails laid during year, 120,194 ; number of stations, 2761 ; passengers killed, 12, injured, 137 ; employees killed, 199, injured, 2122 ; trespassers killed, 503, injured, 490 ; taxes paid hy railways, §4,379,611. Total mileage of elevated and inter-urhan lines was 14,968 ; capital, $83,067,300 ; income, $4,248,286 ; and passengers carried, 74,415,958.

Insurance. — In 1893 the insurance department, formerly a part of the State Auditor's office, became a separate state department under the control of a superintendent appointed by the governor, subject to confirmation by the Senate. The number of life insurance companies entitled to do business in Illinois, 31st December 1899, was 45. Their total assets were $1,590,891,959 ; liabilities, $1,363,246,210 ; surplus, $227,645,748. The number of fraternal beneficiary societies authorized to do business was 94. Their

admitted assets, $14,290,653 ; and their unadmitted assets, $959,409. Their liabilities were $5,575,598. The number of assessment life associations was 30. Their total income for 1899 was §14,460,090; total disbursements, $11,179,096. Admitted assets were $12,966,243 ; unadmitted, $1,736,616. Their total liabilities were $6,325,464. The number of assessment accident associations was 8. The number of fire and marine insurance companies was 203 ; 23 were mutual companies, 48 foreign, having branches in the United States, and 126 were joint-stock companies of other states. The net cash surplus of the fire and marine insurance companies authorized to do business in Illinois in 1900 was, 31st December 1899, $97,812,478; their income, $164,217,137; expenditures, $166,109,193.

Goal. — In amount of bituminous coal mined the state holds second place. For the year ending 30th June 1900 there were fifty-two counties producing coal. The total number of mines was 920, but of this number only 323 were shipping mines. The total output of all mines in tons of 2000 pounds was 25,153,929. The aggregate home value of the total product was $22,510,360. The total number of persons employed was 39,384, of whom 35,203

were at work underground. The number of men accidentally killed was 95, and the number injured so as to lose a week or more of time, 61. The average days of active operations for shipping mines was 214. The number of mines in which mining machines were used was 65, and the number of mining machines in use was 430. The average value per ton, all grades at the mine, was $0-8949. The chief mining counties are Vermilion, Sangamon, La Salle, St Clair, Macoupin, Madison, Bureau, Grundy, and Williamson. A revised mining law became operative 1st July 1899. All mines are required to be in charge of certificated mine managers, mine examiners, and hoisting engineers, where the services of the last^mentioned class are necessary. The number of men permitted to work in any mine not having an escapement cannot in any circumstances exceed ten, and then only for the purpose of completing the escapement. The state is divided into seven inspection districts, and there are seven state mine inspectors appointed by the governor.

Banks. — The number of national banks on 13th December 1900 was 242. The amount of capital stock paid in was $35,996,900. Their surplus fund' was $14,852,722 ; and undivided profits,

$8,371,563. The amount of deposits was $191,236,702 ; and reserve held, $55,770,808. In 1887 Illinois for the first time passed an Act providing for the organization of savings-banks. The number of state banks in operation, 14th December 1900, was 155. Debt. — On 1st November 1900, and for a number of years prior thereto, the principal of the bonded debt outstanding has been $18,500. These bonds ceased to draw interest lat January 1882, and although called in by the governor, have never been presented for payment. The state constitution prohibits the state from loaning its credit or making appropriations in aid of railways or canals, and a similar prohibition is placed on counties, cities, towns, and other municipalities. Neither can the state loan its credit to, or in aid of, any public or other corporation, association, or individual. Tlie state may, to meet casual deficits, contract debts not to exceed in the aggregate $250,000 ; and no other debt, except for repelling invasion, suppressing insurrection, or defending the state in war, can be contracted until submitted to a vote of the people and approved by a majority of the votes cast. No county, city, township, school district, or other municipal corporation can incur indebtedness exceeding 5 per cent, on the value of the taxable property.

In 1890, 46 of the 103 counties of the state were free from debt. Revenues and Taxation. — Receipts in the state treasury from all sources from 1st October 1898 to .30th September 1900 were $16,645,925 ; disbursements for the same period were $14,027,970. The balance in the state treasury, 1st October 1900, was $2,617,955. Under charter of the Illinois Central railway that company is bound to pay into the state treasury semi-annually 7 per cent, of its gross annual earnings, and is relieved from all other taxes on its property. The state has received from the company, 30th April 1900 inclusive, $18,392,243. The inheritance tax brought to the state treasury, from 1st October 1898 to 30th September 1900, $958,785. The total value of all property assessed for taxes for 1899, as fixed by the State Board of Equalization, was $953,099,468. Total number of horses assessed in 1899 was 1,222,048, value $10,127,085 ; cattle, 2,256,759, value $11,350,995; mules and asses, 108,458, value $957,769; sheep, 630,677, value $453,729 ; hogs, 2,730,652, value $2,285,546. The assessed value of railway property was $79,072,674. The equalized value of personal property was $183,526,987 ; of town and city lots, $373,742,282; railway personal property, $1,789,666; railway

lands, $222,010 ; railway town and city lots, $1,048,956.

Churches. — The number of church organizations within the state, census 1890, was 8296 ; the number of church edifices, 7352 ; the seating capacity, 2,260,619 ; the value of church property, $39,715,245 ; the number of communicants, 1,202,588 ; the percentage of population, 31-43. Church membership was divided as follows : Catholics, 475,474 ; Methodists, 189,358 ; Baptists, 109,640 ; Presbyterian, 77,213 ; Lutheran, 116,807 ; Disciples of Christ, 60,867 ; Protestant Episcopal, 20,854 ; Congregational, 35,830. In respect of the value of church property the state ranked fourth.

Population. — ^Illinois ranks third in population among the states of the Union, under the census of 1900. The population was 4,821,550, and the gain for the decade was 995,199. The numerical increase was greater than in any previous decade of the state's history. The gain in the previous decade was 748,480. The number of males was 2,472,782, and females 2,348,768. The number of native-born was 3,854,803, and of foreign-bom 966,747. The total white population was 4,734,873, the native white population was 3,770,238. The average number of persons to the square

mile, under the census of 1900, was 86-0 ; and under that of 1890, 68-3. The number of males of voting age in 1900 was 1,401,456. Of this number 932,574 were native-born and 468,882 foreign-born ; 1,370,209 were white, and 31,247 coloured. There were 29 cities in 1890 having a population exceeding 5000, and 51 in 1900. Of the 930 incorporated cities, towns, and villages in the state in 1900, 614 had less than 1000 inhabitants ; 878 less than 5000 ; 27 more than 5000, but less than 10,000 ; 14 more than 10,000, but less than 20,000; 4 more than 20,000, but less than 25,000 ; and 7 more than 25,000. These seven with their populations were as follows : —

Chicago 1,698,575

Peoria 56,100

Quinoy 36,252

Springfield

Rockford .

East St Louis

JoUet

34,159

31,051

29,655

29,353

(h. vr. E.)

Illustration. — In a general sense illustration is as old as Art itself. There has never been a time since civilization began when artists were not prompted to pictorial themes from legendary, historical, or literary sources. But the art of illustration, as now understood, is a comparatively modern product. The tendency of modern culture has been to make the interests of the different arts overlap. The theory of Wagner, as applied to opera, for making a combined appeal to the artistic emotions, has been also the underlying principle in the development of that great body of artistic production which in painting gives us the picture containing "literary" elements, and, in actual association with literature in its printed form, becomes what we call " illustration." The illustrator's work is the complement of expression in some other medium. A poem can hardly exist which does not awaken in the mind at some moment a suggestion either

of picture or music. The sensitive temperament of the artist or the musician is able to realize out of words some parallel idea which can only be conveyed, or can be best conveyed, through his own medium of music or painting. Similarly, music or painting may, and often does, suggest poetry. It is from this inter-relation of the emotions governing tlie different arts that illustration may be said to spring. The success of illustration lies, then, in the instinctive transference of an idea from one medium to another; the more spontaneous it be and the less laboured in application, the better. But when this

common ground has been stated, it must be recognized that illustration introduces a fresh personality, and, therefore, the risk of departure in feeling from the idea which was in the writer's mind. There is this drawback appertaining to illustration — that while, as art, it may be fine, as illustration it may be very imper-fect. So, also, does the converse hold good. Thus the

Bab Ballads and the Ingoldshy Legends have been more adequately illustrated than the works of Shakespeare. But if to illustrate is a natural artistic impulse, the freedom of the artist to a large extent follows. The written word remains unchanged, and the illustrations may be taken apart from their context. It is only a particular edition, and not the literary essence of a book, that illustration can damage.

Leaving on one side the illuminated manuscripts of the Middle Ages, which have been treated in the ninth edition of this work under Illumixation, we start with the fact that illustration in the accepted sense was coincident with the invention of printing. Italian art produced many fine examples, notably the outline illustrations to the Poliphili Hypnerotomachia, printed by Aldus at Venice in the last year of the 16th century. Other early works exist, the products of unnamed artists of the French, German, Spanish, and Italian schools ; while of more singular importance, though not then brought into book form, were the illustrations to Dante's Divine Comedy made

by Botticelli at about the same period. The sudden development of engraving on metal and wood drew many painters of the Eenaissance towards illustration as a further opportunity for the exercise of their powers ; and the line-work, either original or engraved by others, of PoUajuolo, Mantegna, Michelangelo, and Titian (to name only a few) has its place in the gradual enlargement of illustrative art. The German school of the 16th century committed its energies even more vigorously to illustration; and many of its artists are now known chiefly through their engravings on wood or copper, a good proportion of which were done to the accompaniment of printed matter. The names of Dtirer, Burgmair, Altdorfer, and Holbein represent a school whose engraved illustrations possess qualities which have never been rivalled, and remain an invaluable aid to imitators of the present day.

Illustration has generally flourished in any particular age in proportion to the health and vigour of the artistic productions in other kinds. No evident revival in paint-

ing has come about, no great school has existed during the last four centuries, which has not set its mark upon the illustration of the period and quickened it into a medium for true artistic expression. The etchers of the Low Countries during the 17th century, with Rembrandt at their head, were to a great extent illustrators in their choice of subjects. In France the period of Watteau and Fragonard gave rise to a school of delicately engraved illustration, exquisite in detail and invention. In England Hogarth came to be the founder of many new conditions, both in painting and illustration, and was followed by men of genius so distinct as Eeynolds on the one side and Bewick on the other. With Eeynolds one connects the illustrators and engravers for whom now Bartolozzi supplies a surviving name and an embodiment in his graceful but never quite English art. But it is from Bewick that the wonderfully consistent development of English illustration begins to date. Bewick marks an important period in the technical history of wood-engraving as the practical inventor of the "tint " and

Progress la " white line " method of wood-cutting ; but he . England, also happened to be an artist. His artistic device was to give local colour and texture without shadow, securing thereby an altogether novel amount of truth, side by side with a precision of outline which allowed no form to be lost. And though, in consequence, many of his best designs have somewhat the air of a specimen plate, he succeeded in bringing into black and white illustration an element of colour which had been wholly absent from it in the work of the 15th and 16th century German and Italian schools. Bewick's method started a new school ; but the more racy qualities of his woodcuts were entirely dependent on the designer being his own cutter; and the same happy relationship gave distinct characteristics to the nearly contemporary work of Blake and of Calvert. Blake's wonderful Illustrations to the Book of Job, while magnificent in their conventional rendering of light and shade, still retain the colourlessness of the old masters, as do also the more broadly handled designs to his own books of prophecy and verse ;

but in his woodcuts to Philips's Pastorals the modern tendency towards local colour makes itself strongly felt. So wonderfully, indeed, have colour and tone been expressed in these rough wood-blocks, that more vivid impressions of darkness and twilight falling across quiet landscape have never been produced through the same materials. The pastoral designs made by Edward Calvert on similar lines can hardly be over-praised. Technically these engravings are far more able than those from which they drew their inspiration.

With the exception of the two artists named, and in a minor degree of Stothard and Flaxman, who also produced original illustrations, the period from the end of the 18th century till about the middle of the 19th was less notable for the work of the designer than of the engraver. The delicate plates to Eogers's Italy were done from drawings which Turner had not produced for purposes of illustration ; and the admirable lithographs of Prout and Bonington were merely studies of architecture and landscape

made in a material that admitted of indefinite multipli-
cation. It is true that Gericault came over to Eng-
land about the year 1820 to draw the English racehorse
and other studies of country life, which were published
in London in 1821, and that other fine work in litho-
graphy was done by James Ward, G. Cattermole, and
somewhat later by J. F. Lewis. But illustration proper,
subject-illustration applied to literature, was mainly in the
hands of the wood-engravers ; and these, forming a really
fine school founded on the lines which Bewick had laid
down, had for about thirty years to content themselves
with rendering the works of ephemeral artists, among
whom Haydon and Martin stand out as the chief lights.
It must not be forgotten, however, that while the day of
a serious English school of illustration had not yet come,
Great Britain possessed an indigenous tradition of gross
and lively caricature ; a tradition of such robust force and
vulgarity that, by the side of some choicer specimens of
Gillray and Bunbury, the art of Eowlandson appears
almost refined. This was the school in which George

Cruikshank, John Leech, and the Dickens illustrators had their training, from which they drew more and more away ; until, with the help of Punch, just before the middle of the 19th century, English caricaturists had learned the secret, which in France has not yet been discovered, of how to be apposite and amusing without scurrility and without libel.

It was in about the year 1832 that the illustrated weekly paper started on its career in England, and almost by accident determined under what form a great national art was to develop itself. While in France the illustrators were making their triumphs by means of lithography, English illustration was becoming more and more identified with wood-engraving. The demand for a- method of illustration, easy to produce and easy to print, for books

and magazines of large circulation and moderate price, forced the artist before long into drawing upon the wood itself; and so soon as the artist had asserted

lafiuen^ his preference for facsimile over "tint,"

In^aving. ^^^ school which Came to be called "of the

'sixties " was in embryo, and waited only for

artistic power to give it distinction. The engraver's

translation of the artist's painting or wash-drawing into

"tint" had largely exalted the individuality of the

engraver at the expense of the artist. But from the

moment when the designer began to put his own lines

upon the wood, new conditions shaped themselves ;

and though the artist at times might make demands

which the engraver could not follow, or the engraver

inadequately fulfil the expectation of the artist, the

general tendency was to bring designer and engraver

into almost ideal relations — an ideal which nothing short

of the artist being his own engraver could have equalled.

Out of an alliance cemented by their common use and

understanding of the material on which they worked

came the school of facsimile or partial-facsimile engrav-

ing which flourished during the 'sixties, and lasted just

so long as its conditions were unimpaired — losing its

flavour only at the moment when " improved " mechanical appliances enabled the artist once more to dissociate himself from the conditions which bound the engraver in his craft.

Before the fortunate circumstances which governed the work of the 'sixties became decisive, illustrations of a transitional character but tending to the same end had been produced by John Tenniel, John Gilbert, Birket Foster, Harrison Weir, T. Creswick, W. Mulready, and others ; but their methods were too vague and diffuse to bear as yet the mark of a school ; no single iufluence gave a unity to their efforts. On some of them Menzel's illustrations to Kiigler's Frederick the Great, published in England in 1844, may have left a mark : Gilbert certainly shows traces of the influence of Delacroix and Bonington in the free, loose method of his draughtsmanship, independent of accurate modelling, and with here and there a paint-like dab of black to relieve a generally colourless effect ; while Tenniel, with cold, precise lines of wire-drawn hardness, remained the representative

of the past academic style, influencing others by the dignity of his fine technique, but with his own feeling quite untouched by the Pre-Eaphaelite and romantic movement which was soon to occupy the world of illustration. In greater or less degree it movement, may be said of the work of all these artists that, as it antedates, so to the end does it stand somewhat removed in character from, the school with which for a time it became contemporary. The year which decisively marked the beginning of new things in illustration was 1857, the year of the Moxon Tennyson and of Wilmott's Poets of the Nineteenth Century, with illustrations by Eossetti, Millais, Holman Hunt, and Ford Madox Brown. In these artists we get the germ of the movement which afterwards came to have so wide a popularity. At the beginning, Pre-Raphaelite in name, poetic and literary in its choice of subjects, the school quickly expanded to an acceptance of those open-air and everyday subjects which one connects with the names of Walker, Houghton, Pinwell, and North. The illustrations

of the Pre-Raphaelites were eminently thoughtful, full of symbolism, and with a certain pressure of interest to which the epithet of "intense" came to be applied. As an example of their method of thought-transference from word to form, Madox Brown's drawing for the Dalziel Bible of " Elijah and the Widow's Son " may be taken. The restoration of life to a dead body, of a child to its mother, is there conveyed with many illustrative touches and asides, which become clumsy when stated in words. The hen bearing her chicken between her wings is a perfectly direct and appropriate pictorial symbol, but a far more imaginative stroke is the shadow on the wall of a swallow flying back to the clay bottle where it has made its nest. Here is illustration full of literary symbolism, yet wholly pictorial in its means ; and in this it is entirely characteristic of Pre-Raphaelite feeling, with its method of suggesting, through externals, consideration as opposed to mere outlook. Of this phase Rossetti must be accounted the leader, but it was Millais who, by the sheer weight of his personality, carried English illus-

tration along with him from Pre-Raphaelitism to the freer romanticism and naturalistic tendencies of the 'sixties. Rossetti, with his poetic enthusiasm, his strong personal magnetism, and dramatic power of composition, may be said to have brought about the awakening ; it was Millais who, by his rapid development of style, his origi-nal and daring technique, turned it into a move- 'f/j^fj°^g_ ment. When he started, there were many influences behind him and his fellow-workers — among older foreign contemporaries, those of Menzel and Rethel ; and behind these again something of the old masters. But through a transitional period, represented by his twelve drawings of "The Parables," which appeared first in Good Words, Millais emerged into the perfect independ-ence of his illustrations to Trollope's novels, Framley Parsonage and TJie Small House at Allington, his own master and the master of a new school. Depicting the ugly fashions of his day with grave dignity and distinc-tion, and with a broad power of rendering type in work which had the aspect of genre, he drew the picture of his

age in a summary so embracing that his illustrations attain the rank almost of historical art. For art of this sort the symbolism of the Pre-Raphaelites lost its use : the realization in form of a character conveyed by an author's words, the happy suggestion of a locality helping to fix the writer's description, the verisimilitudes of ordinary life, even to trivial detail, carried out with real pictorial conviction, were the things most to be aimed at. Pictorial conviction was the great mark of the illustrative school of the 'sixties. The work of its artists has absorbed so completely the interest and reality of the letterpress that the results are a model of what faithful yet imaginative illustration should be. In the illustrated magazines of this period, Once a Week, Good Words, Cornhill, London Society, TJie Argosy, The Leisure Hour, Sunday at Home, The Quiver, and Tlie Churchman's Family Magazine, as well as others, is to be found the best work of this new school of illustrators ; and with the greater number of them it cannot be mistaken that Millais is the prevailing force. By their side other men were working, more deeply

influenced by the old masters, and by the minuteness and hard, definite treatment of form which the Pre-Raphaelite school had inculcated. Foremost of these was Frederick Sandys, a draughtsman of great technical power, precise in outline and detail. His method shows a blend of the styles of Dilrer, Holbein, and Bethel, with an acceptance of the more modern devices which suggest colour and tone. His illustrations, scattered through nearly all the magazines which have been named, show always a decora-tive power of design, and are full of fine drawing and fine invention, but remain resolutely cold in handling and lacking in imaginative ardour. The few illustrations done by Burne-Jones at this period show a whole-hearted following of Rossetti, but a somewhat struggling tech-nique; and the same qualities are to be found in the work of Arthur Hughes, whose illustrations in Good Words for the Young (1869) have a charm of tender poetic invention showing through the faults and persistent uncertainty of his draughtsmanship. Higher technical

qualities single out the work of Frederick Shields for notice : his illustrations to Defoe’s History of the Plague have a certain affinity to the work of Sandys ; but, with less power over form, they show a more dramatic sense of light and shade, and at their best can claim real and original beauty. The formality of feeling and composition, and the strained, stiff quality of line in Lord Leighton’s designs to Romola (1863), do a good deal to mar one’s enjoyment of their admirable draughtsmanship.

Many line drawings done at this period by Leighton, Poynter, Armstead, and Burne-Jones, characterized by fine, hard draughtsmanship and close cross-hatching, did not appear until the year 1880 in the “Dalziel Bible G-allery,” when the methods of which they were the outcome had fallen almost out of use.

Deeply influenced by the broad later phases of Millais’s black-and-white work were those artists whose tendency

lay in the direction of idyllic naturalism and popular romance, the men to whom more particularly is given the name of the period and school " the 'sixties," and whose more immediate leader, as far as popular estimation goes, was Frederick Walker. With his, one may roughly group the names of Pinwell, Houghton, North, Keene, Lawless, Mahoney, Morten, and, with a certain reservation, W. Small and Gr. du Maurier. In no very separate category stand two other artists whose contributions to illustration were but incidental, John Pettie and J. M'Neill Whistler. The broad characteristics of this variously related group were a loose, easy line suggestive of movement, a general fondness for white spaces and open-air effects, and in the best of them a thorough sense of the serious beauty of domestic and rural life. They treated the present with a feeling rather idyllic than realistic ; when they touched the past it was with a courteous sort of realism, and a wonderful inventiveness of detail which carried with it a curious charm of conviction. Walker's method shows

a broad and vivid use of black-and-white, with a fine sense of balance, but very little preoccupation for decora^ tive effect. Pinwell had a more delicate fancy, but less freedom in his technique — less ease, but more originality of composition. In Houghton's work one sees a swift, masterful technique, full of audacity, noble in its economy of means, sometimes rough and careless. His tempera- ment was dramatic, passionate, satiric, and witty. Some of his best work, his " Scenes from American Life," appeared in the pages of the Graphic as late as the years 1873-74. There are indications in the work of Lawless that he might have come close to Millais in his power of infusing distinction into the barest materials of everyday life, but he died too soon for his work to reach its full accomplishment. North was essentially a landscape illustrator, notable for the dignity and sense of subject he was able to infuse into compositions which were without figure interest. The delicate sense of beauty in du Maurier's early work became lost in the formal but graceful conventions of his later Punch drawings. It

was in the pages of Punch that Keene, the greatest impressionist illustrator England has produced, secured his chief triumphs. The two last-named artists outstayed the day which saw the break-up of the school of which these are the leading names. It ran its course through a period when illustrated magazines formed the staple of popular consumption, before the illustrated newspapers, with their hungry rush for the record of latest events, became a weekly feature. Its waning influence may be plainly traced through the early years of the Graphic, which started in 1869 with some really fine work, done under transitional conditions before the engraver's rendering of tone-drawings once more ousted facsimile from its high place in illustration.

In connexion with this transitional period, drawings for the Graphic by Houghton, Pinwell, Herkomer, E. J. Gregory, H. Woods, Charles Green, H. Paterson (Mrs Allingham), and William Small deserve honourable mention. Yet it was the last-named who was mainly instrumental in bringing about the change from line-work to

pigment, which, by removing the limitations that had flavoured the artist's work and made it native to its environment, depressed the artistic value of illustration during the 'seventies and the 'eighties to almost absolute mediocrity. Several artists of great ability practised illustration during this period: in addition to those Graphic artists already mentioned there were Luke Fildes, Prank Holl, S. P. Hall, Paul Renouard, and a few others of smaller merit. But the interest was for the time shifting from black-and-white work and turning to colour. Kate Greenaway began to produce her charming idyllic renderings of children in mob-caps and long skirts delicately outlined and tinted. Walter Crane on somewhat similar lines designed his illustrated nursery rhymes. Baby's Opera, Baby's Bouquet, and the like; while Eandolph Caldecott took the field with his fresh and breezy scenes of hunting life and carousal in the times most typical of the English squirearchy. Working with a broad outline, suggestive of the brush by its easy freedom, and adding washes of conventional colour for

embellishment, he was one of the first in England to show the beginnings of Japanese influence. Even more dependent upon colour were his illustrated books for children ; while in black-and-white, in his illustrations to Bracebridge Hall (1876), for instance, pen and ink began to replace the pencil, and to produce a new and more independent style of draughtsmanship. This style, clear and straightforward but without much subtlety, was taken up and followed by many artists of ability, by Harry Furniss, Hugh Thomson, and others, till the influence of E. A. Abbey's more mobile and more elaborate penmanship came to produce a still further development in the direction of fineness and illusion, and that of Phil May, with Linley Samboume for his teacher, to simplify and make broad for those who aimed rather at a journalistic and shorthand method of illustration. (See also Caeicattjrb and Cartoon.)

Under the absolutely liberating conditions of " process reproduction" (see Process) the latest developments in illustration on its lighter and more popular side are full of French influences, or ready

to follow the wind in any fresh direction, whether ,to America or Japan ; but on the graver side they show a strong leaning towards the older traditions of the 'sixties and of Pre-Raphael-itiam. It would be rash from the random and often Coatem-undistinguished cleverness of the popular school to /°^2„„. select names which may have very little permanent standing : the title of the weekly paper which started them on a prosperous career, the Sketch, will indicate where their works may be found and their style studied, just as in the first volume of Black and White may he seen the one serious attempt to revive in connexion with a weekly publication a worthier and less flighty tradition of illustration. A more successful motive force in that direction came from the founding by William Morris of the Kelmscott Press in 1891 (see William Morris, and Book-Printing), through which were produced a series of decorated and illustrated books which aimed frankly at a revival of mediseval taste. In Morris's books decorative effect and sense of material claimed a mastery over the whole scheme, and subdued the illustra-tions to a sort of glorious captivity into which no breath of modern spirit could be breathed. The illustrations of Burne-Jones filled

with a happy touch of archaism the decorative borders of William Morris ; and only a little less happy, apart from their imaginative inferiority, were the serious eif orts of Walter Crane and one or two others to fulfil the requirements of pages which would not abate a decade of their mediseval standpoint to fit with more nicety the requirements of the illustrator. Directly under the Morris influ-ence arose the "Birmingham school," with an entire devotion to decorative methods and still archaic effects which tended some-times to rather inane technical results. Among its leaders may be named Arthur Gaskin, C. M. Gere, and E. H. New ; while work

not dissimilar but more independent in spirit had already been done by Selwyn Image and H. P. Home in The Century Guild Hohby-Horse. But far greater originality and force belonged to the work of a group, known for a time as the neo-Pre-Eaphaelites, which joined to an earnest study of the past a scrupulously open mind towards more modern influences. Its earliest expression of existence was the publication of an occasional periodical, the Dial

(1889 to 1897), but before long its influence became felt outside its first narrow limits. The technical influence of Abbey, but still more the emotional and intellectual teaching of Kossetti and Millais, together with side-influences from the few great French symbolists, were, apart from their own originality, the forces which gave distinction to the work of C. S. Ricketts, C. H. Shannon, R. Savage, and their immediate following. Beauty of line, languorous passion, symbolism full of literary allusions, and a fondness for the life of any age but the present, are the characteristics of the school. Their influence fell very much in the same quarters where Morris found a welcome ; but an affinity for the Italian rather than the German masters (shown especially in the "Vale Press" publications), and a studied note of world-weariness, kept them somewhat apart from the sturdy medisevalism of Morris, and linked them intellectually with the decadent school initiated by the wayward genius of Aubrey Beardsley. But though broadly men may be classed in groups, no grouping will supply a formula for all the noteworthy work produced when men are drawn this way and that by current influences. Among artists resolutely independent of contemporary coteries are W. Strang, whose grave,

rugged work shows him a pupil, through Legros, of Diirer and others of the old masters ; T. Sturge Moore, an original engraver of designs which have an equal affinity for Blake, Calvert, and Hokusai ; W. Nicholson, whose style shows a dignified return to the best part of ttte Rowlandson tradition ; and E. J. Sullivan. Among decorative and romantic illustrators of no particular school may be named G. Moira, Byam Shaw, Anning Bell, R. Spence, Mary S. Florence, J. D. IBatten, Patten Wilson, and C. Robinson — all artists of considerable inventive faculty, but of rather irresolute imagination and style. In the closing years of the 19th century Aubrey Beardsley became the creator of an entirely novel style of decorative illustration. Drawing inspiration from all sources of European and Japanese art, he produced, by the force of a vivid personality and extraordinary technical skill, a result which was highly original and impressive. To a genuine liking for analysis of repulsive and vicious types of humanity he added an exquisite sense of line, balance, and mass ; and partly by succes de scandale, partly by genuine artistic brilliance, he gathered round him a host of imitators, to whom, for the most part, he was able to impart only his more mediocre qiiallties.

In America, until a comparatively recent date, illustration bowed the knee to the superior excellence of the engraver over the artist. Not imtil the brilliant pen-drawing of E. A. Abbey carried the day with the black-and-white artists of England did any work of real moment emanate from the United States, unless that of Elihu Vedder be regarded as au exception. Even now it has no school of illustra-tion properly so called, but its leading magazines contain work of individual power which cannot be overlooked. Howard Pyle is a brilliant imitator of Diirer ; he has also the ability to adapt himself to draughtmanship of a more modem tendency. C. S. Reinhart was an artist of directness and force, in a style based upon modem French and German examples ; while of greater originality as a whole, though derivative in detail, is the fanciful penmanship of Alfred Brennan. Other artists who stand in the front rank of American illustrators, and whose works appear chiefly in the pages of Scribner's, Harper^s, and the Century Magazine, are W. T. Smedley, F. S. Church, R. Blum, Wenzell, A. B. Frost, and in particular C. Dana Gibson, the last of whom has gained a reputation in England as an American du Maurier.

The record of modern French illustration goes back to the day when political caricature and the Napoleonic legend divided between them the triumphs of early lithography. The illustrators of France at that period were also her greatest artists. Of the historical and romantic school were Raffet, Charlet, G^ricault, Delacroix, Isabey, and Achille Dev&ia, many of whose works appeared in V Artiste, a paper founded in 1831 as the official organ of the romanticists ; while the realists were led in the ranee. direction of caricature by two artists of such enormous force as Gavarni and Daumier, whose works, appearing in La Lithographie Mensuelle, Le Charivari, and La Caricature, ran the gauntlet of political interference and suppression during a troubled period of French politics — which was the very cause of their prosperity. Behind these men lay the influence of the great Spanish realist Goya. Following upon the harsh satire and venomous realism of thisfamous school of pictorial invective, the influence of the Barbizon school came as a milder force ; but the power of its artists did not show in the direction of original lithography, and far more value attaches to the few woodcuts of J. F. Millet's studies of peasant United

States.

life. In these we see clearly the tendency of French illustrative art to keep as far as possible the authentic and sketch -like touch of the artist ; and it was no doubt from this tendency that so many of the great French illustrators retained lithography rather than commit themselves to the middleman engraver. Nevertheless, from about the year 1830 many French artists produced illustrations which were interpreted upon the wood for the most part by English engravers. Cunier's editions of Paul et Virginie and La Chaumiere Indienne, illustrated by Huet, Jaoque, Isabey, Johannot, and Meissonier, were followed by Meissonier's more famous illustrations to Contes Bemois. After Meissonier came Detaille and De Neuville, and, with a voluminous style of his own, Dor6. By the majority of these artists the drawing for the engraver seems to have been done with the pen ; and the tendency to pen-manship was still more accentuated when from Spain came the in-fluence of Fortuny's brilliant but restless technique ; while after him, again, came Vierge, to make, as it were, the point of the pen still more pointed. During the middle period of the 19th century the best French illustration was serious in character ; but among

the later men, when we have recognized the grave beauty of Gras-set's Les Quatre Fils d'Aymon (in spite of his vicious treatment of the page by flooding washes of colour through the type itself), and the delicate grace of Boutet de Monvel's Jeanne d^Arc, also in colours, it is to the illustrators of the comic papers that we have to go for the most typical and most adacious specimens of French art. In the pages of Gil Bias, Le Pierrot, VlScho de Paris, Le Figaro Illustre, Le Courrier Franqais, and similar publications, are to be found, reproduced with a dexterity of process unsurpassed in England, the designs of Forain, L§andre, Willette, and Steinlen, the leaders of a school enterprising in technique, and with a mixture of subtlety and grossness in its humour. Caran d'Ache is also well known as a draughtsman of comic drama in outline. Among illustrators of Teutonic race the one artist who seems worthy of comparison with the great Menzel is Hans Tegner, if, indeed, he be not in some respects his technical superior ; but apart from these two, the illustrators Oermany. respectively of Kiigler's Frederick the Great and Holberg's Comedies, there is no German, Danish, or Dutch illustrator who can lay claim to first rank. Max Klinger, A. BockUn, W. Trtibner, Franz Stilck,

and Hans Thoma are all symbolists who combine in a singular degree force with brutality ; the imaginative quality in their work is lor the most part ruined by the hard, braggart way in which it is driven home. The achievements and tendency of the present school of illustration in Germany are best seen in the weekly illustrated journal, Jugend, of Munich. Typical of an older German school is the work of Oberlander, a solid, scientific sort of caricaturist, whose illustrations are at times so monumental that the humour in them seems crushed out of life. Others who command high qualities of technique are W. Dietz, L. von Nagel, Hermann Vogel, H. Luders, and Robert Haug. Behind all these men in greater or less degree lies the influence of Menzel's coldly balanced and dry-lighted realism ; but wherever the influence of Menzel ceases, the merit of German illustration for the most part tends to disappear or become mediocre.

AuTHOEiTiES. — W. J. Linton. The Masters of Wood Engraving. London, 1889. — C. G. Haepee. English Pen Artists of To-day. London, 1892. — Joseph Pennell. Pen Drawing and Pen Draughtsmen. London, 1894 ; Modern Illustration. London, 1895. — Waltee Ceane. The Decorative Dlus-

tration of Books. London, 1896. — Gleeson White. English Illustration: "The ' Sixties" : 1S5S-1870. Westminster, 1897. — W. A. Chatto. A Treatise on Wood Engraving. London, n.d. — Bar-le-Ddc. Les Illustrations du XIX Steele. Paris, 1882. — T. Khtschmann. Geschichte der deutschen Illustration vom ersten Auftreten des Formschnittes bis auf die Gegenwart. Berlin, 1899. (l. ho.)

Tbchkical Developments.

The history of illustration, apart from the merits of indiTidual artists, during the period since the year 1876, is mainly that of the development of what is called Process (q.v.), the term applied to methods of reproducing a drawing or photograph which depend on the use of some mechanical agency in the making of the block, as distinguished from such products of manual skill as steel or wood engraving, lithography, and the like. There is good reason to believe that the art of stereotyping — the multiplication of an already existing block by means of moulds and casts — is as old as the 15th century ; and the early processes were, in a measure, a refinement upon this :

with the difference that they aimed at the making of a metal block by means of a cast of the lines of the drawing

itself, the background of which had been cut away so as to leave the design in a definite relief. Experiments of this nature may be said to have assumed practical shape from the time of the invention of Palmer's process called at first Olyphography, about the year 1844; this was afterwards perfected and used to a considerable extent under the name of Dawson's Typographic Etching, and its results were, in many cases, quite admirable, and often appear in books and periodicals of the first part of the period with which we are now concerned. The Graphic, for instance, published its first process block in 1876, and the Illustrated London News also made similar experiments at about the same time.

From this time begins the gradual application of photography to the uses of illustration, the first successful line blocks made by its help being probably those of Gillot, at Paris, in the early

‘eighties. The next stage was to be the invention of some means of reproducing wash drawings. To do this it was necessary for the surface of the block to be so broken up that every tone of the drawing should be represented thereon by a grain holding ink enough to reproduce it. This was finally accomplished by the insertion of a screen, in the camera, between the lens and the plate — the effect of which was to break up the whole surface of the negative into dots, and so secure, when priated on a zinc plate and etched, an approximation to the desired result. Half-tone blocks (as they were called) of this nature (see Process) were used in the Graphic from 1884 and the Illustrated London News from 1885 onwards, the methods at first in favour being those of Meisenbaoh and Boussod Valadon and Co.‘s phototype. Lemercier and Petit of Paris, Angerer and G6schl of Vienna, and F. Ives of Philadelphia also perfected processes giving a similar result, a block by the latter appearing in the Century magazine as early as 1882. Processes of this description had, however, been used for some years before by Henry Blackburn in his Academy Notes.

During the decade 1875-85, however, the main body of illustra^ tion was accomplished by wood-engraving, which a few years earlier

had achieved such splendid results. Its artistic qualities were now at a rather low ebb, although good facsimile engravings of pen-drawings were not infrequent. The two great illustrated periodicals already referred to during that period relied more upon pictorial than journalistic work. An increasing tendency towards the illustration of the events of the day was certainly shown, but the whole purpose of the journal was not, as at present, subordinated thereto. The chief illustrated magazines of the time, Sarper^s, the Century, the English Illustrated, were also content with the older methods, and are filled with wood-engravings, in which, if the value of the simple line forming the chief quality of the earlier work has disappeared, a most astonishing delicacy and success were obtained in the reproduction of tone.

Perhaps the most notable and most characteristic production of the time in England was colour-printing. The Graphic and the Illustrated London News published full-page supplements of high technical merit printed from wood-blocks in conjunction with metal plates, the latter sometimes having a relief aquatint surface which produced an effect of stipple upon the shading ; metal was also used in preference to wood for the printing of

certain colours. The children's books illustrated by Randolph Caldecott, Walter Crane, and Kate Greenaway at this time are among the finest specimens of colour-printing yet seen outside of Japan ; in them the use of flat masses of pleasant colour in con-nexion with a bold and simple outline was carried to a very high pitch of excellence. These plates were generally printed by Edmund Evans. In 1887 the use of process was becoming still more general ; but its future was by no means adequately foreseen, and the blocks of this and the next few years are anything but satisfactory. This, it soon appeared, was due to inefficient printing on the one hand, and, on the other, to a want of recognition by artists of the special qualities of drawing most suitable for photo-graphic reproduction. The publication of Quevedo's Pablo de /Segovia with illustrations by Daniel Vierge in 1882, although hardly noticed at the time, was to be a revelation of the possibilities of the new development ; and a serious study of pen-drawing from this point of view was soon inaugurated by the issue of Joseph Pennell's Fen Draioing and Pen Draughtsmen in 1889, followed in 1892 by C. G. Harper's English Pen Artists of To-day, and in 1896 by Walter Crane's Decorative Illustration of Books. At

this time also the influence of Aubrey Beardsley made itself strongly felt, not merely as a matter of style, but, by the use of simple line or mass of solid black, as an almost perfect type of the work most suitable to the needs of process. Wider experience of printing requirements, and finer workmanship in the actual making of the blocks, in Paris, Vienna, New York, and London, soon brought the half-tone process into great vogue. The spread of education has enormously increased the demand for ephemeral literature, more especially that which lends itself to pictorial illustration ; and the photograph or drawing in wash reproduced in half-tone has of late to a great extent ousted line work from the better class of both books and periodicals.

Improvements in machinery have made it possible to print illustrations at a very high speed ; and the facility with which photographs can now be taken of scenes such as the public delight to see reproduced in pictures has brought about an almost complete change in pictorial journalism. In addition, reference must be made to an extraordinary increase in the numbers and circulation of cheap periodical publications depending to a very large extent for popularity on their illustrations. Several of these, printed

on the coarsest paper, from rotary machines, sell to the extent of hundreds of thousands of copies per week. It was inevitable that this cheapening process should not be permitted to develop without opposition, and the Dial (1889-97) must be looked on as a protest by the band of artists who promoted it against the unintelligent book-making now becoming prevalent. Much more effective and far-reaching in the same direction was the influence of William Morris, as shown in the publications of the Kelmscott Press (dating from 1891). In these volumes the aim was to produce illustrations and ornaments which were of their own nature akin to, and thus able to harmonize with the type, and to do this by pure handi-craft work. As a result, a distinct improvement is to be found in the mere book-making of Great Britain ; and although the main force of the movement soon spent itself in somewhat unin-spired imitations, there can be no doubt of the survival of a taste for well-produced volumes, in which the relationship of type, paper, illustration, and binding has been a matter of careful and artistic consideration. Under this influence, a notable feature has been the re-issue, in an excellent form, of illustrated editions of the works of most of the famous writers.

Another significant outcome of the trend of popular education has been the rapid creation of a large literature devoted exclusively to art in one form or another. The Art Journal (1849), the Magazine of Art (1878), the Studio (1893), the Artist (in its illustrated form, 1895), and the Connoisseur (1901), as well as the considerable and important publications devoted to architecture and the like, have eagerly availed themselves of the new developments of illustration, and their pages have been the means of bringing before the public many experiments which might not otherwise have been tried. In addition to periodicals, large numbers of books of this nature are now issued, the cheapness and facility of the photographic processes making it possible to render treatises attractive to a much wider circle of readers than before, as well as to multiply evidence and example in a way that the older methods could never permit. But it is to be regretted that a large proportion of these — and indeed of most books of the day illustrated by half-tone blocks — are printed upon clay-faced paper, which it is believed cannot last many years.

The illustration of newspapers pure and simple is a matter of which we are probably only experiencing the beginnings of a great

progress. The Times had occasionally published maps, but the printing of a portrait of Lef roy the murderer by the Daily Telegraph in 1881 was perhaps one of the earliest examples of journalistic enterprise in this direction. On 11th February 1895 the Daily Chronicle published an enlargement from a line drawing by Sir E. Burne-Jones, which was printed from a process line-block on a rotary machine ; and since then illustrations of this kind are yearly becoming more frequent. They are generally in pure line, but the Black and White Budget has printed many half-tones in this manner.

In France the general movement has proceeded upon lines on the whole very similar. Process — especially what was called " Gillotage" — was adopted earlier, and used at first with greater liberality than in England, although wood-engraving has persisted effectively even up to our own time. The French have no periodicals which can compare with the Daily Graphic, or with the great illustrated weekly journals issued in the United Kingdom. Neither have they anything at all like the cheap and so-called "humorous " English papers. But in the various types of periodicals of which the Revue Illustree, Figaro Illustre, and Gil Bias Illustre may be taken as examples, the most noticeable feature is a use of colour-

printing, which is far in advance of anything generally attempted in Great Britain. A favourite and efiective process is that employed for the reproduction of chalk drawings (as by Steinlen) , which consists of the application of a surface-tint of colour from a metal plate to a print from an ordinary process block. L' Illustration still relies on older fashions, and publishes a considerable number of wood-engravings.

In Germany, Jugend, Simplicissimus, and other publications devoted to humour and caricature, employ colour-printing to a great extent with success. The organ of the artists of the younger German schools. Pan (1895), makes use of every means of illustration, and has especially cultivated lithography and wood-cuts, using these arts effectively but with some eccentricity. Holland

has also employed coloured lithography for a remarkable series of children's books illustrated by van Hoytema and others. The Viennese Kunst und Kunsthandwerk is an art publication which is exceptionally well produced and printed.

Illustration in the United States has some few characteristics

which differentiate it from that of other countries. The later school of fine wood-engraving is even yet in existence. American artists also introduced an effective use of the process block, namely, the engraving or working over of the whole or certain portions of it by hand. This is generally done by an engraver, but in certain cases it has been the work of the original draughtsman, and its possibilities foreseen by him in making his drawing. The only other variant of note is the use of half-tone blocks superimposed for various colours ; but the experiments of this nature in Harper's and 8erihner"s magazines cannot be said to have yet achieved all the success that may be expected. (-^ j. g/v

llmenau, a town and summer resort of Germany, grand-duchy of Saxe- Weimar, at the north foot of the Thuringiah Forest and 30 miles by rail south of Erfurt. The town stands picturesquely amongst wooded hills and is much frequented as a health-resort, and is in German literary history associated with Goethe's IpMgenie. It has manufactures of glass and porcelain, toys, gloves, and chemicals, iron and coal mines, and sawmills. Here is a grand-ducal castle, now used as administrative offices.

Population (1885), 5483; (1896), 7958; (1900), 10,419.

Iloilo, capital of the province of the same name, situated on the south-east coast of Panay, one of the Philippine Islands. A small tidal river furnishes a well-protected port, suitable for ships of 15 feet draught, whUe ocean-going vessels can lie off the city in the roadstead between Panay and Guimaras. The town is irregularly built on low ground. Its streets are not paved. There were formerly many good shops and residences, but the town was burned by the Filipino insurgents on the land-ing of the American troops, 11th February 1899, and has not been fully rebuilt. Iloilo ranks next to Manila in commercial importance among Philippine cities. It was organized as a municipality under Spanish rule. It is a port of entry, and is the main shipping-point for the sugar grown in the Visayan Islands. Cocoanut oil, lime, vinegar, mats, and various articles of palm wood are manufactured. It has a good government house and a fine church. Population, about 12,000.

Imaizumi. See Gifu.

Imbros, a Turkish island in the Mgenn, at the southern end of the Thracian Chersonese peninsula. It forms with Samothrace, about 17 miles distant, a caza (or canton) in the sanjak of Lemnos, and province of the Archipelago Isles. The island is the seat of a Greek bishopric. There is communication with the mainland by occasional vessels. The island is of great fertility — wheat, oats, barley, olives, sesame, and valonea being the principal products, in addition to a variety of fruits. The population is about 92,000, nearly all Turks.

Immigration. See Migration.

Impressionism. The word " Impressionist " has come to have a more general application in England than in France, where it took currency as the nickname of a definite group of painters exhibiting together, and was adopted by themselves during the conflict of opinion which the novelty of their art excited. The word therefore belongs to the class of nicknames or battle-names, like "Eomanticist," "Naturalist," "Realist," which preceded it, words into which the acuteness of controversy infuses

more of theoretical purport than the work of the artists denoted suggests to later times. The painters included in such a " school " differ so much among themselves, and so little from their predecessors compared with the points of likeness, that we may well see in these recurring efferves-cences of official and popular distaste rather the shock of individual force in the artist measured against contem-porary mediocrity than the disturbance of a new doctrine. The "Olympia" of Manet, hooted at the Salon of 1865 as subversive of all tradition, decency, and beauty, strikes the visitor to the Luxembourg rather as the reversion to a theme of Titian by an artist of ruder vision than as the demonstration of a revolutionary in painting. Later developments of the school do appear to us revolutionary. With this warning in a matter still too near us for final judgment, we may give some account of the Impression-ists proper, and then turn to the wider significance some-times given to the name.

The words Impressioniste, Impressionisme, are said to have arisen from a phrase in the preface to Manet's cata-

logue of his pictures exhibited in 1867 during the Exposi-
tion Universelle, from which he was excluded. " It is the
effect," he wrote, " of sincerity to give to a painter's works
a character that makes them resemble a protest, whereas
the painter has only thought of rendering his impression."
An alternative origin is a catalogue in which Claude Monet
entitled a picture of sunrise at sea " Une Impression." The
word was probably much used in the discussions of the
group, and was caught up by the critics as characteristic'
At the earlier date the only meaning of the word was
a claim for individual liberty of subject and treatment.
So far as subject went, most, though not all of Manet's
pictures were modern and actual of his Paris, for his power
lay in the representation of the thing before his eye,
and not in fanciful invention. His simplicity in this
respect brought him into collision with popular prejudice
when, in the " Dejeuner sur I'herbe " (1863), he painted
a modern " Fete Champgtre." The actual characters of
his painting at this period, so fancifully reproached
and praised, may be grouped under two heads. (1)

The expression of the object by a few carefully chosen values in flattish patches. Those patches are placed side by side with little attenuation of their sharp collision. This simplification of colour and tone recalls by its broad effects of light and silhouette on the one hand Velasquez, on the other the extreme simplification made by the Japanese for the purposes of colour-printing. Manet, like the other painters of his group, was influenced by these newly-discovered works of art. The image, thus treated, has remarkable hardiness and vigour, and also great decorative breadth. Its vivacity and intensity of aspect is gained by the sacrifice of many minor gradations, and by the judgment with which the leading values have been determined. This matching of values produces, technically, a " solid " painting, without glazing or elaborate transparency in shadows. (2) During this period Manet makes constant progress towards a fair, clear colour. In his early work the patches of blond colour are relieved against black shadows; later these shadows clear up, and in place

of an indeterminate brown sauce we find shadows that

are colours. A typical picture of this period is the

" Musique aux Tuileries," refused by the Salon of 1863.

In this we have an actual out-of-doors scene rendered with

a frankness and sharp taste of contemporary life surpris-

ing to contemporaries, with an elision of detail in the treat-

ment of a crowd and a seizing on the chief colour note

and patch that characterize each figure equally surprising,

an effort finally to render the total high-pitched gaiety of

the spectacle as a banquet of sunlight and colour rather

than a collection of separate dramatic groups.

For life of :fcdouard Manet (1833-1883) see Edmond Bazire.

Manet. Paris, 1884. An idea of the state of popular fepling may be

iMr H.P. HainFriswell has pointed out that the word " impression "

occurs frequently in Chevreul's book on colour ; but It is also cuvvent

among the critios. See Ruskin's chapter on Turner's composition—

" impression on the mind."

gained by reading Zola's eloquent defence in Mon Salon, which

appeared in V^venement (1866) ^udiSdouard Manet (1867), both reprinted in Mes Haines (Paris, 1880). The same author has embodied many of the impressionist ideals in Claude Lantier, the fictitious hero of VCEuvre. Other writers belonging to Manet's group are TurfcoDOEE Dcret, author of Les Peintres Frangais en 1867 and Critique d' avant-garde, articles and catalogue-prefaces reprinted 1885. See also, for Manet and others, J. K. Hotsman's L'Art Moderne (1883) and Certains. Summaries of the literature of the whole period will be found in R. Muther, The History of Modern Fainting (tr. London, 1896), not always trustworthy in detail, and Miss R. G. KiNGSLBY, A History of French Art (1899). For an interesting critical account see W. C. Brownbll, French Art (1892).

The second period, to which the name is sometimes limited, is complicated by the emergence of new figures, and it is difficult as yet, and perhaps will always remain difficult, to say how much of originality belongs to each artist in the group. The main features are an intenser study of illumination, a greater variety of illuminations, and a revolution in facture with a view to pressing closer to a high pitch of light. Manet plays his part in this

development, but we shall not be wrong probably in giving to Claude Monet (born 1840) the chief r81e as the instinctive artist of the period, and to Camille Pissarro (born 1830) a very large part as a painter curious in theory and experiment. Monet at the early date of 1866 had painted a picture as daring in its naive brutality of out-of-door illumination as the " Dejeuner sur I'herbe." But this picture has the breadth of patch, solidity, and suavity of paste of Manet's practice. During the siege of Paris (1870-71) Monet and Pissarro were in London, and there the study of Turner's pictures enlarged their ideas of the pitch in lighting and range of effect possible in painting, and also suggested a new handling of colour, by small broken touches in place of the large flowing touches characteristic of Manet. This method of painting occupied much of the discussion of the group that centred round Manet at the Cai6 Guerbois, in the Batignolles quarter (hence called L'£cole de Batignolles). The ideas were : (1) Abolition of conventional brown tonality. But all browns, in the fervour of this revolt,

went the way of conventional brown, and all ready-made mixtures like the umbers, ochres, siennas, were banished from the palette. Black itself was condemned. (2) The idea of the spectrum, as exhibiting the series of " primary " or " pure " colours, directed the reformed palette. Six colours, besides white, were admitted to represent the chief hues of the spectrum. (3) These colours were laid on the canvas with as little previous mixture on the palette as possible to maintain a maximum of luminosity, and were fused by touch on the canvas as little as possible, for the same reason. Hence the " broken" character of the touch in this painting, and the subordination of delicacies of form and suave continuity of texture to the one aim of glittering light-and-colour notation. Justification of these procedures was sought in occasional features of the practice of Delacroix, of Watteau, of Chardin, in the hatchings of pastel, the stipple of water-colour. With the ferment of theory went a parii^ris for translating all effects into the upper registers of tone (cf. Euskin's chapter on Turner's prac-

tice in Modem Painters), and for emphasizing the colour of shadows at the expense of their tone. The character-istic work of this period is landscape, as the subject of illumination strictly observed and followed through the round of the day and of the seasons. Other pictorial motives were subordinated to this research of effect, and Monet, with a haystack, group of poplars, or church front, has demonstrated the variety of lighting that the day and the season bring to a single scene. Besides Pissarro, Alfred Sisley (1840-1899) is a member of the group, and Manet continues his progress, influenced by the new ideas in pictures like " Le Linge " and " Chez le Pere Lathuille." Edmond Degas (born 1834), a severe and learned draughtsman, is associated with this landscape group by his curiosity in the expression of momentary action and the effects of artificial illumination, and by his experiments in broken colour, more particularly in pastel. The novelty of his matter, taken from unexplored corners of modern life, still more the daring and irony of his observation and points of view, and the strangeness of his composi-

tion, strongly influenced by Japanese art, enriched the associations now gathering about the word "impressionist." Another name, that of Auguste Eenoir (born 1841), completes the leading figures of the group. Any " school " programme would be strained to breaking-point to admit this painter, unless on the very general grounds of love of bright colour, sunlit places, and independence of vision. He has no science of drawing or of tone, but wins a precarious charm of colour and expression.

The landscape, out-of-doors line, which unites in this period with Manet's line, may be represented by these names : Corot, Jongkind, Boudin, Monet. Monefs real teacher was Eugfene Boudin (1824-1898). (See Gustave Cahen's Eugene Boudin. Paris, 1900.) They, and others of the group, worked together in a painters' colony at Saint Simeon, near Honfleur. It is usual to date the origin of plein-air painting, i.e., painting out-of-doors, in an out-of-doors key of tone, from a picture Manet painted in the garden of De Nittis, just before the outbreak of war in 1870. This dates only Manet's change to the lighter key and looser handling. It was Monet who carried the practice to a logical extreme, work-

ing on his canvas only during the effect and in its presence. The method of Degas is altogether different, viz., a combination in the studio from innumerable notes and observations. It will be evident from what has been said above that impressionistic painting is an artistic ferment, corresponding to the scientific research into the principles of light and colour, just as earlier movements in painting coincided with the scientific study of perspective and anatomy. Chbtreul's famous book, already referred to, De la loi du contraste simultani des Couleurs (1838), established certain laws of interaction for colours adjacent to one another. He still, however, referred the sensations of colour to the three impossible "primaries" of Brewster — red, blue, and yellow. The Young-Helmholtz theory affected the palette of the Impressionists, and the work of Ogden Rood, Colour (Intemat. Scientific Series, 1879-81), published in English, French, and German, furnished the theorists with formulae measuring the degradation of pitch suffered by pigments in mixture.

The Impressionist group (with the exception of Manet, who still fought for his place in the Salon) exhibited together for the first time as L'Exposition des Impressionistes at Nadar's, Boulevard

des Capucines, in 1874. They were then taken up by the dealer Durand-Ruel, and the succeeding exhibitions in 1876, 1877, 1879, 1880, 1881, 1882, and 1886, were held by him in various galleries. The full history of these exhibitions, with the names of the painters, will be found in two works : FiiLix-FENEOu , Les Impressionistes en 1886 (Paris, 1886), and G. Geffrot, La Vie Artistique {Histoire de Vlmpressionisme, in vol. for 1894). See also G. LeooMTE, L^Art Impressioniste d^apres la Collection privee de M. Durand-Buel (Paris, 1892) ; Durantt, La Feinture Nouvelle (1876). Besides the names already cited, some others may be added. Madame Berthe Morisot, sister-in-law of Manet ; Paul Cfizanne, belonging to the Manet-Pissarro group ; and later, Gauguin. J. F. RaffaSlli applied a " characteristic " drawing, to use his word, to scenes in the dismal suburbs of Paris ; Forain, the satiric draughtsman, was a disciple of Degas, as also Zandomeneghi. Miss Mary Cassatt was his pupil. Caillebotte, who bequeathed the collection of Impressionist paintings now in the Luxembourg, was also an exhibitor ; and Boudin, who linked the movement to the earlier schools.

The first exhibitions of the Impressionists in London were in

1882 and 1883, but their fortunes there cannot be pursued in the present article, nor the history of the movement beyond its originators. This excludes notable figures, of which M. Besnard may be chosen as a type.

In Manet's painting, even in the final steps he took towards "la peinture claire," there is nothing of the " decomposition of tones " that logically followed from the theories of his followers. He recognized the existence in certain illuminations of the violet shadow, and he adopted in open-air work a looser and more broken touch. The nature of his subjects encouraged such a handling, for the painter who attempts to note from nature the colour

values of an elusive effect must treat form in a summary fashion, still more so when the material is in constant movement lite water. Moreover, in the river-side subjects near Paris there was a great deal that was only pictorially tolerable when its tone was subtracted from the details of its form. Monet's painting carries the shorthand of form

and broken colour to extremity ; the flowing touch of Manet is chopped up into harsher, smaller notes of tone, and the pitch pushed up till all values approach the irides-cent end of the register. It was in 1886 that the docfrmaiVe ferment came to a head, and what was supposed to be a scientific method of colour was formulated. This was pointillisme, the resolution of the colours of nature back into six bands of the rainbow or spectrum, and their repre-sentation on the canvas by clots of unmixed pigment. These dots, at a sufl&cient distance, combine their hues in the eye with the efEect of a mixture of coloured lights, not of pigments, so that the result is an increase instead of a loss of luminosity. There are several fallacies, however, theoretical and practical, in this " spectral palette " and pointillist method. If we depart from the three primaries of the Helmholtz hypothesis, there is no reason why we should stop at six hues instead of six hundred. But pigments follow the spectrum series so imperfectly that the three primaries, even if we could exactly locate them, limit the palette considerably in its upper range. The

sacrifice of black is quite illogical, and the lower ranges suffer accordingly. Moreover, it is doubtful whether many painters have followed the laws of mixture of lights in their dotting, e.g., dotting green and red together to produce yellow. It may be added that dotting with oil pigment is in practice too coarse and inaccurate a method. This innovation of pointillisme is generally ascribed to George Seurat (died 1890), whose picture, " La Grande Jatte," was exhibited at the Kue Laffitte in 1886. Pissarro experimented in the new method, but abandoned it, and other names among the Pointillistes are Paul Signac, Vincent van Gogh, and van Eysselberghe. The theory opened the way for endless casuistries, and its extravagances died out in the later exhibition of the Indipendants or were domesticated in the Salon by painters like M. Henri Martin.

The first modern painter to oonoem himself scientifically with the reactions of complementary colours appears to have been Delacroix (Leonardo, it should be remembered, left some notes on the subject). It is claimed for Delacroix that as early as

1 82-5 he observed and made use of these reactions, anticipating the complete exposition of Chevreul. He certainly studied the treatise, and his biographers describe a dial-face he constructed for reference. He had quantities of little wafers of each colour, with which he tried colour effects, a curious anticipation of pointillist technique. The pointillists claim him as their grandfather. See Paul Signac, " D'Eugfene Delacroix au N6o-Impressionnisme " (Bevue Blanche, 1898). For a fuller discussion of the spectral palette see the Saturday Review, 2nd, 9th, and 23rd February and 23rd March 1901.

In England the ideas connected with the word Impressionism have been refracted through the circumstances of the British schools. The questions of pitch of light and iridescent colour had already arisen over the work of Turner, of the Pre-Eaphaelites, and also of G. F. Watts, but less isolated and narrowed, because the art of none of these limited itself to the pursuit of light. Pointillisme, after a fashion, existed in British water-colour practice. But the Pre-Eaphaelite school had accustomed the English eye to extreme definition in painting and to elaboration of detail, and it happened

that the painting of James M'Neill Whistler (Grosvenor Gallery, 1878) brought the battle-name Impressionism into England and gave it a different colour. Mr Whistler's method of painting is in no way revolutionary, and he prefers to transpose values into a lower key rather than compete with natural pitch, but his vision, like that of Manet under the same influences, Spanish and Japanese, simplifies tone and subordinates detail. These characteristics raised the whole question of the science and art of aspect in modern painting, and the field of controversy was extended backwards to Velasquez as the chief master of the moderns. " Impressionism " at first had meant individualism of vision, later the notation of fugitive aspects of light and of movement ; now it came to mean breadth in pictorial vision, all the simplifications that arise from the modern analysis of aspect, and especially the efEect produced upon the parts of a picture-field by attending to the impression of the whole. Ancient painting analyses aspect into three separate acts as form, tone, and colour. All forms are made out with

equal clearness by a conventional outline ; over this system of outlines a second system of light and shade is passed, and over this again a system of colours. Tone is conceived as a difference of black or white added to the tints, and the colours are the definite local tints of the objects (a blue, a red, a yellow, and so forth). In fully-developed modern painting, instead of an object analysed into sharp outlines covered with a uniform colour darkened or lightened in places, we find an object analysed into a number of surfaces or planes set at different angles. On each of these facets the character of the object and of the illumination, with accidents of reflexion, produces a patch called by modern painters a "value," because it is colour of a particular value or tone. (With each difference of tone, " value " implies a difference of hue also, so that when we speak of a different tone of the same colour we are using the word " same " in a loose or approximate sense.) These planes or facets define themselves one against another with greater or less sharpness. Modern technique follows

this modern analysis of vision, and in one act instead of three renders by a " touch " of paint the shape and value of these facets, and instead of imposing a uniform ideal outline at all their junctions, allows these patches to define themselves against one another with variable sharpness.

Blurred definition, then, as it exists in our natural view of things, is admitted into painting ; a blurring that may arise from distance, from vapour or smoke, from brilliant light, from obscurity, or simply from the nearness in value of adjacent objects. Similarly, much detail that in primitive art is elaborated is absorbed by rendering the aspect instead of the facts known to make up that aspect. Thus hair and fur, the texture of stuffs, the blades of grass at a little distance, become patches of tone showing only their larger constructive markings. But the blurring of definitions and the elimination of detail that we find in modern pictorial art are not all of this ready-made character. We have so far only the scientific analysis of a field of view. If the painter were a scientific reporter he would have to

pursue the systems of planes, with their shapes and values, to infinity. Impressionism is the art that surveys the field and determines which of the shapes and tones are of chief importance to the interested eye, enforces these, and sacrifices the rest. Construction, the logic of the object rendered, determines partly this action of the eye, and also decoration, the effects of rhythm in line and harmony in fields of colour. These motives belong to all art, but the specially impressionist motive is the act of attention as it affects the aspect of the field. ^Ve are familiar, in the ordinary use of the eye, with two features of its structure that limit clearness of vision. There is, first, the spot of clear vision on the retina, outside of which all falls away into blur ; there is, secondly, the action of focus. As the former limits clear definition to one spot in the field extended vertically and laterally, so focus limits clear definition to one plane in the third dimension, viz..

depth. If three objects, A, B, and C, stand at different

depths before the eye, we can at will fix A, whereupon B and C must fall out of focus, or B, whereupon A and G must be blurred, or C, sacrificing the clearness of A and B. All this apparatus makes it impossible to see everything at once with equal clearness, enables us, and forces us for the uses of real life, to frame and limit our picture, according to the immediate interest of the eye, whatever it may be. The painter instinctively uses these means to arrive at the emphasis and neglect that his choice requires. If he is engaged on a face he will now screw his attention to a part and now relax it, distributing the attention over the whole so as to restore the bigger relations of aspect. Sir Joshua Reynolds describes this process as seeing the whole "with the dilated eye" ; the commoner precept of the studios is, " to look with the eyes half closed " ; a third way is to throw the whole voluntarily out of focus. In any case the result is that minor planes are swamped in bigger, that smaller patches of colour are swept up into broader, that markings are blurred. The final result of

these tentative reviews records, in what is blurred and what is clear, the attention that has been distributed to different parts, and to parts measured against the whole. The Impressionist painter does not allot so much detail to a face in a full-length portrait as to a head alone, nor to twenty figures on a canvas as to one. Again, he indicates by his treatment of planes and definitions whether the main subject of his picture is in the foreground or the distance. He persuades the eye to slip over hosts of near objects so that, as in life, it may hit a distant target, or concentrate its attack on what is near, while the distance falls away into a dim curtain. All those devices by which attention is directed and distributed, and the importance in space of an object established, affect impressionistic composition. It is an inevitable misunderstanding of painting which plays the game of art so closely up to the real aspects of nature that its aim is that of mere exact copying. Painting like Manet's, accused of being realistic in this sense, suffi-ciently disproves the accusation when examined. Never did painting show apartipris more pronounced, even more vio-

lent. The elisions and assertions by which Manet selects what he finds significant and beautiful in the complete natural image are startling to the stupid realist, and the Impressionist may best be described as the painter who out of the completed contents of vision constructs an image moulded upon his own interest in the thing seen and not on that of any imaginary schoolmaster. Accepting the most complex terms of nature with their special emotions, he uses the same freedom of sacrifice as the man who at the other end of the scale expresses his interest in things by a few scratches of outline. The perpetual enemy of both is the eclectic, who works for possible interests not his own. Some of the points touched on above will be found amplified in articles by the writer in The Albemarle (September 1892), the Fortnightly Beview (June 1894) , and The Jftist (March-July 1896) . An admirable exposition of Impressionism in this sense is E. A. M. Stevenson's TAe Art of Velasquez (1895). Mr Stevenson was trained in the school of Carolus Duran, where impressionist painting was reduced to a system. Mr Sargent's painting is a brilliant example of the system. (p. s. m.)

Ince-in-Makerfleld, a township in the Ince parliamentary division of Lancashire, England, adjoining the borough of Wigan. The Leeds and Liverpool Canal intersects the township. There are large collieries, iron-works, forges, railway-waggon works, and cotton mills here. Walmesley Park, area 26 acres, was opened in 1895. Area, 2320 acres. Population of urban district (1901), 21,270.

Incense. — The article on incense in the earlier volumes of the Ency. Brit, (ninth edition) gives a fiill account of the nature, preparation, and use of incense in ancient as. well as modern times, and in different parts of the world, but especially in the East. The object of the present article is to give some information as to the use of incense in the Church of England. Mr Scudamore (Notitia Euchar-istica, 2nd ed., pp. 141-142) thus describes the method and extent of its employment at the mass prior to the Refor-mation; "According to the use of Sarum (and Bangor) the priest, after being himself censed by the deacon, censed the altar before the Introit began. The York

rubric directed him to do it immediately after the first saying of the Introit, which in England was thrice said. The Hereford missal gives no direction for censing the altar at that time. The middle of the altar was censed, according to Sarum, Bangor, and Hereford, before the reading of the Gospel. According to Sarum and Bangor, the thurible, as well as the lights, attended the Gospel to the lectern. Perhaps the York rubric implies that this was doner when it orders (which the others do not) the thurible to be carried round the choir with the Gospel while the Creed was being sung. In the Sarum and Bangor, the priest censed the oblations after offering them ; then the space between himself and the altar. He was then, at Sarum, censed by the deacon, and an acolyte censed the choir ; at Bangor the Sinistrum Comu of the altar and the relics were censed instead. York and Hereford ordered no censing at the offertory. There is reason to think that, notwithstanding the order for the use of incense at every celebration, it was in practice burnt only on high festivals, and then only in rich

churches, down to the period of the Reformation. In most parishes its costliness alone would preclude its daily use, while the want of an assistant minister would be a very common reason for omitting the rite almost every-where. Incense was not burnt in private masses, so that the clergy were accustomed to celebrations without it, and would naturally forego it on any plausible ground." The ritual of the mass remained unchanged until the death of Henry VIII. (28th January 1647). In March 1548 the Order of the Communion was published and commanded to be used by royal proclamation in the name of Edward VI. It was the precursor of the Prayer Book, and supplemented the accustomed Latin service by additions in English to provide for the communion of the people in both kinds. But it was expressly stated in a rubric that the old service of the mass was to proceed without variation of any rite or ceremony until after the priest had received the sacrament, that is, until long after the last of the three occasions for the use of incense explained above. But on Whitsunday 1549 the first

Prayer Book of Edward VI. came into use under an Act of Parliament (2 and 3 Ed. VI. ch. 1, the first Act of Uniformity) which required its exclusive use in public worship so as to supersede all other forms of service. Another Act, 3 and 4 Ed. VI. ch. 10, required the old service books to be delivered up to be destroyed. The first Prayer Book does not contain any direction to use or any mention of incense. It has been and still is a keenly controverted question whether incense did or did not continue to be in ceremonial use under the first Prayer Book or during the rest of Edward VI.'s reign. No evidence has hitherto been discovered which justifies us in answering this question in the affirmative. The second Prayer Book of Edward VI. (1652), published under the authority of the second Act of Uniformity (5 and 6 Ed. VI. ch. 1), contains no reference to incense. Edward VI. died on the 6th July 1563. Queen Mary by statute (1 Mary, sess. 2, ch. 2) abolisljed the Prayer Book, repealed the Acts of Uniformity, and restored "divine service and administration of sacraments as were most commonly used in

England in the last year of Henry VIII." The ceremonial use of incense thus became again an undoubted part of the communion service in the Church of England. A proclamation issued (6th December 1653) directed the churchwardens to obtain the proper ornaments for the churches ; and the bishops (at any rate Bishop Bonnor, see Visitation Articles 1564, Cardwell's Doc. Ann. vol. i. pp. 149-153) in their visitations inquired -whether censers had been furnished for use. Mary died 17th November 1658. On 24th June 1569 the second Prayer Book of Edward VI. (with a few alterations having no reference to incense) was again established, under the authority of the third Act of Uniformity (1 Eliz. ch. 2), as the exclusive service book for public service. There is no evidence of the ceremonial use of incense under Elizabeth's Prayer Book, or under the present Prayer Book of 1662 (established by the fourth Act of Uniformity, 13 and 14 Charles II. ch. 4) until the middle of the 19th century ;

and there is no doubt that as a ceremony of divine worship, whether at the Holy Communion or at other services, it was entirely disused. There are, however, a good many instances recorded of what has been called a fumigatory use of frankincense in churches, by which it was sought to purify the air, in times of public sickness, or to dispel the foulness caused by large congregations, or poisonous gases arising from ill-constructed vaults under the church floor. It seems also to have been used for the purpose of creating an agreeable perfume on great occasions, e.g., the great ecclesiastical feasts. But this use of incense must be carefully distinguished from its ceremonial use. It was utilitarian and not symbolical, and from the nature of the purpose in view must have taken place before, rather than during, service. Of the same character is the use of incense carried in a per-fuming pan before the sovereign at his coronation in the procession from Westminster Hall to the Abbey. This observance was maintained from James II.'s coro-nation to that of George III. In the general revival

of church ceremonial which accompanied and followed the Oxford Movement incense was not forgotten, and its ceremonial use in the Pre-E,eformation method has been adopted in a few extreme churches since 1850. Its use has been condemned as an illegal ceremony by the ecclesiastical courts. In 1868 Sir Eobert Phillimore (Dean of the Arches) pronounced the ceremonial use of incense to be illegal in the suit of Martin v. Mackonochie (2 A. and E. L.R. 116). The case was carried to the Privy Council on appeal, but there was no appeal on the question of incense. Again, in 1870, the ceremonial use of incense was condemned by Sir Eobert Phillimore in the suit of Sumner v. Wix (3 A. and E. L.R. 58).

Notwithstanding these decisions, it was insisted by those who defended the revival of the ceremonial use of incense that it was a legal custom of the Church of England.

The question was once more elaborately argued in May 1899 before an informal tribunal consisting of the arch-bishop of Canterbury (Dr Temple) and the archbishop of

York (Dr Maclagan), at Lambeth Palace. On 31st July 1899 the archbishops decided that the liturgical use of incense was illegal. The Lambeth "opinion," as it was called, failed to convince the clergy against whom it was directed any better than the judgments of the ecclesiastical courts, but at first a considerable degree of obedience to the archbishops' view was shown. Various expedients were adopted, as, e.g., the use of incense just before the beginning of service, by which it was sought to retain incense without infringing the law as laid down by the archbishops. There remained, nevertheless, a tendency on the part of the clergy who used incense, or desired to do so, to revert to the position they occupied before the Lambeth hearing^that is, to insist on the ceremonial use of incense as a part of the Catholic practice of the Church of England which it is the duty of the clergy to maintain, notwithstanding the decisions of ecclesiastical judges or the opinions of archbishops to the contrary. (i- t. d.)

Income Tax. — United Kingdom.- — An income tax

was originally imposed by Mr Pitt in 1798, but it did not assume its present form until 1803. It lapsed in 1816, and was revived by Sir E. Peel's Government in 1842. It had always been regarded as a temporary measure, and is still renewed annually ; but it has now become so important a feature of the fiscal system that there does not appear to be any prospect of its being again abandoned. Speaking broadly, it is a tax levied on all incomes derived from sources within the United Kingdom, or received by residents in the United Kingdom from other sources. But incomes under £160 are exempt ; and an abatement is allowed of £160 on those between £160 and £400; of £150 on those between £400 and £600; of £120 on those between £600 and £600 ; and of £70 on those between £600 and £700. An abatement is also allowed on account of any premiums paid for life assurance, provided they do not exceed one-sixth of the total income. The existing limit of total exemption was fixed in 1894, when it was raised from £160 ; and the scale of abatements was last revised in 1898 by admitting

incomes between £600 and £700. The rate of charge has been as high as 16d. (in 1856-67), and as low as 2d. (in 1874-76). Each penny of the tax was estimated to produce in 1898-99 a revenue of £2,248,000. The tax is assessed under five different schedules, known as A, B, C, D, and E. Under schedule A are charged the incomes derived from landed property, including houses, the annual value or rent being the basis of the assessment. A reduction is allowed from this value of one-eighth in the case of land and one-sixth in the case of houses. The occupier is liable for the tax, but is entitled, if not himself the owner, to deduct a proportionate part of the tax on paying his rent. Under schedule B are charged the profits arising from the occupation of land. The amount of such profits is assumed to be one-third of the annual value of the land as fixed for the purposes of schedule A ; but the farmer may, if he chooses, be assessed under schedule D on his actual profits. Schedule C includes income derived from interest, &c., payable out of the public funds of this or any other country. Schedule D, which is the most important

branch of the income tax and the most difiS.cult to assess, includes profits arising from trade, from professional or other employment, and from foreign property. The assessment is in most cases made on an average of the receipts for three years. Schedule E covers the salaries and pensions of persons in the employment of the state or of public bodies, and of the higher ofiicials of public companies, &c. The assessment and collection of the tax under schedules A, B, and D are in the hands of local authorities known as the General or District Commissioners of Taxes. They are appointed by the Land Tax Commissioners out of their own body, and, as regards assessment, are not in any way controlled by the executive Government. They appoint a clerk, who is their principal ofllcer and legal adviser, assessors for each parish, and collectors. There is an appeal from their decisions to the High Court of Justice on points of law, but not on questions of fact. Assessments under schedules A and B are usually made every five years, and under schedule D every year. The interests of the revenue are looked after by of&cers of the

Board of Inland Eevenue, styled Surveyors of Taxes, who are stationed in different parts of the country. They are in constant communication with the Board and with the

public on all matters relating to the assessment and collection of the tax; they attend the meetings of the local commissioners, examinethe assessments and the taxpayers' returns, and watch the progress of the collection. There are also three of&cers, known as Special Commissioners, who are appointed by the Crown and receive fixed salaries from public funds. For the purpose of schedule D, any taxpayer may elect to be assessed by them instead of by the local commissioners ; and those who object to their affairs being disclosed to persons in their own neighbourhood may thus have their assessments made without any risk of publicity. The Special Commissioners also assess the profits of railway companies under schedule D, and profits arising from foreign or colonial sources under schedules C and D. The greater part of the incomes under sched-

ule E is assessed by the commissioners iot public offices, appointed by the several departments of the Government. For further information reference should be made to Dowell's Income Tax Laws, and the Annual Reports of the Commissioners of Inland Revenue, especially those issued in 1870 and 1885. (g. h. m.)

United States. — One of the means adopted by the Federal Government for meeting its expenses during the Civil War was the levying of an income tax. By the Act of Congress of 5th August 1861 a tax of 3 per cent, was imposed on all incomes, with an exemption of $800, and was made payable on or before the 30th of June 1862. No tax, however, was assessed under the law. In March 1862 a new Income Tax Bill was introduced into the House of Representatives. This Act, which was signed 1st July 1862, imposed a tax of 3 per cent, on all incomes not over $10,000, and 5 per cent, on all incomes above that sum, with an exemption of $600. It was also provided that dividends of banks, insurance companies, and railways should be assessed directly ; but the bondholder

was allowed to deduct the dividend so assessed from his taxable income. In the case of Government salaries, the tax was deducted before the salaries were paid. The income tax was first levied in 1863. The rate was changed by Act of Congress in 1865, 1867, and 1870 ; and a joint resolution in 1864 imposed a special additional tax of 5 per cent, for that year. The tax was finally abolished in 1871. The total amount produced by the tax from the beginning waa $376,150,209. The constitutionality of the Act was subsequently brought into question, but was upheld by a unanimous decision of the Supreme Court in 1880, which held that the tax was not a direct tax but an excise tax, and that Congress had a right to impose it so long as it was made uniform throughout the United States. On 27th August 1894 an Income Tax Act was passed as part of the Wilson Bill. By this Act it was provided that a tax of 2 per cent, on all incomes should be levied from 1st January 1895 to 1st January 1900, with an exemption of $4000. The legality of the tax was assailed chiefly on the ground that it was a direct tax, and not

apportioned among the several states in proportion to their population. On 20th May 1895 the Supreme Court, by a vote of five to four, declared the tax to be unconstitutional.

Independence, capital of Jackson county, Missouri, U.S.A., three miles south of the Missouri on the high prairie, at an altitude of 950 feet. It is built on an undulating site, with a regular plan, and is on the Chicago and Alton and the Missouri Pacific railways, besides being connected with Kansas City, 14 miles distant, by street railway. It is one of the oldest cities in Missouri, having been f oimded on the frontier in 1827. For many years thereafter it was the outfitting and starting point for emigrant and exploring parties for the Far West and the Pacific coast. Population (1880), 3146 ; (1890), 6380 ; (1900), 6974.

II^DIA.

Gbogeapht and Statistics.

INDIA, the great country of Asia under British rule or control, from which King Edward VII. takes the title of Emperor, in succession to the first British Empress

of India, Queen Victoria, is a peninsula with a length extending from the 8th to the 37th degree of north latitude, or about 2000 miles. Its greatest breadth is nearly the same distance. To this the British have added the country of Burma, extending along the eastern side of the Bay of Bengal, and stretching inland to the frontiers of China, French Laos, and Siam. Besides the Andaman, Nicobar, and Laccadive Islands, the outlying station of Aden at the mouth of the Eed Sea is politically included within the Indian Empire ; while dots on the shore of the peninsula itself, representing old Portuguese and French settlements, break at intervals the continuous line of British territory. Politically, India, is divided into some thirteen provinces of varying size under direct British administration, and a number of native States, estimated at more than 200, which exercise more or less of the attributes of sovereignty under British control. According to Act of Parliament (62 and 53 Vict. c. 63, sec. 18, subsecs. 4 and 6), " British India " is interpreted to mean " all territories and places within His Majesty's dominions which are for the time

being governed by His Majesty through the governor-general of India or through any other governor or officer subordinate to " him ; and " India " is interpreted to mean " British India together with any territories of any native prince or chief under the suzerainty of His Majesty exercised through the governor-general of India, or through any other governor or officer subordinate to" him.

Native States occupy about 38 per cent, of the total area, and contain about 23 per cent, of the total population. They vary in size from Haidarabad or the Nizam's Dominions (with an area of 83,000 square miles and a population of 11 millions) to a share of a petty village in Kathiawar. The one feature common to all alike is that ordinary British administration is excluded. In Anglo-Indian phraseology, all relations with them are "political" (see below. Native States). Except where otherwise mentioned, as in the section on population, the remainder of this article will deal only with British India.

Population. — The preliminary results of the census of 1901

will he given farther on. Por all details of population recourse has had to be made to the census of 1891. In order to obtain the aggregate population of all India, it is necessary to include certain regions to which the census of 1891 did not extend. For the two independent States of Nepal and Bhutan in the. Himalaya no trustworthy estimates are available. In the fron-tier State of Manipur (subordinate to Assam) the records of the census were destroyed in the disturbances of April 1891. In the State of Sikkim (subordinate to Bengal), in British Baluchistan (excluding Quetta), in some of the Shan States and other frontier tracts of Burma, and also in the hill tracts of Rajputana (mainly occupied by BhUs), only an informal registration was made, so far as possible synchronously with the census. In the Andaman Islands (outside the convict settlement of Port Blair), in the trans-Salween Shan States, and in the Kakhyen hiU country lying between Burma and Assam, no enumeration was attempted. In the French settlements a census was taken simultaneously with that of British India. For the Portuguese possessions, the returns are those of the census of 1887. The following table adds all these excluded items : —

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Tract.

Sikkim (registered)

Manipur (estimated)

British Baluchistan (registered) .

Cis-Salween Shan States (registered)

Burma Frontier Tracts

Eajputana Hill Tracts (registered)

!French Settlements

Portuguese Possessions

Included in the Census

Aggregate ....

The census of 1891, which was taken over

an area of 1,560,160 square miles, returned

a total population of 287,223,431, the aver-

age density being 184 persons per square

mile. The census of 1881 was taken over

a somewhat smaller area, omitting Upper Burma and the State of Kashmir. For the same area, the population increased in ten years by no less than 27,821,420, or at the rate of 10-96 per cent. In British territory alone the increase was 19,294,509, or at the rate of 9-7 per cent. ; in native States the increase was 8,526,911, or at the rate of 15-5 per cent. Some portion of this Increase, especially in native States, is due to improved enumeration, as is evidenced by the higher rate of increase among females (11-16, compared with 10-77 per cent, for males). Some portion, again, is due to recovery from the famine of 1876-78, shown by the percentages of increase in Mysore (18-09), Madras(15-58), and Bombay (13-71), where that famine was most severe. Apart from these two considerations, it is noteworthy that the highest rates of increase

were almost always found in the most thinly peopled tracts, such as Lower Burma, Sind, and the hills of Northern and Central India. The only considerable area that showed an actual decrease (1-4 per cent.) was the water-logged Doab of the North-Western Pro-vinces ; but in Northern Bengal the rate of increase fell to 4-7 per cent., and in Southern Behar to 2 -8 per cent.

The accompanying table shows the area and population, distributed beween British provinces and native States, according to the census of 1891.

*The linguistic information ascertained by the census of 1891 did not extend to Raj-putana. Central India, and Kashmir. It was confined to a total population of 262,047,440. Of these, 195,463,807, or 47-6 per cent., spoke languages of the Aryo-Indic group, of which the chief representa^*

tives are Hindi, Bengali, Marathi, Punjabi, Gujarati, and Uriya ; 52,964,620, or 20-2 per cent., spoke languages of the Dravidian group, of which the chief representatives are Telugu, Tamil, Kanarese, and Malay-alam; 7,293,928, or 2-8 per cent., spoke languages of the Tibeto-Burman group ; 2,959,006, or 1 -1 per cent., spoke languages of the Kolarian group, of which Sonthali is the chief representative ; and 1,329,428, or -5 per cent., spoke languages of the Aryo-Iranic group, chiefly represented by Pashtu, or Pakhtu, the vernacular of the Afghans.

Por the ethnology, the best evidence is derived from the classification of the census of 1891 according to caste or occupation. The largest group was that of respectable cultivators, who numbered 47,927,361, or 16-7 per cent, of the total. Next came the village menials (including leather-workers),

who numbered 30,795,703, or 10-7 per cent.

Military Hindus (including Rajputs, Jats,

Marathas, and Gujars) numbered 29,393,870,

or 10-2 per cent. ; artisans, 28,882,551, or

10-1 per cent. ; cowherds and shepherds,

16,721,494, or 5-8 per cent. ; forest tribes,

15,806,914, or 5-5 per cent. ; priests (mostly

Brahmans), 15,467,752, or 5-4 per cent. ;

and traders, 12,270,973, or 4-3 per cent.

Number of

Persons.

30,458

250,000

145,417

372,969

116,493

204,241

282,923

561,384

287,223,431

289,187,316

Sex. — The classification of the census of 1891 according to sex showed that the female population was in defect by more than six millions. In other words, there were 958 females to every 1000 males. It was only in Upper Burma, Madras, and Bengal that the females were in excess. In the North-Western Provinces the deficiency fell to 923, and in the Punjab to 854 per 1000 males. After a careful examination of all the circumstances, the Census Commissioner (Mr J. A. Baines, C.S.I.) came to the following conclusions: — "In most parts of India proper there is a tendency, in a greater or less degree, to omit from the census record girls of from nine to fifteen, and wives of from fifteen to twenty or thereabouts ; but in every part of the country except the north girls below five are returned as more numerous

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INDIA

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than boys of that age. After that period, apart from wilful or ignorant omission, there is probably a real deficiency in the number of females, extending to about the twentieth year, and due to neglect, premature cohabitation, and unskilful midwifery.

At a later period, hard work, as well as the results of the above influences, and among some classes excessive fecundity, tell on the female constitution, producing greater relative mortality than prevails in the other sex."

Beligion. — The following table distributes the population in 1891 according to religion: —

Population classified according to Beligion.

Per

Tracts where proportionately

cent.

most numerous.

Hindus .

207,731,727

72-34

The South and the mid-

valley of the Ganges.

Mahommedans

57,321,164

19-96

Sind, Punjab, Eastern

Bengal, and Kashmir.

Aborigines

9,280,467

3-23

Central Provinces, Central

India,Bengal,and Assam.

Buddhists

7,131,361

2-48

Burma.

Christians

2,284,380

■*n*

The South, Burma, and

Bengal.

Sikhs .

1,907,833

-66

Punjab.

Jains

1,416,638

■49

Rajputana and Bombay.

Parsis

89,904

-03

Bombay.

Jews

17,194

■01

Bombaiy.

Others .

42,763

-01

Kashmir, Madras, and

Bengal.

Number.

295,016

Per cent.

12-9

40,407

1-8

191,746

8-4

140,592

6-1

1,315,263

67-6

200,467

8-8

100,889

4-4

The only term that requires explanation is "aborigines," which is here used as equivalent to "animistic " for all such wild tribes as are not locally acknowledged to have become either Hindus, Mussulmans, Buddhists, or Christians. Classified according to race, the aboriginal tribes numbered about 15,922,000.

The following table distributes the Christian population in 1891 according to sect ;—

Table showing Distribution of Christian Sects.

Church of England

Presbyterian .

Baptist .

Other Protestant

Roman Catholic

Syrian

Others

Classified according to another principle, Europeans numbered 168,000, of wrhom just half are estimated to be soldiers or the families of soldiers ; Eurasians numbered 79,790 ; and native converts 2,036,590, of whom no less than 61 per cent, were Roman Catholics, and 10 per cent. Syrians of the Jacobite rite. In the native States of Madras, on the Malabar coast. Christians form one-fifth of the total population. Their number is also considerable among the Karens of Burma and the aboriginal tribes of Chota Nagpur.

*Toivns. — There is little tendency for the people to 'crowd into towns. According to the census of 1891, the urban population numbered 27,261,176, or 9-6 per cent, of the total, leaving 90*6 per cent, for the rural popula-*

tion. Again, as compared with 1881, the rate of increase in the urban population was only 9-4 per cent., compared with 10-9 per cent, for the general population. It must further be remarked that this urban population was contributed by 2035 towns, of which 505 had less than 5000 inhabitants. The number of towns with more than 20,000 was only 225. The accompanying table gives a list of all the towns in 1891 with more than 100,000 inhabitants. Bombay stands at the top, as the second most populous city in the British Empire. But if all the suburbs were added to Calcutta, and also Howrah on the opposite bank of the river, the total population of the metropolis on the Hooghly would be raised to more than a million. Haidarabad, Jaipur, Srinagar, Baroda, and Gwalior owe their importance entirely to the courts of large native States. Lucknow, Delhi, Mandalay, Agra, and Poena were formerly capitals. Eangoon and Karachi, as prosperous seaports, show the highest rate of increase. Cawnpore, Bangalore, and Ahmadabad are thriving centres of trade

and manufacture.

List of Towns with a Population of more than 100,000.

Increase or

decrease 1

Population

(1891).

compared with 1881. |

Town.

Province, &c.

Number.

Per cent.

Bombay

Bombay

821,764

-F 48, 568

4-6-3

Calcutta

Bengal

741,144

-1-56,486

4-24-1

Madras

Madras

452,518

4-46,670

4-11-5

Haidarabad .

Decoan

415,039

-1-60,077

4-13-0

Lucknow

Oudh

273,028

-1-11,725

4-4-5

Benares

N.W.P.

219,467

-f4,709

4-2-2

Delhi .

Punjab

192,579

-1-19,186

4-11-1

Mandalay .

Upper Burma

188,815

Cawnpore .

N.W.P.

188,712

-1-37,268

4- 24 -6

Bangalore .

Mysore

180,366

₹ 24, 509

4-15-7

Rangoon

Lower Burma

180,324

f 46, 148

4-34-4

Lahore

Punjab

176,854

f 19, 567

4-12-4

Allahabad .

N.W.P..

175,246

4-15,128

-F9-4

Agra .

N.W.P.-

168,662

+8,459

4-5-3

Patna .

Behar

165,192

-5,462

-3-2

Poona .

Bombay

161,390

-1-31,639

4-24-4

Jaipur .

Rajputana

158,905

-1-16,327

4-11-4

Ahmadabad .

Bombay

148,412

-1-20,791

4-16-2

Amritsar

Punjab

136,766

-15,130

-10-0

Bareilly

Rohilkhand

121,039

4-7,622

4-6-7

Meerut

N.W.P.

119,390

4-19,825

4-19-9

Srinagar

Kashmir

118,960

Nagpur

Central Provinces

117,014

4-18,715

4-19-0

Howrah

Bengal

116,606

4-11,400

4-10-8

Baroda

Gujarat

116,420

4-9,908

4-9-3

Surat .

Bombay

109,229

-615

-0-6

Karachi

Sind

105,199

4-31,639

4-43-0

Gwalior

Central India

104,083

4-16,017

4-18-2

Census of 1901. — The census of 1901, the third general census of India, was taken on the night of 1st March, and the preliminary returns were published on 14tli March. They are given in the table on the following page, which shows the population, male and female, according to British provinces and native States, with •the variations as compared with the census of 1891. The- operations of the census of 1901 extended for the first time to the Shan States and hill tracts of Burma, to the

border States of Manipur and Sikkim, to the troops sta-
tioned on the Afghan frontier, to almost the whole of
Baluchistan, and to the Andaman and Nicobar islanders.
The total population amounted to 294,266,701, compared
with 287,223,431 in 1891, showing an increase of 7,043,270,
or 2-42 per cent. But if the area not enumerated before
be excluded, the increase is reduced to 4,283,069, or 1-49
per cent. In British territory alone the rate of increase
is 4-44 per cent., against which there falls to be set off a
decrease at the rate of 4-34 per cent, in native States.
Some evidence of the general accuracy of the enumeration
may be drawn from the fact that females have apparently
increased more than males, the proportion of females to
every 1000 males having risen from 958 to 963.
An examination of the details clearly reveals the effects
of recent famine. In the native States of Rajputana,
Central India, Bombay, and Baroda the aggregate de-
crease is more than 5|- millions, compared with an aggre-
gate increase of more than 4 millions in the preceding
decade. The Central Provinces show a decrease of nearly

one million, compared with a increase of almost an identical amount. In each of the five Gujarat districts of Bombay there is a decrease, amounting altogether to nearly 400,000. Even where famine was not severe, the rate of increase generally diminished. In Bengal it

[statistics dropped from 6‘9 to 4-7 per cent., most of the densely populated districts of Behar showing an actual decrease. In the North-Western Provinces it dropped from 6-3 to 1-6 per cent. ; in the Punjab, despite the extension of canal irrigation, from 10-7 to 7-6 per cent. ; and in Madras from 15-6 to 7-2 per cent. Only in Assam was the rate of increase higher than in the preceding decade ; and here the whole of the increase may be attributed to the immigration of labourers on the tea gardens. Burma, which stands outside the Indian peninsula and has enjoyed unbroken prosperity, shows an exceptional increase of 18-7 per cent.

The preliminary returns of the census of 1901 show

some variations in the size of the large towns. Calcutta

now stands easily first, with a population of 843,487,

having increased by about 24 per cent, in each of the two

Population of British India and Native States, 1901.

Xl^lixJ T T^” • ■

Total.

Variation on 1891.

Political Divisions.

Males.

Females,

Total Number.

Per cent.

British Teeeitoey :

Ajmer-Merwara

250,721

225,609

476,330

-66,028

-12-2

Assam

3,142,561

2,979,640

6,122,201

+ 688,533

+ 12-7

Bengal

37,376,438

37,336,582

74,713,020

+ 3,366,050

+4-7

Berar

1,394,107

1,358,311

2,752,418

-144,622

-50

Bombay

9,595,805

8,988,691

18,584,496

-288,846

-1-5

Burma

4,705,094

4,516,067

9,221,161

+ 1,450,267

+ 18-7

Central Provinces .

4,841,832

5,003,486

9,845,318

-938,976

-8-7

Coorg

100,214

80,247

180,461

+ 7,406

+4-3

Madras

18,853,024

19,355,585

38,208,609

+2,578,169

+ 7-2

N.W. Provinces and Oudh

24,620,961

23,075,363

47,696,324

+ 791,533

+1-8

Punjab

12,095,711

10,353,773

22,449,484

+ 1,582,637

+ 7-6

Baluchistan ....

445,603

365,208

810,811

Andaman and Nicobar Islands

Total ....

Native States :

18,581

5,918

24,499

...

...

117,440,652

113,644,480

231,085,132

+9,818,563

+4-4

Haidarabad ....

5,664,772

5,510,125

11,174,897

-362,143

-3-1

Baroda

1,007,944

942,983

1,950,927

-464,469

-19-2

Mysore

2,796,165

2,742,317

5,538,482

+ 594,878

+ 12-0

Kashmir ....

1,544,412

1,361,761

2,906,173

+362,221

+ 14-2

Rajputana ....

5,167,640

4,673,392

9,841,032

-2,175,070

-18-1

Central India ....

4,357,225

4,144,658

8,501,883

-1,816,929

-17-5

Bombay

3,504,975

3,386,716

6,891,691

-1,167,607

-14-5

Madras

2,100,313

2,090,009

4,190,322

+489,700

+ 13-2

Central Provinces .

982,823

1,000,673

1,983,496

-177,015

-8-2

Bengal

1,899,704

1,836,011

3,735,715

+439,336

+ 13-3

N.W. Provinces

411,897

387,778

799,675

+7,184

+0-9

Punjab

2,417,932

2,020,884

4,438,816

+ 175,536

+4-1

Burma .....

Total ....

Grand Total .

609,895

618,565

1,228,460

...

32,465,697

30,715,872

144,360,352

63,181,569

-2,868,910

-4-3

149,906,349

294,266,701

+6,949,653

+ 2-4

preceding decades. If the suburbs and Howrah be added, the total is raised to 1,279,511. In Bombay, on the other hand, the population decreased to 770,843, or by 6 per cent., owing to the continued effects of plague. Madras shows a steady rate of increase, to 509,397. Eangoon, the capital and chief port of Burma, rose from the eleventh to the sixth place in the list, with 232,326 in-habitants, being an increase of 29 per cent. The results of plague again appear at Karachi and Poona, which both suffered severely. Karachi, with 116,407 inhabitants, shows an increase of only 9 per cent., compared with an increase of 43 per cent, in the preceding decade. At Poona the population fell to 111,385, or by as much as 31 per cent. The same cause reduced the population of

Bangalore to 159,030, or by 12 per cent. Two cities of the Madras presidency, Madura and Trichinopoly, rise to the class with more than 100,000 inhabitants.

Agriculture. — Agriculture forms the main occupation of the inhabitants. According to the census of 1891, the number of persons employed in agriculture or ladastries j^ connexion with cattle was 175,381,239, being and trade. ^^ ^^^ ^^^^ ^^ ^^^ ^^^^^ population. If we add, las we fairly may, most of those returned as general labourers, the proportion would rise to two-thirds. Of these 149,931,159 were landholders or tenants, 19,673,206 agricultural labourers, and 3,645,849 employed with cattle. Agricultural statistics are now collected by a government department for every British province, though for Bengal the figures must be regarded as only approximate estimates. The two following tables give the returns according to provinces for 1897-98, which may be taken as an average year. The first of the^ tables shows that, out of the total area for which returns exist (excluding tributary States and mountainous or desert regions), forests

cover 12 per cent., and an additional 25 per cent, is not available for cultivation. Of the remainder, 36 per cent, actually yielded crops in 1897-98, while 7 per cent, was current fallow and 20 per cent, cultivable waste. The second table shows the area under each of the principal crops. Of the total cultivated area in 1897-98, no less than 93 per cent, was devoted to food-crops of various kinds, including pulse. Eice alone covers 36 per cent., and wheat 10 per cent. But these two crops are very unevenly distributed. In Lower Burma hardly anything else is grown but rice ; and rice is also the predominant crop in Eastern Bengal and Orissa, in the adjoining valleys of Assam, in the deltas of the Madras rivers, along the sea-coast under the Western Ghats, and among the hills of Chhattisgarh. Wheat, on the other hand, is grown mainly in the plains of the Punjab and the North-Western Provinces, in the valley of the Narbada, and generally throughout the Bombay presidency. Except in the rice tracts, the staple food of the people is derived from millet and other inferior grains, chiefly jowar and hajra in the

statistics]

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Table of Cv

Itivated and Uncultivated Land, 1897-98.

Political Divisions.

Cultivated.

Uncultivated.

Forests.

Total.

Actually Cropped.

Current Fallows.

Available for

Cultivation.

Not Available for

Cultivation.

Acres.

Acres.

Acres.

Acres.

Acres.

Acres.

Bengal ....

55,128,700

3,684,313

12,144,609

20,728,847

5,091,116

96,777,585

North-Western Provinces

24,569,721

2,966,481

8,213,026

6,623,088

8,479,406

50,851,672

Oudh ....

8,318,890

923,441

3,393,582

2,317,145

589,603

15,542,661

Punjab .

22,693,353

5,175,613

21,403,238

12,120,050

4,350,536

65,742,790

Lower Burma .

6,478,339

398,084

15,967,821

26,014,478

4,617,758

53,476,480

Upper Burma .

2,806,550

1,456,4.34

9,058,108

30,367,392

4,428,840

48,117,324

Central Provinces

15,390,504

4,080,059

14,369,164

4,055,076

11,297,971

49,192,774

Assam .

2,247,318

1,248,610

7,380,158

999,550

2,297,715

14,173,.S51

Ajmer-Merwara

404,413

87,628

88,246

351,463

89,060

1,020,810

Coorg .

206,541

36,156

45,561

156,471

567,531

1,012,260

Madras .

24,250,708

5,896,998

6,269,680

13,479,129

12,082,354

61,978,869

Bombay .

27,360,039

10,464,870

7,505,451

20,224,799

8,026,038

73,581,197

Berar

6,635,806

739,498

690,209

679,629

2,608,829

11,353,971

Pargana Manpur

6,350

1,141

10,250

1,357

19,773

38,871

Total .

196,497,232

37,159,326

106,539,103

138,118,424

64,546,5.30

542,860,615

north, and ragi in the south. A little sngar-cane is grown everywhere, but it forms an important crop only in Northern India, from Bengal to the Punjab. Tobacco, also, is grown everywhere in garden plots, but chiefly in Bengal, Upper Burma, Madras, and Bombay. Oil-seeds of different kinds (chiefly linseed, mustard, and gingelly) are grown everywhere for local consumption, and for export in Bengal, the Central Provinces, Bombay, Madras, and the Punjab. Cotton also is widely distributed, the chief exports being derived from Berar, Bombay, the Central Provinces, and Madras. Jute is confined to Eastern Bengal, with a slight extension into the valleys of Assam. Table of Land under Chief Crops, .

1897-98.

Political Divisions.

Eioe.

Wheat.

Other Food

Grains.

Sugar Cane.

Cotton.

Oil Seeds.

Indigo.

Tobacco.

Acres.

Acres.

Acres.

Acres.

Acres.

Acres.

Acres.

Acres.

Bengal ....

40,142,400

1,570,600

11,150,400

972,700

167,700

4,178,600

555,200

648,300

North-Western Provinces

4,168,081

4,500,554

16,640,694

935,902

884,479

599,743

354,588

46,076

Oudh ....

2,364,108

1,497,573

6,014,557

212,252

36,008

201,035

24,451

12,746

Punjab .

786,751

7,769,215

12,934,697

348,121

993,361

1,161,928

94,616

54,465

Lower Burma

5,912,734

14

49,330

11,190

13,311

28,727

2

32,740

Upper Burma

1,349,559

13,659

972,334

1,257

110,602

404,265

792

34,785

Central Provinces

4,817,343

2,172,739

6,552,623

26,953

669,064

1,761,043

21

12,887

Assam .

1,614,292

70

57,658

21,340

2,225

175,983

4

1,414

Ajmer-Merwara

926

29,173

327,058

323

51,018

41,361

79

18

Coorg .

95,247

19,201

**..*

60

20

Madras .

6,935,159

14,951

14,914,557

58,374

1,509,135

1,646,628

323,931

103,357

Bombay

2,651,752

1,982,044

18,834,853

56,892

2,328,609

1,948,614

12,769

81,109

Berar .

42,999

394,129

3,546,140

3,159

2,150,709

416,090

61

20,522

Pargana Manpur

57

1,443

4,147

35

8

587

Total

70,781,408

19,946,164

92,018,249

2,648,498

8,916,229

12,564,664

1,366,513

1,048,439

The following table shows the area under irrigation, omitting Bengal and Assam. In the latter province there is no irrigation whatever, and in the former it is practised to an insignificant extent, as is also the case in Lower Burma. For the rest of British India, just one-fifth of the total area under crops was irrigated in 1897-98, the proportion in the large provinces ranging from 37 per cent, in the Punjab to 14 per cent, in Bombay. Excluding Sind, where more than three-fourths of the cultivated area requires irrigation, the proportion for Bombay would fall to 4 per cent., being little higher than in the Central Pro-

vinces. It was in the unirrigated tracts of Gujarat, Berar, and the Central Provinces that the famine of 1900 was felt with greatest severity. Government canals have been most widely extended in the Punjab, Sind, the North-Western Provinces, and Madras. Private canals are found chiefly in

Table

■)f Certain Areas under

Irrigation,

1897-98.

Political Divisions.

By Canals.

By Tanks.

By Wells.

otherwise.

Total.

Total Area under

Crops.

Government.

Private.

Acres.

Acres.

Acres.

Acres.

Acres.

Acres.

Acres,

North- Western Provinces

1,828,076

3,865

1,122,269

3,820,307

475,116

7,249,632

29,471,005

Oudh ....

853,594

1,592,513

67,735

2,51.3,842

10,767,831

Punjab .

4,395,453

910,295

33,015

3,970,518

162,812

9,472,093

26,810,142

Lower Burma

779

1,112

483

3,707

6,081

6,479,253

Upper Burma

175,806

262,245

87,065

4,235

112,103

631,453

3,007,805

Central Provinces

8,291

462,598

75,959

15,780

562,628

16,525,231

Ajmer-Merwara

...

33,955

107,677

655

142,287

466,718

Coorg .

1,370

1,370

207,245

Madras .

2,644,650

30,966

1,969,678

1,083,014

147,066

5,875,374

27,212,085

Bombay

2,690,556

191,658

108,538

592,827

297,499

3,881,078

28,377,478

Berar .

66

...

...

80,981

1,277

82,324

6,653,884

Pargana Manpur

292

292

6,465

Total

11,736,756

1,398,432

4,671,195

11,328,323

1,283,749

30,418,454

154,976,132

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[statistics

the Punjab, Upper Burma, and Sind. Irrigation from tanks is practised chiefly in Madras and the Central Provinces, irrigation from wells in the Punjab, the North- Western Provinces and Oudh, Madras, and Bombay. The principal crop grown on irrigated land is wheat; and altogether more than 90 per cent, of the total irrigated area in 1897-98 was devoted to food-crops (see also Ieeigation).

Tea, Coffee, Indigo. — The principal agricultural products raised under European supervision and with the help of European capital are tea, coffee, and indigo. Tea is chiefly grown in the extreme north-east — in the two valleys of Assam and in the neighbourhood of Darjiling (Bengal). The following table shows the area under tea (both mature and immature plants) for the seven years 1893-99 : —

Tear.

MUls.

Looms.

Spindles.

Persons

Employed.

1882-1883

1887-1888

1892-1893

1897-1898

1899-1900

62

97

130

163

186

15,116

18,840

26,317

36,946

38,420

1,654,108

2,375,739

3,378,303

4,210,756

4,728,000

53,624

80,515

120,898

148,435

163,200

Tract.

1893.

1894.

1895.

1896.

1897.

1898.

1899.

Acres.

Acres.

Acres.

Acres.

Acres.

Acres.

Acres.

Assam

256,625

268,796

276,290

291,909

310,550

325,823

331,151

Bengal

110,510

98,345

104,197

105,707

128,067

130,241

132,923

Madras

5,600

6,102

6,797

5,270

6,3.35

6,512

10,164

N.W.P. .

7,419

7,652

8,514

7,919

7,965

7,924

7,854

Punjab

8,746

8,921

9,243

9,830

9,970

10,259

10,135

Native States .

7,837

9,079

9,480

11,444

30,076

19,701

23,115

Burma

Total .

802

880

1,196

1,201

747

1,220

1,390

397,539

399,775

415,717

433,280

493,710

501,680

516,732

In 1899 the total production was 186,525,000 ft, of which more than two-thirds came from Assam and nearly one-fourth from Bengal. The total number of persons employed was 656,000, including 96,000 temporary labourers.

The cultivation of coffee is practically confined to the extreme south. It is subject to greater vicissitudes than that of tea, and is generally a less prosperous industry than it was in 1880. A considerable proportion is grown by natives, especially in Mysore. The following table shows the area under coffee for the seven years 1893-99 :—

The total capital invested was more than Ex.16,000,000, almost entirely provided by joint-stock companies. The total consumption of raw cotton was estimated at 464,000

bales of 400 ft each ; being more than half of the normal production. Por 1899-1900 the total output of yarn was reported as 501,294,000 ft, of which 62,071,000 ft (or 13 per cent.) was of counts abov.e No. 20 ; but the production of these finer counts from imported cotton is steadily increasing. The total out-turn of woven goods was reported as 95,320,000 ft. Of the total number of persons employed in 1897-98, 95,962 were adult males, 26,114 women, 15,789 young persons, and 10,570 children. Bombay possessed 70 per cent, of the mills and produced 83 per cent, of the woven goods. There were fourteen mills situated in native States and in French territory.

The spinning and weaving of jute, like the cultivation of the fibre, is practically confined to Bengal, the steam mills being concentrated round Calcutta. The following table gives the chief statistics of this industry for the five years named : —

Tear.

Mills.

Looms.

Spindles.

Persons

Employed.

1882-1883

1887-1888

1892-1893

1897-1898

1899-1900

20

25

27

35

33

5,633

7,389

8,976

13,615

14,021

95,737

146,302

181,172

274,907

293,218

42,797

56,007

67,291

95,934

101,630

Tract.

1893.

1894.

1895.

1896.

1897.

1898.

1899.

Acres.

Acres.

Acres.

Acres.

Acres.

Acres.

Acres.

Coorg

63,783

71,181

73,828

84,820

86,155

82,575

72,296

Madras

62,245

64,512

63,953

56,851

55,895

63,983

66,473

Mysore

132,520

136,032

138,670

141,528

125,876

128,079

128,010

Travancore and

CocMn .

6,244

6,589

7,033

5,748

7,840

6,384

7,069

Burma, Assam,

&c.

Total .

198

248

267

319

308

548

450

264,990

278,562

283,751

289,266

276,074

281,569

274,298

Owing to poor crops and low prices, the total export of coffee was only 225,000 cwts. in 1897-98, as compared with 312,000 cwts. in 1891-92. In 1899-1900 it rose again to 281,000 cwts. The total number of persons

employed was returned as 110,000, of whom 83,000 were temporary labourers.

The cultivation of indigo is even more fluctuating than that of coffee. The normal area under indigo is 1,400,000 acres, of which more than one-third is in Bengal, about one-fourth in the North-Western Provinces, another fourth in Madras, and most of the remainder in the Punjab. European capital is almost confined to Behar in Bengal and the neighbouring districts of the north-west. In 1900 the total area under indigo was only 964,000 acres. The total exports of indigo ranged from 187,000 cwts. in 1895-96 to 111,000 cwts. in 1899-1900.

Textiles. — Next after agriculture, the spinning and weaving of cotton at steam mills is the most important industry in India, being chiefly concentrated in Bombay. The following table gives the principal statistics of this industry for the five years named : —

The total capital invested exceeds Ex.5,000,000, almost entirely provided by joint-stock companies. No returns of

the out-turn are available, but the total quantity of raw jute worked up in the Indian mills is about 7,000,000 cwts., compared with an export of about double that quantity. Of the total number of persons employed in 1897-98, 62,247 were adult males, 17,090 women, 6740 young persons, and 10,853 children, show-ing a much larger proportion of children than in cotton mills.

In 1898 there were four mills for spinning and weaving wool, with 588 looms and 21,444 spindles, employing 2904 persons. The capital invested was E,x.445,000, and the output for 1898 was nearly 3,000,000 ft, valued at Ex.307, 247, chiefly blankets and greatcoats for the army and police, made from the short-stapled Indian wool.

Other Manufactures. — There were in 1898 nine paper mills, employing 4187 persons. The capital invested was Ex.(i27,200, and the out-turn was 42,000,000 ft, valued at Ex.610,000. The materials used are chiefly rags,

grasses, jute cuttings, &c. Most of the paper used in Government oftices is now obtained from these mills. The number of breweries, mostly at hill stations in the Himalaya, is 27, with an out-turn of about 6,000,000 gallons, half of which is purchased by the Commissariat Department. The local production of beer is about twice as large as the import. One boot factory at Cawnpore turned out no less than 735,000 pairs of boots for military purposes during the two years 1899 and 1900. statistics]

other large industries are the rice mills and timber mills of Burma, the factories for ginning and pressing cotton throughout western India, a few sugar refineries, the Barrakur iron works in Bengal, and the pottery works at Eaniganj (also in Bengal).

In 1899 the total number of factories under inspection was 1110, employing 452,796 persons, of whom 65,303 were women, 27,459 young persons, and 27,469 children. Dur-

ing the year the number of a<;cidents reported was 2603, of which 77 were fatal. The convictions for breaches of the Factory Act numbered only 3. In 1899-1900 the total number of joint-stock companies registered was 1340, with an aggregate paid-up capital of £23,625,850.

Coal. — The coal industry is progressing rapidly, especially in Bengal. The following table gives the output of all the coal mines in India for the seven years 1893-99:—

Tract.

1898.

1894.

1895.

1896.

IS'JT.

1898.

1899.

Tone.

Tons.

Tons.

Tons.

Tons.

Tons.

Tons.

Bengal ....

1,915,000

2,036,000

2,718,000

3,038,000

3,142,497

3,622,090

3,883,000

Nizam's Dominions

157,000

241,000

293,000

263,000

365,550

394,622

401,000

Assam ....

164,000

169,000

173,000

177,000

185,533

200,329

226,000

Central Provinces .

135,000

141,000

123,000

142,000

131,629

149,709

157,000

Central India (Rewa) .

94,000

133,000

118,000

115,000

124,778

134,726

164,000

Punjab ....

77,000

66,000

72,000

79,000

92,792

85,862

82,000

Baluchistan .

20,000

22,000

23,000

11,000

8,876

10,667

12,000

Upper Burma

Total .

...

12,000

17,000

23,000

11,472

6,975

8,000

2,562,000

2,820,000

3,537,000

3,848,000

4,063,127

4,604,980

4,933,000

In 1898 the total output was valued at Ex.1,430,467 ; the average value being Ks.3-11 per ton, as compared with Rs.l9‘44per ton for imported coal. The total number of persons employed in coal-mining in 1899 was 72,000, of whom 51,000 were adult males. Nearly one-third of the total output was consumed by the railways,

which now use an insignificant proportion of imported coal (less than 3 per cent, in 1898) . Bengal alone produced nearly four-fifths of the total, exporting by sea to Bombay, Madras, Burma, Ceylon, and the Straits, as well as inland by rail and river. A revised Act for the regulation of coal mines was passed by the Viceroy's Council in March 1901.

Gold. — Gold is known to exist in various parts, and gold-washing is practised in many of the hill streams ; but the extraction of the precious metal by quartz-crushing has been successfully pursued only in the Kolar gold-field of Mysore. Here there are two com-panies, the Mysore and the Champion, which produce each about 150,000 oz. in the year ; while the total production steadily rose from 163,000 oz. in 1892 to SlOjOOO oz. in 1900. A royalty of 5 per cent, is paid to the Mysore State.

Petroleum. — The most important source of petroleum is in Upper Burma, where the output increased from 8,000,000 gallons in 1898 to 37,000,000 gallons in 1900. The petroleum is refined at Rangoon. Petroleum is also produced in the extreme north-east of Assam, iijr the neighbourhood of a coal-field. The output here rose from 42,000 gallons in 1893 to 753,000 gallons in 1900. In addition, there

are petroleum wells on the north-west frontier ; but those in British Baluchistan, which in one year yielded 70,000 gallons, have not been worked since 1894, and the total output in the Punjab is only 2000 gallons a year. Compared with these figures, the total import of mineral oils amounted to more than 80,000,000 gallons.

Salt. — Salt is produced by evaporation almost everywhere along the sea^coast, and at certain inland lakes, of which the Sambhar Lake in Rajputana is the most important. It is also obtained by mining at two places in the Punjab. Its manufacture is a government monopoly. The annual production amounts to about 1,000,000 tons, compared with an importation of about 400,000 tons.

For the statistics concerning railways, see the section History below. The following table shows the general

Table of Foreign Trade (Seorborne) since 1870.

Five Tears'

Average.

Merchandise.

Treasure.

N'et Imports.

Excess Ex-

ports, Mer-

chandise

and

Treasure.

Imports.

Exports.

Excess Ex-

ports.

1869-70

to

1878-74

1874-75

to

1878-79

1879-80

to f

1883-84

1884^^5

to y

1888-89

1889-90

to >■

1898-94

1894-95

to y

1898-99)

Ex.

83,036,588

38,863,886

50,154,241

61,516,273

70,778,890

73,666,886

Ex.

56,262,728

60,824,898

79,084,526

88,689,972

104,992,086

107,583,024

Ex.

28,216,135

21,961,057

28,980,285

27,128,699

34,218,646

88,866,688

Ex.

6l674,240

7,048,286

10,883,962

11,980,856

14,242,482

8,496,808

Ex.

16,641,895

14,912,771

18,596,323

15,143,348

19,971,164

25,371,880

course of the foreign sea-borne trade since 1870. To avoid accidental fluctuations, quinquennial averages have been taken. First are given the value of the imports and exports of merchandise only, and the excess trldef value of the exports of merchandise ; then the net imports of treasure, the exports having been deducted ; and finally, the excess value of the exports of both mer-chandise and treasure which may be regarded as the pay-ment by India to foreign countries for interest on capital invested and for services rendered.

The following table analyses the total foreign sea-borne trade of India for two recent years, 1891-92 and 1897-98 :—

Analysis of Foreign Sea-borne Trade.

Imports —

Private merchandise .

Government stores

Total merchandise

Treasure —

Private

Government

Total treasure

Total imports

Exports —

Indian produce and manu-

factures

Foreign produce and manu-

factures

Government stores

Total merchandise

Treasure —

Private

Government

Total treasure

Total exports

1891-92.

Ex.

66,587,457

2,844,926

69,432,383

14,722,662

1897-98.

Ex.

69,420,120

4,240,340

73,660,460

20,476,286

54,331

14,722,662 20,530,617

84,155,045 94,191,077

103,550,831 93,786,101

4,485,179 3,751,172

137,582 95,508

108,173,592 97,632,781

3,143,186 7,134,169

143,500 14,478

3,286,686 7,148,647

111,460,278 104,781,428

Total sea-borne trade 195,61-5,323 198,972,505

Under imports, the most notable feature is the increase in Government stores, representing larger railway construction by the State. Under exports, the decrease iu Indian produce and manufactures is probably temporaiy, being due to famine and plague ; but the decrease in foreign produce and manufactures shows a permanent change in the character of the re-export trade, Bombay having lost much of its entrepot business with the east coast of Africa and the Persian Gulf.

The re-exports of foreign produce and manufactures reached their maximum of Rx.5, 057,414 in 1894-95, and then fell year by year to only Rx.3,292,491 in 1899-1900.

The following table gives the value (in tens of thousands of rupees) of the chief articles of import for the years named : —

Values of Principal Imported Articles.

Articles.	*1889-90.*	*1894-95.*

1899-1900.

Eb.10,000.

Es.lO,000.

Es.10,000.

Apparel .

1,296

1,435

1,464

Books, &c.

85.5

869

933

Coal .

1,309

1,474

810

Cotton twist, &o.

3,483

2,851

2,460

Cotton piece-goods

26,391

29,822

27,002

Hardware, &o. ,

1,096

1,333

1,590

Liquors .

1,465

1,458

1,597

Machinery, &c.

2,435

2,442

2,542

Iron .

2,414

2,245

2,420

Steel

328

586

1,000

Copper

2,222

1,512

629

Mineral oils

2,479

2,123

3,180

Provisions

1,597

1,576

1,689

Railway materials

1,821

1,557

2,776

Silk manufactures

1,778

1,277

1,129

Raw silk .

1,067

1,037

576

Sugar

2,200

2,875

3,376

Woollen manufactures

1,455

1,542

1,758

Cotton manufactures of all kinds still form 42 per cent, of the total imports, hut ten years earlier the proportion was as high as 45 per cent. The value of piece-goods reached its maximum in 1894-95, and has since fluctuated considerahly. The value of twist

and yarn first fell under competition with the product of local spinning mills, and then rose again when local weaving mills began to use the finer counts of English yarn. At a long distance after cotton manufactures, the next most important article of import is metals of all kinds, which now form normally 7 per cent, of the total. Here the largest increase is under the head of steel. Hardware and cutlery, machinery and mill-work, each show fair increases, while railway plant and rolling stock are subject to fluctuations. Mineral oils have considerably increased, despite a heavier import duty ; and sugar increased yet more considerably, partly under the stimulus of Continental bounties, which are now met by a countervailing duty. Both raw silk and silk manufactures show a heavy decrease. But the most significant decrease is in coal, which is little more than half of what it was in some earlier years. The mines of Bengal are now almost entirely able to supply the railways and mills of all India.

The following table gives the value (in tens of thousands of rupees) of the chief articles of export for the same years : —

Values of Principal Exported Articles.

Articles.

1889-90.

1894-95.

1899-1900.

Es.10,000.

Es.10,000.

Es.10,000.

Coffee

1,500

2,209

1,506

Raw cotton

18,671

8,708

9,925

Cotton twist

5,840

5,784

7,008

Potton manufactures

2,733

3,600

2,611

Indigo

3,863

4,746

2,692

Rice

10,110

13,815

13,101

Wheat .

5,793

2,566

3,909

Hides

4,524

6,560

10,464

Raw jute .

8,640

10,576

8,071

Jute manufactures .

2,791

4,211

6,265

Lac ....

489

1,406

1,137

Opium

10,116

9,065

8,203

Oil-seeds .

10,631

14,206

10,110

Tea .

5,445

7,989

9,177

Wood

875

665

1,096

Raw wool .

1,779

2,016

1,801

Here rice takes the first place, with a steady average of about 12 per cent, of the total value. It should be borne in miiid that rice is the only article subject to an export duty. Even the famine of 1896-97 hardly checked the export of rice from Burma to foreign countries. The quantity of rice exported reached its maximum (38,000,000 cwts.) in 1898-99. Raw cotton falls to the second place, owing to its wide fluctuations. The maximum quantity was over 6,000,000 cwts. in 1889-90, which fell to only 3,000,000 cwts. in 1894-95 and again in 1897-98. The next place is held by oil-seeds, which similarly fluctuated from a maximum of 24,000,000

cwts. in 1893-94 to a minimum of 11,000,000 cwts. in 1896-97. Raw jute shows a steady increase, the quantity having reached its maximum (15,000,000 cwts.) in 1897-98. Tea also shows a steady increase, the quantity having risen almost year by year from 105,000,000 lb in 1889-90 to 176,000,000 lb in 1899-1900. Hides increased considerably, but the very high figure for 1899-1900, explained by the mortality of cattle from drought, is by no means a sign of prosperity. Wheat is liable to excessive fluctuations ; from a maximum quantity of 30,000,000 cwts. in 1891-92 to only 2,000,000 cwts. in each of the two years 1896-97 and 1897-98. Opium shows a decrease, from 118,598 cwts. in the first year to 93,378 cwts. in the last. Indigo shows wide fluctuations, from a maximum quantity of 187,337 cwts. in 1895-96 to a minimum of 111,420 cwts. in 1899-1900. The most remarkable increase of all is in manufactures of jute, the produce of the mills near Calcutta, which more than doubled in value. The export of jute cloth (as opposed to bags) increased in ten years from 37 to 307 million yards. Cotton piece-goods show a decrease in value, which was very marked during the last five years. The decrease in quantity was from a maximum of 193 to a minimum of 130

million yards. Cotton twist and yarn, on tlie other hand, show a fair increase, the quantity having risen from 143 to 243 million ft. Coffee fluctuated, with a tendency to decrease. The maximum quantity was 367,480 cwts. in 1888-89 ; the minimum was 215,896 cwts. in 1896-97. Raw wool, lac, and timber each show an increase. In quantity, lac of all kinds rose in ten years from 90,240 to 238,450 cwts., and teak timber from 71,402 to 77,822 cubic tons. Among minor articles, not specified in the above table, sugar, spices, dyes (other than indigo), raw silk, and silk manufactures all show decreases. Manures (chiefly animal bones), oils, and tobacco each show an increase ; but the total export of tobacco in 1899-1900 was only 10,000,000 ft, valued at Rx.184,465. In the same year the export of coal was 218,877 tons, valued at Rx.328,315.

The proportion of trade that passes through the Suez Canal remains fairly constant at about 80 per cent, for imports and 57 per cent, for exports. The following table distributes the imports according to the countries from which they were received in each of the three years 1877-78, 1887-88, and 1897-98 :—

Coimtry.

1877-78.

1887-SS.

1897-98.

Value.

h

c o

9 O

Value.

ft

Value.

Is

c o

United Kingdom

Austria-Hungary

Belgium

France ....

Germany

Italy ....

Eussia .

East Coast of Africa .

Mauritius .

United States .

Arabia and Persia

Ceylon .

China .

Straits Settlements .

Turkey in Asia .

Australia

Other Countries

Total

Ex.

84,278,708

118,188

120

461,129

25,488

849,489

217,964

648,274

279,717

860,824

599,759

1,428,672

1,079,702

512,189

298,809

830,288

88

i

‘i

‘i

2

1

2

1

8

2

1

1

1

Ex.

51,650,627

771,078

808,341

849,091

194,493

871,078

227,800

670,275

1,5.80,573

1,080,279

1,080,265

683,663

2,415,321

2,119,772

276,903

484,885

371,686

80

1

i

i

i

2

2

2

1

4

3

‘i

. 1

Ex.

50,796,218

2,146,926

2,286,298

882,802

2,484,519

509,094

2,080,756

190,886

1,684,765

1,444,382

1,272,288

1,095,772

1,691,142

2,410,200

291,286

884,450

2,109,7.30

69

S

3

1

8

1

8

2

‘2

2

2

2

8

i

3

41,464,182

65,004,612

78,660,460

During the first period of ten years the increase in the imports from the United Kingdom almost kept pace with the increase in the total imports, but during the second period of ten years the imports from the United Kingdom decreased absolutely, while their proportion to the total fell from 80 to 69 per cent. What the United Kingdom lost was gained by Germany, Belgium, Austria-Hungary, Eussia, and unnamed countries (including Japan). The imports from other countries show little variation.

The following table distributes the exports according to countries for the same years : —

Country.

1S77-7S.

1SS7-S8.

1S97-9S. 1

Is

Is

Value.

Value.

Value.

Kx.

Ex,

Ex.

United Kingdom

29,*614*,*849*

46

86,*068*,*574*

89

30,*236*,*459*

31

Austria-Hungary

1,*465*, *h92*

2

2,*734*,*509*

8

2,10.‘3,?S.“i

2

Belgium

218,706

8,171,850

4

8,039,289

8

France ....

6,967,608

9

7,209,826

8

5,642,778

6

Oermany

880,794

1,032,347

1

7,188,445

7

Italy .

1,870,007

8

4,527,!>40

5

2,698,744

8

Eussia ....

68,488

471,006

209,707

Egypt . . . .

577,955

i

3,288,889

4

3,971,389

4

Mauritius .

1,198,609

2

1,233,170

1

1,304,405

1

United States .

1,932,727

8

8,782,737

4

6,876,096

6

Arabia and Persia

1,602,428

2

2,477,201

8

2,661,460

8

Ceylon ....

2,846,694

4

2,081,068

2

4,098,875

4

China . . . .

12,748,168

20

18,092,100

14

12.227,882

1,3

Straits Settlements .

2,601,691

4

4,199,595

5

4,605.(>41

.’)

Other Countries .

Total

2,493,777

4

6,238,1.’!2

7

11,765.827

12

65,222,328

90,548,658

!)7.IS’:,7S1

statistics]

INDIA

425

Here the decline of trade with the United Kingdom is still more marked, its proportion to the total having steadily fallen from 46 to 31 per cent. The shares of China and of France also decreased. Germany and Belgium again gained most; while the United States

also show a large increase. The exports to Egypt are probably for distribution to Mediterranean ports. The growing trade with Japan is concealed under " other countries." In 1899-1900 the exports to Japan were valued at Rx.6,336,664, almost entirely raw cotton, with some indigo and rice. In 1890-91 the total value was only Rx.1,210,276.

Turning to the more important articles of import. In 1897-98 the United Kingdom sent 97 per cent, of the cotton piece-goods, the remainder coming chiefly from the United States and Austria-Hungary ; and likewise 97 per cent, of the cotton twist and yarn. Of railway material, and also of machinery and millwork, the share of the United Kingdom was as large as 99 per cent. ; but in the case of hardware and cutlery it dropped to 78 per cent., in iron to 75 per cent., in copper to 70 per cent., and in steel to 50 per cent. In iron, steel, and copper the most formidable competitor of the United Kingdom was Belgium. The imports from Germany consisted mainly of sugar and miscellaneous articles. The importa^ tion of sugar from Austria-Hungary suddenly rose from Rx.131,379 in 1896-97 to Rx.1,044,504 in 1897-98, or eightfold in a single year. Russia now sends nearly three times as much mineral oil as the

United States.

As regards the exports, cotton twist and yarn were sent almost entirely to China ; cotton piece-goods to the neighbouring countries of Asia and Africa ; raw cotton to Japan and the Continent. Of raw jute, the United Kingdom took more than one-half, and Germany nearly one-fifth ; gunny cloth went mainly to the United States, while Australia was the chief market for gunny bags. Rice went to Egypt (for transhipment), Ceylon, the Straits, the United Kingdom, Brazil, Mauritius, and Arabia. Of the exports of tea, no less than 92 per cent, went to the United Kingdom, and 3 per cent, to Australia ; but some success attended the efforts to open up a market in the United States and Canada. Of oil-seeds, the United Kingdom took the largest proportion of linseed ; but rape, sesamum, castor, and poppy went mainly to France and Belgium. The export of dressed hides was mainly to the United Kingdom, and to the United States in the second place ; while Germany took the ■ largest amount of raw hides, with the United States again in the second place. Wheat went mainly to the United Kingdom and other countries in Europe.

The following table distributes the total foreign trade (in mer-

chandise only) among the 16 principal seaports for the two years

1887-88 and 1897-98 :—

ISbT-SS.

1897-«8.

Port.

Value.

Percent-

affe of

Total.

Value.

Percent-

age of

Total.

Calcutta

Bombay

Rangoon

Madras

Karachi

Tuticorin

Moulmein

Bassein

Negapatam

Chittagong

Coconada

Cochin

Calicut

Mangalore

Tellicherri

Akyab

Total

Ex.

58,965,852

59,654,586

9,897,716

8,800,123

5,186,785

1,613,897

787,629

631,533

863,540

1,256,999

703,786

379,052

439,278

319,171

737,557

939,065

38-6

39-0

6-5

5-7

3-4

1-1

•5

•4

•6

•8

•5

•2

■3

•2

•5

■6

Ex.

71,994,608

62,063,062

12,346,725

10,161,018

9,228,432

2,186,426

910,307

884,858

839,837

815,035

777,933

645,197

640,526

549,060

542,183

374,624

43-1

31-2

7-4

6-1

5-5

1-3

•6

•5

■5

•5

•5

■4

•4

•3

■3

•2

151,166,569

98-9

164,958,831

98-8

Grand Total for

British India .

162,856,275

166,957,393

The two great rivals, Calcutta and Bombay, control between them three-fourths of the total trade of India. But while the share of Calcutta has steadily increased, Bombay suffered severely from the combined effects of famine and plague. Rangoon has gained upon Madras, and Karachi comes close behind. Of the minor ports, Tuticorin and Cochin (both in the Madras Presi-dency) show the largest increase ; while Chittagong, Akyab, and Tellicherri conspicuously declined.

Shipping. — ^The following table distributes according to national flags the vessels (both steam and sailing) that cleared for foreign countries from British India in each of the three years 1877-78, 1887-88, and 1897-98 :—

1877-78.

1887-88.

1897-98.

National Flag.

Number of

Vessels.

Tonnage.

Number of

Vessels.

Tonnage.

Number of

Vessels.

Tonnage.

British

3,417

2,394,213

3,049

3,089,264

2,887

3,226,027

Austro-Hungarian

18

22,651

59

102,214

64

138,203

Danish .

4

3,358

1

842

Dutch .

4

2,398

14

12,511

10

7,854

French .

132

70,961

47

37,735

47

59,672

German .

42

33,981

86

95,633

121

192,678

Italian

87

73,291

71

108,134

28

55,604

Norwegian

37

31,944

34

31,699

61

66,243

Portuguese

9

768

12

1,069

1

28

Russian .

7

5,195

1

1,148

2

2,039

Spanish .

2

1,207

1

333

...

...

Swedish .

25

15,005

9

3,746

5

3,673

American

65

75,864

37

53,463

1

1,858

Arab

290

33,789

304

41,866

210

25,716

Japanese

...

,..

9

18,443

Mekran .

7

362

24

865

1

78

Persian .

3

205

2

1,233

Siamese .

2

466

2

796

...

Turkish .

7

5,275

25

7,138

2

1,759

British Indian

1,950

97,278

1,647

72,660

1,201

61,071

Foreign Indian

77

7,158

158

14,547

131

13,848

Others

2

1,577

2

226

...

Total

6,184

2,876,730

5,585

3,676,251

4,784

3,866,869

In this case the United Kingdom holds its own. Though the number of British-owned vessels (including those registered in British India) decreased, the aggregate tonnage rose, and the proportion which this bore to the total remained pretty constant. Here again the most notable increase is shovra by Germany, closely followed by Austria-Hungary. France, Italy, and Sweden each declined, while American ships dropped from 65 to 1. The fall under British Indian is probably a result of re-classification. Treasure. — The following table gives the imports and exports of treasure, distinguishing gold and silver, for each of the ten years ending 1899-1900. During the 50 years ending 1898-99, India imported treasure to the aggregate value of Rx.624,000,000. In no year of that period did the imports of treasure faU to exceed the exports ; but in 1894-95, the year after the mints were closed, the net imports droppe 1 to Rx.l, 365,136. The net imports first rose above Rx.10,000,0

construction was beginning; and first rose above Rx.20,000,000

,at the time of the American Civil War. During the decade end-

ing 1868-69, the net imports of gold averaged nearly Rx.6,000,000

a year, and tte net imports of silver averaged more than

Rx.10,000,000 a year. The closing of the Indian mints to the

free coinage of rupees in June 1893 has had the effect of reducing

the net imports of silver, which now possesses only a bullion

value, and of increasing the net imports of gold.

S.V.-54

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[statistics

I.MI'OKTS.

ExPOKTS.

Net Impobts.

Gold.

Silver.

Gold.

SilTer.

Gold.

Silver.

1890-91

1891-92

1892-93

1893-94

1894-95

1895-96

1896-97

1897-98

1898-99

1899-1900

Ex.

6,500,832

4,118,929

1,781,789

3,146,530

1,756,280

5,029,269

4,491,179

7,281,222

8,840,054

7,632,531

Ex.

15,433,654

10,603,733

15,228,021

15,314,726

7,824,927

8,388,716

8,593,384

13,249,395

9,055,559

6,349,926

864,660

1,705,137

4,594,472

2,505,284

6,730,374

2,503,317

2,200,140

2,372,733

2,336,646

1,338,797

Ex.

1,258,518

1,581,549

2,364,452

1,594,908

1,495,698

1,756,494

2,737,355

4,775,914

5,074,775

3,965,461

Ex.

5,636,172

2,413,792

-2,812,683

641,246

- 4,974,094

2,525,952

2,291,039

4,908,489

6,503,408

6,293,734

Ex.

14,175,136

9,022,184

12,863,569

13,719,818

6,329,229

6,582,222

5,856,029

8,473,481

3,980,784

2,384,465

Coasting Trade. — The following table analyses the total coasting trade of India for the two years 1888-89 and 1897-98. During ten years the aggregate coasting trade increased by 19 per cent. Taking country produce only, imports increased at the rate of 30 per cent. , and exports at the rate of 39 per cent.

In foreign products, imports showed a slight decrease, and exports

Imports —

Private Merchandise

Government Stores

Total Mercliandise .

Treasure .

Total Imports ,

f Country

\ Foreign

/ Country

\ Foreign

1888-89.

Ex.

23,136,488

5,475,424

178,971

193,151

28,984,034

4,055,901

189T-98.

Ex.

30,015,652

5,372,080

404,226

331,996

36,128,954

2,237,461

33,0.89,935 38,361,415

Exports —

Private Merchandise | p^eign

*Government Stores | pg™}^*

Total Merchandise .

Treasure ....

Total Exports .

Grand Total .

1888-89.

189T-9S.

Ex.

Ex,

0,954,551

29,150,764

6,757,845

7,113,212

373,197

416,241

176,074

898,961

28,261,667

4,538,127

37,079,178

2,418,652

32,799,794 39,497,830

65,839,729 77,859,245

a somewhat larger increase. Government transactions increased considerably. The heavy fall in treasure was probably due to the closing of the mints.

The following table distributes among provinces the coasting trade for 1897-98, excluding Government transactions : —

Province.

Imports.

Exports.

Merchandise.

Treasure.

Merchandise.

Treasure.

Country.

Foreign.

Total.

Country.

Foreign.

Total.

Bengal .

Bombay

Sind .

Madras

Burma .

Ex.

7,292,856

12,131,453

1,139,744

4,835,330

4,616,269

Ex.

831,412

630,633

1,620,996

1,183,163

1,105,876

Ex.

8,124,268

12,762,086

2,760,740

6,018,493

5,722,145

Ex.

538,347

259,278

78,827

91,571

1,025,249

Ex.

6,631,623

8,473,451

2,491,478

4,817,536

6,736,676

Ex.

1,409,167

4,610,375

165,118

250,743

677,808

Ex.

8,040,790

13,083,826

2,656,596

5,068,279

7,414,484

Ex.

1,270,963

431,616

7,973

61,717

441,990

Total .

30,015,652

5,372,080

85,387,732

1,998,272

29,150,764

7,113,211

36,263,975

2.214,259

This table brings out the varying character of the coasting trade in the several provinces. Bombay, with its line of active little ports all along the western coast, from Kathiawar to Kanara, possesses more than one-third of the whole, but owing to the preva-lence of plague, its share of the total imports fell from 44 to 36 per cent. Trade is also active along both coasts of Madras, but no increase was shown during 1894-98. In Bengal (where the only

ports besides Calcutta are Chittagong and the Orissa roadsteads), the imports of country produce increased between 1894 and 1898 by 50 per cent., and the exports by 40 per cent. Sind (which means Karachi) imports a larger amount of foreign than of country merchandise, standing alone in this respect ; while its exports, which more than doubled in 1894-98, are almost entirely confined to country produce. In both cases the trade is carried on with Bombay. In Burma the coasting trade in foreign produce remained stationary, the imports being approximately double the exports. The exports of country produce mainly depend upon the demand in India for Burmese rice, and fluctuated within three years from under Rx.3,000,000 to nearly Rx.7,000,000. The imports showed a steady increase, at the rate of 31 per cent, in 1894-98. The coasting trade in treasure consists almost entirely of an export from Bengal to Burma, to move the rice crop.

Trans-frontier Trade. — The following table gives the registered imports and exports by land along the northern frontier of British India, from Sind to Burma, for the two years 1891-92 and 1897-98. The largest portion of this land trade is con-

ducted with Nepal, which sends to Bengal and the North-Western Provinces rice, timber, cattle,)il-seeds, ghi, &c., and receives in exchange cotton, silver, salt, metals, sugar, spices, and tobacco. The trade with independent Afghanistan shows a steady decline, due to the restrictions imposed by the Amir. On the other hand, the trade with Tirah and Bajaur (Afghan territory under British influence) shows satisfactory improvement. The trade with Tibet and Sikkim increased ; but that with Bhutan and along the frontier of Assam is insignificant. Along the frontier of Burma trade is comparatively active, especially with the Shan States ; but it should be remembered that the Shan States are not foreign territory. Of

Country.

Imports from.

Expo

■*ts to.*

1891-92.

1897-98.

1891-92.

1897-98.

Ex.

Ex.

Ex.

Ex.

Lus Bela .

43,785

96,713

23,648

41,241

*Khelat, Kanda^*

har, &c. .

600,317

413,312

682,224

277,921

Kabul

218,120

129,109

658,639

253,979

Tirah and Bajaur

90,748

258,016

114,744

336,516

Kashmir .

650,509

810,510

661,614

681,022

Ladakh

30,779

52,662

22,238

46,635

Nepal .

1,645,066

2,056,529

1,358,554

1,828,810

Sikkim

22,016

49,404

12,699

36,496

Bhutan

33,053

14,685

22,759

15,883

Tibet

130,671

124,388

49,566

100,858

Tawang

2,685

2,261

1,067

2,984

Mishmi Hills, &c.

8,825

8,227

1,594

2,088

Manipur .

7,146

11,453

Hill Tipperah .

46,833

45,560

2,847

11,662

Karennee .

177,333

158,272

51,438

109,921

Shan States

260,165

839,320

174,361!

789,616

Zimme

182,84;-!

288,802

44,550

150,304

Siam .

48,871

131,8:!2

70,944

112,757

Western China .

46,336

147,856

104,539

209,085

4,918,231

Total .

4,238,0-50

5,634,604

4,0:>3.017

the total exports of merchandise, nearly one-half consists of cotton goods. The imports and exports of treasure appear to be almost e(iually balanced.

L'eveiiue and Expenditure. — The following table shows the gross revenue and expenditure in India and in Great Britain for each of the ten years ending 1898-99 : —

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427

Tear.

Gross Eevenne.

Gross Expenditure.

Bnrplus or

Deficit.

In India.

In Great Britain.

Total.

In India.

In Great Britain.

Total.

1889-90

1890-91

1891-92

1892-93

1893-94

1894-95

1895-96

1896-97

1897-98

1898-99

Ex.

84,598,760

85,221,551

88,773,360

89,819,707

90,246,041

94,814,831

97,977,005

93,586,471

96,139,287

101,062,861

Ex.

486,443

520,098

369,923

352,731

319,173

372,598

393,162

548,270

302,717

364,332

Ex.

85,085,203

85,741,649

89,143,283

90,172,4-38

90,565,214

95,187,429

98,870,167

94,129,741

96,442,004

101,426,693

Ex.

60,960,805

61,397,459

65,763,836

64,844,035

66,000,101

65,718,671

69,377,831

69,600,508

76,481,391

72,977,618

Ex.

21,512,365

20,656,019

22,911,912

26,161,815

26,112,111

28,775,648

27,458,338

26,234,255

25,819,824

24,487,765

Ex.

82,473,170

82,053,478

88,675,748

91,005,850

92,112,212

94,494,319

96,836,169

95,83i,763

101,801,215

97,465,383

Ex.

+2,612,033

+3,688,171

+467,535

-833,412

-1,546,998

+693,110

+1,583,998

-1,705,022

-5,359,211

+3,961,310

Between 1880 and 1899 the gross revenue increased at the rate of 48 per cent., while the expenditure increased at the rate of 61 per cent. Of these twenty

Finance. , ^ i i ^ ■

years eleven were years of surplus and nine were years of deficit, the net deficit being Ex.2,026,549. If we go back for a further period of thirty years, i.e., to 1849-50, the net deficit has amounted to Ex.4,000,000 ; but it has to be remembered that a deficit of no less than E.x.32,000,000 was incurred in the three years following

the outbreak of the Mutiny.

As the gross revenue and expenditure of India include large sums on both sides of the account for railways and other commercial services, it will be convenient to consider the chief items separately. The following table gives the principal heads of both revenue and expenditure for the five years named : —

Head.

187T-79.

1882-88.

188T-88.

1892-93.

1897-98.

Bevenue —

Ex.

Ex.

Ex.

Ex.

Ex.

Land

19,563,699

21,876,047

28,189,292

24,905,328

25,683,642

Forests

680,772

938,855

1,124,125

1,591,332

1,739,514

Tributes

675,120

689,945

743,597

790,112

884,029

Opium

9,182,722

9,499,594

8,515,462

7,993,180

5,179,772

Salt .

6,461,225

6,177,781

6,670,728

8,656,104

8,594,225

Stamps

2,993,483

3,379,681

3,876,298

4,448,540

4,837,043

Excise

2,458,029

3,609,561

4,684,655

5,242,443

5,489,454

Customs

2,624,123

1,296,119

1,348,837

1,617,633

4,641,295

Provincial rates

2,255,937

2,683,015

3,035,323

3,706,498

3,723,290

Assessed taxes

101,682

517,811

1,431,436

1,686,141

1,895,465

Eegistration ....

234,160

285,829

311,253

430,064

486,544

Expenditure —

Charges of collection, &o.

8,321,008

8,488,957

9,438,163

9,461,694

10,816,818

Debt

5,158,313

4,770,184

5,441,754

4,374,268

3,472,260

Civil services ....

17,205,098

19,435,241

21,593,591

24,214,358

25,471,965

Military services

18,454,417

19,324,157

22,106,011

25,073,970

28,188,867

Between 1878 and 1898 the land revenue increased by just Rx.6,000,000, but the proportion which it bore to the total gross revenue fell from 34 to 27 per cent. Porests largely increased, especially since 1890. The small increase in tributes is mainly due to the recent levy of the full assessment upott Mysore. Opium decreased very heavily, especially in the last five years, and the proportion which it bore to the total revenue fell from 14 to 5 per cent. The fluctuations in salt were partly due to changes in the rate of duty, which is now levied uniformly (except in Burma) at Ks.2:8:0 per maund.

Stamps steadily increased, the rate of increase during the period being no less than 62 per cent. Nearly two-thirds of the

Commercial Services.

1877-78.

1882-88.

1887-88.

1892-98.

1897-98.

Post Office—

Revenue ....

Expenditure

Net expenditure .

Telegrapfis—

Revenue ....

Expenditure

Net expenditure .

Bailways —

Revenue ....

Expenditure

Net expenditure .

Irrigation —

Revenue ....

Expenditure

Net expenditure .

Total—

Revenue ....

Expenditure

Net expenditure .

Ex.

850,431

979,004

Ex.

977,797

1,217,287

Ex.

1,214,196

1,375,201

Ex.

1,488,875

1,518,545

Ex.

1,879,163

1,729,474

128,573

289,490

161,005

29,670

-149,689

344,971

479,569

524,858

621,257

763,886

786,627

937,743

875,073

1,.309,330

1,051,494

134,598

96,899

22,741

-62,670

-257,836

7,248,730

7,398,877

10,973,080

12,279,224

14,533,.360

16,655,746

19,077,103

20,924,155

21,260,886

22,693,502

150,147

1,306,194

2,122,386

1,847,052

1,432,616

1,144,268

1,808,496

1,533,828

2,249,683

1,714,274

2,461,646

2,418,902

2,940,479

8,569,864

8,144,085

664,228

715,855

747,372

521,577

-425,779

9,588,400

10,660,946

14,009,513

16,367,451

18,225,716

21,279,220

28,922,628

26,258,252

28,019,248

28,618,555

1,077,546

2,857,988

3,053,504

2,335,629

599,312

428

INDIA

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whole is derived from judicial or court-fee stamps. Excise more tljan doubled in the twenty years, but the recent famine caused an actual decline. It is levied on liquors, opium (for local consumption), and other intoxicating drugs. The increase is attributed to more effective control of the administration, thus checking illicit manufacture, rather than to increased consumption. The policy of the State is to increase progressively the rates of duty, according as the articles will admit. The fluctuations under customs are due to changes of financial policy. From 1875 to

1882 there was a general import duty of 5 per cent. In 1882 all articles were admitted free, except liquors, arms, opium, and salt, and all exports were freed from duty, except rice. In 1894 the former tariff of 5 per cent, was reimposed, subject to certain exceptions. In 1896 cotton yarn was exempted from duty, and the rate on all other cotton goods was reduced to 3J per cent. In 1899 (subsequent to the period covered by this table) sugar imported from countries which grant a bounty on exportation was charged with an additional duty equivalent to the bounty, which is esti-mated to yield about Ex. 170,000 a year. In 1897-98, out of a total customs revenue of Ex.4,641,295, the export duty on rice yielded Rx.723,731. Of the import duties, cotton manufactures yielded Ex. 795,721; liquors, Ex.661, 317 ; metals, Ex.577,553; petroleum, Ex.531, 778 ; and sugar, Ex.24;6,045. The present income tax was first imposed in 1886, in substitution for various licenses on trades. It is levied at the rate of 5 pies in the rupee (say 6d. in the £) on incomes exceeding Es.2000, and at the rate of 4 pies in the rupee (say 5d. in the £) on incomes exceeding Rs.500, below which there is total exemption. In 1897-98 the total number of persons assessed under the tax was only 462,383, and the average

incidence of the demand was Es.36 per person assessed.

The table at the bottom of the previous page shows the revenue and expenditure of the commercial services which are included in the Indian budget for the same five years. It will be observed that post-oflfice, telegraphs, and irrigation each yielded a net profit in 1897-98, and that the loss on railways has steadily diminished. Within the period the gross revenue from the post-office more than doubled ; from telegraphs it multiplied nearly fourfold ; from railways nearly threefold ; and from irrigation more than threefold. These figures are, of course, exclusive of capital expenditure.

The two following tables show the net revenue and net expenditure for 1899-1900, according to the form in which the accounts are now laid before Parliament, 15 rupees being taken as the equivalent of £1 : —

Net Revenue, 1899-1900.

Land Revenue, &c. —

Land £16,444,825

Forests .

1,232,685

Tributes .

586,603

Total .

£18,264,113

Opium

• •

2,670,589

Taxation —

Salt

£5,373,776

Stamps .

3,225,920

Excise .

3,810,539

Provincial rates

2,495,458

Customs .

3,058,795

Assessed taxes

1,292,729

Registration .

287,164

Total .

19,544,380

Miscellaneous —

Mint

£289,183

Miscellaneous .

99,382

Total .

388,565

Exchange

- 80,949

Grand Total

Net Ex

PENDITUKB, 1899-1900

£40,786,698

Debt

£1,342,283

Military .

14,968,399

Collection of revenu

e . . . .

4,448,839

Commercial —

Post office

- £126,068

Telegraphs

- 105,891

Railways

-76,756

Irrigation

- 136,387

Total .

Famine relief .

-445 102

- *• •*

2,098,‘848

Civil Services —

Civil departments .

£9,697,544

Miscellaneous .

3,613,138

Construction of raih

ways 2,356

Buildings and roads

2,891,990

Total .

16,005,028

Provincial and Loca

1 balances

-206,220

Grand Total .

£38,212,075

Surplus .

2,574,623

As compared with the preceding year (1898-99) the total net revenue shows a decrease of £892,919, due mainly to a heavy fall under laud, against which may be partly set off improvements under opium and mint. The total net expenditure shows a decrease of £1,026,669, of which £1,189,110 was under army and

£723,473 under commercial services, while £1,307,305 more was spent on famine relief.

Deht.—ThQ total debt consisted in 1898 of Ex. 111,696,634 in India and £123,274,680 in Great Britain, of which Ex.131,030,304 was appropriated to railways and Ex. 32,639,803 to irrigation, leaving Rx.65,300,207 for other purposes. During the ten years 1889-98 the debt in India increased by about Rx. 11,000,000, and the debt in England by more than £28,000,000. Almost all the debt in India bears 3| per cent, interest, the rate having been reduced from 4 per cent, in 1894. The debt in England bears interest at rates varying from 3^ to 2^ per cent. In 1897-1898 the total payments on account of interest amounted to Rx. 10,695,520, of which Rx.5,939,011 was debited against railways and Ex.1,284,249 against irrigation, leaving Ex.2,957,024 for interest on ordinary debt and Ex. 516,236 for interest on other obligations. Since 1887-88, owing to the reduction in the rate of interest, the charge for ordinary debt has fallen by more than Ex.2,000,000. Of the total debt in India, Rx.21,780,893 was in 1898 enfaced for payment of interest in London, and of the remainder it is estimated that Rx. 47,804,990 is held by natives, while about Rx.10,000,000 is held

in reserve by the Government against paper currency.

The expenditure of the Indian Government in England is for the most part met by means of bills (or telegraphic transfers) drawn on India by the Secretary of State, and sold by him in London for sterling. During the 25 years ending 1897-98 the total amount of such bills was Rs.4,829,167,513, and the total amount of sterling received for them was £353,271,946. The difference between these two figures (Rs.129,643,805) repre-sents the "loss by exchange" on the conventional value of the rupee at 2s. During the 26 years the average annual rate obtained per rupee ranged from Is. 10-361d. in 1873-74 to Is. 1-lOOd. in 1894-95. Since the closing of the Indian mints to the free coining of rupees in June 1893 the exchange value of the rupee has been gradually dissociated from the market price of silver, and during 1900 stood pretty steadily at Is. 4d. This is the rate at which, by Indian legislation, sovereigns were made legal tender, £1 being the equivalent of Rs.l5 ; and the accounts of the Indian Government, as laid before Parliament, are now expressed in pounds sterling on this basis.

Savings Banks. — In 1897-98 there were 6484 Government savings

banks in India, mostly connected with the Post Office. The total number of depositora or accounts was 766,426, and the balance at the end of the year was Rx.10,556,733, being an average of Rs. 139 for each depositor. About 90 per cent, of the depositors, with 82 per cent, of the deposits, are natives of India. The rate of interest allowed is 3| per cent., and the maximum amount receivable from any one depositor is Rx.200.

Notation. — In India the method of pointing a statement of rupees differs from the English system. Up to 99,999 the -figures are named and used as in English, but 100,000 rupees is termed a lakh (or tec) and written 1,00,000. Millions are not named in the Indian fashion. Thus 1234567 would not be punctuated 1,234,567, but 12,34,567, reading "Twelve lakhs, thirty-four thousand, five hundred and sixty-seven" rupees. The crore (Indian Karor) is equal to 100 lakhs. Thus 1,23,46,678 would read "One crore, twenty-three lakhs, forty-five thousand, six hundred and seventy-eight" rupees (English notation 12,345,678). In the case of very large numbers, such as Rs.28;>o2-il5000, a change is introduced. This would be written Rs.2,833,24,15,000 and read "Two thousand eight hundred and thirty-three crores,

twenty-four lakhs, fifteen thousand." This system is also some-times used in enumerating bales of goods, such as jute or cotton, but is never applied to populations.

Army. — The net expenditure on the army was, during 1899-1900, £14,166,617, of which £4,061,817 was spent in Great Britain and £10,824,283 in India. In 1897 the death-rate was 12-75 per thousand for the European army, and 10-70 per thousand for the native army. (For full details see ai-ticle on Armies.)

Police and Prisons. — The total police force of all kinds (exclud-ing village watchmen) consisted in 1899 of 150,016 officers and men, of whom 47,364 were armed with firearms and 38,487 with swords. The total cost was £2,093,968. Compared with 1889, the numbers increased in ten years by 3 per cent., while the cost increased by 17 per cent. The total daily average number of prisoners in all the gaols in 1899 was 104,119, of whom 2770 were females. The death-rate was 22 per thousand, being lower than in any year of the previous decade. The total ex-penditure was Rs.6,179,357, being Rs.69-10 per head of average strength. Compared with 1889, the numbers increased by 25

per cent, and the cost by 27 per cent.

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Posts and Telegraphs. — The following is a comparison of the general statistics of the Imperial Post Office in British India in 1899-1900 compared with 1890-91. The number of post-offices increased in ten years from 8394 to 10,823, or 29 per cent. ; of letter-boxes from 11,999 to 19,822, or 65 per cent. ; the strength of the establishment increased from 44,979 to 55,073, or 22 per cent. The length of railways, roads, &c., oyer which the mails were conveyed increased from 74,393 to 91,534 miles, or 23 per cent. ; the total number of letters, &o., received for delivery from 325,000,000 to 521,000,000, or 60 per cent. ; the gross revenue from Rx.l, 396,385 to £1,299,609, or approximately 40 per cent. ; and the gross expenditure from Bx.l, 177,694 to £999,113, or approximately 27 per cent. The surplus thus grew from Rx.218,691 to £300,496. The rate of postage, extending over the whole of British India, is half an anna (say Jd.) for a weight not exceeding half a tola, and one anna (say Id.) for every one and a half

tolas ; while a postcard, including the cost of the card, costs only 3 pies (say Jd.). •

The following are the corresponding statistics for government telegraphs :— During the ten years from 1890-91 to 1899-1900 the length of lines increased from 37,070 to 52,909 miles, or 43 per cent. ; the length of wires from 113,612 to 170,766 miles, or 50 per cent. ; the length of cable from 251 to 283 miles, or 13 per cent. ; the number of signal offices open from 949 to 1851, or nearly twofold ; the number of messages from 3,403,769 to 6,237,301, or 83 per cent. ; the revenue from Rx.569,081 to £565,676, approximately 50 per cent. ; and the working ex-penses from Kx.468,880 to £447,758, or 43 per cent. The surplus thus rose from Rx.100,201 to £117,918, while, as the capital expenditure increased from Rx.5,024,168 to £4,510,939, the interest on capital outlay advanced from 1-99 to 2-61 per cent.

The ordinary rate of charge for telegraphing throughout the whole of British India (including Burma) is one rupee for eight words, the address being free, with two annas for each additional word. The "urgent" rate is double this, and the "deferred" rate one half.

Municipalities. — The following table gives the chief statistics of municipalities in India, according to provinces, for 1899-1900 : —

It

as

^1

Population,

Income.

•5-sl.

Province.

From Taxation.

From other

Sources.

Total.

Bengal

N.W. Provinces and Oudh

Punjab

Burma

Central Provinces

Assam

Madras

Bombay

India, General .

152

104

148

42

52

14

59

166

20

3,379,749

3,235,685

2,086,327

865,822

683,739

84,727

2,154,920

3,058,311

283,344

Ex.

759,729

372,763

325,967

194,006

112,247

11,164

275,496

1,204,880

34,207

Ex.

512,372

110,617

165,529

328,168

37,947

14,312

420,651

2,941,180

13,335

1,272,101

483,380

491,496

522,174

150,194

26,476

696,147

4,146,060

47,542

Es.

2-25

1-26

1-56

2-24

1‘64

1-32

1-28

3-94

1-21

Total

•

757

15,832,624

3,290,459

4,544,111

7,834,670

2-08

Since 1890-91 the population within municipal limits has increased by 6 per cent., while the income from taxation has increased by 42 per cent., and the total income by 158 per cent.

In 1899-1900 the chief items of expenditure were : conservancy, Rx.896,139; roads, Rx.396,886 ; water-supply, Rx.332,716 ; drainage, Rx.319,525 ; hospitals, Rx.300,776 ; education, Bx.256,478; lighting, Rx. 175,354 ; police, Rx.166,507.

Education. — The following table gives the chief educational statistics for the three quinquennial years 1886-87, 1891-92, and

1896-97 :—

Public Institutions.

1S86-8T.

1891-92.

1896-9T.

Institutions.

Pupils.

Institutions.

Pupils.

Institutions.

Pupils.

Colleges ....

Secondary schools

Primary schools ....

Training schools ....

Special schools

Total ....

Private institutions

Grand Total

114

4,517

89,187

141

329

11,501

429,093

2,513,934

6,123

11,208

141

4,872

97,109

152

402

16,277

473,294

2,837,607

5,146

16,586

160

5,267

103,920

184

355

18,783

535,155

3,209,826

5,667

18,952

94,288

2,970,859

102,676

3,348,910

109,886

3,788,382

32,828

372,685

39,117

507,911

42,139

568,488

127,116

3,343,544

141,793

3,856,821

152,025

4,356,870

During the whole period of ten years the total number of pupils at school increased by just over one million, or at the rate of 30 per cent. Schools did not increase quite so fast, but show a steady improvement in the average strength of each institution. The average attendance at colleges rose from 101 to 117 ; in secondary schools, from 95 to 102 ; and in primary schools, from 28 to 31. Assuming the number of persons of school-going age to be 15 per cent, of the total population, the proportion of these actually attending school rose from 10-7 to 12-5 per cent. The total number of girls attending school increased during the ten years from 266,287 to 402,158, or 51 per cent., while their proportion to the estimated female population of school-going age rose from 1-7 to 2-3 per cent. Mahom-

medans are specially numerous in private institutions, and hold their own in primary schools, but in secondary schools and colleges their proportion steadily falls. Native Christians are well represented throughout. In 1896-97 the total number of pupils learning English was 438,846 (chiefly in Madras and Bengal), being 1 in 79 of the total population of school-going age. There are now five universities in India, which are purely examining bodies, modelled on the pattern of the London University. During the ten years ending 1896-97, the total number of candidates who passed the matriculation was 67,919 ; of those who passed an intermediate examination, 21,240 ; of those who graduated B.A., 10,884; of those who proceeded to the degree of M.A., 917. Colleges and schools are classified according to their management. In 1896-97 only 2 per cent, of the total number of pupils were in institutions under the direct management of the State ; 22 per cent, were in institutions under district boards or municipalities ; 47 per cent, were in " aided " institutions ; 12 per cent, in institutions that receive no assistance from the State but submit to public inspection ; 13 per cent, in private institutions ; and 4 per cent, in native States. It has long been the policy of the

Government to withdraw from active management. The institutions which it still maintains belong to three classes : (1) a few arts colleges and English secondary schools, which are necessary in order to preserve a high standard of instruction ; (2) primary schools in backward tracts or for backward sections of the population ; and (3) special institutions, such as medical and engineering colleges and training schools.

The following table classifies the expenditure on education for the three quinquennial years 1886-87, 1891-92, and 1896-97. During the whole period of ten years the total expenditure increased by just a crore of rupees, or at the rate of 40 per cent. As the rate of increase in pupils was only 30 per cent., it is evident that education is tending to become more expensive.

[statistics

as must inevitably be the case as it becomes more efficient. Nevertheless, the average cost per head of population in 1896-97 was only Rs.0:2:5 (say 2Jd.). It will be observed that the rate of increase has been much the highest under the two last headings, fees

and "other sources," the latter of which includes subscriptions and endowments, missionary contributions, and grants from the revenues of native States. These two headings now contribute more than half of the total expenditure, the actual proportion

Source.

1886-87.

1891-92.

1896-97.

Provincial revenues .

Local funds

Municipal funds

Fees ....

Other sources .

Total

Ks.

85,61,249

37,14,579

12,05,984

65,29,958

52,30,644

Es.

88,13,549

53,94,808

14,09,827

88,54,750

60,46,698

Es.

95,22,985

57,45,944

14,96,721

1,06,10,933

78,68,317

2,52,42,414

3,05,19,632

3,52,44,900

having risen in ten years from 46-6 to 52-4 per cent. Of the total expenditure in 1896-97, 7 per cent, was devoted to arts colleges, 32 per cent, to secondary schools, 31 per cent, to primary schools, and 5 per cent, to special schools. Examined from another point of view, public funds provided 51 per cent, of the cost of colleges,

28 per cent, of the cost of secondary schools, and 52 per cent, of the cost of primary schools. The universities are almost all self-supporting, the total cost being more than balanced by fees.

The following table distributes the pupils for 1896-97 according to provinces, separating the boys from the girls, and giving the percentage of each to the estimated population of school-going age (15 per cent, of the total population) : —

Percentage to esti-

mated Population of

Province.

Boys.

Girls.

Total.

School-going

Age.

Boys.

Girls.

Total.

Madras .

706,106

116,747

822,853

26-7

4-8

16-4

Bombay

590,5i2

82,163

672,705

28-3

4-2

16-6

Benjjal .

1,561,008

113,767

1,674,775

28-5

2-0

15-2

N.W. Provinces and

Oudli.

887,511

15,461

352,972

9-8

■*5*

5-0

Punjab .

344,680

21,242

266,922

14-5

1-6

8-5

Central Provinces

138,710

10,797

149,507

14-2

1-1

7-7

Burma

226,072

29,065

265,137

88-8

6-2

22-3

Assam ....

95,148

8,898

108,541

22-7

2-1

12-7

Coorg

4,814

801

5,115

80-0

7-0

19-7

Berar

Total

50,621

3,722

54,848

22-6

1-8

12-5

8,954,712

402,168

4,866,870

22-3

2-3

12-5

The high position taken by Burma is due to the prevalence of Buddhism, which demands that all young boys shall pass a period of literary training in a monastery, where they are taught Pali, the sacred language, as well as the vernacular. In respect of

secondary education Burma takes a very low place. In justice to Bombay it should be stated that the outbreak of the plague closed nearly all the schools in Bombay city and Poona, the centres of higher instruction. Excluding Burma and Coorg, where the circumstances are peculiar, Madras and Bombay contest the lead in the matter of female education. Each of them has twice the proportion of girls at school that Bengal has, and eight times the proportion of the North- Western Provinces. During the last few years the Punjab has shown the most rapid progress, especially in the local support given to English-speaking schools.

Plague and Famine. — During recent years India has suffered severely from both plague and famine. Bubonic plague first, declared itself in an epidemic form at Bombay city in September 1896, having probably been introduced from Hong-Kong. Since that time the western presidency has never been entirely free from the disease, which has now also extended to other parts of India. Erom September 1896 to April 1901, or for just four and a half years, the total number of recorded deaths from plague was 480,000, of which no fewer than 330,000 were in the presidency of Bombay.

Elsewhere epidemic outbreaks have been confined to Bangalore, parts of Mysore State, and (at a later date) Calcutta and separate tracts in North and South Behar. In the western presidency the city of Bombay itself and the towns of Karachi and Poona have suffered most severely, together with the districts of Satara and Belgaum and the native State of Cutch. In 1902 plague extended to the Punjab in a severe form.

The effects of famine, which are far more widespread than those of plague, have made themselves felt twice within three years. The two famines of 1896-97 and 1899-1900 were both directly caused by drought. On the former occasion the region of extreme distress was confined to the Central Provinces, the North- Western Provinces, and the native States of Bundelkhand that lie between. Elsewhere, as in the Bombay Deccan, the Northern Circars of Madras, and some districts of Bengal and the Punjab, the drought was more or less severe. But the total area in which famine was officially recognized extended over nearly 400,000 square miles, being considerably larger than on any former occasion known to history. The total expenditure by the Government on famine relief during the two financial years 1896-97 and 1897-98 amounted

to no less than Ex. 7,405,133 (nearly £5,000,000 sterling). In the Central Provinces alone the total cost of the famine is calculated at 2^ crores of rupees. Here, mainly owing to the difficult nature of the country and the shyness of the aboriginal tribes, the efforts of the Government to save life failed of complete success. In 1896 the death-rate rose to 49-3 per 1000, and in 1897 there was a further rise to 69-3 per 1000 for the whole province, the rate in two districts being above 90 and in three districts above 80. These figures speak for themselves, especially when it is stated that in the worst district of the North- Western Provinces the death-rate for 1897 was only 61-8, and for the whole province only 40-5 per 1000. The famine of 1899-1900 is estimated to have extended over a total area of nearly 700,000 square miles. The Central Provinces were again included within the region of distress, though the North- Western Provinces altogether escaped. Almost the whole of Bombay suffered, more or less severely ; also Berar, Haidara-bad, and part of the Punjab. But the zone of extreme distress ran from Kathiawar on the western coast, through Northern Guj-arat, into the native States of Rajputana and Central India. Here the deficiency of rainfall not only caused the harvest to fail and

the cattle to perish of starvation, but also reduced the water-supply to such an extent as to expose the unhappy people to the ravages of cholera. During the financial year 1900-1901, the direct expenditure on famine relief was Ex.6,337,600, besides Ex. 1,471, 600 for remissions and suspensions of revenue, and Rx.660,300 for compensation charges: total, Ex.8,469,500. In addition, Rx.4,110,000 was advanced in loans to native States, and Ex.1, 420,000 to agriculturists. Altogether, the drain on the balances caused by famine is estimated to have amounted for two years to nearly £14,000,000 sterling. The total number of deaths due to famine, directly or indirectly, is believed to have been about 1,000,000. The following table shows the distribution of persons in receipt of relief in July 1900, when distress was at its height : —

Province.

Belief Works.

Gratuitous

Belief.

Total.

British Provinces —

Madras ....

8,633

3,060

11,693

Bombay ....

1,168,995

456,644

1,625,639

Bengal ....

11,749

7,807

19,556

N.W. Provinces

1,397

1,397

Punjab ....

136,129

42,917

179,046

Central Provinces .

473, WW

1,760,058

2,233,924

Berar

373,235

143,962

517,197

Ajmer-Merwara

Total .

75,282

31,239

106,521

2,247,889

2,447,084

4,694,973

Native States—

Rajputana

251,018

133,241

384,259

Central India .

85,733

36,117

121,850

Haidarabad

369,236

106,893

476,129

Baroda .

76,726

35,356

112,082

Bombay ....

403,443

66,284

469,727

Punjab

28,740

16,881

45,621

Central Provinces .

12,S0l

39,026

61,827

Kashmir (Jamrau)

Total ....

Grand Total

531

531

1,228,228

433,798

1,662,026

3,476,117

2,880,882

6,356,999

Vital Statistics. — For several years past vital statistics have been collected throughout British India, through the agency of the police. Though considerable improvement in accuracy has been attained, the returns cannot be considered as trustworthy, especially as regards the number of births and the causes of

death. For comparative purposes, however, the number of registered deaths is worthy of attention. This is shown in the following table for each of the ten years ending 1899. During these ten years the total population under registration has increased from 194,000,000 to 214,000,000, mainly by adopting the results of the census of 1891. Registration has not yet been extended to Upper Burma, or to some small tracts in other provinces.

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INDIA

431

Tear.

Deaths from Different Caases,

Eatio of Total

Deaths per 1000

of Population.

Cholera.

Smallpox.

Fevers.

Dysentery and

Diarrhoea.

Injuries.

AU other

Causes.

Total Deaths.

1890

1891

1892

1893

1894

1895

1896

1897

1898

1899

292,528

583,634

729,512

217,507

521,975

313,131

471,767

555,016

150,817

169,237

120,554

98,844

101,142

68,819

43,623

44,979

137,622

167,160

55,713

49,560

4,110,044

3,822,358

4,629,201

3,761,724

4,987,304

4,255,030

4,569,541

5,015,842

3,817,456

4,085,455

230,899

244,889

236,734

201,127

261,996

242,020

239,810

403,394

209,035

244,920

87,495

89,184

86,318

89,498

93,110

94,147

92,251

115,691

91,604

95,524

1,091,609

1,114,620

1,216,058

1,223,932

1,393,162

1,280,758

1,356,834

1,475,042

1,344,927

1,792,726

5,933,129

5,953,529

6,998,965

5,562,607

7,301,170

6,230,065

6,867,825

7,732,145

5,669,552

6,437,422

29-99

28-09

32-12

25-52

33-49

28-60

31-65

36 03

26-44

30-01

It will be observed that the death-rate rose to its maximum in 1897, which was a year of famine, and that the deaths from every cause showed an increase in that year. The largest number of deaths from cholera (729,512) was in 1892, when there was a severe epidemic throughout Northern India ; the smallest number

(150,817) was in 1898. The number of deaths from smallpox ranged from 43,623 in 1894 to 167,160 in 1897, when there was a very severe outbreak in the North -Western Provinces, causing more than half the total number of deaths.

The following table gives the death-rate per 1000, according to causes, for each of the different provinces in 1897. The variations from the average may fairly be taken as evidence of the greater or less extent to which famine prevailed in that year. This does not apply, however, to either Assam or Coorg, in both of which cases the high mortality was caused by the exceptional prevalence of fever. The low fever-rate in Madras is undoubtedly due to a difference of classification : —

Eatio of Deaths per 1000 of Population, 1897.

Province.

Cholera.

Smallpox.

Fever.

Dysentery.

Injuries.

AU other

Causes.

Total.

Bengal

N.W. Provinces

Punjab

Lower Burma .

Central Provinces

Assam

Coorg

Madras

Bombay .

Berar

2-76

0-94

0-08

1-89

6-01

6-62

0-61

4-40

3-03

8-50

0-2T’

1-86

0-78

0-43

0-38

1-08

0-34

0-TO

0-20

0-20

23-62

81-21

20-57

11-46

40-98

28-74

41-60

9-00

24-59

23-00

0-75

1-25

0-77

1-95

8-58

4-61

8-11

1-20

4-67

10-80

0-59

0-71

0-85

0-25

0-79

0-53

0-85

0-80

0-37

0-50

4-92

4-48

8-54

10-28

12-64

9-08

4-12

9-80

7-08

15-10

32-91

40-46

81-04

26-26

69-83

50-61

50-03

25-40

39-84

52-60

All India .

2-59

0-75

23-48

1-87

0-54

6-80

8603

Ebcent Histoet.

The period dealt with in this article is mainly comprised in the interval between the years 1880 and 1900. Roughly speaking, of the years from the close of 1858, when the government of British India was transferred from the East India Company to the Crown, to the commencement of 1900, half were occupied in preparing, in plotting out, and in making a vigorous commencement in the execu-tion of the great projects for the moral and material development of India, of which the latter half saw the

application and extension. The schemes which were then put into force, more particularly for the material development of India, for increasing the system of railway communications, for fiscal reform, or for the prosecution of irrigation works, had their inception in the preceding period, and more particularly in its second decade. The work of reorganization, of progress, and of financial reform, which was commenced in 1859 by Lord Canning, though from time to time hindered under his successors by war, was on the whole continuously carried on. In spite of dis-couragement from famines and plague, from a succession of wars on the north-western and eastern frontiers, and from the ruinous effect on Indian finance of the con-tinuous fall in the value of silver relatively to gold, the work begun in the first half of the forty-one years under review, and vigorously resumed after 1880, was more or less consistently carried on up to 1900. Thus the whole period forms, as it were, one growth. The first half is inextricably bound up with the second ; and while much of the progress of the last twenty years has been in

directions previously but little pursued, more has been but the sequence and necessary outcome of the foregoing period. It is therefore desirable to review the position in which the Government, in some at least of its more important branches, found itself at the close of 1879. With the military and political departments of the Government this article is only so far concerned as may be necessary to show their bearing on finance or polity.

The Position in 1880.

The finances of the country, which, during the years immediately preceding 1876 and 1877, had been very carefully husbanded by the Indian Government, were in those two years made the subject of a fresh and exhaustive study. Sir John Strachey took charge of the finances in 1876, and his administration marks a new era in Indian finance. He was not destined to reap the fruit of all his labours ; but great changes had already been effected by him,and more were

in contemplation, when the stress and

strain of the Afghan war deferred their

execution. The obstructive old internal

salt customs frontier line, stretching at

(j. s. Co.) one time from the Indus to the Mahanadi

in Madras, a distance of 2300 miles, and guarded by

nearly 2000 men, had been finally abolished. .

The inland salt duties throughout India were at

the same time in great measure equalized. In Bengal and

in Northern India the duty had been reduced ; in Bombay

and Madras it had been raised. Arrangements had

been concluded with certain native states by which,

subject to compensation allotted to them, the great

Indian sources of salt supply, which lie for the most

part within their territories, were made over to the

control of the Government of India. The consumption

of salt at once considerably increased as a consequence

of this measure, and the revenue corresponded. Por the

whole of India the average annual consumption rose from

24,424,000 maunds in 1875-77 to 27,560,000 maunds in

1879-81, the revenue increasing at the same time from £5,996,000 to £6,834,000.^ Similar reforms had been contemplated, and in a small measure had been com-menced, with regard to the customs revenue from import duties levied in India on cotton goods. In July 1877 the House of Commons resolved that the import duties levied in India on cotton goods were protective in their nature, and should be repealed as soon as the condition of India should permit. In 1878 the cotton duties were slightly diminished, and some other reductions were made at a cost to the revenue of £77,000. In 1879 the cotton

1 Throughout this article, unless otherwise indicated, the pound sterling is taken to represent ten rupees, being the " conventional sterling," or " Rx." of Indian accounts, till a recent date.

duties were further reduced at a cost of £200,000, but larger remissions were prevented owing to the effect on the finances of military operations in Afghanistan.

During Lord Mayo's rule administrative measures had been initiated, having for their object the decentralization of the finances; the transfer, that is to say, to the several provincial governments of the direct control of a portion of the public receipts and Wzatfonf" expenditure within their limits, with corresponding relief and advantage to the central administration. In 1877-79 these measures were further developed. Certain important local sources of revenue were definitely placed in the hands of the provincial governments, which were left to cultivate and improve them, to augment their produce, and to spend all or a definite part of them, at their discretion. On the other hand, the expenditure in certain branches of administration was transferred to provincial governments, of which the cost would be defrayed from the funds assigned them. Economy and good administration resulted, so far as the finances and the provincial governments were concerned, while the central government was relieved from provincial importunities, of which it co\dd not always measure

the relative importance, and from the control of details of provincial administration of which, in truth, it was not a competent judge.

During the twenty -one years preceding 1880 both Upper and Southern India had been visited at times by devastating famines. The Madras famine of 1877-78 greatly exceeded in severity any which had of late years preceded it, and led to the appointment in January 1878 of a very carefully selected commission, presided over by General Strachey, E.E., to advise and report on meas-ures which might palliate the effects of such calamities in future. In 1880 they presented their report, dealing exhaustively with all aspects of the question. Chief among the subjects handled by them was the extension of railway construction. In 1878 the length of ^^””’”^ guaranteed broad gauge lines was about 6000 ^ay’poiicy. miles, being the fruit of twenty -eight years’ construction. On the state railways, at the same date in the nine previous years, 1050 miles of broad gauge and 1200 miles of narrow gauge had been com-

pleted ; in all, say, 8250 miles. The Government of Lord Mayo had, not long before, inaugurated, in lieu of the costly method of guaranteed railways heretofore in force, the system of construction of state railways by loans, supplemented by such funds as could be annually spared from revenue. The famine commission estimated the length of railway which would be needful to ensure the ends they proposed at 20,000 miles. " Until the whole country," they wrote, "is more completely sup-plied with railways or canals by which food can be transported cheaply and in large quantities to every part where severe want may exist, the possibility of some unusual demand for Government interference in particular localities, or for special classes of people, cannot be shut out, nor the danger of the occurrence of a great calamity altogether removed. It is there-fore to the improvement of the internal communications, and the removal of all obstructions to the free course of trade, accompanied by the extension of irrigation in suitable localities, and an improved agriculture, that

we look for obtaining security against disastrous failures of the food supply in tracts visited by droughts." Though the scheme then put forward has been modified and added to in course of time, the views and estimate of railway requirements thus enunciated by the famine commission have formed a standard which has uniformly guided the Government of India from 1880 to the present day. Similarly, after an elaborate review of the extent of irrigation from public works, the commission had advocated for the needs of each province a large extension of the then existing system. The area under artificial irrigation in 1878 is given in the Eeport of the Indian Famine Commission of 1898 at 5,171,497 acres from productive works (p. 338).

After the famine of 1874 in Bengal Lord Northbrook had declared that to enable the state to meet the obligation of preventing and relieving famine, it was necessary to secure, in prosperous times, a substantial surplus of revenue over expenditure, in addition to that needful margin which a prudent Administration always

requires for the ordinary service of the state. ^^'f/„ce. Due provision would thus be made for meeting occasional expenditure on famine. Taking an average of years, it was subsequently estimated that the annual cost of relieving famine, including loss of revenue and actual expenditure, would not be likely to exceed £1,500,000. As in 1877 the Government believed that the ordinary income and expenditure of the state might be considered to be for practical purposes in a state of equilibrium, it was believed necessary to improve the financial position by £1,500,000 a year on account of famine liabilities alone, and in addition to this to provide a margin on the annual estimates of at least £500,000, to meet unforeseen contingencies. A considerable portion of this £2,000,000 was supplied by a transfer of charges to provincial governments under the decentralization scheme above referred to ; the rest was provided by fresh taxation. New taxation on land by means of rates imposed in Bengal, the North-West Provinces, Oudh, and the Central Provinces, provided about

£626,000. Imposition of a license tax on trades and professions throughout India yielded about £820,000 — in all £1,345,000. This was the total amount of famine insurance taxation then imposed. The money thus obtained, or so much of the one and a half million as remained after meeting charges for famine during any current year, was to be applied to the discharge of debt, or the prosecution of remunerative public works of a character likely to give protection to the country against the effects of drought, that is to say, to construction of railways or irrigation works. But in years of deficit the grant was necessarily suspended, and the fiscal sources from which it was drawn were in part or in whole diverted to meet the requirements of ordinary expenditure.

Education had advanced during the twenty years under review, though relatively to area and population it was still in an extremely backward state. A despatch from England in 1854 had laid down with fulness and precision the principles which were to guide the Government in state education, and its provisions were continued and

enlarged by a subsequent despatch of 1859. These two despatches still form the charter of education in India. In 1869 there are believed to have been but little over 60,000 schools, including indigenous schools, and 926,000 scholars for all India, of whom Education. more than 500,000 were pupils of indigenous schools. In 1881-82 there were 112,632 schools, including those for Europeans and Eurasians and for special instruction, with 2,665,636 pupils. The average throughout British India (exclusive of British Burma), according to the census of 1881, was one male under instruction to 42 of the whole male population, and one female to 868 of the whole female population. This may be contrasted with the rule in European countries, where it is usual to take the children of school-going age as one-sixth of the entire population, so that, in round numbers, one child would be at school for every six persons of the population. A large extension of primary education was therefore urgent, and in all histoky]

Social progress.

respects progress had been extremely slow. The three universities of Calcutta, Madras, and Bombay had been incorporated in 1857 by Acts of the Indian legislature. Among the several presidencies and provinces Bengal and Madras had on the vs^hole shown the greatest advance ; but Bombay, with its large and highly intelligent Parsee population, has always been prominent in respect of education.

The three great codes which pre-eminently do honour to the Indian legislature — the Penal Code, the Code of Criminal Procedure, and the Civil Procedure Code — were passed during the earlier part of the sixth decade of the 19th century. The labours of Sir Henry Sumner Maine and Sir FitzJames Stephen had en-riched the Indian statute-book with other important Acts, such as the Evidence Act,

various forest laws, the Criminal Tribes Act, the Christian Marriage Act, the Mahommedan and Parsee Marriage Act, and an Act for the Prevention of the Murder of Female Infants. The relations of landlord and tenant in Upper India and in Oudh had occupied the attention of the legislature. A high court of judicature, similar to those already existing in Calcutta, Bombay, and Madras, had been established for the North-West Provinces. The police system throughout India had been reorganized; sanitation ,had been especially recognized as claiming attention ; the trade of India had developed from a total in round figures of 41 millions of imports and 43 millions of exports in 1859-64 to a total of 62 millions of imports and 76 millions of exports in 1880-81. Notably the great tea industry had taken firm root, and was assuming ever-increasing proportions. In 1879 there were 58 mills in India for the manufacture of cotton yarn and cloth by steam machinery. They worked 1\ million spindles and 1200 looms, giving employment to upwards of 40,000 persons. Of this total 44 mills were in the

island or province of Bombay, 6 in Calcutta, 3 in Madras, the rest in various localities. There existed at that date 21 jute mills, mostly in Bengal. Brewing had been introduced, and was becoming more and more extended. Steam paper mills and some minor industries had also taken root.

During little less than half of the twenty-one years of the period with which we are dealing, the Government of India had been in the hands of Lord Lawrence and Lord Northbrook. Both were pre-eminently men of caution, and in questions of Indian administration both were highly conservative. Their policy in home matters was to exercise extreme reserve in increasing fiscal burdens, and in foreign matters to abstain rigorously from interference beyond their borders. During their tenure of ofiice. Lord Canning, Lord Elgin, and, on the Adminis- -jyliole. Lord Mayo, shared these characteristics. poii^. The administrative note, therefore, of the seventeen years from 1859, after ‘ the close of the Mutiny, to 1876 was one of moderation and cautious

advance. They were years but little removed from the rule of the late East India Company and the great catastrophe of 1857. ‘ The whole machinery of Government, more especially during the earlier part of that period, was successively brought under review, and in almost every department reorganization more or less complete was projected. It was a time mainly of study and deliberation, preliminary to action; of prudent but thorough overhauling of the administration which had been but recently handed over to the Crown. The educational and other civilizing influences which had been established for the first time in years little anterior to 1869 had scarcely begun to make themselves felt. The population in almost every grade and class was still intimidated, inert, and irresponsive. In the latter half of the seventh decade of the century, however, the confidence and experience gained in previous years were beginning to bear fruit.

Such was the position on the eve of the period about to be dealt with. The revenues were in a sound condition ;

the country was quiet and content; time and scrutiny had suggested reform, for which the moment was now ripe ; a generation had grown up in tranquillity since the horrors of 1857. Suddenly the Afghan war of 1878 broke out. For two years the whole resources of the Administration were strained to bring the ^J^™|^ struggle to a successful issue. The progress of the country was paralysed and the reform of its finances arrested. Nor was it till the close of that war, and the departure of Lord Lytton from the scene in 1880, that work was resumed and effect was given to financial and other reforms, for which the labours of the administration and the lapse of time had now prepared the country. Many eminent men had taken part in the government of India during the period from 1859 to 1880. But in any sketch of that period it should be recorded that among those who assisted successive Viceroys with their advice and experience India owes unquestionably the most to Sir Eichard and Sir John Strachey. Each of these distinguished brothers, in one or other capacity,

successively held high and important offices in the state from 1864 to 1880. The former belonged to that illus-trious corps of Bengal (now Eoyal) Engineers, which has given so many brilliant men to civil and political administration in India; the latter to the Indian Civil Service. In their joint volume, TJie Finances and Public Works of India, from 1869 to 1881, they have left an invaluable record of the principal administrative measures which they initiated or in which they actively participated.

From, 1880 to 1901.

With the advent in 1880 of Lord Eipon as Viceroy the portals of war were closed, and India entered once more upon the pleasant paths of peace. Eemission of taxation, encouragement of primary and secondary education, the promotion of local self-government, the amelioration of the status of the agricultural tenant, the recognition and promotion of native claims to a share in directing the internal affairs of India — these were the cardinal points of the policy of 1880 and the years immediately ensuing. During the preceding period

the attention of the central government, and the genius of those who inspired it, had been more immediately devoted to the material progress of India. Of that sympathetic and indulgent handling of the native population which characterized the East India Company, the traces become less and less apparent as we pass from the sixth towards the close of the seventh decade. The greatest benefits had been conferred on the people by the fiscal and public works measures introduced during those years. But of any seeking or strengthening of personal touch with them on the part of the Administration there is comparatively little trace. Much was done for the people, but in concert with them little was attempted. The steps taken in this direction during the eighth decade mark a return to the more personal and human aspects of administration which before 1867 had been perhaps exclusively prominent, but which of later years might be judged to have fallen too greatly into abeyance. In short, after 1880, and for a brief term of subsequent years, the moral develop-

ment of India again took an equal place in the fore-

ground, and the characteristic note of the decade which

succeeded 1880 is to be found in the greater effort made

during that period to combine moral with material

progress.

[history

When introducing the budget of 1882-83 the financial

member of the Viceroy's council was able to announce that

the surplus in the preceding year amounted ta £1,677,000 ;

the revenue having been £72,913,000, the expenditure

£71,336,000. The flourishing condition of the finances,

he hastened to point out, so far as it resulted from

financial administration, was due, not to the Government

existing at that time, but to its predecessor. In point

of fact, but for certain readjustments and re-

licyf.' payments to provincial governments of sums

borrowed from them during the late years,

the surplus would have been very much larger, and the sum of £1,577,000 fell far short of the amount by which the normal revenue of the year was estimated to exceed the normal expenditure. It has been explained how, by skilful management of the finances, this surplus had been prepared. To Sir Evelyn Baring (afterwards Lord Cromer) fell the pleasant labour of reaping where Sir John Strachey had sown. The remission of import duties, more particularly of import duties on cotton goods, which had been the object of the latter, and which had been in a small measure enforced by him, was carried by the former into full effect. The remaining cotton duties were abolished, involving a reduction of taxation of £655,000, while at the same time the whole of the general tariff of 6 per cent, ad valorem was abandoned, at a net cost (including the cotton duties) of £1,109,000. Thus in 1882 India was freed from taxation on her imports, strong liquors and salt excepted. The customs duty thenceforth, and till further changes, was derived

entirely from the produce of an export duty on rice, and from import duties on salt and alcohol. At the same time the salt duty was reduced from a general rate of Es.2/8 to E,s.2 per maund. The estimated loss of revenue consequent on this reduction was £1,400,000. A total of 2^ millions in taxation was thus remitted to the country. In the light of subsequent events it is necessary and important to record some of the remarks with which Sir Evelyn Baring accompanied the reductions thus effected : " As an incident of her connexion with England, India," he said, "has a right to benefit from English experience and English economic history. That experience and that history show that by the adoption of free trade a country benefits, indeed, all the world, but more especially benefits itself. . . . By the adoption of the measures now proposed India will be more free to exchange her exportable produce for the products of foreign lands than would be possible were the import duties maintained. ... In addition to the general argu-

ments, which would readily admit of further development, there is one consideration which applies especially to India, and which, I venture to think, is at the present moment of considerable importance. The desirability of rapidly extending our railway system is universally recognized. The main obstacle to any such rapid extension is the difficulty of attracting railway capital to India on terms that shall not be too onerous to the state. No fiscal measure of general application would be so likely to give a stimulus to railway construction as the removal of all restrictions on trade." In their Finances and Public Works of India (p. 295) the two Stracheys, writing in 1881, had expressed themselves on the subject in stronger terms :

" The policy followed by the Government of India during the viceroyalty of Lord Lytton was one of absolute free trade, without reserve or qualification, and financial necessities alone prevented that policy from being carried out to the fullest extent. The proceedings of the last three or four years have, however, succeeded in rendering inevitable the almost total abolition of the customs duties.

Tariff

reform.

which of all Indian taxes are probably the worst." In the debate on his financial .statement for 1880-81 Sir John Strachey had said : " I hardly remember the time when I did not argue in the interests of India for the removal of these and all other restrictions on com-merce. ... I would not have accepted my present office if I had not hoped that I should have an opportunity of co-operating with your Excellency in carrying out what I may say without exaggeration have been the convictions of a lifetime " (op. cit, p. 311).

As to the reduction in the salt duty from Es.2/8 to Es.2 per maund, we read in the financial statement for 1882-83: "The advantages to be gained by a reduction of the salt duty are twofold. In the first place, it is exceedingly desirable to reduce the price of a necessary of life which is used by the poorest classes. In the second place, the financial situation will be much strengthened." In was explained in

subsequent words that, " If any unforeseen circum-

stance, such as a heavy fall in the value of ^silver,

takes place, and if at tlie same time the reduction in the

salt duty does not result in any considerable increase in

the consumption of salt, it would be open to us to return

temporarily to a higher rate." The Stracheys had pointed

out that if the policy of maintaining a low and uniform

rate of duty on salt were followed for some years to

come, the average consumption would increase through-

out India, and the revenue would become several millions

larger. The Government would thus have in its hands a

powerful reserve of taxation. " But these results will only

be obtained if we steadily persevere in the course that

has lately been followed. We must finally abandon the

erroneous notion that it is profitable to levy the salt tax

at a high rate on a restricted consumption, and resolve to

act at all times on the only sound principle, that the in-

terests of the people and of the public revenue are identi-

cal ; for we shall receive the largest possible revenue when

the salt duties are low, and when the people throughout

India obtain an unlimited supply of salt at the cheapest possible cost " (pp. cit, 233-34).

When we review the subsequent history of finance in India, we shall learn what has been the fate of the reforms introduced in 1882-83. We may then recall to mind the opinions formed in regard to the cotton and salt duties by two of the most competent men who have directed the finances of India. It is, however, necessary to add that the abolition of the import duties on cotton goods was carried out against the very general feeling whether of Europeans or of the educated natives of India. Sir Evelyn Baring, in his financial statement of 1882-83, referred in the follow- "".^^ ing terms to this aspect of the matter : — ^sue. " Before leaving this subject, I may perhaps be permitted to express the hope that the solution which the Government now offers of this difficult and important problem will be accepted by this council, and by the public opinion of England and India, as satisfactory, and that it will finally set at rest the angry controversy that

has for some years been waged. That controversy has unfortunately taken a form which no true friend of England or of India can view without regret. It has been represented, erroneously, as I venture to think, that in respect to the question now under discussion there is an antagonism of interests between the two countries." It is remarkable that when the first step was taken in 1879 of remitting the duties on all grey goods consisting of yarns finer than 305, it was adopted by Lord Lytton in opposition to the majority of his council. "One of the dissentient members stated that there were not a dozen officials in India who did not regard the policy as having been taken in the supposed interest of a political party histobt]

in England, the leaders of which deemed it necessary at any cost to retain the political support of the cotton manufacturers in Lancashire. The Stracheys admit that, making allowance for some exaggeration of expression,

this statement doubtless contained a good deal of truth as to the state of public opinion {Finances and Public Works of India, p. 287). A striking illustration is to be found in pages where we should have scarcely looked for it. In the latest edition of his Indian Polity (1894) we find an Indian ofBcial of distinction, the late Lieut.-General Sir George Chesney, committing himself to the following expression of views which, in substance and in warmth of expression, recall twelve years later the angry contro-versy of the year preceding 1882 : — " One source of revenue, free from the objections apparent to every other form of import, is to be found in the restoration of the cotton duties. The history of this case is still so fresh in recollection that it is not necessary to recapitulate it. That the tax has not yet been re-imposed is due, not to any consideration for the people of India, but simply to the supposed exigencies of party government at home. The principle involved, however, goes far beyond one of pure finance. It opens up the larger question, whether the Government of India is to be conducted in sym-

pathy with the interests and feelings of the people of the country, or in accordance with the small and shifting policy of party needs ; as to which it may be said that, unless the steps lately taken are retraced, an injury will be done to the good faith and character of the British Government of India, which may and probably will lead to far-reaching consequences" (Indian Polity, 347).

In this matter we may well be guided by the opinion of highly competent Indian financiers like Sir John Strachey and Sir Evelyn Baring, who had devoted to the subject prolonged and anxious inquiry. Nor should undue weight be attached to the dictum of a critic who, though deeply versed in military questions, had enjoyed no opportunities of personally handling many of the fiscal or administrative problems, the merits or demerits of which are pronounced upon in his pages.

The salaries of the upper grades of the native sub-ordinate executive services were improved in 1882, at an estimated increase of about £50,000 a year. It was

declared to be the intention of the British Government and of the Government of India that a constantly increas-ing share of the work of the countryshould be performed by natives of India. Figures showed that of 4082 officials employed in these branches of the public service which are directly engaged in the iaternal administration of the country, as apart from those employed in special branches (such as the post ofllce or telegraph), 2058 were Employ- Europeans and 2024 were natives. In the natives In upper or " Covenanted " service, 861 were of public the former and 12 only of the latter class. In service. ^j^g subordinate service 1197 were Europeans and 2012 were natives. This question of the employment of qualified natives, and of their advancement to higher grades of employment, is one ever present to the mind of the Indian Government, but beset by the greatest difficulties. Eew aspects of Indian administration are more disagreeable at first sight than this, that with few exceptions all the higher posts, which carry with them the larger salaries, are confined to Europeans.

Given the conditions and requirements of the adminis-
tration, this is at present inevitable. But it necessarily
bears on the face of it that appearance of a monopoly
by a foreign caste of the higher grades of employinent,
which cannot fail to attract hostile criticism. It may
confidently be asserted on behalf of the Indian Govern-
ment, that it is ever on the watch to modify the existing
state of matters, and is more than desirous of finding
occasion for the advancement of natives to the higher
ranks of civil employ. Its efforts in this direction have
not been rewarded, so far, with any correspondiag suc-
cess. But it will be seen that at a somewhat later date
than that with which we are dealing the subject was
comprehensively considered by the Government of Lord
DufEerin. A fresh basis was then established, on which
rest the present rules and regulations by which are
governed the admission and advancement of natives into
the higher service. Any native now who, by education,
force of character, probity, or good service, can prove his
fitness for advancement to the higher grades of employ-

ment is no longer debarred from arriving at them.

The system of decentralization, and of assigning to provincial governments the financial profit and loss on certain branches of administration, was largely extended in 1882. Practically, excepting the departments of army, marine, post office, telegraphs, opium, salt, customs, and for the most part the railways, all branches of the public service, with their receipts and expenditure, may be said to have been then made over to provincial hands.

The result has been productive of economy and iocs/ of good government; but on the other hand ment" the measure has erected something of a terrier between the central government and the internal con-duct of affairs. Though the central government retains the supreme authority, and regularly exercises its power of general control, it is now exclusively the business of the several provincial authorities, subject to such occasional check, to see to the practical working of the great machine of home administration. It is certaiu that none but provincial authorities are in close enough

contact with local needs, or well informed enough in regard to them, to be prudently charged with the task. But there is reason to fear that by this strengthening of provincial agency the central government has somewhat lost the advantage of the more direct connexion which previously existed between itself and the masses. To borrow a term from telegraphy, there is a fault in communication. The comparative leisure thus gained by the Viceroy and his council has been perhaps the more often turned in later years from the internal requirements of India to military matters, and to territories beyond the Indian frontier. Opinions differ as to whether this need be regarded as a disadvantage. But of the fact there seems little room for question.

In connexion with the extension of provincial fimance, greater latitude of self-administration was at the same time accorded to municipalities and local bodies throughout India. Few measures that have been greeted on their introduction with comparative indifference are likely, with

lapse of time, to take deeper root in the country than the scheme of conferriug self-government on municipalities. The aim and ideal of the energetic and highly-trained officers to whom is entrusted the administration of the various districts into which India for executive purposes is divided, has been hitherto government of and for the people, rather than government by or with the people. The prestige of the powerful Indian civil service is based on successes achieved in past years, when the authority of its officers was the only authority, ^^/^ss!' and when, by the energetic and enlightened exercise thereof, great results had been everywhere obtained. Intimate knowledge of native character, and daily experience of the weaknesses, the jealousies, the animosities, and the trivial aims and pursuits of native society, might well make those who up to the present had been its guides not a little sceptical as to the uses to which local self-government would be put, and doubtful as to the

intelligence and interest -with which it would be carried into effect. So far as concerns the district or local bodies, these apprehensions have not been without justification. But so far as town and municipal bodies are concerned, the measure of 1882 has met with a degree of success fully equal to any that its authors could have expected. Local self-government in all countries is a plant of slow growth. In India, with its counter-currents of Hindu and Mahommedan, its apathy, its passion for hereditary usages and employment, the indifference of its several units to the general good, the aptitude of the Indian for verbal controversy and inaptitude for collective action, any marked or early development of disinterested public spirit could not be counted on. It would be untrue to assert that the results have so far brought India into line with even moderately progressive European countries. But with regard, at least, to the more important towns, it may be affirmed that the measure enforced by

the Government of Lord Eipon has, up to the present time, proved as useful as its authors hoped, and promises with the progress of years to acquire increasing stability. The spirit in which the measure was introduced augured well for its success. The desire was not to force upon all parts of the country a uniform system, but to secure the gradual training- of the best, the most intelligent, and most influential men in the community to take an interest and an active part in the management of their local aifairs. It was regarded by its promoters as being desirable, less for improvement in administration than as an instrument, of political or popular education. The principle of election was introduced under very careful restrictions. Great latitude was left to provincial governments in devising the system best adapted to their several local circumstances. Considerable control was retained over the exercise of the powers to be entrusted to the newly created municipalities.

Eeviewing in 1896 the working of the measures introduced fourteen years previously, the Government of India

recorded its satisfaction at the marked advance disclosed, and at the activity, intelligence, and general economy with which municipal bodies had improved the conservancy services — the water supply, the drainage, the street paving, the lighting, and the many conveniences of the towns in their charge. At that date, apart from Presidency towns, Rangoon, and Upper Burma, 733 municipalities existed, as against 797 in 1881-82. It was not the number but the composition of municipalities, the mode of nomination by election, the powers conferred on them, and the revenues levied and expended by them, which marked the progress made. Before 1882 municipalities had existed. But they had existed mainly for purposes of local rating, and the consequent relief to the general revenues, enjoying little or no exercise of self-administration. In 1886-87 the total income of all municipalities had amounted to £5,077,764; in 1897-98 it reached the figure of £6,340,661.

Reviewing similarly and at the same time the working of the local boards created in 1882, the Government of

India found that useful work had been done. But it is clear from that review that the several provincial governments wrote without enthusiasm of the public spirit, or the administrative energy exhibited by local boards.

The interest shown in the closely populated municipal areas, by townsfolk working within more limited "fT'dlf spaces, acquainted, for the most part, with one acuities, another, aiming at definite ends, and supplied with sufficient funds, far surpasses that which agricultural magnates or rural leaders of native society in their larger orbits exhibited. These men are for the most part content to look after their own estates or to attend to their professional affairs, leaving, as hitherto. to the British official in charge of their district the initiative and main execution of the measures necessary to local administration.

It is to be noted that in India, and more especially in Upper India, the Mahommedan element, though considerable, is numerically inferior to the Hindu. The former have thus found themselves, wherever election is

the rule of appointment, in danger of being left perma-
nently in a minority. They view with distrust and
natural dislike the passing of authority into Hindu
hands. Especially is this the case where, as often hap-
pens, the hands into which power passes are those of
classes of Hindus who, though previously of no considera-
tion, of obscure origin, and socially of less than little
weight, are enabled by their familiarity with English,
and by their education in British colleges, wholly to
manipulate and control the municipal councils. In this
direction there will for long exist antagonism between
Hindu and Mahommedan. Resentment will smoulder on
the one side, and on the other there will be little wish to
conciliate. In India such differences do not take the
form of party, but are inflamed by the virus of race and
of religion, and become the more embittered.

The conduct of education and the control of colleges
and schools in India is in the hands of the provincial
governments. But in this, as in all other departments,
the central government retains the ultimate authority.

It has been already noted that the main lines on which the system of education in India is carried on were laid down in 1854 and 1859. Since then, necessarily, progress has been made, and fresh developments have called for further instructions. To the three universities of Calcutta, Madras, and Bombay have been added universities at Lahore and at Allahabad, respectively the headquarters of the Punjab and North-Western Governments. All five universities are entirely independent of the department of public instruction. aon””^ They are autonomous bodies, with a constitution moulded on that of the University of London. The governing body consists of a chancellor, vice-chancellor, and senate. The senate for the most part acts through an executive committee of its members, termed the syndicate. Degrees are conferred at the annual meeting of convocation. These universities are essentially examining bodies, though the Punjab University is responsible for the management of the Oriental College at Lahore, and takes an active part in the improvement of vernacu-

lar literature. The influence of the universities, how-
ever, extends beyond the mere sphere of examination.
By their power to grant or to refuse affiliation they are
able to dominate the entire system of higher education
from secondary schools upwards. In many cases the
universities have themselves been affiliated to the two
English Universities of Oxford and Cambridge, so that
their students can obtain certain exemptions from resi-
dence and examination. The universities are practically
self-supporting.
Description of the present state of education in India
would here be out of place. It will suffice for present
purposes to sketch briefly the outlines of the main advance
made since 1880. Some particulars have been given in
a preceding page of the results achieved before that date.
In 1882 a commission of very carefully selected and
competent members was nominated to inquire into
and report upon the working of the system in
force, whether in primary, secondary, or higher ,"^,'
education. It presented, as its report, in the pngress.

following year a most exhaustive and valuable document, to which the reader must be referred who wishes more thoroughly to acquaint himself with the details of Indian education. Educational institutions in history]

India are of two classes. First there are those which conform to the standards prescribed by the department of public instruction or the university, and of which the pupils are examined by one or the other. These are called public institutions, but may be under either public or private management, the latter being mostly known as "aided" schools. These are supported largely by grants in aid from the Government. The second class of institution consists of those which do not fulfil the above conditions, and are called private. The grades of education are found in primary and secondary schools, and in colleges. In the former, reading and writing are taught, and such elementary knowledge as may enable a peasant to look

after his own interests. Secondary schools are divided into English and vernacular, the former being those in which the teaching of English occupies a more prominent part. In colleges, the students are those who, having passed the matriculation examination of a university, are reading for the further examinations required for a degree.

The statistics of educational progress are given in the preceding article, and they show that the number of pupils in the colleges and of each class of schools is increasing steadily. Of a direct state expenditure in 1896-97 of £1,198,664 on institutions, 68-5 per cent, was devoted to institutions under public management, and 31-6 per cent, to " aided " institutions, under which class falls the great and important section of missionary schools. The average cost of educating each student was, in the arts Government colleges in 1896-97, Es.160-3; in professional colleges it reached the highest figure, Es.196-4. Each educated student in the arts college costs the state Rs.269-9.

Western education at the most has as yet touched little

more than the fringe of Indian life. But the crying defect of education in India is the failure to find means of extending education to girls. Only 402,168 girls were under instruction in 1896-97, whether in public or private institutions, forming 2-34 of the percentage of school age. Practically, woman in India is wholly uninfluenced by Western education. Mothers, wives, or daughters at no time of their existence come under its influence. Whether from a social or political point of view this is lamentable, and the consequences are far-reaching and injurious. The influence of women in India is very considerable, and it is to be feared that it is exerted consistently in a direction opposed to the ethical or educational standards set up in English teaching institutions. But the position of woman in the East, and the strictness with which, after her earlier years, she is guarded from contact with all but the nearest members of her family, oppose barriers which are at present impassable. Madras and Bengal show the largest number of girl students (116,747 and 113,767), followed by Bombay

(82,163). Upper India contributes comparatively few. Thus in the North- West Provinces and Oudh, -46 per cent, only of girls of school-going age were under instruction in 1896-97. Even of the small total of 402,168 girls under instruction in all India, a considerable number were native Christians, who are outside the pale of native social life. Another point which may be observed is the comparative backwardness of Mahommedans in attending British schools. Thus in 1896-97, while the proportion of Mahommedans to the total population was 21-81, the percentage of Mahommedans to Hindus and others in primary schools was 20-16, in secondary schools 14-20, in arts colleges 7-00, in professional colleges 6-67. In special schools, being schools either for training masters or mistresses,, or for technical teaching, such as art, law, medicine, surveying, handicrafts, &c., the proportion rose to 26-06. It may, however, be noted that among the most conspicuous examples of successful native effort in public interests in India is the Anglo-Mahommedan College at Aligarh in the North- West Provinces,

founded some years ago by the late Sir Sayad Ahmad Khan.

The instruction for the most part in Indian colleges and schools is literary, as distinguished from professional or technical. Till late years there has been little demand for the engineer, while the lawyer or civil servant has always found openings awaiting him. With the growth of railways and other public works the demand for technical education will increase, but as yet there is little provision for it. In the quinquennial review from which the foregoing figures have been taken it is said that it must not be inferred that the experiment- of giving a more favourable practical turn to education, which was actively started in India about 1890, has proved altogether barren. Though the results may fall short of the anticipation of the more enthusiastic, they are to be seen everywhere, in the more important positions assigned to such practical subjects as agriculture, men-suration, and sanitary science in primary schools, in the rapid spread of drawing, in the popularity of the science

side of the ordinary curriculum in both secondary schools and arts colleges, in the institution of alternative courses of examination, as well as in the steady growth of engineering colleges, in the art institutions, and industrial schools. It is therefore with some surprise that we find that the number of engineering colleges in the five years ending 1896-97 has remained, as compared with the previous quinquennial period, at four, and that though the total number of students has risen, it did not at that date exceed 667. There are in all India but 29 engineering schools, and 1393 scholars. It is greatly to ” be desired that the attendance in the science side of the arts college should increase, and that technical education should expand. The product of the literary side of the Indian arts college is, on the whole, disappointing, and with the growth of time the type does not improve. It varies somewhat in different parts of India, but, though the type more or less obviously is influenced by local conditions, the main characteristics are everywhere identical. It lacks stability, substance, balance

of judgment, a sane estimate of its own acquirements. Memory, imagination, dialectic skill, have been fostered by education, rather than observation, exactness, and patient thought. " The fact is," said Sir Henry Maine, in one of his addresses to the University of Calcutta, "that the educated native mind requires hardening. That culture of the imagination, that tenderness for it which may be necessary in the West, is out of place here ; for this is a society in which, for centuries upon centuries, the imagination has run riot, and miich of the intellectual weakness, and worse evils which afB.ict it in this moment, may be traced to imagination having so long usurped the place of reason. What the native mind requires is stricter criteria of truth ; and I look for the happiest moral and intellectual results from an increased devotion to those sciences by which no tests of truth are accepted except the most rigid."

In general terms it may perhaps be added that, so far as concerns the masses, to live under British administra^ tion, when at its best, is in itself a liberal education.

Enlightened codes, justice, equality before the law, social and religious freedom, protection, order, method, modera^ tion in the assessment of fiscal burdens, good and easy means of transport, are no mean lessons in enlightenment to the millions who, till comparatively recent years, have lived in the dark ages of bigoted tyranny and have cowered under violence and misrule.

Great attention was paid by Lord Eipon's Government towards carrying out the recommendations of the famine

commission of 1880 with regard to the extension of railways. A programme was prepared in 1883-84 covering the ensuing six years, but it was not put into practical effect till Lord Dufferin had assumed the reins of government in 1886. It is dealt with later in this article. This programme contemplated the construction of 3837 miles of railway, including lines in progress, at a cost of 271 millions, to be provided partly by the

a ways, g^g^^g through revenue and loans, partly through the agency of companies. A select committee of the House of Commons also sat in 1884 to consider the question of railway extension in India. Its report was favourable to the projects of the Government of India, with the reserve that railway extension should not involve additional taxation. It was decided by the Secretary of State, in compliance with the select committee's suggestion, that the annual Indian Public Works Rupee Loan for all public works, whether railways or irrigation, should be raised in future from the amount hitherto sanctioned — viz., 2^ millions — to 3^ millions. Events beyond the north-western frontier, and the consequent urgency with which military railways were pushed on, caused the programme of work to be from time to time materially modified. But from that date to the present time the extension of the Indian railway system, whether directly by the state or by aided enterprise, whether for commercial, protective, or military lines, has been pursued with vigour. From a date but

little anterior to 1884 commenced also the important changes which have been made in the system of guaran-tee, without which, in one or other form, it is rare to find enterprise willing to embark capital for railway con-'struction in India. The aim of the Indian authorities is now to retain the ownership of railways in the hands of the state, to make over the construction and working of new railways, or the working or further construction of partly developed railways, to construction or working companies ; to compass these arrangements with a guarantee of the lowest possible terms, whether in regard to its amount, or the length of period for which it is granted; and to provide for the reversion of the railway to the state, either by annuities, or by direct purchase after a given term of years.

A proposed alteration of the Criminal Procedure Code, with the view of conferring criminal jurisdiction over European British subjects upon certain classes of native judicial officers in the interior, caused during 1883 the greatest excitement throughout India. By the Iildian

Criminal Procedure Code, as amended in 1872, Criminal extended jurisdiction over European British subjects was given to judicial officers in the interior, whose powers in such cases had hitherto been practically limited to the trial of certain classes of offences and forcible entries punishable by fine, all more serious offences being disposed of by high courts of committal. Under the code of 1872 all cases which would be adequately punished by three months' im-prisonment or one thousand rupees' fine, or both these punishments combined, were made triable by a first-class magistrate; and all cases which could be met by one year's imprisonment or fine (unlimited), or a combination of both, were made punishable by ses-sions judges, additional sessions judge and certain assistant sessions judges. But it was provided that the magistrate or judge must always be a justice of the peace, and himself a European British subject. In 1872 it had been proposed to modify the procedure then under revision so far as to secure to native

covenanted civil servants, being justices of the peace, jurisdiction over European British subjects. The official members of the Viceroy's legislative council were divided on the point, and the motion was eventually lost by seven votes to five. Ten years later, on the 6th March 1882, a Code of Criminal Procedure was passed. On the 20th March the Lieutenant-Governor of Bengal, Sir Ashley Eden, submitted to the Government a note received by him before the passing of the code from Mr B. L. Gupta, of the Bengal civil service, a native gentleman acting as presidency magistrate in Calcutta, inviting attention to the anomalous position in which the native members of the covenanted service found themselves under the code of 1872. That law limited the jurisdiction over European British subjects in the interior to judicial officers who were themselves European British subjects, although in the Presidency towns native civilians, and indeed native police magistrates of the uncovenanted service, also had such jurisdiction over European British subjects. The lieutenant-governor

expressed the opinion that a discussion on the subject could not with prudence be raised at the final reading of the Criminal Procedure Bill, and it was for this reason that he had not brought forward Mr Gupta's letter at an earlier date. But he suggested that the matter should receive full and careful consideration whenever on any future occasion a fitting opportunity occurred. Sir Ashley Eden was favourable to granting to covenanted native civilians, who had attended the jurisdiction of district magistrates or sessions judges, full powers over all classes, whether Europeans or natives, within his jurisdiction. In April 1882 the question was referred by the Government of India to the several local governments and administrations, and in September 1882 the Government addressed the Secretary of State on the subject, proposing to confine the office of justice of the peace, and with it the powers of trying European British subjects, to those persons, whether European or native, who had received a training that might be presumed to guarantee the possession of the necessary qualities. They advised

that all district magistrates and sessions judges should be vested with the powers in question in virtue of their office, and by a definite provision in the law. They proposed, further, to empower the local governments outside the Presidency towns of Calcutta, Madras, and Bombay to confer these powers on members (a) of the covenanted civil service, (6) of the native civil service constituted under certain statutory rules, (c) certain of the classes of natives already exercising first-class magisterial powers and judged fit to be entrusted with these further powers. The majority of the Viceroy's council concurred in these recommendations, and- a Bill was accordingly introduced on 9th Pebruary 1883. Immediately there arose the clamour of opposition. On the 20th of February a public meeting of the European inhabitants bw.'"'- of Calcutta was held in the Town Hall, at which a resolution was passed denouncing the principle of the Bill, and pledging the community to oppose its progress. Prom that time the opposition rapidly gathered strength, and later in the year became violent beyond

all precedent. The British community, with rare ex-
ceptions, united in opposing the Bill. Meetings were
held throughout the country, but mostly in Bengal and
Upper India. Remonstrances poured in; both the
European and native sections of the community became
greatly embittered. The Secretary of State for India,
addressing the Government of India in November, ex-
pressed his wish that the Bill, as drafted, should be
proceeded with. The measure, however, was not again
brought before the legislative council in 1883, and
throughout Decenrber of that year the British com-
munity was at fever heat. The Government of India
hesitated to press the business to a conclusion ; the opposi-
tion awaited watchfully the action of the Government.
history]

Matters seemed at a deadlock vrhen, on the 4th of January
1884, Mr Ilbert, who as legislative member of council was
in charge of the Bill, moved that it be referred to a select

committee. But before that date informal negotiations had been opened with a member of the Government through the medium of an unofficial member of the legislative council, and eventually the Bill was referred to a select committee to give effect to the following arrangement : — The Government undertook to agree in select committee to the right being given to European British subjects, when brought for trial before a district magistrate or sessions judge, to claim trial by jury, such as is provided by section 451 of the Criminal Procedure Code, subject to the following conditions : (1) No distinction to be made between European or native district magistrates or sessions ju.dges ; (2) the powers of district magistrates under section 446 of the code to be extended to imprisonment for six months or fine of 2000 rupees. The settlement thus arrived at became law without further opposition in January 1884, and remain^ the law on this subject to the present time. It was mainly objected to the Act as passed that the extension of the jury system in India is a retrograde measure. The compromise arrived at is

believed, however, to have been unattended practically by any of the other disadvantages which were at the time urged against it; and it closed, in terms which were acceptable both to the majority of the Viceroy's council and to the public, a controversy which had become intolerable, and from which neither party could find a means of retiring.

From the seed sown in the stormy year 1883 there sprang up a plant possibly of indigenous growth, but carefully matured by friendly British hands, known as the Indian National Congress. The Congress was in some measure a response to an association calling itself the British Defence Association, and purporting to declare with similarly authoritative voice the wishes of European British subjects whom it claimed to represent. It held its first annual meeting in the winter of 1883 ; and it neiadiaa continues to meet at the close of each year, and congress, to pass, and to publish, resolutions having for their object changes of a more or less sweeping character. Its resolutions are aimed mainly at what is

alleged to be the exclusive conduct of affairs by foreigners, at legal and administrative privileges said to be confined to the ruling race, or at restrictions imposed on the free exercise of the rights of debate and public discussion by elected Indian legislative bodies. The so-called Indian Congress, though sedulously and skilfully " boomed " in its earlier years, has never succeeded in getting itself taken seriously, because the strings are admittedly pulled, and very skilfully pulled, by British hands. But the reason has also been that the Congress is representative only in so far as it represents a small section of the educated classes, who are themselves an infinitesimal section of the people ; because this section, again, belongs largely to Bengal, which politically carries little weight in India; because the great body of Mahommedans is opposed to it ; and because the resolutions it puts forward in no way interpret to the Government those vital emotions and impulses which ordinarily lie dormant in the breasts of the people, but which are rarely with impunity to be neglected. The Congress, in short, is not national, for

there is no one nation covering the Indian peninsula.

Nor, either in the persons attending it, or in the mode of their election, or in the views they put forward, are the delegates representative of so wide a range of classes as to justify them in any degree' whatever in claiming to be the nominees of the public.

Among other prominent measures of the early years of the eighth decade was the repeal of the Vernacular Press

Press

Acts.

Acts passed by Lord Lytton. In the opinion of Lord Eipon's Government, the Press Acts passed by Lord Lytton (9 and 16 of 1878) constituted a "direct departure from the policy with respect to the press in India which had been followed by the Government of India for up-wards of forty years. It was the aim of these Acts to restrain the press, which was stated to have been at that time markedly seditious in its tone. They provided that a paper, after having been warned, would be liable to suspension, and they

applied not only to publications of a nature to excite disaffection and endanger the public peace, but also to those affecting private persons and public servants. Other objections apart, it was held by Lord Eipon's Government that an invidious exception was thus permitted in favour of the English press ; and it was contended that if the Penal Code did not meet such cases, the existing defect in the code might be remedied. Acts 9 and 16 of 1878 were accordingly repealed. Later, in 1898, in consequence of plague riots in Poona, the murder of two British officers in retaliation for alleged insults to native usage and custom in the searching of women's apartments, and of much seditious writing connected therewith in the Bombay press, the Penal and Criminal Procedure Codes were respectively amended by Acts 4 and 6 of 1898, which rendered the law in regard to seditious writing very considerably more stringent.

From Lord Eipon's tenure of office date also the .revival and reorganization, in accordance with the recom-

mendations of the famine commission of 1878, of an agricultural department, whether in the Government of India or in provincial governments. Such a department had already been brought into existence in 1871, but only to be abolished in 1877. Agricultural inquiry, agri-cultural improvement, and famine relief were the subjects to which the attention of the department, as revived, was especially directed. In all these branches (more especially in the third) the measure has given useful results, and the department has now taken its definite place in the circle of Indian adminis- ZulJtioi tration. But exhaustive inquiry and minute survey of local requirements throughout the vast area of India must precede any far-searching reforms in its agriculture. Further, there must be both the will and the power among landlords to expend capital in experi-ments and in improved methods of cultivation. It is only by slow degrees and with the lapse of time that material results can be hoped for in this direction. The relations of landlord and tenant, especially in Bengal, in

Oudh, and in the Central Provinces, formed also at this time the subject of legislation. It was not till the tenure of office by Lord Dufferin that the Bengal and Oudh Eent Bills actually became law ; but they had been framed and prepared and made almost ready for legislative sanction before his predecessor resigned office. They aimed at securing to the cultivating tenant a more stable interest in his holding, and they modified previous legislation principally in this direction. It was desired to secure tenants of all kinds of classes, in degrees varying with their occupancy rights, against arbitrary eviction or inequitable enhancement of the rents of their holdings. Compensation for improvements and for disturbance was in many cases arranged for. In Bengal, and in a lesser measure in Oudh, the objects aimed at by the legislature met with strenuous and organized opposition. In both provinces the landlord had hitherto enjoyed in a degree unusual in India the power of rack-renting and evicting his tenants. In neither province had he shown solicitude for the tenant by whose labour he so largely

profited. Unless coerced by legal provisions, the landlord

in Bengal or the Oudh Talukdliar was little likely to improve the tenants' position to the prejudice, as he conceived, of his own. In India, as elsewhere, there have always been two opposed points of view, viz., the point of view of those who regard the land as the property of the landlord, and the tenant as an intruder and an encumbrance ; and the point of view of those who reverse the position, and see in the tenant the party with vested interests in the soil, and in the landlord a useless interloper. The Bengal and Oudh Eent Acts dealt with a vast variety of local tenures and sub-tenures and complicated questions of tenant right in a spirit of equity and moderation. The result has been everywhere beneficial. Speaking in general terms, it may be said that legislation was more favourable to the tenant than to the landlord. The dust of controversy has since settled down, and the new

legislation has become the rule of practice. With protection from arbitrary enhancement of rent and resultsU^^ with security of improvements, we may more and more expect to see property accumulated, credit grow up, and improvements effected in the system of cultivation. There could have been no greater misfortune to the country than that the numbers of the occupancy class should decrease, and that such tenants should be merged in the crowd of rack-rented tenants at will who, owning no permanent connexion with the land, have no incentive to thrift or to improvement. It was desirable for all parties that measures should be framed to secure the consolidation of occupying rights, the enlargement of the numbers of those who held under secure tenures, and the widening of the limits of that security, together with the protection of the tenant at will in his just rights and the strengthening of his position by any wise or equitable measure. It is indeed probable that too little, not too much, has been accomplished. The landlord, on whom, in compliance with English analogies

framed in the time of ignorance as to local tenures and customs, there were conferred proprietary rights of a nature and extent unknown either to Hindu or Ma^ hommedan law or precedent, is still by far the most powerful and the least valuable asset in the Indian agri-cultural economy. There are in this, as in all other matters, notable exceptions. But, generally speaking, in those provinces where the soil is best cultivated, where its proceeds are most equally distributed, where the villages are most flourishing, where cattle, fodder, and manure most abound, where contentment and a moderate and reasonable prosperity most palpably meet the eye on every side, we may be sure that the cultivator is himself the proprietor of the land he tills, or is pro-tected by law from arbitrary exaction and from uncondi-tional ouster.

The year 1885 furnishes the high-water mark of peace-ful and uninterrupted progress. From that date clouds again began to accumulate around and about the Indian horizon. Before that year was over Great Britain had

been nearly plunged into war by a collision between Eussian and Afghan troops at Panjdeh, in Central Asia. Over £2,000,000 had been expended in hurried war preparations ; commercial and famine railway extension had been arrested, and a large scheme of unremuuera-tive military railways had in part overlaid and super-seded it. Then came, almost on the heels of the Panjdeh incident, the outbreak of the Burma war, which in one or other form dragged on for the space of nearly two years. Meanwhile, in view of the approach of Russia in Central Asia, the Government of India had decided to increase the effective strength both of its British and native army, the former by 10,000, the latter by 20,000 men, at an estimated annual increase of little less than 1|- million sterling. Military defence works and measures for more speedy mobilization added largely to prospective military expenditure. Exchange, which had remained for the space of three or four years fairly stationary, again resumed its downward course. A succession of costly frontier wars was entered on;

and, as in 1878, before long the attention of the Gov-
ernment was once more diverted from all home questions.
Finally, though at a later date, came a recurrence of
famine and the appearance in India of the bubonic
plague. Such, during the period from 1885 to 1900,
was the accumulation of disastrous circumstances, some
of which it was not in the power of the Government
of India by the exercise of any prudence or wdsdom
to avert. Following rapidly one on the other, they
again obstructed indefinitely that uncertain and hesitat-
ing path of progress which is so soon lost or choked
by the sudden and tropical growth of tangled troubles
in India.

Before, however, all this had finally occurred, one or
two measures of importance remain to be noticed, which
originated with Lord Dufferin's Government, though they
were in their final stage put into execution by his successor.
They are marked by the desire to conciliate native opinion,
and to provide a field for the due expansion of native am-
bitions, which had uniformly characterized the adminis-

tration both of Lord Dufferin and of his predecessor.

In October 1886 a strong mixed commission was appointed by the Government of Lord Dufferin to inquire into the system under which natives of India were at that time admitted by statute to the covenanted civil service, or to offices formerly reserved exclusively for members of that service ; and also their employment in all branches of the public service connected with the civil administra-tion of the country. The object of the appointment of the commission was, broadly speaking, to devise a scheme which might reasonably be hoped to %'^"i possess the necessary elements of finality, and reform. to do full justice to the claims of natives of India to higher and more extensive employment in the public service. The commission was presided over by the late Sir Charles Aitchison, at that time Lieutenant-Governor of the Punjab. It included a former chief justice of the High Court of Judicature in Madras, several civilian and native officials of high standing, and well-known English and native non-officials. The commission

presented a report at the close of 1887, dealing with all branches of the civil administration. The more important recommendations were those which concerned the admission of natives of India, Eurasians, or European British subjects domiciled in India into the higher grades of civil employment. This was a matter which had at various times come before the Government of India, and had been dealt with by successive statutes in 1861 and 1870. The object of section 6 of the latter statute had been to provide "additional facilities . . . for the employment of natives of India of proved merit and ability in the civil service of her Majesty in India." It empowered the Government of India, with the sanction of the Secretary of State, to make rules for the appointment of natives of India to posts in the civil service, although such natives had not passed the competitive test in England. By native was meant any person born and domiciled in British India, of persons habitually resident in India, and not established there for temporary purposes only. Rules were framed under this statute in 1873 and 1875,

and finally in 1878, these latter being the rules in force when the commission met to reconsider the question. Under the rules of 1878 a proportion not exceeding one-fifth of the total numbers of civilians appointed by the Secretary of State to the civil service in any one year were to be natives selected in India by the local histokt]

governments, and each such candidate was to be, save in exceptional circumstances, regarded as on probation for two years. The commission found, and no doubt justly, that the existing " statutory system," as it was called, had failed to fulfil expectation, and that it was generally condemned and should be abolished. They went on to record their opinion that, in the present circumstances of the country, the claims of natives of India to higher employment and the admission of competent natives to a due proportion of the posts hitherto reserved for the covenanted civil service, would be best met by

reducing the covenanted civil service to a corps d'ilite, by limiting its numbers to what is necessary to fill the chief administrative posts of the Government and such a number of the smaller appointments as would ensure a complete course of training for junior civilians, and by transferring a corresponding number of appointments to a local service to be recruited in each province of India. They preferred to substitute for the old term, " Covenanted Civil Service of India," the expression, " Imperial Civil Service," and to reduce the number of appointments expressly reserved to that service under the schedule attached to the statute 24-25 Vict. cap. 64. They desired that, even to appointments reserved in the schedule, special nomination might be made under due authority on account of noted merit and ability. The higher appointments thus excluded from the schedule were to be amalgamated gradually with the higher appointments in the executive and judicial departments of the then existing uncovenanted service, being the service subordinate in status to the covenanted civil service, and pre-

viously excluded from most of the higher administrative offices. In future this service vould be recruited locally under rules to be made by the Government of India, and would be called the " Provincial Civil Service." Below this again would be a " Subordinate Civil Service," disposing of the lower range of executive posts. Rules were prepared for recruitment, raising of salaries, and so on, with which we need not here concern ourselves. The recommendations of the commission, with comparatively unimportant reservations, were accepted by the Government of India and the Secretary of State for India, and are at the present moment in force. They have greatly improved and strengthened the prospects of higher employment to all classes of natives of India, and have for some time to come, it may be reasonably anticipated, set at rest agitation on this point. It is not to be understood that all the higher appointments thus made available to the provincial civil service were at once made over to the members of that service. It could be by degrees only, with promotion and changes among

present incumbents, and with a sufficient number of duly qualified provincial civil servants competent to fill such appointments, that the new rules could be fully applied. But in future a very considerable proportion of the higher administrative posts in India will be available to natives of the country ; and they can claim them as of right, if qualified by length of service, by ability or by merit, or by the tests prescribed under rules for the time existing.

Another very important innovation, originating with the Government of Lord Dufferin, was carried into effect in 1892-93, to which statutory effect was given by the Indian Councils Act of 1892, having for its object the introduction of the elective system into the nomination of non-official members of the several legislative councils, and greater latitude of inquiry by such members into administrative matters. Hitherto the members of these councils had been nominated by the several Governments, and debate took place only when Bills came up for consideration. No administrative act of the Government could be directly

brought under discussion. Certain municipal corpora-

tions and local boards are now allowed the right of re-

commending a member designated by themselves for a

seat on the provincial council. Considerable classes of

landlords are given the same privilege. In some cases

thechamberof commerceand thelocal university

recommend a member. In the Viceroy's legisla^ c" "^"w

tive council six are in future to be official ^ct

members, and five are to be appointed on the

recommendation of the non-official additional (legislative)

members of the councils of Madras, Bombay, Bengal, and

of the North-West and Oudh respectively, and by the

Calcutta chamber of commerce. The Governor-General is

empowered at his discretion to nominate to such of the

remaining seats as shall not be filled by officials (the

maximum number of seats being sixteen), in such manner

as appears to him most suitable with reference to the

legislative business to be brought before the council and

the due representation of the different classes of the

community. It is obvious that the measure is tentative,

and that the admission of the elective principle is safe-guarded by the most stringent restrictions. Thus the additional members to be designated by elective bodies in any legislative council form a minority of the total maximum number of its members ; the rest are directly nominated by the head of the Government. The re-commendation of the local elective bodies may be dis-regarded ; everywhere the nominees of the Government form the majority. It must be remembered further that the legislative council meet for purposes of legis-lation only, and have no power or authority to discuss, except incidentally in the course of debate, matters of policy or administration. But in remodelling the legis-lative council a further step was taken towards the introduction of a system of debating, permission being given to discuss the annual budget, heretofore allowable only when legislation affecting taxation was before the council; and also, under strict rules, to use the right of interpellation or of asking questions on matters of administration or general interest.

A measure was introduced by Lord Dufferin's Govern-
ment which concerns rather the military and political
than the internal administration of India, but which can-
not be wholly regarded as outside the general scope of
Indian affairs. At the time of the Panjdeh difficulty in
1885, when war with Eussia seemed imminent, all the
leading native princes made offers of pecuniary aid.
Their offers were refused, but it was intimated to them
at a somewhat later date that if they would place a
small military force in each state at the disposal of
the British Government, to be commanded by state
officers, but drilled, disciplined, and armed under the
supervision of British officers and on British
lines, the Government would undertake to find imperial
the necessary supervising officer, arms, and ttmps.
organization. The offer was universally ac-
cepted, and the Imperial State troops, as they are called,
amount at present to nearly 18,000, mainly cavalry and
infantry, whose efficiency is very highly thought of.
They rendered good service in Chitral and Gilgit, in

the wars on the north-west frontier, and in China. The total native state troops are said to number, inclusive of this body, about 110,000, largely an ill-armed and ill-disciplined rabble. The Imperial Service troops, therefore, amount to about 16 per cent, of the total number.

By resolution of the House of Commons a royal commission was asked for to inquire into the opium question ; whether, among other matters, the growth of the poppy and the sale of opium should be prohibited in India except for medical purposes ; the effect of such prohibition on the

finances ; the amount and effect of consumption, in regard to the moral and physical condition of the peo-

quesaoa. P^® ‘ ^^^ attitude of the people of India towards prohibition, and their willingness to bear in

whole or part the cost of prohibitive measures. A royal commission was accordingly appointed and reported in 1895. It found no evidence of extensive moral or physical degradation from the use of opium. Opium-smoking, it stated, was little practised in India. It was not shown to be necessary, or demanded by the people, that the growth of the poppy and manufacture and sale of opium in British India should be prohibited, except for medical purposes. The people of India would be unwilling to bear the cost of prohibitive measures. One member of the commission dissented from the report, and from the conclusions recorded by the majority.

But the result of the inquiry justified the report, and the anti-opium agitation was laid for a further term of years.

The second general census of India was taken in 1891. The population of India, with an area of 1,560,160 square miles, was returned as 287,317,048, being 184 to the square mile. The total urban population numbered 27,261,176, being 9-6 of the total population, and re-

siding in 2035 towns, of which 1401 did not contain as many as 10,000 inhabitants. Of these towns Bombay (821,764) headed the list, Calcutta (741,144) came next; no other town except Madras (452,518) had as many as 450,000 inhabitants. The proportion of sexes was 958 females to 1000 males. Mahommedans formed 20 per cent, of the population, Hindus more than 72 per cent. The third census, taken in 1901, showed a total population of 294,266,701. Calcutta, with its suburbs, had grown to 1,121,664, but Bombay had declined to 770,843, owing to the devastation of the plague. Madras, however, had advanced to 509,397.

In 1897 Burma was raised to the status of a lieutenant-governorship, and a legislative council was conferred on that province and on the Punjab, such as existed already for the other lieutenant-governorships in Bengal and the North- West Provinces.

Surveys and land revenue settlements are always in progress in one or other of those districts of an Indian province where the land revenue is fixed for a given pe-

riod, and which are known, therefore, as temporarily set-
tled districts. But a cadastral survey is also for the first
time in full progress in the permanently settled districts
of Behar, in the lieutenant-governorship of Bengal, having
for its object the record of tenant holdings and the settle-
ment of rents. This, when completed, should be of great
value. Forestry has been the object of much attention in
later years, and is retained by the Central Government
mainly under its direct control. We read in the volume
exhibiting the moral and material progress and condition
of India (1898-99) that " Within the last twenty years
forest laws have been enacted for, aud forest administra-
tion has been placed upon a permanent basis in, every
province of India. The superior officers of the
forest service have been, for the most part,
selected by competition, and have been trained in forestry,
either in Germany, or in Prance, or at Cooper's Hill Col-
lege. During the year 1893-94 it was decided that 20
per cent, of the 210 superior posts in the forest depart-
ment should eventually be filled by selected officers,

chiefly natives of India, from the subordinate or provin-
cial branch of the department. Some of the subordinate
officials are trained at a forest school near Dehra, in the
svib-Himalayan country of the North- Western Provinces,
and this system of professional training at local centres
will be gradually extended. The first object of the forest
administration is to select, acquire, and mark off as
Forests.

reserves an area of state forest in every province sufficient
to supply the wants of the neighbourhood and the pro-
vince in respect of timber, firewood, bamboos, canes, and
other forest produce, and sufficient also for supplying the
foreign demand for such articles as teak timber, sandal-
wood, and rubber. The reserves are, or will be, surveyed,
conserved, and worked on sanctioned plans, designed so
as to obtain the largest possible permanent yield in the
most economical way. Private rights in the reserves are
bought out or compromised. Among the most important
measures of conservancy are the exclusion of the yearly
fires which used to devastate forests, the maintenance of

adequate seed-bearing trees, and the regular reproduction of timber of the more valuable kinds. At the present time the reserves cover an area of more than 80,000 square miles ; and they may hereafter be further extended in Madras and Burma, where the work of reservation is as yet incomplete. Outside the reserves are over 30,000 square miles of state forests, some part of which will be eventually brought within the reserve area, and all of which are managed and worked for the benefit of the people, of their cattle, and of the public revenue. The limited areas of private forest are, except where they have been leased to the Government, being gradually exhausted ; and as yet few private, and no communal, forests have been successfully brought under conservancy. In every province a very few of the most valuable timber trees are declared to be reserved trees, and can only be felled under special license. Outside the reserves, the country folk are generally allowed to obtain from the state forests timber, bamboos, firewood, and grass for their own use, free of charge ; inside the

reserves, only persons specially licensed are allowed to extract timber or other produce, on payment of fees. Por-est revenue is raised by royalties on, or by the sale of, timber or other produce, and by the issue at specified fees of permits to graze cattle, or to extract for sale timber, fire-wood, charcoal, bamboos, canes, and other minor forest produce." The net revenue from forests amounted in 1900-1901 to £536,400 sterling (revenue, Es.19,195,000 ; expenditure, Rs. 11, 120,000 ; excess of receipts, Es.8,076,-000— equivalent in sterling at Rs.l5=£l, £538,300 ; ex-penditure in England, £1900 ; net revenue, £636,400).

Of late years much attention has also been given to the improvement of the police force throughout India. Natives of respectable position are usually unwilling to enter the police force, from fear of the risk of finding themselves entangled in some ruinous intrigue, or, at the least, of being exposed to false charges and malicious accusations ; from dislike, too, of rubbing shoulders with bad characters, and moving habitually in au atmosphere of dishonesty and disreputableness. Till of late years the

pay and advancement of all grades in the police force have been too inconsiderable to preserve the members of the force from temptation. Hence there was no inducement from either side to take police service, and the force has suffered in consequence both in efficiency and in momh'. In the absence of an intelligent press and of a powerful bar, and in presence of a timid and ignorant public, the police are believed very generally to abuse their opportunities; and although not inefficient in the maintenance of order, they are little to be trusted in the detection of crime. On the other hand, it must be allowed that there has been in this regard a material improvement, dating from inquiries set on foot under Lord Dufferin's regime; and that in the police, no less than in other departments, the standard of quality improves with time.

It has been already said that the scheme for railway extension, which had .been considered and matured by Lord Eipon's Government, came finally into operation history]

under the administration of Lord DufEerin, his successor ; and a brief sketch may now be given of the measures then proposed and their practical outcome at the present day. Lord Eipon's Government had proposed in 1883 that there should be completed by the state or under its control, in the space of about five years, a programme having for its object the construction of 3837 miles of railway, including lines in progress, at an estimated cost of 27^ millions. Nearly the whole of the projected mileage was for protection against famine, but about 1600 miles only were regarded as likely to be financially un-productive. For the construction of these lines three agencies were proposed: that of Government itself for about 1915 miles, that of construction and working com-panies for 437 miles, and that of private companies under limited guarantee for 1484 miles. It was also proposed that certain other railways should be con-exteasion. structed by private enterprise, unaided except

by the free grant of land, such lines being of a commercial character, and not mainly needed, as in the case of the mileage above referred to, for protective purposes. It is not necessary to follow here the subsequent changes introduced into the programme by the course of events and by instructions emanating from the India Office. It is sufficient to add that the proposals of the Government of India were in due course submitted to a select committee of the House of Commons, who reported in July 1884. The conclusions laid down by that committee, which principally concern us here, were as follows : — That the evidence in favour of a more rapid extension of railways was conclusive ; that all the leading trunk lines, with their principal feeders, should be on the broad gauge; that the amount proposed for expenditure by the Government of India was moderate ; that the 2^ millions' limit of annual borrowing fixed in 1879 might safely be enlarged; that a fixed scale of expenditure should be maintained over a considerable term of years ; that the bulk of lines should be made

self-supporting; that railway extension should not involve fresh taxation. Before, however, effect could be given to the proposals put forward in 1883, as subsequently modified by the Secretary of State, there occurred the incident of Panjdeh. The Government of India in the spring of 1885 found itself on the verge of war with Russia, and the defects in its frontier communications and want of facilities for the transport of troops and stores were urgently pressed upon it by its military advisers. As a limited sum only could be spared from loan funds annually, and as it was to such funds mainly, apart from the famine insurance annual grant, that expenditure professedly unremunerative could be charged, it followed that the programme of construction adopted in 1884 had even at this early date to be reconsidered. Pressure on the finances both in 1885 and in certain subsequent years, whether from war preparations or from financial difficulties more or less connected with the burden of exchange, has from time to time interrupted the execution both of the original and succeeding pro-

grammes. But railway extension has been pursued as

steadily as circumstances would allow.

The following statement shows the length of railway actually

constructed and open throughout British India and in native

states at the date of 31st March 1901 :—

Standard Gauge, 5 feet 6 inches.

State Lines worked by Companies — Mileage open.

East Indian 1836-15

Bengal Central 125-01

Bengal-Nagpur 1190-16

Indian Midland 796-25

Miscellaneous 365-15

4312-72

State Lines worked by the State —

North-Western

Frontier Section of (Military)

Haidarabad-ShalipuUi .

Oudh and Rohilkhand .

Eastern Bengal

Calcutta Port Commission .

East Coast ....

Mileage

1913-90

1039-90

58-91

950-76

268-04

8-53

803-25

open.

Lines constructed by Guaranteed Companies —

Great Indian Peninsular

Bombay, Baroda, and Central India .

Madras

Lines constructed by Assisted Companies —

Luokeeserai-Gya .

Delhi-Umballa^Kalka .

Tarkessar

Southern Punjab .

Hardwar-Derha .

Tapti Valley –

5043-29

1307-00

460-90

844-23

2612-13

78-83

162-24

22-23

423-72

32-05

155-77

Lines owned by Native States and worked by Companies

Lines owned by Native States and worked by State Rail-

way Agency

874-84

703-55

122-97

13,669-50

the

Metre Gauge, 3 feet 3| inches.

State Lines worked by Companies —

Burma

Bengal North-Westem (including

Tirhoot State Line) .

Lucknow-Bareilly

Eajputanar-Malwa

Palanpur-Deesa .

Southern Mahratta

Gantakul-Mysore .

Mysore Section, South Mahratta

South Indian ....

Mayavaram-Mutapet .

Assam-Bengal

993-29

1157-97

231-17

1674-57

17-28

104204

119-50

296-00

1030-53

54-08

435-45

State Lines worked by the State —

Eastern Bengal

Cawnpore-Burhwal

7051-88

565-03

79-60

Lines worked by Assisted Companies ....

Lines owned by Native States and worked by Companies

Lines owned and worked by Native States

644-63

347-56

381-58

997-98

9423-63

Special Gauge 597-50

We have thus a total open for traffic on the 31st of March 1901—

Standard Gauge 13,669-50

Metre Gauge 9,423-63

Special Gauge 597-40

On the same date 3018-03

sanctioned for construction.

Total . . 23,690-53

miles were under construction or

Of the above list, the principal lines commenced and completed since 1884 have been the Bengal-Nagpur (1190 miles open), the Indian Midland (796 miles open), the great majority of the frontier (military) sections of the North- Western (1039 miles), the East Coast railway (803 miles), the Bezwada-Madras (254 miles), the Delhi-Umballa^Kalka (162 miles), the Southern Punjab (423 miles), in part the Bengal North-Westem (about 440 miles) , the Lucknow-Bareilly(231), much of the Southern Mahratta (say 440), the Assam-Bengal (435), the Biu-ma railway (in part about 650 miles) ; in all, 6863 miles. Taking the mileage in 1878 at 8250 miles, we have therefore an increase of 15,440 in twenty-two years, and the average

of, say, 700 open miles per annum.

The later famine commission in its report of 1898 recorded its opinion that most of the necessary protective railways had been completed, and that in existing circumstances greater protection from famine would be afforded by the extension of irrigation works than by construction of further protective railways.

It will be seen that 13,669 of a total of 23,690 miles are on the standard gauge. The select committee of the Commons in 1884 had laid it down that all the leading trunk lines, with the principal feeders, should be on this gauge ; the metre gauge

[history

being, as a rule, confined to tracts of country where that system was already in successful operation, and to local lines where the traffic is so light that cheapness of construction more than counterbalances the undoubted disadvantages of break of gauge.

The state railways completed or under construction in 1880 have been mostly carried out by allotments from the annual rupee loan of 3^ millions, by assistance from the famine grant, and from funds

supplied by construction and working companies having some form of limited guarantee. Thus the Indian Midland and Bengal-Nagpur Companies, both of which have constructed and worked state lines, receive interest on the share capital raised by them in sterling at the rate of 4 per cent, per annum and one-fourth of the surplus profits, that is, of the excess of the net earnings over annual interest on the total capital provided. The Burma railway, also a state railway worked and partly constructed by a company, is guaranteed 2J per cent, per annum on share capital, retaining in addition one-fifth of surplus profits. The Secretary of State guaranteed, however, to the company up to the 30th of June 1901 not less than Jf per cent, per annum on paid-up share capital as its one-fifth share, thus making the total guarantee up to that date 2|. In all cases there is reserved to the Secretary of State the right to terminate the contract by a given date and on specified terms. It is not necessary further to describe the terms of guarantee given in the case of other less important railways, but it may in general terms be added that the financial conditions imposed on working and construction companies have become progressively less favour-able to the companies. In the case of the Bengal and ISTorth-Western,

no guarantee of interest having been given by the Secretary of State, all net earnings belong to the company. The Rohilkhand and Kumaon railway also receives no formal guarantee, except during construction ; but on the opening of the line an annual subsidy was granted for a period of twelve years from registration of the company, and a fixed sum for carriage of mails throughout the term of contract.

All capital raised from time to time by guaranteed companies is paid into the hands of the Secretary of State, who pays the guaranteed rate of interest on such deposits, which, however, is a first charge on the net earnings of the open line. The Secretary of State annually reallots to each company from the funds deposited a sum based on its requirements for construction of main and feeder lines, as determined, not by itself, but by a commission of olficials sitting in India en permanence, by which quinquennial forecasts are made, for each guaranteed railway, of the works to be annually carried out. Thus the guaranteed or assisted companies are financially in the position of departments of the state administration rather than of quasi-independent bodies. In ordinary times no great inconvenience may result from this procedure. But in times of financial

stress, such as not infrequently occur in India, the deposits of the companies may be partly needed for the cash requirements of the Secretary of State ; and construction is delayed until it is found convenient to replace at the companies' disposal sums which may be urgently required for their needs. Their progress is therefore regulated, not so much by their own financial position, as by the requirements of the Government of India. These vary with the seasons, with war or peace, with a hundred disturbing forces, so that the guaranteed railways are sometimes allowed the use of their own funds, and sometimes are denied it, and their development is liable to be constantly arrested. Only in the case of the East Indian railway have independent powers of borrowing been given by statute. A Government director, nominated by the India Office, attends each London board's sitting of a guaranteed company, and the Secretary of State is kept informed of the progress of its affairs. The financial results to the state of working Indian railways, according to the estimates for the financial year 1899-1900, were as follows in conventional sterling : —

Losses.

Gains.

Guaranteed railways .

State railways —

Military state lines .

Leased to companies

*State railways, commercial, *

unopen (

Add charges debited to land, 1

supervision, and miscellan- V

oous ;)

738,900

664,600

629,500

82,800

State railways, 1

commercial . f

State lines,

worked by]

companies

Add total Loss .

£

52,600

2,288,600

2,110,800

248,100

2,841,200

12,700

2,888,900

2,858,900

The total loss to the state, therefore, was apparently £12,700 on the year's working. But of the charges a considerable sum was due to annuities paid in England, comprising a large contribution for sinking funds for redemption of capital. Of the loss of ,£2,110,800 in 1898-99, the sum of £664,600, it will be observed, is due to military railways. The loss on the three great " guaranteed " railways is £733,900. The latter source of loss will be lessened as the railways in due course are successively bought up by the state.

Including unfinished lines, the total capital expenditure in all India, from the commencement of railway construction up to 1st December 1899, amounted to 302 crore of rupees (the crore being

a million sterling at 10 rupees = £1): —

Standard

Gauge.

Metre Gauge.

Special

Gfauge.

ITnclassifled

Expenditure.

Total.

220-43

78-94

2-09

0-82

302-28

" The policy," says the royal commission on the admin-

istration of the expenditure of India (1900), "under

■which capital and expenditure amounting to Ex.288,000,-

000 have been incurred" (this was up to 1898-99 only),

" must give opportunity for -wide differences of opinion.

Some may think that progress has been too fast, some

that it has been too slow. There may be legitimate questions as to the manner in which money for these great works has been raised, or as to the amount of outlay on working expenses. There is no necessity for us to enter into these questions. We deal with the facts as they are, and on these facts we think that the Indian taxpayer of the present obtains the benefit of a vast railway system at a comparatively light cost ; that the fall in exchange has subjected the financial result of the Government railway policy to very severe trial ; that if the loss ^gg^ng „/ on purely military lines were transferred to the railway military expenditure, and if the charge of fam- policy on ine protective lines and of lines under construe- ”^’^■ tion were eliminated, there would be no charge on the taxpayer — in other words, that the true commercial lines pay their way ; and that there is a fair prospect with improved exchange that the charge on the taxpayer will, even on the account as at present presented, entirely disappear. If a fair and constant surplus should hereafter be realized, it will be reasonable subject for consideration

whether larger sums might not with advantage be devoted to improvement of the lines, but we quite understand that the Indian Government make it an object in the first instance, and within reasonable limitations, to relieve the taxpayer of any charge in respect of railway administration." It would be sanguine to look for a fair or constant surplus, since much remains yet to be done in Indian railway construction of a more or less unproductive nature. The profit on commercial lines will very probably be neutralized for years to come by calls for further protective and military railways which may be to-day unforeseen, but which, if experience should guide us, will to-morrow be declared to be indispensable. That commercial lines, if wisely selected, will yield a fair profit admits of little question. But, in respect of the taxpayer, state railway expenditure must be taken as a whole. There is little practical use in contending that if certain conditions ceased to exist results would prove more'favourable, unless there are good grounds for anticipating a change in such conditions. As a matter of fact,

the charge for railways has for long years weighed heavily on Indian finance. The gain to India may, notwithstanding, have been greater than the burden of the charge. This is matter of opinion. But to meet the difiicultyby a series of assumptions such as those above quoted, viz., that if exchange had been more favourable, or if frontier lines had been charged to military expenditure, or if protective lines had been separately shown, the net profit on commercial lines would have been greater, will not in any way assist the taxpayer. If another method of bookkeeping had been adopted the burden would have been shifted, but not lightened. The deficit would still have to be met, and the charge on the taxpayer would remain the same. Eeckoning from 1858-59 history]

to the end of 1899, the total loss to the state on the railway account has been £57,811,487, which, in general terms, may be looked on as the price at which its railway

experience and the indirect advantages resulting from the construction of railways have been acquired by the Government of India.

In 1896 the Government of India drew up and published the terms on which it was prepared to consider ofEers for the construction by the agency of private companies of branch lines, ordinarily not exceeding 100 miles in length, forming feeders either to state lines worked by the state or to railways worked by companies. It is too early yet to be assured that the terms so offered will lead to any considerable extension of feeder lines.

Irrigation has been dealt with in another article. The Indian service, to its credit, has furnished a school of irrigation engineers which has of late years applied to Egypt its resources and experience, and which apparently is destined to repeat in that country and in the Sudan its former triumphs in the Gangetic valley, in Madras and Mysore, and in the arid Punjab plains.

The practical working of the famine grant from 1880-81 to 1899-1900, under the various heads of famine relief,

railway and canal construction, and reduction of debt, has been as follows. Nearly £29,000,000 has been distributed from the current revenues which furnish the grant, under the following heads : —

Famine Relief.

Construction of Protective Irrigation Works.

Construction of Protective Eailwaya.

Reduction and Avoidance of Debt.

Total.

7,776,097

1,941,688

12,853,885

6,353,799

28,925,469

As the protective railway mileage contemplated by the Government has been practically completed, the famine grant would seem to have done its work. The special taxation devoted to it might be thought therefore to be no longer justifiable. But in the financial statement for 1900-1901 the maintenance of the grant was thus explained : — " The programme of purely protective railway works has been practically exhausted, and that of irriga^ tion works has been much reduced of late years, and, though the latter may be capable of some expansion, the ■expenditure on these works will not be large, while the amount required to cover the loss on the Indian Midland and Bengal-Nagpur railways, which it was specially decided to charge to the grant some years ago, will not usually exceed Es.30,00,000. There will therefore, now that the grant is relieved from charges for such railways as the East Coast and South Indian, be a, large balance in normal years when there is no •direct expenditure on famine, a balance likely to in-

■*crease as the loss on the Indian Midland and the Bengal-Nagpur lines diminishes. It has hitherto been the practice to show this unappropriated balance under the ieading of reduction of debt, a heading which has puzzled people who ask how there can be a reduction*

■*of debt in a year when fresh loans are raised or in which no debt is discharged ? We hope to clear up the difB.culty by altering this heading to that of reduction or avoidance*

■*of debt. It may lead people to grasp more readily what is actually happening in a normal year. In such a year the Indian Government raises more revenue than it .actually requires to meet its ordinary charges against revenue by the amount of the unappropriated balance of the famine grant. This amount is devoted to expenditure on public works which would otherwise have to be provided by loan. For instance, in a normal year, in which ordinary revenue and expenditure balanced, the Government of India, instead of raising a loan of three icrores for public works, would be able to reduce the three crores by the unappropriated balance, say a crore,*

of the famine grant. Less debt would be incurred in normal years, and the credit of the Government would be higher when it was compelled to borrow."

Sanitation makes comparatively little progress in India. DifRculties caused by climate, by long periods of drought succeeded by torrential rains, by the great heat, the vast, flat alluvial plains, the overcrowded population and their habits — above all, by the need of very large sums and the difficulty of finding even a fraction of them — interpose an insuperable barrier to rapid progress. Still something is annually done. The Presidency towns have a good supply of water, and are tolerably drained.

The large cities in the interior, notably in the f/o^'f"' North- West Provinces and Oudh, have supplied themselves with waterworks and pumping machinery, which ensure an ample siipply. Situated, as the majority of these cities are, on the banks of great rivers, the business of providing themselves with a good supply of suitable water has proved comparatively simple. But in all of them drainage is still in its infancy, and the system in

force can be described as little more than makeshift or elementary. In the rural villages some slight attempts have been made to grapple with the difficulties at least of a good water supply. Here again similar obstacles present themselves. Nothing could be more unjust than to charge the provincial governments with indifference to the subject. Sanitary officers and officials in every province alike labour to introduce a better order. But for the reasons given, the circumstances and conditions are not such as to justify the hope that they will achieve any very rapid or signal success. Meanwhile, a fresh factor has been introduced into the problem. The appearance of plague in India has placed sanitary reform, once and for all, in the foreground of the country's needs.

In every large or important town are one or more hospitals supported partly by the provincial governments, partly from private subscriptions, and served by the Government medical staff. In the rural population dispensaries are established, and are main-

tained partly by private subscriptions, partly by grants

in aid. In 1898-99 their number and distribution were

as follows: —

Province.

II

Number of Dispensaries,

Square Miles.

^£5

Square Miles

in

Dispensary.

Population

in

Dispensary.

Bengal

Bombay

Madras

Central Provinces

Punjab

North-West Provinces

Burma

‘487

337

496

121

265

331

99

311

371

280

591

417

324

1731

145,103

56,086

71,885

78,524

78,720

141,707

76,820

5,913

5,074

8,161

12,499

12,232

10,983

7,620

Mention may here be made of the medical aid and relief for women, the building of women's hospitals, and the arrangements for the education and training of lady doctors and female nurses, which have been inaugurated since 1886 under the auspices of the Countess of Dufferin's fund, and embodied in the National Association for supplying female medical aid to the women of India. The fund owes its origin to the humanity, energy, and wisdom of the Marchioness (at that time the Countess) of Dufferin. In 1900 there were twelve branches working under

the central committees. There were 235 hospitals, wards, and dispensaries of various kinds for the treatment of women by women. In the above hospitals or in their

homes 1,519,990 women and children received medical relief during the year under review. Thirty-three lady doctors of the first grade, 73 assistant surgeons, and 271 hospital assistants and practitioners of the third grade were employed in zenana hospitals and institutions. Three hundred and fifty-four women were studying medicine in the various medical colleges and schools in India. This association, and the institutions supported by it, are of invaluable service to the women of India. Large sums have been subscribed, mainly in India, and are invested in its behalf, so that it is self-supporting. Not only has it proved of incalculable benefit to women, especially of the classes who are precluded from attending public hospitals and are now enabled to receive female medical

advice and treatment at their own homes, but it has liberated for the use of males a large number of wards in the general hospitals which had been heretofore assigned to women.

In 1896-97 India was revisited by famine, and the bubonic plague, which has since been constantly present in more or less virulence, first showed itself. The famine of 1896-97 extended over some 310,000 square miles, with a population in round figures of 35 millions, and was most severe in the North-West Provinces, in Oudh, and in the Central Provinces. It lasted from about Septem-ber 1896 till October 1897. At the worst time the total numbers on relief were 4,609,000. The death-rate per mille in the famine districts rose from 32-80, the normal death-rate, to 39-54. The total Government expendi-ture and loss to G-overnment is estimated at about 17^ millions. A commission was appointed at the close of 1897 to report on the working of the Famine Code, and on the sufiiciency of measures taken to Finance combat famine. It reported in the ensuing

plague. year. The bubonic plague was first identified in Bombay city towards the end of September 1896, and afterwards spread to the Deccan, the western districts of the Nizam's Dominions, the Punjab, the North-West Provinces, and Bengal. Prom September 1896 to the end of April 1900 the reported plague deaths in the whole of the Bombay country were 299,844, and 58,841 for other parts of India, while the actual plague deaths were probably considerably more. The Bombay and Karachi export trade has been seriously affected by the plague. Grievous as is the mortality from plague, a total even, say, of 475,000 for a period of nearly four years is less than the difference between the highest cholera mortality (727,493 in 1892) and the lowest (152,703 in 1898) in British India in a single year. In November 1898 a mixed commission, consisting of three medical experts from the United Kingdom and two Indian officials, was appointed to investigate the plague question in India. Their report favoured inoculation; opposed the enforced removal of

plague patients to hospitals, which had proved the cause of much rioting and violence ; and made other suggestions of which the sense generally was unfavourable to segregation, or evacuation of infected places except in villages and small towns, and to cordons, and the search of railway passengers. Again, in 1900, famine appeared and proved itself most severe in Bombay, Eajputana, and the Central Provinces. The tract concerned contained a population of 85 millions, of whom perhaps 52 millions were severely affected. Of the 85 millions, 43| millions were inhabitants of native states, and 41| millions were in British territory. At the close of May 1900, 5,802,000 were in receipt of relief. After the rainy season of 1900 distress gradually abated. The expenditure necessary to cope with the famine was estimated at £13,000,000 (at 15 rupees to the £1). The death of adults from starvation is stated to have been of rare occurrence, and due entirely to the apathy of the people themselves.

Attention may now be turned to the course of finance,

and to the disturbing influences to which, successively or simultaneously, it was submitted from 1885 to 1900. In 1884, while the Government of India was engaged in the consideration of the projected extension of its railway system, an agreement had been arrived at between her Majesty's Government and the Government of Russia for the employment of a joint commission to delimit the frontier between the Eussian dominions in „. Central Asia and Northern Afghanistan. To- cb^ls. wards the close of that year the respective commissioners had met and commenced operations. In .the spring of the ensuing year a collision took place between Eussian and Afghan troops owing to claims put forward on either side to the occupation of the district and village of Panjdeh, lying within the dis- puted frontier zone. The work of the commission was temporarily suspended, and for some weeks it appeared probable that war would be declared between Great Britain and Eussia. The difficulty was, however, ar- ranged, and delimitation of the entire frontier ultimately

effected. But the incident led to steps being taken by the Government of Lord Dufferin, with the view of strengthening the military system of India, which have had far-reaching effects on Indian finance. In August 1885 the Government of India (two members of the Viceroy's council dissenting) proposed an increase in the strength of the army in India, amounting to 10,657 British troops and 16,540 to the native army, with other changes, of which the result would be an estimated increased annual charge of about £1,500,000. These proposals were approved by the Secretary of State, and immediate measures were taken to carry them into effect. Projects for strengthening the defences of India, whether on its north-western frontier or on its seaboard, were also taken into prompt consideration. A scheme of frontier railways was elaborated, and a vigorous commencement was at once made in the direction of the Khojak tunnel, in the great Amran range, and on the approaches to Kandahar from the British side, and from the direction of Quetta. While clouds were

gathering over the finances and internal progress of the country in this direction, a somewhat sudden and abrupt termination to a dispute between the Government of India and King Thibaw of Burma was brought about by the outbreak of war with Burma in 1885. For the causes of the dispute with the Government of Burma, and a description of the military operations which ensued after the deposition of King Thibaw before the country was finally pacified, the reader may be referred to the article on Burma. The financial results only will be noted in the course of this article. For the present, it will be sufficient to say that the first-fruits of political complications and militarjr measures, combined with a further fall in the exchange, was the repeal of the then existing licence tax and the reimposition of an income tax in March 1886 ; tliis being the first of a succession of fiscal measures \yj which in the course of the ensuing eight years the work of Sir John Strachey and Sir Evelyn Baring was gradually but completely undone, and the country again subjected to methods of taxation

which it had been the object of their reforms finally to remove. The principal provisions of the income tax, as reimposed, were and are (for the tax has remained in force since its enactment in 1886) that incomes should be estimated under one or other of certain classified grades ; that incomes amounting to Es.2000 per annum should pay 5 pie in the rupee (2-6 per cent.), and if less than Es.2000, 4 pie in the rupee (about 2 per cent.). All

incomes of less than Es.500 in the year are exempted, and the tax is not levied on agricultural profits, or incomes, or on military salaries of less than Es.500 per mensem. The tax produced in the first year of its assessment £1,369,000, and has since risen in round figures to £1,800,000.

In introducing the Income Tax Bill in 1886, the financial member of the council had said: "With the present year our brief spell of happiness has come to an

end. The fat kine have passed on, and the lean kine

have come in. . . . Three uninterrupted years of pro-

sperity is a godsend in the annals of every nation; in

our Indian annals it is extraordinarily good fortune." In

1885-86 the fall in exchange which had been temporarily

suspended recommenced, and the Burma war broke out.

In 1886 India definitely entered into the region of depres-

sion and storm from war, famine, pestilence, and exchange,

from which in 1902 she had not yet emerged.

The following paragraphs show the accumulation of diflSculties

during the years 1896 to 1900, and the measures taken to meet

them : —

In 1881-82 the net sterling expenditure

had amounted to £14,029,700

The average rate at which remittances

were effected was d.19-815

The total charge for exchange was . . £2,985,500

In 1886 the net sterling expenditure was . £14,172,300

The average rate at which remittances

were effected was .... d.17'441

The total charge for exchange was . . £5,631,800

An increase of £2,646,300 had thus heen charged to the Indian revenues in five years, mainly by a fall of 2Jd. in the exchange, as the net sterling expenditure had but little increased.

The following table shows the progressive charge on account of exchange from 1881-82 to 1899-1900, the last two years being estimates : —

Tear.

Net Sterling Expenditure.

Average Eate. Exchange on Net Sterling Expenditure.

Total Charge for Exchange.

£ d. £

£

1881-82

14,029,700

19-895

2,894,300

2,985,500

1882-83

13,692,200

19-525

3,140,900

3,205,500

1883-84

14,764,100

19-536

3,373,700

3,358,900

1884-85

13,844,000

19-308

3,364,000

3,535,900

1885-86

1.3,755,700

18-294

4,329,900

4,289,800

1886-S7

14,172,300

17-441

5,329,700

5,831,800

1887-88

16,128,000

16-898

6,356,900

6,049,300

1888-89

14,652,600

16-379

6,817,600

6,388,100

1889-90

14,513,200

16-566

6,512,800

6,758,000

1890-91

15,176,900

18-090

4,959,000

5,468,000

1891-92

15,718,800

16-733

6,825,200

7,200,900

1892-93

16,114,300

14-985

9,694,800

10,287,300

1893-94

15,633,400

14-547

10,159,600

11,523,400

1894-95

15,504,000

13-101

12,899,100

15,046,000

1895-96

15,380,000

13-638

11,685,200

13,990,900

1898-97

15,468,700

14-451

10,222,200

12,116,400

1897-98

16,004,600

15-354

9,012,500

10,562,300

1898-99

16,091,200

16-000

8,045,600

9,253,600

1899-1900

16,324,500

15-750

8,550,900

9,686,500

The reason of the difference between columns 4 and 5 is that in the latter are included additional payments to European soldiers on account of exchange from 1883-84 onwards, and exchange compensation to officers from 1893-94. It will be seen that from 1881-82 to 1884-85 exchange remained fairly stationary. In 1885-86 there was a fall of more than Id., another fall in 1886-87, and again in 1887-88, when a pause ensued till 1890-91, in which year there was a marked temporary rise, due to legislation in America. In 1891-92 the exchange again fell, and continued to fall till 1894-95, when it reached its lowest point, viz., 13-101, the total charge for exchange amounting in that year to £15,045,000. In 1893 the Indian mints were closed to the coining of silver, with little immediate effect on exchange. In 1898 a gold standard was adopted, the sovereign was made legal tender in India, and interchangeable at the rate of one sovereign for fifteen rupees. From that time the exchange has remained comparatively steady. Taking the average net expenditure of the years 1883-85, and contrasting it with 1895-96, the Indian expenditure commission found that the increase in the later period amounted to 12J

millions, thus: —

Defence and For-

eign Affairs

Civil Charges

Interest on Debt .

Railways and Irri-

gation. . . .

India.

England.

Exchange.

Total,

&

5,747,000

1,637,000

-2,073,000

^,371,000

£

-201,000

238,000

112,000

922,000

£

4,240,000

1,415,000

1,393,000

3,341,000

£

9,786,000

3,290,000

-568,0001

-108,000

940,000

1,071,000

10,389,000

12,400,000

1 In 1888, 534 millions of sterling 4 per cent, debt was converted into 3J stock, securing a reduction of £266,000 annually. In 1894, 90 millions of rupee 4 per cent, debt was similarly converted, causing a saving of Rx.450,000.

To meet the increased expenditure it had therefore become neces-

sary that the resources of the Indian treasury should be increased

by about £12,000,000. This was effected over the term of years

1886 to 1894 as follows (the figures taken here are those furnished

by the Indian expenditure commission report) : —

Income Tax

[noo

Salt Tax

Customs

Excise

Patwd,ri (village ac-

countant) cess

. £1,319,000 April 1886, licence duty repealed

and income tax imposed.

1,500,000 Duty raised in 1888 from 2 to

2/8 per maund.

2,750,000 In 1894the5percent. adBaZoreni

duties of customs repealed in

1882 were reimposed, cotton

goods being exempted, and a

further import duty was put on

petroleum. In 1895 the 5 per

cent, import duty was extended

to cotton, and an excise duty was

imposed on Indian cotton mills.

1,000,000 Estimated by Indian expenditure

commission to be due to in-

crease of taxation.

242,000 Repealed in 1882 by Sir E. Bar-

ing, but reimposed in 1888.

£6,811,000

Normal growth of

net revenue . £5,800,000

Add new taxation . 6,811,000

Total . £12,611,000

Thus the taxation on salt and imports, which was abolished by Sir John Strachey and Sir E. Baring, has now been reimposed, and remains in force. Other taxation has been added ; apart from the taxes above enumerated, countervailing duties were in 1899 im-posed on bounty-fed beet sugar. The normal growth of revenue during the period of comparison (£5,800,000) was absorbed by the

increase of expenditure under " defence and foreign affairs " — in other words, military and political — in India, and apart from the charge for exchange.

Of the total increased expenditure of £12,400,000, not less than £9,786,000, inclusive of exchange, was due to military and political expenditure. Inclusive of exchange, but exclusive of military works and minor charges, the net army expenditure is stated by the Indian expenditure commission to have risen from £16,147,000 in 1884-85, which was the last year before the increase in the army and the resumption of military activity, to £23,302,000 in 1896-97, an increase of 44 per cent. But this was only the increased charge on account of military expenditure of a permanent character. From 1886 onwards, with but brief intervals, there has occurred a series of wars and frontier expeditions, some of which, such as the Burmese war of 1886-87, were extremely costly. The preparation for possible war with Russia amounted, in 1885-86, to over two millions. The war with Burma cost, in the three years 1885-86 to 1887-88, over four millions. Minor expeditions, from 1887-88 to 1895-96, cost over five millions. The Tirah campaign of 1897-98 (though this was of a date later than 1896-97,

the last year of the commission's comparison) cost over three millions — say in all, in round numbers, fourteen millions in eleven years. Increase in military and political expenditure, and increased loss by exchange (itself partly caused by the increase in military expenditure), are the causes which have led to the reimposition of the customs duties on cotton and other goods, and to the raising of the salt duties. The increased loss by exchange has been checked by closing the Indian mints to the coinage of silver and by the adoption of a gold standard. The further increase of military and political expenditure must largely depend on the policy

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pursued by the Government of India with regard to the tribes on its north-western frontier, and to the course of events hereafter in Afghanistan.

From 1880-81 to 1899-1900 the following have been the years respectively of surplus and deficit, and the chief causes of increase or decrease in the revenues are indicated in the final column : —

Tear.

Surplus.

Deficit.

Kemarks.

1880-81

1881-82

1882-83

1883-84

1884^5

1885-86

1886-87

1887-88

1888-89

1889-90

1890-91

1891-92

1892-93

1893-94

1894-95

1895-96

1896-97

1897-98

1898-99

1899-1900

£

2,582,727

706,633

1,879,707

178,427

37,018

2,612,033

3,688,171

467,525

693,110

1,533,098

3,961,310

4,059,400

£

4,044,000

386,446

2,891,726

2,028,832

833,410

1,546,998

1,705,022

5,359,211

Afghan war.

f Financial effect of Sir John

\ Strachey's reforms,

r Customs duties abolished,

\ Salt duty lowered.

(Russian war scare ; com-

J. mencement of Burma war;

1. fresh fall in exchange.

/Income tax imposed, and

\ Burma war.

r Burma war and civil

i charges ; continuous fall

(in exchange.

Salt duty raised.

American silver legislation.

Heavy fall in exchange,

f Exchange compensation

\ first granted to officers,

f Customs and cotton duties

\ reimposed during year.

War and famine.

"War.

Gold standard adopted.

Total .

22,399,159

18,795,645

In 1882-83, the year in which the customs and salt duties were removed, the gross revenue was £70,125,231, and the gross expenditure was £69,418,598. In 1898-99, the year in which the finances were restored to order by the adoption of a gold standard, the gross revenue was £101,426,693, the gross expenditure was £97,465,383. Prom 1881-82 to 1899-1900, £6,350,000 are estimated as having been spent from the famine insurance grant — in other words, from current revenue — in reduction or avoidance of debt. On the other hand, in comparing surplus and deficit, it must

be remembered that between 1886 and 1894 taxation yielding annually since the latter date £6,800,000 has been at different times reimposed. If we remove on the one hand the deficit of 1880-81, as due to the Afghan war, and on the other the surplus of 1898-99 and 1899-1900, as due to improvement in exchange following on the adoption of a gold standard, we have for the remaining seventeen years practically equilibrium. But this equilibrium is entirely due to the taxation imposed since. 1886. It is probable that the necessity of accumulating a large gold reserve will compel the Government of India to maintain for a time much of this taxation which might otherwise have come under reduction.

The position therefore is this : The total charge on account of exchange remains, and is likely to remain, steady unless the Secretary of State increases his drawings. We may on the present revenues reckon on a surijlus of revenue over expenditure of not less than four millions, in the absence of war and famine. But there remain on the taxation roll import duties and enhanced salt duties, yielding collectively about four millions annually, which have been unreservedly condemned by the highest financial authorities in India, as permanent sources of revenue, and which

were removed in 1878 and subsequent years. The surplus of revenue over expenditure, viz., £4,000,000, and the proceeds of these taxes balance one another, leaving the finances in bare equilibrium, with the prospect, on the one hand, of an annual addition say of £500,000 from normal expansion of revenue, against which, on the other hand, will be debited corresponding annual growth in expenditure.

Reference has been frequently made in these pages to the royal commission on the administration of the expenditure of India. This commission was appointed in 1895 "to inquire into the administration and management of the military and civil expenditure incurred under the authority of the Secretary of State for India in council and of the Government of India, and the apportionment of charges between the Governments of the United Kingdom and of India for purposes in which both are interested." The commission presented in 1900 an exhaustive and very valuable report, dealing, however, with revenue and expenditure up to 1895-96 only, between which date and 1900 there had occurred two famines, two or three very costly frontier expeditions, and the very important currency legislation of 1898, so that by 1900 the course of

events had already discounted much of the value of the com-
mission's conclusions. The report, nevertheless, presents an
exhaustive study of the financial mechanism of the Indian Gov-
ernment, with a careful, if somewhat favourable, review of the
progress of its revenues and expenditure from 1862 to 1895-96. It
also deals with the apportionment of charges between England and
India in respect of army and naval and certain civil and miscel-
laneous charges, and recommends grants to the annual amount of
£230,000 from the Imperial Government to the Government of
India, being as follows : — In aid of the charge for the Indian Office
(£50,000), one-half of the military charges for Aden (£108,000),
increased contribution to the charge of the Persian mission (£5000),
half the cost of transport of troops to and from India (£130,000).
Some account must here be given of the measures suc-
cessively adopted by the Secretary of State for India for
the reform of Indian currency by the closing
of the Indian mints and the adoption of a gold aimmUies.
standard. In 1892 Indian representatives were
sent to the International Monetary Conference at Brussels,
which was convened for the consideration of measures for

the increased use of silver as money. The Government of India in June 1892 proposed that, should the conference fail to arrive at a satisfactory conclusion, it should at once close its own mints to the free coinage of silver and make arrangements for the introduction of a gold standard. Its proposals were submitted by the Secretary of State to a committee in October 1892, which in May of the ensuing year reported that they could not oppose the proposals of the Government of India as to closing the mints against the free coinage of silver, but recommended that they should be accompanied by an announcement that, though closed to the public, the mints should be used by the Government for the coinage of rupees in exchange foi; gold at a rate to be then fixed, say Is. 4d. per rupee, and that at the Government treasury gold would be received in satisfaction of public dues at the same rate. The committee's recommendations having been approved by the Imperial and Indian Governments, an Act was passed on the 26th June 1893 for the closing of the Indian mints to the free coinage of both gold and

silver. Arrangements were at the same time made for the receipt of gold at the Indian mints in exchange for rupees at the rate of 16d. per rupee ; for the receipt of sovereigns and half-sovereigns in payment of sums due to the Government at the rate of 15 rupees for a sovereign ; and for the issue of currency notes in exchange for British gold at the above rates, or for gold bullion at a corresponding rate. Gold, therefore, was not made a legal tender in India in pursuance of these arrangements, though the Government was prepared to receive it in payment of public dues.

The rupee remained by law the only coin in which other than small payments could be made; no legal relation was established between rupee and gold, but the Government of India declared (until further notice) the rate at which rupees could be purchased for gold or bullion. In 1893-94 the average rate per rupee at which council bills and telegraphic transfers were sold in London was 14-547d. ; in 1894-95 the exchange fell to 13-lOld. ; in 1895-96 it was 13-638d. ; in 1896-97 it had risen to

14‘491d.; and in 1897-98 it reached 15-354d. The effect of closing the mints in 1893 thus first began to make itself distinctly felt in 1896-97.

In 1898 the Government of India made further proposals with the view of keeping the exchange value of the rupee at a steady level of 16d. These proposals were, in their turn, submitted in April of that year to a mixed committee, which reported in July 1899. The recommendations of the committee were : —

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(1) That the British sovereign should be made a legal tender and a current coin in India.

(2) That the Indian mints should be thrown open to the unrestricted coinage of gold on terms and conditions such as govern the three Australian branches of the royal mint.

(3) That no legal obligation should be imposed on the Government of India to give gold for rupees, or, in other words, to substitute the former for the latter on demand of the holders.

But though there should not be convertibility on demand, gold should be freely available for foreign remittances whenever the exchange fell below specie point. The Government of India should make its gold available for this purpose, when necessary, under such conditions as the circumstances of the time might render desirable. The exclusive right to coin fresh rupees should remain vested in the Government of India. Though the existing stock of rupees might suffice for some time, regulations would hereafter be needed for providing such addition to the silver currency as might prove necessary.

The fixed permanent relation which the rupee should bear to the sovereign should be Is. 4d.

Legislative effect was given to these proposals in September 1899, and the currency system of India is at present arranged in conformity with them. The time has not come when the success of the measure adopted can be confidently affirmed, whether as regards the Government or the course of trade. While the experiment is viewed with distrust by the majority of export traders, it has been uncompromisingly condemned by

the authority of Sir Eobert Giffen. Writing in 1898 to Tlie Times (19th May 1898), Sir Robert expressed his belief that the . attempt to introduce a gold standard in a poor country like India must fail; that gold to the amount of £90,000,000 at least should be accumulated beforehand ; and that the Indian Government could not bear the expense. On the other hand, in his financial statement for 1900-1901, the financial member of council stated that before the beginning of 1899-1900 the Government had added 305 lakhs from the reserve to the volume of silver in circulation in exchange for gold presented to them. During the year 1899-1900 they had added 776 lakhs (a lakh is equal' to Es.100,000) in exchange for gold presented in India, and 226 lakhs in exchange for gold presented in England, a total for the year of 10 crores (1 crore is equal to one million rupees). To enable the Government to make these additions they had coined 1\ crores of new rupees, and had decided on supplementary coinage to the extent of 1 crore, a total of 2\ crores. The position in respect of gold was

strong. In India and in London nearly £8,600,000 had been accumulated. £5,000,000 had been set aside for the present as a minimum reserve against eventualities, against the contingency of the Secretary of State's being obliged to restrict or curtail his drawings or to ask the Government of India to ship home gold to enable him to meet his obligations. Gold was coming in in large quantities. There was no appearance of any falling of£ of the export trade owing to the adoption of a gold standard, or gold currency convertible at Is. 4d.

The statistics of trade are given elsewhere. Of the three great industries introduced by British capital into India, two are unhappily at the present moment in a state of singular depression, and one is in chronic insecurity.

Tea is suffering from the effects of over-production and the placing of inferior teas on the European market.

The cotton-spinning industry has been depressed owing to keen competition from China and Japan, and unfavourable seasons for the purchase of cheap cotton.

Indigo, though not depressed, is continuously threatened

with competition, and possible extinction, by the intro-
duction and perfecting of chemical dyes.
Since 1889 India has suffered from a succession of
frontier wars. At the close of the Kabul war in 1880
the British Cabinet decided to withdraw not from Kabul
only, but from Kandahar. The policy of the Govern-
ment of that day is fully stated in the twp despatches
of the Marquis of Hartington (afterwards Duke of
Devonshire), respectively dated 21st May and Events
11th November 1880 (to be found in the Af- oatbe
ghanistan Blue Book, No. 1 of 1881). Events “”–;^”’*
were shaped accordingly ; and with the excep-
tion chiefly of the Pishin and Sibi districts, and of
Quetta, the British retired within their former borders.
So matters remained till 1883-84, when the advance of
Russia in Central Asia again turned the attention of
the Government of India to affairs on and beyond the
frontier, and led ultimately to the final abandonment
of the policy of observation and reserve, which is
known as the Lawrence policy. The control of the

frontier was transferred in the latter part of the eighth decade from the Lieutenant-Governor of the Punjab to the Government of India in its foreign department. From that time the policy of non-interference was replaced by increasing activity. Prom 1885, when war with Russia seemed imminent, there has been more or less (less from 1886 to 1889, and in later years far more) continuous movement along one or other part of the frontier and beyond the British border, indicating the gradual development of a pre-arranged plan of operations. Between the years 1885-96 there were delimited at various times by joint commissions the Russo-Afghan frontier between the Oxus and Sarakhs on the Persian frontier, the Russo-Afghan frontier from Lake Victoria to the frontier of China, and the Afghan-Indian frontier from the Kunar river to a point in the neighbourhood of the Nawa Kotal. To the westward, after various disagreements and two military expeditions, the territories comprising the Zhob, Barhan, and Bori valleys, occupied by Pathan tribes,

were in 1890 finally incorporated in the general system of the Trans-Indus protectorate. About the same time (in 1889) at the other end of the frontier, where it touches China, the post of British resident in Gilgit had been re-established. The result became very shortly apparent. The government of Kashmir having for the time passed under the direct control of the British authorities through the death of the Maharaja in 1889, a council of regency was established under the supreme direction and authority of the British resident in Kashmir. Acting under his instructions, the Council asserted and, with the aid of its troops led by the Resident of Gilgit and by other British officers, re-established its supremacy over the petty states of Hunza and Nagar, in the neighbourhood of Gilgit, which it claimed as feudatories. The former chieftains were deposed, and others, more friendly to the British Government, replaced them. In 1893 the frontiers of Afghanistan and British India were defined by a joint agreement between the two Governments. There followed, on the part of the British authorities,

interference in Chitral, which had fallen to India, ending in an expedition in 1895 and the ejection of the local chiefs in favour of candidates amenable to British influence. A more formidable hostile combination, however, awaited the Government of India. By the agreement of 1893 with the Amir most of the Waziri clan, the Bajouris, and the Afridis had been left outside the limits of the Amir's influence and transferred to the British zone. Soon after that date the establishment by the British military authorities of posts within the Waziri country had led to apprehension on the part of the local tribesmen. In 1895 the occupation of points within the Swat territory for the safety of the road from India to Chitral similarly roused the suspicion of the Swatis. The Waziris and Swatis successively rose in arms, in June and July 1897, and their example was followed by the Mohmands. Finally, in August the

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powerful Afridi tribe joined the combination and closed the Khyber Pass, which runs through their territory, and which was held by them, on conditions, in trust for the Government of India. This led to the military operations known as the Tirah campaign, which proved very costly both in men and money. It was not till February 1898 that hostilities finally ceased along the border, with a total British loss in all the several engagements with the several tribes of 506 of all ranks killed, 637 dead of disease, 1428 wounded, and 9 missing— in all 2480. By the middle of 1898 British authority had been made paramount throughout the whole belt of territory which stretches between the former British frontier and the frontiers of Russia and Afghanistan, and from the Karakoram Pass to Pishin.

These campaigns on the frontiers occurred at a time of great diflBculty, when, owing to increasing loss by exchange, and latterly to famine and plague, the resources of

India were subjected to excessive strain. Public attention in the United Kingdom was consequently much engaged iipon the whole question of Indian frontier policy ; and it was very generally felt that of late years the Government of India had been permitted to embark in a course of aggression and adventure on its frontier for which no adequate necessity could be shown to have existed.

From 1890 to 1898 many millions were spent in asserting British supremacy over the territories brought within what is sometimes known as its " political frontier."

The active exercise of such supremacy still remains, however, in abeyance. The tribes to be dealt with are noted for their lawlessness, treachery, and violence, even among Afghan tribes. It is to be hoped that they may gradually allow themselves to be peacefully incorporated within the system of British India. However this may be, considerable increase of expenditure must be anticipated as a result of the hew departure. At the best, roads must be constructed, military levies must be raised and paid, and some efforts must be encouraged to introduce among the

tribesmen the elementary institutions of civilization.

Other smaller frontier expeditions were undertaken by the Government of India in the Hazara country on the north-west frontier in 1888-89 and 1891-92, in Sikkim in 1888-89, in Miranzai in 1891-92, and in Manipur in 1891-92. But these entailed comparatively little expenditure (about one million in all) ; they were isolated and apart from any general plan of frontier policy, and have been productive of no great increase of permanent expenditure.

The main incidents of the course of events within British India since 1880 have now been briefly reviewed. Much of interest has of necessity been omitted. But it is hoped that a general idea may have been conveyed of their tendency and progress. It has been seen that the state barometer, which stood at its highest in 1881 and 1882, began again to fall in 1885, and passing rapidly from that year through periods of violent disturbance, remained at its lowest from 1892 to 1899. Since 1899 there are signs of more settled conditions, and it may be

that before long India will have returned to the brighter promise of 1881. If war, famine, and exchange no longer deplete the treasury, more funds may be forthcoming from the proceeds of taxation to meet the j)ressing civil needs of the taxpayer, such as sanitation, education, fg^^ggf better remuneration to subordinate officials, a higher-paid and better-conducted police force, good feeder roads — in short, the many internal requirements for which little consideration has been available in recent years of stress. The promotion of the internal prosperity of India is, by common consent of all parties, the main obligation which rest on its Government ; and to secure this it is above all necessary that the administration should have the leisure, the will, and the means to provide the conditions most favourable to such an end. Prolonged peace and comparative freedom from fiscal burdens are among the most important of such conditions. There seems some ground for now hoping that the difficulties caused of later years by the burden of exchange have been at least restricted within practical

limits. But famine is ever a probable danger; and political and military ambitions, with the complications attendant on them, have always to be reckoned with.

The Viceroys who held office during the period here dealt with were the Marquess of Eipon, 1880-84; the Marquess of Dufferin and Ava, 1884^88 ; the Marquess of Lansdowne, 1888-95; the Earl of Elgin, 1896-99; Baron Curzon of Kedleston, 1899. Pew of his predecessors in the Government of India were animated by greater zeal, or sustained by a higher conception of duty, than Lord Eipon. In the prime of life, possessed of much ability, an indefatigable worker, and of experience in public affairs, he was greeted on arrival in India with a welcome the more warm in that the public had grown distrustful of his predecessor. Before he laid down office the goodwill with J^^™pg', which he had been received had turned into hatred such as had never before dogged the footsteps of an Indian Governor-General. So long as Lord Eipon con-

fined himself to raising and improving the status of the native of India his action was followed by the British community, if not with warm approval, at least with kindly goodwill. But when he proceeded to assimilate the authority of native magistrates over European British subjects to that of British magistrates themselves, he was rudely made to feel that the Government of India, autocratic though it may at times be with the natives, miist be more circumspect in dealing with the British community. The struggle with his fellow-countrymen in which Lord Eipon suffered himself to be involved dealt a death-blow to his usefulness as Viceroy. Instead of holding the balance between all parities, the Viceroy became seemingly . a partisan of one against another. When Lord Eipon's name grew to be a symbol between contending factions, nothing remained for him but to withdraw from an office in which he could no longer render useful service. But the Indian historian will hereafter record that to Lord Eipon belongs the distinction of having been the first Viceroy openly to recog-

nize and give practical encouragement to the growth of a self-respecting spirit of endeavour and of the desire for some measure of self-government among the more advanced classes of the natives. He sought, as events have shown not unsuccessfully, to assist them in raising themselves from an attitude of passive administrative subjection to a position more worthy both of themselves and of the Government under whose liberal rule they live. His generous and kindly recognition of their claims and capacity was warmly responded to by all classes of natives ; and if he was condemned to leave Calcutta in whatever disgrace may be thought to attach to the censure of that city, he received from the natives of India thoughout his journey to Bombay a spontaneous and enthusiastic ovation, of which the like has never been accorded to his predecessors or successors. It is greatly to the honour of Lord Dufferin that, though by no means indifferent to popularity among his country-men, he never for a moment hesitated to continue and to carry farther the main lines of the enlightened policy

which had been initiated by Lord Eipon. But in Lord Dufferin's sagacious hands the rocks and shoals on which his predecessor foundered were avoided. In raising the

status of the native civil service, and in enlarging the basis and extending the attributes of the several legislative councils, Lord Dufferin laid the native population under a lasting debt of gratitude. In the historic interview with the Amir of Afghanistan in 1886 at Rawalpindi, as throughout his treatment of the Panjdeh incident, his characteristic firmness and suavity were equally displayed. His term of ofB.ce was darkened by financial difficulties, largely owing to the fall in exchange. The conquest of Upper Burma, though it increased his popularity and added to the lustre of his Viceroyalty, reopened the floodgates of military expenditure and added to financial troubles. He maintained throughout his term of office a high standard of adminis-

tration, while his personal charm of manner, his tact, his hospitality, his wit and genial humour, secured for him universally the affection of his countrymen. With the advent of Lord Lansdowne the liberal policy of his immediate predecessors suffered eclipse. Lord Lansdowne's urbanity and high distinction conciliated and impressed all with whom he was brought into personal contact. But, as time passed, it became evident that his thoughts were more occupied with affairs beyond the north-west frontier of India than with the interests' of good government within its limits. The growing influence exercised over the Viceroy by his chief military and political advisers became more and more matter of uneasy comment. Under their influence, and probably with approval in Whitehall, Lord Lansdowne renewed in substance Lord Lytton's policy, and the wars which have drained India of money and men since 1896 were due to the course of action adopted under his auspices in the years preceding. There never was a time since 1838 when Simla was so actively the centre of ambitions, and

of designs beyond the Indus. The most favoured type of Indian official was no longer the provincial governor or the sagacious resident, but that warden of the marches of Baluchistan, Sir Robert Sandeman, whose unique aim it was to extend the zone of British influence beyond the frontier, and whose method was to participate in tribal dissensions, and to profit by them. "Sande-mania," which has proved so contagious, then first became epidemic in high quarters. It should be added, however, to the credit of his administration, that Lord Lansdowne grappled successfully with one hideous evil in Hindu social life, which required all the more courage to combat because it rested on immemorial custom, and was hallowed by religious sanction. He left behind him an Act to raise the age of consent among Indian wives from ten to twelve, which, while it provoked much popular clamour, was approved by men of enlightenment of all creeds and races. During so much of his term of office as was not occupied with combating famine and plague, Lord Elgin was engaged in conflict beyond

the frontier with enemies who were none of his own seeking, or in acrid controversy with political friends in England on questions arising out of the political difficulties which had been bequeathed to him by his predecessor. Though the credit of introducing a gold standard into India does not personally rest with Lord Elgin, it was during his term of office that the measure was matured and effect given to it. Of Lord Curzon it is premature to speak. But his frontier policy would seem to be conciliatory and judicious, and to be framed with that regard for economy which of late years has been conspicuously absent. The creation of a border province beyond the Indus under a separate head (the North-West District), which was accomplished in 1901, would have been, when Lord Lytton first proposed it, premature. At that time, when the frontier was as yet undefined, and when the relations of the tribes with the British and Afghan Governments, and of those Governments with one another, were unsettled, the measure would certainly have provoked collision, especially

if a successful and ambitious soldier had been selected to be chief of the proposed province. As matters now are, the arrangement may be regarded with more satisfaction.

Towards the latter years of the 19th century the last of the old Haileybury civilians, who entered the service as nominees of the East India Company's directors under the system aholished in 1857, were leaving India. For thirty years or so they had heen contemporaries and rivals of their brethren who had been recruited since 1856 by the present rule of open competition. It is noticeable that, towards the close of their term of corporate existence, most of the highest ofB.ces available in India to the civilian were held by Haileybury men. The public works and financial members of the Viceroy's council, with the Lieutenant-Governor of the Punjab, the North-West Provinces, and Bengal, were in 1887 all nominees of the East India Company. While none will regret the demise of the system of nomination, the fact shows that with much rubbish it furnished also useful material. It may interest Etonians to find that in 1890-91 tl^e Viceroy (Lord Lansdowne), the Commander-in-Chief (Lord Eoberts), the Governor of Madras (Lord Wenlock),

the Lieutenant-Governor of Bengal (Sir SteuartBayley), the Lieu-
tenant-Governor of the North- West Provinces (Sir AucklandColvin),
and the Lieutenant-Governor of the Punjab (Sir James Lyall) were
all old Etonians.

In the course of the debate in the House of Commons
on the Indian budget of 1900-1, Lord George Hamilton
observed that he sometimes doubted whether, in spite
of all their labours, the popularity of the British in
India had increased. The substitution of a mechanical
for a patriarchal system of rule seemed to the Secretary
of State for India to lie at the bottom of any
loss of popularity which might have occurred. ^5}”’

To observers who have better opportunities of relations.
personally judging than the Secretary of State,
there seems no good reason for believing that British un-
popularity has increased among the Indian masses. They
are as amenable as of old to British officers, they consult
them as freely, they crowd to their camps when on tour,
and are as friendly in intercourse and bearing as in former
times. Itis in the so-called “educated classes,” the outcome

of Western education, that goodwill is less apparent. The native educated by English methods looks on himself and his countrymen as unduly debarred from many prizes offered to his British fellow-subjects, and keenly resents the social ostracism to which he is too frequently subjected. He has command of a press, both English and vernacular, which vividly reflects his discontent, and therefore suggests the existence of more widespread disaffection than in truth exists. By these and similar methods he seems to possess more influence than he really wields, and he labours to have it appear that the dissatisfaction which he personally feels is generally shared by his fellows. Then again the glamour of success, the mesmeric fascination, the ikhAl (to use an expressive Arabic word in familiar Indian use), the star, as ISTapoleon would have said, which did so much for British influence in an earlier day, when no one knew much about the new rule, but every one saw that it was irresistible, has greatly died away. The nature, the defects, the limitations, and the difficulties of British rule are now matter of more

analysis and speculation. Familiarity has produced some-thing of its proverbial effect, and there is little in the present social relations between the races to bring the critics and the criticized on to a footing of more mutual goodwill. The levelling tendency of British rule again is abominable to the powerful classes which have hitherto monopolized authority. The " new man," viewed as a type of humanity, is often but a poor creature compared with many of those whose influence he is displacing. The dislike which attaches to his ascendancy is passed on to

the Government -which has created him. As the new man is himself foremost in censuring and in criticizing British authorities, the Government meets on either side with disfavour. Finally, outside of all this, there arise from time to time special causes of dissatisfaction. In Bombay and in the North- West Provinces the population has re-belled against restrictive measures which were thought

necessary to prevent the spread of plague. As the plague commission has also pronounced against many of these measures, it is much to be regretted that resort should have been had to them. There is little that the native of India will not submit to in the way of arbitrary exaction or injustice, but the Government which violates the privacy of his hearth will infallibly rouse him to fury. Little has happened at Bombay and in the North- West but what men of experience must have expected. The memory of that painful time will long rankle in the hearts of those who have survived it. Nothing has hitherto lent niore strength to the British Government than its invariable regard for the sanctity of domestic life and for the free exercise of religious faith. One of these bulwarks has been seen momentarily to crumble, and it is to be hoped that the administration, which has now hastened to retrace its steps, will remain within the limits of its former policy. The curious demonstra-tions against cow-killing which occurred in recent years in parts of the North- West Provinces are more obscure

in origin. But it may be conjectured that the zealots of the Hindu faith do not witness without emotion the widespread sapping of their creed which is everywhere obvious, or harbour towards the Government with which they connect it any feeling except that of hatred.

During the years 1880-1900 various figures have flitted across the Indian stage and have come more or less into notice. Of such, among the British, was Mr Allan Hume, the sponsor of the Congress, a retired Indian civilian. The late Sir George Allen left India in recent years, after a lifetime spent in maturing and bringing to a successful issue various useful industrial enterprises. Sir George Chesney, whose comparatively early death is greatly to be deplored, took with him to Parliament, where he represented the city of Oxford, the prestige of his career and some remembrance of his literary successes. Sir William Hunter, also too soon summoned away, employed his pleasant and instructive pen in familiarizing the general public in England with the history and cir-

cumstances of their great dependency ; Sir Alfred Lyall strengthened his reputation as an original thinker on Indian and Asiatic problems. The Stracheys published their important volume on the Finance and Public Works of India. Mr Crooke and Mr Grierson explored the folk-lore, the dialects, and the rural customs of the North- West Provinces and Behar ; Mr Growse wrote on Hindu archi-tecture and archaeology. The classical age of Anglo-India — the age, that is to say, of Warren Hastings — was brought before the eye of the present generation by Dr Busteed, in his charming Eclioes from Old Calcutta. Mr Howell brought to a term the heavy labours of his Arabic Orammar. Mr Arnold, of the Anglo-Mahommedan College at Aligarh, took up the cudgels for the Mahommedan conqueroi's of past time in his Preaching of Islam; Mr C. J. Lyall published an interesting volume of extracts translated from pre-Mahommedan Arabic poetry. But conspicuous among all has been the rise to fame in England of Mr Rudyard Kipling, whose earlier efforts, "When they first appeared in the early 'eighties in India,

"were at once hailed with unanimous recognition. Regarded as pictures of society, his Plain Tales from the Hills were manifestly caricature. But as clever etchings of types and characters, and as brilliant sketches of lighter aspects of Anglo-Indian life, they were felt to be pertinent and truthful. The language in which they were written was by no means conspicuous for purity or refinement. But it served all the more to bring vividly home to its readers the scenes and the persons described ; for it was served up smoking-hot from the mess, the cutchery, the assembly rooms, the gymkhana — from wherever, in a word, Anglo-Indians resort. When Mr Kipling passed on to other conquests in other lands, the good wishes of all whom he left behind in India accompanied him. But when presently it was found that his pen and ink sketches, which were taken quite seriously in England as pictures of daily social life in India, brought no little obloquy on its society, and when it was seen that the author was at no pains to put his readers right, Anglo-India somewhat faltered in its allegiance. His popularity,

nevertheless, in India, as elsewhere, eclipses that of all other Anglo-Indian writers. Yet there is one whose memory his admirers would not willingly let die. Many recall, with singular pleasure, the gentle malice of Aberigh Mackay ; nor would they hesitate to barter many chapters of the Plain Tales for the delicate vignettes, the sparkling epigrams, the keen but inoffensive banter, and the incisive word, in a single page of Ali Baba.

Among natives of India, Sir Madhava Rao and Sir Sayad Ahmad remained severally conspicuous among their Hindu and Mahommedan contemporaries for all that is most worthy and sincere in Indian aspiration and performance. Two Indian gentlemen, Mr Dadabhai Naoroji and Sir Mancherjee Bhownaggree, succeeded in gaining admission to the House of Commons in the Radical and Conservative interest respectively. H.R.H. the late Duke of Clarence and the Cesarewitch, afterwards the Tsar Nicolas, successively visited India in the early 'nineties. Various Indian princes, such as Holkar, Baroda, and Rampur, came to England. A host

of minor Indian writers burst out from time to time into ephemeral life and activity, or were hatched in tropical heat of controversy. Mr Bahramji Malabari, author and reformer, continued, not without success, his great crusade against infant marriage and in favour of the re-marriage of Hindu widows. Intellectual struggle, increasing antagonism between old and new ideas, the growth of a corporate feeling of self-respect, a keen and fixed desire, therefore, among educated and enlightened men to be of more account in the affairs of their country, the weakening of old bonds, the sapping of old prejudices — to apply, in short, to a peninsula a simple but expressive metaphor from progress in another line — the " gradual getting up of steam " — are the great characteristics of the present day. Erom 1860 to 1900 what changes ! what advance ! Every year adds to the number of Indians who flock to British colleges or to the Inns of Court. The iron bands of caste, of custom, and of spiritual authority are more and more relaxing. The sanctions and the penalties by which Hindu society was

regulated are gradually but surely falling into disuse, and as yet there is no new system to replace them. Slowly (and better therefore if slowly) an ancient creed is nodding to its fall. It is the story of the sleeping Princess. For long ages India has slumbered immovable, but at length the spell is broken. From the far West has come the awakening. Suddenly life is actively resumed. The parrots and the monkeys scold, the geese cackle, the ass brays, but man hurries anew about his business. Torpor is shaken off, and a nervous activity takes the place of silence and inaction. The Princess has arisen, and moves forward, though with dazed eyes and uncertain steps, encumbered by the folds of her old-world garments. In confidence, yet not without hesitation, she follows the stranger into a world which is new and unimaginable to NATIVE states]

her. The dawn as she draws onward quickens all her pulses, and shines more and more upon her, as she ad-

vances, with the light of incomparable promise.

(a. CO.)

The Native States.

The .origin of the native states of India, and their

political relations to the British empire, can only be

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origin. condition of India in the middle of the 18th

century. At the opening of that century the

Moghal emperor was still formally supreme throughout,

from the northern mountains almost everywhere to the

sea; and the whole country was distributed into great

provinces directly under imperial rule, except where petty

chiefships survived which more or less acknowledged the

Moghal supremacy and professed to be feudatories, or in

districts that were openly defying the imperial governors.

The strength and size of the chiefships, as of the districts

in rebellion, varied in proportion to their distance from

headquarters, to their accessibility, and to the vicissitudes

of the imperial policy. In the wilder parts of India there

were tribes that had never been effectively subdued, and

there were chiefs in the highland tracts whose subordination to the Delhi Government had been merely nominal. On the western side the Marathas had raised, and were maintaining, a formidable insurrection. Yet it may be afB.rmed generally that from the Himalaya mountains to Cape Comorin no separate state existed that had established and openly asserted its independence or denied the imperial sovereignty. But after the death (in 1707) of Aurungzeb, the Moghal empire declined rapidly towards its fall, and within the next forty years it had subsided into complete dilapidation. Nadir Shah had crossed the north-western frontier of India in 1735, sacked Delhi, and extorted the cession of the emperor's western provinces along the Indus. The Afghans poured down from the north into the Punjab; the Marathas overspread the central region, and were pushing northwards and southwards ; the great viceroyalty of the Dekhan had been converted into a rulership under the Nizams of Haidarabad; while in Bengal and Oudh there were military adventurers who governed in the emperor's name, but

were actually carving out possessions for themselves.

In that wide central region, which had been occupied for centuries by the Eajput clans, the chiefs kept up a precarious resistance against Marathas from the south and Mahommedans from the north. The map of the Moghal empire had thus been torn into pieces, and the whole territory was being parcelled out again into principalities which merely represented the fragments that rival potentates could seize and hold. If we set aside the group of ancient Rajput chiefships, every considerable native state that at the present moment exists in India traces its formation no farther back than to this epoch, and is ruled by some family whose founder won his lands in this period of universal confusion.

Almost all the native states of India, therefore, represent the scattered remnants of those rulerships that were hastily built up out of the ruins of the Moghal empire, which had itself consolidated a number of pre-existent kingdoms. The whole Indian continent had fallen back into that condition of separate contend-

ing principalities, professing but not practising allegiance to ■ an emperor at Delhi, which prevailed before Baber founded the Moghal dynasty in the early part of the 16th century. That dynasty had now succumbed; but it had hardly passed away before another empire began to take the vacant place, growing slowly at first and with almost imperceptible advances. The rise and progress of the British power, however, in no way followed the method of its predecessor ; and this difference had an important effect upon the formation of the native states as we now see them. In the 16th century Baber conquered all northern India by force of arms, and his successors extended their dominion by a series of campaigns; they subdued all opposition by superiority in war. They left standing no rivals whom they could overthrow ; their object was to bring the whole country under their yoke; they tolerated no equality ; their monarchy was avowedly military and aggressive; their power levelled every obstacle that it could reach.

The British dominion began in another manner and went on by other methods. Englishmen had obtained their foot-hold on the Indian sea-coast as traders, and for some time afterwards they neither attempted nor f.“-^!”^ desired territorial possessions. Their gradual control. interference in the quarrels and intrigues of the native princes was mainly forced upon them in their com-mercial competition with the French ; and thus they entered upon a system of extending their sphere of influence by alliances with the nearest states, assisting them with troops and money, so that their general policy was to join any friendly power in resistance against a common enemy. When in 1767 Clive made for the East India Company their first substantial conquest of territory — the province of Bengal — he merely added one more to the long list of states, held nominally by a grant from the Delhi emperor but really independent, into which the old empire had been broken up piecemeal. And as the British dominion inevitably expanded by reason of its superior military strength and resources, this policy of alliances

with friendly or needy potentates against hostile and jealous rivals was steadily preserved, sometimes with a view to a balance of powers, at other times in order to interpose a belt of protected states between the English border and formidable neighbours, and occasionally to unite in some offensive operation against a common foe. The East India Company extended their territory by cessions from their friends, taken in exchange for assistance, as well as by conquests from enemies ; they received assignments of land as security for subsidies or for the payment of troops lent. At the end of a successful war they did not, at this period, utterly destroy their antagonist ; they disabled him by annexing or distributing large portions of his territory, by disarming him, and sometimes by placing an English garrison with a diplomatic agent at or near his capital.

The policy of the East India Company, therefore, during the first period of their establishment in India had been to avoid aggrandizement and to fortify their position by alliances with the neighbouring states. They soon found

themselves obliged by stress of circumstances to fight for their safety, and afterwards to contend for ascendency, as the only sure basis for maintaining- themselves in the prevailing confusion and for securing the tranquillity of the country. They could not reduce their own troops while other armies were incessantly in the field. The course they adopted was to cut down the strength of their enemies, and gradually to assume control over the military forces and political relations of their allies, obtaining large accessions of territory by conquest and by cession. At the close of the 18th century there were only two native powers in contact with British possessions whose hostility was formidable — the Mahommedan dynasty in Mysore, and the group of Maratha chiefships. During the Governor-Generalship of Lord Wellesley (1798-1805) Tipu, sultan of Mysore, was defeated and slain, and the Maratha con-federacy was broken up. Lord Wellesley introduced that system of subsidiary treaties which has played so im-portant a part in the expansion of British dominion. His

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policy was to extend the British protectorate over all the states with which Great Britain had then any concern, by insisting that each native ruler should reduce his army, and should rely for external defence upon the military power of the British Government. Each protected state was required to supply, not troops as formerly, but money, and the British Government undertook to raise, train, and pay a fixed number of troops in return for a subsidy, or for a cession of land yielding equivalent revenue, that would provide the cost of the troops furnished by the protecting authority.

But Lord Wellesley's polieyj which aimed at the universal dominion of the English in India, and indeed laid its foundation, was discontinued for a time by his successors, who desired to free themselves from such extensive liabilities, and to be content with the defence of British territories, leaving the states beyond the frontier to fight out their own quarrels. The result was that all

central India fell back into a condition of incessant war and disorder, for the predatory Maratha hordes and bands of armed adventurers overran the country, and were rapidly destroying all the weaker states. Many of the chiefs appealed to the British Government, affirming that the imperial power in India, by whomsoever it had been exercised, had always recognized and acted upon the inherent duty and obligation of protecting the minor states, and of imposing peace and good order throughout the empire. This was the principle upon which Lord Hastings at last interfered, in 1817, to suppress the Pindarees, whose predatory armies roved at large through the midland country, and to preserve the minor chiefships from aggression and gradual dismemberment. The Pindaree hordes were attacked, pursued, and broken up. The great Maratha chiefs were compelled by force of arms to sign treaties acknowledging the supreme prerogative of the British Government for adjusting the reciprocal rights and relations between them and the minor states which they were holding

in tributary subjection. The petty chiefships were thus placed under the protection of the British Government ; and treaties were made directly with the larger Eajput states, whose independence was thus secured and whose territories were saved from imminent destruction. The same system was extended to the minor states in Gujarat and western India generally, while all the principal states were required to accept the position of subordi-nate alliance with the British Government, which as-sumed the paramount powers of supreme authority and control. The rulership in the Punjab and in Sind lay at this period outside the sphere of British dominion. But for all the rest of India it became thenceforward a recog-nized principle of public policy that every state should make over the control of its foreign relations to the British Government, should submit all disputes to their arbitration, and should defer to British advice regarding internal management. A British resident was apj)ointed to the courts of all the greater princes, while military supremacy was consolidated by locating the subsidiary

forces at important capitals, and by placing British officers in command over the auxiliary troops that some states were under obligation to supply.

It is to be observed that under this system, although the British empire increased mightily in territory and in the extension of irresistible influence, yet the original policy of the preservation of native states was never abandoned. The Mahommedan dynasty of Mysore was destroyed in 1799, yet the Mysore state exists, under its ancient Hindu family of rulers, to this day. The Maratha confederacy were the most obstinate of England's enemies, yet none of the five great chiefs who fought against her were completely stripped of their possessions by Lord Wellesley or Lord Hastings, and the descendants of three (Holkar, Sindia, the Gaekwar) still govern considerable states. The barbarous rule of the chief of Coorg, in South India, and his obstinate refusal to amend it, did indeed bring about the absorption of that small state in 1834. But with this exception it may be generally affirmed that the policy of complete annexation

and absorption into British territory came in during Lord Dalhousie's Governor-Generalship (1849-56). He declared the doctrine that it was the prerogative, and indeed the duty, of the British Government to assume possession of a subordinate state that should have lapsed to the sovereignty by failure of heirs natural, unless there were some strong reason to the contrary; and he acted on this doctrine by annexing Satdira, Nagpore, and Jhansi. The Punjab was taken by conquest after two fierce wars, and the kingdom of Oudh was annexed on the ground of long and incurable misrule. But after the mutiny of 1857 this doctrine was virtually abandoned. The policy now consistently prevailing is expressed by Lord Canning's formal recognition in 1862 of the right of all ruling chiefs, upon failure of heirs natural, to adopt successors according to the customs of their religion, race, or family, so long as they are loyal to the British crown and faithful to their engagements. Yet no subordinate principality can pass to an heir, whether by adoption or ordinary succession,

without the assent of the paramount power, a condition that is undoubtedly based on established usage and long tradition.

We have now traced rapidly the course of events and transactions by which the dominion of the Moghal emperors, which began in the middle of the 16th century, became transformed into the n^Mon British dominion of India, and was centralized la the under one great sovereignty during the reign ladian of the Queen-Empress Victoria. Its full de- “»/”»• velopment is to be surveyed in the present constitution of the Indian empire, composed partly of the British-Indian provinces and partly of states under British protection and undisputed ascendancy. An official paper issued by the Government of India in 1886 recorded 629 subordinate or feudatory states, with territories aggregating 628,672 square miles and a population of 66 millions. Most of these states — indeed, almost all the larger ones — repre- sent, as has been said, the military chiefships which arose out of the confusion that followed the fall of the Moghal

empire, and which the British Government has preserved on a diminished scale instead of absorbing them. Some of them are constituted from the domains that were left to adversaries who submitted after war ; others belong to a class which, like the Haidarabad state, were originally allies of Great Britain, and have retained their internal dependence under the limitations imposed by treaties or by the general constitution of the empire. Of the minor chiefships the greater number owe their existence to the protection given them by Great Britain against predatory aggression. They had been tributaries of the larger native states, and the dominion over them was trans-ferred, by conquest or cession, to the British Government, which has now guaranteed their rights and obligations, and allows no other person to interfere with them. Every one of these native states, great and small, has yielded up the management of its external relations to the British Government, and has no sovereign rights internationally ; while in all matters that concern the empire at large the states are expected to conform to the decision of the

paramount suzerain. In measures taken for the common defence of India they may be required to co-operate, and to permit anything to be done that is necessary for the general safety. On the other hand, the British

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Government undertakes to regard their interests in all external affairs as identical with, its own, to make no arrangement which would place them at a disadvantage, and to protect them if necessary with the whole force of the empire.

The regulating authority of the British Government is exercised over the states in various modes and degrees. In deciding disputes over succession to the rulership, in questions of adoption, in the control of affairs during minorities, in the limitation of their armaments, and in any matter affecting the peace of the empire, the British Government is supreme arbiter. And since this supreme power is prepared to support the legitimate ruling au-

thority of the chiefs, to assist them in suppressing revolts, and to prevent usurpation, the obligation to interfere for the purpose of checking gross abuses, serious misgovernment, or the excessive squandering of the states' finances, which leads to misrule, necessarily follows. What circumstances constitute a case for such interference, and how far it should be carried, are matters for discretion in each instance. On subjects which concern the general interest, such as commerce, coinage, and railways, the states are expected to defer to the advice of the British Government ; over all trunk lines of railway communication, and indeed over every line that does not begin and end within the territory of a single state, the supreme Government retains jurisdiction. The states are all bound to give extradition, on demand, of heinous criminals ; and in one department of internal administration, the judicial authority of the chief, there are degrees of limitation. Tor while in the larger states sentences of death can be passed by the state's tribunals, in others a reference to the British agent is necessary, and in the lesser states the

judicial power is graduated according to class or capacity. The residuary superior jurisdiction in these cases is vested in the British Government. Many of these petty chiefs are little more than large proprietors with privileged jurisdiction of a feudal kind, not unlike some of those which existed under the German Empire up to the end of the 18th century.

It is necessary to understand clearly the real nature and constitutions of all these native states. In the first place, they in no sense represent nation-alities; they are marked off by no differences of language, by no separate community of religion or race; they do not contain homogeneous populations under a national ruler. They are territorial jurisdic-tions, or imperfect sovereignties marked out on the general map of India, usually formed by acquisitions, ^f for the most part fortuitous, of each ruling and family, and fixed within the limits finally coastita- recognized and confirmed by the British ”””■ Government. With the majority of his sub-

jects the ruler has not necessarily any connexion — religious, tribal, or linguistic. At Haidarabad a Mahommedan prince of foreign descent governs an indigenous population that is mainly Hindu ; at Gwalior a Maratha chief from south-west India reigns over millions of northern Indians to whom the Maratha language is foreign' — his capital has grown up round the fortress where his ancestor pitched a standing camp. Secondly, it must be explained that there is a great difference in structure between the different groups of these states. Many of them were formed by simple conquest; they are the lands which the founder of the dynasty seized by the power of a mercenary army. But a Eajput state in central and western India denotes the territory over which a particular clan, or division of a clan, claims dominion for its chief and possession for itself by right of ancient settlement and continual habitation, although the existing territorial boundaries were constantly changing under incessant warfare up to the period of British pacification. The chief of the ruling clan is chief of the

state, and all the great landholders are usually his kins-
men, while the people who are not Rajputs hold a
lower position as merchants and cultivators, or as inferior
castes and aboriginal tribes. In the wilder outlying tracts
these aboriginal tribes have kept up their local inde-
pendence in political subordination to the Eajput chief.
For conducting, upon the principles above described, the
relations between the Government of India and the native
states a system has grown up of establishing political agents,
who usually reside within the states' territory. A resident
officer of superior rank has charge either of a single im-
portant state, or of a group of minor states, having in the
latter case other agents of lesser rank under his orders.
And since this arrangement is connected historically with
the position, geographical or political, of the several chief-
ships, it may conveniently be followed as a classification
in the sketch which will now be given of their origin,
their character, and the circumstances that have led up to
and determined their existing status within the empire.
Thesuperior Agencies corresponddirectly with the Govern-

ment of India ; but since many of the minor chief ships are by their situation and interests closely intermixed with British provinces, their business is primarily managed by the adjoining local governments, subject to reference, on questions of principle, to the Governor-General in council. The states of the first magnitude, to each of which a superior Resident is attached, are as follows : —

1. Haidarabad.

2. Mysore.

3. Trayancore.

4. Gwalior.

5. Indore.

6. Baroda.

7. Kashmir.

The first three states in this list are situated in southern India, Travancore being at its extreme promontory. The next three are in the central region ; and Kashmir, with its tributaries, lies in the highland country on the farthest northern frontier of the Indian empire.

Haidarabad.

The ruler of this state is entitled the Nizam. His family was founded by Asaf Jah, a very able military leader, who was appointed in 1714 governor of the great imperial province of the Dekhan, and raised his governor-ship to an independent principality during the confusion of the next twenty years. His death in 1748 was followed by a war of succession, in which the French and British companies on the south-eastern coast of India took part, and which ended in the rulership of Asaf J^h's son, with the hereditary title of the Nizam. By that time the French had lost all their political influence in southern India, and the rivalry between the native powers for territory and dominion lay between the Marathas, the ISTizam, and the Mahommedan dynasty of Mysore. The English East India Company on the sea-coast, whose position was put in jeopardy by these turbulent neighbours, became entangled in their quarrels; and when hostilities began between Haidarabad and Mysore the Company sent a subsidiary force to co-operate with the Nizam, in consideration of the cession by him of certain districts. But the Nizam soon

afterwards made a secret compact with Hyder Ali of Mysore for a joint attack upon the company. Some sharp fighting ensued, in which the Nizam was so roughly handled by the British that he was glad to make terms. During the period that followed, the policy of the Hai-darabad state varied with the vicissitudes of the incessant contest that went on among the three native powers. With the English Company the Nizam was alternately in

alliance and at enmity ; but as his military strength was much inferior to that of the Mysore sultan and of the Marathas, who were also formidable adversaries of the British, the concurrence of their common interests gradu-ally drew the ISTizam and the Company into a less unstable alliance. So in the first war (1790) against Tippu, sultan of ilysore, the two Governments acted together in the field, and shared the lands which were wrested from him. But in 1795, when the Marathas invaded the Haidarabad

territory, the Nizam's urgent appeal for assistance was rejected by the English Governor-General (Lord Teignmouth), who feared the consequences of joining in hostilities against the Maratha power. The results were, in the first place, that the Marathas routed the Nizam's army and forced him to make peace on very extortionate terms; and, secondly, that the Nizam's deep resentment against the way in which the British had deserted him led him to increase those regiments in his own service that were commanded by French oflScers, whose influence at his court was proportionately augmented. When, in 1798, Lord Mornington assumed the Governor-Generalship of India, the Nizam's army was largely in the hands of Frenchmen. As war with Tippu of Mysore was imminent, an alliance with the Nizam became again of importance to the English, and the Nizam's own condition forced him to the conclusion that in this alliance lay his only assurance of permanent protection from the Marathas and the powerful hostility of Mysore. He was therefore induced to agree by a treaty to disband the French corps (nearly

14,000 men), to dismiss the oflB^cers, and to allow a substantial increase of the troops furnished by the British Government on payment of a subsidy. The Nizam's army co-operated in the war which terminated in the conquest of Mysore, and a considerable share of the conquered territory was handed to Haidarabad. In 1800 was made another treaty, which is not only the foundation of British relations with Haidarabad, but has also served as the model of subsequent relations with other important states. By this treaty the British Government engaged to defend Haidarabad against foreign aggression, while the Nizam placed in British hands the direction of all his foreign affairs, admitted a British force to be stationed at his capital, and ceded territory yielding revenue sufficient to defray the cost of its maintenance. Since that time the only material transaction with the Hai-darabad state has been the assignment to the British Government of certain districts yielding a net revenue set apart for the payment of an auxiliary force that the Nizam had undertaken to maintain, the surplus, if any,

of revenue after payment of the troops to be credited to the Haidarabad treasury. The districts that are still thus held in trust under British management constitute what is commonly called the province of Berar.

As the Nizam's family is Mahommedan, the nobles and most of the chief officers of the state are of that religion ; but a very large majority of the population are Hindu.

Mysore.

The present Maharaja of Mysore has descended from a Hindu dynasty that took its rise in the 16th century. During the confusion that spread over south India in the 18th century the reigning prince was deposed and his kingdom was seized by Haidar Ali, a soldier of fortune, who established a strong military power in that country and pillaged all his neighbours. These incursions, and the active correspondence of the Mysore rulers with the French at a time when France and England were at war, produced a state of intermittent hostility with the British Government, while Mysore was also alternately in alliance or at enmity with the Nizam and the Marathas. In 1780

Haidar Ali invaded the (Jarnatic with a large army, and ravaged the lands protected or possessed by the East India Company up to the suburbs of Madras, defeating the English troops sent against him. A French squadron appeared off the coast to co-operate with him, but with-drew, and Haidar was at last beaten and driven away at the battle of Porto Novo. His son, Tippu Sahib, carried on the war until peace was made in 1783 ; but war broke out again in 1791, with the result that a British army under Lord Cornwallis forced him to sign a treaty that ceded half his territory to the British Government. Tippu Sahib nevertheless continued to strengthen his army, to negotiate with France for assist-ance, and generally to prepare for fresh hostilities, until Lord Morning-ton formally required him to disarm and relinquish his alliance with France, then again at war with England. On his refusal he was attacked in 1799, was driven into Seringapatam, and besieged there until the place was taken by assault, and Tippu was slain in the fighting. After allotting certain portions of his

kingdom to the British Government and its allies in the war, Lord Mornington reconstituted the remainder into a state under the old Hindu reigning family. Then followed a period of oppressive misrule and serious squandering of the revenues, until in 1831 the Government of India placed the state in sequestration, and assumed the direct administration for fifty years. In 1868 it was publicly resolved that the representative of the family, then a minor, should be restored to the rulership, and in 1881 he was formally placed upon the throne. The instrument recording the transfer of the Mysore state to its hereditary ruler laid down certain conditions, territorial, financial, and military, that have been attached to the rendition in accordance with the general principles that govern the reciprocal relations of the native states with the British Government.

Travancore.

The country belonging to this state, which lies along the south-eastern coast-line of India, where it runs down to a point at Cape Comorin, was consolidated out of several

petty chiefships into one principality about the middle of the 18th century. It was never conquered by the Moghals, and although the ruler at one time paid tribute to the nearest Mahommedan governor, his successor, find-ing himself threatened by the sultan of Mysore, obtained aid and protection from the British authorities at Madras. When Tippu of Mysore invaded Travancore in 1789, the British compelled him by force of arms to restore the territory that he had seized ; and in 1799 the troops of Travancore joined in the campaign that ended with his death and the extinction of his dynasty in Mysore. In 1805 the state was brought formally within the British protectorate by a treaty in which its ruler acknowledged British suzerainty, and bound himself to the payment of a subsidy toward the maintenance of troops for "his terri-tory's defence. With the exception of some internal troubles, which were from time to time suppressed or adjusted by the interposition of the British Government, the state has since had an uneventful history, and is now prosperous and orderly. According to the laws which

determiiie the succession in this state, the descent is in the female line; so that, for example, the rulership would pass on the death of a chief, not to his sons, who can in no case inherit, but to his uterine brothers, or else to his sisters' sons. And if an adoption became necessary for the continuance of his line, a female could be chosen to transmit the succession. The latest adoption of this kind occurred in 1857.

The three states of Gwalior, Indore, and Baroda are alike in their origin. It may be explained that at the NATIVE states]

beginning of the 18th century the Marathas had acquired a great dominion in western India under the leadership of the famous Sivaji.and his successors, who had rebelled against and driven out the imperial governors in that re-gion. By the middle of the century the house of Sivaji

had been supplanted and reduced to merely titular sovereignty by the family of the Peshwas, or prime ministers of the Maratha Government; and the Peshwas in their turn soon found themselves unable to control their own military commanders, who used their troops for seizing territory on their own account, and defied the attempts of the central Maratha power at Poona to enforce subordination. In these three states, therefore, the rulers are the descendants of successful generals who rose to independent power towards the end of the 18th century, who were the leaders of the Maratha confederacy that contended against the British arms in several wars for predominance, and who finally submitted at different times to treaties according the states protection with internal autonomy under British supremacy.

Qwalior.

The Gwalior state was founded by Madhaji Sindia, who had commanded an expedition sent in 1770 by the Maratha Government at Poona into northern India, where he established by conquest a considerable Maratha

dominion. His operations brought him into collision with the British, but although he concluded a treaty with them in 1782, the policy of Madhaji and of his able successor, Doulut Eao, naturally continued adverse to the growing power of the British Government. The jealousies and dissensions among the leaders of the Maratha confederation, however, disorganized their resistance to the common enemy. They fought among themselves for territory and for supremacy until the Peshwa, who was the titular head of the confederation, was completely defeated in battle by the Maratha chief Holkar, fled from his capital, and placed himself under British protection by the treaty of Bassein in 1802. This interposition of the British Government was resented by the confederacy, and it brought on the Maratha war of 1803. In the campaign that followed a combined Maratha army, in which Sindia's troops furnished the largest contingent, was defeated by General Arthur Wellesley at Assaye and Argaum, in central India; and Lord Lake routed Sindia's forces in northern India at Agra, Alighur, and

Laswaree. Many districts that Sindia had seized in the north and some in the south were ceded to the British Government, and his state's territory was materially reduced.

In 1817, when the Peshwa attempted to raise the Maratha chiefs in combination against the British Government, Sindia was only deterred from joining in the war by a movement of British troops to overawe him, and his connivance with the enemy cost him the compulsory cession of two fortresses. Under Doulut Eao, Sindia's successor, the state fell into confusion and was distracted by mutinies, until the growth of turbulence and misrule on the British border induced Lord Ellenborough to interpose, and a British force advanced upon Gwalior. The Maratha troops were defeated at Maha^ raj pur and Punniar, with the result that the Gwalior government signed a treaty ceding territory with revenue sufficient for the maintenance of a force to be stationed at the capital, and fixing the future strength of the Gwalior army. In 1867 this force joined the general

mutiny; the ruling chief abandoned Gwalior until the place was retaken and his authority restored by Sir Hugh Rose (Lord Strathnairn) in 1858 ; and since that pacification of the country its princes have continued in firm and loyal amity with the British Government.

Indore.

The state of which Indore is the capital had its origin in an assignment of lands made early in the 18th century to Mulhar Eao Holkar, who held a command in the army of the Maratha Peshwa. Before his death in 1765 Mulhar Eao had added to his assignment large territorial possessions acquired by his armed power during the confusion of the period ; and by the end of that century the rulership had passed to another leader of the same class, Tukaji Holkar, whose son, Jeswant Eao, took an important part in the contest for predominance in the Maratha-confederation. He did not, however, join the combined army of Sindia and the raja of Berar in their war against the British in 1803, but after its termination he provoked hostilities which led to his complete discomfit-

ure. At first he defeated a British force that had marched against him under Colonel Monson ; but when he made an inroad into British territory he was completely defeated by Lord Lake, and was compelled to sign a treaty which deprived him of a large portion of his possessions. After his death his favourite mistress, Tulsi Bace, assumed the regency, until in 1817 she was murdered by the military commanders of the Indore troops, who declared for the Peshwa on his rupture with the British Government. After their defeat at Mehidpore in 1818, the state submitted by treaty to the loss of more territory, transferred to the British Government its suzerainty over a number of minor tributary states, and acknowledged the British protectorate. For many years afterwards the administration of the Holkar princes was troubled by intestine quarrels, misrule, and dynastic contentions, necessitating the frequent interposition of British authority ; and in 1857 the army, breaking away from the chief's control, besieged the British Eesidency, and took advantage of the Mutiny of the Bengal sepoys to

spread turbulent disorder over that part of central India. They were subdued and the country was pacified after some fighting; but the relations of subsequent rulers with the British Government have since been frequently unsatisfactory, although no material change has taken place in their status or territorial settlement up to the present time.

Baroda.

The family of the Gaekwar, the hereditary title of the ruling prince of Baroda, was established about the middle of the 18th century in Gujarat, then a province of the Moghal empire on the western sea^coast of India. The founder of this family had been, like the other Maratha chiefs, a commander in the armies of the Peshwa, and, like the others, his descendant succeeded, after some fighting, in winning his independence and consolidating a separate chiefship. During the latter part of the cen-tury the Gaekwars contended with varying fortunes against the attempts of their nominal sovereign, the Peshwa, to regain his supremacy, until in 1780 the state's

independence was recognized by a treaty made with the British Government, under which that Government afterwards interposed on several occasions to protect the Gaekwar's territory from dismemberment by his rivals, and to support him against other claimants to the ruler-ship. The mutinies and internal disorders, which are or-dinary events in the history of these military chiefships, followed in due course; and the British Government, after lending aid to suppress them, applied the usual remedy of placing at the capital a subsidiary force, to be commanded by British of&cers and maintained by cession of land yielding revenue equal to its cost. The Gaek^var also had to keep up a body of cavalry for co-operation with the British army when required, and for upholding peace and good order within his own dominion.

[native states

It is unnecessary to recount the many instances in

which maladministration, financial difficulties, and the caprice of successive princes compelled the British Government to interfere during the 19th century, but it must be mentioned that in 1874 IVCulhax Rao G-aekwar was deposed, after a formal trial instituted by the Viceroy's order, for proved unfitness and incapacity. The widow of his predecessor was allowed to adopt a child, one of the family, who after the expiry of his minority was placed upon the throne, and has since proved himself a loyal and very capable ruler.

Kashmir.

The territory ruled by the Maharaja of Kashmir, with its tributary chief ships, comprises a wide highland region of 80,000 square miles, situated between the northern frontier of the Punjab and the Mustagh and Karakoram ranges of high mountains which mark the south-west frontier of Chinese Tibet. The early history of this country is obscure, although several invasions by the first Mahommedan conquerors of India are recorded, until the southern portion, Kashmir proper and Jamu, was finally annexed to

his Moghal empire by Akbar in 1587. But when Nadir Shah, the Persian, overran northern India and had sacked Delhi in 1735, he afterwards occupied Kashmir, which was incorporated with the kingdom of Kabul, and remained under that sovereignty until the Mahommedan governor of Kashmir revolted and made himself independent in 1809. Ten years later it fell beneath the rising power of the Sikhs, became a province of Ranjit Singh's kingdom in the Punjab, and on the conclusion of the campaign in 1846, in whi,ch the Sikh army was defeated after some fierce battles by the British, Kashmir was surrendered to the British Government and transferred as an independent rulership to Eaja Golab Singh, the Sikh governor, who had assisted the British forces during the war.

Bajputaiia.

In the official nomenclature of India Eajputana denotes a group of nineteen states, with varying area and importance, having each its own autonomy and separate chief, whose aggregate territories extend across India from the

borders of the North- West Provinces and the Punjab on the east and north to Sind and the Bombay Presidency on the west. To the south Eajputana marches with the states of central India. Sixteen of these states are ruled by chiefs of different Eajput clans, two of them by chiefs of the Jat tribe, and one by a Mahommedan prince. If the three last-mentioned states are for the present set aside, Eajputana may be described as the region within which the Eajput clans have maintained their independence under their hereditary chiefs ever since the Mahommedan irruptions drove them out of northern India to seek fresh settlements in the wilder and less accessible country where they are now found. Here they maintained constant resistance against the Mahommedan powers, until in the 16th century they submitted to the suzerainty of the Emperor Akbar, and began to furnish contingents to the Moghal armies in the incessant wars of the empire. When that empire collapsed the Eajput states were very nearly involved in its ruin, for during the political anarchy of the 18th century they were invaded,

pillaged, and almost brought under subjection by the Marathas and other predatory leaders. And although at the beginning of the 19th century the Maratha confederacy was broken up by the British forces, the Eajput states were incessantly harried and plundered by Pindarees and others, until, in 1818, the English Governor-General, Lord Hastings, interfered to save and protect them. Then ensued a great rectification of boundaries and restoration of territory that had been violently seized. The Eajput states made treaties acknowledging the British supremacy, and the whole country has thenceforward enjoyed security, disturbed only by a short period of confusion during the sepoy mutiny of 1867, and by occasional disorders that have arisen out of misrule or disputed successions in particular states.

The geographical position, within Eajputana, of the nineteen states may be roughly given as follows : — In the west and north are Marwar or Jodhpur, Bikanir, Jesulmer, ruled separately by chiefs belonging to the same clan. In the north-east is Alwar and a tract called the

Shaikhawati, subject indirectly to Jaipur. Jaipur, Bhart-pur and Dholpur (the two Jat states), Karauli, Bundi, Kotah, and Jhalawar may be grouped together as the eastern and south-eastern states. The southern states are Partabgarh, Banswara, Dungarpur, and Meywar or Oodipur, with its subordinate chiefship of Shahpura. Sirohi lies in the south-west corner, Kishangarh near the centre, while the Mahommedan state of Tonk consists of six isolated patches of territory. The Eajput states, ruled by the hereditary chiefs of the clans, represent by far the oldest principalities in India, tracing their origin to a period long anterior to the Moghal empire, whereas we have seen that almost all other states in India arose in the confusion that followed the empire's dissolution. The states of Bhartpur and Dholpur were founded towards the end of the 18th century by families of the Jat tribe, and Tonk is formed out of the lands confiLrmed in the possession of a famous f reebooting leader. Amir Khan, by the British Government in 1817.

Central India.

Under this official heading are grouped a number of states lying to the south and east of Eajputana. They include seventeen principal states, of which the largest are Gwalior and Indore, already noticed separately, and a number of petty chiefships that had been made tributaries to the great Maratha states, but which are now under the immediate protection of the British Government. Many of the minor chiefships belong to the Eajput families ; others were acquired by the Maratha leaders at the time when this part of India had fallen almost entirely under the Maratha domination ; and Bhopal was founded early in the 18th century by an Afghan commander in the service of the Moghal emperor. The petty chiefships of Dewas and Dhai are ruled by the descendants of an ancient Maratha family which acquired lands in central India during the 18th century.

At the close, in 1818, of the Pindaree war the whole country that is now imder the central Indian agency was in great confusion and disorder, having suffered heavily

from the extortions of the Maratha armies and from the predatory bands. It had been the policy of the great jNIaratha chiefs, Holkar and Sindia, to trample down into complete subjection all the petty Eajput princes, whose lands they seized and from whom they levied heavy contributions of money. Many of these minor chiefs had been expelled from their possessions, had taken refuge in the hills and forests, and retaliated upon the Maratha usurpers by wasting the lands which they had lost until the Marathas compounded for peace by paj— ment of blackmail. In this state of affairs all parties agreed to the interposition of the British Government for the restoration of order, and under Lord Hastings the work of pacification was effected. The policy pursued was to declare the permanency of the rights existing at the time of the British interposition, conditionally upon the maintenance of order; to adjust and guarantee the relations of subordinate and tributary chiefs -v^ith their

superiors, so as to prevent all further disputes or encroacli-ments ; and to settle the claims of the ousted landholders who had resorted to pillage or blackmail, by jBxing grants of land to be made to them, or settling the money allow-ances to be paid to them. The general result was to place all the privileges, rights, and possessions of these inferior chiefs under the guarantee or protection of the British Government, to whom all disputes between the superior and inferior states must be referred, and whose decision is final upon all questions of succession to hereditaiy rights or rulership.

Other States.

There is also a group of minor states lying along the south-west border of the British North- Western Provinces, in political relation with the Central Indian agency, whose country has the general name of Bundelkhand. In num-ber they are thirty-one, the largest being Eewa ; and most of them resemble in origin and formation the states in Rajputana, being ruled by chiefs of dominant Eajput clans. Their history is similar to that of the Central

Indian chiefships : they were invaded and partly subdued in the course of the 18th century by the Maratha powers ; they suffered much from the confusion of that period, until at the beginning of the 19th century some of them placed themselves under the protection of the British Government; and when, in 1817, the Peshwa ceded all his sovereign rights over this country to the British, a general settlement ensued. Some portions of the territory accrued, by cession or lapse, to the British Government ; and all the remaining chiefships were secured in their rights and possession by treaties or grants, or by taking acknowledgments of fealty, on the usual conditions of allegiance and orderly rule.

The very numerous minor states not belonging to the groups that have already been described are all attached, for supervision and immediate control, to the local governments of the British provinces to which they are adjacent, or within whose territories they are enclosed, important political questions being referred to the Government of India. They may be thus classified : —

States in relation with the Punjab, including the petty Himalayan chiefships.

States in relation with the North-West Provinces and Bengal.

States within or attached to the Bombay Province.

States within or adjacent to the Central Provinces.

States within or adjacent to the Madras Province.

The petty chiefships and tribal tracts on the border-land between Burma and China or Siam, and on the north-eastern frontier of Assam, can hardly be reckoned geographically among the native states of India, although they are in political subordination to the nearest local governments, or, as in the case of Manipur, to the Gov-ernment of India. There are, moreover, some important states situated within the great mountain ranges that separate India from the rest of Asia, which are in treaty relations with the British Govermnent, and over which that Government maintains a protectorate, in the sense of allowing no interference with them by any foreign Power. In this class may be placed Bhotan and Sikkim on the

north-east frontier, with Nepal; and Gilgit, Hunza, and Chitral on the extreme north-west frontier of the Indian empire. Between the north-west border of the Punjab province and the kingdom of Afghanistan are the high-lands inhabited by various unruly tribes, whom the Indian Government is gradually bringing under some control. And beyond the western frontier of India, extending to the borders of Persia, lies Baluchistan, a wide, sparsely populated region, occupied by tribes under the nominal headship of the khan of Kelat. It may be classed as a protectorate under the superintendence of a British Resident at Quetta, a military station in the British dis-trict that has been established at the north-eastern corner of Baluchistan.

Further details concerning the native states will be found under the separate headings. (a. c. l.)

India, French.— This name denotes the French establishments in India — on the Coromandel coast, Pondi-cherry and Karikal ; on the Orissa coast, Yanaon ; on the Malabar coast, Mah^ ; and in Bengal, Chandarnagar. In

addition there are a few " lodges " divided among these five districts, but they are merely nominal remnants of Prench dominion. The total area extends to about 200 square miles, of which 120 square miles belong to the territory of Pondicherry. In 1897 the total population amounted to 283,053, that of Pondicherry being 172,941 (city only, 48,473) ; of Karikal, 70,526 ; of Chandarnagar, 24,281; of Mahe, 9978; of Yanaon, 5327. In 1901 the total was only 273,185. By decree of 25th January 1879 French India was provided with an elective general council and elective local councils. The results of this measure have not been very satisfactory, and the qualifications for and the classes of the franchise have been variously modi-fied. The governor resides at Pondicherry, and is assisted by a privy council. There are two tribunals of first in-stance (at Pondicherry and Karikal), one court of appeal (at Pondicherry), and five justices of the peace. The local budget for 1901 balanced at £78,135. In the colonial budget of Prance for 1900 the possessions figured for £18,200. The debt (annuity) amounts to £4000. The

agricultural produce consists of rice, earth-nuts, tobacco, the betel nut, and vegetables. Earth-nut cultivation is passing through a serious crisis, which has considerably affected the trade of Pondicherry. There are 35,000 head of cattle. Pondicherry manufactures and exports " quinees " and muslins ; Karikal, linen cloth ; Chandar-nagar, jute ; Mahe, spirits.

The following table shows the value of the imports and exports in 1898 : —

District.

Imports.

Exports.

Pondicherry .

Karikal .

Chandarnagar

Mah6 .

Yanaon

£83,000

36,000

2,400

3,800

£231,000

82,800

i',900

500

Total .

£125,200

£316,200

Of the total imports Prance sent to the value of £82,500 ; of the total exports she received to the value of £19,600. In 1899 the imports reached a total value of £192,560 (£59,520 from Prance), and the exports a value of £371,320 (£119,320 to Prance). The trade with Prance has declined more rapidly than the general trade, though that has fallen from a total (imports and exports) of £1,020,000 in 1888. British India and Great Britain have a predominating share in both imports and exports. At Pondicherry and Karikal, in 1898, 397 vessels of 643,760 tons entered, and 397 of 643,710 tons cleared. See Haurigot. French India. Paris, 1887. — Heneiqtie. Les

Colonies Frangaises. Paris, 1889. — Lee. French Colonies. Foreign OflBce Report, 1900.— iMranee Coloniale. Paris, 1900. (p. x,.)

Indiana, one of the central states of the American Union, was admitted into the Union in 1816. Then it was the most westerly state on the frontier. The centre of population of the United States now rests within her borders. The soil is fertile, the climate equable, the average temperature being 52° P., and the rainfall 39^^ inches per annum.

Population. — The population has increased steadily

from the first, and, as shown by the national census, nearly constantly at the rate of 300,000 in each decade except that ending with 1890. In 1890 the population was 2,192,404, of whom 2,046,199 were native and 146,205 foreign-born. In 1900 it was 2,616,462, showing an increase of 324,058, or 14-8 per cent., as compared with 214,103, or 10-8 per cent., in the preceding ten years. Of the total population in 1900, 1,285,404 (51-1 per cent.)

were males, and 1,231,068 (48-9 per cent.) females; 2,374,341 native-born, and 142,121 (5-6 per cent.) foreign-born ; 2,458,502 were white, and 57,960 (2-3 per cent.) coloured, of whom 57,505 were negroes, 207 Chinese, 6 Japanese, and 243 Indians. The total land surface is approximately 35,910 square miles, so that the average number of persons per square mile was 70-1 in 1900, as compared with 61-1 in 1890. There were in 1900 42 in-corporated places with more than 5000 inhabitants; of these 23 had between 5000 and 10,000 inhabitants, 14 had from 10,000 to 26,000, and 5 had more than 26,000. These 6 were Indianapolis with 169,164, Evansville with 59,007, Fort Wayne with 45,115, Terre Haute with 36,673, and South Bend with 35,999. In 1890 the urban popula-tion (persons in cities of 8000 inhabitants or more) was 400,566, or 18-3 per cent, of the total population of the state ; in 1900 it was 607,834, or 24-2 per cent, of the total population.

Agriculture. — ^Agriculture was the first, and remains the chief industry. All kinds of cereals, fruits, and domestic animals, com-

mon to the temperate zone, are raised throughout the state. In 1900 there were grown 169,926,921 bushels of corn, and in 1899 31,357,099 bushels of wheat. In 1899 farm products yielded an aggregate value of $167,967,870.

Coal, Gas, and Oil. — Since 1880 great progress has been made in mechanical and mining industries, owing largely to the development of the coal-fields and the discovery of natural gas and petroleum. The coal-fields lie in the south-western part, and have an area of 7660 square miles. The coal is practically inexhaustible, excellent in quality, and finds a ready market in the state, and also in Chicago, St Louis, and other cities. It is a favourite fuel with railway companies. The output was 4,228,086 tons in 1897, 5,177,044 tons in 1898, and 6,283,063 in 1900. Natural gas was discovered in 1884. It was soon ascertained that the field was the largest known in the United States. It covers an area 100 miles long and 70 miles wide, between Indianapolis and Tort Wayne. The gas is found in a porous (Trenton) limestone, at an average depth of 1000 feet. Since 1887 it has been used almost exclusively for fuel and light over the entire field. At first the natural pressure (325 pounds to the square inch) was sufficient to carry it for

many miles, and it was supplied through pipes to the towns and cities within 40 or 50 miles of the rim of the reservoir, and used for fuel. Pipe lines also extend to Chicago, Dayton, and other cities, the natural force being supplemented by artificial power. The enormous draft on the reservoir is reducing the pressure and narrowing the area. The state has passed necessary laws to prevent waste. Soon after the discovery of gas, oil was found just underneath it. In popular parlance, " as gas gives out oil comes in." A dead gas well is sometimes turned into a live oil well. On 1st January 1900 there were in the state 5480 wells, producing oil at the rate of 4,912,675 barrels per year. Coal, gas, oil, and other resources, including great beds of Oolite limestone and excellent clays, have since 1880 made Indiana a great manufacturing state. The gas field has become a hive of industry. Glass of all kinds, tin-plate, iron and steel products, wire, nails, tiles, bricks, and many other articles are manufactured.

Manufattures. — The condition of manufacturing industries in 1890 and 1900 is shown in the following general table : —

1890.

1900.

Per Cent,

of Increase.

Number of establish-

ments .

Capital

Wage-earners (exclu-

sive of salaried oifi-

cials, clerks, &c.) .

Total wages

Jliscellaneous expenses

Cost of materials used

Value of products

12,354

$131,606,366

110,590

$42,577,258

$16,500,903

$130,119,106

$226,825,082

18,015

$234,481,628

156,956

$66,847,317

$33,052,160

$214,961,610

$.378,120,140

45-8

78-2

41

■57

100-3

65-2

60-7

The following table shows the statistics of the leading indus-

tries : —

Industry.

Number of

Establish-

ments.

Wage-

Earners.

Value of

Products.

Flouring and grist mill

products ....

897

2,124

$30,150,766

Foundry and machine-

shop products

337

10,339

17,228,096

Glass

110

13,015

14,757,883

Iron and steel .

27

7,579

19,338,481

Liquors, distilled and

malt ....

66

1,281

22,738,105

Lumber and timber pro-

ducts ....

1849

9,603

20,613,724

Slaughtering and meat

packing ....

36

3,597

43,862,273

Bailways. — Railway facilities have developed hand in hand with the manufactures. The mileage rose from 4963 in 1880 to 9072 in 190i!), and the business has grown in a greater ratio. Nineteen through lines cross the state from east to west, and eight lines from

north to south. Over these through lines passes almost the whole of the trans-continental traffic. The gross earnings in the state on domestic and through traflfic were reported in 1898 as follows : Local freight traffic, $49,903,808 ; through freight traffic, $39,127,-558 ; local passenger traffic, $20,827,316 ; through passenger traffic, .$6,235,542.

Valuation, Banks, &c. — The assessed valuation of all property in the state in 1880 was $767,387,172. The appraised value for 1900 was as follows : —

Value of lands

Improvement on lands

Value of lots

Improvement on lots

Personal property

Eailway property

Telegraph, Telephone, Express and Sleep-ing Car Companies

$462,647,064

84,058,993

159.572,824

162,450,644

318,942,386

163,938,059

6,136,828

$1,337,746,698

The state debt on 1st July 1901 was only $4,204,615. In 1901 there were 123 national banks, with resources amounting to $97,142,000 ; 104 state banks, with resources amounting to $25,644,273 ; 29 trust companies, with resources amounting to $12,336,207 ; 6 savings banks, with resources amounting to $7,237,684 ; 408 building and loan associations, with resources amounting to $31,435,587. The business done through the Indianapolis clearing-house in 1898 was $272,285,316 ; in 1899 ifwas $304,242,272.

Education and Charities. — Education is general and compulsory. In 1901 there were in the state 757,616 persons of school age (between six and twenty-one) . All children between seven and fourteen are required to attend public, private, or parochial schools for a period each year not less than the length of the term of the public school in the district in which the child lives, which in 1901 was at least six months. The average length of the annual term

throughout the state was 152 school days. Attendance is enforced by truant officers. Out of 720,206 males of voting age, 40,016 were illiterate (unable to write), of whom 7083 were foreign-born and 5042 were negroes. The state maintains graded and high schools, a university at Bloomington, a normal school at Ten-e Haute, and an agricultural and mechanical school (Perdue) at La Fayette. In 1898 there were twenty-seven higher institutions of learning in the state, with 4422 students and 537 instructors. The state also maintains a school for the orphans of soldiers and sailors. It also maintains four hospitals for the insane, with 3520 inmates ; one school for the blind, with 135 inmates ; one school for the deaf and dumb, with 336 inmates ; one boys' reform school, with 502 inmates ; one girls' reform school, with 56 inmates ; one prison for confirmed criminals, with 769 inmates ; one prison for reforming criminals, with 918 inmates ; one women's prison, with 253 inmates. Over all these institutions a state board of charities exercises a general supervision, and also over the gaols and poor-houses throughout the state.

Beligion. — In 1900 the number of communicants or membere of the principal religious denominations in the state was as follows :

Roman Catholic, 145,269 ; Methodist, 174,862 ; Baptist, 52,992 ; Presbyterian, 43,433; Lutheran, 69,697; Disciples of Christ, 92,788 ; Protestant Episcopal, 5003 ; Congregational, 3732. The total membership of all denominations was 725,409.

Local Government. — In 1899 the state adopted a new system of local administration, which is still in its experimental stage. In each township the voters elect a board of advisers, in whom is

vested the legislative power of settling the township expenditures for the ensuing year and levying taxes to meet the authorized outlay. In each county a hoard of seven councillors is elected, with similar powers and duties. These bodies are in fact local legislatures. They sit in public on certain fixed days, and pass the appropriations and levy the taxes for their several localities. Other local officers are charged with executing these laws, but they are prohibited from creating any debts except as authorized by the proper local boards. It is thought that this entire separation of legislative and executive duties will work a reform in the adminis-tration of local affairs and conduce to the public welfare.

Since 1860 the population has doubled, and owing to deaths, immigration, emigration, and natural growth, has almost entirely changed ; yet the political division of the voters has been so nearly equal that, during the period 1860-1900, each party won the election ten times, and owing to the presence of a small third party neither has generally polled quite 50 per cent, of all the votes cast. In the Presidential election of 1900 the total of votes cast was 664,094, of which 336,063 were RepubUcan and 309,584 Democrat. Constant rivalry and change have resulted in an honest administration of state affairs, and continued interest has not only trained many men to the duties of government and developed them into wider fields of statesmanship, but it has aroused others to activity in literature and art. (a. C. H.)

Indianapolis, the capital and chief city of the state of Indiana, U.S.A., situated in the centre of the state, in 39° 47′ N. lat., 86° 6′ W. long. . In 1900 it em-braced an area of 17,792 acres. Its population in 1890 was 105,436; in 1900, 169,164, with a death-rate of 16-7. Of the total population in 1900, 17,122 were foreign-born and 15,931 negroes. There were 48,697

persons of school age (5 to 20 years inclusive). Out of 62,544 males of voting age, 2526 were illiterate (unable to write). The streets are broad, well paved, shaded, and are often lined with lawns on either side. The state house and the court house stand in the centre of large squares, and the new post-office building is surrounded by a park. These, with its broad and shady streets and its many parks, aggregating in all over 1200 acres, make it one of the beautiful cities of the United States. The monument erected by the state in the centre of the city at a cost of over half a million dollars, to the memory of her soldiers and sailors of the Civil War, was designed by Bruno Schmidt of Berlin and executed in part by Macmonnies, and is considered to possess fine artistic qualities. There is an art school, and the University of Indianapolis, founded in 1896, has more than a thousand students. In 1900 there were 1910 manufacturing establishments with a capital of f36,828,114, an average number of 25,511 wage-earners (exclusive of salaried officials, clerks, &c.), and products valued at $68,607,579.

The most important industry was that of slaughtering and meat packing, with four establishments, 1920 wage-earners, and products valued at $18,382,679. Other important industries with the value of their products were : carriages and waggons, $2,264,928; flouring and grist mill products, $3,820,373 ; foundry and machine-shop products, $5,733,469.

As a railway centre Indianapolis is one of the leading cities of the Union, owing largely to its geographical position at a point Where the roads connecting north and south, east and west, naturally converge. It is estimated that 25,000 passengers daily pass through the Union Station near the heart of the city. The freight traffic is handled on a loop line (the Belt railway) through the outskirts, over which a million cars pass annually. Indianapolis is the great live-stock market for the Ohio valley, and the third largest in the United States. The railway traffic, together with the introduction of natural gas as a cheap fuel, has given a great impetus to industrial enterprise. In addition to the steam railways, electric street j-ailways diverge from the centre of the city and run to many surrounding towns. The assessed value of real

and personal property in 1900, on a basis of about two-thirds of the full value, was $126,675,040, and the total tax rate for all purposes was $19-20 per thousand dollars. The power to create municipal debts is limited by the state" constitution to 2 per cent, of the approved value. The debt in 1900 was $2,152,000. The capital invested in manufactures in 1890 was over fifteen million dollars, and the value of the product $36,426,974. (a. c. h.)

Indian Ocean, The, bounded on the N. by India and Persia ; on the W. by Arabia and Africa, and the meridian passing southwards from Cape Agulhas ; and on the E. by Farther India, the Sunda Islands, West and South Australia, and the meridian passing through South Cape in Tasmania. As in the case of the Atlantic and Pacific Oceans, the southern boundary is taken at either 40° S., the line of separation from the great Southern Ocean, or, if the belt of this ocean between the two meridians named be included, at the Antarctic Circle. It attains its greatest breadth, more than 6000 miles, between the south points of Africa and Australia, and becomes steadily narrower towards the

north, until it is divided by the Indian peninsula into two arms, the Arabian Sea on the west and the Bay of Bengal on the east. Both branches meet the coast of Asia almost exactly on the Tropic of Cancer, but the Arabian Sea communicates with the Bed Sea and the Persian Gulf by the Straits of Bab-el-Mandeb and Ormuz respectively. Both of these, again, extend in a north-westerly direction to 30° N. Murray gives the total area, reckoning to 40° S. and including the Eed Sea and Per-sian Gulf, as 17,320,550 English square miles, equivalent to 13,042,000 geographical square miles. Karstens gives the area as 48,182,413 square kilometres, or 14,001,000 geographical square miles ; of these 10,842,000 square kilometres, or 3,160,000 geographical square miles, about 22 per cent, of the whole, lie north of the equator. Eor the area from 40° S. to the Antarctic Circle, Murray gives 9,372,600 English square miles, equivalent to 7,057,568 geographical square miles, and Karstens'24,718,000 square kilometres, equivalent to 7,182,474 geographical square miles. The Indian Ocean receives few large rivers, the

chief being the Zambezi, the Shat-el-Arab, the Indus, the Ganges, the Brahmaputra, and the Irawadi. Murray estimates the total land area draining to the Indian Ocean at 5,050,000 geographical square miles, almost the same as that draining to the Pacific. The annual rainfall draining from this area is estimated at 4380 cubic miles.

Belief. — Large portions of the bed still remain unexplored, but a fair knowledge of its general form has been gained from the soundings of H.M.S. Challenger, the German Gazelle Expedition, and various cable ships, and in 1898 information was greatly added to by the German Valdivia Expedition. A ridge, less than 2000 fathoms from the surface, extends south-eastwards frOm the Cape (see Atlantic Ocean). This ridge, on which the Crozet Islands and Kerguelen are situated, is directly connected with the submarine plateau of the Antarctic. From it the depth increases north-eastwards, and the greatest depression is found in the angle between Australia and the Sunda Islands, where " Wharton deep," below the 3000-fathom line, covers an area of nearly 50,000 square miles. Immediately to the north of Wharton deep is the smaller "Maclear deep," and the long narrow "Jeffreys deep" off the

south of Australia completes the list of depressions below .3000 fathoms in the Indian Ocean. The 2000-fathom line approaches close to the coast except (1) in the Bay of Bengal, which it does not enter ; (2) to the south-west of India along a ridge on which are the Lacoadive and Maldive Islands ; and (3) in the Mozambique Channel, and on a bank north and east of Madagascar, on which are the Seychelles, Mascarene Islands, and other groups.

Islands. — Like the Pacific, the Indian Ocean contains more islands in tiie western than in the eastern half. Towards the centre, the Maldive, Chagos, and Cocos groups are of characteristic coral formation, and coral reefs occur on most parts of the tropical coasts. There are many volcanic islands, as Mauritius, the Crozet Islands, and St Paul's. The chief continental islands are Madagascar, Sokotra, and Ceylon. Kerguelen, a desolate and uninhabited island near the centre of the Indian Ocean at its southern border, is noteworthy as providing a base station for Antarctic exploration.

Volume and Mean Depth. — The greatest depth hitherto recorded is 32-32 fathoms, by the Valdivia, in 18° 18′ S. and 96° 20′ E. Karstens gives the total volume of the ocean down to 40° S.

as 187,396,627 cubic kilometres, or 29,352,683 (geographical) cubic miles, whence he obtains a mean depth of 2216 fathoms. Calculating for the area down to 66° S., he finds the volume to be 266,354,254 cubic kilometres, or 41,720,132 cubic miles, giving a

mean depth of 1997 fathoms. Murray's value for the total volume (to 40° S.) is 44,446,700 (English) cubic miles, giving a mean depth of 2286 fathoms. For the areas and depths at different levels Murray gives the following: —

Depth

Area

Volume

(Fathoms).

(Square Miles),

(Cubic Miles).

0-100

979,500

1,910,300

100-500

809,100

7,243,800

500-1000

551,700

8,720,100

1000-2000

1,596,950

16,416,100

2000-3000

13,344,600

10,153,550

3000-4000

38,700

2,850

17,320,550

44,446,700

Deposits. — The bottom of the Bay of Bengal, of the northern part of the Arabian Sea, of the Red Sea and the Persian Gulf, and of the narrow coastal strips on the east and west sides of the ocean, are chiefly covered by blue and green muds. Off the African coasts there

are large deposits of Glauoonitic sands and muds at depths down to 1000 fathoms, and on banks where coral formation occurs there are large deposits of coral muds and sands. In the deeper parts the bed of the ocean is covered on the west and south by Globigerina ooze, except for an elongated patch of red clay extending most of the distance from Sokotra to the Maldives. The red clay covers a nearly square area in the eastern part of the basin bounded on two sides by the Sunda Islands and the west coast of Australia, as well as two strips extending east and west from the southern margin of the square along the south of Australia and nearly to Madagascar. In the northern portion of the square, north and east of "Wharton deep, the red clay is replaced over a large tract by Radiolarian ooze.

Temperature. — The mean temperature of the surface water is over 80° F. in all parts north of 13° S., except in the north-west of the Arabian Sea, where it is somewhat lower. South of 13° S. temperature falls uniformly and quickly to the Southern Ocean. Between the depths of 100 and 1000 fathoms temperature is high in the north-west, and in the south centre and south-west, and low in the north-east, the type of distribution remaining substantially the same. At 1500 fathoms temperature has become very uniform,

ranging between 35° and 37° F., but stiU exhibiting the same type of distribution, though in a very degenerate form.

Salinity. — The saltest surface water is found in (a) the Arabian Sea and (6) along a belt extending from West Australia to South Africa, the highest salinity in this belt occurring at the Australian end. South of the belt salinity falls quickly as latitude increases, while to the north of it, in the monsoon region, the surface water is very fresh off the African coast and to the north-east. Little is known with certainty about the distribution of salinity in the depths, the number of trustworthy observations available being still very small. Probably the northern and north-eastern region, within the monsoon area, contains relatively fresh water down to very considerable depths.

Circulation. — ^North of the equator the surface circulation is under the control of the monsoons, and changes with them, the currents consisting chiefly of north-east and south-west drifts in the open sea, and induced streams following the coasts. During the northern summer the south-west monsoon, which is sufBciently strong to bring navigation practically to a standstill except for powerful steamers, sets up a strong north-easterly drift in the

Arabian Sea, and the water removed from the east African coast is replaced by the upwelling of cold water from below ; this is one of the best illustrations of this action extant. Along the line of the equator the Indian counter-current flows eastwards all the year round, acting as compensation to the great Equatorial current flowing westwards Isetween the parallels of 7° and 20° S. The equatorial current, on meeting the northern extremity of Madagascar, sends a branch southwards along the east coast of that island, sometimes called the Mascareiie current. When the main equatorial current reaches the African coast a minor stream is sent northwards to the source of the Indian counter-current, but tho discharge is chiefly by the Mozambique current, which south of Cape Corrientes becomes the Agulhas current, one of the mo.st powerful stream currents of the globe. On the west coast of Madagascar and on tho banks off the African coast south of 30° S., reaction currents or "back-drifts" move in the opposite direction along the flanks of the Agulhas current ; these back-drifts are of great importance to navigation. On clearing the land south of the Cape the waters of the Agulhas current meet those of the west wind drift of the Southern Ocean, and mingle with tHem in such a manner as to

produce, by interdigitation, alternate strips of warm and cold water, which are met with at great distances south-west and south of the Cape. Between South Africa and Australia the waters form a part of the great west wind drift. The waters of this drift are, in general, of very low temperature, but it is remarkable that the interdigitation just mentioned continues far to the eastward, at least as far as Kerguelen. This fact is probably due partly to the actual intrusion of warm water from the Mascarene current east of Madagascar, and partly to the circumstance that the different temperatures of the waters are so compensated by their differences of salinity that they have almost precisely the same specific gravity in situ. The west wind drift sends a stream north-wards along the west coast of Australia, the West Australia current, the homologue of the Benguela current in the South Atlantic. The principal feature in the circulation in the depths of the Indian Ocean is a slow movement of Antarctic water northwards along the bottom to take the place of that removed from the surface by evaporation, and by currents in the lower latitudes. Little is known beyond the bare fact that such movement does take place. (h. n. d.)

Indians, North American. — The last quarter of the 19th century was marked by a few significant uprisings among the Indian tribes of the United States. The year 1875 closed with the Indians generally peaceable, although trouble had been anticipated with mixed bands of Sioux, under Sitting Bull, who had refused to recognize Federal authority, and who for some years had been leading a roving life, plundering and murdering settlers and extending their hostility to friendly tribes. This force, numbering 3000, was augmented from time to time; and early in 1876, owing primarily to infraction of treaty stipulations by the white invasion due to the discovery of gold in the Black Hills, a large number of starving Sioux fled from their agencies and joined the hostiles. As the Indians refused to return to their reservations when so ordered, the matter was placed in the hands of the War Department, 1st February 1876. Under the leadership of Sitting Bull, Crazy Horse, and others, the uprising assumed a more general nature by the enlistment of the northern Cheyennes in the Sioux cause. The first blow

was struck by Crook, who surprised the camp of Crazy Sioux Horse, 16th March, and destroyed 110 lodges and other j876^ property. Later a force of about 2700 men (besides the Crow scouts) , in three columns, under Terry, Gibbon, and Crook, was made ready ; and on 17th June the last mentioned, with 1000 men, met the enemy near Rosebud river, and after fighting for six hours the Indians retired. On 22nd June Custer, with 7th cavalry, was sent up the Rosebud, and continued up that stream until the evening of the 24th, the next morning passing over the divide to the Little Big Horn, where the Sioux were discovered. Custer divided his regiment into four commands, his own comprising 262 men. Continuing a few miles down stream, he soon came upon what was supposed to be a single Sioux village, and began to attack its lower end ; the Indians, however, proved to number from 8000 to 10,000, including 2500 to 3000 warriors. Custer's little force was soon completely surrounded, and the entire command, save a single Crow scout, was slaughtered. The Indians now separated into two bands, under Sitting Bull and Crazy Horse, who were soon reinforced by other reservation Indians. Fresh troops were hurried forward. (5n 29th September a band under American Horse was defeated and their leader killed. In

October Sitting Bull was pursued by Colonel Miles for 40 miles, and by the close of the month about 5000 Indians surrendered. The campaign continued throughout the winter and early spring under Crook and Miles, and several fights occurred, in which the Indians suffered severely. In March 1877 300 surrendered, and these were followed on 22nd April by 2000 under Crazy Horse. Sitting Bull, however, eluded capture, and crossing the Canadian border was soon largely renif orced. This warrior held out defiantly until 1880, when he returned to Dakota with his 2856 followers and surrendered. One of the immediate effects of the beginning of this revolt was the appointment of a commission which negotiated for the surrender of the Black Hills country. The treaty was approved by Congress on 28th February 1877.

Before the conclusion of difficulties with the Sioux trouble was experienced with the Nez Percys of northern Idaho, the course of which was similar to that of most of the Indian hos-tilities—the discovery of gold, the influx of miners and ,m If settlers, the establishment of towns on Indian lands, the confiscation of Indian property. To regulate the difficulties a series of treaty commissions was appointed, which succeeded

in effecting a reduction of the Indian tribal lands, although the action was bitterly opposed by a non-treaty element of the tribe. Such, in brief, were the transactions up to 1875 ; tlien a member of the band of chief Joseph, the leader of the non-treaty Nez Percfe, was killed by whites, and the Indians are said to have made depredations on the crops of the latter ; while a

Baanock

outbreak.

native leligious sect, known as Dreamers, under the leadership of Smohalla, tended to widen the breach. Matters grew so serious that, in October 1876, another commission was appointed, and in December it recommended that the medicine-men be ordered to their reservation, that Wallowa valley be occupied by the military, and that Joseph and his band be placed on Lapwai reserve. These recommendations were adopted, and a force was despatched under General 0. 0. Howard. In May 1877 he held three councils with the discordant Indians, and even induced them to visit Lapwai reserve to select their lands ; but when the time came for leaving

their ancestral home, although Joseph used his influence to avert the clash, open hostilities began on 14th June by the massacre of twenty-one white men and women in revenge for the recent murder of one of the Nez Percys by white robbers. From this time the fighting between Joseph's liundred warriors and the troops was brave, though severe ; but surrounded by an overwhelming and well-equipped force, hindered in their movements by 350 helpless women and children, and discouraged by the loss of some of their leaders, the struggle ended on 5th October, after a retreat of over a, thousand miles, probably unequalled in Indian warfare, by the surrender of almost the entire force to Colonel Miles on condition that they were placed on Lapwai reserve. Regardless of this agreement, the surrendered Nez Percys were sent to Quapaw Agency, Indian Territory, whence, after seven years of delay, and the loss by death of nearly two-thirds of the band, they were returned to the north-west.

These experiences seemed to be of little avail in causing the Government to carry out its treaty obligations ; consequently there were outbreaks by the Indians, owing mainly to the loss of their hunting lands, the diminution of the bison herds, and the

failure of Congress to render timely relief. It was principally these causes which led to the Bannock outbreak of 1877, their trouble, like that of the Nez Percys, being of long standing. The climax was almost reached early in the year named, when, during the exciting times of the Nez Percfe war, the Bannocks were forced to remain on their inhospitable reservation, to face the continued encroachment of the whites, and to subsist on gdods provided from an appropriation amounting to 2J cents per capita per diem. During the summer a drunken Indian of the tribe shot and wounded two teamsters ; the excitement and bitter feeling caused by his arrest on 23rd November resulted in the killing of an agency employee. Troops were called for, and the murderer was pursued, captured, tried, and executed. This so increased the excitement of the Indians that, fearing what was assumed to be threatening demonstrations, the troops surrounded and captured two Bannock camps in January 1878 ; but most of the Indians were afterwards released. On account of insufficient food the Bannocks left the reservation in the spring and went to Camas prairie, where they killed several settlers. A vigorous campaign under General Howard resulted in the capture

of about a thousand of them in August, and the outbreak came to an end after a fight, 5th September, at Clark's Ford, where twenty Bannock lodges were attacked, and all the women and children killed.

After the close of the Sioux outbreak of 1876-77 the Northern Cheyennes, numbering 937, who participated with the Sioux in that rebellion, were sent to Indian Territory. Early In September 1878 about 300 of these Indians, dissatisfied with their new quarters, left the reservation, determined to rejoin the Sioux. In passing through Kansas they killed more than forty whites, and committed other outrages. They were pursued, and 150 were captured and confined at Fort Robinson, Nebraska, whence it was decided to return them to Indian Territory, a plan to which the Indians refused to agree. After starving and freezing for several days, they made a desperate attempt to escape in June 1879, when nearly all were killed. The survivors were sent back to Indian Territory.

In July 1879 about 100 men of the White River Agency, Colorado, roamed from their reservation into southern Wyoming to hunt. During this time some forests were fired by railway tiemen, resulting in great loss of timber, and calling forth complaint

against the Indians, who were ordered to remain henceforth on their reservation. In September the agent. Meeker, was assaulted after a quarrel with a petty chief, and requested military aid, which was granted. Orders were later issued for the arrest of the Indians charged with the recent forest fires, and Major Thornburgh was sent with a force of 190 men. Suspecting the outcome, the Indians procured ammunition from neighbouring traders, and informed the agent that the appearance of the troops would be regarded as an act of war. On 20th September Thornburgh's detachment was ambushed, and their leader and thirteen men were killed. The com-mand fell back. On 2nd October a company of cavalry arrived, and three days later Colonel Merritt with 600 troops reached the scene. At or near the agency the bodies of Meeker and seven employees were found ; all but one of the agency buildings had been rifled and burned. The conflict was soon ended, mainly through the peaceful attitude and influence of chief Ouray.

*Ever since they have been known to history the various bands of Apaches have been hostile in character ; and although some of their raids have seemingly been unprovoked, the most serious outbreaks in modern times have been attributable P" **•*

to mismanagement on the part of the civil authorities. The most Important series of outbreaks during this period was by the Chiri-cahua band under Cochise, and later Victorio, who, together with 500 Mimbreflos, Mogollones, and Mescaleros, were assigned, about 1870, to the Ojo Caliente reserve. New Mexico. Cochise, who had repeatedly refused to be confined within reservation limits, fled with his band, but returned in 1871, at which time 1200 to 1900 Apaches were on the reserve. Complaints by neighbouring settlers caused their removal to Tularosa, some distance north-westwards, but a thousand fled to the Mescalero reserve on the Pecos river, while Cochise left on another raid. Efforts of the military agent in 1873 to compel the restoration of some stolen cattle caused all (then numbering 700) again to decamp, but they were soon captured. Following the wishes of the Indians, they were returned to Ojo Caliente in 1874. Soon afterwards Cochise died, and the Indians began to show such interest in agriculture that by the following year there were 1700 Apaches at Ojo Caliente, and no depredations were reported. In 1870 the Chiricahua reservation in Arizona was abolished, and 325 of the Indians were removed to the San Carlos agency ; others joined their kindred at Ojo Caliente, while some

either remained in the mountains of their old reservation, or fled across the Mexican border.

This removal of Indians from their ancestral homes was in pursuance of a "policy of concentration." The cost of the experiment is difficult to estimate ; the expense of the campaigns which followed during the next ten years of warfare amounted '^^PoU'V to millions of dollars, while fortunes were lost in the ^^fjig^""' destruction of property, and hundreds of lives were sacrificed on both sides. This policy was thoroughly tested in the Chiricahua removal in Arizona, for in April 1877 Geronimo and other chiefs, with the remnant of the band left on the old reservation, and evidently the Mexican refugees, began depredations in southern Arizona and northern Chihuahua ; but in May 433 were captured and returned to San Carlos. At the same time, the policy of concentration was applied to the Ojo Caliente Apaches of New Mexico, who were making good progress in civilized pursuits, but when the plan was put in action only 450 of the 2000 Indians were found, the remainder forming into predatory bands under Victorio. In September 300 Chiricahuas (mainly of the Ojo Caliente band) escaped from San Carlos, but surrendered after many engagements.

These were returned to Ojo Caliente, but they soon ran off again. In February 1878 Victorio surrendered, in the hope that he and his people might remain on their former reservation. Instead of this, another attempt was made to force the Indians to go to San Carlos, with the same result. In June the fugitives again appeared at the Mescalero agency, and arrangements were at last made for them to settle there ; but the civil authorities finding indictments against Victorio and others, charging them with murder and robbery, this chief with his few immediate followers, and some Mescaleros, fled from the reserve and resumed marauding. There was the usual call for an increased force of military, but the skirmishes in which they were engaged with the Chiricahuas met with remarkable success for the latter, while seventy settlers were murdered during a single raid. Thus encouraged, Victorio was joined before April 1880 by 350 Mescaleros and Chiricahua refugees from Mexico, and the repeated raids which followed struck terror to the inhabitants of New Mexico, Arizona, and Chihuahua. On 13th April 1000 troops under Colonel Hatch arrived, and these were later greatly augmented. Victorio's band was frequently encountered by overwhelming forces, and although supported during most of the time

by only 250 or 300 warriors, this warrior usually inflicted severer punishment than he suffered. In these raids 200 citizens of New Mexico, and as many more of Mexico, were killed. At one time the band was virtually surrounded by a force of over 2000 cavalry and several hundred Indian scouts ; but Victorio eluded capture and fled across the Mexican border, where his bloody campaign was continued. Pressed on both sides of the international boundary, and at times harassed by American and Mexican troops combined, Victorio finally suffered severe losses and his band became divided. In October 1880 Mexican troops, under Colonel Terrazas, encountered Victorio's party, comprising 100 warriors, with 400 women and children, at Tres Casillos. The Indians were surrounded and attacked in the evening, the fight continuing throughout the night. In the morning the ammunition of the Indians became exhausted, and although rapidly losing in strength, the remnant refused to surrender, until Victorio, who had been wounded several times, finally fell dead. This disaster to the Indians did not quell their hostility. Victorio was succeeded by Nana, who collected the divided force, received reinforcements from the Mescaleros and the San Carlos Chiricahuas, and between July 1881 and April 1882 continued

the raids across the border, but was again driven back into Chihuahua. While these hostilities were in progress in New Mexico and

*Chihualiua, the Chiricahuas of San Carlos were striking terror in Depreda- *^.® settlements of Arizona. In 1880 Juh and Geronimo, tlotts In ^^*^ ■'■^^ followers, were captured and returned to San Arizona. Carlos, and in June 1881 trouble arose among the White Mountain Apaches on Cibicu Creek, owing to a medi-cine-man named Nakaidoklini, who claimed the power to revive the dead— for a consideration. Being liberally compensated, the prophet began the incantations that were to fulfil his predictions. His adherents waited the resurrection until August, when Nakai-doklini avowed that the dead refused to return because of the presence of whites. As affairs were assuming a serious aspect, the prophet's arrest was ordered. He surrendered quietly, but as the troops were making camp the scouts and many other Indians opened fire on them. After a sharp fight Nakaidoklini was killed and his adherents were repulsed. Skirmishes continued during the next day, but the troops were reinforced, and the Indians soon*

surrendered in small bands. Two chiefs, known as George and Bonito, who had not been engaged in the White Mountain troubles, surrendered to General Wilcox, 25th September, at Camp Thomas, but were paroled. On 30th September Colonel Riddle was sent to bring these chiefs and their bands back to Camp Thomas; but they became alarmed and fled to the Chiricahuas, seventy-four of whom left the reserve, and, crossing the Mexican border, took refuge with the late Victorio's band in Chihuahua. During the same year Nana (Victorio's successor) made one of his bloody raids from across the line, and in September Juh and Nahchi, with a party of Chiricahuas, again fled from the reservation, and were forced by the troops into Mexico, where, in April 1882, they were joined by Geronimo and the rest of the hostile Chiricahuas of San Carlos, with Loco and his Hot Springs band.

The depredations committed in northern Chihuahua under Geronimo and other leaders were perhaps even more serious than those within the limits of the United States. In March 1883 Chato, with twenty-six followers, made a dash into New Mexico, murdering a dozen persons. Meanwhile the white settlers on the upper Gila consumed so much of the water of that stream as to

threaten the Indian crops ; then coal was discovered on the reservation, which brought an influx of miners ; and investigation by the Federal grand jury of Arizona, on 24th October 1882, showed that, in the management of Indian affairs on San Carlos reservation, "fraud, peculation, conspiracy, larceny, plots and counter-plots seem to be the rule."

Meanwhile General Crook had been assigned the task of bringing the raiding Apaches to terms by co-operating with the Mexican troops of Sonora and Chihuahua. In May 1883 Crook crossed the international boundary to the headwaters of the Rio Yaqui with 50 troops and 163 Apache scouts. On the 13th the camp of Chato and Bonito was discovered, and attacked with some loss. By employing two captives as emissaries, communication was soon had with the others, and by 29th May 354 Chiricahuas had surrendered.

On 7th July the War Department assumed police control of the San Carlos reservation, and on 1st September the Apaches were placed under the entire charge of General Crook, who began to train them in the ways of civilization, with such success that in 1884 over 4000 tons of grain, vegetables, and fruits were harvested.

In February 1885 Crook's powers were curtailed ; this led to con-

flict of authority between the civil and military officers, but before matters could be adjusted half the Chiricahuas left the reservation in May and fled to their favourite haunts. Troops and Apache scouts were again sent forward, and many skirmishes took place, but the Indians were wary, and again Arizona and New Mexico were thrown into a state of excitement and dread by raids across the American border, in which seventy-three white people and many friendly Apaches were killed.

In January 1886 the American camp, under Captain Crawford, was attacked through misunderstanding by Mexican irregular Indian troops, resulting in Crawford's death. By the following March the Apaches became tired of the war and asked for a parley, which Crook granted as formerly ; but before the time for the actual surrender of the entire force arrived the wily Geronimo changed his mind, and with his immediate band again fled beyond reach. This led to severe criticism of Crook's policy. He was consequently relieved, at his own request, in April, and to General Miles was assigned the completion of the task. Geronimo and his band finally surrendered, 4th September 1886, and with numerous friendlies were sent to Florida as prisoners. They were

later taken to Fort Sill, Oklahoma, where, now numbering 298, they are making progress towards civilization. Some of the mal-contents were never captured, but remained In the mountains, and as late as November 1900 manifested their warlike propensity in a fight with Mormon settlers ; but Apache hostility in Arizona and New Mexico has entirely ceased.

No further trouble of a serious nature was experienced among the Indians until 1890, in which year occurred the so-called Sioux outbreak, which culminated in the tragedy of Wounded Knee.

This diifloulty was due in part to a religious excitement, known as the ghost-dance craze, which had its origin in the dream of a Paiute Indian of Nevada, and which spread from the Canadian ^ boundary to Oklahoma ; and secondarily, to the failure J°”,, on the part of the Government to fulfil its treaty stipu- ^^^ ^^ lations in the matter of rations. By October 1890 it was reported that some of the Sioux, under the influence of the noted Sitting Bull, had become excited over the prediction of an approaching millennium, or ” return of the ghosts, ” when the white people would be annihilated ; but to bring about this result the Indians must believe and organize the ghost-dance. By 13th

November, some of the agents having lost control owing to the excitement caused by the new doctrine, the War Department assumed authority. On 15th November the agent at Pine Ridge became panic-stricken and sent for troops, and soon there were nearly 3000 soldiers in the Sioux country. The appearance of the military was a signal for the flight to the Bad Lands of 1500 Indians, who were soon followed by others, until 4000 had left their agencies. As Sitting Bull still continued the ghost-dance, his arrest was planned. On 15th December Indian police surrounded his house, when he agreed to surrender, but the gathering of his immediate followers encouraged him to change his mind ; he defied arrest ; one of his friends shot a policeman, and Sitting Bull himself, his son, and seven others were killed in return, the Indian police losing six. The killing of Sitting Bull resulted in the stampede of another party, but they were overtaken. An attempt to disarm them on the morning of 29th December at Wounded Knee Creek, a few miles from the Pine Ridge agency, led to a hand-to-hand encounter, in which nearly every Indian warrior and a number of their women and children fell. The women and children who survived the first volleys were pursued by the troops for two miles, their dead bodies

littering the way. Of the 370 members of Big Foot's band, including all ages and both sexes, about 300 were killed. This broke the backbone of the outbreak. The remaining Indians surrendered 16th June 1891, and thus was ended what. In aU probability, will be the last experiment in warfare by the Sioux.

The last Indian trouble occurred among the hitherto friendly Pillager Chippewas of Leech Lake, Minnesota. In 1889 the Chippewas ceded large tracts of valuable pine land on the representation that the sale of the timber would yield S^'fV^^ them a large fund. In the course of time three boards sturb- of appraisers were appointed, their e^xpenses, payable ^'"^• from the Indian funds, amounting to $280,000, the only return which the Indians received being an appraisal of their timber at from a fourth to a half of its value. Then authority was granted to white lumbermen to dispose of only " dead and down timber," but green timber was cut in enormous quantities at the expense of the Indians, while groves were burned to bring the trees nominally under the head of "dead" timber. In further justification of their final protest against white interference, it was officially announced that wholesale arrests of the Chippewas were made for

the sake of the fees which accrued to the state oflficials, and that Indians had been helped to obtain whisky by those who arrested them for using it. It was an arrest of this sort in September 1898 that led to the rescue of the prisoners by a number of their relatives, the result of which was the issuing of warrants against the Indians who had thus defied the law. Councils were held by the Chippe-was, at which the decision was reached not to surrender the men wanted by the court officials. On 3rd October, special Government agents having reached the scene, a general council was called, with assurance that none who attended would be arrested. Meanwhile troops had arrived to quell any threatened disturbance and to aid the sheriff in making the arrest. The accidental discharge of a gun by a soldier on 5th October caused some Indians secreted in the woods to open fire, killing Major Wilkinson and several soldiers. On the following day additional troops arrived, another council was held, and difficulties came to an end with the arrest and moderate punishment of most of those for whom warrants had previously been issued.

Such is the history of the strife between the Indian and the white man during the last quarter of the 19th

century. It has been seen that, in addition to delays on the part of the United States Congress in fulfilling its treaty obligations, the cause of many of the outbreaks was due to the fact that the Indian had too often failed to receive the sympathy which his savage state should have inspired in his civilized neighbour; again, as has been officially recognized, corrupt and ignorant agency employees frequently promoted discontent among their charges, while changing administrations often caused changes in the Indian service at times when men of experience were greatly needed. For these and other reasons there was for many years no definite policy on the part of the

United States Government for solving what became known as the Indian question. Indeed, as late lutlm'n." as 1876 it was officially declared that " the fundamental difficulty in our relations hitherto with Indians has been the want of a well-defined, clearly-understood, persistent purpose on the part of the Gov-

ernment." i&evertheless, it was not until 1887 that any definite plan for the civilization of the Indian was adopted, although much had been accomplished towards his education. At one time the policy was to concen-trate all the Indians within the limits of the United States on three great reservations, an expansion of the plan adopted earlier in the century, which set aside for the use of the eastern Indians the former " Indian country," which in after years became restricted to the Indian Territory. The sentiment in regard to great reservations, however, gradually weakened, until in 1878 it was proposed to concentrate the Indians on smaller reservations, "where they might be more readily pro-tected in their property rights," their vacated lands to be sold for their benefit. But gradually a feeling against the entire reservation system arose, and grew in strength from year to year, until finally definite action was taken by Congress 8th February 1887, which has had greater effect than any other towards dissolving tribal relations. This was the .enactment

of the " land severalty " law, which, as amended

severalty " 1890, provides for the survey of reser-

law, 1890. vations and the allotment to each person

of a tract ranging from 40 to 160 acres.

The law also provides for doubling the allotments

when the land is found valuable only for grazing,

and the sale of the remainder to white settlers.

Provision is also made that after receiving such land

allotments the Indians are declared citizens. Allotments

in severalty had been made to various Indians under

treaty provisions and congressional enactments, but it is

under the law of 1887 that most of the allotments have

been made. To 30th October 1900, 6,736,504 acres had

been allotted to 66,996 Indians. With the general allot-

ment law in operation, the way was clear for the final

abolishment of the reservation and agency systems.

All subsequent laws and treaties have had these ends in

view.

Ever since the establishment of the Government, in-

terest in the education of the Indians has been felt, and

as treaties were made and ratified, funds were sometimes provided for this purpose. Reservation boarding-schools were founded in 1865; in 1870 Congress appropriated $100,000 for Indian education. In 1877, $20,000 was appropriated for the support of Indian schools ; and in 1878, i $30,000 was granted for that purpose. In the latter year 103 Indian children were received at Hampton Institute, Virginia ; and on 1st November 1879, Lieutenant E. H. Pratt opened an Indian school at Carlisle Barracks, Pennsylvania, with 168 children. This was the beginning of the now well-known Carlisle school, which in 1900 had an enrolment of 1080 Indian pupils. The Indians are given a common school and industrial education, and an effort is made to equip each pupil with means for self-support. Unfortunately, many of the Indians on returning to their homes, owing to the lack of demand for their acquired knowledge, lapse into the primitive ways of their fathers. One of the features of the Carlisle school is its " outing system," by which pupils are employed by farmers and others as labourers,

domestic servants, &c. In 1890, 807 youths were employed during the summer, and 316 during the winter season. The earnings of the pupils during this year amounted to $27,255. One of the objects of establishing the school at Carlisle was its remoteness from tribal Education.

influence and its proximity to civilization, where constant object-lessofts might be taught. For the same reason other non-reservation schools were established at various points between 1880 and 1898, so that by June 1900 25 such schools were in operation, with 7430 pupils enrolled. In addition, there were 81 reservation boarding-schools with an enrolment of 9604, and 147 day schools with 5090 pupils. Contracts are also' made with public schools in various localities ; in these there are 246 children. In the boarding-schools of all classes the average attendance increased from 3077 in 1882 to 17,708 in 1900; in the day schools the increase was from 1637 to 3860 during the same period. In 1900 there were also 884 children in various contract schools, mainly sectarian in character.

In addition, there are 22 reservation mission schools, with an average attendance of 946 boarding pupils and 193 day pupils.

*In the education of its Indian wards Congress has been liberal. From 1877, when the first regular appropriation of $20,000 for Indian schools was made, until 1900-1, when $3,087,367 was allotted 'for f**;^ Indian schools alone, more than $35,000,000 has been expended in this direction. Of the estimated 268,000 Indians within the limits of the United States, 46,270 (exclusive of school-children) are supported entirely by rations issued at public expense, while 12,670 are partially supported. Almost without exception these Indians formerly gained their livelihood through bison-hunting. Apart from the cost of supporting these dependent people, which amounts to about $1,250,000 per annum, the ration system tends to encourage idleness, and thus to retard advancement towards enlightenment. Again, mainly in pursuance of treaty stipulations from time to time during the century, but*

also through interest on trust funds (amounting to $33,317,965) and moneys derived from grass-land leases, &c., annuities are paid to Indians, which range in sums per capita from 60 cents to $255 per annum ; these annuitants number 63,496, and the aggregate sum paid them in 1900 was $1,507,542. Owing to the evils arising from the prospective payments from time to time, the present policy is gradually to extinguish the trust funds, just as the policy for years has been to dissolve the reservation system by allotting lands in severalty.

While the Government has been responsible for many Indian revolts and their terrible consequences, it must not be assumed that the United States has been illiberal in its support of its Indian wards, for the total expenditure on account of the Indian service (exclusive of the vast sums expended in the prosecution of warfare against the tribes) from 1789 to 1900 has reached the enormous sum of $368,358,217, although a goodly proportion of this sum has been devoted to the purchase of tribal lands.

In order to render an idea of the progress of the United States reservation Indians in the pursuits of civilization, the following statistics for 1899 are given: —

Land cultivated, 334,666 acres; land under ^Jj^f^ fence, 1,667,143 acres; corn raised, 1,386,977 bushels; wheat, oats, and barley raised, 1,832,607 bushels; vegetables raised (exclusive of melons and pumpkins), 445,935 bushels; hay produced, 250,231 tons; lumber sawn, 6,917,000 feet; timber marketed, 68,678,795 feet ; wood cut, 91,023 cords ; horses, mules, and asses owned, 298,277 ; cattle owned, 325,898 ; swine owned, 50,216 ; sheep owned, 1,100,912 ; goats owned, 257,445; domestic fowls owned, 222,047; earnings from freightage, $91,768; value of products of labour sold, $1,324,103.

The total number of Indians in the United States in 1890 was 273,607 ; in 1900 it was 266,760. In 1890 the number of "Indians

not taxed," that is, of Indians living in tribal relations, was 189,447 ; in 1900 it had fallen to 129,518. In 1890 the number of "Indians taxed," that is, of Indians found living among the general population, and therefore liable to taxation, was 84,160 ; in 1890 the number had grown to 137,242, a large increase, especially in view of the fact that the total number of Indians had somewhat decreased. The states and territories which contained the largest numbers of Indians in 1900 were as follows :— Indian Territory, 52,500 ; Alaska, 29,536, including 2499 of mixed parentage (descendants of native Indians and Russians) ; Arizona, 26,480 ; South Dakota, 20,225 ; California, 15,377 ; New Mexico, 13,144 ; Oklahoma, 11,945 ; Montana, 11,343 ; Washington, 10,039 ; Minnesota, 9182 ; Wisconsin, 8372.

The following is a list of the principal tribes within the limits of the United States, Canada, and Mexico. Mexico has no reservation system, its numerous Indians (statistics of the population of whom are untrustworthy) being regarded as citizens of the Republic: —

Indian Tribes of America North of Mexico with Population of 600 or more.

Tribe.

Abuaki

Algonquian

Aht

Wakashan

A Ignnlriii

Algonquian

Apache

Athapascan

Arapaho

Assiniboin

Auk

Bannock

Bellacoola

Blaokfeet (Sik-

sika)

Bloods

Caddo

Cariboo-eaters

(Ethen-eldeli)

Caughnawaga

Cayuga

Cherokee

Cheyenne

Chickasaw

stock.

Algonquian

Siouan

Koluschan

Shoshonean

Salishan

Algonquian

Algonquian

Caddoan

Athapascan

Iroquoian

Iroquoian

Iroquoian

Algonquian

Muskhogean

Situation and Population.

1182 in Canada, 625 in Maine.

Total 1807.

Includes several small divisions

on Vancouver Island and

the Makah in Washington.

Population 3600.

400 in Ontario, about 4400 in

Quebec. Total 4800.

298 Chiricahua prisoners at

Fort Sill, Oklahoma ; 647

Coyoteros on White Moun-

tain reservation, Arizona ;

831 Jicarillas and 443 Mes-

caleros in New Mexico ; 176

Kiowa Apaches (Nadiishan-

dina) in Oklahoma ; 2155

" San Carlos " Apaches and

1849 " White Mountain "

Apaches on White Mountain

reservation, Arizona ; 30

children at Carlisle school.

Total 6429.

976 in Oklahoma, 806 in Wyo-

ming, 5 children at Carlisle.

Total 1787.

1323 in Montana, 1245 in

Canada, 9 children at Car

hsle. Total 2577.

640 in Alaska.

513 (including others) in Ida-

ho, 4 children at Carlisle.

■ *Total 517.*

About 2500 (including Heilt-

suqs of Wakashan family)

in British Columbia.

1060 in North-west Territories,

Canada. See Bloods, Pie-

gans.

1247 in North-west Territories, Canada. (A Blackfoot division.)

About 500 in Oklahoma.

About 1200 east of Lake Athabasca, Canada.

2005 in Quebec.

About 1075 in Ontario, 170 in New York, about 164 in Indian Territory, 4 children at Carlisle. Total 1413.

1363 in North Carolina, 29,511 in Indian Territory (excluding 4000 negroes and intermarried whites). Total 30,874.

2071 in Oklahoma, 1363 in Montana, 61 in South Dakota, 22 children at Car-

lisle. Total 3517.

About 5000 in Indian Terri-

tory (excluding about 4000

freedmen and intermarried

whites).

Chippewa

Chippewaian

Choctaw

Comanche

Cree

Creeks

Crows (Absar-

oka)

Delawares

Dogribs

Eskimo

Flatheads

Grosventres

(Atsina)

Haida

Hares or Kaw-

oho-tinneh

Hidatsa

Hopi or Moki

Iroquois

Kaibabits

Kickapoo

Kiowa

Klamath

Kutenai

Kwakiutl

Loucheux or

Kutchin

Menomini

Miami

Algonquian

Athapascan

Muskhogean

Shoshonean

Algonquian

Muskhogean

Siouan

Algonquian

Athapascan

Eskimoan

(Mixed)

Algonquian

Skittagetan

Athapascan

Siouan

Shoshonean

Iroquoian

Shoshonean

Algonquian

Kiowan

Lutuamian

Kitunahan

Wakashan

Athapascan

Siouan

Algonquian

situation and Population.

26 in Kansas, 3480 in Michi-

gan, .3304 at Leech Lake,

and 4619 at White Earth,

Minnesota ; 2551 in North

Dakota ; 4982 in Wiscon-

sin, 73 children at Carlisle,

11,862 in Ontario, about

4117 in Manitoba, about

1340 in North-west Terri-

tories. Total 36,354.

About 3000 in vicinity of Lake

Athabasca.

About 15,000 in Indian Terri-

tory (excluding 4250 freed-

men and intermarried

whites).

1490 under Kiowa agency,

Oklahoma.

3000 in Manitoba, 7000 under agencies, and about 5000 roving in North-west Territories. Total 15,000.

About 8700 in Indian Territory (excluding about 6000 freedmen and intermarried whites).

1962 under Crow agency, Montana.

About 1000 with the Cherokees in Indian Territory, 95 in Oklahoma, about 753 (including Munsees and " Moravians ") in Ontario, 26 in Kansas, 60 in Wisconsin, 40 with the Iroquois in New York. Total 1974.

About 1000 between Great Slave and Great Bear Lakes,

Canada.

About 20,000 Innuit in Alaska, about 1100 Eskimo in Baf-fin Land, about 2000 in Labrador, about 11,000 in Greenland. Total 34,100 (estimated).

1816 under Flathead agency, Montana (includes Peiid d'OreUles and Kutenais).

619 under Fort Belknap agency, Montana. Distinct from the Hidatsa or Mini-tari, a Siouan tribe, also called Grosventres, number-ing 459 on Fort Berthold reservation. North Dakota.

2500 in British Columbia, in-cluding 630 under North-west Coast agency.

600 on Mackenzie, Anderson, and McFarland rivers, Canada.

See Grosventres.

About 1800 in north-eastern Arizona.

See under the tribal names.

600 (including Shiv wits) in Nevada, 470 in Utah. Total 1070.

240 in Kansas, 234 in Oklahoma, about 200 in Mexico. Total 680.

1074 in Oklahoma.

731 in Oregon, 073 in California. Total 1404.

491 in British Columbia, 450 in Montana. Total 941.

1597 (including 291 Lekwiltok) in British Columbia.

About 4400 on lower Macken-

zie river and in Alaska.

1389 under Green Bay agency,

Wisconsin.

439 in Indiana, 101 in Indian

Territory. Total 540.

INDIANS, NORTH AMEEICAN

467

Tribe.

stock.

Situation aud Fopulation.

Micmao

Algonquian

634 in Quebec, 960 in New

Brunswick, 2018 in Nova

Scotia, 308 on Prince Ed-

ward Island. Total 3920.

Mission Indians

‘Shoshonean

■\ Yum an

Under Mission Tule agency,

California.

Missisaga

Algonquian

764 in Ontario.

Mohave

Yuman

1962 under Colorado Biver

agency, Arizona.

Mohawk

Iroquoian

3103 in Ontario and Quebec.

Monsoni

Algonquian

4000 (including Maskegon) in

eastern Rupert Land.

Montagnais

Algonquian

1793 in Quebec ; distinct from

a group of Athapascan tribes

known under the same name.

Munsee

Algonquian

See Delawares.

Nahani

Athapascan

700 on Stickeen river and Con-

nolly lake, B.C.

Nascapl

Algonquian

About 2800 on lower St Law-

rence, Quebec.

Nasqa or Nass

Chimmesyan

2781 in British Columbia.

Navaho

Athapascan

About 20,000 on reservation in

New Mexico and Arizona.

Nez Percys or

Shahaptian

1639 in Idaho, 127 in Wash-

Chopunnish

ington. Total 1766.

Okanagan

Salishan

673 in "Washington, about 900

in British Columbia. Total

1473.

Omaha

Siouan

1157 on Omaha and Winne-

bago reservation, Nebraska.

Oneida

Iroquoian

1941 in Wisconsin, 255 in

New York, 1068 in Ontario.

Total 3264.

Onondaga

Iroquoian

551 in New York, 385 in On-

tario. Total 936.

Osage

Siona.n

1765 under Osage agency, Ok-

lahoma.

Ottawa

Algonqiiia,n

4000 in Michigan, 165 in Indian

Territory, 1000 in Canada.

Total 5168 (estimated).

Paiute

Shoshonean

1415 under agencies and 6815

wandering in Nevada, 200

in California, 200 in Ore-

gon, 100 in Utah. Total

8730, including Pahvant,

Gosiute, &c.

Papago

Piman

1726 under agencies and 2046

wandering in Arizona, about

1000 in Sonora. Total 4772

(estimated).

Pawnee

Caddoan

664 in Oklahoma.

Piegan

Algonquian

1957 (including some Bloods

and Blaokf eet) in Montana,

519 in North-west Terri-

tories, Canada. Total 2476.

Pima

Piman

4260 in southern Arizona.

Pit Kiver In-

Palaihnihan

1573 (estimated) in northern

dians

California, 94 in Oregon.

Total 1667.

Ponka

Siouan

567 in Oklahoma, 231 in Ne-

braska. Total 798.

Potawatomi

Algonquian

569 in Kansas, 77 in Michigan,

1618 in Oklahoma, 280 in

Wisconsin, about 334 in

Ontario. Total 2878.

Pueblos of New

Tanoan

Excludes the Hopi, Acoma,

Mexico

Keresan

566 ; Cochiti, 355 ; Isleta,

Zunian

1000 ; Jemez, 456 ; Laguna,

1143 ; Nambe, 98 ; Picuris,

96 ; Sandia, 77 ; San Felipe,

650; San Ildefonso, 150;

San Juan, 378 ; Santa Ana,

300; Santa Clara, 248;

Santo Domingo, 1015 ; Taos,

402 ; Tesuque, 84 ; Sia, 104 ;

Zuni, 1422 ; Pojoaque, 20 ;

Hano (Arizona), 600 (?).

Total 9164.

Puyallup

Salishan

555 in western Washington.

Sauk and Fox

Algonquian

522 in Oklahoma, 390 in Iowa,

78 in Kansas. Total 990.

St Regis Iroquois

Iroquoian

About 1171 in New York, 1351

in Quebec. Total 2522.

Tribe.

Seminole

Seneca

Shawnee

Shoshoni

Sicanni

Sioux or Dakota ;

Santee

Sisseton

Yankton

Yanktonnais

Teton

Miscellaneous

Slaves

Spokan

Thompson River

Indians (Ntla-

kyapamuq)

Tsekehne

Tuscarora

Ute

stock.

Muskhogean

Iroquoian

Algonquian

Shoshonean

Siouan

Athapascan

Salishan

Salishan

Athapascan

Iroquoian

Shoshonean

Situation and Population,

2900 (including 1450 freed-

men) in Indian Territory,

575 in Florida. Total 3475.

165 with Cayugas in Indian

Territory, 2812 in New

York, 230 in Ontario. Total 3207.

674 in Oklahoma, 93 under Quapaw agency, and about 800 with the Cherokees in Indian Territory. Total 1567.

1437 in Idaho (including Sheep-eaters), 296 in Nevada, 842 in Wyoming. Total 2575.

See Tsekehne.

1285 in Nebraska (includes Mdewakantons and Wahpekutes), about 54 in North Dakota, 907 Mdewakantons in Minnesota, 161 Mdewakantons and Wahpekutes in North – west Territories. Total 2407.

1884 in South Dakota (in-

cludes Wahpetons), about

863 Sissetons, Wahpetons,

and Cutheads (Yankton-

nais) in North Dakota, 283

Wahpetons and Sissetons

in North-west Territories.

Total 3030.

1701 in South Dakota, about

126 in North Dakota. To-

tal 1827.

1222 in Montana, 3575 (in-

cluding about 1000 Uncpapa

and Sihasapa Blackfeet) in

North Dakota, 1047 in South

Dakota. Total 5844.

2552 Two-kettles, Sihasapa

Blackfeet, Sans Arcs, and

Minneoonjous under the

Cheyenne River agency,

South Dakota ; 6452 Oglalas under the Pine Ridge agency, South Dakota ; 4862 Upper Brulfe, Loafers (Oglalas), Wazhazhas (Oglalas), Two-kettles, and Lower Brulfis under the Rosebud agency, South Dakota ; 472 Lower Brule's under the Lower BruM agency. South Dako-ta. Total 14,338.

52 children at Carlisle, 172 at Muscowpetung, and 60 roving in North-west Terri-tories. Total 284.

About 1000 west of Great Slave Lake and Mackenzie river.

91 in Montana, 695 in Wash-ington. Total 786.

About 4500 in British Colum-

bia.

About 1400 (including 500

Tsekehnes proper), about

Canadian Rockies, 700

Beavers about Peace river,

203 Sarsis east of Rockies,

51° N. Total 2303.

378 on Tuscarora reserve, New

York ; 365 in Ontario. Total

743.

998 Moaches, Capotes, and Wi-

minuchis in Colorado ; 471

Uintas, 851 Uncompahgres,

and 380 White River Utes

in Utah. Total 2700.

468

INDIAN TEREITOEY

Tribe.

stock.

Situation and Population.

Walapai

Yuman

611 on Colorado river, north-

western Arizona.

Wallawalla

Shahaptian

529 at Umatilla agency, Ore-

Wichita

Caddoan

gon.

956 (including aiEiliated bands)

in Oklahoma.

Winnebago

Siouan

1129 in Nebraska, 1447 in

Wisconsin. Total 2576.

Wyandotte or

Iroquoian

449 in Quebec, 6 in Ontario,

Huron

344 in Indian Territory.

Total 799.

Yakima

Shahaptian

2000 (estimated) in Washing-

ton ; includes about 950

Yakima proper and nume-

rous small tribes.

Yavapai

Yuman

702 under the San Carlos

agency, Arizona. Officially

called Apache Mohaves.

Yellowknives

Athapascan

About 500 north-east of Great

(T'atsan-ottine)

Slave Lake, Canada.

Y\una

Yuman

707 under the Mission Tule

agency, California ; re-

mainder under the San

Carlos agency, Arizona.

(v. W. H.)

Indian Territory, situated in central southern

United States, between 33° 25' and 37° N. and 94° 25'

and 98° W., bounded on the IST. by Kansas, on the E. by-

Missouri and Arkansas, on the S. by Texas, and on

the W. by Oklahoma Territory. Without organized ter-

ritorial form of government, it comprises for the most

part the lands of the Cherokee, Creek, Seminole, Choc-

taw, and Chickasaw tribes of Indians, known as the Five

Civilized Tribes, whose possessions occupy 31,060 square

miles of the 31,400 square miles contained in the Terri-

tory. The balance, located in the north-east corner, is

occupied by Indians of the Quapaw Agency, composed

of remnants of eastern Shawnees, Miamis, Ottawas,

Peorias, Quapaws, Senecas, Cayugas, and Wyandottes,

and a few scattered .members of other tribes. The Territory was originally much larger, and included all of Oklahoma and a portion of Arkansas. It is divided geologically into, first, the Wichita mountain region of Appalachian-like folds of Palaeozoic strata, chiefly Carboniferous, with some older PalaBozoic rocks on the southern border, including a field of granite rocks near Tishomingo. Within this field are found building stones of sand and granite and limestone, also Coal Measures on the northern side and asphalt on the sduthern. Secondly, there is the Ozark Plateau, a region of nearly horizontal and greatly dissected Carboniferous and Silurian rocks, containing limestone, zinc, and lead. Then, thirdly, there are the Prairie Plains, which are a continuation of similar plains in southern Kansas, being nearly horizontal Carboniferous rocks, which contain coal and evidence of petroleum. The fourth division comprises southern prairies, which are the northern edge of the Cretaceous rocks of the Texas region, a country of sands, limestones, and marls, containing agricultural lands and also evidences of artesian water.

The topography is varied, the eastern part being mountainous and rugged, the middle part generally rolling or hilly, and the western part largely prairie, with the exception of a group of hills in the central portion of the Chickasaw Nation, known as the Arbuckle Mountains. Woodland, composed of many varieties of oak and (along streams) of cottonwood, elm, pecan, &c., is well scattered over the entire area ; but the heaviest timber is confined to the eastern half, where, in addition to the trees mentioned, are found yellow pine and cedar on high ground, and walnut on streams, in sufficient quantity to make them of commercial value. The oaks are used only for fuel and railway ties. The principal streams are the Arkansas, Canadian, Grand, Verdigris, Illinois, Deep Fork, Washita, and Eed, flowing through valleys which are generally broad and fertile, producing excellent crops. The highest elevation reached above sea-level is about 3000 feet, and the lowest about 350 feet. The climate is similar to that of northern Georgia, with a mean annual rainfall of about 36 inches. Of the wild animals and birds

to be found may be mentioned black bear, cougar, wolf, coyote, fox, deer, squirrel, rabbit, prairie dog, turkey, prairie chicken, quail, eagle, hawk, and buzzard.

The first settlement of Indian Territory was by Creek Indians in 1827, and certain lands were set aside for their use in 1829. It formed a portion of the territoty embraced in the Louisiana purchase in 1803. To enable the whites to obtain possession of the Indian lands in the southern states east of the Mississippi, these lands in what is now Indian Territory were set aside, and in 1830, under President Jackson, the removal of the Indians was ordered. The Cherokees, Creeks, Choctaws, and Chickasaws began their removal about 1833, but the Seminoles were not removed until 1845. The various tribes of the Qua,paw Agency were removed at different times. Much of their original holdings has been sold to meet the demands of white settlement.

The rive Civilized Tribes are called Nations, and occupy separate land areas covered by patents. Each has an independent elective form of government, similar to that of the states of the United States, and they elect governors, legislators, judges, and minor officials. A United States judicial system is provided, divided into

three districts ; and under recent enactment by Congress these courts have entire jurisdiction, the Indian courts being set aside. Under United States law no alcoholic liquors are permitted to be sold in the Territory. The Indians of the Quapaw Agency are under the care of a United States agent, each tribe having its chief, and they have long since taken their lands in severalty. The Five Civilized Tribes are self-supporting, and they are in charge of a United States agent at Muscogee, his relations with the Five Tribes being regulated by the treaties, and by instructions from the Secretary of the Interior. Ample funds, derived from sale of lands, are held in trust for the several nations, upon which interest is paid to them annually.

There was a large increase in the acreage cultivated of all farm products during the closing years of the 19th century, but no statistics have been gathered. The principal products are cotton, corn, oats, wheat, potatoes, and hay. The extensive prairies furnish pasturage for a large number of cattle, some of which are raised in the Territory, but the larger portion is shipped in from Texas to fatten for northern markets. Some horses and swine are raised, and a few sheep. There are 1260 miles of railway in the

Territory, traversing it in all directions, making nearly every section accessible by rail. In 1900 the number of manufacturing establishments in the Territory (excluding 348 having a product of less than $500 each) was 789, with a total invested capital of $2,624,265. There were 135 salaried employees, and an average number of 1714 wage-earners. The added values of the products in the different establishments amounted to $3,892,181. There were 187 cotton-ginning establishments, with a capital of $572,475 and a product of $345,751 ; 61 flouring and grist mills, with a capital of $478,241 and a product of $1,198,472 ; 6 lumber and planing mills, with a capital of $265,683 and a product of $424,399 ; and 6 cotton-seed oil and oil-cake establishments, with a capital of $394,850 and products of $451,656. '

The total population of Indian Territory in ■ 1900 was 392,060, including 51,393 Indians not taxed. In 1890 the total population was 180,182. The population of the principal towns is as follows : Ardmore, 5681 ; Muscogee, 4254 ; South McAlester, 3479 ; Chickaha, 3209 ; and Durant, 2969. The capital of the Cherokee Nation is Talequah ; of the Creek Nation, Okmulgee ; of the Seminole Nation, Wewoka ; of the Choctaw Nation, Tuskahoma ; of

the Chickasaw Nation, Tishomingo. There is no capital for the Territory. Of the total population in 1900, 208,952 (53-3 per cent.) were males and 188,108 (46-7 per cent.) were females; 387,202 were native-born, and 4858 (1-2 per cent.) were foreign-bom; 802,680 were white, and 89,880 coloured (22-8 per cent.), of whom 27 were Chinese, 36,853 negroes, and 52,500 were Indians. The death-rate in 1900 was about 13-4 per cent. The number of persons of school age (5 to 20 years) was 159,125. Out of 97,861 males of voting age 15,473 were illiterate (unable to write), of whom 8477 were white, 3776 negi-oes, and 8220 Indians.

Many of the Indians still use the Indian language, and the Cherokees have an alphabet, and print their laws, books, and newspapers in the Cherokee language. The Indians are well housed, cultivate farms, raise cattle, horses, and hogs, and com-pare favourably with their white neighbours in the adjoining states. There is a large number of churches and schools, well

attended. Many of the traditional customs are still retained, and ball games, dances, and other amusements and ceremonials are

held. Many freed negroes and their descendants speak only the Indian language. These freedmen will have a share in the allotment of lands which is in progress. They are industrious and fairly well advanced, and in some of the tribes have occupied high positions, while some of them are possessed of considerable wealth. The full-blood Indians live as far as possible from the white settlements ; and as the whites are numerous, the Indians have been crowded back into the wooded and mountainous regions, but those of the mixed blood are generally progressive and quite able to take care of their interests in their contact with the " non-citizens " or " intruders."

Under Indian laws, Indian citizens hold as much land as they desire, as long as it is occupied or used by them or their lessees. White men, or non-citizens, can obtain no land by purchase, but under the Indian system of leasing and permits these non-citizens have obtained the use of lands under lease from individual Indians and by paying for a permit or tax to the Indian government. The holdings thus made to white men are immense, both for grazing and cultivation ; and in the tovms there are many expensive buildings, the owners of which have no valid title to the land. In the

next few years there will probably be a division of land in severalty. The subdivision surveys have been made, and town site surveys are in progress. When they are completed the lots will be appraised and sold. This division, and in fact all changes, have been bitterly opposed by the Indians who have leased the holdings, as also by the full-blood Indians. (c. H. F.)

I|^DO-CHI|^A, FREIN^CH

DURING the last twenty years of the 19th century important changes took place in the Par East and the peninsula of Indo-China. The principal European Powers considerably extended their influence and increased their possessions in this region. In Indo-China, more particularly, great alterations were effected. The political condition of the country was entirely changed. In many parts its frontiers were rearranged. New areas were added to the Erench possessions, and treaties and agreements concluded between France and China and France and Si am. A partition of influence between France and Great Britain was also agreed upon. Explorations and numerous more or less careful surveys

have made us acquainted with regions hitherto imperfectly known. The governmental organization, greatly modified, has now taken definite, and probably final, form. Physical conditions have improved, owing partly to the restoration of order and security to the country and the consequent growth of conditions favourable to the settling and cultivation of long-abandoned districts, and partly to the construction of roads, bridges, canals, and railways, and the investigation and exploitation of mineral wealth.

Geography. — The geographical denomination of French Indo-China includes Annam and Tongking, Cochin-China, Cambodia, and part of the Laos country. In 1900 the newly-acquired territory of Kwang-Chow-Wan, on the coast of China, was placed under the authority of the governor-general of Indo-China. Cochin-China, a geographical definition which formerly included all the countries in the Annamese empire — Tongking, Annam, and Cochin-China — now signifies only the French colony, consisting of the " southern provinces " originally conquered from

Annam, having Saigon as its capital. In its entirety Frenchlndo-China, the eastern portion of the Indo-Chinese peninsula, lies between 8° 30' and 23° 26' N. and 100° and 109° 20' E. It is bounded on the N by China, on which side the frontiers have been delimited; on the E. and S.E. by the Gulf of Tongking and the China Sea; on the S.W. and W. by a conventional line between Cambodia and Siam, thence by the right bank of the Mekong, which divides it from Siam and Burma. The configuration of the country is determined by two rivers of unequal importance and a continuous chain of mountains, an offshoot of the great Chinese group of Yunnan, which, making a double curve, forms an immense S. To the north and north-east of this chain the valley of the Song-Koi, or Red river, constitutes almost the whole of Tongking, of which its delta represents the most fertile and populous if not the largest portion. The small mountainous provinces of Lang-son, That Ke, and Kao-bang belong, however, geographically to the Si-Kiang basin. On the east the small province of Monkai, on the borders of

Kwangtung, forms a little basin enclosed between the

5

mountains and the sea ; on the south the province of Thanh-hoa, although crossedby the small river Song-ma, forms the extremity of the Red river delta and belongs to it, the two rivers being united at some distance from the sea by a natural channel formed by the junction of a northern branch of the Song-ma with a southern branch of the Song-Koi. The Red river descends from the mountains of Yunnan, rising near Tali-fu between deep and inaccessible gorges, and becomes navigable only on its entry into Tongking territory. Means have been taken to render it available to steam launches, and in consequence of an agreement between the State and the Compagnie des Correspondances Fluviales a service of steamers is provided from its mouth to Laokai. Near Hung-hoa the Red river receives its two chief tributaries, the Black river from the plateaux of the west — the land of the Muongs — and the Clear river, one of the largest of whose tributaries issues from the Ba-be lakes. The Black river is naviga/-

ble for a considerable distance, the Clear river only from Tuyen Kwang. Between the basins of the Song-Koi and the Mekong the chain of mountains, crowned by tolerably extensive plateaux, covers, with its ramifications and transverse spurs, a vast extent of country as yet little known, although several trade-routes traverse it, thus placing the Laos country in communication with Tongking and Annam. In about 19° N. the mountain-ridge approaches the sea and runs parallel to thecoast, presentingon its eastern side a steep declivity which encloses a narrow littoral, in places only a mile or two broad, between the base of its cliffs and the shore. This coast-belt constitutes the habitable and cultivable portion of Annam proper, and consists of alluvial matter accumulated at the mouths of mountain streams, and marshes and swamps enclosed between land and sea by sand ridges heaped up by wind and tide. The high valleys and plateaux originally belonged to the empire, the limits of which, although invaded and occupied by Siamese, formerly extended to the banks of the Mekong. The western slopes

now form part of the French Laos possessions. The Mekong valley includes Laos, Cambodia, and the greater part of Cochin-China. The Mekong is one of the largest rivers of south-eastern Asia, having a course 1900 miles in length. The conditions of navigation have been sufl-ciently improved to permit of a fairly regular service of boats between Saigon and Pnom-penh, Kratie, Stung-treng, Khong, Pak-mun, and Vien-tian. At Khong a transshipment by means of a railway (3^ miles) gives access to the latter portion (which extends from Khong to Pak-mun or Savanna-kek) of the river's first course. The second reach, 310 miles in length, extends from Savanna-kek to Vien-tian. From Vien-tian to Luang-Prabang the river is practicable only for canoes. The mouths of the Mekong, six in number, communicate by means of a navigable canal with the Saigon river (fed by

the Donnai and the two Vaico rivers), which is navigable by the largest warships, ~~rendering Saigon the most im~~

portant natural port of Indo-China.

Geology. — The low-lying portions of Indo-China consist of two deltas — ^that of the Mekong, which comprises the lower parts of Cambodia and southern Cochin-China, and the Eed river delta, or eastern Tongking. These deltas are composed of alluvium (generally silicious clay) deposited by the rivers. The mountains from which this soil is derived are granitic in formation, the framework being almost always schists of ancient date, dislocated, folded, and occasionally rounded into hills 1000 to 1300 feet in height, belonging to the Devonian period. Above these schists lie — more especially in the north and south of Tongking — marbles and other highly crystalline limestones, upon which rest, unconformably in places (Nong-son, Ke-bao, Hongai), Carboniferous formations. In the upper part of the Eed river valley rich deposits of coal have been found between Yenbai and Bai-Duong, in a considerable tract of Tertiary rock. Limestone occurs also in the valley of the Mekong, forming an extensive massif in the district of Lakhon and in the basins of the

Nam-ka-dinh and E"am-hin-bun. These limestones appear to be Carboniferous. In the region south of Lakhon the rock is Triassic, and gold has been observed in several districts. The natives collect it in very small quantities by a washing process. In the lateral valleys of the Mekong copper and tin are found. On the course of the Nam-paton, a tributary of the Nam-hin-bun, the natives work a moderately productive tin-mine. Layers of spiegeleisen, limonite, and other iron ores are numerous in the Laos states, in which also antimony occurs.

Climate. — The climate of Indo-China is that of an inter-tropical country, damp and hot. But the difference between the southern and northern regions is marked, as regards both temperature and meteorology. Cochin-China and Cambodia have very regular seasons, corresponding with the monsoons. The north-easterly monsoon blows from about the 16th of October to the 15th of April, within a day or so. The temperature remains almost steady during this time, varying but slightly from

78-8° to 80-6° F. by day to 68° F. by night. This is the dry season. From the 15th of April to the 15th of October the monsoon reverses, and blows from the south-west. The season of daily rains and tornadoes commences. The temperature rises from 80-6° to 84-2° F., at which it remains day and night. April and May are the hottest months (from 86° F. to 93-2° F.). The damp unwhole-some heat sometimes produces dysentery and cholera. The climate of Annam is less regular. The north-easterly monsoon, which is " the ocean-wind," brings the rains in September. The north-easterly gales lower the tempera^ ture to below 59° F. September is the month in which the typhoon blows. During the dry season — June, July, and August — ^the thermometer oscillates between 86° F. and 95° F. The nights, however, are comparatively cool. Tongking has a winter season— October to May. The temperature, lowered by fc^ and the rains, does not rise above 75-2° F. and descends to 50° F. over the delta, and to 44-6° F. and even 42-8° F. in the highlands, where white frost is occasionally seen. The summer, on the

other hand, is scorching. The wind veers to the south-east and remains there until ()ctober. The temperature rises to 82-4° F. to 86° F. ; often it reaches, and continues for several days at, 95° F., 100-4° F., and even 104° F. The nights are distressingly airless. The Laos country in the interior and lying at a high altitude is cooler and drier. Its deep valleys and high hills vary its climate. Observations made of late years show its salubrity, the temperature varying in summer between 68° F. and 77° F., in winter between 34-4° F. and 37-4° F.

Fauna and Mora. — In the populous cultivated districts wild animals, once plentiful, have retired towards the wooded districts. The wild life of Laos includes fairly numerous herds of elephants, the rhinoceros (one- and two-horned; rhinoceros horn, employed as a "medicine," fetches about 56 piastres, 132 francs, per kilogram), tiger, panther, brown bear, tree bear, monkeys, and rats, among which are the musk rat, the palm rat, and the mirkJii, or rat found in the rice-fields of the highlands, in

which its ravages are considerable. In mountain dis-
tricts the leopard, wild boar, and deer are found, and in
the neighbourhood of habitations the tiger-cat and ich-
neumon. The buffalo is commonly found wild in Laos;
as a domesticated animal it also holds a prominent place.
The zebu bull is used for transport purposes. Attempts
to acclimatize the Arab horse and to introduce sheep from
Aden and China have failed. There is, however, an in-
digenous race of horses, excellent in spite of their
small size — the horses of Phu-Yen. Among birds the
woodcock, peacock, and numerous species of duck in-
*habit the woods and marshes. The goose and guinea^*
fowl appear, as also the turkey, to have become easily
acclimatized. Eeptiles (apart from the caymans of
the Mekong, which attain a length of over 30 feet,
and are much appreciated by the Annamese as food)
are extremely numerous and varied in species. The
rivers are rich in fish. The sole is found in the rivers
of Tongking. The Mekong is fished for two species
peculiar to it — the pa-beuk and the porleum, which at-

tain a length of nearly 6 feet, and upon which the fishermen pay a tax of one piastre per fish into the royal treasury. This tax brings in 1000 piastres annually. All varieties of mosquitoes, ants, and leeches combine to render the forests bordering the Mekong impracticable. Peculiar species of grubs and caterpillars destroy the cotton and coffee plantations of Cochin-China. The silkworm may be said to be indigenous to Tongking, where there are 7460 acres of mulberry trees. The flora is inter-tropical, and comprises nearly all the trees known in China and Japan. Formerly the teak was believed not to exist in the forests of Indo-China, but it was found some years ago in considerable abundance, and plantations of it have been made. Certain hard woods are used for marqueterie and other ornamental work. New products have been introduced. Cotton, previously cultivated in Cochin-China and Cambodia, gives excellent results in Laos. Tea, of which there are a certain number of plantations in the highlands of Tongking and Annam, grows wild in Upper Laos, and

in quality closely resembles tlae Pou-eurl or Pueul variety so noted in Yunnan. Cocoa, coffee, and cotton have been cultivated in Tongking and Cambodia. Cinnamon and cardamoms are gathered in Laos and Annam. The area under rice has been much extended. All European fruits and vegetables have been introduced into Tong-king, and with certain exceptions — the grape, for example— succeed perfectly. Measures taken to secure the monopoly of opium have notably increased the cultivation of the poppy.

Ethnology. — The Annamese and Cambodian populations have long been known, but since they have been brought into touch with civilization they have developed new characteristics. Since, owing to the restored tranquillity of his country, the fruit of his labour has been secured to him the Annamese has become more active and more industrious. As a soldier he has displayed the valuable qualities of endurance, intelligence, and discipline. The race is capable of development. Independent populations, isolated and even savage, the names of which

were hardly known, have been brought into contact with civilization. It has been recognized that the races familiarly known by a certain name have also various others. It is generally believed that the yellow people from China and the brown people of Aryan stock from India have driven back the older Malay races into the interior of the country. The Khmer of Cambodia probably belong to the Brahminical race ; the sculptures of Angkor, in which are to be recognized the primitive Indian deities, give colour to this belief. Driven into the interior, the vanquished races have mixed and blended with the peoples whom they found there. New tribes have arisen, intermingled with fugitives from China, Annam, and even Siam. The Laos folk have for the most part come to predominate in this mixture. However this may be, the savage tribes (a term no longer exact) fall into two categories. In the north of Tongking people of Laos origin occur — the Th8s round Kaobang,

the Muongs in the mountains bordering the Red river. When mixed with Chinese the Muongs and the Th5s are known as the Hung-dans, Mans, and Miens. The Muongs are bigger and stronger than the Annamese, their eyes often almost straight. They have square foreheads, large faces, and prominent cheek-bones. In the centre and south of the Indo-Chinese mountain chain are found, under a multiplicity of names — Phon-tays, Souis, Bah-nan, Bolovans, Stiengs, Mors, Kongs, &c. — people of Malayan origin mixed with all the races of Indo-China. Laos is inhabited by an essentially miscellaneous population — Laotians, Kh§,s, Phais, Yuns, Lus, Phou-thais, Meos, Hos, and Yaos— of which the Laotians, numbering 67,000, and the KhSs, 63,000, form the bulk. Although Laotian legends assign to these a common origin, the difference of types, languages, and religions is at variance with this hypothesis. The Kh§,s appear to have preceded the Laotians in the country, though it is probable that the Laotians of Dien-bien-Phu have conquered and subjected the former. The Laotians may be of Mongol origin. The

Yuns are Laotians settled on the right bank of the Mekong at Xieng-Mai, Xieng-Sen, and Muong-Nam, and are only distinguished from their congeners by the parts of the body on which they are tattooed. They tattoo the body instead of the thighs and legs as do the Laotians, whom for this reason they call " Lao-phung-kao," "the white-bodied Laotians," terming themselves " Lao-phung-dam," or "black-bodied Laotians." The KhSs, Meos, Yaos, and Hos are probably aborigines, and cultivate rice, poppy, and maize. The first-named, settled on the mid-course of the Mekong, between Lakhon and Stung-treng, were at a comparatively recent date veritable savages, reduced to the lowest degree of misery.^ To-day they are on the road to civilization. They trade with Cochin-China and Cambodia, and at Stung-treng there is a post office and a steamer service.

Area and Population. — The extent of the area of French Indo-China is not exactly known. It is estimated approximately at 250,000 square miles.^ No census has been taken of the population except in Cochin-China.

It is estimated at 20,000,000, of whom 11,000,000 are in Tongking, 4,000,000 in Annam, 2,300,000 in Cochin-China, 1,500,000 in Cambodia, about 450,000 to 500,000 in the Laos states. The population of this latter country was estimated at first at only 160,000, but the verifications made since the French occupation have modified this figure. The province of Stung-treng alone, formerly believed to be almost uninhabited, contains 60,000 inhabitants.

1 Le Laos et les populations sauvages de I'Indo-Chine. Harmand, 1880.

2 This is claiming a large portion of country actually in the hands of Siam and administered by Siam.— Ed. E. B.

Religions. — The Annamese religion is a somewhat vague and very tolerant Buddhism, which in practice resolves itself chiefly into the worship of ancestors. Certain ceremonies performed in Cambodia resemble distantly the Brahminical cult. The Catholic religion has been introduced by missionaries. The course of its history has not been free from catastrophes and accidents.

There is an apostolical vicariate in Cochin-China, one in Cambodia, and several mission stations in Tongking. Two of these missions are mainly conducted by Spanish priests. Public instruction, means of communication, roads, railways, are "localized," and will be found separately treated in the articles upon Tongking, Cochin-China, and the Laos states.

Government and Finance. — Before taking its present form the governmental organization of Indo-China underwent many changes. Originally Cochin-China, the only French possession in the peninsula, was a colony directly administered, like other colonies, by the ministry of marine, and its earliest governors were admirals. Later, as further conquests were effected, ^ Tongking and Cambodia were subjected to the regime of a protectorate somewhat ill-defined, and placed under the authority of a resident-general. The seat of the resident-general of Tongking was at Hanoi; of Cambodia, at Pnom-penh. The government of the colonies having been transferred from the ministry of marine to the ministry

of commerce (by the decrees of 14th March 1889, 17th January 1893, and the law of 20th March 1894, which constituted a special ministry of the colonies), the control of the residencies passed gradually into the hands of civil agents. Cochin-China, which already by the decree of 8th February 1880 had been endowed with a colonial council, had a municipality, a chamber of commerce, and even a deputy in the French Parliament. There had been thus since 1817 three distinct states, each with its own ruler and government. But by the decrees of 17th October and 3rd November 1887 the unity of Indo-China was determined. By decree of October the post of director of the interior of Cochin-China was done away with and replaced by that of lieutenant-governor. Cochin-China thus ceased to be under the direct administration of the ministry of the colonies, and was placed under the immediate authority of the governor-general. The functions and powers of this ofRcial were, however, but vaguely defined before the decree of 21st April

1891, which conferred on M. de Lanessan, appointed governor-general, the most extensive powers. The residents-general and the lieutenant-governor of Cochin-China, as well as the military authorities, were placed under him. But this change of policy, which put an end to the system of expeditions and minor military operations, and restricted the power of the residents whilst restoring to the mandarins a share of authority, was unwelcome to numerous interests, which, combining, secured the abrupt recall of M. de Lanessan on 29th December 1894. The decree of 21st April 1891 was not, however, revoked, but the powers it conferred were restricted. After the appointment of M. Doumer, successor to M. Rousseau, who died 10th December 1896, this decree was again put in force on the former scale, and in 1898 it was supplemented by the decrees of 3rd and 31st July, which definitely established the political and financial unity of Indo-China. The unification of the budget has specially contributed to that of the government. The financial scheme is based on the political. Just as a

single central government directs the various local govern-

ments, so in addition to the general budget comprising

1 See Tongking and Cochin-China in the earlier volumes of the

Ency. Brit, (ninth edition).

the revenue and expenditure of the supreme government

there are several local budgets, including the revenue and

expenditure incidental to the individual provinces.

The revenue of this budget is provided by customs and

excise duties, indirect taxes and contributions levied all

over the country, and the opium monopoly formerly con-

ceded, as regards the kingdom of Annam, to a company

whose concession was revoked on 1st July 1893. Opium

is taxed in Tongking. In Annam it is still farmed. The

remaining resources belong to the local budgets, and are

supplemented, when inadequate, by grants from the general

budget. Since 1894 another budget, or rather several other

budgets, have been created in Tongking, namely, those of

the provinces or municipalities. Since the decree of 12th

March 1882, Cochin-China has had municipal budgets ; Tongking since 1894.

The customs tariff for Indo-China was fixed as regards imports by the law of 11th January 1892 and the decree of 29th November 1892; for exports, by the decree of 29th December 1898. Special taxes have been sanctioned by various orders or decrees from 1898 to 1899, as follows : upon salt, 25 francs per ton ; upon alcohol, 2-50 francs per litre of pure alcohol ; upon tobacco and cigars, 1-60 franc per kilogram of cigars, 0-75 franc of cigarettes, and 15 francs upon the hali-picul (30 kilograms) native-grown or introduced tobacco in leaf.

The sums assigned directly to the kings of Annam and Cambodia are chargeable upon the general budget. In consequence of agreements with the court of Annam, the king — or rather the council of ministers — nominates and directly pays the native officials in Annam, as distinct from Tongking. Hence the financial credit assigned to the court of Hue reaches a sum of 928,000 piastres, 533,000 of which are assigned to the expenses of the

court and comat (council of ministers), 369,000 to the salaries of officials, and 26,000 to "unforeseen outlay." The allowance made to the court of Pnom-penh is a purely personal one. The king's civil list amounts to 372,000 piastres, that of the secondary king — ^the obbarach — to 25,200 piastres. The princes, sons of the king, are apportioned 15,000 piastres, not an excessive sum. King Norodom having fourteen sons and twenty-two daughters. The princes, sons of the obbarach, receive together 3000 piastres. In both 1898 and 1899 there was a consider-able surplus balance both on the general budget and on the local budgets.

The following were the estimates for 1901 : — Revenue, 22,998,000 piastres; expenditure, 22,982,000; surplus, 16,000 piastres. The principal receipts were classified as follows : —

Customs

Indirect taxes and excise

Registration of lands and stamp duties

Posts and telegraphs

Forests . . ...

Interest on capital ....

5,940,000 piastres.

15,060,000 ”

807,000

382,000 ”

247,000 ”

200,000 ”

Any available surplus was, by decree of 20th October 1900, to be applied to the formation of a general reserve fund. Each of the local budgets has its own reserve, and official statements show that these reserves will enable Indo-China to contribute the sum of 12 million francs — more than half — -to the military expenses chargeable on the mother country, and to appropriate about 20 million francs to railway construction.

Administration. — The government in its present form was organized by the decrees of 17th October and 3rd to 12th November 1887, and by those of 21st April 1891 and 31st July 1898. Indo-China financially and

politically unified is, as we have seen, placed under the authority of a governor-general, assisted by a superior council of Indo-China, which, reorganized by the decree of 8th August 1898, is composed as follows : president, the governor-general ; the general commanding as head of the troops ; the rear-admiral commanding the naval squadron of the Far East; the lieutenant-governor of Cochin-China; the resident superiors of Tongking, Annam, and Cambodia; a representative (appointed by the governor-general) of the government of Laos ; the chief of the contrdle financier; the head of the judicial service of Indo-China ; the superintendent of the customs and excise of Indo-China ; the president of the colonial council of Indo-China ; the presidents of the chambers of commerce of Saigon, Hanoi, and Haiphong ; the presidents of the united chambers of commerce and agriculture of Annam and Cambodia; the presidents of chambers of agriculture ; two influential natives, and the chief of the governor-general's cabinet. A " permanent commission " of the council has been formed. The superior council

meets annually to receive the budget, which "must be accepted by the governor-general at a session of the superior council." It must also be consulted on the distritution of military credits, and on the credits to be devoted to public works.

The governor-general is also assisted by a "council of defence." The general services of the customs, justice, public works, agriculture, and commerce are placed directly in the hands of the governor-general. He presides over the council of ministers — comat — of Annam. The protected governments of Annam and Cambodia are under his control, and, in reality, under his command. He therefore exercises sovereign power throughout Indo-China. He is answerable to the minister of the colonies. There is a contrdle financier in Indo-China, dependent upon the ministry of the colonies. Its returns have to be communicated to the governor-general.

The town of Saigon (q.v.) is officially the capital of Indo-China. The superior council, however, does not necessarily sit at Saigon. It is annually convoked in

the capital of one of the local governments, as Hanoi, Pnom-penh, and Hue.

Justice. — The whole of Indo-China is, in principle, subject to French justice, represented by a court of appeal and a certain number of tribunals. As recently as 1898 the administration of justice was not centralized. There was a court of appeal at Hanoi, and another at Saigon. But the decree of 8th August 1898 suppressed the court of appeal at Hanoi, which ranks now only as "the third chamber of the court of appeal of Saigon." Three mixed tribunals of commerce are establi^ed at Saigon, Hanoi, and Haiphong. There are courts of first instance at Saigon (not classified), My-tho, Viah-Long, Hanoi (1st class), Bentre, Chaudoc, Cam-tho, Via^vinh, Long-Trang, Long Xuyen, and Pnom-penh, and several justices of the peace, from whose judgments there is no appeal.

In Cochin-China no trace of Annamese justice now remains. All the inhabitants, without distinction of race, are amenable to French tribunals. The decree of 7th March 1895, on " the organization of justice" in Cochin-China and Cambodia, contained an almost complete code of civil and criminal procedure. The decree of 8th August 1898 extended over the whole of Indo-China

the jurisdiction of the court of appeal at Saigon. In Annam-Tonglting, however, the natives are still subject to Annamese justice, represented in each province by a mandarin, called the An Sat. At the same time, whenever a Frenchman, or a naturalized Frenchman, is a party in an affair, French justice only is competent.

Public Works.~T\e order of 9th September 1898 placed the public worlcs of Indo-China under the " direct authority of the governor-general as regards works entered to the general budget account." There is a director of public works in^Indo-China'at Saigon, a director of engineering in the other countries. In 18115 a "special service" was created in Tongking to consider railway business.

Posts and Telegraphs.— The postal service of Cochin-China was reorganized by a decree of 7th October 1881, that of Tongking by a decree of 20th September 1883. A general management created in 1887 was suppressed by an order of 10th January 1889. At present there is no general management. The post and telegraph offices in Indo-China number 2- '0, of which 60 are in Cochin-

China, 106 in Tongking, 22 in Annam, 18 in Cambodia, and 18 in Laos.

The Army — Land Force. — The military services are under the authority of a general of division commanding in chief. There is a Direction cf Artillerie in Tongking, and another in Cochin-China. The ^ troops form three brigades of three regiments with seven batteries. The four military districts of Tongking are commanded by superior officers. In 1898 four regiments of Tongkingese tirailleurs- (sharp-shooters), one of Annaraese, a company of Cambodian tirailleurs, and a squadron of Annamese chasseurs or light horse were raised, and a mobile reserve of about 7500 men constituted. The pay of sub-officers has been raised, and 178,000 piastres are spent on the gendarmerie.

Sea Force. — Indo-China is protected by the naval division of the Far East, to which is also attached a certain number of iron-clad gunboats.

Navigation. — The general movement of the ports of Indo-China is shown in the following table : —

Year.

Steamers.

Sailing Vessels and

Junks.

Total.

1885

1895

Number.

766

766

Tons.

775,745

764,444

Number.

120

1525

Tons.

15,494

72,624

Number.

886

2291

Tons.

791,239

837,068

Taking the movement country by country, the shipping figures

for 1898 were as follows: —

Number.

Tonnage.

Annam

Entries . . j

Tongking

Entries . . j

Cochin-China |

Entries . . “j

Annam

Departures . j

Tongking J

Departures . j

Cochin-China J

Departures .

French vessels . .

Foreign vessels . .

12

135

27,950

38,345

Total . . . .

147

66,295

French vessels . .

Foreign vessels

132

915

132,827

195,640

Total ....

1047

328,467

French vessels . .

Foreign vessels . .

221

377

305,500

425,868

Total ....

598

731,368

General total . .

1792

1,126,1.30

French vessels . .

Foreign vessels . .

16

1.35

30,597

36,821

Total ....

151

67,418

French vessels . .

Foreign vessels . .

130

752

130,315

186,040

Total ....

882

316,355

French vessels . .

Foreign vessels . .

223

356

305,500

424,281

Total . . . .

579

729,781

General total . .

1612

1,113,554

In 1899 there entered the port of Saigon 237 French vessels of 333,714 tons, and 435 foreign vessels — for the most part British — of 477,443 tons. For Annam the figures were, 124 French vessels of 156,256 tons, and 375 foreign vessels of 73,890 tons, besides 7194 Annamite junks of 94,705 tons.

Commerce.— The commercial movement of Indo-China notably increased during the last ten years of the 19th century, as is apparent from the following figures: — In 1888 Indo-China, as a whole, imported to the value of 56,086,752 francs, exported to the value of 71,026,683 francs ; general commercial total, 127,113,435 francs. In 1892 commercial statistics were tabulated for each of the three countries separately : —

Imports

(Franca).

Exports

(Francs).

Total General

Commerce

(Francs).

Cochin-China and I

Cambodia . J

Annam

Tongking .

Totals .

35,546,628

4,671,473

28,432,772

80,706,856

3,513,688

10,851,026

116,253,484

8,185,161

39,283,798

68,650,873

95,071,570

163,722,443

In 1898 the imports (excluding specie) from France and French colonies amounted to 44,415,786 francs ; from other countries to 58,028,560 francs ; total, 102,444, .346 francs ; the exports to France and French colonies amounted to 29,592,742 francs ; to other

countries to 97,918,237 francs; total, 127,610,979 francs.

The chief articles of import were colonial commodities for consumption, valued at 4,583,927 francs (France supplied the value of 3,176,713) ; farinaceous foodstuffs, 1,517,9.58 francs (Hong-Kong 1,149,785) ; textile fabrics, 15,731,000 francs (France 6,.546,865, England 3,329,574, Hong-Kong 3,304,348, Singapore 2,446,765) ; and metal-work, 33,369,772 francs (France 19,483,370, England 1,520,622, China and Japan 11,029,058). Special mention should be made of "Siamese paddy," which is benefiting by the temporary duty-free admission. In 1898, from August to December (inclusive) 6,240,875 kilograms entered, and from September to December 4,303,249 kilograms (2,699,476 white rice, 1,603,773 rice cargo or partially husked rice). Rice and its derivatives, which in 1898 reached a value of 88,113,033 francs, ranked first among the exports. Fishery products figured at 6,487,841 francs, pepper at 4,418,028 francs, raw hides at 1,747,586 francs, cotton-in-pod — which finds a market in Japan — at 1,621,697 francs, raw silk at 1,332,037 francs. In 1899 the value of the imports amounted to 115,424,500 francs, of which France contributed 30,880,000, and the exports to 140,137,240 francs, of which 46,071,000 went to France. In 1900

the imports reached a value of 186,044,000 francs, of which France contributed 74,226,000 francs, and the exports 151,338,000 francs, of which 33,052,000 went to France.

Mines and Metals. — Tongking, in its mountainous districts, is rich in metals. Considerable quantities of coal are mined at Hongai, on Allong Bay, in the island of Kebao, situated in the same bay, and at Nongson near Tourane. The output of Hongai coal amounted in 1899 to 210,446 tons. Coal concessions have been made in the coal regions of the Bed river, at Thuyen-Khan, and in the neighbourhood of Yenbai. Zinc mines are also worked. Gold-washing on the rivers of Tongking is still carried on by Chinese. Concessions have been applied for in Laos for gold and tin mining. A tin mine of rather small yield worked by natives exists on the river Patten.

Weights and. Measures. — ^A recent decree has introduced the French system of weights and measures into Cochin-China, but in the other four countries the ancient weights and measures are still in use.

Money. — Native money consists of sapeks, ligatures, imA piastres of variable currency. The piastre, which formerly was equivalent to 4-50 francs, has now fallen in value to 2-40 francs. The ” ques-

tion of the piastre," with its bearings on administration on one hand and commerce on the other, is one of the most complicated problems which could be presented to the Government.

History. — From 1884 onwards the history of Indo-China may be divided into two distinct periods, characteristic of the political conception and governmental system adopted by the French Government. In the first period, 1884-91, the French agents in Tongking and Indo-China generally proceeded (under cover of the protectorate established by the treaty of 5th June 1884 between France and Annam) with the definite conquest and annexation of Tongking and also Annam. Cochin-China itself openly designed to seize the southern provinces of Annam, upon the borders of which it lay. This policy, momentarily checked by the war with China, was vigorously, even violently, resumed after the treaty of Tientsin, 9th June 1885. The citadel of Hue was occupied on j5th July 1885 by General de Courcy. The Annamese Government forthwith decided upon rebellion. An improvised attack upon the French troops was led by the

ministers Thu-ygt and Thu-ong. The revolt was promptly suppressed. The regent Thu-yet and the king Ham-N'ghi — Prince Ung-lich, crowned 12th August 1884 under the title of Ham N'ghi — fled. The germ of this policy is to be found in the treaty of 6th June 1884, which gave France the protectorate over Annam. The French Government, following a very widespread error, regarded Tongking and Annam as two distinct countries, inhabited by populations hostile to each other, and considered the Tongkingese as the oppressed vassals of the Annamese conqueror. To conquer Annam, it was said, would liberate Tongking. This misconception produced the worst consequences. With the flight of the king civil war commenced in Annam. The people of Tongking, whose submission the court of Hue had not dared to demand,

began to rise. Taking advantage of this state of anarchy, pirates of the Black Flag, Chinese deserters,

and Tongkingese rebels devastated the country. The occupation of Tongking became a prolonged warfare, in which 25,000 French, compelled to guard innumerable posts, had to oppose an intangible enemy, appearing by night, vanishing by day, and practising brigandage rather than war. The military expenditure, met neither by commerce, which had become impossible, nor taxation, which the Annamese could not pay nor the French receive, resulted in heavy deficits. Paul Bert, who hoped to gain the confidence of the mandarins by kindness and goodwill, did not succeed in preventing, or even moderating, the action of the military rSgime. Under his governorship there was much fighting. Thanquan, Hon-Koi, Laokai, Pak-Lun, and Cao-Bang were occupied, but the troops were driven back to the delta and almost invested in the towns. Disappointed in his hopes and worn out rather by anxiety than work, Paul Bert succumbed to his troubles on 11th Kovember 1886. His successors possessed neither the strength nor the insight necessary to grapple with the situation. M. Constans, however, appointed " pro-

visional " governor-general after the death of M. Filippini, succeeded to a certain extent in reviving commerce in the towns of the delta. But after him MM. Eichaud, Bihourd, and Piquet were all equally powerless to deal with the uninterrupted " bush-fighting " and the augmentation of the deficit, for no sooner was the latter covered by grants from the mother country than it began to grow again.

At the close of the financial year in 1890 France had paid 13,000,000 francs. In April 1891 the deficit again approached the sum of 12,000,000 francs. The rebels held almost all the delta provinces, their capitals excepted, and from Hanoi itself the governor-general could see the smoke of burning villages at the very gates of his capital.

At this point a complete change of policy took place. M. de Lanessan, a Paris deputy sent on a mission in the coui'se of 1887, made himself acquainted with the government and the court of Hue. He recognized the absolute falsity of the story which represented the Tongkingese as the oppressed subjects of the Annamese. He demon-

strated the consanguinity of the populations, and after intercourse with the regents, or ministers, of Hue he realized that the pacification of the country depended upon harmonious relations being established between the general government and the court. Appointed governor-general with the fullest powers on 21st April 1891, he presented himself at Hue, concluded with the comat an agreement based on the principle of a " loyal protectorate," and reassured the court, up to this point uneasy under menace of annexation. The comat shortly issued a proclamation under the great royal seal, never hitherto attached to any of the public acts imposed iipon the king by the governors, who had been unaware of its existence. In this proclamation the king ordered all his subjects to obey the governor-general and to respect him, and commanded rebels to lay down arms. The effect was immediate — disorders in the delta ceased. The pirates alone, in revolt against the king of Annam and all authority, continued their brigandage. But the governor-general instituted four "military districts," the commanders of

which were commissioned to destroy the pirates. At the same time he placed a force of native police, the linh co, at the disposal of the mandarins, hitherto regarded with suspicion and intentionally deprived of all means of action. Order was restored within the delta. In the mountainous districts infested by pirates roads were opened and posts established. The chief haunts of the pirates, among others those of Yen-The, were demolished, and during 1893 the foremost pirate chiefs gave in their submission. The Indo-Chinese budget regained its balance. On the Chinese frontier agreements were concluded with Marshal Sou, in command of the Chinese forces, regarding the simultaneous repression of piracy in both countries. But on the Mekong difficulties arose with the Siamese. For centuries Siam had occupied the valley of the Mekong, and her troops had crossed the river and occupied the left bank. Luang-Prabang was in the hands of the Siamese, who had also established posts at Stung-treng and elsewhere. Friction occurred between the French agents and Siamese soldiery. After the death of

Inspector Grorguin on 5th June 1893 the French Government occupied Stung-treng and Khong. France demanded explanations and redress at Bangkok, but the court refusing concessions, an ultimatum was presented to the king by M. Pavie, French minister to Siam. The terms of the ultimatum not having been complied with within the given time, the French flotilla, consisting of the gunboats L' Inconstant and La ComHe, crossed the bar of the Menam on 13th July 1893, forced the entrance of the channel, and anchored at Bangkok, before the French legation. A second ultimatum was then presented. It contained the following conditions : — First, the occupation of Chantabun by the French until the Siamese should have entirely evacuated the left bank of the Mekong ; secondly, the Siamese to be interdicted from maintaining military forces at Battambang, Siem-Rap, and generally from establishing fortified positions within 16|- miles of the right bank of the Mekong; thirdly, Siam to be interdicted from having armed boats on the great lake Tonle-Sap. This agree-

ment was executed immediately, the Laotians being eager parties to it. On 29th September 1893 the king of Luang-Prabang (the " Cliau SaJckarine Tap Ritti Tam-rong") made his submission to the French Government, and besought it to use its influence with the court of Siam for the return to their families of the sons of princes and mandarins then in schools at Bangkok. The Siamese evacuated the left bank of the Mekong, and France took possession of Laos, a treaty, on the basis of the ultimatum, being signed on 1st October 1893. The disputes to which this affair with Siam had given rise between France and Great Britain were amicably settled by an agreement concluded 15th January 1896. This " declaration," virtually ratifying the treaty concluded in 1893 between France and Siam, settled the limits of the zones of influence of the two contracting Powers in the north of the Mekong regions and on the frontiers of Siam and Burma. Great Britain resigned to France the regions of the Muong-Sing which she had previously occupied. The great part of Siam included in the

Menam basin was declared neutral, as also the Jle-Ing basin in the north, Meklong Petchaburi and Bang Pa Kong rivers in the south. The neutral zone 15' miles wide on the right bank of the Mekong was formally recognized.

During this period considerable changes were taking place in Indo-China. Bitterly attacked by the military authorities, who were irritated at being subordinated to a civil governor, and by the bureaux of the central adminis-tration, which had been compelled by the decree of 1891 to yield certain of their powers to the governor-general, M. de Lanessan was abruptly recalled on 29th December 1894. On the arrival of his successor, M. Rousseau, and before he was able fully to acquaint himself with the con-dition of the countiy, military expeditions recommenced, and the deficit soon reappeared. Tranquillity, however, being restored, attention was given to public works. On 12th October 1895 M. Rousseau left to ask Parliament to vote a loan of 100,000,000 francs. On 10th February 1896 a law was passed authorizing a loan of 80,000,000

francs, and on 14th March 1896 an office for the financial control of the government-general of Indo-China was established. In the interval a French company had obtained from China a concession to prolong the railway from Langson to Langchou on a tribntaiy of the Canton river. M. Rousseau, who died on 10th December 1896, was replaced by M. Doumer, previously minister of finance, under whose government was realized, as has been before stated, the union of Indo-China. A great programme of public works was drawn up, and on 20th December 1898 M. Doumer obtained from Parliament authorization to contract a loan of 200,000,000 francs. A railway line between Hue and Tourane is in coilrse of construction. In virtue of the powers gsanted for this loan, two issues each of fifty millions were successively fioated, and the proceeds appropriated to the construction of the following railway lines: — (1) Hanoi to Haiphong (98 miles); (2) Hanoi to Ninh-binh (73 miles) ; (3) Saigon to Tan-lin

(82 miles) ; (4, 6, 6) lines from Tourane to Hu^ (66 miles), from Yen-bai to Lao-kai (94 miles), and from Ninh-binh to Vinh (85 miles) ; (7 and 8) lines from Tan-lin to Lang-bian and Khan-hoa (321 miles), and from Lao-kai to Yunnan-sen (302 miles). The whole of these lines will constitute, with the lines already constructed, a complete network, bringing Saigon and Hanoi into direct communication with the Chinese frontiers of Kwang-li and Yunnan. The line from Hanoi to Kwang-si, constructed with the eighty million loan, is in operation. Finally a line is projected from Hu^ vid Ailao towards the Mekong as high as Savanna^kek.

Authorities. — Since 1885 numerous official or semi-official periodical publications liave been established ; the two chief are JSevue Indochinois (Hanoi), and the Bulletin economique de Vlndo-Chine (Saigon). Amongst standard works on the country may be mentioned: — Bauinais and Paulis. L' Indo- Chine : la Cochin-chine contemporaine, 1885. — Dnpuis. La Conquete du Tonkin. — Mat-Gioi. Le Tonkin actuel. — Leoleke. Becherohes sur la legislation du Cambodge, 1895. — ^De Lanessan. U Indo- Chine : VEs-

pansion coloniale de la France. Various. — La Mission Pavte, 1899. — AuBAKET. L^ Code Annamite. — Lemiue. V Indo-Chine. — BoNHOURE. L' Lido- Chine, 1900. — Colonel Pamin. Au Tonkin. — PicANON. Le Laos Frangais, 1901. (j. m. a. de l.)

In do re, a native state of India, in the Central India agency, with a total area of 8402 square miles. The population in 1881 was 1,055,217, and in 1891 it was 1,094,150, giving an average density of 130 persons per square mile. In 1901 the population of the Indore agency, which is not co-extensive with the state of Indore, was returned at 333,044, showing a decrease of 11 per cent., due to famine. The gross revenue is estimated at Es.70,00,000. The Maharaja, Shivaji Eao Holkar, G.C.S.I., has visited England. The soil in the valley of the Karbada produces fine crops of wheat and poppy, yielding the Malwa opium of commerce ; but drought prevailed in portions of the state in 1897, and again in 1900. The metre gauge railway from Khandwa to Mhow and Indore city (86 miles), continued to Neemuch and Ajmere, was constructed in 1876 at the cost of the state.

About Es.12,00,000 are coined annually at the mint. The city of Indoeb is situated 1786 feet above the sea, on the left bank of the river Katki, near its junction with the Khan. It has a railway station. The population in 1881 was 83,091, and in 1891 it was 92,329. These figures include the residency, which is under British administra-tion. The chief educational institutions are the Daly College, for the sons of the chiefs of Central India ; the Holkar and Canadian Mission colleges, both afSliated to the University of Calcutta ; and four high schools. There are two hospitals, maintained at a cost of about Es. 1,00,000, and a gaol, with an average of 300 prisoners. The Maharaja maintains a cotton mill, established in 1872, with 468 looms and 26,296 spindles, employing 1000 hands. In 1897-98 the number of chests of opium exported through the Indore agency was 4898, paying a duty of Es.27,52,350.

Indre, a department in the centre of France, watered by the Creuse, the Vienne, and the Indre.

Area, 2666 square mileS. From 296,147 inhabitants in 1886 the

population decreased to 286,961 in 1901. Births in 1899, 6834, of which 420 were illegitimate ; deaths, 5261 ; marriages, 2226. The department in 1896 had 546 schools, with 39,000 pupils, and the illiterate formed 5 per cent, of the population. The area under culti-vation amounted in 1896 to 1,532,108 acres, 1,057,628 acres being plough-land and 37,066 acres vineyards. The wheat produce in 1899 amounted to the value of £1,175,000; rye, £87,000 ; barley, £151,000; oats, £655,000; vines, £39,000; the natural pastures and grass lands, £583,000. Indre in 1899 owned 26,230 horses, 13,480 asses, 138,920, cattle, 527,200 sheep, 96,200 pigs, and 39,700 goats. The production of iron maintains a fairly important indus-try in metals. Wool-spinning and pottery are likewise developed. Distillation produced in 1899 72,000 gallons of alcohol. Chateau-roux, the capital, in 1901 contained 24,522 inhabitants.

Indre-et- Loire, a department in the centre of France, watered by the two rivers naming it.

Area, 2377 square miles. The population decreased from 340,921 in 1886 to 334,073 in 1901. Births in 1899, 6913, 424 of them ille-gitimate ; deaths, 6316 ; marriages, 2384. In 1896 there were 648 schools, with 41,000 pupils, and 3 per cent, of the population was

illiterate. The area under cultivation in 1896 amounted to 1,364,070 acres ; 830,300 acres plough-land and 143,326 acres vine-yards. The land in wheat yielded in 1899 the value of £1,323,000 ; rye, £64,000 ; barley, £88,000 ; oats, £40,000 ; vines, £1,004,000. Beetroot, hemp, and apples also yield important returns. Man-gold-wurzel produced (1899) the value of £83,000. The live stock included 45,450 horses, 129,700 cattle, 165,920 sheep, and 64,200 pigs. Though destitute of coal and iron, the department in 1896 produced 108 metric tons of steel. Silk tissues constitute a thriving industry, as do also rope and paper manufacture. In 1898 96,000 gallons of alcohol were manufactured, and in 1901 the yield of wine amounted to 36,318,000 gallons. Tours, the capital, had in 1901 a population of 64,448.

Indus. — A considerable accession of exact geographi-cal knowledge has been gained of the upper reaches of the river Indus and its tributaries by means of those military and political movements which have been so constant on the northern frontiers of India of recent years. The sources of the Indus are to be traced to the glaciers of the great Kailas group of peaks in 32° 20′ N. and 81° E., which

overlook the Manasarowar Lake and the sources of the Brahmaputra, the Sutlej, and the Gogra to the south-east. Three great aflEluents, flowing north-west, unite in about 80° E. to form the main stream, all of them, so far as we know at present, derived from the Kailas glaciers. Of these the northern tributary points the road from Ladak to the Jhalung goldfields, and the southern, or Gar, forms a link in the great Janglam — the Tibetan trade route — which connects Ladak with Lhasa and Lhasa with China. Gartok (about 50 miles from the source of this southern head of the Indus) is an important point on this trade route. At Leh, the Ladak capital, the river is already some 300 miles in length, having pursued an almost even north-westerly course throughout that distance except for a remarkable divergence to the south-west which carries it across, or through, the Ladak range to follow the same course on the southern side that had been maintained on the north. This very remarkable instance of transverse drainage across a main mountain axis occurs in 79° E., about 100 miles above Leh. For

another 230 miles, in a north-westerly direction, the Indus pursues a comparatively gentle and placid course over its sandy bed between the giant chains of Ladak to the north and Zaskar (the main "snowy range" of the Himalaya) to the south, amidst an array of mountain scenery which for the majesty of sheer altitude is un-matched iDy any in the world. Then the river takes up the waters of the Shyok from the north (a tributary

nearly as great as itself), having already captured the Zaskar from the south, together with innumerable minor glacier-fed streams.

The Shyok Affluent. — The Shyok is an important feature in Trans-Himalayan hydrography. Rising near the southern foot of the well-known Karakoram pass on the highroad between Ladak and Kashgar, it first drains the southern slopes of the Karakoram range, and then breaks across the axis of the Muztagh chain (of which the Karakoram is now recognized as a subsidiary ex-

tension northwards) ere bending north-westwards to run a parallel course to the Indus for 150 miles before its junction with that river. The combined streams still hold on their north-westerly trend for another 100 miles, deep hidden under the shadow of a vast array of snow-crowned summits, until they arrive within sight of the Rakapushi peak which pierces the north-western sky midway between Gilgit and Hunza. Here the great change of direction to the south-west occurs, which is thereafter maintained till the Indus reaches the ocean.

Tim Gilgit Affluent. — At this point it receives the Gilgit river from the north-west, having dropped from 15,000 to 4000 feet (at the junction of the rivers) after about 500 miles of mountain descent through the independent provinces of northern Kashmir. (See Gilgit.) A few miles below the junction it passes Bunji, and from that point to a point beyond Chilas (60 miles below Bunji) it runs within the sphere of British interests. Then once again it resumes its " independent " course through

the wild mountains of Kohistan and Hazara, receiving tribute from both sides (the Bunar contribution being the most noteworthy) till it emerges into the plains of the Punjab below Darband, in 34° 10' IST. All this part of the river has been mapped in more or less detail of late years. The hidden strongholds of those Hindustani fanatics who had found a refuge on its banks since Mutiny days have been swept clean, and many ancient mysteries have been solved in the course of its surveying. Amongst other interesting relics of the past the great "rock" Aornos of Alexandrian fame has been finally identified with Mahaban, and even the names of some of the contiguous villages of Greek story have been found in faint survival.

Indus of the Plains. — From its entrance into the plains of India to its disappearance in the Indian seas, the Indus of to-day is the Indus of the 'fifties — only modified in some interesting particulars. It has been bridged at several important points. There are bridges even in its upper mountain courses. There is a wooden

pier bridge at Leh of two spans, and there are native suspension bridges of cane or twig-made rope swaying uneasily across the stream at many points intervening between Leh and Bunji ; but the first English-made iron suspension bridge is a little above Bunji, linking up the highroad between Kashmir and Gilgit. Next occurs the iron girder railway bridge at Attok, connecting Peshawar with Rawal Pindi, at which point the river narrows almost to a gorge, only 900 feet above sea-level. Twenty miles below Attok the river has carved out a central trough which is believed to be 180 feet deep. Forty miles below Attok a bridge of boats carries the traffic from the rail-way terminus at Kushalgarh to the road which leads westwards to Kohat. At Mari, beyond the series of gorges which continue from Kushalgarh to the borders of the Kohat district, at the northern railway terminus of the Sind-Sagar line, there is a boat-bridge leading to Kalabagh (the Salt City) and northwards to Kohat. There is a boat-bridge opposite Dera Ismail Khan to connect that place with the railway; but there is nothing new in

these southern sections of the Indus valley railway system except the extraordinary development of cultivation in their immediate neighbourhood. The Lansdowne bridge at Sukkur, whose huge cantilevers stand up as a monument of British enterprise visible over the flat plains for many miles around, is one of the greatest triumphs of Indian bridge-making and the most important of Indus bridges. Kotri will inevitably be connected with Haidarabad in Sind, and the Indus ere long will become the best-bridged river in India. The intermittent navigation which was maintained by the survivals of the Indus flotilla as far north as Dera Ismail Khan long after the establishment of the railway system has ceased to exist with the natural dissolution of the fleet, and the high-sterned flat Indus boats once again have the channels and sandbanks of the river all to themselves.

Lower Indus and Delta. — Within the limits of Siad the vagaries of the Indus channels have necessitated a fresh survey of the entire riverain. The results, however,

indicate not so much a marked departure in the general course of the river as a great variation in the channel beds within what may be termed its outside banks. Collaterally much new information has been attained about the ancient beds of the river, the sites of ancient cities, and the extraordinary developments of the Indus delta. The changing channels of the main stream since those prehistoric days when a branch of it found its way to the Rann of Kutch, through successive stages of its gradual shift westwards — a process of displacement which marked the disappearance of many populous places which were more or less dependent on the river for their water supply — to the last and greatest change of all, when the stream burst its way through the limestone ridges of Sukkur and assumed a course which has been fairly constant for 160 years, have all been traced out with systematic care by modern surveyors till the mediaeval history of the great river has been fully gathered from the characters written on the delta surface. That such changes of river bed and channel should have

occurred within a comparatively limited period of time is the less astonishing if we remember that the Indus, like many of the greatest rivers of the world, carries down sufficient detritus to raise its own bed above the general level of the surrounding plains in an appreciable and measurable degree. At the present time the bed of the Indus is stated to be 70 feet above the plains of the Sind frontier, some 60 miles to the west of it.

Statistics. — The total length of the Indus, measured directly, is about 1500 miles. "With its many curves and windings it stretches to about 2000 miles, the area of its basin being computed at 372,000 square miles. Even at its lowest in winter it is 500 feet wide at Iskardo (near the Gilgit junction), and 9 or 10 feet deep. The temperature of the surface water during the cold weather in the plains is found to be 5° colder than that of the air (64° and 69° F.). At the beginning of the hot weather, when the river is bringing down snow water, the difierence is 14° (87° and 101° June). At greater depths the difference is still greater. At Attok, where the river narrows between rocky banks, a height of 60 feet in the flood season above lowest level is common, with a velocity of 13

miles per hour. The record rise (since British occupation of the Punjab) is 80 feet. At its junction with the Panjnad (the combined rivers of the Punjab east of the Indus) the Panjnad is twice the width of the Indus, but its mean depth is less, and its velocity little more than one-third. The discharge of the Panjnad at low season is 69,000 cubic feet per second, that of the Indus 92,000. Below the junction the united discharge in flood season is 380,000 cubic feet, rising to 460,000 (the record in August). The Indus after receiving the other rivers carries down into Sind, in the high flood season, turbid water containing silt to the amount of Tji, part by weight, or ^ by volume— equal to 6480 millions of cubic feet in the three months of flood. This is rather less than the Ganges carries. The silt is very fine sand and clay. Unusual floods, owing to landslips or other exceptional causes, are not infrequent. The most disastrous flood of tliis nature occurred in 1858. It was then that the river rose 80 feet at Attok. The

most striking result of the rise was the reversal of the current of the Kabul river, which flowed backwards at the rate of 10 miles per hour, flooding Naoshara and causing immense damage to property.

See Maclagan. Proceedings B.G.S., vol. iii. — Haig. The Indus Delta Country. London, 1894. — Godwin-Austen. Proceedings M.Gr.S., vol. vi. (t. h. h.)*

Industrial and Reformatory Schools.—

These two classes of institutions are frequently confounded in the public mind. In outward characteristics they are very similar ; their system of management, their discipline, and the life led within their walls are alike. Nor is there much difference between the character of the inmates ; the distinction is one not so much of criminality as of age. The senior schools or reformatories are schools to which are sent juveniles up to the age of 16 who have been convicted of an offence punishable with penal servitude or imprisonment; the junior or industrial schools, on the other hand, are designed, broadly speaking, for

children up to the age of 14 who may not actually have commited an offence, but whose circumstances are such that if left in their surroundings they are likely to join the delinquent population. Thus the reformar tories are for actual, the industrial schools for potential, delinquents, and the former contain juveniles some three years older on an average than the latter. The limit of detention in the former is the age of 19, and in the latter the age of 16. The two overlap to some extent, in that an actual delinquent, if under 12 and not previously convicted, may be committed to an industrial school.

The origin and history of the two classes of schools are distinct. Reformatories derive from the voluntary institutions established by the Marine Society, founded in 1756, and the Philanthropic Society, founded in 1788,

Origin of -which occupied themselves in receiving and reforming the younger classes of criminals, particularly boys sentenced to transportation or long terms of imprisonment, and pardoned condi-

tionally on their detention in such homes. In 1837 the Government itself made an effort to apply re-formatory treatment to juveniles in Parkhurst Prison. Outdoor industrial employment was there combined with school instruction and religious teaching, with a view to the reformation of criminal boys; but the place remained technically a prison, and after a fluc-tuating career it was closed in 1864. The number of inmates had fallen from 536 in 1854 to 68 in 1864, no doubt owing to the passing in the interval of the first Reformatory Act. Thus reformatories have always had so much association with prisons that they have run parallel with them.

Industrial schools have never had any sort of associa^ tion with prisons. They are the direct descendants of the " ragged schools," whose object was to provide educa-tion for destitute children, and so prevent them

Origin of from falling into vagrancy and crime. The schcmis.^ father of ragged schools was John Pounds, the Portsmouth shoemaker, who in the early years

of the 19th century devoted himself to the improvement of the outcast children in his neighbourhood. By 1840 the ragged school movement had become an important one, and enlisted the powerful advocacy of such men as Lord Shaftesbury, Dr Guthrie, and Sheriff Watson of Aberdeen. There are industrial schools now in existence which actually occupy in part the primitive buildings m which they were housed as ragged schools.

These preliminary remarks will render intelligible a brief history of legislation in regard to reformatory and industrial schools in Great JJritain.

Before 1854 the only children legally detained in a reforma-

tories.

reformatory were those sent there under conditional pardon (Parkhurst Prison Act, 1 and 2 Vict., c. 82, s. 11).

The decade between 1840 and 1850 was marked , ; / .

by a powerful stirring of the public conscience tioa as to with regard to the state of juvenile delinquency retorma-

in the growing towns of the country, and a ‘<"'^*-

desire to check its growth by other than penal measures. Mr Monckton Milnes (afterwards Lord Houghton) introduced a Bill in 1846 for the establishment of reformatory schools. The Bill was rejected, but its introduction focussed the general interest, and in 1851 an important conference was held at Birmingham, the results of which were: — (1) The appointment of a committee by the House of Commons for the investigation of juvenile delinquency ; (2) the introduction of a Bill by Mr Adderley (afterwards Lord Norton); (3) the establishment of reformatory schools in various districts by the independent efforts of individuals like Mr Adderley, Lord Leigh, Mr Barwick Baker, and Miss Mary Carpenter. A second conference was held at Birmingham in 1863, and resulted in the Government finally accepting Mr Adderley's Bill and carrying through in 1854 the first Reformat tory Schools Act (17 and 18 Vict. c. 86). This Act was amended in 1865, 1866, and 1857. The Act of 1857 was important, in that it enabled for the first time local authorities, viz., Quarter-Sessions in counties and

Councils of Quarter-Sessions in boroughs, to contribute towards the establishment of reformatories and the maintenance of children in them. Further, the power was given to grant licences to the inmates of reformatories. In the same year the Rev. Sydney Turner, who had been the superintendent of the Philanthropic Society's school, and was responsible for the establishment of the reformatory at Redhill on the lines of the agricultural colony of Mettray in France, was appointed her Majesty's inspector attached to the Home OfB.ce. In 1866 previous Acts were repealed, and the Consolidating and Amending Act now in force was passed. Amending Acts have been passed in 1872, 1874, 1891, 1893, and 1899, while by the Prison Act of 1877, which transferred local prisons to the state, the power of prison authorities to contribute to reformatories was expressly saved. The principal modifications which these amending Acts have effected are : — (1) The age up to which juvenile delinquents may be sent to industrial schools instead of to reformatories was raised to 12 (Acts of 1893, and Youthful Offenders Act,

1901) ; (2) imprisonment prior to committal to a reformar tory school was abolished (Act of 1899) ; (3) the period of detention was to be not less than three nor more than five years — the offender in any case was not to be detained beyond 19 (Act of 1893) ; (4) extensive powers were given to managers to dispose of children without their parents' consent (Act of 1891).

The first Industrial Schools Act, introduced by Mr Dunlop, was passed in 1864, and applied to Scotland exclusively. It enabled a sheriff or magistrate to commit, up to 16, vagrant children, though not charged j^,^,3, with any offence. Amending Acts were passed tion as to in 1855 and 1856, and in 1861 a consolidating industrial statute was passed. The classes of children s^*""'- admissible were enlarged, so as to include not only mendicant and destitute children, but children under 12 charged with offences, and refractory children under 14. The powers of supervision, &c., which had by the original Act been given to the Committee of Council on Education, were transferred to the Home Secretary. The first*

English Act was passed in 1857. Amending Acts were passed in 1860 and in 1861. These early English Acts closely followed the lines of the Scottish ones, save as regards the admission of pauper children. In 1866 the English and Scottish Acts were consolidated by the

principal Act now in force, the effect of which, was, save again as regards pauper children, to place the industrial schools of both countries on the same footing. The local authority was to be the prison authority in England and the county board in Scotland, and the inspector of industrial schools and the inspector of reformatories were to be the same person, appointed by the Home Secretary. Amending Acts were passed in 1871 (the Prevention of Crimes Act), 1872, 1874, 1880, 1891, 1894, and in 1901 (the Youthful Offenders Act). The effect of these amending Acts has been in the main as follows : — (1) To increase the powers of local authorities to establish and maintain schools and con-

tribute towards the establishment or maintenance of schools (Acts of 1872 and 1874) ; (2) to add to the classes of vagrant, mendicant, destitute, criminal, and refractory children already admissible to the schools (a) children under 14 of a woman twice convicted for crime, and (b) children under 14 found lodging in dis-orderly houses (Act of 1880) ; (3) greater powers were given to managers to dispose of children without their parents' consent (Act of 1891) ; (4) though children could not be detained in an industrial school after the age of 16, the period of supervision by the managers was extended to 18 (Act of 1894) ; (5) Courts of Assize were given the same powers as Courts of Summary Jurisdiction to commit children to industrial schools, and a previous conviction, resulting merely in a whipping or in the benefit of the First Offenders Act, was not to be a bar to the committal of a child under 12 td an industrial school (Youthful Offenders Act, 1901).

But the effect of these amending Acts is small beside

that of the parallel legislation affecting industrial schools

„ to be found in the Elementary Education Acts.

tary ‘ The English Elementary Education Act of 1870, Education providing for the establishment of school boards, ‘’^’ gave them much the same powers in relation to industrial schools as had been in the hands of prison authorities. In 1871, by the Elementary Education (England’) Act, school boards in England were enabled to establish and maintain industrial schools. The Elementary Education Act of 1876 carried the movement still further in England, making it obligatory on a school authority to take steps to send children to industrial schools who were liable to be sent, unless the school authority thought it inexpedient. Further, school authorities were required to apply to the justices for orders compelling the attendance at school of children over 5 and under 14 whose elementary education was habitually neglected, or who were found habitually wandering, &c. Justices were enabled, on the breach of such a school attendance order, to commit a child to a day*

industrial school, or, in default of that, to an ordinary industrial school ; but a licence might be granted in Education Act cases after a lapse of one month instead of eighteen months, as in other cases. The effect of these provisions in the education acts has been a great increase in the number of children committed to the schools, and the establishment of two subsidiary classes of industrial schools — short detention or truant schools, and day industrial schools, in which children do not reside, but receive their meals, their elementary education, and a certain amount of industrial training. School boards in Scotland have been placed in almost precisely the same position as school boards in England by the Day Industrial Schools (Scotland) Act, 1893. Besides these public Acts, there are a few local Acts in force which should be mentioned— the Middlesex County Industrial Schools Acts, 1854 and 1875; the Glasgow Juvenile Delinquency Act, 1878; the Aberdeen Eeformatory and Industrial Schools Act, 1885; the Eeformatory and Industrial Schools (Manx Children) Act, 1884; the Eeformatory

and Industrial Schools (Channel Islands Children) Act, 1885.

At the close of 1900 there were in Great Britain 48 reformatory-schools, 142 ordinary industrial schools, 15 truant schools, and 22 day industrial schools. Of the schools for boys, 26 statistics. reformatories and 48 industrial schools in England, with 4 reformatories and 13 industrial schools in Scotland, were under Protestant management ; 4 reformatories and 13 industrial schools in England, with 1 reformatory and 3 industrial schools in Scotland, were under Roman Catholic management. Of the schools for girls, 7 reformatories and 32 industrial schools in England, with 2 reformatories and 12 industrial schools in Scotland, were under Protestant management ; 2 reformatories and 12 industrial schools in England, with 1 reformatory and 3 industrial schools in Scotland, were under Roman Catholic management. In addition there were in England 3 and in Scotland 2 mixed schools with departments for both girls and hoys ; these were all under Protestant management. Of the boys' reformatories 2 were training-ships, and all but three or four of the remainder farm or country schools. Of the boys' industrial schools 8 were training-ships, and

the remainder pretty equally divided between town and country schools. All the reformatories and the bulk of the industrial schools were managed by voluntary committees. Ten, however, of the latter (with all the truant and all save one of the day industrial schools) were managed by school boards, 8 by county councils, and one by the corporation of Birmingham. Affiliated with the industrial schools were 17 working boys' homes — a wholesome development of the licensing system which is likely to grow. On the 31st December 1900 there were 4953 boys (England 4189, Scotland 764) and 658 girls (England 554, Scotland 104) nominally under sentence of detention in reformatories: 3786 Protestant, 1167 Roman Catholic boys; 498 Protestant, 160 Roman Catholic girls. But of these there were at large on licence 860 boys and 27 girls. On the same date there were under commitment to industrial schools 14,384 boys (England 10,861, Scof^ land 3523) and 4719 girls (England 3302, Scotland 1417) : 11,135 ^ Protestant, 3249 Roman Catholic boys ; 3042 Protestant, 1677 Roman Catholic girls. Of these there were at large on licence 1498 boys and 266 girls. Truants numbered 1332, with 4283 on licence, and children attending day industrial schools 3263, with

417 on licence.

If the figures for the period between 1876 and 1900 are studied, it will be seen that the number of juveniles sent to reformatories has positively diminished, while the number of those sent to industrial schools, after rapidly mounting up to 1893, has since that year remained practically stationary.

The cost of the schools falls on the Treasury, local rates, and voluntary subscriptions. In addition, the schools to a certain extent earn, or save, money by the industries they prac- tise. The Government grant is a weekly capitation "«"<«. fee ; it varies from 6s. to 2s. a week. Reformatories and most of the training-ships get 6s. a week. In industrial schools the grant is varied in accordance with two considerations : — (1) Where a school was established prior to 1872, it gets for certain cases 5s. a week ; later schools, 3s. 6d. ; (2) whether the degree of criminality implied in the charge under which the child is committed is large or small, e.g. , for a child described as a thief the highest grant is given, for a child merely described as refractory 2s. is given. In all cases, however, both reformatory and industrial, the rates over 2s. are reduced after an individual has been for a certain time

in the school. In the case of very young children nothing is paid by the Treasury up to six years of age, and the full grant only when the child attains ten years of age. In nearly all the English industrial schools the managei-s require the Government allowance to be made up to 7s. or 7s. 6d. a week by the local authority concerned. The total amount of the Treasury payments to reformatories in 1900 was, in England £62,053, Scotland £10,384. The contributions from county and borough rates were respectively £22,247 and £2652. Subscriptions, &c., came respectively to £1925 and £321. The profit on industi-ial depart-ments was respectively £9384 and £1634. In the case of industrial schools during 1900 the Ti-easury grant was, for England £128,799, Scotland £54,413. Payments from the rates came respectively to £137,696 and £12,692 ; subscriptions to £15,819 and £9078 ; profits from industi'ial departments to £18,941 and £4935. It will be noticed that the share contributed by local authorities in Scotland is less than in England. As a matter of fact, there are several schools in Scotland which endeavour to struggle along on the Government grant, and receive practically no subvention from the rates. Speaking in round figui'es, it may be said that

each inmate of a reformatoiy school costs £21 a year ; of this £14 comes from the Exchequer, £5 fi'om the rates, and £2 from voluntary subscriptions and payments made by the parents. Each

Inmate of an industrial school costs £20 a year, of which £9, 10s. comes from the Exchequer, £9 from the rates, and £1, 10s. from subscriptions and parents' payments. In considering comparative tables from the years 1876, 1886, and 1896, it will be seen that while the share paid by the state has remained practically stationary, that of the rates has largely increased, and has to a considerable extent displaced voluntary subscriptions. The total cost per child has varied very little.

The death-rate for schools in Great Britain for 1900 was 4-47 per 1000.

An important feature of the reformatory and industrial school system of Great Britain has been the recognition and enforcement of the duty of parents to contribute towards their children's Pareatal maintenance. The contributions are collected by the contrlbu- inspector, and are paid in to the Exchequer in reduction

tloas. of the Government grant. The work of gathering in this money presents serious difficulties, despite which, however, the amount realized is substantial. In the year 1900 it amounted to over £26,000. The Youthful Offenders Act, passed in 1901, places stringent powers in the hands of the department, and greatly simplifies the legal processes involved in the collection. It is fair to expect that in the future the amount collected will increase, and the moral effect on parents be correspondingly strengthened.

*As has been explained above, the system at work in reformatory and industrial schools is very much the same. An effort is made to arouse in the schools something of System *^® public school Spirit, and as far as possible at work the size of the various institutions has been kept la the within reasonable limits. The ideal aimed at schools. jj^^g begQ tjie avoidance of schools so big that the superintendent cannot know personally each of the children committed to his charge. Many successful boys' reformatories will be found with fewer than 100 inmates, and industrial schools with 160 or fewer inmates. The*

numbers in girls' schools are fewer, 50 in reformatories and from 60 to 80 in industrial schools being fair average numbers. Roman Catholic schools as a rule run to larger numbers than Protestant ; this is probably due partly to the nature of their management, generally a religious community, and partly to motives of economy. Three girls' industrial schools and one boys' reformatory (Eed-hill) are on the system of a community of separate houses or cottages. One girls' industrial school (Maryhill, Glasgow) combines the advantages of the central home and the detached cottages.

The reformatory influences at work in both reformatory and industrial schools may be described under four heads : —

1. Religious Instruction. — In every school the superin-tendent is assisted by ministers of religion in the effort to inculcate the principles of religion and morality. Many of the Roman Catholic schools are actually under the management of religious communities. In accordance with the salutary tendency to allow children the utmost

possible liberty, and to increase their opportunities of mixing with the outside world, it is considered more satisfactory, in Protestant schools at any rate, that children should attend divine service at outside churches than in a chapel of their own.

2. Elementary Education. — The scheme of elementary education is very much the same as obtains in the ordinary day-school. Most of the children only attend school half-time, but they attend regularly ; and in a good industrial school it will be found that what a child loses in the schoolroom it more than gains in a workshop or needle-room, where educational methods are employed.

3. Industrial Training. — More variety in industrial training is to be found in boys' than in girls' schools. There are training-ships, with their nautical training; farm-schools, where agricultural work takes the principal place; town schools, where trades are practised; and suburban schools, where a training can be given in horticulture as well as in trades. In nearly all boys' schools great importance is attached to musical training, since

an efiBcient school band affords an excellent means of disposing of boys in army bands. The industrial training in boys' schools is improving ; the principles of technical education are better understood, and an attempt is made not only, by occupying children, to inculcate the habits of industry, but also, by explaining to them the theory of what they are practising, to develop the intelligence. The value, too, of drawing is now generally reeognized. The main object in the case of girls is to prepare them for domestic service. Here also an effort is made to perfect their industrial training. In many schools not only do the girls assist in the school kitchen, needle-room, laundry, &c., but the older ones also attend definite courses of lessons in cookery, laundry work, cutting-out, and dressmaking. Although the great majority of girls enter domestic service, a few are singled out for training as teachers, dressmakers, shop assistants, or other occupations for which they show a special aptitude.

4. Physical Culture. — Physical culture receives marked consideration, for it is recognized as a duty to do the

utmost by a sound athletic and gymnastic training to repair the ill effects of early neglect. The report of the Anthropometric Committee of 1883 brought to light the fact that the children entering industrial schools are physically the lowest class of the population, and though statistics published in H.M. inspector's report for 1900 show an improvement, the relative position remains the same. !N"evertheless, small though the boys are, they are good material to work upon, for in many cases it is the excess of qualities like enterprise and courage which has got them into trouble. The physical training of girls is largely designed to improve their figures and gait; the utter neglect from which many have suffered in early childhood renders the task a dijBGlcult one, but the results to be achieved by patient work in a girls' school are just as encouraging as in a boys'. Mention may be made of various athletic leagues, which introduce a healthy spirit of competition, and remove the feeling of isolation, and of the open-air camp life indulged in by many schools, girls' as well as boys', during the summer.

An important auxiliary in the maintenance of discipline in general use is a mark system, to which various rewards are attached. The object of these mark systems is to reduce punishment to a minimum, and to form character as much by encouraging industry and good conduct as by punishing idleness and misbehaviour.

*The managers of schools are placed by the law in loco parentis, but it is often a hard struggle to prevent the natural, however undesirable, parents from again getting hold of their children when they reach a wage-earning age. For three years after children have ^^'JfJ'/g ”' left a school the managers have to keep an and eye on them, and to report to H.M. inspector results their addresses, occupations, and characters. °y^„^*

The report of H.M. inspector for 1900 describes the position at the end of that year of the children who left the schools in the years 1897, 1898, and 1899. The total number of boys was 13,390, of whom 1939 were in the army, 443 in the navy, 1204 in the mercantile marine or fishermen, 1028 in farm service, 678 in

*factories, 487 miners, 475 carters, 395 iron and steel workers. Other occupations, in which fewer were engaged, need not be specified, but the number described as in merely casual employment was 577, of re-convictions 970, or 7 per cent., and of those lost sight of 727, or 5 per cent. The total number of girls was 3005 : of these more than half entered domestic service, 381, or 38 per cent., in households where more than one servant was kept; laitndry-maids numbered 244. The number in casual employment was 202, of re-convictions 62, or 2^*

per cent., and of those lost sight of 141, or nearly 6 per cent. It is when the di£B.cult work of cUs2')osal is under review that the Rev. Sydney Turner's contention in favour of the voluntary management of schools carries conviction. A discussion of the effect of the schools on crime would require a treatise in itself. We may be content here to quote the guarded judgment of the editors of the judicial statistics during recent years. They are clearly of opinion that crime in England has

diminished, and the editor for 1899, reviewing the period 1893-99, says : "I am inclined to think that the tendency towards a decrease in crime generally during the period extends to juvenile crime as a whole, and that at all events there is no ground for believing that there has been any large increase." Of the credit for this happy state of things a fair share may reasonably be claimed by the reformatory and industrial schools.

The Irish reformatory and industrial schools are, so far as regards the central authority, under the Irish Govern-ment, and the headquarters of the inspector, appointed by Ireland ^^® Lord-Lieutenant, are at Dublin Castle. A Reformatory Schools (Ireland) Act was passed in 1858, and amended by Acts of 1868, 1881, 1893, and 1899. The Irish Industrial Schools Act was passed in 1868, and amended by Acts of 1871 (Prevention of Crimes Act), 1880, and 1901 (Youthful Offenders Act). Though there are minor differences, the law in Great Britain and Ireland is very similar, but the practice appears to have differed considerably. The royal commission of 1884 reported that, owing perhaps to the facts that there

were in Ireland no school boards or board schools, no compulsory education, no district workhouse schools — no refuge, in fact, for children of the destitute and deserted class save the ordinary workhouse schools and the industrial schools, the latter were regarded as institutions for poor and deserted children, rather than for those of a semi-criminal class. The commissioners had no doubt that many children were sent to industrial schools in Ireland who could not be so sent in England, while they apprehended that numbers who were proper subjects for these institutions were left on the streets as waifs and strays. Efforts have been made by the Irish Government, particularly by a circular issued in 1898, to redress the balance. The royal commission of 1884 called attention to the number of children committed for " begging," and stated that there was reason to believe that children were often sent out to beg in order to qualify for admission to schools. But in H.M. inspector's report for 1900 it will be found that the number committed for " begging " had dropped from 1204 in 1894 to 676 in 1898, and 160 in 1900.

At the close of 1900 there were in Ireland 6 reformatory and 70 industrial schools, the Immense majority of them being statistics ^^^^^ Roman Catholic management. On 31st December 1900 there were 559 boys and 65 girls nominally under sentence of detention in a reformatory, but of these there were at large on licence 26 boys. On the same date there were 3672 (535 Protestants) boys and 4549 (401 Protestants) girls under commitment to industrial schools, but of these there were at large on licence 235 boys and 189 girls. An outstanding feature of these figures, as compared with those for England, is the high proportion of girls ; the absolute number is nearly as high as that for the whole of Great Britain, viz., 4719. On the whole, numbers in Irish schools show a tendency of late years to decrease. Finance is regulated very much as in Great Britain, but the capitation grant is not reduced as it is there after a certain period. Per contra, Ireland lacks some of the minor advantages {e.g., licence grants in reformatory cases) enjoyed in Great Britain. The Treasury contributed in 1900, to Irish reformatories £8915 ; rates, £4198 ; other sources, £349 ; and profits were estimated at £1055. To industrial schools in 1900 the Treasury contributed £97,853 ; rates, £41,il44 ; other

sources, £8779 ; while profits were estimated at £10,546.

The death-rate in Irish industrial schools in 1900 was 8. 39 per 1000.

The system at work in the Irish schools is, with natural modi-

fications, much the same as that which obtains in Great Britain.

[See the reports of the House of Commons Committee of 1858,

of the Royal Commission of 1884, of the Departmental

Committee of 1895, and the annual reports of H.M. In-

spectors for Great Britain and Ireland.]

Though the idea of the reformatory school was indi-

genous in England, its realization owed much to foreign

precept and example. The provision of the

French Penal Code, by which offenders under ^^^°™^”

16 are held to have acted sans discernement, abroad.

was prominent iu the minds of those who

fought from 1840 to 1850 for the passing of a Eefor-

matory Schools Act. The leading reformatory in Great

Britain to-day is the Philanthropic Society’s farm-school

at Redhill, which was avowedly modelled on the famous

agricultural colony at Mettray, near Tours, founded by

M. Demetz in 1839. Both at Redhill and Mettray the

colony is divided into separate houses, each containing from forty to sixty inmates, and supervised, as in the case of an English public school, by a house-master ; but the colony at Eedhill is smaller, the arrangement of the houses is on a less formal plan, and the display of " uniform " among the officers is reduced to a minimum. Another foreign school which largely influenced public opinion in Great Britain, as in Germany, was the Eauhe Haus, near Hamburg, founded by Dr Wickern in 1833. This l3egan with a single cottage, but had grown in twenty years to a hamlet of twenty houses, with from twelve to sixteen inmates in each. The establishment was a Lutheran one; both boys and girls were admitted, though to separate houses, and a marked feature of the place was the number of " brothers," young men of good character qualifying for rescue-work as superintendents of homes, prison officers, and schoolmasters, who took part in the work, and swelled to an unusual extent the proportion of officials to inmates. The character and aims of the Eauhe Haus seem to have changed somewhat in modern

days.

There are schools or " colonies " analogous to reforma-

tory and industrial schools in most European countries

— Prance, Germany, Austria, Belgium, Sweden, Norway,

Switzerland (where the influence of Pestalozzi is dis-

cernible), and Italy. In all the principle of voluntary

management is admitted, but in Prance, Germany, Aus-

tria, Belgium, and Italy there are schools directly managed

by the Government or State. It may be fairly claimed

for the system and the schools of Great Britain, as com-

pared with those of the Continent, that the system attempts

more jealously to enforce the principle of parental respon-

sibility, and that the schools have as a general rule two

signal advantages : (1) they are less formal and institu-

tional ; (2) far more use is made of the healthy discipline

of games and fleld-sports.

In the United States, as on the continent of Europe,

schools correspondingto reformatory and industrial schools

are to be found, the oldest, the New York House

*of Eefuge, dating from 1824. But the unique g^t^*

interest of the United States is connected with adait

the adult reformatories, the best known of which ■ '^torma-

*are the establishments at Elmira in New York '"'"'**■*

and Concord in Massachusetts (see Prison Discipline).

The character and the scale of these may in a measure be

judged by the following particulars : —

The reformatory, the buildings of which are on an ambitious

scale and ornamental in style, was opened in 1876 for the recep-

tion of youthful male felons who are committed tliere for the statu-

tory term for their particular offence to undergo a process of training

and reformation in place of tire ordinary punishment.

The total number received during the seventeen years was

0551 ; the age of the inmates varied from 16 years to 30

years, the average age being 21 years. The average number

in confinement during 1803 was 1470. There were 1378 inmates

at the close of the year, with an average period of detention of

seventeen months. The total cost of maintenance for 1893 was

$216,223. The trade earnings amounted to $53,458, leaving a net

cost of $161,766.

The reformatory is provided with 1258 cells, so that about 400

were necessarily associated two in one room. To avoid still more

overcrowding it had been found necessary to transfer 150 of the least promising inmates to the state prisons. This course had been found to act as an incentive to troublesome conduct on the part of inmates in order to secure their transfer to the prison, where an abatement of their sentence might be earned with less exertion on their part.

The prisoners committed to the reformatory are felons ; 45 per cent, of them had previously been in contact with the restraining agencies of the law ; 68 per cent, were illiterate ; 75 per cent, were without regular occupation ; 92 per cent, were without the benefits of good home surroundings. The object of the reformatory is, as far as practicable, to place the prisoner in " conditions parallel with those of free life, " there to work out his institutional career.

The moral inducements of reformation consist of (1) division into grades, with differing degrees of comfort and social standing ; (2) a wage-earning mark system ; (3) the personal influence of the

reformatory staff. Between 70 and 80 per cent, are said to respond to the efforts made for their good. For the remainder compulsion is found necessary, either by means of forfeiture of marks, degradation of rank, or personal chastisement. Thirty-four different trades had been taught during the year, and it is claimed that 78 per cent, of the discharged inmates went straight to the trade learned in the reformatory. Two evenings a week are devoted to education, and twenty of the best educated amongst the inmates assist in this work. Lectures and concerts are given periodically. There is a gymnasium, and 1175 of the able-bodied inmates are formed into a regiment to go through a course of military drill and training. Prisoners can, at the discretion of the managers, be released on parole, to be brought back again if found to be drifting into crime, but the release is made absolute after six months' satisfactory trial. The total number "paroled" during the seventeen years was 3723. Of these 259 were brought back, 110 were paroled a second time, and 10 a third time. It is claimed that probably about 80 per cent, of the prisoners are reformed, that is, "the discharged inmate returns to society not more, but probably less, likely to fall into crime than the virtuous of the class to which he

belongs."

Elraira and the kindred institutions of the United States have been keenly discussed of recent years among European penologists. The success of the system for adults has not been universally admitted, and its adaptability to the conditions of the more thickly populated countries of the Old World has been questioned. Critics have further been alarmed by the costliness of the system. An English account of these American adult reformatories, with observations upon them, will be found in a Report to the Home Secretary, published in 1897 by Mr Ruggles-Brise, C.B., chairman of the Prison Commissioners. (j. q. l.)

Ineboli, a town, with an open roadstead, on the north coast of Asia Minor. It is the port of Kastamiini, with which it is connected by a carriage road, and exports wool and mohair. The exports and imports are valued at £445,000 annually. The population is 9000 (Moslems 7000, Christians 2000). There are British and other consular officers.

Inebriety, Law of. — The legal relations to which drunkenness gives rise are partly civil and partly criminal.

The law as to the civil c&pacity of the drunkard is practically identical with the law as to the civil capacity of a person suffering from mental disease (see Insanity, Law op). He can enter into a valid marriage or make a valid will, or bind himself 'by a contract, if he is sober enough to know what he is doing, and no improper advantage of his condition is taken. The Sale of Goods Act, 1893, also provides that where necessaries are sold and delivered to a person who by reason of drunkenness is incompetent to contract, he must pay a reasonable price for them; and "necessaries" for the purposes 'of this provision mean goods suitable to the condition in life of such person and to his actual requirements at the time of the sale and delivery.

Drunkenness comes under the cognizance of the criminal law as a form of breach of the peace. The Licensing Acts and other statutes of a similar character also create various offences in connexion with the sale of intoxicating liquors. Neither of these subjects needs to be touched upon here.

The law as to the criminal responsibility of drunkards

must, however, be examined.

Drunkenness, unlike insanity, was at one time regarded as in no way an excuse for crime. According to Coke, a drunkard, although he suffers from acquired insanity, dementia affectata, is voluntarius dcemon, and therefore has no privilege in consequence of his state ; " but what hurt or ill soever he doth, his drunkenness doth aggravate it." Sir Matthew Hale took a more moderate view, viz., that a person under the influence of this voluntarily contracted madness " shall have the same judgment as if he were in his right senses " ; and admitted the existence of two "allays" or qualifying circumstances : (1) temporary iienzj induced by the unskilf ulness of physicians or by drugging ; and (2) habitual or fixed frenzy. Those early authorities have, however, undergone considerable development and modification in later years. It is settled law that where a particular intent is one of the constituent elements of an offence, the fact that a prisoner was intoxicated at the time of its commission is relevant evidence to show that he had not the capacity to form that intent. Drunkenness is also

a circumstance of which a jury may take account in considering whether an act was premeditated, or whether a prisoner acted in self-defence or under provocation, when the question is whether the danger apprehended or the provocation was sufficient to justify his conduct or to alter its legal character. Moreover, deliriuTn tremens, if it produce such a degree of madness as to render a person incapable of distinguishing right from wrong, relieves him from criminal responsibility for any act committed by him while under its influence; and in one case at nisi prius (Beg. v. Baines, The Times, 25th Jan. 1886) this doctrine was extended by Mr Justice Day to temporary derangement occasioned by drink.

The law of Scotland accepts, if it does not indeed go somewhat beyond, the later developments of that of England in regard to criminal responsibility in drunkenness. Indian law on the point is similar to the English. In the United States the same liberal view is the prevalent legal doctrine.

Provision is made for the care of habitual drunkards by

the Inebriates Acts of 1879, 1888, 1898, and 1899. Only an outline of the provisions of these statutes can here be attempted. They deal in the first place with non-criminal, and in the second place with criminal, habitual drunkards. For the purposes of the Acts the term "habitual drunkard " means " a person who, not being amenable to any jurisdiction in lunacy, is notwithstanding, by reason of habitual intemperate drinking of intoxicating liquor, at times dangerous to himself or herself, or incapable of managing himself or herself and his or her affairs." A person would become amenable to the lunacy jurisdiction not only where habitual drunkenness made him a "lunatic" in the legal sense of the term, but where it created such a state of disease and consequential "mental infirmity " as to bring his case within section 116 of the Lunacy Act, 1890, the effect of which is explained in the article Insan-ity, Law of. Any "habitual drunkard" within the above definition may obtain admission to a " licensed retreat " on a written application to the licensee, stating the time (the maximum period is two years) that he undertakes to remain

in the retreat. The application must be accompanied by the statutory declaration of two persons that the applicant is a habitual drunkard, and its signature must be attested by a justice of the peace who has satisfied himself as to the fact, and who is required to state in part of the attestation that the applicant understood the nature and effect of his application. Licences (each of which is subject to a duty and is impressed with a stamp of £5, and 10s. for every patient above ten in number) are granted for retreats by the borough council and the town clerk in boroughs, and elsewhere by the County Council and the clerk of the County Council. The maximum period for which alicence

may be granted is two years, but licences may be renewed by the licensing autliority on payment of a stamp duty of the same amount as on the original grant. When a habitual drunkard has once been committed to a retreat, he must remain in the retreat for the time that he has him-

self fixed in his application, subject to certain statutory provisions similar to those prescribed by the Lunacy Acts for asylums as to leave of absence and discharge ; and he may be retaken and brought back to the retreat under a justice's warrant. The term of detention may be extended on its expiry, or an inebriate may be readmitted, on a fresh application, without any statutory declaration, and without the attesting justice being required to satisfy himself that the applicant is a habitual drunkard. Licensed retreats are subject to inspection by an inspector of retreats appointed by the Home Secretary, to whom he makes an annual report. The Home Secretary is empowered to make rules and regulations for the management of retreats, and "regulations and orders," not inconsistent with such rules, are to be prepared by the licensee within a month after the granting of his licence, and submitted to the inspector for approval. The rules now in force were made on 10th August 1888. There are also statutory provisions, similar to those of the Lunacy Acts, as to offences — (i.) by licensees failing to comply

with the requirements of the Acts ; (ii.) by persons ill-treating patients, or helping them to escape, or unlawfully supplying them with intoxicating liquor ; (iii.) by patients refusing to comply with the rules. The Home Secretary may (i.) authorize the establishment of " State Inebriate Reformatories," to be paid for out of moneys provided by Parliament ; and (ii.) sanction " Certified Inebriates' Reformatories " on the application of any borough or County Council, or any person whatever, if satisfied concerning the reformatory and the persons proposing to maintain it. An inspector of certified inebriate reformatories has been appointed.

Any person convicted on indictment of an offence punishable with imprisonment or penal servitude (i.e., of any non-capital felony and of most misdemeanours), if the court is satisfied from the evidence that the offence was committed under the infiuence of drink, or that drink was a contributing cause of the offence, may, if he admits that he is, or is found by the jury to be, a habitual drunkard, in addition to or in substitution for any other sentence, be

ordered to be detained in a state or certified inebriate re-
formatory, the managers of which are willing to receive
him. Again, any habitual drunkard who is found drunk
in any public place, or who commits any other of a series
of similar offences under various statutes, after having
within twelve months been convicted at least three times
of a similar offence, may, on conviction on indictment, or
if he consent, on summary conviction, be sent for deten-
tion in any certified inebriate reformatory. The expenses
of prosecuting habitual drunkards under the above pro-
visions are payable out of the local rates upon an order
to that effect by the judge of assize or chairman of quarter-
sessions if the prosecution be on indictment, or by a court
of summary JTirisdiction if the offence is dealt with sum-
marily. The Inebriates Acts apply to Scotland and Ireland
with adaptations.

Authorities. — As to the history of legislation on the subject
see Pari. Paper No. 242 of 1872 ; 1893 C. 7008.— TAe Annual
Beports of the Inspector of Licensed Betreats. — Wyatt Paine. 7n-
ebriates Acts, 181^-1898. London, 1899. — Blackwell. Inebriates

Acts, 1879-1898. London, 1899. — Wood Renton. Lunacy. London and Edinburgh, 1896. — Kerr. Inebriety, .3rd edition, London, 1894, in which an excellent account of the systems in force in other countries for the treatment of inebriates will be found.

Infantry. — This term, adopted into the English language from either Italian or French, implies men equipped and armed for fighting on foot. The Italian /ante, Boccaccio's fanteria, the French fantassin and in-fanterie, are portions of the same stock, offshoots from the Latin infans, employed in the sense of " youth." During the days of chivalry, youths of good family, dependants, and servants all marched as infantry in rear of the knights. The development of infantry soldiers during the long period between the mythical dawn of history and the present time is a continuous narrative of war following war, with scant intervals of peace. Infantry formed the bulk of all early armies from the date of David's capture of Jerusalem or the uncertain date of the siege of Troy, through the eras of the Greek and Mace-

donean phalanx and of the Eoman Legion. Franks from Germany marched and fought on foot during and after the conquest of Gaul ; Charlemagne in the 8th century employed masses of infantry to keep order in a kingdom extending from the Elbe to the Ebro, from the Atlantic to the mountains of Bohemia, and diagonally from the British Channel to IS'aples. The institution of chivalry did little to diminish the numerical preponderance of foot-soldiers over the rest of the forces ; but growing skill in metal-working, and its special application to arms and armour, increased the relative power of mounted men, for they alone could bear the weight of complete defence. The cost of armour was great, and on the continent of Europe the infantry service was relegated to slaves and to freed serfs, whilst in England, from the Conquest onwards, yeomen and dependants of the feudal tenants formed a numerous but ill-armed and unorganized mass of infantry. On the borderland of the 12th and 13th centuries, infantry militia was the principal force em-ployed by Philip Augustus in his contests against the

English king and the Flemish soldiers of the Emperor Otho IV. In the 14th century cavalry of the highest quality dismounted and fought on foot both at Creqy and Poictiers, and at Agincourt the English archers played havoc with the cavaliers of France. A century later Spanish infantry rose to formidable prominence synchronously with the introduction of muskets and standing armies. In' 1494 Charles VIII. embarked on his Italian campaign at the head of an army consisting of 3600 men-at-arms, 20,000 native infantry, 8000 Swiss mercenaries, a considerable body of infantry raised in Germany and called Lansquenets (Landsknecht), together with a formidable train of artillery ; and with these he fought his way to Naples and back, although the bulk of the native infantry were the refuse of society — " branded and ear-cropped" for various crimes. The well-organized and, for the period, well-armed Swiss infantry withstood the shock of the best cavalry furnished by the Pope, the Emperor Ferdinand of Spain, and the republic of Venice. The Swiss, during their long defence against the

House of Austria, compelled by poverty to depend exclusively on infantry, had gained confidence in resisting cavalry, and European powers employed them as mercenaries ; but being as exacting as Praetorian guards, and therefore dangerous to their employers, they were gradually discarded, and armies were raised from native races.

In modern times, as of old, infantry form the main body of all armies in the field ; they are self-containing to a greater extent than either cavalry or artillery, and although limited as to speed of movement, they are less hampered by accidents of the ground than either of the other arms, and less dependent on daylight for effective action. They have a special value to Great Britain, in that their sea transportation is a comparatively easy matter.

The proportion of infantry to cavalry in most modern armies is approximately 6 to 1, with perhaps 3 artillery guns to each 1000 men of the other two arms combined;

but this ratio is varied in practice according to the climate to be encountered and the nature of the field of campaign.

A proportion of cavalry and artillery which would be suitable to action in the plains of India would ill befit operations on the Himalayan spurs, or in the tropical forests of West Africa.

A branch of infantry service has grown into prominence during Great Britain's unceasing small wars. Mounted infantry are foot-soldiers who ride for purposes of accelerated locomotion ; their action in the field differs from that of cavalry, whose normal fighting formation and equipment are planned for mounted men, whereas the rifle and bayonet of the infantry soldier preclude him from mounted combat.

The varying formation adopted by commanders of infantry during successive centuries is in the strictest sense a question of tactics, but the quality of the infantry in courage, discipline, and armament has largely affected the subject. Up to the time of Epamiuondas, in the 4th century b.c, contending forces faced one another along their whole front of battle, but he introduced what

is now called an echelon formation : his infantry of the highest quality were placed in a massive column on one flank or other, and the less good, indifferently armed, lighter troops were kept diagonally "refused" ; thus the advanced flank of the line gave the heavy blow, which was supported by the refused echelon gradii-ally .coming into contact with the enemy. The Macedonian phalanx of the next generation, under the consummate leadership of Philip, overthrew the Peloponnesian armies ; and that massive formation with flanking cavalry held good till the development of the more mobile Roman legions. Similarly at a later date the stately and successful flanking movements of the Prussian king, when continued by unappreoiative successors, yielded to the new-born reckless mobility of the French under Napoleon ; but the latter, during his prolonged wars, was driven to adopt more massive formations, as the battle losses of successive years weak-ened the fighting qualities of his armies. Nemesis, however, was unrelenting, for the fire efficiency of thin lines, with ample working space for individual soldiers, destroyed for all time the validity of dense columns.

The armament of infantry has varied with the years ; from short

swords and slings, to javelins, bows, and spears ; thence to pikes and matchlocks, to flint muskets with bayonets in the muzzles, percussion guns with bayonets outside, muzzle-loading rifles, breech-loading rifles, to the magazine rifles and smokeless powder of the present day. Defensive armour has gradually been abandoned under the stress of desired mobility, and during each succeeding war period the weight of accoutrements carried by a foot-soldier is reduced more and more to the barest necessity — the extreme weight under which he can march and work being made up by ammunition in ever-increasing quantity as the improved mechanism of his arm demands a more lavish supply.

The numbers of infantry in Europe are enormous on paper, and in some of the well-governed states the actual and the paper numbers approximate to one another. By the army returns of the latest dates Europe retains 2f millions of infantry on a peace establishment ; this number might be increased to 15| millions in war, but both numbers are subject to some discount. In one state the war army is returned as a levy en masse of the male population, which means not an army, but a disorganized crowd of men with or without rifles and ammunition. On the other hand, Russia or

Turkey might with comparative facility increase their numbers in Europe by transporting Asiatic troops, who could migrate westwards without impinging on foreign territory.

The formation of infantry into sections, companies, and battalions, these last growing in strength from 400 to 900, can be traced during the 700 years between the dates of Lycurgus and Polybius. Nestor recommended Agamemnon to accept a territorial system {Iliad, ii. 364) by which men and officers from the same district served together. The organization of infantry now generally holding is about 1000 men in each battalion, with either four or eight captain's companies in each ; the papers and documents are compiled for the battalion, although large disciplinary power, varying in different countries, is placed in the hands of the company commanders. The range and accuracy of modern firearms enforce a thinner formation, and consequently a more extended one, as science increases the power of both artillery and rifles, and the full effect of smokeless propellants in war has yet to be learned ; hence the responsibilities of captains of companies grow visibly, as those officers have command of the largest body that can certainly be influenced by the personality of a single commander under the

stress of combat. The working unit of infantry is practically the company, commanded by its captain, and this seems to be common in all armies from biblical times to the present; the centurion, or commander normally of 100 men, has been a recognized character since history began ; sub-units, either half-companies or sections under lieutenants or other subaltern officers, and smaller bodies under sergeants or corporals, may have effective duties both in peace and war. Two, three, or four battalions form a regiment, generally of a territorial nature, and sometimes with some form of additional veteran battalions or militia, as reinforcing bodies in war. The largest pure unit of infantry is a brigade ; divisions may contain two or three brigades, but have troops of other arms attached. The infantry of all countries have at times shown brilliant courage and military qualities, but check or failure seems unduly to affect the troops of some nationalities. In the American Civil War troops of nationalities with high reputation in some portions of the Old World proved often to be broken reeds in times of stress. Since the days of Caesar and his Xth Legion probably no infantry have deservedly held so dominating a reputation as the Light Division of the Duke of Wellington's army in the Peninsula ;

but they had a great literary artist as their historian, and he was a gallant member of their noble body. The foundation of war success for infantry, as with all troops, is confidence — well founded on long experience of the officers ; Great Britain had, at times, to bear the bitter burden of the reverse, but, for the most part, a resilience supervened in changed circumstances, or the British Empire would not hold the position it now does on the scroll of civilizing powers. In the last BoerWar the British infantry proved splendid fighters.

Literature on the subject is profuse ; perhaps the best condensation is Die Fechtweise alter Zeiten, by Boguslawski. (j. b. s.)

Infants. — There have been various recent modifications in the law of the United Kingdom affecting infants. By the Sale of Goods Act, 1893, an infant liable on a contract for necessaries can be sued only for a reasonable price, not necessarily the price he agreed to pay. The same statute declares " necessaries " to mean " goods suitable to the condition in life of the infant and to his actual requirements at the time of the sale and delivery." In the case of goods having a market price,

the market price is reasonable. In all other cases the question is one of fact for the jury. Eecent decisions have explained and interpreted the Infants' Relief Act, 1874. For some years after the passage of that statute highly conflicting views were held as to the meaning of the part of section 2 whereby it was enacted that " no action shall be brought whereby to charge any person . . . upon any ratification made after full age of any promise or contract made during infancy." Some authorities were of opinion that the section only applied to the three classes of contract made void by the previous section, viz., for goods supplied, money lent, and on account stated. Others thought the effect to be that no contract, except for necessaries, made during infancy could be enforced after the infant came to full age. After several conflicting decisions it has been settled that both these views were wrong. Of the infant's contracts voidable at common law there were two kinds. The first kind became void at full age, unless expressly ratified. The second kind were valid, unless repudiated within a reasonable time after full

age was attained by the infant. The Infants' Eelief Act (section 2) strikes only at the first class, and leaves the second untouched. Thus a promise of marriage made during infancy cannot be ratified so as to become action-able ; but an infant's marriage settlement, being of the second class, is valid, unless it is repudiated within a reasonable time after the infant attains full age. What is a reasonable time depends on all the circumstances of the case. In a case decided in 1893 a settlement made by a female infant was allowed to be repudiated thirty years after she attained full age, but the circnmstances were exceptional.

The Guardianship of Infants Act, 1886, places the mother almost on the same footing as the father as to guardianship of infants. On the death of the father the mother becomes guardian under the statute, either alone when no guardian has been appointed by the father, or

jointly -witli any guardian appointed by Mm under 12

Chas. II. c. 24. A change of the law even more important is that -whereby the mother may by deed or will appoint a guardian or guardians of her infant children to act after her death. If the father survives the mother, the mother's guardian can only act if it be shown to the satisfaction of the court that the father is unfitted to be the sole guardian. On the death of the father, the guardian so appointed by the mother acts jointly with any guardian appointed by the father. The Guardianship of Infants Act, 1886, also gives power to the High Court and to county courts to make orders, upon the application of the mother, regarding the custody of an infant, and the right of access thereto of either parent. The court must take into consideration "the welfare of the infant, and . . . the conduct of the parents, and . . . the wishes as well of the mother as of the father." The same statute also empowers the High Court of Justice, " on being satisfied that it is for the welfare of the infant," to " remove from his ofB.ce any testamentary guardian or any guardian

appointed or acting by virtue of this Act," and also to appoint another in place of the guardian so removed. The same statute gives power to a court sitting in divorce practically to take away from a parent guilty of a matrimonial offence all rights of guardianship. When a decree for judicial separation or divorce is pronounced, the court pronouncing it may at the same time declare the parent found guilty of misconduct to be unfit to have the custody of the children of the marriage. " In such case the parent so declared to be unfit shall not, upon the death of the other parent, be entitled as of right to the custody or guardianship of such children." The court exercises this power very sparingly. When the declaration of unfitness is made, the practical effect is to give to the innocent parent the sole guardianship, as well as power to appoint a testamentary guardian to the exclusion of the guilty parent.

Another radical change has recently been made in the rights of parents as to guardianship of their children. In consequence of several cases where, after children had

been rescued by philanthropic persons from squalid homes and improper surroundings, the courts had felt bound by law to redeliver them to their parents, the Custody of Children Act, 1891, was passed. It provides that when the parent of a child applies to the court for a writ or order for the production of the child, and the court is of opinion that the parent has abandoned or deserted the child, or that he has otherwise so conducted himself that the court should refuse to enforce his right to the custody of the child, the court may, in its discretion, decline to issue the writ or make the order. If the child, in respect of whom the application is made, is being brought up by another person (" person " includes " school or institution "), or is being boarded out by poor-law guardians, the court may, if it orders the child to be given up to the parent, further order the parent to pay all or part of the cost incurred by such person or guardians in bringing up the child.

A parent who has abandoned or deserted his child is, primd facie, unfit to have the custody of the child. And

before the court can make an order giving him the custody, the onus lies on him to prove that he is fit. The same rule applies where the child has been allowed by the parent " to be brought up by another person at that person's expense, or by the guardians of a poor-law union, for such a length of time and under such circumstances as to satisfy the court that the parent was unmindful of his parental duties."

The 4th section of the Custody of Children Act, 1891, carefully preserves the right of the parent to control the religious training of the infant. The father, however unfit he may be to have the custody of his child, has the legal right to require the child to be brought up in his own religion. If the father is dead, and has left no directions on the point, the mother may assert a similar right. But the court may, if the child appears capable of understanding the matter, consult the wishes of the child ; and when an infant has been allowed by the father to grow up in a faith different from his own, the court will not, as a rule, order any change in the character of

religious instruction. This is especially the case where the infant appears, on examination, to be settled in his convictions.

In the same direction as the Custody of Children Act, 1891, is the Prevention of Cruelty to Children Act, 1894, whereby considerable powers have been conferred on courts of summary jurisdiction. Magistrates are empowered to punish parents or other custodians of children for cruelty, to deprive them of the custody of the children, and to remove the children, until they attaiu the age of sixteen, to other custody.

The Guardianship of Infants Act, 1886, the Custody of Children Act, 1891, and the Prevention of Cruelty to Children Act, 1894, all apply to Scotland. (r. s. d.)

Influenza. — Like cholera and plague, influenza has reappeared, after an interval of many years, in epidemic or rather pandemic form, and has exhibited a far greater power of diffusion and a more generally destructive influence upon life and health than either cholera or plague. The previous severe visitations in

Great Britain during the 19th century occurred in 1803, 1833, 1837-38, and 1847-48. After the year 1848, in which 7963 deaths were directly attributed to influenza in England and Wales, the disease continued more or less prevalent until 1860, with distinct but minor epidemic exacerbations in 1861, 1855, and 1858 ; but during the next decade the mortality dropped rapidly though not steadily, and the diminution continued down to the year 1889, in which only 55 deaths were ascribed to this cause. It is not clear whether the disease ever disappears wholly or not. Every year doctors meet with cases of illness which they call influenza, and the 55 deaths registered in 1889 are the lowest number recorded in any year since the Registrar-General's returns began. Occasionally also local outbreaks of illness resembling epidemic influenza have been observed during the period of abeyance, as, for instance, in Norfolk in 1878 and in Yorkshire in 1887 ; but whether such outbreaks and the so-called " sporadic " cases that occur every year are nosologically identical

with epidemic influenza is open to some doubt. The relation seems rather to be similar to that between Asiatic cholera and " cholera nostras." Individual cases may be indistinguishable, but as a factor in the public health the difference between sporadic and epidemic influenza is quite as great and unmistakable as that between the two forms of cholera. This fact, which had been forgotten by some since 1847 and never learnt by others, was brought home forcibly to all by the visitation of 1889.

The disease began then, though it did not obtain a distinct hold of England until the very close of the year. According to the exhaustive report drawn up by Dr H. Eranklin Parsons for the Local Government Board, the earliest appearances were observed in May 1889, and three localities are mentioned as affected at the same time, all exceedingly remote and widely separated from each other — namely, Bokhara in Central Asia, Athabasca in the North- West Territories of Canada, and Greenland. About the middle of October it was reported at Tomsk in

Siberia, and by the end of the month at St Petersburg. During November Russia became generally affected, and cases were noticed in Paris, Berlin, Vienna, London, and Jamaica (?). In December epidemic influenza became fully established over the whole of the continent of Europe, along the Mediterranean, in Egypt, and over a large area in the United States. It also appeared in several towns in England, beginning with Portsmouth, during December, but did not become generally epidemic until the commencement of the new year. In London the full onset of unmistakable influenza dated from 1st January 1890. Everywhere it seems to have exhibited the same explosive character when once fully estab-lished. In St Petersburg, out of a Government staff of 260 men, 220 were taken ill in one night, 16th November. During January 1890 the epidemic reached its height in London, and appeared in a large number of provincial towns throughout the British Islands,

though it was less prevalent in the north and north-west than in the south. The experience of many Continental countries in the same month was very similar, though, generally speaking, they were somewhat in advance of England. January witnessed a great extension of the disease in Germany, Holland, Switzerland, Austria-Hungary, Italy, Spain, and Portugal; but in Russia, Scandinavia, andErance it was already declining. On the whole, the period of greatest activity in Europe was the latter half of December and the earlier half of January, with the change of the year for a central point. Other parts of the world affected in January 1890 were Cape Town, Canada, the United States generally, Algiers, Tunis, Cairo, Corsica, Sardinia, Sicily, Honolulu, Mexico, the West Indies, and Montevideo. In February the provincial towns of England were most severely affected, the death-rate rising to 27-4, but in London it fell from 28-1 to 21-2, and for Europe generally the back of the epidemic was broken. On the other hand, it extended in the Ear East at the same time, appearing in Ceylon,

Penang, Japan, Hong-Kong, and India -, also in West Africa, attacking Sierra Leone and Gambia i\i the middle of the month ; and finally in the west, where Newfoundland and Buenos Aires were invaded. In March influenza became widely epidemic in India, particularly in Bengal and Bombay, and made its appearance in Australia and New Zealand. In April and May it was epidemic all over Australasia, in Central America, Brazil, Peru, Arabia, and Burma. During the summer and autumn it reached a number of isolated islands, such as Iceland, St Helena, Mauritius, and Eeunion. Eventually, towards the close of the year, it was reported from Yunnan in the interior of China, from the Shire Highlands in Central Africa, Shoa in Abyssinia, and Gilgit in Kashmir. In the course of fifteen months, if we begin with its undoubted appearance in Siberia in October 1889, it had traversed the entire globe and visited every quarter, however remote.

The localities attacked by influenza in 1889-90 appear in no case to have suffered severely for more than a month

or six weeks, the disease then ceasing to be epidemic, if it did not wholly disappear. Thus in Europe and North America generally the visitation had come to an end in the first quarter of 1890, though small local outbreaks were reported here and there later in the year and during the following winter. The earliest signs of an epidemic revival on a large scale occurred about the same time, namely, March 1891, in the United States and the north of England. In the former it was reported from Chicago and other large towns in the central states, whence it spread eastwards, reaching New York about the end of March. In England it began in the Yorkshire towns, particularly in Hull, and also independently in South Wales. In London influenza became epidemic for the second time about the end of April, and soon afterwards was widely distributed in England and Wales. The large

towns in the north, together with London and Wales, suffered very much more heavily in mortality than in the previous attack, but the south-west of England, Scotland, and Ireland escaped with comparatively little sickness. The same may be said of the European continent generally, with the exception of parts of Russia, Scandinavia, and perhaps the north of Germany. This second epidemic coincided with the spring and early summer ; it had subsided in London by the end of June. The experience of Sheffield is interesting. In 1890 the attack, contrary to general experience, had been undecided, lingering, and mild ; in 1891 it was very sudden and extremely severe, the death-rate rising to 73-4 during the month of April, and subsiding with equal rapidity. During the third quarter of the year, while Europe was free, the Antipodes had their second attack, which was more severe than the flrst. As in England, it reversed the previous order of things, beginning in the provinces and spreading thence to the capital towns. The last quarter of the year was signalized by another recrudescence in Europe, which

reached its height during the winter. All parts, including Great Britain, were severely affected. In England it began in the south and south-west in the month of October, and at the same time, or a little earlier, in Scotland at Dundee, and in Ireland at Londonderry. All these parts suffered heavily, together with Northumberland, Durham, and Cumberland, but those which had borne the brunt of the epidemic in the early part of the year escaped. In fact, these two revivals may be regarded as one, temporarily interrupted by the summer quarter.

The recrudescence at the end of 1891 lasted through mid- winter, and in many places, notably in London, it only reached its height in January 1892, subsiding slowly and irregularly in February and March. Brighton suffered with exceptional severity. The Continent seems to have been similarly affected. In Italy the notifications of influenza were as follows : 1891 — January to October, 0 ; November, 30 ; December, 6461 ; 1892 — January, 84,543 ; February, 65,362; March, 28,046; April, 7962; May,

1468 ; June, 223. Other parts of the world affected were the West Indies, Tunis, Egypt, Sudan, Cape Town, Tehran, Tongking, and China. In August 1892 influenza was reported from Peru, and later in the year from various places in Europe.

A fourth recrudescence, but of a milder character, occurred in Great Britain in the spring of 1893, and a fifth in the following winter, but the year 1894 was freer from influenza than any since 1890. In 1895 another extensive epidemic took place. In 1896 the enemy seemed to have spent its strength, and hopes were entertained that it was dying out, but these were falsified by an increased pre-valence in 1897, which was repeated on a larger scale in 1898, and again in 1899i when 12,417 deaths were recorded in England and Wales. The experience of other countries has been very similar ; they have all been subjected to periodical revivals of epidemic influenza at irregular intervals and of varying intensity since its original appearance in 1889, but on the whole there has been a general though not a steady decline in its activity

and potency. Its behaviour is, in short, quite in keeping with the experience of 1847-60, though the later visitation appears to have been considerably more violent and more fatal than the former. Its diffusion was also more rapid and probably more extensive.

The foregoing general summary may be supplemented by some further details of the incidence in Great Britain. The number of deaths directly attributed to influenza.

and tlie death-rates per million in each year in England and Wales, are as follows : —

1S90.

1891.

1892.

1893.

1894.

1895.

1896.

1897.

1898.

Deaths .

Death-rates

per million .

4523

15T

16,686

674

15,78T

534

9669

825

6625

220

12,880

424

3T53

122

6088

196

10,405

831

It is interesting to compare these figures "with the

corresponding ones for the previous visitation : —

1847.

1848.

1849.

1850.

1851.

1852.

1853.

1854.

1855.

Deaths .

Death-rates

per million .

4881

285

7968

460

1611

92

18S0

78

2152

120

1359

76

1789

99

1061

58

3568

198

The two sets of figures are not strictly comparable, because registration was in its infancy during the first period, and notification of the cause Of death was not made compulsory until many years later ; but it seems clear that, when all allowances have been made, the later wave was much the more deadly. The average annual

death-rate for the nine years is 320 in the one case against 162 in the other, or as nearly as possible double. In both epidemic periods the second year was far more fatal than the first, and in both a marked revival took place in the ninth year; in both also an intermediate recrudescence occurred, in the fifth year in one case, in the sixth in the other. The chief point of difference is the sudden and marked drop in 1849-50, against a persistent high mortality in 1892-93, especially in 1892, which was nearly as fatal as 1891.

To make the significance of these epidemic figures clear, it should be added that in the intervening period 1861-89 the average annual death-rate from influenza was only fifteen, and in the ten years immediately preceding the 1890 outbreak it was only three. Moreover, in epidemic influenza the mortality directly attributed to that disease is only a fraction of that actually caused by it. For instance, in January 1890 the deaths from influenza in London were 304, while the excess of deaths from respiratory diseases was 1464 and from all causes

1958 above the average.

We have seen above that the mortality was far greater in the second epidemic year than in the first, and this applies to all parts of England, and to rural as well as to urban communities, as the following table shows : —

Deaths from Influenza.

	1890.	1891.
London	624	439
24 Great Towns over 80,000 population .	186	46
35 Towns tetween 20,000 and 80,000	62	317
21 Towns between 10,000 and 20,000		
60 Towns under 10,000		
85 Rural Sanitary Districts		

2302

2417

765

196

196

841

In spite of these figures, it appears that the 1890 attack, which was, generally speaking, much more sudden in its onset than that of 1891, also caused a great deal more sickness. More people were " down with influenza," though fewer died. For instance, the number of persons treated at the Middlesex Hospital in the two months' winter epidemic of 1890 was 1279 ; in the far more fatal three months' spring epidemic of 1891 it was only 726. One explanation of this discrepancy between the incidence of sickness and mortality is that in the second attack, which was more protracted and more insidious, the stress of the disease fell more upon the lungs, and so led to more fatal results. Another is that its comparative mildness. combined with the time of year, in itself proved dangerous,

because it tempted people to disregard the illness, whereas in the first epidemic they were too decidedly ill to resist. It may also be that there was some change in the practice of medical men with regard to certifying, and more readiness on their part to record influenza as a cause of death in the second year, when they understood it better. On the whole, rural districts showed a higher death-rate than towns, and small towns a higher one than large ones in both years. This is explained by the age distribution in such localities ; there are more old people, to whom influenza is particularly fatal. Certain counties were much more severely affected than others. The eastern counties, namely, Essex, Suffolk, and Korfolk, together with Hampshire and one or two others, escaped lightly in both years; the western counties, namely, North and South"Wales, with the adjoining counties of Monmouth, Hereford, and Shropshire, suffered heavily in both years. It will be convenient to discuss seriatim the various points of interest on which light has been thrown by the experience described above.

The bacteriology of influenza is discussed in its proper place under Pathology (Parasitic Diseases). The disease is often called Russian influenza, and its origin in 1889 suggests that the name may have some foundation in fact. According to information collected by Dr Parsons, it came to Europe by way of Siberia and Eussia, having been first recognized in Central Asia. A writer, who saw the epidemic break out in Bokhara, is quoted by him to the following effect : — " The summer of 1888 was exceptionally hot and dry, and was followed by a bitterly cold winter and a rainy spring. The dried-up earth was full of cracks and holes from drought and subsequent frost, so that the spring rains formed ponds in these holes, inundated the new railway cuttings, and turned the country into a perfect marsh. When the hot weather set in the water gave off poisonous exhalations, rendering malaria general." On account of the severe winter, the people were enfeebled from lack of nourishment, and when influenza broke out suddenly they died in large numbers. Europeans were very severely affected, the entire house-

hold of the Russian Legation being in bed at one time. Russian officials and others, hurrying home, carried the disease westwards, and caravans passing eastwards took it into Siberia. One cannot but be struck by the similarity of the conditions described to those observed in connexion with outbreaks of other diseases, particularly typhoid fever and diphtheria, which have occurred on the super-vention of heavy rain after a dry period, causing cracks and fissures in the earth. Assuming the existence of a living poison in the ground, we can easily understand that under certain conditions, such as an exceptionally dry season, it may develop exceptional properties and then be driven out by the subsequent rains, causing a violent outbreak of illness. Some such explanation is required to account for the periodical occurrence of epidemic and pandemic diffusions starting from an endemic centre. We may suppose that a micro-organism of peculiar robustness and virulence is bred and brought into activity by a com-bination of favourable conditions, and is then disseminated, more or less widely according to its " staying power," by

human agency. Whether Central Asia is an endemic centre for influenza or not there is no evidence to show, but the disease seems to be undoubtedly more often prevalent in the Russian Empire than elsewhere. Extensive outbreaks occurred there in 1886 and 1887, and it is certain that the 1889 wave was active in Siberia at an earlier date than in Europe, and that it moved eastwards. The hypothesis that it originated in China is unsupported by any evidence. But whatever may be the truth with regard to origin, the dissemination of influenza

by human agency must be held to be proved. The establishment of this fact is the most important addition to our knowledge of the subject that has been contributed by recent research. We owe it to the investigations of Dr Parsons, who carefully traced the movements of the 1889-90 epidemic from place to place and examined the various conditions under which it prevailed. The upshot of his inquiry was to negative all theories of atmospheric

influence, and to establish the conclusion that the disease was "propagated mainly, perhaps entirely, by human intercourse." He found that it prevailed independently of climate, season, and weather ; that it moved in a contrary direction to the prevailing winds ; that it travelled along the lines of human intercourse, and not faster than human beings can travel ; that in 1889 it travelled much faster than in previous epidemics, when the means of locomotion were very inferior; that it appeared first in capital towns, seaports, and frontier towns, and only affected country districts later ; that it never commenced suddenly with a large number of cases in a place previously iree from disease, but that epidemic manifestations were generally preceded for some days or weeks by a succession of scattered cases ; that conveyance of infection by individuals and its introduction into fresh places had been observed in many instances ; that persons brought much into contact with others were generally the first to suffer in a household or establishment; that persons brought together in large numbers in enclosed spaces, as in public

of&ces and institutions, suffered more in proportion than others, and that the rapidity and extent of the outbreak in institutions corresponded with the massing together of the inmates. These conclusions, based upon the 1889-90 opidemic, have been confirmed by subsequent experi-ence, especially in regard to the complete independence of season and weather shown by influenza. It has appeared and disappeared at all seasons and in all weathers — warm, cold, wet, dry, changeable, windy, still, foggy, and clear — and only popular ignorance continues to ascribe its be-haviour to atmospheric conditions. In Europe, however, it has prevailed more often in winter than in summer, which may be due to the greater susceptibility of persons in winter, or, more probably, to the fact that they con-gregate together more in buildings and are less in the open air during that part of the year. No doubt is any longer entertained of its infectious character, though the degree of infectivity appears to vary considerably. Many oases have been recorded of individuals introducing it into houses, and of all«a- most of the other inmates then taking

it from the first case. In other instances it has failed to spread in large households, in spite of close and constant contact of other persons with the sick. This difference in behaviour may possibly be explained by differences in the type of illness, the " catarrhal " form, in which the air-passages are affected, being more infectious than those in which the stress falls on the nervous or intestinal systems, just as the " pneumonic " form of plague is more infectious than the other varieties. How far the infection of influenza is air-borne has not been determined, but the evidence tends to negative the hypothesis that it can be conveyed any considerable distance. On the other hand, cases have been recorded which go far to prove the dissemination by means of infected articles of clothing, letters, and the like. Of the lower animals, horses are liable to an inflammation of the mucous membrane, known as "pink eye," which has prevailed at the same time as influenza ; but whether the two are connected has not been definitely ascertained. Other domestic animals seem to be free from any suspicion. Sanitary conditions, other than overcrowding,

do not appear to exercise any influence on the spread of influenza.

Influenza has been clearly shown to be an acute specific fever, having nothing whatever to do with a " bad cold." Theremay be someinflammation of the respiratory passages, and then symptoms of catarrh are present, but that is not necessarily the case, and in some epidemics such symptoms are quite exceptional. This had been recognized by various writers before the 1889 visitation, but it had not been generally realized, as it has been since, and some medical authorities, who persisted in regarding influenza as essentially a " catarrhal " affection, were chiefly to blame for a widespread and tenacious popular fallacy. The " period of incubation" is indeterminate, as usual. The most common interval between exposure to infection and onset of symptoms seems to be two or three days, but it may be much less or much more. On this head it may be remarked that recent demonstrations of the capacity of some people to be infected with specific microbes for an indefinite time without showing any symptoms go far to

explain the elasticity of "periods of incubation," and make any attempt at precision a little ridiculous. Susceptibility varies greatly, but the conditions that influence it are matters of conjecture only. It appears that the inhabitants of Great Britain are less susceptible than those of many other countries. Dr Parsons gives the following list, showing the proportion of the population estimated to have been attacked in the 1889-90 epidemic in different localities : —

Place.

Per

Cent.

Place.

Per

Cent.

St Petersburg .

Berlin

Nuremberg

Grand-Duchy of Hesse

Grand-Duchy, other

Districts

Heligoland

Budapest .

50

33

67

25-30

50-75

50

50

Portugal .

Vienna

Belgrade .

Antwerp .

Gaeta

Massachusetts .

Peking

St Louis (Mauritius)

90

30-40

33

33

50-77

39

50

67

In and about London he reckons roughly from a number of returns that the proportion was about 12^ per cent, among those employed out of doors and 25 per cent, among those in offices, &c. The proportion among the troops in the Home District was 9-3 per cent. The General Post Office made the highest return with 33-6 per cent., which is accounted for partly'by the enormous number of persons massed together in the same room in more than one department, and partly by the facilities for obtaining medical advice, which would tend to bring very light cases, unnoticed else-where, upon the record. No public service was seriously disorganized in England by sickness in the same manner as on the Continent, though much inconvenience was

caused at the height of the first epidemic. In subsequent ones, as has already been observed, there was less illness, though more mortality. Some individuals appear to be totally immune ; others take the disease over and over again, deriving no immunity, but apparently greater susceptibility from previous attacks.

The symptoms were thus described by Dr Bruce Low from observations made in St Thomas's Hospital, London, in January, 1890 : —

The invasion is sudden ; the patients can generally tell the time when they developed the disease ; e.g., acute pains in the back and loins came on quite suddenly while they were at work or walking in the street, or in the case of a medical student, while playing cards, rendering him unable to continue the game. A workman wheeling a barrow had to put it down and leave it ; and an omnibus driver was unable to pull up his' horses. This sudden onset is often accompanied by vertigo and nausea, and sometimes actual vomiting of bilious matter. There are pains in the limbs and general sense of aching all over ; frontal headache of special severity ; pains in the eyeballs, increased by the slightest movement

of the eyes ; shivering ; general feeling of misery and weakness, and

great depression of spirits, many patients, both men and women, giving way to weeping ; nervous restlessness ; inability to sleep, and occasionally delirium. In some cases catarrhal symptoms develop, such as running at the eyes, which are sometimes injected on the second day ; sneezing and sore throat ; and epistaxis, swelling of the parotid and submaxillary glands, tonsilitis, and spitting of bright blood from the pharynx may occur. There is a hard, dry cough of a paroxysmal kind, worst at night. There is often tenderness of the spleen, which is almost always found enlarged, and this persists after the acute symptoms have passed. The temperature is high at the onset of the disease. In the first twenty-four hours its range is from 100° F. in mild cases to 105° in severe cases.

Dr J. S. Bristowe gave tlie folloVing description of the illness during the same epidemic : —

The chief symptoms of influenza are, coldness along the back, with shivering, which may continue off and on for two or three days ; severe pain in the head and eyes, often with tenderness in the

eyes and pain in moving them ; pains in the ears ; pains in thesmall of the back ; pains in the limbs, for the most part in the fleshy portions, but also in the bones and joints, and even in the fingers and toes ; and febrile temperature, which may in the early period rise to 104° or 105° F. At the same time the patient feels excessively ill and prostrate, is apt to suffer from nausea or sickness and diarrhoea, and is for the most part restless, though often (and especially in the case of children and those advanced in age) drowsy. ... In ordinary mild cases the above symptoms are the only important ones which present themselves, and the patient may recover in the course of three or four days. He may even have it so mildly that, although feeling very ill, he is able to go about his ordinary work. In some cases the patients have additionally some dryness or soreness of the throat, or some stiffness and discharge from the nose, which may be accompanied by slight bleeding. – And in some cases, for the most part in the course of a few days, and at a time when the patient seems to be convalescent, he begins to suffer from wheezing in the chest, cough, and perhaps a little shortness of breath, and before long spits mucus in which are contained pellets streaked or tinged with blood. . . . Another complication is

diarrhoea. Another is a roseolous spotty rash. . . . Influenza is by no means necessarily attended with the catarrhal symptoms which the general public have been taught to regard as its distinctive signs, and in a very large proportion of cases no catarrhal condition whatever becomes developed at any time.

Several writers have distinguished three main varieties of the disease — namely, (1) nervous, (2) gastric, (3) catarrhal, according to the predominant symptoms. Perhaps the most marked feature of influenza, and certainly the one which victims have learned to dread most, is the prolonged debility and nervous depression that frequently follow an attack. Other common after-effects are neuralgia, dyspepsia, -insomnia, weakness or loss of the special senses, particularly taste and smell, abdominal pains, sore throat, rheumatism, and muscular weakness. The feature most dangerous to life is the special liability of patients to inflammation of the lungs. This affection, dangerous at all times, and particularly so in persons weakened by influenza, must be regarded as a complication rather than an integral part of the illness. No age is exempt, but

the mortality is much greater among elderly persons than among the young, and it increases with advancing years. The following table shows the proportional mortality per 1000 living at different ages, and for each sex, in 1891 : —

Proportional Mortality per 1000 Living, 1891

All Ages.

0-5.

5-10.

10-16.

15-20.

20-25.

25-.35.

85-45.

«-65,

66-66.

65-76.

T5-S5.

S5-

Males

Females .

•61

■54

■54

■38

■07

•09

•07

■09

■17

■14

•20

■11

•32

•26

•62

•42

Ml

•79

1-91

V54

3^43

3^12

5^71

5-17

6-93

7^91

Both Sexes

•57

•46

•08

■08

■15

•19

■29

•52

•94

1^73

8 -27

5^40

This table shows that influenza is least fatal to children between five and fifteen years, that younger children suffer more, and that after fifteen the proportional mortality rises steadily and rapidly. With regard to sex, the disease is on the whole more fatal to males than to females ; but this is obviously due to habits of life, and particularly to the greater exposure suffered by men in the period of greatest activity. The higher male mortality begins to assert itself just when boys first go out to earn a living, and the difference increases up to sixty-five, after which the two approximate again, and eventually the female mortality is the higher of the two, as it was in childhood. The deaths directly attributed to influenza are few in proportion to the number of cases, though the aggregate mortality is large on account of its universal prevalence. In the milder forms it offers hardly any danger to life if reasonable care be taken, but in the severer forms it is a, fairly fatal disease. In eight London hospitals the case-mortality among in-patients in the 1890 outbreak was

34:-5 per 1000 ; among all patients treated it was 1^6 per 1000. In the army it was rather less.

There is no routine treatment for influenza except bed. In all cases bed is advisable, because of the danger of lung complications, and in mild ones it is sufficient. Severer ones must be treated according to the symptoms. Quinine has been much used, but its efficacy is doubtful. Modern " anti-pyretic " drugs have also been extensively employed, and when applied with discretion they may be-useful, but patients are not advised to prescribe them for themselves. The chief lesson derived from experi-ence is the need for care during convalescence and the danger of trying to resist the disease or underrating its seriousness.

The infectious character of influenza having been de-termined, suggestions were made for its administrative control on the familiar lines of notification, isolation, and disinfection, but this has not hitherto been found prac-ticable. In March 1895, however, the Local Government Board issued a memorandum recommending the adoption

of the following precautions wherever they can be carried, out: —

1. The sick should be separated from the healthy. This is especially important in the case of first attacks in a locality or a household.

2. The sputa of the sick should, especially in the acute stage of the disease, be received into vessels containing disinfectants. Infected articles and rooms should be cleansed and disinfected.

3. When influenza threatens, unnecessary assemblages of persons, should be avoided.

4. Buildings and rooms in which many people necessarily congregate should be efficiently aerated and cleansed during the intervals of occupation.

It should also be borne in mind that the liability tO' contract influenza, and the danger of an attack if contracted, are increased by depressing conditions, such as- exposure to cold and to fatigue, whether mental or physical. Attention should therefore be paid to all measures tending- to the maintenance of health, such as the use of clothing- of suitable warmth and a sufficiency of wholesome food.

Persons who are attacked by influenza should at once seek

rest, warmth, and medical treatment, and they should bear

in mind that the risk of relapse, with serious complica-

tions, constitutes a chief danger of the disease. It may

be added that influenza is no re-

specter of persons. It levels all

ranks, and nothing has been more

striking in the visitations than

the large number of prominent and

exalted personages whom it has

attacked with disabling or fatal

*results, among the victims bein^*

the heirs to two European thrones — those of the United.

Kingdom and Belgium. (a. sl.)

Ingelow, Jean (1820-1897), English poet and

novelist, was born at Boston, in Lincolnshire, in 1820,,

being the daughter of William Ingelow, a banker of that

town. As a girl she contributed verses and tales to the

magazines under the pseudonym of " Orris," but her first (anonymous) volume, A Bhyming Clironide of Incidents and Feelings, did not appear until her thirtieth year. This Tennyson said had " very charming things " in it, and declared he should "like to know" the author, who was later admitted to his friendship. Miss Ingelow iollowed this book of verse in 1851 with a story, Allerton «nd Dreux, but it was the publication of her Poems in 1863 Tvhich suddenly raised her to the rank of a popular writer. They ran rapidly through numerous editions, were set to music, and sung in every drawing-room, and in, America obtained an even greater hold upon public estimation. In 1867 she published TJie Story of Doom and other Poems, and then gave up verse for a while and became industrious as a novelist. Off the Skelligs appeared in 1872, Fated to be Free in 1873, Sarah de Berenger in 1880, and John Jerome in 1886. In addition to these she -wrote Studies for Stories (1864), Stories told to a Child (1865), Mopsa the Fairy (1869), and other stories for •children — a form of literature in which she excelled.

Her third series of Poems was published in 1885. She Tesided for the last years of her life in Kensington, and somewhat outlived her popularity as a poet. She died .20th July 1897. Her poetry has often the genuine ballad note, and as a writer of songs she was exceedingly successful. " Sailing beyond Seas," and "When Sparrows build " in Supper at the Mill were deservedly among the most popular songs of the day; but they share, with the lest of her work, the faults of affectation and stilted phraseology. Her best known poem was the " High Tide •on the Coast of Lincolnshire," which reached the highest level of excellence. The blemishes of her style were ■cleverly indicated in a well-known parody of Calverley's ; a false archaism and a deliberate assumption of unfamiliar .and unnecessary synonyms for simple objects were among the most vicious of her mannerisms. She wrote, however, in verse with a sweetness which her sentiment and her heart inspired, and in prose she displayed feeling for character and the gift of narrative ; while a delicate underlying tenderness is never wanting in either medium

to her sometimes tortured expression. Miss Ingelow was

A woman of frank and hospitable manners, with a look of

the Lady Bountiful of a country parish. She had nothing

■of the professional authoress or the "literary lady" about

her, and, as with characteristic simplicity she was accus-

•tomed to say, was no great reader. Her temperament was

Tather that of the improvisatore than of the professional

■author or artist. (a. wa.)

Ingersoll, a town and port of entry of Oxford

•county, Ontario, Canada, 19 miles east of London, on

the river Thames and the Grand Trunk and Canadian

Pacific railways. The principal manufactures are agri-

•cultural implements, furniture, pianos, and screws. There

is a large export trade in cheese and farm produce. Ex-

ports in 1899-1900 were valued at $2,427,335. Popu-

lation (1881), 4318; (1901), 4572.

1.

Ingersoll, Robert Green (1833-1899), Ameri-

■can lawyer and lecturer, was born in Dresden, New

York, 11th August 1833. His father was a Congrega-

tional minister, who moved -west when Eobert was ten jears old, and the latter entered the practice of law and politics in Illinois. During the Civil War he organized a ■cavalry regiment, of which for a short time he was colonel. He was appointed attorney-general of Illinois in 1866, and in 1876 his speech in the Republican National Convention, naming James Gr. Blaine for the Presidential nomination, won him a national reputation as a public ■speaker. He was most widely known, however, for his public lectures attacking the Bible, and his anti-Christian views were an obstacle to his political advancement. Ingersoll was an eloquent rhetorician rather than a logical reasoner. His principal lectures and speeches included The Gods and other Lectures (1876) ; Some Mistakes of Moses (1879); Prose Poems (1884); Great Speeches (1887); The Bible; Ghosts; Foundations of Faith. He died at Dobbs Perry, New York, 21st July 1899.

ingolstadt, a fortified town of Upper Bavaria, Germany, on the left bank of the Danube, 52 miles by rail north from Munich. Its newer public buildings

embrace an Evangelical church, a civil hospital, an arsenal, and an orphanage. The industries are cannon-founding, manufacture of gunpowder and cloth, and brewing. Population (1885), 16,388 ; (1900), 22,206.

Innerleithen, a police burgh and health resort of Peeblesshire, Scotland, on the Leithen water, half a mile from its junction with the Tweed. It is arbitrarily identified with the St Ronans of Sir Walter Scott's novel. The stronger of its two medicinal springs contains 216-72 grains of chloride of sodium, 148-16 of chloride of calcium, 16-17 of magnesium, 1-15 of sulphate of magnesia, 5-03 of carbonate of lime per gallon of water. There are five woollen mills, turning out tweeds and fine yarns. The churches are Established, United Free, Congregational, and Roman Catholic. The public school had an average attendance of 452 in 1898-99. Population (1901), 2181.

inness, George (1825-1894), American land-scape painter, was born near Newburgh, N.Y., 1st May 1825. Before he was five years of age his parents had moved to New York and afterwards to Newark, N.J., in

which latter city his boyhood was passed. He would not "take education" at the town academy, nor was he a success as a greengrocer's boy. He had a strong bent towards art, and his parents finally placed him with a drawing-master named Barker. At sixteen he went to New York to study engraving, but soon returned to Newark, where he continued sketching and painting after his own initiative. In 1843 he was again in New York, and is said to have passed a month in Gignoux's studio. What he learned from these masters no one knows. He was too impetuous, too independent in thought, to accept teaching; and, besides, the knowledge of his teachers must have been limited. Practically he was self-taught, and always remained a student. In 1851 he went to Europe, and in Italy got his first glimpse of real art. He was there two years, and naturally imbibed some traditions of the classic landscape, as his pictures of this period show. In 1854 he went to Prance, and there studied the Barbizon painters, whom he greatly admired, especially Daubigny and Rousseau. After his return to

America he opened a studio in New York, then went to Medfield, Mass., where he resided for five years. A pastoral landscape near this town inspired the characteristic painting reproduced in the Plate — "The Medfield Meadows." Again he went abroad and spent six years in Europe. He came back to New York in 1876, and lived there, or near there, until his death, which took place at Bridge of Allan on 3rd August 189-4 while travelling in Scotland. He was a National Academician, a member of the Society of American Artists, and had received many honours at home and abroad. He was married twice, his son, George Inness, jun., being also a painter. Inness was emphatically a man of temperament, of moods, enthusiasms, convictions. He was fond of speculation and experiment in metaphysics and religion, as in poetry and art. Swedenborgianism, symbolism, socialism, appealed to him as they might to a mystic or an idealist. He aspired to the perfect unities, and was impatient of structural

foundations. This was Ms attitude towards painting. He sought the sentiment, the light, air, and colour of nature, but was put out by nature's forms. How to subordinate form without causing weakness was his problem, as it was Corot's. His early education gave him no great technical facility, so that he never was satisfied with his achievement. He worked over his pictures incessantly, retouching with paint, pencil, coal, ink — anything that would give the desired effect — yet never content with them. In his latter days it was almost impossible to get a picture away from him, and after his death his studio was found to be full of experimental canvases. He was a very uneven painter, and his experiments were not always successful. His was an original — a distinctly American —mind in art. His point of view was his own. At his best he was often excellent in poetic sentiment, and superb in light, air, and colour. He had several styles : at first he was somewhat grandiloquent in Roman scenes, but sombre in colour ; then under French influence his

brush grew looser, as in the " Grey Lowering Day " ; finally he broke out in full colour and light, as in the " Niagara " and the last " Delaware Water-Gap." Some of his pictures are in American museums, but most of them are in private hands. (j. c. van d.)

Innsbruck, the capital of Tirol, Austria, and one of the most beautifully situated towns in Europe. It is on the Brenner line and 109|- miles by rail from Munich. Among the twenty-eight statues round the cenotaph of Maximilian is one of King Arthur of Britain. Hofer and his companions are actually buried beneath the monu-ments set up in their honour. The university is now attended by about 1000 students. Innsbruck has little commercial or industrial importance, being rather a. political and military stronghold, and having a permanent garrison of about 2000 men. It stands at a height of 1880 feet above the sea-level. In 1890 its population (including the garrison) amounted to 23,320 souls, mainlj'-Romanist and German-speaking; there were but 309 Protestants and 100 Jews, while 468 persons spoke

Italian or Ladin, and 497 more persons languages other than German, Italian, or Ladin. In 1900 the population was 27,066.

Inowrazlaw, formerly Jung-Beeslau, a town of Prussia, province of Posen, 21 miles by rail south-west of Thorn. It has mines of rock-salt and iron pyrites, flour mills, distilleries, iron foundries, and manufactures of salt-petre and machinery ; also, an active trade in agricultural produce. Population (1886), 13,648 ; (1900), 26,140.

II^rSAE^ITY.

Legal Developments.

IT is proposed in this article to deal with the changes in the law of lunacy since the article in the earlier volumes of the Encyclopcedia Britannica (9th ed., vol. xiii. pp. 111-113) was published. Por convenience' sake the arrangement adopted in the original article has been followed. The only point in which the introduc-tory remarks need to be supplemented is with regard to the chief legal terms respecting persons suffering under mental disabilities. The subject is now of less

importance than formerly, because the modern tendency of the law is to determine the capacity or responsibility of a person alleged to be insane by considering it with reference to the particular matter or class of matters which brings his mental condition sub judice. But the literature of the law of lunacy cannot be clearly under-stood unless the distinctions between the different terms employed to describe the insane are kept in view. The term non compos mentis is as old as the statute De Prcerogativd Regis (17 Edw. II. cc. 9 and 10) and is used sometimes, as in that statute, to indicate a species con-trasted with idiot, sometimes {e.g., in Co. Litt. 246 (&)) as a genus, and afterwards, chiefly in statutes relating to the insane, in connexion with the terms " idiot " and " lunatic " as a word ejusdem generis. The word " idiot " (Greek, tSios, a private person, one who does not hold any public office, and iShotj^s, an ignorant and illiterate person) appears in the statute De Prcerogativd Regis as fatuus naturalis, and it is placed in contradistinction to non compos mentis. The " idiot " is defined by Coke

(4 Rep. 124 (6)) as one who from his nativity, by a perpetual infirmity, is non compos mentis, and Hale (Pleas of the Crown, i. p. 29) describes idiocy as " fatuity a nativitate vel dementia naturalis." In early times various artificial criteria of idiocy was suggested. Fitzherbert's test was the capacity of the alleged idiot to count twenty pence, or tell his age, or who were his father and mother (De Naturd Brevium, 233). Swinburne proposed as a criterion of capacity, inter alia, to measure a yard of cloth or name the days in the week (Testaments, 42). Hale propounded the sounder view that "idiocy or not is a question of fact triable by jury and sometimes by inspection" (Pleas of the Grown, i. p. 29). The legal incidents of idiocy were at one time distinct in an important particular from those of lunacy. Under the statute De Prcerogativd Regis the king was to have the rents and profits of an idiot's lands to his own use during the life of the idiot, subject merely to an obligation to provide him with necessaries. In the case of the lunatic the king was a trustee, holding his lands

and tenements for his benefit and that of his family. It was on account of this difference in the legal conseqtiences of the two states that on inquisitions distinct writs, one de idiotd inquirendo, the other de lunatico inquirendo^ were framed for each of them. But juries avoided find-ing a verdict of idiocy wherever they could, and the writ de idiotd inquirendo fell into desuetude. A further blow was struck at the distinction when it came to be recognized even by the legislature (see the Idiots Act, 1886) as a scientific fact that idiots are capable of being educated and trained, and it was practically abolished when the Lunacy Regulation Act, 1862, in a provision reproduced in substance in the Lunacy Act, 1890, limited the evidence admissible in proof of unsoundness of mind on an inquisition (without special leave of the Master trying the case) to a period of two years before the date of the inquiry, and raised a uniform issue, viz., the state of mind of the alleged lunatic at the time when the inquisition is held.

The term " lunatic," derived from the Latin luna in con-

sequence of the notion that the moon had an influence on mental disorders,^ does not appear in the statute-book till the time of Henry VIII. (33 Hen. VIII. c. 20). Coke defines a lunatic as a "person who has sometimes his understanding and sometimes not, qui gaudet lucidis inter-vallis, and therefore he is called no7i compos mentis sO' long as he has not understanding " (Co. Litt. 247 (o), 4 Rep. 124 (b)). Hale defines " lunacy " as " interpolated " (i.e., intermittent) dementia accidentalis vel adventitia, whether total or (a description, it will be observed, of

1 The word for " lunatic " in several other languages has a similar etymology. Gp. Italian lunatico, Spanish alunado, Greek |im<6t (epileptic), German moiidsuchtig.

"partial insanity") quoad hoc vel illud {Pleas of the Grown, i. p. 29). In modern times the word " lunacy " has lost its former precise signification. It is employed sometimes in the strict sense, sometimes in contradistinc-

tion to ” idiocy ” or ” imbecility ” ; once at least — viz., in the Lunacy Act, 1890 — as including ” idiot ” ; and frequently in conjunction with the vague terms “unsound mind” (non-sane memory) and “insane.” Section 116 of the Lunacy Act, 1890, has by implication extended the meaning of the term lunacy so as to include for certain purposes the incapacity of a person to manage his affairs through mental infirmity arising from disease or age.

” Imbecility ” is a state of mental weakness ” between the limits of absolute idiocy on the one hand and of perfect capacity on the other ” (see 1 Haggard Ecdes. Bep. p. 401).

The law as to the criminal responsibility of the insane has pursued in England a curious course of development. The views of Coke and Hale give the best exposition of it in the 17th century. Both were agreed that in criminal causes the act and wrong of a madman shall not be imputed to him ; both distinguished, although in different language, between dementia naturalis (or a nativUate) and dementia accidentalis or adventitia; and the main points

in which the writings of Hale mark an advance on those of Coke are in the elaboration by the former of the doctrine of "partial insanity," and his adoption of the level of under-standing of a child of fourteen years of age as the test of responsibility in criminal cases (Pleas of the Crown, i. pp. 29, 30 ; and see Co. 4 Rep. 124 (6)). In the 18th century atest, still moreunsatisfactory than this "child of fourteen" theory, with its identification of " healthy immaturity " with " diseased maturity " (Steph. Hist. Crim. rmnas. j^^^^ .^.qJ jj p 150), "was prescribed. On the trial of Edward Arnold in 1723 for firing at and wound-ing Lord Onslow, Mr Justice Tracy told the jury that " a prisoner, in order to be acquitted on the ground of insanity, must be a man that is totally deprived of his understanding and memory, and doth not know "what he is doing, no .more than an infant, than a brute or wild beast." In the beginning of the 19th century a fresh statement of the test of criminal responsibility in mental disease was attempted. On the trial of Hadfield for shooting at George III. in Drury Lane Theatre on 16th

May 1800, Lord Chief Justice Kenyon charged the jury in the following terms : " If a man is in a deranged state of mind at the time, he is not criminally answerable for his acts ; but the material part of the case is wliether at the very time when the act was committed the man's mind was sane." The practical effect of this ruling, had it been followed, would have been to make the question of the amenability of persons alleged to be insane to the criminal law very much one of fact, to be answered by juries according to the particular circumstances of eacifi case, and without being aided or embarrassed by any rigid external standard. But in 1812, on the trial of Bellingham for the murder of Mr Perceval, the First Lord of the Treasury, by shooting him in the lobby of the House of Commons, Sir James Mansfield propounded yet another criterion of criminal responsibility in mental disease, viz., whether a prisoner has, at the time of committing an offence, a sufficient degree of capacity to distinguish between good and evil. The objection to this doctrine, of course, consisted in the fact, to which the writings of

Continental and American jurists soon afterwards began to give prominence, that there are very many lunatics whose general ideas on the subject of right and wrong are quite unexceptionable, but who are yet unable, in consequence of delusions, to perceive the wrongness of particular acts. Sir James Mansfield's statement of the law was discredited in the case of Daniel Macnaughton, who was tried in March 1843, before Chief Justice Tindal, Mr Justice Williams, and Mr Justice Coleridge, for the murder of Mr Drummond, the private secretary of Sir Robert Peel. Mr (afterwards Lord Chief Justice) Cockburn, who defended the prisoner, used Hale's doctrine of partial insanity as the foundation of the defence, and secured an acquittal. Chief Jus- a?"™" tice Tindal telling the jury that the question was whether Macnaughton was capable of distinguishing right from wrong with respect to the act with which he stood charged. This judicial approval of the doctrine of partial insanity formed the subject of an animated debate in the House of Lords, and in the end certain questions were*

put by that House to the judges, and answered by Chief Justice Tindal on behalf of all his colleagues except Mr Justice Maule, who gave independent replies. The answers to these questions are commonly called " The Rules in Macnaughton's case," and they still nominally contain the law of England as to the criminal responsibility of the insane. The points affirmed by the Rules that must be noted here are the propositions that knowledge of the nature and quality of the particular criminal act, at the time of its commission, is the test of criminal responsibility, and that delusion is a valid exculpatory plea, when, and only when, the fancies of the insane person, if they had been facts, would have been so. The Rules in Macnaughton's case are open to serious criticism. They ignore, at least on a literal interpretation, those forms of mental disease which may, for the present purpose, be roughly grouped imder the heading "moral insanity," and in which the moral faculties are more obviously deranged than the mental — the affections and the will, rather than the reason, being apparently dis-

ordered. The test propounded with reference to delusions has also been strenuously attacked by medical writers, and especially by Dr Maudsley in his work on Responsibility in Mental Disease, on the ground that it first assumes a man to have a delusion in regard to a particular subject, and then expects and requires him to reason sanely upon it. It may be pointed out, however, that in thus localizing the range of the immunity which insane delusion confers, the criminal law is merely following the course which, mutatis mutandis, the civil law has with general acceptance adopted in questions as to the contractual and testamentary capacity of the insane.

The Rules in Macnaughton's case have, as regards moral insanity, undergone considerable modification. Soon after they were laid down, Sir (then Mr) James Eitz-James Stephen, in an article in the Juridical Papers (vol. i. 67) on the policy of maintaining the existing law as to the criminal responsibility of the insane, foreshadowed the view which he subsequently propounded in his History of

the Criminal Lata (vol. ii. p. 163), that no man who was deprived by mental disease of the power of passing a fairly rational judgment on the moral character of an act could be said to "know" its nature and quality within the meaning of the Rules ; and it has in recent years been found possible in practice so to manipulate the test of criminal responsibility which they prescribed as to afford protection to the accused in the. by no means infrequent cases of insanity which in its literal interpretation it would leave without excuse.

In Scotland the Rules in Macnaughton's case are recognized, but, as in England, there is a tendency among judges to adopt a generous construction of them. Mental unsoundness insufficient to bar trial, or to exempt from punishment, may still, it is said, be present in a degree which is regarded as reducing the offence from a higher to a lower category, — a doctrine first practically applied in Scotland, it is believed, in 1867 by Lord Deas ; and the

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fact that a prisoner is of weak or ill-regulated mind is often urged with success as a plea in mitigation of punishment. The Indian Penal Code (Act 46 of 1860, § 84) expressly adopts the English test of criminal responsibility, but the qualifications noted in the case of Scotland have received some measure of judicial acceptance (see Mayne, Crim. Law Ind. pp. 368-384 ; Nelson, Ind. Pen. Code, pp. 79-89). The rules in Macnaughton's case have also been adopted in substance in those colonies which have codified the criminal law. The following typical references may be given : 55 and 56 Vict. (Can.) c. 29, § 11; 57 Vict. (N.Z.), No. 66 of 1893, § 23; No. 101 of 1888 (St Lucia), § 60; No. 6 of 1876 (Gold Coast), § 49 (h). The Eules were rapidly reproduced in the United States, but the modern trend of American judicial opinion is adverse to them (see Clevenger, Med. Jur. of Ins. p. 125). On the Continent moral insanity and irresistible impulse are freely recognized as exculpatory pleas (see the French Code Penal, § 64 ; Belgian Code Penal, § 71 ;

Oerman Penal Code, § 51).

Not only is insanity at the time of the commission of an offence a valid exculpatory plea, but supervening insanity stays the action of the criminal law at every stage from arrest up to punishment. High treason was formerly an exception, but the statute making it so (33 Hen. VIII. c. 20) was repealed in the time of Philip and Mary. The Home Secretary has power, under the Criminal Lunatics Act, 1884, to order by warrant the removal of a prisoner, certified to be insane, to a lunatic asylum, before ^ trial or after trial, whether under sentence of death or not. Prisoners dealt with under these provisions are styled " Secretary of State's lunatics." On the other hand, a prisoner who on arraignment appears, or is found by the jury to be unfit to plead, or who is found " guilty but insane " at the time of committing the offence — a verdict substituted by the Trial of Lunatics Act, 1883, for the old verdict of " acquitted on the ground of insanity," in the hope that the formal conviction recorded in the new finding might have a deterrent

effect on the mentally unstable — is committed to a criminal lunatic asylum by the order of the judge trying the case, to be detained there " during the Sovereign's pleasure." Lunatics of this class are called " Sovereign's pleasure lunatics." There was no doubt at common law as to the power of the courts to order the detention of criminal lunatics in safe custody, but prior to 1800 the practice was varying and uncertain. On the acquittal of Hadfield, however, in that year for the attempted murder of George III., a question arose as to the provision which was to be made for his detention, and the Criminal Lunatics Act, 1800, part of which is still in force, was passed to affirm the law on the subject.

The Criminal Lunatics Act contains provisions similar to those of the Lunacy Act, 1890, as to the discharge (conditional or absolute) and transfer of criminal lunatics and the detention of persons becoming pauper lunatics. The expenses of the maintenance of criminal lunatics are defrayed out of moneys provided by Parliament (Crim. Luns. Act, 1884, and Hansard, 3rd series, vol. ccxc. p.

75; 139 Com. Jo., pp. 336, 340, 344). The Lunatics'

Eemoval (India) Act, 1851, provides for the removal to a

criminal lunatic asylum in Great Britain of persons found

1 It has sometimes been stated in recent years that this power, which

ought clearly, in the interests alike of prisoners and of the public, to

be exercised with caution, is in fact exerted in an unduly large number

of cases. The following figures, taken from the respective volumes of

the Criminal Judicial Statistics, show the number of criminal lunatics

certified insane before trial. In 1884-85, out of a total of 938 criminal

lunatics, 169 were so certified; in 1885-8(i, 149 out of 8t)0; in 1889-90,

108 out of 926; in 1890-91, 95 out of 900; in 1894, 78 out of 738; in

1895, 84 out of 757 ; in 1896, 88 out of 769; in 1897, 85 out of 764; in

1898, 17 out of 209.

guilty of crimes and offences in India, and acquitted on

the ground of insanity. Similar provisions with regard

to colonial criminal lunatics are contained in the Co-

lonial Prisoners' Eemoval Act, 1884 ; and the policy of

this statute has been followed by No. 6 of 1894

(New South Wales), and Ordin. No. 2 of 1895 (Falk-

land Islands). Indian law (see Act 5 of 1898, §§

464-475) and the laws of the colonies (the Cape Act No. 1 of 1897 is a typical example) as to the trial of lunatics are similar to the English. In Scotland all the criminal lunatics, except those who may have been removed to the ordinary asylums or have been discharged, are confined in the Criminal Asylum established at Perth in connexion with H.M.'s General Prison, and regulated by special Acts (23 and 24 Vict. c. 105, and 40 and 41 Vict. c. 53). Provision, similar to the English, has been made for prisoners found insane as a bar to trial, or acquitted on the ground of insanity, or becoming insane in confinement. In New York and Michigan there are criminal lunatic asylums. Elsewhere insane criminals are apparently detained in state asylums, hospitals, or prisons. The statutory rules as to the maintenance of criminal lunatic asylums, the treatment of the criminal insane, and the plea of insanity in criminal courts in America, closely resemble English practice. The only special point in Continental law calling for notice is the system by which official experts report

for the guidance of the tribunals on questions of alleged criminal irresponsibility (see, e.g., the German Code of Penal Procedure, § 293, and cp. § 81).

The law as to the civil capacity of the insane was for some time influenced in Great Britain by the view propounded by Lord Brougham in 1848 in the case of Waring v. Waring, and by Sir J. P. Wilde in a later case, raising the question of the validity of a marriage, that, as the mind is one and indivisible, the least dis-order of its faculties was fatal to civil capacity. In the leading case of Banks v. Goodfellow in 1870, the Court of Queen's Bench, in an elaborate judgment delivered by Chief Justice Cockburn, disap- '^l^city. proved of this doctrine, and in effect laid down the principle that the question of capacity must be con-sidered with strict reference to the act which has to be or has been done. Thus a certain degree of unsoundness of mind is not now, in the absence of undue influence, a bar to the formation of a valid marriage, if the party whose capacity is in question knew at the time of the marriage

the nature of the engagement entered into (but see 51 Geo. III. c. 37 as to the marriage of lunatics so found by inquisition). Again, a man whose mind is affected may make a valid will, if he possesses at the time of executing it a memory sufficiently active to recall the nature and extent of his property, the persons who have claims upon his bounty, and a judgment and will sufficiently free from the influence of morbid ideas or external control to determine the relative strength of those claims. So far has this rule been carried, that in 1893 probate was granted of the will of a lady who was a Chancery lunatic at the date of its execution, and died without the inquisition having been superseded. It is also now settled that the simple contract of a lunatic is voidable andnot void, and is binding upon him, unless he can show that at the time of making it he was, to the knowledge of the other party, so insane as not to know what he was about. The test established by Ba.nks v. Goodfellow is applied also in a number of minor points in which civil capacity comes into question, e.g., competency of the insane as witnesses. The law implies

on the part of a lunatic, whether so found or not, an obligation to pay a reasonable price for " necessaries " supplied to him ; and the term " necessaries " means goods suitable to his condition in life and to his actual require-

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ments at the time of sale and delivery (Sale of Goods Act, 1893).

The question of the liability of an insane person for tort appears still to be undecided (see Pollock on Torts, 5th ed. p. 51 ; Clerk and Lindsell on Torts, 2nd ed. pp. 39, 40; Law Quart. Rev. vol. xiii. p. 325). Supervening insanity is no bar to proceedings by or against a lunatic husband or wife for divorce or separation for previous matrimonial offences. It does not avoid a marriage nor constitute per se a ground either for divorce or for judicial separation. But cruelty does not cease to be a cause of suit if it proceeds from disorderly affections or want of moral control falling short of positive insanity; and

possibly even cruelty springing from intermittent or recurrent insanity might be held a ground for judicial separation, since in such case the party offended against cannot obtain protection by securing the permanent confinement of the offending spouse. Whether insanity at the time when an alleged matrimonial offence was committed is a bar to a suit for divorce or separation is an open question ; and in any event, in order that it may be so, the insanity must be of such a character as to have jjrevented the insane party from knowing the nature and consequences of the act at the time of its commission. The laws of Scotland, Ireland, India (see, e.g., Act 9 of 1872, § 12), the colonies, and the United States, are substantially identical with English law on the subject of the civil capacity of the insane. The German Civil Code (§ 1569) recognizes the lunacy of a spouse as a ground for divorce, but only where the malady continues during at least three years of the union, and has reached such a pitch that intellectual intercourse between the spouses is impossible, and that every

prospect of a restoration of such association is ex-
cluded. If one of the spouses obtains a divorce on
the ground of the lunacy of the other the former has
to allow alimony, just as a husband declared to be the
sole guilty party in a divorce suit would have to do
(§§ 1585, 1578).

In order to effect a change in the status of persons
alleged to be of unsound mind, and to bring their persons
and property under control, the aid of the jurisdiction in
lunacy must be invoked. Under the unrepealed statute
Be Prcerogativd Regis (17 Edw. II. cc. 9 and 10)
the care and custody of lunatics belong to the
Crown. But the Crown has, at least since the
16th century, exercised this branch of the prerogative by
delegates, and principally through the Lord Chancellor —
not as head of the Court of Chancery, but as the representa-
tive and delegate of the sovereign. Under the Lunacy
Acts, 1890 and 1891, the jurisdiction in lunacy is exer-
cised first by the Lord Chancellor and such of the Lords
Justices and other judges as may be invested with it by

the sign-manual; and, secondly, by the two Masters in lunacy, appointed by the Lord Chancellor from members of the bar of at least ten years' standing, whose duties include the holding of inquisitions and summary inquiries, and the making of most of the consequential orders dealing with the persons and estates of lunatics. County court judges may also exercise a limited jurisdiction in lunacy, in the case of lunatics as to whom a reception order has been made, if their entire property is under £200 in value, and no relative or friend is willing to undertake the management of it; in partnership cases where the assets do not exceed £500 ; and upon application by the guardians of any union for payment of expenses incurred by them in relation to any lunatic.

Persons of unsound mind are brought under the juris-diction in lunacy either by an inquisition de lunatico inquirendo, or, in certain cases which will be adverted to below, by proceedings instituted under § 116 of the Jurisdic-

tion.

Lunacy Act, 1890, which is now the great practice section in the Lunacy Office. Prior to 1853 a special commission was issued to the Masters in each alleged case of lunacy. But by the Lunacy Regulation Act of that year a general commission was directed to the Masters, empowering them to proceed in each case in which the Lord Chancellor by order required an inquisition to be held. This procedure is still in force. A special commission would now be issued only where both Masters were personally interested in the subject of the inquiry, or for some other similar reason. An inquisition is ordered by the judge in lunacy (a term which does not, for this purpose, at present in-clude the Masters, although this is one of the points in regard to which a change in the law is (1901) contem-plated) on the petition generally of a near relative of the alleged lunatic. The inquiry is held before one of the Masters, and a jury may be summoned if the alleged lunatic, being within the jurisdiction, demands it, unless the judge is satisfied that he is not compe-tent to form and express such a wish; and even in

that case the Master has power to direct trial by jury if he thinks fit on consideration of the evidence. Where the alleged lunatic is not within the jurisdiction the trial must be by jury ; and the judge in lunacy may direct this mode of trial to be adopted in any case whatever.

A few points of general interest in connexion with inquisitions must be noted. In practice thirty-four jurors are summoned by the sheriff, and not more than twenty-four are empannelled. Twelve at least must concur in the verdict. Counsel for the petitioner ought to act in the judicial spirit expected from counsel for the prosecution in criminal cases. The issue to be determined on an inquisition is " whether or not the alleged lunatic is at the time of the inquisition of unsound mind, and incapable of managing himself and his affairs " (a special verdict may, however, be found that the lunatic is capable of managing himself, although not his affairs, and that he is not dangerous to others) ; and without the direction of the person holding the inquisition, no evidence as to the

lunatic's conduct at any time being more than two years before the inquisition is to be receivable. This limitation, both of the issue and of the evidence, was imposed with a view to preventing the recurrence of such cases as that of Mr Windham in 1861-62, when the inquiry ranged over the whole life of an alleged lunatic, forty-eight witnesses being examined on behalf of the relations, and ninety-one on behalf of the respondents, while the hearing lasted for thirty-four days. Eor the purpose of assisting the Master or jury in arriving at a decision, provision is made for the personal examination of the alleged lunatic by them on oath or otherwise, and either in open court or in private, as may be directed. The proceedings on inquisition are open to the public. When a person has been found lunatic by inquisition he becomes subject to the jurisdiction in lunacy, and remains so (unless he succeeds in setting aside the verdict by a " traverse " — a proceeding which ultimately comes before and is determined by the King's Bench Division in London, or at the assizes, according to circumstances) until his recovery,

when the inquisition may be put an end to by a procedure technically known as " supersedeas," or by his death. The results of the inquisition are worked out in the Lunacy Office. The control of the estate, and, except where he was found incapable of managing his property only, of the person of the lunatic is entrusted to committees of the estate and person, who are appointed by and account-able to the Master in Lunacy, and whose legal position corresponds roughly with that of the tutors and curators of the civil law. The committee of the estate in par-ticular exercises over the property of the lunatic, with

the sanction or by the order of the Master, very wide powers of management and administration, including the raising of money by sale, charge, or otherwise, to pay the lunatic's debts, or provide for his past or future maintenan ce, charges for permanent improvements, the sale of any pro-perty belonging to the lunatic, the execution of powers

vested in him, and the performance of contracts relating to property.

The alternative method of bringing a person of unsound mind under lunacy jurisdiction was created by § 116 of the Lunacy Act, 1890. The effect of that section briefly is to enable the Master, on a summons being taken out in his chambers and heard before him, to apply the powers of management and administration summarized in the last preceding paragraph, without any inquisition, to the following classes of cases : lunatics not so found by inquisition, for the protection or administration of whose property any order was made under earlier Acts ; every person lawfully detained, within the jurisdiction of the English courts, as a lunatic, though not so found by inquisition ; persons not coming within the forego-ing categories, who are "through mental infirmity arising from disease or age " incapable of managing their affairs ; persons of unsound mind whose property does not exceed £2000 in value, or does not yield an annual income of more than £100 ; and criminal lunatics continuing

insane and under confinement. The effect of the introduction of this simple summary procedure on the number of inquisitions will be apparent from the following figures, which are taken from the Civil Judicial Statistics. The annual average of inquisitions executed was, from 1858 to 1862, 64 ; from 1863 to 1867, 75 ; from 1868 to 1872, 86 ; from 1873 to 1877, 116 ; from 1878 to 1882, 112 ; from 1883 to 1887, 93 ; from 1888 to 1892, 80 ; from 1894 to 1898, 41-0. No annual average of the proceedings under § 116 has yet been taken. But in 1895 there were subsisting 945 cases under the section ; in 1896, 1274 ; in 1897, 1323 ; in 1898, 1440. During 1897 orders for administration and management under the section are stated to have been made in 327 cases, while in the same year only 42 inquiries were held. At the end of 1897 the number of subsisting cases under inquisition was 1016.

In Scotland the insane are brought under the jurisdiction in lunacy by alternative methods, similar to the English inquisition and summary procedure, viz., " cogni-

tion," the trial taking place before the Lord President of the Court of Session or any judge of that court to whom he may remit it, and a jury of twelve — see 31 and 32 Vict, c. 100, and Act of Sederunt of 3rd December 1868 — and an application to the Junior Lord Ordinary of the Court of Session, or (43 and 44 Vict. c. 4, § 4) to the Sheriff Court, when the estate in question does not exceed £100 a year, for the appointment of a curator bonis or judicial factor.

The powers of the Lord Chancellor of Ireland with regard to lunatics are generally similar to those of the English Chancellor (see 34 Vict. c. 22 and Colles on The Lunacy Regulations (Ireland) Act).

The main feature of the French system is the provision made by the Civil Code (Arts. 489-512) for the interdiction of an insane person by the Tribunal of First Instance, with a right of appeal to the Court of Appeal, after a preliminary inquiry and a report by a family council (Arts. 407, 408), consisting of six blood relatives in as near a degree of relationship to the lunatic as possible, or, in default of such relatives, of six relatives by marriage.

The family council is presided over by the Juge die Paix of the district in which the lunatic is domiciled. There are provisions, it may be noted, in Scots law for the interdiction of lunatics, either voluntarily or judicially (see Bell's Principles, § 2123). The German Civil Code provides for insane persons beingmade subject to guardianship (vormundung), on conditions similar to those of Scots and French law (see Civil Code, §§ 6, 104, 1896, 1906, 645-679). In the United States tAe fundamental procedure m an inquisition is conducted on practically the same lines as in England.

Asylum administration in England is now regulated by the Lunacy Acts, 1890 and 1891. Eeceptacles for the insane are divisible into the following classes : (i.) Institutions for lunatics, including asylums, registered hospitals, and licensed houses. The asylums are provided by counties or boroughs, or by union of counties or boroughs.

Registered hospitals are hospitals holding certi- ^dm"J?s- ficates of registration from the Commissioners tration.

in Lunacy, where lunatics are received and

supported wholly or partially by voluntary contributions or charitable bequests, or by applying the excess of the payments of some patients towards the maintenance of others. Licensed houses are houses licensed by the Commissioners, or, beyond their immediate jurisdiction, by justices; (ii.) Workhouses — see article Poob Law ; (iii.) Houses in which patients are boarded out ; (iv.) Private houses (unlicensed) in which not more than a single patient may be received. A person, not being a pauper or a lunatic so found by inquisition, cannot, in ordinary cases, be received and detained as a lunatic in any institution for the insane, except under a " reception order " made by a county court judge, or stipendiary magistrate, or specially appointed justice of the peace. The order is made on a petition presented by a relative or friend of the alleged lunatic, and supported by two medical certificates, and after a private hearing by the judicial authority. The detention of a lunatic is, however, justifiable at common law, if necessary for his safety or that of others ; and the Lunacy Act, 1890, borrowing from

the lunacy law of Scotland, provides for the reception of a lunatic not a pauper into an asylum, where it is expedient for his welfare or the public safety that he should be confined without delay, upon an "urgency order," made if possible by a near relative, and accompanied by one medical certificate. The urgency order only justifies detention for seven days (the curtailment of this period to four days is proposed), and before the expiration of that period the ordinary procedure must be followed. " Summary reception orders " may be made by justices otherwise than on petition. There are four classes of cases in which such orders may be made, viz. : (i.) lunatics (not paupers and not wandering at large) who are not under proper care and control, or are cruelly treated or neglected ; (ii.) resident pauper lunatics ; (iii.) lunatics, whether pauper or not, wandering at large ; (iv.) lunatics in workhouses. (As to pauper lunatics generally, see article Poor Law.) A lunatic may also be received into an institution under an order by the Commissioners in Lunacy ; and a liinatic so found by in-

quisition under an order signed by the committee of his person.

The chief features of English asylum administration requiring notice are these. Mechanical restraint is to be applied only when necessary for surgical or medical purposes, or in order to prevent the lunatic from injuring himself or others. The privacy of the correspondence of lunatics with the Lord Chancellor, the Commissioners in Lunacy, &c., is secured. Provision is made for regular visits to patients by their relatives and friends. The employment of males for the custody of females is, except on occasions of urgency, prohibited. Pauper lunatics may be boarded out with relatives and friends. Elaborate provision is made for the official visitation of every class of receptacle for the insane. The duties of visitation are divided between the Commissioners in Lunacy, the

Chancery Visitors, and various other visitors and visiting

committees. There are ten Commissioners in Lunacy — four unpaid and six paid, three of the latter being barristers of not less than five years' standing at the date of appointment, and three medical. The Commissioners in Ljinacy, who are appointed by the Lord Chancellor, visit every class of lunatics except persons so found by inquisition. These are visited by the Chancery Visitors. There are three Chancery Visitors, two medical and one legal (a barrister of at least five years' standing at the date of his appointment), who are appointed and removable by the Lord Chancellor. The Chancery Visitors (together with the Master in Lunacy) form a Board, and have oflBces in the Eoyal Courts of Justice. In addition to these two classes of visitors, every asylum has a Visiting Committee of not less than seven members, appointed by the local authority; and the justices of every county and quarter-sessions borough not within the immediate jurisdiction of the Commissioners in Lunacy annually appoint three or more of their number as visitors of licensed houses.

Provision is made for the discharge of lunatics from asylums, &c., on recovery, or by habeas corpus, or by the various visiting authorities. Any person who considers himself to have been unjustly detained is entitled on discharge to obtain, free of expense, from the secretary to the Lunacy Commissioners a copy of the documents under which he was confined.

The Irish and Scots asylum systems present no feature sufficiently different from the English to require separate notice, except that in Scotland "boarding out" is a regular, and not merely an incidental part of asylum administration. The " boarding out " principle has, however, received its most extended and most successful application in the Gheel colony. In the French (see laws of 30th June 1838 and 18th December 1839) and German (see Journal of Comparative Legislation, N.S. vol. i. at pp. 271, 272) asylum systems the main features of English administration are also reproduced. In America the different States of the Union have each their own lunacy legislation. The Government of the United

States provides only for the insane of the army and navy, and for those residing in the District of Columbia. The various laws as to the reception, &c., of the insane into asylums closely resemble English procedure. But in several States the verdict of a jury finding lunacy is a necessary preliminary to the commitment of private patients.

AnTHOKiTiES. — The following references may be added to those appended to the original article : Collinson on the Law of Lunatics and Idiots, 2 vols., London, 1812; Shelfobd on the Law of Lunatics and Idiots, London, 1847. On all points relating to the history and development of the law these two treatises are invaluable. Pope on Lunacy, 2nd edit. London, 1890 ; Aech-bold's Lunacy, 4th edit. London, 1895 ; Elmer on Lunacy, 7th edit. London, 1892 ; Wood Eenton on Lunacy, London and Edin-burgh, 1896 ; Fry's Lunacy Laws, 3rd edit. London, 1890 ; Pitt-Lewis, Smith and Hawke, The Insane and the Law, London, 1895 ; Hack-Tuke, Dictionary of Psychological Medicine, London, 1892, and the bibliographies attached to the various legal articles in that work ; Clevenger, Medical Jurisprudence of Insanity,

2 vols. New York, 1899 ; Semblaigne, Les Alienistes Franqais, Paris, 1849. (a. W. B.)

Hospital Teeatmeitt.

The era of real hospitals for the insane properly belongs to the 19th century. There had been estab-lished here and there in different parts of the world, it is true, certain asylums or places of restraint before the beginning of the 19th century. We find mention in history of such a place established by monks at Jerusalem in the latter part of the 5th century. There is evidence that even earlier than this in Egypt and Greece the insane were treated as individiials suffering from disease. Egyptian priests employed not only music and the beau-tiful in nature and art as remedial agents in insanity, but recreation and occupation as well. A Greek physician protested against mechanical restraint in the care of the insane, and advocated kindly treatment, the use of music, and of some sorts of manual labour. But these ancient beneficent teachings were lost sight of during

succeeding centuries. The prevailing idea of the par thology of insanity in Europe during the Middle Ages was that of demoniacal possession. The insane were not sick, but possessed of devils, and these devils were only to be exorcised by moral or spiritual agencies. Mediaeval therapeutics in insanity adapted itself to the etiology indicated. Torture and the cruellest forms of punishment were employed. The insane were regarded with abhorrence, and were frequently cast into chains and dungeons. Milder forms of mental disease were treated by other spiritual means — such as pilgrim-ages to the shrines of certain saints who were reputed to have particular skill and success in the exorcism of evil spirits. The shrine of St Dymphna at Gheel, ia Belgium, was one of these, and seems to have originated in the 7th century, a shrine so famed that lunatics from all over Europe were brought thither for miraculous healing. The little town became a resort for hundreds of insane persons, and as long ago as the 17th century acquired the reputation, which

still exists to this day, of a unique colony for the insane. At the present time the village of Gheel and its adjacent farming hamlets (with a population of some 13,000 souls) provides homes, board, and care for nearly 2000 insane persons under medical and government supervision. ^Numerous other shrines and holy wells in various parts of Europe were resorted to by the mentally af&icted — such as Glen-na-Galt in Ireland, the well of St Winifred, St Nun's Pool, St Eillans, &c. At St Nun's the treatment consisted of plunging the patient backwards into the water and dragging him to, and fro until mental excitement abated. Not only throughout the Middle Ages, but far down into the 17th century, demonology and witchcraft were regarded as the chief causes of insanity. And the insane were frequently tortured, scourged, and even burned to death.

Until as late as the middle of the 18th century, mildly insane persons were cared for at shrines, or wandered homeless about the country. Such as were deemed a menace to the community were sent to ordinary prisons,

or chained in dungeons. Thus large numbers of lunatics accumulated in the prisons, and slowly there grew up a sort of distinction between them and criminals, which at length resulted in a separation of the two classes. In time many of the insane were sent to cloisters and monasteries, especially after these began to be abandoned by their former occupants. Thus " Bedlam " (the present Bethlehem Koyal Hospital) was originally founded in 1247 as a priory for the brethren and sisters of the Order of the Star of Bethlehem. It is not known exactly when lunatics were first received into Bedlam, but some were there in 1403. Bedlam was rebuilt as an asylum for the insane in 1676. In 1815 a committee of the House of Commons, upon investigation found it in a disgraceful condition, the medical treatment being of the most antiquated sort, and actual inhumanity practised upon the patients. Similarly the Charenton Asylum, just outside Paris, near the park of Vincennes, was an old monastery which had been given over to the insane. Numerous like instances could be cited, but the interesting point to be borne in

mind is, that with a general tendency to improvement in the condition of imbeciles upon public charge, idiots

[hospital TREATME:S'r

and insane persons came gradually to be separated from criminals and other paupers, and to be segregated. The process of segregation was, however, very slow. Even after it had been accomplished in the larger centres of civilization, the condition of these unfortunates in provincial districts remained the same. Furthermore, the transfer to asylums provided especially for them was not followed by any immediate improvement in the patients. The accounts of the state of the insane in various countries during the latter part of the 18th century and the beginning of the 19th are shocking to read.

Twenty-five years after Pinel had, in 1792, struck the chains from the lunatics huddled in the Salpetri6re and Bicetre of Paris, and called upon the world to realize

the horrible injustice done to this wretched and suf-
fering class of humanity, a pupil of Pinel, Esquirol,
wrote of the insane in Prance and all Europe, "These
unfortunate people are treated worse than criminals,
reduced to a condition worse than that of animals.
I have seen them naked, covered with rags, and hav-
ing only straw to protect them against the cold moisture
and the hard stones they lie upon ; deprived of air, of
water to quench thirst, and all the necessaries of life ;
given up to mere gaolers and left to their surveil-
lance. I have seen them in their narrow and filthy
cells, without light and air, fastened with chains in
these dens in which one would not keep wild beasts.
This I have seen in France, and the insane are every-
where in Europe treated in the same way." It was not
until 1838 that the insane in France were all transferred
from small houses of detention, work-houses, and prisons
to asylums specially constructed for this purpose.
In Belgium, in the Middle Ages, the public execu-
tioner was ordered to expel from the towns, by

flogging, the poor lunatics who were wandering about the streets. In 1804 the Code Napoleon "punished those who allowed the insane and mad criminals to run about free." In 1841 an investigation showed in Belgium thirty-seven establishments for the insane, only six of which were in good order. In fourteen of them chains and irons were still being used. In Germany, England, and America, in 1841, the condition of the insane was practically the same as in Belgium and France.

These facts show that no great advance in the humane and scientific care of the insane was made till towards the middle of the 19th century. Only then did the actual metamorphosis of asylums for detention into hospitals for treatment begin to take place.

Hand in hand with this progress there has grown, and still is growing, a tendency to subdivision and specialization of hospitals for this purpose. There are now hospitals for the acutely insane, others for the chronic insane, asylums for the criminal insane, institutions for

the feeble-minded and idiots, and colonies for epileptics. There are public institutions for the poor, and well-appointed private retreats and homes for the rich. All these are presided over by the best of medical authorities, ;supervised by unsalaried boards of trustees or managers, and carefully inspected by Government lunacy com-missioners, or boards of charities — a contrast, indeed, to the gaols, shrines, holy wells, chains, tortures, monkish exorcisms, &c., of the past !

The statistics of insanity have nowadays been fairly well established. The ratio of insane to normal popula-tion is about 1 to 300 among civilized peoples. This proportion varies within narrow limits in different races and countries. It is probable that intemperance in the use of alcohol and drugs, the spread of venereal diseases, and the over-stimulation in many directions induced by modern social conditions, have caused an increase of insanity in the 19th as compared with past centuries. The amount of such increase is probably very small, but on superficial examination might seem to be large,

owing to the accumulation of the chronic insane and the constant upbuilding of asylums in new communities. The imperfections of census-taking in the past must also be taken into account.

The modern hospital for the insane does credit to latter-day civilization. Physical restraint is no longer practised. The day of chains — even of wrist-lets, covered cribs, and straight-jackets — is past. Neat dormitories, cosy single rooms and sitting and dining rooms, please the eye. In the place of bare walls and floors and curtainless windows, we observe pictures, plants, rugs, birds, curtains, and in many asylums even the barred windows have been abolished. Some of the wards for milder patients have unlocked doors. Many patients are trusted alone about the grounds and on visits to neighbouring towns. An air of busy occupation is observed in sewing rooms, schools, shops, in the fields and gardens, employment contributing not only to economy in administration, but to improvement in mental and physical conditions. The general progress

of medical science in all directions has been man-
ifested in the department of psychiatry by improved
methods of treatment, in the way of sleep-producing
and alleviating drugs, dietetics, physical culture, hydro-
therapy, and the like. There are few asylums now
without pathological and clinical laboratories, in which
work is going on with a view to unravelling some of the
mysteries of disordered mind. While it is a far cry from
the prisons and monasteries of the past to the modern
hospital for the insane, it is still possible to trace a
resemblance in many of our older asylums to their ancient
prototypes, particularly in those asylums built upon the
so-called corridor plan. It is always dif&cult to break
away from established forms, and though each generation
contributed something new, antecedent models were more
or less adhered to. Progress in asylum architecture has
hence advanced more slowly in countries where monas-
teries and cloisters abounded than in countries where
fixed models did not exist. Architects have had a freer
hand in America, Australia, and Germany, and even in

Great Britain, than in the Catholic countries of Europe. At the present time Germany approaches nearest to an ideal standard of provision for the insane. The highest and best idea which has yet been attained is that of small hospitals for the acutely insane in all cities of more than 60,000 inhabitants, and of colonies for the chronic insane in the rural districts adjacent to centres of population.

The psychopathic hospital in the city gives easy and speedy access to persons taken suddenly ill with mental disease, aids in early diagnosis, places the patients within reach of the best specialists in all departments of medicine, and associated, as it should be, with a medical school or university, affords facilities not otherwise available for scientific research and for instruction in an important branch of medical learning. A feature of the psychopathic hospital should be the reception of patients for a reasonable period of time, as sufferers from disease, without the formality of legal commitment papers. Such papers are naturally required for the detention and

restraint of the insane for long periods of time, but in the earlier stages they should be spared the stigma, delay and complicated procedure of commitment for at least ten days or two weeks, since in that time many may convalesce or recover, and in this way escape the public record of their infirmities, unavoidable by present judi-cial procedure.

There should be associated with such hospitals for the acutely insane in our cities out-door departments or dispensaries, to which patients may be brought in still earlier stages of mental disorder, at a period when early diagnosis and preventive therapeutics may have their best opportunities to attain good results. In Germany a psychopathic hospital now exists in every university town, under the name of Psychiatrische Klinik. As far as the writer knows, there are no such institutions in Great Britain, Prance, or America.

Colonies for the chronic insane are established in the

country, but in the neighbourhood of the cities having psychopathic hospitals, to receive the overflow of the latter when the acute stage has passed. The true colony is constructed on the principle of a farming hamlet, without barracks, corridored buildings, or pavilions. It is similar in most respects to any agricultural community. The question here is one of humane care and economical administration. Humane care includes medical supervision, agreeable home-life, recreation, and, above all things, regular manual and out-of-door occupation in garden, farm, and dairy, in the quarry, clay-pit, or well-ventilated shop. Employment for the patients is of immense remedial importance, and at the same time is of great value from the standpoint of economical administration. In the colony system the small cottage homes of the patients are grouped about the centres of industry. The workers in the farmstead live in small families about the farmstead group of buildings ;, the tillers of the soil adjacent to the fields, meadows, and gardens ; the brick-makers, quarrymen, and artizans in still other cottages

in the neighbourhood of the scenes of their activities. In addition to these groups of cottages, which constitute the majority of the buildings in the village, an infirmary for bedridden, excited, and crippled patients is required, and a small hospital for the sick. All the inhabitants of the colony are under medical supervision. A laboratory for scientific researches forms a highly important part of the equipment. The colony is not looked upon as a refuge for the incurable ; it is still a hospital for the sick, where treatment is carried on under the most humane and most suitable conditions, and wherein the percentage of recoveries will be larger than in asylums and hospitals as now conducted. In respect of the establishment of colonies for the insane upon the plan outlined here, Germany has, as in the case of the psychopathic hospital, led the world. It has been less difficult for that country to set the example, because she had fewer of the conditions of the past to fight, fewer of the old-time models to contend against, and with her the progress of medical science and of methods of instruction in all

departments of medicine has been more pronounced and rapid. As already stated, every university town in Germany has its psychopathic hospital, and in the matter of colonies for the insane many of the provinces have already established them. Among the colonies, that at Alt-Scherbitz, near Leipzig, is the oldest and most successful, and is pre-eminent in its close approach to the ideal village or colony system. Professor Kraeplin of Heidelberg (PsycMatrie, 6th edition, 1899), states that the effort is made everywhere in Germany to give the exterior of asylums, by segregation of the patients in separate home-like villas, rather the appearance of hamlets for working-people than prisons for the insane, and says, further, that the whole question of the care of the insane has found solution in the colony system, which is the best and cheapest method of support. " I have myself," he writes, "had opportunity to see patients, who had lived for years in a large closed asylum, improve in the most extraordinary manner under the influence of the freer movement and more independent occupation of colony life."

There is no institution in England or America constructed on the village system, with the sole exception of the Craig Colony for Epileptics at Sonyea, where the colony scheme has been adopted by the State of New York, and is being carried out on a large and successful scale.

That the tendency nowadays, even outside of Germany, in the direction of the ideal standard of provision for the insane is a growing one, is manifested in all countries by a gradual disintegration of the former huge cloister-like abodes. More asylums are built on the pavilion plan, which is a step in the right direction. Many asylums have, as it were, thrown off detached cottages for the better care of certain patients. Some asylums have even established small agricultural colonies a few miles away from the parent plant, like a vine throwing out feelers. What is called the boarding-out system is an effort in a similar direction. Patients suffering from mild forms of insanity are boarded out in families in the country, either upon public or private

charge. Gheel is an example of the boarding-out system practised on a large scale. But it is only a matter of time when the ideal system of psychopathic hospital and colony for the insane will be gradually adopted everywhere.

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*[For the pathological discussion of Insanity see Pathology, Neuropathology.^*

Inscriptions. — In addition to the account of this subject given in the earlier volumes of this encyclopaedia (9th edition), the new information derived from the discovery of ancient inscriptions will be found, together with allied questions of interest, under PaljEOGeapht, Wkiting, Egyptology, Babylonia, and other headings

in the new volumes. See also the topographical articles giving the results of modern excavation. The following recent works of authority should be consulted : —

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Il^SECTS.

IN the following supplementary article the order of treatment is similar to that adopted ia the earlier volumes of this encyclopaedia (9th edition).

1. Number of Species. — It is now considered that 2,000,000 is a moderate estimate of the species of insects actually existing. Some authorities consider this total to be too small, and extend the number to 10,000,000. Upwards of 300,000 species have been collected and described, and at present the number of named forms increases at the rate of about 8000 species per annum. The greater part by far of the insects existing in the world is still quite unknown to science. Many of the species are in process of extinction, owing to the extensive changes that are taking place in the natural conditions of the world by the extension of human population and of cultivation, and by the destruction of forests ; hence it is probable that a considerable proportion of the species at present existing will disappear from the face of the earth before we have discovered or preserved any specimens of them.

2. Antiquity. — A large number of species of fossil insects have been recently discovered in the Carboniferous measures of Commentry, in Erance. They have been de-

scribed by the late M. Charles Brongniart, and indicate a much greater richness and variety of insect life in Palaeozoic times than was formerly believed to exist. On the other hand, no greater extension of the absolute antiquity of insects has been found. It is true that a Silurian fossil — Palceoblattina douvillei — ^has been described as an insect relic, but this identification is probably erroneous. Some of the Carboniferous insects were of gigantic size, one form — apparently allied to the Odonata, or dragon-flies, of our own epoch — measuring more than 2 feet across the expanded wings. Blattidae, or cockroaches, existed abundantly in Carboniferous times, and were apparently not very different from those now extant. The insects of the Palaeozoic epoch have been combined in a great group, called Palaeodictyoptera by Scudder. This classification is apparently chiefly justified by the fact that many Palaeozoic insects cannot be satisfactorily placed in the same divisions as existing insects.

3. Geographical Distribution. — Recent discoveries induce the belief that islands, even when remote from

continents, possess a greater number of species peculiar to them than was formerly supposed. More extensive investigation of island-life is, however, urgently needed.

4. Duration of Life. — The flour-moth {Epliestia kulini-ella) sometimes passes through five or six generations in a single year. Although one of the characteristics of insects is the brevity of their adult lives, a considerable number of exceptions to the general rule have been dis-covered. These exceptions may be briefly summarized as follows : (1) Certain larvae, provided with food that may be adequate in quantity but deficient in nutriment, may live and go on feeding for many years ; (2) certain stages of the life that are naturally " resting stages " may be in exceptional cases prolonged, and that to a very great extent; in this case no food is taken, and the activity of the individual is almost nil ; (3) the life of certain insects in the adult state may be much prolonged if celibacy be maintained ; a female of Gybister roeselii (a large water-beetle) has lived five and a half years in the adult state in captivity. In addition to these abnormal

cases, the life of certain insects is naturally more pro-
longed than usual. The females of some social insects
have been known to live for many years. In Cicada
sepiendecim the life of the larva extends over from thirteen
to seventeen years. The eggs of locusts may remain for
years in the ground before hatching ; and there may thus
arise the peculiar phenomenon of some species of insect
appearing in vast numbers in a locality where it has not
been seen for several years.

6. Economic Entomology. — The influence of insects on
the prosperity of man, and practical work in connexion
therewith, have attracted great attention, and there are
now various countries in which experts are employed by
the State to study this subject and give advice thereon.
(See Economic Entomology, Mosquito, Tsetse Ely.)

J. B. Smith estimates that in New Jersey insects diminish the
vaUxe of the crop annually to the extent of at least 20 or 25 per
cent. ; and Osborn considers that, in ordinary pasture, insects take
a toll of ahont one-half the produce. As the multiplication of
animals of this class is sometimes both great and rapid, it happens

not infrequently that crops are totally destroyed. Official statistics show that in the island of Cyprus more than 1300 tons of locusts' eggs were collected and destroyed in the year 1881. The regions that suffer most are lands in which cultivation is proceeding in proximity to large districts still in a wild state. Islands to which new forms of cultivated vegetation are introduced sometimes suffer severely. The undue multiplication of insects destructive to vegetation is, in lands in a state of nature, checked by other insects that feed on, or in, the injurious kinds. When foreign plants are introduced to a region it often happens that insects injurious to them are sooner or later found to be present, while the natural enemies of the destroyers may be totally absent. A remedy for this has been sought by introducing the beneficial insects into the region devastated, a proceeding that is sometimes followed by satisfactory results. The orange and lemon trees of California ten years ago were in immediate danger of total extermination owing to the attacks of Icerya purchasi, a scale insect. Vedalia cardinalis, a lady-bird or beetle of the family Coccinellidse, was brought from Australia to California, and checked the ravages of the Iceiya in a most rapid and successful manner. The Coccidae, or scale-insects,

are amongst the most injurious ; they are minute creatures, with extremely limited faculty of locomotion, that fix themselves on plants, and are endowed with great powers of multiplication. Aphidse, or plant-lice, are allied to Coccidae, and in some countries are very injurious. Many other kinds of insects have been found to be injurious, and the treatment necessary to counteract their ravages varies in accordance with the habits and nature of the ravagers. Countries in which cultivation has long been predominant do not as a rule suffer severely from insect depredations, a kind of fluctuating natural balance existing between depredators and their destroyers. Artificial forests (under which we include forests the natural conditions of which have been much interfered with) appear, however, to be everywhere liable to destruction.

Mosquitoes and Malaria. — Increase of knowledge as to the minute organisms that are the causes of certain diseases in man (and the fact that an extremely minute quantity of matter is adequate for the transference of germs) has led to the belief that various diseases may be disseminated by insects. In the case of malaria it is now established that it is conveyed by mosquitoes of the genus Ano-

pheles, and that these insects are essential to its existence. The organism that gives rise to the symptoms of malaria exists in the blood, where it attacks the corpuscles, and may increase greatly in numbers. There are several forms of these parasites, and the generic name Hasmamosba is now applied to them. Ross calls the form that gives rise to quartan fever in man HsemamcBba malarise. It was formerly supposed that malaria was communi-cated by infected water or air, but the parasite has now been found to live in the body of the Anopheles. When a mosquito bites a person it injects a minute quantity of its saliva into the wound, and the malarial parasite is thus introduced. The parasite multiplies in the blood, so that if the patient be again bitten and blood sucked from him by another mosquito the insect becomes thereafter an inoculatory agent. It would appear to be probable that negroes, who in many cases are themselves nearly immune to the pathological symptoms of malaria, serve to keep the mosquitoes supplied with the malarial organism. The parasite is taken into the alimentary canal of the mosquito, passes into the body cavity of the fiy, and thence into the salivary glands, and undergoes an important part of its development in the insect.

The mosquito is essential to the existence of the disease, because it is in the body of the fly that an important part of the series

of life-changes of the parasite is passed through. (See also Mosquito and Sporozoa.)

6. Fertilization of Plants. — Bombi, or bumble-bees, have been successfully introduced into New Zealand, with the result that clover produces plenty of seed there, and that seedlings of various other plants are much augmented. But in Australia the introduction has not been successful.

7. Luminosity. — This subject has received considerable attention, but is still a difficult one. In some of the light-giving forms the eggs have been found to be lumi-nescent before any development takes place in them, it being thus proved that the property is not dependent on the existence of a special organ. The view that tl>e light is due to phosphorus in any form has not been sustained. It is affirmed by Dubois that luminescence is due to the reactions of two special substances, luciferase

and luciferine. In a luminous organ light is produced by the entry of hsemolymph, or blood containing luciferine, to the area containing luciferase. The light given by insects has been shown to be highly economical, and if a similar illuminating agent can be produced artificially it will be a great boon.

8. Galls. — A great variety of deformations and growths produced by insects and mites as well as by fungi has been described. They are in some cases very slight, and in others form remarkably large and definite structures. The whole are now included under the term Cecidia; a prefix gives the name of the organism to which the attacks are due, e.g., Phytoptocecidia are the galls formed by Phytoptid mites. Simple galls are those that arise when only one member of a plant is involved ; compound galls are the result of attacks on buds. Amongst the most remarkable galls recently discovered we may mention those found on Eucalyptus, Casuarina, and other trees and plants in Australia. They are remarkable for their variety, and are due to small

scale-insects of the peculiar sub-family Brachyscelinae. As regards the mode of production of galls, the most important distinction is between galls that result from the introduction of an egg, or other matter, into the interior of the plant, and those that are due to an agent acting externally, the gall in the latter case frequently growing in such a manner as ultimately to enclose its producers. The form and nature of a gall are the result of the powers of growth possessed by the plant. It has long been known, and is now generally recognized, that a gall can only be produced when the tissue of a plant is interfered with during, or prior to, the actual development of the tissue. Little more than this is known. The power that gall-producers possess of influencing by direct interference the growth of the cells of the plant that affords them the means of subsistence is an art that appears to be widely spread among animals, but is at the same time one of which we have little knowledge. The views of Adler as to the alternation of generations of numerous gall-flies have been fully confirmed, it having been ascer-

tained by direct observation that the galls and the insects produced from them in one generation are entirely different from the next generation ; and it has also been rendered certain that frequently one of the alternate generations is parthenogenetic, no males being produced. It is supposed that these remarkable phenomena have gradually been evoked by difference in the nutrition of the alternating generations. When two different generations are produced in one year on the same kind of tree it is clear the properties of the sap and tissues of the tree must be diverse so that the two generations are adapted to different conditions. In some cases the alternating generations are produced on different species of trees, and even on different parts of the two species.

9. Anatomy — Morphology. — Much work has been devoted to ascertaining the structure of the insect during the period of development in the egg. The addition of this embryological knowledge to the results yielded by study of the comparative anatomy of the perfect insect is en-

Obcl

Morphology of an Insect : the embryo of Gryllotalpa, Bomewhat dia^am-matlc. {After Beywons.) The longitudinal segmented band along the middle line represents the early segmentation of the nervous system and the subsequent median field of each sternite ; the lateral transverse unshaded bands are the lateral fields of each segment ; the shaded areas indicate the more internally placed mesoderm layer. The segments are numbered 1-21 ; 1-6 vrill form the head, 7-9 the thorax, 10-21 the abdomen. A, anus ; Abx^, Abx^-^, appendage of Ist and of 11th abdominal segments ; Ans. anal piece=tel8on or I2th abdominal segment ; Ant, antenna ; Ve, deuterencephalon ; Md, mandible ; Mc^, first maxilla ; Jfa-a, second maxilla or labium ; {?, mouth ; Obcl, rudimentary labrum and clypeus \ Pre, protencephalon ; Sti, S^io, stigmata 1 and 10; Terg, tergite; 7%iC,, appendage of first thoracic segment; Tre, tritencephalon ; Ut, a thickening at hinder margin of the mouth.

abling us to interpret the structure of the latter correctly, and to form an opinion as to what are the most important of the similarities and distinctions we observe. Our knowledge relates at present chiefly to the lower insects. The

*higher members of the class undergo at the penultimate stages of their life a metamorphosis so complete and rapid as to render the correct interpretation of their structures a matter of very gr^at difficulty. (For details see § 10 below, under Metamorphosis^*

Segments. — One of the most constant features of insect structure is the segmentation (see Fig.). The segments are perceptible at a very early stage of the development –

as a number of transverse bands arranged in a linear sequence. The first segmentation of the ventral plate — the minute part of the blastoderm that ultimately de-velops into the embryo — is not, however, very definite, and the segmentation does not make its appearance si-multaneously throughout the whole length of the plate ; the anterior parts are segmented before the posterior. In Orthoptera and Thysanura, as well as some others of the lower insects, it may be said that twenty-one of these divisions — not, however, all similar — may be distin-

guished, six of which subsequently enter into the forma-
tion of the head, three going to the thorax and twelve to
the abdomen. In Hemiptera only eleven, and in Collem-
bola only six, abdominal segments have been detected.
The first and last of these twenty-one divisions are so
different from the others that they can scarcely be con-
sidered true segments.

Head Segments. — In the adult insect the head is Insignificant in
size compared with the thorax or abdomen, but in the embryo it
forms a much larger portion of the body than it does in the adult.
Its composition has been the subject of prolonged difference of
opinion. Formerly it was said that the head consisted of four
divisions, viz., three segments and the procephalic or prse-oral
lobes. It is now ascertained that the procephalic lobes consist of
three divisions, so that the head may be said to be formed from
six divisions. The first of these, according to the nomenclature of
Heymons, is the mouth, or oral, piece ; the second, the antennal
segment ; the third, the intercalary or pr»-mandibular segment ;
while the fourth, fifth, and sixth are respectively the segments
of the mandibles and of the first and second maxillae. These six

divisions of the head are diverse in kind, and subsequently undergo so much change that the part each of them takes in the formation of the head-capsule is not finally determined. The labrum and clypeus are developed as a single prolongation of the oral piece, not as a pair of appendages. The antennal segment apparently entirely disappears, with the exception of a pair of appendages it bears ; these become the antennae ; it is possible that the original segment, or some part of it, may even become a portion of the actual antennae. The intercalary segment has no appendages, or rudiments thereof, and probably subsequently entirely disappears. The appendages of the posterior three, or trophal, segjnents become the parts of the mouth. The appendages of the two maxillary segments arise as treble, instead of single, projections, thus differing from other appendages. From these facts it appears that the anterior three divisions of the head differ strongly from the posterior three, which greatly resemble thoracic segments ; hence it has been thought possible that the anterior divisions may represent a primitive head, to which three segments and their leg-like appendages were subsequently added to form the head as it now exists. This is, however, very doubtful, and an entirely different

inference is possible. In reference to the structure of the head-capsule in the imago, it appears that the clypeus and labrum represent, as already said, an unpaired median outgrowth of the oral piece; that immediately behind them comes the "frons," formed by the junction in the median line of the sides of the oral piece, but without suture there, because the junction takes place early and before any process of chitinous excretion occurs ; that the " vertex" is formed by the tergites — or lateral growths — of the posterior three head segments, the mandibular segment contributing also the genae.

Sypopharynx. — Great difference of opinion exists as to this structure, which is extremely different in the various kinds of insects ; it may be briefly described as a fold forming the floor, or a part thereof, of the mouth. It has even been thought that it represents a distinct segment, or the pair of appendages of a distinct segment. Heymons considers that it represents the sternites of the three trophal segments, and that the "gula" is merely a secondary development. Folsom looks on the hypopharynx as a secondary development, but considers that some lateral parts in connexion with it represent an additional or seventh segment,

which he calls superlingual, and considers as situate between the mandibular and first maxillary segments. The ganglia of the nervous system offer some important evidence as to the morphology of the head, and are alluded to below.

Thoracic Segments. — These are always three in number. The three pairs of legs appear very early as rudiments. Though the thoracic segments bear the wings, no trace of these appendages exists till the close of the embryonic life, nor even, in many cases, till much later. The thoracic segments, as seen in an early stage of the ventral plate, display in a well-marked manner the essential elements of the insect segment. These elements are, a central piece or sternite, and a lateral field on each side bearing the leg-rudiment. The external part of the lateral field subsequently grows up, and by coalescence with its fellow forms the tergite or dorsal part of the segment.

Abdominal Segments and Appendages. — We have already seen that in numerous lower insects the abdomen is formed from twelve divisions placed in linear fashion. Eleven of these may perhaps be considered as true segments, biit the twelfth or terminal one is-different, and is called by Heymons a telson ; in it is placed the

anal orifice, and the mass subsequently becomes the upper and lower laminae anales. In Hemiptera this telson is absent, and the anal orifice is placed quite at the termination of the eleventh segment. Moreover, in this Order the abdomen shows at first a division into only nine segments and a terminal mass, which last subsequently becomes divided into two. The appendages of the abdomen are called cerci, styles, and gonapophyses. They differ much according to the kind of insect, and in the adult according to sex. Difference of opinion as to the nature of the abdominal appendages prevails. The cerci, when present, appear in the mature insect to be attached to the tenth segment, but according to Heymons they are really appendages of the eleventh segment, their connexion with the tenth being secondary and the result of considerable changes that take place in the terminal seg-ments. It has still to be shown that any true cerci exist in the higher insects. In those insects in which a median terminal appendage exists between the two cerci this is considered to be a prolongation of the eleventh tergite. The styles, when present, are placed on the ninth segment, and in some Thysanura exist also-on the eighth segment ; their development takes place later in' life

than that of the cerci. The gonapophyses are the projections near the extremity of the body that surround the sexual orifices, and vary extremely according to the kind of insect. They have chiefly been studied in the female, and form the sting and ovipositor, organs peculiar to this sex. They are developed on the ventral surface of the body, and are six in number, one pair arising from the eighth ventral plate and two pairs from the ninth. This has-been found to be the case in insects so widely different as Orthop-tera and Aculeate Hymenoptera. The genital armature of the male is formed to a considerable extent by modifications of the seg-ments themselves. The development of the armature has been little studied, and the question whether there may be present gona-pophyses homologous with those of the female is open.

In the adult state no insect possesses more than six legs, and they are always attached to the thorax ; in many Thysanura there are, however, processes on the abdomen that, as to their position, are-similar to legs. In the embryos of many insects there are projec-tions from the segments of the abdomen similar, to a consideiuble extent, to the rudimentary thoracic legs. The question whether these projections can be considered an indication of former polypody in

insects has been raised. They do not long persist in the embryo, but disappear, and the area each one occupied becomes part of the sternite. In some embryos there is but a single pair of these rudiments (or vestiges) situate on the first abdominal segment, and in some cases they become invaginations of a glandular nature. Whether cerci, styles, and gonapophyses are developed from these rudiments has been much debated. It appears that it is possible to accept cerci and styles as modifications of the temporary pseudopods, but it is more difficult to believe that this is the case with the gonapophyses, for they apparently commence their development considerably later than cerci and styles and only after the apparently complete disappearance of the embryonic pseudopods. The fact that there are two pairs of gonapophyses on the ninth abdominal segment would be fatal to the view that they are in any way homologous with legs, were it not that there is some evidence that the division into two pairs is secondary and incomplete. The pseudopods that exist on the abdomen of numerous caterpillars may possibly arise from the embryonic pseudopods, but this also is far from being established.

Nervous System. — The nervous system is ectodermal in origin, and is developed and segmented to a large extent in connexion

with the outer part of the body, so that it affords important evidence as to the segmentation thereof. The continuous layer of cells from which the nervous system is developed undergoes a. segmentation analogous with that we have described as occurring in the ventral plate ; there is thus formed a pair of contiguous ganglia for each segment of the body, but there is no ganglion for the telson. The ganglia become greatly changed in position during the later life, and it is usually said that there are only ten pairs of abdominal ganglia even in the embryo. In Orthoptera, Heymons has demonstrated the existence of eleven pairs, the terminal pair becoming, however, soon united with the tenth. The nervous system of the embryonic head exhibits three ganglionic masses, anterior to the thoracic ganglionic masses ; these three masses subsequently amalgamate and form the sub-CBSophageal ganglion, which supplies the trophal segments. In front of the three masses that will form the sub-oesophageal ganglion the mass of cells that is to form the nervous system is very larger

and projects on each side ; this anterior, or prae-oral, mass consists

of three lobes (the prot-, deut-, and tritencephalon of Viallanes and others), each of which may represent a segmental ganglion. They subsequently form the supra-cesophageal ganglion, or brain proper. Thus the evidence afforded by the great ventral chain of nerves supports the view that the number of divisions of the body in the lower insects is twenty, plus a terminal piece or telson. The telson and the anterior segment, or head-piece, at the other extremity exhibit considerable distinctions from the other segments. There are other ganglia in addition to those of the ventral chain, and Ch. Janet supposes that the ganglia of the sympathetic system indicate the existence of three other head-segments ; the remains of the segments themselves are, in accordance with this view, to be sought in the stomodseum (to which we allude below). Folsbm considers that there are seven sets of cephalic ganglia, and thus supports his view as to the composition of the head.

Alimentary Canal. — The anterior and posterior parts of the alimentary canal have for long been known to have their origin in ectoderm, and to be thus, as it were, parts of the exterior of the body ; they are called respectively the stomodseum and procto-

daeum. The middle portion of the alimentary canal — ^the stomach or mesenteron — has until recently been considered to be endodermal. Heymons has shown that it is of secondary ectodermal origin in several insects, and his views have been confirmed, from study of other Orders, by various authorities. It appears, therefore, to be established that in the majority of insects the mesenteron is formed by cells from the stomodseum and prootodaeum that subsequently unite, and not from endodermal rudiments in close proximity with these two parts, as Graber and others believed, and as is usually the case in other animals. Heymons has also found that in Lepisma the mesenteron arises in a different manner, and is of endodermal origin, being developed from the yolk-cells.

10. Metamorphosis. — A great deal of investigation has been devoted to this remarkable feature of insect life. The outer layer — or embryonic ectoderm — of an insect consists of a layer of cells forming a continuous structure ; the orifices in it — mouth, spiracles, anus, and terminal portions of the genital ducts — being invaginations of the outer wall. This cellular layer is Called the hypo-

dermis ; it is protected externally by a cuticle, a layer of matter it itself excretes, or in the excretion of which it plays, at any rate, an important part. The cuticle is a dead substance, and is composed in large part of chitin. The cuticle contrasts strongly in its nature with the hypodermis it protects. It is different in its details in different insects and in different stages of the life of the same insect. The " sclerites " that make up the skeleton of the insect (which skeleton, it should be remembered, is entirely external) are made up of this chitinous excretion. The growth of an insect is usually rapid, and as the cuticle does not share therein, it is from time to time cast off by moulting or ecdysis. Before a moult actually occurs the cuticle becomes separated from its connexion with the underlying hypodermis. Con-comitant with this separation there is commencement of the formation of a new cuticle within the old one, so that when the latter is cast off the insect appears with a partly completed new cuticle. The new instar — or temporary form — is often very different from the old

one, and this is the essential fact of metamorphosis. Metamorphosis is, from this point of view, the sum of the changes that take place under the cuticle of an insect between the ecdyses, which changes only become externally displayed when the cuticle is cast off. The hypodermis is the immediate agent in effecting the external changes.

The study of the physiology of ecdysis in its simpler forms has unfortunately been somewhat neglected, investigators having directed their attention chiefly to the cases that are most striking, such as the transformation of a maggot into a fly, or of a caterpillar into a butterfly. The changes have been found to be made up of two sets of processes : histolysis, by which the whole or part of a structure disappears ; and histogenesis, or the formation of the new structure. By histolysis certain parts of the hypodermis are destroyed, while other portions of it develop into the new structures. The hypodermis is composed of parts of two different kinds, viz., (1) the larger part of the hypodermis that exists in the maggot or caterpillar and is dissolved at the metamorphosis : (2) parts that remain comparatively quiescent previously, and that

grow and develop when the other parts degenerate. These centres of renovation are called imaginal discs or folds. The adult caterpillar may be described as a creature the hypodermis of which is studded with buds that expand and form the butterfly, while the parts around them degenerate. In some insects (e.g., the maggots of the blowfly) the imaginal discs are to all appearance completely separated from the hypodermis, with which they are, however, really organically connected by strings or pedicels. This connexion was not at first recognized and the true nature of imaginal discs was not at first perceived, even by Weismann, to whom their discovery in Diptera is due. In other insects the imaginal discs are less completely disconnected from the superficies of the larval hypodermis, and may indeed be merely patches thereof. The number of imaginal discs in an individual is large, upwards of sixty having been discovered to take part in the formation of the outer body of a fly. With regard to the internal organs, we need only say that transformation occurs in an essentially similar manner, by means of a development from centres distributed in the various organs. The imaginal discs for the outer wall of the body, some of them, at any rate, include mesodermal rudiments (from which the muscles are

developed) as well as hypodermis. The imaginal discs make their appearance (that is, have been first detected) at very different epochs in the life ; their absolute origin has been but little investigated. Pratt has traced them in the sheep-tick to an early stage of the embryonic life.

Histolysis and Histogenesis. — The process of destruction of the larval tissues was first studied in the forms where metamorphosis is greatest and most abrupt, viz., in the Muscid Diptera. It was found that the tissues were attacked by phagocytic cells that became enlarged and carried away fragments of the tissue ; the cells were subsequently identified as leucocytes, or blood-cells. Hence the opinion arose that histolysis is a process of phagocytosis. It has, however, since been found that in other kinds of insects the tissues degenerate and break down without the intervention of phagocytes. It has, moreover, been noticed that even in cases where phagocytosis exists a greater or less extent of degeneration of the tissue may be observed before phagocytosis occurs. This process can therefore only be looked on as a secondary one that hastens and perfects the destruction necessary to permit of the accompanying histogenesis. This view is confirmed by the fate

of the phagocytic cells. These do not take a direct part in the formation of the new tissue, but it is believed merely yield their surplus acquisitions, becoming ordinary blood-cells or disappearing altogether. As to the nature of histogenesis, nothing more can be said than that it appears to be a phenomenon similar to embryonic growth, though limited to certain spots. Hence we are inclined to look on the imaginal discs as cellular areas that possess in a latent condition the powers of growth and development that exist in the embryo, powers that only become evident in certain special conditions of the organism. What the more essential of these conditions may be is a question on which very little light has been thrown, though it has been widely discussed.

Much consideration has been given to the nature of metamorphosis in insects, to its value to the creatures, and to the mode of its origin. Insect metamorphosis may be briefly described as phenomena of development characterized by abrupt changes of appearance and of structure, occurring during the period subsequent to embryonic development and antecedent to the reproductive state. It

is, in short, a peculiar mode of growth and adolescence. The differences in appearance between the caterpillar and the butterfly, striking as they are to the eye, do not suffi-ciently represent the phenomena of metamorphosis to the intelligence. The changes that take place involve a re-volution in the being, and may be summarized under three headings : — (1) The food-relations of the individual are profoundly changed, an entirely different set of mouth-organs appears, and the kind and quantity of the food taken is often radically different. (2) A wingless, seden-tary creature is turned into a winged one with superlative powers of aerial movement. (3) An individual in which the reproductive organs and powers are functionally absent becomes one in which these structures and powers are the only reason for existence, for the great majority of insects die after a brief period of reproduction. These changes are in the higher insects so extreme that it is difficult to

imagine how they could be increased. In the case of the

common drone-fly, the individual, from a sedentary maggot living in fiJth, without any relations of sex, and with only unimportant organs for the ingestion of its foul nutriment, changes to a creature of extreme alertness, with magnificent powers of flight, living on the products of the flowers it frequents, and endowed with highly complex sexual structures.

In connexion with the question whether metamorphosis has been gradually acquired we have to consider two aspects, viz., the bionomic nature of metamorphosis, and to what extent it existed in primitive insects. Bionomically, metamorphosis may be defined as the sum of adaptations that have gradually fitted the larva (caterpillar or maggot) for one kind of life, the fly for another. So that we may conclude that the factors of evolution would favour its development. With regard to its occurrence in primitive insects, our knowledge of the geological record is most imperfect, but so far as it goes it supports the conclusion that holometabolism (i.e., extreme metamorphosis) is a comparatively recent phenomenon of insect

life. None of the groups of existing Holometabola have been traced with certainty farther back than the Mesozoic epoch, and all the numerous Palaeozoic insect-fossils seem to belong to forms that possessed only imperfect metamorphosis. The only doubt arises from the existence of insect remains, referred to the order Coleoptera, in the SilesianCulmof Steinkunzendorf. The oldest larva known, Mormohicoides articulatus, is from the New Red Sandstone of Connecticut ; it belongs to the Sialidae, one of the lowest forms of Holometabola. It is now, in fact, generally admitted that metamorphosis has been acquired comparatively recently, and Scudder in his review of the earliest fossil insects states that "their metamorphoses were simple and incomplete, the young leaving the egg with the form of the parent, but without wings, the assumption of which required no quiescent stage before maturity."

The Pupa. — A brief digression must be devoted to this peculiar instai. If we admit that the larva has, in the phylogeny of insects, gradually diverged from the imago, and if we recollect that in the ontogeny the larva has always to become the imago (and of

course still does so) notwithstanding the increased difficulty of the transformation, we cannot but recognize that a period of helplessness in which the transformation may take place is to be expected. It is generally considered that this is sufficient as an explanation of the existence of the pupa. This, however, is not the case, because the greater part of the transformation precedes the disclosure of the pupa, which, as Miall remarks, is structurally little other " than the fly enclosed in a temporary skin." Moreover, in many insects with imperfect metamorphosis the change from larva or (as the later stage of the larva is called in these cases) nymph to imago is about as great as the corresponding change in the Holometabola, as the student will recognize if he recalls the histories of Ephemeridse, Odonata, and male Coccidse. But in none of these latter cases have the wings to be changed from a position inside the body to become external and actively functional organs. The difierence between the nymph or false pupa and the true pupa is that in the latter a whole stadium is devoted to the perfecting of the wings and body-wall after the wings have become external organs ; the stadium is one in which no food is or can be taken, however prolonged may be its existence. Amongst insects with

imperfect metamorphosis the nearest approximations to the true pupa of the Holometabola are to be found in the subimago of Ephemeridse and in the quiescent or resting stages of Thysanoptera, Aleurodidss, and CoccidsB. A much more thorough appreciation than we yet possess of the phenomena in these cases is necessary in order completely to demonstrate the special characteristics of the holometabolous transformation. But even at present we caxi correctly state that the true pupa is invariably connected with the transference of the wings from the interior to the exterior of the body. It cannot but suggest itself that this transference was induced by some peculiarity as to formation of cuticle, causing the growth of the wings to be directed inwards instead of outwards.

We may remark that the flea possesses no wings, but is understood to possess a true pupa. This is a most remarkable case, but unfortunately very little information exists as to the details of metamorphosis in this group.

It has been incidentally remarked that the phenomena of holometabolism are connected with the development of wings inside the body (except in the case of the flea, where there are no wings in the perfect insect). The

term Endopterygota has been proposed for those insects in which the early stages of development of the wing occur inside the body, and the term Exopterygota for those in which the wing development is entirely external. Of existing insects 90 per cent, belong to the Endopterygota. At the same time we have no evidence that any Endopterygota existed amongst Palaeozoic insects, so that the phenomena of endopterygotism are comparatively recent, and we are led to infer that the Endopterygota owe their origin to the older Exopterygota. In Endopterygota the wings commence their development as invaginations of the hypodermis, while in Exopterygota the wings begin — and always remain — as external folds or evaginations. The two modes of growth are directly opposed, and at first sight it appears that this fact nega^ tives the view that Endopterygota have been derived from Exopterygota.

Only three hypotheses as to the origin of Endopterygota can be suggested as possible, viz. : — (1) That some of the Palaeozoic insects, though we infer them to have been

exopterygotous, were really endopterygotous, and were the actual ancestors of the existing Endopterygota ; (2) that Endopterygota are not descended from Exopterygota, but were derived directly from ancestors that were never winged; (3) that the predominant division — i.e., Endo-pterygota— of insects of the present epoch are descended from the predominant — if not the sole — group that existed in the Palaeozoic epoch, viz., the Exopterygota. The first hypothesis is not negatived by direct evidence, for we do not actually know the ontogeny of any of the Palaeozoic insects ; it is, however, rendered highly im-probable by the modern views as to the nature and origin of wings in insects, and by the fact that the Endoptery-gota include none of the lower existing forms of insects. The second hypothesis — to the effect that Endopterygota are the descendants of apterous insects that had never possessed wings (i.e., the Apterygogenea of Brauer and others, though we prefer the shorter term Apterygota) — is rendered improbable from the fact that existing Apterygota are related to Exopterygota, not to En-

dopterygota, and by the knowledge that has been gained as to the morphology and development of wings, which suggest that — if we may so phrase it — were an apterygotous insect gradually to develop wings, it would be on the exopterygotous system.

From all points of view it appears therefore probable that Endopterygota are descended from Exopterygota, and we are brought to the question as to the way in which this has occurred.

It is almost impossible to believe that any species of insect that has for a long period developed the wings outside the body could change this mode of growth directly for an internal mode of development of the organs in question, for, as we have already explained, the two modes of growth are directly opposed. The explanation has to be sought in another direction. Now there are many forms of Exopterygota in which the creatures are almost or quite destitute of wings. This phenomenon occurs among species found at high elevations, among others found in arid or desert regions, and in some cases

in the female sex only, the male being winged and the female wingless. This last state is very frequent in Blattidae, which were amongst the- most abundant of Palaeozoic insects. The wingless forms in question are always allied to winged forms, and there is every reason to believe that they have been really derived from winged forms. There are also insects (fleas, &c.) in which

metamorphosis of a holometabolous character exists, though the insects never develop wings. These cases render it highly probable that insects may in some circumstances become wingless, though their ancestors were winged. Such insects have been styled anapterygotous.

In these facts we have a clue to the change from exopterygotism to endopterygotism, namely, by an intermediate period of anapterygotism.

Although we cannot yet define the conditions under which exopterygotous wings are suppressed or unusually developed, yet we know that such fluctuations occur.

There are, in fact, existing forms of Exopterygota that are usually wingless, and that nevertheless appear in certain seasons or localities with wings. We are therefore entitled to assume that the suppressed wings of Exopterygota tend to reappear; and speaking of the past, we may say that if after a period of suppression the wings began to reappear as hypodermal buds while a more rigid pressure was exerted by the cuticle, the growth of the buds would necessarily be inwards, and we should have incipient endopterygotism. The change that is required to transform Exopterygota into Endopterygota is merely that a cell of hypodermis should proliferate inwards instead of outwards, or that a minute hypodermal evaginated bud should be forced to the interior of the body by the pressure of a contracted cuticle.

If it should be objected that the wings so developed would be rudimentary, and that there would be nothing to encourage their development into perfect functional organs, we may remind the reader that we have already

pointed out that imperfect wings of Exopterygota do, even at the present time under certain conditions, become perfect organs ; and we may also add that there are, even among existing Endopterygota, species in which the wings are usually vestiges and yet sometimes become perfectly developed. In fact, almost every condition that is required for the change from exopterygotism to endopterygotism exists among the insects that surround us.

11. Classification. — The application of morphological (including developmental) studies to the classification of insects necessarily renders the perfection of a natural system a slow process. So far as it has been carried out, it has not resulted in a tendency to reduce the number of Orders, but rather to increase them. Twenty-two primarily different kinds of insects must at present be recognizled, viz. : (1) CoUembola, (2) Thysanura, (3) Mallophaga, (4) Anoplura (or Pediculidae), (5) Aphaniptera (now frequently called Siphonaptera), (6) Orthoptera, (7) Perlidae (or Pleeoptera),(8)Psocid8e, (9)Termitid8e (or Platyptera),

(10) Embiidse, (11) Ephemeridse, (12) Odonata, (13) Thy-sanoptera, (14) Hemiptera(orEhynchota), (16) ISTeuroptera, (16) Panorpatse (or Mecaptera), (17) Trichoptera, (18) Lepidoptera, (19) Coleoptera, (20) Strepsiptera, (21) Diptera, (22) Hymenoptera. These groups are of most unequal extent, some of them numbering a score or two of species, and some of them scores of thousands. Although various attempts have been made to combine these twenty-two groups into a smaller number of divisions, they have none of them received general assent. We may, however, mention that groups 1-5 are purely apterous insects ; that the members of groups 6-14 have the wings placed outside the body on the back during development, and form the Exopterygota ; while groups 15-22 form the Endoptery-gota, the wings during development being quite invisible externally. Great difficulty is experienced in classifying the purely apterous divisions. 1 and 2, CoUembola and Thysanura, are usually separated from the others under the name Apterygogenea, or that of Apterygota or Aptera ; and it is supposed by many that not only are they them-

selves wingless, but that their ancestors were always in the same state of winglessness. Groups 3-5 are, on the contrary, supposed to be descended from winged forms, and have been termed Anapterygota. The Anapterygota consist entirely of epizoic forms (i.e., creatures dwelling on the bodies of other living animals), and are of two very distinct kinds. In Mallophaga and Anoplura the parasitic, or epizoic, life is complete and there is no metamorphosis, while in the fleas (Aphaniptera) metamorphosis is strongly developed and the epizoic life is but partial.

12. Ethology. — Eecent observation of the habits and instincts of insects has resulted in accentuating the great difference that exists between the intelligence of the insect and that of the vertebrate. The subject is much obscured by the difficulty that exists in agreeing as to the terms that are used in discussing it. In making use of the words reason and intelligence in connexion with insects we are met by the difficulty that we know but little of the nervous actions, and nothing of the consciousness that may or may not accompany them in insects, while in

ourselves we form our conclusions as to reason and intelligence largely by the nature of the consciousness that accompanies the nervous processes. Some naturalists deny any intelligence to insects, and contend that their actions are merely reflex. It is, however, impossible to compare the insect mind with any one set of the categories in which we class our own actions. In short, the proceedings of insects must be judged by the results the species attains, and not by a comparison with the methods we ourselves should use for attaining similar results. If we view the subject in this light, we find a thorough harmony to exist between the main peculiarities of the insect's life and what we must perforce style its mental characteristics. There are, however, great distinctions in the Jives of the different kinds of insects, so that it is impossible for us here to pursue this subject in detail.

The most surprising of all the discoveries in entomology are those that have been made as to social insects. The number of kinds of these is comparatively small.

They are all included amongst the termites, wasps, bees, and ants. All these social insects exhibit a more or less considerable departure from the biological characters of the non-social insects. The generations are not isolated, but overlap; the life of the individual is unusually long, and, what is more to the point, it is the adult or perfected stage of the life that is prolonged. The young are fed from the mouths of the nurses, and the food is modified by the processes of the feeder's body. Most remarkable is the fact, that though the communities of social insects often include a countless number of individuals, the work of reproduction is limited to an extremely small number of them, and in the highest developments of insect socialism to a single mother. This individual is thus, in some cases, the immediate progenitor of scores of thousands of individuals, all living with her and assisting in her work, inasmuch as they feed and care for her young. This social system is therefore a highly perfected form of family life.

Perhaps the most remarkable fact as regards the higher

societies of insects is that though the individuals composing a community are the offspring of one mother, and (in the case of the social Hymenoptera) of a single copula, yet they do not resemble their parents, and, moreover, exhibit a good deal of difference among themselves, consisting of soldiers of different grades, as well as of workers and nurses, each kind being formed so as to adapt it to its special duties. The way in which these castes are produced has been much debated. There is much variety in social insects ; in the Hymenoptera all the castes are composed of the altered females (sometimes called

neuters). One set of savants contends that tlie whole of these castes are directly due to food. It is not supposed that there is a particular kind of food for producing each caste, but rather that the nutritive powers of the foods supplied are different, and affect the growth of the larvae, and possibly the growth of the eggs in the ovaries ; variations in the moment of the development at which a

change of food is made, and the fact that the food may affect the development of some organs more than others may be important, and, combined with the correlation of organs, may be adequate to produce the results. This has been supported by Grassi and Herbert Spencer. A very different view has been maintained by Weismann. He considers that the various castes may be accounted for by supposing each egg to contain a variety of rudiments (to an uncertain extent) for each organ, and that the food merely excites the development of one set of rudiments rather than another. Individuals intermediate between the various castes, and others of anomalous developments, are occasionally found; and as it is not possible to believe in special rudiments as their cause, it is clear that we must admit some amount of plasticity in the development of the rudiments. Hence the existence of a variety of rudiments need not be invoked, and can only be admitted when the rudiments are actually demonstrated.

AuTHOKiTiEs. — The works and papers published on insects

at present number annually more than 1000. It is impos-

sible to give here a list of even the more important of those

published since 1880. In the following list we mention one or

two of the more recent in several departments ; these will be

found in most cases to include references to earlier works. General

"Works: — A. S. Packard. Text-Book of Entomology. London,

1898. — D. Sharp. "Insects," the Cambridge Natural Bistoi-y,

vol. v., 1895; vol. vi., 1899. London. — C. Janet. A series of

papers in various French periodicals under the title of " iltudes

sur les Fourmis, les Gu§pes et les Abeilles," 1893-1900. — S. H.

ScuDDEK. " Review of Fossil Insects," Sull. U.S. Geol. Survey,

No. 71, 1886. — Luminosity: — R. Dnnois. "Legons de Physiologie

G6n6rale et Compar^e." Paris, 1898.— Galls :— J. W. H. Traill.

Ann. Scott. Nat. Hist., p. 171, 1897. — Rubsaamen. "Australian

Brachyscelid-galls," Berlin. Ent. Zeitschr., xxxix., 1894. — Mor-

phology and Embryology: — Dr R. Hetmons. "Beitrage zur

Morphologie und Entwicklungsgeschichte der Rhynchoten," Acta

Ac. German., Ixxiv., No. 3, 1899. — J. Pantel. " Essai mono-

graphique sur les caraotferes ext^rieurs, la biologle et I'anatomie

d'une larve parasite du groupe des Tachinaires,"ia Cellule, xv.,

1898. — L. C. Miall and A. Denny. The Structure and Life-History of the Cockroach. London, 1886. — ^Parthenogenesis: — L. F. Henneguy. “Les modes de reproduction des Insectes,” Bull. Soc. Philom. (9), i. p. 41, 1899. — Metamorphosis: — De Bruyne. ” Sur P intervention de la phagocytose dans le dfiveloppement des Invert^brfe,” Mem. Cour. Ac. Belgique, 4to, Ivi., 1899. — J. Gonin. ” Recherches sur la metamorphose des L^pidoptferes,” Bull. Soc. Vaudoise, xxx. p. 89, 1894. — A. L. Miall. The Structure and Life-History of the Harlequin Ely. London, 1900. — Ethology: — J. H. Fabre. Souvenirs Entomologiques, 7 vols. Paris, 1882-1900. — Mimicry : — E. Haase. ” Untersuchungen uberdieMimicry,” Bibl. Zool., iii., 1891. (d. s.)*

Insomnia. — Inability to sleep is a common and troublesome feature of most illnesses, both acute and chronic. It may be due to pain, fever, or cerebral ex-citement, as in delirium tremens, in which the patient sometimes does not obtain a moment’s sleep for several days and nights together, or it may be due to organic changes in the brain. The treatment, when failure to sleep occurs in connexion with a definite illness, is part

of the treatment of that illness. But there is a form of sleeplessness not occurring during illness to which the term "insomnia" is commonly and conveniently applied. It must not be confounded with mere occasional wakefulness caused by some disturbance or irritation or minor discomfort, such as indigestion, nor with the "bad nights" of the valetudinarian, who complains of not having " closed an eye " all night, after several hours of sound sleep during the day. Real insomnia consists in the prolonged inability to obtain sleep sufficient in quantity and quality for the maintenance of health. It is a condition of modern urban life, and may be regarded as a malady in itself. It is a very troublesome and Serious condition, and probably the most potent factor in causing those nervous breakdowns which are ascribed to " overwork." It may occur as a sequel to some exhausting illness, notably influenza, which affects the nervous system long after convalescence. But it very often occurs without any such cause. The patients are usually men of mature age, though youth may suffer from insomnia

also, brought on by work for examinations, for instance, or some other over-stimulation of the brain. But in youth the cause is easily removed as a rule, and the tissues quickly regain their normal tone. Continued deprivation of sleep, however, produces the most serious effects even in the young. Later in life the cause is less easily removed and the recuperative powers are less vigorous. Professional and business men are the most frequent sufferers, because the strain of mental work and anxiety falls more heavily upon them than upon any other class. Insomnia is comparatively rare among the poor, who do little or no brain work, and, living always from hand to mouth, with nothing to lose, never feel the same anxiety. It may be brought oh by some exceptional strain, by long-continued worry, or by sheer overwork. The broad pathology is simple enough. It has been demonstrated by exact observations that in sleep the blood leaves the brain automatically. The function is rhythmical, like all the vital functions, and the mechanism by which it is carried out is no doubt the vaso-motor

system, which controls the contraction and dilation of the blood-vessels. In sleep the vessels in the brain automatically contract. When the brain is working actively, on the contrary, a plentiful supply of blood is required, and the vessels are dilated. If the activity is carried to great excess the vessels become engorged, the mechanism does not act, and sleep is banished. Hence the common phenomenon of children being unable to sleep "for excitement." In insomnia this condition has become fixed. It seldom produces absolute sleeplessness. What happens is that a man goes to bed, and cannot get to sleep for hours. He is turning things over in his head. Eventually he falls asleep towards morning, and after a brief period of unconsciousness he is awakened to the day's work again. Or it may be that he falls asleep on going to bed and wakes up not long afterwards, to lie broad awake for the rest of the night. In either case he has not had suflficJent cerebral rest, and returns heavy and dull to his work, which once more goads the tired brain into excitement and renews the

evil. Crescit indidgens sibi dirus hydrojis. The longer it goes on the more fixed becomes the condition of cerebral engorgement, until the brain gives way and a touch of paralysis, loss of memory, mental aberration, or complete collapse follows.

When such a breakdown has happened or is pending the only treatment is complete rest, combined, if possible, with change of air and scene; but if the mischief has gone far it will take very long to repair, and may never be repaired at all. In no matter of health is the importance of "taking it early" more pronounced. Delay is the worst economy. A few days' holiday at the commencement of trouble may save months or years of enforced idleness. Sea-air sometimes acts like a charm. But if it is impossible, as it sometimes is, to give up work and leave worry behind, even for a short time, sleep should be carefully wooed by every possible means. In the first place, plenty of time should be devoted to it, and no chance should be missed. That is to say, the night

should not be curtailed at either end, and if sleepiness approaches in the daytime, as it often does, it should be encouraged. It is better to lie still at night and try to sleep than to give way to restlessness, and a few minutes snatched in the daytime, when somnolence offers the opportunity, has a restorative effect out of all proportion to the time occupied. Then all accidental causes of disturbance should be avoided. Lights and sounds should be excluded, comfort studied, and digestion attended to. Very often the trouble might be cut short if the patient and the other people in the house realized the seriousness of the condition and took pains to ameliorate it in little things. If a hypochondriacal tendency is present conversation should be sympathetic, but cheerful and encouraging. Fresh air is a great help. As much time should be spent out of doors as possible, and exercise, even to the point of fatigue, may be found helpful. But this requires watching : in some cases bodily exhaustion aggravates the malady, and in particular bicycle exercise,

which has a peculiarly exhausting effect on some people, should be used with care. In abstemious persons a little alcohol often acts as a complete restorative. The following case is instructive. Mr X., a professional man, carrying a great responsibility upon his shoulders, was subjected to a specially severe strain of anxiety, work, and worry. Though a strong man, he was always " a bad sleeper," and under the strain insomnia came on ; his health completely gave way, a slight attack of paralysis supervened, and he had to spend months in the south of Europe. Two years later the same strain recurred, but more severe and more prolonged; yet he slept quite well, and went through it with ease. The sole difference was that he had been induced to take a glass of wine every day. Its effect was immediate ; he slept better and felt better than he had done for years. A little hot food with some stimulant immediately before going to bed is useful in inducing sleep, and persons who are apt to wake in the night and lie awake for hours may obtain relief by the same means. A little light reading, or the recalling of

pleasant experiences, is sometimes a useful way of dis-engaging the mind from oppressive thought on going to bed. Hypnotic drugs, which have greatly multiplied of late years, should only be taken under medical advice. They have their use, but the principle of obtaining sleep by such means is not a sound one. The real end to aim at is the restoration of the natural function, and the sub-stitution of artiiicial sleep, which differs in character and effect, tends rather to prevent than to promote that end.

Like many other morbid conditions, insomnia is more easily prevented than cured. It is really the penalty exacted by E"ature for a long course of systematic de-fiance. When a man's sleeping apparatus is in good working order it may be thrown out of gear for a short time by some great strain, but it will recover in the course of a few days at most, and will not inflict upon him the horrors of insomnia. But when it has been ruined by prolonged interference it stops work alto-gether under the strain. Habits of life .interfere

with it by curtailing the time required for the due fulfilment of the rhythmical cycle of this vital function. It may be said with confidence that in modern town life men habitually sleep too little, and this is even more injurious to them than the other habit of eating too much. They "burn the candle at both ends." They get up in the morning and go to their work, but in the evening instead of going to bed they go out to dinners and parties and theatres and other distractions. Time which should be given to sleep is devoted to something else. A little of it does no great harm, but regular and prolonged interference with the mechanism gradually destroys it. The adaptability of the human organism is great, and no effects may be observed for years ; but Nature is not mocked, and when a special strain comes she manifests her resentment in insomnia. If no such occasion arises, the penalty^ is still exacted in the form of premature death. Thus the time robbed is paid back again. The premature death of hard-working professional and business men, which is so

common a feature of modern life, is probably due more to insufficiency of sleep than to any other cause, though they may never develop actual insomnia. The lesson is the same, namely, the importance of taking sufficient sleep as a regular habit. What constitutes sufficient sleep depends upon the individual. Persons differ so much that it is no more possible to lay down a fixed amount for every one than it is to prescribe a fixed quantity of food. Besides, the requirements of the same person vary under different conditions ; one needs more sleep in cold weather than in hot, in winter than in summer, when tired than when not. The only rule to go by is to have one's sleep out, so as to feel thoroughly refreshed on awakening, as children do. Less than that is insufficient.

Insterburg, a town of Prussia, province of East Prussia, 57 miles by rail east of Konigsberg. It has manufactures of machinery and bricks, iron foundries, flax-spinning mills, bone mills, sawmills, distilleries and breweries, and an active trade in agricultural produce. It is an important railway junction. Population (1885),

20,914; (1900), 27,787.

Instinct. — There is little to add in general to the treatment of this subject by Romanes in the earlier volumes of this Encyclopaedia (ninth edition), but a good deal of interesting work has been done in the way of detailed inquiry into the problems raised by the application of the doctrine of heredity {q.v.) to its explanation, mainly by Lloyd Morgan and Lord Avebury in biology, and by Wundt, W. James, and Stout in psychology. While it is generally conceded that instinct in animals covers "congenital characters," and intelligence "acquired characters," it is frequently difficult to decide how far intelligence modifies instinct or instinct stimulates intelligence. The actual part, too, played by natural selection is disputed, the genesis of instinct being attributed by Wallace to natural selection alone, by Spencer to inherited habit, by Eomanes to both. Lloyd Morgan, the chief authority at the jiresent time, regards the direct transmission of acquired modes of behaviour as non-proven. Heredity, the latter points out (Proc. Boy. Inst, 1899), plays a

double part: —

It provides, through natural selection or otherwise, an outline sketch of relatively definite behaviour, racial in value ; it provides also that necessarily indefinite plasticity which enables an animal to acquire and to utilize experience, and thus to reach adaptation to the circumstances of its individual life. It becomes, therefore, a matter of practical inquiry to determine the proportion which the one kind of hereditary legacy bears to the other. Observation seems to show that those organisms in which the environing conditions bear the most uniform relations to a mode of life that is relatively constant are the ones in which instinct preponderates over intelligent accommodation ; while those in which we see the most varied interaction with complex circumstances show more adaptation of the intelligent type. The growth of individual plasticity of behaviour in race development would seem to be accompanied by a disintegration of the definiteness of instinctive response, natural selection favouring rather the plastic animal capable of indefinitely varied accommodation than the more rigid type, whose adaptations are congenitally defined.

See Lloyd Morgan. Habit and Instinct. London, 1896. —

Eomanes. Natural History of Instinct. London, 1886. — Sir J. LoBBOCK [LoKD Avebuet]. On the Instincts of Animals. 1889. — Marshall. Instinct and Season. New York, 1898. — Mills. Nature of Animal Intelligence. London, 1898.

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IJ^-SURAI^CE.

I. GrENEEAL HiSTOET.

DTJEINGr the years since the article "Insurance" in the ninth edition of this work was written, the practice of insurance has extended with unprecedented rapidity, partly in novel forms. While its several branches, such as life insurance, casualty insurance, and others, have each had an independent and characteristic development, it should be observed that all these together form an institution peculiar to the modern world, the origin and growth of which attest a remarkable change in men's ideas and habits of thought — a change the character and extent of which, if fully traced, would fill an impressive chapter in the history of civilization. Some sketch of

it will fittingly introduce a brief account of the recent growth and present condition of each branch of the business, especially in Great Britain and America.

The simplest and most general conception of insurance is a provision made by a group of persons, each singly in danger of some loss, the incidence of which cannot be foreseen, that when such loss shall occur to any of them it shall be distributed over the whole group. Its essential elements therefore are foresight and co-operation; the former the special distinction of civilized man, the latter the means of social progress. But foresight is possible only in the degree in which the consequences of conduct are assured, i.e., it depends on an ascertained regularity in the forces of nature and the order of society. To the savage, life is a lottery. In hunting, rapine, and war, all his interests are put at hazard. The hopes and fears of the gambler dominate his impulses. As nature is studied and subdued, and as society is developed, the element of chance is slowly eliminated from life. The measure of civilization is the degree in which men rely

on the future, in which foresight guides conduct, and life, ceasing to be a series of hazards, becomes a series of actions planned with the reasonable expectation of definite results. The gambling spirit survives, indeed, often assuming new and refined forms in the most advanced communities, but it is always the foe of civilization. In a progressive society, education, science, invention, the arts of production, with regular government and civil order, steadily work together to narrow the realm of chance and extend that of foresight. But after they have done their best to conquer the forces of nature and regulate human passions, so that achievement shall follow purpose with uniformity, there remain certain events which may disturb all anticipations, and in spite of any man's best wisdom and effort may deprive him of the fruits of his labour. These are mainly of two classes : (1) damage to property by .the great forces of nature,

such as lightning and hail, by the perils of the sea, and by fire ; (2) premature death. A useful life has an economical value. But no skill can make certain its continuance to its normal close, and in each individual case its duration is indeterminate. In the reasonable expectation that it will last until a competence is gained or the family ceases to be dependent, young men marry ; but some will die too soon, and in the aggregate multitudes are left destitute. Both classes of loss are alike, in that they fall on individuals in the mass who are not known beforehand nor selected by any traceable law. But the sufferers are ruined, while the same pecuniary loss, if distributed over the whole number, would be little felt. Wherever the sense of community has existed this has been discerned, and some effort made to act upon it. Thus in feudal Europe it was customary for the houses of vassals to be restored after fire at the cost of the estate. In England in the 17th century the Government practised a method of relief after accidental fires. A¥hen such a loss was proved to- the king in council, the chancellor sent

a king's brief to churches, sheriffs, and justices, asking contributions, and trustees for the sufferers administered the funds collected. But under the last two Stuarts gross frauds resulted, and the system fell into disrepute and disuse. At best, the voluntary relief provided by charity after losses are incurred is but sporadic and irregular. Insurance begins when the liability to loss is recognized as common, and provision is made beforehand to meet it from a common fund. The eflicient organization of communities or groups for this purpose is an essentially modern achievement of social science, and has become one of the chief commercial and moral factors of civilization. But the history of the conception in its formative stages is extremely obscure.

Its first appearance in business life is often sought in the marine loans of the ancient Greeks, fully described by Demosthenes. Money was advanced on a ship or cargo, to be repaid with large interest if the voyage prosper, but not repaid at all if the ship be lost, the rate of interest being made high enough to pay not only

for the use of the capital, but for the risk of losing it. Loans of this character have ever since been common in maritime lands, under the name of bottomry and respondentia bonds. (See below. Marine Insurance.) But the direct insurance of searrisks for a premium paid independently of loans began, as far as is known, in Belgium about A.D. 1300. During the next century the risks of insurance for the usual voyages between London and Continental ports were carefully considered, and customary rates became established. Ordinances and legislation for the regulation of marine insurance grew up, and show that the practice was recognized as a legitimate business. In his address in opening Elizabeth's first Parliament in 1559, Sir Nicholas Bacon said, " Doth not the wise merchant in every adventure of danger give part to have the rest assured?" In 1601 Parliament created a commission to decide disputes under contracts for marine insurance, and the preamble of the Act (43 Eliz. ch. 12) expresses the best thought of the British mind in that day upon the subject. Thus the business

of marine insurance was intelligently and wisely practised three centuries ago. The ratio of losses to voyages, the varying hazards of particular seas and seasons, and the seaworthiness of different classes of vessels, must have been roughly studied to yield a recognized basis for rates. But the underwriters were private persons, actiug independently, so that the insured lacked the benefit of large aggregations of capital to make his contract safe; while the insurer, who took one or a few risks, was without the security of large averages, and might be crushed by an exceptional loss. A partial remedy was gradually reached in London.]Men who had capital to employ in this hazardous business used to meet at fixed hours when shipowners and merchants could nego-tiate with them. The higgling of the open market, in view of all the circumstances of each risk— as the char-acter and condition of the siiip, its crew and cargo, the length and route of the voyage, the season, the current rate of interest and profits— determined the rate of premium ; and when'this obtained general assent, the written agree-

ment was signed by each underwriter for that pai-t of the risk which he tissumed. Towards the end of the 17th century these meetings were held in Lloyd's Coffee-house, history]

and their simple practice gradually grew into the complete and complicated system of marine insurance now general. The underwriters together evolved rules and improved methods, but continued for generations to insure severally, without corporate powers or common responsibility, so that the name Lloyd's became throughout the commercial world the symbol of marine insurance. More recently the name has been adopted in the United States by associa-tions of private or individual underwriters as distinguished from insurance corporations.

Although the underwriters at Lloyd's often considered and assumed other than marine risks, and made contracts some of which were merely wagers on public or private events, there is no record of insurances by them against

fire on land. But fire insurance, it is vaguely known, had previously been practised, in a crude form, in several European cities. In 1635, and again in 1638, citizens of London petitioned Charles I. for a patent of monopoly to insure houses at the rate of one shilling yearly for each £20 of rent, the association to repair or rebuild those burned, to maintain a perpetual fire-watch in the streets, and to pay £200 yearly towards rebuilding St Paul's Cathedral until finished. The attorney-general approved the project, but in the disorders of the kingdom it was forgotten. The Great Fire of 1666 revived interest in the subject, and the discussion of it soon led to definite views and practical measures. In May 1680 a private Fire Office was opened "at the back side of the Eoyal Exchange " to insure houses in London, by assuming the risk of loss to a fixed amount for a fixed premium, namely, 2^ per cent, of the yearly rent for brick houses and 5 per cent, for frame houses, the rent being always assumed to be one-tenth of the value of the fee. The estimates of the promoters are interesting. In the fourteen years

since the Great Fire 750 houses had been burned in London, with an average loss of £200. A fund of £40,000 subscribed as guaranty was to be increased by £20,000 for every 10,000 houses insured, and the interest of the fund alone, therefore, might be expected to meet all losses and leave a surplus. Thus the security was perfect and the promise of profit great. Meagre as was the basis of facts for the calculations, and crude as was the statistical method employed, the insurance offered met a general want, and the business grew rapidly. Within a year a strong demand was heard that the City of London should itself insure the houses of its citizens, and the Common Council voted to do so at lower rates than the Fire Office. But the courts put a speedy end to this movement, holding that the charter conferred on the City no power to transact such business. Thus the socialistic theory that insurance is properly a branch of government is almost as old as the business itself, though it has never found favour or been practically tested on a large scale in Great Britain or America.

The next notable step in the evolution of modern methods was the organization of mutual insurance associations. In 1684 the Friendly Society was organized. Each member paid a small entrance fee for expenses, made a cash deposit as a reserve for emergencies, to be returned at the end of his term, and agreed to meet equitable assessments for current losses. Payments were computed on the assumption that one house in 200 is burned every fifteen years. The rivalry between the proprietary and the mutual systems began at once, and has continued till now. In 1686 "the Fire Office at the back side of the Koyal Exchange" petitioned for a patent of the fire insurance policy, and a monopoly of its issue for thirty-one years. The Friendly Society opposed the grant. The most eminent lawyers for both were heard by the king in council, and on 30th January 1687 King James II. decided the case. No charter was granted, but the Fire Office might continue its business, having a monopoly for one year. Thereafter the Friendly Society might for three months sell policies, but must then suspend for three

months, and so on for alternate quarters. But the Fire Office must pay the ordinance service for its work in extinguishing fires, the amount to be fixed for each fire by the king. This was the first appearance of the plan, so widely prevalent in after years, of imposing on insurance companies the support of fire departments ; that is, of taxing the prudent who insure to protect the reckless who do not.

After 1688 the atmosphere of England was freer, and underwriting was soon practised without special license. In 1704 the societies began to insure household goods and stocks in trade, and the insurance of personal property rapidly became as important as that of buildings. In 1706 the Sun Fire Office was founded, and began to issue policies on both real and personal property in all parts of England. Other associations arose in quick succession, of which the Union Fire Office, dating from 1714, and the Westminster from 1717, still siirvive. Before 1720 both fire and marine insurance had become general in all great centres of trade. But life insurance was as

yet hardly conceived. Sporadic evidences that it was needed, and that men were feeling after it, occur in very early records. It was a medieeval custom to advance to a mariner goods or money, to be restored with large additions, but only in case of safe return; or to contract, for a sum in hand, to ransom him if captured by pirates, or to pay a fixed amount to his family if he were lost. To evade the usury laws life annuities were often sold at a low rate, redeemable for a stipulated sum. Life estates were sold upon some guess at their probable duration ; and leases, especially of Church lands, were made for one, two, or three lives on rude and conventional estimates of the time they would run. Thus there was a commercial and social pressure for some intelligent method of valuing life contingencies. But the direct insurance of life, as a means of reducing the element of chance in human aiJairs, was hardly thought of. Indeed, such contracts were commonly regarded as mere forms of gambling, and were prohibited in France as against good morals.

The earliest known policy of life insurance was made in the Eoyal Exchange, London, 18th June 1583, for £383, 6s. 8d. for twelve months, on the life of William Gibbons. Sixteen underwriters signed it, each severally for his own share, and the premium was 8 per cent. The age of the insured is not referred to, nor was it then considered, ex-cept when far advanced, in fixing the premium. Gibbons died 29th May 1584. The underwriters refused to pay, alleging that twelve months, in law, are twelve times twenty-eight days, and that Gibbons had survived the term. The court, of course, enforced payment. A few instances of similar contracts are found, mostly in judicial records, during the 17th century ; but every such transac-tion was justly regarded as a mere wager, at least on the part of the insurer: It could not be otherwise until the principles of probability and the uniformity of large averages were understood and trusted; that is, until a new science should be created, and its authority estab-lished in the business community. A few great thinkers were pondering the subject, groping for principles which

were profoundly to modify the practical reasoning of after-generations. But their work first obtained wide recognition upon the publication of the Ars Conjectandi, the posthumous treatise of James Bernouilli, in 1713. Meanwhile the social need for insurance continued to express itself in empirical efforts, which at least helped to make clearer the problems to be solved. Thus in 1699 " The Society of Assurance for Widows and Orphans" was

founded in London, a crude form of what is now called an assessment company. Each of 2000 healthy men under fifty-five years of age was to pay 6s. as entrance fee, Is. quarterly for expenses, and 6s. at the death of another member ; and at his own death his estate should receive £600, less 3 per cent. On default in any payment his interest was forfeited. The society lasted about eleven years, and the accounts of its eighth year are preserved, showing the payment of £6200 upon twenty -four claims.

The economic significance of this society lies in its distinct recognition of the principle of association for the distribution of losses. Together with the Friendly Society, it shows that this principle had now been so widely grasped by business men that, when embodied in a practical venture, it found substantial support.

The conception of a corporation as an artificial person to hold property and support obligations uninterrupted by the death of individuals, was found in Roman law and custom. Its first use in modern business enterprise was perhaps the Bank of St George in Genoa, about a.d. 1200, a joint-stock company with transferable shares, whose owners were liable only to the amount of their shares. In England the Crown, itself the chief and type of corporations sole, was the source of chartered rights, and from about 1600 the principle steadily gained recognition, the advantages of incorporation being attested by the successes of the great trading companies. Experience showed that the corporate form was the obvious remedy for the chief difficulties in the practice of insur-

ance. Single risks were but speculative wagers ; a great number must be taken together to obtain a trustworthy average. A larger capital than an average private fortune was demanded as a guaranty, and this capital must not be exposed to the dangers of trade, but set aside for the special purpose. Individual underwriters may die or fail ; only a permanent institution can be trusted in long contracts. Several projects were devised on this basis. Early in the 18th century, indeed, the English Government refused a charter for marine insurance, declaring that corporate insurance was an untried and needless experiment, while private underwriting was satisfactory and sufficient. But in 1720, when two sets of promoters offered £300,000 each for a charter, exclusive of other associations, though not of individuals, to insure marine risks, Parliament chartered the Koyal Exchange and the London Assurance Company with a monopoly to this extent. The business disappointed its projectors at first, and the Government accepted half the price rather than revoke the grant. In 1721 the

companies extended their operations to fire insurance throughout England.

Thus the principle of insurance had now become a distinct part of the common stock of thought in enlightened nations, and gradually, by association with successive new ideas, plans, and methods, was developed into a business or trade, which before the middle of the 18th century already formed an essential element of the social scheme. Most of the modern forms of insurance against the elements were known, and at least crudely practised. Risks were defined, appraised, and roughly classified ; premiums were determined with some regard to experience, and attempts were made to collect, classify, and study the facts. Corporate and private enterprise competed for patronage, mutual and proprietary methods were discussed and tried; disputed contracts were interpreted and enforced by the courts, laying the foundar tions of insurance law. But there was no scientific basis for the business. Premiums were fixed, not by computation from known facts or reasonable assumptions, but by

guess and the higgling of the market. Only the competition of capital checked the extortionate demands of underwriters. The first important steps towards a scientific valuation of hazards were taken in dealing with the class of risks hitherto so much neglected, those which depend upon human mortality. Marine and fire insurance had their origin in the pressure of need. The practice began before a theory existed. Men who must have protection were ready to pay so largely for it that capital was tempted to feel its way by the roughest estimates. But life insurance had its origin in the scientific study of the facts of human mortality, which suggested the possibility of provision against premature death. Both marine and fire insurance became general before there was any intelligent study of the risks by statistical or mathematical methods, nor can it be said that much progress has since been made towards establishing a scientific basis for the valuation of risks in these classes. But life insurance may be said to have been impossible until the theory of probabilities had become a recognized part of the common

stock of ideas.

The value of insurance as an institution cannot be measured by figures. No direct balance-sheet of profit and loss can exhibit its utility. The insurance contract produces no wealth. It represents only expenditure.

If a thousand men insure themselves against any contingency, then, whether or not the dreaded event occurs to any, they will in the aggregate be poorer, as the direct result, by the exact cost of the machinery for effecting it. The distribution of property is changed, its sum is not increased. But the results in the social economy, the substitution of reasonable foresight and confidence for apprehension and the sense of hazard, the large elimination of chance from business and conduct, have a supreme value. The direct contribution of insurance to civilization is made, not in visible wealth, but in the intangible and immeasurable forces of character on which civilization itself is founded. It is pre-eminently a modern institution. Two centuries ago it had begun to influence centres of trade, but the mass of civilized men had no

conception of its meaning. Its general application and popular acceptance began within the last three generations, and its commercial and social importance have multiplied a hundred-fold within living memory. Its development measures and promotes the growth of the spirit of community. It has done more than all gifts of impulsive charity to foster a sense of human brotherhood and of common interests. It has done more than all repressive legislation to destroy the gambling spirit. It is impossible to conceive of our civilization in its full vigour and progressive power without this principle which, in all its varied applications together, unites the fundamental law of practical economy, that he best serves humanity who best serves himself, with the golden rule of religion, "Bear ye one another's burdens."

II. Casualty and Miscellaneous Insurance.

Before proceeding with an account of the standard institutions of fire and life insurance, it is proper to glance at the recent vast extension of casualty insurance, which

has assumed new and varied forms, and to notice certain novel applications of the insurance principle to other special classes of events. The novelty of these enterprises, however, is not in the general idea underlying each of them. In almost every instance in which insurance has been extended, so as successfully to cover new kinds of risks, it will be found that the suggestion is nearly as old as the practice of life insurance. Many more kinds of in-surance than areevennowfounduseful were attemptedmore than a century ago. But no statistical basis then existed for determining the probability of loss from various casual-ties, nor had modern methods of canvassing, accounting,

proving and checking losses, reached the perfection now-recognized as necessary for efiBcieney and safety. The various branches of business which, in distinction from the great standard institutions of life, fire, and marine insurance, are commonly treated in the mass as miscel-

laneous insurance, differ widely in their subjects and methods. The most general of them, and that most widely known, is insurance against personal injury by accidents of every kind. Much has already been done by the companies in collecting and analysing facts, especially from their own experience, so as to determine the average risk of injury and disablement among different classes of men ; and thus progress is steadily made towards a trustworthy basis of rates. But there is as yet no such union of effort among them to combine their resources for such purposes as among the life companies, nor does the subject admit of treatment so exact as that of human mortality. Hence it is impossible to speak of a theory of accident insurance in a scientific sense ; and in its practice premiums and necessary reserves are determined by the trained business judgment of individual managers, guided by successive experiments, rather than by the calculations of actuaries from statistical collections of facts.

The insurance of railway travellers against injury upon

trains was the first form of accident insurance which proved widely acceptable. This is still practised as a special business by several companies, tickets, entitling the purchaser or his family to a fixed compensation in case of his injury or death, being offered for sale with the railway tickets. Another special form of insurance is that against injury while riding a bicycle, often including also the rider's risk of liability for injuring any other person. But the development of insurance against personal injuries, which is most characteristic of the times, is the wholesale insurance of the employer against liability to the employed for accidental injuries sustained in his service. This was first undertaken on a large scale by the "Employers' Liability Assurance Corporation of London," founded for the purpose in 1880, immediately after the passage of the Employers' Liability Act by Parliament, which made e;mployers of labour liable for injuries sustained in their service to an extent unknown to the common law. This company has gradually adapted its methods to the needs of its clients,

and in 1886 extended its agencies beyond the United Kingdom, especially in America. The business has been vigorously prosecuted, and is now carried on by at least ten companies in Great Britain and seven in the United States, while nine new associations were registered in England for this special purpose in 1899. The policies are issued to the owners or operators of mills, mines, factories, railroads, and vessels, to builders and contractors, or other large employers of labour, agreeing to indemnify them for any loss to which they may be subjected, at common law or by statute, in consequence of bodily injuries suffered by any employee while engaged in their service. The insurance company undertakes the investigation and settlement of each claim within the limits prescribed by the policy, and conducts any litigation which may result. The adjustment of damages is made with more economy and skill by the companies than is usually possible for the employer, and the danger of fraudulent claims is largely reduced by methods experience has taught them. The price charged for such

insurance is commonly a small percentage of the aggregate wages paid during the term, fixed in view of the peculiar hazards of the employment. But special forms of collective insurance of a similar kind are issued to cover liability for injuries suffered by casual visitors in theatres, in passenger elevators, or in the neighbourhood of factories or the works of contractors, often for fixed premiums.

The most common form of accident insurance, however, is still represented by the policy which promises the assured a fixed sum in case of death by accident, and a weekly compensation during disability from such a cause. Many policies also specify a sum to be paid for the loss or permanent damage of a member, as an eye, a hand, or foot. A recent extension of the personal accident policy is the addition of some form of health insurance, especially the grant of a weekly sum to the insured during incapacity for work caused by certain named diseases. Fourteen companies practising accident insurance against personal injuries in the United States

reported for 1899 upon this class of policies aggregate premium receipts of 1 5,237,363, and losses paid $2,325,399. Besides the business of these stock companies, with fixed premiums, there are more than sixty associations in the United States organized for insurance against personal injury by accident, and relying upon the assessment of members to pay claims as they mature. Most of these are local and ephemeral ; but a number of them, formed by men engaged in common pursuits, for mutual protection, have attained importance. Such are especially some of the commercial travellers' and the railway employees' accident associations, and a few connected with the Masonic or similar beneficiary orders. Eighteen of these societies reported the payment to members in 1899 of $874,084 in claims.

Another large class of casualty insurances applies to various forms of damage to property. The branch which seems most to have attracted promoters is the insurance of plate glass against fracture, which is carried on by at least twenty -two companies in Great Britain, and is the

only business of many of them. Although twelve of these companies collected in 1898 less than £200 each in premiums, yet six new associations for this exclusive purpose were registered in England in 1899. In the United States there are five corporations which insure plate glass alone, with an aggregate capital of $650,000, annual premium receipts (1899) of $978,129, and risks in force of about $46,000,000. Seven other casualty companies issue also policies on glass to the amount of $18,000,000, for premiums of nearly $400,000. This business is not conducted in any other country upon so large a scale, but is attracting more attention than heretofore in Europe, and especially in Great Britain.

There are at least four companies in the United Kingdom and five in America which make the insurance against damage by the explosion of steam boilers a special feature of their work, but by-far the greater part of the business is transacted by one company in each country. The service rendered is one of special skill and vigilance, extending far beyond the contract for indemnity. The company, in fact, employs inspectors of the highest scientific

qualifications, who assume constant supervision of the machinery, and require its structure and conduct to be freed from elements of danger. It is prevention rather than compensation that is sought, and the outlay made by the companies is mainly for inspection and control, not for losses. It is usual to promise in a policy upon a steam boiler some compensation also for any personal injury which may result from an explosion.

Two small companies in England have insurance against burglary for their principal purpose, while at least six of the British accident companies and three in America issue policies of this kind, but most of the business is in the hands of one company. It is an experiment of the last few years, and the risks taken are for moderate sums, |50,000 as a maximum, at premiums determined in each case by an estimate of the danger founded on a study of all the circumstances. There is no information published concerning this branch of insurance in other countries, but the aggregate premiums paid in the United States in 1899 upon $40,000,000 of property were almost exactly $300,000, and the losses were $100,000. It is believed by many that there is an important future for burglary insurance, in connexion with improved methods

of protection, by safes, automatic alarms, and constant inspec-

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tion, for dwelling-houses, shops, and offices, which are often unoccupied.

Insurance against damage to growing crops by hail is practised in several parts of Europe and America, commonly by small local associations on the mutual plan, or as an incident to the business of fire insurance. No statistics can be obtained of these operations. The same is true of the insurance against the ravages of tornadoes, and against sickness and accident in domestic animals.

A wholly distinct business, commonly classed as a branch of insurance, has recently grown to great importance, that of guaran-teeing the fulfilment of contracts and of indemnifying employers against defalcations in their service. The bond of a corporation of large capital is widely taking the place which personal surety has filled in connexion with undertakings on contract, and with offices and occupations of trust, both in public and in px-ivate life. Fi-delity insurance is carried on by a few of the general casualty com-

panies, but as the practice of it extends it becomes more and more the work of special institutions organized for this purpose, alone. About fifteen of these in the United States are corporations of excellent standing, with aggregate paid-up capital of more than $15,000,000 and surplus funds of nearly $10,000,000 more, and collecting in premiums about |4,000,000 annually upon bonds and guaranties amounting to more than $1,250,000,000. The business has been almost wholly created within the last fifteen years. It has had similar if not equal development in Great Britain and in several other countries, but it is only in the United States that the statistics of it are officially collected.

The insurance of titles to real property has also become widely extended within a few years, and is conducted in the United States almost wholly by fourteen corporations, with an aggregate capital of about $5,300,000. Their business, however, has indemnity for losses as but an incidental purpose. The principal aim is to furnish a final and responsible assurance that the title is flawless. Several of these companies possess elaborate and expensive collections of records, covering the sources of title for cities or large districts ; all of them employ expert ability of a high order ; and

when they approve a title as perfect, the purchaser or lender of money may receive, with the approval, a guaranty against loss in accepting it, whicli private examiners or counsel cannot give. Titles are insured also in other countries, but the business has nowhere else attained such importance, nor do the institutions transacting it make full and separate statements of its accounts. Some conception of the volume of business now transacted in the several branches of casualty insurance may be obtained from the following summary of the latest published returns in the principal countries. It must, however, be observed that the aggregates given are those of the most recent reports of established corporations, and are not of the same date, those in the United States covering the business of 1899, while those in other countries are nearly all of 1898 ; nor are they complete, since many companies have published no statements, while the business of local mutual and assessment associations is not included. Further, no account is made of the premiums and losses of title insurance and mortgage guarantee companies. The summary is in every case reduced to pounds sterling : —

Premiums received and Losses paid Annually by Casualty and

Fidelity Companies.

United States and Canada .

Great Britain ...

Germany

France

Switzerland

Austria

Russia

Belgium and Holland . .

Denmark, Sweden, & Norway

Italy

No. of

Cos.

49

12

5

16

7

8

7

2

Premium

Receipts.

£4,476,096

3,129,006

1,811,929

1,158,027

1,059,110

557,481

206,941

187,526

106,214

56,640

Losses Paid.

£1,791,913

1,736,070

926,195

688,611

596,716

573,142

131,.S40

75,831

71,134

35,994

III. PlEB In.SUEANCB.

The growth of the business of fire insurance since 1880 or thereabouts has been commensurate with the increase of wealth and of commercial activity in the foremost nations, while the practice of it has also become general in countries in which it was till of late little linown.

The statistics of the subject have in recent years become far more full and more accessible than formerly ; partly because many Governments require detailed reports of resources, receipts, and expenditures from all companies permitted to establish agencies within their jurisdiction, and periodically publish summaries of the returns ; but also largely because the companies seek the widest publicity as their best means of advertising. It is to be regretted, however, that there is as yet no uniformity of method in these returns, such as would make it possible

to combine or to compare the results with entire confi-
dence; while somS of the most important elements of
the subject are not suificiently illustrated for the student
in the published statistics. Those of the companies of
Europe, including Great Britain, are defective in that
they commonly give only aggregates of each branch of
receipts, expenditures, and funds, without distinguishing
the business done in different countries. Many compa-
nies of the United Kingdom transact business throughout
a great part of the world, and there is no means of deter-
mining how much of their receipts or their losses must
be referred to Great Britain. Further, they fail to give
classified amounts at risk, so that it is impossible to
estimate with any confidence the total sum for which
any kind of property, such as dwellings, factories, house-
hold goods, stocks of merchandise, or wares in transit, is
insured. The returns of the London Fire Brigade, how-
ever, which is in part maintained by regular contributions
from the fire underwriters at the rate of £36 for each
£1,000,000 of risks assumed by them within the metro-

politan district, continue to exhibit a regular growth.

The aggregate amount insured in the metropolis was

reported as follows : —

In 1882

. £696,715,141

1886

. 741,109,316

1890

. 806,131,385

1894

. 845,998,895

1898

. 909,962,574

It appears probable that the rate of increase here shown.

is not greater than the actual growth of insurable property

during the same period, so that it may be reasonably

supposed that the custom of protecting all exposed pro-

perty by insurance was already general in London many

years ago. But the transactions of the British fire offices

have grown much more rapidly, and indicate that, outside

of the metropolitan district, the practice of insurance has extended greatly. Thus for 1898 the net premium receipts of fifty-eight such companies were reported as £19,346,666, and the losses paid by them in the year as £11,646,080. The tendency to concentrate the business in the control of large capital and experience is shown by the fact that more than £18,600,000 of the premiums were received, and more than £11,000,000 of the losses were paid, by thirty-one companies. There were at the same time thirty-eight corporations of foreign countries with agencies for fire insurance in the United Kingdom,, but many of these do but a nominal amount of business, and twenty-three of them are exclusively or chiefly engaged in re-insurance. This tendency has been a marked feature in the recent history of fire insurance everywhere. The companies which are now in the field are the survivors of tenfold as many projected enterprises which have failed. The records of about two thousand organizations-for the purpose, in America alone, which have undertaken the work and disappeared within fifty years, show the

dangers to which inadequate skill and capital are exposed. But a small proportion of these failures were the direct, result of sweeping disasters, though about seventy of them followed the memorable fires in Chicago and Boston in 1871 and 1872. Many more, nearly one-half of the whole, have followed a short career, in which the help-lessness of inexperience to compete with long training and complete organization was demonstrated. Many hundreds of these projects were mere speculations or even frauds from the beginning; and the better education of the-community at large in the principles and methods of fike]

insurance has been the chief agent in checking such enterprises, aided by the stringent legislation of several countries and of the states in America, and by the criti-cism of the press.

The difficulty of establishing a new joint-stock fire insurance company is far greater in the present highly perfected state of the

business than formerly, and constantly increases. The reports of the insurance departments in the United States show that less than one-eighth of the premiums are now collected by companies founded since 1880 ; and, except in districts remote from the principal financial centres, or mutual associations for special classes of hazards, new ones are not often formed. In Great Britain a considerable number of new corporations are registered every year, with fire insurance among their professed objects (at least twelve in 1899), but almost always in connexion with some forms of casualty insurance, which appear to be practically the purpose in view. The reports of the fire business in the United Kingdom for recent years, as collected in Bourne^s Manual, show that less than one-fourteenth of it is done by companies organized since 1870. Though new companies have been registered, usually several every year, the number actually transacting successful business has not increased since 1880. Of the sixty British com-panies now recognized, the twelve smallest together collect but 1 per cent, of the premiums received by one of the largest, and the tendency to concentrate the business seems progressive. Tliese facts are explained by the necessity of a vast basis of

average and of a large capital for security, and still more by the increasing demand for a thoroughly trained and organized body of agents, able to protect their companies from fraud and imposition, and at the same time to compete for public patronage. The competition among the companies is extremely sharp, and tends to break down such of their number as are deficient in any of these qualifications.

The Mutual principle has a strong attraction for many insurers and projectors. The conditions under which it can succeed, in the practical conduct of the business, have been put to severe tests in recent years. When a large number of pieces of property, so distributed that a single fire cannot destroy a considerable proportion of the whole, are yet owned and controlled by persons who can fully trust one another, both for financial responsibility and for good faith, there may be no need of a large capital in hand, nor of much of the costly machinery re-

^stem

for the assessment on all the property of losses as they occur, at rates fixed by the estimated exposure,

may form a safe basis for an association. The fixed payments may be limited to necessary expenses, with a moderate reserve for emergencies, all excess of collections to be returned to the insured. This simple conception of an insurance associ,ation, with such modifications as experience indicates, has been accepted for a time as ideal in almost every civilized community, and attempts are continually made to realize it, but in the vast majority of instances with complete failure as the result. Like every other product of human skill, insurance is, for the most part, best supplied to the market by those who make it their calling to produce it for gain. But while the mutual plan has proved poorly adapted to the general service of the commercial world, so that scores of companies founded upon it disappear every year, and the number of such companies is far less than it was many years ago, yet in some communities, and especially among the owners of certain classes of property, it has achieved great and apparently permanent success. This is particularly true of manufacturing districts, in which

numbers of mills and factories are exposed to peculiar danger of fire by the nature of their own operations. The best safeguard they can have is by employing great skill in the construction, arrangement, and conduct of their works, placing them for this purpose under expert supervision, trained and organized to apply every device for the diminution of the risk. A group of such properties, associated for the ~~prevention of loss, is naturally stimu~~ lated to highest efficiency when the whole group undertakes to bear all losses which are not prevented, and thus every member has a strong interest in making the protection complete. It is in associations of this character that the mutual plan of fire insurance has rendered its greatest services, and regulations for construction and management devised by such companies have in several instances become recognized standards for the classification and valuation of similar risks everywhere. The mutual plan has been widely adopted also in local associations for the insurance of dwellings and farm improvements, where the individual risks are small, and where

technical classification and special safeguards against fraud are not considered necessary, often with the result of affording satisfactory protection at low rates. But the ratio of this part of the business to that conducted by joint-stock companies diminishes from year to year, even in the agricultural and rural districts of the United States. According to the reports of the insurance departments of the States, as summarized in the Spectator Company's Year-Book, more than half of the cash premiums of mutual insurance companies are collected in the two manufacturing states of Massachusetts and Rhode Island.

The criticism of the mutual plan in the article on Fire Insurance by Mr M'Candlish in Ency. Brit., vol. xiii. p. 163, has been continuously justified by experience in Great Britain, where this system has failed to win a high degree of public confidence. It is also confirmed by the almost exclusive employment of the joint-stock plan in France, Belgium, Holland, Russia, and Norway down to the present time. But it must be qualified by observing that, under the fostering influence of the national and municipal

governments, the mutual plan has reached an important development in the Austrian Empire, Germany, Switzerland, and Sweden. In all these countries, indeed, corporate enterprise on a large scale, in every branch of business, is of comparatively recent growth, and mutual fire insurance was a familiar practice long before joint-stock companies entered upon this field of activity. The tendency in the large cities and commercial centres is to throw new insurances into the business corporations, while yet the time-honoured mutual associations retain their standard character and customary clientage. But in these countries the mutual plan has an established place in the confidence of the rural population, who are generally strongly prejudiced against moneyed corporations. This is especially true of the cantons in Switzerland and certain districts in the Austrian Empire, where fire insurance is administered by the local governments in connexion with a minute police supervision of the construction of buildings and of other conditions affecting the risk. From the published returns of the companies and the authorities, as collected for the Post Magazine Almanack (1900), it would appear that of all the fire insurance premiums paid in Switzerland, nearly 54 per cent, is collected by

the mutual associations and the cantonal authorities ; while in Italy 37 per cent., in Germany 27 per cent., in Sweden 27 per cent., and in the Austro-Hungarian Empire 20 per cent, go to mutual companies.

*The earliest plan of insurance which was successful as a business was that practised at Lloyd's Coffee-house in London (fully described in Ency. Brit., vol. xiv. 741), and there applied almost exclusively to marine risks. Although the association known as Lloyds has been for generations a strong financial institu-tion, with every modern safeguard, and since "■" *' 1871 has been a chartered corporation with large funds, yet its name has become accepted as the symbol of the primitive practice of combined underwriting by individ-uals, each upon his own credit, for a share of the risk, and without common liability. A few associations on this general principle were known to exist in America, and to issue fire policies on a small scale, before 1892, but chiefly for mutual insurance. In that year, in a general revision of the insurance laws of New York, such associations*

already in existence were expressly exempted from all

its provisions. Speculators at once discerned an oppor-

tunity. If a company by omitting to take corporate

form could carry on the business free from all restrictions

and burden of state supervision, it would compete at great

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advantage with the insurance corporations. While the

new law was in prospect there was time to take action ;

and upon its passage there suddenly appeared a multi-

tude of " organizations " claiming the exemption as

Lloyds, or associations of individual underwriters, and

offering fire policies at rates materially lower than those

of the joint-stock companies. Each of these was repre-

sented and managed by an attorney for the subscribers,

supposed to have power to bind them severally to the

amount of their subscriptions. The standard policy pre-

scribed by law in New York was issued, with a clause

making tlie liability several only, and fixing the amount.

The Lloyds entered the market with the zeal and prestige of a new idea and a great name, and they grew rapidly in number and in business, but made no reports. Extending their agencies into other states, they occasioned much litigation concerning their legal existence and rights, and some rash and inharmonious legislation. But several attempts to establish similar Lloyds in other places failed. Experience soon showed that it was impossible to enforce claims in the courts, when the liability was distributed among many, without excessive expense and delay, even when all the subscribers were solvent, while a few good names, however useful in canvassing, were no guarantee of the responsibility of unknown associates. In 1896 the executiTC and legal authorities of New York assumed a hostile attitude towards speculative schemes of this class, and indictments were found against a number of promoters for falsely antedating constituent agreements. The bubble burst suddenly, and within three years more than one hundred of the Lloyds disappeared. A few reinsured their risks

or were merged in permanent companies, but the mass of them proved to have no substance. Four or five only of the best continue to issue fire policies within a narrow and special circle, but as a group they no longer compete for general business.

The Tany system, described in the earlier volumes of the Encyclopaedia Britannica (9th ed.), has steadily developed in minuteness of classification and in adaptation to wider experience, as well as to the changes in the character of many classes of risks by improvements in building and by the introduction of new kinds of goods and machinery. But the principles there explained are still recognized. The estimates of risk and the determination of premiums are largely governed by individual opinion and by competition, no amount of experience furnishing a Tariff statistical basis on which trustworthy predic-

figs^” ‘ tions of average loss can be made. The irregularities and fluctuations in the extent of destruction by fire in different districts and periods of time continue to be great and incalculable, and risks can

only be valued, within limits which render the business safe, by making use of the largest available basis of average drawn from the experience of many companies and many communities. Hence it is only by constant co-operation among insuring institutions in the exchange and combination of their observations that justice can be done to them and to the public. The proper extent of this co-operation is easily attained where the business is free from all restrictions except those of the common law, as in Great Britain, and the competition of capital for profits is keen enough to keep the rates within reasonable limits. But in countries in which the Government regulates the business in a more paternal spirit, and meddles with all its details for the avowed purpose of securing the safest and best public service, many difficulties arise. This is increasingly the case in several of the nations of Europe, notably in Austria, Switzerland, and Germany. But it is in the several states of the United States that the Government supervision of insurance has most interfered with and modified the natural development of the business.

In recent years, beginning with 1885, sixteen of these states have enacted legislation, dictated by the growing jealousy of corporate powers and privileges, forjoidding fire insurance companies or their agents to combine in any form for the determination of rates. Companies have often been indicted, fined, and deprived of authority to issue policies because of membership in associations for the purely scientific purpose of ascertaining their average experience. The courts have frequently narrowed in their interpretations the sweeping intent of such laws, but have generally sustained them as within the power of the legislature, and at the present time there is an overwhelming public sentiment in large sections of the country arrayed against every semblance of union or consultation among the companies upon the basis of their business. In several instances all the important insurance companies have withdrawn their agencies at once from particular states, and the business community has been sorely distressed for want of their protection. But the popular prejudice has not

yielded to its demand, and the companies have never been able to maintain their own position with unanimity, the temptation to secure a vast business upon any terms being always too strong for some of them to resist.

This form of legislation has beyond dispute increased the cost of insurance to the people, while it has embarrassed and disturbed the regular work of the companies. But it is a favourite subject among politicians of appeal to popular prejudice, and is likely to continue so until its uselessness and injurious effects become understood by the mass of insurers.

Another pernicious tendency of popular legislation is found in the Valued Policy laws, the first of which was adopted by Wisconsin in 1874, providing that when any insured building is wholly destroyed by fire the amount of the policy shall be conclusively taken as the amount of the loss. This principle, with various modifications and extensions, has now become law in twenty states of the Union, though in many of them its enactment has been vigorously resisted by the executive

Government ; several governors have vetoed such Bills, while most of the supervising officers have had the intelligence to disapprove them. The provision is regarded by all insurance authorities as highly dangerous, inviting over-insurance and incendiarism ; and there is no doubt that it has this tendency in many instances. But the statistics available, while showing that in general the rate of loss has increased where such laws are in force, do not demonstrate any such wide and ruinous stimulation of fraudulent practices as has been apprehended by thoughtful critics. The actual result is commonly to throw upon the insurer the responsibility for providing in advance against over-insurance by minute surveys and, in special cases, for continual watchfulness against depreciation. Like all other interference of Government with private contract, however, it has a marked effect in increasing the difficulty and expense of business transactions.

The direction in which fire insurance as a social institution calls most pressingly for improvement is the exten-

sion of the principle of co-insurance. The importance of this can only be understood by remembering that the aggregate losses of the community by fire are chiefly made up of innumerable small fires, Need of which destroy but a portion of the particular Z'cef"" risk exposed, and not of sweeping conflagra- tions. Thus the fire patrol of New York, which surveys with extreme care every loss incurred in that city, reports the following summary of all losses during 1895-99, with the amount of insurance in force upon mee]

INSUKANCE

513

the buildings in which the fires occurred and upon their contents : —

Buildings.

Year.

Insurance.

Loss.

Eatio

Loss to Insurance.

1895

1896

1897

1898

1899

119,954,269

24,753,499

25,598,474

39,326,676

43,021,638

$1,063,328

1,015,187

801,694

1,382,553

2,282,538

•0533

•0410

•0315

•0351

■0530

Contents.

Year.

Insurance.

Loss.

Eatio

Loss to Insurance.

1895

1896

1897

1898

1899

$10,782,646

14,864,703

12,133,154

13,724,161

32,013,617

$2,.S71,570

2,736,358

2,208,997

2,765,087

4,899,229

•2199

•1840

•1820

•2014

•1530

The report for 1899 covers 6449 fires, of which twenty-two resulted each in a loss to the insurers of f 50,000 or more, the average being $180,000 ; while for the remaining 6427 fires the companies paid an average loss of f 496.

• There are few districts in which records so complete are kept, but the experience of every company confirms the general truth, that the number of fires in which a building is totally destroyed, or in which the loss amounts to the greater part of the property exposed under the same risk, is comparatively very small. It may be asserted with confidence that, in the grand aggregate of the business, much more than three-fourths of the loss occurs in fires in which less than one-tenth of the insurable value at risk is

destroyed. The practical result is obvious. If fires destroy a million of dollars' worth in property insured for its full value, and a million's worth more in property insured for one-tenth of its value, the insurers will pay $1,000,000 upon the first group and more than $750,000 upon the second. But if all the insurance is taken at the same rate the insurers will have received premiums ten times as great on the former group as upon the latter. This rough illustration, which might be • indefinitely extended, shows' that in an equitable adjustment of rates the amount insured as compared with the value exposed is a prime element, and that premiums might justly form a scale, highest on the smallest fractions of value, and diminishing rapidly as the percentage of insurance increases. Such a scale is, however, impracticable for many reasons, apart from the endless complications which, even if it could be constructed, it would introduce into the classification of risks. Any scientific plan of insurance, therefore, must provide another method for maintaining the proportion between amounts of premiums paid and

the share in its benefits obtained for them. This is the purpose of what are generally called average or co-insurance clauses. The principle is, that when a proper rate for a class of risks is found, then the insured may protect at that rate any percentage of such a risk, and in case of fire shall be indemnified for the same percentage of his loss. When once clearly grasped, this principle largely simplifies and rectifies the business. It is in universal use in marine insurance under the name of "average," and is there recognized as indispensable. It is embodied in all fire policies in France, Germany, and several other countries of Europe, and in 1826 was made compulsory in Great Britain by law in all "floating policies," those, that is, which cover stocks of goods distributed in several places and in fluctuating amounts. But it has not yet become general in Great Britain or America, although every writer of authority on the subject, and every practical underwriter of large experience, approves it. Systematic attempts have been made since about 1892 to extend its application in the United States with much success,

but they have been met by strong opposition, which shows a widespread misunderstanding of its true bearing. The co-insurance clause, indeed, which has been generally approved by the American associations of underwriters, and applied in the great commercial cities, is less sweeping than the parallel agreements used in France and Germany. The latter regard the insured owner as self-insurer for the entire value at risk not covered by the policy, and grant indemnity only for that fraction of the loss which the amount insured bears to the whole amount exposed. The American clause is less logical, commonly providing that : " If at the time of fire the whole amount of insurance on the property covered by this policy shall be less than 80 per cent, of the actual cash value thereof, this company shall … be liable only for such portion of such loss or damage as the amount insured by this policy shall bear to the said 80 per cent., of the actual cash value of such property." But this limitation of the basis of co-insurance average to 80 per cent, of the total value is in perfect harmony with the conservative policy

which seeks in all cases to prevent over-insurance. The most serious danger to which the entire system is open is that a fire may promise profit to the insured. To avoid this, it is a small enough margin to exclude from protection by the policy one-fifth of the estimated value, and to require the owner to assume that proportion of the risk. It is therefore reasonable not to require in any case a larger share than four-fifths to be covered, and not to press the co-insurance principle so far as to offer a differential advantage to those who insure above this limit. Thus, for practical purposes, and in the general mass of business, the 80 per cent, clause may be accepted as approximately the best application of the principle. It makes possible substantial equity in distributing the cost, while it does not interfere with proper safeguards against over-insurance. The cordial support of the mercantile community in the great cities, and of the most intelligent state officers, has been given to it.

A popular outcry has, however, arisen against all forms of co-insurance, on the superficial and mistaken assumption

that in every case the principal sum named in the policy measures the insurance paid for by the premium ; and that any limitation upon it must be a wrong to the insured, for the emolument of the insurance corporation. No less than ten states have passed laws prohibiting the clause within their jurisdiction, though Maine in 1895, after a trial of two years, repealed the prohibition. The law of Tennessee, a typical form, is as follows : " Insurance companies shall pay their policy-holders the full amount of loss sustained upon property insured by them, provided said amount of loss does not exceed the amount of insurance expressed in the policy, and all stipulations in such policies to the contrary are and shall be null and void " (except in caseof insurance upon eottonin bales). In several states the use of the co-insurance clause is made a penal offence. It is an interesting fact, however, that while this principle, whenever it has been generally applied, has led not only to a fairer equalization of premium rates, but, on the whole, to a marked reduction of them, the laws in question have deprived the people adopting them of the re-

sulting benefit. In the year 1899 the average premium rate upon all fire risks written in the states in which co-insur-ance was wholly or partly prohibited was something more than $1.20 per f 1000, while in the rest of the country, where the clause was permitted and to a large extent used, the rate was but 96 cents per $1000. The marked difference, which tends to increase, is a perpetual object-lesson which must in the end appeal strongly to the popular intelligence. The varying attitude of several civilized Governments towards the institution of insurance has found significant

[fiee

expression in their tax laws. In Great Britain a stamp duty of 6d. was imposed in 1694 upon ” every piece of vellum or parchment or sheet of paper upon which any policy of insurance should be engrossed or IVinsaf- ‘^“tten,” and was doubled in 1698. It was aace. ‘ further increased (reaching 3s. lOd. per policy

in 1713) and varied by many subsequent Acts, under some of which the percentage duty on fire insurance was also made payable by stamps upon policies. But in 1865 the stamp tax was finally reduced to the nominal sum of Id. upon each policy. A far heavier burden, however, was imposed uponinsurers by the measure of Lord North in 1782, charging all fire insurances in force with an annual duty of Is. 6d. for every £100 insured. In 1815 the general rate was made 3s. per £100, but was collected once for all upon the policy when issued ; and it so remained until reductions began in 1864. The duty was wholly abolished in 1869. The revenue from this source reached its highest point in 1863, when it was £1,714,622, presumably representing insurances effected in that year to the amount of £1,143,081,333. There are no data for determining the amount of premium receipts or of losses realized on the same volume of insurance ; but the tax was recognized by economists as well as by all parties to the policy contracts as an excessive burden. In many instances it more than doubled the

cost of insurance. Its effect in discouraging the prudent custom of insuring against fire was very serious, and after its abolition this custom extended so rapidly that it soon became, and continues, practically universal- in Great Britain. Upon the continent of Europe fire insurance is generally taxed quite heavily ; most so in Trance, where the direct duties on the premiums, together with the registry and stamp taxes paid by the companies, have been estimated to add one-fourth, or perhaps one-third, to the cost of insurance. In the United States the com-panies are taxed, each by the state in which it is domiciled, upon their real estate, and often upon their capital, surplus, or profits, and are required in other states to pay fees to the insurance departments, and commonly an excise of from one to two and a half per cent, of their premiums. An elaborate table is prepared each year by a committee of the National Board of Fire Underwriters, showing the aggregate amount of taxes paid by the companies operat-ing in New York in comparison with their receipts and profits. The statement received and published by the

Board in 1900 contained the following : —

Tor the Tear

For Twelve Years

1899.

1888-99.

Premiums (fire and marine)

$134,450,639

$1,425,929,631

Losses paid (fire and marine) .

91,031,677

856,978,494

Expenses

52,849,129

517,667,238

Increase of liability (unearned

premiums, &o.)

8,998,526

59,104,388

Net loss in the last year .

18,428,693

...

Net profit in twelve years .

7,820,489

Amount of taxes paid

4,495,332

35,984,081

Taxes were of premiums .

3^34 %

2-52 %

Taxes were of premiums, less

losses

10-35 %

6-32 %

In qualification of this statement, it may be said that the

reported expenses appear to include taxes, and that the

additions charged to liability are to some extent theoretical

and flexible. It also appears from the state reports that

upon the entire capital and net surplus of $191,000,000

employed in the business in the United States by 316

joint -stock companies, dividends to the amount of

$8,000,000, or 4-2 per cent., were paid in 1899 to share-
holders. Nevertheless it is true that competition among the
companies, together with unfriendly legislation, has re-
duced the profit upon their aggregate capital near the van-
ishing point, and that the taxes, the average rate of which in-
creased 50 per cent, within the period 1891-99, are heavier
in many states than can be justified by public policy or by
the analogy of other corporate interests. The true prin-
ciple, doubtless, is that while the capital employed in insur-
ance for gain ought to contribute to the state the same share
of its profits as other capital, yet the premiums, agencies,
policies, and entire machinery representing only losses and
providing for their distribution, should be exempted, as
far as the necessities of the public treasury permit.
One aspect of the taxation of fire insurance is of especial in-
terest, namely, the very general disposition of legislatures and muni-
cipal authorities to impose upon the underwriters the cost of fire
departments. The systematic prevention and extinguishment of
fires are everywhere assumed to be proper work for the community
at large, and are commonly assigned to a special branch of the local

government. But the first license granted by the Crown to issue insurance policies in London in 1687 was conditioned upon regular contributions by the authorities to support the king's gunners as a fire brigade, and in the public mind the privilege of insuring the prudent has ever since been vaguely associated with the duty of guarding the property of the whole community. The voluntary support of fire patrols by the companies in London, New York, and other cities has done much to promote this view ; and a substantial part of the taxes paid upon fire policies in the United States is levied for the support of fire departments, the pay and pensions of firemen, and similar purposes. The tendency to increase such taxes, under the pretext that the protection afforded is for the special benefit of the companies, is strong in some of the states ; though it would be equally rational to compel life insurance companies to maintain general hospitals for the sick.

The most complete statistics of the fire insurance business collected in any country are those presented in the United States to the National Board of Fire Underwriters at each annual meeting. The following table is a summary of part of the information submitted stausti

by the committee on statistics, 10th May 1900,

giving the amount of fire risks insured in the United

States, premiums received for them, and losses paid upon

them, by all joint-stock fire insurance compajiies for the

years 1897, 1898, and 1899 :—

Fire Insurance in the United States. Joint-Stock Companies.

Fire Eisks

Assumed.

Fire

Premiums

Received.

Fire

Losses

Paid.

Is

o

c—

So

o

eg

1897

1898

1899

American Cos. 238

Foreign Cos. 29

AU Cos. 262

American Cos. 226

Foreign Ooa. 82

All Cos. 258

American Cos. 218

Foreign Cos. 36

AU Cos. 253

i

10,829,475,852

5,463,483,991

16,292,909,843

11,897,206,098

5,924,876,178

17,822,081,271

12,261,299,499

6,087,670,275

18,388,869,774

%

91,527,779

41,072,624

182,600,408

90,071,290

40,883,900

130,410,190

98,577,169

42,058,472

136,585,641

»

44,210,383

20,592,681

64,808,064

50,666,461

24,026,856

74,681,817

69,119,018

29,865,014

88,984,082

•

■S452

•7518

-8139

-7903

-6808

■7528

•7688

■7057

-7445

%

■4082

■8769

■3977

•4445

•4055

■4311

■4826

■4906

■4852

%

■4880

■5014

■4S»T

■5624

■59.56

■5726

■681S

■6975

■6617

These returns do not include mutual companies. The compilers of the Iiisurance Year-Book, however, have obtained from the several state departments of insurance the reports of all companies made to them of the business done within each state ; and from these it appears that in 1899, 160 mutual companies assumed fire risks to the amount of $1,119,772,848. Many small local associations have made no returns, but their operations are too limited

materially to affect the aggregate. It is noteworthy that while mutual companies transact less than 6 per cent, of the business of the whole country, yet in the state of Rhode Island, a densely peopled manufacturing community, they have more than 78 per cent., and in Massachusetts nearly 24 per cent. ; and that, while less than one-ninth of the insured property of the United States is situated in these two states, they contain nearly two-thirds of that which is insured by mutual associations. The fire insurance business of foreign companies in the United States was comparatively small until 1870. Four strong British fike]

corporations were then in the field, and their transactions amounted to less than 9 per cent, of the entire joint-stock business. But their success attracted others in rapid succession, especially from Great Britain and from Germany, and in 1880, 19 foreign companies assumed 23-7 per cent, of all the risks reported to the National Board ; in 1889, 23 such companies took 30-3 per cent. ;

and in 1899, 35 such companies took 33-2 per cent. The distribution of the business among them is not given by the Board tables, but can be gathered from the reports of the American branches to the insurance departments of the states, which are summarized in the Spectator Company's Year-Books. It appears from these that of 39 branches of foreign companies in the United States in 1899 —

Collected In Premiums.

24 British . .?35,266,610

10 German . 5,540,504

2 Canadian. 2,754,292

Collected in Premiums.

1 Swiss . $786,158

1 Swedish . 435,126

1 Dutch . 406,098

In the United Kingdom the statistics of fire insurance are less accessible and less complete, no ofSeial returns or records being made of the local distribution of the property insured, while the published accounts of the companies are not suflBlciently uniform and detailed to make a trustworthy summary of the entire business possible.

Much of it is done by foreign companies, of whose British business we have no separate statement. The following statement of the revenue accounts of 58 British companies insuring against fire shows the aggregate premium receipts and payments for losses during 1898 ; and of 17 of them, which receive 70 per cent, of the premiums and pay about 70 per cent, of the losses, the total amount of insurance written in 1899 and of risks in force at the end of that year. Assuming that the remaining companies have a similar average rate of premium and of loss, the aggregate of the business of the British companies will be as found in this table : — •

Fire Insurance in the United Kingdom. British Companies.

Premiums received last Fiscal Tear.

Losses paid last Fiscal Tear.

Percent-

age Lossto

Premium.

Estimated

Eisks written

in 1899.

Estimated

Eisks in Force

Deo. 31, 1899.

58 Com-

panies .

£19,552,065

£11,971,863

61-28

£6,060,000,000

£7,100,000,000

These sums include business done by many of the companies in all parts of the world, and while they serve to indicate the volume of their transactions, they are no index to the value of property insured in Great Britain.

In the Dominion of Canada the insurance companies make detailed reports to the Government Bureau, and the statistics of the business are full and accurate. There were in 1900 seven Canadian companies, twenty-one British, and nine from the United States, takirig fire risks in Canada; and the comparative share of each class, and its recent growth, are shown by the following statement of capital em-ployed, and of risks 5,ssumed and in force, for the calendar years 1895 and 1899. The aggregates may be accepted as fairly representing the entire business in the Dominion : —

Fire Insurance Business in Canada.

No. of

Cos.

Tear ending 31st December 1895. 1

Funds.

Eisks written.

Eisks in Force.

Canadian Cos.

British ,,

U.S.

5

20

7

14,587,0651

11,784,712 2

1,212,822 3

$127,869,652

445,816,220

98,936,452

$143,522,252

565,683,862

117,978,254

Total . .

32

$17,584,599

1672,622,324

$827,184,368

No. of

Cos.

Tear ending 81st December 1899. 1

Funds.

Eisks written.

Eisks in Force.

Canadian Cos.

British ,,

U.S.

7

21

8

$5,003,8181

15,747,565"

1,449,5558

$130,509,195

524,980,342

100,767,561

$169,792,859

654,890,000

112,186,809

Total . .

36

$22,200,938

$756,257,098

$936,869,668

1 Including $1,889,920 capital paid in.

2 Including $2,105,105 capital paid in.

‘ Funds in Canada only.

Upon the continent of Europe the fire insurance business is conducted, partly by local companies in each country, and partly by the great international offices of Great Britain and Germany. The local associations in Austria, Germany, and Switzerland a'e of three classes — public assurance organizations connected with local governments, private mutual companies, and joint-stock companies. It is impossible to obtain balance-sheets of all, nor is any information available concerning the local distribution of the risks, or the whole amount of property insured. The following table, exhibiting the capital employed by stock corporations in this business in each country, and the aggregate premium receipts and payments for losses in the last year of which a report is available, has been

compiled almost wholly from the statements collected by the Post Magazine Almanack for 1900. In most cases the figures given are for the operations of 1898, but the fiscal years are not the same for all. The capital in each case is that actually paid in ; the subscribed capital is usually much larger. The amounts are reduced to pounds sterling : —

Fire Insurance in Continental Europe.

Business of 1898.

Number of

Companies.

Paid-up

Capital!

Premiums

received.

Losses paid.

Germany —

Stock . .

Mutual . .

Total .

France . .

(1 Mutual)

Russia . . .

(1 Mutual)

Austria —

Stock . .

Mutual . .

Total .

Belgium . .

Sweden —

Stock . .

Mutual . .

Total .

57

*49**

1065

246 -1

“}

18

*20**

38

16'

9

11

20

£2,305,373

£7,399,762

2,623,462

£10,023,224

£4,799,200

1,627,805

£2,305,373

£6,427,005

£2,722,303

£4,454,875

£2,409,584

£2,771,667

£3,054,897

£2,542,115

£1,602,083

110,692

£1,712,775

£2,530,000

737,000

£3,267,000

£1,807,000

418,000

£2,226,000

£499,803

£653,846

£1,066,967

£638,766

£278,204

37,240

£315,444

£469,733

128,525

£598,2.58

£653,846

Switzerland —

Stock . .

Mutual and

Cantonal

4 1

21 y

£252,227

£821,834

£515,130

Total .

Italy-

Stock . .

Mutual . .

25 J

£4,32,219

£412,606

£245,405

Total .

15 i

Denmark —

Stock . .

Mutual . .

Total .

Norway . .

HoUand . .

j}.

8

108

£276,923

£273,112

£115,667

£319,388

£253,040

£26,075

£147,242

£60,068

£258,056

Balkan Penin-

sula . .

5

£241,980

£204,292

£108,619

While most of the fire insurance business in the

Australian colonies is in the hands of British companies,

- *Many of the mutual companies in Germany and Austria are*

divided into distinct departments, one for houses and one for personal

property, with separate accounts, but being under the same manage-

ment, the two are here regarded as one company.

5 Seven companies not reported.

6 Two companies not reported.

7 Four important companies not reported.

8 Statements incomplete.

[life

local institutions for the purpose have had a considerable

development on the same general lines as in Great Britain

and with similar freedom from interference by the govern-

ments. But no accounts of the receipts and losses are

available, most of the companies conducting a marine or

life insurance business, or both, under the same general management. There are at. least five flourishing companies in Melbourne, with paid-up capital of £272,600 ; five in Sydney, with paid-up capital of £190,000 ; five in New Zealand, with paid-up capital of £484,000 ; and two in Tasmania, with paid-up capital of £87,500.

Beyond the limits of the great commercial nations, no satisfactory information is accessible concerning the practice of fire insurance. Even in Spain and Portugal there is far less intelligent interest in the subject than in neighbouring countries, and the agencies of foreign companies transact much of the business in the large towns. Six Portuguese companies have maintained themselves for many years, a few of them for nearly a century, and have established agencies in the Spanish islands and in Madeira.

For other nations than those represented in the table above, the only systematic effort to collect the facts is made by the compilers of the Year-Book, and the results are extremely meagre. The great British and German corporations are zealous in extending their transactions to the commercial ports everywhere, and local companies are often formed in the colonies. 'It is only in Australia

and in Cape Colony that these have become financially important, though small native companies have been successful in establishing their credit in Japan, Brazil, the Argentine Republic, Chile, and Peru. A considerable business is done in insuring the property of foreign residents In the Levant, on the coasts of Asia, in South Africa, and the Pacific Islands, but mostly by European companies, and as an incident to the more general practice of marine insurance. There are several successful fire companies among the Dutch in Java, and, under British management, two at Georgetown in Britisli Guiana, and one in the Transvaal. The small business in Mexico appears to be wholly in the hands of foreign companies.

IV. Life Insurance.

Before the middle of the 17th century no marked improvement had been made in the method of collecting and classifying social facts since Herodotus and Pausanias. General descriptions, mostly from personal observation, extended by hearsay, with vague inferences, were the sum of available information on the volume and movement of population, industry, and wealth. A few German

and Italian writers had attempted large collections of comparative data in this field, but without trustworthy sources or useful method, so that their labours served only to indicate a want, not to supply it. In 1609, indeed. Sully, the great minister of Henry of Navarre, ordained a permanent national bureau to inquire into the economical and social conditions of the kingdom, but this magnificent scheme, in advance of his age, fell with the tragic death of his master. The fruitful use of statistics was impossible until the principles of the science of probabilities were grasped ; and as these gradually became part of the common stock of ideas among advanced minds, statistical method was developed. The famous correspondence between Pascal and Permat in 1654 shows two of the greatest minds of the age engaged in groping painfully after solutions of problems which are now considered elementary, the thought that probabilities can be definitely appraised and compared being grasped as a fresh discovery. Step by step a new science was created, that of the laws governing events whose causes cannot be traced.

The leading conceptions of this science were firmly implanted first in the minds of a few mathematicians, were then applied to the study of social facts, especially those of human mortality, and in succeeding generations have become familiar to all educated men. The world has slowly but thoroughly learned that events which individually are impossible of prediction, whose determining forces defy analysis, and which to us are therefore casual, tend to occur with greater and greater uniformity the larger the number of instances collected ; that averages are the clues to general truths, and that deviatiQns from average diminish as instances multiply, while any persistent failure of such deviations to diminish is the clear indication that some disturbing force is exerting a uniform influence which requires investigation. Until these principles were clearly understood life insurance was impossible. They first began to find acceptance with the foremost thinkers of Europe during the second half of the 17th century. If their gradual development could be traced for the last three hundred years, from the first

hints of mathematicians, philosophers, and statesmen, to their general recognition in modern research, it would form one of the most important chapters in the history of thought.

We can refer only to the outline of their progressive application to the facts of human mortality. Guesses at the probable length of life for the purpose of valuing or commuting life-estates, leases, or annuities were indeed made even by the ancients, and crude estimates of the number of years' purchase such interests are worth occur in Roman law and in many mediaeval writings. In 1540 Parliament enacted that an estate for a ^ '^' single life should be valued as a lease of seven years, one for two lives as a lease of fourteen years, and for three lives as a lease of twenty -one years. More than a century later The Cambridge Tables for renewing of Leases and purchasing Liens, a standard work in England, with the certificate of Sir Isaac ISTewton to its accuracy, proposed, as a remedy for the inequity of this fanciful rule, to make the increase for each additional life less by one year, so that, valuing

a single life at ten years, two lives shall be reckoned as nineteen years and three lives as twenty-seven years. No distinction of ages was recognized, and the results, tabulated to decimal parts of months, are of course worthless. Thus the foremost minds of the world had as yet no apprehension of a true method of reasoning on the subject. The first clear insight into the character of the problem appears in Natural and Political Observations on the Bills of Mortality, published in 1661 under the name of John Graunt, a haberdasher and train-band captain of London. Graunt recognized the principle of uniformity in large groups of vital and social facts, and actually prepared, from the mortality registers of London, what he calls a " Table showing of one hundred quick conceptions, how many die within six years, how many the next decade, and so for every decade till 76." This was the earliest crude suggestion of a table of mortality, and Graunt's interest in the inquiry was scientific, without definite practical purpose. But a little later the sale of annuities was pressed upon Governments as a method

of discounting future revenues. In 1671 John De Witt, Grand Pensionary of Holland, reported to the States General a plan for such sales upon a scientific method, the insight and skill of which, had he possessed proper statistical data, would have anticipated results only reached by later generations. The report, however, was buried in the Dutch archives and forgotten for nearly two centuries. It was unknown in England when, in 1692, the Government undertook the sale of annuities. A loan of £1,000,000 was offered, each £100 paid in to purchase a life annuity of £14, without distinction of age. A table accompanied the offer, purporting to show how many of 10,000 persons now living, old and young taken together at random, are likely to die in each year from one to ninety-nine. Of course the purchasers, though without clear understanding of the principle, were instinctively shrewd enough to select healthy young lives for annui-tants, and the nation paid enormously for the error. This speculation of the public treasury led the eminent mathematician and astronomer Dr Edmund Halley to

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*examine the subject. In 1693 he presented to the Eoyal Society a study of "The degrees of mortality of mankind." The parish registers of England took no note of age at death, and Halley, perceiving that the average duration of life in large groups of persons can only be Taft/ef * determined when ages at death are known, sought in vain a statistical basis for such an inquiry in his own country and in many others. But it hajjpened that the city of Breslau in Silesia had kept such records, and he succeeded in obtaining the registers for five years, 1687-91, including 6193 births and 6869 deaths. No census of the city having been taken, he made the best estimate he could of the population, and computed how many of a thousand children taken at the age of one year will die in each succeeding year. Arranging the results in three parallel columns, showing in successive lines the age, the number living at that age, and the number of*

deaths during the year, he formed the first mortality table. The arrangement was itself a discovery, exhibiting at a glance the essential data for valuing life-risks, and suggesting solutions for problems which had puzzled the ablest students. This general form of the mortality table remains in use as the natural and best for such collections of facts. The method of using such a table in calculating the values of life contingencies was also discovered by Dr Halley. He showed that where a payment is to be made at a future date, if a named person be then alive, its present value is the sum which compounded at interest during the interval will amount to that payment multiplied by the fraction representing the probability that the person will survive. These two elements, compound interest and the probability of life or death, are the foundations of the theory of life contingencies.

From Halley's time the progress of the theory has been in three directions : first, in accumulating facts from which averages are deduced, and analysing the

data so as to eliminate disturbing influences, that is, in constructing trustworthy tables of mortality ; secondly, in extending the inferences from such tables, and multiplying their applications to needs of practical life ; and thirdly, in facilitating the calculations which these applications require, the enormous labour of them being beyond human capacity until the highest mathematical skill has devised means of shortening them. But while Dr Halley thus firmly and lastingly drew, in outline, the theory of life contingencies, the numerical results attained by him were grossly imperfect. Forced by the lack of data to assume that the population was stationary, and to rely on a rude estimate of its numbers, he well knew that his conclusions were but provisional. Yet they were far in advance of the general mind of his time. As late as 1694, and even in 1703, Parliament substantially re-enacted the old law for valuing leases at seven years for each life. The meagre Breslau Table long remained the only serious attempt to utilize actual observations of mortality for scientific purposes. In 1746 de Parcieux, a mathematician

of Paris, published an Essai sur les Probabilitis de la Durie de la Vie Humaine, in which he presented mortality tables formed by himself, one from the records of certain Tontine associations, and five others from those of several religious orders in Paris. The Tontine experience table was a much closer approximation to the true course of mortality, as shown by later investigations, than any of its predecessors, and indeed now appears, despite the crude manner in which the materials were treated, to have been more accurate and more trustworthy than the Northampton or even the Carlisle Table of much later date. The essay of de Parcieux was an important source of information to advanced students in France and Germany, but attracted no general or popular interest, nor was it followed up by progressive researches of the same character in continental Europe, while it remained almost unnoticed in England.

Throughout the 18th century the customary treatment of life annuities was as chaotic and fanciful as before, though some writers of eminence, most notably Dr

Thomas Simpson of London (1752), treated the theory of the subject with great intelligence, and in 1753 Dodson of London (great-grandfather of Dr A. de Morgan) projected a life insurance company in which the premiums should be accommodated justly to the ages of the insured. But life insurance as a business really began with the Equitable Society of London, founded in 1762. The associates petitioned for a charter, but the law officers of the Crown refused it, saying that the scheme depended for success on the truth of certain tables of life and death, " Whereby the Chance of Mortality is attempted to be reduced to a certain standard. This is a mere speculation, never tried in practice." The society was organized as a voluntary association, and began business in 1765. Its premiums were computed from the Breslau Table, with some corrections from the London Bills of Mortality, and were far higher than any now in use. But the managers, in face of actual business, needed more light. Dr Price, a student of the new science of life contingencies, was consulted, and soon devised tests of the society's experi-

ence and measures of the financial results, which are in principle those still practised. He also aspired to construct a more accurate table of mortality, and discovered data in certain parish registers of Northampton which promised to represent the average of life in England. From these he formed in 1780 the Northampton Table of Mortality, and computed a new and ^nlr/ATr largely reduced scale of premiums for the society. The historical importance of the Northampton Table lies in the profound impression it made on the general mass of intelligent mind, spreading widely the new conception of a regular death-rate of population, to be determined only by observations classified according to age. The crude state of previous knowledge on such subjects is hard to realize. Although mortality had long been recognized by special inquirers as a promising theme for statistical inquiry, its actual treatment, except in the narrow school founded by Stlssmilch in Germany (1746), and in the isolated and almost prophetic work of de Parcieux in France, had been speculative and

vague. De Moivre handled it with mathematical acuteness, but framed his scale of mortality (about 1750) on a hypothesis of his own, not on known facts. Out of each group of eighty-six deaths, according to this scale, one dies on the average each year till all are gone ; so that X being the present age, the probability of death within a year is always oT — • This conjecture, which, during middle life, served as a rough approximation to the truth, almost as well as some of the early tables of repute, long found remarkable acceptance among men of science as a discovery. Dr Price's researches first brought to general apprehension the conviction that a large basis of observed facts is the only source of real knowledge. The Government of the day felt the influence of the movement. In 1786 Mr Pitt, then Chancellor of the Exchequer, consulted Dr Price on plans for the conversion of debt, and in 1789 the Government first showed knowledge that in granting annuities ages must be distinguished, and that the prospective life at ninety and that at twenty-five are not to be estimated as equal. About 1808 a conversion of 3 per

cents, into annuities was planned. The Northampton Table was adopted, and Mr Morgan computed rates from it which were used for twenty years. It proved to represent a mortality far in excess of the average, and in

1821 Mr John Finlaison, being made Actuary to the Debt Commissioners, protested against the rates in use. But the G-overnment was slow of conviction, and not until 1828, when the Treasury had lost two millions of pounds by selling annuities too cheap, was the law repealed. Mr Knlaison then constructed a new and less wasteful scale of conversions, but singular results followed. At the age of ninety, for instance, £100 would purchase an annuity of £&2. Combinations were formed to purchase annuities on the lives of old people selected for their vigour ; 675 of these were taken, with a further loss of at least a million to the Treasury. The ITorthampton Table, in fact, like the earlier Breslau Table, was formed without a

census, and upon the false assumption that the population was stationary. Dr Price's estimate, founded on the recorded baptisms, was much too low, many of the people being of a sect which rejected infant baptism. His table represents an average life of twenty-four years, whilst subsequent inquiries indicate a true average of about thirty years at that time in the same parishes. The actual mortality in the Equitable Society proved to be less by one-third than that anticipated by the table. The error had consequences of vast moment. The immediate and dazzling prosperity of the societies founding rates on this supposed scientific basis excited the public imagination, stimulated the business exceedingly, and led to many extravagant projects, followed by fluctuations and failures which impaired its healthy growth and usefulness.

In spite of gross defects, the Northampton Table remained for a century by far the most important table of mortality, employed as the basis of calculation by leading companies in Great Britain, and adopted by the courts as practically a part of the common law. Parliament,

followed by some state legislatures and many courts in America, even made it the authorized standard for valu-ing annuity charges and reversionary interests. But in life insurance practice it is now wholly antiquated, though its service in first introducing the common mind to the elements of the subject gives it great historical interest. Like its most famous successor, the Carlisle Table of Mr Milne, it rested upon observations of the population of a town. How far this limited and peculiar group Recent represented the nation was still doubtful ; noless progress. SO how far the rate of mortality among applicants for insurance, accepted by the offices, would cor-respond with thatoftheurbancitizens or of the whole body. As soon as the companies had sufficient records of their own experience the work began of striving to construct, for business use, tables which should truly express it. This branch of research has ever since been prosecuted with all the resources they could command of industry, practical judgment, and mathematical skill ; and the successive achievements in it may be accepted as in general the sum

and measure of the progress of actuarial science. Thus during the last three generations the recognition of an ascertainable uniformity in human mortality has become part of the general stock of thought, and the accurate determination of the normal rate for all ages has been an accepted branch of scientific inquiry. The great mental and social changes in civilized men, which are implied in the general adoption of the practice of insurance, the growth of associated forethought and the decline of the gambling spirit, have no doubt made gradual and continuous progress in all the enlightened nations. But actuarial science, which originated in Great Britain, was long the peculiar and almost exclusive possession of British students, and even till now has been practised most fruitfully in its first home, mainly by the actuaries of life insurance institutions, but with important contributions from other inquirers, especially those in the service of the Kegistrax-General. The most complete storehouse of technical and practical learning on the general theory and on all its applications to life insurance

practice is found in the successive volumes of the Journal of the Institute of Actuaries. The tables published by the Institute in 1872, founded on the experience to 1863 of twenty companies, and suflfi.oiently described in Ency. Brit., vol. xiii. p. 170, still remain the most authoritative expression of the mortality of insured lives, and have largely replaced all earlier standards in the valuations of the British companies, more than three-fourths of which, in their latest returns to the Board of Trade, compute their reinsurance reserves by the H™- and H””-‘ tables. But for several years a committee of the Institute and of the Scottish Faculty of Actuaries has been engaged in collecting and arranging for investigation the far vaster experience which has now accumulated in the hands of sixty companies, including the records of more than a million policies. The large basis of facts thus obtained will be treated with special reference to different classes of risks, and will throw much light on difficult questions of selection, which have hitherto been treated speculatively, or at least without the conclusive evidence

of large averages, and are still more or less in controversy. Some of these will require more detailed notice hereafter. It is only since tlie middle of the 19tli century that actuarial science has rapidly advanced in other countries, chiefly under the stimulus of the extending practice of life insurance. Both in America and upon the continent of Europe the small business transacted by the pioneer companies was largely conducted on empirical and conjectural methods from year to year, English custom being consulted as a guide in fixing premiums. The Gotha Bank, the first institution to insure lives upon business principles in Germany, adopted at its foundation in 1827 a mortality table formed by Mr Babbage upon the basis of the Northampton Table, corrected from cursory notes upon the early experience of the Equitable Society, which had been given by its actuary to a general meeting of its members in 1800. The French companies, and several in Germany of later origin than the Gotha, took as their standard the so-called Table of de Parcieux, previously described ; and this table, with modifications dictated by experi-ence, was continued until very recently in general use in France. The Seventeen Companies' Table of 1843 was adopted by the

Insurance Commissioners of Massachusetts, who in 1859 introduced the methods of state supervision of insurance now generally practised in the United States. This table, though long superseded in the esteem of actuaries in their ordinary work, is still the standard for official valuations in most states of the Union, a fact which has given it undue prominence. The so-caUed American Table, derived in 1868 from the limited experience of the largest American company during its earliest years, was the first important work of the kind done in America. In view of its narrow basis of facts, it has stood the test of time singularly well, and it is now in wider use than any other for computing the premiums of American companies. Its most marked difference from the standard British tables for insured lives is that it indicates a decidedly lower rate of mortality throughout the period of mature manhood, between the ages of thirty-five and seventy -five, though with a higher rate at the extremes of life ; and this peculiarity is also found in American tables deduced from more recent and far larger experience. Actuarial science has been widely cultivated in the United States of late years, the numbers and zeal of its professional students having kept pace with the extraordinary growth of life

insurance. The aggressive activity of the companies through their agents and solicitors has brought the principles of the business home to the popular mind as in no other country, and a large number of periodicals are published devoted entirely to the subject of insurance, and striving constantly to make it intelligible and interesting to the general reader. These tendencies have been strengthened by the system of supervision practised by the states, vrhich has also greatly influenced public opinion, directing attention in an extraordinary degree to certain special and technical features, to the neglect of more comprehensive and more useful criticism. In the official work of the state departments the actuary's province appears substantially to begin and end with the valuation of liabilities upon the net premium basis, which is applied with increasing strictness as the sole and final standard of solvency, and the determination by it of the "legal surplus" of each company. But a considerable number of professional actuaries have prosecuted their studies in a scientific spirit, and most of these since 1889 have been associated in the Actuarial Society of life]

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America, which has established a high standard of professional competence in its examinations and transactions. The question how far the rate of mortality among insured lives in America is fairly represented by tables drawn from British experience has of course attracted much inquiry; and many companies have made important contributions to it from their own records, in several instances in the finished form of carefully graduated tables, each with an individual character, but all with some features which distinguish them as a group. By far the most comprehensive effort to establish a standard table for America is that of a committee of actuaries, for which, in 1881, L. W. Meech published the classified experience of thirty offices to the end of 1874, including most of the large companies in the United States, and embracing more than a million policies. The observations collected in this work have furnished materials for many important investigations, but the finished tables have rarely been applied in practice, being drawn from an aggregation of largely incongruous experiences, the influence of each of which upon the general average is indeterminate.

The business of life insurance upon the continent of Europe

*has extended rapidly since 1880, and has given an extra-ordinary stimulus to actuarial studies. Before 1883 the German companies computed their premiums and reserves by antiquated life tables, partly borrowed from early British usage and partly constructed by rough methods upon meagre observations. The most approved of these, as illustrating the duration of German life, was that prepared by Brune of Berlin in 1837 from the records for seventy years of an annuity society for widows, which practised careful medical selection of the husbands and kept exact mortality registers. In 1883 was published an admirable table founded on the combined experience of twenty-three German companies, which has superseded all other standards for ordinary valuations within the German Empire. The French companies generally continued to rely on the tables of de Parcieux, with modifications of their most glaring defects, until a still later date. In 1898 a committee of French actuaries published a new set of tables drawn from the experience of four of the principal offices in France, and these are now accepted as the best basis for life insurance practice by similar companies there. * Schools of actuarial science have been opened in both Germany and France, and the professional actuaries of*

these countries, and of Austria and Belgium, have formed asso-ciations for the promotion of their pursuits. In 1895 delegates from the several institutes and societies of actuaries throughout the world met in general congress at Brussels, and again in 1898 in London, and in 1901 in Paris. Such sessions, which are held triennially, do much to broaden and harmonize the scope and aims of the profession.

Elaborate efforts^ave been made by several enlightened governments to employ the vast machinery of census bureaus for determining the general rate of mortality, and it has been the worthy ambition of able actuaries to devise trustworthy methods of utilizing the census returns for this purpose. The British Statistical Office, under Dr William Farr and his successors, and more recently the Swiss Federal Bureau of Statistics, have accomplished ^orta"ity. ^^^ ^®® work in this direction, and the series of "English Life Tables," founded on successive decennial censuses, interpreted by the registered deaths during the intervals, are the most useful data now available for the average value of civilized life. But all such general*

tables are as yet but tentative and provisional. The imperfections of mortuary registries and of census returns are great, and result from a variety of causes, and corrections are largely conjectural. Until new and completer methods of collecting the facts are practised, the experience of life insurance companies promises to furnish the only mortality tables having claim to authority. Such a table, in the most trustworthy form now attained for it in each of the enlightened nations, is the result of immense intellectual labour for generations. A brief sketch of its evolution cannot suggest the amount of patient observation, of profound reflection, of ingenious mathematical research, which has gone to its production. As it approaches accuracy it become^ an epitome of human destiny, an essential element in momentous problems, historical and social. The work of correcting and improving it will go on with increasing zeal and insight. But the inquiry thus made does not aim, as some have imagined, at the formulation of a final law of mortality. The highest perfection attainable is but the expression

of a temporary phase of human progress. It is already becoming evident that the general rate of mortality, and in particular the rate at each age of life, not only differs widely in different communities, but undergoes important changes in successive generations. A multitude of forces are at work in civilized society which must influence the average duration of life, such as the extension and concentration of many industries, the vast growth of cities, the progress of medical and hygienic science, the increase of wealth, comfort, and luxury, the changes in the frequency and destructiveness of war. It is plausibly maintained, on the one hand, that these and other causes have already added some years to the average lifetime of civilized man ; and again, on the contrary, that their combined effect has been to lessen the sharpness of the struggle for existence, to rescue the weaklings from destruction and enable them to multiply, and so to weaken society at large. The final decision of the question will be found in the gradual modifications of the true table of mortality through successive epochs.

Eor the purposes of life insurance the future of mortality tables looks to less ambitious problems. The business calls for exact equity in determining the value of all life contingencies, and therefore for the most precise forecast attainable of the dates at which the amounts assured must be paid. Some idea of the historical progress of this inquiry may be gathered from the accompanying table, which epitomizes the general characteristics of a number of typical tables of mortality, showing at ages which are multiples of five years the annual death-rate indicated by each of them. The comparison will be found interesting in many ways, most strikingly, perhaps, as suggesting what is confirmed by a detailed examination of the facts, that insured life on the average in Great Britain is decidedly inferior to that in the United States, but superior to that upon the continent of Europe, and especially in Germany. Erom a careful investigation of the published experience, Dr McClintock concludes : " It is an ascertained fact that after the first five years of insurance the probability of death," in Great Britain, " is

fully one-fifth greater at any given age than the corre-

sponding probability shown by American experience " ;

while " the average value of assured life in Germany is

as much inferior to that shown in the H"- experience as

that in America has been found to be superior." ^

Table showing the number of persons who will die in a year out

of 100,000 who have attained the given age, according to several

tables of mortality : —

Age

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1780.

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1843.

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1869.

1869.

1868.

1881.

1888.

1895.

10

15

20

25

80

35

40

45

50

65

60

65

70

T5

80

85

90

916

922

1,408

1,575

1,710

1,870

2,090

2,401

2,885

8,860

4,023

4,902

6,493

9,616

13,488

22,043

26,087

449

619

706

731

1,010

1,026

1,.300

1,481

1,342

1,792

3,349

4,109

5,164

9,562

12,172

17,528

26,056

676

694

729

777

842

929

1,036

1,221

1,594

2,166

8,034

4,408

6,493

9,556

14,040

20,609

32,873

490

287

688

668

772

877

1,081

1,219

1,595

2,108

2,968

4,348

6,219

9,816

14,465

20,988

27,945

400

825

888

1,050

920

1,000

1,182

1,294

1,712

2,219

8,064

4,461

6,284

9,949

14,677

21,010

28,244

749

768

780

806

848

896

979

1,116

1,878

1,867

2,669

4,018

6,199

9,437

14,447

88,565

45,455

648

659

676

708

748

821

936

1,120

1,417

1;898

2,668

8,864

6,778

8,779

13,407

20,868

82,816

‘919

854

882

999

1,176

1,487

1,814

2,506

8,685

4,943

7,276

10,647

15,516

22,211

32,856

864

516

690

628

698 ‘

807 ;.

975

1,286

1,688 i

2,268

3,218

4,675

6,897

10,241

15,119 ,

22,382

82,226 ;

No final explanation has been given, and there is no proof that the average life in America is longer than in England or Germany. But Dr McClintock inclines to

1 On the Effects of Selection, by Emory McClintock (New York, 1892), p. 94.

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belieTe that one potent cause of the great difference in the insured experience is that, while European offices have generally awaited applications, which are commonly prompted by some sense of need for insurance, the custom of American companies is actively to solicit business through agents. On the average, lives which are only induced by persuasion to insure are better than those which voluntarily apply. That this suggestion points out a real and perhaps an important differentiating influence upon groups of risks is not doubted, but the measure of its

effects has not yet been determined. The question is one of many which yearly assume more prominence, o/ se/e™ and which, as a class, are conventionally termed tioa. problems of selection. Assuming that the general rate of mortality is precisely known, any deviation from it occurring in a special group of insured lives, as the result of some influence peculiar to that group, is called the effect of selection. If insurance were offered on equal terms to all, the feeble and dying would apply in disproportionate numbers, and the mortality would be excessive. To avoid this danger careful medical examinations are required, excluding risks which appear to be impaired; and this selection by the insurer uniformly reduces the mortality below the general average during the earliest years of insurance. During these years large numbers of the insured withdraw, either from inability or from indisposition to pay their premiums, but the motive to do so is weakest with lives which have become impaired. The average vitality is lowered by the loss on the whole of a superior class, and the average mortality of*

those who persist rises. The extent of this influence varies widely with the proportionate number of lapses and the motives which induce them, increasing in a startling degree, when lapses multiply in a discredited company, and remaining small, or even at times doubtful, under very favourable conditions ; so that the ascertainment of its amount in different circumstances, and for different groups of the insured, is a problem of extreme complication. Its importance is increased by two tendencies which have grown stronger in the practice of recent years : first, to permit at all times the withdrawal by any policy-holder of a substantial part of the technical or average reserve upon his assurance, a privilege which legislation and public opinion in the United States have extorted from the companies; and, secondly, the extensive introduction, under competition for public favour, of forms of policies which grant the option, at fixed dates in the future, between withdrawing the entire "accumulations," or technical reserve and surplus, and continuing the insurance. It is well known that at the maturity of

these options the motive is strong for impaired lives to remain insured, and that the cash withdrawals are so largely of superior lives that the subsequent rate of mortality is much increased. Other problems in selection arise from varieties in the forms of policies. It is commonly recognized that there are general and marked differences between the mortality experienced upon assurances issued at low and those at high premium rates- Policies for short terms, on which the computed net rates are the lowest, have been found so unprofitable to the insurers that they are rarely granted, and only with a very heavy loading of the tabular value. Upon those insured for life, with annual premiums, there is a large and constant excess of death losses above the endowment assurances, while groups of policies with tontine or cumulative features of reserved bonuses, available only after surviving a term of years, uniformly experience aAow mortality. It is also to be remarked that, as the result of several investigations, it is found in general that the average amount of policies matured by death is higher than the

average of all policies in force ; and some actuaries incline to believe that tables of pecuniary loss might, for practical use, take the place of tables of mortality, since the actual claims are in units of money, not of lives. The vast field of inquiry opened to actuaries by these and many more special questions of selection promises to engross more and more of their attention and labour. The technical methods of reducing and treating the data of mortality have been brought to a high degree of perfection, but the necessity for a better classification of the data themselves, with reference to special groxips of lives or policies, differentiated by social or local circumstances, by business methods, by forms of contract, by race or personal characteristics, must assume ever greater prominence. It is conceivable that, at some period hereafter, the practical reliance of the offices will be more upon tables to be computed for such special groups, from select experience, than upon those drawn from vast aggregates without discriminating among their somewhat incongruous divisions.

The mortality tables in common use, however, have
been proved by a vast experience to furnish a safe and
fairly equitable basis for the business of assuring lives.
Assuming that the table shows how many of a large group
now assured may be expected to end in each succeeding
year, the present value of the claims upon them depends
exclusively upon the rate of interest at which funds will
accumulate. Exact foresight of this rate being impossible,
the insurer must assume a rate which can with certainty
be realized. The difficult problem of determining the
limits of safety in this assumption attracts the more
attention now, because of the recent pej-sistent decline
in the average productiveness of invested capital. The
actuary is forced to observe that the interest factor in
his calculations is much less definitely fixed
*by known facts than the mortality factor. The ™**
longer a contract has to run, the greater the fyctw.
effect of the difference in rate. The value
of a payment to be made in thirty years is greater by
above one-half with interest taken at 3 per cent, than

at 4^ per cent., and one to be made in thirty-six years is more than twice as great. Hence the most careful study of the forces determining for long periods the average rate of interest is fundamental in life insurance. But while the general theory of interest has been treated with masterly skill by some economists, it is but within a few years that the special problem of ascertaining what maximum rate can with entire safety be assumed, as obtainable for one or more generations hereafter, has excited wide discussion, and it has elicited singular diversity of judgment. The tendency of opinion is to hold that a progressive lowering of interest rates must result from the accumulation of wealth. In support of this belief it is pointed out that from 1872 nearly to the present time there has been a general and somewhat uniform decline in the yield of invested capital, as represented by government stocks, mortgage loans, savings bank deposits, and discounts in all commercial nations. The movement has been disguised by wide fluctuations, temporary or local, but has been on the whole world-wide and continuous, when great

masses of capital, such as the investments of life com-
panies, are kept in view. The fall has been greatest, too,
in countries where rates were formerly highest, suggesting
that as the great financial markets of the world become
more intimately connected the normal rate of interest
assumes a more cosmopolitan character, with an increasing
tendency to equality among them. These considerations
have had an important influence upon the computations
of life insurance companies. In Great Britain, and com-
monly in continental Europe, the leading offices from the
first assumed lower rates of interest than those in America,
usually 3^ or 3 per cent. ; and the reductions in their
life]

estimates have as yet been moderate, only thirty-one out
of seventy-four British offices having lowered the interest
basis in their valuations reported to the Board of Trade.
These returns show that of these companies only twenty-
three now compute reserves upon a rate as high as 3|

per cent., while forty-four assume 3 per cent., and seven a still lower rate. But in America, when the business first became important, 6 per cent, was a more frequent rate of investment than 5 per cent., and the laws of New York and of many other states countenanced the confident expectation of a permanent yield of at least 4| per cent. The rate of 4 per cent, adopted by the principal companies, and by the law of Massachusetts from 1861, was regarded as highly conservative. But as early as 1882 one important company began to reserve upon new business at 3 per cent., and since 1895 there has been a gradual change by the leading ofQces to 3J- per cent., and in a few instances to 3 per cent., as the basis of premiums and of reserves upon new policies. Serious efforts have been made to induce legislation which will gradually establish one of these rates as a test of technical solvency.

There are not wanting, however, indications that the protracted decline in rates of interest in the world's markets may have been checked, and even that a reverse

movement has begun. Rates of discount everywhere, interest on government loans except in America, and on mortgage loans in Europe, on the whole advanced during 1897-1900, the minimum average rates having been reached, after twenty-five years of gradual reduction, in 1897. These facts are entirely consistent with the conclusions suggested by the history of the subject. No uniform or secular tendency to reduction in the average rate of interest, which is the index of the average productiveness of capital, not of its amount, can be found to have prevailed. Fluctuations in the average rate are found, quite independent of the local and temporary fluctuations, which are often extreme ; and these long tidal waves of change have at times, for generations together, risen and fallen with some approach to periodicity. The prevailing rate has been a little lower on the average in the 19th century than in the 18th, but was lower through the middle decades of the 18th century than through those of the 19th. On the whole, it seems clear that the accumulation of wealth in itself has no necessary tendency to

diminish the productiveness of capital ; that this productiveness, on the general average, has not materially varied in many generations ; but that the promise and expectation of productiveness which prompt the demand for its use depend upon the activity of enterprise, growing out of the prevailing spirit of hope ; upon the rapidity with which new inventions are made, industries extended, and floating or loanable capital expended in permanent works. These conditions are subject to fluctuations extending through considerable periods, so that for a number of years the rate may be higher, and then for a similar series of years lower than the normal rate, determined by average productiveness, but always tending to return to this normal rate, as the tide-swept surface of the ocean to its normal level. With this principle in view, it may be affirmed that, since the years 1895-99 were, on the whole, the period in which the average rates of interest were the lowest ever known throughout the commercial world, and since there were already unmistakable indications of an incipient advance, any rate the assump-

tion of which for life assurance investments proved safe through these years may with much confidence be assumed for an indefinite future. Neither economic science nor history gives support to the belief, so often expressed, that a progressive decline in interest is the necessary result of increasing wealth, and must be accepted as a law of our

Assets and

reserve.

industrial civilization. And while the excess of the average yield of capital in America, above that of the older nations, is diminished as the facilities of transfer and exchange increase, there is no reason to conclude that it will disappear for generations to come. It seems, there-fore, that the general assumption of 3 per cent, for the valuation of British offices, and that of 3+ per cent, which is becoming the accepted standard for the companies of the United States, should command unquestioned con-fidence.

The present value of all the sums the future payment of which is promised by its policies, makes up the amount

which the company must in some form possess, and must accumulate at interest, to meet these payments. If all insurance were purchased for cash (single-payment policies) this amount would be its necessary reserve. But the system of annual premiums, adopted for the convenience of the insured, is so nearly universal, that it has controlled the form in which the subject is conceived by actuaries as well as by the public. Let a mutual company be asked to insiire one thousand healthy men, each aged thirty, for life for f 1000 each. It assumes that their lives will end substantially in accordance with an approved table of mortality, and that the price it receives for its contracts can be improved at compound interest until they mature. Making these assumptions conservative, it may perhaps value at this time the entire million of dollars to be paid in the future at $331,407. But as a provision for the expense of management, and as a margin to protect it against all contingencies, such as excessive mortality or losses upon investments, it may add a charge of 30 per cent., with the understanding that whatever proves from

time to time to be excessive in the price shall be equitably returned to the insured. Each policy then is sold for $430-83. The insurance becomes the property of the insured, the price of it belongs to the company. But the actual transaction, under the customary system, is this : The insured, instead of paying the price in cash, grants the company an annuity due upon his life, making one payment for the first year. These annuities, if valued by the same assumptions of mortality and interest as the insurance, may be for $21-76 each, the average present value of them being the price of the policy, or $430-83. It is evident that' while the company has sold its contracts for full value, it has invested 96 per cent, of the proceeds in the annuities, and has but 5 per cent, in hand for other purposes, less than one-fourth of the amount it has prudently assigned for expenses and as a margin upon its own assumptions. Each of the insured takes his policy subject to a lien or mortgage to secure an annuity worth 95 per cent, of its price; and of each annual payment subsequently made, the excess above his share of the

expenses of the year, including losses by death, is applied to reduce this lien. In fact, if there were no expense and no deaths, it would still require fifteen annual payments by each of them, and compound interest for fifteen years upon these payments, to extinguish the debt. After thirty years, if we suppose all the contracts to have been kept, there may be 681 survivors of the 1000 insured; and their policies, upon the original assumptions, are now worth $421,471-68, the amount which, with its interest, will pay them at maturity. The company must have this sum secured, together with a proper addition for expenses and a margin for safety. The annuities of $21-76 upon each survivor are now together worth $152,180-69. If this sum be still held to include a margin of 30 per cent, for all possible needs apart from expected death claims, the company must hold in other good investments than its future annual premiums at least $304,409-52 as a guaranty for these contracts. Thus it is evident that the true assets of an active company must always consist in

laxge proportion of the future premiums secured to it by a lien upon its policies. But, in common language, its assets are understood to include only the funds held or invested by it in other forms ; and its reserve is defined as that sum which, together with the appraised value of its future premiums, will suffice to pay its policies. This conception of the reserve would be strictly logical if the valuation of the premiums were exact. But no general method for this valuation has any claim to scientific precision. The net premium method generally adopted, and made obligatory by the laws of many of the United States,^ has its important uses, as an aid to the management of the company, both in determining its condition and the tendencies of its progress towards strength or weakness, and in ascertaining the amount which can with entire safety be treated as surplus. The reserve thus computed is properly kept in view by actuaries, and its integrity is

jealously guarded by all companies in good standing. When, however, a net valuation of liabilities by one fixed standard is imposed upon all companies by law, and the continuous possession of the technical reserve is made the condition of solvency, much injury is done in several ways. This reserve, being definite and easily calculable, has obtained undue prominence in the public mind and in legislation, as the one infallible test of a company's trust-worthiness, to the exclusion of others, at least equally important, which are mainly matters of practical judg-ment. As a merely numerical test it is widely unequal in its application to companies with different scales of office premiums. In some instances, too, companies have been pronounced insolvent, and forced into costly and wasteful liquidation in the courts, to the irretrievable loss of their members, because of a technical deficiency of reserve, which would without doubt have been speedily recovered if they had been continued under wise manage-ment. The assumptions on which the net reserve is computed are all taken with wide margins upon the side

of safety. It is assumed that future interest will be lower than the average now obtained ; that the mortality will be that indicated by a table, which represents a probable maximum ; and that the entire margin for ,all purposes provided in the loading on future premiums will be absorbed in expenses alone. These possible sources of surplus, taken together, give an immense recuperative power to the administration of a well-established company, and a rule which excludes them from consideration is not justified by business principles.

A prevailing fallacy in thp popular mind, which has grown out of the practice of net valuations, is the inference that the average technical reserve represents the value of the individual policy. Each risk is properly assumed at its probable or average value at the time. But from that moment its circumstances are constantly changing in directions then unforeseen, and the expectation that such changes will occuris the motivefor insuring. To treat them singly as unchanged in value at any later time is as illogical as it would be after some have matured. The actual value

of any one risk borne by a company is indeterminate. It may become a claim to-morrow, or not for a generation to come. In the former case the company must now hold funds to pay in full ; in the latter, the future premiums will perhaps more than suffice, so that no present reserve is needed. An entire reserve for the whole body of risks is essential, audits amount is definite, upon the reasonable assumption that the general average remains undisturbed by individual changes. A distinct reserve for a single policy is inconceivable. To recognize it is to deny the first principle of insurance. The average amount by which the reserve of a company must be increased, because of

1 It is fully explained in the earlier article in Ency. Brit. (9tli ed,.), Tol. xiii. pp. 176, 177.

the existence of policies of a given class, is to the actuary an important fact, and is commonly accepted as his best guide in the distribution of surplus. But a popular theory has seized upon the assignment of this average sum to each policy, in the technical shorthand of the actuary, and holds that it is in each case the special property of

the owner of that policy. The practical consequences are serious when, as often, many of the insured cease to pay premiums, and each demands the amount of the supposed individual reserve. His right to claim it is countenanced by a widespread public opinion, which has inspired statutes in Massachusetts and some other states, requiring companies to redeem all policies lapsing after the first two or three years of insurance at a price founded on the technical reserve. Yet, in by far the majority of instances, the lapse of policies is of itself a loss to the company. It is deprived of business secured at much expense before it has derived any of the advantage expected from the accession. It is compelled to pay numbers of its profitable contributors for ceasing to contribute. The burden falls in a mutual company upon the insured who fulfil their contracts. Such laws favour those who withdraw after few payments at the cost of those who maintain their insurance to the end, or for many years. But the American companies have largely yielded to the pressure of a mistaken public sentiment, and compete

for favour by promising excessive values in case of sur-
render. Similar conditions exist in Switzerland, Austria,
and other countries in which the business is minutely
regulated by Government bureaus. But in Great Britain
the companies are largely free from such influences, while
an open market exists for policies which have a com-
mercial value, with results on the whole more satisfactory
to all parties interested than any rule of compulsory
purchase which could be enforced on the companies.
A special form of life insurance, which has had a wonder-
ful development of late years, is the family insurance of
the labouring people by the so-called industrial companies.
Until recently this class of people had no satisfactory share
in the benefits of insurance, although the friendly societies
in Great Britain, and many forms of beneficial
associations in the United States, were attempts, 'f"'"^^'^'
often in part successful, to provide for special
wants, mainly for maintenance of the sick and for the
costs of burial. Most of them, however, lacked a scientific
basis and an efficient and permanent organization, while

thousands of them were grossly mismanaged, and proved expensive burdens to their members. In Germany an elaborate scheme of compulsory insurance for labourers was established by a law of the empire in 1883, and extended in subsequent years ; and similar legislation has been enacted in several other countries, most thoroughly in Switzerland and Austria. The ultimate value of this great social experiment cannot yet be determined. That it relieves much want and does a great service in preventing pauperism is not disputed ; but that it also undermines the independent spirit of the people, and that it imposes a burden upon the national industry, which not only hampers it in the world's competition, but reacts with special injury upon the class it aims to benefit, are criticisms not satisfactorily answered. No scheme of Government insurance, certainly, is adapted to a people impatient of paternalism in its rulers and thoroughly habituated to voluntary association for all common interests. The solution of the great problem, how to apply the insurance principle to the most pressing needs for

protection of the class supported by the wages of labour, IS now sought in Great Britain and America mainly in the universal offer to them of industrial insurance. The Prudential Assurance Company of London was the pioneer in this work, beginning it experimentally in 1848, but life]

gradually adapting its methods to the new field, until a generation later they showed themselves so efficient that an extraordinary growth resulted, and has continued without interruption. This company and others upon a similar plan assure whole households together for burial expenses in case of death, and a small provision for dependents or for old age, charging as premiums small fractions of a day's wages, which must be collected weekly. The great difficulties encountered were the cost of small and frequent collections, and the high rate of mortality, which is from 40 to 90 per cent, more than that in the experience of the older companies. This high death-rate

is due not so much to the fact that life is shorter in the labouring class, as to the lack of efficient medical selection, which would be too costly. The premiums, at best, must be made higher than in offices insuring for annual payments, but the demand for insurance extended as rapidly as the system could be explained, and the Prudential is said to have now in force 12,000,000 policies, with an average premium of twopence a week, secured by an accumulated insurance fund of £17,000,000. It has superseded a host of petty assessment societies of various classes without scientific basis or business Tcsponsibility, which deluded and disappointed the poor. The British Government in 1864 undertook to administer a plan for the insurance of working men, but in thirty years accomplished less than the work of one private company in a year. Eleven joint-stock companies and two mutual companies transact industrial business in the United Kingdom, besides a large number of friendly societies which have adopted similar plans. No complete statistics of their operations are available, but the claims paid by them in

1898 amounted to more than £3,900,000.

The system of industrial insurance was introduced into the United States in 1876. Its growth, though much more rapid than in Great Britain, was at first slow compared with that of recent years. The following table, condensed from the Insurance Tear-Book for 1900, is an interesting exhibit of the character as well as of the extent of this form of insurance among working men : —

Industrial Insurance in the United States.

Tear.

No. of Cos.

Insurance written.

PolioieB in force 31st December.

Insurance tn force 81st December.

Premiums

received.

Losses

paid.

1876

1880

1884

1888

1892

1896

1899

1

3

8

7

11

11

16

$400,000'

84,212,181

89,150,302

161,260,885'

276,893,928

360,852,458

619,789,085

2,500

228,857

1,076,422

2,788,000

5,118,897

7,875,688

10,048,625

$248,842

19,590,780

108,451,099

802,033,066

582,710,809

886,484,869

1,292,805,402

$14,495

1,155,360

4i486,612

11,989,540

24,852,900

40,058,701

66,159,889

$1,958

480,681

1,499,432

4,162,745

8,847,822

13,420,836

17,028,485

It is remarkable that the average weekly premium in the United States appears to be about 10 cents, or two and a half times as high as in Great Britain. The average policy is also proportionally larger, and the progressive increase in its amount deserves notice. At the rate at which the practice of insurance is now extending among working men, it would require but few years for it to become as universal in these countries as any paternal government

has aimed to make it by compulsion.

On the subject of surplus and its distribution little need be added. The very large sums officially reported as surplus by many American companies, and computed by net valuations of their contracts, are to be used with extreme caution as a means of comparing their merits. The character of their risks and their investments, the actual premiums and other terms of their con-

surpius tracts, are at least equally important elements tion.' "' of the question. But when these are satis-

factory, and no reason appears for holding a large margin beyond the computed reserve, it is safe to treat the technical surplus as real, and in mutual companies to distribute it in some form among the insured. Besides the several bonus systems mentioned in Ency. Brit, vol. xiii. p. 178, the so-called " contribution plan" deserves notice, since its theory is generally accepted by the American companies, though carried out with many variations in detail by different actuaries. The principle is, that since each of the insured is charged

in his premium a safe margin above all probable outlays, when the necessary amount under each head becomes determinate the several excesses should be returned to him. It is therefore sought to calculate what each member would have been charged for net premium and loading had the mortality, rate of interest, and expenses been precisely known beforehand, and to credit him with the balance of his payments. As a corollary of the theory of net valuations, which regards every life insured as an average life until its end, and assumes the rigid accuracy and equity of all the formulas employed to represent business facts, it is consistent and complete. But many minds find it more curious than practical, and prefer to seek equity in faithfulness to contract rights rather than in adjustments which they deem too refined, if not fanciful. The plan has met with little favour in England, where surplus is more commonly distributed on general business principles. Enormous bonuses were saved by the British offices out of the excessive premiums at first collected, and by the American companies during the epoch of high

interest rates. But the use of more accurate tables, the decline in interest, and the increased expenses of later years, have vastly reduced the apparent profits. Former methods of distributing surplus, when ascertained, have largely given way in America to novel and more complex plans. The Tontine idea, historically familiar, was for many years imitated by some offices in their assurance contracts. All premiums above outlay, in a company or a class of policies, were accumulated, only stipulated amounts being paid on death claims meanwhile maturing, with no compensation to its members withdrawing, until the end of a fixed term, when the whole fund was apportioned to the survivors. Large returns were some-times made, but many who could not maintain their policies were dissatisfied. " Semi-tontines " followed, partly meeting the difficulty by pooliag only the surplus, and allowing some return in case of withdrawal. But these cruder forms of contract are now largely superseded by various "reserve-dividend," "accumulation," "bond," and " investment " policies, with options at stated periods

between cash withdrawals and continued assurance, the simple inducement to provide against death being more or less merged in that of making a profitable investment of capital. Kew and ingenious forms of contiact are devised to meet the needs and fancies of all classes. This tendency is promoted by the growing wealth of the community, and is fostered by the companies, because small and frequent returns are far less impressive and less useful than the large accumulations of long periods.

With the general increase of wealth and intelligence life assurance and investment become ever more closely associated.

A remarkable difference in the development of life insurance between Great Britain and the United States is, that among the British companies only one-third of the assurances in force is in purely mutual institutions, while in America the proportion exceeds four-fifths. In both countries there are also "mixed" companies, in which policy-holders receive a fixed percentage of the realized surplus, often from three-fourths to nine-tenths of the whole, but the control and management are in the hands of share-

holders. These form the great majority of the proprietary oflEces in the United Kingdom, and the profits of the business have been large. The amount of capital paid in by shareholders of forty-one joint-stock companies was £5,931,000, but the capital authorized and subscribed was much more, and the subscriptions have often been paid, wholly or in part, by credits from surplus. The shares of these companies, at market prices, represent a value of at least £50,000,000, but the dividends upon these shares are drawn largely from other business, many of the largest and most

prosperous corporations conducting also fire insurance, and some of tliem marine or casualty insurance.

No branch of social statistics has been more diligently studied than this, and several governments publish classified accounts of corporations insuring lives within their jurisdiction. But the reports are not uniform in method and in periods covered, and aggregates derived from them must be used with reserve. A few tabular summaries of the general condition and growth of the business in the principal nations will illustrate the import-

ance which the institution has attained, and its present tendencies and rate of development. By the Life Assurance Companies Act, 1870, and amendments made in later years, each company issuing policies in the United Kingdom must deposit with the Board of Trade every year its revenue account and balance-sheet for the preceding year, and must at fixed intervals cause an investigation of its financial condition to be made by an actuary, and furnish the public through the Board of Trade with the detailed results, in forms prescribed by the Act. Thus these returns are the highest authority for the conditions and operations of the offices, which often supplement or anticipate them by voluntary publications. In the United States the laws exact still more minute and much prompter reports to the insurance departments of the states ; and every annual statement is required to show the results of an actuarial investigation, so that the

fullest information concerning the business in any year and the condition of each of the companies is made public early in the following year. All these facts are diligently collected, classified, and compared by statisticians for several standard annuals in both countries, especially the Post Magazine Almanack and Bourne's Directory and Manual in London, and Tlie Insurance Year-Boole of the Spectator Company in ISTew York. The first table eon-tains a condensed summary of the accounts of the British companies for 1896-99, so arranged as to show in general the volume of the business, its rate of growth, and its finan-cial results. The aggregates, however, are not precise for any date, since for some of the companies the fiscal year and the calendar year do not coincide.

Aggregate Bevenue and Assurance Accounts of British Companies.

INSUEANCE

Industrial Companies (Joint- Stock').

[life

Bendered in . .

No. of Cos. re-

porting .

Total Funds . .

Beceipts—

Premiums . .

For Annuities .

Interest and Di-

vidends . . .

Appreciation of

Investments .

Miscellaneous .

Total . . .

Diabv/raemeniB—

Death Claims and

Endowments .

Bonuses and Re-

ductions of Pre—

miums . . .

Surrenders . .

Annuities . .

Commissions and

otlier Expenses

Losses and De-

preciations . .

Dividends to

Siiareholders .

Miscellaneous .

Balance, Increase

of Funds . . .

Total . . .

Assurances in

force . . .

No. of Policies

In force . . .

1895.

1896.

1897.

1898.

1899.

j- 88

85

87

86

85

£

188,872,686

£

196,010,388

£

204,379,825

£

214,137,829

£

224,372,465

16,862,514

1,415,769

7,252,747

189,614

90,156

17,637,683

1,742,387

7,898,789

198,286

43,896

18,657,348

2,865,466

7,576,282

401,206

87,561

19,604,748

2,830,881

7,964,761

196,515

867,067

20,199,386

1,986,892

8,198,530

282,081

79,266

25,810,799

27,016,991

29,087,853

80,968,472

80,746,105

j 12,774,929

j 1,085,490

1,006,851

1,054,276

2,504,429

89,288

581,004

134,908

j 6,679,629

12,792,262

1,054,089

981,465

1,135,282

2,584,635

148,886

616,696

64,890

7,687,847

13,614,138

1,008,220

978,787

1,230,700

2,714,975

245,886

578,562

471,466

8,266,730

18,191,929

1,201,863

993,897

1,377,819

2,840,424

61,586

458,961

949,643

9,888,856

13,176,900

1,023,896

980,839

1,604,226

2,899,497

112,591

861,919

488,051

10,248,187 .

26,810,799

27,015,991

29,087,858

80,968,472

30,746,105

500,006,066

629,184,344

661,645,412

562,344,968

537,907,816

j 1,291,148

1,428,187

1,494,000

1,548,026

1,693,043

Eendered in .

1395.

1S96.

1897.

1398.

1899.

No. of Cos. re-

porting . . .

\ ”

11

11

11

11

Total Funds . .

£

11,875,423

£

12,290,052

£

14,329,635

£

15,487,618

£

16,969,333

BeceipiB —

Premiums , .

For Annuities .

Interest and Di-

vidends . . .

Appreciation of

Investments .

Capital paid in .

Miscellaneous .

5,927,885

791

(868,639

8,739

101,406

32,061

6,382,927

10,550

896,850

958

104,438

42,586

6,616,618

6,114

486,808

53

111,064

39,067

7,151,109

5,734

480,264

1,863

116,853

43,644

7,570,150

1,685

528,361

1,788

104,433

49,168

Total . . .

6,484,461

6,988,864

7,209,214

7,798,467

8,250,580

Diaburami&nta —

Death Claims and

Endowments .

Bonuses and Re-

duction of Pre-

miums . .

Surrenders .

Annuities . .

Commissions and

other Expenses

Losses and De-

preciations . .

Dividends to

Shareholders

Miscellaneous .

Balance, Increase

in Funds . .

2,647,882

27

20,893

2,418

j- 2,572,780

i 864

281,256

93

j 1,059,348

2,418,764

13

25,220

3,806

2,788,915

208

286,119

690

1,414,629

2,774,101

8

24,353

4,151

2,919,529

92

333,644

46

1,158,295

2,751,230

579

27,702

4,733

3,159,90^

4,269

382,331

600,075

967,142

2,912,046

288

87,836

5,142

8,272,583

4,041

886,771

100,053

1,531,315

Total . . .

6,484,461

6,938,854

7,209,214

7,798,467

8,260,680

Assurances in)

Force . . .)

128,064,110

144,142,569

147,187,937

162,078,819

166,988,498

No. of Policies j

in force . .)

13,324,778

14,990,681

15,801,621

15,860,654

17,230,712

A similar table follows, summarizing the accounts of

American companies reporting to the New York Insurance

Department. The income and outgo here include those

of the industrial business, but the assurance account is of

ordinary assurances only.

Aggregate Bevenue Account of American Companies having

Agencies in New York.

1895.

1896.

1897.

1398.

1899.

No. of Cos.

85

36

35

36

37

$

$

i

$

$

Funds .

Beceipts —

Premiums

1,142,419,926

1,228,824,842

1,384,051,345

1,451,116,914

1,576,834,673

211,621,718

213,676,475

238,830,276

247,639,649

276,687,528

For Annui-

ties . . .

8,577,584

5,038,846

6,064,135

5,027,386

6,400,834

Other In-

terest, D i –

■ 61,697,900

55,658,786

61,873,763

68,098,594

72,907,648

vidends,

&c . . . .

Total

Disburae-

266,897,202

279,873,107

801,263,179

320,810,623

865,946,005

menta —

Death

Claims

I 71,926,224

76,110,579

76,977,875

81,409,305

92,800,710

Endow-

• 10,471,786

12,026,828

12,725,176

13,872,113

16,323,268

Annuities

2,394,662

2,631,399

2,985,266

3,367,804

8,664,728

Bonuses,

1

Dividends

to Policy

\ 16,297,604

17,083,169

18,425,197

19,700,600

20,917,148

Holders

Surrenders .

22,889,498

26,868,039

26,431,812

26,437,777

23,080,966

Commis-

sions,

Taxes, and

■ *62,052,872*

64,160,732

67,682,026

72,898,502

86,622, f.9T

other Ex-

penses . .

Dividends

to Share-

741,318

798,052

789,664

829,151

746,068

holdors

Total

S

185,772,904

199,178,298

206,866,394

218,615,257

248,154,559

Assurance Account.

1895.

1896.

1897.

1898.

1S99.

Ordinary-

Assurances

In force

No. of Poli-

oies in

force

$

4,818,170,945

4,967,576,418

5,285,726,646

$

6,680,058,811

6,266,908,078

1,877,303

1,976,747

2,156,241

2,861,697

2,700,660

life]

INSUEANCE

The reports of tlie insurance department of New York cover more companies than those of any other state. The institutions not included in them are about thirty-five in number, mostly small and local. In the aggregate, as appears by their statements to the authorities of the states in which they organized, they held, 31st December 1899, in accumulated funds ^24,470,240; their aggregate income for the year was $9,972,260; with assurances in force at the end of the year, $231,301,327. The New York reports, therefore, may be accepted as representing 95 per cent, of the entire business of the United States. On the other hand, while the amount of life assurance done by British and other foreign offices ia the United States is insignificant, fourteen companies of the United States have agencies in Canada (ten for new business), and four transact business in Europe and in other parts of the world. The foreign operations of these companies brought in 1899 premium receipts of $34,609,291, and their assurances in force upon foreign lives was

$826,537,158. Thus the home business of the American companies is in the aggregate about 87-|- per cent, of the whole.

There are fifteen companies engaged in industrial insur- ance in the United States, whose aggregate assurances in force were as follows, on 31st December of each year : —

1896.

1896.

1897.

1898.

1899.

Industrial As- 1

Burances .)

Number off

Policies . f

$

819,621,578

$

886,484,869

$

995,545,736

$

1,109,526,870

$

1,292,806,402

6,943,769

7,875,688

8,000,636

8,794,178

10,048,625

The statistics of life assurance in the Dominion of Canada are collected and published by the insurance department with the same diligence as in New York.

A summary follows of the ordinary life insurance business transacted by the Canadian companies during the years 1895 to 1899. Sixteen of these are joint-stock companies, the one mutual company holding about 9^ per cent, of the assurances in force, and issuing about 8^ per cent, of the new assurances in 1899.

Life Insurance Business of Canadian Companies.

1895.

1896.

1897.

1898.

1899.

No. of Companies

No. of Policies ?

Issued . . .)

Assurances of)

New Policies ‘ f

Total Premiums 1

Eeceived . . J

*Income from**

other Sources j

Policy Claims paid

Expenses . . .

Dividends onl

Capital . . f

Capital Stock paid 1

In . . . f

Life Assurance]

Funds(exclu8ive J

of Capital). .)

Assurances in)

force 31st De- {

ceraber 2 . .)

18

18

16

16

17

22,181

23,827

8^,840

41,686

42,054

$32,027,664

6,259,758

1,608,611

1,784,762

1,729,351

132,113

848,729

34,658,727

204,414,026

$31,611,074

6,905,674

1,576,037

2,268,575

1,806,656

76,291

866,041

88,826,142

214,208,998

$38,576,944

7,469,350

1,992,260

2,420,631

2,138,898

83,774

1,480,958

42,108,403

231,827,406

$42,984,588

8,291,226

2,074,299

2,540,406

2,483,487

87,956

1,816,862

46,669,716

252,077,492

$48,890,881

11,834,838

2,183,242

2,873,845

2,616,220

88,510

1,976,679

51,785,129

279,962,174

There are also fourteen British companies and fourteen of the United States which report Canadian business to- the Government office, though five of the former and four of the latter group have ceased to issue new policies there. The financial operations and policy accounts of these companies are included in their statements to the British Board of Trade and to the New York State Department. The assurances in force upon Canadian lives in these companies were as follows : —

14 British Companies

14 American ,,

Dec. 31, 1895.

134,451,168

93,402,067

Dec. 31, 1899.

$38,025,948

104,460,607

None of the tables given above include the business done by assessment insurance associations, orders, and companies, most of which is of a local or ephemeral character. The volume of it in

Life Assurance Companies on the Continent of Europe.

Business of 1898.

New

Assurances.

Total

Assurances.

Premiums

Eeceived.

other

Incomes.

Claims Paid.

Annuities

Paid.

Funds.

Capital

Paid In.

Germany —

28 JoinVStock Cos.

34 Mutual „.

Total . : .

France —

17 Joint-Stock Cos.

Austria —

10 Joint-Stock Cos.

10 Mutual „.

Total . . .

Russia —

8 Joint>Stook Cos.

*Holland *—*

*22 Joint-Stock Cos. *

2 Mutual „ J

Sweden —

12 Joint-Stock Cos. ■

3 Mutual ,, ,’

Switzerland —

5 Joint-Stock Cos. ”

2 Mutual „ /

Denmark—

*3 Joint-Stock Cos. *

3 Mutual ,, J

Italy—

3 Joint-Stock Cos.

Norway—

4 Joint-Stock Cos. 1

2 Mutual ,, /

£20,670,633

17,348,753

£38,019,386

£173,436,668

178,667,545

£352,104,213

£8,112,066

6,954,597

£15,066,663

£2,083,809

2,081,328

£4,165,137

£2,503,592

2,949,043

£5,452,635

£382,825

180,623

£563,448

£49,960,803

56,577,207

£106,538,010

£80,139,881

£18,921,284

6,388,407

£25,309,691

£1,706,555

£1,677,127

£13,923,178

£142,288,325

£1,427,526 8

£270,694

£2,148,363

£56,961

27,493

£84,444

£47,133

£119,975

£11,120,370

3,507,042

£14,627,412

£73,441,978

23,893,985

£97,335,963

£2,472,091

931,154

£3,403,245

£708,237

239,943

£948,180

£471,861

£1,112,070

367,337

£1,479,407

£1,156,250

£1,212,800

£7,994,630

£45,398,731

£1,665,584

£562,273

£365,617

£9,792,693

£6,699,513

£6,186,412

£3,466,040

£36,654,-367

£1,376,157

£206,959

£.395,3.36

£622,492

£187,663

£49,451

£555,380

£118,851

£5,220,167

£28,457,540

£904,299

£762,973

£438,252

£341,054

£175,099

£233,373

£248,016

£39,107

£48,821

£16,954

£18,797

£1,002,215

£19,220,874

£202,925

£209,525

£119,582

£62,823

£326,824

£311,064

£131,739

£43,980

£5,480,976

£1,458,099

£9,179,379

£5,744,744

£2,107,397

£1,194,736

£8,450,982

£858,021

£5,254,503

£1,304,915

1 Including renewals, but exclusive of industrial policies.

8 Credit balance after payment of claims, &c.

2 Exclusive of industrial assurances.

- *The largest company is included only in the last two columns.*

[maeinb

the United States and Canada was very large a few years ago, but

it is rapidly declining in amount and in public confidence, except

where it is made an incident of membership in a benefit society. No general statistics relating to it are sufficiently comprehensive and accurate to be of value.

In the principal countries of continental Europe life assurance is offered by the chief international institutions of Great Britain and the United States, and their policies are in force probably to the aggregate amount of £140,000,000. The domestic companies have been stimulated to increased activity by the aggressive canvassing of the foreign agencies, and the business in recent years has grown rapidly, until now the total sum assured upon lives on the continent of Europe is little less than a milliard of pounds sterling. The preceding table collects in outline the accessible information concerning the life insurance companies of the countries named, as shown by their published reports at the close of 1898, all amounts being reduced to sterling money. Where the annuities paid are not specified, they are included in claims paid. The column of " Funds " gives the amount of accimiula^ tions held for life assurance in addition to the share

capital, but in a few instances amounts held for other branches of business are included.

In Belgium there are four flourishing life companies, with accumulated funds of at least £1,500,000, and paying large dividends to shareholders. There are also six in the Balkan peninsula, three of them at Bucharest, most of which transact several kinds of insurance and are prosperous, though of only local importance. In Australia there are eleven domestic companies in the field, besides the Government Life Insurance Office of New Zealand. These Australasian offices together collected in 1899 premiums to the amount of £2,879,642 ; paid for death claims, £1,097,279 ; for endowments, £469,894 ; for annuities, £44,265 ; for surrenders, £517,714 ; and in cash bonuses, £69,458. They issued new assurances for £9,194,752, and held at the end of the year accumulated funds of £26,783,808. There are three small domestic corporations for life insurance in India, one in China, and two in Cape Colony, all conducted by Enghshmen ; but Brazil has five, the Argentine Eepublic one, Mexico two, and Japan thirty-three companies, organized and carried on by native managers. (c. t. l.)

V. Maeinb Insurance.

Marine insurance long antedates the kindred businesses of fire and life insurance. Villani, a 14th-century Florentine historian, speaks of marine insurance as having originated in Lombardy in 1182. This proves, at least, that in his day it was no novelty. It is mentioned in a Pisan ordinance of 1318, and in Venetian public documents of the early years of the 15th century. The earliest niatory. fQjm Qf policy known is that given in the Florentine statute of 1523. It is uncertain whether insurance was introduced into England directly from Italy or by way of Flanders. The earliest policies issued in England which have yet been discovered are in Italian, but the subscriptions are in English (Santa Maria di VeneMa, Cadiz to London, 1547, Santa Maria de Porto Salvo, Hampton to Messina, 1548).

The earliest known policies in English are one of 1555 on the Sancta Crux "from any porte of the Isles of Indea of Calicut unto Jiixborne," and one of 1557 on the Ele from Velis Maliga to Antwerp. In the Sancta Crux policy there is no detailed statement of perils insured against, or of risks undertaken by the

underwriter ; the whole obligation of the underwriter to the assured is embodied in the following words ; — "We will that this assurans shall be so strong and good as the most ample writinge of assurans, which is used to be maid in the strete of London, or in the burse of Andwerp, or in any other forme that shulde have more force." This reference to Antwerp usage is 67 years before the date of Malyne's statement that all Antwerp policies contained a clause providing that they should in all things be the same as policies made in Lombard Street of London. The wording of the English policies written In Italian is very much simpler than the Florentine form of 1523, from which it almost seems that the wording used in England followed an earlier Italian form. But even the Italian policies in the two Santa Marias mention the uses and customs of " questa strada Lombarda di Londra " as the standard of the assurance they afford. The next most ancient policy we possess is dated 1613 ; it covers goods on the Tiger from London to " Zante, Petrasse, and Saphalonia." This document is much more ample than any of those already mentioned : it details the perils insured against in words closely resembling the Florentine formula of 1523, and differing only slightly from the

form adopted by Lloyd's at a general meeting held in 1779, and afterwards incorporated in the Sea Insurance Stamp Act of 1795, which is the stem form of all modern British and American marine insurance policies.

While the form of the insurance policy was thus developing, there was a singular absence of legislation (and, as far as we can yet trace, of litigation) on the subject. Till 1601 differences seem to have been generally settled by arbitration. This accounts for the poverty of the British Admiralty records in matters of marine insurance. In 1601 a special tribunal was established by statute for summary trial of disputes arising on insurance policies ; but, owing mainly to the opposition of the common-law judges, the new court languished, and by 1720 it had fallen into utter dis-use. Park states that not more than sixty insurance cases were reported between 1603 and 1756. Consequently, when Lord Mans-field came to the Court of King's Bench in the latter year, he found a clear field. He practically created the insurance law of England. He made use of all the Continental ordinances and codes extant in his day, taking his legal principles largely from them ; the customs of trade he learnt from mercantile special

jurors. Subsequent legislation referred solely to the prohibiting of certain insurances (wager policies, &c.), the naming in the policy of parties interested therein, and the stamp duty levied on marine insurances. In 1894 Lord Herschell introduced his Marine Insurance Bill, which endeavoured " to reproduce as exactly as possible the existing law relating to marine insurance." This Bill has been examined and amended by various bodies of parties interested, and was referred to a committee. It was reprinted in 1899, but has not yet become law. In America a similar fate has attended the insurance code, forming part of the proposed civil code of New York, completed and published in 1865, of which a very slightly altered version was adopted in California and has been in effect there since 1st January 1873. On the Continent legislation at first took the form of local ordinances of commercial cities, such as Barcelona (1434-1484), Florence (1523), Burgos (1538), Bilbao (1560), Middelburg (1600), Rotterdam (1604-1655). In the third quarter of the 16th century Rouen produced a handy guide to marine insurance, Le guidon de la mer ; and in 1656 Cleirac published there his TTs et coutumes de la mer. This was followed in 1681 by the Ordonnance de la marine, which, through Lord

Mansfield, had a great effect on English case law. In 1807 France produced the Code de commerce, on the model of which nearly every European nation has issued a similar code. Probably the best of these, and the most adequate as regards marine insurance, is that of the German Empire ; but Hamburg and Bremen still preserve many of their local conditions by special contract in their policies. At the Buffalo conference of the International Law Society in 1899 an attempt was made to harmonize some discrepancies between the insurance contracts of different States, and the matter was referred to a committee, which reported to the conference of 1900 at Rouen, and of 1901 at Glasgow.

A contract of marine insurance is a contract of indemnity, whereby the insurer undertakes to indemnify the assured, in the manner and to the extent agreed, against marine losses, i.e., the losses incident to marine adventure. There is a " maritime adventure," where any ship, goods, or other movables are exposed to maritime perils, such property being termed " insurable property " ; also where the earning of any freight, hire, or other pecuniary profit or benefit, or the security " '"'■

for any loan or expenditure, is endangered by the exposure of insurable property to maritime perils ; and where any liability to a third party may be incurred by the person interested in or responsible for insurable property by reason of its exposure to maritime perils. By " maritime perils " are meant the perils consequent on or incidental to the navigation of the sea, i.e., perils of the seas, fire, war perils, pirates, rovers, thieves, captures, seizures and restraints, and detainments of princes and peoples, jetti-sons, barratry, and any other perils, whether of the like kind or not, which may be designated by the policy.

The contract being one of indemnity against maritime perils, it is evident that no one can derive benefit from it who has not some marine]

interest exposed to these perils. Hence the illegality of " wager " policies which are made "interest or no interest," or "policy proof of interest," or "without benefit of salvage," or subject to any other such term (19 Geo. II. c. 27). Wager policies are illegal

only in the sense of being null and void to all intents and purposes. They cannot be sued upon, hence they are known as "honour" policies. They are of frequent use, generally for the protection of interests which, though real, are not easily defined, or are of pecuniary value hard to determine. But they are utterly ignored by the courts. The essential of insurable interest is the pecuniary advantage seen at the time of insurance as arising to the person in question from the safety or due arrival of the adventure, or the pecuniary disadvantage similarly arising from its loss or deterioration. But such interest may lapse before arrival or destruction of the venture, and with the interest lapses the right of the assured to recover from the underwriter. Should the assured simply transfer his interest to another, e.g., by sale, he can assign his policy to the party who acquires his interest — unless, of course, the policy contains terms expressly prohibiting assignment. The customary form of assignment is endorsement of the policy either in blank or to a specified party. Within the limits already named, uiterests are insurable whether complete or partial, defeasible or contingent ; similarly loans on bottomry or respondentia, advance freight not repayable in case of loss, charges of insurance, and

shipmaster's, but not yet officers' or seamen's wages. The owner of insurable property may insure its full value even though, some third party have agreed or become liable to indemnify him in case of loss :

■* "*■ *a mortgagor has the same right of insuring to full value ; while a mortgagee may insure only up to the sum due or to become due to him under the mortgage, unless the mortgagee is insuring for the benefit of the mortgagor as well as for himself, in which case, even though he insure in his own name only, he may insure up to the full value. A consignee may insure in his own name the total amount of his interest and that of others for whose benefit he insures. Where no special contract is made between assured and underwriter, the insurable value of certain matters of insurance is ascertained as follows. Ship — Her value at the commencement of the risk, including outfit, provisions, stores, advances of wages, and any other outlays needed to make the ship fit for the voyage or period of navigation covered, plus cost of insurance upon the whole. In the case of a steamship,*

the word " ship " includes machinery, boilers, coals, and engine stores. In the case of a vessel engaged in a regu-lar trade, the word "ship" includes the permanent fittings necessary for that trade. Freight (whether paid in advance or not) — The gross amount of freight at the risk of the assured, plus cost of insurance. Goods — The prime cost, plus expenses of shipping and cost of insurance. Other Interests — The amount at the assured risk when the policy attaches, plus cost of insurance.

A contract of marine insurance must be embodied in a document called a policy, which must specify the name of the assured (or of his agent in the effecting

Policy. q£ ^j^g policy), the undertaking to insure, the objects insured, and the risk insured against, the voyage or time (or both) covered, the sum insured, the name of the assurers. The signature of the assurer is necessary ; it is found at the end of the policy, and he is often on this account called the underwrit-er. The objects insured must be designated with reasonable certainty, regard being had to customary usage. The undertaking is usually expressed

by saying that the assured or his agent " doth make assur-
ance and cause himself to be insured." The risks are
either the whole bodj"- of maritime perils detailed above,
or any one or set of these, or any other named peril
against which the assured desires protection. There is
no restriction by law of the length of voyage that may
be insured, but time policies are invalid if made for
more than one year ; a voyage and a period of time not
exceeding a year may be covered on one policy. Policies
are classed as time or voyage policies. It is not necessary
to state in the policy the value of the objects insured, but
generally the value is given ; policies are therefore classed
as valued or unvalued, the latter being often called open
policies. The values of objects insured under open or
unvalued policies are the insurable values given above.
As it frequently happens that merchants desire to have
all their shipments covered, by whatever vessel they may
come, they require insurance in general terms ; such a
policy is termed a floating policy. It states the limits of
voyage and value covered by the underwriter, ^nd the

class of ships to be employed. The particulars of each shipment are declared as the shipments occur, the declarations being usually endorsed on the policy. All shipments within the terms of the policy must be declared at their honest value, or in accordance with the special provisions of the policy, if any.

The consideration paid by the assured to the underwriter in return for the protection granted by the latter is called the premium. Until payment be made or tendered the policy is not ordinarily issuable, i.e., unless otherwise agreed. When the assured effects insurance with an underwriter through a broker, then, unless otherwise agreed, the broker is liable for the premium to the underwriter, who is, however, directly responsible to the assured for losses or liabilities falling on the policy. But the broker has a lien on the policy for the premium and for his brokerage, and in case he has had dealings as a principal with the assured, he has a lien on the policy for any balance due to himself in insurance transactions, unless he should have known that in these transactions the assured was merely an agent. Some policy forms state definitely that the premium has been paid ; when such a form is

used and no fraud is proved, this receipt is binding between assured and underwriter, but not between broker and underwriter. If an insurance is effected at a premium "to be arranged," and no aiTangement is made, then a reasonable premium is payable. The same holds where additional premiums have to be charged at a rate to be arranged and no arrangement is made.

It is evident that in nearly all the particulars of any adventure insured by an underwriter he is entirely dependent upon the assured for correct information. It is therefore the law that an insurance contract can be avoided and broken by either of the parties to it if the utmost good faith be not observed by the other. The obligation of perfect good faith is thus made reciprocal. Bad faith may show itself either in concealment or in misrepresentation. It is therefore made essential to the stability of any insurance contract that the assured must disclose before conclusion of the contract every material circumstance known by him, failing which the underwriter may avoid the contract. Every circumstance is deemed material which would influence the underwriter in his decision as to acceptance of the risk or the fixing of the rate of premium. Consequently the assured is not bound, unless specially

asked by the underwriter, to disclose the favourable features of the risk offered, or matters known or presumably known by the underwriter (matters which are of common knowledge, and such as an underwriter ought in his usual business to be aware of), or matters respecting which the underwriter waives or declines information, or which the nature of the transaction renders superfluous. An agent effecting an insurance must, in addition, disclose everything material known to himself, or that he should know in the ordinary conduct of his business. Every representation of material fact made to an underwriter before conclusion of a contract by the assured or his agent must be true, or the underwriter may avoid the contract. Every representation is material which would influence thfi underwriter in his decision as to acceptance of the risk or to filing of the rate of premium. A representation of fact is regarded as true if it be substantially correct ; literal correctness is not "essential. A representation of expectation or belief is true if it is made in good faith. The contract is deemed to be concluded when the underwriter accepts the risk.

It frequently happens in the course of business that before a vessel has completed the venture on which she

is engaged arrangements have already been made for her future employment. Where a vessel is insured on time, this is of no moment as respects her insurance. It has likewise been decided that where any insurable object is covered by a voyage policy " from " or ^sured "at and from " a named place, the policy is not rendered invalid by her not being at that place when the insurance is concluded ; but, on the other hand, there is an implied condition that she will begin the venture

within a reasonable time, and that if she fails in this the underwriter may avoid the contract. If the delay springs from circumstances known to the underwriter at the time of conclusion of the contract, or if the underwriter then acquiesces in it, the implied condition is nullified. If the assured abandons the venture insured, the contract expires ; e.g., if, before the risk commences, the vessel's destination is changed to one not covered by the policy. Where

the policy specifies a place of departure, and the ship does not sail from th^it place, the risk does not attach. If, however, the vessel actually starts from her intended port of departure, and commences the venture, and thereafter it is decided to change her destination, this decision constitutes a change of voyage. In default of provision to the contrary the underwriter may elect to avoid his assurance from the time of that decision, although the ship be still in the course she would have followed in her originally intended venture.

Should a ship depart from the proper course of the voyage she starts upon, and for which she is insured, such departure, when made without lawful excuse or justification, is termed deviation. From the moment it occurs, even though she subsequently return to her proper course without loss or injury, the underwriter may avoid his contract ; but the intention to deviate is not effective. Deviation occurs (1) when in a policy a course is definitely specified and the vessel departs from it ; (2) when, in absence of such definite specification in the policy, the vessel departs from the coarse usually and customarily followed in the voyage insured ; (3)

when, in absence both of definite specification in the policy and of customary course of navigation, the vessel, to the knowledge of the assured, departs from the course which would be followed by a prudent master acting in a seamanlike manner. If a policy provides for several named ports of discharge, the vessel may, without committing deviation, omit to proceed to one or more ; but whether she goes to all or to some she must (in absence of usage or sufficient cause to the contrary) take them in the order in which they appear in the policy. If the policy provides for ‘ ‘ ports of discharge ” in a given district, then (in absence of usage or sufficient cause to the contrary) unless the vessel proceeds to them in their geographical order she makes a deviation. Similarly, in the case of a voyage policy, the want of reasonable despatch throughout, unless lawful excuse or justification exists, entitles the underwriter to avoid the contract from the time that the delay becomes unreasonable. As excuses for deviation or delay on the voyage contemplated by the policy, the following are regarded as valid : authorization by license or other provision in the policy, force majeure, compliance with express or implied conditions of the policy (e.g., warranties, see below), reasonable

steps taken for the safety of the ship or other objects insured, saving life, or helping a ship in such distress that life may be in danger. If barratry is insured against, delay arising from barratrous conduct of master or crew does not avoid the policy. A deviation ceases to be excusable unless the ship resumes her proper course and proceeds on her voyage with reasonable promptitude after the cause of the reasonable delay ceases to be effective.

In every contract of insurance there are certain conditions precedent to the liability of the underwriter and incumbent on the assured, which must be fully and literally complied with, whether material to the risk or not. These conditions are known in insurance as warranties. The name is unfortunate, as in every other branch of the law of contract it bears another meaning ; still it is convenient, and its insurance signification is now firmly established. Failure on the part of the assured to fulfil a warranty literally entitles the underwriter to avoid his contract as from the moment of breach,' but it does not limit his obligation up to that moment. Breach of warranty is not nullified by sub-

sequent remedy of the breach, consequently loss occurring after breach of warranty is not at the charge of the underwriter, even although before the loss the assured

1 Lord Mansfield expressed it : "The warranty in a contract of insurance is a condition or a contingency, and unless that be performed there is no contract " {Hibbert v. Pigou, apud Marshall, 3rd ed., p. 375).

Warraa

iles.

has again complied with the warranty. Breach of warranty is excused in two cases only : (a) when by change of circumstances the warranty ceases to be applicable to the contract, (b) when by subsequent legislation the warranty becomes unlawful.

"Warranties are of two classes : (1) express, (2) implied. Express warranties must be written or printed on the policy, or contained in some document explicitly referred to in the policy, and so regarded as incorporated in the contract. No special form of words is essential to the validity of a warranty if the intention to warrant can be inferred. Express warranties may refer to any-

thing which the parties to the contract choose, e.g., the nationality of the vessel, her sailing on a named day, proceeding , under convoy, being excluded from certain voyages or trades or the carriage of certain cargoes, being " well " or " in good safety " on a named day (in which case the warranty is fulfilled if she be safe at any time of that day). As regards nationality, if no express warranty be given there is no undertaking on the part of the assured that the vessel is of any particular nationality, or that she will not change it while the risk lasts. The warranty of neutrality in case of a ship's insurance means that at the commencement of the risk the vessel concerned is actually neutral, and that as far as the assured can control the matter she shall so continue during the whole course of the risk. It is also an implied condition of the ship being warranted neutral that to the utmost of the assured's power she must carry the papers necessary to establish her neutrality, must not falsify or suppress these papers, or use simulated papers ; if this condition is broken the assurer can avoid the contract. Where goods are insured and warranted neutral, they must be owned by neutrals during the whole course of the risk, be properly documented, be shipped to a neutral

destination on a neutral vessel, which must, so far as she is within the assured's control, remain neutral throughout the venture.

The words of an express warranty are always to be taken in their commercial sense ; within that sense they are to be strictly and literally taken.

In addition to these expressed conditions, there are also certain essential factors or conditions inherent in each and every contract of marine insurance without exception ; these are implied warranties, which are presumed from the very fact of the making of the insurance. They are (a) completion of the prescribed venture without deviation, (6) legality of the venture (viz., that the adventure insured is a lawful one, and that, so far as the assured can control it, it shall be carried out in a lawful manner), (c) seaworthiness of the ship. In a voyage policy it is an Implied warranty that at the commencement of the voyage the ship shall be seaworthy for the particular venture insured. If the risk commences when the ship is in port, then she must in addition be reasonably fit to stand the ordinary dangers of the port. If the voyage insured is one in which different degrees of peril are to be encountered, or for which the ship needs different kinds of outfit

at different stages, then she must be seaworthy for each stage at its commencement, and the warranty will be fulfilled if she is at the beginning of each stage seaworthy for that stage. The warranty of seaworthiness is held to be fulfilled when the ship is reasonably fit in every respect to meet the ordinary marine dangers of the venture insured ; that is to say, the mere loss of a vessel by perils of the sea is not a proof of unseaworthiness in the sense of this warranty. The^ only ship policies not subject to the warranty of seaworthiness are policies on time (the reason given being that there is nothing to prevent a time policy lapsing and a new one commencing when the vessel is at sea beyond her owner's control as to seaworthiness) ; but where the assured knowingly sends a ship to sea in an unfit state, and the loss is produced by that unseaworthiness, the underwriter is not liable for such loss. It is not implied in a policy on goods or movables that these goods, &c., are seaworthy.

When the main points of the preceding particulars of the contract of insurance are summarized it may be said that the transaction is (1) a contract of indemnity reduced to written or printed words, (2) made in good faith, (3)

referring to a defined proposition or amount, (4) of a

genuine interest in a named object, (5) being against

contingencies definitely expressed, to which that object is

actually exposed, and (6) in return for a fixed and deter-

mined consideration. The presentation of the contract

in words may fail to convey the complete

common intention of the parties making it, and '^^J"""^'

it is therefore necessary to state in what way

the written document is properly to be interpreted. Duer

(M. I. i. 158, 1 69) states that with the exception of con-

marine]

ditions in a policy which are construed as warranties,

and must be literally fulfilled,

the actual intention of tlie parties is the controlling principle from

which all the special rules of interpretation flow, and to which

they are all subsidiary and subordinate. These rules have no

positive and arbitrary force.

But as the policy is a written instrument, account must

be taken of its wording. The terms used in the policy

are assumed to be understood in their plain, ordinary, and popular

sense, unless they have generally in respect to the subject matter,

as by the known usage of trade and the like, acquired a peculiar

sense distinct from the popular sense of the same words, or unless

the context evidently points out that they must, in the particular

instance and in order to effectuate the immediate intention of the

parties, be /understood in some special and peculiar sense (Ellen-

borough, Bobertson v. French, 1803).

In briefer form, the words of the policy are to have

their proper value and effect given to each of them, and

to be understood in their plain sense, except in so far as

they are affected by (a) custom or (b) context.

(a) As regards custom, the policy is interpreted in

accordance with the usages of the particular trade in

which the adventure insured is engaged or employed.

In fact, a valid usage is a part of the contract.

Lord Mansfield «aid, "Usage is always considered in policies of

insurance even when the words are plain" (^Preston v. Greenwood,

1785); and BuUer, J., stated that "Usage not only explains but

controls the policy" (Long . Allen, 1785). Duer (M. Z i. 245) develops this dictum as follows : " Where the words to be interpreted are indeterminate or ambiguous, the usage explains them ; but when they convey a definite meaning that the court would be bound to adopt, or their construction has been settled by law, the usage controls them : and in these cases it does set aside what, judging alone from the terms of the policy or the rule of law, was the plaiu intention of the parties ; but, in controlling, the usage does not contradict the words — it merely varies by extending or enlarging their application."

(6) The contract being one contract, the various parts of it are reasonably to be expected to tend to one end ; therefore the document must receive the effect of its general scope and intent. Consequently, should there be two possible readings of an ambiguous clause, the one of which would add nothing to the contract as expressed elsewhere, while the other adds to the effect of it,- the latter interpretation is to be adopted. It cannot have been added without the intention of extending the contract. But this principle operates within the limits pre-

scribed by the nature of the insurance itself ; so the words insuring against "all other perils, losses, and misfortunes " are restricted to apply only to occurrences of the same class (ejusdem generis) as those perils enumerated in the policy. Similarly, as the policy has been for the last 150 years generally a printed document, clauses specially added have attached to them more weight than the ordinary text of the policy. These may be printed clauses in the margin of the policy, or printed clauses impressed on or attached to the policy, or clauses written on the policy. At each stage we come nearer to the circumstances of the particular risk and the special contract of assured and underwriter. Duer {M. I. i. 166) puts it, the printed words "may not express the intentions of the parties," while the written words "certainly do": it might be safer to say " are certainly expected to do so." The policy being a contract of indemnity to the assured, its provisions in his favour are to be taken cumulatively, and not as restricting or excluding one another, the underwriter being taken to intend that he shall under-

*stand the indemnity given to be as extensive as its terms will upon any fair consideration import. Similarly, as the policy is the language of the underwriter, any ambiguity in it must be taken most strongly against him. It has become a settled rule of marine insurance that " the underwriter is liable for no loss which is not proximately caused by the perils insured against." The decisions of the courts lead to the conclusion that what has to be done is to determine the imme- p^"*f,,a. diate, the very last cause of the loss or damage ; if this very last cause is one of the perils insured against, or is ejusdem generis, then the loss or damage is at the charge of the underwriter, unless there is among the more remote causes personal fault of the assured, simple tear and wear, ordinary leakage and breakage, unseaworthiness of the vessel, or the inherent nature of the article insured (vice propre). Where a policy insures against only certain named perils to the exclusion of others, it becomes of primary importance as regards the incidence of liability to determine whether the causa proxima (the immediate*

cause) of any particular disaster is of the perils enumer-
ated in the policy or not. Some of the most difficult ques-
tions of marine insurance have arisen in this connexion.
The earliest English policies named neither the perils
which they were meant to cover, nor the kinds of losses
for which the underwriters were liable, nor the
pecuniary limit to which that liability extended. “ °’
Later policies designated the perils, but none “^’
of them contains full details either of the kind of losses
covered by them or of the extent of the underwriter’s
liability. In the ” sue and labour ” clause (which ap-
pears to be indigenous to England, and has not yet been
traced farther back than the policy of 1613 on the Tiger)
particulars are given of the special kind of liability im-
posed by it on the underwriters, and the principle of pro
raid liability of the several underwriters is stated. But
this is only a subsidiary side-contract dealing with par-
ticular charges. The ” waiver ” clause, which grew out
of the ” sue and labour ” clause, mentions ” abandonment ”
as somehow connected with the perils insured against;

but this clause is not found as early as 1613. Lastly, in the Memorandum, which was first introduced into policies about the year 1749, there are found the words " average, unless general." It is therefore only in an indirect way that we can arrive at a knowledge of the " losses and misfortunes " that are at the charge of the underwriter. One occasion of liability must from the first have presented itself as indubitable, namely, actual total loss arising from any of the perils insured against. Very nearly allied to it is total loss by disappearance, manifested by want of news within reasonable time respecting the venture, i.e., the case of a "missing ship." Next comes the case of an insured object being so damaged by perils insured against, that although not actually and absolutely lost, it is to all reasonable and commercial intents and purposes as bad as lost: this is what is known as "constructive total loss." But marine perils may produce loss not necessarily total, i.e., partial loss : it may only amount to " damage," which may be either a diminution in quantity (total loss of part) or a deteriora-

tion in quality of the objects insured. The liability attaching to a marine policy for such losses less than total is termed " average." When the loss is in the end borne by the various parties to the venture, the average is called " common " or " general average " ; when it is throughout entirely borne by the party interested in that object, it is known as "particular average." Again, as is explained above, there are side-agreements embodied in the same document as the ordinary insurance contract, dealing with "sue and labour" expenses or "particular charges," and (in most modern steamer and sailer policies) there is the clause in which the underwriter assumes liability for a stated proportion of the vessel's liabilities for damage done by "running down" another vessel in collision.

The law on these various losses is as, follows.

A total loss may be (1) actual, or (2) constructive ; and

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an insurance against total loss covers the assured against both, unless a different intention appears from the terms of the policy. It is an actual total loss when o OSS. ^j^g object insured is completely destroyed, or is damaged beyond repair — so as to cease to be of the denomination of goods to which it belonged when insured, or so as to be incapable of reaching destination in specie — or when the assured is irretrievably deprived of the property insured. Under this may be regarded the case of a missing venture, i.e., where after a reasonable lapse of time no news has been received of the ship concerned, in which case an actual total loss may be presumed. When a ship is so damaged by perils insured against that the costs of repairing the damage would exceed the value of the ship after repairs, there is a constructive total loss. Among the costs of repair are reckoned the expense of future salvage operations and future contributions to general average which the ship would have to make. (It appears to be doubtful whether the damaged value of the ship should come

into calculation at all : if so, then it should be deducted from the repaired value of the ship: v. Tlie Gallia, before Phillimore, J., Liverpool, 6th December 1899). If the assured is deprived of possession of his ship by an assured peril, and it is doubtful whether her recovery is possible, or can be effected at a cost less than her value when recovered, there is a case of constructive total loss of ship. In the case of all interests other than ship, where the damage or deprivation by insured perils is so severe that it is not, in view of the cost, commercially reasonable to insist on the completion of the venture, there is a constructive total loss. In determining what is commercially reasonable, regard is to be had to the course which would be adopted in the same circumstances by a prudent person uninsured.

When the assured has proved his loss to be constructively total, he must decide within reasonable time whether he will treat the loss as partial (and receive his indemnity as described below under partial loss), or as an actual total loss, and abandon the object insured

to the underwriter. If he elects the latter he must give notice of abandonment, failing which the loss will be treated as merely partial. ITotice of abandonment must clearly indicate the intention of the assured to abandon the goods without reserve or condition to the underwriter: it may be spoken or written, or partly spoken and partly written. ISTotice should be given as soon as the assured has such definite intelligence as will enable him to make up his mind that the venture is in effect totally lost. Once notice is given it is irrevocable unless the underwriter consents to the withdrawal. Similarly notice may be waived by the underwriter. The refusal of the underwriter to accept abandonment does not prejudice the rights of the assured. If the underwriter returns no reply to the tender of abandonment he is held to have declined acceptance. But he may accept either by express statement or by implication. Acceptance once stated or implied is irrevocable, being regarded as conclusive admission of the loss and of liability for it. Notice is unnecessary when there can be

no possible benefit from it to the underwriter at the time news of the loss reaches the assured. When abandonment is declined, the validity of the abandonment is determined from the state of the case at the time of action brought. In consequence it has become not un-usual for the assured to add to tenders of abandonment words in which they request, in case abandonment is declined, to be put in the same position as if writs had been issued and thus action brought. Valid abandonment effects an immediate transfer to the underwriter of all interest in what remains of the property insured, and he becomes possessed of all rights and remedies of the assured connected therewith as from the time of the casualty causing the loss. He equally stands at the risk of all reasonable acts or things done in good faith by the assured or his agents after the date of the casualty causing the loss. In the case of abandonment of a ship in course of a voyage the underwriter becomes entitled to the freight she is in the process of earning, and does earn after the casualty leading to the abandonment, but he is not

entitled to the transfer of any other freight contracts.

Should the vessel at time of abandonment be carrying goods belonging to her owner, the underwriter is after valid abandonment entitled to reasonable freight for any carriage of them which the ship may perform after the accident causing the abandonment. When the assured fails in an action for total loss, actual or constructive, he is not precluded from recovering a partial loss if the policy insures him against partial loss. When in consequence of the occurrence of a total loss, actual or constructive, the assured has a valid claim against his underwriter on a valued policy, the assured receives from the underwriter the amount which the latter has insured, and surrenders to him what remains of the subject matter of the insurance.

If the policy be unvalued the assured cannot recover beyond the insurable value of the property insured, and each underwriter is liable for his pro raid share up to the amount of his subscription.

Losses other than total would naturally be called partial losses, but there is some variation in the use of

this expression. By many it is used as designating solely diminution in quantity or deterioration in quality of objects insured, that is, as equivalent to particular average as explained above. Some would also include under it general average; others would add salvage charges, particular (or special") charges, and sue and labour expenses. General average is really an outlying branch of the law of affreightment; it is a reciprocal liability of shipowner and cargo owner to one another, and comes into insurance only in so far as the underwriter aterP' has assumed the liability of either of these parties. An act whereby any extraordinary sacrifice or expense is voluntarily and reasonably made or incurred at a moment of danger, and to preserve the whole common venture, is called a general average act ; the loss directly arising from it is called a general average loss. In case of such a loss the various parties to the adventure are by the universal law maritime liable for a rateable contribution to the same, called general average contribution. The amount of contribution from the owner of any parti-

cular goods is, subject to the terms of the policy, recover-
able from the underwriter to the full extent, if the amount
insured on these goods equals or exceeds their contributing
value, but pro raid if it is less. If the general average
act is a peril insured against in the policy, as jettison
usually is, then the assured can claim his whole loss by the
act directly from his underwriter, who enters into his rights
of recovery in general average. But the underwriter is
not liable for general average loss or contribution not
incurred in connexion with perils against which he insures.
The costs of services in the nature of salvage rendered by
the assured or his agents or employees to avert from the
whole venture some peril insured against, are apportioned
as general average rateably over all the interests benefited.
The shipowner is bound to take the necessary steps for pi-o-
curing an adjustment of any general average loss connected
with his vessel and for securing its payment. Should
ship, freight, and cargo all belong to one person, he may
recover from the underwriters of each separate interest
their share as if they had insured them for different

persons. Particular average may now be defined as a loss which is not general average loss ; it falls exclusively maeiste]

on the owner or other person interested in the goods, and gives no claim for contribution from other average?^ persons Concerned in the common marine venture. The consideration of particular average is much complicated by the fact that in modern insurance practice hardly any object is insured without some special condition in the policy, usually expressed in the form of a warranty, that the iasurance is either to be free from claim for particular average altogether, or free unless the damage attain a certain percentage of the value of the object. What follows must therefore be taken subject to any such special provision expressed in the policy. When a damaged ship has been repaired the owner insured is entitled to recover the reasonable cost of these repairs, less certain customary deductions based on tradition and long-

standing practice (such as the deduction of one-third from the cost of new materials used ia repairs, called thirds " new for old "), but he cannot recover in respect of any one accident more than the sum insured. The same cost of repairing the whole damage similarly reduced by deductions is the limit of the underwriter's liability in case the vessel is not repaired at all, or if she is only partly repaired. If the vessel is not repaired, but sold during the course of the risk, the assured is entitled to the reasonable cost of the repairs less the proper deductions ; but in this case the limit of indemnity is the actual depreciation as ascertained by the sale. In case of partial loss of freight the assured recovers such proportion of the insured value (in a valued policy) or insurable value (in an unvalued policy) that the amount of freight lost bears to the whole freight at the assured's risk. While particular average on ship is usually determined by the cost of repairs, particular average on goods is usually determined by survey and appraisement of the percentage of damage, or by sale of the goods and by comparison of the sound and the damaged

arrived values. The percentage of loss is applied to the Lasured value if the policy be valued, and to the insurable value if unvalued, and the amount thus arrived at is the liability of the underwriter. The sound and damaged values employed are the gross sound and damaged values of the goods at the time and place of arrival when freight duty and landing charges have been paid ; except in the case of certain articles subject to severe customs duties, and therefore usually sold by importers in bond (such as tobacco, tea, coffee, wiues, spirits), ia which case the price in bond is taken as the gross value. The expenses of sale falling on the buyers are added to the gross proceeds ; and if a claim is established against the underwriter, they are recoverable from him as "extra charges." If various classes of goods are insured in a valued policy without specification of the separate items, the insured value of each class is ascertained by taking the same proportion of the policy valuation that the insurable value of each class bears to the insurable value of the whole ; and the claim on the underwriter is made up as above.

When the policy contains such warranties respecting particular average as have been indicated above, then the loss of any separate parcel or parcels is not recoverable unless there is an agreement to that effect in the policy, or the parcels are separately valued therein, or there is a conimercial custom to treat them as if separately valued. When a particular average warranty specifies a c^ertain percentage below which no liability attaches to the underwriter, this percentage is called the franchise. As a rule, the more delicate the goods the higher the franchise. It is not permissible to add general average contribution or loss to particular average loss to make up the franchise. On voyage policies separate losses occurring on the voyage can be added to make up the percentage : on time policies the losses of each separate voyage have to be treated separately as regards franchise, and the underwriter is liable for them although the sum of them may exceed the amount insured. But if a total loss occurs to an insured object which has sustained damage for which no recovery has been made from the underwriter, then the underwriter is not liable except for the total loss. In order to prevent the failure to attain the franchise becoming onerous to the assured, and thereby as it were depriving him of the

protection of insurance, the plan was adopted of breaking up a shipment into subdivisions, each of which is treated for purposes of franchise as a separate interest ; these subdivisions are called series. The size of the series depends on the value of the goods ; it is usually taken as about one hundred pounds' worth of the article insured, e.g., 10 bales of cotton, each package of indigo, 10 chests of tea, 20 baskets of Java sugar, 50 bags of pepper. But as this arrangement was introduced for the benefit of the assured, the specification of franchise in the policy does not override his right to claim his indemnity on the whole if that is more to his advantage.

Certain charges and expenses are treated similarly to particular average : (1) Sue and labour expenses incurred solely with a view to the preservation or benefit of the particular object insured ; (2) the charges recoverable by a salvor under maritime law, which may be called charges for independent or speculative salvage, to distinguish them from the salvage services of agents hired to effect a benefit to the whole venture, which are apportioned as general average ; (3) particular or special charges, such as cost of reconditioning cargo at an intermediate point on the voyage, warehouse rent there, cost of reshipping, and cost of forwarding.

But special charges are not particular average, so they are not excluded by a particular average warranty, and they do not need to attain any named percentage to be recoverable.

This method of determining an underwriter's liability for damage applies only to cases in which the cargo reaches its destination. When it does not arrive, but remains at an intermediate point, and either cannot be forwarded at all or cannot be forwarded except at a loss, it becomes a constructive total loss ; and when the underwriter accepts abandonment or pays the loss the proceeds become his. The practice in such cases is for the captain or ship's agent at the intermediate point to sell the cargo, and forward the proceeds to the consignee through the ship's agents or owners at destination; whereupon the assured claims from the underwriter the difference between the amount insiu-ed and the proceeds realized. This form of settlement is termed a loss with salvage or a salvage loss. When an underwriter pays for a loss, total or partial, he thereupon becomes possessed of all the rights and remedies of the assured in so far as the assured has been indemnified by the payment of the loss : in case of payment for a total loss, whatever remains of the object insured becomes vested in the underwriter.

It may happen by accident or by design that an insurable object has been covered twice or more times, and that in consequence the sum of the insurance effected exceeds the value in the policy or the insurable “/^ *value, if an unvalued policy has been employed.*

This occurrence involves a new set of relations between the assured and his various underwriters; the underwriters themselves are brought into relation to one another. As regards the assured, he may, in the absence of agreement to the contrary, claim payment from whomsoever of the underwriters he may select, but he is not entitled to receive in all more than his proper indemnity. Each underwriter is entitled to receive credit for his proper proportion of the sum received by the assured under any other policy. If the assured does obtain any sum in excess of indemnity, he is regarded as holding it in trust for his whole body of underwriters. In such case each underwriter is bound, as between himself and the other underwriters, to contribute to the loss rateably in proportion to the amount of his liability under the policy ; and

if any one pays more than his proper share, he is entitled to sue the rest for contribution. Should the assured get any of his premium back ? It would not be equitable to enforce a return from any underwriter who has at any time stood alone so as to be liable to the full extent of his policy ; but if overlapping policies were accidentally effected all at the same time, the case is rather different. This leads to the general question of return of premium. Such return may be claimed under the terms of the policy, in which case the claim for return is simply the carrying out of the agreement between the parties; it may refer to the whole or to a part of the interest insured. But there are other circumstances in which returns can legally be claimed. For instance, it may turn out that interest insured by a particular vessel and for a particular voyage is never shipped in that vessel for that

[mabine voyage ; the miderwriter has in this case run no risk, and

therefore the consideration for which he received the premium totally fails, and the premium is properly returnable to the intending assured, unless there has been fraud or illegality on the part of the assured. Similarly in the case of part of the interest insured on a policy, if that part is distinguishable in the policy or by custom of trade. But the interest might have made the voyage in the vessel, and the intending assured might yet remain without insurable interest. In this case, in absence of fraud or illegality, and if the policy is not merely a gaming or wagering contract, the assured is entitled to return of his premium. Similarly if the underwriter legally voids his policy from the beginning of the risk ; as he runs no risk, he receives no premium. The only cases, except those of fraud and illegality, in which the underwriter can retain his premium without running risk, are those of risks underwritten lost or not lost, and arrived safely, in which the underwriter takes his chance as to the condition and situation of the ship when he assumes the risk. But this is practically a case of agreement that there shall be no

return.

Recent extensions of marine insurance in England have mostly been in the direction of giving to shipowners protection against liabilities to third parties. The first addition was the running down clause (r.d.c.) by which underwriters take burden of a proportion, usually three-quarters, of the damage inflicted on other vessels by collision for which the insured vessel is held to blame. The rapid increase in the use and size of steamships was accompanied by an equally rapid increase in the frequency of collisions at sea, tending to make the shipowner's liability increasingly serious, and to make the shipowner desirous of insuring himself against the balance of his collision liability, and against whatever other liabilities to third parties might be imposed upon him. There was a hesitation on the part of underwriters to meet these wants, and the result is that in Great Britain most liability insurances are effected in mutual insurance societies. The insurance of such liabilities is perhaps simpler in Great Britain than in other countries, as the amount for which

a shipowner can be liable is limited by law, although, of course, none but English tribunals are bound by that law. The general rule of English law regarding the indemnity to be paid by an underwriter on liabilities is that its amount is (subject to the amount insured and the provisions of the policy) the sum payable by the assured to the injured third party. Another interesting class of insurances has received much attention, namely, those against the risks of capture, seizure, and detention by a hostile Power, generally described briefly as war risks. But the difficulties connected with such risks probably lie more in determining the legal position of the owners of the property and the obligations under which they lie, than in settling those of their underwriters. Such questions concern blockade, contraband, domicile, nationality, neutrality, &c.

An attempt was made at the Buffalo conference of the International Law Association in 1899 to prepare a body of rules dealing with those parts of marine insurance on which the laws of maritime countries differ. This undertaking is of

the same nature as the earlier efforts of the same asso-

ciation which resulted in the formulation of the York-Antwerp rules

of general average. There are four important subjects on which

great divergence prevails : (a) Constructive total loss ; (6) Deduc-

tions from cost of repairs, new from old ; (c) Effect of unseaworthi-

ness and negligence ; (d) Double insurance.

(a) Constructive total loss results, according to the law of France,

Italy, Spain, Belgium, Holland, in case of loss or deterioration of

the things insured amounting to not less than three-quarters ; in

German law a ship is considered to be " unworthy of repair " when

the cost of the repair, without deductions new for old, would

amount to over three-fourths of the ship's former value (no similar

provision seems to exist in Germany for goods) ; in the law of

Conflict

of laws.

America a damage over 50 per cent, of the value of the vessel when

repaired is a constructive total loss of the vessel, in case of the

policy containing no express provision to the contrary. None of

these varying systems appears to be so equitable to all concerned as

the British rule, which was for this reason suggested to the Buffalo

conference for international adoption. As regards the time when the test for constructive total loss should be applied, it was suggested to reject the British rule, prescribing that it shall be the time of commencing action against underwriters, and to adopt the Continental and American rule referring to the facts as they existed at the time of abandonment. Then, as respects the effect of a valid abandonment on the rights in the property insured, the conference proposed to adopt the British and American rule of making the abandonment refer back to the time of the loss, as against the Continental system of making the transfer operative only from the date of the notice of abandonment. Finally, as to the freight of a properly-abandoned ship, it was proposed to follow for international purposes the American rule of dividing the freight of the voyage between shipowner and underwriter in the proportion of the distances run before the disaster and to be run thereafter, rejecting the British rule of complete transfer to the underwi-iter and the various Continental rules of proportional division between shipowner and underwriter.

(6) It was proposed to adopt the deductions set forth in the York-Antwerp rules as being suitable for international adoption in

marine insurance contracts.

(c) As regards unseaworthiness and its effect on insurances on ships and goods, it was proposed in the case of ships to reduce materially the obligations of the assured as required by English and American law ; to diminish the requirement from the absolute attainment of seaworthiness to the mere exercise of all reasonable care to make the vessel seaworthy. Even this attenuation did not appear sufficient, as it was proposed to degrade the performance of the already minimized warranty from being a condition of the insurance, and its non-performance from invalidating the policy. As to goods, they were proposed to be exempted from any warranty of seaworthiness of ship. Concerning negligence, it was proposed to hold the underwriter liable (subject to the new seaworthiness warranty) for any loss caxised proximately by a peril insured against, although wholly or partly the result of the neglect of the assured, or his servants or agents, or by the wilful act of his servants or agents, or the inherent nature or unsoundness of the article insured.

(d) The conference proposed to adopt the British rule of making all the policies effectual, independently of the order in which they

were effected, and of making all the underwriters entitled to contributions inter se. As regards the premium, it was proposed that no premium should be returnable where the risk has attached.

With the exception of those embodying the two suggestions named in par. (a) , all the resolutions proposed were accepted by the conference. But it appears extremely unlikely that British and American underwriters will voluntarily consent to the practical annihilation of the seaworthiness warranty, and no less improbable that American and Continental assured will voluntarily accept the stricter rule of constructive total loss embodied in English law, when their national law enforces on the underwriter terms more favourable to the assured. The fewness of the international insurance markets of the world diminishes the need for uniform international regulations in this matter. The matter may be one for adjustment by variation in the rate of premium, but this is not certain.

The Glasgow conference of 1901 adopted the rules, after excepting time policies from the scope of the rule respecting seaworthiness. The rules are to be known as the Glasgow Marine Insurance Rules.

The usual procedure in the offer and acceptance of a

risk is as follows : — The intending assured (principal or broker) offers the risk by showing to the under-

writer a brief description of the venture in ques- ‘r^”^^ °’

tion, called in Great Britain a slip, in America “ ””*’*

an application. The underwriter signifies his acceptance of the whole or of a part of the value exposed to perils by signing or initialling the slip, putting down the amount for which he accepts liability. Or he may sign and issue to the assured (principal or broker) a similar document made out in his own office, called a covering note or insurance note. These documents are simply first sketches of the contract, mdmoires pour senir, so imperfect that they can be explained only in conjunction with the contract m its completed form (the policy). In America it is not at all rare for insurances to be effected through applications alone without any policy existing. In Great Britain the existence of a policy is essential, slips and coyering notes POST office]

being merely provisional agreements, binding in honour only, to issue policies on certain terms and conditions on receipt of the necessary information. One reason for insisting on a policy being issued for every risk is that a means of raising revenue by stamp taxes is thus created.

In Great Britain the stamp duties under the Stamp Act, 1891, are as follows : —

Where the premium does not exceed Jper cent, of the amoimt insured . . Id.

Where the premium exceeds \ per cent, of amount insured —

(a) On any voyage, per £100 or per any fractional part of £100 3d.

(6) For any time not exceeding six months, per £100 &o., as above 3d.

(c) Por any time exceeding six months, and not exceeding twelve months, per £100, &c., as above . . . 6d.

In consequence of this regulation, no time policy can be issued for a period exceeding twelve months. Policies or certificates of insurance coming from abroad are subject to the same duties, which should be paid within ten days after

receipt in the United Kingdom. The shortness of the time allowed for stamping often prevents payment of the tax. These stamp regulations are very troublesome, and produce only a comparatively insignificant revenue. On small premium insurances the tax is so excessive that it drives business out of the country. A uniform tax per policy has been several times suggested, but these proposals have not yet been accepted by the Treasury.

*The documents required to establish a claim for total loss are: — (1) Protest of master. (2) Set of bills of lading (endorsed if necessary, so as to be available to the underwriter). (3) Policy or certificate of insurance (endorsed if necessary). (4) In the United States : Statement of loss in detail. In the United States certified copies of Nos. (1), (2), and (3) are taken; but as none of these copy-documents can transfer possession to the underwriter, there is necessary for tha,t purpose another document, viz., (5) Bill of sale and abandonment with subrogation to underwriter — that is, an *' assignment of all interest to the underwriter. In the*

absence of the full set of bills of lading, a similar document should be taken in Great Britain, especially in all cases in which salvage operations are likely to be undertaken. Such a document handed to a salvage association or a manager of salvage (whether acting for shipowner or for underwriter) settles the ownership of salved goods, and ensures that any claim for salvage expenses will be sent directly to the underwriter. This is from the assured's point of view desirable, and it greatly simplifies the management of salvage cases. As a claim for total loss cannot extend beyond the full amount insured in the policy, it follows that the documents required to substantiate such a claim must be supplied to the underwriter free of charge.

For the substantiation of a claim for particular average the following documents are required: — (1) Protest of master or log-book. (2) Set of bills of lading (cargo claims). (3) Policy or certificate of insurance (endorsed if necessary). (4) Certified statements in detail of actual cash value at destination of goods in damaged state, all

charges paid. Certified statements in detail of sound value at destination of goods on same day, all charges paid. Or original vouchers of costs of repair of ship, all discounts, rebates, allowances, and returns deducted. (5) In the United States, subrogation to underwriters of damaged goods.

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VI. British Post Office Insurance.

In 1864, Mr Gladstone, then Chancellor of the Ex-

chequer, advocated the extension of life insurance amongst persons of small means, and, encouraged by the remarkable success of the Post Office Savings Bank, then recently established, proposed that the services of the Postmaster-General should be enlisted in the promotion of insurance. The result was the passing of the Government Annuities Act, 1864. This Act authorized the Commissioners for the Eeduction of the National Debt, for the first time, to insure a life without granting an annuity upon it, and enabled the Postmaster-General to act as the agent of the Commissioners in the issue of life policies and the grant of annuities. The limits of insurance were fixed at £20 and £100, and of annuities at £4 and £50 ; and the purchase of deferred annuities or old-age pay, by monthly, or even more frequent instalments, was sanctioned. The work was eagerly accepted by Lord Stanley of Alderley, the Postmaster-General of the day, and the machinery for putting the Act in action was elaborated by Mr Scudamore of the Post Ofiice and Sir Alexander Spearman of the National

Debt office. The business was commenced on the 17th of April 1865. By the end of the year 660 policies of insurance had been issued, and 94 immediate and 54 deferred annuities granted. In the first twelve months these figures had increased to 809 policies and 230 annuities. The opportunity thus given of insuring through the Post Office with Govetnment security was not, however, embraced with the warmth which had reforms. been anticipated. In 1882, when Mr Pawcett, then in office, examined the siibject, he found that the average number of policies of insurance granted annually during the seventeen years which had elapsed was under 400 — less, in fact, than during the first twelve months of the system. The purchase of annuities had increased slightly, but the business was transacted chiefly in immediate annuities, and hardly, therefore, indicated any progress in provision for old age by means of early savings. Mr Fawcett procured a Select Committee of the House of Commons on the subj ect. Before this Com mittee Mr Cardin, then Assistant Receiver and Accountant-General of the

Post Office, propounded a scheme for combining the an-
nuity and insurance business of the Post Office with that
of the savings bank. The Committee recommended the
adoption of this scheme, together with some enlargement

of range and some relaxation of conditions. The recom-
mendations of the Committee were embodied in the
Government Annuities Act, 1882, which came into opera-
tion on the 3rd June 1884, and which forms the basis of
the present system.

Any person between 14 and 65 can now insure through
the medium of the Post Ofiice Saviags Bank for any
amount from £5 to £100 ; and the life of a young
person between 8 and 14 can be insured for £5.

Through the same channel can be purchased annuities,
immediate or deferred, from £1 to £100, on the life
of any person from 6 years old upwards. Old-age
policies, that is, policies securing payment of a specific

sum either at the expiration of a fixed period (varying from 10 to 40 years), or upon the attainment of a certain age, or sooner in case of death, can also be obtained. Policies for a fixed period can only be purchased by a single payment, but in all other cases the purchase can be effected by payment either of a lump sum or of annual instalments. Further, all purchases are effected through the Post Office Savings Bank. As soon as a contract is completed, the purchaser is required to pay the first instalment to his account in the bank, or, if he has no account already, to open an account for the purpose. This and all further instalments are then transferred by the Postmaster-General, as they become due, to the credit of the E"ational Debt Commissioners ; all the purchaser has to do is to keep his banking account in funds ; he can pay his savings into the bank when and as he pleases. So, also, when old-age pay, secured either by a deferred annuity or an endowment policy, becomes due, it is paid to the account of the purchaser ; and, if it does not cause the sum stand-

ing to his credit to exceed the statutory limits, it can remain there earning interest, and be drawn out in such amounts as may be convenient from time to time. The purchaser has also the advantage of the ubiquity of the Post Ofiice Savings Bank. He can make his deposits, and can draw out his old-age pay when it becomes due, at any one of the 12,900 post offices where savings bank business is transacted. He can even, if his savings are made from day to day, use the penny stamp slips introduced by Mr Fawcett, affixing a stamp whenever he has a penny to spare, and paying in the slip when it is worth a shilling. In short, every advantage open to the ordinary depositor in the Savings Bank is placed at the service of the working man or woman who wishes to secure old-age pay, or to have a small sum to aid those who may suffer pecuniarily from his or her death. Even the reluctance of many persons to submit themselves to medical examination is tenderly regarded. A policy for any sum up to £25 may, if the information afforded is satisfactory, be obtained without a doctor's certificate,

on condition that, if death happens during the first year, only the premium paid is returned, and if during the second year, only half the sum insured is paid. As regards old-age pay, a purchaser can, by adopting a slightly higher scale of payment, secure the return of his purchase money if at anytime before the annuity falls in he repents of his bargain. Further, employers of labour and friendly societies can, on behalf of their workmen or members, make all the payments necessary to buy an insurance or annuity, and recoup themselves out of wages or members' contributions.

The Act of 1882 directed that the tables upon which annuities and policies of insurance are granted should be revised from time to time ; and in February 1896 new tables reducing the rates of annual premiums, and giving greater facilities for old-age insurance, were issued. The rates are now but very slightly (less than 3 per cent.) higher than the average rates of the larger insurance offices. But the expense of small insurance business must necessarily be above the average, and it is fairer to com-

pare the Post Office rates with those of the office which stands pre-eminent in the insurance of the working classes. Such a comparison shows that up to the age of 40 a life insurance can be effected with the Post Office at a cheaper rate than with the Prudential Insurance Company ; between 40 and 60 the advantage is slightly on the side of the company.

Nevertheless, the endeavour to popularize the provision for old age and death through the machinery of the Post Office must be pronounced a failure. In 1885, the first complete year after Mr Fawcett's improvement took effect, 103 deferred annuities and 457 insurance policies were granted; in 1898, 164 deferred annuities and 731 policies. The increase of business, measured in percentages, is no doubt appreciable, but the figures themselves are so small as to make such a comparison trivial. If we compare the two periods, before and after Mr Fawcett's reforms, we find that between 17th April 1865 and 2nd June 1884 (about 19 years) 7064 policies of insurance, amounting to £567,625, were issued, and between the lat-

ter date and the end of 1898 (about 14 years) 11,681 policies, amounting to £620,266. For the whole period the figures are 18,645 policies for £1,177,891. During the same time 3144 contracts for old-age pay, amounting in all to £64,378, were made. When we contrast with this sum total the fact that in 1898 alone 1,333,395 new accounts were opened in the Post Office Savings Bank, and more than £37,000,000 deposited in the bank in the course of the year, it becomes apparent that, while the Savings Bank has reached the mass of the population, insurance agaiust old age and death through the Post Office has not.

In 1894 Mr Lang, the Controller of the Post Office Savings Bank, and Mr Cardin, giving evidence before the Commission on Old-Age Pensions, ascribed the small insurance and annuity business of the Post Office to the want of a personal canvass. They pointed out that there had been some temporary increase in insurance through ^ an appeal to the Post Office employes themselves, and they suggested that something might be done if the masters of

the elementary schools could be induced to interest them-
selves in recommending to their scholars and the parents
of their scholars the advantages offered by the Post Office.
It was also pointed out that the friendly societies might,
if they were so disposed, act as intermediaries between
their members and the Post Office, and thereby, as it were,
reinsure their risks with the Government ; but it was
added that all overtures of this nature to the societies
had failed, apparently from the fear — quite groundless —
of introducing Government control of the societies' affairs.
There may, indeed, be another reason for the failure of
the deferred annuity system. The insurance of old-age
pay is not at present popular even amongst the members
of friendly societies, or even in Germany, where it has
been given to the workmen largely at the expense of other
people. Insurance against death, sickness, and accidents
appeals to the young working man ; but old age is too far
off to be an object of solicitude, or to warrant the fore-
going of the many pleasant things that money can give.
However, if at any time opinion changes, the Post Office

stands ready to make foresight or philanthropy easy.

Though no great results have been achieved, a ma-

chinery has been established which works with perfect

smoothness, and which may some day be of service to the

nation.

Ahthorities. — Annual Report of the Postmaster-Creneral, pre-

sented to Parliament by Command. — Beport of lioyal Commission

on the Aged Poor, vol. iii., Evidence, pp. 744-765.

(r. H.)*

INTEELAKE N — I NTEEJSTATIONAL LAW 535

Interlaken, a Swiss village, 1864 feet above the

sea, in the canton of Bern, between the lakes of Thun

and Brienz. It is 17| miles from Thun by rail (itself

19^ miles from Bern), while from Interlaken cog-wheel

lines run to Lauterbrunnen (8 miles), up to the Schynige

Platte (4-|- miles) and to Grindelwald (12^ miles) . In

different parts of the church of the old Monastery various

denominations now have places of worship. The popula-

tion of Interlaken proper {i.e., all on the left bank of the

Aar) was 2968 in 1900. The town of Unterseen (2612

inhabitants in 1900) was built on the right bank of the Aar in 1280 by Berchtold von Eschenbach.

International Arbitration.

Inteknational.

See Akbiteation,

International Law (Private). — There is in every territory the law of the land, or territorial law, by which the courts decide all cases that include no cir-cijmstances connected with any foreign territory. Often, however, such a circumstance suggests the question whether justice does not require that the law of some other territory shall be applied. Thus the Gretna Green mar-riages, by which English unions escaped the necessity of banns or the consent of parents or guardians, suggested the question, which was answered in the affirmative, whether even in England their validity ought not to be tried by the law of Scotland, where they were celebrated. Often, again, the question is suggested whether justice does not require that the courts of law should allow some effect to foreign legal proceedings, such as a judgment

obtained or litigation pending abroad. Such questions as these are answered by private international law, which, since both laws and legal proceedings are emanations of public authority, may be defined as the department of legal science which is concerned with the effect to be given in the courts of law of any territory to the public author-ity of another territory. The extradition of criminals is also an effect given to foreign public authority, but rather by the Government which surrenders the criminal (see Extkadition) than by the courts of law, whose only func-tion is to check the surrender so far as the domestic leg-islation allows them to do so. If private international law were defined as the effect to be given by any mode in one territory to the public authority of another, extrar dition would be included in it, as is often done ; but since the principles governing extradition have little to do with those applicable to the other cases, it seems best to treat it as a separate department of law, as is generally done in England.

Comity of Nations. — In the 17th century the Dutch

jurists Paul and John Voet and Huber brought forward a view which has since been largely adopted in England and the United States, namely, that the effect given by courts of law to foreign public authority is only due to the comity of nations, but for which every possible question before them would have to be decided by the law of the land. Comity, in that phrase, may only be intended to express the truth that foreign public authority has no inherent effect, without denying that the effect which domestic public authority allows to it is dictated by justice. But the limitations implied in the popular meaning of comity have sometimes been made the ground for deciding questions of private international law in the manner supposed to be most for the interest of litigants belonging to the territory; the phrase is consequently reprobated by most Continental writers, and had better be dropped. The justice on which private international law is founded acknowledges no interest but the general one of intercourse between persons sharing a common civilization in different countries. This interest, as mani-

festing itself in the domain of law, it seeks to satisfy.
and it is therefore a true legal justice, rightly classed
under law, droit, recht, diritto, derecho, and other corre-
sponding terms.

Of the two words which, together with law, make up the
title of our subject, pnmte is justified by the fact that its
application is between litigants in courts of law, and not
between Governments except so far as they may be such
litigants. International (although interterritorial would
be better) is justified by the facts that public authority,
which may be internationally foreign, has to be consid-
ered, and that Governments display a great interest in the
question by concluding treaties about it, and occasionally
even by suspending diplomatic relations when a court of
one country has applied to the subjects of another a rule
which the Government of the latter deems unjust. But
those who think that the primary division of law should
be into public and private, and not into international (or
interterritorial) and territorial, object to the order in
which the three words of the name are usually placed,

and call the subject " international private law."

*Conflict of Laws. — This is another name for our subject, and indeed an older one than " private international law," besides being still much used. But although laws may differ, they cannot properly be said to conflict, unless each can lay a just claim to application in the same circum-stances. Now this does not happen. The justice which points out that in certain cases effect ought to be given in one territory to the laws or legal proceedings of another, really traces the limits of laws and legal proceedings in space ; and the tracing of limits is rather the prevention of conflict than its solution. Savigny has well pointed out that our subject is analogous to the determination of the limits of laws in time, which has to be made when the just application of a new enactment is to be distinguished from the ex po-ft facto application which cannot justly be allowed it. The truth which is aimed at in the phrase " conflict of laws " is that the main problem of our sub-ject is the selection of a law for each given case ; but dif-ferent laws are candidates for selection, not from anything

in them as laws, but from differing opinions about the justice of the case. From this selection, again, will be seen the contrast between private international law and attempts at the assimilation of the laws of different countries. To a great extent such assimilation is desirable, especially in mercantile law, but it must always be limited by different views of social order and differences in national habits of thought and action. So far as it is realized, private international law comes to an end with the occasion for selection.

Territory. — This word, as entering into the definition of private international law, does not imply a separate state, whether sovereign or semi-sovereign; it includes every geographical area having a separate legal system, England and Scotland, as well as Prance or Germany. The case of the Gretna Green marriages above referred to illustrates the necessity of rules of private international law between all such, as well as between areas internationally foreign to one another ; and indeed the rules are so applied, and in the language of our subject, the area of

every separate legal system is foreign to every other such area. Only where a rule contemplates a person as attached more or less permanently to a particular territory, the tie which so attaches him to it may be either nationality or domicile if the territory is a separate state, as Prance ; but it can only be domicile if the territory is combined with others in one state. Nothing but domicile can distinguish British subjects as belonging to England, Scotland, or Jamaica, or citizens of the United States as belonging to New York or Pennsylvania.

Legal rules must have relation to the physical and mental characters, and the consequent habits of action, of

the populations for wMcli they are intended ; they would not satisfy legal justice if they endangered social order as understood and desired by those populations, or if they failed to give due effect to the expectations of parties.

This must be true for the rules of private international law as well as for those of any territorial law, and it leads

us to ask whether the differences which preclude the universal identity of the latter must not also preclude the existence of the former. The answer is: (1) That where circumstances connected with different territories are concerned, wise rules for the selection of a law will generally give better effect to the expectations of the parties than an exclusive adherence to the territorial law of the court ; (2) That the circumstances in which a foreign law is held to apply are exceptional as compared with those in which the domestic law applies, and naturally occur oftenest among the persons and in the affairs having most of a cosmopolitan character, so that the moral shock of applying to them a law founded in a foreign social order is greatly attenuated ; (3) That throughout Christendom (to which Japan has been added for legal purposes) there does exist, though not an identity, yet a considerable similarity in views of social order and prevalent habits of thought and action. Within the same geographical limits there also exists another requisite for the working of a system of private international law, namely, a mutual con-

fidence between countries in the enlightenment and purity of their respective judicatures, to whose proceedings the respect enjoined by the rules of our subject is to be mutually given.

Even within the geographical limits just mentioned there are certain differences on points of social order, especially on marriage or divorce, which have hitherto prevented a complete agreement being attained in the rules of private international law. But no attempt has ever been made to establish any system of the kind as between Christian communities and Mahommedan or other polygamous ones, or between countries enjoying a Christian standard of civilization and those, of which China may be taken as an example, which, whether polygamous or not, do not inspire the necessary confidence in their judicatures. In Turkey and other Eastern countries (in which designation Japan is no longer in-cluded for purposes of law) Christians are placed by treaty under the jurisdiction in civil matters of their respective consuls. When in the courts of Christian

countries Eastern persons or circumstances connected with Eastern laws have to be dealt with, the peculiar institutions of those countries are not enforced ; and while in other respects the judges may be assisted by some of the rules of private international law, especially such as have for their object to carry into effect the reasonable intentions of parties, yet those rules are not applied as parts qf an authoritative system.

Rules for the selection of the territorial law to be applied in the different classes of cases, or for the recognition of foreign legal proceedings, have sometimes been made the subject of international treaties, and have often been enacted by territorial legislatures. England possesses a few such enactments, as in the Bills of Exchange Act, 1882, and many other countries possess them to a much larger extent in their codes. Where such enactments exist, or where treaty stipulations have been made and the territorial law makes such stipulations binding on the judges, the courts of law must obey and apply them as they must obey and apply any other part of the law of

the land. If, as in England, judicial precedents are held to be binding, so that the law of the land consists in part of judge-made law, a similar result is produced; an English court must follow English precedents on the application of foreign law or the refusal to apply it, to the same extent to which it would be bound to follow them on any other point. So far as our matter remains open for a judge, he has, to assist him towards a just decision, the treaties, written laws, and judicial precedents of other countries as examples, and a vast literature which has grown up in all Christian countries. That this apparatus does not always furnish concordant results is due, not only to the divergences on points of social order above referred to, but also to the different bases of the legal systems with which the respective Governments and writers have been familiar. The legal systems of different countries have been founded on Eoman law, feudal law, English common law, and still other bases. The arguments of lawyers are affected by the prepossessions thence arising, and they have consequently failed to arrive at so

much agreement on the rules of private international law as would have been compatible with the conditions and modes of life and action surrounding them. It is possible that lawyers, whose tendencies are usually conservative, have been left a little behind on the roads by which the modern world seems to be travelling towards uniformity. But the general acceptance of a complete body of rules on private international law is a goal well within sight, and it is probable that for its attainment we must look to international treaties concluded under the joint direction of professional and non-professional minds.

The most remarkable steps that have been taken in or towards the conclusion of such treaties as have been mentioned were those initiated, to its high credit, by the Government of the Netherlands. That Government first moved in the matter in 1874, but it was not till 1893 that it succeeded in assembling at The Hague the official representatives of Germany, Austria, Hungary (separately represented, because having different laws from Austria), Belgium, Denmark, Spain, France, Italy, Luxemburg, the

Netherlands, Portugal, Rumania, Russia, and Switzerland. A second conference was held at the same place in 1894, at which the same Powers were represented, with the addition of Sweden and Norway, also separately repre-sented, as differing in their laws ; and the result was a considerable, though far from complete, body of rules of private international law, which the delegates of all the sixteen countries agreed in submitting to the appreciation of their respective Governments, subject to the reserva-tions expressed in the minutes of the sittings. These rules related to the conditions for the validity of marriage, the effects of marriage on the status of the wife and children, divorce and judicial separation, guardianship, bankruptcy, wills and succession to property on death, and several points of judicial procedure. On 14th November 1896 a treaty embodying seventeen out of the twenty articles on judicial procedure (to be found at length in the Revue de droit international et de legislation compar&e, tome xxviii. pp. 674-579) was signed at The Hague by eight of the Powers above mentioned, and all .

the others have since acceded to it. A third conference met at The Hague in 1900, and prepared draft treaties completing the subjects of marriage, divorce, and succession on death, and adding that of the guardianship of minors. These drafts, as well as the remainder of the work of the preceding conferences, await adoption by the Powers represented. Next in importance among combined official efforts should be mentioned the congress of seven South American States at Montevideo in 1888-89, which on many branches of private international law drew up rules intended for adoption by treaty on that continent. And though the Institute of International Law, founded in 1873, is not an official body, a high place in this subject must be given to its discussions and votes, in which eminent lawyers of almost every country have participated.

In considering the particular rules of private international law which are most consonant with justice

Nation- perhaps the most obvious cases which present aiity; themselves for admitting foreign circumstances domicile. ^Q influence the decision of a judge are those in which rights are so connected with the person of an individual that the justice of deciding on th6m by a law having relation to his person speaks almost for itself. Hence arises the notion of a personal law, which must be that either of the person's political nationality or of his domicile, these being the only circumstances that for the time being are fixed for the individual irrespectively of the spot where he may happen to be, and of the transaction in which he may happen to engage. Political nationality, or the membership of a separate international state, with the circumstances of parentage or place of birth on which it depends, and its change by naturalization or otherwise, belongs to public international law, though it may produce its effects in private law. Domicile, though it occasionally produces effects in public law, belongs originally to private law. It is residence considered technically, residence viewed in the

light of technical rules intended to secure that each person shall have but one domicile at a time, as is necessary if it is to be the criterion of personal law. For that purpose it is distinguished into domicile of origin and acquired domicile. The former is that which is attributed to every one at his birth, in general the domicile of the father at the date of the birth ; the latter is that which a person sui juris acquires by changing either his domicile of origin or any other domicile he may have previously acquired, which change must be made animo et facto, by intention-ally taking up a new principal and permanent residence. Of the subsidiary rules the chief are that the domicile of a person under age follows that of his father, and that of a wife follows the domicile of her husband, through all their changes respectively. In and long after the Middle Ages domicile was the unquestioned criterion of the personal law, so far as such a law was allowed to be applied in preference to the territorial law of the court. Political nationality had not then been defined with the clearness which now marks it, and the variety of laws

which existed within most of the larger states, together with the narrow geographical range within which inter-course was usually restricted, caused questions about the conflict of laws to arise with much the greatest frequency between subjects of the same state, who could for the present purpose be distinguished only by the provinces in which they were domiciled. Now all these conditions being changed, there has been on the continent of Europe a wide movement towards adopting nationality as the criterion of personal law. Certainly it has the advantage of being seldom doubtful, while the determination of domicile gives rise to many of the most difficult and most expensive lawsuits, depending as it often does on evidence about the acts and intentions of a person in changing his residence or as between two residences, sometimes even about such acts and intentions on the part of a person long dead, from whom it may be alleged that a domicile of origin was derived. The British dominions, however, include, besides England and Scotland with their different laws, other legal provinces governed by what in the

main is English law, though more or less varied by local legislation (Ireland, Australia, West Indies, &c.), Eoman-Dutch law (Ceylon, Cape, Natal, Guiana), the French codes (Mauritius), and a code largely based on older French law (Quebec), not to mention India, with its copious and independent legislation, tempered by the large application, still necessarily made there, of Mahommedan and Hindoo laws. Domicile, and not political nationality, therefore, continues to be the only possible criterion of personal law in a very large part of the cases which come before the English courts of justice — a circum-stance which no doubt has contributed to the preference of it as a criterion even in other cases which those courts still display.

Formerly, and as late as Lord Eldon's time, or even later, the English courts, peculiar in this respect, held that the competency of a person to contract depended on the law of the place where the contract was made. This doctrine, carried to America with the rest csf English jurisprudence, still maintains in the g^t^l'f^'

courts of the United States a struggle with the doctrine of personal law as governing capacity and status, which now prevails in England, as in most other countries — such personal law being in Jlngland based on domicile. Thus the capacity of a party to enter into a contract, whether it be disputed on the ground of his age, or, in the case of the contract of marriage, on the ground of his consanguinity or affinity with the other party, will be decided in England by the law of his domicile. Guardians, curators, and committees of foreign minors or lunatics, deriving their authority from the law or jurisdiction of the latter's domicile or nationality, can sue and give receipts in England for their personal property. The English court will not decree the divorce of persons not domiciled within its jurisdiction, and it will recognize foreign divorces if and only if they have been decreed by a jurisdiction to which the parties were subject by domicile or nationality. The legitimation of a child by the subsequent marriage of its parents will be held in England to depend on the law of its father's domicile or nationality. In France the

Code Napoleon, Art. 3, says that " the laws concerning the status and capacity of persons govern Frenchmen even though residing in foreign countries " ; and the French courts, by analogy, determine the status and capacity of foreigners by the law of their nationality. The Italian code, preliminary Art. 6, says that " the status and capacity of persons, and their family relations, are governed by the law of the nation to which they belong." The German statutory provisions belonging to private international law are contained in the statute enacting the code, of which Art. 7 says that " the capacity of a person shall be determined according to the law of the state to which he belongs," but adds, " If a foreigner enters in Germany into a transaction for which he is incapable or has only a restricted capacity, he is to be treated for that transaction as being so far capable as he would be by the German legislation. This, however, does not apply to transactions with regard to rights of family or of succession, or to those disposing of foreign immovable property." It may be added that Art. 13 makes it clear that marriage

stands on the same footing as contracts relating to the family, capacity for it by his or her national law being required from each party. In a spirit similar to that which dictated the German enactment, the French courts have not generally allowed a Frenchman to suffer from the incapacity, by his personal law, of a foreigner who contracts in France, when the foreigner would have been capable by French law, and the Frenchman was in good faith and without great imprudence ignorant of his incapacity. Lately a disposition has been shown to limit this protection of nationals to the case in which the foreigner has been guilty of fraud. English cou.rts usually hold themselves to be more stringently bound by rules, whether those enacted by Parliament or those which they have adopted for themswTes ; and if they should continue to profess the doctrine that capacity depends on the law of the domicile, it is not probable that they will deem themselves entitled to make exceptions for the protection of persons contracting in England with foreigners not enjoying such capacity. The point furnishes an illustration of

the fact that to deal satisfactorily with so complex a subject as private international law requires the assistance of the legislature, which again cannot be given with full utility unless uniform provisions, to be enacted in different countries, are settled by international convention.

Another ground for the application of a personal law is furnished by the cases in which masses of property and rights have to be dealt with collectively, by reason of their being grouped around persons. The principal instances of that kind are when it is necessary to determine the validity and operation of a marriage settlement or contract, or the effect of marriage on the property of the husband and wife in the absence of any express settlement or contract, and when property passes on death, either by a wiU or by intestate succession. These matters, at least when the property concerned is movable, are generally

referred to the personal law of the husband at the time of the marriage, or to that of the deceased respectively ; but about them, besides the question between domicile and nationality, there arises the question whether immovable property is to be included in the mass governed by the personal law, or is to follow the territorial law of its own situation (lex situs). Here we touch the distinction between real and personal statutes which arose in the Middle Ages, when the local legislation of the free cities was contrasted, under the name of statutes, with the general Eoman law. That distinction did not bear the same character at all times, but in the 16th century, under d'Argentre, it acquired its most developed form, absorbing all laws into one or other of the two classes, and giving a vast extension to the real class, for which was claimed exclusive application to immovables situate in the territory of the law. In accordance with this system, the highly feudal character of which was very sympathetic to English jurisprudence, English practice has refused to include English immovables in the mass to be

dealt with as a unit on marriage or death. But it refers the validity and operation of a marriage settlement, at least as to movables, and the effect of marriage, in the absence of express contract, on the movable property of the husband and wife, to the law of the husband's domicile at the time of the marriage, called the matrimonial domicile. And with regard to the succession to movables on death, it adopts the principle of massing them irrespectively of their situation, so far as is permitted by the peculiar system under which the property in movables situate in England does not pass directly to the legatees or next of kin, but to the executors or administrators, who are charged with the duty of paying the debts of the deceased and distributing the beneficial surplus. The validity of a will of movables, otherwise than in respect of form (about which more hereafter), and the rights, whether under a will or under an intestacy, in the beneficial surplus arising from them, are determined in England by the law of the testator's last domicile. On the points here glanced at, the decisions in the United States generally agree with

those in England, only allowing the pecuniary relations of a married couple, in the absence of express contract, to be varied by a change of domicile, notwithstanding that such change is in the husband's exclusive power, instead of maintaining them as fixed by the matrimonial domicile. On the continent of Europe partisans of a variation after the marriage are scarcely to be found ; but as between the nationality and the domicile of the husband or of the deceased, and on the question whether the mass to be governed either by nationality or domicile, on marriage or on death, includes immovables situate under a different law, the division of opinion, legislation, and practice is considerable and intricate.

Lex situs, lex loci actus, lex loci contractus, lex fori. — The law of the territory in which they are situate (lex situs) is generally applied to the property in particular things, whether movable or immovable, so far as they are not included in any mass grouped round a person; in England, therefore, always to immovables. In drawing up documents and conducting ceremonies public func-

tionaries must necessarily follow the law from which they derive their authority, wherefore the law of the place where any public document is entered into, or any public ceremony performed (lex loci actus), is the only one that can be followed in its external form. This maxim applies to the forms of notarial acts, and to that of marriage celebrated with the official concurrence of clergymen, registrars, and so forth. And since documents and ceremonies entered into without official concurrence are rarer on the continent of Europe than in England, the inevitableness of the form of the lex actus, when such concurrence is had, has generally led to the form being also held sufficient whenever the affair comes to be inquired into later. Nor in England has the sufficiency of the form of the lex lad actus for the celebration of marriage ever been doubted, but a will made by a notarial act in accordance with that law was not admitted. Disregarding the distinction between external form and internal validity and operation, a will of English land could not take effect unless made in English form (that

is, since the Wills Act of 1837, with two witnesses), and a will of personal estate could not be admitted in England to probate unless made in the form of the law of the testator's last domicile. But now, by Lord Kingsdown's Act, passed in 1861, there are given for wills of personal estate made by British subjects, besides the form of their last domicile, three alternative forms, namely, the form of the place of making the will, that of the testator's domicile at the time when it was made, and that of the part of the British dominions where he had his domicile of origin — only the first of the three, however, being offered when the will is made in the United Kingdom ; and no will is to be revoked or invalidated by a change of the testator's domicile after making it. The law of the place of contract, lex loci contractus, is distinguished into that of the place where the contract is entered into, lex loci contractus celebrati, and that of the place where it is to be performed, which, from the particular case in which the performance consists only in a payment, is called lex loci solutionis. To the first of these is generally referred the

formal validity of a contract, so far as entered into without the intervention of a functionary, and therefore not covered by the principle of the lex loci actus, and so far also as the performance is not tied to any particular place. For example, the form for contracting marriage, whether with official intervention as in England, or by private and even oral contract as in Scotland, depends, both as to necessity and as to sufficiency, on the law of the place of contracting it. But as to the internal validity, interpretation, and operation of a contract, there has been and still remains much difference of opinion between the laws of the place of contracting and of that of stipulated performance ; the former being supported, among other grounds, on some texts of Eoman law which Savigny has shown to have been misunderstood, while the latter agrees much oftener with the intention of the parties. The English decisions do not adhere closely to either of those laws, but while repeating much of the traditional language about the lex loci contractus, they aim at doing substantial justice by referring a contract to that place with which its

matter has the closest connexion, or which the intention of the parties points out. In matters of legal procedure every court follows its own practice exclusively (lex fori), as, for instance, whether the remedy on a contract shall be damages or specific performance, and whether a judg-

ment may be executed against the person or only against the property of a party. A point much disputed under this head is whether the time of limitation of actions shall, as held in the United Kingdom, be decided by the lex fori, as an incident to the procedure, or by the lex Icmi contractus in one of its varieties, as au essential modal-ity of the obligation.

It must not be supposed that the law of the land, the proper territorial law of the court which has to deal with a case in which foreign circumstances arise, always gives way to the law pointed out by the general maxims which even that particular court accepts with regard to the law of the domicile or state, or that of the

situation of property or the place of contract. All rules for the application of foreign laws are subject to an exception commonly called that of public order, i.e., where such application" would interfere with essential principles of morality or policy received in the territory. This reservation is usually made in general terms where legislation on private international law is attempted, as in Article 6 of the Code Napoleon, and preliminary Article 12 of the Italian code; but the courts have to administer it, as they have also in England and other countries where it rests only on judicial practice, and the greater or less extent given to it is one of the causes of the uncertainty and want of uniformity in our subject. One example often quoted is the refusal of the courts in all Christian countries to give effect to polygamous marriage, but this case goes deeper still, for none of the countries in which polygar mous marriage exists is allowed to enter at all into the communion of private international law. All, so far as Great Britain has settled legal relations with

them, are among those in which British subjects live under consular protection and jurisdiction, or (in Egypt) under that of the Mixed Courts. A better instance is afforded by the refusal of courts, normally within the pale of European legal communion, to recognize divorce as dissolving a marriage, notwithstanding that it has been decreed under the personal law. As another instance, there can be little doubt that an incapacity to marry imposed by the personal law in virtue of religious vows or orders would be disregarded by the English courts in the case of a person marrying in England. Again, it is established in England that damages cannot be recovered for a tort unless the act complained of was a wrong both by the law of the country where it was done and by the law of England ; and Article 12 of the statute enacting the German code is in accordance with that doctrine. Now the law of the country where the act is done would naturally give the standard for measuring its legal consequences, and it seems to be due to the connexion which laws qualifying acts as wrongs have with public

order that respect for that law is tempered by respect for the law of the countries in which it is invoked ; but Article 8 of the Belgian code refers the liability for torts to the former law without any restriction.

In the rules which have passed before us in the foregoing general review it is easy to perceive a leading motive — that of securing, so far as public order allows, the certainty and stability both of personal and of business relations in the international or interterritorial intercourse which has always accompanied civilization, but is now

Foreign especially frequent and extensive. It has been Judgments, attempted to erect this motive into a guiding principle of law, laying down that rights once accrued in any territory, or sometimes, it is said, by virtue of any territorial law, are to be recognized and enforced, subject to the requirements of public order, in any other territory in which they may be invoked before a court of justice. Prom this, which may be called the principle of the acceptance of foreign rights, it is claimed that the rules of private international law are to be deduced, and

that by their consonance with it any such rules are to be tested when proposed. The difficulties of the subject, however, do not admit of being unlocked by so simple a key. They meet us again when we inquire in what territory, or by virtue of what territorial law, a particular alleged right has accrued. Persons belonging by domicile or nationality to A enter in B into a contract to be performed in C ; where and by virtue of what law does either acquire a right against the other ? Is it to be in or by the law of their homes, where they are normally, though not always necessarily, to be sued ? Or of the country where they contract, which for various purposes, as those of police, but not for all purposes, has the control of them when they contract ? Or of the country where their contract is to be performed, under a similar control by which, perhaps extending to the very acts of performance, they or their agents may be brought by the operation of their contract ? Evidently we cannot apply the principle to guide us in our choice of a law till the very problem which that choice presents has first been

solved. There is, however, one case in which the principle of the acceptance of foreign rights leads to a conclusion, namely, where the right has been declared by the judgment of a competent court, which may have been given in an ordinary case, presenting no question of private international law, but in which, if such a question arose, it has been solved by choosing the law and basing the judgment on it. The rule in England and in many other countries as to foreign judgments is that the judgments of competent courts in other territories (foreign in the sense of civil law, whether politically foreign or not) are to be enforced without reopening the merits of the questions disposed of by them. In some countries, however, a foreign judgment is examinable on its merits before being enforced. This was formerly the unquestioned rule in France, though the practice there seems to be now turning the other way.

In the system adopted in England everything turns on the competence. Eor judgments in rem, declaring or disposing of the property in a thing, the test of competence is that the thing, whether movable or immovable,

was within the territory of the court. Judgments which declare the status of a person, as with regard to marriage or majority, are competent if the person was subject to the jurisdiction by nationality or domicile. The property or the status is treated as being what has been so declared or decreed. For judgments in personam, decreeing the payment of a certain sum, the test of competence for the present purpose is again that the person against whom it was prononnced was subject to the jurisdiction by nationality or domicile; the judgment may then be sued on as giving of itself a good title to the sum decreed by it to be paid. For domestic purposes the competence may exist on quite other grounds. By its own territorial law a court may be anthorized to entertain a siait in personam because the plaintiff possesses its nationality, as by Article 14 of the Code Napoleon, or because the contract sued on was made or was to be performed in the territory, and so forth. But judgments based on these grounds will not be enforceable outside the territory. Here we touch the root principles of our subject. The distinction be-

tween domestic and international grounds of competence can only be explained by the history of law, and we come in sight of the fact that the rules of private international law rest finally on conventions which could not have existed if the civilization of different countries had not so much that was common in its origin and in the course which it has followed, but which suit the life of those countries just because that life is itself another outcome of those common antecedents.

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INTERPOLATION

The best authority on the history of private international law to the end of the 18th century is LainS, Introduction au droit international privd, 2 vols., Paris, 1888. For modern progress the most copious materials are to be found in the Revue de droit international et de Ugislation comparie, Brussels, from 1869 ; the Jmtrnal du droit international privi et de la jurisprudence coinparie, Paris, from 1874 ; and the Annuaire de Vinstitut de droit international, Paris, from 1877. The most comprehensive general treatise is that of von Bar, of which the 2nd edition appeared at

Gbttingen in 1889, and has been translated : The Theory and Practice of Private International Law, by L. v. Bar, 2nd edition, translated by Gillespie, Edinburgh, 1892. Other works, many of great merit, are numerous in all languages ; but in this, as in every department of law, the first place for England and the United States must be given to the different Law Reports, since in those countries it is not in the study but on the bench that the highest legal intellect is usually displayed, and the judgments delivered are often essays on the points involved. The following works, however, among others, treat the subject from the English or United States point of view : — Stokt. Commentaries on the Conflict of Laws, Foreign and Domestic, 8th edition, by Bigelow. Boston, 1883. — Whartou. A Treatise on the Conflict of Laws or Private International Law, 2nd edition. Philadelphia, 1881. — Westlake. a Treatise on Private International Law, with Principal Peference to its Practice in England, 3rd edition. London, 1890. — FooTE. A Concise Treatise on Private International Juris-prudence, based on the Decisions in the English Courts, 2nd edition. London, 1890. — DrcET. A Digest of the Law of England with Reference to the Conflict of Laws, unth Notes of American Cases by

J. B. Moore. London, 1896. (jno. w.)

Interpolation. — If m denote any function (known or unknown) of a variable quantity x, and if the values of u for a series of values of x be given, it is the business of Interpolation to deduce from these data the values of u for intermediate values of x. We shall deal first with the case in which the given values of u correspond to equidiflferent values of x. Explanation will be facilitated by an example : —

Specimen Table.

14=1000 xl0».

a; = log

u

1000-

X

u

First

Differences.

Second

Differences.

Third

Differences.

Fourtll

Differences.

Fifth

Differences.

•0

•1

•2

•3

■*4*

•5

•6

■*7*

•8

■*9*

1-0

1000

1259

1585

1995

2512

3162

3981

5012

6310

7943

10,000

259

326

410

517

650

819

1031

1298

1633

2057

67

84

107

133

169

212

267

335

424

17

23

26

36

43

55

68

89

6

3

10

7

12

13

21

-.3

+ 7

-3

+ 5

+ 1

+ 8

In the above table the first column contains a series of values of x proceeding by increments of ‘1. The second column contains the corresponding values of u. By subtracting each of these from the next we obtain the First Differences, or Differences of the First Order, which form the third column. Each of them is written opposite the space between the two values of u whose difference it is. In the same way the Second, Third, Fourth, and Fifth Orders of Differences, which form the remaining four columns, are obtained, each from the column which precedes it. In general the successive orders of differences diminish rapidly, and the process is to be continued till

they either vanish or become small and irregular.

Notation. — Anyone of the given values of is being denoted by Mm, the preceding and following values will be denoted hj Um-i and Mm+i. Thus any five consecutive values may be called « 2, « . i. Mo, ui, Mj. A«m denotes Um+i-Um] l^Um, denotes Aitm+i-Awm ; A'm„, is A%m^i – A^j^m ; and so on.

Putting/(a!) for u, and taking h to denote the constant increment of X, we have by definition hfx=f(x + h)-f{x). Wo may accordingly write

(1 + A)/(a!) =/i;») + ^f(x) =f[x + h),

and, by repeating this operation n times,

(l + A)«/(K)=/(a: + mA) • (1)

"We shall now extend the definition of A by removing the implied restriction that n is an integer ; and shall adopt equation (1) with n unrestricted as our working definition of A. It is easy to show that A conforms to the ordinary laws of combination of algebraic symbols. Hence, by the binomial theorem, we have from (1)

/(. + ™;i) = {l + »A + ‘A + ^^p2)^3 + &e.W=«) (2)

which, when n is fractional, is a formula for interpolation, and is

the best known of all the formulae for this purpose. It may be

written

m„=mo+«.Amo +

n{n-l)

AhH +

n{n-l)(n-2)

2 ” “^^ 2.3

If we employ another symbol 5, defined by

Sf{x) = f{:x)-f{x-h),

or more generally by

0.-SrAx)=f{,x-nh), . .

we obtain for f{x — nh) or m „ the expression

A’jto+&c.

u.„ =’.

2.3

0 + &C.

(A)

(3)

(B)

In onr specimen table, if we take the value 2512 as Uo, then the

numbers 650, 169, 43, 12, which slope down from it, will be Amo, A2M0, A'tto, A^uo ; and the numbers 517, 107, 23, 6, which slope up from it, will be Sv^, Shio, S%o, S^o-

The value assigned to » in (A) and (B) may be either positive or negative, (l + A)"" being equivalent to (1-5)", and (1-5)-'" to (1 + A)».

*To interpolate in our specimen table the value of M for a;= '42, we may start from x= -i and put n = i in (A) or – i in (B). The former gives Mo=2512, Alio =650, A^Uo=lQ9, A*tto=43, A*

re(TO-l) £ n(n-l]{n-2) 6 n(n – l){n – 2){n – 3)

""' 2 ~~25' 2.3 ~125' 2.3.4*

-21

= -gng ; whence 2630 '1 is found as the required interpoland.

To interpolate for x= '48 it is better to start from x='5 and put n=lm (B) or -iin (A).

Eapid convergence is promoted by taking the starting-point as near as possible to the desired interpoland.

Exponents of A and d as Co-ordinaies. — The symbol ASu or its equivalent SAu indicates the number in our table which will be reached, from any selected value of m as starting-point, by taking

two steps, one in the direction indicated by A and one in the direction indicated by 5. The number thus reached wiU be the " second difference " standing opposite the selected value of u. In like manner A'^Shb is the ' ' fourth difference " standing opposite to u. If ii is 2512, ASu is 133 and A^S'u is 10. To reach A^8m from u requires two steps in the direction A and one in the direction 5 ; and to reach A^5"% requires two steps in the direction A and one opposite to the direction S. "When the two exponents (which may be regarded as oblique co-ordinates) are equal in magnitude and opposite in sign, we are carried finally to the same column from which we started. For instance, if m is 2512, the number below it (3162) is AS'hi,, which may be written -ju; the number above it

I

u or A'8"'m is the third number

(1995)isSA-'Mor^M.

(5012) below it ; and

(I)'

^)

is the third number (1259) above it.

Symbolic Law. — ^The position of ASu in the column of second

differences, opposite the space between A?t below and Su above,

shows that A5u=Au-Su. Accordingly the operation A5 is equi-

valent to the operation A – S, and we are entitled, in all trans-

formations, to employ any substitutions derivable from

A-S=AS (4)

treated as an algebraic equation. "We might have deduced it from

the fact that Ml, which we have just seen is TMo, is also (l-^A)«(|;

or that Uo, which is ^mj, is also (1 – 5)«i, or from mo = (1 – S)«i

= (l-S)(H-A),to.

Any difference, of whatever order, can be expressed in terms

of tabulated values of u by writing -g – 1 for A. For example.

Similarly, A%=«4- 4M3-)-6i(2-4tii ɨ Mo =A'^5=!t2 (5)

Bisection of Intervals. — The value ui interpolated midway be-

. , /A\»

tween Uo and Mj 13 represented by I ɨ 1 mo ; and the value u-i mid-

way between w-i and Moby f-jj . Butwehave|(j] -f (^j I

INTERPOLATION

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fA+sy

(A-Sf+iAS,

AS

to AS reduces to 4 +

which by the equivalence of A – S

= 2 +

A3

■+5i2-^°’*

AS. Hence (f)’ + (1)’ =2 (i + t)’

(Ci)

*A^S^*

4 ~ 64

If the operand is Mq the first member represents mj + m. j.

If the operand is mj the first member represents lij+Mo, and we

/ AS\i

have Mo+‘iii = 21 1 + j 1 mj, whence

/ AS\ -i

Ml = 4(1 +

= ‘(-f).

4

AS

(ua + Ui)

, f, AS 3AW 5A35' ^1, , , „„,

*= n^‘8”+128—1024 + *”}(“»+”’^ • • • (0)*

This is the best formula for midway interpolation. For x= “45 in our table it gives

2512 + 3162=5674; – J(133 + 169)= -37-76 ;

j|g(10 + 7) = -40 ; i(5674 – 37 75 + -40) = 2818 -3.

Broader View of Interpolation. — ^The first difference {x + hY-af of any positive integral power of x contains no higher power of x than the (r-1)’ ; hence, if successive differences are taken of a positive integral function*

u=ai) + aiX+aiiOi?+ . . . +a^, ... (8)

the r’ difference will be constant and the (r+1)’* will be zero. Conversely, if the r”^ differences of a function of x have a constant value, the function is expressible as a rational and integral function of X of degree r. Hence all methods of interpolation by means of differences virtually assume that u can be expressed with sufficient accuracy by a series of the form (8) in which r is a small integer.*

A very direct method of obtaining an interpolation formula from any small number ?• + 1 of given values of M (not necessarily equi-distant) is to form r + 1 equations by substituting corresponding

values of w and x in (8), and to deduce from them the r + 1 con-

stants do, Oi, . . . ffir ; but the calculation is rendered much easier

by a transformation of (8).

Let Mo, Ml, ... Mr be the given values of m, and Xo, xi, . . . x^ the

corresponding values of aj, which are not necessarily equidifferent,

nor in order of magnitude. Assume

M = Ao(a; -x{)(x-x-^...{x-x^ + kiix – x^{x – ajj) . . . (a; – x^ + &c. (9)

the factor x — Xo being omitted in the first term, (x-Xi) in the

second, and so on. The number of factors involving x in each

term is r, and each term (and therefore also the whole series) is of

the form (8). Substituting Mo and a;o, all the terms will vanish

except the first, and we shall have Ua = Ao(a;o – Xi){xo – X2) . . . {xo – x,),

which gives Ao. Substitutiug accordingly for Ao, the first term of

/nM, {X-Xi){x-X2). . .{X-Xr)

(9) becomes

-5(----^~-(~—-)Mo, (10)

and the other terms can be written down by changing suffixes.

This process (commonly called Lagrange's) affords great facility for calculating the coefficients. It has the disadvantage, in common with (8), that if we wish to improve upon a first approximation by including a larger number of given values, all the coefficients must be recalculated. This inconvenience is avoided in the following method, employed by Stirling in his Methodus Differentialis.

Assume

u=a<,+ai{x-x^ + a4x-x,s){x-x{) + a4,x-xii){,x-xi)(x-xij

-Xo)(p-x{). . . (x-Xr-l)

(11)

+ . . . +ar{x

Then we have the equations

Mo=ao; Ml = (to + 11(2^1 – a!o) ;

ti;)=ao + aiixi-Xo) + ai{xi-Xo){X2-Xi); . , . (12)

and so on.

ao is given by the first equation, ai by the first two, 02 by the first three, and so on.

This method is especially useful when the given values of x are

equidifferent — an application to which we shall now proceed. We shall call the values of M ordinates, the values of x being regarded as abscisses. The given ordinates will be equidistant, their common distance being Ji, and we shall take n to denote j. so that n will increase by unity from each ordinate to the next. (11) will be obviously reducible to

M = Ao + Ai(» – Wo) + A2(re – no)(ra – %) + A3(» – mo)(ra – «i)(™ – “2) + &0

(13)

where %, rai, rea, &o., are in random order of magnitude.

When the number of given equidistant ordinates is odd, it is best to take the origin on the middle ordinate ; the values of n will then be 0, ±1, ±2, ±3, &c. Introducing them into (13) in th6 order 0, 1, -1, 2, -2, &c., we shall have

M = Ao + Aiw + A2«(m – 1) + A3(?!, + 1)m(?i – 1) + A4(«. + l)7i(m-l)(»-2) + &o (14)

whence the values of the coefficients can be deduced by the method just indicated. The following method has the advantage of more directly indicating the general expression for any coefficient. We shall operate alternately by A and 5, remembering that, since the

common increment of « is unity, A/(«,) is f{n + \)-J{n), and Sf{n)

is /(to) -/(to – 1). We thus obtain from (14)

Am =Ai + TO2A2 + (TO + l)TO3A3 + (m + l)TO(TO-l)4A4 + &o.

ASM =2A2 + to2.3As + to(to-1)3.4A4 + &c.

A^Sm =2.3A3+to2.3.4A4+&c.

A2S=m=2.3.4A4+to2. 3. 4. 5A5 + &C.

From these and (14), by putting to=0,

Ao=Mo, Ai=Amo, 2A2 = ASmo, 2.3A3=A“Smo, 2.3.4A4=A^5%o, &o.

Hence

M = {1 +toA + ‘!(»- l^A.

,TO(TO°-l)(TO-2)^;g2 !

2.3.4

2.3

h&C. >Mo

If we had introduced the values of to in the order 0, — 1,

2, &c., and operated first by 3, we should have obtained

« = |l + toS + (” + ^)“A8 +”(f-^W

m(TO?-l)(TO + 2)^2j, 3^ \ .

2.3.4 i

(D)

(E)

Adding these two results and halving, we have Stirling's first formula in central differences,

1) A°8 + A3'

2

-{>

*,i^±iH-»'AS+'^*

^^2 2.3

+^^^m-+t..]u, (F)

The two next terms are

|-to(to°-1)(to'4) A"3' + A'S' toV l)(TO"-4)^3g3l

\ 2.3.4.5 2 2.3.4.5.6 /

hMo.

2.3.4.5 2 2

The even differences ASmo, AWmo . . . A"5"Mo are called central differences relative to Mo, and the same name is extended to the means J(Amo + Smo), ^(A"Smo + AS^Mo), &c., of adjacent odd differences. In the standard arrangement, illustrated by our specimen table, the even central differences of Mo stand at the same level as Mo, and the odd central differences are the mear^ of the odd differ-

ences which stand nearest to this level.

When the number of given equidistant ordinates is even, take

the origin at their centre, which will be midway between the two

innermost. For these two to will be +4, for the two next beyond

them ±1, for the next two +f, and so on. Introducing them

into (14) in the order 4, -\,l, – h &c., we have

M=Ao+(TO-4)Ai + (TO + 4)(TO-4)A2 + (TO + 4.)(™-4X™-f)-A-3 + &C.

Am=Ai + (to + 4)2A2+(to-i-4)(to-4)3A3 + &c.

ASm = 2 Aa + (to – 4)2 . 3 A3 + &o.

and by putting to alternately equal to 4 and – \,

Ao=Mi, Ai=Am j=Smi, 2A2=ASmj, 2. 3A3=A^Sm.j=A6=M|

TO^-i (m^-i)(»-|) –

u = u\ + {n- 4)Smj + — 2 — ““i +*

(«’-«(‘^’

^A»SS + ^-

2 3

-i)(«”-i)(«^-i)

2.3.4 ” ” ■r« ■ 2 .

If the order of introduction is – 4, 4,

TO^J,

M=M_j + (ra + 4)3Mj + — n^ A5m_j +

.4.5

f, I, &c., we find

{n?-mi+

A^S^Mi + Ac. (G)

2.3

A5=M}

(^^_|X^^_|) (TO’i)(TO’|)(TO + f)^2g3^^^ jj

2.3.4 ”’ 2.3.4.5

Adding these two results and halving, we have Stirling’s second

formula in central differences,

M-J + Ml . TO’

u = — ‘g — + toSmj + –

(to2

j AS(M_t + Mi) njn

2 2 ■•” 2.3

i)

-i)(»”

I) A“S°(M_i + Mi) to(to°-

2 “ “2.

i){rfi-l)

A2S3mj + &c.(K)

2.3.4 2 ^ 2.3.4.6

which, when to is 0, reduces to the midway-interpolation formula

(C). We may change m_j into Mo and Mj into Mi throughout the

formula. The differences which enter it are "central" relative

to the midway position which we have taken as origin. Each

of the odd differences can be expressed indifferently as A'S'.Smj or

A'S^Am.).

Reduction to Symmetrical Form. — (K) with iio and Mi in place of

«.j and M} is reducible, by putting n=p-\=^-q, to the form

370'

M = Mi + ?Mo – –{{P + 1)ASmi + (g' + 1)A5mo}

+M^ + g£±i){(p + 2)A25^i + (?+2)A=5%o}-&o., . (L)

or the more easily remembered form

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INTRA— INVERNESS

(y + lMj9-l)

u=pui + –]^ 2 3

+ &C

ASui +

(p + 2){p + l)p{p-l){p-2)

1.2.3.4.5

A^S'ui

(g + lg)(g-l)

(g + 2)(g + l)g(g-l)(g-2)

■ (M)

A2S% + &c.,

+ 2^0 + 1.2.3 ^*"» + 1.2.3.4.5

where p is the distance of the interpoland from Uo, and q its distance from Ui. Each pair of terms in (L) or (M) is equivalent to the term of the same order together with the term of next higher order in (K). The mutual equivalence of (M) and (L) is established without difficulty. The equivalence of either of these to (K) is most easily shown by beginning with (L) and reducing to (K).

Dediiction of Differential Coefficients. — Since n is defined as

X , d ^ d „ ^du du ,jPu "

h' """ ^^^^ rfi = *^- ""'' ^dx =Tn'

, du d?v,

” dx^ d/ri^’

The values of

,., 5-2, &o., for any of the tabulated values of u

are the coefficients of «,-i~o, &c., in Stirling’s first formula (F).

Thus we find

dii

*dx^*

(A + d

“V 2"

(

*A^S-hAS^ A’>5' + A^S^*

12

^2g2 ^353

r2”+“90 ”

60

1. ju

&0.

■ &0.)m

(N)

For a value of u midway between two tabulated values Uo and Mi,

we have in like manner from (K)

3A253

du

^dx

-(n ^

-1^-24

640

+

-&c.)mi

-&0. j

Uo + Ui

(P)

5760 “•”•; 2

For general values of u, we may differentiate either (F) or (K).

From (F) we find

du fA + S ., /w= l\A2S-fAS2

+ (f-^2)A=S^ + &o.}«o; (Q)

K’

dhi

da?

-~{.

A5 + n -f.

(|‘ yA25^+&o.}«„,; . (Q’)

n denoting the distance of u from the tabulated value «o.

The series (A) and (B) give, for tabulated values of u,

h’^ = {A-\A^ + iA^-ka.)u=^{S + lS^+\S^ + hs.)u . (E) (S)

h?^^ = {A^-A^ + iiA”-ka.)u = {S^+S^+i^S^ + ka.ya (Ri) (S’)

Limit of Error. — In our specimen table, the values of u are given to the nearest integer ; their limit of error is therefore ‘5. The sum or difference of any two of them has a. limit of error double of this — a fact which we shall express- by saying that its error-ratio is 2. For a linear fimotion aMo+J«i±cM2 the error-ratio is ffi-t-6 + c. A first difference Mi-Mo has an error-ratio 2. For a second difference u^-lux-Vuts the error-ratio is 4. For a third difference M3 – 3^2 ⊣ 3mi – Mo it is 8, and in general for a difference of order r it is V. We shaU. investigate the error-ratio of the determination of A^ by the formulae (N) (P) (E) (S), sup-posing fifth differences to be negligible.

(N) give^*rf^ = \^-^— — 12 — j«o=4(Mi-M-i)

- tV(“2 – 2mi ⊣ 2m-i – M.a) = fMi – |U-i – A^ + A”-2.

Error-ratio = J + |-(A + A = 14

dtt / AS^X ,_,_„_„.

(P) gives A^ = (5 – 24)«i=«i-«o-A-(m2-3«i-1-3mo-m.i)

= 1|mi – 1 Jmo – Am2 ‡ iiVw- 1-

Error-ratio = \ + \ + -h + -i-s. = ‘^-

(E) gives (A- JA2-HA«-iAVo= -2iVwoH-4«i-3Ma-HjM3- Jm4.

Error-ratio = 1-^ + ^ + ‘i + \ + \ = \^\, which is also the error-ratio for (S). Thus the limit of possible error is fully seven times as large with either of these formulae as with the central-difference formula (N).

The midway-interpolation formula (C) reduces (when sixth differences are negligible) to

^4J=■^f5•{150(Mo + MI)-25(■^t l-^«2)-^3(M-2-l-«3)}■ ■ . (T), giving as the error-ratio -jl^ (150-f254-3) = lH. The formula for the same purpose obtained by putting w = i in (A) reduces to r4^(35Mo + 140Mi-70M2-f28M3-5M4), giving Ti^(35H-140-l-70-l-28-l-5) = 2Ji as the error-ratio.

The actual error in interpolation is usually very far below the theoretical limit. If the six intervals lying between ‘2 and ‘8 in our specimen table are bisected by means of (C) the errors will be

found^to be % % ‘2, ‘3, “1, ‘1 ; whereas the errors of the seven tabulated numbers between which they lie are ‘1, “3, -1, -3, “1, ‘1, ■4 ; so that the interpolated results are on the whole more exact than the tabulated numbers. This suggests the possibility of increasing the accuracy of a given table by interpolation. For instance, (T) can be employed to recalculate the value of m for a;= ‘5 by means of the tabulated values for -0, % -4, -6, -8, 1-0. Another mode of procedure is to put the sixth difference equal to zero, thus obtaining

M„ = ^15(M i-|-Ml)-6(i« 2 + M2)-f«-3 + M3} • • (U)

These two methods agree in giving 3162-4, the true value being 3162-3, and the tabulated value 3162.

Addendum. — Eesearches made since the foregoing article was written have shown that the two formulae (F) and (K), known by Stirling’s name, are really Newton’s, and were first published in his MetJwdus Differentialis, 1711 ; also that the conimon formula (A) is Newton’s, being given in geometrical form in Lemma 5, Book III., PriTicipia. Stirling, in a paper entitled “Methodus Differentialis Newtoniana illustrata,” Phil. Trans., 171S, emphasizes the value of these publications ; but in his own Methodus IHfferen-

tialis, 1730, where the formulae are more fuUy discussed, he does not repeat the reference to Newton. The symmetrical formula (M) was first published at the British Association, 1900 {Report, p. 648), and is further illustrated in Jour. Inst. Actuaries, January 1901. The combined use of the two operators A and S was described at the British Association, 1899 (Report, p. 645), and in Quar. Jour. Math., 1900, 1901. Modem works on practical interpolation are : — Institute of Actuaries' Text-Book, Part II., by Gkorgb King; and Theory and Practice of Interpolation, by H. E. EicE, U.S. Naval Observatory, which contains full tables of numerical values of coefficients. A paper entitled "Central Difference Formula," by W. F. Sheppard, Proc. Lond. Math. Soc, vol. xxxi., contains the fullest collection we have seen of such formulae, and a discussion of the limits of error in interpolation. An excellent summary of the early history of interpolation is ^ven in the introduction to the first edition of Hutton's Mathematical Tables. (j, d. E.) Intra, an industrial town, province of Novara, Piedmont, Italy, on the -west shore of Lago Maggiore, 9 miles east of Gravellona. It has a station on the Simplon railway, and busy cotton miUs, chemical works, hat factories,

and dyeworks, and a large institute of arts and sciences. The parish church (1708-51) has a monumental dome (1890) and a belfry (1877), 177 feet high. There are statues to Garibaldi and Victor Emmanuel (1887). Population (1881), 5745; (1898), 5700.

InverCSirg'ili, capital town of 'Southland county. South Island, New Zealand, 100 mQes west-south-west of Dunedin. It is the centre of the large grazing and farming district of Southland. Amongst its chief buildings are the government offices, excellent public reading-rooms, and a number of factories. Most of its trade passes through Bluff Harbour, some miles away, which is connected with the town by rail. The exports of the two places were in 1900, £741,750; their imports in 1900, £288,170. Bluff Harbour is the port of call and departure for steamers for Melbourne and Hobart. Population, including suburbs, 10,630.

Inverness, a royal and parliamentary burgh (Inverness group) and the county town of Inverness-shire, Scotland, near the mouth of the river Ness, 165 miles

north-north-west of Edinburgh by the Forth Bridge route. Eecent erections include four churches, a town hall, a theatre, new public market (to replace one burned down in 1889), Highland orphanage, new academy, and new post office. The cemetery of Tomnahurich is one of the most beautifully situated burying-grounds in the United King- • dom. Inverness — " the capital of the Highlands," as it is called — is the centre of traffic in connexion with the shoots ing season, and is thronged with tourists every summer. The Northern Meeting and County Ball at the end of September usually indicate the close of the midsummer vacation. Inverness is the port for the passenger traffic on the Caledonian Canal, the pier being a mile or so dis- tant from the town. The finely wooded islands in the

river are a popular resort. It is commonly said that the inhabitants speak the best English in the British Isles. The extension of the harbour was undertaken at a cost of .£50,000. There were 42 vessels of 3272 tons registered

at the port in 1898. In 1888, 3139 vessels of 362,953 tons entered; in 1898, 3775 vessels of 484,574 tons. Imports were valued at £58,991 in 1888, and £97,065 in 1898. Coal and wood are the chief imports. Tweed (tartan) manufacture is the leading industry. Inverness is a great distributing centre of trade to the Highlands. The academy is an endowed secondary school. Valuation, 1889-90, £90,280; 1899-1900, £118,845. Population (1881), 17,385; (1901), 21,193.

Inverness-shire, a maritime Highland county of North Scotland, bounded on the N. by Eoss-shire, on the N.E. by Nairn and Elgin, on the E. by Banffshire and Aberdeenshire, on the S.E. by Perthshire, on the S. by Argyllshire, and on the W. by the Atlantic.

Area mid Population. — In 1891 the Argyll portion of Small Isles was placed in Inverness, as were the Nairn parts of Daviot and Dunliehty and Petty ; Cawdor was placed wholly in Nairn ; the parish of (Jrray with a portion of Kilmorack added was restricted to Rosa ; and the boundary was also altered between Inverness and Elgin, in the parish of Cromdale, which became an Elgin parish,

its Inverness portion being added to another Inverness parish.

The area of the county (foreshore excluded) is 2,784,884 acres, or 4351 ‘5 square miles. The population was in 1881, 90,454 ; in 1891, 89,317 ; in 1891, on the above area, 90,121, of whom 43,585 were males and 46,536 females ; in 1901, 90,182, of whom 43,810 were males and 46,372 females. On the old area, taking land only (2,616,545 acres or 4088 “3 square miles), the number of persons to the square mile in 1891 was 22, and the number of acres to the person 29‘3. In the registration county, which had a population of 85,536 in 1891, the population decreased between 1881 and 1891 by 1‘37 per cent. Between 1881 and 1891 the excess of births over deaths was 7700, and the decrease of the resident population 1193.

The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 :—

Tear.

Deaths.

Marriages.

Births.

Percentage of

Illegitimate.

1880

1890

1899

1422

1424

1479

366

346

420

2313

2033

2004

8-5

7-43

8-4

The birth-rate, death-rate, and marriage-rate are all below the rates for Scotland. The following table gives the birth-rate, death-rate, and marriage-rate per thousand of the population for a series of years : —

1880.

1881-90.

1S90.

1S91-9S.

1899.

Birth-rate .

Death-rate .

Marriage-rate

26-83

16-49

4-24

26-41

16-44

4-51

23-83

16-69

4-05

24-06

17-64

5-05

23-78

17-55

4-98

The number of Gaelic-speaking persons in the county in 1891 was 44,814, of whom 17,316 spoke Gaelic only ; and there were 86 foreigners. Valuation in 1889-90, £316,411 ; 1899-1900, £366,237.

Administration. — The county returns a member to Parliament. Inverness (21,193) is the only royal burgh, and one of the Inverness group of parliamentary burghs. There are 33 civil parishes, with poorhouses at Inverness and in Skye and the Long Island. The number of paupei-s and dependants in September 1899 was 3372. Inverness forms a sheriffdom with Elgin and Nairn, and there are resident sheriffs-substitute at Inverness, Fort-William, Portree in Skye, and Lochmaddy in North Uist.

Education. —Thirty-seven school boards manage 1 68 schools, which had an average attendance of 12,289 in 1898-99, while 14 voluntary schools (8 Roman Catholic, 3 Episcopal) had 684. There are 2 secondary schools in Inverness, and 24 other schools in the county earned grants in 1898 for giving higher education. The county council hands over the "residue" grant to the county committee on secondary education, which allocates it among district committees

for expenditure on local technical classes ; Inverness town council subsidizes the burgh technical and art school.

Agriculture. — In 1898 the percentage of land under crops was only 5-38, being higher than that in Sutherland alone, but since 1852 the cultivated area has increased more than 300 per cent. An immense majority of the holdings are crofts, the average size of the 6961 holdings in 1895 being 22 acres ; 2780 or 39-99 were under 5 acres, 3590 or 51-65 were between 5 and 60 acres, and only 8-36 were above 60 acres. The number between 50 and 100 acres was 295 ; between 100 and 300, 249 ; between 300 and 500, 26 ; between 500 and 1000, 6 ; and there were 5 over 1000. Oats are the predominant crop, and are about stationary in acreage ; and the same may be said of barley since it reached its maximum in the 'eighties. The wheat acreage is trifling. The following table gives the principal acreages, as far as possible, at intervals of five years from 1880 : —

Tear.

Area under

Crops.

Corn

Crops.

Green

Crops.

Clover.

Perma-

nent

Pasture.

Fallow.

1880

1886

1890

1895

1899

126,306

149,521

160,529

150,725

148,766

39,584

36,966

39,777

37,883

38,333

19,613

19,493

18,646

17,344

16,827

27,166

29,976

32,266

29,927

31,365

39,140

58,924

68,995

66,132

61,740

914

1432

830

388

464

The following table gives particulars of the live stock during

the same years : —

Tear.

Total

Horses.

Total

Cattle.

Cows or

Heifers in

Milk or Calf.

Sheep.

Pigs.

1880

1886

1890

1895

1899

8938

8692

8744

8872

8952

51,287

51,279

48,602

51,799

52,321

20,208

21,035

21,046

21,261

22,362

711,910

684,246

675,148

645,900

628,695

2897

3488

3809

3019

2669

From the commencement of the operations of the Crofters' Commission in 1886 to the end of 1898, 5269 applications to fix fair rent were dealt with in the county, and rents amounting to £21,036 were reduced to £15,336, while of £69,944 of arrears £49,365 was cancelled ; 890 applications for enlargement of holdings were dealt with, and 8354 acres were added to existing holdings. In 1895, 150,929 acres were under wood, of which 6944 had been planted since 1881. At the census of 1891 there were 11,958 men and 1835 women in the county engaged in agriculture. Deer forests covered 713,491 acres in 1899, an increase of 149,451 acres since 1883, and their annual value was £47,440.

Industries and Trade. — The ports and creeks of Invemess-shire are distributed among five fishery districts — Findhorn, Stornoway, Barra, Loohcarron and Skye, and Fort- William — and number 65,

having in 1898, 1091 boats of 3058 tons, with 3077 resident fisher-men and boys, and a catch valued at £27,001. Barra is an exclusively Inverness district, and comparative statistics may best be given for it and Lochcarron and Skye together : —

Tear.

Boats.

Value of

Gear.

Resident

Fishermen

and Boys.

Total

Value of

all Fish.

No.

Tons.

Value.

1890

1898

1899

962

962

940

3198

3644

3444

£7,615

£10,618

£10,451

£26,223

£18,469

£18,219

2915

2511

2482

£20,940

£28,144

£108,650

Of the total value of fish caught in 1899, £90,617 was the value of the herring catch and £11,863 the value of shell-fish. In 1899

there were 3987 persons employed in the two districts in connexion with the various branches of the fishing industry. A number of new railways were built during the last twenty-five years of the 19th century, including the West Highland (Glasgow to Banavie), opened inl894-95, and the Aviemore-Inverness direct line, opened in 1898. These two added 70 miles to the railway mileage ; and there are also the Mallaig extension of the West Highland and the Invergarry and Fort- Augustus line (1900).

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I N V E E U R I E — I 0 W A

Inverurie, a royal and parliamentary burgh (Elgin group) of Aberdeenshire, Scotland, at the confluence of the rivers Don and Ury, 16Jf miles north-west of Aberdeen by rail. Paper and mineral waters are the only manufactures, but the town is an important centre of the cattle trade for the London market. The workshops of the Great North of Scotland Eailway Company are here, and a new station was opened in 1900. There is a town hall. Population (1881), 3048; (1901), 3454.

Ionia, a city and the capital of Ionia county, Michigan, U.S.A., on Grand river, and on the Detroit, Grand Eapids, and Western, and the Grand Trunk

railways, at an altitude of 650 feet. It is in a farming and lumber region, and contains the state asylum for insane criminals and the house of correction. Population (1880), 4190; (1890), 4482; (1900), 5209, of whom 864 were foreign-born.

Ionian Islands. See Greece.

Iowa, one of the states of the American Union, situated on the western bank of the Mississippi river, the sixteenth admitted, and the tenth in population according to the censuses of 1880, 1890, and 1900. The area is 66,025 square miles, of which 650 miles is water surface. It is the twenty-second of the states in size. The population in 1900 was 2,231,853, giving 39-84 to the square mile, a gain of 319,957, or 16-74 per cent., since the census of "1890. Of the total, 1,166,849 (61-8 per cent.) were males and 1,075,004 (48-2 per cent.) females; 1,925,933 were native-born and 305,920 (13-7 per cent.) foreign-born ; 2,218,667 were white and 13,186 (0-6 per cent.) coloured, of whom 12,693 were negroes, 104 Chinese, 7 Japanese, and 382 Indians. The urban

population in 1900, classing as such all persons residing in cities of 8000 inhabitants or more, was 374,726, or 16-8 per cent, of the total population, as against 14-1 per cent, in 1900. The death-rate in 1900 was about 8-7 per cent.

The city of Des Moines is situated near the centre of the coal-bearing area. The annual output of coal ranges in value from 15,000,000 to f 6,000,000. The coal mines gave employment in 1899 to 10,736 persons, of whom 7829 were miners. Clays suitable for a great variety of uses are found in the state. Extensive beds of gypsum occurring near Port Dodge are probably of Cretaceous age. The manufacture of stucco from Fort Dodge gypsum has become an important industry, the annual value of the product approximating a quarter of a million dollars. The Pleistocene deposits include five successive drift-sheets, which give a great variety of remarkably productive soils. The loess is a peculiar silt-like deposit, a secondary product of the drift, covering more than half the area, and possessing characteristics which make it for many purposes

one of the most desirable of soils. Eich alluvial deposits occurring in the wider stream valleys are also secondary products of the drift. Lead is found to some extent in the vicinity of Dubuque. The first enterprise ever set on foot in any part of what is now Iowa was that of mining lead, which was begun over a hundred years ago by Julien Dubuque.

Education. — Liberal provision is made for common schools. In 1900 fliere were 12,615 ungraded schools and 5766 rooms in graded schools. The number enrolled in the schools during the previous school year was 566,223, and the average attendance 373,474. The number of instructors was 28,789, of whom 23,840 were women. The expenditure during that year on account of teachers was 15,606,932, and for all other purposes $8,421,986. There were 13,861 school-houses valued at $17,655,992, with over $700,000 worth of apparatus and more than 300,000 volumes in district libraries. The permanent school fund amounts to $4,746,632. The amount of interest apportioned to the counties during 1900 was $237,400. The number of illiterates over ten years of age in 1895 was 11,102, or about 0-54 per cent, of

the entire population. The clear proceeds of all fines collected, and the proceeds of a county tax of not less than $1 or more than $3 on the f 1000 of the taxable value of property, together with the apportionment of the income of the permanent school fund, constitute what is known as the temporary school fund, which is distributed twice a year among the school districts according to the number of youths therein between five and twenty-one years of age, and is used altogether for the payment of teachers. In 1900 the number of persons of school age (five to twenty years inclusive) was 767,870. Out of 635,298 males of voting age, 17,061 were illiterate (unable to write) of whom 8273 were foreign-bom and only 975 were negroes. The state university is at Iowa City, the former capital. It has a collegiate department with a faculty of forty-eight professors ; a law department with six ; a medical department with twenty-three ; a homoeopathic medical department with thirteen ; a dental department with three ; and a pharmacy department with nine. The number of students in attendance in 1900 was 1438. It has an annual income from the state treasury amounting to $125,500, besides interest on trust funds and other sources of revenue. The university is governed by a

board of regents, consisting of the governor of the state, the superintendent of public instruction, and eleven other members chosen by the general assembly for six years. The Iowa state college of agriculture and mechanic arts at Ames has a tract of land comprising 840 acres, on which are forty-three farm and college buildings besides the equipment of the several departments, the whole being valued at $755,327. The endowment ftmd amounts to $683,000, mainly derived from the proceeds of the sale of 240,000 acres of land granted the state in 1862 by the Federal Government. The college is governed by a board of trustees constituted similarly to the board of regents. The Iowa state normal school is at Cedar Falls, Blackhawk county. It had in 1900 forty instructors and 1610 students. It draws from the state treasury annually for support and contingent expenses $59,000. There are also a number of denominational and undenominational colleges. Charities, &c. — There are several institutions of an eleemosynary and penal character. The Iowa soldiers' home at Marshalltown, with a membership of 646 ; the orphans' home and home for destitute children at Davenport, with 436 inmates ; the college for the blind at Vinton, with an attendance of 131 ; the school for the

deaf at Council Bluffs, with 251 pupils ; the institution for feeble-minded children at Glenwood, with 879 under its care. There are three hospitals for the insane, situated at Mount Pleasant, Independence, and Clarinda, with 2905 patients. The penitentiaries are at Fort Madison and Anamosa, and have 94.3 prisoners. There is an industrial school at Eldora for boys, and one at Mitchellville for girls. They have 630 inmates. The property connected with all these institutions comprises 4190 acres of ground. They are all under the direction of a, board of control, consisting of three persons appointed by the governor and Senate for a term of six years.

Beligion. — The number of church organizations at the last state census was 4862, with 571,264 church members, owning 4498 church edifices, with a seating capacity of 1,803,804, and valued at $15,105,085. The leading denominations, in the order of the number of church edifices, are : the Methodist, with 1382 ; the Presbyterian, with 454 ; the Lutheran, with 424 ; the Catholic, with 411 ; the Baptist, with 398 ; the "Disciples of Christ" and "Christian Connection" (not distinguished, but mostly of the former), with 325 ; Congregational, with 251 ; United Brethren, with 156 ; Friends, with 82 ; Reformed, with 66 ; Protestant-

Episcopal, with 65 ; Adventist, with 56.

Agriculture.— Oi its 35,000,000 acres of land there is very little which is not susceptible of cultivation. Indian corn is the principal staple. The agricultural products for 1900 were as follows : —

Crop,	*Amount.*	*Per Acre.*
	Bushels.	
Corn	*353,365,000*	*40-8*
Fall wheat .	*1,018,070*	*13-3*
Spring wheat	*20,280,280*	*14-8*
Oats .	*138,832,830*	*34-7*

Rye . .

1,621,630

15-6

Barley ....

12,695,200

25-3

Buckwheat .

180,000

16-0

Flaxseed

1,222,980

11-7

Potatoes

10,850,900

72-0

Hay, cultivated .

Tons.

3,609,010

1-4

Hay, wild .

1,630,050

1-1

Other products of the soil were valued as follows : — Timothy seed, $825,000 ; clover seed, $350,000 ; sorghum, $275,000 ; broom corn, $35,000 ; corn fodder, $9,500,000 ; pasturage, $30,000,000 ; straw and other forage, $4,000,000 ; fruits and vegetables, $8,600,000 ; sweet potatoes, $276,000.

IOWA

545

The whole aggregated 1229,805,058 in value. The cereals amounted in volume to an average of more than five tons for each inhabitant. The increment gained by converting soil products into beef, pork, mutton, dairy and poultry products, horses, &c., added materially to the foregoing value.

The number and value of live stock in 1900 were as follows : —

Stock.

Number.

Value.

Horses ....

Mules ....

Milch cows .

Other cattle .

Sheep ....

Goats ....

Swine ....

Total

979,389

31,232

1,263,283

2,178,129

419,218

10,869

3,534,833

Dollars.

48,810,774

1,708,906

44,088,577

72,930,788

1,333,113

31,163

18,466,739

8,416,953

187,370,060

The total number of creameries was 779, and there were 188 "skim stations," their total value being f 2,320, 727. Estimating for some creameries not reported, the aggregate product in 1899 was 87,972,470 R), of which 77,013,875 lb were shipped. There were 69 cheese factories, with an estimated value of #105,915, with a total annual production, in 1899, of 3,669,109 R). For the production of cheese, butter, and condensed milk at factories, see the following paragraph.

Manufactures. — ^The statistics of manufactures in 1890 and 1900, with the percentage of increase during the decade, are shown by the following table : —

Pep cent.

1890.

1900.

of

Increase.

Number of manufac-

turing establish-

ments

7,440

14,819

99-2

Capital

$77,513,097

$102,733,103

32-5

Salaried officials, clerks.

&c

8,1371

5,6642

30-43

Salaries

$5,449,377 1

$4,486,117

17-78

Wage-earners, average

number .

51,037

58,553

14-7

Total wages

$20,429,620

$23,931,680

17-1

Miscellaneous expenses

$5,732,206

$7,988,767

39-4

Cost of materials used

$79,292,407

$101,170,357

27-6

Value of products, in-

cluding custom work

and repairing .

$125,049,183

$164,617,877

Four of the most important manufacturing industries in the state in 1900, with the value of their products, were : Slaughtering and meat packing (wholesale), $25,296,518; cheese, butter, and condensed milk (factory product), $15,846,077 ; flouring and grist mill products, $13,823,083 ; lumber and timber products, $8,677,058.

Mailways. — In the early history of Iowa much of the transportation was by boats on the Mississippi, Missouri, and Des Moines, and occasionally the Cedar, Iowa, and other rivers. Now the interior rivers are entirely abandoned as commercial highways, and the Missouri river nearly so, while the traffic on the Mississippi is greatly diminished in volume. Railways have come in to supply the vastly greater facilities which are now needed for moving the products and crops. The first railway in any part of Iowa was constructed in Davenport and Scott county in 1854, but there was no locomotive in the state until the next year. There are now 9400 miles of railway, valued at $185,000,000. The most extensive is that of the Chicago, Milwaukee, and St Paul railway system, which has 1775 miles. The next is the Chicago and North-western railway system, with 1418 miles, followed by the Chicago, Bur-

lington, and Quincy railway system, with 1333 miles ; the Chicago, Eock Island, and Pacific railway system, with 1200 ; the Burlington, Cedar Rapids, and Northern railway system, with 967 ; and the Dubuque and Sioux City railway, which is a part of the Illinois Central railway system, with 836 miles.

Finances. — Property is assessed at presumably its full value, and local, county, and state boards of review are required to consider the assessment thus made, and bring it to what in their judgment

1 Includes proprietors and firm members, with their salaries; in 1900 their salaries were not reported, but their number was 10,619.

2 Greatest number reported employed at any one time during the year.

s Decrease.

is its true value. When the latter is thus ascertained, one-fourth of it is taken for the taxable value of the property. Upon this basis the average rate of taxation for all purposes is about three and one-third per cent., or eight and one-hall mills on the dollar of the ascertained value of all property. This value in 1900, on one-fourth of which the taxes would be collected in the following year, was $2,158,693,096, or $967 for each person in the popula-

tion. The levy for state purposes to be collected during 1901 was $2.60 on the .flOOO of taxable valuation, besides 20 cents on each $1000 for improvements at the university and at the college of agriculture. In addition to the direct tax on property the state derives considerable revenue from other sources. The receipts into the treasury for the fiscal year ending .SOth June 1900 amounted to $2,592,496, and the disbursements to $2,056,027 ; and there was a balance in the treasury over and above all outstanding obligations of $946,001. The state is entirely out of debt, excepting the amount of $10,936, which it owes to its own school fund, and on which it .pays 6 per cent, interest.

Banks. — On the 5th day of September 1900 there were 196 national banks, having capital approximately of $14,500,000, and individual deposits aggregating $49,440,759. At the same time there were 216 incorporated state banks other than savings-banks, having capital of $9,474,800, and deposits amounting to $33,921,531. There were also 232 "savings banks," a large proportion of which, however, did a commercial banking business. Their capital amounted to $8,835,100, and their deposits to $60,751,672, making the aggregate of deposits in incorporated

banks $144,113,962. There are no official statistics of private banks, but the number is not far from 400. The total number of banks and banking-houses is greater than in any other state in the Union. There are also something like 20 loan and trust companies, statistics of which are not collected. Their capital varies from $50,000 to $500,000. On the 31st of December 1900 there were 87 building and loan associations in the state, with assets amounting to $8,208,405. Government. — The General Assembly, as the legislative body is called, is composed of a Senate of fifty members, elected for four years from as many districts, and a House of Representatives, consisting of 100, elected for two years from 84 counties and 6 districts (each composed of two or three counties). The state officers are governor, lieutenant-governor, secretary of state, auditor of state, treasurer of state, attorney-general, and superintendent of public instruction, each elected by the people for a term of two years, and three railway commissioners, chosen for three years. The govei-nor has a qualified veto on all legislative acts. The governor, secretary, auditor, and treasurer constitute the executive council, which body is clothed with quite extensive powers, among them being that of assessing the property of railway, express,

telegraph, and telephone corporations. The supreme court consists of six judges chosen by the popular vote for six years. The clerk of this court and the reporter of its decisions are each elected by the people, for four years. There are fifty-three district judges, in twenty districts, elected for four years. All incorporated places having a population of 2000 or over are known as cities ; all other incorporated places are designated as towns. A platted town-tract, which is not incorporated, is called a village. The principal cities, with their population, are : Des Moines, the capital, 62,139 ; Dubuque, 36,297 ; Davenport, 35,254 ; Sioux City, 33,111 ; Council Bluffs, 25,802 ; Cedar Rapids, 25,656 ; Burlington, 23,201 ; Clinton, 22,698 ; Ottumwa, 18,197; Keokuk, 14,641; Muscatine, 14,07.3. All cities and towns may establish waterworks, or gas or other lighting works, or they may give franchises to private individuals therefor, or for street railways, but the establishment of such on the part of the city, or the granting of franchises, must first be approved by a vote of the people. Cities and towns are limited in their current expenses to an amount not exceeding 1 per cent, of the taxable value of property. Additional amounts may be levied for waterworks or improvements, and also to pay the principal

and interest of public debt. All counties, cities, towns, and school districts are restricted as to public indebtedness to 5 per cent, of the taxable value of the property within their limits respectively.

History. — Politically the Democratic party controlled the state during most of its first decade, and until the slavery question became the overshadowing one. Since the organization of the Republican party in 1856, that party has had a majority of the legislature, and with the exception of a period of four years the governors have been of that party, while the electoral vote of the state has uniformly from 1852 to 1900 been cast for the same party's candidates for President and Vice-President. At the election of 1900 President McKinley (Republican) received 307,808 votes ; Bryan (Democrat), 209,265; Wooley (Prohibitionist), 9502; four other candidates, 3780 ; McKinley's plurality was 98,543, his majority 85,261. The state raised four regiments of infantry and two batteries of artillery at the time of the Spanish war (1898), but the early close of hostilities prevented more than one regiment from seeing active service. (l. m. g.)

Iowa City, capital of Johnson county, Iowa, U.S.A., on the Iowa, at an altitude of 654 feet. It has an undulating site and a regular plan. It is served by the Chicago, Eock Island, and Pacific, and the Burlington, Cedar Rapids, and Northern railways. It is the seat of the state university, a non-sectarian, co-educational institution, opened in 1855. The university has collegiate, professional, and graduate departments, the professional departments including law, medical, homoeopathic, dental, and pharmaceutical schools. In 1899 the professors and other instructors numbered 100, and the attendance of students was 1339, of whom one-fifth were women. Its property was valued at $982,000, and its total income from aU sources was $151,300. Population (1880), 7123; (1890), 7016 ; (1900), 7987, of whom 1355 were foreign-born.

Ipswich, a municipal, county, and parliamentary borough of England, capital of Suffolk county, on the

estuary of the Orwell, 69 miles by rail north-east of London. Several of the churches have been wholly or partly restored since 1880— St Mary at the Elms, St Matthew's, St Peter's, St Stephen's, Holy Trinity, and the Presbyterian church. All, Saints' was' built in 1892, the new St John the Baptist's in 1898-99, and St Bartholomew's in 1900-1. A new cemetery was laid out in 1893-96. In 1887 the library was enlarged, and in 1892 the science and art schools. The Eastern Counties Dairy Institute, which was established at Aken-ham in 1888, was transferred to Gipperswyk Park at Ipswich in 1895. The Lyceum Theatre was built in 1890-91. New corporation baths were opened in 1894. The public institutions embrace a public library of nearly 20,000 volumes, and a small medical library, the East Suffolk hospital and dispensary, the fever hospital, the borough lunatic asylum, the nurses' home for the sick poor, and the borough of Ipswich science, art, and technical schools. These last have a picture gallery and college in Christchurch mansion. There are also the

middle school for boys, a high school for girls and an endowed school for girls, and a scientific society. The corporation consists of a mayor, 10 aldermen, and 30 councillors. In 1880-81 Ipswich was provided with a system of sewage with outfall works 1^ miles below the town ; and in 1892 a new reservoir in connexion with the waterworks was purchased by the corporation. The spring assizes are held here ; the summer assizes at Bury St Edmunds. Amongst the industries may be mentioned engineering, the manufacture of railway plant, of boots and shoes, clothing, corsets, bricks, and tobacco, and malt-ing. The navigation of the port was facilitated by the completion of a new lock entrance in 1881. In 1895 the imports amounted to £247,349 in value, and the ex-ports to £31,155; in 1900 to £541,014 and £27,933 respectively. The latter consist chiefly of agricultural machines, railway plant, artifical manures, oils and oil-cake, bricks, grain and flour, and roots. In 1900 the port was entered by 213 vessels of 69,006 tons engaged in foreign trade. There is also a coasting trade of 600,000

tons annually, entered and cleared together. At the same date 124 vessels of 7647 tons were registered as belonging to this port, and 49 fishing boats of 360 tons. The parliamentary borough returns two members to the House of Commons. Population (1891), 57,433; (1901), 66,622. Birth-rate, 29-5 (1898) ; death-rate, 16-6 (1898).

See N. Bacon, Annalls of Ipsw'". Ipswich, 1884.

Ipswich, a town in the county of Stanley, Queensland, Australia, on the river Bremer, 23^ miles west of Brisbane. The river is here crossed by two bridges, the newer built to carry the railway. The district is a mining, manufacturing, and agricultural one ; coal is worked with little labour, being near the surface. Population (1891), 7625; (1901), 8637.

Iquique, or Puerto de Iquiqub, a town and port in Chile, capital of the province and department of the same name, in 20° 12' 15" S. and 70° 11' 15" W. The population in 1895 was 33,031. It has railway communication with Pisagua, and is 820 miles north of Valparaiso. It was occupied by the Chilian

forces in 1879 during the war with Peru, and finally ceded to the former country by the treaty of 20th October 1883. Iquique exists under the most artificial conditions, being entirely dependent on outside sources for all its supplies of food, water, and fuel. Practically the whole population is engaged in the manufacture of iodine and nitrate of soda, Iquique being the centre of trade. Nevertheless it disputes with Valparaiso the position of having the largest foreign trade of any seaport in the country. In 1899 Valparaiso led, having £6,327,427, as compared with £6,155,300 for Iquique; whereas in 1900 Iquique came first with £7,194,570, as compared with £6,892,660 for Valparaiso. In the latter year no less than 33 per cent, of the total foreign trade of Chile entered and cleared at Iquique. (See Chile.)

Irak, a province of Persia, situated west of Kum and Kashan and east of Burujird, and paying a yearly revenue of about £15,000. Its capital is Sultandbad, situated in 34° 6' N. and 48° 25' E., at an elevation of 5880 feet, and 77 miles from Kum. It was founded in the

beginning of the 19th century, and is still occasionally spoken of as Shahr-i-No, the " new city." Its population is about 8000. The province produces much grain, and supplies neighbouring districts, particularly those situated eastwards, but its greatest income is derived from the carpets which are made in many of its villages and mostly exported to Europe, and the value of which is estimated at about £100,000 per annum. Two British firms are established at SultanabM solely for this trade.

Irawadi, or Irrawaddy, the principal river in the province of Burma, traversing the centre of the country, and probably running throughout its entire course in British territory. It is formed by the confluence of the Mali and N'mai rivers (usually called Mali-kha and N'mai-kha, the klux being the Kachin word for river) in 25° 45' N. The N'mai is the eastern branch. The definite position of its source is still uncertain, and it seems to be made up of a number of considerable streams, all rising within a short distance of each other in about 28° 30' N. It is shown on some maps as the Lu river

of Tibet, but it is now quite certain that the Tibetan Lu river is the Salween, and that the N'mai has its source or sources near the southern boundary of Tibet, to the north-east or east of the source of the Mali. At the confluence the N'mai is larger than the Mali. The general width of its channel seems to be 350 or 400 yards during this part of its course. In the rains this channel is filled up, but in the cold weather the average breadth is from 150 to 200 yards. The N'mai is practically unnavigable. The Mali is the western branch. Like the main river, it is called Nam Kiu by the Shans. It rises in the hills to the north of the Hkam Ti country, probably in about 28° 30′ N. Between Hkam Ti and the country comparatively close to the confluence little or nothing is known of it, but it seems to run in a narrow channel through continuous hills. The highest point on the Mali reached from the south by Major Hobday in 1891 was Ting Sa, a village a little off the river, in 26° 15′ N. About a mile above the confluence it is 150 yards wide in January and 17 feet deep, with a current of 3| miles an

hour. Steam launches can only ascend from Myit Kyina to the confluence in the height of the rains. Native boats ascend to Laikaw or Sawan, 26° 2′ N., all the year round, but can get no farther at any season. From the confluence the river flows in a southerly direction as far as Bhamo, then turns vilest as far as the confluence of the Kaukkwe stream, a little above Katha, where it again turns in a southerly direction, and maintains this ■ in its general course through Upper and Lower Burma, though it is somewhat tortuous immediately below Mandalay. Just below the confluence of the Mali and N'mai rivers the Irawadi is from 420 to 460 yards wide and about 30 feet deep in January at its deepest point. Here it flows between hills, and after passing the Manse and Mawkan rapids, reaches plain country and expands to nearly 600 yards at Sakap. At Myit Kyina it is split into two channels by Naungtalaw island, the western channel being 600 yards wide and the eastern 200. The

latter is quite dry in the hot weather. At Kat-kyo, five or six miles below Myit Kyina, the width is 1000 yards, and below this it varies from 600 yards to three-quarters of a mile at different points. Three miles below Sinbo the Third Defile is entered by a channel not more than 50 yards wide, and below this, throughout the defile, it is never wider than 250 yards, and averages about 100. At the " Gates of the Irawadi " at Poshaw two prism-shaped rocks narrow the river to 60 yards, and the water banks up in the middle with a whirlpool on each side of the raised pathway. All navigation ceases here in the floods. The defile ends at Hpatin, and below this the river widens out to a wet-weather channel of 2 miles, and a breadth in dry weather of about 1 mile. At Sinkan, below Bhamo, the Second Defile begins. It is not so narrow nor is the current so strong as in the Third Defile. The narrowest place is more than 100 yards wide. The hills are higher, but the defile is much shorter. At Shwegu the river leaves the hills and becomes a broad stream, flowing through a wide plain. The First Defile is

tame compared with the others. The river merely flows between low hills or high wooded banks. From Mandalay up to Bhamo the river is navigable a distance of nearly a thousand miles for large steamers all the year round, but small launches and steamers with weak engines are often unable to get up the Second Defile in the months of July, August, and September, owing to the strong current. The Irawadi Flotilla Company's steamers go up and down twice a week all through the rains, and the mails are carried to Bhamo on intermediate days by a ferry-boat from the railway terminus at Katha. Dui'ing the dry season the larger boats are always liable to run on sand-banks, more especially in November and December, when new channels are forming after the river has been in flood. From Bhamo up to Sinbo no steamers can ply during the rains, that is to say, usually from June to November. From November to June small steamers can pass through the Third Defile from Bhamo to Sinbo. Between Sinbo and Myit Kyina small launches can run all the year round. Above Myit Kyina small steamers

can reach the confluence at the height of the flood with some dif&culty, but when the water is lower they cannot pass the Mawkan rapid, just above Mawme, and the navigation of the river above Myit Kyina is always diffi-cult. The journey from Bhamo to Sinbo can be made during the rains in native boats, but it is always difficult, and sometimes dangerous. It is never done in less than flve days, and often takes twelve or more.

For the Irawadi in its lower course see the earlier volume of the Encyclopaedia Britannica, ninth edition. (j. g. so.)

Irbit, a district town of Eussia, government of Perm, 110 miles north-east of Ekaterinburg, on the Nitsa, 72 miles from KamyshlofE railway station. It is famous for a great fair, which lasts for two months, and at which all sorts of European and Asiatic goods are offered, the yearly returns of articles sold representing a value of over £4,000,000 :— Cottons, £1,850,000; woollens, £264,000; flax and hemp, £261,000 ; silks, leather, as well as all sorts of metals, metallic and other manufactured goods from Russia, furs, £260,000 ; hides, felt, raw wool, represent-

ing an aggregate value of £522,000, from Siberia and the Kirghiz Steppe ; while tea (£495,000) and various other goods (£52,000) are brought from China and Turkestan. These are average figures, but there have been years when goods to the value of nearly £6,000,000 have been brought to the fair. The Irbit ironworks are 41 mUes to the south-west. Population, 20,064.

IRELAI^D.

Geography and Statistics.

IRELAND, an island to the west of Great Britain, to-gether with it forming the United Kingdom, extends from 51° 26′ to 55° 21′ N. and from 6° 25′ to 10° 30′ W. It is bounded on the north, south, and west by the Atlantic Ocean, and on the east is separated from Great Britain by the North Channel, the Irish Sea, and St George's Channel. Its greatest length is 302 miles, and its greatest breadth 174 miles.

Area and Population. — The total area comprises 20,825,596 acres, which includes 492,252 acres under the larger rivers, lakes, and tideways, and 129,681 acres under the smaller rivers and

lakes. Territorially the island is divided into 4 provinces and 32 counties, Leinster having 12 counties, Munster 6, Ulster 9, and Connaught 5. Excluding the extent of land under the larger rivers, lakes, and tideways, the table on the following page shows the area in square miles by provinces and counties, the popular tion in 1881, 1891, and 1901, and the average number of persons to a square mile in 1901. The 1901 populations are of the administrative counties imder the Local Government (Ireland) Act, 1898.

Of the total population in 1891, 2,318,953 were males and 2,385,797 females. It will be seen that between 1881 and 1891 the total population decreased by 470,086 or 9-08 per cent., the population of Leinster by 87,207 or 6-8 per cent., of Munster by 157,472 or ll-S per cent., of Ulster by 123,261 or 7-07 per cent., and of Connaught by 102,146 or 12-4 per cent. Only one county showed an increase of population during the decennial period — Antrim with 2-1 per cent, increase, due to the growth of Belfast. All the other counties showed a decline, varying from 16-1 per cent, in Monaghan to -87 per cent, in Down.

In 1891 Dublin, with an average of 1177 persons to the square

mile, was the most densely populated county, and Wicklow, with an average of only 82 to the square mile, was the least densely populated. The total rural population was 3,460,637, being an average of 110 persons to the square mile, or of 148 persons to each square mile under crops and pasture, and the urban population 1,244,113. Of the total population in 1901, 2,197,739 were males and 2,258,807 females. Between 1891 and 1901 the total popula-tion decreased by 248,204 or 5-3 per cent., the population of Leinster by 41,297 or 3-5 per cent., of Munster by 98,568 or 8-4 per cent., of Ulster by 38,463 or 2‘4 per cent., and of Connaught by 69,876 or 9-7 per cent. Three counties showed an Increase — Dublin and Down of 7-3 per cent, each, and Antrim of 7-0 per cent. All the others showed a decline, varying from 13-6 per cent, in Monaghan to 5-1 per cent, in Londonderry. Between 1881 and 1891 the population of towns of 10,000 inhabitants and upwards increased by 30,375, this increase being altogether owing to the growth of Belfast, Londonderry, and a few other industrial towns in the north, and to the extension of the Dublin suburbs.

[statistics

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Population

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Population

1 « ®

Counties

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Counties

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Provinces.

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ProvinceB.

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1881.

1891.

1901.

1 zs~

1881.

1891.

1901.

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Lbinstbk

Carlow .

7566

1,278,989

1,191,782

1,150,486

162

TJlbtek

Antrim

8314

1,743,075

1,619,814

1,581,351

190

345

46,568

41,964

37,728

109

1111

421,943

430,865

461,240

415

Dublin.

854

418,910

416,860

447,266

1268

Armagli

489

163,177

137,877

126,238

266

Kildare.

664

75,804

70,206

63,469

97

Cavan ....

729

129,476

111,917

97,368

183

Kilkenny .

King’s County .

793

99,631

87,496

78,821

82

Donegal

1869

206,035

186,685

178,626

98

771

72,852

65,663

60,129

78

Down ....

956

272,107

269,734

289,838

803

Longford

403

61,009

62,647

46,681

115

Fermanagh .

653

84,879

74,170

65,243

99

Louth ....

815

77,684

71,914

66,741

209

Londonderry

802

164,991

152,009

144,329

180

Meath ....

904

87,469

76,111

67,468

74

Monaglian .

498

102,748

86,206

74,505

149

Queen's County

664

78,124

63,866

57,226

85

Tyrone

1217

197,719

171,401

150,468

128

Westmeath .

678

71,798

68,611

61,627

91

Wexford

904

123,854

112,068

103,860

115

Wicklow .

Mtjnstek

Clare ....

781

70,386

64,492

60,679

78

OONKATJGHT .

Galway

9296

1,881,115

1,178,648

1,076,075

115

6616

821,657

719,511

649,635

98

1201

141,467

126,244

112,129

93

2847

242,005

211,227

192,146

81

Cork .

2874

496,607

488,482

404,813

140

Leitrim

689

90,372

78,618

69,201

117

Kerry ....

1882

201,039

179,136

165,831

90

Mayo ....

2069

246,212

218,698

202,627

98

Limerick

1036

180,632

158,912

146,018

141

Roscommon

915

132,490

116,562

101,639

111

Tipperary .

1639

199,612

176,217

159,764

97

Sligo ....

706

111,578

94,416

84,022

119

713

112,768

96,702

87,030

122

lEILAND

31,791

5,174,886

4,704,750

4,456,546

140

Between 1891 and 1901 the population of the same towns increased by 160,076, the increase being largely due to the extension of the municipal boundaries of .Dublin and Belfast. All other towns either remained practically stationary or seriously diminished during both decennial periods, because they are not centres of industry, but mainly markets for the agricultural produce of the vicinity. The following table shows the population of the six county boroughs in 1881, 1891, and 1901 : —

Tear.

Dublin.

Belfast.

Cork.

Limerick.

Londonderry.

Waterford.

1881

1891

1901

249,602

268,587

289,1081

208,122

273,0792

348,965

80,124

75,345

76,978

38,562

37,155

38,085

29,162

33,200

39,873

22,467

26,203

26,743

1 The municipal area was extended in 1900.

2 By the extension of the municipal area in :

largely increased.

the population of Belfast "was

The table given belo-w proves that the number of Irish-speaking persons decreased between 1881 and 1891 : —

ProvinceB.

1881.

1891.

Percentage of Population

who could speak Irish.

Who spoke

Irish only.

Who spoke Irish

and English.

Total who could

speak Irish.

Who spoke

Irish only.

Who spoke Irish

and English.

Total who could

speak Irish.

1881.

1891.

Leinster .

Munster .

Ulster .

Connaught .

Ireland

50

18,422

12,360

33,335

27,402

427,344

98,163

332,856

27,452

446,766

110,523

366,191

8

9,060

7,063

22,071

13,669

298,573

77,099

252,712

13,677

307,633

84,162

274,783

2-1

33-5

6-3

44-6

1‘2

26-2

5-2

37-8

64,167

885,765

949,932

38,192

642,063

680,245

18-2

14-6

The number of families in 1891 was 932,113, of which 97,317 inhabited 1st class, 499,033 2nd class, 315,034 3rd class, and 20,729 4th class bouses. The number of families in 1901 was 910,508, a

decrease of 2-3 per cent. It will be seen from the tables given below that between 1881 and 1891 both the number of 4th class houses and the number of families with 4th class house-accommo-dation were largely diminished.

The numbers of the different classes i of inhabited houses and the number of uninhabited houses in 1881 and 1891 were : —

Provinces.

Number of Inhabited Houses.

Provinces.

Number of Inhabited Houses.

1881.

1891.

1881.

1891.

Leinster —

1st class

2nd „.

3rd „.

4th „.

Total

Munster —

1st class

2nd „.

3rd „.

4th „.

Total

Ulster—

1st class

2nd „.

3rd „.

4th „.

Total

26,972

104,294

75,576

9,383

27,072

113,624

61,882

5,036

Connaught —

1st class

2nd „.

3rd „.

4th „.

Total

Ireland —

1st class

2nd „.

3rd „.

4th „.

Total

4,549

45,243

86,846

8,782

4,704

62,816

71,986

4,603

216,225

207,614

145,420

134,009

15,736

100,109

88,329

15,458

16,603

110,485

67,959

7,361

66,727

422,241

.384,476

40,665

70,740

466,632

312,589

20,617

219,631

202,408

914,108

870,578

19,471

172,595

133,724

7,042

22,361

189,707

110,762

3,717

Uninhabited Houses.

Built .

Building .

Total

58,267

1,710

69,320

2,602

332,832

326,547

69,967

71,922

1 The 4th class includes all single-room houses built of mud or

In 1901 there were altogether 868,503 houses inhabited, thus

distributed : 205,867 in Leinster, 193,663 in Munster, 332,106 in

Ulster, and 126,867 in Connaught, and in addition 72,682 uninhab-

ited houses and 2692 building.

The number of families in each class ^ of house-accommodation

in 1881 and 1891 was :—

Class of

House-accommodation.

Number of Families in

1881.

1891.

1st class .

2nd „ . . .

3rd „ . . .

4th „ . . .

Total .

57,673

403,862

443,247

90,292

62,613

454,870

369,308

65,322

996,074

932,113

If we take into consideration the number of inhabited houses in the whole of Ireland, it will be found that in 1881 there were 6-6 persons in each house, in 1891 there were 5-4 persons, and in 1901, 5 ‘2.

The table which follows on the next page shows the number of persons returned as belonging to different occupations in 1881 and 1891 :—

perishable material ; the 3rd, houses with from two to four rooms and windows; the 2nd, good farmhouses or small town houses having 5 to 7 rooms and windows ; the 1st, aU houses of a better description than the preceding.

2 Ist class accommodation consists of 1st class houses occupied by 1 family ; 2nd class of 2nd class houses occupied by I family, or of ist class houses occupied by 2 or 3 families ; 3rd class of 3rd class houses with 1 family each, 2nd class houses with 2 or 3 families, and 1st class houses occupied by 4 or 5 families ; and 4th class of all 4th class houses, 3rd class houses with more than 1 family, 2nd class houses with 4 or more families, and 1st class houses occupied by 6 or more families.

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I E E L A N D

549

Tear.

Pro-

fessional.

Domestic.

Com-

mercial.

Agri-

cultural.

Industrial.

Indefinite

and Non-

productive.

1881

1891

198,684

214,248

426,1611

255,144

72,245

83,178

997,966

936,759

691,509

666,410

2,788,281

2,669,0211

The numbers of permanently and of temporarily diseased

persons and percentage to population in 1871, 1881, and 1891, were

thus returned : —

Nature of Disablement.

Tears.

1S71.

1881.

1891.

Dumb, and deaf and dumb .

Blind

Lunatic and idiotic

Total, permanently diseased .

Sick at home

Sick in infirmaries and hospitals .

Sick in workhouse hospitals .

Total temporarily diseased

(■ Sum total

(. Percentage to population .

5,554

6,347

16,505

5,136

6,111

18,413

4,464

5,341

21,188

28,406

29,660

30,993

23,923

3,625

16,485

17,805

4,170

18,115

16,466

4,490

14,789

44,033

40,090

35,745

72,439

69,750

66,738

1-3

1-3

1-4

The increase in the number of insane is marked : in 1871 the proportion to the total population was 1 in 678 ; in 1891, 1 in 535.

Movement of Population. — The births and deaths registered in the different provinces from 1897 to 1900 were :—

Proylnoes.

Births.

Deaths. 1

1897.

1898.

1899.

1900.

1897.

1898.

1899.

1900.

Leinster .

Munster .

Ulster . .

Connaught

Total .

27,305

24,899

89,667

14,898

27,108

24,644

39,542

14,268

26,870

24,109

88,982

18,989

26,089

28,600

88,109

18,761

24,058

18,620

30,987

10,274

23,524

19,086

29,771

10,024

23,388

17,991

29,358

9,017

26,167

20,618

81,880

10,051

106,664

105,457

103,900

101,459

83,839

82,404

79,699

87,606

Thus the number of births registered in Ireland exceeded the number of deaths in 1897 by 22,825, in 1898 by 23,053, in 1899 by 24,201, and in 1900 by 13,853 ; but the decrease of population, which still continues, is explained by the fact that the number of emigrants is always larger than the excess of births over deaths, and the number of immigrants is altogether insufficient to redress the balance. The number of illegitimate births in 1900 was 2702.

The number of marriages registered in the different provinces from 1890 to 1900 was :—

In the four separate years for which statistics are given above the emigrants were scattered as follows : —

Tear.

Colonies and Foreign Countries.

Great Britain.

U.S.A.

Aus-

tralia.

New

Zea-

land.

Canada,

Other

Coun-

tries.

England

and

■*Wales.*

Scotland.

1897

1898

1899

1900

Total

28,760

27,855

35,433

37,765

676

837

1005

834

61

86

56

64

397

456

397

472

360

248

200

103

1454

1667

2633

4123

827

1142

1508

1927

129,813

3352

217

1722

911

9877

5404

Provinces.

1890.

1891.

1892.

1898.

1894.

1895.

1896.

1897.

1898.

1899.

1900.

Leinster . .

Munster . .

Ulster . .

Connaught

Total

6,868

4,640

8,146

2,386

6,958

4,658

8,604

2,360

6,901

4,788

8,465

2,391

6,167

4,777

8,412

2,368

6,030

4,606

8,600

2,366

6,408

4,921

9,171

2,625

6,409

4,778

9,847

2,526

6,207

4,951

9,279

2,454

6,207

4,818

9,226

2,829

6,221

4,819

8,917

2,824

5,934

4,481

8,623

2,842

20,990

21,475

21,530

21,714

21,602

23,120

23,055

22,891

22,680

22,311

21,830

Of the total population in 1891 (of those of seventeen years and upwards), 47 per cent, were unmarried, 42 per cent, married, and 11 per cent, widowed. In 1900, 14,795 Roman Catholic marriages were celebrated, and 6535 Protestant and other marriages. The number of marriages in 1900 was equal to 4-78 per 1000 of the estimated population, being -05 below the average of the previous ten years..

The number of emigrants — ^natives of Ireland — from each province and from all Ireland, from 1st May 1851 to 31st December 1900, is shown by the following table : —

Provinces.

Number from

1st May 1851

to 81st Dec.

1896.

Number in each Tear.

Total Number ftom Ist May 1861

to 31st Dec. 1900.

Per cent, of

Emigration

in 1898 to

Population

in 1891.

1897.

1898.

1899.

1900.

Males.

Females.

Total.

Leinster . .

Munster

Ulster . . .

Connaught .

Unclassified .

669,260

1,287,887

1,054,282

668,576

110,668

8,210

12,798

6,266

10,261

8,840

18,018

5,577

10,811

8,542

15,758

8,701

18,231

8,857

17,938

9,438

14,060

859,045

689,525

599,368

298,645

61,766

824,164

657,864

484,861

322,794

48,902

688,209

1,846,889

1,084,214

616,489

110,668

0^8

1^5

0-5

1-9

Total, Ireland

8,690,128

32,535

82,241

41,232

45,288

2,008,344

1,888,075

3,841,419

0-9

1 Housekeepers who were wives or other near relations of heads of families were tabulated in 1881 in Class II. and in 1891 in Class VI.

Emigration continues to be the chief drain on the population of Ireland, and, as the above tables show, the numbers considerably increased in 1899 and 1900 a^ compared with the two previous years. The largest number that emigrated from any

individual county from 1851-1900 was 500,239 from Cork. In 1900 there were 1819 emigrants not of Irish nationality, making the total number of emigrants for 1900, 47,107. Of these the Irish emigrants from Leinster formed 8-2 per cent. ; from Munster, 38-1 per cent. ; from Ulster, 200 ; from Connaught, 29-8 per cent. ; while the non-Irish emigrants formed the remaining 3-9 per cent. The vast majority — 82-2 per cent. — of the emigrants were persons between fifteen and thirty-five years of age. The males num-bered 23,295, and the females 23,812.

Constitution and Government—The Redistribution of Seats Act, 1885, entirely altered the parliamentary representation of Ireland. The following twenty-two boroughs were disfranchised : Armagh, Athlone, Bandon, Carlow, Carrickfergus, Clonmel, Coleraine, Downpatrick, Drogheda, Dundalk, Dungannon, Dungarvan, Ennis, Ennis-killen, Kinsale, Lisbum, Mallow, New Ross, Portarling-ton, Tralee, Wexford, and Youghal. Galway, Limerick, and Waterford lost one member each. Dublin and Belfast were divided into four divisions, each returning one member. In all, 85 members represent the counties, 16 the cities

and towns, and 2 Dublin University — a total of 103.

Excluding the University of Dublin, the number of

registered electors in 1901 was 731,132 — counties 622,466,

and boroughs 108,667 ; while in 1891 the number was

736,259— counties 642,533, and boroughs 93,726. By

section 2 of the Representation of the People Act, 1884, a

uniform household franchise and a uniform lodger franchise

were established in all counties and boroughs

of the United Kingdom, and by section 3 the

service franchise was introduced.

By the local Government (Ireland) Act,

1898, the system of local government in

Ireland was entirely remodelled., A county

council, consisting of a chairman and coun-

cillors, was established in each administrative county.

For this purpose new administrative counties were formed,

in some cases by the alteration of existing boundaries, in

other cases by the adoption without alteration of the old

judicial counties. Thus, the judicial counties of Antrim,

Armagh, Carlow, Clare, Do-vtu, Dublin, Galway, Kilkenny,

Londonderry, Louth, Mayo, Queen's Countyj Roscommon,

Sligo, Westmeath, Wexford, and Wicklow, have been

either diminished or increased in area ;

Cavan, Cork, Donegal, Fermanagh,

Kerry, Kildare, King's County, Leit-

rim. Limerick, Longford, Meath,

Monaghan, and Tyrone, retain their

boundaries unaltered, and Tipperary

has been di'vided into two administra-

tive counties almost identical with the

old North and South Ridings. To

the county council the Act transferred

all the fiscal and administrative duties

of the grand j ury, with the exception of the power of making

presentments for malicious injury, which passed over to the

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county courts. Besides these powers of the grand jury,

the county council has now the power of the board of

guardians with regard to raising and levying the poor rate ; that is to say, all the rates in so much of the county as is not included in an urban district are now raised by the county council in one general rate. In addition, the administration of the Diseases of Animals Act, the Explosives Act, and the Acts relating to technical education and the management of lunatic asylums, was vested in the county council, upon which were also conferred extensive powers for acquiring land for county purposes, and a number of other duties. The county council is elected by the parliamentary electors of the county, with the addition of women and peers otherwise qualified to vote. Subordinate bodies, called district councils, were established by the same Act to manage the affairs of the various local areas within each county. It was provided (1) that, where an urban sanitary authority existed at the passing of the Act, an urban district council should be formed, having within its own area all the powers of the grand jury with regard to roads, &c., and with the right to raise its own rates, but subject to

some general control by the county council, and liable for certain contributions ; and (2) that, in the areas where no urban sanitary authority existed at the passing of the Act, rural districts, governed by rural district councils, should be formed, corresponding, as far as possible, with the existing poor-law unions. Therural district councillors elected for each division also act as the- poor-law guardians for that division, so that in all rural unions, situated wholly within the county, which do not include any town that is an urban district, there are now two bodies having the same members, but discharging different functions. But where an urban district is included within the limits of a union, or where a union extends over more than one county, and particularly where both these conditions are present, the constitution of the board of guardians is very complex, and would require a more detailed explanation than can be given here. In order to facilitate the working of the Act in this respect, the Local Government Board was given power to alter the boundaries of poor-law unions. With regard to the effect

of the Act on cities and towns, these may now be grouped in five classes: (1) county boroughs — Dublin, Belfast, Cork, Limerick, JLondonderry, and Waterford — governed by separate county councils ; (2) five boroughs — Kilkenny, Sligo, Clonmel, Drogheda, and Wexford — which retain their corporations, but practically rank as urban sanitary districts ; (3) urban sanitary districts, governed by urban district councils ; (4) towns having town commissioners who are not sanitary authorities ; and (6) non-municipal towns with populations of over 1500, and entitled to petition for town commissioners. The Act provides special facilities for the conversion of any of the two latter classes of towns into urban districts.

Justice. — By the Act of 1887, to amend the Supreme Court of Judicature (Ireland) Act, 1877, the office of Chief Justice of the Common Pleas, from the passing of the Act, was reduced to an equality with the office of puisne judge ; the rank and title were abolished. It was provided that the office of Chief Baron of the Exchequer should be similarly treated on the occasion of the first vacancy, and that the Lord-Lieutenant should have the power to

consolidate by an Order in Council the Common Pleas Division with the King's Bench Division. By a further amending Act in 1897 the Exchequer Division was amalgamated with the King's Bench Division — the chief baron to rank after the lord chief justice — the Court of Bankruptcy was consolidated with the Supreme Court, and it was enacted that on the next vacancy in the judgeship, the Probate and Matrimonial Division should be abolished and the division amalgamated with the King's Bench Division. By the Land Law (Ireland) Act, 1881, a Land Commission was established, consisting of a judicial commissioner, who was to become an additional judge of the Supreme Court of Judicature, and two other commissioners. By subsequent enactments the commission was made perpetual, and the number of commissioners other than the judicial commissioner was increased to four. As a result of all these changes the Supreme Court of Judicature in Ireland is now constituted as follows : — The Court of Appeal, which consists of the Lord Chancellor, the Lord Chief Justice, the Master of the Rolls, and the Chief Baron of the Exchequer as ex-officio members, and three lords justices of appeal ; and the High Court of Justice, which includes (1) the Chancery Division,

composed of the Lord Chancellor, the Master of the Bolls, the Vice-Chancellor, and a land judge ; (2) the King's Bench Division, composed of the Lord Chief Justice, the Chief Baron of the Ex-chequer, and eight justices, who include the Probate, the Admiralty, and the Bankruptcy judges ; and (3) the Land Commission, the judicial commissioner alone ranking as a member of the Supreme Court. By the County Officers and Courts (Ireland) Act, 1877, it was provided that the chairmen of quarter sessions should be called "county court judges and chairmen of quarter sessions," and that their number should be reduced to twenty-one, which number was to include the recorders of Dublin, Belfast, Cork, Londonderry, and Galway. At the same time the jurisdiction of the county courts was largely extended. There are now 70 resident (stipendiary) magistrates in Ireland, and 4 police magistrates for the Dublin police district. On 30th September 1900 the Royal Irish Constabulary was composed of an inspector-general, a deputy-inspector-general, 2 assistant-inspector-generals, a surgeon, a veterinary surgeon, a barrack-master and store-keeper, a police instructor and schoolmaster, a town inspector (Belfast), 36 county inspectors, 214 district inspectors, 251 head

constables, 1869 sergeants, 423 acting-sergeants, and 8371 constables.

The expenditure on the force in 1901-2 was £1,376,406.

The following table gives the number of persons committed for trial, convicted, and acquitted in Ireland in 1881, 1886, 1891, and 1900 :—

Tear.

Committed for Trial.

Convicted.

Acquitted.

1881

1886

1891

1900

5311

3028

2112

1682

2698

1619

1255

1087

2443

1286

669

331

Of the 1682 persons committed in 1900, 639 were charged with offences against the person, 132 with offences against property with violence, 606 with similar offences without violence, 104 with malicious offences against property, 35 with forgery and offences against the currency, and 166 with other offences.

The number and nature of agrarian offences between 1881 and 1900 are thus returned : —

Against

Against

Against

Threatening

Total

ear.

Person.

Property.

Public Peace.

Letters, &c.

1881-90

917

2595

3795

6793

14,100

1888

53

161

197

249

660

1889

37

155

148

194

534

1890

48

121

151

199

519

1891

22

145

90

216

472

1892

31

115

67

192

405

1893

24

116

67

173

380

1894

18

82

40

136

276

1895

48

82

14

117

261

1896

17

92

28

114

251

1897

18

81

44

104

247

1898

14

90

39

100

243

1899

16

85

35

no

246

1900

15

75

52

138

280

It will be seen that between 1888 and 1808 the number steadily declined. Between 1881 and 1890, when the land agitation was at its height, agrarian crime enormously increased, the number of offences being nearly treble the number in the previous ten years.

In 1899, 98,401 cases of drunkenness were brought before the Irish magistrates, as compared with 214,298 in Euglaaid and Wales, and 44,351 in Scotland.

Pauperism. — For the reconstitution of the poor-law authorities, see the paragraph on local government, above.

The aggregate number of persons relieved, and total poor relief expenditure in each year from 1889 to 1898, are shown on the following page.

During 1898-99 the average daily number in receipt of in-door relief was 42,7i;8, and in receipt of outdoor relief, 64,604. The corresponding figures during 1899-1900 were 41,980 and 58,012. On 1st January 1898 the ratio of pauperism to population in Ireland was 1 in every 45 persons, or 2-2 per cent, of the popula-

tion ; and in England and Wales on the same date the ratio was 1 in every 87 persons, or 2-7 per cent, of the population.

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Tear

ending

29th

Sept.

Aggregate Number relieved

continuously or successively. i

Total Poor

EeUef Ex-

penditure.

Year

ending

29tll

Sept.

Aggregate Number relieved

continuously or successively. ^

Total Poor

Belief Ex-

penditure.

£

In-door.

Out-door.

Total.

In-door.

Out-door.

Total.

1889

1890

1891

1892

1898

369,570

884,168

811,604

815,818

824,888

120,665

120,010

125,848

117,708

107,785

490,225

464,178

486,947

438,526

482,128

858,912

866,008

871,424

869,192

857,910

1894

1895

1896

1897

1898

828,094

816,788

884,170

851,828

875,915

108,885

116,688

99,058

106,518

149,189

486,429

438,866

488,223

458,841

525,104

869,674

863,944

868,969

894,846

981,888

Seligion.— In 1891, 3,547,307 or 75-4 per cent, of the inhabit-ants were Roman Catholics ; 600,103 or 12-7 per cent. Protestant Episcopalians; 444,974 or 9-5 per cent. Presbyterians; 55,500 or 1-2 per cent. Methodists; and 56,866 or 1-2 per cent, adherents of other denominations. In 1901 the corresponding ligures were 3,310,028 or 74-3 per cent., 579,385 or 13-0 per cent., 443,494 or 10-0 per cent., 61,255 or 1-4 per cent., and 62,384 or 1-3 per cent. Antrim, Down, Armagh, and Londonderry' are the only counties in which less than half the inhabitants are Roman Catholics. As compared with 1891, Roman Catholics showed a decrease of 237,279 or 6-7 per cent. ; Protestant Episcopalians a decrease of 20,718 or 3-5 per cent. ; Presbyterians a decrease of 1480 or 0-3 per cent. ; and Methodists an increase of 5755 or 10-4 per cent. Jews increased from 1779 to 3769.

The number of bishoprics in the Church of Ireland is now eleven, as the see of Clogher was revived in 1886. In 1899 the clergy numbered 1650, and the churches 1400. For the year ending 31st December 1900 the accounts of the representative body show that the interest on investments amounted to £311,342, 6s. lid., contributions to diocesan stipend, general

and episcopal funds, to £115,012, 3s. 6d., parochial endowments to £41,125, 18s. 8d., and glebe rents to £18,595, 10s. ; while, on the side of expenditure, £291,453, 15s. 4d. was paid to diocesan financial schemes, and £35,987, 8s. 7d. in commutations and annuities. On 31st December 1900 there were in the hands of the representative body various capital sums, amounting to more than £8,000,000, derived from the following sources:— £1,500,000, the balance of the commutation money received to pay the annuities of the clergy, £500,000 received in lieu of private endowments, £1,500,000 derived from the composition of annuitants, and £5,000,000 voluntarily contributed.

The whole of the clergy of the Roman Catholic Church in Ireland are supported by various forms of voluntary contributions. In addition to the secular clergy, 70 or 80 communities of different religious orders are scattered throughout the country, ministering in their own churches, but without parochial jurisdiction. At

the census of 1891 the total clergy, including archbishops, bishops, private chaplains, and professors, amounted in number to 3502.

Prom the minutes of the General Assembly of the Presbyterian Church in Ireland in 1900 it appears that in the year ending in March there were 058 ministers, besides 88 licentiates and ordained ministers without charge, 570 congregations, and 481 manses. The following figures show the revenue and expenditure of the Church for the same year: — Pew rents, £53,447 ; raised for building or repairing churches, manses, and schools, £39,425 ; raised for the sustentation fund, £23,072 ; Sabbath collections, £26,904 ; mission collections, £21,591 ; other charitable collections, £45,081 ; stipends paid to ministers, £55,265. The Wesleyan Methodist body in the United Kingdom forms one connexion, but has two conferences, one for Great Britain and the other for Ireland. The president of the British conference is also president of the Irish conference. The number of ministers in Ireland is about 250.

Education. — The following table shows for each province and all Ireland, by religious professions, the percentage of the popula-

tion, five years old and upwards, who could read and write, read only, and neither read nor write, in 1881 and 1891 : —

Roman Catholics.

Protestant

Episcopalians.

Presbyterians.

Methodists.

, other

Denominations.

Totals.

Provinces.

§

1

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Si

a

o

1

f 1881

Leinster jjgg^

Munster {^\

Ulster {1881

f 1 881

Connaught< -j^gg^

61-2

71-4

57-9

70-5

47-4

60-2

45-2

60-5

15-9

11-3

12-0

8-5

21-5

15-8

15-3

11-0

22-9

17-3

30-1

21-0

31-1

24-0

39-5

28-5

89-6

92-5

89-4

92-7

65-2

74-4

85-2

89-2

5-1

3-3

4-9

3-1

20-3

14-2

7-3

5-6

5-3

4-2

5-7

4-2

14-5

11-4

7-5

5-2

92-4

94-7

93-7

95-0

75-4

82-9

90-6

93-5

4-2

2-4

3-1

2-4

17-3

11-4

56

3-6

3-4

2-9

3-2

2-6

7-3

5-7

3-8

2-9

93-5

95-2

93 1

93-4

80-9

86-2

94-3

94-5

2-9

1-9

3-1

3-0

12-8

8-9

3-3

3-3

3-6

2-9

3-8

3-6

6-3

4-9

2-4

2-2

92-3

90-5

93-2

91-4

82-4

86-7

93-6

92-8

2-8

2-3

2-4

1-7

12-1

8-8

3-7

2-5

4-9

7-2

4-4

6-9

5-5

4-5

2-7

4-7

65-3

74-6

59-9

71-9

60 0

70-7

47-2

61-8

14-4

10-0

11-6

8-2

19-7

13-9

14-9

10-8

20-3

15-4

28-5

lO-S

20-3

15-4

.37-9

27‘4

*Ireland {l^*

54-1

66-7

15-8

11-3

30-1

22-0

74-9

81-5

14-2

9-9

10-9

8-6

76-2

83-4

16-7

11-0

7-1

5-6

84-6

88-4

9-9

7-2

5‘5

4-4

84-5

87-6

10-2

7-4

5-3

5-0

59-3

70-6

15-5

11-0

25-2

18-4

It will be seen that the percentage of illiterates sensibly diminished all over Ireland, and that the provinces occupied the same relative positions, as regards standard of education attained,

in 1891 as in 1881. During the week ending 30th May 1891 the proportion per cent, of the total population, between five and sixteen years of age, attending school was 54-1, and not attending school 45-9.

In 1881 the number of universities and other colleges in Ireland was 16, attended by 4288 students, of whom 1919 were Roman Catholics, 1364 Protestant Episcopalians, and 1005 belonged to the Presbyterian and other denominations ; in 1891 there were 15 colleges, with 3498 students, of whom 1658 were Roman Catholics, 1046 Protestant Episcopalians, and 794 Presbyterians and other denominations. In 1900 Trinity College, Dublin, had 1076 students on its books, and in the previous year the univer-sity conferred 421 degrees. In 1887 medical school buildings were completed at a cost of £20,000. The Royal University of Ireland was founded in 1880, and since 1882 has superseded the old Queen's University. The government is vested in a senate, con-sisting of a chancellor and not more than 36 senators, with power to confer degrees upon male and female students in all the usual subjects except theology. No residence in any college, nor attendance at lectures, or any other course of instruction, is

obligatory. There are fellowships and examinerships attached

1 Exclusive of persons in institutions for the blind, deaf and dumb, and for idiots or imbeciles. DuriQg the ten years 1889-98 these persons averaged about 950 in each year.

to the university. At the first matriculation examination in December 1881, 508 candidates, including 25 females, passed ; in 1900 the number was 688, which included 170 females. The entire number of persons who passed the academic examinations in 1900 was 1783 out of 2658 candidates. The revenue of the university for the year 1900-1 was £39,488, and the expenditure £24,847. The three Queen's Colleges of Belfast, Cork, and Galway, which formed the Queen's University, still exist as university colleges. The buildings of the college at Belfast have been largely increased of recent years. The number of students attending the three colleges in 1899-1900 was 635— Belfast 347, Cork 178, and Galway 110. In the same year the number that entered was 197 — Belfast 99, Cork 51, and Galway 47. Prac-tically all the students graduate in the Royal University. In 1882 the Roman Catholic bishops resolved to place the buildings ,of the Roman Catholic University in Dublin, which is wholly

supported by voluntary contributions, under the control of the archbishop of Dublin, who undertook to maintain a college where instruction would be given in arts and medicine according to the requirements of the Royal University. In 1883 the direction of the college was entrusted to the Jesuit Fathers. Several of the fellows of the Royal University are professors in the college. In 1881 the faculty of the Presbyterian General Assembly's College, Belfast, and the theological professors of the Magee College, Londonderry, were incorporated by Royal Charter, and constituted as a faculty, with power to grant degrees in divinity. The Magee College, whose professors must all sign the Westminster Confession of Faith, though no religious test is prescribed for

[statistics

students, provides literary and scientific education as well as theological.

In 1900 tlie examinations of the Intermediate Education Board were held at 247 centres. The number of candidates for examination was 7608 (boys 5611, and girls 1997), of whom 5314

passed (boys 3799, and girls 1515). 84 boys and 24 girls gained exhibitions (£20 for one year) in the preparatory grade, 190 boys and 83 girls exhibitions (£20 for tliree years) in the junior grade, 60 boys and 24 girls exhibitions (£30 for two years) in the middle grade, and 20 boys and 11 girls exhibitions (£50 for one year) in the senior grade, while 651 boys and 292 girls were awarded prizes. In 1880 the number of candidates was 5561 (boys 4114, and girls 1447), of whom 4010 passed (boys 2899, and girls 1111). The amount of results fees paid to managers of schools in 1900 was £56,158 — £41,098 for boys and £15,060 for girls.

The following table shows the number of primary and superior schools, with details of their pupils, for 1881 and 1891 : — £1,492,172 (including a parliamentary grant of £1,387,503), and the expenditure was £1,465,480.

The following table gives details for 31st December 1900 : —

Province.

Number

of

Schools.

Number of Pupils.

Average

Daily

Attend-

ance.

Eoman

Catholics,

Protestant

Episcopalians.

Others.

Total.

Leinster .

Munster

Ulster .

Connaught

Total .

1795

2115

8249

1525

146,176

182,170

111,888

119,791

15,629

6,840

62,284

8,922

2,767

1,851

92,838 ‘

610

164,572

190,361

266,605

124,828

107,088

126,964

172,598

71,629

8684

559,520

88,675

97,666

746,861

47S.224

Number of Schools.

Number of Pupils and Eeligious Professions.

Total

Pupils,

Male and

Female.

Schools.

Male.

Female.

Mixed.

Total.

Eoman

Catholics.

Protestant

Episcopalians.

Presbyterians

and Others.

M.

P.

M.

P.

M.

.F.

Primary \^l

2088

2148

1745

1684

6318

5360

9161

9177

269,631

258,880

261,187

268,968

42,066

42,105

89,182

89,255

37,908

41,988

86,127

88,938

675,036

686,084

Superior j j^gg^

205

199

117

91

166

185

488

475

6,218

8,198

4,927

5,674

8,986

8,607

2,606

2,627

2,100

2,108

1,670

2,167

20,405

24,271

Tot-i \ml

2298

2342

1862

1775

5484

6535

9639

9662

264,849

267,028

266,114

269,542

46,041

45,712

41,637

41,882

40,008

44,046

36.797

4i;095

695,441

709,305

The number of National schools, the number of pupils on the rolls, and the amount of parliamentary grants from 1881 to 1900,

are thus returned : —

Tears.

Number of

Number of

Amount of

Schools.

Pupils.

Grant.

1881

7648

1,066,259

729,868

1885

7936

1,075,604

814,003

1891

8346

1,022,361

866,539

1896

8606

808,9391

1,186,187

1897

8631

798,972

1,276,560

1898

8651

794,8182

1,304,734

1899

8670

785,139

1,299,117

1900

8684

745,861

1,387,503

Pn 31st December 1900 the National Board had in their service 8244 principal teachers and 3684 assistants, 897 work-mistresses and industrial teachers, 13 junior literary assistants, 32 temporary assistants, 5 temporary work-mistresses. The total emoluments from all sources, available for the teaching staff for the year ending 31st March 1901, was £1,174,690. The total receipts of the National Board for the same year were

In 1900 the average number of inmates in the six reformatory schools was 584, and the cost of maintenance and management was £13,780. In the same year the number of schools having certificates under the Irish Industrial Schools Act, 1868, was 70—8 Protestant (3 for boys and 5 for girls), and 62 Eoman Catholic (17 for boys, 44 for girls, and 1 mixed). The total number of inmates was 7802.

On 31st December 1900 there were, throughout Ireland, 30 model schools, with 8871 pupils on the rolls and an average daily attendance of 6547 ; 150 workhouse schools, with 4422 pupils on

the rolls and an average daily attend-

ance of 3747.

The Irish Education Act of 1892 pro-

vided that the parents of children of

not less than 6 nor more than 14 years of age should cause them

to attend school, unless there was a reasonable excuse for non-attend-

ance, on at least 150 days in the year in municipal boroughs and

in towns or townships under commissionei-s. It was also enacted

that any county council which might be established by any future

Act might by resolution, and should, on application made by any

baronial council (now rural district council), apply the foregoing

provision to any part of their county. The commissioners were

empowered by the same Act to acquire land for school-houses and

teachers' residences, and provisions were made for the partial or

total abolition of fees in specified circumstances, and for a parlia-

mentary school grant, in lieu of abolished school fees, for the

augmentation of the salaries of the National teachers.

Under the Educational Endowments (Ireland) Act, 1885, a scheme

was prepared for altering the constitution of the old "Commissioners

of Education," who had the management of the endowed and dio-

cesan schools, and for the future control of the Ulster royal schools. A Protestant and a Roman Catholic Board were constituted for each of the following districts : Armagh, Tyrone (with part of London-derry), Fermanagh (with part of Monaghan), Cavan, and Donegal. The endowments are now distributed in equal shaa-es. In 1900 the receipts of the commissioners amounted to £8098.

Finance. — The amount of imperial revenue collected in Ireland during the five years ending 31st March 1900 was : —

Tears.

Customs.

Excise.

Stamps.

Property

and In-

come Tax.

Post Oflace

and

■*Telegraphs.*

Miscel-

laneous.

Total

Eevenue.

Estimated

True

Eevenue.

Per Head

of Estimated

Population.

1896

1897

1898

1899

1900

£

2,152,000

2,176,000

2,221,000

2,002,000

2,159,000

£

5,299,000

5,361,000

5,449,000

6,518,000

6,274,000

£

917,000

1,010,000

948,000

1,085,000

945,000

£

703,000

666,000

670,000

687,000

694,900

£

795,000

809,000

824,000

846,000

878,000

£

164,000

168,000

146,000

169,000

167,500

£

10,080,000

10,190,000

10,258,000

10,247,000

11,117,500

£

8,084,000

8,146,000

8,114,000

8,202,000

8,664,600

£ s. d.

1 15 1

1 15 9

1 15 8

1 16 1

1 18 2

The amount of imperial revenue expended in Ireland during the same five years was :

Tears.

Consoli-

dated

Fund.

Voted.

Local Taxation

Accounts.

Civil

Charges.

Collection

of

Taxes.

Post

Oflil-O

Services.

Total

Expendi-

ture.

Estimated

True

Eevenue.

Contribu-

tion.

Local

Taxation

Ueveuue.

Exchequer

Eevenue.

1890

1897

1898

1899

1900

£

177,000

177,000

174,000

176,000

179,000

£

4,880,000

4,297,000

4,802,000

4,206,000

4,072,000

£

858,000

401,000

611,000

447,000

409,000

£

40,000

40,000

40,000

404,000

1,058,000

£

4,902,000

4,1116,000

5,027,000

5,292,000

5,713,000

£

228,000

282,000

241,000

242,000

242,000

£

807,000

823,000

866,000

948,000

1,025,000

£

6,987,000

5,970,000

6,184,000

0,477.000

6,980,000

£

8,084,000

8,146,000

8,114,000

8,202,000

8,664,500

£

2,097,000

2,176,000

1,980,000

1,725.000

1,684,500

From a variety of circumstances it is extremely difficult to arrive at even an approximate estimate of the wealth of Ireland.

1 Number of pupils on the rolls on 31st December.

2 Number of iiupils on tliu rolls on 30th September. Prior to 1896 the basis of the returns was the total number on the rolls who had made at least one attendance in the year.

The following statistics, however, may serve as a sort of summary estimate of Irish property in 1900-1, though many important factors, such as the amount of capital invested in the linen industry, cannot be included owing to tlie uncertainty of the figures : —Tenement valuation, £14,933,524 ; value of crops, £30,104,392 ;

8 81,149 Presbyterians.

statistics]

value of live stock, £82,146,137 ; paid-up capital and reserve , funds of joint-stock banks, £10,910,512 ; deposits in joint-stock banks, in trustee savings banks, and in P.O. savings banks, £52,197,000 ; investments in Government stock, transferable at

the Bank of Ireland, £30,395,000 ; paid-up share and debenture capital of railways, £39,765,573 ; paid-up stock and share capital of tramway companies, £1,833,003 ; fisheries — value of exports, £367,655 ; mines — value of productions, £239,840 ; total, £262,891,636. In this connexion it may be noted that deposits in joint-stock banks rose from £28,289,000 in 1881 to £41,568,000 in 1901 ; deposits in trustee savings banks from £2,078,707 in 1881 to £2,340,000 in 1901 ; and deposits in P.O. savings banks from £1,645,000 in 1881 to £8,289,000 in 1901. The amount of Government and other stock on which dividends are paid at the Bank of Ireland rose from £28,289,000 in 1881 to £30,395,000 in 1901. In the year ending 6th April 1900 the net annual value of property and profits assessed to the income tax was £24,439,941.

In 1897 the local taxation of Ireland amounted to £3,978,136, as compared with £3,559,093 in 1890. More than 75 per cent, of the total amount was raised by rates on real property. The Local Government (Ireland) Act, 1898, effected considerable changes in local finance. Each county council has now three sources of revenue : (1) The agricultural grant ; (2) the licence duties and

other imperial grants ; and (3') the poor rate, — which it will be convenient to consider separately. (1) It was provided by the Act that the Local Government Board should ascertain the amount of county cess and poor rate levied off agricultural laud in Ireland during the year ending, as regards the poor rate, on 29th September, and, as regards the county cess, on 21st June, 1897, and that half this amount, to be called the agricultural grant, should be paid annually, without any variation from the original sum, out of the consolidated fund to a local taxation account. The amount of the agricultural grant has now been ascertained to be £727,666. Elaborate provisions were also made in the Act for fixing the proportion of the grant to which each county should be entitled, and the Lord-Lieutenant was empowered to pay half-yearly the proportion so ascertained to the county council. (2) Previous to the passing of the Act, grants were made from the imperial exchequer to the grand juries in aid of the maintenance of lunatics, and to the boards of guardians for medical and educational purposes, and for salaries under the Public Health (Ireland) Act. In 1897 these grants amounted to £236,483. Under the Local Government Act they ceased, and in lieu thereof it

was provided that there should be annually paid out of the consolidated fund to the local taxation account a sum equal to the duties collected in Ireland on certain specified local taxation licences. In addition, it was enacted that a fixed sum of £79,000 should be forthcoming annually from the consolidated fund. (3) The county cess was abolished, and the county councils now levy a single rate for the rural districts and unions, called by the name of poor rate, for all the purposes of the Act. It is made upon the occupier and not upon the landlord, and the occupier is not entitled, save in a few specified cases, to deduct any of the rate from his rent. The total amount raised by the poor rate in the year ending 29th September 1898 was £1,087,920.

The total amount issued on loan, exclusive of closed services, by the Commissioners of Public Works in Ireland up to 31st March 1900 was £24,228,037, which included the loans granted under the Land Improvement Acts, the Seed Supply Acts, and section 31 of the Land Act, 1881 (^Agriculture below). On the same date there had been repaid of the principal sum £13,531,079, £7,141,423 had been paid by way of interest, and £1,597,050 had been remitted. The balance outstanding was — principal

£9,099,908, and interest £193,892. Exclusive of the loans already mentioned, the following were the chief items of the total amount :—Railways £1,200,127, lunatic asylum buildings £2,620,385, public health £2,690,278, Labourers' Acts £1,830,188, river drainage and navigation £2,082,052, grand juries for roads, &c., £807,667.

In 1894 a Royal Commission was appointed to consider the financial relations between Great Britain and Ireland and the taxable capacity of the two countries, and presented a voluminous final report in 1896. The commissioners differed on several points, but were practically agreed on the following five conclusions : (1) That Great Britain and Ireland must, for the purposes of this inquiry, be considered as separate entities ; (2) that the Act of Union imposed upon Ireland a burden which, as events showed, she was unable to bear ; (3) that the increase of taxation laid upon Ireland between 1853 and 1860 was not justified by the then existing circumstances ; (4) that identity of rates of taxation did not necessarily involve equality of burden ; (5) that, whilst the actual tax revenue of Ireland was about one-eleventh of that of Great Britain, the relative taxable capacity

of Ireland was very much smaller, and was not estimated by any of the commissioners as exceeding one-twentieth. Since its publication the report has become a standing subject of political and economic controversy. (See History below.)

Defence. — The militia has been reorganized under recent army regulations, and now consists of the 3rd and 4th battalions of certain of the territorial regiments.

Production and Industry.

By the Purchase of Land Act, 1891, a body was constituted, called the Congested Districts Board, composed of the Chief Secretary, a member of the Land Commission, and five other members. The Act placed at the disposal of the Board the Irish Reproductive Loan Eund, the Sea and Coast Fisheries Fund (except the sum of £20,000— see Fisheries below), and the interest, at the rate of 2| per cent., on a sum of £1,600,000 charged on the Irish Church Temporalities Fund. It was provided that where more than 20 per cent, of the population of a county lived in electoral divisions of which the total rateable value, when divided by the number of the population, gave a sum of less than £1, 10s. for each individual, these divisions should,

for the purposes of the Act, form a separate county, called a congested districts county, and should be subject to the operations of the Board. In order to ameliorate the condition of affairs in these separate counties, the Board was empowered (1) to amalgamate small holdings (within certain specified limits), either by directly aiding migration or emigration of occupiers from one holding to another, or by recommending the Land Commission to facilitate amalgamation, and (2) generally to aid and develop, out of its resources, agriculture, forestry, the breeding of live stock, weaving, spinning, fishing (including the construction of piers and pontoons, and the supply of boats and gear), and any other suitable industries. Further provisions regulating the operations of the Board were made by an Act of' 1893, and by the Land Law Act, 1896. By its constituting Act, the new Department of Agriculture, &c., was empowered to exercise and discharge, at the request of the Board, any of its powers and duties in a congested districts county. For the year ending 31st March 1899 the receipts of the Board were £111,162, and the expenditure £106,165. By an Act of 1899, a Department of Agriculture and other Industries and Technical Instruction was

established in Ireland. The Chief Secretary is president of the department, to which have been transferred the powers and duties of the Lord-Lieutenant, under the Diseases of Animals Acts, 1894 and 1896 ; under the Destructive Insects Act, 1877, and the Fertilizers and Feeding Stuffs Act, 1893 ; the powers and duties of the Registrar-General and of the Land Commission with reference to the collection of statistics ; the powers and duties of the Land Commission under the Markets and Fairs (Weighing of Cattle) Acts, 1887 and 1891 ; the administration of the grant for science and art in Ireland ; the administration of the grant for technical education ; the powers and duties of the Department of Science and Art in relation to any public building or institution under their control, and also any property held by them ; and the powers and duties of the inspectors of Irish fisheries, who are henceforth to be ofiBcers of the department. To assist the department, the Act also provided for the establishment of a Council of Agriculture, an Agricultural Board, and a Board of Technical Instruction, specifying the constitution of each of the three bodies. Certain moneys (exceeding £180,000 per annum) were placed by the Act at the disposal of the department, pro-

visions were made for their application, and it was enacted that local authorities might contribute funds.

Minerals. — The mineral output of Ireland is still very limited, and the production of lead and copper, the combined value of which in 1876 was over £50,000, has now practically ceased, as has the production of silver. In 1900 the coal mines in Kilkenny,

Mineral.

1899.

1900. 1

Quantity.

Value.

Quantity.

Talus.

Coal

Iron ore .

Salt

Slate

Other minerals

Total .

Tons,

125,420

102,262

47,055

5,443

£

51,460

16,015

13,319

13,410

125,926

Tons.

124,699

99,641

44,194

5,637

S ‘

62,249

17,670

7,554

14,433

137,g34

...

220,130

239,740

Queen's County, Tipperary, Antrim, Tyrone, Leitrim, and Ros-

common produced 124,699 tons, of the value of £62,249, Kilkenny

having the largest output, with 62,817 tons of anthracite coal.

In the same year eleven iron ore mines were worked in County

Antrim, and produced 99,641 tons, valued at the mines at

£17,610. In 1892 the output of iron ore was 76,739 tons, of the

value of £11,626. Rock salt of a superior quality is raised at

Carrickfergus in County Antrim, the production in 1900 having

[statistics

been 44,194 tons, valued at B7554:. Alum clay or bauxite is

found in beds between sheets of Tertiary basalt in tlie same

county. The quantity raised from five mines in 1900 was 5779

tons, valued at the mines at £1350. The alumina is prepared

at works near Lame, and the quantity extracted in 1900 was 1600 tons, value £30,500 which produced 560 tons of aluminium, value £72,800. The preceding table contains a general summary of the mineral output of Ireland in 1899 and 1900.

Agriculture. — The Land Act of 1881 provided that a fair rent

Method of Procedure.

c

1'

o

■3 ^

First Statutory Term.

By chief commission and sub-commissions

On reports of valuers , . . .

By civil bill courts

By agreements between landlords and tenants .

By arbitration . . . . ,

Total of first statutory term

Second STATtrTORT Term.

By chief commission and sub-commissions

On reports of valuers

By civil bill courts

By agreements between landlords and tenants .

Total of second statutory term

171,718

1,562

18,271

187,131

88

5,711,509

67,072

552,815

8,525,785

8,289

£

4,016,429

43,901

850,877

2,811,076

8,266

£

8,128,828

85,099

263,161

1,901,848

2,804

24-9

20-0

24-9

17-7

29-4

828,720

9,859,970

6,725,049

5,325,740

20-8

26,844

291

1,954

23,807

788,027

12,814

68,881

562,943

524,852

7,263

88,290

289,075

896,098

5,702

29,366

234,942

24-4

21-4

25-9

18-8

52,896

1,432,615

858,9801

666,108

22-4

when fixed could not be raised or altered for fifteen years — the first statutory term— and that a second term could be fixed in the last year of that period at a revised rent. The table above shows the number of fair rents fixed between 22nd August 1881 and 31st March 1900. The judicial rents fixed for the first statutory term show a reduction of a fraction over 20 per cent, on the old rents ; those fixed for the second statutory term, a still further reduction of over 22 per cent. In addition, 154 judicial leases (i.e., leases approved by the court to exclude the Act of 1881) were executed during the same period, and 45 fixed tenancies (i.e., tenancies to which the Act of 1881 does not apply) were sanctioned. Since the Land Act of 1881, which seemed to the tenant a near approximation to the " three f's " — free sale, fair rent, and fixity of tenure, — several measures have been passed dealing with the tenure and purchase of land in Ireland. By the Purchase of Land (Ireland) Act, 1885, which was described as "an Act to provide greater facilities for the sale of land to occupying tenants," elaborate provisions were made for advances by the Land Commission (established by the Act of 1881) in order to enable tenants to purchase their holdings

either from the Laud Commission itself or from their landlords, and for the repayment of such advances. For the pui-pose of advances, or of purchases of estates by the Land Commission, it was further enacted that any sum or sums, not exceeding in all £5,000,000, might be issued out of the consolidated fund. The Acts of 1881 and 1885 were amended and extended by the Land Law (Ireland) Act, 1887. By the Purchase of Land Amendment Act, 1889, the Land Commission was empowered to advance money to tenants to purchase lands to increase the size of their holdings. The Purchase of Land Act, 1891, provided further funds for the purchase of land by tenants, established the Land Commission as a permanent tribunal, and constituted a body called the Congested Districts Board (see above). The Land Law Act of 1896 contained further provisions for the fixing of fair rents and certain regulations as to the duties of the Land Judge and the Judicial Commissioners, and amended in some respects the previous law as to the purchase of land. There is no provision for compulsory sale in any of the Acts.

The following table shows, by provinces, applications for loans

Under an act of 1898 money can be lent to Boards of Guardians

for the supply of seed potatoes, seed oats, and potato spraying machines and spraying material to occupiers of land unable through poverty to obtain such supplies. Up to 31st March 1900, £78,670 had been so advanced. Under the previous Seed Supply Acts a sum of nearly £1,000,000 has been advanced by the Commissioners of Public Works.

The amount sanctioned under the Act of 1885 was £9,992,640 to 25,368 tenants. In the first year the purchase money actually issued was 18-3 years' purchase on the rental, the highest figure ever reached. In 1897 it fell to 15-2 years' purchase, and the average for the entire period was 17 years' purchase. The amount sanctioned under the Acts of 1891 and 1896 was £7,550,765 to 24,337 tenants. The purchase money actually issued was 17-3 years' purchase on the rental.

Below are given the number and amount of loans issued in each county and province under the Land Improvement Acts from 1847 to 1900.

Over £4,000,000 was applied for drainage

purposes. During the year ending 31st March 1900, 294 applications were received under these Acts, and £38,900 was issued. Under sect. 19 of the Land Act 1881, 260 loans, amounting to £15,275, to tenant farmers for labourers' dwellings, were sanctioned up to 31st March 1900. A large number of loans are made under sect. 31 of the same Act, and the

Provinces

No. of

Amount

Provinces and

No. of

Amount

and Oounties.

Loans.

Issued.

Counties.

Loans.

Issued.

Leikstee.

£

Ulstee.

£

Carlow

285

109,969

Antrim

224

188,203

DiibUn

321

98,770

Armagh

8

22,868

Kildaro

838

146,252

Cavan

206

55,690

Kilkenny .

270

76,825

Donegal

S32

190,129

King’s

255

71,624

Down .

179

99,765

Longford .

843

188,986

Fermanagh

200

87,158

Louth

122

47,794

Londonderry

201

74,578

Meath

486

211,852

Monaghan .

114

46,568

Queen's

886

161,648

Tyrone

822

149,245

Westmeath

332

106,467

Wexford .

383

135,610

Wioklow .

Total

MXTNSTEE.

274

127,880

Total

CoNNAtJGHT.

8745

1,477,077

1786

868,694

Clare

514

177,819

Gahvay

839

892,919

Cork

1546

451,588

Leitrim

204

76,486

Kerry

856

479,626

Mayo

526

282.761

Limerick .

956

395,680

Roscommon

490

281,560

Tipperary .

815

231,406

Sligo

303

139,900

Waterford

Total

Total

Total— Ireland .

2861

1,073,616

4988

1,824,838

12,574

.“1,239,220

following table gives a summary by provinces of the number and amounts of loans issued for drainage, fencing, erecting of farm-houses, cottages, scutch mills, &c.

Provinces.

Loans Sanctioned.

Total Issued,

Number.

Amount.

Leinster

Munster

Ulster .

Connaught .

Total— Ireland .

2,715

6,784

2,025

3,332

£

290,980

557,150

150,322

246,985

£

247,822

480,062

126,895

216,327

14,8.56

1,245,437

1,071,106

Provinces.

Under Act of 1 9S5,

From August 1885 to March 1900.

Under Acts of 1891 and ls9C,

From August 1891 to March 1900,

Total Loans

Issued.

Applications.

Loans Issued,

Applications.

Loans Issued,

No.s

Amount.

No,!

Amount.

No.=

Amount.

No,!

Amount.

No.=

Amount.

Leinster .

Munster .

Ulster .

Connaught

Total— Ireland

6,062

6,898

14,528

3,426

£

2,7.58,639

8,687,801

4,171,518

799,842

4,222

5,204

12,9.54

2,988

£

2,858,188

8,222,056

8,749,421

662,980

0,084

n,!)40

12,420

5,053

£.

2,699,400

2,604,a59

2,758,386

962,420

4,117

4,195

8,400

2,509

£

1,798,327

1,826,480

l,95n,SR6

508,574

8,839

9,899

21,360

6,497

£

4,151,510

6,n48,4S0

5,“0.‘i,:i07

l,171,,’->54

23,909

11,866,795

25,868

9,992,610

29,503

8,985,024

19,227

6,084,217

44,596

10,076,867

and loans issued under the Land Purchase Acts, 1885, 1891, and

1896, from 22nd August 1885, to 31st March 1900.

1 Judicial rents for first statutory term.

2 The number of tenants is the same as the number of loans.

The following table gives the num-

ber of difierent holdings iu each pro-

vince and in all Ireland in 1881, 1891,

and 1900, with, in each case, the

increase or decrease between 1881 and

1900.

As the holdings not exceeding 1 acre

consist to a large extent merely of

small gardens, the increase in their

number cannot be regarded as a very

important factor in an agricultural

estimate. As regards other holdings,

the general tendency has been for those

between 1 acre and 30 acres to decrease,

and for those over 30 acres to increase. So far as the firet

class is concerned, this applies to all the provinces without ex-

ception. But as regards the second class, while there was an

increase between 1881 and 1900 in holdings over 30 acres in

Munster of 1120, in Ulster of 1959, and in Connaught of 1605,

statistics]

I E E L A N D

555

Provinces.

Holdings not exceeding

AboTO 500

Acres.

Toi:aI.

1 Acre.

5 Acres.

15 Acres.

80 Acres.

50 Acres.

100 Acres.

200 Acres.

500 Acres.

fl881 . ‘ .

Leinster -J 1891 .

[1900 .

Increase or decrease be-

tween 1881 and 1900 .

ri881 .

Munster -^1891 .

[1900 .

Increase or decrease be-

tween 1881 and 1900 .

fl881 .

Ulster ■ 1891 .

[1900 .

Increase or decrease be-

tween 1881 and 1900 .

ri881 .

Connaught J. 1891 .

[1900 .

Increase or decrease be-

tween 1881 and 1900 .

fl881 .

Ireland -{ 1891 .

[l900 .

Increase or decrease be-

tween 1881 and 1900 .

17,289

17,696

24,301

18,804

18,034

17,426

26,048

25,881

25,255

22,623

22,258

21,952

15,527

15,206

15,222

14,044

13,865

14,039

6,776

6,867

6,890

2765

2785

2829

363

415

411

124,239

123,007

128,825

+ 7,012

-1,378

-798

-671

-306

-5

+ 114

+ 64

+48

+ 4,086

11,828

14,922

21,949

11,096

11,207

11,493

19,747

19,254

19,349

25,030

24,368

24,288

21,953

22,176

22,271

22,054

22,068

22,602

9,085

9,143

9,325

2752

2768

2680

347

363

388

123,842

126,269

134,340

+ 10,121

+397

-398

-742

+318

+548

+ 290

-72

+ 36

+ 10,498

14,733

17,026

18,962

21,971

21,287

20,672

68,362

64,760

63,555

55,227

53,825

53,622

24,370

25,013

24,989

13,562

14,090

14,461

3.367

3,654

3,725

968

1041

1031

243

259

263

202,803

200,955

201,280

+ 4,229

-1,299

-4,807

-1,605

+619

+ 899

+ 358

+ 63

+20

-1,523

7,146

5,984

6,636

15,200

12,936

12,563

49,888

46,766

46,592

32,913

33,496

33,688

10,535

11,526

11,567

5,941

6,338

6,474

3,036

3,147

3,111

1719

1686

1679

477

530

482

126,855

122,409

122,792

-510

-2,637

-3,296

+ 775

+ 1,032

+ 533

+ 75

-40

+5

-4,063

50,996

55,628

71,848

67,071

63,464

62,154-

164,045

156,661

154,751

135,793

133,947

133,530

72,385

73,921

74,049

55,601

56,361

57,576

22,214

22,811

23,051

8204

8280

8219

1430

1567

1539

577,739

572,640

586,717

+20,852

-4,917

-9,294

-2,263

+ 1,664

+ 1,975

+837

+ 15

+ 109

+ 8,978

Leinster showed a decrease of 84. Taking the whole of Ireland, the decrease in the first class was 16,474, and the increase in the second class was 4600.

The following table shows the number of occupiers in 1881 and 1900 resident in each province, classified according to the total extent of land held, without reference to the townland, poor law union, county, or province in which the portions of land are situated : —

Provinces.

Number of Occupiers holding Land.

Total.

Kot exceeding

1 Acre.

Between

1 and 5.

Between

5 and 16.

Between

15 and 80.

Between

30 and 60.

Between

50 and 100.

Between

100 and 200.

Between

200 and 500.

Above

60O.

Leinster {]f^;_;

Increase or decrease

Munster {\^l ; ;

Increase or decrease

Ulster {iz : :

Increase or decrease

Connaught {l^Sl • •

Increase or decrease

Ireland {^^ ; ;

Increase or decrease

16,975

24,066

16,988

15,893

22,218

21,632

19,052

18,840

13,299

13,160

12,313

12,442

6,099

6,391

2896

2989

717

692

110,551

116,104

+ 7,090

-1,090

-586

-212

-139

+ 129

+292

+94

-25

+ 5,553

11,635

21,752

9,738

10,278

16,614

16,193

21,505

20,972

19,196

19,629

20,082

20,957

8,629

9,283

8195

3164

638

562

111,182

122,780

+ 10,117

+ 540

-421

-533

+433

+925

+654

-31

-86

+ 11,698

14,480

18,816

19,711

19,080

62,102

58,244

50,701

49,357

23,125

23,851

13,763

14,539

3,816

4,141

1195

1200

317

331

189,208

189,559

+4,336

-631

-3,858

-1,344

+ 726

+ 777

+326

+ 5

+ 14

+ 351

6,866

6,470

18,836

11,401

46,862

43,765

31,366

32,186

9,997

11,145

5,376

6,144

2,371

2,803

1413

1686

657

616

118,743

116,116

-895

-2,436

-8,097

+ 820

+ 1,148

+ 768

+482

+173

-41

-2,627

49,955

71,108

60,268

56,652

147,796

139,834

122,624

121,356

65,617

67,785

61,488

64,082

20,914

22,618

8698

8989

2829

2191

529,684

544,559

+21,148

-3,616

-7,962

-1,269

+ 2,168

+2,699

+ 1,704

+241

-188

+ 14,875

Prom the above it is seen that, as might have been expected

from the previous table, the occupiers of holdings not exceeding 1 acre largely increased ; those occupying holdings between 1 acre and 30 acres decreased (by 12,847), and occupiers of holdings over 30 acres increased (by 6574).

The following table gives in statute acres the distribution of land during 1900 in the various counties, alphabetically arranged under their provinces. The totals for the provinces and for all Ireland are collected into a separate table for the purpose of comparison with the figures for 1881 ; in this table, below the acreage occupied by each kind of land, is given the percentage it forms of the whole province or county as the case may be.

From the table it will be seen that between 1881 and 1900 the area under crops, including meadow and clover, decreased by 536,643 acres. Each of the four provinces showed a decline, the largest — 184,742 acres — being in Ulster; and the smallest— 81,105 acres — in Connaught. On the other hand, the area under grass (pasture) increased by 487,948 acres. Each of the four provinces showed an increase, the largest — ^212,846 acres^being in Ulster, and the smallest — 18,919 acres — in Munster. Taking the areas under crops and grass (pasture) together, we find that the total

number of acres in use for agricultural purposes decreased by 48,695 acres. Owing, however, to a more than proportionate decline in the population, the census returns of 1881 and 1891 show that the average number of acres of arable and pasture land to each person of the rural population was 3 ‘5 in the former year and 8.9 in the latter year. Turning to the other headings, it will be seen that “woods and plantations” declined by 17,055 acres, but the decrease is to a large extent more apparent than real, as a stricter method of enumeration was adopted in 1891. ” Bog and marsh ” showed a decline of 142,035 acres, which would seem to point to a considerable reclamation of land. As has been seen from the figures given above, large sums of money have been advanced to tenants for the purpose of draining. In 1900

[statistics

Counties.

Crops includ-

ing Meadow

and Clover.

Grass.

Fallow.

■*Woods and*

Plantation.

Turf,

Bog.

Marsh.

Barren Moun-

tain Land.

Water,

Koads,

Fences, &c.

Total.

Leinster.

•

Carlow .

71,486

122,649

114

3,240

688

2,367

10,647

10,267

221,458

Dublin .

68,913

122,373

502

3,986

55

1,194

13,305

16,358

226,686

Kildare

101,628

260,290

199

6,288

80,581

2,891

1,474

16,145

418,496

Kilkenny

140,216

313,021

417

9,963

2,539

5,125

13,537

24,427

509,245

King's County-

108,647

239,858

400

6,870

96,129

14,774

5,752

20,833

493,263

Longford

62,953

140,427

129

3,595

30,642

4,842

1,511

13,671

257,770

Loutli .

82,394

89,398

190

4,524

1,138

1,219

12,924

10,387

202,174

Meath .

114,812

414,837

498

9,811

8,649

2,369

347

26,420

577,743

Queen’s County .

127,305

228,397

147

10,685

18,914

4,338

17,009

17,895

424,690

Westmeatli .

78,489

286,542

194

7,915

35,127

5,219

880

20,260

434,626

Wexford

193,160

321,393

204

10,206

794

7,694

17,090

28,177

578,718

“Wicklow

89,532

238,481

308

17,957

4,446

11,937

119,444

17,852

499,957

MUNSTER.

Clare .

145,959

478,411

243

7,840

28,312

8,098

79,432

36,661

784,956

Cork .

415,766

971,221

1608

29,099

24,996

68,997

213,688

83,546

1 ,808,921

Kerry .

154,881

533,696

161

15,019

62,819

39,404

311,318

42,058

1,159,356

Limerick

160,191

427,367

293

9,069

9,343

4,067

24,950

27,693

662,973

Tipperary

246,353

623,874

403

26,469

35,788

9,819

67,471

39,953

1,050,130

Waterford .

77,016

245,465

181

19,455

1,347

15,410

75,140

18,910

452,924

Ulster.

Antrim

228,251

347,184

1111

5,920

22,121

7,246

61,820

37,834

711,487

Armagh

133,747

139,646

564

3,106

5,949

2,063

8,139

19,445

312,659

Cavan .

132,391

261,104

127

5,281

13,493

4,685

12,375

37,569

467,025

Donegal

220,864

422,862

995

5,890

102,465

28,614

346,289

62,289

1,190,268

Down .

255,745

262,237

763

13,573

1,688

4,129

41,495

32,463

612,093

Fermanagh .

98,287

249,574

83

5,777

18,680

1,774

21,196

22,294

417,665

Londonderry

176,663

219,269

367

4,484

25,944

4,232

58,352

24,077

513,388

Monaghan .

113,311

169,112

450

4,591.

5,646

1,184

1,514

23,298

318,806

Tyrone .

235,479

832,667

463

9,658

47,598

6,843

109,997

36,238

778,943

CONNAUGHT.

Gal way .

196,365

755,888

851

25,166

141,925

54,876

221,259

67,100

1,463,430

Leitrim

76,879

216,457

44

3,074

20,488

4,070

30,159

25,339

376,510

Mayo .

157,279

534,764

429

8,870

278,151

44,517

232,644

71,123

1,327,777

Roscommon .

120,406

358,090

69

7,444

75,431

9,875

6,213

29,474

607,002

Sligo .

73,364

236,818

82

7,123

35,716

6,517

65,382

17,203

442,205

Provinces.

Crops,

Including

Meadow and

Clover.

Grass.

Total Land

in use for

Agriculture.

Fallow.

“Woods

and

Plantations.

Bog and

Marsh.

Barren

Mountain

Land.

Water,

Roads,

Fences, &c.

Total.

1881

1,439,381

29-8

2,567,796

531

4,007,177

82-9

6,445

•1

99,362

2-1

334,652

6-9

190,685

3-9

200,189

4-1

4,838,510

Leinster

1900

1,239,535

25-6

2,777,666

57-3

4,017,201

82-9

3,302

•1

95,040

2-0

293,671

6-0

213,920

4-4

221,692

46

4,844,826

“1881

1,271,116

21-5

3,261,115

55-0

4,532,231

76-5

2,821

■0

113,210

1-9

321,114

5-4

732,157

12-3

233,149

3-9

5,934,682

Munster

1900

1,200,166

20-2

3,280,034

55-1

4,480,200

75-3

2,889

■0

106,951

1-8

308,400

5-2

801,999

13-5

248,821

4-2

6,949,260

Ulster

1881

1,779,480

33-4

2,190,809

41-2

3,970,289

74-6

10,169

■2

62,968

1-2

356,900

6-7

675,776

12-7

246,219

4-6

5,822,321

1900

1,594,738

30-0

2,403,655

45-2

3,998,393

75-2

4,923

•1

57,980

1-1

304,354

5-7

661,177

12-4

295,507

6-5

5,322,334

1881

705,398

16-7

2,055,704

48-6

2,761,102

65-3

1,769

•0

63,163

1-2

707,360

16-7

519,054

12-3

190,792

4-6

4,233,240

Connaught i

1900

624,293

14-8

2,102,017

49-9

2,726,310

64-7

1,475

■0

51,677

1-2

671,566

15-9

656,657

13-2

210,239

50

4,216,924

Ireland

1881

5,195,375

25-6

10,075,424

49-6

15,270,799

75-2

21,204

•1

328,703

1-6

1,720,026

8-4

2,117,672

10-4

870,349

4-3

20,328,753

1900

4,658,732

22-9

10,563,372

52-0

15,222,104

74-9

12,589

■1

311,648

1‘5

1,577,991

7-7

2,232,753

11-0

976,2591

4-8

20,333,344 2

five counties had over 100,000 acres of bog and marsh — Mayo, 322,688 ; Galway, 196,801 ; Donegal, 131,079 ; King's County, 110,903; and Kerry, 102,223. On the other hand, "barren mountain land " showed an increase of 115,081 acres. The explanation of this increase probably lies in the fact that between 1841 and 1871 over 2,000,000 acres of waste land were reclaimed, or, at all events, brought into agricultural use, and that since 1871, with a steadily declining population, a portion of this reclaimed land has proved to be useless either for grazing or cultivation.

The returns for the whole of Ireland, showing the extent in statute acres under each of the principal crops, the percentages — these are of the area under all crops — the average yield per acre, and the total produce for a series of years, are given in the table on the following page.

The area under green crops fell from 1,270,026 acres in 1881, or 24-6 of the total extent under crops, to 1,098,377 acres in 1900, or 23-6 of the total extent, a decline of 171,649 acres. The decline was almost entirely due to the large fall in the area under potatoes,

for turnips, mangel and beet, and cabbage all exhibited an increase, while vetch and rape only fell from 0‘3 per cent, to 0-2 per cent., and the percentage of other green crops remained the same. The decline in potatoes is no doubt largely due to the fact that in the interval a large proportion of that part of the population whose staple food is the potato had left the country. But considering the existence of the linen industry, the most remarkable decline during the period under review was in flax, which decreased by about 100,000 acres. As was to be expected, the number of scutching-mills also decreased from 1172 in 1881 to 815 in 1900, of which 804 were in Ulster. Efforts are at present being made in the north of Ireland, to which the growing of flax is practically confined, to restore and improve its cultivation, but in face of the competition from foreign countries, especially Belgium, it is very

1 Including 129,681 acres under water.

2 Exclusive of 492,252 acres vmder the large rivers, lakes, and tideways.

8 The difference between the total areas for 1881 and 1900 is owing to the adoption in 1891 of revised areas for certain counties, and the mclusion of some slob lands in the county of “Wexford.

statistics]

I E E L A N D

557

Tears.

Extent under FTincipal Grope.

Wheat.

Oats.

Barley.

Bere.

Eye,

Potatoes.

Turnips.

Mangel and

Beet.

Cabbage.

Flax.

Hay.

1881 .

1886 .

1891 .

1896 .

Average 1888-97 .

1900 .

1881 . .

1900 .

1881 .

1886 .

1891 .

1896 .

Average 1888^7 .

1900 .

1881 .

1886 .

1891 .

1896 .

Average 1888-97 .

1900 .

158,794

69,646

80,870

38,019

1,398,812

1,821,988

1,215,896

1,198,581

210,098

181,598

177,966

178,082

474

298

358

888

7,588

10,676

13,448

13,715

865,293

799,847

753,332

705,665

296,212

299,823

800,826

808,471

44,838

87,413

61,757

54,801

28,496

40,112

43,049

44,198

147,146

127,810

74,665

72,258

2,001,029

2,094,209

2,059,529

2,202,424

66,850

1,227,074

174,047

808

13,454

740,015

303,311

50,059

42,540

86,108

2,162,859

58,821

1,105,060

173,906

177

11,407

664,079

297,869

68,808

42,918

47,451

2,165,716

Percentages of Area, under all Crops.

8-0

1-2

26-8

28-7

4‘0

8-7

16-3

14-0

5-8

6-4

0-9

1-5

0-5

0-9

2-8

1-0

88-5

46-5

0-2

0-3

Average Produce per Acre.

Cwts.

Cwts.

Cwts.

Cwts.

Cwts.

Tons. .

Tons.

Tons.

Tons.

Stones.

Tons.

14-9

14-5

17-3

16-8

14-1

18-9

15-5

14‘2

16-8

15-8

18-6

16-2

14-5

13-8

18-4

12-8

10‘5

11-6

18-6

12-7

4-0

8-8

4-0

8-8

12-9

18-8

14-5

16-6

18-4

18-6

15 -6

14-4

9-8

9-7

10-1

10-8

80-8

29-2

29-5

22-8

2-0

2-1

2-1

2-1

15-9

14-7

16-9

18-8

12-7

8-4

14-0

14-6

9‘8

28-1

2-2

16-7

15-8

16‘0

141

12-8

2-8

14-9

17-2

10-4

84-8

2-4

Total Produce.

Cwts.

Cwts.

Cwts.

Cwts.

Cwts.

Tons.

Tons.

Tons.

Tons.

Tons.

Tons.

2,297,131

1,007,186

1,401,127

689,678

19,703,074

18,878,618

18,883,576

17,008,184

8,826,916

2,772,386

8,810,459

3,142,580

6880

4104

4717

4708

79,946

122,722

182,206

174,673

3,483,593

2,667,724

8,036,586

2,701,000

8,820,946

8,974,476

4,349,464

4,782,769

601.792

505;688

807,204

782,672

279,588

888,344

435,981

455,021

28,332

28,879

13,768

10,292

8,989,834

4,428,732

4,342,852

4,781,455

1,047,790

18,014,165

2,984,518

4042

170,628

2,541,192

4,244,608

781,740

415,878

15,027

4,764,711

901,224

17,611,579

2,779,367

2601

146,645

1,841,832

4,426,427

1,186,582

447,206

10,181

5,218,968

doubtful whether the flax-hearing area will ever be raised to its former proportions. The total extent of land under cereals, green crops, and flax thus showed a decrease during the twenty years of 701,329 acres, or 21-2 per cent. The extent of land under meadow and clover, or hay, increasing, on the other hand, by 164,686 acres, the total decline was brought down to 536,643 acres as originally stated. Of the 2,165,715 acres returned in 1900 as under hay, 690,753 were in Leinster, 663,536 in Munster, 592,923 in Ulster, and 318,508 in Connaught, the first-mentioned province being the only one in which a falling-off was exhibited. The total value of the cereal and other crops in 1900 was estimated at £34,230,892. The decrease of 536,643 acres was largely balanced by the increase of 487,948 acres in the area under pasture. Thus, with the exception of 48,695 acres, all the land that was withdrawn in the interval from the cultivation of cereal and green crops appears to have been devoted to the raising of live stock, which it will now be shown did indeed largely increase in quantity between 1881 and 1900.

Crops and Pasture. — As has been already stated, the extent of land under crops, including meadow and clover, decreased by 536,-643 acres between the years 1881 and 1900. The chief decline was

in cereals, which fell from 1,777,175 acres, or 34-2 per cent, of the total area under crops, to 1,347,189 acres, or 28-9 of the total area under crops. The only cereal crop which showed an increase was rye, and the total acreage of that was very small. The acreage of beans and pease decreased from 11,914 acres to 2738 acres. The several acreages covered by wheat, oats, and barley in 1900 were thus distributed among the provinces : —

Province.

Wheat,

Oats.

Barley.

Leinster

Munster

Ulster .

Connaught .

14,782

15,529

17,535

5,975

245,734

206,765

535,255

117,296

125,063

41,353

4,384

3,196

Live Stock. — The following table shows the quantity and de-

scription of live stock in each province and all Ireland in 1881,

1891, and 1900 :—

Province,

Horses.

Mules.

Asses,

Cattle.

Sheep.

Pigs.

Goats.

Poultry.

(-1881.

Leinster i 1891 .

1. 1900 .

rl881.

Munster i 1891 .

(. 1900 .

f 1881 .

Ulster i 1891 .

(1900 .

fl881.

Connaught J. 1891 .

(1900 .

fl881 .

Ireland \ 1891 .

{ 1900 .

171,348

185,003

175,119

8,509

8,385

8,800

49,504

52,845

57,245

1,012,421

1,120,110

1,177,968

1,125,690

1,577,676

1,494,127

275,373

843,845

297,724

65,724

81,990

65,105

3,409,020

3,660,228

4,218,216

138,529

. 154,201

147,725

9,410

11,297

13,064

54,476

66,114

82,165

1,297,805

1,465,209

1,513,157

760,309

1,127,724

950,208

402,728

435,106

887,009

88,563

106,337

108,035

8,419,029

3,468,805

4,186,826

170,832

182,052

178,398

2,394

2,328

1,869

23,672

26,554

28,816

1,028,486

1,174,374

1,203,459

378,915

677,740

644,555

249,298

383,192

341,498

74,202

92,234

80,326

4,585,779

5,832,246

6,896,032

67,665

71,563

65,736

6,079

6,650

6,945

59,491

70,755

74,021

617,883

688,818

713,966

991,271

1,339,478

1,297,986

168,431

205,569

242,290

37,589

65,776

62,612

2,658,598

2,814,850

3,296,233

548,374

592,819

566,978

26,392

28,660

30,678

187,143

216,268

242,247

3,956,595

4,448,511

4,608,550

3,256,185

4,722,618

4,386,876

1,095,830

1,867,712

1,268,521

266,078

336,837

306,078

13,972,426

15,276,128

18,547,307

In 1900 the number of cattle was 101,093 higher than in the previous year, and formed the highest total ever recorded in the agricultural statistics ; the number of sheep was 66,422 higher than the average of the preceding ten years, though lower than the figures for 1890, 1891, 1892, and 1893. Taking for purposes of comparison three sheep as equal to one head of cattle, the total

increase in the twenty years amounted to 1,028,852 head, or 20-4 per cent., as compared with an increase of only 4-8 per cent, in the extent of pasture. To put the comparison in a different way, in 1881 the average number of acres to one head of cattle was 2-0 ; in 1900 it was 1-7. Although there have been variations in inter-vening years, it will be seen that between 1881 and 1900 the increase in cattle and sheep was shared by all the four provinces. The total value of horses, cattle, sheep, and pigs in 1900 was

[statistics

estimated as £81,159,732. The figures respecting the number of horses used for agricultural purposes, the number of milcli cows, and the number of ewes were thus returned in 1881 and 1900 : —

Leinster.

Munster.

Ulster.

Con-

naught.

Ireland.

Horses used J 1881 .

in agriotulture 1 1900 .

MUohCowB. ^IgSSl.

Ewes . .|1881.

103,702

99,469

227,690

280,966

453,902

602,826

92,846

92,133

582,475

577,578

329,714

396,859

136,898

135,838

423,157

444,803

167,351

284,498

42,483

42,246

188,690

204,727

386,904

614,900

376,879

869,685

1,872,012

1,468,074

1,887,871

1,798,078

It wiU be observed that there is a general decrease in the number of horses used in agriculture. Tor the exports of cattle, &c., to Great Britain, see Shipping and Commerce, below.

Dairy Industries. — In consequence of the growing importance of the dairy industries in Ireland, statistics bearing on the subject have been embodied in the agricultural reports in recent years.

In 1891 the number of factories for which returns were made was 152 (107 in Munster, 35 in Leinster, 6 in Ulster, and 4 in Connaught), 129 of which were worked by steam power, and the number of hands permanently employed amounted to 1213. The quantity of butter produced during the year ending 30th September 1891 was 121,309 owts., and of cheese 1048 cwts., while the number of cans of condensed milk amounted to 8,646,173. In 1900 the number of factories had risen to 506 — 333 in Munster, 52 in Leinster, 92 in Ulster, and 29 in Connaught — and the number of hands permanently employed to 3656 (190 factories belonged to co-operative societies ; see below). There were 985 milk-separators in the factories, of which 889 were worked by steam power. During the year ending 30th September 1900, 401,490 cwts. of butter and 439 cwts. of cheese were produced.

Agricultural Co-operation.— lu 1894 the efiorts of a number of Irishmen, drawn from all political parties, were successfully directed towards the formation of the Irish Agricultural Organization Society, which has for its object the organizing of groups of fanners on co-operative principles, and the provision of instruction in proper technical methods. The society had at first many difficulties

to confront, but after the first two or three years of its existence its progress became more rapid. The chief success of the movement has lain in the direction of co-operative dairy societies. For the year 1900, 171 of these societies made complete returns, from which it appears that they received over 35^ miDious of gallons of milk at an average price to the suppliers of 3Jd. a gallon, from which were produced over 13^ million R) of butter, realizing an average of 10-84d. per lb. Milk payments absorbed £570,075, and working expenses amounted to £74,259 ; the amount realized by sales was £703,826. A net profit of £12,472 was earned on the year's trading. The Organization Society also aims at the establishment of agricultural societies, agricultural banks, and home industries societies. The following is a provincial summary showing the number of the various societies and the membership on 31st December 1900 :—

Description of Society.

Leinster.

Munster.

Ulster.

Connaught.

Total.

Societies.

Members.

Societies.

Members.

Societies.

Members.

Societies.

Members.

Societies.

Members.

Dairy Societies (with auxil-

iaries) ....

Agricultural Societies

Poultry Societies

Banks

Miscellaneous .

Total .

25

26

2

7

11

1,903

2,776

234

310

701

69

17

4

8

3

5,474

1,811

404

251

83

109

9

9

17

15

10,825

545

744

656

467

33

54

6

44

9

8,375

6,829

1,187

2,021

710

236

106

21

76

38

26,577

11,961

2,569

3,138

1,961

71

5,924

101

8,023

159

13,137

146

19,122

477

46,206

Fisheries. — A number of Acts were passed during the last twenty years of the 19th century with a view of promoting the fi-shing

industry in Ireland. In 1882 the Commissioners of Public Works were given further powers under the Irish Reproductive Loan Fund Act, 1874, to lend money to fishermen on the recommendation of the Inspectors of Pisheries. In 1883 the Land Commission were authorized to pay from time to time such sums, not exceeding in all £250,000, as the Commissionfers of Public Works might require, for the creation of a Sea Fisheries Fund, such fund to be expended on the construction of piers and harbours. A sum of about £230,000 has been thus expended up to the present time. In 1889 the Inspectors of Fisheries were empowered to prohibit steam trawling within 3 miles of the Irish coast. Specific Acts were also passed in 1884 for the establishment of oyster fisheries, in 1890 for the promotion of poUan fisheries, and in 1898 for the development of mussel fisheries. In accordance with the terms of the Purchase of Land and Congested Districts (Ireland) Act, 1881, a portion of the Sea Fisheries Fund was reserved for adminis-tration by the Inspectors of Fisheries in non-congested dis-tricts. Of this amount £20,985 was advanced up to 31st Decem-ber 1898, the repayments amounting to £13,240. The powers and duties of the Inspectors of Fisheries have been transferred to

the Department of Agriculture and Other Industries, which is to apply annually the sum of £10,000 to the promotion of sea fisheries.

In 1900 there were 31 deep-sea and coast fishing districts, in which 6500 vessels with 26,073 hands were engaged, as compared with 5646 vessels with 21,940 hands in 1891, and 6458 vessels with 24,528 hands in 1881. The number of salmon-fishing dis-tricts in 1900 was 24, in which 11,366 persons were employed, and the amount of license duty paid was £9522, as compared with 13,112 persons and £10,543 in 1897, and 13,179 persons and £10,448 in 1895. At the end of 1900 the number of licenses in operation for oyster-beds was 62 ; the estimated value of the catch of shell-fish in the same year was £61,426.

Manufactures, cfcc— The linen industry is still practically confined to the north-east portion of Ireland. It cannot be said that the

Tears.

In Working

Factories.

In Closed

Factoi-ies.

Total.

1880

1885

1890

1895

1900

839,191

810,456

815,685

849,410

827,882

43,884

63,454

11,766

l6,‘7O0

883,075

873,910

827,451

849,410

838,582

trade has undergone much alteration since 1881. There have naturally been fiuctuations — some years bad and some good — but, as will be seen from the foregoing table, the number of spindles in factories actively at work in 1900 was very much the same as in 1881. The power-looms in separate factories, however, conside:> ably increased in number : —

Tears.

Attached to

to Mills.

In Separate

Factories.

Total.

1880

1885

1890

1900

10,283

11,103

10,270

8,941

10,894

13,197

16,322

23,304

21,177

24,300

26,592

32,245

The statistics relating to the persons employed were consider-

ably changed in consequence of the Act of 1895, which requires an

annual enumeration. The tables put the flax, hemp, and jute

makers together, and give no separate details. In 1881 the num-

ber of persons employed in the fiax-mills and factories of Ireland

was 61,749, and in 1890, 64,475, while in 1898-99 the number of per-

sons employed in the flax, hemp, and jute trades was returned as

67,957.

From the report of the Chief Inspector of Factories for 1898-99

it appears tliat in that year in Ireland 809 persons were employed

in the cotton industry, 3323 in the wool, woreted, and shoddy in-

dustries, 71 in the silk industry, and 602 in the manufacture of

hosiery. The total number of textile factories or departments was 553, employing 72,762 persons. The number of persons employed in non-textile factories was 116,317.

Next to linen, the production of alcoholic drinks, in the forms of whisky, porter, ale, and beer, is the most important manufacturing industry in Ireland. Porter, ale, and beer are classed under the general title of "beer" by the Inland Revenue Department. Though the number of distilleries remained practically the same between 1880 and 1900—28 in the former year and 29 in the latter — the production of whisky largely increased, risinc; from 9,721,000 gallons in 1800 to 14,480,871 gallons in 1900. This large increase, however, does not imply a corresponding increase of the amount consumed by the inhabitants of Ireland, since the quantity consumed as a beverage in Ireland fell from 5,184,963 gallons in 1881 to 4,713,178 gallons in 1900. The increase in the production of whisky between 1880 and 1900 was accompanied by an increase in the production of beer (including ale and porter). In 1880 2,066,000 barrels of beer were brewed, while in 1900 the number of barrels charged with duty was 8,041,009. The net annual amount of excise duties received in Ireland in a series of years is

shown in the following table :—

statistics]

I K E L A N D

559

Articles.

1896.

189T.

1S08.

1899.

1900.

Beeri ....

Licences

Spirits 1 ....

Other Articles

Total

£

874,249

198,752

4,098,696

479

£

87f,815

200,954

4,156,941

467

£

919,859

203,696

4,212,226

441

£

939,786

207,821

4.252,818

419

£

988,841

209,577

4,952,061

467

5,172,076

6,232,177

5,835,622

5,400,344

6,145,966

The following table gives the number and tonnage o£ the vessels built in Ireland (exclusive of those for foreign firms) in various years since 1881. Since that year shipbuilding in Ireland has largely increased.

Tear.

SaUing.

Steam.

No.

Net Tonnage.

No.

Net Tonnage.

1881

1886

1891

1896

1898

1899

1900

2

11

17

4

13

12

8

199

■ *8,929*

22,331

2,528

239

669

361

12

10

20

12

17

16

21

13,694

9,863

49,312

40,033

68,284

78,273

94,666

This increase, however, has not been due to any wide extension of the industry, but solely to the growth of two Belfast firms. In the five years 1895-99, 97 vessels of 579,467 gross tonnage were launched at Belfast, including the Oceanic passenger steamer — the largest vessel then afloat.

Commerce. — The export of animals to Great Britain is the most important department of Irish trade. The following table, giving the number of cattle, sheep, and swine exported in various years between 1881 and 1900, shows how much the trade has grown in

that time : —

Years,

Cattle.

Sheep.

Swine.

Total.

1881

571,557

577,627

382,995

1,532,179

1886

717,389

734,213

421,285

1,872,887

1891

630,802

893,175

505,584

2,029,561

1896

681,560

737,306

610,589

2,029,455

1900

745,519

862,263

715,202

2,322,984

In 1891 the number of horses exported to Great Britain was

33,396 ; in 1900, 35,606.

The quantity and value at fixed prices of the fish exported

annually to the principal English markets from 1895 to 1899 were

thus returned : —

Tears.

Salmon,

Herrings.

Mackerel.

Cod,

Total Value

Exported.

Boxes

150 lb each.

Value

Is. 3d, alb.

Boxes

2 cwt. each.

Value

£2 a Box,

Boxes

2 cwt. each.

Value

21s, a Box.

Boxes

2 cwt, each.

Value

£3 a Box.

1895

1896

1897

1898

1899

61,315

61,343

55,685

52,317

54,676

£

574,828

575,091

522,047

490,473

512,587

69,638

72,880

74,085

67,901

69,259

£

139,276

145,760

148,170

135,802

138,518

88,585

91,026

95,495

85,714

90,446

£

93,014

95,577

100,270

90,000

94,908

42,555

43,152

44,041

40,438

40,209

£

127,665

129,456

132,123

121,314

120,627

£

9.34,783

945,884

902,&10

837,589

866,700

The average annual export of linen yams from Belfast, which is the headquarters of the industry, and provides employment for some 40,000 workers, during the ten years ending 1900, was 19,750,304 lb, with a value exceeding £1,000,000. Other statistics can be given only for the United Kingdom, and the following table shows the amount and value in various years of imports of ilax

and tow thereinto, and exports of linenr yams and manufactures therefrom, between 1889 and 1900: —

Tears.

Imports of Flax and Tow.

Exports of Linen Tarns and Manufactures.

Total Value of Exports

£,

Tons.

Value £.

Tarns lb.

Value £.

Piece Goods yds.

Value £.

Thread

lb.

Value

£,

Unenumerated,

Value

£,

1889

1892

■ *1895*

1900

89,*153*

86,*655*

102,*622*

71,*586*

3,*066*,*328*

2,*743*,*305*

3,*270*,*840*

2,*509*,*810*

13,*944*,*700*

15,*460*,*600*

17,045,600

16,347,100

849,263

890,142

965,926

934,201

180,630,200

171,302,500

203,587,600

154,708,200

4,309,980

3,882,650

4,080,261

3,851,615

2,800,200

2,548,400

2,401,500

1,838,100

365,080

309,613

263,947

237,154

1,102,405

973,639

1,006,817

1,135,825

6,626,728

6,056,044

6,316,951

6,158,795

The following returns "show the total annual value of imports from foreign countries and British possessions, and exports to foreign countries and British possessions, for a series of years between 1886 and 1900 :—

Tear.

Total Imports.

Exports, 1

Declared Value,

British and Irish

Produce and

Manufactures.

Computed Eeal

Value, Foreign

and Colonial

Merchandise.

Total

Value.

1886

1891

1896

1900

£

6,802,638

9,868,973

9,366,485

12,014,597

£

815,996

253,799

235,276

344,328

£

9,183

8,469

80,966

967,720

£

825,179

262,268

316,242

1,312,048

It will be seen that the imports increased by over £5,000,000, and that the exports, as the result of the creation of a flourishing trade in foreign and colonial merchandise, also increased, although there was a fall of about 60 per cent, in the value of the exports of British and Irish goods.

Shipping. — The number of steam vessels registered at Irish ports considerably increased between the years 1881 and 1900. The returns at intervals of five years from 1881 are given in the following table : —

1 After deducting portion of beer duty (3d. per barrel) and additional duty on spirits (6d. per gallon), surrendered to local taxation. In 1899-1900 the amount of beer duty so surrendered was £41,150, and of spirit duty £87,101.

Tear,

Under 50 Tons.

Above 50 Tons. 1

No,

Ton.

No.

Ton.

1881

1886

1891

1896

1900

78

73

65

73

90

1770

1555

1414

1575

1927

175

196

218

249

267

59,062

82,101

122,121

150,278

192,548

The following tables give for a series of years (1) the number and tonnage of vessels that entered and cleared with cargoes in the coasting trade ; (2) the same for those engaged in the foreign trade ; and (3) the totals for both trades. Eepeated voyages are

included.

Coasting Trade.

Tear.

Entered.

Cleared.

Sailing.

Steam,

Sailing.

Steam.

No,

Ton,

So.

Ton,

No.

Ton.

No.

Ton,

1886

1891

1896

1900

10,884

8,568

6,891

4,708

991,182

740,511

482,176

344,587

16,399

18,835

22,171

22,768

4,202,214

4,765,994

6,199,860

6,129,571

4432

4666

8686

3348

378,693

645,057

249,798

245,057

13,203

18,054

14,680

15,423

3,512,697

8,795,488

4,098,028

4,156,004

Foreign Trade.

Tear.

Entered.

Cleared.

British.

Foreign.

British.

Foreign,

No.

Ton.

No,

Ton.

No.

Ton.

No.

Ton.

1886

1891

1896

1900

769

818

829

780

550,*408*

617,*866*

751,*496*

856,407

881

346

357

256

192,462

189,392

208,066

178,383

118

91

143

135

42,594

38,980

54,088

69,800

28

12

8

5

12,201

7,018

5,015

6,3S9

560

I E E L A N D

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Coasting and Foreign Trade.

Tear.

Entered.

Cleared.

British.

Foreign.

Britisli.

Foreign.

No.

Ton.

No.

Tod.

No.

Ton.

No.

Ton.

1886

1891

1896

1900

27,482

28,189

29,376

28,232

6,787,428

6,117,819

6,429,474

6,825,173

401

873

872

275

198,788

195,444

212,129

178,775-

16,717

17,791

18,490

18,887

3,921,522

4,176,761

4,896,856

4,467,484

64

82

27

19

24,668

9,777

10,668

8,316

The number and tonnage of vessels engaged in trade between Great Britain and Ireland were thus returned in various years between 1881 and 1900 :—

Tear.

Entered and Cleared.

British.

Foreign.

No.

Ton.

No.

Ton.

1881

1886

1891

1896

1900

82,816

79,061

81,959

83,481

81,235

18,114,334

17,484,389

18,808,017

19,370,658

18,430,729

78

90

87

55

55

23,624

34,614

15,923

15,706

12,762

Bailways. — The total amount of capital and loans authorized by Parliament for all classes of railways up to 31st December 1900 was £45,293,090. The paid-up capital (including that raised by loans and debentures) in 1890 was £36,269,000; and in 1900, £39,765,573.

Some eighteen short lines, with a total mileage in 1898 of 229 miles, have been authorized at different times under the Tramways (Ire-land) Acts, 1860 to 1883. In 1889 an Act was passed to facilitate the construction of light railways In Ireland, and further enacts ments were made with the same object in 1890 and 1896. Under these Acts fourteen lines, with a mileage of nearly 300 miles, had been constructed up to 1898, principally in the more backward districts of the west, from Donegal to Kerry. The total length of lines open, the passenger traf&c, and the total receipts are severally shown below at intervals of five years from 1881: —

Years.

Length

of Lines

open.

Passengers

(exclusive of Beason-Ticltet Holders).

Receipts.

1st Class.

2nd Class.

8rd Class.

Total.

Passenger

Traffic.

Goods

Traffic.

Total.

1881

1886

1891

1896

1900

2441

2632

2863

3178

3183

1,675,876

1,384,682

1,512,544

1,628,977

1,496,145

4,021,240

4,034,745

4,196,426

4,384,517

3,927,553

11,946,144

13,300,868

16,493,288

20,551,776

22,226,117

17,643,260

18,720,295

22,202,258

26,565,270

27,649,815

£

1,425,284

1,482,538

1,696,082

1,858,653

2,034,717

£

1,176,193

1,270,145

1,463,125

1,555,067

1,698,909

£

2,601,477

2,752,688

3,159,207

3,413,720

3,733,626

Reference has been made throughout to various official and semi-official publications such as the Census Beports (1881, 1891, and 1901), Agricultural Beturns, Beports of the Begistrar-Oeneral, Beports of the Congested Districts Board, Beports of the Irish Agricultural Organization Society, Board of Trade Beturns, Annual Beports of the Flax Supply Association and of other local bodies.

1aow.“s Official Almanac contains a useful summary of official statistics. For further information upon the economic and industrial condition of Ireland reference may be made to the following : — Gkimshaw (late Registrar-General), Facts and Figures about Ireland, London, 1893 ; Dennis, Industrial Ireland, London, 1887 ; The Beport of the Beeess Committee of 1896. The latter was published in Dublin, and is now very difficult to procure. See also Beport of the Financial Belations Commission, 1897.

(w. H. Po.)

History since 1879.

During the last twenty years of the 19th century Irish history was chiefly concerned with the two questions of the land and legislative independence. Isaac Butt {q.v.) died in May 1879. He had led a parliamentary party of fifty-four, but the Conservatives had been strong enough to outvote them and the Liberals together. His procedure was essentially lawyer-like, for he respected the House of Commons and dreaded revolutionary violence. His death left the field clear for younger and bolder men. W. Shaw succeeded him as chairman of the Irish party in

Parliament ; but after the election of 1880, Parnell {q.v.), who had the Land League at his back, ousted him by 23 votes to 18.

The -Land Law of 1860, knovm as Deasy's Act, was based on the principle that every tenancy rested on contract either express or implied. The Act of 1870, admitting the divergence between theory and practice, protected the tenants' improvements and provided compensation for disturbance within certain limits, but not where the ejectment was for non-payment of rent. In good times this worked well enough, but foreign competition began to tell, and 1879 was the worst of several bad seasons. A succession of wet summers told against all farmers, and in mountainous districts it was difficult to dry the turf on which the people depended for iael. A famine was feared, and in the west there was much real distress. The Land League, of which Michael Davitt was the founder, originated in Mayo in August, and at a meeting in Dublin in October the organiza- ^^ J^/ tion was extended to all Ireland, with Parnell

as president. The country was thickly covered vritli branches before the end of the year, and in December Parnell went to America to collect money. He was absent just three months, visiting over sixty cities and towns ; and 200,000 dollars were subscribed. PameU had to conciliate the Clan-narGael and the Fenians generally, both in Ireland and America, while abstaining from action which would make his parlia^ mentary position untenable. He did not deny that he would like an armed rebellion, but acknowledged that it was an impossibility. Speaking at Cincinnati on 23rd February 1880, he declared that the first thing necessary was to undermine English power by destroy-ing the Irish landlords. Ireland might thus become independent. " And let us not forget," he added, "that that is the ultimate goal at which all we Irishmen aim. Kone of us, whether we be in Am-erica or in Ireland, or wherever we may be, will be satisfied until we have destroyed the last link which

keeps Ireland bound to England."

At Galway in October of the same

year he said that he "would not

have taken off his coat" to help the

tenant farmers had he not known

that that was the way to legisla-

tive independence. Eenianism and agrarianism, essen-

tially different as they are, might be worked to the

same end.

To meet the partial failure of the potatoes in Connaught

and Donegal, very large sums were subscribed and ad-

ministered by two committees, one under the duchess of

Marlborough and the other under the lord mayor of

Dublin. When Lord Beaconsfield appealed to the country

in March 1880, he reminded the country in a letter to the

Viceroy, the duke of Marlborough, that there was a party

in Ireland "attempting to sever the constitutional tie

which unites it to Great Britain in that bond which has

favoured the power and prosperity of both," and that such

an agitation might in the end be "scarcely less disastrous

than pestilence and famine." But the general election did not turn mainly upon Ireland, and the result gave Gladstone a majority of 50 over Conservatives and Home Eulers combined. Lord Cowper became lord-lieutenant, with W. E. Forster as chief secretary, and Parnell remained chairman of his own party in Parliament. The Compensation for Disturbance Bill, even where the ejectment was for non-payment of rent, passed the House of Commons, but the Lords threw it out, and this has often been represented as the great cause of future trouble. Probably it made little re^l difference, for the extreme party in Ireland were resolved to stop at nothing. It is not easy to defend the principle that a landlord who has already lost his rent should also have to pay the defaulter history]

Boy-

cotting.

before getting a new tenant or deriving a profit from the

farm by working it himself. Speaking at Ennis on 19th September, Parnell told the people to punish a man for taking a farm from which another had been evicted " by isolating him from his kind as if he was a leper of old." 'The advice was at once taken and its scope largely extended. For refusing to receive rents at figures fixed by the tenants, Captain Boycott, Lord Erne's agent in Mayo, was severely "boy-cotted," the name of the first victim being given to the new system. His servants were forced to leave him, his crops WBre left unsaved, even the post and telegraph were interfered with. The Ulster Orangemen resolved to get in the crops, and to go in armed force sufficient for the purpose. The Government had to let 50 of them go under the protection of about 900 soldiers. The cost seemed great, but the work was done and the law vindi-cated. In Cork Mr Bence-Jones was attacked. The men in the service of the steam-packet companies refused to put his cattle on board, and they were eventually smuggled across the Channel in small lots. Several associations

were formed which had more or less success against the League, and at last a direct attack was made. Parnell with four other members of Parliament and the chief officers of the Land League were indicted for conspir-acy in the Queen's Bench. No means of intimidating the jurors was neglected, and in the then state of public feeling a verdict was hardly to be expected. On 25th January 1881 the jury disagreed, and Parnell became stronger than ever.

Then followed a reign of terror which lasted for years. No one was safe, and private spite worked freely in the name of freedom. The system originated by Parnell's Ennis speech became an all-devouring tyranny. In the House of Commons, on 24th May 1882, Gladstone said that boycotting required a sanction like every other creed, and that the sanction which alone made it effective " is the murder which is not to be denounced." The following description by a resident in Munster was published in Tlie Times of 5th November 1885 : — " Boycotting means that a peaceable subject of the Queen is denied food and drink,

and that he is ruined in his business ; that his cattle are unsaleable at fairs ; that the smith will not shoe his horse, nor the carpenter mend his cart ; that old friends pass him by on the other side, making the sign of the Cross ; that his children are hooted at the village school ; that he sits apart like an outcast in his usual place of public worship : all for doing nothing but what the law says he has a perfect right to do. I know of a man who is afraid to visit his own son. A trader who is even suspected of dealing with such a victim of tyranny may be ruined by the mere imputation ; his customers shun him from fear, and he is obliged to get a character from some notorious leaguer. Membership of the National League is, in many cases, as necessary a protection as ever was a certificate of civism under Robespierre. The real Jacobins are few, but the masses groan and submit." Medicine was refused by a shopkeeper even for the sick child of a boycotted person. A clergyman was threatened for visiting a parishioner who was under the ban of the League. Sometimes no one could be found to dig a grave. The League

interfered in every relation of life, and the mere fact of not belonging to it was often severely punished. " The people," says the report of the Cowper Commission, " are more afraid of boycotting, which depends for its success on the probability of outrage, than they are of the judgments of the courts of justice. This unwritten law in some districts is supreme."

The session of 1881 was chiefly occupied with Ireland. " With fatal and painful precision," Gladstone told the House of Commons on 28th January, " the steps of crime dogged the steps of the Land League," and the first thing was to restore the supremacy of the law. In 1871 there had been an agrarian war in West- "‘—’ ‘”’■ meath, and an Act had been passed authorizing the arrest of suspected persons and their detention without trial. The ringleaders disappeared and the county became quiet again. It was now proposed to do the same thing for the whole of Ireland, the power of detention to continue until 30th September 1882. Parnell cared nothing for the dignity of the House of Commons. His leading

idea was that no concession could be got from England by fair means, and he made himself as disagreeable as possible. Parliamentary forms were used with great success to obstruct parliamentary action. The " Coercion Bill" was introduced on 24th January. There was a sitting of 22 hours and another of 41 hours, and on 2nd February the debate was closured by the Speaker on his own responsibility and the Bill read a first time. The Speaker's action was approved by the House generally, but acrimonious debates were raised by Irish members. Parnell and 35 of his colleagues were suspended, and the Bill became law on 2nd March, but not before great and permanent changes were made in parliamentary procedure. An Arms Bill, which excited the same sort of opposition, was also passed into law.

That a Land Act should be passed was a foregone conclusion as soon as the result of the general election was known. There were many drafts and plans which never saw the light, but it was at last fggf'-' resolved to adopt the policy known as the

” Three F’s ” — free sale, fixity of tenure, and fair rents. By the first tenants at will were empowered to sell their occupation interests, the landlord retaining a right of pre-emption. By the second the tenant was secured from eviction except for non-payment of rent. By the third the tenant was given the right to have a “fair rent ” fixed by a newly formed Land Commission Court, the element of competition being entirely excluded. There were several exceptions and qualifying clauses, but most of them have been swept away hy later Acts. The Act of 1881 can scarcely be said to have worked well or smoothly, but it is not easy to see how any sort of settlement could have been reached without accepting the principle of having the rent fixed by a third party. Drastic as the Bill was, Parnell refused to be a party to it, and on the second reading, which was carried by 362 to 176, he walked out of the House with 35 of his followers. When the Bill became law in August he could not prevent the tenants from using it, but he did what he could to discourage them in order

to please his American paymasters, who repudiated all parliamentary remedies. In September a convention was held in Dublin, and Parnell reported its action to the American Land League : — " Eesolutions were adopted for national self-government, the unconditional liberation of the land for the people, tenants not to use the rent-fixing clauses of the Land Act, but follow old Land League lines, and rely on the old methods to reach justice. The executive of the League is empowered to select test cases, in order that tenants in surrounding districts may realize, by the results of cases decided, the hoUowness of the Act " (Barry O'Brien, Life of G. S. Parnell, i. 306). His organ United Ireland declared that the new courts must be cowed into giving satisfactory decisions. The League, however, could not prevent the farmers from using the fair-rent clauses. It was more successful in preventing free sale, maintaining the doctrine that, rent or no rent, no evictions were to be allowed. At the first sitting of the Land Commission in Dublin the crier, perhaps by accident, declared "the court of

the Land League to be open." Speaking at Leeds on

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7th October, Gladstone said "the resources of civiliza-

tion were not exhausted," adding that Parnell "stood

between the living and the dead, not like Aaron to stay

the plague, but to spread the plague." Two days later

Parnell called the prime minister a "masquerading

knight-errant," ready to oppress the unarmed, but sub-

missive to the Boers as soon as he found " that they

were able to shoot straighter than his own soldiers."

Four days after this Parnell was arrested under the

Coercion Act and lodged in Kilmainham gaol.

Kiimain- The Land League having retorted by ordering

*'•treaty." *^® tenants to pay no rent, it was declared*

illegal, and suppressed by proclamation. Parnell

is said to have disapproved of the no-rent manifesto, as

also Mr Dillon, who was in Kilmainham with him, but

both of them signed it {ib. i. 319). At Liverpool on 27th October Gladstone described Parnell and his party as ” marching through rapine to the disintegration and dis-memberment of the empire.” In 1881, 4439 agrarian outrages were reported ; nothing attracted more attention in England than the cruel mutilations of cattle, which became very frequent. The Ladies’ Land League tried to carry on the work of the suppressed organization, and there was even an attempt at a Children’s League. Sex had no effect in softening the prevalent style of oratory, but the Government thought it better to take no notice. The imprisonment of suspects under the Coercion Act had not the expected result, and outrages were incessant, the agitation being supported by constant supplies of money from America. Gladstone resolved on a complete change of policy. It was decided to check evictions by an Arrears Bill, and the three imprisoned members of Parliament — Messrs Parnell, Dillon, and O’Kelly — were released on 2nd May 1882, against the wishes of the Irish Government. This was known

as the Kilmainham Treaty. Lord Cowper and Forster at once resigned, and were succeeded by Lord Spencer and Lord Frederick Cavendish, who entered Dublin on 6th May.

That same evening Lord Frederick and the permanent under-secretary Thomas H. Burke were murdered in the Phoenix Park in broad daylight, under the new Pbwuix lord-lieutenant's windows. The weapons were amputating knives imported for the purpose.

The assassins drove rapidly away ; no one, not even those who saw the deed from a distance, knew what had been done. A Dublin tradesman named Field, who had been a juror in a murder trial, was attacked by the same gang and stabbed in many places. He escaped with life, though with shattered health, and it was the identi-hcation of the man who drove his assailants' car that afterwards led to the discovery of the whole conspiracy.

The clue was obtained by a private examination of suspected persons under the powers given by the Crimes Act. To obtain convictions the evidence of an informer

was wanted, and the person selected was James Carey, a member of the Dublin Corporation and a chief contriver of the murders. He swore that they had been ordered immediately after the appearance of an article in the Freeman's Journal which declared that a " clean sweep " should be made of Dublin Castle officials. The evidence disclosed the fact that several abortive attempts had been previously made to murder Forster. Out of twenty persons subsequently arrainged, five were hanged, and others sentenced to long terms of imprisonment. Carey embarked for South Africa in the following July, and was murdered on board ship by Patrick O'Donnell, who was brought to England, convicted, and hanged on 17th December 1883.

Mr G. 0. Trevelyan had been appointed chief secretary in May 1882, and in July the Crimes Prevention Act was

Park

murders.

passed for three years on lines indicated by Lord Cowper. In the first six months of the year 2597 agrarian outrages

were reported, and in the last six months 836. They fell to 834 in 1883, and to 744 in 1884. The Arrears Bill also became law. Money enough was advanced out of the surplus property of the Irish Church to pay for tenants of holdings under £30 one year's rent upon all arrears accruing before November 1880, giving them a clear receipt to that date on condition of their paying another year themselves ; of the many reasons against the measure the most important was that it was a concession to agrarian violence. But the same could be and was said of the Land Act of 1881. That had been passed, and it was probably impossible to make it work at all smoothly without checking evictions by dealing with old arrears. The Irish National League was, however, founded in October to take up the work of the defunct ^^^^ Land League, and the country continued to be disturbed. The law was paralysed, for no jury could be trusted to convict even on the clearest evidence, and the National League branches assumed judicial functions. Men were openly tried all over the country for disobeying

the revolutionary decrees, and private spite was often the cause of their being accused. " Tenants," to quote the Cowper Commission again, "who have paid even the judicial rents have been summoned to appear before self-constituted tribunals, aud if they failed to do so, or on appearing failed to satisfy those tribunals, have been fined or boycotted." In February 1883 Mr Trevelyan gave an account of his stewardship at Hawick, and said that all law-abiding Irishmen, whether Conservative or Liberal, were on one side, while on the other were those who " planned and executed the Galway and Dublin murders, the boycotting and firing into houses, the mutilation of cattle, and intimidation of every sort." In this year the campaign of outrage in Ireland was reinforced by one of dynamite in Great Britain. The home secretary, Sir W. Harcourt, brought in an Explosives BiU "J-™""- on 9th April, which was passed through all its stages in one day and received the royal assent on the next. The dynamiters were for the most part Irish-Americans, who for obvious reasons generally spared Ireland, but one*

land-agent's house in Kerry was shaken to its foundations in November 1884. At Belfast in the preceding June Lord Spencer, who afterwards became a Home Ruler, had announced that the secret conspirators would " not terrify the English nation." On 22nd February 1883 Forster made his great attack on Parnell in the House of Commons, accusing him of moral complicity with Irish crime. A detailed answer was never attempted, and public attention was soon drawn to the trial of the " Invincibles " who contrived the Phoenix Park murders. On the 11th of December Parnell received a present of £37,000 from his followers in Ireland. The tribute, as it was called, was raised in spite of a papal prohibition. As acom plement to the Land Act and Arrears Act, boards of guardians were this year empowered to build labourers' ^^"™" cottages with money borrowed on the security of the rates and repayable out of them. Half an acre of land went with the cottage, and by a later Act this was unwisely extended to one acre. That the labourers had been badly housed was evident, and there was little

chance of improvement by private capitalists, for cottage property is not remunerative. But the working of the Labourers Acts has been very costly, and cottages are often assigned to people who are not agricultural labourers at all. In many districts the building has been quite overdone, and the rent obtainable being far less than enough to recoup the guardians, the system operates as out-door relief for the able-bodied and as a rate in aid of wages.

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IRELAND

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Act

The Explosives Act, strong as it was, did not at once effect its object. In February 1884 there was a plot to blow up four London railway stations by means of clock-work infernal machines containing dynamite, brought from America. Three Irish-Americans were convicted, of whom one, John Daly, who was sentenced to penal

servitude for life, lived to be mayor of Limerick in 1899. In January 1885 Parnell visited Thurles, where he gave a remarkable proof of his power by breaking down local opposition to his candidate for Tipperary. In April the prince and princess of Wales visited Ireland. At Dublin they were well received, and at Belfast enthusiastically, but there were hostile demonstrations at Mallow and Cork. In May it was intended to renew the Crimes Prevention Act, but before that was done the Government was beaten on a financial question by 264 to 252, Parnell and 39 of his followers voting with the Conservatives. The Crimes Prevention Act expired on the 12th July, and the want of it was at once felt. The number of agrarian outrages reported in the first six months of the year was 373 ; in the last six months they rose to 543, and the number of persons boycotted was almost trebled. Lord Salisbury came into oflS.ce, with Lord Carnarvon as lord-lieutenant and Sir W. Hart Dyke as chief secretary. The lord-lieutenant had an interview with Parnell, of which very conflicting accounts were given, but the

Irish leader issued a manifesto advising his friends to vote against the Liberals as oppressors and coercionists, who promised everythiug and did nothing. The constitutional Liberal party in Ireland was in fact annihilated by the extension of the franchise to agricultural labourers and very small farmers. The most important Irish measure of the session was the Ashbourne Act, by which £5,000,000 was allotted on the security of the land for the creation of an occupying proprietary. Later the same sum was again granted, and there was still a good deal unexpended when the larger measure of 1891 became law. In December, when the general election was over, an anonymous scheme of home rule appeared in some newspapers, and in spite of disclaimers it was at once believed that Gla.dstone had made up his mind to surrender. In October 1884, only fourteen months before, he had told political friends that he had a sneaking regard for Parnell, and that home rule might be a matter for serious consideration within ten years (Sir A. West's Recollections, 1899, ii. 206). The

shortening of the time was perhaps accounted for by the fact that the new House of Commons consisted or 331 Liberals, 249 Conservatives, 86 Home Eulers and Independents, Parnell thus holding the balance of parties. In Ireland there had been 66 elections contested, and out of 451,000 voters 93,000 were illiterates (Parliamentary Eeturn, 6th May 1886). Such were the constituencies to whom it was proposed to hand Ireland over. On 26th January 1886 the Government were defeated by a combination of Liberals and Nationalists on an issue not directly connected with Ireland, and their resignation immediately followed. Gladstone became prime Home minister, with Lord Aberdeen as lord-lieutenant and Mr John Morley as chief secretary. Lord Hartington and Mr Goschen were not included in this administration. In February Parnell again showed his power by forcing Captain O'Shea upon the unwilling electors of Gal way. He introduced a Land Bill to relieve tenants from legal process if they paid half their rent, and foretold disorder in consequence of its rejection. In April

the Government of Ireland Bill was brought in, Mr Chamberlain, Mr Trevelyan, and others leaving the ministry. The Bill attempted to safeguard British interests, while leaving Ireland at the mercy of the native politicians. Irish members were Excluded from the Imperial Rale BUI,

1886.

Parliament. The local legislature was to consist of two orders sitting and voting together, but with the power of separating on the demand of either order present. The 28 representative peers, with 75 other members having an income of £200, or a capital of £4000, elected for ten years by £25 occupiers, were to constitute the first order. The second was to have 204 members, returned for five years by the usual parliamentary electorate. The status of the lord-lieutenant was unalterable by this legislature. Holders of judicial oflftces and permanent civil servants had the option of retiring with pensions, but the constabulary, whom the Home Eulers had openly threatened to punish when their time came,

were to come after an interval under the power of the Irish Parliament. Parnell accepted the Bill, but without enthusiasm.

The Government of Ireland Bill gave no protection to landowners, but as the crisis was mainly agrarian, it would have been hardly decent to make no show of considering them. A Land Purchase Bill was accordingly introduced on 16th April by the prime minister under "an obligation of honoifr and policy," to use his own words. Fifty millions sterling in three years was proposed as payment for what had been oflB.cially undervalued at 113 millions. It was assumed that there would be a rush to sell, the choice apparently lying between that and confiscation, and priority was to be decided by lot. The Irish landlords, however, showed no disposition to sell their country, and the Purchase Bill was quickly dropped, though Gladstone had declared the two measures to be inseparable. He reminded the landlords that the " sands were running in the hour-glass," but this threat had no effect. The Unionists of Ireland had been taken by surprise, and out

of Ulster they had no organization capable of opposing the National League and the Government combined. Individuals went to England and spoke wherever they could get a hearing, but it was uphill work. In Ulster the Orange lodges were always available, and the large Protestant population made itself felt. The police were looked upon as the emissaries of a ministry who had abandoned Ireland to the rebels. Terrible riots took place at Belfast in June, July, and August. In October there was an inquiry by a royal commission with Mr Justice Day at its head, and on the report being published in the following January there were fresh riots. Foolish and criminal as these disturbances were, they served to remind the English people that Ireland would not cease to be troublesome under Home Eule. In Parliament the Home Eule Bill soon got into rough water ; John Bright declared against it. The " dissentient Liberals," as Glad-stone always called them, were not converted by the abandonment of the Purchase Bill, and on 7th June 93 of them voted against the second reading, which was lost

by 30 votes. A general election followed in July, and 74 Liberal Unionists were returned, forming with the Conservatives a Unionist party, which outnumbered Gladstonians and Parnellites together by over a hundred. Gladstone resigned, and Lord Salisbury became prime minister, with Lord Londonderry as lord-lieutenant and Sir M. Hicks-Beach as chief secretary.

The political stroke having failed, agrarianism again occupied the ground. The "plan of campaign" was started, against Parnell's wishes, towards the end of 1886. The gist of this movement was ™e "ptan that tenants should offer what they were pleased "Jalgn." to consider a fair rent, and if it was refused, should pay the money into the hands of a committee. In March 1887 Sir M. Hicks-Beach resigned on account of illness, and Mr Arthur Balfour became chief secretary.

The attempt to govern Ireland under what was called "the ordinary law" was necessarily abandoned, and a

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perpetual Crimes Act was passed which enabled the lord-lieutenant to proclaim disturbed districts and dangerous associations, and substituted trial by magistrates for trial by jury in the case of certain acts of violence. In August the National League was suppressed by proclamation. The conservative instincts of the Vatican were alarmed by the lawless state of Ireland, and an eminent ecclesiastic, Monsignor Persico, arrived in the late summer on a special commission of inquiry. He made no secret of his belief that the establishment of an occupying proprietary was the only lasting cure, but the attitude of the clergy became gradually more moderate. The Government passed a bill giving leaseholders the benefit of the Acts of 1881, and prescribing a temporary reduction upon judicial rents already fixed. This last provision was open to many great and obvious objections, but was more or less justified by the fall in prices which had taken place since 1881.

The steady administration of the Crimes Act by Mr

Balfour gradually quieted the country. Parnell had now gained the bulk of the Liberal party, including Lord Spencer (in spite of all that he had said and done) and Sir G. Trevelyan (in spite of his Hawick speech). In the circumstances the best chance for Home Eule was not to stir the land question. Mr Cecil Rhodes, who hoped to help imperial federation by breaking up the United Kingdom, gave Parnell £10,000 for the cause. In September 1887 a riot arising out of the " plan of campaign " took place at Mitchelstown. The police fired, and two lives were lost, Messrs Labouchere, M.P., and Brunner, M.P., being present at the time. The coroner's jury brought in a verdict against the police, but that was a matter of course, and the Government ignored it. A telegram sent by Gladstone a little later, ending with the words " remember Mitchelstown," created a good deal of feeling, but it did the Home Eulers no good. In October Mr Chamberlain visited Ulster, where he was received with enthusiasm, and delivered several stirring Unionist speeches. In November Lord Hartington and Mr

Goschen were in Dublin, and addressed a great loyalist meeting there.

In Jvlj 1888 an Act was passed appointing a commission, consisting of Lord Justice Hannen, Mr Justice Day, and Mr Justice A. L. Smith, to inquire Parnell jnto certain charges made by Tlie Times against Parnell and his party. What caused most excitement was the publication by The Times on 16th May 1887 of a facsimile letter purporting to have been written by Parnell on 15th May 1882, nine days after the Phoenix Park murders. The writer of this letter suggested that his open condemnation of the murders had been a matter of expediency, and that Mr Burke deserved his fate. Parnell at once declared that this was a forgery, but he did nothing more at the time. Other alleged incriminating letters followed. The case of O'Donnell v. Walter, tried before the Lord Chief Justice of England in July 1888, brought matters to a head, and the special commission followed. The proceedings were necessarily of enormous length, and the commis-

sioners did not report until 13th Pebruary 1890, but the question of the letters was decided just twelve months earlier, Eichard Pigott, who shot himself at Madrid, having confessed to the forgeries. A fevr days later, on 8th March 1889, Parnell was entertained at dinner by the Eighty Club, Lords Spencer and Eosebery being present ; and he was well received on English platforms when he chose to appear. Yet the special commission shed a flood of light on the agrarian and Nationalist movement in Ireland. Eight members of Parliament were pronounced by name to have conspired for the total political separa-tion of the two islands. The whole party were proved Commis'

sion.

to have disseminated newspapers tending to incite to sedition and the commission of crime, to have abstained from denouncing the system of intimidation, and to have compensated persons injured in committing crime. The conduct of the agrarian war had in the meantime almost passed from Parnell's hands. The "plan of

campaign " was not his work, still less its latest and most remarkable exploit. To punish Mr -//pperary. Smith-Barry for his exertions in favour of a brother landlord, his tenants in Tipperary were ordered to give up their holdings. A sum of £50,000 was collected to build "New Tipperary," and the fine shops and flourishing concerns in the town were deserted to avoid paying small ground-rents. The same course was pursued with the farmers, some of whom had large capitals invested. Mr William O'Brien presided at the inaugural dinner on 12th April, and some English M.P.'s were present, but his chief supporter throughout was Father Humphreys. Parnell was invited, but neither came nor answered. No shopkeeper nor farmer had any quarrel with his landlord. " Heretofore," a tenant wrote in The Times in the following December, " people were boycotted for taking farms, I am boycotted for not giving up mine, which I have held for twenty-five years. A neighbour of mine, an Englishman, is undergoing the same treatment, and we alone. We are the only Protestant

tenants on the Cashel estate. The remainder of the tenants, about thirty, are clearing everything off their land, and say they will allow themselves to be evicted." In the end the attack on Mr Smith-Barry completely failed, and he took back his misguided tenants. But the town of Tipperary has not recovered its old prosperity. The principal Irish measure passed in 1891 was Mr Balfour's Purchase Bill, to extend and modify the opera^ tion of the Ashbourne Acts. Thirty millions were provided to convert tenants into proprie- panbase. tors, the instalments paid being again available, so that all the tenanted land in Ireland might ultimately be passed through if desired. The land itself in one shape or another forms the security, and guaranteed stock is issued which the holder may exchange for consols. The 40th clause of the Land Act of 1896 greatly stimulated the creation of occupying owners in the case of over-incumbered estates, but solvent land- lords are not in a hurry to sell. The interests of the tenant are so carefully guarded that the prices obtain-

able are ruinous to the vendor unless he has other re-
sources. The security of the Treasury is also so jealously
scrutinized, that even the price which the tenant may
be willing to pay is often disallowed. Thus the Land
Commission really fixes the price of all property, and
the last vestige of free contract is obliterated. Com-
pulsory purchase has become a popular cry, especially
in Ulster, and several members of Parliament are pledged
to further it. It is certain, however, that owners cannot
with any pretence of justice be forced to sell at ruinous
prices, nor can tenants be forced to give more than they
think fair. If the State, for purposes of its own, insists
upon expropriating all landlords, it will have to find the
difference, or to enter upon a course of undisguised con-
fiscation. The Purchase Act was not the only one relied
on by Mr Balfour. The Light Railways Act passed by
him in 1890 has done much to open up some of the
poorest parts of the west, and the temporaiy scarcity of
that year was dealt with by relief works.

An action begun by Parnell against TJie Times was

settled by the payment of a substantial sum and the withdrawal of the Pigott letters. The Nationalist leader seemed to stand higher than ever, but the writ in the divorce proceedings, brought by Captain O'Shea against his wife, with the Irish leader as co-respondent, was.

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hanging over him. To public astonishment, when the case came on for trial there was no defence, and on 17th November 1890 a decree nisi was granted. Parnell's subsequent marriage with the respondent before a registrar did him no good with his Eoman Catholic supporters. The Irish bishops remained silent, while in Eng-

*dowttfaU. ^^^*^ *^® " Nonconformist conscience " revolted. Three days after the verdict a great meeting was held in the Leinster Hall, Dublin, attended by 25 of the Irish parliamentary party. The result was an enthusiastic vote of confidence in Parnell, moved by Mr Justin M'Carthy and seconded by Mr T. M. Healy.*

Five dayslater he was unanimou^sly re-elected chairman by his party in Parliament, but the meeting was scarcely over when Gladstone's famous letter to Mr Morley became public. The writer in effect demanded Parnell's resig-nation of the leadership as the condition upon which he could continue at the head of the Liberal party. He had to choose between the Nonconformist vote and the Irish leader, and he preferred the former. Next day the secession of the Irish members from their chief began. Long and acrimonious debates fol-lowed in committee-room 15, and on 6th December Par-nell was left in the chair with only 26 supporters. The majority of 45 members — Anti-Parnellites, as they came to be called — went into another room, unanimously de-posed him, and elected Mr Justin M'Carthy in his place. Parnell then began a campaign as hopeless as that of Napoleon after Leipzig. He seized the office of United Ireland in person. The Fenian element was with him, as he admitted, but the clergy were against him, and the odds were too great, especially against a Protestant

politician. His candidate in a bye-election at Kilkenny was beaten by nearly two to one, and he himself was injured in the eyes by lime being thrown at him. Similar defeats followed at Sligp and Carlow. He went over to France to meet Messrs Dillon and O'Brien, who had not yet taken sides, but nothing was agreed to, and in the end both these former followers went against him. Every Saturday he went from London to Dublin and addressed some Sunday meeting in the country. The last was on 27th September. On 6th October 1891 he died at Brighton, from the effects of a chill following on over-work and excitement. His funeral at Glasnevin was attended by 200,000 people. At the general election of 1892, however, only 9 Parnellites — the section which under Mr John Redmond remained staunch to his memory — were returned to Parliament.

The " Parnellite split," as it was called, proved fatal to the cause of Home Rule, for the Nationalist party broke up into factions. No one of the sectional leaders com-manded general confidence, and personal rivalries were of

the bitterest kind. An important result of these quarrels was to stop the supply of American money, without which neither the Land League nor the Home Rule agitation could have been worked. The Unionist party had adopted a policy of local government for Ireland while opposing legislative independence, and a bill was introduced into the House of Commons by Mr Balfour in February 1892. The principle was afB.rmed by a great majority, but the measure could not then be proceeded with. At the general election in July the Gladstonians and Nationalists together obtained a majority of 40 over Conservatives and Liberal Unionists. Lord Salisbury resigned in August, and was succeeded by Gladstone, with Lord Houghton as lord-lieutenant and Mr John Morley as chief secretary. The Crimes Act, which had already been relaxed, was altogether suspended, and the proclamation declaring the National League illegal was revoked. The lord-lieutenant, on taking up his quarters in Dublin, refused a loyal address because of its Unionist tone ; and in October the Government issued a commission, with Mr Justice

Mathew as chairman, which had the restoration of the evicted tenants as its avowed object. Two of the commissioners very shortly resigned, and. the whole inquiry became somewhat farcical. It was given in evidence that out of £234,431 collected under the plan of campaign only £125,000 had been given to evicted tenants. In February 1893, on the application of the sheriff of Kerry, an order from the Castle, refusing protection, was pronounced illegal in the Queen's Bench, and persons issuing it were declared liable to criminal prosecution. In the same month Gladstone introduced his second Home Rule Bill, which proposed to retain 80 "giTma. Irish members in the Imperial Parliament instead of 103, but they were not to vote on any proceedings expressly confined to Great Britain. On 8th April 1886 he had told the House of Commons that it " passed the wit of man " to draw a practical distinction between imperial and non-imperial affairs. On 20th July 1888 he informed the same assembly that there was no diflculty in doing so. It had become evident,

in the meantime, to numberless Englishmen that the exclusion of the Irish members would mean virtual separation. The plan now proposed met with no greater favour, for a good many English Home Rulers had been mainly actuated all along by the wish to get the Irish members out of their way. The financial provisions of the Bill were objected to by the Nationalists as tending to keep Ireland in bondage.

During the year 1892 a vast number of Unionist meetings were held throughout Ireland, the most remarkable being the great Ulster convention in Belfast, and that of the three other provinces in Dublin, on the 14th and 23rd of June. On 22nd April 1893, the day after the second reading of the Bill, the Albert Hall in London was filled by enthusiastic Unionist delegates from all parts of Ireland. Next day the visitors were entertained by Lord Salisbury at Hatfield, the duke of Devonshire, Mr Balfour, Mr Goschen, and Mr Chamberlain being present. Between the second reading and the third on 1st September the Government majority fell from 43 to 34. A great part of

the Bill was closured by what was known as the device of the " gag " without discussion, although it occupied the House of Commons altogether eighty-two nights. It was thrown out by the Lords by 419 to 41, and the country undoubtedly acquiesced in their action. On 3rd March 1894 Gladstone resigned, and Lord Rosebery became prime minister. A bill to repeal the Crimes Act of 1887 was read a second time in the Commons by 60, but went no farther. A committee on the Irish Land Acts was closured at the end of July by the casting vote of the chairman, Mr Morley, and the minority refused to join in the report. The bill to restore the evicted tenants, which resulted from the Mathew Commission, was rejected in the Lords by 249 to 30. In March 1895 Mr Morley introduced a Land Bill, but the Government majority continued to dwindle. Another Crimes Act Repeal Bill passed the second reading in May by only 222 to 208. In July, however, the Government were defeated on the question of the supply of small-arms ammunition. A general election followed, which resulted in a Unionist

majority of 150. The Liberal Unionists, whose extinction had once been so confidently foretold, had increased from 46 to 71, and the Parnellites, in spite of the most violent clerical opposition, from 9 to 12. Lord Cadogan became lord-lievitenant of Ireland, and Mr Gerald Balfour— who announced a policy of " killing Home Rule by kindness " — chief secretary.

In the session of 1896 a new Land Act was added to the statute-book. The general effect was to decide most disputed points in favour of the tenants, and to repeal the

exceptions made by former Acts in the landlord's favour. Dairy farms, to mention only a few of the most important points which had been hitherto excluded, were admitted within the scope of the Land Acts, and purely pastoral holdings of between £60

and £100 were for the first time included. A presumption of law in the tenant's favour was created as to improvements made since 1850. The 40th clause introduced the principle of compulsory sale to the tenants of estates in the hands of receivers. The tendency of this provision to lower the value of all property has been partly, but only partly, neutralized by the firmness of the land judge. The landlords of Ireland, who had made so many sacrifices and worked so hard to return Lord Salisbury to power, felt that the measure was hardly what they had a right to expect from a Unionist administration. In their opinion it unsettled the agricultural mind, and encouraged judicial tenants to go to, law at the expiration of the first fifteen years' term instead of bargaining amicably vnth their landlords.

In the autumn of this year was published the report of the Royal Commission on the financial relations between England and Ireland. Mr Childers was the ^elaaoas orig^al chairman of this commission, which was appointed in 1894 with the object of determin-

ing the fiscal contribution of Ireland under Home Eule, and after his death The O'Conor Don presided. The report — or rather the collection of minority reports — gave some countenance to those who held that Ireland was overtaxed, and there was a strong agitation on the subject, in which some Irish Unionists joined without perceiving the danger of treating the two islands as " separate entities." No individual Irishman is taxed on a higher scale than any corresponding citizen of Great Britain. No tax, either on commodities or property, is higher in Ireland than it is in England. The alleged grievance has, however, been exploited to the utmost extent by the Nationalist party. In 1897 a Eoyal Commission, with Sir Edward Ery as chairman, was appointed to inquire into the operation of the Land Acts. Voluminous evidence was taken in different parts of Ireland, and the com-missioners reported in the following year. The methods and procedure of the Land Commission were much criticized, and many recommendations were made, but no legislation followed. This inquiry proved, what few in Ireland

doubted, that the prices paid for occupancy interest or tenant right increased as the landlord's rent was cut down.

The session of 1898 was largely occupied with the discussion of a bill to establish county and district , . councils on the lines of the English Act of Oovern- 1888. The fiscal jurisdiction of grand juries, meat Act, which had lasted for more than two centuries ■''*■ and a half, was entirely swept away. Local government for Ireland had always been part of the Unionist programme, and the vote on the abortive bill of 1892 had committed Parliament to legislation. It may, nevertheless, be doubted whether enough atten- tion was paid to the local peculiarities of Ireland, and whether English precedents were not too closely followed. In Ireland the poor-rate used to be divided between land- lord and tenant, except on holdings valued at £4 and under, in which the landlord paid the whole. Councils elected by small farmers were evidently unfit to impose taxes so assessed. The poor-rate and the county cess,*

which latter was mostly paid by the tenants, were consoli-
dated, and an agricultural grant of £730,000 was voted
by Parliament in order to relieve both parties. The con-
solidated rate is now paid by the occupier, who will profit
by economy and lose by extravagance. The towns gained
nothing by the agricultural grant, but union rating

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was established for the first time. The net result of the
county council elections in the spring of 1899 was to dis-
place, except in some northern counties, nearly all the
men who had hitherto done the local business. Nation-
alist pledges were exacted, and long service as a grand
juror was an almost certain bar to election. The Irish
gentry, long excluded, as landlords and Unionists, from
political life, now felt to a great extent that they had no
field for activity in local affairs. The new councils very
generally passed resolutions of sympathy with the Boers
in the South African war. The one most often adopted,
though sometimes rejected as too mild, was that of the

Limerick corporation, hoping " that it may end in another Majuba Hill." Efforts not wholly unsuccessful were made to hinder recruiting in Ireland, and every reverse or repulse of British arms was greeted with Nationalist applause.

The scheme for a Catholic University — of which Mr Arthur Balfour, speaking for himself and not for the Government, made himself a prominent champion — was much canvassed in 1899, but it came to nothing. It must always be very difficult to devise a scheme satisfactory both to Parliament and to the Roman Catholic hierarchy. It has not been forgotten that this question wrecked the Liberal party in 1874.

The chief Irish measure of 1899 was an Agricultural and Technical Instruction Act, which established a new department with the chief secretary at its head and an elaborate system of local committees. Board ot Considerable funds were made available, and Mr Horace Plunkett, who as an independent Conservative member had been active in promoting associa-

tions for the improvement of Irish methods in this direction, became the first vice-president, retaining his seat in Parliament under the Act. It remains to be seen what can be done in the way of technical instruction in a country where organized industries have hitherto been so few. Probably an attempt will be made to foster manual dexterity in the primary schools, where education has been too exclusively literary. In agriculture, and especially in cattle-breeding, improvement was formerly due mainly to the landlords, who have now been deprived by law of much of their power. The gap may be partly filled by the new department, but progress must be slow. Some experience has been gained not only through the voluntary associations promoted by Mr Plunkett, but also from the Congested Districts Board founded under the Land Purchase Act of 1891. This board has power within the districts affected by it to foster agriculture and fisheries, to enlarge holdings, and to buy and hold land. In March 1899 it had from first to last laid out a little more than half a million. The principal source of

income was a charge of £41,250 a year upon the Irish Church surplus, but the establishment expenses were paid by Parliament.

At the opening of the session in January 1900 there was a formal reconciliation of the Dillonite, Healyite, and

Eedmondite or Parnellite factions. It was evi-

dent from the speeches made on the occasion ’”” ’”

that there was not much cordiality between the various

leaders, but the outward solidarity of the party was

calculated to bring in renewed subscriptions both at home

aiid from America. It was publicly agreed that England’s

difficulty in South Africa was Ireland’s opportunity, and

that all should abstain from supporting an amendnient to

the address which admitted that the war would have to

be fought out. Mr John Redmond was chosen chairman,

and the alliance of Nationalists and Gladstonians was

dissolved. The United Irish League, founded in Mayo in

1898 by Mr William O’Brien, had recently become a sort

of rival to the parliamentary party, its avowed object

teing to break up the great grass farms, and its methods

resembling those of the old Land League.

The most striking event, however, in Ireland in the

earlier part of 1900 was Queen Victoria’s visit. Touched

by the gallantry of the Irish regiments in South Africa, and moved to some extent, no doubt, by the presence of the duke of Connaught in Dublin as commander-in-chief, the Queen determined in April to make up for the loss of her usual spring holiday abroad by paying a visit to Ireland. The last time Her Majesty had been in Dublin was in 1861 with the Prince Consort. Since then, besides the visit of the prince and princess of Wales in 1885, Prince Albert Victor and Prince George of Wales had visited Ireland in 1887, and the duke and duchess of York in 1897 ; but the lack of any permanent royal residence and the long-continued absence of the Sovereign in person had aroused repeated comment. Directly the announcement of the Queen's intention was made the greatest public interest was taken in the project. Shortly before St Patrick's Day the Queen issued an order which intensified this interest, that Irish soldiers might in future wear a sprig of Shamrock in their headgear on this national festival. Por some years past the "wearing of the green" had been regarded by the army authorities as

improper, and friction had consequently occurred, but the Queen's order put an end in a graceful manner to what had formerly been a plausible grievance. The result was that St Patrick's Day was celebrated in London and throughout the empire as it never had been before, and when the Queen went over to Dublin at the beginning of April she was received with the greatest enthusiasm.

The general election later in the year made no practical difference in the strength of parties, but Mr George Wyndham took Mr G. Balfour's place as chief secretary, without a seat in the Cabinet. Both before and after the election the United Irish League steadily advanced, fresh branches continually springing up.

The visit of Mr Redmond and others to America in 1901 was not believed to have brought in much money, and the activity of the League was more or less restrained by want of funds. Boycotting, however, became rife, especially in Sligo, and paid Agents also promoted an agitation against grass farms in Tipperary, Clare, and

other southern counties. In Eoscommon there was a strike against rent, especially on the property of Lord De Preyne. This was due to the action of the Congested Districts Board in buying the Dillon estate and reducing all the rents without consulting the effect upon others. It was naturally argued that no one else's tenants could be expected to pay more. Some prosecutions were under-taken, but the Government was much criticized for not using the special provisions of the Crimes Act; and in April 1902 certain counties were " proclaimed " under it. In February 1902 Lord Rosebery definitely repudiated Home Eule, and steps to oppose his followers were at once taken among Irish voters in English constituencies.

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Ireland, Church of.— The ancient Church of Ireland (described in the Irish Church Act, 1869, by this, its historic title) has a long and chequered history, which it will be interesting to trace in outline. The beginnings of Christianity in Ireland are difficult to trace (see Ency. Brit. vol. v. p. 303), but there is no doubt that the first Christian missionary whose labours were crowned with any considerable success was Patrick (fl. cir. 450), who has always been reckoned the patron saint of the country. Por six centuries the Church of which he was the founder occupied a remarkable position in Western

Christendom. Ireland, in virtue at once of its geographical situation and of the spirit of its people, was less affected than other countries by the movements of European thought ; and thus its development, social and religious, was largely independent of foreign influences, whether Roman or English. In full communion with the Latin Church, the Irish long preserved many peculiarities, such as their monastic system and the date at which Easter was kept, which distinguished them in discipline, though not conspicuously in doctrine, from the Christians of countries more immediately under papal control. In the 6th, 7th, and 8th centuries Ireland was famous as the home of sacred letters and as the nursery of zealous missionaries who carried the Gospel not only to Scotland, but to Burgundy and Switzerland, with the fervour of Celtic devotion (see Ency. Brit. vol. xiii. p. 248). The incessant incursions of the Danes, who were the scourge of the land for a period of nearly three hundred years, pre-vented the Church from redeeming the promise of her infancy ; and at the date of the English conquest of

Ireland (1172) she had lost much of her ancient zeal and of her independence. By this time she had come more into line with the rest of Europe, and the Synod of Cashel put the seal to a new policy by its acknowledgment of the papal . jurisdiction and by its decrees assimilating the Church, in ritiial and usages, to that of England. There was no thought of a breach of continuity (see Ency. Brit. vol. viii. p. 490), but the distinctive features of Celtic Christianity gradually disappeared from this time onwards. Thenceforth she was an appanage of the Church of England, the intervention of the stronger island being, however, as distasteful to the Irish in religious as in political affairs. English influence was strong only in the region round Dublin (known as the Pale) ; and beyond this district the Irish, though they had acquiesced in the discipline of the Church as directed from Rome, to which England was subject like the rest of Europe, were not disposed to view with favour any ecclesiastical reforms which had their origin in the sister country. Thus from the days of Henry VIII. the Reformation moveinent was

hindered in Ireland by national prejudice, and it never succeeded in gaining the allegiance of the Irish people as a whole. The policy which directed its progress was blundering and stupid, and reflects little credit on the English statesmen who were responsible for it (see Ency. Brit. vol. XX. p. 337). The episcopal succession was, indeed, unbroken, and the continuity of the Church of Ireland with the ancient Celtic Church is a historical fact. Not only is she in possession of many ancient buildings which have been consecrated to Christian worship for many centuries, such as the cathedrals at Armagh and Dublin, but her bishops can claim descent in direct line from the successors of St Patrick. Nevertheless, she has not gained the people, and she is to this day the Church of a small section only of the population.

The Reformation period begins with the passing of the Irish Supremacy Act (1637). As in England, the changes in religion of successive sovereigns alternately checked and promoted the progress of the movement, although in

Ireland the mass of the people were less deeply affected by the religious controversies of the times than in Great Britain. At Maiy's accession five bishops either abandoned, or were deprived of, their sees ; but the Anglo-Irish who remained faithful to the Reformation were not subjected to persecution such as would have been their fate on the other side of the Channel. Again, under Elizabeth, while two bishops (Walsh of Meath and Leverous of Kildare) were deprived for open resistance to the new order of things, and while stern measures were taken to suppress treasonable plotting against the constitution, the uniform policy of the Government in ecclesiastical matters was one of toleration. James I. caused the Supremacy Act to be rigorously enforced, but on political rather than on religious grounds. It was in his reign that the first Convocation of the clergy was summoned in Ireland, of which assembly the most notable act was the adoption of the "Irish Articles" (1615).

These had been drawn up by tJssher, and were more decidedly Calvinistic in tone than the Thirty-nine Articles, which were not adopted as standards in Ireland until 1634, when Strafford forced them on Convocation. During the Commonwealth period the bishoprics which became vacant were not filled ; but on the accession of Charles II. the Church was strengthened by the translation of Bram-hall from Derry to Armagh, and the consecration of eight other bishops, among whom was Jeremy Taylor. The short period during which the policy of James II. pre-vailed in Ireland was one of disaster to the Church ; but under William and Mary she regained her former position. She had now been reformed for more than 100 years, but had made little progress ; and the tyrannical provisions of the Penal Code introduced by the English Government made her more unpopular than ever. The clergy, finding their ministrations unacceptable to the great mass of the population, were tempted to indolence and non-residence ; and although bright exceptions could be named, there was much that called for reform. To William King

(1650-1729), Bishop of Derry and subsequently Archbishop of Dublin, it was mainly due that the work of the Church was reorganized, and the impulse which he gave it was felt all through the 18th century. His ecclesiastical influence was exerted in direct opposition to Primate Boulter and his school, who aimed at making the Established Church the instrument for the promotion of English political opinions rather than the spiritual home of the Irish people. In 1800 the Act of Union was passed by the Legislature; and thenceforward, until Disestablishment, there was but one "United Church of England and Ireland."

Continuous agitation for the removal of Roman Catholic disabilities brought about in 1833 the passing of the Church Temporalities Act, one of the most important provisions of which was the reduction of the number of Irish archbishoprics from four to two, and of bishoprics from eighteen to ten, the funds thus released being administered by commissioners. In 1838 the Tithe Rentcharge Act, which transferred the payment of tithes from the occupiers

to the owners of land, was passed, and thus a substantial grievance was removed. It became increasingly plain, however, as years passed, that all such measures of relief were inadequate to allay the dissatisfaction felt by the majority of Irishmen because of the continued existence of the Established Church. Her position had been pledged to her by the Act of Union, and she was undoubtedly the historical representative of the ancient Church of the land ; but such arguments proved unavailing in view of the visible fact that she had not gained the affections of the people. The census of 1861 showed that out of a total population of 5,798,967 only 693,357 belonged to the Established Church, 4,505,266 being Roman Catholics ; and once this had been made clear, the passing of the Act of Disestablishment was only a question of time. Introduced by Mr Gladstone, and passed in 1869, it became law on 1st January 1871. (See Establishment.)

The Church was thus suddenly thrown on her own resources, and called on to reorganize her ecclesiastical system, as well as to make provision for the mainten-

ance of her future clergy. A convention of the bishops, clergy, and laity was summoned in 1870, and its first act was to declare the adherence of the Church of Ireland to the ancient standards, and her determination to uphold the doctrine and discipline of the Catholic and Apostolic Church, while reaffirming her witness, as Protestant and Reformed, against the innovations of Rome. Under the constitution then agreed on, the supreme governing body of the Church is the General Synod, consisting of the bishops and of 208 clerical and 416 lay representatives of the several dioceses, whose local affairs are managed by subordinate Diocesan Synods. The bishops are elected as vacancies arise, and, with certain restrictions, by the Diocesan Synods, the Primate, whose see is Armagh, being chosen by the bishops out of their own number. The patronage of benefices is vested in boards of nomination, on which both the diocese and the parish are represented. The Diocesan Courts, consisting of the bishop, his chancellor, and two elected members, one clerical and the other lay, deal as courts of first instance

with legal questions ; but there is an appeal to the Court of the General Synod, composed of three bishops and four laymen who have held judicial office. During the years 1871 to 1878 the revision of the Prayer Book mainly occupied the attention of the General Synod; but although many far-reaching resolutions were proposed by the then predominant Evangelical party, few changes of moment were carried, and none which affected the Church's doctrinal position. A two-thirds majority of both the lay and clerical vote is necessary before any change can be made in the formularies, and an ultimate veto rests, on certain conditions, with the house of bishops.

The effects of Disestablishment have been partly good and partly evil. On the one hand, the Church has now all the benefits of autonomy and is free from the anomalies incidental to state control. Her laws are definite, and the authority of her judicial courts is recognized by all her members. The place given to the laity in her synods has quickened in them the sense of responsibility

so essential to the Church's progress. And although there are few worldly inducements to men to take orders in Ireland, the clergy are, for the most part, the equals of their predecessors in social standing and in intellectual equipment, while the standard of clerical activity is higher than in pre-Disestablishment days. On the other hand, the vesting of patronage in large bodies like synods, or (as is the case in some districts) in nominators with little knowledge of the Church beyond the borders of their own parish, is not an ideal system, although it is working better as the dangers of parochialism and provinciality are becoming more generally recognized than in the early years of Disestablishment.

The finances are controlledby the Representative Church Body, to which the sum of £7,581,075 to provide annuities for the existing clergy (2043 in number), amounting to £596,913, was handed over by Parliament in 1870.

So skilfully was this fund administered that on 31st December 1900, while only 200 annuitants were living, a small balance of £919,192 remained of the capital sum.

In addition, the voluntary offerings of the clergy and the laity for the thirty-one years ending 31st December 1900 amounted to £5,494,586, the totat moneys at the disposal of the Church amounting at that date to £8,220,073.

Out of the interest on this sum, augmented by the annual parochial assessments, which are administered by the central office, provision has to be made for two archbishops at £2600 per annum, eleven bishops, who receive about £1600 each, and 1534 parochial clergy. Of the clergy only 361 are curates, while 1173 are incumbents, the average annual income of a benefice being about £240, with (in most cases) a house. The large majority of the clergy receive their training in the Divinity School of Trinity College, Dublin. At the census of 1901 the members of the Church of Ireland numbered 679,385 out of a total population of 4,456,546.

Authorities. — Manx. History of the Church ofIreland,2 vols. London, 1840. — Essays on the Irish Church, by various writers.

Oxford, Parker, 1866.— Stokes. Ireland and the Celtic Church. London, 1888. Ireland and the Anglo-Norman Church. London, 1892. Some Worthies of the Irish Church. London, 1900. — Olden. The Church of Ireland. London, 1892.— Ball. The Reformed Church of Ireland. London, 1890. — Beports of the Bepresentative Church Body. Dublin, 1872-1900. (j. h. be.)

Ireland, John (1838-

)^ Eoman Catholic Arch

bishop of St Paul, Minnesota, U.S.A., was born in Burn-church, County Kilkenny, Ireland, 11th September 1838. When he was a boy his parents emigrated to America; but he received his theological education in France, and was ordained in St Paul, Minnesota, in 1861. He was chaplain of a Minnesota regiment during part of the Civil War, and afterwards was appointed rector of the cathedral at St Paul. In 1876 he became coadjutor-bishop, in 1884 bishop, and in 1888 archbishop of St Paul. In all his positions he has been active in religious, educa-tional, and charity work; has organized many total abstinence societies; promoted the settlement of the*

north-west ; and aided largely in the establishment of the Roman Catholic university at Washington. He has also been many years president of the state Historical Society of Minnesota, and is author of Tlie Church and Modem Society (1896).

Irenaeus (the so-called PFAFriAisr Fragments).

— In 1716 a scholar of Tubingen, Christoph Matthaus Pfaif, published at The Hague what professed to be four fragments of the writings of St Irenaeus, which he said that he had discovered in MS. Catenae in the library at Turin (see Migne, Pair. Gfraec, vii. 1248-1256). The subjects with which they deal are the true knowledge which is according to Christ, the oblation in the Eucharist, Christian freedom as regards fasts and festivals, and the second coming of Christ. If genuine, therefore, they are of no little importance, and on this account they have been frequently made use of and not a little discussed. Scipio Maffei impugned them during PfafE's lifetime ; and their genuineness has often been suspected since, partly on critical grounds, and partly be-

cause the alleged MS. Catenae has never been seen since Pfaff's day. On the other hand, they have been as strongly defended, and the general feeling seems to have been that if not genuine fragments of Irenaeus, they were at least in all probability of the 2nd century, the work of some writer like-minded with Irenaeus. Since 1900 the question may be said to have been set at rest entirely by Dr Adolf Harnack, who has proved almost to demonstration that they are forgeries by Pfaff himself. His reasons are shortly as follows : the Catenae are not to be found in the library, and have never been seen by anybody unless by Pfaff ; the catalogues of the library show no signs of their existence ; Pfaff's statements on the matter were not free from contradiction ; the fragments show signs of being based on the Apostolical Constitutions (q.v.), and there-fore must be later in date than they are ; in grammar and style they do not coincide with those either of their alleged author or of their alleged date; they appear to depend upon the text of Halloix's edition of Irenaeus, and a false reading of his is incorporated; the New Testament is

used according to the Textus Receptus; above all, they represent Pfaff's own theological position, so that the reason for the forgery is supplied. Altogether, Harnack's proof is as ingenious and convincing a piece of argument as could be wished for.

See Ad. Haknack, Die Ffaff^schen Irenaus-Fragmente als Fal-schungen Pfaffs nachgewiesen. (Gebhardt and Harnack, Texte und JJntersuchungen, neue iFolge, vol. v. part 3, Leipzig, 1900.)

(w. E. Co.)

Iriga, a town in the extreme south of the province of Ambos Camarines, Luzon, Philippine Islands, in the district known as La Rinconada on account of its inaccessibility. It has a temperate and very healthful climate. The soil in its vicinity is rich, producing rice, Indian corn, sugar, pepper, cacao, cotton, abaca, tobacco, and copra. The neighbouring forests furnish ebony, molave, tindalo, and other very valuable hardwoods. The language is Bicol. Population, 17,000.

Irkutsk, a government of Asiatic Russia, East Siberia, bounded on the W. by Tomsk and Yeniseisk, on

the N. by Yakutsk, on the E. by Lake Baikal and Trans-baikalia, and on the S. and S.W. by Mongolia (China). Its area is 287,061 square miles. The most populous region is a belt of plains, from 1200 to 2000 feet in altitude, stretching north-west to south-east between the Sayan mountains on the one side and the Baikal mountains on the other, narrowing as it approaches the town of Irkutsk. The highroad, now the Trans-Siberian railway, follows this belt. The south-western part of the govern-ment is occupied by mountains of the Sayan system, whose exact orography is as yet hot well known. From the high plateau of Mongolia {q.v.), fringed by the Sayan mountains, of which the culminating point is the snow-clad Munku-Sardyk (11,600 feet), a number of mountain ridges, from 7500 to 8500 feet high, strike off in a north-east direction. Going from south to north they are distinguished as the Tunka Alps, the Kitoi Alps (both snow-clad nearly all the year round), the Ida mountains, and the Kuitun mountains, which, however, are far from being the regular chains running between rivers which

most maps show them to be. On the contrary, these high-lands are a complex result of upheavals which took place at different geological epochs, and of denudation on a colossal scale. Gold in the north-west (Nizhneudinsk taiga) and graphite of the highest quality (Alibert's mine, 8000 feet) are found in these mountains. A beautiful, fertile valley, watered by the Irkut, spreads between the Tunka Alps and the Sayan, and another somewhat higher plain, but less wide, stretches along to Kitoi. A succession of high plains, from 2000 to 2600 feet in altitude, formed of horizontal beds of Devonian (or Upper Silurian) sandstone and limestone, spreads to the north of the railway along the Angara, the Nizhnyaya Tunguska (its tributary), and the upper Lena, as far asKirensk. The Bratskaya Steppe is a prairie peopled by Buryats.

A mountain region, usually described as the Baikal range, but consisting in reality of several ranges running north-eastwards, across Lake Baikal, and scooped out to form the depression occupied by the lake, is fringed on its north-western slope by horizontal beds of sandstone and lime-

stone. Farther north-east the space between the Lena and the Vitim is filled by another mountain region belonging to the Olekma and Vitim system, composed of several parallel mountain ridges running north-eastwards (across the lower Vitim), and auriferous in the drainage area of

the Mama. The imniense Lake Baikal separates Irkutsk from Transbaikalia. The chief rivers of the government are the Angara, which flows from this lake northwards, with numerous sharp windings, and receives from the left several large tributaries, as the Irkut, Kitoi, Byelaya, Oka, and lya. The Lena is the main means of communication both with the gold mines on the lower Vitim and with the province of Yakutsk. The Nizhnyaya Tunguska flows northwards, to join the Angara in the far north, and the mountain streams tributary to the Vitim water the north-eastern part of the province. The Post-Tertiary formations are represented by glacial deposits in the highlands and

loess on their borders. Jurassic deposits are met with in a zone running north-westwards from Lake Baikal to Nizh-neudinsk. The remainder of this region is covered by vast series of Carboniferous, Devonian, and Silurian deposits — the first two but slightly disturbed over wide areas. All the highlands are built up of older, half crystalline Gambro-Silurian deposits, which attain a thickness of 2500 feet, and of crystalline slates and limestones of the Laurentian system, with granites, syenites, diorites, and diabases protruding from beneath them. Very ex-tensive beds of basaltic lavas and other volcanic deposits are spread along the border ridge of the high plateau, about Munku-Sardyk, up the Irkut, and on the upper Oka, where cones of extinct volcanoes are found (Junbulak). Earthquakes are frequent in the neighbourhood of Lake Baikal and the surrounding region. Gold is extracted in the Nizhneudinsk district to the extent of about 10,000 oz. yearly ; graphite is found on the Botogol or Alibert mountain (abandoned many years since) and on the Olkhon island of Lake Baikal. Brown coal (Jurassic) is

found in many places, and coal on the Oka. The salt springs of Usoliye (45 miles west of Irkutsk), as also those on the Ilim and of Ust-Kut (on the Lena), yield annually about 7000 tons of salt. Fireclay, grindstone, marble and mica, lapis-lazuli, granites, and various half-precious stones occur on the Sludyanka (south-west corner of the Baikal). The climate is severe : the mean temperar tures are at Irkutsk (1510 feet), being for the year 31° Fahr., for January -6°, for July 65° ; at Shimki (valley of the Irkut, 2620 feet), for the year 24°, for January -17°, for July 63°. The average rainfall is 15 inches a year. Immense virgin forests cover all the highlands up to 6200 to 6600 feet. The population, which was 383,578 in 1879, was 506,517 in 1897, of whom 238,997 were women and 60,396 were urban; except about 120,000 Buryats and 1700 Tunguses, they are Eussians. In 1890, of a regis-tered population of 465,000, 223,812 were peasants, 34,-659 common law and 619 political exiles, 5230 Cossacks, and 14,178 settled and 105,718 nomad natives, chiefly Buryats. The yearly increase of population is 1-4 per

cent., to which immigration contributes about 14,000 every year. Schools are numerous at Irkutsk, but quite insufficient in the country, and only 12 per cent, of the children receive education. The soil is very fertile in certain parts of the territory, but meagre elsewhere, and less than a million acres are under crops. Grain has to be imported from West Siberia, and cattle from Trans-baikalia. The live stock of the province numbers 292,-110 horses, 380,340 horned cattle, and 356,400 sheep. Fisheries on Lake Baikal supply every year about 2,400,000 Baikal herring (omul). Industry is only begin-ning to be developed (iron works, glass works, and distil-leries), and all manufactured goods are imported from Russia. (p. A. K.)

Irkutsk, capital of the above province, situated 40 miles west of Lake Baikal, 3378 miles from Moscow by rail, and is connected by rail with the Amur. Several valuable educational institutions have been established ; since the great conflagration of 1879 large parts of the town have been built anew. Its commercial importance,

in respect of the trade both with China and the interior, has been much increased by the railway. Population, 51,484.

IROIN AISTD STEEL,

Summary.

IN the last twenty years of the 19th centrlry the world's production of pig iron more than doubled, and that of steel increased fivefold, while that of wrought iron became of secondary importance. The United States passed from the position of the second to that of by far the greatest producer of both pig iron and steel; its production of the former more than tripled, becoming 46 per cent, greater than that of Great Britain, and its production of steel increased to more than eight and one-half times that of 1880, becoming more than double that of Great Britain, some 70 per cent, greater than that of Germany and Luxemburg together, and 40 per cent, of the total for the whole world. In this period the basic open-hearth and basic Bessemer processes rose from mere beginnings to vast importance, each of them now produc-

ing in these, the three great iron-making countries, about as much steel as the whole world made in 1880. Of the total production of steel in these three countries, some 43 per cent, is made by the acid Bessemer process, 20 per cent, by the basic Bessemer, 16 per cent, by the acid open-hearth, 18 per cent, by the basic open-hearth — the process in which the greatest development is now to be expected — and only about 1 per cent, by the crucible and other minor processes. The production of wrought iron in the United States, which in 1880 was 70 per cent, greater than that of steel, is now only about one-sixth that of steel ; and wrought iron has practically gone out of use for important objects like rails, and the beams, angles, and other chief parts of bridges and iron buildings, though it will probably long be used for special purposes for which great ease of welding or special ductility is needed. Delicate methods of research have revealed the nature and constitution of the several varieties of iron. This knowledge has contributed in no small degree to the important beginning which has been made in the use of

rational methods of thermal treatment, in which a great extension is to be expected, and it has aided in the discovery and utilization of numerous "alloy" steels. For armour plate not only has steel completely displaced wrought iron, but alloy steel, which has been specially and differentially carburized, and has received a special heat-treatment, has come into general use. ISIuch the same ia true of many other important objects for which the highest quality is needed; thus all armour-piercing projectiles, and many important forgings for engines, especially marine engines, are made of the same materials. Through-out the manufacture of iron and steel those twenty years witnessed great simplification, extension of the use of mechanical appliances, and, especially in the manufacture of the relatively simple products, such as rails, wire, sheets, tubing, beams, &c., a concentration of the industry into enormous establishments, operating on so large a constitution]

scale as to warrant the use of powerful and costly labour-saving machinery and the employment of many highly trained specialists to investigate and watch with the utmost care even the slightest details. In the last ten years of the 19th century alone the cost of labour in many important processes was reduced by about one-half, without reducing wages. Processes for obtaining wrought iron and steel " direct " from the ore lost their immediate, though not wholly their prospective, importance, and at the present time nearly all the ore which is mined is converted into pig iron in the iron blast-furnace. Chiefly by daring, and by the use of more powerful blowing engines and hot-blast stoves, and of better arrangements for cooling and so protecting the lower part of the furnace, the production of the blast-furnace was increased, until the average production of a single Carnegie furnace in 1902, some 200,000 tons per annum, was greater than that of all the United States furnaces in 1830, and ten times that of 1820, and was one-fourth that of the whole world in 1800. By using the waste gases of the

blast-furnace in gas engines their importance as sources of power has been greatly increased, so that establishments in which the rolling mills and other machinery adjoin the blast-furnaces, and therefore can be driven by such engines, will be given a new and often an irresistible advantage over their competitors. The use of great " mixers " to lessen the irregularities in the composition of the pig-iron as it issues from the blast-furnace enables the Bessemer process to be applied directly to that iron, without allowing it to solidify and thus to dissipate its heat ; and this same procedure is coming into use for the open-hearth and tentatively for the puddling process. The capacity of a single Bessemer converter has become as much as 20 tons, and that of the open-hearth furnace 100 tons, and owing to the car casting system and other im-provements the production of a single pair of Bessemer converters reaches 60,000 tons per month — a rate forty -four times that of 1870, and more than thrice that of 1880. In some Bessemer works not only is the iron never allowed to cool between its entry into the blast-furnace

in the state of ore and its delivery from the rolling mill in the form of rails or even of billets, but in this progress it undergoes no true heating by extraneous fuel, save in the blast-furnace itself , for the pig iron furnishes its own calorific power in the Bessem er converter, and the only other furnace treatment, that of " soaking," merely equalizes the heat of the ingot, and prevents its escape without adding to it.

I. Constitution, &c.

§ 1. Nomenclature. — The classification given in Table I. is now firmly established. Until about 1860 there were only three important classes of iron — wrought iron, steel, and cast iron. The essential characteristic of wrought iron was its nearly complete freedom from carbon ; that of steel its moderate carbon-content (say between 0-30 and 2 per cent.), which, though great enough to confer the property of being rendered intensely hard by sudden cooling, yet was not so great as to make the metal brittle when cooled slowly ; while that of cast iron was a carbon-content so high as to make the metal brittle whether cooled quickly or slowly. This classification

was based on carbon-content, or on the properties which it gave. Wrought iron, and certain classes of steel which then were important, necessarily contained much slag or "cinder," because they were made by welding together pasty particles of metal in a bath of slag, without subsequent fusion. But the best class of steel, crucible steel, was freed from slag by fusion in crucibles; hence its name " cast steel." Between 1860 and 1870 the Bessemer and open-hearth processes introduced a new class of iron, to-day called " mild " or " low-carbon steel," which lacked the essential property of steel, the hardening power, yet differed from the existing forms of wrought iron in freedom from cinder, and from cast iron in being very malleable. Logically it was wrought iron, the essence of which was, that it was (1) " iron " as distinguished from steel, and (2) malleable, i.e., capable of being " wrought." This name did not please those interested in the new product, because existing wrought iron was a low-priced material. The only justifiable alternative would have been to assign a wholly new name to the wholly new product ; but as

steel was associated in the public mind with superiority, it appeared more profitable to appropriate its valuable name. This was done with the excuse that the new

Table I. — General Classification of Iron and Steel.

*Containing very little Carbon (say, less than 0*30 per cent.).*

Containing an intermediate quantity of Carbon (say, between O'SO and 2 per cent.).

Containing much Carbon (say, from 2 to 5 per cent.).

Slag-bearing or "Weld-metal" Series.

Wrought Ikon.

Puddled and bloomary, or char-coal-hearth iron belong here.

Weld Steel.

Puddled and blister steel belong here.

Slagless or "Ingot-

metal" Series. '

Low Cakbon or Mild Steel,

sometimes called "ingot-iron."

It may be either Bessemer, open-

hearth, or crucible steel.

Half-Hard and High-Carbon

Steels, sometimes called

"ingot-steel."

They may be either Bessemer,

open-hearth, or crucible steel

Malleable cast iron also often

belongs here.

Cast Ikon.

Normal cast iron, "washed" metal,

and most "malleable cast iron"

belong here.

Alloy Steels.

Nickel, manganese, tungsten, and

chrome steels belong here.

Alloy Cast Irons, i

Spiegeleisen, ferro-manganese, and

silico-spiegel belong here.

1 The term "Alloy Cast Irons " is not actually in frequent use, not because of any question as to its fitness or meaning, but because the

need of such a generic term rarely arises in the industry.

product resembled one class of steel — cast steel — in being

free from slag; and, after a period of protest, all ac-

quiesced in calling the new product " steel," which is now

its firmly established name. The old varieties of wrought

iron, steel, cast steel, and cast iron preserve their old

names ; the new class is called steel by main force. As

a result, certain varieties, such as blister steel, are called

" steel " solely because they have the hardening power, and

others, such as low-carbon steel, solely because they are

free from slag. But the former lack the essential quality —

slaglessness — which makes the latter steel, and the latter

lack the essential quality — the hardening power — which

makes the former steel. " Steel " has come gradually to

stand rather for excellence than for any specific quality.

[constitution

These anomalies, however confusing to the general reader, in fact cause no appreciable trouble to important makers or users of iron and steel, beyond forming an occasional side-issue in litigation.

If, however, we are to have a nomenclature comprehensible to the general, public, we may adopt the following definitions, in which the essential distinction between steel and cast iron is that the former is malleable at least in some one range of temperature, malleableness being probably the only important specific property which to-day distinguishes all steels from all cast irons : —

Wrought Iron, slag-bearing, malleable iron, which does not harden materially when suddenly cooled.

Steel, iron which is malleable at least in some one range of temperature, and also is either (a) cast into an initially malleable mass ; or (6) is capable of hardening by sudden cooling ; or (c) is both so cast and so capable of hardening. (Tungsten steel and certain classes of manganese steel are malleable only when red-hot.)

Cast Iron, iron containing so much carbon or its equivalent as not to be malleable at any temperature.

Malleable Cast Iron, iron which has been cast in the condition

of cast iron and made malleable by subsequent treatment without fusion.

Alloy Steels and Cast Irons are those which owe their properties chiefly to the presence of one or more elements other than carbon.

Ingot Iron, slagless steel with less than 0-30 per cent, of carbon.

Ingot Steel, slagless steel containing more than 0 -SO per cent, of carbon.

Weld Iron, the same as wrought iron.

Weld Steel, slag-bearing varieties malleable at least at some one temperature, and containing more than 0-.30 per cent, of carbon.

These definitions cover not all conceivable, but simply the present important classes of iron. Should others later become important, their nomenclature will then be determined solely by trade reasons.

§ 2. Constitution. — The great advance which has taken place in our knowledge of the constitution of steel and the other varieties of iron has shown that they resemble very closely the igneous and metamorphic rocks, i.e., exactly those which, like the different varieties of iron, have formed from the cooling of molten or at least

pasty masses. Just as a granite on close examination is seen to consist of an aggregation of crystalline fragments of mica, quartz, and felspar, each of which is a perfectly definite chemical compound, with definite crystalline form and definite physical properties in general, so the microscope shows us that a given piece of steel or iron usually consists of extremely minute crystalline particles of two or more substances, each of which is a definite entity, with definite chemical composition and definite physical properties. But besides the granitic type, certain varieties of iron seem to represent the obsidian type. In this, as in aqueous solutions, the ratios in which the different chemical substances, the silica, lime, &c., exist are not fixed or definite ; they vary from case to case, not per saltum as between definite chemical compounds, but by infinitesimal gradations. The different substances present appear to be dissolved, as it were, in each other in a sort of solid solution which presents the indefiniteness of composition, the incapacity of being resolved by any magnification of the microscope, and the feeble chemical attraction between

the different components, characteristic of a solution. The schistose structure of rock masses, their columnar or bar saltic structure, arranged in columns perpendicular to the cooling surface, their " vugs " or cavities lined with specimens of free crystals, their segregation, &c., are re-produced in a most interesting way in metallic masses.

Of these different microscopic entities which constitute the differ-ent varieties of iron, only the following here need consideration : —

(1) Ferrite, the name assigned to the microscopic particles of nearly — perhaps perfectly — pure metallic iron. It is very soft and ductile.

(2) Cementite, a definite carbide of iron, FesC, very brittle, harder than hardened steel, scratching glass and felspar, but not quartz (H=6), and present in proportions which in a general way increase with the proportion of carbon present. It is the substance to which chilled cast iron usually owes its hardness and brittleness.

(3) Pearlitc. Slowly cooled steels in general consist essentially of a mixture of ferrite and cementite, in proportions corresponding to the carbon-content of the mass as a whole. But these two sub-

FiG. 1.— Pearlite.

Stances habitually interstratify as a "eutectic"i conglomerate called pearlite (Fig. 1) in the ratio of about seven parts of ferrite to one of cementite, hence containing about 0-90 per cent, of carbon. Steels containing either more or less carbon than 0-90 per cent., that is, an excess of cementite or ferrite over the euteotic ratio of 7:1, are a conglomerate of pearlite plus this excess (Fig. 2). They are called hyper- eutectic or hypo-eutectic according as this excess is cementite or ferrite, i.e., according as their carbon-content is above or below the 0-90 per cent, which the eutectic itself contains. Their constitution is shown in Fig. 3, in which the ordinates of the line ABC represent the percentage of pearlite corresponding to each percentage of carbon, and the intercept ED or FG of any point D or F measures the percentage of the ex-

cess of ferrite or cementite for hypo- and hyper-eutectic steels respectively.

(4) Martensite, the characteristic and chief constituent of hardened steel, is a hard, brittle mass, with a needle-like structure, consisting of iron containing carbon in proportions which vary from nothing up to about 2 per cent. As it has not yet been resolved by the microscope into different components, we regard it provisionally as a "solid solution," the ultimate constituents of which are iron and carbon ; as to the nature of its proximate constituents we can as yet only speculate. When it contains 0-90 per cent, of carbon, and thus corresponds in ultimate composition to pearlite, it is called hardenite.

(6) Graphite, a characteristic

component of J^ grey cast iron,"

of which it usually forms from

2-50 to 3'50 per cent. It is nearly

pure carbon, in very thin lami-

nated plates or flakes, often curved. In grey cast iron these flakes

form a nearly continuous skeleton ; and as they readily split open

when a piece of this iron is broken, rupture passes through them,

with the result that, even though the graphite may form only some

3 per cent, of the mass by weight (say 10 per cent, by volume) ,

practically nothing but graphite is seen in the fracture. Hence the

weakness and the dark grey fracture of "grey cast iron," and

hence, by brushing this fracture with a wire brush and so detach-

ing these loosely adherent flakes of graphite, the colour can be

changed nearly to the very light grey of pure iron.

(6) Slag, the characteristic component of wrought iron, in

which it is usually present to the extent of 0-20 to 2-00 per cent.,

is essentially a silicate of iron, and is present in wrought iron

simply because this product is made by welding together pasty

granules of iron in a bath of such slag, without ever melting the

resultant mass or otherwise giving the envelopes of slag thus im-

prisoned a chance to escape completely.

(7) Austenite, troostite, sorbite, and other constituents have also

been described.

(8) Fig. 4 shows how the occurrence of these constituents varies

both with the temperature and with the proportion of carbon

present. The Roman letters indicate tlie constituents normal and

stable in each of the many fields into which it is divided. Before

considering this diagram we must recognize the further complica-

tion in the constitution of iron, due to its having at least three

distinct allotropic modifications, u, jS, and 7, each corresponding

to a distinct range of temperature.

(9) a iron is the weak, ductile, magnetic variety, Stable below

A2, Fig. 4, characteristic of wrought iron and of low-carbon steel.

Fig. 2. — Pearlite with ferrite. (Sorby.)

The polygons are pearlite ; the net-

work is ferrite.

1 A " Eutectic " is the last-freezing part of an alloy and corresponds

to what the mother-liquor of a saline solution would become if such a

solution, after the excess of saline matter was crystallized out, were

finally completely frozen. It is the mother-liquor or " Bittern " frozen. Its striking characteristics are : (1) that for given metals alloyed to-gether its composition is fixed, and does uot vary with the proportions in which those metals are present, the " excess-metal " freezing before the eutectic ; (2) that though thus constant, its composition is not in simple atomic proportions; (3) that its freezmg-point is constant ; and (4) that it consists of interstratifled layers of the metals which compose it. (See Alloys and Fusion.)

constitution]

?

ytr^nprt^pvoo yoioay^ vSofiiOAiAj^.

N.B. — The "carbon-content" of this diagram refers only to the carbon actually combined with the iron, and excludes that which is present as graphite. This may be regarded as a foreign body. For instance, a grey cast iron containing 3-50 per cent, of carbon, of which 3 per cent, is graphite and only 0-50 per cent, combined, may be looked upon as in effect a hypo-eutectic steel, approximately rail steel, containing 0-50 per cent, of carbon (H in the figure), but

contaminated with S-OO per cent, of graphite as a foreign body.

(10))3 iron is the non-magnetic variety, stable between A2 and As, probably very hard and brittle, and probably characteristic of certain self-hardening steels, such as manganese steel containing 7 per cent, of manganese, and of normal or "carbon" steel when hardened by sudden cooling.

(11) 7 iron is the non-magnetic variety, stable above A3, charac-teristic of nickel and 12 per cent, manganese steels, and probably relatively hard, but ductile.

In Fig. 4, AB and BD represent the freezing-point of iron for different proportions of carbon, and the lines below these, aBc, GOS, SE, MO, and PSP' represent spontaneous retardations which occur during the undisturbed further slow cooling, showing that at these several lines heat is evolved within the metal, and hence that some molecular rearrangement occurs. Each of the tripartite groups of lines, (1) AB, BD, aBc, and (2) GOS, SE, PSP', is ' of the family of curves of the solidification of those solutions which in freezing break up to form a mechanical mixture of (a) a eutectic, and (6) the component of that eutectic which is in excess over the eutectic ratio. The natural inference that these

two groups here represent analogous occurrences is thus far well supported by the evidence.

To illustrate the meaning of the diagram let us follow by means of the ordinate QITW the undisturbed slow cooling from the motten state of a hyper-eutectic steel containing 1-00 per cent, of carbon. When the gradually falling temperature reaches 1460°C., (Q) the mass as a whole freezes gradually, forming martensite, apparently simply a solidified solution of carbon in 7 iron, which, though solid, preserves the essential characteristics of a solution. The heat evolved during solidification retards the fall of tempera-ture ; after this the rate of cooling remains regular until T (850°) on the line STB (Aps) is reached, when a second retardation occurs, due to the heat liberated by the passage within the pasty mass of part of the iron and carbon from a state of mere solution to that of definite combination in the ratio FesC, forming micro-scopic particles of cementite, while the remainder of the iron and carbon continue dissolved in each other as martensite. This formation of cementite continues as the temperature falls, till at about 690° C, (U, called Ara-i) so much of the carbon (in this case about O'lO per cent.) and of the iron has united in the ratio of

cementite, that the composition of the remaining solid-solution or "mother-metal" of martensite has reached that of hardenite; i.e., it now contains 0'90 per cent, of carbon. As the temperature now falls past 690°, this hardenite mother-metal in turn splits up, after the fashion of eutectics, into alternate layers of ferrite and cementite grouped together as pearlite, so that the mass as a whole now becomes a mixture of pearlite with cementite. The iron thus liberated, as the ferrite of this pearlite, changes simultaneously to a ferrite. The passage of this large quantity of carbon and iron, 0 -90 per cent, of the former and 12-6 of the latter, from a state of mere solution as hardenite to one of definite chemical union as cementite, together with the passage of the iron itself from the 7 to the a state, evolves so much heat as actually to heat the mass up so that it brightens in a striking manner. This phenomenon is called the "recalesoence." The change from martensite to ferrite and cementite is accompanied by the loss of the hardening power, as will be explained shortly.

To take a second case, molten hypo-eutectic steel of 0-20 per cent, of carbon on freezing at K passes to the state of martensite, 7 iron with this 0-20 per cent, of carbon dissolved in it. Its

further cooling undergoes three spontaneous retardations, one at K' (Ars), at about 820° C, at which part of the iron isolates itself in separate crystals within the solid solution as ferrite, and in crystallizing passes from the 7 to the j8 state, that is, free iron of the ;8 allotropic modification. At the second retardation, K" (Arj), which occurs at about 770° C, this j3 ferrite changes to the normal and magnetic a state, so that the metal becomes magnetic. Moreover, the crystallization of ferrite within the martensite, which began at Ars, continues until 690° or Ari is reached, by which time so much iron has separated out that the remaining mother-metal has reached the composition of hardenite, i.e., it now contains 0-90 per cent, of carbon. Again, as the temperature in turn falls past A,i, this hardenite mother-metal splits up into cementite and ferrite grouped together as pearlite, with simul-taneous change of this ferrite to the a state, and with the resulting recalesoence. All these phenomena are parallel with those of 1 -00 per cent, carbon steel at this same critical point A,i. As such steel cools slowly past Ar3, Ara, and Ari, it loses its harden-ing power progressively. In short, from Ars to Aji, the excess

[constitution

substance, ferrite or cementite, hypo- and hyper-eutectic steels respectively, progressively crystallizes out within the martensite mother-metal, which thus progressively approaches the composi-tion of hardenite, reaching it at Ari, and there splitting up into ferrite and cementite interstratifled as pearlite. Further, any ferrite liberated at A^g changes there from 7 to /3, and any present at Ar2 changes from ^ to a. Between 0 and S, A^g and Ar2 occur together, as do Ar2 and A^ between S and P', and A^, A^a, and A,i at S itself ; so that these critical points in these special cases are called Ars-a, Ar3_i, and Ar3.2_i respectively. The corresponding critical points which occur during rise of temperature, with the reverse transformations, are called Ad, A<.2, A^j, &c., A (Chernoff) being their generic name, r referring to falling tem-perature (refroidissant), and c to rising temperature (chauffant, Osmond).

To take a third case, that of hyper-eutectic steel containing

Fig. 4. — The constitution of iron and steel. (After Roberts-AnBten, with modifications by

Bakhuis Boozeboom.) The Roman letters indicate the constituents normal and stable in

each of the many fields into which the diagram is divided. The transformations wliich in

cooling occur at the horizontal and oblique boundary lines of these fields are indicated

In itaucs.

2-50 per cent, of carbon, and thus approaching the limits of oast

iron : since some 2 per cent, of carbon suffices to saturate solid

7 iron, the martensite, which progressively freezes out as the

temperature sinks below V, tends to reject, and thus to leave in

the still molten matrix of entangled mother-metal, all carbon in

excess of this quantity. This progressive separation of martensite,

with consequent enrichment of the mother-metal in carbon, con-

tinues with further fall of temperature until, when 1125° C. (V on

aBc) has been reached, the carbon-content of the mother-metal

has reached 4-30 per cent., which is that of the martensite plus

graphite eutectic. As the temperature now sinks past aBo this

mother-metal in turn freezes as a whole, splitting up into the

eutectic conglomerate of martensite plus graphite, and, as in the

other cases, the heat thus liberated retards the cooling. When

the temperature falls to 1000", part of the graphite already formed unites with part of the iron of the martensite to form cementite ; so that between V" and V" the mass is a conglomerate of martensite, cementite, and graphite. On reaching Ari at V" this martensite (now become hardenite) as usual splits up into pearlite, and the mass now becomes a conglomerate of pearlite, cementite, and graphite, and remains so after cooling is complete.

As we pass to cases with higher and higher carbon-content, the martensite which begins freezing on cooling past the line AB forms a smaller and smaller proportion of the whole, and the martensite-graphite eutectic which forms at the second freezing-point aB increases in amount until, when the carbon-content reaches 4-30 per cent., there is but a single freezing-point, and the whole mass when .solid is made up of this eutectic. If there be more than 4-30 per cent, of carbon, then not martensite but graphite solidifies between BD and Be, but, as before, the martensite-graphite eutectic freezes at the lower freezing-point Be. But in either case the changes occur at EF and PSP' which have been described for hyper-eutectic steel of 2-50 per cent, of

carbon.

Just as the presence of carbon shifts the positions of the freezing-point and of the varioiis critical points, so does that of other elements, notably silicon, phosphorus, manganese, chromium, nickel, and tungsten. Nickel and manganese lower these critical points, so that, with 25 per cent, of nickel or with 13 per cent, of manganese, Ars lies below the common temperature of 20° C. These steels then normally consist of 7 iron, modified by the large amount of nickel or manganese with which it is alloyed. They naturally are non-magnetic, or very feebly magnetic. But the critical points of such nickel steel, though thus depressed, are not destroyed ; and if it be cooled in liquid air below its A^, it passes to the a state and becomes magnetic.

§ 3. Thermal Treatment. — The hardening, tempering, and annealing of steel, the chilling and annealing of cast iron, and the annealing of malleable cast iron, are readily-explained by the facts just set forth.

Sudden cooling hardens and embrittles steel and cast iron because it retains the

high temperature martensite state, by denying the time needed for these successive transformations vs^hich, in slow cooling, finally yield a mixture of pearlite either with ferrite, or with cementite alone, or with cementite and graphite; in the cold these transformations cannot take place, thanks to molecular rigidity or other cause. The suddenly cooled metal is hard and brittle, because the cold martensite which it contains is hard and brittle. The degree of hardening which steel undergoes increases with its carbon-content, either (1) because the hardness of martensite increases with its own carbon-content ; or (2) because during sudden cooling the presence of carbon, like a brake, impedes the change from martensite to pearlite with ferrite or cementite, thus leading to a more com-

plete retention of the martensite, or of

the intermediate fi state of the ferrite;

or (3) for both reasons.

But these transformations, though re-

strained by the sudden cooling, still tend

to occur; if we reheat hardened steel to say 260° C.

(482° P.) as in tempering, we so far relax this restraint

that part of the martensite, thus forcibly retained,

changes to pearlite with ferrite or cementite. We undo

the effect of the sudden cooling, to a degree which in-

creases with the temperature of reheating or "temper-

ing," and with the degree of molecular freedom which

it gives. If the reheating be carried still farther, to

a dull red heat, the restraint is wholly relaxed, so that

the change from martensite to pearlite and cementite

becomes complete ; the metal is as soft and ductile as

if the cooling had been slow instead of sudden ; it is

annealed.

" Chilling " cast iron, i.e., hastening its cooling by casting it in

a cold mould, restrains the separation of graphite by hurrying the

metal through the range between ABD and EF in which graphite tends to form, and retains in its stead the supersaturated martensite which the metal forms on sudden solidification, more or less split up into pearlite and cementite on passing A,.2.i. The annealingof such iron may occur in either of two degrees — a small one, as in making common chilled cast iron objects, such as railway car wheels, or a great one, as in making malleable cast iron. In the former case, the objects are heated only to the neighbourhood of Art, so that the martensite may resolve itself into pearlite and cementite. The joint effect of such chilling and such annealing is to make the metal much harder than if slowly cooled, because for each 1 per cent, of graphite which the chillmg constitution]

suppresses, the annealing substitutes 15 1 per cent, of the glass-hard cementite.

In making "malleable cast iron" the reheating is carried to a temperature near or perhaps above EF, so that the graphite-forming tendency, suppressed by the initial relatively rapid cooling — a

suppression favoured by the special composition of the cast iron used — asserts itself. Since graphite and iron combine to form cementite vrhen the temperature sinks past 1000°, reheating the metal above 1000° should cause cementite to split up into martensite plus graphite. Graphite now forms slowly within the mass ; but whereas the graphite which separates when common cast iron objects cool slowly from the melting-point forms large flakes which weaken and embrittle the metal by breaking up its continuity, that which now separates forms a fine powder, naturally much less injurious. For this heating the castings are packed in a mass of iron oxide, which at this temperature gradually removes the fine or "temper" graphite by oxidizing that in the outer crust to carbonic oxide, whereon the carbon farther in begins diffusing outwards by " molecular migration," to be itself oxidized on reaching the crust. This removal of graphite doubtless further stimulates the formation of graphite, by relieving the mechanical and perhaps the osmotic pressure. Thus, first, for the brittle glass-hard cementite and martensite there is gradually substituted the relatively harmless temper graphite ; and, second, even this is in large part removed by surface oxidation.

Each of these ancient processes thus consists essentially in so manipulating the temperature that, out of the several possible constituents, the metal shall actually consist of a special set in special proportions. But in addition there is another very important principle underlying many of our thermal processes, viz., that the state of aggregation of certain of these constituents, and through it the properties of the metal, as a whole, are profoundly affected by temperature manipulations. Thus, prior exposure to a temperature materially above Ad coarsens the structure of most steel, in the sense of giving it when cold a coarse fracture, and enlarging the grains of pearlite, &c., found in the slowly-cooled metal. This coarsening and the brittleness which accompanies it Increase with the temperature to which the metal has been exposed. Steel which after a slow cooling from about 722° C. will bend 166° before breaking, will, after slow cooling from about 1050° C, bend only 18° before breaking. This injury fortunately can be cured either by reheating the steel to A^, when it " refines," i.e., returns spontaneously to its fine-grained ductile state (cooling past Ai does not have this effect) ; or by breaking up the coarse grains by mechanical distortion, e.g., by forging or rolling. For instance, if

steel has been coarsened by heating to 1400° C, and if, when it has cooled to a lower temperature, say 850° Cf. , we forge it, its grain-size and ductility when cold will be approximately those which it would have had if heated only to 850°. Hence steel which has been heated very highly, whether for welding, or for greatly softening it so that it can be rolled to the desired shape with but little ex-penditure of power, ought later to be refined, either by reheating it from below A,i to Aji, or by rolling it after it has cooled to a relatively low temperature, i.e., by having a low " finishing tem-perature." Steel castings initially have the extremely coarse structure due to cooling without mechanical distortion from their very high temperature of solidification; they are "annealed," j.e., this coarseness and the consequent brittleness are removed, by re-heating them to the critical range, which also relieves the internal stresses due to the different rates at which different layers cool, and hence contract, during and after solidification. Foi steel containing less than some 0-13 per cent, of carbon, the embrittling temperature is in a different range, near 700° C., and such steel refines at tem-peratures above 900° C.*

When we consider the great number of different regions

in rig. 4, each ~~with its own set of constituents, and re~~
member that by different rates of cooling from different
temperatures we can retain in the cold metal these differ-
ent sets of constituents in widely varying proportions ;
and when we further reflect that not only the proportion
of each constituent present but also its state of aggrega-
tion can be controlled by thermal treatment, we see how
vast a field is here opened, how great a variety of different
properties can be induced in any individual piece of steel,
how enormous the variety of properties thus attainable
in the different varieties collectively, especially since for
each percentage of carbon an incalculable number of
varieties of steel may be made by alloying it with differ-
ent proportions of such elements as nickel, chromium, &c.
1 Fifteen per cent. , if we add together both the "excess" cementite
and that contained in the eutectic pearlite, which result finally from
the carbon which has been prevented from separating as graphite.
As yet there has been only the roughest survey of certain
limited areas in this great field, the further exploration
of which will enormously increase the usefulness of this

wonderful metal.

§ 4. Alloy steels have come into extensive use for important special purposes, and a very great increase of their use is to be expected. The chief ones are nickel steel, manganese steel, chrome steel, and tungsten steel. The general order of merit of a given variety or specimen of iron or steel may be measured by the degree to wliich it combines strength and hardness with ductility. These two classes of properties tend to exclude each other, for, as a general rule, whatever tends to make iron and steel hard and strong tends to make it correspondingly brittle, and hence liable to break treacherously, especially under shock. Manganese steel and nickel steel form an important exception to this rule, in being at once very strong and hard and extremely ductile. Nickel steel, which usually contains from 3 to 3‘60 per cent, of nickel and about 0-25 per cent, of carbon, combines very great tensile strength and hardness, and a very high limit of elasticity, with great ductility. Its combination of ductility with strength and hardness has given it very extended use for the

armour of war-vessels. Por instance, following Krupp's formula, the side and barbette armour of war-vessels is now generally if not universally made of nickel steel containing about 3-25 per cent, of nickel, 0-25 per cent, of carbon, and 1-60 per cent, of chromium, deeply carburized on its impact face. Here the merit of nickel steel is not so much that it resists perforation, as that it does not crack even when deeply penetrated by a projectile. The combination of ductility, which lessens the tendency to break when overstrained or distorted, with a very high limit of elasticity, gives it great value for shafting, the merit of which is measured by its endurance of the repeated stresses to which its rotation exposes it whenever its alignment is not mathematically straight. The alignment of marine shafting, changing with every passing wave, is an extreme example. Such an intermittently applied stress is far more destructive to iron than a continuous one, and even if it be only half that of the limit of elasticity, its indefinite repetition eventually causes rupture. In a direct competitive test the presence of 3-25

per cent, of nickel increased nearly sixfold the number of rotations which a steel shaft would endure before breaking.

As actually made, manganese steel contains about 12 per cent, of manganese and 1-60 per cent, of carbon. Although the presence of 1‘50 per cent, of manganese makes steel brittle, and although a further addition at first increases this brittleness, so that steel containing between 4 and 5-5 per cent, can be pulverized under the hammer, yet a still further increase gives very great ductility, accompanied by great hardness — a combination of properties which was not possessed by any other known substance when this remarkable alloy, known as Hadfield’s manganese steel, was discovered. Its ductility, to which it owes its value, is profoundly affected by the rate of cooling. Sudden cooling makes the metal extremely ductile, and slow cooling makes it brittle ; its behaviour in this respect is thus the opposite of that of carbon steel. Its great hardness, however, is not materially affected by the rate of cooling. It is used extensively for objects which require both hard-

ness and ductility, such as rock-crushing machinery, rail-way crossings, mine-car wheels, and safes. The burglar's blow-pipe locally " draws the temper," i.e., softens a spot on a hardened carbon steel or chrome steel safe by simply heating it, so that as soon as it has again cooled he can drill through it and introduce his charge of dynamite.

But neither this nor any other known procedure softens manganese steel. This very fact that it is unalterably

[extraction-

hard has, however, limited its use, because of the great difficulty of cutting it to shape, which has in general to be done with emery wheels instead of the usual iron-cutting tools. Another defect is its relatively low elastic limit.

Chrome steel, which usually contains about 2 per cent, of chromium and 0-80 to 2 per cent, of carbon, owes its value to combining, when in the " hardened " or suddenly cooled state, intense hardness with a high elastic limit,

so that it is neither deformed permanently nor cracked by extremely violent shocks. For this reason it is the material generally if not always used for armour-piercing projectiles. It is much used also for certain rock-crushing machinery (the shoes and dies of stamp-mills), and for safes. These are made of alternate layers of chrome steel and soft wrought iron, hardened by sudden cooling. The hardness of the hardened chrome steel resists the burglar's drill, and'the ductility of the wrought iron the blows of his sledge.

Tungsten steel, which usually contains from 5 to 10 per cent, of tungsten and from 1 to 2 per cent, of carbon, is used for magnets, because of its great retentivity, and for lathes and simUar metal-cutting tools which are to cut off a very thick slice at each cut. The great friction, due to the thickness of the cut, heats the tool to a temperature at which the temper of common or "carbon" steel is drawn. The merit of tungsten steel is that, like manganese steel, it retains its extreme hardness even after it has been heated to 400° C. (752° F.). Under these conditions

the Taylor and White variety retains its cutting power even when the friction is so great that the chips of metal cut are so hot as to glow visibly, and even the edge of the tool itself grows red-hot.

§ 5. Deep Garburizing ; Harvey and, Krupp Processes. — Much of the heavy side armour of war-vessels is made of nickel steel initially containing so little carbon that it cannot be hardened, i.e., it remains very ductile even after sudden cooling. The impact face of these plates is given the intense hardness needed by being converted into high-carbon steel, and then hardened by sudden cooling. Harvey carburized the impact face to a depth of about an inch by heating the plate for about a week to about 1200° C. (2192° F.), with that face strongly pressed against a bed of charcoal. The Krupp process, a newer one, carburizes the impact face by exposing it at a high temperature to illuminating gas. This is decom-posed by the heat, and deposits on the face of the plate a layer of fine carbon, which is absorbed by the steel as in the cementation process. The impact face thus carburized

is cooled suddenly from a red heat, e.g., by spraying it with iced brine. An intensely hard impact surface results, the hardness decreasing gradually from this face inwards. Thanks to the glass-hardness of the face, the projectile is arrested so abruptly that it is shattered, and its energy is delivered piecemeal by its fragments ; but as the face is integrally united with the unhardened, ductile, and slightly yielding interior and back, the plate, even if it be bent backwards somewhat by the blow, neither cracks nor flakes.

II. EXTBAOTION OF IkON FKOM ITS OeES.

§ 6. The blast-furnace process has been so much cheap-ened by the great increase in its rate of production, and by the introduction of mechanical appliances for handling the raw materials and the iron and slag, that it is now the sole important process of extracting iron from its ores. Practically all the iron ore mined passes through the blast-furnace, if we except the relatively small quantity used in the puddling and the open-hearth processes, each of which may recover a fraction of the iron of the ore used in

it. The blast-furnace has a very great advantage over the direct processes of extracting wrought iron or steel from the ore, in recovering nearly the whole of the iron present, and in delivering both its products, the metal and the slag, in a molten state, in which they can be handled far extkaction]

more cheaply than if solid or pasty. It is not easy to see how either of these things can be accomplished by any direct process. The advantages of the blast-furnace are so great, that not only have the direct processes practically

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Fig. 6. — Section of one of the Duquesne blast-furnaces. GG, flanges on the ore bucket ; HH, fixed flanges on the top of the furnace ; J, counter-weighted false bell ; K, main bell ; O, tuyere ; I, cinder notch ; E, E', water-cooled boxes ; S, blast pipe.*

ceased to exist, but we can hardly see in what way they are to be revived, unless it be through some modification of the blast-furnace process itself, which shall bring the composition of its product nearer to that of steel, i.e., shall give it less carbon and silicon than are present in cast iron as now made. The stumbling-block in the way of developing such a modification is the removal of sulphur. The processes for converting cast iron into steel can now remove phosphorus easily, but the removal of sulphur in them is so difBcult that it has to be accomplished for the most part in the blast-furnace itself. In the latter there have been remarkable economies in the mechanical arrangements for handling the ore, flux, and fuel, and the cast iron and slag ; a great improvement in the protection of the inner walls of the furnace by better water-cooling ; and a remarkable increase in the output, chiefly due to the use of extremely powerful blowing engines and blast-heating stoves. But the latest great advance, the use in gas engines of the waste gases escaping from the top of the furnace, is perhaps the most

striking and important of all.

A. Z7ie Handling of Bcuw Materials. — That any of the raw materials should be shovelled by hand is a thing

Fig. 7. — ^Diagram showing the transfer of the ore from the bucket to the main charging bell. Lettering as in Fig. 6.

no longer even to be considered in designing new works, at least in the United States. The arrangement at the Carnegie Company's Duquesne works (Fig. 5) may serve as an example of modern methods of handling.

The standard-gauge oars which hring the ore and coke to Duquesne pass over one of three very long rows of bins, A, B, and C (Kg. 5), of which A and B receive the materials (ore, coke, and lime-stone) for immediate use, while C receives those to he stored for winter use. From A and B the materials are drawn as they are needed into large buckets D standing on cars, which carry them to the foot of the hoist track EE, up which they are hoisted to the top of the furnace. Arrived here, the material is introduced into the furnace without allowing any of the furnace gas to escape by an ingenious piece of mechanism. The hoist-engineer in the

house P at the foot of the furnace, when informed by means of an indicator that the bucket has arrived at the top, lowers it so that its flanges GG (Fig. 6) rest on the corresponding fixed flanges HH, as shown in Fig. 7. The further descent of the bucket being thus arrested, the special cable T is now slackened, so that the conical bottom of the bucket drops down, pressing down by its weight the counter-weighted false cover J of the furnace, so that the contents of the bucket slide down into the space between this false c6ver and the tru6 charging bell, K. The special cable T is now tightened again, and lifts the bottom of the bucket so as both to close it and to close the space between J and K, by allowing J to rise back to its initial place. The bucket then descends along the hoist-track to make way for the next succeeding one, and K is lowered, dropping the charge into the furnace. Thus some 1700

tons of materials are charged daily into each of these furnaces

without being shovelled at all, running by gravity from bin to bucket and from bucket to furnace, and being hoisted and charged into the furnace by a single engineer below, without any assistance or supervision at the furnace-top.

The winter stock of materials is drawn from the left-hand row of bins, and distributed over immense stock piles by means of the great crane LL (Fig. 5), which transfers it as it is needed to the row A of bins, whence it is carried to the furnace, as already explained.

B. Handling the Molten Cast Iron. — A great saving of labour was effected by the introduction of "pig-breaking" machines. A whole row or litter of pigs, with its sow (see Ency. Brit., vol. xiii. p. 306, Fig. 24), was lifted from its moulds by a travelling crane, and placed on rollers which progressively fed it forward, one pig at a time, under a hydraulic press with three plungers, of which one broke ofE the sow between a given pig and its neighbour, and two others broke the pig itself into three pieces, which slid down into a car beneath. The iron is handled still more cheaply by the Uehling type of casting

machine (Rg. 8), which consists essentially of a series of thin moulds, BB, carried by endless chains past the lip of a great ladle A. This pours into them the molten cast iron which it has just received direct from the blast-furnace. As the string of moulds, each thus containing a pig, moves slowly forward, the pigs solidify and cool, the more quickly because in transit they are sprayed with water, or even submerged in water in the tank EE. Arrived at the farther sheave C, the now cool pigs are dumped into a railway car. Besides a very great saving of labour, which, however, is partly counterbalanQed by the cost of repairs, these machines have the great merit of making the management independent of a very trouble-some set of labourers, the hand pig-breakers, who were not only absolutely indispensable for every cast and every day, because the pig iron must be removed promptly to make way for the next succeeding cast of iron, but very difficult to replace because of the great physical endurance required.

C. Preservation of the Furnace Walls. — The combined

fluxing and abrading action of the descending charge tends to wear away the lining of the furnace where it is hottest, which of course is near its lower end, thus changing its shape materially, lessening its efficiency, and in particular increasing its consumption of fuel. The walls therefore are now made thin, and are thoroughly cooled by water, which circulates through pipes or boxes bedded in them. Mr James Gayley's method of cooling, shown at the right-hand side of !Fig. 6, is to set in the brickwork walls several horizontal rows of flat water-cooled bronze boxes, BE', extending nearly to the interior of the furnace, and tapered so that they can readily be withdrawn and replaced in case they burn through. The brickwork may wear back to the front edges of these boxes, or even, as is shown at E', a little farther. But in the latter case their edges still determine the effective profile of the furnace walls, since the depressions at the back of these edges become filled with carbon and scoria-ceous matter when the furnace is in normal working. Each of these rows, of which five are shown in

Eig. 6, consists of a great number of short segmental boxes.

D. Blast-furnace Gas Engines. — The gases which escape from the top of the blast-furnace are necessarily very rich in carbonic oxide, of which they usually contain between 20 and 26 per cent., and they are thus a very valuable fuel. They have hitherto been used chiefly for heating the blast, and for raising steam not only for generating that blast, but also more lately for the rolling-mill and other engines of the establishment. But it has now been shown that these gases can be used directly in gas engines, in which they generate about four times as much power as would be developed by the steam raised extraction]

by burning them under boilers. It has been calculated that the gas from a pair of old-fashioned blast-furnaces, making 1600 tons of iron per week, would in this way yield some 16,000 horse-power in ex-

cess of their own requirements. At that rate a pair of the great American furnaces would have some 70,000 horse-power to spare. Although the quantity may really be much less than this, because the higher efficiency of these furnaces leaves less residual calorific power in the waste gases, it is clear that their importance as sources of power is very great. This use of the gas engine is likely to have far-reaching results. In order to utilize this power, the converting, i.e., steel-making, mill and the rolling-mills must adjoin the blast-furnace. The numerous converting mills which treat pig iron made at a distance will now have the crushing burden of providing in other ways the power which their rivals get from the blast-furnace, in addition to the severe disadvantage under which they already suffer, of wasting the initial heat of the molten cast iron as it runs from the blast-furnace.

E. Hot-Blast Stoves. — The cast iron or " pipe " stoves, in which the blast was heated by passing through a long series of cast iron pipes, around and outside which the waste gases of the blast-furnace itself were burnt, are fast going out of use, chiefly because they are destroyed quickly if an attempt is made to heat the blast above 1000° F. (538° C). In their place the regenerative stoves of the Whit-well and Cowper (Fig. 9) types are chiefly used. With these 'the regular temperature of the blast at some works is about 1400° F. (760° C), and the usual blast temperature lies between 900° and 1200° F. (480° and 650° C). Like the Siemens furnace, they have two distinct phases — one " on gas," during which part of the waste gas of the blast-fnrnace is burnt within the stove, highly heating the great surface of brickwork which for that purpose is provided within it ; the other, " on wind," during which the blast is heated by passing it

back over these very surfaces which have thus been heated. They are heat-filters or heat-traps for impounding the heat developed by the combustion of the furnace gas, and later returning it to the blast. Each blast-furnace is now provided with three or even four of these stoves, which collectively may be nearly thrice as large as the furnace itself. At any given time one of these is "on wind" and the others "on gas." The Whitwell stove {Enoy. Brit, vol. xiii. p. 304, Fig. 19) has been simplified by greatly lengthening it and reducing the number of its vertical partitions from nine to three, so that the blast, and also the gas, has only three instead of nine reversals of direction, and the blowing engines have just so much less frictional resistance to overcome. The necessary heating surface is given by three high partitions instead of by nine short ones. The Cowper stove (Fig. 9) differs from the Whitwell (1) in having not a series of flat smooth walls, but a great number of narrow vertical flues, for the alternate absorption and emission

of the heat, with the consequence that, for given out-

side dimensions, it offers about one-half more heating

surface than the Whitwell stove ; and (2) in that the

gas and the blast pass only once up and once down

through it, instead of twice up and twice down as in

the modern Whitwell stoves. As regards frictional

resistance, this smaller number of reversals of direc-

tion compensates in a measure for the smaller size of

its flues. The , large combustion chamber B permits

thorough combustion of the gas.

F. The Increase in the Rate of Production

per furnace has been extraordinary. In 1863 a

daily production of 60 tons per furnace, and in 1880 one

of 115 tons, was unusually large ; but in 1898 one of the

Fig. 9. — Diagram of Cowper hot-blast stove at Duquesne. (After J. Kennedy.)

A, entrance for blast-furnace gas ; B, B, combustion chamber \ C,

chimney valve ; D, cold blast main. Broken arrows show the path of

the gas and air while the stove is "on gas," and solid arrows that of the

blast while it is ' on wind."*

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Duquesne furnaces made 711 tons in a day, and the four furnaces there were making regularly between 2200 and 2300 tons daily, a rate as great as that of the whole world in 1800, and half as great as that of all the United States furnaces collectively in 1870. The rate of output of a single one of these furnaces is much greater than that of all the United States furnaces in 1830, about ten times that of 1820, and nearly four times that of the 163 furnaces in the United States in 1810. These Carnegie furnaces of course are exceptional ones, and the common rate of production, especially in case of European furnaces, is much less. For instance, the average daily production in the eighty-five existing and projected furnaces of Lorraine and Luxemburg is estimated at only 127 tons, and the greatest estimated daily production for any of those now building is only 200 tons. Indeed, it is questioned whether the rapid driving at Duquesne, with its rich Lake Superior ores, would be economical if applied

to the lean Minette ores of Luxemburg and Lorraine. The remarkable increase since 1880 has been brought about, not chiefly by the use of larger furnaces, although the hearth or crucible is made somewhat wider than formerly, but by providing very powerful engines and hot-blast stoves; and it has almost forced the adop-tion of simple mechanical arrangements for handling rapidly both the raw materials and the products of the furnace. Between 1880 and 1899 the importance of anthracite as a fuel for iron smelting decreased greatly and that of charcoal very greatly; thus of the total United States product of pig iron, the percentage made with anthracite decreased in this period from 42 to 12, and that made with charcoal from 13 to 2 (see Table VI.).

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Fio. 10. — Diagrammatic section of the Pietzka puddling farnace.

III. CONVEKSION INTO WkOUGHT IeON AND StEBL.

§ 7. Manufacture of Wrought Iron. — That wrought iron, which in 1880 seemed about to be completely displaced by mild steel, remains in very extensive use is due chiefly

(1) to the conservatism, often reasonable, of certain consumers, (2) to the great ease with which it welds, and (3) to the great purity which can readily be given to it. Thus wrought iron horse-shoes, bars, &c., are made in great quantities for country smiths and others who have had no opportunity to learn the slightly different treatment which mild steel needs. Welded steam, gas, and water pipes also are still often made of wrought iron instead of steel, because here thoroughness of welding is of the first importance, and because if steel for pipes is made sufficiently free from carbon to weld readily, special care is needed to prevent cavities called " blow-holes " (see § 12), due to the escape of gas from the steel when the ingots into which it is initially cast are solidifying. These blow-holes are liable either to aggravate the effects of rusting by causing local pitting, or to injure the soundness of the thread which is cut at the end of each length of pipe. As a material for making the better classes of tool steel by remelting by the crucible process, wrought iron is preferred to mild steel, both because it can be made freer

than mild steel from certain elements, especially man-
ganese, which are here undesirable, and because the cru-
cible steel mad.e from it is, in the opinion of the best
judges, better than that made from mild steel even if of
like composition, though why this is so has not been con-
vincingly explained. For the former of these reasons,
too, and perhaps also because of its very defect of being
laminated by the presence of cinder, wrought iron is more
ductile than mild steel under certain special conditions of
use, such as those of rivets and horse-shoe nails, many of
which are made of it.

While the yearly production of wrought iron in the United
States more than doubled between 1870 and 1890, yet since the
latter year it has shrunk very much, probably nearly to that of
1870 ; and between 1870 and 1900 the proportion wMch the pro-
duction of wrought iron bears to that of steel diminished very
greatly. Of the combined annual production of wrought iron and
steel in the United States, that of wrought iron formed 95 per cent,
in 1870, 63 per cent, in 1880, 37 per cent, in 1890, and probably not
far from 15 per cent, in 1899. The corresponding numbers for

Great Britain are 34 per cent, for 1890, and 19 per cent, for 1899, in which year the average number of British puddling furnaces in operation is reported as 1149 out of a total of 1320 in existence. Thus in nineteen years the position of wrought iron changed from that of the chief product to one of secondary importance.

The Puddling Process still supplies nearly all the wrought iron made. The numerous mechanical puddling furnaces which in 1880 or thereabouts were offered so prominently as means of lessening the very severe labour of the puddler have for the most part disappeared, even the Danks furnace being now almost forgotten, and puddling is now usually done by hand in the old-fashioned furnaces and in the same way as formerly. The novelties in pud-dling which here need notice are (1) the Pietzka furnace, (2) a tentative increase in the size of charges treated, and (3) the use of " direct metal," i.e., molten cast iron direct from the blast-furnace.

A much lower temperature is needed during the early part of the puddling process, in which the initial charge of cast iron, a relatively fusible substance, is melted down,

than towards the end, when the resultant relatively infusible wrought iron must be very highly heated so that its particles may be welded firmly together, and the cinder be so fluid that the greater part of it may readily be squeezed out of the puddled ball. The Pietzka furnace (Fig. 10) is designed to meet this condition, by having two separate " hearths " or working chambers, A, A, in the right-hand or cooler of which a new charge is melted down and puddling is begun, while in the left-hand hearth, which conversion]

is hotter because nearer the fire, another charge is finishing. As soon as this latter charge has been drawn from the furnace and the necessary repairs have been made, the two hearths are made to change places, being lifted by means of the hydraulic plunger B, and rotated 180° about this plunger as an axis. This brings to the hot end of the furnace the charge of which the treatment has been begun at the cooler end. To permit this

rotation the joints C, between the rotating parts of the furnace and the fixed parts, may be made conical. In effect the heat, which in a common puddling furnace would escape directly from the working chamber into the chimney and thus be lost, is here used in the right-hand or cooler hearth for the early part of the process itself. Beyond this, the heat in the escaping products of combustion may be further recovered by the Siemens regenerative or by the recuperative system. Thus arranged, the Pietzka furnace effects a great saving of fuel.

In common practice the cast iron as it runs from the blast-furnace is allowed to solidify and cool completely in the form of pigs, which are then graded by their fracture, and remelted in the puddling furnace itself. At Hourpes, in order to save the expense of this remelting, the molten cast iron as it comes from the blast-furnace is poured directly into the puddling furnace, in large charges of about 2200 pounds, which are thus about four times as large as those of common puddling furnaces. These large charges are puddled by two gangs of four men each,

and a great saving in fuel and labour is effected.

Attractive as are these advances in puddling, they have not been widely adopted, for two chief reasons : Tirst, owners of puddling works have been reluctant to spend money freely in plant for a process of which the future is so uncertain, and this unwillingness has been the more natural because these very men are in large part the more conservative fraction, which has resisted the tempta-tion to abandon puddling and adopt the steel-making processes. Second, in puddling iron which is to be used as a raw material for making very fine steel by the crucible process, quality is the thing of first importance. Now in the series of operations, the blast-furnace, puddling, and crucible processes, through which the iron passes from the state of ore to that of crucible tool steel, it is so difficult to detect just which are the conditions essential to excel-lence in the final product that, once a given procedure has been found to yield excellent steel, every one of its details is adhered to by the more cautious ironmasters, often with surprising conserva-tism. Buyers of certain excellent classes of Swedish iron have been said even to object to the substitution of electricity for water-power as a means of driving the machinery of the forge. In case

of direct puddling and the use of larger charges this conservatism is reasonable, for the established custom of allowing the cast iron to solidify gives a better opportunity of examining its fracture, and thus of rejecting unsuitable iron, than is afforded in direct puddling. So, too, when several puddlers are jointly responsible for the thoroughness of their work, as happens in puddling large charges, they will not exercise such care (nor indeed will a given degree of care be so effective) as when responsibility for each charge rests on one man.

§ 8. In the Siemens-Martin Process, now m6re often called the open-hearth process, the advances have been more important than those in any other branch of steel making. The chief of them are : (1) the wide use of a basic lining and basic .slag, so that the process removes phosphorus from the iron ; (2) a great increase in the size of furnaces, from 10 to 60 and even 100 tons capacity ; (3) the use of tilting furnaces ; and (4) special modes of procedure.

In 1880 the radical defect of the open-hearth process, like that of the Bessemer process, was that it did not

remove phosphorus, of which nearly all pig irons contain more than is desirable, and most of them more than is permissible, in steel. The essence of both these processes is the removal, by oxidation, of the impurities — carbon, silicon, manganese, &c. — which the molten cast iron contains. Phosphorus also may be oxidized by means of iron oxide, forming phosphoric acid, which separates from the molten metal and combines with the slag floating upon it. Phosphoric acid, however, is here so unstable that it tends strongly to be again deoxidized, as fast as it is formed, by the carbon and silicon of the molten iron beneath, or even by the molten iron itself, and, when so deoxidized, it immediately re-unites with that iron, so that in effect dephosphorization is wholly prevented. This strong tendency to instantaneous and complete " rephosphorization" must be counteracted if the removal of phosphorus is to be effective, and to make that possible the slag must be made strongly retentive of phosphoric acid. This is its condition only when it contains an excess of powerful basis, such as lime and iron oxide, for these, so long as they are

in excess, form with the phosphoric acid salts so stable as to resist the deoxidizing action of the molten metal beneath. Silica, or silicic acid, here plays the part of an acid so powerful that, if there be more than some 20 per cent, of it in the slag, it enfeebles the hold of these bases on the phosphoric acid, with the result that much of this substance is reduced to phosphorus, and consequently reabsorbed by the molten metal. To exclude silica the furnace walls, which under other conditions are usually made of sand or clay, are here made either of a neutral substance, chromite (FeO, CrjOg), or of a basic and yet infusible one, such as magnesia or the mixture of magnesia and lime which results from calcining dolomite (Ca, Mg)C03. This, when mixed with some 10 per cent, of dehydrated coal tar, is coked by the heat of the furnace into a hard ringing mass, which is much more resistant than a silicious lining, so that the basic process is actually easier to conduct than the older or " acid " process with its acid, i.e., silicious, walls and slag. The basic variety has reached great importance in Germany, and in America 70

per cent, of the total of open-hearth steel is made by it, though in Great Britain the proportion is only 10 per cent. Furnaces, each treating a charge of 60 tons — five times the weight common in 1880 — have proved so economical that one of 76 tons has been built ; and this has proved so completely successful that one of 100 tons capacity is building. No special difficulties have arisen in the use of these enormous furnaces. The gas and the air each enter the furnace through a single port, yielding a flame so great and long as to fill the whole melting chamber.

Many of these large furnaces are tilted at the end of each charge, as shown by the arrows in Fig. 13, so as to pour the molten steel into the casting-ladle and the molten slag into its receptacle ; thus the troublesome operation of pouring is brought under much better control. This and the other incidental advantages of tilting are much more important in the basic than in the acid process, but even in the former case it is not generally conceded that the tilting system has yet been so perfected as to

make its advantages considerably outweigh its greater cost for installation and repairs.

Figs. 11 to 14 are intended to explain not only the tilting furnace, but the general principle of the Siemens furnace. The charge of metal is melted and brought to the desired composition and temperature in the working chamber or body of the furnace, G, a long quasi-cylindrical vessel of brickwork, heated by burning within it preheated gas with preheated air. This working chamber is the furnace proper, in which the whole of the open-hearth process is carried out, and the function of all the rest of the apparatus, apart from the tilting mechanism, is simply to preheat the air and gas, and to lead them to the furnace proper and thence to the chimney. How this is done may be understood more easily if Pigs. 11 and 12 are regarded for a moment as forming a single diagrammatic figure instead of sections in different planes. The unbroken arrows show the direction of the incoming gas and air, the broken ones the direction of the escaping products of their combustion. The air and gas, the latter coming from the gas producers or other source, arrive through H and J respectively, and their path thence is determined by the position of the reversing

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valves K and K'. In the position shown in solid lines, these valves deflect the air and gas into the left-hand pair of "regenerators," large chambers filled with fire-bricks so piled as to leave abundant free passage for the gases. These, however, are exposed to an

Fig. 11. — Section on EF througb furnace and port ends.

mi I

Fig. 12. — Plan through re';:eneratoi'S, flues, and reversing valves.

Fig. 13. — Section on CD through body of furnace.

Fig. 14. — Section on AB through uptake, Blag pocket, and regenerator.

rigs. 11 to 14. — Diagrammatic sections of tilting and Siemens furnaces: G, funiace hody ; H, air supply; J, gas supply; K, air reversing valve; K', gas reversing valve; L, air port; L', gas port; M, rollers on which the furnace tilts; N, hydraulic cylinder for tilting the furnace ; 0, flue leading to chimney ; P, slag pockets; R, charging boxes; W, water-cooled joints between furnace proper, G, and ports L, L'.

enormous extent of brickwork surface, which we will assume for

the moment has been highly preheated, so that they are heated by contact with it to a light yellow heat, say 1100° C. (2012°?.). Ascending thence as two separate streams through the uptakes (Fig. 14), they first mix at the moment of entering the working chamber through the ports L and L' (Fig. 11). As they are so hot at starting, their combustion of course yields a very much higher temperature than if they had been cold before burning, and they form an enormous flame, which fills the great working chamber. The products of combustion are sucked by the pull of the chimney through the farther or right-hand end of this chamber, out through the exit ports, as shown by the dotted arrows, down through the right-hand pair of regenerators, heating to perhaps 1300° C. the upper part of loosely-piled masses of brickwork within them, and thence past the valves K and K' to the chimney-flue O. During this phase the incoming gas and air have been withdrawing heat from the left-hand regenerators, which hate thus been cooling down, while the escaping products of combustion have been depositing heat in the right-hand pair of regenerators, which have thus been heating up. After some thirty minutes this condition of things is reversed by turning the valves K and K' 90° into the positions

shown in dotted lines, when they deflect the incoming gas and air into the right-hand regenerators, so that they may absorb in passing the heat which has just been stored there ; thence they pass up through the right-hand uptakes and ports into the workmg chamber, where as before they mix, burn, and heat the charge. Thence they are sucked out by the chimney-draught through the left-hand ports, down through the uptakes and regenerators, here again meeting and heating the loose mass of "regenerator " brickwork, and finally escape by the chimney-flue O. After another thirty minutes the current is again reversed to its initial direction, and so on. These regenerators are the essence of the Siemens or " regenerative furnace" ; they are heat-traps, catching and storing by their enormous surface of brickwork the heat of the escaping products of combustion, and in the following phase restoring the heat to the entering air and gas. At any given moment one pair of regenerators is storing heat, while the other is restoring it. The tilting working chamber is connected with the stationary ports L and L' by means of the loose water-cooled joint W in Campbell's system, which is here shown. The furnace, resting on the rollers M, is tilted by the hydraulic cylinder N. The slag

pockets P (Fig. 14), below the uptakes, are provided to catch the dust carried out of the furnace proper by the escaping products of combustion, lest it enter and choke the regenerators. Wellman's tilting furnace rolls on a fixed rack instead of on rollers, and by his charging system a charge of as much as fifty tons is quickly introduced. The metal is packed by unskilled labourers in iron boxes, R (Fig. 13), standing on cars in the stock-yard. A loco-motive carries a train of these cars to the track running beside a long line of open-hearth furnaces. Here the charging machine lifts one box at a time from its car, pushes it through the momen-tarily opened furnace door, and empties the metal upon the hearth of the furnace by inverting the box, which it then replaces on its oar.

New Varieties of the Open-Hearth Process. — Cast iron differs from steel essentially in containing more carbon and silicon, and often more phosphorus ; and the open-hearth process converts molten cast iron into molten steel either (1) by diluting its carbon and silicon hy additions of scrap, steel,»or wrought iron {pig and sa-ap process) ; or (2) by oxidizing its carbon and silicon, jointly by

means of the oxidizing flame of the Siemens furnace, and of iron oxide added in the form of ore or scale {pig and ore process) ; or (3) by both means jointly. Because ore is usually much cheaper than scrap iron, the pig and ore process would usually be the cheaper, were it not that it must be conducted very slowly, lest the frothing due to the escape of the carbonic oxide gas, which results from the oxidation of the carbon of the metal, cause the charge to overflow. Eapid decarburization is permissible in the Bessemer process, which lasts only as many minutes as the open-hearth process lasts hours, because the Bessemer converter is very deep. Further, the cold iron ore of the pig and ore process can be introduced only very slowly, lest it chill the molten metal, both directly and because its reaction on the carbon absorbs heat ; this local cooling, indeed, is what aggravates the frothing. A cold lump of ore chills the slag immediately around it, just where its oxygen reacting on the carbon of the metal generates carbonic oxide ; the slag becomes cool, viscous, and froths easily just where gas is formed.

Bertrand and Thiel oxidize the carbon of molten cast iron by running it into a bath of molten iron which has first been conteesion]

oxygenated, i.e., charged with oxygen and superheated in an open-hearth furnace. The two metallic masses coalesce, and the reaction between the oxygen of one and the carbon of the other is therefore extremely rapid because it occurs throughout their depth, whereas in common procedure oxidation occurs only at the upper surface of the bath of cast iron at its contact with the over-lying slag. Moreover, since local cooling, with its consequent viscosity and tendency to froth, are avoided, the frothing is not excessive in spite of the rapidity of the reaction. The oxygenated metal is prepared by melting cast iron diluted with as much scrap steel as is available, and oxidizing it with the flame an,d with iron ore as it lies in a thin molten layer on the hearth of a large open-hearth furnace ; the thinness of the layer hastens the oxidation, and the large size of the furnace permits considerable frothing. But the oxygenated metal might be prepared easily in a Bessemer

■*converter.*

To enlarge the scale of operations makes strongly for economy in the open-hearth process as in other high temperature ones. (See below.) Yet the use of an open-hearth furnace of very great capacity, say of 75 or of 100 tons per charge, has the disadvantage that such very large lots of steel, delivered at relatively long intervals, are less readily managed in the subsequent operations of soaking and rolling down to the final shape, than smaller lots delivered at shorter intervals. To meet this difficulty Mr B. Talbot carries on the process as a quasi-continuous instead of an inter-mittent one, operating on 75- or 100-ton lots of cast iron in such a way as to draw off his steel in 20-ton lots at relatively short intervals, charging a fresh 20-ton lot of cast iron to replace each lot of steel thus drawn off. Besides minor advantages, this plan has the merit of avoiding an ineffective period which occurs in common open-hearth procedure just after the charge of cast iron has been melted down. At this time the slag is temporarily rich in iron oxide and silica, resulting from the oxidation of the iron and of its silicon as the charge slowly melts and trickles down. Such a slag not only corrodes the furnace lining, but also impedes

dephosphorization, because it is irretentive of phosphorus. Further, the relatively low temperature impedes decarburization. Clearly, no such period can exist in the continuous process.

At a relatively low temperature, say 1300° C, the phosphorus of oast iron oxidizes and is removed much faster than its carbon, while at a higher temperature, say 1500° C, carbon oxidizes in preference to phosphorus. It is well to remove this latter element early, so that when the carbon shall have fallen to the proportion whicli the steel is to contain, the steel shall already he free from phosphorus, and so ready to oast. In common open-hearth procedure, although the temperature is low early in the process, viz., at the end of the melting down, dephosphorization is then impeded by the temporary acidity of the slag, as just explained. At the Carnegie works Mr Monell gets the two dephosphorizing conditions, low temperature and basicity of slag, early in the process, by pouring his molten but relatively cool cast iron upon a layer of preheated lime and iron oxide in the open-hearth furnace. Phosphorus is quickly removed. – The ebullition from the formation of carbonic oxide puffs up the resultant phosphoric slag enough to make most of it run out of the furnace, thus both removing the phosphorus

permanently from danger of being later deoxidized and returned to the steel, and partly freeing the bath of metal from the heat-insulating blanket of slag. Yet frothing is not excessive, because the slag is not, as in common practice, locally chilled and made viscous by cold lumps of ore.

None of these new modifications has been long enough in use to permit a definite estimate of its merit. In the procedures followed by Bertrand'and Thiel and by Monell, the attack of the iron oxide on the basic lining of the furnace may perhaps be a source of trouble.

§ 9. The Bessemer Process. — The chief advances in the Bessemer process have been the use (1) of molten cast iron direct from the blast-furnace, or " direct metal " ; (2) of " mixers " in which the cast iron from several blast-furnaces is mixed together, so as to equalize its composition ; (3) of " car casting," or casting the molten steel in moulds standing on a train of cars. In addition to these, which are advances not in the nature but in the administration of the process, (4) the basic Bessemer or Thomas' process has come into extensive use (Ency. Brit, vol. xiii. 345).

1 Such terms as the " Bessemer-Mushet " process, the "Kelley-Bessemer" process, and the " Snelus-Thomas-Gilchrist " process are no longer in use. The Bessemer process is called after Bessemer alone, while in French and German the basic Bessemer process is called the Thomas process. While several men usually so contribute to the introduction of a process as to seem at iirst to have been essential to it, yet there is generally one great central figure to whom the world is chiefly indebted for its own adoption of the invention.

A. Direct Metal and the Mixer. — Until lately the cast iron for the Bessemer process has nearly always been allowed to solidify in pigs, which were next broken up by manual labour and remelted at great cost. It has long been seen that there should be a great saving if this remelting could be avoided and " direct metal," i.e., the molten cast iron direct from the blast-furnace, be treated in the Bessemer process. The obstacle is that, owing to unavoidable irregularities in the blast-furnace pijocess, the silicon- and sulphur-content of the cast iron vary to a degree and with an abruptness which the Bessemer process can hardly tolerate. Sulphur, which is not re-

moved in the acid Bessemer process, injures the steel so greatly that it must be held below a limit, fixed in each case by the uses to which the steel is to be put. Further, the point at which the process should be arrested is recognized by the appearance of the flame which issues from the converter's mouth, and variations in the silicon-content of the cast iron treated alter this appearance, so that the indications of the flame become confusing, and control over the process is lost. Moreover, the quality of the resultant steel depends closely on the temperature of the process, and this in turn depends upon the proportion of silicon, the combustion of which is the chief source of the heat developed. Hence the importance of having the silicon-content constant. This difficulty was avoided at the Carnegie "Edgar Thomson" works by Captain W. E. Jones's invention of the "Mixer," which is simply a great reservoir into which successive lots of molten cast iron from all the blast-furnaces available are poured, forming a great molten mass of some two hundred or more tons. This is kept molten by a small flame

playing above it, and successive lots of the cast iron thus mixed are drawn off, as they are needed, for conversion into steel by the Bessemer process. This device not only makes the cast iron much more uniform, but also removes much of its sulphur by a curious slow reaction. Many metals have the power of dissolving their own oxides and sulphides, but not those of other metals. Thus iron dissolves its own sulphide freely, but not that of either calcium or manganese. Consequently, when we deoxidize calcium in the iron blast-furnace, it greedily absorbs the sulphur which has dissolved in the iron as iron sulphide, and the sulphide of calcium thus formed separates from the iron. In like manner, if the molten iron in the mixer contains manganese, this metal unites with the sulphur present, and the manganese sulphide, insoluble in the iron, slowly rises to the surface, and there reaching the air, its sulphur oxidizes to sulphurous acid, which escapes. The use of the mixer, and through it that of direct metal, has now become general.

There still remains some irregularity in the silicon-content of the

cast iron, and consequently in the temperature developed in the process, but this is met by throwing into the converter, during the process itself, a variable quantity of cold scrap steel (the crop-ends of rails and other waste pieces), and also by introducing a vanable quantity of steam into the air which is blown through the molten iron. This is decomposed, with great absorption of heat and con-sequent lowering of the temperature, afiording a most convenient way of regulating the temperature. If, on the other hand, the temperature threatens to be too low, it may be raised by so inclining the converter that the layer of metal through which the blast from certain of the tuyeres passes shall be so thin that here the blast shall oxidize much iron, which thus becomes a source of heat, though an expensive one.

B. The Car casting system deserves description chiefly because it shows how, when the scale of operations is as enormous as it is in the Bessemer process, even a slight simplification and a slight heat-saving may be of great economic importance.

Whatever be the form into which the steel is to be rolled, it must in general first be poured from the Bessemer converter in

■which it is made into a large cla:y-lined ladle, and thence' ca^t in vertical pyramidal ingots. To bring them to a temperature suitable for rolling, these ingots must be set in heating or soaking furnaces (§ 13), and this should be done as soon as possible after they are cast, both to lessen the loss of their initial heat, and to make way for the next succeeding lot of ingots, a matter of great importance, because the charges of steel follow each other at such very brief intervals. A pair of working converters has made 4958 charges of 10 tons each, or a total of 50,547 tons, in one month, or at an average rate of a charge every seven minutes and twenty-four seconds throughout every working day. It is this extraordinary rapidity that makes the process so economical and determines the way in which its details must be carried out. Moreover, since the mould acts as a covering to retard the loss of heat, it should not be removed from the ingot until just before the latter is to be placed in its soaking furnace. These conditions are fulfilled by the car casting system of Mr P. W. Wood, of Sparrows Point, Md., in

which the moulds, while receiving the steel, stand on a train of cars, which are immediately run to the side of the soaking furnace. Here, as soon as the ingots have so far solidified that they can be lifted without breaking, their moulds are removed and set on an adjoining train of cars, and the ingots are charged directly into the soaking furnace. The mould-train now carries its empty moulds to a cooling yard, and, as soon as they are cool enough to be used again, carries them back to the neighbourhood of the converters to receive a new lot of steel. In this system there is for each ingot and each mould only one handling, in which it is moved as a separate unit, the mould from one train to the other, the ingot from its train into the furnace. In the other movements, all the moulds and ingots of a given charge of steel are grouped as a train, which is moved as a unit by a locomotive. The difficulty in the way of this system was that, in pouring the steel from ladle to mould, more or less of it occasionally spatters, and these spatter-ings, since the solidified steel is extremely tenacious, if they strike the rails or the running gear of the cars, obstruct and foul them, preventing the movement of the train. But this cannot be toler-ated, because the economy of the process requires extreme prompt-

ness in each of its steps. On account of this difficulty the moulds formerly stood not on cars, but directly on the floor of a casting pit while receiving the molten steel. When the ingots had so far solidified that they could be handled, the moulds were removed and set on the floor to cool, the ingotswere set on a car and carried to the soaking furnace, and the moulds were then replaced in the casting pit. Here each mould and each ingot was handled as a separate unit twice, instead of only once as in the car casting system ; the ingots radiated away great quantities of heat in passing naked from the converting mill to the soaking furnaces, and the heat which they and the moulds radiated while in the converting mill was not only wasted, but made this mill, open-doored as it was, so intolerably hot, that the cost of labour there was materially increased. Mr Wood met this difficulty by the simple device of so shaping the cars that they completely protect both their own running gear and the track from all possible spattering, a device which, simple as it is, has materially lessened the cost of the steel and greatly increased the production. The following table shows how great has been this increase : —

Table II.

Maximum Production of Ingots

by a Pair of American Con-

verters, in gross Tons

per week.

254

3,433

8,549

Year.

1870

1880

1889

1899, for a month the average weekly

production was

11,233

Thus in less than thirty years the rate of production per pair of

vessels has increased forty-four-fold. The production of European

Bessemer works is very much less than that of American. Indeed,

the whole German production of acid Bessemer steel in 1890 was

at a rate but slightly greater than that here given for one pair of

American converters ; and three pairs, if this rate were continued,

would produce almost exactly as much steel as all the sixty-five active British Bessemer converters, acid and basic together, produced in 1899.

C, Range in Size of Converters. — In the Bessemer process, and indeed in most high-temperature processes, to operate on a large scale has, in addition to the usual economies which it offers in other industries, a special one, arising from the fact that from a large hot furnace or hot mass in general a very much smaller proportion of its heat dissipates through radiation and like causes than from a smaller body, just as a thin red-hot wire jsools in the air much faster than a thick bar equally hot. Hence the progressive increase which has occurred in the size of converters, until now some of them can treat a 20-ton charge, is not surprising. But, on the other hand, when only a relatively small quantity of a special kind of steel is needed, very much smaller charges, in some cases weighing even less than half a ton, have been treated with technical success.

This has been particularly true in the manufacture of steel

castmgs, i.e., objects usually of more or less intricate shape, which are cast Initially in the form in which they are to be used, instead of being forged or rolled to that form from steel cast originally in ingots. Por making castings, especially those which are so thin and intricate that, in order that the molten steel may remain molten long enough to run into the thin parts of the mould, it must be heated initially very far above its melting-point, the Bessemer process has a very great advantage in that it can develop a much higher temperature than is attainable in either of its com-petitors, the crucible and the open-hearth processes. Indeed, no limit has yet been found to the temperature which can be reached, if matters be so arranged that not only the carbon and silicon of the pig iron, but also a considerable part of the metallic iron which is the iron itself, be oxidized by the blast ; or if, as in the Walrand-Legenisel modification, after the combustion of the initial carbon and silicon of the pig iron has already raised the charge to a very high temperature, a still further rise of temperature is. brought about by adding more silicon in the form of ferro-silicon,. and oxidizing it by further blowing. But in the crucible and the open-hearth processes the temperature attainable is limited by the

danger of melting the furnace itself, both because some essential parts of it, which, unfortunately, are of a destructible shape, are placed most unfavourably in that they are surrounded by the heat on all sides, and because the furnace is necessarily hotter than the steel made within it. But no part of the Bessemer converter is of a shape easily affected by the heat, no part of it has heat on more than one side, and the converter itself is necessarily cooler than the metal within it, since the heat is generated within the metal itself by the combustion of its silicon and other calorific elements. In it the steel heats the converter, whereas in the open-hearth and crucible processes the furnace heats the steel.

D. The Basic Bessemer Process. — The field of this process is greatly restricted by the fact that there are few ores which yield pig iron suited to it. For though there is usually neither excessive diflculty nor prohibitory expense in complying with the conditions that this iron should contain not more than 1 per cent, of silicon or 042 per cent, of sulphur, and preferably not less than 1-80 per cent of manganese, yet the 1-80 per cent, of phosphorus which it imperatively needs can be supplied by

but few ores. Of these the chief is the lean but very cheap " Minette " ore of the enormous deposits of Luxemburg and Lorraine, though Sweden also has deposits of phosphoric iron ore from which much is to be expected. Eighty-six per cent, of the German and Luxemburg Bessemer steel of 1899, and 28 per cent, of the British, were made by the basic process, which is important also in Belgium and Bohemia. But in the United States few phosphoric ores are so much cheaper than the non-phosphoric or " Bessemer" ores as to permit the basic process, in itself the more expensive, to compete with the original or "acid" Bessemer process. It is carried out at only one American establishment, and even there only intermittently. The rdle of the 1-80 per cent, of phosphorus of the pig iron is to generate, in being oxidized to phosphoric acid by the air blown through the metal, the very high temperature, about 1600° C. (2912° F.), which the process needs because of the high melting-point of its product, Bessemer steel. Silicon cannot be used here as a chief source of heat, as it is in the " acid " Bessemer

process, because the resultant silica would both corrode the basic walls of the converter, and cause " rephosphorization," as explained in § 8, unless counteracted by great additions of lime, which would not only occupy precious room, but in themselves consume most of the heat generated by the oxidation of the silicon. Further, if the treatment]

silicon be much in excess of 1 per cent., it causes such frothing as to throw much of the metal out of the mouth even of these roomy converters. Manganese to the extent of 1-80 per cent, is desired as a means of preventing the resultant steel from being redshort, i.e., brittle at a red or forging heat. The pig iron should be as nearly free as possible from sulphur, because the removal of any large quantity of this injurious element in the process itself is both difficult and expensive. The basic lining of the converters, made of calcined dolomite mixed with 10 per cent, of dehydrated coal tar, is expensive, and

lasts but relatively few charges — in few works more than 200, and in some only 100 — while the silicious lining of the acid converter lasts thousands of charges. Hence, for the basic process, spare converters must be provided, so that there may always be some of them re-lining, either while standing in the same place as when in commission, or, as in Holley's arrangement, in a separate repair house, to which these gigantic vessels are removed bodily. The slag of the process usually contains about 18 per cent, of phosphoric acid, and on this account it is so valuable a fertilizer as to be ■a most important bye-product. Its percentage composi-tion is approximately as follows : —

Phosphoric

Acid.

Silica.

Lime.

Magnesia.

Ferrous

0.xide.

16 to 19

6 to 9

50

3

13

In order that the phosphoric acid may be the more fully liberated by the humic acid, &c., of the earth, a little silicious sand is mixed with the stUl molten slag after it ias been poured off from the molten steel. The slag is used in agriculture with no further preparation, save very :fine grinding.

§ 10. Darby's Becarburizing Process. — In the basic Bessemer process most of the phosphorus is not removed until after the carbon, probably because the lime, which is charged in solid lumps, melts and enters the slag so slowly that not until late in the operation does the slag become so basic as to be retentive of phosphoric acid. Hence in making steel rich in carbon it is not possible, AS in the acid Bessemer process, to end the operation as soon as the carbon in the metal has fallen to the point

sought, but it is necessary to remove practically all of the -carbon, then the phosphorus, and then " recarburize," i.e., add whatever carbon the steel is to contain. On account of certain objections to adding this carbon in the form of cast iron. Darby adds gas-carbon, coke, or other carbon-aceous matter, which is absorbed greedily by the molten steel. This process, which in careful hands yields regular results, is much used in connexion with the basic open-hearth process, though indeed it can be used with either the acid or basic vairiety of the Bessemer and of the open-hearth process.

§ 11. Comparison of Processes. — The puddling process, ■often preceded by the removal of silicon in the " refinery " process, is still widely used for making wrought iron for •certain normal purposes which need great ease in welding ; for purposes requiring special forms of extreme ductility which are not so confidently expected in steel ; for mis-•cellaneous purposes by many users, some ignorant, some very conservative ; and for remelting in the crucible pro-cess. All the best cutlery and tool steel is made by the

crucible process, and indeed all for which any considerable excellence is claimed is supposed to be, though often in-correctly. But the great mass of^ steel is made by the Bessemer and the open-hearth processes. Open-hearth steel is generally considered better than Bessemer, and ihe acid variety of each of these two processes is thought to yield a better product than the basic variety. Probably this is not necessarily true, but the acid variety lends itself more readily to excellence than the basic. A very large proportion of ores cannot be made to yield cast iron either free enough from phosphorus for the acid Bessemer or the acid open-hearth process, neither of which removes that most injurious element, or rich enough in phosphorus for the basic Bessemer process, which must rely on that ele-ment as its source of heat. But cast iron for the basic open-hearth process can be made from almost any ore, since its requirements, comparative freedom from silicon and sulphur, depend on the management of the blast-furnace rather than on the composition of the ore, whereas the phosphorus-content of the cast iron depends solely on

that of the ore, since nearly all the phosphorus of the ore necessarily passes into the cast iron. Thus the basic open-hearth process is the only one which can make steel from cast iron containing more than O'lO per cent, but less than 1-80 per cent, of phosphorus. In cost of conversion the acid Bessemer process is the cheapest, the basic Bessemer next, and the basic open-hearth next, though the difference is not very great. The crucible process, however, is far more expensive than any of the others. Eail steel is almost always made by either the acid or the basic Bessemer process. Between 1880 and 1899 the yearly production of open-hearth steel advanced in the United States from 9 to 39 per cent, of that of Bessemer steel, and in Great Britain from 24 to 166 per cent. In the three great iron-making countries taken collectively. Great Britain, the United States, and Germany and Luxemburg, between 1880 and 1899 the production of acid open-hearth steel increased sevenfold, that of all open-hearth steel sixteenf old, that of the acid Bessemer process more than tripled, the total production of the Bessemer

converter increased fourfold, the total production of steel fivefold, and the basic open-hearth and the basic Bessemer process, which were merely beginning to be used in 1880, in 1899 each produced about as much steel as the whole world produced by all processes in 1880. In these countries in 1899, 43 per cent, of the total steel production was made by the acid Bessemer process, 20 per cent, by the basic Bessemer, 16^ per cent, by the acid open-hearth, 18-^ per cent, by the basic open-hearth, and a little over 1 per cent, by the crucible and other processes.

rV. Mechanical Tkeatmbnt.

§ 12. Defects in Steel Ingots. — These are of three chief classes — pipes, blowholes, and segregation. When molten steel is cast in an ingot in a cold cast iron mould, its outer crust solidifies and cools so far as to be rigid and incompressible, at a time, T, when much of the interior is still molten. In the further cooling the molten interior, because it is at this moment, T, so much hotter than the exterior, has a greater range of temperature to pass through before becoming completely cold ; and for this

reason the interior will undergo more contraction than the exterior. But since the interior just filled the exterior at the moment T, it will not be large enough to fill it completely after it has undergone this excess of contraction. In particular, the interior undergoes much of this excess of contraction between the time T and the time T' when the last of the interior itself solidifies. Consequently at T' the solidifying interior no longer suflces to fill the outer crust; and on this account a deep pear-shaped contraction cavity or pipe is formed, as shown at C in Fig. 15.

Since this pipe is due to the diflerence in the rates of contraction of interior and exterior, it may be lessened by retarding the cooling of the mass as a whole, and it may be prevented from stretching down deep by retarding the solidification of the upper part of the ingot, as, for instance, by preheating the top of the mould, or by

■^r

•V:

covering the ingot -with a great mass of burning fuel or of molten slag. This .keeps the upper part of the mass molten, so that it continues to flow down and feed the pipe during the early part of its formation in the lower and quicker-cooling part of the ingot. In making castings of steel, this same difficulty arises ; and much of the steel-founder's skill consists either in preventing these pipes, or in so placing them that they shall not occur in the finished casting, or at least not in a harmful position. In making armour-plates from steel ingots, as much as 40 per cent, of the metal may be rejected as unsound from this cause. An ingot should always stand upright while solidifying, so that the unsound region due to the pipe may readily be cut off, leaving the rest of the ingot solid. If the ingot lay on its side while solidifying, the pipe would occur as shown in Fig. 16, and nearly the whole length of the ingot would be rendered unsound. Iron, like water and many other sub-

stances, has a higher solvent power for gases, such as hydrogen and nitrogen, when molten, i.e., liquid, than when frozen, i.e., solid. Hence in the act of solidifying it expels any excess of gas which it has dissolved while liquid, and this gas becomes entangled in the freezing mass, causing gas bubbles or blowholes, as at A and B in Fig. 16. Since the volume of the pipe represents the excess of the contraction of the interior between T and T', any space within the ingot-crust occupied by blowholes must diminish by just so much the volume of the pipe, so that the more and larger the blowholes are, the smaller will the pipe be. The interior surface of a blowhole which lies near the outer crust of the ingot, as at A, is liable to become oxidized by the diffusion of the atmospheric oxygen, in which case it can hardly be completely

welded later, since welding implies actual contact of metal with metal ; it thus forms a permanent flaw. But deep-seated blowholes like those at B are relatively harmless, because the subsequent operation of forging or rolling usually obliterates them by welding their sides firmly together.

Blowholes may be lessened or even wholly prevented by adding to the molten metal shortly before it solidifies either silicon or

aluminium, or both ; even as little as 0-002 per cent, of aluminium is usually sufficient. These additions seem to act in part by de-oxidizing the minute quantity of iron oxide and carbonic oxide present, in part by increasing the solvent power of the metal for gas, so that even after freezing it can retain in solution the gas

Tif. 15. — Dia-gram showing how a pipe is formed. A, superficial blowholes ; B, deep-seated blowholes ; C, pipe.

Fig. 16. — Diagram showing a pipe so formed as to render Ingot unsound.

which it had dissolved when molten. But, since preventing blow-holes increases the volume of the pipe, it is often better to allow them to form, but to control their position, so that they shall be deep-seated. This is done chiefly by casting the steel at a rela-tively low temperature, and by limiting the quantity of manganese

and silicon which it contains. Brinell finds that, for certain normal conditions, if the sum of the percentage of manganese plus 5-2 times that of the silicon equal 1‘66, there will be no blowholes ; if this sum be less, blowholes will occur, and will be injuriously near the surface unless this sum be reduced to 0-28. He thus finds that this sum should be either as great as 1-66, so that blowholes shall be absent; or as low as 0‘28, so that they shall be harmlessly deep-seated. These numbers must be varied with the variations in other conditions, such as casting temperature, rapidity of solidification, &c.

The solidification of a large ingot of steel takes place gradually from without inwards, and each layer in solidifying tends to expel into the still molten interior the impurities which it contains, especially the carbon, phosphorus, and sulphur, which by this process are in part concentrated or segregated in the last-freezing part of the ingot. This is in general around the lower part of the pipe, so that here is a second motive for rejecting the piped part of the ingot. While segregation injures the metal here, often fatally, by giving it an indeterminate

excess of phosphorus and sulphur, it clearly purifies the remainder of the ingot, and on this account it ought, under certain conditions, to be promoted rather than restrained. The following is an extreme case : —

Carbon.

Silicon.

Manganese.

Phosphorus.

Sulphur.

Composition of the initial metal per cent

Composition of the segregation . .

1 0-24

|l-27

0-336

0-41

0-97

1-08

0-089

0-753

0-074

0-418

§ 13. Heating Furnaces. — The introduction of the ” soaking ” or Gjers pit and the development of the continuous or Eckman type of furnace have been of great importance. When the outer crust of a large ingot in which a lot of molten steel has been cast has so far

Fig. 17. — Section of Gjers soaking pit.

cooled that it can be moved without breaking, the temperature of the interior is still far above that suitable for rolling or hammering — so far above it that the surplus heat of the interior would more than suffice to reheat the now cool crust to the rolling temperature, if we could only arrest or even greatly retard the further escape of heat from that crust. Bringing such an ingot, then, to the rolling temperature is not really an operation of heating, since its average temperature is already above the rolling temperature, but one of equalizing the temperature, by allowing

teeatment]

lEON AND STEEL

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the internal excess of heat to ” soak” through the mass. Gjers did this by setting the partly-solidified ingot in a well-closed “pit” of brickwork, preheated by the excess heat of previous lots of ingots. The arrangement, shown in Fig. 17, has three advantages — (1) that the temperature is adjusted with absolutely no consumption of fuel; (2) that the waste of iron due to the oxida-tion of the outer crust of the ingot is very slight, since the little atmospheric oxygen initially in the pit is not renewed, whereas in a common heating furnace the flame brings a constant fresh supply of oxygen ; and (3) that the ingot remains upright during solidification, so that its pipe is concentrated at one end and is thus removable. (See § 12.) In this form the system is rather inflexible, for if the supply of ingots be delayed the pits grow un-duly cool, so that the next ensuing lot of ingots either is not heated hot enough or is delayed too long in soaking.

This defect is usually remedied by heating the pits by the Siemens regenerative system (see § 8) ; the greater flexibility thus gained outweighs the cost of the fuel used and the increased loss of iron by oxidation by the Siemens gas flame.

The Gjers system is not applicable to small ingots or " billets," ' because they lack the inner surplus heat of large ingots; indeed, they are now allowed to cool completely. To heat these on the intermittent plan for further rolling, i.e., to charge a lot of them as a whole in a heating furnace, bring them as a whole to rolling

tiiiiiiPlP"

iiiiiiiii

^;oiy^■:^'■^■:'As^y:vivS^'^^<^:;y;:v^^:■^:i

Fig. 18. — Diagram of C. H. Morgan's continuoas heating furnace for 2-inch billets 30 feet long.

A, hottest billet ready for rolling ; B, exit door ; C, pusher, for forcing billets forward ; D, water-cooled pipe on which billets are pushed forward ; E, magnesite bricks on which the hot billets slide forward; F, the billet last entered; G, the suspended roof ; H, the incoming air preheated by G and by the pipes N ; J, the incoming gas ; L, the flame ; M, the escaping

products of combustion ; N, pipes through which the products of combustion pass.

temperature, and then withdraw them as a whole for rolling, is very wasteful of heat, because it is only in the first part of the heating that the outside of the ingots is cool enough to abstract thoroughly the heat from the flame ; during all the latter part of the heating, when the temperature of the ingot has approached that of the flame, only an ever smaller and smaller part of the heat of that flame can be absorbed by the ingots. Hence in the intermittent system most of the heat generated within the furnace escapes from it with the products of combustion.

The continuous heating system (Fig. 18) recovers this heat by bringing the flame into contact with successively cooler and cooler billets, A-F, and finally with quite cold ones, of consequently great heat-absorbing capacity.

As soon as a hot billet A is withdrawn by pushing it endwise out of the exit door B, the whole row is pushed forward by a set of mechanical pushers C, the billets sliding on the raised water-cooled pipes D, and, in the hotter part of the furnace, on the magnesite bricks E, on which iron slides easily when red-hot. A new cold

billet is then charged at the upper end of the hearth, and the cycle begins by pushing out through B a second billet, and so forth. To lessen the loss in shape of " crop ends," and for general economy, these billets are in some cases 30 feet long, as in the furnace shown in Fig. 18. It is to make it wide enough to receive such long billets that its roof is suspended, as here shown, by two sets of iron tie-rods. As the foremost end of the billet emerges from the furnace it enters the first of a series of roll-trains, and passes immediately thence to others, so that before half of the biUet has emerged from the furnace its front end has already been reduced by rolling to its final shape, that of merchant-bars, which are relatively thin, round, or square rods, in lengths of 300 feet. In the intermittent system the waste heat can, it is true, be utilized either for raising steam (but inefEciently and inconveniently, because of the intermittency), or by a regenerative method like the Siemens ; but this would probably recover less heat than the continuous system, first, because it transfers the heat from flame to metal indirectly instead of directly ; and, second, because the brickwork of the Siemens system is probably a poorer heat-catcher than the iron billets of the continuous system, its

disadvantages of low conductivity and low specific heat probably outweighing its advantages of roughness and porosity.

§ 14. The Continuous Boiling-Mill. — The use of the continuous or Bedson type of rolling-mill has been much extended, so that it receives billets as large as 4 by 6|- inches, and rolls sheets, skelp, merchant-bars, cotton-ties, and other important products. In this system several roll-trains stand one behind another in column, so that the forward end of a given steel billet which is under treatment passes immediately from one pair of rolls into the next, and so on, and emerges from the last reduced to a diameter of say three-quarters of an inch, before the rear end of the same billet has entered the first pair of rolls, or indeed has emerged from the furnace in which it has been heated for rolling. By practically eliminating

^ Billets are bars from 2 to 6 inches square, an intermediate product into which large ingots are rolled, to be further rolled into wire rods, sheets, small round and square rods, &o.

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the loss of time between the successive reductions, large billets can be rolled at one operation into small rods of great length, so that the proportion of metal wasted in the form of crop ends is greatly reduced. Once the rod is so very thin as to be flexible, further reduction may be made by the Belgian system, in which the successive roll-trains stand in line instead of in column, and the front end of the rod as it emerges from one pair of rolls is turned 180° in a loop by hand or mechanism, and so returned to undergo another pass in the same train.

By a combination of these two systems, as developed by C. H. Morgan and W. Garrett respectively, billets 3 inches square are rolled at one operation into bars three-quarters of an inch in diameter and about 230 feet long.

§ 15. Hammers and Hydraulic Presses. — The demand for very large forgings, especially for armour-plate and ordnance, has led to the erection of enormous steam-hammers. The falling parts of the largest of these, that at Bethle-

hem, Pa., weigh 125 tons. But even so great a hammer is an ineffective tool for making large forgings, chiefly because the effect of its blow is concentrated on the outside of the forging, and does not penetrate well towards the interior ; indeed, the days of large hammers seem to be over. The use of this particular one has been abandoned for that of an enormous hydraulic press which exerts a pressure of 14,000 tons. It is moved by water under a pressure of 7000 pounds per square inch, supplied by pumps of 16,000 horse-power. For forging shafting and other obj ects not readily made in rolling-mills, because their cross-section is not uniform, the hydraulic press seems to be firmly established as by far the most efRcient tool. But though the great 14,000-ton Bethlehem press is used with great success for forging armour-plate also, the rolling-mill certainly has special merits for such a purpose, and with it all of Krupp's armour-plate is now made. The rolls of this great armour-plate mill are 4 feet in diameter and 12 feet long, and can receive an ingot 4 feet thick.

V. Statistics.

§ 16. Cost of Manufacture. — There has been a remark-

able reduction in the cost of iron and steel manufacture,

a few examples of which, taken from American practice,

are given in Table III. Here we find a reduction of some

35 per cent, in total cost and an even greater reduction in

the cost of labour, reaching in one case even 54 per cent.

in a period of from seven to ten years. The reduction in

the cost of labour has been brought about by improvements

in administration and by mechanical appliances, and not

by reduction of wages. According to Mr Carnegie, in

one of the largest American steel works the average wages

in 1900 for all persons paid by the day, including labour-

Taele III. — Seduction in Cost of Iron Manufacture in America — C. Kirchoff.

Place Eepresented.]

Operation Eepresented.

Period Covered.

Cost, Profit, and Production at end of Period in

Percentage of that at beginning of Period.

From

To

Cost.

1

ft

1

= !■§

» ^ t.

O

“3

i

o

3

1

Total

excluding

Material.

A large Southern Establishment

North-eastern District

Pittsburg District .

Eastern District

Pittsburg

Not stated ....

Manufacture of Pig Iron

Manufacture of Bessemer Steel Ingots

Rolling Wire Rods

1889

1890

1887

1891

1887

1888

1898

1898

1897

1898

1897

1898

79

1037

64-1

97

51-9

61-1

46

75

63-4

65-8

64”39

63”6

44

52

47-9

33-9

167-7

163-3

107

325

ers, mechanics, and boys, were more than $4 (say 16s. 6d.)

a day for the 311 working days. How economical the

methods of mining, transportation, and manufacture have

become is shown by the fact that steel billets have been

sold at $13-96 (£2, 17s. 8d.) per ton, and in very large quantities at f 15 (£3, 2s.) per ton, in the latter case, according to Mr Carnegie, without further loss than that represented by interest, although the cost of each ton includes that of mining two tons of ore and carrying them 1000 miles, mining and coking 1-3 tons of coal and carrying its coke 50 miles, and quarrying one-third of a ton of limestone and carrying it 140 miles, besides the cost of smelting the ore, converting the resultant cast iron into steel, and rolling that steel into rails.

Table IV. — Seduction in Price of Certain Products.

Date.

Average Price in Pennsylvania, 1

Wrought Iron.

Iron

Steel Bails.

No. 1

Foundry

Pig Iron.

1800, Jan.

1100

1815, Feb.

155

Best

...

1824, Nov.

80

I Hammered

. ..

1837, Apr.

115 ,

1850, Aug.

59-541

$47-88

.$20-88

1865 „.

106-38

98-02

(1868) 1158-50

46-12

1870 „.

78-96

Rolled

72-25

106-75

33-25

1880 „.

49-25

67-50

28-50

1890 „.

45-92

31-76

18-40

1898 „.

17-62

ll-Ofi

Table IV. shows the reduction in prices. The price of wrought iron in Philadelphia reached $155 (£32, Os. 8d.) in 1815, and, after declining to $80 (£16, 10s. 8d.), again

reached $115 (£23, 15s. 4d.) in 1837. Bessemer steel rails sold at $174 in the depreciated currency of 1868 (equivalent to about £25, 17s. 4d. in gold), and at $17 (£3, 10s. 3d.) in 1898.

VI. Increase in Production.

§ 17. In 1810 the United States made about 7 per cent., and in 1830, 1850, and 1860 not far from 10 per cent, of the world's production of pig iron, though, indeed, in 1820 their production was only about one-third as great as in 1810. But after the close of the Civil War the production increased by leaps and bounds, till in 1899 it was sixteen times as great as in 1865; and the percentage which It formed of the world's production rose to some 14 per cent, in 1870, 21 per cent, in 1880, and 34 per cent, in 1899. Between 1880 and 1899, though the British production increased only 20 per cent., that of the United States more than tripled, that of Germany and Luxemburg nearly tripled, and that of the world more than doubled. The corresponding changes in case of steel are even more striking. The United States production in

1899 was nearly 800 times that of 1866 ; and the propor-
tion of the world's steel which it formed rose from 3 per
cent, m 1865 to 10 per cent, in 1870, 30 per cent, in
1880, 36 per cent, in 1890, and 40 per cent, in 1899.
Between 1880 and 1899 the production of Great Britain
statistics]

has increased to nearly four times, and that of the United
States to eight and a half times, their respective produc-
tions in 1880. As has been already indicated, of the com-
bined wrought iron and steel of the United States, steel
formed 2 per cent, in 1866, 37 per cent, in 1880, but
about 85 per cent, in 1899. The age of iron has in these
nineteen years given place to the age of steel.

The per capita consumption of iron in Great Britain,
excluding exports, has been calculated as 144 pounds in
1855 and 250 pounds in 1890, that of the United States
as 117 pounds for 1855, 300 pounds for 1890, and some
378 pounds for 1899, or more than thrice that of 1855.

Aniong the chief causes of this increase in the consumption of iron by the human race we may recognize, in addition to the general advance in wealth and civilization, the increasing diversion of mankind from agricultural to manufacturing, i.e., machinery-using, occupations — and nearly all machinery is necessarily made of iron; the displacement of wood by iron for ship and bridge building ; the great extension of the use of iron beams, columns, and other pieces in constructing buildings of various kinds; the growth of steam and electric railways; anc^ the introduction of iron fencing. The increased importance of Germany and Luxemburg may be referred in large part to the invention of the basic Bessemer and open-hearth processes by Thomas, who by them gave an inestimable value to the phosphoric ores of these countries. That of the United States is due in part to the growth of its population; to the introduction of labour-saving machinery in iron manufacture ; to the grand scale on which this manufacture is carried on; and to the discovery of the cheap and rich ores of the Mesabi region of Lake Superior.

But, given all these, the thousand miles which separate the ore fields of Lake Superior from the cheap coal of Pennsylvania would have handicapped the American iron industry most seriously but for the remarkable cheapening of transportation which has occurred. As this in turn has been due to the very men who have developed the iron industry, it can hardly be ‘ questioned that, on further analysis, this development must in considerable part be referred to racial qualities. The same is true of the German iron development. We may note with interest that the three great iron producers so closely related by blood — Great Britain, the United States, and Germany and Luxemburg — made in 1889 79 per cent, of the world’s pig iron and 81 per cent, of its steel; and that the four great processes by which nearly all steel and wrought iron are made — the puddling, crucible, and both the acid and basic varieties of the Bessemer and open-hearth processes, as well as the steam-hammer and grooved rolls for rolling iron and steel — were invented by Britons, though in the case of the open-hearth process Great Britain must share

with France the credit of the invention. (h. m. h.)

Tables V., VI., VII., and VIII., are compiled mainly from

figures given in Mr. J. M. Swank's Reports (American Iron and

Steel Association). Other authorities are indicated as follows :

", The Mineral Industry, 1892 ; ', Idem, 1899 ; <, Journal Iron and*

Steel Institute, 1881, ii.

Table V. — Production of Pig Iron (in thousands of long tons).

Tear.

United States.

Great Britain.

Germany and

Luxemburg.

The World.

1800

825

1810

54

...

• ••

1830

165

677

...

1,826

1850

565

4,750

1865

832

4,825

972

9,250

1870

1,665

5,964

1,369

11,900

1880

3,835

7,749

2,685

17,950

1890

9,203

7,904

4,583

27,157

1899

13,621'

9,302'

7,900'

39,752'

Table VI. — Production of Pig Iron in th^ United States

(in thousands of long tons).

Tear.

Anthracite.

Charcoal.

Coke and

Bituminous.

Total.

1880

1885

1890

1895

1899

1,614

1,299

2,186

1,271

1,600'

480

357

628

225

285'

1,741

2,389

6,388

7,950

11,736'

3,835

4,045

9,202

9,446

13,621'

“Anthracite” here includes iron made with anthracite and coke mixed, and “Bituminous” includes iron made with coke, with raw bituminous coal, or with both.

Table VII. — Production of Wrought Iron, also that of Bloomary Iron (in thousands of long tons).

1870.

1880.

1890.

1899.

^1

Si

1|

torn

*-*3 C*

11

II

si

Wrought ■)

Iron /

Bloomary 1

Iron direct 1

from the j

ore . . J

1153"

2803°

34

...

2518

8

1894"

3

1202'

e Hammered products are excluded.

Table VIII. — Production of Steel (in thousands of long tons).

1870.

ISSO.

1890.

1899. 1

Ii

SI

i^ a

4

S3

tDCO

la ^

Germany

and

Luxem-

burg.

u

Pqq

Germany

and

Luxem-

burg.

^1

t3M

.|.|

Germany

and

Luxem-

burg.

^1

Bessemer .

Open-hearth .

Crucible and \

Miscellaneous j

Total .

37

1

31

215

(for 1873)

78

1,074

101

72

1,044

251

80

608<«

87”

*33**

3,689

513

75

2,015

1,564

100

-

f Acid

\ Basic

fAcid

t Basic

7,586

867

2,080

106

1,308'

517'

2,736'

295'

145

61.3'

3,909'

1 1,667'

69

292"

692<»

1,247

1,375

728

4,205»

4,277

3,679

2,127

11,902»

10,639

5,001

26,685»

Table IX. — Tonnage (gross register) of Iron and Steel Vessels

*built under Survey of Lloyd's Begistry, in thousands oftons.^*

1877.

1880.

1885.

1890.

1895.

Wrought Iron

Steel

443

0

460

35

304

163

42

958

8

863

1 J. Eiley.

VII. Iron Okbs.

§ 18. Distribution. — Iron ores are widely distributed, and found associated with rocks of various geological ages in most of the explored regions of the earth. But their practical exploitation is not as universal as their occur-rence, although explorers report, even in remote portions, crude appliances for smelting ores and producing iron

590

IRON AND STEEL

[ikon okes

therefrom. The number of regions in which iron ore mines are developed and iron ore is produced on any considerable scale is limited, and the different countries may be divided into three general classes : —

(1) Those which mine sufficient iron ore practically

to supply their domestic demand, and export none, or but small amounts, such as the United States, Eussia, Austria^Hungary, China, Mexico, &c.

(2) Those which produce and consume domestic ores, but are obliged to draw largely from other countries in order to obtain sufficient raw material of the required character for the iron manufactured. This class includes Great Britain, Germany, France, and Belgium.

(3) Those which have excellent iron ore resources, easily exploited, but utilize only a small proportion and export large amounts of ore. Spain, Sweden, Algeria, Cuba, Italy, and Greece are in this category.

A fourth class will include those countries which neither use nor export any considerable amount of iron ores, e.g., Australia, the South American States, &c.

Considered simply as iron ore producers, the United States ranks first, followed by the German empire, British empire, Spain, France, Russia, AustriarHungary, Sweden, &c.

" § 19. Composition. — Iron ores vary greatly in chemi-

cal composition and physical characteristics, but may be segregated into four general classes : —

A. Magnetites, in which three atoms of iron united with four atoms of oxygen form the magnetic oxide, yielding 72-4 per cent, of iron. These ores are usually hard and dense, and are seldom found unassociated with phosphorus, sulphur, or titanium, while earthy impurities often reduce their commercial yield still further. Magnetites have, however, been won in large quantities which produced 70 per cent, of iron. Some of the leaner ores are enriched by crushing them and separating the ore grains from the gangue by electro-magnetic methods or by jigs. Sulphur is eliminated by roasting.

B. Bed Hematites, in which two atoms of iron are combined with three atoms of oxygen to form ferric oxide, yielding 70 per cent, of iron. Many of these have an excess of earthy impurities, while some approach chemical perfection as to iron contents, and a number are quite low in phosphorus. Sulphur and titanium are seldom present in notable proportions. They include fossil,

slate, dyestone, and flax-seed ores.

C. Brown Hematites are of the same chemical composi-tion as red hematites, but the ferric oxide is hydrated, so that the practical limit of yield may be taken at 60 per cent, of iron. In these there is apt to be a considerable amount of phosphorus and often manganese, but seldom sulphur. Some are merely carbonate ores changed by weathering. Bog ores are brown hematites deposited in the beds of extinct or existing lakes. Limonite, goethite, &c., also fall under this head.

D. Carbonates are found associated with the Coal Measures, and are combinations of ferrous oxide and carbonic acid in such proportions as to yield when pure to 48-2 per cent, of iron. By roasting, as by protracted weathering, the carboiiic acid is driven off, and yields of iron are obtained approximating to those from brown hematite. Carbonates are locally known as clay iron-stone, spathic iron ore, black band ore.

A majority of the ores used yield 50 per cent, or more of iron, although where the supply is favoured by local

conditions some containing only about 40 per cent, are smelted. The tendency is to use ores naturally rich in iron or to beneficiate lean ores. The expansion of the Bessemer steel industry has required a general subdivision of all ores into Bessemer and non-Bessemer grades, based on the phosphorus contents. Nominally a Bessemer ore may carry one part of phosphorus to each 1000 parts of iron, but commercially the proportion is nearer one to 1300. The practical yield of metal from iron ores as used may be considered as — Magnetites, 45 to 65 per cent. ; red hematites, 40 to 60 per cent. ; brown hematites, 40 to 55 per cent. ; carbonates (roasted), 40 to 55 per cent.

§ 20. Production. — The total iron ore production of the world in 1899 is estimated at 81,000,000 gross tons, and for purposes of comparison, figures showing the output of the principal countries in 1880, 1890, and 1899 are given in the following table : —

Production of Iron Ore in the Principal Countries of the World.

Countries.

1880.

1890.

1899.

Great Britain .

18,026,049

13,780,767

14,461,330

United States .

7,120,362

16,036,043

24,683,173

Germany and Luxem-

burg ....

7,238,640

11,406,132

17,970,679

France ....

2,874,263

3,471,718

5,067,500

.Spain . . . .

3,565,338

6,546,495

9,234,302

Eussia ....

1,023,883

1,767,313

4,871,461«

Austria-Hungary .

1,142,606

2,153,789

3,400,585«

Sweden ....

775,344

941,241

2,435,200

Belgium ....

253,499

186,546

217,370"

Algeria ....

164,146

474,632

473,569«

Cuba ....

None.

362,068

368,758

” Figures are for year 1898.

The tons used in this table are the gross avoh-dupois (2240 B))

and metric (2204 lb).

Great Britain. — Sir Lowthjan Bell classifies British iron ores as

follows : —

1. Altered carbonates (a variety of brown ores), got by open

work from the Lias and Oolitic formations in Lincolnshire, North-

amptonshire, Leicestershire, &o.

2. Carbonate (clay ironstone), got by mining in the Lias, as in

Cleveland.

3. Carbonate (clay ironstone), got from the Coal Measures as it

occurs in Scotland, Stafiordshire, &c.

4. Red hematite, largely wrought in Lancashire and Cumberland.

5. Brown hematites, such as the ores of Antrim in Ireland and the Forest of Dean, neither of these being now of much importance.

6. Sundries, consisting of difierent varieties, but all in unimportant quantities.

In the principal iron ore region in England (the Cleveland district) there are two well-known seams of ironstone, the "upper" and " lower " beds. The first is silicious and irregular in quality, and the lower bed may be regarded as the only general source of supply. From this district is obtained nearly one-half the iron ore mined in England, the production for 1899 being estimated as 5,612,742 tons. The ore carries about 33 per cent, of iron on the average. British ores are supplemented by liberal additions of foreign ores, obtained principally from Spain, Sweden, Greece, Algeria, Elba, India, &c. In the year 1899 the imports of foreign ore and manganiferous iron ores into Great Britain was 7,054,578 long tons, of which 6,186,022 tons were contributed by Spain, the greater portion being from the Bilbao district. The probable exhaustion of the rich and easily-mined Bilbao ores has directed

attention to other large deposits in the southern section of Spain, which could be drawn upon if needed, while Sweden can supply quantities of magnetic ore. Great Britain's maximum production of iron ore in 1882 was 18,031,957 long tons, while in 1899 but 14,461,330 tons were mined.

United States.— In. 1899 the United States, the largest pig-iron-producing country in the world, most of it being smelted from native ores, contributed 24,684,173 tons of iron ores. Of this amount 81 per cent, was of the red hematite variety, 11-23 per cent, brown hematite, 7 per cent, magnetite, and 1-3 per cent, carbonate ores. The iron ore output of 1900 is estimated at 25,500,000 tons. Over 70 per cent, of the domestic iron ores (17,802,955 tons) in 1899 came from the Lake Superior region, situated in the states of Michigan, Minnesota, and Wisconsin.

In the Lake Superior basin there are enormous deposits of iron ore. Those upon the south and west are in the United States, and have been liberally exploited. The Canadian deposits in the north have but lately been developed. The American deposits occur in five districts or ranges— Marquette range, in the state of Michigan ; Gogebic range and Menominee range, in Michigan

and Wisconsin ; and Vermilion and Mesabi ranges in Minnesota. Mesabi the youngest and Marquette the oldest ranges are the largest producers. Many of the deposits are wrought upon an enormous scale, ten mines in the Lake Superior region producing from 500,000 to over 1,000,000 tons in 1899. In the eastern portion of the United States, New York and New Jersey supply magnetites, Massachusetts and Connecticut brown hematites. Pennsylvania produces about one million tons annually, most of which is magnetite from the Cornwall ore hills. In the south, "Virginia, Georgia, Alabama, Tennessee, and Texas supply hema^ tites. Hematites also and some magnetites are won in the Rocky Mountains region, from the states of Wyoming, Colorado, Utah, and New Mexico Territory. Some of this iron ore and also that obtained in California is used as a flux for silver smelting. Carbonate ores are mined in Pennsylvania, New York, Ohio, and Maryland.

Germany. — ^Iron ores are liberally distributed throughout the German empire, but the largest deposits are in the Grand Duchy

of Luxemburg and German Lorraine, where Oolitic ores, locally known as minette, are found, in a length of rather less than 40 miles and a width of about 8 miles; the beds also extend into Belgium and France. More than one-half of the output of the German empire comes from this minette district of Lorraine and Luxemburg. The average analyses of the ores show that they contain from 28 to occasionally 48 per cent, of iron, with phosphorus ranging from 0-5 to 2 per cent. The ore district of Siegerland ranks next in importance. Most of the ores are spathic, although in some cases red hematites occur. The district contributes about one-tenth of the total for the empire. In Hesse-Nassau red hematites are associated in some instances with brown ores, and manganiferous iron ores form an important supply for the Westphalia furnaces. Probably five-sixths of the German product consists of brown hematite ores in various forms. Germany exports minette ores chiefly to Prance and Belgium, and imports a considerable amount of foreign ores, the greater portion coming from Sweden. The maximum German product of iron ore, 17,989,665 metric tons, was in 1899.

France. — The iron ore deposits of Prance, though numerous, are

scattered, and except in the eastern portion of the country there are none capable of feeding any considerable number of blast-furnaces. The maximum production was 5,067,500 metric tons in 1899. Since the loss of Alsace-Lorraine a considerable amount of iron ore has been imported into Prance from the region which was annexed to Germany, while Algeria, Spain, and Italy also contribute.

Sussia. — Iron manufacture in Eussia, since 1700, has been confined mostly to the Ural region, the ore being smelted with charcoal. Of late years blast-furnaces have been built in Southern Russia to smelt the rich ores found there with mineral fuel, and the advance has been rapid. The ore deposits are chiefly of the magnetic, specular, and red hematite variety ; but in Olnetz and Finland lake and bog ores are won, whUe in Southern Poland brown hematites are found. Practically all the iron ore mined is smelted in the blast-furnaces of the country. The greatest pro-duction of iron ore was in 1898, when 4,871,461 tons were reported as being mined.

Spain. — Distributed throughout Spain are large deposits of iron ores, but owing to the lack of good mineral fuel the pig iron industry has not attained importance, and most of the ore won is

exported. The greatest yield has been from the Biscayan pro-vinces in the north, but there are valuable deposits extending along the south-eastern coast, commencing with those at Porman, continuing at moderate distances from the coast through the provinces of Muroia, Almeria, and Malaga, and finally trending north-west to the district of Seville, farther inland. The ores of Biscaya are, near the surface, hydrated peroxides, rich in iron and fairly free from phosphorus and sulphur. At greater depths the mass of the unchanged deposit below the gossan or oxidized out-crop is found to be spathic iron ore, containing a larger proportion of sulphur than the zone above. The mines most extensively worked are in the vicinity of Bilbao, and form three groups, knovra. as the Somorrostro, Galdames, and OUargon. From this district the bulk of the iron ore imported into Great Britain is obtained. Spain in 1899 produced 9,234,302 tons of iron ore.

Sweden. — This country, famous for its iron industry, is almost entirely dependent on magnetic ores, although some hematite or specular ores, and a small amount of lake or bog ore, is mined. The Swedish ores vary from 30 to 70 per cent, of iron, averaging about 50 per cent., and generally (except in the north) contain

very little phosphorus. The principal iron ore deposits extend across the country from the Dannemora region, north of Stockholm, towards the Norwegian border, and cover a length of 180 miles. Southwards the region continues to the middle part of the province of OstergStland, and northwards to the northern boundary of Dalecarlia, thus covering 5800 square miles. In the vicinity of the Arctic Circle, in Swedish Finland, are the large deposits of Gellivara, Kirunavara, and Luossavara, connected by a railway, 129 miles long with the harbour of Lulea, at the north end of the Baltic Sea. The quality of these ores is variable, but they are usually rich in iron. Although Bessemer ores occur in considerable quantity, the greater part are high in phosphorus. The percentage of sulphur, however, is small. Most of these rich ores are exported, chiefly to Germany, Great Britain, and Austria. Owing to the annual increase of this export trade, and to obtain a harbour open all the year, a railway has been constructed to Victoria Haven (Narvik) in Norway. The advance in the production of iron ore since the opening of the Gellivara deposits in 1892 has been rapid, the maximum for Sweden being 2,435,200 tons in 1899, of which over one-half was exported.

Belgium. — Only about one-tenth of the iron ores smelted in the Belgian blastfurnaces comes from native mines. These are Oolitic iron ores, minette ore, bog ore from Campine, and manganiferous iron ore from Lifege. The chief domestic supply comes from the Luxemburg and Lorraine Oolitic limonite ores, carrying 30 to 35 per cent, of iron. The foreign imports are chiefly from Germany, France, Spain, Sweden, Algeria, &c. The amount of native ore produced approximates 200,000 tons per annum ; about 2J million tons of iron ore are annually imported, and 300,000 tons exported.

Other Countries. — Algeria has important deposits of iron ore, chiefly magnetite, red and brown hematite, and siderite. The mines at present worked are in the department of Constantine, and produce annually about half a million tons, of iron ore, all of which is exported. The iron ores of Greece are carbonates, hematites, and magnetites, most of which contain manganese. A considerable quantity of ore is mined, all of which is exported.

In Italy about 250,000 tons of red hematite and specular, with some magnetic iron ore, is mined and exported, mostly from the island of Elba. Owing to the lack of fuel, the pig iron industry of

Italy is of minor importance. In the south-eastern portion of Cuba are rich deposits of red hematite ores, operated by American companies, producing, in 1899, 368,758 tons of ore. Since 1884, when shipments commenced, Cuba produced to 1899 inclusive 4,000,000 tons of iron ore, nearly all of which was sent to the United States. Canada has numerous deposits of iron ore, and is developing an important iron industry. On Lake Superior red hematite is worked, in Nova Scotia red and brown hematites are won, in Ontario red hematites and magnetites occur, while in Quebec bog ores are obtained. In British Columbia are deposits of magnetite. Newfoundland has an extensive deposit of red hematite ore, carrying about 50 per cent, of iron, which is easily won by quarrying. Asia, Africa, South America, and Australia have iron ore deposits, but only India, China, and Mexico can be considered as manufacturing iron in appreciable amounts. (j. bi.)*

Iron Mountain, capital of Dickinson county, Michigan, U.S.A., on the Menominee river, in the northwestern part of the state, at an altitude of 1142 feet. Its site is level and its plan regular. It is at the intersection of branches of the Chicago and North- Western, and the

Chicago, Milwaukee, and St Paul railways. It is in an iron-mining and lumber region. Population (1890), 8699 ; (1900), 9242, of whom 4376 were foreign-born.

I ronton, capital of Lawrence county, Ohio, U.S.A., on the north bank of the Ohio, in the southern part of the state, at an altitude of 540 feet. It has three railways — the Cincinnati, Hamilton, and Dayton, the Ironton, and the Norfolk and Western, which, with the navigation of the river, give it a large trade in iron and coal, which are the leading products of the surrounding region. It contains blast-furnaces, rolling-mills, and foundries, and has extensive manufactures of iron goods. It contained in 1900 112 manufacturing establishments, which had a total capital of $3,321,219, and employed an average number of 1758 wage-earners. The total value of the products was $5,715,112. Population (1880), 8857; (1890), 10,939; (1900), 11,868, of whom 714 were foreign-born and 924 were negroes.

Iron wood, a city of Gogebic county, Michigan, U.S.A., in the Gogebic iron range, in the extreme north-

western part of the state, at an altitude of 1506 feet. It is on the Chicago and North- Western and the Wisconsin Central railways, and is devoted almost entirely to iron-mining. Population (1890), 7745; (1900), 9705, of whom 4615 were foreign-born.

I. General.

THE subject of irrigation is discussed generally in the earlier volumes of the Encyclopsedia (9th edition, vol. xiii.), and the treatment of -water-meadows in England is there described minutely and accurately. Little is said, however, of the great systems of irrigation prevail-ing in tropical and sub-tropical countries, which differ from the irrigation practised in England as much as the cultivation of an American prairie differs from that of a dainty English flower-garden. It is of this irrigation on a large scale that it is now proposed to treat. It is to be found in Europe only in the rich plains of Northern Italy, and in some of the provinces of Spain. In Spain

it can be traced directly to the Moorish Conquest, and almost everywhere throughout Asia or Africa where the Moslem has raised his green flag is to be found some knowledge of irrigation. But the art was known long before the days of Mahommed, and it is certain that there could have been ho population in the Nile valley until the habit was established of sowing grain on the muddy surface of the land from which the flood water was slowly retreating, and in due time of reaping the crops.

The simplest form of irrigation is when the water is raised from a river or lake, or from a well situated in a field. The sculptures and paintings of ancient meOiodf. -^Sjpt bear no trace of anything approaching scientific irrigation, but they often show the peasant bailing the water up from the Nile. By means of this simple plan of raising water and pouring it over the fields thousands of acres are watered every year in India, and the system has many advantages in the eyes of the peasant. Though there is great waste of labour, he can

apply his labour when he likes ; no permission is required from a G-overnment of&cial; no one has to be bribed. The simplest and earliest form of water-raising machinery is the pole with a bucket suspended from one end of a crossbeam and a counterpoise at the other. In India this is known as the denkli or paecottah; in Egypt it is called the shacMf. All along the Nile banks from morning to night may be seen brown-skinned peasants working these shadufs, tier above tier, so as to raise the water 15 or 16 feet on to their lands. With a shad^f it is only possible to keep about 4 acres watered, so that a great number of hands are required to irrigate a large surface. Another method largely used is the shallow basket or bucket suspended to strings between two men, who thus baU up the water. A step higher than these is the rude water-wheel, with earthen pots on an endless chain running round it, worked by one or two bullocks. This is used everywhere in Egypt, where it is known as the sakya. In Northern India it is termed the harat, or Persian wheel. With one such water-wheel a pair of oxen can

raise water any height up to 18 feet, and keep from 5 to 12 acres irrigated throughout an Egyptian summer. A very familiar means in India of raising water from wells in places where the spring level is as much sometimes as 100 feet below the surface of the field is the cliurras, or large leather bag, suspended to a rope passing over a pulley, and raised by a pair of bullocks which go up and down a slope as long as the depth of the well. All these primitive contrivances are still in full use throughout India. Egypt has of late years been more in touch with Western civilization, and the prosperous farmer prefers to employ a centrifugal pump driven by a fixed or portable steam engine. There are now about 400 of the former and 2000 of the latter at work on the Nile and the canals of Lower Egypt.

Irrigation on a really large scale, however, requires that the water shall flow over the surface of the land by gravitation, without being artificially raised. This may be effected either by canals drawn from a river, and flowing on a slope less than that of the country, so as

ultimately to obtain a command over it, or by reservoirs formed by throwing masonry or earthen embankments across valleys, and there storing up the rainfall. The water is discharged from a sluice at the bottom of the embankment, and flows over the adjoining land at the foot of the valley. Canal irrigation is very much the more important of the two, but before describing it a little will be said about what can be done by reser-voirs.

Among the valleys of a rolling country it is often easy to find a site for a good reservoir, and if the rainfall comes down in heavy showers, it may not be difficult to catch and store it. The points to be '//Jf^""" aimed at are to find (1) a valley with a large y,,/,/ catchment basin and hard rocky sides, off which the rain water will quickly flow ; (2) a narrow neck across which a dam may easily be thrown, with firm sides into which it can be built ; (3) a good site for a waste-weir and channel down which to pass flood water ; and (4) either good and easily quarried stone for building a

masonry dam, or beds of clay for constructing the solid puddle core which should form the centre of an earthen embankment. Of course all these requirements are useless if there is not also suitable land to irrigate downstream of the dam.

Reservoirs are familiar everywhere for the water-supply of towns, but as the volume necessary, even for a large town, does not go far in irrigating land, many sites which would do admirably for the former would not contain water suflS.cient to be worth applying to the latter purpose. In the Mediterranean provinces of Spain there are some very remarkable irrigation dams. The great masonry dam of Alicante on the river Monegre, which dates from 1579, is situated in a narrow gorge, so that while 140 feet high, it is only 190 feet long at the crest. The reservoir is said to' contain 130 million cubic feet of water, and to serve for the irrigation of 9000 acres, but unless it refills several times a year, it is hardly possible that so much land can be watered in any one season. The Elche reservoir, in the

same province, has a similar dam 55 feet high. In neither case is there a waste-weir, the surplus water being allowed to pour over the crest of the dam. South of Elche is the province of Murcia, watered by the river Segura, on which there is a dam 26 feet high, said to be 800 years old, and to serve for the irrigation of 26,000 acres. The Lorca dam in the same neighbourhood irrigates 27,000 acres. In the jungles of Ceylon are to be found remains of gigantic irrigation dams, and on the neighbouring mainland of Southern India, throughout the provinces of Madras and My- ° ”” sore, the country is covered with irrigation reservoirs, or, as they are locally termed, tanks. These vary from village ponds to lakes 14 or 16 miles long. Most of them are of old native construction, but they have been greatly improved and enlarged since, say, 1860. The casual traveller in Southern India constantly remai-ks the ruins of old dams, and the impression is conveyed that at one time, before British rule prevailed, the irriga-tion of the country was much more perfect than it is

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amals.

now. That idea, however, is mistaken. An irrigation reservoir, like a human being, has a certain life. Quicker or slower, the water that fills it will wash in sand and mud, and year by year this process will go on till ultimately the whole reservoir is filled up. The embank-ment is raised, and raised again, but at last it is better to abandon it and make a new tank elsewhere, for it would never pay to dig -out the silt by manual labour. It may safely be said that at no time in history were there more tanks in operation than at present. The ruins which are seen are the ruins of long centuries of tanks that once flourished and became silted up. But they did not all flourish at once. In the countries now being considered, the test of an irrigation work is how it serves in a season of drought and famine. It is evident

that if there is a long cessation of rain, there can be none to fill the reservoirs. In September 1877 there were very few in all Southern India that were not dry. But even so, they helped to shorten the famine period ; they stored up the rain after it had ceased to fall, and they caught up and husbanded the first drops when it began again.

Irrigation effected by river-fed canals naturally depends on the regimen of the rivers. Some rivers vary much in their discharge at different seasons. In some cases this variation is comparatively little. Sometimes the flood season recurs regularly at the same time of the year ; sometimes it is uncertain. In some rivers the water is generally pure ; in others it is highly charged with fertilizing alluvium, or, it may be, with barren silt. In rainless countries, such as Egypt or Sind, there can be no cultivation without irrigation. Elsewhere the rainfall may be sufiicient for ordinary crops, but not for the more valuable kinds. In ordinary years in Southern India the maize and the millet, which

form so large a portion of the peasants' food, can be raised without irrigation, but it is required for the more valuable rice or sugar-cane. Elsewhere in India the rainfall is usually suf&cient for all the cultivation of the district, but about every eleven years comes a season of drought, during which canal water is so precious as to make it worth while to construct costly canals merely to serve as a protection against famine. When a river partakes of the nature of a torrent, dwindling to a paltry stream at one season and swelling into an enormous flood at another, it is impossible to construct a system of irrigation canals without very costly engineering works, sluices, dams, waste-weirs, &c., so as to give the engineer entire control of the water. Such may be seen on the canals of Cuttack, derived from the Mahanadi, a river of which the discharge does not exceed 400 cubic feet per second in the dry season, and rises to 1,600,000 cubic feet per second in the rainy season. Very dif-ferently situated are the great canals of Lombardy, drawn from the Ticino and Adda rivers, flowing from the

Maggiore and Como lakes. The severest drought never exhausts these reservoirsj and the heaviest rain can never convert these rivers into the resistless floods which they would be but for the moderating influence of the great lakes. The Ticino and Adda>do not rise in floods more than 6 or 7 feet above their ordinary level, or fall in droughts more than 4 or 5 feet below it, and their water is at all seasons very free from silt or mud. Irrigation cannot be practised in more favourable circumstances than these. The great lakes of Central Africa, Victoria and Albert Nyanzas, and the vast swamp tract of the Sudan, do for the NUe on a gigantic scale what Lakes Maggiore and Como do for the rivers Ticino and Adda. But for these great reservoirs the Nile would decrease in summer to quite an insignificant stream. India possesses no great lakes from which to draw rivers and canals, but through the plains of Northern India flow rivers which are fed from the glaciers of the Himalaya; and the Ganges, the Indus, and their tributaries are thus prevented from diminishing very much in volume. The greater the

heat, the more rapidly melts the ice, and the larger the quantity of water available for irrigation. The canal system of Northern India is the most perfect the world has yet seen, and contains works of hydraulic engineering which can be equalled in no other country. In the deltas of Southern India irrigation is only practised during the monsoon season. The Godaveri, Kistna, and Kaveri all take their rise on the Western Ghats, a region where the rainfall is never known to fail in the monsoon season. Across the apex of the deltas are built great weirs (that of the Godaveri being 2\ miles long).

Sea

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. Drainage ■ lines.

Tig. 1. — Diagram showing irrigation properly combined with drainage (to left), and laid out regardless of drainage required later (to right).

at the ends and centre of which is a system of sluices feeding a network of canals. Eor this monsoon irrigation there is always abundance of water, and so long as

the canals and sluices are kept in repair, there is little trouble in distributing it over the fields. Similar in character was the ancient irrigation of Egypt, practised merely during the Nile flood — a system which is still the only one that prevails throughout the greater part of Upper Egypt. A detailed description of it will be found below.

Where irrigation is carried on throughout the whole year, even when the supply of the river is at its lowest, the distribution of the water becomes a very delicate operation. It is generally considered ^m”/? sufficient in such cases if during any one crop ^°“e° * one-third of the area that can be commanded is actually supplied with water. This encourages a rotation of crops and enables the precious liquid to be carried over*

a larger area than could be done otherwise. It becomes

then the duty of the engineer in charge to use every effort to get its full value out of every cubic foot of water. Some crops of course require water much oftener than others, and much depends on the temperature at the time of irrigation. During the winter months in Northern India magnificent wheat crops can be produced that have been watered only twice or thrice. But to keep sugar-cane, or indigo, or cotton alive in summer before the monsoon sets in in India or the Nile rises in Egypt the field should be watered every ten days or fortnight, while rice requires a constant supply of water passing over it.

Experience in these sub-tropical countries shows the absolute necessity of having, for successful irrigation, also a system of thorough drainage. It was some ra nage. ^^^^ before this was discovered in India, and the result has been the deterioration of much good land. In Egypt, prior to the British occupation in 1883, no attempt had been made to take the water off the land. The first impression of a great alluvial plain is that it is absolutely flat, with no drainage at all. Closer examina-

tion, however, shows that if the prevailing slopes are not more than a few inches in the mile, yet they do exist, and scientific irrigation requires that the canals should be taken along the crests and drains along the hollows. In the preceding diagram (Eig. 1) is shown to the right of the river a system of canals branching out and afterwards rejoining one another, so as to allow of no means for the water that passes off the field to escape into the sea. Hence it must either evaporate or sink into the soil. Now nearly all rivers contain some small percentage of salt, which forms a distinct ingredient in alluvial plains. The result of this drainless irrigation is an eflorescence of salt on the surface of the field. The spring level rises, so that water can be reached by digging only a few feet, and the land, soured and water-logged, relapses into barrenness. Of this description was the irrigation of Lower Egypt previous to 1883. To the left of the diagram is shown (by firm lines) a system of canals laid out scientifically, dn'd of drains (by dotted lines) flowing between them. It is the effort of the British engineers in Egypt to remodel

the surface of the fields to this type.

Further information may be found in Monceieff. Irrigation in Southern Europe. London, 1868. — Monceieff. "Lectures on Irrigation in Egypt," Professional Papers of the Corps of Boyal Engineers, vol. xix. London, 1893. — Willcocks. Egyptian Irrigation, 2nd edition. London, 1899. (c. s. M.)

II. Egypt.

The very life of Egypt depends on its irrigation, and, ancient as this irrigation is, it was never practised on a really scientific system till after the British occupation.

As every one knows, the valley of the Nile outside of the tropics is practically devoid of rainfall. Yet it istfcsot ' "w^as the produce of this valley that formed the the Nile chief granary of the Roman Empire. Probably vaWey and nowhere in the world is there so large a population per square mile depending solely on the produce of the soil. Probably nowhere is there an agricultural population so prosperous, and so free from the risks attending seasons of drought or of flood. This wealth and prosperity are due to two very remarkable

properties of the Nile. Eirst, the regimen of the river is nearly constant. The season of its rise and its faU, and the height attained by its waters during the highest flood and at lowest Nile, vary to a comparatively small extent. Year after year the Nile rises at the same period, it attains its maximum in September and begins to diminish first rapidly till about the end of December, and then more slowly and more steadily until the following June. A late rise is not more than about three weeks behind an early rise. Erom the lowest to the highest gauge of water-surface the rise is on an average 25-5 feet at the First Cataract. The highest flood is 3-5 feet above this average, and this means peril, if not disaster, in Lower Egypt. The lowest flood on record has risen only to 5-5 feet below the average, or to 20 feet above the mean water-surface of low Nile. Such a feeble Nile flood has occurred only twice in modern history : in 1877, when it caused widespread famine and death throughout Upper Egypt, 947,000 acres remained barren, and the land revenue lost £1,112,000 ; and in 1899, when by the thorough remodel-

ling of the whole system of canals since 1883 all famine and disaster were avoided, and there occurred a loss of only £300,000 to the revenue of the country. This regularity of flow is the first exceptional excellence of the river Nile. The second is hardly less valuable, and consists in the remarkable richness of the alluvium brought down the river year after year during the flood. The object of the engineer is so to utilize this flood-water that as little as possible of the alluvium may escape into the sea, and as much as possible may be deposited on the fields. It is the possession of these two properties that imparts to the Nile a value quite unique among rivers, and gives to the farmers of the Nile Valley advantages over those of any rain-watered land in the world.

Until the 19th century irrigation in Egypt on a large scale was practised merely during the Nile flood. Along each edge of the river and following its course has been erectedan earthen embankmenthigh enough irrigation not to be topped by the highest floods. In tigbme. Upper Egypt, the valley of which rarely exceeds

six miles in width, a series of cross embankments have been constructed, abutting at the inner ends on those along the Nile, and at the outer ends on the ascending sides of the valley. The whole country has thus been divided into a series of oblongs, surrounded by embank-ments on three sides and by the desert slopes on the fourth. These oblong areas vary from 60,000 to 1500 or 2000 acres in extent. Throughout all Egypt the Nile is deltaic in character ; that is, the slope of the cormtry in the valley is away from the river, and not towards it. It is easy, then, when the Nile is low, to cut short, deep canals in the river banks, which fill as the flood rises, and carry the precious mud-charged water into these great flats. There the water remains for a month or more, some three feet deep, depositing its mud, and thence at the end of the flood the almost clear water may either be run off directly into the receding river, or cuts may be made in the cross embankments, and it may be allowed to flow from one flat to another, and ultimately into the river. In November the waters have passed off ; and whenever a man can walk

over the mud with a pair of bullocks, it is roughly turned over with a wooden plough, or merely the branch of a tree, and the wheat or barley crop is immediately sown. So soaked is the soil after the flood, that the grain germinates, sprouts, and ripens in April, without a shower of rain or any other watering. In Lower Egypt this system was somewhat modified, but it was the same in principle. No other was known in the Nile Valley until the country fell, early in the 19th century, under the vigorous rule of Mehemet All Pasha. He soon recognized that with such a climate and soil, with a teeming population, and with the markets of Europe so near, they might produce in Egypt something more profitable than wheat and maize. Cotton and sugar-cane would fetch far higher prices, but they could only be grown while the Nile was low, and they required water at all seasons.

It has already been said that the rise of the Nile is about 2^\ feet, so that a canal constructed to draw water out of the river while at its lowest must be 25^ feet

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during

low Nile.

deeper than if it is intended to draw ofP only during the highest floods. Mehemet Ali began by deepening the canals of Lower Egypt by this amount, a gigantic and futile task ; for as they had been laid out on no scientific principles, the deep channels became filled with mud during the first flood, and all the excavation had to be done over again, year after year. With a serf population even this was not impossible ; but as the beds of the canals were graded to no even slope, it did not follow that if water entered the head it would flow evenly on. As the river daily fell, of course the water in the canals fell too, and since they were never dug deep enough to draw water from the very bottom of the river, they occasionally ran dry altogether in the month of June, when the river was

at its lowest, and when, being the month of greatest

heat, water was more than' ever necessary for the cotton

crop. Thus l^rge tracts which had been sown, irrigated,

weeded, and nurtured for perhaps three months, perished

The Nile

barrage.

Pig. 2. — 'Map showing the Damietta and Eosetta dams on the Nile

in the fourth, while all the time the precious Nile water

was flowing useless to the sea. The obvious remedy

was to throw a weir across each branch of the river

to control the water, and force it into canals taken

from above it. The task of constructing this great

work was committed to Mougel Bey, a French engineer

of ability, who designed and constructed the great

barrage across the two branches of the NUe

at the apex of the delta, about 12 miles

north of Cairo (Fig. 2). It was built to con-

sist of two bridges — one over the eastern or Damietta

branch of the river having 71 arches, the other, over the

Kosetta branch, having 61 arches, each arch being of 5

metres, or 16-4 feet, span. The building was all of stone, the floors of the arches were inverts. The height of pier from edge of flooring to spring of arch was 28-7 feet, the spring of the arch being about the surface-level of maximum flood. The arches were designed to be fitted with self-acting drop gates ; but they were not a success, and were only put into place on the Rosetta branch. The gates were intended, to hold up the water 4-5 metres, or 14-76 feet, and to divert it into three main canals — the Behera, on the west, the Menufia in the centre, and the Tewfikia on the east. The river was thus to be emptied, and to flow through a whole network of canals, watering all Lower Egypt. Each barrage was provided with locks, to pass Nile boats 160 by 28 feet in area. Mougel's barrage, as it may now be seen, is a very imposing and stately work. Considering his want of experience of such rivers as the Nile, and the great difiiculties he had to contend with under a succession of ignorant Turkish rulers, it would be unfair to blame him because, until it fell into the hands of British engineers

in 1884, the work was condemned as a hopeless failure. It took long years to complete, at a cost which can never be estimated, since much of it was done by serf labour. In 1861 it was at length said to be finished, but it was not until 1863 that the gates of the Eosetta branch were closed, and they were reopened again immediately, as a settlement of the masonry took place. The experiment was repeated year after year till 1867, wlieu the barrage cracked right across from foundation to top. A massive coffer-dam was then erected, covering the eleven arches nearest the crack; but the work was never trusted again, nor the water-surface raised more than about three feet.

An essential part of the barrage project was the three canals, taking their water from just above it, as shown in Fig. 2. The heads of the existing old canals, taken out of the river at intervals throughout the delta, were to be closed, and the canals themselves all put into connexion with the three high-level trunk

lines taken from above the barrage. The central canal, or Menufia, was more or less finished, and, although full of defects, has done good service. The eastern canal was never dug at all until the British occupation. The western, or Behera, canal was dug, but within its first 60 miles it passes through desert, and sand drifted into it. Corvies of 20,000 men used to be forced to clear it out year after year, but at last it was abandoned. Thus the whole system broke down, the barrage was pronounced a failure, and attention was turned to watering Lower Egypt by a system of gigantic pumps, to raise the water from the river and discharge it into a system of shallow surface-canals, at an annual cost of about £250,000, while the cost of the pumps was estimated at £700,000. Negotiations were on foot for carrying out this system when the British engineers arrived in Egypt. They soon resolved that it would

be very much better if the original scheme of using the barrage could be carried out, and after a careful examinar tion of the work they were satisfied that this could be done. The barrage rests entirely on the alluvial bed of the Nile. Nothing more solid than strata of sand and mud is to be found for more than 200 feet below the river. It was out of the question, therefore, to think of founding on solid material, and yet it was desired to have a head of water of 13 or 14 feet upon the work. Of course, with such a pressure as this, there was likely to be percolation under the foundations and a washing-out of the soil. It had to be considered whether this percolation could best be checked by laying a solid wall across the, river, going down to 50 or 60 feet below its bed, or by spreading out the foundations above and below the bridge, so as to form one broad water-tight flooring — a system practised with eminent success by Sir Arthur Cotton in Southern India. It was decided to adopt the latter system. As originally designed, the flooring of the barrage from up-stream to down-stream face was 111-50 feet wide, the

distance which had to be travelled by water percolating under the foundations. This width of flooring was doubled to 223 feet, and along the up-stream face a line of sheet piling was driven 16 feet deep. Over the old flooring was superposed 15 inches of the best rubble

masonry, an ashlar floor of blocks of close-grained trachyte being laid directly under the bridge, where the action was severest. The working season lasted only from the end of November to the end of June, while the Nile was low; and the difficulty of getting in the, foundations was increased, as, in the interests of irrigation and to supply the Menufia canal, water was held up every season while the work was in progress to as much as 10 feet. The work was begun in 1886 and completed in June 1890. Moreover, in the meantime the eastern, or Tewfikia, canal was dug and supplied with the necessary masonry works for a distance of 23 miles,

to where it fed the network of old canals. The western, or Behera, canal was thoroughly cleared out and re-modelled; and thus the whole delta irrigation was supplied from above the barrage.

The outlay on the barrage between 1883 and 1891 amounted to about £460,000. The average cotton crop for the 5 years preceding 1884 amounted to 123,000 tons ; for the 5 years ending 1898 it amounted to 251,200 tons. At the low rate of £40 per ton, this means an annual increase to the wealth of Lower Egypt of £5,128,000. Since 1890 the barrage has done its duty without accident, but a work of such vast importance to Lower Egypt required to be placed beyond all risk.

It having been found that considerable hollow spaces existed below the foundations of some of the piers, five bore-holes from the top of the roadway were pierced vertically through each pier of both barrage, and similar holes were drilled at intervals along all the lock walls. Down these holes cement grout was injected under high pressure on the system of Mr

Kinipple. The work was successfully carried out during the seasons 1896 to 1898. During the summer of 1898 the Eosetta barrage was worked under a pressure of 14 feet. But this was looked on as too near the limit of safety to be relied on, and in 1899 subsidiary weirs were started across both branches of the river a short distance below the two barrages. These were estimated to cost £530,000 altogether, and were to stand 10-8 feet above the river's bed, allowing the water-surface upstream of the barrage to be raised 7-2 feet, while the pressure on that work itself would not exceed 10 feet. These weirs were satisfactorily completed in 1901.

The barrage is the greatest, but by no means the only, important masonry work in Lower Egypt. Numerous regulating bridges and locks have been built, to give absolute control of the water and facilities for navigation; and in 1901 a second weir was begun opposite Zifta across the Damietta branch of the Nile, to improve the irrigation of the Dakhleh province.

In the earlier section of this article it is explained how

necessary it is that irrigation should always be accom-
panied by drainage. This had been totally neglected iu
Egypt ; but very large sums have been spent on it, and
the country is now covered with a network of drains
nearly as complete as that of the canals.
The ancient system of basin irrigation is still gener-
ally pursued in Upper Egypt. It seems simple enough ;
Basia ^^^ ^^ order really to flood the whole Nile
irrigaiioa valley during seasons of defective as well
of Upper as favourable floods, a system of regulating
Egypt sluices, culverts, and syphons is necessary;
and for want of such a system it was found, in the
feeble flood of 1888, that there was an area of 260,000
acres over which the water never flowed. This cost
a loss of land revenue of about £300,000, while the
loss of the whole season's crop to the farmer was of
course much greater. The attention of the British
engineers was then called to this serious calamity;
and fortunately for Egypt, there was serving in the
country Col. J. C. Eoss, E.E., an officer who had de-

voted marfy years of hard work to the irrigation of the North-West Provinces of India, and who possessed quite a special knowledge as well as a glowing enthusiasm for the subject. Fortunately, too, it was possible to supply him with the necessary " funds to complete and remodel the canal system. When the surface-water of a river is higher than the fields right and left, there is nothing easier than to breach the embankments and flood the fields — in fact, it may be more difficult to prevent their being flooded than to flood them — but in ordinary floods the Nile is never higher than all the bordering lands, and in years of feeble flood it is higher than none of them. To water the valley, therefore, it is necessary to construct canals having bed-slopes less than that of the river, along' which the water flows until its surface is higher than that of the fields. If, for instance, the slope of the river be 4 inches per mile, and that of the canal 2 inches, it is evident that at the end of a mile the water in the canal will be 2 inches higher than in the river ; and if the surface of the land is

3 feet higher than that of the river, the canal, gaining on it at 2 inches per mile, will reach the surface in 18 miles, and from thence onwards wUl be above the adjoining fields. But to irrigate this upper 18 miles, water must either be raised artificially, or supplied from another canal taking its source 18 miles farther up. This would, how-ever, involve the country in great lengths of canal be-tween the river and the field, and circumstances are not so unfavourable as this. Owing to the deltaic nature of the Nile valley, the fields on the banks are 3 feet above the flood, at 2 miles away from the banks they may not be more than 1 foot above that level, so that the canal, gaining 2 inches per mile and receding from the river, will command the country in 6 miles. The slope of the river, moreover, is taken in its winding course ; and if it is 4 inches per mile, the slope of the axis of the valley parallel to which the canals may be made to flow is at least 6 inches per mile, so that a canal with a slope of 2 inches gains 4 inches per mile.

The system of having one canal overlapping another

has one difficulty to contend with. Occasionally the desert cliffs and slopes come right down to the river, and it is difficult, if not impossible, to carry the higher-level canals past these obstructions. It should also be noticed that on the higher strip bordering the river it is the custom to take advantage of its nearness to raise water by pumps, or other machinery, and thereby to grow valuable crops of sugar-cane, maize, or vegetables. When the river rises, these crops, which often form a very important part of the year's produce and are termed JSfabdri, are still in the ground, and they require water in moderate and regulated quantities, in contradistinction to the wholesale flooding of the flats beyond. Fig. 3 will serve to explain this system of irrigation, the firm lines representing canals, the dotted lines embankments. It will be seen, beginning on the east or right bank of the river, that a high-level canal from an upper system is carried, past a steep slope, where perhaps it is cut entirely out of rock, and it divides into two. The right branch waters all the desert slopes within its reach and

level. The left branch passes, by a syphon aqueduct, under what is the main canal of the system, taken from the river close at hand (and therefore at a lower level). This left branch irrigates the Nabdri on the high lands bordering the river. In years of very favourable flood this high-level canal would not be wanted at all : the irrigation could be done from the main canal, and with this great advantage, that the main canal water would carry with it much more fertilizing matter than would be got from the tail of the high-level canal, which left the river perhaps

25 miles up. The main canal flows freely over the flats C and D, and, if the flood is good, over B and part of A. It is carried round the next desert point, and to the north becomes the high-level canal. The masonry works required for this system are a syphon to pass the high level under the main canal- near its head, bridges fitted with sluices where each canal passes under an embank-

ment, and an escape weir at the tail of the system, just south of the desert point, to return surplus water to the river. Turning to the left bank, there is the same high-level canal from the upper system irrigating the basins K, P, and L, as well as the large basin E in such years as it cannot be irrigated from the main canal. Here there are two main canals — one following the river, irrigating a series of smaller basins, and throwing out a branch to its left, the other passing under the desert slopes and sup-plying the basins F, G, H, and S. Tor this system two syphons will be required near the head, regulating

Fig. 3. — Map of the basin system of irrigation.

bridges under all the embankments, and an escape weir back into the river.

In the year following 1888 about 100 new masonry works of this kind were built in Upper Egy^jt, nearly 400 miles of new canal were dug, and nearly 300 miles of old canal were enlarged and deepened. The outlay altogether was about £800,000, and the result has been, as already stated, that with a complete failure of the Nile

flood the loss to the country has been trifling compared with that of 1877.

There is one exception in Upper Egypt to the basin system of irrigation. The Khedive IsmaD. having acquired vast estates in the provinces of Assiut, Minieh, Beni-Suef, and the Fayiim, resolved to grow sugar-cane on a very large scale, and with this object constructed a very important perennial canal, named the Ibrahimia, taking out of the left bank of the Nile at the town of Assiut, and flowing parallel to the river for about 200 miles, with an important branch which irrigates the Fayum. This canal was badly constructed, and by entirely blocking the drainage of the valley did a great deal of harm to the lands. Most of its defects have been remedied, but one remains. Their being at its head no weir across the Nile, the water in the Ibrahimia canal rises and falls with that of the river, and so the supply is apt to run short during the hottest months, as was the case with the canals of Lower Egypt before the barrage was built. To supply the Ibrahimia canal at all during low Nile,

it had been necessary to carry on dredging operations at an annual cost of about £12,000. This has now been rectified, in the same way as in Lower Egypt, by the Assiut construction of a weir across the Nile, intended '^* " to give complete control over the river and to raise the water-surface 8-2 feet. The Assiut weir is constructed on a design very similar to that of the barrage in Lower Egypt. It consists of a bridge of 111 arches, each 5 metres span, with piers of 2 metres thickness. In each arch are fitted two gates. There is a lock 80 metres long and 16 metres wide at the left or western end of the weir, and adjoining it are the regulating sluices of the Ibrahimia canal. The Assiut weir across the Nile is just about half a mile long. The work was begun at the end of 1898, and finished early in 1902.

This weir, as well as that in Lower Egypt, is intended to raise the water-surface above it , and to control the distribution of its supply, but in no way to store that supply. The idea of ponding up the superfluous flood discharge of the river is not a new one, and

if Herodotus is to be believed, it was a system actually
pursued at a very early period of Egyptian history,
when Lake Moeris in the Fayiim was filled at
each Nile flood, and drawn upon as the river ran
down. When British engineers
first undertook the management of "^"
Egyptian irrigation, many representations
were made to them of the advantage of
storing the Nile water; but they con-
sistently maintained that before entering on
that subject it was their duty to utilize
every drop of the water at their disposal.
This seemed all the more evident, as at that
time financial reasons made the construction
of a costly Nile dam out of the question.
Every year, however, between 1890 and
1902 the supply of the Nile duriag May
and June was actually exhausted, no
water at all flowing then out into the sea.
In these years, too, owing to the extension

of drainage works, the irrigable area of
Egypt was greatly enlarged, so that if peren-
nial cultivation was at all to be increased,
it was necessary to increase the volume of the river, and
this could only be done by storing up the flood supply.
The first diflculty that presented itself in carrying this
out, was that during the months of highest flood the Nile
is so charged with alluvial matter that to pond it up then
would inevitably lead to a deposit of silt in the reservoir,
which would in no great number of years fill it up. It
was found, however, thatthe flood water was comparatively
free from deposit by the middle of November, whUe the
river was still so high that, without injuring the irrigation,
water might go on being stored up until March. Accord-
ingly, the dam is supplied with sluices large enough to
discharge unchecked the whole volume of the river as it
comes down until the middle of November, and then to
begin the storage.
The site selected for the great Nile dam was at the
head of the First Cataract above Assuan. A dyke of

syenite granite here crosses the valley, so hard

that the river had nowhere scoured a deep

channel through it, and so it was found

possible to construct the dam entirely in the open air,

without the necessity of laying under-water foundations.

The length of the dam is about 6400 feet — nearly 1

mile. The greatest head of water in it is 65 feet. It

is pierced by 140 under-sluices of 150 square feet

each, and by 40 upper-sluices, each of 75 square feet.

These, when fully open, are capable of discharging the

ordinary maximum Nile flood of 350,000 cubic feet

per second, with a velocity of 15-6 feet per second and a

head of 6-6 feet. The top width of the dam is 23 feet,

the bottom width, at the deepest part, about 82 feet.

On the left flank of the dam there will be a canal, pro-

vided with four locks each 262 by 31 feet in, area, so

that navigation will be possible at all seasons. It was

Nile

dam.

598

intended at first to raise the dam 26 feet higher, but this would have involved the yearly submergence ef the celebrated classical temples of Philse, situated on an island just up-stream of the dam. Had the natives of Egypt been asked to choose between the preservation of Ptolemy's famed temple and the benefit to be derived from an additional 20 feet depth of water storage, there can be no question that they would have preferred the latter ; but they were not consulted, and the classical sentiment and artistic beauty of the place, skilfully pleaded by archaeologists and artists, carried the day. As at present designed, the storage capacity of the reservoir is estimated at about 3,750,000 millions of cubic feet, which will create a lake extending up the Nile valley for about 200 miles. It is calculated that yearly the reservoir should be full before the end of March ; after that the water-surface in it will remain constant, the volume reaching the reservoir from the south being passed on

through the sluices. In May, when the demand for water increases, first the upper and then the under sluices will be gradually opened, so as to increase the river supply, until July, when all the gates will be open, to allow of the free passage of the flood. In 1902 this magnificent work was completed. The engineer who designed it was Mr W. Willcocks, C.M.G. The contractors were Messrs John Aird & Co., the contract price being £2,000,000. The financial treaties in which the Egyptian Government are bound up would prevent their ever paying so large a sum as this within five years ; but a company was formed in London which advances periodically the sum due to the contractors, on receipt from the Government of Egypt of promissory notes to pay sixty half-yearly instalments of £78,613, commencing on the 1st July 1903. There are no treaties to prevent the Government of Egypt from paying so moderate a sum as this year by year, and the payments do not begin until the first year that a return may be expected from the additional irrigation to be effected.

See Willcocks, Egyptian Irrigation, 2nd edition, 1899 ; Mon-

CRiEFF, Lectures on Irrigation in Egypt. Professional Papers of the

Corps ofBoyal Engineers, vol. xix., London, 1893. (o. s. M.)

III. India.

At pp. 754, 755 of vol. xii. of this work (9th edition)

will be found some account of the irrigation works of

India, of the outlay incurred and of the revenue obtained

up to the year 1878. That year, which saw the end of a

most disastrous famine, may be considered as the com-

mencement of a new era as regards irrigation. It had at

last been recognized that such famines must be expected

to occur at no very long intervals of time, and that the

cost of relief operations must not be met by increasing the

permanent debt on the country, but by the creation of a

famine relief and a famine insurance fund. For this purpose

it was fixed that there should be an annual provision of

Rx.1,500,000, to be spent on — (1) relief, (2) protective

works, (3) reduction of debt. Among protective works

the first place was given to works of irrigation. These

works were divided into three classes — (i.) productive

works ; (ii.) protective works ; (iii.) minor works. Productive works, as their name implies, are such as may reasonably be expected to be remunerative, and they include all the larger irrigation systems. Their capital cost is provided from loan funds, and not from the relief funds mentioned above. In the seventeen years ending 1896-97 the capital expenditure on such works was Ex.10,954,948, including a sum of Ex.1,742,246 paid to the Madras Irrigation Company as the price of the Kurnool-Ouddapah canal, a work which can never be financially productive, but which nevertheless did good service in the famine of 1896-97 by irrigating 87,226 acres. In the famine year 1877-78 the area irrigated by productive canals was 5,171,497 acres. In the famine year 1896-97 the area was 9,571,779 acres, including an area of 123,087 acres irrigated on the Swat river canal in the Punjab. The revenue of the year 1879-80 was nearly 6 per cent, on the capital outlay. In 1897-98 it was 7i per cent. In the same seventeen years Ex.2,099,253 were spent on the construction of protective irrigation works, not expected

to be directly remunerative, but of great value during famine years. On four works of this class were spent Ex.1,649,823, which in 1896-97 irrigated 200,733 acres, a valuable return then, although in an ordinary year their gross revenue does not cover their working expenses. Minor works may be divided into those for which capital accounts have been kept and those where they have not. In the seventeen years ending 1896-97, Ex.827,214 were spent on the former, and during that year they yielded a return of 9-13 per cent. In the same year the irrigation effected by minor works of all sorts showed the large area of 7,442,990 acres. Such are the general statistics of out-lay, revenue, and irrigated area up to the end of 1896-97. The Government might well be congratulated on having through artificial means ensured in that year of widespread drought and famine the cultivation of 27,326 square miles, a large tract even in so large a country as India. Some description will now be given of the chief of these irrigation works. Beginning with the Punjab, the province in which most progress has been made, the

great Sutlej canal, which irrigates the country to the left of that river, was opened in 1882, and the "Western Jumna canal (perhaps the oldest in India) was extended into the dry Hissar and Sirsa districts, and generally improved so as to increase by nearly 50 per cent, its area of irrigation between 1878 and 1897. Perhaps this is as much as can well be done with the water at command for the country between the Sutlej ftnd the Jumna, and it is enough to secure it for ever from famine. The Bari Doab canal, which irrigates the Gurdaspur, Amritsar, and Lahore districts, has been enlarged and extended so as to double its irrigation since 1877-78. The Chenab canal was only begun in 1889-90, and is finished. In 1896-97 it irrigated 520,279 acres, and yielded a revenue of 6-75 per cent, on the capital cost. In constructing this canal an experiment was made which proved a great success. Former canals were made in populous districts where the people were ready at once to take the water offered to them. The Chenab canal flows through what was practi-cally a desert. Doubt was expressed as to whether colo-

nists from more populous tracts would migrate to the banks of the new canal. But these doubts soon vanished, and in 1897 650,000 acres had been allotted to new settlers, while there were many more applicants. A much smaller work, but one of great interest, is the Swat river canal in the Peshawar valley. It was never expected that this would be a remunerative work, but it was thought for political reasons expedient to construct it, in order to induce turbulent frontier tribes to settle down into peaceful agriculture. This has had a great measure of success, and the canal itself has proved remunerative, irrigating 123,000 acres in 1896-97. Another great canal drawing its water f romthe Jlielum will irrigate the country between that river and the Chenab. It is intended to irrigate 424,000 acres, and the capital cost is estimated at Ex.1,228,000. A much greater scheme than any of the above is that of the Sind Sagar canal, which it is proposed to draw from the left bank of the Indus opposite Kalabagh, to irrigate 1,750,000 acres at a cost of Ex.6,000,000. Another great canal scheme under consideration in the Punjab proposes to take

off from the right bank of the Sutlej, and to irrigate about 600,000 acres in the Montgomery and Multan districts, at

a cost of Ex.2,500,000. These three]ast projects would add 2,774,000 acres to the irrigated area of the province, and as they would flow through tiacts almost unpeopled, they would afford a most valuable outlet for the congested districts of Northern India. In addition to these great perennial canals, much has been done since 1878 in enlarging and extending what are known as the "inundation canals " of the Punjab, which utilize the flood waters in the rivers during the monsoon season, and are dry at other times. By these canals large portions of country throughout most of the Punjab are brought under cultivation, and the area thus watered has increased from about 180,000 to 500,000 since 1878.

It is on inundation canals such as these that the whole cultivation of Sind depends. In 1878 the area was about

1,600,000 acres ; in 1896-97 it had increased to 2,484,000 acres. This increase was not due to famine in Sind, for that rainless province depends always on the Indus, as Egypt does on the Nile, and where there is no rainfall there can be no drought. But the famine prices obtained for agricultural produce doubtless gave an impetus to cultivation. In Sind, too, there is room for much increase of irrigation. It has. been proposed to construct two new canals, the Jamrao and the Shik^rpur, and to improve and extend three existing canals — Nasrat, Naulakhi, and Dad. The total cost of these five projects, some of which are now in progress, will be Rx.1,596,682, and the extension of irrigation is estimated at 660,563 acres.

Turning from the basin of the Indus to that of the Ganges, the commissioners appointed to report on the famine of 1896-97 found that in the country between the Ganges and the Jumnalittle was left to be done bey ond the completion of some distributary channels. The East India Com-

pany's great work, the Ganges canal, constructed between 1840 and 1854, before there was a mile of railway open in India, still holds its place unsurpassed among later irrigation work for boldness of design and completeness of execution, a lasting monument to the genius of Sir Proby Cautley, an officer of the Bengal Artillery but a born engineer. Ever since 1870 consideration has been given to projects for irrigating the fertile province of Oudh by means of a great canal to be drawn from the river Sarda. The water is there in abundance, the land is well adapted for irrigation, but as there is a considerable rainfall, it is doubtful whether the scheme would prove remunerative, and a large section of the landowners have hitherto opposed it, as likely to waterlog the country. Among the four protective works of irrigation which were said above to have irrigated 200,733 acres in 1896-97, one of the most important is the Betwa canal, in the parched district of Bundelkhand. This canal has cost Kx.428,086, and causes

an annual loss to the state in interest and working expenses of about E,x.20,000. It irrigated, however, in 1896-97 an area of 87,306 acres, raising crops valued at Rx.231,081, or half the cost of the canal, so it may be said to have justified its construction. A similar canal from the river Ken in the same district has long been under consideration, but was not yet sanctioned in 1901. Proceeding farther east, we find very satisfactory progress in the irrigation of southern Behar, effected by the costly system of canals drawn from the river Sone. In 1877-78 these canals irrigated 241,790 acres. Eapid progress was not expected here, and 792,000 acres was calculated as being the maximum area that could be covered with the water supply available. In the five years preceding 1896-97 the average irrigated area was 392,921 acres, and during that year the area was 555,166 acres. •

The canal system of Orissa was never expected to be remunerative, since in five years out of six the local rainfall is sufficient for the rice crop. In 1878-79 the area irrigated was 111,250 acres, and the outlay up to date was

Rx.l, 750,000. In 1896-97 the area was 185,048 acres, and the capital outlay amounted to Rx.2,623,703. It should be mentioned in favour of these canals that although the irrigation is not of yearly value, they supply very important water communication through a province which, from its natural configuration, is not likely to be soon intersected by railways. If, moreover, such a famine were again to occur in Orissa as that of 1866-67, there would be no doubt of the value of these fine canals.

In the Madras Presidency and in Mysore irrigation has long assumed a great importance, and the engineering works of the three great deltas of the Godaveri, Kistna, and Kaveri, the outcome of the genius and indefatigable enthusiasm of Sir Arthur Cotton, have always been quoted as showing what a boon irrigation is to a country. In 1878 the total area of irrigation in the Madras Presidency amounted to about 5,000,000 acres. The irrigation of the eight productive systems was 1,680,178 acres, and the revenue Rx.739,778. In 1898 there were ten of these systems, with an irrigation area, as shown by the

accompanying table, of 2,685,915 acres, and a revenue of

Rx.1,163,268 :—

Irrigation.

Area

Watered.

Total

Kevenue.

Total

Expendi-

ture.

Net

Eevenue.

Capital

and

Indirect

Charges.

Percentage

of Net

Eevenue

to Capital.

Major Worke—

1. Godaveri Delta .

2. Kistna „ .

8. Penner Weir 1

System . f

4. Sangam System

5. Kurnool Canal .

6. Barur Tank System .

7. Kaveri Delta .

8. Srivaikuntam

System .

9. Periyar Project .

10. Kushikulya Canal .

Total .

Minor Works—

23 Works for whicli ”

Capital and Re-

venue Accounts

are kept .

Minor Works for

■*which such Ac-*

counts are not

kept ....

Grand Total

- Acres.

779,435

620,873

70,464

76,277

47,008

4,421

989,808

41,668

89,148

67,318

Ex.

828,443

254,679

28,160

82,627

16,622

1,162

434,846

19,349

37,626

11,454

Ex.

68,876

74,142

5,087

7,037

12,404

885

43,464

4,680

10,761

8,678

Ex.

260,067

130,437

23,123

26,590

8,218

777

890,882

14,669

26,775

7,776

Ex.

1,297,807

1,319,166

189,919

885,601

2,171,740

4,250

199,458

147,192

862,914

464,428

19-15

18-18

7-69

8-68

•15

1-39

44-87

5-45

-27

-64

2,686,915

1,168,268

229,954

933,314

7,032,470

7-88

535,818

8,131,009

200,658

880,175

34,666

193,295

166,903

686,880

1,693,878

4-44

6,852,737

2,194,001

467,904

1,786,097

In the three great deltas, and the small southern one that depends on the Srivaikuntam weir over the river Tumbraparni, extension and improvement works have been carried dn. The Sangam and Penner systems depend on two weirs on the river Penner in the Nellore district, the former about 18 miles ■ above and the latter just below the town of Nellore. The former irrigates on the left, the latter on the right bank of the river. This district suffered severely in the famine of 1877-78, and the irrigation ~~*vvorks were started in con*~~ *sequence. The Barur tank system in the Salem district*

was also constructed after the famine of 1877-78.

As yet it has not fulfilled expectations. The Periyar scheme has for its object both the addition of new irrigation and the safeguarding of that which exists in the district of Madura, a plain watered by means of a great number of shallow tanks drawing their supply from a very uncertain river, the Vaigai. This river takes its rise on the eastern slopes of the Ghat range of mountains, and just opposite to it, on the western face of the range, is the source of the river Periyar. The rainfall on the west very much exceeds that on the east, and the Periyar

used to find its way by a short torrent course to the sea, rendering no service to mankind. Its upper waters are now stemmed by a masonry dam 178 feet high, forming a large lake, at the eastern end of which is a tunnel 5700 feet long piercing the watershed, and discharging 1600 cubic feet per second down the eastern side of the

mountains into the river Vaigai. ISTo bolder or more original work of irrigation has been carried out in India, and the credit of it is due to ColonelJ. Pennycuick, C.S.I. The dam and tunnel were works of unusual difficulty. The country was roadless and uninhabited save by wild beasts, and fever and cholera made sad havoc of the working parties ; but it was successfully accomplished. The last of those given in the table above was not expected to be remunerative, but it should prove a valuable protective against famine. The system consists of weirs over the rivers Gulleri, Mahanadi, and Eushikulya in the backward province of Ganjam, south of Orissa. From these weirs flow canals altogether about 127 miles long, which, in connexion with two large reservoirs, are capable of irrigating 120,000 acres. The works were not yet finished in 1901, but already irrigated 67,318 acres.

In addition to all these great engineering systems. Southern India is covered with minor works of irrigation, some drawn from springs in the sandy beds of rivers,

some from the rainfall of half a square mile ponded up in a valley. In other cases tanS:s are fed from neighbouring streams, and the greatest ingenuity is displayed in preventing the precious water from going to waste. Allusion has been already made to the canals of Sind. Elsewhere in the Bombay Presidency, in the Deccan and Gujarat, there are fewer facilities for irrigation than in other parts of India. The rivers are generally of uncertain volume. The cost of storage works is very great. The population is backward, and the black soil is of a nature that in ordinary years can raise fair crops of millet and maize without artificial watering. Up to the end of 1896-97 the capital spent on the irrigation works of the Deccan and Gujarat was Ex.2,616,959. The area irrigated that year was 262,830 acres. The most important works are the Mutha and Nira canals in the Poona district.

In Upper Burma three productive irrigation works have been proposed — the Mandalay, the Shwebo, and the Mon canals, of which the first was in progress in 1901.

It was estimated to cost E.x.323,280, and to irrigate 72,000 acres. The area estimated from the whole three projects is 262,000 acres, situated in the only part of Burma that is considered liable to famine.

See Annual Beports Irrigation Department Local Governments of India. Beports of the Indian Famine Commissions of 1878 and 1898. (6. s. M.)

IV. United States.

On account of the aridity of the climate throughout the greater part of the western third of the United States, the practice of agriculture is dependent upon an artificial supply of water. On most of the country west of the 97th meridian and extending to the Pacific Ocean less than 20 inches of rain falls each year. The most notable exceptions are in the case of a narrow strip west of the Cascade Range and of some of the higher mountain masses. In ordinary years the climate is too dry for successful cultivation of the field crops, although under favourable conditions of soil and cultivation there are certain areas where cereals are grown by what is

known as " dry farming." -The eleventh census of the United States, 1890, showed that 3,564,416 acres were irrigated in 1889. This included only the lands from which crops were produced. Besides this, there were probably 10 million acres under irrigation systems constructed in whole or in part. An estimate for the year 1899 gave the following figures of area cropped by irrigation, these being, in round numbers : —

Arizona 180,000

California 1,500,000

Colorado 1,250,000

Idaho 500,000

Montana 800,000

Nevada 500,000

New Mexico 200,000

Oregon 300,000

Utah 500,000

Washington 100,000

Wyoming 500,000

Total

6,330,000

In addition to the area above given, about 100,000 acres are under irrigation in what is known as the sub-humid region, east of the states above mentioned and including portions of the states of North and South Dakota, Nebraska, Kansas, and Texas, and the territory of Oklahoma.

The greater part of these lands is irrigated by canals or ditches built by individuals acting singly or in co-operation with their neighbours, or by corporations. The national and state governments have not built any works of reclamation excepting where the Federal Government, through the Indian department, has constructed irrigation ditches for Indian tribes, notably the Crow Indians of Montana. A few of the state governments, such, for example, as Colorado, have built small reservoirs or portions of canals from internal improvement funds.

The construction of irrigation canals and ditches has for the most part been brought about by farmers joining to plough out or dig ditches from the rivers, descending

on a gentle grade. The cost of those under 5 feet in width has been less than $500 per mile, and from 5 to 10 feet in width, $1500 per mile. Some of the corporar tions constructing' works for the sale of water have built structures of notable size, such, for example, as the Sweetwater and Hemet dams of southern California, the Bear river canal of Utah, and the Arizona canal, taking water from Salt river, Arizona. The cost of bringing water to the land has averaged about $8 per acre where the ordinary ditches have been built. The owners of extensive works have charged from $12 to $20 per acre and upwards for so-called " water rights," or the privilege to take water from the canal, this covering cost of con-struction.

Besides the first cost of construction, the irrigator is usually called upon to pay annually a certain amount for maintenance, which may often be worked out by labour on the canal. The cost ranges from 60 cents to $1 per acre; or, with incorporated companies, from $1.50 to $2.50 per acre and upwards. The largest expense for

water rights and for annual maintenance is incurred in southern California, where the character of the crops, such as citrus fruits, and the scarcity of the water makes possible expensive construction and heavy charges. The legal expense for the maintenance of water rights is often large because of the interminable suits brought during the times of water scarcity. The laws regarding water in most of the arid states are indefinite or contradictory, being based partly on the common law regarding riparian rights, and partly upon the Spanish law allowing diversion of water from natural streams. Few fundamental principles have been established, except in the case of the state of "Wyoming, where there is an official charged with the duty of ascertaining the amount of water in the streams aud apportioning this to the claimants in the tTNITED states]

order of tlieir priority of appropriation for beneficial use.

Irrigation has progressed to such an extent, that in the year 1900 there remained few localities where water could

not be easily or cheaply diverted from creeks and rivers for the cultivation of farms. The claims for the available supply from small streams now exceed the water to be had in the latter part of the irrigating season. There remain large rivers and opportunities for water storage which can be brought under irrigation at considerable expense. The large canals and reservoirs built by corpora,tions have, however, rarely been successful from a financial standpoint, and irrigation construction during the latter part of the decade 1890-99 was relatively small. Owing to the diflculty and expense of securing water from running streams by gravity systems, a great variety of methods has been developed of pumping water by windmills, gasolene or hot-air engines, and steam. Ordinary reciprocating pumps are commonly employed, and also air lifts and similar devices for raising great quantities of water to a height of from 20 to 50 feet. Por greater depths the cost is usually prohibitive. Throughout the Great Plains region, east of the Eocky Mountains, and in the broad valleys to the west, windmills are extensively

used, each pumping water for from 1 to 5 acres of culti-vated ground. In a few localities, notably in South Dakota, the Yakima valley of Washington, San Joaquin, and San Bernardino valleys of California, San Luis valley of Colorado, and Utah valley of Utah, water from artesian wells has also been used for the irrigation of from 1 to 160 acres. The total acreage supplied by such means is probably less than 1 per cent, of that watered by gravity systems.

The development-of irrigation has in part been retarded by the improper or wasteful use of water. On permeable soils, especially those of the terrace lands along the val-leys, the soluble salts commonly known as alkali are grad-ually leached out and carried by the percolating waters towards the lower lands, where, reaching the surface, the alkali is left as a glistening crust or as pools of inky blackness. Farms adjacent to the rivers are for a time increased in richness by the alkaline salts, which in diffuse form may be valuable plant foods, and then suddenly become valueless when the concentration of alkali has

reached a degree beyond that which the ordinary plants will endure.

The conditions governing the practice of irrigation vary widely in different parts of the arid region of the United States, and may best be summed up by taking the larger political divisions in geographical order."

In the states of Oregon and Washington there is great diversity of climate. The western third of these states, extending from the sea-coast to the tops of the Cascade Range, is humid, and in the valleys crops are successfully raised, although the yield per acre is increased by irrigation during the summer droughts. Fully two-thirds of the area of these states lies east of the Cascade Range, and the broad valleys and open plains are arid, the rainfall being from 8 to 12 inches per annum. Irrigation is practised wherever water can be diverted from the streams — notably the Yakima river! of "Washington and its tributaries rising in the Cascade Mountains.

In the eastern part of these states wheat and other cereals are raised without irrigation, owing to peculiar conditions of soil. Columbia river and its principal tributary. Snake river, have ample water-supply for navigation, but these streams have cut

deep gorges or canons, and the water cannot be taken out upon the adjacent plateaus. A small amount is pumped by water-wheels, irrigating orchards and gardens on the narrow strip of bottom land between the river and the high cliffs.

In Idaho agriculture by irrigation is practised on the lava-covered plains in the southern portion of the state and in the valleys of streams tributary to Snake river. This stream, issuing from the mountains of Wyoming, flows for a time on the surface of the lava, and then by a series of falls, of which the principal are American and Shoshone, descends into narrow oafions. In the upper part of its course the greater part of the summer flow is diverted for the

irrigation of lands in south-eastern Idaho. In the south-western part of the state waters are taken from Boise, Payette, and Weiser rivers.

In Montana agriculture is confined mainly to valleys at the head-waters of Missoviri river. The Gallatin, Madison, and Jefferson rivers, which unite at Threef orks to form the Missouri, each supply numerous ditches and systems of canals. The small streams which

issue from the eastern front of the main range of the Rocky Mountains are also used, the principal of t\iese being the Teton, Sun, Marias, and Milk. Along the Missouri itself the difficulties of diverting water are such that irrigation has been practised only to a small extent. Along the Yellowstone, in the southern part of the state, where the fall of the stream is considerable, irrigation canals of considerable size have been taken out. In the vicinity of Miles City a small area is watered from artesian wells.

In the state of Wyoming the general altitude is greater than that of any other part of the United States, and, as a consequence, agricultural operations are limited by the short growing season. Irrigation is, however, practised in the valleys in the northern part of the state, where the altitude is relatively low, particularly in the country east of the Bighorn Range, water being obtained from streams flowing from these mountains. On the Laramie plains, whose altitude is 7000 feet and upwards, irrigation, mainly of forage crops, is practised. Water is taken also from Laramie river by means of a tunnel through the Laramie Hills out on the plains, in the vicinity of Wheatland, Which lies about 70 miles northerly from Cheyenne, the capital of the state. The irrigation of forage crops

is also practised throughout the mountain valleys of the state. In the state of Colorado irrigation is practised in the valleys and on the plains immediately adjacent to the Rocky Mountains front, water being had from the small streams which form the South Platte river, or, to the south of this, the Arkansas river. On the divide between these streams, cereals, and occasionally field crops, are raised by dry farming. Great success has been had in the cul-

tivation of the potato by irrigation in the vicinity of Greeley, and in the production of melons of superior quality and in enormous quantities near Rockyford. In the western portion of the state orchards are irrigated in the lower or more open valleys, the country being notable for the production of peaches and apples. In the San Luis valley, in the southern part of the state, whose altitude is over 7500 feet, wheat is raised by using the waters of the Rio Grande, and to a small extent by water-supply from artesian wells. The state of Utah, lying in the centre of the arid region, affords typical examples of irrigation. Here the system of artificially applying water to the soil to any considerable extent was first practised by people emigrating from humid regions. The Mormons on coming into the country in 1847 found that crops could not be raised without water, and, forced by circumstances, developed methods suited to the physical conditions. The principal streams used are those issuing from the Wasatch Range and flowing towards the west into the valleys of Utah and Great Salt lakes. Prom each of these creeks or rivers water has been diverted, mainly by community effort, and used upon the lands surrounding the Mormon settlements. Until recently there have been no corporate

enterprises, all of the construction having been done by associations of irrigators. Since 1890, however, a few large irrigation works have been built by outside or foreign capital, but these were financially unsuccessful. In the north-eastern portion of the state, in Cache valley, the lowlands are irrigated, and the high terrace lands are used for raising winter wheat without an artificial supply of moisture. In the southern ‘ part of the state, along the streams of the high plateaus, irrigation is practised in a small way ; and in the extreme south-western comer, in the vicinity of St George, a small amount of cotton is reported to be produced by the aid of irrigation.

The state of Nevada, lying west of Utah, and between it and Colorado, contains the largest proportion of desert land and the smallest available water-supply. The principal river is the Humboldt, which flows south-westerly across the state, and along which irrigation is practised in a crude way, mainly for the production of grass. The principal part of the population of the state is in the extreme western angle adjacent to California. The Truckee, Carson, and Walker rivers, issuing from the mountains of California, are used in the low valleys, the excess water collecting in sinks and

disappearing by evaporation.

California contains not only the largest area irrigated, but offers examples of the most complete utilization of water, especially in the southern end, where high-class citrus fruits are produced. Along the north-western coast the climate is humid, and there is also ample precipitation upon the high mountains extending along the eastern side of the state. The great interior valley, drained by the Sacramento river coming from the north and the San Joaquin from the south, is arid, and crops must be irrigated. Along the foothills on the eastern side of the valley ample water can usually be obtained from the streams issuing from the high sierras. The water of many of these was diverted during the period of active

gold-mining, from 1850 to 1870, and expensive dams and canals built for bringing out water to the placer mines. With the decline of these, following the enforcement of the debris law, these works were gradually used and enlarged for irrigation, particularly of orchards and vineyards. In the southern or upper end of the San

Joaquin valley raisin grapes have been particularly successful. Southern California is shut off from the remainder of the state by the abrupt Sierra Madre Kange, giving it a distinctive climate, which has been found to be particularly adapted to the cultivation of oranges, lemons, walnuts, and various high-priced fruits. Water is relatively scarce, and the works for its development and control are most elaborate and expensive. The perennial streams are small, but during floods these have brought down from the high mountains enormous quantities of sand and gravel, which have been built up in great alluvial cones around the edges of the valleys. These pervious deposits are filled with water percolating from the mountains, which has been brought to the surface and used for irrigation by means of wells, some of which overflow, or by tunnels driven on a slightly ascending grade, out of which the percolating water flows. Large reservoirs have also been constructed for holding the flood waters. Owing to the unprecedented drought of 1898 and 1899, most of these were dry during the summer of the latter year. Water is also pumped from the sandy beds of the streams, and is used with great care and economy in the ratio of one miner's inch, or a fiftieth of a cubic foot, per

second per acre, on every 5 to 10 or even more acres.

The territory of Arizona, lying south of Utah and east of California, has in the southern portion the warmest climate of the arid region. The northern part of the territory consists of high plateaus, deeply cut by the Colorado river and its tributaries. The Gila river flows westerly across the southern part of the state, receiving its water-supply from the abrupt southern front of the high plateau region, its principal tributaries being Salt and Verde rivers. Extensive irrigation works have been built to divert water below the junction of these latter streams, covering what is known as Salt river valley, within which the capital. Phoenix, is located. Water is also taken out of the Gila river by a number of canals rising both above and below the junction with Salt river. The principal crops are alfalfa and cereals, a considerable area being planted in groves of oranges and similar fruits.

The territory of N'ew Mexico lies south of Colorado, and receives a considerable portion of its water from the Rio Grande, which' rises in this state and flows south through New Mexico, and then forms the international boundary between the republics of the United States and Mexico. This river passes alternately through

deep cailons and open valleys, and in the latter its waters are diverted by ditches, many of which are of unknown antiquity, having been constructed by the Pueblo, or town-dwelling, Indians long before the advent of the white men. The diversion and loss of water through evaporation is so complete, that during a portion of the year the river is dry in southern New Mexico and along the border of western Texas. To the east of the Kio Grande is the Pecos, its main tributary from the north. The waters of this stream come largely from enormous springs, and irrigation systems of considerable size have been constructed, using the greater part of the flow.

The country lying to the east of the states and territories just described consists for the most part of the high plains, whicli ex-tend from the Rooky Mountains range, sloping gradually into the Mississippi valley. Perennial streams are comparatively rare, and are at long distances from each other. The plains region is, how-ever, underlaid over considerable areas by water-bearing sands and gravels, and wells are successfully dug or drilled to depths of from 60 to 300 feet. Water is pumped from these by innumerable wind-mills of various descriptions, most of them being of the modern

rapid-running, steel construction, designed to operate in light breezes, automatically throwing themselves out of the wind during sudden storms. Most of the water is pumped for cattle, the area being devoted mainly to grazing. Irrigation is practised in a small way at the home ranches scattered over this so-called semi-arid or sub-humid region, which is included in the states of North and South Dakota, Nebraska, Kansas, Texas, and the territory of Oklahoma. On these high plains there are occasional years when the rainfall is sufficient for the production of crops, and settlements have during these seasons rapidly sprung up, to be abandoned after the continued drought through a succession of years has destroyed the crops.

Irrigation is not wholly confined to the arid and semi-arid regions of the west, but is practised in the rice-fields of Texas and Louisiana bordering upon the Gulf of Mexico. It is also employed to a small extent in the orange groves of Florida, water being pumped and distributed in pipes. At various points along the Atlantic coast it is used in the production, on the sandy soils, of the early vegetables shipped to the larger cities, and even as far north as Massachusetts is employed in the raising of cranberries,

and on water meadows. (f. h. n.)

I run, a frontier town of north-east Spain, in the province of Guipuzcoa," 8 miles east of San Sebastian. A new suburb has sprung up between the station and the old town, where the massive town hall deserves notice. The local industries (tanning, brandy, brick and paper manufactures) have developed rapidly, but Irun derives its prosperity from the fact that it is the most important custom-house in Spain for the overland trade with the rest of Europe. The receipts amount to about 10 per cent, of the whole proceeds of the Peninsular customs. Irun is also on the chief highway for travellers and almost all the mails. The town was the first in Spain to use electricity for general lighting. It is the terminus of some important narrow-gauge mining railways and steam tramways, placing it in communication with the mining districts of Guipuzcoa and Navarre, and with the highlands of both provinces, where timber is extracted in larger amount every year from- splendid forests of oak, beech, and pine. Population (1897), 9739.

Irvine, a royal and parliamentary burgh (Ayr group) of Ayrshire, Scotland, near the mouth of the river Irvine, 27 miles south-west of Glasgow by rail. In 1892 Irvine was restored to the status of a port. In 1898, 1119 vessels of 98,632 tons entered, and 1108 vessels of 97,791 tons cleared. Shipbuilding is a growing industry ; 12 vessels of 3410 tons were launched in 1899. Additions have been made to the town hall, and the academy is being replaced by a larger secondary school. A bronze statue of Burns (who learned flax-dressing in Irvine) was unveiled in 1896. There are three excellent golf courses. Population (1881), 8498 ; (1901), 9603.

Irving, Sir Henry (John Henry Beodeibb), (1838), Tilnglish actor, son of Samuel Brodribb, was born at Keinton, near Glastonbury, 6th February 1838. After a few years' schooling he became, at the age of fourteen, a clerk in the oflices of a firm of East India merchants in London. His strong taste and capacity for acting soon led him to give up all idea of a commercial career, and before he was nineteen he obtained

his first engagement on the stage. This was in a theat-rical company at Sunderland, where, on 29th September 1856, he made his first appearance at the New Royal Lyceum Theatre. For stage purposes he discarded his patronymic of Brodribb, and was known as Henry Irving (eventually assuming Irving as an additional surname by royal licence in June 1889). For ten years he went through an arduous but invaluable training in various stock companies in Edinburgh, Glasgow, Liverpool, and Manchester, amassing a very wide and diversified store of experience, as may be inferred from the fact that during this period he performed between five and six hundred parts. By degrees (especially in Manchester, where, he had achieved a marked success as Eawdon Scudamore in Boucicault's Hunted Doivn) his ability gained recognition, with the result that in October 1866 he was offered and accepted an engagement at the St James's Theatre, London, to play Doricourt in The Belle's Strata-gem. A year later he joined the company of the newly-opened Queen's Theatre, Long Acre, where he acted

in association with Charles Wyndliam, J. L. Toole, Lionel Brough, John Clayton, Mr and Mrs Alfred Wigan, Miss Ellen Terry, and Miss Nelly Farren. Two years of useful work with them were followed by short engagements at the Haymarket and Drury Lane, until, in December 1869, Irving made his first conspicuous success as Mr Chevenix in H. J. Byron's play. Uncle Dick's Darling, at the Gaiety Theatre. He followed this up by a masterly performance of Digby Grand in The Two Roses at the Vaudeville Theatre in 1870. In 1869 he married Miss Florence O'Callaghan, daughter of a

surgeon-general in the Indian army ; his two sons, Henry Brodribb and Laurence, both afterwards taking to the stage. In 1871 began his association with the Lyceum Theatre with his engagement to support Miss Bateman there, under her father's management. The fortunes of the house were at a very low ebb when the tide was turned by Irving's instantaneous success in Tlie Bells,

which " ran " for 160 nights. With Miss Bateman, Irving was seen in Charles I., Evyene Aram, Richelieu, and eventually, ,in October 1874, in Hamlet. The unconventionality of his performance as Hamlet (during a "run" that lasted for 200 nights) aroused keen discussion, and singled him out as the most interesting actor of his day. In 1875 he was seen, still with Miss Bateman, as Macbeth; in 1876 as Othello, and as Philip in Tennyson's Queen Mary; in 1877 in Richard III. and The Lyons Mail. In 1878 the Bateman regime at the Lyceum ceased, and in December of that year Irving opened the theatre under his own management. Assisted by Miss Ellen Terry, whose Ophelia was the first of a long series of triumphs for her, he revived Hamlet for a further run of a hundred nights; and after appearing in Tlie Corsioan Brothers, he produced The Merchant of Venice in 1879. His Shylock was as much discussed as his Hamlet had been, the dignity with which he invested the Jew pleasing some as much as it offended others. This

performance, and Miss Terry's as Portia, placed them definitely at the head of their profession. Two years later (after the production of Tennyson's The Cup, a revival of Othello in conjunction with the American actor Edwin Booth, and Romeo and Juliet') there began a period at the Lyceum Theatre which may be reckoned as in some respects the most notable in the recent history of the English stage. The Lyceum stage management, and the brilliancy of its productions in scenery, dressing, and accessories, were revelations in the art of mise-en-sc^ne. Much Ado About Nothing in the autumn of 1882 was followed by Twelfth Night in 1884, Olivia in 1885, Faust in 1886, The Dead Heart in 1889, and Ravens-wood in 1890; the winter of 1888 was remarkable for the production of Macbeth, and the year 1892 for two very fine assumptions of the characters of Wolsey in Henry VIII. and King Lear, followed by a peculiarly striking and dignified performance (in 1893) of the part of Becket in Tennyson's play of that name. During these years, too, Irving, with the whole Lyceum com-

pany, paid several visits to America, which met with conspicuous success and were repeated in succeeding years. The chief remaining novelties at the Lyceum during Irving's sole managership (the theatre passed, at the beginning of 1899, into the hands of a limited liability company) were Comyns Carr's King Arthur in 1895, Cymbeline, in which Irving played lachimo, in 1896, Sardou's Madame Sans-Gine in 1897, Peter the Great, a play by Laurence Irving, the actor's second son, in 1898, and Conan Doyle's Waterloo (1894). The new rigime at the Lyceum was signalized by the production of Sardou's Robespierre in April 1899, in which Irving reappeared after a serious illness, and in 1901 by an elaborate revival of Coriolanus. Both on and off the stage he always maintained a high ideal of the actor's profession, and in 1895 he received the honour of knighthood. He was also the recipient of honorary degrees from the universities of Dublin, Cambridge, and Glasgow. Sir Henry Irving's acting, apart from his genius as a presenter of plays, has divided criticism, opinions differing as to the extent to

which his undoubted mannerisms of voice.and deportment interfered with or assisted the expression of his ideas. So strongly marked a personality as his could not help giving its own colouring to whatever part he might assume, but the richness and originality of this colouring at its best cannot be denied, any more than the spirit and intellect which characterized his renderings. At the least, extraordinary versatility must be conceded to an actor who could satisfy exacting audiences in rdles so widely different as Digby Grand and Louis XL, Richard III. and Becket, Benedick and Shylock, Mathias and Dr Primrose.

Irvington, a town of Essex county, New Jersey, U.S.A., in the north-eastern part of the state, just west of Newark, of which it is a residential suburb. Population (1900), 5256, of whom 993 were foreign-born.

Isabella 11. (1830), ex-queen of Spain, was born in Madrid on 10th October 1830. She was the eldest daughter of Ferdinand VII., king of Spain, and of his fourth wife, Maria Christina, a Neapolitan Bourbon, who

became queen-regent on 29th September 1833, when her daughter, at the age of three years, was proclaimed on the death of the king. Queen Isabella succeeded to the throne because Ferdinand VII. induced the Cortes to assist him in setting aside the Salic law, which the Bourbons had introduced since the beginning of the 18th century, and to re-establish the older succession law of Spain. The brother of Ferdinand, Don Carlos, the first pretender, f oiight seven years, during the minority of Isabella, to dispute her title, and her rights were only maintained through the gallant support of the army, the Cortes, and the Liberals and Progressists, who at the same time established constitutional and parliamentary government, dissolved the religious orders, confiscated the property of the orders and of the Jesuits, disestablished the Church property, and attempted to restore order in finances. After the Carlist war the queen-regent, Christina, resigned to make way for Espartero, the most successful and most popular general of the Isabelline arniies, who only remained regent two years. He was turned out in 1843 by a military and political

pronunciamiento, led by Generals O'Donnell and Narvaez, who formed a cabinet, presided over by Joaquin Maria Lopez, and this Government induced the Cortes to declare Isabella of age at thirteen. Three years later the Moderado party or Castilian Conservatives made their queen marry, at sixteen, her cousin, Prince Francisco de Assisi de Bourbon (1822-1902), on the same day (10th October 1846) on which her younger sister married the duke of Montpensier. These marriages suited the views of France and Louis Philippe, who nearly quarrelled in consequence with Great Britain ; but both matches were anything but happy. Queen Isabella reigned from 1843 to 1868, and that period was one long succession of palace intrigues, back-stairs and ante-chamber influences, barrack conspi-racies, military pronunciamientos to further the ends of the political parties — Moderados, who ruled from 1846 to 1854, Progressists from 1854 to 1856, Union Liberal from 1866 to 1863 ; Moderados and Union Liberal quickly succeeding each other and keeping out the Progressists so steadily that the seeds were sown which budded into the

revolution of 1868. Queen Isabella II. often interfered in politics in a wayward, unscrupulous manner that made her very unpopular. She showed most favour to her reactionary generals and statesmen, to the Church and religious orders, and was constantly the tool of corrupt and profligate courtiers and favourites who gave her court a deservedly bad name. She went into exile at the end of September 1868, after her Moderado generals had made a slight show of resistance that was crushed at the battle of Alcolea by Marshals Serrano and Prim. The only redeeming traits of Queen Isabella's reign were a war against Morocco, which ended in an advantageous treaty and some cession of territory; some progress in public works, especially railways ; a slight improvement in commerce and

finance. Isabella was induced to abdicate in Paris on 26tli June 1870 in favour of her son, Alphonso XII., and the cause of the restoration was thus much furthered. She had separated from her husband in the previous

March. She continued to live in France after the restorar tion in 1874. On the occasion of one of her visits to Madrid during Alphonso XII.'s reign she began to intrigue with the politicians of the capital, and was peremptorily requested to go abroad again.

Isar, a river of Bavaria, in many respects the national stream of the Bavarian people. It rises in the Alps of Tirol, north-east from Innsbruck, at an altitude of 6840 feet, winds in deep, narrow glens and gorges through the Alps, and at Tolz (2100 feet), due north from its source, enters the Bavarian plain, which it traverses in a generally north and north-east direction, flowing through Munich and past Freising and Landshut, and pours its green waters into the Danube immediately below Deggendorf after a course of 219 miles. The area of its drainage basin is 38,200 square miles. Below Munich the stream is 140 to 360 yards wide, and is studded with islands. It is not navigable, except for rafts. The total fall of the river is 4816 feet.

Isbarta (ancient Babis), the chief town of the

Hamid-abad sanjak of the Konia vilayet, in Asia Minor, well situated on the edge of a fertile plain at the foot of Aghlasiin Dagh. It suffered severely from the earth-quake of 16th-17th January 1889. Population 20,000 (Moslems 13,000, Christians 7000). Baris was once an important city, striking coins, and the seat of a bishopric.

Ischia, an island of Italy, on the north-west side of the Gulf of Naples, with far-famed mineral baths. In 1881 it was visited by an earthquake, and in 1883 by another, much more destructive, which laid Casamicciola almost entirely in ruins. The town has, however, been rebuilt, and contains about 3600 inhabitants. The town of Ischia has about 7000, and Porio more than 7000 inhabitants.

Ischi, a watering-place in the district of Gmunden (Salzkammergut), Upper Austria, the favourite summer resort of the Emperor Prancis Joseph I. and the imperial family. The population of the commune in 1890 was 8473, in 1900 9646, German, and mostly Catholic.

There are about 18,000 visitors during the season. The salt-works yield ■ about 16,000 tons of salt annually, of a value of £120,000, in addition to large quantities of brine. There is a rack-and-pinion mountain railway (1893) from St Wolfgang to the top of the neighbouring Schafberg.

I sere, a department in the south-east of Prance, crossed by the Alps of the Dauphine, and watered by the Ehone and the Islre.

Area, 3180 square miles. The population decreased from 581,680 in 1886 to 563,813 in 1901. Births in 1899, 10,936, 552 of them illegitimate ; deaths, 11,127 ; marriages, 4078. There were in 1896 1576 schools, with 85,000 pupils, and the illiterate constituted 1^ per cent, of the population. The area under cultivation comprised, in 1896, 1,504,926 acres, of which 756,169 acres were plough-land and 61,660 vineyards. The land in wheat produced the value of £1,064,000; rye, £122,000; buckwheat, £65,000; oats, £198,000; vines, £720,000 ; potatoes, £483,280 ; natural pastures, £480,000. Among the industrial cultures, those of linen and hemp deserve mention. The live stock in 1899 included 33,540 horses, 213,540

cattle, 163,550 sheep, 40,850 pigs, and 63,720 goats. Mining in 1898 produced 204,000 metric tons of fuel, of the value of £120,000, 9000 tons of turf, 12,000 tons of iron ; and the industry in metals, which is developed in this department, produced 35,000 tons of cast iron, 2000 tons of iron, and 5300 tons of steel. Among the other industries the most important are the manufacture of gloves, cement, and paper (Rives). Vizille is an important weaving centre. Grenoble, the capital, had (1900) 68,052 inhabitants.

Iserlohn, a town of Prussia, province of Westphalia, 30 miles by rail east-north-east of Barmen. It is a seat of the metal industries, especially in iron, steel, and brass, manufactures of needles and pins, lamp and similar fittings, bronze ornaments, furniture, and tinned and silvered wares. In 1883 a bronze statue of the Emperor William I. was unveiled. Population (1886), 20,102; (1900), 27,268.

Isfahan (older form Ispahan), an important province of Persia, situated in the centre of the country, and bounded on the S. by Pars, on the E. by Yezd, on the IST. by Kashan, Natanz, and Irak, and on the W. by the

*Bakhti^ri district and Arabistdin. It pays a yearly revenue of about £100,000, and its population exceeds 600,000. It is divided into twenty ~~five districts, its capi~~ tal, the town of Isfahan, forming one of them. These twenty-five districts, some very small and consisting of only a little township and a few hamlets, are Isfahan, Jai, Barkhar, Kahab, Kararaj, Baraan, Riidasht, Marbin, Lenjan, Kerven, Ear, Kiar, Mizdej,*Ganduinan, Somairam, Jarkuyeh, Ardistan, Kuhpayeh, Najafabad, Komisheh, Chadugan, Varzek, Tokhmaklu, Gurji, Chinariid. Most of these districts are very fertile, and produce great quantities of wheat, barley, rice, cotton, tobacco, and opium. Lenjan, west of the city of Isfahan, is the greatest rice-producing district ; the finest cotton comes from Jarkuyeh ; the best opium and tobacco from the villages in the vicinity of the city. Isfahan-, the capital of the -above province, is situated on the Zayendeh river, in 32° 36' N. and 61° 40' E., at an elevation of 6370 feet. Its popular tion, excluding that of the Armenian colony of Julfa, on the right bank of the river (about 4000), is about 82,000.*

In 1882 it was 73,654 (37,629 males, 36,125 females), including 6883 Jews (2930 males, 2963 females). It is divided into 37 mahallehs (parishes), and has 210 mosques and colleges, 84 caravanserais, 150 public baths, and 68 flour mills. The water-supply is principally from open canals led off from the river, and from streams and canals which come down from the hills in the north-west. The name of the Isfahan river was originally Zendek, " the great " ; it then became Zindeh, " the living," and is now Zayendeh, " the life-giving." The river flows into the Gavkhani depression, about 70 miles east of Isfahan, and its volume of water at Isfahan during the spring season has been estimated at 60,000 cubic feet per second ; in autumn the quantity is reduced to one-third. (a. h.-s.)

■ *shim, a district town of West Siberia, government' of Tobolsk, 276 miles E.N.E. of Kurgan railway station, on a river of the same name, tributary, on the left, of the Irtysh. The fair is one of the most important in Siberia, being the central market for the fertile prairies*

around, and its returns are estimated at £500,000. Population (1897), 7161.

Ishpeming, a city of Marquette county, Michigan, U.S.A., in the Marquette iron range, at an altitude of 1400 feet. It is on the Chicago and North-Western, the Duluth, South Shore and Atlantic, and the Lake Superior and Ishpeming railways. In and about the city are great iron mines of red hematite ore, and the business of mining and shipping the ore is practically the only industry. Population (1880), 6039 ; (1890), 11,197; (1900), 13,256, of whom 5970 were foreign-born.

Ismail Pasha (1830-1896), Khedive of Egypt, was bom at Cairo on the 31st of December 1830, being the second of the three sons of Ibrahim and grandson of Mehemet Ali. After receiving a European education at Paris, where he attended the ficole d'ilStat-Major, he returned home, and on the death of his elder brother

became heir to his uncle Said Mohammed, the Vali

of Egypt. Said, who apparently conceived his own safety to lie in ridding himself as much as possible of the presence of his nephew, employed him in the next few years on missions abroad, notably to the Pope, the Emperor Napoleon III., and the Sultan of Turkey. In 1S61 he was despatched at the head of an army of 14,000 to quell an insurrection in the Sudan, and this he successfully accomplished. On the death of Said, on 18th January 1863, Ismail was proclaimed viceroy without opposition. Being of an Orientally extravagant disposition, he found with considerable gratification that the Egyptian revenue was Tastly increased by the rise in the value of cotton which resulted from the American Civil War, the Egyptian crop being worth about £25,000,000 instead of £5,000,000. Besides acquiring luxurious tastes in his sojourns abroad, Ismail had discovered that the civilized nations of Europe made a free use of their credit for raising loans. He proceeded at once to apply this idea to his own country by transferring his private

debts to the State and launching out on a grand scale of expenditure. Egypt was in his eyes the ruler's estate which was to be exploited for his benefit and his renown. His own position had to be strengthened, and the country provided with institutions after European models. To these objects Ismail applied himself with energy and cleverness, but without any stint of expense. During the 'sixties and 'seventies Egypt became the happy hunting-ground of self-seeking financiers, to whose schemes Ismail fell an easy and a willing prey. In 1866 he obtained from the Sultan of Turkey, in exchange for an increase in the tribute, a firman giving him the title of Khedive, and changing the law of succession to direct descent from father to son ; and in 1873 he obtained a new firman making him virtually independent. He projected vast schemes of internal reform, remodelling the Customs system and the Post OflBce, stimulating commercial progress, creating a sugar industry, introducing European improvements into Cairo and Alexandria, building palaces, entertaining lavishly, and maintaining an

opera and a theatre. It has been calculated that, of the total amount of debt incurred by Ismail for his projects, about 10 per cent, may have been sunk in works of permanent utility — always excluding the Suez Canal. Meanwhile the openiiig of the Canal had given him opportunities for asserting himself in foreign Courts. On his accession he refused to ratify the con-cessions to the Canal Company made by Said, and the question was referred in 1864 to the arbitration of Napoleon III., who awarded £3,800,000 to the company as compensation for the losses they would incur by the changes which Ismail insisted upon in the original grant. Ismail then used every available means, by his own un-doubted powers of fascination and by judicious expendi-ture, to bring his personality before the foreign sovereigns and public, and he had no little success. He was made G.C.B. in 1867, and in the same year visited Paris and London, where he was received by Queep. Victoria and welcomed by the Lord Mayor ; and in 1869 he again paid a visit to England. The result was that the opening of

the Canal in November 1869 enabled him to claim to rank among European sovereigns, and to give and receive royal honours : this excited the jealousy of the Sultan, but Ismail was clever enough to pacify his overlord. In 1876 the old system of consular jurisdiction for foreigners was abolished, and the system of mixed courts was introduced, by which European and native judges sat together to try all civil cases without respect of nationality. In all these years Ismail had governed with ddat and profusion, spending, borrowing, raising the taxes on the fellaheen, and combining his policy of independence with dazzling visions of Egyptian aggrandizement. In 1874 he annexed Darfur, and was only prevented from extending his dominion into Abyssinia by the superior fighting power of the Abyssinians. But at length the inevitable financial crisis came. A national debt of over one hundred millions sterling (as opposed to three millions when he became viceroy) had been incurred by the Khedive, whose fundamental idea of liquidating his borrowings was to borrow

at increased interest. The bondholders became restive. Judgments were given against the Khedive in the international tribunals. When, he could raise no more loans he sold his Suez Canal shares (in 1875) to Great Britain for £3,976,582 ; and this was immediately followed by the beginning of foreign intervention. In December 1876 Mr Stephen Cave was sent out by the British Government to inquire into the finances of Egypt, and in April 1876 his report was published, advising that in view of the waste and extravagance it was necessary for foreign Powers to interfere in order to restore credit. The result was the establishment of the Caisse de la Dette. In October Mr (afterwards Lord) Goschen and M. Joubert made a further investigation, which resulted in the establishment of Anglo-French control. A further commission of inquiry by Major Baring (afterwards Lord Cromer) and others in 1878 culminated in Ismail making over his estates to the nation and accepting the position of a constitutional sovereign, with Nubar as Premier, Mr (afterwards Sir Charles) Rivers

*Wilson as Finance Minister, and M. de Blignieres as Minister of Public Works. Ismail professed to be quite pleased. " Egypt," he said, " is no longer in Africa ; it is part of Europe." The new regime, however, only lasted six months, and then Ismail dismissed his ministers, an occasion being deliberately prepared by his getting Arabi (q.v.) to foment a militaTy pronunciamiehto. England and Prance took the matter seriously, and insisted (May 1879) on the reinstatement of the British and French ministers ; but the situation was no longer a possible one: the Tribunals were still giving judgments for debt against the Government, and when Germany and Austria showed signs of intending to enforce execution the Governments of Great Britain and France perceived that the only chance of setting matters straight was to get rid of Ismail altogether. He was first advised to abdicate, and a few days after-wards (26th June), as he did not take the hint, he received a telegram from the Sultan (who had not forgotten the earlier history of Mehemet All's dynasty), addressed to him as ex-Khedive, and informing him that his son^*

Tewfik, was his successor (see also Egypt, sections Finance and History). He at once left Egypt for Naples, but eventually was permitted by the Sultan to retire to his palace of Ermighian on the Bosphorus. There he remained, more or less a State prisoner, till his death on 2nd March 1896. Ismail was a man of undoubted ability and remarkable powers. But beneath a veneer of French manners and education he remained throughout a thorough Oriental, though without any of the moral earnestness which characterizes the better side of Mahommedanism., Some of his ambitions were not unworthy, and though his attitude towards Western civilization was essentially cynical, he undoubtedly helped to make theEgyptian upper classes realize the value of European education. Moreover, spendthrift as he was, it needed — as is pointed out in Milner's England in Egypt — a series of unfortunate conditions to render his personality as pernicious to his country as it actually became. " It needed a nation of submissive slaves, not only bereft of any vestige of liberal institutions, but devoid of the slightest spark of the

spirit of liberty. It needed a bureaucracy which it would

have been hard to equal for its combination of cowardice and corruption. It needed the whole gang of swindlers — mostly European — by whom Ismail was surrounded." It was his early encouragement of Arabi, and his introduction of swarms of foreign concession-hunters, which precipitated the " national movement " that led to British occupation. His greatest title to remembrance in history must be that he made European intervention in Egypt compulsory. (h. ch.)

ismailiya, a town of Lower Egypt, the central station on the Suez Canal, on Lake Timsah, about 50 miles from the Mediterranean and the Eed Sea. It is connected by rail with Cairo and Suez, and by steam tramway and steamer with Port Said; has sprung up since 1860 in connexion with the works of the Suez Canal; and has a population of nearly 4000. The town is divided into two quarters by the road leading from the landing-place to

the railway station, and has numerous public offices, warehoiises, and other buildings, including a palace of the Khedive, which was used as a military hospital during the British occupation of the place in 1882, but is now in a dilapidated state.

Ismay, Thomas Henry (1837-1899), British ship-owner, was born at Maryport, Cumberland, on 7th January 1837. He received his education at Croft House School, Carlisle, and at the age of sixteen was apprenticed to Messrs Imrie & Tomlinson, shipowners and brokers, of Liverpool. He then travelled for a time, visiting the ports of South America, and on returning to Liverpool started in business for himself. In 1867 he took over the White Star Line of Australian clippers, and in 1868, per-ceiving the great future which was open to steam naviga-tion, established, in conjunction with William Imrie, the Oceanic Steam Navigation Company, which has since become famous as the White Star Line. While continuing the Australian service, the firm determined to engage in the American trade, and to that end ordered from Messrs

Harland & Wolff, of Belfast, the first Oceanic, which was launched in 1870. This vessel, which had a gross tonnage of 3807, was the first to have her saloon accommodation amidships, and may fairly be said to have marked an era in North Atlantic travel. The same is true of the successive types of steamer which Mr Ismay, with the co-operation of the Belfast shipbuilding firm, subsequently provided for the American trade. Each one of these made its appearance only when the time was fully ripe, and in consequence each was a complete success. In 1876 the Britannic and Germanic — the first ships over 6000 tons, always excepting the Great Eastern, whose great fault was that she was built some forty years before she was needed — were added to the fleet, and performed the journey between Liverpool and New York in about seven and a half days. Eourteen years later came the Teutonic and Majestic, of nearly double the tonnage, which reduced the time of the passage to less than six days. In another ten years, in 1899, Mr Ismay's supreme creation, the second Oceanic, started on her maiden voyage, to be followed two

years later, though after his death, by the Celtic. These two vessels were the largest that had ever been built up to that date, the former being a mail boat of 21 knots speed and a gross tonnage of over 17,000 tons, and the latter a cargo steamer (capable, nevertheless, of carrying over 3000 persons) of nearly 21,000 tons gross register. To Mr Ismay is mainly due the credit of the arrangement by which some of the fastest ships of the British mercantile marine are held at the disposal of the Government in case of war. The origin of this plan dates from the Eusso-Turkish war, when there seemed a likelihood of England being involved in hostilities with Russia, and when, therefore, Mr Ismay offered the Admiralty the use of the White Star fleet. In building the Teutonic and Majestic their possible employment as armed merchant cruisers was kept specially in view, and the former, armed with sixteen guns, took part in the naval review held at Spithead in 1897 in honour of the Diamond Jubilee of Queen Victoria. Mr Ismay died at Birkenhead on 23rd November 1899.

Is mid, Nicomedia, in Asia Minor, the chief town of

theKhoja Hi sanjak of Constantinople, situated on rising ground near the head of the Gulf of Ismid. The sanjak has an area of 4660 square miles, and a population of 225,000 (Moslems 131,000, Christians and others 94,000). It is an agricultural district, producing cocoons, tobacco, &c., and there are large forests of oak, beech, and fir. Near Yalova there are hot mineral springs, much frequented in summer. The town is connected by the lines of the Anatolian Eailway Company with Haidar Pasha, the western terminus, and with Angora, Konia, and Smyrna. It contains a fine 16th-century mosque, built by the celebrated architect Sinan. The population is 20,000 (Moslems 9500, Christians 8000, Jews 2600). There is a British consular agent. The head of the Gulf of Ismid is gradually silting up. The dockyard' was closed in 1879, and the port of Ismid is now at Darinje, 3| miles distant, where the Anatolian Eailway Company have established their workshops and have built docks and a quay.

Isola del Liri, a town of the province of Caserta,

Campania, Italy, on an island enclosed between two arms of the Liris (Garigliano), 26 miles north-west of Cassino by rail. It is the seat of large paper, cloth, and woollen mills, which derive their motive power from falls in the river. There are also steel and iron works. Population (1881), 4669; (1899), about 6000.

Ispahan. See Isfahan.

Israels, Josef (1824), Dutch painter, was born at Groningen, of Hebrew parents, on 27th January 1824. His father intended him to be a man of business, and it was only after a determined struggle that he was allowed to enter on an artistic career. However, the attempts he made under the guidance of two second-rate painters in his native town — Buys and Van Wicheren — while still working under his father as a stockbroker's clerk, led to his being sent to Amsterdam, where he became a pupil of Jan Kruseman and attended the drawing class at the academy. He then spent two years in Paris, working in Picot's studio, and returned to Amsterdam. There he remained till 1870, when he moved to The Hague

for good. Israels is justly regarded as one of the greatest of Dutch painters. He has often been compared to J. P. Millet. As artists, even more than as painters in the strict sense of the word, they both, in fact, saw in the life of the poor and humble a motive for expressing with peculiar intensity their wide human sympathy; but Millet was the poet of placid rural life, while in almost all Israels pictures we find some piercing note of woe. Duranty said of them that "they were painted with gloom and suffering." He began with historical and dramatic subjects in the romantic style of the day. By chance, after an illness, he went to recruit his strength at the fishing-town of Zandvoort near Haarlem, and there he was struck by the daily tragedy of life. Thenceforth he was possessed by a new vein of artistic expression, sincerely realistic, full of emotion and pity. Among his more important subsequent works are "The Zand-voort Fisherman" (in the Amsterdam gallery), "The

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Silent House" (whieli gained a gold medal at the Brussels Salon, 1858), and "Village Poor" (a prize at Manchester). In 1862 he achieved great success in London with his " Shipwrecked," purchased by Mr Young, and " The Cradle," two pictures of which the Athenmum spoke as " the most touching pictures of the exhibition." We may also mention among his maturer works " The Widower " (in the Mesdag collection), " When we grow Old " and " Alone in the World " (Amsterdam gallery), " An Interior " (Dordrecht gallery), " A Frugal Meal " (Glasgow museum), " Toilers of the Sea," " A Speechless Dialogue," " Between the Fields and the Seashore," " The Bric-a-brac Seller" (which gained medals of honour at the great Paris Exhibition of 1900). "David Singing before Saul " is one of his latest works, and seems to hint at a return on the part of the venerable artist to the Eembrandtesque note of his youth (see Plate).

As a water-colour painter and etcher he produced a vast number of works which, like his oil paintings, are full of deep feeling. They are generally treated in broad masses of light and shade, which give prominence to the principal subject without any neglect of detail.

See Jan Veth. Mannen of Beteckenis : Jozef IsraUs. — Ches-NEAu. Peintres Franqais et Etrangers. — Ph. Zilcken. Peintres Hollandais Modernes, 1893. — Dumas. Illustrated Biographies of Modern Artists, 1882-84. — J. de Meester, in Max Rooses' Dutch Painters of the Nineteenth Century, 1898. — Jozef Israels. Spain : the Story of a Journey, 1900.

I Stria (German Istrien), a margraviate and crown-land of the Cisleithan part of the Austro-Hungarian monarchy. It forms, together with Gorz, Gradisca, and Trieste, the so-called Austro-Illyrian Kiistenland or littoral, united for certain administrative purposes. The population in 1880 was 292,006, and in 1890, including garrison of 8630 men, 317,610, or 166-44 inhabitants per sq.uare mile.' The proportion of females to males was 923 to 1000. Forty-five per pent, are Serbo-Croatians, 38

per cent. Italians, 15 per cent. Slovenes, and 2 per cent. Germans. The population is almost exclusively Eoman Catholic (99-7 per cent.), a small minority being Greek Orthodox, Protestant, and Jewish. The population in 1900 was 344,173. In 1897 the marriage-rate was 7-64, the birth-rate 40-36, or excluding still-births 39-48, and the death-rate 23-99. Of the births, 3-97 per cent, were illegitimate. The birth-rate steadily increases. Istria sends 5 representatives to the Keichsrath (3 Italians and 2 Slovenes). The provincial Diet is composed of 21 Italians and 12 Croatians. (For education, communications, &c., see KusTENLAND.) Only 11-7 per cent, of the population are engaged in industry, principally shipbuilding, the recovery of salt from sea water (nearly 15 per cent, of the total Austrian product), fish-curing, and mining (lignite and alum). Naturally fishing and seafaring pursuits are also considerable resources in a territory possessing such important harbours as Pirano, Pola, and Lussin-Piccolo, and visited by a total in all its ports and roadsteads of nearly 40,000 vessels, with a total

tonnage of 2^ millions. The chief agricultural resources are viticulture, oil, fig-, fruit-, and corn-growing, and cattle-breeding (principally sheep, horned cattle, mules and asses, and pigs). The timber trade is now of less importance, but gall-nuts, oak bark, cork, and charcoal are largely exported.

See GoRAcucHi. Die Adria und ihre Kilsten. Trieste, 1872. — A. Euthnek. Das Kustenland und das Konigreich Dalmatien. Vienna, 1880. — Combi. Istria : Studi storici e politica. Milan, 1886. — T. G. Jackson. Dalmatia, the Quarnero, and Istria. Oxford, 1887. — Stache. tfbersicht der geolog. Verhdltnisse der oesteir. KXistenlander. Vienna, 1889.— Tomasin. Die Volkstdmme im Gebiet von Triest und in Istrien. Trieste, 1890.

{m. o's.)

Iswar Chandra (1820-1891), writer and social reformer of Bengal, was born at Birsinha (Midnapur district) in 1820. He was removed to Calcutta by his father at the age of nine, was admitted in the Sanskrit College and carried on his studies in the midst of priva^ tions and extreme poverty. In 1839 he finished his

education, and obtained the title of Vidyasagar (= " Ocean of learning ") after passing a brilliant examination, and in 1841 was appointed head Pandit of Fort William College in Calcutta. In 1847 appeared his first great literary work in Bengali prose. The twenty-five Tales of a Betal. This was succeeded by his Sakuntcda in 1855, and by his greatest work, Tlie Exile of Sita, in 1862. These works are marked by a literary grace and beauty which Bengali prose had never known before. The literature of Bengal, previous to the 19th century, was entirely in verse. Eam Mohan Koy, the religious reformer of Bengal, created the literary prose of Bengal early in the 19th century by his numerous translations and religious tracts ; and Iswar Chandra Vidyasagar and his fellow-worker, Akhay Kumar Datta, added to its power and beauty about the middle of that century. These three writers are generally re-cognized as the fathers of Bengali prose literature.

As a social reformer and educationist, too, Iswar Chandra made his mark. He associated himself with Drinkwater Bethunein the cause of female education ; and

the management of the girls' school, called after Bethune, was entrusted to him in 1850. And when Eosomoy Datta, a cultured and distinguished Indian gentleman of the time, resigned the post of secretary to the Sanskrit College of Calcutta, a new post of principal was created, and Iswar Chandra was appointed to it. Iswar Chandra's influence in the education department was now unbounded. He simplified the method of learning the Sanskrit language, and ,, thus spread a knowledge of that ancient tongue among his country-men. He was consulted m all educational matters by Sir Frederick Halliday, the first Lieutenant-Governor of Bengal. And when the great scheme of education under Sir Charles Wood's despatch of 1854 was inaugurated in India, Iswar Chandra established numerous aided schools under that scheme in the most advanced districts of Bengal. But a greater task than literary work or educational reforms claimed the attention of the patriot and reformer. The wrongs of Hindu widows awakened his sympathy .~~and aroused his energies. He had dis~~

covered that the ancient Hindu scriptures did not enjoiE perpetual widowhood, and in 1855 he startled the Hindu world by his work on the Remarriage of Hindu Widows. Such a work, from a learned and presumably orthodox Brahman, caused the greatest excitement, but Iswar Chandra remained unmoved amidst a storm of indignation. Associating himself with the most influential men of the day, like Prosonno Kumar Tagore and Eam Gopal Ghosh, he appealed to the British Government to declare that the sons of remarried Hindu widows should be considered legitimate heirs. The British Government responded ; the Act was passed in 1856, and some years after Iswar Chandra's own son was married to a widow. In the last years of his life Iswar Chandra wrote works against Hindu polygamy; but that custom, never very widely prevalent, is dying out without the aid of any legislative measures. Iswar Chandra was as well known for his charity and wide philanthropy as for his educational and social reforms. His vast income, derived from the sale of school-books, was devoted almost entirely to

the succour of the needy : hundreds of young men owed their education to him ; hundreds of widows depended on him for their daily bread. The Indian Government made him a Companion of the Indian Empire in 1877. He died in 1891. (e. c. d.)

ITALY.

Geography and Statistics.

ACCORDING- to the calculation of the Italian Military Geographical Institute, the area of the kingdom of Italy is 110,646 square miles. Pending the completion of the Institute's labours, the Statistical Bureau provision-ally measured the outstanding provinces and districts whose area has still to be exactly determined. The fol-lowing table indicates the areas thus calculated for the several provinces (sixty-nine in number), the population of each according to the censuses of 31st December 1881 and of 9th February 1901, together with the density per square mile at that date. (The larger divisions or com-partments in which the provinces are grouped are not

officially recognized.)

Area,

Square

MUes.

Population. 1

Provinces and

Compartments,

1881.

1901.

Density

per

Mile, 1901.

Alessandria

1,950

729,710

812,022

416-42

Cuneo

2,882

635,400

641,172

222-47

Novara

2,55.3

675,926

745,357

291-95

Turin

Piedmont

Genoa

3,955

1,029,214

1,127,760

285-15

11,340

3,070,250

3,326,311

293-83

1,582

760,122

935,483

591-83

Porto Maurizio .

LlGUKIA .

Bergamo .

455

132,251

145,461

319-69

2,037

892,373

1,080,944

530-65

1,098

390,775

457,983

417-02

Brescia

1,845

471,568

537,690

291-44

Como

1,091

515,050

576,276

528-21

Cremona

695

302,097

327,802

471-67

Mantua

912

295,728

812,329

342-47

Milan

1,228

1,114,991

1,442,767

1,179-69

Pavia

1,290

469,831

496,916

385-21

Sondrio

1,232

120,534

126,425

102-62

LOMBABDY

Belluno

9,386

3,680,574

4,278,188

455-81

1,293

174,140

191,400

148-03

Padua

823

397,762

443,100

538-40

Kovigo

685

217,700

222,005

324-09

Treviso

.

960

375,704

410,684

427-80

tidine

.

2,541

501,745

694,334

233.90

Venice

.

934

356,708

400,030

428-30

Verona

.

1,188

394,065

422,355

355-52

Vicenza

1,052

396,349

446,521

424-45

Venetia .

Bologna .

9,476

2,814,173

3,130,429

330-35

1,448

464,879

527,642

364-89

Perrara

1,012

230,807

271,467

268-25

Forli

725

251,110

279,072

384-93

Modena

987

279,254

322,617

826-87

Parma

1,250

267,306

294,312

235-45

Piacenza

954

226,758

245,049

256-86

Ravenna

715

218,359

235,766

329-74

Reggio (EmUia)

EaiLiA .

Arezzo

876

244,959

275,827

314-87

7,967

2,183,432

2,451,752

307-74

1,273

238,744

272,359

218-95

Florence .

2,265

790,776

937,786

414-03

Grosseto .

1,738

114,295

144,825

83-88

Leghorn .

133

121,612

124,088

932-99

Lucca

558

284,484

318,610

670-99

Massa and Carrara .

687

169,469

195,840

285-07

Pisa ....

1,179

283,568

320,020

271-43

Siena

1,471

205,926

234,626

159-50

Tusc

ANT .

9,304

2,208,869

2,548,154

273-88

Provinces and

Compartments.

Ancona

Asooli Piceno .

Macerata .

Pesaro and Urbino .

Marches

Perugia — Umbku.

Rome — Lazio .

Aquila degli Abruzzi ‘

(Abruzzo Ulteriore

II.) . . .

Campobasso (Molise)

Chieti (Abruzzo Ci-‘l

teriore) . . J

Teramo (AbruzzoUl- 1

teriore I.) . J

Abruzzi and Mouse

Avellino (Principato 1

Ulteriore) . j

Benevento

Caserta (Terra di “I

Lavoro) . . /

Naples

*Salerno (Principato *

Citeriore) . /

Campania

Bari delle Puglie "I

(Terra di Bari) /

Poggia (Capitanata) .

Lecce (Terra di

Otranto) . . j

Ajolia .

Potenza — Basilicata

Catanzaro (Calabria I

TJlteriorelL) . /

Cosenza (Calabria "I

Citeriore) . j"

Reggio di Calabria!

(Calabria Ult. I.) /

Calabria

Caltanissetta

Catania .

Girgenti .

Messina .

Palermo .

Syracuse .

Trapani .

Sicily

Cagliari

Sassari

Sardinia

Kingdom op Italy

Area,

Square

Miles.

762

796

1,087

1,118

8,768

8,748

4,6

2,484

1,691

1,138

1,067

Population.

6,880

1,172

818

2,033

850

1,916

6,289

2,065

2,688

2,623

7,876

8,845

2,030

2,568

1,221

5,819

1,268

1,917

1,172

1,246

1,948

1,442

948

267,338

209,185

289,713

228,043

939,279

572,060

903,472

9,936

5,204

4,090

9,204

110,623

353,027

365,434

848,948

254,806

302,460

245,883

261,953

254,453

1,064,749

644,367

Density

per

Square

Mile, 1901

396-98

808-90

240-99

227-59

282-95

171-92

1,206,354

1,317,215

392,619

238,425

714,131

1,001,245

550,157

2,896,577

679,499

356,267

553,298

1,589,064

524,504

433,975

451,185

372,723

1^257,888

266,379

563,457

312,487

460,924

699,151

341,626

283,977

2,927,901

420,635

261,367

682,002

28,459,628

397,645

866,841

871,293

807,086

1,442,365

402,898

257,101

783,495

1,135,906

562,978

8,142,378

823,998

418,510

706,915

1,949,423

490,000

482,788

462,893

480,079

1,875,760

830,972

711,923

371,471

548,898

785,016

427,429

353,557

3,529,266

482,000

807,314

789,314

32,449,754

258-71

160-08

216-64

326-27

287-80

226-08

343-77

314-80

385-89

3,245-45

298-83

499-66

399-03

155-70

269-51

264-29

127-44

237-83

180-25

352-24

2.36-43

262-06

371-37

316-95

440-53

402-99

296-41

372-95

355-20

92 ■6-2

75-14

84-92

293-28

Of the total, 91,393 square miles represent the Italian mainland, the remainder belonging to the islands, mainly Sicily and Sardinia. The total length of the land frontiers is 1203 miles, the Italo-French frontier being 302 miles long, the Italo-Swiss 417 miles, and the Italo-Austrian 484. The length of the mainland coast-line is 2100 miles,

and that of the islands 2169 miles.

statistics]

ITALY

609

No change has taken place in the chief territorial divisions, and the kingdom is still divided into 60 provinces, 284 regions (of which 197 are classed as cireondarii audi 87 as districts), 1806 administrative divisions (mandamenti), and 8262 communes. The mandamenti or administrative divisions no longer correspond to the judicial divisions {mandamenti giudiziarii), vphich in November 1891 were reduced in number from 1806 to 1535 by a law which provided that the judicial reform should not modify existing administrative and electoral divisions.

Population. — The population of Italy, which, according to the census of 1881, was 28,459,628, was, according to the census of 9th February 1901, 32,449,754. In consequence of this increase in number, the average density of the population has increased from 257-21 per square mile in 1881, to 293-28 in 1901. The density, however, varies considerably, as vrill be seen in the above table. Modes of life also vary considerably, according as the inhabitants

live scattered over the country, congregated in rural towns and villages, or aggregate themselves around farmhouses of importance. In Venetia, Emilia, the Marches, Umbria, and Tuscany the proportion of concentrated population is only from 40 to 55 per cent. ; in Piedmont, Liguria, and Lombardy the proportion rises to from 70 to 76 per cent. ; in southern Italy, Sicily, and Sardinia it attains a maximum of from 76 to 93 per cent. The majority of Italians (19,000,000) live in communes of less than 10,000 inhabitants, and only 3,000,000 in communes of more than 50,000. As a rule, they prefer living in hamlets and small towns to isolated life in the country or the urban life of large cities.

The population of the chief provincial towns, according to the census of 9th February 1901, is given in the following table : —

Town.

Population.

Town.

Population.

Alessandria .

71,293

Messina

149,823

Ancona

56,825

Milan .

491,460

Aquila .

21,215

Modena

64,941

Arezzo .

44,350

Naples .

563,731

Asooli Picenc

28,882

Novara

44,928

Avellino

23,790

Padua .

82,283

Bari

79,693

Palermo

310,352

Belluno

18,649

Parma .

49,370

Benevento

24,650

Pavia .

35,372

Bergamo

45,785

Perugia

61,453

Bologna

152,009

Pesaro .

25,115

Brescia

70,618

Piacenza

36,064

Cagliari

58,734

Pisa

61,279

Caltanissetta

44,600

Porto Maurizio

7,207

Campobasso

15,046

Potenza

‘ 16,. 520

Caserta

32,729

Ravenna

63,839

Catania

149,694

Keggio (di Cala- 1

bria) /

44,417

Catanzaro

31,887

Chieti .

26,406

Eeggio (Emilia) .

59,176

Como .

38,902

Kome .

463,000

Cosenza

21,402

Rovigo .

11,174

Cremona

37,651

Salerno

42,736

Cuneo .

27,182

Sassari .

38,178

Ferrara

87,697

Siena .

28,678

Florence

204,950

Sondrio

8,700

Foggia .

53,351

Syracuse

32,074

Forli .

43,457

Teramo

24,578

Genoa .

234,800

Turin .

335,639

Girgenti

25,069

Trapani

60,257

Grosseto

9,600

Treviso

34,004

Lecee .

32,485

Udine .

37,933

Leghorn

98,505

Venice

151,841

Lucca .

74,718

“Verona

74,261

Macerata

22,806

Vicenza

44,261

Mantua

29,160

Massa .

26,325

Total .

5,614,587

Occupations. — In the census of 1871 all inhabitants of communes with a population of less than 6000 were assigned to the rural

population, and thotee of larger communes to the urban population. In southern Italy, however, the population of many peasant communes exceeds 6000, and it is scarcely possible to classify the inhabitants of Italy except according to their occupations.

Thus :—

Percentages of Poptilation (persons of nine years and upwards).

Agriculture, hunting, aud fishing . 38

Manufactures and mining ... 19

Trade and transport 3

Public and private employees (including domestic servants) ... i

Carry forward ... 64

Percentages of Population (persons of nine

Brought forward .

Liberal professions, education, fine arts, and public worship

Capitalists and proprietors .

Army and navy

Other professions ....

Unclassified (including housewives,

students, &c.) . . . .

years and upwards).

64

2

4

1

1

28

100

Although the percentage of Italians employed in agriculture and allied occupations is probably destined, as in other countries, to undergo some diminution in favour of the percentage employed in trade and industry, the generality of the population of Italy preserves its rural character.

Marriages, Births, Deaths. — The proportion of mamages in Italy showed a slight diminution between 1881 and 1899, the rate having been 8-11 per 1000 in the former and 7-42 in the latter

year. During the same period the birth-rate decreased from

38-10 to 34-27 per 1000, and the death-rate from 27-63 to 22-15.

Thus :—

Tear.

Marriages.

Births.

Deaths.

Per 1000

Per 1000

Per 1000

Total.

Inhabi-

tants.

Total.

Inhabi-

tants.

Total.

Inhabi-

tants.

1881

230,143

8-11

1,081,125

38-10

784,181

27-63

1885

233,931

8-03

1,125,970

38-67

787,217

27-03

1891

227,656

7-53

1,132,139

37-42

795,327

26-29

1895

228,152

7-36

1,092,102

35-22

783,813

25-28

1898

219,597

6-96

1,070,074

33-89

732,265

23-19

1899

235,665

7-42

1,088,558

34-27

703,393

22-15

The marriage-rate varies considerably in the different Italian regions. It is highest in Umbria, Apulia, the Abruzzi and Molise, and Calabria ; and lowest in Liguria, Piedmont, and Venetia. The highest birth-rate is found in Apulia, the Marches, Calabria, the Abruzzi and Molise; the lowest in Piedmont, Liguria, and Sardinia. The death-rate is lowest in the northern provinces, and particularly in Venetia and Piedmont ; and highest in Apulia, in the Abruzzi and Molise, and in Sardinia. Out of 1,070,074 births registered in 1898, 1,002,812 were legitimate and 67,262 illegitimate. The latter total comprises natural children recognized by their fathers (38,900), as well as the unrecognized and the foundlings. The percentage of illegitimate births tends to decrease ; thus: — •

Tear.

Illegitimate

Births.

Per Cent.

1881 .

1891 .

1895 .

1897 .

1898 .

1899 .

79,508

80,041

70,539

70,199

67,262

66,852

7-35

7-07

6-46

6-37

6-29

6-14

The regions which give the highest proportion of illegitimates continue to be the Romagna, with 203-6 per 1000 ; Lazio, with 217-6 per 1000 ; aud Umbria, with 142-2 per 1000.

The fall in the death-rate is principally due to improvement

of hygienic and sanitary conditions (better water supply, improved drainage, &c.), and partly to the increase of general welfare.

Emigration. — The movement of emigration may be divided into two currents, temporary aud permanent — the former going chiefly towards neighbouring European countries, and consisting of manual labourers, the latter towards trans-oceanic countries, principally Brazil, Argentina, and the United States. These emigrants remain abroad for several years, even when they do not definitively establish themselves there. They are composed principally of peasants, unskilled workmen, and other manual labourers. The provinces which furnish the chief contingents of emigrants to non-European countries are those of Genoa, Cosenza, Potenza, Salerno, Avellino, Campobasso, and Catanzaro ; but Venetia, Lombardy, and Piedmont also provide considerable numbers. As shown by the following table, there was, on the whole, a tendency towards increased emigration during the last quarter of the 19th century. The principal causes are the growth of population, and the over-supply of and low rates of remuneration for manual labour in various Italian provinces : —

[statistics

Year.

Temporary Emigration.

Permanent Emigration. [

Total No. of

Emigrants.

Per every

100,000 of

Population.

Total No. of

Emigrants.

Per every

100,000 of

Population.

1881

1885

1891

1895

1896

1897

1898

1899

94,225

80,164

118,111

123,668

123,862

134,426

156,928

177,031

333

276

389

397

394

425

493

553

41,607

77,029

175,520

169,513

183,620

165,429

126,787

131,308

147

265

578

543

585

523

398

410

From the next table will be seen the direction of emigration

in the years specified : —

Emiy:rants to

1S97.

1S98.

lb’J9.

European Countries .

North Africa ....

United States and Canada .

*Brazil, Argentine, Central and *

other South American States J

“America” (country not named)

Other Countries ....

Total

125,310

2,457

47,139

123,075

1,080

794

144,528

3,251

56,703

76,737

1,753

743

162,899

4,566

64,177

74,897

860

940

299,855

283,715

308,339

Up to 1901, Italian emigration was regulated by the Law of 1888, which dealt principally with the relations between emigration agents and the emigrants, and made some provision for the protection of the latter during the journey. At the beginning of 1901 a new Emigration Law was finally sanctioned by Parliament. It suppressed emigration agents, strictly established the liability of the steamship companies towards the emigrants, provided for proper sanitation on board emigrant ships, and created a special Com-

missionership of Emigration (attached to the Ministry for Foreign Affairs) to administer the provisions of the Law, and to deal with the foreign countries whither emigrants chiefly go, and to fix the passenger rates.

Agriculture. — Accurate statistics with regard to the area occupied in different forms of cultivation are difficult to obtain, both on account of their varied and piecemeal character and from the lack of a complete cadastral survey. A complete survey was ordered by the Law of 1st March 1886, but many years must elapse before its completion. The law enabled provinces most heavily burdened by land tax to accelerate their portion of the survey, and to profit by the reassessment of the tax on the new basis. In eighteen provinces, therefore, the cadastral operations are completed ; they have been begun, and in some cases nearly completed, in twenty-one other provinces. Thirty provinces are still outstanding. An idea of the probable effects of the new survey may be gathered from the fact that the assessments in the four provinces of Mantua, Ancona, Cremona, and Milan, which formerly

amounted to a total of 36,367,400 lire, are now 69,702,000, an increase of 91 per cent. Similar results will probably be attained in the other provinces of the kingdom. Of the total area of Italy, 71 per cent., or 20,283,000 hectares out of 28,704,843 hectares, are classed as " productive." The unproductive area comprises 16 per cent, of the total area, or 4,647,451 hectares ; and the uncultivated area 13 per cent., or 3,774,392 hectares.

The cultivated area of Italy may be divided into five agrarian regions or zones, named after the variety of tree culture which flourishes in them, and around which the herbaceous cultures most readily group themselves. (1) Proceeding from south to north, the first zone is that of the agrumi (oranges, lemons, and similar fruits). It comprises a great part of Sicily. In Sardinia it extends along the southern and western coasts. It predominates along the Ligurian Eiviera from Bordighera to Spezia, and on the Adriatic, near S. Benedetto del Tronto and Gargano, and, crossing the Italian shore of the Ionian Sea, prevails in some regions of Calabria, and terminates

around the gulfs of Salerno, Sorrento, and Naples. (2) The region of olives comprises the internal Sicilian valleys and part of the mountain slopes ; in Sardinia, the valleys near the coast on the south-east, south-west, and north-west ; on the mainland it extends from Liguria and from the southern extremities of the Romagna to Cape Santa Maria di Leuca in Apulia, and to Cape Spartivento in Calabria. Some districts of the olive region are to be found near the lakes of Upper Italy and in Venetia, and the territories of Verona, Vicenza, Treviso, and Friuli. (3) The vine region completes, so to speak, the orange region, wherever the olives fail to find a suitable climate. It begins on the sunny slopes of the Alpine spurs and in those Alpine valleys which are open towards the south. In Sardinia it covers the mountain slopes to a consider-able height, and in Sicily covers the sides of the Madonie range, reaching the level of 1000 metres on the southern slope of Etna. The Calabrian Alps, the less rocky sides of the Apulian Murge, and the whole length of the Apennines are covered at different heights, according to

their situation. The hills of Tuscany, and of Monferrato in Piedmont, produce the most celebrated Italian vintages. (4) The region of chestnuts extends from the valleys to the high plateaux of the Alps, along the northern slopes of the Apennines in Liguria, Modena, Tuscany, Eomagna, Umbria, the Marches, and along the southern Apennines to the Calabrian and Sicilian ranges, as well as to the mountains of Sardinia. (5) The wooded region covers the Alps and Apennines above the chestnut level. The woods consist chiefly of pine and hazel upon the Apennines, and upon the Calabrian, Sicilian, and Sardinian mountains of oak, ilex, hornbeam, and similar trees. Between these regions of tree culture lie zones of different herbaceous culture, cereals, vegetables, and textile plants, according to the different conditions of climate and soil.

Agrarian Production. — Herbaceous cultures occupy the first place in extension and importance, covering nearly 15,000,000 hectares, or three-fifths of the productive area, and more than half the total area of Italy. Wheat stands first, with an area (in 1896)

of 4,593,274 hectares. From 1884 to 1899 the wheat harvest varied between 38 and 51 million hectolitres, equal to an average of 6-5 to 11 hectolitres per hectare. In some fertile spots, how-ever, the yield reaches 20 or even 30 hectolitres per hectare.

Next in importance to wheat comes maize, which is cultivated almost everywhere as an alternative crop. The area under maize is now about 2,000,000 hectares, and the yield approximately 27,000,000 hectolitres. During the period 1S84-99 the maximum maize crop was that of 34,000,000 hectolitres in 1884, and the minimum 21,000,000 in 1894. In 1899, 31,200,000 hectolitres were produced. The average crop per hectare is between 16 and 18 hectolitres.

Rice is cultivated in low-lying, moist lands, where spring and summer temperatures are high. The Po valley and the valleys of Emilia and the Romagna are most adapted for rice, but the area is diminishing on account of the competition of foreign rice and of the impoverishment of the soil by too intense cultiva-tion. The average area is 200,000 hectares, with an average annual crop of from 7,000,000 to 8,000,000 hectolitres. Rye, barley, and oats are less cultivated. The area under rye" is

about 150,000 hectares, of which about two-thirds lie in the Alpine and about one-third in the Apennine zone. The average annual crop is about 1,500,000 hectolitres. The barley zone is geographically extensive, but embraces not more than 300,000 hectares, of which half are situated in Sardinia and Sicily. The average annual production is between 10 and 11 hectolitres per hectare. Oats, which are cultivated in tlie Roman and Tuscan maremma and in Apulia, are used almost exclusively for horses and cattle. The area of oats cultivation is 450,418 hectares, ^iviug a crop of 7,000,000 hectolitres, or 16 hectolitres per hectajre." The other cereals, millet and panico sorgo, have lost much of their importance in consequence of the introduction of maize and rice. Millet, however, is still cultivated in the north of Italy, and is used as bread for agricultural labourers, and as forage when mixed with buckwheat (sorghum saccaratum).

The cultivation of various forms of green forage is extensive, and is divided into the two categories of temporary and perennial. The temporary includes vetches, pulse, lupine, clover, and statistics]

ITALY

trifolium ; and the perennial, meadow-trefoil, lupinella, sulla (Hedysarum coronarium) , lucerne, and darnel. The natural grass meadows are extensive, and hay is grown all over the country, but especially in the Po valley. The area covered by green fodder is 5,500,000 hectares, exclusive of Alpine and flat pasturages, which cover 3,000,000 hectares. Returns for this zone of cultivation are only approximate, and, judged by the quantity of live stock in Italy, are probably below reality. According to these returns, the average annual crop of hay is 68,000,000 quintals ; that of beet-root, turnips, and tuberous growths, 3,500,000 quintals ; and of green fodder, 159,000,000 quintals. Seed-bearing vegetables are comparatively scarce in Italy. The principal are, white beans, which are largely consumed by the working classes ; lentils, much less cultivated than beans ; and green peas, largely consumed in Italy, and exported as a spring vegetable. Chick-pease are extensively cultivated in the southern provinces. These varieties of seed-bearing vegetables occupy about 200,000 hectares, and yield from 10 to 30 hectolitres per hectare. Horse beans {viciafaba) are grown especially in the south and in the larger islands ; they

occupy altogether about 400,000 hectares, and yield from 15 to 25 hectolitres per hectare.

Among tuberous vegetables the potato {solanum tuberosum) comes first. Some 200,000 hectares are devoted to its cultivation, the yield being from 18 to 20 tons per hectare. Turnips {brassica rapa) are grown pKncipally in the central provinces as an altema^ tive crop to wheat. They yield as much as 30 tons per lieotare.

Beet-root {beta vulgaris) is used as fodder, and yields between 20 and 30 tons per hectare. Sugar beet is extensively grown to supply the seventeen large sugar factories now existing in Italy.

Market gardening is carried on both near towns and villages, where products find ready sale, and along the great railways, on account of transport facilities.

Among the chief industrial plants cultivated in Italy must be mentioned tobacco, which grows wherever suitable soil exists.

Since tobacco is a Government monopoly, its cultivation is subject to official concessions and prescriptions. In 1898 the cultivation of 134,175,000 plants was authorized, and concessions were issued by the provincial commissions for 93,258,226, but only 80,569,176 were actually planted, over an area of 4951 hectares. The gross yield

for that year was 5,625,124 kilogrammes. Experiments hitherto made show that the cultivation of Oriental tobacco may profitably be extended in Italy.

The chief Italian textile plants are hemp, flax, and cotton.

Hemp {cannabis sativa) is largely cultivated in the provinces of Turin, Ferrara, Bologna, Forli, Ascoli Piceno, and Caserta. Bologna hemp is specially valued. More than 100,000 hectares are employed in hemp cultivation, the average crop being 800,000 quintals. Flax {linum usitatiasimum) covers between 60,000 and 70,000 hectares, with a product, in fibre, amounting to about 200,000 quintals, or 3 quintals per hectare, and, in seed, of 18 hectolitres per hectare. Cotton {gossypium, herbaceum) , which at the beginning of the 19th century, at the time of the Continental blockade, and again during the American War of Secession, was so largely cultivated in Italy as to cover an area of 90,000 hectares, and to yield 628,000 quintals of raw cotton, has now almost completely died out, and is cultivated only in parts of Sicily and in a few southern provinces.

The most important of the ligneous plants cultivated in Italy is the vine {vitis vinifera), which is to be found in 7212 out of the

8262 Italian communes. The vine-growing area covers about 3,446,000 hectares. In 1898 the vintage amounted to 32,940,000 hectolitres, and in 1899 to 31,800,000 hectolitres ; the maximum vintage was 38,227,000 hectolitres in 1886. "Within the last few years the vine has been attacked by three terrible enemies — the oidiiim Tuckeri, the phylloxera vastatrix, and the ^eronospora viti-cola, which in rapid succession have wrought great havoc in Italian vineyards. Government and vine-growers are, however, energet-ically combating these scourges.

Olives are cultivated in every region of Italy except Piedmont.

The olive-growing area occupies 1,033,796 hectares, yielding : —

1884-85

3,323,120 hectolitres

1896-97

1,912,009 „

1897-98

1,600,000 „

1898-99

2,300,009

1899-1900 .

920,000

The falling off of the crop was due to bad seasons and to insects, notably the cycloconium oleoginum and the dacus olece, or oil fly, which have ravaged the olive-yards. With the development of agricultural knowledge, notable improvements have been effected in the manufacture of oil. In 1895 the number of oil-mills in Italy was 14,500, and at present is probably 17, .500. Between 70,000 and 80,000 workmen find employment in the mills, five-sixths of which are worked by animal power, 2000 by hydraulic, and 250 by steam power. The steam mills give the best results. Very little oil is made in Italy from oil-seeds, although a certain amount of linseed-oil is made in Lombardy, Sicily, Apulia, and Calabria ; colza in Piedmont, Lombardy, Venetia, and Emilia ; and castor-oil in Venetia and Sicily. The total product is calculated to be 120,000 quintals, principally used for industrial purposes, but partly ia the preparation of food.

Agrumi (oranges, lemons, citrons, &o.) are cultivated especially in Sicily, Calabria, Sardinia, and Liguria. In northern and central Italy, except in the province of Brescia, they are almost non-existent. The trees are planted on irrigated soil, and the fruit gath-

ered at various times between November and August. The area occupied in orange and lemon cultivation is calculated to be 40,000 hectares. In the quinquennium 1879-83 the number of trees was 15,698,000, and in 1890-98 17,000,000, with an average annual crop of 3,000,000,000 of fruit. In the year 1899-1900 the crop was 4,500,000,000. The value of the crop varies considerably, according to the market price. Considerable trade is done in agro di limone, or lemon extract, which forms the basis of citric acid. Extraction is extensively carried on in the provinces of Messina and Palermo. During recent years, however, the cultivation of agrumi as a whole has not given favourable results, a falling-off, amounting to some £400,000 per annum, having taken place between 1895 and 1899.

Among other fruit trees, apple-trees have special importance. In 1899 the total apple crop was calculated to be 475,930 quintals, worth £571,000. Almonds are vridely cultivated in Sicily, Sardinia, and the southern provinces ; walnut-trees throughout the peninsula, their wood being more important than their fruit ; hazel nuts, figs, prickly pears, locust beans, and pistachio nuts are among the other fruit trees. The mulberry-tree {morus alba), whose leaves serve

as food for silkworms, has particular importance in Italy. It is cultivated in every region, considerable progress having been made in its cultivation and in the rearing of silkworms since 1850. Silkworm-rearing establishments of importance now exist in the Marches, Umbria, in the Abruzzi, Tuscany, Piedmont, and Venetia. In 1899, 41,557,000 kilogrammes of cocoons were produced, worth £6,649,120. The chief silk-producing provinces are Lombardy (15,100,000 kilogrammes of cocoons), Venetia (8,720,000 kilogrammes), and Piedmont (7,270,000 kilogrammes). During the period 1880-99 the production oscillated about a mean of 40,000,000 kilogrammes per annum, but it is noteworthy that whUe, at the outset, three-fourths of the cocoons were Chinese or Japanese, almost all are now native Italian cocoons. Moreover, while the yield per cocoon tends to increase, the number of eggs hatched tends to diminish. In 1880, 1,700,000 ounces of eggs were hatched ; now only 900,000 ounces are required, a result due to the selection of the species most fertile in silk, and to improved methods of culture.

Woods and Forests. — Woods and forests play an important part in Italy, especially in regard to the consistency of the soil and to the

character of the watercourses. Three great zones may be distinguished— (o) up to 1200 feet above sea-level, (6) from 1200 to 3000 feet, and (c) from 3000 feet upwards. The first region is losing importance on account of the continual spread of land under cultivation. Nevertheless, along the Roman and Tuscan littoral, in the province of Ravenna, here and there in southern Italy, and in Sicily and Sardinia, pine, ash, and oak woods of considerable extent are to be found. In the second region the chestnut predominates, its wood being of great value and its fruit an article of popular consumption. The third region is characterized by beech and fir trees. Good timber is furnished by the pine and fir forests of the Alps and Apennines. Notwithstanding the efforts of the Italian Government to unify and co-ordinate the forest laws previously existing in the various Italian states, deforestation has continued in many parts of Italy. Between 1871 and 1898 the forest department has replanted 20,366 hectares at a cost of £205,930. Forest nurseries have also been founded. There are now forty-nine of them, covering 53 hectares, and producing on an average 7,000,000 nurselings per annum.

Live Stock. — According to an approximate calculation carried

out in 1890, the number of head of live stock in Italy was 16,620,000, thus divided :— Horses, 720,000 ; asses, 1,000,000 ; mules, 300,000 ; cattle, 5,000,000 ; sheep, 6,000,000 ; goats, 1,800,000; swine, 1,800,000. The approximate value of this live stock was calculated to be £87,640,000, of which £55,000,000 was represented by cattle. In upper Italy cattle are principally reared in pens and stalls ; in central Italy cattle are allowed to run half wild, the stall system being little practised ; in the south and in the islands cattle are kept in the open air, few shelters being provided. The erection of shelters is, however, being encouraged by the State. Horse-breeding is on the increase. The State helps to improve the breeds by placing choice stallions at the disposal of private breeders at a low tariff. Cattle-breeding varies with the different regions. In the Lombard farms it is carried on intensively, i.e., in stalls and enclosed spaces, on a large scale. Along the Mediterranean coast, in the south, and in the islands it is carried on in the open air. Sheep are chiefly reared in Lazio, the Abruzzi, Apulia, Basillcata,

[statistics

Calabria, and Sardinia, where extensive pasturage exists. In other provinces, where agriculture is more advanced, sheep-farming is confined to hilly districts. Old established habits prevent rapid improvement of method. The number of sheep is diminishing in Italy, especially in Apulia. Similarly, the number of goats, which are reared only in hiUy regions, is decreasing, especially on account of the existing forest laws. The production of wool is less considerable than in the past, and in 1895 was estimated at 9,777,000 kg. Swine are extensively reared in many provinces, and less extensively throughout the whole peninsula. Fowls are kept on all Italian farms, and though methods are still antiquated, trade in fowls and eggs is rapidly increasing. The number of eggs exported more than doubled within the last decade of the 19th century.

The milk and cheese-making industry is acquiring great importance, especially in northern Italy, Lombardy, and Venetia, where co-operative dairy farms are numerous and flourishing. Modern methods have been generally introduced. In 1895 the production was calculated to be as follows : — Cheese, 74,328,000 kg. ; butter, 15,922,000 kg.; curds, 1,874,000 ; other milk products, 5,278,000.

Drainage, &c. — The drainage of marshes and marshy lands has

considerably extended. A law passed on 22nd March 1900 has given a special impulse to this form of enterprise by fixing the ratio of expenditure incumbent respectively upon the State, the provinces, the communes, and the owners or other private individuals directly interested. On 31st December 1897 seventy-five drainage operations had been completed, or were in course of completion, either directly or indirectly by the State. They affected a total area of 697,561 hectares, of which 309,970 had been completely drained and rendered susceptible of cultivation.

Agrarian Economics. — The Italian Federation of Agrarian Unions has greatly contributed to agricultural progress. In December 1899 the number of Unions (Gonsorzii) federated was 161, exclusive of the non-co-operative agricultural societies. Some of these unions annually purchase large quantities of merchandise for their members, especially chemical manures.

Income from land has diminished on the whole. The chief diminution has taken place in the south in regard to oranges and lemons, cereals, and (for some provinces) vines. Since 1895, however, the heavy import corn duty has caused a slight rise in the income from corn lands. The principal reasons for the general

decrease are the fall in prices through foreign competition and the closing of certain markets, the diseases of plants and the increased outlay required to combat them, and the growth of State and local taxation.

The relations between owners and tillers of the soil are still regulated by the ancient forms of agrarian contract, which have remained almost untouched by social and political changes. The possibility of reforming these contracts in some parts of the king-dom has been studied, in the hope of bringing them into closer harmony with the needs of rational cultivation and the exigencies of social justice.^ The following forms of contract are most usual in the several Italian regions: — In Piedmont the mezzadria {meta-yage'), the terzieria, the colonia parziaHa, the boaria, the schia-venza, and the affitto, or lease, are most usual. Under mezzadria the contract generally lasts three years. Products are usually di-vided in equal proportions between the owner and the tiller. The owner pays the taxes, defrays the cost of preparing the ground, and provides the necessary implements. Stock usually belongs to the owner, and, even if kept on the half-and-half system, is usu-ally bought by him. The peasant, or mezzadro, provides labour.

Under terzieria, the owner furnishes stock, implements, and seed, and the tiller retains only one-third of the principal products. In the colonia parziaria the peasant executes all the agricultural work, in return for which he is housed rent-free, and receives one-sixth of the corn, one-third of the maize, and has a small money wage. This contract is usually renewed from year to year. The boaria is widely diffused in its two forms of cascina fatta and paghe. In the former case a peasant family undertakes all the necessary work in return for payment in money or kind, which varies according to the crop ; in the latter the money wages and the payment in kind are fixed beforehand. Schiavenza, either simple or with a share in the crops, is a form of contract similar to the boaria, but applied principally to large holdings. The wages are lower than under the boaria. In the affitto, or lease, the proprietor furnishes seed and the implements. Rent varies according to the quality of the soil.

In Lombardy, besides the mezzadria, the lease is common, but

1 In 1899 special inquiries were carried out In regard to this subject by the Ministry of Agriculture. In 1893 a Government Commission studied and proposed changes in the existing laws with regard to

agrarian contracts and labour contracts. Several reform Bills have been presented, including that of Baron Sidney Sonnino In November 1900, and that brought forward by the Zanardelli-Qiolitti Cabinet in the sprmg of 1902.

the terzieria is rare. The lessee, or farmer, tills the soil at his own risk ; usually he provides live 'stock, implements, and capital, and has no right to compensation for ordinary improvements, nor for extraordinary improvements effected without the landlord's consent. He is obliged to give a guarantee for the fulfilment of his engagements. In some places he pays an annual tribute in grapes, corn, and other produce. In some of the Lombard mezza-dria contracts taxes are paid by the cultivator.

In Venetia it is more common than elsewhere in Italy for owners to till their own soil. The prevalent forms of contract are the mezzadria and the lease. Mezzadria contracts are usually renewed year by year; if the stock belongs to the peasant, he retains aU the profit from them, but if to the owner, they are held in simple partnership. In several districts, such as Padua and Eovigo, where farms are extensive, the implements and stock belong to the farmer, who gives a guarantee for the payment of rent.

In Liguria, also, mezzadria and lease are the chief forms of contract. Under mezzadria, however, live stock belongs to the owner of the soil, who pays for planting the olive-trees and provides manure. The olives, chestnuts, and other fruits usually go two-thirds to the owner and one-third to the peasant. Farm leases generally run from three to nine years, and provide compensation for certain improvements effected by the farmer.

In Emilia both mezzadria and lease tenure are widely diffused in the provinces of Ferrara, Eeggio, and Parma; but other special forms of contract exist, known as the famiglio da spesa, boaria, braccianti obbligati, Sindi bracciantidisobbligati. Under the mezzadria produce is divided equally, except grapes (of which two-thirds go to the landlord) and mulberry leaves (which go to him entirely). Taxes and the cost of seed are equally divided. Stock, as a rule, belongs to the landlord. Leases are stipulated for periods varying from three to nine years, and the tenant must guarantee payment of rent. If stock, implements, fodder, and seed are furnished by the landlord, they are valued, and the tenant is obliged to restore the same value on the lapse of his lease.

In the famiglio da spesa the tiller receives a small wage and a

proportion of certain products. The boaria is of two kmds. If the tiller receives as much as 45 lire per month, supplemented by other wages in kind, it is said to be boaria a salario ; if the principal part of his remuneration is in kind, his contract is called boaria a spesa.

In the Marches, Umbria, and Tuscany, mezzadria prevails in its purest form. Profits and losses, both in regard to produce and stock, are equally divided. In some places, however, the landlord takes two-thirds of the olives and the whole of the grapes and the mulberry leaves. Leasehold exists in the province of Grosseto alone. In Lazio leasehold and farming by landlords prevail, but cases of mezzadria and of "improvement farms" exist. In the agro Romano, or zone immediately around Rome, land is as a rule left for pasturage. It needs, therefore, merely supervision by guardians and mounted overseers, or butteri, who are housed and receive wages. Large landlords are usually represented by ministri, or factors, who direct agricultural operations and manage the estates. "Wherever corn is cultivated, leasehold predominates. Near Velletri and Frosinone "improvement farms" prevail. A piece of uncultivated land is made over to a peasant for a period

varying from 20 to 29 years. Vines and olives are usually planted, the landlord paying the taxes and receiving one-third of the produce. At the end of the contract the landlord either cultivates his land himself or leases it, repaying to the improver part of the expenditure incurred by him. This repayment sometimes consists of half the estimated value of the standing crops.

In the Abnizzi and in Apulia leasehold is predominant. Usually leases last from three to six years. In the provinces of Foggia and Lecce longleases (up to twenty-nine years) are granted, but in them it is explicitly declared that they do not imply evfiteusi (perpetual leasehold), nor any other form of contract equivalent to co-proprietorship. Mezzadria is rarely resorted to. On some small holdings, however, it exists with contracts lasting from two to six years.

The landlord furnishes seed and implements, especially for oil-making, the whole being valued for restitution upon expiry of the contract. The produce is equally divided after the deduction of seed, except in the case of oil, of which the cultivator receives from one-sixth to one-fourth. Special contracts, known as colonic inamovibili trndcolonietemporanee, are applied to the latifondiov huge estates, the owners of which receive half the produce, except that

of the vines, olive-trees, and woods, which he leases separately. " Improvement contracts" also exist. They consist of long leases, under which the landlord shares the costs of improvements and builds farm-houses ; also leases of orange and lemon gardens, two-thirds of the produce of which go to the landlord, while the farmer contributes half the cost of farming besides the labour. Leasehold, varying from four to six years for arable land and from six to eighteen years for forest-land, prevails also in Campania, Basili-cata, and Calabria. The estaglio, or rent, is often paid in kind, and is equivalent to half the produce of good land and one-third of the statistics]

produce of bad land. "Improvement contracts" are granted for uncultivated bush districts, where one-fourth of the produce goes to the landlord, and for plantations of fig-trees, olive-trees, and vines, half of the produce of which belongs to the landlord, who at the end of ten years reimburses the tenant for a part of the improve-ments effected. Other forms of contract are the piccola mezzadria, or sub-letting by tenants to under-tenants, on the half-and-half

system ; enflteusi, or perpetual leases at low rents — a form which has almost died out ; and mezzadria (in the provinces of Caserta and Benevento), upon the basis that two-thirds of the olive-oil belongs to the landlord, and varying proportions of other produce, all labour being provided by the tenant.

In Sicily leasehold prevails imder special conditions. In pure leasehold the landlord demands at least six months' rent as guarantee, and the forfeiture of any fortuitous advantages. Under the gabella lease the contract lasts twenty-nine years, the lessee being obliged to make Improvements, but being sometimes exempted from rent during the first years. Inquilinaggio is a form of lease by which the landlord, and sometimes the tenant, makes over to tenant or sub-tenant the sowing of corn. There are various categories of inquilinaggio, according as rent is paid in money or in kind. Under mezzadria or metateria the landlord divides the produce with the farmer in various proportions. The farmer provides all labour. Latifondi'isiTms are very numerous in Sicily. The landlord lets his land to two or more persons jointly, who undertake to restore it to him in good condition with one-third of it " interrozzito," that is, fallow, so as to be cultivated the following year according to trien-

nial rotation. These lessees are usually speculators, who divide and sub-let the estate. The sub-tenants in their turn let a part of their land to peasants in mezzadria, thus creating a system which is disastrous both for agriculture and the peasants. At harvest-time the produce is placed in the barns of the lessor, who first deducts 25 per cent, as premium, then 16 per cent, for battiteria (the difference between com before and after winnowing) , then deducts a proportion for rent and subsidies, so that the portion retained by the actual tiller of the soil is extremely meagre. In bad years the tiller, moreover, gives up seed corn before beginning harvest.

In Sardinia landlord- farming and leasehold prevail. In the few cases of mezzadria the Tuscan system is followed.

Industrial Progress. — The industrial progress of Italy has been great since 1880. Many articles formerly imported, are now made at home, and some Italian manufactures have begun to compete in foreign markets. The amount of coal consumed in generating steam power for industrial purposes gives an index of this development.

In 1887 the amount spent for coal was 116,930,849 lire ; in 1891 it was 146,274,447 lire ; and in 1898, 178,198,880

lire. The increase in the number of steam motors (in-

cluding those for industrial and agricultural use, but

excluding railway locomotives and steamships) amounted

to more than one-third between 1890 and 1898. Thus r —

Tear.

1890

1895

1898

Steam Motors.

14,502

18,441

20,472

The application of water power to industry is also grow-

ing, especially in the form of water-driven dynamos

for the generation of electricity. At the end of 1898

600,000 horse-power are calculated to have been available

for motive power.

Another sign of industrial development is to be found

in the growing number of manufacturing companies, both

Italian and foreign. In less than fifteen years their

capital has doubled itself : —

Tear.

Industrial Companies.

Italian.

Foreign.

Number.

Paid-up Capital.

Number.

Paid-up Capital.

1883 .

1890 .

1897 .

304

483

513

tire.

644,229,722

1,310,273,741

1,253,995,117

79

121

147

Lire.

379,532,858

449,822,351

548,273,409

Particularly worthy of note is the rapid and continuous progress of applied electricity during recent years. During the triennium ending in 1899 the electrical horse-power produced in Italy rose from 60,000 to 100,000, of which about 80,000 was employed in central stations for public services and 20,000 for private use. In 1899 and 1900 the increase was still more rapid. Piedmont and Lombardy are the chief centres of electrical industry.

Mechanical Industries. — ^The chief development has taken place in mechanical industries, though it has also been marked in metallurgy. Sulphur mining supplies the industries of sulphur-refining and grinding. In 1899, 564,000 tons of raw sulphur, 110,000 tons of refined sulphur, and 162,000 tons of ground sulphur were produced. 698 factories with 6721 workmen are engaged in refining

and grinding. Very little pig iron is made, most of the iron ore being exported. In 1883 24,000 tons of pig iron were produced and in 1899 only 19,000. The number of workmen was 296 in 1883 and 308 in 1899. Most of the iron manufactured in Italy consists of old iron resmelted. This branch of industry developed principally between 1883 and 1889, in which latter year 182,000 tons were produced. It subsequently fell off, but of late has again increased, 198,000 tons, worth nearly 55,000,000 lire, having been produced in 1899. Steel-making, for which foreign pig iron is chiefly used, increased from 3630 tons in 1881 to 158,000 in 1899, but diminished, with intermediate oscillations, to 108,000 tons in 1899. The manufacture of steel rails, carried on first at Temi and afterwards at Savona, began in Italy in 1886. The production in 1898 was 21,926 tons. Tin has been manufactured since 1892. Lead, antimony, mercury, and copper are also dealt with, the production of copper and its alloys having been 14,000 tons in 1899.

Whereas in 1880 the various machine workshops be-longing to the Government, the railway companies, and private individuals turned out products worth about

70,000,000 lire, the output rose, between 1887 and 1890, to 100,000,000 lire on account of the great development of public works. During the early 'nineties it fell off, but afterwards rose again. Some of these workshops, particularly those of Lombardy and Piedmont, do an export trade.

Textiles. — The textile industries, some of which are of ancient date, are among those that have most rapidly developed. Hand-looms and small spinning establishments have, in the silk industry, given place to large establishments with steam looms. ^ The production of raw silk at least tripled itself between 1875 and 1900. The value of the silks woven in Italy, estimated in 1890 to be 15,000,000 lire, is now, on account of the development of the export trade, calculated to be 100,000,000 lire. Lombardy (especially Como, Milan, and Bergamo), Piedmont, and Venetia are the chief silk-producing regions. The cotton industry has also rapidly developed. The number of spindles, which in 1880 was 900,000, had increased to about 1,900,000 in 1897. Home products not only supply the Italian market in increasing degree, but find their way into foreign markets. While importation of raw cotton in-

creases (272,340 quintals in 1871, 1,308,509 quintals in 1899) importations of cotton thread (85,804 quintals in 1871, 8116 in 1899) and of cotton stuffs (which amounted to 100,921 quintals in 1871) have rapidly decreased. At the same time exports of cotton thread and stuffs have increased, the exact

figures being 235 quintals of thread in 1871, 85,596 in 1899 ; 1613 quintals of woven cotton stuffs in 1871, 123,262 quintals in 1899.

In 1897 the number of cotton mills was 376, 80,000 workmen being employed in the industry. The value of the annual produce of the various branches of the cotton industry, which in 1885 was calculated to be 180,000,000 lire, was in 1900, notwithstanding the fall in prices, about 300,000,000 lire. The industry is chiefly developed in Lombardy, Piedmont, and Liguria ; to some extent also in Campania, Venetia, and Tuscany, and to a less extent in Lazio (Rome), Apulia, Emilia, the Marches, Umbria, the Abruzzi, and Sicily.

In 1894 the number of woollen mills was 489. The industry gave employment to 30,625 hands, of whom 15,544 were males (2080 under fifteen years) and 15,081 females (1578 under fifteen years). The value of woollen fabrics was about 100,000,000 lire, exclusive of the output of home industry — an increase of some 20,000,000 lire since 1884. As in the case of cotton, Italian iln 1891 the number of mills was 2084, with 1116 steam boilers, 1345 steam and water motors, and 54,588 basins for silk winding. The number of spindles was 1,534,849 ; that of carding machines .339 ;

looms, 14,949, of which 2535 were machiiie looms. 172,356 workmen were employed in the factories, of whom 154,644 were women (34,258 under fifteen years) and 17,712 men (2328 under fifteen years).

[statistics

woollen fabrics are conquering the home market in increasing degree. The importation of raw wool increases (95,537 quintals in 1881, 133,982 in 1899), while the importation of spun and woven wool decreases. The industry centres chiefly in Piedmont (province of Novara), Venetia (province of Vicenza), Tuscany (Florence), Lombardy (Brescia), Campania (Caserta), Genoa, Umbria, the Marches, and Rome. To some extent the industry also exists in Emilia, Calabria, Basilicata, the Abruzzi, Sardinia, and Sicily. The other textile industries (flax, jute, &c.) have made notable progress. The jute indiistry is concentrated in a few large factories, which from 1887 onwards have more than supplied the home market, and have begun considerably to export.

Chemical industries show an output worth 52,000,000 lire in 1899,

as against 26,000,000 in 1893. Between 1893 and 1898 the number of workmen employed rose from 3275 to 5311. The chief products are sulphuric acid (valued at 6,000,000 lire in 1899), sulphate of copper (5,000,000 lire), employed chiefly as a preventive of certain maladies of the vine ; carbonate of lead (about 3,000,000 lire), hyperphosphates and chemical manures (21,500,000 lire In 1899, with a total output of 270,000 tons as compared with 72,000 tons in 1893). Pharmaceutical industries, as distinguished from those above mentioned, have kept pace with the general development of Italian activity. The principal product is quinine, the manufacture of which has acquired great importance, notwithstanding the fall in prices. Milan and Genoa are the principal centres. Other industries of a semi-chemical character are candle-, soap-, glue-, and perfume-making, and the preparation of indiarubber. The last named has succeeded, by means of the large establishments at Milan, not only in supplying the whole Italian market, but in doing an export trade. The products of this group of industries are worth approximately 12,000,000 lire.

The match-making industry is subject to special fiscal conditions. In 1898-99 there were 312 match factories scattered throughout

Italy, but especially in Piedmont, Lombardy, and Venetia. For some years the industry has been almost stationary. In 1898-99 47,379 million matches were made. The number of hands employed was 6400.

The beetroot-sugar industry has attained considerable proportions in Umbria, the Marches, Lazio, Venetia, and Piedmont since 1890. In 1899 59,724 quintals were produced. The rise of the industry has been favoured by protective tariffs and by a system of excise which allows a considerable premium to manufacturers.

Alcohol has undergone various oscillations, according to the legislation governing distilleries. In 1871 only 20 hectolitres were produced, but in 1881 the output was 318,000 hectolitres, the maximum hitherto attained. Since then special laws have hampered development, some provinces, as for instance Sardinia, being allowed to manufacture for their own consumption but not for export. In other parts the industry is subjected to an almost prohibitive excise-duty. The average production is about 180,000 hectolitres per annum. The greatest quantity is produced in Lombardy, Piedmont, Venetia, and Tuscany.

Paper-making is highly developed in Italy, and is carried on in the provinces of Novara, Caserta, Milan, Vicenza, Turin, Como, Lucca, Ancona, Genoa, Brescia, Cuneo, Macerata, and Salerno. In 1897 there existed 424 paper mills, giving employment to about 16,000 workmen. The output, which in 1887 was 680,000 quintals, had risen to 1,000,000 quintals in 1897, and has since increased.

Furniture-making in different styles is carried on all over Italy, especially as a result of the establishment of industrial schools. Each region produces a special type, Venetia turning out imitations of 16th and 17th century styles, Tuscany the 15th century or cinquecento style, and the Neapolitan provinces the Pompeian style. Furniture and cabinet-mai:ing in great factories are carried on particularly in Lombardy and Piedmont. Bent^wood f actoriei have been established in Venetia and Liguria.

A characteristic Italian industry is that of straw-plaiting for hat. making, which is carried on principally in Tuscany, in the district of Ferrao, in the Alpine villages of the province of Vicenza, and in some communes of the province of Messina. The plaiting is done by country women, while the hats are made up in factories. Both plaits

and hats are largely exported, trade in the former having increased steadily to the level of 23,000 quintals in 1899, and m the latter, though somewhat reduced during recent years, to 37,506 hundreds in 1899.

Ceramics and glass-working also show great development, particularly in Tuscany, the Romagna, Venetia, and Naples, and are extending their foreign markets to a considerable degree.

Fisheries. — The number of boats and smacks engaged in the fisheries has remarkably increased. Thus : —

Tear.

Boats and Smacks.

Number.

Tonnage.

1881 .

1891 .

1898 .

1899 .

15,914

19,885

23,578

23,668

49,103

54,019

68,654

69,259

In 1899, 185 boats were engaged in coral fishing, 267 in sponge fishing, and 23,216 in fishing proper. The boats engaged in deep-sea fishing numbered, in 1899, 1608, vfith a total tonnage of 18,177 and crews numbering 10,012 ; of these 139 fished for coral, 141 for sponges, and 1328 for fish of various kinds. Most of the fishing boats, properly so called, start from the Adriatic coast, the coral boats from the western Mediterranean coast, and the sponge boats from the western Mediterranean and Sicilian coasts. Fishing and trawling are carried on chiefly off the Italian (especially Ligurian), Austrian, and Tunisian coasts ; coral is found principally near Sardinia and Sicily, and sponges almost exclusively off Sicily and Tunis, in the neighbourhood of Sfax.

Fishing proper is steadily increasing ; coral fishing, which feU oft between 1889 and 1894 on account of the temporary closing of the Sciacca coral reefs by royal decree on 29th December 1888,

is again developing. Sponge fishing has notably increased, particularly in 1899. The total value of fish caught in 1899 was estimated to be 12,759,584 lire. Though the fishing industry is extending as regards the number of boats and crews, the value of the aggregate catch tends to diminish. The tunny fisheries ui 1899 gave employment to fifty establishments with 3661 workmen, who handled 43,450 quintals of tunny worth 2,564,099 lire. The coral fisheries in the same year produced 350,892 kilogrammes, worth 1,772,970 lire. Sardinian coral commands from 80 to 95 lire per kilogramme, and is much more valuable than the Sicilian coral.

Mines. — The number of Italian mines increased from 589 in 1881 to 1548 in 1899. The number of miners has grown from 45,420 in 1881 to 61,472 in 1899. The output in 1881 was worth about 70,000,000 lire, but by 1895 had decreased to 45,000,000, chiefly on account of the fall in the price of sulphur. But it afterwards rose, and was worth more than 91,000,000 lire in 1899. The chief minerals are sulphur and bora.cic acid, in the production of which Italy holds one of the first places. Iron,

zinc, lead, and, to a smaller extent, copper of an inferior quality, are successfully mined.

”

Output (In Tons).

Value (in Lire).

1881.

1891.

1898.

1899.

1881.

1891.

1898.

1899,

Sulphur .

Boracic acid

Iron ore .

Zinc .

Lead

Copper .

Argentiferous ores

2,659

421,065

72,176

39,533

26,257

1,444

i’,775

216,486

120,685

30,233

53,059

2,006

3,362,841

2,650

190,110

132,099

33,930

95,128

435

3,763,206

2,674

236,549

150,629

31,046

94,764

540

2,127,280

4,605,933

4,691,843

8,184,377

1,664,955

2,238,951

887,500

2,767,187

12,720,605

5,984,231

2,829,334

1,973,484

40,375,152

848,000

2,746,239

12,061,667

5,221,240

2,131,497

380,238

44,114,503

855,680

3,534,117

24,233,330

5,610,806

3,438,861

582,262

The output of stone from quarries is greatly diminished (from 12,500,000 tons, worth 48,000,000 lire, in 1890, to 8,000,000 tons, worth 35,000,000 lire, in 1899), a circumstance probably attributable to the slackening of building enterprise in many cities, as well as to the decrease in the demand for stone for railway, maritime, and river embankment works.

Communications. — Between 1881 and 1897 the length of the Italian railway system almost doubled itself ; as the

following statistics show in detail, the passenger traffic

increased by 60 per cent., and the goods traffic by 97 jier

cent ; —

statistics]

ITALY

615

Length

Passengers.

Goods.

Cattle.

■a ■

.

Year.

of lines

open to

II!

traffic

(kUo-

Number.

Quantity

(Tons).

*1!^*

No. of

Head.

No. of

Trucks.

metres).

g§l

^^1

■ 1881

8,893

84,040,515

48

10,844,282

124

2,186,905

1891

18,898

49,570,716

44

17,158,806

116

961,686

69,452

1896

15,479

62,726,888

44

18,669,188

109

1,188,695

74,844

1897

15,696

54,416,294

44

20,429,709

112

1,169,287

78,756

The development of traffic depends not only upon the opening of new lines, but also upon the industrial and commercial development of the country and upon the general increase of economic activity. The opening of the St Gothard tunnel in 1881 placed Italy in more direct communication with central and northern Europe, and acted as a powerful stimulus to trade. By the law of 27th April 1885, which sanctioned the so-called Railway Conventions, the principal Italian lines, though remaining State property, were farmed out to three private companies known, from the regions through which they chiefly pass, as the "Mediterranean," "Adriatic," and " Sicilian " (Sicule). There is, besides, a Sardinian railway system worked by two companies, and several minor private lines on the mainland and in the islands. The State shares the profits of the various lines in different degrees, but assigns a part of its share to the upkeep of the permanent way and of the rolling stock. The State, besideS(5 grants annual kilometric subsidies to certain lines. The cost of the lines, including rolling

stock, was calculated to be, on 31st December 1897, 5,106,000,000 lire (£204,240,000), of which 4,765,000,000 lire (£190,600,000) represents the cost of the permanent way and plant, and 341,000,000 lire (£13,640,000) the value of the rolling stock : —

Names of Lines.

Length open to traffic on Slst December 1897 (metres).

No. of Railway Servants.

Eolling Stock.

Totals.

1

g

i3

Mediterranean .

Adriatic .

Sicilian

Secondary lines

Totals

5,806,751

5,742,375

1,083,055

3,063,710

49,644

39,108

4,566

7,747

8-58

6-91

4-22

2-53

1,322

1,111

156

376

3,753

3,158

456

1,218

24,164

21,210

2,107

3,375

15,695,891

101,065

6-49

2,965

8,585

50,856

Railway revenue, after deducting working expenses, was, in 1886, 76,852,176 lire (£3,074,087), equal to 7017 lire or, approximately, £280 per kilometre. It rose to 86,353,952 lire in 1899 (7282 lire per kilometre), but in 1897 fell to 81,493,266 lire (5234 lire per kilometre), a diminution chiefly due to the construction of unremunerative lines, the working expenses of which often exceed revenue. The net receipts vary considerably on different

lines (6529 lire per kilometre in 1897 for the "Mediterranean," 7044 for the "Adriatic," 1445 for the "Sicilian"), and for some lines, like those of Sardinia, are insufficient to cover expenses. The principal Sardinian line loses 1152 lire per kilometre per annum, and the secondary lines 1570 per kilometre.

Steam and Electric Tramxoays. — ^Tramways with mechanical traction have developed rapidly. Between 1878, when the first line was opened, and 1898 the length of the lines grew to exceed 3000 kilometres:—

Tear.

1878

1881

1885

Length of Mechanical Tramways.

Kilometres.

9

960

2061

Tear.

1891

1895

1898

Kilometres.

2539

2852

3107

These lines exist principally in Lombardy (especially in the province of Milan, which on 31st December 1898 possessed 386 kilometres), in Piedmont, especially in the province of Turin (322 kilometres), and in other regions of northern and central Italy. In the south they are rare, partly on account of the mountainous character of the country and partly from the scarcity of traffic. Carriage-roads have been greatly extended. On 31st December 1897 there existed 6873 kilometres of State roads, 38,970 of provincial roads, and 54,190 of compulsory communal roads, making a total of 100,033 km., corresponding to 35 km. of road per 100 sq. km. and to 318 km. per 100,000 inhabitants. Accurate statistics are lacking with regard to the optional communal roads and to the rights of way. The ratio of road to area varies in different provinces. Piedmont having 61 km. of road per 100 sq.

km., Lombardy 56 km., Venetia 49 km., while other regions are almost roadless, like Sicily, Calabria, Basilicata, and Sardinia. Sardinia has only 16 km. of road per 100 sq. km.

Posts, Telegraphs, and Telephones. — The number of post-offices increased from 4823 in 1881 to 6700 in 1891, and to 7707 on 30th June 1898. During the year 1897-98 the Italian post-offices transmitted 547,755,768 letters and post-cards, a total corresponding to an average of 8 ‘41 per inhabitant, as compared with the average of 5-67 in 1887-88. The other services, more directly connected with the development of trade, have also increased. The number of parcels and post-office orders transmitted has kept pace with the growth of general activity, the value of money orders having almost tripled itself between 1875 and 1900. The telegraph system, which in 1881 covered 26,880 kilometres, had extended to 42,005 km. on 30th June 1898. Thirty-seven submarine cables of a total length of 1978 km. unite the various parts of Italy and provide telegraphic communication with neighbouring States. Between 1881 and 30th June 1898, telegrams

sent from Italy abroad increased from 540,672 to 1,039,770. Internal telegrams increased less rapidly, 5,495,387 having been sent in 1881 and 7,565,564 in 1897-98. Telephones, first introduced in 1881, have rapidly extended, and on 30th June 1898 59 cities possessed a public telephone service. Inter-provincial telephone lines have been laid, and at the end of 1901 direct telephonic communication was opened between Eome and Paris. From 31st December 1884 to 30th June 1898 private telephone concessions increased in number from 192 to 1005.

Mercantile Marine. — Between the years 1881 and 1899 the number of ships visiting Italian ports for trading purposes decreased slightly (219,598 in 1881, and 211,536 in 1899), while their aggregate tonnage considerably increased (32,070,704 in 1881 and 60,470,392 in 1899), and the quantity of goods unloaded rose from 9,690,933 tons in 1881 to 16,676,751 tons in 1899. The diminu-tion of the number of ships and the increase of their aggregate tonnage is due to the substitution of steam

for sailing vessels. The following table illustrates this

tendency: —

1

General Maritime TrafBc.

Sailing Vessels.

Steamships.

Arrivals

and

Sailings.

Agffreffato

Dis[)lace-

raent

(tons).

Tons of

Merchandise

(loaded and

unloaded).

Arrivals

and

Sailings.

Aggregate

Displace-

ment

(tons).

Tons of

Merchandise

(loaded and

unloaded).

1881

1891

1898

1899

169,690

183,649

132,911

135,618

7,078,287

7,079,638

5,753,066

6,869,704

5,069,866

4,801,551

4,089,068

4,325,867

50,008

67,819

75,862

75,918

24,992,467

39,820,040

53,729,997

54,600,688

4,531,067

8,855,924

11,743,665

12,860,884

In the movement of shipping, trade with foreign countries prevails (especially as regards arrivals) over trade between Italian ports. Out of the 11,486,468 tons of merchandise unloaded in Italian ports in 1899, 9,058,529 hailed from abroad and only

2,427,939 from the interior ; out of the 5,190,283 tons embarked, 2,767,336 were sent abroad and 2,422,947 to home ports. Most of the merchandise and passengers bound for and hailing from foreign ports sail under foreign flags. Out of the 9,058,529 tons of merchandise landed in Italian ports from abroad in 1899, only 2,409,157 came in Italian bottoms, and the remaining 6,649,372 in foreign bottoms. Similarly, foreign vessels prevail over Italian

[statistics

vessels in regard to goods embarked, 1,581,488 tons out of 2,767,336 loaded in 1899 having been carried in foreign bottoms. In the passenger traffic, out of a total of 510,407 passengers landed in Italy, 106,700 landed from Italian and 403,707 from foreign steamers ; while 148,547 embarked upon Italian and 387,447 upon foreign steamers. European countries absorb the greater part of Italian sea-borne trade, whereas most of the passenger traffic goes to North and South America.

The substitution of steamships for sailing vessels has brought about a diminution in the number of vessels belonging to the

Italian mercantile marine, whether employed in the coasting trade, the fisheries, or in traffic on the high seas. Thus : —

Tear.

Total

No. of

Ships.

Steamships.

SaUing Vessels. 1

Number.

Tonnage

(Net).

Horse-

power.

Number.

Tonnage

(Net).

1881

1891

1898

1899

7,815

6,617

6,148

6,074

176

305

384

409

93,698

199,945

277,520

314,830

?

220,641

303,858

317,942

7,639

6,.312

5,764

5,665

895,359

625,812

537,642

558,224

Among the steamers the increase has chiefly taken place in vessels of more than 1000 tons displacement, but the number of large sailing vessels has also increased.

Foreign Trade. — Italian trade with foreign countries (imports and exports) during the quinquennium 1872-76 averaged 2,350,000,000 lire (£94,000,000) a year; in the quinquennium 1893-97 it fell to 2,244,000,000 lire (£88,960,000) a year. In 1898, however, the total rose to 2,617,000,000 lire (£104,680,000), but the increase was principally due to the extra importation of corn in that year. In 1899 it was nearly 3,000,000,000 lire, or £120,000,000. Thus :—

Tear.

Trade with Foreign Countries (exclusiye of precious metals).

Totals.

Imports.

Exports.

Excess of

Imports over

Exports.

1881

1891

1898

1899

2,405,187,767

2,003,384,738

2,616,904,650

2,937,977,586

1,239,671,520

1,126,584,583

1,413,335,346

1,506,561,188

1,165,516,247

876,800,155

1,203,569,304

1,431,416,398

74,155,273

249,784,428

209,766,042

75,144,790

The recent general depreciation of agricultural and industrial produce must, however, be taken into account, and the same money value probably represents an increased quantity of merchandise. Supposing the prices of 1884 to have been constant, the returns for 1898 would show an increase of 392,000 lire in' exports and 270,000,000 lire in imports. From 1882 to 1887 imports steadily increased from 1,227,000,000 lire to 1,605,000,000 lire. In 1888, after the tariff reform of 1887, they fell considerably, and in 1894 were only 1,095,000,000 lire. During recent years the tendency has been towards a slight increase of imports.

The countries with which Italy carried on most active import trade in 1899 were : —

Lire.

Lire.

Great Britain

299,537,000

Russia .

. 96,157,000

Germany

193,964,000

British India .

. 73,999,000

United States

168,449,000

China .

. 68,754,000

Austria-Hungary

160,848,000

Switzerland .

. 49,337,000

France

152,330,000

Rumania

. 27,299,000

With regard to exports alone, fully one-half of the

total amount is absorbed by the markets of Switzerland (246,618,000 lire), Germany (236,107,000 lire), France (201,293,000 lire), and Austria-Hungary (158,698,000 lire). The remainder, worth about 500,000,000 lire, is distributed between Great Britain (147,958,000 lire), the United States (118,116,000 lire), and the Argentine Republic (60,674,000 lire). Switzerland has therefore been the chief customer of Italy since the rupture of Italian commercial relations with France, which prior to 1888 absorbed some 375,000,000 lire of Italian products. Now, in spite of the Franco-Italian commercial treaty of 1898, France only buys some 200,000,000 lire per annum.

Lire.

Lire.

. 28,420,000

Uruguay .

7,781,000

27,719,000

Chile

4,872,000

24,424,000

Sweden and Norway

3,654,000

19,194,000

Denmark

1,567,000

14,105,000

Mexico .

704,000

13,720,000

Bulgaria .

275,000

8,317,000

The other countries which absorb Italian products are, in order of importance, as follows : —

British India .

Egypt .

Belgium

Holland

Spain

Russia .

Greece .

The most important imports are minerals, including coal and metals (both in pig and wrought); silks, raw, spun, and woven; stone, potter's earths, earthen-ware, and glass ; corn, flour, and farinaceous products ; cotton, raw, spun, and woven; and live stock. The principal exports are silk in all its forms, live stock, wines, spirits, and oils; corn, flour, maccaroni, and similar products ; and minerals, chiefly sulphur. The raw materials for manufacture represent about 60 per cent. of the imports and more than 50 per cent, of the exports. Prior to the tariff reform of 1887 manufactured articles, alimentary products, and raw materials for manu-facture held the principal places in the imports. In the exports, alimentary products came first, while raw materials for manufacture and manufactured articles were of little account. After 1888 the importation of alimentary products and manufactured articles fell ofl^, while that of raw and semi-raw materials for manufacture

increased. Exports, which fell off during the years 1888 and 1890, on account of the economic crisis, have more than recovered their position. The transformation of Italy from a purely agricultural into a largely industrial country is shown by the circumstance that trade in raw stuffs, semi-manufactured and manufactured materials, now preponderates over that in alimentary products and wholly-manufactured articles. The balance of Italian trade has undergone frequent fluctuations. The large predominance of imports over exports after 1884 was a result of the falling off of the export trade in live stock, olive oil, and wine, on account of the closing of the French market, while the importation of corn from Russia and the Balkan States increased considerably. In 1894 the excess of imports over exports fell to 68,000,000 lire, but by 1898 it had grown to 210,000,000 lire, in consequence chiefly of the increased importation of coal, raw cotton and cotton thread, pig and cast iron, old iron, grease, and oil-seeds for use in Italian industries. In 1899, however, the excess of imports over exports fell to

75,000,000 lire.

Currency. — The total amount of money coined in Italy (exclusive of Eritrean currency) from 1st January 1862 to the end of 1899, was l,100,114,269-64 lire, thus divided: gold, 427,099,650 lire; silver at '»%m„ 364,637,025 lire; silver at ^^Viooo, 204,698,544 lire; nickel, 20,000,000 lire; copper, 83,679,060-54. During the same period coins to a nominal value of 731,676,238 lire were withdrawn from circulation in the following proportions: gold, 41,072,935; silver, 662,262,759; copper 28,340,544. The forced paper currency, in-stituted by the decree of 1st May 1866, was abolished by the law of 7th April 1881, which also dissolved the Union of Banks of Issue created in 1874 to furnish to the State treasury a milliard of lire in notes, guaranteed collectively by the banks. The amount of notes actually furnished to the State was, however, only 940,000,000 lire. The law of 7th April 1881 enacted that all the notes of the Bank Union circulating on 1st July of that year should pass to the charge of the State treasury,

and that 600,000,000 of the 940,000,000 lire of notes furnished to the State should be gradually redeemed with the proceeds of a loan which the Minister of the Treasury was authorized to contract for the sum of 644,000,000 statistics]

lire. The remaining 340,000,000 lire of Union notes were to be replaced by 240,000,000 of ten-lire and 100,000,000 of five-lire State notes, such State notes to be payable at sight in metallic legal tender by certain < State banks. Nevertheless the law of 1881 did not succeed in maintaining the value of the State notes at a par with the metallic currency, and from 1885 onwards there reappeared a gold premium, which during 1899 and 1900 remained at about 7 per cent., but which has since fallen to about 3 per cent. The paper circulation to the debit of the State on 31st December 1899 consisted of 451,431,780 lire in State notes, 42,138,152 in bons de caisse, making in all a total of 493,569,932

lire. At the same time the paper currency issued by the

authorized State banks amounted to 1,180,110,330 lire,

thus : —

Date.

Paper Currency.

Direct Liability of State.

Notes Issned by

State Banks.

General Total.

Total.

State Notes.

Sons de Caisse.

Aggi-cgate Paper

Currency.

Eatio per

Inhabitant.

3l8t December 1881 .

„ 1886 . .

1891 . .

1896 . .

1899 . .

Lire.

940,000,000

446,665,535

341,949,237

510,000,000

493,569,932

Lire.

940,000,000

446,665,535

341,949,237

400,000,000

451,431,780

Lire.

110,000,000

42,138,152

Lire,

735,579,197

1,031,869,712

1,121,601,079

1,069,233,376

1,180,110,330

Lire.

1,675,579,197

1,478,535,247

1,463,550,316

1,579,233,376

1,673,680,262

Lire.

58-88

50-28

48-23

50-47

52-54

The metallic reserve of the Treasury on 31st December 1899 (exclusive of copper and nickel) was 122,037,827 lire, consisting of 30,565,434 lire in gold and 91,472,393 lire in silver, 6,036,595 of the latter being in five-franc pieces. At the same date the Treasury possessed 1,219,391 lire of nickel coins and 4,320,291 lire of copper coins. The metallic reserve of the State banks was altogether

541,125,623 lire, of which 488,043,793 was in gold or in securities equal to gold (foreign gold bills, foreign bank notes, foreign treasury bills, and credits in foreign current accounts), and 53,081,830 in silver.

Banks. — Prior to the year 1893 the juridical status of the Banks of Issue was regulated by the laws of 30th April 1874 on paper currency and of 7th April 1881 on the abolition of forced currency. At that time four limited companies were authorised to issue bank notes, namely, the National Bank, the National Bank of Tuscany, the Roman Bank, and the Tuscan Credit Bank ; and two banking corporations, the Bank of Naples and the Bank of Sicily. In 1893 the Eoman Bank was put into liquidation, and the other three limited companies were fused, so as to create the Bank of Italy, the privilege of issuing bank notes being thenceforward confined to the Bank of Italy, the Bank of Naples, and the Bank of Sicily. By the law of 10th August 1893 a new bank statute was instituted, but was modified subsequently by the laws of 1894, 1895, 1897, and 1898. The paid-up capital of

the Bank of Italy, and of the two southern banks available for currency purposes, is 287,000,000 lire, thus divided: Bank of Italy, 210,000,000 lire; Bank of Naples, 65,000,000 lire ; and Bank of Sicily, 12,000,000 lire. The following table gives an analysis of the condition of these banks on 31st December 1899 : —

Banks of Issue.	*Bank Notes in Circulation.*	*Metallic Keserve.*	*Securities, Bills, and Advances.*
Bank of Italy	*881,813,128*	*236,585,511*	*61,711,691*
Bank of Naples	*422,258,152*		
Bank of Sicily			

118,486,888

40,799,282

407,273,365

87,412,102

43,761,857

Totals

1,180,110,330

581,544,322

538,447,324

The discount operations effected by the banks of issue increased from 2,273,706,411 lire in 1881 to 2,807,015,942 lire in 1899; and advances on current account from 269,735,002 in 1881 to 347,656,418 lire in 1899.

The price of Italian consolidated 5 per cent, stock, which is the security most largely negotiated abroad, and used in settling differences between large financial institutions, has steadily risen during recent years. After being depressed between 1885 and 1894, the prices in Italy and abroad reached, in 1899, on the Kome Stock Exchange, the average of 100-83, and of 94-8 on the Paris Bourse. By the end of 1901 the price of Italian stock on the

Paris Bourse had, however, risen to par or thereabouts. Rates of exchange, or, in other words, the gold premium, favoured Italy during the years immediately following the abolition of the forced currency in 1881. In 1885, however, rates tended to rise, and though they fell in 1886, they subsequently increased to such an extent as to reach 110 per cent, at the end of August 1894.

For the next four years they continued low, but rose again in 1898 and 1899. In 1900 the maximum rate was 107-32, and the mini-mum 105-40, but in 1901 rates fell considerably.

There are in Italy six Clearing Houses, namely, the ancient one at Leghorn, and those of Genoa, Milan, Rome, Florence, and Turin, founded since 1882. The total amount cleared in 1899 was nearly 36 milliards of lire, of which 28^ milliards were cleared by compensation. The difference of 7349 million lire was settled, partly by credits in current account (4738 million lire) , and partly (2611 million lire) by money payments. Stock exchange transac-tions represented 9 J out of the total clearings of 36 milliards of lire. The amount cleared, which decreased considerably in 1890, 1891, and in 1894-95, has again increased, especially in 1898-99 : — Clearing House Operations.

Tear.

Lire.

1891 .

1895 .

1899 .

13,423,249,649

15,379,192,320

” 35,869,587,721

The number of ordinary banks, which diminished between 1889 and 1894, increased again in the following years, and was 158 in 1898. At the same time the capital employed in banking decreased by nearly one-half, namely, from 309 millions in 1880 to 163 millions in 1898. This decrease was due to the liquidation of a number of large and small banks, amongst others the Bank of Genoa, the General Bank, and the Society di Credito Mobiliare Italiano of Rome, and the Grenoa Discount Bank — establishments which alone represented 121 millions of paid-up capital. Ordinary credit operations are also carried on by the co-operative credit societies, of which there were 696 in 1898, with a capital of 103,736,000 lire.

Agrarian Credit Banks. — The banks which make a special business of lending money to owners of land or buildings (credito fondiario) are regulated by the laws of 17th July 1890, 6th May 1891, 10th Augiist 1893, and 8th August 1895. Loans are repayable by instalments, and are guaranteed by first mortgages not greater in amount than half the value of the hypothecated property. The banks may, moreover, buy up mortgages and ad-vance money on current account on the security of land or buildings. The development of building enterprise in the large cities has induced these land and mortgage banks to turn their attention rather to building enterprise than to mortgages on rural property. The transactions of these institutions have notably increased : the value of their land certificates or caHelle fondiarie (representing capital in circulation) rose from 263 millions in 1881 to 389 millions in 1886, and to 768 millions in 1891, but fell to 733 millions in 1896 and to 684 millions in 1898 ; the amount of money lent increased from 261 millions in 1881 to 390 millions in 1886, and 770 millions in 1891,

but fell to 733 millions in 1896 and 684 millions in

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1899. The dimimition was due to the law of 10th April

1893 upon the banks of issue, by which they were obliged

to liquidate the loan and mortgage business which they

had previously carried on.

In view of the importance of agriculture in Italy, various

laws have been passed to facilitate agrarian credit. The

law of 23rd January 1887 (still in force) extended the

dispositions of the Civil Code with regard to " privileges," ^

and established special " privileges " in regard to harvested

produce, produce stored in barns and farm buildings, and

in regard to agricultural implements. Loans on mort-

gage may also be granted to land-owners and agricultural

unions, with a view to the introduction of agricultural

improvements. These loans are regulated by special dis-

position, and are guaranteed by a share of the increased

value of the land after the improvements have been carried out. Agrarian credit banks may, with the permission of the Grovernment, issue caii.elle agrarie, or agrarian bonds, repayable by instalments and bearing interest.

On 31st December 1898 only five agrarian banks proper were in existence, but the Monte dei Paschi of Siena and the Bologna Savings Bank have special sections for agrarian credit. The paid-up capital of these seven institutions was at that date 3,274,921 lire. The value of the agrarian bonds in circulation was 1,403,000 lire, the discount operations 13,942,422 lire, and the sums advanced on current account, 1,006,419 lire.

Condition of the Working Classes.— The condition of the numerous agricultural labourers (who constitute one-third of the population) is, except in some regions, hard, and in places absolutely miserable. Much light was thrown upon their position by the agricultural inquiry {inchiesta agraria) completed in 1884. The large numbers of emigrants, who are drawn chiefly from the rural classes, furnish another proof of poverty. The terms of

agrarian contracts and leases (except in districts where mezzadria prevails in its essential form) are in many regions disadvantageous to- the labourers, who suffer from the obligation to provide guarantees for payment of rent, for repayment of seed corn, and for the division of products.

Examining in detail the position of tlie rural classes in Lombardy and Venetia, there exist — in addition to the factor, who super-intends work and has a comfortable position, with 1200 to 1800 lire (£48 to £72) per annum, plus a share in the profits — the casaro, who conducts the industry of cheese-making, and receives in return from £4 to £8 a year in money, an allotment to cultivate for himself, and a certain proportion of wine, oil, and milk, earn-ing altogether between £24 and £28 a year ; the bifolco, who has charge of the draught cattle and horses, and receives a cottage, firewood, and an allotment, earning altogether about £20 a year ; the oavallaro and vaccaro, who tend the horses and cows, and receive the same treatment as the bifolco ; and the day labourers, who earn from 5d. to 8d. a day, plus an additional percentage at seed time, hoeing time, harvest, and threshing. Chance labourers

are better paid (lOd. a day in winter. Is. 3d. a day in summer), but suffer from lack of regular employment. In Venetia the lives of the small proprietors and of the salaried peasants are often extremely miserable. There and in Lombardy the disease known as pellagra is most widely diffused. According to recent investigations, the disease is not due to the insufficient alimentary power of cereals, but to poisoning by micro-organisms produced by deteriorated maize, and can be combated successfully by care in ripening, drying, and storing the maize. The most recent statistics show the disease to be diminishing. Whereas in 1881 there were 104,067 (16-29 per 1000) peasants afflicted by the disease, in 1899 there were only 72,603 (10-80 per 1000) peasants, with a maximum of 39,882 (34-32 per 1000) peasants in Venetia, and 19,557 (12-90 per 1000) peasants in Lombardy. The decrease of the disease is a direct result of the efforts made to combat it, in the form of special hospitals or pellagrosari, economic kitchens.

1 " Privileges " assure to creditors priority of claim in case of foreclosure for debt or mortgage. Prior to the law of 23rd Jan uary 1887 harvested produce and agricultural implements were legally exempt from "privilege."

rural bakeries, and maize-drying establishments. A Bill for the better prevention of pellagra was introduced by the Zanardelli Cabinet in the spring of 1902.

Li Liguria, on account of the comparative rarity of large estates, agricultural labourers are in a better condition. Men earn between Is. 3d. and 2s. Id. a day, and women from 5d. to 8d. In Emilia, the day labourers, known asdisobbligati, earn, on the contrary, low wages, out of which they have to provide for shelter and to lay by something against unemployment. Their condition is miserable.

In Tuscany, however, the prevalence of mezzadria, properly so called, has raised the labourers' position. Yet in some Tuscan provinces, as, for instance, that of Grosseto, where malaria rages, labourers are organized in gangs under " corporals," who undertake harvest work. They are poverty-stricken, and easily fall victims to fever. In the Abruzzi and in Apulia both regular and irregular workmen are engaged by the year. The curatari or euratoli (factors) receive £40 a year, with a slight interest in the profits ; the stockmen hardly earn in money and kind £13 ; the muleteers and underworkmen get between £5 to £8, plus firewood, bread, and oil ; irregular workmen have even lower wages, with a daily distri-

bution of bread, salt, and oil. In Campania and Calabria the eura-toli and massari earn, in money and kind, about £12 a year ; cow-men, shepherds, and muleteers about £10 ; irregular workmen are paid from 8Jd. to Is. 8d. per day, but only find employment, on an average, 230 days in the year. The condition of Sicilian labourers is also miserable. The huge extent of the latifondi, or large estates, often results in their being left in the hands of speculators, who exploit both workmen and farmers with such usury that the latter are often compelled, at the end of a scanty year, to hand over their crops to the usurers before harvest. In Sardinia wage-earners are paid lOd. a day, with free shelter and an allotment for private cultivation. Irregular adult workmen earn between lOd. and Is. 3d., and boys from 6d. to lOd. a day. Woodcutters and vine-waterers, however, sometimes earn as much as 3s. a day.

The condition of the workmen employed in the various branches of manufacturing industry has improved during recent years. Wages are higher, the cost of the prime necessaries of life is, as a rule, lower, so that an improvement, not merely nominal, but real, has taken place in the remuneration of work. Taking into account the variations in wages and in the price of wheat, it may be cal-

culated that the number of hours of work requisite to earn a sum equal to the price of 100 kilogrammes of wheat fell from 183 in 1871 to 76 in 1894. In 1898 it was 105, on account of the rise in the price of whea^, which averaged 27 lire per quintal in bond, while in 1894 it was only 19 lire per quintal. Wages, however, have not risen in all industries. In the mining and woollen industries they have fallen, but have increased in mechanical, chemical, silk, and cotton industries. Wages vary greatly in different parts of Italy, according to the cost of the necessaries of life, the degree of development of working-class needs, and the state of working-class organization, which in some places has succeeded in increasing the rates of pay. Women are, as a rule, paid less than men, and though their wages have also increased, the rise has been slighter than in the case of men. In some trades, for instance, the silk trade, women earn little more than lOd. a day, and, for some classes of work, as little as 7d. and 4^d.

Strikes. — The number of industrial strikes has risen from year to year, although, on account of the large number of persons involved in some of them, the number of strikers has not always corresponded to the number of strikes. Accurate statistics are only forthcoming

up to the end of 1899. During the years 1900 and 1901, however, strikes were increasingly numerous, chiefly on account of the growth of Socialist and working-class organizations. During 1901 the strikes numbered nearly 1500, and involved a considerable proportion (approximately 1,000,000) of the industrial and agricultural population of northern and central Italy. The following table indicates the increase during the two decades 1879-99 : —

	Number of Strikes.	Number of Strikers.
1879	*32*	*4,011*
1890	*139*	*38,402*
1895	*126*	*19,307*

1897 ....

217

76,570

1898 .

256

35,705

1899 ....

269

43,194

The greatest proportion of strikes takes place in northern Italy, especially Lombardy and Piedmont, where manufacturing industries are most developed. In 1897, however, a strike, involving 41,550 persons, took place among the Tuscan straw-plaitera (women). The smallest proportion occurs in the south, especially in Calabria, Apulia, and Sardinia. In 1896 strikes were numerous among the Sicilian sulphur-miners. Textile, building, and mining industries show the highest percentage of strikes, since they give employment statistics]

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to large numbers of men concentrated in single localities. The strikes of day-labourers or braccianti who work in gangs upon rail-way embankments, railway cuttings, excavations, and similar undertakings are, however, frequent in central Italy, particularly in Romagna, but their number varies little from year to year. Printers, lithographers, carpenters, and hat-makers strike less than other trades. It may be noted that printers and hat-makers possess the oldest and soundest trade organizations. The days of work lost through strikes were in 1897 1,113,535, in 1898 239,292, and in 1899 231,590. The chief motives are demands for an increase of pay (44 per cent, in 1899), opposition to a decrease of pay (11 per cent, in 1899), attempts to obtain shorter hours of work (7 per cent, in 1899), and resistance to increased hours of work (2 percent.). Of late a tendency has become apparent to demand simultaneously an increase of wages and reduction of the hours of work. Fifty-eight per cent, of the strikes in 1899 ended in favour of the workmen — 31 per cent, wholly and 27 per cent, partially ; 42 per cent, gave a purely negative result. Agricultural strikes, though less frequent than those in manufacturing industries, have special importance in Italy. They were exceptionally numerous

in the years 1885, 1886, 1897, and 1898, but in the spring and summer of 1901 they were more numerous than ever before. Instead of occurring most frequently in the purely agricultural districts of the south, they are most common in the north and centre, a circumstance which shows them to be promoted less by the more backward and more ignorant peasants than by the better-educated labourers of Lombardy and EmUia, among whom Socialist organizations are widespread. ,

Although in some industrial centres the working-class movement has assumed an importance equal to that of other countries, there is a complete lack of any general working-class organization com-parable to the English trade unions. Mutual benefit and co-operative societies often serve the purpose of working-class defence or offence against the employers, but it is difficult to ascertain the exact number of associations designed to protect the interest of workmen. Roughly speaking, they may be divided into two groups, Mazzinians and Socialists, the former of which makes little progress, while the latter is rapidly gaining ground. In 1893, after many vicissitudes, the Italian Socialist Labour Party was founded, and has now become the Italian Socialist Party, in which

the majority of Italian workmen tend increasingly to enrol them-
selves. Printers and hat-makers, however, possess trade societies,
that of the former being known as the Federazione Italiana dei
*lavoratori del libra. In 1899 an agitation began for the organiza^*
tion of " Chambers of Labour," intended to look after the techni-
cal education of workmen and to form commissions of arbitration
in case of strikes. They act also as employment bureaux, and are
often centres of political propaganda. At present such ' ' chambers ' '
exist in many Italian cities, while "leagues of improvement," or
of " resistance," are rapidly spreading in the country districts. In
many cases the action of these organizations has proved, at least
temporarily, advantageous to the working classes.

Labour legislation is backward in Italy, on account of the late
development of manufacturing industry and of working-class
organization. A law dated 26th February 1886, on child labour,
forbids — (a) the employment of children under nine years of age in
factories, quarries, and mines, or under ten years if work is
carried on underground ; (6) the employment of children under
fifteen years of age, unless famished with medical certificates of
physical fitness ; (c) limiting the working day to eight hours for

children between nine and twelve years of age ; (d) forbidding employment of children under fifteen in dangerous or unhealthy, trades. This law has not been strictly applied. On 17th April 1898 a species of Employers' Liability Act compelled employers of more than five workmen to insure their employees against accidents. The law applies to quarries, mines, building trades, shipyards, naval arsenals, railways, and factories, and embraces betyreen 1,700,000 and 2,000,000 workmen.i On 17th July 1898 a national fund for the insurance of workmen against illness and old age was founded by law on the principle of optional registration. In addition to an initial endowment by the State, part of the annual income of the fund is furnished in various forms by the State (principally by making over a proportion of the profits of the Post Office Savings Bank), and part by the premiums of the workmen. The minimum annual premium is six lire for an annuity of one lira per day at the age of sixty, and insurance against sickness. At present fewer than 20,000 workmen are inscribed. The low level of wages in many trades and the jealousies of the "Chambers of Labour" and other working-class organizations impede rapid development.

The French institution of Prudhommes was introduced into Italy in 1893, under the name of Gollegi di Probiviri. Hitherto the institution has not attained great vogue, the number of colleges being only eighty-six. Milan has eleven, Rome six, Florence six, Turin five, and Bologna four ; but many large cities have none. Most of the colleges deal with matters affecting textile and mechanical industries. Each "college" is founded by royal decree, and consists of a president, with not fewer than ten and not more than twenty members. A conciliation bureau and a jury are elected to deal with disputes concerning wages, hours of work, labour contracts, &c., and have power to settle the disputes, without appeal, whenever the amounts involved do not exceed £8.

Provident Institvtions. — ^Provident institutions have considerably developed in Italy under the forms of savings banks, assurance companies, and mutual benefit societies. Besides the Post Office Savings Bank and the ordinary savings banks (the former regulated by the law of 27th March 1875, and the latter by the laws of 15th July 1888 and 17th July 1898^, many co-operative credit societies and ordinary credit banks receive deposits of

savings. Altogether these institutions now number 6226, namely, 404 ordinary savings banks, 680 co-operative credit societies, 113 ordinary credit banks,^ and 6029 branches of the Post Office Savings Bank. The total number of savings bank books issued was 5,693,856, representing an aggregate deposit of 2,358,674,649 lire. These totals were split up as follows: —

Savings Bank

Books.

Sums Deposited.

Ordinary Savings Banks .

Co-operative Credit Societies

Ordinary Credit Banks

Post Office Savings Bank .

1,630,678

297,990

100,570

3,664,618

1,430,816,003

233,841,979

66,016,667

628,000,000

The greatest increase has taken place in the deposits of the Post Office Savings Bank. In 1899 the number of books issued was nearly eight times and that of the deposits nearly ten times as much as in the year 1881. The books issued by the ordinary savings banks increased during the same period by nearly two-thirds, while the deposits doubled themselves.

Tear.

Ordinary Savings Banks.

Co-operative and Ordinary Credit Societies

used as Sayings Banks.

Post Office Sayings Bank.

No. of

Banks.

No. of Books

issued to

BepoBitors.

Aggregate

Deposits.

No. of

Banks.

No. of Books

issued to

Depositors.

Aggregate

Deposits.

No. of

Brancli

OfBoes.

No. of Books

issued to

Depositors.

Aggregate

Deposits.

1881 .

1890 .

1895 .

1899 .

355

392

402

404

997,026

1,397,301

1,588,424

1,630,678

714,805,451

1,166,385,847

1,343,720,018

1,430,816,003

249

749

793

205,488

424,304

374,294

197,586,249

315,501,265

266,053,032

3406

4479

4777

5029

471,094

2,126,289

2,938,402

3,664,618

66,996,865

310,483,635

462,413,311

628,000,000

The greatest number of savings banks exists in Lombardy ; Piedmont and Venetia come next. Campania holds the first place in the south, most of the savings of that region being deposited in the provident institutions of Naples. In Ligiiria and Sardinia the habit of thrift is less developed.

Assurance societies in Italy are subject to the general dispositions of the commercial code regarding commercial companies. At the end of 1898 there were 158 assurance companies, of which 102

were Italian and 56 foreign. Thirty-eight carried on the business of life assurance, 58 that of fire insurance, 37 that of insurance of goods and persons during transport, 19 insurance hail, 12 insurance against accidents, and 16 other forms of insurance.

Mutual benefit societies have increased rapidly, both because lit has been proposed to extend this law to seamen, fishermen, navvies, workmen employed in fixing or repairing lightning conductors, drivers of traction engines and steam ploughs or reapers, &«.

2 The data with regard to the co-operative credit societies refer to the year 1898, and those relating to the ordinary credit banks to the year 1895.

[statistics

their advantages have been readily appreciated, and because, until recently, the State had taken no steps directly to insure workmen against illness. The present Italian mutual benefit societies strongly resemble the ancient beneficent corporations and institutions, of which in some respects they may be considered a continuation.

The societies require Government recognition if they wish to enjoy legal rights. The State (law of 15th April 1896) imposed this condition in order to determine exactly the aims of the societies, and, while allowing them to give help to their sick, old, or feeble members, or aid the families of deceased members, to forbid them to pay old-age pensions, lest they assumed burdens beyond their financial strength. Nevertheless, the majority of societies have not sought recognition. The total number of societies, recognized and unrecognized, which was 2091 in 1878, had risen to 6725 in 1895, but the number of members is not known in all cases. In 1895 returns were made by 6587 societies, which possessed an aggregate membership of 994,183. For recognized societies more recent figures are obtainable. On 31st December 1897 they numbered 1166, with an aggregate membership of 187,657 and an aggregate capital of more than 18,000,000 lire.

Co-operation. — Co-operation, for the Tarious piorposes of credit, distribution, production, and labour, has attained great development in Italy. Some of the societies have complied with the dispositions of the commercial code, and possess a corporate juridical personality ; others simply

exist without juridical status. Credit co-operation is represented by a special type of association known as People's Banks (Banche Popolari), which have gradually spread throughout Italy. In 1881 they numbered 171, and in 1898 had increased to 696 ; with an increase of capital from 53,386,000 lire in 1881 to 103,736,000 lire in 1898, and of membership from 105,177 to 381,445.^ People's banks, however, are not, as a rule, supported by workmen or peasants, but rather by small tradespeople, manufacturers, and farmers, who in 1898 made up 50 per cent, of their members, while workmen represented only 9 per cent., and peasants 4 per cent. A recent form of co-operative credit banks are the Casse Burali, or rural banks, on the Eaffeisen system, which lend money to peasants and small proprietors out of capital obtained on credit or by gift. These loans are made on personal security, but the members of the bank do not contribute any quota of the capital, though their liability is unlimited in case of loss. The first rural bank was founded in 1882. At present they number 904, and both their membership

and the amount of business done have largely increased. They are especially widespread in Lombardy and Venetia, in part of which regions the Clerical party has, for purposes of political propaganda, worked to extend their sphere of action and to multiply their number. Among co-operative societies those engaged in distribution are most numerous, having increased from 18 with a paid-up capital of 420,000 lire (£16,800) in 1883 to 508 with a paid-up capital of more than 4,500,000 lire (£180,000) in 1898. These, however, are all recognized by the State, and consequently possess juridical status. The unrecognized societies numbered about 700 in 1895. Distributive co-operation is confined almost entirely to Piedmont, Liguria, Lombardy, Venetia, Emilia, and Tuscany, and is practically unknown in Basilicata, the Abruzzi, and Sardinia. Most of the societies exist in thickly-populated centres, where the cost of commodities tends to increase. As in the case of the people's banks, many of them are supported rather by civil servants and officers than by working men proper, and even those supported by workmen differ from the English type of society in that they, as a rule, sell at cost price instead of selling at current prices so as to be able

to distribute dividends at the end of the year.

In spite of the difficulties everywhere experienced in productive co-operation, Italian societies of production have attained considerable importance. Day labourers and bricklayers have succeeded in organizing themselves into societies requiring little capital and uhdertaking various public works. They contract directly for the work to be done, and distribute it between gangs of their members, who are paid at a fixed rate. They supply the necessary tools to the workmen who have none, and at the end of the contract divide the profits between members in proportion to the

1 These figures refer only to the 124 banks which made returns in 1881 and to the 594 which made returns in 1898.

work done by each. The most important of these societies is that of the ftraccjareti or labourers of Ravenna; though at the end of 1894, the latest date for which statistics have been collected, there existed 522 productive co-operative societies of this kind, which during the year had executed 126 contracts for an aggregate of 1,469,486 lire (£58,800). Co-operative house-building is also on the increase, and is supported not only by workmen, but also by persons of other classes in search of remunerative investments.

Education. — The number of persons unable to read and write has gradually decreased, both absolutely and in proportion to the number of inhabitants. The census of 1871 gave 73 per cent, of illiterate, that of 1881 67 per cent., while the proportion of illiterates to the population above six years of age diminished from 69 to 62 per cent. It may be calculated that at present less than one-third of the adult males and about one-half of the adult females are unable to read or write. The ratio of illiterates varies according to provinces, the north, especially the provinces of Turin, Sondrio, and Como, giving the lowest, and the south, especially Sicily (province of Girgenti) and Calabria, the highest percentages. As might be expected, progress has been most rapid wherever education, at the moment of national unification, was most widely diffused. Por instance, the number of bridegrooms unable to write their names in 1872 was in the province of Turin 26 per cent., and in the Calabrian province of Cosenza 90 per cent. ; in 1899 the percentage in the province of Turin had fallen to 5 per cent., while in

that of Cosenza it was still 76 per cent. The decrease of illiteracy is a direct consequence of the increase of primary popular education. Infant asylums (where the first rudiments of instruction are imparted to children between two and a half and six years of age) and elementary schools have increased in number. There has been a corresponding increase in the number of scholars.

Thus :—

Tear.

Infant Asylums

(Public and Private).

Daily Elementary Schools

(Public and Private).

Number of

Asylums.

Number of

Scholars.

Number of

Schoolrooms.

Number of

Scholars.

1885-86

1890-91

1897-98

1898-99

2083

2296

2989

3205

240,365

278,204

324,751

346,837

53,628

57,077

57,384

60,483

2,252,898

2,418,692

2,531,744

2,636,957

The rate of increase in the public State-supported schools (1,873,723 scholars in 1882-83 and 2,444,288 in 1898-99) has been much greater than in the private schools (163,102 in 1882-83 and 192,669 in 1898-99). School buildings have been improved and the qualifications of teachers raised. Nevertheless, many schools are still defective, both from a hygienic and a teaching point of view ; while the economic position of the elementary teachers, who in Italy depend upon the communal administrations and not upon the State, is still in many parts of the country extremely low. The law of 1877 rendering education compulsory for children between six and nine years of age has been the principal cause of the spread of elementary education. The law has been gradually applied in the various communes, but is still imperfectly enforced. At the end of 1898-99 only 66 per cent, out of the whole number of children between six and nine years of age were registered in the lower standards of the elementary and private schools. The evening schools, established for the benefit of those who have only been able to attend the lowest standards of the elementary schools, have to some extent helped to spread education.

Their number and that of their scholars have, however, decreased since the withdrawal of State subsidies. In 1895-96 they numbered 4245, with 138,181 scholars. Regimental schools impart elementary education to illiterate soldiers. Whereas the levy of 1894 showed 40 per cent, of the recruits to be completely illiterate, only 27 per cent, were illiterate when the levy was discharged in 1897. Private institutions and working-class associations have for some years striven to improve the intellectual conditions of the working classes. Popular universities have lately attained considerable development , in the principal Italian cities. The number of institutes devoted to secondary education remained almost unchanged between 188()-81 and 1895-96. In some places the number has even been diminished by the suppression of private educational institutes. statistics]

On the other hand, the number of scholars has considerably increased, and shows a ratio superior to the general increase of the population. The greatest increase has taken place In technical education, where it has been much more rapid than in classical education.

This is a result of the industrial and commercial development of the country. There are three higher commercial schools, with academic rank, at Venice, Genoa, and Bari, and eleven secondary commercial schools ; and the technical and commercial schools for •women at Florence and Milan should also be mentioned. The number of agricultural schools has also grown, although the total is relatively small when compared with population. The number of university students has almost doubled, having grown from 11,368 in 1881-82 to 22,257 in 1897-98, exclusive of the students attending university lectures in the lyceums and in the schools of superior studios. The faculties attended by the largest number of students are those of medicine and surgery (6374), law (6315), while those of physical and natural sciences counted 2269, and of letters and philosophy 1351. The schools of practical engineering were in 1898-99 attended by 1218 students. On the whole, the increase has been more rapid in the philosophical and scientific faculties than in those of jurisprudence and medicine. The most frequented State universities are those of Naples, Turin, Eome, Padua, Pavia, and Bologna ; and of the free universities, Perugia and Camerino come first.

The number of students in the schools of fine art and in the

State musical conservatories has remained almost stationary : —

Tear.

Fine Art

Students.

Music

Students.

1888-89 .

1897-98 .

1971

2198

794

875

Libraries are numerous in Italy, those even of small cities being

often rich in manuscripts and valuable works. Statistics, collected

in 1893-94 and 1896, revealed the existence of 1831 libraries, either

private (but opera to the public) or completely public. Porty-two

belonged to the State, 418 to the communal or provincial authorities,

378 were attached to institutes for primary or secondary education,

45 were military, 46 were attached to archives or State departments,

172 to academies, scientific institutes, or chambers of commerce, 478 belonged to i^utual benefit societies and circulating libraries, 175 were archiepiscopal, parochial, or seminarist, 35 belonged to other institutes, and 40 to private individuals. There are no statistics of the works read or of the readers, except as regards the State libraries. In 1872 these libraries were visited by 853,900 persons, to whom 1,218,887 books or manuscripts were distributed ; in 1898 the number of visitors had grown to 1,294,869, and that of the works and manuscripts read to 1,690,825. The increasing number of books and periodicals printed every year in Italy is a further sign of the improvement in general culture. In 1871 news-papers and reviews numbered 765 ; in 1895 they numbered 1901, a total equal to 1 per 16,361, as against 1 per 35,034 inhabitants in 1871. Of these periodicals 128 were daily newspapers, 613 weekly, and 458 monthly publications ; 566 were political in character, including- 87 politico-religious publications. Administrative, juridi-cal, economic, and sociological periodicals numbered 327, while those devoted to agriculture, commerce, industry, or finance were 202. The new works published in 1898 were 9670. Deducting the 926 statutes and parliamentary estimates, 715 religious works, and 604

parliamentary reports, the total is reduced to 7425. Of these 1047 were devoted to agriciilture, industry, or trade, 942 to medicine, 632 to history and geography, while 596 were school-books. Three hundred and thirty-two works were published in foreign languages, among them being 224 in Latin and 58 in French.

Crime. — Crime, on the whole, has increased in Italy, 626,300 crimes having been reported in 1887, and 839,606 in 1898. This increase consists chiefly of simple contraventions of bye-laws and regulations (equivalent to the English summons), which in Italy, as elsewhere, tend to grow in number as laws and regulations are multiplied and are more strictly enforced. This fails, however, to account for the whole increase, for if contraventions or summonses increased from 168,870 in 1887 to 312,423 in 1898, crimes increased during the same period from 357,430 to 527,383. Analysing these more serious breaches of the law, it is found that murders and homicides decreased by one-third in less than twenty years (5418 in 1880, and 3749 in 1898). As culture spreads, violent crime tends to diminish, but Italy still remains

one of the states in which it is most frequent; after Italy come Austria, France, and, at considerable distance, Ireland, Germany, England, and Scotland. Infliction of bodily hurt remains nearly stationary (about 88,000 cases per annum, nearly half of which refer to slight wounds and blows). Libels and insults steadily increase (48,704 in 1887, and 86,332 in 1898). Violent resistance to public authority is shown to be on the increase by the occurrence of 17,301 cases in 1898, as compared with 12,354 in 1887. Crimes against property, such as serious robbery, extortion, and blackmail, fluctuate from year to year ; in 1880 they numbered 3947, in 1889 1924, and in 1898 3864. Thefts or petty larcenies vary according to the condition of the country from year to year. In 1887 there were only 89,774, but, in 1898, chiefly on account of the distress prevailing in that year, they rose to 137,967. Thus during twenty years murders have decreased, petty offences against persons, frauds, and resistance to authority have increased, and thefts have varied according to distress. Generally speaking, crime, and

particularly violent crime, is more common in Lazio,

Sardinia, Sicily, and the south than tlie north.

As in most civilized countries, the number of suicides in Italy

has increased from year to year : —

Year. Suicides.

1881 1343

1891 1697

1895 1874

1899 2019

The Italian suicide rate of 6‘36 per 1,000,000 is, however, lower

than those of Denmark, Switzerland, Germany, and France, while

it approximates to that of England. The Italian rate varies in

different provinces, it being highest in the more enlightened and

industrial north, and lowest in the south. Emilia gives a maximum

rate of 10-48 per 100,000, while that of Liguria and Lazio is but

little lower. The minimum of 1-27 is foimd in the Basilicata,

though Calabria gives only 2-13. The greatest number of suicides

(22 per cent.) are committed with firearms, 20 per cent, by drown-

ing, 17 per cent, by hanging, and 9 per cent, by precipitation from

some elevated spot. These percentages vary, however, according

to sex.

Charities. — The patrimony of Italian charitable institutions is considerable and is constantly increasing. In 1880 the number of charitable institutions (exclusive of public pawnshops, or Monti di Pietd,, and other institutions which combine operations of credit with charity) was approximately 22,000, with an aggregate patrimony of nearly two milliards of lire, equal to £80,000,000. The revenue was about 90,000,000 lire, or, after deduction of taxes, interest on debts, expenses of management, &c., 52,000,000 lire, or £2,080,000. Adding to this 31,000,000 lire of communal and provincial subsidies, the product of the labour of inmates, temporary subscriptions, &c., the net revenue available for charity was, during 1880, 96,500,000 lire, or £3,860,000. Of this sum 6,500,000 lire was spent for religious purposes. Between 1881 and 1898 the bequests to existing institutions and sums left for the endowment of new institutions amounted to 294,796,966 lire, or about £11,792,000.

The following table shows the gradual increase of bequests for

charitable purposes between 1881 and 1898 : —

Tear.

Number of

Bequests.

Total Value of

Legacies In Personal

and Real Estate.

1881

1891

1895

1898

831

1121

1357

1569

(In lire.)

11,254,914

11,406,023

1^,787,515

17,245,903

Charitable institutions take, as a rule, the two forms of outdoor and indoor relief and attendance. The latter, or indoor institutions, are the more important in regard to endowment, and consist of hospitals for the infirm (692,000,000 lire of patrimony at the end of 1898) ; of hospitals for chronic and incurable diseases (29,000,000 lire) ; of orphan asylums (346,000,000 lire) ; of

poorhouses and shelters for beggars (143,000,000 lire) ; of infant asylums or institutes for the first education of children under six yearaof age (64,000,000 lire) ; of lunatic asylums (19,000,000 lire) ; of homes for the deaf and dumb (11,000,000 lire) ; and of institutes for the blind (14,500,000 lire). The outdoor charitable institutions include those which distribute help in money or food (patrimony, 220,000,000 lire); those which supply medicine and medical help (73,000,000 lire) ; those which aid mothers unable to rear their own children (1,500,000 lire) ; those which subsidize orphans and foundlings (1,500,000 lire); those which subsidize educational institutes (45,000,000 lire) ; and those which supply marriage por-

tions (65,000,000 lire). Between 1881 and 1898 the chief increases took place in the endowments of hospitals (90,000,000 Ure) ; orphan asylums (32,000,000 lire) ; infant asylums (31,000,000 lire) ; poor-houses (28,500,000 lire) ; almshouses (19,000,000 hre) ; voluntary workhouses (11,000,000 lire) ; and institutes for the blind (10,500,000 Ure).

Italian charity legislation was reformed by the law of 17th July 1890, which attempted to provide efficacious protection for endowments, and to ensure the application of the income to the purposes for which it was intended. The law considers as ‘ ‘ charitable institutions” all poorhouses, almshouses, and institutes which partly or wholly give help to able-bodied or infirm paupers, or seek to improve their moral and economic condition ; and also the Congregazioni di carita (municipal charity boards existing in every commune, and composed of members elected by the municipal council), which administer funds destined for the poor in general. All charitable institutions are under the protection of provincial administrative junta, existing in every province, and empowered to control the management of charitable endowments. The supreme control is vested in the Minister of the Interior. The

law also concentrates under the management of the communal charity boards {Congregazioni di carita) all the institutions having less than £200 a year income ; those intended to assist the poor in one or more communes which together have less than 10,000 inhabitants ; and especially those which, in course of time, have either become superfluous or have ceased to promote the objects for which they were instituted. The law of 1890 also empowers every citizen to appeal to the tribunals on behalf of the poor, for whose benefit a given charitable institution may have been intended.

Public pawnshops, or Monti di Pieta, numbered 555 in 1896, with a net patrimony of 71,986,698 lire. In that year their income, including revenue from capital, was 10,409,537 lire, and their expenditure 7,505,754. The amount lent on security was 103,830,735 lire.

The Monti fruraentarii, or co-operative corn deposits, which lend seed corn to farmers, and are repaid after harvest with interest in kind, numbered 1615 in 1894, and possessed a patrimony of 12,000,000 lire.

In addition to the regular charitable institutions, the communal and provincial authorities exercise charity, the former to the extent

of 44,000,000, and the latter to the extent of 21,500,000 lire per annum. Part of these sums is given to hospitals, and part spent directly by the communal and provincial authorities. Of the 44,000,000 spent by the communes, about 21,000,000 goes for the sanitary service (doctors, mid wives, vaccination), 5,500,000 for the maintenance of foundlings, 4,000,000 for the support of the sick in hospitals, and 2,000,000 for sheltering the aged and needy. Of the 21,500,000 spent by the provincial authorities, 13,000,000 goes to lunatic asylums and 6,000,000 to the maintenance of found-ling hospitals.

Religions. — The great majority of Italians are Roman Catholics. Protestants number some 62,000, of whom half are Italian and half foreign. The number of Jews ■was returned as 38,000, but is certainly higher. There are, besides, in Italy several thousand members of the Greek Orthodox Church. There were, on 31st December 1896, 20,183 parishes in Italy, with the same number of parish priests and about 8000 assistant parish priests. The average size of an Italian parish is 14 square kilometres, with an average population

of 1550 souls. The size of parishes varies, however, from province to province, Sicily having larger parishes in virtue of the old Sicilian church laws, and Naples, and some parts of central Italy, having the smallest. The Italian parishes have a total gross revenue, including assignments from the public worship endowment fund, of 32,000,000 lire, or an average of 1572 lire (nearly £63) per parish. Fifty -one per cent, of this gross sum consists of revenue from glebe lands. The average income per parish varies in different localities. The maximum of 3077 lire is found in Sicily, and the minimum of 843 lire in Umbria.

The kingdom is divided into 276 sees and ten abbeys, or prelatures nullius dioceseos. Besides, the diocese of San Giovanni di Moriana is administered by a bishop domiciled in France. Except the diocese of Rome, which is administered by the cardinal-vicar, there are in Italy six suburbicarian sees governed by cardinals of the Order of Bishops ; 76 immediately subject to the Holy See, 12 of which are arohiepiscopal and the rest episcopal ; and 193 sees composing the so-called "ecclesiastical provinces," of which 45 are arohiepiscopal

and 148 episcopal. Excluding the diocese of Eome and suburbica^ rian sees, each see has an average area of 1111 square kilometres and a population of 121,285 souls. The largest sees exist in Venetia and Lombardy, and the smallest in the provinces of Naples, Leghorn, Forli, Ancona, Pesaro, Urbino, Caserta, Avellino, and Ascoli. The Italian sees (exclusive of Kome and of the suburbicarian sees) have a total annual revenue of 5,150,000 lire, equal to an average of 20,000 lire per see. The richest is that of Girgenti, with 157,596 lire, and the poorest that of Porto Maurizio, with only 6160 lire. The laws which govepn ecclesiastical affairs in their relation to the State are still that of 7th July 1866, which suppressed religious corporations, converted their property into consolidated stock, instituted the public worship endowment fund {fondo per il culto), and regulated the division of the patrimony of the suppressed corporations; and that of 19th June 1873, which extended the law of 1866 to the province and city of Rome, creatiag a special charitable and religious fund for the city. The objects for which the public worship endowment fund was created, namely, to sup-port worship out of the proceeds of the sale of ecclesiastical properties, have to a great extent been attained. The fund has

relieved the State exchequer of the cost of public worship ; has gradually furnished to the poorer parish priests an addition to their stipends, raising them to 800 lire per annum, with the prospect of further raising them to 1000 lire ; and has contributed to the outlay incurred by the communes for religious purposes. The monastic buildings required for public purposes have been made over to the communal and provincial authorities, while the same authorities have been entrusted with the administration of the ecclesiastical revenues previously set apart for charity and education, and objects of art and historical interest have been consigned to public libraries and museums.

On 30th June 1899, the patrimony of the endowment fund amounted to 440,462,790 lire, of which only 11,817,937 lire were represented by buildings. The rest was made up of capital and interest. The liabUities of the fund (capitalized) amounted to a total of 237,106,310 lire, of which monastic pensions represented 87,167,415 lire ; supplementary stipends to priests, 66,025,389 lire ; assignments to the Sardinian clergy, and disbursements for wor-ship, previously incumbent upon the State, 24,895,009 lire ; other ecclesiastical assignments, 22,984,835 lire. The credit balance was

thus 203,356,480 lire. The chief items of annual expenditure drawn from the fund are the supplementary stipends to priests and the pensions to members of suppressed reUgious houses. In 1898-99 the amounts paid respectively under these headings were 3,446,783 and 4,459,500 lire. The number of persons in receipt of monastic pensions on SOth June 1899 was still 13,255. While this item of expenditure is gradually decreasing by reason of the deaths of those entitled to pensions, the supplementary stipends are gradually increasing. The following table shows the course of the two main categories of the fund from 1876 to 1898-99 : —

Tear.

Monastio Pensions,

Liquidation of

Kell^ious Property,

and Provision of

Shelter for Nuns.

Supplementary

Stipends to Bishops

and Parochial Cler^*,

Assignments to

Sardinian Clergy,

and Expenditure for

Education and

Chai-itable Purposes.

1876 ....

1881 ....

1885-86

1890-91

1898-99 .

Lire.

18,729,311

18,279,440

12,283,487

9,819,106

5,661,969

Lire.

3,572,794

4,253,045

3,213,007

3,718,642

5,250,512

Soman Charitable and ReUgious Fund. — The law of 19ta June 1873 contained special provisions, in conformity with the character of Rome as the seat of the papacy, and with the situation created by the Law of Guarantees. New parishes were created, old parishes were improved, the property of the suppressed religious corporations was assigned to charitable and educational institutions and to hospitals, while property having no special application was used to form a charitable and religious fund. On 30th June 1899 the balance-sheet of this fund showed a credit amounting to 46,030,151 and a debit of 18,689,414 statistics]

lire. Expenditure for the year 1898-99 was 2,192,200 lire, and revenue 2,217,133 lire.

Political Constitution. — The constitution of the king-dom of Italy has undergone no substantial change since its promulgation by King Charles Albert on 4th March 1848. Nevertheless, the constitution has been so inter-

preted that government has become increasingly parlia-mentary. Some changes have taken place in the number and functions of the departments of State, the number of ministries having been increased from nine to eleven. Under the law of 12th February 1888, the number and the attributes of ministers are fixed by royal decree, each minister being aided by an under-secretary of State, whose duties are settled by regulations drawn up by the minister. The two new ministries are those of the Treasury and of Posts and Telegraphs. The latter was detached from the Ministry of Public Works by a decree dated 10th March 1889 ; the former was separated from the Ministry of Finance on 24th March 1889. The office of President of the Council of Ministers was, further-more, created. It may be held by itself or in conjunction with any other portfolio. The Presidency of the Council, however, does not form a State department by itself. Notwithstanding various proposals for reform, the composition of the Senate remains as it was fixed by the constitution of 1848, senators being chosen by the king

from among the categories of persons therein enumerated.

The following table shows the composition of the Senate

and the categories of persons from which senators are by

preference chosen : —

Senators Cre-

ated between

Srd April 1848

and 2nd March

1897.

Living and in

Discharge of

Senatorial

Functions on

and March 1897.

Ministers, Deputies and Presidents’]

of Provincial Councils (Categories V

II., v., and XVI.) . . .J

Higher Civil and Military OfBcialsl

(Categories VI., XV., XVII.) . /

Large Taxpayers (Category XXI.) .

Eminent Scientists, Men of Letters,

Artists, or men having rendered 1

signal service to the country (Cate- ‘

gories XVIII., XIX., and XX.). J

High Ecclesiastical Dignitaries I

(Category I.) . . . ./

Totals

387

310

286

135

7

178

90

84

28

1125

380

Comparing the number of senators with the calculated

population of the country on 31st December 1896, it is

seen that the 66 provinces of the realm represented in the Senate were represented in very unequal proportions. While seven provinces (Genoa, Palermo, Porto Maurizio, Turin, Leghorn, Naples, and MUan) had each one senator for a unit of population varying from 36,385 to 44,658 inhabitants, four provinces (Treviso, Aquila, Sassari, and Parma) had only one senator for a minimum unit of 250,000 and a maximum of 413,635 inhabitants.

The Chamber of Deputies has been profoundly modified by the franchise extension of 1882, although the status and rights of its members are still those defined by the constitution of 1848. The franchise extension considerably enlarged the electorate, and, except for slight modifications, has not since been changed. On the other hand, the electoral system, which, according to the law of 1882, was to be that known as scrutinio di lista, has been repeatedly altered. On 5th May 1891 the scrutinio di lista was abandoned in favour of the old system of uninominal constituencies, which still remains in force, although attempts have again been made to return to the

scrutinio di lista. Under the electoral law now in force (law of 28th March 1895) the electors must possess Italian civil and political rights either by birth or naturalization, must have completed twenty-one years of age, and must know how to read and write. In addition, electors must have gone through the first standard of primary education, and must pay in direct taxation not less than 19-80 lire a year, or a certain house rent, which varies according to the population of the different communes. The reform of 1882 more than tripled the number of electors, who in 1900 numbered more than 2,000,000. In proportion to population there are 7-08 electors per 100 inhabitants throughout the kingdom, but this ratio varies greatly from one district to another, Piedmont having, for instance, 11 per cent, of electors, and Sicily less than 4 per cent. The number of constituencies, which by the law of 1860 was fixed at 443, was raised subsequently to 508. Under the scrutinio di lista., in which each elector voted for a number of deputies, the list-constituencies numbered 135, but upon the abolition

of the sarutinio di lista the number of constituencies again became 508. At present the average number of inhabitants per constituency is slightly more than 61,000, but only 44 of the 508 constituencies have a popular tion approximating to the average, while half of the remainder are below the average and half above, the maximum being 75,000 inhabitants : —

Tear.

Number of Constitu- encies.

Number of Deputies.

Number of Registered Electors.i

Total.

Per 100 Inhabitants.

1879

1882

1890

1892

1898

508

135

135

508

508

508

508

508

608

608

621,896

2,017,829

2,752,658

2,934,445

2,247,031

2-22

7-07

9-16

9-64

7-12

1 Exclusive of electors temporarily deprived of their rights owing to their positions as nou-eommissioned officers or men of the army and navy, or as members of corps organized on a military basis by the State, the provinces, or the communes.

The number of voters has considerably increased, but the proportion of electors who go to the poll has remained about 60 per cent., notwithstanding the reform of 1882:—

Date of General Election.

Number of Voters at First Ballot.

Number of Voters per 100 Eegistered Electors.

16th May 1880 (before extension of”!

franchise) J

*29th October 1882 (immediately after *

extension) /

3rd June 1900 (general election)

369,627

1,223,851

1,310,480

59-44

60-65

58-28

The proportion of qualified electors to population is higher in the north than in the south, on account of the greater diffusion of education. The number of voters to registered electors is, however, higher in the south, because the electorate is more organized and more directly under the influence of the upper classes and the party chiefs.

Administration of Justice. — No change has taken place in the organization of civil courts (offices of conciliation, praetors' offices, ordinary tribunals, courts of appeal,

Court of Cassation), nor in that of penal courts (praetors' offices, offices of examining magistrates, ordinary tribunals, indictment divisions, courts of appeal, Court of Cassation) ; some changes have, however, been introduced in the competence and number of these authorities. By the law of 16th June 1892, offices of conciliation were made competent to deal with disputes involving sums up to 100 lire, instead of 60 lire as previously. No money limit

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"was set to their competence as conciliators in cases where their good offices are requested. Praetors were made competent to deal with cases involving sums above 100 lire, but below the limit (1500 lire) of the competence of the civil tribunals. The changes in the competence of conciliators affected the praetors, since conciliators' sentences, which had been final as long as their competence was limited to 50 lire, became susceptible of appeal before the praetors when relating to sums between 60 and 100 lire.

More important were the changes introduced by the promulgation, on 1st January 1890, of a single penal code for the whole kingdom in place of the two codes previously existing. The new code reformed the whole penal system, both as regards the underlying juridical principles and the degrees of punishment. Penalties on the whole were rendered less severe, but were more strictly applied, especially as regards solitary confinement, while money fines were considerably extended as single and optional punishments. The competence of the praetors was reduced, and, in place of dealing with all offences liable to punishment by prison or exile for not more than three months, or by fines up to 300 lire, their action was limited to minor offences and to venal contraventions of the law. A part of their competence passed to the tribunals which now deal with all cases punishable by imprisonment up to ten years and with serious breaches of the law. The tribunals thus encroached upon the competence of the Assize Courts, which, with an assize jury, deal with all crimes liable to penalties of more than ten years' imprison-

ment, and with all political crimes. These changes in the competence of the tribunals of first instance affected also the courts of appeal, since the competence of the ordinary tribunals, sitting in appeal as judges on penal sentences passed by the praetors, has been enlarged, and these tribunals now deal with a larger proportion of cases.

The competence of the courts of appeal proper, which deal principally with sentences of the ordinary tribunals, has on the one hand been restricted by the enlargement of the competence of praetors in regard to cases formerly dealt with by the ordinary tribunals, and on the other has been extended by the enlargement of the competence of the ordinary tribunals to deal with cases formerly reserved for assize courts. The sentences of assize courts continue to be final in points of merit, and can only be impugned on points of form on appeals to the Eome Court of Cassation.

Some changes have taken place in the mimber of judicial institutions. The tribunals of commerce were abolished in 1888 ; the preture or praetors' offices, which up to 31st December

1891 numbered 1819, were reduced to 1549 ; and the competence of the courts of cassation has been modified. Prior to 1888 there were five courts of cassation (Turin, Florence, Naples, Palermo, and Rome), which, while instituted for the purpose of ensuring exact observance of the law, dealt in penal cases with the sentences of praetors not otherwise subject to appeal ; with sentences of the ordinary tribunals sitting as courts of appeal upon praetors' judgments ; with sentences of the courts of appeal proper and of assize courts ; and, in civil cases, with sentences pronounced by the courts of appeal. Since 1888, juris-diction in penal cases has been reserved to the Rome Court of Cassation, which, besides sharing with the other four courts of cassation jurisdiction in civil affairs, possesses special competence to deal with disputes between the judicial and administrative authorities, and between lesser judicial authorities.

The number of commercial and civil suits annually begun increased from 1,201,560 in 1881 to 1,469,300 in, 1898. The in-crease applies not to the higher grades of jurisdiction (appeals of all categories tend to diminish), but to the oases brought before the offices of conciliation and the praetors, which increased from

571,596 in 1875 to 1,340,324 in 1898.

The statistics of civil proceedings vary cOhsiderably from province to province. Lombardy, with 25 lawsuits per 1000 inhabitants, holds the lowest place ; Emilia comes next with 31 per 1000 ; Tuscany has 39 ; Venetia, 42 ; Calabria, 144 ; Rome, 146 ; Apulia, 153 ; and Sardinia, 360 per 1000. The high average in Sardinia is chiefly due to cases within the competence of the conciliation offices, the difference between Sardhiia and the mainland being much less noticeable in regard to cases within the jurisdiction of other courts. The number of penal proceedings, especially those within the competence of praetors, has also increased, chiefly on account of the frequency of minor contraventions of the law referred to in the section Crime. As in the case of civil suits, the ratio of criminal proceedings to population varies from province to province, but is, as a rule, mvch higher in the south than in the north. ^

The introduction of the new penal code m 1890 modified to some extent the prison system previously existing. A royal decree, dated 1st February 1891, established three classes of prisons :— judiciary prisons, for persons awaiting examination or persons

sentenced to arrest, detention, or seclusion for less than six months ; penitentiaries of various kinds (ergastoli, case di reclusione, detenzione, or custodia), for criminals condemned to long terms of imprisonment ; and reformatories, for criminals under age and vagabonds. Certain types of dangerous individuals are relegated to special penal colonies known as domicilii coatti, or "forced residences." These establishments are, however, unsatisfactory, and a Bill for their abolition has already been promoted. On 31st December 1898 the number of prisons and cells was as follows : —

Number of Prisons.	*Number of Places.*	*CeUs. 1 For Continual Solitary Confine-*

ment.

For

Nocturnal

Solitary

Confine-

ment.

Judiciary Prisons .

Penitentiaries .

*Reformatories ||*j*^jg ;.*

Totals .

1456

82

9

34

65,401

30,759

1,940

5,825

5879

3589

24

251

2432

1262

1581

103,925

9492

3945

Notwithstanding the construction of new prisons and the trans-formation of old ones, the number of cells for solitary confinement is still insufficient for a complete application of the penal system established by the code of 1890. The total number of prisoners, including minors and inhabitants of enforced residences, which from 76,066 (2-84 per 1000 inhabitants) on 31st December 1871 rose to a maximum of 80,792 on 31st December 1879 (2-87 per 1000), decreased gradually, notwithstanding some slight fiuctua-tions, to a minimum of 60,621 in 1896 (1-94 per 1000), and on 31st December 1898 rose again to 75,470 (2-38 per 1000), of whom 75,470, less than one-tenth, or 7038, were women.

Army. — The organization of the Italian army has under-

gone no substantial change since the promulgation of the Army Bill of 7th June 1876, in virtue of which the military forces of the kingdom are divided into three categories : — (a) Standing army, (6) mobile militia, and (c) territorial militia. Nevertheless the number of men enrolled in these three categories has continually in-creased. Thus : —

Date.

Total.

Standing

Army.

Mobile

Militia.

Territorial

Militia,

Oflicers.i

Men.

30th Sept. 1871

1876

1881

30th June 1886

1891

1898

14,070

17,440

22,482

31,193

36,739

35,765

521,969

1,028,203

1,833,554

2,464,680

2,821,867

3,221,726

536,039

626,934

731,149

898,505

843,160

828,543

276^973

294,714

283,437

445,315

465,361

143,943

823,970

1,302,709

1,563,784

1,946,418

1 Including complementary officers on auxiliary service or in the reserve.

On 30th September 1871 the various categories of the army included only 2 per cent, of the population, but on 30th June 1898 they included 10 per cent. The increase is due to the effect of the Bill of 1876, which rendered all citizens liable to some form of qiilitary service until the completion of their 39th year. The above figures would undergo considerable reduction in case of mobiliza-

tion, on account of deaths, illness, desertions, and foreign residence. Nor would the city guards, customs officers, prison guards, post office and railway employees be in-cluded in the mobilized army.

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The standing army is divided into twelve army corps and tvfenty-flve divisions. At present the army corps, with their respective divisions, are distributed as follows. The divisions are given in parentheses : — I., Turin (1st Turin, 2nd Novara); II., Alessandria (3rd Alessandria, 4th Cuneo); III., Milan (5th Milan, 6th Brescia); IV., Genoa (7th Piaoenza, 8th Genoa); V., Verona (9th Verona, 10th Padua); VI., Bologna (11th Bologna, 12th Ravenna); VII., Ancona (13th Ancona, 14th Chieti); VIII., Elorence (15th Florence, 16tb Leghorn) ; IX., Rome (17th Rome, 18th Perugia, 25th Cagliari); X., Naples (19th Naples, 20th Salerno); XI., Bari (21st Bari, 22nd Catanzaro) ; XII., Palermo (23rd Palermo, 24th Messina).

Ordinary and extraordinary military expenditure for the financial

year 1898-99 amounted to 246,647,646 lire, an increase of more than 97,000,000 lire as compared with 1871, when the expenditure was 149,584,632 lire. During the discussion of the military estimates for 1901-2, however, the Italian Chamber, in view of the tendency towards an increase of military expenditure, decided that for the following six years, i.e., from 1st July 1901 until 30th June, 1907, Italian military expenditure proper should not exceed the maximum of 239,000,000 lire fixed by the Army Bill of May 1897, and that the sum annually expended on military pensions should not exceed 36,000,000 lire. Thus, in the absence of unforeseen complications, Italian military expenditure may until 1907 be regarded as consolidated at 275,000,000 lire (£11,000,000) per annum, including £9,560,000 for the army proper and £1,440,000 for pensions.

Navy. — The conditions of service in the Italian navy were considerably modified by the Navy Bills of 28th August 1885, 12th July 1888, 30th June 1899, and 1st February 1900. Able-bodied men enrolled for naval service are divided into three categories : — (a) Men required for active service, whose number is fixed every year by law ; (&) able-bodied supernumeraries not required

for active service. These two categories are sorted by lot.

(c) Able-bodied men exempt from active service for family reasons or other causes. Third category men belong to the naval reserve, into which men of the first and second categories pass after twelve years' liability to active service. For purposes of naval organization the Italian coast is divided into three maritime departments, with headquarters at Spezia, Naples, and Venice ; and into two comandi militari, with headquarters at Taranto and at the island of Maddalena. The personnel of the navy consists of the following corps : — (1) General staff; (2) naval engineers, chiefly employed in building and repairing war vessels ; (3) sanitary corps ; (4) commissariat corps, for supplies and account-keeping; (5) crews. The following table shows the variations in the number of the personnel from 1872 to 1898, the increase noticeable from 1886 onwards being due to the circumstance that the Bill of 28th August 1885 abolished absolute exemption from naval service, and assigned certain duty to the third category men formerly exempt : —

Tear.

Officers.

Men.

Total.

1872

1173

10,766

11,939

1876

1078

22,611

23,684

1881

980

34,914

35,894

1886

1066

40,884

41,950

1891

2201

71,397

73,598

1896

2322

94,851

97,178

1897

2385

97,501

99,886

1898

2359

100,513

102,872

The materiel of the Italian navy has been completely transformed, especially in virtue of the Bill of 31st March 1875. Old types of vessels have been sold or demolished, and replaced by newer types. The number and tonnage

of the ships, with their crews, up to the end of 1899 are given in the following table : —

Total Number of Ships Built, in Course of Construction, or Tear. Pitting Out. Ships in Service. Total. No. of Ships. Tonnage. Crews. No. of Ships. Tonnage. Crews. Total. Armoured.

Unarmoured.

31st December 1876 .

73

18

55

65

14

59,330

5638

51

50,812

5,774

1881 .

71

18

53

65

13

69,914

5330

52

58,842

6,101

1886 .

215

21 ‘

194

140

14

82,955

5986

126

66,477

7,342

1891 .

329

22

307

319

20

169,316

9077

299

134,663

13,811

,,.„ 1896 .

825

24

301

313

18

161,172

9202

295

128,045

12,727

1st November 1899 .

338

27

811

817

18

161,172

9012

299

142,288

13,983

The following classes of vessels were in active service on 1st November, 1899 :-

Number of Vessels.

HuUs.

Displace-

ment in

Metric

Tons.

Maximum

I.H.P. of –

Engines.

No. of

Princi-

pal

Guns.

Armoured,

Unarmoured.

Total.

Of

Iron.

Of

steel.

Iron

and

Steel.

Of

Wood.

1st Class Battleships

2nd Class „

3rd Class ,,

4th, 5th, 6th, and 7th Class Battleships .

Destroyers . . ....

Torpedo boats

Auxiliary vessels

Local vessels for harbour use .

Tugs

Tenders

Lagoon gunboats

Steam torpedo launches ....

Total ....

10

“e

“2

...

28

144

42

30

25

9

5

13

10

“e

28

3

144

44

80

25

9

5

13

“5

12

8

16

3

5

8

“i

28

^ 3

144

25

12

4

6

2

“7

10

5

13

129,710

25,950

48,820

938

10,208-5

68,208

13,751

1,649

4,472

440

153-4

128,036

23,853

144,519

16,800

180,183

57,050

2,788

2,557

1,468

325

1,710

502

205

470

16

240

191

20

11

“5

18

18

299

317

49

231

2

85

304,299-9

509,289

1678

At the same date 21 new vessels were in course of construction or were being fitted out for active service ; 9 of these were armoured and 12 unarmoured. Of the armoured vessels, 4 were first class and 5 second class battleships ; of the unarmoured, 3 were battle-ships of the fifth and sixth classes, 8 destroyers, and 1 auxiliary vessel.

Naval expenditure has enormously increased since 1871, the total for 1871 having been 22,116,710 lire, and the total for 1898-99 105,438,874 lire, an increase of more than 83,000,000 lire. Violent fiuctuations have, however, taken place from year to year, according to the state of Italian finances. In order to obviate this drawback, and to permit the steady execution of a normal pro-gramme of shipbuilding, the Italian Chamber, on 4th May 1901, adopted a resolution limiting naval expenditure, inclusive of naval

pensions and of premiums on mercantile shipbuilding, to the sum of 121,000,000 lire (£4,840,000) for the following six years, i.e., from 1st July 1901 until 30th June 1907. This sum consists of 106,000,000 lire (£4,240,000) of naval expenditure proper,

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5,500,000 lire (£220,000) for naval pensions, and of 9,500,000 lire (£380,000) for premiums upon mercantile shipbuilding. During the financial year ending 30th June 1901 these figures were slightly-exceeded, the total naval expenditure being 123,000,000 lire (£4,920,000), made up of 106,000,000 for the navy proper, 5,200,000 for naval pensions, and 11,800,000 for premiums to the mercantile marine.

Finances. — The volume of the Italian budget has considerably increased both as regards income and expenditure. The income of 1,518,536,464 lire in 1881 rose in 1899-1900 to 1,747,928,147 lire; vyhile the expenditure increased from 1,467,648,226 lire in 1881 to 1,742,717,661

in 1899-1900, an increase of about 230,000,000 lire in income and 275,000,000 in expenditure. These figui-es include not only the categories of " income and expendi-ture " proper, but also those kno-wn as " movement of capital," "railway constructions," and "partite di giro," which, while they form part of the Italian budgetary system, do not constitute by themselves real income and expenditure.^ Considering only income and expenditure proper, the totals from 1882 to 1889-1900 are :—

Financial Tear.

Revenue

(in Millions of

Lire).

Expenditure

{in MillionB of

Lire).

Surpluses or

Deficits (in

MUIions of

Lire).

1882 ....

1885-86 .

1890-91 .

1895-96 .

1898-99 .

1899-1900 .

1900-1901 .

1301-62

1409-10

1540-00

1633-60

1658-82

1671-52

1720-73

1297-62

1432-61

1615-04

1699-07

1626-16

1633-09

1652-36

+4-00

-23-51

-75-04

-65-47

+32-66

+ 38-43

+ 68-37

The financial year 1862 closed with a deficit of more than 400,000,000 lire, which increased in 1866 to 721,000,000 lire on account of the preparations for the war against Austria. Excepting the increases of deficit in 1868 and 1870, the annual deficits tended thencefor-ward to decrease, until in 1875 equilibrium between ex-penditure and revenue was attained, and was maintained until 1881. Advantage was taken of the equilibrium to abolish certain imposts, amongst them the grist tax, which prior to its gradual repeal produced more than 80,000,000 lire a year. From 1885-86 onwards, outlay on public works, military and colonial expendi-

ture, and especially the commercial and financial crises, contributed to produce annual deficits ; but owing to drastic reforms introduced in 1894-95 and to careful management the year 1898-99 inarked a return of surpluses (nearly 33,000,000 lire), and 1899-1900 gave a surplus of 38,000,000 lire.

The proportion of revenue derived from the various fiscal and other sources during 1899-1900 is shown by the following figures : —

1 " Movement of capital " consists, as regards " income," of the proceeds of the sale of buildings, Church or Crown lands, old prisons, barracks, &c., or of moneys derived from sale of consolidated stock. Thus " income " really signifies diminution of patrimony or increase of debt. In regard to " expenditure," " movement of capital" refers to extinction of debt by amortization or otherwise, to purchases of buildings, or to advances made by the State, as, for instance, the Italian instalment of the loan granted by the Powers to the provisional government of Crete. Thus " expenditure " really represents a patrimonial improvement, a creation of credit, or a decrease of indebtedness. The items referring to " railway construction " represent, on the one hand, repay-

ments made to the exchequer by the communes and provinces of money disbursed on their account by the State Treasury ; and, on the other, the cost of new railways incurred by the Treasury. The items of the "partite di giro" are inscribed both on the credit and debit sides of the budget, and have merely a figurative value, as, for instance, when the rent of a barracks belonging to the State is in the general estimates debited to. the War OfiBce and credited to the Treasury, while in the War OflSce estimate the rent of the same barracks would be debited to the Treasury and credited to the War Office.

Millions of Lire.

Percentage of

Total Revenue.

Crown lands and properties

Imposts, taxes, and trade mono-)

polies . . . . /

Prooeedsof public services (posts, 1

telegraphs, .&c.) . . i

Kepayments and contributions')

from provinces, communes, &c. /

Sundry revenues ....

102-40

1409-71

98-01

23-05

31-23

6-1

84-7

6-0

1-4

1-8

The State therefore draws its principal revenues from the imposts, the taxes, and the monopolies. According to the Italian tributary system, "imposts," properly so called, are those upon land, buildings, and personal estate. The impost upon land is based upon the cadastral survey independently of the vicissitudes of harvests, Italian territory being divided for this purpose into nine cadastral compartments. In 1869 the main quota of the impost was increased by one-tenth, in addition to the extra two-tenths previously imposed in 1866. Subsequently, how-

ever, it was decided to repeal these additional tenths, the first being abolished in 1886 and the rest in 1887. On account of the inequalities still existing in the cadastral survey, in spite of the law of 1886 (see Agriculture, above), great differences are to be found in the land tax assessments in various parts of Italy. Land is not so heavily burdened by the Government quota as by the additional centimes imposed by the provincial and communal authorities. It may be calculated that on an average Italian landowners pay nearly 25 per cent, of their revenues from land in the various forms of government and local land tax. The buildings impost has been assessed since 1866 upon the basis of 12-50 per cent, of "taxable revenue." Taxable revenue corresponds to two-thirds of actual income from factories and to three-fourths of actual income from houses ; it is ascertained by the agents of the financial administration. In 1869, however, a third additional tenth was added to the previously existing additional two tenths, and, unlike the tenths of the land tax, they have not since been abolished. At present the main quota

with the additional three-tenths amounts to 16-25 per cent, of taxable income. The imposts on incomes from personal estate {ricchezza mobile) were introduced in 1866 ; it is not a general income tax, but applies to incomes derived from investments, industry, or personal enterprise, but not to landed revenues. It is proportional, and is collected by deduction from salaries and pensions paid to servants of the State, and from interest on consolidated stock ; and by register in the cases of professional men, capitalists, or manufacturers. From 1871 to 1894 it was assessed at 13-20 per cent, of taxable income, this quota being formed of 12 per cent, main quota and 1-20 per cent as an additional tenth. In 189-4 the quota, including the additional tenth, was raised to the uniform level of 20 per cent.

Taxes proper are divided into (n) taxes on business transactions and (6) taxes on articles of consumption. The former apply principally to successions, stamps, registrations, mortgages, &c. ; the latter to distilleries, breweries, explosives, native sugar, and matches, though the customs revenue and octrois upon articles

of general consumption, such as corn, wine, spirits, meat, flour, petroleum, butter, tea, coffee, and sugar, may be considered as belonging to this class.

The monopolies are those of salt, tobacco, and the lotto.

In the financial year 1899-1900 the largest revenue was yielded by the income tax on personal estate or ricchezza mobile (289,000,000 lire), and by the customs and maritime dues (244,000,000 lire) . The taxes on business transactions yielded 200,000,000 lire; the tobacco monopoly, 196,000,000 ; the land tax, 106,000,000 ; the buildings tax, 89,000,000 ; the salt monopoly, 74,000,000 ; statistics]

the lotto, 71,000,000; the octrois, 53,000,000; and the tax on manufactures, 64,000,000.

Since 1880, while income from the salt and lotto monopolies has remained almost stationary, and that from land tax and octroi has diminished, revenue derived from all other sources has notably increased, especially that from the income tax on personal estate,

the customs, and the tobacco monopoly, the yield from which has been doubled as regards the first, and tripled as regards the two latter.

With regard to eaypenditure, the following table demon- strates the chief items which make up the total amount : — MiUionsofLlre.

Percentage.

Consolidated and redeemable “| debt, pensions, and royal [■ civil list .... J

Cost of general administration .

Cost of collecting taxes, im- \ posts, &c. . . . /

Cost of civil services (justice, \ education, agriculture, &c.) /

Military and naval services

Civil and military services in “j Africa (Eritrea, Somaliland, J- &c.) . . . . j

Other expenditure (railways, “1

Church lands, &c.) . . j

Total

728-35

45-10

163-56

267-56

346-82

9-11

82-60

44-60

2-76

10-00

15-77

21-24

0-56

5-07

1643-10

100-00

Nearly half the total expenditure is absorbed by interest

on debt, which in the financial year 1899-1900 amounted

to about 689,000,000 lire, exclusive of the 83,000,000 lire required for civil and military pensions. Debt has continually increased with the development of the State, especially as regards, the military and civil services and the provision of railways and public works. The sum paid in interest on debt amounted to 441,000,000 lire in 1871, 486,000,000 in 1881, 640,000,000 in 1891-92, and 689,000,000 in 1899-1900. Next in order of importance comes naval and military expenditure, which in 1899-1900 amounted to 347,000,000 lire, or 243,000,000 for the army and 104,000,000 for the navy.i Of the 267,000,000 lire required for the various civil services, 61,000,000 are absorbed by posts and telegraphs, 48,000,000 by education, 32,000,000 by the administration of justice, 26,000,000 by prisons, 18,000,000 by police, while only 12,000,000 are allotted to agriculture, industry, and trade.

Since 1880 military expenditure has risen from 209,000,000 to 239,000,000, and the naval from little more than 40,000,000 to 104,000,000.

At the beginning of the financial year 1899-1900 the value of the

patrimony of the State was calculated to be nearly eight milliards (7,974,901,559 lire). At the same time the indebtedness of the State was more than twice as much (16,435,941,523 lire). The credit side included railways, canals, salt, tobacco, telegraphs, &c., for 4,236 million lire; military and naval material, 1651 millions; land, buildings, furniture, and securities, 602 millions; Treasury balance, 655 millions; property of the State services, 632 millions; and scientific and artistic objects, 221 millions. The debit side included consolidated stock and redeemable debt, 14,669 millions; pensions (capitalized), 1634 millions; Treasury debt and State notes having forced currency, 11,482 millions.

Local Government. — Italian local government, or the provincial or communal administrative system, was modified by the law of 10th February 1889 and by posterior enactments. The elective principle has been extended in regard to the choice of syndics or mayors, who were previously royal nominees, but are now elected by a secret ballot of the communal council. In the provincial

1 During the discussion of the estimates for the financial year 1901-1902 the Chamber and Senate adopted resolutions consolidating

Italian military and naval expenditure for the following six years at a total of 396,000,000 lire annually, inclusive of naval and military pensions and of premiums on mercantile shipbuilding (see sections ArmyBiDA Navy).

administrations the functions of the prefects have been curtailed. Whereas the prefect was formerly ex officio president of the provincial deputation or executive committee of the provincial council, his duties under the present law are reduced to mere participation in the management of provincial affairs, the president of the provincial deputation being chosen among and elected by the members of the deputation. The most important change introduced by the new law has been the creation in every province of a provincial administrative junta entrusted with the supervision of communal administrations, a function previously discharged by the provincial deputation. Each provincial administrative junta is composed, in part, of Government nominees (the prefect, acting as president, two councillors of the prefecture, and a supernumerary appointed at the beginning of every

year by the Minister of the Interior), and in part of elective elements (four members and two supernumerar ries), elected by the provincial council for four years, half of whom require to be elected every two years. The acts of communal administration requiring the sanction of the provincial administrative junta are chiefly financial (sale or purchase of property ; investments, other than purchases of buildings ; loans on mortgage security ; leases for more than twelve years ; expenditure affecting the communal budget for more than five years ; modifications of the octroi and other communal imposts ; or changes in police and building regulations). Both communal coun-cils and prefects may appeal to the Government against the decision of the provincial administrative juntas, the Government being guided by the opinion of the Council of State. Besides possessing competence in regard to local government elections, which previously came within the jurisdiction of the provincial deputations, the pro-vincial administrative juntas discharge magisterial func-tions in administrative affairs, and deal with appeals

*presented by private persons against acts of the communal and provincial administrations. The juntas are in this respect organs of the administrative jurisprudence created in Italy by the law of 1st May 1890, in order to provide juridical protection for those rights and interests outside the competence of the ordinary tribunals.^*

The former qualifications for electorship in local government elections (to be an Italian citizen, to be able to read and write, and to have completed the twentieth year of age) have been modified, and it is now sufficient to pay five lire annually in direct taxes, five lire of certain communal taxes, or a certain rental (which varies according to the population of a commune), instead of being obliged to pay, as previously, at least five lire annually of direct taxes to the State. In consequence of this change the number of local electors increased by more than one-third between 1887-89 ; it decreased, however, as a result of an extraordinary revision of the registers in 1894.

Tear.

Numter of Qualified Local Electors. 1

Totals.

Per 100

Inhabitants.

jgg^ j Before the Reform

1889-)

1895 V After the Reform .

1898)

1,849,304

2,026,619

3,343,875

2,772,934

2,894,592

6-43

6-87

11-19

8-94

9-17

1 In addition to the magisterial functions of the provincial administrative juntas, and with the same object of providing juridical protection for private interests, otherwise undefended, a fourth section of the Council of State was instituted in 1889, with competence to deal

with the following matters: (a) To decide with regard to appeals based on pleas of incompetence, abuse of power, or infractions of law, which may be presented by individuals or corporate personalities, against enactments of local authorities, or administrative bodies;

(6) to decide both as regards merit and form in cases of controversy between the State and its creditors, in matters relating to the interpretation of contracts, public loans, seizures of the temporalities of bishops and priests, and boundary disputes between communes and provinces.

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ITALY

[history

The ratio of local electors to population varies greatly in the different provinces. In Piedmont it is 79 per cent. , but in Sicily less than 45 per cent. The ratio of voters to qualified electors tends to increase ; it is highest in Campania, Basilicata, and in the south generally ; the lowest percentages are given by Emilia and Liguria : —

Year.

Number of Voters.

Totals.

Per 100 Qualified

Voters.

1887 .

1889 .

1895 .

893,050

2,002,630

1,762,081

44-07

59-89

63-55

Local finance in Italy is regulated by the communal and provincial law of 4th May 1898, which, while retaining the fundamental characteristics of previous legislation, provided more efficacious control over the communes by instituting provincial administrative juntas, empowered to examine and sanction the acts of the communal financial administrations. As has been already explained, the sanction of the provincial administrative junta is necessary for sales or purchases of property, alterations of

rates (although in case of increase the junta can only act upon request of ratepayers paying an aggregate of one-twentieth of the local direct taxation), and expenditure affecting the communal budget for more than five years. The provincial administrative junta is, moreover, empowered to order " obligatory " expenditure, such as the upkeep of roads, sanitary works, lighting, police, charities, education, &c. , in case such expenditure is neglected by the communal authorities. The cost of fire brigades, infant asylums, evening and holiday schools, is classed as " optional " expenditure. Communal revenues are drawn from the proceeds of communal property, interest upon capital, taxes and local dues.

The most important of the local dues is the gate tax, or dazio di consumo, which may be either a surtax upon commodities (such as alcoholic drinks or meat), having already paid customs duty at the frontier, in which case the local surtax may not exceed 50 per cent, of the frontier duty, or an exclusively communal duty limited to 10 per cent, on flour, bread, and farinaceous products, and to 20 per cent, upon other commodities.*

In addition, the communes have a right to levy a surtax not exceeding 50 per cent, of the quota levied by the State upon lands

and buildings ; a family tax, or fuocatico, upon the total incomes of families, which, for fiscal purposes, are divided into various categories ; a tax based upon the rent-value of houses, and other taxes upon cattle, horses, carriages, and servants. Occasional sources of interest are found in the sale of communal property, the realization of communal credits, and the contraction of debt. According to the statistics for 1897, the total revenue proper of the communes was 554,008,117 lire, of which 157,416,184 lire were yielded by gate tax, or octroi, and 132,961,697 by the surtax on lands and buildings ; 21,000,000 lire were furnished by the family tax ; 15,000,000 lire by the cattle tax, and 6,000,000 lire by the shop tax. Patrimonial revenues yielded 15,000,000 lire, while new debt was contracted for 81,000,000 lire. Including money raised by loan, revenue balanced expenditure, 97,000,000 being spent in administration ; 86,000,000 for local and sanitary police ; 77,000,000 for public works ; 76,000,000 for education ; 27,000,000 for public worship and charity ; and 11,000 for general police and administration of justice. Interest on debt absorbed 53,000,000 lire out of a total of 170,000,000 lire of the expenditure classed as "patrimonial burdens," which, inter aKa, included the cost of

tax collection, &c. Since 1880 communal revenue has greatly increased. The chief increases in expenditure come under the heads of "patrimonial burdens," especially as regards interest on debt, local and sanitary police (from 52,000,000 to 86,000,000 lire), and for education (from 50,000,000 to 75,000,000 lire).

The provincial administrations, which act as links between the communes and the State, are entrusted with the management of the affairs of the provinces in general, as distinguished from those of the communes. Their expenditure is likewise classed as " obligatory" and "optional." The former category comprises the maintenance of provincial roads, bridges, and watercourse embankments ; secondary education, whenever this is not provided for by private institutions or by the State (elementary education being maintained by the communes), and the maintenance of foundlings and pauper lunatics. "Optional" expenditure includes the cost of services of general public interest, though not strictly indispensable. Provincial revenues are drawn from provincial property, school taxes, tolls, and surtaxes on land and buildings. The pro-

1 At the beginning of 3902 the Italian Parliament sanctioned a Bill providing for the abolitiou of municipal duties on bread and farina-

ceous products within three years of the promulgation of the Bill ou 1st July 1902.

vincial surtaxes may not exceed 50 per cent, of the quotas levied by the State. In 1897 tlie total provincial revenue was 93,306,835 lire, of which 86,600,000 lire were obtained from the surtax upon lands and buildings. Expenditure amounted to 94,222,208 lire, of which the principal items were 19,000,000 for roads and bridges, 13,000,000 for lunatic asylums, 6,000,000 for foundling hospitals, 8,000,000 for interest on debt, and 5,000,000 for police. Like communal revenue, provincial revenue has considerably increased since 1880, principally on account of the increase in the land and building surtax.

The Italian local authorities, communes and provinces alike, have considerably increased their indebtedness since 1882. The ratio of communal and provincial debt per inhabitant has grown from 30-79 lire to 43-70 lire, an increase due in great part to the need for improved buildings, hygienic reforms, and education, but also attributable in part to the manner in which the finances of many communes are administered.

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agrieoltura durante Vanno 1899. Rome, Bertero, 1901. — Statistica delle Societa cooperative di lavoro. Published by the General Statistical Bureau, 1895. — Statistica delle Societa cooperative di consumo, 1897. — Statistica delle Banche popolari, 1900. — Statistica dei Bilanci comunali. Published annually by the General Statistical Bureau. — Statistica deiBilanci provinciali. — Statistica dei debiti comunali e provinciali. Published periodically by the General Statistical Bureau. — 11 bilancio italiano del Begno d'ltalia negli esercizio finanziari dal 1862 al 1899-1900. Published by the Ragionerva generale dello Stato. Eome, 1901. (a. bo.)

E.ECENT History.

Few dates in modern European history equal in significance that of 20th September 1870, when the Italian troops under General Cadorna took possession of Eome in the name ofthe Italian nation, and completed at one stroke both the work of the Risorgimento and the destruction of the temporal power of the Roman pontiff. The adoption on 2nd October, by 133,681 votes against 1507, of the plebiscitary formula, " "We desire our union to the kingdom of Italy under the constitutional monarchical

government of King Victor Emmanuel II. and of his successors," merely conferred formal popular sanction upon the act of capitulation previously signed by the papal General Kanzler with the approval of the pope and his advisers.

For many years the destruction of the pope's temporal sovereignty had been recognized as a corollary to, if not a synonym for, the complete union of Italy. Dreamers or timorous politicians alone believedcompromise possible. " Under the aegis of free institutions we leave to the wisdom of the Italian Government the task ™e of assuring the independence of the spiritual o°™aoii authority of the pontiff "—declared the pro-clamation by which the provisional junta of Roman citizens called upon the people of the Papal States to accomplish the plebiscite. In the mind of the Italian Government and nation, and of a considerable propor-tion of the Italian clergy, no necessary connexion existed between the pope's temporal power and his spiritual history]

independence. The Vatican and its supporters held, and hold, a contrary view. Their opposition, indeed, had proved a source of discord between Italy, France, and the Curia ever since Cavour, on 26th March 1861, had declared to the Subalpine parliament, " Only Eome can be the capital of Italy." Cavour's untimely death (6th June 1861) had interrupted his negotiations with Napoleon for the withdrawal of the French garrison from Eome, negotiations which Napoleon had declined to continue with Ricasoli, successor of Cavour, in spite of Eicasoli's declaration that Italy desired to go to Eome, "not with the'Taelp of inopportune, insurrectionary elements, but in full agreement with France, in order to restore to the Church that freedom and independence, that simplicity of discipline, whereby she had attained power and renown in the early centuries of her exist-ence." The advent of the weak and tortuous Eattazzi administration (March 1862) had led to the ill-considered

Garibaldian enterprise against Eome, which ended piti-fully at Aspromonte (29th August 1862), and which increased, on the one hand, the diffidence of France, and on the other the impatience of the Italian Eadical " party of action." Not until 1864 was it possible for the Minghetti-Visconti Venosta cabinet to conclude with France, on the lines laid down by Cavour, a convention (15th September 1864) arranging for the evacuation of Eome by the French troops within two years, on condition that Italy should respect and enforce respect of papal ter-ritory, and should, as a pledge of abstention from imme-diate designs upon Eome, transport her capital from Turin to Florence. The " September convention" has been the subject of prolonged and bitter controversy ; but it has not always been borne in mind that in 1864 the approach-ing downfall of the French empire could not be foreseen, nor that the solution of the Eoman question must then have appeared strictly contingent upon the will of Napoleon. As long as France remained directly respon-sible for the integrity of the papal domain, any attempt

to complete Italian unity could but arouse her hostility. The imperial troops once withdrawn, Italy might trust to "moral means," i.e., to the strength of unitary sentiment, and to the efforts of patriotic committees in the papal states, to hasten the consummation of her Eisorgimento. If, by guaranteeing papal territory against attack, Minghetti and his colleagues undertook an ungrateful task, and seemed to forego, or indefinitely to postpone, the realization of unitary aspirations, their error was remedied by their successor. La Marmora, who in a note addressed to the French Government on 7th November 1864 formally reserved for Italy freedom in regard to those national aspirations, " which, by their very nature, belonged to the national conscience, and could not be discussed between two Governments." Judged in the light of subsequent events, the September convention is seen to have marked the first stage on the road to Eome, and to have secured for Italy, by the withdrawal of the French garrison, a diplomatic advantage which even Clerical trickery in con-nexion with the Legion of Antibes failed substantially to

affect.

Any expectation that the transfer of the Italian capital to Florence (February 1865) and the evacuation of Eome by the French (December 1866) would have convinced the Vatican of the wisdom of conciliation with Italy was upset Ipy the failure of two Italian missions to Eome, conducted by Vegezzi (April-June 1865) and by Tonello (December 1866). Moreover, the question of a modus Vivendi between Italy and the Papacy was complicated in 1867 by the return of Eattazzi to power. While explicitly accepting and promising loyally to execute the September convention, Eattazzi connived at Garibaldi's ill-starred adventure, which afforded a pretext for the reoccupation of Eome by the French (30th October 1867), and ended in the catastrophe of Mentana (3rd November 1867). Though Eome was again evacuated in the following month, a French garrison, 5000 strong, at Civitar vecchia, lent point to Eouher's famous declaration (5th December 1867), that Italy would "–"^ "never" be allowed to take possession of Eome. In

Italy this declaration was met two dayslaterby a resolution in which the Senate reaffirmed the Italian claim to Eome as capital. Anxious to settle the Eoman question, or to cast its burden upon other shoulders than his own, Napoleon resorted to the time-worn suggestion of a European conference, a suggestion sterilized in this instance by Bismarck's desire to maintain the French occupation of Civitavecchia as a chronic source of discord between Italy and France. Foiled in this attempt, the French emperor next sought to profit by a proposal from Victor Emmanuel for a return pure and simple to the convention of September, by making such return conditional upon the conclusion of a Franco-Italian offensive and defensive alliance. Austria, already approached by Napoleon on the subject of an anti-Prussian league, had insisted that Italy should be a party to the scheme if only to preclude the renewal of the Prusso-Italian alliance of 1866. In June 1869 negotiations were opened directly between Napoleon and Victor Emmanuel, General Menabrea, in his double capacity as premier and aide-de-camp

to the king, being the only Italian minister fully cognizant of the scheme. He, however, insisted that eventual war should not destroy the North German Confederation, and demanded, as a sine qud non, both the recall of the French troops from Civitavecchia and permission for Italy to occupy all the papal states except Eome, and even, under certain conditions, Eome itself. The Italian demands were supported by the Austrian chancellor. Count von Beust, who, in his fervour for the alliance, declared himself ready to guarantee Italy a rectification of her frontier on the eastern Alps ; but Napoleon, though at first inclined to accept the Italian conditions, gave way to the adverse influence of M. de la Vallette, who, encouraged by the empress, refused to countenance the clauses relative to Eome. Thus the projected alliance remained in abeyance until pressure of impending hostilities induced Napoleon to reopen negotiations on 16th July 1870.

In the meantime political conditions in Italy underwent considerable change. The Mentana episode and the pro-

longed French occupation of Civitavecchia profoundly irritated public feeling, while, after a crisis of unprecedented length, the Menabrea cabinet was succeeded (12th December 1869) by a strong administration, in which Giovanni Lanza, Quiutino Sella, and Visconti Venosta held the chief portfolios. Sella, strong-willed and clear-headed, was heartily averse from all idea of a French alliance. Better acquainted than his sovereign or his colleagues with the respective conditions of Prussia and France, and consequently less persuaded than they of the certainty of a French victory in an eventual war, he was anxious that Italy should not be entangled by a pact which might prove ruinous, nor be compelled to incur outlay which might endanger the success of his herculean efforts to reorganize Italian finance. He was, moreover, convinced that the moment was approaching for a definitive settlement of the Eoman question. When renewed in July 1870, the French proposal for an anti-Prussian league again suffered shipwreck upon the Italian demand for the withdrawal of the garrison from Civitavecchia and for

permission to go to Eome. A strong despatch from Beust to the Austrian representative in Paris in support of the Italian demand irritated M. £mile Ollivier, who declared that the French garrison would "never" be withdrawn

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from CivitaTecehia, and on 25th July, in a letter to the emperor, characterized Beust's proposal to deliver Rome to the Italians as " pitiful and impracticable."

Reiatioas According to M. Ollivier, the only possible France. basis of alliance with Italy would be a return to the September convention. Without recog-nizing the sufficiency of such a basis, Visconti Venosta, Italian foreign minister, notified the Due de Gramont on 29th July that Italy was prepared to execute the convention. On 5th August the French garrison evacu-ated Civitavecchia. Italy, convinced that France would not sanction her occupation of Rome, set about organiz-ing with Great Britain and Austria a league of neutral

Powers, after King Victor Emmanuel, by means of a special envoy, Count Vimercati, had made, on 2nd and 3rd August, a last vain attempt to induce Napoleon at Metz to agree to the Italian condition with regard to Rome. Italian neutrality was, moreover, soon imposed by the dibdcle of the French army and by the action of the Tsar, who had warned Austria that any breach of neutrality on her part in favour of France would be followed by Russian intervention in support of Germany. Victor Emmanuel's chivalrous desire to render Napoleon a military equivalent for Magenta and Solferino, and the appeals of France for help, failed to shake the attitude of the Italian cabinet, which, apart from other considerations, knew only too well that the condition of the Italian army precluded rapid mobilization of any considerable force. Pressed by his colleague Sella and by the agitation of the Radical " party of action " for an immediate advance upon Rome, Visconti Venosta, on 29th August, addressed a circular note to the Powers, setting forth the reasons which compelled

Italy to avail herself of the reserves formulated by La Marmora on 7th November 1864 in regard to the fulfilmeat of national aspirations.

Even if the fall of the French empire on 4th September 1870 had not released Italy de facto et de jure from the September convention, the Italian Government would have been compelled to occupy the papal states. Armed bands were preparing to make an onslaught upon Rome, a mutiny had broken out among the pontifical Zouaves, and in Rome itself signs of incipient revolution were apparent. Before advancing upon Rome King Victor Emmanuel sent Count Ponza di San Martino to the pope with a letter containing protestations of solicitude for the welfare of the Church, and an appeal for a peaceful occupation of Rome upon terms guaranteeing the pontiff's spiritual independence. Pius IX. indignantly rejected the proposal, and the Italian envoy, on 11th September, returned empty-handed to Florence. On the morrow the general forward movement began, Viterbo being occupied the same day, Civitavecchia on 16th Sep-

tember, and Rome on the morning of 20th September. Attempts made by Count von Arnim, Prussian minister to the Holy See, to promote a peaceful occupation of Rome were unavailing to shake the determination of the pope, who instructed General Kanzler, papal commander-in-chief, only to yield to force. As soon as a breach, battered in the wall near Porta Pia, had been stormed by the Italian troops. General Kanzler yielded and signed a formal capitulation. Some 200 men had been killed and wounded on both sides. On 21st September the whole of Rome was occupied except the Leonine City, the occupation being, however, extended to the Leonine City on 22nd September at the special request of the pope for reasons of public order.

The downfall of the temporal power was hailed throughout Italy with unbounded enthusiasm. Abroad, Catholic countries at fixst received the tidings with resignation, and Protestant countries with joy. In France, where the Government of National Defence had replaced the Empire, M. Cremieux, as president of the Government

*delegation at Tours, hastened to offer his con- ^^^y^*
gratulations to Italy ; while M. Senard, French occ^a-
minister at Florence, wrote to Victor Emmanuel : tion
" I desire not to lose a single instant in address- "tRome.
ing to your Majesty, on behalf of my Government and
in my own name, my sincere congratulations on this
happy event." The occupation of Rome caused no sur-
prise to the French Government, which had been fore-
warned on 11th September of tl^ Italian intentions.
On that occasion M. Jules Favre had recognized the
September convention to be dead, and, while refusing
explicitly to denounce it, had admitted that unless
Italy went to Rome the city would become a prey to
dangerous agitators. At the same time he made it
clear that Italy would occupy Rome upon her own re-
sponsibility, though he subsequently telegraphed to
M. Senard: "France cannot directly meddle in the
Roman question. The temporal power has been a scourge
to the world; it has fallen, and we shall not raise it
again, but we feel too unfortunate to trample upon it.

We shall see the Italian Government go to Rome with pleasure. It is necessary that it should go. Order and peace in Italy are at this price." Agreeably surprised by this attitude on the part of France, Visconti Venosta lost no time in conveying officially the thanks of Italy to the French Government. He doubtless foresaw that the language of MM. Favre, Cremieux, and Senard would not be endorsed by the French Clericals. Prussia, while satisfied at the fall of the temporal power, seemed to fear lest Italy might recompense the absence of French opposition to the occupation of Rome by armed intervention in favour of France. Bismarck, moreover, was indignant at the connivance of the Italian Government in the Garibaldian expedition to Dijon, and was irritated by Visconti Venosta's plea in the Italian parliament for the integrity of French territory. On 10th March 1873 Bismarck, indeed, confessed to the Prussian Herrenhaus that, towards the end of the Franco-German war, he had been disposed to make an arrangement with the Holy See

detrimental to Italy. Negotiations for some such arrangement took place between him and Cardinal Ledochowski, but failed through Bismarck's fear of falling a victim to ecclesiastical duplicity. The course of events in France, however, soon calmed German apprehensions. The advent of M. Thiers, his attitude towards the petition of French bishops on behalf of the pope, the recall of M. Senard and the instructions given to his successor, the count of Choiseul, to absent himself from Italy at the moment of Victor Emmanuel's official entry into Rome (2nd July 1871), and the haste displayed in appointing a French ambassador to the Holy See, rapidly cooled the cordiality of Franco-Italian relations and reassured Bismarck on the score of any dangerous intimacy between the two Governments.

The friendly attitude of France towards Italy during the period immediately subsequent to the occupation of Rome seemed to cow and to dishearten the Vatican. For 3, few weeks the relations between the Curia and the Italian authorities were marked by a conciliatory spirit.

The secretary-general of the Italian Foreign Office, Baron Blanc, who had accompanied General Cadorna to Rome, was received almost daily by Cardi- fl^^ nal Antonelli, papal secretary of state, in order va««ii. to settle innumerable questions arising out of the Italian occupation. The royal commissionerforfinance. Signer Giacomelli, had, as a precautionary measure, seized the pontifical treasury ; but upon being informed by Cardinal Antonelli that among the funds deposited history]

in the treasury were 1,000,000 crowns of Peter's Pence offered by the faithful to the pope in person, the commissioner was authorized by the Italian council of state not only to restore this sum, but also to in- demnify the Holy See for moneys expended for the service of the October coupon of the pontifical debt, that debt having been taken over by the Italian state. On 29th September Cardinal Antonelli further apprised

Baron Blanc that he was about to issue drafts for the monthly payment of the 50,000 crowns inscribed in the pontifical budget for the maintenance of the pope, the Sacred College, the apostolic palaces, and the papal guards. The Italian treasury at once honoured all the papal drafts, and thus contributed a first instalment of the 3,226,000 lire per annum afterwards placed by Article 4 of the Law of Guarantees at the disposal of the Holy See. Payments would have been regularly continued had not pressure from the French Clerical party coerced the Vatican into refusing any further instalment.

Once in possession of Eome, and guarantor to the Catholic world of the spiritual independence of the pope, the Italian Government prepared juridically to regulate its relations to the Holy See. A Bill known as the Law of Guarantees was therefore framed and laid before parliament. The measure was an amalgam of Cavour's scheme for a "free Church in a free State," of Eica-TheUaw soli's Free Church Bill, rejected by parliament

tee^”” ”” ”” ” °-^ years previously, and of the proposals pre-
sented to Pius IX. by Count Ponza di San
Martino in September 1870. After a debate lasting
nearly two months the Law of Guarantees was adopted
in secret ballot on 21st March 1871 by 185 votes
against 106. It consisted of two parts. The first, con-
taining thirteen Articles, recognized (Articles 1 and 2)
the person of the pontiff as sacred and intangible, and
while providing for free discussion of religious questions,
punished insults and outrages against the pope in the
same way as insults and outrages against the king.
Eoyal honours were attributed to the pope (Article 3),
who was further guaranteed the same precedence as that
accorded to him by other Catholic sovereigns, and the
right to maintain his Noble and Swiss guards. Article 4
allotted the pontiff an annuity of 3,225,000 lire (£129,000)
for the maintenance of the Sacred College, the sacred
palaces, the congregations, the Vatican chancery, and the
diplomatic service. The sacred palaces, museums, and
libraries were, by Article 5, exempted from all taxation,

and the pope was assured perpetual enjoyment of the Vatican and Lateran buildings and gardens, and of the papal villa at Castel Gandolfo. Articles 6 and 7 forbade access of any Italian ofB.cial or agent to the above-mentioned palaces or to any eventual conclave or oecu-menical council without special authorization from the pope, conclave, or council. Article 8 prohibited the seizure or examination of any ecclesiastical papers, docu-ments, books, or registers of purely spiritual character. Article 9 guaranteed to the pope full freedom for the exercise of his spiritual ministry, and provided for the publication of pontifical announcements on the doors of the Roman churches and basilicas. Article 10 extended immunity to ecclesiastics employed by the Holy See, and bestowed upon foreign ecclesiastics in Eome the rights of Italian citizens. By Article 11, diplomatists accredited to the Holy See, and papal diplomatists while in Italy, were placed on the same footing as diplomatists accredited to the Quirinal. Article 12 provided for the transmission free of cost in Italy of all papal telegrams and correspond-

ence both with bishops and foreign governments, and sanctioned the establishment, at the expense of the Italian state, of a papal telegraph office served by papal oflBcials in communication with the Italian postal and telegraph system. Article 13 exempted all ecclesiastical seminaries, academies, colleges, and schools for the education of priests in the city of Eome, from all interference on the part of the Italian Government.

This portion of the law, designed to reassure foreign Catholics, met with little opposition ; but the second portion, regulating the relations between State and Church in Italy, was sharply criticized by deputies who, like Sella, recognized the ideal of a •" free Church in a free State " to be an impracticable dream. The second division of the law abolished (Article 14) all restrictions upon the right of meeting of members of the clergy. By Article 16 the Government relinquished its rights to apostolic legation in Sicily, and to the appointment of its own nominees to the chief benefices throughout the kingdom. Bishops were further dispensed from swearing fealty to

the king, though, except in Eome and suburbs, the choice of bishops was limited to ecclesiastics of Italian nationality. Article 16 abolished the need for royal exequatur and placet for ecclesiastical publications, but subordinated the enjoyment of temporalities by bishops and priests to the concession of state exequatur and placet. Article 17 maintained the independence of the ecclesiastical jurisdiction in spiritual and disciplinary matters, but reserved for the state the exclusive right to carrj' out coercive measures. On 12th July 1871, Articles 268, 269, and 270 of the Italian Penal Code were so modified as to make ecclesiastics liable to imprisonment for periods varying from six months to five years, and to fines from 1000 to 3000 lire, for spoken or written attacks against the laws of the state, or for the fomentation of disorder. A encyclical of Pius IX. to the bishops of the Catholic Church on 15th May 1871 repudiated the Law of Guarantees, and summoned Catholic princes to co-operate in restoring the temporal power. Practically, therefore, the law has remained a one-sided enactment,

by which Italy considers herself bound, and of which she has always observed the spirit, even though the exigencies of self-defence may have led in some minor respects to non-observance of the letter. The annuity payable to the pope has, for instance, been made subject to quinquennial prescription, so that in the event of tardy recognition of the law the Vatican could at no time claim payment of more than five years' annuity with interest.

For a few months after the occupation of Eome pressing questions incidental to a new change of capital and to the administration of a new domain distracted public attention from the real condition of Italian affairs. The rise of the Tiber and the flooding of Eome in December 1870 (tactfully used by Victor Emmanuel as an opportunity for a first visit to the new capital) illustrated the imperative necessity of reorganizing the drainage of the city and of constructing the Tiber embankment. In spite of pressure from the French Government, which desired Italy to maintain Florence as the political and to regard

Eome merely as the moral capital of the realm, the Government offices and both legislative chambers were transferred in 1871 to the Eternal City. Early in the year the Crown Prince Humbert with the Princess Margherita took up their residence in the Quirinal Palace, which, in view of the Vatican refusal to deliver up the keys, had to be opened by force. Eight monasteries were expropriated to make room for the chief state departments, pending the construction of more suitable edifices. The growth of Clerical influence in France engendered a belief that Italy would soon have to defend with the sword her newly-won unity, while the tremendous lesson of the Franco-Prussian war convinced the military authorities of the need for thorough military reform. General

Ricotti, minister of war, therefore framed an Army Eeform Bill designed to bring the Italian army as nearly as possible up to the Prussian standard. Sella,

minister of finance, notwithstanding the sorry plight of the Italian exchequer, readily granted the means for the reform. " We must arm," he said, " since we have overturned the papal throne," and he pointed to France as the quarter from which attack was most likely to come.

Though perhaps less desperate than during the previous decade, the condition of Italian finance was precarious indeed. With taxation screwed up to breaking point on personal and real estate, on all forms of commercial and industrial activity, and on salt, flour, and other neces-saries of life ; with a deficit of £8,500,000 for nance. ^ current year, and the prospect of a further aggregate deficit of £12,000,000 during the next quin-quennium, Sella's heroic struggle against national bank-ruptcy was still far from a successful termination.

He chiefly had borne the brunt and won the laurels of the unprecedented fight against deficit in which Italy had been involved since 1862. As finance minister in the Rattazzi cabinet of that year he

had been confronted with a public debt of nearly £120,000,000, and with an immediate deficit of nearly £18,000,000. In 1864, as minister in the La Marmora cabinet, he had again to face an excess of expendi-ture over income amounting to more than £14,600,000. By the seizure and sale of Church lands, by the sale of state railways, by " economy to the bone," and on one supreme occasion by an appeal to taxpayers to advance a year's quota of the land-tax, he had met the most pressing engagements of that troublous period. The king was persuaded to forego one-fifth of his civil list, ministers and the higher civil servants were required to relinquish a portion of their meagre salaries, but, in spite of all. Sella had found himself in 1865 compelled to pro-pose the most hated of fiscal burdens — a grist tax on cereals. This tax (macinatd) had long been known in Italy. Vexatious methods of assessment and collection had made it so unpopular that the Italian Government in 1859-60 had thought it expedient to abolish it throughout the realm. Sella hopedby the application of a mechanical

meter both to obviate the odium attaching to former methods of collection and to avoid the maintenance of an army of inspectors and tax-gatherers, whose stipends had formerly eaten up most of the proceeds of the impost. Before proposing the reintroduction of the tax. Sella and his friend Ferrara improved and made exhaustive experiments with the meter. The result of their efforts was laid before parliament in one of the most monumental and most painstaking preambles ever prefixed to a Bill. Sella, nevertheless, fell before the storm of opposition which his scheme aroused. Scialoja, who succeeded him, was obliged to adopt a similar proposal, but parliament again proved refractory. Ferrara, successor of Scialoja, met a like fate ; but Count Cambray-Digny, finance minister in the Menabrea cabinet of 1868-69, driven to find means to cover a deficit aggravated by the interest on the Venetian debt, succeeded, with Sella's help, in forcing a Grist Tax Bill through parliament, though in a form of which Sella could not entirely approve. When, on 1st January 1869, the

new tax came into force, nearly half the flour-mills in Italy ceased work. In many districts the Government was obliged to open mills on its own account. Inspectors and tax-gatherers did their work under police protection, and in several parts of the country riots had to be suppressed manu militari. At first the net revenue from the impost was less than £1,100,000 ; but under Sella's firm administration- (1869-73), and in consequence of improvements gradually introduced by him, the net return ultimately exceeded £3,200,000. The parliamentary opposition to the impost, which the Left denounced as "the tax on hunger," was largely factitious. Few, except the open partisans of national bankruptcy, doubted its necessity; yet so strong was the current of feeling worked up for party purposes by opponents of the measure, that Sella's achievement in having by its means saved the financial situation of Italy deserves to rank among the most noteworthy performances of modern parliamentai-y statesmanship.

Under the stress of the appalling financial conditions, represented by chronic deficit, crushing taxation, the heavy expenditure necessary for the consolidation of the kingdom, the reform of the army, and the interest on the pontifical debt. Sella, on 11th December 1871, exposed to parliament the financial situation in all its nakedness. He recognized that considerable improvement had already taken place. Revenue from taxation had risen in a decade from £7,000,000 to £20,200,000 ; profit on state monopolies had increased from £7,000,000 to £9,400,000 ; exports had grown to exceed imports ; income from the working of telegraphs had tripled itself ; railways had been extended from 2200 to 6200 kilometres, and the annual travelling public had augmented from 16,000,000 to 25,000,000 persons. The serious feature of the situation lay less in the income than in the " intangible " expenditure, namely, the vast sums required for interest on the various forms of public debt and for pensions. Within ten years this category of outlay had increased from £8,000,000 to £28,800,000. During the

same period the assumption of the Venetian and Roman debts, losses on the issue of loans, and the accumulation of annual deficits, had caused public indebtedness to rise from £92,000,000 to £328,000,000, no less than £100,000,000 of the latter sum having been sacrificed in premiums and commissions to bankers and under-writers of loans. By economies and new taxes Sella had reduced the deficit to less than £2,000,000 in 1871, but for 1872 he found himself confronted with a total expen-diture £8,000,000 in excess of revenue. He therefore proposed to make over the treasury service to the state banks, to increase the forced currency, to raise the stamp and registration duties, and to impose a new tax on textile fabrics. An optional conversion of sundry in-ternal loans into consolidated stock at a lower rate of interest was calculated to effect considerable saving. The battle over these proposals was long and fierce. But for the tactics of Rattazzi, leader of the Left, who, by basing his opposition on party considerations, impeded the seces-sion of Minghetti and a part of the Right from the

ministerial majority. Sella would have been defeated.

On 23rd March 1872, however, he succeeded in carrying his programme, which not only provided for the pressing needs of the moment, but laid the foundation of the much-needed equilibrium between expenditure and revenue.

In the spring of 1873 it became evident that the days of the Lanza-Sella cabinet were numbered. Fear of the advent of a Radical administration under Rattazzi alone prevented the Minghettian Right from revolting against the Government. The Left, conscious of its strength, impatiently awaited the moment of accession to power. Sella, the real head of the Lanza cabinet, was worn out by four years' continuous work, and disheartened by the perfidious misrepresentation in which Italian politicians, particularly those of the Left, have ever excelled. By sheer force of will he compelled the Chamber early in 1873 to adopt some minor financial reforms, but, on 29th April, found himself in a minority on the question histoetJ

of a credit for a proposed state arsenal at Taranto.

Pressure from all sides of the House, however, induced the ministry to retain ofBce until after the debate on the application to Eome and the Papal States of the Religious Orders Bill (originally passed in 1866) — a measure which, with the help of Eicasoli, was carried at the end of May. While leaving intact the general houses of the various confraternities (except that of the Jesuits), the Bill abolished the corporate personality of religious orders, handed over their schools and hospitals Orders" to civil administrators, placed their churches at BUI. tlie disposal of the secular clergy, and provided pensions for nuns and monks, those who had families being sent to reside with their relatives, and those who by reason of age or bereavement had no home but their monasteries being allowed to end their days in religious houses specially set apart for the purpose. The proceeds of the sale of the suppressed convents*

and mpnasteries were partly converted into pensions for monks and nuns, and partly allotted to the municipal charity boards which had undertaken the educational and charitable functions formerly exercised by the religious orders. To the pope was made over £16,000 per annum as a contribution to the expense of maintaining in Eome representatives of foreign orders ; the Sacred College, however, rejected this endowment, and summoned all the suppressed confraternities to reconstitute themselves under the ordinary Italian law of association. A few days after the passage of the Eeligious Orders Bill, the death of Eattazzi (5th June 1873) removed all probability of the immediate advent of the Left. Sella, uncertain of the loyalty of the Eight, challenged a vote on the immediate discussion of further financial reforms, and on 23rd June was overthrown by a coalition of the Left under Depretis with a part of the Eight under Minghetti and the Tuscan Centre under Correnti. The Administration which thus fell was unquestionably the most important since the death of

Cavour. It had completed national unity, transferred the capital to Eome, overcome the chief obstacles to financial equilibrium, initiated military reform, and laid the foundation of the relations between State and Church.

The succeeding Minghetti- Visconti Venosta cabinet — which held office from 10th July 1873 to 18th March 1876 — continued in essential points the work of the preceding Administration. Minghetti's finance, though less clear-sighted and less resolute than that of Sella, was on the whole prudent and beneficial. With the aid of Sella he concluded conventions for the redemption of the chief Italian railways from their French and Aus-

' trian proprietors. By dint of expedients he gradually overcame the chronic deficit, and, owing to the normal increase of revenue, ended his term of office with the announcement of a surplus of some £720,000. The question whether this surplus was real or only apparent has been much debated, but there is no reason to doubt its substantial reality. It left out of account a

sum of £1,000,000 for railway construction which was covered by credit, but, on the other hand, took no note of £360,000 expended in the redemption of debt. Practically, therefore, the Eight, of which the Minghetti cabinet was the last representative administration, left Italian finance with a surplus of £80,000. Outside the all-important domain of finance, the attention of Minghetti and his colleagues was principally absorbed by strife between Church and State, army reform, and railway redemption. For some time after the occupation of Eome the pope, in order to substantiate the pretence that his spiritual freedom had been diminished, avoided the creation of cardinals and the nomination of bishops. On 22nd December 1873, however, he unexpectedly created twelve cardinals, and subsequently proceeded to nominate a number of bishops. Visconti Venosta, who had retained the portfolio for foreign affairs in the Minghetti cabinet, at once drew the attention of the European Powers to this proof of the pope's spiritual freedom and of the imaginary nature of his

” imprisonment ” in the Vatican. At the same time he assured them that absolute liberty would be guaranteed to the deliberations of a conclave. In relation to the Church in Italy, Minghetti’s policy was less perspicacious. He let it be understood “that the announcement of the appointment of bishops and the request for the royal exequatur might be made to the Government impersonally by the congregation of bishops and regulars, by a municipal council or by any other corporate body — a concession of which the bishops were quick to take advantage, but which so irritated Italian political opinion that, in July 1875, the Government was compelled to withdraw the temporalities of ecclesiastics who had neglected to apply for the exequatur, and to evict sundry bishops who had taken possession of their palaces without authorization from the state. Parliamentary pressure further obliged Bonghi, minister of piiblic instruction, to compel clerical seminaries either to forego the instruction of lay pupils or to conform to the laws of the state in regard to inspection and examination, an ordinance which

gave rise to conflicts between ecclesiastical and lay authorities, and led to the forcible dissolution of the Mantua seminary and to the suppression of the Catholic university in Eome.

More noteworthy than its management of internal affairs were the efforts of the Minghetti cabinet to strengthen and consolidate national defence. Appalled by the weakness or, rather, the non-existence of the navy, Admiral Saint-Bon, with his coadjutor, Signor Brin, addressed himself earnestly to the task of re-creating the fleet, which had never recovered from the effects of the disaster of Lissa. During his three years of office he laid the foundation upon Military which Brin was afterwards to build up a new "ntorm." Italian navy. Simultaneously General Eicotti matured the army reform scheme which he had elaborated under the preceding Administration. His Bill, adopted by parliament on 7th June 1875, still forms the ground plan of the Italian army. Besides providing for an extensive system of fortification and ter-

ritorial defence, it fixed the period of military liability for able-bodied men at nineteen years, beginning on the completion of the twentieth and ending with the thirty-ninth year of their age. Eecruits were divided into three categories. Infantry, artillery, and engineer recruits of the first category were made liable to serve from two to three years with the colours, cavalry recruits four years, and carabineer recruits five. After discharge from active service, men belonging to the infantry, artillery, and engineers pass into the standing army reserve until completion of their twenty-eighth year, and cavalrymen and carabineers until completion of their twenty-ninth year. From the beginning of their twenty-ninth to the end of their thirty-second year first-category men of the infantry, artillery, and engineers are placed in the milizia mobile (a formation corresponding to the first levy of the German Landwehr), and for the last seven years of their military liability pass into the territorial or local militia (approximately equivalent to the second levy of the Landwehr).

First-category cavalrymen and carabineers, after complet-

ing their twenty-ninth year, are placed immediately in

the territorial militia, since the milizia mobile possesses

no cavalry or carabineer cadres. The second category

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consists of supernumerary recruits for whom no place

exists in the standing army. These belong for eight

years to the standing army reserve, whence they pass

for four years into the milizia mobile, and finally for

seven years into the territorial militia. The third

category is made up of men legally exempt from mili-

tary service with the colours (i.e., only sons, eldest sons

of widows, eldest brothers of families of orphans,

brothers of soldiers killed or wounded on active ser-

vice, &c.), who belong for nineteen years to the territo-

rial militia. This category represents at least 30 per

cent, of the total annual levy. Voluntary, or one year's

service with the colours, is admitted in the case of those who have successfully completed five years' instruction in the elementary schools and who pay the War Ofiice a sum varying from £48 to £64, according to the arm in which they serve. The number of recruits annually incorporated in the active army is fixed every year by parliament on proposal of the war minister. At the time of the application of the Eicotti law, the annual levy was approximately 65,000, but has since grown to exceed 95,000. Theoretically, the army now comprises 784,424 men, including 14,414 officers and 216,723 men in active service and 6294 officers and 646,771 men of the standing army reserve. The milizia mobile consists approximately of 600,000 officers and men, and the territorial or local militia approximately of 2,100,000 officers and men. Considerations of economy, however, preclude the effectual training of anything like these totals. The outlay necessitated by the adoption of the Ricotti Bill amounted to £6,600,000 ordinary and and £800,000 extraordinary expenditure per annum,

a total which has by degrees been increased to and consolidated at the present level of £9,560,000.

It may be accounted as a piece of rare fortune for Italy that during the whole period 1869-76 the direction of her foreign policy remained in the experienced hands of Visconti Venosta, a statesman whose trustworthiness, dignity, and moderation even political opponents have been compelled to recognize. Diplomatic records fail to substantiate the accusations of lack of initiative and instability of political criterion currently policy brought against him by contemporaries. As under the foreign minister of a young state which had '-"^ attained unity in defianqe of the most formidable religious organization in the world and in opposition to the traditional policy of France, it could but be Visconti Venosta's aim to uphold the dignity of his country while convincing European diplomacy that United Italy was an element of order and progress, and that the spiritual independence of the Roman pontiff had suffered no diminution. Prudence, more-

over, counselled avoidance of all action likely to serve the predominant anti-Italian party in France as a pretext for violent intervention in favour of the pope. On the occasion of the Metrical Congress, which met in Paris in 1872, he, however, successfully protested against the irecognition of the Vatican delegate, Father Secchi, as a representative of a "state," and obtained from Count de Eemusat, French foreign minister, a formal declaration that the presence of Father Secchi on that occasion could not constitute a diplomatic precedent. The irritation displayed by Bismarck at the Francophil attitude of Italy towards the end of the Franco-German war gave place to a certain show of goodwill when the great chancellor found himself in his turn involved in a struggle against the Vatican and when the policy of M. Thiers began to strain Franco-Italian relations. M. Thiers had consistently opposed the Emperor Napoleon's pro-Italian policy. In the case of Italy, as in that of Germany, he frankly fegretted the constitution of powerful homogeneous states upon the borders of

France. Personal pique accentuated this feeling in regard to Italy. The refusal of Victor Emmanuel II. to meet M. Thiers at the opening of the Mont Cenis tunnel (a refusal not unconnected with offensive language employed at Florence in October 1870 by M. Thiers during his European tour, and with his instructions to the French minister to remain absent from Victor Emmanuel's official entry into Rome) had wounded the amour propre of the French statesman, and had decreased whatever inclinar tion he might otherwise have felt to oppose the French Clerical agitation for the restoration of the temporal power, and for French interference with the Italian Religious Orders Bill. Consequently relations between France and Italy became so strained that in 1873 both the French minister to the Quirinal and the Italian minister to the Republic remained for several months absent from their posts. At this juncture the emperor of Austria invited Victor Emmanuel to visit the Vienna Exhibition, and the Italian Government received a confi-dential intimation that acceptance of the invitation to Vienna would be

followed by a further invitation from Berlin. Perceiving the advantage of a visit to the imperial and apostolic court after the Italian occupation of Rome and the suppression of the religious orders, and convinced of the value of more cordial intercourse with the German empire, Visconti Venosta and Minghetti advised their sovereign to accept both the Austrian and the subsequent German invitations. The visit to Vienna took place on 17th to 22nd September, and that to Berlin on 22nd to 26th September 1873, the Italian monarch being accorded in both capitals a most cordial reception, although the contemporaneous publication of La Marmora's famous pamphlet. More Light on the Events of 1866, prevented intercourse between the Italian ministers and Bismarck from being entirely confidential. Visconti Venosta and Minghetti, moreover, wisely resisted the chancellor's pressure to override the Law of Guarantees and to engage in an Italian Kulturkampf. Nevertheless the royal journey contributed notably to the establishment of cordial relations between Italy and the central Powers,

relations which were further strengthened by the visit of the Emperor Francis Joseph to Victor Emmanuel at Venice in April 1875, and by that of the German emperor to Milan in October of the same year. Meanwhile M. Thiers had given place to i\Iarshal Macmahon, who effected a decided improvement in Franco-Italian relations by recalling from Civitavecchia the cruiser Orinoque, which since 1870 had been stationed in that port at the disposal of the pope in case he should desire to quit Rome. The foreign policy of Visconti Venosta may be said to have reinforced the international position of Italy without sacrifice of dignity, and without the vacillation and short-sightedness which was to characterize the ensuing administrations of the Left.

The fall of the Right on 18th March 1876 was an event destined profoundly and in many respects adversely to affect the course of Italian history. Theoretically, it may be argued that the advent of the new men, and the ultra-democratic ideas associated with the historic Left, was not only inevitable, but bene-

ficial, since the concentration of power for a long period in the hands of the representatives of any one class or region of a country could not fail to be detrimental; practically, however, it is essential that new men should equal .those whom they replace in personal integrity and aptitude for government. Except at rare and not auspicious intervals, the Right had held office from 1849 to 1876. Its rule was associated in the popular mind with severe administration; hostility to the democratic elements represented by Garibaldi, Crispi, history].

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Depretis, and Bertani; ruthless imposition and collection of taxes in order to meet the financial engagements forced upon Italy by the vicissitudes of her Risorgi-

mento; strong predilection for Piedmontese, Lombards, and Tuscans, and a steady determination, not always scrupulous in its choice of means, to retain executive power and the most important administrative offices of the state for the consorteria, or close corporation, of its own adherents. For years the men of the Left had worked to inoculate the electorate with suspicion of Conservative methods and with hatred of the imposts which they nevertheless knew to be indispensable to sound finance. In regard to the grist tax especially, the agitators of the Left had placed their party in a radically false position. Moreover, the redemption of the railways by the state — contracts for which had been signed by Sella in 1875 on behalf of the Minghetti cabinet with Rothschild at Basel and with the Austrian Government at Vienna — had been fiercely opposed by the Left, although its members were for the most part convinced of the utility of the operation. When, at the beginning of March 1876, these contracts were submitted to parliameat, a group of Tuscan deputies, under Cesare Correnti, joined the opposition, and on 18th

March took advantage of a chance motion concerning the date of discussion of an interpellation on the grist tax to place the Minghetti cabinet in a minority. Depretis, ex-pro-dictator of Sicily, and successor of Eattazzi in the leadership of the Left, was entrusted by the king with the formation of a Liberal ministry. Besides the premiership, Depretis assiimed the portfolio of finance ; Nicotera, an ex-Garibaldian of somewhat tarnished reputation, but a man of energetic and conservative temperament, was at the ministry of the interior; public works were entrusted to Zanardelli, a Radical doctrinaire of considerable juridical attainments; General Mezzacapo and Signor Brin replaced General Ricotti and Admiral Saint-Bon at the War OfB.ce and Ministry of Marine; while to Mancini and Coppino, prominent members of the Left, were allotted the portfolios of justice and public instruction. Great difficulty was experienced in finding a foreign minister willing to challenge comparison with Visconti Venosta. Several diplomatists in active

service were approached, but, partly on account of their refusal, and partly from the desire of the Left to avoid giving so important a post to a diplomatist bound by ties of friendship or of interest to the Right, the choice fell upon Melegari, Italian minister at Bern.

The new ministers had long since made monarchical professions of faith, but, up to the moment of taking office, were nevertheless considered to be tinged with an almost revolutionary hue. The king alone appeared to feel no misgiving. His shrewd sense of political expediency and his loyalty to constitutional principles saved him from the error of obstructing the advent and driving into an anti-dynastic attitude politicians who had succeeded in winning popular favour. Indeed, the patriotism and loyalty of the new ministers were above suspicion. Danger lay rather in entrusting men schooled in political conspiracy and in unscrupulous parliamentary opposition with the government of a young state still beset by enemies at home and abroad. As an opposition party the Left had lived upon the facile credit of

political promises, but had no well-considered programme nor other discipline nor unity of purpose than that born of the common eagerness of its leaders for office and their common hostility to the Right. Neither Depretis, Nicotera, Crispi, Cairoli, nor Zanardelli was disposed permanently to recognize the superiority of any one chief. The dissensions which broke out among them within a few months of the accession of their party to power never afterwards disappeared, except at rare moments when it became necessary to unite in preventing the return of the Conservatives. Considerations such as these could not be expected to appeal to the nation at large, which hailed the advent of the Left as the dawn of an era of unlimited popular sovereignty, diminished administrative pressure, reduction of taxation, and general prosperity. The programme of Depretis corresponded only in part to these expectations. Its chief points were extension of the franchise, incompatibility of a parliamen-tary mandate with an official position, strict p^^ enforcement of the rights of the State in regard gramme

to the Church, protection of freedom of con- <»' ">«
science, maintenance of the military and naval “-‘
policy inaugujated by the Conservatives, acceptance
of the railway redemption contracts, consolidation of
the financial equilibrium, abolition of the forced cur-
rency, and, eventually, fiscal reform. The long-promised
abolition of the grist tax was not explicitly mentioned,
opposition to the railway redemption contracts was trans-
formed into approval, and the vaunted reduction of taxar
tion replaced by lip-service to the Conservative deity
of financial equilibrium. The railway redemption con-
tracts were in fact immediately voted by Parliament,
with a clause pledging the Government to legislate
in favour of farming out the railways to private
companies.

Nicotera, minister of the interior, began his adminis-
tration of home affairs by a sweeping change in the per-
sonnel of the prefects, sub-prefects, and public prosecutors,
but found himself obliged to incur the wrath of his sup-
porters by prohibiting Radical meetings likely to endanger

public order, and by enunciating administrative principles which would have befitted an inveterate Conservative. In regard to the Church, he instructed the prefects strictly to prevent infraction of the law against religious orders. At the same time the cabinet, as a whole, brought in a Clerical Abuses Bill, threatening with severe punishment priests guilty of disturbing the peace of families, of opposing the laws of the state, or of fomenting disorder. Depretis, for his part, was compelled to declare impracticable the immediate abolition of the grist tax, and to frame a Bill for the increase of revenue, acts which caused the secession of some sixty Radicals and Republicans from the ministerial majority, and gave the signal for an agitation against the premier similar to that which he himself had formerly undertaken against the Right. The first general election under the Left (November 1876) had yielded the cabinet the overwhelming majority oi 421 Ministerialists against 87 Conservatives, but the very size of the majority rendered it unmanageable. The Clerical Abuses Bill provoked further dissensions : Nicotera was

severely affected by revelations concerning his political past ; Zanardelli refused to sanction the construction of a railway in Calabria in which Nicotera was interested ; and Depretis saw fit to compensate the siipporters of his Bill for the increase of revenue by decorating at one stroke sixty ministerial deputies with the Order of the Crown of Italy. A further derogation from the ideal of democratic austerity was committed by adding £80,000 per annum to the king's civil list (14th May 1877) and by burdening the state exchequer with royal household pensions amounting to £20,000 a year. The civil list, which the law of 10th August 1862 had fixed at £660,000 a year, but which had been voluntarily reduced by the king to £530,000 in 1864, and to £490,000 in 1867, was thus raised to £570,000 a year. Almost the only respect in which the Left could boast a decided improvement over the administration of the Right was the energy displayed by Nicotera in combating brigandage and the maffla in Calabria and Sicily. Successes achieved in

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those provinces failed, however, to save Nicotera from the wrath of the Chamber, and on 14th December 1877 a cabinet crisis arose over a question concerning the secrecy of telegraphic correspondence. Depretis thereupon re-constructed his administration, excluding Nicotera, Mele-gari, and Zanardelli, placing Crispi at the home office, entrusting Magliani with finance, and himself assuming the direction of foreign affairs.

In regard to foreign affairs, the dibut of the Left as a governing party was scarcely more satisfactory than its home policy. Since the war of 1866 the Left had advo-cated an Italo-Prussian alliance in opposition to the Fran-cophil tendencies of the Right. On more than one occasion Bismarck had maintained direct relations "with

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the Lett to prevent a Franco-Italian alliance by encour-aging the "party of action" to press for the occupation of Rome. Besides, the Left stood for anti-

clericalism and for the retention by the State of means of coercing the Church, in opposition to the men of the Eight, who, with the exception of Sella, favoured Cavour's ideal of "a free Church in a free State," and the consequent abandonment of state control over ecclesiastical government. Upon the outbreak of the Prussian KuUurkampf the Left had pressed the Right to introduce an Italian counterpart to the Prussian May laws, especially as the attitude of Thiers and the hostiliiy of the Prench Clericals obviated the need for sparing Prench susceptibilities. Visconti Venosta and Minghetti, partly from aversion to a Jacobin policy, and partly from a conviction that Bismarck sooner or later would undertake his Gang nach Canossa, regardless of any tacit engagement he might have assumed towards Italy, had wisely declined to be drawn into any infraction of the Law of Guarantees. It was, however, expected that the chiefs of the Left, upon attaining office, would turn resolutely towards Prussia in search of a guarantee against the Clerical menace embodied in the regime

of Marshal Macmahon. On the contrary, Depretis and Melegari, both of whom were imbued with Prench Liberal doctrines, adopted towards the Republic an attitude so deferential as to arouse suspicion in Vienna and Berlin. Depretis recalled Nigra from Paris and replaced him bj^ General Cialdini, whose ardent plea for Italian intervention in favour of Prance in 1870, and whose comradeship with Marshal Macmahon in 1859, would, it was supposed, render him persona gratissima to the Prench Government. This calculation was falsified by events. Incensed by the elevation to the rank of embassies of the Italian legation in Paris and the Prench legation to the Quirinal, and by the introduction of the Italian Bill against clerical abuses, the Prench Clerical party not only attacked Italy and her representative. General Cialdini, in the Chamber of Deputies, but promoted a monster petition against the Italian Bill. Even the ioup d'Mat of 16th May 1877 (when Macmahon dismissed the Jules Simon cabinet for opposing the Clerical petition) hardly availed to change the attitude of Depretis.

As a precaution against an eventual Prench attempt to restore the temporal power, orders were hurriedly given to complete the defences of Rome, but in other respects the Italian Government maintained its subservient attitude. Yet at that moment the adoption of a clear line of policy, in accord with the central Powers, might have saved Italy from the loss of prestige entailed by her bearing in regard to the Russo-Turkish war and the Austrian acquisition of Bosnia, and might have prevented the disappointment subsequently occasioned by the outcome of the Congress of Berlin. In the hope of inducing the European Powers to " compensate " Italy for the increase of Austrian influence on the Adriatic, Crispi undertook in the autumn of 1877, with the approval of the king, and in spite of the half-disguised opposition of Depretis, a semi-official mission to Paris, Berlin, London, and Vienna. The mission appears not to have been an unqualified success, though Crispi afterwards affirmed in the Chamber (4th March 1886) that Depretis might in 1877 " have harnessed fortune to the Italian chariot." Depretis,

anxious only to avoid " a policy of adventure," let slip whatever opportunity may have presented itself, and neglected even to deal energetically with the impotent but mischievous Italian agitation for a " rectification " of the Italo-Austrian frontier. He greeted the treaty of San Stefano (3rd March 1878) with undisguised relief, and, by the mouth of the king, congratulated Italy (7th March 1878) on having maintained with the Powers friendly and cordial relations " free from suspicious pre-cautions," and upon having secured for herself "that most precious of alliances, the alliance of the future " — a phrase of which the empty rhetoric was to be bitterly demonstrated by the Berlin Congress and the Prench occupation of Tunis.

The entry of Crispi into the Depretis cabinet (December 1877) placed at the ministry of the interior a strong hand and sure eye at a moment when they were about to become imperatively necessary. Crispi was the only man of truly statesmanlike calibre in the ranks of the Left. Formerly a friend and disciple of ''■*

Mazzini, with whom he had broken on the question of the monarchical form of government which Crispi believed indispensable to the unification of Italy, he had afterwards been one of Garibaldi's most efBcient coadjutors and an active member of the "party of action." Passionate, not always scrupulous in his choice and use of political weapons, intensely patriotic, loyal with a loyalty based rather on reason than sentiment, quick-witted, prompt in action, determined and pertinacious, he possessed in eminent degree many qualities lacking in other Liberal chieftains. Hardly had he assumed office when the unexpected death of Victor Emmanuel II. (9th January 1878) stirred national feeling to an unprecedented depth and placed the „ ^, continuity of monarchical institutions in Italy victor upon trial before Europe. For thirty years Emmanuel Victor Emmanuel had been the centre point of p}^^ national hopes, the token and embodiment of the struggle for national redemption. He had led the country out of the despondency which followed the defeat

of ISTovara and the abdication of Charles Albert, through all the vicissitudes of national unification to the final triumph at Rome. His disappearance snapped the chief link with the heroic period and removed from the helm of state a ruler of large heart, great experience, and civil courage, at a moment when elements of continuity were needed and vital problems of internal, reorganization had still to be faced. Crispi adopted the measures necessary to ensure the tranquil accession of King Humbert with a quick energy which precluded any Radical or Republican demonstrations. His infiuence decided the choice of the Roman Pantheon as the late monarch's burial-place, in spite of formidable pressure from the Piedmontese, who wished Victor Emmanuel II. to rest with the Sardinian kings at Superga. He also persuaded the new ruler to inaugurate, as King Hum-bert I., the new dynastical epoch of the kings of Italy, instead of continuing as Humbert IV. the succession of the kings of Sardinia. Before the commotion caused by the death of Victor Emmanuel had passed away, the

decease of Pius IX. (7th February 1878) placed further demands upon Crispi's sagacity and promptitude. Like Victor Emmanuel, Pius IX. had been bound up with the history of the Risorgimento, but, unlike him, had history]

represented and embodied the anti-national, reactionary spirit. Having once let slip tlie opportunity which presented itself in 1846-48, of placing the papacy at the head of the unitary movement, he had seen himself driven from Eome, despoiled piecemeal of papal territory, reduced to an attitude of perpetual protest, and finally confined, voluntarily, but still confined, within the walls of the Vatican. Ecclesiastically, he had become the instrument of the triumph of Jesuit influence, and had in turn set his seal upon the dogma of the Immaculate Conception, the Syllabus, and Papal Infallibility. Yet, in spite of all, his jovial disposition and good-humoured cynicism saved him from unpopularity, and rendered

his death an occasion of mourning. Notwithstanding the pontiff's bestowal of the apostolic benediction in articulo mortis upon Victor Emmanuel, the attitude of the Vatican had remained so inimical as to make it doubtful whether the conclave would be held in Eome. Crispi, whose strong anti-clerical convictions did not prevent him from regarding the papacy as pre-eminently an Italian institution, was determined both to prove to the Catholic world the practical independence of the government of the Church and to retain for Eome so potent a centre of universal attraction as the presence of the future pope. The Sacred College of cardinals having decided to hold the conclave abroad, Crispi assured them of absolute freedom if they remained in Eome, or of protection to the frontier should they migrate, but warned them that, once evacuated, the Vatican would be occupied in the name of the Italian Government and be lost to the Church as headquarters of the papacy. The cardinals thereupon overruled their former decision, and the conclave was held in Eome, the new

pope. Cardinal Pecci, being elected on 20th February 1878 without let or hindrance. The Italian Government not only prorogued the Chamber during the conclave to prevent unseemly inquiries or demonstrations on the part of . deputies, but by means of Mancini, minister of " ' justice, and Cardinal di Pietro, assured the new pope protection during the settlement of his outstanding personal affairs, an assurance of which Leo XIII., on the evening^ after his election, took full advantage. At the same time the duke of Aosta, commander of the Eome army corps, ordered the troops to render royal honours to the pontiff should he officially appear in the capital. King Humbert addressed to the pope a letter of congratulation upon his election, and received a courteous reply. The improvement thus signalized in the relations between Quirinal and Vatican was further exemplified on 18th October 1878, when the Italian Government accepted a papal formula with regard to the granting of the royal exequatur for bishops, whereby they, upon nomination by the Holy See, recognized state con-*

trol over, and made application for, the payment of their temporalities.

The Depretis-Crispi cabinet did not long survive the opening of the new reign. Crispi's position was shaken by a morally plausible but juridically untenable charge of bigamy, while on 8th March the election of Cairoli, an opponent of the ministry and head of the extremer section of the Left, to the presidency of the Chamber, induced Depretis to tender his resignation to the new king. Cairoli succeeded in forming an administration, Cairoii. ^^ T^liich his friend Count Corti, Italian ambassador at Constantinople, accepted the portfolio of foreign affairs, Zanardelli the ministry of the interior, and Seismit Doda the ministry of finance. Though the cabinet had no stable majority, it induced the Chamber to sanction a commercial treaty which had been negotiated with France and a general " autonomous " customs tariff. The commercial treaty was, however, rejected by the French Chamber in June 1878, a circumstance necessitating the application of the Italian general tariff, which implied a 10 to 20

per cent, increase in the duties on the principal French exports. A highly imaginative financial exposition by Seismit Doda, who announced a surplus of £2,400,000, paved the way for a Grist Tax Eeduction Bill, which Cairoli had taken over from the Depretis programme. The Chamber, though convinced of the danger of this reform, the perils of which were incisively demonstrated by Sella, voted by an overwhelming majority for an immediate reduction of the impost by one-fourth, and its complete abolition within four years. Cairoli's premiership was, however, destined to be cut short by an attempt made upon the king's life in November 1878, during a royal visit to Naples, by a miscreant named Passanante. In spite of the courage and presence of mind of Cairoli, who received the dagger thrust intended for the king, public and parliamentary indignation found expression in a vote which compelled the ministry to resign.

Though brief, Cairoli's term of office was momentous in regard to foreign affairs. The treaty of San Ste-

fano had led to the convocation of the Berlin Congress, and though Count Corti was by no means ignorant of the rumours concerning secret agreements between Germany, Austria, and Eussia, and Germany, Austria, and Great Britain, he scarcely seemed alive to the possible effect of such agreements upon Italy. Eeplying on 9th April 1878 to interpellations by Visconti Venosta and other deputies on the impending Congress of Berlin, he appeared free from apprehension lest Italy, isolated, might find herself face to face with a change of the balance of power in the Mediterranean, and declared that in the event of serious complications Italy would be " too much sought after rather than too much forgotten." The policy of Italy in the congress, he added, would be to support the interests of the young Balkan nations. Wrapped in this optimism. Count 'g"", Corti proceeded, as first Italian delegate, to congress. Berlin, wherp he found himself obliged, on 28th May, to join reluctantly in sanctioning the Austrian occupation of Bosnia and Herzegovina. On 8th July

the revelation of the Anglo-Ottoman treaty for the British occupation of Cyprus took the congress by surprise. Italy, who had made the integrity of the Ottoman Empire a cardinal point of her Eastern policy, felt this change of the Mediterranean status quo the more severely inasmuch as, in order not to strain her relations with France, she had turned a deaf ear to Austrian, Eussian, and German advice to prepare to occupy Tunis in agreement with Great Britain. Count Corti had no suspicion that France had adopted a less disinterested attitude towards similar suggestions from Bismarck and Lord Salisbury. He therefore returned from the German capital with " clean " but empty hands, a plight which found marked disfavour in Italian eyes, and stimulated anti-Austrian Irredentism. Ever since Venetia had been ceded by Austria to the Emperor Napoleon, and by him to Italy, after the war of 1866, secret revolutionary committees had been formed in the northern Italian provinces to prepare for the "redemption" of Trent and Trieste. For twelve years these J^*""

committees had remained comparatively in-

active, but in 1878 the presence of the ex-Garibaldian

Cairoli at the head of the Government, and popular

dissatisfaction at the spread of Austrian sway on the

Adriatic, encouraged them to begin a series of noisy

demonstrations. On the evening of the signature at

Berlin of the clause sanctioning the Austrian occupar

tion of Bosnia and Herzegovina, an Irredentist riot

took place before the Austrian consulate at Venice. The

Italian Government attached little importance to the

occurrence, and believed that a diplomatic expression

of regret -would suffice to allay Austrian irritation.

Austria, indeed, might easily have been persuaded to

ignore the Irredentist agitation, had not the equivocal

attitude of Cairoli and Zanardelli cast doubt upon

the sincerity of their regret. The former at Pavia

(15th October 1878), and the latter at Arco (3rd

November), declared publicly that Irredentist manifestations could not be prevented under existing laws, but gave no hint of introducing any law to sanction their prevention. " Eepression, not prevention," became the official formula, the enunciation of which by Cairoli at Pavia caused Count Corti and two other ministers to resign.

The fall of Cairoli, and the formation of a second Depretis cabinet in 1878, brought no substantial change in the attitude of the Government towards Irredentism, nor was the position improved by the return of Cairoli to power in the following July. Though aware of Bismarck's hostility towards Italy, of the conclusion of the Austro-German alliance of 1879, and of the undisguised ill-will of France, Italy not only made no attempt to crush an agitation as mischievous as it was futile, but granted a state funeral to General Avezzana, president of the Irredentist League. In Bonghi's mordant phrase, the foreign policy of Italy during this period may be said to have been characterized by " enormous intellectual im-

potence counterbalanced by equal moral feebleness." Home affairs were scarcely better managed. Parliament had degenerated into a congeries of personal groups, whose members were eager only to overturn cabinets in order to secure power for the leaders and official favours for themselves. Depretis, who had succeeded Cairoli in December 1878, fell in July 1879, after a vote in which Cairoli and Nicotera joined the Conservative opposition. On 12th July Cairoli formed a new Administration, only to resign on 24th November, and to reconstruct his cabinet with the help of Depretis. The administration of iinance was as chaotic as the condition of parliament. The £2,400,000 surplus announced by Seismit Doda proved to be a myth. Nevertheless Magliani, who succeeded Seismit Doda, had neither the perspicacity nor the courage to resist the abolition of the grist tax. The first vote of the Chamber for the immediate diminution of the tax, and for its total abolition on 1st January 1883, had been opposed by the Senate. A second Bill Finance. ^^^ passed by the Chamber on 18th July 1879,

providing for the immediate repeal of the grist tax on minor cereals, and for its total abolition on 1st January 1884. While approving the repeal in regard to minor cereals, the Senate (24th January 1880) again rejected the repeal of the tax on grinding wheat as prejudicial to national finance. After the general election of 1880, how-ever, the Ministerialists, aided by a number of factious Conservatives, passed a third Bill repealing the grist tax on wheat (10th July 1880), the repeal to take effect from 1st January 1884 onwards. The Senate, in which the partizans of the ministry had been increased by numerous appointments ad hoc, finally set the seal of its approval upon the measure. Notwithstanding this prospective loss of revenue, parliament showed great reluctance to vote any new impost, although hardly a year previously it had sanctioned (30th June 1879) Depretis's scheme for spending during the next eighteen years £43,200,000 in building 5000 kilometres of railway, an expenditure not wholly justified by the importance of the lines, and useful principally as a source of electoral sops for the constituents

of ministerial deputies. The unsatisfactory financial condition of the Plorence, Rome, and Naples municipalities necessitated state help, but the Chamber nevertheless proceeded with a light heart (23rd February 1881) to sanction the issue of a foreign loan for £26,000,000, with a view to the abolition of the forced currency, thus adding to the burdens of the exchequer a load which three years later again dragged Italy into the gulf of chronic deficit.

In no modern country is error or incompetence on the part of administrators more swiftly followed by retribution than in Italy ; both at home and abroad she is hemmed in by political and economic conditions which leave little margin for folly, and still less for " mental and moral insufficiency " such as had been displayed by the Left. Nemesis came in the spring of 1881, in the form of the French invasion of Tunis. Guiccioli, the biographer of Sella, observes that Italian politi- ""^ cians find it especially hard to resist " the temptation of appearing crafty." The men of the Left believed them-

selves subtle enough to retain the confidence and esteem of all foreign Powers while coquetting at home with elements which some of these Powers had reason to regard with suspicion. Italy, in constant danger from France, needed good relations with Austria and Germany, iDut could only attain the goodwill of the former by firm treatment of the revolutionary Irredentist agitation, and of the latter by clear demonstration of Italian will and ability to cope with all anti-monarchical forces. Depretis and Cairoli did neither the one nor the other. Hence, when opportunity offered firmly to establish Italian predominance in the central Mediterranean by an occupation of Tunis, they found themselves deprived of those confidential relations witli the central Powers, and even with Great Britain, which might have enabled them to use the opportunity to full advantage. The conduct of Italy in declining the suggestions received from Count Andrassy and General Ignatieff on the eve of the Russo-Turkish war — that Italy should seek compensation in Tunis for the extension

of Austrian sway in the Balkans — and in subsequently rejecting the German suggestion to come to an arrangement with Great Britain for the occupation of Tunis as compensation for the British occupation of Cyprus, was certainly due to fear lest an attempt on Tunis should lead to a war with France, for which Italy knew herself to be totally unprepared. This very unpreparedness, however, rendered still less excusable her treatment of the Irredentist agitation, which brought her within a hair's-breadth of a conflict with Austria. Although Cairoli, upon learning of the Anglo-Ottoman convention in regard to Cyprus, had advised Count Corti of the possibility that Great Britain might seek to placate France by conniving at a French occupation of Tunis, neither he nor Count Corti had any inkling of the verbal arrangement made between Lord Salisbury and M. "Waddington at the instance of Bismarck, that, when convenient, France should occupy Tunis, an agreement afterwards confirmed (with a reserve as to the eventual attitude of Italy) in despatches exchanged in July and August 1878

between the Quai d'Orsay and Downing Street. Almost up to the moment of the French occupation of Tunis the Italian Government believed that Great Britain, if only out of gratitude for the bearing of Italy in connexion with the Dulcigno demonstration in the a\itunm of 1880, would prevent French acquisition of the Regency. Ignora,nt of the assurance conveyed to France by Lord Granville that the Gladstone cabinet would respect the engagements of the Beaconsfield-Salisbury administration, C'airoli, in deference to Italian public opinion, endea-voured to neutralize the activity of the French consul Roustan by the appointment of an equally energetic Italian consul, Signor Maccio. The rivalry between these two officials in Tunis contributed not a little to strain histoet]

rranco-Italian relations, but it is doubtful wliether Prance would have precipitated her action had not General Menabrea, Italian ambassador in London, urged his

Government to purchase the Tunis-Goletta railway from the English company by which it had been constructed. A French attempt to purchase the line was upset in the English courts, and the railway was finally secured by Italy at a price more than eight times its real value. This pertinacity engendered a belief in France that Italy was about to undertake in Tunis a more aggressive policy than necessary for the protection of her commercial interests. M. Eoustan therefore hastened to extort from the bey concessions calculated to neutralize the advantages which Italy had hoped to secure by the possession of the Tunis-Goletta line, and at the same time the Erench Government prepared at Toulon an expeditionary corps for the occupation of the Eegency. In the spring of 1881 the Krounfir tribe was reported to have attacked a French force on the Algerian border, and on 9th April M. Eoustan informed the bey of Timis that France would chastise the assailants. The bey issued futile protests to the Powers. On 26th April the island of Tabarca was occupied by the French, Biserta was seized

on 2nd May, and on 12th May the bey signed the treaty of Bardo accepting the French protectorate. France undertook the maintenance of order in the Eegency, and assumed the representation of Tunis in all dealings with other countries.

Italian indignation at the French coup de main was the deeper on account of the apparent duplicity of the Government of the Eepublic. On 11th May the French foreign minister, M. Barthelemy de Saint Hilaire, had oflS.cially assured the Italian ambassador in Paris that France "had no thought of occupying Tunis or any part of Tunisian territory, beyond some points of the Kroumir country." This assurance, dictated by M. Jules Ferry to M. de Saint Hilaire in the presence of the Italian ambassador, and by him telegraphed en clair to Eome, was considered a binding pledge that France would not materially alter the status quo in Tunis. Documents subsequently published have somewhat attenuated the responsibility of M. Ferry and M. de Saint Hilaire for this breach of

faith, and have shown that the French forces in Tunis acted upon secret instructions from General Farre, minister of war in the Ferry cabinet, who pursued a policy diametrically opposed to the ofiieial declarations made by the premier and the foreign minister. Even had this circumstance been known at the time, it could scarcely have mitigated the intense resentment of the whole Italian nation at an event which was considered tantamount not only to the destruction of Italian aspirations to Tunis, but to the ruin of the interests of the numerous Italian colony and to a constant menace against the security of the Sicilian and south Italian coasts.

Had the blow thus struck at Italian influence in the Mediterranean induced politicians to sink for a while their personal differences and to unite in presenting a firm front to foreign nations, the crisis in regard to Tunis might not have been wholly unproductive of good. Unfortunately, on this, as on other critical occasions, deputies proved themselves incapable of common effort to promote general welfare. While excitement over Tunis was at its height,

but before the situation was irretrievably compromised to the disadvantage of Italy, Cairoli had been compelled to resign by a vot^ of want of confidence in the Chamber. The only politician capable of dealing adequately with the situation was Sella, leader of the Eight, and to him the crown appealed. The faction leaders of the Left, though divided by personal jealousies and mutually incompatible ambitions, agreed that the worst evil which could befaU Italy would be the return of the Eight to power, and conspired to preclude the possibility of a Sella cabinet. An attempt by Depretis to recompose the Cairoli ministry proved fruitless, and after eleven precious days had been lost. King Humbert was obliged, on 19th April 1881, to refuse Cairoli's resignation. The conclusion of the treaty of Bardo on 12th May, however, compelled Cairoli to sacrifice himself to popular indignation. Again Sella was called upon, but again the dog-in-the-manger policj- of Depretis, Cairoli, Nicotera, and Baecarini, in conjunction with the intolerant attitude of some extreme Conserva-tives, proved fatal to his endeavours. Depretis then

succeeded in recomposing the Cairoli cabinet without Cairoli, Mancini being placed at the Foreign Office. Except in regard to an increase of the army estimates, urgently demanded by public opinion, the new ministry had practically no programme. Public opinion was further irritated against France by the massacre of some Italian workmen at Marseilles on the occasion of the return of the French expedition from Tunis, and Depretis, in response to public feeling, found himself obliged to mobilize a part of the militia for military exercises. In this condition of home and foreign affairs occurred disorders at Eome in connexion with the transfer of the remains of Pius IX. from St Peter's to the basilica of San Lorenzo. Most of the responsibility lay with the Vatican, which had arranged the procession in the way best calculated to irritate Italian feeling, but little excuse can be offered for the failure of the Italian authorities to maintain public order. In conjunction with the occupation of Tunis, the effect of these disorders was to exhibit Italy as a country

powerless to defend its interests abroad or to keep peace at home. The scandal and the pressure of foreign Catholic opinion compelled Depretis to pursue a more energetic policy, and to publish a formal declaration of the intangibility of the Law of Guarantees.

Meanwhile a conviction was spreading that the only way of escape from the dangerous isolation of Italy lay in closer agreement with Austria and Germany. Depretis tardily recognized the need for such agreement, if only to remove the " coldness and invincible diffidence " which, by subsequent confession of Mancini, then characterized the attitude of the central Powers ; but he was opposed to any formal alliance, lest it might arouse French resentment, while the new Franco-Italian 'f°' " treaty was still unconcluded, and the foreign Alliance? loan for the abolition of the forced currency had still to be floated. He, indeed, was not disposed to concede to public opinion anything beyond an increase of the army, a measure insistently demanded by Garibaldi and the Left. The Eight likewise desired to strengthen*

both army and navy, but advocated cordial relations with Berlin and Vienna as a guarantee against French domineering, and as a pledge that Italy would be vouchsafed time to effect her armaments without disturbing financial equilibrium. The Eight also hoped that closer accord with Germany and Austria would compel Italy to conform her home policy more nearly to the principles of order prevailing in those empires. More resolute than Eight or Left was the Centre, a small group led by Sidney Sonnino, a young politician of unusual fibre, which sought in the press and in parliament to spread a conviction that the only sound basis for Italian policy would be close alliance with the central Powers and a friendly understanding with Great Britain in regard to Mediterranean affairs. The principal Italian public men were divided in opinion on the subject of an alliance. Peruzzi, Lanza, and Bonghi pleaded for equal friendship with all Powers, and especially with France ; Crispi, Minghetti, Cadorna, and others, including Blanc, secretary-general to the Foreign

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Office, openly favoured a pro-Austrian policy. Austria and Germany, however, scarcely reciprocated these dispositions. The Irredentist agitation had left profound traces at Berlin as well as at Vienna, and had given rise to a distrust of Depretis which nothing had yet occurred to allay. ISTor, in view of the comparative weakness of Italian armaments, could eagerness to find an ally be deemed conclusive proof of the value of Italian friendship. Count di Eobilant, Italian ambassador at Vienna, warned his Government not to yield too readily to pro-Austrian pressure, lest the dignity of Italy be compromised or her desire for an alliance be granted on onerous terms. Mancini, foreign minister, who was as anxious as Depretis for the conclusion of the Franco-Italian commercial treaty, gladly followed this advice, and limited his efforts to the maintenance of c'orrect diplomatic relations with the central Powers. Except in regard to the Eoman question, the advantages and

disadvantages of an Italian alliance with Austria and Germany counterbalanced each other. A rapprocJiement with France and a continuance of the Irredentist movement could not fail to arouse Austro-German hostility ; but, on the other hand, to draw near to the central Powers would inevitably accentuate the diffidence of France. In the one hypothesis, as in the other, Italy could count upon the moral support of Great Britain, but could not make of British friendship the keystone of a Continental policy. Apart from resentment against France on account of Tunis, there remained the question of the temporal power of the pope to turn the scale in favour of Austria and Germany. Danger of foreign interference in the relations between Italy and the papacy had never been so great since the Italian occupation of Eome as when, in the summer of 1881, the disorders during the transfer of the remains of Pius IX. had lent an unwonted ring of plausibility to the papal complaint concerning the " miserable " position of the Holy See. Bismarck at that moment had entered upon

his pilgrimage to Canossa, and was anxious to obtain from the Vatican the support of German Catholics. What resistance could Italy have offered had the German chancellor, seconded by Austria, and assuredly supported by France, called upon Italy to revise the Law of Guarantees in conformity with Catholic exigencies, or had he taken the initiative of making papal independence the subject of an international conference ? Friendship and alliance with Catholic Austria and powerful Germany could alone lay this spectre. This was the only immediate advantage Italy could hope to obtain by drawing nearer the central Powers.

The political conditions of Europe favoured the realization of Italian desires. Growing rivalry between Austria and Russia in the Balkans rendered the continuance of the " League of the Three Emperors " a practical impossibility. The Austro-German alliance of 1879 formally guaranteed the territory of the contracting parties, but Austria could not count upon effectual help from Germany in case of war, since Russian attack upon Aus-

tria would certainly have been followed by French attack upon Germany. As in 1869-70, it therefore became a matter of the highest importance for Austria to retain full disposal of all her troops by assuring herself against Italian aggression. The Tsar, Alexander III., under the impression of the assassination of his father, desired, however, the renewal of the Dreikaiserbund, both as a guarantee of European peace and as a conservative league against revolutionary parties. The German emperor shared this desire, but Bismarck and the Austrian emperor wished to substitute for the imperial league some more advantageous combination. Hence a tacit understanding between Bismarck and Austria that the latter should profit by Italian resentment against France to draw Italy into the orbit of the Austro-German alliance.

For the moment Germany was to hold aloof lest any active initiative on her part should displease the Vatican, of whose help Bismarck stood in need.

At the beginning of August 1881 the Austrian press

mooted the idea of a visit from King Humbert to the Emperor Francis Joseph. Count di Eobilant, anxious that Italy should not seem to beg a smile from the central Powers, advised Mancini to receive with caution the suggestions of the Austrian press. Depretis took occasion to deny, in a form scarcely courteous, the probability of the visit. Eobilant's opposition to a precipitate acceptance of the Austrian hint was founded upon fear lest King Humbert at Vienna might be pressed to disavow Irredentist aspirations, and upon a desire to arrange for a visit of the Emperor Francis Joseph to Eome in return for King Humbert's visit to Vienna. Seeing the hesitation of the Italian Government, the Austrian and German semi-official press redoubled their efforts to britig about the visit. By the end of September the idea had gained such ground in Italy that the visit was practically settled, and on 7th October Mancini informed Eobilant (who was then in Italy) of the fact. Though he considered such precipitation impolitic, Eobilant, finding that confidential information of Italian intentions had already been con-

veyed to the Austrian Government, sought an interview with King Humbert, and on 17th October started for Vienna to settle the conditions of the visit. Depretis, fearing to jeopardize the impending conclusion of the Franco-Italian commercial treaty, would have preferred the visit to take the form of an act of personal courtesy between sovereigns. The Austrian Government, for its part, desired that the king should be accompanied by Depretis, though not by Mancini, lest the presence of the Italian foreign minister should lend to the occasion too marked a political character. Mancini, unable to brook exclusion, insisted, however, upon accompanying the king. King Humbert with Queen Margherita reached Vienna on the morning of 27th October, and stayed at the Hofburg until 31st October. The visit was marked by the greatest cordiality. Count Eobilant's fears of inopportune pressure with regard to Irredentism proving groundless. Both in Germany and Austria the visit was construed as a preliminary to the adhesion of Italy to the Austro-German alliance. Count Hatzfeldt, on behalf of the German

Foreign Office, informed the Italian ambassador in Berlin that whatever was done at Vienna would be regarded as haying been done in the German capital. Nor did nascent irritation in France prevent the conclusion of the Franco-Italian commercial treaty, which was signed at Paris on 3rd November.

In Italy public opinion as a whole was favourable to the visit, especially as it was not considered .an obstacle to the projected increase of the army and navy. Doubts, however, soon sprang up as to its effect upon the minds of Austrian statesmen, since on 8th November the language employed by Baron de Kallay and Count Andrassy to the Hungarian delegations on the subject of Irredentism was scarcely calculated to soothe Italian susceptibilities. But on 9th November the European situation was suddenly modified by the formation of the Gambetta cabinet, and, in view of the policy of revenge with which Gambetta was supposed to be identified, it became imperative for Bismarck to assure himself that Italy would not be enticed into a Francophil attitude by any concession Gambetta

might offer. As usual when dealing with weaker nations, the German chancellor resorted to intimidation. He not only re-established the Prussian legation to the Vatican, suppressed since 1874, and omitted from the imperial histokt]

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message to the Eeichstag (ITtli November 1881) all reference to King Humbert's visit to Vienna, but took occasion on 29th. November to refer to Italy as a country tottering on the verge of revolution, and opened in the German semi-official press a campaign in favour of an international guarantee for the independence of the papacy. These manceuvres produced their effect upon Italian public opinion. In the long and important debate upon foreign policy in the Italian Chamber of Deputies (6th to 9th December) the fear was repeatedly expressed lest Bismarck should seek to purchase the support of German Catholics by raising the Eoman question. Mancini, still unwilling frankly to adhere to the Austro-

German alliance, found his policy of "friendship all round " impeded by Gambetta's uncompromising attitude in regard to Tunis. Bismarck nevertheless continued his press campaign in favour of the temporal power until, reassured by Gambetta's decision to send M. Eoustan

back to Tunis to complete as minister the anti-Italian programme begun as consul, he finally instructed his organs to emphasize the common interests of Germany and Italy on the occasion of the opening of the St Gothard tunnel. But the effect of the German press campaign could not be effaced in a day. At the new year's reception of deputies King Humbert aroused enthusiasm by a significant remark that Italy intended to remain " mistress in her own house " ; while Mancini addressed to Count de Launay, Italian ambassador in Berlin, a haughty despatch, repudiating the supposition that the pope might (as Bismarckian emissaries had suggested to the Vatican) obtain abroad greater spiritual liberty than in Eome, or that closer relations between Italy and Germany, such as were required by the interests and aspirations of the two countries, could be made in any way contingent upon a modification of Italian freedom of action in regard to home affairs.

The sudden fall of Gambetta (26th January 1882) having removed the fear of immediate European com-

plications, the cabinets of Berlin and Vienna again displayed diffidence towards Italy. So great was Bismarck's distrust of Italian parliamentary instability, his doubts of Italian capacity for offensive warfare, and his fear of the Francophil tendencies of Depretis, that for many weeks the Italian ambassador at Berlin was unable to obtain audience of the chancellor. But for the Tunisian question Italy might again have been drawn into the wake of France. Mancini tried to impede the organization of French rule in the Eegency by refusing to recognize the treaty of Bardo, yet so careless was Bismarck of Italian susceptibilities, that he instructed the German consul at Tunis to recognize French decrees. Partly under the influence of these circumstances, and partly in response to persuasion by Baron Blanc, secretary-general for foreign affairs, Mancini instructed Count di Eobilant to open negotiations for an Italo-Austrian alliance — instructions which Eobilant neglected imtil questioned by Count Kalnoky on the subject. The first exchange of ideas between the two Governments proved fruitless, since

Kalnoky, somewhat Clerically-minded, was averse from guaranteeing the integrity of all Italian territory, and Mancini was equally unwilling to guarantee to Austria permanent possession of Trent and Trieste. Mancini, moreover, wished the treaty of alliance to provide for reciprocal protection of the chief interests of the contracting Powers, Italy undertaking to second Austria-Hungary in the Balkans, and Austria and Germany pledging themselves to support Italy in Mediterranean questions. Without some such proviso Italy would, in Mancini's opinion, be exposed single-handed to French resentment. At the request of Kalnoky, Mancini defined his proposal in a memorandum, but the illness of himself and Depretis, combined with an untoward discussion in the Italian press on the failure of the Austrian emperor to return in Eome King Humbert's visit to Vienna, caused negotiations to drag. The pope, it transpired, had refused to receive the emperor if he came to Eome on a visit to the Quirinal, and Francis Joseph, though anxious to return King Humbert's visit, was unable to offend the

feelings of his Catholic subjects. Meanwhile (11th May 1882) the Italian parliament adopted the new Army Bill, involving a special credit of £6,100,000 for the creation of two new army corps, by which the war footing of the regular army was raised to nearly 850,000 men and the ordinary military estimates to £8,000,000 per annum. Garibaldi, who, since the French occupation of Tunis, had ardently worked for the increase of the army, had thus the satisfaction of seeing his desire realized before his death at Caprera, oaWfaiW/ on 2nd June 1882. " In spirit a child, in character a man of classic mould," Garibaldi had remained the nation's idol, an almost legendary hero whose place none could aspire to fill. Gratitude for his achievements and sorrow for his death found expression in universal mourning wherein king and peasant equally joined. Before his death, and almost contemporaneously with the passing of the Army Bill, negotiations for the alliance were renewed. Encouraged from Berlin, Kalnoky agreed to the reciprocal territorial guarantee,

but declined reciprocity in support of special interests. Mancini had therefore to be content with a declaration that the allies would act in mutually friendly intelligence. Depretis made some opposition, but finally acquiesced, and the treaty of triple alliance was signed on 20th May 1882, five days after the promulgation of the Franco-Italian commercial treaty in Paris. Though sixnatare partial revelations have been made, the exact otthe tenor of the treaty of triple alliance has never Treaty, been divulged. It is known to have been con-cluded for a period of five years, to have pledged the contracting parties to join in resisting attack upon the territory of any one of them, and to have specified the mili-tary disposition to be adopted by each in case attack should come either from France, or from Eussia, or from both simultaneously. The Italian General Staff is said to have undertaken, in the event of war against France, to operate with two armies on the north-western frontier against the French armee des Alpes, of which the war strength is about 250,000 men. A third Italian army would, if expedient,

pass into Germany, to operate against either France or Eussia. Austria undertook to guard the Adriatic on land and sea, and to help Germany by checkmating Eussia on land. Germany would be sufficiently employed in carrying on war against two fronts. Kalnoky desired that both the terms of the treaty and the fact of its conclusion should remain secret, but Bismarck and Mancini hastened to hint at its existence, the former in the Eeichstag on 12th June 1882, and the latter in the Italian semi-official press. A revival of Irredentism in connexion with the execution of an Austrian deserter named Oberdank, who after escaping into Italy endeavoured to return to Austria with explosive bombs in his possession, and the cordial refereiices to France made by Depretis at Stradella (8th October 1882), prevented the French Government from suspecting the existence of the alliance, or from ceasing to strive after a Franco-Italian understanding. Suspicion was not aroused until March 1883, when Mancini, in defending himself against strictures upon his refusal to co-operate with Great Britain in Egypt, practically revealed the existence of

the treaty, thereby irritating France and destroying

Depretis's secret hope of finding in the triple alliance

the advantage of an Austro-German guarantee without the

disadvantage of French enmity. In Italy the revelation

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of the treaty was hailed with satisfaction except by

the Clericals, who were enraged at the blow thus struck

at the restoration of the pope's temporal power, and by

the Radicals, who feared both the inevitable breach with

republican France and the reinforcement of Italian consti-

tutional parties by intimacy with strong monarchical states

such as Germany and Austria. These very considerations

naturally combined to recommend the fact to constitu-

tionalists, who saw in it, besides the territorial guarantee,

the elimination of the danger of foreign interference in the

relations between Italy and the Vatican, such as Bismarck

had recently threatened and such as Prance was believed

ready to propose.

Nevertheless, during its first period (1882-87) the triple alliance failed to ensure cordiality between the contracting Powers. Mancini exerted himself in a hundred ways to soothe French resentment. He not only refused to join Great Britain in the Egyptian expedition, but agreed to suspend Italian consular jurisdiction in Tunis, and deprecated suspicion of French designs upon Morocco. His efforts were worse than futile. France remained cold, while Bismarck and Kalnoky, distrustful of the Eadicalism of Depretis and Mancini, assumed towards their ally an attitude almost hostile. Possibly Germany and Austria may have been influenced by the secret treaty signed between Austria, Germany, and Russia on 21st March 1884, and ratified during the meeting of the three emperors at Skiernewice in September of that year, by which Bismarck, in return for " honest brokerage" in the Balkans, is understood to have obtained from Austria and Russia a promise of benevolent neutrality in case Germany should be "forced" to make

war upon a fourth Power — France. Guaranteed thus against Russian attack, Italy became in the eyes of the central Powers a negligible quantity, and was treated accordingly. Though kept in the dark as to the Skier-newice arrangement, the Italian Government soon dis-covered from the course of events that the triple alliance had practically lost its object, European peace having been assured without Italian co-operation. Meanwhile France provided Italy with fresh cause for uneasiness by abating her hostility to Germany. Italy in conse-quence drew nearer to Great Britain, and at the London conference on the Egyptian financial question sided with Great Britaiu against Austria and Germany. At the same time negotiations took place with Great Britain for an Italian occupation of Massawa, and Mancini, dreaming of a vast Anglo-Italian enterprise against the Mahdi, expatiated in the spring of 1886 upon the glories of an Anglo-Italian alliance, an indiscretion which drew upon him a scarcely-veiled ddmenti from London. Again speaking in the Chamber, Mancini

claimed for Italy the principal merit in the conclusion of the triple alliance, but declared that the alliance left Italy full liberty of action in regard to interests outside its scope, " especially as there was no possibility of obtaining protection for such interests from those who by the alliance had not undertaken to protect them." These words, which revealed the absence of any .stipulation in regard to the protection of Italian interests in the Mediterranean, created lively dissatisfaction in Italy and corresponding satisfaction in France. They hastened Mancini's downfall (17th June 1885), and prepared the advent of Count di Robilant, who three months later succeeded Mancini at the Italian Foreign Office. Robilant, for whom the Skiernewice pact was no secret, followed a firmly independent policy throughout the Bulgarian crisis of 1885-86, declining to be drawn into any action beyond that required by the treaty of Berlin and the protection of Italian interests in the Balkans. Italy, indeed, came out of the Eastern crisis with enhanced prestige and with her relations to

Austria greatly improved. Towards Prince Bismarck Robilant maintained an attitude of dignified independence, and as, in the spring of 1886, the moment for the renewal of the triple alliance drew near, he profited by the development of the Bulgarian crisis and the threatened Franco-Russian understanding to secure from the central Powers "something more" than the bare territorial guarantee of the original treaty. This " something more " consisted, at least in part, of the arrangement, with the help of Austria and Germany, of an Anglo-Italian naval understanding having special reference to the Eastern question, but providing for common action by the British and Italian fleets in the Mediterranean in case of war. A vote of the Italian Chamber on 4th February 1887, in connexion with the disaster to Italian troops at Dogali, in Abyssinia, brought about the resignation of the Depretis-Robilant Cabinet. The crisis dragged for three months, and before its definitive solution by the formation of a Depretis-Crispi ministry, Robilant succeeded (17th March 1887) in renewing

the triple alliance on terms more favourable to Italy than those obtained in 1882. Not only did he ^^^^^ ^^ secure concessions from Austria and Germany newaiot corresponding in some degree to the improved the Triple state of the Italian army and navy, but, in Aiiiaace. virtue of the Anglo-Italian understanding, assured the practical adhesion of Great Britain to the European policy of the central Powers, a triumph probably greater than any registered by Italian diplomacy since the completion of national unity.

The period between May 1881 and July 1887 occupied, in the region of foreign affairs, by the negotiation, conclusion, and renewal of the triple alliance, by the Bulgarian crisis, and by the dawn of an Italian colonial policy, was marked at home by urgent political and economic problems, and by the parliamentary phenomena known as trasformismo. On 29th June 1881 the Chamber adopted a Franchise Reform BiU, ^fo™/. which increased the electorate from 600,000 to 2,000,000 by lowering the fiscal qualification from

40 to 19-80 lire in direct taxation, and by extending the suffrage to all persons who had passed through the two lower standards of the elementary schools, and practically to all persons able to read and write. The immediate result of the reform was to increase the political influence of large cities where the proportion of illiterate workmen was lower than in the country districts, and to exclude from the franchise numbers of peasants and small proprietors who, though of more conservative temperament and of better economic position than the artizan population of the large towns, were often unable to fulfil the scholarship qualification. On 12th April 1883 the forced currency was formally abolished by the resumption of treasury payments in gold with funds obtained through a loan of £14,600,000 issued in London on 6th May 1882. Owing to the hostility of the French market, the loan was covered with difficulty, and, though the gold premium fell and commercial exchanges were temporarily facilitated by the resumption of cash payments, it is doubtful whether these

advantages made up for the burden of £640,000 additional annual interest thrown upon the exchequer. On 6th March 1885 parliament finally sanctioned the conventions by which state railways were farmed out to three private companies — the Mediterranean, Adriatic, and Sicilian. The railways redeemed in 1875-76 had been worked in the interval by the Government at a heavy loss. A commission of inquiry reported in favour of private management. The conventions, concluded for a period of sixty years, but terminable by either party history]

after twenty or forty years, retained for the state the possession of the lines, but sold rolling stock to the companies, arranged various schedules of state subsidy for lines projected or in course of construction, guaranteed interest on the bonds of the companies, and arranged for the division of revenue between the companies, the reserve fund, and the state. National control of the

railways was secured by a proviso that the directors must be of Italian nationality. Depretis and his col-

league Genala, minister of public works, experienced great difficulty in securing parliamentary sanction for the conventions, not so much on account of

The rail- their defective character, as from the opposi-

Zentions. º °^ local interests anxious to extort new liaes from the Government. In fact, the con-

ventions were only voted by a majority of twenty-three votes after the Government had undertaken to increase the length of new state-built lines from 1500 to 2500 kilometres. Unfortunately, the calculation of probable railway revenue on which the conventions had been based proved to be enormously exaggerated. For many years the 37|^ per cent, of the gross revenue (less the cost of maintaining the rolling stock, incumbent on the state) scarcely sufficed to pay the interest on debts incurred for railway construction and on the guaranteed bonds. A competent German authority has calculated that, on the whole, railways have cost Italian taxpayers

£8,000,000 a year. Gradually the increase of traf&c consequent upon the iadustrial development of Italy has decreased the annual losses of the state, but the position of the Government in regard to the railways still remains so unsatisfactory that the basis of the conventions will probably be radically altered on the expiration of the first period of twenty years in 1905. Intimately bound up with the forced currency, the railway conventions, and public works was the financial question in general. From 1876, when equilibrium be-tween expenditure and revenue had first been attained, taxation yielded steady annual surpluses, which in 1881 reached the satisfactory level of £2,120,000. The gradual abolition of the grist tax on minor cereals diminished the surplus in 1882 to £236,000, and in 1883 to £110,000, while the total repeal of the grist tax on wheat, which took effect on 1st January 1884, coincided with the opening of a new and disastrous period of deficit. True, the repeal of the grist tax was not the only, nor possibly even the principal, cause

of the deficit. The policy of "fiscal transformation" inaugurated by the Left increased revenue from indirect taxation from £17,000,000 in 1876 to more than £24,000,000 in 1887, by substituting heavy corn duties for the grist tax, and by raising the sugar and petroleum duties to unprecedented levels. But partly from lack of firm financial administration, partly through the increase of military and naval expenditure (which in 1887 amounted to £9,000,000 for the army, while special efforts were made to strengthen the navy), and principally through the constant drain of railway construction and public works, the demands upon the exchequer grew largely to exceed the normal increase of revenue, and necessitated the contraction of new debts. In their anxiety to remain in office Depretis and the Finance Minister, Magliani, never hesitated to mortgage the financial future of their country. No concession could be denied to deputies, or groups of deputies, whose support was indispensable to the life of the cabinet, nor, under such conditions, was it possible to place any effec-

tive check upon administrative abuses in which politicians or their electors were interested. Railways, roads, and harbours which contractors had undertaken to construct for reasonable amounts were frequently made to cost thrice the original estimates. Minghetti, in a trenchant exposure of the parliamentary condition of Italy during this period, cites a case in which a credit for certain public works was, during a debate in the Chamber, increased by the Government from £6,600,000 to £9,000,000 in order to conciliate local political interests. In the spring of 1887 Genala, minister of public works, was taken to task for having sanctioned expenditure of £80,000,000 on railway construction while only £40,000,000 had been included in the estimates. As most of these credits were spread over a series of years, succeeding Administrations found their financial liberty of action destroyed, and were obliged to cover deficit by constant issues of consolidated stock. Thus the deficit of £940,000 for the financial year 1885-86 rose to nearly £2,920,000 in 1887-88, and in 1888-89 attained the

terrible level of £9,400,000.

Nevertheless, in spite of many and serious short-comings, the long series of Depretis administrations was marked by the adoption of some useful measures. Besides the realization of the formal programme of the Left, consisting of the repeal of the grist tax, the abolition of the forced currency, the extension of the suffrage, and the development of the railway system, Depretis laid the foundation for, land tax re-assessment by introducing a new cadastral survey. Unfortunately, the new survey was made largely optional, so that provinces which had reason to hope for a diminution of land tax under a revised assessment hastened to complete their survey, while others, in which the average of the land tax was, and is, below a normal' assessment, have neglected to comply with the provisions of the scheme. Hence, pending compulsory completion of the survey, the Land Tax Equalization Bill has resulted in loss to the exchequer. An important undertaking, known as the Agricultural Inquiry, brought to light vast quan-

tities of information valuable for future agrarian legislation. The year 1885 saw the introduction and adoption of a measure embodying the principle of employers' liability for accidents to workmen, a principle subsequently extended and more equitably defined in the spring of 1899. An effort to encourage the development of the mercantile marine was made in the same year, and a convention was concluded with the chief lines of passenger steamers to retain their fastest vessels as auxiliaries to the fleet in case of war. Sanitation and public hygiene received a potent impulse from the cholera epidemic of 1884, many of the unhealthiest quarters in Naples and other cities being demolished and rebuilt, with fimds chiefly furnished by the state. The movement was strongly supported by King Humbert, whose intrepidity in visiting the most dangerous spots at Busca and Naples while the epidemic was at its height, reassuring the panic-stricken inhabitants by his presence, excited the enthusiasm of his people and the admiration of Europe. During the accomplishment of these and other reforms

the condition of parliament underwent profound change.

By degrees the Administrations of the Left had ceased to

rely solely upon the Liberal sections of the Chamber, and

had carried their most important Bills with the help of the

Eight. This process of transformation was not exclusively

the work of Depretis, but had been initiated as

early as 1873, when a portion of the Eight under '^Jf^J°,^'

Minghetti had, by joining the Left, overturned

the Lanza-Sella cabinet. In 1876 Minghetti himself had

fallen a victim to a similar defection of Conservative

deputies. The practical annihilation of the old Eight in

the elections of 1876 opened a new parliamentary era.

Eeduced in number to less than one hundred, and radically

changed in spirit and composition, the Eight gave way,

if not to despair, at least to a despondency unsuited to an

opposition party. Though, on more than one occasion

personal rancour against the men of the Moderate Left

prevented the Eight from following Sella's advice and regaining, by timely coalition with cognate parliamentary elements, a portion of its former influence, the bulk of the party, with singular inconsistency, drew nearer and nearer to the Liberal cabinets. The process was accelerated by Sella's illness and death (14th March 1884), an event which cast profound discouragement over the more thoughtful of the Conservatives and Moderate Liberals, by whom Sella had been regarded as a supreme political reserve, as a statesman whose experienced vigour and patriotic sagacity might have been trusted to lift Italy from any depth of folly or misfortune. By a strange anomaly the Eadical measures brought forward by the Left diminished instead of increasing the distance between it and the Conservatives. Numerically insufficient to reject such measures, and lacking the fibre and the cohesion necessary for the pursuance of a far-sighted policy, the Eight thought prudent not to employ its strength in uncompromising opposition, but rather, by supporting the Government, to endeavour to modify Eadi-

cal legislation in a Conservative sense. In every case the calculation proved fallacious. Eadical measures were passed unmodified, and the Eight was compelled sadly to accept the accomplished fact. Thus it was with the abolition of the grist tax, the reform of the suffrage, the railway conventions, and many other Bills. When, in course of time, the extended suffrage increased the Eepublican and Extreme Eadical elements in the Chamber, and the Liberal " Pentarchy " (composed of Crispi, Cairoli, Nicotera, Zanardelli, and Baccarini) assumed an attitude of bitter hostility to Depretis, the Eight, obeyihg the impulse of Minghetti, rallied openly to Depretis, lending him aid without which his prolonged term of office would have been impossible. The result was parliamentary chaos, baptized trasformismo. In May 1883 this process received official recognition by the elimination of the Eadicals Zanardelli and Baccarini from the Depretis cabinet, while in the course of 1884 a Conservative, Signor Biancheri, was elected to the presidency of the Chamber, and another Conservative, General Eicotti, appointed

to the War Office. Though Depretis, at the end of his life in 1887, showed signs of repenting of the confusion thus created, he had established a parliamentary system destined largely to sterilize and vitiate the political life of Italy.

Contemporaneously with the vicissitudes of home and foreign policy under the Left there grew up in Italy a marked tendency towards colonial enterprise. The tendency itself dated from 1869, when a congress of the Italian chambers of commerce at Genoa had oonfy" urged the Lanza cabinet to establish a commercial depSt on the Eed Sea. On 11th March 1870 an Italian shipper, Signor Eubattino, had bought the bay of Assab, with the neighbouring island of Darmakieh, from the local Sultan Berehan for £1880, the funds being furnished by the Government. In consequence of this purchase an exchange of despatches had taken place in 1871 between the Italian foreign minister, Visconti Venosta, and the Egyptian Government, the latter being unwilling to re-

cognize the sovereignty of Berehan over Assab or his right to sell territory to a foreign Power. So decided was Egyptian opposition that Visconti Venosta thought it opportune not to occupy Assab, but to allow the question to slumber. No further step was taken until, at the end of 1879, Eubattino prepared to establish a commercial station at Assab. The British Government made inquiry as to his intentions, and on 19th April 1880 received a formal undertaking from Cairoli that Assab would never be fortified nor be made a military establishment. Meanwhile (January 1880) stores and materials were landed, and Assab was permanently occupied. Eighteen mouths later a party of Italian sailors and explorers under Lieutenant Biglieri and Signor Giulietti were massacred in Egyptian territory. Egypt, however, refused to make thorough inquiry into the massacre, and was only prevented from occupying Eaheita and coming into conflict with Italy by the good offices of Lord Granville, who dissuaded the Egyptian Government from enforcing its sovereignty. On 20th September 1881 Berehan formally

accepted Italian protection, and in the following Febru-
ary an Anglo-Italian convention established the Italian
title to Assab on condition that Italy should formally
recognize the suzerainty of the Porte and of the khedive
over the Eed Sea coast, and should prevent the transport
of arms and munitions of war through the territory of
Assab. This convention was never recognized by the
Porte nor by the Egyptian Government. A month later
(10th March 1882) Eubattino made over his establish-
ment to the Italian Government, and on 12th June the
Chamber adopted a Bill constituting Assab an Italian
crown colony.

Within four weeks of the adoption of this Bill the
bombardment of Alexandria by the .British fleet (11th
July 1882) opened an era destined profoundly to affect
the colonial position of Italy. The revolt of Arabi
Pasha (September 1881) had led to the meet-
*ing of an ambassadorial conference at Con- J'***
stantinople under the presidency of the Italian (fst.
ambassador. Count Corti. The conference had

been promoted by Mancini, Italian minister for foreign affairs, in the hope of preventing European interven-tion in Egypt and the permanent establishment of an Anglo-Erench condominium to the detriment of Italian influence. Prior to the meeting of the conference Italy had proposed to the Powers that a mandate be conferred upon Turkey to intervene in the Egyptian crisis, and the Porte hastened to despatch to Cairo a high commissioner, Dervish Pasha, whose arrival at Cairo led to the sangui-nary riots of 11th June 1882. At the opening of the conference (23rd June 1882) Italy secured the signature of a self-denying protocol whereby all the great Powers undertook to avoid isolated action in their own individual interests; but the rapid development of the crisis in Egypt, and the refusal of France to co-operate with Great Britain in the restoration of order, necessitated vigorous action by the latter alone. In view of the French refusal. Lord Granville on 27th July invited Italy to join in restoring order in Egypt ; but Mancini and Depretis, in spite of the efforts of Crispi, then in

London, declined the offer. Financial considerations, lack of proper transports for an expeditionary corps, fear of displeasing France, dislike of a "policy of adventure," misplaced deference towards the ambassadorial conference in Constantinople, and unwillingness to thwart the current of Italian sentiment in favour of the Egyptian "nationalists," were the chief motives of the Italian refusal, which had the effect of somewhat estranging Great Britain and Italy. Anglo-Italian relations, however, regained their normal cordiality two years later, and found expression in the support lent by Italy to the British proposal at the London conference on the Egyptian question (July 1884), for which Great Britain officially returned thanks. About the same time Mancini was informed by the Italian agent in Cairo that Great Britain would be well disposed towards an Italian occupation of a part of the Eed Sea coast. Having sounded Lord Granville, Mancini received encouragement to seize Beilul and Massawa, in view of the projected restriction of the Egyptian zone of military occupation. Lord Granville

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further inquired whether Italy would co-operate in paci-fying the Sudan, and received an affirmative reply. Italian action was hastened by news that, in December 1884, an exploring party under Signor Bianchi, royal commissioner for Assab, had been massacred in the Haussa country, an event which aroused in Italy a desire to punish the assassins and to obtain satisfaction for the still unpunished massacre of Signor Giulietti and his companions. Partly to satisfy public opinion, partly in order to profit by the favourable disposition of the British Government, and partly in the hope of remedying the error committed in 1882 by refusal to co-operate with Great Britain in Egypt, the Italian Government in Jan-uary 1885 despatched an expedition under Admiral Caimi and Colonel Saletta to occupy Massawa and Beilul. The occupation, effected on 5th February, was acceler-ated by fear lest Italy might be forestalled by France or

Russia, both of which Powers were suspected of desiring to establish themselves firmly on the Bed Sea and to exercise a protectorate over Abyssinia. News of the occupation reached Europe simultaneously with the tidings of the fall of Khartum, an event which disappointed Italian hopes of military co-operation with Great Britain in the Sudan. The resignation of the Gladstone-Granville cabinet further precluded the projected Italian occupation of Suakin, and the Italians, wisely refraining from an independent attempt to succour Kassala, then besieged by the Mahdists, bent their efforts to the increase of their zone of occupation around Massawa. Arafali, 50 miles south, and Arkiko, 9 miles south-east, of Massawa were occupied during the month of April. The extension of the Italian zone excited the suspicions of Johannes, negus of Abyssinia, whose apprehensions were assiduously fomented by Alula, ras of Tigre, and by French and Greek adventurers. In order to reassure the negus. Captain Ferrari and Dr Nerazzini were despatched on a mission to Abyssinia. The mission was

apparently successful, and arrangements were made with the negus for the ratification of undertakings entered into by Ferrari and Nerazzini by means of a second mission under General Pozzolini. Protection inopportunely accorded by Italy to enemies of Eas Alula, however, induced the Abyssinians to assume an attitude so hostile that the Pozzolini mission had to be abandoned. In January 1886 Ras Alula raided the village of Wa, to the west of Zula, but towards the end of the year '(23rd November) Wa was occupied by the irregular troops of General Gen^, who had superseded Colonel Saletta at Massawa. Angered by this step, Ras Alula took prisoners the members of an Italian exploring party commanded by Count Salimbeni, and held them as hostages for the evacuation of Wa. General Gene nevertheless reinforced Wa and pushed forward to Saati a detachment from Arkiko. On 25th January 1887 Ras Alula attacked Saati, but was repulsed with loss. On the following day, however, the Abyssinians succeeded in surprising, near the village of Dogali, an Italian force of 524 of&cers and

men under Colonel De Cristoforis, who were convoying provisions to the garrison of Saati. The Abyssinians, 20,000 strong, speedily overwhelmed the small "/fl'a// Italian force, which, after exhausting its ammunition, was destroyed where it stood. One man only escaped. Four hundred and seven men and twenty-three officers were killed outright, and one officer and eighty-one men wounded. Dead and wounded alike were horribly mutilated by order of Alula. Fearing a new attack. General Gend withdrew his forces from Saati, Wa, and Arafali ; but the losses of the Abyssinians at Saati and Dogali had been so heavy as to dissuade Alula from further hostilities.*

In Italy the disaster of Dogali produced consternation, and caused the fall of the Depretis-Robilant cabinet. The Chamber, eager for revenge, voted a credit of £200,000 and sanctioned the despatch of reinforcements. General Gen^ was reprimanded, and superseded by General Saletta, who fortified Massawa and prepared to resist further attack. Meanwhile Signor Crispi, who,

though averse from colonial adventure, desired to vindicate Italian honour, entered the De- ' •"**'"'* pretis cabinet as minister of the interior, and obtained from parliament a new credit of £800,000. In November 1887 a strong expedition under Generafdi San Marzano raised the strength of the Massawa garrison to nearly 20,000 men. The British Government, desirous of preventing an Italo-Abyssinian conflict, which could but strengthen the position of the Mahdists, despatched Sir Gerald Portal from Massawa on 29th October to mediate with the negus. The mission proved fruitless. Sir Gerald Portal returned to Massawa on 26th December 1887, and warned the Italians that Johannes was preparing to attack them in the following spring with an army of 100,000 men. On 28th March 1888 the negus indeed descended from the Abyssinian high plateau in the direction of Saati, but finding the Italian position too strong to be carried by assault, temporized and opened negotiations for peace. His tactics failed to entice the Italians from their position, and on 3rd April*

sickness among his men compelled Johannes to withdraw the whole Abyssinian army to Ghiuda. Danger being past. General di San Marzano was recalled from Massawa and the colonial garrison considerably reduced. The negus next marched against Menelek, king of Shoa, whose neutrality Italy had purchased with 5000 Remington rifles and a supply of ammunition, but found him with 80,000 men too strongly entrenched to be successfully attacked. Tidings of a new Mahdist incursion into Abyssinian territory reached the negus at that moment, and induced him to postpone the settlement of his quarrel with Menelek until the dervishes had been chastised. Marching towards the Nile, he joined battle with the Mahdists, but on 10th March 1889 was defeated and killed near Metammeh. His death gave rise to an Abyssinian war of succession between Mangash^, natural son of Johannes, and Menelek, grandson of the Negus Sella-Sellassi^. Menelek, by means of Count Antonelli, resident in the Shoa country, requested Italy to execute a diversion in his favour by occupying

Asmara and other points on the high plateau. Antonelli profited by the situation to Obtain Menelek's signature to a treaty fixing the frontiers of the Italian colony and defining Italo-Abyssinian relations. The treaty, signed at Ucciali on 2nd May 1889, arranged for regular intercourse between Italy and Abyssinia ; conceded to Italy a portion of the high plateau, with the positions of Halai, Saganeiti, and Asmara; ^^^i°' fixed an import and export duty of 8 per cent. ad valorem on caravans entering and leaving Ethiopia for Massawa; reserved to Menelek the exclusive right to import firearms; arranged for reciprocal extradition of criminals ; prohibited the slave trade, and accorded to Italy special commercial privileges. The main point of the treaty, however, lay in clause 17 : "His Majesty the King of Kings of Ethiopia consents to make use of the Government of His Majesty the King of Italy for the treatment of all questions concerning other Pow-ers and Governments." Upon this clause Italy founded her claim to a protectorate over Abyssinia. In Septem-

“ber 1889 the treaty of Ucciali was ratified in Italy by Menelek’s lieutenant, the Degiacc Makonnen, who was received by the Italian Government with great pomp and ceremony. Makonnen further concluded with the Italian premier, Crispi, a convention whereby Italy recognized

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Menelek as emperor of Ethiopia, Menelek recognized the Italian colony, and arranged for a special Italo-Abyssinian currency and for a loan. On 11th October Italy communicated article 17 of the treaty of Ucciali to the European Powers, interpreting it as a valid title to an Italian protectorate over Abyssinia. Eussia alone neglected to take note of the communication, and persisted in the hostile attitude she had assumed at the moment of the occupation of Massawa. Mean-while the Italian mint coined thalers bearing the por-trait of King Humbert, with an inscription referring to the Italian protectorate, and on 1st January 1890

a royal decree conferred upon the colony the name of

" Eritrea."

In the colony itself General Baldissera, who had

replaced General Saletta, delayed the movement against

Mangasha desired by Menelek. The Italian general

would have preferred to wait until his intervention was

requested by both pretenders to the Abyssinian throne.

Pressed by the home Government, he, however, instructed

a native ally to occupy the important positions

Opera- of Keren and Asmara, and prepared himself

*Myssfnia. *° *^^® *^® offensive against Mangasha and Eas*

Alula. The latter retreated south of the river

Mareb, leaving the whole of the cis-Mareb territory, in-

cluding the provinces of Hamasen, Agameh, Serae, and

Okule-Kusai, in Italian hands. General Orero, successor

of Baldissera, pushed offensive action more vigorously,

and on 26th January 1890 entered Adowa, a city con-

siderably to the south of the Mareb — an imprudent step

which aroused Menelek's suspicions, and had hurriedly

to be retraced. Mangashi, seeing further resistance to be

useless, submitted to Menelek, who at the end of February ratified at Makalle the additional convention to the treaty of Ucciali, but refused to recognize the Italian occupation of the Mareb. The negus, however, conformed to article 17 of the treaty of Ucciali by requesting Italy to represent Abyssinia at the Brussels anti-slavery conference, an act which strengthened Italian illusions as to Menelek's readiness to submit to their protectorate. Menelek had previously notified the chief European Powers of his coronation at Entotto (14th December 1889), but Germany and Great Britain replied that such notification should have been made through the Italian Government. Germany, moreover, wounded Menelek's pride by employing merely the title of " highness." The negus took advantage of the incident to protest against the Italian text of article 17, and to contend that the Amharic text contained no equivalent for the word " consent," but merely stipulated that Abyssinia " might " make use of Italy in her relations with foreign Powers. On 28th October 1890 Count Antonelli, negotiator of

the treaty, was despatched to settle the controversy, but on arriving at Addis Abbaba, the new residence of the negus, found agreement impossible either with regard to the frontier or the protectorate. After protracted negotiations, during which Antonelli was induced to sign a draft treaty apparently arranging for the delimitation of the Italo-Abyssinian boundary and for the main-tenance of article 17 with the original discrepancy be-between the Italian and Amharic texts, the Italian plenipotentiary, finding that he had again been duped, repudiated his signature and left Addis Abbaba in haste (February 1891). On 10th April Menelek communi-cated to the Powers his views with regard to the Italian frontier, and announced his intention of re-establishing the ancient boundaries of Ethiopia as far as Khartum to the north-west and Victoria Nyanza to the south. Meanwhile the Marquis di Rudini, who had succeeded Crispi as Italian premier, had authorized the abandon-ment of article 17 eyen before he had heard of the failure of Antonelli's negotiations. Eudini was glad to leave

the whole dispute in abeyance and to make with the local ras, or chieftains, of the high plateau an arrangement securing for Italy the cis-Mareb provinces of Serae and Okule-Kusai under the rule of an allied native chief named Bath-Agos.

The period 1887-90 was marked in Italy by great political activity. The entry of Crispi into the Depretis cabinet as minister of the interior (4th April 1887) introduced into the Government an element of vigour which had long been lacking. Though sixty-eight years of age, Crispi possessed an activity, a rapidity of decision, and an energy in execution with which none of his contemporaries could vie. Within four ™J^' months the death of Depretis (29th July 1887) cabinet opened for Crispi the way to the premiership.

Besides assuming the presidency of the council of ministers and retaining the ministry of the interior, Crispi took over the portfolio of foreign affairs which Depretis had held since the resignation of Count di Eobilant. One of the first questions with which he had

to deal was that of conciliation between Italy and the Vatican. At the end of May the pope, in an allocution to the cardinals, had spoken of Italy in terms of unusual cordiality, and had expressed a wish for peace. A few days later Signor Bonghi, one of the framers of the Law of Guarantees, published in the Nuova Antologia a plea for reconciliation on the basis of an amendment to the Law of Guarantees and recognition by the pope of the Italian title to Eome. The chief incident of the move-ment towards conciliation consisted, however, in the publication of a pamphlet entitled La Conciliazione by Father Tosti, a close friend and confidant of the pope, extolling the advantages of peace between Vatican and Quirinal. Tosti's pamphlet was known to represent papal ideas, and Tosti himself was persona grata to the Italian Government. Eeconciliation seemed within sight when suddenly Tosti's pamphlet was placed on the Index, ostensibly on account of a phrase, "The whole of Italy entered Eome by the ^'^Hta-" breach of Porta Pia ; the king cannot restore tioa.

Rome to the pope, since Eome belongs to the Italian people." On 4th June 1887 the official Vatican organ, the Osservatore Romano, published a letter written by Tosti to the pope conditionally retracting the views expressed in the pamphlet. The letter had been written at the pope's request, on the understanding that it should not be published. On 15th June the pope addressed to Cardinal Eampolla del Tindaro, secretary of state, a letter reiterating in uncompromising terms the papal claim to the temporal power, and at the end of July Cardinal Eampolla reformulated the same claim in a circular to the papal nuncios abroad. The dream of conciliation was at an end, but the Tosti incident had served once more to illustrate the true position of the Vatican in regard to Italy. It became clear that neither the influence of the regular clergy, of which the Society of Jesus is the most powerful embodiment, nor that of foreign clerical parties, which largely control the Peter's Pence fund, would ever permit renunciation of the papal claim to temporal power. France, and

the French Catholics especially, feared lest conciliation

should diminish the reliance of the Vatican upon

France, and consequently French hold over Terms

the Vatican. The Vatican, for its part, felt of the

its claim to temporal power to be too valuable ”””“ “J””,,

a pecuniary asset and too efficacious an in- ’”” “”’

strumeut of Church discipline lightly to be thrown

away. The legend of an ” imprisoned pope,” subject to

every whim of his gaolers, had never failed to arouse

the pity and loosen the purse-strings of the faithful;

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dangerous innovators and would-be reformers within the

Church could be compelled to bow before the symbol

of the temporal power, and their spirit of submission

tested by their readiness to forego the realization of their

aims until the head of the Church should be restored to

his rightful domain. More important than all was the

interest of the Eoman Curia, composed almost exclusively

of Italians, to retain in its own hands the choice of the pontiff and to maintain the predominance of the Italian element and the Italian spirit in the ecclesiastical hierarchy. Conciliation with Italy would expose the pope and his Italian entourage to suspicion of being unduly subject to Italian political influence — of being, in a word, more Italian than Catholic. Such a suspicion would inevitably lead to a movement in favour of the internationalization of the Curia and of the papacy. In order to avoid this danger it was therefore necessary to refuse aU compromise, and, by perpetual reiteration of a claim incompatible with Italian territorial unity, to prove to the Church at large that the pope and the Curia were more Catholic than Italian. Such rigidity of principle need not be extended to the affairs of everyday contact between the Vatican and the Italian authorities, with regard to which, indeed, a tacit modus Vivendi was easily attainable. Italy, for her part, could not go back upon the achievements of the Eisorgimento by restoring Eome or any portion of Italian

territory to the pope. She had hoped by conciliation to arrive at an understanding which should have ranged the Church among the conservative and not among the disruptive forces of the country, but she was keenly desirous to retain the papacy as a preponderatingly Italian institution, and was ready to make whatever formal concessions might have appeared necessary to reassure foreign Catholics concerning the reality of the pope's spiritual independence. The failure of the conciliation movement left profound irritation between Vatican and Quirinal, an irritation which, on the Vatican side, found expression in vivacious protests and in threats of leaving Rome; and, on the Italian side, in the deposition of the syndic of Eome for having visited the cardinal-vicar, in the anti-clerical provisions of the new Penal Code, and in the inauguration (9th June 1889) of a monument to Giordano Bruno on the very site of his martyrdom.

The internal situation inherited by Crispi from Depretis was no sinecure. Extravagant expenditure on railways

and public works, loose administration of finance, the cost of colonial enterprise, the growing demands for the army and navy, the impending tariff war with France, and the over-speculation in building and in industrial ventures, which had absorbed ail the floating capital of the country, had combined to produce a state of affairs calling for firm and radical treatment. Crispi, burdened by the premier-ship and by the two most important portfolios in the cabinet, was, however, unable to exercise efS.cient control over all departments of state. Nevertheless his adminis-tration was by no means unfruitful. Zanardelli, minister of justice, secured in June 1888 the adoption of a new Penal Code ; state surveillance was extended to the opere pie, or charitable institutions ; municipal franchise was reformed by granting what was practically man-hood suffrage, with residential qualification, provision be'ing made for minority representation ; and the central state administration was reformed by a Bill fixing the number and functions of the various ministries. The management of finance was scarcely satisfactory, for

though Giolitti, who had succeeded Magliani and Perazzi at the treasury, suppressed the former's illusory " pension fund," he lacked the fibre necessary to deal with the enormous deficit of nearly £10,000,000 in 1888-89, the existence of which both Perazzi and he had recognized. The most successful feature of Crispi's term of oiflce was his strict maintenance of order and the suppression of Eadical and Irredentist agitation. So vigorous was his treatment of Irredentism that he dismissed without warning his colleague Seismit Doda, minister of finance, for having failed to protest against Irredentist speeches delivered in his presence at Udine. Firmness such as this secured for him the support of all constitutional elements, and after three years' premiership his position was infinitely stronger than at the outset. The general election of 1890 gave the cabinet an almost unwieldy majority, comprising four-fifths of the Chamber. A lengthy term of office seemed to be opening out before him when, on 31st January 1891, Crispi, speaking in a debate upon an unimportant Bill, angrily rebuked the

Eight for its noisy interruptions. The rebuke infuriated the Conservative deputies, who, protesting against Crispi's words in the name of the "sacred memories" of their party, precipitated a division and placed the cabinet in a minority. The incident, whether due to chance or guile, brought about the resignation of Crispi. A few days later he was succeeded in the premiership by the Marquis di Eudini, leader of the Eight, who formed a coalition cabinet with Nicotera and a part of the Left.

The sudden fall of Crispi wrought a great change in the character of Italian relations with foreign Powers. His policy had been characterized by extreme cordiality towards Austria and Germany, by a close understanding with Great Britain in regard to Mediterranean qiiestions, and by an apparent animosity towards France, which at one moment seemed likely to lead to war. Shortly before the fall of the Depretis-Eobilant cabinet Count Eobilant had announced the intention of Italy ■'?"'"" • to denounce the commercial treaties with France and

Austria, which would lapse on 31st December 1887, and had intimated his readiness to negotiate new treaties. On 24th June 1887, in view of a possible rupture of commercial relations with France, the Depretis-Crispi cabinet introduced a new general tariff. The probability of the conclusion of a new Franco-Italian treaty was small, both on account of the protectionist spirit of France and of French resentment at the renewal of the triple alliance, but even such slight probability vanished after a visit paid to Bismarck by Crispi (October 1887) within three months of his appointment to the premiership. Crispi entertained no d priori animosity towards France, but was strongly convinced that Italy must emancipate herself from the position of political dependence on her powerful neighbour which had vitiated the foreign policy of the Left. So far was he from desiring a rupture with France, that he had subordinated acceptance of the portfolio of the interior in the Depretis cabinet to an assurance that the triple alliance contained no provision for offensive warfare. But his ostentatious

visit to Friedrichsruh, and a subsequent speech at Turin, in which, while professing sentiments of friendship and esteem for France, he eulogized the personality of Bismarck, aroused against him a hostility on the part of the French which he was never afterwards able to allay. France was equally careless of Italian susceptibilities, and in April 1888 M. Goblet made a futile but irritating attempt to enforce at Massawa the Ottoman regime of the capitulations in regard to non-Italian residents. In such circumstances the negotiations for the new commercial treaty could but fail, and though the old treaty was prolonged by special arrangement for two months, differential tariffs were put in force on both sides of the frontier on 29th February 1888. The value of French exports into Italy decreased immediately by one-half, while Italian

exports to Trance decreased by nearly two-thirds. At the end of 1889 Signor Crispi abolished the differential

duties against French imports and returned to the general Italian tariff, but France declined to follow his lead, and maintained her prohibitive dues. Meanwhile the enthusiastic reception accorded to the young German emperor on the occasion of his visit to Rome in October 1888, and the cordiality shown towards King Humbert and Crispi at Berlin in May 1889, increased the tension of Franco-Italian relations ; nor was it until after the fall of Prince Bismarck in March 1890 that Crispi adopted towards the Eepublic a more friendly attitude by sending an Italian squadron to salute President Carnot at Toulon. The chief advantage derived by Italy from Crispi'S foreign policy was the increase of confidence in her Government on the part ol her allies and of Great Britain. On the occasion of the incident raised by M. Goblet with regard to Massawa, Bismarck made it clear to France that, in case of complications, Italy would not stand alone ; and when in February 1888 a strong French fleet appeared to menace the Italian coast, the British Mediterranean squadron demonstrated its readiness to support Italian

naval dispositions. Moreover, under Crispi's hand Italy awoke from the apathy of former years and gained consciousness of her place in the world. The conflict with France, the operations in Eritrea, the vigorous interpretation of the triple alliance, the questions of Morocco and Bulgaria, were all used by him as means to stimulate national sentiment. With the instinct of a true statesman, he felt the pulse of the people, divined their need for prestige, and their preference for a Government heavy-handed rather than lax. How great had been Crispi's power was seen by contrast with the policy of the Eudini cabinet which succeeded him in February 1891. Crispi's so-called "megalomania" gave place to retrenchment in home affairs and to a deferential attitude towards all foreign Powers. The premiership of Eudini renewal of 'was hailed by the Eadical leader, Cavallotti, as the Triple a pledge of the non-renewal of the triple Alliance, alliance, against which the Eadicals began a vociferous campaign. Their tactics, however, produced a contrary effect, for Eudini, accepting proposals from

Berlin, renewed the alliance in June 1891 for a period of twelve years. None of Rudini's public utterances justify the supposition that he assumed office with the intention of allowing the alliance to lapse on its expiry in May 1892; indeed, he frankly declared it to form the basis of his foreign policy. The attitude of several of his colleagues was more equivocal, but though they coquetted with French financiers in the hope of obtaining the support of the Paris Bourse for Italian securities, the precipitate renewal of the alliance destroyed all probability of a close understanding with France. The desire of Eudini to live on the best possible terms with all Powers was further evinced in the course of a visit paid to Monza by M. de Giers in October 1891, when the Russian statesman was apprised of the entirely defensive nature of Italian engagements under the triple alliance. At the same time he carried to a successful conclusion negotiations begun by Crispi for the renewal of commercial treaties with Austria and Germany upon terms which to some

extent compensated Italy for the reduction of her com-
merce with France, and concluded with Great Britain
conventions for the delimitation of British and Italian
spheres of influence in north-east Africa. In home
affairs his Administration was weak and vacillating,
nor did the economies effected in naval and military ex-
penditure and in other departments suffice to strengthen
the position of a cabinet which had disappointed the
hopes of its supporters. On 14th April 1892 dissensions
between ministers concerning the financial programme
led to a cabinet crisis, and though Eudini succeeded in
reconstructing his administration, he was defeated in the
Chamber on 5th May and obliged to resign. King
Humbert, who, from lack of confidence in Eudini, had
declined to allow him to dissolve parliament, entrusted
Signor Giolitti, a Piedmontese deputy, sometime treasury
minister in the Crispi cabinet, with the forma-
tion of a ministry of the Left, which contrived ” ‘
to obtain six months’ supply on account, and dissolved
the Chamber.

The ensuing general election (November 1892), marked by unprecedented violence and abuse of official pressure upon the electorate, fitly ushered in what proved to be the most unfortunate period of Italian history since the completion of national unity. The infiuence of Giolitti was based largely upon the favour of a court clique, and especially of Eattazzi, minister of the royal household. Early in 1893 a scandal arose in connexion with the management of state banks, and particularly of the Banca Eomana, whose managing director, Signor Tanlongo, had issued £2,500,000 of duplicate bank-notes. Giolitti scarcely improved matters f^^^ais. by creating Tanlongo a member of the Senate, and by denying in parliament the existence of any mis-management. The Senate, however, manifested the utmost hostility to Tanlongo, whom Giolitti, in consequence of an interpellation in the Chamber, was compelled to arrest. Arrests of other prominent persons followed, and on 3rd February the Chamber authorized the prosecution of De Zerbi, a Neapolitan deputy accused of corruption.

On 20th February De Zerbi suddenly expired. For a time Giolitti successfully opposed inquiry into the conditions of the state banks, but on 21st March was compelled to sanction an official investigation by a parliamentary commission composed of seven members. On 23rd November the report of the commission was read to the Chamber amid intense excitement. It established that all Italian cabinets since 1880 had grossly neglected the state banks; that the two preceding cabinets had been aware of the irregularities committed by Tanlongo ; that Tanlongo had heavily subsidized the press, paying as much as £20,000 for that purpose in 1888 alone ; that a number of deputies, including several ex-ministers, had received from him loans of a considerable amount, which they had apparently made no effort to refund ; that Giolitti had deceived the Chamber with regard to the state banks, and was open to suspicion of having, after the arrest of Tanlongo, abstracted a number of documents from the latter's papers before placing the remainder in the hands of the judicial

authorities. In spite of the gravity of the charges formulated against many prominent men, the report merely "deplored" and "disapproved" of their conduct, without proposing penal proceedings. Fear of extending still farther a scandal which had already attained huge dimensions, and the desire to avoid any further shock to national credit, convinced the commissioners of the expediency of avoiding a long series of prosecutions. The report, however, sealed the fate of the Giolitti cabinet, and on 24th November it resigned amid general execration.

Apart from the lack of scruple manifested by Giolitti in the bank scandals, he exhibited incompetence in the conduct of foreign and home affairs. On 16th and 18th August 1893 a number of Italian workmen were massacred at Aigues-Mortes. The French authorities, under whose eyes the massacre was '^^'^' perpetrated, did nothing to prevent or repress massacre. it, and the mayor of Marseilles even refused to admit the wounded Italian workmen to the municipal

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hospital. These occurrences provoked anti-French demonstrations in many parts of Italy, and revived the chronic Italian rancour against France. The Italian foreign minister, Signor Brin, began by demanding the punishment of the persons guilty of the massacre, but hastened to accept as satisfactory the anodyne measures adopted by the French Government. Giolitti removed the prefect of Rome for not having prevented an expression of popular anger, and presented formal excuses to the French consul at Messina for a demonstration against that consulate. In the following December the French tribunal at AngoulSme acquitted all the authors of the massacre. At home Signor Giolitti displayed the same weakness. Eiots at Naples in August 1893 and symptoms of unrest in Sicily found him, as Visual, unprepared and vacillating. The closing of the French market to Sicilian produce, the devastation wrought by the phyl-

loxera, and the decrease of the sulphur trade had com-
bined to produce in Sicily a discontent of which Socialist
agitators took advantage to organize the workmen of
the towns and the peasants of the country
insamc- jjjjjq groups known as fasci. The movement
Sicily. lia'd no well-defined object. Here and there
it was based upon a bastard Socialism, in
other places it was made a means of municipal party
warfare under the guidance of the local mafiia, and
in some districts it was simply popular effervescence
against the local octrois on bread and flour. As early
as January 1893 a conflict had occurred between the
police and the populace, in which several men, women,
and children were killed, an occurrence used by the
agitators further to inflame the populace. Instead of
maintaining a firm policy, Giolitti allowed the move-
ment to spread until, towards the autumn of 1893, he
became alarmed and drafted troops into the island,
though in numbers insufficient to restore order. At the
moment of his fall the movement assumed the aspect of

an insurrection, and during the interval between his resignation (24th November) and the formation of a new Crispi cabinet (10th December) conflicts between the public forces and the rioters were frequent. The return of Crispi to power — a return imposed by public opinion as that of the only man capable of dealing with the des-perate situation — marked the turning-point of the crisis. Intimately acquainted with the conditions of his native island, Crispi adopted efficacious remedies. The fasci were suppressed, Sicily was filled with troops, the reserves were called out, a state of siege proclaimed, military courts instituted, and the whole movement crushed in a few weeks. The chief agitators were either sentenced to heavy terms of imprisonment or were compelled to flee the country. A simultaneous insurrection at Massa-Carrara was crushed with similar vigour. Crispi's methods aroused great outcry in the Radical press, but the severe sentences of the military courts were in time tempered by the royal prerogative of amnesty.

But it was not alone in regard to public order that

heroic measures were necessary. The financial situa-
tion inspired serious misgivings. While engagements
contracted by Depretis in regard to public works had
more than neutralized the normal increase of revenue
from taxation, the whole credit of the state had been
affected by the severe economic and financial
*cHsis’”’ ^^’^^^^ °^ *^® y®^^^ 1889-93. The state banks,*
already hampered by maladministration, were
encumbered by huge quantities of real estate which
had been taken over as compensation for unredeemed
mortgages. Baron Sidney Sonnino, minister of finance
in the Crispi cabinet, found a prospective deficit of
£7,080,000, and in spite of economies was obliged to
face an actual deficit of more than £6,000,000. Drastic
measures were necessary to limit expenditure and to
provide new sources of revenue. Sonnino applied, and
subsequently amended, the Bank Reform Bill passed
by the previous Administration (10th August 1893)
for the creation of a supreme state bank, the Bank
of Italy, which was entrusted with the liquidation of

the insolvent Banca Romana. The new law forbade the state banks to lend money on real estate, limited their powers of discounting bills and securities, and reduced the maximum of their paper currency. In order to diminish the gold premium, which under Giolitti had risen to 16 per cent., forced currency was given to the existing notes of the banks of Italy, Naples, and Sicily, while special state notes were issued to meet immediate currency needs. Measures were enforced to prevent Italian holders of consols from sending their coupons abroad to be paid in gold, with the result that, whereas in 1893 £3,240,000 had been paid abroad in gold for the service of the January coupons and only £680,000 in paper in Italy, the same coupon was paid a year later with only £1,360,000 abroad and £2,540,000 at home. Economies for more than £1,000,000 were immediately effected, taxes, calculated to produce £2,440,000, were proposed to be placed upon land, incomes, salt, and corn, while the existing income-tax upon consols (fixed at 8 per cent, by Cambray-Digny in 1868, and raised to 13-20

per cent, by Sella in 1870) was increased to 20 per cent, irrespectively of the stockholders' nationality. These proposals met with opposition so fierce as to cause a cabinet crisis, but Sonnino, who resigned office as minister of finance, returned to power as minister of the treasury, promulgated some of his proposals by royal decree, and in spite of vehement opposition secured their ratification by the Chamber. The tax upon consols, which, in con-junction with the other severe fiscal measures, was regarded abroad as a pledge that Italy intended at all costs to avoid bankruptcy, caused a rise in Italian stocks. When the Crispi cabinet fell in March 1896 Sonnino had the satisfaction of seeing revenue increased by £3,400,000, expenditure diminished by £2,800,000, the gold premium reduced from 16 to 5 per cent., consolidated stock at 95 instead of 72, and, notwithstanding the expenditure necessitated by the Abyssinian war, financial equilibrium practically restored.

While engaged in restoring order and in supporting Sonnino's courageous struggle against bankruptcy,. Crispi

became the object of fierce attacks from the Radicals, Socialists, and Anarchists. On 16th June an attempt by an anarchist named Lega was made on Crispi's life; on 24th June President Carnot g^crispi. was assassinated by the anarchist Caserio ; and on 30th June an Italian journalist was murdered at Leghorn for a newspaper attack upon anarchism — a series of outrages which led the Government to frame and parliament to adopt (11th July) a Public Safety Bill for the prevention of anarchist propaganda and crime. At the end of July the trial of the persons implicated in the Banca Romana scandal revealed the fact that among the documents abstracted by Giolitti from the papers of the bank manager, Tanlongo, were several bearing upon Crispi's political and private life. On 11th December Giolitti laid these and other papers before the Chamber, in the hope of ruining Crispi, but upon examination most of them were found to be worth-less, and the rest of so private a nature as to be unfit for publication. The effect of the incident was rather to

increase detestation of Giolitti than to damage Crispi.

The latter, indeed, prosecuted the former for libel and for abuse of his position when premier, but after many vicissitudes, including the flight of Giolitti to Berlin in order to avoid arrest, the Chamber refused authorization for the

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prosecution, and the matter dropped. A fresh attempt of the same kind was then made against Crispi by the Eadical leader Cavallotti, who advanced unproven charges of corruption and embezzlement. These attacks were, however, unavailing to shake Crispi's position, and in the general election of May 1895 his Government obtained a majority of nearly 200 votes. Nevertheless public confidence in the efl&cacy of the parliamentary system and in the honesty of politicians was seriously diminished by these unsavoury occurrences, which, in combination with the acquittal of all the defendants in the Banca Eomana

trial and the abandonment of the proceedings against Griolitti, reinforced to an alarming degree the propaganda of the revolutionary parties.

The foreign policy of the second Crispi Administration, in which the portfolio of foreign affairs was held by Baron Blanc, was, as before, marked by a cordial interpretation of the triple alliance and by close accord with Great Britain. A strong Italian squadron took part in the opening of the North Sea Canal at Kiel, and in the Armenian question Italy seconded with energy the diplomacy of Austria and Germany, while the Italian fleet joined the British Mediterranean squadron in a demonstration off the Syrian coast. Graver than any foreign question were the complications in Eritrea. Under the arrangement concluded in 1891 by Rudini with native chiefs in regard to the Italo-Abyssinian frontier districts, relations with Abyssinia had remained comparatively satisfactory. Towards the Sudan, however, the Mahdists, who had recovered from a Compiica- defeat inflicted by an Italian force at Agordat

Eritrea. i^ 1890, resumed operations in December 1893. Colonel Arimondi, commander of the colonial forces in the absence of the military governor. General Baratieri, attacked and routed a dervish force 10,000 strong on 21st December. The Italian troops, mostly native levies, numbered only 2200 men. The dervish loss was more than 1000 killed, while the total Italian casualties amounted to less than 260. General Bara-tieri, upon returning to the colony, decided to execute a coup de main against the dervish base at Kassala, both in order to relieve pressure from that quarter and to preclude a combined Abyssinian and dervish attack upon the colony at the end of 1894. An agreement had been concluded with Great Britain on 15th April 1891, to the effect that, were Kassala occupied by the Italians, the place should be transferred to the Egyptian Government as soon as the latter should be in a position to restore order in the Sudan. Concentrating a little army of 2600 men, Baratieri surprised and captured Kassala on 17th July 1894, and garrisoned the place with native levies

under Italian oflS.cers. Meanwhile Menelek, jealous of the extension of Italian influence to a part of Somali-land and to the Benadir coast, had, with the support of France and B,ussia, completed his preparations for assert-ing his authority as independent suzerain of Ethiopia. On 11th May 1893 he denounced the treaty of Uociali, but the Giolitti cabinet, absorbed by the bank scandals, paid no heed to his action. Possibly an adroit repeti-tion in favour of Mangashi, and against Menelek of the policy formerly followed in favour of Menelek against the negus Johannes might have consolidated Italian influence in Abyssinia by preventing the ascendency of any single chieftain. The Italian Government, how-ever, neglected this opening, and Mangasha came to terms with Menelek. Consequently the efforts of Crispi and his envoy. Colonel Piano, to conclude a new treaty with Menelek in June 1894 not only proved unsuccess-ful, but formed a prelude to troubles on the Italo-Abys-sinian frontier. Bath-Agos, the native chieftain who ruled the Okul^-Kusai and the cis-Mareb provinces on

behalf of Italy, intrigued with Mangasha, ras of the trans-Mareb province of Tigre, and with Menelek, to raise a revolt against Italian rule on the high plateau. In December 1894 the revolt broke out, but Major Toselli with a small force marched rapidly against Bath-Agos, whom he routed and killed at Halai. General Baratieri, governor of Eritrea, having reason to suspect the complicity of Mangasha in the revolt, called upon him to furnish troops for a projected Italo-Abyssinian campaign against the Mahdists. Mangasha made no reply, and Baratieri crossed the Mareb and advanced to Adowa. This movement, intended to overawe the Tigrins, failed in its effect, since Baratieri four days later was obliged to evacuate Adowa and return northwards. Mangasha thereupon took the offensive and attempted to occupy the village of Coatit in Okule-Kusai, but was forestalled and defeated by Baratieri on 13th January 1895. Hurriedly retreating to Senafe, hard pressed by the Italians, who shelled Senafe on the evening of 15th January, Mangasha was obliged to

abandon his camp and provisions to Baratieri, who also secured a quantity of correspondence establishing the complicity of Menelek and Mangasha in the revolt of Bath-Agos.

The comparatively facile success achieved by Baratieri against Mangasha seems to have led him to undervalue his enemy, and to forget that Menelek, negus and king of Shoa, had an interest in allowing Mangasha to be crushed, in order that the imperial authority and the superiority of Shoan over Tigrin arms might be the more strikingly asserted. After obtaining the establishment of an apostolic prefecture in Eritrea under the charge of Italian Franciscans, Baratieri expelled from the colony the French Lazarist missionaries for their alleged complicity in the Bath-Agos insurrection, and in March 1895 under-took the conquest of Tigre. Occupying Adigrat and Makalle, he reached Adowa on 1st April, and thence pushed forward to Axum, the holy city of Abyssinia. These places were garrisoned, and during the rainy season Baratieri returned to Italy, ^“rirrf

where he was received with unbounded enthusiasm. Whether he or the Crispi cabinet had any inkling of the enterprise to which they were committed by the occupation of Tigre is more than doubtful. Certainly Baratieri made no adequate preparations to repel an Abyssinian attempt to reconquer the province. Early in September both Mangasha and Menelek showed signs of activity, and on 20th September Makonnen, ras of Harrax, who up till then had been regarded as a friend and quasi-ally by Italy, expelled all Italians from his territory and marched with 30,000 men to join the negus. On returning to Eritrea, Baratieri mobilized his native reserves and pushed forward columns under Major Toselli and General Arimondi as far south as Amba Alagi. Mangasha fell back before the Italians, who obtained several minor successes ; but on 6th December Toselli's column, 2000 strong, which through a misunderstanding continued to hold Amba Alagi, was almost annihilated by the Abyssinian vanguard of 40,000 men. Toselli and all but three officers and 300 men fell at

their posts after a desperate resistance. Arimondi, col-

lecting the survivors of the Toselli column, retreated to

Makallfe and Adigrat. At Makall^, however, he left a

small garrison in the fort, which on 7th January was

invested by the Abyssinian army. Repeated attempts to

capture the fort having failed,'Menelek and Makonnen

opened negotiations with Baratieri for its capitulation,

and on 21st January the garrison, under Major Galliano,

who had heroically defended the position, were permitted

to march out with the honours of war. INIeanwhile

Baratieri received reinforcements from Italy, but remained

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undecided as to the best plan of campaign. Thus a month

was lost, during which the Abyssinian army advanced to

Hausen, a position slightly south of Adowa. The Italian

commander attempted to treat with Menelek, but his

negotiations merely enabled the Italian envoy, Major

Salsa, to ascertain that the Abyssinians were nearly

100,000 strong, mostly armed with rifles and well supplied with artillery. The Italians, including eamp-foUowers, numbered less than 25,000 men, a force too small for effective action, but too large to be easily provisioned at 200 miles from its base, in a roadless, mountainous country, almost devoid of water. For a moment Baratieri thought of retreat, especially as the hope of creating a diversion from Zeila towards Harrar had faUed in consequence of the British refusal to permit the landing of an Italian force without the consent of France. The defection of a number of native allies (who, however, were attacked and defeated by Colonel Stevani on 18th February) rendered the Italian position still more precarious, but Baratieri, unable to make up his mind, continued to mancBuvre in the hope of drawing an Abyssinian attack. These futile tactics exasperated the home Government, which on 22nd February despatched General Baldissera, with strong reinforcements, to supersede Baratieri. On 26th February Crispi telegraphed to Baratieri, denouncing his operations as " military

phthisis," and urging him to decide upon some strategic plan. Baratieri, anxious probably to obtain some success before the arrival of Baldissera, and alarmed by the rapid diminution of his stores, which precluded further immobility, called a council of war (29th February) and obtained the approval of the divisional commanders for a plan of attack. During the night the army advanced towards Adowa in three divisions, under Generals Dabormida, Arimondi, and Albertone, each division being between 4000 and 6000 strong, and a brigade 6300 strong, under General Ellena, remaining in reserve. All the divisions, save that of Albertone, consisted chiefly of Italian troops. During the march Albertone's native division mistook the road, and found itself obliged to delay the Arimondi column by retracing its steps. Marching rapidly, however, Albertone outdistanced the other columns, but, in consequence of allowing his men an hour's rest, arrived upon the scene of action when the Abyssinians, whom it had been hoped to surprise at dawn, were

ready to receive the attack. Pressed by overwhelming forces, the Italians, after a violent combat, began to give way. The Dabormida division, unsupported by Albertone, found itself likewise engaged in a separate combat against superior numbers. Similarly the Arimondi brigade was attacked by 30,000 Shoans, and encumbered by the dSbris of Albertone's troops. Baratieri vainly attempted to push forward the reserve, but the Italians were already overwhelmed, and the battle — or rather, series of distinct engagements — ended in a general rout. The Italian loss is estimated to have been more than 6000, of whom 3125 were whites. Between 3000 and 4000 prisoners were taken by the Abyssinians, iacluding General Albertone, while Generals Arimondi and Dabor-mida were killed and General Ellena wounded. The Abyssinians lost more than 5000 killed and 8000 wounded. Baratieri, after a futile attempt to direct the retreat, fled in haste and reached Adi-Caje before the debris of his army. Thence he despatched telegrams to Italy throwing blame for the defeat upon his troops,

a proceeding which subsequent evidence proved to be as unjustifiable as it was unsoldier-like. Placed under court-martial for his conduct, Baratieri was acquitted of the charge of having been led to give battle by other than military considerations, but the sentence "deplored

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that in such difficult circumstances the command should have been given to a general so inferior to the exigencies of the situation."

In Italy the news of the defeat of Adowa caused deep discouragement and dismay. On 6th March the Crispi cabinet resigned before an outburst of indignation which the Opposition had assiduously fomented, and five days later a new cabinet was formed by General Ricotti, who, however, made over the premiership to the Marquis di Eudini. The latter, though leader of the Eight, had long been intriguing with Cavallotti, leader of the Extreme Left, to overthrow Crispi, but without the disaster of Adowa his plan would scarcely have suc-

ceeded. The first act of the new cabiaet was to confirm instructions given by its predecessor to General Baldissera (who had succeeded General Baratieri on 2nd March) to treat for peace with Menelek if he thought desirable. Baldissera opened negotiations with the negus through Major Salsa, and simultaneously reorganized the Italian army. The negotiations having failed, he marched to relieve the beleaguered garrison of Adigrat ; but Menelek, discouraged by the heavy losses at Adowa, broke up his camp and returned southwards Abyssia- to Shoa. At the same time Baldissera detached '^^f'"' Colonel Stevani with four native battalions to relieve Kassala, then hard pressed by the Mahdists. Kassala was relieved on 1st April, and Stevani a few days later severely defeated the dervishes at Mount Mokram and Tucruff. Eeturning from Kassala (which Italy decided to hold until it could be transferred to the Anglo-Egyptian forces then moving towards Dongola), Colonel Stevani rejoined Baldissera, who on 4th May relieved Adigrat after a well-executed march. By adroit*

negotiations with Mangasha the Italian general obtained the release of all the Italian prisoners in Tigre, and towards the end of May withdrew his whole force north of the Mareb. Active hostilities over, most of the Italian troops were ordered home ; and after a fruitless attempt by the pope to induce Menelek to release the Italian prisoners in the Shoa province. Major Nerazzini was despatched as special envoy to the negus to arrange terms of peace. On 26th October Nerazzini succeeded in concluding, at Addis Abbaba, a provisional treaty abolishing the treaty of Ucciali; recognizing the absolute independence of Eritrea ; postponing for one year the definitive delimitation of the Italo-Abyssinian boundary, but allowing the Italians meanwhile to hold the strong Mareb-Belesar-Muna line ; and arranging for the release of the Italian prisoners after ratification of the treaty in exchange for an indemnity of which the amount was to be fixed by the Italian Government. The treaty having been duly ratified, and an indemnity of £400,000 paid to Menelek, the Shoan prisoners were

released, and Major Nerazzini once more returned to Abyssinia with instructions to secure, if possible, Menelek's assent to the definitive retention of the Mareb-Belesa-Muna line by Italy. Before Nerazzini could reach Addis Abbaba, Eudini, in order partially to satisfy the demands of his Eadieal supporters for the abandonment of the colony, announced in the Chamber the intention of Italy to limit her occupation to the triangular zone between the points Asmara, Keren, and Massawa, and, possibly, to withdraw to Massawa alone. This declaration, of which Menelek was swiftly apprised by French agents, rendered it impossible for Nerazzini to obtain more than a boundary leaving to Italy but a small portion of the high plateau and ceding to Abyssinia the fertile provinces of Sera^ and Okule-Kusai. The fall of the Eudini cabinet in June 1898, however, enabled Signer Ferdinando Martini and Captain Cicco di Cola, who had been appointed respectively civil

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governor of Eritrea and minister resident at Addis Abbaba, to prevent the cession of Serafe and Okule-Kusai, and to secure the assent of Menelek to Italian retention of the Mareb-Belesa-Muna frontier. Eritrea has now approximately the same extent as before the revolt of Bath-Agos, except in regard (1) to Kassala, which was transferred to the Anglo-Egyptian authori-ties on 25th December 1897, in pursuance of the above-mentioned Anglo-Italian convention; and (2) to slight rectifications of its northern and eastern boundaries by conventions recently concluded between the Eritrean and the Anglo-Egyptian authorities. Under Signor Ferdinando Martini's able administration the cost of the colony to Italy has been reduced to £260,000 per annum, its trade and agriculture have vastly improved, and the discovery of gold in the neighbourhood of Asmara now justifi.es the hope that it may ere long become a source of profit to Italy.

While marked in regard to Eritrea by vacillation and

undignified readiness to yield to Eadical clamour, the policy of the Marquis di Rudini was in other respects chiefly characterized by a desire to demolish Crispi and his supporters. Actuated by rancour against Crispi, he on 29th April 1896 authorized the publication of a G-reen Book on Abyssinian affairs, in which, without the consent of Great Britain, the confidential Anglo-Italian, negotia-tions in regard to the Abyssinian war were disclosed. This publication, which amounted to a gross breach of diplomatic confidence, might have endangered the cor-diality of Anglo-Italian relations, had not the esteem of the British Government for General Eerrero, Ital-ian ambassador in London, induced it to overlook the incident. Fortunately for Italy, the Marquis Viscpnti Venosta shortly afterwards consented to assume the port-folio of foreign affairs, which had been resigned by Duke Caetani di Sermoneta, and again to place, after an interval of twenty years, his unrivalled experience at the service of his country. In September 1896 he succeeded in concluding with France a treaty with re-

gard to Tunis in place of the old Italo-Tunisian treaty, denounced by the French Government a year previously. During the Greco-Turkish war of 1897 Visconti Venosta laboured to maintain the European concert, joined Great Britain in preserving Greece from the worst consequences of her folly, and lent moral and material aid in establishing an autonomous government in Crete. At the same time he mitigated the Francophil tendencies of some of his colleagues, accompanied King Humbert and Queen Margherita on their visit to Homburg in September 1897, and, by loyal observance of the spirit of the triple alliance, retained for Italy the confidence of her allies without forfeiting the goodwill of France.

The home administration of the Eudini cabinet compared unfavourably with that of foreign affairs. Bound by a secret understanding with the Eadical leader Cavallotti, an able but unscrupulous demagogue, Eudini was compelled to bow to Eadical exigencies. He threw all the influence of the Government against Crispi,

who was charged with complicity in embezzlements per-
petrated by Favilla, managing director of the Bologna
branch of the Bank of Naples. After being subjected to
persecution for nearly two years, Crispi's character was
substantially vindicated by the report of a parliamentary
commission appointed to inquire into his relations with
Favilla. True, the commission proposed and the Chamber
adopted a vote of censure upon Crispi's conduct in 1894,
when, as premier and minister of the interior, he had bor-
rowed £12,000 from Favilla to replenish the secret service
fund, and had subsequently repaid the money as instal-
ments for secret service were in due course furnished by
the treasury. Though irregular, his action was to some
extent justified by the depletion of the secret service fund
under Giolitti and by the abnormal circumstances pre-
vailing in 1893-94, when he had been obliged to quell
the insurrections in Sicily and Massa-Carrara. But the
Eudini-Cavallotti alliance was destined to produce other
results than those of the campaign against Crispi. Pressed
by Cavallotti, Eudini in March 1897 dissolved the Cham-

ber and conducted the general election in such a way as to crush by Government pressure the partisans of Crispi, and greatly to strengthen the (Socialist, Eepublican, and Eadical) revolutionary parties. More than ever at the mercy of the Eadicals and of their revolutionary allies, Eudini continued so to administer public affairs that subversive propaganda and associations obtained unprecedented extension. The effect was seen in May 1898, when, in consequence of a rise in the price of bread, disturbances occurred in southern Italy. The corn duty was reduced to meet the emergency, but the disturbed area extended to Naples, Foggia, Bari, Minervino-Murge, Molfetta, and thence -°y%gg *along the line of railway which skirts the Adriatic coast. At Faenza, Piacenza, Cremona, Pavia, and Milan, where subversive associations were stronger, it assumed the complexion of a political revolt. From 7th to 9th May Milan remained practically in the hands of the mob. A palace was sacked, barricades were erected, and for forty-eight hours the troops under General Bava-*

Beccaris, notwithstanding the employment of artillery, were unable to restore order. In view of these occurrences, Eudini authorized the proclamation of a state of siege at Milan, Florence, Leghorn, and Naples, delegating the suppression of disorder to special military commissioners. By these means order was restored, though not without considerable loss of life at Milan and elsewhere. At Milan alone the of&cial returns confessed to eighty killed and several hundred wounded, a total generally con-sidered below the real figures. As in 1894, excessively severe sentences were passed by the military tribunals upon revolutionary leaders and other persons considered to have been implicated in the outbreak, but successive royal amnesties obliterated these condemnations within three years.

No Italian administration since the death of Depretis underwent so many metamorphoses as that of the Marquis di Eudini. Modified a first time within five months of its formation (July 1896) in connexion with General Eicotti's Army Eeform Bill, and again in December 1897,

when Zanardelli entered the cabinet, it was reconstructed for a third time at the end of May 1898 upon the question of a Public Safety Bill, but fell for the fourth and last time on 18th June 1898, on account of public indignation at the results of Eudini's home policy as exemplified in the May riots. On 29th June Eudini was succeeded in the premiership by General Luigi Pelloux, a Savoyard, whose only title to office was the confidence of the king. The Pelloux cabinet possessed no clear programme except in regard to the Public Safety Bill, which it had taken over from its predecessor. Presented to parliament in November 1898, the Peiioux Bill was read a second time in the following ^^aion. spring, but its third reading was violently obstructed by the Socialists, Eadicals, and Eepublicans of the Extreme Left. After a series of scenes and scuifles the Bill was promulgated by royal decree, the decree being post-dated to allow time for the third reading. Again obstruction precluded debate, and on 22nd July 1899 the decree automatically acquired force of law, pend-

ing tlie adoption of a Bill of indemnity by the Chamber. In February 1900 it was, however, quashed by the supreme court on a point of procedure, and the Public Safety Bill history]

as a whole had again to be presented to the Chamber. In view of the violence of Extremist obstruction, an effort was made to reform the standing orders of the Lower House, but parliamentary feeling ran so high that General Pelloux thought it expedient to appeal to the country. The general election of June 1900 not only failed to reinforce the cabinet, but largely increased the strength of the extreme parties (Eadicals, Eepublicans, and Socialists), who in the new Chamber numbered nearly 100 out of a total of 508. General Pelloux therefore resigned, and on 24th June a Moderate Liberal cabinet was formed by the aged Signor Saracco, president of the Senate. Within five weeks of its formation King Humbert was shot by an anarchist assassin named Bresci

while leaving an athletic festival at Monza, where his Majesty had distributed the prizes (29th July 1900). The death of the unfortunate monarch, against whom an attempt had previously been made by the anar-

ofKhi ^^^^^ Acciarito (22nd April 1897), caused an Humbert, outburst of profound sorrow and indignation. Though not a great monarch, King Humbert had, by his unfailing generosity and personal courage, won the esteem and affection of his people. During the cholera epidemic at Naples and Busca in 1884, and the Ischia earthquake of 1885, he, regardless of danger, brought relief and encouragement to sufferers, and res-cued many lives. More than £100,000 of his civil list was annually devoted to charitable purposes. Humbert was succeeded by his only son, Victor Emmanuel III. (born 11th November 1869), a liberal-minded and well-educated prince, who at the time of his father's assassina-tion was returning from a cruise in the eastern

otKing" Mediterranean. The remains of King Humbert victor were laid to rest in the Pantheon at Eome

Bmmaauei beside those of his father, Victor Emmanuel II. (9th August). Two days later Victor Emmanuel III. swore fidelity to the constitution before the assembled Houses of Parliament and in the presence of his consort, Elena of Montenegro, whom he had married in October 1896. During the first year of the new reign (1st June 1901) the royal household was gladdened by the birth of a princess, named Yolanda Margherita of Savoy.

The later course of Italian foreign policy was marked by many vicissitudes. Admiral Canevaro, who had gained distinction as .commander of the international forces in Crete (1896-98), assumed the direction of foreign affairs in the first period of the Pelloux administration. His diplomacy, though energetic, lacked steadiness. Soon after taking offtce he completed the negotiations beg^n by the Eudini administration for a new amirs? commercial treaty with France (October 1898), whereby Franco-Italian commercial relations were placed upon a normal footing after a breach which

had lasted for more than ten years. By the despatch of a squadron to Central America he obtained satisfaction for injuries inflicted thirteen years previously upon an Italian subject by the United States of Colombia. In December 1898 he convoked a diplomatic conference in Eome to discuss secret means for the repression of anarchist propaganda and crime in view of the assassination of the empress of Austria by an Italian anarchist (Luccheni), but it is doubtful whether results of practical value were achieved. The action of the Tsar of Eussia in convening the Peace Conference at The Hague in May 1900 gave rise to a question as to the right of the Vatican to be ofl&cially represented, and Admiral Canevaro, supported by Great Britain and Germany, succeeded in preventing the invitation of a papal delegate. Shortly afterwards his term of office was brought to a close by the failure of an attempt to secure for Italy a coaling station at San Mun and a sphere of influence in China ; but his policy of active participation in Chinese affairs was continued in a modified form by his successor, the

Marquis Visconti Venosta, who, entering the reconstructed Pelloux cabinet in May 1899, retained the portfolio of foreign affairs in the ensuing Saracco administration, and secured the despatch of an Italian expedition, 2000 strong, to aid in repressing the Chinese outbreak and in protecting Italian interests in the Far East (July 1900). With characteristic foresight, Visconti Venosta promoted an exchange of views between Italy and France in regard to the Tripolitan hinterland, which the Anglo-French convention of 1899 had placed within the French sphere of influence — a modification of the status quo ante considered highly detrimental to Italian aspirations in Tripoli. For this reason the Anglo-French convention had caused profound irritation in Italy, and had tended somewhat to diminish the cordiality of Anglo-Italian relations. Visconti Venosta is believed, however, to have obtained from France a formal declaration that France would not transgress the limits assigned to her influence by the convention. Similarly, in regard to Albania, Visconti Venosta exchanged notes with Austria with a view to

the prevention of any misunderstanding through the conflict between Italian and Austrian interests in that part of the Adriatic coast. Upon the fall of the Saracco cabinet (9th February 1901) Visconti Venosta was succeeded at the foreign office by Signor Prinetti, a Lombard manufacturer, of strong temperament, but without previous diplomatic experience. The new minister continued in most respects the policy of his predecessor. The outset of his administration was marked by Franco-Italian fStes at Toulon (10th to 14th April 1901), when the Italian fleet returned a visit paid by the French Mediterranean squadron to Cagliari in April 1899 ; and by the despatch of three Italian warships to Prevesa to obtain satisfaction for damage done to Italian subjects by Turkish officials.

The Saracco administration, formed after the obstructionist crisis of 1899-1900 as a cabinet of transition and pacification, was overthrown in February 1901 in consequence of its vacillating conduct towards a dock strike at Genoa. It was succeeded by a Zanardelli

cabinet, in which the portfolio of the interior ^.“f.^f”” was allotted to Signor Giolitti. Composed cabinet. mainly of elements drawn from the Left, and dependent for a majority upon the support of the subversive groups of the Extreme Left, the formation of this cabinet gave the signal for a vast working-class movement, during which the Socialist party sought to extend its political influence by means of strikes and the organization of labour leagues among agricultural labour-ers and artisans. The movement was confined chiefly to the northern and central provinces. During the first six months of 1901 the strikes numbered 600, and in-volved more than 1,000,000 workmen, many of whom obtained some temporary or permanent increase of pay. Encouraged rather than opposed by the Government, and kept, on the whole, within legal bounds by the Socialists, who had every reason to avoid embarrassing excesses, the movement constituted an important development in the economic and political life of Italy — economic, as mark-ing a strong departure towards labour organization, and

political, as proving the ascendancy acquired by the Socialist party, which, though represented by only twenty-eight deputies in the Chamber, threatened to become a dominant factor in Italian politics. A fatal strike riot at Berra, near Ferrara, at the end of June 1901, during which the troops were obliged to use their firearms, induced the Socialists, however, to engage in a campaign against the army, and caused a

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split between the ministerial and anti-ministerial members of the party. The two factions then entered upon a struggle for mastery, the former in the hope of realizing Socialist aims by pacific legislative means, and the latter in order to maintain the violent revolutionary attitude characteristic of Italian Socialism.

After the adoption of heroic measures for the restora-

tion of Italian finance in 1894r-95, the condition of the Italian exchequer remained as satisfactory as is possible in a country where interest on national debt absorbs nearly one-half of the total revenue. Income largely increased without further taxation; trade and industry more than recovered from the depression of 1893-94; military expenditure remained stationary at the level of £9,560,000 fixed by the Army Bill of May 1897, while military pensions were consolidated at £1,440,000; the naval estimates, of about £4,000,000 a year, were supplemented by special credits for shipbuilding ; banking institutions (in-cluding the Bank of Naples, which was saved from failure by an operation effected in 1897 by Signer Luzzatti, treasury minister) greatly strengthened their position, and largely liquidated the enormous quantities of real estate by which they were encumbered through the crisis of 1889-93. Savings banks returns showed satisfactory progress, co-operation in all its forms rapidly developed, and the creation of a State institute for insuring the

working classes against illness and destitution marked a step towards the realization of an ideal long entertained by Italian economists and statesmen. Agriculture began slowly to adopt modern methods, though hampered by lack of adequate markets, and suffering more than it could profit by the unwholesome effect of high protective duties. The most serious defects in the public life of Italy were to be found in parliamentary instability and the consequent interference of favour-hunting deputies with the working of State departments, in excessive bureaucracy, and in faulty administration of justice. Nevertheless Italy, with her popular monarchy, comparatively strong defensive organizations, valuable alliances, and sober, intelligent, and industrious people, promised, if honestly and firmly governed, to develop gradually into a strong and prosperous state. Taxation, though heavy, was not unbearable, and the discontent existing in parts of the country was dangerous to the State only in so far as it was fomented by, and served as a handle for. Socialist and Clerical agitators. Authorities. — In Italian. — Atti Zfffioiali della Camera dei De-

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LiTEKATUEE SINCE 1880.

The period between 1880 and 1902 is interesting to the student of Italian literature, apart from the intrinsic merit of the writers representing it, chiefly from the fact of its embracing almost the entire literary effort of the younger, and necessarily much altered, generation which sprang up after the unification of Italy. The period was also characterized by the increased impulse towards national culture given to all classes by the new order of things. This impulse took two parallel directions: on the one side we have a return to a deeper and more organized investigation of the first origins and developments of

national literature, on the other a tendency to realize more and more broadly the influence of foreign history and of the new currents in foreign literature and research. Therefore, because of this influence exercised by the thought of other nations on the minds of the younger generation, many writers who would otherwise have remained in the sphere of literature pure and simple come to be classed among historical or scientific writers, while for merits of style their achievement is such that they cannot be overlooked even in a purely literary survey of the period. The first name we meet of those still living in 1902 among those who may be called the fathers of the period is that of Giosue Carducci (q.v.), one of the grandest literary and poetic figures of his time. His genius has admirably summed up the two above-mentioned tendencies, insomuch that his poetic production, ranging from 1850 to the publication of a complete edition of his work in 1896, came upon Italy like a burst of fresh life and renewed vigour, while his essays inaugurated a broader, fuller, and in many ways

til] then unknown method of literary criticism. The greater part of Carducci's work is anterior to the present period, but he was brought into more fraternal contact with the aims of the younger generation by the efforts of Angelo Sommaruga, "who became, about 1880, the publisher of a group of young unknown writers all destined to some, and a few to great, accomplishment. The period of his prosperity was a strange one for Italy. The first ten years of the newly constituted kingdom had passed more in stupor than activity; original contributions to literature had been scarce, and publishers had preferred bringing out inferior translations of not always admirable French authors to encouraging the original work of Italians — work which it must be confessed was generally mediocre and entirely lifeless. Sommaruga's creation, a literary review called La Cronaca Bizantina, gathered together such beginners as Giovanni Marradi, Matilde Serao, Edoardo Scarfoglio, Guido Magnoni, and Gabriele d' Annunzio. In order to obtain the sanction of

what he considered an enduring name, the founder turned to Giosu^ Carducci, then living in retirement at Bologna, discontented with his fate, and still not generally known by the public of his own country. The activity of Sommaruga exercised a great influence on Giosu^ Carducci. "Within the next few years he published the three admirable volumes of his Covfessioni e BattagUe, the Qa Ira sonnets, the Nuove Odi Barbari, and a considerable number of articles, pamphlets, and essays, which in their collected edition form the most living part of his work. His lyrical production, too, seemed to reach its perfection in those five years of tense, unrelenting work ; for the Canzone di Legiiano, the Odes to Rome and to Monte Mario, the Elegy on the urn of Percy Bysshe Shelley, the ringing rhymes of the Intermezzo, in which he happily blended the satire of Heine with the lyrical form of his native poetry — all belong to this period, together with the essays on Leopardi and on Parini, the admirable litebatuee]

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discussions in defence of his Qa Ira, and the pamphlet called Etemo Femminino regale, a kind of self-defence, undertaken to explain the origin of the Alcaic metre to the Queen of Italy, which marks the beginning of the last evolution in Carducci's work (1881). The revolutionary spirits of the day, who had always looked upon Giosufe Carducci as their bard and champion, fell away from him after this poem written in honour of a queen, and the poet, wounded by the attitude of his party, wrote what he intended to be his defence and his programme for the future in pages that will remain amongst the noblest and most powerful of contemporary literature. P'-om that time Carducci appears in a new form, evolved afterwards in his last Odes, II Piemonte, La Bicocca di San Griacomo, the Ode to the daughter of Francesco Crispi on her marriage, and the one to the church where Dante once prayed. Alia Chiesetta del Polenta, which is like the withdrawing into itself of a warlike soul weary of its battle.

The same qualities which placed Carducci among the classics of

Italy in his earlier days remained consistently with him in later life. His thought flows limpid, serene, sure of itself above an undercurrent of -sane and vigorous if pagan philosophy. Patriotism, the grandeur of work, the soul-satisfying power of justice, are the poet's dominant ideals. For many years the national struggle for liberty had forced the best there was in heart and brain into the atmosphere of political intrigue and from one battlefield to another; Carducci therefore found a poetry emasculated by the deviation into other channels of the intellectual virility of his country. On this mass of patriotic doggerel, of sickly, languishing sentimen-tality as insincere as it was inane, he grafted a poetry not often tender, but always violently felt and thrown into a mould of majestic form ; not always quite expected or appreciated by his contemporaries, but never commonplace in structure ; always high in tone and free in spirit. The adaptation of various kinds of Latin metres to the somewhat sinewless language he found at his disposal, whilst it might have been an effort of mere pedantry in another, was a life-giving and strengthening inspiration in his case. Another of his characteristics, which made him peculiarly precious to his countrymen, is the fact that his poems form a kind of lyric

record of the Italian struggle for independence. The tumultuous vicissitudes of all other nations, however, and the pageantry of the history of all times, have in turns touched his particular order of imagination. The more important part of his critical work which belongs to this later period consists of his Conversazioni Critiche, his Storia filosoflca della leUeratura Italiana, and a masterly edition of Petrarch. That he snould have had the faults of his qualities is not remarkable. Being almost a pioneer in the world of criticism, his essays on the authors of other countries, though appearing in the light of discoveries to his own country, absorbed as it had hitherto been in its own vicissitudes, have little of value to the general student beyond the attraction of robust style. And in his unbounded admiration for the sculptural lines of antique Latin poetry he sometimes relapsed into that fascination by mere sound which is the snare of his language, and against which his own work in its great moments is a reaction.

Fiction in an original form has only revived in Italy since about 1880. Before that time Italian novels, with the solitary exception of Ipromessi sposi, simply did not exist ; the demand for fiction seemed amply and danger-

ously easily satisfied by inept translations from foreign writers, while the authors chosen were seldom those most worthy of translation. The first to shake off this yoke and write on lines of his own was Antonio Fogazzaro (q.v.), whose work is traceable to no particular parentage, exceptjn so far as he has directly continued the traditions of Manzoni. His ideal of literary achievement in point of style is simplicity, and the effect thus attained by him is considerable. His chief works are Daniele CoHis, Malombra, and among the later ones Piccolo Mondo Antico, in which the details of the domestic life of a small corner of Italy during the stirring times of her national struggle, with its sharpened emotions and highly-strung aspirations, are presented with extreme vividness and noiselessly woven into, genuine drama. Not the least of Fogazzaro's merits is the capacity for delicate humour both in characterization and reflection, which he shares with so few of his contemporaries, or indeed of his countrymen. Fogazzaro is a poet by temperament, with an intense appreciation of the higher emotions in

life and art ; the personages of his preference in his own work are the simpler souls attracted by singleness of heart and nobility of purpose. He might have won for himself an even greater place in the literature of his country had his medium been a language entirely national and less dialectal.

Giovanni Verga (born 1840) has also contributed some powerful work, inspired from the fierce passions and primitive manners of humble Sicilian life. His two best novels, however, Malavoglia and Mastro Don Oesualdo, are not his best work, and he will live longest by his short stories {e.g., Cavalleria Busticana). Fogazzaro and Verga faithfully chronicled between them the inner and popular life of northern and southern Italy.

Gabriele d' Annunzio is, however, the Italian writer whose reputation has travelled farthest. Of Dalmatian extraction, he was born at Pescara (Abruzzi) in 1863. The first years of his youth were spent in the freedom of the open fields; at sixteen he was sent to school in Tuscany. While still at school he published a small

volume of verses called Priyno Vere (1879), in which, side by side with some almost brutal imitations of Lorenzo Stecchetti, the then fashionable poet of Postuma, were some translations from the Latin, distinguished by such agile grace that Giuseppe Chiarini on reading them brought the unknown youth before the public in an enthusiastic article. The young poet then went to Eome, where he was received as one of their own by the Cronaca Bizantina group. Here he published Canto Nuovo (1882), Terra Vergine (1882), L' Intermezzo di Rime (1883), II Libro delle Vergini (1884), and the greater part of the short stories that were afterwards collected under the general title of San Pantaleone (1886). In Canto Nuovo we have admirable poems full of pulsating youth and the promise of power, some descriptive of the sea and some of the Abruzzi landscape, commented on and completed in prose by Terra Vergine, the latter a collection of short stories dealing in radiant language with the peasant life of the author's native province. With the Intermezzo di Rime we have the beginning of d' Annunzio's

second and characteristic manner. His conception of style was new, and he chose to express all the most subtle vibrations of voluptuous life. Both style and contents began to startle his critics ; some who had greeted him as an enfant prodige — Chiarini amongst others — rejected him as a perverter of public morals, whilst others hailed him as one bringing a current of fresh air and the impulse of a new vitality into the somewhat prim, lifeless work hitherto produced.

Meanwhile the Review of Angelo Sommaruga perished in the midst of scandal, and his group of young authors found itself dispersed. Some entered the teaching career and were lost to literature, others threw themselves into journalism. Gabriele d' Annunzio took this latter course, and joined the staff of the Tribuna. For this paper, under the pseudonym of " Duca Minim o," he did some of his most brilliant work, and the articles he wrote during that period of originality and exuberance would well repay being collected. To this period of greater maturity and deeper culture belongs II Libro d' Isotta (1886), a love

poem, in which for the first time he drew inspiration adapted to modern sentiments and passions from the rich colours of the Renaissance. II Libro d' Isotta is interesting also, because in it we find most of the germs of his future work, just as in Intermezzo melico and in certain ballads and sonnets we find descriptions and emotions which later went to form the aesthetic contents of II Piacere, II Trionfo della Morte, and Elegie Bomane (1892).

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D'Amumzio's first novel, II Piacere, appeared in 1889, and was followed in 1891 by L' Innocente, and in 1892 by G iovanni Epismpo. These three novels created a profound impression. L' Innocente, admirably translated into French by Georges Herelle, brought its author the notice and applause of foreign critics. His next work, II Trionfo della Morte (1894), was followed at a short distance by Le Vergini della Roccio (1896) and II Fuoco (1900), which in its descriptions of Venice is perhaps the most ardent

glorification of a city existing in any language.

D'Annunzio's poetic work of this period, in most respects his finest, is represented by II Poema Paradisiaco (1893), the Odi Navali (1893), a superb attempt at civic poetry, and Laudi (1900).

A later phase of d'Annunzio's work in his dramatic production, represented by II Sogno di un mattino di primavera (1897), a lyrical fantasia in one act ; his Citta Morta (1898), written for Sarah Bernhardt, which is certainly among the most daring and original of modern tragedies, and the only one which by its unity, persistent purpose, and sense of fate seems to continue in a measure the traditions of the Greek theatre. In 1898 he wrote his Sogno di un Pomeriggio d'Autunno and La Gioconda ; in the succeeding year La Gloria, an attempt at contemporary political tragedy which met with no success, probably through the audacity of the personal and political allusions in some of its scenes ; and finally Francesca da Rimini (1901), a perfect reconstruction of mediaeval atmosphere and emotion, magnificent in style, and declared by one of

the most authoritative Italian critics — Edoardo Boutet — to be the first real although not perfect tragedy which has ever been given to the Italian theatre.

The work of d'Annunzio, although by many of the younger generation injudiciously and extravagantly admired, is almost the most important literary work given to Italy since the days when the great classics welded her varying dialects into a fixed language. The psychological inspiration of his novels has come to him from many sources — French, Russian, Scandinavian, German — and in much of his earlier work there is little fundamental originality. His creative power is intense and searching, but narrow and personal ; his heroes and heroines are little more than one same type monotonously facing a different problem at a different phase of life.

But the faultlessness of his style and the wealth of his language have been approached by none of his contemporaries, whom his genius has somewhat paralysed. In his later work, when he begins drawing his inspiration from the traditions of bygone Italy in her glorious centuries, a current of real life seems to run through the veins of his personages. And the lasting merit of d'Annunzio, his real value to the literature of his country, consists precisely in

that he opened up the closed mine of its former life as a source of inspiration for the present and of hope for the future, and created a language, neither pompous nor vu'gar, drawn from every source and district, suited to the requirements of modern thought yet absolutely classical, borrowed from none, and, independently of the thought it may be used to express, a thing of intrinsic beauty. As his sight became clearer and his purpose strengthened, as exaggerations, affectations, and moods dropped away from his conceptions, his work became more and more typical Latin work, upheld by the ideal of an Italian Renaissance in art and letters. Some of the most remarkable poetic work between 1890 and 1902 was that of Ada Negri (born 1870) and Pascoli. The former, in her first book of poems, Tempeste (1891), tells the helpless tragedy of the forsaken poor and of those whom life has conquered in words of hot, vehement beauty. The promise of more polished form, however, was insufiiciently fulfilled in her second work, Fatalita (1892), while the violent burst of emotion which startles the reader into admiration in her first poems had a tendency to repeat itself on the, same lines, therefore

dwindling into a mannerism. Pascoli, a mild and solitary spirit, is best known by his Myricce and Poemetti, both poems of domestic life and social ideals.

The next name of importance to fiction we find during this period is that of Matilde Serao (born 1856). She was born at Patrasso, Greece. Her father was a political emigrant, and her mother was a Greek. On returning to Naples she became a schoolmistress, and she afterwards, with truly delicious grace, described those years of labo-rious poverty in the preface to a book of short stories called Leggende Napolitane (1881). But attention was first attracted to her name by her Novelle, published in a paper of Rocco de Zerbi's, and later by her first novel, Fantasia (1883), which definitely established her as a writer full of feeling and analytical subtlety. She spent the years between 1880 and 1886 in Home, where she published her next five volumes of short stories and novels, all dealing with ordinary Italian, and especially Roman, life, and distinguished by great accuracy of obser-vation and depth of insight : Guore Inferno (1881), Fior

di Passione (1883), La conguista di Roma (1885), La Virtu di CheccJiina (1884), and Piccole anime (1883). She then founded II Corriere di Roma, the first Italian attempt to model a daily journal on the lines of the Parisian press. The paper was short-lived, and when it was given up Matilde Serao established herself in Naples, where she edited II Corriere de Napoli, and later founded II Mattino, which became by 1902 the most im-portant and most widely read daily paper of southern Ita,ly. But the stress of a journalistic career in no way limited her literary activity ; in the ten years between 1890 and 1900 she produced Pasce di Cuccagna, Ventre di Napoli, Addio Amore, AW Erta Sentinella, Castigo, La Ballerina, Suor Giovanna della Croce, novels in which the character of the people is rendered with minute, sensitive power and sympathetic breadth of spirit.

Matilde Serao's place as a contemporary Italian novelist is one apart : she is a naturalist, but her naturalism should be understood in a much wider sense than that which is generally given to it. She is a naturalist because her books reflect life with the utmost

simplicity of means, sometimes with an utter neglect of means, and at the same time she is an idealist through her high sense of the beauty and nobility which humanity can attain, and to which her writings continually aspire. All her work is truly and profoundly Italian ; it is the literature of a great mass of individuals, rather than of one peculiarly accentuated individual ; the joy and pain of a whole class rather than the perplexities of a unique case or type pulsates through her pages.

Matilde Serao's defects are always defects of style ; her want of sufficient choice of detail often clogs the movement of her narrative and mars the artistic effect of her always animated pages. Like Fogazzaro's, her speech is too often the popular speech of her particular province, in description as well as in dialogue.

Among those writers who, although they have produced some works of fiction of considerable merit, cannot, strictly speaking, be termed novelists we may mention Edmondo d'Amicis (born 1846). His best-known books are personal diaries and descriptions of travel, worthy of consideration for a certain limpidity of expression and grace of thought. Enrico Panzacchi (born 1842) is a

serious critic and graceful poet; and Felice Cavallotti (born 1842) is the author, among other minor poetry, of the stirring Marcia de Leonida.

The activity of this more recent period of Italian literature was manifested quite as much in the field of critical research as in that of artistic creation : Carducci, Alessandro d'Ancona (born 1835), Adolfo Bartoli (born 1833), Alessandro Torraca, and Gassing have done much for the history of Italian literature, while Tivaroni (1812-1872), amongst others, contributed similar work in the service of political and social history. In the realm of synthetic historical reconstruction we find Professor Pasquale Villari (born 1827), with his studies on Machiavelli and Savonarola; Del Lungo (born 1841), with several admirable contributions to the history of Old Florence; Molmenti (born 1852), who has done the same for Venice ; Senatore Negri (1809-1896), with his many essays on historical personages ; Ruggero Bonghi (1826-1895), whose Roman History, admirably

begun, was never carried beyond the first centuries, owing to the preoccupations of political life; Domenico Comparetti (born 1835), to whom we owe some curious studies on Virgil in the Middle Ages; Arturo G-raf (born 1848), who has also contributed numerous pamphlets on mediaeval studies, besides a learned and interesting work on the various legends of the Devil ; and Ferrero, whose first volume of a History of the Greatness and Decadence of Eome (1901) promised to be a work both profound and original.

A characteristic movement of modern Italian literature, brought about by the excessively grave social difficulties that latterly came to be connected with the life of the country, was caused by the extraordinary interest in social studies taken by all classes. It would be impossible not to mention Lombroso's {q-v.) studies in criminology, and Loria's (born 1819^ studies in economics, precisely because of the great influence they exercised on that section of the general studious public in no way pro-

fessionally dedicated to such studies, and because such writers on subjects hitherto little dealt with helped to create the style and language most suitable to them, and henceforth adopted. (m. he.)

Ithaca. See Gbbbcb : Ionian Islands.

Ithaca, capital of Tompkins county, New York, U.S.A., at the head of Cayuga Lake, at an altitude of 389 feet. Most of the city is in the level valley, from which it spreads up the heights on the west. It is on the Lehigh Valley and the Delaware, Lackawanna, and Western railways. It is the seat of Cornell University. Situated in a fertile farming region, its manufactures relate largely to agriculture, and consist in great part of agricultural tools and implements. It was chartered as a city in 1888. Population (1880), 9105; (1890), 11,079; (1900), 13,136—1310 foreign-born and 364 negroes.

I to H i ro b u m i , Maequis (1838), Japanese statesman, was born in 1838, being the son of Ito Juz8, and (like his father) began life as a retainer of the Lord

of Choshiu, one of the most powerful ngbles of Japan. Choshiu, in common with many of his fellow Daimios, was bitterly opposed to the rule of the Shfigun or Ty-coon, and when this rule resulted in the conclusion of the treaty with Commodore Perry in 1854, the smoul-dering discontent broke out into open hostility against both parties to the compact. In these views Ito cor-dially agreed with his chieftain, and was sent on a secret mission to Yedo to report to his lord on the doings of the Government. This visit had the effect of causing Ito to turn his attention seriously to the study of the British and of other military systems. As a result he persuaded Choshiu to remodel his army, and to exchange the bows and arrows of his men for guns and rifles. But Ito felt that his know-ledge of foreigners, if it was t-o be thorough, should be sought for in Europe, and with the connivance of Choshiu he, in company with Inouye and three other young men of the same rank as himself, determined to risk their lives by committing the then capital

offence of visiting a foreign country. "With great secrecy they made their way to Nagasaki, where they concluded an arrangement with the agent of Messrs Jardine, Matheson & Co., for passages on board a vessel which was about to sail for Shanghai (1863). At that port the adventurers separated, three of their number taking ship as passengers to London, while Ito and Inouye preferred to work their passages before the mast in the Pegasus, bound for the same destination. For a year these two friends remained in London studying English methods, but then events occurred in Japan which recalled them to their country. The treaties lately concluded by the Shogun with the foreign Powers conceded the right to navigate the strait of Shimonoseki, leading to the Inland Sea. On the northern shores of this strait stretched the feudal state ruled over by Prince Choshiu, who refused to recognize the clause opening the strait, and erected batteries on the shore, from which he opened fire on all ships which attempted to force the passage. The ShSgun having declared himself

unable in the circumstances to give effect to the provision, the treaty Powers determined to take the matter into their own hands. Ito, who was better aware than his chief of the disproportion between the fighting powers of Europe and Japan, memorialized the Cabinets, begging that hostilities should be suspended until he should have had time to use his influence with Choshiu in the interests of peace. With this object Ito hurried back to Japan. But his efforts were futile. Choshiu refused to give way, and suffered the consequences of his obstinacy in the destruction of his batteries and in the infliction of a heavy fine. The part played by Ito in these negotiations aroused the animosity of the more reactionary of his fellow-clansmen, who made repeated attempts to assassinate him. On one notable occasion he was pursued by his enemies into a tea-house, where he was concealed by a young lady beneath the floor of her room. Thus began a romantic acquaintance, which ended in the lady becoming the wife of the fugitive. Subsequently (1868) Ito was made Governor of Hiogo,

and in the course of the following year became Vice-Minister of Finance. In 1871 he accompanied the Daimio Iwakura on an important mission to Europe, which, though diplomatically a failure, resulted in the enlistment of the services of European authorities on military, naval, and educational systems. After his return to Japan Ito served in several cabinets as head of the Bureau of Engineering and Mines, and in 1886 he accepted ofBce as Prime Minister, a post which by 1902 he had held four times. In 1882 he was sent on a mission to Europe to study the various forms of constitutional government ; on this occasion he attended the coronation of the Tsar Alexander III. On his return to Japan he was entrusted with the arduous duty of drafting a constitution. In 1890 he reaped the fruits of his labours, and nine years later he was destined to witness the abrogation of the old treaties, and the substitution in their place of Conventions which place Japan on terms of equality with the European States. In all the startling reforms in the Land of the Eising Sun Ito played a leading part. It

was mainly due to his active interest in military and naval affairs that he was able to meet Li Hung Chang at the end of the Chinese and Japanese war (1895) as the representative of the conquering state, and the conclusion of the Anglo-Japanese Alliance in 1902 testified to his triumphant success in raising Japan to the first rank among civilized Powers. As a reward for his conspicuous services in connexion with the Chinese war Ito was made a marquis, and in 1897 he accompanied Prince Arisugawa as a joint representative of the Mikado at the Diamond Jubilee of Queen Victoria. At the close of 1901 he again, though in an unofficial capacity, visited Europe and the United States.

luka, capital of Tishomingo county, Mississippi, U.S.A., on the Southern railroad, at an altitude of 460 feet. It is chiefly known as the site of a battle during the Civil War between a part of General Grant's army under General Eosecrans and the Confederates under General Price, in which the latter were defeated. Population (1890), 1019 ; (1900), 852.

658 IVANOVO-VOZNESENS K — I Z U-N 0-S H I C H I-T 0

Ivanovo-Voznesensk, a town of Middle Eussia,

government and 86 miles by rail north of Vladimir. It

has thirty-eight cotton factories, which employ 26,000

hands, and thirty-two other factories, the aggregate

returns being about £3,800,000 per annum. Population (1887), 22,000 ; (1897), 63,950.

Ivory Coast, The, a Prench West African colony, bounded on the S. by the Gulf of Guinea, on the W. by Liberia and French Guinea, on the N. by Senegal and the military territories of the Sudan, on the E. by the Gold Coast. The coast is low, bordered with lagoons, and difficult of access on account of the bar. Back from the coast are the Kong ranges of hills, from 3000 to 4000 feet high, terminating in steep slopes in the south. Starting on the Liberian frontier, the rivers are the Cavally, the San Pedro, the Sassandra (240 miles), which comes from the extremity of the Kong plateaus, the Bandama (226 miles), formed by the White and the Eed Bandama, and the Komoe (360 miles). The climate is in general hot on the coast and (owing to the lagoons) un-healthy, the rainfall being very heavy. The fauna and flora are similar to those of Senegal and the Sudan. This country is stated to have been visited by Dieppe mer-chants even in the 14th century, and a French factory

was established from 1700 to 1707. After exploration by Commandant Bouet Williaumez in 1838, the natives ceded some territories to the Monarchy of July. In 1843 Assinie and Grand Bassam were occupied. In 1849, and again in 1893, armed conflicts arose between the Europeans and the native tribes. France evacuated her factories in 1872, but reoccupied them in 1883. Between 1887 and 1889 Captain Binger traversed the whole region between the coast and the Niger, visited Bonduku and the Kong country, and signed protectorate treaties with the chiefs. It was to the zone between the Kong states and the hinterland of Liberia that Samory fled for refuge before he was taken prisoner, and for a short time he was master of Kong. Serious trouble was experienced with the natives as late as 1899. The boundary on the west was settled by the Franco-Liberian Agreement of 1892 ; that on the east by the Anglo-French Agreement of 1893 and 1898. The present northern boundary of the hinterland was fixed on the division of the Sudan {q.v. : French) among the other French West

African colonies in 1899, when the Ivory Coast, which previously administered most of the Kong protectorate, received the circles of Odjenne, Kong, and Buna. The present area of the colony is estimated at 119,500 square miles, and its population at 1,500,000. It was separated from Senegal in 1893, and is administered by a governor — himself, however, since 1896, under the governor-general of French West Africa — assisted by a council composed of three official and three civilian members. The Ivory Coast, like Guinea and Dahomey, has been allowed to manage its own finances, with the result that it has had to make no claim upon France. In 1899 both revenue and expenditure materially exceeded the budget estimates, the former amounting to £71,000, the latter to £72,000, but the small apparent deficit was in reality fully provided for. The budget for 1900 showed an increase on the former one, and balanced at £56,000. Indirect contributions were estimated to produce £54,000.

The natives cultivate almost nothing but maize and

rice; Europeans are trying the cultivation of coffee, which gives good results. Palm-tree products and rubber are collected. It is worth noticing that the collection of the latter in increasing quantities is being effected without destroying the source of supply. Inland there are immense forests rich in mahogany, which are now beginning to be worked. Gold is found, but not in sufficient quantities to tempt Europeans to work it ; the natives, however, obtain it to a value ranging from £1000 to £36,750 in the year. The exportation of ivory has almost ceased. By the agreement of 1898 commerce as far as 9° N. is duty-free for at least thirty years. The value of the trade has rapidly increased. In 1900 imports were valued at £263,000, of which £103,000 was the share of France and her colonies. The principal items in 1898 (total, £224,000), apart from specie (£22,000), were,: cotton fabrics (almost entirely from Great Britain), £34,400 ; intoxicants (mostly from the United States), £30,400; and leaf tobacco" (Holland, the United States, and Germany), £18,600. Exports increased in value from

£202,000 in 1898 (of which only £37,400 worth went to France) to £323,000 in 1900. Three articles of export at present stand out high above all others : mahogany, valued at £46,000 in 1898 and £24,000 in 1899 ; palm oil, £70,000 in 1898, £73,000 in 1899 ; rubber, £52,000 in 1898, £114,000 in 1899. The lagoon of Grand Bassam, affording shelter for vessels, constitutes a good inland roadstead. Similarly, Assinie, 30 miles to the east, is situated on a lagoon. Elima is the centre of coffee plantations covering 1600 acres. Grand Lahou has the trade of the Bandama. Grand Bassam is in regular communication by steamer with Bordeaux and Marseilles and Liverpool. It is also connected with Europe by submarine cable. Inland, roads have been constructed. A considerable portion of a telegraph line connecting the coast with the Sudan has been laid down, and a railway, 178 miles long, running inland from Abidjean is under construction.

AuTHOKiTiES. — BiNGEE. Dbt Niger an G-olfe de Guinee. Paris, 1890. — Henrique. Les Colonies Fran^aises. Paris, 1890. —

Marcel Mounter. La Mission au Oapitaine Binger. Paris, 1892. — Lee. French Colonies. Poreign Office Report, 1900. — L'Annee Coloniale. Paris, 1900. (p. l.)

Ivry-SUr-Seine, a town and railway station in the arrondissement of Sceaux, department of Seine, France, about half a mile S.S.E. of the Outer Circle of Paris. It has a large hospital for incurables. There are important steel-works, brgweries, and oil-works. Port traffic, including Pont d'lvry, 1900, 178,822 tons. Population (1891), 19,830; (1901), 28,685.

Ixelles, a town of Belgium, in the province of Brar bant, containing the zoological gardens — a favourite promenade— of Brussels, of which it is a suburb. Population (communal, 1880), 36,324 ; (1900), 68,615.

Izhevskiy Zavod, or Izhevskoi, town of Russia, in the Ural Mountains, government of Vyatka, 146 miles south-west of Perm, 27 miles from the Kama, on Izh river. It has one of the chief steel and rifle works of the Eussian Crown. About 190,000 rifles are produced yearly at the works, while the making of sporting guns

is a widely-spread domestic industry. Population, 21,500.

Izmail, a district town of Eussia, government of Bessarabia, on the left bank of the Kilia branch of the Danube, 57 miles below Eeni railway station. It was annexed to Eussia in 1878. There are steam and horse flour-mills. It has a custom-house, and is visited every year by more than 1000 vessels. The population in 1897 was 31,000, comprising Great and Little Eussians, Bulgars, Jews, Tziganes (Gypsies), &c.

Izu-no-shichi-td, the seven (sMcJit) islands (td) of Izu, which are included in the empire of Japan. They stretch in a southerly direction from a point near the mouth of T6ky5 Bay, and lie between 33° and 34° 48' N. and between 139° and 140° E. Their names, com-mencing from the north, are Izu-no-Oshima, T6-shima,

Nii-shima, K5zu-shima, Miyake-shima, and Hachijo-shima. There are some islets in their immediate vicinity. Izu-no-Oshima, an island 10 miles long and 6^ miles -wide,

is only 15 miles from the nearest point of the Izu promontory. It is known to western cartographers as Vries Island, a name derived from that of Captain Martin Gerritsz Vries, a Dutch navigator, who is supposed to have discovered the island in 1643. But the group was known to the Japanese from a remote period, and used as convict settlements certainly from the 12th century and probably from a still earlier era. Hachijo, the most southerly, is often erroneously written " Fatsisio " on English charts. Izu-no-Oshima, or Vries Island, is remarkable for its smoking volcano, Mihara (2395 feet), a conspicuous object to all ships bound for Yokohama. Three others of the islands — Nii-shima, Kozu-shima, and Miyake-shima — have active volcanoes. Those on Nii-shima and K6zu-shima are of inconsiderable size, but that on Miyake-shima, namely, Oyama, rises to a height of 2707 feet. The most southerly island, Hachijo-shima, has a still higher peak, Nishi-yama (2913 feet), but it does not emit any smoke.

Izyum, a district town of Eussia, government and

81 miles south-east of Kharkov, on the Donets. There is trade in corn and cattle. Population, 13,000.

Jaca, a town of Spain, near the French frontier, in the province of Huesca. Owing to its position on the Pyrenean high road to France, and on the projected international railway, the town has gained in commercial importance. General improvements have been effected and frontier defence works constructed in the neighbourhood. Population, 5157.

Jackson, capital of Jackson county, Michigan, U.S.A., on the Grand river, near its head, at an altitude of 925 feet. The city has a rather irregular plan, is divided into eight wards, and has an excellent water-supply by the Holly pumping system, and good sewerage. It is at the intersection of four railways : the Cincinnati Northern, the Grand Trunk, the Lake Shore and Michigan Southern, and the Michigan Central. It contains the state penitentiary and the principal shops of the Michigan Central railroad. Its manufacturing establishments in 1890 numbered 220, with a capital of nearly $5,000,000,

employing 3630 hands and producing goods valued at $5,376,347. Prominent among these were carriages and waggons, whose value was nearly one-fifth of the total product ; flour, corsets, and machine-shop products. Population (1880), 16,105; (1890), 20,798; (1900), 26,180, of whom 3843 were foreign-born and 473 negroes.

Jackson, capital of Hinds county and of the state of Mississippi, U.S.A., on the Pearl river, at an altitude of 291 feet, at the intersection of three railways: the Illinois Central, the Queen and Crescent, and the Yazoo and Mississippi Valley. It has a large cotton trade. Population (1890), 5920 ; (1900), 7816, of whom 119 were foreign-born and 4447 negroes.

Jackson, capital of Jackson county, Ohio, U.S.A. It lies in an iron and coal region, and contains furnaces and other ironworks. It is on the Baltimore and Ohio South-Western, the Ohio Southern, and the Hocking Valley railways. Population (1880), 3021; (1890), 4320 ; (1900), 4672, of whom 232 were foreign-born and 140 negroes.

Jackson, capital of Madison county, Tennessee, U.S.A., at an altitude of 425 feet, at the intersection of the Illinois Central, the Mobile and Ohio, and the Nashville, Chattanooga, and St. Louis railways. It has a large cotton trade and railway machine works. It is the seat of the South- Western Baptist University, which in 1898 had 11 instructors and 270 students. Population (1880), 5377 ; (1890), 10,039 ; (1900), 14,511, of whom 224 were foreign-born and 6108 negroes.

Jackson, Helen Maria (1831-1885), American poetess, known by her pseudonym of " H. H.," was born in Amherst, Massachusetts, on the 18th October 1831, the daughter of Nathan W. Piske, a professor in the college at that place. Her first husband was Captain Edward B. Hunt, of the United States army. After his death, in 1863, and other bereavements, Mrs. Hunt's mind turned towards serious thought on many moods of life and experience, which she expressed in a little volume of meditative Verses (1870), of which the aged Emerson, in the preface to his Parnassus (1874) remarked : " The

poems of a lady who contents herself with the initials H. H. . . . have rare merit of thought and expression, and will reward the reader for the careful attention which they require." Thenceforward she was a prolific writer of prose and verse, including juvenile tales, books of travel, household hints, and novels, of which none has retained a place in American literature save Bamona (1884), a defence, in the form of fiction, of the Indian character, in which she had become deeply interested. A Century of Dishonor (1881) was an arraignment, in historical chapters, of the treatment of the Indians by the United States. In 1875 she married William S. Jackson, a merchant of Colorado Springs, Colorado ; and died in San Francisco, on the 12th of August 1885. (c. F. E.)

Jacksonville, capital of Duval county, Florida, U.S.A., on St Johns river. It is regularly laid out, and has a good water-supply and sewerage. It is entered by six railways, which, with the fine harbour, greatly improved by dredging, give it a large commerce. Its exports con-

sist of cotton, lumber, naval stores, fruit, and phosphates. Its manufactures consist largely of lumber and cigars. Population (1890), 17,201 ; (1900), 28,429, of whom 1166 were foreign-born and 16,236 negroes.

Jacksonville, capital of Morgan county, Illinois, U.S.A., at an altitude of 578 feet, and at the intersection of the Chicago and Alton, the Chicago, Peoria, and St Louis, the Jacksonville and St Louis, and the Wabash railways. It is the site of several state charitable institutions, the Deaf and Dumb Asylum, the Insane Asylum, and the Blind Asylum. It contains also several educational institutions, especially Illinois College, a non-sectarian institution, which in 1899 had 15 instructors and 239 students, and Illinois Women's College, which in the same year had 16 instructors and 248 students. Population (1890), 12,935; (1900), 15,078, of whom 1497 were foreign-born and 997 negroes.

Jacobabad, a town of British India, the adminis-trative headquarters of the Upper Sind frontier district in Bombay ; a station on the Quetta branch of the North-

western railway, 37 miles from the junction at Euk on the main line. Population (1881), 11,352; (1891), 12,396. The town was founded in 1847 by General John Jacob, for many years commandant of the Sind Horse who died here in 1858. It has cantonments for a cavalry and an infantry regiment, with accommodation for caravans from Central Asia. It is watered by two canals. An annual horse show is held in January.

Jacobsen, Jens Peter (1847-1885), Danish imaginative writer, was born at Thisted in Jutland, on the 7th of April 1847 ; he was the eldest of the five children of a prosperous merchant. From 1856 to 1862 he was at school in his native town ; he then read at home for a year, and was sent later in 1863 to Copenhagen. He became a student at the university in 1868. As a boy he showed a remarkable turn for science, particularly for botany. In 1870, although he was secretly writing verses already, Jacobsen dejfinitely adopted botany as a profes-

sion. He was sent by a scientific body in Copenhagen to report on the flora of the islands of Anholt and Loeso. About this time the discoveries of Darwin began to exercise a fascination over him, and finding them little understood in Denmark, he translated into Danish Tim Origin of Species and Tlie Descent of Man. He continued to work at the lower vegetable forms with such energy that his zeal, in fact, proved fatal to him, for in the autumn of 1872, while collecting plants in a morass near Ordrup, he contracted pulmonary disease. His illness, which cut him off from scientific investigation, drove him to literature. He met the famous critic, Dr Georg Brandes, who was struck by his powers of expression, and under his influence, in the spring of 1873, Jacobsen began his great historical romance of Marie Grubbe. His method of composition was painful and elaborate, and his work was not ready for publication until the close of 1876. His health grew steadily but very slowly worse. In 1879, indeed, he was too ill to write at all ; but in 1880 an improvement came, and he finished his second novel,

Niels Lylme. In 1882 he published a volume of six short stories, most of them written a few years earlier, called, from the first of them, Mogens. After this he wrote no more, but lingered on in his mother's house at Thisted until 30th April 1885. In 1886 his posthumous fragments were collected It was early recognized that Jacobsen was the greatest artist in prose that Denmark has produced. He has been compared with Flaubert, with De Quincey, with Pater; but these parallelisms merely express a sense of the intense individuality of his style, and of his untiring pursuit of beauty in colour, form, and melody. Although he wrote so little, and crossed the living stage so hurriedly, his influence in the North has been far-reaching. It may be said that no one in Denmark or Norway has tried to write prose carefully since 1880 whose efforts have not been in some degree modified by the example of Jacobsen's laborious art. His Samlede Shrifter appeared in two volumes in 1888 ; in 1899 his letters {Breve) were edited by Edvard Brandes. In 1896 an English translation of part of the former was

published under the title of Siren Voices: Niels Lyhne, by Miss E. E. L. Eobertson. (b. g.)

Jade, or Jahde, a deep bay and estuary of the North Sea, belonging to the grand duchy of Oldenburg, Germany. The bay, which was for the most part made by storm-floods in the 13th and 16th centuries, measures 70 square miles, and has communication with the open sea by a fairway, some 2 to 3 miles wide, which never freezes, and with the tide gives access to the largest vessels. On the west side of the entrance to the bay is the Prussian naval port of Wilhelmshaven. A tiny stream, about 14 miles long, also known as the Jade, enters the head of the bay.

Jaen, a province of southern Spain. It is divided into 13 administrative districts and 97 parishes, covering 5184 square miles. In 1897 the population was 463,806. The birth-rate was 3-92 per thousand and the death-rate 38-5 per thousand; the proportion of illegitimate births was only 3-63 per cent. The main railway line from Madrid to Cordova, Seville, and Cadiz

runs through the province, and has a branch from Vendellano to the important mining centre of Linares. Another line runs from Linares to Puente Jenil. There are 200 miles of first-class roads, and the municipal and provincial roads are fairly good. Apart from agriculture and mines, the only local industries are saw-milling and manufactures of oils, alcohols, and esparto-grass rugs. The mining interests of the province are progressing. More mines are being worked and fresh concessions duly registered every year, and the works also are developing. Two zinc and 294 lead mines give employment to 7800 hands. No less than 180 tons of zinc, 119,376 tons of lead, 7935 tons of carbonate have been extracted, and the factories have turned out 29,163 tons of lead and 13,000 tt> of silver. There are in addition 349 registered and yet unproductive mines, mostly lead. In 1898 the live stock in the province included 6469 horses, 16,775 mules, 11,890 asses, 10,305 cattle, 197,619 sheep, 48,136 goats, 32,115 pigs. Agriculture is thriving ; there were 520,000 acres covered with wheat crops, 342,500 acres with oats,

rye, barley, maize, 115,000 acres with pod fruit, 9000 acres with vines, and 382,000 acres with olives.

Jaen, the capital of the above province. Its educational establishments include primary schools for both sexes, an institute, a school for training teachers, a couple of religious seminaries, and several convents for girls. Its silk industry, formerly in good repute, has decayed, and the local manufactures are now mostly leather, soap, alcohol, and linen stuffs. Population, 25,804.

Jaffna, a town of Ceylon, at the northern extremity of the island. In 1901 it had a population of about 47,000, while in the district or peninsula of the same name there were 299,541 persons, nearly all Tamils, the only Europeans being the civil servants and a few planters. Cocoanut planting has not been successful of recent years. The natives grow palmyras freely, and have a trade in the fibre of this palm. They also grow and export tobacco, but not enough rice for their own requirements. A steamer calls weekly, and there is considerable trade. The railway extension from Kurunegala d\ie north to

Jaffna and the coast was commenced in 1900. Annual average rainfall, 44 inches ; average temperature, 81-7°. Jaffna is the seat of a government agent and district judge, and criminal sessions of the supreme court are regularly held. Much missionary and educational work is carried on in the peninsula, by Eoman Catholic, Church of England, Wesleyan, and American missions.

Jagannath Shankersett (1800-1865), the recognized leader of the Hindu community of Bombay for more than forty years, was born in 1800 into a family of goldsmiths of the Daivadnya caste. Unlike his forefathers, he engaged in commerce, and, by means of diligence joined to intelligence and force of character, he soon acquired what was in those days a large fortune, a great part of which he devoted to the good of the public. So high was his credit in the city that Arabs, Afghans, and other foreign merchants chose to place their treasures in his custody rather than with the banks. Foreseeing the need of better methods of education, he became one of the founders of the School Society, and the Native School of

Bombay, the first of its kind in Western India, which in 1824 developed into the Bombay Native Institution, and again in 1840 into the Board of Education which preceded the Elphinstone Educational Institution founded in 1856. In all these successive advances in the educational life of those times Jagannath Shankersett took the leading and most active part. When the Students' Literary and

Scientific Society first opened their girls' schools, in spite of strong opposition of the Hindu community, Jagannath backed the reformers up, and soon set the good example of providing another girls' school entirely at his private cost. His zeal for progress was also shown in his starting at his own expense the English School, the Sanskrit Seminary, and the Sanskrit Library, all in Girgaum. He was President of the Agri-Horticultural Society of Western India, of the Victoria and Albert Museum, and Victoria Gardens Committee, and of the Bombay Association. In all municipal and sani-

tary affairs of Bombay he took keen interest, and his efforts in support of railways and new roads were un-tiringand successful. To Jagannath Shankersett, indeed, and his public-spirited friends. Sir George Birdwood and Dr Bhau Daji, Bombay is indebted for the reconstruction which, beginning in 1857, has gradually changed a close network of lanes and streets into a spacious and airy city, adorned with five avenues and splendid buildings. He very early became and remained an acceptable adviser to the Government, and was consulted by them on all matters connected with the views and sentiments of the natives. In this way he secured for them in 1829 the right of sitting in the Grand Jury, and their inclusion in the Commission of Justices of the Peace. He was the first Indian to be nominated to the Legislative Council of Bombay under the Act of 1861, an honourable recognition of the confidential services rendered by him to a long series of governors. While, on the one hand, his weighty influence was used by Sir John Malcolm to induce the Hindus to acquiesce in the suppression of sati or widow-burning, his own

community remember gratefully that to him they owe the cremation ground at Sonapur, still used for the burning of their dead. He died at Bombay, on the 31st July 1865, regretted by all daises of society, who in token of respect, about a year before his death, in a public meeting assembled at the Town Hall, voted a marble statue to perpetuate his memory. He was a fine type of those Indians who for generation after generation have devoted their lives to unite the races of the East and West by the strong ties of mutual regard and friendship. (n. b. w.)

Jagerndorf (Czech, Krnov), the chief town of a government district and principality of the same name in Austrian Silesia, situated at the confluence of the Gold-Oppa and the Oppa at the foot of the Burgberg. It is a station on the Central Moravian-Silesian and Prussian State railways. It has a chateau belonging to Prince Liechtenstein, who holds large estates in this district, and on the neighbouring Burgberg is a church much visited as a place of pilgrimage, and the ruins of the seat of the former princes of Jagerndorf. The town suffered severely in the

Thirty Years' War, and was the scene of engagements between the Prussians and Austrians in May 1745 and January 1779. The claim of Prussia to the principality of Jagerndorf was the occasion of the First Silesian War. The partition which followed left Austria the larger portion, now part of Austrian Silesia. The town has a considerable trade and a large textile industry (cloth and woollens), a machine factory, &c. The population in 1890 was 14,267, chiefly German and Catholic (2 per cent. Czech, 4 per cent. Jewish, and 3 per cent. Protestant); (1900), 14,675.

Jaice, Jajce, or Iaitze, an ancient royal town of Bosnia, 97 miles north-west of Sarajevo by rail, splendidly situated on the slope of the Gola Planina and on the left bank of the Vrbas (an affluent of the Save), where it receives the waters of the Pliva by a magnificent waterfall of 100 feet. It is specially celebrated for its ancient fortress, which preserves within its walls portions of a still more ancient royal palace of the kings of Bosnia. There are also large catacombs. In the Franciscan church is the coffin

with remains (rediscovered in 1888) of Tomashewitch, the last king of Bosnia, captured and executed by the Turks in 1493. The water-power of the Pliva fall has been used for industrial purposes. Population, 6000.

Jain ism. — Considerable progress has been made in the publication and elucidation of the original authorities for this interesting form of faith. But a great deal remains yet to be done. The oldest books now in the possession of the modern Jains purport to go back, not to the foundation of the existing Order in the 6th century e.g., but only to the time of Bhadrabuhu, two centuries later. The whole of the still older literature, on which the revision then made was based, the so-called P'krvas, have been lost. And the existing canonical books, while preserving a great deal that was probably derived from them, contain also much of later material. The problem remains to sort out the older from the later, to distinguish between the earlier form of the faith and its subsequent developments, and to collect the^ numerous data for the general,

social, industrial, religious, and political history of India. Prof. Weber has given a fairly full and carefully-drawn-up analysis of the whole of the more ancient books in the second part of the second volume of his Catalogue of the Sanskrit MSS. at Berlin, published in 1888, and Prof. Bhandarkar has given an account of the contents of many later works in his Repoi-t on the Search for Sanskrit MSS., Bombay, 1883. And a small beginning has been made in editing and translating these works. The best precis of a long book, given in a few pages only, can necessarily only deal with the more important features in it. And in the choice of what should be included, and what left out, the jjr^as-writer will often omit precisely the points some subsequent investigator may most especially want. All the older works ought therefore to be properly edited and translated in full, and properly indexed. The Jains themselves have now printed in Bombay a com-plete edition of their sacred books. But the critical value of this edition, and of other editions of separate texts printed elsewhere in India, leaves much to be desired.

Prof. Jacobi has edited and translated the Kalpa Sutra containing a life of the founder of the Jain Order ; but this can scarcely be older than the 6th century^ of our era. He has also edited and translated the Aydranya Sutta of the Swetambara Jains. The text, published by the Pali Text Society, is of 140 pages octavo. The first part of it, about 50 pages, is a very old document on the Jain views as to conduct, and the remainder consists of appendixes, added at different times, on the same subject. The older part may go back as early as the 3rd century B.C., and it sets out more especially the Jain doctrine of tapas or self-mortification, in contradistinc-tion to the Buddhist view, which condemned asceticism. The rules of conduct in this book are for members of the Order. Dr Rudolf Hoernle has edited and translated an ancient work on the rules of conduct for laymen, the Uvdsaga Dasdo} Prof. Leumann has edited another of the older works, the Aupapdtika Siitra, and a fourth, entitled the Dasa-vaikdlika SiJctra, both of them published by the German Oriental Society ; and finally. Prof. Jacobi has

translated two more, the Uttarddhydyana and the Siitra Kritdnga.^ Thus about one-hundreth part of these interesting and valuable old records are now accessible to the European scholar. It is the sect of the Svetftmbaras which has preserved the oldest literatures. Prof. Jacobi has discussed

1 Published in the Bihliotheca Indica, Calcutta, 1888.

2 These two, and the other two mentioned above, form vols. i. and ii. of his Jaina Sutras, published in the Sacred Books of the East, 1884, 1895.

in two papers the history of the schism between them and the Digambaras, and several scholars — notably Bhagvanlal Indraji, Mr Lewis Eice, and Hofrath Biihler in the articles mentioned below^ — have treated of the remarkable archaeological discoveries lately made. These confirm the older records in many details, and show that the Jains, in the centuries before the Christian era, were a wealthy and important body in widely separated parts of India. A further confirmation of the substantial accu-

racy of the existing Jain records has been found in the numerous references to Jains, and to points of Jain belief, in the recently published Buddhist NikSiyas. These are older than the oldest of the Jain books. But the details they give show that the latter have not altered very much from the original tenets of their faith so represented, not seldom with evident bias, by their rivals the Buddhists.

It is now certain that the Jain community was really even older than the time of the Buddha, and was reorganized by his contemporary the Mah§, Vira, named Vaddham9,na. And it is also clear that the Jain views of life were, in the most important and essential respects, the exact reverse of the Buddhist views. The two orders, Buddhist and Jain, were not only, and from the first, independent, but directly opposed the one to the other. In philosophy the Jains are the most thorough-going supporters of the old, animistic position. Nearly everything, according to them, has a soul within its outward visible shape — not only men and animals, but also all

plants, and even particles of earth, and of water (when it is cold), and fire and wind. The Buddhist theory, as is well known, is put together without the hypothesis of " soul " at all. The word the Jains use for soul is fiva, which means life ; and there is much analogy between many of the expressions they use and the view that the ultimate cells and atoms are all, in a more or less modified sense, alive. They regard good, and evil, and space as ultimate substances which come into direct contact with the minute souls in everything. And their best-known position in regard to the points most discussed in philosophy is Sy&d-vMa, the doctrine that you may say " Yes " and at the same time " No " to everything. You can affirm the eternity of the world, for instance, from one point of view, and at the same time deny it from another ; or, at different times and in different connexions, you may one day af&rm it and another day deny it. This position both leads to vagueness of thought and explains why Jainism has had so little influence over other schools of philosophy in India. On the other hand, the Jains are as

determined in their views of asceticism (tapas) as they were compromising in their views of philosophy. Any injury done to the " souls " being one of the worst of iniquities, the good monk should not wash his clothes (indeed, the most austere will reject clothes altogether), nor even wash his teeth, for fear of injuring living things. " Subdue the body, chastise thyself, weaken thyself, justasfireconsumes dry wood." It was by suppressing, through such self-tor-ture, the influence on his soul of all sensations that the Jain could obtain salvation. It is related of the founder himself, the MahS, Vira, that after twelve years' penance he thus obtained Nirvana (Jacobi, Jaina Si\tra, i. 201) before he entered upon his career as a teacher. And through the rest of his life, till he died at PavS,, shortly before the Buddha, he followed the same habit of continual self-mortification. The Buddha, on the other hand, obtained Nirvana in his 35th year, under the Bodhi-tree, after he had abandoned penance ; and through the rest of his life he spoke of penance as quite useless from his point of view.

1 The Hatthi Gumphd and three other inscriptions at Cuttacli:,

Leydeu, 1885; Sravana Belgola inacxiptions, Bangalore, 1889; Vienna Oriental Journal, vols, ii.-v. ; Epigraphia Indica, vols, i.-iv. There is no manual of Jainism as yet published, but there is a great deal of information on various points in the introductions to the works quoted above, (t. w. r. d.)

Jalaun, a town and district of British India, in the Allahabad district of the North-West Provinces. The town has a population of about 10,000, but is not a municipality. Formerly it was the residence of a Ma,hra,tta governor, but never the headquarters of the district, which are at Oral. The district of Jalaun forms part of British Bundelkhand ; area, 1480 square miles. The population in 1881 was 418,142 ; in 1891, 396,361 ; and in 1901, 400,619 ; average density, 268 per square mile ; land revenue and rates, Es.5,92,905, the incidence of assessment being E.l : 1 : 4 per acre ; cultivated area (1896-1897), 283,641 acres, of which 59,810 were irrigated, including 47,075 from Government canals ; number of police, 1743 ; number of vernacular schools (1896-97), 62, with 2264 pupils ; registered death-rate (1897), 68-9 per

thousand. The two largest towns are Kunch (13,408) and Kalpi (12,713). The district is now traversed by the line of the Indian Midland railway from Jhansi to Cawnpore. A small part of it is watered by the Betwa canal, a " protective" work which has never paid the interest on the capital expended.

Jalisco, a state of Mexico, bounded on the N. by the states of Sinaloa, Durango, Zacatecas, and Aguascalientes ; on the E. by Zacatecas, San Luis Potosi, Guanajuato, and Miehoacan ; on the S. by Colima and Michoacan ; and on the W. by the Pacific. It has an area of 31,855 square miles, and had a population in 1879 of 983,484, and in 1900 of 1,137,311. It is well timbered, and has a climate varying according to the altitude. It is rich through its mines, agriculture, and stock-raising. The capital, Guadalajara, had in 1895 a population of 83,934; and amongst other towns are Zapotlanejo (20,270), Ciudad Guzman (17,374), Lagos (14,716), Sayula (8819), Tamazula (8783), Autlan (8710), Teocaltiche (7568), Ameca (7212), Cocula (7090), Etzatlan (6753), La Barca (6465), Zacualco

(6338), Tepatitlan (5994), Tizapan el Alto (5708), Colotlan (5590), Atotonilco el Alto (5551), Arandas (5367), and Ahualuco (5302).

Jalon, a river of Spain, having its source near Estiras, in the province of Soria, where it flows for nearly 32 miles in mountainous districts, before it enters the province of Saragossa. In this province it pursues a direction from west to east, passing near Alhama, Ateca, Calatayud, thence to Paracuellos, Eicla, Eueda, and, going under the imperial canal, joins the Ebro on its right bank at Alagon, after a total course of 180 miles. It has many tributaries in the provinces of Soria and Saragossa. It is not navigable.

Jalpaiguri, or Julpigoree, a town and district of British India, in the Eajshahi division of Bengal. The town is on the right bank of the river Tista, and has a railway station about 300 miles due north of Calcutta. Population (1891), 9682. There is a Government high school, with 226 pupils in 1896-97, and one printing-press. The district of Jalpaiguri occupies an irregularly-shaped

tract south of Darjiling and Bhutan and north of the state of Cooch Behar. It includes the Western Dwars, annexed from Bhutan after the war of 1864-65. Area, 2962 square miles. The population in 1881 was 581,096 ; in 1891, 681,352, showing an increase of 17 per cent. ; average density, 230 persons per square mile. In 1901 the population was 787,954, showing a further increase of 16 per cent. Land revenue and rates, Es.7,57,965 ; number of police, 336 ; number of boys at school (1896-97), 9691,

being 17.7 per cent, of the male population of school-going age; registered death-rate (1897), 34-03 per thousand.

The Western Dwars portion of the district is the principal centre of tea cultivation in Bengal. In 1897 the number of gardens was 285, employing 37,627 hands, with 65,072 acres under tea, yielding 24 million pounds. All these figures show a considerable increase on the previous year. The other portion of the district produces jute. There are 3 steam jute presses, employing 77 hands, with an out-

turn of 26,000 bales; and 5 hand-presses, employing 130 hands, with an out-turn of 30,000 bales. The district is traversed by the main line of the Eastern Bengal railway to Darjiling. It is also served by the Bengal Dwars railway, with 102 miles open in 1900, and net earnings of £12,929.

Jamaica, the largest island of the British West Indies, lying between the Caribbean Sea and the Gulf of Mexico, about 80 miles to the southward of the eastern extremity of Cuba, within 17° 40' and 18° 30' N. and 76° 10' and 78° 38' W. It possesses many varieties of climate, due principally to the differences of altitude. Nearly one-half of the area of the whole island is above 1000 feet in height, and temperate in climate. At Kingston the temperature ranges from 70°-7 to 87°-8, and this is generally applicable to all the low-lying land round the coast. At Cinchona, at an elevation of 4907 feet, it varies from 57°-5 to 68°-5. The rainfall varies greatly. For the whole island the annual average is 66-3 inches ; at Kingston it is 32-6 ; at Cinchona it is 105-57 ; in parts

of the north-east it exceeds 200 inches. No month is, as a rule, quite without rain, but the heavy rains come in May and October, the latter being the heavier and lasting the longer. Except near lagoons and morasses, the island is healthy. Yellow fever rarely occurs nowadays. When it did occur in 1885 and 1897, the deaths due to it were in each case under 100, or less than 1 per cent, of the general mortality. The climate of the Santa Cruz mountains is, by reason of its dryness and equability, an ideal one for persons in the early stages of consumption, and for rheumatic subjects. About a century ago Jamaica suffered much from hurricanes, which destroyed buildings and crops. But now, fortunately, they pass to the north and east, and also to the south and west, with comparative frequency, but they rarely strike the island itself.

Flora and Fauna. — Jamaica is most favourably situated for the botanist. The flora shows types from North, Central, and South America, as well as a few European forms and the common plants found everywhere in the tropics. Of flowering plants there are about 2180

distinct species, besides many varieties, and of ferns about 450 species, a number of both being indigenous. The great number of species may be to some extent accounted for by the ranges of altitude, temperature, and humidity to be found in different parts. Amongst the woods suitable for cabinet work, mahogany, cedar, mahoe, yacca, and satinwood are most used. The principal objects of the Government botanical department are the supply of plants yielding products new to the agriculture of the colony, or of a better kind, 40,000 plants being on an average distributed annually; and the providing of information regarding the kind of soil, climate, &c., fitted for the plants, their proper cultivation and preparation for the markets. The principal public garden, with the official residence of the director of public gardens and plantations, is at Hope (700 feet), 5 miles from Kingston ; other gardens are at Castleton (680 feet), in the centre of the island ; the Hill Gardens at Cinchona (3000 to 6300 feet), in the Blue Mountains ; the arboretum, Bath (70 f eet) , in the east end ; and gardens in Kingston and at King's

House. Forty-three of the birds of Jamaica are presumed to be peculiar to the island. The chief are the quail, the mountain partridge, the Jamaica heron, ducks, doves, and pigeons. The list by Alfred and Edward Newton, given in the Jamaica Handbook for 1881, still remains the standard. The land-crab is considered a delicacy, the land-turtle is eaten, but the iguana is not now used as food. In the sea around the coast there is a fair supply of good fishes, excellent in their way, but lacking for the most part the flavour of fishes of temperate waters. The more popular studies of entomology and conchology still reward the collector by the discovery of new and rare species, or of important facts of. structure and life-history. The island is justly celebrated for the number of species of land-shells to be found in it. Similarly with the bats, birds, lizards, and amphibia, there is very much to reward the trained observer or enthusiastic collector. The very abundantand often large limestonecaves all over the island, some with and others without water, have not yet been thoroughly explored, but, judging from results elsewhere,

should contain unique specimens. In marine zoology, the coral reefs, with their varied skeleton-forming polyps and anemones, the numerous alcyonarians, various coral-dwelling animals, and fishes of brilliant hues and strange forms, are readily accessible along most parts of the coast.

Ethnology. — Only recently has anything like a systematic investigation and study been made of the relics of Jam aica's long-extinct Araw§,k Indian inhabitants, but this has shown that the island is rich in such evidences, and more yet remains to be discovered. Collectors still find an abundance of aboriginal petaloid celts and other im-plements, flattened skulls and vessels in the limestone caves, miscellaneous objects from their kitchen-middens, and now and again an image or rock-carving. The inhabitants at present consist of Maroons, the descend-ants of those slaves of the Spaniards who fled into the fastnesses of the mountains on the conquest of the island by the British; the descendants of white settlers ; British officials ; a few still surviving natives of Africa originally

imported as slaves ; the descendants of African slaves ; a mixed race of British and African blood; coolies from India, and a few Chinese. The number of white inhabit-ants, other than British, is very small. The Maroons live by themselves, and are an almost negligible quantity. The negroes are developing into a land-owning peasantry ; the coloured section enter into trade and the professions ; the white settlers are not increasing ; the coolies on the expiration of theirindentures frequently devote themselves to shopkeeping, as do the Chinese.

Area and Population. — The island is divided into three counties Surrey in the east, Middlesex in the centre, and Cornwall in the west, which are again suhdivided into fifteen parishes, as follows : —

Area in

Population

Population

County.

Parish.

Sqnare

by Census

estimated,

Miles.

of 1891.

1901.

Portland

285

31,998

37,817

St Thomas

274

32,176

87,299

Surrey . ■

St Andrew

166

37,885

42,161

Kingston

5A

46,542

1 52,475

Port Koyal

2A

1,962

St Mary

249

42,915

51,671

St Ann

476

54,127

67,133

Middlesex ■

St Catherine

470

65,-509

76,295

Clarendon

474

57,105

68,692

Manchester

302

55,462

70,294

Hanover

167

32,088

37,373

St James

234

35,0-50

38,967

Cornwall ■

Trelawny

333

30,996

35,095

St Elizabeth

462

62,256

77,553

Westmorelan

d 308

53,450

62,905

*4,207^*

639,521

755,730

664

JAMAICA

The following table shows the changes in population according

to the census of 1881 and 1891 : —

1881

Census.

1891

Census.

White ....

Coloured .

Black ....

East Indian

Chinese ....

Not stated

Total

Males ....

Females ....

14,432

109,946

444,186

11,016

99

1,125

14,692

121,955

488,624

10,116

481

3,653

580,804

639,521

282,957

297,847

305,958

333,563

No census of the population was taken in 1901.

The following table gives the annual rate of births and deaths per thousand estimated on the mean population, the marriages celebrated, and the illegitimate births per hundred: —

ISSl.

1891.

1900-1.

Births per thousand

Deaths

Marriages celebrated

Illegitimate births per hundred

36-7

26-0

2178

57-7

38-3

22-7

3560

60-7

35-7

21-6

3221

62-4

The only emigration of any Importance in the last quarter of the 19th century was during the years 1883-86, when the Panama Canal was in course of construction. The emigration was confined almost entirely to adult men, and resulted in a loss to the island of about 20,000 of the population, the chief loss taking place in 1883-84, when 34,852 emigrated to the Isthmus, and only 14,600 returned. Towards the close of 1900 about 2500 labourers emigrated to work on the construction of a railway in Ecuador.

The number of Indian immigrants between 1870 and 1880 was 9023 ; since then it has been as follows :— 1880, 747 ; 1881, 504 ; 1882, none ; 1883, 396 ; 1884, 680 ; 1885, 601 ; 1886 to 1890, none ; 1891, 2136 ; 1892, none ; 1893, 484 ; 1894, none ; 1895, 698 ; 1896

to 1898, none ; 1899, 615 ; 1900, 650.

Government. — The system of Crown government (instituted in 1865) by governor, assisted by a legislative council consisting of ex-officio and nominated members, worked well till 1884, when matters came to a deadlock on account of a vote forced by the Government for damages for the seizure of the Florence, a vessel suspected of a breach of the foreign enlistment laws. This resulted in the resignation of all the unofacial members, and in the unwillingness of any private person to accept the position of a nominated member. Accordingly a change was made by which members elected by a limited suffrage were substituted for members nominated by the Crown, and the council was reconstituted with three ex-officio, four nominated officials, and nine elected members, with the governor as president. In 1895 the number of elected members was increased from nine to fifteen, i.e., one for each parish of the island, the number of nominated and oflBcial members being at the same time proportionately increased from eleven to fifteen, but four of these seats were left vacant. In 1900 four additional nominated members were called in to take their seats, raising the official side of the House to fifteen in number, with fifteen elected members. The local affairs

of the various parishes are controlled by elected parochial boards, subject to supervision by the Government.

jkeligion.— Under the disestablishment law of 1870, which arranged for a gradual disendowment of the Church of England, there are still in receipt of official salary five island curates and one stipendiary curate. The Disestablished Church of England in Jamaica has, including these, 102 clergy ; the Baptists, 63 ; the Wesleyans, 49 ; the Presbyterian Church, 30 ; the Moravians, 25 ; the Roman Catholics, 12 ; the United Methodists, 9 ; the Christian Church, 7 ; the Congregationalists, 5 ; and the Church of Scotland, 4. The Salvation Army has a branch in the island. There are two Jewish synagogues in Kingston. The Church of England maintains a theological college, a deaconess home, and an orphanage ; the Roman Catholics maintain a training college for female teachers, two industrial schools, and two orphanages ; and the Baptists have a theological college.

Education. — There has been some reduction in the expenditure for education, and a slight alteration in the school age, which is now 6 to 14. Some inefficient schools have been closed. No grants to new denominational schools will be made, and closely-situated

denominational schools will be amalgamated, where practicable, with Government schools. The elementary schools, attendance at which is voluntary, numbered in 1901, 720. They rose from 687 in 1881 steadily to 962 in 1895, since which date they have steadily declined. There were in 1901, 86,491 scholars on the books and 47,441 in average attendance. These schools are subsidized by the State, and receive (in addition) grants in lieu of fees, which were abolished in 1893. The teachers, both male and female, for these elementary schools are trained in the main at three training colleges subsidized by the Government. For higher education there are the University College and High School at Hope near Kingston, Potsdam School in St. Elizabeth, Wolmer's Free School in Kingston (for boys and girls) founded in 1729, the Montego Bay Secondary School, and numerous other endowed and self-supporting establishments. Every year a scholarship is awarded of a total value of £600, spread over three, four, or five years, tenable at any of the universities of Great Britain and Ireland. Other smaller scholarships, varying from £60 to £10, are given every year. The Cambridge Local Examinations have been held regularly since 1882. In 1900, 263 candidates (168 boys and

95 girls) entered ; of these 199 passed, including the best senior boy and the best senior girl in the empire.

Negroes. — A negro peasant population is growing up, which will, it is to be hoped, in a generation or two prove a mainstay and a support to the industries of the island. Two generations ago the Jamaica negro was treated little better than an ox, and too often purposely kept from all advance either in morals or education ; and the consequences of this state of things remain. In many cases a field negro will not work for his employer more than four days a week. He may till his own plot of ground on one of the other days or not, as the spirit moves him, but four days a week will keep him easily. He has little or no care for the future. If by chance he is out of employment (and it is probably his own doing if he is), his needs are few. He has possibly squatted on some one's land, and has no rent to pay. Clothes he need hardly buy, fuel he wants only for cooking purposes, and food is ready to his hand for the picking. Unfortunately a wide-spread indulgence in prsedial larceny is a great hindrance to agriculture as well as to moral progress. But that habits of thrift are being inculcated is shown by the steady increase in the accounts in the Government savings banks. That

superstition is still prevalent amongst the negroes is unfortunately evidenced by the cases of obeah, or witchcraft, that come before the courts from time to time. The years that have passed since emancipation have been all too short to enable the ministers of religion and educators to grapple with the beliefs which are the outcome of centuries of the blackest superstition.

Finance. — The public debt of the colony was in 1901 £3,702,362. The public revenue for 1900-1 was £760,386, and the expenditure £763,662. Nearly half the public revenue (£360,000) is raised by customs duties, in very many cases by an ad valorem charge of 161 per cent. Another chief source of revenue consists of licences, excise and internal revenue (£156,575). The more important items of the expenditure of 1900-1 were Debt Charges, £221,323 ; Administrative Departments (Governor, &c., £6584 + Privy Council £103 ┼ Legislative Council £1257 + Colonial Secretariat £5182 -f Clerks to Parochial Boards £947 ŧ Registrar-General £4835 -f Registrar of Titles £1563), £20,471; Railway, £51,288 ; Judicial, £40,306 ; Medical, £50,234 ; Police and Prisons, £74,846 ; Education, £56,071 ; and Public Works £74,873. Ecclesiastical charges (owing to the results of disestablishment)

dwindled from £10,000 in 1879 to £2090 in 1901.

Defence. — There are military forces to the number of about 1750, consisting of a detachment of an infantry regiment and a company of Royal Artillery and one of Royal Engineers, and headquarters stafi and four companies of the West India Regiment. There is also a militia, infantry and artillery, about 800 strong. The entrance to the harbour of Port Royal is strongly fortified.

Agriculture. — A Board of Agriculture has recently been appointed by the Government in order to develop the productive resources of the island ; and there is also an agricultural society with twenty-six branches throughout the island. . Agricultural enterprise in Jamaica may be divided into three kinds — pen-keeping (i.e., the breeding of horses, mules, cattle, and sheep), planting, and a combination of the two. The principal industries of the planter are sugar, coffee, banana and (latterly) orange cultivation, cocoa, cocoanuts, ginger, limes, logwood, nutmegs, pimento, pineapples, and tobacco. Tobacco cultivation was till recently carried on principally by settlers from Cuba, many of whom, however, after the close of the Spanish-American war returned

to their own country. Bee-keeping is a rising industry. Sugar estates have been gradually decreasing in number for years, but well-managed estates in advantageous situations still yield Ejood profits. Jamaica Blue Mountain coffee realizes the highest price in the London market, and Jamaica ginger maintains its high reputation. The increase in the planting and exportation of bananas has been remarkable, the value of fruit exported in 1879 having been 2-9 per cent, of the total exports, and in 1899, 41-4 per cent. Of other fruits, the chief exported are oranges, and, to a small extent, grape-fruit, limes, pineapples, and mangoes. Of Crown lands there are about 100,000 acres, of which much is

suitable for cultivation. About 18,000 acres of Crown land are leased to some 2000 tenants ; 46,000 are unplanted. Crown lands are sold in small lots to settlers on easy terms.

Manufactures. — The manufactures are few. In addition to the sugar and coffee estates and cigar factories, there are tanneries and breweries, electric light and gas works, iron-foundries, potteries, and factories for the production of cocoanut oil, essential oil, ice,

matches, and mineral waters. There is an important establishment at Spanish Town for the production of logwood extract.

Trade. — The following table shows the fluctuations in the imports for home consumption in the years specified : —

	1879.	*1889.*	*1899.*
Live animals, food, drink, and narcotics	£633,565	39,776	668,356
Raw material .	5,645	£660,676	33,996
Manufactured articles	841,911		
Coin and bullion			
Total			

61,017

£674,094

63,286

1,033,388

17,664

£1,347,342

£1,597,600

£1,788,432

In 1900 the imports amounted to £1,806,865. The following

shows the source of supply of the imports for the years named : —

1879.

1889.

1899.

United Kingdom

United States .

Canada ....

Other countries

50-90

31-40

13-96

3-74

55 0

33 9

9-2'

1-9

44-7

45-1

7-1

3-1

100-0

100-0

100-0

The exports for the same years and 1900 were :-

1879.

£1,357,530

1899.

£1,662,542

1900.

£1,868,079

£1,614,824

The following is a comparative statement of the proportion of

exports during the years stated : —

1879.

1889.

1899.

Fruit ....

Sugar ....

Rum ....

Coffee ....

Dye-woods .

Pimento

Minor products .

2-9

14.4} 45-0

18-3

14-0

5-8

14-0

20-3

.^«:?}25-4

19-4

25-0

3-2

6-7

41-4

*6-1/ ^^^*

10-5

8-8

8-3

15-1

100 0

100-0

100-0

The exports for these years were distributed in the following

manner : —

1879.

1889.

1899.

United Kingdom

United States .

Canada ....

Other countries

73-2

14-9

1-0

10-9

37-3

50-2

2-3

10-2

20-0

59-0

1-0

20-0

100 0

100-0

100-0

Shipping and Navigation. — Several steamship companies run steamers between Jamaica and England, and between Jamaica and the United States and Canada. In 1900 Messrs Elder, Dempster,

and Company started their Imperial Direct West India Line with a subsidy of £40,000 contributed jointly by the Imperial Exchequer and the Jamaica Government, with a view to the encouragement of a fruit trade with England. Two steamers, in connexion with the Koyal Mall and Direct Lines respectively, go round the island once a week, calling at all the principal ports. A number of sailing ‘ ‘ drogh-ers ” also ply from port to port. Kingston harbour, the finest in the West Indies, has a total area of about sixteen square miles, of which about seven have a depth of from seven to ten fathoms. After Kingston, the principal ports are Port Antonio, Port Morant, Montego Bay, Lucea, Rio Bueno, and Port Maria, in addition to numerous reef-protected roadsteads. The ports of the island are cleared on an average by 1178 vessels of 829,390 tons annually.

Internal Communication. — Many miles of good driving-roads and bridle-paths have been made, opening up much land for cultivation and beautiful scenery for tourists. Many bridges have been built, rendering passable at all times streams which are unfordable during the rainy season. The main roads, about 1912 miles in extent, under the control of the Public Works Department, encircle the island, with several connexions from

north to south. The parochial roads, which are maintained by the parochial boards, measure about 4318 miles. The railway (retrans-ferred to the Government by the American company which had bought it in 1889, but which had failed to work it efBciently) traverses the island diagonally from Kingston in the south-east to Montego Bay in the north-we.st (113 miles distant), and also in a north-easterly direction to Port Antonio and in a central direction northwards to Ewarton.

Posts and Telegraphs. — Jamaica is included in the Postal Union and in the Imperial penny post and parcel post schemes. There is a weekly mail service to and from England by means of the Royal Mail and Direct Lines, but mails are also carried vid, the United States by the Hamburg-American and other companies. There are 149 post-offices in the island, and a tri-weekly (and in many cases a daily) post for letters, book packets, and parcels. Jamaica is connected with America, through Cuba, by the lines of the West India and Panama Telegraph Company, and with Halifax, Nova Scotia, through Bermuda, by the Direct West India Cable. There are telegraph stations at 70 post-offices.

Banking. — In Kingston there are branches of the Colonial

Bank of London and the Bank of Nova Scotia. In the Government Savings Bank in Kingston in 1900 there were 32,218 depositors, including charities, societies, clubs, &c., with a total of £468,817 on deposit. There are fourteen branches of the Government savings banks, and thirteen sub-branches. Penny banks have also been established in nearly all the districts of the island by ministers of religion and others.

Currency. — The coins in circulation are British coins, gold and silver of all denominations, but not bronze, instead of which local nickel is used. United States gold passes as currency. English weights and measures are used.

Kingston, the capital of Jamaica, stands on a gravelly soil. The population by local census (1901) was 46,642. It covers, with its suburbs, an area of 1080 acres of ground regularly sloping down to the sea. An underground system of drainage is being introduced. The principal streets have been or are being reconstructed, brick, macadam, and asphalt being used in different parts, and the irregularities, due to neglect and heavy washings by rains, are being rectified. The water-supply has been

increased, and there is a constant house-to-house supply throughout the city. A system of electric tramways runs throughout the town and suburbs. In the town. Myrtle Bank Hotel, the Jamaica Club, the additions to the lunatic asylum, and the theatre, and to the north of it, the Mico Training College and the Church of England Theological College, are the principal recent buildings. The Institute of Jamaica maintains a public library, museum, and art gallery, especially devoted to local interests. There is a good supply of both gas and electric light, as well as a telephone service and a supply of ice in the city.

PoKT EoYAL, formerly the finest town in the British West Indies, never recovered from the effects of the fire of 1816. It is now only a naval and military station, and has been removed from the jurisdiction of the Kingston municipal authorities and placed under a separate board with control by the military and naval authorities. Commanding as it does the entrance to the harbour, it is strongly fortified. The commodore on the station resides

there. The naval hospital is of considerable importance.

Spanish Town, the former capital (5019), has since

the removal of the seat of government to Kingston in

1872 gradually sunk in importance, the only public office

now maintained there being the Eecord Office.

Montego Bat (4803), on the north-west coast, is the

second town in the island in respect of commerce, but

Poet Antonio (1784), on the north-east, promises, owing

to its fruit trade, to surpass it.

Included in the government of Jamaica are the Turks

and Caicos Islands, which geographically form part of the

Bahama Islands, to which they at one time belonged; the

Cayman Islands, which lie from 110 to 160 miles north-

west of the west end ; the Morant Cays, about 33 miles

south-east of the east end of the island ; and the Pedro

Cays, about 40 miles southwest of Portland Point, the

most southerly point of the island. The inhabitants of

the Turks and Gaicos Islands (5350 in 1901) live almost entirely by the profits of the salt industry, the salt being made from the sea by evaporation in salt-ponds, the bulk of the product going to the United States. The sea around the Gaicos Islands produces a considerable quantity of sponges. The Cayman Islanders, who are in the fortunate position of having no pauper roll, live chiefly by turtling and by the exportation of phosphates. The Morant and Pedro Gays, which are uninhabited, are leased for the purposes of collecting guano, boobies' eggs, and turtle. Turks Islands are reached in two days by steamers which ply monthly between Jamaica and Halifax.

&%e Jamaica Handbook, 1901 ; Bacon and Aaron's iVeio Jamaica (1890); W. P. Livingstone's Black Jamaica (1900) ; Robert T. Hill's The Geology and Physical Geography of Jamaica (1899) ; Maxwell Hall's Bainfall Atlas (1892). (p. cu.)

Jamaica, in the western part of Long Island, formerly a village of Queens county, New York, U.S.A., but since 1st January 1898 a part of the fourth ward of the borough of Queens, one of the five boroughs of which

New York City is composed. Population (1880), 3922 ; (1890), 5361.

James, David (1839-1893), English actor, was born in London in 1839, his real name being Belasco. He began his stage career at an early age, and after 1863 gradually made his way up in the profession in humorous parts. His creation, in 1876, of the part of Perkyn Middlewick in Our Boys made him famous as a comedian, the performance obtaining for the piece a then unprece-dented "run" from 16th January 1876 till 18th April 1879. In 1885 David James had another notable success as Blueskin in the burlesque Little Jack Sheppard at the Gaiety Theatre, his principal associates being Pred Leslie and Nelly Parren. His song in this burlesque, " Botany Bay," became widely popular. In the part of John Dory in Wild Oats he again made a great hit at the Criterion Theatre in 1886 ; and among his other most successful im-personations were Simon Ingot in David Qarrick, Tweedie in Tweedie' s Rights, Macclesfield in The Ouv'nor, and Eccles in Caste. His unctuous humour and unfailing spirits,

combined with his ripe knowledge of theatrical methods and traditions, made him a great popular favourite. He died 2nd October 1893.

James, Henry (1843-

American author.

was born in New York on the 15th of April 1843. His father was Mr Henry James, a theological writer of considerable originality, from whom both he and his brother Professor William James derived their psychological subtlety and their idiomatic, picturesque English. Most of Henry's boyhood was spent in Europe, where he studied under tutors in England, Prance, and Switzerland. In 1860 he came back to America, and began reading law in the Harvard Law School, only to find speedily that literature, not law, was what he most cared for. His earliest short story appeared in 1865, in the Atlantic Monthly, and frequent stories and sketches followed. In 1869 he again went to Europe, where he has since made his home, for the most part in London. Among his specially noteworthy works are the following : Watch and Ward, 1871 ;

Roderick Hudson, 1875; The American, 1877; Daisy Miller, 1878 ; A Life of Hawthorne, 1879 ; The Portrait of a Lady, 1881 ; Poi-traits of Places, 1884 ; Tlie Bosto-nians, 1886; The Tragic Muse, 1890; Essays in London, 1893; The Two Magics, 1898. As a novelist, Mr James is a modern of the moderns both in subject-matter and in method. He is entirely loyal to contemporary life and reverentially exact in his transcription of the phase. His characters are for the most part people of the world who conceive of life as a fine art and have the leisure to carry out their theories. Earely are they at close quarters with any ugly practical task. They are subtle and complex with the subtlety and the complexity that come from conscious preoccupation with themselves. They are spe-cialists in conduct and past masters in casuistry, and are full of variations and shadows of turning. Moreover, they are finely expressive of milieu ; each belongs un-mistakably to his class and his race ; each is true to inherited moral traditions and delicately illustrative of some social code. To reveal the power and the tragedy of

life through so many minutely limiting and apparently artificial conditions, and by means of characters who are somewhat self-conscious and are apt to make of life only a pleasant pastime, might well seem an impossible task. Yet it is precisely in this that Mr James is pre-eminently successful. The essentially human is what he really cares for, however much he may at times seem preoccupied with the technique of his art or with the mask of conventions through whichhe makes theessentially human reveal itself. Nor has " the vista of the spiritual been denied him." No more poignant spiritual tragedy has been recounted in recent fiction than the story of Isabel Archer in TJie Portrait of a Lady. Mr James's method is as modern as his subject-matter. He early fell in love with the "point of view," and the good and the bad qualities of his work all follow from this literary passion. He is a very sensitive impressionist, with a technique that can " fix " the most elusive phase of character and " render" the most bafling surface. The skill is unending with which he places his characters in such relations and under such lights that

they flash out in due succession their continuously varying facets. At times he may seem to forget that a character is something incalculably more than the sum of all its phases ; and then his characters tend to have their exist-ence, as Positivists expect to have their immortality, simply and solely in the minds of other people. But when his method is at its best, the delicate phases of character that he transcribes coalesce perfectly into clearly-defined and suggestive images of living, acting men and women. Doubtless, there is a certain initiation necessary for the enjoyment of Mr James. He presupposes a cosmopolitan outlook, a certain interest in art and in social artifice, and no little abstract curiosity about the workings of the human mechanism. But for speculative readers, for readers who care for art in life as well as for life in art, and for readers above all who want to encounter and comprehend a great variety of very modern and finely modulated characters, Mr James holds a place of his own, unrivalled as an interpreter of the world of to-day.

JameSj Henry James, 1st Baron (1828),

English lawyer and statesman, son of P. T. James, surgeon, was born at Hereford, 30th October 1828, and educated at Cheltenham College. A prizeman of the Inner Temple, he was called to the bar in 1852 and joined the Oxford circuit, where he soon came into prominence. In 1867 he was made " postman " of the Court of Exchequer, and in 1869 became a Q.C. As the result of the general election of 1868 he obtained a seat in Pai-liament for Taunton as a Liberal, by the unseating of Mr Serjeant Cox on a scrutiny in IMarch 1869, and he kept the seat till 1885, when he was returned for Bury. He attracted attention in Parliament by his speeches in 1872 in the debates on the Judicature Act. In 1873 (September) he was made Solicitor-General, and in November Attorney-General, and knighted ; and when Mr Gladstone returned to power in 1880 he resumed his office. He was respon-sible for carrying the Corrupt Practices Act, 1883. On

Mr Gladstone's conversion to Home Eule, Sir Henry

James parted from him and became one of the most in-
fluential of the Liberal Unionists: Mr Gladstone had
offered him the Lord Chancellorship in 1886, but he de-
clined it ; and the knowledge of the sacrifice he had made
in refusing to follow his old chief in his new departure
lent great weight to his advocacy of the Unionist cause
in the country. He was one of the leading counsel for
Tlie Times in the Parnell Commission, and from 1892 to
1895 was Attorney-General to the prince of Wales. In
1895 he entered the Unionist Ministry as Chancellor for
the Duchy of Lancaster, and was made a peer as Baron
James of Hereford.

James River, a river of Virginia, U.S.A., rising in
the Allegheny Front, on the boundary between Virginia
and West Virginia, and flowing across the Appalachian
Valley, through the Blue Eidge and down the Atlantic
slope with a general eastward course, to the foot of Chesa-
peake Bay. Its length is 360 miles, and it drains an area
of 9684 square miles. Besides many rapids in its upper
course, it flows over falls at Richmond, where it crosses

the " Fall Line," which have been utilized as sources of power. Below this point the river is a navigable and tidal estuary.

Jameson, Leander Starr (1853), British Colonial administrator, son of E,. W. Jameson, a writer to the signet in Edinburgh, was born at Edinburgh in 1853, and was educated for the medical profession at University College Hospital, London (M.E.C.S. 1875 ; M.D. 1877). After acting as House Physician, House Surgeon, and Demonstrator of Anatomy, and showing promise of a successful professional career in London, his health broke down from overwork in 1878, and he went out to South Africa and settled down in practice at Kimberley. There he rapidly acquired a great reputation as a medical man, and besides numbering President Kruger and the native chief Lobengula among his patients, came much into contact with Mr Cecil Ehodes. In 1888 he enabled the British South Africa Company to obtain con-cessions in Matabeleland by visiting Lobengula at Bula-wayo ; and when the Chartered Company proceeded to

, open up the country, he abandoned his medical practice and joined the pioneer expedition of 1889. From this time his fortunes were bound up with Mr Ehodes's schemes in the north. In 1890 he obtained the concession from Gungunhana in Gazaland which prevented Portugal from practically asserting her claim to the country. In 1891 Dr Jameson was appointed Administrator of Ehodesia. The events connected with his vigorous administration and the wars with the Matabele are narrated under Ehodesia. At the end of 1894 " Dr Jim " came to England, and was f^ted on all sides ; he was made a C.B., and returned to Africa in the spring of 1895 with enhanced prestige. On the last day of that year the world was startled to learn by telegraph from Africa that he, with a force of 600 Bechuanaland Police, had made a raid into the Trans-vaal from Mafeking in support of a projected rising in Johannesburg, which had been connived at by Mr Ehodes at the Cape (see Ehodes and Transvaal). It need only be stated here that Dr Jameson's force was compelled to surrender at Doornkop ; he and his officers were sent to

Pretoria, and first sentenced to be shot, but then handed over to the British Government for punishment. They were tried in London under the Foreign Enlistment Act in May 1896, and Dr Jameson was sentenced to fifteen months' imprisonment at Holloway. Dr Jameson served a year in prison, and was then released on account of ill-health. He still retained the affections of the white population of Ehodesia, and subsequently returned there in an unofficial capacity. He was the constant companion of Mr Ehodes on his journeys up to the end of his life, and when Mr Ehodes died in 1902, Dr Jameson was left one of the executors of his will.

Jamestown, a city of Chautauqua county. New York, U.S.A., at the outlet of Chautauqua Lake. It is on the Erie and the Jamestown and Chautauqua rail-ways, at an altitude of 1317 feet. It is a popular summer resort, with an irregular plan, a good water-supply and sewer system and other municipal improvements. A good and cheap water power from the lake outlet is rapidly bringing it into prominence as a manufacturing city.

Population (1890), 16,038 ; (1900), 22,892, of whom 7270 were foreign-born and 77 negroes.

Jamestown, a district in James City county, Virginia, U.S.A., near the mouth of the James river. The first permanent English settlement within the limits of the United States was founded here in 1607 by 105 colonists under Christopher Newport. At that time it was a peninsula, but the action of the river has changed the peninsula to an island. The town was the capital of the colony until 1699, after which it declined in population and importance, and there are now only a few ruins to mark the spot. The first colonial assembly in America was held here in 1619. It was the scene of an Indian massacre in 1622, and was burned in 1676 during Bacon's rebellion.

Jamkhandi, a native state of India, in the Deccan division of Bombay, ranking as one of the Southern Mahratta Jagirs. Area, 655 square miles. The population in 1881 was 83,917; in 1891, 102,162; average density, 184 persons per square mile; estimated gross revenue, Es.10,73,324, of which Es.62,660 was expended

on public works in 1897-98 ; tribute, Es.20,841 ; number of police, 326; number of schools 41, with 2318 pupils. The chief, whose title is Bhau Saheb Patwardhan, is a Brahman by caste. The state is under British adminis-tration. The town of Jamkhandi is situated in 60° 30' N. and 75° 22' E., 68 miles east of Kolhapur. It has a high school, with 261 pupils in 1897-98. Population (1891), 12,504.

J am mil, or Jummoo, capital of the native state of Jammu and Kashmir in Northern India, situated in 32° 44' N. and 74° 64' E., on the river Tavi, a tributary of the Chenab. Population (1891), 34,352 ; (1901), 34,097. It is connected with Sialkot in the Punjab by a railway 16 miles long constructed by the state. In 1898 the town was devastated by a fire, which destroyed most of the public offices. Jammu was formerly the residence of an independent Eajput dynasty, which was conquered by the Sikhs at the beginning of the 19th century, and acquired by Ghulab Singh as the nucleus of his dominions, to which the British added Kashmir in 1846. The state of

Jammu proper, as opposed to Kashmir, consists of a sub-montane tract, forming the upper basin of the Chenab. Population (1891), 1,439,643 ; (1901), 1,516,998, showing an increase of 5 per cent., compared with an increase of 22 per cent, for Kashmir. A land settlement has recently been introduced under British supervision.

Jamsetjee Jeejeebhoy, Sir, 1st Bart. (1783-1859), Indian merchant and philanthropist, was born in Bombay in 1783, of poor but respectable parents, and was left an orphan in early life. At the age of sixteen, with a smattering of mercantile education and a bare pittance, he commenced a series of business travels which were destined eventually to lead him to fortune and fame. After a preliminary visit to Calcutta, he imdertook a voyage to China, which in those times was fraught with so much difficulty and risk that it was regarded as a venture betokening considerable enterprise and courage ; and he subsequently initiated a systematic trade with that

country, being himself the carrier of his merchant wares on his passages to and fro between Bombay and Canton and Shanghai. His second return voyage from China was made in one of the East India Company's fleet, which, under the command of Sir Nathaniel Dance, defeated the French squadron under Admiral Linois (15th February 1804) ; and on his fourth return voyage from China, the Indiaman in which he sailed was forced to surrender to the French, by whom he was carried as a prisoner to the Cape of Good Hope, then a neutral Dutch possession ; and it was only after much delay, and with great difficulty, that he made his way to Calcutta in a Danish ship. Nothing daunted, he undertook yet another voyage to China, which was more successful than any of the previous ones. By this time he had fairly established his reputation as a merchant possessed of the highest spirit of enterprise and considerable wealth, and thenceforward he settled down permanently in Bombay, where he directed his commercial operations on a widely extended scale. His system of conducting busi-

ness on strictly moral principles, and under his own personal supervision, combined with the high esteem in which he was held for his sagacity, wide experience, and energy, resulted in success after success, until he was recognized throughout India as the prince of merchants. By 1836 his firm was large enough to engross the energies of his three sons and other relatives ; and he had amassed what at that period of Indian mercantile history was regarded as fabulous wealth. An essentially self-made man in the strictest sense of the term, and having experienced in early life the miseries of poverty and want, in his days of affluence Jamsetjee Jeejeebhoy developed an active instinct of sympathy with his poorer countrymen, and commenced that career of private and public philanthropy which is his chief title to the admiration of mankind. His liberality was unbounded, and the absorbing occupation of his later life was the alleviation of human distress. To his own community he gave lavishly, but his benevolence was mainly cosmopolitan. Hospitals, schools, homes of charity, pension funds,

were founded or endowed by him, while numerous public works in the shape of wells, reservoirs, bridges, cause-ways, and the like, not only in Bombay, but in other parts of India, were the creation of his bounty. The total of his known benefactions amounted at the time of his death, which took place in 1859, to over £230,000. It was not, however, the amount of his charities so much as the period and circumstances in which they were per-formed that made his benevolent career worthy of the fame he won. In the first half of the 19th century the different communities of India were much more isolated in their habits and their sympathies than they are now. Jamsetjee Jeejeebhoy's unsectarian philanthropy awak-ened a common understanding and created a bond between them which has proved not only of domestic value but has had a national and political significance. His firm faith in the benevolence and protection of British rule, of which he gave evidence by placing all his endowments, and even his own wealth, in British securities, infused in the people of India for the first time a spirit of firm con-

fidence in that rule and an unquestioning faith in its stability. These great services were recognized first in 1842 by the bestowal of a knighthood upon him, and in 1858 by that of a baronetcy. These were the very first distinctions of their kind conferred by Queen Victoria upon a British subject in India. His title devolved in 1859 on his eldest son Cubsetjee, who, in pursuance of a provision in the letters-patent, took the name of Sir Jamsetjee Jeejeebhoy as second baronet. At his death, which occurred in 1877, his eldest son, Menekjee, assumed the same patronymic and became Sir Jamsetjee Jeejeebhoy, the third baronet. Both had the advantage of a thoroughly good English education, and continued the career of benevolent activity and devoted loyalty to British rule which had signalized the life-work of the founder of the family. They both visited England to do homage to their sovereign ; and their public services were recognized by their nomination to the order of the Star of India, as well as by appointment to the Legislative Councils of Calcutta and Bombay. On the demise of the

third baronet, the title devolved upon his brother, Cow-SAJBE, who became Sir Jamsetjee Jeejeebhoy, fourth baronet, and the recognized leader of the Parsee community all over the world. Since their emigration from Persia, that community had never had a titular chief or head, its communal funds and affairs being managed by a public body, more or less democratic in its constitution, termed the "'Parsee Panchayat." The first Sir Jamsetjee, by the hold that he established on the community, by his charities and public spirit, gradually came to be regarded in the light of its chief; and the recognition which he was the first in India to receive at the hands of the British sovereign finally fixed him and his successors in the baronetcy in the position and title of its recognized official leader. (m. m. bh.)

Janesville, capital of Eock county, Wisconsin, U.S.A., on the river Eock and the Chicago and North-Western and the Chicago, Milwaukee and St Paul railways, at an altitude of 802 feet. Its site is level and the plan irregular. It is in an agricultural region, and its

manufactures consist largely of farming implements and machines, waggons and carriages. The Wisconsin school for the blind is situated here. Population (1890), 10,836 ; (1900), 13,186, of whom 2409 were foreign-born.

Janet, Paul (1823-1899), French philosophical writer, was born in Paris on 30th April 1823. He was professor of moral philosophy at Bourges (1845-48) and Strasburg (1848-57), and of logic at the Lycee de Louis le Grand, Paris (1857-64). In 1864 he was appointed to the chair of philosophy at the Sorbonne, and elected a member of the Academy of the Moral and Political Sciences. He wrote a large number of books and articles upon philosophy, politics, and ethics, on idealistic lines : La Famille, Histoire de la Philosophie dans I'antiquiti et dans le temps moderne, Histoire de la science politique, Philosophie de la Revolution Frangaise, &c. They are not characterized by much originality of thought. In philosophy he was a follower of Victor Cousin, and through him of Hegel. His principal work in this line, Thiorie de la morale, is little more than a somewhat patronizing

reproduction of Kant. He died in October 1899.

Jang Bahadur, Sir, Maharaja (1816-1877), ruler of Nepal, was a grand-nephew of Bhim Singh Thappa, the famous military minister of Nepal, who from 1804-to 1839 was de facto ruler of the state under the Queen Tripuri and her successor. Bhim Singh's supremacy was threatened by the Kala Pandis, and many of his relations, including Jang Bahadur, went into exile in 1838, thus escaping the cruel fate which overtook Bhim Singh in the following year. The Pandi leaders, who then reverted to power, were in turn assassinated in 1843, and Matabar Singh, uncle of Jang Bahadur, was created prime minister. He appointed his nephew general and chief judge, but shortly afterwards he was himself put to death. Fateh Jang thereon formed a ministry, of which Jang Bahadur was made military member. In the following year, 1846, a quarrel was fomented, in which Fateh Jang and thirty-two other chiefs were assassinated, and the queen appointed Jang Bahadur sole minister. The queen quickly changed her mind, and planned the death of her new minister, who

at once appealed to the maharaja. But the plot failed. The

king and the queen wisely sought safety in India, and Jang Bahadur firmly established his own position by the rem oval of all dangerous rivals. He succeeded so well that in January 1850 he was able to leave for a visit to England, from which he did not return to Nepal until 6th February 1851. On his return, and frequently on subsequent dates, he frustrated conspiracies for his own assassination. The reform of the penal code, and a desultory war with Tibet, occupied his attention until news of th% Indian Mutiny reached Nepal. Jang Bahadur resisted all overtures from the rebels, and sent a column to Gorakpur in July 1857. In December he furnished a force of 14,000 Gurkhas, which reached Lucknow on 11th March 1858, and took part in the siege. The moral support of the Nepalese was more valuable even than the military services rendered by them. Jang Bahadur was made a G.C.B., and a tract of country annexed in 1815 was restored to Nepal. Various

frontier disputes were settled, and in 1875 Sir Jang Bahadur was on his way to England when he had a fall from his horse in Bombay and returned home. He received a visit from the prince of Wales in 1876. On 25th February 1877 he died, having reached the age of sixty-one. Three of his widows immolated themselves on his funeral pyre. (w. l.-w.)

Janina, or Yanina, capital of the vilayet of the same name, Albania, Turkey-in-Europe, on the west side of Lake Janina, 80 miles west of Larissa and 50 miles east of Corfu, the seat of a Greek archbishopric. Apart from the embroidery work of the women it has no special industry, and since 1881 its commercial importance has greatly diminished. Prior to the annexation of Thessaly to Greece a large proportion of the dealings in the grain produce of that province were transacted and settled in Janina. The export trade is now limited to cheese, hides, bitumen, and sheepskins, the annual value being about £120,000, and the import trade, valued at about double the export trade, to the supply of local wants. Popula-

tion, 20,000.

Janiuay, a town in a beautiful valley near the centre of the province of Iloilo, island of Panay, Philippine Islands. The neighbouring country is hilly but fertile, producing rice, sugar, and tobacco ; and wheat grows in the vicinity of the town. The women weave and sell beautiful fabrics of pineapple fibre, silk, cotton, and abacd;. The language is Panay- Visayan. Population, 28,000.

Janjira, a native state of India, in the Konkan division of Bombay, situated along the coast among the spurs of the Western Ghats, 40 miles south of Bombay city. Area, 324 square miles. The population in 1881 was 76,361 ; in 1891, 81,780 ; average density, 252 persons per square mile. In 1901 the population was 85,392, showing an increase of 4 per cent. The estimated gross revenue is E,s.5,09,750, of which Es.64,704 was expended on public works in 1897-98 ; no tribute ; number of police, 135 ; number of schools, 60, with 3709 pupils. The chief, whose title is Nawab Saheb, is by descent a

Sidi or Abyssinian Mahommedan ; and his ancestors were for many generations admirals of the Mahommedanrulersof the Deccan. The present (1902) nawab was educated at the Kajkot college, and is K.C.I.E. He is entitled to a salute of nine guns. The state, popularly known as Habsan (= Abyssinian), did not come under direct subordination to the British until 1870. It supplies sailors and fishermen, and also firewood, to Bombay, with which it is in regular communication by steamer. The town of Janjika is merely a fortress on a small island of the same name. The principal seaport is Shrivardhan ; population (1891), 7102. Nurud had a population in 1891 of 5883. The Nawab of Janjira is also chief of the state of Jafaeabad, on the south coast of the peninsula of Kathiawar. Area, 42 square miles ; population (1891), 12,389. The town of Jafaeabad is on the estuary of a little river, about a mile from the sea, and has considerable trade ; population (1891), 5212.

Janssen, Pierre Charles Cesar (1824--), French astronomer, was born on 22nd February

1824 at Paris, and studied mathematics and physics at the Faculty of Sciences in that city. For some time he taught in the Lyc^e Charlemagne and the School of Architecture, but his life was mainly devoted to astronomical observations and especially to the study of the sun. In the pursuit of scientific knowledge he travelled all over the world. Thus in 1857 he went to Peru in order to determine the magnetic equator ; in 1867 he carried out optical and magnetic observations at the Azores with Saint Claire Deville ; in 1874 he visited Japan to view the transit of Venus ; and he made several long expeditions to enjoy the opportunity for observations afforded by a total eclipse of the sun, e.g., to Trani (1867), Guntoor (1868), Algiers (1870), Siam (1875), and the Caroline Islands (1883). To see the eclipse of 1870 he escaped from Paris, then invested by the German army, in a balloon. At the great Indian eclipse of 1868 he employed the spectroscope to reveal the nature of the red prominences as masses of glowing vapour, and devised a method (which was almost simultaneously thought of by several other astronomers)

of observing them under ordinary conditions, when the sun's disk is not obscured by the moon. He also devoted much attention to the spectroscopic analysis of the sun's composition, particularly in reference to the question whether it contains oxygen or not. His efforts were directed towards eliminating, or getting an accurate estimate of, the disturbing effects of the oxygen in the earth's atmosphere, and his bold project of establishing an observatory on the top of Mont Blanc was prompted by a perception of the advantages to be gained by reducing the thickness of air through which observations have to be made. This observatory, the foundations of which were fixed in the snow that appears to cover the summit to a depth of ten metres, was built in September 1893, and Janssen, in spite of his sixty-nine- years, made the ascent and spent four days taking observations. In 1876 he was appointed director of the astrophysical observatory which the French Government established in that year at Meudon.

Jaora, a native state of India, in the Malwa Agency.

It lies in two isolated tracts, between Eutlam andNeemuch. Area, with the dependencies of Piplauda and Pant Piplauda, 581 square miles. The population in 1881 was 108,434 ; in 1891, 117,650, showing an increase of 8 per cent. ; average density, 203 persons per square mile. The estimated revenue is Es. 8,00,000 ; subsidy for military contingent, Es.1,61,810. The chief, whose title is Nawab, is a Mahommedan of Afghan descent. The late Nawab, who died in 1895, was an honorary major in the British army. His son was educated in the Daly College at Indore, with a British ofiicer for his tutor. The adminis-tration is highly spoken of. There is an accumulated surplus of nearly Es.3,00,000. The town of Jaoba is on the Eajputanar-Malwa railway, 20 miles north of Eutlam. Population (1881), 19,902; (1891), 21,844. It is well laid out, with many good modern buildings, and has a high school and dispensary. In 1897-98 the exports of opium amounted to 876 chests, on which the duty was Es.4,94,650. To celebrate Queen Victoria's Diamond Jubilee, a Victoria Institute and a Zenana Dispensary

were opened in 1898.

1. GrBOGEAPHT AND STATISTICS.

EASTEEN ASIA stretches two arms into the ocean, Kamchatka in the north, Malacca in the south, and between them lies a long, attenuated cluster of islands constituting the Japanese empire. On the ex- Positiott treme north are the Kuriles (called by the Jap- extent anese Chishima, or the “myriad isles”), which extend to east longitude 166° 32' and to north latitude 50° 66' ; and on the extreme south are the Pes- cadores (called by the Japanese Hoko46), which extend to east longitude 119° 20' and to north latitude 21° 48’. Thus the islands of Japan cover 37° 12' of longitude and 29° 8' of latitude. There are five large islands, namely, Ezo, or Yezo, as it was called in the ninth edition of this work (which with the Kuriles is called Hokkai-do, or the north-sea district) ; Nippon (the ” origin of the sun “), which is the main island ; Shikoku (the “four provinces “),

*which lies on the east of the main island ; Kiushiu (the " nine provinces "), which lies on the south of Nippon, and Formosa (called by the Japanese Taiwan), which forms the most southerly link of the chain. Formosa and the Pescadores were added to the empire after the victorious war with China in 1894-96. The following table shows the number, the lengths of coast-line in miles, and the areas, in square miles of the vaiious groups of islands, only those being indicated that have a coast-line of at least 1 ri (2^ miles), or those that, though of less development, are inhabited; except in the case of Formosa and the Pescadores, where the whole numbers are given :^*

Number.

Length of Coast in miles.

Area in square miles.

Nippon

1

4,765-03

86,373-57

Isles adjacent to Nippon

166

1,275-09

470-30

Shikoku .

1

1,100-85

6,861-39

Isles adjacent to Shikoku

74

548-12

175-40

Kiushiu .

1

2,101-28

13,778-68

Isles adjacent to Kiushiu

150

2,405-06

1,821-85

Ezo ....

1

1,423-32

30,148-41

Isles adjacent to Ezo

12

110-24

30-51

Sado

1

130-05

335-92

Oki .

4

182-27

130-40

Isle adjacent to Oki .

1

3-09

0-06

Awaji

1

94-43

217-83

Isle adjacent to Awaji

1

5-32

0-83

Iki . .

1

86-47

50-96

Isle adjacent to Iki .

1

4-41

0-47

Tsushima .

1

454-49

261-94

Isles adjacent to Tsushim

i 5

454-49

261-94

Riiikiu(or Loochoo Islands

) 55

768-74

935-18

Chishima (Kuriles) .

32

1,496-23

6,159-42

Ogasawara Islands (com

monly called Bonin)

20

174-65

26-82

Taiwan (Formosa) .

1

731-31

13,429-31

Isles adjacent to Formosa

29

128-32

not surveyed

Hoko-t6 (Pescadores)

48

98-67

85-50

Totals

607

18,541-93

161,556-69

If the various islands of smaller dimensions than the above be included, a total of over 3000 in number is reached, but there has not been any absolutely accurate calculation of this figure.

The population of the various parts of the

Population, gjjjpire was as follows on 31st December 1898 :—

Population,

Nippon 1 33,327,935

Shikoku 3,013,817

Population per

square mile.

380-0

430-0

Carry forward

36,341,752

387-0

1 The figures include the population of the small isles adjacent to

each of the islands indicated.

Brought forward

Kiushiu

Hokkaido

Formosa .

Hoko-ta (Pescadores)

Grand totals

The following figures show the rate of increase between

the years 1889 and 1898 :—

Population.

Population per

square mile.

36,341,752

387-0

6,808,908

404-1

610,155

15-5

2,640,309

195-5

49,787

582-3

46,450,911

288-0

Males.

Females.

Totals.

1889 .

1894 .

1898 .

20,246,336

21,122,899

22,072,057

19,825,684

20,690,316

21,688,149

40,072,020

41,813,215

43,750,206

According to historical records, the population of the empire in the year a.d. 610 was 4,988,842, and in 736 it had grown to 8,631,770. It is impossible to say how much reliance may be placed on these figures, but from the 18th century, when the name of every subject had to be inscribed in the roll of a temple as a measure against his adoption of Christianity, a tolerably trustworthy census could always be taken. The returns thus obtained show that from the year 1723 until 1846 the population re-

mained almost stationary, the figure in the former year being 26,065,422, and that in the latter year 26,907,626. There had, indeed, been five periods of declining population in that interval of 124 years, namely, the periods 1738—44, 1769-62, 1773-74, 1791-92, and 1844-46. But after 1872, when the census showed a total of 33,110,826, the population grew steadily, its increment between 1872 and 1898 inclusive, a period of 27 years, being 10,649,990. Such a rate of increase invests the question of subsistence with great importance. In former times the area of land under cultivation increased in a marked degree. Returns prepared at the beginning of the 10th century showed 2-1-million acres under crops, whereas the figure in 1834 was over 8 million acres. But the development of means of subsistence has been signally outstripped by the growth of population during recent years. Thus, during the ten-years period 1888-97, the population received an increment of 4,089,964, or over 10 per cent., whereas the food-producing area remained almost stationary. Indeed, there was reason to think that in 1901 Japan proper, as distinguished from

the northern island of Ezo, had nearly reached the limit of her capacity for the production of food-stuffs, and that her people would henceforth become more and more dependent upon supplies from abroad, for it was plain that, under the greatly improved conditions of life resulting from the enlightened government of the 3TeiJ> era, a steady growth of population was to be anticipated.

Divided according to castes, the population groups itself as follows : —

Heads of

Members of

Families.

FamUies.

Nohility (kwazoku) .

706

8,845

Former samurai (shizoku)

439,386

1,666,310

Commoners Qieimin)

. 8,179,704

33,470,864

The following table shows the number of marriages and

divorces in Japan in 1889 and 1898 : —

Marriages,

Marriages

per 1000 of

Population,

Divorces.

Divorces

per 100 of

Population.

1889 .

1898 .

340,445

471,217

8-50

10-77

107,478

99,469

2-68

2-27

geography]

JAPAN

671

The fact that, speaking roughly, one divorce takes place for every four marriages, has often evoked severe comment from foreign critics. But it should be observed that the causes of divorce in Japan differ from those operative in Europe. The great majority of marriages among the lower orders are merely arrangements designed to test a couple's suitability to each other as helpmates in the struggle of life. If experience shows incompatibility of temper or any other mutually repellent disposition, divorce follows as a matter of course. On the other hand, divorces among persons of the upper classes are comparatively rare, and divorces on account of a wife's unfaithfulness are almost unknown.

The number of households in Japan at the close of 1898 was 8,175,208, and it follows that the average num-

ber of persons per household was 6‘35.

The number of births per 100 inhabitants during the decade ended 1898 varied from 2-99 to 3-14 — the male children averaging 104 to every 100 female — and the number of deaths per 100 inhabitants varied from 2-04 to 2-28. Illegitimate births exhibit an evident tendency to increase, as may been seen from the figures for the five years ended 1898 : —

lUegitimate

Number per 100 of

population.

0-182

Births.

1894

76,407

1895

80,168

0-189

1896

84,479

0-198

1897

90,128

0-208

1898

108,485

0-248

The Japanese show a steadily growing disposition to visit foreign countries. In 1889 the number residing abroad was only 18,688, whereas in 1898 it was 70,801. The bulk of that increase was due to emigration to Hawaii, where 36,000 Japanese are now employed on the sugar plantations, and to settling in Korea, where the Japanese residents increased from 5689 in 1889 to 15,309 in 1898. The Australian colonies, especially Queensland, also attract Japanese enterprise — there were 6000 Japanese living there in 1898, against only 450 ten years previously, — andmore than 3000 find employment in Russian colonies. If the Chinese element be excepted, the number of for-eigners residing in Japan underwent little change during

the period 1889-99, as the following figures show : —

FOEEIGNEKS RESIDING IN JaPAN.

Americans

British

Russians

Dutch

French

Portuguese

Germans

Peruvians

Swiss

Belgians

Italians

Danes

Swedes and Norwegians

Spaniards

Brazilians

Austro-Hungarians

Hawaiians

Chinese

Koreans

Greeks

Australians

Mexicans

Canadians

Others

9,062 11,684

This slow growth of the foreign residents is remarkable when contrasted with the fact that the volume of the country's foreign trade, which constitutes the business in which they are engaged, grew in the same period from

899

1,296

1,701

2,013

63

134

85

85

335

463

108

158

550

532

...

3

57

94

31

26

37

51

*• 79

59

83

42

15

50

..*

1

56

83

16

..•

“4,975

6,372

8

188

• •.

1

1

*• •**

3

13

30

136 million yen’^ to 443 millions. It may be added that out of 11,589 foreigners residing in Japan at the close of 1898, the number engaged in commerce and other pro-fessions was 10,654 ; the number in the service of the

Government was 100, and the number in the service of private companies, institutions, &c., was 718, the remainder being officials.

In 1898 there were 21 towns in Japan having a population of over 50,000. They were as follows : —

Ueban Populations.

T6ky6 .

1,440,121 persons

Osaka

821,235

Ky6t6

353,139

Nagoya .

244,145

Kobe

215,780 „.

Yokohama

193,762

Hiroshima

122,306

Nagasaki

107,422

Kanazawa

83,595

Sendai

83,325

Hakodate

78,040

Pukuoka

66,190

Wakayama

63,667

Tokushima

61,501

Kumamoto

61,463

Toyama

59,558 „.

Okayama

58,025 „.

Otaru

56,961

Kagoshima

53,481

Niigata .

53,366

Sakai

50,203 „.

The first three of the above list, namely, T6ky6, Osaka, and Ky5t5, are called "cities" (/M),the remainder being " towns " (shi). The number of towns having a popuW tion of over 20,000 is 76.

The Japanese islands may be said to be traversed throughout their entire length from north to south by a range of mountains forming a kind of back-bone, which sends out lateral branches at """" "' various places. A special feature is that lofty summits are separated by comparatively low passes, owing to the fact that the latter lie at the level of crystalline rocks and schists constituting the original uplands upon which*

the summits have been piled by volcanic action. The scenery among the mountains is generally soft. Time's influence has been so strongly assisted by climatic agencies that everything rugged or abrupt has been smoothed and modified, until an impression of gentle undulation rather than of grandeur or boldness is suggested. Nowhere is the region of eternal snow reached, and seldom are masses of tender and varied foliage wanting to enhance the gentle aspect of the scenery and glorify it in autumn with tints of striking brilliancy and diversity. Extensive plains are exceptional. As a general rule, mountain alternates with valley, so that not more than one-eighth of the country's entire area is cultivable.

The king of Japanese mountains is Euji-san (Peerless Mount), of which the highest point (Ken-ga-mine) is 12,395 feet above sea-level. The remarkable grace of this mountain's curve — it has been mathematically shown to be an inverted catenary — renders it one of the most beautiful objects of its kind in the world, and has obtained for it a prominent place in the

field of Japanese decorative art. Great streams of lava flowed from the crater in ancient times. The course of one is still visible to a distance of 15 miles from the summit, but the rest are covered, for the most part, with deep deposits of ashes and scorias. On the south Fuji-yama slopes unbroken to the sea, but on the other three sides the plain from which it rises is surrounded by mountains, among which, on the north and west, a series

1 The yen is the Japanese monetary unit, over 2 shillings sterling, or 50 cents (gold). It is equal to a fraction

Japanese Alps.

of most picturesque lakes has been formed in consequence of the ashes ejected from Fuji's crater damming the waters of the rivers. To a height of some 1500 feet the slopes of the mountain are cultivated; a grassy moor-

land stretches up the next 2500 feet ; then follows a forest, the upper edge of which climbs to an altitude of nearly 8000 feet on one side, and finally there is a wide area of ashes and seoriee. There is entire absence of the Alpine plants found abundantly on the summits of other high mountains in Japan, a fact due, doubtless, to the comparatively recent activity of the volcano. The ascent of Fuji presents no difficulties. A traveller can reach the usual point of departure, Gotemba, by rail from Yoko-hama, and thence the ascent and descent may be made in one day by a sturdy pedestrian, though two days are generally allotted to the task.

*The provinces of Hida and Etchiu are bounded on the east by a chain of mountains, including, or having in their immediate vicinity, the highest peaks in ^*e Japan after Fuji. Six of these summits rise to a height of 9000 feet or upwards, and constitute the most imposing assemblage of mountains in Japan. The ridge from which they push their heads runs due north and south through a length of from 60 to*

70 miles, and has a width of from 5 to 10 miles. It is mostly of granite, only two of the mountains — Norikura and Tateyama — showing clear traces of volcanic origin. The lower flanks of the ridge are clothed with forests of beech, conifers, and oak. Farther south, in the same range, stands Ontake, the second highest mountain in Japan proper, as distinguished from Formosa ; and other remarkable though not so lofty peaks distinguish the same regions. This grand group of mountains has been well called the "Alps of Japan," and a good account of their features may be found in a book (Tlie Japanese Alps) compiled by the Rev. W. Weston. On the summit of Ontake are eight large and several small craters, and there also may be seen displays of trance and "divine possession," such as are described by Mr Percival Lowell in Occult Japan.

*Even more interesting and more picturesque, though less lofty, than the Alps of Japan, are the Nikko mountains, celebrated as enclosing the mausolea of molX/fls. *^® ^"^° greatest of the Tokugawa Shoguns.*

The highest of these peaks are Shirane-san (7491 feet), Nantai-san (8169 feet), Nyoho-zan (8100 feet), and Omanago (7646 feet). They are clothed, for the most part, with magnificent vegetation, and everywhere they echo the voices of waterfalls and rivulets.

In the north of the main island there are no peaks of remarkable height. The best known are Chokai-zan, called "Akita Fuji" (the Fuji of Akita pro- Mouaiaias yince), a volcano 7081 feet high, which was "Jorth. active as late as 1861 ; Ganju-san (7447 feet), called also " Nambu Fuji " or Iwate-zan, remark- able for the beauty of its logarithmic curves; Iwaki-san (4650 feet), known as Tsugaru-Fuji, and said by some to be even more imposing than the Peerless mountain itself; and the twin mountain Gassan (6447 feet) and Haguro-san (5600 feet). A little farther south, enclosing the fertile plain of Aizu (Aizu-taira, as it is called), several important peaks are found, among them being lide-san (6169 feet) ; Azuma-yama (6473 feet), a mountain which, after a long interval of quiescence, has given

many evidences of volcanic activity during recent years ; Nasudake (6286 feet), an active volcano; and Bandai-san (6444 feet). A terrible interest attaches to the last-named mountain, for, after having remained quiet for a time so long as to lull the inhabitants of the neighbouring district into complete security, it suddenly burst into fierce activity on 16th July 1888, discharging a vast avalanche of earth and rock, which dashed down the slopes of the mountain like an inundation, burying four hamlets, partially destroying seven villages, killing 461 people, and devastating an area of 27 square miles.

In the province of Kotsuke, which belongs to the central part of the main island, the noteworthy mountains are Asama-yama (8136 feet), one of the best „„„^„^„„g known and most violently active volcanoes of ofKbtsuke, Japan ; Akagi-san, a circular range of peaks Kai, and surrounding the base of an old crater and ”””“o-rising to a height of 6210 feet ; the Haruna group, celebrated for scenic beauties, and Myogi-san, a cluster of

pinnacles which, though not rising higher than 3880 feet, offer scenery wholly different from anything to be seen elsewhere in Japan; scenery which dispels the delusion that nature, as represented in the classical pictures {bun-jincfwa) of China and Japan, exists only in the artist's

imagination. Farther south, in the province of Kai (K5shiu), and separating two great rivers, the Fuji-kawa and the Tenryu-gawa, there lies a range of hills with peaks second only to those of the Japanese Alps spoken of above. The principal elevations in this range are Shirane-san (different from the mountain of the same name in the Nikko group) — with three summits, Nodori (9970 feet), Ai-no-take (10,200 feet), and Kaigane (10,330 feet) — and Hoozan (9650 feet). It will be observed that all the highest mountains of Japan form a species of belt across the widest part of the main island, commencing on the west with the " Alps " of Etchiu, Hida, and Shinano, and ending on the east with Fuji-yama. In all the regions of the main island southward of this belt the only mountains of conspicuous altitude are Omine (6169 feet) in Yamato, Odai-yama (6540 feet) in the same province, and Daisen or Oyama (5951 feet) in Hoki.

The island of Shikoku has no mountains of notable magnitude. The highest is Ishitsuchi-yama ^^^^^^^ (7743 feet), but there are several peaks varying o/SA/ioiu.

from 3000 to 6000 feet.

Kiushiu, though abounding in mountain chains, independent or connected, is not remarkable for lofty peaks. In the neighbourhood of Nagasaki, over the celebrated solfataras of Unzen (called ^”f^” also Onsen), stands an extinct volcano, whose summit, Fugen-dake, is 4800 feet high. More notable is Aso-san, some 20 miles from Kumamoto; for though the highest of its five peaks has an altitude of only 6644 feet, it boasts the largest crater in the world, with walls nearly 200 feet high and a basin from 10 to 14 miles in diameter. Aso-san is still an active volcano, but its eruptions during recent years have been confined to ashes and dust. Only two other mountains in Kiushiu need be mentioned — a volcano (4000 feet high) on the island Sakura-jima, in the extreme south; and Kirishima-ya]na (6528 feet), on the boundary of Hyuga, a mountain specially sabred in Japanese eyes, because on its eastern peak (Takachihodake) the god Ninigi is believed to have descended as the forerunner of the first Japanese sover-*

eign, Jimmu.

The following list shows the principal mountains of

Japan in the order of their altitudes, as well as the pro-

vinces in which they are situated: —

Niitake-yama (Mt Morrison)

Height in feet.

14,350

Province.

Formosa.

Setsuri-san (Mt Sylvia) .

12,800

Formosa.

Fuji-san ....

12,395

Suruga.

Ontake

10,446

Shinano.

Norikura-dake

10,387

Hida.

Sliirane-san

10,330

Kai.

Akaislii-yama

10,147

Shinano.

Yariga-dake

10,144

Hida.

Orenge-yama

9,977

Etchiu.

Komaga-take

9,842

Kai.

geography]

Yakushi-dake

Yatsuga^dake

Tate-yama .

Kokushi-dake

Kimpu-san .

Yariga-mine

Tateshima-yama

Iwasugo-yama

Nantai-san .

Asama-yama

Nyoh6-zan .

Kabushi-dake

My6k6-zan

Takatsuma/-yama

Yake-yania

Cha-oha-nobori

Ena-san

Hiuchi-dake

Haku-san .

Ishitsuchi-yama

Azuma-yama

Dairaugen-yama

Oraanago .

Akanagi-san

Shirane-san

Ganju-san .

Tsurugi-san

Ch6kai-san

Kuroboshi-yama

Japan is abundantly watered. Indeed, there is pro-

bably no other country in the world that

””■ possesses a closer network of streams, supple-*

mented by canals and lakes. But the quantity of water

Heipht in feet

ProTinoe.

9,816

Kai.

9,612

Kai.

9,186

Etchiu.

8,438

Shinauo.

8,369

Kai.

8,369

Etchiu and Hida

8,300

Shinano.

8,251

Shinano.

8,169

Shimotsuke.

8,136

Shinano.

8,100

Shimotsuke.

8,064

Kai.

8,061

Eohigo.

7,956

Echigo.

7,906

Eohigo.

7,900

Kuriles.

7,874

Mino.

7,816

Iwashiro.

7,797

Kaga.

7,743

lyo.

7,733

Shinano.

7,647

Suruga.

7,546

Shimotsuke.

7,513

Shimotsuke.

7,491

KOtsuke.

7,447

Rikuchiu.

7,355

Awa.

7,081

Ugo.

7,047

Tdtdmi.

Lonath

in miles.

Source.

Point of Eiil.

Ishikari-gawa

407(f)

Ishikari-dake . .

Otaru.

Shinano-grawa

215

Kimpu-zan

Nilgata.

Teshio-gawa ...

192

Teshio-dake

Sea of Japan.

Tone-gawa .

m

Monju-zan Kdtsuke .

Choshi (Shimosa).

Mogami-gawa

151

Dainichi-dake (Uzen)

Sakata.

ToBhino-gawa

149

Tahazu-yama (Tosa)

Tokushima (Awa).

Kitakami-gawa .

146

Nakayama-dake (Ri-

Ishinomakl (Eiku-

kuchiu>

Suwako (Shinano) .

zen).

Tenryu-gawa

136

T6t6mi Bay.

Go – kawa or Iwame-

gawa ....

123

Maruse-yama (Bingo)

Iwami Bay.

Abukuma-gawa .

122

Asahi-dake (Iwa-

shiro)

Tokachi^dake .

Matsushima Bay.

Tokachi-gawa

120

Tokachi Bay.

Sendai-gawa .

112

Kunimi-zan (Hyflga)

Kumizaki (Satsu-

ma).

Suruga Bay.

Oi-gawa ....

112

Shirane-zan (Kai)

Kiso-gawa

112

Kiso-san (Shinano) .

Bay of Ise.

TiSkyfl Bay.

Ara-kawa

104

Chichibu-yama .

Naga-gawa .

102

Nasu-no-yama (Shi-

Naka-no-minato

motsuke)

(Hitachi).

Aka-no-gawa

97

Osenuma (Kdtsuke)

Matsugasaki (Echi-

and Inawashiro

go).

Lake

Imizu-gawa .

93

Dainichi-dake (Mino)

Fushikl (Etchiu).

Jinza-gawa .

98

Norikura-dake (Hida)

Toyama (Etchiu).

Tama-gawa .

i)2

Daibosatsu-toge (Kai)

Haneda (T6ky6

Bay).

Aaahi-gawa (called also

Nishl-0-kawa)

90

Mimasaka (N.W.) .

Kojima Bay.

Shiribeshi-gawa .

88

Shiribeshi-dake .

Suttsu Bay.

Ki-DO-kawa .

85

Odai-san (Yamato) .

Wakayama.

8hing6-gawa .

85

Yoshino-san (Yamato)

Shingii (Kii).

Chikugo-gawa

85

Bungo and a second

source in Higo

Chikushi Bay.

Fujl-kawa

85

Tatsuga-dake (Kai) .

Suruga Bay.

Ono-gawa

83

ABO-san (Higo) .

Oita (Bungo).

Kushiro-gawa

81

Kushiro-numa .

Kushiro.

Miya-kawa .

78

Odaisan (Yamato) .

Ise Bay.

Kuzuryu-gawa

73

Mino ....

Fukui (Echizen).

Yahagi-gawa

78

Shinano

Chita Bay (Owari).

Hitaka-gawa .

76

K6ya-san .

Kii Bay.

Banyfl-gawa .

75

Yamanaka Lake (Kai)

Sagaml Bay.

Yoahii-gawa (called also

Higashi-0-kawa)

75

Mimasaka (N.) .

Kajima Bay.

Yura-kawa .

74

Wakasa

Tango Bay.

Omono-gawa .

78

Kurlkoma-dake (Ei-

kuzen) .

Tsurugi-san

Tsuohizaki (Akita).

Naka-gawa .

68

South of A wail.

Takahashi-gawa .

68

Border of Izumo

KurasMki (Bitohiu).

Koko-gawa .

68

Tamba

Harima Bay.

Mimizu-gawa

63

Border of Higo .

Hyflga Bay.

Toshibetsu-gawa .

64

Toshibetsu

Sea of Japan.

Northern sea.

vabetsa-gawa

64

Kitami plains .

Nyodo-gawa .

64

lyo ... .

Tosa Bay.

Oyodo-gawa .

61

Kuishima-yama

Border of Awa .

Miyazaki.

Monobe-gawa

61

Tosa Bay.

ffaruse-gawa

61

Border of Uzen .

Nobiru.

Nojiro-gawa .

61

Osaru-zan (Rikuchiu)

Nojiro (Ugo).

.Ma'benhi-gawa

61

Border of Rikuchiu .

Hachinohe (Mutsn).

Kiima-gawa

m

Border of Hyfiga

Yatsushiro,

carried seawards by these numerous rivers varies within wide limits; for whereas, during the rainy season in summer and while the snows of winter are melting in spring, great volumes of water sweep down from the mountains, these broad rivers dwindle at other times to petty rivulets trickling among a waste of pebbles and boulders. Neither are there any long rivers, as compared with Occidental figures, and all are so broken by shallows and rapids that navigation is generally impossible except by means of flat-bottomed boats drawing only a few inches. The chief rivers are given in the above table. There are eleven other rivers — the Iwata, the Ota, the Abashiri, the Shonai, the Iwaki, the Midori, the Yodo,

the Hei, the Takatsu, the Watari, and the Abe — varying in length from 59 to 49 miles, in the order here set down, but they are not of sufficient importance to warrant fuller notice.

Japan has many lakes, remarkable for the beauty of their scenery rather than for their extent. Some are contained in alluvial depressions in the river valleys ; others have been formed by volcanic ^ate?ft/“s. eruptions, the ejectamenta damming the courses of the rivers and piling up their waters until exits were found over cliffs or through gorges. Some of these lakes have become favourite summer resorts for foreigners touring or residing in Japan. To that category belong especially the lakes of Hakone, of Chiusenji, of Sh&ji, of Inawashiro, and of Omi. Among these the highest is Lake Chiusenji, which is 4375 feet above sea-level, has a maximum depth of 93 fathoms, and empties itself at one end over a fall (Kegon) 250 feet high. The ShSji lakes lie at a height of 3160 feet, and their neighbourhood abounds in scenic charms; Lake Hakone is at a height of

2428 feet; Inawashiro, at a height of 1920 feet ; and Omi, at a height of 328 feet. The Japanese associate Lake Omi with eight views of especial loveliness (Omi-no-hakkei). Lake Suwo, in Shirano, which is emptied by the Tenryu-gawa, has a height of 2624 feet. In the vicinity of many of these mountain lakes thermal springs, with remarkable curative properties, are to be found, and there can be no doubt that among the features of Japan's future will be the establishment of health-resorts in regions offering so many attractions. The names and sizes of the principal lakes, so far as they have been surveyed, are as follow : —

In the Tokaido Begion.

Circum-

ference

Name. in miles.

Ashi-no-ko 1 (Lake Hakone in Sagami) . . . 11-78

Inba-numa (Shimosa) ....

29-28

Tega-numa (Shimosa)

Kasumi-ga-ura (Hitachi) .

87-89

Kita-ura (Hitachi)

36-60

Kare-numa (Hitachi)

Ushiku-numa (Hitachi)

Kawaguchi-ko (Kai) .

Nishino-umi (Kai) .

Yamanakar-ko (Kai) , .

Motosu-ko (Kai)

Sh6ji-ko (Kai) ....

TJkijima^numa (Suruga)

In the Tosando Region.

Biwa-ko (Omi) 180 -20

Suwa-ko (Shinano) .

11-10

Chiusenji-ko (Shimotsuke)

19-52

Sumoto-ko (Shimotsuke) .

Inawashiro-ko (Iwashiro) .

33-06

Shinai-numa (Eikuzen)

...

Kawara^numa (Mutsu)

33-33

Tawada-ko (Mutsn) .

37-48

J(isan-gata (Mutsu) .

Hachiro-gata (Ugo) 36-60

1 By the terms ko or numa or ike a lake is to be understood ; by the

terms ura or kata, a lagoon.

S.V.-Ss

674

JAPAN

[geogbapht

In the Hokuriku Region.

Name.

Kita-gata (Eohizen) .

Kawakita-gata (Kaga)

Shibayama-gata (Kaga)

Ochi-gata (Noto)

Fukushima-gata (Echigo)

Yoroi-gata (Echigo)

Ebisuminato-gata (Sado)

In the Kanai Begion.

Omuku-no-ike (Yamashiro)

Sayama^ike (Kawachi)

Circum-

ference

in miles.

10-44

In the Sanindo Begion.

Nakano-uml (Izumo) 39-77

Shinji-ko (Izuino) 31-72

T6g6-no-ike (HSki)

Koyama-ike (Inaba) . •

In the Sanyodo Begion.

Tokiwa^ike (Nagato) 8

In the Saikaido Begion.

Ikeda-ko (Satsuma)

(There are also about 40 small lakes at Kirishima-yama.)

In the Nankaido Begion.

There are no large lakes in this region ; only such small

ones as H6jd-ike and Mano-ike.

7)1 the Hokkaido Region.

Circum-

ference

in miles.

24-40

27-00

36-60

48-80

T6ya-ko (Iburi) ....

Shikotsu or Chitose-ko (Kushiro)

Harutori or Kushiro-ko (Kushiro)

Fure-numa (Nemuro)

Saruma^ko (Kitami)

Notoro-ko (Kitami)

There are seventy-four meteorological stations in the

Japanese empire, whence reports are constantly forwarded

by telegraph to the central observatory in Toky6, and the latter issues daily statements foJ°”” of the climatic conditions during the previous twenty-four hours, as well as forecasts of the weather during the next twenty-four. The whole country is divided into seven districts for meteorological purposes, and storm-warnings are addressed to one or more of the divisions when such a precaution is judged necessary. At the most important stations observations are taken every hour; at the less important, six observations daily; and at the least important, three observations. This work is carried on by Japanese experts solely. Hitherto no attempt has been made to strike averages of the observa-tions covering a number of years; but as without such averages no trustworthy deduction can be drawn, the reports of the observatories for the ten years ending 1900 are now collated to form the following table : —

AVERAGES OF METEOROLOGICAL OBSERVATIONS.

Velocitv oi

Atmospheric

Temperature of

g£

i

Quantity of

Wind per

second. –

Pressure.

the Air.

las

si-

Kflin and Snow.

Number of Days.

o1

^1

II

aS

2|

§1

^1

.-S

S|

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II

«£

S3I

0

to -a

0

to

a

1

to

1

CQ

5

1

3

1^’

41

mm.

mm.

mm.

mm.

mm.

mm.

Metres. 1

1. Nagasaki.

761-8

775-5

787-2

14° 6'

84° 8-

3° 7'

10-8

67

1822-2

122-8

165-8

14-6

19-7

12-0

0-8

37-6

41-5

136-8

19-8

2-1

21-2

2. K6ohi .

761-2

777-9

787-2

15° 8'

84°7'

5° 4'

12-4

74

2815-7

186-0

145-5

4-1

0-4

11-3

0-7

80-5

69-8

126-1

18-6

2-2

22-T

8. Kanazawa

761-5

776-0

741-6

18° 8 ‘1

34° 8′

6° 2′

10-0

78

2468-7

89-8

216-0

55-8

86-8

12-7

0-8

27-8

18-8

212-1

20-7

2-8

19-8

4. T6ky« .

760-6

775-6

788-9

14° 0'

84° 0'

6° 4'

10-3

73

1467-7

110-8

146-5

11-9

7-3

14-9

18-0

68-8

55-1

137-2

47-4

3-5

22-2

5. Hakodate

760-2

775-5

738-2

8° 2'

31° 9′

18° 8′

7-6

78

1186-4

81-5

192-6

108-1

38 8

10-4

15-1

72-1

20-4

163-4

158-2

5-0

23-5

6. Kagosliima

761-3

774-6

749-8

17° 0′

84° 6′

4° 2′

11-8

73

1967-2

128-2

162-8

6-4

8-4

12-7

0-8

48-6

49 -S

146-1

18-2

2T-0

19-2

T. Osaka

761-5

775-9

738-5

14° 9′

85° 8′

3°5′

10-5

73

1846-6

86-7

14-4

16-1

8-5

18-4

4-1

8-4

44-6

103-1

55-8

3-6

21-9

3. Akamagaseki .

761-6

775-1

742-4

15° 2′

3403′

4° 2′

11-1

75

1430-9

94-6

164-5

20-2

29-7

18-5

7-8

7-4

7-1

152-4

T6-6

4-5

8-9

9. Sakai

761-7

776-1

740-0

14° 8′

35° 6′

5° 2′

10-7

77

1997-7

181-2

207-8

49-0

81-8

12-4

6-0

87-4

21-1

168-0

55-5

8-4

24-6

10. Akita

760-7

775-4

740-2

10° 2′

82° 9′

15° 6′

8-9

80

1764-6

82-7

234-8

91-7

31-4

11-1

6-5

40-7

15-1

202-1

8-7

4-2

2&-8

11. Isliiiiomakl

760-6

775-0

789-6

11° 0′

31° 2′

10° r

9-3

78

1188-1

86-8

144-0

45-2

5-8

10-0

81-8

66-7

25-7

138-5

117-4

4-2

26-4

12. Nemur’ .

759-6

775-6

732-6

5° 8′

80° 0′

17° 3′

6-8

78

961-4

81-0

160-4

92-8

45-4

6-0

87-5

116-1

29-2

154-8

196-5

6-5

30-4

18. Wakayama

14. Hiroshima

761-8

775-4

788-9

16° 4'

34°1'

3° 2'

10-3

72

1651-1

136-0

137-0

13-8

10-3

10-6

2-6

52-6

32-6

158-0

26-0

2-9

24-1

762-8

776-8

741-6

14° 9'

84° 5'

4°1'

11-1

78

1823-3

108-9

180-6

24-6

8-0

8-0

12-0

54-0

47-6

121-0

10-0

2-3

*21-^*

15. Ky6t6 .

762-8

775-5

740-1

14° 2'

35° r

8° 8'

10-4

73

1770-2

102-2

157-0

93-9

6-6

10-0

5-0

97-0

81-6

141-6

5-3

1-6

18-6

16. Miyafco .

760-S

775-0

789-0

10° 8′

32° 7′

11° 5′

8-2

76

1628-9

119-5

145-8

86-6

14-8

7-8

16-0

88-6

45-6

129-0

22-8

2-6

17-9

17. Sapporo .

759-5

774-8

735-0

7° 2'

81° 4'

28° 1'

7-1

79

1059-7

71-8

184-6

110-0

83-3

6-0

14-8

98-0

20-0

127-8

104-8

8-8

23-1

18. Pescadores

759-0

772-1

787-5

22° 6′

.32° 8′

8° 8′

17-8

84

1240-2

204-8

146-0

21-0

5-5

86-5

128-0

287-0

11-1

24-1

19. Henchung

758-7

770-5

737-5

24° 7'

88° 2'

12° 0'

19-7

83

2911-8

287-8

161-6

36-6

21-0

127-6

81-0

4-8

21-1

20. Taipeli .

21. Nafe (Elukiu) .

759-9

774-8

784-3

21° 7′

86° 1′

4°1′

16-8

82

2485-6

183-2

190-0

60-0

21-5

1-5

18-5

194-0

72-5

1-6

25-2

760-1

772-5

738-8

22° 5′

83° 4′

8° 8′

16-5

79

23T7-7

177-6

111-0

1-5

26-6

2-5

17-0

198-0

77-0

4-4

29-6

22. Nagano .

761-4

777-7

742-9

11° 9′

38° 6′

11° 6′

9-1

81

1889-7

73-2

176-0

67-0

8-6

18-5

16-6

118-0

2-5

14-5

62-6

•2-4

21-S

IT'.B.— For the first Ave places in the above list the averages cover 10 years ; for the next seven— fi:om Kagoshima to Nemuro inclusive— they cover 7 years ;

for the next five places— from Wakayama to Sapporo inclusive— they cover 3 years; and for the last five places they cover 2 years. The quantity of rain and

snow is the total height of the water collected at the hours of observations without taking count of duration. The number of days of rain, snow Ac. is

reckoned for a period of 24 hours since the last observation, whatever may have been the duration of the phenomena, and a fall of rain, snow, or hail less than

Jji of a millimetre is not taken into account. The columns of snow and hail include all the days when these phenomena presented themselves in the above

degree, and consequently these days are repeated in the three columns. As to foggy days, a thick fog is to be understood. For calculating cloudiness the

standard 10 is taken, a cipher indicating absolute oloudlessness, and 10 a completely overcast sky. A ^' clear day" is when the quantity of cloud does not

exceed 2 according to this scale, all other days being counted cloudy. A tempestuous day is when the velocity of the vriaA exceeds 2 metres per second The

temperatures in the table are Centigrade. ^

The tables on the next page afford data for comparing

the climates of Peking, Shanghai, Hakodate, Toky6, and

San Francisco.

As might be expected from the large extension of the Japanese islands in a northerly and southerly direction, great varieties of climate exist. As Climate. general characteristics may be mentioned hot and humid though short summers, and long, cold, and clear winters. The equatorial currents laving the shores of the islands produce conditions differing from those existing at corresponding latitudes on the neighbouring continent. In Kiushiu, Shikoku, and the southern half of the main island, the months of July and August alone are marked by inconvenient heat at the sea-level, while in elevated districts a cool and even bracing temperature may always be found, though the direct rays of the sun retain inconvenient power. Winter, also, in these districts does not last more than two months, from the end of December to the beginning of Ttlarch; for although the latter month is not free from frost, and even snow, the balminess of spring makes itself plainly perceptible. On the other hand, in the northern half of the main island, in Ezo and in the Kuriles, the

cold is severe during the winter, which lasts for at least four months, and snow falls sometimes to great depths. This may be illustrated by saying that whereas in Tokyo the number of frosty nights during a year does not average much over 60, the corresponding number in Sapporo or railways]

the north-west of Ezo is 146. But the variation of the thermometer in winter and summer being considerable — as much as 40° C. in Toky6 — the climate proves some-what trying to persons of weak constitution. On the

Longitude.

Latitude.

Mean Temp.

Peking

116° 29′ E.

39° 57′ N.

11° 48′ 1

Shanghai

121° 20′ E.

31° 12′ N.

15° 12′

Hakodate

140° 45′ E.

41° 46′ N.

8° 6′

T6ky6 .

139° 47′ E.

35°41’N.

18° 54′

San Francisco .

122° 25′ E.

37° 48′ N.

13° 30′

Hottest Month.

Mean Temp,

of Hottest Month.

Peking

Shanghai

Hakodate

T6kyS ....

San Francisco

July

)»

August

)i

Septeratier

26° 6'

28° 6'

21° 44'

26° 24'

16° 12'

Coldest Month.

Mean Tecop. of

Coldest Month.

Difference.

Peking

Shanghai .

Hakodate .

TSkyS

San Francisco .

January

-4° 36′

-3° 30′

-2° 36′

2° 24′

9° 48′

30° 42′

31° 36′

24° 0′

24° 0′

6° 48′

, other hand, the mean daily variation is in general less than in other countries having the same latitude : it is greatest in January, when it reaches 10° C, and least in July, when it barely exceeds 6° C. The monthly variation is very great in March, when it usually reaches 24° C. There are two wet seasons in Central Japan, each of six weeks' duration, the first commencing in June, the second

in September. Between these seasons are the dog days (doyo), from the middle of July till the second half of August. September is the wettest month ; January the driest. During the four months from November to February inclusive only about 18 per cent, falls of the whole rain for the year. In the districts on the east of the main island the snowfall is insignificant, seldom attaining a depth of more than four or five inches, and generally melting in a few days, while bright, sunny skies are usual. But in the mountainous provinces of the interior and in those along the western coast, deep snow covers the ground throughout the whole winter, and the sky is usually wrapped in a veil of clouds. These differences are due to the action of the north-westerly wind that blows over Japan from Siberia. The intervening sea being comparatively warm, this wind arrives at Japan having its temperature increased and carrying moisture which it deposits as snow on the western faces of the Japanese mountains. Crossing the mountains and descending their eastern slopes, the wind becomes less saturated and warmer,

so that the formation of clouds ceases.

Railways. — The work of railway building was com-

menced by the Meiji Government in 1869, and the first

line— that between Tokyo and Yokohama, a distance of

18 miles — was opened for trafflc in 1872. But private

capitalists showed no inclination to engage in such enter-

prise, and when at length in 1888 a company — the Nippon

Tetsudo Kaisha (Japan Railway Company) — was projected,

its organization could not be completed until the Treasury

guaranteed 8 per cent, on the paid-up capital for 15 years.

Progress was slow at first, so that in 1888 the total length

of lines in operation was only 318 miles, of which 205

miles had been built by the Government and 113 by private

enterprise. Thenceforth the work of construction pro-

ceeded more rapidly, so that the average annual addition

made to private lines until the close of 1899 was 208

miles, aud that made to State lines, 40 miles.

1 The temperatures are Centigrade.

The total length of lines open for traffic at the end

of 1899 was 3639 miles, of which 833 miles had been

constructed by the State and 2806 miles by private companies. The expenditure on account of State lines had been 70 million yen in round numbers, or 84,034 yen per mile ; and that on account of private lines, 187 millions (including debentures and loans), or 66,286 yen per mile. The difference in cost of construction is explained by the facts that portions of the State lines were built before experience had indicated cheap methods ; that extensive works for carriage-building, repairs of locomotives, &c., are connected with the Government lines, and that it fell to the lot of the State to undertake lines running through districts that present exceptional engineering difficulties, such districts being naturally avoided by private companies. The number of passengers and the quantity of goods carried over all the lines during 1899 were 102,115,942 and 18,820,034 tons respectively; the gross earnings amounted to 38,219,272 yen, and the working expenses to 18,833,217 yen, leaving a net profit of 19,386,065 yen. Thus the working expenses represented 49 per cent, of the earnings and the

net profits averaged a little over 7^ per cent, of the invested capital.

The Government programme involves the construction of 1230 miles of new railways, and private companies — which number 103 in all — have obtained charters for building 961 miles, the former work involving an outlay of 114^ million yen, and the latter an outlay of 60 millions. Thus the lines in operation and projected total 6830 miles, and the capital involved aggregates 431^ million yen.

The programme of railway construction, as originally planned and subsequently carried out in great part, had for its basis a grand trunk line extending the whole length of the main island from Aomori on the north to Shimonoseki on the south, a distance of 1153 miles ; and a continuation of the same line throughout the length of the southern island of Kiushiu, from Moji on the north — which lies on the opposite side of the strait from Shimonoseki — to Kagoshima on the south, a distance of 232| miles ; as well as a line from Moji to Nagasaki, a distance of 163^ miles.

Of this main road the State undertook to build the central section (376 miles), between TokyS and Kobe (vid Kyoto) ; the Japan Railway Company undertook the portion (467 miles) northward of Tokyo to Aomori; the Sanyo Railway Company undertook the portion (320 miles) southward of TokySto Shimonoseki; and the Kiushiu Railway Company undertook the lines in Kiushiu. The whole line is now in operation, with the exception of two sections, measuring 46^ miles and 89J miles respectively, namely the part of the Sanyo railway between Mitajiri and Shimonoseki, and the part of the Kiushiu railway between Kumamoto and Kagoshima. It is not literally correct to say that this main trunk line has been constructed as originally planned. Th e first project was to carry the T6ky5-Ky6to line through the interior of the island so as to secure it against enterprises on the part of a maritime enemy. Such engineering diffi-culties presented themselves, however, that the coast route was ultimately chosen, and though the line through the interior was subsequently constructed, strategical con-siderations have not been allowed to govern its direction

completely.

When Japan began to build railways, much discussion was taking place in England and India as to the relative advantages of the wide and narrow gauges, and so strongly did the arguments in favour of the metre gauge appeal to the Indian Government that it adopted the latter in 1873, although some 6000 miles of wide-gauge roads had already been built. The English advisers of the Japanese Govern-ment maintained similar views, and it resulted that the

[government

metre (3 feet 6 inches) gauge was chosen. Some fitful efforts made in later years to change the system proved unsuccessful, and there is now little reason to foresee any departure from the metre gauge. The lines, too, are single, for t|}.e most part: only 250 miles of double track exist out of the 3639 miles of line that have been built ; and as the embankments, the cuttings, the culverts, and the bridge-piers have not been con-

structed for a double line, any change now would be very costly. The average speed of passenger trains in Japan is 18 miles an hour, the corresponding figure over the metre-gauge roads in India being 16 miles, and the figure for English parliamentary trains from 19 to 28 miles. British engineers surveyed the routes for the first lines and superintended the work of construction, but within a few years the Japanese were able to dispense with foreign aid altogether, both in building and operating their railways. They also construct carriages and waggons, but not locomotives, for though one was successfully built at the Kobe workshops under the superintendence of a British engineer, the enterprise did not continue. The lines are well ballasted, but the carriages are not comfortable, and the points and signal arrangements are of old patterns. Nevertheless there is tolerable immunity from accidents and irregularities, and seeing that the working expenses average only 49 per cent, of the gross earnings, whereas the corresponding figure in England is 55, it can scarcely be doubted that

the management is eflcient.

The central administration of public affairs is carried on by a cabinet, under the personal direction of the Sovereign, . and by nine State departments, namely, those of civit foreign affairs, home affairs, finance, war, the admiais- navy, justice, education, agriculture, and com- tratioa. rnerce. The heads of these departments are called " ministers of State." They form a cabinet, under the direction of a minister president of State. Thus the cabinet numbers ten members, exclusive of the Emperor. Each department has a parliamentary and a permanent vice-minister, and is divided into bureaux presided over by chiefs. There is a privy council, charged with the duty of advising the Sovereign upon all questions submitted to it ; and there are also a board of audit, which discharges important functions with regard to the public accounts ; an administrative court, which takes cognizance of all legal questions connected with officials ; and an administrative bureau of the House of Peers, as well as one of the House of Representatives. The affairs of the Imperial household

and of the Imperial estates are managed by a household department under a minister, who has not a seat in the cabinet and is independent of ministerial vicissitudes. As a general rule, the portfolios of war and of the navy have changed hands on occasions of cabinet changes, but there is a growing tendency to invest these portfolios with a technical character and to make their tenure independent of the cabinet's life. Under the control of the central administration, though not forming an integral part of it, are the bureau of T5ky6 police, the Hokkaido bureau, the governors of prefectures and their staffs, and the govern-ment of Formosa.

Japanese officials are divided into four classes : the first comprising those that receive their commissions directly from the Emperor and are entitled to report offic a s. personally to him ; the second, those that receive their commissions through the minister of adepartment and have the ent7-6e to the palace on State occasions ; the third, those commissioned similarly to the second class, but not having the entrie to the palace ; and the fourth, those

temporarily engaged and having the status of mere em-

ployes. There is also another classification into nine ranks,

each having two grades. The place occupied by an official

in this list is granted by the Emperor as a recognition

of merit, and the designation is prefixed to the name,

like a title, in official documents. Thus Shd-ni-i Kdshdku

ltd, " First-grade second rank Marquis Ito " ; or J-Q^sammi

Danshaku Iwakura, " Second-grade third rank Baron

Iwakura." Admission to officialdom is by examination,

except in the case of candidates possessing certain duly

attested educational qualifications.

The following table shows the number of officials be-

longing to the central Government and their respective

emoluments : —

Officials.

Total

Number.

Total Yearly

Emoluments.

Ten.

Average Yearly-

Emoluments.

Yen,

First-class

Second-class .

Third-class .

Fourth-class .

Totals .

259

4,269

38,082

26,266

1,010,540

4,296,208

9,094,462

4,186,600

3,962 (£397)

1,006 (£101)

238 (£24)

159 (£16)

68,876

18,587,710

269 (£27)

There has been of late years a steady tendency towards increase in the number of central Government officials. In 1893 the total was only 45,508, against 68,876 at present, and the emoluments aggregated 10,745,348 yen, whereas they now aggregate 18,587,710 yen.

For purposes of local administration the whole empire is divided into 47 prefectures Qcen) ; 653 counties (^un) ; 48 towns {shi), and 14,734 districts (c/io or son).

The three metropolitan prefectures of Tokyo, ^°<^j Osaka, and KyotS are called fu, and the dis- u-Sioa. ‘ tricts are divided into “urban” (c7io) and ” rural ” {son), according to the number of houses they contain. The prefectures are named after their chief towns, except in the case of Hokkaido and Okinawa.

The names of the prefectures, with their population and superficies, are as follow : —

Prefecture.

Area in square

miles.

Population.

T6ky5

749-76

1,507,642 1

Kanagawa .

927-79

776,642

Saitama

. 1,585-30

1,174,094

Chiba

. 1,948-85

1,273,387

Ibaralii

. 2,2.35-67

1,131,556

Tochigi

. 2,854-14

788,324

Gumma

. 2,427-21

774,604

Nagano

. 5,088-41

1,237,584

Yamanashi

. 1,727-50

498,539

Shizuoka .

. 3,002-76

1,199,805

Aichi

1,864-17

1,591,357

Miye

. 2,196-56

495,389

Gifu

. 4,001-84

996,062

Shiga

. 1,540-30

712,024

Fukui

. 1,621-50

633,840

Ishikawa .

. 1,611-59

392,905

Toyama

. 1,587-80

785,554

The above 17 prefecture

s form Central <

Japan.

Prefecture.

Area in square

miles.

Population.

Niigata

. 4,914-55

1,812.289

Fukushima

. 5,042-57

1,0.57,971

Miyagi

. 3,223-11

835,830

Yamagata

. 3,576-89

820,210

Akita

. 4,493-84

775,077

Iwate

5,359-17

720,380

Awomori .

. 3,617-89

612,171

The above 7 prefectures

form Northern

Japan.

Prefecture.

Area in square

miles.

Population.

Ky6t6

. 1,767-43

9.31,5762

Osaka

689-69

1,311,9092

Nara .

. 1,200-46

638,507

1 This is not the populatiou of the city proper, but that of the urban

prefecture called Tokyo-fu.

2 This is not the population of the city proper, but of the urban

prefecture.

administration]

Prefecture.

Wakayama

Hyogo

Okayama .

Hiroshima

Yamaguchi

Shimane

Tottori

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Area in square

miles.

1,851-29

3,318-31

2,509-04

3,103-84

1,324-34

2,697-48

1,335-99

Population.

681,572

1,667,226

1,132,000

1,436,415

986,161

721,448

418,929

These 10 prefectures form Southern Japan.

Prefecture.

Tokushima

Kagawa

Ehime

Kochi

Area in square

miles.

1,616-82

976-46

2,033-57

, 2,720-13

Population.

699,398

700,402

997,481

616,549

The above 4 prefectures form the island of Shikoku.

Prefecture.

Nagasaki .

Saga .

Fukuoka .

Kumamoto

Oita .

Mlyazaki .

Kagoshima

Okinawa .

Area in square

miles.

1,401-49

984-07

1,894-14

2,774-20

2,400-27

2,904-54

3,589-76

935-18

The above 8 prefectures form Kiushiu,

Prefecture.

Hokkaido .

Area in square

miles.

36,328-34

Population.

821,323

621,011

1,362,743

1,151,401

839,485

454,707

1,104,631

1,104,631

Population.

610,155

In the system of local administration full effect is given to the principle of popular representation. Each prefecture (urban or rural), each county, each town and each district (urban or rural) has its local assembly, the number of members being fixed in proportion to the population. There is no superior limit of number in the case of a prefectural assembly, but the inferior limit is 30. For a town assembly, however, the superior limit is 60 and -the inferior 30 ; for a county assembly the corresponding figures are 40 and 15, and for a district assembly, 30 and 8. These bodies are all elective. The property qualification for the franchise in the case of prefectural and county assemblies is an annual payment of direct national taxes to the amount of 3 yen; and in the case of town and district assemblies, 2 yen; while to be eligible for election to a prefectural assembly a yearly payment of 10 yen of

direct national taxes is necessary ; to a county assembly, 6 yen, and to a town or district assembly, 2 yen. In towns and districts franchise-holders are further divided into classes with regard to their payment of local taxes. Thus, for town electors there are three classes, differentiated by the following process : — On the list of ratepayers the highest are checked off until their aggregate payments are equal to one-third of the total taxes. These persons form the first class. Next below them the persons whose aggregate payments represent the same fraction (^) of the total amount are checked off to form the second class, and all the remainder form the third class. Each class elects one-third of the members of assembly. In the districts there are only two classes, namely, those whose payments, in order from the highest, aggregate one-half of the total, the remaining names on the list being placed in the second class. Each class elects one-half of the members. This is called the system of d-jinushi (large land-owners), and it is found to work satisfactorily as a device for conferring representative rights in proportion to property. The

franchise is withheld from all local salaried officials, from judicial officials, from ministers of religion, from persons who, not being barristers by profession, assist the people in affairs connected with law courts or official bureaux, and from every individual or member of a company that contracts for the execution of public works or the supply of articles to a local administration, as well as from persons unable to write their own names and the name of the candidate for whom they vote. Members of assembly are not paid. For prefectural and county assemblies the term is four years ; for town and district assemblies, six years, with the provision that one-half of the members must be elected every third year. The prefectural assemblies hold one session of 30 days yearly; the county assemblies, one session of not more than 14 days ; the town and district assemblies have no fixed session : they are summoned by the mayor or the head-man (to whom further allusion will presently be made) when their deliberations appear necessary, and they continue in session till their business is concluded. Speaking

broadly, the chief function of the assemblies is to deal with all questions of local finance. They discuss and vote the yearly budgets ; they pass the settled accounts ; they fix the local taxes within a maximum limit which bears a certain ratio to the national taxes ; they make representations to the minister for home affairs ; they deal with the fixed property of the locality ; they raise loans, and so on. It is necessary, however, that they should obtain the consent of the minister for home affairs, and sometimes of the minister of finance also, before disturbing any objects of scientific, artistic, or historical importance ; before contracting loans ; before imposing special taxes, or passing the normal limits of taxation ; before enacting new local regulations or changing the old ; before dealing with grants in aid made by the central Treasury, &c. The governor of a prefecture, who is appointed by the central administration, is invested with considerable power. He oversees the carrying out of all works undertaken at the public expense ; he causes bills to be drafted for discussion by an assembly ; he is respon-

sible for the administration of the funds and property of the prefecture ; he orders payments and receipts ; he directs the machinery for collecting taxes and fees; he summons a prefectural assembly, opens it and closes it, and has competence to suspend its session, should such a course seem necessary. Many of the functions performed by the governor with regard to prefectural assemblies are discharged by a " head-man " (gun-chd) in the case of county assemblies. This head-man is a salaried official appointed by the central administration. He convenes, opens, and closes the county assembly ; he may require it to reconsider any of its financial decisions that seem improper, explaining his reasons for doing so, and should the assembly adiere to its original view, he may refer the matter to the governor of the prefecture. On the other' hand, the assembly is competent to appeal to the home minister from the governor's decision. The county head-man may also take upon himself, in case of emergency, any of the functions falling within the competence of the county assembly, provided that he reports the fact to the assembly

and seeks its sanction at the earliest possible opportunity. In each district also there is a head-man, but his post is always elective and generally non-salaried. He occupies towards a district assembly the same position that the county head-man holds towards a county assembly. Over the governors stands the minister for home affairs, who discharges general duties, of superintendence and sanction, has competence to delete any item of a local budget, and may, with the Emperor's consent, order the dissolution of a local assembly, provided that steps are taken to elect and convene another within three months. The machinery of local administration is completed by councils, of which the governor of a prefecture, the mayor^ of a town, or the head-man of a county or district, is ex

1 The mayor of a town {shichd) is nominated hy the minister for home affairs from among three men chosen by the town assembly.

officio president, and the councillors are partly elective,

partly nominated by the central Government. The councils may be said to stand in an executive position towards the local legislatures, namely, the assemblies, for the former give effect to the measures voted by the latter, take their place in case of emergency, and consider questions submitted by them. This system of local government has now been in operation since 1885, and has been found to work well. It constitutes a thorough method of political education for the people, since the local assemblies — prefectural, county, town, and district — aggregate no fewer than 15,492 throughout the empire. In feudal days popular representation had no existence, of course, but a very effective chain of local responsibility was manufactured by dividing the people — apart from the samurai — into groups of five, families, which were held jointly liable for any offence committed by one of their members. Thus it cannot be said that the people were altogether unprepared for this new system.

Law. — The laws of Japan are codified. They have all

been drafted since the Restoration, their bases being the laws of Europe. In the work of drafting the Japanese received large assistance from foreign experts, and no efforts were spared to adopt the best principles of Occi-dental jurisprudence without doing violence to the customs and traditions of the nation. Thfe civil code, the code of civil procedure, and the commercial code are modelled chiefly on the laws of Germany ; the criminal code and the code of criminal procedure, on the laws of France. In one respect the code of criminal procedure has been allowed to fall behind the spirit of the age : preliminary examinations are private, and during them the accused is not allowed the benefit of counsel. Until a recent date persons under examination might be ordered into solitary confinement by the judge, if he considered that step necessary for eliciting the truth, but the mise en sicret was abolished in 1899, and a judge's power in preliminary examination is limited to separation of a prisoner's cell, and to forbidding intercourse between him and other persons.

The tribunals of justice are local courts, district courts,

courts of appeal, and a supreme court, each having public procurators as well as judges attached to them. Local courts are presided over by a single judge, but all the other tribunals are collegiate, the district courts, appeal courts, and the supreme court being divided into several sections, each consisting of three, five, or seven judges respectively. Trial by jury has not been adopted in Japan, and is unlikely to be ever adopted. Neither is there any law of the nature of habeas corpus. The code of criminal procedure provides that a prisoner must be brought up for preliminary examination within forty-eight hours from the time of his apprehension, and empowers the examining judge to grant bail, the prisoner being entitled to complain to the court if bail is refused. There are also courts of conciliation, where cases are decided without being carried to contentious issues. There are 365 tribunals of justice in the empire, presided over by 1201 judges, with the assistance of 471 public procurators and 6987 clerks. It has been complained that the number of tribunals and their personnel are not sufficient to discharge

the business coming before them. The criticism is probably just, but statistics show that the courts perform their functions rapidly, for in 1897 they dealt with 313,571 cases altogether, namely, 7654 appeals and 133,472 first instance cases in civil suits, 8507 questions of conciliation and 8723 appeals, and 155,215 first instance or magisterial cases in criminal matters.

In order to qualify for the post of judge or public procurator two examinations have to be passed. They are separated by an interval of at least two years, during which time the aspirant receives practical training in the duties of his profession. The Constitution provides that a judge's appointment shall be for life, and in practice he is not removed except by decision of the Disciplinary Court, or in consequence of a sentence for crime.

The number of police-offices in the empire (including Formosa) is 13,821, and the total number of police of&cials of all grades 32,910, or 1 for every 1421 of the population. The police force has been increased by 4591 since 1885, but of that increment the newly-organized force for

Formosa represents 2934.

*The new criminal code came into operation in 1882, a reform which meant not only the complete abolition of torture, but also a sudden and striking change ^^^ from laws of extreme severity to laws framed in ‘ “** accordance with the most humane principles of Western jurisprudence. An experiment so daring surprised foreign onlookers, and seemed to justify the appre-hensions they freely expressed. But it does not appear from the records that by abandoning the system of heavy penalties encouragement was offered to crime. Taking the eight-years period from 1890 to 1897, by which time the police had learned to discharge their functions efficiently, and the compilation of statistics had become quite trustworthy, it is found that the number of persons charged with crimes or delicts in every thousand of the population stood at 3‘21 in 1890, at 3-46 in 1891, at 3-71 in 1892, at 3-83 in 1893, at 3-88 in 1894, at 3-41 in 1895, at 3-40 in 1896, and at 3-32 in 1897. There is thus a tendency towards a decrease*

rather than an increase of crime, and the suitability of the new code to the conditions existing in Japan seems to have been clearly established. A similar tendency shows itself with regard to the inmates of houses of correction, the number having fallen from 1057 in 18i)0 to 692 in 1897. The effect of police vigilance, aided by improving conditions of life, is apparent also in checking incendiarism. This is a question of great importance for Japan, where, owing to the inflammable nature of the materials used in building habitations, danger of fire is always imminent. In the early part of the Meiji era fully 7 houses out of every 1000 in the country were destroyed yearly by conflagrations. In 1892 the number was 5-81, and in 1897 it had fallen to 4-20. More than 16 per cent, of these fires were due to incendiarism, \m.t there has been a steady improvement in that respect, so that, whereas 2733 cases of arson occurred in 1892, the number in 1897 was only 1551.

Laws specially affecting Foreigners. — Under the revised treaties now in operation the following privileges are con-

ceded to foreigners : (1) They may trade, travel, and reside in any part of Japan, enjoying full protection for their persons and property. (2) They may use the law courts on the same terms as Japanese subjects. (3) They have full religious freedom. (4) They are exempt from any taxes except those imposed on Japanese subjects. (5) They are exempt from military service, military contributions, and forced loans. (6) They may engage in all legitimate trades and mechanical operations, subject to the provisions of law. (7) They may enter into partnership with Japanese or foreigners, or become shareholders in joint-stock companies. (8) Their ships and cargoes may come to all ports open to foreign commerce without paying any higher duties or charges than those paid by Japanese subjects. (9) They are exempt from all transit dues, and they enjoy equality of treatment with Japan in regard to drawbacks, exportation, and warehousing facilities ; but the coasting trade is reserved to Japanese vessels, except in the case of the existing open ports. (10) They may lease land. (11) They may take mortgages on

land.

finance].

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Foreigners are not at present permitted to own land in Japan in their individual capacity. The forms of tenure lawful for them are (1) tenure by ordinary lease; (2) tenure by superficies ; and (3) tenure by ownership as a juridical person. Tenure by ordinary lease is limited to twenty years (subject to renewal), and the lessee is entitled to use and enjoy the object of the lease, whether land or buildings, under conditions substantially the same as those prescribed by English law, except that buildings, fixtures, trees, and plants placed there by the tenant may be removed by him at the termination of his lease. Tenure biy " superficies " — a term which does not accurately represent its Japanese original, " superficial right " — is, in effect, a lease for purposes of building or planting. Such a lease may be for any term of years, fixed according to the convenience of the contracting parties, and

the lessee (superficiary) is absolutely guaranteed against disturbance throughout that period — whether it be fifty or a thousand years. Even though the owner mortgages or sells the land before the expiration of the period, the rights of the superficiary are not affected, and the superficiary, on his side, may assign his superficies without prejudice to the rights of the owner. In short, this kind of tenure differs from actual ownership in name only.

As to ownership by a juridical person, it is to be noted that the term "juridical person" signifies an association of two or more individuals of any nationality, or of mixed nationalities, formed for commercial, industrial, or certain other purposes, registered in Japan, and carrying on business according to the provisions of Japanese law. Such an association, in its corporate capacity, may own land. Thus two or three foreigners, contemplating the erection of a factory or mercantile premises in Japan, can become owners of land for that purpose, though as individuals they are not entitled to such a privilege.

A mortgagee does not become the owner of the mort-

gaged property by foreclosure, nor acquire any right of possession in it. When the debt is not discharged at the maturity of the mortgage, the property has to be sold by order of a court. There is also a special point with regard to the removal of mortgages. The purchaser of mortgaged property may offer a certain sum for the removal of the mortgage ; and if the mortgagee, refusing the offer, demand a sale by auction, he must pledge himself to buy the property for a price at least 10 per cent, higher than the sum offered, in the event of that sum not being realized at the auction. Should the mortgagee be a foreigner, and the mortgaged property be land, then, since a foreigner cannot own land, the law provides that he must merely bind himself to be responsible for the difference between the amount bid at auction and a sum 10 per cent, higher than that offered originally for the removal of the mortgage. These various restrictions greatly" impair the value of mortgages for business purposes. In the case of a pledge, also, Japanese law requires that the thing pledged must be actually delivered

into the possession of the pledgee, except when it is in transit or stored in a public warehouse. The practice of hypothecating chattels by a registered bill of sale is not recognized.

Protection is given by Japanese law to foreign patents, designs, and trade-marks if proper steps are taken to register them. The applicant, if not domiciled in Japan, must appoint a representative domiciled there. The principles and rules governing the procedure in these matters are identical with those observed in Europe, and Japan is a member of the International Union for the Protection of Industrial Property.

The family law and the law of succession in Japan "being based upon and adapted to the social conditions and customs long prevailing in the country, it has been considered wise by Japanese legislators that foreigners domiciled in Japan should be exempted from the operation of these laws, and left to be governed by the laws of their own nationalities, administered, of course, by Japanese tribunals.

Taxation. — The principal national taxes imposed in Japan are on land, incomes, business, vehicles, and sake (rice-beer). For purposes of taxation land is valued and a certain percentage of the assessed value is levied — 5 per cent, in the case of urban lands, and 3^ per cent, in the case of rural lands. The assessment now adopted is generally the same as that made in 1873. Even at that time it did not amount to more than one-half of the market value of the land, and as the latter has largely appreciated, the tax actually paid is much below its nominal rate, especially in the cities, where the assessments are only a small fraction of the land's selling price. This tax is payable by the owner of the land. Income tax is payable, not only by Japanese subjects, but also by all persons having a domicile in Japan, or having resided there for more than one year. The minimum taxable income is 300 yen (£30) annually, and the rate for such an income is 1 per cent. As the income increases so does the rate, up to a limit of 5^ per cent., which is paid by persons having an income of 100,000 yen (£10,000) or

*upwards. The business tax is levied on various branches of business : as sales of merchandise, banking, insurance, warehousing, manufacturing, printing, photography, trans-portation, restaurants, hotels, factors and brokers. When levied on the amount of mercantile transactions, it is ■j-;^ for wholesale dealers and y^^h f°' retail dealers. In other cases it is levied at the rate of ywuts '^^ *^® capital engaged, or at the rate of from 2 per cent, to 6 per cent. on the rental value of the buildings employed. When a business is carried on partly in a foreign country and partly in Japan, only the capital used in Japan is liable to tax. The taxes on vehicles and sake do not call for any special notice. Stamp duties and registration fees are also collected.*

The total local expenditures are a little over 40 million yen annually. They increased from 25 millions to 40 millions in a period of 6 years (1895-99), but the increase is not an evidence of extravagance fj^oces in administration, as 11 millions of it was de-voted to useful public works, and nearly 2 millions to

education. Eevenue to meet these outlays is derived from five taxes — land-rate (13i millions), house tax (5^ millions), business tax (2|- millions), and miscellaneous tax (3^ millions). A large sum is obtained from property owned by the local administrations, and the central Treasury grants aids to the extent of 4^ million yen.

The system of local taxation is complicated, but, speaking generally, two kinds of impost have to be paid : first, a prefectural tax; and, secondly, a town or district tax. Some of the local taxes are levied on the basis of the national tax — in which case the former must not exceed a certain fixed fraction of the latter ; som e are levied indepen-dently, as taxes on houses, vehicles, and draught-animals. A marked distinction is made between vehicles or animals kept for hire and those maintained by private individuals, and the same principle of graduation observed in the case of the income tax is applied to the house tax, so that the burden decreases rapidly as the poorer classes are reached.

Education is compulsory. Every child, on attaining

the age of six, must attend a common elementary school, where, during a four years' course, instruction is given in morals, reading, writing, arithmetic, the ""'^*'<"'- rudiments of technical work, gymnastics, and poetry. Year by year the attendance at these schools increases. In 1898 4,062,418 children received education out of a total of

7,125,966, the percentage of school-goers being 68-91. The desire for instruction is keener among boys than among girls : of the former, 82-42 per cent, attend school, and of the latter only 53-73.

There are 26,322 public common elementary schools, and the total annual cost of maintaining them is £1,715,469. Hence the average yearly expense of each school is £65; the average number of students, 164; and the average annual cost per child, 8s. 6d., to which the child's parents contribute Is. 9d. yearly, or l|d. per month. These elementary schools form part of the

communal system, and such portion of their expenses as is not covered by tuition fees, income from school property, and miscellaneous sources, must be defrayed out of the proceeds of local taxation. The taxpayers' burden on this account is £1,160,446, and it thus appears that the four years' course of elementary education given to a Japanese child costs the taxpayer 22s. 6d., and costs the child's parents 7s. The expense to parents will be still less in future, for by an ordinance issued in August 1900 it was enacted that whereas the payment of tuition fees has hitherto been the rule, and exemption from payment the exception, hereafter exemption is to be the rule and payment the exception. In short, elementary education will be virtually free.

There are also 174 public kindergartens, with an attendance of 16,000 infants, whose parents pay 3d. per month on the average for each child. In general the kindergartens are connected with elementary schools or with normal schools.

Many (4735) of the common elementary schools have

a section where, subsequently to the completion of the regular curriculum, a special supplementary course of study may be pursued in agriculture, commerce, or industry (sewing in the case of girls). For the same purpose there exist also 318 higher elementary schools, to which a child can gain admittance after passing out of a common elementary school. The time devoted to these special courses is two, three, or four years, according to the degree of proficiency contemplated, and the cost to the parents is 6d. per month.

If a child, after graduating at a common elementary school, desires to extend its education, it passes into a common middle school, where training is given for practical pursuits or for admission to higher educational institutions. The ordinary curriculum at a common middle school includes moral philosophy, English language, history, geography, mathematics, natural history, natural philosophy, chemistry, drawing, and the Japanese language. Five years are required to graduate, and from the fourth year the student may

take up a special technical course as well as the main course ; or, in accordance with local requirements, technical subjects may be taught conjointly with the regular curriculum throughout the whole time. The law provides that there must be at least one common middle school in each prefecture. The actual number is 169, with 2061 teachers and 49,684 students, being an average of 294 students to each school, and 1 teacher to 24 students. The total anuual cost of maintenance is £207,166. Thus each school requires an average outlay of £1226, of which sum the taxpayers defray £720. A student in a common middle school costs the State £2, 19s. yearly, and his five years' course represents a local tax of £14, 15s. It will be seen, therefore, that when a child has completed its four years in a common elementary school and five years in a common middle school, its education has cost the public £15, 17s. 6d.

Great inducements attract attendance at a common middle school. Not only does the graduation certificate

carry considerable weight as a general qualification, but it also entitles a young man to volunteer for one year's service with the colours, thus escaping two of the three years he would have to serve as an ordinary conscript.

The graduate of a common middle school can claim admittance, without examination, to a high school, where he spends three years preparing to pass to a university, or four years studying a special subject, as law, engineering, or medicine. By following the course in a high school a youth obtains exemption from conscription until the age of 28, when one year as a volunteer will free him from all service with the colours. There are 6 high schools, with a total attendance of 4664 students, and the instructors number 351, or 1 to every 13 students. A high school certificate of graduation entitles its holder to enter a university without examination, and qualifies him for all public posts.

In addition to the schools already enumerated, which

may be said to constitute the machinery of general educa^ tion, there are special schools (6) and technical schools (74) where instruction is given in agriculture, commerce, mechanics, applied chemistry, navigation, electrical engineering, art (pictorial and applied), veterinary science, sericulture, and various other branches of industry.

There are also 17 apprentices' schools, classed under the heading of " elementary," where courses of not less than six months, and not more than four years, may be taken in dyeing and weaving, embroidery, the making of artificial flowers, tobacco manufacture, sericulture, reeling silk, pottery, lacquer, wood-work, metal-work, or brewing.

On the average, each of these schools has 67 students and 6 teachers, and costs £620 annually, or £7, 16s. per student. The taxpayers contribute £355 yearly towards the support of each school, and the expense to the student is about 2s. 6d. per month.

Normal schools are maintained for the purpose of training teachers. There are two high normal schools, one for males, the other for females, the former having

655 pupils, the latter 171 ; and there are 47 common normal schools, with 7302 male students and 879 females. Great difficulty is experienced in obtaining a full complement of teachers for elementary public schools. The total number required is 95,000 approximately, and the number actually available is only 64,000. That is mainly due to the very small emoluments given for such service. Out of 64,000 teachers now employed in elementary schools, only 60 get as much as £48 a year ; 11,000 have less than £10 annually, and the salaries of 49,000 range from £11 to £24. Considering that a common labourer now earns £18 a year, the reason for the insufficiency of teachers is apparent.

There are two Imperial universities, one in Tokyo and one in Kyoto. The latter is not yet fully organized. The former has 206 professors and instructors and 2463 students. Its colleges number six — law, medicine, engineering, literature, science, and agriculture. It has a university hall where post-graduate courses are studied, and it publishes a quarterly journal giving accounts of

scientific researches which indicate not only large erudi-

tion, but also original talent.

All the figures given above are independent of private

educational institutions. Of these there are 1600, employ-

ing 5;M6 teachers andhaving 149,230 pupils. The tendency

of the system pursued by the State is to discourage private

education, for unless a private school brings its curriculum

into accord with that prescribed for public institutions, its

students are denied the valuable privilege of exemption

from conscription, as well as the other advantages attach-

ing to State recognition. Further, the disposition to

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present large sums for educational purposes has not

yet become widely effective among private individuals

in Japan. Voluntary contributions in aid of public

schools aggregate about £90,000 annually, but the efforts

made by the people on this account are still comparar

tively insignificant.

The Anglo-Saxon element predominates largely among the foreigners engaged in education. Out of a total of 270 instructors, 198 are American and British. France comes third on the list with 42; Germany fourth with 16, and Eussia fifth with 4.

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When reference is made to the Japanese nation in connexion with the radical changes of 1867, it must be The observed that only the nobles and the samurai natioa's (military class) are indicated — in other words, part la the a section of the population representing about changes, one-sixteenth of the whole. The bulk of the people — ^the agricultural, the industrial, and the mercantile classes — remained outside the sphere of politics, not sharing the anti-foreign prejudice, nor taking any serious interest in the great questions of the time. Foreigners often noted with surprise the contrast between the fierce antipathy displayed towards them by the samurai on the one hand, and the genial, hospitable reception given to them by the common

peo'ple on the other. History teaches that the latter was the natural disposition of the Japanese — the former a mood educated by special experiences. Further, even the comparatively narrow statement that the restoration of the administrative power to the Emperor was the work of the nobles and the samurai miist be taken with limitations. A majority of the nobles entertained no idea of any necessity for change. They were either held fast in the vice of Tokugawa authority, or paralysed by the sensuous seductions of the lives provided for them by the machinations of their retainers, who held the administrative authority of the fiefs in their own hands, leaving its shadow only to their lords. It was, in fact, among the retainers that longings for a new order of things were generated. Some of these men were sincere disciples of progress — a small band of students and deep thinkers who, looking through the narrow Dutch window at Deshima, had caught a glimmering perception of the realities that lay beyond the horizon of their country's prejudices. But the influence of such Liberals was com-

paratively insignificant. Though they showed remarkable moral courage and tenacity of purpose, the age did not furnish any strong object-lessons to enforce their propaganda of progress. The factor chiefly making for change was the samurai's loyal instinct, reinforced by the teachings of Chinese philosophy, by the revival of the Shinto cult, by the promptings of national enterprise, and by the suggestions of foreign intercourse.

Throughout the whole period of Tokugawa rule there had been a strong, if somewhat fitful, leaning of the national mind towards the political philosophy of Confucius and Mencius, as expounded by Choo He and Yang Wang-ming. lyeyasu himself had given the first impetus to this disposition by his patronage of literature. Without any perception of the true spirit of the Chinese sages' teachings, he ordered that primers of the " old learning " should be procured and studied. Thus the Zen doctrines of Buddhism, which contributed so much to the development of the heroic and the sentimental, and were therefore favourable to the stability of military feudalism, gradually

gave place to a theory that the only legitimate ruler was heaven-appointed, that the good of the people should be the first object of administration, and that to fail in achieving that object was to forfeit the title of administrator. A century later, another Tokugawa Shogun (Tsunayoshi) fostered a movement equally fatal to the permanency of feudalism; he encouraged the revival of the Shinto cult which teaches the divine origin of the Mikado, and constructively inculcates that every exercise of administrative authority by a subject is a usurpation. It is possible that although the current of thought inspired by the Chinese philosophy and the Japanese cult was opposed to the dual government of Yedo and Kyoto, the system might have long survived this theoretical disapproval had nothing occurred to furnish signal proof of its practical defects. But the crisis caused by the advent of foreign ships, and by the forceful renewal of foreign intercourse, afforded a convincing proof of the Shogunate's incapacity to protect the State's supposed interests and to enforce the

traditional policy of isolation which had come to be considered essential to the empire's integrity and to the sanctity of the throne. Thus it may be alleged that the nation's mind was already educated for the change which the advent of foreigners precipitated.

But though essentially imperialistic in its prime purposes, the revolution which involved the fall of the Shogunate, and ultimately of feudalism, may be called democratic with regard to the personnel of those who f'[”'‘ planned and directed it. They were, for the most voiutioa. part, samurai, without either official rank or social standing. That is a point essential to a clear understanding of the issue. Fifty-five men may be said to have planned and carried out the overthrow of the Yedo administration, and only five of them were territorial nobles. Eight, belonging to the Court nobility, laboured under the traditional disadvantage of their class, poverty ; and the remaining forty-two, the hearts and hands of the movement, may be described as ambitious youths, who sought to make a career for themselves in the first place,

and for their country in the second. The average age of the whole did not exceed thirty. There was another element also — an element for which any student of Japanese history might have been prepared : the Satsuma samurai aimed not merely at overthrowing the Tokugawa, but also at obtaining the Shogunate for their own chief. Possibly it would be unjust to say that all the leaders of the great southern clan harboured that idea. But some of them certainly did, and not until they had consented to abandon the project did their union with Choshiu, the other great southern clan, become possible — a union without which the revolution could scarcely have been accomplished. This ambition of the Satsuma clansmen deserves special mention, because it bore remarkable fruit ; it may be said to have laid the foundation of constitutional government in Japan. For, in consequence of the distrust engendered by such aspirations, the authors of the Eestoration agreed that when the Emperor assumed the reins of power, he should pledge himself by oath to convene a deliberative assembly, and to appoint to administrative jjosts men of

intellect and erudition wherever they might be found.

At the outset the necessity of abolishing feudalism did

not present itself clearly to the leaders of the revolu-

tion. Their sole idea was the unification of the

nation. But when they came to consider closely J^J^^f”*

the practical side of the problem, they understood laea.

how far it would lead them. Evidently that one

homogeneous system of law should replace the more or less

heterogeneous systems operative in the various fiefs was

essential, and such a substitution meant that the feudatories

must be deprived of their local autonomy and, incidentally,

of their control of local finances. That was a stupendous

change. Hitherto each feudal chief had collected the

revenues of his fief and had employed them at will, subject

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to the sole condition, of maintaining a body of troops

proportionate to his income. He had been, and was

still, an autocrat within the limits of his territory. On the other hand, the active authors of the revolution were a small band of men mainly without prestige or territorial influence. It was impossible that they should dictate any measure sensibly impairing the local and fiscal autonomy of the feudatories. No power capable of enforcing such a measure existed at the time. All the great political changes in Japan had been preceded hitherto by wars culminating in the accession of some strong clan to supreme authority, whereas in this case there had been a displacement without a substitution — the Tokugawa had been over-thrown and no new administrators had been set up in their stead. It was, moreover, certain that an attempt on the part of any one clan to constitute itself executor of the Sovereign's mandates would have stirred the other clans to vehement resistance. In short, the leaders of the revolution found themselves pledged to a new theory of government without any machinery for carrying it into effect, or any means of abolishing the old practice. An

ingenious exit from this curious dilemma was devised by the young reformers. They induced the feudal chiefs of Satsuma, Choshiu, Tosa, and Hizen, the four most powerful clans in the south, publicly to surrender their fiefs to the Emperor, praying his Majesty to reorganize them and to bring them all under the same system of law. In the case of Shimazu, chief of Satsuma, and Yodo, chief of Tosa, this act must stand to their credit as a noble sacrifice. To them the exercise of power had been a reality, and the effort of surrendering it must have been correspondingly costly. But the chiefs of Choshiu and Hizen obeyed the suggestions of their principal vassals with little, if any, sense of the probable cost of obedience. The same remark applies to all the other feudatories, with exceptions so rare as to emphasize the rule. They had long been accustomed to abandon the management of their affairs to their leading clansmen, and they allowed themselves to follow the same guidance at this crisis. Out of the whole 276 feudatories, only 17 hesitated to imitate the example of the four southern fiefs.

An explanation of this remarkable incident has been sought by supposing that the samurai of the various clans, when they advised a course so inconsistent with Motives fidelity to the interests of their feudal chiefs, "reformers, "'"ere influenced by motives of personal ambition, imagining that they themselves might find great opportunities under the new regime. Some hope of that kind may fairly be assumed, and was certainly realized, in the case of the leading samurai of the four southern clans which headed the movement. But it is plain that no such expectations can have been generally entertained. The simplest explanation seems to be the true one : a certain course, indicated by the action of the four southern clans, was conceived to be in accord with the spirit of the Restoration, and not to adopt it would have been to shrink publicly from a sacrifice dictated by the principle of loyalty to the throne — a principle which had acquired supreme sanctity in the eyes of the men of that era. There might have been some uncertainty about the initial step ; but so soon as that was taken by the southern clans their

example acquired compelling force. History shows that in political crises the Japanese samurai is generally ready to pay deference to certain canons of almost romantic morality. There was a fever of loyalty and of patriotism in the air of the year 1869. Any one hesitating, for obviously selfish reasons, to adopt a precedent such as that offered by the procedure of the great southern clans, would have seemed to forfeit the right of calling himself a samurai.

But although the leaders of this remarkable move-ment now understood that they must contrive the total abolition of feudalism and build up a new administra^ tive edifice on foundations of constitutional monarchy, they appreciated the necessity of advancing slowly towards a goal which still lay beyond the range of their followers' vision. Thus the first steps taken after the surrender of the fiefs were to appoint the feudatories to the position of governors in the districts over which they had previously ruled; to confirm the samurai in the possession of their incomes and ofi&cial positions;

to put an end to the distinction between Court nobles and territorial nobles, and to organize in KyotS a cabinet consisting of the leaders of the Restoration. Each new governor received one-tenth of the income of the fief by way of emolument ; the pay of the officials and the samurai, as well as the administrative expenses of the district, was defrayed from the same source, and the residue, if any, was to be passed into the treasury of the central Government.

The defects of this system from a monarchical point of view soon became evident. It did not give the power of either the purse or the sword to the Sovereign.

The revenues of the administrative districts con- ^^'^ "' tinued to be collected and disbursed by the former measures. feudatories, who also retained the control of the troops, the right of appointing and dismissing officials, and almost complete local autonomy. A further radical step had to be taken, and the leaders of reform, seeing nothing better than to continue the method of procedure which had thus far proved so successful, contrived, first, that

several of the administrative districts should send in petitions seeking to surrender their local autonomy, and be brought under the direct rule of the central Government ; secondly, that a number of samurai should apply for permission to lay aside their swords and become farmers. The growth of the samurai class and their differentiation from the agriculturists to whom they originally belonged had been an essential feature of the feudal system. It was thought necessary that reversion to the original state of affairs in these respects should accompany the fall of feudalism. While the nation was digesting the principles embodied in these petitions, the Government made preparations for further measures of reform. The ex-chief of Satsuma, who showed some umbrage because the services of his clan in promoting the Restoration had not been more fully recognized, was induced to take high ministerial office, as were also the ex-chiefs of Choshiu and Tosa. Each of the four great clans had now three representatives in the ministry. These clans were further persuaded to send to T6ky5 — ^whither the Emperor had moved his

court — contingents of troops to form the nucleus of a national army. Importance attaches to these details because the principle of clan representation, illustrated in the organization of the cabinet of 1871, continued to be approximately observed for many years in forming minis-tries, and ultimately became a target for the attacks of party politicians.

On the 29th of August 1871 an Imperial decree an-nounced the abolition of the system of local autonomy and the removal of the territorial nobles from the posts of governors. The taxes of the former fiefs ^^optio" were to be paid thenceforth into the central me" treasury ; all officials were to be appointed by the Imperial Government, and the feudatories, retainingper-manently an income of one-tenth of their original revenues, were to make Tokyo their place of residence. As for the samMj-a j, they remained for the moment in possession of their hereditary pensions. Radical as these changes seem, the disturbance caused by them was not great, since they left the incomes of the military class untouched. Some of the*

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incomes were for life only, but the majority were heredi-
tary, and all had been granted in consideration of their
holders devoting themselves to military service. Four
hundred thousand men approximately were in receipt of
such emoluments, and the total amount annually taken
from the taxpayers for this purpose was about two
million pounds sterling. Plainly the nation would have
to be relieved of this burden sooner or later. The
samurai were essentially an element of the feudal sys-
tem, and that they should survive the latter's fall would
have been incongruous. On the other hand, suddenly
and wholly to deprive these men and their families — a
total of some two million persons — of the means of sub-
sistence on which they had hitherto relied with absolute
confidence, and in return for which they and their fore-
fathers had rendered faithful service, would have been
an act of shocking inhumanity. It may easily be con-

ceived that this problem caused extreme perplexity to the administrators of the new Japan. They left it unsolved for the moment, trusting that time and the loyalty of the samurai themselves would suggest some solution.

As for the feudal chiefs, who had now been deprived of all official status and reduced to the position of private gentlemen, without even a patent of nobility to distinguish them from ordinary individuals, they did not find anything specially irksome or regrettable in their altered position. No scrutiny had been made into the contents of their treasuries. They were allowed to retain unquestioned possession of all the accumulated funds of their

former fiefs, and they also became public creditors for annual allowances equal to one-tenth of their feudal revenues. They had never previously been so pleasantly circumstanced. It is true that they were entirely stripped of all administrative and military authority ; but since their possession of such authority had been in most cases merely nominal, they did not feel the change except as a relief from responsibility.

By degrees public opinion began to declare itself with regard to the samurai. If they were to be absorbed into the bulk of the people and to lose their fixed revenues. Treatment some Capital must be placed at their disposal to samurai, begin the world again. The samurai themselves showed a noble faculty of resignation. They had been a privileged class, but they had purchased their privileges with their blood and by serving as patterns of all the qualities most prized among Japanese national characteristics. The record of their acts and the recognition of the people entitled them to look for munificent treatment at the hands of the Government which they

had been the means of setting up. Yet none of these considerations blinded them to the painful fact that the time had passed them by — that no place existed for them in the new polity. Many of them voluntarily stepped down into the company of the peasant or the tradesman, and many others signified their willingness to join the ranks of common bread-winners if some aid were given to equip them for such a career. After two years' consideration the Government took action. A decree announced, in 1873, that the Treasury was prepared to commute the pensions of the samurai at the rate of six years' purchase for hereditary pensions and four years for life pensions — one-half of the commutation to be paid in cash, and one-half in bonds bearing interest at the rate of 8 per cent. Eeducing this to arithmetic, it will be seen that a perpetual pension of £10 would be exchanged for a payment of £30 in cash, together with securities giving an income of £2, 8s. ; and that a £10 life pensioner received £20 in cash and securities yielding £1, 12s. annually. It is scarcely credible that the samurai should have accepted

such an arrangement. Something, perhaps, must be ascribed to their want of business knowledge, but the general explanation is that they made a large sacrifice in the interests of their country. Nothing in all their career as soldiers became them better than their manner of abandoning it. They were told that they might lay aside their swords, and many of them did so, though from time immemorial they had cherished the sword as the mark of a gentleman, the most precious possession of a warrior, and the one outward evidence that distinguished men of their order from common toilers after gain. They saw themselves deprived of their military employment, were invited to surrender more than one-half of the income it brought, and knew that they were unprepared alike by education and by tradition to earn bread in any calling save that of arms. Yet, at the invitation of a Government which they had helped to establish, many of them bowed their heads quietly to this sharp reverse of fortune. It was certainly a striking instance of the fortitude and resignation which the

creed of the samurai required him to display in the presence of adversity. It is to be noted, however, that as yet the Government's measures with regard to the samurai were not compulsory. Men laid aside their swords and commuted their pensions at their own option.

Meanwhile differences of opinion began to develop among the leaders of progress themselves. Coalitions formed for destructive purposes are often found unable to endure the strain of constructive efforts. Such lack of cohesion might easily have been foreseen in the case of the Japanese reformers. Young men without experience of public affairs, or special education to fit them for responsible posts, found the duty suddenly devolved on them not only of devising administrative and fiscal systems universally applicable to a nation hitherto divided into a congeries of semi-independent principalities, but also of shaping the country's demeanour towards novel problems of foreign intercourse and alien civilization. So long as the heat of their assault upon the Shogunate fused them

into a homogeneous party they worked together suc-
cessfully. But when they had to build a brand-new
edifice on the ruins of a still vivid past, it was inevitable
that their opinions should vary as to the nature of the
materials to be employed. In this divergence of views
many of the capital incidents of Japan's modern history
had their origin. It has been stated already that the de-
claration which the young Emperor was invited
to make on assuming the reins of government g^^y^jg
included a promise constructively pointing to a represea-
representative polity, and that the promise was tativegov
suggested by mutual jealousy of the planners of ™™'"-
the Restoration rather than by any sincere desire for parliar
mentary institutions. Some zealous reformers certainly
wished to follow, in this respect, the example of the foremost
Occidental nations; but a great majority of the statesmen
of the time thought only of a system which, by endowing
all the clans with a share of administrative authority,
would prevent the undue preponderance of any one of
them. It need scarcely be repeated that the military

class alone entered into this account. A ” national assem-

bly ” was regarded solely as an instrument for eliciting

the views of the samurai. Two such assemblies actually

met in the years immediately following the Restoration.

But they were nothing more than debating clubs. No

legislative power was entrusted to them, and their opin-

ions received little official attention. After the second

fiasco they were tacitly allowed to pass out of existence.

Everything, indeed, goes to show that representative

government might have long remained outside the range

of practical politics had not its uses derived vicarious

value from special complications.

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[history

Chief among those complications was the Korean

question. The story of Japan’s relations “with Korea,

*The Korean *^o^g^ dating from very remote times and in-*

qaestion, eluding Several memorable incidents, may be

and Its epitomized here into the statement that from the

effects. ^g^j^ century, when the peninsula was over-run by Japanese troops, its rulers made a habit of sending a present-bearing embassy to facilitate the accession of each Japanese Shogun. But after the fall of the Tokugawa Shogunate the Korean court desisted from this custom, declared its determination to have no further relations with a country embracing Western civilization, and re-fused even to receive a Japanese embassy. Naturally such conduct roused deep umbrage in Japan. Already much friction had been developed among the leaders of national reform. Of the fifty-five men whose united efforts had compassed the fall of the Shogunate, five stood conspicuous above their colleagues. They were Iwakura and Sanjo, Court nobles ; Saigo and Okubo, samurai of Satsuma, and Kido, a samurai of Choshiu. In the second rank came many men of great gifts, whose youth alone disqualified them for prominence — Ito, the constructive statesman of the Meiji era, who inspired nearly all the important measures of the time, though he did not openly figure as their originator ; Inouye, who never lacked a resource

or swerved from the dictates of loyalty ; Okuma, a politician of subtle, versatile, and vigorous intellect; Itagaki, the Rousseau of his era, and a score of others created by the extraordinary circumstances with which they had to deal. But the five first mentioned were the captains, the rest only lieutenants. Among the five, four were sincere reformers — ^not free, of course, from selfish motives, but truthfully bent upon promoting the interests of their country before all other aims. The fifth, Saigo Takamori, was a man in whom boundless ambition lay concealed under qualities of the noblest and most en-during type. His absolute freedom from every trace of sordidness gave currency to a belief that his aims were of the simplest ; the story of his career satisfied the highest canons of the samurai; his massive physique, commanding presence, and sunny aspect impressed and attracted even those who had no opportunity of admiring his life of self-sacrificing effort or appreciating the remarkable military talent he possessed. In the first part of his career, the object of his ambition was Satsuma; in the latter part,

Saigo. The overthrow of the Tokugawa Shogunate presented itself to him originally as a prelude to the supremacy of the Satsuma clan, and when the abolition of feudalism defeated that purpose, Satsuma assumed in his eyes the guise of Saigo. Whether he clearly recognized his own proj ect or was unconsciously swayed by it, there is no doubt that he looked to become supreme in the administration of State affairs. To that end the preservation of the military class was essential. By the swords of the samurai alone could a new imperium in imperio be carved out. On the other hand, Saigo's colleagues in the ministry saw clearly not only that the samurai were an unwarrantable burden on the nation, but also that their continued existence after the fall of feudalism would be a menace to public peace as well as an anomaly. Therefore they took the steps already described, and followed them by the enaction of a conscription law, making every adult male liable for military service without regard to his social standing. It is easy to conceive how painfully unwelcome this conscription law proved

to the samurai. Many of them were not unwilling to commute their pensions, since their creed had always forbidden them to care for money. Many of them were not unwilling to abandon the habit of carrying swords, since the adoption of foreign costume rendered such a custom incongruous and inconvenient. But very few of them could readily consent to step down from their cherished position as the military class, and relinquish their traditional title to bear the whole responsibility and enjoy the whole honour of fighting their country's battles. They had supposed, not unreasonably, that service in the army and navy would be reserved exclusively for them and their sons, whereas now the commonest rustic, mechanic, or tradesman would be equally eligible.

While the pain of this blow was still fresh the question of Korea's contumacious conduct presented itself. It produced an immediate and violent disruption in the ranks of the little band of reformers. Saigo f^'J^^ ^^^ saw in a foreign war the sole remaining chance reformers.

of achieving his ambition by lawful means. The Government's conscription scheme, yet in its infancy, had not produced even the skeleton of an army. If Korea had to be conquered, the samurai must be employed; and their employment would mean, if not their rehabilitation, at least their organization into a force which, under Saigo's leadership, might dictate a new polity. Other members of the cabinet believed that the nation would be disgraced if it tamely endured Korea's insults. Thus several influential voices swelled the clamour for war. But a peace party offered strenuous opposition. Its members saw the collateral issues of the problem, and declared that the country must not think of taking up arms during a period of radical transition. The final discussion took place in the Emperor's presence. Probably none of those engaged in it understood the whole scope of its national significance, or perceived that they were debating, not merely whether there should be peace or war, but whether the country should halt or advance on its newly-adopted path of progress.

The peace party prevailed, and four members of the cabinet, including Saigo, resigned. This rupture was destined to have far-reaching consequences. One of the seceders immediately raised the standard of revolt. Among the devices employed by him to win adherents was an attempt to fan into flame the dying embers of the anti-foreign sentiment. The Government crushed the insurrection easily. Another seceder was Itagaki Taisuke. He believed in representative institutions, and advocated the establishment of a national assembly consisting half of officials and half of popular nominees. His views, premature and visionary, obtained no currency at the moment, but in later years became the shibboleth of a great political party.

Saigo, the most prominent of the seceders, seems to have concluded from that moment that he must abandon his aims or achieve them by force. He retired to his native province of Satsuma, and applied his whole resources, his great reputation, and the devoted loyalty of a number of able followers to organizing and equipping

a strong body of samurai. Matters were facilitated for him by the conservatism of the celebrated Shimazu Saburo, former chief of Satsuma, who, though not opposed to foreign intercourse, had been revolted by the wholesale iconoclasm of the time, and by the indiscrimate rejection of Japanese customs in favour of foreign. He protested vehemently against what seemed to him a slavish abandonment of the nation's individuality, and finding his protest fruitless, he set himself to preserve in his own distant province, where the writ of the Yedo Government had never run, the fashions, institutions, and customs which his former colleagues in the administration were ruthlessly rejecting. Satsuma thus became a centre of conservative influences, among which Saigo and his constantly augmenting band of samnrni found a congenial environment. During four years this breach between the central Government and the southern clan grew constantly history]

wider. The former steadily organized its conscripts, trained them in foreign tactics, and equipped them wholly with foreign arms. The latter adopted the rifle and the drill of Europe, but clung to the sword of the samurai, and engaged ceaselessly in exercises for developing physical power.

Many things happened in that four-years interval ; among them a military expedition to Formosa, which led Japan to the verge of war with China. The ostensible Bxpedi- cause of this complication was the barbarous Formosa, treatment of castaways from Eiukiu by Formosan aborigines. Upon the Chinese Government properly devolved the duty of punishing its subjects, the Formosans. But as the Chinese Government showed no inclination to discharge the duty, Japan took the law into her own hands. She would never have done so, however, had she not hoped to placate thereby the Satsuma samurai. The Riukiu islands had been for centuries an appanage of the Satsuma fief, and the Government, in undertaking to protect the islanders, not only showed consideration for the

discontented clan, but also acceded to the samurai's wish for an over-sea campaign. From a military point of view the expedition was successful. But little glory was to be gained by shooting down the semi-savage inhabitants of Formosa, and whatever potentialities the expedition might have possessed with regard to domestic politics were marred by the bad grace shown in carrying it out and by the feebleness of its international issue. For the T6ky5 Government, by seeking at the eleventh hour to stay the departure of the ships, seemed to dissociate itself from the enterprise, and by subsequently sending an ambassar dor to Peking with instructions to contrive a peaceful solution, lost credit with the samurai whom it had hoped to gratify.

A year after the return of the Formosa expedition, that is to say, at the close of 1875, the Koreans completed their rupture with Japan by firing on the boats of a Treaty Japanese war-vessel engaged in the peaceful operation of coast-surveying. No choice now remained except to despatch an armed expedi-

tion against the truculent kingdom. In this matter Japan showed herself an apt pupil of Occidental methods such as had been practised against herself in former years. She assembled an imposing force of warships and transports, but instead of proceeding to extremities, she employed the squadron — which was by no means so strong as it seemed — to intimidate Korea into signing a treaty of amity and commerce, and opening three ports to foreign trade. That was the beginning of Korea's friendly relations with the outer world, and Japan naturally took credit for the fact that, thus early in her new career, she had become an instrument for extending the principle of universal inter-course opposed so strenuously by herself in the past. But the incident only accentuated the dissatisfaction of the conservative samurai. They did not want treaties of commerce, and they held it a national humiliation that the country should have negotiated on equal terms with a little state which they regarded as a tributary, and which acknowledged China as its suzerain.

Two extreme measures were now (1876) adopted by the

Government : a veto against the wearing of swords, and an edict ordering the compulsory commutation of

–‘ the pensions and allowances received by the

%°swoi^- nobles and the samurai. Three years previously wearing the wearing of swords had been declared optional,

“ ”’ and a scheme of voluntary commutation had

peas ons, ^^^^ announced. Many had bowed quietly to the spirit of these enactments. But many still retained their swords and drew their pensions as of old, obstructing, in the former respect, the Government’s projects for the re-organization of society, and imposing, in the latter, an with

Korea.

intolerable burden on the resources of the Treasury. The Government thought that the time had come, and that its own strength suflB.ced, to substitute compulsion for persua-sion. The financial measure — which was contrived so as to affect the smallest pension-holders least injuriously — evoked no complaint. The samurai remained faithful to the creed which forbade them to be concerned about money.

But the veto against sword- wearing overtaxed the patience of the extreme conservatives. It seemed to them that all the most honoured traditions of their country were being ruthlessly sacrificed on the altar of alien innovations. Armed protests ensued. A few scores of samurai, equip-ping themselves with the hauberks and weapons of old times, fell upon the garrison of a castle, killed or wounded some 300, and then, retiring to an adjacent mountain, died by their own hands. Their example found imitators in two other places, and finally the Satsuma samurai rose in arms under Saigo.

This was an insurrection very different in dimensions and motives from the paltry outbreaks that had preceded it. During four years the preparations of the Satsuma men had been unremitting. They were satsuma equipped with rifles and cannon ; they numbered tion. some 30,000, being thus nearly as numerous as the Government's standing army ; they were all of the military class, and in addition to high training in Western tactics and in the use of modern arms of precision, they

knew how to wield that formidable weapon, the Japanese sword, of which their opponents were for the most part ignorant. Ostensibly their object was to restore the samurai to their old supremacy, and to secure for them all the posts in the army, the navy, and the administration. But although they doubtless entertained that intention, it was put forward mainly with the hope of winning the co-operation of the military class in all parts of the empire. The real purpose of the revolt was to secure the governing power for Satsuma. A bitter struggle ensued. Beginning on 29th January 1877, it was brought to a close on 24th September of the same year by the death, voluntary or in battle, of all the rebel leaders. During that period the number of men engaged on the Government's side had been 66,000, and the number on the side of the rebels 40,000, out of which total the killed and wounded aggregated 35,000, or 33 per cent, of the whole. Had the Government's troops been finally defeated, there can be no doubt that the samurai's exclusive title to man and direct the army and navy would have been re-established, and Japan

would have found herself permanently saddled with a military class, heavily burdening her finances, seriously impeding her progress towards constitutional government, and perpetuating all the abuses incidental to a policy in which the power of the sword rests entirely in the hands of one section of the people. The nation scarcely appreciated the great issues that were at stake. It found more interest in the struggle as furnishing a conclusive test of the efiiciency of the new military system compared with the old. The army sent to quell the insurrection consisted of recruits drawn indiscriminately from every class of the people. Viewed in the light of history, it was an army of commoners, deficient in the fighting instinct, and traditionally demoralized for all purposes of resistance to the military class. The Satsuma insurgents, on the contrary, represented the flower of the samurai, long trained for this very struggle, and led by men whom the nation regarded as its bravest captains. The result dispelled all doubts about the fighting quality of the people at large.

Concurrently with these events the Government dili-

gently endeavoured to equip the country with all the para-

phernalia of Occidental civilization. It is easy to under-

stand that the master-minds of the era, who had planned and

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carried out the Restoration, continued to take the lead in

all paths of progress. Their intellectual superiority en-

titled them to act as guides ; they had enjoyed

pnm'ess exceptional opportunities of acquiring enlighten-

ment by visits to Europe and America, and the

Japanese people had not yet lost the habit of looking to

officialdom for every initiative. But the spectacle thus

presented to foreign onlookers "was not altogether with-

out disquieting suggestions. The Government's reforms

seemed to outstrip the nation's readiness for them, and

the results wore an air of some artificiality and confusion.

Englishmen were employed to superintend the building

of railways, the erection of telegraphs, the construction

of lighthouses, and the organization of a navy. To Frenchmen was entrusted the work of re-casting the laws and training the army in strategy and tactics. Educational affairs, the organization of a postal service, the im,provement of agricxilture and the work of colonization were supervised by Americans. The teaching of medical science, the compilation of a commercial code, the elaboration of a system of local government, and ultimately the training of military officers were assigned to Germans. Eor instruction in sculpture and painting Italians were engaged. Was it possible that so many novelties should be successfully assimilated, or that the nation should adapt itself to systems planned by a motley band of aliens who knew nothing of its character and customs ? These questions did not trouble the Japanese nearly so much as they troubled strangers. The truth is that conservatism was not really required to make the great sacrifices suggested by appearances. Among all the innovations of the era the only one that a Japanese could not lay aside at will was the new

fashion of dressing his hair. He abandoned the queue irrevocably. But for the rest he lived a dual life. During hours of duty he wore a fine uniform, shaped and decorated in foreign style. But so soon as he stepped out of office or off parade, he reverted to his own comfortable and picturesque costume. Handsome houses were built and furnished according to Western models. But each had an annex where alcoves, verandahs, matted floors and paper sliding doors continued to do traditional duty. Beefsteaks, beer, " grape-wine," knives and forks came into use on occasion. But rice-bowls and chop-sticks held their everyday place as of old. In a word, though the Japanese adopted every convenient and serviceable attribute of foreign civilization, such as railways, steamships, telegraphs, post-offices, banks, and machinery of all kinds ; though they accepted Occidental sciences and, to a large extent, Occidental philosophies ; though they recognized the superiority of European jurisprudence and set themselves to bring their laws into accord with it, they nevertheless preserved the essentials of their own mode

of life and never lost their individuality. A remarkable spirit of liberalism and a fine eclectic instinct were needed for the part they acted, but they did no radical violence to their own traditions, creeds, and conventions. There was indeed a certain element of incongruity and even grotesqueness in the nation's doings. Old people cannot fit their feet to new grooves without some clumsiness. The Japanese had grown very old in their special paths, and their novel departure was occasionally disfigured by solecisms. The refined taste that guided them unerringly in all the affairs of life as they had been accustomed to live it, seemed to fail them signally when they emerged into an alien atmosphere. They have given their proofs, however. It is now seen that the apparently excessive rapidity of their progress did not overtax their capacities ; that they have emerged safely from their destructive era and carried their constructive career within reach of certain success, and that while they have still to develop some of the traits of their new civilization, there is no prospect whatever of its proving ultimately

unsuited to them.

After the Satsuma rebellion, nothing disturbed the even tenor of Japan's domestic politics except an attempt on the part of some of her people to force the growth of parliamentary government. ISTo one ^^^Y°^' reading Japanese history carefully can fail represen- to infer that representative institutions are in the genius of the nation. Erom an early era ^J^™' the Sovereign ceased to be autocratic. All the highest offices of state became hereditary possessions of certain great families, and as generation followed genera^ tion, each unit of this oligarchy of households attained the dimensions of a clan. By and by the exigencies of the time gave birth to a military aristocracy, headed by a generalissimo (Shogun), into whose hands the administra- tive authority passed. But even in this military feudal- ism no traces of genuine autocracy were found. Just as the extensive powers nominally vested in the central figure, the Shogun, were in reality wielded by a large body of ministers and councillors, so the local autonomy

enjoyed by each fief was exercised, not by the chief himself, but by his leading vassals. A united effort on the part of all the clans to overthrow this system and wrest the administrative power from the Shogun could have only one logical outcome, the combined exercise of the recovered power by those who had been instrumental in recovering it. That was the meaning of the oath taken by the Emperor at the Restoration, when the youthful sovereign was made to say that " wise counsels should be sought, and all things determined by public discussion." But the framers of the oath had the samurai alone in view. Into their consideration the " common people " — farmers, mechanics, tradesmen — did not enter at all, nor had the common people themselves any idea of advancing a claim to be considered. A voice in the administration would have been to them an embarrassing rather than a pleasing privilege. Thus, as already related, the first deliberative assembly was composed of nobles and samurai only. A mere debating club without any legislative authority, it was permanently dissolved after two sessions.

Possibly the problem of a parliament might have been long postponed after that fiasco, had it not found an ardent advocate in Itagaki Taisuke (afterwards Count Itagaki). A Tosa samurai, conspicuous as a leader of the Restoration movement, Itagaki was among the advocates of recourse to strong measures against Korea in 1873, and his failure to carry his point, supplemented by a belief that a large section of public opinion would have supported him had there been any machinery for appealing to it, gave fresh impetus to his faith in constitutional government. Leaving the cabinet on account of the Korean question, he became the nucleus of agitation in favour of a parliamentary system, and under his banner were enrolled not only discontented samurai, but also many of the young men who, returning from direct observation of the working of constitutional systems in Europe or America, and failing to obtain official posts in Japan, attributed their failure to the oligarchical form of their country's polity. Thus in the interval between 1873 and 1877 there were two centres of disturbance in Japan:

one in Satsuma, where Saigo figured as leader ; the other in Tosa, under Itagaki's guidance. AVhen the Satsuma men appealed to arms in 1877, a widespread apprehension prevailed lest the Tosa politicians should throw in their lot with the insurgents. Such a fear had its origin in failure to understand the object of the one side or to appreciate the sincerity of the other. Saigo and his adherents fought to substitute a Satsuma clique for the oligarchy already in power. Itagaki and his followers history]

struggled for constitutional institutions. The two could not have anything in common. There was consequently no coalition. But the Tosa agitators did not neglect to make capital out of the embarrassment caused by the Satsuma rebellion. While the struggle was at its height, they addressed to the Government a memorial, charging the administration with oppressive measures to restrain the voice of public opinion, with usurpation of power to

the exclusion of the nation at large, and with levelling downwards instead of upwards, since the samwrat had been reduced to the rank of commoners, whereas the commoners should have been educated to the standard of the samurai. This memorial asked for a representative assembly and talked of popular rights. But since the document admitted that the people were uneducated, it is plain that there cannot have been any serious idea of giving them a share in the administration. In fact, the Tosa Liberals were not really contending for popular representation in the full sense of the term. What they wanted was the creation of some machinery for securing to the samurai at large a voice in the management of State affairs. They chafed against the fact that whereas the efforts and sacrifices demanded by the Restoration had fallen equally on the whole military class, the official prizes under the new system were monopolized by a small coterie of men belonging to the four principal clans. It is on record that Itagaki would have been content originally with an assembly consisting half of officials, half of non-offi-

cial samurai, and not including any popular element whatever.

But the Government did not believe that the time had come even for a measure such as the Tosa Liberals advocated. The statesmen in power conceived that the nation must be educated up to constitutional standards, and that the first step should be to provide an official model. Accordingly, in 1874, arrangements were made for periodically convening an assembly of prefectural governors, in order that they might act as channels of communication between the central authorities and the provincial population, and mutually exchange ideas as to the safest and most effective methods of encouraging progress within the limits of their jurisdictions. This was intended to be the embryo of representative institutions. But the governors, being officials appointed by the cabinet, did not bear in any sense the character of popular nominees, nor could it even be said that they reflected the public feeling of the districts they administered, for their habitual and natural tendency was to try,

by means of heroic object-lessons, to win the people's allegiance to the Government's progressive policy, rather than to convince the Government of the danger of over-stepping the people's capacities. These conventions of local officials had no legislative power whatever. The foundations of a body for discharging that function were laid in 1875, when a senate (genro-in) was organized. It consisted of official nominees, and its duty was to discuss and revise all laws and ordinances prior to their promulga-tion. It is to be noted, however, that expediency not less than a spirit of progress presided at the creation of the senate. Into its ranks were drafted a number of men for whom no places could be found in the executive, and who, without some official employment, would have been drawn into the current of disaffection. From that point of view the senate soon came to be regarded as a kind of hospital for administrative invalids, but undoubtedly its discharge of quasi-legislative functions proved suggestive, useful, and instructive.

The second meeting of the provincial governors had just

been prorogued when, in the spring of 1878, the great minister, Okubo Toshimitsu, was assassinated. Okubo, uniformly ready to bear the heaviest burden of responsi-

govera-

ment

bility in every political complication, had stood promi-nently before the nation as Saigo's opponent. He fell under the swords of Saigo's sympathizers. They immediately surrendered themselves to justice, ^ssassina-having taken previous care to circulate a okubo.

statement of motives, which showed that they ranked the Government's failure to establish representa-tive institutions as a sin scarcely less heinous than its alleged abuses of power. Well-informed followers of Saigo could never have been sincere believers in representative institutions. These men belonged to a province far removed from the scene of Saigo's desperate struggle. But the broad fact that they had sealed with their life-blood an appeal for a political change indicated the existence of a strong public conviction which would

derive further strength from their act. The Japanese are essentially a brave people. Throughout the troublous events that preceded and followed the Eestoration, it is not possible to point to one man whose obedience to duty or conviction was visibly weakened by prospects of personal peril. Okubo's assassination did not alarm any of his colleagues ; but they understood its suggestive-ness, and hastened to give effect to a previously formed resolve.

Two months after Okubo's death, an edict announced that elective assemblies should forthwith be established in the various prefectures and cities. These assemblies were to consist of members having "–^i a high property qualification, elected by voters having one-half of that qualification ; the voting to be by signed ballot, and the sessions to last for one month in the spring of each year. As to their functions, they were to determine the method of levying and spend-ing local taxes, subject to approval by the minister of State for home affairs; to scrutinize the accounts for

the previous year, and, if necessary, to present petitions to the central Government. Thus the foimdations of genuine representative institutions were laid. It is true that legislative power was not vested in the local assemblies, but in all other important respects they discharged parliamentary duties. Their history need not be related at any length. Sometimes they came into violent collision with the governor of the prefecture, and unsightly struggles resulted. The governors were disposed to advocate public works which the people considered extravagant, and further, as years went by and as political organizations grew stronger, there was found in each assembly a group of men ready to oppose the governor simply because of his official status. But on the whole the system worked well. The local assemblies served as training schools for the future parliament, and their members showed devotion to public duty as well as considerable aptitude for debate.

This was not what Itagaki and his followers wanted. Their purpose was to overthrow the clique of clansmen

who, holding the reins of administrative power, monopolized the prizes of officialdom. Towards e^'**'"*' *the consummation of such an aim the local assemblies helped little. Itagaki, redoubled his agitation. He organized his fellow-thinkers into an association called Jiyuto (Liberals), the first political party in Japan, to whose ranks there very soon gravitated several men who had been in office and resented the loss of it ; many that had never been in office and desired to be ; and a still greater number who sincerely believed in the principles of political liberty, but had not yet considered the possi-bility of immediately adapting such principles to Japan's case. It was in the nature of things that an association of this kind, professing such doctrines, should present a picturesque aspect to the public, and that its collisions with the authorities should invite popular sympathy.*

Nor were collisions infrequent. For the Government,

arguing that if the nation was not ready for representa-
tive institutions, neither was it ready for full freedom of
speech or of public meeting, legislated consistently with
that theory, and entrusted to the police certain po,wers of
control over the press and the platform. The exercise
of these powers often created situations in which the
Liberals were able to pose as victims of oflftcial tyranny,
so that they grew in popularity and the contagion of
political agitation spread.
Three years later (1881) another split occurred in the
ranks of the ruling oligarchy. Okuma Shigenobu (after-
wards Count Okuma) seceded from the admin-
ThePro- istration, and was followed by a number of
pa.^^■ble men who had owed their appointments to
his patronage, or who, during his tenure of
office as minister of finance, had passed under the influ-
eiice of his powerful personality. If Itagaki be called
the Eousseau of Japan, Okuma may be regarded as the
Peel. To remarkable financial ability and a lucid, vigor-
ous judgment, he added the faculty of placing himself on

the crest of any wave which a genuine aura popularis had begun to swell. He too inscribed on his banner of revolt against the oligarchy the motto " Constitutional Government," and it might have been expected that his followers would join hands with those of Itagaki, since the avowed political purpose of both was identical. They did nothing of the kind. Okuma organized an independent party, calling themselves " Progressists " (Shimpoto), who not only stood aloof from the Liberals but even assumed an attitude hostile to them. This fact is eloquent. It shows that Japan's first political parties were grouped, not about principles, but about persons. Hence an inevitable lack of cohesion among their elements and a constant tendency to break up into caves and coteries. These are the characteristics that render so perplexing to a foreign student the story of political evolution in Japan. He looks for differences of platform and finds none. Just as a true Liberal must be a Progressist, and a true Progressist a Liberal, so, though each may cast his profession of faith in a mould of different phrases, the

ultimate shape must be the same. The mainsprings of early political agitation in Japan were personal grievances and a desire to wrest the administrative power from the hands of statesmen who had held it so long as to overtax the patience of their rivals. He that searches for profound moral or ethical bases will be disappointed. There were no Conservatives. Society was permeated with the spirit of progress. In a comparative sense the epithet " Conservative " might have been applied to the statesmen who proposed to defer parliamentary institutions until the people, as distinguished from the former samurai, had been in some measure prepared for such an innovar tion. But since these very statesmen were the guiding spirits of the whole Meiji revolution, it was plain that their convictions must be radical, and that, unless they did violence to their record, they must finally lead the country to representative institutions, the logical sequel of their own reforms.

Okubo's assassination had been followed, in 1878, by an edict announcing the establishment of local assem-

blies. Okuma's secession in 1881 was followed by an edict announcing that a national assembly would be convened in 1891.

The political parties, having now virtually attained their object, might have been expected to desist from ,, further agitation. But they had another task oovern- to perform — that of disseminating anti-official meat prejudices among the future electors. They agitation, .^(rorked diligently, and they had an undisputed field, for no one was put forward to champion the Government's cause. The campaign was not always conducted on lawful lines. There were plots to assassinate ministers ; there was an attempt to employ dynamite, and there was a scheme to incite an insurrection in Korea. On the other hand, dispersals of political meetings by order of police inspectors, and suspension or suppression of newspapers by the unchallengeable verdict of a minister for home affairs, were common occurrences. The breach widened steadily. It is true that Okuma rejoined the cabinet for a time in 1887, but he retired again in cir-

cumstances that aggravated his party's hostility to officialdom. In short, during the ten years immediately prior to the opening of the first parliament, an anti-Government propaganda was incessantly preached from the platform and in the press.

Meanwhile the statesmen in power resolutely pursued their path of progressive reform. They codified the civil and penal laws, remodelling them on Western bases; they brought a vast number of affairs within the scope of minute regulations ; they rescued the finances from confusion and restored them to a sound condition ; they recast the whole framework of local government ; they organized a great national bank, and established a network of subordinate institutions throughout the country; they pushed the work of railway construction, and successfully enlisted private enterprise in its cause ; they steadily extended the postal and telegraphic services ; they economized public expenditures so that the State's income always exceeded its outlays ; they laid the foundations of a strong mercan-tile marine ; they instituted a system of postal savings

banks ; they undertook large schemes of harbour improve-
*ment and road-making ; they planned and put into opera^*
tion an extensive programme of riparian improvement ;
they made civil service appointments depend on competi-
tive examination ; they sent numbers of students to
Europe and America to complete their studies ; and by
tactful, persevering diplomacy they gradually introduced
a new tone into the empire's relations with foreign Powers.
Japan's affairs were never better administered.
In 1890 the Constitution was promulgated. Imposing
ceremonies marked the event. AH the nation's notables
were summoned to the palace to witness the
delivery of the important document by the Sov- ™ ^'''*
ereign to the prime minister ; salvos of artillery ott890.
were fired ; the cities were illuminated, and the
people kept holiday. Marquis^ Ito directed the framing
of the Constitution. He had visited the Occident for the
purpose of investigating the development of parliamen-
tary institutions and studying their practical working.
His name is connected with nearly every great work of

constructive statesmanship in the history of new Japan, and perhaps the crown of his legislative career was the drafting of the Constitution, to which the Japanese people point proudly as the only charter of the kind voluntarily given by a sovereign to his subjects. In other countries such concessions were always the outcome of long struggles

1 A title of nobility in Japan does not indicate necessarily that its possessor belongs to the ancient aristocracy. In former times titles did not exist. There were olficial ranks, and very often these were prefixed to a name in the manner of a title. But actual titles were not introduced until 1885. In the iuterval separating the latter date from the fall of feudalism in 1871, the former territorial chiefs and Court nobles could not be titularly distinguished from commoners. But in 1885 the Emperor, acting on tlie advice of Ito (afterwards marquis), instituted five orders of nobility (apart from princes of the blood), namely, princes, marquises, counts, viscounts, and barons. These, of course, are translations. The Japanese terms— affixed, not prefixed, to a name— are kd, kd, haku, shi, dan. The greatest of the territorial nobles received the title of prince ; the smallest, that of baron. The practice was also inaugurated of bestowing titles on men of merit

without regard to their original social status. There are no life titles. In 1900 the princes numbered 11, the marquises 33, the counts 89, the viscounts 363, and the barons 280.

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between ruler and ruled. In Japan the Emperor freely divested himself of a portion of his prerogatives and transferred them to the people. That view of the case, as maybe seen from the story told above, is not untinged with romance; but in a general sense it is true. The framers of the Constitution did not err on the side of liberality. They fixed the minimum age for electors and candidates at twenty-five, and the property qualification at a payment of direct taxes to the amount of 15 yen (30 shillings) annually. The result was that only 460,000 persons' were enfranchised out of a nation of 42 millions. A bicameral system was adopted for the Diet ; the Upper House being in part elective, in part hereditary, and in part nominated by the Sovereign " ; the Lower consisting

of 300 elected members. Freedom of conscience, of speech, and of public meeting, inviolability of domicile and correspondence, security from arrest or punishment, except by due process of law, permanence of judicial appointments, and all the other essential elements of civil liberty were guaranteed. In the Diet full legislative authority was vested : without its consent no tax could be imposed, increased, or remitted ; nor could any public money be paid out except the salaries of officials, which the Sovereign reserved the right to fix at will. In the Emperor were vested the prerogatives of declaring war and making peace, of concluding treaties, of appointing and dismissing officials, of approving and promulgating laws, of issuing urgency ordinances to take the temporary place of laws, and of conferring titles of nobility.

No incident in Japan's modern career seemed more hazardous than this sudden plunge into parliamentary institutions. There had been, as shown above, workiag some preparation. Provincial assemblies had "system. partially familiarized the people with the

methods of deliberative bodies. But provincial assemblies were at best petty arenas — places where the making or mending of roads, and the policing an-d scaveng-ing of villages came up for discussion, and where political parties exercised no legislative function nor found any opportunity to attack the Government, or to debate problems of national interest. Thus the convening of a Diet, and the sudden transfer of financial and legislative authority from the throne and its entourage of tried states-men to the hands of men whose qualifications for public life rested on the verdict of electors, themselves apparently devoid of all light to guide their choice — ^this sweeping innovation seemed likely to tax severely, if not to overtax completely, the progressive capacities of the nation.

What enhanced the interest of the situation was that the oligarchs who held the administrative power had taken no pains to win a following in the political field. Knowing

1 Since the promulgation of the Constitution a Reform Bill has been passed, after several failures owing to disagreement between the two Houses, the House of Peers having shown itself in this matter, as in

all others, strongly opposed to the Radical tendencies of the House of Representatives. In the system introduced by this Bill the property qualification for electors was reduced to payment of national taxes amounting to 10 yen annually, the number of franchise-holders being thus raised to 800,000, approximately ; secret balloting was adopted ; no property qualificati(^ was required in the case of a candidate for election, neither need he have any connexion with the locality which he sought to represent ; the limits of electoral districts were extended so as to embrace whole prefectures, and the number of members of the Lower House was increased to 363.

2 Princes and marquises sit by right of their titles ; counts, viscounts, and barons are elected by their respective orders ; each prefecture re-turns one member representing the highest taxpayers, and the Emperor nominates men of learning or public merit. The House of Peers now contains 319 members. A salary of 2000 yen (£200) annually is paid to the members of the Diet ; each House has a president, nominated by the Sovereign from among three names selected by the House. He receives 4000 yen a year. The vice-president is elected by the House independently of Imperial nomination, and receives 3000 yen annually.

that the opening of the Diet would be a veritable letting loose of the dogs of war, an unmuzzling of the agitators whose mouths had hitherto been partly closed by legal restrictions upon free speech, but who would now enjoy complete immunity within the waUs of the assembly, what-ever the nature of their utterances — foreseeing all this, the statesmen of the day nevertheless stood severely aloof from alliances of every kind, and discharged their adminis-trative functions with apparent indifference to the changes that popular representation could not fail to induce. This somewhat inexplicable display of unconcern became par-tially intelligible when the Constitution was promulgated, for it then appeared that the cabinet's tenure of office was to depend solely on the Emperor's will ; that minis-tets were to take their mandate from the Throne, not from Parliament. This fact was merely an outcome of the theory underlying every part of the Japanese polity. Laws might be redrafted, institutions remodelled, systems recast, but amid all changes and mutations one steady point must be carefully preserved, the Throne. The

makers of new Japan understood that so long as the sanctity and inviolability of the Imperial prerogatives could be preserved, the nation would be held by a strong anchor from drifting into dangerous waters. They laboured under no misapprehension about the inevitable issue of their work in framing the Constitution. They knew very well that party cabinets are an essential outcome of representative institutions, and that to some kind of party cabinet Japan must come. But they regarded the Imperial mandate as a conservative safeguard, pending the organization and education of parties competent to form cabinets. Such parties did not yet exist, and until they came into unequivocal existence, the Restoration statesmen, who had so successfully managed the affairs of the nation during a quarter of a century, resolved that the steady point furnished by the Throne must not be abandoned.

On the other hand, the agitators found here a new platform. They had obtained a Constitution and a Diet, but they had not obtained an instrument for pulling

down the "clan" administrators, since these stood secure from attack under the segis of the Sovereign's mandate. They dared not raise their voices against the unfettered exercise of the Mikado's prerogative. The nation, loyal to the core, woxild not have suffered such a protest, nor could the agitators themselves have found heart to formulate it. But they could read their own interpretation into the text of the Constitution, and they could demonstrate practically that a cabinet not acknow-ledging responsibility to the Legislature was virtually im-potent for law-making purposes.

These are the broad outlines of the contest that began in the first session of the Diet and continued for several years. It is unnecessary to speak of the special points of controversy. Just as the political aadthe parties had been formed on the lines of persons. Govern-not principles, so the opposition in the Diet was directed against men, not measures. The struggle presented varying aspects at different times, but the fundamental question at issue never changed. Obstruction was the

weapon of the political parties. They sought to render legislation and finance impossible for any ministry that refused to take its mandate from the majority in the Lower House, and they imparted an air of respectability and even patriotism to their destructive campaign by making " Anti-clannism" their war-cry, and industriously fostering the idea that the struggle lay between administration guided by public opinion and administration controlled by a clique of clansmen who separated the Throne from the nation. Had not the House of Peers stood staunchly by the Government throughout this

contest, it is possible that the nation might have suffered severely from the rashness of the political parties. There was something melancholy in the spectacle. The Restoration statesmen were the men who had made modern Japan ; the men who had raised her, in the face

of immense obstacles, from the position of an insignificant Oriental state to that of a formidable unit in the comity of nations; the men, finally, who had given to her a constitution and representative institutions. Yet these same men were now fiercely attacked by the arms which they had themselves nerved; were held up to public obloquy as self-seeking usurpers, and were declared to be impeding the people's constitutional route to administrar tive privileges, when in reality they were only holding the breach until the people should be able to march into the citadel with some show of orderly and competent organization. That there was no corruption, no abuse of position, is not to be pretended ; but on the whole the conservatism of the clan statesmen had only one object — to provide that the newly-constructed representative machine should not be set working until its parts were duly adjusted and brought into proper gear. On both sides the leaders understood the situation accurately. The heads of the parties, while publicly clamouring for parliamentary cabinets, privately confessed that they

*were not yet prepared to assume administrative responsi-bilities ; * and the so-called " clan statesmen," while re-fusing before the world to accept the Diet's mandates, admitted within official circles that the question was one of time only.*

The situation did not undergo any marked change until, the country becoming engaged in war with China (1894-95), domestic squabbles were forgotten in the presence of foreign danger. From that time an era of coalition commenced. Both the political parties joined hands to vote funds for the prosecution of the campaign, and one of them, the Liberals, subsequently gave support to a cabinet under the presidency of Marquis Ito, the purpose of the union being to carry through the Diet an extensive scheme of enlarged armaments and public works planned in the sequel of the war. The Progress-ists, however, remained implacable, continuing their opposition frankly for the sake of opposition, and with-out any pretence of consideration for the nature of the measures they opposed.

The next phase (1898) was a fusion of the two parties into one large organization which adopted the name " Constitutional Party " (Kensei-to). By this Fusion ot -union the chief obstacles to parliamentary parties. cabinets were removed. Not only did the Constitutionalists command a large majority in the Lower House, but they also possessed a sufficiency of men who, although lacking ministerial experience, might still advance a reasonable title to be entrusted with portfolios. Immediately the Emperor, acting on the advice of Marquis Ito, invited Counts Okuma and Itagaki to form a cabinet. It was essentially a trial. The party politicians were required to demonstrate in practice the justice of the claim they had been so long asserting in theory. They had worked in combination for the destructive purpose of pulling down the so-called "clan statesmen"; they had now to show whether they could work in combination for the con-structive purposes of administration. Their heads, Counts Okuma and Itagaki, accepted the Imperial

mandate, and the nation watched the result. There was no need to wait long. In less than six months these new

1 Neither the Liberals nor the Progressists had a working majority in the House of Representatives, nor could the ranks of either have furnished men qualified to fill all the administrative posts.

links snapped under the tension of old enmities, and the coalition split up once more into its original elements. It had added a novel word to the language—" office-hunting fever" (riyokan-^etsu) — and demonstrated that the sweets of power which the " clan statesmen " had been so vehemently accused of coveting possessed even greater attractions for their accusers. The issue of the experiment was such a palpable fiasco that it effectually rehabilitated the " clan statesmen," and finally proved, what had indeed been long evident to every close observer, that without the assistance of those statesmen no political party could hold office successfully.

Thenceforth it became the unique aim of Liberals and Progressists alike to join hands permanently with the men towards whom they had once displayed such

implacable hostility. Marquis Ito, the leader ^f^Zsn
of the Meiji statesmen, received special solicitar statesmen
tions, for it was plain that he would bring to 'f^f^'/^!^'
*any political party an overwhelming accession ^g„g_*
of strength, alike in his own person and in the
number of friends and disciples certain to follow him.
But Marquis Ito declined to be absorbed into any existing
party, or to adopt the principle of parliamentary cabinets.
He would consent to form a new association, but it must
consist of men sufficiently disciplined to obey him im-
plicitly, and sufficiently docile to accept their programme
from his hand. The Liberals agreed to these terms. They
actually dissolved their party (August 1900) and enrolled
themselves in the ranks of a new organization, which did
not even call itself a party, its designation being Rikken
Seiyu-kai (Association of Friends of the Constitution),
and which had for the cardinal plank in its platform a
declaration of ministerial irresponsibility to the Diet. A
singular page was thus added to the story of Japanese
political development ; for not merely did the Liberals

enlist under the banner of the statesmen whom for twenty yea,rs they had fought to overthrow, but they also erased from their profession of faith its essential article, parliamentary cabinets, and by resigning that article to the Progressists, created for the first time an Opposition with a solid and intelligible platform. The whole incident vividly illustrated the fact that persons, not principles, were the bases of political combinations in Japan. Marquis Ito's attraction alone gave cohesion to the Rikken Seiyukai.

It could scarcely have been expected that neither tumult nor intemperance would disfigure the proceedings of a Diet whose members were entirely without parliar mentary experience, but not without grievances JJ^^fl™t to ventilate, wrongs (real or fancied) to avenge, and abuses to redress. On the whole, however, there was a remarkable absence of anything like disgraceful license. The politeness, the good temper, and the sense of dignity which characterize the Japanese, always saved the situation when it threatened to degenerate into a " scene."

Foreigners entering the House of Representatives inTokyo for the first time might easily misinterpret some of its habits. A number distinguishes each member. It is painted in white on a wooden indicator, the latter being fastened by a hinge to the face of the member's desk. When present he sets the indicator standing upright, and lowers it when leaving the House. Permission to speak is not obtained by catching the President's eye, but by calling out the aspirant's number, and as members often emphasize their calls by hammering their desks with the indicators there are moments of decided din. But, for the rest, orderliness and decorum habitually prevail. Speeches have to be made from a rostrum. There are few displays of oratory or eloquence. The Japanese formulates his views with remarkable facility. He is absolutely free from gaucherie or self-consciousness when speaking in histoky]

public. He can think on his feet. But his mind has

never busied itself much with abstract ideas and subtleties of philosophical or religious thought. Flights of fancy, impassioned bursts of sentiment, appeals to the heart rather than to the reason of an audience, are devices strange to his mental habit. He can be rhetorical, but not eloquent. Among all the speeches hitherto delivered in the Japanese Diet it would be difficult to find a passage deserving the latter epithet. From the first the debates were recorded verbatim. Years before the date fixed for the promulgation of the Constitution a little band of students elaborated a system of stenography and adapted it to the Japanese syllabary. Their labours remained almost without recognition or remuneration until the Diet was on the eve of meeting, when it was discovered that a competent staff of shorthand reporters could be organized at an hour's notice. Japan can thus boast that, alone among the countries of the world, she possesses an exact record of the proceedings of her Diet from the moment when the first word was spoken within its walls. A special feature of the Diet's

procedure helps to discourage oratorical displays. Each measure of importance has to be submitted to a committee, and not until the latter's report has been received does serious debate take place. But in ninety-nine cases out of every hundred the committee's report determines the attitude of the House, and speeches are felt to be more or less superfluous. One result of this system is that business is done with a degree of celerity scarcely known in Occidental legislatures. For example, the meetings of the House of Eepresentatives during the session 1896-97 were 32, and the number of hours occupied by the sittings aggregated 116. Yet the result was 55 Bills debated and passed, several of them measures of prime importance, as the Gold Standard Bill, the budget, and a statutory tariff law. Such a record seems difficult to reconcile with any idea of careful legislation ; but it must be remembered that although actual sittings of the Houses are comparatively few and brief, the committees remain almost constantly at work from morning to evening throughout the twelve weeks of the session's

duration.

Financial questions have occupied an important place in the story of Japan's modern career. In order to obtain a clear idea of them it is necessary to make a Finance. somewhat extended retrospect. Under the feudal system the land throughout the empire was regarded as State property, and parcelled out into 276 fiefs, great and small, which were assigned to as many feudatories. These held the land in trust, being empowered to derive revenue from it for the support of their households, for administrative purposes, and for the maintenance of armed forces, whose numbers were nominally, but not accurately, regulated in proportion to the wealth of the fief. The basis of taxation varied greatly in different districts, but, at the time of the Restoration in 1867, the generally recognized principle was that four-tenths of the gross produce should go to the feudatory, six-tenths to the farmer. In practice this rule was applied to the rice crop only, the assessments for other kinds of produce being levied partly in money and partly in manufactured

goods at rates often of the most arbitrary nature. Forced labour also was exacted, and artisans and tradesmen were subjected to pecuniary levies of greater or less magnitude as official necessity arose. These last two factors, however, are of such uncertain dimensions that they do not admit of arithmetical statement for the purposes of a general review. The total yield of rice in 1867 was 154 million bushels,[1] of which the market value

1 This figure represents the closest approximation furnished by at prices then ruling was 24 million pounds sterling, or 240 millions of yen. Hence the grain tax represented, at the lowest calculation, 96 millions of yen, the farmers' portion being 144 millions. When the administration reverted to the Emperor in 1867 the central Treasury was empty, and the funds hitherto employed for governmental purposes in the fiefs did not at once begin to flow into the coffers of the State. They continued to be devoted to the support of the feudatories, to the payment of the samurai, and to defraying the expenses of local administration, the central Treasury receiving only what-

ever small fraction might remain after these various out-
lays. The Shogun himself, whose income amounted to
about 3|- millions sterling, did not, on abdicating, hand
over to the sovereign either the contents of his treasury
or the control of the lands from which he derived his
revenues. He contended that funds for the government
of the nation as a whole should be levied from the people
at large. Partly owing to this complication, and partly
because of the obstinate fealty of some of the Shogun's
vassals, swords were drawn, and the impecunious min-
istry had to engage in campaigns, which, though they
placed the Treasury in command of some limited sources
of revenue, had also the effect of augmenting its liabili-
ties.

The little band of men who had assumed the direction
of national affairs saw no exit from the dilemma except
an issue of paper money. This was not a
novelty in Japan. Paper money had been issue ot
known to the people since the middle of the moaej'.
17th century, and in the era of which we

are now writing no less than 1694 varieties of notes were circulating in the 270 fiefs. There were gold notes, silver notes, casA-notes, rice-notes, umbrella-notes, rjbbon-notes, lathe-article-notes, and so on through an interminable list, the circulation of each kind being limited to the confines of the issuing fief. Many of these notes had almost ceased to have any purchasing power, and nearly all were regarded by the people as evidences of official greed and unscrupulousness. The first duty of a centralized, progressive administration should have been to reform the currency : to substitute uniform and sound media of exchange for these multitudinous and unsecured tokens which hampered trade, destroyed credit, and opposed barriers to commercial intercourse between neighbouring provinces and districts. The political leaders of the time appreciated that duty, but instead of proceeding to discharge it, saw themselves compelled by stress of circumstances to adopt the very device which in the hands of the feudal chiefs had produced such deplorable results. It was an irksome necessity, and the new Government

sought to relieve its conscience and preserve its moral prestige by pretending that the object of the issue was to encourage wealth-earning enterprise, and that the notes would be lent to the fiefs for the purpose of promoting commerce and industry. The people appraised these euphemisms at their true worth, and the new notes fell to a discount of 50 per cent. Then ensued a brief but sharp struggle between rulers and ruled. The Govern-ment resorted to arbitrary measures, sometimes of great severity, to force its notes into circulation at par with silver. But there was no continuity of policy. One day men were imprisoned for discounting paper tokens ; the next, they were released. In December the authorities officially recognized a depreciation of 20 per cent. ; in the following April they withdrew the recognition, and proclaimed the equality of specie and paper. Now, they promised to redeem the notes in thirteen years ; then, they statistics. But the reader should he warned that absolute accuracy cannot be claimed for returns compiled before the Meiji era.

shortened the period to five, and again they postponed it indefinitely. Nothing is more astonishing than the fact that, despite this bewilderment and vacillation, the Government's financial credit gradually acquired strength, so that ■within five years, though the issues of paper money aggregated nearly 60 million yen, it circulated freely throughout the whole empire at par with silver, and even commanded at one time a small premium. It is true that by this epoch the revenues of all the fiefs had become available for the service of the State, and that only one-tenth of their total had been appropriated for the support of the territorial nobles, now deprived of all administrative functions and reduced to the rank of private gentlemen, without either titles to distinguish them from their former vassals or estates to give them local prestige. But the central Government, having diminished the taxes to about one-third of their former total, as will presently be shown, found the public income too small

for the expenditure. The paper money of the fiefs, amounting to 25 million yen, had been exchanged for Treasury notes. The building of railways had been commenced. The foundations of an army and a navy had been laid. A postal system, a telegraph system, a prison system, a police system, and an educational system had been organized. The construction of roads, the improvement of harbours, the lighting and buoying of the coast, had been vigorously undertaken. A mercantile marine had been created. Public works had been inaugurated on a considerable scale. Many industrial enterprises had been started under official auspices as object-lessons for the people, and large sums in aid of similar projects had been lent to private persons. Thus the Government, living far beyond its income, had unavoidable recourse to further issues of fiduciary paper, and in proportion as the volume of the latter exceeded the actual currency requirements of the time, its value depreciated until in 1881, fourteen years after the Eestoration, notes to the face value of 150 million yen had been put into circula-

tion ; the Treasury possessed specie amounting to only 8 millions, and 18 paper yen could be purchased with ten silver coins of the same denomination.

Up to that year (1881) fitful efforts had been made to strengthen the specie value of. fiat paper by throwing quantities of gold and silver upon the market

Method of from time to time, and large sums — totalling “p^fg”” 23 million yen — had been devoted to the pro-

payments. motion of industries whose products, it was hoped, would go to swell the list of exports,

and thus draw metallic money to the country. But these superficial devices were now finally abandoned, and the Government applied itself steadfastly to reducing the volume of the fiduciary currency on the one hand and accumulating a specie reserve on the other. The steps of the programme were simple. By applying the pruning knife boldly to administrative expenditure ; by transferring certain charges from the Treasury to the local communes ; by suspending all grants in aid of provincial public works and private enterprises, and by a

moderate increase of the tax on alcohol, an annual surplus of revenue, totalling 7^ million yen, was secured. This was applied to reducing the volume of the notes in circulation. At the same time, it was resolved that all officially conducted industrial and agricultural works should be sold — since their purpose of instruction and example seemed now to have been sufficiently achieved — and the proceeds, together with various securities (aggregating 26. million yen in face value) held by the Treasury, were applied to the purchase of specie. The latter was a delicate and difficult operation. Had the Government entered the market openly as a seller of its own fiduciary notes, its credit must have suffered. There were also ample reasons to doubt whether any available stores of precious metal remained in the country. In obedience to elementary economical laws, the cheap money had steadily driven out the dear, and although the Government mint at Osaka, founded in 1871, had struck 80 million yen worth of gold and silver coins between that date and 1881, when the policy of which

we are now speaking was inaugurated, the customs re-
turns showed that a great part of this metallic currency
had flowed out of the country. In these circumstances
Japanese financiers decided that only one course re-
mained: the Treasury must play the part of national
banker. Produce and manufactures destined for export
must be purchased by the State with fiduciary notes,
and the metallic proceeds of their sales abroad must
be collected and stored in the Treasury. This programme
required the establishment of consulates in the chief
marts of the Occident, and the organization of a great
central bank — the present Bank of Japan — as well as of
a secondary bank — the present specie bank of Yokohama
— the former to conduct transactions with native producers
and manufacturers, the latter to finance the business of
exportation. The outcome of these various arrangements
was that, by the middle of 1885, the volume of fiduciary
notes had been reduced to 119 million yen, their depre-
ciation had fallen to 3 per cent., and the metallic reserve
of the Treasury had increased to 45 million yen. The

resumption of specie payments was then announced, and became, in the autumn of that year, an accomplished fact.

These facts rightly stand at the head of a retrospect of Japanese finance, not merely because they set forth a fine economical feat, indicating clear insight, good organizing capacity, and courageous en- Reasons ergy, but also because volumes of adverse for- ^^^ ^ eign criticism were written into the margin of loan. the story during the course of the incidents it embodies. Many onlooking strangers were prepared each with an infallible nostrum of his own, the rejection of which convinced him of Japan's hopelesg stupidity. Now she was charged with robbing her own people be- cause she bought their goods with paper money and sold them for specie ; again, she was accused of an offi- cial conspiracy to ruin the foreign local banks because she purchased exporters' bills on Europe and America at rates that defied ordinary competition ; and while some declared that she was plainly without any understand-

ing of her own doings, others, averring that she could not possibly extricate herself from the slough of an inflated and largely depreciated fiat currency without recourse to European capital, predicted that her heroic method of dealing with the problem would paralyse industry, interrupt trade, produce widespread suffering, and, in short, bring about the advent of the proverbial seven other devils. Undoubtedly, to carry the currency of a nation from a discount of 70 or 80 per cent, to par in the course of four years, reducing its volume at the same time from 150 to 119 millions, was a financial enterprise violent and daring almost to rashness. The gentler expedient of a foreign loan would have commended itself to the majority of economists, but it may be here stated, once for all, that until her adoption of gold monometallism in 1897,^ the foreign money market was practically closed to

1 This operation sliould be called more properly a reversion to gold monometallism. The currency system established by Japanese financiers at the beginning of the Meijl era was based on the gold standard, the unit being the gold yen, a coin worth four shillings in

round numbers. But, in the first place, Japan's stock of gold was soon driven out of the country by her depreciated fiat currency, and, in the second, as all the other Oriental nations were silver-using, fend as the silver Mexican dollar was the unit of accounts in Far Eastern trade, Japan ultimately drifted into silver monometallism, the silver histoet]

Japan. Had she borrowed abroad it must have been on a sterling basis. Receiving a fixed sum in silver, she would have had to discharge her debt in rapidly ap-preciating gold. Twice, indeed, she had recourse to London for small sums, but when she came to cast up her accounts the cost of the accommodation stood out in deterrent proportions. A 9 per cent, loan, placed in England in 1868 and paid off in 1889, produced 4| million yen, and cost altogether llf millions in round figures ; and a 7 per cent, loan, made in 1872 and paid off in 1897, produced lOf millions, and cost 36 millions. These considerations were supplemented by a strong

aversion from incurring pecuniary obligations to Western states before the latter had consented to restore Japan's judicial and tariff autonomy, a point which will be fully explained by and by. The example of Egypt showed what kind of fate might overtake a semi-independent state falling into the clutches of foreign bondholders. Japan did not wish to fetter herself with foreign debts while struggling to emerge from the ranks of Oriental Powers. After all, nothing succeeds like success. Japanese financiers made a signal success. Having undertaken to reorganize the administration of an empire, and to inaugurate a vast programme of reform, they met the difficulty of an empty Treasury by issuing fiat notes, and then, fourteen years later, grappling boldly with the problem of this inflated and heavily depreciated currency, they restored its value to par and resumed specie payments in the brief space of four years.

It is advisable at this point to examine the question of the national debt incurred by Japan since the unification

of the empire. As already stated, when the

fi" fiefs were surrendered to the Sovereign, it was

debt decided to provide for the feudal nobles and the

samurai in general by the payment of lump

sums in commutation, or by handing to them public bonds,

the interest on which should constitute a source of income.

The result of this transaction, into the details of which we

need not enter, was that bonds having a total face value

of 191^ million yen were issued, and ready-money payments

aggregating 21\ million yen were made.'^ This was the

foundation of Japan's national debt. Indeed, these public

bonds may be said to represent the bulk of the State's

liabilities during the first twenty-five years of the Meiji

period. The Government had also to take over the debts

*of the fiefs, amounting to 41 million yen, of which 21-^*

millions were paid with interest-bearing bonds, the re-

yea becoming her unit of currency. So soon, however, as the in-

demnity that she received from China after the war of 1894^95 had

placed her in possession of a stock of gold, she determined to revert to

the gold standard. Mechanically speaking, the operation was very

easy. Gold having appreciated so that its value in terms of silver had exactly doubled during the first thirty years of the Meiji era, nothing was necessary except to double the denominations of the gold coins in terms of yen, leaving the silver subsidiary coins unchanged. Thus the old 5-yen gold piece, weighing 2‘22221 momme of 900 fineness, became a W-yen piece in the new currency, and a new B-yen piece of half the weight was coined. No change whatever was required in the reckonings of the people. The yen continued to be their coin of account, with a fixed sterling value of a little over two shillings, and the denominations of the gold coins were doubled. Gold, however, is little seen in Japan ; the whole duty of currency is done by notes.

1 The amounts include the payments made in connexion with what may be called the disestablishment of the Church. There were 29,805 endowed temples and shrines throughout the empire, and their estates aggregated 354,481 acres, together with 1% million bushels of rice (representing 2>^ millions of yen). The Government resumed possession of all these lands and revenues at a total cost to the State of a little less than 2)^ million yen, paid out in pensions spread over a period of fourteen years. The measure sounds like wholesale confiscation. But some extenuation is found in the fact

that the temples and shrines held their lands and revenues under titles which, being derived from the feudal chiefs, depended for their validity on the maintenance of feudalism.

mainder with ready money. If to the above figures we add two foreign loans aggregating 16|- million yen (completely repaid by the year 1897) ; a loan of 15 million yen incurred on account of the only serious rebellion that marked the passage from the old to the new regime — the Satsuma revolt of 1877 ; loans of 33 million yen for public works, 13 million yen for naval construction, and 14^ millions in connexion with the fiat currency, we have a total of 305 million yen, being the whole national debt of Japan during the first twenty-eight years of her new era under Imperial administration.*

The above statements sufficiently explain the liabilities incurred by the country during what may be called the first epoch of her modern financial history. We now pass to the second epoch, dating from the war with China in 1894-95. The direct expenditures on account of the war aggregated 200 million yen, of which total 135

millions were added to the national debt, the re- Y'/i^s.

mainder being defrayed with accumulations of

surplus revenue, with a part of the indemnityreceived from

China, and with voluntary contributions from patriotic

subjects. As the immediate sequel of the war, the Govern-

ment elaborated a large programme of armament expan-

sion and public works. The army, at the time of the war,

consisted of six divisions and the imperial guards ; the

peace establishment being 70,000, and the war strength

268,000. The navy comprised 33 vessels — exclusive

of 26 torpedo-boats — representing a displacement of

63,000 tons. It was resolved to raise the number of

divisions to twelve, with a peace establishment of 145,000

and a war strength of 560,000, and the navy to 67 ships'

(besides 11 torpedo-catchers and 115 torpedo-boats), with

an aggregate displacement of 258,000 tons. The ex-

penditure for these unproductive purposes, as well as

for coast fortifications, dockyards, and so on, came

to 314 million yen, and the total of the productive

expenditures included in the programme was 190 million

yen — namely, 120 millions for railways, telegraphs, and telephones; 20 millions for riparian improvements; 20 millions in aid of industrial and agricultural banks, and so forth — the whole programme thus involving an outlay of 504 million yen. To meet this large figure, the Chinese indemnity, surpluses of annual revenue and other assets, furnished 300 millions ; and it was decided that the remaining 204 millions should be obtained by domestic loans, the programme to be carried completely into operation — with trifling exceptions — ^by the year 1905. In practice, however, it was found impossible to obtain money at home without paying a high rate of interest. The Government, therefore, had recourse to the London market in 1899, raising a loan of 10 million pounds sterling at 4 per cent., and selling the £100 bonds at 90. In this matter of raising loans it is of course impossible here to anticipate subsequent events. In 1902 it was not expected that Japan*

2 This sum represents interest-bearing bonds issued in exchange for fiat notes, with the idea of reducing the volume of the latter. It was a tentative measure, and proved of no value.

- *Japan's fleet at the time of the war consisted of comparatively small vessels, the largest being three coast-defence ships of 4278 tons. She captured from China an armour-clad of 7335 tons — the first line-of4)attle-ship in her navy. Her post-bellum, fleet, as planned (1901), included 6 first-class battle-ships, ranging from 12,500 to 15,000 tons approximately; 6 first-class cruisers of 9200 tons; 9 second-class cruisers, ranging from 3700 to 4800 tons ; 10 third-class cruisers, ranging from 3300 tons, &c. (See also Navies.)*

< Japan suffers severely from inundations. Many of the rivers have been banked up in the course of centuries until their beds lie considerably above the level of the surrounding county, and a breach of the embankments involves widespread disaster. It has been estimated that the average annual loss from this source does not fall short of 19 million yen. In 1887 an extensive scheme of riparian improvement was undertaken. It involved a total expenditure of 26 million yen, of which 6 millions had been expended when the war with China broke out.

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would need any further immediate recourse to foreign borrowing. According to existing arrangements, Japan's national indebtedness would reach its maximum, namely, 675 million yen, in the year 1903, and would thence-forward diminish steadily.' It remains to consider briefly the annual revenues and expenditures of the State, and the manner of their growth during recent years.

The burden of taxation is small, especially compared with the career of vigorous progress upon which the country has embarked. Only 120 million yen " ^" was raised in 1900 by direct taxes ; that is to say, something less than 3 yen (6 shillings) per head of population. The sources were these : —

Millions of Yen.

Land tax 47

Income tax

Business tax

Sake (rice wine) tax

Soy (fish sauce) tax .

Miscellaneous taxes .

Credit.

Total 120

A further sum of 72 million yen was obtained by indirect taxation, namely : —

Millions of Yen.

Customs and tonnage dues 16

State undertakings (railways, posts, telegraphs, tobacco monopoly, and forests) 43

Stamp duties 11

Miscellaneous . . 2

Total 72

On the other hand, the ordinary expenditure aggregated 149 million yen. Thus there was a surplus of 43 million yen. For the moment this surplus was absorbed for extraordinary and terminable enterprises forming part of the post-bellum programme described above, but iu a short time the country might look forward to finding itself with a substantial annual balance on the right side.

It is remarkable that, in spite of the conclusive evidence furnished by such figures as these, there should have

prevailed in Europe and America up till a comparatively recent date an impression that Japan's financial condition was not sound. The misapprehension was mainly due to the fact that the national expenditure grew from 63 million yen to 149 millions in the ten years ending 1900. Not unnaturally, such a rate of increase seemed startling. The development of the revenue in the same time from 76 millions to 192 millions appears to have escaped attention, or possibly even accentuated the distrust by suggesting excessive taxation. Looking at the figures without any reference to the past, it is necessary to admit that excellent financial management is required in order that a nation of 43J million inhabitants, which maintains an army of half a million of men and a fleet of 268,000 tons, may pay its way at a cost of less than fifteen million pounds sterling. Such a feat presents itself in a scarcely credible light to Occidental statesmen. Again, observing that the annual expense of

1 All Japan's domestic loans are now placed on a uniform basis. They carry 5 per cent, interest, run for a period of 5 years without

redemption, and are then redeemed within 60 years at latest. The Treasury has competence to expedite the operation of redemption according to financial convenience, but the sum expended on amortization each year must receive the previous consent of the Diet. Within the limit of that sum redemption is effected either by purchasmg the stock of the loans in the open market or by drawing lots to determine the bonds to be paid off. Perhaps a more suggestive idea may be furnished of Japan's finance during the Meiji era if we say that, owing to the processes of conversion, consolidation, &c., and to the various requirements of the State's progress, twenty-two different kinds of national bonds were issued from 1870 to 1890 ; that they aggregated 673,215,500 yen ; that 269,042,198 yen of that total had been paid off at the close of 1897, and that the remainder will be redeemed, according to the present programme, by 1946.

maintaining the army and navy is only 56 million yen, whereas the tax on sake (rice wine) alone yields 56 millions, and noting that this tax — which falls on a luxury — grew from 4 million yen in 1891 to 56 millions in 1900, it seems plain that if the country has greatly increased its armaments, there has been found at the

same time a compensatory source of revenue which does not add seriously to the burdens of the people at large. Further, that a large reserve of taxable capacity exists cannot be doubted. It has been shown above that before the fall of the feudal system the farmer paid into the local treasury two-fifths of his whole rice crop. The average annual yield of rice at present is 200 million bushels, and the monetary value of two-fifths of that quantity is 160 million yen, in round numbers, whereas the total tax levied on the land is only 47 millions. Thus the difference is more than three to one in favour of the present system. Another factor which has operated injuriously to Japan's credit is that her politicians, by assaults upon the budget in the Diet and by clamouring for a reduction of the land tax as well as of official salaries, greatly misled the foreign public. That this outcry was merely a convenient weapon for attacking the cabinet and courting favour with the constituencies was amply proved in the sequel, when these same agitators voted to increase the land tax and to augment official salaries. But they had

sustained the clamour so vigorously and incessantly during session after session of the Diet, that the world ultimately learned to regard Japan as a country crushed by a weight of taxation which the people's representatives were vainly struggling to lighten, and preyed upon by a number of overpaid officials whom the Diet was seeking to deprive of their excessive emoluments. Accepting the estimates made by the Japanese themselves, Europe and America regarded Japan as an embarrassed country, instead of recognizing the abundance and elasticity of her resources.

The wealth of Japan is a subject which ias not yet been investigated so thoroughly that an altogether trustworthy statement can be made. The following figures give the closest approximations possible in 1901 : —

Millions of Ten.

Value of lands (agricultural, building, forest, &c.)

Value of buildings .....

Value of household furniture and utensils

Value of cattle, horses, fowls, &c.

Value of railways .

Value of mercantile marine

Value of merchandise

Gold and silver bullion and coins

Miscellaneous ....

Total .

3600

1100

550

60

250

33

430

250

2000

8273

It will be observed that this sum is approximately one-tenth of the accumulated capital of Great Britain and Ireland. That is what might have been expected, for, speaking roughly, money is ten times as valuable in

Japan as in the United Kingdom.

With regard to the income derived by Japan from her capital, the following figures are deduced from the best statistics : — ^

Millions of Yen.

Products of agriculture, forestry, and fisheries . 750

Produce of mines

Manufactured articles

Land-transport earnings

Water-transport earnings

House rent

Profits on foreign trade

Banking profits

Profits on business .

Total

30

400

90

15

28

25

27

98

1463

The development of Japan's foreign trade was checked

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at first not only by the unpopularity attaching to all intercourse with outside nations, but also by embarrassment resulting from the difference between the silver price of gold in Japan and its silver price in Europe, the precious metals being connected in Japan by a ratio of 1 to 5, and in Europe by a ratio of 1 to 15. This latter fact led to some arbitrary and even disgraceful doings on the part of foreign traders, and was also the cause of a sudden and violent appreciation of values ; for the Government, seeing the country threatened with loss of all its gold, tried to avert the catastrophe by altering and reducing the weights of the silver coins without altering

their denominations, and a corresponding difference ex-
hibited itself, as a matter of course, in the silver quotar
tions of commodities. Another source of dif&culty was
the attitude of officialdom. During several centuries,
Japan's over-sea trade had been under the control of the
Government, to whose coffers it contributed a substantial
revenue. But when the foreign exporter entered the
field under the conditions created by the new system, he
diverted to his own pocket the handsome profit previously
accruing to the Government ; and since the latter could
not easily become reconciled to this loss of revenue, or
wean itself from its traditional habit of interference in
affairs of foreign commerce, and since the foreigner, on
his side, not only desired secrecy in order to prevent
competition, but was also tormented by inveterate sus-
picions of Oriental espionage, not a little friction occurred
from time to time. Thus the impression suggested by
the scanty records of that early epoch is that trade was
beset with great difficulties, and that the foreigner had
to contend against most adverse circumstances, though in

truth his gains amounted to 40 or 50 per cent.

The chief staples of the early trade were tea and silk. It happened that, just before Japan's raw silk became available for export, the production of that article in France and Italy had been largely curtailed owing to a novel disease of the silkworm. Thus, when the first bales of Japanese silk appeared in Loudon, and when it was found to possess qualities entitling it to the highest rank, a keen demand sprang up, so that in 18^3, the fourth year after the inauguration of the trade, no less than 2\ million lb were shipped. Japanese green tea, also, differing radically in flavour and bouquet from the black tea of China, appealed quickly to American taste, so that 6 million Sb of it were sent across the Pacific in 1863. The corresponding figures for these two staples in 1899 were 14 million lb and 46 million lb respectively. This remarkable development is typical of the general history of Japan's foreign trade in modern times. Omitting the first decade, the statistics for which are imperfect, the volume of the trade grew from 5f millions sterling in 1868 to

43^ millions in 1899. It was not a uniform growth. The period of 32 years divides itself conspicuously into two eras : the first, of 18 years (1868-85), during which the development was from 6f millions to 13 millions, a ratio of 1 to 2 J, approximately ; the second, of 14 years (1886-99), during which the development was from 13 millions to 42^ millions, a ratio of nearly 1 to 4.

That a commerce which did little more than double itself in the first eighteen years should have nearly quadrupled in the next fourteen is a fact inviting attention. There are two principal causes : one general, the other special. The general cause was that several years necessarily elapsed before the nation's material condition began to respond perceptibly to the improvements effected by the Meiji Government in matters of administration, taxation, and transport facilities. Fiscal burdens had been reduced and security of life and property obtained, but railway building and road-making, harbour construction, the advantages of posts, telegraphs, exchanges and banks, and the development of a mercantile marine did not

exercise a sensible influence on the nation's prosperity until 1884 or 1886. From that time the country entered a period of steadily growing prosperity, and from that time private enterprise may be said to have finally started upon a career of independent activity. The special cause which, from 1885, contributed to a marked growth of trade was the resumption of specie payments. Up to that time the Treasury's fiat notes had suffered such marked fluctuations of specie value that sound or successful commerce became very difficult. Against the importing merchant the currency trouble worked with double potency. Not only did the gold with which he purchased goods appreciate constantly in terms of the silver for which he sold them, but the silver itself appreciated sharply and rapidly in terms of the fiat notes paid by Japanese consumers. Cursory reflection may suggest that these factors should have operated inversely to stimulate exports as much as they depressed imports. But such was not altogether the case in practice. For the exporter's transactions were always hampered by the pos-

sibility that a delay of a week or even a day might increase the purchasing power of his silver in Japanese markets by bringing about a further depreciation of paper, so that he worked timidly and hesitatingly, dividing his operations as minutely as possible in order to take advantage of the downward tendency of the fiat notes. Not till this element of pernicious disturbance was removed did the trade recover a healthy tone and grow so lustily as to tread closely on the heels of the foreign commerce of China, with her 300 million inhabitants, and long-established international relations.

Japan's trade with the outer world was built up chiefly by the energy and enterprise of the foreign middleman. He acted the part of an almost ideal agent. As an exporter, his command of cheap capital, his experience, his knowledge of foreign markets, and his connexions enabled him to secure sales such as must have been beyond reach of the Japanese working independently. Moreover, he paid to native consumers ready cash for their staples, taking upon his own shoulders all the risks of finding markets abroad.

As an importer, he enjoyed, in centres of supply, credit which the Japanese lacked, and he offered to native consumers foreign produce laid at their doors with a minimum of responsibility on their part. Finally, whether as exporters or importers, foreign middlemen always competed with each other so keenly that their Japanese clients obtained the best possible terms from them. Yet the ambition of the Japanese to oust them cannot be regarded as unnatural. Every nation must desire to carry on its own commerce independently of alien assistance, and it may be added that certain features of the foreigner's methods in Japan have rendered his intervention specially irksome. His practice is openly based on the hypothesis that no Japanese tradesman is trustworthy, and he takes frequent occasion to proclaim his want of confidence. Undoubtedly thisdistrusthashad justification. Social conditions in Japan during feudal centuries were altogether unfavourable to the development of a " commercial conscience," and there has not yet been time for the new order of things to produce a radical improvement in that respect. Japanese publi-

cists themselves frankly recognize this unfortunate fact, but the average tradesman can scarcely be expected to admit it. He resents being preached to about commercial morality by foreigners whom he himself considers arbitrary, exacting, and often unjust. He is jealous, too, of the strangers' manner of life. Their comparatively fine mansions, their carriages, and their apparently profuse expenditure suggest that they derive princely incomes from their business. Thus there are several reasons for wishing to dispense with the alien, and it is plain that these reasons are operative ;

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for whereas in 1888 native merchants carried on only 12 per cent, of the country's foreign trade without the intervention of foreign middlemen, their share rose to 35 per cent, in 1899. That this rate of increase would be steadily maintained was not, however, an inference to be accepted. The day is still distant when Japanese merchants can hope to establish with the Occident, rela-

tions of such mutual intimacy and confidence as will enable them to take the place now occupied by foreign middlemen.

Analysis of Japan's foreign trade during the Meiji era (1868 to 1899, inclusive) shows that imports exceeded exports in 17 years and that exports exceeded o/tv". imports in 15 years. This would suggest a tolerably well balanced trade. But closer examination does not confirm the suggestion. Reckoning from 1872, when returns relating to movements of specie became available for the first time, it is found that imports totalled 218|^ millions sterling and exports 1S>Q\ millions, so that the excess of imports was S2\ millions. On the other hand, the exports of specie for the same time were 38 millions sterling and the imports 33 millions, showing an excess of 5 millions on the side of exports. Obviously Japan cannot have paid for imports worth S2\ millions sterling by a disbursement of only 5 millions. This apparent anomaly admits of an easy explanation. After the war of 1894r-95, Japan received from China an indemnity*

of 36^ millions of pounds, out of which she brought 18f millions into the country. Further, in 1898 she sold bonds to the value of 4-|- millions in the London market and caused the money to be sent to Tokyo. If these 23 millions be taken into account, the excess of unpaid-for imports is reduced to 4^ millions sterling, the greater part of which, if not the whole, is accounted for by the ex-penditures of foreigners resident in the country and of tourists visiting it. There could be no question, however, that Japan's foreign trade was causing an outflow of her specie. Only within the four years 1896 to 1899, how-ever, was the balance seriously against her, the imports for that period totalling 91^ millions sterling and the exports 66 millions. Doubtless the explanation is to be sought in the fact that after 1896 the Government was spending great sums on works connected with the post-bellum programme of armament expansion, and that the millions thus scattered among the people have increased their purchasing power to an abnormal extent.

It can scarcely be doubted that the future development

of Japan's trade will be in the direction of manufactures.

She will always be able to send abroad consid-

Commer- erable quantities of raw silk and tea and com-

prospects. paratively inconsiderable quantities of marine

products,^ copper, coal,^ camphor, sulphur, rice,

and minor staples, but, with regard to these, either her pro-

ducing capacity is inelastic or her market is limited. It is

certain, indeed, that she will by and by have to look abroad

for supplies of the necessaries of life. Rice is the staple

diet of her people, and she seems almost to have reached

the potential maximum of her rice-growing area ; for, in

1 Japan's fishing industry is doubtless capable of great development.

She has 17,1)02 miles of coast, and 270,000 families devoted to fishing,

or more than 15 families to each mile. They employ 330,706 boats and

1,194,408 nets, representing a capital of about 3 millions sterling,

and the total value of the annual catch is put at 5 millions sterling,

though 10 millions would probably be nearer the truth. The fisher-

men are sturdy, courageous fellows, but their methods are primitive

and virtually no improvements have yet been introduced.

2 It was at one time supposed that Japan possessed great mineral

wealth, but the question remains uncertain. The output of her various mines increases steadily, it is true, but its total annual value does not exceed 3 millions sterhng. Recently gold has been discovered in seemingly large (juantities in Hokkaido, and kerosene in Echigo as well as in Hokkaido. The practical value of these discoveries remains to be determined.

spite of her genial climate and seemingly fertile soil, the extent of her arable land is disproportionately small. She has only 11^ millions of acres under crops, and there is no prospect of any large extension, or of the yield being improved by new agricultural processes. The Japanese farmer understands his work thoroughly. His competence is sufficiently proved when we say that, by the skilful use of fertilizers, he has been able to raise good crops of rice on the same land during fifteen or twenty centuries.

On the other hand, not only is the population increasing at the rate of half a million annually, but in proportion to the growth of general prosperity and the distribution of wealth, the lower classes of the people, who used formerly to be content with barley and millet, now regard rice as

an essential article of food. It cannot be long, therefore, before large supplies of this cereal will have to be drawn from abroad. The same is true of timber, which has already become inconveniently scarce. Further, Japan cannot even grow her own cotton, and nature has not fitted her pastures for sheep, so that much of the material for her people's clothing has to be imported. Her future lies undoubtedly in industrial enterprise. She has an abundance of cheap labour, and her people are exceptionally gifted with intelligence, docility, manual dexterity, and artistic taste. Everything points to a great future for them as manufacturers. This is not a matter of mere conjecture. Striking practical evidence has already been furnished. Cotton-spinning may be specially referred to. As long ago as 1862 the feudal chief of Satsuma started a mill with five thousand spindles. During a whole decade he found only one imitator. In 1882, however, a year which may be regarded as the opening of Japan's industrial era, this enterprise began to attract capital, and in the course of four years 15

mills were established, working 65,000 spindles. By foreign observers this new departure was regarded with contemptuous amusement. The Japanese were declared to be without organizing capacity, incapable of sustained energy, and generally unfitted for factory work. These pessimistic views had soon to be radically modified, for by 1897 the number of mills had increased to 63; the number of spindles, to some 800,000; the capital invested, to 21 million yen, and the average annual profit per spindle was 3^ yen, or 13^ per cent, on the capital. The rapidity of this development suggests unsoundness, but speed is a mai-ked characteristic of Japan's modern progress. In 1880, for example, a man named Isozaki, of Okayama prefecture, carried to' Kobe a specimen of a new kind of floor-mat, the outcome of two years' thought and trial. Briefly described, it was matting with a weft of fine green reeds and a warp of cotton yarn, having a coloured design woven into it. Isozaki found difficulty in getting any one to test the saleability of his invention by sending it

abroad. Sixteen years later the " brocade-matting " industry of Okayama prefecture alone occupied 734 weaving establishments, with 9085 stands of looms; gave employment to 9357 artisans, of whom 5335 were females, and turned out 2^ million yen worth of this pretty floor-covering. Meanwhile, the total value of the industry's output throughout the empire had reached nearly 6 million yen, and the quantity exported stood at nearly 4 millions approximately in the customs returns. Here, then, is a trade which rose from nothing to a position of importance in sixteen years. Even more remarkable in some respects has been the development of the textile industry. In 1884 the total production of silk and cotton fabrics was 6 million yen; in 1898 It had increased to 110 millions.^ The manufacture of

' The Japanese have been skilled weavers for many ceuturies, but history]

lucifer matches is another industry of entirely recent

growth. A few years ago Japan used to import all the matches she needed, but by 1899 she was able not only to supply her own wants, but also to send abroad 6 million yen worth. Without carrying these statistics to wearisome length, it will suffice to note that, in six branches of manufacturing industry which may be said to have been called into active existence by the opening of the country — namely, silk and cotton fabrics, cotton yarns, matches, fancy matting, and straw braid — Japan's exports in 1888 aggregated only \ million yen, ■*whereas the corresponding figure for 1899 was 68 millions. With such results on record, it is impossible to doubt that Japan has a great manufacturing future. The fact has, indeed, been partially recognized and much talked of within the past few years, especially in the United States, where the prospect of Japanese industrial competition was recently presented to the public in almost alarming proportions. On the other hand, among foreigners resident in Japan the general estimate of native manufacturing capacity is low.*

Doubtless, as is usually the case, the truth lies between the two extremes. Japanese industrial competition will be a formidable fact one of these days, but the time is still distant. Progress is checked by one manifest obstacle, defective integrity. Concerning every industry whose products have found a place in the catar logue of modern Japan's exports, the same story has to be told: just as really substantial development seemed to be visible, fraudulent adulteration or dishonestly careless technique interfered to destroy credit and disgust the foreign consumer. The Japanese deny that the whole responsibility for these disastrous moral laches rests with them. The treaty-port middleman, they say, buys so thriftily that high-quality goods cannot be supplied to him. That excuse may be partially valid, but it is certainly not exhaustive. The vital importance of establishing and maintaining the reputation of an article offered newly in markets where it has to compete with rivals of old-established excellence is not yet fully appreciated in Japan. As to organizing capacity, the possession of which

by the Japanese has been strenuously doubted by more than one foreign critic, there are proofs more weighty than any theories. In the cotton-spinning industry, for example, the Japanese are brought into direct competition in their own markets with Indian mills employing cheap native labour, organized and managed by Englishmen, and having the raw material at their doors. The victory rests with the Japanese, from which it may fairly be inferred that their organization is not specially defective or their method costly.^ Yet there is one consideration that must not be lost sight of : it is the inexperience of the Japanese ; their lack of standards. Japan is dressing herself in a material civilization that was made to the measure of alien nations, and curious misfits are inevitably developed in the process. If the England of 1837, a great impetus was given to this enterprise by the introduction of improved machinery and the use of aniline dyes, after the opening of the country to foreign intercourse. Indigo has always been the staple dye-stuff of the country. Twenty million yen worth is produced annually. But for colours other than blue and its

various tones, aniline dyes are now imported to the extent of IJ million yen yearly. The growth of the textile industry has also been greatly stimulated by the introduction of cotton yarns of fine and uniform quality. Formerly all cotton cloths were woven out of coarse, irregular, handspun yarns, so that nothing like regularity of weight and texture could be secured. It thus appears that Japan owes the remarkable development of her textile industry to foreign intercourse.

1 Japanese mills are kept at work twenty-three hours out of the twenty-four, with one shift of operatives, and their production per spindle is 40 per cent, greater than the production at Bombay mills and nearly double the production at English mills.

for example — that is to say, England as she was at the commencement of the Victorian era — could have been suddenly projected forward to 1897, and invited to adapt herself to the moral and material conditions of the latter period, the task, though almost inconceivably difficult, would have been easier than that which Japan set herself in 1870, for England would at least have pos-sessed the preliminary training, the habit of mind,

and the trend of intelligence, all of which were want-
ing to Japan. This essential difference should be easy
to remember, yet it is constantly forgotten by observers
of Japan's progress. Again and again they make
the mistake of measuring her acts by the standards
to which they have themselves been educated. Again
and again they fall into the error of deducing from
her failures and perplexities the same inferences that
similar perplexities and failures would suggest in Europe
or America. If the citizens of Tokyo hesitate to spend
large sums upon street repair, they are accused of blind
parsimony, though the fact is that, never having had
any practical knowledge of really fine roadways, they
have not yet learned to appreciate them. If Japanese
officials do not at once succeed in solving the very
difficult problem of Eormosan administration, it is
concluded that they lack administrative ability, though
absolute lack of experience suffices to account for their
ill-success. If the people have not yet made any sig-
nificant contribution to the sum of Occidental scientific

knowledge or mechanical contrivances, they are dis-
missed as imitative, not initiative, which is much as
though we should charge a lad with want of originality
because, having barely mastered the integral calculus,
he did not write some new chapters on quaternions.
If they have not yet reduced constitutional government
to a smoothly working system, have not yet emerged
from a confusion of political coteries into the orderly
condition of two great parties, each capable of assum-
ing and discharging administrative responsibilities they
are declared unfit for representative institutions, though
they have tried them for only a few years after fifteen
centuries of military feudalism or hereditary oligarchy.
If they do not carry on their new industries with the
minimum of ef&cient labour, and if they fail to appre-
ciate the economical necessity of bestowing constant
care upon the machinery and of seeking to rise above first
results instead of regarding them as the ne plus ultra
of subsequent achievement, they are pronounced radically
deficient in the industrial instinct, whereas the truth is

that they have not as yet any accurate perception of the standards which experience and competition have established in foreign countries. The condition of their army and of their navy shows that not capacity but practice is what the Japanese lack. These two services are altogether modern creations. There was nothing in the history of Japan to suggest her competence for managing such machines. Yet the excellence of her military organization was fully demonstrated in her campaign against China in 1894-96, and again in the Peking expedition of 1900. In the former she had to undertake the most difficult task that falls to the lot of a belligerent, the task of sending over-sea two corps d'arm&e (aggregating a hundred and twenty thousand men), and maintaining them for several months in widely separated fields — one in eastern and central Manchuria; the other in the Liaotung peninsula, and, subsequently, in Shantung province. The effort did not appear to embarrass her. There was no sign of confusion or perplexity ; no breakdown of the commissariat or transport arrangements ; no failure of the ambulance or hospital

service. Everything worked smoothly, and the public

were compelled to recognize that Japan had not only

elaborated a very efficient piece of military mechanism,

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but had also developed ability to employ it to the best

advantage. The same inference "was suggested by her

navy. Although during two and a half centuries her

people had been debarred by arbitrary legislation from

navigating the high seas, the twenty-iifth year after the

repeal of these crippling laws saw the State in posses-

sion of a squadron of thirty -three serviceable ships of

war, of&cered and manned solely by Japanese, constantly

mancEuvring in distant waters without accident, and

evidently possessing all the qualities of a fine fighting

force. In the war with China this navy showed its

capacity by destroying or capturing, without the loss

of a single ship, the whole of the enemy's fleet, whereas

the latter's superiority in armour and armament ought to have produced a very different issue. On the other hand, a visit to Japanese factories often shows machinery treated carelessly, employes so numerous that they impede rather than expedite business, and a general lack of the precision, regularity, and earnestness that characterize successful industrial enterprises in Europe and America. Achievement in one direction and comparative failure in another, although the factors making for success are similar in each, indicate, not incapacity in the latter case, but defects of standard and experience. The vast majority of the Japanese have no adequate conception of what is meant by a highly-organized industrial or commercial enterprise.' They have never made the practical acquaintance of anything of the kind, nor even breathed a pure business atmosphere.^ For elaborating their military and naval systems they had close access to foreign models, every detail of which could be carefully scrutinized, and they availed themselves freely

iThe railways and posts constitute additional examples. The Jap-

anese haTe long been able to survey, plan, and build their own lines of railways, to run the trains and to manage the traffic. For these achievements they deserve much credit. But their arrangements for handling, forwarding, and delivering goods are very defective, when judged by good Occidental standards, and their provision for the comfort of passengers leaves a great deal to be desired. So, too, their postal service invites criticism in some very important respects, if it merits praise in others. All such defects would soon be corrected if free recourse were had to the assistance of foreign experts, who have the advantage of familiarity with higher standards. It is unfortunate that a people so liberal in their adoption of the best products of Western civilization should hesitate to avail themselves of the best means of learning to utilize them.

2 Another serious obstacle to the industrial development of the Japanese is their difficulty in deciphering foreign tastes. It results that in fields where their capacity is highest their success is often smallest. They export some two millions of umbrellas at a cost of lOJd. apiece, 30,000 pairs of boots at lljd. a pair, and 190,000 dozen pairs of socks at Is. 3d. a dozen. There can be no mistake about the shape and style of these things ; a pattern alone suffices for guide.

But, on the other hand, take the case of lacquer. In the quality and beauty of their lacquer the Japanese stand easily at the head of all nations. There, if anywhere, they should be able to defy rivalry. Yet what are the facts ? Japanese lacquer experts, in their attempts to capture the New York market, have been distanced by Germans, who gauge the taste of the Americans with much greater accuracy, and produce lacquers better appreciated and cheaper than those of the Japanese themselves. Not finer lacquer, indeed, nor anything like as fine, but ibetter suited to the immediate purpose of its manufacturers. Another case In point is the work of the silversmith. As chisellers of metal the Japanese have no superiors. Their skill in that line ought to open a wide and profitable field in Europe and America. But it does not. With the exception of a few fancy articles, objects of art rather than of utility, they sell nothing abroad. They have not yet found the range of Occidental taste, and, judging from past experience, it seems likely that they will continue to waste their strength for a long time upon unfruitful essays. It would appear, in short, that intercourse and interchange of ideas between the East and West must become much closer and less superficial before Japanese manufacturers can adapt themselves to the requirements of the Occi-

dent sufficiently to be formidable competitors. In such staples as cotton yams, textile fabrics, silk handkerchiefs, lucifer matches, boots, umbrellas, and so forth, they find easy guidance, but where independent judgment and the mercantile instinct are needed, they still show themselves backward.

of the assistance of foreign experts— French, German, and British. But in the field of manufacture and trade their inspection of foreign models is necessarily superficial, and they are without the co-operation of foreign experts. It may be supposed that, since the foreign middleman plays such an important part in the country's over-sea commerce, his skill and experience must have been equally available for the purposes of industrial enterprise. But two difficulties stood in the way : one legal, the other sentimental. The treaties forbade foreigners to hold real estate or engage in business outside the limits of the settlements, thus rendering it impossible for them either to start factories on their own account or to enter into partnership with native maniif acturers ; and an almost morbid anxiety to prove their independent

competence impelled the Japanese to dispense prematurely with the services of foreign employes. Eapid as has been the country's material progress, it might have been at once quicker and sounder had these restrictive treaties been revised a dozen years earlier, when Japan was still upon the threshold of her manufacturing career, and before repeated failures to obtain considerate treatment at the hands of "Western Powers had prejudiced her against foreigners in all capacities. In 1885 she was ready to welcome the Occidental to every part of the country, regarded it as a matter of course that he should own real estate, and would gladly have become his partner in commerce or manufactures. In 1895 she had come to suspect that closer association with him might have dangers and disadvantages, and that the soil of Japan ought to be preserved from falling into his possession. There are clear evidences that this mood, so injurious to her own interests, is being replaced by more liberal sentiments, but in the meanwhile she has been induced to stand aloof from alien aids at a time when they might

have profited her immensely, and to struggle without guidance towards standards of which she has as yet only a dim perception. Already, too, some of the advantages of cheap labour and inexpensive living are disappearing, and, on the whole, there seems to be little doubt that though great manufacturing successes lie before her, she will take many years to realize them.

Japan's great diflculty is want of capital. The capital actually engaged in public and private enterprises is 60 million pounds sterling in round numbers, and 79 millions more are pledged though not yet paid up. On the other hand, the volume of circulating media is only 25 millions, of which amount 22 millions consist of convertible notes ; the deposits in the banks total 33 millions, and their capitals aggregate 49|- millions. ^ In such circumstances the rate of interest is necessarily high — it averages about 12 per cent, throughout the empire — and many profitable enterprises remain undeveloped. Eecourse to cheap foreign capital would be the natural solution of the difficulty. But so long as her currency was on a silver basis Japan

hesitated to contract gold debts, and European capitalists would not lend in terms of silver. After she had adopted the gold standard her situation appeared more favourable. Europe and America, however, had still not acquired confidence in her finances or her integrity, and in the meanwhile a great opening for foreign capital vainly offered in the field of industrial enterprises. Eecent returns issued

8 The efficiency of money has greatly increased, of course, during recent years. Thus, whereas in 1873 there were only half-a-dozen banks with a total capital of £6000, and aggregate loans of the same amount, approximately, the number at the close of 1899 was 2296, with a total capital of 49J millions sterling and loans aggregating 267 millions. In 1873 the sums deposited by mdividuals in banks amounted to half a million ; in 1899 they aggregated 33 millions. In 1887, the year after the establishment of Clearing Houses in Tokyo and Osaka, the clearances aggregated less than 3 millions sterling ■ in 1899 they totalled over 129 millions.

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by 68 joint-stock companies show that they paid an average annual dividend of 16^ per cent., and it is not to be doubted but that still better results could be attained were foreign business experience and cheap capital available. •

It has always been considered expedient, and certainly it is wise, that the subjects and citizens of Occidental Christian states, when visiting or inhabiting foretoiera Oriental countries which are not Christian, should be exempted from the penalties and procedure prescribed by the criminal law of the latter ; that they should continue, in short, to enjoy, even within the territoriesof suchcountries,theprivilege of being arraigned before tribunals of their own nationality and tried by judges of their own race. In civil cases a division of jurisdiction is arranged, the question being always adjudicated by a tribunal of the defendant's nationality, but in criminal cases jurisdiction is wholly reserved. In pursuance of that principle the various Powers having treaties with Oriental nations establish consular courts within the

latter's borders, and the jurisdiction exercised by these courts is called " extra-territorial," to distinguish it from the jurisdiction exercised by native or territorial tribunals. The system was applied to Japan's ease, as a matter of course, in 1858. It had been similarly applied in the 16th century, in the days of her first foreign intercourse, and just as it had then been a cause of the Dutch traders' imprisonment within the narrow limits of the island of Deshimaat Nagasaki, so in the 19th century it necessitated the confinement of the foreign residents in settlements grouped around the sites of their consular courts ; for the plainest principles of prudence forbade that these residents should have free access to provincial districts far remote from the oaly tribunals competent to control them. The Japanese negotiators in Yedo raised no objection to the embodiment of this system in the treaties. But it was one of the features most vehemently condemned by the conservative statesmen and politicians in Kyoto, and no sooner had the administration beenrestoredtothe Emperor than an embassy was despatched to Europe and America

with the object of inducing Occidental Governments to revise the treaties, in the sense of abolishing consular jurisdiction and changing the tariff so as to enable Japan to obtain a larger revenue from customs duties. This embassy sailed in 1871. It had a specific right to raise the question, for the treaties contained a provision declaring them to be subject to revision in that year. As a matter of course the embassy failed. The conditions originally necessitating consular jurisdiction had not undergone any change justifying its abolition. Neither the character of Japan's laws nor the methods of her judicial procedure were such as to warrant foreign Governments in entrusting to her care the lives and properties of their subjects and citizens. It must be confessed, on the other hand, that the consular courts themselves were not beyond reproach. A few of the Powers, notably Great Britain and the United States, had organized competent tribunals and appointed expert judicial officials to preside over them. But a majority of the Treaty Stateis were content to delegate consular duties to merchants, who not only lacked legal*

training of any kind, but were themselves engaged in the commercial transactions upon which they might at any moment be required to adjudicate in a magisterial capac-ity. Thus it happened, sometimes, that a Japanese sub-ject desiring to invoke the aid of the law against a

1 The tariff was fixed originally on a basis of 10 per cent, duty on imports, but in 1865 Japan consented, under heavypressure and even armed menace, to reduce the rate to 5 per cent. This, too, was only nominal, for the conversion of ad valorem duties Into specific was managed in such a manner that the sum actually levied on imports did not average as much as 2i per cent, of their value at the port of shipment.

*treaty revision^*

foreigner who seemed to have wronged him, found that the defendant in the case would also be the judge. In any circumstances the dual functions of consul and judge could not be discharged by the same official with-out anomaly, for his rdle of consul compelled him to act as advocate in the initiatory stages of complications about which in the position of judge he might ultimately be

required to deliver an impartial verdict. It would be an error to suppose, however, that the course of consular jurisdiction in Japan was disfigured by many abuses. On the whole the system worked satisfactorily, and if it hurt patriotic Japanese, it also saved them from innumerable complications into which they would have blundered inevitably had they been entrusted with a jurisdiction which they were not prepared to exercise satisfactorily. Nevertheless, they determhied from the first that no effort should be spared to qualify for the exercise of a right which is among the fundamental attributes of every sovereign state — the right of judicial autonomy. In any circumstances the recasting of their laws and the re-organization of their law courts would have occupied a prominent place in the programme of general reform suggested by contact with the Western world, but the "extra-territorial" question certainly stirred them to special legislative efforts. With the aid of foreign experts they set themselves to elaborate codes of criminal and civil law, excerpting the best features of European

jurisprudence, and adapting them to the conditions and usages of Japan. They also remodelled their law courts, and took steps, slower but not less earnest, to educate a judiciary competent to administer the new codes. After twelve years devoted with partial success to these great works, Japan in 1883 renewed her request for segotia- the abolition of consular jurisdiction. She tionsfor asked that all foreigners within her borders, without distinction of nationality, should be subject to her laws and judiciable by her law courts, as foreigners found withia the borders of every sovereign state in the Occident were subject to its laws and judi- ciable by its tribunals of justice, and she supplemented her application by promising that its favourable reception should be followed by complete opening of the country and the removal of all restrictions hitherto imposed on foreign trade, travel, and residence in her realm. Erom the first it had been the habit of Occidental peoples to up- braid Japan on account of the barriers opposed by her to full and free foreign intercourse, and she was now able to

claim that the barriers were no longer created by her intention or maintained by her desire, but that they existed because of a system which theoretically proclaimed her unfitness for free association with Western nations, and practically made it impossible for her to throw open her territories completely for the ingress of strangers.

A portly volume might be filled with the details of the negotiations that followed Japan's proposal. Never before had an Oriental state sought such recognition, and there was extreme reluctance on the part of Western Powers to try the unprecedented experiment of entrusting the lives and property of their subjects and citizens to the keeping of a " pagan " people. Even the outlines of the story cannot be sketched here, though it abounds with diplomatic curiosities, and though several of its incidents do as much credit to Japan's patience and tact as its issue does to the justice and liberality of Occidental Governments. There is, however, one page of the history that calls for brief notice, since it supplies a key to much which would otherwise be inexplicable. The respect entertained by a nation for its own laws and the confidence it reposes in their administrators are in direct proportion to the efforts it has expended upon the development of the former and the education of the latter. Foreigners residing in Japan

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naturally clung to consular jurisdiction as a privilege of inestimable value. They saw, indeed, that such a system could not be permanently imposed on a country where the conditions justifying it had nominally disappeared. But they saw, also, that the legal and judicial reforms effected by Japan had been crowded into an extraordinarily brief period, and that, as tyros experimenting with alien systems, the Japanese might be betrayed into many errors. A struggle thus ensued between foreign distrust on the one side and Japanese aspirations on the other — a straggle often developing painful phases. For whereas the case for the foreign resident stood solid and rational so long as it rested on the basis of his proper attachment to the laws and the judiciary which the efforts of his countrymen through long generations had rendered worthy of trust and reverence, and on the equally intelligible and reasonable ground that he wanted convincing proofs of Japan's competence to discharge her novel functions with discretion and impartiality before submitting him-

self to her jurisdiction, it ceased to be a solid and rational case when its champions undertook, not merely to exaggerate the risks of trusting Japan implicitly, but also to demonstrate her radical unworthiness of any trust whatever, and to depict her under aspects so deterrent that submission to her jurisdiction assumed the character of a catastrophe. The struggle lasted eleven years, but its gist is contained in this brief statement. The foreign resident, whose affection for his own systems was measured by the struggle their evolution had cost, and whose practical instincts forbade him to take anything on trust where security of person and property was concerned, would have stood out a wholesomely conservative and justly cautious figure had not his attitude been disfigured by local journalists who, in order to justify his conservatism, allowed themselves to be betrayed into the constant rdle of blackening the character of Japan, and suggesting harshly prejudiced interpretations of her acts and motives. It is one thing to hesitate before entering a new house until its fitness for occupation has been ascertained: it

is another thing to condemn it without trial as radically and necessarily deficient in this respect. The latter was in effect the line often taken by the noisiest opponents of Japan's claims, and, of course, no little resentment and indignation were aroused on the side of the Japanese, who, chafing against the obvious antipathies of their foreign critics, and growing constantly more impatient of the humiliation to which Japan was internationally condemned, were sometimes prompted to displays of resentment which became new weapons in the hands of their critics. Throughout this struggle the Government and citizens of the United States always showed conspicuous sympathy with Japanese aspirations, and it should also be recorded that, with exceptions so rare as to establish the rule, foreign tourists and publicists discussed the problem liberally and fairly, perhaps because, unlike the foreign communities resident in Japan, they had no direct interest in its solution.

At last,' after long years of diplomatic negotiation

1 It would be incorrect to suppose that the responsibilityifor the

*delay can be thrown entirely on the foreign side. More than once an agreement had reached the verge of conclusion, when Japanese public opinion, partly incited by political intrigues, rebelled vehemently against the guarantees demanded of Japan, and the negotiations were interrupted in consequence, not to be again resumed until a considerable interval had elapsed. This point will easily be understood when we say that whereas, at the outset of the discussion, Japanese officialdom had the matter entirely in its own hands, and might have settled it on any basis, however liberal to foreigners, without provoking, for the moment at all events, seriously hostile criticism on the part of the nation, there gradually grew up among the people, pari passu with journalistic development, with the study of international law, and with the organization of political parties, a strong sense of what an independent state has a right to expect, and thus the longer and public discussion, European Governments conceded the justice of Japan's demands, and it was agreed that from July 1899, subject to the pre- 2^^^"'"^^ vious fulfilment of certain conditions,^ Japan- i^^grs. * ese tribunals should assume jurisdiction over every person, of whatever nationality, within the con-*

fines of Japan, and the whole country should be thrown open to foreigners, the "settlements" being abolished, and all limitations upon trade, travel, and residence removed throughout the length and breadth of the realm. Great Britain took the lead in thus releasing Japan from the fetters of the old system. The initia- tive came from her with special grace, for the system' and all its irksome consequences had been imposed on Jajjan originally by a combination of Powers with Great Britain in the van. As a matter of historical sequence the United States dictated the terms of the first treaty providing for consular jurisdiction. But from a very early period the Washington Government showed its willingness to remove all limitations of Japan's sovereignty, whereas Europe, headed by Great Britain, whose preponderating interests entitled her to lead, resolutely refused to make any substantial concession. In Japanese eyes, therefore, British conservatism seemed to be the one serious obstacle, and since the British residents in the settlements far out- numbered all other nationalities, and since they alone had

newspaper organs to ventilate their grievances, and exhibited all a Briton's proverbial indifference to the suavities and courtesies of speech and method that count for so much in disarming resentment, it was certainly fortunate for the popularity of her people in the Ear East that Great Britain saw her way finally to set a liberal example. Nearly five years were required to bring the other Occidental Powers into line with Great Britain and America. It should be stated, however, that neither reluctance to make the necessary concessions nor want of sympathy with Japan caused the delay. The explanation is that each set of negotiators sought to improve either the terms or the terminology of the treaties already concluded, and that the tariff arrangements for the different countries required elaborate discussion.

Until the last of the revised treaties was ratified, voices of protest against revision continued to be vehemently raised by a large section of the foreign community in the settlements. Some were honestly apprehensive as to the issue of the experiment. Others were swayed by racial

prejudice pure and simple. A few had fallen into an incurable habit of grumbling, or found their account in professing to champion foreign interests; and all were naturally reluctant to forfeit the immunity from taxation hitherto enjoyed. It seemed as though the inauguration of the new system would find the foreign community in a mood which must greatly diminish the chances of a happy result, for where a captious and aggrieved disposition exists, opportunities to discover causes of complaint cannot be wanting. But at the eleventh hour this unfavourable demeanour underwent a marked change. So soon as it became evident that the old system was hopelessly doomed, the sound common-sense of the European and American business man asserted itself. The foreign residents let it be the negotiations were protracted the keener became the popular scrutiny to which they were subjected, and tlie greater the general reluctance to endorse any irksome concessions. Had foreign diplomacy recognized the growth of that sentiment, and been content to take moderate advantage of the Japanese negotiator's mood, the issue might have been comparatively satisfactory to foreigners. But by asking too much

and hagglmg too long, AVestern statesmen lost their opportunity of obtaining any substantial guarantees, and had ultimately to hand over their compatriots to Japanese jurisdiction on pure trust.

2 The main, indeed the only notable condition was that the whole of the new Japanese codes of law must have been in operation for a period of at least one year before the abolition of consular jurisdiction. history]

seen that they intended to bow cheerfully to the inevitable, and that no obstacles would be willingly placed by them in the path of Japanese jurisdiction. The Japanese, on their side, took some striking steps. An Imperial rescript declared in unequivocal terms that it was the Sovereign's policy and desire to abolish all distinctions between natives and foreigners, and that by fully carrying out the friendly purpose of the treaties his people would best consult his wishes, maintain the character of the nation, and promote its prestige. The Premier an d other Ministers of State issued instructions to the effect that the responsi-

bility now devolved on the Government, and the duty on the people, of enabling foreigners to reside confidently and contentedly in every part of the country. Even the chief Buddhist prelates addressed to the priests and parishioners in their dioceses injunctions pointing out that, freedom of conscience being now guaranteed by the Constitution, men professing alien creeds must be treated as courteously as the followers of Buddhism, and must enjoy the same rights and privileges.

Thus the great change was effected in circumstances of happy augury. Its results were successful on the whole. Difficulties, it is true, were not altogether absent. The Japanese made some mistakes, and the novelty of the experiment predisposes the conservative foreigner to be hypercritical of its working. Never before since the crown of civilization was placed upon the head of the Occident had Western Christians passed under the juris-diction of Oriental "pagans." This unprecedented act of trust on the part of Occidental Governments did not signify a corresponding access of confidence on the part

6 t oi Occidental subjects and citizens. The average European or American approaches the contemplation of all the acts of the Japanese people in a spirit of condemnar tion or condescension, and considers that he practises praiseworthy self-denial when he pays to Japanese laws or their guardians even a moiety of the deference that he would intuitively render in similar circumstances in a Western country. Administration can never achieve more than a success of sufferance when the ruled stand upon a plane higher than that conceded to the rulers. But it has been shown, at all events, that the measure of tolerance which foreigners are prepared to display is sufiicient for the working of the novel system, and that all the sinister predictions once so freely uttered about the vindictive advantage which the Japanese would certainly take of their newly-acquired power were baseless. Foreigners residing in Japan now enjoy immunity of domicile, personal and religious liberty, freedom from official interference, and security of life and property as fully as though they were living in their own

country.

No sooner did the Diet commence its sittings in 1891 than a Bill was introduced for removing all restrictions iipon freedom of speech. Already (1887) the Government had voluntarily made a great step in advance by divesting itself of the right to imprison or fine editors by executive order. But it reserved the power of suppress-

Preedom jjjg qj. suspending a newspaper, and against that reservation a majority of the Lower House voted, session after session, only to see the Bill rejected by the peers, who shared the Government's opinion that to grant a larger measure of liberty would certainly encourage license. Not until 1897 was this opposition overcome. A new law, passed by both Houses and confirmed by the Emperor, took from the executive all power over journals, except in cases of lese-majesty, and nothing now remains of the former arbitrary system. The result has falsified all sinister forebodings. A much more moderate tone pervades the writings of the Press since restrictions were entirely removed, and although

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there are now 829 journals and periodicals published throughout the empire, with a total annual circulation of 463 million copies, intemperance such as in former times would have provoked official interference is practically unknown to-day.

The quality of journalistic writing in Japan is marred by extreme and pedantic classicism. There has not yet been any real escape from the trammels of a tradition which assigned the crown of scholarship to whatever author drew most largely upon the resources of the Chinese language. A pernicious example in this respect is set by the Imperial court. The Sovereign, whether he speaks by rescript or by edict, never addresses the bulk of his subjects. His words are taken from sources so classical as to be intelligible only to the highly-educated minority. Several of the newspapers affect a similar style. They sacrifice their audience to their erudition, and prefer classicism to circulation. Their columns are

a sealed book to the whole of the lower middle classes and to the entire female population. Others, taking a more rational view of the purposes of journalism, aim with success at simplicity and intelligibility, and thus not only reach an extended circle of readers, but also are hastening incidentally the advent of a great reform, the assimilation of the written and spoken languages, which will probably prelude that still greater desideratum, abolition of the ideographic script. Apart from this pedantic defect, the best Japanese editors have caught with remarkable aptitude the spirit of modern journalism. But a few years ago they used to compile laborious essays, in which the construction was involved, the ideas were trivial, the inspiration was drawn from Occidental textbooks, and the alien character of the source was hidden under a veneer of Chinese aphorisms. To-day they write terse, succinct, closely-reasoned articles, seldom diffuse, often witty, and generally free from extravagance of thought or diction. Yet, with a few exceptions, the profession of journalism is not remunerative. Very low rates

of subscription, and almost prohibitory high charges for advertising, are chiefly to blame.^ The vicissitudes of the enterprise may be gathered from the facts that whereas 2767 journals and periodicals were started between 1889 and 1894 (inclusive), no less than 2465 ceased publishing. The largest circulation recorded in 1901 was about 30,000 copies daily.

Since the abolition of feudalism Japan has been engaged in three over-sea wars. The first, in 1874, was an expedition to Formosa. This has already been spoken of. It was insignificant from a military ^/"Jf° point of view, but it derived vicarious interest from its effect upon the relations between China and Japan, and upon the question of the ownership of the Eiukiu Islands. These islands, which lie at a little distance south of Japan, had for centuries been regarded as an appanage of the Satsuma fief. The language and customs of their inhabitants showed unmistakable traces of relationship to the Japanese, and the possibility of the islands being included among the dominions of China

had probably never occurred to any Japanese states-

man. When, therefore, in 1873, the crew of a wrecked

Eiukiuan junk were barbarously treated by the inhabit-

ants of northern Formosa, the Japanese Government

unhesitatingly assumed the responsibility of seeking

redress for this outrage. Formosa being a part of the

Chinese empire, complaint was duly preferred in Peking.

But the Chinese authorities showed such resolute indif-

ference to Japan's representations that she finally took

the law into hei own hands, and sent a small force to

1 The highest rate of subscription to a daily journal is twelve

shillings per annum, and the usual charge for advertisements is from

7d. to one shilling per line of 22 ideographs (about nine words) .

punish the Formosan murderers, who, of course, were

found quite unable to offer any serious resistance. The

Chinese Government, now recognizing the fact that its

territories had been invaded, lodged a protest which

threatened for a moment to involve the two empires in war, and might not have been amicably settled but for the intervention of the British minister in Peking. The final terms of arrangement were that, in consideration of Japan's withdrawing her troops from Formosa, China should indemnify her to the extent of half a million dollars (about £100,000) on account of the expenses of the expedition.

Had Japan needed any confirmation of her belief that the Eiukiu Islands belonged to her, this incident would have furnished it. Thus, in 1876, she did not question.'" l^^sitate to extend her newly organized system of prefectural government to Eiukiu, which thenceforth became "Okinawa Prefecture," the former ruler of the islands being pensioned, according to the system followed in the case of the feudal chiefs in Japan proper. China entered an objection immediately. She claimed that Riukiu h^d always been a tributary of the Middle Kingdom, and she was doubtless perfectly sincere in the contention. But China's interpretation of tribute

did not seem reducible to a working theory. So long as her own advantage could be promoted, she regarded as a token of vassalage the presents periodically carried to her court from neighbouring states. But so soon as there arose any question of discharging a suzerain's duties, she classed those offerings as insignificant interchanges of neighbourly courtesy. It was true that Riukiu had followed the custom of despatching gift-bearing envoys to China from time to time, just as Japan herself had done, though with less regularity. But it was also true that Riukiu had been subdued by Satsuma without China's stretching out a hand to help her ; that for two centuries the islands had been included in the Satsuma fief, and that China had recently made a practical acknowledgment of Japan's superior title to protect the islanders. Each empire asserted its claims positively; but whereas Japan put hers into practice, China confined herself to remon-strances. Things remained in that state until 1880, when General Grant, visiting the Bast, suggested the advisability of a compromise. A conference met in

Peking, and the plenipotentiaries agreed that the islands should be divided, Japan taking the northern group, China the southern. But on the eve of signature the Chinese plenipotentiary drew back, pleading that he had no authority to conclude an agreement without previously referring it to certain other dignitaries. Japan, sensible that she had been flouted, withdrew from the discussion and retained the islands, C|iina's share in them being reduced to a grievance.

From time immemorial China's policy towards the petty states on her frontiers had been to utilize them as buffers for softening the shock of foreign contact, while ™* *contriving, at the same time, that her relations question, with them should involve no inconvenient re-sponsibilities to herself. The aggressive impulses of the outside world were to be checked by an unproclaimed understanding that the territories of these states partook of the inviolability of the Middle Kingdom itself, while the states, on their side, must never expect their suzerain to bear the consequences of their acts. This arrangement,*

depending largely on sentiment and prestige, retained its validity in the atmosphere of Oriental seclusion, but quickly failed to endure the test of modern Occidental practicality. Tongking, Annam, Siam, and Burma were withdrawn, one by one, from the circle of buffers and from the fiction of dependence on China and independence towards all other countries. But with regard to Korea, China proved more tenacious. The possession of the peninsula by a foreign Power would have threatened the maritime route to the Chinese capital and given easy access to Manchuria, the cradle of the dynasty which ruled China. Therefore Peking statesmen endeavoured to preserve the old-time relations with the little kingdom. But they never could persuade themselves to modify the indirect methods sanctioned by tradition. Instead of boldly declaring the peninsula a dependency of the Middle Kingdom, they sought to keep up the romance of ultimate dependency and intermediate sovereignty. Thus, in 1876, Korea was suffered to conclude with Japan a treaty of which the first article declared her

*“an independent state enjoying the same rights as Japan,” and subsequently to make with the United States (1882), Great Britain (1883), and other Powers, treaties in which her independence was constructively admitted. China, however, did not intend that Korea should exercise the independence thus conventionally recognized. A Chinese Resident was placed in Seoul, and a system of steady though covert interference in Korea’s domestic and foreign affairs was inaugurated. The chief sufferer from these anomalous conditions was Japan. In all her dealings with Korea, in all complications that arose out of her comparatively large trade with the peninsula, in all questions connected with her numerous settlers there, she found herself negotiating with a dependency of China, and with of&cials who took their orders from the Chinese representative. China had long entertained a rooted apprehension of Japanese aggression in the peninsula — an apprehension not unwarranted by history — and that distrust tinged all the influence exerted by her agents there. Much space . would be required to recapitulate the occasions upon *

which Japan was made sensible of the discrimination thus exercised against her. Little by little the consciousness roused her indignation, and although no single instance constituted a ground for strong international protest, the Japanese people gradually acquired a consciousness of being perpetually bafled, thwarted, and humiliated by China's interference in the peninsular kingdom's affairs. To appreciate the bitterness of such conditions, it has to be remembered that for the previous thirty years China had treated Japan as a contemptible deserter from the Oriental standard, and had regarded her progressive efforts with openly disdainful aversion ; while Japan, on her side, had chafed more and more to furnish some striking evidence of the wisdom of her preference for Western civilization. In the breast of each nation there had been smouldering a sentiment of umbrage which could scarcely fail to be translated into hostile action sooner or later, unless either Japan reverted to conservatism or China became progressive. Even more serious were the consequences of Chinese interference when considered from the point of

view of Korean administration. The rulers of the country lost all sense of national responsibility, and gave unrestrained sway to selfish ambition. The functions of the judiciary and of the executive alike came to be discharged by bribery only. Family interests predominated over those of the State. Taxes were imposed in proportion to the greed of local o£&cials. No thought whatever was taken for the welfare of the people or for the development of the country's resources. Among the upper classes faction struggles, among the lower, insurrections, began to be more and more frequent. Personal responsibility was unknown among officials, family influence overshadowing everything. To be a member of the Bin family, to which the queen belonged, was to possess a passport to office and an indemnity against the consequences of abuse of power, however flagrant. From time to time the advocates of progress or the victims of oppression rose in arms. They effected nothing except to recall to the world's

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recollection the miserable condition into which the penin-sula had fallen. Chinese military aid was always fur-nished readily for the suppression of these imeutes, and thus the Bin family learned to base its tenure of power on ability to conciliate the Middle Kingdom, and on readiness to obey Chinese dictation, while the people at large fell into the apathetic condition of men that possess neither the blessing of security of property nor the in-centive of national ambition.

As a matter of State policy the Korean problem caused much anxiety to Japan. Her own security being deeply concerned in preserving Korea from the grasp of a Western Power, she could not suffer the little kingdom to drift into a condition of such administrative incompe-tence and national debility that a strong aggressor might find at any moment a pretext for interference. On two occasions, namely, in 1882 and 1884, when China's armed intervention was employed in the interests of the Bin to

suppress movements of reform, the partisans of the victors, regarding Japan as the fountain of progressive tendencies, attacked and destroyed her legation in Seoul and compelled its inmates to fly from the city. Japan behaved with forbearance at these crises, but in the consequent negotiations she acquired conventional titles that touched the core of China's alleged suzerainty. Por in 1882 her right to maintain troops in Seoul for the protection of her legation was admitted, and in 1885 she concluded with China a convention by which each Power pledged itself not to send troops to the peninsula without notifying the other, the two empires being thus placed on an equal military footing with regard to the peninsular kingdom.

In the spring of 1894 a serious insurrection broke out in Korea, and the insurgents proving themselves superior to the ill-disciplined, ill-equipped troops of the The nip- Government, the Bin family had recourse to its familiar expedient, appeal to China's aid. The appeal elicited a prompt response. On the 6th of

July 2500 Chinese troops embarked at Tientsin and were transported to the peninsula, where they went into camp at Ya-shan, on the south-west coast, notice of the measure being given by the Chinese Government to the Japanese representative at Peking, according to treaty. During the interval immediately preceding these events, Japan had been rendered acutely sensible of China's arbitrary and unfriendly interference in the peninsula. Twice the efforts of the Japanese Government to obtain redress for unlawful and ruinous trade prohibitions issued by the Korean authorities had been thwarted by the action of the Chinese representative in Seoul ; and once an ultimatum addressed from Tokyo to the Korean Government, as the sequel of long and vexatious delay, had elicited from the Viceroy Li in Tientsin an insolent threat of Chinese armed opposition. Still more strikingly provocative of national indignation was China's procedure with regard to the murder of Kim Ok-kyiin, the leader of progress in Korea, who had been for some years a refugee in Japan. In-veigled from Japan to China by fellow-countrymen sent

from Seoul to assassinate him, Kim was shot in a Japanese hotel in Shanghai ; and China, instead of punishing the murderer, conveyed him, together with the corpse of his victim, in a warship of her own to Korea, the assassin to be publicly honoured, the body to be savagely mutilated. When, therefore, the insurrection of 1894 in Korea induced the Bin family again to solicit China's armed intervention, the TSkyo Government concluded that, in the interests of Japan's security and of civilization in the Orient, steps must be taken to put an end finally to the barbarous corruption and misrule which rendered Korea a scene of constantdisturbance,offeredincessantinvitationstoforeign aggression, and checked the country's capacity to maintain tare with

China.

its own independence. Japan did not claim for herself any rights or interests in the peninsula superior to those possessed there by China. She was always ready to work hand in hand with the Middle Kingdom in inaugurating and carrying out a system of reform. But there was not

the remotest probability that China, whose face had been contemptuously set against all the progressive measures adopted by Japan during the preceding twenty-five years, would join in forcing upon a neighbouring kingdom the very reforms she herself despised and abhorred, were her co-operation invited through ordinary diplomatic channels only. It was necessary to contrive a situation which would not only furnish clear proof of Japan's resolution, but also enable her to pursue her programme independently of Chinese endorsement, should the latter be finally unobtainable. She therefore met China's notice of a despatch of troops with a corresponding notice of her own, and the month of July 1894 found a Chinese force assembled at Ya-shan and a Japanese force occupying positions in the neighbourhood of Seoul. China's motive for sending troops was nominally to quell the Tonghak insurrection, but really to reaflftrm her own domination in the peninsula, and to reseat in the administrative saddle men under whose guidance the country was losing all capacity for independence. Japan's

motive was to secure a position such as would enable her to insist upon the radically curative treatment of Korea's malady. Up to this point the two empires were strictly within their conventional rights. Each was entitled by treaty to send troops to the peninsula, provided that notice was given to the other. But China, in giving notice, described Korea as her "tributary state," thus thrusting into the forefront of the discussion a contention which Japan, from conciliatory motives, would have kept out of sight. Once formally advanced, however, the claim had to be challenged. In the treaty of amity and commerce concluded many years previously between Japan and Korea, the two high contracting parties were explicitly declared to possess the same national status. Japan could not agree that a Power which for two decades she had acknowledged and treated as her equal should be openly classed as a tributary of the Middle Kingdom. She protested, but the Chinese statesmen took no notice of her protest. They continued to apply the disputed appellation to Korea, and they further asserted their

assumption of sovereignty in the peninsula by seeking to set limits to the number of troops sent by Japan, as well as to the sphere of their employment. Japan then proposed that the two empires should unite their efforts for the suppression of the disturbances in Korea, and for the subsequent improvement of that kingdom's administration, the latter purpose to be pursued by the despatch of a joint commission of investigation. That was an important stage in the dispute. It rested then with China to avert all danger of war by joining hands with Japan for the regeneration of a nation in whose prosperity and independence the two empires were equally interested. But she refused everything. Eeady at all times to interfere by force of arms between the Korean people and the dominant political faction, she declined to interfere in any way for the promotion of reform. Ready at all times to crush the little kingdom into submission to a corrupt and demoralizing administration, she refused to aid in rescuing it from the suffering and enervation entailed by the sway of such an oligarchy. She even expressed superciliously

an insolent surprise that Japan, while asserting Korea's independence, should suggest the idea of peremptorily reforming its administration. In short, for Chinese purposes the Peking statesmen openly declared Korea a tributary of the Middle Kingdom, and denied Japan's assertion of its independence ; but for Japanese purposes

they insisted that it must be held independent, and that Japan must abide strictly by her assertion of its independence. The Tokyo cabinet now declared their resolve not to withdraw the Japanese troops without " some understanding that would guarantee the future peace, order, and good government of Korea," and since China still declined to come to such an understanding, Japan undertook the work of reform single-handed.

The Chinese representative in Seoul threw the whole weight of his influence into the scale against the success of these reforms. Still, nothing immediately oc-

curred to drive the two empires into open warfare. The determining cause of rupture was in itself a belligerent operation. China's troops, as already stated, had been sent originally for the purpose of quelling the Tonghak rebellion. But the rebellion having died of inanition before the landing of the troops, their services were not required or employed. Nevertheless they were not withdrawn. China kept them in the peninsula, her declared reason for doing so being the presence of a Japanese military force. Thus, throughout the subsequent negotiations the Chinese forces lay in an entrenched camp at Ya-shan, while the Japanese occupied Seoul. The trend of events did not import any character of direct mutual hostility to these little armies. But when it became evident that all hope of friendly co-operation between the two empires must be abandoned, and when Japan, single-handed, had embarked upon her scheme of regenerating Korea, not only did the continued presence of a Chinese military force in the peninsula assume special significance, but

any attempt on China's part to send reinforcements could be construed in one sense only, namely, as an imequivocal declaration of resolve to oppose Japan's proceedings by force of arms. Seeing, then, that China was preparing to send reinforcements, Japan warned the Peking Government of the construction she must place upon any act of the kind. Nevertheless China not only despatched troops by sea to strengthen the camp at Yashan, but also sent an army overland across Korea's northern frontier. It was at this stage that an act of war occurred. Three Chinese men-of-war, convoying a transport with 1200 men, encountered and fired on three Japanese cruisers. One of the Chinese ships was taken ; another was so shattered that she had to be beached and abandoned ; the third escaped in a dilapidated condition, and the transport, refusing to surrender, was sunk. This happened on 25th July, and an open declaration of war .was made by each empire six days later.

The narrative set down above represents the last chapter only of a history having its beginnings a quarter of a

century earlier. From the moment that Japan applied herself to break away from Oriental traditions, and to tear from her limbs the fetters of Eastern conservatism, it was inevitable that a widening gulf should gradually grow between herself and China, the inveterate representative of those traditions and that conservatism. Thus the struggle that occurred in 1894 was rather a contest between Japanese progress and Chinese stagnation than a fight to determine China's suzerainty or Korea's independence. To secure Korean immunity from foreign — especially Eussian — aggression was of capital importance to both empires. Japan believed that such security could be attained by introducing into the peninsula the civilization which had contributed so signally to the development of her own strength and resources. China thought that she could guarantee it without any departure from old-fashioned methods, and by the same process of capricious protection which had failed so signally in the cases of Annam, Tongking, Burma, and Siam. The issue really at stake was whether Japan should be suffered to act

as the Eastern propagandist of "Western progress, or whether her efforts in that cause should be held in check by Chinese conservatism.

The war itself was a succession of triumphs for Japan. Four days after the first naval encounter she sent from Seoul a column of troops who attacked the Chinese entrenched at Ya-shan and routed SJ"a/-?' them without difficulty. Many of the fugi-tives effected their escape to Phyong-yang, a town on the Taidong river, offering excellent facilities for de-fence, and historically interesting as the place where a Japanese army of invasion had been defeated by Chinese and Korean troops at the close of the 16th century. There the Chinese assembled a force of 17,000 men, and made full preparations for a decisive contest. They had ample leisure. A period of forty days elapsed before the Japanese columns, one moving due north from Seoul, the other striking west from Yuen-san, con-verged upon Phyong-yang, and that interval was utilized by the Chinese to throw up parapets, mount Krupp

guns, and otherwise strengthen their position. More-over, they were armed with repeating rifles, whereas the Japanese had only single-shooters, and the ground offered little cover for an attacking force. In such circumstances, the advantages possessed by the defence ought to have been well-nigh insuperable ; yet a day's fighting sufficed to carry all the positions, the assailants' casualties amounting to less than 700, and the defenders losing 6000 in killed and wounded. It was a brilliant victory, and it proved to be the prelude of another equally conspicuous success at sea. For on the 17th September, the very day after the battle at Phyong-yang, a great naval fight took place near the mouth of the Yalu river, which forms the northern boundary of Korea. Fourteen Chinese warships and six torpedo-boats were returning to home ports after convoying a fleet of transports to the Yalu, when they encoun-tered eleven Japanese men-of-war cruising in the Yellow Sea. Hitherto the Chinese had sedulously avoided a contest at sea. Their fleet was the stronger, since it

included two armoured line-of-battle ships of over 7000 tons displacement, whereas the biggest vessels on the Japanese side were belted cruisers of only 4000 tons. -In the hands of an admiral appreciating the value of sea power, China's naval force would certainly have been led against Japan's maritime communications, for a successful blow struck there must have put an end to the Korean campaign. History had already demonstrated that fact, for on two occasions in former ages attempts made by Japan to conquer the peninsula were rendered abortive by the superior maritime strength of the Koreans and Chinese. On land her soldiers proved invincible, but her sea-route being severed, she had to abandon the enterprise. The Chinese, however, failed to read history. They employed their war-vessels as convoys only, and when not using them for that purpose, hid them in port. Everything goes to show that they would have avoided the battle off the Yalu had choice been possible, though when forced to fight they fought bravely. Four of their ships were sunk, and the remainder escaped to Wei-hai-

wei, the vigour of the Japanese pursuit being greatly irnpaired by the presence of torpedo-boats in the retreating squadron.

The Yalu victory opened the over-sea route to China. Japan could now strike at Talienwan, Port Arthur, and Wei-hai-wei, naval stations on the Liaotung and Shantung peninsulas, where the powerful permanent fortifications, built after plans prepared by European experts and armed with the best modern weapons, were regai-ded as almost impregnable. They fell before the assaults of the Japanese troops as easily as the comparatively history]

rude fortifications at Phyong-yang had fallen. The only resistance of a stubborn character was made by the Chinese fleet at Wei-hai-wei ; but after the whole squad-ron of torpedo-craft had been destroyed or captured as they attempted to escape, and after three of the largest vessels had been sunk at their moorings by Japanese

torpedoes, and one by shot and shell, the remaining, four ships and five gunboats surrendered, and their brave commander, Admiral Ting, committed suicide. This ended the war. It had lasted seven and a half months, during which time Japan put into the field five columns, aggregating about 120,000 of all arms. One of these columns marched northwards from Seoul, won the battle of Phyong-yang, advanced to the Yalu, forced its way into Manchuria, and moved towards Mukden vid Peng-hwan, fighting several minor engagements, and conducting the greater part of its operations amid deep snow in mid-winter.

The second column diverged westwards from the Yalu, and, marching through southern Manchuria, reached Hai-cheng, whence it advanced to the capture of Newchwang and Ying-kow. The third landed on the Liaotung peninsula, and, turning southwards, carried Talienwan and Port Arthur by assault. The fourth moved up the Liaotung peninsula, and, having seized Kaiping, advanced against Ying-kow, where it joined hands with the second column.

The fifth crossed from Port Arthur to Wei-hai-wei, and

captured the latter. In all these operations the total Japanese casualties were 1005 killed and 4922 wounded — figures which sufficiently indicate the ineflRciency of the Chinese fighting. The deaths from disease totalled 16,866, and the total monetary expenditure was £20,000,000 sterling.

The Chinese Government sent Li Hung-chang, Viceroy of Pechili and senior Grand Secretary of State, and Li Ching-fong, to discuss terms of peace with Japan, the latter being represented by Marquis Ito and Count Mutsu, Prime Minister and Minister for Foreign Affairs respectively. A treaty was signed at Shimonoseki on the 17th of April 1895, and subsequently ratified by the Sovereigns of the two empires. It declared the absolute independence of Korea ; ceded to Japan the part of Manchuria lying south of a line drawn from the mouth of the river Anping to the mouth of the Liao, vid Feng-hwan, Hai-cheng, and Ying-kow, as well as the islands of Formosa and the Pescadores ; pledged China to pay an indemnity of 200,000,000 taels; provided for the occupation of

Wei-hai-wei by Japan pending payment of the indem-
nity ; secured some additional commercial privileges, as
the opening of four new places to foreign trade, and the
right of foreigners to engage in manufacturing enter-
prises in China, and provided for the conclusion of a
treaty of commerce and amity between the two empires,
based on the lines of China's treaties with Occidental
Powers.

No sooner did this agreement receive ratification at the
hands of the Sovereigns of Japan and China, than three
of the great European Powers — Eussia, Ger-
Foreign In- j^any, and France — stepped forward, and pre-
sented a joint note to the T6ky8 Government,
recommending that the territories ceded to Japan on the
mainland of China should not be permanently occupied,
as such a proceeding would be detrimental to the lasting
peace of the Orient. The recommendation was couched
in the usual terms of diplomatic courtesy, but everything
indicated that its signatories were prepared to enforce
their advice by an appeal to arms. Japan found herself

compelled to comply. Exhausted by the Chinese campaign, which had drained her treasury, consumed her supplies of warlike material, and kept her squadrons constantly at sea for eight months, she had no residue of strength to oppose such a coalition. Her resolve was quickly taken. The day that saw the publication of the ratified treaty saw also the issue of an Imperial rescript in which the Mikado, avowing his unalterable devotion to the cause of peace, and recognizing that the counsel offered by the European States was prompted by the same sentiment, "yielded to the dictates of magnanimity, and accepted the advice of the three Powers." The Japanese were shocked by this incident. They could understand the motives influencing Eussia and France, for it was evidently natural that the former should desire to exclude warlike and progressive people like the Japanese from territories contiguous to her borders, and it was also natural that France in the East should remain true to her alliance with Eussia in the West. But Germany, wholly uninterested in the ownership of Manchuria, and by pro-

fession a warm friend of Japan, seemed to have joined in robbing the latter of the fruits of her victory simply for the sake of establishing some shadowy title to Eussia's good-will. It was not known until a later period that the emperor of Germany entertained profound apprehensions about an irruption of Oriental hordes into the Occident, and held it a sacred duty to prevent Japan from gaining a position which might enable her to construct an immense military machine out of the countless millions of the Chinese nation. When his Majesty's mood came to be understood, much of the resentment provoked by his seemingly reckless unfriendliness in the Manchurian affair was softened by the mirth which his chimera excited.

Japan's third expedition over-sea in the Meiji era had its origin in causes which belong to the history of China {q.v.). It will suffice to say here that in the second half of 1900 an anti-foreign and anti- Chiaese dynastic rebellion, breaking out in Shantung, jpoo. spread to the neighbouring metropolitan pro-

vince of Pechili, and resulted in a situation of extreme peril for the foreign communities of Tientsin and Peking. It was impossible for any European Power, or for the United States of America, to organize sufficiently prompt measures of relief. Thus the eyes of the world turned to Japan, whose proximity to the scene of disturbance rendered intervention comparatively easy for her. But Japan hesitated. Knowing now with what suspicion and distrust the development of her resources and the growth of her military strength were regarded by some European peoples, and aware that she had been admitted to the comity of Western nations on sufferance, she shrank, on the one hand, from seeming to grasp at an opportunity for armed display, and on the other, from the solecism of obtrusiveness in the society of strangers. Not until Europe and America made it quite plain that they needed and desired her aid did she send a division (21,000 men) to Pechili. Her troops acted a fine part in the subsequent expedition for the relief of Peking, which had to be approached in mid-summer under very trying conditions.

Fighting side by side with European and American soldiers, and under the eyes of competent military critics, the Japanese acquitted themselves in such a manner as to establish a high military reputation. Further, after the relief of Peking they withdrew a moiety of their forces, and that step, as well as their unequivocal co-operation with Western Powers in the subsequent negotiations, helped to show the injustice of the suspicions with ■?vhich they had been regarded.

The final stage in the recognition of Japan as one of the Great Powers was accomplished in February 1902, when an offensive and defensive treaty of alliance was signed between her and Great Britain, on terms which were published to the world at large. From that moment the British and Japanese Powers were united to maintain the status quo in the Far East. (f. by.)

III. The Japanese Aemy.

Originally the Japanese nation consisted entirely of soldiers. The Sovereign was the commander-in-chief; the 0-omi and Omuraji were his lieutenants. The duty of serving in the ranks devolved on all subjects alike, the great nobles forming a patriarchal council of generals. But at the close of the 7tli century of the Christian era, when the Empress Jito sat upon the throne,

- **”’■”■ the social system of the Tang dynasty of China commended itself for adoption. The civil and military were then divided for the first time. Certain officers received commissions appointing them to special posts — as the generals of the left and of the right, the brigadiers of the left and of the right, the captains of the left and of the right, and so on ; a war office (JiyobvrsJio) was organized, as were also cavalry departments of the left and of the right, and each important district throughout the empire had its military division (gundan). All having been originally soldiers, no hereditary claim to carry arms could be set up. Physical qualifications alone received*

consideration. One-third of the nation's able-bodied males constituted the army, and these being divided into three equal parts, one part served in the capital as palace guards, one had its headquarters in Kiushiu, forming a legion for the protection of the southern coasts against Korean raiders or for service abroad, and the third part garrisoned the provincial posts. As to tactical formation, 6 men made a section, 2 sections a company, 5 companies a battalion, 2 battalions a regiment, and 10 regiments a division. Six horses were assigned to a company, the best riders and archers being selected for cavalry duty. A division consequently consisted of 600 mounted men and 400 foot soldiers. Service was for a .period only, and during that period taxes were remitted, so that military duties always found men ready to discharge them. Thus the hereditary soldier — afterwards known as the samurai or bushi — did not yet exist, nor was there any such thing as an exclusive right to carry arms. Weapons of war were the property of the State, stored away in times of peace, and served out periodically when required

for fighting or for training purposes. The next stage of development had its origin in the assumption of high offices of State by great families, who encroached upon the Imperial prerogatives, and appropriated as hereditary perquisites posts which should have remained in the gift of the Sovereign. The Tujiwara clan, taking all the civil offices, resided in the capital, whereas the military posts fell to the lot of the Taira and the Minar moto, who, settling in the provinces, and being thus required to guard the outlying districts and to quell rebellions, found it expedient to surround themselves with men who made soldiering a profession. These latter, in their turn, copying the customs of their superiors, transmitted their functions to their sons, so that there grew up in the shadow of the great houses a number of military families devoted to maintaining the power and promoting the interests of their masters, from whom they derived their own privileges and emoluments. At the close of the 8th century stubborn insurrections on the part of the autochthons gave new importance to the soldier. The

conscription list had to be greatly increased, and it came to be a recognized principle that every stalwart man should bear arms, every weakling become a bread-winner. Thus, for the first time, the distinction between " soldier " and " working man " ■' received official recognition, and in

^The term (hyalcu-sho) here translated "working man" means literally "one engaged in any ol the varions callings ' ' apart from military service. In a later age a further distinction was established between the agriculturist, the artisan, and the trader, and the word hyaku-sho then came to cany the signification of "husbandman" only, which sense it now possesses.

consequence of the circumstances attending the distinction a measure of contempt attached to the latter as compared with the former. History reveals that the continuous growth of the great provincial nobles tended to deepen this line of cleavage, so that, from the middle of the 10th century, the terms samurai and husM acquired a special significance, being applied to themselves and their followers by the local magnates, whose power tended more and more to eclipse even that of the Throne.

Finally, in the 12th century, when the Minamoto brought the whole country under the sway of military organi-zation, the privilege of bearing arms was restricted to the samurai. Thenceforth the military class entered upon a period of administrative and social superiority which lasted, without serious interruption, until the middle of the 19th century. But it is to be observed that the distinction between soldier and civilian, samurai and commoner, was not of ancient existence, nor did it arise from any question of race or caste, victor or vanquished, as is often supposed and stated. It was an outcome wholly of ambitious usurpations, which, relying for success on force of arms, gave practical im-portance to the soldier, and invested his profession with factitious honour.

The how was always the chief weapon of the fighting-man in Japan. ” War ” and ” bow-and-arrow ” were . synonymous terms. History tells how Tame- y^^ ^^ tomo shot an arrow through the crest of his brother’s helmet, in order to recall his allegiance,

without injuring him ; how Nasuno Minetaka discharged a shaft that severed the stem of a fan swayed by the wind ; how Mutsuru, ordered by an emperor to rescue a fish from the talons of an osprey without kOling bird or fish, cut the osprey's legs with an arrow so that the fish dropped into the palace lake and the bird continued its flight; and there are many similar records of Japanese skill with the weapon. Still more suggestive and better authenticated were the feats performed at the "thirty-three-span halls" in Kyoto and Tedo, where the archer had to shoot an arrow through the whole length of a corridor 128 yards long and only 16 feet high. Wada Daihachi, in the 17th century, succeeded in sending 8133 arrows from end to end of the corridor in 24 consecutive hours, being an average of over 5 shafts per minute; and Matatoki, in 1852, made 6383 successful shots in 20 hours, or more than 4 a minute. The lengths of the bow and arrow were determined with reference to the capacity of the archer. In the case of the bow, the unit of measurement was the dis-

tance between the tips of the thumb and the little finger with the hand fully stretched. Fifteen of these units gave the length of the bow, or about 7-J- feet. The unit for the arrow was from 12 to 15 hand-breadths,, or from 3 feet to 3f feet. Originally the bow was of unvarnished boxwood or zelkowa; but subsequently bamboo alone came to be employed. Binding with cord or rattan served to strengthen the bow, and for precision of flight the arrow had three feathers, an eagle's wing being most esteemed for that purpose, and after it, in order, that of the copper pheasant, the crane, the adjutant, the snipe.

Next in importance to the bow came the sword, which is often spoken of as the samuraVs chief weapon, though there can be no doubt that during long ages it ranked after the bow. It was a single-edged weapon remarkable for its three exactly similar curves — edge, face-line, and back; its almost imperceptibly convexed blade; its admirable tempering; its beautiful and consummately skilled forging ; its razor-like sharpness, and its cunning distribu-

tion of weight, giving a maximum effect of stroke. The aemt]

lOth century saw this unequalled weapon carried to completion, and it has been inferred that only from that epoch did the samurai begin to esteem his sword the greatest treasure he possessed, and to rely on it as his best instrument of attack and defence. But it is evident that the evolution of such a blade must have been due to an urgent, long-existing demand, and that the katana came as the sequel of innumerable efforts on the part of the swordsmith and generous encouragement on that of the soldier. Many pages of Japanese annals and household traditions are associated with its use. In every age numbers of men devoted their whole lives to acquiringnovel skill in swordsmanship. Many of them invented systems of their own, differing from one another in some subtle details unknown to any save the master himself and his favourite pupils. Not merely the method of handling the weapon had to be

studied. Associated with sword-play was an art variously known as shinobi, yawara, and jiujutsu, names which imply the exertion of muscular force in such a manner as to produce a maximum of effect with a minimum of effort, by directing an adversary's strength so as to become auxiliary to one's own. It was an essential element of the expert's art not only that he should be competent to defend himself with any object that happened to be within reach, but also that without an orthodox weapon he should be capable of inflicting fatal injury on an assailant, or, at any rate, of disabling him. In the many records of great swordsmen instances are related of men seizing a piece of firewood, a brazier-iron, or a druggist's pestle as a weapon of offence, while, on the other side, an umbrella, an iron fan, or even a pot-lid served for protection. In short, the samurai had to be prepared for every emergency. Were he caught weaponless by a number of assailants, his art of yawara was supposed to supply him with expedients for emerging unscathed. Nothing counted save the issue. The methods of gaining victory

or the circumstances attending defeat were scarcely taken into consideration. The true samurai had to rise superior to all contingencies. Out of this perpetual effort on the part of hundreds of experts to discover and perfect novel developments of swordsmanship, there grew a habit which held its vogue down to modern times, namely, that when a man had mastered one style of swordplay in the school of a teacher, he set himself to study all others, and for that purpose undertook a tour throughout the provinces, fencing whenever he found an expert, and, in the event of defeat, constituting himself the victor's pupil. It may indeed be said that the sword exercised a potent influence on the life of the Japanese nation. The distinction of wearing it, the rights that it conferred, the deeds wrought with it, the fame attaching to special skill in its use, the superstitions connected with it, the incredible value set upon a fine blade, the honours bestowed on an expert sword-smith, the traditions that had grown up around celebrated weapons, the profound study needed to be a competent judge of a sword's qualities — all these

things conspired to give to the katana an importance beyond the limits of ordinary comprehension. A samurai carried at least two swords, a long and a short. Their scabbards of lacquered wood were thrust into his girdle, not slung from it, being fastened in their place by cords of plaited silk. Sometimes he increased the number of swords to three, four, or even five, before going into battle, and this array was supplemented by a dagger carried in the bosom. The short sword was not employed in the actual combat. Its use was to cut off an enemy's head after overthrowing him, and it also served a defeated soldier in his last resort — suicide. In general the long sword did not measure more than 3 feet, including the hilt; but some were 5 feet long, and some were 7. Considering that the scabbard, being fastened to the girdle, had no play, the feat of drawing one of these very long swords demanded extraordinary aptitude, i

Spear and halberd were among the weapons of the ancient Japanese as well as sword and bow. The oldest form of spear was derived from China. Its handle

measured about 6 feet and its blade 8 inches, and it had sickle-shaped horns at the junction of blade andhilt. This weapon served almost exclusively for guarding palisades and gates. In the 14th century a true lance came into use. Its length varied greatly, and it had a hog-backed blade tempered almost as finely as the sword itself. This, too, was a Chinese type, as was also the halberd. The term ” halberd ” is a defective translation of the word naginata (long-sword), which was really a scimitar-like blade, some 3 feet in length, fix:ed on a slightly longer haft. Originally the warlike monks alone employed this weapon, but from the 12th century it found much favour among military men. Ultimately, however, its use may be said to have been limited to women and priests.

Speaking broadly, Japanese armour may be described as plate armour, but the essential difference between it and the Norman type was that, whereas the latter took its shape from the costume of the period, ‘”’”’»”’■ the former bore no resemblance and never was designed to

bear any resemblance to ordinary garments. Hence the only changes that occurred in Japanese armour from generation to generation had their origin in improved methods of construction. In general appearance it differed from the panoply of all other nations, so that, although to its essential parts we may apply with propriety the European terms — helmet, corselet, taches, epaulieres, brassart, cuissart, and greaves — individually and in combination these parts were not at all like the originals of those names. Perhaps the easiest way of describing the difference is to say that whereas a Norman knight seemed to be clad in a suit of metal clothes, a Japanese samurai looked as, if he wore protective curtains. The Japanese armour was, in fact, suspended from, rather than fitted to, the person. It had only one element counterparted in the European suit, namely, a tabard, which, in the case of men of rank, was made of the richest brocade. Iron and leather were the chief materials, and as the laminse were strung together with a vast number of coloured cords — silk or leather — an appearance of considerable brilliancy was

produced. Ornamentation did not stop there. Plating and inlaying with gold and silver were freely resorted to, and finely-wrought decoration in chiselled, inlaid, and repousse work was profusely applied to the helmet and its appendages, to the corselet, the epaulieres, and the brassarts. On the whole, however, despite the highly artistic character of its ornamentation, the loose, pendulous nature of Japanese armour detracted greatly from its workmanlike aspect, especially when the horo was added — a curious appendage in the shape of a curtain of fine transparent silk, which was either stretched in front between the horns of the helmet and the tip of the bow, or worn on the shoulders and back, the purpose in either case being to turn the point of an arrow. A true samurai observed the strict rules of etiquette with regard even to the garments worn under his armour, audit was part of his soldierly capacity to-be able to bear the great weight of the whole without loss of activity, a feat impossible to any untrained man of modern days. Common soldiers, of course, who went on foot, wore much scantier protection ; a comparatively light

helmet and a corselet generally constituted their panoply.

lA Chinese historian, speaking of the Japanese invasion of Korea

at the close of the 16th century, says of the samurai in action, that

‘ ‘ he brandished a 5-foot blade with such rapidity that nothing could

be seen except a white sheen of steel, the soldier himself being alto-

gether invisible.”

[aemt

War-

horses,

The Japanese never had a war-horse worthy to be so

called. The mis-shapen ponies which carried them to battle

showed qualities of hardiness and endurance, but

were so deficient in stature and massiveness that

when mounted by a man in voluminous armour

they looked painfully puny. Nothing is known of the

early Japanese saddle, but at the beginning of historic

times it approximated closely to the Chinese type. Sub-

sequently a purely Japanese shape was designed. It con-

sisted of a wooden frame so constructed that a padded numnah could be fastened to it. Galled backs or withers were unknown with such a saddle : it fitted any horse.

The stirrup, originally a simple affair resembling that of China and Europe, afterwards took the form of ^ shoe-sole with upturned toe. Both stirrups and saddle-frame were often of beautiful workmanship, the former covered with rich gold lacquer, the latter inlaid with gold or silver.

In the latter part of the military epoch chain armour was adopted for the horse, and its head was protected by a monster-faced mask of iron.

Flags were used in battle as well as on ceremonial occasions. Some were monochrome, as the red and white g^^. flags of the Taira and the Minamoto clans in strategy their Celebrated struggle during the 12th cen-aad tury; and some were streamers emblazoned tactics. Yfifii figures of the sun, the moon, a dragon, a tiger, and so forth, or with religious legends, as Namu Amida Butsu (the common invocation to Buddha), Namu Horenkyo (the formula of the Mchiren sect), or Hachi-

inan Daibosatsu (the name of the god of battles). Fans with iron ribs were carried by commanding officers, and signals to advance or retreat were given by beating drums and metal gongs and blowing conches. During the military epoch it was considered proper that a campaign should be opened or a contest preluded by a human sacrifice to the god of war, the victim at this rite of blood (cM-miatsuri) being generally a prisoner or a condemned criminal. Other preliminaries also had to be respected. Men went about the business of killing each other in an orderly and punctilious manner. Ambuscades and surprises played a large part in all strategy, but pitched battles were the general rule, and it was de rigiieur that notice of an intention to attack should be given by discharging a "singing arrow." Thereafter the assaulting army, taking the word from its commander, raised a shout of " Ei ! Ei ! " to which the other side replied, and the formalities having been thus satisfied, the fight commenced. In early mediaeval days tactics were of the crudest description. An army consisted of a congeries of

little bands, each under the order of a chief who considered himself independent, and instead of subordinating his movements to a general plan, struck a blow wherever he pleased, thinking much more of his own reputation as a warrior than of the interests of the cause for which he fought. From time immemorial a romantic value has attached in Japan to the " first " of anything : the first snow of winter ; the first water drawn from the well on New Year's Day ; the first blossom of the spring ; the first note of the nightingale. So in war the first to ride up to the foe or the wielder of the first spear was held in high honour, and the samurai strove for that distinction as his principal duty. It necessarily resulted, too, not only from the nature of the weapons employed, but also from the immense labour devoted by the true samurai to perfecting himself in their use, that displays of individual prowess were deemed the chief object in a battle. Some tactical formations borrowed from China were familiar in Japan, but their intelligent use and their modification to suit the circumstances of the time were inaugurated only by the

great captains of the 15th and 16th centuries. Prior to that epoch a battle resembled a monster fencing match. Men fought as individuals, not as units of a tactical formation, and the engagement consisted of a number of personal duels, all in simultaneous progress. It was the samurai's habit to proclaim his name and titles in the presence of the enemy, sometimes adding from his own record or his father's any details that might tend to dispirit his hearers. Then some one advancing to cross weapons with him would perform the same ceremony of self-introduction, and if either found anything to upbraid in the other's antecedents or family history, he did not fail to make loud reference to it, such a device being counted efficacious as a means of disturbing an adversary's sang-froid. The duellists could reckon on finishing their fight undisturbed, but the victor frequently had to endure the combined assault of a number of the comrades or retainers of the vanquished. Of course a skilled swordsman did not necessarily seek a single combat ; he was equally ready to ride into the thick of the fight without discrimination, and a group of common

soldiers never hesitated to make a united attack upon a mounted officer if they found him disengaged. But the general feature of a battle was individual contests, and when the fighting had ceased, each samurai proceeded to the tent^ of the commanding officer and submitted for inspection the heads of those whom he had killed.

The disadvantage of such a mode of fighting was demonstrated for the first time when the Mongols invaded Japan in 1274. The invaders moved in phalanx, guarding themselves with pavises, and covering ^^^f f ”’ their advance with a host of archers shooting clouds of poisoned arrows.^ When a Japanese samurai advanced singly and challenged one of them to combat, they opened their ranks, enclosed the challenger, and cut him to pieces. Many Japanese were thus slain, and it was not until they made a concerted movement of attack that they succeeded in driving back the enemy. Seven years later the Mongols, coming a second time, had a different reception. They were never suffered to land or to form their favourite phalanx. The Japanese, in small open

boats, without any protection for the rowers, rushed again and again to the assault of the invaders' immense fleet, which consisted of comparatively large vessels, decked, protected by bulwarks of timber, matting, and shields, and equipped with artillery to which the Japanese could oppose only bow and arrow. When, however, the samurai succeeded in boarding a Chinese vessel, their swords did such terrible execution that the vessels of the huge flotilla, huddling together for mutual protection, abandoned their offensive rdle, and while vainly seeking a safe landing were shattered by a tempest. But although the advantage of preventing an enemy from massing his strength was thus recognized, the Japanese themselves did not adopt the formation which the Mongols had shown to be so formidable. Individual prowess continued to be the prominent factor in battles down to a comparatively recent period. The great captain s, Takeda Shingen and Uyesugi Kenshin, who flourished during the first half of the 16th century, are supposed to have been Japan's pioneer tacticians. They certainly appreciated the value of a

formation in which the action of the individual should be subordinated to the unity of the whole. But when it is rejnembered that firearms had already been in the hands of the Japanese for several years, and that they had means of acquainting themselves with the tactics of Europe through their intercourse with the Dutch, it is remarkable that the changes attributed to Takeda and Uyesugi were not more drastic. Speaking broadly, what they did was to organize

1 A tent was simply a space enclosed with strips of cloth or silk, on which was emblazoned the crest of the commander. It had no covermg.

"The Japanese never at any time of their history used poisoned arrows ; they despised them as depraved and inhuman weapons.

a column with the musqueteers and archers in front ; the spearmen, halberdiers, and swordsmen in the second line ; the cavalry in the third line ; the commanding officer in the rear, and the drums and standards in the centre. At close quarters the spear proved a highly effective weapon, and

in the days of Hideyoshi, the Taikd, combined flank and front attacks by bands of spearmen became a favourite device. The importance of a strong reserve also received recognition, and in theory, at all events, a tolerably intel-ligent system of tactics was adopted. Not until the close of the 17th century did the doctrine of strictly disciplined action obtain practical vogue. Yamaga Soko is said to have been the successful inculcator of this principle, and from his time the most approved tactical formation was known as the Yamaga^ryu (Yamaga style), though it showed no innovation other than strict subordination of each Unit to the general plan.

Although, tactically speaking, the samurai was every-thing and the system nothing prior to the second half of the 17th century, and although strategy was miacipies. chiefly a matter of deception, surprises, and • ‘ ambushes, it must not be supposed that there were no ” classical principles.” The student of European military history searches in vain for the “rules and maxima of war ” so often invoked by glib critics, but the

student of Japanese history is more successful. Here, as in virtually every field of things Japanese, retrospect discovers the ubiquitous Chinaman. Sung and 'Ng — called in Japan " Son " and " Go " — Chinese generals of the third century after Christ, were the Jomini and the Hamley of their era, and their treatises continued to be the classics of Par Eastern captains through all generations. Yoshitsune, in the 12th century, deceived a loving girl to obtain a copy of Sung's work which her father had in his possession, and Yamaga, in the 17th century, when he set himself to compose a book on tactics, derived his materials almost entirely from the monographs of the two Chinese generals. There is proof that these treatises came into the hands of the Japanese in the 8th century, when the celebrated Kibi no Mabi went to study civilization in the Middle Kingdom, just as his successors of the 19th century went to study a new civilization in Europe and America. Thenceforth " Son " and " Go " became household words among Japanese soldiers. Their volumes were to the samurai what the Mdhdyana sutra was to the

Buddhist. They were believed to have collected what-
ever of good had preceded them, and to have forecast
whatever of good the future might produce. Something
of that credit they certainly deserve, for their principles
are not yet out of date : —

An army undertaking an offensive campaign must be twice as
numerous as the enemy. A force investing a fortress should he
numerically ten times the garrison. Troops for escalade should
muster five for every one of their foes. When the adversary
holds high ground turn his flank ; do not deliver a frontal attack.
When he has a moimtain or a river behind him, cut his lines of
communication. If he deliberately assumes a position from which
victory is his only escape, hold him there, but do not molest him.
If you can surround him, leave one route open for his escape, since
desperate men fight fiercely. Be warned of an ambush when you
see birds soaring in alarm, and if animals break cover in your
direction look out for a pending onset. When you have to cross
a river, put your advance-guard and your rear-guard at a distance
from the banks, and never approach with the bulk of your troops.
When the enemy has to cross a river, let him get well engaged in

the operation before you strike at him. If a march has to be traversed, make celerity your first object. Pass no copse, enter no ravine, nor approach any thicket until your scouts have explored it fully.

Such precepts are multiplied, and there is much about stratagems, deceptions and, above all, the employment of spies

but when those ancient authors discuss tactical formations, thej" do not seem to have contemplated any-thing like rapid, weltordered changes of mobile, highly

Ethics

of the

samurai.

trained masses of men from one formation to another, or their quick transfer from point to point of a battlefield.

The basis of their tactics is the Book of Changes. Here again is encountered the superstition that underlies nearly all Chinese and Japanese institutions : the superstition that took captive even the great mind of Confucius.

The male and the female principles ; the sympathetic and

the antipathetic elements ; cosmos growing out of chaos ; chaos reabsorbing cosmos — on such phantasies they founded their tactical system. The result was a phalanx of complicated organization, difficult to manoeuvre and liable to be easily thrown into confusion. Yet when Yamaga in the 17th century interpreted these ancient Chinese treatises, he detected in them suggestions for a very shrewd use of the principle of echelon, and applied it to devise formations which combined much of the frontal expansion of the line with the solidity of the column. More than that cannot be said for Japanese tactical genius. The samurai was the best fighting unit in the Orient — probably one of the best fighting units the world ever produced. It was perhaps because of that excellence that his captains remained indifferent tacticians.

In estimating the military capacity of the Japanese, it is essential to know something of the ethical code of the samurai, the bushi-do (" way of the warrior") as it was called.

The first source of information that presents itself

is the rules of conduct prescribed by feudal chief-

tains, and of these a typical example is furnished

in the code of Kato Kiyomasa, a celebrated general of the 16th

century : —

Regulations for Samurai of every Bank ; the Highest and Lowest

alike.

1. TlJe routine of service must be strictly observed. From

6 a.m. military exercises shah be practised. Archery, gunnery,

and equestrianism must not be neglected. If any man shows

exceptional proficiency he shall receive extra pay.

2. Those that desire recreation may engage in hawking, deer-

hunting, or wrestling.

3. With regard to dress, garments of cotton or pongee shall be

worn. Any man incurring debts owing to extravagance of

costume or living shall be considered a law-breaker. If, however,

being zealous in the practice of military arts suitable to his rank,

he desires to hire instructors, an allowance may be granted to him

for that purpose.

4. The staple of diet shall be unhuUed rice. At social enter-

tainments one guest for one host is the proper limit. Only

when men are assembled for military exercises shall many dine together.

5. It is the duty of every samurai to make himself acquainted with the principles of his craft. Extravagant displays of adornment are forbidden in battle.

6. Dancing or organizing dances is unlawful ; it is likely to betray sword-carrying men into acts of violence. Whatever a man does should be done with his heart. Therefore for the soldier military amusements alone are suitable. The penalty for violating this provision is death by suicide.

7. Learning shall be encouraged. Military books must be read. The spirit of loyalty and filial piety must be educated before all things. Poem-composing pastimes are not to be engaged in by samurai. To be addicted to such amusements is to resemble a woman. A man born a samurai should live and die sword in hand. Unless he is thus trained in time of peace he will be useless in the hour of stress. To be brave and warlike must be his invariable condition.

8. Whosoever finds these rules too severe shall be relieved from service. Should investigation show that any one is so unfortunate

as to lack manly qualities, he shall be singled out and dismissed forthwith. The imperative character of these instructions must not be doubted.

The plainly paramount purpose of these rules was to draw a sharp line of demarcation between the samurai and the courtiers living in Ky8t5. The dancing, the couplet^composlng, the sumptuous living, and the fine costumes of the officials frequenting the Imperial capital were strictly interdicted by the feudatories. Frugality, fealty, and filial piety — these may be called the funda-mental virtues of the samurai. Owing to the circumstances out of which his caste had grown, he regarded all bread- winning pur-suits with contempt, and despised money. To be swayed in the smallest degree by mercenary motives was despicable in his eyes.

[abmt

Essentially a stoic, he made self-control the ideal of his existence, and practised the courageous endurance of suffering so thoroughly that he could without hesitation inflict on his own body pain of the most horrible description. The power of surrendering life

with heroic calmness has been attained by men in all ages, and is regarded by philosophers as an elementary form of human virtue, practised with most success in an uncivilized state of society, before the finer appreciations of the imaginative and intellectual faculties have been developed by education. But the courage of the samurai cannot justly be ascribed to bluntness of moral sensibility resulting from semi-savage conditions of life. From the 8th century onwards the current of existence in Japan set with general steadiness in the direction of artistic reiinement and voluptuous luxury, amidst which men could scarcely fail to acquire habits and tastes inconsis-tent with acts of high courage and great endurance. The samurai's mood was not a product of semi-barbarism, but rather a protest against emasculating civilization. He schooled himself to regard death by his own hand as a normal eventuality. The story of other nations shows epochs when death was welcomed as a relief and deliberately invited as a refuge from the mere weariness of living. But wherever there has been liberty to choose, and leisure to employ, a painless mode of exit from the world, men have invariably selected it. The samurai, however, adopted in haraJcairi (disembowelment) a mode of suicide so painful and

so shocking that to school the mind to regard it with indiffer-ence and practise it without flinching was a feat not easy to conceive. Assistance was often rendered by a friend who stood ready to decapitate the victim immediately after the stomach had been gashed ; but there were innumerable examples of men who consummated the tragedy without aid, especially when the sacrifice of life was by way of protest against the excesses of a feudal chief or the crimes of a ruler, or when some motive for secrecy existed. It must be observed that the suicide of the samurai was never inspired by any doctrine like that of Hegesias. Death did not present itself to him as a legitimate means of escap-ing from the cares and disappointments of life. Self-destruction had only one consolatory aspect, that it was the soldier's privilege to expiate a crime with his own sword, not under the hand of the executioner. It rested with his feiidal chief to determine his guilt, and his peremptory duty was never to question the justice of an order to commit suicide, but to obey without murmur or protest. For the rest, the general motives for suicide were to escape falling into the hands of a victorious enemy, to remonstrate against some official abuse which no ordinary complaint could reach, or, by

means of a dying protest, to turn a liege lord from pursuing courses injurious to his reputation and his fortune. This last was the noblest and by no means the most infrequent reason for suicide. Scores of examples are recorded of men who, with everything to make existence desirable, deliberately laid down their lives at the prompting of loyalty. Thus the samurai rose to a remarkable height of moral nobility. He had no assurance that his death might not be wholly fruitless, as indeed it often proved. If the sacrifice achieved its purpose, if it turned a liege lord from evil courses, the samurai could hope that his memory would be honoured. But if the lord resented such a violent land conspicuous mode of reproving his excesses, then the faithful vassal's retribution would be an execrated memory and, perhaps, suffering for his family and relatives. Yet the deed was perpetrated again and again. It remains to be noted that the samurai entertained a high respect for the obligations of truth ; " A bushi has no second word," was one of his favourite mottoes. However, a reservation is necessary here. The samurai's doctrine was not truth for truth's sake, but truth for the sake of the spirit of uncompromising manliness on which he based all his code of

morality. A pledge or a promise must never be broken, but the duty of veracity did not override the interests or the welfare of others.

Something more, however, than a profound conception of duty was needed to nerve the samurai for sacrifices such as he seems to have been always ready to make. It is true that Religious Japanese parents of the military class took pains to Influence, familiarize their children of both sexes from very tender years with the idea of self-destruction at any time. The little boy was taught how the sword should be directed against his bosom ; the little girl, how the dagger must be held to pierce the throat ; and botli grew up in constant fellowship with the convic-tion that suicide must be reckoned among the natural incidents of everyday existence. But superadded to the force of education and the incentive of tradition there was a transcendental influence. Buddhism supplied it. The tenets of that creed divided them-selves, broadly speaking, into two doctrines, salvation by faith and salvation by works, and the chief exponent of the latter principle is the sect which prescribes " meditation " as the vehicle of enlightenment. Whatever be the mental processes induced by this

rite, those who have practised it insist that it leads finally to a state of " absorption " in which the mind is flooded by an illumination, revealing the universe in a new aspect, absolutely free from all traces of passion, interest, or affection, and showing, written across everything in flaming letters, the truth that for him who has found Buddha there is neither birth nor death, growth nor decay. Lifted high above his surroundings, he is prepared to meet every fate with indifference. The attainment of that state seems to have been a fact in the case both of the samurai of the military epoch, and of the Japanese soldier to-day, producing in the former readiness to look calmly in the face of any form of death, and in the latter a high type of patriotic courage.

In 1873, after the transfer of the administrative authority from the Shogun to the Emperor had been completely consummated, the conscription system was re-introduced by the new Government, f^^^'''''''

So far as concerned quality of material for organizing a national army, the samurai would have been unique. But since they were essentially an outgrowth of

military feudalism, the abolition of the latter involved the disappearance of the former as a distinct class. Many persons viewed this hazardous experiment with deep misgiving. They feared that it would not only alienate the samurai, but also entrust the duty of defending the country to men unfitted by tradition and custom for such a task, namely, the farmers, artisans, and tradespeople, who, after centuries of exclusion from the military pale, might be expected to have lost all martial spirit. The Government, however, did not suffer itself to be deterred by these apprehensions. It argued that since the distinction of samurai and commoner had not originally existed, and since the former was a product, not of natural selection, but of accidental conditions, there was no valid reason to doubt the military capacity of the people at large. The justice of this reasoning was put to a speedy test. For, some three years after the introduction of the new system, an army of conscripts had to take the field against the elite of the samurai, and the result showed that the peasant, the mechanic, and the tradesman

might safely be trusted to fight their country's battles.

At 20 years of age every subject, of whatever status, becomes liable for conscription. There exists an accurate system of registration which places the authorities in possession of full information about each unit of the population, and effectually prevents any successful attempts to evade conscription. Conscripts are selected by lot after medical examination. The minimum height for the infantry, cavalry, and army service corps is 6-2 feet ; that for the artillery and engineers, 5-4 feet. It rests with the Minister of War, under sanction of the Emperor, to determine what number of conscripts shall be taken each year.

There are four principal kinds of service, namely, service with the colours (genyeki), for three years ; service with the first reserves (yobi), for 4-J- years ; service with the second reserves (gobi), for 5 years ; and service with the territorial troops (koJctntilnJiei) up to the age of forty.

There are also two bodies of supernumeraries (Jwju).

The first consists of men who, though liable for conscription and medically qualified, have escaped the lot for

service with the colours. The second consists of those similarly liable and qualified, who have escaped not only the Ibt for service with the colours, but also the lot for service with the first supernumeraries. The period for the first supernumeraries is 7-^ years, and that for the second, 1-^ years, after which both pass into the territorial army. Their purpose is to fill vacancies in the troops with the colours, but in time of peace that liability devolves upon the first supernumeraries alone, and during the first year after conscription only. The full period of training for the first supernumeraries is 150 days, which may be divided according to convenience, but, in general, 90 days' training is given during the first yeai-. The aemtJ

second supernumeraries do not, in ordinary circum-stances, receive any training during the interval of 1^ years prior to their enrolment in the territorial army. As for the first reserves and the second reserves, each is

called out twice during its full term, the first reserves for three or four weeks at a time, the second reserves for two weeks approximately. After reaching the territorial army a man is relieved from all further training. The total number of youths eligible for conscription each year is 427,000, and 60,000 are taken for service with the colours, 131,300 being drafted into the supernumeraries. A recruit upon whom the lot falls for service with the colours may be discharged before the expiration of three years if his conduct and aptitude are exceptional. Hitherto this privilege has never been granted earlier than the close of the second year of service.

A youth is exempted from liability to conscription if it be clearly established that his absence from home would deprive his family of the means of subsistence.^ Eejection by medical examiners does not confer final immunity unless the cause is found to exist in two consecutive years.^ Men who have been convicted of crime are disqualified, but those who have been temporarily deprived of civil rights on account of some offence must

present themselves for conscription at the termination of their sentence. One of the chief exemptions is in connexion with education. Any youth attending the course of study at an officially recognized school or college of sufficiently high grade is exempted up to the age of 28, provided that in the meanwhile he volunteers for military training according to a system which will be presently explained. If he passes the age of 28 without volunteering, then he is taken for service with the colours, his chance of escaping by lot like an ordinary conscript being forfeited. After 28, if he has duly complied with the regulation as to volunteering, he passes into the territorial forces. Residence in a foreign country also secures exemption up to the age of 32 — provided that official permission to go abroad has been obtained. A man returning after the age of 32 is drafted into the territorial army, but if he returns before that age he must volunteer to receive training, otherwise he is taken without lot for service with the colours. The system of volunteering is largely resorted to by persons of the

better classes. Any youth who possesses certain edu-
cational qualifications, indicated by a diploma from an
officially recognized school or college, or determined by
passing a special examination, and who has not been
guilty of any offence against the law, is entitled to vol-
unteer for training. If accepted after medical inspec-
tion, he serves with the colours for one year, three
months of which time must be passed in barracks like a
common soldier — ^unless a special permit be granted by
the colonel commanding the battalion — but for the re-
maining nine months attendance at drills alone is re-
quired. A volunteer serving with the infantry pays 62
yen on .account of his clothing and equipments, and 38
yen on account of his food, and a cavalry volunteer has to
defray an additional charge of 76 yen for the mainte-
nance of a horse.^ At the conclusion of a year's training

1 This privilege led to great abuses originally. It became a common
thing to employ some aged and indigent person, set him up as the
head of a "branch iamily," and give him for adopted sou a youth
liable to conscription. The law is now framed so as to prevent all such

frauds.

2 This does not apply, of course, to permanent deformities.

8 These payments are not final. If they prove insufficient the vol-
unteer must be prepared to make good the deficiency. If they are
found to be excessive the surplus is returned. In the case of youths
who, though otherwise entitled to be volunteers, are in such straitened
circumstances that they cannot defray the whole of the prescribed
charges, the Government contributes a part.

the volunteer is drafted into the first reserve for 64- years
and then into the second reserve for 5 years, so that his
total period (12^ years) of service before passing into
the territorial army is the same as that of an ordinary
conscript. Graduates of duly accredited normal schools
and teachers in public elementary schools are exempted
from more than six weeks' service with the colours, after
which they pass at once into the territorial army, the
Government defraying their expenses during the period
of training. But if a teacher abandons that calling be-
fore the age of 28, he becomes liable, without lot, to two*
years with the colours, unless he adopts the alternative

of volunteering.

Officers are obtained in two ways. There are six local preparatory schools (yonen-gakko) in various parts of the empire, where lads of from 13 to 15 are „. received as cadets if they can show — either by certificate or examination — that they possess a certain degree of general education. ° After three years at one of these schools, a graduate passes to the central preparatory school (chuo-yonen-gakko) in Tokyo, where he spends twenty-one months. If he graduates with sufficient distinction at the latter institution he becomes eligible for admission to the officers' college (shikan-gakko) without further test of proficiency. The second method of obtaining officers is by competitive examination for admission to the officers' college. Graduates from officially recognized middle schools or higher educational institutions are only required to pass in mathematics and foreign languages, but all other candidates have to submit to a severe test. Each class of cadet, whether a graduate o'f the central preparatory school

or a direct candidate by competitive examination, is sent to serve with the colours for a year, or at least six months, before commencing, his course at the officers' college. During that time he is treated as a common soldier, except that his promotion to non-commissioned rank is rapid. The period of study at the officers' college is one year, and after graduating successfully the cadet is drafted for six months' service with the branch to which it is proposed that he shall be finally attached. At the end of that period his name is submitted to a council of staff officers who have watched his progress, and if they report favourably he receives a commission as a sub-lieutenant. Cadets for the scientific branches — engineers and artillery — are then sent to a special college where they receive a year's training, theoretical and practical.

There are three grades of privates, upper soldiers {joto-7iei), first-class soldiers (itto-sotsu), and second-class soldiers (nito-sotsu). A private on joining is a second-class soldier. Tor proficiency and good conduct a^"/^^"

he is raised to the rank of first-class soldier,

and ultimately to that of upper soldier. His pay, his

duties, and the number of stripes on his arm vary with

his grade. Non-commissioned officers are obtained from

the ranks, or from special candidates. Their grades are

corporal (gocho), sergeant (gunso), sergeant-major (socho),

and special sergeant-major (tokumv^socho). If a soldier

undertakes the duties of sergeant he must serve at least

four years with the colours. He may, if he pleases,

continue to serve in that capacity up to the age of 25, but

- *Conscription without lot is the punishment for all failures to com-*

ply with the military laws, or for anjr attempt to evade them by

malingering or by fraudulent representations.

5 Sons of officers' widows, or of officers in reduced circnmstances,

are educated at these schools either as free cadets or at half charges.

In the latter case the payments are 10 yen yearly for clothes and 3-25

j/en monthly for rations. In the case of the ordinary cadet the corre-

sponding payments are 30 yen and 6'50 yen respectively. If a free, or

half-free, cadet leaves school without graduating, he is required to pay

up the total sum that he would have defrayed as an ordinary cadet.

[aemt

a period of four years is compulsory. His service with the reserves is correspondingly reduced. Acceptance of the post of special sergeant-major entails the obligation of serving up to the age of 37, with the option of remaining until the age of 45. All the promotion in the non-commissioned ranks is by merit. Officers' ranks are the same as in the British army, but the nomenclature is much simpler. The terms, with their English equivalents, are shoi (second lieutenant), chiui (first lieutenant), tail (captain), shosa (major), cJiiusa (lieut.-colonel), taisa (colonel), shosho (major-general), chiujo (lieut.-general), taisJio (general), gensui (field-marshal).^ Promotion for officers in the junior grades is by seniority and merit. Two-thirds of the second lieutenants attain the rank of first lieutenant by seniority and one-third by merit. One-half of the first lieutenants are promoted to be captains by m erit and one-half by seniority. After the rank of captain

all promotion is by merit, and it results that many officers never rise higher than captain, in which case retirement is compulsory at the age of 48. It is necessary that a second lieutenant should have served at least two years before promotion to the rank of first lieutenant; the corresponding term for a first lieutenant being two years ; for a captain, four years ; for a major, three years ; for a lieutenant-colonel, two years; and for a major-general, three years. Above the rank of lieutenant-general promotion is not governed by any rule.

The pay of non-commissioned officers and privates is as follows : —

First-class Special Sergeant-Major

Second-class Special Sergeant-Ma]'

First-class Sergeant-Major

Second-class Sergeant-Major

First-olass Sergeant

Second-class Sergeant .

Pirst-class Corporal

Second-class Corporal .

Upper Soldier , .

Pirsl^class Private

Second-class Private

Per month.

Ten.

14-10

12-90

8-61

8-01

6-42

5-85

5-07

4-53

1-50

1-20

0-90

28

26

17

16

1

5

2i

12 Hi

11 lOJ

10 3

9 2

*3 0^*

2 5

1 10

Eations and uniforms are also furnished. The men are

paid weekly, and all have quarters within the barracks.

The officers' pay is as follows : —

6000

£600

4000

400

3150

315

2352

238

1752

175

1152

115

708

71

468

47

336

342

General .

Lieutenant-General

Major-General

Colonel .

Lieutenant-Colonel

Major

Captain .

First Lieutenant

Second Lieutenant

There is also a carefully graduated system of retiring allowances, for which officers andnon-commissioned officers become eligible after eleven years' full service with the colours. The figures, freed from confusing details, are these : —

General — retiring allowance

Lieutenant-General .

Major-General .

Colonel

Lieutenant-Colonel .

Major

Captain

First Lieutenant

Second Lieutenant .

Special Sergeant-Major

iThe same terms are applied to the ranks of oflBcers in the navv (with the exception of gensui), and thus all confusion about questions of relative rank is avoided.

2 The pay is not uniform in the case of captains and lieutenants, but further details are unnecessary. When an officer is not actually

serving, his pay is reduced by one-half approximately.

Yearly

£150 to £223

120 „.

175

105 „.

156

75 „.

112

60 „.

89

45 „.

67

30 „.

45

23 „.

34

18 „.

26

15 „.

The army consists of 12 divisions, numbered from 1 to 12, and a division of Guards, making 13 divisions in all. Each division is under the command of a lieutenant-general, and is permanently stationed ^oa*”’™’ in a certain district. It is organized as a complete fighting unit, its composition being 4 regiments of infantry, 1 regiment of cavalry, 1 regiment of field artillery, 1 battalion of engineers, and 1 battalion of army service. A regiment of infantry consists of 4 battalions, and a battalion consists of 3 companies. A regiment of cavalry consists of either 3 or 4 squadrons, each squadron being 100 sabres. A regiment of field artillery consists of 6 batteries, and a battery has 6 guns. A battalion of engineers consists of 3 companies, or 600 men, and a battalion of army service numbers 300 men. It will thus be seen that the composition of a division — with the exception of the Guards division, which is somewhat smaller — is, infantry, 9600 ; cavalry, 300 ; artillery, 36 guns ; engineers, 600 ; army service,

300. There are also 6 regiments of mountain artillery, or 216 guns in all. The total force of field artillery is 17 regiments, or 612 guns, and the total force of cavalry is 15 regiments, or about 6000 sabres. It is impossible to give absolutely accurate figures, as a certain reserve is exercised by the War Department. In addition to the above, the followiag divisions include extra corps, namely : —

The Guards division has a brigade (2 regiments) of cavalry, a brigade (3 regiments) of field artillery, and a battalion of railway engineers.

.The first division has a brigade (2 regiments) of cavalrj-, a brigade (3 regiments) of field artillery, and 1 regiment of garrison artillery for service in the Tokyo Bay forts.

The fourth division has 1 regiment of garrison artillery for the Yura forts.

The fifth division has 1 regiment of garrison artillery for the Kure forts, and 1 battalion of garrison artillery for the Geiyo forts.

The sixth division has 1 regiment of garrison artil-

lery for the Saseho forts, and 1 battalion of garrison artillery, together with 1 battalion of garrison infantry, for the Tsushima forts.

The seventh division has 1 battalion of garrison artillery for the Hakodate forts.

The tenth division has 1 battalion of garrison artillery for the Maizuru forts.

The twelfth division has 1 regiment of garrison artillery for the Shimonoseki forts.

When the scheme of army organization, adopted in 1896 after the war with China, is completed in 1906, the strength of the army on a peace footing will be 160,000 of all ranks, with 30,000 horses, and the strength on a war footing, 500,000 men, with 100,000 horses. It is impossible to state the exact strength, but a peace footing of 100,000 will be a very close approximation.

Recruits for the Guards are taken from every part of the empire, but those for a division are taken from its district, each divisional district being divided for recruiting purposes into four regimental districts, each of which

supplies recruits for a particular regiment. The garri-

soning of Formosa is effected by a mixed brigade ^fur-

nished by the divisions in turn.

TheEmperoristhe Commander-in-Chief of the army, and

theoretically the sole source of military authority, which

he exercises through a general staff and a war department,

with the assistance of a board of field-marshals (gensui fu).

^ The terra

army]

JAPAN

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The General Staff has for chief a field-marshal, and for vice-

chief a general or lieutenant-general. It includes five

offices for the transaction of ordinary business, as well as

a survey bureau, a trigonometrical section, a cartographic

section, and a topographic section, and the military college

is under its direction. The War Department is presided

over by a general ofS.cer whose name is borne on the active

list, and who is a member of the cabinet without being

necessarily affected by ministerial changes. A T6ky5

defence office, presided over by a lieutenant-general, super-
intends the defences of Tokyo Bay ; the same duty with
regard to the other fortifications throughout the empire
is entrusted to three major-generals, who have their head-
quarters in Yokohama, Shimonoseki, and Yura respect-
ively ; and the whole empire is divided into three military
districts, the eastern, the central, and the western, each
under the command of a general or lieutenant-general.
There are, further, an artillery committee and an engi-
neering committee, composed of experts from these two
branches of the service, who consider all questions relat-
ing to the manufacture of arms and ammunition, and
there is a remount office.
The medical service is exceptionally well organized. It received
unstinted praise from European and American experts who observed
it closely during the wars of 1894-95 and of 1900. The
Medical fixed establishment of surgeons to each division is
service. -jqq approximately, and arrangements complete in
every detail are made for affording relief to men in the fight-
ing line, for bandaging stations, for field hospitals, for standing

hospitals in the enemy's territory, and for special hospitals at home. Much assistance is rendered in this department of military affairs by the Red Cross Society of Japan, which has an income of two million yen annually, a fine hospital in T6ky6, a large staff of trained nurses of both sexes, and two hospital ships specially built and equipped for the transport of wounded men. During the early part of the campaign in Pechili in 1900 the French column entrusted its wounded to the care of the Japanese.

The staple article of commissariat for a Japanese army in the field is hoshii (dried rice), prepared by boiling rice and drying it in the sun or by artificial heat. Thus treated the rice Provisions, shrinks into a small compass, and three days' supply can easily be carried in a bag by the soldier. "When required for use the rice, being placed for a few moments in boiling water ^old water serves on emergency — swells to its original bulk, and is eaten with a relish of salted fish, dried sea-weed, or pickled plums. The task of provisioning an army on these lines is comparatively simple. The Japanese soldier, though low in stature, is well set up, muscular, and hardy. He has great powers of endurance, and one of his strong points is that he manoeuvres with

remarkable celerity, doing everything at the run, if necessary, and continuing to run without distress for a length of time astonishing to Occidental observers. He is much subject, however, to attacks of kakke (beri-beri), and if he has recourse to meat diet, which appears to be the best preventive, he will probably lose something of his capacity for prolonged rapid movement. He attacks with apparent indifference to danger, preserves his cheerfulness amid hardships, and has always shown himself thoroughly amenable to discipline.

There are several schools for the special education of ofBcers, non-commissioned officers, and military mechanics. The most important of these institutions is the Bikugun Daigakko,

Military qj. ^rmy College, where officers are prepared for ser-

scbools. ^jpg jjj ^jjg upper ranks and for staff appointments.

A first or second lieutenant is eligible for admission after two years' service with the colours, provided that he is recommended by his commanding officer and passes a written examination in subjects indicated by the chief of the General Staff thrbugh the War Department, the examination papers being sent to the headquarters of the division to which the officer belongs.

The course of study at the college extends over three years, and embraces scientific training of a high character.' An officer's future promotion depends largely on the record he establishes at this college and on the place he obtains in the final examination. The Toyama School — so called because it is situated in the Toyama suburb of T6kyd— stands next in importance to the Army College. The courses pursued there are in strategy and tactics, musketry, gymnastics, and fencing, and officers up to the rank of captain are admitted from the infantry, garrison artillery, or engineers, non-commissioned officers also being allowed to take the musketry course. The term of training is five months, and two batches of students graduate annually. For this school officers are selected by the commanders of the corps with which they are serving. Officers of the scientific branches are instructed at the Hokogakko (School of Artillery and Engineers), as already stated. While studying at any of these institutions an officer receives full pay, and all expenses connected with education or training are defrayed by the Government. There are, further, two special schools of gunnery — one for field artillery, the other for garrison artillery. The course at the Field Artillery School is for three months ;

admission is by recommendation of a commanding officer, and, as a general rule, first lieutenants and captains study there, though second lieutenants may be admitted on special recommendation. The Garrison Artillery School receives officers of similar rank belonging to that branch of the service, but it also receives sergeants and candidates for non-commissioned officers. The course for officers extends to four months, and the course for non-commissioned-officer candidates to eighteen months. The other educational institutions are — the Cavalry Practical School, the Army Service School, the Army Medical School, the Veterinary School, the Arsenal School, and the School of Military Music. Officers obtain admittance to these various schools by recommendation of divisional or regimental commanders, while in the Veterinary School and the Arsenal School common soldiers are trained to be farriers and armourers. There is an inspection department of military education, the inspector-general being an officer of the rank of lieut.-general, under whom are fifteen officers, ranking from lieut.-colonel to major-general, who act as inspectors not only of the various schools and colleges, but also of all educational matters connected with the different branches of the service.

The Japanese officer is one of the strongest features of the army. His pay is small according to European standards, but his mode of life is frugal. Quarters are not assigned to him in barracks. He lives ^^”’”^’”^■ outside, frequently with his own family, and when duty requires him to take his meals in barracks, food is brought to him in a luncheon-box. His uniform is plain and inexpensive,^ and he has no desire to exchange it for ” mufti,” as so many Occidental officers have. Being thus without mess expenses, contribution to a band, or luxuries of any kind, and nearly always without private means to supplement his pay, his habits are thoroughly economical, and a campaign involves comparatively few privations for him. He devotes himself absolutely to his profession, living for nothing else, and since he is strongly imbued with an effective conception of the honour of his cloth, instances of his incurring disgrace by debts or dissipation are exceptional. The samurai as a distinctive class were abolished simultaneously with the feudal system, but they may be said to have been revived again in the officers of

the modern army, who preserve and act up to all the old traditions. The system of promotion has evidently much to do with this good result, for no Japanese officer can hope to rise above the rank of captain unless, by showing himself really zealous and capable, he obtains from his commanding officer the recommendation without which all higher educational opportunities are closed to him. It might be supposed that under such a system favouritism would prevail more or less, but no scandal of that kind has come to public knowledge since the modern army was organized. Corruption also appears to be virtually absent. In the stormiest days of parliamentary warfare, when charges of dishonesty were freely preferred by party politicians against all departments of officialdom, no whisper ever impeached the integrity of army officers, and when the test of war has been applied, all the equipments of the service have been found complete and in good order. It is evident, indeed, that when an army of such magnitude is maintained at an annual outlay of 37,000,000 yen (£3,700,000), there cannot be very much opportunity for

peculation.

The time devoted daily to the training of a soldier is from four to six hours, and the courses are theoretical and practical. In the practical course the subjects are —

1 Uniform does not vary according to regiments or divisions. There is only one type for the whole of the Infantry, one for the cavalry, and so on.

marchiug, movements in the ranks, gymnastics (to which special attention is paid), musketry or gunnery, artisan-ship, swimming, riding, movements against obstacles, making and taking cover, and constructing temporary bridges. In the theoretical course the' subjects are — morality, distinctions of various arms of the service and their interactions, principles of tactical formation, duties of units of a body of troops, and duties in the field.

With regard to exercises in the field there is no fixed

limit of time. The captain of a company, using his own discretion, takes his men out for half a day, or a whole day, or for two or three days together, as often as he deems expedient. Generally these exercises in the case of a company take place twice a month, after the men have been a few months with the colours. A similar system holds with regard to field exercises for a battalion, a regiment, a brigade, or a division. The officer in command chooses the occasions and regulates the time. Every autumn manoeuvres are organized on a large scale, two or more divisions taking part, and every second year there are special manoeuvres for cavalry, artillery (field and garrison), and engineers. Rifle and gun practice is of three kinds — instruction practice, fighting practice, and test practice. The number of rounds of ball cartridge fired by the infantry soldier during the first year is 205, and the number during the second and third years, 185 rounds. The artillery fires 130 rounds per gun annually. There is no fixed rule as to the number of rounds fired at each

practice ; it varies according to the capacity shown by the individual soldier.

The articles carried by an infantry soldier in the field weigh altogether 43^ lb (exclusive of the clothes he is actually wearing) — namely, arms, water-bottle, and accoutrements, 22-|- lb ; knapsack and contents, 20f lb. The weight of a cavalry trooper's arms, &c., stands thus — carbine and ammunition, 10|- lb ; sword, 3^ lb ; clothes, 14^ lb ; saddle and equipments, &c., 74 lb ; the total being 7-|- stone approximately. As the average weight of the trooper himself is 10 stone, the weight carried by the horse is 17^ stone. The infantry soldier carries a repeating rifle of Japanese design Arms. ^|.j^g Arisaka pattern), and the field and horse artillery have two patterns of guns, field and mountain, each having the same calibre (7-5 cm., 2-955 inches), and each firing the same ammunition, of which the com-mon shell weighs 4-28 kilo. (9-435 ft). The field gun itself weighs 298 kilo, (nearly 6 cwt.), and the mountain gun, 103^ kilo. (228 ft) ; but these are being changed for

a weapon designed by Colonel Arisaka. An arsenal in Tokyo, another in Osaka, and a third in Taipeh Maautac- (Formosa) are intended to supply arms and arms,&c. ammunition, but they have not hitherto been able fully to meet the requirements of the service.

One difficulty has been that metal for dockyard and arsenal purposes has to be imported. An irou-foundry constructed at Wakamatsu in Kiushiu, however, will remedy this defect. Small arms are manufactured suc-cessfully and in sufficient quantities.

Originally the Government engaged^ French officers to assist in organizing the army and elaborating its system of tactics and strategy, and during several years a misnion militaire,. composed of competent experts, resided in Tokyo and rendered valuable aid to the Japanese. After-wards German officers were employed, but ultimately the services of foreigners were dispensed with altogether, and Japan now adopts the plan of sending picked men to complete their studies in Europe. She has followed her usual eclectic course in this matter, not modelling herself

on any one foreign system, but choosing from each what-
ever seemed most desirable. (f. by.)

IV. Japanese Akt.

Since the article by Sir Eutherf ord Alcock in the ninth
edition of this work, a great amount of historical, techni-
cal, and critical information has been brought to light,
and the art-workers of New Japan have been by no
means idle. It is now known that Japan can show a
long and sustained history of artistic culture of which
any nation might be proud. Absorbing Chinese civilizar
tion, when that was perhaps the worthiest and most com-
plete in the world, Japan gave a royal welcome to all
that her great neighbour could offer. Chinese
*religion, literature, art, and science were as "m*t^JL-*
*swiftly assimilated in the 7th and 8th centu- an^*
ries of our era as European science and mili-
tarism in the latter part of the 19th century. In. the
middle of the 7th century even the Government was
entirely remodelled on the Chinese bureaucratic plan, and
a department of art was not forgotten. The emperors,

then and for over 300 years later, devoted their energies to the cultivation of poetry, painting, sculpture, music, and many another art of refinement, leaving the cares of government in the hands of ambitious vassals. China was the fountain-head of all their knowledge and accomplishments, and nearly all that was not Chinese was regarded as barbaric and effete. Japanese art based on Chinese models attained a level during this era that it has scarcely since surpassed and, in some respects, has failed to equal. In following but its development it will be convenient to outline first the history of pictorial art, to which all other branches owe their most striking features.

Pictorial Art.

The development of Japanese painting may be divided into six periods, each signalized by a wave of progress. First Period. — From the middle of the 6th century to the middle of the 9th century : the naturalization of Chinese and Chino-Buddhist art. Second Period. — Prom the middle of the 9th century to the middle of the loth century : the establishment of great native schools under

Kose no Kanaoka and his descendants and followers, the pure Chinese school gradually falling into neglect. Tliird Period. — From the middle of the 15th century to the latter part of the 17th century: the revival of the Chinese style. Fourth Period. — From the latter part of the 17th to the latter part of the 18th century: the establishment of a popular school. Fifth Period. — From the latter part of the 18th to the latter part of the r9th century : the foundation of a naturalistic school, and the first introduction of European influence into Japanese painting; the acme and decline of the popular school. Sixth Period. — From about 1875 to the present time: a period of transition.

First Per/of?.— Tradition refers to the advent of a Chinese artist named Nanriu, invited to Japan in the 5th century as a painter of the imperial banners, but of the labours and influence of this man and of his descendants we have no record. The real beginnings of the study of painting and sculpture in their higher branches must be dated from the introduction of Buddhism from China in

the middle of the 6th century, and for three centuries after this event there is evidence that the practice of the arts was carried on mainly by or under the instruction of Korean and Chinese immigrants. The paintings of which we have any mention were almost limited to representations of Buddhist motives executed in the style of the Chinese masters of the T'ang dynasty (a.d.' 618-905), notably Wu Tao-tsz' (8th century), of whose genius romantic stories are related. The oldest existing work of this period is a mural decoration in the hair of the art]

temple of Horiuji, Nara, attributed to a Korean priest named DonchS, who lived in Japan in the 6th century ; and this painting, in spite of the destructive effects of time and exposure, shows traces of the same power of line, colour, and composition that st3,mps the best of the later examples of Buddhist art.

Second Period. — The native artist who crested the first

great wave of Japanese painting was a court noble named Kos6 no Kanaoka, living under the patronage of the Emperor Seiwa (850-69) and his successors down to about the end of the 9th century, in the midst of a long tprm of peace and culture. Of his own work few, if any, examples have reached us ; and those attributed with more or less probability to his hand are all representations of Buddhist divinities, showing a somewhat formal and conventional design, with a masterly caligraphic touch and perfect harmony of colouring. Tradition credits him with an especial genius for the delineation of animals and land-scape, and commemorates his skill by a curious anecdote of a painted horse which left its frame to ravage the fields, and was reduced to pictorial stability only by the sacrifice of its eyes. He left a line of descendants extend-ing far into the 15th century, all famous for Buddhist pictures, and some engaged in establishing a native style, the " Wargwa riu."

At the end of the 9th century there were two exotic styles of paintjng, the Chinese and the Buddhist, and

the beginning of a native style founded upon these.

All three were practised by the same artists, and it was

not until a later period that such became the badge of

a school.

The Chinese style (Kara riu), the fundamental essence

of all Japanese art, had afairly distinct history, dating back

to the introduction of Buddhism into China

S-fcf' (^•°- ^2)' ^^^ ^* ^^ ^^^'^ *^° ^^^^ ®^ chiefly*

from the works of Wu Tao-tsz', the master of

the 8th century, that Kanaoka drew his inspiration. This

early Chinese manner, which lasted without sign of

failure in the parent country down to the end of the 13th

century, was characterized by a virile grace of line, a

grave dignity of composition, striking simplicity of

technique, and a strong but incomplete naturalistic ideal.

The colouring, harmonious but subdued in tone, held

a place altogether secondary to that of the outline,' and

was frequently omitted altogether, even in the most

famous works. Shadows and reflexions were ignored, and

perspective, approximately correct for landscape distances,

was isometrical for near objects, while the introduction of a symbolic sun or moon lent the sole distinction between a day and a night scene. The art was one of imperfect evolution, but for thirteen centuries it was the only living pictorial art in the world, and the Chinese deserve the honour of having created landscape painting. The materials used were water colours, brushes, usually of deer-hair, and a surface of unsized paper, translucent silk, or wooden panel. Its chief motives were landscapes of a peculiarly wild and romantic type, animal life, trees and flowers, and figure compositions drawn from Chinese and Buddhist history and Taoist legend ; and these, together with the grand aims and strange shortcomings of its principles and the limited range of its methods, were adopted almost without change by Japan. It was a noble art, but unfortunately the rivalry of the Buddhist and later native styles permitted it to fall into comparative neglect, and it was left for a few of the faithful, the most famous of whom was a priest of the 14th century named Kawo, to preserve it from inanition till the great Chinese

” renaissance ” that lent its stamp to the next period.

The reputed founder of Japanese caricature may also be added to this list. He was a priest named Kakuyu, but better known as the Abbot of Toba, who lived in the 12th century. An accomplished artist in the Chinese manner, he amused himself and his friends by burlesque sketches, marked by a grace and humour that his imitators never equalled. Later, the motive of the ” Toba pictures,” as such caricatures were called, tended to degenerate, and the elegant figures of Kakuyu were replaced by scrawls that often substituted indecency and ugliuess for art and wit. Some of the old masters of the Yamato school were, however, admirable in their rendering of the burlesque, and in modern times Kiosai, the last of the Hokusai school, outdid all his predecessors in the riotous originality of his weird and comic fancies. A new phase of the art now lives in the pages of the Manirmaru Chimbun, the Tokyo Punch.

The Buddhist style was probably even more ancient than the last, for the scheme of colouring distinctive of

the Buddhist picture was almost certainly of Indian origin; brilliant and decorative, and f^/^*'' heightened by a lavish use of gold, it was an essential to the effect of a picture destined for the dim light of the Buddhist temple. The style was applied only to the representations of sacred personages and scenes, and as the traditional forms and attributes of the Brahmanic and Buddhist divinities were mutable only within narrow limits, the subjects seldom afforded scope for originality' of design or observation of nature. The principal Buddhist painters down to the 14th century were members of the Kose, Takuma, and Kasuga lines, the first descended from Kanaoka, the second from Takuma Tameuji (ending 10th century), and the third from Fujiwara no Motomitsu (11th century). The last and greatest master of the school was a priest named Meicho, better known as Ch6 Densu, the Japanese !Fra Angelico. It is to him Japan owes the possession of some of the most stately and most original works in Japanese art, sublime in conception, line, and colour,*

and deeply instinct with the religious spirit. He died in 1427, at the age of 76, in the seclusion of the temple where he had passed the whole of his days.

The native style, Yamato or Wargwa riu, was an adaptation of Chinese art canons to motives drawn from the Court life, poetry, and stories of old Japan. It was undoubtedly practised by the Kose line, and perhaps by their predecessors, but it did not take shape as a school until the beginning of the 11th century under Fujiwara no Motomitsu, who was a pupil of Kose no Kinmochi ; it then became known as " Yamato riu," a title which two centuries later was changed to that of " Tosa," on the occasion of one of its masters, Fujiwara no Tsunetaka, assuming that appellation as a family name. The Yamato-Tosa artists painted in all styles, but that which was the speciality of the school, to be found in nearly all the historical rolls bequeathed to us by their leaders, was a lightly touched outline filled in with flat and bright body colours, in which a verdigris green played a great

part. The originality of the motive did not prevent the adoption of all the Chinese conventionalities, and of some new ones of the artist's own. The curious expedient of spiriting away the roof of any building of which the artist wished to show the iaterior was one of the most remarkable of those. Amongst the foremost names of the school are these of Motomitsu (11th century), Nobuzane (13th century), Tsunetaka (13th century), Mitsunobn (15th and 16th centuries), his son, Mitsushige, and Mitsu-oki (17th century). The long struggle between the Taira and Minamoto clans for the power that had long been practically abandoned by the Imperial line lasted through the 11th and the greater part of the 12th centuries, ending only with the rise of Generalissimo Yoritomo to supreme power in 1186. These internecine disturbances had been

Native

style.

unfavourable to any new departure in art, except those appertaining to arms and armour, and the strife between two puppet emperors for a shadow of authority in the 14th century brought another distracting element. It was not until the peace following the triumph of the northern dynasty was achieved through the prowess of an interested champion of the Ashikaga clan that the

culture of ancient Japan • revived. The palace of the Ashikaga Shoguns then replaced the Imperial Court as the centre of "patronage of art and literature, and established a new era in art history.

Tliird Period. — It .was towards the close of the Ashikaga Shogunate that painting entered a new phase. Talented rej)resentatives of the Kose,"Takuma, and Tosa lines maintained the reputation of the native and Buddhist schools, and the long-neglected Chinese school was destined to undergo a vigorous revival. The initiation of the new movement is attributed to a priest named J6setsu, who lived in the early part of the 15th century, and of whom little else is known. It is not even certain whether he was of Chinese or Japanese birth; he is, however, believed by some authorities to have been the teacher of three great artists — Shiubun, Sesshiu, and Kano Masanobu — who became the leaders of three schools : Shiubun, that of the pure Chinese art of the Sung and Yuen dynasties (10th and 13th centuries) '; Sesshiu, that of a modified school bearing his name; and Masanobu,

of the great Kano school, which has reached to the present day. The qualities of the new Chinese schools were essentially those of the older dynasties : breadth, simplicity, a daringly caligraphic play of brush that strongly recalled the accomplishment of the famous scribes, and a colouring that varied between sparing washes of flat local tints and a strength and brilliancy of decorative effort that rivalled even that of the Buddhist pictures. The motives remained almost identical with those of the Chinese masters, and so imbued with the foreign spirit were many of the Japanese disciples, that it is said they found it difficult to avoid introducing Chinese accessories even into pictures of native scenery. Sesshiu (1421-1507) was a priest who, after passing his meridian, visited China and studied painting there for several years, at length returning in 1469, disappointed with the living Chinese artists, and resolved to strike out a style of his own, based upon that of the old masters. He was the boldest and most original of Japanese landscape artists, leaving powerful and poetic records of the

scenery of his own land as well as that of China, and trusting more to the sure and sweeping stroke of the brush than to colour. Shiubun was an artist of little less power, but he followed more closely his exemplars, the Chinese masters of the 12th and 13th centuries ; while Kano Masanobu (1424—1520), trained in the love of Chinese art, departed little from the canons he had learned from J6setsu or Oguri S6tan. It was left to his more famous son, Motonobu, to establish the school which bears the family name. Kano Motonobu (1477-1559) is esteemed one of the greatest of Japanese painters, an eclectic of genius, who excelled in every style and every branch of his art. His variety was inexhaustible, and he remains to this day a model whom the most distinguished artists are proud to imitate. The names of the celebrated members of this long line are too many to quote here, but the most accomplished of his descendants was Tanyu, who died in 1674, at the age of seventy-three. The close of this long period brought a new style of art, that of the Korin

school. Ogata Korin (1663-1710) is claimed by both the Tosa and Kano schools, but his work bears more resemblance to that of an erratic offshoot of the Kano line named Sotatsu than to the typical work of the academies. He was an artist of eccentric originality, who achieved wonders in bold decorative effects in spite of a studied contempt for detail. It is difficult to know whether he was more genius or charlatan, for he was a sort of Cagliostro in art. As a lacquer painter, however, he left a strong mark upon the work pf his. contemporaries and successors. His brother and pupil, Kenzan, adopted his style, and left a reputation as a decorator of pottery hardly less brilliant than Korin's in that of lacquer; and a later follower, Hoitsu (1762-1828), greatly excelled the master in delicacy and refinement, although inferior to him in vigour and invention.

Down to the end of this era painting was entirely in the hands of a patrician caste — courtiers, priests, feudal nobles and their military retainers, all men of high education, gentle birth, living in a polished circle. It

was practised more as a phase of aesthetic culture than with any utilitarian views. It was a labour of love or loving service, untouched by the spirit of material gain, conferring, in its result, upon the work of the older masters a dignity and poetic feeling which we vainly seek in much of the later work. Unhappily, but ^almost inevitably, over-culture led to a gradual falling-off from the old virility. The strength of Meicho, Sesshiu^ Moto-nobu, and Tanyu gave place to a more or less slavish imitation of the old Japanese painters, and their Chinese exemplars, till the heirs to the splendid traditions of the great masters of the past preserved little more than their conventions and shortcomings. It was time for a new departure, but there seemed to be no sufficient strength left within the charmed circle of the orthodox schools, and the new movement was fated to come from the masses, whose voice had hitherto been silent in the art world.

Fourth Period. — A new era in art began in the latter half of the 17th century with the establishment of a

popular school under an embroiderer's draughts-
man named Hishigawa Moronobu {circa 1646- ^h"'V
1713). Perhaps no great change is ever entirely
a novelty. The old painters of the Yamato-Tosa line had
frequently shown something of the daily life around them,
and one of the later scions of the school, named Iwasa
Matahei, had even made a speciality of this class of
motive ; but so little is known of Matahei and his work,
that even his period is a matter of dispute, and the few
pictures attributed to his pencil are open to question on
grounds of authenticity. He probably worked some two
generations before the time of Moronobu, but there is no
reason to believe that his labours had any material share
in determining the creation and trend of the new school.
Moronobu was a consummate artist, with all the delicacy
and caligraphic force of the best of the Tosa masters,
whom he undoubtedly strove to emulate in style ; and his
pictures are not only the most beautiful but the most
trustworthy records of the life of his time. It was not
to his paintings, however, that he owed his greatest

influence, but to the powerful impulse he gave to the illustration of books and broadsides by wood-engravings. It is true that illustrated books were known as early as 1608, if not before, but they were few and unattractive, and did little to inaugurate the great stream of Ehon, or picture books, that were to take so large a share in the education of his own class. It is to him, and to him only, that Japan owes the first development and popularization of artistic wood-engraving, for there was nothing before his series of xylographic albums that approached his best work in strength and beauty, and nothing since that has surpassed it. Later there came abundant aid to the good cause of popular art, partly from pupils of the Kano and Tosa schools, but mainly from the artisan class. Most of these artists were designers for books and broadsides by calling.

Carp in Stream. By Moef-yama Okio, 1782 (Shijo School).

(On- silk in colcmrs.)

The Thousand Oaki>. By In-acaki.

(From a picture on silk painted in vKninclimiic.)

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painters only on occasion, but a few of them did nothing for the engravers. The story of these men will be told elsewhere — ^how engraviag in black and white and in colours prospered in their hands down to the present day. Throughout the whole of this period, embracing about a hundred years, there still continued to work, altogether apart from the men who were making the success of popular art, a large number of able painters of the Kano, Tosa, and Chinese schools, who multiplied pictures that had every merit except that of originality. These men, living in the past, paid little attention to the great popular movement, which seemed to be quite outside their social and artistic sphere and scarcely worthy of cultured criticism. It was in the middle of the 18th century that the decorative, but relatively feeble, Chinese art of the later Ming period found favour in Japan and a clever exponent in a painter named EiurikiS. It must be regarded

as a sad decadence from the old Chinese ideals, which was further hastened, from about 1765, by the popularity of the southern Chinese style. ^This was a weak affecta-tion that found its chief votaries amongst literary men ambitious of an easily-earned artistic reputation. The principal Japanese supporter of this school was TaigadS (1722-1775), but the volume of copies of his sketches, Taigadd sansui jusiki, published about 1870, is one of the least attractive albums ever printed in Japan.

The fifth period was introduced by a movement as momentous as that which stamped its predecessor — the foundation of a naturalistic school under a group Natural- of men outside the orthodox academical circles. ‘school. ‘^^^ naturalistic principle was by no means a new one ; some of the old Chinese masters were naturalistic in a broad and noble manner, and their Japanese followers could be admirably and minutely accurate when they pleased, but too many of the latter were content to construct their pictures out of fragmentary reminiscences of ancient Chinese masterpieces, not pre-

suming to see a rock, a tree, an ox, or a human figure, except through Chinese spectacles. It was a farmer's son named Okio, trained in his youth to paint in the Chinese manner, who was first bold enough to adopt as a canon what his predecessors had only admitted under rare exceptions, the principle of an exact imitation of nature. Unfortunately, even he had not all the courage of his creed, and while he would paint a bird or a fish with perfect realism, he no more dared to trust his eyes in larger motives than did the most devout follower of Shitibun or Motonobu. He was essentially a painter of the classical schools, with the speciality of elaborate reproduction of detail in certain sections of animal life, but fortunately this partial concession to truth, em-phasized as it was by a rare sense of beauty, did large service. Okio rose into notice about 1775, and a number of pupils flocked to his atelier in Shijo Street, Ky5t6 (whence the name " Shij6 school"). Amongst these the most famous were Goshun (1742-1811), who is sometimes regarded as one of the founders of the school; Sosen

(1757-1821), an animal painter of remarkable power, but especially celebrated for pictures of monkey life ; Shiuho, the younger brother of the last, also an animal painter ; Kosetsu (1756-1799), the best landscape painter of, his school ; Keibun, a younger brother of Goshun, and some later followers of scarcely less fame, notably Hoyen, a pupil of Keibun ; Tessan, an adopted son of Sosen ; Ipp6 and Y5sai (1788-1878), well known for a remarkable set of volumes, the Zenken Kojitsu, containing a long series of portraits of ancient Japanese celebrities. Ozui and Ojiu, the sons of Okio, painted in the style of their father, but failed to attain great eminence. Lastly, amongst the associates of the Shijo master was the celebrated Ganku (1798-1837), who developed a special style of his own, and is sometimes regarded as the founder of a distinct school. He was, however, greatly influenced by Okio's example, and his sons, Gantai, Ganrio, and Gantoku or Eerizan, drifted into a manner almost indistinguishable from that of the Shijo school.

It remains only to allude to the European school,

if school it can be called, founded by Kokan and Denkiehi, two contemporaries of Okio. These artists, at first educated in one of the native scbmi^ schools, obtained from a Hollander in Nagasaki ‘ some training in the methods and principles of European painting, and left a few oil paintings in which the laws of light and shade and perspective were correctly observed. They were not, however, artists of sufiicient capacity to render the adopted manner more than a subject of curiosity, except to a few followers who have reached down to the present generation. It is possible that the essays in perspective found in the pictures of Hokusai, Hiroshig^, and some of the popular artists of the 19th century, were suggested by the Kokan’s drawings and writings.

The siooth period began about 1875, when an Italian artist was engaged by the Government as a professor of painting in the Engineering College at TokyS. Since that time some distinguished European artists have visited Japan, and several Japanese students have made a pilgrim-

age to Europe to see for themselves what lessons may be gained from Western art, but it is a noteworthy fact that the pictures painted in the foreign style have as yet found little patronage either from native connoisseurs or foreign admirers of Japanese art. The Government, however, has instituted a department of art, and has done invaluable service in protecting the priceless treasures still lying in the temples of Japan. The Emperor extends his personal patronage to living artists who display special ability. Fine-art schools in T6kyo and Kyoto are well organized and conducted by talented native professors, and a Society of Oil Painters, Hakuha Kuwai, is doing good work. Art exhibitions are held at frequent intervals, and show that the old power both of painting and sculpture is still alive. Two good art magazines, with admirable repro-ductions of ancient and modern works, are now in course of publication, and two volumes of a large and important collection of copies by photographic and other processes of old masterpieces, edited by some of the leading connoisseurs of the country, appeared in 1901. The

future of Japanese art is still " on the knees of the gods," but the art of the past has never found a higher apprecia^ tion than at present. The time has not yet come for the almost inevitable revolution, but the change awaits only the man, and it is to be devoutly hoped that when it is accomplished it will preserve all that we most admire in the splendid but incomplete art of the old masters.

(w. An.)

Glyptic and Applied Art.

Histprical Sketch. — The principal forms of modem glyptic art have been referred to in the earlier article, but more recent historical research has shown that sculpture in wood and metal is of ancient date in Japan, and claims a prominent position in the history of the world's art. Its antiquity is not, indeed, comparable to that of ancient Egypt or Greece, but no country in the world besides Japan can boast a living and highly-developed art that has numbered upwards of twelve hundred years of unbroken and brilliant productiveness. Setting aside prehistoric and rudimentary essays in stone and metal, which have their

special interest for the antiquary, we have examples of sculpture in wood and metal, magnificent in conception and technique, dating from the earliest periods of what

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we may term historical Japan, that is, from near the beginning of the great Buddhist propaganda under the Emperor Kimmei (a.d. 540 to 671) and the princely hierarch, Shotokn Taishi (573 to 621). It may be here mentioned that stone has never been in favour in Ja'pan as a material for the higher expression of the sculptor's art.

The first historical period of glyptic art in Japan reaches from the end of the 6th to the end of the 12th century, culminating in the work of the great Nara sculptors, Unkei and his pupil Kwaikei. Happily, there are still preserved in the great temples of Japan, chiefly in the ancient capital ■of Nara, many noble relics of these six hundred years, but ■only a few of the number need be noticed here. The place

of honour in the selection may perhaps be conferred upon sculptures in wood, representing the Indian Buddhists, Asangha and Vasabandhu, preserved in the Golden Hall of Kofukuji, Nara. These are attributed to a Kamakura sculptor of the 8th or 9th century, and in simple and realistic dignity of pose and grand lines of composition are not unworthy of comparison with some of the works of ancient Greece. With these may be named the vigorous demon lantern-bearers, so perfect in the grotesque treatment of the diabolical heads and the accurate anatomical forms of the sturdy body and limbs ; the colossal Temple Guardians of the great gate of TQdaiji, by Unkei and Kwaikei (11th century), somewhat conventionalized, but still bearing evidence of direct study from nature, and inspired with intense energy of action ; and the smaller but more accurately modelled Temple Guardians in the Saikondo, Nara, which almost compare with the " Fighting Gladiator " in their realization of menacing strength. The " Goddess of Art " of Akishino-dera, ISTara, attributed to the 8th century, may be named as the most

graceful and least conventional of the female sculptures in Japan, but iniinitely remote from the feminine conception of the Greeks. The wooden portrait of Vimalakirtti, attributed to Unkei, at Kofukuji, Nara, has some of the qualities of the images of the two Indian Buddhists. The sculptures attributed to- J6cho, the founder of the Nara school, although powerful in pose and masterly in execu-tion, lack the truth of observation seen in some of the earlier and later masterpieces.

The most perfect of the ancient bronzes is the great image of Bhaichadjyaguru in the temple of Yakushiji, Nara, attributed to a Korean monk of the 7th century, named Giogi. The bronze image of the same divinity at Horiuji, said to have been cast at the beginning of the 7th century by Tori Busshi, the grandson of a Chinese immigrant, is of good technical quality, but much inferior in design to the former. The colossal Nara Daibutsu (Vairotchana) at TQdaiji, cast in 749 by a workman of Korean descent, is the largest of the great bronzes in Japan, but ranks far below the Yakushiji image in artistic quali-

ties. The present head, however, is a later substitute for the original, which was destroyed by fire.

The great Nara school of sculpture in wood was founded in the early part of the 11th century by a sculptor of Imperial descent named J5ch6, who is said to have modelled his style upon that of the Chinese wood-carvers of the T'ang dynasty, and his traditions were maintained by his descendants and followers down to the beginning of the 13th century. It is to be noticed that all the artists of this period were men of aristocratic rank and origin, and were held distinct from the carpenter architects of the imposing temples which were to contain their works.

Sacred images were not the only specimens of glyptic art produced in these six centuries; reliquaries, bells, vases, incense-burners, candlesticks, lanterns, decorated arms and armour, and many other objects, showing no less mastery of design and execution, have reached us. Gold and silver had been applied to the adornment of helmets and breast-plates from the 7th century, but it was in the 12th century that the decoration reached the high degree of elaboration

shown us in the armour of the Japanese Bayard, Yoshitsune, which is still preserved at Kasuga, Nara.

Wooden raasks employed in the ancient theatrical per-formances were made from the 7th century, and offer a distinct and often grotesque phase of wood-carving. We do not know by what class of sculptors these were executed, but their designs have beencaref ully preserved and imitated down to the present day.

The second period in Japanese glyptic art extends from the beginning of the 13th to the early part of the 17th century. The great struggle between the Taira and Minamoto clans had ended, but the militant spirit was still strong, and brought work for the artists who made and ornamented arms and armour. The MiQchins, a line that claimed ancestry from the 7th century a.d., were at the head of their calling, and their work in iron breastplates and helmets, chiefly in repousse, is still unrivalled. It was not until the latter half of the 15th century that there came into vogue the elabo-rate decoration of the sword, .a fashion that was to

last four hundred years. The metal guard (tsuba), made of iron or precious alloy, was adorned with engraved designs, often inlaid with gold and silver. The free end of the hilt was crowned with a metallic cap or pommel (kasJiira), the other extremity next the tsuba was embraced by an oval ring (fuchi), and in the middle was affixed on each side a special ornament called the minuki, all adapted in material and workmanship to harmonize with the guard. The kodzuka or handle of a little knife implanted into the sheath of the short sword or dagger was also of metal and engraved with like care. The founder of the first great line of ts^iba and minuki artists was Goto Yujo (1440-1512), a friend of the painter Kano Motonobu, whose designs he adopted. Many families of sword artists sprang up at a later period, the Nara, Hirata, Hamano, Omori, and Umetada lines furnishing treasures for the collector even down to the present day, and their labours reached a level of technical mastery and refined artistic judgment almost without parallel in the art industries of Europe. The

men by whom these beautiful works were executed, like the makers of the blade, were members of the military caste. Buddhist sculpture was by no means neglected during this period, but there are few works that call for special notice. The most noteworthy effort was the casting by Ono Goroyemon in 1252 of the well-known bronze image, the Kamakura " Daibutsu."

The third period includes the 17th, I8th, and the greater part of the 19th centuries. It was the era of the artisan artist. The makers of Buddhist images and of sword ornaments carried on their work with undiminished industry and success, and some famous schools of the latter, notably the Nara, Hirata, Hamano, and Omori lines, arose during thisperiod. The Buddhist sculptors, however, tended to grow more conventional and the metal-workers more naturalistic as the 18th century began to wane. It was in connexion with architecture that the great artisan movement began. The initiator was Hidari Jingoro (1594-1652), at first a simple carpenter, afterwards one of the most famous sculptors in a land of great artists. The

gorgeous decoration of the mausoleum of ly^yasu at Nikko, and of the gateway of the N ishi Hong wan j i temple at Kyoto, are the most striking instances of his handiwork or direction. The pillars, architraves, ceilings, panels, and almost every available part of the structure, are covered with arabesques and sculptured figures of dragons, lions, tigers, birds, flowers, and even pictorial compositions with landscape and figures, deeply carved in solid or open work — the wood

sometimes jjlain, sometime^ overlaid -witli pigment and gilding, as in the panelled ceiling of the chapel of ^y^ya^su m T6ky6. The designs for these decorations, like those of the sword ornaments, were adopted from the masters of the great schools of painting, but the invention of the sculptor was by no means idle. It was from this time that the temple carvers, although still at-tached to the carpenters' guild, took a place apart from the rest of their craft, and the genius of Hidari Jingoro

secured for one important section of the artisan world a recognition like that which Hishigawa Moronobu, the painter and book illustrator, a few generations afterwards won for another.

A little later arose another art industry, also emanating from the masses. The use of tobacco, which became prevalent in the 17th century, necessitated the pouch. In order to suspend this from the girdle there was employed a kind of button or toggle— the rdtsuU. The metallic bowl and mouthpiece of the pipe offered a tempting surface for embellishment, as well as the clasp of the pouch ; and the ndtsuM, being made of wood, ivory, or other material susceptible of carving, also gave occasion for art and ingenuity. The rdtsuM, indeed, was not entirely new, for it had been employed as a pendant to the inro, or medicine-box, from the time of Ashikaga Yoshimasa (1444-1473), but it had not come into general use. The carver, a clever artisan, did not feel bound to follow traditional models as the temple sculptors did, but, light-hearted fellow as he was, he liked to produce comic and

cheery images, or simple objects that daily familiarity had endeared to him ; and when he took up classical or religious themes he treated them in his own manner, never fearing to sacrifice dignity to humour. The engravers of pipes, pouch clasps, and the metallic discs (kagamirbutd) attached to certain n&tsukis, sprang from the same class, and were little more serious and not less original. They worked, too, with a skill little inferior to that of the Gotos, Naras, and other aristocratic sculptors of sword ornaments, and often with a refinement which their relative disadvantages in education and associations render especially remarkable. The nitsuM and the pipe, with all that pertained to it, were for the commoners what the sword hilt and guard were for the gentry. Neither class cared to bestow jewels upon their persons, but neither spared' thought or expense in the embellishment of the object they most loved. The most honoured names amongst nitsukS-cavYexs are those of Shiuzan and Deme-Uman.

The final manifestation of popular glyptic art was the

okimono, an ornament pure and simple, or one in which utility was altogether secondary in intention to decorative effect. The manufacture as a special branch of art work dates from the rise of the naturalistic school of painting and the great expansion of the popular school under the Katsugawas, but the okimono was not altogether a modern innovation, for it formed an occasional amusement of the older glyptic artists from remote times. Some of the most exquisite and most ingenious of these earlier pro-ductions, such as the magnificent iron eagle in the South Kensington Museum, the wonderful articulated models of crayfish, dragons, serpents, birds, that are found in many European collections, came from the ateliers of the Mioehins ; but these were the play of giants, and were not made as articles of commerce. The new artisan makers of the okimono struck out a line for themselves, one influenced more by the naturalistic and popular schools than by the classical art, and the quails of Kamejo, the tortoises of Seimin, the dragons of Tolin and Toriu, and in recent years the falcons and the peacocks of Susuki

Chokiehi, are the joy of the European collector. These are usually modelled in wax and cast in bronze and various other alloys, and sometimes in pure silver, and finished, if necessary, with the chisel and graver ; they are sometimes fashioned in repoussi with the hammer. The best of these are exquisite in workmanship, graceful in design, often strikingly original in conception, and usually naturalistic in ideal. They constitute a phase of art in which Japan has few rivals.

Thepresentgenerationismoresystematicallycommercial in its glyptic produce than any previous age. Millions of articles de commerce in metal work, wood, and ivory flood the European markets, and may be bought in any street in Europe at a small price, but they ofi'er a variety of design andan excellence of workmanship which place them almost beyond Western competition. Above all this, however, the Japanese sculptor is a force in art. He is nearly as thorough as his forefathers, and maintains the same love of all things beautiful ; and if he cannot show any epoch-making novelty, he is at any rate doing his best to sup-

port unsurpassed the decorative traditions of the past.

(w. An.)

Modern Developments of Applied Art.

Metal Work. — There is a radical difference between the point of view of the Japanese connoisseur and the point of view of the Western connoisseur in estimating the merits of sculpture on metal. The quality of the chisel-ling is the first feature to which the Japanese directs his attention ; the decorative design is the prime object of the Occidental's attention. With very rare exceptions, the decorative methods of Japanese sword furniture were always supplied by painters. Hence it is that the Japanese connoisseur draws a clear line of distinction between the decorative design and its technical execution, crediting the former to the pictorial artist and the latter to the sculptor. He detects in the stroke of a chisel and the lines of a graving tool subjective beauties which appear to be hidden from the great majority of Western dilettanti. He estimates the rank of a specimen by the quality of the chisel work. The Japanese kinzoku-shi

(metal sculptor) used thirty-six principal classes of chisel, each with its distinctive name, and as most of these classes comprised from five to ten sub- varieties, his cutting and graving tools aggregated about two hundred and fifty. Scarcely less important in Japanese eyes than the chiselling of the decorative design itself is the preparation of the field to which it is applied. There used ÷^ ^j^j^ to be a strict canon with reference to this in torscuip- former times. iVamafco (fish-roe) grounds were tared de- counted de rigueur for the mountings of swords ” ”^ ‘” ’■ worn on ceremonial occasions, the ishime (stone-pitting) or jimigaki (polished) styles being considered less aristo- cratic. As a broad definition, it may be said that namako is obtained by punching the whole surface — except the portion carrying the decorative design — into a texture of microscopic dots. The first makers of namako did not aim at regularity in the distribution of these dots ; they were content to produce the effect of .millet-seed sifted haphazard over the surface. But from the 16th century the punching of the dots in rigidly

straight lines came to be considered essential, and the difficulty involved in this tour de force was so great that mamaA;o-making took its place among the highest achievements of the sculptor. When it is remembered that the punching tool was guided solely by the hand and eye, and that three or more blows of the mallet had to be struck for every dot, some conception may be formed of the patience and accuracy needed to produce these tiny protuberances in perfectly straight lines, at exactly equal intervals and of absolutely uniform size. Namako disposed in straight parallel lines originally ranked at the head of this kind of work. But a new kind was. intro-

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duced in the 16tli century. It was obtained by punching the dots into intersecting lines, so arranged that the dots fell uniformly into diamond-shaped groups of five each. This is called go-no-me namako, because of its resemblance to the disposition of chequers in the Japanese

game of go. A century later, the daimyo namako was invented, in which lines of dots alternated with lines of polished ground. As for ishime, ib may be briefly described as diapering. There is scarcely any limit to the ingenuity and skill of the Japanese expert in diapering a 'metal surface. A Tokyo collector possesses a silver teapot having its surface recessed in forty leaf -shaped panels, each filled with a different diaper of extraordinarily minute and delicate workmanship. It is not possible to enumerate here even the principal styles of ishime, but mention may be made of the zara^maki (broad-cast), in which the surface is finely but irregularly pitted after the manner of the face of a stone; the nasMji (pear-ground), in which we have a surface like the rind of a pear ; the hari-ishime (needle is/w'me), where the indentations are so minute that they seem to have been made with the point of a needle ; the gamorishime, which is intended to imitate the skin of a toad igama) ; the tsuycu-isJiime, produced with a chisel sharpened so that its traces have a lustrous (tsuya) appearance ; the ore-kuchi (broken tool), a peculiar kind obtained

with a jagged tool; and the gozami, which resembles the plaited surface of a fine straw mat.

Great importance has always been attached by Japanese experts to the patina of metal used for artistic chiselling. It was mainly for the sake of their patina that value attached to the remarkable alloys shakudo ,(3 parts of gold to 97 of copper) and shibuichi (1 part of silver to 3 of copper). Neither metal, when it emerges from the furnace, has any beauty, shakudo being simply dark-coloured copper, and shibuichi pale gun-metal. But after proper treatment^ the former develops a glossy black patina with violet sheen, and the latter shows beautiful shades of gray with silvery lustre. Both these compounds afford delicate, unobtrusive, and effective grounds for inlaying with gold, silver, and other metals, as well as for sculpture, whether incised or in relief. Copper, too, by patina-producing treatment, is made to show not merely a rich golden sheen with pleasing limpidity, but also red of various hues, from deep coral to light vermilion, several shades of gray,

and browns of numerous tones from dead-leaf to choco-
late. Even greater value has always been set upon the
patina of iron, and many secret recipes were preserved
in artist families for producing the fine, satin-like texture
so much admired by all connoisseurs.
In Japan, as in Europe, three varieties of relief carving
are distinguished — alto (taka-bori), mezzo (chiuniku-bori),
and basso (usuniku-bori). But it may be added
*'cMseUing. ^^' ^^ *^® Opinion of the Japanese expert,*
these styles hold the same respective rank as
that occupied by the three kinds of ideographic script
in the realm of caligraphy. High relief carving corre-
sponds to the kaisho, or most classical form of writing ;
medium relief to the gyosho, or semi-cursive style ; and
low relief to the sosho or grass character. With regard
to incised chiselling, the commonest form is " hair-carving"
(hebori), which may be called engraving, the lines being
of uniform thickness and depth. Very beautiful results
are obtained by the kebori method, but incomparably the
finest work in the incised class is that known as kata-kiri-

bori. In this kind of chiselling the Japanese artist can

1 It ia first boiled in a lye obtained by lixiviating ■wood ashes • it is next polished with charcoal powder ; then immersed in plum viaegar and salt ; then washed with weak lye and placed in a tub of water to remove all traces of alkali, the final step being to digest in a boiling solution of copper sulphate, verdigris, and water.

claim to be unique as well as unrivalled. Evidently the idea of the great Yokoya experts, the originators of the style, was to break away from the somewhat formal mo-notony of ordinary engraving, where each line performs exactly the same function, and to convert the chisel into an artist's brush instead of using it as a common cutting tool. They succeeded admirably. In the katOrkiri-bori every line has its proper value in the pictorial design, and strength and directness become cardinal elements in the strokes of the burin just as they do in the brushwork of the picture painter. The same fundamental rule applied, too, whether the field of the decoration was silk, paper, or metal. The artist's tool, be it brush or burin, must per-form its task by one effort. There must be no appearance

of subsequent deepening, or extending, or recutting, or finishing. Kata-kiri-bori by a great expert is a delight. One is lost in astonishment at the nervous yet perfectly regulated force and the unerring fidelity of every trace of the chisel. Another variety of carving much affected by artists of the 17th century, and now largely used, is called shishi-ai-bori, or niku-ai-bori. In this style the surface of the design is not raised above the general plane of the field, but an effect of projection is obtained either by recessing the whole space immediately surrounding the design, or by enclosing the latter in a scarped frame. Yet another and a very favourite method, giving beautiful results, is to model the design on both faces of the metal so as to give a sculpture in the round. This fashion is always accompanied by chiselling h jour (sukashi-bori), so that the sculptured portions stand out in their entirety.

Inlaying with gold or silver was among the early forms of decoration in Japan, but the skill developed in modern times is at least equal to anything which the

past can show, and the results produced are much ” “^ “’ more imposing. There are two principal kinds of inlaying : the first called hon-zogan (true inlaying), the second nunome-zogain, (linen-mesh inlaying). As to the former, the Japanese method does not differ from that seen in the beautiful iron censers and vases inlaid with gold which the Chinese produced from the Shuntieh era (1426-36). In the surface of the metal the workman cuts grooves wider at the base than at the top, and then hammers into them gold or silver wire. Such a process presents no remarkable features, except that it has been carried by the Japanese to an extraordinary degree of elaborateness. The nunome-zogan is more interesting. Suppose, for example, that the artist desires to produce an inlaid diaper. His first business is to chisel the surface in lines forming the basic pattern of the design. Thus, for a diamond-petal diaper the chisel is carried across the face of the metal horizontally, tracing a number of parallel bands divided at fixed intervals by ribs which are obtained by merely straightening the chisel and striking it a heavy*

blow. The same process is then repeated in another direction, so that the new baiids cross the old at an angle adapted to the nature of the design. Several independent chisellings may be necessary before the lines of the diaper emerge clearly, but throughout the whole operation no measurement of any kind is taken, the artist being guided entirely by his hand and eye. The metal is then heated, not to redness, but sufdciently to develop a certain degree of softness, and the workman, taking a very thin sheet of gold (or silver), hammers portions of it into the salient points of the design. In ordinary cases this is the sixth process. The seventh is to hammer gold into the outlines o± the diaper : the eighth, to hammer it into the pattern tilling the spaces between the lines, and the ninth and tenth to complete the details. Of course the more intricate the design the more numerous the processes. It is scarcely possible to imagine a higher effort of hand and work]

eye than this nunome-zogan displays, for while intricacy and elaborateness are carried to the very extreme, absolute mechanical accuracy is obtained. Sometimes in the same design we see gold of three different hues, obtained by varying the alloy. A third kind of inlaying, peculiar to Japan, is sumi-zogan (ink-inlaying), so called because the inlaid design gives the impression of having been painted with Indian ink beneath the transparent surface of the metal. The difference between this process and ordinary inlaying is that for sumi-zogan the design to be inlaid is fully chiselled out of an independent block of metal with sides sloping so as to be broader at the base than at the top. The object which is to receive the decoration is then channelled in dimensions corresponding to those of the design block, and the latter having been fixed in the channel, the surface is ground and polished until absolute intimacy seems to be obtained between the inlaid design and the metal forming its field. Very beautiful effects are thus produced, for the design seems to have grown up to the surface of the

metal field rather than to have been planted in it. Shi-huichi inlaid with shakudo used to be the commonest combination of metals in this class of decoration, and the objects usually depicted were bamboos, crows, wild-fowl under the moon, peony sprays, and so forth.

A variety of decoration much practised by early experts and carried to a high degree of excellence in modern times, is called mdkume-ji, or wood-grained ‘j ground. The process in this case is to take grounds. ^ thin plate of iron — if iron is the metal to be treated — and beat it into another plate of similar metal, so that the two, though welded together, retain their separate forms. The mass, while still hot, is coated with hena-tsuchi (a kind of marl) and rolled in straw ash, in which state it is roasted over a charcoal fire raised -^to glowing heat with the bellows. The clay having been removed, another plate of metal is beaten in, and the same process is repeated. This is done several times, the number depending on the quality of graining that the expert desires to produce. “■ The

manifold plate is then heavily punched from one side, so that the opposite face protrudes in broken blisters, which are then hammered down until each becomes a centre of wave propagation. In fine work the apex of the blister is ground off before the final hammering. Iron was the metal used exclusively for work of this kind down to the 16th century, but various metals began thenceforth to be combined. Perhaps the choicest variety is gold graining in a shakudo field. By repeated hammering and polishing the expert obtains such control of the wood-grain pattern that its sinuosities and eddies seem to have developed symmetry without losing anything of their fantastic grace. There are other methods of producing mokume-ji, but their details may be omitted here.

It has been frequently asserted by Western critics that the year (1876) which witnessed the abolition of sword-wearing in Japan, witnessed also the anrf end of her artistic metal work. That is a aacieat great mistake. The art has merely developed

skjii. jjg^ phases in modern times. Not only are its masters as skilled now as they were in the days of the Got5, the Nara, the Yokoya, and the Yanagawa celebrities, but also their productions must be called greater in many respects and more interesting than those of their renowned predecessors. They no longer devote themselves to the manufacture of sword ornaments, but work rather at vases, censers, statuettes, plaques, boxes, and other objects of a serviceable or ornamental nature. All the processes described above are practised by them with full success, and they have added others quite as remarkable. Of these, one of the most interesting is called kiribame (insertion). The decorative design having been completely chiselled in the round, is then fixed in a field of a different metal, in which a design of exactly similar outline has been cut out en bloc. The result is that the picture has no blank reverse. For example, on the surface of a sMbuichi box-lid we see the backs of a flock of geese chiselled in silver, and when the lid is opened, their breasts and the undersides of their pinions appear.

The difB^culty of such work is plain. Microscopic accu-
racy has to be attained in cutting out the space for the
insertion of the design, and while the latter must be
soldered firmly in its place, not the slightest trace of
solder or the least sign of junction must be discernible
between the metal of the inserted picture and that of the
field in which it is inserted. Suzuki Gensuke is the in-
ventor of this method. He belongs to a class of experts
called uchimono-shi (hammerers) who perform preparatory
work for glyptic artists in metal. The skill of these men
is often wonderful. Using the hammer only, some of them
can beat out an intricate shape as truly and delicately as a
sculptor could carve it with his chisels. Ohori Masatoshi,
an uchimono-shi of Aizu (died 1897), made a silver cake-
box in the form of a sixteen-petalled chrysanthemum.
The shapes of the body and lid corresponded so intimately
that whereas the lid could be slipped on easily and
smoothly without any attempt to adjust its curves to those
of the body, it always fitted so closely that the box could
be lifted by grasping the lid only. Another feat of his was

to apply a lining of silver to a shakudo box by shaping and hammering only, the fit being so perfect that the lining clung like paper to every part of the box. Suzuki Gensuke and Hirata S6ko are scarcely less expert. The latter once exhibited in Tokyo a silver game-cock with soft plumage and surface modelling of the most delicate character. It had been made by means of the hammer only. Suzuki's kiribame process is not to be confounded with the kiribame-zogan (inserted inlaying) of Toy6da Koko, also a modern artist. The gist of the latter method is that a design chiselled d, jour has its outlines veneered with other metal which serves to emphasize them. Thus, having pierced aspray of flowers in a thin sheet of shibiiichi, the artist fits a slender rim of gold, silver, or shakudo into the petals, leaves, and stalks, so that an efllect is produced of transparent blossoms outlined in gold, silver, or purple. Another modern achievement — also due to Suzuki Gensuke — is designated maze-gane (mixed metals). It is a singular conception, and the results obtained depend largely on chance. SMbuichi and shakudo are melted separately, and

when they have cooled just enough not to mingle too intimately, they are cast into a bar which is subsequently beaten flat. The plate thus obtained shows accidental clouding, or massing of dark tones, and these patches are taken as the basis of a pictorial design to which final character is given by inlaying with gold and silver, and by katakiri sculpture. Such pictures partake largely of the impressionist character, but they attain much beauty in the hands of the Japanese artist with his extensive reper-toire of suggestive symbols. A process resembling maze-gane, but less fortuitous, is shibuichi-ddshi (combined sMbuichi), which involves beating together two kinds of sMbuichi and then adding a third variety, after which the details of the picture are worked in as in the case of maze-gane. The charm of these methods is that certain parts of the decorative design seem to float, not on the surface of the metal, but actually within it, an admirable effect of depth and atmosphere being thus produced. Mention must also be made of an extraordinarily elaborate and troublesome process invented by Kajima Ippu, a really

great artist of the present day. It is called togi-dashi-

zogan (ground-out inlaying). In this exquisite and in-

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geaious kind of work — the technical details of -which are

too complicated to set down here — the design appears to be

growing up from the depths of the metal, and a delightful

impression of atmosphere and water is obtained. All

these processes, as well as that of repoussi, in which the

Japanese have excelled from a remote period, are now

practised with the greatest skill in Tokyo, Ky8t6, Osaka,

and Kaga. At the art exhibitions held semi-annually in

the principal cities there may be seen specimens of

statuettes, alcove ornaments, and household utensils

which reach a strikingly high level of ability, and show

that the Japanese worker in metals stands more indis-

putably than ever at the head of the world's artists in

that field. The Occident does not yet appear to have

fully realized the existence of such talent in Japan, partly perhaps because its displays in former times were limited chiefly to sword-furniture, insignificant objects possessing little interest for the average European or American; and partly because the Japanese have not yet learned to adapt their skill to foreign requirements. They confine themselves at present to decorating plaques, boxes and eases for cigars or cigarettes, and an occasional tea or coffee service, but the whole domain of salvers, dessert-services, race-cups, and so on remains virtually unexploted. Only within the past few years have stores been established in the foreign settlements for the sale of silver utensils, and already the workmanship on these objects displays palpable signs of the deterioration which all branches of Japanese art have undergone in the attempt to cater for foreign taste. In the general sense the European or American is a much less exacting connoisseur than the Japanese. Broad effects of richness and splendour captivate the former, whereas the latter looks for delicacy of finish, accuracy of detail, and, above all, evidences of

artistic competence. It is nothing to a Japanese that a vase should be covered with profuse decoration of flowers and foliage : he requires that every blossom and every leaf shall be instinct with vitality, and the comparative costliness of fine workmanship does not influence his choice. But if the Japanese sculptor adopted such standards in working for the clieritMe which he finds in the foreign settlements, his market would be reduced to very narrow dimensions. He therefore adapts himself to his circumstances, and using the mould rather than the chisel, produces ‘ specimens which show tawdry handsomeness and are attractively cheap. It must be admitted, however, that even though the appreciative faculty were sufficiently educated on the foreign side, the Japanese artist in metals would still labour under a great difficulty, that of devising shapes to take the place of those which Europe and America have learned to consider classical.

Bronze is called by the Japanese Jcara-Mne, a term signifying ” Chinese metal ” and showing clearly the source from which knowledge of the alloy was obtained.

c^tlag. It is a copper4ead-tin compound, the proportions of its constituents varying from 72 to 88 per cent, of copper, from 4 to 20 per cent, of lead, and from 2 to 8 per cent, of tin. There are also present small quantities of arsenic and antimony, and zinc is found generally as a mere trace, but sometimes reaching to 6 per cent. Gold is supposed to have found a place in ancient bronzes, but its presence has never been detected by analysis, and of silver not more than 2 per cent, seems to have been admitted at any time. Mr W. Gowland has shown that, whatever may have been the practice of Japanese bronze-makers in ancient and medieeval eras, their successors in later days deliberately introduced arsenic and antimony into the compound in order to harden the bronze without impairing its fusibility, so that it took a sharper impression of tha mould. Japanese bronze is well suited for castings, not only because of its low melt-ing-point, great fluidity, and capacity for taking sharp impressions, but also becaiise it has a particularly smooth surface and readily develops a fine patina. One variety

deserves special mention. It is a golden yellow bronze, called sentoku — this being the Japanese pronunciation of Shuntieh, the era of the Ming dynasty when this compound was invented. Copper, tin, lead, and zinc, mixed in various proportions by different experts, are the ingredients, and the beautiful golden hues and glossy texture of the surface are obtained by patina-producing processes, in which branch of metal work the Japanese show altogether unique skill.

From the time when they began to cast bronze statues, Japanese experts understood how to employ a hollow, removable core round which the metal was run in a skin just thick enough for strength without waste of material ; and they also understood the use of wax for modelling jjurposes. In Ordinary circumstances, a casting thus obtained took the form of a shell without any break of ‘ continuity. But for very large castings the process had to be modified. The great image of Lochana Buddha at ISTara, for example, would measure 138 feet in height were it standing erect, and its weight is about 560 tons. The

colossal Amida at Kamakura has a height only 3 feet less. It would have been scarcely possible to cast such statues in one piece in situ, or, if cast elsewhere, to transport them and elevate them on their pedestals. The plan pursued was to build them up gradually in their places by casting segment after segment. Thus, for the Nara Dai Butsu, the mould was constructed in a series of steps ascending 12 inches at a time, until the head and neck were reached, which, of course, had to be cast in one shell, 12 feet high.

The term " parlour bronzes " serves to designate objects for domestic use, as flower-vases, incense-burners, and alcove ornaments. To the manufacture of these objects bronze-casters began to turn their attention about the middle of the 17th century. Not until that epoch did the art of casting bronze become so refined and delicate that its products covild rank with the forged and chiselled works of earlier eras, and it is generally supposed to have reached its culmination in the hands of a group of great experts — Seimin, Toun, Masatune, Teij5, Somin,

Keisai, Takusai, Gido, Zenriusai, and Hotokusai — who flourished during the second half of the 18th century and the first half of the 19th.]\Iany brilliant specimens of these men's work survive, their general features being that the motives are naturalistic, that the quality of the metal is exceptionally fine, that in addition to beautifully clear casting obtained by highly skilled use of the ceraperduta process, the chisel was employed to impart delicacy and finish to the design, and that modelling in high relief is most successfully introduced. But it is a mistake to assert, as many have asserted, that after the era of the above ten masters — the latest of whom, Somin, ceased to work in 1871 — rio bronzes comparable with theirs were cast. Between 1876 and 1879 sonie of the finest bronzes, probably the very finest of their kind ever produced in Japan, were turned out by a group of experts working in combination under the firm name of " Sanseisha." Started by two brothers, Oshima Katsujiro (art-name Joun), and Oshima Yasutaro (art-name Shokaku), this association secured the services

of a number of skilled chisellers of sword-furniture, who had lost their mitier owing to the abandonment of the sword-wearing custom. Nothing could surpass the delicacy of the works executed at the Sanseisha's atelier in Toky5, but unfortunately such productions were above the standard of the customers for whom they were intended. Foreign buyers, who alone stood in the market at that time, failed to distinguish the carving]

fine and costly bronzes of J6un, Shokaku, and their colleagues from cheap imitations which soon began to compete with them, so that ultimately the Sanseisha had to be closed. This page in the modern history of Japan's bronzes needs little alteration to become true of her applied art in general. Foreign demand has shown so little discrimination that experts, finding it impossible to obtain adequate remuneration for first-class work, have been obliged to abandon the field altogether, or to

lower their standard to the level of general appreciation, or, by forgery, to cater for the perverted taste which attaches unreasoning value to age. J6un has produced, and is thoroughly capable of producing, bronzes at least equal to the best of Seimin's masterpieces, yet he has often been induced to put Seimin's name on objects for the sake of attracting buyers who attach more value to cachet than to quality. If to the names of Joun and his brilliant pupil Eiuki we add those of Suzuki Chokichi, Okazaki Sessei, Hasegawa Kumazo, Kanaya Gorosaburo, and Jomi Eisuke, we have a group of modern bronze-casters who unquestionably surpass the ten experts beginning with Seimin and ending with Somin. Okazaki Sessei has successfully achieved a task previously beyond the strength of his country's experts, the casting of huge panels carrying designs in high relief ; and whether there is question of patina or of workmanship, J5mi Eisuke has never been surpassed.

Occidental influence has been felt, of course, in the field of modern bronze-casting. At a school of art officially

established in Toky5 in 1873 under the direc-

2rfluM«’ ^^°^ °-^ Italian teachers — a school which owed

its signal failure partly to the incompetence and

intemperate behaviour of some of its foreign professors, partly to a strong renaissance of pure Japanese classicism — one of the few accomplishments successfully taught was that of modelling in plaster and chiselling in marble after Occidental methods. Marble statues are out of place in the wooden buildings as well as in the parks of Japan, and even plaster busts or groups, though less incongruous perhaps, have not yet found favour. Hence the skiU un-doubtedly possessed by several graduates of the defunct art school has to be devoted chiefly to a subordinate pur-pose, namely, the fashioning of models for metal-casters. To this combination of modellers in European style and metal-workers of such force as Suzuki and Okazaki, Japan owes various memorial bronzes and likeness efiSgies which are gradually finding a place in her parks, her museums, her shrines, or her private houses. There is here little departure from the well-trodden paths of Europe. Studies

in drapery, prancing steeds, ideal poses, heads with fragments of torsos attached (in extreme violation of true art), crouching beasts of prey — all the stereotyped styles are reproduced. The imitation is excellent. That is all that can yet be said, though some of these works suggest that Japanese artists will by and by attain distinction in the new field.

Wood and Ivory Carving. — Among the artists of early times it is often perplexing to distinguish between the carver of wood and the caster of bronze. The latter sometimes made his own models in wax, sometimes chiselled them in wood, and sometimes had recourse to a specialist in wood-carving. The group of splendid sculptors in wood that graced the 11th, 12th, and 13th centuries left names never to be forgotten, but undoubtedly many other artists of scarcely less force regarded bronze-casting as their principal business. Thus the story of wood-carving is very difficult to trace. Even in the field of architectural decoration for interiors, tradition tells us scarcely anything about the masters who carved such magnificent

works as those seen in the Kyoto temples, the Tokugawa mausolea, and some of the old castles. There are, however, no modem developments of such work to be noted. The ability of former times exists and is exercised in the old way, though the field for its employment has been greatly narrowed.

"When Japanese sculpture in wood or ivory is spoken of, the first idea that presents itself is connected with the nitsuM, which, of all the art objects found in Japan, is perhaps the most essentially Japan-j."rs' ese. If Japan had given us nothing but the n6tsuM, we should still have no difficulty in differentiating the bright versatility of her national genius from the comparatively sombre, mechanic, and unimaginative temperament of the Chinese. But the nitsuM may now be said to be a thing of the past. The inro (medicine-box), which it served to fix in the girdle, has been driven out of fashion by the new civilization imported from the West, and artists who would have carved nitsvki in former times now devote their chisels to statuettes and alcove

ornaments. It is not to be inferred, however, though it is a favourite assertion of collectors, that no good netsuki have been made in modern times. That theory is based upon the fact that after the opening of the country to foreign intercourse in 1867, hundreds of inferior speci-mens of n&tsuke — ceasing on the one hand to be valued by the Japanese themselves, and becoming on the other objects of curiosity and admiration to foreigners — were chiselled by inexpert hands, purchased wholesale by treaty-port merchants, and sent to New York, London, and Paris, where, though they brought profit to the exporter, they also disgusted the connoisseur and soon earned discredit for their whole class. But in fact the glyptic artists of Tokyo, Osaka, and Kyoto, though, as has been said above, they now devote their chisels chiefiy to works of more importance than the nStsnke, are in no sense inferior to their predecessors of feudal days, and many beautiful nitsuM bearing their signatures are in existence. As for the modern ivory statuette or alcove ornament, of which great numbers are now carved for the

foreign market, it certainly stands on a plane much higher than the nksuM, since anatomical defects, which escape notice in the latter owing to its diminutive size, become painfully obtrusive in the former. It may confidently be said, therefore, of the modern Japanese sculptor in ivory that since, on the whole, he succeeds in avoiding such defects, he is a greater artist than the wdfsM&e-carver of former times.

*One of the most remarkable developments of figure sculpture in former Japan was due to Matsumoto Kisar buro (1830-69). He carved human figures with as much accuracy as though they were destined ** ” ” for purposes of surgical demonstration. Considering that this man had neither art education nor anatomical instruction, and that he never enjoyed an opportunity of studying from a model in a studio, his achievements were -remarkable. He and the craftsmen of the school he established completely refute the theory that the anatomical solecisms commonly seen in the works of Japanese sculptors are due to faulty observation.*

Without scientific training of any kind Matsumoto and his followers produced works in which the eye of science cannot detect any error. But it is impossible to admit within the circle of high-art productions these wooden figures of everyday men and women, unrelieved by any subjective element, and owing their merit entirely to the fidelity with which their contours are shaped, their mus-cles modelled, and their anatomical proportions preserved. They have not even the attraction of being cleanly sculp-tured in wood, but are covered with thinly lacquered muslin, which, though doubtless a good preservative, accentuates their puppet-like character. Nevertheless, Matsumoto' s figures marked an epoch in Japanese wood

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sculpture. Their vivid realism appealed strongly to the taste of the average foreigner. A considerable school of

carvers soon began to work in the Matsumoto style, and hundreds of their productions have gone to Europe and America, finding no market in Japan.

Midway between the Matsumoto school and the pure style approved by native taste in former times stand a number of wood-carvers headed by Takamura

The semi- Koun, who occupies in the field ^ of sculpture schooL much the same place as that held by Hashimoto Gaho in the realm of painting. Koun carves figures in the round which not only display great power of chisel and breadth of style, but also tell a story not necessarily drawn from the motives of the classical school.

This departure from established canons must be traced to the influence of the short-lived academy of Italian art established by the Japanese Government early in the Meiji era. In the forefront of the new movement are to be found men like Yoneharu Unkai and Shinkai Take-taro, the former of whom chiselled a figure of Jenner for the Medical Association of Japan when they celebrated the centenary of the great physician, and the latter has

carved life-size ef&gies of two Imperial princes who lost their lives in the war with China (1894-95). The artists of the Koun school, however, do much work which appeals to emotions in general rather than to individual memories Thus Arakawa Eeiun, one of Koun's most brilliant pupils, exhibited a figure of a swordsman in the act of driving home a furious thrust. The weapon is not shown. Eeiun sculptured simply a man poised on the toes of one foot, the other foot raised, the arm extended, and the body straining forward in strong yet elastic muscular effort. This carving emphasizes the advantage of not working from a model. A posed figure could not possibly suggest the alert vitality and high muscular tension of the swordsman. A more imaginative work by the same artist is a figure of a farmer who has just shot an eagle that swooped upon his grandson. The old man holds his bow still raised. Some of the eagle's feathers, blown to his side, suggest the death of the bird ; at his feet lies the corpse of the little boy, and the horror, grief, and anger that such a tragedy would inspire are

depicted with striking realism in the farmer's face.

Such work has very close aflB.nities with Occidental conceptions. The chief distinguishing feature is that the glyptic character is preserved at the expense of surface finish. The undisguised touches of the chisel tell a story of technical force and directness which could not be suggested by perfectly smooth surfaces. To subordinate process to result is the European canon; to show the former without marring the latter is the Japanese ideal. Many of Koun's sculptures appear unfinished to eyes trained in Occidental galleries, whereas the Japanese connoisseur detects evidence of a technical feat in their seeming roughness.

Textile Fabrics. — In no branch of applied art does the decorative genius of Japan show more attractive results than in that of textile fabrics, and in none has there been more conspicuous progress during recent years. Her woven and embroidered stuffs have always been beautiful ; but in former times few pieces of size and splendour were produced, if we except the curtains used for

draping festival cars and the hangings of temples. Tapestry, as it is employed in Europe, was not thought of, nor indeed could the small hand-looms of the period be easily adapted to such work. All that has been changed, however. Arras of large dimensions, showing remarkable workmanship and grand combinations of col- ours, is- now manufactured in Kyoto, the product of years of patient toil on the part of weaver and designer alike. Kawashima of Kyoto has acquired high reputation for work of this kind. He inaugurated the new departure a few years ago by copying a Gobelin, but it may safely be asserted that no Gobelin will bear comparison with the pieces now produced in Japan. The most approved fashion of weaving is called tsuzure-ori (linked-weaving) ; that is to say, the cross threads are laid in with the fingers and pushed into their places with a comb by hand, very little machinery being used. The threads extend only to the outlines of each figure, and it follows that every part of the pattern has a rim of minute holes like the pierced lines separating postage stamps in a

sheet, the effect being that the design seems to hang suspended in the ground — linked into it, as the Japanese term implies.' A specimen of this nature recently manufactured by Kawashima's weavers measured 20 feet by 13 feet, and represented the annual festival at the Nikko mausolea. The chief shrine was shown; the gate and long flight of stone steps leading up to it, several other buildings, the groves of cryptomeria that surround the mausolea, and the festival procession. All the architectural and decorative details, all the carvings and colours, all the accessories — everything was wrought in silk, and each of the 1500 figures forming the procession wore exactly appropriate costume. Even this wealth of detail, remarkable as it was, seemed less surprising than the fact that the weaver had succeeded in producing the effect of atmosphere and aerial perspective. Through the graceful cryptomeria distant mountains and the still more distant sky could be seen, and between the buildings in the foreground and those in the middle distance atmosphere appeared to be perceptible. Two years of incessant la-

bour with relays of artisans working steadily throughout the twenty-four hours were required to finish this piece. Naturally such specimens are not produced in large numbers. Next in decorative importance to tsuzure-ori stands yuzen hirddo, commonly known among English-speaking people as " cut velvet." Dyeing by the yuzen process is an innovation of modern times. The design is painted on the fabric, after which the latter is steamed, and the picture is ultimately fixed by methods which are kept secret. The soft silk known as habutaye is a favourite ground for such work, but silk crape also is largely employed. No other method permits the decorator to achieve such fidelity and such boldness of draughtsmanship. The difference between the results of the ordinary and the yuzen processes of dyeing is, in fact, the difference between a stencilled sketch and a finished picture. In the case of " cut velvet," the yuzen process is supplemented by an operation which can be easily described. The cutter, who works at an ordinary wooden bench, has no tool except a small sharp chisel with a V-shaped point. This chisel

is passed into an iron pencil having at the end guards, between which the point of the chisel projects, so that it is impossible for the user to cut beyond a certain depth. When the velvet comes to him, it already carries a coloured picture permanently fixed by the yuzen process, but the wires have not been withdrawn. It is, in fact, velvet that has passed through all the usual stages of manufacture except the cutting of the thread along each wire and the withdrawal of the wires. The cutting ai-tist lays the piece of this unfinished velvet before him on his bench, and proceeds to carve into the pattern with his chisel, just as ' though he were shading the lines of the design with a steel pencil. When the pattern is lightly traced, he uses his knife delicately ; when the lines are strong and the shad-ows heavy, he makes the point pierce deeply. In short, the little chisel becomes in his fingers a painter's brush, and when It IS remembered that, the basis upon which he works , 1 This method ia some 300 years old. It is by no means a modem mventiou, as some writers have asserted.

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broidery.

being simply a thread of silk, his – hand must be trained to such delicacy of muscular effort as to be capable of arresting the edge of the knife at varying depths within the diameter of the tiny filament, the difficulty of the achievement will be understood. Of course it is to be noted that the edge of the cutting tool is never allowed to trespass upon a line which the exigencies of the design require to be solid. The veining of a cherry petal, for example, the tesselation of a ‘ carp’s scales, the serration of a leaf’s edge — all these lines remain intact, spared by the cutter’s tool, while the leaf itself, or the petal, or the scales of the fish, have the threads forming tl;iem cut so as to show the velvet nap and to appear in soft, low relief. In one variety of this fabric, a slip of gold foil is laid under each wire, and Jeft in position after the wire is withdrawn, the cutting tool

being then used with freedom in some parts of the design, so that the gold gleams through the severed thread, producing a rich and suggestive effect. Velvet, however, is not capable of being made the basis for pictures so elaborate and microscopically accurate as those produced by the yuzen process on silk crape or liabutaye. The rich-toned, soft plumage of birds or the magnificent blending of colours in a bunch of peonies or chrysanthemums cannot be obtained with absolute fidelity on the ribbed surface of velvet.

The embroiderer's craft has been followed for centuries in Japan with eminent success, but whereas it formerly ranked with dyeing and weaving, it has now come to be regarded as an art. Formerly the embroiderer was content to produce a pattern with his needle, now he paints a picture. The statement is not an exaggeration. So perfectly does the modern Japanese embroiderer elaborate his scheme of values that all the essential elements of pictorial effects — chiaroscuro, aerial perspective, and atmosphere — are present in his

work. Thus a graceful and realistic school has replaced the comparatively stiff and conventional style of former times. Further, an improvement of a technical character was recently made, which has the effect of adding greatly to the durability of these embroideries. Owing to the use of paper among the threads of the embroidery and sizing in the preparation of the stuff forming the ground, every operation of folding used to cause perceptible injury to a piece, so that after a few years it acquired a crumpled and dingy appearance. But by the new method em-broiderers now succeed in producing fabrics which defy all destructive influences except, of course, dirt and decay.

Keramics. — Speaking broadly, the distinguished pro-ducts of Japanese keramic art in pre-Tlfei/i days may be said to have been the porcelains of Hizen and Kutani and the faiences of Satsuma and Kyot8. Many other wares have attracted attention, but though not without merits and even beauties, they are comparatively insignificant. In the term "Hizen porcelains" are included

not merely the richly decorated Imari ware —

the " Old Japan " of Western collectors — ^but

also the finely modelled and delicately coloiu'ed master-

pieces of Hirado, and the jewelled specimens of Nabe-

shima, which undoubtedly stand at the head of all

Japanese porcelains ornamented with vitrifiable enamels

over the glaze. Many examples of these varieties deserve

the enthusiastic admiration they have received, yet

they unquestionably belong to a lower rank of keramic

achievements than the choice productions of Chinese kilns.

The potters of the Middle Kingdom, from the early eras

of the Ming dynasty down to the latest years of the 18th

century, stood absolutely without rivals — haud cequi aut

secundi — as makers of porcelain. Their technical ability

was incomparable — though in grace of decorative concep-

Orlental

Pottery.

tion they yielded the palm to the Japanese — and the

representative specimens they bequeathed to posterity re-

mained, until quite recently, far beyond the imitative

capacity of European or Asiatic experts. As for faience and pottery, however, the Chinese despised them in all forms, with one notable exception, the Yishing-yao, known in the Occident as boccaro. Even the Yishing-yao, too, owed much of its popularity to special utility. It was essentially the ware of the tea-drinker. If in the best specimens exquisite modelling, wonderful accuracy of finish, and pdtes of interesting tints are found, such pieces are, none the less, stamped prominently with the character of utensils rather than with that of works of art. In short, the artistic output of Chinese kilns in their palmiest days was, not faience or pottery, but porcelain, whether of soft or hard paste. Japan, on the contrary, owes her keramic distinction in the main to her faience. A great deal has been said by enthusiastic writers about the FamiUe Chrysanthemo-PSonienne of Imari and the Oeiire Kakiemon of Nabeshima, but these porcelains, beautiful as they undoubtedly are, cannot be placed on the same level with the Kican-yao and Famille Rose of the Chinese experts. The Imari ware, even though its thick biscuit and gener-

ally ungraceful shapes be omitted from the account, shows no enamels that can rival the exquisitely soft, broken tints of the Famille Rose; and the Kakiemon porcelain, for all its rich though chaste contrasts, lacks the delicate transmitted tints of the shell-like Kwan-yao. So, too, the blue-and-white porcelain of Hirado, though assisted by exceptional tenderness of sovs-pdte colour, by milk-white glaze, by great beauty of decorative design, and often by an admirable use of the modelling or graving tool, represents a keramic achievement palpably below the soft paste Kai^pieriryao of Ching-t§-ch@ng. It is a curious and interesting fact that this last product of Chinese skill remained unknown in Japan down to very recent days.

In the eyes of a Chinese connoisseur, no blue-and-white porcelain worthy of consideration exists, or ever has existed, except the Kai-pien-yao, with its imponderable pdte, its wax-like surface, and its rich, glowing blue, entirely free from superficigjity or garishness, and broken into a thousand tints by the microscopic crackle of the glaze. The Japanese, although they obtained from their neighbour

almost everything of value she had to give them, did not know this wonderful ware, and their ignorance is in itself sufficient to prove their keramic inferiority. There remains, too, a wide domain in which the Chinese developed high skill, whereas the Japanese can scarcely be said to have entered it at all ; namely, the domain of monochromes and polychromes, striking every note of colour from the richest to the most delicate; the domain of truiti and flambi glazes, of "transmutation ware " (Yd-pien-yao), and of egg-shell with incised or translucid decoration. In all that region of achievement the Chinese potters stood alone and seemingly unapproachable. The Japanese, on the contrary, made a speciality of faience, and in that particular line they reached a high standard of excellence. 1^0 faience produced either in China or any other Oriental country can dispute the palm with really representative specimens of Satsuma ware. Not without full reason have Western connoisseurs lavished panegyrics upon that exquisite production. The faience of the Kyoto artists never reached quite to the level of the Satsuma in quality oipdte

and glowing mellowness of decoration: their materials were slightly inferior^ But their skill as decorators was as great as its range was wide, and they produced a multitude of masterpieces on which alone Japan's keramic fame might safely be rested.

Such, briefly speaking, had been the story of the art and the distinction between the methods of its practice in China and Japan until the commencement of a new era

[pottery in the latter country. When the mediatization of the fiefs, in 1871, terminated the local patronage hitherto . extended so munificently to keramic and other sty"e^after artists, the Japanese gradually learned that tfie /?estora- they must thenceforth depend chiefly upon the "»"• markets of Europe and America. They had to appeal, in short, to an entirely new " gallery," and how to secure its approval was to them a perplexing problem. Having little to guide them, they often interpreted West-

ern taste incorrectly, and impaired their own repiTtation in a corresponding degree. Indeed, it may truly be said that the urgent need of Japan even at present is some intelligent appreciation of foreign wants. Just as her metal-workers devote themselves to the production of cigar-boxes, plaques, and other objects falling within the pecuniary reach of a very small circle of buyers, so her keramists confine their efforts to vases, censers, and more rarely tea and coffee services, this last class of commodities being too often disfigured by some unsightliness of form or clumsiness of design. What has to be considered here, however, is not the business aspect of the question, but rather the gradual steps of technical progress by which the present stage has been reached. In the early years of the Meiji era there was a period of complete prostitution. ISTo new skill was developed, and what remained of the old was expended chiefly upon the manufacture of meretricious objects, disfigured by excess of decoration and not relieved by any excellence of technique. In spite of their artistic defects, these specimens

were exported in considerable numbers by merchants in the foreign settlements, and their first cost being very low, they found a not unremunerative market. But as European and American collectors became better acquainted with the capacities of the pre-ilf^i/i potters, the great inferiority of these new specimens was recognized, and the prices commanded by the old wares gradually appreciated. What then happened was very natural : imitations of the old wares were produced, and having been sufficiently disfigured by staining and other processes calculated to lend an air of rust and age, were sold to ignorant persons, who laboured under the singular yet common hallucination that the points to be looked for in specimens from early kilns were, not technical excellence, decorative tastefulness, and richness of colour, but dinginess, imperfections, and dirt ; persons who imagined, in short, that defects which they would condemn at once in new porcelains ought to be regarded as merits in old. Of course a trade of that kind, based on deception, could not have permanent success. One of the imitators of " old

Satsuma" was among the first to perceive that a new line must be struck out. Yet the earliest results of his awakened perception helped to demonstrate stUl further the depraved spirit that had come over Japanese art. For he applied himself to manufacture wares having a close affinity with the shocking monstrosities used for sepulchral purposes in ancient Apulia, where fragments of dissected satyrs, busts of nymphs, or halves of horses were con-sidered graceful excrescences for the adornment of an amphora or a pithos. This Makuzu faience, produced by the now justly celebrated Miyagawa ShSzan of Ota (near Yokohama"), survives in the form of vases and pots having birds, reptiles, flowers, Crustacea, and so forth, plastered over the surface — specimens that disgrace the period of their manufacture, and represent probably the worst aberration of Japanese keramic conception.

A production so degraded as the early Makuzu faience could not possibly have long vogue. Miyagawa ^fChi"" °° began to cast about for a better inspira-

modeis. tion, and found it in the monochromes and

polychromes of the Chinese Kang-hsi and Yxmxj-cheng kilns. The extraordinary value attaching to the incomparable red glazes of China, not only in the country of their provenance but also in the United States of America, where collectors showed a fine instinct in this matter, seems to have suggested to Miyagawa the idea of imitation. He took for model the rich and delicate " liquid-dawn " monochrome, and succeeded in producing, not indeed a rival of that grand ware, but at any rate some specimens of considerable merit. Thenceforth his example was largely followed, and it may now be said that the tendency of many of the best Japanese keramists is to copy Chinese chefs-d'ceuwe. To find them thus renewing their keramic reputation by reverting to Chinese models, is not only another tribute to the perennial supremacy of Chinese porcelains, but also a fresh, illustration of the eclectic genius of Japanese art. All the products of this new effort are porcelains proper. It is not intended to suggest that beautiful faience has ceased to be a Japanese speciality. The Kyoto potters

still tread successfully in the old grooves. But the question here is of a novel departure which distinguishes the present era. Seven kilns are devoted, wholly or in part, to the new wares : namely, that of Miyagawa Sh8zan of Ota, that of Seifu Y6hei of Kyoto, those of Takemoto Hayata and Kato Tomojiro of TSkyo, that of Higuchi Haruzaue of Hirado, that of Shida Yasukyo of Kaga, and that of Kato Masukichi of Seto.

Among the seven keramists here enumerated, Seifu of Kyoto probably enjoys the highest reputation.

If we except the ware of Satsuma, a unique product, it may be said that nearly all B“ the fine faience of Japan was manufactured formerly in Ky6t8. Nomura Ninsei, in the middle of the 17th century, inaugurated a long era of beautiful productions with his cream-like, “fish-roe” a-aqueM glazes, carrying rich decoration of clear and brilliant vitrifiable enamels. • It was he who gave their first really artistic impulse to the kilns of Awata, Mizoro, and Iwakura, whence so many delightful spec-*

imens of faience issued almost without interruption until the middle of the 19th century and continue to issue to-day. The three Kenzan — of whom the third died in 1820 ; Ebisei ; the four Dohachi, of whom the fourth is still alive; the Kagiya family, manu-facturers of the celebrated KiiMzan ware ; Hozan, whose imitations of Delft faience and his pdte-sur-pdte pieces with fern-scroll decoration remain incomparable ; Taizan Yohei, whose ninth descendant of the same name now pro-duces fine specimens of Awata ware for foreign markets ; Tanzan Yoshitaro and his son Eokuro, to whose credit stands a new departure in the form of faience having pdte-sur-pdte decoration of lace patterns, diapers and archaic designs executed in low relief with admirable skill and minuteness ; the two Bizan, renowned for their representations of richly-apparelled figures as decorative motives ; Eokubei, who studied painting under Maruyama Okyo and followed the naturalistic style of that great artist ; Mokubei, the first really expert manufacturer of translucid porcelain in Kyoto ; Shuhei, Kintei, and above

all, Zengoro Hozen, the celebrated potter of Eiraku wares — these names and many others give to Ky6t6 keramics an eminence as well as an individuality which few other wares of Japan can boast. Nor is it to be supposed that the ancient capital now lacks great potters. Okamura Yasutaro, commonly called Shozan, produces specimens which only a very acute connoisseur can distinguish from the work of Nomura Ninsei ; Tanzan Rokuro's half-tint enamels and soft creamy glazes would have stood high in any epoch ; Taizan Yohei produces Awata faience not inferior to that of former days ; Kagiya S6bei worthily supports the reputation of the 'Ki)iMzan ware ; Kawamoto Eijiro has made to the order of a well-known Kyoto firm potteet]

many specimens now figuring in foreign collections as old masterpieces ; and Ito Tozan succeeds in decorating faience ■with, seven colours sous couverte (black, green, blue, russet-red, tea-brown, purple, and peach), a feat never be-

fore accomplished. It is therefore an error to assert, as has been so often asserted, that Ky5t6 has no longer a title to be called a great keramic centre if estimated by old-time standards. Seifu Yohei, however, has the special faculty of manufacturing monochromatic and jewelled porcelain and faience, which differ essentially from the traditional Kyoto types, their models being taken directly from China. But a sharp distinction has to be drawn between the method of Seifu and that of the other six keramists mentioned above as "following Chinese fashions. It is this, that whereas the latter produce their chromatic effects by mixing the colouring matter with the glaze, Seifu paints the biscuit with a pigment over which he runs a translucid colourless glaze. The Kyoto artist's process is much easier than that of his rivals, and although his monochromes are often of most pleasing delicacy and fine tone, they do not belong by any means to the same category of technical excellence as the wares they imitate. From this judgment must be excepted, however, his ivory-white and. ciladon wares, as

well as his porcelains decorated with blue, or blue and red sous couverte, and with vitrifiable enamels over the glaze. In these five varieties he is emphatically great.

It cannot be said, indeed, that his ciladon shows the velvety richness of surface and tenderness of colour that distinguished the old Kuang-yao and Lungchuan-yao of China, or that he has ever essayed the moss-edged crackle of the beautiful Ko-yao. But his cMadon certainly equals the more modern Chinese examples from the Kang-hsi and Yung-cheng kilns. As for his ivory-white, it distinctly surpasses the Chinese Ming Chen-yao in every quality except an indescribable intimacy of glaze and pdte which probably can never be obtained by either Japanese or European methods.

Miyagawa Shozan, or Makuzu, as he is generally called, has never followed Seifii's example in descending from the difficult manipulation of coloured glazes to the shoza^" comparatively simple process of painted biscuit. This comment does not refer, it need scarcely be said, to the use of blue and red sous couverte. In that

class of beautiful ware the application of pigment to the unglazed pdte is inevitable, and both Seifu and Miyagawa, working on the same lines as their Chinese predecessors, produce porcelains that almost rank with choice Kang-hsi specimens, though they have not yet mastered the processes sufficiently to employ them in the manufacture of large imposing pieces or wares of moderate price. But in the matter of true monochromatic and polychromatic glazes, to Shozan belongs the credit of having inaugurated Chinese fashions, and if he has never fully succeeded in achieving Lang-yao (sang-de-boeuf), Chi-hung (liquid-dawn red), Chiang-tow-hung (bean-blossom red, the " peach-blow" of American collectors), or above all Pin-Jcwo-tsing (apple-green with red bloom), his efforts to imitate them have resulted in some very interesting pieces.

Takemoto and Kato of Toky6 entered the field subsequently to Shozan, but follow the same models approximately. Takemoto, however, has made a l^ramists Speciality of black glazes, his aim being to rival the Sung Ghien-yao, with its glaze of mir-

ror-black or raven's-wing-green, and its leveret-fur streaking or russet-moss dappling, the prince of all wares in the estimation of the Japanese tea-clubs. Like Shozan, he is still very far from his original, but, also like Shozan, he produces highly meritorious pieces in his efforts to reach an ideal that will probably continue to elude him forever. Of Kato there is not much to be said. He has not succeeded in winning great distinction, but he manufactures some very delicate monochromes, fully deserving to be classed among prominent evidences of the new departure. Tokyo was never a centre of keramic production. Even during the 300 years of its conspicuous prosperity as the administrative capital of the Tokugawa Shoguns, it had no noted factories, doubtless owing to the absence of any suitable potter's clay in the immediate vicinity. Its only notable production of a keramic character was the work of Miura Kenya (1830^3), who followed the methods of the celebrated Haritsu (1688-1704) of Kyoto in decorating plain or lacquered wood with Mosaics of Baku faience having coloured glazes.

Kenya was also a skilled modeller of figures, and his factory in the Imado suburb obtained a considerable' reputation for work of that nature. He was succeeded by Tozawa Benshi, now an old man of over seventy, who, using clay from Owari or Hizen, has turned out many porcelain statuettes of great beauty. But al-though the capital of Japan formerly played only an insignificant part in Japanese keramics, modem Tokyo has an important school of artist-artisans. Every year large quantities of porcelain and faience are sent from the provinces to the capital to receive surface decorar tion, and in wealth of design as well as carefulness of execution the results are praiseworthy. But of the pigments employed nothing very laudatory could be said until very recent times. They were generally crude, of impure tone, and without depth or brilliancy. Now, however, they have lost these defects and entered a period of considerable excellence. As for the nature of the designs, it may fairly be said that figure-subjects constitute their chief feature. A majority of the artists

are content to copy old pictures of Buddha's Sixteen Disciples, the Seven Gods of Happiness, and other similar assemblages of mythical or historical personages, not only because such work offers large opportunity for the use of striking colours and the production of meretricious effects, dear to the eye of the average Western householder and globe-trotter, but also because a complicated design, as compared with a simple one, has the advantage of hiding the technical imperfections of the ware. Of late there have happily appeared some decorators who prefer to choose their subjects from the natural field in which their great predecessors of former times excelled, and there is reason to hope that this more congenial and more pleasing style will supplant its modern usurper. The best known factory in Tokyo for decora-tive purposes is the Hy5chi-en. It was established in the Eukagawa suburb in 1876, with the immediate object of preparing specimens for the first Tokyo Exhibition held at that time. Its founders obtained a measure of official aid, and were able to secure the services of some

good artists, among whom may be mentioned Obanawa and Shimauchi. The porcelains of Owari and Arita naturally received most attention at the hands of the Hyochi-en decorators, but there was scarcely one of the principal wares of Japan upon which they did not try their skill, and if a piece of monochromatic Minton or Sevres came in their way, they undertook to improve it by the addition of designs copied from old masters or suggested by modern taste. To all such pieces the cachet of the Eukagawa atelier was indiscriminately applied, and has probably proved a source of considerable confusion to collectors. Many other factories for decoration were established from time to time in Tokyo. Of these some still exist; others, ceasing to be profitable, have been abandoned. On the whole, the industry may now be said to have assumed a domestic character. In a house, presenting no distinctive features whatsoever, one finds the decorator with a cupboard full of bowls and vases in

[pottery

glazed biscuit, which he adorns, piece by piece, using the simplest conceivable apparatus and a meagre supply of pigments. Sometimes he fixes the decoration himself, employing for that purpose a small kiln which stands in his back garden ; sometimes he entrusts this part of the work to a factory where greater facilities are provided. As in the case of everything Japanese, there is no pretence, no useless expenditure about the process. Yet it is plain that this school of Tokyo decorators, though often choosing their subjects badly, have contributed much to the progress of the keramic art during the past few years. Little by little there has been developed a degree of skill which compares not unfavourably with the work of the old masters. Table services of Owari porcelain — the ware itself excellently manipulated and of almost egg-shell fineness — are now decorated with floral scrolls, landscapes, insects, birds, figure-subjects, and all sorts of designs, chaste, elaborate, or quaint ; and these services, representing so much artistic labour and originality, are sold for

prices that bear no due ratio to the skill required in their manufacture. There is only one reservation to be made in speaking of the modern decorative industry of Japan under its better aspects. It is a reservation applying equally to the work done in T5ky6, Ky6t8, Yokohama, and Kobe, in all of which places decorating ateliers (etsuke-dokoro), similar to those of Tokyo, have been established in modern times : the artists use chiefly pigments, seldom venturing to employ vitrifiable enamels. That the results achieved with these different materials are not comparable is a fact which every connoisseur must admit. The glossy surface of a porcelain .glaze is ill fitted for rendering artistic effects with ordinary colours. The proper field for the application of these is the biscuit, in which posi-tion the covering glaze serves at once to soften and to preserve the pigment. It can scarcely be doubted that the true instincts of the keramist wiU ultimately counsel him to confine his decoration over the glaze to vitrifiable enamels, with which the Chinese and Japanese potters of former times obtained such brilliant results. But to employ

enamels successfully is an achievement demanding special training and materials not easy to procure or to prepare. The Tokyo decorators are not likely, therefore, to change their present methods immediately. An impetus was given to keramic decoration by the efforts of a new school, which owed its origin to Dr G. Wagener, an eminent German expert formerly in the service of the Japanese Government. Dr Wagener conceived the idea of developing the art of decoration under the glaze, as applied to faience. Faience thus decorated has always been exceptional in Japan. Eare specimens were produced in Satsuma and KySto, the colour employed being chiefly blue, though brown and black were used in very exceptional instances. The difficulty of obtaining clear, rich tints was nearly prohibitive, and though success, when achieved, seemed to justify the effort, this class of ware never received much attention in Japan. By careful selection and preparation of pdte, glaze, and pigments, Dr Wagener proved not only that the manufacture was reasonably feasible, but also that decoration thus applied to pottery

possesses unique delicacy and softness. Ware manufactured by his direction at the T6kyo School of Technique {Shokkd Qakkff), under the name of Asahi-yaki, ranks among the interesting productions of modern Japan. The decorative colour chiefly employed is chocolate brown, which harmonizes excellently with the glaze. But the ware has never found favour in Japanese eyes, an element of unpleasant garishness being imparted to it by the vitreous appearance of the glaze, which is manufactured according to European methods. The modern faience of Ito Tozan of KySto, decorated with colour under the glaze, is incomparably more artistic than the Tokyo Asahi-yaki, from which, nevertheless, the Kyoto master doubtless borrowed some ideas. The decorative industry in Tokyo owed much also to the Kosho-Kaisha, an institution started by Messrs Wakai and Matsuo in 1873, with official assistance. Owing to the intelligent patronage of this company, and the impetus given to the keramic trade by its enterprise, the style of the TokyS etsuke was much improved and the field

of their industry extended. It must be acknowledged, however, that the TokyS artists often devote their skill to purposes of forgery, and that their imitations, especially of old Satsuma-yaki, are sometimes franked by dealers whose standing should forbid such frauds.

In this context it may be mentioned that, of late years, decoration of a remarkably microscopic character has been successfully practised in Kyot8, Osaka, and Kobe, its originator being Meisan of Osaka. Before dismissing the subject of modern Tokyo keramics, it may be added that Kato Tomataro, mentioned above in connexion with the manufacture of special glazes, has also been very successful in producing porcelains decorated with blue sous couverte at his factory in the Koishikawa suburb.

Higuchi of Hirado is to be classed with keramists of the new school on account of one ware only, namely, porcelain having translucid decoration, the so-called " grains-of-rice " of American collectors, Modern designated " fire-fly style" Qiotanu-de) in Japan, h^^o/

That, however, is an achievement of no small consequence, especially since it had never previously been essayed outside China. The Hirado expert has not yet attained technical skill equal to that of the Chinese. He cannot, like them, cover the greater part of a specimen's surface with a lacework of transparent decoration, exciting wonder that pdte deprived so greatly of continuity could have been manipulated without accident. But his artistic instincts are higher than those of the Chinese, and there is reasonable hope that in time he may excel their best works. In other respects the Hirado factories do not produce wares nearly so beautiful as those manufactured there between 1769 and 1840, when the Hirado-yaki stood at the head of all Japanese porcelain on account of its pure, close-grained pdte, its lustrous milk-white glaze, and the soft clear blue of its carefully executed decoration.

The Owari potters were slow to follow the lead of Miyagawa Shozan and Seifu Yohei. At the industrial exhibition in Kyoto in 1895 the first results of their

efforts were shown, attracting attention at once. o^”’

Owari, though from the abundance of the output

of its Seto kilns the Japanese generic term for keramic

ware (setomono) is derived, never deserved to be reckoned

among the centres of art production. In mediaeval times

it was celebrated for faience glazes of various colours,

much affected by the tea-clubs, but its staple manufacture

from the beginning of the 19th century was porceMn

decorated with blue under the glaze, the best specimens

of which did not approach their Chinese prototypes in

fineness of pdte, purity of glaze, or richness of colour.

During the first twenty-five years of the 3fe>Ji era the

Owari potters sought to compensate the technical and

artistic defects of their pieces by giving to them magnifi-

cent dimensions ; but at the Tokyo industrial exhibition

of 1891 they were able to contribute some specimens

showing decorative, plastic, and graving skill of no

mean order. Previously to that time, one of the Seto

experts, Kato Gosuke, had developed remarkable ability

m the manufacture of c(}Iadon, though in that field he

was subsequently distanced by Seifu of Kyoto. Only lately did Owari feel the influence of the new movement towards Chinese types. Its potters took flamM glazes enamel]

Ware ot

Kaga.

for models, and their pieces of that nature possessed an air of novelty that attracted connoisseurs. But the style was not calculated to win general popularity, and the manufacturing processes were too easy to occupy the attention of great potters. On a far higher level stood egg-shell porcelain, remarkable examples of which were sent from Seto to the Ky6t6 industrial exhibition of 1895. Chinese potters of the Yung-lo era (1403-14) enriched their country with a quantity of ware to which the name of totai-Jci (bodiless utensil) was given on account of its wonderfully attenuated pdte. The finest specimens of this porcelain had incised decoration, sparingly employed but

adding much to the beauty of the piece. In subsequent eras the potters of Ching-te-chen did not fail to continue this rema,rkable manufacture, but its only Japanese repre-sentative was a porcelain distinctly inferior in more than one respect, namely, the egg-shell utensils of Hizen and Hirado, some of which had finely woven basket-cases to protect their extreme fragility. The Seto experts, how-ever, are now making bowls, cups, and vases that rank nearly as high as the celebrated Yung-lo totai-ki. In purity of tone and velvet-like gloss of surface there is distinct infferiority on the side of the Japanese ware, but in thinness otpdte it supports comparison, and in profusion of beauty of incised decoration it excels its Chinese original.

Latest of all to acknowledge the impulse of the new departure have been the potters of Kaga. Por many years their ware enjoyed the credit, or discredit, of being the most lavishly decorated porcelain in Japan. It is known to Western collectors as a product blazing with red and gold, a very degenerate

offspring of the Chinese Ming type, which Hozen of Kyoto reproduced so beautifully at the beginning of the 19th century under the name of Eiralcvryaki. Undoubtedly the best specimens of this kinranrde (brocade) porcelain of Kaga merit praise and admiration ; but, on the whole, ware so gaudy could not long hold a high place in public esteem. The Kaga potters ultimately appreciated that defect. They still manufacture quantities of tea and coffee sets, and dinner or dessert services of red-and-gold porcelain for foreign markets; but about 1885 some of them made zealous and patient efforts to revert to the processes that won so much fame for the Kutani-yaki in the old times, with its grand combinations of rich, lustrous, soft-toned glazes. The attempt was never entirely successful, but its results restored something of the Kaga kilns' reputation. Since 1895, again, a totally new departure was made by Morishita Hachizaemon, a keramic expert, in conjunction with Shida Yasukyo, president of the Kaga Products Joint Stock Company {Kaga Bussan Kabushiki

Kaisha) and teacher in the Kaga Industrial School.

The line chosen by these keramists is purely Chinese.

Their great ^lim seems to be the production of the

exquisite Chinese monochromes known as u-kwo-tien4sing

(blue of the sky after rain) and yueh-peh (clair-de-lune),

into the composition of both of which glazes gold

enters. But they also devote much attention to porce-

lains decorated wjth blire or red sous couverte. Their

work shows much promise, but like all fine specimens of

the Sinico-Japanese school, the prices are too high to at-

tract wide custom.

The sum of the matter is that the modern Japanese

keramist, after many efforts to cater for the taste of the

Occident, evidently concludes that his best

ammary. j^^pg consists in devoting all his technical and

artistic resources to reproducing the celebrated wares of

China. In explanation of the fact that he did not essay

this route in former times, it may be noted, first, that he

had only a limited acquaintance with the wares in question ;

secondly, that Japanese connoisseurs never attached any

value to their countrymen's imitation of Chinese porce-
lains so long as the originals were obtainable ; thirdly,
that the keramic art of China not having fallen into its
present state of decadence, the idea of competing with it
did not occur to outsiders ; and fourthly, that Europe
and America had not developed their present keen ap-
preciation of Chinese masterpieces. Yet it is remarkable
that China, at the close of the 19th century, should have
again furnished models to Japanese eclecticism. There
are reasons which render it doubtful whether the
Japanse potter, without a radical change of technical
methods, will ever reach the level upon which the
Chinese masters stood, but it is very probable that he may
produce en route many beautiful and excellent varieties of
porcelain.

Cloisonnd Enamel. — Cloisonne enamel is a branch of
applied art which may be considered essentially of modem
development in Japan. The process was known
*at an early period, and was employed for pur- * *”’”*
poses of subsidiary decoration from the close of the 16th

century, but not until the 19th century did Japanese experts begin to manufacture the objects known in Europe as " enamels " ; that is to say, vases, plaques, censers, bowls and so forth, having their surface covered with vitri-fied pastes applied either in the cliamplevi or the cloisonni style. It is necessary to insist upon this fact, because the only European author who has attempted to discuss the subject of Japanese enamels at any length fell into the serious error of supposing that numerous specimens which began to be exported from 1865 were the outcome of industry commencing in the 16th century and reaching its point of culmination at the beginning of the 18th. There is not the slenderest ground for such a theory. The work began in 1838, and Kaji Tsunekichi of Owari was its originator. Without pausing here to describe the circumstances that led to this innovation, it will be sufS.-cient to say that, during twenty years previously to the reopening of the country in 18‘58, cloisonni enamelling was practised in the manner now understood by the term, and that when foreign merchants began to settle

in Yokohama several experts were working skilfully in Owari after the methods of Kaji Tsunekichi. Up to that time there had been little demand for enamels of large dimensions, but when the foreign market called for vases, censers, plaques, and such things, no diflB-Culty was found in supplying them. Thus, about the year 1865, there commenced an export of enamels which had no proto-types in Japan, being destined frankly for European and American collectors. Erom a technical point of view these specimens had much to recommend them. The base, usually of copper, was as thin as cardboard ; the cloisons, exceedingly fine and delicate, were laid on with care and accuracy ; the colours were even, and the designs showed artistic judgment. Two faults, however, marred the work — first, the shapes were clumsy and unpleasing, being copied from bronzes whose solidity justified forms unsuited to thin enamelled vessels ; secondly, the colours, sombre and somewhat impure, lacked the glow and mellowness that give decorative superiority to the technically inferior Chinese enamels of the later Ming and early Tsing eras.

Very soon, however, the artisans of Nagoya (Owari), Yokohama, and T6ky5 — ^where the art had been taken up — found that faithful and fine workmanship did not pay. The foreign merchant desired' many and cheap specimens for export, rather than few and costly. There followed then a period of gradual decline, and the enamels exported to Europe showed so much inferiority that they were supposed to be the products of a widely different era and of different makers. The industry was threatened with extinction, and would certainly have dwindled to

[lacquer

New

schools.

insignificant dimensions had' not a few earnest artists, working in the face of many difficulties and discourage-ments, succeeded in striking out new lines and establish-ing new standards of excellence.

Three clearly differentiated schools now (1875) came into existence. One, headed by Namikawa Yasuyuki of Kyoto, took for its objects the utmost delicacy and perfection of technique, richness of decoration, purity of design, and harmony of colour. The thin clumsily-shaped vases of the Kaji school, with their uniformly distributed decoration of diapers, scrolls, and arabesques in comparatively dull colours, ceased altogether to be produced, their place being taken by graceful specimens, technically flawless, and carrying designs not only free from stiffness, but also executed in colours at once rich and soft. This school may be subdivided, Ky6t6 representing one branch, Nagoya, Tokyo, and Yokohama the other. In the products of the Kyoto branch the decoration generally covered the whole surface of the piece; in the products of the other branch the artist aimed rather at pictorial effect, placing the design in a monochromatic field of low tone. It is plain that such a method as the latter implies great command of coloured pastes, and, indeed, no feature of the

manufacture is more conspicuous than the progress made during the period 1880-1900 in compounding and firing vitrifiable enamels. Many excellent examples of cloisonne enamel have been produced by each branch of this school. There is nothing like them to be found in any other country, and they stand at an immeasurable distance above the works of the early Owari school represented by Kaji Tsunekiehi and his pupils and colleagues.

The second of the modem schools is headed by Namikawa Sosuke of T5kyo. It is an easily traced outgrowth of the second branch of the first school just cioisoaiess described, for one can readily understand that from placing the decorative design in a monochromatic field of low tone, which is essentially a pictorial method, development would proceed in the direction of concealing the mechanics of the art in order to enhance the pictorial effect. Then arose the so-called " cloisonless enamels" (musenjippd). They are not always without cloisons. The design is generally framed at the outset

with a ribbon of thin metal, precisely after the manner of ordinary doisonnS ware. But as the work proceeds the cloisons are hidden — ^unless their presence is necessary to give emphasis to the design — and the final result is a picture in vitrified enamels.

The characteristic productions of the third among the modern schools are monochromatic and translucid enamels. All students of the keramio art know that the dimmatic moi^ochromeporcelains of China owe their beauty enamels, to the fact that the colour is in the glaze, not under it. The keramist finds no difficulty in applying a uniform coat of pigment to porcelain biscuit, and covering the whole with a diaphanous glaze. The colour is fixed and the glaze set by secondary firing at a lower temperature than that necessary for hardening the pdte. S,uch porcelains, however, lack the velvet-like soft-ness and depth of tone so justly prized in the genuine monochrome, where the glaze itself contains the colouring matter, pdte and glaze being fired simultaneously at the same high temperature. It is apparent that a vitrified

enamel may be made to perform, in part at any rate, the function of a porcelain glaze. Acting upon that theory, the experts of T6ky5 and Nagoya have produced many very beautiful specimens of monochrome enamels — yellow (canary or straw), rose du Barry, liquid-dawn red, auber-gine purple, green (grass or leaf), dove-gray and lapis-lazuli blue. These pieces do not quite reach the level of Chinese monochrome porcelains, but their inferiority is not marked. The artist's great difficulty is to hide the metal base completely. A monochrome loses much of its attractiveness when the colour merges into a metal rim, or when the interior of a vase is covered with crude unpolished paste. But to spread and fix the enamel so that neither at the rim nor in the interior shall there be any break of continuity, or any indication that the base is copper, not porcelain, is a tour deforce demanding qiiite exceptional skill.

The translucid enamels of the modern school are gener-ally associated with decorative bases. In other words, a suitable design is chiselled in the metal base so

as to be visible through the diaphanous enamel. l^^°^ll^'^ Very beautiful effects of broken and softened lights, combined with depth and delicacy of colour, are thus obtained. But the decorative designs which lend themselves to such a purpose are not numerous. A gold base deeply chiselled in wave diaper and overrun with a paste of aubergine purple is the most pleasing. A still higher achievement is to apply to the chiselled base designs executed in coloured enamels, finally covering the whole with translucid paste. Admirable results are thus produced; as when, through a medium of cerulean blue, bright goldfish and blue-backed carp appear swimming in silvery waves, or brilliantly-plumaged birds seem to soar among fleecy clouds. The artists of this school show also much skill in using enamels for purposes of subordinate decoration — ^for example, suspending enamelled butterflies, birds, floral sprays, &c., among the reticulations of a silver vase chiselled d, jour ; or filling with translucid enamels parts of a decorative scheme sculptured in iron, silver, gold, or shakudo.

It will be seen at once that Japanese workers in doisonn& enamels have made immense strides since the days when they sent to Europe specimens such as those depicted in Mr Audsley's book on The Oi-namental Arts of Japan. The art may indeed be said to have been developed during the last quarter of the 19th century from a condition of comparative crudeness to one of unparalleled excellence. There was no reason to anticipate that the Japanese would take the lead of the world in this branch of applied art. They had no presumptive title to do so. Yet they certainly have done so. (r. by.)

Lacquer. — The early history of the art of lacquer work in Japan consists of references to it in the ancient chronicles, and to the creation of official posts for its regulation, which go back to a date as early as the 3rd century b.c. These statements may not be of absolute authenticity, but it is indisputable that the industry existed at that time or soon afterwards, and at an extraordinarily early period a very considerable amount of skill had been developed in working it. In the temple at Nara are still preserved

specimens of lacquer work attributed to the 3rd century of our era, and a series of objects which certainly belonged to Shotoku Daishi (died a.d. 621), as well as other examples but little later in date. The art became popular, and was always in high favour among the aristocracy, so that from this time numerous records of its progress are found, as well as a continuous series of examples. Up to the end of the 12th century the art had been practised at Kyoto; but the first Shoguns removed the capital at that time to Kamakura, which thus became its centre for the next 200 years, after which it again followed the seat of the main Government. Among the many skilled artists who have practised this beautiful craft since the first on record, Kiyohara Norisuye (c. 1169), may be mentioned Koyetsu (1558-1637) and his pupils, who are especially noted for their inro (medicine-cases worn as part of the costume); Ka3ikawaKinjir5(c. 1680), the founder of the engkaving]

great Kajikawa family, wHch continued up to the 19th century ; and Koma Kiuhaku (d. 1715), whose pupils and descendants maintained his traditions for a period of equal length. Of individual artists, perhaps the most notable is Ogata Korin, whose skill was equally great in the arts of painting and pottery. He was the eldest son of an artist named Ogato S5ken, and -studied the styles of the Kan5 and Tosa schools successively. Among the artists who influenced him were Kaiio Tsunenobu, Nomura Sotatsu, and Koyetsu. His lacquer ware is distinguished for a bold and at times almost eccentric impressionism, and his use of inlay is strongly character-istic. He died in 1716 at an age variously stated by Japanese authorities as fifty-five and fifty-nine. Eitsuo (1663-1747), a pupil and contemporary of K6rin, and like him a potter and painter also, was another laoquerer of great skill. Then followed Hanzan, the two Shiome, Yamamoto ShunshS and his pupils, Yamada Joka and Kwanshosai T6y6 (late 18th century). In the beginniag of the 19th century worked Shokwasai, who frequently

collaborated with the metal-worker Shibayama, encrusting his lacquer with small decorations in metal by the latter. The greatest laoquerer of the 19th century was, however, Shifaata Zeshin (a pupil of Koma Kwansai), who died, in 1891, and to whose efforts and influence the survival of the making of good art lacquer ware in Japan at the present time is undoubtedly due. His pupil, Ikeda Taishin, was alive in 1894, and his son, Eeisai Shibata, has also produced excellent work on the lines of that of his father. It is of interest to note that the Official Report of the Third National Industrial Exhibition of Japan classified the lacquer workers of T6ky6 into five groups, headed by the following artists respectively ; — 1. Shibata Zeshin ; 2. Ogawa Sh6mia ; 3. Shirayama Shoya ; 4. Kawanobe Itcho ; 6. Uyematsu Homin. With the growth of commerce with the West there was a great danger that this beautiful and laborious art would be vulgarized in order to meet the demand in Europe for cheap imitations of the old wares ; but although the modem productions are perhaps hardly

quite up to the level of those of bygone days, still they do retain very considerable artistic qualities, and the patronage extended to the lacquerers by the Court and aristocracy of Japan is still suf&cient to preserve it as a living art. (See also Lacquee.)

Ahthorities. — QniN. Beport by H.M. Acting Consul at Sako-date ore the Lacqiter Industry of Japan. Japan, No. 3, 1882. — GiLBERTSON. Japanese Lacquer. Burlington Fine Arts Club. Catalogue of Exhibition, 1894. — Bing. Artistic Japan. Asiatic Society of Japan. Transactions. — Japan Society. Transactions. — AnDSLET. The Ornamental Arts of Jopare.— Tomkinson. A Japanese Collection. (e. f. s.)

Engraving. — Although a little engraving on copper has been practised in Japan of late years, it is of no artistic value, and the only branch of the art which calls for recognition is the cutting of wood-blocks for use either with colours or without. This, however, is of supreme importance, and as its technique differs in most respects from the European practice, it demands a somewhat de-tailed description. The wood used is generally that of

the cherry-tree, saJcura, which has a grain of peculiar evenness and hardness. It is worked plank-wise to a surface parallel with the grain, and . not across it. A design is drawn by the artist, to whom the whole credit of the production generally belongs, with a brush on thin paper, which is then pasted face downwards on the block. The engraver, who is very rarely the designer, then cuts the outlines into the block with a knife, after-wards removing the superfluous wood with gouges and chisels. Great skill is shown in this operation, which produces perhaps the finest facsimile reproduction of drawings ever known without the aid of photographic processes. A peculiar but highly artistic device is that of gradually rounding off the surfaces where necessary, in order to obtain in printing a soft and graduated mass of colour which does not terminate too abruptly. In printing with colours a separate block is made in this manner for each tint, the first containing as a rule the mere lines of the composition, and the others providing for the masses of tint to be applied. In all printing the

paper is laid on the upper surface of the block, and the impression rubbed off with a circular pad, composed of twisted cord within a covering of paper, cloth, and bamboo-leaf, and called the baren. In colour-printing the colours, which are much the same as those in use in Europe, are mixed, with rice-paste as a medium, on the block for each operation, and the power of regulating the result given by this custom to an intelligent crafts-man (who, again, is neither the artist nor the engraver) was productive in the best period of very beautiful and artistic effects, such as could never have been obtained by any mechanical device. A register or correct super-position successively of each block of wonderful accuracy is got mainly by the skill of the printer, who is assisted only by a mark defining one corner, and another showing the opposite side limit. The origins of this method of colour-printing are obscure. It has been practised to some extent in China and Korea, but there is no evidence of its antiquity in these countries. It appears to be one of the few indigenous arts of Japan. But before accept-

ing this conclusion as final, one must not lose sight of the fact that the so-called chiaroscuro engraving was at the height of its use in Italy at the same time that embassies from the Christians in Japan visited Home, and that it is thus possible that the suggestion at least may have been derived from Europe. The fact that no traces of it have been discovered in Japan would be easily accounted for, when it is remembered that the examples taken home would almost certainly have been religious pictures, would have been preserved in well-known and accessible places, and would thus, likely enough, have been entirely destroyed in the terrible and minute extermination of Christianity by Hideyoshi at the beginning of the 17th century. The Japanese tradition ascribes the invention of colour-printing to Idzumiya Gonshiro, who about the end of the 17th century first made use of a second block to apply a tint of red (beni) to his prints. Sir Ernest Satow states more definitely that " Sakakibara attributes its origin to the year 1695, when portraits of the actor Ichikawa Dajiuro, coloured by this process,

were sold in the streets of Yedo for five cash apiece." The credit of the invention is also given to Torii Kiyo-nobu, who worked at about this time, and, indeed, is said to have made the prints above mentioned. But authentic examples of his work now remaining, printed in three colours, seem to show a technique too complete for an origin quite so recent. However, he is the first artist of importance to have produced the broadsheets — chiefly for many years portraits of notable actors, his-torical characters, and famous courtesans — which are the leadiag and characteristic use to which the art was applied. Pupils, the chief of whom were Kiyomasa, Kiyotsume, Kiyomitsu, Kiyonaga, and Kiyomiae, carried on his tradition untUthe end of the 18th century, the earlier using but few colours, while the works of the two last named show a technical mastery of all the capabilities of the process. The next artist of importance is Sazuki Harunobu (worked c. 1760-80), to whom the Japanese sometimes ascribe the invention of the process, probably on the grounds of an improvement in his technique, and

the fact that he seems to have been one of the first of the colour-print makers to attain great popularity. Katsukawa

[illustration

Shunsho (d. 1792) must next be mentioned, not only for the beauty of his own work, but because he was the first master of Hokusai; then Yeishi (worked c. 1781-1800), the founder of the Hosoda school ; Utamaro (1754-1806), whose prints of beautiful women were collected by Dutchmen while he was still alive, and have had in our own day a vogue greater, perhaps, than those of any other of his fellows; and Toyokuni I. (1768-1826), who especially devoted himself to broad-sheet portraits of actors and dramatic scenes. The greatest of all the artists of the popular school was, however, Hokusai (1760-1849). His most famous series of broadsheets is the "Thirty-Six Views of Mount Tuji" (1823-29), which, in spite of the conventional title, includes at least forty-six. His work is catalogued

in detail by E. de Goncourt. At the beginning of the 19th century the process was technically at its greatest height, and in the hands of the great landscape artist, Hiroshige I., as well as the pupils of Toyokuni I. — Kunisada and Kuniyoshi — and those of Hokusai, it at first kept up an excellent level. But an undue increase in the number of blocks used, combined with the badness of the imported colours and carelessness or loss of skill in printing, brought about a rapid decline soon after 1840. This continued until the old traditions were well-nigh exhausted, but since 1880 there has been a distinct revival. The prints of the present day are cut with great skill, and the designs are excellent, though both these branches seem to lack the vigour of conception and breadth of execution of the older masters. The colours now used are almost invariably of cheap German origin, and though they have a certain prettiness — ephemeral, it is to be feared— they again cannot compare with the old native productions. Among workers in this style, Yoshitoshi (died c. 1898) was perhaps the

best. Living artists in 1902 included Toshihide, Miyagawa Shuntei, Yoshiu Chikanobu — one of the elder generation — Tomisuka Yeishu, Toshikata, and Gekko. Formerly the colour-print artist was of mean extraction and low social position, but, thanks perhaps to European influence, he now has some recognition at the hands of the professors of more esteemed branches of art. (b. f. s.)

Illustrated Books. — The history of the illustrated book in Japan may be said to begin with the Ise Monogatari, a romance first published in the 10th century, of which an edition adorned with woodcuts appeared in 1608. In the course of the 17th century many other works of the same nature were issued, including some in which the cuts were roughly coloured by hand ; but the execution of these is of no great merit, and certainly not as good as con-temporary European work. The date of the first use of colour-printing in Japanese book illustration is uncertain. In 1667 a collection of designs for kimono appeared, in which inks of several colours are made use of ; but these are only employed in turn for single printings, and in no

case are two of them used on the same print. It is certain, however, that the mere use of coloured inks must soon have suggested the combination of two or more of them, and it is probable that examples of this will be discovered much earlier in date than known at present. About the year 1680 lived and worked Hishikawa Moronobu, whose vigour and artistic excellence achieved a great popularity for woodcut illustration, and laid the foundations of the splendid school which followed. The names of the engravers who cut his designs are not known, and in fact the reputation of these craftsmen is curiously subordinated to that of the designers in all Japanese work of the kind. Moronobu died between 1711 and 1716, at the age of about 70. With him must be associated Okumura Masanobu, i who was a little later perhaps in date, but whose work is also of considerable value. During the ensuing thirty years numerous illus-trated books appear, including the earliest yet known which are illustrated by colour-printing. The next artist of importance is Nishikawa Sukenobu (1671-

1751), who illustrated a very large number of books, many of which were only published after his death. With him may be associated Ichio Shumboku (died c. 1773) and Tsukioka Tange (1717-1786), the latter of whom made the drawings for many of the meishd or guide-books which form so interesting and distinctive a branch of Japanese illustration. The work of Tachi-bana Morikuni (1670-1748) is also of great importance. The books illustrated by the men of this school were mainly collections of useful information, guide-books, romances, and historical and religious compilations; but much of the best of their work is to be found in the collections of pictorial designs, very often taken from Chinese sources, which were produced for the use of workers in lacquer, pottery, and similar crafts. These, both for design and for skill of cutting, hold their own with the best work of European wood-cutting of any period. The development of the art of Japanese colour-printing naturally had its effect on book-illustration, and the latter years of the 18th and the

earlier of the 19th century saw a vast increase of books illustrated by this process. The subjects also now include a new series of landscapes and views drawn as seen by the designers, and not reproductions of the work of other men ; and also sketches of scenes and characters of every-day life, and of the folk-lore in which Japan is so rich. Of the artists of this period, as of all others in Japan, Hokusai • (1760-1849) is absolutely pre-eminent. His greatest production in book-illustration was the Mangwa, a pollection of sketches which cover the whole ground of Japanese life and legend, art and handicraft. It consists of fifteen volumes, which appeared at intervals from 1812 to 1875, twelve being published during his life and the others from material left by him. Among his many other works may be mentioned shortly the Azuma Asobi, " Walks round Yedo" (1799), The Hundred Views of Mount Fuji (1834), and his many illustrations to novels. Of his pupils, Hokkei (1780-1856) and Kiosai were the greatest. Most of the artists, whose main work was the designing of broadsheets, produced elaborately illustrated

books ; and this series includes specimens of printing in colours from wood-blocks, which for technique have never been excelled. Among them, as typical instances, should be mentioned Shunsho (Seird Bijin Awase kagami, 1776) ; Utamaro (Seird Nenjiu gioji, 1804) ; Toyokuni I. (Yakusha Kono Teikishvwa, 1801); as well as Harunobu Yeishi {Onna sanjiu rokkasen, 1798); Kitao Masanobu, and Tachibana Minko, each of whom produced beautiful work of the same nature.

In the period next following the chief artists were Keisai Yeisen (Keisai so-gwa, 1832), and Kikuchi Yosai (Zenken Kojitsu), the latter of whom ranks perhaps as highly as any of the artists who confined their work to black and white. The books produced in the period 1880-1900 in Japan are still of high technical excellence. The colours are, unfortunately, of cheap European manufacture ; and the design, although quite characteristic and often beautiful, is as a rule merely pretty.

The engraving is as good as ever. Among the book-illustrators of our own generation must be again men-

tioned Kiosai; K6no Bairei (d. 1895), whose books of

bn-ds— the Bairei Hyakuchd Ghoafu (1881 and 1884) and

/«afca-mo-rsMA;i(1889)— are unequalled of their kind ; Imao

Keinen, who also issued a beautiful set of illustrations of

birds and flowers, Keinen Kwachd Gfwafti, engraved by

Tanaka Jirokichi, and printed by Miki Nisaburo (1891-92) ;

litekatuee]

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R\u\ Watanabe Seitei, whose studies of similar subjects

licive appeared, in Seitei Kwachd Gwafu (1890-91) and the

BiJiUsu Sekai (1894), engraved by Gqt8 TokujirS. Men-

tion should also be made of several charming series of

fairy tales, of which that published in English by the

KobunsJia at Tokyo in 1886, &c., is perhaps the best. In

their adaptation of modern processes of illustration the

Japanese are entirely abreast of the Western nations,

the chromo-lithographs and other reproductions in

the Kokkwa, a periodical record of Japanese works of art

(begun in 1889), and in the publications of Ogawa being

of quite a high order of merit.

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These are the more modern authorities only, and cover the subject of Japanese engraving as well as of book-illustration.

(e. f. s.)

V. Recent Literature (1867-1900).

The downfall of the Shogunate was a fatal blow to the Chinese influences which for two and a half centuries had moulded every department of the Japanese national life — the political institutions, laws, science, philosophy, and literature. Signs of change were observable at an earlier period. In the latter part of the 18th century China had already lost some of its prestige, and the Dutch language with the European art of medicine had begun to be studied. But no substantial progress in the substitution of Europe for China as a source of knowledge and inspiration was made until the revolution which in 1867 restored the Mikado to his rightful position as sovereign. Under the new political conditions there were at first more

urgent matters to be attended to than the cultivation of literature. The constitution had to be rebuilt, the laws remodelled, an army and navy organized, and a national system of education establis|ied. Eor these purposes, however, the study of European models was indispensable, and was taken up with extraordinary zeal and energy by all the younger and more active minds. A group of writers now came forward who made it their business to meet the demand of their countrymen for information as to the manners and customs, the learning, science, and institutions of Europe. Of these the most eminent was Fukuzawa, whose Seiyo Jijo (" Tilings European ") was published in 1866, while a more recent work, an aiuto-biography, bears date 1899. The latter is a noteworthy document bearing on the spread of European ideas in Japan. Translations of English books appeared in increas-ing numbers, and about 1872 a fresh impulse was given to the dissemination of European knowledge by the rise of a magazine and newspaper press.

The influence of Europe on Japanese literature proper

dates from 1879, when a translation appeared of Lord Lytton's Ernest Maltravers. It attracted great attention, and was followed by other works of flction, mostly English. More recently, French, German, and even Russian novelists have Ijeen laid under contribution.

'The result has been a thorough revolution in the Japanese art of novel-writing. The artificial word-plays, conventional character-drawing, fantastic morality, and extravagances of every kind of the older romantic school, have now been in great measure abandoned in favour of a more sober, common-sense style of writing. Tsubolichi Yuzo was the leader of this movement. His Shdzetsu Shinsui (" Spirit of Fiction") is an unsparing attack on the methods and principles of Bakin and his school. He illustrated his views by novels and dramas, which have not only much intrinsic merit, but are valuable as pointing the way to a return to living realities. Bimy6sai writes in the colloquial dialect, which in Japan differs considerably in grammar and vocabulary from the literary language. His Natsu Kadachi is a series of short stories

which bear manifest traces of the influence of European models. Koyo in his realistic novels is also a writer in the colloquial dialect, the use of which for literary purposes has made great progress in recent years. Rohan is perhaps the most popular, as he is the most voluminous, writer of the present day. His historical novels ate distinguished by dignity of language and by a tone of moral sentiment which belongs more to the past than to the present. Ichiyo, who died in 1896 at the age of twenty-four, was the author of a series of novelettes of great promise. She took the human and especially the female heart for her province. Tliere is no little pathos in some of her stories, but it is to be regretted that the pleasure of their perusal is often marred, at least for European readers, by a subtlety or haziness of expression which borders on the unintelligible. Murai's Hinodeshima (1898-1900) is an entertaining study of New Japan, in which those who are interested in the curious moral and social results of the conflict between old and nevr, between China and Europe, will find much food for reflexion.

Fiction occupies as prominent a position in recent Japanese literature as it does in Great Britain or the United States, and the above-mentioned writers are only a few out of many. Both for quality and quantity it is the most important that Japan has yet seen.

Although European principles of historical criticism are to some extent known and appreciated in Japan, little practical progress has been made in writing historical works. There is no scarcity of books of this kind, but they are generally either epitomes of Chinese, Japanese, or European histories, or else mere collections of materials. Tokutomi Iichir5's SMrai no Nihon (" Japan of the Future ") is an attempt to forecast the future of Japan by a philosophical examination of its past history. It has received high praise, not only for its matter, but for its style. Other important works are Marquis Ito's Commentary on the Constitution, Nose Yei's Treatise on Education, and a History of Japanese Literature by Mikami and Takatsu.

Until recently the poetry of Japan consisted mainly of

short effusions in pure Japanese of seventeen or thirty-one syllables, forms of verse which afford no scope for the exercise of the poet's higher faculties. The publication in 1882 of a little work entitled Shintaishishd (" Poetry of New Form ") by three authors, one of whom was Toyama, a professor of the Imperial University, marks the beginning of a new era in the history of Japanese poetry. It consists of nineteen poems of no great length, only a few of which are original compositions, the remainder being with one exception verse translations from English poets. The writers follow the traditional rule of the alternation of phrases of five and seven syllables, which in Japan constitutes metre, but the influence of their foreign models is traceable in the division of their poems into stanzas of equal length, an improvement which has been largely followed. Their most striking innovation, however, is the free introduction of Chinese words, which, on account of their flagrantly exotic appearance, had hitherto been rigorously excluded from all but the most vulgar forms of verse. A rule which debarred the use of such common

words as budd (vine), Tokyo (the name of the capital), honshin (conscience), was bound sooner or later to be • relaxed, but Toyama probably went too far in this direction. The most successful poets of the new school are far more sparing in their use of Chinese vocables. In

their choice of themes and mode of treatment, Toyama and his collaborators are avowedly influenced by their English models. A lively controversy between old and new was aroused by this publication. The new school is at present unquestionably in the ascendant, and though the old thirty-one-syllable poems are still written, they must be regarded rather as literary exercises than as literature. The real poetry of Japan is exemplified by such works as Hana Momiji by Shiwoi Uko and two others, Natsumushi Suzumushi by Usuda, and Wakana-SMu by Shiwozaki, collections of vague and dreamy, but pleasing and melodious lyrics, which give promise of better days for the art of poetry in Japan.

Authorities. — A History of Japanese Literature, by W. G. Aston. — Various articles In the Japan Weekly Mail. — B. H. CHAMBEnLAW. Things Japanese, third edition ; and his Moji no Shirube. ‘ (w. G. As.)

Jarkent, or Djaekent, a district town of Russian Central Asia, province Semiryechensk, 163 miles east of Yyernyi, near to Hi river. It has a customs house for trade with China. Population (1897), 16,372.

Jaromierz (Czech, Jaromef), a town in the government district of Koniginhof in Bohemia. It has two suspension bridges across the Elbe, and is a station on the Austrian North- Western railway. It has manufactures of chicory, sugar, jute, and textiles, and has a number of steam mills and brickfields. Population (1890), 6543, mostly Czech and Eoman Catholic ; (1900), 6671.

Jaroslau, the chief town of a government district in Galicia”, Austria, on the left bank of the San, a tributary of the Vistula, and a station on the Austrian State railway between Cracow and Lemberg. It is the military headquarters of the district and has a garrison of

4964 men. The manufactures comprise linen, spodium or tutty, bricks and tiles, pottery, spirits, &c., and there is a considerable trade in hides, corn, and timber. Popular tion (1890), 18,065 ; (1900), 22,614.

Jarrow-on-Tyne, a municipal borough (1875, extended 1884) in the Jarrow parliamentary division of County Durham, England, 6 miles east of Gateshead by rail. St Peter's Church was erected in 1881, and a chapel of ease in 1885, besides a mission church and Eoman Catholic, Congregational, Baptist, Presbyterian, Wesleyan, and other places of worship. The area of the borough is 1064 acres. Population (1881), 26,483; (1901), 34,294.

J assy, in Rumanian last, a town of Rumania, chief town of the district of Jassy and the former capital of Moldavia, is situated 6 miles west of the Pruth, at the junction of railways from Galatz, Czernowitz, and Odessa. The town stands pleasantly amid vineyards and gardens, partly on the slopes of two hills, partly in the hollow between them, and is the see of an archbishop of the Orthodox Greek Church and of a bishop of the Roman

Catholic Church ; the seat of a university with about 420 students, a military school, music school, art school, and commercial school ; and has an active trade in cereals, petroleum, salt, textiles, clothing, and metals. Population (1900), 78,067. Population of the district of Jassy (1900), 191,828 ; area, 1201 square miles.

Jath, a native state of India, in the Deccan division of Bombay, ranking as one of the Southern Mahratta Zagirs. Area (together with Daphlapur), 979 square miles. The population in 1881 was 49,486; in 1891 71,443; average density (with Daphlapur), 81 persons per square mile; estimated gross revenue, Rs.4,05,195 of which Rs.10,243 was devoted to public works in 1897-^ 1898;, tribute, Rs.6400; number of police, 72; number of schools, 27, with 870 pupils. The chief, whose title is Deshmukh, is a Mahratta of the Daphle family. The town of Jath is 92 miles south-east of Satara. Population (1891), 6264.

Jativa, a town of Spain, in the province of Valencia, on the railway from Madrid to Valencia. The popula-

tion is decreasing, and in 1897 was only 11,830. It is a centre for trade in the agricultural products of the fertile surrounding districts — wheat, fruit of all kinds, raisins, wine, oil, and rice. Several public buildings have been erected, including an institute, a foundling hospital, a bull-ring, two theatres, fine markets, and public lavatories.

Jauer, a town of Prussia, province of Silesia, 13 miles by rail south of Liegnitz, on the Roaring (Wiithende) Neisse. It has a new town hall (1898), and is famous for its cooked sausages. The chief industries include sugar, carpets, leather, cloth, and carriages. Population (1886), 11,178; (1896), 11,978; (1900), 13,027.

Jaunpur, a city and district of British India, in the Benares division of the North-West Provinces. The city is on the left bank of the river Gumti, 34 miles north-west from Benares by rail. Population (1881), 44,845; (1891), 42,819 ; (1901), 42,532 ; municipal income (1897-1898), Rs.35,178 ; incidence of taxation, R.0:9:3 per head ; registered death-rate (1897), 46-29 per thousand. The city has lost its importance, the only industry surviving

being the manufacture of perfumes. The district of Jauistpuk has an area of 1660 square miles. The population in 1881 was 1,209,663 ; in 1891, 1,264,949, showing an increase of nearly 5 per cent. ; average density, 810 persons per square mile, being the highest in the province. In 1901 the population was 1,202,710, showing a decrease of 5 per cent. The land revenue and rates were Es. 12,56,047, the incidence of assessment being just under R.l per acre; cultivated area (1896-97), 600,666 acres, of which 351,540 were irrigated entirely from private wells ; number of police, ■ 2612 ; number of vernaoular schools (1896-97), 112, with 4671 pupils; registered death-rate (1897), 36-40 per thousand. There are five printing-presses, all owned by Mahommedans, issuing one vernacular newspaper ; 161 indigo factories, employing 5474 persons, with an out-turn valued at Rs.2,11,000. The district is crossed by the line of the Oudh and Rohilkhand railway from Benares to Eyzabad.

Jaureguiberry, Jean Bernard (1815-1887),

French admiral, was born at Bayonne, 26th August

1815. He entered the navy in 1831, was made a lieu-tenant in 1845, commander in 1856, and captain in 1860. After serving in the Crimea and in China, and being governor of Senegal, he was promoted to rear-admiral in 1869. During the Franco-German war he had a command under Chanzy, and was repeatedly mentioned in despatches for his brilliant conduct and remarkable tenacity. He was promoted to be vice-admiral on 9th December 1870 ; and in the following January he played a brilliant part at the battle of Le Mans. In 187f he commanded the fleet at Toulon ; in 1875 he was a member of the council of admiralty ; and in October 1876 he was appointed to command the evolutionary squadron in the Mediterranean. In February 1879 he became minister of the navy in the Waddington cabinet, and on the 27th May following was elected a senator for life. He was again minister of the navy in the Freyeinet cabinet in 1880. He was made commander of the Legion of Honour in 1861, grand officer on 17th November 1870, and grand cross on 14th January 1879. A fine example of the

fighting French seaman of his time, Jaureguiberry died at Paris on the 21st of October 1887.

JAVA

Java, an island of the Malay (or Eastern) Archipelago, chief of the Dutch foreign possessions. It has a total area, with Madura, of 50,390 square miles.

Physical Features. — Three points in the geology of Java are important. (1) Like Sumatra and Borneo, Java was for several geological periods united with south-eastern Asia; hence the shallowness of the sea to the north, contrasting with the greater depth on the south in the direction of the Indian Ocean. (2) During the Triassic and Jurassic, though not during the Cretaceous era, Java, like Sumatra, was raised above sea-level, and in the Eocene and Oligocene periods subsided to below it. The strata of the late Tertiary era, broken and folded, constitute with their eruptive rocks the prevalent formation of Java. They compose the steep coasts and mountains up to 2950 feet high, and, at a lower level, the deep bays

and gulfs of the straits of Sunda and Bali on the extreme east and west and of parts of the south coast, such as the gulfs of Prigi and Patjitan. (3) Later formations, viz., diluvial tuffs and alluvium of rivers and seas, gradually silting up bays and lakes and extending the coasts, served ultimately to piece together into one island the separate islands (at least eight) of which in that age Java consisted. Volcanoes especially have played a great part in giving to Java its present shape and char-acter of surface. How far the younger formations prevail over the older rocks will be evident from the following arithmetical determinations : — All rocks dating from before the late Tertiary formation occupy only 1-16 per cent, of the surface. Rocks of the late Tertiary formation occupy 37-7 per cent. These stretch in a west-to-east direction over nearly all the residencies, with a thickness of from 10,000 to 19,600 feet and more. Recent vol&anic rocks (leucite and phonolith) and volca-noes occupy 27-6 per cent. These lie in the direction of the longitudinal axis or run in cross lines. Only four-

teen of the volcanoes have remained active within historic times. The Quaternary and recent formations occupy 33-5 per cent. These are found as alluvial deposits along the north and south coasts near the rivers, and as diluvial tuffs at the base or in the neighbourhood of the volcanoes, filling up lakes or basins in the Tertiary formation and occupying plains.

The relief of the surface of Java is in close keeping with its geological formations. Leaving out of account the oldest rocks, it is to be observed in respect of the Tertiary sediments and their eruptive rocks that, like the Deccan traps in British India, they have formed, as in South Preanger, plateaux of gentle declivity, or, as in Gunong Gaja in Tegal and Gunong Lingga in Kediri, steep and, owing to erosion, fantastically-shaped mountains, with a maximum height of 6200 feet ; the former rise in chalk ranges to 2950 feet, in other sedimentary rocks to from 4200 to 4400 feet. The recent volcanoes vary much in height. There are fourteen more than 10,000 feet, Smeru being 12,060 feet; Slamat, 11,391 feet; Arjuno, 10,925 feet;

Sumbing, 10,915 feet; Ravun, 10,902 feet; Lavu, 10,712 feet. In respect of the recent formations, it is to be observed that the alluvium of sea and rivers deposits itself in more level layers, or rises in table-lands of not more than 300 to 400 feet. More elevated, however, are the volcanic sediments of lakes formed in Tertiary basins, and drained by rivers eroding the banks. These old lake bottoms now form high plateaux, which are very fertile and often healthy. Such is the ;plateau of Bandong (2230 feet), the plain of Garut (1640 to 2290 feet), of Sumedang (1500 feet), of Ambarava (1500 feet), «&c. Western, middle, and eastern Java are distinguished from one another by the character of their mountains and plains. Bounded on the east by Tji Losari and Tji Tan-duwi, western Java is a mountain mass of volcanic sum-mits and plateaux, relieved by valleys, and is resolvable into five distinct regions : (1) The isolated mountains of north and west Bantam; Gunong Ayung and Batur in Anjer, and the extinct volcanoes Pulosari and Karang. (2) The mountains of south Bantam, covered with forests

and thinly populated. (3) The Blue Mountains on the frontier of Batavia and Preanger, with the volcanic systems of Slamat and Gede. ^ (4) The mountains of Preanger, consisting of four plateaux, those of Bandong, Pengalengan, Tegal Badung, and Garut, encircled by volcanoes. (5) The mountains of north-east Preanger and Cheribon, bounded on the east by the plain of Sumedang and the Tjerimai. The low-lying plains of any great extent in western Java are all in the northern half, though some plains of narrow compass skirt parts of the west and south coast. Middle Java, stretching from Tjerimai and Losari on the west to Merbabu and Merapi on the east, presents narrower chains, each flanked by low lands, smaller and more isolated volcanoes, and, accordingly, larger rivers flowing to the south coast. The high land of the western part as far east as the Slamat, 1000 to 1300 feet in height, stretches in a N.N.W.-S.S.E. direction. The high land of the central part pursues a course S.S.E.-N.N.W., reaching in the Jembangan a height of 8200 feet. The eastern part is

occupied with the plateau of Dieng, the soil of which consists of the lava of a crater, with lakes and ruins round its edge. Its highest point is Prahu. The valley of the Progo, stretching away southwards, between the volcanoes of Sumbing and Sindoro on its west and of Merbabu and Merapi on its east, is included within the limits of middle Java. Eastern Java differs in its orographic character from both western and middle Java. Barren mountain chains of limestone and sandstone skirt the north and the south coast, running in a double range along the former. The plains lie between the coast chains and the intermediate volcanoes. Flowing between the coast chains in a west-to-east or east-to-west direction, or winding in a south-to-north direction between the volcanoes, the rivers drain much larger basins.

The plains differ in surface and fertility, according to their geological formation. Built up of alluvium and diluvium, the plains of the north coast lands in western and middle Java are at their lower levels, near the mouths of rivers and the sea, in many cases marshy and abounding in

lakes and coral remains, but for the rest they are fertile and available for culture. The plains, too, along the south coast of middle Java — of Banyumas andBagelen — contain many morasses as well as sandy stretches and dunes impeding the outlet of the rivers. They are, nevertheless, available for the cultivation more particularly of rice, and are thickly peopled. In eastern Java, again, the narrow coast plains are to be distinguishedfrom the wider plains lying between the parallel chains of limestone and between the volcanoes. The narrow plains of the north coast are constituted of yellow clay and tuffs containing chalk, washed down by the rivers from the mountain chains and volcanoes. Like the western plains, they, too, areinmany cases low and marshy, and fringed with sand and dunes. The plains, on the other hand, at some distance from the sea, or lying in the interior of eastern Java, such as Surakarta, Madiun, Kediri, Pasui-uanJ Probolinggo, and Besuki, owe their formation to the volcanoes at whose bases they lie, occupying levels as high as 1640 feet down to 328 feet above the sea, whence they decline to the lower plains of the coast. Lastly, the

plains of Lusi, Solo, and Brantas, lying between the parallel chains in Japara, Rembang, and Surabaya, are in part the product of rivers formerly flowing at a higher level of from 30 to 60 or 70 feet, in part the product of the sea, dating from a time when the northern part of the above-named residencies was still an island, such as Madura

is still, the mountains of -which are the continuation of the north parallel chain.

The considerable rivers of western Java all have their outlets on the north coast, the chief among them being the Tji Tarum and the Tji Manuk. They are navigable for native boats and rafts, and are used for the transport of coffee and salt. On the south coast the Tji Tanduwi, on the east of the Preanger, is the only stream available as a waterway, and this only for a few miles above its mouth. In middle Java, also, the rivers discharging at the north coast — the Pamali, Tjomal, &c. — are service-able for the purposes of irrigation and cultivation, but

are navigable only near their mouths. The rivers of the south coast — Progo, Serayu, Bogowonto, and Upak, enriched by rills from the volcanoes — serve abundantly to irrigate the plains of Bagelen, Banyumas, &c. Their \stony beds, shallows, and rapids, and the condition of their mouths lessen, however, their value as water-ways. More navigable are the larger rivers of eastern Java. The Solo is navigable for large praus or native boats as far up as Surakarta, and above that town for lighter boats, as is also its afB.uent the Gentung. The canal constructed in 1893 at the lower part of this river, and alterations effected at its mouth, have proved of important service both in irrigating the plain and facilitating the river's outlet into the sea. The Brantas is also navigable in several parts. The smaller rivers of eastern Java are, however, much in the condition of those of western Java. They serve less as waterways than as reservoirs for the irrigation of the fertile plains through which they flow.

The north coast of Java presents everywhere a low

strand covered with nipa or mangrove, morasses and fish-ponds, sandy stretches and low dunes, shifting river-mouths and coast lines, ports and roads, demanding continual attention and regulation. The south coast is of a different make. The dunes of Banyumas, Bagelen, and Jokjokarta, ranged in three ridges, rising to 50 feet high, and varying in breadth from 300 to over 1600 feet, liable, moreover, to transformation from tides and the east monsoon, oppose everywhere, also in Preanger and Besuki, a barrier to the discharge of the rivers and the drainage of the coast lands. They assist the formation of lagoons and morasses. At intervals in the dune coast, running in the direction of the limestone mountains, there tower up steep inaccessible masses of land, showing neither ports nor bays, hollowed out by the sea, rising in perpendicular walls to a height of 160 feet above sea-level. Sometimes two branches project at right Angles from the chain on to the coast, forming a low bay be-tween the capes or ends of the projecting branches, from 1000 to 1600 feet high. Such a formation occurs fre-

quently along the coast of Besuki, presenting a very irregular coast line. Of course the north coast is of much greater commercial importance than the south coast.

Climate. — The meteorological observations accumulated at Batavia, tlie extension of stations for measurement of rainfall all over the archipelago, and the instructive publications of the director of the Batavia Observatory, have contributed materially to the scope and definiteness of our knowledge of the climate. The monthly temperature, reaching the high mean throughout the year of '78-69° F., shows variations among the different months of not more than 1-8° F. The warmest months are May and October, registering 79-50° and 79-46° F. respectively. The coldest months are January and Febniary, registering 77-63° and 77-70° F. respectively. The daily variations are much greater than the monthly, amounting to from 9° to 10-8° F. The causes of such a steady high temperature are to be attributed, not solely to the perpendicular direction of the sun's rays on the island, but also as Mr Wallace rightly observes, to the warmth of the soil, the dampness of the atmosphere, and the high temperature of the sea (82-4° to 84-2° F.) over which the winds sweep. Anemometrical

observations of higher precision and of wider compass show a strongly prevalent N.W. -wind blowing from November to March, and a prevalent S.E. wind throughout the other half of the year. In some parts, however, of the archipelago, N.B. and S.W. winds occasionally take the place of the prevailing winds, a phenomenon to be explained by the fact of the transition of the one monsoon into the other (" Kentering," as it is called), by the mutual influence of land and sea breezes, or perhaps by the neighbourhood of the large island of Borneo. The amount of rainfall and the number of rainy days under the N. W. and under the S.E. monsoon are represented by very different figures. Out of 72-283 inches of annual rainfall at Batavia, 51-496 inches is the contribution of the N.W., and only 20-787 inches of the S.E. monsoon. The heavier burden of moisture brought by the N.W. monsoon and the lesser borne by the S.E. is to be explained not only by the interception of neighbouring Australia and its limitation of the sea on the S.E., but also by the fact that the ocean over which the S.E. monsoon blows is cooler than the Sea of Java, which is licked by the N.W. monsoon. The climate of western and middle Java differs in many respects from that of eastern Java. In

western and middle Java the amount of rainfall and the number of rainy days increase with the increase of height, and the rain is much more regularly distributed over the year. Buitenzorg, e.g., receives from November to April 97-5 inches of rain ; in the other months 75-15 inches. Sinagar, south-east of Salak and Gede, again, has a rainfall from November to April of 75-075 inches ; in the other months of 49-335 inches. In eastern Java the coast lands receive a smaller share of the annual rainfall — less than 58 inches. But contrasting the interior of the island in western and middle Java on the one hand with the interior of eastern Java on the other, whereas the former gets yearly from 108-6 to 156 inches or more of rain, the latter's share is only 72-6 to 117-6 inches. In eastern Java the four dry months from July to October show a great difference in their respective rainfalls, the monthly rainfall for each showing respectively a declining series of 1-1, 0-51, 0-236, and 0-157 inches, while the number of wet days in these months dwindles down to as low as 2 and 1 at Pasuruan and Besuki. On the south coast Tjilatjap is remarkable for the annual amount of its rainfall, 151-43 inches, the greater portion of which, 87-8 inches, is brought by the S.E. monsoon. The climate differs, of course,

with difference of altitude.

Area and Population. — The following table gives the areas of the different residencies, together with the numbers of the various races inhabiting the island, and the total population in 1897 : —

Residencies.

Area in Square Miles.

Euro-peans,

Chinese.

Arabs.

other Foreign Inhabi-tants.

Natives.

Total Popula-tion 1897.

Bantam

8,030

302

1,959

64

85

706,989

709,889

Batavia

2,631

12,434

82,510

3,279

147

1,215,018

1,313,388

Krawan^.

1,785

201

4,717

90

441,967

446,965

Preanger .

7,885

2,475

5,274

110

14

2,166,271

2,174,144

Clieribon .

2,608

867

21,108

1,896

120

1,658,630

1,677.621

Tegal . .

1,466

953

8,660

717

7

1,191,292

l,20i;619

Pelcalongan

691

607

6,917

944

51

666,626

574,146

Banyumas .

2,1«

915

6,454

11

101

1,264,096

1,270,677

Bagelen

1,824

1,029

8,937

52

1,459,886

1,464,408

Jolcjolcarta .

1,192

2,409

3,836

“86

142

861,919

858,392

Surakarta .

2,404

2,863

8,824

86

246

1,214,860

1,226,368

Kedu .

791

858

7,274

138

6

769,528

767,794

Samarang .

2,002

6,648

20,421

831

1,130

1,481,647

1,509,677

Japara

1,205

983

10,988

74-

167

968,640

965,847

Eembang ,

2,910

1,013

16,651

887

68

1,833,972

1,351,986

Madiwdn .

2,506

1,863

4,466

15

T4

1,182,657

1,188,565

Kediri

2,610

2,171

10,034

1,287,692

1,299,897

Surabaya .

2,091

8,785

22,526

8,463

676

2,181,671

2,217,120

Pasuruafa ,

2,066

2,442

7,071

1,284

88

1,057,118

1,068,008

Probolinggo

1,126

1,477

8,684

446

11

672,298

577,866

Madura

1,770

568

4,262

1,591

108

1,646,071

1,652,680

Besulti

Java (with

8,890

1,394

2,220

1,579

758,726

758,919

the isles).

50,130

51,737

261,107

17,075

8,238

26,791,953

26,125,110

The total population in 1880 was 19,794,505, and in 1890, 23,912,564. The population of 1898 shows a considerable decline from the figures of 1897, being only 25,697,701, in which the native element numbers 25,370,545. The number of British residents at Batavia at the end of 1899 was 128 ; at Surabaya, 84 ; and at Samarang, 17. The population of Batavia (31st December 1896) was 115,567, 9423 of them Europeans ; Buitenzorg, 25,000, 1500 of them Europeans ; Surabaya, 142,980, 6988 of them Europeans ; Samarang, 84,266, 3355 of them Europeans. The population of Batavia in 1897 was 115,567; Samarang, 84,244 ; Surabaya, 142,980; Surakarta, 86,074, of whom 1370 were Europeans ; and Jokjokarta, 60,523, of wliom 2240 were Europeans. One million out of the twenty-six millions are concentrated in towns, a fact readily ex-plained by their sources of livelihood.

Occupations. — Of theEuropeaninhabitants, one-half are employed in the civil and military service, one-third are engaged in agricul-ture, and one-sixth follow trades. The Chinese inhabitants are mostly traders and labourers. The Arabs are nearly all traders

or employed on ships. At least three-quarters of the natives live hy agriculture, and therefore the differences in density and concentration of population are chiefly to be explained by the different character of the land and the special physical features ; in part, however, they are due to the character and habits of the Javanese, to the care exercised by the Government for the improvement of agriculture, ways of communication, and means of irrigation, to say nothing of its efforts for alleviating the pressure of inundation, blight of crops, and the low prices of products.

Beligion and Instruction. — The number of Christians in Java increased from about 6000 in 1875 to 19,193 on the 1st January 1896. In 1900 there were 141 Christian missionaries in the Dutch East Indies. Primary schools for the natives increased from 306 with 37,099 pupils in 1883 to 468 with 67,480 pupils in 1899. The number of teachers in Government schools was, in 1888, 1405 ; in 1899, 1824. For the education of Europeans and persons assimilated with them, there were in the Dutch East Indies, in 1899, 7 public middle-class schools, with 1051 pupils and 118 teachers, costing the Government £49,278, the revenue from school fees being £7268. Eor Europeans there were, besides, in 1899, 135 mixed public

elementary schools, 30 girls' schools, and 21 private schools. The 165 public schools had 546 teachers with 15,132 pupils, 1626 of them natives. The 21 private schools had 166 teachers with 3270 pupils. The cost of public elementary schools was, in 1899, £212,211, and the income £23,674. The Government expenditure on public instruction for the natives of Java in 1899 amounted to £125,108.

Minerals. — The geological explorations of Dr Verbeek have revealed the poverty of Java in minerals. Gold has been found in very small quantity, if, indeed, it actually has been found. Lead, copper, and zinc have been found in only two residencies, also in very small quantity. Coal is found only in Preanger and Bantam, but, handicapped by the want of railways and good ports in the neighbourliood of the coal-fields, not in paying quantity. Veins of iodine and salt, sulphur and marble, and latterly petroleum, particularly in Surabaya, Eembang, and Samarang, have been worked.

Cultivation and Production. — Taking as basis Dr Holle's charts and statistics and the Government Colonial Report for 1892-93, we find that 40 per cent, of the soil is under cultivation. Bantam and

Besuki have each 16 per cent, of land under cultivation ; Krawang, 21 per cent. ; Preanger 23 per cent. ; Rembang 30 per cent. ; Japara, 62 per cent. ; Surabaya, 65 per cent. ; Kedu, 66 per cent. ; Samarang, 67 per cent. Proceeding along the south coast from its west end, we find that in Bantam all the land cultivated on its south shore amounts to at most but 5 per cent, of that regency ; in Preanger and Banyumas, as far as TjUatjap, the land under cultivation amounts at a maximum to 20 per cent. Bast of Surakarta the percentages of land on the south coast under cultivation decline from 30 to 20 and 10. East of the residency of Probolinggo the percentage of land cultivated on the south coast sinks to as low as 2. On the north coast, in Krawang and Rembang, with their morasses and double chains of chalk, there are districts with only 20 and 10 per cent, of the soil under cultivation. In the residencies, on the other hand, of Batavia, Cheribon, Tegal, Samarang, Japara, Surabaya, and Pasu-ruan, there are districts having 80 to 90 per cent, of soil, and even more, under cultivation.

The agricultural products of Java must be distinguished into those raised by the natives for their own use and those raised for the Government and private proprietors. The land assigned to the

natives for their own culture and use amounts to about 9,625,000 acres. In western Java the prevailing crop is rice, less prominently cultivated in middle Java, while in eastern Java and Madura other articles of food take the first rank. The agricultural produce grown on the lands of the Government and private proprietors, comprising an area of about 3J million acres, consists of sugar, cinchona, coffee, tobacco, tea, indigo, &c. The number of factories for the manufacture of sugar was, in 1881, 42; in 1890, 57; in 1899, 144; and the production in these three years was, in piculs, each of 135,872 lb avoir., respectively 528,420, 1,512,955, and 9,792,957. The average production per backu (If acres) of cultivated land rose from 52-88 piculs in 1881 to 110-91 piculs in 1899. About 4 million piculs are exported to the United States and Canada, 2 millions to China, and l| millions to Europe. The total crop of sugar in 1899 amounted to 11,895,010 piculs (or 796,324 tons), against 11, ,349,523 piculs (or 689,104 tons) in 1898 and 9,025,617 piculs (or 546,760 tons) in 1897. About 6,600,000 lb of cinchona are annually raised. The export of cinchona bark from Java amounted in 1899 to 11,221,000 Amsterdam lb (1 Amst. lb = 1-0893 lb avoir.), against 11,150,000 Amst. ft in 1898, and 8,511,000 Amst. lb in 1897. The

production of coffee for the Government, often 1 million piculs in a year between 1874 and 1884, amounted in 1890 to 96,000 piculs ; in 1892 to 693,000 ; in 1893 to 69,000 ; in 1897 to 474,000 ; and in 1899 to 198,858 ; the amounts for 1890 and 1893 being minimum yields. The production of coffee on private property increased from 120,000 piculs in 1890 to 550,000 piculs in 1893. The total crop of coffee in 1899 was 44,900 tons, against 29,827 tons in 1898 and 55,280 tons in 1897. In the production of coffee and cinchona Preanger, Pasuruan, and Tegal take the first place.

Java tobacco, amounting to about 35,200,000 ft avoir, a^ear, is cul-tivated almost exclusively in eastern Java. The tobacco crop of 1899 amounted to 53,417,672 lb avoir., against 49,853,656 ft in 1898 and 30,223,416 ft in 1897. The tea crop was, in 1899, 12,841,702 ft ; in 1898, 2,110,724 ft ; in 1897, 11,218,559 ft ; and in 1896, 9,568,732 ft. The production of indigo in 1899 amounted to 1,784,553 ft, against 2,555,133 ft in 1898 and 2,107,921 ft in 1897, the falling-off being due to the fall in prices and the consequent reduction in the area of land laid out. The production of cocoa in 1899 was 2,116,976 ft, against 2,073,592 ft in 1898, 1,920,184 ft in 1897, and 1,784,875 ft in 1896. The production of nutmegs was

241,000 ft, and of mace 33,048 ft in 1899, against 182,784 ft of nutmegs and 87,176 ft of mace in 1898, 81,600 ft of nutmegs and 12,452 ft of mace in 1897. The rice raised for export in 1899 amounted to 43,265 tons, against 36,211 tons in 1898 and 18,236 tons in 1897. The yield of pepper in 1899 amounted to 18,840,272 ft , against 8,686,864 ft in 1898 and 12,409,184 ft in 1897. In 1899, 499,703 hides were exported ; in 1898, 504,058. Of arrack 430,274 gallons were exported in 1899, against 404,477 gallons in 1898 and 499,016 gallons in 1897. In 1899, 45,331 tons of copra were exported, against 2467 tons in 1898, 5541 tons in 1897, and 19,122 tons in 1896.

Live Stock. — As in agricultural products, so also in cattle-rearing, western Java is distinguished from middle and eastern Java. There were, in 1895, 2,643,223 buffaloes, 2,572,231 head of cattle, 485,567 horses, numbers which underwent no material alteration in succeeding years. The average distribution of buffaloes is 106 per 1000 inhabitants, varying considerably in diiJerent districts, being greatest in western Java. The fact that rice is the prevailing culture in the west, while in eastern Java other plants constitute the chief produce, explains the larger number of buffaloes

found in western Java, these animals being more in requisition in the culture of rice.

Shipping and Commerce. — The total tonnage of sailing and steam vessels chartered in 1899 amounted to 678,671 tons, against 555,718 tons in 1898. The total number of steam vessels entered in 1899 at the ports of Batavia, Samarang, and Surabaya, was 2146 of 2,840,159 tons. The total number of sailing vessels entered in 1899 at these ports was 264 of 151,056 tons. The steam vessels that cleared at these ports in 1899 were 2173 of 2,749,386 tons, while the sailing vessels that cleared numbered 258 of 146,115 tons. In addition to the agricultural exports, tin was exported, from Banka and Billiton through Java, in 1899 to the amount of 16,807 tons, against 14,128 tons in 1898. The imports into Java (and Madura) in 1899 included cotton goods bleached, from Holland, of the value of £616,124, against £738,770 in 1898; and, from Great Britain, in 1899, £395,729, against £326,593 in 1898 ; cotton goods printed and coloured, from Holland, £364,320, against £333,159 in 1898; and from Great Britain in 1899 £414,310, against £395,404 in 1898. Petroleum, 13,258,419 gallons, against 16,144,942 gallons in 1898. The .lava Bank has a, capital of £500,000 and a reserve of

about £100,000. In March 1900 there were notes in circulation to the value of £6,049,250, and bank operations to the value of £2,718,583. The amounts deposited in the Post Office Savings Bank in 1900 were : Europeans, 2,521,963 florins ; natives, 266,003 fl.; Chinese and other Asiatics, 50,021 fl.; or a total of 2,837,987 fl.

Moads and Mailways. — Unless for purposes of defence and political communications, the roads and railways under the management of the Government avoid the uninhabited mountain chains of sandstone and chalk. For the most part they follow the fertile plains and table-lands along the coast and between the volcanoes. Besides the Kalisat^Banyuwangi Extension Railway there is the Batavia-Anjer line, which was opened as far as Serang in July 1900. Altogether there were in 1900 in Java 1106 miles of railway and 414 miles of tramway. There are also 344 post and telegraph stations. The Dutch Steam Navigation Company has 31 steamers running through the whole archipelago.

Authorities. — ^Veth. Java, geographisch, ethnologisch, historisch. 2nd ed., 1895. — Verbeek and Fennema. Geologische Beschryving van Java en Madoera, 1896 ; with atlas and geological

bibliography. — Veth's Album, with articles on coasts and orography of Java. — ^Van Dokp. Officieele Beisgids. 1897. — Van dek Stok. Begenwaarnemingen in N. Indie (1899), and Atlas of Wind and Weather, &c. — Van Gokkom. De Indische Cultures, 2nd ed. — Jaarcyfers ZHtgegeven door de Centrale Commissie voor de Statistiek. The Hague, 1899. — JEneyclopaedie v. iV. Indie, art. "Java." — Guide a travers V Exposition de Paris, The Hague, 1900 ; with articles by specialists on each department of the Dutch colonies, more particularly Java. — Koloniale Verslagen en Begeerings-almanak van N. Indie, being official publications of the Dutch and Dutch East-Indian Government. (c. M. K.)

Recent History. — Being tlie principal Dutch colony in the Malay Archipelago, Java was the first to benefit from the material change which resulted from the introduction of the Ch-ondwet or Fundamental Law of 1848 in Holland. The main changes were of an economical character, but the political developments were also important. Since

1850 Dutch authority has steadily advanced, principally at the expense of the semi-independent sultanates in central Java, which had been allowed to remain after the capture and exile of Dipa Negara, the last Javanese prince, who claimed the whole island, a man as capable as he was unscrupulous, as bold as he was influential. To subdue him and his following taxed all the resources of the Dutch Indian army for a period of five years, and cost it the loss of 16,000 officers and soldiers, besides millions of guilders. Nor did his great influence die with him when his adventurous career came to a close in 1855 at Macassar. Many Javanese, who dream of a restoration of their ancient empire, do not believe even yet that Dipa Negara is dead. They are readily persuaded by fanatical hadjees that their hero will suddenly appear to drive away the Dutch and claim his rightful heritage. Several times there have been political troubles in the native states of central Java, in which Dipa Negara's name was used, notably in 1883, when many rebellious chieftains had to be exiled. Similar attempts at revolt

had been made before, mainly in 1865 and 1870, but none so serious perhaps as that in 1849, in which a son and a brother of Dipa NegdrS, were implicated, whose avowed aim was to deliver and reinstate the latter. All such attempts proved as futile there as others in different parts of Java, especially in Bantam, where the troubles of 1850 and 1888 had a religious origin, and in the end they directly contributed to the consolidation of Dutch sway. The power of the sultans of Jokjokarta and Surakarta has diminished ; in 1863 Dutch authority was strengthened in the neighbouring island of Madura, and Bantam has lost every vestige of semi-independence. Everywhere, in fact, since 1850 the position of the Dutch in Java has become much stronger. Their increase in power has largely resulted from a more statesmanlike and more generous treatment of the natives, who have been educated to regard the Orang blanda, or white man, as their protector against the native rulers. Thus, in 1866, passports for natives in Java, when travelling, were abolished by the then Governor-General, Dr Sloet van de Beele,

who also introduced many reforms, reducing the corvh in the Government plantations to a minimum, and doing away with the monopoly of fisheries. Six years later a primary education system for the natives, and a penal code, whose liberal provisions seemed framed for Europeans, were introduced. Material welfare was also promoted by lines of steamships between Java and the other islands, all belonging to a Eoyal Packet Company, established in 1888 under a special statute, and virtually possessing a monopoly on account of the Government mail contracts ; as well as by the construction of a system of railways, which, gradually extending in all directions, now enable the traveller to cover the whole of Java in a few days. The earliest Java lines, between Batavia and Buitenzorg, its pleasant suburb, and between Samarang and the capitals of the sultanates, were built, about 1870, by a private company with a State guarantee. Since 1875, when the late Dr van Goltstein, then a cabinet minister and afterwards Netherlands minister in London, had an Act passed for the construction of State railways in Java, their pro-

*gress has become much more rapid. In addition, several private companies have built either light railways or tramways. Telegraphs have also been extensively laid between Java and the other islands of the archipelago — Java forming an important link in the cable communication with Australia. The services for passengers, goods, and mails from Europe to Java, and vice versd, have also improved since the establishment of the Netherland and Rotterdam Lloyd Steamship Companies. The construction of large harbour works at Tandjong Priok, near Batavia, which took eight years to build (1877-85), contributed to the increased prosperity of Java during the second half of the 19th century— a progress all the more remarkable because of industrial and agricultural depression. Among the exceptions, the chief one to be noted is the petroleum industry. In 1875 the existence of petroliferous deposits in Java was not so much as suspected, but at the beginning of the present century several large companies were successfully at work in Surabaya, Samarang, and Rembang, the principal petroleuqi centres of Java to-day.**

For the recent history of Java, consult the works mentioned under Holland and Malay Archipelago ; also Prof. P. J. Veth's Java (in Dutch), an indispensable and masterly compendium largely based upon Junghuhn's description. The second edition of Veth's Java, much enlarged and brought up to date, is in course of publication. Haarlem, 1895 et seq. (h. ti.)

Jawhar, a native state of India, in the Konkan division of Bombay, situated among the lower ranges of the Western Ghats. Area, 634 square miles. The population in 1881 was 48,656; in 1891, 62,831; average density, 99 persons per square mile. In 1901 the population was 47,264, showing a decrease of 11 per cent. The estimated gross revenue is Es. 1,67,520, of which Es.37,063 was expended on public works in 1897-98 ; no tribute ; number of police, 41 ; number of schools, 8, with 449 pupils. The chief, who is a Koli by caste, traces back his descent to 1343. The town of Jawhar is 50 miles north-east of Thana, on a plateau about 1000 feet above the sea. Population (1891), 2991.

J a wo row, the chief town of a district in the Aus-

trian crownland of Galicia, 30 miles west of Lemberg. It has a pottery, a brewery, and a distillery, and some trade in agricultural produce. In 1890 the commune had a population of 9219 Euthenians and Poles, including 2572 Jews ; (1900), 10,090.

Jaworzno, a market-place in the Galician government district of Chrzandw, Austria, 30 miles west of Cracow, and a station on the Ferdinands-Northern railway. It has important coal-mines, deposits of calamine or hydrous silicate of zinc, smelting furnaces for this ore, and a glass factory. Population, mostly Polish (1890), 6637; (1900), 9206.

Jeannette, a borough of Westmoreland county, Pennsylvania, U.S.A., on the Pennsylvania railroad. It is situated in the natural-gas territory, and has extensive glass factories. Population (1890), 3296 ; (1900), 6865, of whom 1340 were foreign-born.

Jebrail, a district town of Russia, Transcaucasia, government and 105 miles south-south-east of Elisabethpol, one of the chief custom-houses for trade with Persia.

Jedburgh, a royal burgh and the county town of Roxburghshire, Scotland, on the Jed water, 56 miles south-east of Edinburgh by rail. Its constituency was merged in that of the county in 1885. The town has five woollen mills. The ruined abbey was acquired from the heritors by the marquis of Lothian in 1875 in exchange for a fine church and manse. There are two public parks, a new pviblic hall (in place of the Corn Exchange burned down), and a free library. A new grammar school, built in 1883, is the only public school. Population (1881), 3400; (1901), 2222. .

Jedlersdorf, officially Gh-oss-Jedlersdorf, an industrial village in the government district of Floridsdorf, in Lower Austria, situated in the Marchf eld, north of Vienna.*

It has extensive railway works and manufactures of macliinery, screws, malt, yeast, gutta-percha, &c. Population (1890), 2038; (1900), 2607.

Jefferies, Richard (1848-1887), English natur-

alist and author, was born on 8th November 1848, at a farmhouse called Coate, which stands about 2+ miles from S^ndon, on the road to Marlborough, Wiltshire, England. He was sent to school, first at Sydenham and then at Swindon, till the age of fifteen or so, but his actual education was at home, at the hands of his father, who gave him his love for Nature and taught him how to observe. Eor the faculty of observation, as JefEeries, Gilbert White, and Thoreau have remarked, several gifts are necessary, including the possession of long sight and quick sight, two things which do not always go together. To them must be joined trained sight and the knowledge of what to expect. The boy's father first showed him what there was to look for in the hedge, in the field, in the trees, and in the sky. This kind of training would in many cases be wasted : to one who can understand it, the book of Nature will by and by offer pages which are blurred and illegible to the city-bred lad, and even to the country lad the power of reading them must be main-tained by constant practice. To live amid streets or

in the working world destroys it. The observer must live alone and always in the country ; he must not worry himself about the ways of the world; he must be always, from day to day, watching the infinite changes and variations of Nature. Perhaps, even when the observer can actually read this book 'of Nature, his power of articulate speech may prove too imperfect for the expression of what he sees. But Jefferies, as a boy, was more than an observer of the fields ; he was bookish, and read all the books that he could borrow or buy. And presently, as is apt to be the fate of a bookish boy who cannot enter a learned profession, he became a journalist and obtained a post on the local paper. He developed literary ambitions, but for a long time to come was as one beating the air. He tried local history and novels ; but his early novels, which were published at his own risk and expense, were, deservedly, failures. In 1872, however, there appeared a remarkable letter in The Times from him, on "The Wiltshire Labourer," full of original ideas and of facts new to most readers. This was in

reality the turning-point in his career. In 1873, after more false starts, Jefferies returned to his true field of work, the life of the country, and began to write for Fraser's Magazine on " Farming and Farmers." He had now found himself. The rest of his history is that of continual advance, from close observation becoming daily more and more close, to that intimate communion with Nature with which his later pages are filled. The de-velopments of the later period are throughout touched with the melancholy that belongs to ill-health. For, though in his prose poem called "The Pageant of Summer," the writer seems absolutely revelling in the strength of manhood that belongs to that Pageant, yet, in the " Story of my Heart," written about the same time, we detect the mind that is continually turned to death. He died at Goring, worn out with many ailments, on 14th August 1887. The best-known books of Eiehard Jefferies are : — The Gamelceeper at Home (1878) ; The Story of my Heart (1883); Life of the Fields (1884), containiag the best paper he ever wrote, " The Pageant of Summer " ;

Amaryllis at the Fair (1884), in which may be found
the portraits of his own people; and The Open Air.
He stands among the scanty company of men who ad-
dress a small audience, for whom he read aloud these
pages of Nature spoken of above, which only he, and
the few like untc» him, can decipher. (w. be.)
Jefferson City, capital of Cole county and of
the state of Missouri, U.S.A., on the south bank of the
Missouri, at an altitude of 655 feet. The Missouri Pacific,
the Chicago and Alton and the Missouri, Kansas and Texas
railways pass through it. Its site is partly in the bottom-
lands of the river and partly on the steep banks. Popu-
lation (1890), 6742; (1900), 9664, of whom 786 were
foreign-born and 1822 negroes.
Jefferson, Joseph (1829), American actor,
was born at Philadelphia on the 20th of February 1829.
He was the third and most famous actor of this name,
and perhaps the most famous of all American comedians.
In childhood he appeared as a supernumerary, and fol-
lowed the company of which his father and mother

were members throughout the west and south, becoming himself a stock actor and manager. His first pronounced success was made in 1858 as Asa Trenchard in Tom Taylor's Our American Cousin. The naturalness and spontaneity of humour with which he acted the love scenes revealed a spirit in comedy new to his contemporaries, long used to a more artificial convention ; and the touch of pathos which the part required revealed no less to the actor an unexpected power in himself. Other early parts were Newman Noggs in Nicholas Nicklehy, Caleb Plummer in The Cricket on the Hearth, Dr Pangloss in Tlie Heir at Law, Salem Scudder in The Octoroon, and Bob Acres in The Rivals, the last part being not so much an interpretation of the character as Sheridan sketched it as a creation of the actor's. In 1859 Jefferson made a dramatic version of the story of Bip Van WinJcle on the basis of older plays, and acted it with success at Washington. The play was given its permanent form by Dion Boucicault (1865) in London, where it ran 170 nights, with Jefferson in the leading rdle. Jefferson continued to

act with undiminished popularity in a limited number of parts in nearly every town in the United States, his Eip Van Winkle, Bob Acres, and Caleb Plummer being the most popular. He was one of the first to establish the travelling "combinations" which superseded the old system of local stock companies. With the exception of minor parts, such as the First Gravedigger in Hamlet, which he played in an " all star combination " headed by Edwin Booth, Jefferson created no new character after 1865 ; and the success of Eip Van Winkle was so pronounced that he has often been called a one-part actor. He devoted much of his time to painting. The Autobiography of Joseph Jefferson (New York, 1889) is written with admirable spirit and humour, and its judgments with regard to the art of the actor and of the playwright will probably entitle it to a place beside An Apology for the Life of Colley Cibber.

Jeffersonville, capital of Clark County, Indiana, U.S.A., on the north bank of the Ohio, opposite Louisville, Kentucky, with which it is connected by several bridges.

It is on the Baltimore and Ohio South- Western and the Pittsburg, Cincinnati, Chicago and St Louis railways, and is a,t an altitude of 441 feet. It is at the head of the falls, which descend 26 feet in two miles, giving abundant water power, which is utilized in manufactures both here and in Louisville. Population (1890), 10,666; (1900), 10,774, of whom 615 were foreign-born and 1818 negroes.

Jeisic, a district town of Eussia, northern Caucasia, in Jeisk Bay, in the north-east of the Sea of Azov, province of Kuban, 140 miles north-west of Ekaterinodar. Owing to its situation amidst a fertile region, its exports of corn, wool, and linseed are of some importance. Population (1897), 20,706.

Jena, a town of Germany, grand-duchy of Saxe

Weimar, on the Saale, 28 miles by rail east of Erfurt (14 , east of Weimar), the seat of the joint university of the Saxon duchies ; in 1900 nearly £40,000 was voted for providing new university buildings. Amongst the famous

Jena professors have been Schiller, Oken, Fichte, Schelling, and Hegel. In 1900 the university was attended by 768 students, and had 97 professors. Its library now numbers 200,000 volumes. Jena is the seat of a veterinary school, an agricultural institute, a new astronomical observatory, all connected with the university ; and in 1900 it was proposed as the seat of a technical high school for the Saxon duchies. There are monuments to Bismarck (1892), Fritz Renter (1888), and the students' societies of the first half of the 19th century, the Burscherv-schaften (1883), by Donndorf. The Lichtenhainer beer, brewed in the villages adjacent (Lichtenhain, Zeigenhain, Wollnitz, &c.), is widely celebrated. Population (1885), 11,680; (1900), 20,677.

Jenkin, Henry Charles Fleeming (1833-1885), British engineer, was born near Dungeness on 25th March 1833, his father (died 1885) being a naval commander, and his mother (died 1885) a novelist of some literary repute (her best books perhaps being Cousin Stella, 1859, and Who Breaks, Pays, 1861). Eleeming

Jenkin was educated at first in Scotland, but in 1846 the family went to live abroad, owing to financial straits, and he studied at Genoa University, where he took a first-class degree in physical science. In 1851 he began his engineering career as apprentice in an establishment at Manchester, and subsequently he entered Newall's submarine cable works at Birkenhead. In 1869 he began, in concert with Sir William Thomson (afterwards Lord Kelvin), to work on problems respecting the making and use of cables, and the importance of his researches on the resistance of gutta-percha was at once recognized. Erom this time he was in constant request in connexion with submarine telegraphy, and he became known also as an inventor. In 1865 he was elected F.E.S., and was appointed professor of engineering at University College, London. In 1868 he obtained the same professorship at Edinburgh University, and in 1873 he published a text-book of Magnetism and Electricity, full of original work. He was the author of the article Bridges in the ninth edition of this Encyclopaedia.

His influence among the Edinburgh students was pronounced, and E. L. Stevenson's well-known Memoir is a sympathetic tribute to his ability and character. His interests were by no means confined to engineering, but extended to the arts and literature ; his miscellaneous papers, showing his critical and unconventional views, were issued posthumously in two volumes (1887). In 1882 Jenkin invented an automatic method of electric transport for goods — "telpherage," but before he could complete its details he died (12th June 1886). A telpher line on his system was subsequently erected at Glynde in Sussex. Fleeming Jenkin was also well known as a sanitary reformer, and during the last ten years of his life he did much useful work in inculcating more enlightened ideas on the subject both in Edinburgh and outside.

Jenner, Sir William, 1st Bakonet (1816-1898), English physician and surgeon, was born at Chatham on 30th January 1816, and educated at University College, London. He became M.E.C.S. in 1837,

and F.R.C.P. in 1862, and in 1844 took the London M.D. degree. In 1847 he began at the London Fever Hospital investigations into cases of "continued" fever which enabled him finally to make the distinction between typhus and typhoid with which his reputation as a pathologist is principally connected. In 1849 he was appointed professor of pathological anatomy at University College, and also assistant physician to the hospital ; afterwards he held other professorships there, and was physician (1864-76) and consulting physician (1879), besides holding similar appointments at other hospitals. He was President of the College of Physicians (1881-88), President of the Epidemiological Society (1866-68), of the Pathological Society (1873-75), and of the Clinical Society (1876) ; he was elected F.E.S. in 1864, and re-received honorary degrees from Oxford, Cambridge, and Edinburgh. He was in constant attendance on the Eoyal Family. In 1861 he was appointed physician extraordinary to Queen Victoria, in 1862 physician in ordinary, and in 1863 physician in ordinary to the prince

of Wales, and he attended both the Prince Consort and the prince of Wales in their attacks of typhoid fever. In 1868 he was created a baronet. As a consultant Sir William Jenner had a great reputation, and he left a large fortune when he died on 11th December 1898, having then retired from practice for eight years owing to ill-health.

Jerez de la Frontera, a town of Spain, in the province of Cadiz, on the railway from Cadiz to Seville. Its population is decreasing, and was only 66,961 in 1897. With the growth of its wine trade and its commerce in agricultural products, however, Jerez has become one of the most important cities of southern Spain. The modern buildings are of handsome appearance, and include the institute, 14 primary schools, a state remount and stud, an academy of law, a school of medicine, a fine arts and Philharmonic academy, model farms, a commercial ex-perts' school, a chamber of commerce, several casinos, orphanages for both sexes, hospitals, and a reformatory. There are also public gardens, and tramways have been

laid down. The vineyards around Jerez furnish in reality only part of the wine actually exported and labelled Vino de Jerez. In 1898 this amounted to 4,949,100 gallons. The export of wine is no longer confined practically to Great Britain. In 1898 the export to France was valued at £170,908, and that to England at only £167,827, the total exports being valued at £497,904. The district has earned a reputation for being disaffected, and has frequently been the scene of anarchical outbursts.

Jericho, now Ekiha, 820 feet below the level of the sea, a village in the Jordan valley, east-north-east of Jerusalem. It forms part of one of the large estates owned by the Sultan in Palestine, and is a centre of administration under a Mudir. An aqueduct has been built and much waste land has been brought under culti-vation. Clearances in the jungle east of 'Ain es-Sultan, "Elisha's fountain," have brought to light several re-mains of Eoman and Byzantine Jericho. There are Greek and Eussian churches and monasteries.

Jersey. See Channel Islands.

Jersey City, capital of Hudson county. New Jersey, U.S.A., the second city in size in the state and its principal seaport, on the Hudson river, opposite New York, of which it is a part commercially and industrially. It is well paved, most of its streets being of either granite blocks or asphalt ; it has a good water-supply and is well sewered, and is progressive in all matters of municipal government and improvement. It is the terminus of several steamship lines from Europe and the south of the United States, and of most of the railway lines from tlie south and west to New York. These lines are connected with New York by ferries. Of the foreign commerce it is impossible to supply figures, as the city is included in the port of New York, for which alone statistics are given. Although Jersey City is mainly a commercial city, its

manufactures are of much, importance. In 1890 it contained 726 establishments, with a total capital of $18,165,094. They employed 12,869 hands, and their

yield had a value of $37,376,322. The principal were meat, the product of slaughtering and meat-packing establishments, $10,624,859; soap and candles, $1,554,270; chemicals, $1,804,339; foundry and machine shop products, $1,822,104; cars, $1,484,423; and silk goods, $1,066,000. The assessed valuation of real and personal property in 1900 was $93,325,000, the net debt was $16,701,353, and the rate of taxation was $28.20 per $1000. The total receipts for the fiscal year were $7,433,501, and the expenditures were $6,811,104. Population (1880), 120,722; (1890), 163,003; (1900), 206,433, of whom 68,424 were foreign-born and 3704 negroes. There were 63,495 persons of school age (5 to 20 years). Of 60,319 males 21 years of age and over, 3094 were illiterate (unable to write), of whom only 192 were native-born.

Jerusalem. — Letters found at Tell el-'Amarna, which were written by an early ruler of Jerusalem, show that the name existed under the form Vrusalim — ^that is, " city of Salim," or " city of peace " — many years before

the Israelites entered Canaan. Jerusalem was then one of the most important cities in southern Palestine, subject to Egypt, and ruled by princes, or possibly priest-kings, who were appointed by the Pharaoh.

Natural Topography and Results of Excavations.

Since the termination of Sir C. Warren's noteworthy researches in 1870, excavations have been made for the Palestine Exploration Fund by M. Clermont-Ganneau, 1873-74, and Dr Bliss, 1894-97; for the German Palestine Society by Professor Guthe, in 1881; by the Eussian Palestine Society ; and by the German Government. Information, chiefly derived from excavations made for building purposes, has also been collected by Dr Schick, P^re Vincent, and others.^ Much light has been thrown on the course of the old walls, but excavations are still necessary at several points to disclose the original form of the ground upon which the city was built.

Jerusalem is a mountain city — ^the highest point within tbe walls is 2570 feet above the sea — situated in the heart

of the hiU country of southern Palestine, amidst lime-stone hills which are seamed by countless ravines. It has been connected with Jaffa by a railway, but a few years ago it could only be approached by rough mountain roads. Thus, though close to, it was in a sense remote from the maritime plain along which the great highway of the nations formerly ran. The city occupies the lower extremity of a limestone plateau, barely 1000 acres in extent, which projects southwards from the central watershed of the country, and is bounded on the east by Wadi Sitti Maryam, valley of the Kidron, and on the west by Wadi Rabdlbi, valley of Hinnom. These valleys unite beneath the south-east corner of the plateau after a fall of 670 feet, and for some distance above their junction are deep rocky ravines. The city is thus easily accessible from the north, whilst on all other sides it is protected by nature. The little plateau is itself divided into two spurs of unequal size by a ravine, called by Josephus " Tyropoeon," which joins the Kidron at Siloam. The western spur, upon which stood the palace of Herod

and the " Upper City " of Josephus, is the broader and higher. The eastern. Mount Moriah, on which the Temple was built, is, so far as it lies within the walls, a narrow

1 See Quarterly Statements of Pal. Exp. Fund, the Zeitschrift d. Deutschen Pal. Vereins, and the Revue Biblique.

ridge of rock, of which the exact form is still imperfectly known. Towards the north this spur is cut into by a short deep ravine, possibly the " ravine called Kedron " of Josephus, which runs through the north-east corner of the city, and joins the Kidron near the " Golden Gate." The sides of the ravines are covered with the ruins of ancient Jerusalem, and their beds are concealed by dihris, which in one place is 125 feet deep. The geological structure of the plateau — thin beds of hard silicious chalk, locally called misse, overlying a thick bed of soft white limestone, meleke — facilitated in many ways the growth of the city. Excellent building material was obtained from both beds, whilst in the meleke were hewn underground chambers, tanks, cisterns, tomt)s, aque-ducts, and drains. The plateau is arid. The only

known spring is the " Pountain of the Virgin," in the Kidron valley, and the only deep well is Bir Eyiib, below the junction of the Kidron and Hinnom valleys. The city was consequently dependent upon rain-water, collected and stored in tanks and cisterns, and upon water brought from a distance by aqueducts. Many interesting remains of these works are visible. Since 1865 several projects have been brought forward for the improvement of the water-supply.

The extensive building operations north of the city have brought to light no trace of any rock-hewn ditch, nor of any masonry that could have formed part of a wall erected for purposes of defence. This strongly supports the view that the present north wall follows closely the line of that which is called by Josephus the " third wall." South of the city Dr Bliss ascertained the course of the wall from the south-west angle of the existing fortifications to Siloam. Several building periods were recognized, and it was found that whilst at one time the wall excluded the two pools of Siloam, at another it was carried across

the dam of the lower pool so as to include them. The form and size of the two pools, and the remains of the church at Siloam, mentioned by pilgrims before the Arab conquest, were discovered at the same time ; and light was thrown on the ancient system of drainage, and on the course of the mediaeval walls on the western spur. Amongst other discoveries are the ruins of the Church of St Stephen, built by the Empress Eudocia in 460 ; of the Church of St Mary-the-Less ; of portions of the buildings erected by Constantino near the reputed sepulchre of Christ; and of the mediaeval Church and Pool of Bethesda.

Ancient Jerusalem.

Jerusalem, when the Israelites entered Palestine, probably consisted of a walled town and acropolis on the eastern spur, and of a small suburb on the lower slopes of the western spur. The town was captured and burned by Judah, but the acropolis, or stronghold of Zion, held out until it was stormed by Joab. David strengthened the acropolis and made it his residence, whence it was

called the " City of David," a name that was soon ex-
tended to all that part of the city which lay on the
eastern spur. Uiider Solomon, Jerusalem became the
religious and political centre of the Hebrews ; there was
a great development of trade, and a period of prosperity,
during which the city was enlarged and fortified, and
the Temple and the royal palace were built. The large
increase of the population was met by enclosing that
portion of the western spur which lay south of the Jaffa
Gate, and joining it to the City of David. Special at-
tention was paid to the fortifications by Uzziah, Jotham,
Hezekiah, and Manasseh ; and it was probably Hezekiah.
who built the " second waU. " to protect a suburb which
had grown up to the north of Solomon's wall on the
western spur. Hezekiah also greatly improved the water-

supply of the city. After the Captivity, jSTehemiah re-
built the walls on the old lines, and it is impossible to
reconcile his account of their restoration and dedication

with the theory that the city was then confined to the eastern spur.^ During the five centuries that intervened between ISTehemiah and Herod, no occasion arose for a large extension of the city's limits, and no record has survived of the execution during that period of a work of such magnitude as the fortification of the western spur with a great wall standing above a rock-hewn scarp. According to the writer's view, Jerusalem, in the reign of Hezekiah, was practically coextensive with the walled

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Plan of the Three Walls op Jerusalem.

city of Herod. Nehemiah mentions the gates and towers of the walls under their old names, and various attempts have been made to reconstruct pre-exilic Jerusalem from his description."

Nehemiah, when restoring the walls, must have rebuilt the acropolis, of which the towers of Meah and Hananeel possibly formed part. It is apparently mentioned as the " castle (Birah) that appertaineth to the house " (Neh. ii.

8) ; and may have been the fortress which, according to Aristeas, stood on a commanding eminence to the north of the Temple. That position was certainly occupied by

1 The area of this spur is 255,939 square yards, whioh, allowing 30 square yards per person,— a high allowance, considering that the Temple, acropolis, and palaces are included,— would give a population of 8531.

2 The reconstruction suggested by the writer, which differs from that proposed by the late Professor Robertson Smith in the 9th edition of this Encyclopsedia, is given in Smith's Dictionary of the Bible, 2nd ed., art. Jerusalem.

the Acra, or acropolis, built by Antiochus Epiphanes, 187-168 B.C., which is described as being in close prox-imity to and overlooking the Temple (1 Mace. iv. 41 ; Josephus, Ant. xii. 5, § 4). As in the earlier case of the City of David, the name of the citadel, "Acra," was popularly applied to the spur. After the demolition of the Macedonian fortress apportion of its site was reoccii-pied by the Baris of Hyrcanus, and this in turn was replaced by Herod's castle called Antonia. The city

as it existed at the time of the siege by Titus, and the important buildings erected by Herod, are described by Josephus. On the eastern spur stood the Temple, connected by colonnades with the castle of Antonia; the palaces of Helena, Monobazus, and Grapte ; and the hippodrome. On the western were Herod's fortress-palace with 'its three lofty towers, and the palace of Agrippa. The northern side of the city was then defended by three walls, and with regard to the position of the " first," or oldest, there are few differences of opinion. But it is still a question whether the " second " wall included or excluded the Church of the Holy Sepulchre; and whilst some authorities identify the line of the "third" wall with that of the present north wall of the city, others draw it so as to enclose a large additional area on the north-west. The two questions

upon which, perhaps, there has been most
controversy are the site of the Temple of
the Jews and that of the tomb of Christ.
It is agreed that the Temple stood within
the limits of the enclosure known as the
Haram esh-Sherif, but there is a diverg-
ence of opinion as to the exact position
within that area occupied by the building
and its courts. It has been maintained on
the one hand that the Temple occupied
the south-west corner of the Haram, and
on the other that it stood near the centre
of the same enclosure.^ Both views pre-
sent difficulties which can only be solved
by excavation. The Church of the Holy
Sepulchre stands on the ground which was
once occupied by the churches erected
by Constantino over and adjoining the
rock-hewn tomb which he believed to be
^^^ ^ that of Christ. It has been maintained,

Oxford^ t^ai. however, that the information at the

disposal of the Emperor and his advisers

was not sufficient to enable them to de-

termine the exact position of Golgotha, and that

the place selected must have been within the "second"

wall of Josephus, and so not genuine. Several

opinions have been expressed with regard to the

position of Golgotha by those who reject the site

honoured by Constantine. Amongst these the view

of Otto Thenius, published in 1849, that Christ was

crucified on the hillock above "Jeremiah's Grotto,"

outside the Damascus Gate, has attracted most attention

from its adoption by General Gordon. This identifi-

cation rests on no evidence and no tradition, and is

simply a guess. In the absence of any precise indication

of direction in the Bible there can be no certainty; but

if excavations ever show that the Church of the Holy

*a -4;?^^?,"^^?°" "^ ** whole question by the writer will be found in*

bmith s ntctwnary of the Bible, 2nd ed., art. Jeeusalbm, pi,. 1634-42.

' J "^^ theory see Fergusson, The Temples of the Jeics; for the

second, Warren, Underground Jerusalem, and T/ie Temple or Tomb; Conder, Tent Work in Palestine.

Sepulchre is outside the " second " wall, it will be difficult to dispute the authenticity of the sites it covers.

Modern Jerusalem.

Jerusalem is the chief town of a sanjak, goTCrned by a mutesarrif, who reports directly to the Porte. It has the usual executive and town councils, upon which the recog-nized religious communities, or millets, have representatives; and it is garrisoned by infantry of the fifth army corps. The city is connected with its port, Jaffa, by a carriage road, forty-one miles, and by a metre-gauge railway, fifty-four miles, which was completed in 1892, and is worked by a French company. There are also carriage roads to Bethlehem, Hebron, and Jericho. Prior to 1858, when the modern building period commenced, Jerusalem lay wholly within its 16th-century walls, and even as late as 1875 there were few private residences beyond their limits.

At present Jerusalem without the walls covers a larger area than that within them. The growth has been chiefly towards the north and north-west; but there are large suburbs on the west, and on the south-west neai the rail-way station on the " Plain of Kephaim." The village of Siloam has also increased in size, and the western slopes of Olivet are being rapidly covered with churches, mon-asteries, and houses. Amongst the most marked features of the change that has taken place since 1875 are the growth of religious and philanthropic establishments ; the settlement of Jewish colonies from Bokhara, Yemen, and Europe ; the migration of Europeans, old Moslem families, and Jews from the city to the suburbs ; the increased vegetation, due to the numerous gardens and improved methods of cultivation; the substitution of timber and red tiles for the vaulted stone roofs which were so characteristic of the old city ; the striking want of beauty, grandeur, and harmony with their environment exhibited by most of the new buildings ; and the introduction of wheeled transport, which, cutting into the soft limestone,

has produced mud and dust to an extent previously unknown. To facilitate communication between the cily and its suburbs, the Bab ez-Zahire, or " Herod's Gate," and a new gate, near the north-west angle of the walls, have been opened ; and a portion of the wall, adjoining the Jaffa Gate, has been thrown down, to allow free access for carriages. Within the city the principal streets have been roughly paved, and iron bars placed across the narrow alleys to prevent the passage of camels. Without the walls carriage roads have been made to the Mount of Olives, the railway station, and various parts of the suburbs, but they are kept in bad repair. Little effort has been made to meet the increased sanitary requirements of the larger popular tion and wider inhabited area. There is no municipal water-supply, and the main drain of the city discharges into the lower pool of Siloam, which has become an open cesspit. In several places the dihris within the walls is saturated with sewerage, and the water of the Fountain of the Virgin, and many of the old cisterns, is contaminated and unfit for drinking. Amongst the more important

buildings for ecclesiastical and philanthropic purposes erected to the north of the city since 1860 are the Russian cathedral, hospice, and hospital ; the French hospital of St Louis, and hospice and church of St Augustine; the German schools, orphanages, and hospitals ; the new hospital and industrial school of the London Mission to the Jews ; the Abyssinian church ; the church and schools of the Church Missionary Society ; the Anglican church, college, and bishop's house; the Dominican monastery, seminary, and church of St Stephen; the Rothschild hospital and girls' school ; " and the industrial school and workshops of the Alliance Israelite. On the Mount of Olives are the Russian church, tower, and hospice, near the Chapel of the Ascension ; the French Paternoster church ; the Carmelite nunnery ; and the Russian church of St Mary Magdalene, near Gethsemane. South of the city are the Armenian monastery of Mount Zion and Bishop Gobat's school. On the west side are the Institution of the Sisters of St Vincent ; the Ratisbon school ; the Montefiore hospice ; the British ophthalmic

hospital of the Knights of St John ; the convent and church of the Clarisses ; and the Moravian leper hospital. Within the city walls are the Latin Patriarchal church and residence ; the school of the Frferes de la Doctrine Chretienne; the schools and printing house of the Franciscans ; the Coptic monastery ; the German church of the Redeemer, and hospice ; the United Armenian church of the Spasm ; the convent and school of the ScEurs de Zion ; the Austrian hospice ; the Turkish school and museum ; the monasteryand seminary of the Fr^resdela Mission Al-g^rienne, with the restored church of St Anne ; the church, schools, and hospital of the London Mission to the Jews ; the Armenian seminary and Patriarchal buUdings ; the Rothschild hospital ; and Jewish hospices and synagogues. The climate is naturally good, but continued neglect of sanitary precautions has made the city unhealthy. During the summer months the heat is tempered by a fresh sea^ breeze, and there is usually a sharp fall of temperature at night ; but in spring and autumn the east and south-east winds, which blow across the heated depression of the Ghdr,

are enervating and oppressive. A dry season, which lasts from May to October, is followed by a rainy season, divided into the early, winter, and latter rains. Snow falls two years out of three, but soon melts. The mean annual temperature is 62°-8 F., the maximum 112°, and the minimum 25°. The mean monthly temperature is lowest (47°-2) in February, and highest (76°-3) in August. The mean annual rainfall (1861 to 1899) is 26-06 inches. The most unhealthy period is from 1st May to 31st October, when there are, from time to time, outbreaks of typhoid, small-pox, diphtheria, and other epidemics. The un-healthiness of the city is chiefly due to want of proper drainage, impure drinking-water, miasma from the dis-turbed rubbish heaps, and contaminated dust from the uncleansed roads and streets. The only industry is the manufacture of olive-wood and mother-of-pearl goods for sale to pilgrims and for export. The imports (see Joppa) are chiefly food, clothing, and building material. The popu-lation in 1899 was about 48,600 (Moslems 7700, Christians 10,900, Jews 30,000).' During the pilgrimage season it

is increased by about 15,000 travellers and pilgrims.

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I The number of Jews has been placed as high as 55,000, but an inquiry by the writer led him to believe that it does not exceed 30,000. The Jewish Annual (Luncz) published in Jerusalem gives 28,600 ; Baedeker 41,000.

Jesi, a town and episcopal see of the province of Ancona, the Marches, Italy, 17 miles south-west of Ancona by rail. It is a place of very considerable industry, especially silk-spinning, raising of cocoons, and manufacture of matches, also manufacture of hosiery, hats, paper, tanning, and brick-making. Jesi has a technical school. Pergolese (1710-1736), composer of a Stabat Mater, was born here. Population (1881), 12,118 ; (1899), 6200.

Jessel, Sir George (1824-1883), British judge, was born in London on the 13th of February 1824. He

was the son of Zadok Aaron Jessel, a Jewish coral merchant, trading in the City of London and living in Savile Row, Piccadilly. George Jessel was educated at Mr Neumegen's school for Jews at Kew, and being prevented by then existing religious disabilities, since abolished, from proceeding to Oxford or Cambridge, went to University College, London. He entered as a student at Lincoln's Inn in 1842, and a year later took his B.A. degree at the University of London, graduating with honours in Mathematics and Natural Philosophy, gaining honours also and a prize in Vegetable Physiology and Structural Botany, and becoming M.A. and gold medallist in Mathematics and Natural Philosophy in 1844. In 1846 he became a fellow of University College, and on the 4th of May 1847 he was called to the bar at Lincoln's Inn. His earnings during his first three years at the bar were 52, 346, and 795 guineas, from which it will be seen that his rise to a tolerably large practice was rapid. His work, however, was mainly conveyancing, and for long his income remained almost stationary, so that,

like many other young barristers, he declared his belief that he had mistaken his vocation. By degrees, however, he got more work, and having applied for silk and been refused it by Lord Westbury in 1861, eventually, on the recommendation of the same Lord Chancellor, was called within the bar in 1865, becoming a bencher of his Inn in the same year and practising in the Rolls Court. He entered Parliament as Liberal member for Dover in 1868, and although neither his intellect nor his oratory was of a class that would be likely to commend itself to his fellow-members of the House of Commons, he attracted the attention of Mr Gladstone by two learned and lawyer-like speeches on the Bankruptcy Bill which was before the House in 1869, with the result that when in 1871 Sir Robert Collier was made a judicial member of the Privy Council (in evasion of the Act which constituted that office), and Sir John Duke Coleridge succeeded him as Attorney-General, Jessel received the post of Solicitor-General and was knighted. His reputation at this time stood high in the Chancery

Courts; on the Common Law side he was unknown, and on the first occasion upon which he came into the Court of Queen's Bench to move on behalf of the. Crown, there was very nearly a collision between him and the bench, composed of Lord Chief Justice Cockburn, Mr Justice Blackburn, and Mr Justice Lush. Mr Justice Blackburn having interrupted with a question and a suggestion. Sir George answered promptly, if without heat, "Will your lordship hear the words of the statute before you rush to hasty analogies?" "Mr Solicitor," said Cockburn, as presiding judge, "we are not accustomed to be addressed in this way." Jessel made no direct reply, but continued his argument perfectly unmoved, saying only, "My Lords, when I was interrupted I was reading the words of the statute. I propose to read them to the end." He obtained the rule he asked for, and his forceful and direct method of bringing his arguments home to the bench was not modified in his subsequent practice before it. His great powers were fully recognized; his business in addition

to that on behalf of the Crown became very large, and his income for three years before he was raised to the bench amounted to nearly £26,000 per annum. He had married a rich wife, so that the pecuniary loss was comparatively immaterial to him when in 1873 he succeeded Lord Romilly as Master of the Rolls, the Attorney-General having declined to exercise his own right to do so. From 1873 to 1881 Sir George Jessel sat as a judge of first instance in the Rolls Court, being also a member of the Court of Appeal. In November 1874 the first Judicature Act came into effect, and in 1881 the Judicature Act of that year made the Master of the Rolls the ordinary president of the first Court of Appeal, relieving him of his duties as a judge of first instance. In the Court of Appeal Sir George Jessel presided almost to the day of his death. For some time before 1883 he suffered from diabetes with chronic disorder of the heart and liver, but struggled against it ; on the 16th of March 1883 he sat in court for the last time, and on the 21st of March he died at his house, 10 Hyde Park Gardens, Lon-

don, the immediate cause of death being cardiac syncope. As a judge of first instance Sir George Jessel was a revelation to those accustomed to the proverbial slowness of the Chancery Courts and of the Master of the Rolls who preceded him. He disposed of the business before him with rapidity combined with correctness of judgment, and he not only had no arrears himself, but was frequently able to help other judges to clear their lists. His knowledge of law and equity was wide and accurate, and his memory for cases and command of the principles laid down in them extraordinary. In the Rolls Court he never reserved a judgment, not even in the Epping Forest case {Commissioners of Seivers v. Glasse, L.R. 19 Eq. Times, 11th November 1874), in which the evidence and arguments lasted twenty-two days (150 witnesses being examined in court, while the documents went back to the days of King John), and in the Court of Appeal he did so only twice, and then in deference to the wishes of his colleagues. The second of these two occasions was the case of Bobarts v. Tlie Corporation of London

(49 Law Times 455; Times, 10th March 1883), and those who may read Jessel's judgment should remember that, reviewing as it does the law and custom on the subject, and the records of the City with regard to the appointment of a Remembrancer from the 16th century, together with the facts of the case before the court, it occupied nearly an hour to deliver, but was never-theless delivered without notes — this, too, on the 9th of March 1883, when the judge who uttered it was within a fortnight of his death. Never during the 19th century was the business of any court performed so rapidly, punc-tually, and satisfactorily as it was when Jessel presided. He was Master of the Rolls at a momentous period of legal history. The Judicature Acts, completing the fusion of law and equity, were passed while he was a judge of first instance, and were still new to the courts when he died. His knowledge and power of assimi-lating knowledge of all subjects, his mastery of every branch of law with which he had to concern himself, as well as of equity, together with his willingness to

give effect to the new system, caused it to be said when he died that the success of the Judicature Acts would have been impossible without him. His faults as a judge lay in his disposition to be over-rapid, and to be intolerant of those who, not able to follow the rapidity of his judgment, endeavoured to persist in argument after he had made up his mind; but though he was peremptory with the most eminent counsel, young men had no cause to complain of his treatment of them. His masterfulness in his own court was carried into matters of detail. He

was known to tell a counsel to take his hands out of his pockets while addressing the court, and to say to a law ofB-cer of the Crown, who was employing more rhetorical methods than are usual in Chancery courts, " Stop, please, Sir 'Enry ; we don't allow eloquence in this division." His inability to aspirate his h'a led Serjeant Parry, when a junior remarked on it, to turn fiercely round and say to the critic, " I would rather drop my ^'s with Jessel than

aspirate them with you."

Among other public duties performed by him, Sir George Jessel sat on the Eoyal Commission for the Amendment of the Medical Acts, taking a keen interest in the subject and an active part in the preparation of the report published by the Commission. He interested himself also actively in the management of London University, of which he was a fellow fronj. 1861, and of which he was elected vice-chancellor in 1880. He was one of the commissioners of patents, and trustee of the British Museum. He was also chairman of the committee of judges which drafted the new rules rendered necessary by the Judicature Acts. He was treasurer of Lincoln's Inn in 1883, and vice-president of the Council of Legal Education. He was also a fellow of the Eoyal Society. He marks an epoch on the bench, owing to the active part taken by him in rendering the Judicature Acts effective, and also as being the last judge capable of sitting in the House of Commons, a privilege of which he did not avail himself.

He was the first Jew who, as Solicitor-General, took a share in the executive government of his country, the first Jew who was sworn a regular member of the Privy Council, and the first Jew who took a seat on the judicial bench of Great Britain ; he was also, for many years after being called to the bar, so situated that any one might have driven him from it, because, being a Jew, he was not qualified to be a member of the bar. In person Sir George Jessel was a stoutish, square-built man of middle height, with dark hair, somewhat heavy features, a fresh ruddy complexion, and a large mouth. A bust by W. H. Ingram near the entrance to the Chancery Court of Appeal at the Eoyal Courts of Justice keeps alive some memory of his personality. Sir George Jessel married in 1856 Amelia, daughter of Joseph Moses, who survived him together with three daughters and two sons, the elder of whom was made a baronet shortly after the death of his distinguished father and in recognition of his services. (b. a. Ar.)

Jessore, a town and district of British India, in

the presidency division of Bengal. The town is on the Bhairab river, and has a railway station 75 miles north-east of Calcutta. Population (1881), 8495 ; (1891), 8302. It has a Government high school, with 191 pupils in 1896-97, and four printing-presses, issuing two vernacular periodi-cals. The district of Jessorb has an area of 2926 square miles. The population in 1881 was 1,939,375 ; in 1891, 1,888,827; showing a decrease of 3 per cent.; average density, 646 per square mile, or nearly one to every acre in a purely rural tract. Classified according to religion, Hindus numbered 737,601; Mahommedans, 1,150,135; Christians, 840, of whom 64 were Europeans; "others," 251. In 1901 the population was 1,812,770, showing a fur-ther decrease of 4 per cent. Land revenue and rates (1897-98), Es.9,70,834 ; number of police, 503 ; number of boys at school (1896-97), 40,063, being 28-4 per cent, of the male population of school-going age ; registered death-rate (1897), 33-36 per thousand. Jessore is the centre of sugar manufacture from date palms. There are 120 refin-eries, employing 1200 hands, with an out-turn valued at

Es.14,82,000. Indigo is a declining industry. There are sixteen concerns and factories, employing 4500 hands, with an out-turn valued at Es. 2,35,000. The district is crossed by the Bengal Central railway, but the chief means of communication are waterways.

J ever, a town of Germany, grand-duchy of Olden-burg, 13 miles by rail north-west of Wilhelmshaven, and connected with the North Sea by a navigable canal. It boasts of a castle (15th and 16th centuries), a town hall (1609), and an old parish church, with the marble tomb of the Erisian prince, Edo Wiemkens (died 1511), and monuments to the historian Schlosser (1776-1861) and the chemist Mitscherlich (1794-1863), both natives of the place. The fathers (getreuen) of the town used to send an annual birthday present of 101 plovers' eggs to Prince Bismarck. Population (1895), 5306 ; (1900), 6486.

Jevons, William Stanley (1835-1882), English economist and logician, was born at Liverpool on 1st September 1835. His father, Thomas Jevons, a man of

strong scientific tastes and a writer on legal and economic subjects, was a member of a firm of iron merchants. His mother, Mary Ann Jevons, was the daughter of William Eoscoe, the author of the Life of Lorenzo de' Medici.

At the age of fifteen he was sent to London to attend University College School. He appears at this time, though with habitual reserve he kept his aspirations to himself, to have already formed the belief that important achievements as a thinker were possible to him, and at more than one critical period in his career this belief was the decisive factor in determining his conduct. Towards the end of 1853, after having spent two years at University College, where his favourite subjects were chemistry and botany, he unexpectedly received the offer of the assayership to the new mint in Australia. The idea of leaving England was distasteful, but pecuniary considerations had, in consequence of the failure of his father's firm in 1847, become of vital importance, and he accepted the post. He left England for Sydney in June 1854, and remained there for five years. At the end of that

period, though he was earning a satisfactory and in-
creasing income, he came to the conclusion that he
" could not any longer sacrifice everything that he really
desired and that he thought would prove a really useful
way of spending life." He therefore resigned his ap-
pointment, and in the autumn of 1869 entered again
as a student at University College, London, proceeding
in due course to the B.A. and M.A. degrees of the Uni-
versity of London. He now gave his principal atten-
tion to the moral sciences, considering that his powers
lay mainly in that direction. But his interest in natu-
ral science was by no means exhausted : throughout
his life he continued to write occasional papers on scien-
tific subjects, and his intimate knowledge of the physical
sciences greatly contributed to the success of his principal
logical work, The Principles of Science. Not long after-
taking his M.A. degree Jevons obtained a post as tutor
at Owens College, Manchester ; but the work was arduous
and badly paid, and, when added to his literary occupa-
tions, it involved a great strain upon his health. In 1866

he was elected professor of logic and mental and moral IDhilosophy and Cobden professor of political economy in Owens College. Next year he married Harriet Ann Taylor, whose father had been the founder and proprietor of the Manchester Guardian. Jevons suffered a good deal from ill-health and sleeplessness, and found the delivery of lectures covering so wide a range of subjects very burdensome. He felt it to be an absurdity that one man should have to deal with " the whole sphere of the logical, metaphysical, • mental, moral, and economical sciences," and in 1876 he was glad to exchange the Owens professorship for the professorship of political

economy in University College, London, a chair yielding a smaller income, but limited to one, subject. Travelling and music, to wMch he was greatly devoted, were the principal recreations of his life; but his health continued bad, and he suffered from depression. He found

his professorial duties increasingly irksome, and feeling that the pressure of literary work left him no spare energy, he decided in 1880 to resign the post. On the 13th of August 1882 he was drowned whilst bathing near Hastings. Throughout his life he had pursued with devotion and industry the ideals with which he had set out, and his journal and letters display a noble simplicity of disposition and an unswerving honesty of purpose. In early manhood he had a great dislike of speaking in public, and lecturing was never his strong point. On giving up his professorship at University College, he wrote: "Sometimes I have enjoyed lecturing, especially on logic, but for years past I have never entered the lecture-room without a feeling probably like that of going to the pillory. I shall never lecture, speech-ify, or do anything of that sort again if I can pos-sibly help it." He was a prolific writer, and at the time of his death he occupied the foremost position in England both as a logician and as an economist. Professor Marshall has said of his work in economics

that it " will probably be found to have more constructive force than any, save that of Ricardo, that has been done during the last hundred years." His literary productiveness continued unabated to the end, and at the time of his death he was engaged upon an economic work that promised to be at least as important as any that he had previously undertaken. It would be difficult to exaggerate the loss which logic and political economy sustained through the accident by which his life was prematurely cut short.

Jevons arrived quite early in his career as a student at the doctrines that constituted his most characteristic and original contributions to economics and logic. The theory of utility, which became the keynote of his general theory of political economy, was practically formulated in a letter written in 1860 ; and the germ of his logical principle of the Substitution of Similars may be found in the view which he propounded in another letter written in 1861, that " philosophy would be found to consist solely in pointing out the likeness of things." The theory of utility above

referred to, namely, that the degree of utility of a commodity is some continuous mathematical function of the quantity of the commodity available, together with the implicated doctrine that economics is essentially a mathematical science, took more definite form in a paper on "A General Mathematical Theory of Political Economy," written for the British Association in 1862. This paper does not appear to have attracted much attention either in 1862 or on its publication four years later in the Journal of the Statistical Society ; and it was not till 1871, when the treatise on the Theory of Political Economy appeared, that Jevons set forth his doctrines in a fully-developed form. It is an interesting fact that it was not till after the publication of this work that Jevons became acquainted with the applications of mathematics to political economy made by earlier writers, notably Cournot and Gossen. It is also noteworthy that the theory of utility was, about 1870, being independently developed on somewhat similar lines by Menger in Austria and Walras in Switzerland. As regards the discovery of the connexion

between value in exchange and final (or marginal) utility, the priority belongs to Gossen, but this in no way detracts from the great importance of the service which Jevons rendered to English economics by his fresh discovery of the principle, and by the way in which he ultimately forced it into notice. In his reaction from the prevailing view he sometimes expressed himself without due qualification: the declaration, for instance, made at the commencement of the TJieory of Political Economy, that "value depends entirely upon utility," lent itself to misinterpretation. But a certain exaggeration of emphasis may be pardoned in a writer seeking to attract the attention of an indifferent public.

It was not, however, as a theorist dealing with the fundamental data of economic science, but as a brilliant writer on practical economic questions, that Jevons first received general recognition. His tract on A Serious Fall in the Value of Gold, published in 1863, in which he discussed the economic consequences of the gold discoveries of the preceding decade, and his work

on Tlie Goal Question, published in 1866, in which he demonstrated the dangerous rate of consumption of British coal supplies, placed him in the front rank as a writer on applied economics and statistics ; and he would be remembered as one of the leading economists of the 19th century even had his Theory of Political Econojuy never been written. Amongst his economic works, in addition to those already referred to, may be mentioned a short treatise on Money and the Mechanism of Exchange (1875), written in a popular style, and descriptive rather than theoretical, but wonderfully fresh and original in treatment and full of suggestiveness, a Primer on Political Economy (1878), Tlie State. in Relation to Labour (1882), and two works published after his death, namely. Methods of Social Beform and Investigations in Currency an d Finance, containing papers that had been written at various times and that had appeared separately in various forms during his lifetime. The last-named volume contains Jevons's interesting speculations on the connexion between 'com-mercial crises and sun-spots. As already mentioned, he

was engaged at the time of his death upon a large treatise on economics, in which he intended to go over the whole field of the subject.

Jevons's work in logic went on pari passu with his work in political economy. In 1863 he speaks of having got his logical system free from further doubt, and in 1864 he published a small volume, entitled Pure Logic; or the Logic of Quality apart from Quantity, which was based on Boole's system of logic, but freed from what he considered the false mathematical dress of that system. In the years immediately following he devoted considerable attention to the construction of a logical machine, exhibited before the Eoyal Society in 1870, by means of which the conclusion derivable from any given set of premisses could be mechanically obtained. In 1866 what he regarded as the great and universal principle of all reasoning dawned upon him ; and in 1869 he published a sketch of this fundamental doctrine under the title of The Substitution of Similars. He expressed the principle in its simplest form as follows : " Whatever is true of a

thing is true of its like," and he worked out in detail its various applications. In the following year appeared the Elementai-y Lessons on Logic, which soon became, and has probably since continued to be, the most widely read elementary text-book on logic in the English language. In the meantime, from 1868 onwards, he was engaged upon a much more important logical treatise, which ap-peared in 1874 under the title of Tlie Principles of Science. In this work Jevons embodied the substance of his earlier works on Pure Logic and the Substitution of Similars ; he also enunciated and developed the view that induction is simply an inverse employment of deduction ; he treated in a luminous manner the general theory of probability, and the relation between probability and induction ; aiid his knowledge of the various natural sciences enabled him throughout to relieve the abstract character of logical doc-trine by concrete scientific illustrations, often worked out

in great detail. Jevons's general theory of induction was

a revival of the theory laid down by Whewell and criticized by Mill ; but it was put in a new form, and was free from some of the non-essential adjuncts which rendered Whewell's exposition open to attack. The work as a whole must be regarded as one of the most notable contributions to logical doctrine that appeared in Great Britain in the 19th century. Another logical work, entitled Studies in Deductive Logic, and consisting mainly of exercises and problems for the use of students, was published in 1880. In 1877 and the following years Jevons contributed to the Contemporary Review some articles on J. S. Mill, which he had intended to supplement by further articles, and eventually publish in a volume as a criticism of Mill's philosophy. These articles and one other were republished after Jevons's death, together with his earlier logical treatises, in a volume entitled Pure Logic and other Minor Works. The criticisms on Mill contain much that is ingenious and much that is forcible, but on the whole they cannot be regarded as taking rank with Jevons's other work. His strength lay

in his power as an original thinker rather than as a critic ; and it will be by his constructive work as a logician, an economist, and a statistician that he will be remembered. See Letters and Journal of W. Stanley Jevons, edited by his wife, 1886. This work contains a bibliography of Jevons's writings. (j. N. K.)

Jewellery. — The Paris International Exhibition of 1900 was the occasion of a display of goldsmith's work which marked it as an epoch in the history of the craft. If we look back to 1875, we see at once that during the two subsequent decades this industry, though prosperous from the commercial point of view, and always remarkable from that of technical finish, remained stationary as an art. During these twenty years French j ewellery rested on its reputation. The traditions were maintained of either the 17th and 18th centuries or the style affected at the close of the Second Empire — light pierced work and design borrowed from natural flowers. The last type, introduced by Massin, had exercised, indeed, a revolu-tionary influence on the treatment of jewellery. This

clever artist, not less skilful as a craftsman, produced a new genre by copying the grace and lightness of living blossoms, thus introducing a perfectly fresh element into the limited variety of traditional style, and by the tise of filagree gold work altering its- character and giving it greater elegance. Massin still held the first rank in the Exhibition of 1878 ; he had a marked influence on his contemporaries, and his name will be remembered in the history of the goldsmith's art to designate a style and a period. In 1889 the report of this section in the Great Exhibition still records that " flowers and foliage held the first place in jewellery for the hair or bodice." Throughout these years the craft was exclusively devoted to perfection of workmanship. The utmost finish was aimed at in the mounting and setting of gems ; jewellery was, in fact, not so much an art as a high-class industry ; individual effort and purpose were absent. Still goldsmith's work was an important factor in fashionable jewellery. In 1867, how-ever, the diamond mines discovered in South Africa had begun to supply the markets of Europe with a profusion of

these stones. Diamonds were no longer the choice jewels of the privileged few ; they were within reach of moderate fortunes. Gold ornaments were cast aside in their favour, and it is, in fact, to this economic development that the modern change of taste in jewellery is mainly due. The constantly growing output of gems led to competition in the production of jewellery, and it became an object to increase the quality and reduce the cost. In the report of the Exhibition of 1889 we are told that mechanical processes have been introduced into the manufacture, hand labour having proved insufficient. Up to that time precious stones had been of such intrinsic value that the jeweller's chief skill lay in displaying these costly stones to the best advantage ; the mounting was a secondary consideration. The settings were seldom long preserved in their original condition, but in the case of family jewels were renewed with each generation and each change of fashion, a state of things which could not be favourable to any truly artistic development of taste, since the work was doomed, sooner or later, to destruc-

tion. However, the evil led to its own remedy. As soon as diamonds fell in value they lost at the same time the prestige which made them an attribute of wealth. Aristo-cratic taste now gave a preference to trinkets which derived their value and character from artistic design. This revolutionized the jeweller's craft, and revived the simple ornament of gold or silver, which came forward but timidly at first, till, in the Exhibition of the Salon in 1895, it burst upon the world in the exhibits of Eene Lalique. This artist at the present day holds a unique position. The Exhibition of 1900 confirmed him in it, not only by the beautiful work he produced, but by the evident influence he exerted during the previous five years over all his rival brethren of the craft. What especially stamps the works of Lalique is their striking originality ; his individuality is as plainly expressed in his smallest piece as that of Ingres or of Delacroix in their slightest sketches. He has raised jewellery from ranking as an industry to the dignity of an %rt. His work may be considered from the point of view of design and from

that of execution. As an artist he has completely reconstructed from the foundation the scheme of design which had fed the poverty-stricken imagination of the last generation of goldsmiths. He had recourse to the art of the past, but to the spirit rather than the letter, and to nature for many new elements of design — free double curves, suave or soft; opalescent harmonies of colour-ing ; reminiscences, with quite a new feeling, of Egypt, Chaldsea, Greece, and the East, or of the art of the Renaissance ; an infinite variety of floral forms even of the humblest : the dandelion, the thistle, the nasturtium, mistle-toe, and honesty, now classical in their artistic application. He introduces also the female nude in the form of sirens and sphinxes, full of tragic force and character. In fact, we find in Lalique a poet who has created an art at once logical and imaginative, full of feeling and of method. As a craftsman he has effected a radical change, breaking through old routine, throwing off old fetters, combining all the processes of the goldsmith, the chaser, the enameller, and the gem-setter, and freeing himself from the narrow

lines in which the art had been confined. He ignores the hierarchy of gems, caring no more on occasion for a diamond than for a flint, since, in his view, no stone, whatever its original estimation, has any value beyond the characteristic expression he lends it as a means to his end. Thus, whilehesometimes uses diamonds, rubies, sapphires, or emeralds as a background, he will, on the other hand, give a conspicuous position to common stones — carnelian, agate, malachite, jaspar, coral, and even materials of no intrinsic value, such as horn. One of his favourite stones is the opal, which lends itself to his arrangements of colour, and which has inconsequence become a fashionable stone in French jewellery. It is to be feared that after Lalique the rather doubtful tendencies of his art may lead to its decadence by an unintelligent adoption of his theories and bad imitations of his style, for the tendency is to produce important pieces, beautiful by themselves, but too heavy for the person. M. Henri Vever, with whom Lalique formerly worked, has, however, done much to save it by reviving old traditions. What distinguishes M. Vever's

work from that of Lalique (though he has often borrowed from him) is that }ie has maintained the distinction between gem-setting and goldsmith's jewellery. In the former class of work he, like the earlier jewellers, attaches great importance to the selection of stones ; but while returning with judgment to the old ways, he shows much freedom of invention and superior methods of composition and execution. His taste, which is solid and serious, has real distinction, and his exhibit in 1900 contributed to mark the date as memorable in the history of French jewellery. Besides these two artists, there are old-established jewellers (famous for the work of Desbazeille and others) who have maintained their high reputation by adopting the new tendencies, among others Messrs Boucheron, Falize, and Sandoz, noted for admirable work-manship and the good style of their pieces, Messrs Coulon, Chaumet, Marret, Mellerio, Desprfes, and others.

' The movement which took its rise in France spread in

due course to other countries. In England the impulse has come from three different directions. The classic work in gold by the elder Giuliano gave way to a treatment of enamel by the same artist which has scarcely been sur-passed for perfection of execution and sobriety of taste in design and colour, while the endless variations, original in themselves, on conventional forms show extraordinary resource and invention. The reputation of the father has, since his death, been sustained by the sons, and in a measure also by imitators. Parallel with the Arts and Crafts movement, designers like C. K. Ashbee, Fred Eobinson, and Nelson a^id Edith Dawson have aimed at purging the jeweller's craft of its character of mere gem-mounting in conventional forms (of which the more un-imaginative, representing stars, bows, flowers, and the like, are varied by such absurdities as insects, birds, animals, figures of men, and objects made up simply of stones clustered together). Their work is often excellently and fancifully designed, but it lacks that exquisite perfection of execution achieved by the incomparable craftsmen of

France. English sculptor-decorators — such as Alfred Gilbert, E..A., and George J. Frampton, A.E.A. — have produced objects of a still higher class, but it is usually the work of the goldsmith rather than of the jeweller. Examples may be seen in the badge executed by Mr Gilbert for the president of the Institute of Painters in Water Colours, and in the mayoral chain for Preston. Symbolism here enters into the design, which has not only an ornamental but a didactic purpose.

In the United States the neglect of gems for their own sake, which is the chief note of the " New Jewellery " in France, has not yet been so clearly dem onstrated. Tiffany, usually regarded in Europe as the leader of American artificers, was seen in the Paris Exhibition of 1900 to have maintained the admirable character of workmanship while developing more and more the richness and magni-ficence that dazzle rather than charm. Philippe Wolfers occupies in Belgium the position which in France is held by Rene Lalique. If his design is a little heavier, it is not less beautiful La imagination or less masterly in execu-

tion. Graceful, ingenious, fanciful, elegant, fantastic by turns, his objects of jewellery and goldsmithery have a solid claim to be considered criations cVart. In Germany the movement is headed by Werner and by Hugo Schaf er of Berlin, and on a lower plane by StoflSer and Zerenner of Pforzheim ; but the handling of these distinguished craftsmen is heavier still. J. M. Olbrich and Eobert Koch, though not without originality, may be considered as followers of Lalique. In Austria Franz Hauptmann has taken the lead in artistic jewellery. As a representative of Russia, Faberge of St Petersburg deserves to be mentioned along with Lalique and Wolfers. In Switzerland the development, so far as it is original, seems to have proceeded mainly in the direction of enamelling — not only in " superficial " or painted enamel, but also in plique d, jour (see Enamels), in which Desbazeille of Paris attracted much attention about the year 1890. It must be admitted that many of the best artists who have devoted themselves to jewellery have been more successful in design than in securing lightness su-ch as is required by

the wearer, which was a characteristic in the works of the Italian craftsmen of the Renaissance. For this reason many of their masterpieces are more beautiful in the case than upon the person.

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(li. BE. ; M. H. S.)

Jeypore, or Jaipur, a native state of India, in the Eajputana Agency. Total area, 15,349 square miles. The population in 1881 was 2,634,357; in 1891, 2,832,276, showing an apparent increase of 12 per cent. ; average density, 184 persons per square mile. In 1901 the popular tion was 2,658,075, showing a decrease of 6 per cent.,

due to the results of famine. The revenue (1896-97) was Rs.67,00,000, of which Rs.8,82,526 was expended on public works ; tribute, Rs.4,00,000 ; number of schools, 772, attended by 25,589 pupils, of whom 261 were girls, the proportion of boys at school being 11 per cent, of those of school-going age. The reigning maharaja, Madho Singh, G.C.S.I., was born in 1861, and succeeded in 1880. He is distinguished for his enlightened administration and his patronage of art. The mint coins gold, silver, and copper, the emblem being a jhar, or branch of -six sprigs. In 1896-97 the coinage amounted to Es.13,13,000. Public works are under the charge of a British officer. Since 1868 no less than Rs.47,00,000 has been expended on irrigation. The number of works is 149, irrigating 84,000 bighas, and yielding a revenue of Rs.3,00,000. The founder tion-stone of a new irrigation project at Ramgarh, esti-mated to cost Rs.6,13,000 and to irrigate 30,000 bighas,wa.s laid in 1897. The state is traversed by the Rajputana railway, with its two branches to Agra and Delhi. A railway of 73 miles, begun at the expense of the state, is

estimated to cost Rs.28,47,000. The state suffered from the famine of 1899-1900. The city of Jeypore is 84 miles north-east of Ajmir by rail. Population (1881), 142,578 ; (1891), 168,905, being the seventeenth largest town in India ; (1901), 159,650. It is surrounded by a lofty crenelated wall, with seven gates. Unfortunately the architecture is largely pink stucco, in imitation of sandstone. The palace is in the centre, surrounded by pleasure gardens. An excellent water-supply is provided at an annual cost of Es.60,000. There are a college, with 56 students in 1897-98 ; a high school, with 684 pupils ; a flourishing art school, which owes much of its success to the active interest of Dr Hendley, who has also been for many years in charge of the Alayo Hospital ; and an industrial and economic museum.

Jeysulmere, or Jaisalmee, a native state of India, in the Eajputana Agency. Area, 16,039 square miles. The population in 1881 was 108,143; in 1891, 115,701 ; average density, 7 persons per square mile, compared with 94 persons for Eajputana generally. In 1901

the population was 73,436, showing a decrease of 37 per cent., due to the results of famine. The gross revenue (1897-98) was Es.1,60,000 ; no tribute. The chief, whose title is maharawal, is the head of the Bhati olauof Eajputs,

J H A B U A — J H E L U M

who claim a very ancient descent, and have been settled here for more than a thousand years. Their territory once extended to the Indus. The state came under British protection in 1818. The present maharawal, Salivahan, is a minor, born in 1886. The state suffered from famine in 1897, and to a less extent in 1900. There are no railways. G-old, silver, and copper are coined at the mint, to the value of Es.49,000 in 1897-98. The town of Jbysulmbkb is on a ridge of yellowish sandstone, crowned by a fort, which contains the palace. Many of the houses and temples are sculptured with fine carving. Population (1881), 10,965.

Jhabua, a native state of India, in the Bhopawar Agency. It borders on the Panch Mahals district of Bombay. Area, with the dependency of Eutanmal, 1219 square miles. The population in 1881 was 92,938 ; in 1891, 119,787, showing an apparent increase of 29 per cent. ; average density, 99 persons per square mile. About half the inhabitants belong to the aboriginal tribe of

Bhils. The revenue (1897-98) was Es.1,65,215 ; subsidy to the Malwa Bhil corps, Es.l470. The chief, whose title is raja, is a Eajput of the Eahtor clan, descended from a branch of the Jodhpur family. The raja, Udai Singh, was in 1901 invested with the powers of admiaistration.

The town of Jhabua is on the bank of a lake, and is surrounded by a mud wall. There is an Anglo-vernacular school. A road is under construction to Meghonagar station on the Eajputana railway. A dispensary and a rest-house were constructed in commemoration of Queen Victoria's Diamond Jubilee in 1897.

Jhalawar, a native state of India, in the Eajputana Agency. Area, 3043 square miles. The population in 1881 was 340,488 ; in 1891, 343,601, showing an insignifi-cant increase; average density, 113 persons per square mile; gross revenue (1896-97), Es.16,53,413 ; tribute, Es.80,000; expenditure on public works, Es.1,10,814; military force, 1811 men ; boys at school, 964. The late rana, whose relations with the British Government had long been strained, was finally deposed in 1896, "on account

of persistent misgovernment and proved unfitness for the powers of a ruling chief." He now lives at Benares, on a pension of Es.30,000; and the administration was placed in the hands of the British resident. After much consid-eration, the Government resolved in 1897 to break up the state, restoring the greater part to Kotah, but forming the two districts of Shahabad and the Chaumahla into a new state, of which Kuar Bhawani Singh, a descendant of Zalim Singh, was appointed chief. In 1901 the population of the reduced state was 90,174, on an area of about 1140 square miles. The chief town is Patau, or Jhalra Patan, founded on an old site by Zalim Singh in 1796, by the side of an artificial lake. It is the centre of trade; but the palace is at the cantonment of Chhaoni, 4 miles north. Population of Patan (1881), 11,469; (1891), 10,783. Population of Chhaoni (1881), 20,303; (1891), 23,381.

J hang, a town and district of British India, in the Lahore division of the Punjab. The town, which forms one municipality with the newer quarter of MaghiSina, is about 3 miles from the present right bank of the river

Chenab. Population (1881), 21,629; (1891), 23,290; municipal income (1897-98), Es.44,188. It has manufactures of cotton goods. The district of Jhang extends along both sides of the Chenab, including its confluences with the Jhelum and the Eavi. Area, 5871 square miles. The population in 1881 was 395,296 ; in 1891, 436,841, showing an increase of 10 per cent. ; average density, 74 persons per square mile. In 1901 the population was 378,800, showing an apparent decrease of 13 per cent., due to the creation of the new district of Lyallpur. The land revenue and rates are Es.10,01,784, the incidence of assessment being five annas per acre; cultivated area (1896-97), 669,342, of which 563,607 were irrigated, including 302,969 from Government canals; number of police, 529; number of schools (1896-97), 204, with 4371 pupils, the proportion of boys at school to male population of school-going age being 10-8 per cent. ; registered death-rate (1897), 40-37 per thousand. It has five factories for cleaning and pressing cotton, and one printing-press and one flour-mill, both)vithin the Chenab canal colony, of which the centre

is Lyallpur, called after a late lieutenant-governor. This colony, in the north-east of the district, is due to an extension of the Chenab canal system from the adjoining district of Gujranwala. Within Jhang 700,000 acres of Government waste have already been allotted to colonists, who are reported to be flourishing. A branch of the North-Western railway enters the district in this quarter, and will extend throughout its entire length. There are only 9 miles of metalled road, but 180 miles of navigable river.

J ha n si, a city and district of British India, in the Allahabad division of the North- West Provinces.. The city is the centre of the Indian Midland railway system, whence four lines diverge to Agra, Cawnpore, Allahabad, and Bhopal. Formerly the capital of a Mahratta principality, after the troubles of the Mutiny it was made over to Gwalior, but has been exchanged for other territory. Even when the city was in Gwalior, the civil headquarters and the cantonment were at Jhansi Noabad, under its walls. Population (1891), 53,779 ; (1901), 55,288 ; municipal income (1897-98), Es.47,901 ; incidence of taxation,

Es.0:ll:6 per head; registered death-rate (1897), 49‘68 per thousand. The district of Jhansi forms part of British Bundelkhand. It has been enlarged by the incorporar tion of the adjoining district of Lalitpur, which extends still farther into the hill country, almost entirely surrounded by native states. The combined area is 3587 square miles. The population in 1881 was 624,963 ; in 1891, 683,619, showing an increase of nearly 10 per cent. ; average density, 191 persons per square mile, ranging from 249 in Jhansi proper to 141 in Lalitpur. In 1901 the population was 611,644, showing a decrease of 11 per cent., due to the results of famine. The land revenue and rates were Es.6,95,040, the incidence of assessment being six annas per acre; cultivated area (1896-97), 590,635 acres, of which 66,811 were irrigated, including 3934 from Government canals; number of police, 2700 ; number of vernacular schools (1896-97), 106, with 3192 pupils ; death-rate (1897), 47-38 per thousand. There are seven printing-presses, including one owned by the railway company ; one factory for pressing cotton. The railway

line from Bhopal to Cawnpore runs through the length of the combined district.

Jhelum, or Jehlam, a town and district of British India, in the Eawalpindi division of the Punjab. The town is on the right bank of the river Jhelam, here crossed by a bridge of the North- Western railway which for some years had its terminus on the opposite bank, 103 miles north of Lahore. Population (1881), 21,107; (1891), 12,878; municipal income (1897-98), Es.28,568. It is a modern town, with river and railway trade, boat-building, and cantonments for a cavalry and an infantry regiment. The district of Jhelum stretches from the river Jhelum almost to the Indus, its chief physical feature being the Salt Eange. Area, 3996 square miles. The population in 1881 was 589,373 ; in 1891, 609,056, the rate of increase being 3 per cent.; average density, 152 persons per square mile. In 1901 the population was 594,018, showing a decrease of 2 per cent. The land revenue and rates were Es.7,69,177, the incidence of assessment being Es.0 : 4 : 7

per acre ; cultivated area (1896-97), 592,979 acres.

of wMcli 39,879 were irrigated, mostly from private wells, number of police, 496; number of schools (1896-97), 615, with 10,943 pupils, the proportion of boys at school to male population of school-going age being 15 per cent. ; registered death-rate (1897), 31-59 per thousand. At the Mayo mine in the Salt E.ange, salt is annually quarried to the amount of nearly two million maunds, yielding a net revenue of about Rs. 50,00,000. There are two coal-mines, the only ones worked in the province, employing nearly 2000 miners, from which the North-Western railway obtains about 86,000 tons of coal annually. It has one printing-press, issuing two vernacular periodicals. The most populous place and chief centre of the salt trade is Pind DadanKhan; population (1891), 15,055. The district is crossed by the main line of the North-Western railway, and also traversed along the south by a branch line, 74

miles. There are no metalled roads, nor any Government canals. The river Jhelam is navigable throughout for 127 miles.

Jhering, Rudolf von (1818-1892), German jurist, was born on the 22nd of August 1818 at Aurich in East Friesland, where his father practised as a lawyer and his family had been resident for several generations. Having received his early education at the gymnasium of his native town, young Jhering entered the University of Heidelberg in 1836 as a student of jurisprudence, and, after the fashion of German students, visited successively Gottingen and Berlin. Of his university career little is known, except that Puchta, the famous civilian and author of Oeschichte des Rechts bei dem romischen VolJce, alone of all his teachers appears to have gained his admiration and influenced the bent of his mind. After graduating doctor juris, Jhering established himself in 1844 at Berlin as privat-docent for Eoman law, and delivered public lectures on the Oeist des romischen RecMs, the theme which was nearest his heart, and the elaboration of which may be

said to have constituted his life's work. In 1845 he accepted a call as ordinary professor to Basel, in 1846 to Eostock, in 1849 to Kiel, and in 1851 to Giessen. Upon all these seats of learning he left his mark; beyond any other of his contemporaries he animated the dry bones of B.oman law. The German juristic world was still under the dominating influence of the Savigny cult, and the older school looked askance at the daring of the young professor, who, acting in the spirit of his idea — Durcli das romische Recht iiber das romische Recht Mnaus — essayed to adapt the old to new exigencies and to build up a system of natural jurisprudence. This is the keynote of his famous work, Geisf des romischen Rechts auf den ver-schiedenen Stufen seiner JSntwickelung (Leipzig, 1852-65), which for originality of conception and lucidity of scientific reasoning placed its author in the forefront of modern Roman jurists.

The time of Jhering's professional activity at Giessen coincided with the most famous period of that university's history. Liebig had already made its name of world-wide

reputation in the field of chemical research, and it now attracted law students from all climes, eager to sit at the feet of the brilliant young professor. – It is no exaggeration to say that in the second half of the 19th century the reputation of Jhering occupied as high a position as that of Savigny in the first. Their methods were entirely distinct, nay, almost diametrically opposed. Savigny and his school represented the conservative, historical tendency. In Jhering the philosophical conception of jurisprudence, as a science to be utilized for the further advancement of the moral and social interests of mankind, was predominant. In 1868 Jhering accepted a call to Vienna to the chair of Roman Law, and the fascination he had ever exercised as a teacher did not fail him in his new sphere of activity. His lecture-room was crowded, not only with regular students but with men of all professions and even of the highest ranks in the official world, and he became in the Kaiserstadt one of the lions of society, the Austrian Emperor conferring upon him in 1872 a title of hereditary nobility. But to a mind constituted as his, the social

functions of the Austrian metropolis became wearisome, and he gladly exchanged its brilliant circles for the repose of Gottingen, his own Alma Mater, where he became professor in 1872. In this year he had read at Vienna before an admiring audience a lecture, published under the title of Der Kampf urn's Recht (Vienna, 1872 ; English ed.. Battle for Right, London, 1884). Its success was extraordinary. Within two years it attained twelve editions, and it has been translated into twenty-six languages. This was followed a few years later by Der ZwecJc'im Recht (2 vols., Leipzig, 1877-83). In these two works is clearly seen Jhering's individuality. The Kampf urn's Recht shows the firmness of his character, the strength of his sense of justice, and his juristic method and logic : " to assert his rights is the duty that every responsible person owes to himself." In the Zweck im Recht is perceived the bent of the author's intellect. But perhaps the happiest combination of all his distinctive characteristics is to be found in his Jurisprudenz im tdglichen Leben (Jena, 1870). A great feature of his

lectures was his so-called Praktika, problems in Roman law, and a collection of these with hints for solution was published as early as 1847 under the title Civilrechtsfdlle ohne Entscheidungen. In Gottingen he continued to live and work until his death, which occurred on the 17th of September 1892. A short time previously he had been the centre of a devoted crowd of friends and former pupils, assembled enfSte at Wilhelmshohe near Cassel to celebrate the jubilee of his doctorate. Almost all countries were worthily represented, and this pilgrimage to do honour to the man affords an excellent illustration of the extraordinary fascination and enduring influence that Jhering commanded. He was indeed a delightful personality : he retained until the last the freshness and vigour of youth; he was the light-hearted, joyous German student once more, eloquent, humorous, kindly, with nothing about him of the pedant. What he undertook he grasped with all the powers of his intellect and the fervour of his soul, and what he imparted to his hearers bore testimony to the lucidity of his grasp of the sub-

ject. In appearance he was of middle stature, his face clean-shaven and of classical mould, lit up with vivacity and beaming with good nature. He was perhaps seen at his best when dispensing hospitality in his own house ; and none of his guests would ever forget the sparkle of the wit and geniality of his entertainer. With him died the best beloved and the most talented of Roman-law professors of modern times. It was said of him by Professor Adolf Merkel in an In Memoriam. address, R. v. Jliering (Jena, 1893), that he belonged to the happy class of persons to whom Goethe's lines are applicable: "Was ich in der Jugend gewilnscht, das habe ich im Alter die Fillle," and this may justly be said of him, despite the fact that he did not live to finish his life's programme, which would have been to complete his Geist des romischen Rechts and his RechtsgeschicMe. For this work the span of a single life would have been insufficient, but what he has left to the world is a monument of vigorous intellectual power and stamps Jhering as an original thinker and unrivalled exponent in his peculiar interpretation of the

spirit of Roman law.

Among others of his works, all of them characteristic of the author and sparkling with jeux d'esprit, may be mentioned the following : Beitrdge zur Lehre von Besitz, first published in the

Jahrbiicher fur die Dogmatik des Jieutigen romischen und deutschen Privat-rechts, and then separately ; Der Beaituwille, and an article entitled " Besitz " in the Handworterhuoh der Staatswissen-schaften (1891), which aroused at the time much controversy, par-ticularly on account of the opposition manifested to Savigny's conception of the subject. See also Soherz und Ernst in der Jurisprudent (Leipzig, 1885) ; Das Schuldmoment im romischen Privat-recht (Giessen, 1867) ; JDas Trinkgeld (Bmnswick, 1882) ; and among the papers he left behind him his Vorgeschiahte der Indoeuropder, a fragment, has been published by v. Ehrenberg (Leipzig, 1894). See for an account of his life also M. de Jonge, Budolfv. Jliering (Berlin, IS88), und Meyer's Konversations-Lexi-r kon, 1897 ; for his relation to Savigny cf. that article in the ninth edition of the Encyelopcedia Britannica. (p. a. A.)

Jicin. See Gitschin.

Jilolo. See Halmaheka.

Jimena d© la Frontera, a town of Spain, in the province of Cadiz. Built on a spur of the mountains, its streets are very irregular: and steep. There are two parish churches, and the ruins of a castle on the site of an older Roman structure. The local industries include the manufacture of leather, flour-milling, and the making of esparto-grass rugs. The trade is chiefly in wheat, cork, oranges, wine, and fruit. Population, 7720.

Jind, a native state of India, within the Punjab. It ranks as one of the cis-Sutlej states, which came under British influence in 1809. The territory consists of three or four isolated tracts, amid British districts. Total area, 1268 square miles. The population in 1881 was 249,862 ; in 1891, 284,560. In 1901 the population was 282,051, showing a decrease of 1 per cent., compared with an increase of 14 per cent, in the previous decade. The average density is 224 persons per square mile. Estimated gross revenue, Es.6,28,000; military force (including

police), 2043 men ; no tribute. The chief, whose title is raja, is a Sikh of the Sidhu Jat clan and of the Phul-kian family. The dynasty has always been famous for its loyalty to the British, especially during the Mutiny, which has been rewarded with accessions of territory. The present (1902) raja is a minor, under charge of a British tutor, while the state is managed by a coun-cil of regency. During the Tirah expedition of 1897-98, the Jind Imperial Service infantry specially distin-guished themselves. In 1896-97 the number of schools was 34, attended by 1031 pupils, of whom 9 were girls ; the proportion of boys at school was 11 to every 151 of the total male population. There were three Anglo-vernacular schools. The town of Jind is situated in 29° 19' N. and 76° 23' E., and is a station on the Southern Punjab railway, 80 miles north-west of Delhi. Population (1881), 7136.

Jizakh, a district town and fort of Russian Central Asia, province and 64 miles north-east of Samarkand, on the Transcaspian railway. Population, 16,041.

Joachim, Joseph (1831-

-), German violinist

and composer, was born at Kitsee, near Pressburg, 28th

June 1831, the son of Jewish parents. He lived at Pesth

from the age of two, and studied there under Serwaczynski,

who introduced him at a concert when he was only eight

years old. Afterwards he learnt from Hellmesberger and

Joseph Bohm in Vienna, the latter instructing him in the

management of the bow. In 1843 he went to Leipzig,

where the Conservatorium was newly founded ; at Men-

delssohn's recommendation he received a thorough educa-

tion in music generally from Ferdinand David and Moritz

Hauptmann. In 1844 he came to England, and made

his first appearance at Drury Lane Theatre, where his

playing of Ernst's fantasia on Otello made a great sensa-

tion ; he also played Beethoven's concerto at a Philhar-

monic Concert conducted by Mendelssohn. In 1847-4:9 I

and 1862 he revisited England, and after the foundation 1

of the Popular Concerts in 1859, up to 1899, he played

there regularly in the latter part of the season. On Liszt's

invitation, he accepted the post of " Konzertmeister " (i.e., orchestral leader) at Weimar, and was there from 1850 to 1863. Prom that year he was royal "Konzert-direktor" at Hanover until 1868, when Berlin became his place of residence. He married in 1863 the mezzo-soprano singer, Amalie Weiss (Schneeweiss) ; she died in 1899. In 1869 Joachim was appointed head of the newly founded " Hochschule fiir Musik " in Berlin. The famous "Joachim Quartet" was started in the Sing-Akademie in the following year. Besides the consum-mate manual skill which helped to make him famous in his youth, Joachim was gifted with the power of inter-preting the greatest music in absolute perfection : while Bach, Mozart, Beethoven, and Brahms were masters whose works he played with a degree of insight that has never been approached, he was no less supreme in the music of Mendelssohn and Schumann ; in short, the whole of the classical repertory has becoine identified with his playing. His compositions, which have won a high place in the estimation of musicians, are marked by a

strong sense of orchestral colouring. His works include two concertos and three other works for violin and orchestra, the best known of which is the famous " Hungarian Concerto," which he has often played in England ; six pieces for violin and piano; two works (one set of " Hebrew Melodies ") for viola and piano ; several overtures and marches for orchestra, and a " Scena der Marfa " for mezzo-soprano from Schiller's Demetrius. No survey of Joachim's career would be complete which omitted mention of his absolute freedom from tricks or mannerism, his dignified bearing, and his unselfish character. His devotion to the highest ideals, combined with a personal massiveness and repose, has brought against Joachim's style an accusation of coldness from admirers of a more effusive temperament. But the answer to this is given by the depth and variety of expression which his mastery of the resources of his instrument put at his command. His biographer, Herr Andreas Moser, summed up all that the world needs to know of one of the most beautiful natures the world has seen in the words, "He

plays the violin, not for its own sake, but in the service of an ideal."

Joachimsthal (Czech, Jdchymov), chief town of a government district in Bohemia, 10 miles north of Karls-bad. It is a mining centre. In 1890 the population of the commune was 7046, German and Catholic; (1900), 7378. The mines are now nearly exhausted, and but small quantities of silver and uranium are recovered. The State tobacco factory and the manufacture of gloves, uranium, colour-stuffs, lace, and paper are the most important industries.

Jodhpur, orMABWAE, a native state of India, in the Rajputana Agency. Total area (including the dependency of Mallani), 37,445 square miles. The population in 1881 was 1,750,403 ; in 1891, 2,521,727, showing an apparent increase of 44 per cent. ; average density, 67 persons per square mile. In 1901 the population was 1,936,909, show-ing a decrease of 23 per cent., due to the results of famine. The gross revenue (1897-98) was Rs.58,24,000 of which Rs.20,00,000 was expended on • public works ; tribute,

Rs.2,13,000. The late maharaja, Jaswant Singh, who died in 1896, was a very enlightened ruler. His brother, Pertap Singh, G.C.S.I., ^ lieutenant-colonel in the British army and LL.D. of Cambridge, visited England on the occasion of Queen Victoria's Diamond Jubilee, and served on the staff of Sir W. Lockhart during the Tirah campaign, being slightly wounded, and also in the cam-paign in China against the Boxers. He conducted the

administration until his nephew came of age in 1898. The Imperial Service cavalry formed part of the reserve brigade during the Tirah campaign. The state maintains a railway leading to Bikanei. Total length, 320 miles ; gross receipts (1897-98), Rs.10,56,000, yielding a profit of 1050 per cent, on a capital outlay of Rs.64,63,140. A branch railway of 135 miles towards Haidarabad in Sind is now under construction, at an estimated cost of Es. 42,77,000. Gold, silver, and copper money is coined. The state emblems are a jhar or sprig of seven branches

and a Tchanda or sword. A few years ago the amount coined averaged nearly Es.4,00,000, but in 1897-98 it was only Rs.7455. Marwar practically escaped the plague, but it suffered more severely than any other part of Eajputana from the famine of 1899-1900. In February 1900 more than 110,000 persons were in receipt of famine relief. The city of Jodhpue is 64 miles by rail north-west of Marwar junction, on the Eajputana railway. Population (1881), 57,211 ; (1891), 61,849 ; (1901), 60,437. The new palace is lighted by electricity. It has many fine buildings, temples, gardens, and tanks. A steam tramway for conservancy purposes, 4^ miles long, has been constructed at a cost of Es. 1,18,000. Mills for grinding flour and crushing grain have been constructed for the Imperial Service troops. The Jaswant College has been affiliated to the B.A. standard of the Allahabad University. To the Hewson Hospital a wing for eye diseases was added in 1898, and the Jaswant Hospital for vfomen is under an English lady M.D.

Johannesburg, a town of British South Africa,

the largest place in the Transvaal, and in the whole of Africa south of Cairo. It had an estimated population of from 120,000 to 130,000 before the exodus which took place previous to the outbreak of hostilities in 1899. Yet it is quite a recent foundation, which owes its existence to the discovery of the rich Witwatersrand goldfields about 1885. It stands 5500 feet above the sea, on the southern slope of the Eand, near the sources of the Natal Spruit, flowing southwards to the Vaal, and of the Jokeskei, going northwards to the Limpopo. It lies 26 miles south by west of Pretoria, with which it is connected by a circuitous railway connecting at Elandsfontein station with the main Transvaal system. The town has been described as a strange intermingling of squalor and luxury, of dirt outside and cleanliness within, of native hovels, wretched stores and shanties jostling shops and warehouses that would not be out of place in London or New York. It is traversed by one or two spacious thoroughfares, such as Commissioner and Pritchard Streets, which are flanked by some stately public buildings, palatial business offices,

and private residences, and commanded by a formidable-looking fort erected by the Boer Government to overawe the Uitlanders, but now dismantled. According to the 1896 census, the motley population included 43,000 natives, nearly 1000 Malays, -4800 Chinese, and 51,000 whites, of whom 34,000 were British, 8000 Boers, 5500 Eussians and Germans, 800 Hollanders, 600 Americans, and 1600 French, Italians, and other Europeans. But many of these foreigners disappeared after the occnpar tion by the British forces under Lord Eoberts on 29th May 1900. In the neighbouring village of Krugersdorp stands the national monument erected on the open veldt to commemorate the Boer victory over the Zulu kino-Dingaan, in 1838, and the declaration of independence in 1880. (A. H. K.)

Johns Hopkins University The Johns Hop-kins University was incorporated in 1867, at Baltimore, Maryland, and formally inaugurated in 1876, after the founder's death. The founder, Johns Hopkins, divided the major part of his fortune between the university and

a hospital, giving each about $3,500,000. The first presi-
dent, Daniel Coit Gilman, served from 1875 to 1901, when
he was succeeded by Ira Eemsen. The university includes :
(1) a graduate school, which confers the degree of Ph.D.
after at least three years' residence ; (2) a medical school,
closely affiliated with the Johns Hopkins Hospital and
planned for the instruction of those who have already
received a degree in the liberal arts ; and (3) a college, in
which any one of seven parallel four-years courses leads
to the degree of B.A. In 1901 the teaching staff numbered
143, and the students 650. Of the university graduates
of the institution, over one-third influence the trend
of higher education in America, about 350 holding pro-
fessorships and instructorships in colleges and imiversities
throughout the land, and 70 teaching in higher-grade
schools. The chief characteristics of the university are a
gradual growth from a flrm basis, no needless duplication
of the work of other institutions, freedom in methods of
teaching, the liberal encouragement of research, the train-
ing of collegiate graduates through the stiniulus of original

investigation, and medical education on advanced scientific lines. It supports in whole or in part the following serial publications, some of them past their twentieth volume : Tlie American Journcd of Mathematics, The American Chemical Journal, Tlie American Journal of Philology, Studies in Historical and Political Science, Memoirs from the Biological Laboratory, The University Circulars, Contributions to Assyriology, Modem Language Notes, TJie Journal of Experimental Medicine, and Terrestrial Magnetism. Over three hundred doctors' dissertations have likewise been printed, besides many works by members of the academic staff. The library contains 103,000 volumes. Since its founding the university has received gifts amounting to considerably more than $1,000,000. (See also Baltimore, Education, Medical Education, and Universities.)

Johnston, Joseph Eggleston (1807-1891), American general in the Confederate army, was born at Cherry Grove, Eockingham county, Virginia, on 3rd February 1807. His father was Judge Peter Johnston,

a Virginian of Scottish descent, who in boyhood served in the War of the Eevolution, and afterwards became a distinguished jurist ; his mother was Mary Wood, a niece of Patrick Henry. He graduated at the U.S. Military Academy at West Point, in the same class with Robert E. Lee, and was promoted to brevet second lieutenant, 4th ArtiUery, in 1829. He served with distinction until 1837, when he was engaged as a civil engineer, but a year afterwards he was reappointed in the army as first lieutenant of the corps of Topo-graphical Engineers. During the Mexican war he served in that capacity, and later as lieutenant-colonel of a regiment of voltigeurs. He was twice severely wounded in a reconnaissance at Cerro Gordo, 1847. He was engaged in the siege of Vera Cruz, the battles of Contreras, Cherubosco, Molino del Rey, the storming of Chapultepec, and the assault on the city of Mexico, and received three brevets for gallant and meritorious service. In 1860 he was commissioned quartermaster-general. On 22nd April 1861 he resigned from the U.S. army and

entered the Confederate service. He was commissioned major-general of volunteers in the army of Virginia, and assisted General Lee in organizing the volunteers. He was later appointed a general officer of the Confederacy, and assigned to the command of the army of the Shenandoah, being opposed by the Federal army under General Patterson. When General M'Dowell advanced upon the Confederate forces under Beauregard at Manassas, Johnston moved with great rapidity to the latter's assistance, and

being senior oi&cer, took command on the field, and won the decisive victory of Manassas or Bull Eun for the Confederate arms. On 31st August 1861 he was made one of the five full generals of the Confederacy, and remained in command of the forces in Virginia designated as the army of the Potomac. He commanded in the battle of Seven Pines (31st May 1862), and was so severely wounded as to be incapacitated for duty for several months. On 24th March 1863 he was assigned to the

command, of the south-west, including the forces of Generals Bragg, Kirby Smith, and Pemberton, and iu May was ordered to take immediate command of all the Confederate forces in Mississippi, then threatened by Grant, who was approaching to attack Vicksburg. When Pemberton's army was besieged in the city of Vicksburg by Grant, Johnston used every effort possible to relieve it, but his force was inadequate. On 18th December 1863 he was transferred to the command of the army of Tennessee, with headquarters at Dalton, Georgia. In February he successfully resisted the advance of the Federal army under General Thomas. On 3rd May 1864 Sherman commenced his advance upon Johnstoa's army at Dalton. In the remarkable campaign that followed, both armies were reinforced ; a conservative estimate places Sherman's average of effective forces throughout at about 100,000 men, and Johnston's at less than half that number. From 9th May to 17th July Johnston fought Sherman almost daily, his line of battle constantly confronting and engaging Sherman's largely preponderat-

ing forces, the principal engagements being Tunnel Hill, Rooky Face Kidge, Buzzard Eoost, Dug Gap, Mill Creek Gap, Snake Creek, and Varnells, from May 3rd to 12th ; Dalton and Resaca, May 13th and 14th; Adairsville, May 17th ; Cassville and Kingston,, May 18th to 24th ; Dallas and New Hope, May 26th, 26th ; Pickett's Mill, May 27th; Kenesaw Mountain, including Pine Knob, Kulp's, M'Afee's, Golgotha, Latimer, and Powder Springs, June 9th to 30th ; engagements on the Chattahoochie and in front of Atlanta, June 30th to July 17th. Sherman's plans seem to have been to press his large and well-equipped army upon the small force under Johnston and compel him to retreat, but the retrograde movement on the part of Johnston was conducted with such skill that Sherman's advance hardly exceeded an average of a mUe a day. Johnston's losses were 10,672. Sherman's losses are given by him approximately at 3700 killed, 19,648 wounded, and 3800 missing. On 17th July Johnston was succeeded in command by General Hood, and on 23rd February 1866 he was ordered by Lee to assume control

of the army of Tennessee and all the troops in South Carolina, Georgia, and Florida. Concentrating all available troops,.which numbered about 16,000, Johnston threw himself in front of Sherman's army of 60,000, and attacking the head of his column at Benton ville, North Carolina, captured four pieces of artillery and 900 prisoners. He then retired to Raleigh, and later to Greensboro. After Lee surrendered the army of Northern Virginia to Grant, Johnston advised Mr Davis that it was in his opinion wrong and useless to continue the conflict, and he was authorized to make terms with Sherman. The terms entered into between these generals, 18th AprO., having been rejected by the United States Government, another agreement was signed 26th April, similar in terms to the surrender of Lee. After the close of the war Johnston engaged in civil pursuits, and occupied business positions of importance. In 1874 he published a Narrative of Military Operations during the Civil War. In 1877 he was elected to represent the Richmond district of Virginia in Congress. In 1887 he was appointed by President Cleve-

land U.S. Commissioner of Railroads. Johnston ifas
married in early life to Louisa, daughter of Louis M'Lane;
she died in 1886. He died at Washington, D.C., on 21st
March 1891, leaving no children. (j. wh.)

Johnstone, a police burgh and manufacturing
town of Renfrewshire, Scotland, on the Black Cart river,
about 10 miles west by south of Glasgow by raU.
The industrial establishments include a large shoe-lace
factory. Recent erections are an Established church,
municipal buildings, a cottage hospital, and a drill hall ;
there are also a town hall, and a combination hospital
for infectious diseases. The gasworks have been ac-
quired by the town. Population (1881), 9268; (1901),
10,602.

Johnstown, capital of Fulton county, New York,
U.S.A., on the Fonda, Johnstown, and Gloversville
railroad, at an altitude of 659 feet. It has a regular
plan, and a good water-supply and sewerage system.
It is largely engaged in the manufacture of gloves.
Population (1880), 6013; (1900), 10,130, of whom 1663

were foreign-born and 108 negroes.

Johnstown, capital of Cambria county, Pennsylvania, U.S.A., on the Conemaugh river and on the Pennsylvania and the Baltimore and Ohio railways, at an altitude of 1170 feet. Its site is the narrow gorge of the river, along which its buildings are arranged irregularly for a considerable distance. It has iron manufactures, and contains furnaces, rolling-mills, and foundries, being the headquarters of the Cambria Steel Works. Its manufactures had in 1900 a capital of $16,940,460, employed 6116 hands, and the product was valued at $22,669,890, nearly all of which consisted of iron and steel. In 1889 a dam on the Little Conemaugh, nine miles above Johnstown, burst, and the flood swept away nearly the entire town and caused the loss of thousands of lives and the destruction of millions of dollars' worth of property. The town was, however, quickly rebuilt, and has since grown with great rapidity. In 1900 the assessed valuation of real and personal property, on a basis of about two-thirds of the full value, was

$13,861,987; the net debt was only $373,786, and its rate of taxation was $15-70 per $1000. Population (1880), 8380; (1890), 21,805; (1900), 35,936, of whom 7318 were foreign-born and 314 negroes.

Johor (not Johokb), an independent Malayan state at the southern end of the peninsula, stretching from 2-40° S. to Cape Romania (Ramunya), the most southerly point on the mainland of Asia, and including all the small islands adjacent to the coast which lie to the south of parallel 2-40° S. It is bounded on the N. by the protected native state of Pahang ; on the N.W. by the NSgri SSmbilan and the territory of Malacca; on the S. by the strait which divides Singapore island from the mainland; on the E. by the China Sea ; and on the W. by the straits of Malacca. The province of Muar was placed under the administration of Johor by the British Government as a temporary measure in 1877, and has continued to be a portion of the sultan's dominions since that date. The coastline, which is the boundary of the state on three sides, measures about 250 miles in length. Greatest length from

north-west to south-east, 165 miles; greatest breadth from east to west, 100 mile^. The area is estimated at about 9000 square miles. The principal rivers are the Muar, which is the most important waterway in the south of the peninsula ; the Johor, up which river the old capital of the state was situated; the Endau, which marks the boundary with Pahang; and the B8,tu PS,hat and SSdSli, which, however, are of comparative unimportance. Johor is less mountainous than any other state in the peninsula. The highest peak is Gunong LSdang, called Mount Ophir by Europeans, which measures some 4000 feet in height.

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JOINYILLE

Like the rest of the peninsula, Johor is covered from end to end by one vast spread of forest, only broken here and there by clearings and settlements of insignificant area. The capital is Johor Bharu, situated at the nearest point on the mainland to the island of Singapore. The late sultan built a fine palace at this place, which is the prin-

cipal feature of the town. The inhabitants number about 20,000. It is chiefly attractive as a kind of Oriental Monte Carlo, and is much resorted to from Singapore, to which place it is joined by a. road 14 miles in length. There is a good service of coaches. The capital of the province of Muar is Bandar Maharani, named after the wife of the late sultan before he had assumed his final title. It is not a very important place. The climate of Johor is healthy and equable for a country situated so near to the equator ; it is cooler than that of Singapore. No exact figures can be obtained as to the population of Johor, but the best estimates place it at about 200,000, of whom 150,000 are Chinese, 35,000 Malays, 16,000 Javanese. We are thus presented with the curious spectacle of a country under Malay rule in which the Chinese outnumber the people of the land by more than four to one. It is not possible to obtain any exact data on the subject of the revenue and expenditure of the state. The revenue, however, is probably about three-quarters of a million of dollars, and the expenditure upon

public service is comparatively small. The revenue is chiefly derived from the revenue farms for opium, spirits, gambling, &c., and from duty on pepper and gambler exported by the Chinese. The cultivation of these products forms the principal industry. There is little known mineral wealth.

History. — It is claimed, in common with many of the other states of the peninsula, that the Mahommedan empire of Johor was founded by the sultan of Malacca after his expulsion from his kingdom by the Portuguese in 1511. It is certain that Johor took an active part, only second to that of Achin, in the war which was so long protracted between the Portuguese and the Dutch for the possession of Malacca. Later we find Johor ruled by an officer of the sultan of Eiau, bearing the title of Tumgnggong, and owing feudal allegiance to his master in common with the BSn-da.hS,ra of Pahang. In 1812, however, this officer seems to have thrown off the control of Eiau, and to have assumed the title of sultan, for one of his descendants, sultan Husain, ceded the island of Singapore to the East

India Company in 1819. In 1855 the then sultan, Ali, was deposed, and his principal chief, the Tumgnggong, was given the supreme rule by the British. His son Tumgng-gong Abubakar proved to be a man of exceptional in-telligence. He made numerous visits to Europe, took considerable interest in the government and development of his country, and was given by Queen Victoria the title of maharaja in 1879. In 1885 he entered into a new agreement with the British Government, and was allowed to assume the title of sultan of the state and territory of Johor. He was succeeded in 1895 by his son sultan Ibrahim. The government of Johor has been so com-paratively free from abuses under its native rulers that it has never been found necessary to place it under the residential system in force in the other native states of the peninsula which are under British control, and on several occasions the late sultan used his influence with good effect on the side of law and order. Mftar was placed under the rule of Johor in 1877.

The close proximity of Johor to Singapore has caused

the rulers of the former state to be constantly subjected to the influence of European public opinion, and this has served to bring about the abolition of most of the abuses which are wont to disflgure native rule in a Malayan state. None the less, the Malay is by nature but ill-fitted for the drudgery which is necessary if proper attention is to be paid to the dull details whereby government is rendered good and efficient. In sultan Abubakar Johor possessed a man of quite exceptional force of character and intellect, and his principal adviser, the D§.to' Mgntri, was a worthy servant of his master. Now, however, the reins of government are mostly in the hands of a set of young men who lack either experience or the serious devotion to dull duties which is the distinguishing mark of the English civil servants whose system is mimicked in Johor. The result is that the country is not well ruled, and that the finances are sadly mismanaged. Miiar, in imitation of the British system, is ruled by a raja of the house of Johor, who bears the title of Eesident. He has travelled a good deal in other countries. A legal

interest attached to one incident connected with his residence abroad. He was made the defendant in a suit for breach of promise of marriage in the English law courts, but the plaintiff was non-suited, since it was decided that no action lay against a foreign sovereign. (h. cl.)

Joinville, Francois Ferdinand Philippe Louis Marie, Prince de (1818-1900), the third son of Louis Philippe, due d'Orleans, afterwards king of the French, was born at Neuilly, 14th August 1818. He was educated for the navy, and after passing regularly through every grade of instruction, became lieutenant in 1836. His first conspicuous service was at the bombardment of San Juan de Ulloa, in November 1838, when he headed a landing party and took the Mexican general Arista prisoner with his own hand. He was promoted to be captain, and was in 1840 entrusted with the charge of bringing the remains of Napoleon from St Helena to Prance. The question of Mehemet Ali caused at the time apprehensions of a war with Great Britain, and the prince made some political capital

with his countrymen and excited some ridicule abroad by needless declarations of his intentions in case of his vessel being attacked. In 1845 he conducted naval operations on the coast of Morocco, bombarding Tangier and occupying Mogador, and was recompensed by the grade of vice-admiral. In the following year he published an article on the deficiencies of the Prench navy which attracted considerable attention, and studied in every way to acquire popidarity, especially by an affectation of ill-will towards Great Britain. The Revolution of 1848 nevertheless swept him away with the other Orleans princes. He hastened to quit Algeria, where he was then serving, and took refuge at Claremont, in Surrey, with the rest of his family. In 1861, upon the breaking out of the American Civil War, he proceeded to Washington, and placed the services of his son and two of his nephews at the disposal of the United States Government. Otherwise, he was little heard of until the overthrow of the Empire in 1870, when he re-entered France, only to be promptly expelled by the Government

of National Defence. Eeturning incognito, he joined the army of General d'Aurelle de Paladines, under the assumed name of Colonel Lutherod, fought bravely before Orleans, and afterwards, divulging his identity, formally sought permission to serve. Gambetta, however, arrested him and sent him back to England. In the National Assembly, elected in February, the prince was returned by two departments and elected to sit for the Haute Marne, but, by an arrangement with Thiers, did not take his seat until the latter had been chosen President of the provincial republic. His deafness prevented him from making any figure in the Assembly, and he resigned his seat in 1876. In 1886 the provisions of the law against pretenders to the throne deprived him of his rank as vice-admiral, but he continued to live in France,

and died at Paris, 16th June 1900. He had married in 1843 the Princess Francisca, sister of Pedro II., emjieror of Brazil, and had a son, the due de Penthifevre,

also brought up to the navy. The prince de Joinville "was the author of several essays and pamphlets, on naval affairs and other matters of public interest, including a criticism on the Potomac campaign of 1862, which were collected and republished after the overthrow of the Second Empire. (e. g.)

Jokai, Maurus (1825), the greatest Hungarian novelist of the 19th century, was born at E^v-Komarom on 19th February 1825. His father, Joseph, was a member of the Asva branch of the Ancient J6kay family ; his mother was a scion of the noble Pulays. The lad was timid and delicate, and therefore educated at home till his tenth year, when he was sent to Pressburg, subsequently completing his education at the Calvinist college at P^p^, where he first met Petofi, Alexander Kozma, and several other brilliant young men who subsequently became famous. His family had meant him to follow the law, his father's profession, and accordingly the youth, always singularly assiduous, plodded conscientiously through the usual curriculum at Kecskemet and Pest, and as a full-blown

advocate actually succeeded in winning his first case. But the drudgery of a lawyer's office was uncongenial to the ardently poetical youth, and, encouraged by the encomiums pronounced by the Hungarian Academy upon his first play, Zsiddfiu ("The Jew Boy "), he flitted, when barely twenty, to Pest in 1845 with a MS. romance in his pocket ; he was introduced by Petofi to the literary notabilities of the Hungarian capital, and the same year his first notable romance, Hitkoznapok ("Working Days"), appeared, first in the columns of the Pesti Dievatlap, and subsequently, in 1846, in book form. H&tkoznapok, despite its manifest crudities and extravagances, was instantly recognized by all the leading critics as a work of original genius, and in the following year Jdkai was appointed the editor of MetMpek, the leading Hungarian literary journal, and gathered round him all the rising talent of the country. On the outbreak of the revolution of 1848 the young editor enthusiastically adopted the national cause, and served it with both pen and sword. Now, as ever, he was a moderate Liberal, setting his face steadily

against all excesses ; but, carried away by the Hungarian triumphs of April and May 1849, he supported Kossuth's fatal blunder of deposing the Hapsburg dynasty, and though, after the war was over, his life was saved by an ingenious stratagem of his wife, the great tragic actress, Koza Benke Laborfalvi, whom he had married on 29th August 1848, he lived for the next fourteen years the life of a political suspect. Yet this was perhaps the most glorious period of his existence, for during it he devoted himself to the rehabilitation of the proscribed and humili-ated Magyar language, composing no fewer than thirty great romances, besides innumerable volumes of tales, essays, criticisms, and facetiae. This was the period of such masterpieces as ErdilyArany Kord (" The Golden Age of Transylvania"), with its sequel Torokvildg Magyar-orszdgon (" The Turks in Hungary "), Egy Magyar Ndbob (" A Hungarian Nabob "), Karpdthy Zoltdn, Janicsdrok vignapjai (" The Last Days of the Janissaries "), Szomorii, napok (" Sad Days "). On the re-establish-ment of the Hungarian constitution by the Composition

of 1867, J6kai took an active part in politics. As a constant supporter of the Tisza Administration, not only in parliament, where he sat continuously for more than twenty years, but also as the editor of the Government organ, Hon, founded by him in 1863, he became a power in the state, and, though he never took office himself, frequently extricated the Government from difficult places. Asa suave, practical, and witty debater he was particularly successful. Yet it was to literature that he continued to devote most of his time, and his productiveness after 1870 was stupendous, amounting to many hundreds of volumes. Stranger still, none of this work is slipshod, and the best of it deserves to endure. Amongst the finest of his later works may be mentioned the unique and incomparable Az arany ember (" A Man of Gold ") — ^translated into English under the title of " Timar's Two Worlds " — and AUnger-zemii holgy (" The Lady with Eyes like the Sea"), which won the Academy's prize in 1890. J6kai is an arch-romantic, with a perfervid Oriental imagination, and humour of the purest, rarest description. If one can

imagine a combination, in almost equal parts, of Walter Scott, William Beckford, Dumas p&re, and Charles Dickens, plus a semi-savage Magyar je ne sais quoi, one may perhaps form a fair idea of the great Hungarian romancer's indisputable genius.

See Nevy LXszlo, J6kai Mir. — Hegeddsis Sandoe, J6kai M6rr6l.

Jokjokarta (Dutch, Djokdjakarta), a residency of middle Java, on the south coast, forming with Surakarta, another residency, the Vorstenlanden (territories of the princes). Its area is about 1200 square miles. The country is very mountainous, only the southern part between the rivers Progo and Opak beiug low and flat. In the north-west are the southern slopes of the Merapi (9400 feet), and in the east the hills and plateau of Kidul and Sevu, known as the Thousand Hills. The rivers fertilize the soil, but are not navigable. In their im-mediate vicinity are thirty-nine indigo and sixteen sugar factories, but east and west of the streams only two or three factories are found. Coal and marble occur in

Kidul and Sevu. Notwithstanding the natural resources, the natives are poor, owing chiefly to the maladministration of the princes and their functionaries, the use of opium, and the usury practised by foreigners (Chinese, Arabs, &c.). The population in 1897 numbered 858,392 (for details see Java). The principality is divided into the territory of the sultan (vassal of the Dutch Government), that of the so-called independent prince Paku Alam, and two enclaves of Surakarta, Ngawen, and Imogiri. There are good roads, and railways connect the chief town with Batavia, Samarang, Surakarta, &c. Jokjokarta, the chief town, is situated at an altitude of about 300 feet at the foot (S.S.E.) of Merapi. It is connected with Batavia by a tramway 420 kilometres in length. It is the seat of the prince, the resident, and Paku Alam, and comprises separate kampongs for Europeans, Chinese, and other foreigners. Itis governed by Dutchfunctionaries, not by the sultan. The most remarkable section of the town is the Kraton (or citadel), containing palaces and kampongs with about 15,000 inhabitants. The total population

of the town is 60,523 (Europeans 2240, natives 54,219, Chinese 3836).

Veth, Java iii. p. 618; Kogge, "De kraton van Djokja," Volksalmanak van 't nut v. het Algem, 1873, p. 49.

Joliet, capital of Will county, Illinois, U.S.A., on the Des Plaines river and at the intersection of five rail-ways, at an altitude of 538 feet. It has a level site in the bottom-land, and a regular plan, divided into seven wards. It has a good system of water-supply, owned by the city, is sewered, and its business streets are paved. It contains one of the state prisons. It is an important railway centre, with a large trade, and it has, moreover, extensive and varied manufactures. In 1890 there was a manufacturing capital of $9,418,932, employing 3183 hands and producing goods valued at $12,732,933. The

assessed valuation of real and personal property in 1898 was $2,861,152, and the net debt was |239,937. Popu-lation (1890), 23,264; (1900), 29,353, of whom 8636

were foreign-born and 650 negroes.

Joncieres, Victorin (1839- –

1

French com-

poser, was born in Paris, 12th April 1839. He first devoted his attention to painting, but afterwards took up the serious study of music. He entered the Paris Conservatoire, but did not remain there long, because he had espoused too warmly the cause of Wagner against his professor. He has composed the following operas : Sardanapale (Theatre Lyrique, 1867), Le Dernier Jour de Pompei (Theatre Lyrique, 1869), Dimitri (Theatre Lyrique, 1876), La Reine Berthe (Opera, 1878), Le Chevalier Jean (Opera Comique, 1885), Lancelot (Opera, 1900). He has also written incidental music to Hamlet, a symphony, and other works. M. Joncieres' admiration for Wagner asserts itself rather in a musical than a dramatic sense. The influence of the German master's earlier style can be traced in operas. M. Joncieres has, however, adhered to the recognized forms of the French opera and has not modelled his works

according to the later developments of the Wagnerian ” music drama.” He may indeed be said to have been at least as much influenced by Gounod as by Wagner. M. Joncieres, like so many other French composers, is also a writer of musical criticism, and from 1871 acted in this capacity for La Liberti.

Jones, Henry (1831-1899), English author, well known as a writer on whist under his nom-de-guerre ” Cavendish,” was born in London on the 2nd of November 1831, beiug the eldest son of Henry D. Jones, a medical practitioner. He adopted his father’s profession, and after being admitted M.E.C.S. and a member of the Society of Apothecaries in 1852, established himself and continued for sixteen years in practice in London. The father was a keen devotee of whist, and under his eye the son became early in life a good player. He was a member of several whist clubs, among them the ” Cavendish,” and LQ 1862 appeared his Principles of Wliist, stated and explained by Cavendish, which was destined to become the leading authority when disputes had to be

settled as to the practice of the game. This work was followed by treatises on the laws of piquet and ecarte. "Cavendish" also wrote on billiards, lawn tennis, and croquet, and was a contributor of articles on whist and other games to the ninth edition of the Encyclopaedia Britannica. The Times, in a leading article, 17th February 1899, said of him: "'Cavendish' was not a law-maker, but he codified and commented upon the laws which had been made, no one knows by whom, during many generations of card-playing," and stated that one of the most noteworthy points in "Cavendish's" character was the manner in which he kept himself abreast of improvements in his favourite game. He died on the 10th of February 1899.

Jonkoping, one of the principal industrial towns of Sweden, standing at the south extremity of Lake Wetter, 114 miles by rail east of Gothenburg. Its chief industries are the manufacture of matches (since about 1860), and paper and paper roofing ; and at Husqvarna (5 miles to the east) are the principal Swedish factories

for firearms, as well as sewing machines, and foundries Jonkoping is the original home of the well-known sdker-hets-tandstickor (safety matches). Eight miles to the south IS Mount Taberg, a solid mass (394 feet high, 2950 feet long, 1475 feet broad) of magnetic iron ore, which how-e^e/' o^ing to the low percentage (32 per cent.) of iron and the difficulty of smelting it, is but little worked Population (1880), 16,147 ; (1900), 23,143.

Joplin, a city of Jasper county, Missouri, U.S.A., at an altitude of 979 feet. It has a level site and a regular plan. It is entered by four railways, the Kansas City, Fort Scott and Memphis, the Missouri Pacific, the Port Arthur route, and the St Louis and San Francisco. It is the centre of the lead and zinc region of south-western Missouri and south-eastern Kansas, and it contains smelt-ing and other works for reducing ores and making by-products. Population (1880), 7038; (1900), 26,023, of whom 893 were foreign-born and 773 negroes.

Joppa, Yafa, or Jaffa, chief town of a kazaof the Jerusalem sanjak, situated on the sea-coast, and built,

for the most part, on a rounded hill about 110 feet high. It is the port of Jerusalem, with which it is connected by a metre-gauge railway and a carriage road; but steamers have to lie in an open roadstead, about half a mile from the shore, and in stormy weather landing is impossible. In the old town the houses rise in terraces from the water's edge, and the streets are narrow and dirty; but beyond its limits, where the fortifications have been rased, new quarters, with well-built houses and broad streets, have sprung up. The celebrated orange gardens now cover an area of four square miles, and more ground is constantly being brought under cultivation. The principal exports (£264,950 in 1900) are soap from N^blus, oranges, sesame, water-melons, and wine ; and the imports (£382,405 in 1900) are cotton goods, timber, tiles, and petroleum. The average annual value of the trade during the previous five years was exports £317,736, imports £310,260. The increase of the import trade is due to the opening of the railway to Jerusalem. The population is about 35,000

(Moslems 23,000, Christians 5000, Jews 7000). The German "Temple" colony, founded in 1868, numbers about 320 souls. The number of pilgrims passing through Jaffa to Jerusalem in 1900 was 14,500, and the number of tourists 3000. The town contains British, French, and German hospitals and schools for boys and girls; and Russian and Latin monasteries and hospices. On its outskirts there is an excellent agricultural school for Jews, with a large model farm, established by the Alliance Israelite. (c. w. w.)

Jordan (Arabic, esh-Sheria, "the watering-place"), the principal river of Palestine and one of the most remarkable rivers in the world. It flows from north to south in a deep trough-like valley, the Gh6r, which follows the line of a fault, or fracture of the earth's crust, and for more than two-thirds of its course it lies below the level of the sea. It has never been navigable, no important town has ever been built on its banks, and it runs into a sea which has no port and which is destitute of animal life. From its sources to the Dead Sea it rushes down a continuous in-

clined plane, broken here and there by rapids and small falls ; and between the sea of Galilee and the Dead Sea Its sinuosity is so great that in a direct distance of sixty-five miles it traverses at least 200 miles. The river actually flows in a depression, the Z(5r, from a quarter to two miles wide, which it has hollowed out for itself in the bed of the Gh6r. During the rainy season (January and ^ebruary), when Jordan overflows its banks, the Z6i is flooded, but when the water falls it produces rich crops. The floor of the Gh6r falls gently to the Z6r, and is inter-sected by deep channels, which have been cut by the small streams and winter torrents that traverse it on their way to the Jordan. As far south as Kurn Surtabeh most of the valley is fertile, and even between that point and the Dead Sea there are several well-watered oases. In summer the heat m the Ghdr is intense, 110° F. in the shade, but ooo'-®^ *'^® temperature falls to 40°, and sometimes to -3^ , at night. During the seasons of rain and melting*

snow the river is very full, and liable to freshets. After twelve hours' rain it has been known to rise from four to five feet, and to fall as rapidly. In 1257 the Jordan was dammed up for several hours by a landslip, probably due to heavy rain, near the spot at which the stoppage took place when the Israelites crossed opposite Jericho. On leaving the Sea of Galilee the water is quite clear, but it soon assumes a tawny colour from the soft marl which it washes away from its banks and deposits in the Dead Sea. The Jordan is crossed by two stone bridges — one north of Lake Huleh, the other between that lake and the Sea of Galilee — and by a wooden bridge on the road from Jerusalem to Gilead and Moab. During the Eoman period, and almost to the end of the Arab supremacy, there were bridges on all the great lines of communication between eastern and western Palestine, and ferries at other places. The depth of water varies greatly with the season. When not in flood the river is easily fordable, and between the Sea of Galilee and the Dead Sea there are then more than fifty fords — some of them of historic

interest. The natural products of the Jordan valley — a tropical oasis sunk in the temperate zone, and overhung by Alpine Hermon — are unique. Papyrus grows in Lake Huleh, and rice and cereals thrive on its shores, whilst below the Sea of Galilee the vegetation is almost tropical. The flora and fauna present a large infusion of Ethiopian types ; and the fish, with which the river is abundantly stocked, have a great af&nity with those of the rivers and lakes of East Africa.

See Lynch, Narrative of the U. 8. Expedition to the Jordan and Dead Sea, 1850. — Dnc de LtrTNEs, Voyage d^ exploration a la Mer Morte, vol. iil. Geologie. — Pal. Exp. Pund, Hull, Geology of Palestine. — Tkistkam, Flora and Fauna of Palestine. — Post, Flora of Syria and Palestine. — Loetet, La Syrie d'aujourd'hui. — G. A. Smith, Historical Geography of the Soly Land. — Wilson, s.v. in Smith's Diet, of the Bible, 2nd ed. — Waeken, s.v. in Hastings' Diet, of the Bible. (p. w. W.)

Josefstadt (formerly known as Pless), a town in the government district of Koniginhof, north-east Bohemia, Austria, at the confluence of the Aupa and Mettau

with the Elbe. It was fortified up to 1888, and is the head-qaarters of a military district and an artillery depot, with a garrison of 3630 men. Although situated in a small German-speaking enclave, more than half the inhabitants (6116 in 1900) are Czech.

Jdshekan, a small province of Persia covering about 1000 square miles. It has a yearly revenue of about £1200, and is held in fief by the family of Prince Bahram Mirza, Muizz ed Dowleh (died 1882), grand-uncle of the Shah. Its chief town and the residence of the governor used to be J6shekdn-Kali, a large village with fine gardens, formerly famous for its carpets Qcdli), but now the chief place is Maimeh, a little city with a population of 2500, situated at an elevation of 6670 feet, about 63 miles from Isfahan in a north-westerly direction and 13 miles south-west of Jdshek^n-Kali.

Joubert, Petrus Jacobus (1834-1900), commandant-general of the South African Eepublic from 1880 to 1900, was born at Cango, in the district of Oudtshoorn, Cape Colony, on 20th January 1834, an

ancestor of his having been among the French Huguenots who fied to South Africa soon after the revocation of the Edict of Nantes by Louis XIV. Left an orphan at an early age, " Piet " Joubert, after enjoying a rudimentary education in his native home as a British subject, soon migrated to the Transvaal, where he settled in the Wakkerstroom district near Lang's Nek and the north-east angle of Natal. There he not only carried on the business of farmer with great success, but turned his attention to the study of the law. The esteem in which his shrewdness in both farming and legal affairs was held led to his election as the Volksraad member for Wakkerstroom early in the 'sixties, Pretorius being then in his second term of office as President. In 1870 Joubert was again elected, and the vigorous use to which he put his slender stock of legal knowledge secured him the appointment of attorney-general of the republic, while in 1874 he acted as President during the absence of Burgers in Europe. During the first British annexation of the Transvaal, Joubert earned for himself the reputation of a consistent irreconcilable by

refusing to hold office under the Government, as Paul Kruger and other prominent Boers were doing. Instead of accepting the lucrative post offered him, he took a leading part in creating and directing the agitation which led to the war of 1880, eventually becoming, as commandant-general of the Boer forces, a member of the triumvirate that administered the provisional Boer government set up in 1880 at Heidelberg. He was in command at the battles of Lang's Nek, Ingogo, and Majuba Hill, subsequently conducting the earlier peace negotiations that led to the conclusion of the Pretoria Convention.

In 1893 he opposed Kruger in the contest for the Presidency, the voting on that occasion (though there is reason for believing that the voting lists had been manipulated by Kruger's agents) being 7881 for Kruger and 7009 for Joubert, whilst at the next election in 1898 the voting was 12,858 for Kruger and 2001 for Joubert. Joubert's position had then become much weakened by accusations of treachery and of sympathy with the Uitlander agitation, and in order to clear his character of these imputa-

tions it became necessary for him to join those who advocated strong measures against the Jameson Raiders of 1896. He took little part in the negotiations that culminated in the ultimatum sent to Great Britain by Kruger in 1899, and though he immediately assumed nominal command of the operations on the outbreak of hostilities, he gave up to others the chief share in the direction of the war, through his inability or neglect to impose upon them his own will. His cautious nature, which had in early life gained him the sobriquet of " Slim Piet," linked with a lack of determination and assertiveness that characterized his whole career, led him to act mainly on the defensive; and the strategically offensive movements of the Boer forces, such as Elandslaagte and Willow Grange, appear to have been neither planned nor executed by him. As the war went on, physical weakness led to Joubert's virtual retirement, and, though two days earlier he was still reported as being in supreme command, he died at Pretoria from peritonitis on 28th March 1900. Sir George White, the defender of Ladysmith,

summed up Joubert's character when he called him " a soldier and a gentleman, and a brave and honourable opponent." (J- a. j. de v.)

Joule, James Prescott (1818-1889), English physicist, was born on 24th December 1818, at Salford, near Manchester. Although he received some instruction from John Dalton in chemistry, most of his scientific knowledge was self-acquired, and this was especially the case with regard to electricity and electro-magnetism, the subjects in which his earliest researches were carried out. Erom the first he appreciated to the full the importance of accurate measurement, and all through his life the attainment of exact quantitative data was one of his chief considerations. At the age of nineteen he invented an electro-magnetic engine, and in the course of examining its performance dissatisfaction with the vague and arbitrary methods then in vogue of specify-ing electrical quantities caused him to adopt a convenient and scientific unit, which he took to be the amount of electricity required to decompose nine grains of water in

one hour. In 1840 he was thus enabled to give a quantitative statement of the law according to which heat is produced in a conductor by the passage of an electric current, and in succeeding years he published a series of valuable researches on the agency of electricity in transformations of energy. One of these contained the first intimation of the achievement with which his name is most widely associated, for it was in a paper read before the British Association at its Cork meeting in 1843, and entitled the " Calorific Effects of Magneto-electricity and the Mechanical Value of Heat," that he expressed the conviction that whenever mechanical force is expended an exact equivalent of heat is always obtained. By rotating a small electro-magnet in water, between the poles of another magnet, and then measuring the heat developed in the water and other parts of the machine, the current induced in the coils, and the energy required to maintain rotation, he calculated that the quantity of

heat capable of warming one pound of water one degree Fahr. was eqiiivalent to the mechanical force which could raise 838 ib through the distance of one foot. At the same time he brought forward another determination based on the heating effects observable when water is forced through capillary tubes ; the number obtained in this way was 770. A third method, depending on the observation of the heat evolved by the mechanical compression of air, was employed a year or two later, and yielded the number 798 ; and a fourth — the well-known frictional one of stirring water with a sort of paddle-wheel — yielded the result 890 (see Brit. Assoc. Report, 1845), though 781-5 was obtained by subsequent repetitions of the experiment. In 1849 he presented to the Eoyal Society a memoir which, together with a history of the subject, contained details of a long series of determinations, the result of which was 772. A good many years later he was entrusted by the Committee of the British Association on Standards of Electric Eesistance with the task of deducing the mechanical equivalent of

heat from the thermal effects of electric currents. This inquiry yielded (in 1867) the result 783, and this Joule himself was inclined to regard as more accurate than his old determination by the frictional method ; the latter, however, was repeated with every precaution, and again indicated 772-65 foot-pounds as the quantity of work that must be expended at sea-level in the latitude of Greenwich in order to raise the temperature of one pound of water, weighed in vacuo, from 60° to 61° Fahr. Ultimately the discrepancy was traced to an error which, not by Joule's fault, vitiated the determination by the electrical method, for it was found that the standard ohm, as actually defined by the British Association Committee and as used by him, was slightly smaller than was intended ; when the necessary corrections were made the results of the two methods were almost precisely congruent, and thus the figure 772-55 was vindicated. In addition, numerous other researches stand to Joule's credit — the work done in compressing gases and the thermal changes they undergo when forced under press-

ure through small apertures (with Lord Kelvin), the change of volume on solution (with Playfair), the change of temperature produced by the longitudinal extension and compression of solids, &c. It was during the experiments involved by the first of these inquiries that incidentally he was led to appreciate the value of surface condensation in increasing the efiiciency of the steam engine. A new form of condenser was tested on the small engine employed, and the results it yielded formed the starting-point of a series of investigations which were aided by a special grant from the Eoyal Society, and were described in an elaborate memoir presented to it on 13th December 1860. His results, according to Lord Kelvin, led directly and speedily to the present practical method of surface-condensation, which is one of the most important improvements of the steam engine, especially for marine use, since the days of Watt. Joule died at Sale on 11th October 1889. His scientific papers were collected and published by the Physical Society of London : the first volume, which appeared in 1884, contained

the researches for which he was alone responsible, and the second, dated 1887, those which he carried out in association with other workers.

Jovellar y Soler, Joaquin (1819-1892), captain-general of Spain, was born at Palma de Mallorca, 28th December 1819. At the close of his studies at the military academy he was appointed sub-lieutenant in 1836, went to Cuba as captain in 1842, returned to the War Office in 1851, was promoted major in 1853, and went to Morocco as private secretary to Marshal O'Donnell, who made him colonel in 1860 after Jovellar had been wounded at the battle of Wad el Eas. In 1863 Jovellar became a brigadier-general, in 1864 under-secretary for war, was severely wounded in fighting the insurgents in the streets of Madrid in 1866, and rose to the rank of general of division in 1866. Jovellar adhered to the revolution, and King Amadeus made him a lieutenant-general in 1872. He absented himself from Spain when the federal republic was proclaimed, and returned in the autumn of 1873, when Castelar sent him

to Cuba as governor-general. In 1874 Jovellar came back to the peninsula, and was in command of the army of the Centre against the Carlists when Marshal Campos went to Sagunto to proclaim Alphonso XII. General Jovellar became war minister in the first cabinet of the restoration under Canovas, who sent him to Cuba again as governor-general, where he remained until 18th June 1878, when the Ten Years' Insvirrection closed with the peace of Zauj on. Alphonso XII. made him a captain-general, president of the council, life-senator, and governor-general of the Philippines. Jovellar died in Madrid, 17th April 1892. (A. E. H.)

Jowett, Benjamin (1817-1893), Eegius Professor of Greek and Master of Balliol College, Oxford, was born in Camberwell on 15th April 1817. His father was one of a Yorkshire family who, for three generations, had been supporters of the Evangelical movement in the Church of England. His mother was a Langhorne, in some way related to the poet and translator of Plutarch. At twelve the boy was placed on the foundation of St Paul's School,

then in St Paul's Churchyard, and in his nineteenth year he obtained an open scholarship at Balliol, which became his home for the remaining fifty-eight years of his life. In 1838, while an undergraduate, he gained a fellowship, and graduated with first-class honours in 1839. Brought up amongst pious Evangelicals, he came to Oxford at the height of the Tractarian movement, and through the friendship of W. G. Ward was drawn for a time in the direction of High Anglicanism; but a stronger and more lasting influence was that of the Arnold school, represented by A. P. Stanley. Jowett was thus led to concentrate his attention on theology, and in the summers of 1845 and 1846, spent in Germany with Stanley, he became an eager student of German criticism and speculation. Amongst the writings of that period he was most impressed by those of P. C. Baur. But he never ceased to exercise an independent judgment, and his work on St Paul, which appeared in 1855, was the result of much original reflexion and inquiry. He was appointed to the Greek professorship in the autumn of that year. He had been a tutor of Balliol

and a clergyman since 1842, and had devoted himself to the work of tuition with unexampled zeal. His pupils became his friends for life. He discerned their capabilities.

studied their characters, and sought to remedy their defects by frank and searching criticism. Like another Socrates, he taught them to know themselves, repressing vanity, encouraging the despondent, and attaching all alike by his unobtrusive sympathy. This work made gradually a strong impression, and those who cared for Oxford began to speak of him as " the great tutor." As early as 1839 Stanley had joined with Tait, the future archbishop, in advocating certain university reforms. From 1846 onwards Jowett threw himself into this movement, which in 1848 became general amongst the younger and more thoughtful Fellows, until it took effect in the Commission of 1850 and the Act of 1854. Another educational reform, the opening of the Indian civU service to competition, took place at the same time, and

Jowett was one of the Commission. He had two brothers who served and died in India, and he never ceased to take a deep and practical interest in Indian affairs. A great disappointment, his re-pulse for the Mastership of Balliol, also in 1854, appears to have roused him into the completion of his book on The Epistles of St Paid. This work, described by one of his friends as " a miracle of boldness," is full of originality and sugges-tiveness, but its publication awakened against him a storm of theological prejudice, which followed him more or less through life. Instead of yield-ing to this, he joined with Henry Bristowe Wilson and Eowland Williams, who had

been similarly attacked, in the production of the volume known as Essays and Reviews. This appeared in ‘I860 and gave rise to a strange out-break of fanaticism. Jowett’s loyalty to those who were prosecuted on this account was no less characteristic than his persistent silence while the augmentation of his salary as G-reek professor was withheld. This petty persecution was continued until 1865, when, through the discoveries of two historical inquirers, Edward Freeman and Charles Elton, Christ Church was induced to raise the endowment from £40 a year to £500. Meanwhile Jowett’s influence at Oxford had steadily increased. It culminated in 1864, when the country clergy, provoked by the final acquittal of the Essayists, had voted in Convocation against the endowment of the Greek chair. Jowett’s pupils, who

were now drawn from the university at large, supported him with the enthusiasm which young men feel for the victim of injustice. In the midst of other labours Jowett had been quietly exerting his influence so as to conciliate all shades of liberal opinion, and bring them to bear upon the abolition of the theological test, which was still required for the M.A. and other degrees, and for univer-sity and college offices. He spoke at an important meet-ing upon this question in London on 10th June 1864, which laid the ground for the University Tests Act of 1871. In connexion with the Greek professorship Jowett had undertaken a work on Plato which grew into a complete translation of the Dialogues, with introductory essays. At this he laboured in vacation time for at least ten years. But his interest in theology had not abated, and his thoughts found an outlet in occa-sional preaching. The university pulpit, indeed, was closed to him, but several congregations in London delighted in his sermons, and from 1866 until the year of his death he preached annuallyin Westminster Abbey,

where Stanley had become dean in 1863. Three volumes of selected sermons have been published since his death. The years 1865-70 were occupied with assiduous labour. Amongst his pupils at Balliol were men destined to high positions in the State, whose parents had thus shown their confidence in the supposed heretic, and gratitude on this account was added to other motives for his unsparing efforts in tuition. His friends were multiplying, and to one friend, Mr Eobert Lowe (afterwards Lord Sherbrooke), be owed the occasion which led, in 1870, to his election as Master of Balliol. From the vantage-ground of the Mastership the Plato was published in 1871. It had a great and well-deserved success. While scholars criticized particular renderings (and there were many small errors to be removed in subsequent editions), it was generally agreed that he had succeeded in making Plato an English classic. The sale, for a work

of such dimensions, was un-
expectedly rapid, and the call
for a new edition soon made a
fresh demand upon his time
and energy.
If ever there was a bene-
ficent despotism, it was
Jowett's rule as Master. Since
1866 his authority in Balliol
had been really paramount, and
various reforms in college had
been due to his initiative.
The opposing minority were
now powerless, and the younger
fellows who had been his pupils
were more inclined to follow
him than others would have
been. There was no obstacle
to the continued exercise of
his firm and reasonable will.

He still knew the undergradu-

ates individually, and watched

their progress with a vigilant eye. His influence in the

university was less assured. The pulpit of St Mary's

was no longer closed to him, but the success of Balliol

in the Schools gave rise to jealousy in other colleges,

and old prejudices did not suddenly give way ; while a

new movement in favour of " the endowment of research "

ran counter to his immediate purposes. Meanwhile,

the tutorships in other colleges, and some of the head-

ships also, were being filled with Balliol men, and

Jowett's former pupils were prominent in both Houses

of Parliament and at the Bar. He continued the

practice, which he had commenced in 1848, of taking

with him a small party of undergraduates in vacation

time, and working with them in one of his favourite

haunts, at Askrigg in Wensleydale, or Tummel Bridge,

or later at West Malvern. The new hall (1876), the

organ there, entirely his gift (1886), and the cricket

ground (1889), remain as external monuments of the

Master's activity. Neither business nor the many claims of friendship interrupted literary work. The six or seven weeks of the long vacation, during which he had pupils with him, were mainly employed in writing. The translation of Aristotle's Politics, the revision of the Plato, and, above all, the translation of Thucydides many times revised, occupied many years. The edition of the Bepublic,

Benjamin Jowett.

(From aphotograph by Elliott and Fry, London.)

undertaken in 1856, remained nnfinished, but was continued with the help of Professor Lewis Campbell. Other literary schemes of larger scope and deeper interest were long in contemplation, but were not destined to take effect— an Essay on the Religions of the World, a Commentai-y on the Gospels, a Life of Christ, a volume on Moral Ideas. Such plans were frustrated, not only by his practical avocations, but by his determination to finish what he had begun, and the fastidious self-criticism which it

took so long to satisfy. The book on Morals might, how-ever, have been written, but fpr the heavy burden of the vice-chancellorship, which he was induced to accept in 1882, by the hope, only partially fulfilled, of securing many improvements for the university. The vice-chan-cellor was ex officio a Delegate of the Press, where he hoped to effect much ; and a plan for draining the Thames valley, which he had now the power of initiating, was one on which his mind had dwelt for many years. Though his aims were often balked, he made a great impression ; but some of his friends will always regret that a time so pre-cious should not rather have been devoted to some work of moral and spiritual import which might have been a possession for the world at large. The exhausting labours of the vice-chancellorship were followed by an illness (1887) ; and after this he seems to have relinquished the hope of producing any great original writing. His liter-ary industry was thenceforth confined to his Commentary on the Republic of Plato, and some essays on Aristotle which were to have formed a companion volume to the

translation of the Politics. The essays which should have accompanied the translation of Thucydides were never written. He died on the 1st of October 1893, at the age of seventy-six. The funeral was one of the most impressive ever seen in Oxford. The pall-bearers were seven Heads of colleges and the Provost of Eton, all old pupils. Balliol chapel was filled to overflowing with a distinguished gathering. Amongst the many wreaths was one from Miss Plorence Nightingale, inscribed " To the genius of friendship." Jowett never married.

Theologian, tutor, university reformer, a great Master of a college, Jowett's best claim to the remembrance of succeeding generations was his greatness as a moral teacher. Very many of those who towards the end of the 19th century were the salt of the nation owed much of what they were to his precept and example, his penetrative sympathy, his insistent criticism, and his unwearying friendship. To name a mere fraction of what can never be known in full, the list of his pupils and lifelong friends includes a Speaker of the House of Commons, three

Indian Viceroys, two Cabinet Ministers, four judges, several canons, and a dean. Seldom have ideal aims been so steadily pursued with so clear a recognition of practical limitations. As a theologian Jowett's work was transitional, and yet has an element of permanence. As has been said of another thinker, he was " one of those deeply religious men who, when crude theological notions are being revised and called in question, seeks to put new life into theology by wider and more humane ideas." In earlier life he had been a zealous student of Kant and Hegel, and to the end he never ceased to cultivate the philosophic spirit ; but he had little confidence in metaphysical systems, and sought rather to translate philosophy ijito the wisdom of life. As a classical scholar, his scorn of littlenesses sometimes led him into the neglect of minutim, but he had the higher merit of interpreting ideas. His place in literature will not be recognized until the essays which lie buried in the five volumes of his Plato have been published separately. It will then be found that his worth, as a teacher of his countrymen, extends far be-

yond his own generation.

See The Life and, Letters of Benjamin Jowett, by Abbott, and Campbell, 1897 ; Benjamin Jowett, by Lionel Tollemache, 1895. (l. C.)

Jub, or JuBA, an important river of East Africa, flowing south across the Galla and Somali countries from the outer margin of the Abyssinian highlands. Of its three principal head-streams, the largest appears to be that known as the Ganana, itself formed by the junction of the Ganale Guracha (Black Ganale, a rushing stream 100 yards wide) and the Ganale Gudda (Great Ganale). The latter, the most remote source of the Jub, rises in 7° TS., 39° 40° E., at the foot of the mountains which traverse the country of the Arussi Gallas — of which Mount Fakez rises to a height of 10,000 feet— and is swelled by the junction of various streams rising in the same mountains. In the vicinity of its sources the river flows at an altitude of 7400 feet. In 4° 12' N. and about 42° E. the Ganana is joined on the left by the Web, which rises in the Worgoma mountains (7° N., 40° E.), and some 40 miles

from its source passes, first through a canon 500 feet deep, and then through a series of remarkable under-ground caves hollowed out of a quartz mountain, and, with their arches and white columns, presenting the ap-pearance of a pillared temple. At the point of junction the Ganana or Jub is a swift river 85 yards wide, but at the Buntal ferry, 10 miles lower down, it widens to 200 yards, the altitude being here only 590 feet. Just above the ferry, the Daua, the third head-stream of the Jub, enters from the west. It rises between 6° and 7° N., but ■ has few feeders, and in its lower course is only 40 yards wide and from 2 to 3 feet deep. In its middle course it traverses a mountainous country by a deep and narrow gorge. Below the Daua the Jub receives no tributary of importance. It first flows in a valley bounded, especially towards the west, by the escarpments of a high plateau, and containing the towns of Lugh (in 4°, the centre of active trade), Bardera (population about 1200), and Saranli — the two last on opposite sides of the stream, in 2° 20', a crossing-place for caravans. Beyond 1° 46'

the country becomes more level and the course of the river very tortuous. On the west a series of small lakes and backwaters receive water from the Jub during the rains. Just south of the equator the emissaries of the long, branching lake Deshekwama or Hardinge, fed by the Lakjhera river, enter from the west, and in 0° 16' S. the Jub enters the sea across a dangerous bar, which has only one fathom of water at high tide. Below 2° 35' IST., at which rapids occur, the lower Jub is navigable for a shallow-draught steamer, having a general depth of from 4 to 12 feet, though shallower in places. Just above its mouth it is a fine stream 250 yards wide, with a cvirrent of 2^ knots. The country through which the Jub and its branches flow is generally arid, except in the mountainous districts near its head-waters. Here some tropical forest occurs, but otherwise the surface away from the river banks is either bare or covered with thorny scrub. On the lower river the Gosha district on the west bank, between 0° and 1° N., still contains forest, but it is being rapidly cleared for

cultivation. The lower Jub was ascended in 1865 in a steamer by Baron von der Decken, who met his death at Bardera, but the system of the river remained otherwise almost unknown until after 1890. In 1891 a survey of its lower course was executed by Captain Dundas, while in 1892-93 its head-streams were explored by the Italians Bdttego and Grixoni, the former of whom disproved the supposed connexion of the Omo (see Eudolf, Lake) with its system. It has since been further explored by Euspoli, by B6ttego's second expedition, and by Donaldson Smith and others.

See especially Dundas in Qeog. Journal, March 1893 ; B(5ttego, B Giuba Esplorato. Eome, 1895. (e. he.)

JUBBULPOE E — J U N A G A E H

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Jubbulpore, or Jabalpue, a city, district, and division of British India, Central Provinces. The city- is 616 miles north-east of Bombay by rail, and 220 miles south-west of Allahabad. Population (1881), 75,705; (1891), 84,481 ; (1901), 89,708, showing an increase of

6 per cent., compared with 12 per cent, in the preceding decade. Jubbulpore is a modem town, well laid out, with fine artificial lakes in the suburbs. Formerly the capital of the Saugor and Nerbudda territories, it is now the headquarters of the Nerbudda military district, with cantonments for a battery of artillery, a European in-fantry and a Bombay native infantry regiment. It is also one of the most important railway centres in India, being the junction of the Great Indian Peninsula and the East Indian systems. It has a steam cotton-mill, with 154 looms and 16,300 spindles, employing 700 hands, and pottery works, employing 336 hands, with an out-turn valued at E.s.85,000. The Government college, educating for the science course of the Allahabad University, had 93 students in 1896-97; there were three aided high schools with 1547 pupils, a law class, an engineering class, and normal schools for male and female teachers. There is a Government school of industry for Thug and Dacoit approvers, where tents and carpets are turned out on a large scale. There are four printing-presses, issuing

two English newspapers, and several clubs and libraries. A native association, established in 1869, supports an orphanage, with help from Government. A zenana mission manages 13 schools for girls. Waterworks were constructed in 1882, out of a loan advanced by a native banker, and a drainage scheme is under construction. The district of Jubbulpoeb lies on the watershed between the JSTerbudda and the Sone, but mostly within the valley of the former river, which here runs through the famous gorge known as the Marble Eocks. Area, 3948 square miles. The population in 1881 was 687,233 ; in 1891, 748,146, showing an increase of 9 per cent. ; average density, 189 persons per square mile. In 1901 the population was 680,486, showing a decrease of 9 per cent., due to the results of famine. The land revenue was E.s.9,42,-740, the incidence of assessment being under 8 annas per acre ; cultivated area (1897-98), 889,320 acres, of which 2819 were irrigated; number of police, 762; boys at school (1896-97), 9936, being 17-6 per cent, of the male population of school-going age; girls at school, 1519,

being 2-7 per cent. ; registered death-rate (1897), 61-26 per thousand. The principal crops are wheat, rice, pulse, and oil-seeds. A good deal of iron smelting with char-coal is carried on in the forests. The district is traversed by the main railway from Bombay to Calcutta, and by new branches of two other lines which meet at Katni junction. Jubbulpore suffered severely in the famine of 1896-97, the distress being aggravated by immigration from the adjoining native states. Fortunately the famine of 1900 was less severely felt here. The division of Jubbulpoeb lies mainly among the Vindhyan and Satpura hill systems. It comprises the five following districts : Jubbulpore, Saugor, Damoh, Seoni, and Mandla. Area, 19,040 square miles ; population (1881), 2,201,633 ; (1891), 2,375,642, showing an increase of 8 per cent. ; average density, 124 persons per square mile, ranging from 189 in Jubbulpore to 67 in Mandla.

Jujuy, a province in the north-west of the Argentine Eepublic, bounded on the IST. and W. by Bolivia, and on the E. and S. by the Argentine province of Salta. The

official area at the census of 1896 was 18,977 square miles. Population (1869), 40,379 ; (1900), 94,406. The province, which is divided into thirteen departments, contained in 1895, 3103 farms, and 19,898 acres planted with cereals. The capital, Jujut, on the Eio Grande, has a population of about 5000, and is connected with Buenos Aires by rail.

Jullien, Louis Antoine (1812-1860), musical conductor, was born at Sisteron, Basses Alpes, France, on the 23rd of April 1812, and studied at the Paris Conservatoire. His fondness for the lightest forms of music cost him his position in the school, and after conducting the band of the Jardin Turc, he was compelled to leave Paris to escape his creditors, and came to London, where he formed a good orchestra and established promenade concerts. Subsequently he travelled to Scotland, Ireland, and America with his orchestra. For many years he was a familiar figure in the world of popular music in England, and his portly form with its gorgeous waistcoats occurs very often in the early volumes

of Punch. He brought out an opera, Pietro il Grande, at Covent Garden, in 1852, on a scale of magnificence that ruined him, for the piece was a complete faUure. He was in America until 1864, when he returned to London for a short time; ultimately he went back to Paris, where, in 1869, he was arrested for debt and put into prison. He lost his reason soon afterwards, and died 14th March 1860.

Jullundur, or Jalandhae, a city of British India, giving its name to a district and to a division in the Punjab. The city is 260 miles by rail north-west of Delhi. Population (1881), 62,119; (1891), 66,202, show-ing an increase of 27 per cent. ; municipal income (1897-98), Es.67,040. It is a cantonment for artillery and a European and native infantry regiment. There are an American Presbyterian mission. Government normal school, and high schools supported by Hindu bodies. It has five printing-presses, issuing four vernacular periodi-cals. The registered death-rate in 1897 was 30 per thousand. The district of Jullundue occupies the lower

part of the tract known as the Jullundur Doab, between the rivers Sutlej and Bias, except that it is separated from the Bias by the state of Kapurthala. Area, 1223 square miles. The population in 1881 was 789,656 ; in 1891, 907,583, showing an increase of 16 per cent. ; average density, 633 persons per square mile, being the highest in the province. In 1901 the population was 917,896, showing an increase of only 1 per cent. The land revenue and rates were Es.16,30,134, the incidence of assessment being E.l : 11 : 4 per acre, again considerably the highest in the province; cultivated area (1896-97), 721,527 acres, of which 398,816 were irrigated from private wells ; number of police, 257 ; number of schools (1896-97), 421, with 12,526 pupils, the proportion of boys at school to male population of school-going age being 13-9 per cent. ; registered death-rate (1897), 25-7 per thousand. The district is crossed by the main line of the North-Western railway from Phillour towards Amritsar — 49 miles in all. There are 167 miles of metalled road and 80 miles of navigable river, but no

Government canal. The division of Jullundue comprises the five districts of Kangra, Hoshiarpur, Jullundur, Ludhiana, and Ferozepore, all lying along the river Sutlej. Area, 19,008 square miles. The population in 1881 was 3,787,945 ; in 1891, 4,21'(,664, showing an increase of 11 per cent. ; average density, 222 persons per square mile.

Jumilia, a town of Spain, in the province of Murcia. The trade and local industries have considerably increased, and include linen, wine, safran, esparto grass, and phosphorite from mines in the neighbourhood. On a hill close to the town several old sepulchres were discovered in 1892. Population, 15,633.

Junagarh, a native state of India, within the Gujarat division of Bombay, extending inland from the southern coast of the peninsula of Kathiawar. Area,

3283 square miles; population (1881), 387,499; (1891), 484,190 ; estimated gross revenue, Es.26,62,500, of which

Es.3,99,360 was expended on public works in 1897-98 ; tribute to the British Government and the Gaekwar of Baroda, Bs.65,604; but a considerable sum is also re-ceived as tribute from minor states in Kathiawar. The state is traversed by a railway from B.ajkot to the sea^ port of Verawal. It includes the sacred mountain of Girnar and the ruined temple of Somnath. The town of JuNAGAKH is 60 miles by rail south from Eajkot. Population (1881), 24,679; (1891), 31,640, showing an increase of 29 per cent., due to the progressive adminis-tration of the Nawab. The modern town is handsomely built and laid out. In November 1897 Lord Sandhurst, Governor of Bombay, laid the foundation-stones of a new hospital as well as of a library and museum. The high school had 460 pupils in 1896-97. There are three printing-presses, one of which issues an official gazette.

Juneau, formerly Haekisburg, a mining settlement on the continental shore of Gastineau Channel, south-east Alaska, in 58° 16' N. and 134° 20' W., opposite Douglas Island and the properties of the Treadwell mine on the

island shore. It was settled in 1880 by two prospectors named Joseph Juneau and Richard Harris. Its prosperity is due to the mines of gold and silver in the adjacent Silver Bow basin and those of Douglas Island. The latter comprise mills of 880 stamps and one of the largest and most profitable of low-grade ore deposits. It has a custom-house, U.S. court-house, several churches, a hospital and schools ; but, owing to want of room for growth between the precipitous mountains and the water, and to other causes, Douglas, on the island of the same name, and Skagway, the port for the Yukon mines, are overtaking Juneau, and bid fair to outgrow it in population and business. Population, 2650 (including 450 Indians).

Jung-Bunzlau, the chief town of a government district in Bohemia, 30 miles north-north-east of Prague. It has a garrison of 879 men, and has an important corn trade, textile industries, and manufactures of sugar, starch, soap, beer and spirits, and flour. Population (1890), 11,518 ; (1900), 13,479, mostly Czech and Eoman Catholic.

Junin, an interior department of Central Peru, contained a population of 394,393 in 1896. The provinces are Cerro de Pasco, Tarma, Jauja, and Huancayo, and the principal towns, Tarma (6000), Jauja (15,000), and Pasco (15,000).

Junker, Wilhelm (1840-1892), German explorer, was born at Moscow on the 6th April 1840. He studied medicine at Dorpat, Gottingen, Berlin, and Prague, but did not practise this profession for long. After a series of short journeys to Iceland, Tunis, and Lower Egypt, he remained almost continuously in Africa from 1875 to 1886, making Khartum the base of 'his expeditions into the interior. He joined marauding bands sent out by the Egyptians into the Mahdi's country, and was an unwilling witness of many scenes of great atrocity. Junker, unlike most explorers, was a leisurely traveller and a careful observer ; his main object was to study the peoples with whom he came into contact, and to collect specimens of plants and animals, and the result of his investigations in these particulars is given in his Reisen in Afrika (3 vols.

Vienna, 1889-91), a work of high merit. But perhaps the greatest service he rendered to geographical science was his investigation of the area intersected by the tributaries of the Nile, when he successfully combated Schweinfurth's hydrographical theories and established the identity of the Well^ and Mobangi. On the outbreak of the Mahdi's insurrection in 1884 he was cut off and isolated, and an expedition, fitted out in 1885 by his brother in St Petersburg, failed to reach him ; he succeeded, however, unaided, in reaching Zanzibar in December 1886, and thence returned to Germany. In 1887 he received the gold medal of the Eoyal Geographical Society in London. As an African explorer Junker is entitled to the highest rank, and must be classed with such men as Speke and Nachtigal. He died at St Petersburg on the 13th February 1892.

Jura, a department on the eastern frontier of Prance, bordering on Switzerland.

Area, 1951 square miles. The population decreased from 281,292 in 1886 to 259,212 in 1901. Births in 1899, 5624, 284 of them

illegitimate ; deaths, 5626 ; marriages, 1933. There were in 1896 1001 schools, with 45,000 pupils, and the illiterate composed less than 1 per cent, of the population. Out of 1,052,706 acres of cultivated land in 1896, 390,440 were plough-land and 87,060 vineyards. In 1899 wheat returned a value of £446,000 ; oats, £132,000 ; barley, £64,000 ; vines, £220,000— from the vineyards of Arhois. The natural pastures and grass lands on the high plateaux yielded in 1899 a value of £538,000. The live stock in-cluded (1899) 155,940 cattle, 13,840 horses, 15,650 sheep, and 48,160 pigs. The dairy produce yielded a revenue of not less than £800,000. The mining industry in 1898 registered 2000 metric tons of peat, 4000 tons of iron, and 21,400 tons of rock-salt. The extensive industry in metals produced in 1898, 18,000 metric tons of iron and 19,000 tons of steel, valued at £281,000. The other industries are in a backward state.

Jurien de la Craviere, Jean Baptiste Edmond (1812-1892), French admiral, son of Ad-miral Jurien, who served through the Eevolutionary and Napoleonic wars and was a peer of Prance under Louis Philippe, was born on 19th November 1812. He entered

the navy in 1828, was made a commander in 1841, and captain in 1850. During the Eussian war he commanded a ship in the Black Sea. He was promoted to be rear-admiral on 1st December 1855, and appointed to the command of a squadron in the Adriatic in 1859, when he absolutely sealed the Austrian ports with a close blockade. In October 1861 he was appointed to command the squadron in the Gulf of Mexico, and two months later the expedition against Mexico. On 15th January 1862 he was promoted to be vice-admiral. During the Franco-German war of 1870 he had command of the French Mediterranean fleet. In 1871 he was appointed " director of charts." As having commanded in chief before the enemy, the age limit was waived in his favour, and he was continued on the active list. He had been given the Cross of the Legion of Honour in 1854, and the rank of OflBcer of the order in 1865 ; he received the Grand Cross in 1876. He died on 4th March 1892. He was a voluminous author of works on naval history and biography, most of which first ap-peared in the Revue des Deux Mondes. Among the most

noteworthy of these are Ouei-res Maritimes sous la Ripub-
lique et VEmpire, which was translated by Lord Dunsany
under the title of Sketches of the last Naval War; Souve-
nirs d'un Amiral, that is, of his father. Admiral Jurien ;
La Marine d' Autrefois (1865), largely autobiographical ;
La Marine d'Aujourd'hui (1872). In 1866 he was elected
a member of the Academy. (j. k. l.)

Jurua. See Amazon.

Jutland, in Danish, Jylland, the ancient Cherso-
nese or Cimbric peninsula, the continental portion of the
kingdom of Denmark. It stretches from Kolding and Elbe
northwards to the Skaw (Skagen), and embraces nine
counties (Vejle, Aarhus, Eanders, Aalborg, Hjorring,
Ihisted, Viborg, Eingkjobing, and Elbe), with an aggregate
area of 9762 square miles. Population (1880), 868,511 ;
(1890), 942,120 ; (1900), 1,063,792. Although in ancient
times well wooded, the greater portion of the interior
consisted for centuries of barren drift-sand, which grew

nothing but heather ; but since 1866, chiefly through the instrumentalityof the patriotic Heath Association, assisted by annual contributions from the State, a very large proportion of this region has been more or less reclaimed for cultivation. The means adopted are (i.) the plantation of trees ; (ii.) the making of irrigation canals and irrigating meadows, amounting by 1901 to over 100 canals of a total length of 236 miles, and close upon 16,500 acres of meadows ; (iii.) exploring for, extracting, and transporting loam, for which purpose short light railways (over 30 miles at the end of 1900) have been built ; (iv.) and, since 1889, the experimental cultivation of fenny districts. The activity of the association takes the form partly of giving gratuitous advice, partly of experimental attempts, and partly of model works for imitation. The State also makes annual grants directly to owners who are willing to place their plantations under State supervision, for the sale of plants at half price to the poorer peasantry, for making protective or sheltering plantations, and for free transport of marl or loam. At the end of 1900 the Heath Associa-

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of Lagos. LANDLORD AND TENANT. A. Wood Renton, Puisne

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” Registration of Title to Land,” &c. LAW. Lord Da vet, F.R.S., Lord of Appeal in Ordinary;

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Contemporary Artists," " The Italian Pre-Raphaelites," &c. LESSEPS, DE. M. de Blowitz, Correspondent of " The

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British Association for 1902. LIQUOR LAWS. John Koren, Author of "Economic Aspects

of the Liquor Problem," &c.

LISZT. Edward Danneedther, Professor at the Royal College of Music; Author of "Musical Ornamentation," "Critical Edition of Liszt's ifetudes," &c.

LIVERPOOL. W. F. Irvine, Honorary Secretary, Record Society of Lancashire and Cheshire.

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LOG. Captain J. Whitley Dixon, R.N., Author of ” Mariner’s Compass in an Iron Ship.”

LOGIC. Thomas Case, M.A., Professor of Moral and Metaphy- sical Philosophy, Oxford.

LONDON. Geography and Statistics, H. B. Wheatlet, Assist- ant Secretary, Society of Arts, Author of “London Past and Present” ; Government and Administration, F. F. Liddell, M.A., Barrister-at-Law, Fellow of All Souls College, Oxford.

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MADRID. A.E.Houghton, L.C.L., Author of “Restoration of the Bourbons in Spain.”

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MISSOURI. M. S. Snow, A.M., Professor of History, Washing- ton University, St Louis.

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MOON. Professor Simon Newcomb, Ph.D., LL.D., D.Sc. ; for- merly Director U.S. ” Nautical Almanac,” Professor of Mathematics and Astronomy, Johns Hopkins University.

MORMON CHURCH. G. M. Marshall, Ph.B., Profes.sor of English Languages and Literature, University of Utah.

MOROCCO. Budgett Meakin, Author of “The Moorish Em- pire,” &c.

MORRIS, WILLIAJr, Arthur \Vaugh, Author of “Alfred, Lord Tennyson.”

PREFATORY ESSAY.

MODERN CONDITIONS OF LITERARY PRODUCTION. By Augustine Birreli, K.C.

LITERATURE in its widest sense is as large as human life, and has been produced after some fashion or another at all times and in all places, though happily not yet ah omnibus. Before pens and ink were invented men had found means to commentate upon their environment, and to record their history ” with quipo-threads, with feather-pictures, with wampum-belts, still oftener with earth-mounds and monu- mental stone-heaps, whether as-pyramid or cairn.” But the conditions under which literature has been produced have ever been changeable, and still continue to change; and being subjected as they are to all the influences that mould society and alter manners, any history of them that aimed at completeness would resolve itself into a record of that vast, mysterious, fascinating, perplexing movement, which is sometimes called Progress, sometimes Evolution, and sometimes Destiny.

The purpose of this essay is more modest, namely, to call attention to a few of the more obvious changes that have occurred in the last half of the 19th

century in the production and distribution of printed matter. Error lies in wait at the portals of the humblest Inquiry, eager to take the outspread hands of the anxious inquirer, and personally to conduct him by the pleasant paths of Hasty Generaliza- tion to the resting-place of False Conclusions. As we step cautiously into the arena of the book market, our ears are deafened with the roar of its Niagara, its tremendous output, and straightway are excited within us feelings of amazement, admiration, or dismay. The newspapers of a single week, piled one on the top of another, would make a decent hill in a flat country, whilst monthly magazines issue forth in crowds. The spread of what Goethe shudderingly called ” half culture ” is noticeable everywhere. Even polite learning has not wholly escaped the taint of trade. Parnassus is undoubtedly a very noisy mountain, where publishers shout their wares, and authors seek to gain popularity by the doubtful device of exhibit- ing their photographs. A commercial spirit pervades the atmosphere. And no wonder ! Fortunes stockbrokers might envy await the few who can succeed in winning and retaining, though it be but a short while, the ear of some or other of the ” publics,” into which the book-readers of the world are divided. There it is, the great restless, swaying crowd, peopling whole continents, waiting to be amused, to be excited, to be inflamed, to be taken out of themselves ; who would not reach it, teach it, — tax it, if he could? That very risible farce, Charley^ s Aunt, has made more money than is represented by the united fortunes of Scott, Thackeray, and Dickens. Had there been American copyright a generation earlier, the clever authoress of Hast Lynne, or her publishers, must have drawn at least £50,000 from trans- Atlantic readers. It is a pleasant thing, let critics say what they may, to spin a snug family -fortune out of the inventions of your brain.

Considerations of this kind, however, lie merely on the surface, and though they may lend them-

selves to a sardonic humour, or supply an outlet for the spleen of authors whose books do not command, fortunes, or readily convert themselves into neat villas, they carry us a very little way in our investigation. There is

nothing new under the sun, except the conditions under which men go forth to their labour or their folly. The booksellers of the 17th and 18th centuries were every bit as anxious to make money for themselves and their families as any publisher to-day can be. An excellent account of our early booksellers is to be found in John Dunton's Life and Errors, first published in 1705. A few of these men were rogues, others of very doubtful virtue, but some were good fellows ; and as for the authors, they did the best they could for themselves. Some of the worst of them made a great deal of money, and some of the best of them very little, and people complained then just as they do now of the degeneracy of the times and the vulgarity of the age. Indeed, before the age of printing, and when " the trade " was engaged in selling manuscripts, employing in Paris and Orleans alone ten thousand copyists, doleful cries resounded in University and Church circles as to the evil consequences of cheap learning and unlicensed reading. The movable types did not create, though they greatly helped to promote, what is called the Revival of Learning, i.e., the spirit of inquiry. Nor will any one who has any general acquaintance with the literature of the Renaissance marvel at this outcry. To confine your attention to masterpieces is not the best way to appreciate the tone and temper of the period that produced them.

I will take as my point of departure the 1st of July 1842, when the Copyright Act for Books, which is still in force, first came into operation. About this Act itself one or two things are significant. First note the old-world simplicity of its preamble, " Whereas it is expedient to amend the law relating to copyright, and to afford greater encouragement to the production of literary works of lasting benefit to the world." In some dim, undefined way it was supposed that the monopoly called " copyright " could only be justified if it were confined to literature of the highest class ; and certainly IMacaulay in his famous speech in Parliament dealt only with great examples, and the orator would have been very much put out had he been told to say something about the tradesmen's catalogues and stockbrokers' price-lists, which the judges have decided are as much entitled to the benefit of the Act as Darwin's Origin of Species or Macaulay's own History. There is no good reason known to me why catalogues and price-lists should not be protected, for the eighth commandment, " Thou shalt not steal," is or ought to be a law of universal obligation, but it is interesting to notice how a

monopoly that was with great difficulty, and after long delay, wrung from the Legislature in favour of ” literary works of lasting benefit,” was willingly, though in violence to the spirit of the Act of Parliament, extended by the judges in favour of the trading community.

Another thing to notice about the Act is its innocence of the British colonies. In 1842 nobody thought about them — indeed, it was in the course of the speech already referred to, that Macaulay made the observation, ” There is none of us who would lay down £5 for a whole province in the heart of the Australian continent.” The Act, though imperial in its scope, including as it did “all parts of the East and West Indies, and all the colonies, settlements, and possessions of the Crown which now are or here- after may be acquired,” was purely insular in its methods, since its provisions involved publication within Great Britain or Ireland of the book that was to be protected. It never occurred to any one that a Canadian or an Australian author might publish a book in Montreal or Sydney. In those days we English had the homely wits of home-staying men.

Passing away from the Copyright Act of 1842, but keeping its date in mind, the first altered condition, and one the most worthy of notice, to which I would call attention, is that of Population. Between a country containing less than sixteen millions of inhabitants (the population of England and Wales in 1842) and the same country containing thirty millions, great must be the difference. It is difficult to be isolated in the England of to-day. The pressure of the environment is enormous. The contagion of the crowd is quickly propagated. Uniformity is produced. Oddities, quaintnesses, humour- some prejudices, local peculiarities, dialect, persistent individualities, “characters” are disappearing from English life as rapidly and as irrevocably as so much that was picturesque and lovely in English land- scape. There is a passion for equality in externals that is born of numbers. To dress like your neighbour, to live under the same kind of roof, and to eat at the same hours as he does, to share, his tastes, to repeat the same catchwords — all this seems natural and desirable in thickly-populated districts.

PREFATOKY ESSAY IX

When once a book or a paper can be introduced to the notice of such homogeneous compounds, its fortune is made, for it rages among them like an epidemic. This contagion of the crowd powerfully influences the supply and demand of books and newspapers.

In a great population animated by democratic notions, recognizing no external authority in matters of faith or taste, with a growing passion for equality and a greedy desire to handle the good things of this world, as recommended by the modes and methods of life of the wealthy and luxurious, it would be irrational to expect to discover any general refinement or delicacy of thought or feeling. We may rejoice if we are able to observe prevailing signs of a dominant healthy manhood in our recreation grounds, theatres, music halls, factories, regiments, and wherever else our vast populations lead their lives. To expect too much of the human race is the ancient error of moralists and the sin of the satirist. In his lecture on ” Numbers,” delivered in the United States, Mr Matthew Arnold illustrated by quotations from Plato and Isaiah the truth that it is always the remnant that saves a nation or a race, and the advantage of a big country and a great population is that the remnant has at least a chance of being a good large one. A country that has left off breeding has abandoned hope.

Next in importance to the growth of population in the last half-century is the extension of popular Education, which cannot be overlooked when considering the changes that have taken place in the production of literature. The great object of popular education is or ought to be to teach the people to read with perfect ease, and as much intelligence as can be mustered. Unless they can read with ease ninety-nine men out of a hundred will never read at all. The real University, said Carlyle, is a Collection of Books. I cannot admit this to be precisely true, since the function of the University is to teach, but unless books are within your reach physically and mentally, there can be no teaching for you, and primary education must fail to effect its purpose. In 1842 people in England were an unlettered race, a large percentage of the population being unable to read or write. The only public money devoted in that year to the work of primary education was a Parliamentary grant amounting to £29,618, 5s. lOd. In rates and taxes the annual expenditure solely directed to the same end amounted in 1902 to (at least) £16,000,000 sterling. 1842 is a melancholy date in the unhappy

history of English education, for it was that year that witnessed the defeat (owing to ecclesiastical squabbles in which neither the parents nor the children had the faintest interest or concern) of a considerable measure of National Education. What a picture is that drawn by the master hand of Dickens, himself one of the greatest popular educators of the age, of little ” Jo ” moving about among the hieroglyphics of the London streets ! —

It must be a strange state to be like Jo ! To shuf&e through the streets unfamiliar with the shapes, and in utter darkness as to the meaning of those mysterious symbols, so abundant over the shops, and at the corners of streets, and in the doors, and in the windows ! To see people read, and to see people write, and to see the postman deliver letters, and not to have the least idea of all that language — to be to every scrap of it stone blind and dumb ! It must be very puzzling to see the good company going to the churches on Sundays with their books in their hands, and to think what does it all mean, and if it means anything to anybody, how comes it that it means nothing to me ? To be hustled and jostled and moved on; and really to feel that it would appear to be perfectly true that I have no business here, or there, or anywhere ; and yet to be perplexed by the consideration that I am here, somehow, too. Jo’s ideas of a criminal trial, or a judge, or a bishop, or a government, or that inestimable jewel to him (if he only knew it) the constitution, should be strange. His whole material and immaterial life is wonderfully strange; his death, the strangest thing of all.

” Jo ” had to wait from 1842 to 1870 for his education, but he has got it now ; for although it cannot, and probably never will be said of Englishmen that they are a reading people, they have at least become a people who can read.

The immediate result of these changes in Great Britain, both in numbers and intellectual qualifica- tions, has been the multiplication of cheap periodical prints, for to call them generally ” newspapers ” would be inaccurate. The vastness of the public who can read, the marvellous plenitude of copper coins, the cheapening (though the price varies very much) of paper, the extraordinary perfection of the printing- press, and the many processes for producing pictures, have both tempted and enabled those traders who

are concerned in such matters to put upon the market day by day and week by week the most bewildering number of “papers” (as they are called) for men, women, and children — some with pretentious pictures, others with drawings and cuts, which appear to find ready purchasers in the streets. In these papers is to be found a great variety of matter. Amidst a little that is positively bad, and much that is distress- ingly trivial and vulgar, occasionally may be noted a touch of elevation, chiefly conveyed by means of quotations, which are at least capable of awakening a response in minds attuned to better things.

The activity of the press is not confined to the production and distribution of newspapers and periodicals. It also turns out, by the million, popular books at democratic prices. This cheapening of books is one of the great facts of the age. For a penny apiece may be bought no inconsiderable number of books, and among them are included some of the most famous in the world ; whilst any one who is prepared to give sixpence a copy may include in his library almost everything that is really worth reading in the English tongue, whether grave or gay, in verse or prose.

To measure the effect upon the population of this amazing output is impossible. Cheap books have their drawbacks. A twopenny Bible is not treated with much deference. Still, the sale of a million copies of such a book as Charles Kingsley’s Westward Ho ! at fourpence-halfpenny a copy means something. Cheap books disseminate the habit of reading, circulate the knowledge that there is pleasure to be got out of books, stimulate the desire of a wider range of study, contribute to the refinement of the race, and so affect the conditions under which books are produced and distributed.

Here, again, I must be permitted to interpolate the remark that it is the size and reading-power of the crowd that have changed rather than its character, for there has been for many a long year a market for cheap books in England. Long before 1842 enterprising and not always over-scrupulous cheap book- sellers had the wit to see that money was to be made out of the masses by providing them with books no less than with gin and beer. Book-stall hunters still see perched on their upper shelf the editions of these

pioneers of popular education— ill-printed it may be, but handy for the pocket — Tom Jones, The Vicar of Wakefield, Tristram Shandy, all our British poets, and many another volume of delight ; what is more, these cheap booksellers made large fortunes.

There have always been readers among all classes in England. The Pilgrim's Progress and Robinson Crusoe were from the first the favourites of the populace, whilst chap-books, prophecies, like those of " red- faced Nixon " (named in Pickwick'), ballads, and tales, have proved more profitable to their printers than heavier works have done. But the crowd was a small crowd and an ill-educated one ; now it is a larger crowd, and can read. To expect this crowd to devote its scanty leisure, gained after hours of exacting labour or distressing tedium, to the perusal of masterpieces is unreasonable. To hard-working men and women, and, unfortunately we must add, to hard-working children, reading can never be more than a pastime competing with many other pastimes. The newspaper and the story-book are not likely to be dethroned until the conditions of human life undergo greater alterations even than those that have been witnessed during the last half-century.

In the class above what are commonly called the working class a great change is noticeable in the style and character of their books and reading. We hear complaints loud and long in England about Secondary Education, and they are mostly just complaints, but it is sheer ignorance to suppose that the Act of 1870, and the splendid work of the best School Boards, although confined to what is called "Primary Education," have not had a great effect upon the intelligence of the middle classes, who, finding themselves left out of the national calculations, have taken their culture into their own hands. In this undertaking they have been greatly assisted by the publishers and printers, who have sent forth an ever-increasing number of good books, cheap in price, and in many cases carefully edited. It is the fashion of middle- class people to abuse the middle classes, to call them Puritans and Philistines, tasteless and " suburban," but no inconsiderable portion of this class have had the good sense to profit by this abuse, and have gone steadily on their way, reading good books, attending lectures, making notes, curing their defects, enlarging their horizons, and purifying their tastes, until, far short as they still may be of perfection, they can hardly be said to be far

behind their critics, who indeed are usually the more impecunious members of their own households.

PEEFATORY ESSAY XI

In proof of tliis improvement I can appeal to the private libraries of the land. In the ‘forties and ‘fifties of the last century the books in too many middle-class homes were a doleful crew, and unless the heads of the family were closely identified with some religious body of publishing proclivities, few in number. A badly-printed Shakespeare was to be found somewhere, and Robertson’s Histories, and Josephus in one volume. Hervey’s Meditations among the Tombs and Zimmerman on Solitude were in the best bedrooms, and perhaps John Newton’s Oardiphonia. These latter are now scarce books. With good luck you might hap upon Pope’s Homer and the Essay on Man, or some odd volumes of the Spectator and a tiny Rasselas. For poetry there was Thomson’s Seasons, Cowper’s Task, and Longfellow alone of the moderns.

Now the blessed change ! In countless households scattered up and down the country intelligent students are to, be found of Chaucer, of Spencer, of Shakespeare. Modern editions of Bacon’s Essays, the Anatomy of Melancholy, of Walton’s Angler and Lives, of Sir Thomas Browne’s Religio Medici, of Mon- taigne’s Essays, of Jeremy Taylor’s masterpieces, of Milton’s prose, are as plentiful as blackberries in September. Miss Austen rules with a mild sceptre over a thousand homes, and little Miss Burney once more has her admirers. The Waverley Novels take the field almost every year in some fresh guise. Gait’s Provost and Annals of the Parish give rise to many a quiet chuckle ; Charles Lamb is among the Lares and Penates of Great Britain ; Hazlitt has come to life again. It is no exaggeration to say that the whole capacious field of English literature has been ransacked and rifled of its choicest treasures in order to place them in good type, on good paper, and at a low price within the reach of almost every one who has any true feeling for books and reading.

It is an age of cheap reprints and collected editions and literary appreciations. It is easy to sneer at cheap culture, and crude admiration, and University Extension Lectures. It is, not given to many to enter into the soul of any literature. The best judges often make great mistakes, and it cannot

be expected that good taste should be universal ; but among our middle class there has sprung up, of late years, an honest love of literature. England is now full of good editions of good books, and the demand for them increases. This is one of the conditions under which literature is produced to-day.

Midway between the Newspaper and the Book stands the Magazine — a now almost venerable form of literature. How many an author has been able to recall, as the great ” Boz ” loved to do, his emotions on reading his first ” article ” in a magazine ! Dr Johnson wrote for a magazine. Sir Walter Scott was a diligent contributor to periodicals. Lamb, Hazlitt, De Quincey, Carlyle, Thackeray, Dickens, Froude, Matthew Arnold, were all ” magazine ” men, and their collected contributions, torn from their first birth- places, now make famous books in their own right. Magazines have played no mean part in disseminating literature and encouraging literary ambitions, and have helped to increase the numbers of those who are on the look-out for books on all the varied subjects of interest with which magazines concern themselves. Almost every subject has its own magazine ; nothing is too old or too new — one member of a family is mad about motor cars, another cares for butterflies, a third for folk-lore and early religions, a fourth for pedigrees and book-plates, a fifth for prints and ivories ; each has his pet magazine. All this endless inquiry promotes and stimulates the book market to an extent which would make old ” Sylvanus Urban,” and good Mr Bowyer and his biographer, Mr John Nichols, stare and gasp.

Another powerful influence of the time is the spread of public and proprietary libraries throughout the land. There are four kinds of libraries — the Private Library, the Public or Free Library, the Pro- prietary Library, and the Circulating Library. To the private library reference has already been made. I am well persuaded, despite the grumblings of the booksellers, who sell new books and have their great difficulty about discounts, that the private libraries of the land, if so important a word may without offence be applied to small collections, go on steadily improving in England. Scotland in this matter lags behind. Public or Free Libraries have, of course, enormously increased in number, being not only the pet objects of two well-known money-givers, — Mr Passmore Edwards and Mr Carnegie, — but, if a popular vote can be obtained (not always an easy matter), they can be

supported, to a limited extent, out of the rates. In almost all the large English towns, and in not a few villages, free libraries rear their

heads. The contents of free libraries vary very much, but there they are, bringing knowledge and pleasure within the reach of nearly everybody. Tired men and women, imperfectly educated, will not frequent public libraries in large numbers to read history, philosophy, or science ; they will prefer to turn over the back numbers of illustrated papers, or to read some stirring tale or romantic adventure, nor is their taste in these matters likely to be a cultivated one. But the habit of reading is generated, strengthened, and possibly transmitted ; and besides this, it is surely a comfortable thought, that assuming a child to have genius or capacity, the desire for knowledge, or the craving after perfection, no longer can chill penury shut him out from the accumulated wisdom of the race to which he belongs. The waste of a free library is nothing to the waste of Nature. The Proprietary Libraries which supply their members and subscribers with books, and as it were keep a library for them, have done more than the Universities to spread a love of reading among the middle classes. In most large towns such libraries exist on a con- siderable scale, and have been, and are, true centres of education. Lyceums, Athenaeums, and other high-sounding names, describe places to which many of us owe much. Of the Circulating Library it is unnecessary to speak, for all are acquainted with its beneficent operations.

The booksellers eye all these public and semi-piiblic establishments with disfavour, thinking that they dissuade people from buying books. I doubt this being so. Speaking generally, the more people read the more books will they have about them ; the fact that there are now collected in public, proprie- tary, and circulating libraries, many millions of books, and that these places of resort are daily visited by thousands and thousands of readers, must have some effect in promoting the demand for literature. ^

The habit of travelling by rail, now so general, is thought by some observers to have increased the disposition to read on the part of an otherwise sluggishly -minded population. The railway book-stall has perhaps played some part in education ; if so, it has been but an obscure part, for except in

the matter of newspapers and the most advertised novel of the moment, it cannot be said even to respect the average intelligence of the travelling public. A reformed railway book-stall is a dream of the future ; but perhaps railways themselves may have become a memory of the past before this dream has even a chance of realization.

Let us go farther afield. What is to be said of those vast multitudes all the world over who read English as their native tongue ? In 1842 the white population of the United States of America was a very little over fourteen millions — it was in 1902 more than sixty-seven millions. The population of Canada increased from a million and a half to five and a half millions, whilst the Australian Colonies, with but a quarter of a million in 1842, contained in 1902 more than three and a half millions of inhabitants. All these good people, or such of them at least as are not infants, read books ; and though settlers in new countries are not great readers, having other things to do, still signs are not wanting to indicate that the Colonial book market will soon be a busy one. It is, however, the growth of the population in the United States that is the most important factor in the case, for in the States are to be found (to use Mr Arnold's word) a " remnant " great in numbers, even though it be but a minority of the whole population, who both think and read, and pursue with .unresting energy and an amazing seriousness a thousand fancies and phantoms of the brain. The American Copyright Acts of 1891-95, by conferring the monopoly of reproduction on all books printed and published within the States (following in this respect the British Copyright Statute of 1842), have gone a long way to unite the British Islands and America into a Book-Union. There is a complete reciprocity of authors ; and though many American- bred authors find a great sale in their native land, and hardly any in the United Kingdom, and many British authors who are, in the vile phrase of the trade, " much esteemed " at home, count for next to nothing in the States, still the tendency is, and must be, to throw all English-writing authors into hotch-pot, to find their readers wherever they can. London publishers have very close connexions with New York. A popular author in England is quite as likely to receive a call from an American as from an English agent. The sermons of a popular divine, the last story of a popular novelist, the new drama of a popular playwright, circulate freely on both sides of the Atlantic ; whilst for the graver work of the theologian, the philosopher, moral or

political, and the historian, there is the same well-tempered 1 In the free libraries of eight British towns there are gathered together more than a million volumes.

enthusiasm in Boston as in London, and in London as in Boston. The reading public of both countries is now equally within the reach of every English-writing author. It is indeed an enormous public. When St Augustine wrote his Oity of Q-od he too had a great public, and his famous treatise, copied though it had to be by hand, soon spread itself over Europe ; but what was Augustine's public in numbers compared with that of an author of to-day, who catches the fancy of both England and America ?

Under these conditions it is not surprising that there should be an enormous output of books, and particularly of books which do not demand of those who produce them any great store of acquired learning. The novel lies to anybody's hand. Anybody, so it is said, can write a dozen bad novels or one good one. It is easier to believe the first part of this saying than the second. Fortunately every- body does not try, although the temptation to do so must be great, for this huge possible public is divided into many markets, each quite distinct from the other, and to gain a reputation in any one of these markets is to succeed — not necessarily as an artist, but as a family man. Nobody knows with any degree of precision all the markets. The late Mr James Payn knew many things about books, but he did not know the John Inglesant market, or, at all events, he had not watched its growth. There are indeed many markets where a lively trade is done in books and papers, for fiction is only one of the fields now cultivated with an almost nervous activity. In almost every department of Belles Lettres — including in that phrase the popular aspects of theology — in popularized science, and in Philosophy, the labourers are many. Little books are written about big books ; and big books are written about little men ; essays, monographs, appreciations abound. It is debated whether our living poets are to be counted by tens or scores. Book-making goes on all round. We can almost hear the clicking of the type-writer. The commercial spirit has never been absent from literature, but in earlier times the author was in the background. All he had to sell was his manuscript — this he did, if he could, to a

member of the Stationers' Company, who straightway registered it as his own "copy." To-day authors take the front seats, or try to do so, and as they are a numerous body they necessarily make a great deal of noise. Women, too, in large numbers, have joined their ranks. The feminine note is predominant in some departments of Literature.

We are thus forced to contemplate three great crowds — one of readers, one of producers, and a third of distributors. Here is where the conditions have altered — in the size and intellectual equipment of the reading public, and consequently in the numbers of those engaged in the work of supplying, fostering, and stimulating its unceasing and increasing demand for something to read. To expect delicacy and distinction to be characteristics of such a roaring mart as this would be irrational. On the other hand a tendency would be expected, and has in fact occurred, to produce numbers of books of practical utility, — primers of science, history, literature, — volumes making knowledge easy and easily accessible. This is particularly the case in America, where the people at large began to "want to know" much earlier than the corresponding public in England.

A noticeable incident of the time, and one significant of much change in the conditions of the book- market, is the disposition to combine which authors have lately exhibited. This is a new thing, for, as a rule, authors have hitherto taken small pleasure in each other's society. It is mainly a trade feeling that has brought them together, although no doubt the instincts of the journalist — and how many writers of books are journalists ! — have always been gregarious. The combination of authors has done a good deal to improve their condition commercially, and it may some day do something to destroy the cruel delusions that there is a market for every kind of paper ~~staining, and that anybody who has ever written any~~ thing has a claim upon the consideration of his fellow-men, and a right to find a publisher ready to employ both capital and labour in palming off upon the public a new book.

One other powerful influence of the time must not pass unnoticed — the influence upon the minds, both of authors and readers, of foreign literatures made generally known by means of translations. Never before since the days of Elizabeth has the ordinary English reader been so familiarized with

foreign books. Tolstoy is one of the spirits of our age. No English author since Dickens has so powerfully moved so many English people, whilst there are at least a dozen French authors, chiefly novelists, whose influence upon British writers has been enormous. Nor can Ibsen and Maeterlinck be counted for little. Cosmopolitanism in

literature may be expected. The whole western world is pervious to the same ideas. Though in statecraft the tendency may be for the consolidation of kindred states and the isolation of dominant races, in the realms of science, thought, and imagination a counter influence will more and more assert itself. International copyright is the first law which can with pardonable exaggeration be described as having been passed in the Parliament of Europe. With a few exceptions it is now true that a European author enjoys in every country in Europe the same property rights in the works of his brain as the law of his own country confers upon its native-born writers.

The change is indeed great since the days when Madame de Stael, being banished from France, first introduced Germany to the notice of polite Europe ; since 1834, when Carlyle, striving and crying in the pages of Frasers Magazine, besought his countrymen, who had not then learnt to endure his style, ” to close their Byron and open their Goethe ” ; and when none but a few pale students knew more of the Literature of Italy than was contained in a canto of the Inferno, a sonnet of Eilicaia’s, and the novel of Manzoni.

Now that the Fmnee, the Peres et JEnfants and the Etranges Histoires of Tourgueneif, the Anna Karenine and RSsurrection of Tolstoy, and Le Crime et le Ghdtiment of Dostoieffsky have made dumb Russia speak at last, it is not too much to say that all Europe contributes to a general fund or stock of ideas available for the common use.

And what is more, there are many English and American readers who take more kindly and sympathetically to the ideals and thought-tendencies of foreign authors — even when read, as they generally have to be, in translations — than to those of their native authors. Nor is this alwajs due to

the superior genius of the foreigner; it may be partially accounted for by his freedom from literary restraints that have grown stale and by the freshness of his imagery and novelty of atmosphere. Nor will this disposition of mind be destroyed by ridicule. Wilhelm Meister has survived the unseeml_y merriment of De Quincey, nor have the shafts of Mr Anstey's admirable humour injured the permanency of Ibsen's reputation.

But whilst we cannot fail to notice from what widely different quarters, from what strange sources and far-off countries, the " reading public " now derives its sustenance, and how completely our mental ports are thrown open to the literary goods of the foreigner, it would be rash to attempt even to name the rival influences that visit our shores in these strange times, and either contend with those of native manu- facture for mastery over us, or at least imperatively demand the rights of expression and free circulation. Never before were so many influences at work upon men's minds, seeking to mould and control them, as now. If it would be difficult to name these influences, to seek to estimate their several strengths would be clearly impossible.

Whether the minds of men are more readily moved to important issues by the force of great events or of great thoughts is hard to determine. The French Revolution — though of course itself the result of a thought-movement — had a more obvious effect upon the current of men's thinking than have most of the great books of the world. This probably is what was in Michelet's mind when, if Mr Lewes is to be believed, he once began a lecture as follows : " Messieurs, dans ce monde il y a deux nations. Ces deux nations, messieurs, sont les Juifs et les Frangais. Ces deux nations, messieurs, ont deux livres, seulement deux. Les Juifs, messieurs, ont la Bible; les Frangais ont la Revolution."

For present purposes it is enough here to note the expansion of the Englishman's Library. The old, famous, homespun names which have so long reigned over our shelves, with no competitors save the Delphine Classics, have not indeed been forced to abdicate — for supreme they will probably ever remain within these Realms — but, in future, they must be content to brook with foreign rivals very near their thrones.

To attempt to state in exact language the results that have followed these changed conditions in the production of modern literature would be impossible, but one of those results is particularly noticeable. Modern literature is singularly sensitive, and reflects almost instantaneously the humours and sentiments of the hour. Owing to our numbers, our great populations living closely together, and the general spread of education, ideas are now most infectious, and run through the land with amazing agility. We act and react upon each other. A particular spirit or tendency evokes an author, and the author generates with

velocity the spirit that begot him. As examples of what I mean may be cited two writers, Captain Mahan and Mr Rudyard Kipling. It is but the other day that these two men began to write, each in his own different way, and yet what an impression they have already made, what an influence they have exerted! Their thoughts and arguments, their tricks of speech, are recognizable everywhere — have become to a greater or less extent part and parcel of the intellectual output of the average man. Never before surely was this contagiousness of ideas so noticeable. ^

When once an idea or notion has taken root, a whole host of ready writers grab hold of it, and with loud cries and exclamations carry it into every quarter. They popularize it, they vulgarize it, they mix it with their cheap spirits or their cold water, but in one way or another they fit it for every palate. It does not matter what the notion may be, — imperialism, federalism, evolution, sacramentarianism, or only a particular kind of humour, or a mode of narrative ; if it has any popular virtue within it, it will be caught hold of and carried in triumph into every book market of Great Britain. The imitators, who sometimes are skilful men, and sometimes gross and clumsy personators, are often more prosperous than the originators — if indeed any one is entitled to be called an original. The doctored article is usually more to the taste of the many than the true manufacture, which is apt to have a certain pungency, sternness, and reticence almost certain to be ” caviare to the general.” This characteristic of the time is naturally pleasing to those observers who share the prevailing sentiment, and not so agreeable to those who remain either unconscious of its claim or suspicious of its

tendency. When the crowd is on your side you regard its rude horse-play with benevolence ; if it is against you, with disgust. Moods will vary, opinions change, ” no altar standeth whole,” but this responsiveness of the public mood to the prevalent spirit of the time will probably grow quicker and keener with the growth of population and the spread of popular education. An age of widespread diffusion of knowledge can hardly present a romantic aspect. A dungeon is more romantic than a school. Large masses of people, necessarily very imperfectly educated, but with a great conceit of themselves, all eager to know and discuss results, and to experience new sensations, are not likely at first to throw their influence on the side of the things that are ” quiet, wise, and good.” Dwellers in great cities and in populous and half-educated countries must learn to put up with a great deal of noise of all kinds. It is absurd to be too sensitive. Everything runs its course. After contemplating the changed conditions of modern literature, we may congratulate ourselves that wherever we look we see all the symptoms of life and activity in a people striving to get quit of the clogs of ignorance, and to enter upon the glorious inheritance that belongs by right to every cultivated intelligence.

ENCYCLOPEDIA BRITANNICA,

(NEW VOLUMES.)

KAB AD IAN-KABUL

Kabadian, a bekdom of south Bokhara, Hissar region, situated on the right bank of the Amu river, be- tween the lower courses of its two tributaries, Vaksh and Surkhan. It is also watered by the Kafirnagan, another tributary of the Amu. The population consists mainly of Uzbegs, whose chief occupation is agriculture, silk- worm culture, and gathering of pistachio nuts. The chief town, of the same name, is a walled town, built on an island formed by two branches of the Kafirnagan, 30 miles above its junction with the Amu and 268 miles south-east of Bokhara.

Kabansk, a village of Eussia, East Siberia, province of Transbaikalia, district of Verkhneudinsk, 275 miles west of Chita, on the lower Selenga. Owing to its posi- tion on the Amur highway, it became a wealthy spot, the

inhabitants of which were engaged in the transport of tea and other goods. Population, 5000.

Kabardia, a territory of Eussia, occupying the southern middle portion of North Caucasia, now part of the province of Terek. It is divided into Great and Small Kabardia, and covers about 3800 square miles, on the northern slopes of the main Caucasus range (from Mount Elbruz to Passis-mta), including the Black Mountains and the high plains on the northern slope of the latter. Be- fore the Eussian conquest it extended as far as the Sea of Azov. Its population is now about 75,000. One-fourth of the territory is ‘owned by the aristocracy, organized in a feudal fashion, and the remainder (874,000 acres) is divided among the auls or villagers. A great portion is under permanent pasture, and part under forests and per- petual snow. Excellent breeds of horses are reared, and the peasants are in possession of about 117,000 horned cattle and 246,000 small cattle. The land is well cultivated in the lower parts, the chief crops being millet, Indian corn, wheat, and oats. Bee-keeping is widely spread, and Kabar- dian honey is in repute. Wood-cutting and the manufacture of various wooden goods, the making of b4rkas (felt and fur cloaks), and saddlery are very general. A school forthe mountaineers is kept at Nalchik, which is the chief town.

The Kabardians are a branch of the Adyghe (Tcherkess). The Russians met them very early In their advance into Caucasia and the policy of Russia was always to be friendly with the Kabardian aristocracy, who were possessed of feudal rights over the Ossets, the Ingushes, the Abhazes, and the mountain Tatars, and had the command of the passages leading to Transcaucasia. John the Terrible took Kabardia under his protection. Later, Russian influence was balanced by that of the Crimea khans, but the Kabardian nobles nevertheless supported Peter I. during his Caucasian campaign. In 1739 Kabardia was recognized as free, or rather as being under the double protectorate of Eussia and Turkey, but thirty-five years later it was definitively an- nexed to Russia, and several risings of the population in 1804 and 1822 were violently and cruelly suppressed, liussia carefully maintained the old feudal organization under which the people were governed by the mekhemes, or councils composed of the nobles, under the presidency of the oldest prince, who was also a vali (judge). But after the revolts the organization was defi- nitively abolished in 1866, when

all servile dependency of the people was terminated, and the auls, as well as the nobles, re- ceived regular land allotments. Besides this land there is also a reserve land, which was confiscated, but returned to the Kabardians in 1864, to form, with its revenues, “the reserve capital of the Kabardian people.” Kabardia is still considered as a school of good manners in Caucasia ; the Kabardian dress is the fashion of all the mountaineers. Kabardians constitute the best detach- ment of the personal Imperial Guards at St Petersburg. A short grammar of the Kabardian language and a Russian- Kabardian dictionary, by Lopatinsky, were published in Sbornik Materialov dla opisaniya Kavkaza, vol. xii. Tiflis, 1891. Fragments of the poem ” Sosyruko,” some Persian tales, and the rules of Musulman religion were printed in Kabardian, in 1864, by Kazi Atazhoukin and Shardanofi. The common law of the Kabardians has been studied by Professors Maxim Kovalevsky and Vsevolod Miller. (p. a. k.)

Kabul. — The city of Kabul, the capital of Afghanis- tan, stands at an elevation of 6900 feet above the sea in 34° 32′ N. and 69° 14′ E., as determined by the surveys of the Afghan campaign of 1879-80. It lies close under the low spurs of hills to the west (the heights of Asmai, Sher Darwaza, &c.), which run to 400 feet in altitude above the city, dominating it completely, and shutting off the plains of Chardeh which stretch to the foothills of the Hindu Kush. Through these hills the Kabul river passes by the Deh Mozang gorge; and this gorge now

forms the best highway to Chardeh and Maidan. To the north, intersected by lines of low ridges and hills, are the fertile plains of the Koh Daman (reaching to Charikar) and of the Kabul river, which winds through them to a sudden descent from the eastern edge above Butkak. South of Kabul are the rugged hills which form the western buttresses of the Safed Koh range ; athwart them are the narrow valleys leading to Charasia and Logar. The ancient history of Kabul and of its dynasties of Hindu and Mahommedan rulers belongs to the story of Afghanistan. Its importance as the key to northern India — as the base from which, for covintless ages, inva- sions have been projected and carried to a successful issue, and through which

irruptions from central Asia have often swept — is proved by the story of India. In the strategical geography of Asia Kabul must always have held a prominent place. It is therefore somewhat remarkable that there should be so few allusions to it by classical writers under any recognized name.

Of late years Kabul has been visited by many Euro- peans, some of whom have resided there for years, and have exercised definite influence in shaping the progress, and possibly the destinies, of the city. After the accession of the Amir Abdur Rahman in 1880 it underwent great changes. In 1880, when the city was still occupied by British troops, there was not much to record which differs materially from the description given by Yule in the earlier volumes (ninth edition) of this work. The Bala Hissar (the Ortospana of Alexander) was then destroyed and has never since been entirely rebuilt, and a fortified cantonment at Sherpur (one side of which was represented by the historic Bemaru ridge) has taken the place of the old earthworks of the British occupation of 1842 which were constructed on nearly the same site. The city streets were as narrow and evil-smelling, the surrounding gardens as picturesque and attractive, and the wealth of fruit was as great, as they had been fifty years previously.

The Amir, however, proved himself to be an enlight- ened ruler in all matters pertaining to the improvement of his capital, excepting only as regards railways and telegraphs, or any other scientific development which might lead to the introduction of a European population. He projected many roads, so that Kabul is now connected by well-planned and metalled roads with AfghanTurkestan on the west, with the Oxus and Bokhara on the north, and with India on the east. The road to India was first made by British and is now maintained by Afghan engi- neers. The road southwards to Ghazni and Kandahar was always naturally excellent and has probably needed little engineering, but the general principle of road- making in support of a military advance has always been consistently maintained, and the expeditions of Kabul troops to Kafiristan have been supported by a very well graded and substantially constructed road up the Kunar valley from Jalalabad to Asmar, and onwards to the Bashgal valley of Kafiristan. This road may yet find its terminus in Badakhshan. The city ways have been improved until it has become possible for wheeled vehicles to pass, and the various local roads connecting the suburbs and the city are always

efficiently maintained. A purely local railway has also been introduced, to assist in transporting building material. The buildings erected by the Amir were pretentious, but unmarked by any originality in design and hardly worthy representations of the beauty and dignity of Mahommedan architecture. They included a new palace and a durbar hall, a bridge across the river and embankment, a pavilion and garden laid out around the site of Babar's tomb overlooking the Chardeh valley ; and many other buildings of public utility connected with stud arrangements, the manufac-

ture of small arms and ammunition, and the requirements of what may be termed a wholesale shop under Eui-opean direction, besides hospitals, dispensaries, bazaars, &c. The new palace is within an entrenchment just outside the city. It is enclosed in a fine garden, well planted with trees, where the harem serai (or ladies' apartments) occu- pies a considerable space. The public portions of the buildings comprise an ornamental and lofty pavilion with entrances on each side, and a high-domed octagonal room in the centre, beautifully fitted and appointed, where public receptions take place. The durbar hall, which is a separate building, is 60 yards long by 20 broad, with a painted roof supported by two rows of pillars. But the ar- rangement of terraced gardens and the lightly-constructed pavilion which graces the western slopes of the hills overlooking Chardeh are by far the most attractive of these innovations. Here, on a summer's day, with the scent of roses pervading the heated air, the cool refresh- ment of the passing breezes and of splashing fountains may be enjoyed by the officials of the Kabul Court, whilst they look across the beauty of the thickly-planted plains of Chardeh to the rugged outlines of Paghman and the snows of the Hindu Kush. The artistic taste of the landscape gardening is excellent, and the mountain scenery is not unworthy of Kashmir. It is pleasant to record that the graveyard of those officers who fell in the Kabul campaign of 1879-80, which lies at the northern end of the Bemaru ridge, is not uncared for. If the graves are not actually restored from time to time, they are at least protected.

Trade was apparently decreasing at .the end of the century. This was doubtless due to the prohibitive transit duties levied on the Afghan frontier. Between Kabul and India in 1896-97 the exports were 151|- lakhs, and the im- ports 303 lakhs, showing a drop of about one-third and one-half their

values respectively during the previous five years. Statistics as to population are not trustworthy, but it has been estimated at about 140,000 (1901).

See C. Yate. NoHhern Afghanistan. London, 1888. — Gray. At the Court of the Amir. London, ISOo. (x. H. H*.)

Kadiak (pronounced Kad-yak'), the largest island of Western Alaska, and also the post-office name for the chief settlement, St Paul, on Chiniak Baj', in 57° 48′ N. and 152° 22′ W. The name is derived from that of the Kaniak Eskimo, the original inhabitants. The settlement originated with the Eussian fur-traders in 1784, and was only established by Shelikoff after severe fighting. It was the headquarters of the Eussian American Company until their transfer to Sitka about 1806. St Paul is the centre of the fur trade and traffic for this district, and has a considerable commerce. Settlements on Woody Island, Afognak (the only native reservation in western Alaska), Uyak Bay with extensive salmon canneries, and Karluk, the greatest salmon fishery in the world, where more than 3,000,000 salmon have been canned in one season, em- ploying some 1500 hands, all pay tribute in some degree to the central settlement. Ice was formerly exported to Sau Erancisco from "Woody Island, and one of the grow- ing industries on the small islands is the rearing of foxes for their fur. The mean temperature of Kadialv is A3-o° E. The summers are warmer and more sunny, and the winters colder than at Sitka. The yearly rainfall aver- ages 73-0 inches. The total population (1900) of St Paul and its tributary settlements is 1146 whites and 624 natives, chiefly of Eskimo stock. The wooded coast region of Alaska reaches its western limit neai- St Paul, the coast and islands westwards and northwards being treeless. (w. h. d.)

KafTraria, Kaffres. — Although possessing no official value {Ency. Brit. vol. xiii. p. 816), the term

K A F I R I S T A N

Kaffraria or Kaffreland is not yet quite obsolete as a geogi-aphical expression, while it still obtains currency in popular language. But the former distinction between British Kaffraria and Kaffraria Proper ceased to have any meaning after the year 1894, when the whole region became

British territory by the incorporation with Cape Colony of that portion of Pondoland which had till then enjoyed a measure of self-government. In consequence of this annexation, which had been necessitated by the constant feuds and bloodshed caused by the rivalries of native chiefs, Kaffraria now comprises the whole of the region lying between the Great Kei and Umzimkulu rivers ; that is, between Cape Colony proper and Natal. For adminis- trative purposes it is constituted in four main divisions, with areas and populations as under : —

Area In sq. miles.

Population (1891).

Whites.

Natives.

Total.

Griqualand East . Tembuland . Trauskei Pondoland

Total .

7,600 4,120 2,550 4,040

4,150 5,180 1,020

148,470 175,240 152,560 166,000

152,620 180,420 153,570 166,000

18,. 310

10,350

642,260

662,610

Griqualand East, so called to distinguish it from Griqualand West, which, lies north of the Orange river and consequently never formed part of Kaffraria, comprises the whole of the debate- able region formerly called Noman's Land, and afterwards named Adam Kale's Land from the Griqua chief who occupied it in 1862 with the consent of the British authorities. But these Griquas, from whom the district takes its present designation, are disposing of their lands to the white settlers, and are thus disappearing amongst the labouring classes. The great majority of the inhabit- ants are In fact no longer Griquas, hut Basutos and Kaffres (Pondomisi, Ama^Baka, and other tribes). Since its annexation to Cape Colony Griqualand East has made rapid progress, and is now traversed by good roads and even telegraph lines, while the population rose from 121,000 in 1881 to over 152,000 in 1891. Stock-breeding on the uplands, tillage on the lower slopes of the Drakenberg, are the chief industries. On these slopes and up- lands the climate is delightful and well suited for the European constitution.

Tembuland, which lies south-west of Griqualand East and com- prises the districts of Tembuland proper, Emigrant Tembuland, and Bomvaniland, takes its name from the Ama-Tembu nation, popularly called Tambookies, who are one of the most powerful of all the Kaftre groups, and still number probably over 120,000 souls. In the national genealogies they hold an honourable position, being traditionally descended from Tembu, elder brother of Xosa, from whom most of the other Kaffres claim descent. Tembuland is also flourishing, and the coalfields, which appear to be extensive and easily worked, have already attracted a considerable mining population. The inhabitants, amongst whom are several thousand white settlers, increased from 160,000 to 180,000 in the decade ending 1891.

Translcei, or the Transkei Territories, had been completely in- corporated with Cape Colony by 1885, a few years after the close of the Kaffre wars. It comprises the districts of Mngoland, the Idutywa Eeserve, and Galekaland, this last being named from the renowned Galeka nation, who claim to be the senior branch of the Xosa family. They still form the chief element of the popula- tion, which rose from 136,000 in 1881 to nearly 154,000 m 1891. Here are some prosperous missionary stations, where the natives are taught agriculture, several mechanical industries, and even a knowledge of letters. They appear to be happy and contented under their British

magistrates, who administer justice in accord- ance with the Native Territories Penal Code. The heroic deeds of Hinza, Kreli, and the other famous chiefs in the Kaffre wars are still remembered in the local traditions ; but all desire to emulate their achievements, or to revive the superstitions associated with witchcraft, rain-making, and other pagan practices, seems to have died out.

Even more advanced in all social respects are the formerly degraded but now respected and civilized Fingos or Fengus, who give their name to the district of Fingoland, and also form the bulk of the population in the Idutywa Beserve. They have adapted themselves to Western culture almost as thoroughly as the Japanese, wearing European clothes, supporting their schools by voluntary contributions, editing newspapers, translating English poetry, setting their national songs to correct music, and on the whole conforming their lives to their Christian professions.

Since 1887 the several administrative divisions constituted out of the Transkeian Territories enjoy the franchise, with the right of returning representatives to the Cape Parliament.

See G. M'Call Tiieal. History of South Africa, 1887-91.— S. W. Silver. Handbook of South Africa, 1891. — A. H. Keane. Africa, vol. ii. 1895. (a. h. k.)

Kafiristan. — ^Very little of this country was known with accuracy and nothing at first hand until the late General Sir W. (then Colonel) Lockhart headed a mission to examine the passes of the Hindu Kush range in 1885-86. He penetrated into the upper part of the Bashgal valley, but after a few days he found himself compelled to return to Chitral. Previously Major Tanner, E.A., had sought to enter Kafiristan from Jalalabad, but sudden severe illness cut short his enterprise. Mlifair, the famous explorer of the Indian Survey department, believed that he had actually visited this little ~~known land during an adventurous journey which he made from India and through Chitral in disguise; but the internal evidence of his reports shows that he mistook the Kalash district of Chitral, with its debased and idolatrous population, for the true Kafiristan of his hopes. In 1889 Mr G. S. Eobertson (afterwards Sir George Eobertson, K.C.S.I.) was sent on a mission to Kafiristan. He only remained a few days, but a year later he~~

~~revisited the country, staying amongst the Kafirs for nearly a year. Although his movements were hampered, his presence in the country being re~~ garded with suspicion, he was able to study the people, and, in spite of intertribal jealousy, to meet members of many of the tribes. The facts observed and the in- formation collected by him during his sojourn in eastern Kafiristan, and during short expeditions to the inner valleys, are the most trustworthy foundations of our knowledge of this interesting country.

Kafiristan, which literally means “the land of the infidel,” is the name given to a tract of country enclosed between Chitral and Afghan territory. It was formerly peopled by pagan mountaineers, who maintained a wild independence until 1895, when they were finally subdued by Abdur Eahman, the Amir of Kabul, who also com- pelled them to accept the religion of Islam. The terri- tory thus ill named is included between 34° 30′ and 36° N., and from about 70° to 71° 30′ E. As the western and northern boundaries are imperfectly known, its size cannot be estimated with any certainty. Its greatest extent is from east to west at 36° 10′ N. ; its greatest breadth is probably about 71° E. The total area ap- proximates to 6000 square miles. Along the N. the boundary is the Amir of Kabul’s Afghan Turkestan province of Badakhshan, on the N.E. the Lutkho valley of Chitral. Chitral and lower Chitral enclose it to the E., and the Kunar valley on the S.E. Afghanistan proper supplies the S. limit. The ranges above the Nijrao and Pansher valleys of Afghanistan wall it in upon the W. The northern frontier is split by the narrow Minjan valley of Badakhshan, which seems to rise in the very- heart of Kafijistan. Speaking generally, the country consists of an irregular series of main valleys, for the most part deep, narrow, and tortuous, into which a varying number of still deeper, narrower, and more twisted valleys, ravines, and glens pour their torrent water. The mountain ranges of Metamorphic rock, which separate the main drainage valleys, are all of considerable altitude, rugged and difficult, with the outline of a choppy sea petrified. During the winter months, when the snow lies deep, Kafiristan becomes a number of isolated communities, with few if any means of intercommunication. In the whole land there is probably nothing in the shape of a plain. Much of the silent, gigantic country warms the heart as well as

captivates the eye with its grandeur and varied beauty ; much of it is the bare skeleton of the world wasted by countless centuries of storms and frost, and profoundly melancholy in its sempiternal ruin. Every variety of mountain scenery can be found ; silent peaks and hard, naked ridges, snowfields and glaciers ; or mighty pine forests, wooded slopes and grazing grounds ; or wild vine and pomegranate thickets bordering sparkling streams. At low elevations the hillsides are covered with the wild olive and evergreen oaks. Many kinds of fruit trees — walnuts, mulberries, apricots, and apples — grow near the villages, or by the wayside, as well as splendid horse- chestnuts and other shade trees. Higher in elevation, and from 4000 to 8000 feet, are the dense pine and cedar forests. ‘ Above this altitude the slopes become dreary, the juniper, cedar, and wild rhubarb gradually giving place to scanty willow patches, tamarisk, and stunted birches. Over 13,000 feet there are merely mosses and rough grass. Familiar wildflowers blossom at different heights. The rivers teem with fish. Im- mense numbers of red-legged partridges live in the lower valleys, as well as pigeons and doves. Gorgeously- plumaged pheasants are plentiful. Of wild animals the chief are the markhor (a goat) and the uridl (a sheep). In the winter the former are recklessly slaughtered by hunters, being either brought to bay by trained hounds, or trapped in pits, or caught floundering in the snow- drifts; but in the summer immense herds move on the higher slopes. The ibex is very rare. Bears and leop- ards are fairly common, as well as the smaller hill creatures.

Passes and Roads. — All the northern passes leading into Badakhshan or into the Minjan valley of Badakh- shan seem to be over 15,000 feet in altitude. Of these the chief are the Mandal, the Kamah (these two alone have been explored by a European traveller), the Kti, the Kulam, and the Kamgal passes. Those to the east, the Chitral passes, are somewhat lower, ranging from 12,000 to 14,000 feet, e.g., the Zidig, the Shui, the Shawal, and the Parpit, while the Patkun, which crosses one of the dwindled spurs near the Kunar river, is only 8400 feet high. Between neighbouring valleys the very numerous communicating footways must rarely be lower than 10,000, while they sometimes exceed 14,000 feet. The western passes are unknown. All these toilsome paths are so faintly indicated, even when free from snow, that to adventure them without a local guide is usually unsafe. Yet the light-framed cattle of these jagged mountains can be forced over

many of the worst passes. Ordinarily the herding tracks, near the crest of the ridges and high above the white torrents, are scarcely discoverable to untutored eyes. They wind and waver, rise, drop, and twist about the irregular semi-precipitous slopes, with baffling eccentricity and abruptness. Never- theless the cattle nose their way along blunderingly, but without hurt. Of no less importance in the open months, and the sole trade routes during winter, are the lower paths by the river. An. unguided traveller is continually at fault upon these main lines of intercourse and traffic.

Rivers. — All the rivers find their tumultuous way into the Kabul, either directly, as the Alingar at Laghman, or after commingling with the Kunar at Arundu and at Chigar-Serai. The Bashgal, draining the eastern portion of the country, empties itself into the Kunar at Arundu. It draws its highest waters from three main sources at the head of the Bashgal valley. It glides gently through a lake close to this origin, and then through a smaller tarn. The first affluent of importance is the Skorigal, which joins it above the village of Pshui. Next comes the noisier Manangal water, from the Shawal pass, which

enters the main stream at Lutdeh or Bragamatal, the chief settlement of the Bashgal branch of the Katir tribe. By and by the main stream becomes, at the hamlet of Sunra, a raging, shrieking torrent in a dark narrow valley, its run obstructed by giant boulders and great tree-trunks. Placing past Bagalgrom, the chief village of the Madugal Kafirs, the river clamours round the great spur, which, 1800 feet higher up, gives space for the terraces and houses of Kamdesh, the headquarters of the Kam people. The next important affluent is the river which drains the Pittigal valley, its passes and branches. Also on the left bank, and still lower down, is the joining-place of the Gourdesh valley waters. Einally it ends m the Kunar just above Arundu and Birkot. The middle part of Kafiristan, including the valleys occupied by the Presun, Kti, Ashkun, and Wai tribes, is drained by a river variously called the Pech, the Kamah, and the Presun or Viron river. It has been only partially explored. Ped by the fountains and snows of the quinquefid upper Presun valley, it is joined at the village of Shtevgrom by the torrent from the Kamah pass. Thence it moves quietly past meadowland, formerly set apart as holy ground, watering on its way all the Presun villages. Below the last of them, with an abrupt bend, it hurries into the

unexplored and roekbound Tsaru country, where it absorbs on the right hand the Kti and the Ashkun and on the left the Wai rivers, finally losing itself in the Kunar, close to Chigar-Serai. Concerning the Alingar or Kao, which carries the drainage of Western Kafiristan into the Kabul at Laghman, there are no trustworthy details. It is formed from the waters of all the valleys inhabited by the Eamgal Kafirs, and by that small branch of the Katirs known as the Kulam tribe.

Climate. — The climate varies with the altitude, but in the summer time it is hot at all elevations. In the higher valleys the winter is rigorous. Snow falls heavily every- where over 4000 feet above the sea^level. During the winter of 1890-91 at Kamdesh (elevation 6100 feet) the thermometer never fell below 17° P. In many of the valleys the absence of wind is remarkable. Consequently a great deal of cold can be borne without discomfort. The Kunar valley, which is wet and windy in winter, but where snow, if it falls, melts quickly, gives a much greater sensation of cold than the still Kafiristan valleys of much lower actual temperature. A deficiency of rain necessi- tates the employment of a somewhat elaborate system of irrigation, which in its turn is dependent upon the snowfall.

The Kafirs. — The present inhabitants are probably mainly descended from the broken tribes of Eastern Afghanistan, who, refusing to accept Islam (in the 10th century), were driven away by the fervid swordsmen of Mahommed. Descending upon the feeble inhabitants of the trackless slopes and perilous valleys of modern Kafir- istan, themselves, most likely, refugees of an earlier date, they subjugated and enslaved them and partially amalga- mated with them. These ancient peoples seem to be represented by the Presun tribe, by the slaves and by fragments of lost peoples, now known as the Jazhis ajid the Aroms. The old division of the tribes into the Siah-Posh, or the black-robed Kafirs, and the Safed-Posh, or the white-robed, was neither scientific nor convenient, for while the Siah-Posh have much in common in dress, lan- guage, customs, and appearance, the Safed-Posh divisions were not more dissimilar from the Siah-Posh than they were from one another. Perhaps the best division at present possible! is into (1) Siah-Posh, (2) Waigulis, and (3) Presungalis or Viron folk.

Tlie Siah-Posh. — The blaok-robed Kafirs consist of one very large widely-spread tribe, the Katirs, and four much smaller communi- ties, the Kam, the Madugalis, the Kashtaii, or Kashtoz, and the

Gourdesh. Numerically, It is probable that the Katirs are more important than all the remaining tribes put together. They inhabit several valleys, each community being independent of the others, but all acknowledging the same origin and a general relationship. The Katirs fall readily into the following groups : (a) Those of the Bashgal valley, also called Kamoz and Lutdehchis, who occupy eleven villages between Badawan and Sunra, the border hamlet of the Madugal country, namely, Ptsigrom, Pshui, or Pshowar, Apsai, Shidgal, Bragamatal (Lutdeh), Bajindra,Badamuk, Oulagal, Chabu, Baprok, and Purstam ; (6) the Kti or Katwar Kafirs, who live in two settlements in the Kti valley ; (c) the Kulam people, who have four villages in the valley of the same name ; (d) the Ramgalis, or Gabariks, who are the most numerous, and possess the western part on the Afghan border. Of the remaining tribes of the Siah-Posh, the chief is the Kam, or Kamtoz, who inhabit the Bashgal valley, from the Madugal boundary to the Kunar valley, and its lateral branches in seven chief settlements, namely, Urmir, Kambrom, or Kamdesh, Mergrom, Kamu, Sarat, Pittigal, and Bazgal. The next Siah-Posh tribe in importance is the Muman, or Madugal Kafirs, who have three villages in the short tract between the Katirs and the Kam in the Bashgal valley. The last Siah-Posh tribe is the Kashtan, or Kashtoz, who in 1891 were all located in one greatly overcrowded village, their outlying settlement having been plundered by the Afghan tribes of the Kunar valley. One colony of Siah-Posh Kafirs lives in the Gourdesh valley ; but they differ from all the other tribes, and are believed to be descended, in great part, from the ancient people called the Aroms.

The Waigvlis. — Our exact knowledge of the Waigulis is scanty. They seem to be related in language and origin with a people fierce, shy, and isolated, called the Ashkun, who are quite unknown. The Wai speak a tongue altogether different from that spoken by the Siah-Posh and by the Presungalis. The names of their ten chief villages are Runchi, Nishi,

Jamma, Amzhi, Chimion, Kegili, Akun or Akum, Mildesh, Bargal, and Prainta. Of these Amzhi and Nishi are the best known.

The Presungalis. — The Presungalis, also called Viron, live in a high valley. In all respects they differ from other Kafirs, in none more than in their unwarlike disposition. Simple, timid, stolid-featured, and rather clumsy, they are remarkable for their industry and powers of endurance. They probably represent some of the earliest immigrants. Six large, well-built villages are occu- pied by them — Shtevgrom, Pontzgrom, Diogrom, Kstigigrom, Satsumgrom, and Paskigrom.

The Slaves. — The slaves are fairly numerous. Their origin is probably partly from the very ancient inhabitants and partly from war prisoners. Coarse in feature and dark in tint, they cannot be distinguished from the lowest class of freemen, while their dress is indistinctive. They are of two classes — household slaves, who are treated not unkindly ; and artisan slaves, who are the skilled handi- craftsmen— carvers, blacksmiths, bootmakers, and so forth ; many of the musicians are also slaves. They live in a particular portion of a village, and were considered to a certain extent unclean, and might not approach closely to certain sacred spots. All slaves seem to wear the Siah-Posh dress, eveu when they own as masters the feeble Presungal folk.

Women. — Little respect is shown to women, except in particular oases to a few of advanced years. Usually they are mistresses and slaves, saleable chattels and field-workers. Degraded, immoral, overworked, and carelessly fed, they are also as a rule unpleasant to the sight. Little girls are sometimes quite beautiful, but rough usage and exposure to all weathers soon make their complexions coarse and dark. They are invariably dirty and uncombed. In comparison with the men they are somewhat short. Physically they are capable of enormous labour, and are very enduring. All the field work falls to them, as well as all kinds of inferior occu- pations, such as load-carrying. They have no rights as against their husbands or, failing them, their male relations. They cannot inherit or possess property.

Language. — There are certainly three tongues spoken, besides many dialects, that used by the Siah-Posh being of course the most common ; and although it has many dialects, the employers of one seem to understand all

the others. It is a Prakritic lan- guage. Of the remaining two, the Wai and the Presun have no similarity ; they are also unlike the Siah-Posh. Kafirs themselves maintain that very young children from any valley can acquire the Wai speech, but that only those born in the Presungal can ever converse in that language, even roughly. To European ears it is disconcertingly difficult, and it is perhaps impossible to learn.

Beligion. — All the Kafirs were idolaters of a rather low type. There were lingering traces of ancestor-worship, and perhaps of fire- worship also. The gods were numerous ; tribal, family, household deities had to be propitiated, and mischievous spirits and fairies haunted forests, rivers, vales, and great stones. Imra was the Creator, and all the other supernatural powers were subordinate to him. Of the inferior gods, Moni seemed to be the most ancient ; but Gish, the war-god, was by far the most popular. It was his

worship, doubtless, which kept the Kafirs so long independent. In life as a hero, and after death as a god, he symbolized hatred to the religion of Mahommed. Every village revered his shrine ; some possessed two. Imra, GIsh, and Moni were honoured with sepa- rate little temples, as was usually Dizani goddess ; but three or four of the others would share one between them, each looking out of a small separate square window. The worshipped object was either alarge fragment of stone or an image of wood oonventionallycarved, with round white stones for eyes. Different animals were sacrificed at difierent shrines : cows to Imra, male goats and bulls to Gfeh, sheep to the god of wealth ; but goats were generally acceptable, and were also slain ceremonially to discover a complaisant god, to solemnize a vow, to end a quarrel, to ratify brotherhood. The min- isters of religion were a hereditary priest, a well-bom chanter of praise, and a buffoon of low station, who was supposed to become inspired at each sacrifice, and to have the power of seeing fairies and other spirits whenever they were near, also of understanding their wishes. The blood of the offering, together with flour, wine, and butter, was cast on the shrine after the animal and the other gifts had been sanctified with water sprinkled by the officiating priests, while he cried “Such, such!” (“Be pure I”). Dense clouds of smoke from burning juniper-cedar, which crackled and gave forth pungent incense, added to the spectacle, which was dig- nified by the bearing of the officials and solemnized by the devout responses of the congregation. There was no

human sacrifice ex- cept when a prisoner of war, after a solemn service at a shrine, was taken away and stabbed before the wooden tomb of some unavenged headman. Kafirs believed in a kind of Hell where wicked people burned ; but the Hereafter was an underground region entered by a guarded aperture, and inhabited by the shapes which men see in dreams. Suicide was as unknown as fear of dying. Melancholy afflicted only the sick and the bereaved. Religious traditions, mir- acles, and anecdotes were puerile, and pointed no social lesson or any religious law. Music, dancing, and songs of praise were accep- table to the gods, and every village (grom) had its dancing platform and dancing house (grom ma") , furnished with a simple altar. No prayers were offered, only invocations, exhortative or remonstrant. Tribal Organization. — The great majority of the tribes were made up of clans. A person's importance was derived chiefly from the wealth of his family and the number of male adults which it con- tained. The power of a family, as shown by the number and quality of its fighting men as well as by the strength of its f oUoweis, was the index of that family's influence. Weak clans and detached families, of poor but free households, carried their independence modestly. The lowest clan above the slaves sought service with their wealthier tribesmen as henchmen and armed shepherds. By intricate cere- monial, associated with complicated duties, social and religious, which extended over two years, punctuated at intervals by pro- digious compulsory banquets, rich men could become elders or jast. Still further outlay and ostentation enabled the few who could sustain the cost to rank still higher as chief or Mir. Theo- retically, all the important and outside affairs of the tribe were managed by the jast in council ; actually they were controlled by two or three of the most respected of that class. Very serious questions which inflamed the minds of the people would be de- bated in informal parliaments of the whole tribe. Kafirs have a remarkable fondness for discussing in conclave. Orators, conse- quently, are influential. The internal business of a tribe was managed by an elected magistrate with twelve assistants. It was their duty to see that the customs of the people were respected ; that the proper seasons for gathering fruit were rigidly observed. They regulated the irrigation of the fields, moderating the incessant quarrels which originated in the competition for the water ; and they kept the channels in good repair. Their chief, helped by contributions in kind from all householders, entertained tribal guests. He also saw that the weekly Kafir Sabbath, from the sowing to the carrying of

the crops, was carefully observed, the fires kept burning, and the dancers collected and encouraged. Opposition to these annual magistrates or infraction of tribal laws was punished by fines, which were the perquisites and the payment of those officials. Serious offences against the whole people were judged by the community itself ; the sentences ranged as high as expulsion from the settlement, accompanied with the burning of the culprit's house and the spoliation of his goods. In such cases, the fp,mily and the clan refusing to intervene, the offender at once became cowed into submission.

Houses and Villages. — Habitations are generally strong, and built largely of wood. They are frequently two or more storeys high, often with an open gallery at the top. Wealthy owners.were fond of elaborate carving in simple designs and devices. A room is square, with a smoke-hole when possible ; small windows, with shutters and bolts, and heavy doors fastened by a sliding wooden pin, are common. The nature of the ground, its defensible char- acter, the necessity of not encroaching upon the scanty arable land, and such considerations, determine the design of the villages. Specimens of many varieties may be discovered. There is the

shockingly overcrowded oblong kind, fort-shaped, three storeys high, and on a river's bank, which is pierced by an underground way leading to the water. Here all rooms look on to the large central courtyard ; outwards are few or no windows. There is also the tiny hamlet of a few piled-up hovels perched on the flattish top of some huge rock, inaccessible when the ladder connecting it with the neighbouring hillside or leading to the ground is with- drawn. Some villages on mounds are defended at the base by a circular wall strengthened with an entanglementof branches. Others cling to the knife-edged back of some difficult spur. Many are hidden away up side ravines. A few boldly rely upon the numbers of their fighting men, and are unprotected save by watch-towers. While frequently very picturesque at a distance, all are dirty and grimed with smoke ; bones and horns of slaughtered animals litter the ground. The ground floor of a house is usually a winter stable for cows and the latrine, as well as the manure store for the

household ; the middle part contains the family treasures ; on the top is the living-place. In cold valleys, such as the Presungal, the houses are often clustered upon a hillock, and penetrate into the soil to the depth of two or more apartments. Notched poles are the universal ladders and stairways.

Characteristics. — In height Kafirs average about 5 feet 6 inches. They are lean ; always in hard condition ; active jumpers, untiring walkers, expert mountaineers ; exceptionally they are tall and heavy. With chests fairly deep, and muscular, springy legs, there is some lightness and want of power about the shoulder muscles, the arms, and the hand-grasp. In complexion they are purely Eastern. Some tribes, notably the Wai, are fairer than others, but the average colour is that of the natives of the Punjab. Albinos, or red-haired people, number less than \ per cent, of the population. As a rule, the features are well-shaped, especially the nose. The glance is wild and bold, with the wide-lidded, rest- less gaze of the hawk ; or the exact converse — a shifty, furtive peer under lowered brows. This look is rather common amongst the wealthier families and the most famous tribesmen. The shape of a man's head not uncommonly indicates his social rank. Several have the brows of thinkers and men of affairs. The degraded forms are the bird-of-prey type — low, hairy foreheads, hooked noses with receding chin, or the thickened, coarse features of the darker slave class. Intellectually they are of good average power. Their moral characteristics are passionate covetousness, and jealousy so intense that it smothers prudence. Before 13nally destroying, it constantly endangered their wildly cherished independence. Revenge, especially on neighbouring Kafirs, is obtained at any price. Kafirs are subtle, crafty, quick in danger and resolute, as might be expected of people who have been plunderers and assassins for centuries, whose lives were the forfeit of a fault in unflinohingness or of a moment's vacillation. Stealthy daring, bom of wary and healthy nerves and the training of generations, almost transformed into an instinct, is the national characteristic. Ghastly shadows, they flitted in the precincts of hostile villages far distant from their own valleys, living upon the poorest food carried in a fetid goatskin bag ; ever ready to stab in the darkness or to wriggle through apertures, to slay as they slept men, women, and babies. Then, with clothing for prize, and human ears as a trophy, they sped, watchful as hares, for their far-away hills, avenger Pathans racing furiously in their track. Kafirs, most faithful to one another, never abandoned a

comrade. If he were killed, they sought to carry away his head, for funeral observances. As traders, though cunning enough, they are no match for the Afghan. They were more successful as brigands and blackmailers than as skilled thieves. In night robbery and in pilfering they showed little ingenuity. Truth was considered innately dangerous ; but a Kafir is far more trustworthy than his Mahommedan neighbours. Although hospitality is gener- ally viewed as a hopeful investment, it can be calculated on, and is unstinted. Kafirs are capable of strong friendship. They are not cruel, being kind to children and to animals, and protective to the weak and the old. Family ties and the claim of blood even triumph over jealousy and covetousness.

Dress, Weapons, Utensils, &c. — The national attire of the men is a badly-cured goatskin, confine^; at the waist by a leather belt studded with nails, supporting the I-hilted dagger, strong but clumsy, of slave manufacture, sheathed in wood covered with iron or brass, and often prettily ornamented. Women are dressed in a long, very dark tunic of wool, ample below the shoulders, and edged with red. This is fastened at the bosom by an iron pin, a thorn, or a fibula ; it is gathered round the body by a woven band, an inch wide, knotted in front to dangle down in tassels. On this girdle is carried a fantastically-handled knife in a leather covering. The woman’s tunic is sometimes worn by men. As worn by women its shape is something between a long frock-coat and an Inverness cape. Its hue and the blackness of the hairy goatskin give the name of Siah-Posh, ” black-robed,” to the majority of the clans. The other tribes wear such articles of cotton attire as they can obtain by barter, by theft, or by killing beyond the border, for only woollen

cloth is made in the country. Of late years long robes from Chitral and Badakhshan have been imported by the wealthy, as well as the material for loose cotton trousers and wide shirts. Clothing, always hard to obtain, is precious property, lormeriy little girls, the children of slaves, or else poor relations, used to be sold in exchange for clothes and ammunition. Mahommedans eagerly bought the children, which enabled them in one transaction to acquire a female slave and to convert an infidel. Men go bare-headed, which wrinkles them prematurely, or they wear Chitral caps. Certain priests, and others of like degree, wind a strip of cotton cloth round

their brows. Siah-Posh women wear curious horned caps or a small square white head-dress upon informal occa- sions. Females of other tribes bind their heads with turbans orna- mented with shells and other finery. Excellent snow gaiters are m ade of goat's hair for both sexes, and of woollen material for women. Boots, strongly sewn, of soft red leather cannot be used in the snow or when it is wet, because they are imperfectly tanned. For the ceremonial dances all manner of gay-coloured articles of attire, made of cheap silk, cotton velvet, and sham cloth-of-gold, are dis- played, and false jewellery and tawdry ornaments ; but they are not manufactured in the country, but brought from Peshawar by pedlars. Woollen blankets and goat's-hair mats cover the bedsteads — four- legged wooden frames laced across with string or leather thongs. Low square stools, 18 inches broad, made upon the same principle as the bedsteads, are peculiar to the Kafirs and their half-breed neigh- bours of the border. Iron tripod tables, singularly Greek in design, are fashioned in Waigul. A warrior's weapons are a matchlock (rarely a flintlock), a bow and arrows, a spear, and the dagger which he never puts aside day or night. The axes, often carried, are light and weak, and chiefly indicate rank. Clubs, carefully ornamented by carving, are of little use in a quarrel ; their purpose is that of a walking-stick. As they are somewhat long, these walking-clubs have been often supposed to be leaping-poles. Swords are rarely seen, and shields, carried purely for ostentation, seldom. Soft stone is quarried to make large utensils, and great grim chests of wood become grain boxes or coffins indifferently. Prettily carved bowls with handles, or with dummy spouts, hold milk, butter, water, or small quantities of flour. Wine, grain, everything else, is stored or carried in goatskin bags. Musical instruments are represented by reed flageolets, small drums, primitive fiddles, and a kind of harp. Peculiar Customs. — Isolated and at the outskirts of every village is a house used by women when menstruating and for lying-in. Children are named as soon as born. The infant is given to the mother to suckle, while a wise woman rapidly recites the family ancestral names ; the name pronounced at the instant the baby begins to feed is that by which it is thereafter known. Everybody has a double name, the father's being prefixed to that given at birth. Very often the two are the same. There is a special day for the first head-shaving. No hair is allowed on a male's scalp, except from a 4-inch circle at the back of the head, whence long locks hang down straight. Puberty is attained ceremoniously by boys. Girls simply change a

fillet for a cotton cap when nature proclaims womanhood. Marriage is merely the purchase of a wife through intermediaries accompanied by feasting. Divorce is often merely a sale or the sending away of a wife to slave for her parents in shame. Sexual morality is low. Public opinion applauds gallantry, and looks upon adultery as hospitality, provided it is not discovered by the husband. If found out, in flagrante delicto, there is a fiscal fine in cows. There is much collusion to get this penalty paid in poor households. Funeral rites are most elaborate, accord- ing to the rank and warrior fame of the deceased, if a male, and to the wealth and standing of the family, if a woman. Children are simply carried to the cemetery in a blanket, followed by a string of women lamenting. A really great man is mourned over for days with orations, dancing, wine-drinking, and food distribution. Gun- firing gives notice of the procession. After two or three days the corpse is placed in the coffin at a secluded spot, and the observances are continued with a straw figure lashed upon a bed, to be danced about, lamented over, and harangued as before. During regular intervals for business and refreshment old women wail genealogies. A year later, with somewhat similar ritual, a vs'ooden statue is inaugurated preliminary to erection on the roadside or in the village Valhalla. The dead are not buried, but deposited in great boxes collected in an assigned place. Finery is placed with the body, as well as vessels holding water and food. Several corpses may be heaped in one receptacle, which is, rarely, ornamented with flags ; its lid is kept from warping by heavy stones. The wooden statues or effigies are at times sacrificed to when there is sickness, and at one of the many annual festivals food is set before them. Among the Presungal there are none of these images. Blood-feuds within a tribe do not exist. The slayer of his fellow, even by accident, has to pay a heavy compensation or else become an outcast. Several hamlets and at least one village are peopled by families who had thus been driven forth from the community. The stigma attaches itself to children and their marriage connexions. Its outward symbol is an inability to look in the face any of the dead person's

family. This avoidance is ceremonial. In private and after dark all may be good friends after a decorous interval. The compensa- tion is seldom paid,

although payment carries with it much enhance- ment of family dignity. All the laws to punish theft, assault, adultery, and other injury are hased on a system of compensation whenever possible, and of enlisting the whole of the community in all acts of punishment. Kafirs have true conceptions of justice. There is no death penalty ; a fighting male is too valuable a pro- perty of the whole tribe to be so wasted. War begins honourably with proper notice, as a rule, but the murder of an unsuspecting traveller may be the first intimation. Bullets or arrow-heads sent to a tribe or village is the correct announcement of hostilities. The slaying of a tribesman need not in all oases cause a war. Sometimes it may be avoided by the sinning tribe handing over a male to be killed by the injured relations. Ambush, early morning attacks by large numbers, and stealthy killing parties of two or three are the favourite tactics. Peace is made by the sacri- fice of cows handed over by the weaker tribe to be offered up to a special god of the stronger. When both sides have shown equal force and address, the same number of animals are exchanged. Field work falls exclusively to the women. It is poor. The ploughs are light and very shallow. A woman, who only looks as if she were yoked with the ox, keeps the beast in the furrows, while a second holds the handle. All the operations of agriculture are done primitively. Grazing and dairy-farming are the real trade of the Kafirs, the surplus produce being exchanged on the frontier or sold for Kabul rupees. Herders watch their charges fully armed against marauders.

See Robertson. Kafirs of the Hindu-Kush. London, 1896.

(g. S. k.) Kagalnik, a town of south-east Russia, province of Don Cossacks, 27 miles south-west of Rostov. It has important fairs, and trade in horses, cattle, and fish. Kagalnitskiy Jcut is the name given to the north-east littoral of the Sea of Azov, renowned for its fisheries. Population, 14,000.

Kahlur, or Bilaspub, a native state of India, within the Punjab, one of the hill states that came under British protection after the first Sikh war in 1846. It occupies part of the basin of the Sutlej, amid the lower slopes of the Himalaya. Area, 451 square miles. The population in 1881 was 86,546 ; in 1891, 91,760 ; average density, 203 persons per square mile; estimated gross revenue, Rs.l, 67,000 ; tribute, Es.8000 ; military force, 1021. The chief, whose title is raja, is a Chandeli Rajput. The present raja (1902) is

distinguished for his successful administration. The town of Bilaspub is situated in 31° 19′ K. lat., and 76° 50′ E. long., on the left bank of the Sutlej, which is here crossed by a bridge, 1465 feet above the sea.

Kaira, or Kheda, a town and district of British India, in the Gujarat divisioia of Bombay. The town is 20 miles north-west of Ahmedabad, and 5 miles from a railway station. Population (1881), 12,640; (1891), 10,101. There are two printing-presses, each issuing a vernacular newspaper ; a brass foundry ; and a creamery with 36 separators. The district has an area of 1609 square miles. The population in 1881 was 804,800 ; in 1891, 871,589, showing an increase of 8 per cent. ; aver- age density, 542 persons per square mile, being consider- ably the highest in the province. In 1901 the population was 715,726, showing a decrease of 18 per cent., due to the results of famine. The land revenue was Rs.21,39,700, the incidence of assessment being Rs.3:13:6 per acre; cultivated area (1897-98), 639,672 acres, of which 38,011 were irrigated from wells, &c., including 1126 acres from Government canals; number of police, 707; chil- dren at school (1897-98), 29,497, being 3-5 per cent, of the total population; registered death-rate (1897), 28-48 per thousand. The principal crops are cotton, millets, rice, and pulse ; the manufactures are of cotton cloth, calico-printing, dyeing, soap, and glass. The chief centre of trade is Nariad, on the railway, with a cotton mill. The Bombay and Baroda railway runs through the dis- trict for 72 miles. A special article of export is ghi,

or clarified butter. The famine of 1899-1900 was felt more severely here than in any other part of the province, the loss of cattle being specially heavy.

Kaiserslautern, a town of Bavaria, Germany, in the Palatinate, 41 miles by rail west of Mannheim. It has a couple of technical schools, school of architecture, and agricultural school. It has developed considerable industrial activity in cotton spinning and weaving, fac- tories for sewing-machines, brewing, brickworks, railway works, sawmills, iron works and foundries, and the manu- facture of calico and wooden wares. Population (1885),

31,449 ; (1900), 48,306.

Kalach, a Cossack village of south-east Russia, province of the Don, chief river port on the Don, 31 miles north-east of Nijne-Chirskaya, at the place where the Don approaches nearest the Volga. Its permanent population, which numbers but a few thousands, much increases in summer. It is the terminus of the 50-miles railway which connects the Don with Tsaritsyn on the Volga, and all the goods which are brought from the Caspian Sea up the Volga and are destined for middle Russia, or for export through the Sea of Azov, are unloaded at Tsaritsyn and sent over to Kalach on the Don, to be shipped either up or down the Don or to be sent to middle Russia by rail. Large quantities of fish, from the lower Volga, Ural, and Caspian fisheries, are sent on this route. Naphtha, which comes from Baku, is pumped at Tsaritsyn from the ships to cistern-waggons and brought partly to Kalach. Finally, corn and timber, which are shipped down the Volga, are also sent from Tsaritsyn to Kalach to be shipped thence south-westwards. Nearly 460,000 tons reach Kalach to be distributed every year, giving employment to from 150 to 300 vessels ; corn alone represents an item of 370,000 tons.

Kalahandi, or Kaeond, a feudatory state of India, in the Chhattisgarh division of the Central Provinces. Area, 3746 square miles; population (1881), 224,548; (1891), 326,296 ; average density, 87 persons per square mile. In 1901 the population was 336,961, showing an increase of 3 per cent., compared with an apparent in- crease of 46 per cent, in the previous decade. The estimated revenue is Rs. 1,55,000 ; tribute, Rs.12,000. The chief, who is a Rajput, is the only one in the Central Provinces entitled to a salute of 9 guns, which he received at the Delhi durbar in 1877. The present (1901) chief is a minor, and the state is under British administration. The inhabitants mostly belong to the aboriginal race of Kandhs. A murderous outbreak against Hindu settlers called for armed intervention in 1882.

Kalamata, a town in the Morea, Greece, 17 miles west by south of Sparta, in the province of Messenia, about a mile from the sea. The harbour, though recently improved, offers little shelter to shipping. Vessels load and discharge by means of lighters, the outer harbour having a depth at entrance of 24 feet and inside of 14 feet. The inner harbour has a depth of 15 feet, and is sheltered by a breakwater 1640 feet in length. The silk industry, formerly important, still employs about 300 women and girls in four

spinning establishments. Olive oil and silk are the chief exports. Population (1889),

10,696 ; (1896), 14,298.

Kalamazoo, capital of Kalamazoo county, Michi- gan, U.S.A., on the Kalamazoo river, at an altitude of 760 feet. It has a fairly level site and a regular plan, is divided into five wards, and has a good water-supply by the Holly pumping system. The river furnishes water power for manufactures, which in 1890 had a capital of $4,000,000, employed over 6000 hands, and had a product valued at $6,000,000. It is at the intersection of four railways, the

Chicago, Kalamazoo, and Saginaw, the Grand Eapids and Indiana, the Lake Shore and Michigan Southern, and the Michigan Central. Kalamazoo is the seat of Kalamazoo College, a Baptist institution, founded in 1855, which had in 1899 fourteen instructors and 241 students, 94 of whom were women. One of the state insane asylums is located here. Population (1890), 17,853 ; (1900), 24,404, of whom 4710 were foreign-born and 471 negroes.

Kalat (Khalai), capital of Baluchistan, situated in 29° 2′]Sr. and 66° 37′ E., about 6780 feet above sea-level. The word Kalat is derived from kala — a fortress — and Kalat is the most picturesque and most impressive fortress to be found in the Baluch highlands. It crowns a low hill, round the base of which clusters the closely-built mass of fiat-roofed mud houses which form the insignifi- cant town. Kalat as a capital and the residence of the chief of Baluchistan has long been eclipsed in importance by Quetta, about 90 miles to the north, the residence of the agent to the Governor-General of India. There is a popu- lation of 7000 to 8000 people within the town walls of Kalat. The valleys immediately surrounding the prettily situated fortress are well cultivated and thickly inhabited, in spite of their elevation and the extremes of temperature to which they are exposed. Eecent surveys of Baluchistan have determined the position of Khozdar (27° 48′ N., 66° 38′ E.) about 50 miles south of Kalat. Khozdar was the former capital of

Baluchistan, and is as directly con- nected with the southern branches of the Mulla pass as Kalat is with the northern, the Mulla being the ancient trade route to Gandava (Kandabel) and Sind. In spite of the rugged and barren nature of the mountain districts of the Kalat highlands, the main routes through them (con- centrating on Khozdar rather than on Kalat) are compar- atively easy. The old ” Pathan vat,” the trade highway between Kalat and Karachi by the Hab valley, passes through Khozdar. Erom Khozdar another route strikes a little west of south to Wad, and then passes easily into Las Bela. This is the ” Kohan vat.” A third route runs to ISTal, and leads to the head of the Kolwah valley (meet- ing with no great physical obstruction), and then strikes into the open highroad to Persia. Some of the valleys about Kalat (Mastang, for instance) are wide and fertile, full of thriving villages and strikingly picturesque ; and in spite of the great preponderance of mountain wilder- ness (a wilderness which is, however, in many parts well adapted for the pasturage of sheep) existing in the Sar- awan lowlands almost equally with the Jalawan high- lands, it is not difficult to understand the importance which the province of Kalat, anciently called Turan (or Tubar^n), maintained in the eyes of mediaeval Arab geo- graphers (see Baluchistan). New light has been thrown on the history of KaMt by the translation of an unpub- lished manuscript obtained at Tatta by Mr G. P. Tate, of the Indian Survey Department, who has added thereto notes from the Tufhat-ul-Kirdim, for the use of which he was indebted to Khan Sahib Rasul Baksh, mukhtiardar of Tatta. According to these authorities, the family of the khans of Kalat is of Arabic origin, and not, as is usually stated, of Brahuic extraction. They belong to the Ahmadzai branch of the Mirwari clan, which originally emigrated from Oman to the Kolwah valley of Makr^n.

See Mr Tate’s pamphlet, published in Calcutta in 1890.

(t. h. h*.)

Kalgoorlie, a thriving town of West Australia, 24 miles east-north-east of Coolgardie by rail. Good water was struck in 1896. The gold-field here is a rich one, supporting about 16,000 miners. Population, 6583.

Kalisz, a government of Russian Poland, having Prussia on the W. and N.W., and the governments of

Warsaw and Piotrkdw on the E. and S. Its area occupies 4392 square miles. Its surface is a lowland, sloping to- wards the west, and is watered by the Prosnaandthe Warta and their numerous small tributaries, as also the Bzura. It was formerly covered with countless small lakes and thick forests, now mostly destroyed. Many, small lakes and large marshes exist still. Its population was 846,719 in 1897 (427,978 women), of whom 113,609 lived m towns. They are chiefly Poles. The vast majority of the people are Roman Catholics, but the Jews and Protestants each number some 80,000. The land is divided among 80,000 owners (including 142 village communities), the subdivision of land rapidly progressing, and its market value growing steadily. In 1900, 109,100 acres were under crops, and 230,000 under forests. Agriculture is carried on to perfection on a number of estates, as also cattle-breeding. There were in 1897, 92,098 horses, 261,046 horned cattle, and over 1,104,000 sheep, out of which about 600,000 were of finer breeds. A variety of domestic trades, including the weaving of linen and wools, is carried on in the villages. There are various factories, the joint output of which is valued at two millions sterling. The government is divided into eight districts, the chief towns of which are : Kalisz (21,680 inhabitants). Koto (9400), Konin (8530), Leczica (8863), STupec (3758), Sieradz (7019), Turek (8141), and Velun

(7442).

Kalisz, chief town of the above province, situated in the low valley of the Prosna, 148 miles west-south-west of Warsaw, near the Prussian frontier. Population (1897), 21,680, of whom 48 per cent, were Catholics, 37 per cent. Jews, and 11 per cent. Protes- tants. Several factories (sugar, woollen cloth, woollens, ribbons, &c.), with an aggregate return of £300,000 are situated in the town and its suburbs.

Kalitvenskaya, a Cossack village of Russia, pro- vince of the Don, 7 miles east-south-east of Kamenskaya, on a tributary of the Donets. Good sandstone is extracted in considerable quantities. Population, 20,025.

Kalk, a town of Prussia, in the Rhine province, 2 miles east of Cologne. It has various iron and chemical industries, brickworks, and breweries. Population (1885),

11,418; (1900), 20,581.

Kalmyk, or Kalmuck Steppe, a territory or reserva- tion belongingto the Kalmyks, having a quadrilateral shape and limited by the Volga on the N.E., and the Manych (West Caucasia) on the S. W., the Caspian Sea on the S.E., and the province of the Don Cossacks on the N.W. Its area covers 36,900 square miles, to which a second reservation (1,955,000 acres), on the left bank of the lower Volga, must be added. According to Mushketoff, the Kalmyk Steppe must be divided into two parts, western and east- ern. The former, occupied by the Ergheni Hills, is a deeply ravined plain, 300 and occasionally 630 feet above the sea. It is built up of Tertiary deposits, of the Sarma- tian division of the Miocene period, covered with loess and black earth, and its escarpments represent the old shore- line of the Caspian. No Caspian deposits are found on or within the Ergheni Hills. The flora of these hills is the usual black earth flora, and they have a settled population. The eastern part is a low plain lying for the most part from 30 to 40 feet below the level of the sea, gently sloping from Sarepta to the Volga. Post-Pliocene ” Aral-Caspian de- posits,” containing the usual fossils {Hydrohia. Xeritina, eightspecies of Cardium, two of Dreifmcna, three otAdacna and Lithogh/phiisvasjiius), attain varying thicknesses from 105 feet to 7 or 10 feet, and disappear in places. Lacvistriue and fluviatile deposits are found mixed with the above. Large tracts of moving sands are spread about Enotaevsk, where high dunes or barkhans have been formed. A narrow tract of land along the north-west coast of the Caspian,

described as mochaghi by the Russians, and known in geography as the ” hillocks of Baer,” is covered with hillocks elongated from west to east, perpendicularly to the coast-line, the spaces between these mounds being filled with water or covered with thickets of rushes, as well as with thickets of Salix, Ulmus campestris, almond trees, &c. Quite an archipelago of little islands is formed close to the littoral by these mounds, which have on the north and north-west a succession of salt lakes partly desiccated. Small streams originate in the Erghenis, but are lost as soon as they reach the low laud, where water can only be obtained from wells, while the scanty

vegetation becomes a mixture of the flora of south-east Russia and of the deserts of Central Asia. The steppe is divided into eight uluses, and has a total population of 27,713 Mbitkas, or felt tents, and 109,620 souls. There are no less than 62 Buddhist monasteries and 965 lamas for that population. Part of the Kalmyks are settled (chiefly in the hilly parts), the remainder being nomads. They have over 60,000 horses, 180,000 cattle, and half a million sheep, but suffer heavy losses from murrain. Some attempts at agriculture and tree-planting on a small scale are being made. Cattle-breeding, fishing, and some domestic trades, chiefly carried on by women, are the main sources of living. The steppe is intersected in all directions by paths, and communication is everywhere easy.

Prof. MuSHKETOFF. Geol. Sesearches in the Kalmyk Steppe in 1884-85. St Pet., 1894 (Russian).— Kostenkoff's works (1868- 70) ; and a great number of earlier works enumerated in P. Seme- noff's Geogr. Dictionary and Buss. Encycl. Diet. (p. a. k.)

Kalnoky, Custav, Count (1832-1898), Austrian statesman, was born at Lettowitz, in Moravia, of an old Transyjvanian family. After spending some years in the army, in 1854 he entered the diplomatic service ; was for the ten years 1860 to 1870 secretary of Legation at Lon- don, and then, after serving at Rome and Copenhagen, was in 1880 appointed ambassador at St Petersburg. The ability he showed in this important post, especially, it is said, in the despatches he sent home, attracted the attention of the Emperor, and on the death of Baron v. Haymerle in 1881 he was appointed Minister of Eoreign Affairs for Austria^Hungary, and held this post for four- teen years. Essentially a diplomatist, he took little or no part in the vexed internal affairs of the empire, and he was little heard of in public except at the annual statement on foreign affairs before the Delegations. His management of the affairs of his department was, how- ever, very successful : he confirmed and maintained the alliance with Germany which had been formed by his predecessors, and co-operated with Bismarck in the arrangements by which Italy joined the alliance. Kal- noky's special influence was seen in the improvement of Austrian relations with Russia, which followed the meet- ing at Skiernevice at which he was present, a policy which caused some adverse criticisminHungary. His friendliness for Russia did not, however, prevent him from strengthen- ing the position of

Austria in the Balkan peninsula and establishing a closer political and commercial understand- ing with Servia and Rumania. In 1885 he interfered after the battle of Slivnitza to arrest the advance of the Bulgarians. Though he kept aloof from the Clerical party, Kalnoky was a strong Catholic ; and his sympathy for the difiiculties of the Church caused some adverse comment in Italy, when, in 1891, he stated in a speech that the question of the position of the Pope was still quite unsettled. He explained that by this he did not refer to the Roman question, which was of course permanently settled, but to the possibility of the Pope leaving Rome. It was the jealousy felt in Hungary against the TJltramontanes which led to his fall. In 1896 a case of clerical aggression by

Agliardi, the Nuncio in Hungary, aroused a strong pro- test in the Hungarian parliament, and Banffy, the Hun- garian minister, expressed himself in such a way as to trespass on the functions of the foreign minister. Kal- noky therefore ofiiered his resignation, which, after some delay, the Emperor was obliged to accept. He died on the 13th of February 1898.

Kalpi, or Calpbe, a town of British India, in the Jalaun district of the North-West Provinces, on the right bank of the Jumna, 45 miles south-west of Cawnpore. Population (1891), 12,713 ; municipal income (1897-98), Rs.14,368. It is still a centre of local trade, with a sta- tion on the Indian Midland railway from Jhansi to Cawnpore, which here crosses the Jumna. There are manufactures of sugar and paper, and a municipal school.

Kaluga, a province of middle Russia, with an area of 11,942 square miles. Its surface is an undulating plain, 800 to 900 feet in its highest parts in the south-west, and deeply ravined, especially in the north-east. It is built up mainly of Carboniferous deposits — upper, middle, and lower (coal-bearing), with patches of the soft Jurassic clays and lime- stones which formerly covered them. Cretaceous deposits (phosphorites) occur in the south-west, and Devonian lime- stones and shales creep out in the south-east. It is covered with a thick layer of boulder clay in the north, with vast ridges and fields of boulders brought by the ice-sheet from Finland and Olonets ; large areas are strewn with flint boulders in its middle parts, and patches of loess are seen farther south. Iron ores are the chief mineral wealth, 30,000 tons of cast-iron being obtained, and nearly 40,000 persons

being engaged in mining. Beds of coal are known in several places, and some of them are worked. Fireclay, chinarclay, chalk, grindstone, pure quartz sand (for glass), phosphorite, and copper are also extracted. Forests cover 19 per cent, of the surface, but are distributed very unequally, chiefly in the south. The soil, which is rather unfertile, is not very suitable for agriculture, and owing to a rather dense population, considerable numbers of the inhabitants find occupation in industry, or as carriers and carpenters who work for one half of the year at the Black Sea ports.

The population ‘(1,025,705 in 1860) was 1,185,726 in 1897, nearly all Great Russians. There are 116 women to 100 men, 94,853 living in towns. Of the 7,663,000 acres of available land, 4,072,700 acres were owned by the peasant communities, 2,993,300 acres by private owners, and 249,500 by the Crown. The chief crops are rye, oats, barley, sarrazin, and potatoes. Hemp is grown for local use and export. There were in 1892, 417 factories, employing 14,520 persons, and showing an annual output valued at about 16,500,000 roubles. The chief items of industry are dis- tilleries, iron works, woollen cloth, cottons, paper, matches, leather, china, steam flour-mills, and oil works. Large quantities of all sorts of wooden goods are fabricated in the villages of the south. A considerable trade is carried on in hemp, hempseed, and hemp- seed oil, corn and hides ; and iron, machinery, leather, glass, chemi- cals, and linen are exported. The schools are very insufficient (853), and there were in them 38,325 boys and only 9590 girls. Owing to the great number of Nonconformists, many children are taught in private peasant schools. The province is divided into 11 districts: Kaluga, Borovsk (8407 inhabitants), Kozelsk (5908), Likh-vin (1776) , Maloyaroslavets (2500) , Medyil (4392) , Meshohovsk (3667), Mosalsk (2652), Peremyshl (3956), Tarusa (1989), and Zhizdra (5996) . Several villages, such as Ludinovo, Polotnyanyi Zavod, and several others, are more populous than the above towns. Kaluga, the capital, is situated on the Oka, 149 miles south-west of Moscow, and is connected by rail with Vyazma (103 miles) and Tula (81 miles). Population (1862), 37,918 ; (1897), 49,728.

KaTusz, a district town and trading centre in south- eastern Galicia, Austria, on the Lomnicza, a tributary of the Dniester. It has large salt works, and a considerable timber, corn, and cattle trade. Population (1890); 7626 ;

(1900), 7821.

Kamchatka, a large peninsula of north-east Asia, in the northern Pacific, stretching from the Land of the

CliukcMs in a southern direction for 860 miles, with a width of from 70 to 250 miles (51° to 60° N., and 156° to 164° 20′ E.), between the Sea of Okhotsk and Bering Sea, forming part of the Russian Maritime Province (Primor- skaya Ohlasf), with an area of 104,260 square miles.

The orography is not yet fully known, but the ridge which is drawn on many maps, from the Land of the Chukchis to the south- ern extremity of the peninsula, does not exist. From 59° 40′ N. to 62° N. the isthmus which connects the peninsula with the mainland is a flat tundra, gently sloping both ways (Ditmar, Bogdanovioh, Kennan). As to the ridge, which Ditmar called central, it seems to be interrupted under 57° N. by a deep indentation corresponding to the valley of the Tighil, where the hydrographical net, as well as the south-west to north-east stretching of the olay-slates and Metamorphic schists on Ditmar’s map, seems rather to indicate the existence of two chains running south-west to north-east, parallel to the volcanic chain of south-east Kamchatka. Glaciers were not known till the year 1899, when they were discovered by an expedi- tion on the Byelaya and Ushkinskaya mountains. They are small, but formerly had a much greater extension. Thick Tertiary deposits, probably Miocene, cover the middle portions of the west coast. The southern parts of the central ridge are composed of granites, syenites, porphyries, and crystalline slates, while in the north of Ichinskaya volcano, which is the highest summit of the peninsula (16,920 feet), the mountains consist chiefly of Tertiary sandstones and old volcanic rooks. Coal-bearing clays, containing fresh-water molluscs and dicotyledonous plants, as also conglomerates, alternate with the sandstones in these Tertiary deposits. Amber is also found in them. Very extensive layers of melaphyre and andesite, as also of conglomerates and

volcanic tuffs, cover the middle portions of the peninsula. The south-eastern portion is occupied by a range of volcanoes, both active and extinct, running south-west to north- east along the indented coast, from Cape Lopatka to Cape Kronotskiy (54° 25′ N.), and separated from the rest of the peninsula by the valleys of the Bystraya (west coast) and the Kamchatka river. Another chain of volcanoes runs from Ichinskaya (which burst into activity several times in the 18th and 19th centuries) to Shiveluch, seemingly parallel to the above, but to the north of it. The two chains contain twelve active and twenty-six extinct volcanoes, from 7000 to more than 15,000 feet high. The highest volcanoes are grouped under the 56th degree of latitude, and the highest of them, Kluchevskaya (16,032 or 16,500 feet), is in a state of almost continuous activity, a. flow of its lava having reached to Kamchatka river in 1863. The active Shiveluch (9898 feet) is the last volcano of this row. Several lakes and probably Avacha Bay are old craters. Copper, mercury, and iron ores, as also pure copper, ochre, and sulphur, are found in the peninsula. The main river is the Kamchatka (about 325 miles long), which flows first north-eastwards in a fertile longitudinal valley, and then, bending suddenly to the east, pierces the above-mentioned volcanic ridge. The other rivers are the Tighil (135 miles) and the Bolstraya (120 miles), both flowing into the Sea of Okhotsk ; the Avacha, flowing into the Pacific ; and the Zhupanova. The floating ice which accu- ■mulates in the northern parts of the Sea of Okhotsk and the cold current which flows along the east coast of the peninsula render its summers cold, but the winter is relatively warm, and temperatures below —40° Fahr. are only found in the highlands of the interior and on the Okhotsk littoral. The average temperatures at Petro- pavlovsk (53° N.) are : year 36° Tahr., January 17°, July 58° ; while in the valley of the Kamchatka the average temperature of the winter is 16°, and of the summer as high as 58° and 64°. The rains and snow are copious, and dense fogs clothe the coast in summer ; conse- quently the mountains are well covered with wood and the meadows with grasses, except in the tundras of the north. The coasts are rich in Delphinopterus leucus, Otaria Stelleri, and walrus. The sea-otter (JSnhydris marina) has been destroyed. The population, which numbered 7331 in 1853 and 5810 in 1870, was 7199 in 1888. The southern part of the peninsula is occupied by Kamchadales, who have many features of the Mongolian race, but are more similar to the aborigines of north-east Asia and north-west America. Dr Dybowski found them rather good-looking, and with less flat

faces and less prominent cheek-bones than Siberian aborigines. Steller and Krasheninnikoff, who visited Kamchatka in the 18th century, found the Kamchadales still in the mode of life of the Stone Age. They have since taken to the Uussian mode of living. Fishing (quantities of salmon enter the rivers) and hunting are their chief occupation. The efforts of the Government to introduce cattle-breeding have failed, there being in 1889 only 055 horses, 18-‘<2 cattle, and 43,300 reindeer. Beyond the 57th degree the peninsula is peopled with Koryaks, settled and nomads, and Lamuts or Tunguses, who came from the west coast of the Sea of Okhotsk. The chief Russian settlements are : I'l'lropavlovsk, on the east coast, on Avacha Bay (53° N. and 158° 44′ E.), excellent roadstead ; Verkhne-Kamohatsk and Nijne-Kamchatsk, in the

valley of the Kamchatka river ; Bolsheryetsk, on the Bolstraya ; and Tighil. All goods, except rye, flour, and tobacco, are imported from San Francisco. The trade is nearly all by barter.

LiTERATUKE. — See, besides the works mentioned in the earlier volumes C von Ditmar’s ” Reisen und Aufenthalt in Kamchatka in den’ j’ahren 1851-1855,” in Beitrage zur Kenntniss des Bussischen Beichs, 3te Folge, Bd. vii.— K. Diener, in Petermann’s Mitteilungen, 1891, Bd. xxxvii.— Obkuohefi?, in Izvestia ot the East Siberian Geographical Society, vol. xxiu. pp. 4, 5, 1892.— GuiLLEMAN. Oridsfi of the ” Marchesa.” (p. A. K.)

Kamenets Podolsk, a town of south-west Eussia, chief town of the government of Podolia, 876 miles south- west of Moscow, near the Austrian frontier, 3 miles from the railway terminus of the south-western railways. - A.n interesting archaeological museum for church antiquities was founded in 1890. Population (1863), 20,699 ; (1897),

34,383.

Kamenskaya, a district town of Eussia, province of the Don, on the northern Donets, 66 miles by rail north of ISTovocherkassk. It is one of the richest places in the province, owing to the neighbouring coal mines, and has also tanneries and oil works, as well as trade in cattle and grain. Population (1897), 23,576.

Kamerun. See Cameroon.

Kampti, or Kamthi, a town of British India, in the Nagpur district of the Central Provinces, just below the coniauence of the Kanhan with the rivers Pench and Kolar ; 1019 feet above the sea ; 8 miles north-east of ISTagpur by rail Population (1881), 50,987; (1891), 43,159. Kampti is well laid out with wide roads, gardens, and tanks. It is the headquarters of a military district, though the garrison is now much reduced, consisting of a battery of artillery, a European and a Madras native infantry regi- ment. It is an important centre of trade, especially since the opening of the Bengal-Nagpur railway, which here crosses the Kanhan river by a fine iron-girder bridge. There are two steam factories for ginning and pressing cotton. The Eoman Catholic convent school had 11 boys and 125 girls in 1896-97.

Kamrup, a district of British India, in the Brahma- putra valley division of Assam. The headquarters are at Gauhati, the former capital. Area, 3660 square miles ; in 1881 the population was 644,960 ; in 1891, 634,249, showing a small decrease ; average density, 173 persons per square mile, being the highest in the Brahmaputra valley. Classified according to religion, Hindus numbered 445,377; Mahommedans, 55,350; hill tribes, 131,759; Christians, 948, of whom 42 were Europeans ; ” others,” 815. In 1901 the population was 589,303, showing a further decrease of 7 per cent., which may be ascribed to the prevalence of a malignant type of fever. The land revenue was Es.13,88,194, the incidence of assessment being Es.2:8:2 per acre; number of police, 304; number of boys at school (1896-97), 12,185, being 25-3 per cent, of the male population of school-going age ; registered death- rate (1897), 46-19 per thousand. In 1897 the number of tea gardens was 31, with 5873 acres under tea, employing 3959 persons, of whom 1211 were children, and producing an out-turn of 7.’>3,228 lb, or at the rate of 132 lb per acre. A section of the Assam-Bengal railway, which will ulti- mately be continued across the hills, starts from G-auhati. In 1896 about 75 miles of this section were open, but had to be closed owing to the damage caused by the earthquake of 12th June 1897, which was estimated at Es.6,55,000. In 1899 it was reopened to a farther length of 93 miles in nil. A metalled road runs due south from Gauhati to Shillong (63 miles), which was also seriously damaged by the earthquake. -A. ferry across the Brahmaputra at Gauhati is worked by a Government steamer.

Kamyshin, a district town of Eussia, government and 120 miles south-south-west of Saratoii, on the right

bank of the Volga. Being the terminus of the railway to Tamboff, Moscow, and the Baltic ports, it is an im- portant port for the export of corn and salt from the Volga, and imports timber and wooden goods. Popula- tion (1861), 8644 ; (1897), 15,934.

Kanara, or Canaba, the name of two districts of British India — North Kanara attached to Bombay, South Kanara to Madras. North Kanaka district forms part of the Konkan division of Bombay. The administrative headquarters are at Karwar, which is also the chief sear port. Area, 3910 square miles ; population (1881), 421,- 840 ; (1891), 446,351, showing an increase of nearly 6 per cent. ; average density, 114 persons per square mile, being the lowest in the Presidfency. In 1901 the popula- tion was 454,238, showing a further increase of 2 per cent. The land revenue and rates were Rs.11,08,400, the incidence of assessment being nearly Ks.3 per acre ; number of police, 702; children at school, 11,358, being 2-6 per cent, of the population ; death-rate (1897), 36 per thousand. The Bombay survey tenure has not been fully extended to North Kanara, so that agricultural statistics are not available. Forests cover no less than 3794 square miles. The trade of the interior, which used to pass down to the seaports, has now been largely diverted by the opening of the Southern Mahratta rail- way. South Kanaka district has its headquarters at Mangalore. Area, 3902 square miles ; population (1881), 959,514; (1891), 1,066,081, showing an increase of 10 per cent. ; average density, 271 persons per square mile. In 1901 the population was 1,134,624, showing a further increase of 7 per cent. The land revenue and rates (1897-98) were Es.15,27,035, the rate of assessment being nearly Iis.3 per acre ; number of police, 609 ; chil- dren at school (1896-97), 27,010, being 1 in 39 of the total population; death-rate (1897), 28 per thousand. The one staple crop is rice. The Madras rayatwari system has not been extended to South Kanara, where land is treated as private property, subject to a traditional assessment. Tiles are manufactured in several places out of a fine potter’s clay. In 1897-98 the total sea- borne

trade was valued at E,s.l,77,04,146, of which nearly one-third was with foreign countries.

Kandahar. — Since the withdrawal of the British army of occupation from southern Afghanistan, at the close of the Afghan war of 1878-80, no important infor- mation (other than that which is supplied by a native agent to the Indian political department) has been gathered about Kandahar. The close of the Russo- Afghan Boundary Commission in 1887 afforded an oppor- tunity for surveying the country bordering the Helmund which lies beyond Kandahar, on the road to Parah and Herat. This district, known as Zamindawar, is very highly cultivated and thickly populated, and it is here that the most turbulent and most fanatical of Afghan tribesfolk (Achakzais and Nurzais of the Durani clans) are mostly gathered. To the south those routes which connect the city with the coast of southern Baluchistan and Karachi have been carefully surveyed, but of the city itself nothing more is known than has already been included in the description given of it in the earlier volumes of this work. Trade statistics of late years show a gradual increase of exports to India from Kanda- har and the countries adjacent thereto, but a curious falling-off in imports. The exports in 1899-1900 amounted to about Es.43,24,772 in value, but the im- ports, Rs. 28,18,412, contrasted unfavourably with those of 1894-95. The short-sighted policy of the Amir Abdur Rahman in discouraging imports doubtless affected the balance, nor did his affectation of ignoring the railway between New Chaman and Kila Abdulla (on the Peishin

side of the Kojak) conduce to the improvement of trade. (t. h. h*.)

Kandy, a town near the centre of Ceylon, 75 miles from Colombo by rail. It has been greatly improved. Governor Sir William Gregory did much to restore the ancient Kandy decorations, while the Victoria Jubilee Commemoration Building, including ” Ferguson Memorial Hall,” and two fine hotels, add to the improvements. The Royal Botanic Gardens are situated at Peradeniya, 3 miles distant. It is a uniquely beautiful, highland, tropical town, full of interesting historical and Buddh- istical associations. A water-supply and electric light- ing are amongst recent introductions. Roman Catholic missions are extensive, and very active in the work of education, for which a large block of buildings has been erected. The

Church of England, Wesleyan, and Baptist missions are also at work. The population of the town in 1900 was 26,117 ; of the district, 375,665. Average annual rainfall is 81 1- inches ; average tempera- ture is 76-3°. There is a branch railway from Kandy, north to Matale, 17 miles.

Kane, a borough of McKean county, Pennsylvania, U.S.A., at the intersection of several railways. It lies in a region of natural gas, oil, and lumber, and contains railway repair shops. Population (1890), 2944 ; (1900), 5296, of whom 971 were foreign-born.

Kangavar, a small district of Persia, situated be- tween Hamadan and Kermanshah, and, being held in fief by the family of a deceased court official, forming a separate government. The district is very fertile and contains 30 villages. Its revenues amount to about £500 per annum, and its chief place is the large village of Kan- gavar, which has a population of about 2500, and is 47 miles from Hamadan on the high-road to Kermanshah.

Kangra, a town and district of British India, in the Jullundur division of the Punjab. The town, sometimes called Nagarkot, is situated in 32° 6′ N. and 76° 18′ E., 2409 feet above the sea. Population (1881), 6387; (1891), 5234 ; municipal income (1897-98), Rs.5670. In 1855 the headquarters of the district were removed to the sanitarium of Dharmsala, where a zenana hospital was opened in 1897. The district of Kangra extends from the Jullundur Doab far into the southern ranges of the Himalaya. Besides some Rajput states, annexed after the Sikh wars, it includes Lahul, Spiti, and Kulu, which are essentially Tibetan. Area, 9674 square miles, of which Kangra proper has only 2725. Population (1881), 730,845; (1891), 763,030; average density, 80 persons per square mile, ranging from 224 in Kangra proper to only one person per square mile in Spiti. In 1901 the population was 768,382, showing an increase of less than 1 per cent. The land revenue and rates were Es.9,17,049, the incidence of assessment being R.l : 1 : 11 per acre ; cultivated area (1896-97), 602,867 acres, of which 173,037 were irrigated from private canals ; num- ber of police, 427; number of schools (1896-97), 88, with 3619 pupils, the proportion of boys at school to the male population of school-going age being 6-9 per cent. ; regis- tered death-rate (1897), 28-6 per thousand. Tea cultiva- tion was introduced into Kangra

about 1850, and has been adopted by the natives. There are also several English planters. The total area under tea is about 10,000 acres, with a yearly out-turn of about 2,300,000 ft. There are a printing-press and a brewery at Dharmsala. There is no railway in the district, nor are there any metalled roads.

Kankakee, capital of Kankakee county, Illinois, U.S.A., on the Kankakee river, at an altitude of 627

feet. It is at the intersection of the Cleveland, Cincinnati, Chicago and St Louis, the Illinois Central, and the Indiana, Illinois, and Iowa railways. It has a level site on the prairie and a regular plan. It contains a state insane asylum. Population (1890), 9025; (1900), 13,595, of whom 3346 were foreign-born and 176 negroes.

Kano. See Hausa.

Kansas, the central commonwealth of the American Union, bounded on the IsT. by Nebraska, on the E. by Missouri, on the S. by Oklahoma and Indian Territory, on the W. by Colorado. It is commonly known as the Sunflower State. The eastern third of the state is heavily timbered along the streams, and the forest area increased rather than diminished during the last quarter of the 19th century, in consequence of the settling of the country, which put a stop to prairie fires. The rainfall is ample, and general crop failures are unknown. The western third of the state is in the semi-arid region, with insuffi- cient rain and without forests. The prevalent natural vegetation is buffalo grass, cactus, and yucca. Alfalfa, Kaffre corn, and other drought-resisting plants are grown, and cattle raising and fattening have become the most profitable industries. The central third of the state is intermediate in character between the eastern and western sections. The annual rainfall of the eastern section is 35 inches ; of the central section, 25 inches ; of the west- ern section, 15 inches.

Population. — According to the census of 1880, the population was 99-5,966 ; in 1890 it was 1,427,096, and in 1900 it was 1,470,495. There was a steady increase from 1880 until 1888, when it reached 1,518,552. The opening of Oklahoma for settlement in 1889 withdrew at least 50,000 people, and this, combined with unsettled political conditions, produced a reduction to 1,334,734 in 1895. During each year since 1895 there was a gradual gain, until in 1899 the population reached 1,425,119, and in 1900 was 1,470,495. The net increase from 1880 to 1890 was 43-3 per cent., and from 1890 to 1900, 3 per cent. The population of the eleven largest towns in 1900 was as follows : Kansas City, 51,418 ; Topeka, 33,608; Wichita, 24,671 ; Leavenworth, 20,735; Atchison, 15,722 ; Lawrence, 10,862 ; Fort Scott, 10,322 ; Galena, 10,155 ; Pittsburg, 10,112; Hutchinson, 9379; Emporia, 8223. Of the population of Kansas in 1900, 768,716 (52-3 per cent.) were males and 701,779 were females ; 1,343,810 were native-bom and 126,685 (8-6 per cent.) were foreign-born. The total white population was 1,416,319 ; the total coloured population was 54,176, of whom 52,003 were negroes, 4 Japanese, 39 Chinese, and 2130 Indians.

Education. — The total amount expended for common school purposes in Kansas in 1899 exceeded $4,000,000 ; the number of children of school age was 496,000 ; the number of pupils enrolled was 370,240 ; the average daily attendance was 257,000 ; the number of teachers required was 12,513 ; the average length of the school year was twenty-five weeks ; the average salary of male teachers was $39 per month, of female teachers, $32 ; the total value of common school property was 110,000,000. In 1900 Kansas stood near the head of the list of American states in the small percentage of illiteracy. Out of 413,786 adult males, 14,214, or 3-4 per cent., were illiterate (unable to write) ; the percentage of illiteracy among the native white adult males of native parents was only 1-7. Not a single soldier in the famous 20th Kansas regiment in the Spanish war was unable to write his own name. The state maintains, as a part of her free school system, a well-equipped state university at Lawrence, an Agri- cultural College at Manhattan, and a Normal School at Emporia. The university in 1900 had a faculty of 78 members, an attend- ance of 1150 students, 10 buildings, and an annual maintenance fund of $130,000. The state Agricultural College and the state Normal School had also progressed satisfactorily. In addition

to the state schools, flourishing colleges are supported by the various religious denominations.

Charities. — The following table shows the state charitable and correctional institutions, with the number of inmates, May 1900, and the appropriations for support for 1899 and 1900. In addition to this, 77 counties, with farms for poor, cared for 1595 indigent persons in 1899 at a net cost of $105,440 ; out-door relief given in 100 counties amounted to $344,555. The state voted support for 14 charitable institutions, chiefly hospitals, amount- ing to $19,600 for 1899 and 1900, and reimbursed counties for the support of insane in previous years to the amount of $221,950, besides providing for the expenses of the state Board of Charities

to the amount of $17,000, and for other local boards to the amount of $11,600 for the years named.

Name.

Locality.

Inmates.

Appropriation.

Current Expenses.

Improvements.

Penitentiary .... Industrial Keformatory Industrial School (girls) Reform School (boys) . Insane Asylum . Insane Asylum Blind Asylum Imbecile School . Deaf and Dumb School Soldiers’ Orphans’ Home .

Lansing

Hutchinson

Beloit

Topeka

Topeka

Osawatomie

Kansas City

Winfleld

Olathe

Atchison

9881 220 116 180 850 1080 85 204 250 184

$308,702

115,680

48,820

126,804

287,620

808,198

49,678

88,940

92,180

75,960

$154,000 77,500 25,000 25,000 33,600 50,000

None

40,000 4,000

None

Agriculture.— T:\ie. following table exhibits the quantities and values of farm crops and live-stock products for 1899: —

1899 Quantities. 1899 Values.

42,815,471 bushels $22,016,970

871,542 225,183,4.32 26,046,773 1,754,406 3,352,845 8,268 7,664,405 334,080 37,862

27,650 lb 1,412,941 bushels 34,000 K) 12,250 „ 14,000,705 „

796,320 tons 1,539,193 gallons

Winter wheat

Spring wheat

Corn .

Oats .

Rye .

Barley

Buckwheat

Irish potatoes

Sweet potatoes

Castor beans

Cotton

Flax .

Hemp

Tobacco

Broom corn

Millet 2

Sorghum

Sorghum forage

Milo maize .

Kaffre corn

Jerusalem corn

Forage ^

Animals * .

Poultry and eggs

Wool clip .

Cheese

Butter

Milk sold .

Garden products

Horticultural ^

Woods

Wine .

Honey and Beeswax

Grand total

25,159 tons 2,095,429 „

10,497 „ 2,656,482 „

712,181 ft

1,163,680 „

43,757,767 „

155,778 gallons 760,450 ft

389,441

53,530,576

4,951,636

690,408

781,202

5,874

2,612,340

150,269

34,070

1,383

1,271,647

1,700

1,225

455,023

2,354,348

492,. 541

2,457,304

66,093

5,073,598

25,179

9,278,817

50,533,797

4,241,869

106,827

104,731

5,890.273

648,054

700,745

523,445

125,105

116,834

114,307

8169,747,037

Mineral Products. — Since 1880 extensive mineral deposits have been discovered. A bed of rock-salt underlies nearly the whole of central and western Kansas at depths of from 300 to 1200 feet, varying in thickness from 250 feet in Ellsworth county to up- wards of 400 feet in Harper, Kingman, and Reno counties. The salt mined in 1899 was valued, without cooperage, at $760,200, and the total production since 1880 was valued at $5,538,855. Natural gas, oil, zinc, and lead have been discovered in south-eastern Kansas. In 1899, 63,369 tons of zinc ore, worth $2,321,775, yielded 31,684 tons of metallic zinc, valued at $3,643,729 ; and 13,190 tons of lead ore, worth $337,038, yielded metallic lead of the value of $429,844. The coal produced was valued at $5,124,248, and the total output 1880 to 1899 was valued at $60,209,900. The total value of mineral products in 1899 was $11,894,576, and the grand total value 1880 to 1899 was estimated at $120,053,088.

iifiaways.— There are 29 railways in the state, with a total Kansas mileage of 8777 in 1899, as compared with 3104 in 1880. The most important of these railways and their respective mileage in Kansas are as follows : Atchison, Topeka, and Santa Ff , 2440 miles ; Chicago, Rock Island, and Pacific, 1124 miles ; Union Pa^ ciflc, 480 miles ; Chicago, Burlington, and

Quincy, 259 miles ; St Louis and San Francisco, 269 miles ; Missouri Pacific, 182(! miles ; Kansas City, Fort Scott, and Memphis, 268 miles ; Missouri, Kan- sas, and Texas, 444 miles.

Finance. — Tl\e total assessed valuation of property for the fiscal year 1898-99 was $325,889,744. The total state tax le'y for the same year was 4-^ mills, but the amount of income from this

207 from Oklahoma, 3 Federal civil

Including Hungarian. For slaughter.

8 Grass, alfalfa, and clover c Sold. 6 Marketed.

KANSAS CITY

13

levy was so much in excess of the amount required for the state expenses that the sum of $80,000 was returned to the various counties. The constitution of Kansas forbids the contraction of a state debt in excess of |1 ,000,000. The actual state debt, 30th June 1900, was $692,000.

Banks. — According to the report of the state bank com- missioner of 1898, there were in Kansas 101 national banks, with capital stock paid in of $8,442,100, with individual deposits of $21,243,147, and with average reserve held of 33-69 per cent. There were also 370 state and private banks, with an average invested capital of $7,436,097, with individual deposits of $22,500,000, and a reserve of nearly 50 per cent. \

Religious Sects. — The statistics of religious denominations in Kansas in 1890 were as follows : Number of congregations, 4927 ; number of churches, 2859; seating capacity, 708,134 ; value of church property, $7,452,269 ; communicants, 236,729 ; percentage of communicants to population, 23-58. The following is a tabular exhibit of the different denominations and their statistics : —

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AdventiBts

lOT

25

5,090

$19,650

8,205

Baptists ....

61T

364

96,715

921,958

84,665

Catholics

367

271

55,780

625,661

67,562

“Christians” . . . .

49

8

1,665

8,250

1,676

Congregationallsts

188

152

84,975

485,975

11,945

Disciples of Christ

352

197

65,045

468,975

25,200

Dunkards

91

40

15,185

61,625

4,067

EraDgelical Association

96

60

10,060

85,600

4,459

Friends (8 bodies)

70

56

16,884

84,815

8,267

German Evangelical Synod .

28

19

3,794

87,750

2,058

Lutherans . . . ,

205

147

38,688

418,410

16,262

Latter-Day Saints

25

4

800

8,800

1,072

Mennonites ....

62

81

9,203

45,180

4,620

Methodists

1629

894

219,889

2,280,265

95,781

Presbyterians . . . .

521

859

91,984

1,299,260

31,398

Protestant Episcopal (2 bodies) .

96

48

9,090

816,225

8,693

Eeformed

29

18

8,882

56,400

1,189

United Brethren ....

355

139

86,660

193,970

14,856

Others

129

49

10,466

89,960

4,966

Manufactures. — The following table shows the condition of manufacturing in Kansas in 1890 and 1900 : —

Per cent.

1890.

1900.

of Increase.

Number of establishments

4,471

7,830

75-1

Capital

$43,926,002

$66,827,362

52-1

Average number of wage-

earners.

28,237

35,193

24-6

Total wages

$13,288,175

$16,317,689

22-8

Salaried officials, clerks, fee- Number

4,6061

3,860

16-2 2

Salaries

$3,040,3101

$3,256,086

7-1

Miscellaneous expenses .

$5,853,466

$5,241,450

10-5 2

Cost of materials used .

$78,845,167

$129,485,320

64-2

Value of products, includ-

ing custom work and re-

pairing ….

$110,219,805

$172,129,898

56-2

The most important manufacturing industry in 1900 was slaughtering and meat-packing, with 14 factories, a capital of $16,486,177, an average number of 8117 wage-earners, and products valued at $77,411,883. The flouring and grist-mill industry ranked next, with 533 factories, an average number of 1451 wage- earners, and products valued at $21,926,768.

Politics. — Until 1890 Kansas had always been strongly Re- publican, giving in 1888 a majority of 80,000 for Benjamin Harrison in the Presidential election. But widespread depres- sion on account of short crops

and excessive mortgage indebted- ness gave rise to the People's Party, commonly known as the Populist Party, and in 1890 the Republican state ticket was elected by only a small plurality. In general, the People's Party alone has not been able to carry the state ; but in 1896, by means of a fusion, it elected the state officials and both branches of the legislature, and Bryan Presidential electors. In 1898, with the return of prosperity, the payment of $100,000,000 of mortgage indebtedness, and the decline of the silver issue, the Republicans elected the state ticket.

Liquor Traffic. — The people of Kansas, in November 1880, adopted an amendment to the state constitution forever pro- hibiting the manufacture and sale of intoxicating liquors except

1 Includes proprietors and firm members, with their salaries. 2 Decrease.

for medical, scientific, and mechanical purposes. At every subse- quent session of the legislature the enemies of the prohibitory law attempted to overthrow it, but without avail. The degree of its enforcement has varied from zero to perfection, according to the locality. Being an agricultural state, with no city of more than 50,000 inhabitants, and only eight cities exceeding 10,000, Kansas is favourably conditioned for the enforcement of such a law. According to the Brewers'' Journal, the official organ of the United States Brewers' Association (January 1900), Kansas con- sumes annually an average of 5257 barrels of beer, or only l-30th as much as Nebraska, l-40th as much as Colorado, and l-450th as much as Missouri. (f. h. s.)

Kansas City, capital of Wyandotte county, Kansas, U.S.A., in 39-07° N. and 94-37° W., on the west bank of the Missouri, at the mouth of the Kansas, at an altitude of 760 feet. It is separated from Kansas City, Missouri, only by the state line. It Is the largest city in the state, and is built mainly upon the low, level bottom-land, at the junction of the two rivers, in part spread up on the sur- rounding heights. Its plan is regular ; it is divided into six wards, and its business streets are paved mainly with wood. It contains numerous stockyards, and its chief business is slaughtering and meat-packing. With the exception of Chicago, it is the largest . live-stock market in the world. The census of 1900 showed 492 manu- facturing establishments, with $18,633,475 capital, 10,544 hands, and a product valued at 182,768,943. Of

this $73,205,027 consisted of the product of its slaughtering and meat-packing houses. The city is upon the Union Pacific, the Missouri Pacific, and the Kansas City and North-Westernrailway s. Kansas City University was founded in 1896. In 1899 this had 78 instructors and 213 students, of whom 49 were women. The assessed valuation of real and personal property in 1900, on a basis respectively of about one-third and one-fifth of the full value, was $10,956,263; net debt, $2,392,216; rate of taxation, $50 per $1000. Kansas City was founded in 1886, by the consolidation of Kansas City, Armourdale, Armstrong, and Wyandotte. Population (1890), 38,316 ; (1900), 51,418, 6377 being foreign-born and 6509 negroes.

Kansas City, in Jackson county, Missouri, U.S.A., the second city in size and importance in the state, is situated on the right bank of the Missouri, immediately below the mouth of the Kansas river, in 39° 5′ N. and 94° 38′ W. It lies on the boundary line between Missouri and- Kansas, and adjoins Kansas City, Kansas. The two form a single commercial community with un- divided interests. Kansas City, Missouri, in 1890 had 132,416 inhabitants, and in 1900, 163,752, 18,410 being foreign-born and 17,567 negroes. Out of 53,708 adult males, 2096 were illiterate (unable to write), of whom 1176 were negroes. The two cities cover an area of 40 square miles. Though the cities have separate municipal organizations, the boundary is so little heeded that in many cases houses and factories have been built upon it. Kansas City, Missouri, is built upon an irregular surface with a variation of almost 300 feet in altitude from the heights to the stretches which lie along the rivers, and which are occupied by railroad tracks, wholesale houses, and live-stock yards. As a result of the trend of trade, which makes the commercial territory of most American cities lie to the west of them, it is allied more with Kansas than with Missouri. Its live-stock market is the second largest in the world, receipts in 1901 having amounted to 6,640,000 head of cattle, hogs, and sheep, of which 6,350,000 were slaughtered, in the great packing-houses of the city, and the product distributed throughout the world. It is the largest primary winter wheat market in the United States. Its grain receipts in 1901 were 40 million bushels. It has flour-mills with capacity for 2 million barrels a year. Its sales of agricultural machinery exceed

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those of any other city in the world, and it has a large wholesale trade in groceries, hardware, drugs, dry goods, shoes, shirts, and garments, extending to the Gulf of Mexico and to the Paciiic coast. Twenty-two railways, of sixteen separate systems, have termini in Kansas City. The Con- vention Hall can accommodate 20,000 persons. The city has ten miles of boulevards, and the park system includes 450 acres in the city and 1350 acres lying four miles beyond the city limits. The cost of buildings erected in 1901 was 7 million dollars. The street car systems embrace 140 miles of track, and are worked by electricity and by cable. The deposits in the banks amount to 75 million dollars. The bank clearances in 1901 were 920 million dollars. The annual cost of city government is above 1 million dollars, and the municipal debt (1901) was $3,600,000, including $3,100,000 invested in the waterworks, which the city owns, and which yield a net revenue more than sufficient to pay the interest. (w. k. is.)

Kansk, a district town of Russia, eastern Siberia, government of Yeniseisk, 142 miles by rail east of Krasnoyarsk, on the Kan river and the Siberian highway. Although it is the chief town of a district in which gold is found (in the tributaries of the Kan), the town is slow to develop, as it lies on low ground inundated by the river. Population (1897), 7504.

Kaposvar, a corporate town in the south-western part of Hungary, capital of the county of Somogy. It is a pleasant little town, with a large hospital, county hall, state gymnasium, two secondary schools (burgher schools) for girls, an institute for children of railway employees, a foundling hospital, three military barracks, and school for deaf and dumb children. Among the factories are a sugar refinery, a cement-plate works, and two steam mills. Its industry and commerce, as well as its stock-rearing, are considerable. Population (1890), 12,644 ; (1900), 18,218.

Kapu nda, a town of South Australia, in the county of Light, 48 miles by rail north-north-east of Adelaide. The celebrated copper mines were closed in 1879. The district is a wheat-growing one, and has quarries of fine marble.

Kapurthala, a native state of India, within the Punjab. Area, 598 square miles ; population (1881), 252,617 ; (1891), 299,690, showing an increase of 19 per cent. ; average density, 501 persons per square mile. In 1901 the population was 314,269, showing a further increase of 6 per cent. The estimated gross revenue was Rs.20,00,000 ; tribute, Es.1,31,000; military force (including police) 1773 men. The raja. Sir Jagatjit Sing, K.C.S.I., has more than once visited Europe, and was present at the celebration of Queen Victoria's Diamond Jubilee in London. During the Tirah expedition of 1897-98 the raja's Imperial Service infantry took a prominent part. The territory is crossed by the railway from Jullundur to Amritsar. In 1896-97 the total number of schools was 160, with 3985 pupils, including 214 girls ; the proportion of boys at school was as high as 1 out of every 41 of the total male population. There is one arts college, with 6 students; and four Anglo-vernacular schools, with 944 pupils, of whom 9 passed the matriculation. The town of Kapurthala is situated in 31° 23′ N. and 75° 25′ E., 11 miles from Jullundur. Population, about 15,000.

Karachev, a district tojvn of Russia, government and 56 miles by rail west-north-west of Orel. It is one of the oldest towns of Russia, having been mentioned in the annals since 1146, and has hemp factories and oil works, besides trade in grain, hemp, hempseed, hides, and horses. Population, 15,605.

Karachi, or Kuekachee, a seaport city and district of British India, in the Sind province of Bombay, llie city is at the extreme western end of the Indus delta, 600 miles by sea from Bombay and 820 mUes by rail from Lahore, being the maritime terminus of the ^orth- Western railway. Population (1881), 73,560; (1891)» 106,199, showing an increase of 44 per cent.; (1901), 116,407, showing a further increase of 10 per cent. Karachi practically dates from its occupation by the British in 1839, when it was at once chosen for the seat of government for Sind instead of Haidarabad. The natural harbour formed by Manora Point has been greatly improved by the construction of the N"apier mole from Kiamari island to the mainland, and of a breakwater sea- wards. It can now admit vessels of the largest tonnage, and has excellent railway accommodation. It has been growing yearly in importance as the maritime outlet for the produce of the entire valley of the Indus. It ranks as the fifth port in India, with nearly 7 per cent, of the total

commerce. In 1897-98 the aggregate value of its sea- borne trade amounted to Rs.14,91,31,890, of which Rs.9,63,21,602represented foreign trade and Rs.5,28,10,288 coasting trade. The foreign imports were valued at Rs.6,01,10,718, of which Rs.2,95,97,101 represented imports from the United Kingdom, the other countries next in order being Germany, Austria, Belgium, Mauritius, Persia, Turkey, the Mekr&,n coast and Prance. The number of steamers that entered with cargoes was 111, of 168,154 tons; the number that cleared was 130, of 225,553 tons. The gross amount of import duty collected was Rs.27,05,844. During the ten years from 1888-89 to 1897-98, the total value of private merchandise imported rose from Rs.3,56,29,670 to Rs.4,63,28,110; and the total value of private merchandise exported rose from Rs. 3,81,42, 550 to Rs.4,69,56,210. During the same period the total num- ber of steam and sailing vessels that entered and cleared with cargoes fell from 764 to 727 ; but the tonnage rose from 413,676 to 431,236. The large industries include seven cotton presses, employing about 300 hands ; three ironworks, employing 400 hands ; and six flour-mills. There are also manufactures of cotton-cloth, silk scarves, and carpets. Manora Head contains the lighthouse and the port establishment. The military cantonments, stretch- ing north-east of the city, contain accommodation for a battery and a European regiment. An excellent water- supply is provided lay an underground aqueduct 18 miles in length. The chief educational institutions are the Dayaram Jethmal College, with a law class ; five high schools, of which two are for Europeans ; a convent school for girls, with a training class for mistresses ; and an engineering class. In 1896-97 almost all of these were closed because of the plague, which ravaged the city intermittently for four years. In 1897 the registered death-rate was 70 per 1000 ; and down to July 1898 the total number of deaths from plague was 6800. The expenditure incurred has reduced the municipality almost to a state of bankruptcy. There are thirteen printing- presses, issuing several newspapers in English and the vernaculars. The district of Karachi has an area of 14,182 square miles ; population (1881), 489,496 ; (1891), 560,880, showing an increase of 15 per cent. ; average density, 40 persons per square mile. In 1901 the popula- tion was 607,439, showing an increase of 6 per cent. The land revenue and rates were Rs.15,34,763, the incidence of assessment being R.l per acre ; cultivated area (1897-98), 591,135 acres, of which 439,253 were irrigated, including 191, .^42 from Government canals ; number of police, 1285 ;

children at school (1897-98), 14,677, being 2-9 per cent, of the total population ; registered death-rate (1897), 22 per 1000, showing that the plague was then abnost confined

to the city, though in 1898 it broke out rather severely in the district from April to June. The principal crops are rice, millet, oil-seeds, and wheat. In addition to Karachi, there are seaports at Sirgonda and Keti Bandar, which conduct a considerable coasting trade. Tatta was the old capital of Smd. Kotri is an important railway station on the Indus. The main line of the North- Western railway runs through the district for 230 miles, with 15 stations. From Kotri downwards the line has been doubled to Karachi, and at Kotri a bridge has been constructed across the Indus opposite Haidarabad, to connect with the Rajputana railway' system. (j. s. co.)

Kara-Hissar. — 1. Apiun Kaba-Hissak (q.v.). 2. IcHjE, or IscHA Kara Hissab, the ancient Docimium, a small village about fourteen miles north-east of No. 1. Docimium was a Macedonian colony established on an older site. It was a self-governing municipality, striking its own coins, and stood on the Apamea^Sy nnada-Pessinus road, by which the celebrated marble called Syunadic, Docimian, and Phrygian was conveyed to the coast. The quarries are two and a half miles from the village, and the marble was carried thence direct to Synnada (Chifut Kassaba). Some of the marble has the rich purple veins in which poets saw the blood of Atys. (Ramsay, Hist. Geog. of Asia Minor ; Mubbay, Hbk. to Asia Minor.) 3. Kaba-Hissab Shaeki, i.e., western Kara-Hissar, also called Shabin Kara-Hissar from the " alum " mines in its vicinity, the chief town of a sanjak of the same name in the Sivas vilayet of Asia Minor. The town (the ancient Colonia, Armenian Nikopoli), altitude 4860 feet, is built round the foot of a lofty rock, upon which stand the ruins of the Byzantine castle, Maurocastron. It is con-nected with its port, Kerasund, and with Sivas, Erzingan, and Erzerum, by carriage roads. Its population is 12,000 (Moslems 7500, Christians 4500). In October 1895 there was a massacre of Armenians. Colonia was a fortress of importance during the frontier wars of the later Byzantine Empire.

Karakoram. See Pamies.

Karakorum (Turkish, black stone dibris), the name of two cities in Mongolia. One of these, according to Potanin, was the capital of the Uigur kingdom in the 8th century, and the other was in the 13th century a capital of the steppe monarchy of Mongolia. The same name seems also to have been applied to the Khangai range at the headwaters of the Orkhon. (1) The Uigur Kabakobum, also named Mubalik {bad town), was situated on the left bank of the Orkhon, in the Talal-khain-dala steppe, to the south-east of Ughei-nor. It was deserted after the fall of the Uigur kingdom, and in the 10th century Abaki, the founder of the Kidan kingdom, planted on its ruins a stone bearing a description of his victories. (2) The Mongolian Kabakobum was founded at the birth of the Mongolian monarchy established by Chinghiz Khan. A palace for the khan was built in it by Chinese architects in 1234, and its walls were erected in 1235. Piano Carpini visited it in 1246, Ruysbruk in 1253, and Marco Polo in 1275. Later, the fourth Mongolian king, Khubilai, left Karakorum, in order to reside at Kai-pin-fu, near Peking. When the khan Arik-bog declared himself and Karakorum in- dependent of Khubilai-khan, the latter besieged Kara-korum, took it by famine, and probably laid it waste so thoroughly that the town was afterwards forgotten. The exact sites of the two Mongolian capitals were only established in 1889-91. Yule (The Book of Marco Polo, 1871) was the first to distinguish two cities of this name. The Russian traveller Paderin in 1871 visited the Uigur capital, named now by the Mongols Khara-kherem (black wail), of which only the wall and a tower are in existence,

while the streets and ruins outside the wall are seen at a distance of If miles. As to the site of the Mongolian Karakorum, the natives describe it as the ruins of Keta- khoto. The proper position of the two Karakorums was determined by the expedition of Yadrintseff in 1889, and the two expeditions of the Helsingfors Ugro-Einnish Society (1890) and the Russian Academy of Science, under Dr Radlolf (1891), which were sent out to study Yadrintseff’s discovery. See Works (Trudy) of the OrkJion Expedition. St Petersburg, 1892. (p. a. k.)

Kara-kul, Great and Small, two lakes of Russian Turkestan, Osh district of Fergana, on the Pamir plateau. Great Kararkul, 14 miles long and about 13 miles wide (formerly much larger), is under 39° N., to the south of the trans- Alai range, at an altitude of 13,200 feet ; it is surrounded by high mountains, and is reached from the north through the Kizil-art pass (14,660 feet). Small Kara-kul lies in the north-east Pamir, or Sarykol, to the north-west of the Mustagh-ata peak (26,800 feet), at an altitude of 12,700 feet. A stream of the same name flows through it, and is named Ghoz in its farther course. Kaba-kul is also the name of an oasis on the Trans- caspian railway, formerly flourishing but now nearly buried in sand.

Kara-kum (Black Sands), two plains, partly prairie- like and partly sandy, in Russian Central Asia. One of them occupies a surface of nearly 110,000 square miles, bounded on the N. W. by the Ust-urt plateau, on the E. by the Amu- daria, on the S. by the Turcoman oases, and on the W. nearly reaching the Caspian Sea. Only part of this sur- face is covered with real sand. There are also wide spaces (takyrs), nearly horizontal, covered with clay, upon which water accumulates in the spring ; in the summer they are muddy first, but later quite dry, and merely a few Solaneae and bushes grow on their surface. There are also shors, similar to the above, but covered with salt and gypsum, and adorned only with Solaneae along their borders. The remainder is occupied with sand, which, according to V. Mainoff, takes five different forms : (1) The barkhans, chiefly in the east, which are mounds of loose sand, from 15 to 35 feet high, hoof-shaped, having their gently-sloping convex side turned towards the prevailing winds, and a concave side, 30° to 40° steep, on the opposite slope. They are disposed in groups or chains, and the winds make them slowly progress towards the south and south-east. Some grass (Stipa pennata) and bushes of saksaul (Hal- oxylon ammodendron), and other steppe bushes (Calli- gonum, Halimodendron, Atraphaxis, &c.), cover them. (2) Mounds of sand, of about the same size, but irregular and of a slightly stronger consistence, mostly covered with the, same bushes, and also with Artemisia and Tamarix; they are chiefly met with in the east and south portion of the Kara-kums. (3) A sandy desert, slightly undulating, and covered in the spring with grass and flowers (tulips. Rheum, various umbellifers, &c.), which are soon burned by the sun ; they cover very large spaces in the south-east. (4) Sands disposed in large waves from 50 to 70, and oc- casionally up to 100, feet high, at a distance of from

200 to 400 feet from each other ; they cover the central portion, and their vegetation is about the same as in the preceding division. (6) The dunes on the shores of the Caspian, composed of moving sands, from 35 to 80 feet high and devoid of vegetation.

A typical feature of the Karar-kums is the number of “old beds,” which may have been either beds of branches of the Amu and other rivers, or depressions which contained elongated salt lakes. (See Transcaspian Peovince.) Water is only found in wells, from 1.3 to 20 miles apart — sometimes as much as 100 and 110 miles — which are pierced in the takyrs and give salted water, occasionally unfit to drink, and in kaks or pools of rain-water retained in the lower parts of the takyrs. The population of

the Kara-kums, consisting of nomadic Kirghiz and Turcomans, is very small. The region in the north of the Syr-daria, towards Lake Chalkar denghiz, is also called Kara-kum. (p. a. k.)

Karasu-bazar, a town of Russia, Crimea, govern- ment of Taurida, district and 28 miles east-north-east of Simpheropol. Population (1897), 12, 961, consisting of Tatars, Armenians, Greeks, Karaims, Jews, and about 200 so-called Krymchaki, i.e., Jews who have adopted the Tatar language and dress, who live chiefly by embroidering morocco leather goods and by other small handwork. It is a considerable centre for the export of fruit from various parts of Crimea.

Karatau, a chain of mountains in Eussian Turk- estan, running from the south-west extremity of the Talas Alatau (Tian Shan) in a north-west direction, for 250 miles, between the Syr-daria and the Chu, ending in 44° 15′ N. Its average altitude is about 5000 feet, and some of its summits, especially in its middle and south-east portion, reach 7000 feet. It is built up of Metamorphic slates and Devonian, Carboniferous, and Jurassic deposits, with occasional intrusions of granites and melaphyres. Its south-west slope is gentler than the opposite slope. The ridge is but poorly clothed with forests in its south- east parts, and the rivers which rise in it are short and

soon lost in the sands. At its base it has a girdle of loess. Goal, lead, and iron are found.

Karateghin, a bekdom occupying a hilly part of Bokhara, on the middle course of the Vaksh or Surkhab. It has on the N. the Eussian Turkestan provinces Samar- kand and Fergana, from which it is separated by the Hissar and Alai ridges ; Fergana on the E. ; Darvaz on the S. (ridge of Peter the Great) ; and Hissar on the W. Its area covers about 4200 square miles, and its population numbers some 60,000. Surrounded by high mountain ridges of diflftcult access, it is also nearly all covered with mountains, its best part being the high valley of Surkhab (4500 to 6500 feet of altitude). The population consists chiefly of Tajiks and some 10,000 Kara-kirghiz in the east. The former carry on agriculture and gardening, and the latter cattle-breeding. Some rough stuffs, carpet-bags, and woollen goods are made in the villages. Sheepskins, furs, carpet-bags, and so on are exported. The chief town is Garm, on the Vaksh.

Karauli, or Keeowlee, a native state of India, in the Eajputana Agency. Area 1229 square miles ; popula- tion (1881), 148,670; (1891) 156,587, showing an increase of 5 per cent. ; average density, 127 persons per square mile. In 1901 the population was 156,786. The rev- enue (1896-97) was Es.4,67,000 ; no tribute. The maha- raja, Bhanwar Pal Deo, was born in 1862 and succeeded in 1866. He was appointed G.C.I.E. in 1897, on the occasion of Queen Victoria’s Diamond Jubilee. In 1897- 98 coins to the value of Es.25,060 were struck at the mint. On the reverse they bear the title ” Kaisar-i-Hind ” in Persian characters. The town of Kabauli has a pop- ulation (1881) of 25,607 ; (1891), 23,124. Its schools had 198 pupils in 1897-98, of whom 39 were learning English.

Karen-ni, the country of the Eed Karens, a collec- tion of small states, formerly independent, but now feudatories of Burma. It is situated approximately between 18° 50′ and 19° 56′ N. and between 97° 10′ and 97° 50′ E. The tract is bounded on the N. by the Shan States of Mong Pai, Hsatung, and Mawkmai ; on the E. by Siam ; on the S. by the Papun district of Lower Burma ; and on the W. a stretch of mountainous country, inhabited by the Brfe and various other small tribes, formerly in a state of

independence, divides it from the districts of Tungu and Yamfethin. It is divided in

a general way into eastern and western Karen-ni ; the former consisting of one state, Gantarawadi, with an approximate area of 2500 square miles ; the latter of the four small states of Kyebogyi, with an area of about 350 square miles ; BawMke, with an area of 200 square miles ; NammekSn, with 50 square miles ; and Naungpale, with about 30 square miles. The small states of western Karen-ni were formerly all subject to Bawiake, but the subordination had for long been becoming less and less defined, and has now ceased. There was also a small state in the hills west of the Pawn stream, called Saoh- payun, containing six villages, with a chief in charge of them. The state of Ngwedaung, called Loi Ngiin by the Shans, is now also subordinate to Gantarawadi. Karen-ni consists of two widely differing tracts of country, which roughly mark now, and formerly actually did mark, the division into east and west. Gantarawadi has, however, encroached westwards beyond the boundaries which nature would assign to it. The first of these two divisions is the southern portion of the valley of the Hpilu, or Balu stream, an open, fairly level plain, well watered and in some parts swampy. The eastern half consists of the Loikaw and ISTgwedaung circles of Gantarawadi, and the western of the Nammekon and jSTaungpale states. South of this valley and between the Nam Pawn and its principal tributary, the Tu, lies a stretch of downs, having no overground drainage, undu- lating and exceedingly dry, though in parts fertile. On its eastern side are two or three small lakes, tinged by the soil to a permanent brick red. On the western side, in Kyebogyi state, are a few small streams, which in April and May almost entirely dry up and only just suffice for the wants of the villages. The second division is a series of chains of hills, intersected by deep valleys, through which run the two main rivers, the Salween and the Pawn, and their feeder streams. Many of the latter are dried up in the hot season and only flow freely during the rains. Here there are small, level, watered valleys, as at Mese, Man Mali (Ywathit), Hsataw, and SawlSn, but for the most part the country is precipitous and the soil arid. The whole country being hilly, the most conspicuous ridge is that lying between the Pawn and the Salween, which has an average altitude of 6000 feet. It is crossed by several tracks, passable for pack-animals, the most in use being the road between Sawlon, the capital of Gantarawadi and Man Mail. The

principal peak east of the Salween is on the Loi Lanridge, 7109 feet above mean sea-level. Parts of this ridge form the boundary between eastern Karen-ni and Mawkmai on the west and Siam on the east. It falls away rapidly to the south, and at Pang Salang is crossed at a height of 2200 feet by the road from Hsataw to M^hawnghsawn. West of the Balu valley the continua- tion of the eastern rim of the Myelat plateau rises in Loi Nangpa to about 6000 feet. The Nam Pawn is a large river, with an average breadth of 100 yards, but is unnavi- gable owing to its rocky bed. Even timber cannot be floated down it without the assistance of elephants. The Salween throughout Karen-ni is navigated by large native craft. Its tributary, the Me Pai, on the eastern bank, is navigable as far as M^hawnghsawn in Siamese territory. The Balu stream flows out of the Inle lake, and is navigable from that point to close on Lawpita, where it sinks into the ground in a marsh or succession of funnel holes. Its breadth averages 50 yards and its depth is 15 feet in some places.

Little of the history of the Eed Karens is known, but it appears to be generally admitted that Bawlak^ was originally the chief state of the whole country, east and west, but eastern Karen-ni under Papaw-gyi earlj^ became the most powerful. Slaving raids far into the Shan States brought on invasions from Burma, which, however, were

not too successful. Eastera Karen-ni was never reduced until Sawlapaw, having defied the British Government, ■was overcome and deposed by General Gollett in the beginning of 1889. Sawlawi was then appointed Myoza, and received a sanad or patent of appointment on the same terms as the chiefs of the Shan States. The independence of the western Karen-ni states had been guaranteed by the British Government in a treaty with King Mindon in 1875. They were, however, formally recognized as feudatories in 1892 and were presented with saiiads on the 23rd Jan- uary of that year. Gantarawadi pays a regular tribute of Rs.6000 yearly, whereas these chieflets pay an annual kadaw or nuzzur of Rs.lOO. They are forbidden to carry out a sentence of death passed on a criminal, without the sanction of

the superintendent of the southern Shan States, but otherwise retain nearly all their customary law.

Tin, or what is called tin, is worked in Bawiakfe. It appears, however, to be very impure. It is worked intermittently by white Karens on the upper waters of the HkSmapyu stream. Rubies, spinels, and other stones are found in the upper Tu valley and in the west of Nammfekon state, but they are of inferior quality. The trade in teak is the chief or only source of wealth in Karen-ni. The largest and most important forests are those on the left bank of the Salween. Others lie on both banks of the Nam Pawn, and in western Karen-ni on the Nam Tu. The yearly out-turn is estimated at over 20,000 logs, and forest officers have estimated that an annual out-turn of 9000 logs might be kept up without injury to the forests. Some quantity of cutch is exported, as also stick-lao, which the Red Karens graft so as to foster the production. Other valuable forest produce exists, but is not exported. Rice, areoa-palms and betel-vine leaf are the chief agricultural products. The Red Karea women weave their own and their husbands' clothing. A characteristic manufacture is the Pa-si or Karen metal driim, which is made at Ngwedaung. These drums are from two and a half to three feet across the boss, with sides of about the same depth. The sound is out of proportion to the metal used, and is inferior to that of the Shan and Burmese gongs. It Is thought that the population of Karen-ni is steadily decreasing. The estimated totals in 1897 were Gantarawadi, 23,000 ; Kyfebogyi, 4400 ; Bawiak6, 4500 ; Nammfekon, 3500 ; Naungpalfe, 1750. The birth- rate of the people is considered to exceed the death-rate by very little, and the Red Karen habit of life is most unwholesome. They are short and small-made, but have great powers of endurance. Numbers have enlisted in the Burma police, but there are various opinions as to their value. (j. q, gc.)

Karlsburg. See Gtula Fehbbvab.

Karnal, a town and district of British India, in the Delhi division of the Punjab. The town is 7 miles from the right bank of the Jumna ; railway station, 76 miles north of Delhi. Population (1881), 23,133; (1891), 21,963; municipal income (1897-98), Es.31,234; death- rate (1897), 37 per 1000. There are manufactures of cotton cloth, blankets, and boots, besides considerable local trade and an annual horse fair. There is a municipal high

school, with boarding-house, a printing-press, and four literary institutions. The district of Kaknal stretches along the right or west bank of the Jumna, north of Delhi. It includes the historic sites of Panipat and Thanesar. Area, 2440 square miles; population (1881), 645,219; (1891), 683,718, showing an increase of 6 per cent.; average density, 280 persons per square mile. In 1901 the popu- lation was 883,457, showing an increase of 29 per cent., probably due to the extension of canal irrigation. The land revenue and rates (1897-98) were Es.9,57,734, the incidence of assessment being 8 annas per acre ; culti- vated area, 449,621 acres, of which 289,356 were irri- gated, including 169,083 from Government canals ; num- ber of police, 555; number of schools (1896-97), 166, attended by 4185 boys, being 6-7 per cent, of boys of school-going age ; death-rate (1897), 40-8 per 1000. The principal crops are millet, wheat, pulse, rice, cotton, and sugar-cane. There are two factories for ginning and pressing cotton. The district is traversed for 74 miles

by the Delhi-Umballa-Kalka railway, and also by the Western Jumna canal. It suffered from the famine of 1896-97, when the maximum number of persons on relief was 12,361 in March 1897 ; and again to some extent in

1899-1900.

Karnul, or Kurnool, a town and district of British India, in the Madras Presidency. The town is at the confluence of the Hindri river with the Tungabhadra. Population (1881), 20,329; (1891), 24,376; municipal income (1897-98), Ks.68,110. The water-supply was provided at a cost of Rs.1,50,000. The municipal high school had 137 pupils in 1897. The district of Kabnul has an area of 7514 square miles ; population (1881), 678,551 ; (1891), 817,811, showing an increase of 21 per cent, after the famine of 1876-77 ; average density, 109 persons per square mile, being the lowest in the province. In 1901 the population was 872,423, show- ing a further increase of 6 per cent. The land revenue and rates (1897-98) were Rs.19,54,404, the incidence of assessment being R.l per acre ; cultivated area, 1,835,560 acres, of which 89,313 were irrigated, includ- ing 23,307 from Government canals ; number of police 1071; boys at school (1896-97), 11,776, being 19 per cent, of the male population of school-going age ; registered death-rate (1897), 28-8 per 1000. The prin- cipal crops are millet,

cotton, oil-seeds, and rice, with a little indigo and tobacco. Karnul suffered very severely from the famine of 1876-77, and to a slight extent in 1896-97. It is traversed by the branch of the Southern Mahratta railway from Guntakal to Cumbum. It is also the chief scene of the operations of the Madras Irrigation Company, taken over by Government in 1882. The canal, which starts from the Tungabhadra river near Karnul town, was constructed at a total cost of Rs.2,16,38,942. In 1897-98 the irrigated area was 46,402 acres ; and the receipts were Rs.1,66,220, com- pared with an expenditure (including interest) of Rs.9,92,670. A more successful work is the Cumbum tank, formed under native rule by damming a gorge of the Gundlakamma river. In 1897-98 the irrigated area was 8192 acres ; and the return on capital outlay was 9 per cent. Apart from the weaving of coarse cotton cloth, the chief industries are 3 cotton presses, 167 indigo vats, and 21 saltpetre refineries.

Karolinenthal (Czech, Karlln), the chief town of a government district in Bohemia, Austria, and a manu- facturing suburb of Prague, in which it is now practi- cally merged. Population (1890), 19,540 ; (1900), 21,094, chiefly Czech.

Karoiyi Aloys, Count (1825-1899), Austrian diplo- matist, was born 8th August 1825. He sprang from a noble Magyar family which can trace its genealogy to the time of the foundation of the monarchy. After hold- ing various inferior diplomatic appointments, he was in 1860 appointed envoy at Berlin. This post he held till the outbreak of war in 1866, and it was his duty to conduct the lengthy and complicated negotiations regard- ing Schleswig-Holstein, first during the co-operation of the two Great Powers, and afterwards when the final rupture was approaching. The story is well known how at the beginning of 1865 he was instructed categorically to ask Bismarck whether Prussia proposed to violate the treaty of Gastein. ” No,” answered Bismarck, but con- tinued, ” If we did intend to do so, I should give the same answer.” It was. a tribute to the ability he had shown in a very difficult position that he was chosen to negotiate with Bismarck the treaty of Nikolsburg, and when after 1870 thoroughly friendly relations were re-established

between the two German powers, he returned with the rank of ambassador to his old post. He was one of the Austrian representatives at the Congress of Berlin in 1878. In the next year he was transferred to London, where he remained till the year 1888, when he retired, owing to ill-health. It was to him that in 1880 Mr Gladstone addressed an apology for the unfriendly expressions regarding Austria-Hungary which he had used in his Midlothian campaign of that year. Karolyi died suddenly, while out shooting in Hungary, on 20th De- cember 1889.

Karpathians. See Cakpathian.

Karr, Jean Baptiste Alphonse (1808-1890), French novelist, was born in Paris, 24th November 1808, and after being educated at the College Bourbon, became a teacher there. In 1832 he published a novel, Sous les tiUeids, characterized by an attractive originality and a delightful freshness of personal sentiment. A second novel, Une heure trap tard, followed next year, and was succeeded regularly by many others, which speedily made Karr a public favourite. His Vendredi Soir (1836) and Le chemin le plus court (1836) continued the vein of autobiographical romance with which he had made his first success. Oinevi&ve (1838) is one of his best stories, and his Voyage autour de mon jardin (1845), was de- servedly popular. Others were Feu Bressier (1848), and Forte en tMme (1853), which had some influence in stimu- lating educational reform. In 1839 Alphonse Karr, who was essentially a brilliant journalist, became editor of Le Figaro, to which he had been a constant contributor ; and he also started a monthly journal, Les Guipes, of a keenly satirical tone, a publication which brought him the reputation of a somewhat bitter wit. In 1848 he founded Le Journal. In 1855 he went to live at Nice, where he indulged his predilections for floriculture, and gave his name to more than one new variety. He was also devoted to fishing, and in Les Soirees de Sainte-Adresse (1853) and Au bord de la mer (1860) he made use of his experiences. His reminiscences, Livre de bord, were published in 1879-80. He died at Nice, 30th September

1890.

Karsandas Mulji (1832-1875), native journalist and social reformer of western India, was born on 26th of July 1832, of parents belonging to the Bania caste. Having lost his mother in infancy, he was left to the care of his stepmother, whose relations with Karsandas were not very affectionate. He received an ordinary Gujrathi education and then joined the Elphinstone In- stitution to study English. He competed for a prize offered for an essay on the re-marriage of Hindu widows, but his parents were so shocked at the lad's earnest advo- cacy of this reform that they turned him out of the house. He had to stop his collegiate education, and starvation stared him in the face. At last he succeeded in getting a teachership at the Gokuldas Tejpal seminary, thus attaining a position in which he could freely express his views on social reform. To promote this end he also co-operated with some benevolent men of Bombay, promi- nent among whom was Eaghunathdas Madhowdas, J.P., who set a practical example by marrying a widow him- self. They started two weekly papers, The Bast Ooftar and The Satyapralcash, to influence public opinion. The part Karsandas took in the controversy that ensued was the chief work of his life. When the American Civil War gave an impetus to the cotton trade of Bombay in 1864, Karsandas was sent to England by a firm in Bom- bay as their agent, but this new movement did not thrive long. On his return in 1874 he was met by perse-

cution from his caste people. The Governor, Sir Bartle Prere, who had a high opinion of him, appointed him to administer the native state of Limree during the minority of the chief. He held that ofBce till his death in 1875.

Karsandas Mulji's title to the memory of his oo-religionists rests on his work as editor of The Satyaprakash, out of which the notorious "Maharaja" libel case arose. The hereditary chief priests of the Vaishnava community of Bombay are called Mahara- jas. They are descendants of the religious teacher Vallabhacharya (born in Champaran in Sam vat 1535, a.d. 1479), and are like him believed to be incarnations of the god Krishna. Karsandas began about 1857 to denounce their avarice and immorality. The Maharajas tried in vain to silence the newspaper by threats of excommunication, and in order to avoid publicity, urged the passing of an Act to exempt them from personal attendance in courts of justice. After some years of religious polemics regard- ing female education and widow re-marriage, one

Maharaja Jadu- nathji Brijratanji, in May 1861, filed an action for a libel contained in an article dated the 21st October 1860, in which Karsandas replied to the charge of heresy made by the Maharajas in their monthly magazine. Karsandas pleaded not guilty, and also justification, urging that the plaintiff and the other Maharajas Carried into practice the carnal knowledge of female worshippers which is inculcated in the religious worlis explaining the Pushtl- marga rule of life, and exalted by the Vallabhacharya sect into a new creed. At a meeting of the Bhattia caste, on the 6th September 1861, in order to suppress evidence of notorious im- moralities, it was resolved that no one should bear witness against the plaintiff under the penalty of excommunication. The un- daunted Karsandas thereupon charged the instigators of this resolution with conspiracy to defeat justice, and on conviction some of them were heavily fined. The trial of the libel case began in the Supreme Court on the 26th January 1862, and, after a lengthy hearing before Chief Justice Sir Mathew Sausse and Mr Justice Sir Joseph Amould, the plaintifi was awarded nominal damages on the plea of not guilty, but both judges found that the charges of immoral dealings made by Karsandas were proved to be true. The Chief Justice held, nevertheless, that Karsandas had no right to publish them ; but Sir Joseph Amould was of the contrary opinion (on the authority of Harrison v. Bush, 5 Ellis and Blackburn), holding that as a Vallabhacharyan addressing his co- sectaries, and as a Banian addressing his caste fellows, he had a right, and as a journalist addressing readers composed prin- cipally of followers of the Maharajas, he had a duty to attack their misdeeds ; for if such evils were to exist for ever without public animadversion, one of the great uses of a free press would be at an end. The result of the trial was a great victory for the reformers in the Vaishnava community. (For the dogma and history of the Vallabhacharyan religion, and details of the trial in the Supreme Court, see Histoi-y of the Sect of Maharajas or Vallabhacharyas of Western India. London, Truhner and Co., 1865.) (n. b. w.)

Karwar, or Caewak, a town of British India, ad- ministrative headquarters of North Kanara district in Bombay; on the searcoast 295 miles south of Bombay city. Population (1881), 13,761; (1891), 14,579. Its commercial importance has declined since the opening of the Southern Mahratta railway system. There is a high school, with 279 pupils in 1896-97; and two printing- presses, issuing one vernacular newspaper.

Kashan, a small province of Persia, situated between Isfahan and Kum. It is divided into the two districts Germsir, the ” warm,” and Sardsir, the ” cold,” the former with the city of Kashan in the plains, the latter in the hills. It has a population of 75,000 to 80,000, and pays a yearly revenue of about £18,000. Kashan (Cashan) is the provincial capital, in 3i° 0′ N. and 51° 27′ E., at an elevation of 3190 feet, 150 miles from Tehran; popula- tion, 25,000 to 30,000, comprising a few hundred Jews occupied as silk-winders, and a few Zoroastrians engaged in trade. Great quantities of silk stufEs, from raw material imported from GiMn, and copper utensils are manufactured at Kashan and sent to all parts of Persia. Kashan also exports rose-water made in some villages in the hilly district about 20 miles from the city, and is the only place in Persia where cobalt can be obtained from the mine at Kamsar, 19 miles to the south.

Kashinath Trimbak Telang (1850-1893), a puisne judge of the High Court, Bombay, was bom at Bombay on 30th August 1850. By profession an advocate of the High Court, he was also a brilliant Sanskrit scholar. He took besides a vigorous share in literary, social, municipal and political work, as well as in the affairs of the University of Bombay, over which he presided as vice-chancellor from 1892 till his death. He was held in high esteem by Europeans in India, and his career is cherished by the native community as an example of varied eminence, attained by personal merits on the soil of India itself, circumstances having prevented him from ever visiting Europe. Telang grew up in a patri- archal family of Gaud Saraswat Brahmins, who derived their origin from Goa. He was the second son of Bapu, but was adopted by his uncle. At the age of five he was sent to the Amarchaud Wadi vernacular school, and in 1869 entered the high school in Bombay which bears the name of Mountstuart Elphinstone. Here he came under the influence pf Narayan Mahadev Purmanand, a teacher of fine intellect and force of character, afterwards one of Telang’s most intimate friends. Erom this school he passed to the Elphinstone College, of which he became a fellow, and after taking the degree of M.A. and LL.B., decided to follow the ex- ample of Bal Mangesh Wagle, the first Indian admitted by the judges to

practise on the original side of the High Court, a position more like the status of a barrister than a vakil or pleader. He passed the examination and was en- rolled in 1872. His learning and other gifts soon brought him an extensive practice. He had complete command of the English language, and his intimacy with Sanskrit enabled him to study and quote the Hindu law-books with an ease not readily attained by European counsel. Mr Telang, finding his career assured, declined an offer of ofla.cial employment. But in 1889 he accepted a seat on the High Court Bench, where his judgments are recognized as authoritative, especially on the Hindu law. He was syndic of the university from 1881, and vice- chancellor from 1892 till his death. In that year also he was elected president of the local branch of the Eoyal Asiatic Society. These two of&ces had never been held by a native of India before. His intimacy with Dr Words- worth when at the Elphinstone College, his experience as professor of law, joined with his keen intellect and never- ceasing study, fitted Telang for the influential part he was called to take in many educational matters where both European methods and Oriental sentiments had to be con- sidered. The decoration of CLE. conferred on him in 1882 was a recognition of his services as a member of a mixed commission appointed by the Government to deal with the educational system of the whole of India. He was nominated to the local legislative council in 1884, but declined a similar position on the Viceroy's council. Along with Mr P. M. Metha, he was the originator of the Bombay Presidency Association. When a student he had won the Bhugwandas scholarship in Sanskrit, and in this language his later studies were profound. His translation of the Bhagwadgita into English prose and verse is a standard work ; and he criticized Professor Weber's hypo- thesis that the story of the Ramayana was influencedby the Homeric epics. While devoted to the sacred classics of the Hindus, Telang did not neglect his own vernacular, Mah- ratti literature being enriched by his translation of Lessing's Nathan the Wise, and an essay on Social Compromise. Mr Telang married a lady of the Kanvinde family, and left two sons and three daughters. Learned, judicial, and amiable, Telang was in his social life, like many other Brahmins, a man of plain living and high thinking. He spoke, wrote, and worked consistently for social reform, the elevation of women, the permission to widows to

remarry, female education, and so forth. He died at Bombay, 1st September 1893.

(n. b. w.)

Kashmir. — Since 1880 the Kashmir Durbar has re- sumed its authority over those outlying provinces stretch- ing to the north-west, the administrative responsibility for which had been inherited by the Dogras from the Sikhs. The centre of these trans-Indus provinces is Gilgit, on the river of that name which joins the Indus where it takes its great bend to the south-west ere breaking through the Himalaya to the Peshawar plain. Kashmir had never loosed its hold on Gilgit, but Gilgit had never paidKashm ir tribute ; so that the hold in 1885 was weak, and Kashmir authority, in some parts of the Gilgit basin, was set at naught. Kashmir suzerainty was even disputed by China. The late history of Kashmir consequently largely centres in the story of the establishment of the Gilgit Agency (in March 1889) and those subsequent events which hinged upon it, including expeditj ons to Chitral and the conquest of the valley of Hunza. Kuch of this, together with a gen- eral account of the geogvaphical conformation and ethno- logy of the Gilgit province, will be found elsewhere (see Gilgit). Much has h-appened in the chequered history of the valley of Kashrair (that land of enchantment — the only land which never disappoints expectations) which re- quires a brief record. In September 1885 the Maharaja Sir Pratap Singh, G.C.S.I., succeeded his father Zanbir Singh, and at once inaugurated a series of most useful reforms. There is no longer a British officer on ” special duty ” in Kashmir, but a Eesident who resides at Srinagar and Jammu, and who permanently represents the British Government in the Durbar. The political influence thus established reaches by proxy to Kashgar, to Leh (the capital of Ladakh), to Gilgit, and Chitral. The Eesident at Srinagar is the warden of British India on the north. With the establishment of the Residency there has been an increase in the number of English visitors yearly, and a certain amount of British settlement in the country. The hill station of Gulmurg, in one of the glades on the northern slopes of the Pir Panjal, has sprung into exist- ence. Here the construction of temporary residences is permitted by the Maharaja, and the European visitors to Srinagar follow the Eesident in his summer migration to the hills. Eound about Lake Dal there is already a scattering of pretty English villas,

and the cultivation of fruit, hops, and vines has advanced beyond the experi- mental stages of 1890. A syndicate has been formed for the exploitation and working of the mineral wealth of the country, and a railway will place Srinagar in direct connexion with the Punjab. Meanwhile an im- mense improvement in the matter of roads has been effected. A good cart road now connects Murree with Baramulla, and Baramulla with Srinagar ; and the transit by tonga over this road, with regular stages at in- tervals, is a delightful experience compared with the- old wearisome monotony of daily marches. The dis- tances from point to point of the route are as follows : — Erom the rail-head at Eawal Pindi to Murree is a drive of 40 miles — all uphill. From Murree to Kohala (where the Jhelum is bridged) is a downhill journey of 20 miles. Then, following the left bank of the Jhelum closely, there are 90 miles of road to Baramulla. From Baramulla to Srinagar a driving road of about 35 miles in length now supersedes the old boat journey through the Wulur lake by the Jhelum, although it can hardly afford the attraction of the placid, if somewhat indolent, method of drifting to the capital amidst the ever-varying scenery of the most beautiful country in the East. From Bandipur, on the northern edge of the Wulur, an excellent road now leads to Gilgit across the Tragbal pass, rising from 5200 feet

in the valley to 11,400 feet on the pass, and falling again into the sweet valley of Gurais before surmounting the Burzil (13,600 feet) and striking the Astor valley, which it follows to its junction with the Indus near Bunji. At Bunji the river is bridged. Here the height above sea- level is little over 4000 feet, and there is a compara- tively gentle rise to Gilgit (4400 feet), although the road climbs over many a spur and skirts many a precipice in its course. Gilgit is by this route about 400 miles from the railway at Rawal Pindi. A route to Leh, which has been developed for trade purposes, now follows the Sind valley to its head under the Soji La (11,300), and then crosses the elevated Dras plateau to the Indus. This is the great trade artery of Kashmir and Tibet. The im- provement in these main lines of communication, to- gether with the introduction of telegraphs, has doubtless developed a certain amount of internal traffic ; but it is a curious feature of

this general commercial advance that the trade with Tibet has rather diminished than in- creased in value. The general increase in Kashmir trade may be gathered from the following statistics : — In 1892- 93 the value of the exports (exclusive of treasure) was Ex.533,309, and the imports Ex.486,825. In the year 1896-97 the exports amounted to Rx.759,740, and the imports to Ex.702,842.

But undoubtedly the most beneficial measure introduced by the administration within late years was the land settlement in the Kashmir valley and the inauguration of an equitable assessment of property and crops. In the year 1887 the people were still in a condition of serfdom, with no rights and no power to represent their grievances. They were forced to labour and to sow, and others gathered the increase. Cultivation was bad, and the revenue was not paid. The character of the people, timid yet per- sistent, degraded yet intellectual, was the direct result of evil administration. Forced labour was imposed by local officialdom, and no heart was left in the labourers. Yet with the persistency of their forefathers, who had survived the despotism of Pathan, Moghul, Sikh, and Dogra, the Kashmiris clung to their land and their tradi- tions ; and they probably represent to this day a people historically older than any to be found in northern India still associated with the land of their ancestors. Remem- bering the beauty and the fertility of the vale of Kashmir, this is perhaps not so surprising as it would otherwise seem. There is but little crime amongst these people. They are a law-abiding race, as they were under their Hindu kings. Successive dynasties have left no impress on their national character. They are to-day what they were thousands of years ago. And at last the land set- tlement has brought a good measure of prosperity and contentment amongst them.

The revenues collected from the valley of Kashmir in 1880-89 amounted to — Land revenue, E.x.123,126, other sources, Ilx.65,312 ; in 1893-94, land revenue, Ex. 147,984, other sources, Ex.91,627. The valley comprises three dis- tricts (Khas, Anantnag, and Sopur) with eleven tehsils, independently of the districts of Mozafarabad, Gilgit, and Astor, and is under the executive charge of the Governor of Kashmir (the Hakim-i-Ala). Ladakh and Skardu are under the Governor of Jammu. In 1835 the population of the valley did not exceed 200,000, to which it had been reduced from 800,000 in twenty years by oppression, earth- quake, pestilence, and famine. In 1866 a census

(the accuracy of which, however, is doubtful) gave a]iopula- tion of 112,715. In 1873 another census returned the total population of the valley at rather under 500,000. Later, but before the famine, they were computed at 400,000. In 1877-79 there occurred the terrible scourge of famine, and the mortality which ensued has never been fully estimated. It seems probable that 67,000 people

died in the city (rather more than half of its inhabitants) and 175,000 in the villages (or about three-fifths of the population). A number of the chief valleys of the north were entirely deserted — whole villages lay in ruins, some suburbs of the city were tenantless, the city itself half destroyed, the graveyards were filled to overflowing, the river had been full of corpses thrown into it. In 1891 the population of the valley was 814,000, of whom 119,000 lived in Srinagar. Ninety-three per cent, of the people were Mahommedans, and the rest chiefly Hindus. In 1901 the population of the state of Kashmir numbered 1,157,759, of whom 122,536 were in Srinagar. The 1901 census gives for Jammu, Kashmir, Malakand, Chitral, and the neighbouring frontier states a total population of 2,906,173, as compared with 2,543,952 in 1891.

But the terrible famine of 1877-79 is not the only calamity to be recorded in the last quarter of the 19th century. In 1885 an earthquake occurred of long duration, which occasioned great loss of life. Three thousand five hundred people are believed to have perished. The most violent shocks were felt in an elliptical area whose focuses were Srinagar and Baramulla. The earthquake commenced on 30th May, and shocks were felt up to 16th August. Villages were destroyed and panic was universal. Old water springs disappeared and landslips occurred fre- quently. Large earth fissures appeared about Baramulla

In 1892 between 11,000 and 12,000 persons died of cholera in the Kashmir valley, and the horror and de- moralization of that terrible visitation are still vivid in the minds of the people. Villages were deserted, culti- vation was abandoned, and business entirely stopped. Men would not lend money, and in the villages the people would sit all day long about the graveyards, abso- lutely silent. The long lines of coffins borne to the burial- grounds resembled an endless regiment on the march, while on the river a sad

procession of boats floated down to the burning ghats, and living passengers in other boats passed by with averted faces.

Truly, if Kashmir is the land of Oriental ideal around which have been woven endless tales in prose and song — a theme for romance, offering wide fields for revels of imagination or for the exercise of vivid description — it is a land of calamity also ; a land of grim, gray catastrophe and horror, such as is hardly known in countries less fair. But a brighter dawn has already broken, and the chequered light and shadow of her late history are rapidly yielding to the broad day of contentment and prosperity.

See Drew. Jammu and Kashmir. — Laurence, W.‘R. The Val- ley of Kashmir, London, 1895.— Durand, Col. A. The flaking of a Frontier, London, 1899.— Lydekker, R. “The Geology of the Kashmir and Chamba Territories,” Secords of the Geological Survey of India. (j.. h. h*.)

Kasimoff, a district town of Eussia, government and 90 miles east-north-east of Eyazan, on Oka river. The population in 1897 was 13,500, of whom about 1000 are Tatars (about 5000 in the district). It is a wealthy town, well provided with educational institutions, and famed for its tanneries and leather goods, sheepskins and bells, these trades giving occupation to nearly 4000 persons. It was founded in 1152. In ti\e 15th century it became the capital of a Tatar khanate, vassal to and patronized by Moscow, as a rival to Kazan, and contains interesting antiquities.

See Veliaminoff-Zernoff’s T!ie Kasimoff’s Tsars. St Petere- burg, 1863-77.

Kassa (Kaschau), a municipal town of Hungarv, capital of the coimty of Abauj-Torna. Formerly the chief town of Upper Hungary, it is still in respect of industry commerce, and traffic the centre of the north-eastern pait of the country. Its most important manufactures are

tobacco, macMnery, iron, furniture, and textiles ; there are many steam mills. Population (1890), 28,884: (1900),

40,101.

Kastamuni, or Kastambul. — 1. A viMyet of Asia Minor which includes Paphlagonia and parts of Pontus and Galatia. It is divided into four sanjaks — Kastamuni, Boli, Changra, and Sinope — is rich in mineral wealth, and has many mineral springs and extensive forests. Its population comprises 1,000,000 Moslems and 30,000 Christians. 2. The capital of the above, the ancient Castamon, altitude 2500 feet, situated in the narrow valley of the Geuk Irmak (Amnias), and connected by a carriage road, 64 miles, with its port Ineboli on the Black Sea. The town is noted for its copper utensils, and it has a large trade in mohair. The climate, though subject to extremes of heat and cold, is healthy; in winter the roads are often closed by snow. The popu- lation of 17,000 includes 2900 Christians. Castamon, an important city in later Byzantine times, was taken by the Danishmand Emirs of Sivas early in the twelfth century.

Katha, a district in the northern division of Upper Burma, with an approximate area of 7000 square miles, 3000 of which consist of the former separate state of Wuntho. It is bounded on the N. by the Upper Chind- win, Bhamo, and Myitkyina districts, on the E. by the Kaukkwe river as far as the Irrawaddy, thence east of the Irrawaddy by the Shan State of Mona Mit (Momeik), and by the Sliweli river, on the S. by the ruby mines district and Shwebo, and on the W. by the Upper Chind- win district. There are three ranges of hills running through the district, known as the Minwun, Gangaw, and Mangin ranges. They separate the three main rivers — the Irrawaddy, th^ Meza, and the Mu. The Minwun range runs from north to south, and forms for a considerable part of its length the dividing line between the Katha district proper and what formerly was the Wuntho state. Its average altitude is between 1500 and 2000 feet. The Gangaw range runs from the north of the district for a considerable portion of its length close to and down the right bank of the Irrawaddy as far as Tigyaing, where the Myatheindan pagoda gives its name to the last point. Its highest point is 4400 feet, but the average is between 1600 and 2000 feet. The Katha branch of the railway crosses it at Petsut, a small village 12 miles west of Katha town. The Mangin range runs through Wuntho. Its highest peak, Makigthon, attains an altitude of 5450 feet.

Gold, copper, iron, and lead are found in considerable quantities in the district. Tlie Kyaukpazat gold mines, worked by an English company, give good returns. The iron, copper, and lead are not now worked. Jade and soapstone also exist, and salt is produced from brine wells. There are three forest reserves in Katha — the Upper Mfeza range with 234 square miles, the Lower Mfeza range with 188 square miles, and the Irrawaddy range, which is under process of constitution. The population according to the census of 1891 was as follows : — Europeans and Eurasians, 78 ; other mixed classes, 1400 ; Hindus, 500 ; Mahommedans, Burmese, Shans, and Kadus, 105,796 ; aboriginal races, mainly Kachins, 3814 — a total of 111,588 ; and in 1901, 176,514, of whom 86,790 were males and 89,724 females. The number of Shans is about half that of Bur- mese, and of Kadus half that of Shans. The Shans are mostly in the Wuntho subdivision. Eioe is the chief crop in the plains, tea, cotton, sesamum, and hill rice in the hills. The valley of the Mfeza, which is very malarious, was used as a convict settlement in Burmese times. The district was first occupied by British troops, but it was not finally quieted till 1890, when the Wuntho Sawbwa was deposed and his state incorporated in the Katha district.

Katha, the headquarters of the district, contained 486 houses in 1897. The principal public buildings are the courthouse, jail, hospital, bazaar, telegraph and post offices, military and civil police lines, railway station and wood depOt, dak bungalow and public works department offices. The principal means of communi-

cation are the Irrawaddy Flotilla steamers, which run between Mandalay and Bhamo, and the railway which communicates with Sagany to the south and Myitkyina to the north. A ferry-boat plies between Katha and Bhamo. (j. g. so.)

Kathiawar, or Kattywar, a peninsula of India, within the Gujarat division of Bombay, giving its name to a political agency. Total area, about 23,300 square miles ; population, 3,000,000. These figures include a portion of the British district of Ahmedabad, a portion of the state of Baroda, and the small Portuguese settlement of Diu. The political agency of Kathiawar has an area of 20,569 square miles; population (1881), 2,343,899; (1891), 2,752,404, showing an increase of 17 per cent. ; average density, 134

persons per square mile. In 1901 the popu- lation was 2,327,456, showing a decrease of 15 per cent., due to the results of famine. The estimated gross revenue was Rs. 1,98,19,620; total tribute, Rs.11,36,000.

There are altogether 188 states of varying size and importance, of which 14 exercise independent jurisdiction, while the rest are more or less under British administration. Most of them pay tribute to the British Government, the Gaekwar of Baroda, or the Nawab of Junagarh ; but the tribute is always collected by British officials. The seven states of the first class are Junagarh, Nawana- gar, Bhaunagar, Porbandar, Dhrangadra, Morvi, and Gondal. The headquarters of the political agent are at Eajkot, in the centre of the peninsula, where also is the Rajkumar College, for the education of the sons of the chiefs. There is a similar school for girasias, or chiefs of lower rank, at Gondal. In 1897-98 the total number of schools was 1334, with 85,569 pupils, being 3-1 per cent, of the population, compared with 2.4 per cent, for the whole of Bombay. An excellent system of metre-gauge railways has been provided at the cost of the leading states. Maritime trade is also very active, the chief ports being Porbandar, Mangrol, and Verawal. In 1897-98 the sea-borne exports were valued at Rs.2,01, 06,931, and the imports at Rs.2, 39,31, 523. The progressive prosperity of Kathiawar received a shook from the famine of 1899-1900, which was felt everywhere with extreme severity. The monsoon again failed in 1901.

Katkofr, Michael Nikiforovitch (1818-1887), Russian journalist, was born in Moscow in 1818. On finishing his course at the university he devoted himself to literature and philosophy, and showed so little in- dividuality that during the reign of Nicholas I. he never once came into disagreeable contact with the authorities. With the Liberal reaction and strong reform movement which characterized the earlier years of Alexander II.‘s reign (1856-81) he thoroughly sympathized, and for some time he warmly advocated the introduction of liberal institutions of the British type, but when he perceived that the agitation was assuming a Socialistic and Nihilist tinge, and that in some quarters of the Liberal camp indulgence was being shown to Polish national aspirations, he gradually modified his attitude until he came to be regarded by the Liberals as a renegade. At the beginning of 1863 he assumed the management and editorship of the Moscow Gazette, and he retained that position till his death in 1887. During these twenty-four years

he exercised considerable influence on public opinion and even on the Government, by representing with great ability the moderately Conservative spirit of Moscow in opposition to the occasionally ultra-Liberal and always cosmopolitan spirit of St Petersburg. With the Slavo- phils he agreed in advocating the extension of Eussian influence in south-eastern Europe, but he carefully kept aloof from them and condemned their archaeological and ecclesiastical sentimentality. Though generally temperate in his views, he was extremely incisive and often violent in his modes of expressing them, so that he made many enemies and sometimes incurred the displeasure of the press-censure and the ministers, against which he was more than once protected by the emperor Alexander III. in consideration of his able advocacy of national interests. His frequent changes of opinion are now forgotten, and he is remembered chiefly as an energetic opponent of

Polish national aspirations, of extreme Liberalism, of the system of public instruction based on natural science, and of German political influence. In this last capacity he helped to prepare the way for the Franco-Eussian alliance. (d. m. w.)

Katrine, Loch, a Scottish lake, lying between Stirling and Perth shires, 364 feet above the sea. It has an area of about 4000 acres, and a maximum depth of 78 fathoms. Glengyle water and nearly fifty rivulets feed it, and it is drained by Achray water and by the tunnels of the Glasgow waterworks. Since 1859 it has been the principal source of the water-supply of Glasgow, and the surface has been raised 6 feet in order to increase the capacity, which, along with that of Loch Arklet, with which it is connected, is 12,000 million gallons. One con- sequence of the raising of the level was the submergence of the Silver Strand and an appreciable lessening of the size of Ellen’s Isle.

Kattowitz, a town of Prussia, province of Silesia, 5 miles south-south-east of Beuthen. It lies in the midst of ironworks and coal mines, and has flour mills and manu- factures of glass, machinery, and household utensils. Population (1885), 14,200; (1900), 31,745.

Kaufbeuren, a town of Bavaria, Germany, district of Swabia, on the Wertach, 65 miles by rail south-west of Munich. It is still surrounded by walls, and has a new town hall. It is a seat of the cotton industries. Population (1885), 6496 ; (1900), 8361.

Kaufmann, Constantine Petrovitch (1818- 1882), Russian general, was born at Maidani on 3rd March 1818. He entered the Imperial Engineers in 1838, served in the army of the Caucasus, rose to be colonel, and commanded the sappers and miners at the siege of Kars in 1855. On the capitulation of Kars he was deputed to settle the terms with General Sir W. Fen wick Williams. He was promoted to be major-general in 1867, and in 1861 became director-general of engineers at the War Office at St Petersburg, assisting General Milutin in the reorganization of the army. Promoted lieutenant-general in 1864, he was nominated aide-de-camp-general and governor of the military conscription of Vilna. In 1867 he became governor of Turkestan, and held the post until his death, making himself a name in the expansion of the empire in central Asia. He accomplished a successful campaign in 1868 against Bokhara, capturing Samarkand and gradually subjugating the whole country. In 1873 he attacked Khiva, took the capital, and forced the khan to become a vassal of Russia. Then followed in 1875 the campaign against Khokand, in which Kaufmann defeated the khan, ISTasr-ed-din. Khokand north of the Syr-daria was annexed to Russia, and the independence of the rest of the country became merely nominal. This rapid absorption of the khanates brought Russia into close proximity to Afghanistan, and the reception of Kauf- mann’s emissaries by the Amir was a main cause of the British war with Afghanistan in 1878. Although Kaufmann was unable to induce his Government to support all his ambitious schemes of further conquest, he sent Skobeleff in 1880 and 1881 against the Akhal Tekk^s, and was arranging to add Merv to his successful annexations when he died suddenly at Tashkend on 15th May 1882. (r. h. v.)

Kaukauna, a city of Outagamie county, Wiscon- sin, U.S.A., on the Fox river and the Chicago and North- western railroad. It has paper and pulp mills. Poiiula- tion (1880), 8,“4 ; (ISOO), 4667 ; (1900), 5115, of whom 1044 were foreign-born.

Kavala, or Cavalla, a town of Turkey, on the

shore of the Bay of Kavala, behind the ^gean island of Thasos. Its resident population of about 17,000 is increased in summer by an influx of peasantry, of whom during the season 5000 to 6000 are employed m curing, drying, and preparing for export the tobacco which is the speciality of the town, and which engrosses all its agri- cultural, industrial, and commercial energies. The pro- duction more than doubled in the last twenty years of the 19th century. It is now largely bought by the State monopolies of Austria-Hungary, Italy, Eumania,_ and Servia, and is making way in Germany, Great Britain, Russia, and the United States. The crop of 1898 produced 16,000 tons of marketable tobacco, and that of 1899 was even larger. In 1900, out of a total export value of £1,220,670, over £1,193,220 was for tobacco. The total imports average about a quarter of a million sterling. The house in which Mehemet Ali was born— a mean little structure in one of the tortuous streets of the old town — is still standing. It is distinguishable by a plate which the authorities have affixed to it.

Kavanagh, Arthur Macmorrough (1831- 1889), Irish politician, son of Thomas Kavanagh, M.P., who traced his descent to the ancient kings of Leinster, was born in Co. Carlow, Ireland, 25th March 1831. He had only the rudiments of arms and legs, but in spite of these physical defects had a remarkable career. He learnt to ride in the most fearless way, strapped to a special saddle, and managing the horse with the stumps of his arms; and also fished, shot, drew, and wrote, various mechanical dodges being devised to supplement his limited ^ physical capacities. He travelled extensively in Egypt, Asia Minor, Persia, and India between 1846 and 1853, and after succeeding to the family estates in the latter year, he married in 1855 his cousin, Miss Frances Mary Leathley. Assisted by his wife, he was a most phil- anthropic landlord, and was an active county magistrate and chairman of the board of guardians. A Conservative and a Protestant, he sat in Parliament for Co. Wexford from 1866 to 1868, and for Co. Carlow from 1868 to 1880. He was opposed to the disestablishment of the Irish Church, but supported the Land Act of 1870, and sat on the Bessborough Commission. In 1886 he was made a member of the Privy Council in Ireland. He died of pneumonia 25th December 1889, in London. It is supposed that his extraordinary career suggested the idea of ” Lucas Malet’s ” novel, Tlie Histm-y of Sir BicJiard Cahnady.

Kazan, a government of middle Russia, at the con- fluence of the Volga with the Kama. Area, 24,601 square miles. Population (1879), 1.872,437; (1897), 2,191,058, of whom 1,113,555 were women, and 176,396 lived in towns. It consisted of Russians (885,683 out of a total of 2,221,100 in 1893), Tatars (688,650), and a variety of Finno- Turkish stems: Chuvashes (482,260), Chere- misses (118,511), Mordves (26,648), Votyaks (8792), Mescheryaks (3628) ; some Jews (2829), some Poles (2702), &c. The Russians belong to the Greek Church or are Nonconformists ; the Tatars are Mussulmans, and the other Fiuno-Turkish stems ai-e either pagans or belong officially to the Greek Church, the respective figures being (in 180.”) : Greek Orthodox, 1,529,235 ; Nonconformists, 24,112 (more in reality) ; other Christian religions, 4025 ; Mussulmans, 648,877 ; Jews, 2367 ; pagans, 12,462. The average natural yearly increase of population (slightly in excess among the Russians) was about 26,000 ; marriages about 18,000.

Agriculture is tlie chief occupation, and 82 per cent, of the population are peasants. Out of 7,672,600 acres of arable land 4,516,500 were under crops — chiefly rye, oats, some wheat, barley’,

sarrazin, lentils, flax, hemp, and potatoes. The crops leave on an average year an available surplus of ahout 1,460,000 quarters, resulting in a great scarcity and even famine in bad years. There are 450,000 horses, 300,000 horned cattle, 1,200,000 sheep, 100,000 swine, and 32,000 goats. Bee-keeping is an important branch of income. Factories occupy only about 10,000 persons, and show a yearly return of about £1,500,000. A great variety of petty trades, especially those connected with wood, are carried on in the villages, partly for export. The fairs are well attended. There is con- siderable shipping on the Volga, Kama, Vyatica, and their tribu- taries, the yearly returns of the aggregate shipping on the first two rivers being estimated at from £800,000 to £1,100,000. The schools are very unequally distributed in the different dis- tricts of the province, and are attended mainly by the Russians and the Chuvashes, but not by the Mussulman children. There were, in 1892, 1238 schools, of which 101 were at Kazafl.

The village schools were visited by 40,209 boys and 11,039 girls. A seminary for teachers, 12 Russian schools, and 682 medresses and TOeteeftsgave education to 20,930 Mussulman boys and 12,295 girls. Kazan is divided into twelve districts, the chief towns of which are Kazail, Cheboksary (4568 inhabitants), Chistopol (20,161), Kozmo- demiyansk (5172), Laishev (3743), Mamadyzh (4213), Spassk (2779), Sviyazhsk (2363), Tetyushi (4754), Tsarevokokshaisk (1654), Tsyvilsk (2337), and Yadrin (2467).

Kazan, capital of the above government, 60 miles above the confluence of the Volga with the Kama, and 5 miles from the left bank of the Volga, one of the chief cities of eastern Russia. It has not yet been brought into direct railway communication with Moscow, and is situated 276 miles to the east of the ISrijni-lsTovgorod railway ter- minus ; but it has been connected by a branch line with Saransk on the Eyazan-Samara line (head of the Siberian railway). It is probably on this account that its popular tion, which rapidly increased from 1860 to 1883, when it reached 140,726, has since decreased (125,889 in 1889), and only rose to 131,508 in 1897. Russians form 83 per cent, of its population and Tatars 11 per cent. The city has been embellished by several churches and public buildings. The university of Kazan, to which students flock from north-east, east, and south-east Russia, as well as from Siberia, has an average of about 800 students, an excellent library (150,000 vols.), good laboratories, an ob- servatory, a botanical garden, and a variety of museums (relics of Bulgarian antiquities at the Archaeological Soci- ety ; Persian moneys and Arabian MSS., both described in special works). Nine scientiflc and medical societies con- nected with the university, and issuing their special serials, are important centres for the study of north-east and east Russia and for scientific research. The factories (100) show a yearly return of about £900,000. Soap and candle works, tanneries and metal works are the chief. Kazan is also a very important centre for trade, not only with eastern Russia, but also with Turkestan, Bokhara, and Persia.

See Pineghin’s Kazan New and Old. — Towns and Villages ore the Volga, by the Statistical Committee ; Year-hooks of the same. — V. VELiAMiNorF Zbenoff’s Kasimof Tsars and Tsarevitchs. St Petersburg, 1864, 3 vols. — Zarinskt’s Sketches of Old Kazan. Kazafl, 1877. — Trofimoff’s The Siege of Kazan in IS 52. Kazan, 1890. — N. A. Firsoff’s

works relative to the history of the native population. Kazafi, 1864 and 1869. (p. x. K.)

Kazanskaya. — 1. A Cossack village of south-east Russia, province of Don Cossacks, district Donets, on the left bank of the upper Don, 165 miles north-north-east of Kamenskaya. It has rapidly developed, owing to its trade in cattle and horses, and its vineyards. Population, 16,970. 2. Another Cossack village of same name, in North Caucasia, government and 92 miles west-north-west of Stavropol, on Kuban river. It has become a centre of home industries for the weaving of coarse linen and knit- ting of woollen hosiery. Population, 6550.

Kazbek (Georgian, Mkin-vari; Ossetian, Urs-khoTch), one of the chief summits of theCaucasus (the sixth in order of altitude), 42° 41′ 56″ N. and 44° 29′ 48″ E., altitude 16,546 feet, 7 miles as the crow flies from a station of the

same name on the high road to Tiflis. It rises at the eastern extremity of the high range which runs to the north of the main range (main water-parting), and which is pierced by the gorges of the Ardon and the Terek. It represents an extinct volcano covered with lava, and has the shape of a^ double cone, whose base lies at an altitude of about 5700 feet. Owing to the steepness of its slopes, its eight glaciers cover only an aggregate sur- face of 8 square miles, and the longest of them, Ortz-veri, is only 5 miles long with its nev4 and 24 miles without it. The best-linown glacier is the Devdorak, which creeps down the north-eastern slope into a gorge of the same name, reaching a level of 7580 feet with its snout. Its fall being very steep, and its snout being only 3-4 miles from the military highway, masses of ice and snow occasionally fall down upon the latter. Parrot and Engelhardt made the first attempt to climb up Kazbek in 1811, but reached only a height of 13,863 feet ; neither Meyer in 1829 (14,840 feet) nor Colenati in 1844 (14,547 feet) reached the summit, which was first attained in 1868 by Preshfield, Moore, and Tucker, with a Swiss guide. Several successful ascents have been made since, the most valuable in scientific results being that of Pastukhoff (1889). Kazbek has a great literature, and has left a deep mark in Russian poetry (see D. W. Freshfield in Proceedings Geogr. Soc, Nov. 1888, and The Exploration of the Caucasus, 2 vols., 1896; Hatisian’s

“Kazbek Glaciers,” in Zzvestia Buss. Geogr. Soc. xxiv. 1888; Pastukhoff in Izvestia of the Caucasus Branch of Buss. Geogr. Soc. vol. x. 1. 1891, with large-scale map).

Kazvm, a province of Persia, situated north-west of Tehran and south of Gilan. On the west it is bounded by Khamseh. It pays a yearly revenue of about £22,000, and contains many important and rich villages which produce much grain. Kazvin, the capital of the province, is situated at an elevation of 4165 feet, in 36° 15′ N. and 60° E., and 92 miles by road from Tehran. It has a population of about 35,000, and a thriving transit trade, particularly since the carriage road between Easht and ‘Tehran, with Kazvin as half-way stage, was opened. It has a telegraph station (since 1859) and a post office (since 1876). It is the birthplace of several celebrated writers (mentioned in the earlier volumes), notably of Hamd UUah Mustofi, postmaster-general in the beginning of the 14th century, author of the Nuzhat ul Kulub, the TdHkh i guzideh, and the Zafar ndmeh, the last a very rare MS. obtained by the British Museum a few years ago.

Kearney, capital of Buffalo county, Nebraska, U.S.A., in the broad bottom-lands of the Platte river on the north side, at an altitude of 2162 feet. Its site is level and its plan regular. It is on the main overland line of the Union Pacific, and on a branch of the Burlington and Missouri River railroad. It is in a very fertile agri- cultural region, with whose development it has kept pace. Population (1880), 1782; (1890), 8074; (1900), 6634, of whom 650 were foreign-born.

Kearsley, a township in the Radcliffe-cum-Earn- worth parliamentary division of Lancashire, England, 4 miles south-east of Bolton, with a station on the Lancashire and Yorkshire railway. Besides the parish church of St Stephen, there are Congregational, Wesleyan, Primitive Methodist, and Swedenborgian places of worship. The industries are coal-mining, iron-founding, paper-making, and cotton-spinning. Area of township and urban dis- trict, 997 acres ; population (1881), 7263 ; (1901), 9217.

Kecskemet, a municipal town of Hungary, in the county of Pest-Pilis-Solt-Kis-Kun, with 48,493inhabitants in 1890 and 57,812 in 1900. Besides raising cereals,

fruit is extensively cultivated, and there is a considerable production of wine. More than a million baskets of fine apples and apricots are yearly exported.

Keeley, Mary Anne (1806-1899), English actress, was born at Ipswich, 22nd November 1805 or 1806. Her maiden name was Goward. She went on the stage at an early age, and, after some experience in the provinces, appeared in London in 1825. So far she had principally undertaken ” singing parts,” but it was not long before she gave these up in favour of the drama proper, where her powers of character-acting could have scope. In June 1829 she was married to Robert Keeley, an admirable comedian, who died in 1869. Between 1832 and 1838 she acted at Covent Garden, at the Adelphi with Buckstone, and at the Olympic with Charles Mathews. Late in 1838 she made her first great success in the part of jSTydia, the blind girl, in a dramatized version of Tlie Last Days of Pompeii, and followed this with an equally striking impersonation as Smike in Nicholas Nickleby. In 1839 came her decisive triumph with her picturesque and spirited acting as the hero of a play founded upon Harrison Ainsworth’s Jack Sheppard. So dangerous was con- sidered the popularity of the play, with its glorification of the prison-breaking felon, that the Lord Chamberlain ultimately forbade the performance of any piece upon the subject. It is perhaps mainly as Jack Sheppard that Mrs Keeley has lived in the memory of playgoers who saw her, despite her long subsequent career in plays more worthy of her remarkable gifts. Under Macready’s management at Drury Lane she played ISTerissa in The Merchant of Venice, and Audrey in As You Like It ; managed the Lyceum with her husband from 1844 to 1847 ; acted with Webster and Kean at the Haymarket ; returned for five years to the Adelphi ; and eventually made her last regular public appearance at the Lyceum in 1859. From that time she appeared upon the boards only to assist at benefits and similar performances. In spite of the great age she attained, she preserved an alto- gether exceptional vigour and youthfulness of disposition until the short illness which terminated in her death on 12th March 1899. (e. p. s.)

Keeling Islands (often called Cooos, and Cocos- Kbeling Islands), a group of coral islands in the Indian Ocean, between 12° 4′ and 12° 13′ S. and 96° 49’~~57′ E., but including a smaller island in 11° 50′ N. and 96° 60′ E. They were discovered in 1609 by Captain Keeling on his voyage from Batavia to the Cape, were in 1878 (after several years of existence as an independent pos~~ session of the Crown) attached to the Government of Ceylon, and eventually in 1882 were placed under the authority of the governor of the Straits Settlements. Since “Forbes’s account of his sojourn in 1878, the islands have been visited, at the expense of Sir John Murray, the distinguished naturalist of the Challenger, by Dr Guppy, Mr Kidley, and Dr Andrews. The object of their visits was the investigation of the fauna and flora of the atoll, more especially of the formation of the coral reefs, the accountof which by Darwin (who spent a short period on the group in 1836 on his voyage in the Beagle) made the islands classic ground, as it was from the observations he there made that his celebrated theory of the formation of coral reefs was founded. Dr Guppy was fortunate in reaching North Keeling Island, which, as it can be landed on only during the calmest weather, has very seldom been visited. The island he found to be about a mile long, with a shallow enclosed lagoon, less than 3 feet deep at ordinary low water, with a single opening leading into it on its east or weather side. A dense vegetation of iron-wood (Cordia) and other

trees and shrubs, together with a forest of cocoanut palms, covers its surface. It is tenanted by myriads of sea-fowl, frigate-birds, boobies, and terns {Gygis Candida), which find here an excellent nesting-place, free from disturbance, for the island is uninhabited, and is visited by the owner (Mr J. Clunies Ross) only once or twice a year for the purpose of gathering its produce. The excrement from this large colony has changed the carbonate of lime m the soil and the coral nodules on the surface into phosphates, to the extent in some cases of 60-70 per cent., thus form- ing a valuable deposit, beneficial to the vegetation of the island itself and probably yet to be of commercial value. The lagoon is slowly filling up and becoming cultivable land, but the rate of recovery from the sea has been specially marked since the eruption of Krakatoa, the pumice from which has been washed on to it in enormous quantity, so thatthe lagoon has advanced its shores from 20to30 yards. There is an anchorage on the west side of the island ; but, unless in dead calm weather, it must be used with

the utmost caution, as a northerly wind suddenly arising would place a vessel in the greatest jeopardy. Forbes's and Guppy's investigations go to show that, contrary to Darwin's belief, there is no evidence of upheaval or of subsidence in either of the Keeling groups. The atoll has an exceedingly salubrious climate, and it might well be used as a sanar torium for phthisical patients, the temperature never going to extremes. The highest annual reading of the thermo- meter almost never tops 89° F. or falls beneath 70°. The mean temperature for the year is 78-5° F., and as the rain- fall rarely exceeds 40 inches, the atmosphere never becomes unpleasantly moist. The south-east trade blows almost ceaselessly for ten months of the year. Both groups of the Keelings continue under the proprietorship of Mr Ross. A profitable trade is done in cocoanuts, of which the islands, now nearly all fully planted, yield an enormous number. There are few other exports. The imports are almost entirely food-stuffs and other necessaries for the inhabitants, who are all practically the dependants of, and form a patriarchal colony under, Mr Ross, who is the Crown's representative as well as absolute owner, as he holds from the Government under a lease of a thousand years.

See Henry O. Fokbes. A Naturalist'' s Wanderings in the Eastern Archipelago. London, 1884. — Dr H. B. Guppy. "The Cocos- Keeling Islands," Scottish Geographical Magazine, vol. v., 1889.

(h. o. F.)

Keene, Charles Samuel (1823-1891), English black-and-white artist, the son of Samuel Browne Keene, a solicitor, was born at Hornsey on the 10th of August 1823. Educated at the Ipswich Grammar School until his sixteenth year, he early showed artistic leanings. Two years after the death of his father he was articled to a London solicitor, but, the occupation proving uncon- genial, he was soon removed to the office of an architect, Mr Pilkington. His spare time was now spent in drawing historical and nautical subjects in water-colour. For these trifles his mother, to whose energy and common-sense he was greatly indebted, soon found a purchaser, through whom he was brought to the notice of the AMiympers, the wood-engravers. This led to his abandoning his work as an architect and being bound to them as apprentice for five years. His earliest known design is the frontispiece,

signed “Chas. Keene,” to TJie Adventures of Dick Boldhero in Search of his Uncle, &c. (Darton and Co., 1842). His term of apprenticeship over, he hired as studio an attic in the block of buildings standing, up to 1900, between the Strand and Holywell Street, and was soon hard at work for the Illustrated London News. At this time he was a member of the ” Artists’ Society ” in Cliptone Street, after- wards removed to the Langham studios. In December 1851 he made his first appearance in Punch and, after

THRIFT.

Peebles Body {to Tovmsman who was supposed to be in London on a visit) ” E — Efl, Mac ! ye ‘re sune Hame a’gain ! ” Mac. ” E — EH, it’s just a ruinous Place, that ! MuNj a had na’ bees

THE-ERRE ABUNE Twa HoOUBS when — £^JVG— WENT Saxpence///”

“THE UNSEEN WORLD.”

Sclentijic Gent {with his hair on end). “Ve’v strange ! But I could almost

Swear — I hear Foo’stbps— pollowinmedownstairs ;”

{Bolts into his bedroom, locks the door, aiid writes to the *^A thenceum” next day!

“THAT NASTY ORANGE-PEEL!’

r <^ i-aay ysnappislily). "Wht, YOU don’t s’ppoSE I’p SIT DOWN here, vou Old Stdp 1″

[/fc helj)Sjhei’ ujty and maizes off hastily,

lUustmtiom by Chakles Keene. {By permission of the Proprietors of ‘ ‘ Punch.”)

KEEN E — K E E W A T I N

nine years of steady work, was called to a seat at the famous table. It was during this period of probation that he first gave evidence of those transcendent qualities which make his work at once the joy and despair of his brother craftsmen. On the starting of Once a Week in 1859, Keene's services were at once requisitioned, his most notable series in this periodical being the illustra^ tions to Charles Reade's A Good Fight (afterwards re- christened The Cloister and the Hearth) and to Mr George Meredith's Evan Harrington. There is a quality of conventionality in the earlier of these which completely disappears in the later. In 1858 Keene, who was en- dowed with a fine voice and was an enthusiastic admirer of old-fashioned music, joined the " Jermyn Band," after- wards better known as the " Moray Minstrels." He was also for many years a member of Leslie's Choir, the Sacred Harmonic Society, the Catch, G-lee, and Canon Club, and the Bach Choir. He was also an industrious performer on the bagpipes, of which instrument he brought together a considerable collection of specimens. About 1863 the Arts Club in Hanover Square was started, with Keene as one of the original members. In 1864 John Leech died, and Keene's work in Punch thenceforward found wider opportunities. It was about this time that the greatest of all modern artists of his class, Menzel, discovered Keene's existence, and became a subscriber to Punch solely for the sake of enjoying week by week the work of his brother craftsman. In 1872 Keene, who, though fully possessed of the humorous sense, was not within measurable distance of Leech as a jester, and whose drawings were consequently not sufficiently " funny " to appeal to the laughter-loving public, was fortunate enough to make the acquaintance of Mr Joseph Crawhall, who had been in the habit for many years of jotting down any humorous incidents he might hear of or observe, illustrat- ing them at leisure for his own amusement. These were placed unreservedly at Keene's disposal, and to their inspiration we owe at least 250 of his most successful drawings in the last twenty yea,rs of his connexion with Punch. A list of more than 200 of these subjects is given at the end of Tlie Life and Letters of Charles Keene of "Punch." In 1879 Keene removed to 239 King's Road, Chelsea, which he occupied until his last illness, walking daily to and from his house, 112 Hammersmith Road. In 1881 a volume of his Punch drawings was published by Messrs Bradbury and Agnew, with the title Our People. In 1883 Keene, who had hitherto been a strong man, developed symptoms of dyspepsia and rheumatism. By 1889 these had increased to an

alarming degree, and the last two years of his life were passed in acute suffer- ing borne with the greatest courage. He died unmar- ried, after a singularly uneventful life, on the 4th of January 1891, and his body lies in Hammersmith ceme- tery. Keene, who never had any regular art training, was essentially an artists' artist. He holds the foremost place amongst English craftsmen in black and white, though his work has never been appreciated at its real value by the general public. No doubt the main reason for this lack of public recognition was his unconvention- ality. He drew his models exactly as he saw them, not as he knew the world wanted to see them. He found enough beauty and romance in all that was around him, and, in his Punch work, enough subtle humour in nature seized at her most humorous moments to satisfy him. He never required his models to grin through a horse collar, as Gillray did, or to put on their company man- ners, as was du Maurier's wont. But Keene was not only a brilliant worker in pen and ink. As an etcher he has also to be reckoned with, notwithstanding the fact that his plates numbered not more than fifty at the out- side. Impressions of them are exceedingly rare, and

hardly half a dozen of the plates are now known to be in existence. He himself regarded them only as experiments in a difficult but fascinating medium. But in the opinion of the expert they suffice to place him among the best etchers of the 19th century. Apart from the etched fron- tispieces to some of the Punch pocket-books, only three, and these by no means the best, have been published. Writing in U Artiste for May 1891 of a few which he had seen, M. Bracquemond says : " By the freedom, the large- ness of their drawing and execution, these plates must be classed amongst modern etchings of the first rank." A few impressions are to be found in the British Museum, but in the main they were given away to friends and lie hidden in the albums of the collector.

Authorities. — G. S. Layaed : Life and Letters of Charles Keene of "Punch."— The Work of Charles Keene, with an introduction and notes by Joseph Pennell, and a bibliography by W. H. Chesson. — M. H. Spielmann, The History of "Punch." — M. Charpentier, La Vie Moderne, No. 14, 1880. — M. H. Spielmann, Magazine of Art, March 1891. — M. Bracquemond, L^ Artiste, May 1891. — G. S. Layard, Scribner's, April 1892. — Joseph

Pennell, Centxiry, October 1897. — George du Maukier, Harper’s, March 1898. (g. S. l.)

Keene, capital of Cheshire county, New Hampshire, U.S.A., on the Ashuelot, and on branches of the Boston and Maine and the Pitchburg railways. Its site is a level plain, on which it is regularly laid out, with broad, well- shaded streets, and it has an excellent water-supply. It has varied manufactures, including the repairing-works of the Fitchburg railroad. Population (1880), 6784 ; (1900), 9165, of whom 1255 were foreign-born.

Keewatin, a district of Canada, bounded on the E. by Committee Bay, Eox Channel, and Hudson and James Bays, on the S. and S.W. by the Albany and English rivers, Manitoba, Lake Winnipeg, and Nelson river, on the W. by the 100th meridian, and on the N. by Simpson and Rae straits and gulf and peninsula of Boothia ; thus including an area of 445,000 square miles. Its surface is in general barren and rocky, studded with innumerable lakes with intervening elevations, forest-clad below 60° N., but usually bare or covered with moss or lichens, form- ing the so-called “barren lands” of the north. With the exception of a strip of Silurian and Devonian rocks, 40 to 80 miles wide, and extending from the vicinity of the Severn river to the Churchill, and several isolated areas of Cambrian and Huronian, the district is occupied by Laurentian rocks. The principal river is the Nelson, which, with its great tributary, the North Saskatchewan, is 1450 miles long ; other tributaries are the Berens, English, Winnipeg, Red, Assiniboine, and South Sas- katchewan. The Hayes, Severn, and Winisk also fall in from the south-west into Hudson Bay, and the Ekwan, Attawapiskat and Albany, 500 miles long, into James Bay. The Churchill, 925 miles, Thlewiaza, Maguse, and Fer- guson rivers discharge into Hudson Bay on the west side ; the Kazan, 500 miles, and Dubawnt, 660 miles, into Chesterfield Inlet ; and Back’s river, rising near Aylmer Lake, flows north-eastwards 560 miles to the Arctic Ocean. The principal lakes are St Joseph and Seul on the southern boundary ; northern part of Lake Winnipeg, 710 feet above the sea; Island; South Indian; Etawney; Nuelltin ; Yathkyed, at an altitude of 300 feet ; Maguse ; Kaminuriak; Baker, 30 feet; Aberdeen, 130 feet; and Garry. The principal islands are Southampton, with an area of 17,800 square miles ; Marble Island, the usual wintering place for whaling vessels ; and Bell and Coats Islands, in Hudson Bay ; and Akimiski, in James Bay. A few small communities at the posts of the Hudson Bay Company constitute practically

the whole of the white population. In 1897 there were 852 Indians in the Churchill and Nelson rivers district, but no figures are available for the district as a whole. The principal posts

in Keewatin are Norway House, near the outlet of Lake Winnipeg ; Oxford House, on the lake of the same name ; York Factory, at the mouth of Hayes river ; and Forts Severn and Churchill, at the mouths of the Severn and Churchill rivers respectively. The lieutenant- governor of Manitoba is, ex officio, lieutenant-governor of Keewatin. (j. wh*.)

Kehl, a river port of Germany, grand duchy of Baden, standing oa the Ehine, opposite to Strasburg, and 30 miles by rail south-west of the town of Baden. Here was opened in 1900 a harbour, 11,480 feet long, and 330 feet wide, with an easy entrance. It is protected from the Rhine by a dyke 26 feet high (above Ehine low water), and cost some £425,000. A second basin is to be added. Population (1900), 3003.

Kei Islands, a group in the Malay Archipelago, belonging to the residency of Amboyna, lying between 6° and 6° 5′ S. and 131’’ 50′ and 133° 15′ E., and consisting of four parts : Nuhu-Iut or Great Kei, Roa or Little Kei, the Tayanda, and the Kur group. Great Kei differs geologically in every respect from the other groups. It is of Tertiary formation (Miocene), and its mountain-chain of stone, running in the direction of its longitudinal axis, has peaks such as Boo, Daap, &c., reaching a height of 2600 feet. All the other groups are of post- Tertiary formation and of level surface, hardly relieved by any heights. According to Professor Martin, the frontier of the islands, detached as they are from the Asiatic continent on the one hand and the Australian continent on the other, runs between (a) Great Kei and the north- west of Timor and (b) the western isles of the Kei group. Among the products of the islands are copra, maize, yams, and tobacco. Planten estimates the population at about 23,000, of whom 14,900 are pagans, 8300 Mahommedans, and about 22 Christians. Area, 672 square miles.

See Kan, ” Onze geograpMsche kennis der Keij-Eilanden,” in Tijdschr. Aardr. Gen., 1887. — Martin, ” Die Kei-inseln u. ihr Verbal tniss zur Australisch-Asiatisohen Grenzlinie,” in ibid., part vii., 1890. — Van Hoevell, “De Kei-Eilanden,” in Tijdschr. Bat. Gen., 1889 ; ” Verslagen van de wetenscliappelijlfe opnemingen en onderzoekingen op de Keij-Eilanden,” 1889-90, by Planten and Wertheim, 1893, witlx map and ethnographical atlas of the south-western and south-eastern islands by Pleyte.

Keighley, a municipal borough (incorporated 1882, extended 1895) in the Keighley parliamentary division of Yorkshire, England, on the Aire, 9 miles north-west of Brad- ford by rail. By the Leeds and Liverpool canal the town is connected with Hull and Liverpool. A grammar-school was founded in 1713, the operations of which have been extended so as to embrace a trade school (1871) for boys and a grammar-school for girls. The Public Libraries Acts have been adopted. There are a hospital and con- siderable charities, and also three public pleasure-grounds. The principal industries are manufactures of woollen goods, spinning, sewing, and washing machines, and tools. Population (1891), 35,012 ; (1901), 41,565.

Keith, a police burgh and important railway junction of Banffshire, Scotland, on the river Isla, 53^ miles north-west of Aberdeen. There are a public hall, a hospital, and an institute and museum. Keith is the centre of the agricultural trade of Banffshire; there are manure and lime works, and tweed and blanket factories ; an extensive dead meat trade is conducted. The public school has a secondary department. Population (1881),

4339; (1901), 4753.

Kekule, Friedrich August (1829-1896), German chemist, was born at Darmstadt on 7th September 1829. He was intended to adopt the profession of an architect, and it was while he was studying at Giessen, in

furtherance of that design, that he came under the in- fluence of Liebig and was induced to take up chemistry. From Giessen he went to Paris, where he attended lectures by Regnault, Fremy, and Wurtz, and contracted a friend- ship with Gerhardt ; then, after a short sojourn in Switzer- land, he visited England, and became acquainted with the doctrines of Williamson and

Odling. He thus enjoyed the advantage of personal intercourse with several of the leading chemical thinkers of the period. On his return to Germany he started a small chemical laboratory at Heidel- berg, where, with a very slender equipment, he carried out several important researches. In 1858 he was appointed professor of chemistry at Ghent, and in 1865 was called to Bonn to fill a similar position, which he held till his death on 13th June 1896. Kekule's main importance lies in the far-reaching contributions which he made to chemi- cal theory, especially in regard to the constitution of the carbon compounds. The doctrine of atomicity had already been enunciated by Frankland, when in 1858 Kekule published a paper in which, after giving reasons for re- garding carbon as a tetravalent element, he set forth the essential features of his famous doctrine of the linking of atoms. He explained that in substances containing several carbon atoms it must be assumed that some of the affinities of each carbon atom are bound by the affinities of the atoms of other elements contained in the' substance, and some by an equal number of the affinities of the other carbon atoms. The simplest caseis whentwocarbon atoms are combined so that one affinity of the one is tied to one affinity of the other ; two, therefore, of the affinities of the two atoms are occupied in keeping the two atoms to- gether, and only the remaining six are available for atoms of other elements. The next simplest case consists in the mutual interchange of two affinity units, and so on. This conception led Kekule to his "closed chain" or "ring" theory of the constitution of benzene (see Chemistry in vol. xxvi.), which has been called the " most brilliant piece of prediction to be found in the whole range of organic chemistry," and this in turn led in particular to the elucidation of the constitution of the " aromatic com- pounds," and in general to new methods of chemical synthesis and decomposition, and to a deeper insight into the composition of numberless organic bodies and their mutual relations. Professor F. R. Japp, indeed, went so far as to say, in the Kekule memorial lecture he delivered before the London Chemical Society on 15th December 1897, that three-fourths of modern organic chemistry is directly or indirectly the product of Kekule's benzene theory, and that without its guidance and inspiration the industries of the coal-tar colours and the artificial therapeutic agents in their present form and extension would have been inconceivable.

(h. m. E.)

Keller, Gottfried (1819-1890), German novelist, was born at Zilrieli, 19th July 1819. His father, a master joiner, dying while Gottfried was young, his education was imperfect, and he wasted much time in trying to learn to paint. At length interest in politics threw him into litera- ture— his talents, first disclosed by some short poems, obtaining recognition from the government of his native canton, and he was enabled to go through a regular course of study at the University of Heidelberg. From 1850 to 1855 he lived at Berlin, where he wrote his most important novel, Der Griine Heinrkh (23rd ed. 1901), remarkable for its delicate autobiographic portraiture and the beauti- ful episodes interwoven with the action, and Die Lente von SeJdwyla (27th ed. 1901), studies of Ziirich life, including in Romeo uiid Julia aus deni Dorfe the most powerful story of real life ever written in German, and in Die drei gerechten Kammmucher, almost as great a master-

piece in the department of humour. Eeturning to his native city with a considerable reputation, he received the appointment of public secretary. Eor a time his creative faculty seemed paralysed by his public duties, but in 1872 appeared Sieben Legenden, and in 1874 a second series of Die Leute von Seldwyla, in both which books, if no longer visited by such happy inspirations as in his youth, he displayed no abatement of power and originality. He retired from the public service in 1876, and employed his leisure in the production of Ziiricher Novellen (1878), Das Sinngedicht, a charming novel (1881) and Martin Salander (21st ed. 1901), a criticism on Swiss institutions in the form of a fiction (1886). He died on 15th July 1890. Keller’s place among German novelists is very high, and his genius is entirely original. Few have united such fancy and imagination to such uncompromising realism, or such tragic earnestness to such abounding humour. The serious didactic purpose of his novels is so far from being obtruded that, except in the last, it is hardly perceived. His Oesammelte WerJce were published in eleven volumes in 1889-1901.

See Bachtold, Kellers Leben, seine Briefe und Tagehucher (Ber- lin, 1893-95), and Gottfried Keller, a Selection of his Tales, trans- lated by Kate

Freiligrath Kroeker (London, 1891). (k. G.)

Kelso, a burgh of barony and police burgh of Rox- burghshire, Scotland, on the river Tweed at its junction with the Teviot, 23 miles west-south-west of Berwick-on- Tweed by road. The distinctive local industry now is the making of fishing tackle of all kinds, for which Kelso firms are widely famed. There is a high school. Population (1881), 4701 ; (1901), 4006.

Kelvin, William Thomson, 1st Bakon (1824-), British physicist, the second son of James Thom-

son, LL.D., professor of mathematics in the University of Glasgow, was born at Belfast, Ireland, 26th June 1824, his father being then teacher of mathematics in the Koyal Academical Institution. In 1832 James Thomson accepted the chair of mathematics at Glasgow, and migrated thither with his two sons, James and William, who in 1834 matriculated in that university, William being then little more than ten years of age, and having acquired all his early education through his father's in- struction. In 1841 William Thomson entered Peterhouse, Cambridge, and in 1845 took his degree as second wrangler, to which honour he added that of the first Smith's Prize. The senior wrangler in his year was Stephen Parkinson, a man of a very different type of mind, yet one who was a prominent figure in Cambridge for many years. In the same year Thomson was elected Fellow of Peterhouse. At that time there were few facilities for the study of experimental science in Great Britain. At the Royal Institution Faraday held a unique position, and was feeling his way almost alone. In Cambridge science had progressed little since the days of N'ewton. Thomson therefore had recourse to Paris, and for a year worked in the laboratory of Regnault, who was then engaged in his classical researches on the thermal properties of steam; but his stay in Paris was comparatively short, for in 1846, when only twenty-two years of age, he accepted the Chair of Natural Philosophy in the University of Glas- gow, which he filled for fifty-three years, attaining universal recognition as one of the greatest physicists of his time. The Glasgow chair was a source of inspirar tion to scientific men for more than half a century, and many of the most advanced researches of other physicists grew out of the suggestions which Thomson scattered as sparks from his anvil. One of his earliest papers dealt with the age of the earth, and

brought him into collision with the geologists of the Uniformi- tarian school, who were claiming thousands of mill-

ions of years for the formation of the stratified portions of the earth's crust. Thomson's calculations on the conduction of heat showed that at some time between twenty millions and four hixndred millions, probably about one hundred millions, of years ago, the physical conditions of the earth must have been entirely different from those which now obtain. This led to a long contro- versy, in which the physical principles held their ground. In 1847 Thomson first met James Prescott Joule at the Oxford meeting of the British Association. A fortnight later they again met in Switzerland, and together measured the rise of temperature of the water in a mountain torrent due to its fall. Joule's views of the nature of heat strongly influenced Thomson's mind, with the result that in 1848 Thomson proposed his absolute scale of temperature, which is independent of the properties of any particular thermometrie substance (see Thermodynam- ics, Ency. Brit. vol. xxiii. p. 286), and in 1861 he pre- sented to the Royal Society of Edinburgh a paper on the Dynamical Theory of Heat, which reconciled the work of Carnot with the conclusions of Rumford, Davy, Mayer, and Joule, and placed the Dynamical Theory of Heat and the fundamental principle of the Conservation of Energy in a position to command universal acceptance. It was in this paper that the principle of the Dissipation of Energy, briefly summarized in the second law of thermo- dynamics, was first stated (ibid. xxii. 479 ; xxiii. 285). In 1850 Thomson experimentally verified the theoretical conclusion of his brother James that, since water expands on freezing, increase of pressure must lower the freezing point (ibid. xii. 612). Applying his principles of energy to thermo-electric currents, Thomson showed that in an unequally heated conductor of the same metal a current of electricity must generally affect the distribution of temperature ("Thomson effect," ibid. viii. 97).

Although his contributions to Thermodynamics may properly be regarded as his most important scientific work, it is in the field of electricity, especially in its application to submarine telegraphy, that Lord Kelvin is best known to the world at large. From 1854 he is most prominent among telegraphists. The stranded form of conductor was due to his suggestion (ibid, xxiii. 114) ; but it was in the letters which he addressed in November

and December of that year to Professor Stokes, and^rhich were published in the Proceedings of the Royal Society for 1855, that he discussed the mathematical theory of signal- ling through submarine cables, and enunciated the con- clusion that in long cables the retardation due to capacity must render the speed of signalling inversely propor- tional to the square of the cable's length (ibid, xxiii. 115, 126). Some held that if this were true ocean tele- graphy would be impossible, and sought in consequence to disprove Thomson's conclusion. Thomson, on the other hand, set to work to overcome the difficulty by improve- ment in the manufacture of cables, and first of all in the production of copper of high conductivity and the con- struction of apparatus which would readily respond to the slightest variation of the current in the cable. The mirror galvanometer (ibid. x. 49, sq.) and the siphon re- corder, which was patented in 1867 (ibid, xxiii. 124, 125), were the outcome of these researches ; but the scientific value of the mirror galvanometer is independent of its use in telegraphy, and the siphon recorder is the direct pre- cursor of one form of galvanometer (d'Arsonval's) now commonly used in electrical laboratories. A mind like that of Thomson could not be content to deal with any physical quantity, however successfully from a practi- cal point of view, without subjecting it to measurement. Thomson's work in connexion with telegraphy led to the production in rapid succession of instruments adapted to the requirements of the time for the measurement of every

electrical quantity, and when electric lighting came to the front a new set of instruments was produced to meet the needs of the electrical engineer. Some account of Thomson's electrometer is given in the earlier volumes of this work (viii. 119-121), while every modern work of importance on electric lighting de- scribes the instruments which he has specially designed for central station work; and it may be said that there is no quantity which the electrical engineer is ordinarily called upon to measure for which Lord Kelvin has not constructed the suitable instrument. Currents from the ten-thousandth of an ampere to ten thousand amperes, electrical pressures from

a minute fraction of a volt to 100,000 volts, come within the range of his instru- ments, while the private con- sumer of electric energy is provided with a meter record- ing Board of Trade units.

When Weber in 1851 pro- posed the extension of Gauss's system of absolute units to electromagnetism, Thomson took up the question, and, applying the principles of energy, calculated the abso- lute electromotive force of a Daniell cell, and determined the absolute measure of the resistance of a wire from the heat produced in it by a known current. In 1861 it was Thomson who induced the British Association to ap- point its first famous com- mittee for the determination of electrical standards, and it was he who suggested much of the work carried out by Clerk Maxwell, Balfour Stewart, and Fleeming Jenkin as members of that committee {ihid. viii. 44, 45, and 104). The oscillatory character of the discharge of the Leyden jar, the foundation of the work of Hertz and of wireless telegraphy, were investigated by him in 1853.

It was in 1873 that he undertook to write a series of articles for Oood Words on the mariner's compass. He wrote the first, but so many questions arose in his mind that it was five years before the second appeared. In the meanwhile the compass went through a process of com- plete reconstruction in his hands, a process which enabled both the permanent and the temporary magnetism of the ship to be readily compensated, while the weight of the 10-inch card was reduced to one-seventeenth of that of the standard card previously in use, although the time of swing was increased {ibid. vi. 228). Second only to the compass in its value to the sailor is Thomson's sounding apparatus, whereby soundings can be taken in 100 fathoms by a ship steaming at 16 knots ; and by the employment of piano-wire of a breaking strength of 140 tons per square inch and an iron sinker weighing only 34 lb, with a self-registering pressure gauge, soundings can be rapidly taken in deep ocean (ihid. xxii. 281). Thomson's tide gauge, tidal harmonic analyser, and tide predicter are briefly described in the earlier volumes of this work (xxiii. 371), and among his work in the interest of navi- gation must be mentioned his tables for the simplifica-

tion of Sumner's method for determining the position of a ship at sea.

It is impossible within brief limits to convey more than a general idea of the work of a philosopher who has pub- lished more than three hundred original papers bearing upon nearly every branch of physical science; who one day is working out the mathematics of a vortex theory of matter on hydrodynamical principles or discovering the limitations of the capabilities of the vortex atom, on another is applying his knowledge of elasticity to tides in the solid earth, or calculating the size of water mole- cules, and later is designing an electricity meter, a dynamo, or a domestic water-tap. It is only by reference to his published papers that any approximate conception

can be formed of his life's

work ; but the student who

has read all these knows com- paratively little of Lord Kelvin if he has not talked with him face to face. Extreme mod- esty, almost amounting to diffidence, is combined with the utmost kindliness in Lord Kelvin's bearing to the most elementary student, and no- thing seems to give him so much pleasure as an oppor- tunity to acknowledge the efforts of the humblest scien- tific worker. The progress of physical discovery during the last half of the 19th century was perhaps as much due to the kindly encouragement which he gave to his students and to others who came in contact with him as to his own researches and inven- tions ; and it would be diffi- cult to speak of his influence as a teacher in stronger terms than this.

One of his former pupils. Professor J. D. Cormack, writes : " It is perhaps at the lecture table that Lord Kelvin displays most of his characteristics. . . . His master mind, soaring high, sees one vast connected whole, and, alive with enthusiasm, with smiling face and sparkling eye, he shows the panorama to his pupils, pointing out the similarities and differences of its parts, the boundaries of our knowledge, and the regions of doubt and speculation. To follow him in his flights is real mental exhilaration."

1111852 Thomson married Margaret, daughter of Walter Crum of Thornliebank, who died in 1870 ; and in 1874 he married Frances Anna, daughter of Charles E. Blandy of Madeira. In 1866, perhaps chiefly in acknowledgment of his services to transatlantic telegraphy, Thomson received the honour of knighthood, and in 1892 he was raised to the

peerage with the title of Baron Kelvin of Largs. The Grand Cross of the Royal Victorian Order was conferred on him in 1896, the year of the jubilee of his professoriate. In 1890 he became President of the Royal Society. A list of the degrees and other honours which he received during the fifty-three years he held his Glasgow chair would occupy as much space as this article ; but any biographical sketch would be conspicuously incomplete if it “failed to notice the celebration in 1896 of the jubilee of his pro-

LoRD Kelvin. {From a photograph lyy Elliott and Fry, London.)

fessorship. Never before had such a gathering of rank and science assembled as that which filled the halls of the University of Glasgow on 16th, 16th, and 17th of June in that year. The city authorities j oined with the university in honouring their most distinguished citizen. About 2600 guests were received inthe University buildings, the library of which was devoted to an exhibition of the instruments invented by Lord Kelvin, together with his certificates, diplomas, and medals. The Eastern, the Anglo-American, and the Commercial Cable Companies united to celebrate the event, and from the University Library a message was sent through Newfoundland, New York, Chicago, San Francisco, Los Angeles, New Orleans, Florida, and Wash- ington, and was received by Lord Kelvin seven and a half minutes after it had been despatched, having travelled about 20,000 miles and twice crossed the Atlantic during the interval. It was at the banquet in connexion with the jubilee celebration that the Lord Provost of Glasgow thus summarized Lord Kelvin’s character : ” His industry is unwearied ; and he seems to take r^t by turning from one difficulty to another — difficulties that would appal most men and be taken as enjoyment by no one else. . . . This life of unwearied industry, of universal honour, has left Lord Kelvin with a lovable nature that charms all with whom he comes in contact.”

Kemble, Frances Anne (1809-1893), English actress and writer, daughter of the actor Charles Kemble (Ency. Brit. xiv. 30), was born in London 27th Novem- ber 1809, and educated chiefly in France. She first appeared on the

stage in 1829 as Juliet at Covent Gar- den. Her attractive personality at once made her a great favourite, her popularity enabling her father to recoup his losses as a manager. Besides playing all the principal women's parts — Julia in The Hunchback being perhaps her best — she brought out a play of her own in 1832, entitled Francis the First, a piece of no particular merit. In 1833 she went on tour with her father in America, and in 1834 married a Southern planter, Mr Pierce Butler. She was so horrified, however, at the slavery in Georgia, that she eventually refused to live with her husband on his estates, and they separated. She devoted herself largely to literary work. In 1836 she published a volume of her Journal, in 1837 another play. The Star of Seville, and in 1844, Poems. She also returned to the stage, and, following her father's example, had some success as a Shakespearian reader. She travelled in Italy, and in 1847 brought out a book on the subject, A Year of Consolation. In 1856 she published Christmas Tales (from the German), and in 1863 another volume of her Journal (dealing with life on the Georgia plantation), and also a volume of Plays, including trans- lations from Dumas and Schiller. In 1877 she returned to England, where she lived — using her maiden name — till her death in London on 15th January 1893. During this later period Fannie Kemble was a prominent and pop- ular figure in the social life of London. She published Records of a Girlhood (1878), Records of Later Life (1882), JVotes on some of Shakespeare's Plays (1882), Far Away and Long Ago (1889), and Further Records (1891). Her various volumes of reminiscences contain much valuable material for the social and dramatic history of the period. (h. ch.)

Kempten, a town of Bavaria, Germany, district of Swabia, 81 miles by rail south-west of Munich, and on the river Iller. The palace of the former abbot princes (1656-74) is now partly used as barracks, and the town hall, in the old town, has been restored. Numerous Roman remains were discovered near here in 1886. There are an agricultural and a technical school. Cotton spinning

and weaving, brewing, and manufactures of paper, wood- pulp, hosiery, machinery, and matches are carried on. Population (1886), 14,368 ; (1900), 18,857.

Kendal, a parish, municipal borough, and market town in the Kendal parliamentary division of Westmor- land, England, 8 miles from Windermere on the Kendal and Windermere branch of the London and North- We stern railway. Recent erections embrace a town hall, market house, new buildings for the grammar school, electric lighting and power station, and many villas and terraces of houses. There are a fine old parish church, Roman Catholic, Wesleyan, and other chapels, public library, baths, and pleasure-grounds. Area, 2622 acres. Popula- tion (1891), 14,430 ; (1901), 14,183.

Kendall, Henry Clarence (1841-1882), Aus- tralian poet, son of a missionary, was bom in New South Wales, 18th April 1841, and, as a young man, entered a lawyer's office in Sydney. He had always had literary tastes, and sent some of his own verses in 1862 to London to be published in the Athenaeum. Next year he obtained a clerkship in the Lands Department at Sydney, being afterwards transferred to the Colonial Secretary's office ; and he combined this work with the writing of poetry and journalism. His principal volumes of verse were Leaves from an Australian Forest (1869) and Songs from the Mountains (1880), his feeling for nature, as embodied in Australian landscape and bush-life, being very true and full of charm. In 1869 he resigned his post in the public service, and for some little while he was in business with his brothers. Sir Henry Parkes took an interest in him, and eventually appointed him to an inspectorship of forests. He died on 1st August 1882. In 1886 a memorial edition of his poems was published at Melbourne.

Kenealy, Edward Vaughan Hyde (1819-1880), Irish barrister and author, was born at Cork, 2nd July 1819, being the son of a local merchant. He was educated at Trinity College, Dublin, and was called to the Irish bar in 1840 and to the English bar in 1847, and obtained a fair practice in criminal cases. In 1868 he became a Q.C. and a bencher of Gray's Inn. It was not, however, till 1873, when he became leading counsel for the Tichborne claimant, that he came into any great prominence. He behaved so violently that his conduct in the case became a public scandal, and after the verdict against his client he started a paper to plead his cause and to attack the judges. His behaviour was so extreme that in 1874 he was disbenched and disbarred by his Inn. He then started an agitation throughout the country to

ventilate his grievances, and succeeded in 1876 in getting elected to parliament for Stoke ; but no member would introduce him when he took his seat. Dr Kenealy (as he was always known) gradually ceased to attract atten- tion, and on 16th April 1880 he died in London. He published a voluminous amount of verse, and also of somewhat mystical theology, but his title to remembrance rests solely on his connexion with the Tichborne case.

Keng Tung, the most extensive of the Shan States in the province of Burma. It is in the southern Shan States, and lies almost entirely east of the Salween river. The area of the state is rather over 12,000 square miles. On the N. it is bounded by the states of Mang Lon, Mong Lem, and Keng Hung (Hsip Hsawng Panna), the two latter under Chinese control. On the E. it is bounded by the Mekhong river, on the farther side of which is French Lao territory; on the S. by the Siamese Shan States, and on the W. in a general way by the Salween river, though it overlaps it in some places.

The state is known to the Chinese as MSng Keng, and was frequently called by the Burmese “the 32 cities of the Gon ” (Hkon). Keng Tung has expanded very considerably, since the establishment of British control, by the inclusion of the districts of Hsen Yawt, Hsen Mawng, Mong Hsat, Mong Pu, and the cis-Mekhong portions of Keng Cheng, which in Burmese times were separate charges. The “classical ” name of the state is Khemarata or Khemarata Tungkapuri. About 63 per cent, of the total area of the state lies in the basin of the Mekhong river and 37 per cent, in the Sal ween drainage area. The water- shed is a high and generally continuous range. Some of its peaks rise to over 7000 feet, and the elevation is nowhere much below 5000 feet. Parallel to this succes- sive hill ranges run north and south. Mountainous country so greatly predominates that the scattered valleys are but as islands in a sea of rugged hills. The chief rivers, tributaries of the Salween, are the Nam Hka, the Hwe Long, Nam Pu, and the Nam Hsim. The first and last are very considerable rivers. The Nam Hka rises in the Wa or Vtl states, the Nam Hsim on the watershed range in the centre of the state. Eocks and rapids make both unnavigable, but much timber goes down

the Nam Hsim. The lower part of both rivers forms the boundary of Keng Tung state. The chief tributaries of the Mekhong are the Nam Nga, the Nam Lwe, the Nam Yawng, Nam Lin, Nam Hok, and Nam Kok. Of these the chief is the Nam Lwe, which is navigable in the interior of the state, but enters the Mekhong by a gorge broken up by rocks. The Nam Lin and the Nam Kok are also considerable streams. The lower course of the latter passes by Chieng Eai in Siamese territory. The lower Nam Hok or Me Huak forms the boundary with Siam.

The existence of minerals was reported by the Sawbwa, or chief, to Francis Garnier in 1867, hut none are worked or lood,ted. Gold is washed in most of the streams. Teak forests exist in Mong Pu and Mong Hsat, and the Sawbwa works them as Government con- tracts. One-third of the price realized from the sale of the logs at Moulmein is retained as the Government royalty. There are teak forests also in the Mfekhong drainage area in the south of the state, but there is only a local market for the timber. Rice, as elsewhere in the Shan States, is the chief crop. Next to it is sugar-cane, which is grown both as a field crop and in gardens. Earth- nuts and tobacco are the only other field crops in the valleys. On the hills, besides rice, cotton, poppy, and tea are the chief crops. The cotton goes to China, except what is locally used, and so does the surplus opium, which was formerly chiefly sold in the Upper Lao country, now French territory and a closed market. The tea is carelessly grown, badly prepared, and only consumed locally. A great deal of garden produce is raised in the valleys, especially near the capital. The state is rich in cattle, and exports them to the country west of the Salween. There is no means of estimating the volume of trade. Cotton and opium are exported in large quanti- ties, the former entirely to China, a good deal of the latter to northern Siam, which also takes shoes and sandals. Tea is carried through westwards from Keng Hung, and silk from the Siamese Shan States. Cotton and silk weaving are dying out as industries. Large quantities of shoes and sandals are made of buffalo and bul- lock hide, with Chinese felt uppers and soft hobnails. There is a good deal of pottery work, and the chief work in iron is the manu-facture of guns, which has been carried on for many years in cer- tain villages of the Sam Tao district. The gun barrels and springs are rude but effective, though not very durable. The revenue of the state is collected as the ISurmese thathameda, a rude system of income-tax. From 1890, when

the state made its submission, the annual tributary offerings made in Burmese times were continued to the British Government.

Nothing but the roughest enumeration has ever been made of the population. The following estimate was made by Mr Stirling, the political officer in charge of the state, in 1807-98 :— Inhabitants of the valleys, Shans or Shan-Chinese, 116,000 ; inhabitants of the hills, 56,560, giving a total population of 172,560. This is based on a rough enumeration of households. Of the various tribes of Shans, the Hkon and Lii contribute about 36,000 each, the western Shans 32,000, the Lem and Lao Shans about 7000, and the Chinese Shans about 5000. Of the hill tribes, the Kaw or Akha are the most homogeneous with 22,000, but probably the Wa (or Vu), disguised under various gratuitously tribal names, are at least

equally numerous. Nominal Buddhists make up a total of 133,400, and the remainder, 39,160, are admitted followers of animistic re- ligion. Spirit worship is, however, very conspicuously prevalent amongst all classes even of the Shans. The present Sawbwa or chief received his patent from the British Government on the 9th February 1897. The early history of Keng TGng is very obscure, but Burmese influence seems to have been maintained since the lat- ter half, at any rate, of the 16th century. The Chinese made sev- eral attempts to subdue the state, and appear to have taken the capital in 1765-66, but were driven out by the united Shan and Burmese troops. The same fate seems to have attended the first Siamese invasion of 1804. The second and third Siamese invasions, in 1852 and 1854, resulted in great disaster to the invaders, though the capital was invested for a time.

Keng Tung, the capital, is situated towards the southern end of a valley about 12 miles long and with an average breadth of 7 miles. The town is surrounded by a brick wall and moat about 5 miles round. Only the central and northern portions are much built over. The population in 1897 was estimated at about 10,000, with 2500 Shan Chinese in a village immediately outside the walls. It is the most considerable town in the British Shan States. In the dry season crowds attend the market held according to Shan custom every five days, and numerous caravans come from China. The assistant political officer has a guard of fifty sepoys, with a British and

native officer. The military post is 7 miles west of the town, at the foot of the watershed range. At first the head- quarters of a regiment was stationed there ; this was reduced to a wing, and it is contemplated to hold the station with military police. The site was badly chosen, and has proved very unhealthy. The rainfall has not been regularly taken, but probably averages between 50 and 60 inches for the year. The temperature seems to rise to nearly 100° Fahr. during the hot weather, falling 30° or more during the night. In the cold weather a temperature of 40° or a few degrees more or less appears to be the lowest experienced. (j. g. sc.)

Kennedy, Benjamin Hall (1804-1889), English scholar and schoolmaster, was born at Summer Hill, near Birmingham, 6th November 1804. He was ed- ucated at King Edward's School, Bii'mingham, and St John's College, Cambridge. At the university he carried off one classical prize after another, until, having graduated as senior classic, he was elected Fellow and Classical Lecturer of St John's College in 1828. Two years later he became an assistant master at Harrow, from where he went to Shrewsbury School as headmaster in 1836. By this time he had been ordained, and had received the degree of D.D. from his university. In 183lNhe married Miss Janet Caird. He retained the headmastership of Shrewsbury until 1866, the thirty years of his rule there being marked by a long series of successes won by his pupils, chiefly in the field of classics. During that period he held (from 1841) a prebend at Lichfield and (from 1865 to 1868) the incumbency of West Felton, Salop. When he retired from Shrewsbury, a large sum was collected as a testimonial to him, and was devoted partly to the new school buildings and partly to the founding of a Latin professorship at Cambridge. It is cited as characteristic of him that he added £500 to the fund on the special condition that his name should not appear in the designation by which the new professorship was to be known. In 1867 he was elected Begins Professor of Greek at Cambridge and Canon of Ely ; in 1870, member of the Council of the University ; in 1880, Hon. Fellow, and in 1885, Ordinary Fellow of St John's College. From 1870 to 1880 he was a member of the Committee for the Eevision of the New Testament. He was an enthusiastic advocate for the admission of women to a university education, and took a prominent part in the establishment of Newnham and Girton colleges. He was also a keen politician. Among a number of classical school-books published by him are two, a Public ScJiool Latin

Primer and Public School Latin Grammar, which were for long in almost universal use. The former was produced, in accordance with the recommendation of a Eoyal Com- mission upon the chief public schools, by a committee of headmasters (of whom he was one), and was based upon

an Elementary Latin Orammar previously written by him. He published a masterly edition of Sophocles's (Edipus Tyrannus with poetic translation, and performed the same office for Aristophanes's Birds, iEschylus's Aga- memnon, and Plato's Thecetetus. He contributed largely to the collection known as Sabrince Corolla, and published a collection of verse in Greek, Latin, and English under the title of Between Whiles. He died at Torquay, on 6th April 1889. (k. v. s.)

Kenosha, capital of Kenosha county, Wisconsin, U.S.A., on the western shore of Lake Michigan, at an altitude of 611 feet. It is traversed by the Chicago and North-Western railroad. The site of the city is broad and level and its plan fairly regular. It has some lake commerce, and its manufactures include furniture, wag- gons, and carriages. Population (1880), 5039; (1900), 11,606, of whom 3333 were foreign-born.

Kent, a maritime county in the south-eastern corner of England. The area of the ancient county, as given in the census returns, is 995,344 acres, or 1565 square miles, with a population in 1881 of 977,706, and in 1891 of 1,142,324, of whom 555,718 were males and 586,606 females, the number of persons per square mile being 735, and of acres to a person, 0-87. The population of the ancient county in 1901 was 1,351,849. The area of the administrative county, exclusive of the county borough of Canterbury, is 971,849 acres, with a popu- lation of 785,674 ; and including the county borough its area is 975,820 acres, with a population in 1891 of 807,328, and in 1901 of 936,003. Under the provisions of the Local Government Act, 1888, 20,060 acres of the ancient county were transferred to the county of London, and 536 acres, part of Tunbridge Wells urban sanitary district in the ancient county of Sussex, were added in October 1890. The area of the registration county is 968,879 acres, with a population in 1891 of 806,297,

of which 508,647 were urban and 297,650 rural. Within this area the increase of population between 1881 and 1891 was 13-68 per cent. The excess of births over deaths between 1881 and 1891 was 105,557.

The following table gives the number of marriages, births, and deaths, and the number of illegitimate births, in 1880, 1890, and 1899 :—

Tear.

Marriages.

Births.

Deaths.

lUegitimate Births.

Males.

Females.

1880 1890 1899

4794 5242 7029

22,569 22,096 23,566

12,447 12,861 14,876

463 485 465

438 441 464

The following table shows the marriage-, birth-, and death-rates per thousand of the population, with the percentage of illegitimate births, for a series of years : —

18T0-79.

1880.

1880-89.

1890.

1889-98.

1899.

Marriage-rate

14-0

13-6

13-4

13-1

13-7

15-8

Birth-rate .

32-7

30-6

31 -1

27-7

27-1

26-4

Death-rate .

18-4

17-7

16-8

16-1

15-6

16-7

Percentage of

illegitimacy

4-6

4-0

4-3

4-2

4-0

3-9

The birth-rate and death-rate are below the average for England. The number of Scots in the county in 1891 was 6395, of Irish 8155, and of foreigners 3727.

Administration.— The ancient county is divided into eight parliamentary divisions, and it also includes the parliamentary boroughs of Canterbury, Chatham, Dover, Gravesend, Hythe, Maidstone, and Rochester. The administrative county includes seventeen municipal boroughs, exclusive of the county borough of Canterbury (24,868), viz., Chatham (40,753), Deal (10,575), Dover (41,782), Faversham (11,290), Folkestone (30,694), Gravesend (27,176), Hythe (5557), Lydd (2615), Maidstone (33,516),

Margate (23,067), New Bomney (1327), Queenborough (1546), Kamsgate (27,693), Eochester (80,622), Sandwich (3174), Tenterden (3243),

Tunbridge Wells (33,388). The administrative county has one court of quarter sessions and fifteen petty sessional divisions. The non-corporate members of the Cinque Ports of Dover and Sandwich and the municipal boroughs of Canterbury, Deal, Dover, Faversham, Folkestone, Gravesend, Hythe, Maidstone, Margate, Rochester, Sandwich, and Tenterden have each separate commissions of the peace and separate courts of quarter sessions, and the boroughs of Lydd and New Komney have separate commissions of the peace only. The central criminal court has jurisdiction over certain parishes adjacent to London. All those civil parishes within the county of Kent of which any part is within twelve miles of, or of which no part is more than fifteen miles from Charing Cross, are within the metropolitan police district. Kent is in the south- eastern or home circuit, and Maidstone is the assize town for the county, but assizes are also held at Canterbury for the city. The administrative county contains 389 entire civil parishes and parts of 14 others, and the county borough of Canterbury, 24 entire civil parishes and parts of 10 others. The ancient county contains, in addition to those parishes now in the county of London, 466 entire ecclesiastical parishes and parts of 5 others situate in the dioceses of Canterbury, Rochester, and Chichester.

Education. — The number of elementary schools in the coimty on 31st August 1899 was 570, of which 112 were board and 458 were voluntary schools, the latter including 403 national Church of England schools, 11 Wesleyan, 19 Roman Catholic, and 25 “British and others.” The average attendance at board schools was 32,094, and at voluntary schools 86,965. The total school board receipts for the year ended 29th September 1898 were over £134,322. The income under the Agricultural Rates Act was over £2788. Dairy schools have been established by the technical education committee of the Kent county council. Lectures on hop-growing, horticulture, fruit culture, bees (extensively kept in Kent), and poultry rearing have also been established throughout the county. The South-Eastern Agricultural College, Wye, is under the control of the county councils of Kent and Surrey. In 1899 there were six reformatory and industrial schools in the county.

Agriculture.- — About five-sixths of the area of the county are under cultivation, and of this about five-ninths are in permanent pasture. In the thirty years from 1868 to 1898 woodland had increased from 78,000 acres to 96,927 acres ; 6591 acres are occupied by heathland used for grazing. Over 25,000 acres are devoted to orchards and over 22,000 acres to small fruit, and it is estimated that since 1868 the whole area of fruit land has more than doubled. At least 20,000 acres are devoted to the production of vegetables, salads, herbs, and fiowers. Owing to the low prices obtained for hops in recent years the acreage has diminished from 38,606 acres in 1868 to 31,988 acres in 1899. The largest hop acreage in Kent was in 1885, when there were 44,834 acres.

The following table gives the main divisions of the cultivated area at intervals from 1880 : —

Tear.

Total Area under Cul- tivation.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1880 1890 1899

741,384 760,780 748,157

227,907 200,365 153,203

84,438 77,303 70,858

54,221 54,139 52,949

318,619 368,474 408,674

13,217

11,6.39

7,964

The following table gives particulars regarding the principal live stock during the same years : —

Teai-.

Total Horses.

Total Cattle.

Cows or Heifers

in Milk or

in Calf.

Sheep.

Pigs.

1880

‘ 1890

1899

29,120 28,150 27,850

76,776

75,550 78,572

28,821 32,160 34,267

968,258 916,214 942,645

56,006 66,659 63,133

Industries and Trade. — According to the annual report for 1898 of the chief inspector of factories (1900) , the total number of persons employed in factories and workshops in 1897 was 47,089, as com- pared with 44,677 in 1896. Textile factories employed only 225. In non-textile factories 39,790 persons were employed, as compared with 38,200 in 1896, of which number 16,349 persons were em- ployed in the manufacture of machines, appliances, conveyances, and tools, 7194 in the clay and stone industry, and 6491 in paper- making, printing, &c. The number of persons employed in work- shops in 1896 was 7074, of which number 3692 were employed in the clothing industry. The fisheries of Kent are of considerable importance, and are carried on chiefly at Deal, Dover, Folkestone, Margate, Ramsgate ; Pegwell Bay, and Gravesend (shrimps), Queen- borough, Rochester, Milton, Faversham, and Whitstable (oysters). The county is also famous for its shipbuilding and marine engine yards, iron foundries, breweries, tanneries, &c. The dockyards are

at Chatham and Sheerness, packet stations at Dover and Folke- stone, and harbours at Ramsgate and Dover.

Adthobities. — Lambarde. Perambulation of Kent. London, 1576, 1826.— Hasted. History of Kent, 4 vols, folio, Canterbury, 1778-99; 2nd edition, 12 vols. 8vo, Canterbury, 1797-1801.— Milne and Gordon-. Indigenous Botany. London, 1793. — Smith (J. R.). Bibliotheca Cantiana. London, 1837. Archceologia Cantiana {Transactions of the Kent Arohseologioal Society). Lon- don, from 1858. — Glynne. Notes on the Churches of Kent. London, 1877. (h. b. W*.)

Kenton, capital of Hardin county, Ohio, U.S.A., on the Scioto river, at an altitude of 1015 feet, and on the Ohio Central lines and the Cleveland,

Cincinnati, Chicago, and St Louis railroad. Population (1880), 3940 ; (1900), 6862, of whom 493 were foreign-born and 271 negroes.

Kentucky. — One of the central states of the United States of America. It has an area of 40,400 square miles, 400 square miles of which are estimated to be water surface, including the entire breadth of the Ohio river, over which it has jurisdiction, and half of the Mississippi river, leaving as the land area of the state 40,000 square miles.

Population. — The population of the state in 1880 was 1,648,690; in 1890, 1,858,635; and in 1900, 2,147,174, making it at the last date the twelfth state in the coun- try in population. The rate of increase between 1890 and 1900 was 15-5 per cent., about one-fourth less than the average of the country. In 1900 the density of population was about 54 to the square mile ; males were slightly in excess of females, the proportion being 60-8 per cent, males to 49-2 per cent, females. The foreign- born numbered but 50,249, or 2-3 per cent, of the whole population, and the number of negroes was 284,706, or 13-3 per cent. The proportion of negroes is steadily de- creasing, owing to their migration to other states both north and south of Kentucky. The urban population in 1900, classing as such all persons in cities of more than 8000 inhabitants, was 16-9 per cent, of the total popular tion, as compared with 14-9 ten years before. The prin- cipal cities, with their population in 1900, are : Louisville, at the falls of the Ohio, 204,731 ; Covington, 42,938; and Newport, 28,301, on the Ohio, opposite Cincinnati; Lexington, 26,369 ; Paducah, on the Ohio, at the mouth of the Tennessee, 19,446 ; Owensboro, 13,189 ; Henderson, 10,272 ; and Prankfort, the capital, 9487. Of the popu- lation over ten years of age in 1890, 21-6 per cent, were illiterate ; this illiteracy was in great part confined to the negroes, 55-9 per cent, of whom were classed as illiterates, while only 15-8 per cent, of the whites came under this head. Out of 469,206 white males of voting age in 1900, 65,517 were unable to write ; while out of 74,728 negro males of voting age, 36,990 were unable to write.

Agriculture and Mining. — Kentucky is still in the main an agricultural state, its chief industries and avocations relating to that branch. In 1890 there were 179,264 farms, comprising 21,412,229 acres, of which a little more than half, or 11,818,882 acres, 46 per cent, of the total area of the

state, was improved. The average size of farm was 119 acres, or a little less than the average of the country. Three-fourths of all farms were owned by their occupants, the remainder being rented for money or a share of the products. The value of farms, implements, and live stock, or, in other words, the farm capital, ex- ceeded $428,000,000, and the value of products was nearly $66,000,000. Tobacco is one of the chief products of the state. In 1896 there were devoted to its cultivation 196,745 acres, and the crop amounted to 143,623,850 lb, or 36 per cent, of the crop of the entire United States. In 1900, 12,442,846 bushels of wheat were produced, an amount larger than was needed for the supply of the popu- lation, leaving a surplus of at least 2,500,000 bushels for export. In the same year 390,064 tons of hay were pro-

duced, and 2,807,490 bushels of potatoes ; there were 2,701,876 sheep, and the wool clip was 1,675,163 ft of scoured wool. The raising of hemp, which was once an important industry, has greatly diminished. The area of woodland is estimated at 22,200 square miles, or 55 per cent, of the area. The forests are mixed, but composed largely of deciduous trees, valuable for lumber. The chief mineral resources are coal and iron, and their development has progressed rapidly. In 1900, 4,113,620 tons of coal were mined, mainly in the eastern field, where large areas of superior coking coal are found. The amount of coal mined quadrupled between 1880 and 1900, giving Ken- tucky the tenth place among the states in this respect. The amount of pig-iron produced in 1900 was 71,662 tons.

Education, Charities, <6c.— The public school system was main- tained at a cost of $2,650,190 in 1900. The number of pupils enrolled was 501,893, or about five-eighths of the number of persons (798,027) between five and twenty years of age inclusive. The average attendance was only three-fifths of the enrolment. The number of teachers employed was 9960, and schools were open for an average period of only 115 days in the year. There are thirteen colleges for men, including co-educational institutions, and eleven colleges for women. The number of students in all these institutions in 1899 was 5487. The statistics of church membership show that more than three-fifths of all church mem- bers are either Baptists or Methodists. Baptists constituted 37 per cent., Methodists 24 per cent., Roman Catholics 17 per cent., and Disciples of Christ 14 per cent, of all church members. Of

charitable and penal institutions there are state prisons at Frank- fort and Eddyville, asylums for the blind, deaf and dumb at Louisville and Danville, and insane asylums at Lexington, Hopkins- ville, and Anchorage.

Manufactures. — The manufactures are largely comprised in the city of Louisville, where nearly one-half the manufacturing capital of the state is invested. In 1900 the state contained 9559 manu- facturing establishments (including those having product of less than |500 each), with a total capital of §104,030,791 ; they em- ployed 63,206 hands, to whom was paid in wages §22,430,958 ; the products had a value of §154,590,069. The leading products were manufactured tobacco, whisky, malt liquors, flour, foundry and machine-shop appliances, iron and steel, leather, lumber, , carriages and waggons, furniture, agricultural implements, and packed meats.

Railways. — In 1900 the railway mileage was 3083 miles, which was mainly in the hands of the Louisville and Nashville, the Chesapeake and Ohio, and Queen and Crescent companies. These agencies of transportation are supplemented by the Ohio, Missis- sippi, Cumberland, Tennessee, and other navigable rivers, but altogether the means of intercommunication are not as yet well developed.

Finances. — The finances are in an excellent condition. In 1899 the receipts into the state treasury were $5,013,010, and the expenditure was $4,282,225. The amount of indebtedness was trifling, being less than the sinking fund. There were eighty-one national banks in the state, with a capital of §12,000,000, and 225 state and private banks and trust companies, with a capital of

$17,000,000.

Political History. — Politically as well as geographically Ken- tucky is a border state, political parties being almost equally powerful, with perhaps a slight preponderance in favour of the Democratic party, which has commonly carried the elections. The election of 1900 was so close as to leave the governorship in doubt, and during the controversy which followed, Goebel, the Democratic candidate, was killed. The lieutenant-governor on the Democratic ticket was subsequently declared elected, and

was installed as governor. A new constitution was adopted in 1899. . (H.G*.)

Kenya, a great volcanic mountain in East Africa, situated just south of the equator in 37° 20′ E. It is one of the highest mountains of Africa, its highest peak reach- ing an altitude, according to careful triangulation by Captain Smith, E.E., of 17,184 feet. The central cove, which consists of several steep pyramids, is that of a very denuded old volcano, which when its crater was complete may have reached a height of 2000 feet above the present summit. Lavas dip in all directions from the central crystalline core, pointing to the conclusion that the main portion of the mountain represents a single volcanic mass. Prom the central peaks, of which the axis runs from

W.N.W. to S.S.E., ridges radiate outwards, separated by broad valleys, ending upwards in vast cirques. The most important ridges centre in the peak Lenana (16,300 feet) at the eastern end of the central group, and through it runs the chief water-parting of the mountain, in a gener- ally north to south direction. Three main valleys, known respectively as Hinde, Gorges, and Hobley valleys, run down from this to the east, and four — Mackinder, Haus- berg, Teleki, and Hohnel — to the west. From the central peaks a series of glaciers, 15 in number, all lying west of the main divide, descends to the north and south, the two largest being the Lewis and G- regory glaciers, each about a mile long, which, with the smaller Kolb glacier, lie immediately west of the main divide. Most of the glaciers terminate at an altitude of 14,800-14,900 feet, but the small Cesar glacier, drained to the Hausberg valley, reaches to 14,460. There is clear evidence that glaciation was formerly much more extensive, old moraines being observed down to 12,000 feet. In the upper parts of the valleys a number of lakes occur, occupying hollows and rock basins in the agglomerates and ashes, fed by springs, and feeding many of the streams that drain the mountain slopes. The largest of these are Lake Hohnel, lying at an altitude of 14,000 feet, at the head of the valley of the same name, and measuring 600 yards by 400 ; and Lake Michaelson (12,700 feet?) in the Gorges valley. At a distance from the central core the radiating ridges become less

abrupt and descend with a gentle gradient, finally passing somewhat abruptly, at a height of some 7000 feet, into the level plateau. These outer slopes are clothed with dense forest and jungle, composed chiefly of junipers and Podocarpus, and between 8000 and 9800 feet of huge bamboos. The forest zone extends to about 10,500 feet, above which is the steeper alpine zone, in which pasturages alternate with rocks and crags. This extends to a general height of about 15,000 feet, but in damp sheltered valleys the pasturages extend some distance higher. The only trees or shrubs in this zone are the giant Senecio (groundsel) and Lobelia, and tree-heaths, the Senecio forming groves in the upper valleys. Of the fauna of the lower slopes, tracks of elephant, leopard, and buffalo have been seen, between 11,500 and 14,500 feet. That of the alpine zone includes two species of Dassy (Procavia), a coney (Hyrax), and a rat (Otomys). The bird fauna, which resembles that of Mount Elgon, is of considerable interest, the finest species of the upper zone being an eagle-owl, met with at 14,000 feet. Both the fauna and fliora of the higher levels present close affinities with those of other mountains of East Africa and of Cameroon. The true native names of the mountain are said to be Kilinyaga, Doenyo Ebor (white mountain), and Doenyo Egeri (spotted mountain). It was first seen, from a distance, by the missionary Krapf in 1849 ; approached from the west by Thomson in 1883 ; partially ascended by Teleki (1889), Gregory (1893), and Kolb (1896) ; and its summit reached by Mackinder in 1899.

See Grbgoky. The Great Eift- Valley. London, 1896. — Mac- KiNDEK. “Journey to the Summit of Mount Kenya,” Qeogr. Journal, May 1900. (e. he.)

Keokuk, a city of Lee county, Iowa, U.S.A., on the west bank of the Mississippi, near the mouth of the Des Moines, at an altitude of 505 feet. It obtains its water- supply .from the Mississippi by the Holly pumping system. It has five railways : the Chicago, Burlington, and Quincy ; the Chicago, Eock Island, and Pacific ; the Keokuk and Western ; the Toledo, Peoria, and Western ; and the Wabash. These, with the Mississippi, give Keokuk a large trade. Population (1890), 14,101; (1900), 14,641, of whom 1778 were foreign-born and 1192 negroes.

Kerak, the ancient Kir-Hareseth, altitude 3300 feet, the chief town of a sanjak of the same name in the Suriya (Syrian) vilayet of Asiatic Turkey, and an important military station ; situated east of the Dead Sea, in a fertile district, on a shelving rock-plateau almost encircled by deep ravines. It consists of a walled town, with a castle at its south end, which is isolated by a rock-hewn ditch — the whole forming an interesting specimen of a mediaeval fortress. The original entrances were four winding rock- ‘ hewn passages, but the town is now entered through breaches in the walls, which were in a perfect state before the bombardment by Ibrahim Pasha in 1840. There are traces of Byzantine, Roman, and earlier occupation, includ- ing rock-hewn reservoirs, cisterns, and conduits. But the walls, standing on old foundations, are the work of the Crusaders and of their successors, the Eyiibites and the Memluk sultans of Egypt. They were repaired by Sultan Bibars in the 13th century. The population (6000 Moslems and 1800 Orthodox Greek Christians) is of very mixed blood. Many of the Christians are of Egyptian origin, and -the most influential Moslem families came from Hebron, which from a very early date has had close relations with Moab. The Greeks have two churches and a monastery ; the Church Missionary Society, a station with a medical ofhcer ; and the Koman Catholics, a small monastery and church. Kerak was occupied and fortified by the Latin kings of Jerusalem in 1142, and was one of the great fortresses which commanded the important caravan routes from Egypt and Arabia to Damascus. It became the chief town of the Seigneurie of Kerak de Montreal, which included Hebron (Uenaud, in a charter dated 1177, styles himself Hehronensis et Montis Rcgalis dominus) ; and whilst held by the notorious Pv,enaud de Chatillon, 1177-87, it was repeatedly attacked by Saladin, to whom at last it surrendered in 1188. It continued to be a place of importance until the Turks occupied Pales- tine and Egypt. In 1893, after a period of semi-indepen- dence, it was strongly garrisoned by the Turks.

See Duo de Luynes. Exploration de la Mer Morte, ii. 106-129. — ScHLUJiEEKGEK. Beuaud de CliatUlon, 1.89S. — Tristram. Land of Moab. (c. w. w.)

Kerasund, the ancient Pharnacia, a town on the north coast of Asia Minor, in the Trebizond vilayet, and the port — an exposed roadstead — of Kara-hissar Sharki, with which it is connected by a carriage road. The town is

situated on a rocky promontory, crowned by a Byzantine fortress, and has a growing trade. In 1899 the exports — hazel-nuts, walnuts, hides, and timber — amounted to £187,230, and the imports to £135,010. Its population consists of 4500 Moslems, 4000 Greeks, and 1000 Arme- nians. Pharnacia was the place from which the wild cherry was introduced into Italy by Lucullus, and it was afterwards called Cerasus by the Romans.

Kerbela, the chief town of a sanjak of the Baghdad viMyet of Asiatic Turkey, built round the spot where Hosein was murdered. It is the principal place of Shiite pilgrimage, and of its population (65,000) about 54,000 are Shiites, chiefly Persians and British Indians.

Kerkuk, altitude 1100 feet, the chief town of the Shehrizor sanjak of the Mosul vilayet of Asiatic Turkey, and an important military station. It is a centre for the purchase of Arab horses for India. The population numbers about 10,000 Sunni Kurds, with a few Christians and Jews.

Kermanshah, an important province of Persia, situated west of Hamadan, north of Luristan, and south of Kurdistan, and extending in the west to the Turkish frontier. Its population is about 400,000, and it pays a yearly revenue of over £20,000. Many of its inhabitants

are nomadic Kurds and Lurs, who pay little taxes. The province produces much wheat and barley, and could supply great quantities of grain for export if means of transport were better. Kermanshah (Kermanshahan), the capital of the province, is situated at an elevation of 5100 feet in 34° 19′ K”., and 46° 59′ E., about 220 miles from Baghdad, and 250 miles from Tehran. It has a population of about 35,000, post and telegraph offices, and • is situated on the high road between Tehran and Baghdad, and carries on a great transit trade, estimated at £750,000 per annum.

Kerry, a maritime county of Ireland, province of Munster, bounded on the N. by the mouth of the Shannon, on the E. by Limerick and Cork, on the S. by Cork, and on the W. by the Atlantic.

Population.— The area of the administrative county in 1900 was 1,159,356 acres, of which 154,881 were tillage, 533,696 pasture, 161 fallow, 15,019 plantation, 62,819 turf bog, 39,404 marsh, 311,318 barren mountain, and 42,058 water, roads, fences, &o. The new administrative county, under the Local Government (Ireland) Act, 1898, is identical with the old judicial county. The population in 1881 was 201,039, and in 1891, 179,136, of whom 91,017 were males and 88,119 females, divided as follows among the different religions : — Roman Catholics, 173,195 ; Protestant Episcopalians, 5077 ; Methodists, 399 ; Presbyterians, 210 ; and other denominations, 255. The decrease of population between 1881 and 1891 was 10-89 per cent. The average number of persons to an acre was -15. Of the total population, 160,742 persons inhabited the rural districts, being an average of 89 persons to each square mile under crops and pasture. The population in 1901 was 165,831 (Roman Catholics, 160,209 ; Protestant Episcopalians, 4428 ; Methodists, 317 ; Presbyterians, 225 ; others, 152), being a decrease of 7-7 per cent. The following table gives the degree of education in 1891 : — ■

Males.

Females.

Total.

Percentage.

E.G.

Pr.Ep.

Presb.

Meth.

Read and write Read only Illiterate .

57,007

5,961

18,099

51,538

5,886

21,174

108,545 11,847 39,273

67-2

7-5

25-3

91-0 4-1 4-9

97-0 0-5 2-5

89 8 4-6 5-6

The percentage of illiterates among Roman Catholics in 1881 was 36-1. In 1891 there were 8 superior schools, with 393 pupils (Roman Catholics 367, and Protestants 26), and 872 primary schools, with 33,779 pupils (Roman Catholics 32,834, and Protes- tants 945). The number of pupils on the rolls of the national schools on 30th September 1899 was 35,745, of whom 34,907 were Roman Catholics and 838 Protestants.

The following table gives the numbers of births, deaths, and marriages in the years specified : —

Tear.

Births.

Deaths.

Marriages.

1881 1891 1900

5121 4218 3968

2731 2504 2622

630 649 660

The birth-rate per thousand in 1900 was 24-1, and the death-rate, 15-9 ; the rate of illegitimacy was 1 -8 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1899 was 207,786, of whom 103,707 were males and 108,989 females". The chief towns in the county, with their populations, are : — Tralee, 9318 ; Killarney, 6656 ; Listowel, 3800.

Administration. — ~~The county is divided into four parliamentary divisions, north, south, east, and west, the number of registered electors in 1900 being respectively 5675, 6758, 6005, and 5845. The rateable value in 1900 was £.304,275. By the Local Govern~~ ment (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises 3 urban and 6 rural sanitary districts.

Agriculture. — The following table gives the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900 :—

Tear,

1

o

m

s

III OC5(5

II

Total.

1881

1082

27,588

4648

81,178

6728

5401

90,060

166,670

1891

2042

26,661

8888

27,900

6071

7158

95,862

168,6.33

1896

870

28,878

2966

25.2K;!

6050

6718

99,821

165,0R:1

1900

1391

20,747

2285

22,7S6

6509

7605

94,656

1.54, H70

For 1899 the total value of the cereal and other crops was esti- mated by the Registrar-General at £1,032,005. The jiumber of acres under pasture in 1881 was 566,950; in 1891, 618,613; ana in 1900, 533,696.

Year.

Horses and Mules.

Asses.

Cattle.

Sheep.

Pigs.

Goats.

Poultry.

1881 1891 1396 1900

18,868 17,684 18,252 18,877

11,402

8,765

12,804

15,170

242,822 209,739 238,195 251,379

182,196 82,929 115,785 187,943

62,963 46,630 60,199 58,162

26,462 23,442 21,599 24,887

562,812 485,142

.W7,238

647,966

The number of milch cows in 1891 was 107,111, and m 1900, 108,384. It is estimated that the total value of cattle, sheep, and pigs in 1899 was £3,463,163. In 1900 the number of holdings not exceeding 1 acre was 2287 ; between 1 and 5, 1928 ; between 5 and 15, 3176 ; between 15 and 30, 3886 ; between 30 and 50,3790 ; between 50 and 100, 3899 ; between 100 and 200, 1698 ; between 200 and 500, 600 ; and above 500, 110— total, 21,374. The number of loans Issued (the number of loans being the same as the num- ber of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1900 was 1560, amounting to £668,456. The number of loans for agricultural improvements sanctioned under section 31 of the Land Act, 1881, between 1882 and 1900, was 1179, and the amount issued £71,685. The total amount issued on loan for all classes of works under the Land Improve- ment Acts, from the commencement of operations in 1847 to 31st March 1900, was £479,626, the largest amount issued in any county in Ireland.

Fisheries.— The number of vessels registered in 1899 in the deep sea and coast fishery districts of Valentia and Dingle was 822, employing 3487 men and boys. The number of persons employed in the same year in the salmon fishery districts of Kenmare and Killarney was 903. (w. H. Po.)

Kertch, a seaport of Russia, government of Taurida, on the Kertch Strait, chief town of the Kertch -Yenikale township {gradonaclialstvo). Its mineral mud-baths, one of which is in the town itself and the other on the Chokrak lake (9 miles), are much visited. The popula- tion in 1897 was 28,946. Notwithstanding the deepening of the strait, which now allows ships to enter the Sea of Azov, Kertch retains its importance for the export trade in wheat, which is brought hither hy coasting vessels to be mixed with the better sorts of American wheat before it is exported. There is a private museum (Novikoif’s) of antiquities.

Very important finds of old Greek art continue to be made in the neighbourhood, as well as at Tamaii, on the east side of the Strait of Kertch. The catacombs on the northern slope of the Mitridates Hill, of which nearly 200 have been explored since 1859, possess considerable interest, not only for the relics of old Greek art which some of them contain (although most were plun- dered in earlier times), but especially as material for the history and ethnography of the Cimmerian Bosphorus. In 1890 the first Christian catacomb bearing a distinct date, 491, was discovered by Kulakovsky. Its walls proved to be covered with Greek inscrip- tions and crosses.

AuTHORiTiE.‘s. — Reports of the Imp. Arch. Commission. — Izrcftia (Bulletin) of the Archives Commission of Taurida. — Antiquilh du Bosphore C’immerien eotisei’vees an Jltisee Imperial de VErmitage. St Petersburg, 1854. In.^criptiones antiqiiae orae septetitrionalis Ponti Euxini graecae et latinae. with a preface by V. Y. Laty- sheft. St Petersburg, 18Q0. ^Materials for the Arch, of iiKs.o’a, published by the Imp. Arch. Commission, No. 6. St Petersburg, 1891.

(p. A. K.)

Keshub Chunder Sen [Keshava Ch.vxdra Sena] (1838-1884), Indian religious reformer, was born at Calcutta in 1838. His family belonged to one of the highest castes, and boasted a descent which could be” traced through eight centuries. At the age of ten he lost his father, and was brought up under his mother’s charge. He was sent to an English school, where he made good progress, and afterwards studied at the college of Cal- cutta, where he became proficient in English literature and history. In accordance with the Indian custom, he was married at eighteen to a child of ten. His family wished him to follow a business career, and a place was found for him in the Bank of Bengal, but his bent was towards literature and philosophy, and he soon

resigned his post in order to devote himself exclusively to these pursuits. At that time Sir William Hamil- ton, Blair, Parker, Cousin, Newman, and

Emerson were among his favourite authors. Their works made the deepest impression on him, for, as he expressed it, ” Philosophy first taught me insight and reflection, and turned my eyes inward from the things of the external world, so that I began to reflect on my position, charac- ter, and destiny.” Like many other educated Hindus, Keshub Chunder Sen had gradually dissociated him- self from the popular forms of the native religion, with- out abandoning what he believed to be its spirit. As early as 1857 he had joined the Brahmo Somaj, founded in 1830 by Eam Mohun Eoy, who aimed at initiating a religious reform from within, so as to worship Brahma the creator in accordance with what he believed to be the pure theism of the Vedas. His successor, Debendra ISrath_ Tagore, gathered the worshippers into a stricter association with a definite theistic creed and moral code, and disavowed the Vedas because they recognized pan- theism, transmigration, and other similar doctrines. Ke- shub Chunder Sen threw himself with enthusiasm into the work of this society, and in 1862 himself undertook the ministry of a theistic church. In the same year he helped to found the Albert College, and started the Indian Mirror, a weekly journal in which social and moral subjects were discussed. He also travelled about the country lecturing and preaching. Little by little he had drifted away from Debendra Nath Tagore, who wanted to revive the Hinduism of the Upanishads, while Chunder Sen’s sympathies were more catholic and ex- tended to the teachings of Jesus. He also desired to bring about various reforms, such as the remarriage of widows and the abolition of caste. The result was a split in the society, which broke up into two sections, Chunder Sen putting himself at the head of the reform movement, which took the name Brahmo Somaj of India, and tried to propagate its doctrines by missionary enterprise. Its tenets at this time were the following : — 1. The wide uni- verse is the temple of God. 2. Wisdom is the pure land of pilgrimage. 3. Truth is the everlasting scripture. 4. Faith is the root of all religions. 5. Love is the true spiritual culture. 6. The destruction of selfishness is the true asceticism. In 1866 he delivered an address on ” Jesus’ Christ, Europe and Asia,” which caused a good deal of stir, and led to the false impression that he was about to embrace Christianity. This helped to call attention to him in Europe, and an invitation to visit England was accepted in 1869. The visit was paid in 1870. The Hindu preacher was warmly welcomed by almost all de- nominations, particularly by the Unitarians, with whose creed the Brahmo Somaj had most in common, and

it was the committee of the British and Foreign Unitarian Association that organized the welcome soiree at Hanover Square Rooms on 12th April. Ministers of ten different denominations were on the platform, and among those who officially bade him welcome were Lord Lawrence and Dean Stanley. He remained for six months in England, visiting most of the chief towfts, where he lectured, preached, &c., in all addressing over seventy meetings. His eloquence, delivery, and command of the language won universal admiration. His own impression of England was somewhat disappointing. Christianity in England appeared to him too sectarian and narrow, too ” muscular and hard,” and Christian life in England more materialistic and outward than spiritual and inward. ” I came here an Indian, I go back a confirmed Indian ; I came here a Theist, I go back a confirmed Theist. I have learnt to love my own country more and more.” These words spoken at the farewell soiree may furnish the key to the change in him which so greatly puzzled many of

his English friends. He developed a tendency towards mysticism and a greater leaning to the spiritual teaching of the Indian philosophies. Outwardly, too, he returned in many respects to the customs of his country. He gave his child daughter in marriage to the maharaja of Kuch Behar ; he revived the performance of mystical plays, and himself took part in one. These changes alienated many of his followers, who deserted his standard and joined the more conservative section. Two lectures delivered between 1881 and 1883 throw a good deal of light on Chunder Sen’s latest doctrines. They were ” The Mar- vellous Mystery, the Trinity,” and ” Asia’s Message to Europe.” This latter is an eloquent plea against the Europeanizing of Asia, as well as a protest against Western sectarianism. During the intervals of his last illness he wrote the New Samliita, or the Sacred Laws of the Aryans of the New Dispensation. He died in January 1884, leaving many bitter enemies and many warm friends. (a. z.)

Keswick, a township, market town, and railway station, in the Penrith parliamentary division of Cumber- land, England, near Derwentwater, 16 miles west by south of Penrith. Eecent erections include a cottage hospital and a pavilion with a large hall and other accommodation. A public park of 28 acres was provided in 1887. Area of town- ship, 718 acres. Population (1881), 3201 ; (1901), 4451.

Keswick Convention, an annual summer reunion held at Keswick (24 miles from Carlisle), for the main purpose of “promoting practical holiness” by meetings for prayer, discussion, and personal intercourse. Though it has no denominational limits, it is chiefly supported by the ” Evangelical ” section of the Church of England. The meetings are held in a large tent. Sometimes as many as 10,000 people are present during the week. The rise of the Convention should be viewed in connexion with the religious revival of the ‘seventies (various ” confer- ences ” on the spiritual life, visit of Moody and Sankey, rise of parochial and numerous home missions, &c.). The revival was primarily concerned with individual piety, but the interest awakened soon expanded into vigorous missionary enthusiasm.

The Convention, started in a private manner by Canon Harford Battersby in 1875, rapidly grew after the first few years, hoth in numbers and influence, in spite of attacks on the alleged “per- fectionism” of some of its leaders and on the novelty of its methods. Its immediate aim has always been to deepen personal religion, but some indication of its success may be seen in the interest taken by its members in foreign missions. As an instance it may be mentioned that, in consequence of the first missionary meeting of the Convention (1887), seventeen women missionaries went out to the foreign field. In the History of the C.M.8., vol. iii. (by Eugene Stock) the missionary influence of the ” Keswick men,” in Cambridge and elsewhere, may be readily traced. Cf. the brief sketch, PiEEsoN, The Story of Keswick. (q. e. n.)

Ketteler, Wilhelm Emmanuel, Baeon von (1811-1877), German theologian and politician, was born at Harkotten, in Bavaria, 25th December 1811. He studied theology at Gottingen, Berlin, Heidelberg, and Munich, and was ordained priest in 1844. From that period he resolved to consecrate his life to maintaining the cause of the freedom of the Church from the control of the State. This brought him into collision with the civil power, an attitude which he maintained throughout the whole of a stormy and eventful life. Ketteler was rather a man of action than a scholar, and he first dis- tinguished himself as one of the deputies of the Frankfort National Assembly, a position to which he was elected in 1848, and in which he soon became noted for his decision, foresight, energy, and eloquence. In 1850 he was made bishop of Mainz, by order of the Vatican, in preference to the

celebrated Professor Leopold Schmidt, of Giessen, who had been duly elected to the post, but whose Liberal

sentiments were not agreeable to the Papal party. When elected, Ketteler refused to allow the students of theology in his diocese to attend lectures at Giessen, and ultimately founded an opposition seminary in the diocese of Mainz itself. He carried on his warfare with the State in a manner equally uncompromising. Not content with estab- lishing his seminary for priests, he founded orders of School Brothers and School Sisters, to work in the various educational agencies he had called into existence, and he industriously laboured to institute orphanages and rescue homes. In 1858 he threw down the gauntlet against the State in his pamphlet on the rights of the Catholic Church in Germany. In 1863 he took the further step of espous- ing the cause of the masses against the classes by adopting Lassalle's Socialistic views, and published his DieArbeit- frage unci das CJiristenthum. When the question of In- fallibility arose, he opposed the promulgation of the dogma at first on the ground that such promulgation was in- opportune. But he was not very resolute in his opposition. The opponents of the dogma complained at the very outset that he was wavering, half converted by his hosts, the members of the German College at Rome, and further in- fluenced by his own misgivings. He soon deserted his anti-Infallibilist colleagues, and submitted to the decrees in August 1870. He was the warmest opponent of the State in the KulturJcampf provoked by Prince Bismarck after the publication of the Vatican decrees, and was largely instrumental in compelling that statesman to re- tract the pledge he had rashly given, never to " go to Canossa." To such an extent did Bishop von Ketteler carry his opposition, that in 1874 he forbade his clergy to take part in celebrating the anniversary of the battle of Sedan, and declared the Ehine to be a " Catholic river." After this little was heard of him. He died at Burg- hausen. Upper Bavaria, on 13th July 1877. (j. j. l*.)

Kettering, a market town in the eastern parlia- mentary division of Northamptonshire, England, 14 miles north-east of Northampton by rail. Recent erections in- clude Established and Roman Catholic churches, a

Victoria Hall, a free library, two hospitals for infectious diseases, and a general hospital. There are an endowed grammar- school and a cattle-market. Area of parish (an urban district), 2814 acres. Population (1881), 11,095 ; (1901),

28,653.

Kettle, Sir Rupert Alfred (1817-1894), Eng- lish county court judge, was born at Birmingham, 9th January 1817. His family had for some time been connected with the glass-staining business. In 1845 he was called to the bar, and in 1859 he was made judge of the Worcestershire county courts, becoming also a bencher of the Middle Temple (1882). His title to fame rests mainly on his association with the movement for estab- lishing arbitration in trade disputes. He acted as arbitrator in several important strikes, and besides being the first president of the Midland iron trade wages board, he was largely responsible for the formation of similar boards in other staple trades. His name thus became identified with the organization of a system of arbitration between employers and employed, and in 1880 he was knighted for his services in this capacity. In 1851 he married ; one of his sons subsequently became a London police magistrate. Sir Rupert Kettle died on 6th October 1894, at Wolverhampton. He was the author of several important books dealing with the settlement of labour disputes.

Kewanee, a town of Henry county, Illinois, U.S.A., on the Chicago, Burlington, and Quincy railroad, at an altitude of 847 feet. Its manufactures in large part are agricultural implements, waggons, and carriages.

Population (1880), 4207 ; (1900), 8382, of whom 2006 were foreign-born.

Key, Sir Astley Cooper (1821-1888), English admiral, son of Charles Aston Key (1793-1849), a well- known surgeon, pupil of Sir Astley Cooper, whose niece he married, was born in London in 1821, and entered the navy in 1833. After distinguishing himself in active service abroad, on the South American station (1844-46), in the Baltic during the Crimean war (C.B. 1855), and China (1857), he was appointed in 1858 a member of the royal commission on national defence, in 1860 captain of the steam reserve at Devonport, and in 1863 captain of H.M.S. Excellent and superintendent of the Royal Naval College. He had a considerable share in advising as to the

reorganization of administration, and in 1866, having become rear-admiral, was made director of naval ordnance. Between 1869 and 1872 he held the offices of superin- tendent of Portsmouth dockyard, superintendent of Malta dockyard, and second in command in the Mediterranean. In 1872 he was made president of the projected Royal Naval College at Greenwich, which was organized by him, and after its opening in 1873 he was knighted (K.C.B.) and made a vice-admiral. In 1876 he was appointed com- mander-in-chief on the North American and West Indian station. Having become full admiral in 1878, he was appointed in 1879 principal A.D.C., and soon afterwards First Naval Lord of the Admiralty, retaining this post till 1885. In 1882 he was made G.C.B. He died at Maidenhead, 3rd March 1888.

Key West, capital of Munroe county, Florida, U.S.A., on a small island of the same name, south-west of the southern point of the peninsula of Florida. Being in a commanding position at the entrance to the Grdf of Mexico, it is the site of a naval station, which is defended by Fort Taylor. Most of the island is occupied by this station, but there are also several extensive cigar factories, in which Cuban leaf is made into ” Key West ” cigars. This has been the chief, almost the only, business of the inhabitants. In recent years, however, much of this manufacture has removed to Tampa, and with it has gone a part of the population. During the war between the United States and Spain, Key West became a very im- portant rendezvous and supply point. Population (1890), 18,080 ; (1900), 17,114, of whom 7266 were foreign-born and 5562 negroes.

Kezanlik, or Kasanlik, chief town of a depart- ment in the principality of Bulgaria, dominated on the north by the Balkans, at the southern termination of the Shipka pass, on a tributary of the Maritza, about 20 miles north-west of Eski Sagra, and 59 north of Philippopolis. It possesses a higher-class school. The town is the centre of the attar of rose trade in Bulgaria, the whole of the Kezanlik valley being occupied by fields of roses. Cloth is also manufactured. It was from Kezanlik that the Turks during the war of 1877-78 directed their attacks against the Russians who held the Shipka pass. Popula- tion (1893), 10,765, of whom about one-seventh are Turks.

Khabarovsk, a town of Asiatic Russia, capital of the Amur region, of the Maritime Province, and of the Khabarovsk district which comprises the lower Amur from its junction with the Usuri to its mouth. It was founded in 1855, and is built on a high cliff on the right bank of the Amur, at its confluence with the Usuri, 48° 28′ N., 135° 6′ E., 6532 miles east of Moscow by railway to Sryetensk, and thence down the Shilka and the Amur. It became a town in 1880, when it was made the seat of the governor-general of the Amur region (provinces — Amur, Maritime, and Sakhalin Island). It is con-

nected by rail with Vladivostock (469 miles), a branch railway being built from this main trunk to Port Arthur. The thick forests surrounding the town, now cleared to some extent, offer no facilities for agriculture, but its position at the junction of two great rivers makes of it an important entrepot for goods coming from the Usuri and its tributary the Sungacha, as well as a centre of trade and administration. ‘ The town is built of wood, and has a great cathedral, barracks, a corps of cadets, a monu- ment to Count Muravieff-Amurskiy, and large storehouses. It has also a branch of the Russian Geographical So- ciety, a good museum, and a rich library, a technical rail- way school, a gymnasium for girls, various primary schools, and two philanthropic institutions. Population

(1897), 15,082.

Khaibar Pass, the most important of the passes which lead from India to Afghanistan. The mountain barrier which separates the Peshawur plains from the Afghan highlands differs in many radical respects from the mountain barrier which intervenes between the Indus plains and the plateau farther south. To the south this barrier consists of a series of flexures folded parallel to the course of the river, through which the plateau drainage breaks down in transverse lines forming gorges and clefts as it cuts through successive ridges. West of Peshawur the strike of the mountain systems is roughly from west to east, and this formation is maintained with more or less regularity as far south as the Tochi river and Waziristan. Almost

immediately west of Peshawur, and stretching along the same parallel of latitude from the meridian of Kabul to within 10 miles of the Peshawur cantonment, is the great central range of the Saf^d Koh, which forms throughout its long, straight line of rugged peaks the southern wall, or water-divide, of the Kabul river basin. About the meridian of 71 E. it forks, sending off to the north-east what is locally known as a spur to the Kabul river, but which is geographically only part of that stupendous water-divide which hedges in the Kunar and Chitral valleys, and which, under the name of the Shandur range, unites with the Hindu Kush near the head of the Taghdumbash Pamir. The Kabul river does not really terminate this northern spur of the Saf dd Koh ; it breaks through it, and in breaking through it is forced to the northward in a curved channel or trough, deeply sunk in the mountains between terrific cliffs and preci- pices, where its narrow waterway affords no foothold to man or beast for many miles. To reach the Kabul river in the Afghan territory it is necessary to pass over this water-divide ; and the Khaibar stream, flowing down from the pass at Lundi Kotal to a point in the plains opposite Jamrud, 9 miles to the west of Peshawur, affords the opportunity.

From its commencement amongst the foothills opposite Jamrud to the Lundi Kotal, the road (now a driving road) follows much the same alignment as that adopted in the first Afghan war of 1839-^3. It winds amidst mountains, and is flanked by cliffs and dominating hills throughout its course. About half-way between Jamrud and Lundi Kotal the hill fortress of Ali Masjid, perched on a com- paratively isolated spur, absolutely bars the way. It is the key to the Khaibar ; but as the road approaches, it reaches to a height which very considerably reduces the command of the fort, which is not quite so formidable as it appears. From Ali Masjid to the fortified position at Lundi Kotal the road is more open, but it is everywhere a road of the mountains and not of the plains. At Lundi Kotal (3600 feet) the Khaibar ends, and the drop north- wards to Lundi Khana and by the Okha Khwar nullah to Dakka and the Kabul is through Afghan territory.

The Khaibar has been adopted by the British as the main

road to Kabul, but its difficulties, before they were over- come by British engineers, were such that it was never so regarded by former rulers of India.

The old road to India left the Kabul river near its j unction with the Ku- nar, and crossed the great divide between the Kunar val- ley and Bajaor ; then it turned southwards to the plains. The difficulty which the British authorities experienced with the Khaibar was chiefly in maintaining and guarding it against tribal attack. The tribes occupying the momi- tains which flank it and the villages in its immediate neighbourhood are the Zakka Khel Afridis. Farther to the north, within the Kabul bend, and clustering in the open spaces and uplands which lie beyond the dominating peaks of Torsappa (5360 feet), are the Mohmands, a tribe of Afghan extraction, who as a rule give little trouble, as they possess commercial and agricultural re- • lations in the Peshawur valley. Of late years the Khai- bar has been held by Afridi levies drawn chiefly from other clans than the Zakka, and officered by natives. The failure in 1896 to retain the command of the pass, when the Zakka Afridis combined to attack these other Afridi levies (who were unsupported by British troops), induced the Government of India to alter this system. The Afridi levies who defended the pass with great courage and determination against their fellow tribespeople were still retained as guardians of the Khaibar, but they were commanded by British officers.

See Sir R. Wakbukton. Eighteen Years in the Khaibar. Lon- don, 1900. (t. h. h*.)

Khairagarh, a feudatory state of India, in the Chhattisgarh division of the Central Provinces. Area, 940 square miles; population (1881), 166,138; (1891), 181,184; average density, 199 persons per square mile. In 1901 the population was 137,542, showing a decrease of 24 per cent., due to the results of famine. The estimated revenue was Es.2,25,000; tribute, Rs. 70,000. The chief, who is descended from the old Gond royal fam- ily, received the title of raja as a hereditary distinction in 1898. The state includes a fertile plain, yielding rice and cotton. Its prosperity has been promoted by the Bengal-Nagpur railway, which has a station at Dongar- garh, connected by road with Khairagarh town, the resi- dence of the raja.

K ha i redd in (Khair-ed^Din=” Joj of Religion”)

(1890), Turkish statesman, was of Circassian race,

but nothing is known about his birth and parentage. In early boyhood he was in the hands of a Tunisian slave- dealer, by whom he was sold to Hamuda Pasha, then bey of Tunis, who conceived a great affection for the lad, and gave him his freedom and a French education. When Khaireddin left school the bey made him steward of his estates, and from this position he rose to be minister of finance. When the prime minister, Mahmud ben Ayad, absconded to France with the treasure-chest of the prin- cipality, Hamuda despatched Khaireddin on a mission to the French Government to obtain the extradition of the fugitive. The mission failed ; but the six years it occupied enabled Khaireddin to make himself widely known in France, to become acquainted with French political ideas and administrative methods, and, on his return to Tunis, to render himself more than ever useful to his Government. Hamuda died while Khaireddin was in France, but he was highly appreciated by the three beys — Ahmet (1837), Mohammed (1855), and Sadok (1859) — who in turn followed Hamuda, and to his influence was due the sequence of liberal measures which distinguished their successive reigns. But although Khaireddin's protracted residence in France had imbued him with liberal ideas, it had not made him a French partisan, and he strenuously opposed the French scheme of establishing a protectorate

over Tunis upon ~~which France embarked in the early 'seventies. This rendered him obnoxious to Sadok's prime minister — an apostate Jew named Mustapha ben Ism ael — who finding his purposes thwarted by Khaireddin, intrigued against him ^nd succeeded in completely under~~ mining the bey's confidence in him. His position thus became untenable in Tunis, and shortly after the acces- sion of Abdul Hamid he acquainted the sultan with his desire to enter the Turkish service. In 1877 the sultan bade him come to Constantinople, and on his arrival gave him a seat on the Eeform Commission then sitting at Tophane. Early in 1879 the sultan appointed him grand vizier, and shortly afterwards he prepared a scheme of constitutional government, but Abdul Hamid refused to have anything to do with it. Thereupon Khaireddin resigned office, on the 28th July 1879. More

than once the sultan offered him anew the grand vizierate, but Khaireddin persistently refused it, and thus incurred dis- favour. Gouty and otherwise ailing, Khaireddin repeatedly but vainly sought leave of the sultan to go abroad and re- cruit his health. He died in February 1890, practically a prisoner in his own house.

Khairpur, a native state of India, in the Sind pro- vince of Bombay. Area, 6109 square miles ; population (1891), 131,937 ; average density, 22 persons per square mile. In 1901 the population was 199,665, showing an apparent increase of 51 per cent. The estimated revenue was Ks.11,38,000 ; number of police, 181 ; number of schools (1897-98), 110, with 3764 pupils. The title of G.C.I.E. was conferred upon the present Mir on the occasion of Queen Victoria's Diamond Jubilee. He takes an active interest in improving his state, and especially in education. Khaiepub. town is situated in 27° 31′ N. and 68° 48′ B., on a canal about 15 miles east of the Indus ; railway station, 20 miles south of Sukkur, on the Kotri-Rohri branch of the North-Western railway, which here crosses a corner of the state. Population (1891), 6240.

Khamgaon, a town of India, in the Akola district of Berar, 340 miles north-east of Bombay. The popula- tion in 1881 was 12,390, and in 1891 it was 15,598 ; the municipal income in 1896-97 was Ks.26,164. It is an im- portant centre of the cotton trade, with nine ginning factories and five presses, turning out 43,000 bales. It was connected in 1870 with the Great Indian Peninsula railway by a branch line (7-|- miles).

Khamseh, a small but important province of Persia, between Kazvin and Tabriz. It consisted formerly of five districts, whence its name Khamseh, " the five," but is now subdivided into seventeen districts. The language of the inhabitants is Turkish. The province pays a revenue of about £20,000 per annum, and its capital is Zanj^n.

Khandesh, a district of British India, in the Deccau division of Bombay. The present headquarters are at Dhulia, but the railway junction of Bhusawal is the centre of trade. Area, 10,907 square miles ; population (1881), 1,2.52,016 ; (1891), 1,460,851, showing an increase of 17 per cent. ; average density, 134 persons per square mile. In 1901 the population was 1,460,062, showing an increase of less than 2 per cent. The land revenue

and rates were Rs.47,33,892, the incidence of assessment being R.l : 4 : 9 per acre ; cultivated area (1897-98), 3,004,057 acres, of which 67,692 were irrigated from wells, &c., in- cluding 13,610 acres from Government canals ; number of police, 1858 ; children at school (1897-98), 28,916, being 2-1 per cent, of the total population ; registered death-rate (1897), 48-82 per thousand. The principal crops are millet, cotton, pulse, wheat, and oil-seeds. There are 70 factories for ginning and pressing cotton ; a cotton-mill at

Jalgaon, with 411 looms and 20,000 spindles, employing 1300 hands ; and six printing-presses, each issuing a ver- nacular newspaper of small circulation. The district is traversed for 124 miles by the Great Indian Peninsula railway, which branches at Bhusawal (where there is a bridge over the Tapti) towards Jubbulpore and Nagpur. It is also crossed by the Tapti Valley line from Surat. It suffered somewhat from famine in 1896-97, and more severely in 1899-1900.

Khandwa, a town of British India, in the Nimar district of the Central Provinces, of which it is the head- quarters, 363 miles north-east of Bombay by rail. Popu- lation (1881), 15,152 ; (1891), 16,589. Khandwa is an ancient town, with Jain and other temples. As a centre of trade, it has superseded the old capital of Burhanpur. It is an important railway junction, where the Malwa line from Indore meets the main line of the Great Indian Peninsula. There are eight steam factories for ginning and pressing cotton ; an unaided high school, and railway school for Europeans ; and a printing-press, issuing a vernacular newspaper.

Khdr, a small but very fertile province of Persia, known by the ancients as Choara and Choarene. It has a population of about 10,000. The governor of the pro- vince resides at KishMk Khar, a large village situated 62 miles south-east of Tehran, or at Aradan, a village with post and telegraph offices, 9 or 10 miles farther east. The province has an abundant water-supply from the Hableh-riid, and produces great quantities of wheat, barley, and rice. Of the £6000 which it pays to the State, more than £4000 is paid in kind — wheat, barley, straw, and rice. It is held in fief by the minister of Crown domains (Khalisseh).

Kharkoff, a government of Little Russia, belonging partly to the basin of the Don and partly to that of the Dnieper. Area, 21,041 square miles ;

population, 2,036,949 in 1882; 2,509,811 in 1897, of whom 1,242,892 were women and 367,602 lived in towns; 63 per cent, of the land is owned by the peasants, 26 per cent, by the nobility, 6 per cent, by owners of other classes, and 6 per cent, by the Crown and other institutions. Agriculture is the chief occupation, and the crops in an average year are wheat, 1,080,000 quarters ; rye, 1,805,000 ; oats, 1,100,000 ; barley, 724,000 ; millet, sarrazin, and Indian corn, 380,000 ; potatoes, 433,000 quarters. There remain in an average year 161,160 tons of grain available for export. Flax, hemp, and tobacco are also widely cultivated. Gardening and kitchen gardening are common pursuits. There were in 1895, 330,000 horses, 610,000 cattle, and about 1,080,000 sheep. Domestic industries are not widely de- veloped, and industries, except sugar, have not a great development, their aggregate yearly returns being about £4,200,000. Sugar works — chiefly about Sumy — are the chief of them (over £2,500,000) ; but there are also distilleries, wool-cleaning works, steam flour-mills, and tobacco works. Salt is extracted at Slavyansk. The government is divided into eleven districts, the chief towns of which, with their populations in 1897, are Kharkoff (174,846), Akhtyrka (23,390), Bogodukhoff (11,928), Izvum (12,969), Kupyansk (7797), Lebedin (14,206), Starobyelsk (13,128), Sumy (27,676), Valki (8842), Volchansk (11,322), and Zmiyeff (4652).

Kharkoff, capital of the above province, 480 miles by rail south of Moscow. It grew rapidly during the last quar- ter of the 19th century, and has now 174,846 inhabitants (about 195,000 with its suburbs). Of these, 170,000 are Russians, 16,500 Jews, 3500 Poles, and 2000 Germans. The town has been embellished with new buildings, schools, hospitals, &c. Its factories (wool, flour-mills, tobacco,

confectionery, &c.) show an aggregate yearly return of about £600,000. Its importance as an intellectual centre for Little Russia and as a commercial centre for a wide region is steadily growing. Sugar, raw wool, oil, tobacco, wine, crockery, and textile goods, as also cattle hides, tallow, &c., are the chief items of trade.

Kharputjithe most important town in the Memuret el-Aziz vildlyet of Asia Minor, altitude 4350 feet, situated a few miles south of the Murad Su or EasternEuphrates, on the Samsiin-Sivas-Diarbekr road. The town is built on a hill-terrace about 1000 feet above a well-watered plain of exceptional fertility which lies to the south and sup- ports a large population. On a rocky eminence east of the town is the castle in which Jocelyn, Count of Edessa, and Baldwin II. were imprisoned. Kharpiit is an import- ant station of the American missionaries, who have built a college, a theological seminary, and boys' and girls' schools. In November 1895 Kurds looted and burned the Armenian villages on the plain ; and in the same month Kharpiit was attacked, the American schools burned down, and " Euphrates " College shelled by Turkish troops in the presence of the governor of the vilsiyet. A large number of the Gregorian and Protestant Armenian clergy and peo- ple were massacred, and churches, monasteries, and houses were looted. The viMyet was founded in 1888, and is divided into three sanjaks — Kharpiit, Malatia, and Dersim. It has much mineral wealth, a healthy climate, and a fer- tile soil. The population comprises 500,000 Moslems and 80,000 Christians, nearly all Armenians. The seat of government, Mezere, is on the plain, three miles south of Kharput, and is strongly garrisoned.

Khartum, capital of the Anglo-Egyptian Sudan, and before the Mahdist revolt (1883) administrative centre of the Khedivial possessions in the Upper Nile basin. It takes its Arabic name (" Elephant's Trunk ") from the form of the tongue of land at the confluence of the two Niles, about 1340 miles south of Cairo, with which it has been connected by rail since 1899. After its cap- ture in January 1885 it was abandoned by the Mahdi, who established himself at Omdurman on the opposite (left) bank of the White Nile, and this place remained the headquarters of his successor, the Khalifa Abdullah, till September 1898, when it was taken by the Anglo- Egyptian forces under General (afterwards Lord) Kit- chener, and the seat of government again transferred to Khartum. It had a population estimated before the re- volt at about 70,000, and -has once more risen from its ruins and been in great part rebuilt. In 1901 it numbered over 20,000 inhabitants, attracted by the security for life and property guaranteed by the British and Egyptian Government. Conspicuous amongst the new buildings is the Gordon College, which stands on the spot where the hero fell, and was founded in 1899 for the twofold purpose of commemorating his name and

affording useful instruction to the surrounding peoples. Lying at an altitude of 1200 feet above sea-level, about the limits of the northern dry and the southern moist zone, Khartum has a moderate annual rainfall of some 40 inches, with a fairly salubrious climate, which has attracted European visitors, especially during the winter season. It is be- coming again the headquarters of missionary work, the starting-point of all travellers proceeding by the Nile route to the interior, and the chief centre of commercial enterprise and civilizing influences in Anglo-Egyptian Sudan. (a. h. k.)

Khasi and Jaintia Hills, a district of Brit- ish India, in the Hills division of Assam. It occupies the central plateau between the valleys of the Brahmapu- tra and the Surma, rising very abruptly on the south side.

The Khasi Hills are inhabited by a tribe of the same name, who still live in primitive communities under elective chiefs in political subordination to the British Government. There are 25 of these chiefs, called Siems and by other names, who exercise independent jurisdiction and pay no tribute. The Jaintia Hills used to form a petty Hindu principality, which was annexed in 1835. The inhabitants are a quite distinct tribe, called Panar or Santeng. The headquarters of the district were transferred in 1864 from Cherrapunji to Shillong, which is also the capital of the province. Area, 6041 square miles ; population (1881), 169,360 ; (1891), 197,904, showing an increase of 17 per cent. ; average density, 33 persons per square mile. Hill tribes numbered 185,364 ; Christians, 7144, of whom 164 were Europeans, the remainder repre- senting the work of the Welsh Calvinistie mission among the Khasias. In 1901 the population was 198,989, showing an increase of less than 1 per cent. The land revenue was Es.1,97,904, the incidence of assessment being nearly Iis.2 per acre ; number of police, 178 number of boys at school (1896-97), 4180, being 29-45 per cent, of the male population of school-going age number of girls at school, 1806, or 11-65 per cent., com paring with 1-33 per cent, for the province generally registered death-rate in selected areas (1897), 52-94 per thousand. In 1897 there was 1 tea-garden, with 30 acres under tea, yielding 4000 ft. There are 8 limestone quarries, from which 1,630,000 maunds were exported in 1896-97, yielding to Government an annual revenue of E.S. 18,000. There are also a few coal-mines, which are worked on a small scale. A good cart-road

runs north from Cherrapunji through Shillong to Gauhati on the Brahmaputra ;■ total length, 94 miles. On the Sylhet border there is a small state railway 8 miles long, on the 2-^feet gauge, for co'nveying limestone to the river mart, and using local coal. It was wrecked by the earthquake of 12th June 1897, and again damaged by heavy floods ; but it was reopened in March 1898. The district was the focus of the great earthquake, which not only destroyed every per- manent building, but also broke up the roads and caused many landslips. Among the cliff villages near Cherra- punji the loss of life was about 600.

Kheri, a district of British India, in the Lucknow division of Oudh, which takes its name from an insignifi- cant town ; railway station 81 miles north-west of Luck- now. Population (1881), 5996. The administrative head-quarters are at Lakhimpur, 3 miles distant ; population (1891), 8073. The district has an area of 2965 square miles; population (1881), 831,922; (1891), 903,615, showing an increase of nearly 9 per cent., which has been continuous since 1869 ; average density, 305 persons per square mile, being far the lowest in the province. In 1901 the population was 905,199, showing only an infinitesimal increase. The land revenue and rates were Ks.8,98,633, the incidence of assessment being nearly 9 annas per acre; cultivated area (1896-97), 716,809 acres, of which 27,003 were irrigated from wells and tanks; number of police, 2740; vernacular schools (1896-97), 63, with 2855 pupils; death-rate (1897), 34-26 per thousand. The district is now traversed by a branch of the Oudh and Eohilkhand railway from Lucknow to Bareilly.

Kherson, a government of south-west Russia, on the north coast of the Black Sea. Area, 27,523 square miles. The population of the government reached in 1897, 2,732,- 832, of whom 1,332,175 were women and 785,094 lived in towns (including Odessa). Nearly 45 per cent, of the land is owned by the peasants, 31 per cent, by the nobility, 12 per cent, by other classes, and 12 per cent.

by the Crown, the municipalities, and other institutions. The peasants rent as much as 1,730,000 acres more from the landlords. Forests are scarce (176,500 acres). Owing to the fertility of the soil and the proximity oi markets, agriculture is well developed and 8,900,000 acres are under crops. Agricultural machinery is widely used. The crops in an average year are wheat 2,274,000, rye 1,830,000, barley 1,191,000, oats 650,000, millet, sarrazin, and Indian corn 491,000 quarters. It is estimated that the available surplus of grain amounts to 412,500 tons every year. Flax is also cultivated and gardening prospers. The vine is widely grown, yielding 1,220,000 gallons of wine ; the yearly manufacture of tobacco reaches 5000 cwts. There were in 1895 over 400,000 horses, 3,600,000 horned cattle, and 2,000,000 sheep. The aggregate annual returns of the factories attain £4,500,000, and they give occupation to nearly 11,000 persons. There are a few iron works (£100,000) ; machinery and especially agricultural machinery works (£175,000), sugar works (£1,020,000), steam flour works (£700,000), chemical works, &c. The traffic on the railways and the rivers is very large, owing to' the trade of Odessa. The government is divided into six districts, the chief towns of which are Kherson, capital of the province (69,219), Alexandriya (14,002), Ananieff (16,713), Elisavetgrad (61,841), Odessa (405,041), and Tiraspol (27,585). Odessa with its suburbs constitutes a separate township.

Khingan, Great, a range of mountains of eastern Asia, of considerable length and great orographical im- portance. It is not a range of the alpine type, but the eastern border ridge of the immense plateau of eastern Asia which may be traced from the Himalaya to Bering Strait and from the Tian Shan to the Khingan. The plateau consisting in the south of the terraces of Tibet, and including in the west the very high terrace of the Pamir, has also, in north-west Mongolia and East Siberia, two well-defined terraces separated from each other by the Kentei range and the Yablonovoi Khrebet. The upper terrace comprises north-west Mongolia, and, beyond the trench of the Selenga, the Vitim plateau, whose continua- tion beyond the 120th degree of longitude is only partially explored. The lower terrace of the plateau, from 2500 to 3000 feet of average altitude, includes eastern Mongolia, the Gobi (see Mongolia), the Nerchinsk prairies of Transbaikalia, and the region watered by the upper Zeya, a tributary of the Amur.

The Great Khingan is well known from the 50th degree of latitude, where it was crossed by the present writer, to Kalgan, where it is crossed by the highway leading from Urga to Peking. It appears on this stretch as a border ridge of the Mongolian plateau, having very great orographical importance, since it represents an important climatic and geographic botanical boundary, constituting as it does the western limits of the Manchurian flora. The base of its western slope, which is very gentle, lies at altitudes of from 3000 to 3500 feet. Its crest rises to from 4800 to 6000 feet ; and its eastern slope is extremely rapid as it falls to the plains of Manchuria, which have only from 1500 to 2000 feet of altitude. On this stretch one or two subordinate ridges parallel to the main border ridge and separated from it by longitudinal valleys are found to fringe its eastern slope, thus marking two different terraces and giving to the whole system a width of from 80 to 100 miles. Basalts, trachytes, and other volcanic formations are found in the main border ridge and on its south-eastern slopes.

To the south-west of Peking the Great Khingan is continued by the Inshan mountains, which exhibit similar characters to those of the Great Khingan, and represent the like terrace-shaped escarpment of the Mongolian plateau. Moreover, it appears from the map of the Russian General Staff (surveys of Skassi, Obrucheft, Potanin, &o.) that similar terrace-shaped escarpments — but considerably wider apart than in Manchuria — occur in the Slian-si province of China, along the southern border of the South Mongolian plateau. These escarpments are pierced by the Yellow river or Hoang-ho south of the Great Wall, between the 39th and 38th degrees of latitude, and in all probability it will be fcjund that a border range homologous to the Great Khingan separates the upper tributaries of

the Hoang-ho (namely the Dao-ho) from those of the Yang-tse- kiang. It must, however, be noticed that, according to Obruoheff, the escarpments of the Wei-tsi-shan and Lu-huang-lin, by which the southern Ordos falls towards the AVei-ho (tributary of the Hoang-ho), can hardly be taken as corresponding to the Kalgan escarpment. They fall with gentle slopes only towards the high plains lying to the south of them, while a steep fall towards the low plains seems to be found only farther south, between the 32nd and 34th degrees of latitude. It thus remains to be discovered whether the southern continuations of the Great Khingan, south- wards of the 38th

degree, are not wider than in higher latitudes, and do not consist of two separate escarpments. At its northern end the place where the Great Khingan is pierced by the Amur has not yet been ascertained by direct observation. The reasons why the present writer considers that the upper Amur emerges from the high plateau and its border-ridge, the Khingan, below Albazin and above Kumara have been stated in his sketch of the orography of East Siberia published in 1876 (French translation , with addenda, published by the Institut G^ographique of Brussels in 1902) . If this view prevail, and Petermann has adopted it for his map of Asia, and it has been maintained in all the Gotha publica- tions, it will appear that the Great Khingan joins the Stanovoi ridge or Jukjur, in that portion of it which faces the western coast of the Sea of Okhotsk. At any rate the Khingan, separating as it does the Mongolian plateau from the much lower plains of the Sungari and the Nonni, is perhaps the most important division-line in eastern Asia. It sharply separates the Mongolian plateau from the Manchurian plains, and the dry Mongolian landscape and flora from those of Manchuria and the Pacific.

See the earlier bibliography in Semenoff's Geographical Dictionary. — D. V. Putiata. Expedition to the Khingan in 1891. St Petersburg, 1893. — Potanin. "Journey to the Khingan," in Izvestia Buss.Q-eog. Soc, 1901. (p. x. K.)

Khingan, Little, a name indiscriminately ap- plied to two distinct mountain ranges. The proper application of this name — if it be used at all — would be to reserve it for the typical mountain range which the Amur pierces for 40 miles below Ekaterino-Mkolsk, and which is alsoknovm as the Bureya mountains {Bureinskiy Khrebet in Russian) and also Dousse-alin. This great range, which may be traced from the Amur to the Sea of Okhotsk, seems to be pierced twice by the Sungari and to be continued under different local names in the same south-westerly direction to the peninsula of Lao-tung (see Majstghueia). However, the same name of Little Khingan was also often applied, during the war in Manchuria, to the Ilkhuri-alin mountains, which run in a north-westerly direction between the upper Nonni and the Amur, in the west of Blagovestchensk.

Khiva, formerly an important kingdom of central Asia, now a small khanate, vassal to Russia, and limited to the delta of the Amu-daria. Its frontier runs down the left bank of the Amu, from 40° 15′ N., and down its left branch to Lake Aral ; then, for about 40 miles along the south coast of Lake Aral to Cape Urgu, where it goes southwards, following the escarpment of the Ust-Urt. Erom the Transcaspian territory (Russia) Khiva is separated by a line running almost “W.IST.W.-E.S.E. under the 40° 30′ parallel, from the Uzboi to the Amu-daria. The length of the khanate from north to south is 200 miles, and its greatest width 300 miles. The area of the Khiva oasis is ;‘J210 square miles, while the area of the steppes is estimated at about 17,000 square miles. The population of the former is estimated at 300,000, and that of the latter at 400,000 (nomadic). The water of the Amu is brought by a number of large irrigation canals to the lands of the Khiva oasis, the general declivity of the soil westwards facilitating the irrigation. The chief of them are I’ohlwan-ata (57 miles), beginning 8 miles below Titnyak and passing by Khiva, Hazar-asp, Ishan, and Bagat ; Kaz-abad (60 miles) ; Shah- abad (90 miles, 100 feet wide) ; Kilich-niaz-bai (64 miles) ; and Kara-goz (53 miles). Several old beds of the Amu intersect the territory. The water of the Amu and the very thin layer of fertile ooze which it deposits render the

oasis very fertile. Millet, rice, wheat, oats, peas, flax, hemp, madder, and all sorts of vegetables and fruit are grown, as also the vine and the cotton tree. The white- washed houses scattered amidst the elms and poplars and the fields produce the most agreeable impression on the traveller crossing the steppes. Cattle-breeding is carried on on a great scale by the nomads.

The population is composed of four nationalities : the Uzbega (150,000 to 200,000), who are the dominating race among the settled inhabitants of the oasis, and from whom the officials are recruited ; the Sarts and the Tajiks, who are the best agricul- turists, and the tradespeople ; the Turkomans, who live in the steppes, south and west of the oasis, and formerly plundered the settled inhabitants by their raids ; and the Karakalpaks, or Black Bonnets, who were known to the Russian annalists as having helped the Russians

against the Polovtsy, and probably are near of kin to the Pechenyegues, if not their direct descendants. They live in the south of Lake Aral, and in the towns— Kungrad, Hojeili, and Kipohak ; they are the prevailing element. They cultivate the soil, breed cattle, and their women make carpets. There are also about 10,000 Kirghiz, and when the Russians took Khiva there were 29,291 Persian slaves, stolen by Turkoman raiders, and 6515 liberated slaves. The former were at once set free and the slave trade abolished. Of domestic industries, the embroidering of cloth, silks, and leather is worthy of notice. The trade of Khiva is rather considerable : cotton, wool, rough woollen cloth, and silk cocoons are exported to Russia, and various animal products to Bokhara. Cottons, velveteen, hard- ware, and pepper are imported from Russia, and silks, cotton, china, and tea from Bokhara. Khivan merchants habitually attend the Orenburg and Nijni-Novgorod fairs.

The khan of Khiva is a vassal of Russia, and is rapidly losing the last vestiges of his autonomy. He keeps about 2000 soldiers. The khanate, burdened since 1873 by a heavy war indemnity, which has never been paid, must gradually fall under the complete dominion of Russia. The capital is Khiva, to the left of and 20 miles from the Amu-daria, 235 miles west of Bokhara. It Is surrounded by a low earthen wall, and has a citadel, the residence of the khan and the higher officials. There are seventeen mosques built in brick, of whicli the one containing the tomb of Polvan is the best, and four large medresses (Mahommedan schools). Wide gardens are spread in the western part of the town. A small Russian quarter has also grown up. Population, about 12,000. The other towns are Hazar-asp, 50 miles south-east of Khiva, enclosed by high walls, with nearly 4000 inhabit- ants and a great number of shops ; Shah-abad, where is situated the palace of the khan ; Kunya Urghench (Old Urghench) on the Daria-lyk, 95 miles north-west of Khiva, devastated by Turkomans and now in ruins, and New Urghench (3000) ; Hojeili, opposite to Russian fort Nukus (8000) ; and Kungrad (7000, mostly in tents), 160 miles north-west of Khiva. (p. a. k.)

Khokand, a district town of Russian central Asia, province of Fergana, on the railway from Samarkand to Audi j an, 85 miles west-south-west of the latter and 20 miles south of the Syr-daria ; altitude, 1300 feet. It has a severe continentalclimate,the average temperatures being: Year, 56^ ; January 22°, July 65°. Yearly rainfall only 3-6 inches. It is the centre of a

fertile irrigated oasis, and consists of a citadel, enclosed by a wall nearly 12 miles long, and of suburbs containing rich gardens. The town itself is a labyrinth of narrow and winding streets, and has fifteen medresses, many mosques, ten caravanserais, and an animated bazaar. The former palace of the khans, which recalls by its architecture the mosques of Samarkand, is the best building in the town. Khokand is now one of the chief centres of trade in Turkestan. Eaw cotton and silk are the main items of export, while manufactured goods are imported from Russia and distributed from Khokand. Population (1897), 82,054.

The khanate of Khokand was a powerful state which grew up in the 18th century. Its early history is not yet well known, but it is certain that the town was founded in 1732 by Abdu-raim, under the name of Iski-kurgan, or Kali-i-Raim-bai. This must relate, how- ever, to the fort only, because the Arab travellers of the 10th century already mentioned Hovakend or Hokand, whose position has been identified with that of Khokand. Many other populous and wealthy towns are known to

have existed in this region at the time of the Arab conquest of Fergana. In the years 1758-69 the Chinese conquered Dzungaria and East Turkestan, and the beks of Fergana recognized Chinese suzerainty. In 1807 or 1808 Alim, son of ISTarbuta, succeeded in bringing all the beks of Fergana under his authority, and conquered Tashkend and Chimkent. However, his several attacks on the Bokharan fortress Of Urartube were unsuccessful, and the country rose against Alim, who was killed in 1817 by the adherents of his brother Omar. Omar was a poet and encourager of learning, but continued also to enlarge his kingdom, taking the sacred town of Azret (Turkestan), and in order to jjrotect the agricultural Fergana from the raids of the nomad Kirghiz, a series of fortresses was built on the Syr-daria, which became a basis for raids of the Khokand people into Kirghiz land. This was the origin of a conflict with Russia. A series of small wars was undertaken by the Russians after 1847 in order to destroy the Khokand forts, and to take possession, first, of the Ili and next of the Syr-daria region — the result being that in 1866, after the occupation of Urar-tube and Gizakh, the khanate of Khokand was separated from Bokhara. During the forty-five years after the death of Omar (he died in 1822) the khanate of Khokand was the seat of continuous internal wars, the essence of which was a struggle

between the settled Sarts and the nomad Kipchaks, the two parties securing the upper hand in turns, and Khokand falling under the dominion or the suzerainty of Bokhara, which supported Khudoyar-Khan, the representative of the Kip- chak party, in the years 1858-66; while Alim-kul, repre- sentative of the Sarts, stood at the head of the Gazawat (Holy War) proclaimed in 1860, and bravely fought against the Russians until he was killed at Tashkent in 1865. In 1868 Khudoyar-Khan, now separated from Bokhara, concluded a commercial treaty with the Russians, but was compelled to flee in 1875, when a new Holy War against Russia was proclaimed. It ended in the taking of the strong fort Mahram, the occupation of Khokand and Marghelan (1875), and the recognition of Russian superiority by the emir of Bokhara, Nasr-ed-din, who con- ceded to Russia all the territory to the north of the Naryn river. The war, however, broke out again next year, and ended, in February 1876, in the taking of Andijan and Khokand and the annexation of the Khokand khanate to Russia. The Fergana province was made out of it.

Authorities. — The following publications are all Russian : — KuHN. Sketch of the Khanate of Kokand, 1876. — V. Nalivkin. Short History of Kokand (Kazan, 1885). — Niazi-Moiiammed. Tarihi ShahroM, or History of the Bulers of Fergana, edited by Pantusoff (Kazan, 1885). — Maksheeff. Historical Sketch of Turkestan and the Advance of the Russians (St Petersburg, 1890). — N. PETEOTSKir. Old Arabian Journals of Travel (Tashkent, 1894). — Bussian Encyclopedic Dictionary, vol. xv., 1895.

(p. A. K.)

Kholm (Polish Chefm), a district town of Russian Poland, government and 56 miles east-south-east of Lublin. It is a very old city, formerly the see of a bishop. It has now an archaeological museum for church antiquities and a committee for the description of the churches of the Chelm- Warsaw bishopric. Population, 19,236.

Khorassan, one of the five great provinces of Persia. Its administrative divisions are : 1, Nishapiir ; 2, Sabzvar ; 3, Jovain and Asfar^in ; 4, Bujniird ; 5, Kuchan ; 6, Derrehgez; 7, Kelat; 8, Chin^ran; 9, Meshed; 10, Jam, Bakharz, Radkan; 11, Serrakhs ; 12, Sarjam ; 13, Bam and Safiabad ; 14, Turbat i Haidari ; 15, Turshiz ; l(i, Khaf ; 17, Tun and Tabbas ; 18, Kain ;

19, Sist^n. Until a few years ago the division of Nishapur was under the governor-general of Khorassan, but it is now a separate province, with a governor appointed by the central

1891-92

Exports £190,834

1893-94

„ 117,919

1897-98

136,543

government at Tehran. The population is estimated at about a million, and its revenues (cash and kind) at £180,000 a year. About £40,000 of this amount is supposed to reach the Tehran treasury. The value of the exports and imports from and into the whole province for 1890-91 was estimated at £290,190 and £544,670. Later consular reports give figures for Meshed and north- ern Khorassan only : —

Imports £357,758 „ 327,671

„ 290,440

The province produces 20,000,000 ft of wool. About a third of this quantity, valued at £50,000 to £60,000, is exported vid Eussia to the markets of western Europe, notably to Marseilles, Eussia keeping only 200,000 to 300,000 ft. Other important articles of export, all to Eussia, are cotton, carpets, shawls, and turquoises. With the exception of the agents of the Imperial Bank of Persia at Meshed, there was not in 1901 a single

representative of British trade and commerce in the province, while Eussian firms had agents, mostly Armenians, at all cities.

Khulna, a town and district of British India, in the Presidency division of Bengal. The town is on the river Bhairab; terminus of the Bengal Central railway, 109 miles east from Calcutta. Population (1891), 8667. Government high school, with 197 pupils in 1896-97. Khulna is the most important centre of river-borne trade in the delta. The district of Khulxa lies in the middle of the delta of the Ganges, including a portion of the Sundarbans or seaward fringe of swamps. It was formed out of Jessore in 1882. Area (excluding the Sundarbans), 2077 square miles; population (1881), 1,079,948; (1891), 1,177,652, showing an increase of 9 per cent. ; average density, 667 persons per square mile. Classified according to religion, Hindus numbered 672,665 ; Mahommedans, 603,995 ; Christians, 963, of whom 17 were Europeans ; ” others,” 29. In 1901 the population was 1,253,405, showing a fur- ther increase of 6 per cent. The land revenue and rates were Es.7,46,595; number of police, 453 ; number of boys at school (1896-97), 28,964, being 31-2 per cent, of the male population of school-going age; registered death-rate (1897), 34-2 per thousand. There are twelve factories of sugar from the date-palm, with an out-turn valued at Es. 3,53,000. The district is entered by the Bengal Central railway, but by far the greater part of the traffic is still carried by water.

Khurja, a town of British India, in the Bulandshahr district of the North-West Provinces ; 27 miles north-west of Aligarh, on the main line of the East Indian railway. Population (1891), 26,349 ; municipal income (1896-97), Es. 28,592. It is an important centre of trade, with a new Jain temple, many handsome public buildings, and a Victoria Jubilee school.

Khuzistan. See Aeabistan.

Khyber. See Khaibae.

Kiaochow Bay, a large inlet on the south side of the promontory of Shantung, in China. It had no special importance until it was seized in November 1897 by the German fleet, in order to secure reparation for the murder of two German missionaries in the province of Shantung. In the course of the negotiations which followed, it was arranged that the bay and

the land on both sides of the entrance within certain defined lines should be leased to Germany for 99 years. During the continuance of the lease Germany is to exercise all the rights of territorial sovereignty, including the right to erect fortifications. The size of the area leased is about 117 square miles, and a further area, comprising a zone of some 32 miles, measured

from any point on the shore of the bay, is reserved, within which the Chinese Government may not issue any ordin- ances without the consent of Germany. The native popu- lation in the ceded area is about 60,000. The German Government in 1899 declared Kiaochow a free port open to the commerce of all nations. By arrangement with the Chinese Government a branch of the imperial maritime customs has been established there for the collection of duties upon goods coming from or going to the interior, in accordance with the general treaty tariff. Trade centres at a small town named Tsingtao situated within the bay. The country in the neighbourhood is mountainous and bare, but the lowlands are well cultivated.

Kidderminster, a parish, municipal and parlia- mentary borough, and market town of Worcestershire, England, on the Stour, 14 miles north of Worcester by rail. The infirmary has been extended, a technical school erected, and a public recreation ground opened (1887). There is a free library. Area of municipal borough, 1213 acres. Population (1881), 24,270; (1901), 24,692.

Kieff, or Kiev, a government of Little Eussia, in south-western Eussia. It represents a deeply ravined plateau, from 600 to 800 feet in altitude, reaching 960 to 1050 feet in the west, taking a steppe character in the middle, and gently sloping northwards to the marshy regions of the Pripet, while on the east it falls abruptly to the valley of the Dnieper, which has only from 250 to 300 feet of altitude. General A. Tillo has shown that neither geologically nor tectonically can “spurs of the Carpa- thians ” penetrate into Kieff. Many useful minerals are extracted, such as granites, gabbro, labradorites of a rare beauty, also syenites and gneiss, marble, grinding stones, pottery clay, phosphorites, iron ore, and mineral colours. The climate is more moderate than in middle Eussia, the average temperatures at Kieff being— year, 44° ; January, 21° ; July, 68° ; yearly rainfall, 21 inches. The lowlands of the north are covered with woods ; they have the flora of the Polyesiye, and are peopled with animals belonging to

higher latitudes. (Schmahlhausen's Flo7-a of Soutli-West Bussia, Kieff, 1886, contains a good description of the flora of the province.) The population, which was 2,017,262 in 1863, reached 3,576,125 in 1897 ; 1,791,503 were women, and 147,878 lived in towns. According to religion, there were (out of a total of 3,277,019), 2,738,977 Orthodox Greeks, 14,888 Nonconformists, 91,821 Catholics, 423,876 Jews, and 6820 Protestants.

No less than 41 per cent, of the land is in large holdings, 4 per cent, belongs to various institutions, 3 per cent, to the Crown, and 45 per cent, to the peasants. Out of an area of 11,819,000 acres, 11,085,000 acres are available for cultivation, 4,758,000 acres are under crops, 650,000 acres under meadows, and 1,880,000 acres under woods. About 290,000 acres are under beetroot, for sugar, giving a crop of 1,500,000 tons. The average crop of the various grains is 1,150,000 tons and 162,000 tons of potatoes, which affords an available surplus of 306,000 tons of grain and 24,000 tons of potatoes. There were in 1897, 368,455 horses, 608,400 horned cattle, 925,000 sheep, and 447,000 swine. Camels have been used for agricultural work. Bee-keeping and gardening are very general. The chief factories are sugar works (63) and distilleries. The former produce about 2,800,000 cwts. of sugar and over 1,000,000 cwts. of treacle. Every year 870,500 cwts. of sugar are refined. The distilleries (76) show yearly returns of about £1,100,000. The factories include machinery works, tanneries, steam flour-mills, naphtha-refineries, &c. The government is well provided with railways. Two main lines, starting from Kieff and Cherkasy respectively, cross it from north-east to south-west, and two lines cross its southern part from the north-west to the south- east, parallel to the Dnieper, with small side branches. Steamers ply on the Dnieper and some of its tributaries, and the shipping within the government shows a tonnage of 225,000 (£1,060,000). Wheat, rye, oats, barley, and flour are exported (210,000 t(ms in years of good crops). There are two great fairs, at Kieff and Berdioheff, a,nd many of minor importance. Trade is very brisk. The government is better provided with schools than many other provinces of Russia. It is divided into twelve districts, the chief

towns of which are Kieff, Berdicheff (53,728 inbahitants), Cherkasy (29,619), Chigbirin (9870), Kanev (8892), Lipovets (6068), Rado- mysl (11,154), Skvira (16,205), Tarasoha (11,452), Umafi (28,628), Vasilkov (17,824), and Zvenigorodka (16,972). The plains on the Dnieper have been inhabited probably since the Palaeolithic period, and the burial-grounds used since the Stone Age. The burial mounds {hurgans) both of the Scythians and the Slavonians, the traces of old forts (gorodische), the stone statues, and the more recent oaves offer a rich material for anthropology and ethnography.

Authorities. —The ArchcBological Map of the Government by Professor Antonovitch. 1887.— Count Bobrinsky. Kurgans of

Smiela. 1897. (Both contain bibliographical indications.) N

Byelyashevskt. The Mints of Kieff. — A. Selivanoff's article in the Bussian Eneycl. Dictionary. The last tv/o form valuable sources of information. (p A K “)

KiefF, capital of the above government, situated on the right bank of the Dnieper (observatory — 60° 27′ 12″ N., 30° 30′ 18″ E.; altitude, 594 feet; level of Dnieper, 288 feet) ; 626 miles by rail {vi& Kursk) south-west of Mosfeow, and 405 miles by rail north-east of Odessa. Population rapidly increasing: (1862) 70,341, (1874) 127,260, (1893) 193,160, (1897) 247,432. Kieff covers an area of about 13,500 acres, and has a circumference of 32 miles. Altogether it is one of the most beautifully built cities in Eussia, while its neighbourhood is also pictu- resque. Electric and steam tramways have been built for a length of more than 25 miles, and a network of telephones has been established all over the city. Kieff is connected by rail with all the main cities of south-west Eussia, as well as with Poland and Austria, the railway bridge across the Dnieper being the third largest in Eussia. Steamers ply in summer to Krementchug, Ekaterinoslav, Moghilev, Pinsk, and Chernigov. Its educational and scientific institutions are next to those of the two capitals. Its uni- versity has 2773 students (1897), and is well provided with observatories, laboratories, libraries, and museums ; five scientific societies and two societies for aid to poor students are attached to it. There are besides a theologi- cal academy ; a society of church archaeology, which pos- sesses

a museum, very rich in old ikons, crosses, &c. (both Eussian and Eastern) ; several lyceums for boys and high schools for girls ; university courses for ladies ; several technical schools both for boys and girls ; a large poly- technic and numbers of primary schools. There are also many scientific, technical, musical, artistic, and social societies, ten libraries, three theatres, an opera house, and a considerable number of philanthropic institutions, hos- pitals, schools for medical help to children, &c.

Kieff is also an industrial city, and its 119 factories show yearly returns exceeding £1,000,000. It is the main centre for the sugar industry of Kussia, as well as for the general trade of the region. Its Sryetenskaya fair, although showing small returns of goods brought in and sold, is an important centre for commercial trans- actions, which are estimated at more than £1,700,000 a year. Most interesting archseologlcal finds have been made. More than twenty caves were discovered on the slope of a hill (Kiriloff Street), and one of them, excavated in 1876, proved to have belonged to Neolithic troglodytes. Numerous graves, both from the pagan and the Christian periods, the latter containing more than 2000 skeletons, with a great number of various small articles, were discovered in the same year in the same neighbourhood. Many colonial Eoman coins from the 3rd to the 4th centuries, and silver dirgems, stamped at Samarkand, Balkh, Merv, &c., were also found in 1869.

The Russian literature concerning Kieff, its history and anti- quities, is very voluminous. Its bibliography will be found in the Bussian Geographical Dictionary of P. Semenoff, and in the Bus- sian Encyclopedic Dictionary, published by Brocklaus and Effron, vol. XV., 1895. (p. A. K.)

Kiel, the chief naval port of Germany on the Baltic, Prussia, province of Schleswig-Holstein, at the head of Kiel Bay, 70 miles by rail north from Hamburg. Includ- ing the suburb of Wik, the town stretches along the west side of the harbour {\ to 4^ miles in width and 11 miles long) as far as the entrance of the North Sea and Baltic

(Kaiser Wilhelm) Canal, a distance of 2f miles. The harbour has a general depth of at least 40 feet, and even close to the shore it is in many parts as deep as 20 feet. Its defences, which include a couple of forts on the west side and four on the east side, all situated about 5 miles from the head of the

harbour, at a place where its shores approach one another, make it a place of great strategic strength. The imperial docks (five in all) and shipbuild- ing yards are on the east side between Gaarden and Eller- beck ; and in 1901 it was resolved to extend them still farther towards the north — that is, into the fishing village of EUerbeck — by the construction of a spacious basin to accommodate the biggest warships. The imperial naval yard employs nearly 6500 hands, and another 6500 are employed in two large private shipbuilding works, both engaged principally in building warships, torpedo-boats, and docks. Each of the latter has constructed a new shipbuilding yard, and one of them (the Krupp Company) has also put up machinery works here. In 1901 the town authorities voted £65,000 for the construction of an outer commercial harbour at Wik, just south of the entrance into the North Sea and Baltic Canal. On the same shore of the harbour, between the old ducal castle and Wik, there stand several of the most important edifices in Kiel, namely, the university (attended by 780 students, with 100 professors in 1900-01), the imperial admiralty, and the naval academy. Kiel was in 1897 the scene of a memorable naval exhibition. The town and adjacent villages, e.g., Wik, Heikendorf, Laboe, are resorted to for sea-bathing, and in June a famous regatta usually takes place. The waters of the harbour yield sprats (Kieler Sprotten), which are in much repute. Kiel is connected daily and nightly with Korsor in Denmark by express passenger boats. The church of St Nicholas was restored in 1877-84; the church of St James was built in 1886. Kiel possesses an art exhibition, a museum of antique sculptures, the Thaulow Museum (rich in Schleswig-Hol- stein wood-carving of the 16th and 17th centuries), the Schleswig-Holstein Museum of National Antiquities (in the old university buildings), a university infirmary, zoo- logical and mineralogical museums, a botanical garden, and a school of forestry ; also monuments to the Emperor William I. (1896), Bismarck (1897), Duke Frederick William of Mecklenburg (1898), and Lowe (1896), the composer. In addition to the naval academy, the imperial naval institutions include a naval school, a school for petty officers, engineers' school, and seamen's school ; there are further an agricultural college, attached to the university, and technical, commercial, and music schools. The prin- cipal industries are those connected with the imperial navy and shipbuilding, but embrace also flour-mills, oil-mills, iron-foundries, printing-works, breweries, brick-works, fish-curing, &c. Kiel owns a mercantile fleet of about 100 vessels, measuring about 25,000

tons. There is an import- ant trade in coal, timber, cereals, fish, butter, and cheese. The port is entered annually by over 3000 vessels of about 615,000 tons. Population (1885), 51,706; (1890), 69,172; (1900), 107,938 ; or including Gaarden, which was united with Kiel on 1st April 1901, 121,761. (j. t. be.)

Kielce, a government in the south-west of Eussian Poland. Its surface is an elevated plateau from 800 to 1000 feet in altitude, intersected in the north-east by a range of hills reaching 1350 feet and deeply ravined in the south. It is watered by the Vistula on its south-east border, and its tributaries, Nida and Pilica, which have a very rapid fall and occasion inundations. Silurian and Devonian quartzites, dolomite, limestones, and sandstones prevail in the north, and contain rich iron ores, which are worked to a considerable extent, as well as lead and copper ores. Carboniferous deposits containing rich coal seams occur

chiefly in the south, and spread to Piotrkdw ; Permian limestones and sandstones are found in the soutli. The Trias deposits contain very rich zinc ores of considerable thickness, and lead. The Jurassic deposits consist of iron- clays and limestones, in which large caves are found near Oicdw. The Cretaceous deposits contain, besides gypsum and chalk, sulphur (the richest near Czarkowa). White and black marble are also extracted. The soil is of great variety and fertile in parts, but owing to the proximity of the Carpathians, &c., the climate is more severe than might have been expected. Rye, wheat, oats, barley, and sarrazin are grown; modern intensive culture is spreading, and land fetches high prices, the more so as the peasants' al- lotments were small at the outset and are steadily decreas-ing. In 1893 there were 106,608 horses, 243,784 horned cattle, and 131,944 sheep. Grain is exported. Industries are widely developed : 54,400 tons of zinc ores are ex- tracted, and 1000 tons of iron are obtained. The factories employ nearly 5000 persons, and show a yearly return of about £600,000. Tiles, metallic goods, leather, timber goods, and flour are their chief products. Kielce is divided into seven districts, the chief towns of which are

Kielce, Jfdrzejow (Russian, Andreyev, 5010), Miechow (4156), Olkusz (3491), Pinczdw (8095), Stopnica (4669), and Wloszczowa (23,066).

Kielce, capital of the above government, 107 miles by rail south of Warsaw, vid the Ivangorod junction, and 103 miles from Dombrovo on the Austrian frontier. It is situated in a picturesque hilly country. It has an old castle, which was built in 1638 and for some time was inhabited by Charles XII., and which was renowned for its portrait gallery and the library of Zalusski, which was taken to St Petersburg. The lyceum for boys has a good library and museum. The squares and boulevards of the town are' well kept, and adorned with several handsome modern buildings. The aggregate yearly returns of several factories (hemp-spinning, cotton-printing, cement works) attain £100,000. Population (1890), 12,776; (1897),

23,189.

Kilbarchan, a burgh of barony of Renfrewshire, Scotland, 12 miles west by south of Glasgow. It has stations on two sections of the Glasgow and South-West- ern railway. Silk and cotton manufactures are carried on, and the parish contains coal and iron mines, and quar- ries. Water is supplied, and there are two libraries and a public park. The churches are Established and United Free, and the public school had in 1898-99 an average attendance of 463. Population (1881), 2548 ; (1901), 2886.

Kildare, an inland county of Ireland, province of Leinster, bounded on the N. by Meath, on the E. by Dublin and Wicklow, on the S. by Carlow, and on the W. by Queen's county and King's county.

The area of the administrative county in 1900 was 418,496 acres, of which 101,628 were tillage, 260,290 pasture, 199 fallow, 6288 plantation, 30,581 turf bog, 2891 marsh, 1474 barren mountain, and 15,145 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, is identical with the old judicial county. The population in 1881 was 75,804, and in 1891, 70,206, of whom 38,407 were males and 31,799 females, divided as follows among the different re- ligions : Roman Catholics, 59,034 ; Protestant Episcopalians, 9096 ; Presbyterians, 1310 ; Methodists, 573 ; and other denominations, 193. The decrease of population between 1881 and 1891 was 7-88 per cent. The average number of persons

to an acre was ■17. Of the total population, 58,378 persons inhabitated the rural districts, being an average of 107 persons to each square mile under crops and pasture. The population in 1901 was 63,469 (Roman Catholics, 54,794 ; Protestant Episcopalians, 7454 ; Pres- byterians, 666 ; Methodists, 383; others, 172), being a decrease of 9-6 per cent. The following table gives the degree of education in 1891 :—

Males.

Females.

Total.

Percentage.

E.G.

Pr. Ep.

Presb.

Meth.

Read and write Read only Illiterate

27,052 3,315

4,783

21,298 3,175 4,209

48,.350 6,490 8,992

72-0 11-7 16-3

94-9 2-3 2-8

96-3 2-5

l-2j

98-7

■4 ■9

The percentage of illiterates among Roman Catholics in 1881 was 22-6. In 1891 there were 6 superior schools with 880 pupils (Roman Catholics, 873, and Protestants, 7), and 139 primary schools with 8877 pupils (Roman Catholics, 7767, and Protestants, 1110). The number of pupils on the rolls of the national schools on 30th September 1899 was 8873, of whom 8192 were Roman Catholics andi 681 Protestants.

The following table gives the number of births, deaths, and marriages in different years : —

Year.

Births.

Deaths.

Marriages.

1881 1891 1900

1861 1541 1342

1.363 1172 1310

351 298 315

In 1900 the birth-rate per thousand was 21-1, and the death-rate 20-6 ; the rate of illegitimacy was 1-8 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1899 was 35,748, of whom 19,729 were males and 16,019 females. The chief towns in the county, with their populations in 1891, are Athy, 4886 ; Saas, 3774 ; Newbridge, 3318.

Administration. — The county is divided into two parliamentary divisions. North and South ; the number of registered electors in 1900 being respectively 6541 and 7573. The rateable value in 1900 was £362,276. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were estab- lished, and under that Act the county now comprises two urban and five rural sanitary districts.

Agriculture. — The following tables show the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900:—

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6

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1

s

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•a”

1

1831

4125

24,206

18,791

9846

11,618

2690

56,889

120,960

1891

1865

20,440

12,769

7659

10,S68

2162

51,478

106,681

1895

435

21,502

11,509

7841

10,782

2310

67,686

110,865

1900

776

17,656

12,292

6390

9,687

2061

62,776

101,628

In 1899 the total value of the cereal and other crops was estimated by the Registrar-General at £630,198. The number of acres under pasture in 1881 was 235,061 ; in 1891,249,934 ; and in 1900, 260,290 :—

Tear.

Horses andMules.

Asses.

Cattle.

Sheep.

Pigs.

Goats.

Poultry.

1881 1891 1895 1900

14,845 14,820 16,019 18,289

4156 4188 4286 4282

92,249

97,880

92,668

104,077

117,770 176,869 126,881 166,167

12,986 14,942 18,768 11,902

88S6

8991 8869 2810

224,810 209,263 222,668 248,060

The number of milch cows in 1891 was 14,050, and in 1900 12,281. It is estimated that the total value of cattle, sheep, and pigs in 1899 was £1,659,118. In 1900 the number of holdings not exceeding 1 acre was 1814 ; between 1 and 5, 1604 ; between 5 and 15, 1658 ; between 15 and 30, 1184 ; between 30 and 50, 821 ; between 50 and 100, 966 ; between 100 and 200, 721 ; between 200 and 500, 361 ; and above 500, 43 — total, 9122. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1900 was 697, amounting to £541,367. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, between 1882 and 1900 was 219, and the amount issued

was £25,584. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations in 1847 to 31st March 1900 was £146,252.

(w. H. Po.)

Kilia, a town and custom-house of Russia, government of Bessarabia, district Ismail, 100 miles south-west of Odessa, on the Kilia branch of the Danube. It has steam flour-mills and a rapidly increasing trade. Population,

11,703.

KILIMANJAE 0 — K I L K E N N Y

45

Kilimanjaro, a great mountain in East Africa, its centre lying in 3° 5′ S. and 37° 23′ E. It is the highest known summit of the continent, rising as an isolated volcanic cone from a plateau of about 3000 feet to 19,700 feet at its highest point. The major axis of the moun- tain runs almost east and west, and on it rise the two principal summits, Kibo in the west, Mawenzi in the east. Kibo, the higher, is a truncated cone with a nearly perfect extinct crater, and marks a comparatively recent period of volcanic activity; while Mawenzi (17,050 feet) is the very ancient core of a former sum- mit, of which the crater walls have been removed by denudation. The two peaks, which are about 7 miles apart, are connected by a saddle or plateau, about 14,000 feet in altitude, below which the vast mass slopes with great regularity in a typical volcanic curve, especially in the south, to the plains below. The sides are fur- rowed on the south and east by a large number of narrow ravines, down which flow streams which feed the Pangani and Lake Jipe in the south and the Tzavo tributary of the Tana in the east. South-west of Kibo, the Shira ridge seems to be of independent origin, while in the north-west a rugged group of cones, of com- paratively recent origin, has poured forth vast lava- flows. In the south-east the regularity of the outline is likewise broken by a ridge running down from Mawenzi. The lava slopes of the Kibo peak are covered to a depth of some 200 feet with an ice-cap, which, where ravines occur, takes the form of genuine glaciers. The crater walls are highest on the south, three small peaks, un- covered by ice, rising

from the rim on this side. To the central and highest of these, the culminating point of the mountain, the name Kaiser Wilhelm Spitze has been given. The rim here sinks precipitously some 600 feet to the interior of the crater, which measures rather over 2000 yards in diameter, and is in part covered by ice, in part by a bare cone of ashes. On the west the rim is breached, allowing the passage of an important glacier formed from the snow which falls within the crater. Lower down this cleft, which owed its origin to dislocation, is occupied by two glaciers, one of which reaches a lower level (13,800 feet) than any other on Kilimanjaro. On the north-west three large glaciers reach down to 16,000 feet. Mawenzi peak has no permanent ice-cap, though at times snow lies in patches. The rock of which it is composed has become very jagged by denudation, forming stupendous walls and precipices. On the east the peak falls with great abrupt- ness some 6500 feet to a vast ravine, due apparently to dis- location and sinking of the ground. Below this the slope is more gradual and more symmetrical. Like the other high mountains of eastern Africa, Kilimanjaro presents well-defined zones of vegetation. The lowest slopes are arid and scantily covered with scrub, but higher up, between 4000 and 6000 feet on the south side of the mountain, are well watered and cultivated. The forest zone begins, on the south, at about 6500 feet, and extends to 9500, but in the north it is narrower, and in the north-west, which is the driest quarter of the mountain, almost disappears. In the alpine zone, marked especially by tree lobelias and Senecio, flowering plants extend up to 15,700 feet on the sheltered south-west flank of Mawenzi, but elsewhere vegetation grows only in dwarfed patches beyond 13,000 feet. The special fauna and flora of the upper zone are akin to those of other high African mountains, including Cameroon. The southern slopes, between 4000 and 6000 feet, form the well-peopled country of Chagga, divided up into small districts. The best known of these is Moshi, where a German station has been established for some years. Kilimanjaro, first seen by the German Rebmann in 1849, and since visited by von der Decken, New, Thomson, Johnston, and others,

has been the special study of Dr Hans Meyer, who made four expeditions to it, accomplishing the first ascent to the summit in 1889.

See especially Johnston. The Kilimanjaro Expedition. London, 1886. — Meyer. Across Mast African Glaciers. London, 1891 ; Der Kilimanjaro.

Berlin, 1900. (e. he.)

Kilindria, the ancient Kelenderis, a small town on the south coast of Asia Minor. After having been almost deserted, it has rapidly revived under the influence of trade with Cyprus since the British occupation.

Kill(enny, an inland county of Ireland, province of Leinster, bounded on the N. by Queen’s county, on the E. by Carlow and Wexford, on the S. by Waterford, and on the W. by Tipperary.

Tbe area of the administrative county in 1900 was 509,245 acres, of which 140,216 were tillage, 313,021 pasture, 417 fallow, 9963 plantation, 2639 turf bog, 5125 marsh, 13,537 barren mountain, and 24,427 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, includes the county of the city of Kilkenny and one electoral division formerly situated in Waterford, but does not include the portion of the town of New Ross formerly situated in Kilkenny. The population in 1881 was 99,531, and in 1891, 87,496. The decrease of population between 1881 and 1891 was 12-33 per cent. The average number of persons to an acre for the whole county was ■17. Of the total population 75,928 persons inhabited the rural districts, being an average of 109 persons to each square mile under crops and pasture. The population in 1901 was 78,821, of whom 39,933 were males and 38,888 females (Roman Catholics, 74,572 ; Protestant Episcopalians, 3930 ; Presbyterians, 141 ; Methodists, 116 ; others, 62), being a decrease of 9-9 per cent. The following table gives the degree of education in 1891 (exclud- ing the city of Kilkenny) : —

Males.

Females.

Total.

Percentage. 1

E.G.

Pr.Ep,

Presb.

Meth.

94-4 2-8 2-8

Read and write Read only Illiterate

26,083 3,.341 5,209

24,923 4,166 5,734

51,006

7,507

10,943

72-6 11-1 16-3

90-7 4-8 4-5

97-0 1-0 2-0

The percentage of illiterates among Roman Catholics in 1881 was 22-9. In 1891 (including the city of Kilkenny) there were 9 superior schools with 414 pupils (Roman Catholics, 338 ; Pro- testants, 76), and 211 primary schools with 14,901 pupils (Roman Catholics, 14,246 ; Protestants, 655). The total number of pupils on the rolls of the national schools on .30th September 1899 was 13,912, of whom 13,380 were Roman Catholics and 532 Protestants.

The following table gives the number of births, deaths, and marriages in various years : —

Year,

Births.

Deaths.

Marriages.

1881 1891 1900

1957 1770 1602

1722 1563 1619

333 409

283

The birth-rate per thousand in 1900 was 20-3, and the death-rate 20-5 ; the rate of illegitimacy was 2-3 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1899 was 73,028, of whom 37,734 were males and 35,289 females. The chief towns in the county, with their populations in 1891, are Kilkenny, 11,048 (1901, 10,493) ; Cullan, 1973 ; Castlecomer, 1019.

Administration. — The county is divided into two parliamentary divisions. North and South, the number of registered electors in 1900 being respectively 6170 and 5141. The rateable value in 1900 was £334,919. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises ,one urban and eight rural sanitary districts.

Agriculture. — The accompanying tables show the acreage under crops, including meadow and clover, and the amount of live stock

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1881 1891 1896 1900

11,848 5,197 1,156 2,167

35,878 80,612 32,749 27,680

17,511 16,517 18,037 19,897

18,258 16,616 14,813 13,186

9,943 9,686 10,869 10,629

3794 4063 3826 4482

62,077 61,207 66,055 62,276

159,804 142,738 146,505 140,216

in 1881, 1891, 1895, and 1900. The figures for 1900 are for the new administrative county.

In 1899 the total value of the cereal and other crops was esti- mated by the Registrar-General at £945,746. The number of acres under pasture in 1881 was 290,470, in 1891, 304,873, and in 1900,

313,021.

Year.

Horses and Mules.

Asses.

Cattle.

Sheep.

Pigs.

Goats.

Poultry.

1881 1891 1896 1900

17,987

2D,.529

21,747 19,962

5845 5893

6S01

6881

120,604 129,066 125,816 183,866

85,398 121,620 105,080 102,288

39,777 44,791 89,114 35,636

6176 8619

7388 6488

410,484 449,113 439,160 614,061

The number of milch cows in 1891 was 37,106, and in 1900, 38,093. It is estimated that the total value of cattle, sheep, and pigs in 1899 was £1,894,077. In 1900 the number of holdings not exceeding one acre was 1974 ; between 1 and 5, 1684 ; between 5 and 15, 2492 ; between 15 and 30, 2460 ; between 30 and 50, 2171 ; between 50 and 100, 2115 ; between 100 and 200, 806 ; between 200 and 500, 210 ; and above 500, 21— total, 13,933. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1900, was 1155, amounting to £588,502. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, between 1882 and 1900 was 287, and the amount issued was £19,201. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations in 1847 to 31st March 1900 was £76,825. (w. H. Po.)

Kilkenny, an inland city and parliamentary borough, capital of the above county, on the river Nore, 73 miles south-west of Dublin by rail. Under the Local Govern- ment (Ireland) Act, 1898, it retains its mayor and corpora- tion, which, however, has now practically the status of an urban district council. The manufacture of blankets, coarse woollens, and linens has declined. The municipal borough comprises 921 acres. Population (1881), 12,182 ;

(1891), 11,048 ; (1901), 10,493.

Kilmarnock, a parliamentary burgh and import- ant railway centre (Kilmarnock group) of Ayrshire, Scot- land, on Kilmarnock water, 24 miles south-west of Glasgow by rail. The engineering and iron trades have displaced carpet-weaving as the staple industry, though tweed-making has been added to the other woollens ; the workshops of the Glasgow and South-Western railway are situated here, and hydraulic machinery is a speciality of the town. A large cotton factory and another for the making of lace curtains are among the industrial features. The grounds of Kilmarnock House were presented to the town in 1893, and have been laid out as a public park. Eight acres have been added to Kay Park, where a Reformers' Monument was unveiled in 1885. The town hall has been renovated, and

recent erections include a new academy, a corporation art gallery, and a spacious institute containing a free library and a museum. The academy is under the School Board. Population (1881), 23,901 ; (1901), 34,161.

Kilsyth, a police burgh and burgh of barony of Stirlingshire, Scotland, 13 miles north-east of Glasgow by rail. The Forth and Clyde Canal passes near the straggling town. The quarrying of whinstone, which abounds in the neighbourhood, is carried on to a con- siderable extent. Kecent erections are United Free and Wesleyan churches, and a public school, besides which there is a large academy with an elementary department. Population (1881), 6402 ; (1901), 7331.

Kimberley, John Wodehouse, 1st Eael (1826-1902), English statesman, was born 7th January 1826, being the eldest son of the Hon. Henry Wodehouse and grandson of the 2nd Baron Wodehouse, whom he succeeded in 1846. He was educated at Eton and Christ Church, Oxford, where he took a first-class degree in classics in 1847 ; in the same year the new Lord Wode-house married Lady Florence FitzGibbon (d. 1896),

daughter of the last earl of Clare. He was by inheritance a Liberal in politics, and in 1862-66 and 1859-61 he was Under Secretary of State for Foreign Affairs in Lord Aberdeen's and Lord Palmerston's ministries. In the interval (1866-58) he had been envoy-extraordinary to Russia ; and in 1863 he was sent on a special mission to Copenhagen on the forlorn hope of finding a peaceful solution of the Schleswig-Holstein question. The mis-sion was a failure, but probably nothing else was possible. In 1864 he became Under Secretary for India, but towards the end of the year was made Lord-Lieutenant of Ireland. In that capacity he had to grapple with the first manifestations of Fenianism, and in recognition of his vigour and success he was created (1866) earl of Kimberley. In July 1866 he vacated his office with the fall of Lord Russell's ministry, but in 1868 he became Lord Privy Seal in Mr Gladstone's cabinet, and in July 1870 was transferred from that post to be Secretary of State for the Colonies. It was the moment of the great diamond discoveries in South Africa, and the new town of Kimberley was named after the Colonial Secretary of the day. After an interval of Opposition from 1874 to 1880, Lord Kimberley returned to the Colonial Office in Mr Gladstone's next ministry; but at the end of 1882 he

exchanged this office first for that of Chancellor of the Duchy of Lancaster and then for the Secretary- ship of State for India, a post which he retained dur- ing the remainder of Mr Gladstone's tenure of power (1882-86, 1892-94), though in 1892-94 he combined with it that of the Lord Presidency of the Council. In Lord Rosebery's cabinet (1894-95) he was Foreign Secretary. Lord Kimberley was an admirable departmental chief, but it is difficult to associate his own personality with any ministerial act during his occupatiod of all these posts. He was at the Colonial Office when responsible government was granted to Cape Colony, when British Columbia was added to the Dominion of Canada, and during the Boer war of 1880-1881, with its conclusion at Majuba ; and he was Foreign Secretary when the misunderstanding arose with Germany over the proposed lease of territory from the Congo Free State for the Cape to Cairo route. He was essentially a loyal Glad- stonian party man. His moderation, common-sense, and patriotism had their influence, nevertheless, on the policy from time to time agreed upon in concert with his colleagues. As leader of the Liberal party in the House of Lords he acted with undeviating dignity ; and in Opposition he was a courteous antagonist and a critic of weight and experience. He took considerable interest in education, and after being for many years a member of the senate of London University, he became its chancellor in 1899. He died in London, 8th April 1902, being succeeded in the earldom by his eldest and only surviving son. Lord Wodehouse (b. 1848). After Mr Gladstone's retirement from politics, the value of Lord Kimberley's moderating influence on the counsels of his party became more than ever marked, owing to the dissensions which hampered its activity. He took sides with no section, but did his best to keep the party together. It was this element in his character, rather than any special ability, which made him a notable personality in English politics. (h. Oh.)

Kimberley, a town of Cape Colony, centre of the Griqualand West diamond industry. Next to Cape Town and Johannesburg, it is the largest place in South Africa, with a population which rose from about 20,000 in 1881 to 28,718 in 1891. It lies on the main railway running from the Cape towards the Zambezi, about midway between Cape Town and Bulawayo, being 646 miles distant from the former and 714 from the latter place. The mine

whicli gives its name to tile town is one of the great “pipes,” as they are called — Kim barley, De Beers, Du Toit’s Pan, and Bulfontein — which are clustered together on the plateau near the converging frontiers of Cape Colony, the Orange Eiver Colony, and Transvaal, and have collectively for some years controlled and supplied the diamond markets of the world. The pipes are natural ” chimneys,” perhaps extinct craters, which were at first supposed to taper downwards, but are now known to broaden out to depths of over 2000 feet, penetrating through limestones, diorites, porphyries, basalts, and other formations down to the granite and gneiss bed-rocks. The diamonds occur in the yellow, and lower down in the blue eruptive matter which fills the pipes and was prob- ably forced up by the pressure of underground forces. The supply appears to be practically unlimited, but is regulated by the De Beers corporation, which has bought up all minor claims, and is thus able to control the market. Since 1895 the annual output has averaged over £4,500,000 (£4,567,000 in 1898), and the total value of diamonds exported between the years 1867 and 1898 was estimated at £87,878,000. On the outbreak of hostilities in 1899 the Boers laid siege to Kimberley, and held it closely in- vested from 12th October of that year till 15th February 1900, when it was relieved by General Sir John French.

Kincardineshire, or The Meaens, a maritime county of east Scotland, is bounded on the E. by the German Ocean, on the N.W. by Aberdeenshire, and on the S.W. by Forfarshire.

Area and Population. — In 1891 alterations were made in the boundary between Kincardineshire and Aberdeenshire in the parishes of Banohory-Ternan and Drumoak, the first being placed wholly in Kincardine, and the second in Aberdeen. The area of the county (foreshore excluded) is 245,259 acres, or 383-2 square miles. The population was in 1881, 34,464’; in 1891, 35,647; in 1891, on the above area, 35,492 ; m 1901, 40,918, of whom 20,067 were males and 20,851 females. On the old area, taking land only (245,347 acres, or 383-3 square mUes), the number of persons to the square mile in 1891 was 93, and the number of acres to the person 6-9. In the registration county the population increased between 1881 and 1891 by 3-4 per cent. Between 1881 and 1891 the excess of births over deaths was 6444,

and the in- crease of the resident population 1197. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 :—

Tear.

Deaths.

Marriages.

Births.

Percentage of Illegitimate.

1880 1890 1899

542 556 642

204 154 201

1073 1056 1202

11-9

13-08

10-6

The following table gives the birth-rate, death-rate, and marriage-rate per thousand of the population for a series of years : —

ISSO.

1881-90.

1890.

1891-98.

1S99.

Birth-rate . Death-rate . Marriage-rate

30-25 15-29

5-75

30-00

14-98

5-15

28-58

1506

4-17

29-27

14-87

5-57

32-76

17-64

5-52

There were 116 Gaelic-speaking persons in the county in 1891, and 14 foreigners. Valuation in 1889-90, £251,889 ; 1899-1900, £246,819.

Administration. — The county returns a member to Parliament. Bervie (2523) is the only royal burgh, and is one of the Montrose group of parliamentary burghs. Stonehaven (4565), the county town, is a police burgh. There are 19 civil parishes, with a combination poorhouse at Stonehaven, and the number of paupers and dependants in September 1899

was 567. Kincardine is united in one sheriffdom with Aberdeen and Banff shires, and one of the Aberdeen sheriffs-substitute sits at Stonehaven.

Education. — Nineteen school boards manage 48 schools, which had an average attendance of 5402 in 1898-99, while 8 voluntary schools, of which 4 are Episcopal, had 433. There is an academy at Stonehaven, and three other public schools earned grants in 1898 for giving higher education. The county council hands over the “residue” grant to the county secondary education committee, |

which expends it in technical education grants to a number of schools and school boards. At Blairs, near the Dee in the north- east corner of the county, is a Roman Catholic college at which young men are trained for the priesthood by a rector, and four clerical and three lay professors.

Agriculture. — Oats are the principal corn crop, although the acreage has declined of late years with the increase of the barley acreage due to the demands of distilling. Cattle are bred, but the bulk of the stock is kept for feeding. The percentage of cultivated area in 1898 was 49-2 ; and in 1895, 25,795 acres were under wood, of which 1586 had been planted since 1881. The average size of the 1698 holdings in 1895 was 71 acres. The percentage under 5 acres was 12-43 ; between 5 and 50 acres, 42-34 ; and over 50 acres, 45-23. The number between 50 and 100 acres was 336 ; between 100 and 300, 389 ; between 300 and 500, 36 ; and over 500, only 7. The following table gives the principal acreages at intervals of five years from 1880: —

Tear.

Area under Crops.

Corn Crop.s.

Green Craps.

Clover.

Permanent Pa^iture.

Fallow.

1880 1885 1890 1895 1899

120,322 121,496 122,848 120,993 120,685

44,936 44,373 43,405 42,647 44,446

22,662 21,075 21,420 21,073 21,159

46,134 46,674 47,427 48,528 48,257

6,448 8,704 10,281 8,611 8,742

141 68

148

54

2

The following table gives particulars of the live stock during the same years : —

Tear.

Total Horses.

Total

Cattle.

Cows or

Heifers in

Milk or Calf

Sheep.

Pigs.

1880 1885 1890 1895 1899

4903 4651 4733 5433 5009

25,207 25,922 26,627 26,1.33

25,752

6736 7032 7358 6918 6970

32,308 29,987 39,437 37,535 44,483

2196 2894 3138 2680 2544

At the census of 1891, 4685 men and 164 women were returned as being engaged in agriculture.

Industries and Trade. — Apart from agriculture the principal industry is fishing. Stonehaven is the centre of a fishery district which is not exactly conterminous with the county. The follow- ing table gives particulars of the district : —

Boats.

Value.

Value of Gear.

Resident Fishermen and Boys.

Total Value of all Fish.

Tear.

Ro.

Tons.

1880 1890 1899

230 165 153

1864 1714 1538

£2119 £8673 £8067

£12,500 £10,391 £10,863

517 403

377

£26,608 £18,264 £19,565

In 1898, 783 persons were engaged in the district in connexion with the various branches of the sea fisheries. Persons connected with industry numbered 4130 in 1891.

See A. C. Cameron. The History of Fettercairn. Paisley, 1899. — F. C. Eeles. The Bells of Kincardineshire. Stonehaven, 1899. — J. Andekson. The Black Book of Kincardineshire. Stonehaven, 1879. — J. A. Henderson. History of Banchory-Devenick. Aber- deen, 1890. — “W.R. Eraser. History of Laurencekirk. Edinburgh, 1880. — C. A. MoLLTSON. The Parish of Fordoun. Aberdeen, 1893. (w. WA.)

Kinglake, Alexander William (1809-1891), English historian and traveller, was born at Taunton 5th August 1809. His father was a respected and successful solicitor, and intended his son for a legal career. Kinglake went to Eton and Trinity College, Cambridge, where he matriculated in 1828, being a contemporary and friend of Tennyson and Thackeray. He took his B.A. degree in 1832, and his M.A. in 1836. After leaving Cambridge he joined Lincoln’s Inn, and was called to the bar in 1837. While still a student he travelled, in 1835, throughout the East, and the impression made upon him by his experiences was so powerful that he was seized with the desire to record them in literature. The task, however, proved difficult to his fastidious taste, and he was engaged for seven years in elaborating his

manuscript, which he actually rewrote three times. JEothen, a sensitive and witty record of impressions keenly felt and remembered, was published in 1844, and enjoyed considerable reputation. In 1854

he went to the Crimea, and was present at the battle of the Alma. During the campaign he made the acquaintance of LordEaglan, who was so much attracted by his talents that he suggested to Kinglake the plan for an elaborate History of the Crimean War, and placed his private papers at the writer’s disposal. For the rest of his life Kinglake was engaged \vpan the task of completing this monumental history. Thirty-two years elapsed between its commencement and the publication of the last volume, and eight volumes in all appeared at intervals between 1863 and 1887. During the course of its composition Kinglake lived principally in London, and sat in Parlia- ment for Bridgwater from 1857 until the disfranchisement of the borough in 1868. He died 2nd January 1891, in his eighty-second year. Kinglake’s life-work, 77*6 History of the Crimean War, is in scheme and execution too minute and conscientious to be altogether in proportion, but it is a wonderful example of painstaking and talented industry. It is not without errors of partisanship, and its criticisms and eulogies cannot always be accepted. P>ut it shows remarkable skill in the moulding of vast masses of despatches and technical details into an absorbingly in- teresting narrative ; it is illumined by natural descriptions and character-sketches of great fidelity and acumen ; and, despite its length, it remains one of the most picturesque, most vivid, and most actual pieces of historical narrative in the English language. (a. wa.)

King’s County, an inland county of Ireland, province of Leinster, bounded on the K. by Westmeath, on the E. by Kildare, on the S. by Queen’s county, and on the W. by the Shannon.

The area of the administrative county in 1900 was 493,^63 acres, of which 108,647 were tillage, 239,858 pasture, 400 fallow, 6870 plantation, 96,129 turf bog, 14,744 marsh, 5752 barren mountain, 20,833 water, roads, fences, &c. The new administrative connty under the Local Government (Ireland)

Act, 1898, is identical with the old judicial county. The population in 1881 was 72,852, and in 1891, 65,563, of whom 33,777 were males and 31,786 females, divided as follows among the different religions : Roman Catholics, 58,264 ; Protestant Episcopalians, 6432 ; Methodists, 463 ; Presby- terians, 291 ; and other denominations, 113. The decrease in population between 1881 and 1891 was 10-01 per cent. The average number of persons to an acre was ~~13. Of the total population, 55,988 persons inhabited the rural districts, being an average of 104 persons to each square mile under crops and pasture. The population in 1901 was 60,129 (Roman Catholics, 53,778 ; Protest~~ ant Episcopalians, 5520 ; Methodists, 363 ; Presbyterians, 328 ; others, 140), being a decrease of 8-3 per cent. The following table gives the degree of education in 1891 : —

Males.

Females.

Total.

Percentage. 1

E.G.

Pr.Ep.

Presb.

Metli.

Read and write Read only Illiterate

21,975 3,449 5,190

20,4.30 3,784 4,557

42,405 7,233 9,747

68-7 13-3 18-0

92-4 3-6 4-0

93-0 3-9 31

94-6 3-3

2-1

The percentage of illiterates among Roman Catholics in 1881 was 24-2. Invl891 there were 6 superior schools with 131 pupils (Roman Catholics 97, and Protestants 34), and 135 primary schools with 9285 pupils (Roman Catholics 8317, and Protestants 968). The number of pupils on the rolls of the national schools on 30th September 1899 was 10,209, of whom 9429 were Roman Catholics and 780 Protestants.

The following table gives the number of births, deaths, and marriages in various years : —

Year,

Hirtlis.

Deaths.

Marriages,

1881 1891 1900

1683

1404 1175

1234 1081 1175

287 257 257

In 1900 the birth-rate per thousand was 19‘5, and the death-rate 19-5 ; the rate of illegitimacy was 1-7 per cent, of the total births. The total number of emigrants who left the county between 1st May 1857 and 31st December

IK’,19 was 57,765, of whom 29,697 were males and 28,008 females. The chief towns in the county are: Tullamore (40.S!) in 1901) ; Parsonstown, 4438 ; Edciiderry, 1611.

Administration. — The county is divided into two parliamentary divisions, Birr and Tullamore, the number of registered electors in 1900 being respectively 4792 and 4939, The rateable value in 1900 was £246,251. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises two urban and five rural sanitary districts.

Agriculture. — The following table gives the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900 :—

i

£•■§

s

S

u d H

■ssi.

1

1831

14.S7

28,082

16,746

16,758

9,862

8664

50,808

119,752

1891

317

19,898

19,168

14,411

10,,326

8464

46,256

118,a39

1S95

119

21,210

10,761

18,662

10,424

8908

60,266

116,334

1900

3S2

18,620

15,894

12,645

9,320

” sass

48,451

108,647

Eor 1899 the total value of the cereal and other crops was esti- mated by the Registrar-General at £744.288. The number of acres under pasture in 1881 was 231,744 ; in 1891, 232,780 ; and in 1900,

239,858.

Year.

Horses and Mules,

Assea,

Cattle,

Sheep,

Pigs.

Goats,

Poultry,

1881 1891 1895 1900

14,714 16,233 16,631 14,572

6221 6950 6786 7281

68,165 79,136 74,168 82,278

97,670 124,264

96,516 101,730

20,526 28,884 24,589 26,746

3910 6807

5712 6200

271,879 800.868 282,856 306,961

The number of milch cows ,in 1891 was 16,534, and in 1900, 15,569. It is estimated that the total value of cattle, sheep, and pigs for 1899 was £1,278,869. In 1900 the number of holdings not exceeding 1 acre was 1892 ; between 1 and 5, 1620 ; between 5 and 15, 2285 ; between 15 and 30, 2074 ; between 30 and 50, 1336 ; between 50 and 100, 1185 ; between 100 and 200, 548 ; between 200 and 500, 254; and above 500, 53— total, 11,197. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1900, was 383, amounting to £145,204. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, between 1882 and 1900, was 270, and the amount issued was £20,456. The total amount issued on loan for all classes of works under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1900, was £71,524. (ħ. h. Po.)

Kingsley, Mary Henrietta (1862-1900), English traveller and author, daughter of George Henry Kingsley, was born in Islington, London, 13th October 1862. A delicate child, not considered strong enough to face school life, her early years were spent at home. Her father, though less widely known than his celebrated brothers, Charles and Henry ,^ was a man of versatile abilities, and had a passion for travelling, which he managed to indulge in combination with his professional care of individual patients. Mary Kingsley's reading in history, poetry, and philosophy was wide if desultory, but she was most attracted to natural history. Her family, which had settled in Highgate in 1862, removed to Bexley in 1879 and to Cambridge in 1886, and this last change proved beneficial to her health. Prom 1888 to 1892 the illness of her mother developed those qualities of self-reliance which stood her afterwards in such good stead. The loss of both parents in 1892 left her free to pursue her own course, and she resolved to travel and investigate the forms of religion and law among uncivilized races. She started for West Africa in August 1893, with a few introductions to Portuguese colonists, and making her way across much

1 Henry Kingsley (1830-1S7()) , was born in Notts, 2nd January 1830, and after being educated at Kind's College, London, and Worcester College, Oxford, went in 1853 to live in Australia. In 1858 lie returned to England, and in the next year published a novel, Geojl'n'ij Hatnhjn, full ol stirriui;- scenes of colonial life. In ISiil appeared his most famous story, Eitvem^lioe, and in 1863 The Hilli/ars ami the Burtons. Tliese, his best-known works, are characterized by much viniiur and a healthy, robust taste for incident and sentiment. Henry Kingsley died in Sussex, 24th May 1876.

country hitherto untrodden by Europeans, went up the Congo as far as Kabinda and Matadi, and returned to England in June 1894. She gained sufficient knowledge of the native customs to contribute afterwards an intro- duction to Mr Dennett's Notes on the Folk Lore of the Fjort, 1898. Miss Kingsley made careful preparations for a second exploration of the same region, and at the end of 1894 she proceeded vid Old Calabar to French Congo, and ascended the Ogowd river. From this point her journey

was a long series of adventures and hairbreadth escapes, at one time from the dangers of land and water, at another from the cannibal Fans. The story is vividly told in her Travels in West Africa. The book aroused a wide interest, and she lectured to scientific gatherings on the fauna, flora, and folklore of West Africa, and to commercial audiences on the trade of that region and its possible developments, always with a protest against the lack of detailed knowledge chatacteristic of modern dealings with new fields of trade. In both cases she spoke with authority, for she had brought back a considerable number of new specimens of plants and fishes, and had herself traded in rubber and oil in the districts through which she passed. With undaunted energy Miss Kingsley was again on her way in 1900 to the West Coast, but she pro- ceeded in the first instance to South Africa, and she died at Simon's Town, where she was engaged in nursing Boer prisoners, on 3rd June 1900.

King's Mountain, a mountainous ridge in Gaston county, North Carolina, and York county. South Carolina, U.S.A. It is an outlier of the Blue Eidge, running parallel with it, i.e., north-east and south-west, and its highest point, Mount Crowder, has an altitude of some 3000 feet. One of the battles of the American Revolu- tion, known as King's Mountain, was fought near the southern end of this ridge, in South Carolina, 7th October 1780. The American loss was 28 killed, 60 wounded ; the British loss, 389 killed, 716 prisoners.

Kingston, the chief city of Frontenac county, Ontario, Canada, at the north-eastern extremity of Lake Ontario, 260 feet above the sea. It is an important station on the Grand Trunk railway, and terminus of the Kingston and Pembroke railway, and l^as steamboat com- munication with other ports on Lake Ontario, on the St Lawrence and the Bideau canal. It contains a fine stone graving-dock, 280 feet long, 100 feet wide, and with a depth of 16 feet at low water on the sill. The fortifica^ tions, which at one time made it one of the strongest fortresses in Canada, are now out of date, and would offer little resistance to modern artillery. It is the seat of an archbishopric. Queen's University, the Eoyal Mili- tary College, and an artillery school. Vessels entered in- wards in 1900-1901, 1253, of 405,499 tons; exports, f 133,696 ; imports, f 1,245,841 ; total assessment of the city in 1899, $7,809,654. Population (1881), 14,091;

(1891), 19,263 ; (1901), 17,961.

Kingston, capital of ~~Ulster county, New York, U.S.A., on the west bank of the Hudson, 90 miles above New York, at an altitude of 185 feet. It is on thfe West Shore, the Ulster and Delaware, and the Wallkill Valley railways, has ferry communication with Ehinecliff, on the opposite bank of the Hudson, and regular steamboat communication with New York, Albany ,,and other river points. In 1900 it had 344 manufacturing establishments, with $3,657,661 capital, employing 2685 hands and pro~~ ducing goods valued at $5,280,478. Of its manufactures, cigars, cigarettes, and tobacco formed the largest item, with a value of $1,188,556. The manufacture of lime and cement was also important. Population (1890),

21,261 ; (1900), 24,635, of whom 3551 were foreign-born and 645 negroes.

Kingston-on-Thames, a parish, municipal bor- ough, and market town of England, 12 miles west of London Bridge, on the right bank of the Thames, in the Kingston parliamentary division of Surrey. It is a station on the London and South- Western railway. Besides All Saints' Church, restored in 1888, there are in Kingston four parish churches, and Eoman Catholic, Presbyterian, Congregational, Baptist, Friends', and other places of worship. Eecent public buildings are the Albany Hall (1883), the Free Library (1883), and the County Hall (1893). At Norbiton, within the borough, is the Eoyal Cambridge Asylum for soldiers' widows (1854). At Kingston Hill is an industrial and training school for girls, opened in 1892. The Victoria Hospital was erected in 1898. The municipal borough has an area of 1114 acres. Population (1881), 20,648; (1891), 27,059;

(1901), 34,375.

Kingstown, a seaport and urban sanitary district in the county of Dublin, Ireland, on Dublin Bay, 6 miles east-south-east of Dublin by rail. An electric tramway now runs through the township. In 1899, 134 vessels were registered in the fishery district, employing 546 hands. Population (1881), 18,230; (1901), 17,356.

King William's Town, a town of Cape Colony, on the Buffalo river, a few miles north-west of East London, with which it is connected by rail. "

King,” as it is locally called, is an important administrative centre, and has become a flourishing trading place and depot for the traf3.c between the neighbouring Kaffres and the white settlers. Many of these settlers are Germans, descendants of the Anglo-German legion which was dis- banded after the Crimean war. Most of the farmsteads dotted along the banks of the river are inhabited by them ; hence such names as Berlin, Potsdam, Braunschweig, Frankfurt, given to settlements in this part of the country. Population (1881), 6000 ; (1901), 7226.

Kinning Park, a police burgh of the lower ward of Lanarkshire, Scotland, on the south bank of the Clyde between Glasgow and Govan ; it is connected with the city by tramway and subway. Since 1850 it has grown from a rural village to a busy industrial centre, populated by artisans and labourers, and sharing in the activities of the burghs which enclose it. Its industries are engineer- ing, bread and biscuit baking on a considerable scale, soap-making, and paint-making. The Police Commission maintains a police force and a small fire brigade, and Glasgow gas and water are used. Area, 108 acres ; popu- lation (1901), 13,851.

KInross-shire, an inland county of Scotland, next to Clackmannan the sinallest in the country, bounded on the N. and W. by Perthshire, on the E. and on the S. by Fifeshire.

Area and Population. — In 1891 Kinross resigned part of the parish of Portmoali to Fife and parts of Amgask and Forgan- denny to Perth, receiving from Fife parts of the parishes of Dunfermline, Ballingry, and Kinglassie, and from Perth a portion of its own parish of Fossoway and TuUiebole. The area of the county is 55,849 acres, or 87-2 square miles. The population was in 1881, 6697 ; in 1891, 6280 ; in 1891, on the above area, 6673 ; in 1901, 6980, of whom 3342 were males and 3638 females. On the old area, taking land only (46,487 acres, or 72-6 square miles), the number of persons to the square mile in 1891 was 86, and the number of acres to the person 7-4. In the registration county the population decreased between 1881 and 1891 by 8-2 per cent. Between 1881 and 1891 the excess of births over deaths was 521, but the resident population decreased by 603. The table on the next page gives particulars of births, deaths, and marriages in 1880, 1890, and 1899.

S. VL— 7

50

K I N S A L E — K I 0 T 0

Year.

Deaths.

Marriages.

Births.

Percentage of Illegitimate.

1880 1890 1899

143

124 104

36 57 40

204 173

173

11-2 7-51 4-6

The following table gives the birth-rate, death-rate, and marriage-rate per thousand of the population for a series of years : —

18S0.

lSSl-90.

1S90.

1891-98.

1899.

Birth-rate . Death-rate Marriage-rate .

27-67

19-39

4-88

24-53

17-11

5-91

25-55

18-31

8-42

26-40

17-20

6-08

27-94

16-79

6-46

There were 58 Gaelic-speaking persons in the country in 1891, and one foreigner. Valuation in 1889-90, £64,004; 1899-1900, £67,0.30.

Administration. — The county unites with Clackmannan to return a member to Parliament. The only towns are Kinross (2136), the county town and a police burgh, which has a, town hall, a county hall, two railway stations, and several textile factories ; and Milnathort. There are five civil parishes, which had 101 paupers and dependants in September 1899. The county forms a sheriffdom with Fife, and a sheriff-substitute sits at Kinross.

Education. — Five school boards manage 6 schools, which had in 1898-99 an average attendance of 733, while a private school in Orwell parish had 133. The county committee provides bur- saries for scholars attending Dollar Institution, and the county council spends part of the “residue” grant in agricultural experiments.

Agriculture. — In 1898, 63 per cent, of the area was under culti- vation, the county ranking fifth in Scotland in this regard. The standard of farming is high, though the climate is cold and wet. In 1895 the average size of the 302 farms in the county was 119 acres ; only 13-58 per cent, were under 5 acres ; 23-51 between 5 and 50, and 62-91 were over 50 acres. Fifty-four farms were between 50 and 100 acres, 112 between 100 and 300, 21 between 300 and 500, and there were 3 over 500. Stock-raising is the staple industry. The following table gives the principal acreages at intervals of five years from 1880 : —

Tear.

Area under Crops.

Corn Crops.

Green Crops.

OIOTCr.

Permanent Pasture.

Fallow.

1880 1885 1890 1895 1899

31,372 32,246 32,278 35,846 35,357

7417 6558 5924 6892 6939

3773 3339 3138 3526 3481

12,288 11,689 10,350 11,633 12,576

7,872 10,645 12,854 13,761 12,323

22 15 6 19 19

The following table gives particulars of the live stock during the same years : —

Tear.

Total Horses.

Total Cattle.

Cows or

Heifers in

Milk or Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1899

1051 944

894 1179 1106

5763 6475 6106 6948 7091

1045 1284 1110 1196 1321

27,966 30,518 35,539 36,239 40,920

461 548 520 515 671

In 1895, 3258 acres were under wood. At the census of 1891, 727 men and 68 women were engaged in agriculture.

See JE. J. G. Mackay. History of Fife and Kinross. Edin- burgh, 1896. — I. Jaffrey and C. Howie. The Trees and Shrubs of Fife and Kinross. Leith, 1879.— W. J. N. Liddall. The Place Names of Fife and Kinross. Edinburgh, 1895 ; TJie Concise Hand-hook and Map of Fife and Kinross. Cupar. — C. Koss. Antiquities of Kinross-shire. Perth, 1886.— R. B. Bego. The Witches of Kinross-shire. Kinross ; History of Lochleven Castle. Kinross, 1887. (yf_ Tf/-j^\

Kipsale, a maritime town, urban sanitary district, and formerly (until 1885) a parliamentary borough in the county of Cork, Ireland, on the estuary of the Bandon, 24 miles south of Cork by rail. The number of vessels registered in the fishery district in 1899 was 220, employ- ing 1064 men and boys. A fishery pier has been con- structed at a cost of £22,000. Population (1881), 4976 ;

(1901), 4250.

Kioto, or Kyoto, the former capital of Japan, in the province of Yamashiro, in 36° 01′ N. and 135° 46′ E., with a population of 353,139, being thus the third of the empire's chief cities (/«). The Kamo-gawa, upon which it stands, is a mere rivulet in ordinary times, trickling through a wide bed of pebbles ; but the city is traversed by several aqueducts, and was connected with Lake Biwa in 1890 by a canal 6|- miles long, which carries an abundance of water for manufacturing purposes, brings the great lake and the city into navigable communication, and forms with the Kamo-gawa canal and the Kamo-gawa itself a through route to Osaka, from which Kioto is 25 miles distant by rail. Founded in the year 793, Ki8t6 remained the capital of the empire during nearly eleven centuries. The Emperor Kuwammu, when he selected this remarkably picturesque spot for the residence of his court, caused the city to be laid out with mathematical accuracy, after the model of the Tang dynasty's capital in China. Its area, 3 miles by 3^, was intersected by 18 principal thoroughfares, 9 running due north and south, and 9 due east and west, and the two systems being connected at intervals by minor streets. At the middle of the northern face stood the palace, its enclosure covering f of a square mile, and from it to the centre of the south face ran an avenue 283 feet wide and 3^ miles long. Conflagrations and subsequent reconstructions modified the regularity of this plan, but much of it still remains, and its story is perpetuated in the nomenclature of the streets. In its days of greatest prosperity Kioto contained only half a million inhabitants, thus never even approximating to the size of the Tokugawa metropolis, Yedo, or the Hojo capital, Kamakura. The Emperor Kuwammu called it Heian-j6, or the "city of peace," when he made it the seat of government ; but the people knew it as " Miyako," or " Kyoto," terms both of which signify " capital," and in modern times it is often spoken of as " Saikyo," or western capital, in opposition to "Tokyo," or "eastern capital." Having been for nearly eleven centuries the imperial, intellectual, political, and artistic metropolis of the realm, the city abounds with evidences of its unique career. Magnificent temples and shrines, grand monu- ments of architectural and artistic skill, beautiful gardens, gorgeous festivals, and numerous ateliers where the tradi- tions of Japanese art are obeyed with attractive results, offer to the foreign visitor a mine of exhaustless interest. Clear water ripples everywhere through the city, and to this water Kioto owes something of its importance, for nowhere else in Japan can fabrics be bleached so white or dyed in such brilliant colours. The people, like their

Osaka neighbours, are full of manufacturing energy. Not only do they preserve, amid all the progress of the age, their old-time eminence as producers of the finest porcelain, faience, embroidery, brocades, bronze, cloisonni. enamel, fans, toys, and metal work of all kinds, but they have also adapted themselves to the foreign market, and are now weaving and dyeing quantities of silk fabrics, for which a large and constantly growing demand is found in Europe and America. Nowhere else can be traced with equal clearness the part played in Japanese civilization by Buddhism, with its magnificent paraphernalia and impos- ing ceremonial spectacles ; nowhere else, side by side with this luxurious factor, can be witnessed in more striking juxtaposition the austere purity and severe simplicity of the Shinto cult ; and nowhere else can be more intelli- gently observe^ the fine faculty of the Japanese for utilizing, emphasizing, and enhancing the beauties of nature. The citizens' dwellings and the shops, on the other hand, are insignificant and even sombre in appear- ance, theirexteriorconveyingnoideaof the pretty chambers within or of the tastefuUy-laid-out grounds upon which they open behind. Kioto is celebrated equally for its

cherry and azalea blossoms in the spring, and for the colours of its autumn foliage. (f. by.)

Kipling, Rudyard. See English Liteeatuee.

Kirchhoff, Custav Robert (1824-1887), Ger- man physicist, was born at Konigsberg (Prussia) on 12th March 1824, and was educated at the university of his native town, where he graduated Ph.D. in 1847. After acting as privat-docent at Berlin for some time, he became extraordinary professor of physics at Breslau in 1850. Four years later he was appointed professor of physics at Heidelberg, and in 1875 he was transferred to Berlin, where he died on 17th October 1887. Kirchhoff's con- tributions to mathematical physics were numerous and important, his strength lying in his powers of stating a new physical problem in terms of mathematics, not merely in working out the solution after it had been so for- mulated. A

number of his papers were concerned with electrical questions. One of the earliest was devoted to electrical conduction in a thin plate, and especially in a circular one, and it also contained a theorem which enables the distribution of currents in a network of conductors to be ascertained. Another discussed conduction in curved sheets ; a third the distribution of electricity in two in- fluencing spheres ; a fourth the determination of the con- stant on which depends the intensity of induced currents ; while others were devoted to Ohm's law, the motion of electricity in submarine cables, induced magnetism, &c. In others papers, again, various miscellaneous topics were treated — the thermal conductivity of iron, crystalline reflection and refraction, certain propositions in the thermo- dynamics of solution and vaporization, &c. An import- ant part of his work was contained in his Vorlesungen liber Mathematische Physik (1876), in which the principles of dynamics, as well as various special problems, were treated in a somewhat novel and original manner. But his name is best known for the researches, experimental and mathematical, in radiation which led him, in company with Bunsen, to the development of spectrum analysis as a complete system in 1859-60. He can scarcely be called its inventor, for not only had many investigators already used the prism as an instrument of chemical inquiry, but considerable progress, to say the least, had been made towards the explanation of the principles upon which spectrum analysis rests. But to him belongs the merit of having, most probably without knowing what had already been done, enunciated a complete account of its theory, and of thus having firmly established it as a means by which the chemical constituents of celestial bodies can be discovered through the comparison of their spectra with those of the various elements that exist on this earth.

Kirk, Sir John (1832), British naturalist

and administrator, was born at Barry, near Arbroath, on 19th December 1832, and was educated for the medical profession. He graduated M.D. at Edinburgh in 1854, and, after serving on the civil medical staff throughout the Crimean war, was appointed physician and naturalist to Dr Livingstone's second exploring expedition in February 1858. He was by Livingstone's side in most of his journey ings and adventures, and was one of the first four white men to behold Lake Nyasa (16th September 1859). He was finally invalided home on 9th May 1863. His African experience

qualified him for the post of vice- consul at Zanzibar, bestowed upon him in 1866. In 1873 he became consul, and shortly afterwards concluded a treaty with the sultan providing for the extinction of the slave trade in his dominions. Sir John Kirk retired from the consular service in 1887, and subsequently repre- sented the British Government at the African conferences held at Brussels in 1888-90, as commissioner on the Niger

coast in 1895, and as a member of the committee for con- structing the Uganda railway. Besides being foreign secretary to the Koyal Geographical Society, he received its gold medal in 1882. Sir John Kirk married Miss Helen Cooke in 1867, and was made K.C.B. in 1881, and subsequently G.C.M.G.

Kirkcaldy, a royal and parliamentary burgh (Kirk- caldy group) and seaport town of Fifeshire, Scotland, on the Firth of Forth, 26 miles north of Edinburgh by rail (Forth Bridge route). Although within recent years no addition has been made to the harbour accommodation, the shipping trade — chiefly with Baltic ports— continues to increase. In 1885, 2293 vessels of 586,543 tons entered, and 2386 of 227,673 tons cleared ; in 1900, 3190 vessels of 1,328,500 tons entered, and 3308 of 1,388,410 tons cleared. In the latter year the exports were valued at £1,678,650, and the imports at £280,100. Several important puljlic buildings have been erected : sheriff court buildings in 1893, high school — succeeding the burgh school — in 1894, the Swan memorial hall, ~~with rooms for the Young Men's Christian Association, the Adam Smith memorial hall, and the Beveridge public hall and free library (1894). A beautiful park, at the north~~ west end, with an area of 110 acres, was presented in 1892. Population (1891), 27,161 ; (1901), 34,064.

Kirkcudbright, a royal and parliamentary burgh (Dumfries group), and the county town of Kirkcudbright- shire, Scotland, on the river Dee, 6 miles from the sea. Its first charter dates from 1455. There are county buildings, a town hall, and a museum. There is a regular water-supply. The river is spanned by an iron bridge, which can be opened for the purpose of allowing the passage of vessels. The harbour is excellent, but shipping is inconsiderable, as also are manufactures. The churches are Established, two United Free (one 1880), Epis- copal (1870), and Roman Catholic (1880).

Besides an academy, there are four public schools, and the average attendance at elementary classes in 1898-99 was 445 ; an Old Church school had 156, and a Roman Catholic school 134. Population (1881), 2571; (1891), 2533;

(1901), 2386.

Kirkcudbrightshire, or the Stewaetet of Kiek- cuDBEiGHT, a maritime county of south-west Scotland, bounded on the N. and N.W. by Ayrshire, on the E. and N.E. by Dumfriesshire, on the S. by the Solway Firth and the Irish Sea, and on the W. by Wigtownshire and Wigtown Bay.

Area and Population. — According to the latest official estimate, the area of the county (foreshore excluded) is 582,251 acres, or about 909 square miles. The population was, in 1881, 42,127 ; in 1891, 39,985 ; in 1901, 39,407, of whom 18,759 were males and 20,648 females. Taking the land area only (574,588 acres or 897-8 square miles), the number of persons to the square mile was 45 and the number of acres to the person 14-0. Between 1881 and 1891 the population of the registration county decreased by 5 per cent. Between 1881 and 1891 the excess of births over deaths was 4335, and the decrease of the resident population 2143. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 :—

Tear.

Deaths.

Marriages.

Births.

Per cent, of Illegitimate.

1880 1890 1899

707 729 663

207 232 221

1291 1044

978

15-6

14-18

11-8

The following table gives the birth-rate, death-rate, and mar- riage-rate per thousand of the population for a series of years : —

1880.

1881-90.

1890.

1891-98.

1899.

Birth-rate . Death-rate . Marriage-rate

30-64

16-73

4-90

28-19

17-71

5-45

25-89

18-07

5-75

26-24

17-14

5-44

25-50

17-28

5-76

52

There were 69 Gaelic-speaking persons in the county in 1891, and 16 foreigners. Valuation in 1889-90, £346,477 ; 1899-1900, £341,728.

Administration. — The county returns one member to Parliament, and Kirkcudbright (2386), the county town, is one of the Dumfries group of parliamentary burghs ; New Galloway was, with the other burghs of the Wigtown group, merged in its county for parliamentary representation in 1885. There are 28 civil parishes in the county, with a combination poorhouse at Kirkcudbright, and the number of paupers and dependants in September 1899 was 1107. Kirkcudbright forms a part of the sheriffdom of Dumfries and Galloway, and there is a resident sheriff-substitute at Kirk-cudbright, who sits also at Castle Douglas, Maxwelltown, New Galloway, and Creetown.

Education. — Thirty school boards manage 63 schools, which had an average attendance of 5990 in 1898-99, while 6 voluntary schools (of which four are Roman Catholic, and one Episcopal) had 505. There is an academy at Kirkcudbright, and the county committee subsidizes also high schools at Dumfries and Newton- Stewart, while 13 other public schools in the county earned grants in 1898 for giving higher education. Part of the ” residue ” grant is handed over by the county council to the secondary committee, and

is expended on technical classes at Kirkcudbright, Dalbeattie, Castle Douglas, and Dumfries, and part is spent by the council directly in supporting a dairy association, manuring experiments and lectures, and cookery classes.

Agriculture. — The percentage of the area under cultivation in 1898 was 32-9. The greater part of the land is either waste or poor pasture. Green crops rather than grain are favoured by the climate, and cattle breeding and feeding, and dairying (with cheese-making as a staple) are the leading agricultural industries. The average size of the 1605 holdings in 1898 was 119 acres. The percentage under 5 acres was 14-70, between 5 and 50 acres 29-85, and over 50 acres 55-45. Farms between 50 and 100 acres numbered 234 ; between 100 and 300, 486 ; between 300 and 500, 142, and over 500, 28. The following table gives the principal acreages at intervals of five years from 1880 : —

Tear.

Area under Crops.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1880 1885 1890 1895 1899

177,079 182,490 186,580 191,028 191,626

32,672 32,176 29,107 27,860 27,529

17,171 16,953 17,395 16,808 15,782

67,680 69,482 68,269 60,998 63,348

59,418 63,530 71,644 85,109 84,845

138 349 132 221 100

The following table gives particulars of the live stock during the same years : —

Tear.

Total Horses.

Total Cattle.

Cows or

Heifers In

Milk or Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1899

5476 5673 5719 6190 5476

42,463 43,926 46,933 48,213 49,539

11,685 14,489 14,699 16,256 16,246

381,874 367,361 402,033 381,115 399,338

5019 7025 7729 7892 8265′

In 1895, 19,285 acres were under wood, of which 1203 had been planted since 1881. The number of persons returned at the census of 1891 as connected with the pursuit of agriculture was 6281 men and 531 women.

Industries and Trade. — Industries apart from agriculture are not of great importance. Kirkcudbright comes next to Aberdeen as a granite-producing county ; the output was 55,388 tons valued at £35,358 in 1895, and 63,633 tons valued at £28,429 in 1899. Kirkcudbright, Creetown, and Gatehouse are the principal ports, and the exports are mainly agricultural produce, the imports coal and miscellaneous. The fishing industry can scarcely be said to exist. The number of persons connected with industrial pursuits in 1891 was 6000.

See Sir Herbert Maxwell. History of Dumfries and Galloway. Edinburgh, 1896. — P. H. M'Keklie. jlistory of the Lands and their Omiifrs in Galloway. Edinburgh, 1870-79 ; Galloway Ancient and Modern. Edinburgh, 1891. — J. A. H. Murray. Dialect of the Southern Counties of Scotland. London, 1873. — J. M'Anurbw. List of the Floweriny Plants of Dumfriesshire and Kirkcudbrightshire. Dumfries, 1882. — Proceedings of the Society of Antiquaries of Scotland, passim. — Thomas MaoLelland. "The Agriculture of the Stewartry," Trans, of H. and A. Soc, 1875. — J. BiGOAR. The Agriculture of Kirkcudbrightshire. Castle Douglas, 1876. Cw. Wa.)

Kirkintilloch, a burgh of barony and police burgh of Dumbartonshire, Scotland, on the Forth and Clyde Canal, 8 miles north-north-east of Glasgow by rail.

Iron-founding, muslin-weaving, and chemical-manufact- ures are the chief industries. A drainage system has been laid, and a memorial erected (1891) to Miss Beatrice Clugston, to whom was largely due the foundation of the Broomhill Homes in the burgh. In 1898 the burgh acquired as a public park the Peel, containing traces of the Eoman wall, a fort, and the foundation of Comyn's Castle. Baptist and Original Secession chapels have been erected. Population (1881), 8029 ; (1891), 10,312 ; (1901), 10,602. The suburb of Lbnzib, partly included in the burgh, is inhabited chiefly by Glasgow business men. It has a public hall, academy, and an asylum of the Glasgow City Lunacy Board. Population (1891), 1916; (1901),

1879.

Kirk-Kilisseh, a town in the sanjak of Adrian- ople, European Turkey, 35 miles east of Adrianople. The name signifies ” four churches,” and the town possesses many mosques and Greek churches. It has an important trade with Constantinople in butter and cheese, and other articles of commerce are wine, brandy, cereals, and tobacco. Population, 18,000, of whom 3000 are Turks, 9000 Greeks, 5400 Bulgarians, and 600 Jews.

Kirksville, capital of Adair county, Missouri, U.S.A., on the Omaha, Kansas City and Eastern, and the Wabash railways, at an altitude of 975 feet. Situated in an agricultural region, its manufactures consist in great part of agricultural tools and machines. Population (1880), 2314 ; (1900), 5966, of whom 112 were foreign-born and 291 negroes.

Kirkwall, a royal and parliamentary burgh (Wick group) and the county town of Orkney, Scotland, on a bay of the island of Pomona, the largest of the group. It is 51 miles north of Wick in a straight line, and 225 from Leith by steamer. Municipal buildings have been erected, and there are county buildings. A United Eree church has been built. A second pier was erected to improve the harbour in 1885. The industries are those connected with fishing and shipping, and there are two distilleries ad- jacent. At the end of 1900 the port register contained 39 vessels of 2287 tons. In 1888, 2414 vessels of 214,710 tons entered ; in 1900, 2385 vessels of 226,124 tons. The total trade barely exceeds £10,000 in value annually. Population (1881), 3923; (1901), 3660.

Kirman (Keemakt, Kabman), the capital of the Persian province of the same name, situated in 30° 17 ‘N. and 56° 59′ E., at an elevation of 6080 feet. Its population is estimated at 45,000, including about 2000 Zoroastrians, 150 Jews, and a few Shik^rpiiri Indians. Kirman has post (since 1878) and telegraph (since 1879) offi-ces, and a British consulate and an agency of the Im- perial Bank of Persia have been established. Kirman and neighbouring districts produce little grain, and have to get their supplies from districts far away for four or five months of the year. A well-known traveller once said it was easier to get a manu (6^ lb) of saffron at Kirman than a mann of barley to feed his horse, and the writer in 1879 was ordered by the authorities to curtail his trips in the province, ” because his horses and mules ate up all the stock.” (a. h.-s.)

Kirriemuir, a police burgh, manufacturing town, and railway station of Eorfarshire, Scotland, 5 miles west-north-west of Forfar. It is the ” Thrums ” of J. M. Barrie, the novelist, who was born here. It has two large linen factories. There are a public hall and a public park. The Original Secession chapel (Barrie’s ” Auld Licht kirk”), founded 1806, was rebuilt 1893. Population

(1881), 4390 ; (1901), 4096.

Kir-shehr, the ancient Mocissus-JustinianojMlis,

the chief town of a sanjak of the same name in the Angora vilayet of Asia Minor, situated on a tributary of the Kizil Irmak, on the Angorar-Kaisarieh road. The town gives its name to the excellent carpets made in the vicinity. It is on the line of the projected rail- way from Angora to Kaisarieh. Population (1900), 9000 (900 Christians).

Kishangarh, a native state of India, in the Eaj- putana Agency. Area, 874 square miles; population (1881), 112,633 ; (1891), 125,516, showing an increase of 11 per cent. ; average density, 144 per square mile. In 1901 the population was 88,200, showing a decrease of 30 per cent., due to the results of famine. The revenue (1896-97) was Rs.6,68,097; no tribute; number of schools, 20. The chief, whose title is maharaja, is a Eajput of the Rahtor clan. The reigning maharaja, Sardul Singh, G.G.I.E., was born in 1857, and succeeded his father in 1879. He is connected by marriage with all the great houses of Eajputana. The administration, under the Diwan, is highly spoken of. Irrigation from tanks and wells has been extended ; factories for ginning and pressing cotton have been started ; and the social reform movement, for discouraging excessive expenditure on inar- riages, has been very successful. The state is traversed by the Eajputana railway. It suffered severely from the famine of 1899-1900. In 1897-98 rupees were coined at the mint to the value of Es.1,03,379, bearing on the obverse the name of Queen Victoria in Persian char- acters. The town of Kishaistgaeh is

18 miles north-east of Ajmir by rail. Population (1881), 14,824 ; (1891), 15,363. It is the residence of many Jain merchants.

Kishinev, a town of Eussia, capital of the govern- ment of Bessarabia, 120 miles by rail north-west of Odessa and 30 miles from the Eumanian frontier. Population, which is very mixed, and contains many Moldavians and Jews (1862), 91,632 ; (1897), 108,796. It has now a con- siderable number of schools, including a gardening school ; a museum of natural sciences, agriculture, and domestic industries; a public library, and a botanic garden. Fruit- gardens, vineyards, and plantations of silk-worm trees and tobacco cover its suburbs. Paotories, chiefly distilleries, develop but slowly, but the trade in corn, wine, tobacco, fruit, tallow, hides, wool, and cattle (exported abroad), is rapidly grow- ing, and its yearly fair is of importance.

Kissingen, a town and watering- place of Bavaria, Germany, district Lower Franconia, on the Franconian Saale, 43 miles by rail north by east of Wtlrzburg. It is visited annually by 14,000 persons. A marble statue of Ludwig I. of Bavaria was placed in the spa garden in 1891. Population (1900), 4765.

Kistna, a district of British India, in thenorth-east of the Madras Presidency. Masulipatam, the district headquarters, was the first British settlement on the Coromandel coast (1611), and was cap- tured from the French in 1758. Linguis- – ^j^Mli tically, almost all the iDhabitants speak KsmsII Telugu. Area, 8397 square miles; popula- tion (1881), 1,648,480; (1891), 1,866,582, showing an increase of 20 per cent. ; average density, 221 persons per square mile. In 1901 the population was 2,156,199, show- ing a further increase of 16 per cent. The land revenue and rates were Rs.64,25,525, the incidence of assessment per acre being Es.2 : 4 : 0 on ryotwari and Es.O : 10 : 9 on zamindari lands ; number of police, 1097. In 1897-98, out of a total cultivated area of 2,129,669

acres, 432,960 were irrigated, including 384,467 from Government canals. Upon the Kistna delta system of canals, which are available also for navigation, connect- ing with the Godavari system, the capital expenditure has been Es.1,31,91,665, and the profit in 1897-98, after allowing for interest and all indirect charges, was Es.12,62,028, or more than 10 per cent. The surplus rice thus raised in the delta serves to protect the other

portions of the district from the effects of drought, to which it has always been liable. The principal crops are rice, millet, other food grain, pulse, oil-seeds, cotton, indigo, tobacco, and a little sugar-cane. There are 11 factories for ginning and pressing cotton. The cigars known in England as Lunkas are partly made from tobacco grown on lankas or islands in the Kistna. The manufacture of chintzes at Masulipatam is a decaying industry, but cotton is woven everywhere for domestic use. Salt is evaporated, as a Government monopoly, along the coast. The diamond mines visited by Taver- nier, which are said to have yielded the Kohinoor stone, are no longer worked Bezwada, at the head of the delta, is a place of growing importance, as the central junction of the East Coast railway system, which crosses the inland portion of ■ the district in three directions. Some sea-borne trade, chiefly coasting, is carried on at the open roadsteads of Masulipatam and Nizampatam, both in the delta. In 1897-98 the total was valued at Es.27,51,324. The Church Missionary Society supports a college at Masulipatam, and the American Lutheran Mission a smaller one at Guntur — total students in 1896-97, 109. In that year there were 1828 schools, attended by 45,653 pupils, the proportion of boys at school to the male population of school-going age being 26 per cent., and the proportion of girls 6-6 per cent. There are 7 printing-presses, issuing two English and three vernacular periodicals, and several reading-rooms, clubs, and literary institutes. Death-rate (1897), 22 per thousand. (j. s. oo.)

Kites, Military. — A kite, consisting of a frame- work of sticks spreading a light sail of cloth or other material, and held by a string against the pressure of the

Fig. 1. — Military Kite and Basket.

wind, forms so extremely simple a method of lifting any- thing to a height in the air, that it has naturally been suggested as being suitable for various military purposes (Fig. 1) — for instance, for signalling to a long distance,

carrying up flags, or lamps, or semaphores. Trials have been made both in the British army (at Aldershot and elsewhere) and navy, in the latter case for floating torpedoes on hostile positions. As much as two miles of line have been paid out. For purposes of photography a small kite carrying a camera to a considerable height may be caused to float over a fort or other place of which a bird's-eye view is required, the shutter being operated by electric wire, or slow match, or clockwork. Many successful

Fio. 2.— Military Kite iiftinf; a Man.

photographs have been thus obtained in England and America.

The problem of lifting a man by means of kites instead of by a captive balloon is a still more important one. The chief advantages to be gained are : (1) less transport is required; (2) they can be used in a strong wind ; (3) they are not so liable to damage, either from the enemy's fire or from trees, &c., and are easier to mend; (4) they can be brought into use more quickly ; (6) they are very much cheaper, both in construction and in maintenance, not requir- ing any costly gas.

Early in the 19th century one Pooock suggested the use of man-lifting kites for military purposes, and an apparatus was tested at Chatham in 1876, but it failed to lift a man. Captain Baden-Powell, of the Scots Guards, in June 1894 constructed, at Pirbright Camp, a huge kite 36 feet high, with which he suc- cessfully lifted a man on different occasions (Fig. 2). He has since improved the contrivance, using five or six smaller kites attached together in preference to one large one. With this

arrangement he has frequently ascended as high as 100 feet. The kites were hexagonal, being 12 feet high and 12 feet across. The apparatus, which could be packed in a few minutes into a simple roll, weighed in all about 1 cwt. This appliance was proved to be capable of raising a man even during a dead calm, the retaining line being fixed to a waggon and towed along. Lieut. H. D. Wise made some trials in America in 1897 with some large kites of the Hargrave pattern (Hargrave having pre- viously himself ascended in Australia), and succeeded in lifting a man 40 feet above the ground. In the Russian army a mili- tary kite apparatus has also been tried, and was in evidence at the manoeuvres in 1898. Experiments on a small

scale have also been carried out by most of the European Powers. (b. f. s. b.-P.)

Kivu, a considerable lake lying in the Central African rift valley, about 60 miles north of Tanganyika, into which it dis- charges its waters by the Eusizi river, thus belonging to the Congo system. On the north it is separated from the basin of the Nile by a line of volcanic peaks. The length of the lake is about 55 miles, and its greatest breadth over 30, giving an area, including islands, of about 1100 square miles. It is roughly triangular in outline, the longest side lying to the west. The coast-line is much broken, especially on the south-east,' where the indentations present a fjord-like character. The lake is deep, and the shores are everywhere high, rising in places in bold precipitous cliffs of volcanic rock. A large island, Kwijwi or Kwiehwi, oblong in shape and traversed by a hilly ridge, runs in the direction of the major axis of the lake, south-west of the centre, and there are many smaller islands. The lake has many fish, but no crocodiles or hippopotami. South of Kivu the rift valley is blocked by huge ridges, formed of the same eruptive rocks of which the plateaux to the east and west are composed. Through these the Eusizi now breaks its way in a succession of deep gorges,, emerging from the lake in a foam- ing torrent, and descending 2000 feet to the lacustrine plain at the head of Tan- ganyika. There is evidence that the lake was not always drained thus, the ancient water-parting having probably been formed by the eruptive ridge above referred to. The lake fauna is a typically fresh-water one, presenting no affinities with the marine or " halolimnic " fauna of Tanganyika, but similar to that shown by fossils to have once existed in the more northern parts of the rift valley. The former outlet or ex- tension in this direction seems to have been blocked in recent geological times by the elevation of the volcanic peaks which dammed back the water, causing it finally to overflow to the south. The whole of the region to the north is of great interest. The volcanoes (sometimes known generally as the Kirunga mountains) form two groups, separated by a vast lava-field. In the west are the still active peaks, Kirunga-cha-gongo and Kirunga-cha-moto, the former 11,350 feet high. The eastern peaks are still higher, and are snow-clad for part at least of the year. The principal are Sabyin, Karisimbi (13,000 feet), and at the eastern end of the line, that for- merly known as Mfumbiro (andsometimes also as Kirunga), which reaches some 14,000 feet. It has a small crater

filled with water on the summit. Mfumbiro is said to be the name of a district to the north containing niauy hun- dreds of low peaks and craters, now extinct. The eastern

Kirunga separates the basins of the principal feeders of the Albert Edward and Victoria Nyanzas, the Ruchuru and Kagera. Lake Kivu and Mfumbiro were first heard of by Captain Speke in 1861, but not visited by a Euro- pean until 1894, when Count von Gotzen passed through the country on his journey across the continent. The lake and its vicinity have been carefully explored by Dr Kandt, Captain Bethe, Mr E. S. Grogan, Mr J. S. Moore, and Major Gibbons. The ownership of the region has for some time been in dispute between Germany and the Congo State. In the map accompanying the agreement between the two parties in 1886, the boundary was shown as the Rusizi, while in other maps and documents of the same and later dates it was defined as running in a direct line from the head of Tanganyika to the inter- section of 30° E. with 1° 20′ S., thus giving the whole of the Kivu region to the Congo State. The difference was, in 1901, in process of settlement on the spot by the labours of a mixed commission.

See Kandt, in Mitt, aus den Deutsohen Schutzgebieten, No. .5, 1900. — GnoGAN, in Geographical Journal for August 1900.— Moore, ibid., January 1901 ; To the Mountains of the Moon, London, 1901. (e. He.)

Kizil irmak, i.e., “Red River,” the ancient Halys, the largest river in Asia Minor, rising in the Kizil Dagh at an altitude of 6600 feet, and running south-west past Zara to Sivas. Below Sivas it flows south to the latitude of Kaisarieh, and then curves gradually round to the north. Finally, after a course of about 600 miles, it dis- charges its waters into the Black Sea between Sinope and Samsiin, where it has formed a large delta. The only important tributaries are the Delije Irmak on the right and the Geuk Irmak on the left bank.

Kjerulf, Halfdan (1815-1868), Norwegian musical composer, born at Christiania in 1816, was the son of a high Government ofScial. His early

education was al- most entirely aimed at fitting him for a legal career. In his 19th year he graduated at Christiania University, and not till he was nearly 26 — on the death of his father — was he able to devote himself entirely to music, for which he had longed throughout his whole life. As a fact, he actually started on his career as a music teacher and composer of songs before ever having seriously studied music at all, and not for ten years did he attract any particular notice. Then, however, his Government paid for a year's instruction for him at Leipzig. Eor many years after his return to Norway Kjerulf tried in vain to establish serial classical concerts, while he himself was working with Bjornson and other writers at the com- position of lyrical songs. His fame rests almost entirely on his beautiful and manly national part songs and solos ; but his pianoforte music is equally charming and simple. Kjerulf died at Grefsen, 11th August 1868.

Kladno, a mining town in Bohemia, 16 miles west- north-west of Prague. The iron and steel works of the Prague Iron Industry Association employ over 3000 hands, while nearly as many more are engaged in the company's coal mines, and another 3000 find occupation in the six pits worked by the Austro-Hungarian State rail- way. The production of iron and steel in 1893 was over 200,000 tons, and of coal 1,426,000 tons. Population (1890), 17,215 ; (1900), 18,600, Czechs.

Klagenfurt (Slovene, Gelovec), the capital of the Austrian duchy of Carinthia, 41 miles north by west of Laibach, on the Glan, near Lake Worth. Population (1890), 19,756, German and mostly Catholic; (1900), after the incorporation of some suburbs, 24,314. The town has an exceptionally high rate of illegitimacy. In 1892 it was 61 per cent. In 1888 the illegitimate births

were 512 and the legitimate 173. The death-rate de- clined from 32-6 in 1890 to 21-9 in 1895.

Klattau (Czech, Klatovy), chief town of a district of the same name in Bohemia, Austria, 25 miles west by south of Pilsen. It has a machine factory and foundry, steam corn and saw mills, breweries, and manufactories of chicory, lucifer matches, underlinen, &c. Population (1890), 10,811 ; (1900), 12,793, mostly Czech.

Klausenburg. See Kolozsvak.

Klausthal, or Clausthal, a town of Hanover, Prussia, the chief mining town in the Upper Harz Mountains, 50 miles by rail west-south-west of Halberstadt. Its own mines are silver and lead, but it also smelts copper and a little gold. Four or five sanatoria are in the neighbourhood. The museum of the Upper Harz is at Zellerfeld. Population (1886), 8871 ; (1900), 8565.

Klintsy, a town of Russia, government and 95 miles north-east of Chernigov, on the railway to Bryansk. It has several woollen-cloth and sackcloth mills, knitting factories, tanneries, and various smaller factories, the yearly returns from which amount to about £200,000. Many artisans are engaged in shoemaking and the weav- ing of cloth, while the merchants carry on an important trade in furs, hides, hemp-seed, and cattle. Population

(1897), 11,625.

Klondike, a district in Yukon territory, north- western Canada, approximately in 64° N. and 140° W. The limits are rather indefinite, but the district includes the country about the course of Klondike river, a right-hand branch of the Yukon, together with its tributaries ; and in popular usage also the mining region of Indian river, a second branch of the Yukon, flowing into it some distance above the Klondike. It is thus some 40 miles square and includes an area of approximately 1600 square miles. It is an area of hills, or low mountains, rising in the highest summits to altitudes of about 2200 feet above the Yukon or 3600 feet above the sea. Gold was discovered in this region in 1896, by one J. W. Carmach, aided, it is said, by his Indian wife. This discovery was made on Bonanza Creek, where it joins the Klondike just above its mouth. The discovery was followed by a stampede of miners from all the camps for hundreds of miles round, and the creek and its many branches were covered with claims from head to mouth. The ” clean- up ” of the following year, 1897, was a revelation to the world, and the arrival of a steamer at Seattle, bearing a ton of the yellow metal, was the signal for an exodus from all parts to this new Eldorado. The routes chiefly used were by the inside passage to the head of Lynn Canal, to Dyea, and Skagway, thence over the Chilkoot and White passes to the Yukon and down that stream. The city of Dawson was founded in 1897 as the metropolis of the district, and quickly became a large and flourishing city,

with a most heterogeneous population. The Canadian Government, by the aid of its mounted police, maintained excellent order from the first. During 1897 and 1898 prices of labour and the necessaries of life were extravagantly high, but with the development of transportation lines on the Yukon, and the construc- tion of the railway from Skagway, over White Pass and down the Yukon to White Horse rapids, freights were greatly reduced and prices approached a normal level.

The production of gold in the Klondike district was in 1897,

$2,500,000; 1898, $11,000,000; 1899, $16,000,000; 1900, 620,000,000;

1901, estimated at over $20,000,000. This production is entirely from placers. The placers were of two kinds, gulch and hench claims. The gulch claims are on branches of Klondike river — ^not on the main stream, which has been found almost barren — and mainly on Bonanza and Eldorado creeks, the latter a branch of the former,

although gold has been found on many other streams. The gold is found mainly at the bottom of the gravel, on the bedrock, requiring the removal of the overlying gravel. As this material is frozen throughout the year, thavfing only near the surface in summer, mining involves a slow and laborious process of artificially melting the frozen gravel. This process is commonly carried on in the winter, and the gravel is sluiced in the spring and summer. The laws of the Dominion, under which claims are obtained, are very complicated, and have been changed many times since the opening of the district. At present they permit the location of claims 250 feet long, with the full width of the gulch, or, on rivers, with the half width of the valley. Terrace claims are 250

English Miles

Church, Bishop Magee, Croom Robertson, FitzJames Stephen, Sylvester, J. C. Bucknill, Andrew Clark, W. K. Clifford, St Georgo Mivart, M. Boulton, Lord Selborne, John Morley, Leslie Stephen, F. Pollock, Gasquet, C. B. Upton, William Gull, Robert Clarke, A. J. Balfour, James Sully, and A. Barratt.

Papers were read and discussed at the various meetings on such subjects as the ultimate grounds of belief in the objective and moral sciences, the immortality of the soul, &c. An interesting description of one of the meetings was given by Magee (then Bishop of Peterborough) in a letter of 13th February 1873 :—

feet square. Every alternate claim belongs to the Government, and a certain percentage, formerly 10 per cent, of the gross pro- ducts of the claim, is paid to the Government. Aliens, as well as citizens, may take up mining claims. In 1901 the population of the city of Dawson was 9142. (h. g*.)

Knowles, James (1831), English architect

and editor, was born in London in 1831, and was edu- cated, with a view to following his father's profession as an architect, at University College and in Italy. His literary tastes also brought him at an early age into the field of authorship. In 1860 he published Tlie Story of King Arthur. In 1867 he was introduced to Tennyson, whose house, " Aldworth," on Blackdown, he designed ; this led to a close friendship, Mr Knowles assisting Tennyson in business matters, and among other things helping to design scenery for Tlie Cup, when Irving pro- duced that play in 1880. Mr Knowles became intimate with a number of the most interesting men of the day, and in 1869, with Tennyson's co-operation, he started the " Metaphysical Society," the object of which was to at- tempt some intellectual ruiiprochement between Keligion and Science by getting the leading representatives of Faith and Unfaith to meet and exchange views.

The members from first to last were as follows : — Dean Stanley, Seeley, Eoden Noel, Martineau, W. B. Carpenter, Ilinton, Huxley, Pritchard, Hutton, Ward, Bagehot, Fronde, Tennyson, Tyndall, Alfred Barry, Lord Arthur Russell, Gladstone, Manning, Knowles, Sir John Lubbock, Alford, Alex. Grant, Bishop Thirlwall, F. Harrison, Father Dalgairns, Sir 6. Grove,

Shadworth Hodgson, II. Sidgwick, B. Lushington, Bishop EUicott, Mark I'attison, duke of Argyll, Ruskin, Robert Lowe, Grant Duff, Greg, A. C. Eraser, Henry Acland, Maurice, Archbishop Thomson, Mozley, Dean

Archbishop Manning in the chair was flanked by two Protestant bishops right and left ; on my right was Hutton, editor of the Spectator, an Arian ; then came Father Dalgairns, a very able Roman Catholic priest ; opposite him Lord A. Russell, a Deist ; then two Scotch metaphysical writers, Free-thinkers ; then Knowles, the very broad editor of the Contemporary; then, dressed as a layman and looking like a country squire, was Ward, formerly Rev. Ward, and earliest of the perverts to Rome ; then Greg, author of The Creed of Christendom, a Deist ; then Fronde, the historian, once a deacon in our Church, now a Deist; then Roden Noel, an actual Atheist and red republican, and looking very like one ! Lastly Ruskin, who read a paper on miracles, which we discussed for an hour and a half ! Nothing could be calmer, fairer, or even, on the whole, more reverent than the discussion. In my opinion, we, the Christians, had much the best of it. Dalgairns, the priest, was very masterly ; Manning, clever and precise and weighty. Froude, very acute, and so was Greg. We only wanted a Jew and a Mahommedan to make our Religious Museum com- plete {Life, vol. i. p. 284).

The last meeting of the Society was held on 16th May 1880. Huxley said that it died "of too much love"; Tennyson, "because after ten years of stremious effort no one had suc- ceeded in even defining Metaphysics." Ac- cording to Dean Stanley, " We all meant the same thing if we only knew it." The So- ciety formed the nucleus of the distinguished list of contributors who supported Mr Knowles in his capacity as an editor. In 1870 lie became associ- ated with the Contemporary Review, but left it in 1877 and founded the Nineteenth Century (to the title of which, in 1901, were added the words And After). Both periodi- cals became very influential under him, and formed the type of the new sort of monthly Eeview which came to occupy the place formerly held by the Quarterlies.

Knoxvi lie, capital of Knox county, Tennessee, U.S.A., on the north bank of the Tennessee, at an altitude of 891 feet. It is the chief city of the valley of east Tennessee, and is third in size in that state. Its site is undulating and its

plan irregular ; it is well built, is divided into 11 wards, and is paved with brick and macadam. It is on two railways, the Southern and the Atlanta, Knoxville and Northern. It is neat the famous marble quarries of east Tennessee, and it has large and rapidly increasing iron manufactures. In 1900 its manufacturing establishments numbered 218, with a total capital of $6,151,130. They employed 4714 hands, and the product was valued at f 6,943,695. The University of Tennessee, situated here, was opened in 1794, and had in 1899, 65 professors and other instructors and 670 students, 75 of whom were women. Knoxville College, a Presbyterian institution founded in 1875, had in 1899, 2?> instructors and 204 students. The assessed valuation of real and personal property in 1900 was $11,210,200; the net debt was $1,407,191 ; and the rate of taxation was $24.80 per $1000. Population (1880), 9693; (1890), 22,535 ; (1900), 32,637 — 895 foreign-born and 7369 negroes.

Knutsford, an ancient market town and parish in the Knutsford parliamentary division of Cheshire, Eng- land, 24 miles east-north-east of Chester by rail. Over Knutsford was in 1894 incorporated with the township of Knutsford. The grammar school was reorganized in 1885, the present building dating from 1887. There are, besides, the Egerton Schools, erected by Lord Egerton (1893), a market hall, a literary institute, and a sessions-house. The town (which is the “Cranford” of Mrs Gaskell’s novel of that name) and its outskirts are the residence of many Manchester merchants. Its industries comprise cotton, worsted, and leather manufactures. Area of Knutsford, including Nether and Over Knutsford, 1760 acres. Population (1881), 4305; (1891), 4643; (1901), 6172. Knutsford was the birthplace in 1788 of Sir Henry Holland, Bart., the famous physician and writer ; and in 1888 its name was taken for his title by his sou, the second Sir Henry Holland, 1st Baeon Knutsford

(1825), who was Secretary of State for the Colonies

from 1887 to 1892.

Kobdo, a town of the Chinese Empire, north-west Mongolia, at the northern foot of the Mongolian Altai, on the right bank of the Buyantu river, 13 miles from its entrance into Lake Khara-usu; 500 miles east-south-east of Biysk (Russian), and 470 miles west of Ulyasutai. It is situated amidst a dreary plain, and consists of a fortress, the residence of the governor of the Kobdo district, and a small trading town, chiefly peopled by Chinese and a few Mongols. It is, however, an important centre for trade between the cattle-breeding nomads and Peking. It was founded by the Chinese in 1731, and pillaged by the Musuhnans in 1872. The district of Kobdo occupies the north-western corner of Mongolia, and is peopled chiefly by Mongols, and' also by Kirghiz and a few Soyotes, Uryan- khais, and Khotons. It is governed by a Chinese commis- sioner, who has under him a special Mongol functionary (Mongol, dzurgan). The chief monastery is at Ulangom. Considerable numbers of sheep (about 1,000,000), sheep- skins, sheep and camel wool are exported to China, while Chinese cottons, brick tea, and various small goods are imported. Leather, velveteen, cotton, iron and copper goods, boxes, &c., are imported from Eussia in exchange for cattle, furs, and wool. The absence of a cart road to Biysk hinders the development of this trade.

Koch, Robert (1843-

-), German bacteriologist,

was born at Klausthal, Hanover, on 11th December 1843, He studied medicine at Gottingen, and it was while he was practising as a physician at Wallstein that he began those bacteriological researches that have made his name famous. In 1876 . he obtained a pure culture of the anthrax bacillus, announcing a method of preventive in- oculation against that disease seven years later. In 1882, largely as the result of the improved methods of bacterio- logical investigation he was able to elaborate, he discovered the bacillus of tuberculosis ; and in the following year, having been sent on an official mission to Egypt and India to study the aetiology of Asiatic cholera, he identified the comma bacillus as the specific organism of that malady. In 1890 great hopes were aroused by the announcement that in tuberculin he had prepared an agent which exer- cised an inimical influence on the growth of the tubercle bacillus, but the expectations that were formed of it

as a remedy for consumption were not fulfilled, though it came into considerable vogue as a means of diagnosing the existence of tuberculosis in animals intended for food. But even its utility in this respect would be nullified if it should be found, as he stated at the Congress on Tuber- culosis held in London in 1901, that tuberculosis in man and in cattle is not the same disease, and is not trans- missible from one to the other. This statement, however.

was not regarded as properly proved, and pending further inquiry is regarded with general scepticism. Dr Koch also investigated the nature of rinderpest in South Africa in 1896, and of bubonic plague in India in the following year. He became a member of the Sanitary Commission at Berlin and a professor at the School of Medicine in

1880.

Koesfeld, a town of the province of Westphalia, Prussia, 38 miles by rail north-north-west of Dortmund. Here are the ruins of the Ludgeri Castle, formerly the residence of the bishops of Munster (19 miles to the east), and also the castle of Varlar the residence of the counts of Salm-Horstmar. The leading industries include mixed linen goods, woven and dyed, saw-mills, &c. Population

(1900), 7445.

Koflach, a market-place in the government district of Voitsberg, 17 miles west of Gratz, in Styria, Austria. It is the centre of an extensive lignite deposit and of a number of iron-works. There are about 4000 hands employed in the mines, the annual product amounting to 700,000 tons of lignite. There are also some tanning, glass-making, and brewing, and the manufacture of cellulose, together with a number of saw-mills. Popu- lation (1890), 2927 ; (1900), 3345, chiefly German.

Kohat, a town and district of British India, in the Peshawur division of the Punjab. The town is 37 miles south of Peshawur by the Kohat pass, along which a military road was opened in 1901. Population (1881), 18,179; (1891), 27,003; municipal income (1897-98), Es.48,701. In the Tirah campaign of 1897-98 Kohat was the headquarters of the expedition that

operated against the Orakzais and Afridis. The district of Kohat has an area of 2771 square miles; population (1881), 181,540; (1891), 203,175; average density, 73 persons per square mile. In 1901 the population was 218,174, showing an increase of 7 per cent. The land revenue and rates were Rs.1,42,144, the incidence of assessment being Es.0:6:9 per acre; cultivated area (1896-97), 218,616 acres, of which 39,166 were irrigated ; number of police, 457 ; number of schools (1896-97), 58, with 1437 pupils, the proportion of boys at school to male population of school-going age being 6-2 per cent. ; registered death-rate (1897), 22-90 per thousand. The salt-mines produced in 1897-98 salt to the amount of 322,404 maunds, yielding a net revenue of Es.3,86,965. In July 1896 the rate of duty was raised from 8 annas to Es.2 per maund, the standard rate for the rest of India. There are no rail- ways in the district, nor any Government canals. The length of metalled roads is 94 miles, and the Indus is navigable for 84 miles.

Kokomo, capital of Howard county, Indiana, U.S.A., on the Wildcat river, and on the Lake Erie and Western, the Pittsburg, Cincinnati, Chicago and St Louis, and the Toledo, St Louis and Kansas City railways, at an altitude of 821 feet. It is in an agricultural region, and produces a variety of manufactured goods. Population (1880), 4042 ; (1890), 8261 ; (1900), 10,609, of whom 499 were foreign-born and 369 negroes.

Kolaba, a district of British India, in the Konkan division of Bombay. It includes the hill fort of Eaigarh, Sivaji’s capital. The headquarters are at Alibag ; popu- lation (1891), 6888. Since the census of 1891 the dis- trict has been enlarged by the transfer of about 200 villages from Thana. Present area, 2128 square miles ; population (1891), 594,872 ; average density, 279 persons per square mile. In 1901 the population was 606,165, showing an increase of 2 per cent. The land revenues and rates were Es.17,30,703, the incidence of assessment being

R.l : 11 : 10 per acre ; cultivated area (1897-98), 393,819 acres, of which 2418 were irrigated from wells, &c. ; number of police, 658; children at school (1897-98), 10,060, being 1-9 per cent, of the total population; registered death-rate (1897), 37-87 per thousand. The staple crop is rice. A considerable number of the people support themselves by fishing, and the forests yield valu- able timber and other produce. Salt is largely made along the coast by evaporation. There are five printing- presses, and two vernacular newspapers. There is no railway, but communication with Bombay is maintained by a steam ferry. Owing to its proximity to Bombay, the district has suffered severely from plague. Down to July 1898, the total number of deaths reported from plague was 1834. Kolaba district takes its name from a little island off Alibag, which was one of the strongholds of Angria, the Mahratta admiral of the 18th century. The same island has given its name to Kolaba Point, the spur of Bombay Island running south that protects the entrance to the harbour. On Kolaba Point are the terminus of the Bombay and Baroda railway, European barracks, lunatic asylum, and observatory.

Kolar, a town and district of India, in the native state of Mysore. The town is 43 miles east of Bangalore. Population (1881), 11,172 ; (1891), 12,148. The district of KoLAE has an area of 2845 square miles ; population (1881), 461,129 ; (1891), 591,030, showing an increase of 28 per cent. ; average density, 193 persons per square mile. In 1901 the population was 722,761, showing a further increase of 22 per cent. The district is traversed by the Bangalore line of the Madras railway, with a branch 10 miles long, known as the Kolar Goldfields railway. Gold prospecting in this region first began in 1876, and the industry is now settled on a secure basis. Here are situated the mines of the Mysore, Champion, Ooregum, Nundydroog, and other companies, which are among the most profitable in the world. In 1898 the total out-turn exceeded 400,000 ounces, yielding to the Mysore state Es. 13,14,660 in rent and royalties. The municipality called the Gold Fields had in 1901 a population of 37,964. It has suffered severely from plague. Electricity from the falls of the Cauvery (93 miles distant) will be used as the motive power in the mines. The capital expenditure on this work is estimated at £288,000.

Kolbe, Hermann (1818-1884), German chemist, was born on 27th September 1818 at Elliehausen, near Gottingen, where in 1838 he began to study chemistry under Wohler. In 1842 he became assistant to Bunsen at Marburg, and three years later to Playfair at the School of Mines, London. From 1847 to 1851 he was engaged at Brunswick in editing the Dictionary of Oliemistry started by Liebig, but in the latter year he went to Marburg as successor to Bunsen in the chair of chemistry. In 1865 he was called to Leipzig in the same capacity, and he died in that city on 25th November 1884. Kolbe had an im- portant share in the great development of chemical theory that occurred about the middle of last century, especially in regard to the constitution of organic compounds, which he viewed as derivatives of inorganic ones, formed from the latter — in some cases directly — by simple processes of substitution. Unable to accept Berzelius's doctrine of the unalterability of organic radicals, he also gave a new inter- pretation to the meaning of copulse under the influence of hisfellow-workerFrankland'sconceptionof definite atomic saturation-capacities, and thus contributed in an important degree to the subsequent establishment of the structure theory. Kolbe was a very successful teacher, a ready and vigorous writer, and a brilliant experimentalist whose work revealed the nature of many compounds the composition of which had not previously been understood.

Kolberg, or Colbeeg, a seaport town and sea- side resort of Prussia, province of Pomerania, 81 miles by rail north-east of Stettin, near the shore of the Baltic. Except on the side next the sea, its fortifications were razed in 1873. The church of St Mary (begun in 1268 and restored in 1890) is a good Gothic building of brick, with fine aisles and paintings, &c., of the 14th century. The sea-bathing, and brine and mud baths, attract from 10,000 to 11,000 visitors annually. Sea-fishing, wool-spinning, brewing, saw-milling, manufacture of tobacco, and iron- founding are the chief industries. The harbour is 16 feet deep ; its entrance, 16 feet. Population (1886), 16,667 ;

(1900), 20,241.

Kold i ng, a market town of Denmark, county of Vejle, 13 miles by rail west by south of Fredericia. The ruins of the castle have been converted into an

antiquarian and historical museum (1892). Thereare large slaughter-yards for killing cattle for export. In 1899 the port was entered by 1131 vessels of 82,668 tons, and cleared by 1172 of 91,267 tons. The chief imports are iron, coal, and groceries. The harbour throughout has a depth of over 20 feet. Population (1880), 7141 ; (1890), 9658 ; (1900),

12,616.

Kolhapur, a native state of India, within the Deccan division of Bombay. Together with its jagirs or feudatories, it covers an area of 2816 square miles ; population (1881), 800,189 ; (1891), 913,131, showing an increase of 14 per cent. ; average density, 324 persons per square mile. In 1901 the population was 910,176. The estimated gross revenue is Es.45,70,000 ; military force, 700 officers and men. In recent years the state has been conspicuously well governed, on the pattern of British administration. The present raja, Shahu Chha- trapati, G.C.S.I., is entitled to a salute of 19 guns. In 1897-98 the net revenue was Es.18,09,389, and the ex- penditure Es.22,63,421, of which Es. 5,92,655 was devoted to public works, Es.2,48,145 to famine relief, and Es.1,39,- 026 to education. There were 227 schools, with 13,830 pupils; and 16 dispensaries. The principal institutions are the Eajaram College, with 116 students ; the high school, with 334 pupils; a technical school; an agricultural school ; and training-schools for both masters and mistresses. The state railway from Miraj junction to Kolhapur town, 30 miles, is worked by the Southern Mahratta line. In recent years the state has suffered from both famine and plague. The town of Kolhapue, or Karvir, is situated in 16° 42′ N. and 74° 16′ E., the terminus of a branch of the Southern Mahratta railway, 30 miles from the main line. Population (1881), 38,699; (1891), 46,815; municipal income (1897-98), Es.59,603.

-), Swiss

Kolliker, Rudolph Albert (1817- anatomist and physiologist, was born at Zurich on 6th July 1817. His father and his mother were both Zurich people, and he in due time mai-ried a lady from Aargau, so that Switzerlaird can claim him as wholly her own, though he has lived the greater part of his life in Germany. His early education was carried on in Zurich, and he entered the university there in 1836. After two years, however, he moved to

the University of Bonn, and later to that of Berlin, becoming at the latter place the pupil of Johannes Mtiller and of Henle. He graduated in philosophy at Zurich in 1841, and in medicine at Heidelberg in 1842. The first academic post which he held was that of prosector of anatomy under Henle ; but his tenure of this office was brief, for in 1844 his native city called him back to its university to occupy a chair as professor extraordinary of physiology and comparative anatomy. His stay here too, however, was brief, for in 1847 the University of Wlirz- burg, attracted by his rising fame, offered him the post of

professor of physiology and of microscopical and com- parative anatomy. He accepted the appointment, and at Wurzburg he remained thenceforth, refusing all offers tempting him to leave the quiet academic life of the Bavarian town.

Kolliker's name will ever be associated with that of the tool with which during his long life he so assiduously and successfully worked, the microscope. The time at which he began his studies coincided with that of the revival of the microscopic investigation of living beings. Two centuries earlier the great Italian Malpighi had started, and with his own hand had carried far, the study, by the help of the microscope, of the minute structure of animals and plants. After Malpighi this branch of knowledge, though con- tinually progressing, made no remarkable bounds forward until the second quarter of the 19th century, when the improvement of the compound microscope on the one hand, and the promulgation by Schwann and Schleiden of the " cell theory " on the other hand, inaugurated a new era of microscopic investigation, which has lasted until the present day. Into this new learning KoUiker threw himself with all the zeal of youth, wisely initiated into it by his great teacher Henle, whose sober and exact mode of inquiry went far at the time to give the new learning a right direction and to counteract the somewhat fantastic views which, under the name of the cell theory, were tending to be prominent. Henle's labours were for the most part limited to the microscopic investigation of the minute structure of the tissues of man and of the higher animals, the latter being studied by him

mainly with the view of illustrating the former. But Kolliker had another teacher besides Henle, the even greater Johannes MtlUer, whose active mind was sweeping over the whole animal kingdom, striving to pierce the secrets of the structure of living creatures of all sorts, and keeping steadily in view the wide biological problems, of functioii, and of origin, which the facts of structure might serve to solve. We may probably trace to the influence of these two great teachers, strengthened by the spirit of the times, the threefold character of Kolliker's long-continued and varied labours. In all of them, or in almost all of them, the microscope has been the instrument of inquiry, but the problem to be solved by means of the instrument has belonged now to one branch of biology, now to another.

At Zurich, and afterwards at Wurzburg, the title of the chair which he held laid upon him the duty of teaching comparative anatomy, and very many of the numerous memoirs which he published, including the very first paper which he wrote, and which appeared in 1841 before he graduated, " On the Nature of the so-called Seminal Animalcules," are directed towards elucidating, by help of the microscope, the structure of animals of the most varied kinds — that is to say, are zoological in character. Notable among these are his papers on the Medusae and allied creatures. His activity in this direction led him to make zoological excursions in the Mediterranean Sea and on the coasts of Scotland, as well as to undertake, conjointly with his friend Siebold, the editorship of the Zeitschrift fur WissenschaftUche Zoologie, which, founded in 1848, con- tinued, under his hands, to be one of the most important zoological periodicals.

At the time when Kolliker was beginning his career, the influence of von Baer's embryological teaching was already being widely felt. Men were learning to recog- nize the importance to morphological and zoological studies of a knowledge of the development of animals ; and Kolli- ker plunged with enthusiasm into the relatively new line of inquiry. His earlier efforts were directed to the in- vertebrata, and his memoir on the development of cephalo- pods, which appeared in 1844, is a classical work ; but he soon passed on to the vertebrata, and studied not only

the amphibian embryo and the chick, but also the mam- malian embryo. He was among the first, if not the very first, to introduce into this branch of

biological inquiry the newer microscopic technique — the methods of harden- ing, section-cutting, and staining. By doing so, not only was he enabled to make rapid progress himself, but he also placed in the hands of others the means of a like advance. The remarkable strides forward which embryo- logy made during the middle and during the latter half of the 19th century will always be associated with his name. His Lectures on Development, published in 1861, at once became a standard work.

But neither zoology nor embryology furnishes Kolliker's chief claim to fame. If he has done much for these branches of science, he has done stUl more for histology, the knowledge of the minute structure of the animal tissues. This he made emphatically his own. It may indeed be said that there is no fragment of the body of man and of the higher animals on which he has not left his mark, and in more places than one his mark has been a mark of fundamental importance. Among his earlier results may be mentioned the demonstration in 1847 that smooth or unstriated muscle is made up of distinct units, of nucleated muscle-cells. In this work he followed in the footsteps of his master Henle. A few years before this, men were doubting whether arteries were nmscular, and no solid histological basis as yet existed for those views as to the action of the nervous system on the circu- lation which were soon to be put forward, and which have since had such a great influence on the progress of physiology. By the above discovery Kolliker completed that basis.

Even to enumerate, certainly to dwell on, all his contribu- tions to histology would be unfitting here : smooth muscle, striated muscle, skin, bone, teeth, blood-vessels, and viscera were all investigated by him ; and he touched none of them without striking out some new truths. The results at which he arrived are recorded partly in separate memoirs, partly in his great text- book on microscopical anatomy, which first saw the light in 1850, and by which he has advanced histology no less than by his own researches. In the case almost of every tissue our present knowledge contains something great or small which we owe to Kolliker ; but it is on the nervous system that his name is written in largest letters. So early as 1845, while still at Zurich, he supplied what was as yet still lacking, the clear proof that nerve-fibres are continuous with nerve-cells, and so furnished the absolutely necessary basis for all sound speculations as to the actions of the central nervous system.

From that time onward he continually laboured, and always fruitfully, at the histology of the nervous system, and more especially at the difficult prob- lems presented by the intricate patterns in which fibres and cells are woven together in the brain and spinal cord. In his old age, at a time when he had fully earned the right to fold his arms and to rest and be thankful, he still enriched neurological science with results of the high- est value. From his early days a master of method, he saw at a glance the value of the new Golgi method for the investigation of the central nervous system, and, to the great benefit of science, took up once more in his old age, with the aid of a new means, the studies for which he had done so much in his youth. It may truly be said that much of that exact knowledge of the inner structure of the brain, which is rendering possible new and fruitful conceptions of its working, has come from his hands.

Lastly, Kolliker was in his earlier years professor of physiology as well as of anatomy; and not only did his histological labours almost always carry physio- logical lessons, but he also enriched physiology with the

results of direct researclies of an experimental kind, notably those on urari and some other poisons. In fact, we have to go back to the science of centuries ago to find a man of science of so many-sided an activity as he. His life constituted in a certain sense a protest against that specialized differentiation, which, however much it may under certain aspects be regretted, seems to be one of the necessities of modern development. In Johannes Milller’s days no one thought of parting anatomy and physiology ; nowadays no one thinks of joining them together. Kolliker did in his work join them together, and indeed said himself that he thought they ought never to be kept apart.

Xaturally a man of so much accomplishment was not left without honours. Formerly known simply as Kolli- ker, the title ” von ” was added to his name. He was made a member of the learned societies of many countries; in England, which he visited more than once, and where he became well

known, the Royal Society made him a fellow in 1860, and in 1897 gave him its highest token of esteem, the Copley medal.

Koto, a district town of Eussian Poland, government and 46 miles north-east of Kalisz, on an island of the Warta. It has several factories, and china and pottery works. Population (1897), 9400.

Kolomea (Polish, Koiomyja), the chief town of a district of the same name, on the Pruth, 45 miles north- west of Czernowitz, in the Austrian province of Galicia. The population in 1900 was 34,188, half Jews, the rest Poles and Euthenians.

Kolomna, a district town of Eussia, on the right bank of the Moskva, government of Moscow, 72 miles by rail from the capital. It has several old churches of great archaeological interest. Since it was connected by rail with Moscow its trade importance has decreased, but it remains an entrepot for grain, coal, and timber; its factories (silk, saw-mills, rope-mills), however, have grown considerably. Population (1897), 20,970.

Kolozsvar (Klausbnbueg), a municipal town of Hungary, capital of the county of Kolozs, on the Szamos, 80 miles east by south of Nagy- Varad (Grossicardem). The Transylvanian Hungarian Association for Public Culture, situated here, has 20,000 members and property worth 3 million crowns. The house of the Hungarian king, Matthias Corvinus, still stands in good preservation, and contains an ethnographical museum. On the chief square there is an equestrian statue of this famous king, a work of the Hungarian sculptor Fadrusz. Population (1890),

32,766 ; (1900), 49,295.

Kolpino, one of the chief iron-works of the Crown in Eussia, government and 16 miles south-east of St Petersburg, on the railway to Moscow, and on the Izhora river. Over 5000 tons of iron, as also steel and copper goods, are turned out every year. Population (1897),

8076.

Kolyvan. — 1. A town of Eussia, West Siberia, government and district of Tomsk, on the Chaus river, 6 miles from the Ob. It is a wealthy town, the merchants carrying on a considerable export trade in cattle, hides, tallow, corn, and fish. It was founded in 1713 under the name of Chaussky Ostrog, and has rapidly grown. Popu- lation (1897), 11,703. 2. KolyvaS”skiy Zavod, another town of the same government, district of P)iysk, Altai region, on the Byelaya river, 192 miles south-east of Barnaul ; altitude, 1290 feet. It is renowned for its stone- cutting factory, where marble, jasper, various porphyries and breccias are worked into vases, columns, &c. Popu-

lation, 5000. 3. Old name of Eeval, founded by Yaroslav Vsevolodovich in 1233.

Komarom (German, Komorn), a municipal town of Hungary, capital of the county of the same name, on the left bank of the Danube, 48 miles west-north-west of Budapest. Since 1896 it has been united with Uj-Szony. In 1896 a statue of General George Klapka (1820-1892) was erected, in memory of his brilliant defence of the town against the Austrians in the Hungarian revolution. It is the birthplace of the novelist Maurus Jdkai. Popu- lation (1891), 13,076; (1900), 20,264.

Komotau (Czech, Chomutov), the chief town of a government district of the same name in Bohemia, at the foot of the Erzgebirge, 30 miles south-west of Aussig. Among the additions to its industry are the central work- shops of the Buschtiehrad railway, the making of watches, chemicals, tin toys, silk kerchiefs, &c. Population (1890), 13,050 ; (1900), 15,925, almost exclusively German and Catholic.

Kongsberg, a mining town of ISTorway, county Buskerud, 56 miles by rail south-west of Christiania. The annual value of the output of the silver-mines averages £35,000 to £50,000. Population (1875), 4357; (1900),

5585.

Konia. — 1. A vilayet in Asia Minor which includes the whole, or parts of, Pamphylia, Pisidia, Phrygia, Lyeaonia, Cilicia, and Cappadocia. It is divided into five sanjaks — Adalia, Buldur, Hamid-abad, Konia, and Nigdeh. The population (900,000 Moslems and 80,000 Christians) is for the

most part agricultural and pastoral. The only industries are carpet- weaving and the manufacture of cotton and silk stuffs. There are chrome mines and mines of argentiferous lead and rock salt. The principal exports are salt, opium, cotton, cereals, wool, and live stock ; and the imports cloth goods, coffee, rice, and petroleum. 2. The chief town of the above, the ancient Iconium, altitude 3320 feet, situated at the south-west edge of the vast central plain of Asia Minor, amidst luxuriant orchards watered by streams from the hills. There are interesting remains of Seljiik buildings, all showing strong traces of Persian influence in their decorative details. The most important mosque is the great Tilrbe, which contains the tombs of Mevlana Jelal ed-din, founder of the order of Mevlevi (whirling) dervishes, and of his successors. The climate is good — hot in summer and cold, with snow, in winter. The population of 45,000 includes 5000 Christians. Konia is connected by railway with Smyrna, and vid Eski-shehr with Constantinople. After the capture of Nicsea by the Crusaders (1097), Konia became the capital of the Seljiik Sultans of Eiim. It was temporarily occupied by Godfrey, and again by Frederick Barbarossa, but this scarcely affected its prosperity. During the reign of Ala ed-din I. (1219-^6) the city was thronged with artists, poets, historians, jurists, and dervishes, driven westwards from Persia and Bokhara by the advance of the Mongols, and there was a brief period of great splendour. In 1472 it was annexed, with Karamania, to the Osmanli Empire by Muhammad II. In 1832 it was occupied by Ibrahim Pasha.

See Ramsay. Historical Geography of Asia Minor; 8t Paul the Traveller. — Murray. Handbook to Asia Minor.

Konig, Karl Rudolph (1832-1901), physicist, was born at Konigsberg (Prussia) on 26th November 1832, and studied at the university of his native town, taking the degree of Ph.D. About 1852 he went to Paris, and became apprentice to the famous violin-maker, J. B. Vuillaume, and some six years later he started business on his own account. He called himself a ” maker of musical instruments,” but the instruments for which

his name is best known are tuning-forks, which speedily- gained a high reputation among physicists for their ac- curacy and general excellence. From this business Konig derived his livelihood for the rest of his life. He was, how- ever, very far from being a mere tradesman, and even as a manufacturer he regarded the quality of the articles that left his workshop as a matter of greater solicitude than the profits they yielded. Acoustical research was his real interest, and to that he devoted all the time and money he could spare from his business. An exhibit which he sent to the London Exhibition of 1862 gained a gold medal, and at the Philadelphia Exposition of 1876 great admiration was expressedfor a tonometric apparatus of his manufacture. This consisted of about 670 tuning-forks, of as many different pitches, which extended over four octaves, and it afforded a perfect means for testing, by enumeration of the beats, the number of vibrations pro- ducing any given note and for accurately tuning any musical instrument. An attempt was made to secure this apparatus for the University of Pennsylvania, and Konig was induced to leave it behind him in America on the assurance that it would be purchased ; but ultimately, the money not being forthcoming, the arrangement fell through, to his great disappointment and pecuniary loss. Some of the forks he disposed of to the University of Toronto, where they now are. The remainder he used as a nucleus for the construction of a still more elaborate tonometer. While the range of the old apparatus was only between 128 and 4096 vibrations a second, the lowest fork of the new one only made 16 vibrations a second, while the highest gave a sound too shrill to be perceptible by the human ear. Konig will also be remembered as the inventor and constructor of many other beautiful pieces of apparatus for the investigation of acoustical problems, among which may be mentioned his wave-sirens, the first of which was shown at Philadelphia in 1876. His original work dealt, among other things, with Wheatstone’s sound- figures, the characteristic notes of the different vowels, manometric flames, &c. ; but perhaps the most important of his researches are those devoted to the phenomena produced by the interference of two tones, in which he controverted the views of Helmholtz as to the existence of summation and difference tones. He died in Paris on 2nd October 1901.

Koniggratz, a royal circuit town and episcopal seat in Bohemia, Austria, 12 miles north of Pardubitz, which was fortified up to 1884. Population (1890),

7816 ; (1900), 9773, chiefly Czech. A garrison numbering 2256, composed of three battalions of infantry and a regiment of artillery, is stationed here. There are four Czech high schools, and the industry includes the manufacture of machinery, colours, and carton-pierre, as well as gloves and wax candles. Numerous monuments (Austrian, Saxon, and Prussian) have been erected in various parts of the battlefield of 3rd July 1866, still frequently referred to as the battle of Sadowa.

Koniginhof (Czech, Krdlovi Dvur), the chief town of a government district in north-east Bohemia, Austria, 21 miles east of G-itschin. Population (1890), 8635; (1900), 10,601, Czech. The chief industries are cotton-weaving, yarn-spinning, brewing, sugar-refining, tanning, corn-milling, and the sawing of timber.

The controversy concerning the genuineness of the ” Koniginhof MSS.,” containing specimens of old Czech epic and lyric poetry, dating from the 13th century (see Ency. Brit. xi. 440), would now appear to have been iinally decided in the negative by a consensus of Czech and German philologists. The former include the Czech university professors Masaryk, Gebauer, and Goll, and the latter, “Wattenbaoh, Btidinger, and Feifalik. (See articles by Gebauer in the Archiv fur Slaw. Philologie, x.-xi., and his

Pouceni opadelan i/ch rukopisich KrdlovMvorskim a ZelenohorsMm (Prague, 1889) ; Knieschek, Die Streit uber die K’uniginfiofer und Griineberger Handschrift (Prague, 1888), and the Deutsche Zeitschrift fur Geschichtswissenschaft, 1889-90.) In December 1899 there was an alleged discovery, in the 62nd line of the “Judgment of Libussa,” of a cryptioal confession of the author- ship by Wenceslaus Hanka himself. This particular line of the poem contains only two words, the remainder consisting of a number of single coloured letters, of which every second is re- versed. These were described as ‘ ‘ strange characters ‘ ‘ by Palacky, the celebrated Bohemian historian, who regarded them as a kind of trifling on the part of the transcriber. It is now reported that they have been deciphered by Professor Ladislaus Dolansky as ” V. H. A. N. K. A. P. E. C. I. T.,” that is to say, “V. Hanka fecit.” (m. o’n.)

Konigsberg, a town of Prussia, capital of the pro- vince of East Prussia, the second capital of the kingdom of Prussia, a first-class fortress, and

headquarters of the 1st German Army Corps, on hilly ground on both banks of the river Pregel, 4|- miles above its entrance into theFrisches Haff. Konigsberg owes its position as capital to the fact that the first king of Prussia, Frederick I., in 1701 crowned himself in this city, because it stood outside the empire, and thus gave him the standing of a fully independent sovereign. The defensive works consist principally of a dozen outer forts, which in both plan and equipment answer to the rigorous requirements of modern warfare. The city possesses two ornamental sheets of water — the Schloss Teich and the Ober Teich — the former within and the latter without the old ring of fortifications. The suburb of Hufan, outside the western Steindammer, is a favourite pleasure resort, amongst its attractions being the zoological gardens. The conspicuous newbuildings embrace the administrative offices (1882) in the Italian Renaissance style, the synagogue, the imposing Palsestra Albertina (a species of gymnasium, 1898), the gift of Dr Lange of IsTew York, and various offices (railway, &c.). In addition to the older monuments to Frederick I. and Kant, there have been added a bronze statue of Duke Albert (1891) and another of the Emperor William I. (1894), both by Reusch. Konigsberg is well equipped with museums and similar institutions, the most note- worthy being the PrussiaMuseum of Antiquities (specially rich in East Prussian finds from the Stone Age to the Viking period) and the archives. (both these in the castle), the industrial art and technical museum, the collection of the sculptor Siemering's works in the Altstadt town hall, the astronomical observatory, botanical gardens, zoological museum, physical institute, mineralogical-geological insti- tute, the collections of the physical-economical society, the chemical laboratory, the architectural school, and several medical institutes. In 1900-01 the university was attended by 874 students, and had about 120 professors. The tomb of Kant is in the cathedral. Industries have made a great advance ; besides those previously mentioned, there are printing works and manufactories of chemicals and artificial manure, toys, sugar, cellulose, and wood-pulp, tobacco, pianos, and amber wares. A new channel has been made (1901), at the cost of £615,000, between Konigsberg and Pillau, its port, 29 miles distant, on the outer side of the Frisches Haff, so as to admit vessels drawing 20 feet right up to Konigsberg, and the result has been greatly to quicken the trade of the city. It is protected for a long distance by moles, in which a break has been left in the Fischhauser Wiek, to permit of freer circulation of the water and

for the prevention of damage to the mainland. The following are the principal exports of the port: — Cereals and flour (average annual value, £1,250,000), hemp (£600,000), flax (£600,000), timber (£420,000), sugar (£152,000), hemp tow (£162,000), oil-cakes (£240,000), and rags (£60,000). The total trade amounted in 1899 to £10,000,000, of which £4,100,000 was the value of the exports, and £5,900,000

the value of the imports ; as compared with £7,625,000 for exports, and £8,950,000 for imports in 1886, or £16,476,000 altogether. Since 1894, when 2173 vessels of 910,826 tons cleared, there has been a decline in the overseas shipping, namely, to 1620 vessels of 367,160 tons in 1899. There is in addition a river traffic of between 300,000 and 350,000 tons annually. Population (1885),

151,151 ; (1890), 161,666 ; (1900), 187,897.

Konigshiitte, a town of Prussia, province of Silesia, 3 miles south of Beuthen and 122 miles by rail south-east of Breslau. It lies in the centre of coal mines, ironworks, and zinc works, and has also manufactures of bricks, roofing paper, and turnery, flour-mills and saw-mills. Population (1885), 32,072 ; (1900) 57,876.

Kdnigswinter, a town and summer resort of Prussia, in the Khine province, on the right bank of the Rhine, 24 miles south-south-east of Cologne by rail, at the foot of the Siebengebirge and the romantic Draehenfels (ascended by a toothed railway). Many of the inhabitants are stone-dressers, the stone (trachyte) being quarried close by. Population (1900), 3804.

Konotop, a district town of Eussia, government and 83 miles east-south-east of Chernigov, on the Kieff- Kursk railway. It has trade in grain and other agri- cultural produce. Population (1897), 23,083.

Konstantinovskaya, a Cossack village, Eus- sia, province of Don Cossacks, on the right bank of the Don, 48 miles east of Novocherkask. It is the seat

of district administration of the first Don district, and has an important cattle fair. Population (1897),

10,700.

Kooringa, or Bueea, a town of South Australia, in a mining and agricultural district, in the county of Burra, on Burra Creek, 101 miles by rail north by east of Adelaide. The Burra Burra copper-mine is in the immediate neighbourhood. Two iron bridges across the creek connect the town with Baldina and the eastern plains. Large areas in the district are devoted to wheat- growing. Population (1901), 1994.

Kopp, Hermann Franz Moritz (1817-1892), German chemist, was born on 30th October 1817 at Hanau, where his father practised as a physician. After attending the gymnasium of his native town, he studied at Marburg and Heidelberg, and then, attracted by the fame of Liebig, went in 1839 to Giessen, where he became a privat-docent in 1841, and professor of chemistry twelve years later. In 1864 he was called to Heidelberg in the same capacity, and he remained there till his death on 20th February 1892. Kopp devoted himself especially to physico-chemical inquiries, and in the history of chemical theory his name is associated with several of the most important correlations of the physical properties of sub- stances with their chemical constitution. Much of his work was concerned with specific volumes, the conception of which he set forth in a paper published when he was only twenty-two years of age ; and the principles he established have formed the basis of subsequent investiga- tions in that subject, although his results have in some cases undergone modification. Another question to which he gave much attention was the connexion of the boiling- point of compounds, organic ones in particular, with their composition. In addition to these and other laborious researches, Kopp was a prolific writer. In 1843-47 he published a comprehensive History of Chemistry in four volumes, to which three supplements were added in 1869-75. The Development of Chemistry in Recent Times appeared in 1873, and in 1886 he published a work in two volumes on Alchemy in Ancient and Modern Times. In addition he wrote on theoretical and physical chemistry

for the Graham-Otto Lehrhuch der Chemie, and for many years from 1851 he was acting editor of the Annalen der Chemie.

Korat, known officially as !N”akawn Eaja Sbma, a walled town in the Siamese province of the same name, 170 miles north-east of Bangkok, situated in 14° 69′ N. and 102° 6′ E. It is the administrative centre of a munton or ” circle.” Its position makes it the great distributing centre for the whole of the plateau lying between the Me Kong on the north and east, the forested hill ranges of Muang Lom S§,k on the west, and the Dawng Praya Yen and Dawng Eek on the south-west and south. A rail- way from Bangkok was opened in 1900. There are a few hundred Chinese traders in and about Korat, and the total import and export trade of the whole district is calculated to amount only to £130,000. A French consular official now resides in the town by virtue of Article VIII. of the Franco-Siamese treaty. Population, about 6000.

Korea (Ch’ao Hsien, Dai Han). — Korea is an empire of Eastern Asia, the mainland portion of which consists of a peninsula stretching southwards from the maritime pro- vince of Siberia and Chinese Manchuria, with an estimated length of about 600 miles, an extreme breadth of 135 miles,

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Sketch Map of Korea.

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and a coast-line of 1740 miles. It extends from 34° 18′ to 4,”,° N., and from 124° 36′ to 130° 47′ E. Its northern boundary, on which it is conterminous with Eussia for 11 miles, is marked by the Tumen and Yalu rivers ; the eastern by the Sea of Japan ; the southern by the Strait of Korea ; and the western by the Yalu and the Yellow Sea, down to which, from Krasnoye Celo, where three empires meet, it has China on its frontier. The south and

west coasts are fringed by about 200 islands (exclusive of islets), two-thirds of which are inhabited ; 100 of them are from 100

to 2000 feet in height, and many consist of bold bare masses of volcanic rock. The most important are Quel- part (q.v.) and the ISTan Hau group. The latter, 36 miles from the eastern end of Quelpart, possesses the deep, well- sheltered, and roomy harbour of Port Hamilton, which lies between the north points of the large and well-culti- vated islands of Sun-ho-dan and So-dan, which have a population of 2000. Aitan, between their south-east points, completes this noble harbour. The east coast of Korea is steep and rock-bound, with deep water and a tidal rise and fall of from 1 to 2 feet. The west coast is often low and shelving, and abounds in mud-banks, and the tidal rise and fall is from 20 to 36 feet. Korean harbours, except two or three which are closed by drift ice for some weeks in winter, are ice-free. Among them are Port Shestakoff, Port Lazareff, and Won-san in Broughton Bay ; Pusan, Ma-san-po, at the mouth of the Nak-tong, on the south coast; Mok-po, Chin JSTam-po, near the mouth of the Tai-dong; and Chemulpo, near the mouth of the Han, the port of the capital and the sea terminus of the first Korean railway on the west coast.

Mountains. — Korea is distinctly mountainous, and has no plains deserving the name. In the north there are mountain groups with definite centres, the most notable being Paik-tu San (8700 feet), which contains the sources of the Yalu and Tumen. From these groups a lofty range runs southwards, dividing the empire into two unequal parts. On its east, between it and the coast, which it follows at a moderate distance, is a fertile strip difficult of access, and on the west it throws off so many lateral ranges and spurs as to break up the country into a chaos of corrugated and precipitous hills and steep-sided valleys, each with a rapid, perennial stream. Farther south this axial range, which includes the Diamond Mountain group, falls away towards the sea in treeless spurs and small and often infertile levels. The northern groups and the Dia- mond Mountain are heavily timbered, but the hills are covered mainly with coarse, sour grass, and oak and chestnut scrub.

Rivers. — These are shallow and rocky, and are usually only navigable for a few miles from the sea. Among the exceptions are the Yalu (Amnok), Tumen, Tai-dong, Nak- tong, Mok-po, and Han. The last, rising in Kang-won-Do, 30 miles from the east coast, cuts Korea nearly in half, reaching the sea on the west coast near Chemulpo ; and, in spite of many serious rapids, is a valuable highway for commerce for over 150 miles.

Geological Formation. — The geology is little known as yet. The formations are chiefly volcanic. Extinct craters and lava fields frequently occur. Igneous rock abounds. The best soil is finely disintegrated lava. Sedimentary and organic rock is found in the west. Limestone formation occurs largely on the Han and Tai-dong rivers, and the latter is often skirted by high cliHs of coarse conglomerate, presenting a striking vertical cleavage, alternating with red sandstone.' In central Korea white quartz and pink and gray granite abound.

Climate. — The climate is superb for nine months of the year, and the three months of rain, heat, and damp are not injurious to health. Koreans suffer from malaria, but Europeans and their children are fairly free from climatic maladies, and enjoy robust health. The summer mean temperature of Seoul is about 75° E., that of winter about 33° ; the average rainfall, 36-3 inches in the year, and of the rainy season 21-86 inches. The rains come in July and August on the west and north-east coasts, and from April to July on the south coast, the approximate mean annual rainfall of these localities being 30, 35, and 42 inches respectively. These averages are based on the observations of seven years only.

Flora. — The plants and animals await study and classification. Among the indigenous trees are the Abies excelsa, Abies micro- sperma, Firms sinensis, Pinus pinea, three species of oak, five of maple, lime, birch, juniper, mountain ash, walnut, Spanish chest- nut, hazel, willow, hornbeam, hawthorn, plum, pear, peach, Bhus vernicifera, (?) Shus semipinnata, Acanthopanax ricinifolia, Zelkawa, Thuja orientalis, Slceagnus, Sophora Japonica, &c. Azaleas and rhododendrons are widely distributed, as well as other

flowering shrubs and creepers, Ampelopsis Veitchii being universal. Liliaceous plants and cruoiferse are numerous. The native fruits, except

walnuts and chestnuts, are worthless. The persimmon attains perfection, and experiment has proved the suitability of the climate to many foreign fruits. The indigenous economic plants are few, and are of no commercial value, excepting wild ginseng, a good root of which is worth 616 per ounce, bamboo applied to countless uses, and “tak-pul” {Hibiscus Manihot), used in the manufacture of paper.

Fauna. — The tiger takes the first place among wild animals. Ho is of great size, his skin is magnificent, and he is so widely distri- buted as to be a peril to man and beast. Tiger-hunting is a pro- fession with special privileges. Leopards are numerous, and are occasionally shot within the walls of Seoul. There are deer (at least five species) , boars, bears, antelopes, beavers, otters, badgers, tiger-cats, marten, an inferior sable, striped squirrels, &o. Among birds there are black eagles, peregrines (largely used in hawking), and, specially protected by law, turkey bustards, three varieties of pheasants, swans, geese, common and spectacled teal, mallards, mandarin ducks, white and pink ibis, cranes, storks, egrets, herons, curlews, pigeons, doves, nightjars, common and blue magpies, rooks, crows, orioles, halcyon and blue kingfishers, jays, nut- hatches, redstarts, snipe, gray shrikes, hawks, kites, &o. But, pending further observations, it is not possible to say which of the smaller birds actually breed in Korea and which only make it a halting-place in their annual migrations.

Area and Population. — The estimated area is 82,000 square miles, somewhat under that of Great Britain. The first complete census was taken in 1897, and returned the population in round numbers at 17,000,000, females being in the majority. It is estimated that little more than half the arable land is under cultivation, and that the soil could support an additional 7 millions. The native population is absolutely homogeneous. In 1898 the foreign population consisted of 15,000 Japanese, 2000 Chinese, and about 400 of other nationalities, of whom 200 were Americans and nearly 100 British. This population has increased considerably since 1897, owing to the expansion of trade and the opening of new ports. ISTorthern Korea, with its severe climate, is thinly peopled, and the rich and warm provinces of the south and west are populous. A large majority of the people are engaged in agriculture. There is no emigration, except into Eussian and Chinese territory.

Seoul (Han-yang), the capital, is situated in 37° 34′ N. and 127° 6′ E., at an altitude of 120 feet, and is distant 25 miles from Chemulpo, its seaport, and 4 from Mapu, its river-port. It lies in a basin among granite hills no- where exceeding 2627 feet, remarkable for their denuda- tion and their abrupt black crags and pinnacles. A well- built, crenelated stone wall from 20 to 30 feet high, about 11 miles in circuit, and pierced by 8 gateways with double-roofed gate towers, surrounds it. Its population in 1897 was 219,825, with an excess of 11,079 males. The native houses are built of stone or mud, deeply eaved, and either tiled or thatched. Above these rise the towers of the Eoman Catholic cathedral, the high curved roofs of the royal audience halls, the palace gateways, and the showy build- ings of the Eussian and French Legations. Its antiquities are the Bell Tower, with a huge bronze bell dated 1468, a marble pagoda elaborately carved, but not of Korean work-manship, seven centuries old, and a “Turtle-Stone” of about the same date. Seoul has some wide streets of shops, hundreds of narrow alleys, and is very fairly clean. Its supply of water is bad and very limited. It has an electric tramway 4 miles long, and the Seoul and Chemulpo railway was opened in July 1900 to a station within the city. Besides being the seat of government, Seoul is the centre of education, business, and pleasure for the empire, and the residence of a large number of absentee proprietors and officials.

SoNGDO (Kaisong), the capital from about 910 to 1392, is a walled city of the first rank, 25 miles north of Seoul, with a population of 60,000. It possesses the stately remains of the palace of the Korean kings of the Wang dynasty, is a

great centre of the grain trade and the sole centre of the ginseng manufacture, makes wooden shoes, coarse pottery, and fine matting, and manufactures with sesamum oil the stout oiled paper for which Korea is famous.

Phtong-tang, a city on the Tai-dong, had a population of 60,000 before the war of 1894, in which it was nearly destroyed. It is fast regaining its

population. It lies on rocky heights above a region of stoneless alluvium on the east, and with the largest and richest plain in Korea on the west. It has five coal mines within ten miles, and the district is rich in iron, silk, cotton, and grain. It has easy communication with the sea (its port being Chin-nampo), and is important historically and commercially. Auri- ferous quartz is worked by a foreign company in its neigh- bourhood. Near the city is the illustrated standard of land measurement cut by Ki-tze in 1124 e.g.

With the exceptions of Kang-wha, Chong-ju, Tung- NAi, FusAN, Wox-SAN, it is very doubtful if any other Korean towns reach a population of 15,000. The provincial capitals and many other cities are walled. Most of the largertowns are in the warm and fertile southern provinces. One is very much like another, and nearly all their streets are replicas of the better alleys of Seoul. The actual antiquities of Korea are dolmens, sepulchral pottery, and Korean and Japanese fortifications.

Race. — The origin of the Korean people is unknown. They are of the Mongol family ; their language belongs to the so-called Turanian group, is polysyllabic, possesses an alphabet of 11 vowels and 14 consonants, and a script named En-mun. Literature of the higher class and official and upper class correspondence are exclusively in Chinese characters, but since 1895 official documents have con- tained an admixture of En-mun. The Koreans are distinct from both Chinese and Japanese in physiognomy, though dark straight hair, dark oblique eyes, and a tinge of bronze in the skin are always present. The cheek-bones are high ; the nose inclined to flatness ; the mouth thin-lipped and refined among patricians, and wide and full-lipped among plebeians ; the ears are small, and the brow fairly well developed. The expression indicates quick intelligence rather than force and mental calibre. The male height averages 5 ft. 4^ in. The hands and feet are small and well-formed. The physique is good, and porters carry on journeys from 100 to 200 lb. Men marry at from 18 to 20 years, girls at 16, and have large families, in which a strumous taint is nearly universal. Women are secluded and occupy a very inferior position. The Koreans are rigid monogamists, but concubinage has a recognized status.

Government. — Up to July 1894 the system of adminis- tration was modelled on that of China, except that gov- ernment was in the hands of a

hereditary aristocracy, privileged and corrupt. The king was absolute, and law consisted practically of royal edicts, published in the Gazette. During the war between Japan and China, Japan, then in the ascendant, devised special machinery for the reform of Korean abuses, and during the following months the administration was reorganized and greatly assimilated to that of Japan. Between the close of 1895 and 1900 there were ceaseless administrative fluctuations ; valuable reforms quietly lapsed ; the general movement was retrograde, and the old order now exists in the spirit if not in the letter. The emperor is an independent and practically an absolute sovereign, the modifying influence of the cabinet having become insignificant. The central Government consists of a Council of State formed of a president premier, and the heads of nine departments — Home Office, Foreign Office, Treasury, War OfBce, Educa- tion, Justice, and the Ministry of Agriculture, Trade, and Industry, with their subordinate bureaus. This body frames laws and passes resolutions which require the

imperial seal for their validity. There is a Privy Council (consisting of a president, vice-president, not more than 50 councillors appointed by the throne, and two secretaries), which is empowered, when consulted by the cabinet, to inquire into questions referred to it. On paper the new constitution, which was very elaborate, modified the royal absolutism considerably ; but a decree passed towards the end of 1896, after the king's escape from Japanese control, marked a distinct reversion to the absolutism renounced by his oath in January 1895. One by one the checks devised by the Japanese " advisers " became inoperative, and by 1898 the imperial will, working under partially new conditions, produced a continual chaos, and by 1900 suc- ceeded practically in overriding all constitutional restraints.

Local Administration. — Korea for administrative purposes is divided into 13 provinces and 339 prefectures or magistracies, while the capital has a separate government, and each of the eight treaty ports and the Eusso-Korean trading mart, Kyen-heung, is under a superintendent, ranking with a consul. The village is the adminis- trative unit, and under the new system its headman and officials are annually elected. The headman and a man from each family form a village council, which deals by resolution with educational matters, registration of houses and lands, sanitation, roads and

bridges, agricultural improvements, common dykes, payment of taxes, relief in famine, adjustment of the corvee, and bye-laws. All resolutions must be sent up to the Home Office through the prefect and the provincial governor twice a year. Above the village and below the prefecture are cantons and districts, but it is on the efficient working of the village system that much of Korean wellbeing depends.

Education. — The “Royal Examinations” in Chinese literature held in Seoul up to 1894, which were the entrance to official posi- tion, being abolished, the desire for a purely Chinese education has diminished. In Seoul there are now an imperial English school with two foreign teachers, a reorganized Confucian college, a normal college under a very efficient foreign principal, Japanese, Chinese, Russian, and French schools, chiefly linguistic, several Korean primary schools, mission boarding-schools, and the Pai Chai College, connected with the American Methodist Episcopal Church, under imperial patronage, and subsidized by Government, in which a liberal education of a high class is given and En-mun receives much attention. The Koreans are expert linguists, and the Government wisely makes liberal grants to the linguistic schools. About 1100 young men are receiving a liberal edu- cation under foreign teachers ; and in the primary schools about 1200 boys are learning arithmetic, geography, and Korean history, with the outlines of the governmental systems of other civilized countries. The Education Department is tolerably efficient, and aims at the general extension of primary and intermediate schools, and a uniform series of tex1>books in the vernacular.

Law. — A criminal code, scarcely equalled for barbarity, though twice mitigated by royal edict since 1785, remained in force in its main provisions till 1895. Since then a mixed commission of revision has done some good work, but a body of law and the judges to administer it righteously have still to be created. The Ministry of Justice has charge of all judicial matters, and as a high court of justice hears appeals from certain district courts. Five classes of law courts have been established, and provision has been made for appeals in both civil and criminal cases. Elaborate legal machinery was devised, but it exists chiefly on paper, and its provi- sions are daily violated by the imperial will and the gross corruption of officials.

Kyei. — Abtises in legal administration and in tax-collecting are the chief grievances which lead to local insurrections. Oppression by the throne and the official and noble classes prevails extensively ; but the weak protect themselves by the use of the Kyei, or principle of association, which develops among Koreans into powerful trading guilds, trades-unions, mutual benefit associations, money-lending guilds, &c. Nearly all traders, porters, and artisans are members of guilds, powerfully bound together and strong by combined action and mutual helpfulness in time of need.

Bevenue and Finance. — The chief sources of revenue are the land tax, paid since 1896 in money ; the customs duties ; the house tax, from which Seoul is exempt ; the ginseng duty, and the tax on gold dust. These yield roughly as follows :— Land tax, £277,864 ; house tax, £46,564 ; ginseng duty, £15,000 ; duty on gold dust, £4000 ; customs duties, £100,000 ; miscellaneous taxes, £30,000. The budget for 1899 showed an estimated expenditure of £647,113, with a small surplus ; but the revenue for 1900 was only estimated at £520,000, with an expenditure of £690,000, in consequence of which deficit all new works were dropped and relief from financial straits was rendered necessary by a foreign loan. In 18 months

of 1890-97, with an Englishman in control of the Treasury, two- thirds of the Japanese loan of 3,000,000 ijen of 1895 was paid off. The emperor’s privy purse stands at £50,000.

Religion. — Buddhism, which swayed Korea from the 10th to the 14th century, has been discredited for three centuries, and its priests are ignorant, immoral, and despised. Confucianism is the official cult, and all officials offer sacrifices and homage at stated seasons in the Confucian temples. Confucian ethics are the basis of morality and social order. Ancestor-worship is universal. The popular cult is, however, the propitiation of demons, a modification of the Shamanism of Northern Asia. The belief in demons, mostly malignant, keeps the Koreans in constant terror, and much of their substance is spent on propitiations. Sorceresses and blind sorcerers are the intermediaries. The fees annually paid to these persons are estimated

at 3,000,000 dollars. In January 1897 there were in Seoul 1000 sorceresses, earning on an average 15 dollars per month each, an annual expenditure on dealings with spirits by the most enlightened city in Korea of 180,000 dollars, exclusive of very large sums paid to the male sorcerers and geomancers.

Christianity. — Putting aside the temporary Christian work of a Jesuit chaplain to the Japanese Christian General Konishe, in 1694 during the Japanese invasion, as well as that on a larger scale by students who received the evangel in the Roman form from Peking in 1792, and had made 4000 converts by the end of 1793, the first serious attempt at the conversion of Korea was made by the French SooiHe des Missions jEtrangeres in 1835. In spite of frequent persecutions, there were 16,500 converts in 1857 and 20,000 in 1866, in which year the French bishops and priests were martyred by order of the emperor's father, and several thou- sand native Christians were beheaded, banished, or imprisoned. This mission in 1900 had about 30 missionaries and 40,000 con- verts. In 1884 and 1885, toleration being established, Protestant missionaries of the American Presbyterian and Methodist Episcopal churches entered Korea, and have been followed by a large number of agents of other denominations. An English bishop, clergy, doctors, and nursing sisters arrived in 1890. Hospitals, orphan- ages, schools, and an admirable college in Seoul have been founded, along with tri-lingual (Chinese, Korean, and English) printing- presses ; religious, historical, and scientific works and much of the Bible have been translated into En-mim, and periodicals of an enlightened nature in the Korean script are also circulated. The progress of Protestant missions was very slow for some years, but since 1895 converts have multiplied. In 1900 these missions had about 13,000 members and adherents, and 110 missionaries.

Defence. — The standing army, which (on paper) consists of cavalry, artillery, infantry, and engineers, numbers 4000 men in Seoul, 800 of whom constitute the imperial body-guard, 1200 in the provinces, and a cadet corps. Its uniform and equipments are European and modern ; Berdon rifles chiefly and Gatling guns. Between 1893 and 1898 its drill instructors were successively American, Japanese, and Russian. Korea has no fortified places, the ancient "Five Fortresses" for the defence of Seoul being

practically unarmed and in the hands of the priests. There is a naval school at Kong-wha, but no navy. Seoul has 1200 highly- paid military police.

Production and Industries. — (i.) Minerals. — Extensive coalfields, producing coal of fair quality, as yet undeveloped, occur in Hwang-hai Do and elsewhere. Iron is abundant, especially in Phyong-an Do, and rich copper ore, silver, and galena are found. Experts believe that reefs of rich auriferous quartz exist. In 1885 the rudest process of ” placer ” washing produced an export of gold dust amounting to £120,000, and in 1897 to £205,529. These are the amounts declared as passing through the customs, but it is estimated that more than double these values leaves Korea clandestinely. The reefs were left untouched till 1897, when an American company, which had obtained a concession in Phyong-an Do in 1895, introduced the latest mining appliances, and raised the declared export of 1898 to £240,047, believed to represent a yield for that year of £600,000. Russian, German, and English appli- cants have since obtained concessions. The concession- uaires regard Korean labour as docile and intelligent.

(ii.) Acjriculture. — Korean soil consists largely of light sandy loam, disintegrated lava, and rich, stoneless allu- vium, from 3 to 10 feet deep. The rainfall is abundant during the necessitous months of the year, facilities for the irrigation of the rice crop are ample, and drought and floods are seldom known. Land is held from the pro- prietors on the terms of receiving seed from them and

returning half the produce, the landlord paying the taxes. Any Korean can become a landowner by reclaiming and cultivating unoccupied crown land for three years free of taxation, after which he pays taxes annually. Good land produces two crops a year. The implements used are two makes of iron-shod wooden ploughs ; a large shovel, worked by three or five men, one working the handle, the others jerking the blade by ropes attached to it ; a short sharp-pointed hoe, a bamboo rake, and a wooden barrpw, all of rude construction. Eice is threshed by beating the ears on a log ; other grains, with flails on mud threshing- floors. WiRnowing is performed by throwing up the grain on windy days. Rice is hulled and grain coarsely ground in stone querns or by water pestles. There are provincial horse-breeding stations, where pony stallions, from 10 to 12 hands high, are bred for

carrying burdens. Magni- ficent red bulls are bred by the farmers for ploughing and other farming operations, and for the transport of goods. Sheep and goats are bred on the imperial farms, but only for sacrifice. Small, hairy, black pigs and fowls are universal. The cultivation does not compare in neatness and thoroughness with that of China and Japan. There are no trustworthy estimates of the yield of any given measurement of land. The farmers put the average yield of rice at thirtyfold, and of other grain at twentyfold. Korea produces all cereals and root crops except the tropical, along with cotton, tobacco, a species of the Rhea plant used for making grass-cloth, and the Brousonettia papyrifera. The articles chiefly cultivated are rice, millet, beans, ginseng (at Songdo), cotton, hemp, oil-seeds, bearded wheat, oats, barley, sorghum, and sweet and Irish pota- toes. Korean agriculture suffers from infamous roads, the want of the exchange of seed, and the insecurity of the gains of labour. It occupies about three-fourths of the population.

(iii.) Other Industries. — The industries of Korea, apart from supplying the actual necessaries of a poor population, are few and rarely collective. They consist chiefly in the manufacture of sea-salt, of varied and admirable paper, thin and poor silk, horse-hair crinoline for hats, fine split bamboo blinds, hats, and mats, coarse pottery, hemp cloth for mourners, brass bowls, and grass-cloth. Won-san and Fusan are large fishing centres, and salt fish and fish manure are important exports ; but the prolific fishing grounds are worked chiefly by Japanese labour and capital, 6836 Japanese licensed boats having worked from Eusan in 1898. Paper and ginseng are the only manufactured articles on the list of Korean exports. The arts are nil.

Commerce.- — -Since certain Korean ports were opened by treaty to foreign trade the customs have been under the management of European commissioners nominated by Sir Robert Hart of Peking. The dues collected in 1885 were about £25,000, and in 1898 over £100,000. The following returns from 1884 to 1898 apply solely to the direct foreign trade of the open ports : —

(i.) Foreign Trade —

Imports,

Exports.

1884

£170,113

£95,377

1885

290,727

91,759

1886

466,250

104,753

1887

541,761

187,164

1888

597,005

137,283

1889

603,729

185,076

1890

790,261

591,746

1891

876,078

561,057

1892

689,772

366,560

1893

437,598

316,072

1894

584,318

345,614

1895

875,820

396,715

1896

708,461

512,275

1897

1,017,238

906,737

1898

1,194,843

576,896

S. VI. — 9

Gold dust is not included in the foregoing figures for exports. In order of value in 1898 the chief exports (in- cluding gold) stood thus : Rice, £278,272; gold, £240,047 ; beans, £112,469 ; ginseng, £95,446 ; hides, £23,874. Of the total import trade of 1898 cotton goods represented one-half, the British share averaging about £300,000. The other chief imports - were silk piece-goods, £77,676; grass- cloth, £49,417; kerosene oil, £41,309; railway plant an(J machinery, £32,760 ; Japanese matches, £14,204. The imports of Japanese cotton yarn, which is woven into a strong cloth on Korean handlooms during the winter, rose from £33,467 in 1895 to £99,749 in 1898.

(ii.) Shipping. — In 1885 the shipping entered at three open ports was 321 sailing vessels and 138 steamers. In 1898 the shipping entered inwards and outwards at five open ports was as follows :—

Flag.

Total for Korea. j

Sailing.

Steam.

Number of

Vessels.

Tons.

Number of Vessels.

Tons.

Britisli Chinese . Korean German . Japanese . Russian . Norwegian Hawaiian .

Total .

463

377

1359 2

“l

9,257 9,034

53,669

icn

968

1

344 27

758

32

1,908

8i’,b59

23,526

448,476

29,613

2,310

2202

73,078

1164

586,892

There is a noteworthy increase of vessels under the Korean flag. Korea has regular steam communication with ports in Japan, the Gulf of Pe-chi-li, Shanghai, and Vladivostok by Japanese and Russian steamers, and her own steamers call at most of her own ports.

Boads, Posts, Telegraphs. — The main roads centring in Seoul are seldom fit even for the passage of ox-carts, and the secondary roads are bad bridle-tracks, frequently degenerating into ” rook ladder’s. ” The inland transit of goods is almost entirely on the backs of bulls carrying from 450 to 600 lb, on ponies carrying 200 lb, and on men carrying from 100 to 150 lb, bringing the average cost up to a fraction over 8d. per mile per ton. The corvee exists, with its usual hard- ships. Bridges are made of posts, carrying a framework either covered with timber or with pine branches and earth. They are removed at the beginning of the rainy season, and are not replaced for three months. The larger rivers are unbridged, but there are numerous Government ferries. The infamous roads and the risks during the bridgeless season greatly hamper trade. Under Japanese auspices a railway from Chemulpo was completed to the capital in 1900. The Japanese have secured

a concession for a line from Seoul to Pusan, and the French one for a Seoul-Wiju railway, which, however, lapsed in 1899. Japanese steamers ply on the Han between Chemulpo and Seoul. A postal system, established in 1894-1895, has been gradually extended. There is a central office in Seoul, with about thirty provincial branches. There are postage stamps of four values. The Japanese have efBoient post offices in Seoul and the treaty ports. Korea is connected with the Chinese and Japanese telegraph systems by a Japanese line from Chemulpo vid, Seoul to Fusan, and by a line lately acquired by the empire between Seoul and Wiju. The state has also lines from Seoul to Chemulpo, Fusan, and Won-san.

Banks and Money. — Banking facilities consist of the Russo- Korean Bank in Seoul, a branch of the Hong-Kong and Shanghai Bank at Chemulpo, and branches of two .Japanese banks of high repute in Seoul and several of the open ports.

Currency. — Though Korea since the treaties has been constantly engaged in constructing mints, she can hardly be said to possess a currency. In 1894, on a silver basis, she issued a coinage of brass cash, 500 to the dollar, 1-oent copper pieces, 5-cent nickel pieces, and 20- and 100-cent silver. It was soon found that the larger silver coins were minted at a loss, and but few were issued. Korea practically depends on Japan for her currency, but J.apanese silver and notes scarcely pass in the interior, and the medium of ex- change remains the old and still legal debased copper cash, strung in strings of 100 on twisted straw, about 9 lb weight being the equivalent of a shilling. The adoption of a gold standard by Japan has caused much confusion. In 1898 the available coinage in Korea diminished by 2,000,000 yen, leaving only about 1,600,000 in silver and paper, a scarcity which affected trade injuriously.

History. — By both Korean and Chinese tradition Ki-tze — a councillor of the last sovereign of the 3rd Chinese dynasty, a sage, and the reputed author of parts of the famous Chinese classic, the Shu-King — is represented as entering Korea in 1122 b.c. with several thousand Chinese emigrants, who made him their king. The peninsula was then peopled by savages living in caves and subterranean holes. By both learned and popular belief in Korea Ki-tze is recognized as the founder of Korean social order, and is greatly

reverenced. He called the new kingdom Ch’’ ao-Hsien, pacified and policed its borders, and introduced laws and Chinese etiquette and polity. Korean ancient history is far from satisfying the rigid demands of modern criticism, but it appears that Ki-tze’s dynasty ruled the peninsula until the 4th century e.g., from which period until the 10th century a.d. civil wars and foreign aggressions are prominent. Nevertheless, Hiaksai, which with Korai and Shinra then constituted Korea, was a centre of literary culture in the 4th century, through which the Chinese classics and the art of writing reached the other two kingdoms. Buddhism, a forceful civilizing element, reached Hiaksai in a.d. 384, and from it the sutras and images of northern Buddhism were carried to Japan, as well as Chinese letters and ethics. Internecine wars were terminated about 913 by Wang the Founder, who unified the peninsula under the name Korai, made Song-do its capital, and endowed Buddhism as the state religion. In the 11th century Korea was stripped of her territory west of the Yalu by a warlike horde of Tungus stock, since which time her frontiers have been stationary. The Wang dynasty perished in 1392, an important epoch in the penin- sula, when Ni Taijo, or Litan, the founder of the present dynasty, ascended the throne, after his country had suffered severely from Genghis and Khublai Khan. He tendered his homage to the first Ming emperor of China, received from him his investiture as sovereign, and accepted from him the Chinese calendar and chron- ology, in itself a declaration of fealty. He revived the name CW ao-Hsien, changed the capital from Song-do to Seoul, organized an administrative system, which with some modifications continued till 1895, and exists partially still, carried out vigorous reforms, disestablished Buddhism, made merit in Chinese literary examina- tions the basis of appointment to office, made Confucianism the state religion, abolished human sacrifices and the burying of old men alive, and introduced that Confucian system of education, polity, and social order whiohhas dominated Korea forfive centuries. Either this king or an immediate successor introduced the present national costume, the dress worn by the Chinese before the Manchu conquest. The early heirs of this vigorous and capable monarch used their power, like him, for the good of the people ; but later decay set in, and Japanese buccaneers ravaged the coasts, though for two centuries under Chinese protection Korea was free from actual foreign invasion. In 1592 occurred the epoch-making invasion of Korea by a Japanese army of 150,000 men, by order of the great regent Hideyoshi. China came to the rescue with 60,000 men, and six years of a

gigantic and bloody war followed, in which Japan used firearms for the first time against a foreign foe. Seoul and several of the oldest cities were captured, and in some instances destroyed, the country was desolated, and the art treasures and the artists were carried to Japan. The Japanese troops were recalled in 1598 at Hideyoshi's death. The port and fishing privileges of Fusan remained in Japanese possession, a heavy tribute was exacted, and until 1790 the Korean king stood in humiliat- ing relations towards Japan. Korea never recovered from the effects of this invasion, which bequeathed to all Koreans an intense hatred of the Japanese, which has not been greatly modified in the three following centiu-ies. In 1866, 1867, and 1870 French and American punitive expeditions attacked parts of Korea in which French missionaries and American adveriturers had been put to death, and inflicted much loss of life, but retired without securing any diplomatic successes, and Korea continued to preserve her complete isolation. The first indirect step towards breaking it down had been taken in 1860, when Russia obtained from China the cession of the Usuri province, thus bringing a European power down to the Tumeii. A large emigration of famine-stricken Koreans and persecuted Christians into Russian territory followed. The emigrants were very kindly received, and many of them became thrifty and prosperous farmers. In 1876 Japan, with the consent of China, wrung a treaty from Korea by which Fusan was fully opened to Japanese settlement and trade, and Won-san (Gensan) and Inchiun (Chemulpo) were opened to her in 1880. In 1882 China promulgated her "Trade and Frontier Regulations," and America negotiated a commercial treaty, followed by Germany and Great Britain in 1883, Italy and Russia in 1884, France in 1880, and Austria in 181)2. A "Trade Convention " was also concluded with Russia. Seoul was opened in 1884 to foreign residence, and the provinces to foreign travel, and the diplomatic agents of the contracting Powers obtained a recognized status at the capital. These treaties terminated the absolute isolation which Korea had effectually preserved. During the negotiations, although under Chinese suzerainty, she was treated with as an independent state. Between 1897 and 1899, under diplomatic pressure. Song-chin, on

the north-east coast; Ma-san-po, near the mouth of the Nak-tong, 40 miles west of Fusan on the south coast ; and Kun-san, Mok-po, and Chin-nam-po, on the west coast, were opened to foreign trade and residence. From 1882 to 1894 the chief event in the newly- opened kingdom was a plot by the Tai-won-Kun, the present emperor's father, to seize on power, which led to an attack on the Japanese Legation, the members of which were compelled to fight their way, and that not bloodlessly, to the sea. Japan secured ample compensation ; and the Chinese Resident, aided by Chinese troops, deported the Tai-won-Kun to Tientsin. In 1884 at an official banquet the leaders of the progressive party assassinated six leading Korean statesmen, and the intrigues in Korea of the banished or escaped conspirators have created difficulties which have not yet subsided. In spite of a constant struggle for ascen- dancy between the queen and the returned Tai-won-Kun, the next decade was one of quiet. China, always esteemed in Korea, con-solidated her influence under the new conditions through a powerful Resident ; prosperity advanced, and certain reforms were projected by foreign "advisers." In May 1894 a more important insurrec- tionary rising than usual led the king to ask armed aid from China. She landed 2000 troops on 10th June, having previously, in accord- ance with treaty provisions, notified Japan of her intention. Soon after this Japan had 12,000 troops in Korea, and occupied the capital and the treaty ports. Then Japan made three sensible proposals for Korean reform, to be undertaken jointly by herself and China. China replied that Korea must be left to reform her-self, and that the withdrawal of the Japanese troops must precede negotiations. Japan rejected this suggestion, and on 23rd July attacked and occupied the royal palace. After some further negotiations and fights by land and sea between Japan and China war was declared formally by Japan, and Korea was for some time the battle-ground of the belligerents. The Japanese victories resulted for Korea in the solemn renunciation of Chinese suzerainty by the Korean king, the substitution of Japanese for Chinese influence, the introduction of many important reforms under Japanese advisers, and of checks on the absolutism of the throne. Everything promised well. The finances flourished under the capable control of Mr M'Leavy Brown, C.M.G. Large and judicious retrenchments were carried out in most of the Govern- ment departments. A measure of judicial and prison reform was granted. Taxation was placed on an equable basis. The pressure of the trade guilds was relaxed. Postal and educational systems

were introduced. An approach to a constitution was made. The distinction between patrician and plebeian, domestic slavery, and beating and slicing to death were abolished. The age for marriage of both sexes was raised. Chinese literary examinations ceased to be a passport to office. Classes previously degraded were enfranchised, and the alliance between two essentially corrupt systems of govern- ment was severed. For about eighteen months all the departments were practically under Japanese control. On 8th October 1895 the Tai-won-Kun, with Korean troops, aided by Japanese troops under the orders of Viscount Miura, the Japanese minister, captured the palace, assassinated the queen, and made a prisoner of the king, who, however, four months later, escaped to the Russian Legation, where he remained till the spring of 1897. Japanese influence waned. The engagements of the advisers were not renewed. A strong retrograde movement set in. Reforms were dropped. The king, with the checks upon his absolutism removed, reverted to the worst traditions of his dynasty, and the control and arrange- ments of finance were upset by Russia. Korea, incapable of stand- ing alone, now leans upon Russia or Japan, according to the pressure applied at the time. At the close of 1897 the king assumed the title of emperor, and changed the official designation of the empire to Dai Han — Great Han. Early in 1902 the independence of Korea was guaranteed by a clause in the treaty of alliance signed in that year between Great Britain and Japan. (See also China, Japan.)

Authorities. — The first Asiatic notice of Korea is by Khor- dadbeh, an Arab geographer of the 9th century a.d., in his Book of Boads and Provinces, quoted by Baron Richthofen in his great work on China, p. 575. The earliest European source of informa- tion is a narrative by H. Hamel, a Dutchman, who was shipwrecked on the coast of Quelpart and held in captivity in Korea for thirteen years. The amount of papers on Korea scattered through English, German, French, and Russian magazines, and the proceedings of geographical societies, is very great, and for the last three centuries Japanese writers have contributed largely to the sum of general knowledge of the peninsula. The list which follows includes some of the more recent works which illustrate the history, manners and customs, and awakening of Korea : — British Foreign Office Reports on Korean Trade, Annual Series. London. — Bibliographic Koreanne, 3 vols. Paris, 1897. — Bishop, Mrs I. L. Korea and Her Neighbours, 2 vols. London, 1897.—

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Korets, a town of south-west Eussia, government of Volhynia, 73 miles north-west of Zhitomir. It is one of the oldest Eussian towns, being mentioned first in the annals in 1150. It was often plundered by the Lithuanians, the Poles, and the Cossacks in the 15th, 16th, and 17th centuries. It has now woollen-cloth mills, distilleries, and tanneries. Population (1897), 9600.

Korneuburg, the chief town of a government district in Lower Austria, on the left bank of the Danube, opposite Klosterneuburg, 8 miles north by west of A^ienna. It is a steamship station and an important emporium of the salt and corn trade. The industry comprises the manufacture of coarse textiles, pasteboard, &c. Its charter as a town dates from 1298, and it was a much-frequented market in the preceding century. At the beginning of the 15th century it was surrounded by walls, and in 1460 a fortress was erected. It

was frequently involved in the conflict between the Hungarian king Matthias Corvinus and the Emperor Frederick III., and also during the Thirty Years' War. Population (1890), 7271; (1900), 8298, German.

Korostyshev, a town of south-west Eussia, government of Kieff. It lies 13 miles east of Zhitomir, of which it has become a summer resort, on account of its picturesque situation on the Teterev and easy access. It has iron mineral springs, a seminary for teachers, several woollen-cloth mills, two paper mills, saw-mills, tanneries, distilleries, and granite quarries. Population (1897),

13,000.

Korsdr, a seaport town of Denmark, county Soro, on the island of Zealand, 71 miles by rail west-south-west of Copenhagen, on the east shore of the Great Belt. The harbour, which is formed by a bay of the Baltic, has a depth throughout of 20 feet. It is the point of departure and arrival of the steam ferry to Nyborg on Flinen. The port was entered by 1689 vessels of 295,213 tons, and cleared by 1683 of 297,199 tons in 1899. The chief exports were fish, cereals, bacon; the chief imports, petroleum and coal. A market town since the 14tli century, Korsor has ruins of an old fortified castle, on the south side of the channel, dating from the 14th and 17th centuries. Popitlation (1880), 3964 ; (1890), 4685 ; (1900),

6054.

Kosel, a town of Prussia, province of Silesia, on the Oder, 29 miles south-east of Oppeln by rail. It was a fortified town from the 13th century until 1874, when the fortifications were razed and their site laid out as promenades. There is a lively river trade and manu- factui'e of sugar, cheese, and leather ; the royal stud farm for the province is situated here. Population (1885),

5461 ; (1900), 7085.

Kosen, a village and summer resort of Prussia, province of Saxony, 33 miles by rail south by west of Halle, on the Saale. On the adjacent Rudelsburg the German students have erected monuments to their comrades who fell in the Franco-German war of 1870-71, to Bismarck (1896), and to the Emperor William I. Here is also a saline mineral spring used for bathing. Kosen is famous as the central meeting-place of the German students' corps, which holds an annual congress every Whitsuntide. Population (1900), 2901.

Kdslin, a town of Prussia, province of Pomerania, 105 miles by rail north-east of Stettin. There are a cadet academy and a deaf and dumb asylum. Population

(1885), 17,277 ; (1895), 18,935 ; (1900), 20,418.

Kossuth, Lajos [Louis] (1802-1894), Hungarian patriot, was born at Monok, a small town in the county of Zemplin. His father, who was descended from an old untitled noble family and possessed a small estate, was by profession an advocate. Louis, who was the eldest of four children, received from his mother a strict religious train- ing. His education was completed at the Calvinist college of Scharashottak and at the University of Budapest. At the age of nineteen he returned home and began practice with his father. His talents and amiability soon won him great popularity, especially among the peasants. He was also appointed steward to the Countess Szapary, a widow with large estates, and, as her representative, had a seat in the County Assembly. This position he lost owing to a quarrel with his patroness, and he was accused of appropriating money to pay a gambling debt. His fault cannot have been very serious, for he was shortly afterwards (he had in the meantime settled in Pesth) appointed by Count Hunyady to be his deputy at the STational Diet in Pressburg. At the age of twenty he therefore was introduced to political life. It was a time when, under able leaders, a great national party was beginning the struggle for reform against the stagnant Austrian Government. As deputy he had no vote, and he naturally took little share in the debates, but it was part of his duty to send written reports of the proceedings to his patron, since the Government, with a well-grounded fear of all that might stir popular feeling, refused to allow any published reports. Kossuth's letters were so excel- lent that they were circulated in MS. among the Liberal magnates, and soon developed into an organized parlia mentary Gazette (Orszagyulesi tudositasok), of which he was editor. At once his name and

influence spread. In order to increase the circulation, he ventured on lithographing the letters. This brought them under the official censure, and was forbidden. He continued the paper in MS., and when the Government refused to allow it to be circulated through the post, sent it out by hand. In 1836 the Diet was dissolved. Kossuth continued the agitation by reporting in letter form the debates of the county assemblies, to which he thereby gave a political importance which they had not had when each was ignorant of the proceedings of the others. The fact that lie embellished with his own great literary ability the speeches of the Liberals and Reformers only added to the influence of his news-letters. The Government in vain attempted to suppress the letters, and, other means having failed, he was in 1.S.S7, with Weszelenyi and several others, arrested on a charge of high treason. After spend- ing a year in prison at Ofen, he was tried and condemned to four more years' imprisonment. His confinement was strict and injured his health, but he was allowed the use of books. He greatly increased his political information, and also acquired, from the study of the Bible and Shake- speare, a wonderful knowledge of English. His arrest

had caused great indignation. The Diet which met in 1839 supported the agitation, for the release of the prisoners, and refused to pass any Government measures. Metternich long remained obdurate, but the danger of war in 1840 obliged him to give way. Immediately after his release Kossuth married a lady who during his prison days had shown great interest in him. Henceforward she strongly urged him on in his political career. He had now become a popular leader. As soon as his health was restored he was appointed editor of the Festi Hirlap, the newly-founded organ of the party. Strangely enough, the Government did not refuse its consent. The success of the paper was unprecedented. The circulation soon reached what was then the immense figure of 7000. The attempts of the Government to counteract his influence by founding a rival paper, the Vilag, only increased his importance and added to the political excitement. The warning of the great reformer Szechenyi that by his appeal to the passions of the people he was leading the nation to revolution was neglected. Kossuth, indeed, was not content with advocating those reforms — the abolition of entail, the abolition of feudal burdens, taxation of the nobles — which were demanded by all the Liberals. By insisting on the superiority of the Magyars to the Slavonic inhabitants of Hungary, by his violent attacks on Austria (he

already discussed the possibility of a breach with Austria), he raised the national pride to a dangerous pitch. At last, in 1844, the Government succeeded in iDreaking his connexion with the paper. The proprietor, in obedience to orders from Vienna (this seems the most probable account), took advantage of a dispute about salary to dismiss him. He then applied for permission to start a paper of his own. In a personal interview Metter- nich offered to take him into the Government service. The offer was refused, and for three years he was without a regular position. He continued the agitation with the object of attaining both the political and commercial independence of Hungary. He adopted the economic principles of List, and founded a society, the ” Vedegylet,” the members of which were to consume none but home produce. He advocated the creation of a Hungarian port at Fiume. With the autumn of 1847 the great oppor- tunity of his life came. Supported by the influence of Louis Batthyany, after a keenly fought struggle he was elected member for Budapest in the new Diet. “Now that I am a deputy, I will cease to be an agitator,” he said. He at once became chief leader of the Liberals. Deakwas absent. Batthyany, Szechenyi, Szemere,Eotvos, his rivals, saw how his intense personal ambition and egoism led him always to assume the chief place, and to use his parliamentary position to establish himself as leader of the nation, but before his eloquence and energy all apprehensions were useless. His eloquence was of that nature, in its impassioned appeals to the strongest emotions, that it required for its full effect the highest themes and the most dramatic situations. In a time of rest, though he could never have been obscure, he would never have attained the highest power. It was therefore a necessity of his nature, perhaps unconsciously, always to drive things to a crisis. The crisis came, and he used it to the full.

On 3rd March 1848, as soon as the news of the Revolu- tion in Paris had arrived, in a speech of surpassing power he demanded parliamentary government for Hungary and constitutional government for the rest of Austria. He at once became the leader of the European revolution ; his speech was read aloud in the streets of Vienna to the mob by which Metternich was overthrown, and when a deputation from the Diet visited Vienna to receive the assent of the Emperor to their petition, it was Kossuth who received the chief ovation. Batthyany, who formed

the first responsible ministry, could not refuse to admit Kossuth, but he gave him the ministry of finance, pro- bably because that seemed to open to him fewest prospects of engrossing popularity. If that was the object, it was ‘ in vain. With wonderful energy he began developing the internal resources of the country : he established a separate Hungarian coinage — as always, using every means to increase the national self-consciousness ; and it was characteristic that on the new Hungarian notes which he issued his own name was the most prominent inscription ; hence the name of Kossuth notes, which was long celebrated. A new paper was started, to which was given the name of Kossuth Hirlapia, so that from the first it was Kossuth rather than the Palatine or the president of the ministry whose name was in the minds of the people associated with the new Government. Much more was this the case when, in the summer, the dangers from the Croats, Serbs, and the reaction at Vienna increased. In a great speech of 11th July he asked that the nation should arm in self-defence, and demanded 200,000 men ; amid a scene of wild enthusiasm this was granted by acclamation. When Jellachich was march- ing on Pesth he went from town to town rousing the people to the defence of the country, and the popular force of the Honved was his creation. When Batthyany resigned he was appointed with Szemere to carry on the Government provisionally, and at the end of September he was made President of the Committee of National Defence. From this time he was in fact, if not in name, the dictator. With marvellous energy he kept in his own hands the direction of the whole Government. Not a soldier himself, he had to control and direct the movements of armies ; can we be surprised if he failed, or if he was imable to keep control over the generals or to establish that military co-operation so essential to success? Especially it was Gorgei (q.v.), whose great abilities he was the first to recognize, who refused obedience ; the two men were in truth the very opposite to one another ; the one all feeling, enthusiasm, sensi- bility; the other cold, stoical, reckless of life. Twice Kossuth deposed him from the command ; twice he had to restore him. It would have been well if Kossuth had had something more of Gorgei’s calculated ruthlessness, for, as has been truly said, the revolutionary power he had seized could only be held by

revolutionary means ; but he was by nature soft-hearted and always merciful ; though often audacious, he lacked decision in dealing with men. It has been said that he showed a want of personal courage : this is not improbable ; the excess of feeling which made him so great an orator could hardly be combined with the coolness in danger required of a soldier ; but no one was able, as he could, to infuse courage into others. During all the terrible winter which followed, his energy and spirit never failed him. It was he who overcame the reluctance of the army to march to the relief of Vienna : after the defeat of Schwechat, at which he was present, he sent Bern to carry on the war in Transylvania. At the end of the year, when the Austrians were approaching Pesth, he asked for the mediation of Mr Stiles, the American envoy. Windischgratz, however, refused all terms, and the Diet and Government fled to Debrecszin, Kossuth taking with him the regalia of St Stephen, the sacred Palladium of the Hungarian nation. Immediately after the accession of the Emperor Erancis Joseph all the con- cessions of March had been revoked and Kossuth with his colleagues outlawed. In April, when the Hungarians had won many successes, after sounding the army, he issued the celebrated declaration of Hungarian inde- pendence, in which he declared that “the house of Hapsburg-Lorraine, perjured in the sight of God and

man, had forfeited the Hungarian throne.” It was a step characteristic of his love for extreme and dramatic action, but it added to the dissensions between him and those who wished only for autonomy under the old dynasty, and his enemies did not scruple to accuse him of aiming at the crown himself. Eor the time the future form of government was left undecided, but Kossuth was ap- pointed responsible Governor. The hopes of ultimate success were frustrated by the intervention of Eussia ; all appeals to the Western Powers were vain, and on 11th August Kossuth abdicated in favour of Gorgei, on the ground that in the last extremity the general alone could save the nation. How Gorgei used his authority to sur- render is well known ; the capitulation was indeed in- evitable, but a greater man than Kossuth would not have avoided the last duty of conducting the negotiations so as to get the best terms.

With the capitulation of Villages Kossuth’s career was at an end. A solitary fugitive, he crossed the Turkish frontier. He was hospitably received by the

Tui’kish authorities, who, supported by Great Britain, refused, notwithstanding the threats of the allied emperors, to surrender him and the other fugitives to the merciless vengeance of the Austrians. In January 1849 he was removed from Widdin, where he had been kept in honour- able confinement, to Shumla, and thence to Katahia in Asia Minor. Here he was joined by his children, who had been confined at Pressburg; his wife (a price had been set on her head) had joined him earlier, having escaped in disguise. In September 1861 he was liberated and embarked on an American man-of-war. He first landed at Marseilles, where he received an enthusiastic welcome from the people, but the prince-president refused to allow him to cross France. On 23rd October he landed at Southampton and spent three weeks in England, where he was the object of extraordinary enthusiasm, equalled only by that with which Garibaldi was received ten years later. Addresses were presented to him at Southampton, Birmingham, and other towns; he was officially enter- tained by the Lord Mayor of London ; at each place he pleaded the cause of his unhappy country. Speaking in English, he displayed an eloquence and command of the language scarcely excelled by the greatest orators in their own tongue ; and if we recollect that he had never before been outside the Austrian Empire, these speeches must be recognized as being among the most marvellous pro- ducts of haman genius. The agitation had no immediate effect, but the indignation which he aroused against Rus- sian policy had much to do with the strong anti-Eussian feeling which made the Crimean war possible.

From England he went to the United States of America : there his reception was equally enthusiastic, if less digni- fied ; an element of charlatanism appeared in his words and acts which soon destroyed his real influence. Other Hungarian exiles protested against the claim he appeared to make that he was the one national hero of the Eevolu- tion. Count Casimir Batthyany attacked him in The Times, and Szemere, who had been prime minister under him, published a bitter criticism of his acts and character, accusing him of arrogance, cowardice, and duplicity. He soon returned to England, where he lived in close con- nexion with Mazzini, by whom, with some misgiving, he was persuaded to join the Eevolutionary Committee. Quarrels of a kind only too common among exiles fol- lowed ; the Hungarians were especially offended by his claim still to be called Governor. He watched with anxiety every opportunity of once more freeing his country from

Austria. An attempt to organize a Hun- garian legion during the Crimean war was stopped, but in 1869 he entered into negotiations with Napoleon, left England for Italy, and began the organization of a

Hungarian legion, wMcli was to make a descent on the coast of Dalmatia. The Peace of Villafranca made this impossible. From that time he resided in Italy ; he refused to follow the other Hungarian patriots, who, under the lead of Deak, accepted the compromise of 1866 ; for him there could be no reconciliation with the house of Hapsburg, nor would he accept less than full independ- ence and a republic. He would not avail himself of the amnesty, and though elected to the Diet of 1867, never took his seat. He never lost the affections of his country- men, but he refrained from an attempt to give practical effect to his opinions, nor did he allow his name to become a new cause of dissension. A law of 1879, which de- prived of citizenship all Hungarians who had voluntarily been absent ten years, was a bitter blow to him.

He died in Turin on 23rd March 1894, at the age of ninety-two ; his body was taken to Pesth, where he was buried amid the mourning of the whole nation.

There is no full biography of Kossuth, and many points in his career and character will probably always remain the subject of controversy. The fullest account of the Eevolution is given in Helfeet, Geschichte Oesterreichs, Leipzig, 1869, &c., representing the Austrian view.

See also Hungai~y and its Bevolutions, with a Memoir of Louis Kossuth. By E. 0. S. Bohn, 1854. — Hoevath. 25 Jahre aus der Geschichte Ungarns, 18ZS-^8. Leipzig, 1867. — Maueice. Hevo- lutions of 1848-49. — Stiles. Austria in 1848-49. New York, 1852. — SzE.\tEEE. PoUtische Charakterskizzen : III. Kossuth. Hamburg, 1853. — Louis Kossuth. Memoirs of my Exile. — Pul- szKY. Meine Zeit, mein Leben. 1880. ‘ (j. - vv. he.)

Kostroma, a government of middle Eussia. Area, 32,702 square miles. Nearly three-quarters of the surface is covered with woods. Population (1897), 1,429,228, thoroughly Russian, with a small adinixture of other aborigines. Agriculture remains relatively poor. Out of 20,001,000 acres, 7,861,500 acres belong to private owners, 6,379,500 to the peasant communities, 3,660,800 to the crown, and 1,243,000 to the imperial family. Only 2,300,000 acres are under grain crops, the average crop being about 3,300,000 quarters. Flax crops are on the increase, also hops. There were in 1897, 258,207 horses, 435,000 cattle, and 439,000 sheep. Domestic industries are widely spread. Factories are growing — chiefly cotton, flax, and linen mills, chemical works, tanneries, paper mills, &c. — and show an aggregate yearly return of about £3,000,000. There is only one school for 3296 inhabitants. It is divided into twelve districts, the chief towns of which are Kostroma (41,268), Bui (2626), Chukhloma (2200), Galich (6182), Kineshma (7564), Kologriv (2566), Makariev (6068), Nerekhta (3000), Soligalich (3420), Varnavin (1140), Vetluga (5200), and Yurievets (4778).

Kotah, a native state of India, in the Eajputana Agency, with an area of 3803 square miles. The popula- tion in 1881 was 417,275 ; in 1891, 626,267, showing an apparent increase of 26 per cent. ; average density, 138 persons per square mile. In 1901, on an enlarged area of about 6700 square miles, the population was 644,349, showing an average density of only 96 persons per square mile. The gross revenue in 1896-97 was Ks.27,83,072 ; tribute, Rs. 3,84,720 ; expenditure on public works, R8.3,31,390; on army Es.4,20,000 ; number of schools, 26, attended by 1490 pupils, of whom 85 were girls. In 1897 a considerable portion of the area added to Jhalawar in 1838 was restored to Kotah. The present Maharao, Umad Singh, was born in 1873, and succeeded in 1889. He was educated at the Mayo College, Ajmere. A con- tinuation of the branch line of the Indian Midland railway from G-oonato Bara passes through Kotah for 29 miles. It was opened in 1889 at a cost to the state of Ils.19,00,000. It was proposed to construct a light railway from Bara to Kotah town. The state suffered from drought in 1896-07,

and again more severely in 1899-1900. In 1896-97 the coinage at the mint was Es.24,130, the rupee being of the same weight and fineness as the British ruxDee. The inscription on the reverse, in Persian characters, was ”

Her Majesty of England, the victorious monarch." The town of Kotah is on the right bank of the Chambal. Population (1881), 40,270; (1891), 38,793; (1901), 33,679, showing a continuous decrease. A handsome new palace has been constructed, and a water-supply for the town and suburbs is under consideration by the municipal committee. The high school had 378 pupils in 1897-98, of whom 158 were learning English. The school foi- the sons of nobles had 66 pupils, in addition to 9 boys at the Mayo College educated at the expense of the state. There are also two girls' schools, for Hindu and Mahommedan girls. The Victoria Hospital is under a native Christian lady. The public library called the Crosthwaite Institute was founded in 1899.

Kotelna, a town of Eussia, government of Kharkov, district Akhtyrka, on the frontier of Poltava. It has a variety of domestic trades, forges, and oil works. Pop- ulation, 13,960.

Kothen, or Cothen, a town of Germany, duchy of Anhalt, 22 miles by rail north of Halle. It has a technical institute, a school of gardening, and a school of forestry. A new town hall was finished in 1899. Among others, there is a monument to J. S. Bach, who was music director here from 1717 to 1723. Population (1885),

17,473 ; (1900), 22,092.

Kotka, a seaport of Eussia, Finland, government of Viborg, 35 miles by rail from Kuivola junction of the Helsingfors railway, on an island of same name at the mouth of the Kymmene river. Timber is shipped down this river from all the lakes of the Pajane basin to the sawmills of Kotka, employing 1400 workers. Over 200,000 cubic metres of timber are exported. It is also the chief port for exports from and imports to East Finland. It is the military station of the Eussian navy, and has three gymnasia and technical schools. Population (1897), 4801.

Kovalevsky, Sophie (1850-1891), Eussian math- ematician, daughter of General Corvin-Krukovsky, was born at Moscow, 16th January 1850. From her earliest childhood she showed a remarkable love of study and the keenest interest in mathematical forms, even before she had any conception of their meaning. As a young girl she was fired by the aspiration after intellectual lib- erty that animated so many young Eussian women at that

period, and drove them to study at foreign univer- sities, since their own were closed to them. This led her, in 1868, to contract one of those conventional marriages in vogue at the time, with a young student, Waldemar Kovalevsky, and the two went together to Germany to con- tinue their studies. She first went to Heidelberg, where she studied under Helmholtz, Kirchhoff, Konigsberger, and du Bois-Eeymond, and from 1871-74 read privately with AVeierstrass at Berlin, as the public lectures were not then open to women. In 1874 the University of Gottingen granted her a degree in absentid excusing her from the oral examination on account of the remarkable excellence of the three dissertations sent in, one of which, on the theory of partial differential equations, is one of her most remarkable works. Another was an elucidation of Laplace's mathematical theory of the form of Saturn's rings. Soon after this she returned to Eussia with her husband, who was appointed professor of palaeontology at Moscow, where he died in 1883. At this time Madame Kovalevsky was at Stockholm, where Mittag Lefiler, also a pupil of Weierstrass, who had been recently appointed to

the chair of mathematics at the newly-founded university, had procured for her a post as lecturer. She discharged her duties so successfully that in 1884 she was appointed full professor. This post she held till her death on 10th February 1891. In 1888 she achieved the greatest of her successes, gaining the Prix Bordin offered by the Paris Academy. ^The problem set was " to perfect in one im- portant point the theory of the movement of a solid body round an immovable point," and her solution added a result of the highest interest to those transmitted to us by Euler and Lagrange. So remarkable was this work that the value of the prize was doubled as a recognition of un- usual merit. Unfortunately Madame Kovalevsky did not live to reap the full reward of her labours, for she died just as she had attained the height of her fame and had won recognition even in her own country by election to membership of the St Petersburg Academy of Science.

Kovel, a district town of Russia, government of Volhynia, 117 miles by rail south-east of Brest Litovsk, on the marshy banks of the Turiya. Population

(1897), 17,300, more than one-third of whom are Jews.

Kovno, a Lithuanian government of north-west Russia. It touches the Baltic Sea by a narrow strip at Memel. Population (1857), 969,369; (1897), 1,649,444, of whom 788,102 are women, and 147,878 live in towns. Average births 54,000, deaths 36,000; average increase about 1 per cent. The ethnographical composition of the population was estimated by Eittich as : Zhmudes, 40 per cent., chieiiy in the west; Lithuanians, 30 per cent., chiefly in the east ; Jews, 18 per cent. ; Germans, about 16,000 ; Russians only 5280, and Poles only 3130 families. These figures remain approximately correct, only Jews (313,417 in 1892) having grown to be more than 25 per cent, of the population. Agriculture is in a good condition, but the peasants' allotments are small, and a considerable number of the peasants are agricultural labourers. The average acreage under crops is 3,369,400 under various grains, and 202,600 under potatoes, so that in an average year the province has an available surplus of 2,200,000 quarters of grain and about 840,000 quarters of potatoes. Nearly 285,000 cwts. of flax are obtained every year. Dairying is in a good condition, and horse and cattle breeding are attracting attention. Fishing, too, is important, and the navigation on the rivers is brisk. A variety of small and domestic industries is carried on in the towns by the Jewish population (23,769 artisans in 1893), but only to a slight extent in the villages. As many as from 18,000 to 24,000 men are compelled every year to migrate in search of work. The yearly returns of the factories (1360) attain about £650,000(distilleries, tobacco, steam flour-mills, hardware). Schools are insuflBcient (only 13,827 pupils in the element- ary schools), but well organized. All village schools have small libraries and land (1 to 3 acres) for model school gardens. The chief towns of the seven districts into which the government is divided are Kovno, Novoalexandrovsk (6370), Povenyezh (13,044), Eossieny (7455), Shavli (15,914), Telshi (6215), and Vilkomir (13,509).

Kovno (Polish Eowno, Russian Kovna, Lithuanian Kaune), capital of the above government, at the confluence of the Niemen with the Viliya, 503 miles south-west of St Petersburg by rail, and 64 miles from Wierzboiowo (Prussian frontier). It is a first-class fortress. It is an important entrep9t for goods passing from and to Prussia, but the yearly returns of sea-borne goods brought by rail only attain 76,000 tons. Population (1863), 23,937;

(1897), 73,543.

Kovroff, a district town of Russia, government and 40 miles by rail north-east of Vladimir, on the line to

Nijni-Novgorod. It has large railway carriage works, cotton mills (1700 workers), steam flour-mills, tallow houses, &c., and quarries of limestone. Population (1890),

6600; (1897), 14,570.

Kozlov, a district town of Russia, government and 46 miles west of Tambov, on the Lyesuoi Voronezh river, amidst a fertile agricultural region. It is a railway junc- tion, and consequently its importance for the export of cattle (65,000 head), grain, meat, eggs (22,000,000), tallow, hides, &c., is steadily growing, as are also its factories, flour- mills, tallow-houses, distilleries, tanneries, glue-works, &c. Population (1897), 40,347.

Kragerd, a town of Norway, Bratsberg county, on the south coast, 67 miles north-east of Christiansand. The total trade is valued at about £127,000 a year. The chief exports are timber, ice, wood-pulp, and apatite and felspar. Coal is the principal import. The town possesses a mer- cantile fleet of some 46,000 tons burden. Population

(1875), 4669 ; (1900), 6223.

Kraguyevatz, the principal town of central Servia (so-called ” Thoomadiya,” the forest land), 59 miles south-south-east of Belgrade. It is situated on the small river Lepenitza, in a very fertile country. In the first years of Servia’s autonomy under Prince Milosh, it was the residence of the prince and the seat of government (1818-39). Even later, between 1868 and 1880, the National Assembly {Nardona STcvpshtina) usually met there. In 1857 the first cannon-foundry in Servia was established there, and since that time it has developed into the principal arsenal and military store of the country. It is the seat of the district prefecture, of a tribunal, and of a large garrison. It boasts the finest college building and the finest cathedral (in Byzantine style) in Servia. In 1885 it was connected by a branch line (Kraguyevatz-Lapovo) with the principal railway (Belgrade-Nish), and

since then the prosperity of the town has steadily increased. Popu- lation, 14,160.

Krakatoa. See Geology (III.).

Kraszewski, Joseph Ignatius (1812-1887), Polish novelist and miscellaneous writer, was born at Warsaw, 27th July 1812, of an aristocratic family. He showed a precocious talent for authorship, begin- ning his literary career with a volume of sketches from society as early as 1829, and for more than half a century scarcely ever intermitting his literary production, except during a period of imprisonment upon a charge of complicity in the insurrection of 1831. He narrowly- escaped being sent to Siberia, but, rescued by the inter- cession of powerful friends, he settled upon his landed pro- perty near Grodno, and devoted himself to literature with such industry that a mtere selection from his fiction alone, published at Lemberg from 1871 to 1875, occupies 102 volumes. He was thus the most conspicuous literary figure of his day in Poland. His extreme fertility was sugges- tive of haste and carelessness, but he declared that the contrivance of his plot gave him three times as much trouble as the composition of his novel. Apart from his gifts as a story-teller, he did not possess extra-ordinary mental powers; the “profound thoughts” culled from his writings by his admiring biographer Bohdanowicz are for the most part mere truisms. His copious invention is nevertheless combined with real truth to nature, especially evinced in the beautiful little story of Jermola the Potter (1867), from which George Eliot appears to have derived the idea of Silas Marner, though she can only have known it at second hand. Compared with the exquisite art of Silas Marner, Jermola appears rude and unskilful, but it is not on

this account the less touching in its fidelity to the ten- derest elements of human nature. Kraszewski’s literary activity falls into two well-marked epochs, the earlier when, residing upon his estate, he produced romances like Jermola, XJlana, Kordecla, devoid of any special tendency, and that after 1863, when the suspicions of the Russian Government compelled him

to settle in Dresden. To this period belong several political novels published under the name of Boleslawita, historical fictions such as Countess Cosel, and the “culture” romances Jforituri and Resurrection, by which he is perhaps best known out of his own country. In 1884 he was accused of plotting against the German Government, and sentenced to seven years’ imprisonment in a fortress, but was released in 1886, and withdrew to Geneva, where he died on 19th March 1887. His remains were brought to Poland and interred at Cracow. Kraszewski was also a poet and dramatist ; his most celebrated poem is his epic “Anafielas” (1840-43). He was indefatigable as literary critic, editor, and translator, wrote several historical works, and was conspicuous as a restorer of the study of national archeeology in Poland. (k. g.)

Kremenets (Polish, Kremeniec), a district town of south-west Eussia, government of Volhynia, 128 miles west of Zhitomir, and 26 miles east of Brody railway station, in Austrian Galicia. It is situated in a gorge of the Kremenets Hills, where an old Polish fortress, now in ruins, was erected. It has trade in tobacco and grain for export. Population (1897), 17,618.

Kremenskaya, a growing Cossack village of south- east Eussia, province of Don Cossacks, 70 miles north- west of Tsaritzyn. Population (1892), 9900; (1895),

15,727.

Krementchug, a district town of south-west Eussia, government and 76 miles by rail south-west of Poltava, on the left bank of the Dnieper. It is an import- ant entrepot for commerce, chiefly in grain and timber, and is also a considerable river port and a growing in- dustrial centre (steam flour-mills, steam saw-mills, forges, tobacco factories, &c.). Population (1887), 31,000 ; (1897), with Kryukov suburb, on the opposite side of the Dnieper,

58,648.-

Krems, or Keems an dee Doistau, chief town of a district in Lower Austria, at the confluence of the Krems with the Danube. The manufactures comprise steel goods, mustard and vinegar, and a special kind of white lead (Kremser Weiss) is prepared from deposits in the neigh- bourhood. The

trade is mainly in these products and in wine and saffron. The Danube harbour of Krems is at the adjoining town of Stein (4299). Population, with suburbs (1S90), 10,584; (1900), 12,657, including a garrison of 1755.

Kremsier (Czech, Kromei-lz), a town in Moravia, Austria, with a special charter, .‘i7 miles east by north of Briinn. Its industries include the manufacture of machinery and iron-founding, brewing and corn-milling, and there is a considerable trade in corn, cattle, fruit, and manufactures. Population (1800), 12,480; (1900), 13,991, including a garrison of 1066.

Kreuzburg, a town of Prussia, province of Silesia, 24 miles north-north-east of <^ii]jeln. It was the birth- place of Gustav Freytag (18]<'i-1896). Here are flour- mills, distilleries, iron-works, breweries, &c. ; also a provincial lunatic asylum and a teachers' seminary. Population (1885), 6578; (1900), 10,2;i6,

Kreuznach, a town and watering-place of Prussia, in the Ehine province, on the river Nahe, and 9 miles

by rail south of Bingen. In the school of the old town is preserved a collection of Eoman and mediaeval antiquities. Here was discovered in 1893 a finely- preserved Eoman mosaic. A statue of Bismarck (1897) adorns the old town. Its saline waters attract some 6000 persons annually. Population (1885), 16,414; (1900),

21,334.

Kriegspiel, or the “War Game,” is of German origin, as its name indicates. The positions of troops are marked on maps, movements are made under regula- tions, and the whole or portions of past campaigns can be reproduced in outline of fair accuracy, or hypothetical manoeuvres may be formulated for study and instruction. The materials required are at least three copies of the same map, drawn to such scale as may be suitable to the magnitude of the operations to be represented. If the scheme is one for small numbers of troops, maps of large scale are essential, as small features of the ground largely influence the action of small bodies, and it is only on large- scale maps that the real influence of small features can readily be appreciated. Conversely, with large bodies, maps on a diminished scale are

convenient. A great amount of detail is necessary in all maps drawn for military purposes ; heights as represented by contours, roads, build- ings, water-courses, fences, and the nature of the ground, all enter into the question of the feasibility or the reverse of military operations ; and where the map is the actual field of manoeuvre, the features of the natural field must be adequately supplied. Blocks, cut or moulded to scale, represent the different units of the combatants ; and colours, generally red and blue, distinguish friend from foe. Some pairs of dividers and a few measures of the same scale as the maps employed complete the material outfit. Printed regulations for the conduct of kriegspiel are of small value ; and although rules have been drafted at various times and in many languages, they have generally been allowed to lapse, practice having proved that the decision of a com- petent umpire is of more value, as to the soundness or unsoundness of a military manoeuvre, than a code of regulations which inevitably lack elasticity.

The usual course of procedure varies but little in the difierent countries in which the system has been employed. The central map screened from the view of the combatants is used by the umpire, who places on it the forces of both sides ; copies are on either hand behind screens or in adjoining rooms, and on tUem representative blocks are placed in positions which agree with the information possessed by each respective commander. A scheme is formulated such as may occur in war, and a ‘ ‘ General Idea ‘ ‘ or “Narrative ” is the common property of both sides. This contains those items of common knowledge which would be in the possession of either commander in the field. The General Idea is supplemented by “special ideas,” issued one to each of the combatants, supplying the information which a commander might reasonably be expected to have of the details of his own force. A third series of instruc- tions is issued, entitled ” Orders,” which define to each commander the object to be attained ; and on receipt of these he is required to draft specific orders, such as, in manaHivre or in war, would be considered necessary for issue to field units in the assumed circum- stances. Up to this point the instruction is strictly parallel to service conditions, but from the moment the umpire or an assistant moves a unit, falsity may supervene ; armies on the map move without hitch or breakdown, but it is the exception, not the rule, for movements of real bodies to be carried on without unforeseen delay. The units of artillery,

cavalry, infantry, or train-waggons, advance or retreat at a rate approximately regulated to their normal pace. Information gained by advancing patrols is brought at realistic speed to its destination ; and no alteration in the ordered movements of a unit is allowed, till expiration of the calculated time for the transmission of the intelligence and for the issue of fvcKh orders. So the exercise progresses, each movement is marked, and periodically the blocks on the three maps are placed as they would be at a simultaneous moment. Smaller units yield to larger ones of the enemy ; equal forces, if unassisted by superiority of position, ” contain ” one another, and are practically neutralized till reinforcements arrive and equilibrium is overthrown.

The decisions of the umpire are all-important, and it is he who

makes or mars the value of the instruction. Siome axioms must be universally accepted for the guidance both of himself and of the players. A force arrayed within effective range on the flank of an equal and liostile force has the better position of the two. Artillery in position with an unimpeded glacis is a terrible task for a frontal attack. Cavalry, as such, is ineffective in woodlands, marshes, or a country broken up by cross hedges or wire fencing. Infantry in masses is an ideal target for efficient artillery, and in scattered bodies affords opportunities for attack by well-handled cavalry. The just application of the ideas contained in these few sentences to the varying stages of a combat is no mean task for a cultured student.

One of many diiflculties encountered in war is the lack of accurate information. Any one man’s view of details spread over large areas of country is extremely limited ; and even with the greatest precautions against unreality, a commander’s information is vastly more accurate over the extended units of his mimic force at kriegspiel, than when the forces so represented are men, horses, and ma- chines, wrapped in dust or in smoke, and partially obscured by accidents of the ground too insignificant for reproduc- tion on the map. Yet whilst accepting a certain unreality in kriegspiel, and to a less degree in field manceuvres, both by one and the

other military training and education are furthered. The framing of orders follows identical lines at kriegspiel, at manoeuvres, or in war. The movement of troops in mimic warfare should be brought to harmonize as far as possible with reality. The study of past campaigns, laboriously traced through maps and records, matured the prowess of commanders of such various calibres as Frederick, Napoleon, Wellington, and von Moltke. The reproduction on the kriegspiel map of the strategy of Napoleon's campaigns in 1796 and in 1815 shows a similarity of design. In either case he commanded a central force acting against the inner flanks of allies, whose base-communications were divergent. In 1796 the Piedmontese and the Austrians conformed to Napoleon's preconceived idea and retired eccentrically. In the Waterloo campaign, Blucher, with loyal heroism, abandoned his own communication and rallied to his ally. War here differentiated the efficiency gained or lost by good or bad moral force, but it is diflBcult on paper to reproduce similar conditions. The paralysing effect caused by a flanking assault on an attacking force may be indi- cated at kriegspiel, yet it is impossible to gauge theoreti- cally the amount of its efiicacy. A force in position to threaten communications may be placed on the map, but Osman at Plevna delayed the Russian advance to an ex- tent altogether unforeseen. Von Moltke supervised krieg- spiel exercises for the general staff of the German army, and printed records exist of various problems he suggested, orders issued by the selected commanders, and finally the searching criticisms by the field-marshal himself. The concentrating march of the armies on Paris was probably analysed in detail between 1866 and 1870, and treated as a strategical problem on the map, but no seer could have prophesied tactical incidents such as the capture and recapture of Le Bourget or the combats on the plateau of ChStillon. It may be stated with confidence that the measured movements of troops over a kriegspiel map, and the necessary drafting of orders, are aids to the acquisition of military proficiency ; but directly the con- tact of important bodies of troops is represented on paper, imagination, not realism, governs the results, (j. b. s.)

Krishnagar, a town of British India, headquarters of Nadia district in Bengal, situated on the left bank of the river Jalangi, connected with Ranaghat, on the East- ern Bengal railway, by a light railway, 20 miles in length, which was opened in 1899. Population (1881), 27,477 ; (1891) 25,500. It is the residence of the rajah of Nadia. Coloured clay figures are

manufactured. The Government college had 83 pupils in 1896-97 ; there is a collegiate high school, with 194 pupils.

Kristo Das Pal (1838-1884), Indian publicist, was born in Calcutta in 1838, and after receiving an English education at the Oriental Seminary, was appointed assistant secretary to the British Indian Association in 1885. It was an association of Bengal landlords founded about the middle of the 19th century, and numbered among its members some of the most cultured men of the day, such as Raja Radha Kanta Dev, a patron of Sanskrit learning and head of the Orthodox community ; Prosonno Kumar Tagore, the most successful lawyer of his time ; Ram Gopal Ghosh, the most gifted speaker and most patriotic representative of his countrymen ; Debendra Natu Tagore, head of the Brahmo Somaj ; Joy Kishen Mukerjea, an able, far-sighted, practical landlord ; Digambar Mitra, another clear-headed and influential landlord ; Rajendra lal Mitra, the distinguished antiquary and scholar ; Mahendra lal Sarkar, favourably known in India for his scientific researches. Three years after his appointment as assistant-secretary, Kristo Das Pal became editor of the Hindu Patriot, originally started in 1853 and conducted with ability and zeal by Harish Chandra Mukerji until his death in 1861. When Kristo Das Pal became editor, the journal was transferred by a trust deed in 1862 to some members of the British Indian Association, and henceforth became to some extent an organ of that body. Thus from 1862 Kristo Das Pal had rare opportunities for distinction, and proved his abilities and independence during an eventful career of twenty-two years until his death. Among the publicists who helped and co-operated with him were Maharaja Sir Jotendra Mohan Tagore and Maharaja Sir Narendra Krishna Dev, scions of the two most distinguished houses of Calcutta. In 1863 Kristo Das Pal was appointed justice of the peace and muni- cipal commissioner of Calcutta. In 1872 he was made a member of the Bengal Legislative Council, where his practical good sense and moderation were much appre- ciated by successive Lieutenant-Governors of Bengal. His opposition, however, to the Calcutta Municipal Bill of 1876, which first recognized the elective sys- tem, was attributed to his prejudice in favour of the “classes” against the “masses.” In 1883 he was ap- pointed member of the Viceroy’s Legisla-tive Council. In the discussions on the Rent Bill, which came up for consideration before the Council, Kristo Das Pal, as

secretary to the landlords' association, necessarily took the side of the landlords. He died on 24th July 1884. (e. c. d.)

Krivoi Rog, a town of Russia, government of Kher- son, on Ingulets river, near to the station of the same name on the Ekaterinoslav railway, 133 miles north-east of Nikolayev. It is the centre of a district, very rich in metals and various minerals obtained from a narrow stretch of crystalline schists underlying the Tertiary deposits. Iron ores (60 to 70 per cent, of iron), copper ores, colours, brown coal, graphite, slate, and lithographic stone are obtained. Population (1895), 9811.

Krivoscie, a small stretch of barren mountainous country, forming part of the Dinaric alpine region, bounded on the S. by the Bocche di Cattaro, in the Austrian crownland of Dalmatia, and on the N.W., N., and E. by Herzegovina and Montenegro. The district, which is inhabited by Servians, 'has been in the posses- sion of Austria since 1814. It was the scene of two revolts (in 1869 and from December 1881 to March 1882), consequent upon the efforts of the Austrian Government to enforce military service upon the inhabitants. A number of forts have now been erected in the district. Population (1890), 27,947; (1900), 29,979, including a garrison of 2079.

Kronstadt (Hungarian, Brassd), a corporate town

of Hungary and capital of a county, in the extreme south- east of Transylvania, just below the Tomos Pass in the Carpathians. Population (1891), 30,739 ; (1900), 36,646, of ■whom about 12,000 were Hungarians, the others in, about equal proportion Germans and Wallachians. It is an important industrial and commercial town ; its trade, chiefly with Rumania and the Balkan states, is very considerable, and it has manufactures of clothes and sausages, besides distilleries and petroleum refineries. On the top of the Romantic Mount Cenk (3000 feet), near the town, stands one of

the monu- ments, erected (in 1896) at several parts of the country, to commemorate the millennium of the Hun- garian state.

Kruger, Stephanus Johannes Paulus

(1825 •), formerly President of the Transvaal Re- public, was born in Colesberg, Cape Colonj', on 10th Octo- ber 1825. The founder of the Kruger family appears to have been a German named Jacob Kruger, who in 1713 was sent with others by the Dutch East India Company to the Cape. Mr Kruger's father was Caspar Jan Hendrick Kruger, who was born in 1796, and whose wife bore the name of Steyn. At the age of ten Paul Kruger — as he afterwards came to be known — accompanied his parents in the migration, known as the Great Trek, from the Cape Colony to the territories north of the Orange in the years 1835-40 (see South Africa). From boyhood his life was one of adventure. Brought up on the borderland between civilization and barbarism, constantly trekking, fighting, and hunting, his education was necessarily of the most primitive character. He learnt to read and to write, and was taught the narrowest form of Dutch Presby- terianism. His literature was almost confined to the Bible, and the Old Testament was preferred to the New. It is related of Mr Kruger, as indeed it has been said of Piet Retief and others of the early Boer leaders, that he believed himself the object of special Divine guidance. At about the age of twenty-five he is said to have dis- appeared into the veldt, where he remained alone for several days, under the influence of deep religious fervour. During this sojourn in the wilderness Mr Kruger stated that he had been especially favoured by God, who had communed with and inspired him. Throughout his life he professed this faith in God's will and guidance, and much of his influence over his followers is attributable to their belief in his sincerity and in his enjoyment of Divine favour. The Dutch Reformed Church in the Transvaal, pervaded by a spirit and faith not unlike those which distinguished the Covenanters, was divided in the early days into three sects. Of these the narrowest, most puritanical, and most bigoted was the Dopper sect to which Mr Kruger belonged. His Dopper following was always unswerving in its support, and at all critical times in the internal quarrels of the state rallied round him. The charge of hypocrisy, frequently made against Mr Kruger — if by this charge is meant the mere juggling with religion for purely political ends — does not appear entirely just. The

subordination of reason to a sense of superstitious fanaticism is the keynote of his character, and largely the explanation of his life. Where faith is so profound as to believe the Divine guidance all, and the individual intelligence nil, a man is able to x^ersuade himself that any course he chooses to take is. the one he is directed to take. Where bigotry is so blind, reason is but dust in the balance. At the same time there have been incidents in Mr Kruger's life which but ill conform with any Biblical standard he might choose to adopt or feel imposed upon him. Even van Oordt, his eloquent historian and apologist, is cognizant of this fact.

At the age of seventeen Paul found himself an Assistant

Eield Cornet, at twenty he was Field Cornet, and at twenty- seven Commandant in an expedition against a native chief Sechele. In 1853 he took part in another expedition against Montsioa. When not fighting natives in those early days Mr Kruger was engaged in distant hunting excursions which took him as far north as the Zambezi. In 1862 the Transvaal secured the recognition of its independence from Great Britain in the Sand River Con- vention. For twenty years after this date the condition of the country was one bordering upon anarchy, and into the faction strife which was continually going on Mr Kruger freely entered (see Transvaal). In 1857 he joined Pretorius in a conspiracy for abolishing the district governments in the Transvaal and substituting one central government. What was styled a Repre- sentative Assembly was summoned at Potchefstroom in order to arrange a new constitution. At the same time Pretorius, accompanied by Commandant Paul Kruger, led an expedition into the Free State, where, with the help of a malcontent faction within its borders, they hoped to overthrow the Free State Government and compel a federation between the two countries. The invading commando was met on the Rhenoster river by President Boshof, in command of the Free State forces. Finding that even in the Transvaal his action against the Free State had excited the strongest resentment, and that General Schoeman was coming down from Zoutpansberg to assist President Boshof, Pretorius decided to withdraw. Commandant Kruger then bore a flag of truce to President Boshof and ar- ranged terms of peace, which included an apology from the Pretorius party for the invasion. The blackest inci- dent in connexion with this invasion is the fact that the Pretorius and Kruger party had actually sent emissaries to

Basutoland to induce the Basutos to rise and harass the Free State forces behind, while they were attacking them in front.

From this time forward Mr Kruger's life is so intimately bound up with the history of his country, and even in later years of South Africa, that a study of that history is essential to an understanding of it (see Transvaal and South Africa). The years which followed the abortive invasion of the Free State in 1857 were years of con- tinual unrest and faction strife in the Transvaal. In this strife Mr Kruger played a leading part, and showed very little scruple or broad patriotism so long as his party might prevail. In 1864, when Pretorius was president, Kruger was elected commandant-general of the forces of the Transvaal. In 1871 a boundary dispute arose with the British Government, which was settled by the Keate award. The decision caused so much discontent in the Transvaal that it brought about the downfall of Pre- sident Pretorius and his party; and Burgers, an edu- cated Dutch minister, resident in Cape Colony, was elected to succeed him. During the term of Burgers's Presidency, which terminated with the British annexation in 1877, Kruger appeared to great disadvantage. Instead of loyally supporting the President in the difficult task of reducing chaos to order and establishing some sort of civilized government in the Transvaal, he did everything in his power to undermine his authority, even going so far as to urge the Boers to pay no taxes while Burgers was in office. In fact, there is no question that the faction of which he was a prominent member was chiefly responsible for bringing about that impa.fse in the govern- ment of the country which drew such bitter protest from Burgers and terminated in the annexation by the British in 1877. At this period of Transvaal history it is im- possible to trace any true patriotism in the action of the majority of the inhabitants. The one idea of Kruger and his faction was to oust Burgers from office on any pretext,

and, if possible, to put Kmger in his place. When the downfall of Burgers waa assured and annexation offered itself as the alternative resulting from his downfall, it is true that Mr Kruger opposed it. But matters had gone too far. Annexation became an accomplished fact, and Mr Kruger accepted paid

office under the British G-overnment. He continued, however, so openly to agitate for the retrocession of the country, accom- panying two deputations to England, that Sir Theophilus Shepstone, the British administrator, dismissed him from his service. In 1881 the Boer rebellion occurred, and Kruger was one of the famous triumvirate, of which General Joubert and Pretorius were the other members, who, after Majuba, negotiated the terms of peace on which the Pretoria Convention of 1881 was subsequently drafted. In 1883 he was elected President of the Transvaal, receiving 3431 votes as against 1171 re- corded for Joubert.

In November 1883 Presi- dent Kruger again visited England, this time for the purpose of getting another Convention. The visit was successful, the London Con- vention, which for years was a subject of subsequent con- troversy, being granted by Lord Derby in 1884 on be- half of Her Majesty's Gov- ernment. The government of the Transvaal being once more in the hands of the Boers, the country rapidly drifted towards that state of national bankruptcy from which it had only been saved by annexation in 1877. In 1886, the year in which the Eand mines were discovered. President Kruger was by no means a popular man even among his own followers; as an administrator of internal afiEairs he had shown himself grossly incompetent, and it was only the specious success of his negotiations with the British Government which had retained him any measure of support. In 1888 he was elected President for a second term of office. In 1889 Dr Leyds, a young Hollander, was appointed state secretary, and the system of state monopolies around which so much corruption grew up was soon in full course of development. The principle of government monopoly in trade being thus established. President Kruger now turned his attention to the further securing of Boer political monopoly. The Uitlanders were increasing in numbers, as well as providing the state with a revenue. In 1890, 1891-92, and 1894 the franchise law (which at the time of the Convention was on a liberal basis) was so modified that all Uitlanders were practically excluded alto- gether. In 1893 Mr Kruger had to face a third Presidential election, and on this occasion the feeling in the country was so strong that itf was fully anticipated that his more liberal opponent. General Joubert, would be elected. The votes actually returned were 7911 for Kruger and 7246 for Joubert. Before the Presidential election Mr Kruger had taken care to

conciliate the Volksraad members, as well as to see that at all the Volksraad elections, which

Paul Krugeb. {From a- photograph ly Elliott and Fry, London.')

occurred shortly before the Presidential election, his sup- porters were returned, or if not returned, that his opponents were objected to on some trivial pretext, and by this means prevented from actually sitting in the Volksraad until the Presidential election was over. At this time the Hollander and concessionnaire influence had become a strong power in the state, and was all in favour of President Kruger. In spite of these facts, the election was nominally a close one, and there was a general belief that Joubert was elected. General Joubert accused the Government of tampering with the returns, and appealed to the Volksraad. The appeal, however, was fruitless. The action taken by President Kruger at this election, and his previous actions in ousting Presi- dent Burgers and in absolutely excluding all Uitlanders

from the franchise, all show that at any cost, in his opin- ion, the Government must remain a close corporation, and that while he lived he must remain at the head of it. It was a blind, reck- less, and unscrupulous policy, which inevitably led to dis- aster.

After the Jameson Eaid in December 1895 President Kruger put off Sir Hercules Robinson, as well as the reformers in Johannesburg, with promises that the Uit- lander grievances should be seriously considered and dealt with. But no sign of keep- ing this promise was given.

In 1898 Mr Kruger was elected President of the Transvaal for the fourth and last time. In 1899 rela- tions between the Transvaal and Great Britain had be- come so strained that a con- ference was arranged at Bloemfontein between Sir Alfred Milner, the High Commissioner, and President Kruger. Mr Kruger was true to his principles. At every juncture in his life his ob- ject had been to gain for himself and his own narrow policy everything that he could, while conceding nothing in return. It was for this reason that he invariably failed to come to any arrangement with Brand while the latter was President of the Eree State. In all his negotiations with Great Britain after 1881 Mr Kruger had invariably gained something. All the energies of

the Boer President were centred on his intrigues for. obtaining complete independence of Great Britain, and for ignoring the whole spirit, if not the letter, of the Conventions. In 1889, the very year following President Brand's death, he was able to make a treaty with President Eeitz, his successor, which bound each of the Boer Eepublics to assist the other in case its inde- pendence was menaced, unless the quarrel could be shown to be an unjust one on the part of the state so menaced. In effect it bound the Eree State to share all the hazardous risk of the reckless anti-British Transvaal policy, with- out the Eree State itself receiving anything in return. Mr Kruger thus achieved one of the objects of his life. With such a history of apparent success, it is not to be wondered at that the Transvaal President came to

Bloemfontein to meet Sir Alfred jMilner in no mood for concession. After hearing the very moderate franchise pro- posal of Sir Alfred iiilner, he made his counter proposals. These included a treaty of arbitration, and the incorporar tion of Swaziland and Zambaansland (which would have included a piece of the coast-liue) with the Transvaal. The negotiations fell through, as in the temper in which President Kruger entered upon them they were bound to do. It is true that he made an ostensible offer of conces- sion on the franchise question, but even that proposal was made dependent on so many conditions that it was a pal- pable sham. Every proposition which Sir Alfred Milner made was met by the objection that it threatened the inde- pendence of the Transvaal. This retort was President Kruger's rallying cry whenever he found himself in the least degree pressed, either from within or without the state. To admit Uitlanders to the franchise, to no matter how moderate a degree, would destroy the independence of the state; and the same argument had been used in 1897 to rouse the extreme section of his followers into opposi- tion to the report of the Industrial Commission (a com- mission of Mr Kruger's own nominees), who reported in a sense adverse to his exclusive and monopolist policy. In October 1899, after a long and fruitless correspondence with the British Government, war with Great Britain was ushered in by an ultimatum from the Transvaal. Imme-

diately after the ultimatum Natal and the Cape Colony were invaded by the Boers both of the Transvaal and the Free State. Yet one of the most memorable utterances made by Mr Kruger at the Bloemfontein Conference was couched in the following terms : ” We follow out what God says, ‘Accursed be he that removeth his neighbour’s land- mark.’ As long as your Excellency lives you will see that we shall never be the attacking party on another man’s land.” The course of the war that followed is described under Transvaal. In 1900, Bloemfontein and Pretoria having been occupied by British troops, Mr Kruger fled the country and proceeded to Europe, where he endeavoured to induce the European Powers to inter- vene on his behalf, but without success. Mr Kruger was thrice married, and had a large family ; his second wife died in 1891, his third wife in 1901. When he fled to Europe he left his wife in Lord Roberts’s custody at Pre- toria, but she gradually failed, and died there. It is recorded that when the statue to President Kruger at Pretoria was erected, it was by Mrs Kruger’s wish that the hat was left open at the top, in order that the rain- water might collect there for the birds to drink.

AuTHOKiTiES. — Theal. History of Sotith Africa. — Fitz- PATRicK. Tlie Transvaal from Within. — Hillier. South African Studies. — Statiiam, Paul Krutjer. — The Times’’ “His- tory of the Boer War.” — Pratt. Leading Points in South African History. — Van Oordt. Paul Kruger.

Krumau, or Keummau, an old town in Bohemia, on the Jloldau, 14 miles south-west by south of Budweis, marking the northern limit of the German border of Bohemia at this point. A chateau of Prince Schwarzen- berg, with interesting archives, occupies a prominent posi- tion on a rock overlooking the river. The town has a considerable inland trade and an important textile indus- try (linen yarn, cloth, and cashmeres), steam sawmills and cornmills, limekilns and breweries, and manufactures paper, cellulose, &c. Population (1890), 8331 ; (1900), 8673, chiefly Germans.

Krupp, Alfred (1812-1887), German inventor, and founder of the celebrated steel works and gun factory at Essen, was born on 26th April 1812, at that town, where his father, Friedrich Karl Krupp, had set up a small foundry, which, after his death in 1826, was carried on by his widow. Alfred, as the eldest son, found himself com-

pelled, at the age of fourteen, to leave school and take the direction of the works. The prospect was a cheerless one. His father had spent a considerable fortune in the vain attempt to cast steel in large blocks ; and, in order to keep the works going at all, the family had to live with the utmost frugality, while the youthful director worked side by ‘side with his workmen by day, and spent great part of the night carrying on the experiments begun by his father. Even so, for the next fifteen years the returns were never more than sufiicient to cover the workmen’s wages. In spite of all, Krupp never lost confidence in the practicability of his father’s schemes. In 1841 his invention of the spoon-roller brought in sufiicient money to enable him to enlarge his factory and spend money on casting steel blocks. In 1847 he made his first cannon of cast steel. At the Great Exhibition of 1851 in London he exhibited a 6-poimder cannon made entirely of cast steel, and a solid flawless ingot of steel weighing 20001b, more than twice as much as any previously cast. Krupp’s exhibit caused a sensation in the engineering world, and the Essen works at once sprang into fame. In 1861 another successful invention, this time in the making of railway tyres, supplied a profit, which was devoted partly to the enlargement and equipment of the factory, and partly to the execution of his long-cherished scheme — the construction of a breech-loading cannon of cast steel. Krupp himself was strongly convinced of the superiority of breech-loaders to muzzle-loaders, on account of the greater accuracy of firing and the saving of time ; but his view did not win general acceptance in Germany till after the Franco-German war, when the army was sup- plied throughout with Krupp’s perfected field-piece. When once the excellence of its work was recognized, the factory developed with amazing rapidity. At the time of Alfred Krupp’s death (on 14th July 1887) he employed 45,000 men, and, including those in works outside Essen, his rule extended over no less than 75,000 persons. To all these he performed the part of a father. Special ” colonies ” were built for the employes and their families, with parks, libraries, schools, and recreation grounds, while the widows’ and orphans’ fund and other philanthropic and benefit schemes ensured the men and their families against anxiety in case of illness or death. After a time the fame of the Essen works attracted large numbers of visitors, and princes vied with one another in conferring distinc- tions on the ” Cannon King,” the informal title which alone their owner cared to bear. He declined to be ennobled, for he gloried in the name his own work had made celebrated;

thirty-five Orders had been bestowed upon him, but he never wore one. After his death the works were carried on by his only son, Friedrich Alfred, who continued his father's beneficent rule and the inherited tradition of conscientious work and flawless material. (a. z.)

Kuba, Old (Kudial-kcdeh), a district town of Russia, Transcaucasia, government and 95 miles north-west of Baku, on the route to Derbent, on Kudial-chai river ; alti- tude, 1990 feet. It was founded in the 17th century, and annexed to Russia in 1806. The chief occupation of the inhabitants is the silk-worm culture and the fabrication of plain silk stuffs and carpets. Population (1897), 16,346.

Kuban {Kuhanskaya Oblast), a province of Russia, North (Jaucasia, haviirg the Sea of Azov on the W., the province of Don Cossacks on theN., Stavropol and Terek on the E., and Kutais and Tchernomorsk on the S. and S.W. It thus contains the low and marshy lowlands on the Sea of Azov, the western portion of the fertile plains of northern Caucasia, and the northern slopes of the Caucasus range from its north-west extremity to the Elbruz. The

main range, which reaches a height of 9200 feet in the group of peaks of Oshten, and gradually rises to 18,572 feet in the Elbruz, is thickly snow-clad between these two peaks, and very few passes lead from the province of Kuban to the Black Sea littoral. (See Caucasus.) In its southern parts the province includes the parallel ranges known as the Black Mountains, from 3000 to 6000 feet high, intersected by gorges growing deeper and wilder as one approaches the main range. Owing to a relatively wet climate and a profusion of rivers, these mountains are thickly clothed with woods, under the shadow of which a thick underwood of rhododendrons, " Caucasian palms " (Buxus sempervirens), ivy, clematis, &c., develops, so as to render the forests almost impassable. They cover altogether nearly 20 per cent, of the aggregate area. Wide treeless plains, from 1000 to 2000 feet high, spread farther north, and are profusely watered by the many tributaries and sub-tributaries of the Kuban — ■ Little and Great Zelenchuk, Urup, Laba,

Pshish — rush- ing through narrow gorges from the Caucasus range, and spreading fertility in the plains. In its lower course the Kubaii, which is a river nearly 600 miles long, as it ap- proaches the Sea of Azov subdivides into a labyrinth of branches, and enters both the Sea of Azov (main branch in the 15th century) and the Black Sea, forming a wide delta, low, covered with rushes, peopled by boars, and very unhealthy. The same character is maintained by the low plains in the east of the Azov Sea, covered with numerous semi-stagnant lakes. Fishing is the chief wealth of this part of the province, the AchuefE fisheries on the Kuban being famous. Malaria is the enemy of these regions, and is specially deadly on the Taman peninsula, as also along the left bank of the lower and middle Ku.barL.

There is considerable mineral wealth in the province. Coal is found on the Kubaii and its tributaries, but its extraction is still insignificant (less than 10,000 tons per annum). Naphtha wells exist in the district of Maikop, but the best are in the Tama,n penin- sula, where they cover an area of 570 square miles. The yearly extraction of naphtha (begun in 1866) reaches now about 50,000 tons. Iron ores, silver, and zinc are found ; alabaster is extracted, as also some salt, soda, and “Epsom” salt. The best mineral waters are at Psekup and Taman, where there are also numbers of mud volcanoes, which appear of all sizes, ranging from small hillocks to hills 175 feet and 365 feet high (Aktaniz, or Kukuoba), and even higher. They all throw out mud, stones, roots of plants, &c. The soil is very fertile in the plains, parts of which are covered with black earth and are being rapidly populated.

The population reached 1,926,32.3 in 1897, of whom 1,788,622 are Russians, 8000 Poles, 13,095 Armenians, and 11,410 Germans. There were 945,873 women, and only- 156,486 lived in towns. The aborigines were represented by 103,516 Cherkesses and 5000 Nogai Tatars. The Cherkesses or Adyghe (Kabardians, Besleneis, Abadzekhs, &o.), who formerly occupied the mountain valleys, were compelled, after the conquest in 1861, either to settle in the flat land or to emigrate, those who refused to move being driven across the mountains to the Black Sea coast. Most of them (nearly 200,000) emigrated to Turkey, where they formed the Bashi-bazouks. Peasants from the interior provinces of Russia occupied the plains

of the Kuban, and now they number over 1,000,000, while the Kubafl Cossacks number 804,372 (405,428 women).

The area under crops has rapidly extended of late, the cereal crop of 1897 being 6,729,000 quarters (8,000,000 in 1894). Wheat is by far the chief crop (nearly three-quarters of the total area under crops are under wheat) ; rye, oats, barley, millet, Indian corn, some flax and potatoes, as also tobacco (133,000 cwts.), are also grown. Agricultural machinery is largely resorted to, and the province becomes a reserve granary for Russia. There were in 1894, 188,700 horses, 983,600 horned cattle, 1,213,000 sheep, and 25,600 goats. Bee-keeping is general, and gardening and vine-growing are rapidly spreading. Pishing in the Black Sea and Azov Sea, as also in the Kubafl, is important. Industrial pursuits give occupation to a little over 21,000 people (yearly returns about £1,200,000 only).

Two main lines of railway intersect the province, one running north-west to south-east, from Rostoff to Vladikavkaz, and another starting from the former south-westwards to Novorossiysk.

Schools have been introduced since 1863, and there were in 1897, besides the gymnasia in the chief towns, 364 primary schools (many having model gardens or farms), with 31,244 pupils, and 435 church schools (15,600 pupils). The province is divided into 7 districts (otdyels), the chief towns of which are Ekaterinodar, capital of the province (65,697), Anapa (6676), Armavir, chief town of Labinsk (6388), Batalpashinsk (5866), Maikop (34,191), Temryuk (14,476), and Yeisk (35,446). The territory of the Kubafl Cossacks (see Cossacks) is divided into 11 military districts. (p. a. k.)

Kuchinoerabujima, an island belonging to Japan, measuring 8 miles in length by 2^ in breadth, and lying to the south of Kiushiu, in 30° 3′ N. and 130° 10′ E. Its highest peak, Shindake, measures 2313 feet.

Kuenen, Abraham (1828-1891), Dutch theo- logian, the son of an apothecary, was bom on 14th September 1828, at Haarlem, where he was educated at the primary school and gymnasium. On his father’s death, which took place before the boy was fifteen, it became necessary for him to leave school and take a humble place in the business. Happily old friends, who recognized the lad’s ability, arranged to pay for his education first at

the gymnasium and afterwards at the University of Leyden, where he was destined to spend the rest of his life. He studied theology, and won his doctor's degree by an edition of thirty-four chapters of Genesis from the Arabic version of the Samaritan Penta- teuch. In 1853 he became " extraordinary " professor of theology at Leyden, and in 1855, when he became full professor, he married a daughter of Muurling, one of the founders of the Groningen school, which made the first pronounced breach with Calvinistic theology in the Re- formed Church of Holland. Kuenen himself soon became one of the main supports of the modern theology, of which Scholten and Opzoomen were the chief founders, and of which Leyden became the headquarters. His first great work, a Historico- Critical Introduction to the Old Testament, followed the lines of the dominant school of Ewald. But before long he came under the in- fluence of Colenso, and learned to regard the prophetic narrative of Genesis, Exodus, and Numbers as older than what was by the Germans denominated " Grundschrift " (Book of Origins). In 1869-70 he published TJie Religion of Israel. This was followed in 1876 by A Study of Hebrew Prophecy, largely polemical in its scope, and specially directed against those who rest theological dogmas on the fulfilment of prophecy. In 1882 Kuenen came to England to deliver a course of Hibbert lectures on Natural and Universal Eeligion ; in the following year he presided at the Congress of Orientalists held at Leyden. In 1886 his volume on the Hexateuch was published in England. He died at Leyden on 10th December 1891. Kuenen was also the author of numer- ous articles, papers, and reviews ; a series on the Hexa- teuch, which appeared in the Theologisch Tijdschrift, of which he was joint-editor, is one of the finest products of modern criticism. A distinguishing characteristic of the man was his great courtesy, which never failed him even in the most animated controversy, and which set the tone in Holland, where the polemical acrimony so common in many countries is little known. Kuenen was a great ad- mirer of England, which he visited three times, once to meet Colenso, another time as a delegate to the British and Foreign Unitarian Association, and the last time in 1882, when he lectured at London and Oxford. Several of his works have been translated into English by Mr Philip Wicksteed. (a. z.)

Kuen-lun, a geographical term which was used at a time when the geography of Central Asia was almost totally unknown, and which is still

partly retained. The ancients used to imagins an immense range of mountains

crossing Asia from west to east, on the parallel of tlie island of Rhodos, and separating the rivers which flow towards the Arctic Ocean from those which flow south- wards. Humboldt, influenced by his own and Klaproth's studies of Chinese sources, represented Asia as covered with a network of mountain ranges running along the parallels and the meridians ; and among the former he represented the Kuen-lun as a sort of backbone of Asia, " the highest and longest mountain range on the earth," crossing Asia from west to east in its middle parts. Eitter, guided by his keen geographical genius, saw in the Kuen-lun a northern border-ridge of the Tibetan plateau which, together with the Tian-shan mountains, nearly parallel to it, encloses the " high valley " (Hoch- tliaV) or plateau of the Western Gobi or Chinese Turkes- tan (Asien, ii. 409) ; farther east, he added, following Klaproth, it penetrates as a high snow-clad range between the upper Hoang-ho and the sources of the Yang- tse-kiang. This was the right conception. However — following Humboldt — the geographers in the middle of the 19th century, such as Berghaus in his Pliysikal- ischer Atlas (edition of 1852 : " Bergketten von Asien und Europa "), traced a succession of mountain ranges run- ning west to east, from the Bosphorus to the 100th de- gree of longitude. This line passed along the south coast of the Black Sea through Asia Minor, the Anti- Caucasus, and the Kopet-dagh, which were connected farther east, by hypothetical ranges traced across Afghan- istan and the Pamirs (q.v.), with the northern borderranges of the Tibetan plateau (Russian range, Altyn-tagh, and ^an-shan highlands of modern maps); and still farther east Berghaus continued it, though not without some hesitation (see Text, Geologie, p. 4), in the region of the sources of the Blue river. The " Kuen-lun Oneiita or Kulkun " was thus a high range running from the Pamir to the sources of the Ya-long river, as a sort of continuation of a similar range running from the Pamir to the Bosphorus. Kichthofen, in his China, vol. i., 1876, made a notable change in this representation of the Kuen-lun. The northern border range of the Tibetan plateau (which exists in

reality, as is now known, as Russkiy Range and Altyn-tagh) did not appear on his map, and the Kuen-lun was represented as a complex system of numerous parallel ranges, all running along slightly curved lines almost west to east (crossing the 36th parallel under an angle of about 15°), from the Pamir plateau to the 115th meridian. Richthofen thus gave an orographic picture far more remote from reality ^such as we now know it — thau even the picture given in 1852 by Berghaus.

Humboldt's broad generalizations, notwithstandingtheir hypothetical character, and Ritter's far more correct induc- tions, based on a careful description, greatly stimulated research in Central Asia; and owing to the investiga- tions of the Pundits, Carey, Dalgleish, Rockhill, Littledale, the prince of Orleans, and Bonvalot, Dutreuil-de-Rhins in Central Asia, Richthofen and Szecheny in the Par East, Bower and Thorold, and especially the series of Russian expeditions inaugurated by Prjevalsky and continued by Pyevtsoif, Roborovsky, and Kozloff, Potanin, the brothers Grum-Grzimailo, Grombchevskiy, Bogdanovich, Obrucheff, and Skassi, we are now able to construct a more or less correct map of the region over which the Kuen-lun used to be traced. It appears that ranges of mountains of very different geographical aspect and origin have been huddled together by early geographers under the general name of Kuen-lun, which name is now restricted on modern maps (" Asien," in Stieler's Atlas, the maps of the Russian general staff) to the northern border ranges of the Tibetan plateau — thus including the Keriya range in the meridian ■of Khotan, the Russkiy Khrebet, and the Altyn-tagh (or Astyn-tagh).

As to the partially explored highlands around the sources of the Hoang-ho, the region which extends farther east to the 110th meridian, the short ranges Min-shan, Hsi-king-shan, and Tsin-ling-shan, represented by Wegener as continuing the Kuen-lun beyond the 104th meridian, in accordance with Richthofen's views — the whole region has assumed a quite different aspect since the surveys of the Russian explorers of this region have become known. Instead of these ranges we see the escarpments of the south Mongolian plateau facing the plains of China, and running in a north-westerly direction to meet the escarpments of In-shan and the Great Khingan (q.v.) ; while in the upper courses of the Hoang-ho, the Yang-tse-kiang, and the Mekong we find three vast ranges — Burkhan Budha, and

two as yet unnamed — which run distinctly from the north- west to the south-east, between and parallel to these three rivers, as appears from the last expedition of Kozloff.

It may also be added that modern exploration has given a quite different aspect to the mountains of Western Asia as well. Thus we see the mighty Hindu Kush running south-west to north-east to join the Pamirs, and (instead of Berghaus'sManish Koh and Korgan) we have the plateau of Afghanistan fringed and intersected by ranges having the same south-west to north-east direction ; the Kopet- dagh appears as the border range of the Iran plateau running north-west to south-east, and the Elburz and the Anti-Caucasus escarpments have the same direction ; while the Pontic range at the south-east corner of the Black Sea runs south-west to north-east to join the main Caucasus range (see Caucasus). Thus instead of a supposed west-to-east direction for all these mountains, we find two distinct directions, south-west to north-east, and north-west to south-east, or west-north-west to east-south-east, of which — if a suggestion by analogy be permitted — the latter would be of a much younger (Secondary and Tertiary) origin than the former, as they have been shown to be in the Tian-shan by Mushketoff.

The mountain ranges which are found in Central Asia in about the 36th degree of latitude, between the Pamir plateau and the 95th degree of longitude, and which were formerly described under the vague name of Kuen-lun, belong to several quite distinct systems of mountains. It is now known that the mountains which limit the Pamirs on the east — Kashgar mountains, Sary- kol — have the character of a formidable border range, which goes down on the one side to the high plains (3900 to 4500 feet) of Eastern Turkestan, but on the other, or south-western side, has its foot on the high Pamir swelling 10,500 to 13,000 feet above sea-level. These mountain ranges have a definite direction from north-west to south-east. They rise far above the snow-line, which lies at a level of from 18,000 to 20,000 feet, and reach their highest point in the Muztagh-ata massive, which consists of gneisses and granites, and they give origin to several glaciers, which descend to the 18,000 feet level. One, and south of the Muztagh-ata two, parallel snow-clad ranges run in the same direc- tion from 39° 20′ to 36° 30′ N., meeting there the north-eastern end of the Hindu Kush, and giving origin to the Kyzyl-su, the Yarkand- daria, and the

Raskem-daria. The upper parts of these rivers are now known to flow in longitudinal valleys at the south-west foot of the above ranges until they pierce them, to escape into Kash- garia. The few passes across these mountains lie at heights of from 14,800 to 16,340 feet (Kara-tash). Under the name of Chung-kyr, these mountains, retaining still their south-easterly direction, reach 78° 30′ long. The Muz-tagh range (between the Shimshal and the upper Raskem), beginning in 37° N., runs in the same direction, parallel to them, but nearer to the Himalaya (see map of Kanjut, the Raskem, and the Sary-kol by the Russian general staff). On the eastern slopes of the Kashgar mountains the Russian geologist, Bogdanovich found the same red i-ooks with marine fossils which Stoliczka considered in 1874 as belonging to the Triassic age, though they proved to be Upper Devonian (corals, Stromatoporce, Bnjozom^ Atrypa reticularis, A. latilinguis, and ^4. aspera, Spirifer Verneuli, &c.). This important discovery settles also the age of the fossilif erous rocks which Stoliczka found farther south in the Kilian mountains at the issue from the Sanju pass. They also must be Devonian.

From 78° 30′ E. to 51° E. a range of mountains— the Kilian, or the Khotan, or Keriya mountains — runs in a west-north-west to east-south-east direction, representing a mighty snow-clad border

ridge, of which the northern foot rests on the high plains of East Turkestan, 4300 to 4500 feet, while its southern, or rather south- south-west foot, lies on the shoulder of the north-west Tibetan plateau, 15,000 to 16,500 feet. It is in this range that Stoliozka found, at an altitude of nearly 6000 feet, the Oi-yphea fossils which he considered Triassic, and upon which such wide speculations about a Central Asian Mediterranean were baaed later. They belonged, however, to the Upper Devonian age (Bogdanovich). The passes through these mountains rise but a few hundred feet above the high plains of Tibet, and the range has more the character of an escarpment than of a true mountain-chain. The Muz-tagh continues to run nearly parallel to it from north-west to south- east, 100 miles farther to the south-west, raising its peaks to heights of 24,350 to 28,870 feet, and ending on tlie Tibetan plateau about the 79th meridian. It is to this part of the old Kuen-lun (the

Kilian, Khotan, and Keriya mountains) that the name of Kuen-lun is now restricted on many modem maps.

The next division of the North Tibetan border range, which faces East Turkestan, has a quite different direction, namely, from south-west to north-east, which direction becomes west-south-west to east^north-east beyond the 89th meridian. Prjevalsky has named these mountains Bussian Range (Russkiy Khrebet ; Ak-kar-chekyl- taghom), while the eastern portion of the same border range is known as the AUyn-tagh, or, more properly, Astyn-tagh, according to Bogdanovich ; however, the former name is more widely used by cartographers. The Russian range consists mostly of two parallel ranges, one of which is covered with snow. Its north-western foot is in East Turkestan, at an altitude of from 4700 (Keriya) to 4100 feet (Cherchen oasis), while its other foot stands on the inconceivably dreary, stony deserts of the Tibetan plateau, which have an altitude equal to that of high European mountains, i.e., about 16,000 feet. In 86° E. a range named Akka-tagh, and, farther east, Prjevalsky's range, runs nearly due east until it strikes the Jin-ri Peak, or Monomakh's Crown (20,000 feet), in the Columbus ridge, which crosses the Tibetan plateau from north-west to south-east.

A longitudinal valley separates the Russian range from the western end of the Altyn or Astyn-tagh, which decreases in altitude (11,000 to 9300 feet) beyond 92° E. It fringes the Tsaidam plateau, which is only 8000 to 9500 feet high, and con- sequently lower than the preceding portion of the Tibetan plateau. Prom this latter the Tsaidam plain is separated by the Tsaidam, Columbus, Marco-Polo, Garynga, and Torai mountains, all running north-west to south-east.

The Tibetan plateau is intersected in fact by several ranges of mountains, which run either south-west to north-east or north- west to south-east, and thus divide It into rhomboidal divisions, having something of the shape of Bohemia, though on a much larger scale, and representing, so far as our present knowledge goes, terraces, at various altitudes, of these high and massive swellings of the earth's crust. The Tsaidam (or Chaidam) has also that rhomboidal shape. To a great extent it is the bottom of an immense interior lake, now covered with clayey and salty deposit.

The Nan-shan Highlands limit the Tsaidam on the north-east. They embrace a territory 380 miles long and 260 miles wide (about 99,000 square miles), entirely filled with parallel mountain ranges all running from the north-west to the south-east. Plains and plain- like longitudinal valleys, having their flat bottoms at altitudes of 12,000 to 14,000 feet (occasionally 11,150 feet, and 9200 to 9900 at the south-western border) and interspersed with lakes (Kuku-nor, 10,500 feet; Khara-nor, 13,280 feet, and several small ones), fill up the space between these mountain ranges. In the south-east the Nan-shan highlands reach the highlands of the Chinese province of Kan-su, and near the sharp bend of the Hoang-ho at Si-ang-fu (province Shen-si) they meet the escarp- ments by which the great Khlngan and the Su-Shan are continued, and by which the Mongolian plateau sinks down to the lowlands of China. On the north-east the Nan-shan highlands have their foot on the level — about 4000 feet on the average — of the Mon- golian plateau, i.e., in the Ala^shan. On the north-west they are fringed by a border range, the Da-sue-shan, which is a con- tinuation of the Altyn-tagh, from 12,200 to 13,000 feet high in its passes, and pierced by several rivers flowing to Lake Khalachi. This border range, which continues on to the 97th meridian, separates the Nan-shan from the plains of the Bei-shan (see Mongolia), 4100 to 5000 feet high.

The results of the Russian Tibetan expeditions, combined with those of Szecheny, Michaelis, Loczy, and Rockhill, have revealed the true structure of the Nan-shan highlands. Their south-western borders — that is, the mountains which rise along the north-eastern border of the Tsaidam — consist of short irregular chains, interrupted by large plains, which are sprinkled with lakes, and differ but slightly in altitude from the Tsaidam itself. Next comes a succession of narrow mountain ranges which separate this lower border terrace from the higher one (12,000-18,500 feet). The first mountain range on this higher

terrace is Ritter’s range, covered in 38° 20′ N. and 96° E. with formidable snow-fields. The passes at both ends of this snow-clad massive lie at altitudes of 15,990 feet and 14,680 feet respectively. The next range is Humboldt’s or Ama- surgu range, which runs north-west to south-east from the Altyn-tagh to about 38° N., and is perhaps continued by the southern Kuku-nor range, which reaches the Hoang-ho (7440 feet on the banks of the

river) at Gui-de-tin. It includes, in fact, several other parallel ranges — Mushketofi's, Semenoff's, Suess's, Alexander III.'s, Bain-sarlyk, &o. — the mutual relations of which are, however, not yet definitively settled, and consequently Grum- Grzimailo (in his article "Nan-shan" in the Russian Encyclo- paedic Dictionary) is perhaps right in describing this portion of the highlands singly as Central Nan-ahan.

Small lateral chains of mountains, rising some 2000 feet above the general level of that plateau, and owing their origin to erosion, connect th^ central Nan-shan with the next parallel ranges, which may he described as Eastern Nan-shan. The mutual relations of the latter, as well as the names of its different chains, are equally unsettled. Thus, one of them is named indiscrimi- nately Nan-shan, Richthofen's range, or Momo-shan ; whUe another, which runs parallel to the north-eastern slope of the preceding, is named T'holo-shan, or T'holo-Nan-shan, or northern Tetung. In fact, the region is filled by three different ranges of nearly equal height, all rising above the snow-line in many of their peaks. Finally, there is a range of mountains, about 10,000 feet high, named JLung-shan by Obrucheff, which fringes the north-eastern side of the Hang-chu-fu valley, and belongs also to the Nan-shan system. But the string of oases in the Kan-su province, which stretches between the Lung-shan and the pre- ceding range, lies, however, on the lower level of the Mongolian plateau (4000 to 5000 feet).

Generally speaking, the Nan-shan highlands are a wide region raised to from 12,000 to 14,000 feet above the sea, and intersected by a succession of wild, stony, and partly snow-clad mountains, towering another 4000 to 7000 feet above its surface, and arranged in a system of narrow parallel chains all running north-west to south- east. The chains of mountains are from 8 to 17 miles wide, seldom as much as 35, while the broad, flat valleys between them attain widths of from 20 to 27 miles. As a rule the passes are at an altitude of from 12,000 to 14,000 feet, and the peaks reach from 18,000 to 20,000 feet in the western portion of the highlands, while in the eastern portion they may be about 2000 feet lower. The glaciers also attain a greater development in the western portion of the Nan-shan, but the valleys are dry, and the slopes of both the mountains and the valleys, furrowed by deep ravines, are devoid of vegetation. Good pasture grounds are only found near the streams. The soil is a dry gravel and clay, upon which bushes of

Ephedra, Nitraria, and various Salsolacem grow wide apart. In the north-eastern Nan-shan, on the contrary, a stream runs in each gorge, and both the mountain slopes and the bottoms of the valleys are clothed with vegetation. Woods of conifers {Picea obovata) and deciduous trees — Prjevalsky's poplar, birch, mountain ash, &c., and a variety of bushes — appear everywhere. Higher up, in the picturesque gorges, one finds rhododendrons, willows, Potentilla fruticosa, Spirmce, Loniceeros, &o., and the rains must evidently be more copious and better distriljuted. In the central Nan-shan only the north-eastern slopes are covered with forests. In the south, where the Nan-shan enters the Kan-su province, wide accumulations of loess make their appearance, and it is only the northern slopes of the hills that are clothed with trees.

The largest water basin of the Nan-shan is Lake Kuku-nor (altitude about 18,500 feet), which is about 65 mUes long and 40 miles wide, and attains in the south a depth of 59 feet. Its water is salt (0-0111 per cent, of salts). It receives the Bukhain- gol and about 25 other streams, but has no outflow. It is closely surrounded by mountains, but good alpine meadows reach its shores and cover a neighbouring hilly plateau. Rain seems to fall upon its shores in much greater abundance than upon the mountains. Numerous animals, especially the wild donkey (Asinus kiang) and the antelope {Antilope C'uvieri), breed on these meadows, and Tanguts, perhaps also Mongols, graze them with their numerous herds. Two species of fish, belonging to the Schizopygopsis and Diplophysa genera, are found in its waters. Numbers of eagles {Halimtus Macei), gulls {Larus ichthymtus, L. brunneicephalus) , and Indian geese, Casarca rutila, and Podiceps cristatus, are attracted to its shores ; but, probably owing to the lake being frozen from November till the end of March, and to the absence of reeds, few birds visit it during their migrations.

The region situated between 95° and 99° E., as far as lat. 29°, was explored by Kozloff in 1900 and 1901. It appears that south of the Tsaidam the country forms a high plateau, the average level of which lies at 12,000 to 13,000 feet (lower levels are only found in the deeply trenched valley of the Blue River and its tributaries), while four vast snow-clad ridges cross the surface of

the plateau from north-west to south-east, reaching in their passes altitudes of 15,500 to 16,000 feet, and lifting their peaks 500 to 600 feet above the passes. The north-western border ridge of this plateau is formed by the Burkhan-budha and the Amne-maohin, which confront the Tsaidam, with snow-clad, deeply furrowed peaks, that rise 8000 to 9000 feet above its surface. The other three ridges run due north-west to south-east between the upper courses of the Hoang-ho, the Yang-tse-kiang, the Mekong, and the upper Salween. Farther south-westwards, approaching lat. 29^, we enter a region where the monsoons begin to make their influence felt, and the country assumes more and more the charac- ter of an alpine region, with all the differentiations which are characteristic of such regions — this being due to the more pro- nounced erosion. The valleys are deeply sunk into the plateau, as much as 9000 feet at the confluence of the Blue river and the Sy-chu ; and the climate grows much milder down in the valleys, and the vegetation becomes accordingly more varied. In all prob- ability this plateau, with its parallel ranges of mountains, joins some huge but as yet unexplored escarpment which connects the Him- alaya with the Great Khingan.

In the case of the so-called Eastern Kuen-lun, it is sufBcient to look at the modern maps of the Russian general staff which embody Skassi's surveys and the recent materials (map of the Kan-su expedition, corrected in 1891 in Potanin's work), to see that Rich- thofen's and Wegener's representations of that region hardly give a correct idea of its real structure. There are no mountains in this region which could be in any way connected with the Kuen-lun proper, i.e., with the northern border ridge of the Tibetan plateau. On the contrary, we have from Kalgan to the 104th meridian a succession of terrace escarpments by which the South Mongolian plateau (4000 to 5000 feet of altitude) drops down to the high plains of China, 1000 to 2000 feet, and in these terraces it is im- possible not to see a, direct continuation of the Great Khingan. Only these terraces, edged by relatively low border ranges along their escarpments, cover here a zone over 200 miles wide (as against 100 miles, or less, in the Great Khingan, north of Peking), and assume more

and more a direction east-north-east to west-south-west (east to west in the Tsun-ling escarpment ?). However, neither orographioally nor geologically can they be con- nected in any way with the border range which separates Eastern Tarkestan from the North Tibetan plateau, and which is the only portion of the old “Kuen-lun” which can now retain that time- honoured name.

AuTHOEJTiES. — Owing to the vagueness of the conceptions at- tached to the term ” Kuen-lun,” to give its literature would mean to enumerate all the explorations carried on in Central Asia, Mongolia, and Western China for the last thirty years of the 19th century. A good enumeration of the works published before 1890, and a map of itineraries, will be found in Wegener’s Versuch einer Orographie des Kuen-lun, Marburg, 1891, but his map is already out of date. The quarto publications of the Russian Geograph- ical Society, describing the expeditions of Prjevalsky, Pyevt- soff, Roborovsky, and Kozloff, the brothers Grum-Grzimailo, Bogdanovich, Obrucheff, Potanin, and Skassi, for the so-called Eastern Kuen-lun, and of Grombchevskiy and Ivanoff for the Pamirs — in fact, all the series of Izvestia of the Russian Geo- graphical Society, and of Petermann’s Mittheilungen, since 1887 — must be consulted for the itineraries of the Russian and German travellers and the maps based on their surveys, unaltered by sub- sequent modifications ; and the Geographical Journal for the same years, for the same purpose as regards the English travellers. The original reports of the explorations of Sven Hedin, Bonvalot, and the prince of Orleans must be consulted for the travellers of other nationalities. Short indexes of literature will be found also in the articles “Kuen-lun,” by Bogdanovich; ” Nan-shan,” by Grum-Grzimailo, and many others in the Russian EneyclopaecUc Dictionary. (j>_ a. k.)

KiJhne, Willy (1837-1900), German physiologist, was born at Hamburg on 28tli March 1837. After attending the gymnasium at LUneburg, he went to Got- tingeii, where his master in chemistry was Woliler and in physiology K. Wagner. Having graduated in 1856, he studied under various famous physiologists, including du Bois-Reymond at Berlin, Claude Bernard in Paris, and Ludwig and Briicke in Vienna. At the end of 1 863 he was put in charge of the chemical department of the pathological laboratory at Berlin under Virchow ; in 1868 he was appointed professor of physiology at

Amsterdam ; and in 1871 he was chosen to succeed Helmholtz in the same capacity at Heidelberg, where he died on 10th June 1900. His original work falls into two main groups — the physiology of muscle and nerve, which occupied the

earlier years of his life, and the chemistry of digestion, which he began to investigate while at Berlin with Vir- chow. He was also known for his researches on vision and the chemical changes occurring in the retina under the influence of light. The visual purple, described by Boll in 1876, he attempted to make the basis of a photo- chemical theory of vision, but though he was able to establish its importance in connexion with vision in light of low intensity, its absence from the retinal area of most distinct vision detracted from the completeness of the theory and precluded its general acceptance.

Kuija (Chinese, Ili-Iio), a territory in north-west Mongolia, belonging to the Chinese Empire; bounded, according to the treaty of St Petersburg of 1881, on the W. by the Semiryechensk province of Russian Turkestan, on the N. by the Boro-khoro mountains, and on the S. by the mountains Khan-tengri, Muz-art, Terskei, Eshik- bashi, and Narat. It comprises the valleys of the Tekes (middle and lower portion), Kunghes, the Hi as far as the Russian frontier and its tributary, the Kash, with the slopes of the mountains turned tow^ards these rivers. Its area occupies about 19,000 square miles (Grum-Grzi- mailo).

Physical Features. — The valley of the Kash is about 160 miles long, and is cultivated in its lower parts, while the Boro-khoro mountains are snow-clad in their eastern por- tion, and fall vfith very steep slopes to the valley. The Arshan mountains, which separate the Kash from the Kunghes, are lower, but rocky, naked, and difficult of access. The valley of the Kunghes is about 120 miles long ; the river flows first in a gorge, then amidst thickets of rushes, and very small portions of its valley are fit for cultivation. The N”arat mountains in the south are alsci very wild, but are covered with forests of deciduous trees (apple-tree, apricot-tree, birch, poplar, &c.), and pine trees. The Tekes flows in the mountains, and pierces narrow gorges. The mountains which separate it from the Kunghes are also snow-clad, while those to the south of it reach 24,000 feet of altitude in Khan-tengri,

and are covered with snow and glaciers — the only pass through them being the Muzart. Forests and alpine meadows cover their northern slopes. Agricultu.re was formerly developed on the, Tekes, as is testified by old irrigation canals. The Hi is formed by the junction of the Kunghes with the Tekes, and for 120 miles it flows through Kulja, its valley reaching a width of 50 miles at Horgos-koljat. This valley is famed for its fertility, and is admirably irrigated by canals, part of which, however, fell into de- cay after 55,000 of the inhabitants migrated to Russian territory in 1881. The climate of this part of the valley is, of course, continental — frosts of – 22° F. and heats of 107° F. being experienced — but snow lasts only for one and a half months, aud the summer heat is tempered by the proximity of the high mountains. Apricots, peaches, pears, and some vines are grown, as also some cotton-trees near the town of Kulja, where the average yearly tem- perature is 48-5° F. (January 15°, July 77”°). Barley is grown up to an altitude of 6.-)00 feet.

The populatinn may number about 125,000, of whom 75,000 are settled and about 50,000 nomads (Grum- Grzimailo). The Taranchis f roniEast Turkestan represent about 40 per cent, of the population ; about 40,000 of them left Kulja when the Russian troops evacuated the territory, and the Chinese Government sent some 8000 families from different towns of Kashgaria to take their place. There are, besides, about 20,000 Sibos and Solons, 3500 Kara-kidans, a few Dungans, and more than 10,000 Chinese. The nomads are represented by about 18,000 Kalmyks, and the remainder by Kirghiz. Agriculture is insufficient to satisfy the needs of the popu-

lation, and food is imported from Semiryechensk. Excel- lent beds of coal are found hi different places, especially about Kulja, but the fairly rich copper ores and silver ores have ceased to be worked.

The chief towns are Suidun, capital of the province, and Kulja. The latter (Old Kulja) is on the Hi river, and has about 10,000 inhabitants, chiefly Taranchis. It is one of the chief cities of the region, owing to the importance of its bazaars, and is the seat of the Russian consul and a telegraph station.

History. — Two centuries b.c. the region was occupied by the fair and blue-eyed Ussuns, who were driven away in the 6th century of our era by the northern Huns. Later the Kulja territory became a dependency of Dzungarla. The Uigurs, and in the 12th century the Kara^Kidaiis, took possession of it In turn. Tchinghiz Khau conquered Kulja in the 13th century, and the Mongol Khans resided in the valley of the Hi. It is supposed (Grura-Grzimailo) that the Oirats conquered it at the end of the 16th or the beginning of the 17th century ; they kept it till 1755, ■when the Chinese annexed it. During the insurrection of 1864 the Uungans and the Taranchis formed here the Taranohi sultanate, and this led to the occupation of Kulja by the Russians in 1871. Ten years later the territory was restored to China, (p. a. k.)

Kulm, a town of Prussia, province of West Prussia, 33 miles by rail north-north-west of Thorn, on the bank of the Vistula. The existing town walls date from the 13th century. There are large oil-mills, also iron-foundries and machine shops, and manufacture of horse-shoes, as well as an important trade in agricultural produce, includ- ing fruit and vegetables. Poprdation (1886), 9975 : (1900),

11,079.

Kulmsee, a town in the province of West Prussia, Prussia, 14 miles by rail north of Thorn. It has a fine Eoman Catholic cathedral (1251, restored 1422), having been down to 1823 the seat of the see of Kulm. Sugar, butter, and cheese are manufactured. Population (1900),

8987.

Kulp, a village of Transcaucasia, Russia, in the gov- ernment of Erivan, district Surmalinsk, 2 miles from the Arax river. Close by is the Kulp salt mountain, about 1000 feet high, consisting of beds of clay intermingled with thick layers of rock salt, which has been worked from time immemorial. Regular galleries are cut now in the transparent, horizontal salt layers, from which cubes of about 70 tb weight are extracted to the amount of about 170,000 cwts. every year.

Kum, a small province of Persia, bounded on the N. by the province of Tehran, and on the S. by that of Kashan. It is divided into seven districts, has a popu- lation of 45,000 to 50,000, and pays a yearly revenue of about £8000. Kum, the capital, in 34° 39′ N. and 50° 55′ E., has an elevation of 3100 feet. It owes much of its importance to the fact that it contains the tomb of Imam Reza's sister, Fatmeh, who died there in a.d. 816, and large numbers of pilgrims visit the city during six or seven months of the year. The fixed population is about 20,000. A carriage road 92 miles in length, con- structed in 1890-93, connects the city with Tehran. A very fine quality of cotton with a long staple is grown in the surrounding districts.

For full description of province and city, see Eastern Persian Irak, London, 1896.

Kumaon, an administrative division of British India, in the North- West Provinces. It consists of a large Himalayan tract, together with a submontane strip called the Tarai or Bhabar. Area, 13,743 square miles ; popu- lation (1881), 1,046,263; (1891), 1,181,567, showing an increase of nearly 10 per cent. ; average density, 85 per- sons per square mile, ranging from 72 in the mountains to 219 in the Tarai. In 1901 the population was 1,202,130,

showing an increase of less than 2 per cent. At the timo of the census of 1891 the division was composed of the three districts of Kumaon, Garhwal, and the Tarai ; but the two districts of Kumaon and Tarai have since been redistributed and renamed after their headquarters,]S'aini Tal and Almora. The former district of Kumaon had an area of 7161 square miles ; population (1881), 493,641 ; (1891), 563,181, showing an increase of 14 per cent. ; average density, 79 persons per square mile. Kumaon proper, with the Tarai, constituted an old Rajput princi- pality, which became extinct at the beginning of the 1 9th century. The inhabitants are known as Khasias. The country was annexed after the Gurkha war of 1815, and was governed for seventy years on the non-regiUation system by three most successful administrators — Mr Traill, Mr J; H. Batten, and Sir Henry Ramsay. Tea gardens cover an area of about 3000 acres.

Kumta, or Coompta, a town of British India, in the South Kanara district of Bombay, on the sea-coast, 40 miles south of Karwar. It has an open

roadstead, with a lighthouse and considerable trade. Carving in sandal-wood is a speciality. The commercial importance of Kumta has declined since the opening of the Southern Mahratta railway system. Population, 10,713.

Kumyks, a people of Turkish stem in Caucasia, occupying the Kumyk plateau (Kumykskaya ploskost) in North Daghestan and South Terek, and numbering (1897) about 92,400. It is supposed that Ptolemy knew them under the name of Kami and Kamaks. Various explorers see in them descendants of the Khazars. Vambery sup- poses that they settled in their present quarters during the flourishing period of the Khazar kingdom, in the 8th century. It is certain that some Kabardians also settled later. The Russians built forts in their territory in 1559, and under Peter I. Having long been more civilized than the surrounding Caucasian mountaineers, the Kumyks have always enjoyed some respect among them. The ujjper terraces of the Kumyk plateau, which the Kumyks occupy, leaving its lower parts to the Nogai Tatars, are very fertile.

Kunar. — The Kunar valley (Khoaspes in the classics) is the southern section of that great river system which reaches from the Hindu Kush to the Kabul river near Jalalabad, and which, under the names of Tarkhun, Chitral, Kashkar, &c., is more extensive than the Kabul basin itself. The lower reaches of the Kunar are wide and comparatively shallow, the river meandering in a multi- tude of channels through a broad and fairly open valley, well cultivated and fertile, with large flourishing villages and a mixed population of Mohmand and other tribes of Afghan origin. Here the hills to the eastward are com- paratively low, though they shut in the valley closely. Beyond them are the Bajaor uplands. To the west are the great mountains of Kafiristan called Kashmund, snow- capped, and running to 14,000 feet of altitude. Amongst them are many wild but beautiful valleys occupied by Kafirs, who are rapidly submitting to Afghan rule. From 20 to 30 miles u^s the river on its left bank, under the Bajaor hills, are thick clusters of villages, amongst which are the ancient towns of Kunar and Pashat. The latter was visited by the writer in 1895, and the old orange groves and cypress gardens of the days of Babar, with modern pavilions of the Kashmir type, were found still lingering in the beauty of decay. The chief tributary from the Kafiristan hills is the Pechdara, which joins the

river close to Chagan Sarai. It is a fine, broad, swift-flowing stream, with an excellent bridge over it (part of the Amir's military road developments), and has been largely utilized for irrigation. The Pechdara finds its sources in the Kafir hills amongst forests of pine and deodar and thick tangles of wild vine and ivy, wild figs, pomegranates,

olives and oaks, and dense masses of sweet-scented shrubs. Above Cliagan Sarai, as far as Arnawai, where the Afghan boundary crosses the river, and above which the valley belongs to Chitral, the river narrows to a swift mountain stream beset with boulders and hedged in with steep cliffs and difficult " parris," or slopes of rocky hillside. Wild almond here sheds its blossoms into the stream, and in the dawn of summer much of the floral beauty of Kashmir is to be found in the Kunar valley. At Asmar there is a slight widening of the valley, and the opportunity for a large Afghan military encampment, spreading to both sides of the river and connected by a very creditable bridge built on the cantilever system. There are no apparent relics of Buddhism in the Kunar, such as are common about Jalalabad or Chitral, or throughout Swat and Dir. This is probably due to the late occupation of the valley by Kafirs, who spread eastwards into Bajaor within comparatively recent historical times, and who still adhere to their fastnesses in the Kashmund hills. The Kunar valley route to Chitral and to Kafiristan is being developed by Afghan engineering. It may possibly extend ultimately unto Badakshan, in which case it will form the most direct connexion between the Oxus and India, and become an important feature in the strategical geography of Asia. (t. h. h*.)

Kundt, August Adolph Eduard Eberhard

(1839-1894), German physicist, was born at Schwerin in Mecklenburg on 18th November 1839. He began his scientific studies at Leipzig, but afterwards went to Berlin. At first he devoted himself to astronomy, but coming under the influence of Magnus, he turned his attention to physics,

and graduated in 1864 with a thesis on the depolarization of light. In 1867 he became privat^docent in Berlin University, and in the following year was chosen professor of physics at the Zurich Polytechnic ; then, after a year or two at Wurz- burg, he was called in 1872 to Strassburg, where he took a great part in the organization of the new uni- versity, and was largely concerned in the erection of the Physical Institute. Pinally in 1888 he went to Berlin as successor to Helmholtz in the chair of experimental physics and directorship of the Berlin Physical Institute. He died after a protracted illness at Israelsdorf, near Lubeck, on 21st May 1894. As an original worker Kundt was especially successful in the domains of sound and light. In the former he developed a valuable method for the investigation of aerial waves within pipes, based on the fact that a finely-divided powder — lycopodium, for example — when dusted over the interior of a tube in which is established a vibrating column of air, tends to collect in heaps at the nodes, the distance between which can thus be ascertained. An extension of the method renders possible the determination of the velocity of sound in different gases. In light Kundt's name is widely known for his inquiries in anomalous dispersion, not only in liquids and vapours, but even in metals, which he obtained in very thin films by means of a laborious process of electrolytic deposition upon platinized glass. He also carried out many experiments in magneto-optics, and succeeded in showing, what Fara- day had failed to detect, the rotation under the influence of magnetic force of the plane of polarization in certain gases and vapours.

Kunene, formerly known also as Nouese, a river of south-west Africa, with a length of about 700 miles, mainly within Portuguese territory, but in its lower course forming the boundary between Angola and German south-west Africa. The upper basin of the river lies on the inner versant of the high plateau region which runs south- wards from Bihe parallel to the coast, forming in places

ranges of mountains which give rise to many streams running south and south-west to swell the Kunene. The main head-stream rises just north of 13° S., running gener- ally from north to south through four degrees of latitude, but finally flowing west to the sea through a break in the outer highlands. A little south of 16° S. it receives the Kalonga from the east, and in about 16° 50′ the Kakulovar from the west. The Kakulovar has its

sources in the Serra da Chella and other ranges of the Humpata district, but, though the longest tributary of the Kunene, is but a small river in its lower course, which traverses the arid region comprised within the lower basin of the Kunene. In 16° it is less than 10 yards wide, and about 4|- feet deep in the dry season. Between the mouths of the Kalonga and Kar kulovar the Kunene traverses a swampy plain, inundated during high water, and containing several small lakes at other parts of the year. Before assuming a decided westerly course the Kunene has been reported to send one or more divergent branches towards the Etosha salt pan in the south-east, but the truth of this is not established. The river now becomes smaller in volume, entering an almost desert region with little or no vegetation. The stream is sometimes shallow and fordable, at others confined to a narrow rocky channel. The country becomes exceedingly broken, and many rapids obstruct the stream, the rocks presenting the most varied hues ; but near its mouth the Kunene traverses a region of sand-hills which completely block its mouth at low water. There are indications that a former branch of the river once entered a bay to the south which seems to afford anchorage for ships. The best harbour on the coast is, however, the great Pish Bay, a little north of the mouth of the Kunene.

See Costa Leal in Petermann's Mitteilungen, No. 10, 1858. — Mayo. "Journey ... to the River Cunene," Proceedings Moyal Geographical Society, August 1883. —Essen. ' ' Meine Reise nach den Kunene," Verhandl. Gesells. fur Erdkunde zu Berlin, No. 2, 1897 ; and works by Capello and Ivens. (j;. He.)

Kungrad, an important trading town in Russian Central Asia, province of Amu-daria, in the delta of that river, 40 miles south of Lake Aral ; altitude 260 feet. It is the centre of several caravan routes leading to the Caspian Sea and the Uralsk province.

Kungur, a district town of Russia, government and 68 miles south-south-east of Perm, on Sylva river and on the highway to Siberia. It has a technical school, two public libraries, and a high school for girls, besides the usual educational institutions. Tanneries and the manu- facture of boots, plain gloves, leather, overcoats, &c., exported chiefly to Siberia, in which over 1000 families are engaged, are the chief industries. It has trade in

tallow, and linseed is exported and tea imported direct from China. Population (1892), 12,400: (1897),

14,324.

Kun Long, the name of a district and ferry on the Salween in the northern Shan States of Burma. Both are insignificant, but the place has gained notoriety from being the nominal terminus in British territory of the railway under construction across the northern Shan States to the borders of Yunnan. In point of fact, however, this terminus will be seven miles below the ferry and outside of Kun Long circle. At present Kun Long ferry is little used, and the village was burnt by Kachins in 1893. It is served by dugouts, three in number in 1899, and capable of carrj— ing about fifteen men on a trip. Formerly the trade seems to have been more considerable, and the Burmese had a customs station on the island from which the place takes its name, but the rebellion in the great state of Theinni and the southward movement of the Kachins, as well as the Mahommedanrebellionin Yilnnan, diverted the caravans to the northern route to Bhamo, which is still chiefly followed.

K U 0 P I 0 — K U R D I S T A ^

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Kuopio, a government of Finland, Russia, which in- cludes northern Karelia, bounded on the N.W. and N. by Uleaborg, on the E. by Olonets, on the S.E. by Viborg, on the S. by St Michel, and on the W. by Vasa. Its area covers 16,500 square miles. The surface is hilly, reach- ing from 600 to 800 feet of altitude in the north (Suomenselka hills), and from 300 to 400 feet in the south. It is built up of gneisso-granites, which are covered, especially in the middle and east, with younger granites, and partly of gneisses, quartzite, and talc schists, and augitic rocks. The whole is covered with Glacial and later lacustrine deposits. The soil is of moderate fertility, but often full of boulders. Large lakes cover 16 per cent. of surface, marshes and peat bogs over 29 per cent, of the area, and forests occupy 2,672,240 hectares. Steamers ply along the lakes as far as Joensuu. The climate is severe, the average temperature being for the year 36° P., for January 13°, and for July 63°. The population, which was 305,166 in 1897 (226,130 in 1872),

consists almost exclusively of Finns (less than 1600 Swedes). Only 2-3 per cent, of the whole surface is under cultivation. Rye, barley, oats, and potatoes are the chief crops, and in good years these meet the needs of the population. JSTearly 38,800 tons of iron ore are extracted every year, and nearly 12,000 tons of pig iron and 6420 tons of iron and steel are obtained in ten iron-works. Engineer- ing and chemical works, tanneries, saw-mills, paper mills, and distilleries are the chief industrial establishments. The preparation of carts, sledges, and other wooden goods is spreading as a domestic industry. There is considerable trafiic on the railways which cross the government. Timber, iron, butter, furs, and game are exported. The chief towns of the government are Kuopio, Joensuu (3158), and Idensalmi (1300).

Kuopio, capital of the above government, situated on Lake Kalla-vesi, 180 miles by rail from the Kuivola junction of the St Petersburg to Helsingfors main line, and the terminus of the railway which runs south to north from Kotka (Gulf of Finland) across middle Fin- land. Population (1897), 9412. It is picturesquely situated, and has a cathedral, two lyceums, and two gymnasia (both for boys and girls), a commercial and several professional schools. An agricultural school is at Levais, close by. Kyopio, in consequence of its steamer communication with middle Finland and the sea (vid Saima Canal), is a centre for trade, steadily growing in importance.

Kijprolu, or Kupbili (Bulgarian Valesa, Greek Vilissa), a town of Macedonia, European Turkey, in the sanjak of Prizren and vilayet of Salonica, situated 600 feet above sea^level, on the Vardar, and on the Salonica- Metrovitza railway, 26 miles south-east of Uskub. It has a considerable trade in cocoons. Population, 22,000.

Kurdistan, the “country of the Kurds,” including that part of Mount Taurus which buttresses the Armenian tableland and is intersected by the Batman Su, the Bohtan Su, and other tributaries of the Tigris ; and the wild mountain district, watered by the Greater and Lesser Zab, which marks the western termination of the great Iranian plateau.

Population. — The total Kurd population probably ex- ceeds two and a half millions, namely, Turkish Kurds 1,660,000, Persian 800,000, Russian 50,000, but there are no trustworthy statistics. The great mass of the popula-

tion has its home in Kurdistan. But Kurds are scattered irregularly over the country from the river Sakaria on the west to Lake Urmia on the east, and from Kars on the north to Jebel Sinjar on the south. There is also an isolated settlement in Khorassan. The tribes, Ashiret, into which the Kurds are divided, resemble in some

respects the Highland clans of Scotland. Very few of them number more than 10,000 souls, and the average is about 3000. The sedentary and pastoral Kurds, YerU, who live in villages in winter and encamp on their own pasture-grounds in summer, form an increasing majority of the population. The nomad Kurds, Kocher, who al- ways dwell in tents, are the wealthiest and most indepen- dent. They spend the summer on the mountains and high plateaux, which they enter in May and leave in October ; and pass the winter on the banks of the Tigris and on the great plain north of the Jebel Sinjar, where they purchase right of pasturage from the Shammar Arabs. Each tribe iias its own pasture-grounds, and trespass by other tribes is a fertile source of quarrel. During the periodical migrations Moslem and Christian alike suffer from the predatory instincts of the Kiird, and disturbances are frequent in the districts traversed. In Turkey the sedentary Kiirds pay taxes; but the nomads only pay the sheep tax, which is collected as they cross the Tigris on their way to their summer pastures.

Character. — The Kurd delights in the bracing air and unrestricted liberty of the mountains. He is rarely a muleteer or camel-man, and does not take kindly to handicrafts. Though ignorant and unsophisticated, he is not wanting in natural intelligence. In recent years educated Kurds have held high office under the Sul- tan, including that of Grand Vizier, have assisted in translating the Bible into Turkish, and in editing a newspaper. The men are lithe, active, and strong, but rarely of unusual stature. The women do not veil, and are allowed great freedom. The Kurds as a race are proud, faithful, and hospitable, and have rude but strict feelings of honour. They are, however, much under the influence of dervishes, and when their fanaticism is aroused their habitual lawlessness is apt to degenerate into savage barbarity. They are not deficient in mar- tial spirit, but have an innate dislike to the restraints of military service. The written literature is small, but the country is rich in traditions and legends, and in lyric and in

epic poems which have been handed down from earlier times and are recited in a weird melancholy tone.

History. — When Sultan Selim I., after defeating Shah Ismail, 1514, annexed Armenia and Kurdistan, he entrusted the organization of the conquered territories to Idris, the historian, who was a Kurd of Bitlis. Idris found Kurd- istan bristling with castles, held by hereditary tribal chiefs of Kurd, Arab, and Armenian descent, who were practi- cally independent, and passed their time in tribal warfare or in raiding the agricultural population. He divided the territory into sanjaks or districts, and, making no attempt to interfere with the principle of heredity, installed the local chiefs as governors. He also resettled the rich pastoral country between Erzeriim and Erivan, which had lain waste since the passage of Timiir, with Kurds from the Hakkiari and Bohtan districts. The system of admin- istration introduced by Idris remained unchanged until the close of the Russo-Turkish war of 1828-29. But the Kurds, owing to the remoteness of their country from the capital and the decline of Turkey, had greatly increased in influence and power, and had spread westwards over the country as far as Angora. After the war the Kurds attempted to free themselves from Turkish control, and in 1834 it became necessary to reduce them to subjection. This was done by Reshid Pasha. The principal towns were strongly garrisoned, and many of the Kiird beys were replaced by Turkish governors. A rising under Bedr Khan Bey in 1843 was firmly repressed, and after the Crimean war the Turks strengthened their hold on the country. The Russo-Turkish war of 1877-78 was followed by the attempt of Sheikh ObeiduUah, 1880-81, to found

an independent Kurd principality under the protection of Turkey. The attempt, at first encouraged by the Porte, as a reply to the projected creation of an Armenian state under the suzerainty of Eussia (see Armenia), collapsed after Obeidullah's raid into Persia, when various circum- stances led the central government to reassert its supreme authority. Until the Eusso-Turkish war of 1828-29 there had been little hostile feeling between the Kurds and the Armenians, and as late as 1877-78 the mountaineers of both races had got on fairly well together. Both suffered from Turkey, both dreaded Eussia. But the national movement amongst the Armenians, and its encourage- ment by Eussia after the last war, gradually aroused race hatred and fanaticism. In 1891 the activity of the Ar- menian Committees induced the Porte to strengthen the position of the Kurds by raising a body of Kurdish irregular cavalry, which was well armed and called Hamidieh after the Sultan. The opportunities thus offered for plunder and the gratification of race hatred brought out the worst qualities of the Kurds. Minor disturbances constantly occurred, and were soon followed by the massacre of Armenians at Sasun and other places, 1894-96, in which the Kurds took an active part. The Hamidieh has tended to foster aspirations for the estab- lishment of a Kurd principality, and having fulfilled its object, is now regarded with distrust.

Authorities. — Rich. Narrative of a Residence in Koordistan. 1836. — Wagner. Eeise nach Persien und dem Lande der Kurden. Leipzig, 1852. — Cousui Taylor in B. Gh. 8. Journal, 1865. — MiLLiNGEN. Wild Life among the Koords. 1870. — Von Luschan. "Die Wandervolker Kleinasiens," in V". d. G. fur Anthropologie. Berlin, 1886. — Clayton. "The Mountains of Kurdistan," in Alpine Journal, 1887. — Binder. Au Kurdistan. Paris, 1887. — Naumann. Vom Goldnen Horn zu den Quellen des Euphrat. Munich, 1893. — Murray. Handbook to Asia Minor,

Kurdistan, in the narrower sense, a province of Persia, situated in the hilly districts between Azerbaijan and Kermanshah, and extending to the Turkish frontier on the W., and bounded on the E. by Garrus and Hamadan. In proportion to its size and population it pays a very small yearly revenue — only about £14,000 — due to the fact that a great part of the population

consists of wild and dis- orderly nomad Kurds. Some of these nomads pass their winters in Turkish territory, and have their summer pas- ture-grounds in the highlands of Kurdistan. This adds much to the difficulty of collecting taxation. The province is divided into sixteen districts, and its eastern part, in which the capital is situated, is known as Ardelan. The capital is Senendij, usually known as Sinnah (not Sihna, or Sahna, as some writers have it), situated 60 miles north- west of Hamadan, in 35° 15′ N. and 47° 18′ E., at an eleva- tion of 6300 feet. The city has a population of about 35,000, and manufactures great quantities of carpets and felts for the supply of the province and export. Some of the carpets are very fine and expensive, rugs 2 yards by 1^ costing £15 to £20. Post and telegraph offices have been established for a number of years.

Kurgan, a district town (founded 1553) of West Siberia, on the Siberian railway, 160 miles east of Czelya- brusk, situated in a wealthy agricultural district. Owing to its position at the terminus of steam navigation up the river Tobol, it has become second only to Tyumeii as a commercial centre. It has a public library, a botanic garden, and a municipal bank. The returns of its three fairs exceed £300,000 a year. It has a large trade in cattle with Petropavlovsk, and considerable export of grain,

tallow, meat, hides, butter, game, and fish. Population,

10,579.

Kuriles, a chain of small islands belonging to Japan, stretching in a north-easterly direction from Nemuro Bay, on the extreme east of the island of Ezo, to Chishimarkaikyo (Kurile Strait), which separates them from the southernmost point of Kamchatka. They lie between 44° 45′ to 50° 56′ N. and 145° 25′ to 156° 32′ E. Their coasts measure 1496 miles; their area is 6159 square miles; their total number is 32, and the names of the six principal islands, counting from the south, are Kunashiri, Shikotan, Etorofu (gener- ally called Etorop, and known formerly to Europe as Staten Island), Onnekotan, Paramoshiri, and Shumshu. From Notsu-no-saki (Notsu Cape), the most easterly point of Nemuro province, to Tomari, the most westerly point in Kunashiri, the distance is 7|- miles, and the Kurile Strait separating Shumshu from Kamchatka is about the same width. The name ” Kurile ” is derived from the Russian kurity (smoke), in allusion to the active volcanic

character of the group. The dense fogs that envelop these islands, and the violence of the currents in their vicinity, have greatly hindered exploration, so that little is known of their physiography. They lie en- tangled in a vast net of sea-weed ; are the resort of innu- merable birds, and used to be largely frequented by seals and sea-otters, which, however, have been almost com- pletely driven away by unregulated hunting. Near the south-eastern coast of Kunashiri stands a mountain called Eausu-yama (3005 feet high), round whose base sulphur bubbles up in large quantities, and hot springs as well as a hot stream are found. On the west coast of the same island is a boiling lake, called Ponto, which deposits on its bed and round its shores black sand, consisting almost entirely of pure sulphur. This island has several lofty peaks : Ponnobori-yama near the east coast, and Chachanobori and Eurindake in the north. Chachanobori (about 7900 feet) is described by Messrs Chamberlain and Mason as “a cone within a cone, the inner and higher of the two being — so the natives say — surrounded by a lake.” The island has extensive forests of conifers, with an undergrowth of ferns and flowering plants, and bears are numerous. The chief port of Kuna- shiri is Tomari, on the south coast. The island of Shiko-tan is remarkable for the growth of a species of bamboo (called Shikotan-chiku), having dark brown spots on the cane. Etorofu has a coast-line broken by deep bays, of which the principal are Naibo-wan, Eubetsu-wan, and Bettobu-wan on the northern shore, and Shikotap-wan on the southern. It is covered almost completely with dense forest, and has a number of streams abounding with salmon. Shana, the chief port, is in Eubetsu Bay. This island, the principal of the group, is divided into four provinces for administrative purposes, namely, Etorofu, Furubetsu, Shana, and Shibetomo. Its mountains are Atosa-nobori (4035 feet) in Etorofu ; Chiripnupari (5009 feet) in Shana; and Moyoro-dake (3930 feet) and Atuiya- dake (3932 feet) in Shibetomo. Among the other islands three only call for notice on account of. their altitudes, namely, Ketoi-jima, Eashua-jima, and Matua-jima, which rise to heights of 3944 feet, 3304 feet, and 5240 feet respectively.

Population. — Not much is known about the aborigines. By some authorities Ainu colonists are supposed to have been the first settlers, and to have arrived there vid Yezo ; by others, the earliest comers are believed to have been a hyperborean tribe travelling southwards by way of Kamchatka.

The islands themselves have not been suffi- ciently explored to determine whether they furnish an}^ ethnological evidences. The present population aggregates

4413, or 0-7 per square mile, of whom 565 are Ainu. There is little disposition to emigrate thither from Japan proper, the number of settlers being less than 100 annually.

History. — The three southern Kurile islands, Kunashiri, Etorofu, and Shikotan, are believed to have belonged to Japan from a remote date, but at the beginning of the 18th century the Russians, having conquered Kamchatka, found their way to the northern part of the Kuriles in pursuit of fur-bearing animals, with which the islands then abounded. Gradually these encroachments were pushed farther south, simultaneously with aggressions imperilling the Japanese settlements in the southern half of Saghalien. Japan's occupation was very far from being effective in either region, and in 1876 she was not unwilling to conclude a convention by which she agreed to withdraw altogether from Saghalien, provided that Russia withdrew from the Kuriles.

An officer of the Japanese navy, Lieutenant Gunji, left T6ky6 with about forty comrades in 1892, his intention being to form a settlement on Shumshu, the most northerly of the Kurile Islands. They embarked in open boats, and for that reason, as well as because they were going to constitute themselves their country's extreme outpost, the enterprise attracted public enthusiasm. After a long struggle, the immigrants became fairly prosperous. See Notes on th'e Kurile Islands, by Captain Snow, 1896. (p. by.)

Kursk, a government of middle Russia, bounded on the]Sr. by Orel, on the E. by Voronezh, on the S. by Kharkov, and on the W. by Chernigov. Area, 17,937 square miles. It belongs to the central plateau of middle Russia, of which it mostly occupies the southern slope, the highest parts being in Orel and Kaluga, to the north of Kursk. Its surface is from 700 to 1000 feet high, deeply ravined, and consequently assumes a hilly aspect in the valleys of

the rivers. A regular layer of fertile loess of a yellowish colour covers the whole surface, and Kursk belongs almost entirely to the black-earth region of Russia. The flora offers a character quite distinct from that of the provinces situated to the north, not only on account of the black-earth flora which enters into its composition, but also of the plants of south-western Russia which belong to it, a characteristic which is accentuated in the southern portion of the province (V. Zinger, Information about the Mora of Middle Russia, in Russian). The climate is milder than that of middle Russia generally, and winds from the south-east and the south-west prevail in winter. The average temperatures are for the year 42° F., for January 14° E., and for July 67° E. The very interesting magnetic anomaly, known as the Byelgorod anomaly, covering an oval 20 miles long and 12 miles wide, near the town of this name, has been investigated by Smirnoff, PilchikofE, Serghievskiy, and Tillo. The population (1,893,597 in 1862) was 2,396,577 in 1897, of whom 1,208,488 were women and 199,676 lived in towns. It is thoroughly Russian (76 per cent. Great Russians and 24 per cent. Little Rus- sians), and 94 per cent, are peasants, who own about two- thirds of the land (6,808,700 acres), and live mostly in large villages. The yearly increase of population varies from 23,000 (bad crops) to 45,000 (good crops). Owing to the rapid increase of the peasantry and the small size of the allotments given at the emancipation, the holdings are now so small and the rents so high that emigration, chiefly to Siberia, is on the increase. Three-quarters of the available land is under crops, chiefly rye. Grain is exported in considerable quantities. Bees are commonly kept. There were, in 1897, 443,000 horses, 620,000 horned cattle, 1,030,000 sheep, and 300,000 swine. Factories (steam flour-mills, sugar-works, distilleries, wool-washing, &c.) give occupation to about 23,000 workers (£1,700,000 yearly returns). Domestic and

petty trades are on the increase in the villages, and new ones are introduced. More than 1,000,000 pairs of boots (£200,000), 600,000 ikons and shrines (£19,000), toys, caps, various pottery, &c., are made in the villages, but even so great numbers of peasants are compelled to go elsewhere in search of work. The province pays about £1,400,000 of direct and indirect taxes, and £90,000 of municipal and village taxes a year. Notwithstanding the active efforts of the county and district councils (zemstvo), less than 10 per cent, of the population read and write. The province is crossed from north to

south and from west to south by two main lines of railway, having several branches. The trade in grain, hemp, hempseed oil, sheepskins, hides, tallow, felt goods, wax, honey, and leather goods is very brisk. There are fifteen districts, the chief towns of which are Kursk, Byelgorod (21,850), Dmitriev (7315), Eatezh (4959), Graivoron (7669), Korocha (14,405), Lgov (6376), Novyi Oskol (2762), Oboyaii (11,872), Putivl (8965), Rylsk (11,415), Staryi Oskol (16,662), Shchigry (3329), Sudzha (12,856), Tini (7380). Many villages, such as Borisovka (25,080), Veliko-Mikhailovka (20,700), are more important than the district towns, there being twenty-two more villages which have from 6000 to 12,000 inhabitants.

(p. A. K.)

Kursk, capital of the above province. It is built on two hills, having an altitude of 770 feet, the slopes of which are covered with orchards. It has a public garden, and has become the seat of several societies (medical, musical, educational, and for sport). Besides the usual gymnasia for boys and girls, there is a school for teachers. There are four newspapers. Its factories (steam flour- mills, distilleries, tobacco-works, hemp-crushing mills, tanneries, soap-works, iron-works) employ about 1000 workers. It has a great yearly fair (korennaya), to which horses, cattle, hides, sheepskins, furs, down, bristle, wax, tallow, and all sorts of manufactured goods, making an aggregate value of £66,000, are brought, and during which considerable commercial operations in all sorts of raw produce are concluded. Population, 52,896 (but one seemingly correct estimate puts it 62,803 for 1896).

Kurunegala, the chief town in the north-western province of Ceylon. It was in 1902 the terminus of the Northern railway (69 miles from Colombo), which was planned to run, 200 miles farther, to the northernmost coast of the Jaffna peninsula. Kurunegala is the centre of rice, cocoanut palm, tea, coffee, and cacao cultivation. The population of the town is 6300 ; of the district (1901), 246,618; of the province (1901), 345,427.

Kuruntwad, a native state of India, in the Deccan

division of Bombay, forming part of the Southern Mah- ratta Jagirs. Originally created in 1772 by a grant from the Peshwa, the state has been

subdivided since 1811 between a senior and a junior branch. The territory of both is widely scattered among other native states and British districts. Area of the senior branch, 174 square miles ; population (1891), 43,809 ; gross revenue, Rs.2,01,860; police, 114; 13 schools, with 696 pupils. Area of junior branch, 134 square miles ; population (1891), 13,528 ; gross revenue, Rs.1,48,094 ; police, 72 ; 10 schools, with 364 pupils ; joint tribute, Rs.9619. The chiefs, whose title is Patwardhan, are Brahmans by caste. The junior branch was in 1902 represented by two cousins, ruling jointly. The town of Kuruntwad, in which both branches have their residence, is on the right bank of the Panchganga river near its junction with the Kistna. Population, 9136.

Kustanaisk, a district town of Russian Central Asia, in the province of Turgai, on the Tobol river, 600

miles east of Orenburg. It is situated in a very fertile district of the steppes (prairies), the first buildings were erected in 1871, and it has since grown with a quite Ameri- can rapidity. The immigrants from Russia, attracted by the fertility of the land, built a large village which became the centre of the district administration in 1884, and a town in 1893, under the name of Nicolaevsk, changed later into Kustanaisk. It has several schools for boys and girls, a Russian and Kirghiz progymnasium for girls, a society for promoting primary education, which keeps a “church-school,” two libraries — one for the peasants — and a depot for school-books to supply the schools of the district. A cathedral has been built by private subscrip- tion. There are already 20 tanneries, 3 tallow houses, 3 potteries, and a fair which is a centre for trade in cattle, while its trade returns are such as to make of it a rival to Orenburg and Troitsk. Population (1895), 16,136; (1897), 14,065 (settled only).

Kiistendil, the chief town of a department in the principality of Bulgaria, situated in a mountainous coun- try, on a small affiuent of the Strouma, 43 miles south-west of Sofia by rail. The streets are narrow and uneven, and the majority of the houses are of clay or wood. The town is chiefly notable

for its hot mineral springs, in connexion with which there are nine bathing establishments. The vine is largely cultivated in the district. Some remains survive of the Roman period, when the town was known as Pautalia, Ulpia Pautalia, and Pautalia Aurelii. In the 10th century it became the seat of a bishopric, being then and during the Middle Ages known as Velbuzd. After the overthrow of the Servian kingdom it came into the possession of Constantine, brother of the despot John Drajas, and a vassal of Turkey. In the 15th century it was known as Velbuska Banja, and more commonly as Konstantinova Banja (Constantine's Bath), from which has developed the Turkish name Kiistendil. Population

(1900), 12,003.

Kustendji. See Constak-ta.

K listen I and, The (coastland or littoral), common name for the three crownlands of the Austro-Hungarian monarchy, Gorz and Gradisca, Istria, and Trieste. Their combined area is 2976 square miles, and their population (1890) 695,384, and (1900) 756,183. They are united for certain administrative purposes under the governor of Trieste, the legal and financial authorities of which also exercise jurisdiction over the entire littoral. (See separate articles.) In 1898 the educational establishments included 3 theological seminaries, 6 gymnasia, 4 real schools, 58 technical and special schools (including those for girls), and 432 elementary schools. The latter were attended by about 72 per cent, of the children. In 1890 the per- centage of illiterates was 47, an improvement of 9 per cent, on the returns of 1880. This high ratio is due chiefly to the backward condition of the Slav majority. Of the 81 periodiculs and newspapers published, 54 were in Italian, 17 in Slovene, 4 in German, and 2 in Serbo- Croatian, the remainder being polyglot Greek and Prencli. The trade of this part of the empire is concentrated in Trieste {q.v.). In 1898 the entire Kiistenland had 378 miles of railway, nearly 3150 miles of roads, and 74 miles of navigable inland waterways. There were 190 post and 101 telegraph offices, with 752 miles of line and 20G2 miles of wire. In all three crownlands, as also in Dalmatia, sea-fishing affords occupation to a large number of the inhabitants. In 1897-98 the value of the yield amounted to about £222,?,1Q. The important work "of reafforesting the Karst district, which extends over

portions of Gorz, Gradisca, Istria, Trieste, and even (^Urniola, was taken up tentatively as long ago as 1866. For a number of years

small grants were made for experimental planting, which since 1875-76 has been proceeded with in a more syste- matic and more thorough fashion. Between 1881 and 1887 special reafforesting commissions were formed, and pro- vided with funds contributed partly by the State and partly by the crownlands concerned. The results thus far are considered very satisfactory. Politically, the situation in the Kiistenland is characterized by the bitter strife between the Slav majority and the dominant Italian element, which turns mainly on the efforts of the former to secure educational facilities in their own language. The animosity between the two nationalities is as great as that between the Czechs and Germans.

See RuTHNEK. Das Kiistenland und das Konigreich Dalmatien. Vienna, 1880.. — Jackson. Dalmatia, the Quarnero and Istria, with Oeitinje and thd island of Qrado {and Aquileja). Oxford, 1887. (m. o’n.)

Kutaiah, or Kutata, a tovrai of western Asia Minor, connected by a branch line with the main line, Eski-shehr- Afiiin Kara-hissar, of the Anatolian railway.

Kutais, a government of Transcaucasia, Russia, on the Black Sea. Area, 14,082 square miles. The province consists of four distinct parts : (1) the lowlands, watered by the Rion, and continued to the north-west, along the searshore, by the narrow strip of Samurzakan and Abhazia; (2) the slopes of the main Caucasus range ; (3) the western slopes of the Suram mountains, which separate Kutais from the eastern portion of the great Transcau- casian valley occupied by the province of Tiflis ; and (4) the slopes of the Little Caucasus, as well as a portion of its plateau, watered by the Chorokh and its tributary, Ajaris-tskhali, which formerly constituted the Batum province. The main range, on the frontiers of the province, has many high snow-clad peaks, of which the Dykh-tau (17,054 feet), the Shkhara (17,049 feet), and the Adish (16,291 feet) are the main ones. More than 50 glaciers of the first class are already known on the southern slopes of this portion of the main range. Many secondary ridges and spurs shoot off the main range, forming narrow high valleys (see Caucasus). The Suram mountains reach only from 3000 to 4000 feet of altitude, while the Ajar-Akhaltsykh ridge of the Little

Caucasus attains from 8500 to 9343 feet in its highest peaks, and is crossed by a picturesque pass, Zekari (about 8000 feet), leading to the watering-place of Abbas-tuman. The districts of Batum and Artvin in the south-west are filled up by the spurs of the Pontic range, 9000 to 11,243 feet high (peak Karchkhal), the Arsian ridge separating them from the plateau of Kars. Deep gorges, through which tributaries of the Chorokh rush to the main river, intersect these highlands, forming most picturesque gorges in their upper courses. The lowlands occupy over 2400 square miles. They are mostly in the littoral region, but extremely fertile higher up the Rion.

Granites, gneisses, and crystalline slates enter into the composi- tion of the main range, with I'alfeozoio, Jurassic, and Cretaceous deposits in its lower parts. The Suram mountains consist, on their western slopes, chiefly of granites and gneisses, while the highlands of the Little Cauoa.sus consist almost exclusively of lower Tertiary deposits. The climate is very moist and warm. The winters are often without frost at all in the lowlands, while the lowest temperatures ever observed are "18° Fahr. at Batum and 9° at Poti. The mountains condense the moisture brought by the west winds, and the yearly amount of rain varies from 50 to 120 inches. The chief rivers are the Rion, which enters the Black Sea at Poti ; the Chorokh, which enters the same sea at Batum ; and the Ingur, the Kodor, and the Bzyb, also flowing into the Black Sea in Abhazia. The vegetation is extremely rich, its character suggesting the sub-tropic regions of Japan. T\i% popu- lation belongs almost entirely to the Kartvelian or Georgian group, and is distributed as follows : — Imeretians, 46 per cent. ; Mingrelians and Lazes, 2S per cent. ; Gurians, 8 per cent. ; Georgians, 1'5 per cent. ; Svanes, 1'5 per cent. ; of other nation-

alities there are 6-5 per cent, of Abhazians, 3 per cent, of Turks, 2 per cent, of Armenians, 0-6 per cent, of Russians, and so on: 87 per cent, of tiie population are Greek Orthodox, and only 10 per cent. Mussulmans. The total population was 1,075,861 in 1897, of whom 508,468 were women and 77,702 lived in towns. In some districts the density was 104 inhabitants per square mile. The land, among both landlords and peasants, is ex- tremely

subdivided, and, owing to an excellent cultivation, fetches very high prices. The chief crops in 1896 were Indian corn, 1,600,000 quarters ; wheat, 124,000 quarters ; barley, 47,000 quar- ters ; panicum italicum, beans, rye, hemp, potatoes, and tobacco. Indian com is exported. Some plantations of cotton-trees have also been laid down. The vine, olive, mulberry, and all sorts of fruit trees are cultivated, as also many exotic plants (eucalyptus, cork-oak, camellia, and even tea). Manganese ore is the chief mineral, and is extracted for a considerable export (160,000 to 180,000 tons every year), besides coal, lead, and silver ores, copper, naphtha, some gold, lithographic stone, marble, &o. Factories are still in infancy. A railway runs from the Caspian Sea, viS, Tiflis and the Suram tunnel, to Kutais, and thence to Poti and Batum, and from Kutais to the Kvirili coal and manganese mines. The ex- port of both local produce and goods shipped by rail from other ports of Transcaucasia is considerable, Batum and Poti being the two chief ports of Caucasia. It is divided into 7 districts, of which the chief towns are Kutais, capital of the province (32,492) ; Lailashi (834), chief town of Legchum, of which Svanetia makes a separate administrative unit (pristavstvo) ; Ozurgeti (4694) ; Oni, chief town of Kacha ; Senak (101) ; Kvirili, of Sharopan district ; Zugdidi; and 3 semi-military districts— Batum (28,512), Artvin (6622), and Sukhum-kale (7809). (p. _ jj \

Kutais, capital of the above province, situated on both banks of the Rion (480 feet in altitude), and con- nected by a branch railway (5 miles) with the main line. It is well provided with gymnasia and other schools for boys and girls, has a school of gardening, a public library, book-shops, a large champagne factory, &c. Population, 32,492, of whom about 16,000 are Kartvelians, 3000 Armenians, 3000 Jews, and 2000 Russians.

Kutno, a district town of Russian Poland, govern- ment and 83- miles west of Warsaw by rail. It has several woollen, linen, wool-knitting and printed cotton factories, and distilleries, and is the centre of a considerable trade in corn. Population (1895), 11,665, two-thirds of whom were Jews.

Kuttenberg, a mining town and seat of the ad- ministration of a government district in Bohemia, and a station on the Austrian North-Western railway, 40 miles east by south of Prague. An iron-foundry constitutes the chief addition to the industry of the place, which in- cludes sugar-refining,

brewing, the manufacture of cotton and woollen stuffs, leather goods and agricultural imple- ments. On 12th-i6th September 1899 it was the scene of a sensational trial of a Jew named Hilsner on a charge of so-called ” ritual murder,” which was made the starting- point of an anti-Semitic agitation. Population (1890), 13,563 ; (1900), 14,799, mostly Czech.

Kuty, a tovm in the government district of Kosow, Galicia, Austria, 35 miles west of Czernowitz. The principal industry is the manufacture of morocco leather, which, together with the pitch, tar, and rosin recovered in the neighbouring woods, form its principal articles of export. Population (1890), 6353; (1900), 6702, mostly German-speaking Jews. The adjoining village of Kuty Stare, or Old Kuty, has a population of 4425, mostly Ruthenians.

Kuznetsk, two district towns of Russia. 1. Euro- pean Russia, government and 150 miles north-north-east of Saratov, 74 miles by rail east of Penza. It has grown rapidly since the development of the railway system in the Volga basin. It has manufactures of a^ricultui-al machinery and hardware, in a number of small factories and workshops, besides tanneries, rope-works, boot- and shoe-making in houses-, and there is considerable trade in grain, salt, and a variety of wooden goods exported to the treeless regions of south-east Russia. Population

(1897), 23,849. 2. In West Siberia, Altai region, gov- ernment and 210 miles south-east of Tomsk, on upper Tom river, of which it is the head of the navigation. It has trade in grain, cattle, furs, cedar, nuts, wax, and honey, and tallow is shipped northwards. It is the centre of an important mining district. Population,

8980.

Kwangchow Bay, or Kwangchow Wan, a coaling station on the south coast of China, acquired, along with other concessions, by the French Government in April 1898. It is situated on the east side of the peninsula of Lienchow, in the province of Kwangtung, and directly north of the island of Hainan. It is held on lease for 99 years on similar terms to those by which Kiaochow is held by Germany, Port Arthur by Russia, and Wei-hai-wei by Great Britain. The cession includes the islands lying in the bay; these

enclose a roadstead 18 miles long by 6 miles wide, with admirable natural defences and a depth at no part of less than 33 feet. The bay forms the estuary of the Ma-Tsh^ river, navigable by the largest men-of-war for 12 miles from the coast. The limits of the concession inland were fixed in November 1899. On the left bank of the Ma-Tshe France gained from Kao Chow Fu a strip of territory 11 miles by 6 miles, and on the right bank a strip 15 miles by 11 miles from Lei Chow Fu. The country is well populated ; the capital and chief town is Lei Chow. The cession carries with it full territorial jurisdiction during the continuance of the lease. In January 1900 it was placed under the authority of the Governor-General of Indo-China, who in the same month appointed a civil ad- ministrator over the country, which was divided into three districts. A mixed tribunal has been instituted, but the local organiz ion is maintained for purposes of administration. In addition to the territory acquired, the right has been given to connect the bay by railway with the city and harbour of Ompon, situated on the west side of the peninsula, and in consequence of difSculties which were offered by the provincial government on the occasion of taking possession, and which compelled the French to have recourse to arms, the latter demanded and obtained exclusive mining rights in the three adjoin- ing prefectures. Two lines of French steamships call at the bay. By reason of the great strategical importance of the bay and the possibilities of considerable commer- cial development in the country, owing to the presence of large coal-beds in the near neighbourhood, much import- ance is attached by the French to the acquirement of Kwangchow Wan.

Kwanza, a river of West Africa, with a course of about 700 miles, entirely within the Portuguese territory sf Angola. The actual source has not yet been visited, but probably lies in about 13° 40′ S., on the Bihe plateau, at an altitude of over 5000 feet. The Portuguese travellers Capello and Ivens reached in 1878 a point in 13° 3′ S., where they heard of a lake called Mussombo, from which the stream was supposed to rise ; but they were unable to reach it. Just north of 12° they found the Kwanza about 60 yards wide and 13 to 16 feet deep. From this point to 10°, during which interval it flows north-westwards, receiv- ing many tributaries, especially the Loando from the east, its course is imperfectly known. In about 10°, and at in- tervals during its westerly passage through the outer plateau escarpments, its course is broken by rapids, the river flowing in a well-defined valley

flanked by higher ground. The lowest fall is that of Kambamba, or Livingstone, with a drop of 70 feet, below which it is navigated by small steamers, though very shallow in the dry season. There is a shifting bar at its mouth, which can only be crossed with great caution, but as a railway now runs from

St Paul de Loanda to Ambaca, the use of the river as a waterway has become of less importance.

See Alexandeeson. ” On the River Quanza, ” Journal B.G.S., 1876.—Capello and Itens. From Benguela to . . . Yacca. London, 1882. (e. He.)

Kyaukpyu, a district in the Arakan division of Lower Burma, on the eastern coast of the Bay of Bengal. In 1891 the population numbered 163,832, of whom 145,223 were Buddhists and Jains, 13,882 aborigines (mostly Chins), 4301 Mahommedans, 290 Hindus, and 136 Christians (91 of whom were natives) ; in 1901 it was 167,594, showing an increase since 1891 of 2-3 per cent. There were in 1898-99, 1106 villages in the district, paying a revenue of Rs. 4,73,035. Of a total area of 2,807,680 acres, the area cultivated in 1898-99 was 137,559. The rainfall iu 1898-99 was 17-645 inches. The chief town, Kyaukpyu, had a population in 1891 of 3549. It has a municipal committee of twelve members, three ex officio, and nine appointed by the local govern- ment, and there is a third-class district jail. Ramri is also a municipal town. It had a population in 1891 of 3317. Kyaukpyu is a port under the Indian Ports Act (X. of 1889), and the steamers of the British India Navigation Company call there once a week going and coming between Rangoon and Calcutta. There were 106,549 gallons of earth-oil produced in 1898-99 from the Kyaukpyu oil- wells. The amount has remained nearly stationary for some years.

Kyaukse, a district in the Meiktila division of Upper Burma, with an area of approximately 1273 square miles, and a population in 1891 of 126,622, and in 1901 of 141,296. It is also known as the Ko-Tcayaing, so called from the original nine canals of the district. The district consists of a generally level

strip running north and south at the foot of the Shan Hills, and of a hilly region rising up these hills to the east, and including the Yeyaman tract, which lies between 21° 30′ and 21° 40′ N. and 96° 15′ and 96° 45′ E., with peaks rising to between 4500 and 5000 feet. This tract is rugged and scored by ravines, and is very sparsely inhabited. The Panlaung and Zawgyi rivers from the Shan States flow through the district and are utilized for the numerous irrigation canals. Notwithstanding this, much timber is floated down, aad the Panlaung is navigable for small boats all the year round. Kain is very scarce (26-03 inches, 1898-99), but the canals supply ample water for cultivation and all other purposes. They are said to have been dug by King Nawrahta in 1092. He is alleged to have completed the system of nine canals and weirs in three years' time. Others have since been constructed. Since the annexation many were in serious disrepair, but most of them have been greatly improved by the construction of proper regu- lators and sluices. Two-thirds of the population are de- pendent entirely on cultivation for their support, and this is mainly rice on irrigated land. In the Yeyaman tract the chief cultivation is taiutr/ya or hill rice. The great bulk of the population is pure Burmese, but in the hills there are a good many Danus, a cross between Shans and Bur- mese. In 1891 the classification according to religion was — Buddhists and Jains, 122,771 ; Mahommedans, 3133 ; Hiadus, 528; and (Christians, 190. The railway runs through the centre of the paddy-producing area, and feeder roads open up the country as far as the Shan foot- hills. The greater part of the district consists of state land, the cultivators being tenants of Government, but there is a certain amount of hereditary freehold. The total area of cultivated state land is 137,100 acres, and of non-state land 68,205 acres. Kyaukse town is situated on the Zawgyi river, and is well laid out in regular streets,

covering an area of about a square mile. It has a population of approximately 7201, mostly Burmese, with a native-of -India trading colony. Above it are some bare rocky hillocks, picturesquely studded with pagodas.

Kyd, Thomas (1558-1594), one of the most im- portant of the Elizabethan dramatists who preceded Shakespeare, remained until the last decade of the 19th century in what appeared likely to be impen- etrable obscurity. Owing to the industry, however, of certain English and German scholars, a great

deal of light has been thrown on the life and writings of Kyd. He is now known to have been the son of Francis Kyd, citizen and scrivener of London, and to have been bap- tized in the church of St Mary “\Yoolnoth, Lombard Street, on 6th November 1558. His mother, who survived her son, was named Agnes or Anna. In October 1565 Kyd entered the newly-founded Merchant Taylors’ School, where Edmund Spenser and Thomas Lodge must at dif- ferent times have been his school-fellows. It is thought that Kyd did not proceed to either of the universi- ties ; he certainly followed, soon after leaving school, his father’s business as a scrivener. But Nash de- scribes him as a ” shifting companion that ran through every art and throve by none.” He was very early attracted to literature and the stage. Newton’s transla- tion of Seneca, printed in 1581, had, without question, a strong influence on the imagination and style of Kyd. Professor Boas has made a very interesting analysis of the traces of contemporary literature to be found in Kyd’s existing writings. It is believed that he pro- duced his famous play. The Spanish Tragedy, about 1586 ; the earliest surviving quarto is undated. This drama enjoyed all through the age of Elizabeth and even of James I. and Charles I. so unflagging a success that it has been styled the most popular of all old English plays. Certain expressions in Nash’s preface to the 1589 edition of Greene’s Menaphon may be said to have started a whole world of speculation with regard to Kyd’s activity. Much of this is still very puz- zling; nor is it really understood why Ben Jonson called him ” sporting Kyd.” In 1592 there was added a sort of prologue to Tlie Spanish Tragedy, called Tlie First Part of Jeronimo, not printed till 1605. This is not regarded by the latest critics of the dramatist as being his work. On the other hand, it becomes more and more certain that what German criticism calls the Ur-Hamlet, the original draft of the tragedy of the Prince of Denmark, was a lost work by Kyd, probably composed by him in 1587. This theory has been very elaborately worked out by Professor Sarrazin, and con- firmed by Professor Boas ; these scholars are doubtless right in holding that traces of Kyd’s play survive in the first two acts of the 1603 Eirst Quarto of Hamlet, but in our opinion they go too far in attributing much of the actual language of the last three acts to Kyd. Kyd’s next work was in all probability the tragedy of Soliman and Perseda, written perhaps in 1588 and published in 1592. No copy of the first edition has come down to us ; but it was reprinted after Kyd’s death, in 1599. In the summer or autumn of 1590 Kyd seems to have given up writing for the

stage, and to have entered the service of an unnamed lord, who employed a troop of ” players. ” K v d was probably the private secretary of this nobleman, in whom Professor Boas sees Robert Radcliffe, afterwards fifth earl of Sussex. To the wife of the earl (Bridget Morison of Cassiobury) Ivyd dedicated in the last year of his life his translation of Garnier’s Cornelia (1594). the only work to which Kyd attached his name. Two ■ prose works of the dramatist have survived, a treatise on domestic economy, T]ie Householder’’ s Philosophy, 1588 ; and a sensational

account of The most tricked and secret Murdering of John Brewer, Goldsmith, 1592. That many of Kyd’s plays and poems have been lost is proved by the fact that fragments exist, attributed to him, which are found in no surviving context. Towards the close of his life Kyd was brought into relations with Marlowe which place his character in rather a painful light. It would seem that in 1690, soon after he entered the service of his nobleman, Kyd formed the acquaintance of Marlowe. If the former is to be believed, he shrank at once from the latter, as a man “intemperate and of a cruel heart,” and “irreligious.” This, however, was said by Kyd with the rope round his neck, and is scarcely consistent with a good deal of apparent intimacy between him and Marlowe. When, in May 1593, the “lewd libels” and “blasphemies” of Marlowe came before the notice of the Star Chamber, Kyd was immediately arrested, papers of his having been found ” shuffled ” with some of Marlowe’s, who was imprisoned a week later. The pretence on which Kyd was arrested was the suspicion of his having attached a seditious libel to the wall of the Dutch churchyard. Kyd was put to the torture, but nothing was obtained from him in the way of confession. The most serious point made against him was the discovery in his cham- ber of a paper of ” vile heretical conceits denying the deity of Jesus Christ.” Kyd, in an agony of apprehen- sion, asserted that he knew nothing of this document, and tried to shift the responsibility of it upon Marlowe, but he was kept in prison until after the death of that poet (1st June 1593). When he was at length dismissed, his patron refused to take him back into his service. The poet fell into utter destitution, and sank under the weight of ” bitter times and privy

broken passions.” He must have died late in 1594, and on the 30th of December of that year his parents renounced their administration of the goods of their deceased son, in a document of great importance lately discovered by Professor Schick. This posthumous repudiation of the tortured and beggared poet by his respectable parents is the last touch needed to complete the gloomy portrait of Kyd which recent scholarship has filled up.

The importance of Kyd, as the pioneer in the wonder- ful movement of secular drama in England, gives great interest to his works, and we are now able at last to assert what many critics have long conjectured, that he takes in that movement the position of a leader and almost of an inventor. Regarded from this point of view. The Spanish Tragedy is a work of extraordinary value, since it is the earliest specimen of effective stage poetry existing in English literature. It had been preceded only by the nageant-poems of Peele and Lyly, in which all that constitutes in the modern sense theatrical technique and effective construction was entirely absent. These gifts, in which the whole power of the theatre as a place of general entertainment was to consist, were supplied earliest among English playwrights to Kyd, and were first exercised by him, so far as we can see, in 1586. This, then, is a more or less definite starting-date for Elizabethan drama, and of peculiar value to its historians. Curiously enough, TJie Sjxmish Tragedy, which was the earliest stage-play of the great period, was also the most popu- lar, and held its own right through the careers of Shake- peare, Ben Jon son, and Fletchef. It was not any shortcoming in its harrowing and exciting plot, but the tameness of its archaic versification, which probably led in 1602 to its receiving ” additions,” which have been a great stumbling-block to the critics. It is known that Ben Jonson was paid for these additional scenes, but they are extremely unlike all other known writings of his and several scholars have independently conjectured that Webster wrote them. Of K,yd himself it seems

needful to point out that neither the Germans nor even Professor Boas seems to realize how little definite merit his poetry has. He is important, not in himself, but as a pioneer. The influence of Kyd is marked on all the immediate predecessors of Shakespeare, and the bold way in which scenes of violent crime were treated on the Elizabethan stage appears to be directly

owing to the example of Kyd's innovating genius. His relation to iJamtef has already been noted, and Titus Androidcu.s ~~pi'e~~ sents and exaggerates so many of his characteristics that Mr Sidney Lee and others have supposed that tragedy to be a work of Kyd's touched up by Shakespeare. Professor Boas, however, brings cogent objections against this theory, founding them on what he considers the imitative inferiority of Titus Andronicus to Tlie Spanish Tragedy. The German critics have pushed too far their attempt to find indications of Kyd's influence on later plays of Shakespeare. The extraordinary interest felt for Kyd in Germany is explained by the fact that The Spanish Tragedy was long the best known of all Elizabethan plays abroad. It was acted at Frankfurt in 1601, and published soon afterwards at Nuremberg. It continued to be a stock piece in Germany until the beginning of the 18th century ; it was equally popular in Holland, and potent in its effect upon Dutch dramatic literature. Kyd's works were first collected and his life written by Pro- fessor Frederick S. Boas in 1901. The principial German authorities are Sarrazin (1892), Fischer (1893), Gassner (1894), Fleischer (1896), and Schick (1898). (e. g.)

Kyffhauser, a double line of hills in Thuringia, Germany, of which the northern looks steeply down upon the valley of the Goldene Aue, and is crowned by a couple of ruined castles — Rothenburg (1440 feet) on the west, and Kyffhausen (1642 feet) on the east. The latter, built probably in the 10th century, was frequently the residence of the Hohenstaufen emperors, and was finally destroyed in the 16th century. It is surmounted by an imposing monument to the Emperor William I., 213 feet high, the equestrian statue of the emperor alone being 31 feet high. According to a popular and long-accepted legend, the Emperor Barbarossa (Frederick I.) sits asleep beside a marble table in the interior of the mountain, surrounded by his knights, awaiting the destined day when he shall awaken and lead the united peoples of Germany against the enemies of the empire, and so inaugurate an era of unexampled glory. But G. Vogt has advanced cogent reasons (see Hist. Zeit- schrift, vol. xxvi. pp. 131-187) for believing that the real hero of the legend is the last of the great Hohenstaufen emperors, namely Frederick II., not Frederick I. Around him gradually crystallized the hopes of the German peoples, and to him they looked for help in the hour of their sorest need. But this is not the only legend of a slumbering future deliverer which lives on in Germany. Similar hopes cling to the memory of

Charlemagne, sleep- ing in a hill near Paderborn ; to that of Wedekind, in a hill in Westphalia ; to Siegfried, in the hill of Geroldseck ; and to Henry I., in a hill near Goslar. And the legend has its parallel amongst other peoples — e.g., the English looked for the second coming of King Arthur, the Danes for that of Holger Danske, the Swedes for that of King Olaf , the Portuguese for that of Dom Sebastian, the ancient Persians for that of Rustam, and so forth.

Kyosai, Sho-fu (1831-1889), Japanese painter, was born at Koga in the province of Shimotsuke, Japan, in 1831. After working for a short time, as a boy, with Kuniyoshi, he received his artistic training in the studio of Kan 6 Dohaku, but soon abandoned the formal traditions of his master for the greater freedom of the popular school. During the political ferment which produced and followed

the revolution of 1867, KySsai attained a considerable reputation as a caricaturist. He was three times arrested and imprisoned by the authorities of the Shogunate. Soon after the assumption of effective power by the Mikado, a great congress of painters and men of letters was held, at which Ky osai was present. He again expressed his opinion of the new movement in a caricature, which had a great popular success, but also brought him into the hands of the police, this time of the opposite party. Kyosai must be considered as the greatest successor of Hokusai (of whom, however, he was not a pupil), and as the first political caricaturist of Japan. His work — like his life — is somewhat wild and undisciplined, and ” occasionally smacks of the saM cup.” But if he did not possess Hokusai’s dignity, power, and reticence, he substituted an exuberant fancy, which always lends interest to draughtsmanship of very great technical excel- lence. In addition to his caricatures, Kyosai painted a large number of pictures and sketches, often choosing subjects from the folk-lore of his country. A fine col- lection of these works is preserved in the British Museum; and there are also good

examples in the National Art Library at South Kensington, and the Musee Guimet at Paris. Among his illustrated books

may be mentioned Telion Taka-kagami, Illustrations of Hawks (5 vols. 1870, &c.) ; Kydsai Gwafa (1880); Kydsai Dongwa ; Kydsai Baku-gwa; Kydsai Biaku-giva; Kydsai Mangwa (1881); Kydsai Suigwa (1882); and Kydsai G-waden (1887). The latter is illustrated by him under the name of Kawanabe Toyoku, and two of its four volumes are devoted to an account of his own art and life. He died in 1889, at the age of fifty-eight.

See GniMET (E.) and Regamey (F.). Promenades Japonaises. Paris, 1880. — Anderson (W.). Catalogue of Japanese Paint- ings in the British Museum. London, 1886. — Moktimek Menpes. “A Personal View of Japanese Art: A Lesson from KySsai,” Magazine of Art, 1888. (b. f. S.)

Kyshtym, a town and iron-works of Eussia, govern- ment of Perm, and 56 miles by rail east of Tchelyabinsk, on the Siberian main line, and on a river of the sanie name which connects two lakes. The official name is Upper (Verkhne) Kyshtymskiy Zavod, in order to dis- tinguish it from the Lower (Nizhne K.) works, situated 2 miles lower down the same river. Nearly 26,000 tons of iron and iron goods are turned out yearly at these two works, which employ more than 2600 workers. Popu- lation, 12,331.

Labiche, Eugene Marie (1815-1888), French dramatist, was born in Paris on 5th May 1815, of bourgeois parentage. On leaving school he began reading for the bar, but literature had more powerful attractions, and he was hardly twenty years old when he gave to the Chirubin — an impertinent little magazine, long vanished and for- gotten— a short story, entitled, in the cavalier style of the period, Les plus belles sent les plus fausses. A few others followed much in the same strain, but failed to catch the attention of the public. Labiche, as far as we are able to conjecture from his private correspondence, was much impressed by the great works of the flourishing romantic school. Very little trace, however, of its influence can be found in his first literary attempts. He tried his hand at dramatic criticism in the Revue des TJiidtres, and in 1838 made a double venture on the stage. The small Theatre du Pantheon produced, amid some signs of popular favour, a drama of his, L’avocaf Loubet, while a vaudeville, CoylUn on I’homme injiniment poli, written in collaboration with Marc Michel, and given at the

Palais Eoyal, introduced for the first time to the Parisians a provincial actor who was to become and to remain a great favourite with them, Grassot, the famous low comedian. In the following year Labiche, still doubtful about his true vocation, published a romance called La Cli des Champs. M. Halevy, his successor at the Academy and his panegyrist, informs us that the publisher became a bankrupt soon after the novel was out. ” A lucky misadventure, for,” the biographer concludes, ” this timely warning of Destiny sent him back to the stage, where a career of success was awaiting him.” There was yet another obstacle in the way. When he married, he solemnly promised to his wife’s parents that he would renounce once for all a profession then con- sidered incompatible with moral regularity and domestic happiness. But a year afterwards his wife spontaneously released him from his vow, and Labiche many years after- wards recalled the incident when he dedicated the first edition of his complete works — ” To my wife.” Labiche, in conjunction with Varin, Marc Michel, Clairville, and Duma- noir, contributed comic plays interspersed with couplets to various Paris theatres. The series culminated in the memorable farce in five acts, Un clmpeau de paille d’ltalie

(August 1851). It remains to this day an accom- plished specimen of the Prench imbroglio in which some one is in search of something, but does not find it till five minutes before the curtain falls. Prior to that date Labiche had been only a successful vaudevilliste among a crowd of others ; but a twelvemonth later he made a new departure in Le Misanthrope et I’Auvergnat. All the plays given for the next twenty-five years, although constructed on the old plan, contained a more or less appreciable dose of that comic oliservation and good sense which gradually raised the Prench farce almost to the level of the comedy of character and manners. ” Of all the subjects,” he said, ” which offered themselves to me, I have selected the bour- geois. Essentially mediocre in his vices and in his virtues, he stands half-way between the hero and the scoundrel, between the saint and the profligate.” During the second period of his career Labiche had the collaboration of Dela- cour, Choler, and a few others. When it is asked what share in the authorship and success of the plays may be claimed for those men, we shall answer in ifimile Angler’s words : ” The distinctive qualities which secured a lasting vogue for the plays of Labiche are to be found in all the comedies written by him with diiferent collaborators, and are

conspicuously absent from those which they wrote without him.” All that is known of his literarj- methods leads to the same conclusion, namely, that he was both the leading spirit and the working hand in the combined effort. A more usefid and more important collaborator he found in Geoffroy, whom he had known as a debutant in his younger days, and who remained his faithful in- terpreter to the last. Geoffroy impersonated the bourgeois not only to the public, but to the author himself ; and it may be assumed that Labiche, when writing, could see and hear Geoffroy acting the character and uttering, in his pompous, fussy way, the words that he had just coni- mitted to paper.

Celimare le bieii-aime, Le Voyage de PerricJion, La Grammaire, Un Pied dans le Crime, La Cagnotte, may be quoted here as the happiest productions of Labiche. In 1877 he deliberately brought his connexion with the stage to a close, and retired to his rural property in Sologne. There he could be seen every day, dressed as a farmer.

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The Calligeaphbk Oxo-no-Tofu” watching the Perseverance of the Frogs (a similar story to that of Bruce

and the Spider). Painted by Ktosai.

(Victoria and Albeii Museum,)

The Story of the Hares and the Wicked Racoon-dog (TamiM); the Old Woman meeting the Racoon in the

Disguise of her Husband. Painted by Ky6sai in 1868.

{Victoria and Albert Museum.)

with low-brimmed hat, thick gaiters, and an enormous stick, superintending the agricultural work and busily- engaged in reclaiming land and marshes.

His lifelong friend, Augier, visited him in his principality, and, being left alone one day in the library, took to reading his host's dramatic productions, scattered here and there in the shape of theatrical brochures. The result was that he strongly advised Labiche to publish a collected and re- vised edition of his works. The suggestion, first declined as a joke and long resisted, was finally accepted and carried into effect. Labiche's comic plays, in ten volumes, were issued, by successive instalments, during 1878 and 1879. The success was even greater than had been ex- pected by the author's most sanguine friends. It had been commonly admitted that these plays owed their popularity in a great measure to the favourite actors who had appeared in them ; but it was now discovered that, on the contrary, all, with the exception of Geoff roy, had introduced into them a grotesque and caricatural element, thus hiding from the spectator, in many cases, the true comic vein and delightful delineation of human character. The amazement turned into admiration, and the engoue- ment became so general that very few dared grumble or appear scandalized when, in 1880, Labiche was elected to

the French Academy. It was fortunate that, in former years, he had never dreamt of attaining this high distinction; for, as M. Pailleron justly observed, while trying to get rid of the little faults which were in him, he would have been in danger of losing some of his sterling qualities. But when the honour was bestowed upon him, he enjoyed it with his usual good sense and quiet modesty. He died in Paris on 23rd January 1888. Some foolish admirers have placed him on a par with Molifere, but it will be enough to say that he was some- thing better than a public amuseur. Many of his plays have been transferred to the English stage. They are, on the whole, as sound as they are entertaining. Love is practically absent from his theatre. In none of his plaj's did he ever venture into the depths of feminine psychology, and womankind is only represented in them by pretentious old maids and silly, insipid, almost dumb, young ladies. He ridiculed marriage according to the invariable custom of French playwrights, but in a friendly and good-natured manner which always left a door open to repentance and timely amendment. He is never coarse, never suggestive. After he died, the French farce, which he had raised to something akin to literature, relapsed into its former grossness and unmeaning complexity. (a. vi.)

LABOUR LEGISLATIO:^.

I. United Kingdom.

Factories and Workshops. — Since 1878 most important developments of legislation for the protection of labour in industry have been made in the division of the law which relates particularly to factories and workshops. The Act of 1878 remained until 1901, although much had been meanwhile superimposed, a monument to the efforts of the great factory reformers of the first half of the 19th century, and the general groundwork of safety for workers in factories and workshops in the main divisions of sanitation, security against accidents, physical fitness of workers, general limitation of hours and times of employ- ment for young workers and women. The Act of 1901, which came into force 1st January 1902, was an amend- ing as well as a consolidating Act. Comparison of the two Acts shows, however, that, in spite of the advantages of further consolidation and helpful changes in arrange- ment of sections and important additions which tend towards a specialized hygiene for factory life, the funda- mental features of the law as fought out in the 19th cen- tury remain untouched. So far as the law has altered in character, it has done so by gradual development of certain sanitary features, originally subordinate, and not by retreat from its earlier aims.

The precise effect of the new law as a whole, with its considerable amendments, has in working yet to be tested, but its general intention can be made clear by reference to the Acts and decisions which it embodies.

The Act of 1878, in a series of Acts from 1883 to 1895, received striking additions, based (1) on the experience gained in other branches of protective legislation, e.g., development of the method of regulation by “special rules ” and administrative inquiry into accidents under Coal Mines Acts ; (2) on the findings of royal commissions and parliamentary inquiries, e.g., increased con- AddiiioBs troi of “outwork” and domestic workshops, WTs! °* and limitation of “overtime ” ; (3) on the de- velopment of administrative machinery for enforcing the more modern law relating to public health, e.g., transference of administration of sanitary provisions in workshops to the local sanitary authorities ; (4) on the

trade union demand for means for securing trustworthy records of wage-contracts between employer and work- man, e.g., the section requiring particulars of work and wages for piece-workers. The first additions to the Act of 1878 were, however, almost purely attempts to deal more adequately than had been attempted in the code of 1878 with striking instances of trades injurious to health, without any suggestion of a groimdwork for future regu- lation of other injurious or dangerous trades. Thus the Factory and Workshop Act of 1883 provided that white- lead factories should not be carried on without a certifi- cate of conformity with certain conditions, and also made provision for special rules, on lines superseded by those laid down in the Act of 1891, applicable to any employ- ment in a factory or workshop certified as dangerous or injurious by the Secretary of State. The Act of 1883 also dealt with sanitary conditions in bakehouses, a class of workplaces liable to be a menace to public health as well as injurious to workers if the strictest hygienic con- ditions are not fully observed. Certain definitions and explanations of previous enactments touching overtime and employment of a child in any factory or workshop were also included in the Act of 1883. A class of fac- tories in which excessive heat and humidity seriously affected the health of operatives was next dealt with in the Cotton Cloth Factories Act, 1889. This provided for special notice to the Chief Inspector from all occupiers of cotton cloth factories (i.e., any room, shed, or work- shop, or part thereof, in which weaving of cotton cloth is carried on) who intend to produce humidity by arti- ficial means ; regulated both temperature of workrooms and amount of moisture in the atmosphere, and provided for tests and records of the same ; and fixed a standard minimum volume of fresh air (600 cubic feet) to be admitted in every hour for every person employed in the factory. Power was retained for the Secretary of State to modify by order the standard for the maximum limit of humidity of the atmosphere at any given temperature. A short Act of two clauses in 1897 extended this power to other measures for the protection of health, recom- mended by a departmental committee appointed to inquire into the working of the Act of 1889.

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The special measures from 1878 to 1889 gave valuable precedents for further developments of special hygiene in factory life, but the next advance, in the Factory and \‘orkshop Act, 1891, following as it did on the House of Lords Committee on the sweating system and the Berlin International Labour Conference, extended over much wider ground. Its principal objects were: (a) to render adjninistration of the law relating to worls^shops more efficient, particularly as regards sanitation ; with this end in view it made the primary controlling authority for sanitary matters in workshops the local sanitary authority (now known as the District Council), acting by their officers, and giving them for the purpose the powers of the less numerous body of factory inspect- ors, while at the same time the provisions of the Public Health Acts replaced in workshops the very similar sani- tary provisions of the Factory Acts ; (b) to provide for greater security against accidents and more efficient fencing of machinery in factories ; (c) to extend the method of regulation of unhealthy or dangerous occu- pations by application of special rules and requirements to any incident of employment (other than in a domestic workshop) certified by the Secretary of State ■ to be dangerous or injurious to health or dangerous to life or limb ; (d) to raise the age of employment of children and restrict the employment of women immediately after childbirth ; (e) to require particulars of rate of wages to be given with work to piece-workers in certain branches of the textile industries ; (/) to amend the Act of 1878 in various subsidiary ways, with the view of improving the administration of its principles, e.g., by increasing the means of checking the amount of overtime worked, em- powering inspectors to enter workplaces used as dwellings without a justice’s warrant, and the imposition of mini- mum penalties in certain cases. On this Act followed a period of four years of greatly accelerated administrative activity and application of the new powers to make detailed regulations for the promotion of special hygiene in unhealthy industries. No fewer than sixteen trades were in four years scheduled by the Secretary of State as dangerous to health. The manner of preparing and establishing suitable rules (greatly modified by the Act of 1901) will be dealt with below.

The Factory and Workshop Act, 1895, followed thus on a period of exercise of new powers of administrative regu- lation (the period being also that during which the Koyal Commission on Labour made its wide survey of industrial conditions), and after two successive annual reports of the Chief Inspector of Factories had embodied reports and recommendations from the women inspectors, who in 1893 were first added to the inspectorate. Again, the chief features of an even wider legislative effort than that of 1891 were the increased stringency and definiteness of the measures for securing hygienic and safe conditions of work. Some of these measures, however, involved the introduction of new principles, as in the provision for the prohibition of the use of a dangerous machine or structure by the order of a magistrate's court, and the power to in- clude in the special rules drawn up in pursuance of section 8 of the Act of 1891, the prohibition of the. employment of any class of persons, or the limitation of the period of employment of any class of persons in any process scheduled by order of the Secretary of State. These last two powers have both been exercised, and with the exer- cise of the latter passed away, without opposition, the absolute freedom of the employer of the adult male laboui'PT to carry on his manufacture without legislative limitation of the hours of labour. Second only in signi- ficance to these new developments was the addition, for the first time since 1807, of new classes of workplaces not covered by the general definitions in section 9.'! of the

Consolidating Act of 1878, viz. : (ci) laundries (with special conditions as to hours, &c.) ; (b) docks, wharves, quays, warehouses, and premises on which machinery worked by power is temporarily used for the purpose of the construction of a building or any structural work in connexion with the building (for the purpose only of ob- taining security against accidents). Other entirely new provisions in the Act of 1895, later strengthened by the Act of 1901, were the requirement of a reasonable tem- perature in workrooms, the requirement of lavatories for the use of persons employed in any department where poisonous substances are used, the obligation on occupiers and medical practitioners to report cases of industrial poisoning; and the penalties imposed on an employer wilfully allowing wearing apparel to be made, cleaned, or repaired in a dwelling-house where an inmate is suffering from infectious disease. Another provision was new, which aimed at empowering the Secretary of State to specify classes of

outwork and areas with a view to the regulation of the sanitary condition of premises in which outworkers are employed. Owing, however, to the con- ditions attached to its exercise, no case was found in which this power could come into operation, and the Act of 1901 deals with the matter on new lines. The require- ment of annual returns from occupiers of persons em- ployed, and the competency of the person charged with infringing the Act to give evidence in his defence, were two important new provisions calling for notice, as also the adoption of the powers to direct a formal investigation of any accident on the lines laid down in section 45 of the Coal Mines Eegulation Act, 1887. Other sections, relating to sanitation and safety, were developments of previous regulations rather than fresh departures, e.g., the fixing of a standard of overcrowding, provision of sanitary ac- commodation separate for each sex where the standard of the Public Health Act Amendment Act of 1890 had not been adopted, power to order a fan or other mechani- cal means to carry off injurious gas, vapour, or other impurity (the previous power covering only dust). I'nder the head of safety, the fencing of machinery and defini- tion of accidents were made more precise, young persons were prohibited from cleaning dangerous machinery, and additional safeguards against risk of injury by fire or panic were introduced. On the question of employ- ment the two foremost amendments lay in the almost complete prohibition of overtime for young persons, and the restriction of the power of an employer to employ protected persons outside his factory or workshop on the same day that he had employed them in the factory or workshop. Under the head of particulars of work and wages to piece-workers an important and new power, highly valued by the workers, was given to apply the principle with the necessary modifications by order of the Secretary of State to industries other than textile.

In 1899 an indirect modification of the limitation to employment of children was effected by the Elementarj' Education Amendment Act, which, by raising from eleven to tweh'o years the minimum age at which a child may, by the bye-laws of a local authority, obtain a total or partial exemption from the obligation to attend school, made it unlawful for an occupier to take into emploj-ment any child under twelve years in such a manner as to prevent full-time attendance at school. The age of employment became generally thereby the same as it has been for eini)loyment at a mine above ground

since 1887. The Act of 1901 makes the prohibition of employment of a child under twelve years of age in a factory or If^i^f, workshop direct and absolute. Under the divi- sions of sanitation, safety, fitness for employment, special regulation of dangerous trades, special control of bake-

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houses, exceptional treatment of creameries, new methods of dealing with home work and outworkers, important addi- tions have been made to the general law by the Act of 1901, as also in various regulations for strengthened adminis- trative control. New general sanitary provisions are those prescribing : (a) ventilation per se for every workroom, and empowering the Secretary of State to fix a standard of sufiicient ventilation ; (b) drainage of wet floors ; (c) the power of the Secretary of State to define in certain cases what shall constitute sufficient and suitable sanitary accommodation. New safety provisions are those relating to — (a) Examination and report on steam boilers ; (6) prohibition of employment of a child in cleaning below machinery in motion ; (c) power of the District Council to make bye-laws for escape in case of fire. The most im- portant administrative alteratic^ns are the following : (a) A justice engaged in the same trade as, or being officer of an association of persons engaged in the same trade as, a person charged with an offence may not act at the hearing and determination of the charge ; (b) ordinary supervision of sanitary conditions under which outwork is carried on is transferred to the District Council, full power being reserved to the Home Office to intervene incase of neglect or default by any District Council.

The following paragraphs aim at presenting an idea of the scope of the modified and amended law, as a whole, adding where clearly necessary reference to the effect of the Acts of 1878 to 1889, which ceased to apply after 31st December 1901 : —

The workplaces to which the Act applies are, first, “factories ” and “workshops”; secondly, laundries, docks, wharves, &c., enumerated above as introduced and regulated partially- only by the Act of 1895. Apart from this secondary list, and having regard to workplaces which remain undefined by the law, the Act may broadly be said to apply to premises, rooms, or places in which manual labour, with or with- out the aid of mechanical power, is exercised for gain in or inciden- tal to the making, altering, repairing, ornamenting, or finishing or adapting for sale of any article or part of any article. If steam, water, or other mechanical power is used in aid of the manufactur- ing process, the workplace is a factory ; if not, it is a workshop. There is, however, a list of eighteen classes of works (brought under the factory la w for reasons of safety, &c. , before workshops generally were regulated) which are defined as factories whether power is used in them or not. Factories are, again, subdivided into textile and non-textile : they are textile if the machinery is employed in preparing, manufacturing, or finishing cotton, wool, hair, silk, flax, hemp, jute, tow, China grass, cocoanut fibre, or other like material either separately or mixed together, or mixed with any other material, or any fabric made thereof ; all other factories are non-textile. The distinction turns on the historical origin of factory regulation, the earliest places calling for regulation having been the textile factories, and the regulations remain in some respects slightly more stringent than in the non-textile factories and work- shops, though the general provisions are almost the same. Three special classes of workshops have for certain purposes to be dis- tinguished from ordinary workshops, which include tenement work- shops : (a) Domestic workshops, i.e., any private house, room, or place, which, though used as a dwelling, is by reason of the work carried on there a workshop, and in which the only persons employed are members of the same family, dwelling there alone — in these women’s hours are unrestricted ; (6) Women’s work- shops, in which neither children nor young persons are employed — in these a more elastic arrangement of hours is permissible than in ordinary workshops ; (c) Workshops in which men only are employed — these come under the same general regulations in regard to sanitation as other workshops, also under the provisions of the Factory Act as regards security, and, if certified by the Secretary of State, may be brought under special regulations. They are otherwise outside the scope of the Act of 1901.

The persons to whom the regulations apply in the above-defined woTkplSioes Are children, i.e., persons between the ages of twelve and fourteen, young persons, i.e., boys or girls between the ages of fourteen (or if an educational certificate has been obtained, thirteen) and eighteen years of age, and women, i.e., female persons above the age of eighteen ; these are all “protected” persons to whom the general provisions of the Act, inclusive of the regula- tion of hours and times of employment, apply. To adult men generally those provisions broadly only apply which are aimed at

securing sanitation and safety in the conduct of the manufacturing process.

The person generally responsible for observance of the jDrovisions of the law, whether these relate to health, safety, limitation of the hours of labour, or other matters, is the occupier (a term un- defined in the Act) of the factory, workshop, or laundry. There are, however, limits to his responsibility : (a) generally, where the occupier has used due diligence to enforce the execution of the Act, and can show that another person, whether agent, servant, work- man, or other person, is the real offender ; (&) specially in a factory the sections relating to employment of protected persons, where the owner or hirer of a machine or implement driven by mechanical power is some person other than the occupier of the factory, the owner or hirer, so far as respects any offence against the Act com- mitted in relation to a person who is employed in connexion with the machine or implement, and is in the employment or pay of the owner or hirer, shall be deemed to be the occupier of the factory ; (c) for the one purpose of reporting accidents, the actual employer of the person injured in any factory or workshop is bound under pen- alty immediately to report the same to the occupier ; (d) so far as relates to sanitary conditions, fencing of machinery, affixing of no- tices in tenement factories, the owner (as defined by the I’ublic Health Act, 1875,) generally speaking, takes the place of the occupier.

Employment in a factory or workshop includes work whether for wages or not : (a) in a manirfacturing process or handicraft, (6) in cleaning any place used for the same, (c) in cleaning or oiling any part of the machinery, (d) any work whatsoever incidental to the process or handicraft, or connected with the article made. Persons found in any part of the factory or workshop,

where machinery is used or manufacture carried on, except at meal-times, or when machinery is stopped, are deemed to be employed until the con- trary is proved. The Act, however, does not apply to employment for the sole purpose of repairing the premises or machinery, nor to the process of preserving and curing fish immediately upon its ar- rival in the fishing boats in order to prevent the fish from being de- stroyed or spoiled, nor to the process of cleaning and preparing fruit so far as is necessaiy to prevent it from spoiling during the months of June, July, August, and September. Certain light handicrafts carried on by a family only in a private house or room at irregu- lar intervals are also outside the scope of the Act.

The foremost provisions are those relating to the sanitary condition of the workplaces and the general security of every class of worker. Every factory must be kept in a cleanly condition, free from noxious elHuvia, ventilated in sucJti ^^”’’^“oa. a manner as to render harmless, so far as practicable, gases, vapours, dust, or other impurities generated in the manufacture ; must be provided with sufficient and suitable sanitary conveniences separate for the sexes ; must not be overcrowded (not less than 250 cubic feet during the day, 400 during overtime, for each worker). In these matters the law of public health takes in workshops the place of the Factory Act, the requirements being substantially the same. Although, however, primarily the officers of the District Council enforce the sanitary provisions in workshops, the Govern- ment factory inspectors may give notice of any defect in them to the District Council in whose district they are situate ; and if pro- ceedings are not taken within one month by the latter, the factory inspector may act in default and recover expenses from the District Council. This power does not extend to domestic workshops which are under the law relating to public health so far as general sanitation is concerned. General powers are reserved to the Secretary of State, where he is satisfied that the Factory Act or law relating to public health as regards workplaces has not been carried out by any District Council, to authorize an inspector during a period named in his order to act instead of the District Council. Other general sanitaiy provisions administered by the Government inspectors are the requirement in factories and work- shops of washing conveniences where poisonous substances are used ; adequate measures for securing and maintaining a reason- able temperature of such a kind as will not interfere with the purity of the air in each room in which any person is employed ;

maintenance of sufficient means of ventilation in every room in a factory or workshop (in conformity with such standard as may be prescribed by order of the Secretary of State) ; provision of a fan to carry off injurious dust, gas, or other impurity, and prevent their inhalation in any factory or workshop ; drainage of floors where wet processes are carried on. For laundries and bakehouses there are further sanitary regulations ; e.g., in laundries all stoves for heating irons shall be sufficiently separated from any ironhigroom, and the floors shall be “drained in such a manner as will allow the water ‘to flow off freely “; and in bakehouses a system supplying water to a bakehouse must be quite separate from that supplying water to a water-closet, and the latter may not communicate directly with the bakehouse. Use of underground bakehouses (i.e., a baking room with floor more than three feet below the ground adjoining) is prohibited, except where already used at the passing of the Act ; further, in these cases, after 1st January 1904, a certificate as to

suitability in light, ventilation, &c., must be obtained from the District Council. In other trades certified by the Secretary of State further sanitary regulations may be made to increase security for health by special rules to be presently touched on. The Secretary of State may also make sanitary requirements a condition of granting such exceptions to the general law as he is empowered in some cases to grant. In factories, as distinct from workshops, a periodical lime washing (or washing with hot water and soap where paint and varnish have been used) of all inside walls and ceilings once at least in every fourteen months is required (in bakehouses once in six months). As regards sufficiency and suitability of sanitary accom-modation, any standard determined by order of the Secretary of State shall be observed in the districts to which it is made applicable.

Security in the use of machinery is provided for by precautions as regards the cleaning of machinery in motion and working be- tween the fixed and traversing parts of self-acting Security machines driven by power, by fencing of machinery, and by empowering inspectors to obtain an order from a court of summary jurisdiction to prohibit the use, temporarily or absolutely, of machinery, ways, works or plant, in- cluding use of a steam boiler, which cannot be used without danger to Ufe and limb. Every hoist and fly-wheel directly connected with mechanical power, and every part of a water-wheel or engine worked by mechanical power, and every wheel race, must be fenced, whatever its position, and every part of mill-gearing or dangerous machinery must either be fenced or be in such position that it is as safe as if fenced. No protected persons may clean any part of mill-gearing in motion, and children may further not clean any part of or below manufacturing machinery in motion by aid of mechanical power; young persons further may not clean any machinery if the inspector notifies it to the occupier as dangerous. Security as re- gards the use of dangerous premises is provided for by empowering courts of summary jurisdiction, on the application of an inspector, to prohibit their use until the danger has been removed. The District Council or, in London, the County Council, or in case of their de- fault the factory inspector, can require certain provisions for escape in case of fire in factories and workshops, and for this purpose have special powers to make bye-laws. The means of escape must be kept free from obstruction. Certain provisions are also made for doors to open outwards in each room in which more than ten per- sons are employed, and to prevent the locking, bolting, or fastening of doors so that they cannot easily be opened from inside when any person is employed or at meals inside the workplace. Eurther, provisions for security may be provided in special regulations. Every boiler for generating steam in a factory or workshop or place where the Act applies must have a proper safety valve, a steam gauge, and a water gauge, and every such boiler, valve, and gauge must be maintained in proper condition. Examination by a com- petent person must take place at least once in every fourteen months. The occupier of any factory or workshop may be liable for penal compensation not exceeding £100 in case of injury or death due to neglect of any provision or special rule, the whole or any part of which may be applied for the benefit of the injured person or his family, as the Secretary of State determines. When a death has occurred by accident in a factory or workshop, the

coroner must advise the Government inspector for the district of the place and time of the inquest. The Secretary of State may order a formal investigation of the circumstances of any accident, as in the case of mines (§§ 45 and 46 of the Act of 1887). Careful and detailed provisions are made for the reporting by occupiers to in- spectors (and in some oases to certifying surgeons also) and entry in the registers at factories and workshops of accidents entailing absence from ordinary employment, and of cases of lead, phosphorus, arsenical and mercurial poisoning, or anthrax. The duty of report- ing these industrial oases of poisoning is also laid on medical prac- titioners under whose observation they come. The list of classes of poisoning can be extended by the Secretary of State's order.

Certificates of physical fitness for employment must be obtained by the occupier from the certifying surgeon for the district for all persons under sixteen years of age employed in a factory, and an Inspector may suspend any such persons for re-examination in a factory, orfor examination in a workshop, when " disease or bodily infirmity " unfits the person, in his opinion, for the work of the place. An occupier of a factory or workshop or laundry shall not knowingly allow a woman to be employed therein within four weeks after childbirth.

The employment of children, young persons, and women is regu- lated as regards ordinary and exceptional hours of work, ordinary and exceptional meal-times, length of spells, and holi- days. The outside limits of ordinary periods of em- ployment and holidays are broadly the same for textile factories as for non-textile factories and workshops ; the main difference lies in the requirement of not less than a total two hours' interval for meals out of the twelve, and a limit of four and a half hours for any spell of work, a longer weekly half holiday, and a prohibition of overtime, in textile factories, as compared with a

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total one and a half hours' interval for meals and a limit of five hours for spells and (conditional) permission of overtime in non- textile factories. The hours of work in all these cases must be speci- fied, and from Monday to Friday may be between 6 a.m. and 6 p.m., or 7 A.M. to 7 P.M. ; in non-textile factories and workshops the hours also may be taken between 8 a. m.

and 8 p.m. , or by order of the Secre- tary of State for special industries 9 a.m. to 9 p.m. Between these outside limits, with the proviso that meal-times must be fixed and limits as to spells observed, women and young persons may be em- ployed the full time, children on the contrary only half time, on alternate days, or in alternate sets attending school half time regu- larly. On Saturdays, in textile factories in which the period com- mences at 6 A.M. all manufacturing work must cease at 12 if not less than one hour is given for meals, or 11.30 if less than one hour is given for meals (half an hour extra allowed for cleaning), and in non-textile factories and workshops at 2 p.m., 3 p.m., or 4 p.m., ac- cording as the hour of beginning is 6 a.m., 7 a.m., or 8 a.m. In “domestic workshops” the total number of hours foryoung persons and children must not exceed those allowed in ordinary workshops, but the outside limits for be^nning and ending are wider ; and the case is similar as regards hours of women in “women’s work- shops.” Employment outside a factory or workshop in the busi- ness of the same is limited in a manner similar to that laid down in the Shop Hours Act, to be touched on presently. Overtime in certain classes of factories, workshops, and warehouses attached to them is permitted, under conditions specified in the Acts, for women, to meet seasonal or unforeseen pressure of business, or where goods of a perishable nature are dealt with, for young per- sons only in a very limited degree in factories liable to stop- page for drought or flood, or for an unfinished process. These and other oases of exceptional working are under minute and careful administrative regulations. Broadly these same regulations as to exceptional overtime apply in laundries, but the ordinary regular tion of the period of employment does not ; in them the period may be daily changed by the occupier, and the main general limit is to sixty hours a week for women and young persons, and thirty hours a week for children ; the only regulation with regard to meal- times is that protected persons may not be employed for more than five hours without being allowed at least half an hour for a meal. Night work is allowed in certain specified industries under con- ditions for male young persons, but for no other workers under eighteen, and overtime for women may never, except in laundries, be later than 10 p.m. or before 6 a.m. Sunday work is prohibited except in laundries ; and in factories, workshops, and laundries six holidays (generally the Bank holidays) must be allowed in the year. In creameries in which women and young persons are employed the Secretary of State may by special order vary the be- ginning and end of the daily

period of employment, and allow em- ployment for not more than three hours on Sundays and holidays. The general provisions of the Act may be supplemented where specially dangerous or unhealthy trades are carried on, by special regulations to meet the necessities of the case. This was provided for in the law in force until 31st Decern- Dangerous ber 1901, as in the new Act, and the power to establish ^ . .^ rules had been exercised between 1892 and 1901 in the ““dustrles case of twenty-two trades or processes where injury arose either from handling of dangerous substances, such as lead and lead compounds, phosphorus, arsenic, or various chemicals, or where there is inhalation of irritant dust or noxious fumes, or where there is danger of explosion or infection of anthrax. Before the rule could be drawn up under the Acts of 1891 to 1895, the Secretary of State had to certify that in the particular case or class of cases in question (e.g., process or machinery), there was, in his opinion, danger to life or limb or risk of injury to health ; there- upon the Chief Inspector might propose to the occupier of the fac- tory or workshop such special rules or measures as he thought necessary to meet the circumstances. The occupier might object or propose modifications, but if he did not the rules became bind- ing in twenty-one days ; if he objected, and the Secretary of State did not assent to any proposed modification, the matters in difference had to be referred to arbitration, the award in which finally settled the rules or requirement to be observed. In November 1901, in the case of the earthenware and china in- dustry, the last arbitration of the kind was opened and partly concluded ; certain points of difference were by the umpire adjourned for further consideration until May 1903. These points touch : (a) the nature or form of the poisonous material used ; (ft) medical examination and suspension of male adult workers. The parties to the arbitration were the Chief Inspector, on behalf of the Secretary of State, on the one hand, and the occupier or occupiers, on the other hand, but the workmen inter- ested might be represented on the arbitration. In the establishing of the twenty-two sets of existing special rules only thrice has arbitration been resorted to, and only on two of these occasions were workmen represented. The provisions as to the arbitration were laid down in the first schedule to the Act of 1891, and were

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similar to those under the Coal Mines Regulation Acts. After rules were established the Secretary of State might from time to time propose new rules, or amendments of established rules, and the procedure was to be as nearly as possible the same as in the first instance. The rules might not only regulate conditions of employment, but also restrict or prohibit employment of any class of workers ; where such restriction or prohibition affected adult workers the rules must be laid for forty days before both Houses of Parliament before coming into operation. The obligation to ob- serve the rules in detail lies on workers as well as on occupiers, and the section in the Act of 1891 providing a penalty for non-observ- ance was drafted, as in the case of the mines, so as to provide for a simultaneous fine for each (not exceeding two pounds for the worker, not exceeding ten pounds for the employer).

The provisions as to special regulations of the Act of 1901 touch primarily the method of procedure for making the regulations, but they also cover for the first time domestic workshops and add a power as to the kind of regulations that may be made ; further, they strengthen the sanction for observance of any rules that may be established, by placing the occupier in the same general position as regards penalty for non-observance as in other matters under the Act. On the certificate of the Secretary of State that any manu- facture, machinery, plant, process, or manual labour used in fac- tories or workshops is dangerous or injurious to life, health, or limb, such regulations as appear to the Secretary of State to meet the necessity of the case may be made by him after he has duly pub- lished notice : (1) of his intention ; (2) of the place where copies of the draft regulations can be obtained ; and (3) of the time during which objections to them can be made by persons affected. The Secretary of State may modify the regulations to meet the objec- tions made. If not, unless the objection is withdrawn or appears to him frivolous, he shall, before making the regulations, appoint a competent person to hold a public inquiry with regard to the draft regulations and to report to him thereon. The inquiry is to be made under such rules as the Secretary of State may lay down, and when the regulations

are made, they must be laid as soon as possible be- fore Parliament. Either House may annul these regulations or any of them, without prejudice to the power of the Secretary of State to make new regulations. The regulations may apply to all factories or workshops in which the certified manufacture, process, &c. , is used, or to a specified class. They may, among other things, (a) prohibit or limit employment of any person or class of persons ;

(b) prohibit, limit, or control use of any material or process ;

(c) modify or extend special regulations contained m the Act. Although the Factory and Worlishop Acts have not in any way

directly regulated wages, they have made certain provision for secur- ing to the worker that the amount agreed upon shall Measures ije received by him or her : (a) by extending every Act *”’’ in force relating to the inspection of weights, measures,

particulars ^^^^ weighing-machines for use in the sale of goods to worth’s tliose used in a factory or workshop for checking or ascertaining the wages of persons employed; (&) by ensuring that piece-workers in the textile trades (and other trades specified by the Secretary of State) shall receive, before commen- cing any piece of work, clear particulars of the wages applicable to the work to be done and of the work to which that rate is to be ap- plied. Unless the particulars of work are ascertainable by an automatic indicator, they must be given to textile workers in writ- ing, and in the case of weavers in the cotton, worsted, and woollen trades the particulars of wages must be supplied separately to each worker, and also shown on a placard in a conspicuous position. In other textile processes it is sufficient to furnish the particulars sepa- rately to each worker. The Secretary of State has used his powers to extend this protection to non-textile workers, with suitable modi- fications, in various branches of clothing and hardware industries. Under the new Act he further has power to extend this protection to outworkers.

With a view to efficient administration of the Act (a) certain notices have to be conspicuously exhibited at the factory or work- shop, (6) registers and lists kept, and (c) notices sent to the inspector by the occupier. Among the first the most important are the prescribed abstract of the Act, the names

and addresses of the inspector and certifying surgeon, the period of employment, and specified meal-times (which may not be changed without fresh notice to the inspector), the number of persons who may legally be employed in each room, and prescribed particulars of exceptional employment ; among the second are the general registers of children and young persons employed, of acci- dents, of overtime, and lists of outworkers ; among the third are the notice of beginning to occupy a factory or workshop, which the occupier must send within one month, report of overtime employ- ment, notice of accident, poisoning, or anthrax, and returns of persons employed, with such other particulars as may be prescribed. These must be sent to the Chief Inspector at intervals of not less than one and not more than three years, as may be directed by the Secretary of State.

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The Secretary of State for the Home Department controls the administration of the Acts, appoints the inspectors referred to in the Acts, assigns to them their duties, and regulates the manner and cases in which they are to exercise the powers of inspectors defined in the Act. The Act, however, expressly assigns certain duties and powers to a chief inspector and certain to district in- spectors. Many of the provisions of the Acts depend as to their operation on the making of orders by the Secretary of State. These orders may impose special obligations on occupiers and increase the stringency of regulations, may apply exceptions as to employment, or may relax regulations to meet special classes of circumstances. In certain cases, already indicated, his orders guide or detei-mine the action of district councils, and, generally, in case of default by a council he may empower his inspectors to act as regards work- places instead of the council, both under the Factory Acts and the Public Health Acts.

The powers of an inspector are to enter, inspect, and examine, by day or by night, at any reasonable time, any factory or workshop (or laundry, dock, &c.), or part of one, when he has reason to be- lieve that any person is employed there ; to take with him a consta- ble if he has reasonable cause to expect obstruction ; to require production of registers, certificates, &c. , under the Acts ; to examine, alone or in the presence of any other person, as

he sees fit, every pei’son in the factory or workshop, or in a school where the children employed are being educated ; to prosecute, conduct, or defend be- fore a court of summary jurisdiction any proceeding under the Acts ; and to exercise such other powers as are necessary for carrying the Act into effect. The inspector has also the duty of enforcing the Truck Acts in places, and in respect of persons, under the Factory Acts. He may also have assigned to him by the Secretary of State the duty of enforcing the restrictions and conditions of any license for the employment of a child in places of public entertainment under the Prevention of Cruelty to Children Act, 1894. Certifying surgeons are appointed by the Chief Inspector subject to the regu- lations of the Secretary of State, and their chief duties are to exam- ine workers under sixteen, and persons under special rules, as to physical fitness, and to iuvestigate and report on accidents and cases of lead, phosphorus, or other poisoning, and anthrax.

In 1900 there were registered as under inspection 95,664 factories and 1.37,648 workshops (inclusive of laundries), 2097 docks, wharves, and quays, and 3907 warehouses. Of notices of accidents received there were 79,020, of which 1045 were fatal, and of cases of poison- ing by lead, 1058 ; by mercury, 9 ; by phosphorus, 3 ; by arsenic, 22 ; and of anthrax, 37. Notices by inspectors to local sanitary authori- ties numbered 4542. Proceedings were taken by inspectors in 3287, and convictions obtained in 3151 cases.

Coed Mines. — The mode of progress to be recorded in the regulation of coal mines since 1872 can be contrasted in one aspect with theprogress just recorded of factory legis- lation since 1878. Consolidation was earlier adopted when large amendments were found necessary, with the result that by far the greater part of the law is to be found in the Act of 1887 (60 and 51 Vict. cap. 68), which repealed and re-enacted, with amendments, the Coal Mines Acts of 1872 and 1886, and the Stratified Ironstone Mines (Gunpowder) Act, 1881. The Act of 1881 was simply concerned with rules relating to the use of explosives underground. The Act of 1886 dealt with three questions : (a) The election and payment of check-weighers {i.e., the persons appointed and paid by miners in pursuance of section 13 of the Act of 1887 for the purpose of taking a correct account on their behalf of the weight of the mineral gotten by them, and for the correct determination of

certain deductions for which they may be liable) ; (5) provision for new powers of the Secretary of State to direct a formal investigation of any explosion or accident, and its causes and circum- stances, a provision which was later adopted in the law relating to factories ; (c) provision enabling any relatives of persons whose death may have been caused by explosions or accidents in or about mines to attend in person, or by agent, coroners' inquests thereon, and to examine wit- nesses. The Act of 1887, which amended, strengthened, and consolidated these Acts and the earlier Consolidating Act of 1872, may also be contrasted in another aspect with the general Acts of factory legislation. In scope it formed, as its principal forerunner had done, a general code ; and in some measure it went farther in the way of consolidation than the Factory Acts had done, inasmuch

as certain questions, whicli in factories are dealt with by statutes distinct from the Factory Acts, have been included in the Mines Eegulation Acts, e.g., the prohibition of the payment of wages in public-houses, and the machinery relating to weights and measures whereby miners control their payment; further, partly from the less changing nature of the industry, but probably mainly from the power of expression gained for miners by their organiza- tion, the code, so far as it went, at each stage answered apparently on the whole more nearly to the views and needs of the persons protected than the parallel law relating to factories. This is strikingly seen in the evi- dence before the Eoyal Commission on Labour in 1892- 94, where the repeated expressions of satisfaction on the part of the miners with the provisions as distinct from the administration of the code ("with a few trifling exceptions") are in marked contrast with the long and varied series of claims and contentions put forward for amendment of the Factory Acts.

Since the Act of 1887 there have followed only three minor Acts, based on the recommendation of the officials acting under the Acts, while two of them give effect to claims made by the miners before the Labour Commission. Thus, in 1894, the Coal Mines (Checkweigher) Act rendered

it illegal for an employer ("owner, agent, or manager of any mine, or any person employed by or acting under the instructions of any such owner, agent, or manager") to make the removal of a particular cheek- weigher a condition of employment, or to exercise im- proper influence in the appointment of a checkweigher, carrying into effect' the recommendations to the Labour Commission both of inspectors and miners. The need for this provision was demonstrated by a decision of the Court of Session in Edinburgh, which upheld an employer in his claim to the right of dismissing all the workmen and re-engaging them on condition that they would dismiss a particular checkweigher. In 1896 a short Act of seven sections extended the powers to propose, amend, and modify special rules, provided for representation of workmen on arbitration under the principal Act on any matter in difference, modified the provision for plans of mines in working and abandoned mines, amended three of the general rules (inspection before commencing work, use of safety lamp, and non-inflammable substances for stemming), and empowered the Secretary of State by order to prohibit or regulate the use of any explosive likely to become dangerous. In 1900 another brief Act raised the age of employment of boys underground from twelve to thirteen.

While the classes of mines regulated by the Act of 1887 are the same as those regulated by the Act of 1872 {i.e., mines of coal, of stratified ironstone, of shale, and of fire-clay, including works above ground where the minerals are prepared for use by screening, washing, &c.), the interpretation of the term "mine" is rather wider and simpler, including "every shaft in the course of being sunk, and every level and inclined plane in the course of being driven, and all the shafts, levels, planes, works, tramways, and sidings, both below ground and above ground, in and adjacent to and belonging to the mine." Of the persons responsible under penalty for the observance of the Acts the term "owner" is defined precisely as in the Act of 1872, but the term "agent" is modified to mean "any person ap- pointed as the representative of the owner in respect of any mine or any part thereof, and, as such, superior to a manager appointed in pursuance of this Act." Of the persons protected, the term "young person" disappears from the Act, and "boy," i.e., "a male under the age of sixteen years," and "girl," i.e., "a female under the age of sixteen years," take their place, and the term "woman"

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means, as before, “a female of the age of sixteen years and upwards.” The prohibition of employment under- ground of women and girls remains untouched, and the prohibition of employment underground of boys has been successively extended from boys of the age of ten in 1872 to boys of twelve in 1887 and to boys of thirteen in 1900. The age of employment of boys and girls above ground in connexion with any mine is raised from ten years in 1872 to twelve years since 1887. The hours of employ- ment of a boy below ground may not exceed fifty-four in any one week, nor ten in any one day from the time of leaving the surface to the time of returning to the surface. Above ground any boy or girl under thirteen (and over twelve) may not be employed on more than six days in any one week ; if employed on more than three days in one week, the daily total must not exceed six hours, or in any other case ten hours. Protected persons above thirteen are limited to the same daily and weekly total of hours as boys below ground, but there are further pro- visions with regard to intervals for meals and prohibiting employment for more than five hours without an interval of at least half an hour for a meal. Registers must be kept of all protected persons, whether employed above or below ground. Section 38 of the Public Health Act, 1875, which requires separate and sufficient sanitary con- veniences for persons of each sex, was first extended by the Act of 1887 to the portions of mines above ground in which girls and women are employed. Ventilation, the only other requirement in the Acts that can be classed as sanitary, is provided for in every mine in the ” general rules ” which are aimed at securing safety of mines, and which, so far as ventilation is concerned, seek to dilute and render harmless noxious or inflammable gases. The provision which prohibits employment of any persons in mines not provided with at least two shafts is made much more stringent by the Act of 1887 than in the previous code, by increasing the distance between the two shafts from 10 to 15 yards, and increasing the height of communications between them. Other provisions amended or strengthened are those relating to the follow- ing points: (a) Daily personal supervision of the mine by the certificated manager; (&) classes of certificates and constitution of board for granting certificates of competency

; (c) plan of workings of any mine to be kept up to a date not more than three months previously at the office of the mine ; (d) notice to be given to the inspector of the district by the owner, agent, or manager, of accidents in or about any mine which cause loss of life or personal injury : it is provided that the place where an explosion or accident occurs causing loss of life or serious personal injury shall be left for inspection for at least three days, unless this would tend to increase or continue a danger or impede working of the mine : this was new in the Act of 1887; (e) notice to be given of opening and abandonment of any mine : this was extended to the opening or abandonment of any seam ; (/) plan of an abandoned mine or seam to be sent within three months; (g) formal investigation of any explosion or accident by direction of the Secretary of State : this provision, first introduced by the Act of 1886, was modified in 3887 to admit of the appointment by the Secretary of State of “any competent person” to hold the investigation, whereas under the earlier section only an inspector could be appointed.

The ‘‘general rules ” for safety in mines have been added to and strengthened in many ways since the Act of 1872. Particular mention may be made of rule 4 of the Act of 1887, relating to the inspection of conditions as to gas ventila- tion beyond appointed stations at the entrance to the mine or difierent parts of the mine ; this rule generally removed the earlier distinction between mines in which inflammable gas has been found within the preceding twelve months, and mines in which

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it has not been so found ; of rules 8, 9, 10, and 11, relating to the construction, use, &o., of safety lamps, which are more detailed and stringent than rule 7 of the Act of 1872, which they replaced ; of rule 12, relating to the use of explosives below ground ; of rule 24, which requires the appointment of a competent male person not less than twenty-two years

of age for the purpose of working the machinery for lowering and raising persons at the mine; of rule 34, which first required provision of ambulances or stretchers with splints and bandages at the mine ready for immediate use ; of rule 38, which strengthened the provision for periodical inspection of the mine by practical miners on behalf of the workmen at their own cost. With reference to the last-cited rule, it should be men- tioned that during 1898 a Prussian mining commission visited Great Britain, France, and Belgium, with a view to studying and compar- ing the various methods of inspection by working miners established in these three countries. They found that, so far as the method had been applied, it was most satisfactory in Great Britain, where the whole cost is borne by the workers' own organizations, and they attributed part of the decrease in number of accidents per thousand employed since 1872 to the inauguration of this system.

The provisions as to the proposal, amendment, and modification of "special rules," last extended by the Act of 1896, may be con- Soecial trasted with those of the Factory Act. In the latter rules. ^^ ^ °°* until an industry or process has been scheduled

as dangerous or injurious by the Secretary of State's order that occasion arises for the formation of special rules, and then the initiative rests with the Factory Department, whereas in mines it is incumbent in every case on the owner, agent, or manager to propose within three months of the commencement of any work- ing, for the approval of the Secretary of State, special rules best calculated to prevent dangerous accidents, and to provide for the safety, convenience, and proper discipline of the persons employed in or about the mine. These rules may, if they relate to lights and lamps used in the mine, description of explosives, watering and damping of the mine, or prevention of accidents from inflammable gas or coal dust, supersede any general rule in the principal Act. Apart from the initiation of the rules, the methods of establishing them, whether by agreement or by resort to arbitration of the two parties (i.e., the mine owners and the Secretary of State), are prac- tically the same as under the Factory Act, but there is a special provision in the Mines Acts for enabling the persons working in the mine to transmit objections to the proposed rules, in addition to their subsequent right to be represented on the arbitration, if any.

Of the sections touching on wages questions, the prohibition of the payment of wages in public-houses remains unaltered, being re-enacted in 1887 ; the sections relating to payment by weight for amount of mineral gotten by persons employed, and for check- weighing the amount by a ” checkweigher ” stationed by the majority of workers at each place appointed for the weighing of the material, were revised, particularly as to the determination of deductions by the Act of 1887, with a view to meeting some of the problems raised by decisions on cases under the Act of 1872. The attempt seems not to have been wholly successful, the highest legal authorities having expressed conflicting opinions on the precise meaning of the terms “mineral contracted to be gotten.” The whole history of the development of this means of securing the fulfilment of wage contract to the workers may be compared with the history of the sections affording protection to piece-workers by particulars of work and wages in the textile trades since the Factory Act of 1891.

As regards legal proceedings, the chief amendments of the Act of 1872 are: the extension of the provision that the “owner, agent, or manager” charged in respect of any contravention Adminis- ^y a^jjQjjigj. person might be sworn and examined as an tration. ordinary witness, to any person charged with any of- fence under the Act. The result of the proceedings against work- men by the owner, agent, or manager in respect of an offence under the Act is to be reported within twenty-one days to the inspector of the district. The powers of inspectors were extended to cover an inquiry as to the care and treatment of horses and other animals used in the mine, and as to the control, management, or direction of the mine by the manager.

In 1900 the number of coal mines reported on was 3384, and the number of persons employed below ground was 624,223, of whom 47,663 were under 16 years of age. Above ground 155,829 were employed, of whom 4808 were women and girls. The number of separate fatal accidents was 962, causing the loss of 1012 lives. Of prosecutions by far the greater number were against workmen, numbering 646 ; owners and managers were prosecuted in 115 cases, and convictions obtained in 61 cases.

Quarries. From 1878 until 1894 open quarries (as

distinct from underground quarries regulated by the Metalliferous Mines Regulation Act) were regulated only by the Factory Acts so far as they then applied. It was

laid down in section 93 of the Act of 1878 (41 Vict. c. 16), that ” any premises or place shall not be excluded from the definition of a factory or workshop by reason only that such premises, &c., are or is in the open air,” thereby overruling the decision in Kent v. Astley that quarries in “which the work, as a whole, was carried on in the open air were not factories ; in a schedule to the same Act quarries were defined as “any place not being a mine in which persons work in getting slate, stone, cop- rolites, or other minerals.” The Factory Act of 1891 made it possible to bring these places in part under “spe- cial rules ” adapted to meet the special risks and dangers of the operations carried on in them, and by order of the Secretary of State they were certified, 27th December 1892, as dangerous, and thereby subject to special rules. Until then it was, as reported by one of H.M. Inspectors of Factories, the case that quarries had been placed under the Factory Acts without insertion of appropriate rules for their safe working, and that many of them were “developed in a most dangerous manner without any regard for safety, but merely for economy,” and that managers of many had “scarcely seen a quarry until they became managers.” In his report for 1892 it was recommended by H.M. Chief Inspector of Factories that quarries should be subject to the jurisdiction of H.M. Inspectors of Mines. At the same time currency was given, by the published reports of the evidence before the Eoyal Commission on Labour, to the wish of large numbers of quarrymen that open as well as underground quarries should come under more specialized Government inspection. In 1893 a committee of experts, including inspectors of mines and of factories, was ap- pointed by the Home Office to investigate the conditions of labour in open quarries, and to make recommendations. This committee proposed rules covering points not pro- vided for by the Factory Acts, but pointed out that they could not be enforced under existing legislation, and that no special rules applied in open quarries where neither women nor young persons were employed, and they ex- pressed the opinion that further legislation was necessary.

In 1894 the Quarries Act was passed, which brought every quarry, as defined in the Factory Act, 1878, any part of which is more than 20 feet

deep, under certain of the provisions of the' Metalliferous Mines Acts, and under the inspection of the inspectors appointed under those Acts; further, preventing conflict of jurisdiction, it trans- ferred the duty of enforcing the Factory and Workshop Acts, so far as they apply in quarries over 20 feet deep, from the Factory to the Metalliferous Mines inspectors. The provisions of the Metalliferous Mines Acts, 1872 and 1875, applied to quarries, are those relating to payment of wages in public-houses, notice of accidents to the in- spector, appointment and powers of inspectors, arbitration, coroners' inquests, special rules, penalties, certain of the definitions, and the powers of the Secretary of State finally to decide dispiited questions whether places come within the application of the Acts. For other matters, and in particular fencing of machinery and employment of women and young persons, the Factory Acts apply, with a proviso that nothing shall prevent the employment of young persons (boys) in three shifts for not more than eight hours each. In 1899 it was reported by H.M. In- spectors of Mines that special rules for safety had been established in over 2000 quarries. The absence or defi- ciency of external fencing to a quarry dangerous to the public has been since 1887 (50 and 61 Vict. c. 19) deemed a nuisance liable to be dealt with summarily in the man- ner provided by the Public Health Act, 1876.

In 1900, 93,896 persons were employed, of whom 60,631 worked inside the actual pits or excavations, and 33,264 outside. Compared with 1899, there was a total decrease of 4100 in the number of persons employed, 3528

being among inside workers. Patal accidents resulted in 127 deaths; compared with 1899 there was an increase of 10 in the number of deaths. As Prof. Le Neve Foster points out, this exceeds the average death-rate of under- ground workers at mines under the Coal Mines Acts during the last ten years, in spite of the quarrier " having nothing to fear from explosions

of gas, underground fires, or inundations.” He attributes the difference to a lax observance of precautions which may in time be remedied by stringent administration of the law. In 1900 there were 92 prosecutions against owners or agents, with 67 convictions, and 13 prosecutions of workers, with 12 convictions.

In 1883 a short Act of five sections extended to all ” workmen ” ■who are manual labourers other than miners, with the exception of domestic or menial servants, the prohibition of payment Payment of wages in public-houses, beer-shops, and other places of wages fop i\^Q gale of spirituous or fermented liquor, laid down la public- jj^ ^jjg Qoal Mines Regulations and Metalliferous Mines houses. Regulation Acts. The places covered by the prohibition include any office, garden, or place belonging to or occupied with the places named, but the Act does not apply to such wages as are paid by the resident, owner, or occupier of the public-house, beer- shop, and other places included in the prohibition to any workman bonti fide employed by him. The penalty for an offence against this Act is one not exceeding £10 (compare the limit of £20 for the corresponding offence under the Coal Mines Act), and all offences may be prosecuted and penalties recovered in England and Scotland under the Summary Jurisdiction Acts. The Act, however, does not apply to Ireland, and no special inspectorate is charged with the duty of enforcing the Act, whether in relation to employes in factories, shops, docks, or elsewhere.

Shop Hours.— In four brief Acts, 1892 to 1899, the first very limited steps have been taken towards the regu- lation of the employment of shop assistants. In place of such general codes as apply to factories, laundries, mines — touching security, hygiene, limitation of daily periods, provision for holidays, &c. — only three kinds of protective requirement are binding on employers of shop assistants : (1) Limitation of the weekly total of hours of work of persons under eighteen years of age to seventy-four in- clusive of meal-times ; (2) prohibition of the employment of such persons in a shop on the same day that they have, to the knowledge of the employer, been employed in any factory or workshop for a longer period than would, in both classes of employment together, amount to the number of hours permitted to such persons in a factory or workshop ; (3) provision for the supply of seats by the employer, in all rooms of a shop or other premises

where goods are retailed to the public, for the use of female assistants employed in retailing the goods — the seats to be in the proportion of not fewer than one to every three female assistants. The first two of these requirements are contained in the Act of 1892, which also prescribed that a notice, referring to the provisions of the Act, and stating the number of hours in the week during which a young person may be lawfully employed in the shop, shall be kept exhibited by the employer; the third requirement was first provided by the Act of 1899. The two inter- vening Acts of 1893 and 1895 are merely supplementary to the Act of 1892; the former providing for the salaries and expenses of the inspectors which the council of any county or borough (and in the City of London the Common Council) were empowered by the Act of 1892 to appoint for the execution of the Act ; the latter providing a penalty of forty shillings for failure of an employer to keep exhibited the notice of the provisions of the Acts which in the absence of a penalty it had hitherto been impossible to enforce. The penalty for employment contrary to the Acts is a fine not exceeding one pound for each person so employed, and for failure to comply with the requirement as to seats, a fine not exceeding three pounds for a first offence, and for any subsequent offence a fine of not less than one pound and not exceeding five pounds.

A wide interpretation is given by the Act of 1892 to the class of workplace to which the limitation of hours applies. “Shop” means retail and wholesale shops, markets, stalls, and »jg3„/„_. „/ warehouses in which assistants are employed for hire, o^^™,.” and includes licensed public-houses and refreshment houses of any kind. The person responsible for the observance of the Acts is the ” employer ” of the ” young persons ” (i.e., persons under the age of eighteen years), whose hours are limited, and of the “female assistants ” for whom seats must be provided. Neither the term’ “employer” nor “shop assistant” (used in the title of the Act of 1899) is defined ; but other terms have the meaning assigned to them in the Factory and “Workshop Act, 1878. The “employer” has, in case of any contravention alleged, the same power as the ” occupier ” in the Factory Acts to exempt himself from fine on proof of due diligence and of the fact that some other person is the actual offender. The provisions of the Act of 1892 do not apply to members of the same family living in a house of which the shop

forms part, or to members of the employer's family, or to any one wholly employed as a domestic servant.

In London, where the County Council has appointed 6 men and 3 women inspectors to apply the Acts of 1892 to 1899, there were, in 1900, 7.5,929 premises under inspection. All were visited at least once during the year, some repeatedly, and in 9204 irregularities were found. Proceedings were instituted in 117 cases, resulting in 93 convictions. In 1900 the number of young persons under the Acts were : indoors, 10,239 boys and 4428 girls ; outdoors, 35,019 boys, 206 girls. As regards the Act o£ 1899, in only 1088 of the 14,844 shops affected in London was there failure to provide seats for the women employed in retailing goods. The Chief Officer of the Public Control Department reports that with very few excep- tions the law is complied with at the end of the first year of its application.

As regards cleanliness, ventilation, drainage, water-supply, and sanitary condition generally, shops have been since 1878 (by 41 Vict. c. 16, sect. 101) subject to the provisions of the Public Health Act, 1875, which apply to all buildings, except factories under the Factory Acts, in which any persons, whatever their number be, are employed. Thus, broadly, the same sanitary provisions apply in shops as in workshops, but in the former these are enforced solely by the officers of the local authority, without reservation of any power, as in workshops for the Home Office inspectorate, to act in default of the local authority.

Shop assistants, so far as they are engaged in manual, not merely clerical labour, come also under the provisions of the Truck Acts 1831 to 1887, and in all circumstances they fall within the sections directed against unfair and unreasonable fines in the Truck Act of 1896 ; but, unlike employes in factories, workshops, laundries, and mines, they are left to apply these provisions so far as they can themselves, since neither Home Office inspectors nor officers of the local authority have any powers to administer the Truck Acts in

Truck. — Setting aside the special Hosiery Manufacture (Wages) Act, 1874, which was aimed at a particular abuse appearing chiefly in the hosiery industry — the practice of making excessive charges on wages for machinery and frame rents — only two Acts have been added to the general

law against truck since the Act of 1831, which repealed all prior Acts and which still remains the principal Act. The first of the two was the Truck Amendment Act, 1887, which amended and extended the Act without adding any distinctly new principle ; the second was the Truck Act of 1896, which was directed towards providing remedies for matters clearly shown by various decisions under the earlier Truck Acts to be out- side the scope of the principles and provisions of those Acts. Under the earlier Acts the main objects were : (1) to make the wages of workmen, i.e., the reward of labour, payable only in current coin of the realm, and to prohibit whole or part payment of wages in food or drink or clothes or any other articles ; (2) to forbid agreements, express or implied, between employer and workmen as to the manner or place in which, or articles on which, a workman shall expend his wages, or for the deduction of the price of articles (other than materials to be used in the labour of the workmen), supplied by the employer, from wages. The Act of 1887 added a further prohibition by making it illegal for an employer to charge jJ^^J^y* interest on any advance of wages, ” whenever by agreement, custom, or otherwise a workman is entitled to receive in anticipation of the regular period of the payment

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of his wages an advance as part or on account thereof.” Further, it strengthened the section of the principal Act which provided that no employer shall have any action against his workman for goods supplied at any shop belonging to the employer, or in which the em- ployer is interested, by (a) securing any workman suing an employer for wages against any counter-claim in respect of goods supplied to the workman by any person under any order or direction of the employer, and (&) by expressly prohibiting an employer from dismissing any worker on account of any particular time, place, or man- ner of expending his wages. Certain exemptions to the prohibition of payment otherwise than in coin were pro- vided for in the Act of 1831, if an agreement were made in writing and signed by the worker, viz., rent, victuals dressed and consumed under the employer’s roof, medi- cine, fuel, provender for beasts of burden used in

the trade, materials and tools for use by miners, advances for friendly societies or savings banks ; in the case of fuel, provender, and tools, there was also a proviso that the charge should not exceed the real and true value. The Act of 1887 amended these provisions by requiring a correct annual audit in the case of deductions for medi- cine or tools, by permitting part payment of servants in husbandry in food, drink (not intoxicants) or other allow- ances, and by prohibiting any deductions for sharpening or repairing workmen's tools except by agreement not forming part of the condition of hiring. Two important administrative amendments were made by the Act of 1887 : (1) a section similar to that in the Factory and Mines Acts was added, empowering the employer to exempt himself from penalty for contravention of the Acts on proof that any other person was the actual offender aud of his own due diligence in enforcing the execution of the Acts ; (2) the duty of enforcing the Acts in factories, workshops, and mines was imposed upon H.M. Inspectors of the Factory and Mines Departments respectively of the Home Office, and to their task they were empowered to bring all the authorities and powers which they possessed in virtue of the Acts under which they are appointed; these inspectors thus prosecute de- faulting employers and recover penalties under the Sum- mary Jurisdiction Acts, but they do not undertake civil proceedings for improper deductions or payments which would lie with workmen under the Employers and Work- men Act, 1875. The persons to whom the benefits of the Persons - ^^^ applied were added to by the Act of 1887, benefited which repealed the complicated list of trades by Truck contained in the principal Act and substituted ‘’*■ the simpler definition of the Employers and

Workmen Act just referred to. Thus the Acts 1831 to 1887, and also the Act of 1896, apply to all workers (men, women, and children) engaged in manual labour, except domestic servants ; they apply not only in mines, factories, and workshops, but, to quote the published Home Office Memorandum on the Acts, “in all places where work-people are engaged in manual labour under a contract with an employer, whether or no the employer be an owner or ageilt or a parent, or be himself a work- man ; and therefore a workman who employs and pays others under him must also observe the Truck Acts.” The law thus covers outworkers for a contractor or sub- contractor. A decision of the High Court at Dublin in 1900 (Squire v. Sweeney) strengthened the inspectors in investigation of offences

committed amongst outworkers by supporting the contention that inquiry and exercise of all the powers of an inspector could legally take place in parts of an employer's premises other than those in which the work is given out. It defined for Ireland, in a narrower sense than had hitherto been understood, the classes of outworkers protected, by deciding that only

such as were under a contract personally to execute the work were covered.

At the time of the passing of the Act of 1887 it seems to have been generally believed that the obligation under the principal Act to pay the "entire amount of wages earned" in coin precluded and rendered illegal any de- ductions from wages in respect of fines. Important deci- sions in 1888 and 1889 showed this belief to have been ill-founded. The essential point lies in the definition of the word "wages" as the "recom- ^^"jff ,"/ pense, reward, or remuneration of labour," which implies not necessarily any gross snia in question between employer and workmen where there is a con- tract to perform a certain piece of work, but that part of it, the real net wage, which the workman was to get as his recompense for the labour performed. As soon as it became perfectly clear that excessive deductions from wages as well as payments by workers for materials used in the work were not illegal, and that deductions or payments by way of compensation to employers or by way of discipline might legally (with the single exception of fines for lateness for women and children, regulated by the Employers and Workmen Act, 187i3) even exceed the degree of loss, hindrance, or damage to the employer, it also came clearly into view that fur- ther legislation was desirable in order to extend the principles at the root of the Truck Acts. It was desir- able, that is to say, to hinder more fully the unfair deal- ing that may be encouraged by half-defined customs in work-places, on the part of the employer in making a contract, while at the same time leaving the principle of freedom of contract as far as possible untouched. The Truck Act of 1896 regulates the conditions under which deductions can be made by or pay- ʿ ispg* ments made to the employer, out of the " sum contracted to be paid to the worker," i.e., out of any gross sum whatever agreed upon between employer and workman. It makes such deductions or payments illegal unless they are in pursuance of a contract ; and it pro- vides that deductions (or payments) for (a) fines, (&) bad work and damaged goods, (c) materials, machines, and any other thing provided by

the employer in rela^ tion to the work shall be reasonable, and that particulars of the same in writing shall be given to the workman. In none of the three cases mentioned is the employer to make any profit ; neither by fines, for they may only be imposed in respect of acts or omissions which cause, or are likely to cause, loss or damage; nor by sale of materials, for the price may not exceed the cost to the employer ; nor by deductions or payments for damage, for these may not exceed the actual or estimated loss to the employer. Fines and charges for damage must be ” fair and reasonable having regard to all the circumstances of the case,” and no contract could make legal a fine which a court held to be unfair to the workman in the sense of the Act. The contract between the employer and workman must either be in writing signed by the workman, or its terms must be clearly stated in a notice constantly affixed in a place easily accessible to the workman, who shall be entitled, on request, to obtain from the employer a copy of the notice free of charge. On each occasion when a deduction or payment is made, full particulars in writing must be supplied to the workman. The em- ployer is bound to keep a register of deductions or payments, and to enter therein particulars of any fine made under the contract, specifying the amount and the nature of the act or omission in respect of which the fine was imposed. This register must be at all times open to inspection by inspectors of mines or factories, who are also entitled to make a copy of the contract or any part of it. This Act as a whole applies to all workmen included

under the earlier Truck Acts ; but, further, the sections relating to fines apply also in the case of any shop as- sistants. The latter, however, apparently are left to enforce the provisions of the law themselves, as no inspectorate is empowered to intervene on their behalf. In these and other cases a prosecution under the Truck Acts may be instituted by any person. Any workman or shop assistant may recover any sum deducted by or paid to his employer contrary to the Act of 1896, provided that proceedings are commenced within six months, and that where he has acquiesced in the

deduction or payment he shall only recover the excess over the amount which the court may find to have been fair and reasonable in all the circumstances of the case. It is expressly de- clared in the Act that nothing in it shall affect the pro- visions of the Coal Mines Acts with reference to payment by weight, or legalize any deductions, from payments made, in pursuance of those provisions. The powers and duties of inspectors are extended to cover the case of a laundry, and of any place where work is given out by the occupier of a factory or workshop or by a con- tractor or sub-contractor. Power is reserved for the Sec- retary of State to exempt by order specified trades or branches of them in specified areas from the provisions of the Act of 1896, if he is satisfied that they are unnec- essary for the protection of the workmen. This power has been exercised only in respect of one highly organ- ized industry, the Lancashire cotton industry. The effect of the exemption is not to prevent fines and deductions from being made, but the desire for it demonstrated that there are cases where leaders among workers feel competent to make their own terms on their own lines without the specific conditions laid down in this Act. The reports of H.M. Inspectors of Factories demonstrate that in other industries much work has to be done under this Act, and knowledge of a highly technical character to be acquired, before opinions can be formed as to the reasonableness and fairness, or the contrary, of many forms of deduction. For the year 1898 it was reported that convictions were obtained for breaches, in factories and workshops, of the various Truck Acts in 66 cases out of 82 taken before the courts, an average penalty of 10s. 9d. having been imposed. In the year 1899, 20 convic- tions were obtained in 38 cases, the average penalty being £20, Os. 5d. In 1900, 26 cases were taken into court, and 21 convictions were obtained, the average penalty being 18s. 5d.

II. Continental Europe.

In comparing legislation affecting factories, mines, shops, and truck in the chief industrial countries of the Continent with that of Great Britain, it is essential to a just view that inquiry should be extended beyond the codes themselves to the general social order and system of law and administration in each country. Further, as a starting-point, special comparison of the definitions and the sanctions of each industrial code must be recognized as necessary, for these vary in all. In so brief a sum- mary as is appended here

no more is possible than an outline indication of the main general requirements and prohibitions of the laws as regards : (1) liours and times of employment, (2) ordinary sanitation and special requirements for unhealthy and dangerous industries, (3) security against accidents, and (4) prevention of fraud and oppression in fulfilment of wage contracts. As regards the first of these subdivisions, in general in Europe the ordi- nary legal limit is rather wider than in Great Britain, being in most cases not less than 11 hours a day, and the administrative discretion in grantini; exceptions rather more elastic. The weekly half-holiday is a peculiarly British institution. On the other hand, in several Euro-

pean countries, notably France, Austria, and Eussia, the legal maximum day applies to adult as well as youthful labour, and not only to specially protected classes of per- sons. As regards specialized sanitation for unhealthy factory industries, German regulations appear to be most nearly comparable with British. Mines' labour regulation in several countries, having an entirely different origin linked with ownership of mines, is only in few and most recent developments comparable with British Mines Regu- lation Acts. In regulation of shops, Germany, treating this matter as an integral part of her imperial industrial code, has advanced farther than has Great Britain. In truck leg- islation most European countries appear to have been influ- enced by the far earlier laws of Great Britain, although in some respects Belgium, with her rapid and recent industrial development, has made interesting original experiments.

France. — Hours of labour were, in France, first limited in facto- ries (usines et manufactures) for adults by the law of 9th Septem- ber 1848 to 12 in the 24. Much uncertainty existed as to the class of workplaces covered, and various interpretations were given. Finally, in 1885, an authoritative decision defined them as includ- ing : (1) Industrial establishments with motor power or continual furnaces, (2) workshops employing over 20 workers. In 1851, under condition of notification to the local authorities, exceptions, still in force, were made to the general limitation, in favour of certain industries or processes, among others for letterpress and lithographic printing, engineering works, work at furnaces and in heating workshops, manufacture of projectiles of war, and any work for the Government in the interests of national defence or security. The limit of 12 hours was reduced,

as regards works in which women or young workers are emjjloyed, in 1900 to 11, and was to be suc- cessively reduced to lOJ hours and to 10 hours at intervals of two years from April 1900. This labour law for adults was preceded in 1841 by one for children, which prevented their employment in factories before 8 years of age and prohibited night labour for any child under 13. This was strengthened in 1874, particularly as re- gards employment of girls under 21, but it was not until 1892 that the labour of women was specially regulated by a, law still in force, with certain amendments in 1900. Under this law factory and workshop labour is prohibited for children under 13 years, though they may begin at 12 if qualified by the prescribed educational cer- tificate and medical certificate of fitness. The limit of daily hours of employment is the same as for adult labour, and, similarly, from 1st April 1902 was lOJ, and two years later will be 10 hours in the 24. Notice of the hours must be affixed, and meal-times or pauses with absolute cessation of work of at least 1 hour must be specified. One day in the week, not necessarily Sunday, must be given for entire absence from work, in addition to eight recognized annual holidays. Night labour — that is, work between 9 p.m. and 5 A.ji. — is prohibited for workers under 18 years, and only excep- tionally permitted, under conditions, for girls and women over 18 in specified trades. In mines and underground quarries employ- ment of women and girls is prohibited except at surface works, and at the latter is subject to the same limits as in factories. Boys of 13 years maybe employed in certain work underground, but under 16 years may not be employed more than 8 hours in the 24 from bank to bank. As in Great Britain, distinct services of inspection enforce the law in factories and mines respectively. In factories and workshops an inspector may order re-examination as to physical fitness for the work imposed of any worker under 16 ; certain occu- pations and processes are prohibited — e.g., girls under 16 at machines worked by treadles, and the weights that may be lifted, pushed, or carried by girls or boys under 18 are carefully specified. The law applies generally to philanthropic and religious institutions where industrial work is carried on, as in ordinary trading establishments ; and this holds good even if the work is by way of technical instruc- tion. Domestic workshops are not controlled unless the industry is classed as dangerous or unhealthy ; introduction of motor power brings them under inspection. General sanitation in industrial es- tablishments is provided for in a law of 1893, and is supplemented by administrative

regulations for special risks due to poisons, dust, explosive substances, gases, fumes, &c. Ventilation, both general and special, lishting, provision of lavatories, cloakrooms, good drink- ing water, drainage, and cleanliness are required in all workplaces. Ill many industries women, children, and young workers are either absolutely excluded from specified unhealthy processes, or are ad- mitted only under conditions. As regards shops and offices, the only labour laws are : one which protects apprentices against over- work (law of 22nd February 1851), and one (law of 29tl3 December 1900) which requires that seats shall be provided for women and girls employed in retail sale of articles. The latter law is enforced by the inspectors of factories. In France there is no special penal

legislation against abuses of the truck system, or excessive fines and deductions from wages, although bills have frequently been before Parliament. Indirect protection to vrorkers is no doubt in many cases afforded in organized industries by the action of the Vonseus de Prud'hommes.

Belgium.— la 1848 in Belgium the Commission on Labour pro- posed legislation to limit, as in France, the hours of labour for adults, but this never passed, though repeated attempts were made to secure it. Belgian regulation of labour in industry remains essentially, in harmony with its earliest beginnings in 186.3 and onwards, a series of specialized provisions to meet particular risks of individual trades, and did not, until 1809, give any adherence to a common principle of limitation of hours and times of labour for " protected " persons. This was in the law of 13th December 1889, which applies to mines, quarries, factories, workshops, classed as unhealthy, wharves and docks, transports. As in France, industrial establishments having a charitable or philanthropic or educational character are included. The persons protected are girls and women under 21 years, and boys under 16 ; and women over 21 years only find a place in the law through the prohibition of their employ- ment within four weeks after

childbirth. Just as the hours of labour of adult women remain absolutely unlimited by law, so are the hours of boys from 16 to 21. The absolute prohibitions of em- ployment are : for children under 12 years in any industry, manu- facturing or mining or transport, and for women and girls under 21 years below the surface in working of mines. Boys under 16 years and women and girls under 21 years may in general not be employed before 5 a.m. or after 9 p.m., and one day in the seven is to be set apart for rest from employment ; to these rules, however, exception may be made either by royal decree for classes or groups of processes, or by local authorities in exceptional cases. The ex- ceptions may be applied, generally, only to workers over 14 years, but in mines, by royal decree, boys over 12 years may be employed from 4 A.M. The law of 1889 fixes only a maximum of 12 hours of effective work, to be interrupted by pauses for rest of not less than 1 J hours, empowering the king by decree to formulate more precise limits suited to the special circumstances of individual industries. Koyal decrees have accordingly laid down the conditions for twenty- six groups, including textile trades, manufacture of paper, pottery, glass, clothing, mines, quarries, engineering and printing works. In some the daily limit is 10 hours, but in more 10^ or 11 hours. In a few exceptionally unhealthy trades, such as the manufacture of lucifer matches, vulcanization of india-rubber by means of car- bon bisulphide, the age of exclusion from employment has been raised, and in the last-named process hours have been reduced to 5, broken into two spells of 2\ hours each. As a rule the conditions of health and safeguarding of employments in exceptionally in- jurious trades have been sought by a series of decrees under the law of 1863 relating to public health in such industries. Under this, special regulations for safety of workers have been introduced in manufactures of white-lead, oxides of lead, chromate of lead, lucifer match works, rag and shoddy works ; and for dangers common to many industries, provisions against dust, poisons, accidents, and other risks to health or limb have been codified in a decree of 1896. In 1898 a law was passed to enable the authorities to deal with risks in quarries under the same pro- cedure. Safety in mines (which are not private property, but state concessions to be worked under strict state control) has been provided for since 1810. In matters of hygiene, however, until 1899 the powers of the public health authorities to intervene were insufficient, and a law was passed authorizing the Government to make regulations for every kind of risk in any undertaking, whether classed

under the law of public health or not. By a special law of 1888 children and young persons under 18 years are excluded from employment as pedlars, hawkers, or in circuses, except by their parents, and then only if they have attained 14 years. Abuses of the truck system have, since 1887, been regulated with care. The chief objects of the law of 1887 were to secure payment in full to all workers, other than those in agriculture or domestic service, of wages in legal tender, to prohibit payment of wages in public-houses, and to secure prompt payment of wages. Certain deductions were permitted under careful control for specific customary objects : lodging, use of land, uniforms, food, firing. The law of 15th June 1896 regulates tlie affixing in workplaces, where at least five workers are employed, of a notice of the working rules, the nature and rate of fines, if any, and the mode of their application. Two central services, the mines inspectorate and the factory and workshop inspectorate, divide the duties above indicated. There is also a system of local adminis- tration of the regulations relating to industries classed as un- healthy, but the tendency has been more and more to give the supreme control in these matters to the factory service, with its expert staff.

Holland. — The first law for regulation of labour in manufacture was passed in 1874, and this related only to employment of children. In 1889, after many attempts had been made to amend

the law, the basis of all existing regulations was established in the law of 5th May 1889, which applies to all industrial undertakings, excluding agriculture and forestry, fishing, stock-rearing. Employ- ment of children under 12 years is prohibited, and hours are limited for young persons under 16 and for women of any age. These protected persons may be excluded by royal decree from unhealthy industries, and such industries are specified in a decree of 1897 which supersedes other earlier regulations. Hours of em- ployment must not exceed 11 in the 24, and at least 1 hour for rest must be given between 11 a.m. and 3 p.m., which hour must not be spent in a work-room. Work before 5 a.m. or after 7 p.m., Sunday work, and work on recognized holidays is generally prohibited, but there are exceptions. Overtime from 7 to 10 p.m. under conditions is allowed for women and young workers, and Sunday work for women, for example, in butter and cheese making, and night work for boys over 14 in certain industries.

Employment of women within four weeks of childbirth is prohibited. Notices of working hours must be affixed in workplaces. Underground work in mines is prohibited for women and young persons under 16, but only two mines, employing in all some 300 persons, are worked in Holland. In 1895 the first legislative provision was made for protection of workers against risk of accident or special injury to health. Suffi- cient cubic space, lighting, ventilation, sanitary accommodation, reasonable temperature, removal of noxious gases or dust, fencing of machinery, precautions against risk from fire and other matters are provided for. The manufacture of lucifer matches by means of white phosphorus has been forbidden by a law of 28th May 1901. No penal provision against truck exists in Holland, but possibly abuses of the system are prevented by the existence of industrial councils representing both employers and workers, with powers to mediate or arbitrate in case of disputes between the two parties.

Switzerland. — In Switzerland separate cantonal legislation pre- pared the way for the general Federal labour law of 1877 on which subsequent legislation rests. Such legislation is also cantonal as well as Federal, but in the latter there is only amplification or interpretation of the principles contained in the law of 1877, whereas cantonal legislation covers industries not included under the Federal law, e.g., single workers employed in a trade (metier) and employment in shops, offices, and hotels. The Federal law is applied to factories, workshops employing young persons under 18 or more than 10 workers, and workshops in which unhealthy or dangerous processes are carried on. Mines are not included, but are regulated in some respects as regards health and safety by cantonal laws. Further, the Law of Employers' Liability, 1881-87, which requires in all industries precautions against accidents and reports of all serious accidents to the cantonal governments, applies to mines. This led, in 1896, to the creation of a special mining department, and mines, of which there are but few, have to be inspected once a year by a mining engineer. The majority of the provisions of the Federal labour law apply to adult workers of both sexes, and the general limit of the 11-hours' day, exclusive of at least 1 hour for meals, applies to men as well as women. The latter have, however, a legal claim, when they have a household to manage, to leaving work at the dinner- hour half an hour earlier than the men. Men and unmarried women may be employed in such subsidiary work as cleaning before or after the general legal limits. On

Saturdays and eves of the eight public holidays the 11-hours' day is reduced to 10. Sun- day work and night work are forbidden, but exceptions are per- mitted conditionally. Night work is defined as 8 p.m. to 6 a.m. in summer, 8 p.m. to 6 a.m. in winter. Children are excluded from employment in workplaces under the law until 14 years of age, and until 16 must attend continuation schools. Ziirich canton has strengthened the law by fixing the working day for women at 10 hours generally, and 9 hours on Saturdays and eves of holidays. In the German cantons girls under 18 years are not permitted to work overtime ; in all cantons except Glarus the conditional over- time of 2 hours must be paid for at an enhanced wage.

Sanitary regulations and fencing of machinery are provided for with considerable minuteness in a Federal decree of 1897. The plans of every new factory must be submitted to the cantonal government. In the case of lucifer match factories, not only the building but methods of manufacture must be submitted. Since 1901 the manufacture, sale, and import of matches containing white phosphorus have been forbidden. Women must be absent from employment during eight weeks before and after childbirth. In certain dangerous occupations, e.g., where lead or lead com- pounds are in use, women may not legally be employed during pregnancy. Legislative provision against abuses of the truck system appears to be of earlier origin in Switzerland (17th century) than any other European country outside England (15th century). The Federal Labour Law, 1877, generally prohibits payment of wages otherwise than in current coin, and provides that no deduc- tion shall be made without an express contract. Some of the cantonal laws go much farther than the British Act of 1896 in forbidding certain deductions; e.g., Ziirich prohibits any charge

■whatever for cleaning, warming, or ligliting workrooms, or for liire of macliinery. By the Federal law fines may not exceed half a day's wage. Administration of the labour laws is divided between inspectors appointed by the Federal Government and local authori- ties, under supervision of the

cantonal governments. The Federal Government forms a, court of appeal against decisions of the cantonal governments.

Gfermany. — Regulation of the conditions of labour in industry throughout the German Empire is provided for in the Imperial Industrial Code and the orders of the Federal Council based there- on. This Code is based on earlier industrial- codes of the separate states, but more especially on the Code of 1869 of the North German Confederation. It applies in whole or in part to all trades and industrial occupations, with the exception of transport, fisheries, and agriculture. Mines are only included so far as truck, Sunday and holiday rest, prohibition of employment underground of female labour, limitation of the hours of women and young workers are concerned ; otherwise the regulations for protection of life and limb of miners vary, as do the mining laws of the different states. In order to estimate the force of the Industrial Code in working, it is necessary to bear in mind the complicated political history of the Empire, the separate administration by the federated states, and the generally considerable powers vested in administration of initiating regulations. The Industrial Code expressly retains power for the states to initiate certain additions or exceptions to the Code which in any given state may form part of the law regulating factories there. The Code (unlike the Austrian Industrial Code) lays down no general limit for a normal working day for adult male workers, but since 1891 full powers were given to the Imperial Government to limit hours for any classes of workers in industries where excessive length of the working day endangers the health of the worker (R. G. 0. § 120e). Previously application had been made of powers to reduce the working day in such unhealthy industries as silvering of mirrors by mercury and the manufacture of white-lead. Separate states had, under mining laws, also limited hours of miners. Sunday rest was, in 1891, secured for every class of workers, com- mercial, industrial, and mining. Annual holidays were also secured on Church festivals. These provisions, however, are subject to exceptions under conditions. An important distinction has to be brought out when we turn to the regulations for hours and times of labour for protected persons (women, young persons, and children). Setting aside for the moment hours of shop assistants (which are under special sections since 1900), it is to ” factory workers ” and not to industrial workers in general that these limits apply, although they may be, and in some instances have been, further extended —

for instance, in ready-made clothing trades — by imperial decree to work-shops. The term “factory” (Fabrik) is not defined in the Code, but it is clear from various decisions of the Supreme Court that it only in part coincides with the English term, and that some work- places, where processes are carried on by aid of mechanical power, rank rather as English workshops. The distinction is rather between wholesale manufacturing industry, with subdivision of labour, and small industry, where the employer works himself. Certain classes of undertaking, viz., forges, timber-yards, dock-yards, brickfields, and open quarries, are specifically ranked as factories. Employment of protected persons at the surface of mines and underground quarries, and in salt works and ore-dressing works, and of boys underground comes under the factory regulations. These exclude children from employment under 13 years, and even later if an educational certificate has not been obtained ; until 14 years hours of employment may not exceed 6 in the 24. Germany, unlike Great Britain, France, and Switzerland, requires a shorter day for young persons than for women — 10 hours for the former, 11 hours for the latter. “Women over 16 years may be employed 11 hours. Night work is forbidden, i.e., work between 8.30 p.m. and 5.30 A.M. Overtime may be granted to meet special unforeseen pressure or for work on perishable articles, under conditions, by local authorities and the higher administrative authorities. Pre- scribed meal-times are — an unbroken half-hour for children in their 6 hours ; for young persons a mid-day pause of 1 hour, and half an hour respectively in the morning and afternoon spells ; for women, an hour at mid-day, but women with the care of a household have the claim, on demand, to an extra half-hour, as in Switzerland. No woman may be employed within four weeks after childbirth, and unless a medical certificate can then be produced, the absence must extend to six weeks. Notice of working periods and meal-times must be affixed, and copies sent to the local authorities. Employment of protected persons in factory industries where there are special risks to health or morality may be forbidden or made dependent on special conditions. All industrial employers alike are bound to arrange and maintain workrooms and macliinery, and to^ organize labour in such a manner as to secure workers against injury to health and to ensure good conduct and propriety. Suf- ficient light, suitable cloak-rooms and sanitary accommodation, and ventilation to carry off dust, vapours, and other

impurities are especially required. Dining-rooms may be ordered by local authori-

ties. Fencing and provision for safety in case of fire are required in detail. The work of the trade accident insurance associations in their work of preventing accidents- is especially recognized in pro- visions for special rules in dangerous or unhealthy industries. Officials of the state factory departments are bound to give oppor- tunity to trustees of the trade associations to express an opinion on special rules. In a large number of industries the Federal Council has laid down special rules comparable with those for unhealthy occupations in Great Britain. The relations between the state in- spectors of factories and the ordinary police authorities are regu- lated in each state by its constitution. Prohibitions of truck in its original sense — that is, payment of wages otherwise than in current coin — apply to any persons under a contract of service with an employer for a specified time for industrial purposes ; members of a family working for a parent or husband are not included; out- workers are covered. Control of fines and deductions from wages applies only in factory industries and shops employing at least 20 workers. Shop hours are regulated by requiring shops to be closed generally between 9 p.m. and 5 a.m., by requiring a fixed mid- day rest of 1 J hours and at least 10 hours' rest in the 24 for assistants. These limits can be to a certain extent modified by administrative authority. Notice of hours and working rules must be affixed. During the hours of compulsory closing sale of goods on the streets or from house to house is forbidden. Under the Commercial Code, as under the Civil Code, every employer is bound to adopt every possible measure for maintaining the safety, health, and good con- duct of his employes. By an order of the Imperial Chancellor under the Commercial Code seats must be provided for commercial assistants and apprentices.

Austria. — The Industrial Code of Austria, which in its present outline (modified by later enactments) dates from 1888, must be carefully distinguished from the Industrial Code of the kingdom of Hungary. The latter is, owing to the predominantly agri- cultural character of the population, of later origin, and hardly had practical force before the law of 1893 provided for inspection and prevention of accidents in factories. No separate mining code exists in Hungary, and conditions of labour are

regulated by the Austrian law of 1854. The truck system is repressed on lines similar to those in Austria and Germany. As regards limitation of hours of adult labour, Hungary may be contrasted with both those empires in that no restriction of hours applies either to men's or women's hours, whereas in Austrian factories both are limited to an 11-hours' day with exceptional overtime for which payment must always be made to the worker. The Austrian Code has its origin, however, like the British Factory Acts, in protection of child labour against abtise in the end of the 18th and beginning of the 19th century. Its present scope is determined by the Imperial "Patent" of 1859, and all industrial labour is included except mining, transport, fisheries, forestry, agriculture, and domestic industries. Factories are defined as including industries in which a "manufacturing process is carried on in an enclosed place by the aid of not less than twenty workers working with machines, with subdivision of labour, and under an employer who does not himself manually assist in the work." In smaller handicraft industries the compulsory guild system of organization still applies. In every industrial establishment, large or small, the sanitary and safety provisions, general requirement of Sunday rest, and annual holidays (with conditional exceptions), prohibition of truck and limitation of the ages of child labour apply. Night work for women, 8 p.m. to 5 a.m., is prohibited only in factory industries ; for young workers it is prohibited in any industry. Pauses in work are required in all industries ; 1 hour at least must be given at mid-day, and if the morning and afternoon spells exceed 5 hours each, another half-hour's rest at least must l3e given. Children may not be employed in industrial work before 12 years, and then only 8 hours a day at work that is not injurious and if educational requirements are observed. The age of employment is raised to 14 for "factories," and similarly there the work must be such as will not hinder physical development. Women may not be employed in regular industrial occupation within one month after childbirth. In certain scheduled unhealthy industries, where certificates of authorization from local authorities must be obtained by intending occupiers, conditions of health and safety for workers can be laid down in the certificate. The Minister of the Interior is empowered to draw up regulations prohibiting or making conditions for the employment of young workers or women in dangerous or unhealthy industries. The previsions against truck cover not only all industrial workers engaged in manual labour under a contract with an employer, but also shop-assistants ; the special

regulations against fines and deductions apply to factoiy workers and shops where at least 20 workers are em- ployed. In mines under the law of 1884, which supplements the general mining law, employment of women and girls under- ground is prohibited ; boys from 12 to 16 and girls from 12 to 18 may only be employed at light work above ground ; 14 is the earliest age of admission for boys underground.

The shifts from bank to bank must not exceed 12 hours, of which not more than 10 may be effective work. Sunday rest must begin not later than 6 a.m., and must be of 24 hours' duration. These last two provisions do not hold in case of pressing danger for safety, health, or property. Sick and accident funds and mining associations are legislated for in minutest detail. The general law provides for safety in working, but special rules drawn up by the district authorities lay down in detail the conditions of health and safety. As regards manufacturing industry, it is important to note that the Industrial Code lays no obligation on employers to report accidents, and that until the Accident Insurance Law of 1889 came into force no statistics were available. In Austria, un- like Germany, the factory inspectorate is organized throughout under a central chief- inspector.

Scandinavian Countries. — The latest legislation in these coun- tries is, as might be expected, in the two countries where manufac- turing industry has the widest scope. In Sweden the Factory Law was amended in January 1901 ; in Denmark in July 1901. Until that year, however, Norway was in some respects in advance of the other two countries by its law of 1892, which applied to industrial works, including metal works of all kinds and mining. Women were thereby prohibited from employment : (a) underground ; (6) in cleaning or oiling macliinery in motion ; (c) during six weeks after giving birth to a child, unless provided with a medical certifi- cate stating that they might return at the end of four weeks with- out injury to health ; (d) in dangerous, unhealthy, or exhausting trades during pregnancy. Further, work on Sundays and public holidays is prohibited to all workers, adult and

youthful, with con- ditional exceptions under the authority of the inspectors. Children over 12 are admitted to industrial work on obtaining certificates of birth, of physical fitness, and of elementary education. The hours of children are limited to 6, with pauses, and of young persons (of 14 to 18 years) to 10, with pauses. Night work between 8 p.m. and 6 a.m. is prohibited. All workers are entitled to a copy of a code of factory rules containing the terms of the contract of work drawn up by representatives of employ^ with the employers and sanctioned by the inspector. Health and safety in working are provided for in detail in the same law of 1892. Special rules may be made for dangerous trades, and in 1899 such rules were estab- lished for match factories, similar to some of the British rules, but notably providing for a dental examination four times yearly by a doctor. In Denmark, regulation began with unhealthy industries, and it was not until the law of 1901 came into force, on 1st January 1902, that children under 12 years have been excluded from fac- tory labour. In Sweden this 12 years' limit has for some time held in the larger factories, but now the scope has been extended so that it corresponds with the Norwegian law. The hours of children are, in Denmark, 6J for those under 14 years ; in Sweden 6 for those under 13 years. Young persons may not in either country work more than 10 hours daily, and night work, which is forbidden for persons under 18 years, is now defined as in Norway. Women may not be employed in industry within four weeks of childbirth, except on authority of a, medical certificate. All factories in Sweden where young workers are employed are subject to medical inspection once a year. Fencing of machinery and hygienic conditions (ventilation, cubic space, temperature, light) are regulated in detail. In Denmark the use of white phosphorus in manufacture of lucifer matches has been prohibited since 1874.

Italy and Spain. — The wide difference between the industrial development of these southern Latin countries and the two coun- tries with which this summary begins, and the far greater import- ance of the agricultural interests, produce a situation, as regards labour legislation, which makes it convenient to touch on the limited scope of their regulations at the close of the series. It was stated by competent and impartial observers from each of the two countries, at the International Congress on Labour Laws held at Brussels in 1897, that the lack of adequate measures for protec- tion of child-labour and inefScient administration of such regula/- tions as exist

was responsible for abuse of their forces that can be found in no other European countries. “Their labour in factories, workshops, and mines constitutes a veritable martyrdom ” (Spain). ” I believe that there is no country where a sacrifice of child life is made that is comparable with that in certain Italian factories and industries ” (Italy). In neither country is there any limitation of women’s hours, but in Spain a step in this direction has been taken by a law of 1900, which was to take effect in 1902, in regulations for reduction of hours of labour for adults to 11, normally, in the 24. Hours of children under 14 must not exceed 6 in any indus- trial work nor 8 in any commercial undertaking. Labour before the age of 10 years and night work between 6 p.m. and 5 a.m. vvas prohibited, and powers were taken to extend the prohibition of night work to young persons under 16 years. The labour of children in Italy is still regulated in the main by a law of 1886, but a royal decree of 1899 has strengthened it by classing night work for children under 12 years as “injurious,” such

work being thereby generally prohibited for them, though excep- tions are admitted ; at the same time it was laid down that children from 12 to 15 years might not be employed for more than 6 hours at night. The law of 1886 prohibits employ- ment of children under 9 years in industry and under 10 years in underground mining. It is in the direction of fenc- ing and other safeguards against accidents and as regards sani- tary provisions, both in industrial workplaces and in mines, that Italy has made most advance since her law of 1890 for prevention of accidents.

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See also Arbitration and Conciliation, Employers’ Lia- bility, Strikes and Lockouts, Social Progress (Hours of Labour), Trades Unions. (a. m. An.)

III. United States.

Under the general head of Labour Legislation all American statute laws regulating labour, its conditions, and the relation of employer and employ^ must be classed. It includes what is properly known as factory legislation. Labour legislation belongs to the last half of the 19th century, so far as the United States is concerned. Like England in the far past, the United States in colonial days undertook to regulate wages and prices, and later the employment of apprentices. Legislation relating to wages and prices was long ago abandoned, but the laws affecting the employment of apprentices still exist in some form, although the conditions of employment have changed so materially that apprenticeships are not entered as of old ; but the laws regulating the employment of apprentices were the basis on which English legislation found a foot- hold when Parliament wished to regulate the labour of factory operatives. The whole code of labour laws of the present time is almost entirely the result of the industrial revolution which took place during the latter part of the 18th century, under which the domestic or hand-labour system was gradually but rapidly displaced through the

introduction of power maehinery. As this revolution took place in the United States at a somewhat later date than in England, where it began, the labour legislation necessi- tated by it belongs to a later date. The factory, so far as textiles are concerned, was iirmly established in America during the

period from 1820 to 1840, and it was natural that the English legislation found friends and advocates in the United States, although the more objectionable conditions accompanying the English factory were not to be found there.

The first attempt to secure legislation regulating factory employment related to the hours of labour, which were very long, the day's work con- attempts sisting of from twelve to thirteen hours. As to regulate machinery was introdiiced it was felt that /lours. ^j^g day's work should be shortened, as the tension resulting from speeded machines and the close attention required in the factory ought to be accom- panied by a shorter work-day. This view took very firm hold of the operatives, and was the chief cause of the agitation which has resulted in a great body of laws applying in very many directions. The labour legislation as it exists now can be classified into two general branches — first, that relating to the conditions of employment ; second, that relating to the protection of employes from practices tending to prevent them from obtaining or retaining employment. As early as 1806 the caulkers and shipbuilders of ISTew York City agitated for a reduction of hours to ten per day, but no legislation followed their efforts. There were several attempts in the early years of the 19th century to secure some regula- tion relative to hours, but there was no general agitation prior to 1831. As Massachusetts was the state which first recognized the necessity of regulating employment (following in a measure, and so far as conditions demanded, the English labour or factory legislation), the history of such legislation in that state is indicative of that in the United States, and as it would be impossible in this article to give a detailed history of the origin of laws in the different states, the dates of their enactment, and their provisions, it is best to follow primarily the course of the Eastern states, and especially that of Massachusetts, where the first general agitation took place and the first laws were enacted. That ' state in 1836 regulated by law the question of the education of young persons em- ployed in manufacturing establishments. There was no legislation until 1863 coming under the head of this article, except laws relating to the subject of education of children in factories. The question of regulating the hours of labour was warmly discussed in 1832, and several legislative committees and commissions reported upon it, but no specific action on the general question of hours of labour secured the indorsement of the

Massachusetts legis- lature until 1874, although the day's labour of children under twelve years of age was limited to ten hours in 1842. Ten hours constituted a day's labour, on a volun- tary basis, in many trades in Massachusetts and other parts of the country as early as 18r).'^>, while in the ship- building trades this was the work-day in 1844. In April 1840 President Van Buren issued an order "that all public establishments will hereafter be regulated, as to working hours, by the ten-hours system." After this the short-hours movement did not progress with any rapidity, or even persistency, yet there was a constantly increasing belief that a shorter work-day should prevail. The real aggressive movement began in 1845, through numerous petitions to the Massachusetts legislature urging a reduc- tion of the day's labour to eleven hours, but nothing came of these petitions at that time. Again, in 1850, a similar effort was made, and also in 1851 and 1852, but the Bills failed. Then there was a period of quiet until 1865, when

an unpaid commission made a report relative to the hours of labour, and recommended the establishment of a bureau of statistics for the purpose of collecting data bearing upon the labour question. This was the first step in this direc- tion in any country. The first bureau of the kind was established in Massachusetts in 1869, but meanwhile, in accordance with reports of commissions and the address of Governor Bullock in 1866, and the general sentiment which then prevailed, the legislature passed an Act regu- lating in a measure the conditions of the employment of children in manufacturing establishments ; and this is one of the first laws of the kind in the United States, although the first legislation in the United States relating to the hours of labour which the writer has been able to find, and for which he can fix a date, was enacted by the state of Pennsylvania in 1849, the law providing that ten hours should be a day's work in cotton, woollen, paper, bagging, silk, and flax factories.

The Massachusetts law of 1866 provided, firstly, that no child under the age of ten years should be employed in any manufacturing establishment, and that no child between the ages of ten and Employ- fourteen years should be so employed unless cbiUren. he had attended some public or private school at least six months during the year preceding such employment, and, further, that such employment should not continue unless the child attended school at least six months in each and every 3'ear ; secondly, a penalty not

exceeding $60 for every owner or agent or other person knowingly employing a child in violation of the Act ; thirdly, that no child under the age of four- teen should be employed in any manufacturing estab- lishment more than eight hours in any one day ; fourthly, that any parent or guardian allowing or consent- ing to employment in violation of the Act should forfeit a sum not to exceed f 50 for each offence ; fifthly, that the Governor instruct the state constable and his deputies to enforce the provisions of all laws for regulating the em- ployment of children in manufacturing establishments, and to prosecute violations thereof. The same legislature also created a commission of three persons, whose duty it was to investigate the subject of hours of labour in relation to the social, educational, and sanitary condition of the working classes. In 1867 a fundamental law relating to schooling and hours of labour of children employed in manufacturing and mechanical establishments was passed by the Massachusetts legislature. It diifered from the Act of the year previous in some respects, going deeper into the general question. It provided that no child under the age of ten years should be employed in any manufacturing or mechanical establishment of the com- monwealth, and that no child between the ages of ten and fifteen years should be so employed unless he had attended school, public or private, at least three months during the year next preceding his employment. There w^ere some provisions relating to residence, &c., and a further pro- vision that no time less than 120 half days of actual schooling should be deemed an equivalent of three months, and that no child under the age of fifteen years should be employed in any manufacturing or mechanical establish- ment more than sixty hours any one week. The law also providedpenalties for violation. It repealed the Act of 1866.

In 1869 began the establishment of that chain of offices in the United States, the principle of which has been adopted by other countries, known as bureaus of statistics of labour, their especial purpose being the col- lection and dissemination of information relating to all features of industrial employment. As a result of the success of the first bureau, bureaus are in existence in thirty-one states, in addition to the United States Depart- ment of Labour.

states]

A special piece of legislation whicli belongs to the commonwealth of Massachusetts, so far as experience shows, was that in 1872, providing for cheap morning and evening trains for the accommodation of working men living in the vicinity of Boston. Great Britain had long had such trains, which were called parliamentary- trains. Under the Massachusetts law some of the rail- ways running out of Boston furnished the accommodation required, and the system has since been in operation.

In different parts of the country the agitation to secure legislation regulating the hours of labour became aggres- sive again in 1870 and the years immediately following, there being a constant repetition of attempts to secure the enactment of a ten-hours law, but in Massachusetts all the petitions failed till 1874, when the legislature of that commonwealth established the hours of labour at sixty per week not only for children under eighteen years of age, but for women, the law providing that no minor under eighteen years and no woman over that age should be employed by any person, firm, or corpora- tion in any manufacturing establishment more than ten hours in any one day. In 1876 Massachusetts recon- structed its laws relating to the employment of children, although it did not abrogate the principles involved in earlier legislation, while in 1877 the common- P^oiy wealth passed Factory Acts covering the

legislation, J^ . . i? xiL -n ɨ i, i mi.

1877. general provisions oi the British laws. The

law of 1877 went beyond any previous laws, which, as shown, related to the employment of women and children so far as hours were concerned. It provided for the general inspection of factories and public build- ings, the provisions of the law relating to dangerous ma- chinery, such as belting, shafting, gearing, drums, &c., which the legislature insisted must be securely guarded, and that no machinery other than steam engines should be cleaned while running. The question of ventilation and cleanliness was also attended to. Dangers connected with hoistways, elevators, and well-holes

were minimized by their protection by suflB.cient trap-doors, while fire-escapes were made obligatory on all establishments of three or more storeys in height. All main doors, both inside and outside, of manufacturing establishments, as well as those of churches, school-rooms, town halls, theatres, and every building used for public assemblies, should open outwardly whenever the factory inspectors of the commonwealth deemed it necessary. These pro- visions remain in the laws of Massachusetts, and other states have found it wise to follow them ; but to make such laws of any value to the working people of the country, there needed to be inspectors having the power to examine and recommend, and in many cases to order, the safeguarding of machinery and all the devices used in the factory from which there was any danger.

All the states in the Union where textile factories pre- vail, except some of the Southern states, have legislation similar to that which has been described for Massachu- setts, although not always to such an elaborate extent. Some of the Northern and Middle states, however, have extensive codes of factory laws, the aim of which is to protect the lives and the limbs of the operatives, and to secure healthful, sanitary surroundings. The legislation of different states varies according to the nature of the industries carried on therein. Those where mining pre- dominates and iron-works are found have laws which are especially applicable to such industries. Miners are protected both as to the hours and conditions of their labour. But the attempts to enact laws restricting or fixing the hours of labour of adult males have not been successful as a rule. The state of Utah in its constitution has fixed the day’s labour for adults in mining and cer- tain industries. The doctrine that the adult male must

be left at liberty to make his own contracts relative to his working time and his wages has been accepted every- where as the proper rule. A number of states have laws which fix a day’s labour in the absence of any contract, some of them fixing the day at eight hours, so that where an employer and an employe make a contract and do not specify what shall constitute a day’s labour, eight hours would be ruled as the day’s labour in g,^”” any action which came before the courts. The tours. United States Government provides by the law of 1868 that eight hours shall constitute a day’s work for all labourers, workmen, and mechanics employed by or on behalf of the

Government, and by an Act approved 1st August 1892 no officer of the Government can work the employes any longer than that, nor can a contractor having a contract under the Government call for a longer day than eight hours, although under some extraordinary emergency a longer day may be demanded. The day's work has not been fixed in the Southern states, where the textile manufactures have iSeen expanded greatly in the past few years. In those states the day is from eleven to twelve hours, sixty-six hours per week being the prevailing rule. New Jersey has the shortest work- day of any state, fifty-five hours per week; but this regulation is not observed, or at least only in slight degree, outside the silk industry. Sixty hours is the general rule under legislation, although Massachusetts' now provides for fifty-eight hours. In addition to the body of laws regulating conditions of employment, there are a great many laws which relate to methods of em- ployment, such as those authorizing fines for damage to goods, but such laws are vexatious and have not been approved, especially by employes.

Some laws relating to the hours of labour have in some states been declared unconstitutional, not because the laws in controversy fixed the length of day, but because they undertook to regulate the labour of a certain class, thereby bringing the laws under the denomination of class legislation. As a rule, however, the courts have generally sustained the laws regulating conditions for the employment of women and children, on the ground that these are the wards of the state.

The second class of laws, those which protect employes from practices tending to prevent them from obtaining or retaining employment, touch broader and deeper principles than those referred to above. The laws themselves are to be found in the statutes of the Federal and state govern- ments, and are directed against such practices. In addition to the laws bearing directly upon this point, action can be taken under them or under the common law by executive and judicial officers for the purpose of enforcing the provisions of the same or causing penalties provided for violations. The statutes themselves may be divided into three classes — those aimed at practices or deeds of employers of labour, those directed against the deeds of employes, and those providing for action to be taken by third parties. While this statement is true as a general proposition, there are,

nevertheless, statutes aimed at the punishment of conspiracy and the prevention of intimi- dation, coercion, boycotting, and blacklisting, j^^,'^. which apply to the acts of both employers tion.boy- and employes either by direct language or cotting, by inference. Most of the actions of either ^^^1'' employers or employes to which these classes of laws apply are the results of labour disputes and their frequent consequences, such as strikes, lockouts, riotings, &c. Probably responsibility could not be fixed in cases of blacklisting under the common law, nor could some features of conspiracy, or what used to be called " un- lawful combination," for under the common law at the present time workmen have the right to strike or leave

work either singly or in combination at any time. They may take action for the purpose of improving their con- dition, and may use peaceful means, such as persuasion, &e., to induce other workmen either to strike or leave their employment or to refrain from accepting employ- ment; but they must not use unlavs^ful means, such as intimidation, force, coercion, &e., the use of such means being regarded as conspiracy. ISTo state has passed any law attempting to change these principles, but some states have re-afflrmed these principles by direct statu- tory provision. Many states have passed laws aimed at the suppression of blacklisting, boycotting, intimidation, coercion, and the use of force by either the employer or employe, and a large number of states have positively forbidden the practice of blacklisting. A few states have passed laws which in direct terms forbid boy- cotting. The conspiracy laws of a number of the states provide that the combining of two or more persons for the purpose of injuring the business of any other person, or preventing one from obtain- ing employment, or causing the discharge of any one, are conspiracy and punishable as such. There are many decisions of the highest courts of the states relating to boycotting, but they were made in cases arising under the conspiracy laws or under those laws which, while they do not forbid boycotting in terms, do forbid the use

of threats, intimidation, and coercion, which really constitute the illegal features of a boycott. In regard to intimidation, coercion, &c., there are numerous statutes forbidding their use in any efforts made to compel others to do or not to do things which they have a legal right to do or to abstain from doing. It is undoubtedly true that these laws apply in cases of boycotting where in- timidation or coercion is used. The writer does not know of any cases which have arisen or been decided in the courts on this particular feature, but the statutes relating to them have frequently been held to apply to employes engaged in strikes, and when attempting to use the boycott and to prevent the employment of new men.

The illegal acts of strikers have been the subject of legislation. When strikes are in progress, especially those of railway employes, many acts are often committed, either by the strikers or their sympathizers, with a view to preventing the employers from using their property and conducting their business. Such acts may be violent, as the destruction or injury of property, cars, buildings, locomotives, &c., or they may apply simply to the aban- doning of a locomotive or train without warning. A number of states have passed laws intended to prevent such practices and to provide penalties for the commission of the acts alluded to. The statutes have various terms or provisions, and it is often difficult to make a separation or classification of them. They could all undoubtedly be used in the punishment of those attempting to obstruct the conduct of a business by the use of illegal means. Most of the laws enumerate and forbid the commission of certain deeds, and provide penalties for the violation of their provisions.

Closely connected with the class of legislation now under discussion is that relating to efforts made by employers to have no relations with labour organizations in the conduct of their business, and their endeavour in this connexion not to employ workmen who belong to such associations. Several states have passed laws mak- ing such practice on the part of employers unlawful. Many states have enacted laws prohibiting employers from coercing employes, by threats of loss of employment, &c., to vote or not to vote for particular candidates for office or for particular measures, and from discharging employes on account of the way in which their votes have been cast.

The laws relating to apprentices are numerous and voluminous, but, as in England, they do not now have great force, because of the practical abrogation of the apprenticeship system through the operation of the modern methods of production. The number of ap- prentices who may enter a particular trade has been limited in many cases by the trade unions, but there has been no attempt in the United States, except in one state, to prevent such limitation. The state of Georgia has a law to the effect that if any two or more persons shall associate themselves in any society or organization with intent of preventing, in any manner, any person or persons from apprenticing themselves to learn and prac- tice any trade, &c., they shall, upon conviction, be pun- ished as prescribed by the criminal code.

Liens which a workman may place upon buildings and other constructions on which he has been employed are subject to laws legitimately relating to labour. These laws are numerous and bulky, and every state has them. So, state insolvency laws, and the bankruptcy Acts of the Federal Government require that wages shall be paid in full out of the assets of the bankrupt before a dividend is made to general creditors.

A few states have laws upon their statute-books in- tended to prohibit the employment of sailors in work upon wharves, &c., thus preventing the ordinary wharf labourers, stevedores, &c., from being supplanted in their ordinary employment.

The laws just treated relate almost entirely to acts either of employers or of employes, but there is another form of law, namely, that providing for action to be taken by others in the effort to prevent workmen from losing employment, either by their own acts or by those of their employers, or to settle any differences which arise out of controversies relating to wages, hours of labour, terms and conditions of employment, rules, &c. These laws provide for the arbitration of labour dis- putes (see Aebiteation and Conciliation), and many states have provided for the crea- tion of boards of arbitration, before which, by mutual consent, disputes and controversies between em- ployers and employes may be adjusted. At least three states (New York, Massachusetts, and New Jersey) have had considerable experience under this class of legisla- tion, but while, as stated, quite a

number of states have laws for such boards, they have not been carried into effect, except in rare instances. The federal Govern- ment, also, has a law providing for conciliation and arbi- tration in controversies arising between employers and employes where inter-state commerce is involved. No state in the Union has yet provided for compulsory arbi- tration, although some of the features of the Pennsylvania law and of that of Kansas are construed as providing for compulsory arbitration.

The enforcement of laws by executive or judicial action is an important matter relating to labour legislation, for without action such laws would remain dead letters. Under the constitutions of the states, IJaidai en- the governor is the commander-in-chief of the tonement military forces, and he has the power to order ot labour the militia or any part of it into active service °”’*’ in case of insurrection, invasion, tumult, riots, or breaches of the peace or imminent danger thereof. Frequent ac- tion has been taken in the case of strikes with the view of preventing or suppressing violence threatened or hap- pening to persons or property, the effect being, however, that themilitia protects those working or desiring to work, or the employers. The President of the United States may use the land and naval forces whenever by reason of in- surrection, domestic violence, unlawful obstructions, con- spiracy, combinations, orassemblagesofpersonsit becomes

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impracticable to enforce the laws of the land by the ordinary course of judicial proceedings, or when the execution of the laws is so hindered by reason of such events that any portion or class of the people are deprived thereby of their rights and privileges under the constitu- tion and laws of the country. Under this general power the United States forces have been used for. the protec- tion of both employers and employes indirectly, the pur- ipose being,, as in the states, to protect mails and to see that the laws are carried out.

The power of the courts to interfere in labour disputes is through the injunction and punishment thereunder for contempt of court. It is a principle of law that when there are interferences, actual or threatened, with property or with rights of a pecuniary nature, and the common or statute law offers no adequate and immediate remedy for the prevention of injury, a court of equity may interpose and issue its order or injunction as to what must or must not be done, a violation of which writ gives the court which issued it the power to punish for contempt. The doctrine is that something is necessary to be done to stop at once the destruction of property and the obstruction of business, and the injunc- tion is immediate in its action. This writ has been resorted to frequently for the indirect protection of em- ployes and employers.

Employers' liability laws, which belong entirely to modern legislation, have been passed for the purpose of enabling an employe to recover damages from ^iabilUy"' ^^^ employer under certain conditions when he has been injured through accident occurring in the works of the employer. The common-law maxim that the principal is responsible for the acts of his agent does not apply where two or more persons are working together under the same employer and one of the em- ployes is injured through the carelessness of his fellow- employ^, although the one causing the accident is the agent of the principal, who under the common law would be responsible. The old Eoman law and the English and American practice under it held that the co-employe was a party to the accident. The injustice of this rule is seen by a single illustration. A weaver in a cotton factory, where there are hundreds of operatives, is in- jured by the neglect or carelessness of the engineer in charge of the motive power. In such a case, under the common law, the weaver could not recover damages from the employer, because he was the co-employe of the engi- neer. So, one of thousands of employes of a railway system, sustaining injuries through the carelessness of a switchman whom he never saw, could recover no damages from the railway company, both being co-employes of the same employer. The injustice of this application of the common-law rule has been recognized, but the only way to avoid the difficulty was through specific legislar tion providing that under such conditions as those just related, and similar ones, the doctrine of co-employment should not apply, and that the workman should have the same right to recover damages as a passenger

upon a railway train. This legislation has upset some of the most notable distinctions of law.

The first agitation for legislation of this character occurred in England in 1880. There are now a number of states in the Union which have enacted statutes fixing the liability of employers under certain conditions and relieving the employe from the application of the common-law rule. Of course, where the employe himself is contributory to the injuries resulting from an accident he cannot recover, nor can he recover in some cases where he knows of the danger from the defects of tools or implements employed by him. The legislation upon the subject is exceedingly interesting, and involves many

features of legislation which need not be described here, such as those concerning the power of employes to make a contract, and those defining the conditions, often elaborate, which lead to the liability of the employer and the duties of the employe, and the relations in which damages for injuries sustained in employment may be recovered from the employer.

Authorities. — Second Special Beport, U.S. Department of Labour, giving all tlie labour laws in force in the United States in 18i)ii, with annotations of decisions of courts ; bi-monthly Bulletin of Department of Labour, containing laws passed since those published in the foregoing and decisions of courts relating to legislation concerning employers and employes. — “Employer and Employee under the Common Law,” and ” Protection of Workmen in their Employment,” Bulletins Nos. 1 and 26, respectively, V.S. Department of Labour. — “Inspection of Factories and Worksliops in the United States,” Bulletin No. 12, U.S. Dept. of Labour. — Wright. Industrial Evolution of the United Slates, chaps, xxi., xxii., and xxiii. — Reno. A Treatise on the Law of Employers^ Linbility Acts. — Stimson. Handbook to the Labour Laws of the United States, and Labour in its Melations to Law. (c. D. W.)

Labrador, a great peninsula in British North America, bounded on the E. by the North Atlantic, on the N. by Hudson Strait, on the V\ by Hudson and James Bays, and on the S. by an arbitrary line extend- ing eastwards from the south-east corner of Hudson Bay, near 51° N., to the mouth of the Moisie river, on the Gulf of St Lawrence, in 50° IST., and thence eastwards

by the Gulf of St Lawrence. It extends from 50° to 63° N., and from 55° to 80° W., and embraces an approximate area of 511,000 square miles. Recent explorations and surveys have added greatly to the knowledge of this vast region, and have shown that much of the peninsula is not a land of ” awful desolation,” but a well-wooded country, containing latent resources of value in its forests, fisheries, and minerals.

Geology. — The peninsula is a very ancient plateau, formed largely of crystalline schists and gneisses associ- ated with granites and other igneous rocks, all of archaean age ; there are also large areas of non-fossilif- erous, stratified limestones, cherts, shales, and iron ores, the unaltered equivalents of part of the schists and gneisses. Narrow strips of Silurian rocks occur along the low-lying southern and western shores, but there are nowhere else indications of the peninsula having been below sea-level since an exceedingly remote time. During the Glacial period the country was covered by a thick mantle of ice, which flowed out radially from a central collecting-ground. Owing to the extremely long exposure to denudation, to the subsequent removal of the greater part of the decomposed rock by glaciers, and to the un- equal weathering of the component rocks, it is now a plateau, which ascends somewhat abruptly within a few miles of the coast-line to heights of between 500 and 2000 feet. The interior is undulating, and traversed by ridges of low, rounded hills, seldom rising more than 500 feet above the surrounding general level.

Physical Geography. — The highest portion of the plateau extends east and west between 52° and 54° N., where an immense granite area lies between the head-waters of the larger rivers of the four principal drainage basins ; the lowest area is between Hudson Bay and Ungava Bay in the north-west, where the general level is not more than 600 feet above the sea. The only mountains are the range along the Atlantic coast, extending from the Strait of Belle Isle to Cape Chidley ; in their southern half they rarely exceed 1500 feet, but increase in the northern half to a general elevation of upwards of 2000 feet, with numerous sharp peaks between 3000 and 6000 feet. Owing to the exceedingly long period of denudation, the coasts are deeply indented by long irregular bays and fringed with rocky islands, especially along the high

Atlantic coast, where the shore-line is very irregular, and long narrow fiords penetrate inland. Hamilton Inlet, 260 miles north of the Strait of Belle Isle, is the longest of these bays, with a length of 150 miles and a breadth varying from 2 to 30 miles. The surface of the outer portions of the plateau is deeply seamed by valleys, cut into the crystalline rocks by the natural erosion of rivers, depending for their length and depth upon the volume of water flowing through them. The valley of the Hamilton river is the greatest, and forms a continuation of the valley of the Inlet, and extends 300 miles farther inland, while its bottom lies from 500 to 1500 feet below the surface of the plateau into which it is cut. The depressions between the low ridges of the interior are occupied by innumerable lakes, many of great size, includ- ing Mistassini, Michikamau, Clearwater, Kaniapiskau, and Seal, all from 50 to 100 miles long. The streams dis- charging these lakes, before entering their valleys, flow on a level with the country and occupy all depressions, so that they frequently spread out into lake-expansions and are often divided into numerous channels by large islands. The descent into the valleys is usually abrupt, being made by heavy rapids and falls; the Hamilton, from the level interior, in a course of 10 miles falls 900 feet into the head of its valley, this descent including a sheer drop of 315 feet at the Grand Falls, which, taken with the large volume of the river, makes it the greatest fall in North America. The rivers of the northern and western watersheds drain about two-thirds of the penin- sula ; the most important of the former are the Koksoak, the largest river of Labrador, with a length of over 500 miles, the George, Whale, and Payne rivers, all flowing into Ungava Bay. The large rivers flowing westwards into Hudson Bay are the Povungnituk, Kogaluk, Great Whale, Big, East Main, and Rupert, varying in length from 300 to 500 miles. The rivers flowing south are comparatively short and exceedingly rapid, the Moisie, Eomaine, Natashquan, and St Augustine being the most important, and all about 300 miles long. The Atlantic coast range throws most of the drainage northwards into the Ungava basin, and only small streams fall into the ocean, except the Hamilton, North-west, and Kenamou, which empty into the head of Hamilton Inlet.

Climate. — The climate, ranges from cold temperate on the southern coasts to arctic on Hudson Strait, and is generally so rigorous that it is very doubtful if the country is fit for agriculture north of 51°, except on the low grounds near the coast. On James Bay good crops of potatoes and other roots are grown at Fort George, 54° N., while about the head of Hamilton Inlet, on the east coast, and in nearly the same latitude, similar crops are easily cultivated. On the outer coasts the climate is more rigorous, being affected by the floating ice borne southwards on the Arctic current. In the interior at Mistassini, 50° 30′ N., a crop of potatoes is raised annually, but they rarely mature. No at- tempts at agriculture have been made elsewhere inland. Owing to the absence of grass plains, there is little likelihood that it will ever be a grazing district. There are only two seasons in the interior : winter begins early in October, with the freezing of the small lakes, and lasts until the middle of June, when the ice on rivers and lakes melts and summer suddenly bursts forth. From unconnected observations the lowest tem- peratures of the interior range from —50° F. to —60° F., and are slightly higher along the coast. The mean summer temperature of the interior is about 55° F., with frosts during every month in the northern portion. On the Atlantic coast and in Hudson Bay the larger bays freeze solid between the 1st and 15th of December, and

these coasts remain ice-bound until late in June. Hudson Strait is usually sufficiently open for navigation about the 10th of July.

Minerals. — The mineral wealth is quite undeveloped. Thick beds of excellent iron ore cover large areas in the interior and along the shores of Hudson and Ungava Bays. Large areas of mineralized Huronian rocks have also been discovered, similar to areas in other parts of Canada, where they contain valuable deposits of gold, copper, nickel, and lead ; good prospects of these metals have been found.

Vegetation. — The southern half is included in the sub- Arctic forest belt, and nine species of trees constitute the whole arborescent flora of this region ; these species are the white birch, poplar, aspen, cedar, Banksian pine, white and black spruce, balsam fir, and larch. The forest is continuous over the southern portion to 53° N., the only exceptions being the summits of rocky hills and the outer islands of the Atlantic and Hudson Bay, while

the low margins and river valleys contain much valuable timber. To the northward the size and number of barren areas rapidly increase, so that in 55° N. more than half the country is treeless, and two degrees farther north the limit of trees isreached, leaving, to the northward, only barrens covered with low Arctic flowering plants, sedges, and lichens.

Fisheries. — The fisheries along the shores of the Gulf of St Lawrence and of the Atlantic are at present the most valuable resources of Labrador, and form practically the only industry of the white population scattered along the coasts, as well as of a large proportion of the inhabit- ants of Newfoundland. The census (1891) of Newfound- land gave 10,478 men, 2081 women, and 828 children employed in the Labrador fishery in 861 vessels, of which the tonnage amounted to 33,689 tons ; the total catch being 488,788 quintals of cod, 1275 tierces of salmon, and 3828 barrels of herring, which, compared with the customs returns for 1880, showed an increase of cod and decreases of salmon and herring. The salmon fishery along the Atlantic coast is now very small, the decrease being probably due to excessive use of cod-traps on that coast. The cod fishery is now carried on along the entire Atlantic coast and into the eastern part of Ungava Bay, where excellent catches have been made since 1893. The annual value of the fisheries on the Canadian portion of the coast is about $350,000. The fisheries of Hudson Bay and of the interior are wholly undeveloped, and re- main another source of future wealth, as both the bay and the large lakes of the interior are known to be well stocked with several species of excellent fish, including Arctic trout, brook trout, lake trout, white fish, sturgeon, and cod.

Population. — The population is approximately 14,500, or about one person to every 35 square miles ; it is made up of 3500 Indians, 2000 Eskimo, and 9000 whites. The last are confined to the coasts and to the few Hudson Bay Company’s trading posts of the interior. On the Atlantic coast they are largely immigrants from New- foundland, together with descendants of English fisher- men and Hudson Bay Company’s servants. To the north of Hamilton Inlet they are of more or less mixed blood from marriage with Eskimo women. The Newfoundland census of 1901 gave 3634 as the number of permanent white residents along the Atlantic coast, and the Canadian census (1891) gave a white population of 5728, mostly li’rench

(Janadians, scattered along the north shore of the Gulf of St Lawrence, while the whites living at the inland posts did not exceed fifty persons. As regards the native population of Labrador, it is difficult to give more than a rough approximation of their numbers, owing to their habits of roving from one trading post to another,

and the consequent liability of counting the same family several times if the returns are computed from the books of the various posts, the only available data for an exact enumeration. The following estimate is arrived at in this manner : Indians — west coast, 1200 ; Ungava Bay, 200 ; east coast, 200 ; south coast, 1900. Eskimo — Atlantic coast, 1000 ; south shore of Hudson Strait, 800 ; east coast of Hudson Bay, 500. The Indians roam over the south- ern interior in small bands, their northern limit being determined by that of the trees, on which they depend for fuel. They live wholly by the chase, and their num- bers are dependent upon the deer and other animals ; as a consequence there is a constant struggle between the Indian and the lower animals for existence, with great slaughter of the latter, followed by periodic famines among the natives, which greatly reduce their numbers and maintain an equilibrium. These famines have oc- curred several times since the Hudson Bay Company has been established, with the result that the native popular tion has remained about stationary for the last two cen- turies. The Indians belong to the Algonquin family, and speak dialects of the Cree language. By contact with missionaries and fur-traders they are more or less civilized, and the great majority of them are Christians. Those living north of the St Lawrence are Roman Catholic, while the Indians of the western watershed have been converted by the missionaries of the Church Mission Society ; the eastern and northern bands have not yet been reached by the missionaries, and are still pagans. The Eskimo of the Atlantic coast have long been under the guidance of the Moravian missionaries, and are well advanced in civilization ; those of Hudson Bay have been taught by the Church Mission Society, and promise well ; while the Eskimo of Hudson Strait alone remain without teachers, and are pagans. The Eskimo live along the coasts, only going inland for short periods to

hunt the barren-ground caribou for their winter clothing; the rest of the year they remain on the shore or the ice, hunting seals and porpoises, which afford them food, clothing, and fuel. The Christianized Indians and Eskimo read and write in their own lan- guage ; those under the teaching of the Church Mission Society use a syllabic character, the others make use of the ordinary alphabet.

Political Bevieio. — The Labrador peninsula is divided politically between the Governments of*Canada, New- foundland, and the Province of Quebec. The Govern- ment of Newfoundland, under Letters Patent 28th March 1876, exercises jurisdiction along the Atlantic coast; the boundary between its territory and that of Canada is marked by a line running due north and south from Anse Sablon, on the north shore of the Strait of Belle Isle, to 52° N., the remainder of the boundary being as yet undetermined. The northern boundary of the Province of Quebec, as declared by the statutes of Canada, 61 Victoria, cap. 3, follows the East Main river to its source in Patamisk lake, thence by a line due east to the Ashuanipi branch of the Hamilton river ; it then follows that river and Hamilton Inlet to the coast area under the jurisdiction of Newfoundland. The remainder of the peninsula, north of the Province of Quebec, by Order in Council 18th December 1897 ‘was constituted Ungava District, an unorganized territory under the juris- diction of the Government of the Dominion of Canada.

Authorities — R. F. Holmes. “A Journey in the Interior of Labrador,” Proc. B.G.S. vol. x. pp. 189-205, 1887.— A. S. Pack- ard. The Labrador Coast. Hodges, New York, 1891.— Austen Gary. ” Exploration on Grand Biver, Labrador,” Bui. Am. Geo. Soc vol. xxiv. 1892. — R. Bell. “The Labrador Peninsula,” Scottish’ Geo. Map., July 1895. Also the following reports pub- lished by the Geological Survey of Canada :— R. Bell. “Report on an Exploration of the East Coast of Hudson Bay,” 1877-78 ;

” Observations on the Coast of Labrador and on Hudson Strait and Bay,” 1882-84. — A. P. Low. “Report on the Mistassini Expedition,” 1885 ; ” Report on James Bay and the Country East of Hudson Bay,” 1887-88 ; ” Report on Explorations in the Labrador Penin- sula, 1892-95,” 1896 ; “Report on a Traverse of the Northern Part of the Labrador Peninsula,” 1898 ; ” Report on the South Shore of Hudson Strait,” 1899. (a. p. lo.)

Labuan (more correctly written Labuh-an, its mean- ing in the Malayan vernacular being ” anchorage “), an island of the East Indian or Malayan Archipelago, which has been a British possession since 1848. On 1st January 1890 it was transferred for administrative purposes to the Chartered Company of British North Borneo, the Governor of the Company’s territories being from that time forward the governor of Labuan also. As governor of Labuan he holds a commission from the Crown. After its transfer to the Chartered Company the colony still retained its own local laws. The island lies about six miles off the north-western coast of Borneo, opposite the northern end of the great bay of Brunei. Of the total area of 19,347 acres only some 1600 acres are sown with rice, but small tracts of land are covered by cocoanut and sago palms, and about fifty Chinese own vegetable gardens planted on Government ground. The neighbouring island of Pulau Dat is the site of a thriving cocoanut plantation, whence copra and nuts are exported in bulk. The African oil palms have not proved a success. At the time of its oc- cupation a brilliant future was predicted for Labuan : its harbour was to make a second Singapore, and its coal de- posits were to prove an unfailing source of wealth. The anticipations made of the wealth of the coal-fields have not been realized ; after a succession of companies had liquidated or transferred their leases, the Labuan Borneo Company was formed in 1898, but it has since passed into liquidation. Prom the coal-mines near the village of Lubok Termiang, some ten miles of metre-gauge railway lead to Victoria Harbour. In 1898 the coal exported amounted to 36,901 tons. The population of Labuan numbered 6731 in 1881, but had decreased to 3361 in 1891. The mainland of Borneo, since its pacification by the Chartered Company, offered greater scope than for- merly to native enterprise, and emigration from Labuan consequently ensued. There are about fifty European set- tlers living in the island, about ten per cent, of whom are women. The native population includes Malay fishermen, Chinese, Tamils, and Kadayans, Tutongs and other natives from the mainland of Borneo. Victoria Harbour is a naval saluting station, and possesses a good rifle-range. The harbour is commodious and well sheltered. The Eastern Extension Telegraph Company have a central station at Labuan, with cables to Singapore, Hong-Kong, and British North Borneo. The colony joined the Im- perial Penny Postal Union in 1899. There is one hotel, a Roman Catholic church with a resident priest, a Church of England church which is visited periodically by a clergyman

from the mainland, two native and Chinese schools, and a sailors' club built by the R.C. Mission and supported by voluntary contributions. The bishop of Singapore and Sarawak is also bishop of Labuan.

See Keppel. Visit to Indian Archipelago, London, 1853. — MuNDT. Narrative of Events in Borneo. London, 1848. — Bdr- EAGB. Gardens of the Sun. London, 1880. — Hatton. The New Ceylon; North Borneo. — Prter. A Decade in Borneo. — Pose- wiTZ. Borneo. — Roth. Borneo. (h. Cl.)

Lace. — The chief incidents in connexion with making lace by hand and by machinery during the years which have elapsed since the article on Lace was written for the earlier volumes (ninth edition) of this work may be said to be (1) increased production, (2) developed ingenuity in the weaving by machinery of a greater variety of lace-like

textures and ornaments than formerly, and (3) improve- ment in the design of ornament specially destined for translation into lace whether by hand or by machinery.

Fig. 1.— Collar of Irish Crochet Lace.

An extraordinary demand for hand-made laces has led to a revival of this distinctly domestic industry in many parts

Fig. 2. — Lady's Sleeve of Irish Crochet Lace.

of Europe, but particularly in Belgium, where the social and economic conditions are, as they have been in the past,

Collar and Bertha of Irish Crochet Lace.

more conducive and more favourable than elsewhere to its pursuit at a sufficiently remunerative rate of wap;es. The production of hand-made lares in Bel

nwra was i

in 1900

greater than that of France. The principal needle-made lace of Belgium is the “Point de Gaze”; “Duchesse” and Bruges laces are the chief pillow-made lapes ; whilst ” Point Applique ” and ” Plat Applique ” are frequently the results not only of combining needle-made and pillow work, but also of using them in conjunction with machine- made net. Ireland is the best producer of that substantial looped-thread work known as crochet, which must be re- garded as a hand-made lace fabric. It is in this respect quite distinct in char- acter from pseudo-laces, which are really em- broideries with a lace- like appearance, e.g., em- broideries on net, cut and embroidered cam- brics and fine linen. For such as these Ireland maintains a reputation in its admirable Limerick and Carrickmacross laces, which are made not only in Limerick and Carrickmacross, but also in Kinsale, Newry, Crossmaglen, and else- where. The demand from France for Irish crochet is now far beyond the supply, a condition which leads not only to the rapid repetition by Irish workers of old patterns, but tends also to a gradual debasement of both texture and ornament. Attempts have been made occasionally to counteract this tendency, with some success, as the specimens of Irish crochet in Figs. 1, 2, and 3 indicate.

France continues to be faithful to her traditions in maintaining a lively and graceful taste, somewhat, how- ever, at the risk of sacriiicing that higher order of hand- work which has supplied the world with the elaborate and delicate needle-point laces of AleuQon and Argentan. Fashion of late years has called for ampler and more boldly effective laces, readily produced with both braids and cords and far less intricate needle or pillow work than was required for the dainty and smaller laces of earlier date. Other European countries, including Great

Fig. 4.— Machine-made Trimming Border in imitation of Irish Crochet Lace.

Fig, 5. — Border of Machine-made Lace in imitation of 17th-century Pillow Lace.

Britain, do not compete successfully in hand lace-making with Belgium and France. An appreciable amount of pillow-made lace is annually supplied from Devonshire, ‘ Buckinghamshire, Bedfordshire, and Xortliumberland, but it is bought almost wholly for home and not foreign use. The English laces are made almost entirely in accordance with the precedents of the 19th century — that is to say, in definite lengths and widths, as for borders, insertions, and flounces. The recent demand, however, has been chiefly for large shaped articles, such as panels for dresses, long sleeves, complete skirts, jackets, blouses,

Fl&. 6. — Border of Machine-made Lace in the style of 17th-century Pillow Guipure Lace.

and fancifully-shaped collars of considerable dimensions. To make such things entirely of lace necessitates many modifications in the ordinary methods ; the English lace- workers are slow to adapt their work in the manner requisite, and hence are far behind in the race to respond to the fashionable demand. No countries, indeed, succeed

so well in promptly answering the vari- able call of fashion as France and Belgium.

As regards trade in lace, America prob- ably buys more from Belgium than from France ; France and England come next as purchasers of nearly equal quantities, after which come Eussia and Italy.

In respect of lace- like fabrics made by machinery, British capital and labour are concerned in supplying the world with the more important quantity of curtains and hangings. France seems to take the lead in producing the more filmy and more delicate machine-made laces for wearing purposes ; whilst Switzerland (St Gall) and Germany (Plauen in Saxony) are foremost in making by machinery imitations of the more solid laces, such as the Venetian raised or ” Eose ” needle-point laces and Irish crochet. The technical method of making laces by hand, whether on the

pillow with bobbins or in the hand with a needle, has not altered. Plaiting threads on the pillow or looping them together by means of the needle are the same in principle and practice as they were throughout the 16th and 17th centuries, when the fostering and gradual perfection of the art of lace-making were proceeding in Europe.

The Leavers lace-making machine, of which the principal features were briefly indicated in the earlier volumes of

this Encyclopaedia, has not undergone any essential change. Its mechanical principles for weaving the threads together and for ren- dering variety of orna- ment in pattern remain as they were, notwith- standing such rela- tively minor modifi- cations as make it possible to produce readily laces having varied effects such as are shown in the

r.«. 8.-Machine-made Lace of Modem Design. ^^^^^^^^^ ^^ j.j^g_

■5 and 6. The machine imitations of the lighter and £nely-meshed laces, for which the lace-makers at Valen- ciennes and Mechlin have long been famed, continue to be made in great quantities at Nottingham and

Fig. 7.— Machine-roade Lace in imitatioa of 16th-century Needle-point “Eeti- cella ” Lace.

Calais. Within recent years the texture and ornamental design in these fabrics have been so improved that they are worn even by those who not long ago considered hand-made materials to be indispensable. In another branch of lace-making by machinery, mechanical inge- nuity, combined with chemical treatment, has led to surprising results (Figs. 4 and 7). Swiss and German manufacturers use machines in which a principle of the sewing-machine is involved. A fine silken tissue is thereby enriched with an elaborately raised cotton or thread embroidery. The whole fabric is then treated with chemical mordants which, whilst dissolving the silky web, do not attack the cotton or thread embroidery. A relief embroidery possessing the appearance of hand- made raised needle-point lace is thus produced. Figs. 8 and 9 give some idea of the high quality to which this admirable counterfeit has been brought.

Fig. 9. — Machine-made Lace in Imitation of 17th century Needle-point Lace ” Gras point de Venise,”

The success with which machinery can compete with the hand in the making of lace must be largely ascribed to the serious study given by those engaged in directing the manufacture by machinery, and to the various ornamental characteristics exhibited in types of hand-made work of former periods. Collections of these exist in museums and technical institutions, as for instance the Victoria and Albert museum in London, the Musee des Arts Decoratifs in Paris, and Museums at Lyons, Nuremberg, Berlin, Turin, and elsewhere. In such places the opportunity is presented of tracing in chronological sequence the stages of pattern and texture development, and thus a means is provided of acquiring a knowledge which has not been obtainable so readily in past times as it is now. This is a condition which gives vitality to both demand and supply.

In addition to books on lace mentioned at the end of the article in vol. xiv. (9th ed.), it will be useful to give here a brief list of other publications. In 1886 the Libraire Benouard, Paris, published a History of Point (VAlenqon, written by Madame G. Despierkes, which gives a close and interesting account of the industry, together with a list, compiled from local records, of makers and dealers from 1656 onwards. — Embroidery and Lace: their manufacture and history from the remotest antiquity to the present day, by Ernest Lefebure, lace-maker and administrator of the Ecole des Arts Decoratifs, translated and enlarged with notes by Alan S. Cole, was published by H. Grevel, London, 1888. It is a well-illustrated handbook for amateurs, collectors, and general readers. — Irish laces made from selected and recent designs are illustrated In the Benascence of the Irish Art of Lace-making, published in 1888 by Chapman and Hall, London. — Anciennes Dentelles Beiges formant la Collection de feue ‘Madame Augusta Baronne Liedts et donnees au Musee de Grunthui^ a Bruges, published at Antwerp in 1889, consists of a folio volume containing upwards of 181 phototypes — many full size — of fine

specimens of lace. The ascriptions of country and date of origin are occasionally inaccurate, on account of a too obvious desire to credit Bruges with being the birthplace of all sorts of lace work, much of which shown in this work is distinctly Italian. — The Encijclopmdia of Needlework, by Ther^se de Dillmont-Doknach, Alsace, 1891, is a detailed guide to several kinds of embroidery, knitting, crochet, tatting, netting, and most of the essential stitches for needle-point lace. It is well illustrated with wood- cuts and process blocks. — An exhaustive history of Russian laoe- making is given in La Dentelle Busse, by Madame Sophie Davidofp, published at Leipzig by Karl Hiersemann, 1895. Russian lace is principally pillow-work with rather heavy thread, and upwards of eighty specimens are reproduced by photo-litho- graphy in this book. — A short account of the best-known varieties of Point and Pillow Lace, by A. M. S., London, John Murray, 1899, is illustrated with typical specimens of Italian, Flemish, French, and English laces, as well as with magnified details of lace, enabling any one to identify the plaits, the twists, and loops of threads in the actual making of the fabric. — L'' Industrie des Tulles et Dentelles Mecaniques dans le Pas de Calais, 1815-1900, by Henri Henon (B61in Frferes, Paris, 1900), is an important volume of over 600 pages of letterpress, interspersed with abundant pro- cess blocks of the several kinds of machine nets and laces made at Calais since 1815. It opens with a short account of the Arras hand-made laces, the production of which is now almost extinct. The book is sold for the benefit of a public subscription towards , the erection of a statue in Calais to Jacquard, the inventor of the well-known apparatus by means of which all figured textile fabrics are manufactured. It is of some interest to note that machine net and lace making at Calais owe their origin to Englishmen, amongst whom "le sieur R. Webster arrive ^ St Pierre-les-Calais en Dfecembre 1816, venant d'Angleterre, est I'un des premiers qui ont tablij;lans la communaut une fabrique de tulles," &c. Lace- making in the Midlands : past and present, is an ably-written little work by C. C. Channer and M. E. Roberts (Methuen, London, 1900) upon the lace-making industry in Buckinghamshire, Bedfordshire, and Northamptonshire, and contains many illustra- tions of laces made in these counties from the 17th century to the present time. (a. s. C.)

Lachine, an incorporated town in Jacques Cartier county, Quebec, Canada, situated eight miles by rail west of Montreal, on Lake St Louis, an

expansion of the St Lawrence, and at the upper end of the Lachine canal. It is a station on the Grand Trunk railway and port of call for steamers plying between Montreal and the Great Lakes. It is a favourite summer resort for Montrealers. Population (1881), 2406 ; (1891), 3761 ; (1901), 5661.

Laconia, a city of New Hampshire, U.S.A., capital of Belknap county, on the Boston and Maine railroad, and on the west shore of Lake Winnepesaukee. It con- tains several villages, among them Laconia, Lakeport, and The AViers. It contains the car-works of the Boston and Maine railroad. Population (1880), 3790 ; (1890), 6143 ; (1900), 8042, of whom 1770 were foreign-born and 21 were negroes.

Lacquer (Japanese). — No important new developi- ments have taken place during modern times in Japan's lacquer manufacture. Her artists follow the old ways faithfully ; and indeed it is not easy to see how they could do better. On the other hand, there has not been any deterioration; all the skill of former days is still active. The contrary has been repeatedly affirmed by foreign critics,^ but no one really familiar with modern productions can entertain such a view. Lacquer-making, however, being essentially an art and not a mere handi- craft, has its eras of great masters and its seasons of inferior execution. Men of the calibre of Kwoetsu KwSrin, Eitsuo, Kajikawa, and Mitsutoshi must be rare in any age, and the epoch when they flourished is justly remem- bered with enthusiasm. But the Meiji era has had its

1 Professor Rein, for example, in his titeat work on Japan, quotes with approval the opinion of a writer who predicts that " it will not be long before the last competent makiye-shi [lacquer-decorator] of the country has passed away.

Zeshin, and it has now Shirayama Pukumatsu, Kawanabe Icho, Shibayama Soichi, Morishita Morihachi, and other lesser experts, all masters in designing and execution. Zeshin, shortly before he died, indicated Shirayama Pukumatsu as the man upon whom his mantle should descend, and that the judgment of this really great crafts- man was correct cannot be denied by any one who has seen the works of Shirayama. He excels in his repre- sentations of landscapes and waterscapes, and has suc- ceeded in transferring to gold-lacquer panels tender and delicate pictures of nature's

softest moods — pictures that show balance, richness, harmony, and a fine sense of decorative proportion. Kawanabe Icho is celebrated for his representations of flowers and foliage, and Morishita Morihachi and Asano Saburo (of Kaga) are admirable in all styles,^ but especially, perhaps, in the charming variety called togi-dashi (ground down), which is pre-eminent for its satin-like texture and for the atmosphere of dreamy softness that pervades the decoration. The togi-dashi design, when finely executed, seems to hang suspended in the velvety lacquer or to float under its silky surface. The magnificent sheen and richness of the pure Mn-makiye (gold lacquer) are wanting, but in their place we have inimitable tenderness and delicacy.

The only branch of the lacquerer's art that can be said to have shown any marked development in the Meiji era is that in which parts of the decorative scheme consist of objects in gold, silver, shakudo, New shibuichi, iron, or, above all, ivory or mother- ment''' of-pearl. It might indeed be inferred, from some of the essays published in Europe on the subject of Japan's ornamental arts, that this application of ivory and mother-of-pearl held a place of paramount im- portance. Such is not the case.- Cabinets, fire-screens, plaques, and boxes resplendent with gold lacquer grounds carrying elaborate and profuse decoration of ivory and motlaer-of-pearP are not objects that appeal to Japanese taste. They belong essentially to the catalogue of articles called into existence to meet the demand of the foreign market, being, in fact, an attempt to adapt the lacquerer's art to decorative furniture for European houses. On the whole it is a successful attempt. The plumage of gor- geously-hued birds — as peacocks, parroquets, pheasants, &c. — the blossoms of flowers (especially the hydrangea), the folds of thick brocade, microscopic diapers and ara- besques, are built up with tiny fragments of iridescent shell, in combination with silver ^oil, gold lacquer, and coloured bone, the whole producing a rich and sparkling effect. In fine specimens the workmanship is extra- ordinarily minute, and every fragment of metal, shell, ivory, or bone, used to construct the decorative scheme, is imbedded firmly in its place. But in a majority of cases the work of building is done by means of paste and glue only, so that the result lacks durability. The employ- ment of mother-of-pearl to ornament lacquer-grounds dates from a period as remote as the 8th century, but its use as a material for

constructing decorative designs began in the 17th century, and was due to an expert called

‘■’ A large part of the work of lacquer-making is purely technical, namely, the part done by the niirimoiw-shi, who spreads the numerous coats of lacquer and performs the various processes of polishing and grinding. By him is produced what maybe called ” artisan lacquer ” ; that is to say, all varieties of larquer that owe their beauties solely to quality and colour of surface, namely, monochromes, as mirror-black, vermiliou, yellow, brovm, green, cinnabar and other hues of red; grounds ornamented with a dust of gold, silver, mother-of-pearl, tin, or bronze; grounds inlaid with mother-of-pearl; marbled, wood- grained, and so forth. “Art lacquer,” on the other hand, is tliat which, alter einci-ijing from the hands of the nnrimono-shi, passes under those of the makii/e-ahi, who, briefly speaking, paints upon the surface of the lacquer a picture, whether of a landscape, a battle-scene, flowers, foliage, birds, insects, &c., or some more formal decoration of scrolls, arabesques, and diapers. The makiye-shi is a true artist.

^ Obtained from the shell of the haliotis.

Shibayama, whose descendant, SMbayama S6icM, now works in Tokyo.

The following account of the history of the lacquer industry in Japan and the processes of manufacture is taken from the writer’s Japan. Japan derived the art of lacquering History from China (probably about the beginning of the and 6th century), but she ultimately carried it far beyond

processes. Chinese conception. At first her experts confined them- selves to plain black lacquer. From the beginning of the 8th century they began to ornament it with dust of gold or mother-of-pearl, and throughout the Heian epoch (9th to 12th century) they added pictorial designs, though of a formal character, the chief motives being floral subjects, arabesques, and scrolls. All this work was in the style knovyn as hira-makiye (flat decora- tion) ; that is to say, having the decorative design in the same plane as the ground.

In the days of the great dilettante Yoshi- masa (1449-90), lacquer experts devised a new style, taka^makiye, or decoration in relief, which immensely augmented the beauty of the ware, and constituted a feature altogether special to Japan. Thus when, at the close of the 16th century, the Taiko inaugu- rated the fashion of lavishing all the resources of applied art on the interior decoration of castles and temples, the services of the lacquerer were employed to an extent hitherto unknown, and there resulted some magnificent work on friezes, coffered ceilings, door panels, altar-pieces, and cenotaphs. This new departure reached its climax in the Tokugawa mausolea of Yedo and Nikko, which are enriched by the possession of the most splendid applica- tions of lacquer decoration the world has ever seen, nor is it likely that anything of comparable beauty and grandeur will be again produced in the same line. Japanese connoisseurs name the end of the 17th century as the golden period of the art, and so deeply rooted is this belief that whenever a date has to be assigned to any specimen of exceptionally fine quality, it is unhesitatingly referred to the time of J6ken-in (Tsunayoshi). It will thus be perceived that the three great stages in the history of lacquer industry were separated by intervals of 100 years ; namely, the Yoshimasa development at the end of the loth century, the Taiko develop- ment at the end of the 16th, and the Joken-in climax at the end of the 17th. Beyond the last it is difficult to perceive any possibility of advance.

In the manufacture of Japanese lacquer there are three processes. The first is the extraction and preparation of the lac ; the second, its application ; and the third, the decoration of the lacquered surface. The lac, when taken from an incision in the trunk of the Bhus vernioifera (urushi-no-ki), contains approximately 70 per cent, of lac acid, 4 per cent, of gum arabic, 2 per cent, of albumen, and 24 per cent, of water. It is strained, deprived of .its moisture, and receives an admixture of gamboge, cinnabar, acetous protoxide, or some other colouring matter. The object to be lacquered, which is generally made of thin white pine, is subjected to singularly thorough and painstaking treatment, one of the processes being to cover it with a layer of Japanese paper or thin hempen cloth, which is fixed by means of a pulp of rice-paste and lacquer. In this way the danger of warping is averted, and exudations from the wooden surface are prevented from reaching the overlaid coats of lacquer. There are numerous operations of

luting, sizing, lacquering, polish- ing, drying, rubbing down, and so on, until, after many days' treatment, the object emerges with a smooth, lustre-like, dark-gray surface, and is ready to pass into the hands of the makiye-shi, or decorator. The latter is an artist ; those who have performed the preliminary operations are merely skilled artisans. The makiye- shi may be said to paint a picture on the surface of the already lacquered object. He takes for subject a landscape, a seascape, a battle-scene, flowers, foliage, birds, fishes, insects— in short, any- thing. This he sketches in outline with a paste of white lead, and then, having filled in the details with gold and colours, he super- poses a coat of translucid lacquer, which is finally subjected to careful polishing. If parts of the design are to be in relief, they are built up with a putty of black lacquer, white lead, camphor, and lamp-black. In all fine lacquers gold predominates so largely that the general impression conveyed by the object is one of glow and richness. It is also an inviolable rule that every part must show beautiful and highly finished work, whether it be an external or an internal part. The makiye-shi ranks almost as high as the pictorial artist in Japanese esteem. He frequently signs his works, and it results that a great number of names have been handed down during the past two centuries.

See also under Japan. (f. By.)

Lacroma, a small island of the Austrian province of Dalmatia, south of Eagusa, remarkable for the beauty of its sub-tropical vegetation. It was a favourite resort of the Archduke Maximilian, afterwards emperor of Mexico, who restored the chateau and park, and of the Crown Prince Eudolph. It contains an old monastery,

and the remains of a church said to have been founded by Richard Coeur de Lion now form part of the imperial chateau.

See Lacroma, an illustrated descriptive work by the Crown Princess Stephanie (Vienna, 1892).

Lacrosse, a city of Wisconsin, U.S.A., capital of Lacrosse county, on the east bank of the Mississippi river, at the mouths of the Lacrosse and the Black, at an altitude of 669 feet. Its plan is regular, and it has a good water-supply, owned by the city. It is on four railways : the Chicago, Burlington,

and Quincy ; the Chicago and North- western ; the Chicago, Milwaukee, and’ St Paul ; and the Green Bay and Western. Its chief business in the manu- facture of lumber. Its manufactures, according to the census of 1890, had a capital of $10,039,872, employed 4127 hands, and had a product valued at ^ 9,167,601. Lumber was the principal product, with a value of 13,570,522, and next in value was flour, with $2,134,785. The assessed valuation of property, real and personal, was $12,381,952, the net debt of the city was but $401,029, and the rate of taxation $22.60 per $1000. Population (1890), 25,090 ; (1895), 28,769 ; (1900), 28,895, of whom 7222 were foreign-born and 56 were negroes.

Ladak. — Little has occurred in this remote outlying province of the upper Indus to bring it into prominence of late years. It is from Leh, its capital, that western Tibet is most readily accessible, and through Leh the trade of Lhasa ebbs and flows. It is this trade which gives Ladak sufiS.cient local importance to justify the presence of a British political oflftcer, who resides at Leh for half the year ; whilst its geographical position renders it further notable as the starting-point of many adventu- rous journeys into the Tibetan highlands. As year by year the economic possibilities which lie beyond the Himalaya become better known, it is more clearly demonstrated that no great trade developments are to be expected from these Tibetan sources which have already been tested, so long as the spirit of determined opposition to the advance of European influence, and to the introduction of scientific methods, is maintained amongst Tibetan ofiicials. With the gradual awakening of China there may hereafter be reflected some rays of enlightenment into these far-away borders of the ” Celestial Empire,” but at present there is more evidence of a decrease in Tibetan trade than of progress.

In 1896-97 the exports to British India from Tibet, chiefly passing through Leh, amounted to Ex.140,456, showing an increase on the previous year, but a decrease of Ex.5000 on the year before. The imports were Ex.69,406, which is lower than the two previous years. Ladak is, however, improving in its trade prospects apart from. Tibet ; and in 1896-97 the exports amounted to Ex.57,508, and imports to Ex.64,674. It is curious that both Ladak and Tibet import a considerable amount of treasure, for on the borders of western Tibet and within a radius of one or two hundred miles of

Leh there centres a gold-mining industry which apparently only requires scientific development to render it enormously productive. Here the surface soil has been washed ‘for gold, for more centuries than we can count, by bands of Tibetan miners who never work deeper into the soil than from 20 to 60 feet, and whose methods of washing have ever been of the very crudest description. They work in winter, chiefly because of the binding power of frost on the friable soil, suffering great hardships and obtaining but a poor return for their labour. But the remoteness of Ladak and its extreme altitude still continue to bar the way to substantial progress, though its central posi- tion naturally entitles it to be the great trade mart.

The road to Leh from Srinagar lies up the lovely Sind valley to the sources of the river at the Zoji La pass

(11,300 feet) in the Zaskar range. This is the range ■w-hich, skirting the southern edge of the upland plains of Deosai in Baltistan, divides them from the valley of Kashmir, and then continues to Nanga Parbat (26,620 feet) and beyond that mountain, to the north of Swat and Bajaor. To the south-east it stretches in an unbroken chain till it merges into the line of snowy peaks which is seen from Simla and the plains of India — the snowy range ■which reaches past Chini to the famous peaks of G-angotri, ISTandadevi, and Nampa. It is the most central and the best known range in the Himalaya. The Zoji La, which curves from the head of the Sind valley on to the bleak uplands of Dras (where lies the road to the trough of the Indus and Leh), is, in spite of its altitude, a pan in which but little snow lies ; but for local accumulations, it would be open all the year round. It is cited by Oldham, of the Indian Geological Survey, as affording a typical instance of that cutting-back process by which a river-head may erode a channel through a watershed and cut into the plateau behind, there being no steep fall towards the Indus on the northern side of the range. From the Zoji La the road continues by easy gradients, following the line of the Dras drainage, to the Indus, when it turns up the valley to Leh. From Leh there

are many routes into Tibet, the best known being that which comes from the Indus valley to the Tibetan plateau, by the Chang La, to Lake Pang- kong and Eudok (14,000 feet). Kudok occupies a forward position on the western Tibetan border which is analogous to that of Leh in Kashmir. The chief trade route to Lhasa from Leh, however, follows the line offered by the valleys of the Indus and the Brahmaputra (or Tsanpo), crossing the divide between these rivers north of Lake Manasarowar. The development of trade through Ladak depends on the maintenance of this road, which is at present absolutely closed to Europeans.

The observatory at Leh is the most elevated observa- tory in Asia. According to Mr Blandford's work on the climate and weather of India, it is situated 4° farther north than Quetta, and 6,000 feet higher, and "in the leading characteristics of its climate represents that of western Tibet. . . . The atmosphere of the Indus valley is remarkably clear and transparent, and the heat of the sun is very great. There is generally a difference of more than 60° between the reading of the exposed sun thermometer in vacuo and the air temperature in the shade, and this difference has occasionally exceeded 90°. . . . The mean annual temperature at Leh is 40°, that of the coldest months (January and February) only 18° and 19°, but it rises rapidly from February to July, in which month it reaches 62° with a mean diurnal maximum of 80° both in that month and August, and an average difference of 29° or 30° between the early morning and afternoon. The mean highest tem- perature of the year is 90°, varying between 84° and 93° in the twelve years previous to 1893. On the other hand, in the winter the minimum thermometer falls occasionally below 0°, and in 1878 reached as low as 17° below zero. The extreme range of recorded temperature is therefore not less than 110°. The air is as dry as Quetta, and rather more uniformly so. . . . The amount of rain and snow is insignificant. The average rain (and snow) fall is only 2-7 inches in the year, and since that amount is the greatest ever recorded in any one year, and as rain is most frequent in July and August — but even then it only occurs on one day in ten — and the average fall of each rainy day is between one-tenth and two-tenths of an inch, agriculture is therefore almost entirely dependent on irrigation. The winds are generally light, and depend on the local direction of the valleys. At Leh, which stands at the entrance of the valley leading to the Khardong Pass, the most common directions are between south and west

in the daytime and summer, and from north-east in the night, especially in the later months of the year. In January and February the air is generally calm, and April and May are the most windy months of the year.”

Leh has been repeatedly visited since 1880 by travellers bound on Tibetan exploration, including Bower, Wellby, Littledale, Deasy, and others, who have recorded their general impressions, but left little description of districts on the Indian side of the Tibetan border.

The following should he consulted : — God win- Austen. ” The Mountain Systems of the Himalaya,” vol. vi. Proc. B.G.S., 1884. — W. Lawrence. The Valley of Kashmir. London, 1895. — H. F. Blandfokd. The Climate and Weather of India. London, 1889. (t. h. h*.)

Lad rones, or Mariannes, an archipelago in the North Pacific, in about 16°-20°]S”. and 142° E. It con- sists of two groups — a northern of ten volcanic islands, of which only four (Agrigan, Anatahan, Alamagan, and Pagan) are inhabited, and a southern of five (Kota, Guam, Aguigan, Tinian, and Say pan) coralline limestone islands, all inhabited save one, Aguigan. The entire archipelago, except the island of Guam, together with the Caroline and Pelew Islands, was sold bj Spain to Germany for £837,500 in 1899. The total area -is about 220 square miles, and the population 1950, mostly descendants of Tagal immigrants from the Philippines. Cocoanut and areca palms, yams, sweet potatoes, manioc, coffee, cocoa, sugar, cotton, tobacco, and mother-of-pearl are the chief products, and copra the principal export. Administratively the archipelago forms part of the New Guinea Protectorate.

Lafayette, a city of Indiana, U.S.A., capital of Tippecanoe county, on the east bank of the Wabash river, at an altitude of 542 feet. It is well laid out, and is divided into seven wards. Its water-supply is pumped from the Wabash. It is on four railways : the Chicago, Indianapolis, and Louisville ; the Cleveland, Cincinnati, Chicago, and St Louis ; the Lake Erie and Western ; and the Wabash. It is the seat of Purdue University, a, technical school, founded in 1874, which had, in 1899, 64 professors and instructors and was attended by 749 students, 91 of whom were women. Population (1890), 16,243 ; (1900), 18,116, of whom 2266 were foreign-born and 344 negroes.

Laffltte, Pierre (1823), French Positivist, was

born 21st February 1823 at Beguey (Gironde). Residing in Paris as a teacher of mathematics, he became a disciple of Comte, and was one of his testamentary executors. On the schism of the Positivist body, which followed the master's death, he was recognized as head of the section which accepted the full Comtian doctrine; the other section adhering to Littre, who rejected the Religion of Humanity as inconsistent with the materialism of Comte's earlier period. In 1875 LaflRtte published Les grands types de I'humaniti, and Cours de philosophie premi&re (1889). Owing to advanced years he afterwards resigned the active direction of Positivist affairs.

Lagarde, Paul Anton de (1827-1891), Ger- man theologian and orientalist, was born at Berlin on the 2nd of November 1827, and educated there. At Berlin, and afterwards at Halle, he studied theology and philosophy, as well as Oriental languages. In 1862 his studies took him to London and Paris. On his return to Germany in 1854 he obtained the post of teacher at a Berlin public school, but at the same time carried on his Biblical studies. He edited the Syriac "Didascalia Apostolorum," and followed this up with other Syriac texts collected in the British Museum and in Paris. Lagarde kept this post till 1866, when he received three years'

leave of absence ■with a view to collecting fresh materials for his labours. On his return in 1869 he was called to Gottingen to the professorship previously held by Ewald. Like him, Lagarde was an active worker in a great variety of subjects and languages ; but his chief aim, the elucidation of the Bible, was almost always kept in view. He edited the Aramaic translation (known as " Targum ") of the Prophets according to the Codex Reuchlinianus preserved in the library at Karlsruhe, the Hagiographa Chaldaica, an Arabic translation of the Gospels, a Syriac translation of the Old Testament Apocrypha, a Coptic translation of the Pentateuch, and a part of the Lucianic text of the Septuagint, which he was able to reconstruct from manuscripts for nearly half the Old Testament. Besides his Biblical studies, he devoted himself ardently to Oriental scholarship. In 1877 he

engaged in Arme- nian investigations ; in 1883 he took up Persian, and also published his ” jEgyptiaca,” which deals with Cop- tic studies. His minor articles were collected under the titles ” Symmicta ” and ” Mitteilungen,” as well as in volumes issued by the University of Gottingen. Lagarde also took some part in politics. He belonged to the Prussian Conservative party, and was a violent anti- Semite. The bitterness which he showed in this racial question also made itself felt in his other writings, and in his differences with other scholars he showed some of that polemic acrimony which prevails in learned circles in Germany. He died at Gottingen on the 22nd of December 1891. (a. z.)

Lagos, a British colony in West Africa, bounded roughly on the N. by Ilorin, on the E. by Benin (both forming part of Nigeria), on the S. by the Bight of Benin, and on the W. by Dahomey. It was, by a charter dated 13th January 1886, separated from the Gold Coast Colony and erected into a separate colony, the govern- ment of which is conducted by a governor assisted by executive and legislative councils nominated by the Crown. In the legislative council there are four un- official members, two of whom are natives of the country. The colony proper begins on the coast, on the west side, at the boundary of the French protectorate of Dahomey, on the meridian of Ajara Creek, at about 2° 45′ 60″ E., and extends on the east side to Ode, at about 4° 30′ E. Connected with the colony is an administrative protector- ate, within which the courts of the colony have jurisdic- tion. The colony proper and this protectorate together make up an area of some 1600 square miles. The politi- cal protectorate connected with Lagos meets southern Nigeria at Ogbo on the coast, about 4° 49′ E. It in- cludes the Idanre country, but excludes Ilorin. On the west it follows generally the meridian of the Ajara water- course as far north as the neighbourhood of 9° N., in the vicinity of which it passes eastwards, so as to include all Yoruba settlements on the Lagos side of the boundary. The jurisdiction of the supreme court has not been ex- tended to the political protectorate, but a general direct- ing control is maintained there by the commissioners who preserve the public peace and influence and assist native authorities. The population of Lagos, the largest town on the African west coast, is about 33,000, of whom about 300 are Europeans. The largest towns in the protectorate are Abeokuta and Ibadan, estimated to have populations of about 160,000 and 200,000 respectively, but there has been no census. The

population of the colony and pro- tectorate may be altogether upwards of two millions. The total superficial area of the colony and all its de- pendencies is set down at 27,000 square miles. The supreme court has jurisdiction in the administrative pro- tectorate as well as in the colony. The native authorities have, save in the case of some graver crimes, a concurrent

jurisdiction which is exercised in this protectorate. In the political protectorate the laws are administered in the name of the native authorities. The great majority of the civil servants are natives of the country, some of whom have been educated in the colony, others in Eng- land and elsewhere. The European officers number gen- erally about 112; the native officers about 269. Mails are received weekly from Europe, but with some irregu- larity, as there is no subsidized service. There is cable communication with Europe. The British and West African Bank was opened in Lagos on the 1st of April 1891. There is also a Government savings bank. ‘The amount of the deposits is £16,663. The police establish- ment embraces a force of upwards of 350 men. The police is an armed and partially drilled body. There is a Hausa constabulary of about 800 men. These are trained as infantry and artillery by 18 European and 3 native commissioned officers. About 300 men are gener- ally stationed at Lagos, 150 at Ibadan, 60 at Shaki, and others in small detachments elsewhere. The legal status of slavery is not recognized by the courts, and dealing in slaves is suppressed. As an institution slavery is steadily dying out, and will soon become extinct, unless in some veiled domestic form.

Lagos Town. — The principal buildings in the town of Lagos are a large and sumptuous government house ; the Glover Memorial liall, used for public meetings and entertainments ; an elaborate club, provided from public funds ; police quarters, and many sub- stantial villas that serve as quarters for the officers of the civil service. There are many solidly ~~built, handsome private buildings. Regular streets are laid out over about half the town only. Owing to the complete absence of stone, the streets are not macadamized. The chief stores and depots for goods are all on the banks of the lagoon. Merchandise is generally transported by water. An electric tramway is projected, to traverse the town and connect with the railway on the mainland. A considerable portion of the town is supplied with the electric light, which is being extended. Only surface drainage has been~~

~~attempted. Under~~ ground draining is difficult, on account of the low and level nature of the ground. There still exists a large acreage of swamp land in and near the town of Lagos, and costly and persevering efforts are being made to reclaim these swamps. Till this is done it is not likely that Lagos can become even tolerably healthy. The water-supply is derived in many cases from rain-water collected from the iron roofs of houses and stored in tanks, but more generally from wells sunk in the sandy soil on which the town is built. The number of houses covered by galvanized iron is steadily increasing, and now exceeds 5000. There is a dry-earth system of sewerage. No form of municipality has been established. Its inhabitants have always regarded any proposal in that direction with disfavour. The commodious public hospital, of the cottage type, on a good site, with proper accommodation for 10 European and 46 native patients, has European nurses in charge and a resident medical officer. The number of resident patients treated in 1899 was — Europeans 77, others 694 ; outr-patients 4294. There is a good racecourse, which also serves as a general public recreation ground. The port is accessible only to vessels drawing about 10 feet of water, on account of shifting banks of sand that form a bar at the sea entrance of the lagoon. Large ocean-going steamers anchor outside the bar, not less than a couple of miles from land, and goods and passengers are there transhipped into smaller branch steamers for Lagos. Heavy cargo is taken on by the large steam- ers to Forcados and transhipped there into the branch boats for Lagos. It has been estimated that it would cost a million sterling to open the harbour permanently to large steamers.

Communications. — A solidly constructed railway on a 3-feel gauge starts from Iddo Island, and extends past Abeokuta, which is some 60 miles from Lagos, to Ibadan, a total distance of 122 miles. The railway (opened in 1901) crosses from Ebute Metta on the mainland to Iddo Island by the Denton Bridge, a handsome structure of iron 917 feet long. The Carter Bridge, also of iron, 2111 feet long, connects Iddo Island with the town of Lagos. The railway was built by the Government, and cost nearly a million sterling. The lagoon, which lies in a direction generally parallel to the sea, and only a very few miles from it, is entirely free of coral, and contains hardly any rocks of any kind, though it is often shallow and has many mud-banks in its bed. It, however, oifers very convenient channels for numerous small craft, which, with the exception of steain-lauuohes, are almost

entirely native-built canoes. Branch steamers run between Lagos and Porto Novo.

During the last few years some miles of road have been made by the Government at an expense of nearly £40,000.

Industry. — No minerals are known with certainty to exist in the colony. The inhabitants are chiefly engaged in agriculture and trading. The principal articles of cultivation are yams, cas- sava, maize, sweet potatoes, sesame, millet, beans, sugar-cane, and cotton, all original products of the country. To these are being added coffee, cocoa, rubber trees, &o. Model farms are being established for the purposes of experimental culture and for the tuition of the natives. The soil is generally fertile, though as a rule containing a considerable proportion of sand. A few land concessions have been taken up by Europeans on long leases. The native owners profess to be unable to alienate land in perpetuity, but native custom does not preclude leasing. Some of the con- cessions are only for cutting and removing timber, others permit of cultivation.

Climate. — The rainfall has not been ascertained in the interior. In the northern districts it is probably considerably less than at Lagos, where it is about 70 inches a year. The mean temperature at Lagos is 82°-5 F. At certain seasons sudden heavy squalls of wind and rain that last for a few hours are common. The hurri- cane and typhoon are unknown. The climate is not a healthy one, especially for Europeans. The sanitary condition of all towns, in- cluding Lagos itself, is bad. The principal diseases are malarial fever, smallpox, rheumatism, peripheral neuritis, dysentery, chest diseases, and guinea-worm. Eever not unfrequently assumes the dangerous form known as “black-water fever.” The frequency of smallpox is being much diminished outside of the larger towns in the interior, in which, owing to the absence of an organized government, vaccination is neglected. The number of persons vaccinated by the medical department in 1899 was 65,073. A contagious diseases hospital is used for the reception of patients suffering from smallpox, &c. There is a leper asylum, lunatic asylum, and a

laboratory for chemical and pathological study. Tlie absence of plague, yellow fever, cholera, typhoid fever, and scarlatina is noteworthy. Yaws of a mild form is endemic.

Education. — The Government expends directly about £6000 on education annually. Grants are made on examination results as determined by the inspector of schools to seventeen Church of England schools, ten Wesleyan, and ten Koman Catholic schools. Grants are also given to schools for the elementary education of Mahommedans in the form of payment for their teachers (seven in number). Contributions are also made to technical education. Lagos is a centre for the examinations for degrees in arts and laws of the University of London.

Beligion. — Tlie different Christian denominations claim 6700 members, namely : Church of England 2700, Wesleyans 1800, Roman Catholics 1800, Baptists 400. The Mahommedans number about 21,000, which leaves some 50,000 pagans. In some parts of the country Mahommedanism is gaining ground, but it is not of a rigid type.

Finance. — The revenue is chiefly derived from customs, which yield nearly eleven-twelfths of the whole. Over three-fourtlis of the duties is paid on spirits. The revenue for 1890 was £56,340 ; for 1895, £142,049 ; for 1900-01, £211,467 ; and the expenditure for 1890 was £6.3,600 ; for 1895, £144,483 ; for 1900-01, £187,125.

Trade. — The import and export trade is chiefly in the liands of British and German merchants. In 1899 imports by British merchants amounted in round numbers to £878,892 ; by German merchants to £78,623. Exports by British merchants were valued at £577,902 ; by German merchants at £338,032. In 1890 the imports were valued at £464,260, and the exports at £457,649 ; in 1895 these were £815,815 and £985,595 ; in 1899 £957,515 and £915,934 ; and in 1900-01, £806,529 and £831,258.

The principal articles of export for the years 1889 and 1899 were as follows : —

Articles.

1889.

1899.

Palm oil and kernels . . . £373,710

£581,275

Timber

t. .

34,738

Rubber

160,313

Coffee

139

Cocoa

’” 70

3,411

Copra

3

296

Gum .

1,135

507

Ivory

4,093

870

Shea — ^butter

1,393

5,.S23

Other articles

77,245

£457,049

129,062

£915,ii;U

(w. m’g.)

Laguna, a town of the Canary Islands (Spanish), on the island of Tenerife. The population in 1897 was 11,987. It is the seat of a coadjutor bishop of Seville. The soil of the surrounding country is fertile, and yields

wheat, wine, oranges, raisins, tobacco, and other products of agriculture. The town has two large squares, regular and broad streets, a fine modern town hall, hospitals, a public library of 20,000 volumes, an institute, and several schools. There are three churches besides the cathedral, and several handsome residences of the nobility.

Lahn, a river of Prussia, in the Rhine province and province of Hesse-Nassau, rising in the extreme south of the province of Westphalia east of Siegen, at an alti- tude of 2210 feet. It flows at first east as far as Kolbe, then south past Marburg to Giessen, where it turns to the west-south-west, and continues past Wetzlar, Limburg, Ems, and Niederlahnstein, and enters

the Rhine from the right after a course of 135 miles. Its valley is in parts very narrow, and full of picturesque charm.

Lahore, a city of British India, the capital of the Punjab, giving its name to a district and a division. It is situated near the left bank of the river Ravi, 1706 feet above the sea ; 1160 miles by rail north-west of Calcutta, and 290 miles south-east of Peshawar. Poptilafcion (1881), 149,369; (1891), 176,854; (1901), 120,058. The muni- cipal income m 1897-98 was Rs. 4,52, 662 ; death-rate (1897), 29 per 1000. The native town is still surrounded by a brick wall 16 feet high, with thirteen gates and a citadel. To the south lies the suburb of Anarkalli, and eastward of this stretches the European quarter known as Donald Town (after Sir Donald Macleod), with Govern- ment House and the Lawrence Gardens. Still farther east, separated by a branch of the Bari Doab canal, is the cantonment of Mian Mir, which has accommodation for all arms. It is an important junction on the North-Western railway system, but without much trade or manufacture. The chief industries are silk goods, gold and silver lace, and metal work. A cotton-mill was opened in 1897. There are a flour-mill, an ice factory, and several factories for mineral waters. It is the headquarters of the Punjab University, which not only conducts examinations, but also manages the Oriental College, with 70 students in 1896-97. In addition, there are four arts colleges: one maintained by Government, with 246 students ; the Dayanand Anglo-Vedic College, with 383 students ; the Eorman Christian College, with 270 students ; and the Islamiya College, with 48 students. The other educational institutions include the Medical College, with 238 students ; the Law School, with 433 students; the Veterinary College, with 82 students; the Mayo School of Art — perhaps the most successful of its kind in India — with 196 students ; the Central Training College, with 82 students; the Aitehison College, for the training of the sons of native noblemen, on the model of an English public school, with 60 boys; 11 high schools, including one for European boys ; and a railway technical school, with 183 boys. There are 67 printing- presses, issuing 34 newspapers, of which the best known is Tim Civil and Militanj Gazette. The public library and reading-room receives Rs.2666 from Government ; and there are numerous religious institutions, Hindu, Sikh, and Mahommedan, which are active in diffusing education and literature.

The district of Lahore has an area of 3678 miles ; popu- lation (1881), 924,106 ; (1891), 1,075,379, showing an in- crease of 16 per cent., due to the extension of irrigation ; average density, 292 persons per square mile. In 1901 the population was 1,156,548, showing a further increase of 8 per cent. The land revenue and rates were in 1897-98 Us. 10,14,852, the incidence of assessment being Rs.0:8:5 per acre ; cultivated area, 802,853 acres, of which 696,141 were irrigated, including 403,000 from Government canals; number of police, 1404 ; number of schools (1896-97), 267, attended by 13,123 boys, being 14 per cent, of the

boys of school-going age; death-rate (1897), 26-8 per thousand. The principal crops are wheat, pulse, millet, maize, oil-seeds, and cotton. There are about 20 factories for ginning and pressing cotton. Irrigation is provided by the main line of the Bari Doab canal and its branches, and also by inundation-cuts from the Sutlej. The dis- trict is crossed in several directions by lines of the North- Western railway, 127 miles. Some local distress was caused by drought in 1896-97.

The division of Lahore extends along the right bank of the Sutlej, from the Himalaya toMooltan. It com- prises the six districts of Mooltan, Jhang, Montgomery, Lahore, Amritsar, and Gurdaspur. Total area, 24,872 square miles ; population (1891), 4,579,794.

Lai bach, the capital of the Austrian Duchy of Car- niola, on the Laibach, 40 miles south by east of Klagen- furt. The garrison, comprising infantry and artillery, numbers 2592 men. Since the severe earthquake of April 1896, which destroyed part of the town, the old castle, which was used as a prison, is only inhabited by a caretaker. The municipal administration is purely Slovenian, and the Slovenian language is in general ofB.cial use. A subsidized Slovene theatre is maintained, and there are also societies for the promotion of science and literature in the native tongue. The industries now include manufactures of pottery, bricks, lucifer matches, &c. Population (1890), 31,663; (1900), 36,547.

Laing, Samuel (1810-1897), British author and railway administrator, was born at Edinburgh, 12th December 1810. He was the nephew of Malcolm Laing {Ency. Brit. xiv. 216), the historian of Scotland, and his father, Samuel Laing (1780-1868), was also a well-known author, whose books on Norway and Sweden attracted much attention in the ‘forties and ‘fifties. Samuel Laing the younger entered St John’s College, Cambridge, in 1827, and after graduating as second wrangler and Smith’s prizeman, was elected a fellow, and remained at Cam- bridge temporarily as a coach. He was called to the bar in 1837, and became private secretary to Mr Labouchere (afterwards Lord Taunton) the President of the Board of Trade. In 1842 he was made secretary to the railway department, and retained this post till 1847. He had by then become an authority on railway working, and had been a member of the Dalhousie Railway Commission ; it was at his suggestion that the ” parliamentary ” rate of a penny a mile was instituted. In 1848 he was appointed chairman and managing director of the London, Brighton, and South Coast railway, and his business faculty soon showed itself in the largely increased prosperity of the line. He also became chairman (1852) of the Crystal Pal- ace Company, but retired from both posts in 1855. In 1852 he entered Parliament as a Liberal for Wick, and after losing his seat in 1857, was re-elected in 1859, in which year he was appointed financial secretary to the Treasury ; in 1860 he was made Finance Minister in India. On returning from India, he was re-elected to Parliament for Wick in 1865. He was defeated in 1868, but in 1873 ■ he was returned for Orkney and Shetland, and retained his seat till 1885. Meanwhile he had been reappointed chairman of the Brighton line in 1867, and continued in that post till 1894, being generally recognized as an admirable administrator. He was also chairman of the Eailway Debenture Trust and the Railway Share Trust. In later life he became well known as an author, his Modern Science and Modern TJiought (1885), Problems of the Future (1889), and Human Origins (1892) being widely read, not only by reason of the writer’s influential posi- tion, experience of affairs, and clear style, but also through their popular and at the same time well-informed

treatment of the latest scientific problems of the day. Laing died at Sydenham, 6th August 1897.

Lake Charles, a city of Louisiana, U.S.A., capital of Calcasieu, on the Calcasieu river and on the Port Arthur route and the Kansas City, Watkins and Gulf and the Southern Pacific railways. The manufacture of lumber is the principal industry. Population (1880), 838 ; (1890), 3442 ; (1900), 6680, of whom 409 were foreign-born and 2407 negroes.

Lake District, a characteristic region of England, in the counties of Cumberland, Westmorland, and Lancashire, celebrated for the beauty, and even in some degree for the grandeur, of its mountain scenery, and for the loveliness of its lakes. In outline the district is roughly circular, the valleys radiating outwards, each about 15 miles, from an imaginary centre near Langdale Pikes. Most of these valleys contain lakes, long and narrow; and upon the mountains there are frequent tarns. The valley lakes are of two types, one shallow, the other deep. Those of the first groujj, embracing only Derwentwater and Bassenthwaite, have an average depth of 18 feet. The rest, all belonging to the second group, average 40 to 135 feet in depth, and as a rule have steeply sloping sides and flat bottoms, the lake bed in two of them — Windermere and Ullswater — being divided into basins. Three of the lakes — Windermere, Coniston, and Wast water — go down in depth below the level of the sea. The district as a whole is grooved by a main depression, running from north to south along the valleys of St John, Thirlmere, Grasmere, and Windermere, and by a second- ary depression, in the same direction, along Derwentwater, Borrowdale, and Wastwater. 1 The subjoined table gives the names and other particulars of the larger lakes : —

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Windermere (or, more correctly, Winandermere), Conis- ton, Derwentwater, and Ullswater all contain small islands, amongst them being the Floating Island of Derwentwater, a mass of consolidated vegetation which periodically sinks to the bottom of the lake and reascends to its surface.^ Pish — perch, pike, char, and trout — exist in Windermere, Ennerdale, Crummock, Derwentwater, and Bassenthwaite, and the gwyniad or ” fresh-water herring ” in Ullswater. In 1890-94 Thirlmere was dammed at its lower (northern) end, in order to convert the lake into a reservoir for sup- plying Manchester, 95 miles distant, with water, the dam being 800 feet long and

100 feet in height. The effect has been to raise the level of the lake permanently to 554 feet and increase its surface area from 330 acres to 565 acres ; and its level caii be raised another 30 feet, which would give an area of 793 acres. The present drainage area of 7400 acres would also be enlarged to 11,000

iSee Dr H. R. Mill, in Geog. Journal, 1895, pp. 237-246. 2 See Symous, The Floating Island in Derwentwater (1888) .

acres. At the same time a new road was made by the Manchester Corporation along the west side of the lake. Grasmere, Eydal, and Coniston abound in literary associa- tions (see below). The district derives variety and pictur- esqueness from several small waterfalls, e.g., Scale Force (Dano-lSTorwegian, /ors, foss), beside Crummock; Lodore, near Derwentwater, made famous by Southey ; Dungeon Gill, or Ghyll, beside Langdale ; Dalegarth Force or Stanley Gill, in Eskdale ; Aira, near Ullswater, sung by Wordsworth ; Stock Gill, near Ambleside ; and Eydal Falls. The higher mountains range from 2000 to over 3000 feet in altitude. The highest peaks are Scafell Pike (3210 feet), and its sister Scafell (3162 feet) ; of the others the best known are Helvellyn (3118 feet), Skiddaw (3054 feet), Bowfell (2960 feet), Great Gable (2949 feet), Pillar (2927 feet), the Old Man of Coniston (2633 feet), and Langdale Pikes (2401 and 2323 feet). Some of these, such as Scafell, Great Gable, Helvellyn, Langdale Pikes, Old Man, and’ Pillar, furnish ascents which experienced mountaineers do not disdain.^ The district is drained by the Derwent, Leven, Duddon, Esk, Irt, Ehen, and other small streams. Lead and zinc are still mined in the mountains around Keswick (see Cumbbkland and West- moeland).

Climate. — The district records an unusually heavy rainfall. At Grasmere the annual average is 80 to 82 inches ; on the mountains west of that village as nmoh as 140 inches ; and on Styhead pass, at the north foot of Scafell Pike, even as much as 243-98 inches was measured in 1872. At Keswick the annual mean is 59 to 60J inches (55-4 inches in 1899) ; at Derwentwater

54f inches. Taking the summer months (the tourist season), May to October inclusive, an annual average of 27-5 inches fell at Windermere during the eight years 1892-99 inclusive. During the same period, and at the same place, an average of 255 hours of sunshine was recorded for the same summer months.

Literary Associations. — Setting aside London and Edinburgh, there is no locality in the British Isles which is so intimately associated with the history of English literature as the Lake District. In point of time the poet whose name is first connected with the region is Gray, who wrote a journal of his tour in 1769. But it was Wordsworth, a native of Cumberland, born on the outskirts of the Lake District itself, who really made it a Mecca for lovers of English poetry. Out of his long life of eighty years, no less than sixty were spent amid its lakes and mountains, first as a schoolboy at Hawkshead, and afterwards as a resident at Grasmere (1799-1813) and Bydal Mount (1813-50). In the church- yard of Grasmere the poet and his wife lie buried ; and very. near to them are the remains of Hartley Coleridge (son of the poet), who himself lived many years at Keswick, Ambleside, and Gras- mere. Southey, the friend of Wordsworth, was a resident of Keswick for exactly forty years (180.3-43), and was buried in Crosthwaite churchyard. Samuel Taylor Coleridge lived some time at Keswick, and also with the Wordsworths at Grasmere. From 1807 to 1815 Christopher North (John Wilson) was settled at Windermere. De Quincey spent the greater part of the years 1809 to 1828 at Grasmere, in the first cottage which Wordsworth had inhabited. Ambleside, or its environs, was also the place of residence of Dr Arnold (of Rugby), who spent there the vacations of the last ten years of his life ; and of Harriet Martineau, who built herself a house there in 1845. At Keswick Mrs Lynn Linton was born in 1822. Brantwood, a house beside Coniston Lake, was the home of Ruskin during the last years of his life. In addition to these residents or natives of the locality, Shelley, Scott, Nathaniel Hawthorne, Clough, Crabb Robinson, Carlyle, Keats, Tennyson, Matthew Arnold, Mrs Hemans, Gerald Massey, and others of less reputation made longer or shorter visits, or were bound by ties of friendship with the poets already mentioned. The Vale of St John, near Keswick, recalls Scott’s Jlriihil of Triermain. But there is a deeper connexion than this between the Lake District and English letters. German literature tells of several literary schools, or groups of writers animated by the same ideas, and working in

the spirit of the same principles and by the same poetic methods. The most notable instance— indeed it is almost the only instance— of the kind in English literature is the Lake School of Poets. Of this school the acknowledged head and founder was Wordsworth, and the tenets it professed are those laid down by the poet himself in the famous preface to tlie edition

1 See Haskett-Smith, CUmhing in the British Men, Part I. ; and Owen G. Jones, Rock-Climbing in the English Lake Dintrict, 2ud ed. by W. M. Crook (Keswick, 1900).

of The Lyrical Ballads which he published in 1800. Wordsworth's theories of poetry — the objects best suited for poetic treatment, the characteristics of such treatment, and the choice of diction suitable for the purpose — may be said to have grown out of the soil and substance of the lakes and mountains, and out of the homely lives of the people, of Cumberland and Westmorland. Wordsworth is the poet of Nature, as he was the worshipper and priest of the Divine in Nature, and preacher of the beauty and sublimity of the moral law. But the Nature which he worshipped, the Nature which he sang, was nature as he saw her in the green dales, and beside the peaceful lakes and green or craggy fells, of his native Cumberland ; just as the people, whose sincere and simple lives supplied themes for so many of his poems, were the sturdy natives of the same beautiful region. Thus it were hardly an exaggeration to say that the poetic principles of the Lake School are to a certain extent a reflection of the spirit of the Lake District itself. At any rate, not only did its beauties entwine themselves amongst the most cherished recollections of Wordsworth's boyhood, but they also awakened his poetic conscious- ness, and quickened and ripened his poetic faculty, so that he was enabled to enter into the most intimate sympathy with Nature, and bring the Divine which is immanent in her into close, practical relation with the thoughts and feelings of ordinary men. For a fuller discussion of the poet's poetic creed, see the late Professor Minto's admirable article on Wordswokth in the earlier volumes (ninth edition) of this Encyclopaedia.

Dalton, the chemist, whose name is inseparably linked with the Atomic Theory, was born near Cockermouth, and Sir John Richardson, the Arctic explorer, and Romney, the painter, both lived for some time in the district.

The chief mansion in the Lake District is Lowther Castle, partly in the Gothic, partly in the Baronial style, built in 1720 from designs by Sir Robert Smirke; it contains a good collection of pictures by Dutch and other old masters. At Eden Hall, the seat of the Musgrave family, is kept the glass goblet called “the Luck of Eden Hall,” to which a well-known legend is attached. Brougham Hall, in the same neighbourhood, near Penrith, was the ancestral inheritance, and frequently the residence, of Lord Brougham. Muncaster Castle, near the old Roman port of Ravenglass at the mouth of the Esk, has many vestiges of the Roman occupation in its neighbourhood. The antiquarian objects include the Roman encampment known as Hardknott Castle, in Eskdale, with remains of a shrine and of a house with a bath ; the remains of a supposed Roman encamp- ment at Brougham Castle, near Penrith ; the circular area, with fosse and mound, known as King Arthur’s Round Table, also near the same place ; and the ruins of Shap Abbey, of Egremont Castle, belonging to Lord Leconfield, of Calder Abbey, four miles south-east from Egremont, and of Furness Abbey, though these, like most of the preceding, lie on the outer fringe of the district rather than actually within its confines.

See also Hareiet Martineau. The English Lakes. Winder- mere, 1858.- — Mrs Lynn Linton. The Lake Country. London, 1864. — E. Waugh. Rambles in the Lake Country (1861) and /re the Lake Country (1880). — W. Knight. Through the Wordsworth Country. London, 1890. — H. D. Rawnsley. Literary Associa- tions of the English Lakes, 2 vols. (Glasgow, 1894), and Life and Nature of the English Lakes (Glasgow, 1899). — Stopford Brooke. Dove Cottage, Wordsicorth’s Home from 1800 to 1808. — A. G. Bradley. The Lake District, its Highways and Byeioays. London, 1901. — Sir John Harwood. History of the Thirlmere Water Scheme. 1895. — Also, for mountain-climbing, Col. J. Brown. Mountain Ascents in Westmorland and Cumberland. London, 1888.

Lakewood, a village of Ocean county. New Jersey, U.S.A., 8 miles from the coast, and 44 miles nearly south of New York City, on the Central of New Jersey railroad, in a region of pine-woods and ponds. Owing to its temperate, salubrious climate it has become a noted winter resort, with large hotels and many cottages. Popu- lation of the township, including the village (1895), 2201 ;

(1900), 3094.

Lakhimpur, a district of British India, in the Brahmaputra Valley division of Assam. The deputy- commissioner in charge exercises political control over numerous tribes beyond the inner surveyed border. The most important of these tribes are the Miris, Abors, Mishmis, Khamtis, Singphos, and Nagas. The civil headquarters are at Dibrugarh ; the military frontier post is at Sadiya, the limit of navigation on the Brahmaputra. Area, 3724 square miles; population (1881), 179,893; (1891), 254,043, showing an increase of 41 per rent.,

mainly due to the immigration of tea^cooUes ; average density, 68 persons per square mile, the lowest in the Brahmaputra valley. Classified according to religion, Hindus numbered 227,350 ; Mahommedans, 8086 ; Bud- dhists, 4462; Christians, 1606, of whom 305 were Europeans ; hill tribes, 12,536 ; ” others,” 3. In 1901 the population was 371,784, showing a further increase of 46 per cent. The land revenue is Rs.5,40,367, the incidence of assessment being E,s.2 : 8 : 11 per acre; number of police, 1018; number of boys at school (1896-97), 3859, being 18-96 per cent, of the male popu- lation of school-going age ; registered death-rate (1897), 41-58 per thousand. Lakhimpur was the first district into which tea cultivation was introduced by the Govern- ment, and the Assam Company commenced operations here in 1840. In 1897 the number of gardens was 149, with 55,560 acres under tea, employing 121,460 persons, of whom 46,428 had been imported under contract, and producing an out-turn of just 19,000,000 ft, or at the rate of 400 ft per acre. Lakhimpur is also the scene of operations of the Assam railways and Trading Company, which owns a railway, coal mines, and petro- leum wells. The railway, known as the Dibru-Sadiya line, runs from Dibrugarh to Makum, with two branches to Talap and Margherita ; total length, 77i- miles. It will ultimately be connected across the hills with the Assam- Bengal railway. The capital outlay is Ks.74,22,050. In 1897 the gross receipts were Es.7,87,359, and the net profits Es.2,46,749. The company has five coal mines, of which the total output in 1897 was 184,271 tons, yielding to Government a rent and royalty of Es.33,000. The coal is of

excellent quality, and is ex- ported by river as far as Calcutta. The Assam Com- pany works another mine, yielding 1000 tons. The chief oil-wells are at Digboi, where a depth of 1680 feet has been reached. In 1897 the output was 219,780 gallons, yielding to Government a royalty of Es.6500. The oil is refined at Margherita, producing a good quality of kerosene oil and first-class paraffin, with wax and other by-products. The wells at Makuia are disappointing. In 1897 they produced 2297 gallons. The oil is entirely without kerosene or paraffin, but is valuable as a lubricant. The company also manufactures bricks and pipes of various kinds. In 1897 the out-turn of their railway workshops was valued at Es.1,55,782. Yet another industry is timber-mills, for the manufacture of tearchests, &c. There are five of these, employing 800 persons, with an out-turn valued at Es.3,75,000.

Lai in, a township in the north-east of Spain, in the province of Pontevedra. The population in 1897 was 16,441. It is a centre of the trade in agricultural products of the fertile district around it. The local industries are supplied by paper-mills and tanneries. Lalin is situated in the neighbourhood of the ruins of the historic abbey of Carboeiro, a noble Gothic pile.

Lalitpur, formerly a district of British India, in the Allahabad division of the North-West Provinces, incorporated with Jhansi. Area, 1948 square miles. Population (1881), 249,088 ; (1891), 274,200, showing an increase of 10 per cent. ; average density, 141 persons per square mile, being far the lowest in the province except in the Himalayan tracts; number of vernacular schools (1896-97), 45, with 1450 pupils. The district is traversed by the line of the Indian Midland railway from Bhopal to Jhansi. The town of Lalitpuk has a population (1891) of 11,348; municipal income (1897- 98), Es.16,468, the incidence of taxation being just over E.l per head ; death-rate (1897), 76-84 per thousand. It is a railway station, 56 miles south of Jhansi.

LalO, Edouard (1823-1892), French composer,

was born at Lille, 27th January 1823. He began his musical studies at the conservatoire at Lille, and subse- quently went to Paris, where he attended the violin classes of Habeneck, and also worked at composition. For several years Lalo led a modest and retired existence, playing the viola in the quartet party organized by Avmingaud and Jacquard, and in composing chamber music. His early works include two trios, a quartet, and several

pieces for violin and pianoforte. Discourage- ment seems to have taken possession of Lalo, for he re- mained some years without bringing forward anything new. In 1867, however, he took part in an operatic competition, an opera from his pen, entitled Fiesque, ob- taining the third place out of forty-three. This work was actually accepted for production at the Paris Opdra, but delays occurred, and nothing was done. Fiesque was next offered to the Thd§,tre de la Monnaie, Brussels, and was definitely to be produced there when the manager became bankrupt. Thus, when nearly fifty years of age, Lalo found himself again stranded. Fiesque was never performed, but the composer published the pianoforte score, and eventually employed some of the music in other works. After the Franco-German war French composers found their opportunity in the concert- room. Lalo was one of these, and during the succeeding ten years several interesting works from his pen were produced, among them a sonata for violoncello, a ” diver- tissement” for orchestra, a violin concerto, and the Symphonie Espagnole for violin and orchestra, one of his best-known compositions. In the meanwhile he had written a second opera, Le Roi d’Ys, which he fondly hoped would be produced at the Opera. The administra- tion offered him the “scenario” of a ballet instead. Lalo was perforce obliged to be content with this, and set to work with so much energy that he fell ill while engaged upon the music of this ballet, the last scenes of which were orchestrated by Gounod. Namouna, the ballet in question, was produced at the Op^ra in 1882. Six years later, on 7th May 1888, Le Roi d’Ys was brought out at the Opera Comique, and Lalo was at last enabled to taste the sweets of success. Unfortunately, fame came to him too late in life. A pianoforte con- certo and the music to Niron, a pantomimic piece played at the Hippodrome in 1891, were his last two works. He had begun a new opera, but had only written the first act when, on 23rd April 1892, he was carried off by an attack of paralysis. This opera. La Jacquerie, was finished by M. Arthur Coquard, and was produced in 1895, three years after the death of Lalo, at Monte Carlo, Aix-les-Bains, and finally in Paris. Lalo had distinct originality, discernible in his employment of curious rhythmic devices. His music is ever ingenious and brilliantly effective. (a. he.)

La Marmora, Alfonso (1804-1878), Italian gen- eral and statesman, was born at Turin on 18th November 1804. He entered the army as lieutenant of artillery in 1823, but was only captain in March 1848, when he gained

distinction and the rank of major at the battle of Pastrengo. On 5th August 1848 he liberated Carlo Alberto from the Milan revolutionaries, and in October was promoted general and appointed Minister of War. After suppressing the revolt of Genoa in 1849, he again assumed (November 1849) the portfolio of war, which, save during the period of his command of the Crimean expedition, he retained until 1859. Having reconstructed the Piedmontese army, he took part in the war of 1859 ; but in July of that year succeeded Cavour in the premier- ship. In 1860 he was sent to Berlin and St Petersburg to prepare the recognition of the kingdom of Italy, and subsequently held the offices of governor of Milan and

royal lieutenant at Naples, until, in September 1864, he succeeded Minghetti as premier. In this capacity he modified the scope of the September Convention by a note in which he claimed for Italy full freedom of action in respect of national aspirations to the possession of Rome, a document of which Visconti Venosta afterwards took advantage when justifying the Italian occupation of Eome in 1870. In April 1866 La Marmora concluded the Italo-Prussian alliance against Austria, and, on the out- break of war in June, took command of an army corps, but was defeated at Custozza on 23rd June. Accused of treason by his fellow-countrymen, and of duplicity by the Prussians, he eventually published in defence of his tac- tics (1873) a series of dpcuments entitled ” More Light on the Events of 1866,” a step which caused irritation in Germany, and exposed him at home to the charge of hav- ing violated State secrets. Meanwhile he had been sent to Paris in 1807 to oppose the French expedition to Rome, and in 1870, after the occupation of Rome by the Italians, had been appointed lieutenant-royal of the new capital. He died at Florence on 6th January 1878. (h. w. s.)

Lambayeque, a department of northern Peru, is divided into three provinces — Lambayeque, Chiclayo, and Pacasmayu, of which the principal towns are Lambaye- que (population, 6000), Chiclayo (14,000), and Perrinafe (8000). The area of the department is 17,939 square miles. Population (1896), 124,091.

Lambeth Conferences.— The Lambeth Confer- ences, or ” Pan- Anglican Synods,” were an outcome of that fellowship amongst the churches of the Anglican Communion which has shown so remarkable a develop- ment in recent years. There had been a growing sense that this fellowship could only be maintained by mutual knowledge and common counsel, and in 1861 Bishop Hopkins of Vermont, in a letter to the archbishop of Canterbury, expressed his desire that ” in a time of con- troversy and division there should be a council of all the bishops in Communion with your Grace.” But the imme- diate impulse came from the colonial Church in Canada. In 1866 the synod of that province, in an urgent letter to the archbishop of Canterbury (Dr Longley), represented the unsettlement of members of the Canadian Church caused by recent legal decisions of the Privy Council, and their alarm lest the revived action of Convocation “should leave us governed by canons different from those in force in England and Ireland, and thus cause us to drift into the status of an independent branch of the Catl;olic Church.” They therefore requested him to call a “na- tional synod of the bishops of the Anglican Church at home and abroad,” to meet together under his leadership for the purpose of taking combined counsel and action. After consiilting both Houses of the Convocation of Can- terbury, Archbishop Longley assented, and convened all the bishops of the Anglican Communion (then 144 in number) to meet at Lambeth in 1867. Many Anglican bishops (amongst them the archbishop of York and most of his suffragans) felt so doubtful as to the wisdom of such an assembly that they refused to attend it, and Dean Stanley declined to allow Westminster Abbey to be used for the closing service, giving as his reasons the partial character of the assembly, uncertainty as to the effect of its measures, and ” the presence of prelates not belonging to our Church.” Archbishop Longley said in his open- ing address, however, that they had no desire to assume ” the functions of a general synod of all the churches in full communion with the Church of England,” but merely to ” discuss matters of practical interest, and pronounce what we deem expedient in resolutions which may serve as safe guides to future action.” Experience has shown how valuable and wise this course was. The resolutions

of the Lambeth Conferences have never been regarded as synodical decrees, but their weight has increased with each conference ; and in particular the ” Lambeth Quad- rilateral” of 1888 has already had a great effect as a plan of

reunion. Apprehensions such as those which possessed the mind of Dean Stanley have long passed away.

Seventy-six bishops accepted the Primate's invitation to the first Conference, which met at Lambeth on 24th September 1867, and sat for four days, the sessions being in private. The archbishop opened the Conference with an address : deliberation followed (but the appointed sub- jects were not strictly adhered to) ; committees were ap- pointed to report on special questions ; resolutions were adopted, and an encyclical letter was drawn up and ad- dressed to the faithful of the Anglican Communion. Each of the subsequent Conferences has been first received in Canterbury Cathedral and addressed by the archbishop from the chair of St Augustine. It has then met at Lambeth, and after sitting for five days for deliberation upon the fixed subjects and appointment of committees, has adjourned, to meet again at the end of a fortnight and sit for five days more, to receive reports, adopt reso- lutions, and to put forth the encyclical letter.

I. First Conference (Septemtier 24-28, 1867), convened and pre- sided over by Archbishop Longley. The proposed order of subjects was entirely altered in view of the Colenso case, for which urgency was claimed ; and most of the time was spent in discussing it. Of the thirteen resolutions adopted by the Conference, two have direct reference to this case ; the rest have to do with the creation of new sees and missionary jurisdictions, commendatory letters, and a "voluntary spiritual tribunal" in cases of doctrine, and the due subordination of synods. The reports of the committees were not ready, and were carried forward to the Conference of 1878.

II. Second Conference (July 2-27, 1878), convened and presided over by Archbishop Tait. On this occasion no hesitation appears to have been felt ; 100 bishops were present, and the opening sermon was preached by the archbishop of York. In this instance the reports of the five special committees (based in part upon those of the committee of 1867) were embodied in the encyclical letter, viz., on the best mode of maintaining union, voluntary boards of arbitration, missionary bishops and missionaries, Continental chap- lains, and the report of a committee on difiBculties submitted to the Conference.

III. Third Conference (July 3-27, 1888), convened and presided over by Archbishop Benson ; 145 bishops present ; the chief sub- ject of consideration being the position of communities which do not possess the Historic Episcopate. In addition to the encyclical letter, nineteen resolutions were put forth, and the reports of twelve special committees are appended upon which they are based, the subjects being Intemperance, Purity, Divorce, Polygamy, Ob- servance of Sunday, Socialism, Care of Emigrants, Mutual Relations of Dioceses of the Anglican Communion, Home Reunion, Scandi- navian Church, Old Catholics, &o.. Eastern Churches, Standards of Doctrine and Worship. Perhaps the most important of these is the famous "Lambeth Quadrilateral," which laid down a fourfold basis for home reunion — the Holy Scriptures, the Apostles' and Nicene Creeds, the two Sacraments ordained by Christ Himself, and the Historic Episcopate.

IV. Fourth Conference (July 5-31, 1897), convened by Arch- bishop Benson, presided over by Archbishop Temple ; 194 bishops present. One of the chief subjects for consideration was the crea- tion of a " tribunal of reference " ; but the resolutions on this sub- ject were withdrawn, owing, it is said, to the opposition of the American bishops, and a more general resolution in favour of a "consultative body" was substituted. The encyclical letter is accompanied by sixty-three resolutions (which include careful pro- vision for provincial organization and the extension of the title "archbishop" to all metropolitans, a "thankful recognition of the revival of brotherhoods and sisterhoods, and of the office of Deaconess," and a desire to promote friendly relations with the Eastern Churches and the various Old Catholic bodies), and the reports of the eleven committees are subjoined.

See Bishop R. T. Davidsou, Tlie Lambeth Conferences of 1S67, 1878, and 1888, London, 1896. Conference of Bishops of the Anglican Communion, Encyclical Letter, itc, London, 1897. (m. b. s.)

Lamego, a town and episcopal see of Portugal, district Vizeu, 4 miles south of the Douro and 42 east of Oporto. It is famous for its fine fruit and hams.

Vineyards in 1892 covered 3650 acres, and yielded 755,250 gallons of wine, valued at £48,460. Population (1900),

9179.

Lamoureux, Charles (1834-1899), Frencli con- ductor and violinist, was born at Bordeaux, 28th September 1834. He studied at tlife Pau Conserva- toire, was engaged as violinist at the Opera, and in 1864 organized a series of concerts devoted to chamber music. Having journeyed to England and assisted at a Handel festival, he thought he would attempt something similar in Paris. At his own expense he founded the ” Societe de I’Harmonie Sacree,” and in 1873 conducted the first performance in Paris of Handel’s Messiah. He also gave performances of Bach’s St Matthew Passion, Handel’s Judas Maccabanis, Gounod’s Gallia, and Massenet’s Eve. In 1875 he conducted the festival given at Rouen to celebrate the centenary of Boieldieu. The following year he became c/ie/d’orc/iesJre at the Opera Comique. In 1881 he founded the famous concerts associ- ated with his name, which contributed so much to popularize Wagner’s music in Paris. The performances of detached pieces taken from the German master’s works did not, however, satisfy him, and he matured the project to pro- duce Lohengrin, which at that time had not been heard in Paris. For this purpose he took the Eden Theatre, and on 3rd May 1887 he conducted the first performance of Wagner’s opera in the French capital. Owing to the opposition of the Chauvinists of the press and streets, the performance was not repeated ; but it doubtless prepared the way for Ae production of the same masterpiece at the Paris Opera a few years later. Lamoureux was succes- sively second chefd’orchestre at the Conservatoire, first chef d’orchestre at the Opera Comique, and twice first chef d’orchestre at the Opera. He visited London on several occasions, and gave successful concerts at the Queen’s Hall. Lamoureux, whose death occurred at Paris in December 1899, may be said to have died in harness. Tristan und Isolde had been at last heard in Paris, owing to his initia- tive and under his direction. After conducting one of the performances of this masterpiece, he was taken ill, and succumbed in a few days, having had the consolation before his death of witnessing the triumph of the cause he had so courageously championed. (a. he.)

Lampedusa, an island of Italy, belonging to the province of Girgenti, commune Licata, but situated half- way between Malta and the African coast. Area, 11|- square miles. In 1897 its port was cleared by 170 vessels of 27,621 tons. Population, about 1200. The small island of Linosa, 11 miles in circumference, with about 200 inhabitants, lies 31 miles to the north-north-east, and likewise belongs to the commune of .Licata. In 1897 its port was cleared by 121 vessels of 25,286 tons.

Lampeter, a municipal borough (1884), market town, and railway station of Cardiganshire, Wales, on the Teify, 23 miles north-north-east of Carmarthen. A par- liamentary borough until 1886, its representation is now merged in that of the county. St David's College, founded in 1827, has power to grant certain degrees, and is affiliated to the Universities of Oxford and Cambridge. A college school for boys has been opened, and also a sec- ondary school for girls. There is a town hall. Area, 1764 acres. Population (1881), 1443; (1891), 1569;

(1901), 1722.

Lanark, a royal and parliamentary burgh (Falkirk group) and the county town of Lanarkshire, half a mile from the Clyde, 31 miles south-east of Glasgow by rail. A new water scheme has been carried out and the drainage system renewed. A fountain in commemoration of Queen

Victoria's Jubilee has been erected ; also, a convalescent home. Cattle and sheep dealing is the most important industry, and a large retail trade is done witli the sur- rounding country. Population (1881), 5874; (1891), 55.'i7; (1901), 6440. Cotton mills founded by Robert Owen at JSTbw Lanark have been doubled in size since

1881.

Lanarkshire, an inland county of Scotland, bounded on the N. by Dumbarton and Stirling, on the E. by Stirling, Linlithgow, Mid-Lothian, and Peebles, on the S. by Dumfries, and on the W. by Ayr, Renfrew, and Dumbarton.

Ari’a and Population. — In 1891 the parishes of Kirkpatrict-Jiixta and Moffat were placed wholly in Dumfriesshire ; the Peebles part of Culter parish was added to another Peebles parish. In 1892 Cathoart parish was placed wholly in Renfrew, and the Ren- frew parts of East Kilbride and Govan wholly in Lanark. In 1893 the city of Glasgow, a large part of which was included in Lanark- shire, was made a county of a city. The area of the county is 567,027 acres, or about 886 square miles. It is much the most populous county in Scotland. In 1881 the population was 904,412 ; in 1891, 1,046,040 ; in 1891 on the above area, 1,105,899 ; in 1901, 1,339,289, of whom 674,1.36 were males and 665,153 females. On the old area, taking land only (564,284 acres or 881 -7 square miles), the number of persons to the square mile in 1891 was 1186, and the number of acres to the person 0-5. In the registration county the population increased between 1881 and 1891 by 15-8 per cent. Between 1881 and 1891 the excess of births over deaths was 149,761, and the increase of the resident population 141,628. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 : —

Tear.

Deaths.

Marriages.

Births.

Per cent, of Illegitimate.

1880 1890 1899

22,466 23,526 25,846

7241

9221

11,402

35,227 38,069 43,774

6-7

6-09

5-4

The following table gives the birth-rate, death-rate and marriage- rate per thousand of the population for a series of years : —

1880.

1881-90.

1890.

1891-98.

1899.

Birth-rate . Death-rate . Marriage-rate

37-98

24-17

7-79

36-85

22-12

8-02

35-25

21-78

8-53

35-48

20-88

8-30

35-65

21-04

9-28

In 1891 the number of Gaelic-speaking persons in the county was 25,208, and of foreigners 2982. Valuation in 1889-90, £2,226,352 ; 1899-1900, £2,502,345.

Administration. — The county is divided into six parliamentary divisions — North-east, North-west, Mid, and South Lanark, Govan, and Partick. The royal burghs, in addition to Glasgow, are Lanark (6440) and Rutherglen (18,280), of which the former belongs to the Falkirk group and the latter to the Kilmarnock group of parliamentary burghs. Airdrie (22,288) and Hamilton (32,775) are parliamentary burghs of the Falkirk group, and Coatbridge (36,981) is a municipal burgh included in the North-west parliamentary division. Other towns are Govan (76,351) ; Kinning Park (13,851) ; Motherwell (30,243) ; Partick (54,274), and Wishaw (20,869) — all police burghs. Fifteen other towns had more than 2000 inhabitants in 1891. There are 39 civil parishes, and including the two for Glasgow pai-ish, there are eight poor- houses ; the number of paupers and dependants (Glasgow included) in September 1899 was 27,156. There are lunatic asylums for the county at Hartwood in the parish of Shotts, and at Bothwell, and one of the Glasgow asylums is at Gartloch in the parish of Cadder. Lanark is a sheriffdom, whose sheriff-principal is confined to his judicial duties in the county, and he has eight substitutes, five of whom sit constantly in Glasgow, and one each at Airdrie, Hamilton, and Lanark.

Education.— Fifty school boards manage 274 schools, which had an average attendance of 145,703 in 1898-99, while 74 volun- tary schools, of which 56 were Roman Catholic and one Episcopal, had 39,388. There are six high schools in Glasgow and one at Hamilton, a technical school at Coatbridge, and two secondary and technical schools (one Roman Catholic)

at Wishaw, in addition to the Glasgow and West of Scotland Technical College. Thirteen other schools under the Glasgow board, 10 under the Govan board, and 62 in other parts of the county, earned grants in 1898 for giving higher education. The county councU expends the “residue” grant in supporting lectures and classes in agriculture and agricultural chemistry, mining, dairying, cooking, laundry

work, nursing, and poultry-keeping, and in paying fees and rail- way fares and providing bursaries for technical students, and in subsidizing science and art and technical classes in day and evening schools. A director of technical education is maintained by the council. Lanark, Motherwell, and Biggar entrust their shares of the grant to the county council, and Coatbridge and Airdrie them- selves subsidize science and art and evening classes and continu- ation schools.

Agriculture. — The proportion of the acreage cultivated in 1898 was 45-2, the county ranking eleventh in Scotland in this regard. In the Lower Ward market-gardening continues to increase, and there have been large additions in recent years to the quantity of glass. There were 717 acres under orchards in 1898 and 1899 under small fruit, strawberries being grown on a very large scale in the parishes of Lesmahagow, Dalserf, Lanark, Carluke, and Cambusnethan. In the whole county there were 21,499 acres under wood in 1895, of which 957 had been planted since 1881. Oats preponderate in the corn crops, covering 37,691 acres out of 41,406 in 1898. The following table gives the principal acreages at intervals of five years from 1880 : —

Tear.

Area under Crops.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1880 1885 1890 1895 1899

247,053 256,083 258,637 256,737 255,841

50,321

47,975 42,563 41,510 41,110

19,584 16,859 16,403 16,225 16,600

61,137

88,296

115,783

108,043

102,006

115,048

102,285

81,741

88,567

93,7.34

934 666 426 327 376

The following table gives particulars of the live stock during the same years : —

Tear.

Total Horses.

Total Cattle.

Cows or

Heifers in

Milk or Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1899

7795 7418 7988 8631 8074

65,192 72,082 75,775 71,-367 75,408

33,272 37,215 38,604 38,222 39,574

217,563 214,936 236,930 232,673 252,199

6110 8671 7957 8560 7213

Of the 3102 holdings in 1895 the average size was 83 acres. The percentage under 5 acres was 11‘99, between 5 and 50 acres 33-53, and over 50 acres 54-48. The number of farms between 50 and 100 acres was 698, between

100 and 300, 918, between 300 and 500, 65, and over 500 acres 9. At the census of 1891, 8896 men and 1813 women were returned as being engaged in agricul- ture.

Industries and Trade. — The following table gives the output of the principal minerals in 1890 and 1899 : —

Tear.

1890 1899

Coal.

Ironstone.

Fireclay.

Sandstone.

Tons.

Value,

Tons.

Value.

Tons.

Value.

Tons.

Value.

18,584,770 16,416,754

£

4,584,860 6,128,864

118,501 189,628

£

58,525 97,358

294,925 427,590

£

55,744 61.948

834,282

£

74,240

Forty blast furnaces produced 496,218 tons of pig-iron in 1890 ; 85 furnaces produced 1,170,830 tons in 1899. In 1899 were also obtained 56,335 tons of limestone valued at £13,560, and 76,246 tons of oil-shale valued at £19,066.

The industries of the county are for the most part the same as those of Glasgow, and reference may be made to the articles on that city and on other towns of Lanarkshire for details. The number of persons connected with industrial pursuits in 1891 was 260,461 men and 86,468 women, of whom machines and implements engaged the labour of 24,549 men; ships, 9488; textiles, 14,194 men and 28,212 women ; minerals, 94,473 men and 2713 women. About a score of new short branches and extensions have been opened in the county during the past twenty-five years by the three leading Scottish railway companies, the addition to the mileage being between 70 and 80 miles.

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W. Hunter. Biggar and the House of Fleming. Edinburgh, 1867. —J. Wallace. The Parish of Govan. Glasgow, 1877. See also Glasgow bibliography. (w. Wa.)

Lancashire, a north-western maritime connty of England, bounded on the N. by Westmorland, on the E. by Yorkshire, on the S. by Cheshire and the estuary of the Mersey, and on the W. by the Irish Sea. The Furness district to the north, having as its southern boundary the Irish Sea, is detached from the rest of the county and interpolated between Cumberland and Westmorland.

Area and Population.— The area of the ancient county is 1,207,311 acres, or 1887 square miles, with a population in 1881 of 3,454,438 and in 1891 of 3,920,760, of whom 1,889,926 were males and 2,036,834 females, the number of persons per square mile being 2081, and of acres to a person 0-31. In 1901 the pop- ulation numbered 4,406,787. The area of the administrative county in 1891 was 1,124,450 acres with a population of 1,768,273, or, including the county boroughs, of 1,202,726 acres, with a popu- lation of 3,906,721. Since 1891, however, various changes have been made in the administrative area ; in 1895 the county borough of Liverpool was extended, and the parish of Dalton in Lan- cashire was transferred to Westmorland ; in 1896 part of the townships of Appleton-with-Hull, Latchford Without, and Walton Inferior were transferred from Cheshire to Lancashire and added to the municipal borough of Warrington ; and in 1898 part of the township of Ashton-under-Lyne was transferred to Cheshire. The population of the administrative county, without the county boroughs, in 1901 was 1,827,390 ; and with the boroughs, 4,386,961. The area of the

registration county is 1,306,777 acres, with a population in 1891 of 3,957,906, of which 3,646,314 were urban and only 311,592 rural. Within the registration area the per- centage of increase between 1881 and 1891 was 13-54. The excess of births over deaths between 1881 and 1891 was 448,538, but this was exceeded by the actual increase of the papulation, which was 472,807. In 1901 the population of the registration county numbered 4,437,398, of whom 2,131,162 were males and 2,306,236 were females.

The following table gives the number of marriages, births, and deaths, with the number of illegitimate births for 1880, 1890, and 1898 :—

Tear.

Marriages.

Births.

Deaths.

lUegitimate Births. |

Males.

Females.

1880 1890 1898

28,111 32,480 37,060

126,842 125,787 132,491

81,812 91,739 83,831

2918 2840 2631

2855 2563 2524

In 1891 the number of marriages was 37,854, of births 131,945, and of deaths 92,239.

The following table gives the marriage-, birth-, and death-rates, with the percentage of illegitimate births, for a series of years : —

1S7D-79.

1880.

18S0-S9.

1890.

188^97.

1898.

Marriage-rate • Birth-rate Death-rate Percentage of Illegiti- mate births •

18-6 38-8 25-7

4-7

16-3 36-8 23-8

4-6

16-2 35-1 24-5

4-5

16-6 32-1 23-4

4.3

16-2 32-2 21-6

4-1

17-1 30-6 19-4

3-9

The marriage-, birth-, and death-rates are all considerably above the average, but the percentage of illegitimate birtlis is below it. In 1891 the number of Scots in the county was 56,405, of Irish, 164,489, and of foreigners, 25,109.

Constitution and Government. — For parliamentary purposes the four divisions of the ancient county — North Lancashire, North- east Lancashire, South-east Lancashire, and South-west Lanca- shire— are subdivided into twenty-three divisions ; and the county also includes the parliamentary boroughs of Liverpool with nine parliamentary divisions, Manchester with six, and Salford with three, while the following boroughs return two members : Blackburn, Bolton, Oldham, and Preston ; and the following return one each : Barrow-in-Furness, Burnley, Bury, Rochdale, St Helens, Salford, and Wigan, in addition to which parts of Ashton-under-Lyne, Stalybridge, Stockport, and War- rington are included in the county. The administrative county contains the following municipal boroughs: Accrington (43,096), part of Ashton-under-Lyne (43,890), Bacup (22,506), Barrow-in- Furness (57,584), Blackburn (127,527), Blackpool (47,346), Bolton (168,205), Bootle(58,568),Burnley (97,044), Bury (58,028), Chorley (26,850),CIitheroe (11,414), Colne (23,000), Darwen(38,211),Eccles (34,309), Haslingden (18,543), Heywood (26,4()1), Lancaster (40,329), Leigh (40,001), the city of Liverpool (684,947), the city

of Manchester (543,969), Middleton (25,178), Mossley (13,462), Nelson (32,816), Oldham (137,238), Preston (112,982), Rawtsn- stall (31,052V Rochdale (83,112), St Helens (84,410), Sallord (220,956), Southport (48,087), Warrington (64,241), Widnes (28,580), and VVigan (60,770). Barrow-in-Furness, Blackburn, Bolton, Bootle, Burnley, Bury, Liverpool, Manchester, Oldham, Preston, Rochdale, St Helens, Salford, and Wigan are county boroughs. The urban districts are too numerous for mention. The

following have populations of over 10,000 : Ashton-in- Makerlield (18,695), Atherton (16,211), Birkdale (14,197), Chad- derton (24,892), Crompton (13,427), Dalton-in-Furness (13,020), Denton (14,934), Droylsden (11,087), Failsworth (14,152), Farn- worth (25,927), Fleetwood (12,093), Garston (17,288), Gorton (26,564), Great Harwood (12,014), Hindley (23,504), Horwich (15,083), Inoe-in-Makerfield (21,270), Levenshulme (11,485), Litherland (10,593), Littleborou'rh (11,166), Morecarabe (11,798), Moss-side (26,677), Newton-in-Makerfield (16,699), Oswaldtwistle (14,200), Padiham (12,205), Pemberton (21,664), Prestwich (12,837), Radcliffe (25,368), Ramsbottom (15,920), Royton (14,881), Stretford (30,346), Swinton-and-Pendlebury (27,001), Turton (12,353), Tyldesley-with-Shakerley (14,843), Ulverston (10,064), Walton ~~le~~ Dale (11,271), Waterloo – with – Seaforth (23,101), West Houghton (14,377), Withington (36,201), and Worsley (12,448). The county is In the northern circuit, and assizes are held for North Lancashire at Lancaster, and for South Lancashire at Liverpool and Manchester. Twenty-five of the bor- oughs have separate commissions of the peace, and the boroughs of Blackburn, Bolton, Liverpool, Manchester, Oldham, Salford, and Wigan have also separate courts of quarter sessions. The county is still attached to the duchy of Lancaster, and retains the chancery court for the county palatine. The ancient county is chiefly in the diocese of Manchester, but a small part is in Liverpool, the northern portion of Furness is in Carlisle, and a few parishes adjoining Yorkshire are in Ripon or in Wakefield. There are 730 entire ecclesiastical parishes or districts and parts of 10 others.

Education. — Manchester and Liverpool are each seats of a uni- versity and of other important educational institutions. Within the bounds of the county there are many denominational colleges, and at Ashton, near Whalley, is the famous Catholic college of Stonyhurst. There is a day training college for schoolmasters in connexion with University College, Liverpool, and a day training college for both schoolmasters and schoolmistresses in connexion with Owens College, Manchester. At Edgehill, near Manchester, there is a residential training college for schoolmistresses which takes day pupils, at Liverpool a residential Roman Catholic train- ing college for schoolmasters, and at Warrington a residential training college (Chester, Manchester, and Liverpool diocesan) for schoolmistresses. At Burnley there are a board blind school and a board deaf school ; at Liverpool a Catholic blind asylum,

a home for blind children, a school for deaf and dumb, and a school for the indigent blind ; at Oldham, a board deaf school and a board blind school ; at Preston, the Royal Cross School for the deaf ; at Fulwood, an industrial institute for the blind ; and at Stretford a blind asylum and the Manchester schools for the deaf. The total number of elementary schools in the county, including the county boroughs, on 31st August 1898 was 1796, of which 254 were board and 1542 voluntary schools, the latter including 884 National Church of England schools, 139 Wesleyan, 299 Roman Catholic, and 220 “British and other.” The average attendance at voluntary schools was 446,224, and at board schools 144,203. The total school board receipts of the county boroughs for the year ended 29th September 1899 were over £775,037. The income under the Technical Instruction Act was over £7631, and that under the Agricultural Rates Act was over £269. The total school board receipts of the administrative county, apart from the boroughs, were over £127,631. The income under the Technical Instruction Act was over £150, and that under the Agricultural Rates Act was over £1098.

Communications.— By the opening of the Manchester Ship Canal, on, 1st June 1894, a populous inland district has obtained the advantages of immediate sea transport. The canal, which is in great part formed by deepening the bed of the Mersey, stretches by Warrington and Runcorn towards Liverpool, the total length being Zb\ miles, and the cost £11,750,000. The port of Liverpool is now second in importance only to that of London.

Agriculture.— A.hou.i three-fourths of the county is under culti- vation, and of this nearly three-fourths is in permanent pasture, cows being largely kept for the supply of milk to the towns, while in the uplands many sheep are reared. In addition to the culti- vated area, about 92,000 acres are under hill pasturage and over 40 000 acres are under woods. Since 1880 the acreage under corn crops has been gradually increasing, the increase being chiefly m the acreage under oats, which has increased about one-sixth, and is now about seven-tenths of the whole ; but the acreage under wheat, now about one-fifth of the whole, has also increased, while there has been a great decrease in the acreage under barley. More than three-

fourths of the acreage under green crops is occupied by potatoes, and less than one-sixth is usually occupied by turnips and swedes. The following table gives the acreage of the larger main divisions of the cultivated area at intervals from 1885 : —

Year.

Total Acre- ajrc under Cultivation.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1880 1885 1890 1895 1900

783,065 809,927 824,846 823,676 822,866

100,189 102,005 103,688 103,-320 104,024

56,894

56,573 53,324 54,087 51,820

63,161 75,380 86,221 76,. 363 81,374

559,976 574,016 578,044 585,996 576,616

2836 1953 1773 1383 1161

The following table gives the numbers of the principal live stock during the same years : —

Tear.

Total Horses.

Total Cattle.

Cows.

Sheep.

Pi-S.

1880 1885 1890 1895 1900

38,316 35,625 38,939

44,775 44,451

221,018 238,158 233,055 226,2.34 239,507

121,113 130,662 1.32,746 130,041 137,678

318,368 296,425 330,333 306,954 3.34,8.59

34,712 43,880 56,802 60,421 60,617

Industries and Trade. — According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 896,333, as compared with 896,848 in 1896. Of these 434,609 were employed in textile factories, there being a decrease of 1-1 per cent, both between 1895 and 1896 and between 1896 and 1897. The staple textile industry is cotton, which employed 411,808 persons, the centre of the trade being Manchester, Oldham, and the neighbour- ing towns. The woollen, worsted, and silk manufactures, though of less importance, employ considerable numbers, there being 13,805 employed in the woollen industry and 3009 in that of silk ; 4439 were employed in connexion with the flax, hemp, or jute industries. In non-textile factories 384,352 persons were employed, there being an increase between 1895 and 1896 of 9-0 per cent., and between 1896 and 1897 of 0-4 per cent. The manufacture of machines, appliances, conveyances, tools, &c., occupied 112,596 persons, much of it being carried on on a large scale

to supply the needs of the immense weaving and spinning industries. For the same purpose large quantities of bobbins are made from the wood gi- own in the northern districts of the county, wood industries employing 16,804 persons. At Barrow- in-Furness the manufacture of iron and steel has continued to develop ; and in the county 24,089 persons were employed in the founding and conversion, 3580 in the extraction, and 2321 in the galvanizing, &c., of metals. In print, bleach, and dye works 52,672 persons were employed ; in the manufacture of paper, &c., 28,092 ; in clothing industries, 25,222 ; in the manufacture of chemicals, 18,962 ; in food industries, 15,592 ; in those of drink, 8914 ; in glass-making, 9846 ; in india-rubber and gutta-percha industries, 6338 ; and in those of tobacco, snuff, and cigars, 5803. Work- shops employed 77,372 persons, of which 40,450 were employed in clothing industries, 6546 in the manufacture of machines, &c., 5711 in furniture making, and 5725 in food industries. The total number of persons employed in connexion with mines and quarries in 1899 was 90,679. In the same year 1,356,492 tons of clay were raised, 600,480 tons of limestone, 820,232 tons of sand- stone, 20,156 tons of slate, and 99,405 tons of salt, in addition to which 197,610 tons of salt were obtained from brine. In the production of coal Lancashire vies with Yorkshire, but each is about one-third below Durham. The red hsematitic iron obtained in the Furness district is also very valuable. In 1885 the amount of pig-iron made in the county was 695,919 tons, in 1890 it was 716,748 tons, in 1895 it was 540,295 tons, and in 1899 it was 744,065 tons. The following table gives the tonnage and value of the fireclay, coal, and iron production in 1890 and 1899 : —

Tear.

Fireclay.

Coal.

Ironstone.

Tons.

Value.

Tons.

Value.

Tons.

Value.

1890 1899

104,080 186,508

£14,781 £28,885

21,707,867 24,887,475

£6,997,566 £9,177,416

1,021,990 670,924

£447,088 £419,909

The fish landed in 1899 at all the Lancashire stations men- tioned in the sea fisheries return (Fleetwood and Livei-pool are the chief ports) was 217,092 cwt., valued at £153,411.

Authorities. — Among later works are : Robt. Traditions of Lancashire. London, 1882, 2nd ed., 1892. — Anon. Lancashire Gleanings. Manchester, 1883. — Watkin. Boman Lancashire. Liverpool, 1883. — ~~Ceoston. Historic Sites of Lancashire. Man~~ chester, 1883 ; County Families of Lancashire. Manchester, 1887.

—Taylor. Old HaUx of Lancashire. Manchester, 1884.— Mitchell. Birds

Lancaster, a parish, municipal borough (extended 1900), seaport, market town, and county town of Lanca- shire, England, in the Lancaster parliamentary division of the county, on the Lune, 230 miles north-north-west of London by rail. The grammar-school (rebuilt in 1863), the public baths, the county lunatic asylum, and the Eipley Hospital have been enlarged. A Palatine Hall has been established; the Storey Institute and Art Gallery were made over to the corporation in 1893. Recent erections are new buildings for the Eoyal Lancaster Infirmary, a sanatorium, and an observatory in the Williamson Park of 40 acres (1881). Glasson dock, on the south side of the Lune estuary, is accessible to vessels of 600 tons, that is, to vessels drawing 12 to 20 feet, and has a graving- dock attached. The port was in 1900 entered and cleared by an aggregate of 1732 vessels of 254,842 tons, the total trade, however, being valued at only £24,500. Area of borough (1891), 1680 acres; population (1881), 20,663; (1891), 31,034. In 1900 the area was extended so as to embrace 3610 acres ; population, 40,329.

Lancaster, a city of Ohio, U.S.A., capital of Fair- field county, on the Hocking river, at an altitude of 841 feet. It is on the Cincinnati and Muskingum Valley and the Hocking Valley railways. It is in a natural-gas region, and has varied manufactures, principally of flour and agri- cultural implements. Population (1890), 7555 ; (1900), 8991, of whom 442 were foreign-born and 212 were negroes.

Lancaster, a city of Pennsylvania, U.S.A., capital of Lancaster county, on the Conestoga river, at an altitude of 357 feet. It is on four railways, the Cornwall, the Lancaster and Heading, the Pennsylvania, and the Phila- delphia and Eeading. Its manufacturing interests are large. In 1900 there were 738 manufacturing establish- ments with a capital of $10,803,464. They employed 9349 hands, and produced goods valued at $16,370,281. These consisted in great part of cotton goods, foundry and machine-shop products, clothing, and leather. Franklin and Marshall College, situated here, had in 1899 a faculty of 26 and was attended by 332 students. The assessed valuation of property, real and personal, on a basis of about 75 per cent, of the full value, was, in 1900, $16,685,148, the net debt of the city was $764,480, and the rate of taxation was $17.50 per $1000. Population

(1890), 32,011 ; (1900), 41,459, of whom 3492 were foreign- born and 777 were negroes.

Lance (Military). — The lance has been used in war in all ages. It was the chosen weapon in the so-called ages of chivalry, and, though somewhat in disfavour in the 17th century, the renown of the Polish Lancers and Cossack cavalry in the 18th and 19th centuries again brought it into fashion. Now many nations, besides having regular Lancer regiments, arm the front ranks at least of all their cavalry regiments with lances.

The lances used in the British service are of two kinds, those with ash and those with bamboo staves. The latter are much preferred and are generally used, the ” male ” bamboo being peculiarly tough and elastic. The lance (Fig. 1) is provided with a sling, through which the trooper passes his right arm when the lance is carried slung, the point of the steel shoe fitting into a bucket attached to

the right stirrup. A small ” dee ” loop is also provided, by which the lance can be attached to the saddle when the trooper dismounts. The small flag is removed on service. The head is of the best steel. The Germans, doubtless owing to difiiculty in obtaining bamboos, or ash in large quantity straight enough in the grain over a considerable length, for lance staves, have adopted a stave of steel tubing as well as one of pine (Figs. 2, 3, and 4).

The question of the relative efficiency of the lance and the sword as the principal arm for cavalry (q.v.) has been much discussed. Thus it is alleged that the former is heavy and fatiguing to carry, conspicuous, and much in the way when reconnoitring in close country, working through woods and the like ; that, when

Fiq.2.

Fig.3. F;g.4.

fJq.l.

Oee-A j

mStnng binding aSprgn’p.

\!

Ttpes of British and Germau Lances.

Lengtb.

Weisht about.

Fis. 1

Figs. 2 and 3

Fig. 4

British lance, biimboo stave German lance, tubular stc-el sta-ve ,, „ pine stave

9 ft.

10 ft. 6 ins. 10 ft. 2 ins.

4 lbs. 8 ozs.

4 lbs.

4 lbs. 4 ozs.

Both German lances have a loop, attached by string binding, to take the sling. This loop is attached to the grip, shown in Fig. 2, in the case of the tubular lance.

unslung ready for the charge, it is awkward to handle, and may be positively dangerous if a horse becomes restive and the rider has to use both hands on the reins ; that unless the thrust be delivered at full speed, it is easily parried ; and, lastly, that in the mcli’e, when the trooper has not room to use his lance, he will be helpless until he eithtT throws it away, or slings it, and can draw his sword. On the other hand, while admitting the last-

mentioned objection, those who favour the lance contend that success in the first shock of contact is all-important, and that this success the lancer will certainly obtain, owing to his long reach enabling him to deliver a blow before the swordsman can retaliate, while, when the melee commences, the rear rank will come to the assistance of the front rank. Further, it is claimed that the power of delivering the first blow gives confidence to the young soldier ; that the appearance of a lancer regiment, preceded as it were by a hedge of steel, has an immense moral effect ; that in single combat a lancer, with room to turn, can always defeat an opponent armed with a sword ; and, lastly, that in pursuit a lancer is terrible to an enemy, whether the latter be mounted or on foot. As in the case of the perennial argument whether a sword should be designed mainly for cutting or thrusting, it is unlikely that the dispute as

to the merits of the lance over the sword will ever be definitely settled, since so many other factors — horsemanship, the training of the horse, the skill and courage of the adversary — determine the trooper’s success quite as much as the weapon he happens to wield. The following passage from Cavalry: its History and Tactics (London, 1853), by Captain Nolan, explains how the lance gained popularity in Austria :—” In the last Hungarian war (1848-49) the Hungarian Hussars were . . . generally successful against the Austrian heavy cavalry — cuirassiers and dragoons; but when they met the Polish Lancers, the finest regiments of light horse in the Austrian service, distinguished for their discipline, good riding, and, above all, for their esprit de corps and gallantry in action, against those the Hungarians were not successful, and at once attributed this to the lances of their opponents. The Austrians then extolled the lance above the sword, and armed all their light cavalry regiments with it.” Cjj. “W. B.)

Landau, a town of Bavaria, Germany, in the Palatinate, on the east side of the Haardt Mountains, 32 miles by rail south-west of Mannheim. There are manufactures of cigars, beer, horsehair goods, tanning, dyeing, gardening, &c., and trade in wine, cereals, to- bacco, and groceries. Population (1885), 9395; (1900),

15,823.

Landeck, a town and watering-place of Prussia, province of Silesia, 73 miles by rail south of Breslau (16 miles south-east from Glatz), and close to the Austrian frontier, at an altitude of 1477 feet. It is visited by over 10,000 persons annually for its warm sulphur baths (68°-84-2° r.), which have been known since the 13th century. There are also mud-baths and hydropathics. Population (1900), 3626.

Landes, a department in the south-west of France, bordering on the Atlantic Ocean, traversed by the Adour river.

Area, 3615 square miles. The population has decreased from 302,266 in 1886 to 291,657. There were in 1896, 661 schools, with 38,000 pupils, and 10 per cent, of the population was illiterate. Births in 1899, 6459, of which 401 were illegitimate ; deaths, 4929 ; marriages, 2350. The area under cultivation in 1896 was counted at 1,848,044 acres, but of this surface more than 1,161,000 acres were occupied by the Landes, and only 434,900 acres were plough-land and 44,480 acres vineyards. The land in wheat produced in 1899 the value of £330,000 ; rye, £288,000 ; vines, £440,000. The natural pastures yielded a revenue of £322,000. Landes owned in 1899, 32,000 horses, 126,440 cattle, 415,250 sheep, 114,000 pigs, and 23,000 goats. Mining in 1898 produced 750 metric tons of turf and 6900 tons of salt. The industry in metals is, on the other hand, a source of considerable wealth, the department having in 1898 produced 73,500 metric tons of cast iron, 4000 tons of iron, and 50,000 tons of steel, of a total value of £640,000. Of note are also the exportation of resin and the manufacture of alcohol — 60,000 gallons in 1899. Mont^de- Marsau, the capital, had a population of 11,604 in 1900.

Landlord and Tenant. — The law of landlord and tenant has been altered and expanded in such a va- riety of directions since the article in the earlier volumes (ninth edition) of the Encyclopaedia Britanuica appeared, that it seems advisable to take a fresh survey of the field which it covers, assigning special prominence to matters which have arisen subsequently to, or were not empha^ sized in, the original article. The relationship of land- lord and tenant is constituted by a lease, or an agreement for a lease, by assignment, by attornment, and by estop- pel. And first of a lease and an

agreement for a lease. All kinds of interests and property, whether corporeal, such as lands or buildings, or incorporeal, such as rights of common or of way, may be let. The Benefices Act, 1898, however, now prohibits the grant of a lease of an advowson. Titles of honour, offices of trust or relating to the administration of justice, and pensions granted by the Crown for military services are also inalienable. Generally speaking, any person may grant or take a lease. But to this rule there are a number of common-law and statutory qualifications and exceptions. A lease by or to an infant is voidable at his option. But extensive pow- ers of leasing the property of infants have been created

by the Settled Estates Act, 1877, and the Settled Land Act, 1882. A person of unsound mind can grant or take a lease if he is capable of contracting (see Insanity, Legal). Leases may be made on behalf of lunatics who are subject to the jurisdiction in lunacy under the pro- visions of the Lunacy Act, 1890, and the Settled Land Act, 1882. A married woman can lease her ” separate property” apart from or under the Married Women’s Property Acts, as if she were a single woman (femme sole). As regards other property, the concurrence of her husband is generally necessary. An alien was at common law incapable of being either a lessor or a lessee. But this disqualification is removed by the Naturalization Act, 1870. The right to deal with the property of a convict while he is undergoing sentence (but not while he is out of prison on leave) is, by the Forfeiture Act, 1870, vested in his administrator. Leases by or to corporations must be by deed under their common seal, and the leasing powers of ecclesiastical corporations in particular are subject to complicated statutory restrictions which cannot here be examined. Powers of granting building and other leases have been conferred by modern legislation on municipal corporations and other local authorities. There are also special rules of law with reference to leases by persons having only a limited interest in the property leased, e.g., a tenant for life under the Settled Land Acts (see the article Settlements in Encyclopoidia Britannica [ninth edition], vol. xxi.), or a mortgagor or mortgagee. In order to constitute the relationship of landlord and tenant in the mode under consideration, it is necessary not only that there should be parties capable of entering into the contract, but that there should be a letting, as distinct from a mere agreement to let, and that the right con- veyed should be a right to the exclusive possession of the subject of the

letting and not a simple licence to use it. Whether a particular instrument is a lease, or an agree- ment for a lease, or a bare licence, is a question the answer to which depends to a large extent on the circumstances of individual cases ; and the only general rule that can be laid down is that in a lease there must be an expression of intention on the part of the lessor to convey, and of the lessee to accept, the exclusive possession of the thing let for the prescribed term and on the prescribed conditions. It is scarcely necessary to add that the landlord must not part with the whole of his interest, since, if he does so, the instrument is not a lease but an assignment. Where a tenant enters under an agreement for a lease and pays rent, the agreement will be regarded as a lease from year to year ; and if the agreement is one of which specific performance would be decreed {i.e., if it contains a com- plete contract between the parties and satisfies the pro- visions— to be noted immediately — of the Statute of Frauds, and if, in all the circumstances, its enforcement is just and equitable), the lessee is treated as having a lease for the term fixed in the agreement from the time that he took possession under it, just as if a valid lease had been executed. At common law a lease for a term of years (other than a lease by a corporation) might be made by parol. But under the Statute of Frauds leases, except those the term of which does not exceed three ‘years, and in which the reserved rent if equal to two-thirds at least of the improved value of the premises, were required to be in writing signed by the parties or their lawfully author- ized agents ; and now, under the Eeal Property Act, 1845, a lease required by law to be in writing is void unless made by deed. The Statute of Frauds also prohibits an action from being brought upon any agreement for a lease, for any term, unless such agreement is in writing and signed by the party to be charged therewith or by some agent lawfully authorized by him.

The following are the principal forms of tenancy : — (i.)

Tenancy for Life. — A lease for life must be made by deed, and the term may be the life of the lessee, the teaaacyf ^^^® °^ ‘’^^ °^ some Other person or persons, &c. (As to the position of a tenant for life under the

Settled Land Acts, see the article Settlements in vol. xxi. [ninth edition] of this Encyclopaedia.) (ii.) Tenancy for Years, i.e., for a term of years. — This tenancy is created by an express contract between the parties and never by implication, as in the case of tenancy from year to year and tenancy at vt^ill. (iii.) Tenancy from Year to Year. — This tenancy may be created by express agree- ment between the parties, or by implication as, e.g., where a person enters and pays rent under a lease for years, void either by law or by statute, or without any actual lease or agreement, or holds over after the determination of a lease whether for years or otherwise. In the absence of express agreement or custom or statutory provision (such as is made by the Agricultural Holdings Act, 1883), a tenancy from year to year is determinable on half a year's notice expiring at the end of some current year of the tenancy. Closely associated with tenancies from year to year are various other tenancies for shorter periods than a year — weekly, monthly, or quarterly, as the case may be. Questions of considerable importance frequently arise as to the notice necessary to terminate tenancies of this character. The issue is one of fact ; the date at which the rent is payable is a material circumstance, but it may be said generally that a week's notice should be given to determine a weekly tenancy, a month's to de- termine a monthly tenancy, and a quarter's to determine a quarterly tenancy.

It is chiefly in connexion with the letting of lodgings, flats, &c. , that tenancies of this class arise, and it may therefore he conven- ient to notice here a few special incidents attaching to them. Where furnished apartments are let for immediate use, the law implies an undertaking on the part of the landlord that they are fit for habita^ tion, and if this condition is broken, the tenant may refuse to oc- cupy the premises or pay any rent. But there is no implied contract that the apartments shall continue fit for habitation during the term of the tenancy, and the rule has no application in the case of a letting of unfurnished lodgings. In the absence of express agree- ment to the contrary, a lodger has the right to the use of everything necessary to his enjoyment of the premises, such as the door-hell and knocker, and the skylight of the staircase. Whether the rent of furnished apartments can be distrained for where the landlord resides on the premises and supplies attendance, is a question the answer to which is involved in some uncertainty. But a lodger^ s goods are protected from distress for rent due by an immediate to a superior landlord by the Lodgers' Goods Protection

Act, 1871, if the lodger serves the distraining landlord or his bailiff with a written declaration claiming the goods as his property. Where the tenant “holds over” after himself giving notice to quit, the landlord has a statutory right of action for double the rent. Over- crowding lodging-houses may be dealt with as a nuisance under the Public Health Acts, 1875 and 1891. (As to the lodger franchise, see article Kegistration of Voteks.) A lodger is rateable where he is in exclusive occupation of the apartments let to him and the landlord does not retain the control and dominion of the whole structure. There is a considerable body of special law with regard to flats. Thus the occupier of an upper flat has a right to the support of a lower one, although not to the extent of imposing upon the tenant of the latter the duty of actively maintaining such support by repairs. Again, where the only mode of access to a number of residential flats is a common staircase, the land- lord is bound to maintain it so as to be a reasonably safe entrance and exit to the tenants and persons doing business with them.

(iv.) Tenancy at Will. — A tenancy at will is one which endures at the will of the parties only, i.e., at the will of both, for if a demise be made to hold at the will of the lessor, the law implies that it is at the will of the lessee also and vice versd. This form of tenancy, like tenancy from year to year, may be created either by express contract or by implication, as where premises are occupied with the consent of the owner, but without any express or im- plied agreement as to the duration of the tenancy, or where a house is lent rent free by one person to another.

(v.) Tenancy at Sufferance. — A tenant who comes into possession by a lawful demise, but “holds over” or con- tinues in possession after his estate is ended, is said to be a ” tenant at sufferance.” Properly speaking, tenancy at sufferance is not a tenancy at all, inasmuch as if the land- lord acquiesces in it, it becomes a tenancy at will ; and it is to be regarded merely as a legal fiction which prevented the rightful owner from treating the tenant as a trespasser until he had himself made an actual entry on or had brought an action to recover the land. The Distress for Kent Act, 1737, however, enable’s a landlord to recover double rent from a tenant who holds over after having himself given notice to quit ; while another statute in the reign of George II. makes a tenant who holds over after receiving notice from his

landlord liable to the extent of double the value of the premises. There is no tenancy by sufferance against the Crown.

The component parts of a lease are the parties, the recitals (when necessary) setting out such matters as the title of the lessor ; the demise or actual letting (the word ” demise ” is ordinarily used, but any ^™ ”’’ ^ term indicating an express intention to make a present letting is suificient) ; the parcels in which the extent of the premises demised is stated ; the habendum (which defines the commencement and the term of the lease), the reddendum or reservation of rent, and the covenants and conditions. The Conveyancing Act, 1881, provides that, as regards conveyances subsequent to 1881, unless a contrary intention is expressed, a lease of ” land ” is to be deemed to include all buildings, fixtures, ease- ments, &c., appertaining to it ; and, if there are houses or other buildings on the land demised, all out-houses, erections, &e., are to pass with the lease of the land. Covenants in leases may be roughly divided into four groups.

(i.) Implied Covenants. — A covenant is said to be im- plied when it is raised by implication of law without any express provision being made for it in the lease. Thus a lessee is under an implied obligation to treat the premises demised in a tenant-like or ” husband-like ” man- ner, and again, where in alease by deed the word ” demise ” is used, the lessor probably covenants impliedly for his own title and for the quiet enjoyment of the premises by the lessee.

(ii.) ” Usual ” Covenants. — The term ” usual ” has a restricted meaning in this connexion, and includes a cove- nant by the lessor, limited to his own acts and those of persons claiming under or through him, for the ” quiet enjoyment ” by the lessee of the demised premises, and covenants by the lessee to pay rent, to pay taxes, except such as fall upon the landlord, to keep the premises in repair, and to allow the landlord to enter and view the condition of the premises.

(iii.) 37ie Covenants running with the Land. — A covenant is said to ” run with the land ” when the rights and duties which it creates are not merely personal to the immediate parties (in which ease a covenant is said to be “collateral”), but pass also to their assignees. A covenant ” runs with the land ” if it relates either to a thing in esse, which is part and parcel of the

demise, e.g., the payment of rent, the repair of houses or fixtures or machinery already built or set up, or to a thing not in esse at the time of the demise, but touching the land, provided that the word ” assigns ” is used in the covenant. As instances of ” collateral ” ‘covenants, we may take a covenant by a lessor to give the lessee a right of pre-emption over a piece of land adjoining the subject of the demise, or in the case of a lease of a beer-shop, not to keep any similar shop within a prescribed distance from the premises demised, or a covenant by a lessee to pay rates on premises not demised.

(iv.) Restrictive Covenants. — These may be subdivided

into two classes — covenauts not to assign or underlet without the lessor’s consent (it may be noted in passing that such consent must be applied for even if, under the covenant, it cannot be withheld) ; and covenants in restraint of trade, e.g., not to use the demised premises for certain trading purposes, and in the case of ” tied houses ” a covenant by the lessees to purchase all beer required from the lessors.

In addition to those above noted, a lease frequently contains covenants for removal of the lease at the option of the lessee, and for repairs or insurance against damage by fire by the lessee. Leases frequently contain a covenant by the lessee to bear and pay rates, taxes, assessments, and other ” impositions ” or ” charges,” or ” duties ” or ” outgoings,” or ” burdens ” (except property tax) imposed upon the demised premises during the term. Considerable difficulty has arisen in recent years as to the scope of the terms “impositions,” “charges,” ” duties,” ” outgoings,” ” burdens.” The words ” rates, taxes, assessments” point to payments of a periodical or recurring character. Are the latter words in such covenants limited to payments of this kind, or do they include single and definite payments demanded, for ex- ample, by a local authority, acting under statutory powers, for improvements of a permanent kind affecting the premises demised ? The decisions on the point are numerous and difficult to reconcile, but the main test is whether, on the true construction of the

particular cov- enant, the lessee has undertaken to indemnify the land- lord against payments of all kinds.

There are several special points in connexion with rent that deserve to be noted. The amount of rent must be „ . ascertained or ascertainable. There must also

be certainty as to the time of payment. If a tenant pays his rent before the day on which it is due, he runs the risk of being called upon, in certain cir- cumstances, to pay it over again. Such a payment is an advance to the landlord subject to an agreement that when the rent becomes due the advance shall be treated as a fulfilment of the tenant's obligation to pay rent. The payment is therefore, generally speaking, a defence to an action by the landlord or his heirs. But if the landlord mortgages his reversion, either before or after the advance, the assignee will, by giving notice to the tenant before the proper rent day to pay rent to him, become entitled to the rent then falling due. A tenant is not in arrears with his rent until after midnight on the day on which it is due. Payment by cheque is conditional payment only, and if the cheque is dishonoured, the original obligation revives. Where a cheque in payment of rent is lost in the course of transmission through the post, the loss falls on the tenant unless the landlord has expressly or impliedly authorized it to be forwarded in that way ; and the land- lord's consent to take the risk of such transmission will not be inferred from the fact that payments were ordinarily made in this manner in the dealings between the parties. A tenant may deduct from his rent (i.) " landlord's taxes," e.gr., property-tax paid by the tenant, if, as is usual, the statute imposing the tax authorizes the deduction; the deduction should be made from the rent next due after the payment, (ii.) Taxes or rates which the landlord had undertaken to pay, but had not paid — payment having thereupon been made by the tenant, (iii.) Payments made by the tenant which ought to have been made by the landlord, e.g., rent due to a superior landlord. (As to the opportionment of rent, see Apportionment.) A right of distress is incident to rent. The latest statutory development of the law on this subject is the Law of Distress Amendment Act, 1888. This statute confers absolute privilege from distress upon the wearing apparel and " bedding " — a term which includes " bedstead " — of

Termina- tion.

the tenant or his family, and the tools and implements of his trade to the value of £5. The Act does not apply to cases where the interest of the tenant has ex- pired, and where possession of the premises has been demanded, and where distress is made not earlier than seven days after such demand. Under this Act also, distress, unless made by the landlord in person, must be made by a bailiff duly certificated (see the Distress for Rent Rules, 1888 and 1895). The Law of Distress Amendment Act, 1895, supplements the Act of 1888, and in particular gives county court judges wider powers of dealing with the certificates of bailiffs. Rent is also recoverable by action, which must be brought within twenty years after the cause of action has arisen, or after an acknowledgment by the party liable, or his agent, or part payment if the rent is reserved by a lease under seal, and in other cases within six years.

The relationship of landlord and tenant may be altered either voluntarily, by the act of the parties, or involun- tarily, by the operation of law, and may also be dissolved. The principal mode of voluntary alteration is an assignment either by the tenant of his term or by the landlord of his reversion. An assign- ment which creates, it will be observed, the relationship of landlord and tenant between the lessor or lessee and the assignee, must be by deed, but the acceptance by a land- lord of rent from a tenant under an invalid assignment may create an implied tenancy from year to year ; and similarly payment of rent by a tenant may amount to an acknowledgment of his landlord's title. This is one form of tenancy by estoppel. The principle of all tenancies of this kind is that something has been done by the party estopped, amounting to an admission which he cannot be allowed to contradict. " Attornment," or the agreement by a tenant to become tenant to a new landlord, is a term now often used to indicate an acknowledgment of the existence of the relationship of landlord and tenant. It may be noted here that it is still common to insert in mortgage deeds what is called an " attornment clause," by which the mortgagor "attorns " tenant to the mortgagee, and the latter thereupon acquires a power of distress as an ad- ditional security. If the lands assigned are situated in Middlesex or Yorkshire, the assignment should be regis- tered undertheMiddlesexRegistry or Yorkshire Registries Acts, as the case may

be ; and similar provision is now made for the registration by an assignee of his title under the Lands Transfer Acts, 1875 and 1897. Another form of alteration in a contract of tenancy is an under-lease, which differs from assignment in this — that the lessor parts with a portion of his estate instead of, as in assignment, with the whole of it. There is no privity of contract between an under-lessee and the superior landlord, but the latter can enforce against the former restrictive covenants (y. sup.) of which he had notice. The contract of tenancy may also be altered by operation of law. If a tenant becomes bankrupt, his interest passes to his trustee in bankruptcy — unless, as is frequently the case, the lease makes the oc- currence of that contingency determine the lease. So on the death of a tenant his interest passes to his legal repre- sentative.s. Tenancy is dissolved by the expiry of the term for which it was created — a subject which has already been sufficiently touched upon in considering the various kinds of tenancy — or by forfeiture of the tenant's interest on the ground of the breach of some condition by the tenant and re-entry by the landlord. A breach of con- dition may, however, be waived by the landlord, and the legislature has made provision for the relief of the tenant from the consequences of such breaches in certain cases. Relief from forfeiture and rights of re-entry are now regulated chiefly by the Conveyancing Acts, 1881 and

1892. Under these Acts a right of re-entry or forfeiture is not to be enforceable unless and until the lessor has served on the lessee a written notice specifying the breach of covenant or condition complained of, and re- quiring him to remedy it or make compensation, and this demand has not within a reasonable time been com- plied with ; and when a lessor is proceeding to enforce such a right the court may, if it think fit, grant relief to the lessee.

Eef erence may be made, in conclusion, to a few modern statutes which have affected the law of landlord and tenant. The Agricultural Holdings Acts, 1883 (which repeals the Agricultural Holdings Act, 1875) and 1900, give to the agricultural tenant a right to compensation for (i.) certain specified improvements made by him with the landlord's previous consent

in writing ; and (ii.) certain other classes of improvements although the landlord's consent has not been obtained. As examples of class (i.) may be mentioned — erection or enlargement of buildings, laying down of per- manent pasture, making of gardens or. fences, planting of hops, embankments, and sluices ; as examples of (ii.) — chalking of land, clay burning, application to land of pur- chased artificial or purchased manure. In the case of proposed drainage improvements, however, notice in writ- ing must be given to the landlord, who may then execute the improvements himself and charge the tenant with in- terest not exceeding 5 per cent, per annum on the outlay, or such annual instalments, payable for a period of twenty- five years, and recoverable as rent, as will repay the out- lay, with interest at the rate of 3 per cent, a year. An agricultural tenant may not contract himself out of his statutory right to compensation, but " contracting out " is apparently not prohibited with regard to the right given him by the Acts of 1883 and 1900 to remove fixtures which he has erected and for which he is not otherwise entitled to compensation, after reasonable notice to the landlord, unless the latter elects to purchase such fixtures at a val- uation. The Allotments and Cottage Gardens (Compen- sation) Act, 1887, deals, on terms similar to those of the Agricultural Holdings Acts, 1883 and 1900, with allot- ments {i.e., parcels of land of not more than two acres, cul- tivated as gardens or farms, or partly as gardens and partly as farms) and cottage gardens (i.e., allotments attached to cottages) ; and where a tenant is entitled to " compensa- tion " under the Act of 1887 he is not to be so entitled under the Act of 1883 (Tenants' Compensation Act, 1890). Compensation is given to market gardeners for unexhausted improvements by the Market Gardeners' Compensation Act, 1895. The Agricultural Holdings Act, 1883, the Ten- ants' Compensation Act, 1890, the Market Gardeners' Com- pensation Act, 1895, and the Agricultural Holdings Act, 1900, may now (by § 14 (2) of the last-named statute) be cited together as the Agricultural Holdings (England) Acts, 1883 to 1900.

Scotland. — The following statutes relating to the law of landlord and tenant in Scotland must be noted. The Agricultural Holdings (Scotland) Acts, 1883 and 1900, contain provisions — similar to those of the English Acts — as to a tenant's right to compensation for unex- hausted improvements, removal for non-payment of rent, notice to quit at the termination of a tenancy, and a tenant's property in fixtures. The Crofters'

Holdings (Scotland) Acts, 1886, 1887, and 1888, confer on ” crof- ters ” special rights. A crofter is defined as ” a tenant of a holding ” — being arable or pasture land, or partly arable and partly pasture land — ” from year to year who resides on his holding, the annual rent of which does not exceed £30 in money, and which is situated in a ‘crofting parish.’ ” Nearly all the parishes in Argyll, Inverness, Ross, Cromarty, Sutherland, Caithness, and Orkney and Shet- land answer to this description. The crofter enjoys a

perpetual tenure subject to the fulfilment of certain con- ditions as to payment of rent, non-assignment of tenancy, &c., and to defeasance at his own option on giving one year’s notice to the landlord. A Crofters’ Commission constituted under the Acts has power to fix fair rents, and the crofter on renunciation of his tenancy or removal from his holding is entitled to compensation for permanent improvements. The Small Holdings Act, 1892, applies to Scotland.

Ireland. — The history and condition of the law of landlord and tenant in Ireland down to and including the year 1881 will be found stated in the article Ire- land in vol. xiii. (ninth edition) of the Encycloptedia Britannica. The first important statute after that date was the Land Purchase Act of 1885 (Lord Ash- bourne’s Act). It enabled the Land Commission, es- tablished under the Land Act, 1881, to advance to tenants out of a grant of £5,000,000, which it made to the Land Commission for the purpose, the whole money required for the purchase of their holdings (under the Land Act, 1881, the limit of an advance was three-fourths of the purchase money), if provision were made for the lodgment or retention of a guar- antee deposit ; and the sale might be carried out by a vesting order of the Land Commission in lieu of a con- veyance. The advance was m ade repayable by an annuity in favour of the Land Commission of £4 for every £100, and so in proportion for any less sum. Amending Acts were passed in 1887, 1888, 1891, and 1896. The Land Act, 1887, enabled all leaseholders to obtain a judicial revision of their rents ; all middlemen, i.e., leaseholders who had sublet their lands, were allowed, if the courts reduced the rents of their tenants, to throw up their leases ; power was given to the landlord who had obtained judg- ment of eviction to make his tenant a caretaker without first evicting him. An equitable jurisdiction was vested in the county court to hear complaints from tenants, to give them time for the payment of their

rents, when that should be necessary, and when they were honestly in- solvent to relieve them — in like manner as under the bank- ruptcy law — from all or part of their debts, including rent, and in proper cases to reinstate them in their hold- ings at a fair rent. The Land Act, 1888, increased the grant placed at the disposal of the Land Commission by Lord Ashbourne's Act from £5,000,000 to £10,000,000. The Land Purchase Act, 1891, besides providing for the relief of " congested districts " (which were also the sub- ject of legislation in 1893 and 1894) and the allocation of the money to be lent for land purchase, created in- genious machinery for enabling British credit tobe applied in the extension of the system of land purchase. When a landlord and tenant agree on the sale of a holding — the measure is entirely permissive in character — and when the Land Commission has sanctioned the advance, the advance is made to the landlord not in cash but in the issue of guaranteed land stock of the nominal amount of the advance, producing dividends at the rate of 2-| per cent. In order to provide for the payment of these dividends and for the redemption of the whole amount in forty-nine years, the tenant pays a purchase annuity for that period, the normal rate of which is 4 per cent, for the advance, but which is fixed at a higher rate during the earlier years of the term so as to provide a tenants' insurance fund. The purchase annuities are]iaid into a land purchase account, and any deficiency in the payment either of interest or of capital is temporarily advanced out of the Consolidated Fund, which is in turn recouped for these temporary advances out of a guarantee fund, consisting of (i.) a cash portion — the Irish Probate Duty Grant, the annual exchequer contribution, and (a provision abolished by the Land Act, 1896) the county percentage — and (ii.)

a contingent portion including the Irish share of the local taxation (Customs and Excise) duties and various local grants. The Land Act, 1896, reqiiired the court in fixing a fair rent for a holding to ascertain and record in the form of a schedule, inter alia, the condition as to deteriora- tion, cultivation, or otherwise of the holding and any buildings on it, the improvements made at the cost of the tenant and those made at the cost of the landlord, defined

the tenures excluded from its provisions as to fair rents, altered to some extent the mode of calculating the annuity- payable by the tenant, amended the law as to the guarantee deposit, and provided that where an order had been made for a sale of an estate or it had been placed in the hands of a receiver the land judge might, after reference to the Land Commission, offer it for sale to the tenants, but the offer was not to be accepted until all parties had been fully heard and all the circumstances had been considered.

The law of landlord and tenant in the United States is in its principles similar to those of English law. The relationship of landlord and tenant is created, altered, and dissolved in the same way, and the rights and duties of parties are similar. An excellent summary of the law will be found in Bouvier's Law Dictionary (ed. Rawle, 1897), s.v. " Landlord and Tenant." As to India, see India in vol. xii. (ninth edition) of the Encyclopcedia Britannica. The laws of the various colonies on the subject are too numerous and too different to be dealt with here. But there has been a general tendency in recent years to copy modern English statutory developments, as in limiting the right of distress (see No. 1388 of 1895— Victoria— and cp. C. 17 of 1895, and C. 18 of 1896— British Columbia) , securing the protection of lodgers' goods (No. 2 of 1898 — West Australia, and No. 5 of 1898 — Grenada), and in securing compensation to tenants (see No. 11 of 1897 — Barbados).

Authorities. — ^English Law : Wolstenholme, Brinton, and Cherry. Conveyancing and Settled Land Acts. London, 7th edition, 1895. — Hood and Challis. Conveyancing and Settled Land Acts. London, 5th edition, 1898. — Foa on Landlord and Tenant. London, 2nd edition, 1895. — WooDFALLOn Landlord and Tenant. London, 10th edition,' 1898. — Fawcett's Landlord and Tenant. London, 2nd edition (by Lightwood), 1900. — Scots Law : Hunter on Landlord and Tenant. Edinburgh, 4th edition, 1876. — Rankine on Land Ownership. Edinburgh, 3rd edition, 1891. — Rankine nn Leases. Edinburgh, 2nd edition, 1893. — Irish Law: Kelly's Statute Law of Landlord and Tenantin Ireland. Dublin, 1898.— Barton and Cherry's Land Act, 1896. Dublin, 1896.— American Law: Bouvier's iawZJicfionar?/ (ed. Rawle). London, 1897. (a. w. e.)

Land Registration in its two forms — regis- tration of deeds and registration of title — may be best de- scribed as a species of machinery for assisting a purchaser or mortgagee in his inquiries as to his vendor's or mort- gagor's title previously to completing his dealing, and for securing his own position afterwards. The expediency of making some inquiry into the vendor's title before completing a purchase of land (and the case of a mortgage is precisely similar) is so obvious as hardly to need demon- stration. Goods, it is true, are ordinarily bought and sold without any inquiry of this nature, but there is very little analogy between the two cases. In the case of goods, possession may ordinarily be relied on as proof of full ownership ; in the case of land, the person in ostensible possession is very seldom the owner, being usually only a tenant, paying rent to some one else. Even the person to whom the rent is paid is in many cases — probably, in England, in most cases — not the full owner, but only a life owner, or a trustee, whose powers of disposing of the property are of a strictly limited nature. Again, goods are very seldom the subject of a mortgage, whereas land has from time immemorial been the frequent subject of this class of transaction. Evidently, therefore, some sort of inquiry is necessary to enable a purchaser to obtain certainty that the land for which he pays full price is not subject to an unknown mortgage or charge, which, if left undiscovered, might afterwards deprive him of a large part or even the whole of its value. Again : the probability of

serious consequences to the purchaser ensuing from a mistake as to title is infinitely greater in the ease of land than in the case of goods. Before the rightful owner can recover misappropriated goods, he has to find out where they are. This is usually a matter of considerable difficulty. By the time they have reached the hands of a bond fide purchaser all chance of their recovery by the true owner is practically at an end. But with land the case is far otherwise. A dispossessed rightful owner never has any difficulty in tracing his property, for it is immovable. All he has to do is to bring an action for ejectment against the person in possession. For these reasons, among others, it may safely be said that any attempt to deal with land on the simple and unsuspecting principles which obtain in regard to goods would be fraught with grave risks.

Apart from very early and primitive social conditions, when everybody's affairs were more or less within the common knowledge of everybody else, there appear to be only two ways in which the required certainty as to title to land can be obtained. Either the purchaser must satisfy himself, by an exhaustive scrutiny and review of all the deeds, wills, marriages, heirships, and other docu- ments and events by which the property has been conveyed, mortgaged, leased, devised, or transmitted during a considerable period of time, that no loophole exists whereby an adverse claim can enter or be made good — this is called the system of private investigation of title — or the Government must keep an authoritative list, or register, of the properties within its jurisdiction, together with the names of the owners and particulars of the en- cumbrances in each case, and must protect purchasers and others dealing with land, on the faith of this register, from all adverse claims. This second system is called Kegistration of Title. To these two alternatives may perhaps be added a third, of very recent growth — Insurance of Title. This is largely used in the United States. But it is in reality only a phase of the system of private investigation. The insurance company investi- gates the title according to a method of its own, and charges the purchaser a premium to cover the expense and the risk of error. Eegistration of deeds is an ad- junct of the system of private investigation, and, except in England, is a practically invariable feature of it. It con- sists in the establishment of public offices, in which all documents affecting land are to be recorded — partly in order to preserve them in a readily accessible place, partly in order to prevent the possibility of any material deed or document being dishonestly concealed by a vendor from the scrutiny of the intending purchaser. Where registration is effected by depositing a full copy of the deed, it also renders the subsequent falsification of the original document dangerous. Registration of deeds does not (except perhaps to a certain extent indirectly) cheapen or simplify the process of investigation — the formalities at the registry add something to the trouble and cost incurred— but it prevents the particular classes of fraud above mentioned.

The history of land registration follows, as a general rule, a fairly uniform course of development. In very early times, and in small and simple communities, the difficulty which is afterwards found in establishing title to land does not arise, owing to the primitive habit of attaching a certain amount of ceremony and publicity to all dealings. The parties meet on the

land, with wit- nesses ; symbolical acts (such as handing over a piece of earth, or the bough of a tree) are performed ; and a set form of words is spoken, expressive of the intention to convey. By this means the ownership of each estate in the community becomes to a certain extent a matter of common knowledge, rendering fraud and mistake difficult.

But this method leaves a good deal to be desired in point of security. Witnesses die, and memory is uncertain; and one of the earliest improvements consists in the establishment of a sort of public record kept by the magistrate, lord, or other local authority, containing a series of contemporary notes of the effect of the various transactions that take place. This book becomes the general title-deed of the whole community, and as long as transactions remain simple, and not too numerous, the results appear to be satisfactory. Of this character are the Manorial Court EoUs, vi^hich were in the Middle Ages the great authorities on title, both in England and on the Continent. The entries in them in early times were made in a very few words. The date, the names of the parties, the name or short verbal description of the land, the nature of the transaction, are all that appear. In the land registry at Vienna there is a continuous series of registers of this kind going back to 1368, in Prague to 1377, in Munich to 1440. No doubt there are extant (though in a less easily accessible form) manorial records in England of equal or greater antiquity. This may be considered the first stage in the history of Land Eegis- tration. It can hardly be said to be in active operation at the present day in any civilized country— in the sense in which that term is usually understood. Where deal- ings become more numerous and complicated, written instruments are required to express the intentions of the parties, and perform the further function afterwards of supplying evidence of the landowner’s title. It ap- pears, too, that as a general rule the public books already described continue to be used, notwithstanding this change ; only (as would be expected) the entries in them, once plain and simple, either grow into full copies of the long and intricate deeds, or consist of mere notes stating that such and such deeds have been executed,

leaving the persons interested to inquire for the originals, in whose custody soever they may be found. This system, which may be regarded as the second stage in the history of land registration, is called Registration of Deeds. It prevails in France, Belgium, parts of Switzerland, in Italy, Spain, India, in almost all the British colonies (except Australasia and Canada), in most of the states of the American Union, in the South American republics, in Scotland and Ireland, and in the English counties of York- shire and Middlesex. Where it exists, there is generally a law to the effect that in case of dispute a registered deed shall prevail over an unregistered one. The practical effect of this is that a purchaser can, by searching the register, find out exactly what deeds he ought to inquire for, and receives an assurance that if, after completion, he registers his own conveyance, no other deeds — even if they exist — will prevail against him.

The expenses and delays, not to mention the occasional actual losses of property through fraud or mistake, attend- ant on the system of making every purchaser responsible for the due examination of his vendor's title — whether or not assisted by registration of deeds — have ultimately induced several Governments to establish the more perfect system of Registration of Title, which consists in collect- ing the transactions affecting each separate estate under a separate head, in keeping an accurate account of the parcels of which each such estate is composed, and summarizing authoritatively, as each fresh transaction occurs, the sub- sisting rights of all parties in relation to the land itself. This system prevails in Germany, Austria, Hungary, parts of Switzerland, the Australasian colonies, nearly the whole of Canada, some of the states of the American Union, to a certain extent in Ireland, and is in course of establishment in England and Wales. The Register consists of three portions : — (1) The description of the land, now always accompanied by a reference to a map ; (2) the ownership.

giving the name and address of the person who can sell and dispose of the land ; and (3) the encumbrances, in their order of priority, and the names of the persons for the time being entitled to them. When any fresh trans- action takes place the instrument effecting it is produced, and the proper alterations in, or additions to, the register are made : if it be a sale, the name of the vendor is can- celled from the register, and that of the purchaser is en- tered instead ; if it be a mortgage, it is added to the list of

encumbrances; if a discharge, the encumbrance dis- charged is cancelled ; if it is a sale of part of the land, the original plan is marked to show the piece conveyed, while a new plan is made and a new register is opened for the detached parcel. In the English and Australian registries a ” land certificate ” is also issued to the land- owner containing copies of the register and of the plan. This certificate takes the place more or less of the old documents of title. On a sale, the process is as follows. The vendor first of all produces to the purchaser his land certificate, or gives him the number of his title and an authority to inspect the register. In Austria and in some colonial registries this is not necessary, the register being open- to public inspection, which in England is not the case. The purchaser, on inspecting this, can easily see for himself whether the land he wishes to buy is com- prised in the registered plan, whether the vendor’s name appears on the register as the owner of the land, and whether there are any encumbrances or other burdens registered as affecting it. If there are encumbrances, the register states their amount and who are entitled to them. The purchaser then usually ■’ prepares a convey- ance or transfer of the land (generally in a short printed form issued by the registry), and the vendor executes it in exchange for the purchase money. If there are mort- gages, he pays them off to the persons named in the reg- ister as their owners, and they concur in a discharge. He then presents the executed instruments at the registry, and is entered as owner of the land instead of the vendor, the mortgages, if any, being cancelled. Where “land certificates” are used (as in England and Australia), a new land certificate is issued to the purchaser shovsdng the existing state of the register and containing a copy of the registered plan of the land. The above is of course only a brief outline of the processes employed. For further information as to practical details reference may be made to the treatises mentioned at the end of this article. The following particulars indicating the history and distinctive features of different systems prevailing in Great Britain and various other countries may, however, prove interesting : — England and Wales. — In England and Wales land registration is as yet (1902) only partially established. Since the time of Queen Anne deed registries have existed in Middlesex and Yorkshire, and under Lord Hals- bury’s Land Transfer Act of 1897 considerable progress has been made in compiling a register of title in the county of London, but it will probably be some years before this measure will have attained its full effect. The Act of 1897, § 20, provides the means

of gradually extending the system throughout the country on the initiative of the County Councils. The first attempt to introduce general registration of conveyances appears to have been made by the Statute of Enrolments, passed in the 27tli year of Henry VIII. But this was soon found to be capable of evasion, and it became a dead letter. A Registration Act applying to the counties of Lancaster, Chester, and Durham was passed in Queen Elizabeth's reign, but failed for want of providing the necessary machinery for its own observance. The subject reappeared

1 In Prussia all conveyances are verbal, made in person or by attorney before the registrar, who forthwith notes them in his books.

in several Bills during the Commonwealth, but these failed to pass, owing, it would seem, to the objection of landowners to publicity. In 1669 a committee of the House of Lords reported that one cause of the depreciation of landed property was the uncertainty of titles, and proposed registration of deeds as a remedy, but nothing was done.

During the next thirty years numerous pamphlets for and against a general registry were published. In 1704 the first Deed Registry Act was passed, applying to the West Eiding of Yorkshire. In 1707 the system was extended to the East Riding, and in 1708 to Middlesex. These Middlesex and Yorkshire registries remain in operation to the present day, and are greatly valued by the smaller proprietors and mortgagees, owing to the security against fraud which they provide at a trifling cost. The selection of these counties seems capricious : its probable explanation is that in them trade was flourishing, and the fortunes made were frequently invested inland, and a protection against secret encumbrances was most in demand. In 1728 and 1732 Surrey and Derby petitioned, unsuccess- fully, for local registries. In 1735 the North Riding Deed Registry Act was passed. In 1739 a General Registry Bill passed the Commons, but did not reach the Lords. Next year the Lords passed a similar Bill, but it did not reach the Commons. In 1759 a General Registry Bill was thrown out by a majority of one. In 1785 Northumberland unsuccessfully petitioned for a local registry. After this the

subject went almost out of sight till the Real Property Commission of 1828. They reported in 1830 in favour of a general register of deeds, but though several Bills were introduced, none were passed. In 1846 a committee of the House of Lords reported that the marketable value of real property was seriously diminished by the tedious and expensive process of the transfer of land, and that a registry of title to all real property was essential to the success of any attempt to simplify the system of conveyancing. In 1850 a Royal Commission reported in favour of a general register of deeds, and in 1851 Lord Campbell introduced a Bill accordingly, but it was opposed, and was dropped. In 1853 Lord Cranworth introduced a Bill, which passed the Lords but not the Commons. Hitherto only registration of deeds had been considered, but in 1854 a new Royal Commission %vas appointed, which reported in 1857 in favour of a register oftitle. The scheme they recommended was substantially embodied in a Bill introduced in 1869 by Lord Cairns — then Solicitor-General — but a dissolution stopped its progress. In 1862 Lord Westbury had the satisfaction of carrying the first Act for registration of title. This Act enabled any landowner to register an indefeasible title on production of strict proof. The proof required was to be such as the Court of Chancery would force an unwilling purchaser to accept. Only a few hundred titles were registered under this Act, and in 1868 a Royal Commission was appointed to inquire into the causes of its failure. They reported in 1870, making various suggestions of detail, and especially ad- verting to the great expense caused by the strictness of the official investigation of title before a property could be admitted to the register at all. In the same year Lord Hatherley introduced a Transfer of Land Bill, but it was not proceeded with. In 1873 Lord Selborne introduced a Land Titles and Transfer Bill, following more or less the recommendations of the report of 1870, proposing for the first time compulsory registration of title upon every next sale after a prescribed date. Lord Cairns again intro- duced this Bill (with some modifications) in 1874, but it had to be dropped. In 1875 Lord Cairn’s Land Transfer Act of that year was passed, which was much the same as the former Bill, but without compulsion. This Act had no

better success than the Act of 1862, but as its adoption has since been made compulsory, its provisions are import- ant. Its most noticeable feature from a practical point of view is the additional prominence given to an expe-

dient called ” Possessory ” registration (which also existed under another name in Lord Westbury’s Act), whereby is removed the great initial difficulty of placing titles on the register in the first instance. Two sorts of registration were established, ” Absolute ” and ” Possessory.” The effect of an absolute registration was immediately to destroy all claims adverse to the registered title. But this was only to be granted on a regular investigation of title, which, though not so strictasunderthe former Act, yetnecessarily involved a certain amount of time and cost. Possessory registration, on the other hand, was to be granted to any one who could show z. primd fade title — a quick and cheap process. But the effect of such registration would not be immediately felt. It would not destroy existing claims. It would only prevent new difficulties from arising. In course of time such a title would be practically as good as an absolute one. In 1885 the Duke of Marlborough introduced a Bill for a registry of titles, and in the following vacation Lord Davey wrote three letters to The Times advocating the same thing on the general lines afterwards adopted.^ In 1887 Lord Halsbury, by introducing his Land Transfer Bill, commenced a struggle with the opponents of reform, which, after ten years of almost continuous effort, resulted in the passing of his Act of 1897, establishing compulsory registration of title. Without going into the details of this protracted campaign, suffice it to say that Lord Halsbury introduced Bills in 1887, 1888, and 1889. Lord Herschell, who succeeded him after the change of Govern- ment, introduced Bills in 1893, 1894, and 1896, these last three being unanimously passed by the House of Lords on every occasion. The Bill of 1895 reached committee in the Commons, but was stopped by the dis- solution of Parliament. In 1897 Lord Halsbury (who had meanwhile returned to the Woolsack) again introduced the same Bill with certain modifications which caused the Incorporated Law Society to withdraw its opposition in the House of Commons, and the Act was finally passed on the last day of the session. Under it the Privy Council has power to issue orders from time to time declaring that on a certain date registration of title is to be compulsory on sale in a given district. The effect of such an order is to oblige every purchaser of land in the district after that date to register a ” possessory title,” as above described, immediately after his purchase. The compulsory provisions of the Act extend to freeholds and (by a rule afterwards made) to leaseholds having forty years to run. No order except the first can be made, save on the request of a county council. The first order was made in July 1898. It

embraces the whole administrative county of London (including the City of London), proceeding gradually by groups of parishes. Under this order upwards of 32,000 titles have already been registered, representing a value exceeding thirty millions sterling. The cost of originally registering a possessory title, or a subsequent transfer or charge of registered land, is regulated according to the value of the land or charge, and is as follows : —

Value. TJp to £1000 Thence to £3000

Thence to £10,000

Over £10,000

Fee. Is. 6d. per £25 value. £3 for the first £1000, and then Is.

per £25. £7 for the first £3000, and then Is.

per £50. £14 for the first £10,000, and then Is. per £100, up to a maximum of £25 for £32,000 value and over.

1 This summary is an ahridgment (with permission) of pp. 7 to 26 of Mr R. Bumet Morris's book referred to at the end of this article.

Under the operation of this Act, at the expense of a somewhat increased cost on all transactions during a few years, persons dealing with land in the county will ulti- mately experience great relief in the matter both of cost and of delay. Mortgagees will also be protected from risks of fraud, which at present are very appreciable, and of which the Redgrave case is a recent example.

Scotland. — In Scotland registration of deeds was estab- lished by an Act of 1617, which remained unaltered till 1845. There are also Acts of 1868 and 1874. The registry is in Edinburgh. Deeds are registered almost invariably by full copy. The deeds are indexed accord- ing to properties— each property having a separate num- ber and folio called a " search sheet,"

on which all deeds affecting it are referred to. In 1893, 34,767 deeds were registered and 2000 official searches were made. The consequence of the existence of this register is to render fraud in title absolutely unknown. Forty years is the usual period investigated. The investigation can, if desired, be made from the records in the registry alone. The fees are trifling, but suffice to pay the expenses of the office, which in 1893 employed no less than seventy- five permanent clerks in addition to temporary assist- ants. The total costs of conveyancing amount, roughly speaking, to between 1 and 2 per cent, on the purchase money, and are equally shared between vendor and purchaser.

Australia and New Zealand. — ~~These colonies now fur~~ nish the most conspicuous examples in the British Em- pire of the success of registration of title. But prior to the year 1857 they had only registration of deeds, and the expense, delay, and confusion resulting from the frequent dealings appear to have been a crying evil. The late Sir Robert Torrens, then registrar of deeds in South Australia, drew up and carried an Act establish- ing a register of title similar to the shipping register. The Act rapidly became popular, and was adopted (with variations) in all the other Australasian colonies in the years 1861, 1862, 1870, and 1874. Consolidating and amending Acts have since been passed in most of these colonies. Only absolute title is registered. All land granted by Government, after the passing of the several Acts, is placed on the register compulsorily. But volun- tary applications are also made in very large numbers. It is said ordinary purchasers will not buy land unless the vendor first registers the title. The fees are very low — £1 to £3 is a usual maximum — though in some colonies, e.g., Victoria, the fees rise indefinitely, ad valorem, at a rate of about 10s. per £1000. Insur- ance funds are established to provide compensation for errors. At a recent date they amounted to over £400,000, while only £14,600 odd had been paid in claims. All the registries pay their own expenses. Bankers and men of business generally are warm in their appreciation of the Acts, which are popularly called Torrens Acts, after their originator, who, though not a lawyer, originated and carried through this im- portant and difficult legal work.

Canada. — Registration of title was introduced in Van- couver Island in 1861, was extended to the rest of British Columbia in 1870, and was in

1886 adopted by Ontario, Manitoba, and the North-West Territories. Only Que- bec, Nova Scotia, New Brunswick, and Prince Edward Island (all in the extreme east) retain the old English system, plus registration of deeds. The three provinces which have adopted registration of title have adopted it in somewhat different forms. In British Columbia it is similar to Lord Westbury's Act of 1862. The North- West Territories follows closely the Torrens Acts. The Ontario Act is almost a transcript of Lord Cairns's Act of 1875. The fees again are very low, seldom exceeding

a few shillings, but all expenses of the office are paid from this source. The Ontario registry has five district offices, as well as the central one at Toronto. This is apparently the only colonial registry which is not open to public inspection.

Other British Colonies. — In the other British colonies private investigation of title, plus registration of deeds, is the prevailing system, but registration of title has been introduced in one or two instances.

Germany and Austria-Hungary. — By far the most im- portant examples of registration of title at present existing — because they show how the system works when applied to large European communities, with all the intricacies and complications of modern civilized life — are to be found in Germany and AustriarHungary. In some parts of these countries Registration of Title has been established for several centuries — notably in Bohemia ; in most parts it has existed for the greater part of the 19th century ; in some districts, again, notably Tirol and the Rhine Provinces, it is still in course of introduction. In all cases it appears to have been preceded by a system of deed registration, which materially facilitated its introduction. In some cases, Prussia, for instance, the former registers were kept in such a way as to amount in themselves to little short of a registry of title. Very low scales of fees suffice to pay all official expenses. In Prussia, for instance, the fees for registering sales begin at 5d. for a value of £1 ; at £20 the fee is 2s. 7d. ; at £100 it is 7s. 3d. ; at £1000 it is £1, 10s. ; at £5000, £4, 6s., and so on. In case of error, the officials are personally liable ; failing these, the state. Other states are very similar. In 1894, 1,169,995 trans- actions were registered in Prussia. In 1893, 938,708 were registered in Austria. Some idea of the extent to which small holdings prevail in these countries may be

gathered from the fact that 36 per cent, of the sales and mortgages in Austria were for under £8, 6s. 8d. value — 74 per cent, were for under £60. Owing to the ease and simplicity of the registers, it is not always necessary to employ professional help. When such help is required, the fees are low. In Vienna £1 is a very usual fee for the purchaser's lawyer. £10 is seldom reached. In Germany the register is private. In Austria it is open to public inspection. In these registers may be found examples of large estates in the country with numerous charges and encumbrances and dealings therewith; peasants' properties, in numerous scattered parcels, acquired and disposed of at different times, and vari- ously mortgaged; town and suburban properties, flats, small farms, rights to light and air, rights of way, family settlements, and dealings of all sorts — inheri- tances and wills, partitions, bankruptcies, mortgages, and a great variety of dealings therewith. The Continental systems are usually administered locally in districts, about 20 to 30 miles across, attached to the local law courts. In Baden and Wtirtemberg every parish (commune) has its own registry. All ordinary dealings are transacted with the greatest expedition. Security is absolute.'

The United States. — Up to a late date the ordinary English system, with registration of deeds, was universal in the United States. The registries appear to go back practically to the original settlement of the country. Regis- tration is by full copy. It is said that in the large towns the name indexes were often much overgrown owing to the want of subdivision into smaller areas corresponding to the parishes into which the Middlesex and Yorkshire indexes are divided. In the New York registry not many years ago 25,000 deeds were registered annually. At the same time 35,000 were registered in Middlesex. Com-

1 Full Information as to the German and Austrian systems is to be found in a Parliamentary Report of 1896 (C. — 8139) on the subject.

plaints are made by American lawyers of want of accuracy in the indexes also. In 1890 an Act was passed in New York for splitting the indexes into "blocks," which is expected to give much relief in a few years' time. The

average time and cost of an examination of title, as estimated by a committee of the Bar Association of New York in 1887, was about thirty days and 150 dollars (about £30). A later State Commission in Illinois estimates the law costs of a sale there at about 25 dollars (£6) ; the time may run into many months. Allusion has already been made to the insurance of title companies. The rates of insurance are substantial, e.g., 65 dollars (£13) on the first 3000 dollars (£600), and 5 dollars (£1) on each additional 1000 dollars (£200). This would amount to £20 on £2000 value, £110 on £20,000, £610 on £100,000. The guarantee given is very ample, and may be renewed to subsequent owners at one-third of the fee. Eegistration of title has lately been introduced into Illinois, but the practical results have hardly as yet had time to declare themselves.

France.— la France registration of deeds is universal. Sales, mortgages, gifts, and successions; easements, leases of over eighteen years, and transactions affecting the land to the extent of three years' rent, may lose priority if not registered. Wills need not be registered. Mortgages must be registered every ten years. Purchase deeds are registered by filing full copies. Eegistries are established in all the considerable towns. The duty on sales amounts to the high figure of about 6^ per cent, on the value. Part of this is allocated to registration, in addition to which a fixed fee of

1 franc, and stationers' charges averaging 6 francs, are also chargeable. The title can usually be fully investigated from the documents in the registry. Official searches for mortgages are commonly resorted to, at a cost of about 5 francs. Under the monarchy the land system was prac- tically copyhold tenure, but greater validity was attached to the Court Rolls than was the case in England. The present system was established by a law of 1790 after the abolition of seigniorial institutions in 1789. This was modified by the Code Napoleon, and further perfected by a law of 1865. The average value of transactions in Prance is very small. Probably at the presenttime four-fifths of the properties are of under £25 value. The costs of a sale for 200 francs (£8) would be about as follows : — Duty 13 fr. ; Notary (1 p.c),

2 fr. ; expenses, 12 fr.— total 27 fr. A sale for 1000 fr. (£40) would cost about 110 fr. Taking all values, the cost of conveyance and duty reaches the high figure of 10 per cent, in the general run of transactions. The vendor as

a rule has no costs. Indefeasible title is not obtainable, but frauds are almost unknown. A day or two usually suf- fices for all formalities. On large sales a further process known as the ” purge ” is undergone, which requires a few weeks and more expense, in order to guard against possible claims against which the deed registries afford no protection, such as dowries of wives, claims under guardian- ships, &c. A commission (Com mission Extraparlementaire du Cadastre), appointed in 1891 to consider the revision of the Government cadastral maps (which are in very serious arrear) and the establishment of registration of title, has collected, in seven volumes of Comptes Eendus, a great mass of most interesting particulars relating to land questions in France.

Authorities. — A very complete list of some 114 English publications from 1653 to 1895 will be found in R. Buknet Morris. Land Eegistration. Wm. Clowes, 1895.— Parlia- mentary Publications : Second Beport of the Seal Property Commissioners, 1831 ; Beport of the Eegistration and Convey- ancing Commission, 1850 ; Beport of the Eegistration of Title Commission, 1857 ; Beport of the Land Transfer Commission,

1870 ; Beports on Eegistration of Title in Australasian Colonies,

1871 and 1881 ; Beport on Eegistration of Title in Germany and Austria-Hungary, 1896. General reviews of land registration in

the British Isles, the Colonies, and in foreign countries: R. Burnet Morris, as above, and C. F. Biuckdale. Land Transfer in Various Countries. Horace Cox, 1894. Boolcs on practice :— England: Brickdale and Sheldon. The Land Transfer Acts. Stevens and Sons, 1898. — Cherry and Marigold. Tlie Land Transfer Acts, 1898.— Hay. Land Transfer, &o. Waterlow Bros., 1901. — C. F. Brickdale. Eegistration in Middlesex. Waterlow and Sons, 1892. Australia : Duffy and Eagleson, Melbourne. Prussia : Oeerneck. Die Preussischen Grundbuch- gezetze, Berlin, Bahr. Austria : Das allgemeine Orundhuchsgezetz, &o. Vienna, Manzsche Buchhandlung. — Bartsch. Das Oester- reichische Allgemeine Orundhuchsgezetz in seiner practischen An- wendung, Vienna, K. Konegen. Saxony : Siegmann. Sdchsische Hypotheleenrecht. Leipzig, Breitkopf and Hartel. Statistics : Oesterreichische Statistik {Grundbuchs-dmter). Staatsdruokerei, Vienna, annually. (c. F. Br.)

Landsberg, a town of Bavaria, Germany, district of Upper Bavaria, on the river Lech, 38 miles by rail west by south of Munich. Its 16th-century church has fine stained glass. In the town house are a picture by Herkomer and frescoes by Piloty. Hubert von Herkomer was born (1849) at Waal, 7 miles to the south-west of Landsberg. Here also are a fine gateway, an agricultural school, and brewing, tanning, and manufacture of agricul- tural machinery, &c. Population (1900), 6977.

Landsberg – an – der – Warthe, a town of Prussia, on the navigable Warthe, 29 miles east-north-east of Kiistrin by rail. The educational institutions include a gymnasium with real school, a burghers' school, a higher- grade girls' school, an industrial school, a drawing school, and a school for farriery. Population (1890), 28,065;

(1900), 33,597.

Landshut, a town of Prussia, province of Silesia, at the north foot of the Riesengebirge and on the river Bober, 66 miles south-west of Breslau. It carries on flax-spinning and linen-weaving, and manufactures of cloth, shoes, beer, &c. The town dates from the 13th century. Here the Prussians were defeated by the Austrians in 1746, and again in 1760. Population (1900), 8241.

Landskron, chief town of a government district in north-eastern Bohemia, close to the Moravian frontier, in an extensive German-speaking enclave. It has manu- factures of linen and cotton stuffs, tobacco, beer, and spirits. Population (1890), 6843 ; (1900), 6112, German.

Landskrona, a seaport town of Sweden, on the east side of the Sound, about half-way between Helsingborg and Malmo, 15 miles north-east of Copenhagen. The harbour is excellent, giving a depth of 35 feet, with 16 feet beside the quays. The staple industry is sugar manufacture and refining (from beetroot). In 1899 its port was cleared by 1914 vessels of 374,600 tons. On the little island of Hven, immediately opposite the town, Tycho Brahe built his famous subterranean observatory of Uranienborg in the second half of the 16th century. Population (1880), 9763; (1890), 12,253; (1900),

14,399.

Landsturm, the German equivalent of the levie en masse, or general levy of all men capable of bearing arms are not included in the other regularly organized forces, standing army or its second line formations, of Continental nations.

All men coming under the above category are liatde to serve In it ; in Germany from their eighteenth to their forty-(ifth year, in Austria from their nineteenth to their forty-second, and in Russia (where it is known as the ” Opolchenic “) from their twentieth to their forty-third year of age. As a rule, the landsturm would not be called out except in the case of invasion of the country, but certain preparations are in most countries made for its equipment, armament, and formation. It usually consists of two portions — (a) those men who have passed through the army, or have otherwise trained before passing into the landsturm ; and (6) those who have received no training whatever in consequence of

exemption for family or other reasons. Tlie first category has a certain value, and its men would probably be organized in units which might not receive uniforms, but by international law are compelled to wear a distinguishing badge. The second category can be of but little military value, and would probably be employed as working parties, tradesmen in depSts or military factories, or in other non-combatant duties. (j. M. GK.)

Landwehr, a German word meaning “defence of the country ” ; but the term as applied to an insurrec- tional militia is very ancient, and ” lantveri ” are men- tioned in Baluzii Oapitularia, as quoted inHallam’s Middle Ages, i. p. 262, 10th ed.

The landwehr in Prussia was first formed by a royal edict of 17th March 1813, which called up all men capable of bearing arms between the ages of eighteen and forty-five, and not serving in the regular army, for the defence of the country. After the peace of 1815 this force was made an integral part

of the Prussian army, each brigade being composed of 1 line and 1 landwehr regiment. This, however, retarded the mobilization and diminished the value of the first line, and by the reorganization of 1859 the landwehr troops were relegated to the second line. The present conditions of landwehr service are given under Army (Germany). In Austria the landwehr is a totally different organization. It is in reality a cadre force existing alongside the regular army, and to it are handed over such recruits as, for want of vacancies, cannot be placed in the latter. These are trained for two years with the colours, and are afterwards passed for ten years into the non- active portion, but may be called up for training. There is a marked tendency to level up the landwehr to the standard of the army. In Switzerland the landwehr is simply a second line force, in which all citizens serve for twelve years, after passing twelve in the ” Auszug ” or field army. (j. m. Gb.)

Lange, Friedrich Albert (1828-1876), German philosopher and sociologist, was born 28th September 1828, at Wald, near Solingen, the son of the celebrated theologian, J. P. Lange. He was educated at Duisburg, Zurich, and Bonn, where he distinguished himself by gymnastics as much as by study. In 1862 he became schoolmaster at Cologne ; in 1866 privat-docent in phil- osophy at Bonn; in 1868 schoolmaster at Duisburg, resigning when the Government forbade schoolmasters to take part in political agitation. Lange then entered on a career of militant journalism in the cause of political and social reform. He was also prominent in the local affairs of his town, yet found leisure to write most of his best-known books. Die LeibesUbungen (1863), Die Arbeiter- frage (1866), Geschichte des Materialismus and J. S. Mill’s Ansichten Uber die sociale Frage (both 1866). In 1866, discouraged by affairs in Germany, he moved to Winter- thur, near Ztlrich, to become connected with the demo- cratic Winterthurer Landbote newspaper. In 1869 he was privat-docent at Ziirich, and next year professor. The strong French sympathies of the Swiss in the Franco-German war led to his speedy resignation. Thence- forward he gave up politics. In 1872 he accepted a professorship at Marburg. Unhappily, his vigorous frame was already stricken with disease, and, after a lingering illness, he died at Marburg, 21st November 1875, diligent to the end. His Logische Studien was published in 1877. His main work, the History of Materialism (translated into English), which is brilliantly written, with wide

scientific knowledge and more sym- pathy with English thought than is usual in Germany, is rather a didactic exposition of principles than a history in the proper sense. Adopting the Kantian standpoint that we can know nothing but phenomena, Lange main- tains that neither materialism nor any other metaphysical system has a valid claim to ultimate truth. For empirical phenomenal knowledge, however, which is all that man can look for, materialism with its exact scientific methods has done most valuable service. Ideal metaphysics, though they fail of the inner truth of things, have a value as the embodiment of high aspirations, in the same way as poetry and religion. In Lange's Logische Studien,

which attempts a reconstruction of formal logic, the leading idea is that reasoning has validity in so far as it can be represented in terms of space. His Arbeiterfrage advocates an ill-defined form of socialism*. It protests strongly against contemporary industrial selfishness, and against the organization of industry on the Darwinian principle of struggle for existence. (h. st.)

Langen, Joseph (1837-1901), German theologian, was born at Cologne, 3rd June 1837. He studied at Bonn, was ordained priest in 1859, was nominated pro- fessor extraordinary at the University of Bonn in 1864, and a professor in ordinary of the exegesis of the New Testament in 1867 — an of&ce which he held till his death. He was one of the able band of professors who in 1870 supported Dollinger in his resistance to the Vatican decrees, and was excommunicated, with Dollinger, Huber, Friedrich, Reusch, E-einkens, Knoodt, Hilgers, and others, for refusing to accept them. In 1878, in consequence of the permission given to priests to marry, he ceased to identify himself longer with the Old Catholic movement, although he did not return to the Eoman Catholic Church. Langen was more celebrated as a writer than as a speaker. He did not address the various Old Catholic conferences which have been held between 1872 and 1897, but he rendered service to the cause by his numerous books and articles. His first work was an inquiry into the author- ship of the Commentary on St Paul's Epistles, and the Treatise on Biblical Questions, ascribed to Ambrose and Augustine respectively. In 1868 he published an Intro- duction to the New Testament, a work of which a second edition was called for in 1873. He also published works on the Last Days of the Life of Jesus, on Judaism in the Time of

Christ, on John of Damascus (1879), and an Exam- ination of the Vatican Dogma in the Light of Patristic Exegesis of the New Testament. But he is chiefly famous for his History of the Church of Rome to the Pontificate of Innocent III, a work of learning and research in four volumes, which appeared between 1881 and 1893. He also contributed largely to the Internationale Tlieologische Zeitschrift, a review started in 1893 by the Old Catholics to promote the union of National Churches on the basis of the councils of the Undivided Church, and admitting articles in German, French, and English. Langen's articles are on various topics. Among other subjects, he wrote on the School of Hierotheus, on Romish falsifications of the Greek Fathers, on Leo XIII. , on Liberal Ultramon- tanism, on the Papal Teaching in regard to Morals, on Vincentius of Lerins, and he carried on a controversy with Professor Beyschlag, of the German Evangelical Church, on the respective merits of Protestantism and Old Catholicism regarded as a basis for teaching the Christian faith. An attack of apoplexy put an end to his activity as a teacher and hastened his death, which occurred in July 1901, at the age of sixty-four. (j. j. l*.)

Langenbeck, Bernhard Rudolf Konrad

von (1810-1887), German surgeon, was born at Horneburg on 9th November 1810, and received his . medical education at Gottingen, where ' he took his doctor's degree in 1836 with a thesis on the structure of the retina. After a visit to France and England, he returned to Gottingen as privat-docent, and in 1842 be- came professor of surgery and director of the Friedrichs Hospital at Kiel. Six years later he succeeded Dieffen- bach as director of the Clinical Institute for Surgery and Ophthalmology at Berlin, and remained there till 1882, when failing health obliged him to retire. He died at AViesbaden on 30th September 1887. Langenbeck was a bold and skilful operator, but at the same time belonged to the conservative school, and was disinclined to resort

to operation -while other means afforded a prospect of success. He devoted particular attention to military surgery, and was a great authority in the

treatment of gunshot wounds. Besides acting as general field-surgeon of the army in the war with Denmark in 1848, he also saw active service in 1864, 1866, and again in the Franeo- G-erman campaign of 1870-71. During the last, he was in Orleans at the end of 1870, after the city had been taken by the Prussians, and was unwearied in his atten- tions, whether as operator or consultant, to the crowds of wounded men with whom every public building was packed. Nor did he forget to utilize the opportunities for instruction that thus arose, and the ” Militar-Aerztliche Gesellschaft,” which met twice a week for some months, and in the discussions of which every surgeon present in the city was invited to take part, irrespective of nationality, was mainly formed by his personal energy and enthusiasm. He was ennobled for his services in the Danish war of

1864.

Langholm, a market town, burgh of barony, and police burgh (1892) of Dumfriesshire, Scotland, on the river Esk, 21-| miles north by west of Carlisle by rail. There are six tweed mills, two distilleries, and tan works. There are a town hall and a hospital for indigent aged people. The public school gives higher education as well as elementary. Population (1891), 3643 ; (1901), 3142.

Langiewicz, Maryan (1827-1887), Polish patriot, was born at Krotoschin, 5th August 1827, and educated at the district school. His philological studies were completed at Breslau, and all his energies seemed to be directed to professorial work. But in a letter written when he was only seventeen years old, he declared it his wish to devote himself to military service and to the study of artillery. This taste was fostered by a year’s service in the Prussian artillery, and, after some years chiefly spent in foreign travel, he joined in 1860 the ex- pedition of Garibaldi in the kingdom of Naples. When the campaign was over, Langiewicz became professor at Cuneo ; but in 1863, on the outbreak of the Polish insur- rection, he was summoned by the committee and appointed military chief of Sandomir. Within six weeks his courage, his military knowledge, and his victories combined to raise him to the rank of general and dictator. During February and the early part of March 1863, by adopting the tactics of guerilla warfare, he defeated the Russians in several sanguinary battles,

which might have been turned to greater advantage but for the impatience of the Poles. On 10th March he issued a proclamation assum- ing the dictatorship. On the 19th he endeavoured to communicate in person with the Polish Committee in Galieia, but was arrested and interned by the Austrians at Tarnow. On 2nd April he was removed to Tischnowitz, and at the end of the month to the fortress of Josefstadt. Being released in February 1865, he proceeded to Switzer- land, and subsequently entered the Turkish service, in which he remained, under the name of Langie Bey, until his death, which took place at Constantinople, 11th May 1887. (g- f. b.)

~~), Ameri~~

Langley, Samuel Pierpont (1834^

can physicist and astronomer, was born at Eoxbury, Bos- ton, Mass., on 22nd August 1834. After acting for a short time as assistant in Harvard College Observatory, he was appointed assistant professor of mathematics in the U.S. Naval Academy in 1866, and in the following year became director of the Allegheny Observatory at Pittsburg, a position which he held until his selection in 1887 as secretary of the Smithsonian Institution at Wash- ington. His name is especially associated with two main branches of investigation — aeronautics, and theexploration

of the infrarred portions of the solar spectrum. The study of the latter he took up as a result of the publication in 1871 of Ladansky's energy-curve of the spectrum. The imperfections of the thermopile, with which he began his work, led him, about 1880, to the invention of the bolo- meter, an instrument of extraordinary delicacy, which iu its most refined form is believed to be capable of detect- ing a change of temperature amounting to less than one- hundred-millionth of a degree centigrade. Depending on the fact that the electrical conductivity of a metallic con- ductor is decreased by heat, it consists of two strips of platinum, arranged so as to form the two arms of a Wheatstone bridge ; one strip being exposed to a source of radiation from which the other is shielded, the heat causes a change in the resistance of one arm, the balance of the bridge is destroyed, and a deflection is marked on the galvanometer. The platinum strips are exceed- ingly minute, being in some cases only t^ inch in width, and less than one- tenth of that amount in thickness. By the aid of this instrument, Langley,

working on Mount Whitney, at an altitude of 12,000 feet above sea-level, had the good fortune in 1881 to discover an entirely un- suspected extension of the invisible infra-red rays, which he called the ” new spectrum.” The importance of his achievement may be judged from the fact that, while the visible spectrum includes rays having wave-lengths of from about 0-4 fi to 0-76 fi, and no invisible heat-rays were known before 1881 having a wave-length greater than 1-8 ju., he has detected rays having a wave-length of 5-3 /x. But, in addition, taking advantage of the accuracy with which the bolometer can determine the position of a source of heat by which it is affected, he has mapped out in this infrarred spectrum over 700 dark lines or bands resembling the Fraunhofer lines of the visible spectrum, with a probable accuracy equal to that of refined astro- nomical observations. In aeronautics he has succeeded in demonstrating the practicability of mechanical flight. He first undertook a preliminary inquiry into the princi- ples upon which flight depends, and for this purpose established at Allegheny a huge ” whirling table,” the revolving arm of which could be driven by a steam- engine at any circumferential speed up to 70 miles an hour. The actual construction of a flying machine was next attempted. The first difficulty was to make it sufficiently light in relation to the power its machinery could develop ; and in the effort to do this several ma- chines were built in which trials were made of steam, compressed air, and carbonic acid gas as motive agents. About 1893 a satisfactory machine was ready, and a new series of troubles had to be faced, for it had to be launched at a certain initial speed, and in the face of any wind that might be blowing. To enable these conditions to be fulfilled, as well as to ensure that the machine, when it fell, should fall on water, the experiments were carried out on the Potomac river, some 30 miles below Washington. It was not till the autumn of 1894 that, after many failures, an efficient launching apparatus was devised, and then the wings were found not to be strong enough to bear the pressures to which they were subjected. Various other delays and mishaps followed, but ultimately, on the 6th May 1896, a successful flight was made. On that day an aerodrome, weighing about 30 lb and about 16 feet in length, with wings measuring between 12 and 13 feet from tip to tip, twice sustained itself in the air for 1-^ minutes (the full time for which it was supplied with fuel and water), and traversed on each occasion a distance of over half a mile, falling gently into the water when the engines stopped. Later in the same year, on 28th November, a similar

aerodrome flew about three-quarters of a mile, attaining a speed of 30 miles an hour. It is understood that these experiments in artificial flight have since been

continued in connexion with the United States War De- partment, but details have not been published.

Langreo, a township of northern Spain, in the province of Oviedo, situated in a very hilly region watered by the river Nalon, that produces large quantities of wheat, hemp, fruit, and cider. In the neighbourhood are coal and iron mines, foundries, and factories for the manufacture of coarse stuffs for local use. Population

(1887), 14,015 ; (1897), 16,709.

Lanier, Sidney (1842-1881), American poet, was born at Macon, Georgia, on 3rd February 1842. He was of Huguenot descent on his father's side, and of Scottish and Virginian on his mother's. From childhood he was passionately fond of music, and could play on any instru- ment. His subsequent mastery of the flute helped to support him and greatly increased his reputation. At the age of fourteen he entered Oglethorpe College, where, after graduating with distinction, he held a tutorship until the Civil War began. He enlisted in the Confederate army in April 1861, serving first in Virginia, and finding opportunities to continue his studies. After the seven days' battles around Richmond, he was transferred to the signal service. About this time the first symptoms of consumption appeared. He subsequently served in a blockade-runner, but his vessel was captured, and he was confined for five months in a Federal prison, his flute proving the best of companions. Exchanged early in 1865, he started home on foot, arriving in a state of ex- haustion that led to a severe illness. On recovering, he became a clerk in Montgomery, Alabama. In the spring of 1867 he visited New York in connexion with his novel Tiger Lilies — an immature work, dealing in part with his war experiences, and now difficult to obtain. Later in the same year he took charge of a country school in Alabama, and

was married to Miss Mary Day of his native town. The next year he returned to Macon in low health, and began to study and practise law with his father, poetry and music cheering him in his struggles with disease. Late in 1872 he went to Texas for his health, but was forced to return. Then he determined to use his remaining strength in the service of the arts he loved, and went north, securing an engagement as first flute in the Peabody concerts at Baltimore (December 1873). His means were still narrow, and he was much away from his family, travelling for his health, but he found time to write a guide-book to Florida (1876), and tales for boys from Froissart, Malory, the Mabinogion, and Percy's Reliques (1878-82). He now made congenial friends, such as Bayard Taylor, his reputation gradually increased, and he was enabled to study music and literature, especially Anglo-Saxon poetry. In 1876 he wrote his ambitious cantata for the Centennial Exposition, and brought his family north. A small volume of verse appeared in the next year. Travel south was still necessary, but he preserved his courage, and wrote and lectured and played the flute. In 1879 he was made lecturer on English literature at Johns Hopkins University. His lectures became the basis of his Science of EiKjlish Verse (1880) — his most important prose work, and an admirable discus- sion of the relations of music and poetry — and also of his Ewjlish Novel (1883), which, devoted largely to George Eliot, is suggestive, but one-sided. Work had to be abandoned on account of growing feebleness, and in the spring of 1881 he was carried to Lynn, North Carolina, to try camp life, and died there on 7th Sep- tember. Since his death his fame has grown steadily and greatly, an enlarged and final edition of his poems, prepared by his wife, his Letters, 1866-81 (1899), and se-veral volumes of miscellaneous prose having assisted

in keeping his name before the public. Among his more noteworthy poems are " Corn," " The Eevenge of Ham- ish," " Song of the Chattahoochee," and " The Marshes of Glynn." By some his genius is regarded as musical rather than poetic, and his style is considered hectic; by others he is held to be one of the most original and most talented of modern American poets. He is con- sidered the leading writer of the New South, the greatest Southern poet since Poe, and a man of heroic and exquisite character. (w. p. t.)

Lansing, a city of Michigan, U.S.A., capital of Ingham county and the capital of the state, on the Grand river at the mouth of the Cedar, at an altitude of 847 feet. It is on four railways, the Pere Marquette, the Grand Trunk, the Lake Shore and Michigan Southern, and the Michigan Central. Besides the state capitol and other state buildings and institutions, the city contains the State Agricultural College, which had in 1899 a faculty of 43 and was attended by 528 students. It had property and endowments of over a million dollars. The manufactures consist in great part of agricultural tools and machines, waggons, carriages, and flour. Population (1890), 13,102; (1900), 16,485, of whom 2397 were foreign-born and 323 were negroes.

Lansingburg, a village of Eensselaer county. New York, U.S.A., on the east bank of the Hudson river, opposite the mouth of the Mohawk, on the Fitchburg railroad, at an altitude of 113 feet. Its site is level and its plan regular. It has considerable river traffic, and manufactures of clothing, collars, shirts, &c. Population (1890), 10,550 ; (1900), 12,595, of whom 2139 were foreign- born and 90 were negroes.

Lanza, Giovanni (1810-1882), Italian patriot and statesman, was born at Casale in February 1810. While medical student at Turin he founded the journal L'Opinione, to urge Charles Albert to grant reforms and make war upon Austria. In 1848 he offered himself as volunteer, but, upon being elected deputy, returned to Turin, where he became a determined oppo- nent of the Government, accusing the Piedmontese gen- erals of treason and protesting against the conclusion of peace with Austria. In 1854, however, he defended Cavour's Crimean policy, in 1855 was appointed Minister for Education, and in 1858, Finance Minister. After the peace of Villafranca he resigned office, but in 1860 accepted the presidency of the Chamber. Entering the La Marmora Cabinet of 1864, he found himself in disagree- ment with his colleagues on the ecclesiastical question, and resigned. Again elected President of the Chamber, he left that position in 1869 to combat the tobacco monopoly scheme proposed by the Menabrea Cabinet, and, though the scheme was adopted, Lanza's subsequent re-election to the presidency caused a cabinet crisis which was only solved by the formation of a ministry in which Lanza assumed the premiership. The Lanza Cabinet held office from 1869 to 1873, and succeeded in preventing a Franco- Italian alliance against Prussia, in accomplishing the unity of Italy by the

occupation of Pome, in re-establishing sound finance, in passing the Law of Guarantees, and in extending to the city and province of Pome the Ecclesi- astical Law of 1868. A man of unimpeachable integrity and sound judgment, and a prudent rather than a brill- iant statesman, Lanza embodied many of the best quali- ties of the Piedmontese character. He died at Rome on 19th March 1882. (h. w. s.)

Lao, or LoAs, the name given to a branch of the wide- spread Tai or Sh§,n race, which is found over the whole of

Indo-China from 28° N. and the sources of the Irrawaddy, as far as Cambodia, and 7° N. in the Malay peninsula.

The various families of the Tai now met with, owing to the dif- ferent circumstances which have attended their migrations, differ considerably in the degree of civilization to which they have attained. The Lao, who descended from the mountain districts of Yunnan, Sechuan, and Kweichau to the pleasant highland plains of Upper Indo-China, and drove the wilder Ka peoples whom they found in possession into the hills, mostly adopted Buddhism, and formed small settled communities or states in which laws were easy, taxes light, and a very fair degree of comfort was attained. The Lao Pong Dam, so called from their habit of tattooing the body from the waist to the knee, descended by Chieng Sen and Chieng Mai, and now form the western branch of the Lao family, inhabiting the Siamese Lao states of Chieng Mai Lakawn, ‘Turn Pre, and Nan, and reaching as far south as 17° N. Various influences have contributed to making the Lao the pleasant, easy- going, idle fellow that he is. The result is that practically all the trade of these states is in the hands of Bangkok Chinese firms, of a certain number of European houses and others, while most of the manual labour connected with the teak industry is done by Ka Mus, who migrate in large numbers from the left bank of the Mekong.

The Lao Pong Kao, or eastern branch, appear to have migrated southwards by the more easterly route of the Nam-u and the Mekong valley. In

contradistinction to the Lao Pong Dam, who have derived tlieir written language from the Burmese character, the eastern race has retained what appears to be the early form of the present Siamese writing, from which it differs but little. They formed important settlements at various points on the Mekong, notably Luang Prabang, “Wieng Chan, Ubon, and Bassac ; and, head- ing inland as far as Korat on the one side and the Annamite water-shed in the east, they drove out the less civilized Ka peoples, and even the Cambodians, as the Lao Pong Dam did on the west. Wieng Chan during the 18th century was the most powerful of the Lao principalities, and was feared and respected throughout Indo-China. It was destroyed by the Siamese in 1828. The in- habitants, in accordance with the Indo-Chinese custom of the day, were transported to Lower Siam. The Lao Pong Kao below 18° N. are a less merry and less vivacious people, and are for the most part shorter and more thick-set than those of Luang Prabang and the north. If possible, they are as a race lazier than the western Lao, as they are certainly more musical. The “khen,” or mouth organ, which is universal among them, is the sweetest-toned of Eastern instruments.

Closely allied with the Lao are a number of tribes who are found throughout the hill regions of the Upper Mekong, between Yunnan and Kwangsi in China and the upper waters of the Menam in Siam. They have all within recent times been par- takers in the general movement which has been going on towards the south-west from the highland districts of southern China, which has produced so many recruits for the peopling of the Indo-Chinese peninsula. Of this group of people, among whom may be named the Yao, Yao Yin, Lanten, Meo, Musur (or Muhso), and Kaw, perhaps the best known and most like the Lao are the Lu — both names meaning originally “man ” — who have in many cases adopted a form of Buddhism (flavoured strongly by their natural respect for local spirits as well as tattooing) and other relatively civilized customs, and have forsaken their wandering life among the hills for a more settled village existence. Hardy, simple, and industrious, fond of music, kind-hearted, and with a strangely artistic taste in dress, these people possess in a wonderful degree the secret of cheerful contentment.

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Laoag, the capital of the province of North Ilocos, Luzon, Philippine Islands, on the banks of the Laoag river, some three miles from the Pacific coast. It is noted for its fine climate, the name " Laoag " signifying "clear." It is an important centre for the shipment of agricultural products, among which may be mentioned rice, Indian corn, tobacco, and sugar. Cotton is grown in the vicinity, and is woven by the women into fabrics, which find a ready sale among the pagan tribes of the mountains. The language is Ilocano. Population, 37,000.

Laon, chief town of the department of Aisne, 87 miles north-east of Paris, on the railway from Paris to Belgium. It is a first-class military post, and, according to M. T^not, " the strategic key of the whole region comprised between the Aisne and the northern frontier." Since the war of 1870-71 the citadel has been reorganized and two batteries have been erected, one at each of the other angles of the rock on which Laon stands. At distances varying from Z\ to 5 miles from the town are other defences. The Porte des Chenizelles, one of the 13th- century gateways of the town, was restored in 1895. Population (1881), 9662 ; (1891), 9555 ; (1901), 15,434.

La Par, a department of Bolivia, bounded on the N. by the Bolivian territories of Madre de Dios and Beni, on the S. by the departments of Oraro and Cochabamba, on the E. by Cochabamba and Beni, and on the W. by Peru. Its area is 171,130 square miles, and in 1893 it had a population of 593,779. The capital. La Paz, which is also the capital of the republic and the largest city in it, had a population of 62,320. The department is divided into nine provinces. It has 83 schools, attended by about 5000 pupils.

Lapland, although no longer a geographical term, is conveniently retained as an ethnographical conception to indicate the region inhabited by the Lapps ; that is, in Norway, the county of Finmarken,^ and the higher inland parts of counties Tromso and Nordland ; in Sweden, the inland and northern

parts of the division of Norrland, sometimes known as Lappmark, and divided into five districts — Torne Lappmark, Lule Lappmark, Pite Lapp- mark, Lycksele Lappmark, and Asele Lappmark; and in Eussia, the northern part of the Finnish county of Uleaborg, and the western part of the Eussian govern- ment of Archangel as far as the White Sea. In Norway the total number of Lapps was 20,786 in 1891, and in Sweden in 1895 it was oflS.cially estimated that there were 4736. Add to these some 3000 for Eussian Lap- land, and the total Lapp population of northern Europe approximates to 30,000. In Sweden the Lapps are grad- ually abandoning their nomadic habits and becoming merged in the Swedish population. The view that the Lapps at one time occupied the whole of the Scandinavian peninsula, and have during the course of centuries been driven back by the Aryan Swedes and Norwegians, is dis- proved by the recent investigations of Yngvar Nielsen, K. B. Wiklund, and others. The fact is, the Lapps are increasing in numbers, as well as pushing their way farther and farther south. In the beginning of the 16th century their southern border line in Norway ran on the upper side of 64° N. In 1890 they forced their way to the head of the Hardanger Fjord in 60° N. In Sweden the presence of Lapps as far south as Jamtland (or Jemt- land) is first mentioned in 1564. In 1881 they pushed on into the north of Dalecarlia, about 61° 45′ N. The majority of the Norwegian Lapps lead a semi-nomadic existence ; but the number of inveterate nomads can scarcely reach 1500 at the present day. In Sweden there were about 3300 nomads in 1895.

Although the first attempt to convert the Lapps to Christianity seems to have been made in the 11th century, the worship of heathen idols was carried on openly in Swedish Lappmark as late as 1687, and secretly in Norway down to the first quarter of the 18th century, while the practices of heathen superstition survived on into the 19th century, if indeed they are extinct even yet. Lapp graves, prepared in the jaeathen manner, have been discovered in Upper Namdalen (Norway), belonging to the years 1820 and 1826. It may be interesting to mention that Lapps, armed with bows and arrows, were attached to certain regiments of Gustavus Adolphus

1 The Norwegians call the Lapps Finns, and the Finns they call Kvaens or Qvaens, though the word “Lapper” (for Lapps) is coming into use.

in Germany during tlie Tliirty Years' War. It was not until 1840 that tlie New Testament was translated into Norwegian Lappish, and not until the year 1895 that the entire Bible was printed in the same dialect. In the Russian dialect of Lappish there exist only a couple of versions of St Matthew's Gospel. Amongst the more recent works dealing with the Lapp language may be mentioned a dictionary (1887) by J. A. Triis ; a reader, with German translations (1888), by J. Qvigstad; a dictionary (1890) and two grammars (1891 and 1897) of the Lulea dialect, and a chrestomathy of Nor- wegian Lappish (1894), by K. B. Wiljlund ; a dictionary of Russian Lappish, or the Kola dialect (1891) , by A. Genetz ; readers of differ- ent dialects (1885-96), by J. Halasz ; and a grammar of Norwegian Lappish (1882), by S. Nielsen ; further, a comparative study of Lap- pish and Finnish, by Qvigstad in the Acts of the Finnish Academy of Science, vol. xii., 1883 ; the same author's Nordische Lehnworter im Lappischen (1893) ; and Wiklund's i'ntoMr/einp)- urlappischen Lautlehre (1896). The older literature on the Lapps has received a notable addition by the discovery in 1896, amongst the letters of Linnaeus preserved in the British Museum, of a MS. diary of a journey made in 1695 to the north of Swedish Lappmark by Olof Rudbeck the younger.

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La Plata, a city of the Argentine Eepublie, capital of the province of Buenos Aires, 3 miles from the port of La Plata and about 35 miles south-east of the city of Buenos Aires by rail. In 1895 it had a population of 45,609, which

was estimated to have increased in 1900 to 61,000. This large and handsome city was entirely the growth of the last twenty years of the 19th century, having been founded in 1882, two years after Buenos Aires, previously the capital of the province, had been formally declared the federal capital and a separate administrative unit. Laid out on the plan of Washing- ton, the streets are wide and frequently broken by large squares. The principal public buildings are the govern- ment house, the provincial parliament, the town hall, the cathedral (in course of construction), the courts of justice, and the provincial museum. The museum, originally presented by Dr Moreno, has grown to be one of the most important in South America, its palaeontological and an- thropological collections being unique. There are also a university, a national college, a public library, an astro- nomical observatory, and numerous churches and theatres. Electricity is in general use for lighting, and tramways are laid do”\vn in the principal thoroughfares. A large public park is maintained. La Plata is a municipality, but the police are under the provincial government. The harbour of the port of La Plata, which has taken the place of the old port of Ensenada, has been artificially con- structed, and is capable of accommodating the largest ship that can navigate the river Plate. Various canals, &c., give entrance to a large dock about 1450 yards long by 150 broad. TJie export of cattle and agricultural produce furnishes most of the trade. The port is the point of arrival of the Royal Mail and Messageries Maritimes steamers.

Laporte, a city of Indiana, U.S.A., capital of Laporte county, at an altitude of 810 feet. It has modern im- provements, and some reputation as a summer resort. Three railways — the Chicago and West Michigan, the Lake Erie and Western, and the Lake Shore and Micliigan Southern — pass through it. Population (1890), 7126 ; (1900), 7113, of whom 1403 were foreign-born and 59 were negroes.

Lappa, the name given to a station of the Chinese imperial Maritime Customs which collects duties on ves- sels trading between China and the colony of Macao. The

arrangement is altogether abnormal, and was consented to by the Portuguese Government in 1887 to assist the Chi- nese authorities in the suppression of opium smuggling. A similar arrangement prevails at the

British colony of Hong-Kong, where the Chinese customs station is termed Kowloon. In both cases the customs stations are on Chinese territory, just outside the colonial boundary, but in both their function is to levy duties on vessels enter- ing and leaving the foreign port in lieu of levying them, as ought to be done, on entering or leaving a Chinese port. The value of the trade passing through the custom house in 1899 was H. taels 13,748,000 (£2,062,000).

Lappmark, the districts inhabited by the Lapps in Sweden. See Lapland.

Laprade, Pierre Marin Victor Richard de

(1812-1883), known as Victor, French poet and critic, was born 15th January 1812, at Montbrison, in the de- partment of the Loire. He came of a modest provincial family, and owed to the care of excellent parents a deep foundation of character and encouragement to enter upon a scholar's career. His life was singularly uneventful. After completing his studies at Lyons, he produced in 1839 a small volume of religious verse, Les Parfums de Madeleine. This was followed in 1840 by La Colore de Jisus, in 1841 by the religious fantasy of Psyche, and in 1844 by Odes et Po&mes. In 1846 Laprade visited Italy on a mission of literary research, and in 1847 he was appointed professor of French literature at Lyons. ^The French Academy, by a single vote, pre- ferred Emile Angler at the election in 1857, but in the following year Laprade was chosen to fill the chair of Alfred de Musset. In 1861 he was removed from his post at Lyons owing to the publication of a political satire in verse (Les Muses d'Etat), and in 1871 took his seat in the National Assembly on the benches of the Right. He died 13th December 1883. A statue has been raised by his fellow-townsmen at Montbrison. Besides those named above, Laprade's poetical works include Po^mes Evan- giliques (1852), Idylles H&roiques (1858), Les Voix de Silence (1864), Pernette (1868), Po&mes Civiles (1873), Le Livre d'lin Pire (1877), Varia and Livre des Adieux (1878- 1879). In prose he published, in 1840, Des Habitudes Intellectuelles de I'Avocat. Questions d'Art et de Morale appeared in 1861, succeeded by Le sentiment de la nature, avant le Christianisme in 1866, and chez les modernes in 1868, Education LiMrale in 1873. The material for these books had in some cases been printed earlier, after delivery as a lecture. He also contributed articles to the Revue

des Deux Mondes and the Revue de Paris. There is no writer who represents more perfectly than Laprade the admirable genius of French provincial life, its homely simplicity, its culture, its piety, and its sober patriotism. As a poet he belongs to the school of Chateaubriand and Lamartine. Devoted to the best classical models, inspired by a sense of the ideal and by worship of nature as revealing the divine — ~~gifted, too, with a full faculty of expression — he lacked only fire and passion in the equip~~ ment of a romantic poet. But the want of these, and the pressure of a certain chilly facility and of a too conscious philosophizing, have prevented him from reaching the first rank, or from even attaining the popularity due to his high place in the second. Only in his patriotic verse did he shake himself clear from these trammels. Speaking generally, he possessed some of the qualities, and inany of the defects, of the English Lake School. Laprade's prose criticisms must be ranked high. Apart from his classical and metaphysical studies, he was widely read in the literatures of Europe, and built upon the groundwork of a naturally correct taste. His dislike of irony and scepti-

cism probably led him to underrate the product of the 18th century, and there are signs of a too fastidious dread of Philistinism. But a constant love of the best, a joy in nature, and a lofty patriotism are not less evident than in his poetry. Few writers of any nation have fixed their minds so steadily on whatsoever things are pure, and lovely, and of good report. (c.)

Laraiche (El Ardish), a port at the mouth of the Kus in northern Morocco, the nearest to Fez and Me- quinez, adjoining the ruins of Shammish or Lixus. A small mercantile European colony, missions, and con- sular ofiicers are situated here. Exports : 1896, £31,201 ; 1900, £47,033 ; average for 1896-1900, £49,760. Wool and bird-seeds are the largest items of export. Imports, chiefly cottons and sugar : 1896, £249,902 ; 1900, £114,-693 ; average for 1896-1900, £187,630. Shipping : 1896, 63,646 tons ; 1899, 78,765 tons. In 1895, with good crops, Laraiche imported £344,204 worth of foreign goods, the bulk of which were for Fez and Mequinez. Population, about 6500.

Laramie, a city of Wyoming, U.S.A., capital of Albany county, on the Laramie plains, on the east bank of the Laramie river, and on the Union Pacific railroad, at an altitude of 7153 feet. Its site is level, and the city is regular in plan. It is in a live-stock region, and has considerable trade in cattle. It contains the machine works of the Union Pacific railroad. The University of Wyoming, founded in 1887, is situated here. In 1899 it had a faculty of 14 and was attended by 142 students, nearly half of whom were women. The city was founded in 1868 and chartered in 1873. Population (1880), 2696 ; (1890), 6388; (1900), 8207, of whom 1280 were foreign-born and 90 were negroes.

Laredo, a coast town of Spain, in the province of Santander, 20 miles east by south of Santander. The mole and port are blocked by a sandbank, but the town began to recover during the last years of the 19th century from the decay into which it had fallen, and important works have been instituted with the object of restoring it to some of its past importance. There are old forts on the neighbouring heights. The town contains a fine parish church, several convents and chapels, and a large town hall. The principal local industries are connected with the fisheries and manufactures of rope, sails, casks, and tins for fish, great quantities of which are salted and ex- ported. Population (1897), 6073.

Laredo, a city of Texas, U.S.A., capital of Webb county, on the east bank of the Eio Grande, opposite Nuevo Laredo, Mexico, with which it is connected by two bridges, at an altitude of 421 feet. It is on three railways — the International and Great Northern, the Mexico National, and the Eio Grande and Eagle Pass. It is essentially a railway town, with a large export and im- port trade with Mexico. Population (1880), 3521 ; (1890), 11,319; (1900), 13,429, of whom 6882 were foreign-born and 87 were negroes.

Largs, a police burgh on the coast of Ayrshire, Scotland, 43 miles west of Glasgow by rail. A good beach and a dry and bracing climate have attracted an exceptional number of wealthy residents. Skelmorlie Aisle, the remnant of an ancient parish church, was con- verted into a mausoleum in 1636. Near it a mound covers remains, possibly those of Norwegians slain in the famous battle of Largs (1263) between Alexander III. and Haco III. of Norway. The academy has been fitted up as a workmen’s club and library ;

there are two convalescent homes. The harbour, affording 12 to 14 feet of water, is used mainly by Clyde passenger steamers and yachtsmen.

A new parish church cost over £20,000, and a United Free church £30,000. Population (1881), 3079 ; (1901),

3243.

Larissa, a town in the province of Larissa, Thessaly, Greece, on the Peneios, about 35 miles north-west of Volo, with which it is connected by rail. Population (1889),

13,610 ; (1896), 15,373.

Larkhall, a mining and manufacturing town of Lan- arkshire, Scotland, 14 miles south-east of Glasgow by rail. The highest bridge in Scotland has been thrown across the river Avon, which flows close by. Brick-making is carried on at several of the adjoining collieries. Other works are bleach works, a silk-weaving factory, fire-clay and enamelling works, and a sanitary appliances factory. The town has a public hall and baths. Population (1881),

6503 ; (1901), 12,034.

Larkhana, a town of British India, in the Shikar- pur district of Sind, Bombay ; on a canal not far from the right bank of the Indus ; a station on the North- western railway, 281 miles north of Karachi. A centre of trade, with manufactures of cotton, silk, leather, metal- ware, and paper. Population (1881), 13,188; (1891),

12,010.

Larnaca (Laenica or Laeneca; in Turkish Tuzla), a town of the island of Cyprus, situated at the head of a bay on the south coast, 23 miles south-south-east from Nicosia. It is the principal port of the island, exporting barley, wheat, cotton, raisins, oranges, lemons, and gyp- sum. There is an iron pier, 450 feet long, but vessels anchor in the bay, in from 16 to 70 feet of water. It oc- cupies the site of the ancient Gitium, but the citadel of the

ancient city was used to fill up the ancient harbour in 1879. Myceneean tombs and other antiquities have been found in the vicinity. Population (1901), 7964.

Lasalle, a city of Lasalle county, Illinois, U.S.A., on the north bank of the Illinois river, at an altitude of 461 feet. It is built on the face of steep banks, yet with a regular plan. It has three railways — ^the Chicago, Bur- lington, and Quincy, the Chicago, Eock Island, and Pacific, and the Illinois Central. It is in a region of mines of bituminous coal, of which it ships large quantities. It has also zinc smelting works and other manufactures. Population (1890), 9865; (1900), 10,446, of whom 3471 were foreign-born.

Lasker, Eduard (1829-1884), German publicist, was bom on 14th October 1829, at Jaroczin, a village in the province of Posen, being the son of a Jewish tradesman. He attended the gymnasium, and afterwards the University of Breslau. In 1848, after the outbreak of the Eevo- lution, he went to Vienna and entered the Students' Legion which took so prominent a part in the disturbances ; he fought against the Imperial troops during the siege of the city in October, but was fortunate enough to be able to return to his home. He then continued his legal studies at Breslau and Berlin, and after a visit of three years to England, then the model state for German Liberals, entered the Prussian judicial service. He was occupied in various posts, chiefly in the Ber- lin city courts, but he never advanced far in his official career. In 1870 he left the Government service, and in 1873 was appointed to an administrative post in the service of the corporation of Berlin. He had been brought to the notice of the political world by some articles he wrote in 1861 to 1864, which were after- wards published under the title Zur Verfassiingsge- schichte Preussens, and in 1865 he was elected member for one of the divisions of Berlin in the Prussian Parlia- ment. He joined the Eadical or Fortschritt party, and in 1867 was also elected to the German Parliament, but he

joined in forming the National Liberal party, and in consequence lost his seat in Berlin, which remained faithful to the Radicals ; after this he

represented Magde- burg and Frankf ort-on-Main in the Prussian, and Meinin- gen in the German, Parliament. He threw himself with great energy into his parliamentary duties, and quickly became one of the most popular and most influential members. An optimist and idealist, he joined to a fer- vent belief in liberty an equal enthusiasm for German unity and the idea of the German state. His motion that Baden should be included in the North German Confederation in January 1870 caused much embarrass- ment to Bismarck, but was not without effect in hasten- ing the crisis of 1870. His great work, however, was the share he took in the judicial reform which was the great achievement of the parliament during the ten years 1867- 77. To him more than to any other single individual is due the great codification of the law. He threw him- self into this work with remarkable industry, and while he again and again was able to compel the Government to withdraw or amend proposals which seemed dangerous to liberty, he opposed those Liberals who, unable to ob- tain all the concessions they called for, refused to vote for the new laws as a whole. A speech made by Lasker on 7th February 1873, in which he attacked the manage- ment of the Pomeranian railway, caused a great sensa- tion, and his exposure of the financial mismanagement brought about the fall of Wagener, one of Bismarck's most trusted assistants. By this action he caused, how- ever, some embarrassment to his party. This is generally regarded as the beginning of the reaction against economic Liberalism by which he and his party were to be de- prived of their influence. He refused to follow Bismarck in his financial and economic policy after 1878 ; always unsympathetic to the Chancellor, he was now selected for his most bitter attacks. Between the Radicals and Socialists on the one side and the Government on the other, like many of his friends, he was unable to main- tain himself. In 1880 he lost his seat in the Prussian Parliament ; he joined the Secession, but was ill at ease in his new position. Broken in health and spirits by the incessant labours of the time when he did " half the work of the Reichstag," he went in 1883 for a tour in America, and died in that country on the 5th of January 1884. He was unmarried.

Lasker's death was the occasion of a curious episode, which caused much discussion at the time. The American House of Rep- resentatives adopted a motion of regret, and added to it these words : — " That his loss is not alone to be mourned by the people of his native land, where his firm and

constant exposition of, and devotion to, free and liberal ideas have materially advanced the social, political, and economic conditions of these people, but by the lovers of liberty throughout the world. ‘ ‘ This motion was sent through the American envoy at Berlin to the German Foreign Office, with a request that it might be communicated to the Presi- dent of the Reichstag. It was to ask Bismarck oflficially to com- municate a resolution in which a foreign parliament expressed an opinion in German affairs exactly opposed to that which the Em- peror at his advice had always followed. Bismarck therefore re- fused to communicate the resolution, and returned it to the German envoy at Washington. He was much attacked for this ; but the difficulty would have been avoided had the resolution been so framed as not to express an opinion on the merits of Lasker’s opinions, which at that time were a matter of keen controversy, or had it been communicated directly to the President of the Reich- stag, and not by the means of diplomatic agents, who are the agents of communication not between parliament and parliament, but between government and government. (j. w. He.)

Las Palmas, a town on the east coast of the island of Grand Canary, residence of the bishop of Canarias and of the military governor. It is a well-built town, with a modern theatre, athenaeum club, several hospitals, good schools, and an institute. Las Palmas is a free port and harbour of refuge. Its trade is important.

especially as a port of call and a coaling station, and the greater part is in British hands, though the Germans have been trying hard to get a footing since 1896. The coal trade is entirely in British hands ; 213,000 tons were imported in 1898. The total value of imports in 1898 was £438,411, of which £223,127 came from England. The exports were chiefly bananas (£174,900 in 1900), tomatoes, potatoes, and oranges, the greater part for Liverpool and London. The port had a total shipping movement in 1898 of 1816 steamers, of which 1073 were British, 301 Spanish, 174 German, 122 Italian, 78 French, and 1015 sailing vessels, of which three were British and 993 Spanish. The harbour works of the port of La Luz have been much improved since 1883, the Santa Catalina mole has been pushed into deep water, and road communication has been extended to the north and centre of the island and to Las Palmas itself. There are engineering works and

shipbuilding yards, and a slip-^ay which will take vessels up to 800 tons. The harbour has an area of nearly 160 acres, with a depth varying from 36 to 60 feet. Popu- lation (1887), 21,018 ; (1897), 34,770.

Latacunga (Llatacunga, or, according to local usage, Tacunga), chief town of the province of Leon, Ecuador, Central America, on a high plateau of the Andes, over 9000 feet above sea-level, near the confluence of the Alagues and the Cutuchi to form the Patate, an affluent of the Pastaza, 62 miles south of Quito, and about 25 south-east of the volcano of Cotopaxi. Pounded in 1534, it was four times destroyed by earthquakes between 1698 and 1798. It is substantially built, chiefly of pumice stone. A large proportion of the inhabitants are Indians, and the trade is mainly local. Nitrate of potash is obtained from the volcanic deposits in the neighbourhood. In the vicinity are the ruins of a palace of the Incas. Population, 10,000.

Latakia, or Ladikiyeh, the chief town of a sanjak of the Beirut vilayet, situated on the Syrian coast, op- posite the island of Cyprus. The population comprises 12,000 Moslems, 10,000 Christians (Syrians, Armenians, Maronites, Roman Catholics, and Protestants). The people are chiefly employed in tobacco cultivation, silk culture, and the sponge fishery. In 1900 the exports amounted to £79,512, and the imports to £64,000.

Lauban, a town of Prussia, province of Silesia, 16 miles by rail east of Gorlitz. It has potteries, tanneries, bleaching, oil mills, linen and cotton weaving and print- ing, and manufacture of machinery. There are monuments to the Emperor William I. (1895) and the war of 1870-71. Population (1885), 11,236; (1900), 13,792.

Lauenburg, a town of Prussia, province of Pome- rania, 60 miles by rail north-west of Danzig. It has a deaf and dumb asylum, and a provincial lunatic asylum ; and flax and woollen spinning, iron-works, and brick-works. Population (1885), 7214 ; (1900), 10,436.

Laun (Czech, Louny), the chief town of a govern- ment district in north-west Bohemia, Austria, on the right bank of the Eger. The boundary between the Czech and German districts lies between it and the neighbouring town of Postelberg to the west. It has machine and metal

industries, sugar-refining, brewing, and corn-milling. Population (1890), 6346; (1900), 10,212.

Launceston (or Dunhbved), a municipal borough and market town in the North-eastern or Launceston par- liamentary division (since 1885) of Cornwall, England, on the Kensey, 13 miles by road and 19 miles by rail north- west by west of Tavistock. Recent structures are the town hall (1887), a temperance institute (1889), a Baptist chapel (1892), a Bible Christian chapel, water-works (1895\ sewage disposal works (1898), and a public library (1899). There are tanneries and iron-foundries. Area,

2188 acres. Population (1881), 3808 ; (1891), 4346 ;

(1901), 4053.

Launceston, the second city of Tasmania, on the river Tamar, in the county of Cornwall, about 40 miles from the north coast of the island by water. The river is navigable to the town for vessels of 4000 tons at full tide. There is a railway. The city is well laid out and has a good water-supply. The electric lighting has cost £90,000. The Albert Hall seats over 2000 people. The quantity of fruit grown in the district increases yearly. The scenery is very picturesque. The mean annual rain- fall (3 years) is 31-97 inches. Population of city proper

(1891), 17,208 ; (1901), 21,180.

La Union, a town of Spain, province of Murcia, 5 miles east of Cartagena and close to the Mediterranean. Population vnthin municipal boundaries (1887), 20,966 ; (1897), 21,694, of whom a little more than half inhabit the place itself. The rest are scattered among thirty works or foundries, and mine iron, manganese, calamine, sul- phur, and lead. It is quite a modern town, having sprung up in the second half of the 19th century. It has good modern municipal buildings, schools, hospital, town hall, large factories, regular streets, and a very animated aspect.

Laurier, Sir Wilfrid (1841), British Colo- nial statesman, the first French-Canadian Premier of the Dominion, was born at St Lin, Quebec, 20th November 1841. He was educated at L'Assomption College, gradu- ated in law at M'Gill University in 1864, and was ad- mitted to the bar in the same year. His ability at once became manifest, and he rose rapidly in his profession. In 1871 he began his political career, when he was elected as a Liberal to the Quebec Provincial Assembly. His eloquence and grasp of public questions speedily gave him a conspicuous position. In 1874 he was elected to the Dominion Parliament, where by his high personal char- acter and great oratorical gifts he soon became one of the leaders of the Liberal party. At one time he edited Le Difrickeur. In 1877 Laurier was appointed Minister of Inland Revenue in the Mackenzie government, a position which he held until the resignation of the ministry in 1878. He was a consistent advocate of the policy of Free Trade, so far as the revenue requirements of the colony would allow. Although a Eoman Catholic, his uncompromising resistance to the dictation of the Roman Catholic hie- rarchy on the Manitoba schools question demonstrated that he was independent of clerical influence in political affairs. On the retirement of Mr Blake from the leader- ship of the Liberal party in 1891, Laurier was chosen as his successor. When the Conservative Premier brought forward proposals for a reciprocity treaty with the United States, with certain restrictions, Laurier and the Liberals advocated unrestricted reciprocity. At the general elec- tion of 1896 Laurier's platform included fiscal reform in the direction of Free Trade, the extension of the fran- chise, the enlargement of the trade of Canada, and a policy of non-interference with provincial politics, espe- cially with regard to Manitoba. The Liberals secured a striking victory — the numbers being, 118 Liberals, 86 Conservatives, and 8 Independents, who were general supporters of the Liberal party. Laurier became Prime Minister, and the session of 1897 was distinguished for its epoch-making financial measures, a preferential rate in the tariff being given to imports from the mother-country (see Canada). The celebrations of 1897 in honour of Queen Victoria's Diamond Jubilee excited extraordinary enthusiasm throughout Canada. The colonial premiers visited London in order to attend the festivities, and on that occasion Laurier was appointed a privy councillor and created G-.C.M.Gr. His personality at once made an

impression in England. His facial resemblance to both Lord Beaconsfield and Sir John A. Macdonald, his vig- orous patriotic speeches, in which, while acclaiming the Imperial tie with the mother country, he vindicated for Canada its title to be called a ” nation,” and his striking position as a colonial Liberal leader who was yet an Impe- rialist, made him everywhere a remarkable figure. When war broke out in South Africa in October 1899, the Lau- rier Cabinet at once decided to send a force of 1000 men to assist the Imperial Government. In March 1900 the Dominion Assembly, after an eloquent speech from Sir Wilfrid, approved the action of the Government. In November 1900 the general election took place through- out the Dominion, when a largely increased majority was returned for Laurier’s Government. In the session of 1901 Sir Wilfrid Laurier introduced and carried a Bill decreeing that Queen Victoria’s birthday should be made a perpetual holiday throughout the Dominion.

Laurium, a village in Houghton county, Michigan, U.S.A., formerly Calumet. It is on the Upper Penin- sula, in the copper region of Keweenaw Point. Popula- tion (1890), 1169; (1900), 6643, of whom 2286 were foreign-born.

Laurvil(, or Larvik, a seaport town of Norway, at the head of a bay on the south coast, 98 miles by rail south-south-west of Christiania. It has various industries, including saw and planing mills, shipbuilding, glass-works, and factories for wood-pulp, barrels, and potato flour ; and an active trade in exporting timber, ice, wood-pulp, and granite, chiefly to Great Britain, and in importing from the same country coal and salt. The total trade amounts to about £330,000 annually. The port, which can receive the largest vessels, and has a depth of 18 to 24 feet beside the quays, is entered and cleared by close upon 100,000 tons annually. A much-frequented hydropathic was opened in 1880. Population (1891), 11,261 ; (1900), 10,664.

Lausanne, the capital of the canton of Vaud, in Switzerland, 38 miles by rail north-east of Geneva. It is 328 feet above the lake, or 1558^ feet above the level of the sea. The Grand Pont, 79 feet high and 590^ feet long, was widened in 1891. The academy was founded in 1537, immediately after the Bernese conquest of 1636, and in 1891 was raised to the rank of a university. In the winter of 1898-99 it was attended by 264 matriculated

students. Gibbon’s house. La Grotte, was only destroyed a few years ago. Population (1888), 33,340; (1900), 47,444. In 1888 the French-speaking inhabitants numbered 26,750 ; the German-speaking, 6704 ; the Italian-speaking, 862 ; other languages, 1034. In the same year the Protes- tants numbered 28,431 ; Roman Catholics, 4575 ; Jews, 184.

See vols. vi. and vii. (1846-47 and 1851) of the Memoires de la Societe d’Histoire de la Suisse Bomande. — -Meredith Read. Historic Studies in Vaud, Berne, and Savoy, 2 vols. London, 1897. — M. ScHMiTT. Memoires Historiques sur le Diocese de Lausanne, 2 vols. Fribourg, 1859.

Lavagna, a town of the province of Genoa, Liguria, Italy, 43 miles south-east of Genoa by rail, on the shore of the Mediterranean. The church of San Salvador has been proclaimed a national monument. Shipbuilding is carried on, slate and marble are quarried, and olive oil prepared. Population, about 7000.

Laval, chief town of the department of Mayenne, France, 187 miles west-south-west of Paris, on the railway from Paris to Brest. The chief industry is still nomi- nally the same— the manufacture of coutils (tickings) — but ” tickings ” no longer adequately represents the character of the material produced. Coutils now include fabrics of different kinds, either wholly of linen or of cotton, or a mixture of both. The industry is carried on chiefly in

large factories, of whicli there are several in the suburb of Avenieres. Population (1881), 23,534 ; (1891), 24,496 ;

(1901), 30,356.

Laveleye, Emile Louis Victor de (1822-1892), Belgian economist, was born at Bruges on 5th April 1822, and educated there and at the College Stanislas, Paris, a celebrated establishment in the hands of the Oratorians. Thence he returned to Belgium, and con- tinued his studies at the Catholic University of Louvain and afterwards at Ghent, where he came under the

influ- ence of Huet, the philosopher and Christian Socialist. In 1844 he won a prize with an essay on the language and literature of Provence. In 1847 he published L'His- toire des rois francs, and in 1861 a French version of the Nibelungen, but though he never lost his interest in lit- erature and history, his most important work was in the domain of economics. He was one of a group of young lawyers, doctors, and critics, all old pupils of Huet, who met once a week to discuss social and economic questions, and was thus led to publish his views on these subjects. In 1859 some articles published by Laveleye in the Revue des Deux Mondes laid the foundation of his reputation as an economist. In 1864 he was elected to the chair of political economy at the State University of Liege. Here he wrote his most important works : La Russie et VAutriclie depuis Sadowa (1870), Essai sur les formes de gouvernement dans les sociitis modernes (1872), Des causes actuelles de guerre en Europe et de I'arbitrage, and De laproprieti et de ses formes primitives (1874), dedi- cated to the memory of John Stuart Mill and Pranqois Huet. He died at Doyon, near Liege, on 3rd January 1892. De Laveleye's name is particularly connected with bimetallism and primitive property, and he took a special interest in the revival and preservation of small nation- alities. But these subjects by no means exhausted the range of his activity, which included the whole realm of political science, political economy, monetary questions, international law, foreign and Belgian politics, questions of education, religion, and morality, travel and literature. He had the art of popularizing even the most technical subjects, owing to the clearness of his view and his firm grasp of the matter in hand. He was a frequent contrib- utor to the Revue des Deux Mondes, Revue de Belgique, the Nineteenth Century, the Fortnightly, and the Contem- porary reviews. He was especially attracted by England, where he thought he saw realized many of his ideals of social, political, and religious progress. The most widely circulated of Laveleye's works was a pamphlet on Le pai-ti . cUrical en Belgique, of which 2,000,000 copies were circulated in ten languages.

Lavigerie, Charles Martial Allemand (1825- 1892), cardinal archbishop of Carthage and Algiers and primate of Africa, was born at Bayonne, 31st October 1825. The son of a custom-house officer, he chose an ecclesiastical career, and came to St Sulpice, Paris, in 1840. He was ordained priest in 1849, and was professor •of ecclesiastical history at the Sorbonne from 1854 to 1856. His superiors, however, soon discovered that he was an

administrator as well as a scholar, and at the end •of 1856 he accepted the direction of the schools of the East. He started shortly afterwards for Syria, and was thus for the first time brought into contact with the Mahommedan world. ” C’est la,” he wrote, ” que j’ai connu enfin ma vocation.” Activity in directing mission- ary work, and especially in alleviating the distresses of the victims of the Druses, soon brought him prominently into notice; he was made a chevalier of the Legion of Honour, and in October 1861, shortly after his return to Europe, was appointed Prench auditor at Home. Two years later he was raised to the see of Nancy, where he

remained for four years, during which the diocese became one of the best organized and best administered in Prance. While bishop of Nancy he met Marshal MacMahon,then governor-general of Algeria, who in 1866, when the see of Algiers fell vacant, offered him the succession. It had already been raised to an archbishopric in July 1866, the transformation was authorized in August 1867, and Lavi- gerie landed in Africa on the 11th May following. The famine which was to decimate the native population was already making itself felt, and the archbishop began in November to collect the orphans into villages. This action, however, did not meet with the approval of Mac- Mahon, who feared that the Arabs would resent the cessation of the religious peace, and thought that the Mahommedan Church, being a state institution in Algeria, ought to be protected from proselytism ; so it was inti- mated to the prelate that his sole duty was to minister to the colonists. Lavigerie, however, continued his self- imposed task, refused the primacy of Lyons, which was offered to him by the emperor, and won his point. Con- tact with the natives during the famine caused Lavigerie to entertain exaggerated hopes for their general conver- sion, and his enthusiasm was such that he offered to resign his archbishopric in order to devote himself entirely to the missions. Pius IX. refused this, but granted him a coadjutor, and placed the whole of equatorial Africa under his missions. In 1870 Lavigerie warmly supported Papal infallibility. In 1871 he was twice a candidate for the National Assembly, but was defeated. In 1874 he founded the Sahara and Sudan Mission, and sent mis- sionaries to Tunis, Tripoli, East Africa, and the Congo. The order of African missionaries thus founded, for which Lavigerie himself drew up the rule, has since become famous as the “P6res Blancs.” Prom 1881 to 1884 his activity in Tunisia so raised the prestige of France that it drew from

Gambetta the celebrated declaration, ” L’ An- ticlericalisme n’est pas un article d’ exportation,” and led to the exemption of Algeria from the application of the decrees concerning the religious orders. On 27th IMarch 1882 the dignity of cardinal was conferred upon Lavi- gerie, but the great object of his ambition was to restore the see of St Cyprian ; and in that also he was successful, for by a bull of lOth November 1884 the primacy of Carthage was re-erected, and Lavigerie received the pal- lium on the 25th of January following. The later years of his life were spent in ardent anti-slavery propaganda, and his eloquence moved large audiences in London, as well as in Paris, Brussels, and other parts of the Conti- nent. He hoped, by organizing a fraternity of armed lay- men as pioneers, to restore fertility to the Sahara; but this community did not succeed, and was dissolved before his death. In 1890 Lavigerie appeared in the new character of a politician, and arranged with Pope Leo XIII. to make an attempt to reconcile the Church with the Eepublic. He then invited the ofiicers of the Mediterranean Squadron to lunch at Algiers, and, practically renouncing his mon- archical sympathies, to which he clung as long as the comte de Chambordwas alive, expressedhis support of the Repub- lic, and emphasized it by hiring a band to play the “Mar- seillaise.” The further steps in this evolution emanated from the Pope, and Lavigerie, whose health now began to fail, receded comparatively into the background. He died at Al- giers on the 26th November 1892, and by his death France lost one of her most popular prelates and the anti-slavery cause one of its most zealous champions. (g. f. b.)

Lavos, a town of Portugal, district Coimbra, 4 miles south of Figueira da Foz, and on the south side of the estuary of the Mondego. Here the greater part of the British forces landed in 1808. In 1900 it had a popula- tion of 7967.

LAW.

I. United Kingdom.

THE last thirty years of the reign of Queen Victoria were rich in legal changes affecting as well the poli- tical constitution of the government and

the social rights and obligations of the citizens of the United Kingdom as the machinery for the administration of the law. It is with the latter class of reforms, so far as they relate to England, that this article will chiefly deal. By far the most important legal reform, as regards both the magni- tude of the interests concerned and the character of the changes made, was that effected by the passing of the Judicature Act, 1873 (36 and 37 Vict. c. 66). Any person who desires to know in a general way the constitution, jurisdiction, and practice of the Courts of Common Law and Equity, at the commencement of Queen Victoria's reign, should read the brilliant essay of the late Lord Bowen in The Reign of Queen Victoria, published in the Jubilee year 1887. Two systems of jurisprudence were administered by the Common Law Courts and by the Court of Chancery, differing from each other in their rules and methods, and in some respects antagonistic and even contradictory. One person might be recognized as the owner of an estate in the Common Law Courts, and another in the Court of Chancery. Each system had been built up on its own lines by a succession of eminent judges, and was within its limits- logical and complete. But the practice in each system was bound fast by subtle distinctions and useless technicalities, and preserved anomalies which, however interesting to the legal his- torian, were devoid of all meaning to the modern practi- tioner. The Court of Chancery was a byword for dilatory proceeding and magnitude of expense. The number of judges in that court was insuflEicient for the work, while in the arrangements of the Common Law Courts there was a waste of the highest judicial ability. Between the year 1837 and the year 1873 much was done by the Common Law Procedure Acts and the Chancery Amend- ment Acts to reform the more obvious defects in the practice of the courts ; but until the passing of the Judi- cature Act, 1873, the Courts of Common Law and the Court of Chancery retained and exercised their separate jurisdiction. The Court of Chancery still restrained a successful litigant in the Queen's Bench from enforcing his judgment, and so late as the year 1874 (the year before the Judicature Act came into force) a man who had a perfectly good title to relief lost his case in the Court of Chancery because he asked for an injunction, and it was held that his right was to damages, which was cognizable only in a Court of Common Law. His bill was dismissed with costs in Chancery, and he subsequently brought an action-at-law and succeeded (compare Aspden v. Seddon, L.R., 10 Ch. 394 with Aspden v. Seddon, L.E., 1 Ex.D. 496). The Court of Chancery still continued to

conduct its cases by means of bill and answer. Only those who had to prepare these answers to written interrogatories know the weariness of the task — usually without much effect on the result of the case. Except in rare instances, evidence was still taken on afiBdavits, subject only to cross-examination before an Examiner in Rolls Yard. There was an efficient court of appeal in Chancery, but a writ of error from a Common Law Court to the Exchequer Chamber lay only in certain cases, and outside these limits there was no appeal.

The Judicature Act of 1873 was carried through Parlia- ment by Lord Selborne, assisted by the Attorney-General and Solicitor-General (Sir J. D., afterwards Lord, Coleridge

and Sir George Jessel), and with the support of Lord Cairns. It was originally intended to come into operation on 2nd November 1874, but this date was altered by an Amending Act to 2nd November ;J^f^’”” 1875. Various Amending Acts were subse- quently passed, the twelfth of these being in the year 1899. These Acts together form the constitutional charter of the superior courts of England, and with the rules which have been made under them, regulate their jurisdiction, procedure, and practice. By the Act of 1873 the Court of Chancery, the Court of Queen’s Bench, the Court of Common Pleas, the Court of Exchequer, the High Court of Admiralty, the Court of Probate, and the Court of Divorce and Matrimonial Causes were con- solidated into one Supreme^ Court of Judicature (sec. 3), divided into two permanent divisions, called ” the High Court,” with (speaking broadly) original jurisdiction, and ” the Court of Appeal ” (sec. 4). The reader will at once realize the bold and revolutionary character of this enact- ment. By one section of an Act the august Queen’s Bench, the Common Pleas, in which Serjeants only had formerly the right of audience, and the Exchequer, which had its origin in the reign of Henry I., and all their jurisdiction, criminal, legal, and equitable, were vested in the new court. Law and equity can be administered by every branch of the court, and a suitor can no longer be bandied from one court to another, or lose his action merely be- cause he has brought it in a wrong court or sought an inappropriate remedy. Nor can a suitor be deprived of a judgment which he has obtained at common law by an injunction in a court of equity, but every defence, whether legal or equitable, can be raised in the court in which the action is brought (sec. 24).

For the more con- venient despatch of business, however, certain classes of actions are assigned to particular divisions of the High Court (sees. 22 and 24), and there is a power to transfer causes from one division to another.

There were originally three Common Law Divisions of the High Court corresponding with the three former Courts of Common Law. But after the death of Lord Chief Baron Kelly on the 17th September 1880, and of Lord Chief Justice Cockburn on the 20th November in the same year, the Common Pleas and Exchequer Divi- sions were (by Order in Council, 10th December 1880) consolidated with the Queen's Bench Division into one division under the presidency of the Lord Chief Justice of England, to whom, by the 25th section of the Judica- ture Act, 1881 (44 and 45 Vict. c. 68), all the statutory jurisdiction of the Chief Baron and the Chief Justice of the Common Pleas was transferred. The High Court, therefore, now consists of the Chancery Division, the Common Law Division, under the name of the King's Bench Division, and the Probate, Divorce, and Admiralty Division. To the King's Bench Division is also attached, by order of the Lord Chancellor (1st January 1884), the business of the London Court of Bankruptcy.

The Chancery Division originally consisted of the Lord Chancellor as President and the Master of the Polls, and the three Vice-Chancellors. The Master of the Polls was also a member of the Court of Appeal, but Sir George

1 The comte de Franqueville in his interesting work, Le Systeme Judiciaire de la Grande Bretagne, criticizes the use of the word "supreme " as a designation of tliis court, inasmuch as its judgments are subject to appeal to the House of Lords, hut in the Act of 1873 the appeal to the House of Lords was abolished. He is also severe on the illogical use of the words "division" and "court" in many different senses (vol. i. pp. 180-181).

Jessel, who held that office wheu the new system came into force, regularly sat as a Judge of Tirst Instance

until 1881 when, by the Act of that year (sec. d'msZZ 2) the Master of the Eolls became a member

of the Court of Appeal only, add provision was made for the appointment of a judge to supply the vacancy thus occasioned (sec. 3). Sir James Bacon (b. 1798, d. 1895) was the last survivor of the Vice- Chancellors. He retained his seat on the Bench until the year 1886, when he retired after more than seventeen years' judicial service. Por some reason the solicitors, when they had the choice, preferred to bring their actions in the Chancery Division. The practice introduced by the Judicature Act of trying actions with oral evidence instead of affidavits, and the comparative inexperience of the Chancery judges and counsel in that mode of trial, tended to lengthen the time required for the disposal of the business. Demand was consequently made for more judges in the Chancery Division. By an Act of 1877 (40 and 41 Vict. c. 9, sees. 2, 3) the appointment of an additional judge in that division was authorized, and Sir Edward Fry (afterwards better known as a Lord Justice) was appointed. In August 1899 the Crown con- sented to the appointment of a new judge of the High Court in the Chancery Division on an address from both Houses of Parliament, pursuant to the 87th section of the Appellate Jurisdiction Act, 1876 (39 and 40 Yict. c. 69), and in the following month of October Mr Justice Harwell was appointed. The Chancery Division, there- fore, consisted in 1902 of the Lord Chancellor and six puisne judges. The latter are styled and addressed in the same manner as was customary in the old Common Law Courts.^ Until lately there were only four judges of this division (being the successors of the Master of the Eolls and the three Vice-Chancellors) to whom chambers were attached. The fifth judge heard only causes with witnesses transferred to him from the over- flowing of the lists of his four brethren. In each set of chambers there were three chief clerks, with a staff of assistant clerks under them. The chief clerks had no original jurisdiction, but heard applications only on be- half of the judge to whose chambers they belonged, and theoretically every suitor had the right to have his appli- cation heard by the judge himself in chambers. But the appointment of a sixth judge enabled the Lord Chancellor to carry out a reform recommended by a departmental

committee, which reported in 1885. The great difficulty in the Chancery Division always was to secure the continuous hearing of actions with witnesses, as nearly one half of the judge's time was taken up with cases adjourned to him from chambers and other administrative business and non-witness actions and motions. The interruption of a witness action for two or three days, particularly in a country case, occasioned great expense, and had other inconveniences. It was a simple remedy to link the judges in pairs with one list of causes and one set of chambers assigned to each pair. This reform was effected by the alteration of a few words in certain rules of court. There were, therefore, in 1902 only three sets of chambers, each containing four chief clerks, or, as they are now styled. Masters of the Supreme Court, and one of the linked judges, by arrangement between themselves, contin- uously tries the witness actions in their common list.

1 The comte de Franqueville comments on the misuse of the title Lord '' m addressing judges as another anomaly which only adds to the confusion, but perhaps unnecessarily. According to Foss (vol viii. p. 200) it was only in the 18th century that the judges be"-an to be addressed by the title of "Your Lordship." In the Year Books (he adds) they are constantly addressed by the title of " Sir." " Sir, vous voyez bien," etc.

while the other attends in chambers and also hears the motions, petitions, adjourned summonses, and non-witness cases.

Although styled Masters, it does not appear that the chief clerks have any larger or different jurisdiction than they had before. They are still the representatives of and responsible to the judges to whom the chambers are attached. The judge may either hear an application in chambers or may direct any matter which he thinks of sufficient importance to be argued before him in court, or a party may move in court to discharge an order made in chambers vtdth a view to an appeal, but this is not required if the judge certifies that the matter was suf- ficiently discussed before him in chambers.

Under the existing rules of court many orders can now be made on summons in chambers which used formerly to require a suit or petition in court (see Order LV. as to foreclosure, administration, payment out of money in court and generally). The judge is also enabled to decide any

particular question arising in the administration of the estate of a deceased person or execution of the trusts of a settlement without directing administration of the whole estate or execution of the trusts generally by the court (Order LV. rule 10), and where an application for accounts is made by a dissatisfied beneficiary or creditor to order the accounts to be delivered out of court, and the applica^ tion to stand over till it can be seen what questions (if any) arise upon the accounts requiring the intervention of the court (Order LV. 2, 10a). Delay and consequent worry and expense are thus saved to the parties, and, at the same time, a great deal of routine administration is got rid of and a larger portion of the judicial term can be devoted to hearing actions and deciding any question of importance in court. The work of the chambers staff of the judges has probably been increased; but, on the other hand, it has been lightened by the removal of the Winding-up business. The Chancery Division has also inherited from the Court of Chancery a staff of registrars and taxing masters.

The King's Bench Division consists of the Lord Chief Justice and fourteen puisne judges. It exercises original jurisdiction and also appellate jurisdiction from the county courts and other inferior courts. ’”‘^ By the Act of 1873 (sec. 45) this appellate Division. jurisdiction is conferred upon the High Court generally, but in practice it is exercised by a Divisional Court of the King's Bench Division only. The deter- mination of such appeals by the High Court is final, unless leave to appeal is given by the court which heard the appeal or by the Court of Appeal. There was an ex- ception to this rule as regards certain orders of Quarter Sessions; the history of which involves some complica- tion. But by sec. 1 (5) of the Act of 1894 the rule applies to all cases where there is a right of appeal to the High Court from any court or person. It may be here mentioned that if leave is given to appeal to the Court of Appeal there is a further appeal to the House of Lords, except in bankruptcy (47 A'ict. e. 9, sec. 104 (a)), when the decision of the t!ourt of Appeal on appeal from a divisional court sitting in appeal is made final and conclusive. It is suggested that under the new dis- tribution of business in the Chancery Division, appeals from the county courts in equity and some other matters might advantageously go to two judges in that division.

There are masters in the King's Bench Division. Unlike the masters in the Chancery Division, they have original jurisdiction, and are not attached to

any particular judge. They hear applications in chambers, act as taxing masters and occasionally as referees to conduct inquiries, take accounts, and assess damages. There is an appeal

from the master to the judge in chambers. Formerly there was an appeal from the judge in chambers to a divisional court in every case and thence to the Court of Appeal, until the multiplication of appeals in small inter-locutory matters became a scandal. Under the Act of 1894 (57 and 68 Vict. c. 16, sec. 1) there is no right of appeal to the Court of Appeal in any interlocutory matters (except those mentioned in subs. (&)) without the leave of the judge or of the Court of Appeal, and in matters of “practice and procedure” the appeal lies (with leave) directly to the Court of Appeal from the judge in chambers.

The Probate, Divorce, and Admiralty Division consists of the president and one puisne judge. To it are assigned Probate ^^ Causes and matters over which the Court of Divorce, Pi’obate, or the Court for Divorce and Matri-aad monial Causes, or the High Court of Admiralty

oTii’io’J!’ ^^^ exclusive jurisdiction before the Judicature Act. But any cause or matter assigned to this division may be heard at the request of the President of the High Court by any other judge of the High Court. The union of the admiralty with the probate and divorce business in one division is an interesting relic of the time when the jurisdiction in admiralty, probate, and matrimonial causes was confined to the “civilians” in Doctors’ Commons.

There are two registrars of the probate and divorce side of the division. In contentious matters they perform similar duties to those performed by the masters in the King’s Bench Division, and during the long vacation they exercise most of the powers of the judges as to matters heard upon motion (20 and 21 Vict. c. 77, see. 44). In non- contentious matters they issue

grants of probate in common form and letters of administration, and exercise a general control over the procedure in the district registries of the court. There are a registrar and an assistant-registrar on the admiralty side of the division. The office of the registrar is of some antiquity. They hear iaterlocutory applications in pending actions, and they tax costs. The more important part of their duties is to act as referees on references to them, ” assisted by merchants,” to assess damages in collision and salvage cases, and to take accounts on all matters within the admiralty jurisdiction of the court.

The keystone _of the structure is a strong Court of Appeal. Changes have from time to time been made in the constitution of this court.’ As ^Appeal! constituted in 1902, it consisted of ex-officio members and five ordinary members, who are styled Lords Justices of Appeal. The ex-officio members are the Lord Chancellor, every person who has held the office of Lord Chancellor, the Lord Chief Justice, the Master of the Eolls, and the President of the Probate, &c. Division. It usually sits in two divisions of three judges, under the presi- dency of the Master of the Rolls and the senior Lord Justice. The Lord Chancellor, when not engaged in the judicial business of the House of Lords, frequently sits in the court, and the other ex-officio judges also sit when their presence is required, owing to the absence of any of the Lords Justices from illness or public engagements. Lord Herschell, after he ceased to be Lord Chancellor, not unfrequently sat. All courts, however good, have a tendency to run in grooves, and it is eminently desirable to secure such variety in the composition and presidency of this court as will counteract that tendency, and com- mand general confidence for their decisions. It was fortunate that the services were secured of such men (to

1 1875 (38 and 39 Vict. c. 77, sec. 4) ; 1881 (44 and 45 Vict. c. 68, sees. 2, 4) ; 1884 (47 and 48 Vict. c. 61, sec. 3); 1891 (54 and 55 Vict, c. 43, sec. 1).

speak only of those who have gone) as Lord Selborne, Lord Cairns, Sir George Jessel, Lord Justice James, Lord Justice Mellish, Lord Bramwell, Lord Esher, Lord Justice Cotton, and Lord Bowen in building up the new system.

The jurisdiction of the Court of Appeal extends to (1) appeals from decrees and orders of all the divisions of the High Court; (2) appeals from the Court of Chancery of the county palatine of Lancaster ; (3) appeals from the Court of Chancery of the county palatine of Durham (52 and 53 Vict. c. 47, sec. 11) ; (4) appeals from the railway commissioners on questions of law (61 and 62 Vict. c. 25, sees. 17 and 56) ; (5) applications for a new trial or to set aside a verdict, fi.nding, or judgment after trial by a jury (63 and 64 Vict. c. 44, sec. 1) ; (6) appeals from the Lord Chancellor or any other person having jurisdiction in lunacy ; (7) appeals from orders of the Liverpool Court of Passage (Anderson v. Dean, 1894, 2 Q.B. 222) ; (8) appeals from error on the record from the Lord Mayor's Court (Le Blanche v. Beaton Telegram Co., 1 Ex.D. 408) ; and (9) last but not least, appeals from a county court judge or arbitrator on a case stated under the Workmen's Compen- sation Act, 1897, 60 and 61 Vict. c. 27, Sched. 2 (4). By a letter of request of the Lord Chancellor, under sec. 51 of the Lunacy Act (53 and 64 Vict. c. 5) the Lords Justices are entrusted with the jurisdiction of the judge in lunacy, and act as additional judges of the Chancery Division for the purpose of making orders in Chancery as well as lunacy when necessary. Practically, therefore, the Court of Appeal exsrcises the entire lunacy jurisdiction. It has been doubted whether the reference to the " Court of Appeal " in Sched. 2 (4) of the Workmen's Compensa- tion Act, 1897, was not a mistake, and it has been thought that what was intended was the court exercising appellate jurisdiction from county courts, viz., a divisional court of the King's Bench Division. But the construction of the Act is free from ambiguity, and numerous appeals have been entertained, with the result that there is a further appeal in England to the House of Lords, whereas neither in Scotland nor (it is believed) in Ireland is there any such appeal. This, however, was not the only anomaly or difficulty in this singularly ill drawn Act. The jurisdiction of the Court of Appeal is subject to the follow- ing exceptions : — (1) orders of the High Court in appeals from inferior courts, unless leave be obtained of the court by which the order is made, or of the Court of Appeal ; (2) orders of the High Court in registration and election cases without the like leave ; (3) orders made by consent of parties, or as to costs only which by law are left to the discretion of the court; (4) certain interlocutory orders mentioned in sec. 1 of the Act of 1894 (57 and 58 Vict. c. 16) ; (5) orders made in any criminal cause or matter, save for some error of law apparent on the record, as to which no question shall have been

reserved for the Court f oj- Crown Cases Reserved ; (6) orders of the Admiralty Division in cases of prize, the appeal from which lies to His Majesty in Council. The right of appeal is also subject to this limitation, that it does not extend to matters which from their nature were not apj)ealable to any court before the Judicature Act, or in which the Court of Appeal has no means of enforcing or executing its judgment, and therefore it was held in the House of Lords, overruling the Court of Appeal, that no appeal lies from the order of a judge discharging a prisoner under a writ of habeas corpus (Cox v. Hahes, 15 A.C. 506). ” If,” said Lord Herschell, ” the contention of the respond- ent is to prevail, the statute has effected a grave constitu- tional change ” ; and later, ” if ” the High Court ” has inherited the combined powers of the courts whose functions were transferred to it, but none of them had any jurisdiction or authority to review a discharge by a

competent court under a writ of habeas corpus, or to en- force the arrest of one thus freed from custody ... it seems to me to follow, that however wrong the Court of Appeal might think a discharge to have been, it would have been powerless to order a rearrest or at least to enforce such an order." The question whether an appeal would lie from order of the High Court refusing a writ of habeas corpus was left open.

" In the Court of Appeal," says the editor of the Judicial Statistics for 1899,^ " there was a large increase of business during that year. The appeals entered rose from 767 to 826, and were 28-76 in excess of the average for 1894-98. The increase was chiefly in appeals under the Workmen's Compensation Act. Out of a total of 826 appeals entered those under this Act were 140, or 16-96 per cent, of the whole." The list of appeals at the commencement of each successive sittings during the years 1900-1901 showed a steady increase in the num- bers waiting to be heard. It was not very clear how these arrears were to be overtaken. An addition to the number of ordinary members of the Court of Appeal would not achieve that end, unless arrangements could be made for the court to sit (temporarily at least) in three divisions; and it would not do to weaken the authority of the court. And while a special commission might be appointed, the difficulty was that the House of Lords and judicial committee could not spare any of their members.

The order of the Court of Appeal is final in appeals from the High Court in Bankruptcy, unless leave be given to appeal to the House of Lords (sec. 104 Bankruptcy Act, 1883) and in divorce appeals, except where the deci- sion either is upon the grant or refusal of a decree for dissolution or nullity of marriage or for a declaration of legitimacy, or is upon any question of law on which the court gives leave to appeal (44 and 45 Vict. c. 68, sec. 9), but no further appeal to the House of Lords lies, even with leave of the Court of Appeal, on appeals from the High Court sitting as a court of appeal from county courts in bankruptcy. With these exceptions, there is now a right of appeal from every order of the Court of Appeal to the House of Lords. By sec. 20 of the Act of 1873, the appellate jurisdiction of the House of Lords (so far as it affects England) was abolished, but this section was repealed by

the Act of 1876. Experience has proba- bly convinced most persons of the wisdom of retaining a final court of appeal.

The practice and procedure of the supreme court are regulated by rules made by a committee of judges, to which have been added the president of the Practice Incorporated Law Society, and a practising "procedure, barrister and one other person nominated by the Lord Chancellor. The rules in force in 1902 were those of 1883, with some subsequent amend- ments. With the appendices they filled a moderately- sized volume. Complaints are made that they are too voluminous and go into too much detail, and place a bur- den on the time and temper of the busy practitioner which he can ill afford to bear. In the opinion of the writer, the authors of the rules attempted too much, and it would have been better to provide a simpler and more elastic code of procedure. Rules have sometimes been made to meet individual cases of hardship, and rules of procedure have been piled up from time to time, some- times embodying a new experiment, and not always con- sistent with former rules. It is, however, proverbially easy to criticize.

The most important matter dealt with by the rules is the mode of pleading. The authors of the Judicature Act

1 Judicial Statistics, 1899, p. 20.

had before them two systems of pleading, both of which were open to criticism. The common-law pleadings (it was said) did not state the facts on which the pleader relied, but only the legal aspect of the facts or the inferences from them, while the Chancery pleadings were lengthy, tedious, and to a large extent irrelevant and use- less. There was some exaggeration in both statements. In pursuing the fusion of law and equity which was the dominant legal idea of law reformers of that period, the framers of the first set of rules devised a system which they thought would meet the defects of both systems, and be appropriate for both the common law and the Chancery divisions. In a normal case, the plaintiff delivered his statement of claim, in which he was to set forth concisely the facts on which he relied, and the relief which he asked. The defendant then delivered his statement of defence, in which he was to say whether he admitted or denied the plaintiff's facts (every averment not traversed being taken to be admitted),

and any additional facts and legal defences on which he relied. The plaintiff might then reply, and the defendant rejoin, and so on until the pleaders had exhausted themselves. This system of plead- ing was not a bad one if accompanied by the right of either party to demur to his opponent's pleading, i.e., to say, " admitting all your averments of fact to be true, you still have no cause of action," or " defence " (as the case may be). The writer, however, thinks that the authors of the new system were too intent on uniformity when they abolished the common-law pleading, which, shorn of its abuses (as it had been by the Common Law Procedure Acts), was an admirable instrument for defining the issue between the parties, though unsuited for the more complicated cases which are tried in Chancery, and he thinks it would have been better to try the new system in the first instance in the Chancery Division only. It should be added that the rules contain provisions for actions being tried without pleadings if the defendant does not require a statement of claim, and for the plaintiff in an action of debt obtain- ing immediate judgment unless the defendant gets leave to defend. In the Chancerjr Division there are of course no pleadings in those matters which by the rules can be disposed of by summons in chambers instead of by ordi- nary suit as formerly.

The judges seem to have been dissatisfied with the effect of their former rules, for in 1883 they issued a fresh set of consolidated rules, which, with subsequent amendments, were those in force in 1902. By these rules a further attempt was made to prune the exuberance of pleading. Concise forms of statement of claim and de- fence were given in the appendix for adoption by the pleader. It is true that these forms do not display a high standard of excellence in draftsmanship, and it was said that many of them were undoubtedly demurrable, but that was not of much importance. Demurrers were abolished, and instead thereof it was provided that any point of law raised by the pleadings should be disposed of at or after the trial, provided that by consent or order of the court the same might be set down and disposed of before the trial (Ord. xxv. 22. 1, 2). In the opinion of the writer, this was a disastrous change. The right of either party to challenge his opponent in limine, either where the question between them was purely one of law, or where even the view of the facts taken and alleged by his oppo- nent did not constitute a cause of action or defence, was a most valuable one, and tended to the curtailment of both the delay and the

expense of litigation. Any possi- bility of abuse by frivolous or technical demurrers (as undoubtedly was formerly the case) had been met by powers of amendment and the infliction of costs. Many of the most important questions of law had been decided on demurrer both in common law and Chancery.

In the writer's experience it was a useful and satisfac- tory mode of trying questions in Chancery (on bill and demurrer), and was frequently adopted in preference to a special case, which requires the statement of facts to be agreed to by both parties and was consequently more difficult and expensive. It is obvious that a rule which makes the normal time for decision of questions at law the trial or subsequently, and a preliminary decision the exception, and such exception dependent on the consent of both parties or an order of the court, is a poor sub- stitute for a demurrer as of right, and it has proved so in practice. The editors of the Yearly Practice (by Messrs Muir Mackenzie, Lushington, and Fox, 1901) say (p. 272), " Points of law raised by the pleadings are usually dis- posed of at the trial or on further consideration after the trial of the issues of fact," that is to say, after the delay, worry, and expense of a trial of disputed questions of fact which after all may turn out to be unnecessary. The aboli- tion of demurrers has also (it is believed) had a prejudicial effect on the standard of legal accuracy and knowledge required in practitioners. Eormerly the pleader pleaded with the fear of a demurrer before him. Nowadays he need not stop to think whether his cause of action or defence will hold water or not, and anything which is not obviously frivolous or vexatious will do by way of plead- ing for the purpose of the trial and for getting the opposite party into the box.

Another change was made by the rules of 1883, which was regarded by some common-law lawyers as revolu- tionary. Formerly every issue of -fact in a common-law action, including the amount of damage, had to be decided by the verdict of a jury. " The effect of the rules of 1883," says

Lord Lindley, who was a member of the Eule Committee, ” was to make trial without a jury the normal mode of trial, except where trial without a jury is ordered under rules 6 or 7a, or may be had without an order under rule 2 ” (Timson and Wilson, 38 Ch.D. 72, at p. 76). The effect of the rules may be thus sum- marized. (1) In the Chancery Division no trial by jury unless ordered by the judge. (2) Generally the judge may order trial without a jury of any cause or issue, which before the Judicature Act might have been so tried without consent of parties, or which involves prolonged investigation of documents or accounts, or scientific or local investigation. (3) Either party has a right to a jury in actions of slander, libel, false imprisonment, malicious prosecution, seduction, or breach of promise of marriage, upon notice without order ; (4) or in any other action, by order. (5) Subject as above, actions are to be tried without a jury unless the judge, of his own motion, otherwise orders.

Further steps have been taken with a view to simplifi- cation of procedure. By Order xxx. 21 (as amended in 1897), a summons, called a summons for directions, has to be taken out by a plaintiff immediately after the appear- ance of the defendant, and upon such summons an order is to be made respecting pleadings, and a number of interlocutory proceedings. To make such an order at that early stage would seem to demand a prescience and intelligent antici- pation of future events which can hardly be expected of a master, or even a judge in chambers, except in simple cases, involving a single issue of law or fact which the parties are agreed in presenting to the court. The effect of the rule is that the plaintiff cannot deliver his state- ment of claim, or take any step in the action without the leave of the judge. The writer is informed that m Chancery cases the order usually made is that the plaintiff deliver his statement of claim, and the rest of the summons stand over, and the practical effect is merely to add a few pounds to the costs. It may be doubted whether, as applied to the majority of actions, the rule

does not proceed on wrong lines, and whether it would not be better to leave the parties, who know the exigencies of their case better even than a judge in chambers, to proceed in their own way, subject to stringent provisions for immediate payment of the costs occasioned by un- necessary

vexatious or dilatory proceedings. The order does not apply to Admiralty cases or to proceedings under the order next mentioned.

In Order xviii. a (made in November 1893), the Com- mittee took a bolder flight. A plaintiff is thereby allowed to dispense with pleadings altogether, provided that the indorsement of his writ of summons contains a statement sufficient to give notice of his claim, or of the relief or remedy required in the action, and states that the plaintiff intends to proceed to trial without pleadings. The judge may, on the application of the defendant, order a state- ment of claim to be delivered or the action to proceed to trial without pleadings, and if necessary particulars of the claim or defence to be delivered. Out of this order grew what is called the Commercial Court. This is not a distinct court or division or branch of the High Court, and is not regulated by any special rules of court made by the Rule Committee. It originated in a notice issued by the Judges of the Queen's Bench Division, in February 1895 (see W.N., 2nd March 1895), the provisions contained in which represent only " a practice agreed on by the judges, who have the right to deal by convention among themselves with this mode of disposing of the business in their courts " (per Lord Esher in Barry v. Peruvian Corpora- tion, 1896, 1 Q.B. p. 209). A separate list of causes of a commercial character is to be made and assigned to a particular judge, charged with commercial business, to whom all applications before the trial are to be made. The 8th paragraph is as follows : —

(8) Such judge may at any time after appearance and without pleadings make such order as he thinks fit for the speedy deter- mination, in accordance with existing rules, of the questions really In controversy between the parties.

Practitioners before Sir George Jessel, at the Eolls, in the years 1873 to 1880, will be reminded of his mode of ascertaining the point in controversy and bringing it to a speedy determination. Obviously the scheme is only appli- cable to cases in which there is some single issue of law or fact, or the case depends on the construction of some contract or other instrument or section of an Act of Parlia- ment, and such issue or question is either agreed upon by the parties or at once ascertainable by the judge. The success of the scheme must also depend largely on the personal qualities of

the judge to whom the list is assigned. Under the able guidance of Mr (afterwards Lord) Justice Mathew, the Commercial Court became very successful in bringing cases to a speedy and satisfactory determination without any technicality or unnecessary expense, and the business is increasing.^ The question occurs why the same experi- ment should not be tried with actions of other descriptions. Why should not lists be assigned to other selected judges, who should deal with them in the same way as the judge to whom the commercial list is assigned deals with his actions ? Such a practice might go far to meet the complaint fre- quently made, and not without some foundation, of the time expended in the trial of actions, when in the result the real question between the parties turns out to be one of law or an issue of fact, capable of more summary treat- ment. Complaint is also made by counsel and solicitors in the King's Bench Division, that they cannot ascertain in which court, or, even approximately, when their cases will come on for trial until the evening on which they are placed in the list for the following day. This would be

'^Judicial Statistics, 1899, p. 21.

met by assigning his own list to every judge appointed to try actions, as is in fact done in the Chancery Division. And why should not the system of "linked judges," adopted in the Chancery Division, be extended to the other division, and a list be assigned at the commence- ment of every sittings to each pair of judges, and even (if the suggestion does not shock susceptibilities) a master or masters be specially attached to each pair? One judge might then proceed. continuously with the list whilst the other was engaged on circuit, or in chambers, or in a divisional court, or elsewhere.

By sec. 23 of the Judicature Act, 1875, power is conferred on the Crown, by Order in Council, to make regulations respecting circuits, including the discontinu- circaits. g^^^g q£ g^j^y circuit, and the formation of any new circuit, and the appointment of the place at which assizes are to be held on

any circuit. Under this power an Order of Council, dated the 5th February 1876, was made, whereby the circuit system was remodelled. A new circuit, called the North-Eastern Circuit, was created, consisting of Newcastle and Durham taken out of the old Northern Circuit, and York and Leeds taken out of the Midland Circuit. Oakham, Leicester, and Northampton, which had belonged to the Norfolk Circuit, were added to the Midland. The Norfolk Circuit and the Home Circuit were abolished and a new South-Eastern Circuit was created, consisting of Huntingdon, Cambridge, Ipswich, Norwich, Chelmsford, Hertford, and Lewes, taken partly out of the old Norfolk Circuit and partly out of the Home Circuit. The counties of Kent and Surrey were left out of the circuit system, the assizes for these counties being held by the judges remaining in London. Subsequently Maidstone and Guildford were united under the revived name of the Home Circuit for the purpose of the summer and winter assizes, and the assizes in these towns were held by one of the judges of the Western Circuit, who, after disposing of the business there, rejoined his colleague in Exeter. In 1899 this arrangement was abolished, and Maidstone and Guildford were added to the South-Eastern Circuit. Other minor changes in the assize towns were made, which it is unnecessary to particularize. Birmingham first became a circuit town in the year 1884, and the work there became, by arrangement, the joint property of the Midland and Oxford Circuits. There are alternative assize towns in the following counties, viz. : — On the Western Circuit, Salisbury and Devizes for Wiltshire, and Wells and Taun- ton for Somerset; on the South-Eastern, Ipswich and Bury St Edmunds for Suffolk ; on the North Wales Cir- cuit, Welshpool and Newtown for Montgomery ; and on the South AVales Circuit, Cardiff and Swansea for Glamorgan.

According to the arrangements in force in 1902 there were four assizes in each year. There were two principal assizes, viz., the winter assizes, beginning in January, and the summer assizes, beginning at the end of May. At these two assizes criminal and civil business was disposed of in all the circuits. There were two other assizes, viz., the autumn assizes and the Easter assizes. The autumn assizes were regulated by Acts of 1876 and 1877 (39 and 40 Vict. e. 57, and 40 and 41 Vict. c. 46) and Orders of Council made under the former Act. They were held for the whole of England and Wales, but for the purpose of these assizes the work was to a large extent ” grouped,” so that not every county had a separate assize. For

example, on the South-Eastern Circuit Huntingdon was grouped with Cambridge ; on the Midland, Rutland was grouped with Lincoln; on the Northern, Westmorland was grouped with Cumberland; and the North Wales and South Wales Circuits were united, and no assizes were held at some of the smaller towns. At these assizes criminal business only was taken, except at Manchester,

Liverpool, Swansea, Birmingham and Leeds. The Easter assizes were held in April and May on two circuits only, viz., at Manchester and Liverpool on the Northern and at Leeds on the North-Eastern. Both civil and criminal business was taken at Manchester and Liverpool, but criminal business only at Leeds.

Other changes had been made, with a view to preventing the complete interruption of the London sittings in the Common Law Division by the absence of the judges on circuit. The assizes were so arranged as to commence on different dates in the various circuits. Eor example, the summer assizes began in the South-Eastern and Western Circuits on 29th May ; in the Northern Circuit on 28th June ; in the Midland and Oxford Circuits on 16th June ; in the North-Eastern Circuit on 6th July ; in the North Wales Circuit on 7th July ; and in the South Wales Cir- cuit on 11th July. Again, there had been a continuous development of what may be called the single-judge system. In the early days of the new order the members of the Court of Appeal and the judges of the Chancery Division shared the circuit work with the judges in the Common Law Division. This did not prove to be a satis- factory arrangement. The assize work was not familiar and was uncongenial to the Chancery judges, who had but little training or experience to fit them for it. Arrears increased in Chancery, and the Appeal Court was shorn of much of its strength for a considerable part of the year. The practice was discontinued in or about the year 1884. The Appeal and Chancery judges were relieved of the duty of going on circuit, and an arrangement was made by the Treasury for making an allowance for ex- penses of circuit to the Common Law judges, on whom the whole work of the assizes was thrown. In order to cope with the assize work, and at the same time keep the Common Law sittings going in London, an experiment, which had been previously tried by Lord Cairns and Lord Cross (then Home Secretary) and discontinued, was re- vived. Instead of two judges

going together to each assize town, it was arranged that one judge should go by himself to certain selected places — practically, it may be said, to all except the more important provincial centres. The only places to which two judges went in 1902 were Exeter, Winchester, Bristol, Manchester, Liverpool, Not- tingham, Stafford, Birmingham, Newcastle, Durham, York, Leeds, Chester, and Cardiff or Swansea.

It could scarcely be said that, even with the amend- ments introduced under Orders in Council, the circuit system was altogether satisfactory or that the last word had been pronounced on the subject. In the first report of the Judicature Commission, dated 25th March 1869, p. 17 {Pari. Papers, 1868-69), the majority report that “the necessity for holding assizes in every county without regard to the extent of the business to be transacted in such county leads, in our judgment, to a great waste of judicial strength and a great loss of time in going from one circuit town to another, and causes much unnecessary cost and inconvenience to those whose attendance is neces- sary or customary at the assizes.” And in their second report, dated 3rd July 1872 {Pari. Papers, 1872, vol. XX.), they dwell upon the advisability of grouping or a discontinuance of holding assizes “in several counties, for example, Rutland and Westmorland, where it is manifestly an idle waste of lime and money to have assizes.” In the opinion of experienced persons, the defects thus pointed out have not been adequately rem- edied. It is thought that such towns as Oakham^ and

‘ It appears £rom the Judicial Statistics, 1890 (pp. 21, 22), that no actions were entered or tried in that year at Brecon, Mold, Oakham and Welshpool, or Newtown, and in no less than sixteen towns five or fewer actions had been entered and tried during the preceding six years.

others might even cease to be assize towns; that the grouping of counties which has been effected for the autumn assizes might be carried still further and applied to all the assizes; and that the system of holding the assizes

alternately in one of two towns within a county might be extended to two towns in adjoining counties, for example, Gloucester and Worcester. The facility of railway communication renders this reform comparatively easy, and reforms in this direction have been approved by the judges, but ancient custom and local patriotism, interests, or susceptibility bar the way. Nor can it be said that the single-judge system has been altogether a success. When there is only one judge for both civil and criminal work, he properly takes the criminal business first. He can fix only approximately the time when he can hope to be free for the civil business. If the calendar is exceptionally heavy or one or more of the criminal cases prove to be unexpectedly long (as may easily happen), the civil business necessarily gets squeezed into the short residue of the allotted time. Suitors and their solicitors and witnesses are kept waiting for days, and after all perhaps it proves to be impossible for the judge to take the case, and a ” remanet ” is the result. It is the opinion of persons of experience that the result has undoubtedly been to drive to London much of the civil business which properly belongs to the provinces, and ought to be tried there, and thus at once to increase the burden on the judges and jurymen in London, and to increase the costs of the trial of the actions sent there. Some persons advocate the continuous sittings of the High Court in certain centres, such as Manchester, Liverpool, Leeds, Newcastle, Birmingham, and Bristol, or (in fact) a de- centralization of the judicial system. There is already an excellent court for Chancery cases for Lancashire in the County Palatine Court, presided over by the Vice-Chancellor, and with a local bar which has pro- duced many men of great ability and even eminence. The Durham Chancery Court is also capable of devel- opment. Another suggestion has been made for continu- ous circuits throughout the legal year, so that a certain number of the judges, according to a rota, should be con- tinuously in the provinces while the remaining judges did the London business. The value of this suggestion would depend on an estimate of the number of cases which might thus be tried in the country in relief of the London list. This estimate it would, be difficult to make. Mr Justice Kennedy, to whom the writer is indebted for valuable assistance in this portion of the article, expresses the opinion that it is essential in any changes that may be made to retain the occasional administration by judges of the High Court of criminal jurisdiction, both in popu- lous centres and in remote places. It promotes a belief in the importance and dignity of justice and the care to be given to all matters

affecting a citizen’s life, liberty, or character. It also does something, by the example set by judges in country districts, to check any ten- dency to undue severity of sentences in offences against property.

In connexion with the trial of actions, reference may be made to the Arbitration Act, 1889 (52 and 53 Vict. c. 49). This Act is both a consolidating Act and an Arbitra- amending Act, and is, in fact, a concise code of ”””■ the law relating to the subject. By the com-

mon law, no agreement to refer between parties ousted the jurisdiction of the courts of the sovereign, or could be pleaded in bar of an action by one of the parties for the same matter, though where the right of action was only for a sum of money to be ascertained by arbitration, the award of the arbitrator was a condition precedent to the action which could not therefore be maintained until the arbitrator had made his award (Scott v. Avery, 5 H.L.

811). But this general rule of law was modified by sec.

11 of the Common Law Procedure Act, 1854,’ by which a party to a submission, and persons claiming through him, were enabled, if an action was brought by another party to the submission, to apply to the court to stay the pro- ceedings, and the court was empowered (but not obliged) to make an order to that effect. The result was to enable the party sued to obtain, under certain conditions, specific performance of the agreement to refer. This provision is repeated with some variation of language in sec. 4 of the Arbitration Act. Again, by the common law either party might revoke the authority of a particular arbitra- tor at any time before the award. This was modified by legislation (9 and 10 WiU. III. c. 15, and 3 and 4 Will. IV. c. 42), with the result that where the submission might be made a rule of court there was no power to re- voke without the leave of the court. The Common Law Procedure Act, 1854, enabled any submission to be made a rule of court unless it was otherwise provided in the submission. By sec. 1 of the Arbitration Act a sub- mission, unless a contrary intention appears therein, is made irrevocable except by leave of the court, and is declared to have the same effect in all respects as if it had been made an order of court. The effect of the latter words is that an award without the submission having been made a rule of court can be enforced as a judgment of the court, and

thus to abolish the necessity in such a case of bringing a fresh action on the award, but by sec.

12 the leave of the court must be obtained. By sec. 14 (which is substituted for sec. 67 of the Judicature Act, 1873) the court is empowered in any civil proceeding, (a) by consent, (6) where a prolonged examination of documents or scientific or local investigation is required, (c) in matters of account, to refer the whole cause or matter or any question or issue of fact therein either to a special referee or arbitrator agreed upon by the parties or to an official referee or officer of the court. It will thus be seen that facilities have been afforded for giving effect to agreements by the parties referring their dif- ferences to arbitration and for compulsory arbitration, where matters can be more conveniently dealt with in that maimer. On the other hand, assistance is given to arbitrators in the performance of their duties, and the parties are protected against the consequence of mistakes in law by arbitrators by sec. 7 (6), which enables arbitrators to state an award wholly or partly in the form of a special case for the opinion of the court, and sec. 19, which enables an arbitrator at any stage of the proceedings, and obliges him, if so directed by the court, to state in the form of a special case for the opinion of the court any question of law arising in the course of the reference. The arbitrator is not bound to state a case at the request of either of the parties, but his refusal to do so would lead to an application to the court for an order upon him, and, if not justifiable, might amount to misconduct on his part. Practically, therefore, any party to a reference may remove the decision of any real question of law from the arbitrator to the court. There is an appeal to the Court of Appeal, and thence to the House of Lords from the High Court on a case stated under see. 7, but it has been held that there is no appeal on a ease stated under sec. 19, because (it is said) the office of the court is consultative only, and what the court pronounces is an opinion and not an order. (In re Knight, 1892, 2 Q.B. 613. In re Kirkleatham Board, 1893, 1 Q.B. 375.)

Inquiry may now be made as to the results of the new procedure. The expected fusion of law and equity is not complete, because in the nature of things it cannot be so.

1 17 and 18 Vict. c. 125.

In English jurisprudence law and equity deal with differ- ent classes of subjects, and, to a large extent, proceed on different lines and by different methods. But Results equity, as well as law, is now cognizable in all ptocedure. the Courts ; procedure has been simplified, and technicalities have been reduced to even a dangerous minimum. The more important part of the work of the old courts in banc is now done by the Court of Appeal, but their shadow, under the name of a divisional court, still survives. The divisional court is an obsolete institution, and ought to be abolished, except as a court of appeal from inferior courts. The multiplication of appeals in the earlier stages of an action has been miti- gated, and, with a better organization of the Common Law Courts and judicial staff, still further steps might be taken in reducing the expenses of the initial stages of actions. It is difl&cult to say whether either in the King's Bench or the Chancery Division the costs of trial have been reduced, because so many elements enter into the examination. In the latter case they have probably been increased, because trial by oral evidence takes longer and is more expensive than trial by affidavit evidence. Circumlocution and delay in Chancery (the favourite theme of the novelist and satirist) are things of the past, and the expenses of the administrative business of the division have certainly been reduced without any loss of efficiency. Actions come on for trial within a reasonable time after they are ready. During the six years 1894 to 1899 ^ the business in the Chancery Division appeared to be nearly stationary, with a tendency to decrease in some heads. The number of actions heard in 1899 was 575, which is smaller than the number heard in 1898, but somewhat greater than the- average of the previous four years. In the Queen's Bench Division there was for several years a regular and marked decrease of the busi- ness tintil the year 1897. In that year there were 69,050 writs and other originating proceedings and 274.3 actions heard, while in the year 1898 there was a still further increase, the number of writs and other originating pro- ceedings being 71,376, and 3266 actions were heard. On the other hand, in 1899 the figures were 68,464 writs and

other originating proceedings and 2704 actions tried.^ It should be added that the percentage of actions entered in the list for speedy trial of actions under Order XIV. showed a distinct increase of actions so tried, both actual and proportional.'' The average time which elapsed between date of writ and trial of action was estimated to be 194-8 (say 195) days, or, if cases of an exceptional kind were eliminated, 125-7 days.

The outward and visible sign of the passing of the old order was given when the judges left their his- torical home in Westminster Hall for the new 0°^^ t ^^^^*^® o^ Justice in the Strand in the year Justice. 1882, and law and equity forgathered under one roof. Vast as it is, the new building is not adequate for the accommodation of all its inmates, and a judge in 1902 still sat in old Lincoln's Inn Hall. At the time of the opening of the new courts it was remarked that those who were responsible for their arrangement had apparently forgotten that the Court of Appeal sat in two divisions. There is a large hall which leads nowhere, and is as silent and deserted as Westminster Hall itself. The corridors are dark and narrow. The accommodation for counsel in the courts is confined and inconvenient, and the furniture is bare and mean. There is no room in which counsel can wait for their cases to be called on except the library, which is upstairs and unfitted for the purpose. The

1 Judicial Statistics, 1898, 18(19. 2 Ibid., 1899, pp. T6, 76.

"Ibid., 1898, 1899.

Bank- ruptcy.

accommodation for the judges, on the other hand, is excellent.

Bankruptcy proceedings were in 1902 regulated by the Bankruptcy Act, 1883 (46 and 47 Vict. c. 52), amended by an Act of 1890 (53 and 54 Vict. c. 71), and in minor details by other Acts. There has been a curious change of policy in this branch of legal administration. Under the Act of 1849 the bankrupt's propertywas administered by two assignees, one of whom, called the official assignee, was an officer of the court, and the other was chosen by the creditors. In 1869 this procedure was reversed, and under the Act of that year there was one trustee only chosen by the creditors, and facilities

were given for administration of an insolvent's estate outside the court, under deeds of arrangement. The Act of 1883 reintroduced officialism. All bankrupt- cies were placed under the administration of the Board of Trade, and officers of this department (called official receivers) managed the estate until, and unless, another trustee was chosen by the creditors. Alterations were at the same time made in the procedure on a petition of bankruptcy against a debtor. Instead of an immediate adjudication the court made what was called a receiving order, the effect of which was to place the property under the care of an official receiver and to protect it against action by other creditors (sec. 9). A general meeting of the creditors was then held for the purpose of considering whether a proposal for a composition, if made by the debtor, or a scheme of arrangement should be entertained, or whether the debtor should be adjudged bankrupt, and generally as to the mode of dealing with the debtor's property (sec. 15), and a public examination of the debtor was held, at which any creditor might attend and question the debtor (sec. 17). If the creditors resolved on a bankruptcy or came to no decision, or if any composition which might be proposed was not ac- cepted and approved by the court, an adjudication in bankruptcy ensued (sec. 20). The creditors, or the com- mittee of inspection (where one was appointed), selected the trustee (sec. 21). Until one was appointed (sec. 54), and during any vacancy in the office (sec. 87 (4)) the official receiver acted as trustee. The punitive part of bankruptcy administration was strengthened. The court now had an absolute discretion to grant or refuse an order of discharge or suspend the operation of the order for a specified time, or to grant the order subject to any conditions as to the bankrupt's future earnings or after-acquired property, except that no order of discharge could be made where the bankrupt had been guilty of certain offences, which were made misdemeanours, and an absolute order might not be made where the bankrupt had been guilty of other offences enumerated in sec. 28 (3). The vesting of a discretion in the court as to the order of discharge was again a return to the principle of the Act of 1849. Under the Act of 1861, as subsequently amended in 1869, it was held that the court had no discretion, and that on complying with the prescribed conditions the bankrupt was entitled to his discharge unless he had been guilty of any of the offences mentioned in the Act (In re 3[ew and Thome, 31 L.J. Bank. 87, and Ex parte Ham- ilton, 9 Ch.D. 604). Other novel features in the Act of 1883 were, the power of the court to order summary administration where the

official receiver reported that the estate was not likely to exceed in value £300 (sec. 121) ; the power of a county court judge to make an immediate administration order where the debtor's whole indebtedness did not exceed £50 (sec. 122), and the jurisdiction given to the Bankruptcy Court to administer the estate of a deceased debtor according to the law of bankruptcy (sec. 12.5). Original jurisdiction in bankruptcy is exercised in the London district by a judge of the High Court assigned

by the Lord Chancellor for that purpose, subject to an appeal to the Court of Appeal, but not to the House of Lords without leave of the latter court. The juris- diction in the country districts is exercised by the County Courts whatever be the amount of the estate, subject to an appeal to a divisional court of the High Court, of which the judge to whom bankruptcy business is assigned shall be a member. There is no further ap- peal without leave of the Divisional court or the Court of Appeal, and (where leave is given) no further appeal to the House of Lords — see sec. 2 of the Bankruptcy Appeals County Courts Act, 1884 (47 Vict. c. 9), repealing sec. 104 (2) (A) of the Act of 1883, which provided for appeals from the County Courts in bank- ruptcy to the Court of Appeal directly. The Lord Chancellor may exclude any County Court from the exercise of bankruptcy jurisdiction.

It is difficult to form any estimate as to the improvement in efficiency or costs effected by the Bankruptcy Act, 1883. As regards large estates, where it is worth while for the creditors to look after their own interests and the per- centage of the costs on the value of the estate is less, probably there is no great change. Indeed, comparatively few of these estates ever come into bankruptcy. They are usually wound up under deeds of arrangement. The bulk of the bankruptcies are of small estates where the per- centage of expenses of liquidation is large and dividends are infrequent. It is sometimes said that the tendency of the official receivers is to sacrifice the assets for the sake of an immediate return. This is perhaps inevitable, and it must be remembered that creditors are impatient and few estates will bear

the expense of a prolonged bank- ruptcy or of “nursing” the assets. The report of the Inspector-General in Bankruptcy for the year ending 31st March 1900 contained some interesting statistics which illustrate the working of the Act. There were 720 effective receiving orders made in the High Court and 3363 in the County Courts, and 713 adjudications made in the High Court and 3332 in the County Courts. Summary administration under sec. 121 was ordered in 511 cases in the High Court and 2881 in the County Courts. No composition was approved by the court for a less sum than 7s. 6d. in the £. There were 3823 estates wound up by official receivers and closed during the year 1899. Of these in no less than 1734 the assets were under £25. The gross assets in these cases amounted to £18,915, the percentage of costs on gross assets was 96-35, and the total amount paid in dividends was £602 only, or, in other words, the estates were practically absorbed in costs. As the estates increase in value up to £2000 the percentage of costs decreases, being 17-38 only in estates between £1500 and £2000, and the proportionate amount paid in dividends increases. There were 16 estates between £1000 and £2000. The average percentage of costs in these was about 15-9. There were only four estates of £2000 and upwards, viz., one estate between £2000 and £3000, one between £4000 and £5000, one between £5000 and £6000, and one over £20,000. In the last- mentioned case the gross assets were £40,032, the per- centage of costs was 4-51 only, and no less than £38,046 was paid in dividends. Table VII. contained an analysis of the results of administration of 738 estates wound up by non-official trustees during the same year, of which 158 were above £1000 in value as compared with cases in the previous table. The percentage of costs is generally higher, but the proportionate amount paid in dividends to the gross assets is larger, and it appears from a subsequent table that rather more than one-fifth were closed without dividend, whereas rather less than three-fifths were so closed in the estates wound up by official trustees. Eoughly, therefore, the estates which paid no dividend under official

administration were twice as many as those wound up by non-official trustees. These statistics show that in the larger estates, and in those which are expected to yield a dividend, the creditors prefer to have the estates wound up by trustees of their own selection, but the costs in that case are rather higher.

Consistently with its policy of officialism, the Act of 1883 contained no power for an insolvent debtor and the majority of his creditors to come to an arrangement between themselves binding on all the creditors outside the court. Conveyance by a debtor of his property in trust for his creditors does not therefore protect a debtor from bankruptcy, unless assented to by all his creditors, and is, moreover, itself an act of bankruptcy. Estates, however, continued to be wound up under deeds of arrangement, whether in the form of an assignment, or composition, or inspectorship deed. By the Deeds of Arrangement Act, 1887 (50 and 51 Vict. c. 57) every deed of arrangement is made void unless registered with the registrar of bills of sale within seven days of its first execution by the debtor or any creditor, but the Act gives no validity to any deed or instrument which by law is an act of bankruptcy or void or voidable. By a subsequent Act (53 and 54 Vict. c. 71, sec. 25) provision is made for a report to Parliament by the Board of Trade of proceed- ings under the above Act, and for return to the Board by the registrar of all deeds registered and by the trustee thereof of his receipts and payments. The Inspector- General in Bankruptcy in his Eeport for 1899, already quoted, criticized severely the administration of insolvent estates under deeds of arrangement, and pointed to in- stances of abuses and hardship to creditors. ISTo doubt liquidation by private arrangement is exposed to many abuses and dangers from which official administration is comparatively free. But for all that, it seems that some persons among the commercial classes prefer private arrangements to bankruptcy proceedings. It appears from the Inspector-General's report that 3162 deeds were registered in the year 1899, of which 188 were cancelled by subsequent receivership orders, leaving 2974 estates to be wound up privately, of the total estimated value of £1,774,321. Final accounts were rendered during the year of the administration of 2338 estates under deeds of arrangement, in fifteen of which the gross assets were £6000 and upwards. The estates closed without payment of a dividend were 9-97, or, say, one-tenth, and in the majority of cases the dividends were between 2s. 6d. and 7s. 6d. in the £. The percentage of costs on gross assets is not appreciably higher (if at all) than in estates wound up either by official receivers or non-official trustees in bankruptcy. These statistics prove, not that liquidation by private arrangement is superior generally to that in bankruptcy, but that many people think that it is, and they prefer to have the best estates wound up in that manner.

By the Companies (Winding Up) Act, 1890 (53 and 64 Vict. c. 63), the winding up of companies also was placed under the administration of the Board of Trade and the official receivers. The aim of this Act Companies was as far as possible to assimilate the procedure ‘’”’”^ of winding up insolvent companies to that in bankruptcy. The analogy is of course imperfect, because there is no individual or personal insolvent debtor to be dealt with, and the attempt to impose some of the obligar tions and penal provisions of the Bankruptcy Act upon directors of insolvent companies is neither just in principle nor expedient in practice. For some few years after the passing of the Act, directors (whether alleged to have been guilty of fraud or not) were frequently called upon by the official receivers to submit themselves to the trying ordeal of a public examination under sec. 8, in which the

official receiver, the liquidator (where the official receiver is not the liquidator), and any creditor or contributory of the company may take part either personally or by solici- tor or counsel. But it was decided in the House of Lords {ex parte Barnes, 1896, A.C. 146) that an order could not be made for the public examination of any person against whom a primd facie case of fraud had not been found by the report of the official receiver. The general effect of the Act is thus summed up by Mr Justice Buckley in his work on the Companies Act (7th ed. p. 671) : ” The first section and the whole Act which follows are addressed solely to administration. There is to be found in the Act no alteration of rights, but only an alteration of the courts and officers and mode of selection of officers who are to administer those rights, with detailed provisions as to financial control and subsidiary matters.” The reader may be reminded that there were three modes of winding up provided by the Companies Act, 1862 : — (1) Voluntary winding up by resolution of the members ; (2) voluntary winding up under the supervision of the court ; and (3) compulsory winding up by the court on the petition of a creditor or contributory in case of insolvency, and in cer- tain other cases specified in sec. 79 of the Act of 1862. The effect of a

supervision order is to leave the liqui- dators to exercise their powers without the sanction or intervention of the court in the same manner as if the company were being wound up altogether voluntarily, but to enable the court, when called upon, to exercise all the coercive jurisdiction which it might exercise if it were a winding up by the court (sec. 151 of the Act of 1862), and the order usually contains a power for creditors to apply to the court as well as the liquidator and contributories. The Act of 1890, speaking generally, deals only with winding up by the court, but some sections (notaljly sec. 10) apply to voluntary liquidations also. The winding up business is no longer the exclusive property of the Chan- cery Division, and one incidental benefit conferred by the Act is the relief thus afforded to the over-burdened cham- bers of that division. It was provided (sec. 1) that where the capital of the company paid up or credited as paid up exceeded £10,000, a petition for a winding up or super- vision order should be presented to the High Court, with concurrent jurisdiction to the two Palatine courts of Lan- caster and Durham as regards companies within their jurisdiction. When the capital did not exceed £10,000, and its registered office was within the jurisdiction of a County Court having jurisdiction, the petition was to be presented to that County Court. The County Courts having jurisdiction were those having jurisdiction in bankruptcy, with power to the Lord Chancellor to ex- clude any court from winding up jurisdiction. The jurisdiction of the High Court was exercised by a judge of the Chancery Division assigned by the Lord Chancellor, or by the judge exercising the bankruptcy jurisdiction of the court (sec. 2). In practice the winding up business has hitherto been assigned to the bankruptcy judge, who has been made a judge of the Chancery Divi- sion for that purpose. The official receiver is the provi- sional liquidator, and the definitive liquidator of the company, unless another person is appointed official liqui- dator by the court on the application of creditors or con- tributories (sees. 4-6). But whether the official receiver be appointed liquidator or not, he exercises a large control over the course of the winding up under sees. 7 and 8, which require a statement of affairs to be submitted to him, and require him to make certain reports to the court, including a report whether in his opinion any fraud has been committed by any person in the formation of the company, or by any director or other officer since its for- mation. Upon such last-mentioned report the court may order the public examination of the person whose conduct

is impugned (see ex parte Barnes, referred to above). The Board of Trade also takes cognizance of the conduct of liquidators of companies which are being wound up by- order of the court, and either mero motu, or on the appli- cation of any creditor or contributory, may inquire into his conduct and take action thereon (sec. 25). Sees. 15 and 20 contain what are perhaps the most useful provisions in the Act. By sec. 15 (which applies to voluntary liquida- tions as well as windings up by the court) every liquidator after the expiration of the first year is required at stated intervals (by the rules twice in every year) to send to the Registrar of Joint-Stock Companies a full statement and account with respect to the proceedings in and position of the liquidation, and monies in his hands representing assets unclaimed or undistributed for six months are required to be paid into the Bank of England. And sec. 20 provides for an audit by the Board of Trade twice a year of the accounts of every liquidator of a company which is being wound up by the court. This provision might with advantage have been applied with some modification to voluntary liquidations.

There is no doubt more notoriety about winding up proceedings under the new system of procedure. The Inspector-General in Bankruptcy makes his yearly report to Parliament on Companies in Liquidation. The pro- vision for the rendering of accounts and audits of ac- counts are admirable as far as they go, and have done much to mitigate frequent abuses in the liquidation of companies. But in the actual administration of the estate and recovery of monies recoverable from promoters and officers of the company on the ground of fraud, breech of trust, or negligence, it may be doubted whether any great improvement or change can be discerned. Probably (as in bankruptcy) in the larger estates things remain pretty much as they were, but in the smaller estates, where there is very little for either creditors or contributories, the winding up is effected with greater despatch. In his report for the year ending 31st March 1901 the Inspector- General stated that there were during that year 1687 voluntary liquidations, of which 38 were subject to super- vision and 117 compulsory liquidations by order of the court. Some of the voluntary liquidations (estimated by the Inspector-General in a previous report at one-fourth of the number) were for the purpose of reconstruction or amalgamation with other companies. On this basis the number of bankrupt companies for the year would be 1372. In the estates, the winding up of which was com- pleted in the years 1898, 1899,

and 1900, the percentage of costs on gross assets was decidedly least in the purely voluntary liquidations, and remarkably so in the larger estates, and less in the companies wound up under super- vision than in the compulsory liquidations under order of the court, whether by the official receiver or by non- official liquidators, but the percentage in companies wound up by official receivers is less than in those wound up by non-official liquidators. It must, however, be re- memlDered that in the voluntary liquidations some (say one-fourth) were formal liquidations for the purpose of reconstruction or amalgamation, and also that the amount of the costs depends very much upon the circumstances of the particular company and the amount of litigation involved, and where the percentage is based on an aver- age of a few companies only, as in the larger estates, one unusually expensive liquidation unduly affects the result. Moreover, litigation is more likely to take place in wind- ings up under the order of the court. The Inspector-General's Comparative Table II. (p. 74 of the Eeport) therefore does not afford much assistance in arriving at a comparative estimate of the expenses of the two modes of liquidation.

The Companies Act, 1862 (25 and 26 Vict. c. 89), has

been in almost daily use, and under its provisions joint- Com anies ^^°^^ enterprise in England has been developed Actef" ** to enormous dimensions. A committee ap- pointed by the Board of Trade in 1895 stated in their Eeport ' (p. vi.) : —

According to the recent report of the Board of Trade, there were in the United Kingdom, in April 1894, 18,361 companies with a paid-up capital of £1,035,029,835, whereas the capital of all com- panies in France, anonymes and en commandite, was, in December 1894, calculated approximately at £420,000,000. The capital of German companies was estimated by Mr Gerb of H.M.' Consulate- General in Berlin at £200,000,000, but Mr Schuster puts it at £300,000,000. The capital embarked in English companies, there-

fore, exceeds that represented by French and German companies together by at least £315,000,000.

Notwithstanding a continuous criticism of the Act of 1862, comparatively few serious questions of construction have arisen, and judgedby results the Act must be regarded as a great success. It was amended by the Act of 1867 (30 and 31 Vict. c. 131). This Act was chiefly concerned with the reduction of capital by order of the Court, but it contained two obscurely expressed sections, each of which has led to a vast amount of litigation, and in some cases oppression to individuals without any great advantage to anybody. The 25th section provided for every share being deemed to have been issued subject to the payment of the whole amount thereof in cash, unless otherwise determined by a contract in writing filed at or before the issue of the share. Under this section persons who had taken shares represented to be fully paid up in payment of a debt or purchase-money of property, have not only got nothing, but have had to pay large sums in addition. The other section is the 38th, which (to state the effect of it shortly) provided for the date and names of the parties to any contract entered into by the company, or the promoters, directors, or trustees thereof, being specified in a prospec- tus, and declared that any prospectus not specifying the same shall be deemed fraudulent on the part of the per- sons issuing the same. This section was full of difficul- ties of construction, and both sections were examples of well-intentioned but inconsiderate and, therefore, mis- chievous legislation. The Act of 1862 has been further amended or added to in some minor details, as well as by the Companies Winding Up Act, 1890. In the year 1900 the Companies Act of that year (63 and 64 Vict. c. 48) was passed. This Act was founded on a proposed Bill scheduled to the Eeport of the Committee of 1895 already referred to, and was designed to meet some of the more flagrant abuses which have been found to attend the for- mation and management of joint-stock companies. That such abuses too frequently exist there is no doubt, but un- fortunately the dishonest cases are those which strike the public eye. The affairs of the vastly greater number of companies are stated in the Eeport of the Committtee to be conducted with honesty and capacity. It is just at this point that the difficulty of legislation arises. For, while endeavouring to anticipate and counteract the devices of professional promoters and others, the legislator has to be on his guard against imposing such fetters and oner- ous obligations on directors as will

deter men of character and substance from accepting the office. Again, an Act of Parliament cannot endow a rogue with honesty, or his dupe with sagacity, or the imprudent with wisdom. All it can do is to require such information and means of information to be given as will enable an intending sub- scriber to protect himself. At the same tirne the maxim caveat emptor has no application to the relation of such a person towards the persons who invite his subscription, for any adequate investigation into the statements of a

‘ Report of Departmental Committee appointed by the Board of Trade, presented to Parliament in 1895.

prospectus is beyond the powers of many people, and could not practically be undertaken in the time allowed between the receipt of the prospectus and the closing of the subscription list. The obligations of a person who issues a prospectus ought not, therefore, to be limited to that which the law imposes on vendors and parties to an ordinary contract of making no misrepresentation. He should be placed in what is called a ” fiduciary position ” for this purpose towards those to whom the prospectus is addressed, and bear the duty of not only telling what he believes to be or has been informed is the truth, but also of doing his best to ascertain the truth and disclos- ing in good faith every fact within his knowledge which is material for the consideration of the investor. Some people have inferred from certain expressions of noble lords in Central Railway Co. of Venezuela v. Kisch (L.E. 2 H.L. 99) that this was in fact the law, but it has been decided in Derry v. Peek (14 A.C. 337) that directors who issue a prospectus can only be made personally liable for wilful misrepresentation in an action of deceit. The Directors’ Liability Act (53 and 64 Vict. c. 64) went some way in the suggested direction. The Act of 1900 follows the plan of requiring certain specified particulars to be stated in the prospectus (sec. 10). The section is indeed comprehensive, and it is difficult to suggest anything which ought to be stated and is not included. It is, how- ever, the opinion of some reformers that it would have been better policy and more scientific legislation to enact the broad principle, and leave the courts to work it out in detail.

There are, however, at least four valuable provisions in the Act of 1900. It requires a statement in every prospectus of the minimum subscription on which the directors will proceed to allotment, and in the absence of such statement forbids any allotment unless the whole capital offered is subscribed (sees. 4, 6). The absence of such a provision has been a most fruitful cause of disaster. A man who only intended to become a shareholder in a company with a capital of (say) £100,000, finds himself saddled with shares in a company which has failed to obtain subscriptions for one-tenth of that amount. An attempt is made (sec. 12) to give vitality to the first meeting of shareholders required to be held by sec. 29 of the Act of 1862. Certain information has to be given, and the shareholders have the opportunity of considering their position before they are finally embarked on the adven- ture. An attempt is also made (sec. 10 (1) (f) and (2)) to unmask the ” nominal vendor ” (who plays a large part in companies’ promotion), and to discover the intermediate profits made between the real vendor and the purchasing company. By sees. 14 to 18 a register of securities is to be kept by the Eegistrar, subject to public inspec- tion. Every charge created (1) as security for deben- tures, (2) on uncalled capital, (3) on ” personal chattels ” within the Bills of Sales Acts, and (4) a floating charge on the company’s undertaking, is made void as against the liquidator and creditors unless registered within twenty-one days after execution. Finally, sees. 25 and 38 of the Companies Act, 1867, are repealed (schedule), and less objectionable modes provided for attaining the same result.

One novel feature is to be found in sec. 8 of the Act of 1890, whereby it is declared lawful to pay out of the company’s funds either a commission on underwriting or a brokerage for placing shares, provided such payment is authorized by the articles of association and does not exceed the amount so authorized, and the payment is mentioned in the prospectus ; otherwise such payments are prohibited. Mr Justice IBuckley, in his book on the Cpmpanies Acts (7th ed. p. 610), considers that the legality of the payments of brokerage or commission for placing

shares, after some conflicting opinions in the courts, was settled by the case of Metropolitan Association v. Scrim- geour (1895, 2Q.B. 604). A distinction has been made between the payment of brokerage and that of an under- writing commission, but there does not appear to be any real difference in principle. Whether legal or not, such payments were so generally made, either directly out of the company's funds, or indirectly by adding the amount to the price paid to the vendor who made them, that it was no doubt considered better to legalize them under certain restrictions. But the bearing of this section on the issue of shares at a discount will have to Shares at a j^g considered. Such issue has been decided by the House of Lords to be inconsistent with the provisions of the Companies Act, 1862, either as be- tween the company and its creditors (Ooregum Company V. Boper, 1892, A.C. 125), or as between the company and its members (Wilton v. Saffery, 1897, A.C. 299, diss. Lord Herschell). But if the company may pay Is. per share to A for inducing B to take a £1 share, there does not seem to be any sound reason why the company should not pay the same sum to A if he takes the share himself, and indeed the payment of a commission to an underwriter is, or may be, a direct payment or return to the shareholder himself off the nominal amount of his share. The issue of shares at a discount excites an unreasonable prejudice in some minds. It is allowed to companies incorporated under the Companies Clauses Acts on the issue of new shares (26 and 27 Vict. c. 118, as amended by 30 and 31 Vict. c. 127, ss. 27-29), and in other companies the prohibition may be evaded, or at least the same result attained, with the greatest ease. For example, on a new issue the shares may be £10 shares, with a 10 per cent, prefer- ence dividend, and the articles may provide that the shareholders shall receive £20 for each share on dis- tribution of surplus assets in a winding up and have twice the voting power of other £10 shareholders. How does this differ in substance from the issue of a £20 share with a 5 per cent, preference dividend at a discount of 50 per cent. ? In the opinion of the writer the issue of shares at a discount might safely be permitted in circumstances and under con- ditions similar to those prescribed for companies under the Companies Clauses Acts. Another anomaly of com-

pany law is illustrated by what are called “one-man com- panies.” A man may turn a business, of which Oae-maa ^^ jg g^jg proprietor, into a limited company, with the assistance of six clerks or members of his family, to whom he gives one share a piece, taking the rest of the capital himself. He may thus carry on business with limited liability, defy the bankruptcy law, and even issue debentures to himself which will have priority over the trade creditors (Salomon v. Salomon and Co., 1897, A.C. 22). The Act of 1862 (sec. 6) requires seven persons associated for a lawful purpose to form a company, and so much importance is attached to the number of seven, that the failure to maintain that number of shareholders is made a cause of winding vip by the Court (sec. 79 (3)). It may be assumed that the creation of “one-man companies” was not contemplated by the framers of the Act of 1862, but no person has ever suggested a practical remedy (if one be desired) which would be consistent with the scheme of the Acts, and not do more harm than good. The point is not touched by the Act of 1900. That Act is not the last word on com- pany reform, but it contains some good provisions, and may do some good, and probably no harm.

Contemporaneously with the Bankruptcy Act, 1883, the Patents, Designs, and Trade Marks Act, 1883 (46 ai^d 47 Vict. c. 57) was passed. By this Act (which has been

subsequently amended in some details not affecting the general scheme of the Act by Acts of 1885, 1886, and 1888) the administration of the law as to patents, patents copyright in designs, and trade marks is carried designs’, on in one office called the Patent Office, under the andtrade immediate control of an officer called the comp- ”” *’ troUer-general of patents, designs, and trade marks, who acts under the superintendence and direction of the Board of Trade (sec. 82). The Board of Trade is empowered by sec. 101 to make rules and do such things as it thinks expedient, subject to the provisions of the Act, for regu- lating the practice of registration under the Act, and other ancillary purposes, and generally for regulating the business of the Patent Office. The Act deals chiefly with the machinery for making applications for and granting patents and registration of designs and trade marks, and but few changes have been made in sub- stantive law. The application for a patent is made to the comptroller, accompanied by a provisional speci- fication. It is then referred to an examiner to report whether the nature of

the invention has been fairly described, whether the application, specification, and drawings (if any) have been prepared in the pre- scribed manner, and whether the title sufficiently in- dicates the subject matter of the invention (sec. 6). The reader will notice the limited scope of the duties of the examiner. He does not, for instance, report on the novelty of the invention having regard to previous patents. If the examiner reports unfavourably the comp- troller may require an amendment and vary the date so as to make the application run from the time when the amendment is made (Patents Act, 1888, 51 and 52 Vict, c. 10, sec. 2). Under the Patent Law Amendment Act, 1852, all provisional specifications were published. Under the present Acts they are now only published after the complete specification has also been filed, and not at all if the application is abandoned (Patents Act, 1885, 48 and 49 Vict. c. 63, sec. 4). The complete specification must be left at the Patent Office within nine months from the date of application (sec. 8 (1)), with power for the comptroller to extend the term for not exceeding one month (Act of 1885, sec. 3). The complete specifica- tion is again referred to the examiner, and if accepted the comptroller advertises his acceptance, and any person may within two months oppose the grant on various specified grounds, including the ground that the invention has been patented in Great Britain on an application of prior date (sees. 9, 10, and 11). The comptroller hears the parties and gives his decision on the case, but there is an appeal to the law officer (either the Attorney-General or the Solicitor-General) from the comptroller’s decision on this question, as well as from the other decisions of the comptroller of each stage of the proceedings. The law office^j’s decision is final. He has therefore to exercise important judicial functions, but where there is a serious question to be tried the practice is for the law officer to allow the grant to be made, leaving the opponents to assert their right in a court of law. Increased facilities for amending a complete specification, after grant of a patent, are given by sec. 18, and restrictions are placed on the recovery of damage in respect of infringement be- fore amendment by sec. 20. The proceeding by scire facias to repeal a patent is abolished, but revocation of a patent may be obtained on petition to the Court by the Attorney- General or any other person authorized by him, or, speak- ing generally, any person aggrieved by the grant of a patent (see. 25). There are two alterations of substan- tive law which should be noticed. By sec. 22 the Board of Trade is empowered in certain defined cases to order the patentee to grant licences

on such terms as the Board may deem just, and any such order may be enforced by

mandamus. And by sec. 27 a patent has the like effect against the Crown as it has against a subject, but with power to the officers of the Crown to use the invention for the service of the Crown on terms agreed upon, or in default of agreement to be settled by the Treasury. Formerly the rule was otherwise, the Crown not being bound, unless expressly named in the terms of the grant {Feather v. The Queen, 6 B. and S. 2.57).

The practice in trials of patent actions remains unal- tered, except that in a claim for infringement or a pro- ceeding for revocation the Court may at any time give the patentee, on terms, liberty to apply for leave to amend his specification by way of disclaimer, and post- pone the trial in the meantime (sec. 19). No attempt has been made, nor perhaps can successfully be made, by legislation to limit the length and expense of patent actions, for which the parties are chiefly responsible. Something may be done by the judge, no doubt, to limit the number of expert witnesses or curtail the cross-examination, but it is always a delicate matter for the judge to interfere with the discretion of counsel, when the exclusion of evidence may involve defeat in the Courts of Appeal, or, at best, a new trial. Frequently when the case is heard on appeal it is found that the questions both of validity of the patent and infringement turn on the construction of the specification, on which the expert evidence is of little assistance.

It is unnecessary to comment on the procedure pre- scribed for applications to the comptroller for registra- tion of designs and trade marks. The appeal from decisions of the comptroller is to the Board of Trade, which has power to refer the matter to the High Court, and usually does so in a case of any difficulty. One incidental result of the registration of trade marks (first established in 1876) deserves notice. Formerly no dis- tinction was made, and it was not necessary to make any distinction between trade marks and

trade names, mean- ing a name which by usage has come to denote the goods of a particular person or firm in the market. Many of the cases described as trade mark cases are really cases of a trade name. But trade names are not within the Trade Marks Acts. Consequently a person may still prove his right to a trade name and prevent the use of it on the goods of another person, although as a trade mark it does not fulfil the conditions required by the Acts, and is therefore incapable of registration. The jurisdiction of the Court is undoubted, and is founded on elementary principles of mercantile morality (see the cases of Mont- gomery V. Thompson, 1891, A.C. 217, and Beddaway v. Banliam, 1896, A.C. 199, both in the House of Lords). But a distinction must be made between the name attached to a new article introduced by a manufacturer, in the sale of which he has no monopoly, and a name denoting the manufacture of a particular person (see the Cellular Clothing Company's case, 1899, A.C. 326). If all the world may manufacture and sell the goods, they may primd facie describe them by the name by which they are known in the market.

The County Courts (remarks the comte de Franqueville) are at once the most ancient and the most modern of Eng- lish civil tribunals. The Saxon Curia Comitatus, County maintained after the Norman Conquest, was a Courts. IqqqI court and a small debts court. But other- wise it had little similarity to the County Courts founded in the year 1846 by an Act (9 and 10 Vict. c. 95) with the modest title of "An Act for the Eecovery of Small Debts and Demands in England." The original limit of the jurisdiction of the new courts was £20, but this was extended in 1860 to £50 in actions of debt. Thirteen amending Acts were passed, by which new jurisdiction was from time to time conferred on the County Courts, and

in the year 1888 an Act (51 and 52 Vict. c. 43 was passed) repealing the previous Acts and consolidating their pro- visions, with some amendment. This is now the code or charter of the County Courts. The grain of mustard-seed sown in 1846 has grown into a goodly tree, with branches extending over the whole of England and Wales ; and they embrace within their ambit a more multifarious jurisdic- tion than is possessed by any other courts in the kingdom. England and Wales were mapped out into 59 circuits (not including the City of London), with power for the Crown, by Order in Council, to abolish any circuit and rearrange the areas comprised in the

circuits (sec. 4). This power has been exercised, and there are now 54 circuits only. There is at present one judge to each circuit, but the Lord Chancellor is empowered to appoint two judges in a cir- cuit, provided that the total number of judges does not exceed 60. Every circuit (except in Birmingham, Clerk- enwell, and Westminster) is divided into districts, in each of which there is a court, with a registrar and bailiffs. The judges are directed to attend and hold a court in each dis- trict at least once in every month, unless the Lord Chan- cellor shall otherwise direct (sees. 10, 11). But in practice, says Judge Snagge,^ the judge sits several times a month in the large centres of population, and less frequently than once a month in the court town of sparsely inhab- ited districts. By sec. 185 of the Act of 1888 the judges and officers of the City of London Court have the like jurisdiction, powers, and authority as those of a County Court, and the County Court rules apply to that Court.

The ordinary jurisdiction of the County Courts is thus tabulated by Judge Snagge : —

Subject matter. limit o?jSStion.

Common-law actions, with written consent of both parties Unlimited.

Actions founded on contract (except for breach of promise of marriage, in which the County Courts have no jurisdiction) . £50.

Actions founded on tort (except libel, slander, and seduction, in which the County Courts have no jurisdiction) . . £50.

Counter claims (unless plaintiff gives written notice of objection) Unlimited.

Ejectment or questions of title to realty . £50 annual value.

Equity jurisdiction £500.

Probate jurisdiction £200 personalty

and £300 realty.

Admiralty jurisdiction £300.

Bankruptcy jurisdiction .... Unlimited.

Replevin Unlimited.

Interpleader transferred from High Court . £500.

Actions in contract transferred from High Court £100.

Actions in tort transfeiTed from High Court Unlimited.

Companies (winding up), when the paid-up capital does not exceed .... £10,000.

There is no discoverable principle upon which these limits of the jurisdiction of the County Courts have been deter- mined. For example, it is difficult to understand why a County Court should be trusted to try an action of debt for £100 when transferred from the High Court, but not when commenced in the Court itself. Yet it has been so decided on the construction of a badly-drawn section (sec. 85 of the Act of 1888) in Curtis v. Stovin (22 Q.B.D. 613). But the above table is not by any means an exhaustive statement of the jurisdiction of the County Courts. For many years it has been the practice of Parliament to throw on the County Court judges the duty of acting as judges or arbitrators for the purpose of new legislation relating to social subjects. Judge Snagge writes,^ "A

1 " Fifty Years of the English County Courts," by His Honour Judge Snagge, in the Nineteenth Century, October 1897, wMch contains an exhaustive review of the whole subject.

^Nineteenth Century, October 1897, p. 567.

mere catalogue of these Acts of Parliament -would fill a couple of pages, but a short alphabetical list of a few of them may serve by way of illustration : —

Agricultural Holdings Act, 1883.

Bankruptcy Act, 1883.

Coal Mines Regulation Act, 1881.

Debtors Act, 1869.

Employers' Liability Act, 1880.

Friendly Societies Act, 1875. i

Guardiansliip of Infants Act, 1886.

Habitual Drunkards Act, 1879.

Industrial Assurance, &c., Act, 1896.

Law of Distress Amendment Act, 1888.

Mercantile Law Amendment Act, 1856.

Open Shares, &c. , Act, 1890.

Public Health Act, 1875.

Railways Regulation Act, 1871.

Settled Land Acts, 1882-90.

Tithe Act, 1891 ; and (last but not least)

Workmen's Compensation for Injuries Act, 1897."

It appears from the judicial statistics for 1899 ^ that there were in that year 1,152,163 plaints entered in the County Courts to recover sums amounting altogether to £3,485,698. The number of plaints is smaller, but the amount sued for is slightly larger than the corre- sponding figures for 1898. On the whole the number of plaints has been steadily increasing, and in 1901 there were nearly twice as many as there were in 1889. There were also 1618 actions remitted from the High Court during the year 1899. These figures do not in- clude proceedings in bankruptcy, winding up, and other matters.

There is an appeal from the County Courts on matters of law in all cases where the debt or damage or claim in interpleader exceeds £20, and in actions for the recovery of land exceeding £20 in yearly value, to a divisional court of the High Court, i.e., to the Admiralty Division in Admiralty cases and to the King's Bench Division in other cases (sec. 120 of Act of 1888). The determination of the divisional court is final, unless leave be given by that court or the Court of Appeal (Judicature Act, 1894, sec. 1 (5)). But if leave be given there is a further appeal from the Court of Appeal to the House of Lords, except in bankruptcy (47 Vict. c. 9, sec. 2). In proceedings under the Workmen's Compensation Act, 1897 (as we have seen), the appeal from a County Court judge is to the Court of Appeal, with a subsequent appeal to the House of Lords.

The County Courts may have a still greater future. The Judicature Commissioners in their second report^ suggested that the jurisdiction of the County Courts over common-law actions might be made unlimited, with power for defendants to demand a transfer to the High Court. This suggestion (as has been seen) was not adopted, but in the process of decentralization (which seems inevitable) the County Courts may hereafter become local courts of first instance for legal business of every description, without limit of jurisdiction, leaving the courts in London to do the appeal business and the London business proper, with power to remove any action to London for trial for stated reasons.

Few alterations have been made in the administration of the criminal business in the courts during the period under review. Between 1876 and 1880 an trials?^' attempt was made to consolidate and codify the criminal law of England. The subject was referred to a commission, consisting of

Lord Blackburn, Lord Justice Lush, Mr Justice Barry (of the Irish Bench), and Mr Justice Stephen, and upon their report a Bill was introduced by Lord Justice Holker, then Attorney- General, but it did not become law, and has not since

1 Judicial Statistics, 1809, pp. 42, 147.

2 Parliamentary Paper, 1872, No. 631.

been introduced.' The same fate befell a Bill brought in by Lord James of Hereford, when he was Attorney- General, in 1884, for the establishment of a court of criminal appeal. There is a great difference of opinion as to the expediency of a court of criminal appeal, and, as usually happens, the difference is aggravated by persons not exactly realizing what it is they mean. The King's Bench Division (Crown side) and the Court of Crown Cases Reserved exist for the purpose of correcting errors of law which appear on the record in a criminal case, or which arise in the course of the trial, and act as courts of cassation for that purpose. If their jurisdiction is not wide enough to embrace all cases of legal error in criminal trials, let it be amended. The supporters of a court of criminal appeal, however, point to the anomaly of an appeal on facts existing in every civil case affect- ing property, but there being none in cases affecting a subject's liberty or even life. The statement is not correct. There is no appeal from the verdict of a jury in a civil case where there was evidence for their con- sideration, but only a right to a new trial where the ver- dict is against the weight of evidence; and under the rule of Lord Esher a new trial on this ground was practically unattainable. What they really want is a re-trial by the court, and that the court should do for- mally what the Home Secretary does informally. On the other hand, it is urged that it would have a bad effect on juries to take from them the sense of the finality of their verdict and consequent responsibility. One use of a court of criminal appeal would be to attain some general standard in the sentences on convicted persons. In the opinion of the writer a court might safely be established for granting new trials where the verdict is against the weight or (say) preponderance of evidence, or where fresh evidence can be adduced, and with power to diminish but not increase sentences.

By the Criminal Evidence Act, 1898 (60 and 61 Vict, c. 36) a prisoner, or the wife or husband of a prisoner, is made a competent witness for the defence at every stage of the proceedings, subject to certain conditions, of which the principal are that a prisoner shall not be called except on his or her own application, and the failure of the prisoner or his wife or her husband to give evidence is not to be the subject of comment by the prosecution, and the prisoner cannot be cross-ex- amined as to any previous offence or conviction or as to character, unless the proof of a previous offence is admissible evidence in the case, or he or she has given evidence of his or her good character, or cross-examined with that view. A party, therefore, is now competent to give evidence on his or her own behalf, both in civil and criminal matters.

Attention may now be called to other legal reforms which do not relate to the machinery for ad- Legal ministration of the law, but deal with subjects reforms of first-rate importance and directly touch adto/n/f- administration, more particularly in the Chan- tratioa. eery Division of the High Court.

The Conveyancing Act, 1881 (44 and 46 Vict. c. 41, amended by 46 and 46 Vict. c. 39) simplifies and improves the practice of conveyancing. It vests in trustees, mort- gagees, and others various powers commonly conferred by provisions inserted in settlements, mortgages, wills, and other instruments. It prescribes what matters covered by general words shall be deemed to be included, and what covenants for title shall be implied in conveyances of land. And it amends, in certain particulars, the law of

8 It may be of interest to observe that a Code of Criminal Law following with some amendments the Bill of 1880 has been passed by the Parliament of New Zealand, and a similar Code, founded largely on the Report, has been passed by the Parliament of Queensland.

property. But the Act does not lay down or proceed upon any new departure in principle.

Lord Cairns's Settled Land Act, 1882 (45 and 46 Vict. c. 38, amended in details by three subsequent Acts of 1885,

1889, and 1890 1) is an Act of a different f andlrts character. The general scheme of these Acts

is to invest the tenant for life of a settled estate with all the powers of management and disposition which are enjoyed by a fee-simple owner. A tenant for life is empowered to sell the estate (sec. 24) or the heir- looms held with it (sec. 37). But he cannot sell the principal mansion-house, its pleasure-grounds, park, and land usually occupied there, without the consent of the trustees of the settlement or of the court (63 and 54 Vict. c. 69, sec. 10), or the heirlooms without an order of the court (Act of 1882, sec. 37 (3)), and in case of any sale he has to give notice to the trustees (sec. 45 (1)). A tenant for life is required to have regard to the inter- ests of all parties, and is to be deemed to be in the posi- tion and to have the duties and liabilities of a trustee for those parties (sec. 53). What the effect of this section is, beyond requiring the tenant for life to use reasonable means of selling to the best advantage with- out any profit to himself or reservation in his own favour, it is not easy to see. He is made the absolute judge whether the estate shall be sold or not, and it is no objection to a sale that the necessity for it arises from his own extravagance or improvidence, or that it is for his own relief, or that all the other parties interested are opposed to it. In the Ailesbury case (1892, A.C. 356) the tenant for life of a large estate, with a family man- sion and park, had encumbered his life estate to such an extent that it was of no pecuniary value to him, and at the instance of his creditors proposed to sell the whole estate. All the persons interested in remainder opposed the sale, and Mr Justice Stirling refused to consent to the sale ; but his decision was reversed in the Court of Appeal, and the decision of the latter court was affirmed in the House of Lords. The important principle was there laid down that in exercising its discretion the court might have regard to the interests of the tenants on the estate, as well as of the remainder men, and as a tenant for life in that position could not do his duty to the land, the sale was permitted to take place not-

withstanding the opposition of the family. The con- tract was subsequently rescinded on a question of title, and shortly afterwards the tenant for life died. It may be inferred from the judgment of the Court of Appeal in Lord Radnor's case (45 Ch.D. 402), which was an appli- cation for leave to sell certain heirlooms, that the court will not overrule the discretion of the tenant for life when exercised in good faith and on reasonable ground, notwith- standing the opposition of remainder men. The tenant for life is also empowered to grant leases for ninety-nine years for building and for sixty years for mining purposes, and, with the consent of the court, for any term or in per- petuity where it is the custom in the district for land to be sold or where it is difficult otherwise to make leases or grants for these purposes (sees. 6-10), and on a grant in fee for building purposes a rent charged may be reserved (Act of 1890, sec. 9). By sec. 11 of the last-mentioned Act the tenant for life is also empowered to raise money by mortgage of the estate for the discharge of incum- brances The Acts contain provisions for the investment and application of purchase money, or other capital money, arising from exercise of the powers of the Act and other ancillary provisions, and a very wide definition of the persons included under the expression « tenant for life It may be added that the powers of the tenant for hfe

1 48 and 49 Vict. c. 72, 52 and 53 Vict. c. 36, 53 and 54 Vict. o. 69.

cannot be assigned and will not pass by an assignment of the life estate, but cannot be exercised without the consent of the assignee, and that a contract by a tenant for life not to exercise his power is void (Act of 1882, sec. 50 (1) (2)).

The Settled Land Act was unquestionably a bold and well-conceived piece of legislation. It has proved ex- tremely beneficial in ridding land of encumbered owners and making it marketable. It has also benefited owners of settled property, the income of which, when invested in land, is insufficient to support their social position or family obligations. And, on the other hand, an owner who pre- fers to retain his family estate is enabled, either by sell- ing outlying parts or by mortgage, to raise money for its development and permanent improvement.

The history of the registration^ either of assurances or of titles to land in England is one of half-hearted legislation and consequent failure. The subject negistra- was agitated iu the Long Parliament, but it tionot was not until the reign of Queen Anne that the **i**‘^^ *° experiment was made. Eegistries of deeds and ” ‘ wills were established for the county of Middlesex by 7 Anne c. 20, for the West Riding of Yorkshire by 2 and 3 Anne c. 4, and for the East Riding and Kingston-upon-Hull by 6 Anne c. 62; and by 8 Geo. II. c. 6 similar provisions were applied to the North Riding. Presumably these Acts were intended as an experiment, with a view to the ultimate extension of a similar system to other parts of England. The policy of the Acts was to give priority to registered assurances over un- registered ones, and thereby secure publicity and safety to transactions in land. This object, however, was de- feated by the lawyers in the Court of Chancery. It was there held by Lord Hardwicke that the equitable doc- trine as to the effect of notice was not exchided by the Acts, an consequently a settlement prior in date, but unregistered, was allowed priority over a subsequent registered settlement made with notice of the first one {Le Neve v. Le Neve, Amb. 436). Sir William Grant in following this decision said, ” It has been much doubted whether the courts ought ever to have suffered the question of notice to be agitated against a party who has registered his assurance ” (Wyatt v. Barwell, 19 Ves. 435). On the other hand it was held that registration is not notice, so that a prior registered owner for an equitable interest was postponed to a subsequent pur- chaser with the legal estate and with no notice (except by the registration) of the prior interest. This was decided by Lord Camden on the authority of an earlier unreported case. In his judgment Lord Camden said, “If it were a new case I should have my doubts, but the point is closed by the earlier case,” and expressed his opinion that the previous decision had led to great laxity in searching the registers (Morecock v. Dickins, Amb. 678). The experiment was not extended to other parts of England. The chief result of the statutes of Anne was to confer valuable pieces of patronage on the Lord Chancellor, and to increase the cost of conveyancing in the two counties and occasionally furnish materials for litigation.

So things remained until the year 1862, when Lord West- bury carried an Act (25 and 26 Vict. c. 53) for the registra- tion of titles to land. This, it will be observed, was a new departure. The difference between a system of registration of assurances and one of registration of titles is vital. In the former case the conveyance creates the title, and the registration is only for

the purpose of preserving a record of it and giving it publicity. In a system of registration

2 See Registration (Land), Encyclopsidia Britannica, vol. xx. p. 342, and Land Registration in the present volume.

of titles, on the other hand, the entry of the person's name on the register constitutes his title. The previous deed is but the authority to the registrar to enter the name of the grantee in the place of the grantor, and the subsequent certificate is evidence only of the entry. Eeg- istration under Lord Westbury's Act was optional, and the Act required an official investigation and judicial declaration of title before registration. The Act was useful to persons who desired to sell their land in small lots without the expense to the purchasers of investiga- tion of title, but was not likely to be generally adopted. Tew titles could pass the ordeal of an ofiicial examina^ tion, and no prudent person would run the risk of his title being rejected or " blown upon." As it would be necessary to have the title examined by the applicant's own conveyancer before being submitted to the ofS.ce, the expense of registration under this Act was also excessive.

In 1875 Lord Cairns's Land Transfer Act (38 and 39 Vict. c. 87) was passed. Like its predecessor, this Act was optional only. But it introduced the principle of registration without previous investigation. The scheme of the Act was to enable (1) a purchaser of an estate in fee simple, (2) any person entitled in law or equity to a like estate, (3) any person entitled to dispose for his own benefit of a like estate, and in each case, whether subject to incumbrances or not, to be registered, either with an absolute or qualified title, after an ofiicial investigation of the title, or with "a possessory title," without such investigation. A " possessory title " gives no better right to the holder of it than he had before, but forms a root of a new title which, if the land remains on the register, will by lapse of time mature into an absolute registered title. The result is that a vendor with a registered

” possessory title ” can only be required to give a pur- chaser an abstract of his title antecedent to registration for such a period as, together with the period subsequent to registration, would make up forty years. But in prac- tice a purchaser would probably be satisfied with a much shorter period. One objection to Lord Westbury’s Act was thus removed, and in the opinion of the writer this is undoubtedly the sound principle on which legislation should proceed, though some impatient reformers clamour for more drastic treatment. It will be observed that the Act of 1875 does not provide for the registration of land in settlement, except where the legal estate is vested in trustees.

Prior to 31st December 1898, when the Registry Act came into force, 411 titles had been registered under Lord Westbury’s Act, and 187 absolute or qualified titles, and only 144 possessory titles under Lord Cairns’s Act. What is the reason for the failure of landowners to make greater use of these Acts ? It must sorrowfully be ad- mitted that the solicitors (speaking generally) assumed an attitude of hostility or indifference to the new system, and did not advise their clients to register their titles. It would be unfair to a profession of high-minded men to attribute this entirely to motives of self-interest. It arose partly from a natural conservatism, and partly from a professional fear of leaving a system of convey- ancing in which they were brought up, and which they understood, for an untravelled country, the charms of which they inadequately understood and were slow to appreciate. It is not wonderful that eminent members of that branch of the profession have persuaded them- selves and publicly maintained that the disadvantages of a system of registration of title exceed its advantages. But it is strange that the bankers have not been advocates of the new system. They seem to regard the facility of lending money to their customers on deposit of deeds without the publicity of registration as essential to their

business, though it does not exist in Scotland, or at the present time in Yorkshire. And they forget that they have been the principal sufferers from the frauds which have arisen out of this very facility, and which would have been impossible with an efficient system of registration either of title-deeds or of titles.

In the year 1884 the Yorkshire Registries Act (47 and 48 Vict. c. 54) was passed for the purpose of consolidat- ing and amending the law relating to the registration of deeds and other matters affecting lands within the three Eidings. The Act provides for the registration of assur- ances and wills (sec. 4), memoranda of lien or charge (sec. 7), and intestacies (sec. 12). It is provided (sec. 7) that no lien or charge shall have any effect or priority against a registered assurance for valuable consideration unless and until a memorandum thereof has been regis- tered ; and (sec. 14) that all assurances shall have priority according to the date of registration, and every regis- tered will shall have priority according to the date of the testator's death if registered within six months there- after, or according to the date of registration if not made within that period ; and further, that all priorities given by the Act shall have full effect in all courts except in cases of actual fraud, and no person claiming legal or equitable interests under any registered instrument shall lose his priority merely in consequence of having been effected with actual or constructive notice, except in cases of actual fraud. By sec. 16 registration of any instru- ment has the effect of notice of such registration, and of the fact of registration to all persons and for all purposes whatsoever, as from the date of registration. There are other ancillary and necessary provisions. It will thus be seen that the main defects of the Acts of Anne have been remedied so far as the Yorkshire registries are concerned, with the singular result that one county enjoys a system of land tenure differing in material respects from those prevailing in other English counties.

In the successive years 1893, 1894, and 1895, Bills were brought in by Lord Herschell for the compulsory registration of titles to land. The general scheme and main features of all these Bills are the same as those of the Torrens system adopted in Australia, and as those of the system in use in Germany and Austria-Hungary, but they are drafted on the lines of amending and supplement- ing the Act of 1876. At length, in 1897, the Land Trans- fer Act (60 and 61 Vict. c. 66) was passed on a Bill brought in by Lord Halsbury. This Bill was, in fact, the Bill of 1895, with some special provisions to meet objections which had been urged by opponents before the Select Com- mittee of the House of Commons on the earlier Bill. Part I. provides for the real estate of a deceased person becom- ing vested in his personal representative from time to time as if it were a chattel real. This is

an excellent provision, and is essential for any efScient system of registration. Part II. contains amendments of the Act of 1875. Amongst other things provision is made for the registration of set- tled land at the option of the tenant for life either in his name or in the names of trustees, with a power of sale (if any), or in the names of persons having an over-riding power of appointment of the fee simple (sec. 6), with a special provision as to land held by incumbents of a bene- fice (sec. 16) ; and a power is given to remove land from the register (sec. 17), which meets one objection which has been made. Part III. provides for compulsory regis-tration and an insurance fund. The Crown is empowered by Order in Council, as respects any county or part of a county, to declare that after a named day registration of title (under the Act of 1876) shall be compulsory on sale (not, it will be observed, on any devolution of title by death), subject to a veto of the county council. Such an Order in Council has been made as regards the county of

London, and registration is therefore now compulsory in that county. But registration cannot be made compul- sory in any other county except upon a resolution of the county council, passed at a meeting at which two-thirds of the whole number of the members shall be present. It remains to be seen whelher the success of the experi- ment in London will induce other counties to adopt the Act, or whether the Act will share the neglect of previous Acts.

In the meantime the old system of conveyancing will continue. Abstracts of title will still be delivered and investigated afresh on every transaction. Bankers and others will still lend money on deposits of deeds, and find themselves postponed to an earlier equitable title of which they had no notice, or to a subsequent purchaser who has acquired the legal estate without notice of their incum- brance. And it will still be possible for ingenious per- sons to defraud creditors and purchasers by manufactur- ing a duplicate set of deeds. Much has no doubt been done by the

Conveyancing Acts to restrain the exuber- ance of legal language in conveyances and other instru- ments, and perhaps still more has been done by the Solicitors' Remuneration Act, 1881 (44 and 45 Vict. c. 44), which permits ad valorem charges for conveyancing business. Under this Act a scale of costs for convey- ancing business has been established by General Order, 1882. This scale was prepared and agreed upon by the solicitors themselves, but, from the number of decisions on the construction of it, its language does not appear to be free from ambiguity.

A favourite fiction of the common law that husband and wife make one person, and that person, it may be added, the husband, was rudely shaken by the 2s to Married Women's Property Act, 1882 (46 and

married 46 Vict. c. 75), repealing an earlier Act of 1870. women. Under this Act a married woman may possess and enjoy her own, whether acquired before or after mar- riage, and may contract with the consequent ability to sue and liability to be sued in respect of her separate property. Mention may also be made of the G-uardian- ship of Infants Act, 1886 (49 and 60 Vict. c. 27), which for the first time recognizes the right of a widow to be guardian of her own child. The Bill for this Act, as in- troduced into the House of Commons, contained a declara- tion of the equal rights of the spouses in their children during marriage. But this conception of marriage as a partnership between equal partners enjoying equal rights secured by community of interests was thought to be too wide of the facts of life to form a safe basis for legisla- tion. The consideration of the status of married women enjoying separate property has lately come before the courts, chiefly in connexion with the enforcement of judg- ments against them. Some ladies seem to have a rooted distrust of their solicitors and counsel alike, and an im- perfect appreciation of the nature or meaning of a judg- ment. The quarrels between a notorious litigant and her solicitors have had the solitary advantage of helping to settle the law as to the mode of enforcing a judgment against the separate property of a married woman.

The materials with which the lawyer has to do his work are second only in importance to the rules in accordance with which his work has to be done. Eeports Codifica- ^^^ statutes are his stock-in-trade. England is ”””■ not yet within a measurable distance of a civil

or criminal code; but some progress has been_ made towards that end by the passing from time to time of various Acts codifying branches of law. The principal ones are the Bills of Exchange Act, 1882 (45 and 46 Vict. c 61), the Partnership Act, 1890 (63 and 54 Vict. c. 39), the Trusts Act, 1893 (56 and 57 Vict. c. 63), and the Interpretation Act, 1889 (62 and 63 Vict. c. 63). These

Acts have been prepared with great care under the best expert advice, and experience has demonstrated their utility to the layman as well as the lawyer. A Bill for the like treatment of the law relating to marine insurance has been proposed in more than one session. A Bill for a criminal code was brought in in 1879 and dropped.

The Statute Law Revision Committee have continued their useful work of excising dead law from the statute book, partly by repeal of obsolete and spent Acts and parts of Acts, and partly by pruning redundant preambles and words. The construction of a section of an Act may depend on the preamble and the context, and the repeal of the preamble and certain parts of the Act may therefore affect the construction of what is left. This is provided for by a clause which is said to have been settled by Lord Westbury. It provides (in effect) that the repeal of any words or expressions of enactment shall not affect the construction of any statute or part of a statute. The lawyer, therefore, cannot rely on the revised edition of the statutes alone, and it is still necessary for him to consult the complete Act as it was originally enacted. Perhaps it does not very much matter.

But it is a pity, while efforts are made to get rid of dead law and improve the record of that which is kept alive, that equal care is not taken that new enactments should be made in accurate and intelligible language. The most superficial acquaintance with the current deci- sions in the courts will show how much of the time of the judges is taken up in coping with the obscurity of modern Acts of Parliament. This is not altogether the fault of the distinguished lawyers who have filled the place of Treasury counsel or Government drafts- ™ “*^ men. Bills are required to be drawn so as to be passed on the lines of least resistance, and this is found in the clauses incorporating or making applicable sections of a previous Act, or providing that a previous enactment should be read as if a were 6 or c were d.

Sometimes on referring to a previous Act you find that you are referred back to an even earlier one. Legislation by reference has its merits and a use of its own, no doubt, but lucidity is not one of the merits. Again, a minister in charge of a Bill is always desirous of getting it through within his allotted time, and sometimes too readily accepts an amendment without complete appreciation of its bearing on the particular section or the general scheme of the Bill. In the House of Lords ministers are naturally anxious to get a difficult Bill through without serious amendment which will occasion fresh opposition or de- bate in the Commons. More may no doubt be done in the way of revision by the authors of the Bill in the interval between the two Houses, and in the House of Lords if the Bill originates in the Commons. But the remedy in the long-run lies with the House of Commons. The costs of interpreting an obscure enactment (by means of an action with an appeal first to the Appeal Court and then to the House of Lords) fall upon the suitor, i.e., upon the electorate. If members steadily set their faces against the consideration of any Bill the meaning of which cannot be discovered within its four corners, it would do some good ; and if greater care were exercised in accept- ing amendments, and in revising those that have been accepted, still greater improvement might be hoped for.

The pressure on the time of Parliament is the excuse for the growing tendency of leaving the details of legis- lation to be dealt with by rules to be made by an authority named in the Act. This is no doubt necessary in some cases, as for instance in the Judicature Acts. But it is, in fact, the delegation by Parliament to other bodies, or even individuals, of legislation, often of an im- portant character. In many cases the mode in which the enactments are to be worked out in practice may affect

the whole question of the expediency or justice of the Act itself. Again, under the guise, and for the purpose of framing rules, the rule-making authority may and some- times must put its own interpretation on the Act, and if (as is usually the case) the rules have the effect of a stat- ute the

interpretation thus given becomes irrevocable. In this way the function of the courts of law is usurped. It is true that by 56 and 67 Vict. c. 66, notice of the proposal to make any statutory rules (with large excep- tions) is required to be published in the London Gazette, forty days before the making thereof ; and in some cases the rules are required to be laid on the tables of both Houses of Parliament before they come into operation. But every one who has sat in either House knows how slender are the means of the private member to call attention to the subject with effect, and how little real protection is secured by the presentation of the rules to Parliament.

The lawyer relies on the reporter as well as on the legislator, and here he is better served. The movement originated by Mr Daniel led to the formation of the Council of Law Eeporting in the year 1863. poHiag. ‘^’^ council now consists of three ea>officio members — the Attorney-General, the Solicitor-General, and the President of the Incorporated Law Society, and ten members appointed by the three Inns of Court, the Incorporated Law Society, and the council itself on the nomination of the General Council of the Bar. Amongst the eminent persons who have presided over the council the most conspicuous for his services is Mr Joseph Brown, K.C., who for many years successfully devoted a large amount of his valuable time to the de- tails of the business vp^ith a view to the improvement of the Reports and to economy in their production. The practitioner and the student now get for a subscription of four guineas a year the Reports in all the Superior Courts and the House of Lords, and the Judicial Com- mittee of the Privy Council issued in monthly parts, a king’s printer’s copy of the Statutes, and Weekly Notes, containing short notes of current decisions and announce- ments of all new rules made under the Judicature Acts and other Acts of Parliament, and other legal informa- tion. In addition the subscriber receives the Chrono- logical Index of the Statutes published from time to time by the Stationery OfB.ce, and last, but not least, the Di- gests of decided cases published by the Council from time to time. In 1892 a Digest was published contain- ing the cases and statutes for twenty-five years, from 1865 to 1890, and this vfas supplemented by one for the succeeding ten years, from 1891 to 1900. The digesting is now carried on continuously by means of “Current Indexes,” which are published monthly and. annually, and will be consolidated into a digest at stated intervals (say) of five years. The Indian appeals series, which is not required by the general practitioner,

is supplied separately at one guinea a year. Those who remember the cost of keeping up a law library before the publi- cation of the Law Reports will appreciate the immense benefit conferred on the practitioner and on the public by the work of the Council. That the Reports are perfect no one will dare to affirm. Criticisms were freely made on the editing and reporting, and for a few years a rival set of reports with the ambitious title of TJie Reports was published. But this series died a natural death, and under the present editorship it is believed that there is less room for criticism. When the writer was chairman of the Council the complaints were for the most part that too much or too little was reported, showing how difficult is the work of the editor in draw- ing the line between cases laying down new principles or merely applications of old principles. Usually the critic

complained that some case in which he had a special in- terest was not reported. A great portion of the reports is taken up with the construction of public Acts or of statutory rules which is of comparatively ephemeral value.

But what of the Bar itself ? It was widely felt amongst members of the Bar that it was not adequately represented by the Inns of Court with their self-elected ·^ ^^ bodies of benchers. At length a Bar council was formed, consisting of a just proportion of Queen's [King's] Counsel and outer barristers elected by all the members of the Bar. This council was subsequently reorganized under the name of the General Council of the Bar. It receives complaints and suggestions from barristers and watches over the discipline of the Bar, but its most useful public work is in criticizing proposed legal changes and publish- ing reports of its committees thereon. The reports of the Council of the Bar are often of great value and receive attention in the highest quarters. It has sometimes seemed to the writer that to advocate a high standard of legal training for admission to the Bar is presumptuous in one who was called at a time when neither legal education nor examination was required, and who is estopped from saying that a fair measure of success may not be attained both at the Bar and on the Bench without either one or the other. But, nevertheless, the writer believes such a training is essential to the wellbeing or even the con- tinued existence of the Bar. England is no doubt the paradise of amateurs, but, after all, the need of a distinct professional training is gradually being recognized in every profession and calling. A commission which was appointed in 1854

recommended by their report the formation of the Inns of Court into a Legal University, with power to confer degrees in law. In 1876 Lord Selborne brought in a Bill for this purpose, but failed to pass it through Parliament. The writer regrets that the Inns of Court did not avail themselves of the opportunity of carrying out this recommendation in substance by accepting the invitation of the London University Com- missioners to become the Law Faculty of that university. However, the benchers have for some time past recognized the call for some legal education in candidates for the Bar. They have appointed a committee of their own mem- bers, called the Council of Legal Education, under whose auspices lecturers are appointed in the various branches of law, and their lectures have been opened to the general public as well as to the students of the Inns. Candidates since 1872 have been required to pass an examination before being called to the Bar. It has been suggested that a law degree of some English or (under conditions) foreign university might be accepted as a test of general legal knowledge,, and that the tests imposed by the Inns of Court might in that case be confined to such practical or purely professional training as may be thought necessary. Eor admission as a solicitor, a candidate has long been required by the Incorporated Law Society to pass two examinations, but this body has ceased to pro- vide lectures for students.

We have thus seen that within the last thirty years of the Victorian reign the Superior Courts were entirely reorganized on a new model and their procedure cleared of technicality and reduced to the simplest forms, the law relating to bankruptcy, patents, and joint-stock companies reformed, prisoners admitted to give evidence on their own behalf, great innovations made in the law relating to settled estates and the transfer of land, married women entrusted with the ownership of their property and the guardianship of their children, and some progress made towards codification of the law and reduction of the Statute Book to manageable proportions. (d.)

UNITED states]

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II. United States.

The laws of the various states and territories of the United States, and those of England, rest at bottom on the same foundation, namely, the English common law as it existed at the beginning of the 17th century. (See Common Law, below.) The only exceptions worth noting are to be found in the state of Louisiana, the territory of New Mexico, and the acquisitions following the Spanish war of 1898. Those derive most of their law from France or Spain, and thus remotely from the principles of Eoman jurisprudence. A part also, but comparatively a small part, of the law of Texas, Missouri, Arizona, and the Pacific states comes from similar sources. The United States as a whole has no common law, except so far as its courts have followed the rules of English common-law procedure in determining their own. Most of the positive law of the United States comes from the several states. It is the right of each state to regulate at its pleasure the general relations of persons within its territory to each other, as well as all rights to property subject to its jurisdiction. Each state has also its own system of adjective law. The trial courts of the United States of original jurisdiction follow in general the practice of the state in which they sit as to procedure in cases of common-law character. As to that in equity, or what means the same thing, chancery causes, they follow in general the practice of the English Court of Chancery as it existed toward the close of the 18th century, when the original Judiciary Act of the United States was adopted. The public statutes of the United States are to be found in the Revised Statutes of 1873, and in the succeeding volumes of the Statutes at Large, enacted by each Congress. Those of each state and territory are printed annually or biennially as they are enacted by each legislature, and are commonly revised every fifteen or twenty years, the revision taking the place of all former public statutes, and being entitled Revised Statutes, General Statutes, or Public Laws. The private or special laws of each state, so far as such legis- lation is permitted by its constitution, are in some states published separately, and made the subject of similar compilations or revisions ; in others they are printed with the public session laws. American courts are often given power by statute to make rules of procedure which have the force of laws. Municipal subdivisions of a state generally have authority from the legislature to make ordinances or bye-laws on certain subjects, having the character of a local law, with appropriate sanctions, commonly by fine or forfeiture.

Law in the United States has been greatly affected by the results of the Civil War. During its course (1861- 1866) the powers of the President of the Tbexivtb United States may be said to have been mTn”’’ re-defined by the courts. It was its first civil war, and th\is for the first time the exercise of the military authority of the United States within a state which had not sought its aid became frequent and necessary Next followed the Amendments of the Constitution of the United States having for their special purpose the securing beyond question of the permanent abolition of slavery and the civil and political rights of the coloured race. At the outset the Supreme Court of the United States was inclined to treat them as having a very limited operation in other directions. One of the provisions of the XlVth Amendment is that no state shall deny to any person within its jurisdiction the equal pro- tection of the laws. The benefit of this guarantee was claimed by the butchers of New Orleans, in contending against a monopoly in respect of the slaughter of cattle granted by the state of Louisiana to a single corporation. Their suit was dismissed by the Supreme Court in 1873,

with the expression of a doubt whether any action of a state not directed by way of discrimination against the negroes as a class, or on account of their race, would ever be held to come within the purview of the provision in question.! The Chief Justice and three of his associates dissented from the judgment, holding that the XlVth Amendment did protect the citizens of the United States against the deprivation of their common rights by state legislation.^ Public sentiment supported the view of the minority, and it was not long before changes in the personnel of the court, occurring in common course, led it to the same conclusions. The protection of the XlVth Amendment is now invoked before it more frequently than is that afforded by any other article of the Constitution. In one of its recent terms twenty-one cases of this nature were decided.^ Very few of them related to the negro. Since the decision in the Slaughter-house cases, the con- troversies as to the constitutional rights of the negro have been comparatively infrequent, but there has been a great and steadily increasing number in all the courts in the country, involving questions of discrimination in favour of or against particular individuals, or of changes affecting the rights of parties in the accustomed forms of judicial procedure.

Down to 1868, when this Amendment was adopted, it was, as to most matters, for the state alone to settle the civil rights and immunities of those subject to its juris- diction. If they were to be free from arbitrary arrests, secure in liberty and property, equal in privilege, and entitled to an impartial administration, it was because the constitution of the state so declared. Now they have the guarantee of the United States that the state shall never recede from these obligations. This has readjusted and reset the whole system of the American law of per- sonal rights.^

The Supreme Court of the United States has used the great power thus confided to it with moderation. Its general rules of decision are well stated in these words of Mr Justice Brown, found in one of its recent opinions : —

In passing upon the validity of legislation, attacked as contrary to the XIV th Amendment, it has not failed to recognize the fact that the law is, to a certain extent, a progressive science ; that in some of the states methods of procedure, which at the time the constitution was adopted were deemed essential to the protection and safety of the people or to the liberty of the citizen, have been found to be no longer necessary ; that restrictions which had formerly been laid upon the conduct of individuals, or of clas.ses of individuals, had proved detrimental to their interests ; while, upon the other hand, certain other classes of persons, particularly those engaged in dangerous or unhealthful employments, have been found to be in need of additional protection. Even before the adoption of the constitution, much had been done toward mitigating the severity of the common law, particularly in the administration of its criminal branch. The number of capital crimes, in this country at least, had been largely decreased. Trial by ordeal and by battle had never existed here, and had fallen into disu.se in England. The earlier practice of the common law, which denied the benefit of witnesses to a person accused of felony, had been abolished by statute, though, so far as it deprived him of the assistance of counsel and compulsory process for the attend- ance of his witnesses, it had not been changed in England. But, to the credit of her American colonies, let it be said that so op- pressive a doctrine had never obtained a foothold there. The 19th century originated legal reforms of no less importance. The whole fabric of special pleading, once thought to be necessary to the elimination of the real issue between the parties, has crumbled to pieces. The ancient

tenures of real estate have been largely swept away, and land is now transferred almost as easily and cheaply as personal property. Married women have been emancipated from the control of their husbands, and placed upon a practical equality with them with respect to the acquisition, possession, and trans- mission of property. Imprisonment for debt has been abolished.

1 The Slaughter-House Cases, 16 Wallace's Reports, 36, 81.

2 Ibid. 89, 111, 129.

8 Guthrie on the Fourteenth Amendment, 27.

^ Baldwin's Modern Political Institutions, 111, 112.

Exemptions from execution have been largely added to, and in most of the states homesteads are rendered incapable of seizure and sale upon forced process. Witnesses are no longer Incompetent by reason of interest, even though they be parties to the litigation. Indictments have been simplified, and an indictment for the most serious of crimes is novr the simplest of all. In several of the states grand juries, formerly the only safeguard against a malicious prosecution, have been largely abolished, and in others the rule of unanimity, so far as applied to civil cases, has given way to verdicts rendered by a three-fourths majority. This case does not call for an expression of opinion as to the wisdom of these changes, or their validity under the XlVth Amendment, although the sub- stitution of prosecution by information in lieu of indictment was recognized as valid in Hurtado v. California, 110 U.S. 516. They are mentioned only for the purpose of calling attention to the probability that other changes of ho less importance may be made in the future, and that while the cardinal principles of justice

are immutable, the methods by which justice is ad- ministered are subject to constant fluctuation, and that the Constitution of the United States, which is necessarily and to a large extent inflexible and exceedingly difficult of amendment, should not be so construed as to deprive the states of the power to amend their laws so as to make them conform to the wislies of the citizens as they may deem best for the public welfare without bringing them into conflict with the supreme law of the land. Of course, it is impossible to forecast the character or extent of these changes, but in view of the fact that from the day Magna Charta was signed to the present moment, amendments to the structure of the law have been made with increasing frequency, it is im- possible to suppose that they will not continue, and the law be forced to adapt itself to new conditions of society, and particu- larly to the new relations between employers and employes, as they arise.!

The Civil War deeply affected also the course of judicial decision in the Southern states. During its progress it engaged the attention of a very large part of the popula- tion, and the business of the courts necessarily was greatly lessened. Upon its close political power passed, for a time, into new hands, and many fronj. the Northern and Western states took prominent positions both at the bar and on the bench. The very basis of society was changed by the abolition of slavery. ISTew state constitutions were adopted, inspired or dictated by the ideas of the North. The transport system was greatly extended, and com- merce by land took to a large extent the place formerly filled by commerce by navigation. Manufacturing came in to supplement agricultural industry. Cities grew and assumed a new importance. Northern capital sought investment in every state. It was a natural consequence of all these things that the jurisprudence of the South should come to lose whatever had been its distinctive character. The unification of the nation inevitably tended to unify its law.

An important contribution towards this result was made by the organization of the American Bar Association in 1878. Of. the fourteen signers of the call for The Bar ^j^e preliminary conference, five were from the ihm”^’ Southern states. Its declared objects were “to advance the science of jurisprudence, promote the administration of justice and uniformity of legislation throughout the Union, uphold the honour of the pro- fession of the law, and encourage cordial intercourse among the members of the

American Bar.” Each meeting is opened by an address from the president, in which he is to “communicate the most noteworthy changes in statute law on points of general interest made in the several states and by Congress during the preced- ing year.” It has discussed and published papers upon such subjects as ” American institutions and laws” ; “the civil law and codification ” ; ” avoidable causes of delay and uncertainty in our courts ” ; ” the relationship of law and national spirit ” ; ” the distinction between legis- lation and judicial functions” ; “the opportunity for de- velopment of jurisprudence in the United States ” ; “law

1 Solden v. Hardy, 169 United States Reports, 33G, 385-87.

Law schools.

reports and law reporting ” ; “jurisprudence considered as a branch of the social science”; “judicial indepen- dence”; “the necessity for uniformity in the laws governing commercial paper ” ; and ” the development of the law of contracts.” The reports of its committees, and the action which it has taken from time to time, have had a wide influence, not only in shaping legisla- tion, but in directing the course of legal opinion and legal education.

Largely through its efforts, the American law schools have taken on a new character. The course of study has been both broadened and prolonged, and the attendance of students has increased in full pro- portion to the additions to the facilities for obtaining a more thorough training in the profession. In 1898-99 there were nearly 12,000 matriculations in these institutions, which is more than double the num- ber at the close of the preceding decade. When the association commenced its labours, those studying law in the ofl&ces of practising lawyers very largely outnum- bered those found in the law school. The proportion is now reversed. During the year 1900, for instance, the State Board of Law Examiners in New York examined 899 applicants for admission to the bar of that state. Of these all but 157 had received their legal education wholly or in part at a law school.^ In 1878 few law schools had adopted any system of examination for those desiring to enter them. Such a requirement for admis- sion is now common. In only one school were opportu- nities then afforded for advanced studies by graduate students with a view to attaining the doctorate in law. Courses of this description are now offered by several of the university schools.

A more scientific character has thus been taken on by American law. It is noticeable both in legal text-books and in the opinions of the courts of last resort. In the latter precision of statement and method in discussion are invited by the uniform practice of preparing written opinions. The original practice of reading these from ^^

the bench has been generally discontinued. They are simply handed down to an oflB.cial reporter for pub- lication, which is done at the expense of the Govern- ment by which the court is commissioned. With the judicial reports

of each state the lawyers of that state are required to be familiar ; and this is rendered possible, even in the larger ones, by state digests, prepared every few years by private enterprise. Outside of the state their circulation is comparatively limited, though sets of all are generally found in each state library, and of many in the Bar libraries at the principal county seats. The private libraries of lawyers in large practice also often contain the reports of adjoining and sometimes those of distant states, as well as those of their own and of the Supreme Court of the United States. The decisions of one state, however, are now best known in others through unofiicial reports. One large publishing concern prints every case decided in the courts of last resort. They are published in several distinct series, those, for instance, coming from the Northern Atlantic states being grouped together as the Atlantic Reporter, and those from the states on the Pacific coast as the Pacific Reporter. Another house has published a compilation professing to give all the leading American cases from the iirst to the latest volume of reports. Another makes a similar selection from the decisions of each year as they appear, and publishes them with critical annotations. There are also annual digests of a national character, com- prehending substantially all American cases and the leading English cases reported during the preceding year.

^ Columbia Law Review, i, 99.

These various publications are widely diffused, and so the American lawyer is enabled, in preparing for the argument of any cause involving questions of difficulty, to inform himself with ease of such precedents as may apply. A court in Texas is thus as likely to be made acquainted with a decision in Maine or Oregon as with one in any nearer state, and in the development of Ameri- can law all American courts are brought in close touch with each other.

This tendency has been advanced by the steady growth of codification. (See Code.) That is beginning also to Bngiisb serve to bring English and American law nearer and together in certain directions. A Negotiable

American Instruments Act, promoted by the American ‘*”’■ Bar Association, and prepared by a conference

of commissioners appointed by the several states to con- cert measures of uniform legislation, has been adopted in the leading commercial states. It is founded upon the English “Chalmers’s Act,” and the English decisions giving a construction to that have become of special importance. The Acts of Parliament known as the Employers’ Liability Act and the Eailway and Canal Traffic Act have also served as the foundation of similar legislation in the United States, and with the same result. Modern English decisions are, however, cited less fre- quently in American courts than the older ones ; and the older ones themselves are cited far less frequently than they once were. In the development of their legislation, England and the United States have been in general harmony so far as matters of large commercial import- ance are concerned, but as to many others they have since 1860 drawn apart. Statutes, at one point or another, probably now affect the disposition of most litigated causes in both countries. Their application, therefore, must serve more or less to obscure or displace general principles, which might otherwise control the decision and make it a source of authority in foreign tribunals. The movement of the judicial mind in the United States, and also its modes and form of expression, have a different measure from that which characterizes what comes from the English bench. American judges are so numerous, and (except as to the Supreme Court of the United States) the extent of their territorial juris- diction so limited, that they can give more time to the careful investigation of points of difficulty, and also to the methodical statement of their conclusions. Whatever they decide upon appeal being announced in writing, and destined to form part of the permanent published records of the state, they are expected and endeavour to study their words and frame opinions not only sound in law but unobjectionable as literary compositions.

The choice of American judges, particularly in the older states, has been not uninfluenced by these considerations. Marshall, Bushrod Washington,

Story, _ Kent, Ware, Bradley, and many of their contemporaries and successors, were put upon the bench in part because of their legal scholarship and their power of felicitous expression. Hence the better American opinions have more elabo- ration and finish than many which come from the English courts, and are more reaifily accepted as authorities by American judges. But the great multiplication of re- ports has so widened the field of citation, as in effect to reduce it. Each of the larger and older states has now a settled body of legal precedent of its own, beyond which its judges in most cases do not look. If a prior decision applies, it is controlling. If there be none, they prefer to decide the case, if possible, on principle rather than authority.

While the state courts are bound to accept the con- struction placed upon the Constitution and laws of the United States by the Supreme Court of the United States,

and thus uniformity of decision is secured in that regard, the courts of the United States, on the other hand, are as a rule obliged to accept in all other particulars the con- struction placed by the courts of each state on its constitution and laws. This often gives a seeming incongruity to the decisions of the Supreme Court of the United States. A point in a case coming up from one judicial circuit may be determined in a way wholly different from that followed in a previous judgment in a cause turning upon the same point, but appealed from another circuit, because of a departure from the common law in one state which has not been made in another. In view of this, a doctrine originally proposed by Mr Justice Story in 1842 ‘ has not been infrequently invoked of late years, which rests upon the assumed existence of a distinctive federal jurisprudence of paramount authority as to certain matters of general concern, as for example those intimately affecting commerce between the states or with foreign nations. The consequence is that a case involving such questions may be differently adjudged, according as it is brought in a state or in a federal court.^

The divergences now most noticeable between English and American law are in respect of public control over personal liberty and private property, criminal procedure, and the scope of the powers of municipal corporations.

Under the constitutional provision that no one shall be deprived of life, liberty, or property without due process of law, American courts frequently

declare void statutes which in England would be within the acknowledged powers of Parliament. These provisions are liberally expounded in favour of the individual, and liberty is held to include liberty of contract as well as of person. Criminal procedure is hedged about with more refine- ments and safeguards to the accused than are found in England, and on the other hand, prosecutions are more certain to follow the offence, because they are universally brought by a public officer at public expense. The arti- ficiality of the proceedings is fostered by a general right of appeal on points of law to the court of last resort. It is in criminal causes involving questions of com- mon-law liability and procedure ^ that English law-books and reports are now most frequently cited. American mu- nicipal corporations are confined within much narrower limits than those of England, and their powers more strictly construed.

Trial by jury in civil causes seems to be declining in public esteem. The expenses necessarily incident to it are naturally increasing, and the delays are greater also from a general tendency, especially in cities, T^'^ *•'' where most judicial business is transacted, to reduce the number of hours a day during which the court is in session. The requirement of unanimity is dispensed with in a few states, and it has been thus left without what many deem one of its essential features. The judge interposes his authority to di- rect and expedite the progress of the trial less fre- quently and less peremptorily than in England. A jury is waived more often than formerly, and there is a

1 Swift v. Tyson, 16 Peters' Reports, 1, 19.

2 See Forepaugh v. Delaware, Lackawanna, and Western Eailroad Company, 128 Pennsylvania State Reports, 267 ; Faulkner v. Hart, 82 New York Reports, 313 ; and Lake Shore and Michigan Southern Railway Company y. Prentice, 147 United States Reports, 101.

sSee as examples, Commonwealth v. Rubin, 165 Massachusetts Reports, 453, in wiiich Holmes, C.J., traces the rule that, it a man abuse an authority given him by the law, he becomes a trespasser ab initio, back to the Year Books; and Commonwealth v. deary, 172 Massachusetts Reports, 175, in which the same judge refers to Glan- ville and Fleta as authority for the proposition that the admission in evidence, in cases of rape, of complaiats

made by the woman soon after the commission of the offence is a perverted survival of the old rule that she could not bring an appeal unless she had made prompt hue and cry.

growing conviction that, with a capable and independent judiciary, justice can be looked for more confidently from one man than from thirteen.

The United States entered on the work of simplifying the forms of pleading earlier than England, but has not carried it so far. Demurrers have not been abandoned, and in some states little has been done except to replace one system of formality by another hardly less rigid. The general plan has been to codify the laws of pleading by statute. In a few states they have proceeded more nearly in accordance with the principles of the English Judicature Act, and left details to be worked out by the judges, through rules of court.'

Most of the state constitutions assume that the powers of government can be divided into three distinct depart- ments, executive, legislative, and judicial ; and Theiegis- direct such a distribution. In thus ignoring the courts. ^^^ administrative functions of the state, they have left a difficult question for the coiirts, upon which the legislature often seeks in part to cast them. The general tendency has been to construe, in such circumstances, the judicial power broadly, and hold that it may thus be extended over much which is rather to be called quasi-judicial.^ A distinction is taken between entrusting jurisdiction of this character to the courts, and imposing it upon them. Where the statute can be construed as simply permissive, the authority may be exercised as a matter of grace, when it would be peremptorily declined, were the meaning of the legislature that it must be accepted.' The courts, for similar reasons, have generally declined (in the absence of any constitutional requirement to that effect) to advise the legislature, at its request, whether a pro- posed statute, if enacted, would be valid. While its validity, were it to be enacted, might become the subject of

a judicial decision, it is thought for that reason, if for no other, to be improper to prejudge the point, without a hearing of parties interested. The constitu- tions of several states provide for such a proceeding, and in these the Supreme Court is not infrequently called upon in this way, and gives responses which are always considered decisive of legislative action, but would not be treated as conclusive in any subsequent litigation that might arise.

The general trend of opinion in the Supreme Court of the United States since 1870, upon questions other than those arising under the XlVth Amendment, has been towards recognizing the police power of the Police several states as entitled to a broad scope. states." Even, for instance, in such a matter as the regulation of commerce between diiierent states, it has been upheld as justifying a prohibition against running any goods trains on a Sunday, and a require- ment that all railway cars must be heated by steam.^ In the " Granger Cases," * the right of the state to fix the rate of charges for the use of a grain elevator for rail- way purposes, and for general railway services of trans- portation, was supported, and although the second of these was afterwards overruled," the principle upon which it was originally rested was not shaken.

On the other hand, reasons of practical convenience

1 This has been carried farthest in Connecticut. See Botaford v. Wallace, 72 Connecticut Reports, 195.

2 Norwalli: Street Railway Company's Appeal, 69 Connecticut Re- ports, 576; 38 Atlantic Reporter, 708.

8 Zanesville v. Zanesville Telephone Company, 63 Ohio State Reports, 442 ; 59 North-Eastern Reporter, 109.

- New York Railroad v. New York, 165 United States Reports, 628.

5 Munn T. Illinois, 94 United States Reports, 113 ; Chicago Railroad Company v. Iowa, ibid. 1.55.

8 Wabash Railway Company v. Illinois, 118 United States Reports, 657 ; Reagan v. Farmers' Loan and Trust Company, 154 United States Reports, 362.

have necessarily favoured the substantial obliteration of state lines as to the enforcement of statutory private rights. Massachusetts in 1840, six years before the passage of Lord Campbell's Act, provided a remedy by indictment for the negligent killing of a man by a rail- way company, a pecuniary penalty being fixed which the state was to collect for the benefit of his family. In most of the other states by later statutes a similar result has been reached through a civil action brought by the executor or administrator as an agent of the law. In some, however, the state must be the plaintiff ; in others the widow, if any there be. The accident resulting in death often occurs in a state where the man who was killed does not reside, or in which the railway company does not have its principal seat. It may therefore be desirable to sue in one state for an injury in another. Notwithstanding such an action is unknown to the com- mon law, and rests solely on a local statute, the Ameri- can courts uniformly hold that, when civil in form, it can be brought under such statutes in any state the public policy of which is not clearly opposed to such a remedy. In like manner the responsibilities of stock- holders and directors of a moneyed corporation, under the laws of the state from which the charter is derived, are enforced in any other states in which they may be found. Thus a double liability of stockholders to creditors, in case of the insolvency of the company, or a full liability to creditors of directors who have made false reports or certificates regarding its financial condition, is treated as of a contractual nature, and not penal in the international sense of that term.' As a judgment of one state has equal force in another, so far as the prin- ciple of res adjudicata is concerned, the orders of a court in a state to which a corporation owes its charter, made in proceedings for winding it up, may be enforced to a large extent in any other. The shareholders are regarded as parties by representation to the winding-up proceed- ings, and so bound by decrees which are incidental to it.8

See also Cooley on The Constitutional Limitations which rest upon the Legislative Power of the States of the American Union ; Andrews on

American Law ; and. Russell on TTie Police Power of the State, and Decisions thereon as illustrating the Development and Value of Case Law.

Appendix.

The following series of sub-titles, alphabetically ar- ranged, deals with points in American law not treated elsewhere in this work, generally showing a divergence from English law or practice.

Adoption. — Adoption of minors is permitted by statute in many of the states. These statutes generally require some public notice to be given of the intention to adopt, and an order of approval after a hearing before some public authority. The consequence commonly is that the person adopted becomes, in the eye of the law, the child of the person adopting, for all purposes. Such an adop- tion, if consummated according to the law of the domicile, is equally effectual in any other state into which the parties may remove. The relative status thus newly acquired is ubiquitous. (See Whitmore, Laws of Adoption; Moss v. Boss, 129 Massachusetts Reports, 243.)

Adultery. — This is everywhere ground of divorce, and there is commonly no prohibition against marrying the paramour or other re-marriage by the guilty party. Even

‘ Huntington v. Attrill, 146 United States Reports, 657.

8 Great Western Telegraph Company v. Purdy, 162 United States Reports, 329 ; Fish v. Smith, 73 Connecticut Reports, 377 ; 47 Atlantic Reporter, 710.

if there be such a prohibition, it would be unavailing out of the state in which the divorce was granted; marriage being a contract which, if valid

where exe- cuted, is generally treated as valid everywhere. Adul- tery gives a cause of action for damages to the wronged husband. It is in some states a criminal offence on the part of each party to the act, for which imprisonment in the penitentiary or state prison for a term of years may be awarded. *

Allegiance. — The English doctrine (prior to the Natural- ization Act of 1870) that no man can cast off his native allegiance without the consent of his sovereign, was early abandoned in the United States, and in 1868 Congress declared that ” the right of expatriation is a natural and inherent right of all people, indispensable to the enjoy- ment of the rights of life, liberty, and the pursuit of happiness,” and one of “the fundamental principles of the republic.” {United States Revised Statutes, sec. 1999.) Every citizen of a state owes a double allegiance, one to it and one to the United States. He may be guilty of treason against one or both. If the demands of these two sovereigns upon his duty of allegiance come into conflict, those of the United States have the paramount authority.

Appeal. — This term may mean (1) a removal of a cause to a higher court for a new trial on all the questions involved, or (2) taking up points of law only by pro- ceedings in error, for revision by a higher court. Decrees in admiralty and equity in the courts of the United States are the subjects of an appeal ; judgments in actions at law, of a writ of error. On an equity appeal the evidence taken at the original hearing is reported at length to the appellate court, and it has the right to review the conclusions of fact reached by the court below and come to different ones. This, however, is seldom done, the appeal being almost always decided on points of law based upon the conclusions of fact reached in the original hearing. In admiralty appeals the conclusions of fact reached by the trial court are specially set forth, and are final.

” Appeal ” in many of the states is the general term for reviewing any judgment of an inferior court on assign- ments of error. It is also often used to signify a mode of reviewing proceedings of municipal bodies, affecting the interests of particular persons, e.g., in matters of licences or assessments.

In criminal prosecutions an appeal, or writ of error on points of law, is almost everywhere allowed to the defendant, and often to the state. This is a matter of statute regulation. (United States v. Sanges, 144 United States Eeports, 310 ; State v. Lee, 65 Connecticut Reports, 265.)

Appraiser. — This is a term often used to describe a person specially appointed by a judicial or quasi-judicial authority to put a valuation on property, e.g., on the items of an inventory of the estate of a deceased person, or on land taken for public purposes by the right of eminent domain. Appraisers of imported goods and boards of general appraisers have extensive functions in administering the customs laws of the United States.

Arbitration. — Arbitration is ordinarily conducted out of court, but in most states an agreement to settle a con- troversy in this way may be filed in a court and enforced by its authority. There are also statutes of the United States providing facilities for adjusting disputes between certain classes of employers and workmen in this way. The United States law allows arbitration proceedings between corporations engaged in commerce between the states and their employes to take place before official arbitrators and at the public expense. (30 United States Statutes at Large, 424.)

The United States ratified in 1900 the convention

agreed on at The Hague in 1899 with reference to inter- national arbitration. (For a discussion of the mode of proceeding before the court which has been organized under its provisions, and of the initiative belonging to the President of the United States, see an article on ” The Entry of the United States into World Politics as one of the Great Powers,” in the Yale Review for February

1901.)

Attachment. — Attachment of debts is a statutory remedy accorded in most of the states in certain circumstances for the security of creditors, by the seizure by the sheriff of the debtor’s goods or the imposition of a lien upon his land, before judgment, and sometimes at the very commencement of the action. In some states it is only allowed in special cases, as when the debtor

has absconded, or is a non-resident, or guilty of fraud ; in a few it may be had, as of right, at the commencement of ordinary actions. The com- mon-law courts of the United States (by Act of Congress) follow the practice in this regard of the state in which they sit. Such attachments (on mesne process) can generally be dissolved by the substitution of a bond with surety. The body can also be attached in most states on civil actions of tort (for a wrongful or negligent act to the damage of another), but not in actions on contract.

Attainder. — Bills of attainder are expressly forbidden by the constitution of the United States, both as respects them and the several states. This prohibition is under- stood not to be confined to attainders of death, but to extend to any law inflicting a punishment for a criminal offence, without a previous opportunity for a hearing and defence.

Attorney-at-Law. — Formerly, in some states, there existed a grade among lawyers of attorneys-at-law, which was inferior to that of counsellors-at-law, and in colonial times New Jersey established a higher rank still — that of serjeant-at-law. Now the term attorney-at-law is precisely equivalent to that of lawyer. Attorneys are admitted by some court to which the legislature confides the power, and on examination prescribed by the court, or by a board of state examiners, as the case may be. The term of study required is generally two or three years, but in some states less. In one no examination is required. College gradu- ates are often admitted to examination after a shorter term of study than that required from those not so educated. In the courts of the United States admission is regulated by rules of court and based upon a previous admission to the state bar. The American attorney exercises all the functions distributed in England between barristers, attorneys, and solicitors. When acting in a court of admiralty he is styled ” proctor ” or ” advocate.” (See Bar.)

Attorney-General. — The United States has an o£B.cer of this name, who has a seat in the Cabinet. Every state but one or two has a similar officer. He represents the state in important legal matters, and is often required to assist the local prosecutor in trials for capital offences. He appears for the public interest in suits affecting public charities. He is generally elected by the people for the same term as the Governor, and on the same ticket.

Bar. — Each state has its own bar, consistmg of all attorneys-at-law (q.v.) residing within it who have been admitted to practice in its courts. As a general thing, attorneys are admitted in one court to practice in all courts. Each of the United States courts has a bar of its own. An attorney of a state cannot practise in a court of the United States unless he has been admitted to it, or to one of the same class in another district or circuit. He cannot appear in the Supreme Court of the United States

unless specially admitted and sworn as an attorney of that court, wMch is done on motion in case of any one who has practised for three years in the highest courts of his state and is in good standing at its bar. In most of the states there is a state Bar Association, and in some cities and counties local Bar Associations. These consist of such members of its bar as desire thus to associate, the object being to guard and advance the standards of the profession. Some own valuable libraries. These associations have no oificial recognition, but their influence is considerable in recommending and shaping legislation respecting the judicial establishment and procedure. They also serve a useful purpose in instituting or promoting proceedings to discipline or expel unworthy attorneys from the bar. There is an American Bar Association, founded in 1877, composed of members of the bars of different states of like character and position. Some of these associations publish annually a volume of transactions.

Betting. — Many of the states make this a penal offence when the bet is upon a horse-race, or an election, or a game of hazard. Betting contracts and securities given upon a bet are often made void, and this may destroy a gaming note in the hands of an innocent purchaser for value. The United States has no statutes on this subject. It lies outside of its field.

Carrier. — A railway company receiving goods destined for transportation by rail to a point beyond its line is generally held liable only for their transportation to the end of its line and delivery there to the connecting line,

unless it specially stipulates for their carriage to the final point of destination. {Myrick v. Michigan Central

B. B. Co., 107 United States Eeports, 102.) Chancellor. — The principal judge of equity (or, what

is the same thing, chancery) causes in a state. Only a few states have such an oflB.cer. His functions are purely judicial. In states where legal and equitable remedies are administered by the same judges, a judge in disposing of an equity cause is sometimes spoken of as a chancellor, but the meaning is simply that he is performing functions similar to those of a chancellor.

Chancery. — This word is generally used as the synonym of equity. Chancery practice is practice in causes of equity. Chancery courts are equity courts. (See Equity.)

Code. — An orderly and systematic statement of the law on one or more large subjects. This word is sometimes used to signify an official revision of the statutes of a state. That, however, simply undertakes to state the existing statute la.w, not (as is the true ofiice of a code) to combine this with the unwritten or customary law and so turn that into statute also. Most of the states have codes stating the law of pleading in civil actions, and such states are often described as code states to distinguish them from those adhering to the older forms of action, divided between those at law and those in equity. A few states have general codes of political and civil rights. The general drift of legislation and of public sentiment is toward the extension of the principle of codification, but the contrary view has been ably maintained. (See James

C. Carter’s Provinces of the Written and the Unwritten Law, 1889.) New York and Georgia were pioneers in American codification. California has carried it as far as any state.

Common Law, the unwritten or customary law, which is the substratum of the municipal law of each state. Tor every state, except Louisiana, which has been added since the adoption of the Constitution of the United States, it is (unless otherwise provided by statute) the common law of England as it

stood at the early part of the 17th century, subject to such modifications or omis- sions as were generally considered essential throughout

the old thirteen colonies to adjust it to American con- ditions, and to such others as were deemed necessary to that end in the states from which most of the early settlers came, and also to such as have been made from time to time since the early settlements, within what are now the limits, by the usages of the people and common consent. It comprehends the main body of the law in each state, which has not a complete code or set of codes. As a matter of fact, it does not essentially differ in any of them. There are occasional points of diver- gence, but they are few, and seldom of great practical importance.

The common law is to be found in such books as Blackstone's Commentaries, Kent's Commentaries, and Swift's Digest, in unofiicial treatises of acknowledged weight on particular topics, and in the reported decisions of the courts. The main work of giving it such form and precision as it may be said to possess has been done by the judges in disposing of actions at law. They have necessarily assumed the function of declaring what of English law the people have treated as unsuited to their social conditions, or obsolete, and also of declaring what has been added to or derived from the ancient common law from time to time.

Offences against the common law can be prosecuted in many states, though not violations of any statute. This is not so in the courts of the United States. The United States has no common law, except so far as its courts have adopted it as to matters of judicial procedure, and as resort must be had to it to explain the meaning of terms used in their constitution or statutes. There are, how- ever, certain uniform rules of general jurisprudence, mainly relating to commercial transactions, which the courts apply without regard to any common law to the contrary existing in any particular state.

Common Pleas, Court of. — This name is given to certain inferior courts in several of the states. These are generally the lowest courts of general jurisdiction in which a jury trial, as at common law, can be had. Frequently they have also equitable jurisdiction over causes involving only small amounts.

Constitutional Law. — The law peculiarly conversant with the effect and meaning of written constitutions of political government. The constitution of the United States is the supreme law of the land as to the matters which it embraces. The constitution of each state is the supreme law of the state, except so far as it may be con- trolled by the constitution of the United States. Every statute in conflict with the constiti,Ttion to which it is subordinate is void so far as this conflict extends. If it concerns only a distinct and separable part of the statute, that part only is void. Every court before which a statutory right or defence is asserted has the power to inquire whether the statute in question is or is not in conflict with the paramount Constitution. This power belongs even to a justice of the peace in trying a cause. He sits to administer the law, and it is for him to determine what is the law. Inferior courts commonly decline to hold a statute unconstitutional, even if there may appear to be substantial grounds for such a decision. The presumption is always in favour of the validity of the law, and they generally prefer to leave the responsibility of declaring it void to the higher courts.

The judges of the state courts are bound by their oath of ofiice to support the Constitution of the United States. They have an equal right with those of the United States to determine whether or how far it affects any matter brought in question in any action. So, vice versd, the judges of the United States courts, if the point comes up on a tiial before them, have the right to determine whether or how far the constitution of a state invalidates a

statute of the state. They, however, are ordinarily bound to follow the views of the state courts on such a question. They are not bound by any decision of a state court as to the effect of the Constitution of the United States on a state statute or any other matter. This judicial power of declaring a statute void because unconstitutional has been not infrequently exercised, from the time when the first state constitutions were adopted.

Juries in criminal causes are sometimes made by American statutes or recognized by American practice as judges of the law as well as the fact. The better opinion is that this does not make them judges of whether a law on which the prosecution rests violates the paramount Constitution and is therefore void. (United States v. Callender, Wharton's State Trials, 688 ; State v. Main, 69 Connecticut Eeports, 123, 128.)

If a state court decides a point of constitutional law, set up under the Constitution of the United States, against the party relying upon it, and this decision is afSrmed by the state court of last resort, he may sue out a writ of error, and so bring his case before the Supreme Court of the United States. If the state decision be in his favour, the other side cannot resort to like proceedings.

A decree of the Supreme Court of the United States on a point of construction arising under the Constitution of the United States settles it for all courts, state and national.

Contempt of Court. — The maximum punishment for this offence is generally fixed by statute. It is also a common provision of statute that courts cannot punish for con- tempts committed out of court, unless in such circum- stances as immediately to affect the administration of justice. (See United States Revised Statutes, § 726.) American legislative bodies (being without any judicial functions) have not the power to punish for contempt possessed by the Houses of Parliament in England. {Kilbourn v. Thompson, 103 United States Reports, 168.)

Corporation. — The United States and each state, each territory, and municipalities in general, are public corpo- rations. They are public agencies for public purposes. Private corporations are those formed for private, or partly for private and partly for public purposes. The United States can create corporations so far as may be necessary for the proper execution of their general pow- ers, but these powers being few, the corporations which it has created are not numerous. Most of them are national banking associations. The organized territories of the United States can create corporations by general incorporation laws, and there are many which have been thus formed. The earlier American corporations were all created by special charter, but the practice of per- mitting incorporation

under general incorporation laws under equal terms to all, which was instituted in the 19th century in some of the states, though at first con- fined to religious societies, library companies, &c., has gradually spread, until it is now almost the rule. Many of the states have constitutions forbidding special char- ters for corporations, and in the others most incorpora- tions are effected under appropriate general laws. The charter of a private corporation creates a contract between the corporation and the state, which, under the provisions of the Constitution of the United States, cannot be sub- stantially altered without the consent of the corporation, unless a power to that effect was reserved at the time of the incorporation. Such a power is generally reserved, but even then cannot extend to radical and fundamental changes.

The franchises of municipal corporations can be revoked or altered at the pleasure of the state. They are mere agencies for the public good, and, if better ones can be provided, that should be done. Municipal corporations

have, besides the powers expressly granted, such as are necessary for their proper execution or indispensable to attaining the object of the incorporation. Private cor- porations have such implied powers as are fairly incident to the convenient exercise of those expressly granted.

If a corporation assumes to make a contract beyond its powers, the better opinion is that the contract is void. If, in consequence of it, acts have been done, or values received, these may support an action, not because the contract gave rights, but because the transaction did. Thus there may be a liability to account for benefits received. The contract in such case may be available in evidence for certain purposes, e.g., to limit the recovery to the stipulatecT price. {Central Transportation Co. v. Pullman's Palace Gar Co., 139 United States Reports, 24 ; Pullman's Palace Car Co. v. Central TranspoHation Co., ibid. 62 ; California Bank v. Kennedy, 167 United States Reports, 362.)

If a private corporation becomes insolvent, and falls into the hands of the courts, its assets are treated as a trust fund for the benefit of its creditors. It does not occupy the position of a trustee towards creditors so long as it is a going concern, under the control of its own managers, and not in a state of

insolvency. {Hol- lins V. Brierjield Coal and Iro7i Co., 160 United States Reports, 371.)

American law differs from the English in recognizing the right of a corporation to adopt or ratify the contracts of its promoters made before its organization. (See Taylor on Private Corporations, sec. 87.)

American law also regards directors of corporations as agents of the law, who, when acting as a board, are the general agent of the company, by force of the law. English law looks upon them rather as special agents of the corporation, and so constituted by the agreement of the shareholders. (See Thompson on Private Corpora- tions, III., 2881.)

Court. — The United States is divided into a large number of judicial districts, of which each state embraces one or more, each with a separate district court held by a district judge. Several of these districts are created in each circuit, of which there are nine. In each circuit there are one or more circuit judges, who may hold circuit courts, as may also the district judge. The district and circuit courts are courts of original jurisdiction. That of the district court is mainly confined to causes in admiralty or bankruptcy, or in which the United States is a party, including criminal cases. That of the circuit court extends to matters of both common law and equity, where the adverse parties are citizens of different states or where the case arises under the laws of the United States, but ordinarily not unless $2000 in value is in controversy. It has also jurisdiction in all criminal prosecutions. In each circuit there is a circuit court of appeal having appellate jurisdiction only. This juris- diction is final as to most causes, but does not extend to the determination of errors assigned on points arising under the Constitution of the United States. This court is held by three of the circuit judges. A district judge may also sit in the place of a circuit judge.

The Supreme Court of the United States sits only at Washington, and consists of a Chief Justice and eight associate justices. Its jurisdiction is mainly appellate. Appeals from the inferior federal courts lie to it on points arising, under the Constitution of the United States, and in capital causes. It can revise the judg- ments of the highest court of any state on a claim of right raised under the Constitution, laws, or treaties of the United States, if

the decision was adverse to such claim. The justices can also sit in the circuit courts and circuit courts of appeal.

A circuit court can be held by one judge, or by two, or by three. If two sit, the opinion of the ranking judge prevails for the purposes of the case if a difference of opinion arises between them in the course of the trial.

Prize cases are appealed directly from the district court to the Supreme Court.

Causes can be removed, before trial, from a state court to a circuit court of the United States, in certain circum- stances.

There is also a court of claims sitting at Washington, having cognizance only of claims against the United States. Such claims may also be sued in the district court, if for not over f 1000, and in the circuit court, if for not over f 10,000. *

There is a court of private land claims, of a temporary character, to pass upon claims against the United States respecting lands in certain parts of the Par West.

In the District of Columbia there is a separate judicial system, with a local court of appeals.

Each territory has a separate judicial system, estab- lished by Act of Congress.

Each state has a separate judiciary of its own. In most it is as follows : justices of the peace are allowed to dispose of petty causes, civil and criminal (subject to an appeal), and to bind over those charged with grave offences for trial before a jury in a higher court. In cities and other considerable municipalities there are local courts, having a larger

jurisdiction over civil and criminal causes. In each county there are one or more courts, known as county courts, courts of common pleas, or superior courts. These are the main courts of original jurisdiction, and also have some appellate jurisdiction over proceedings before the tribunals previously men- tioned. They administer both legal and equitable re- lief, generally in one form of action. Above all is a supreme court, sometimes styled a court of appeals, or a supreme court of errors, with only appellate jurisdic- tion. An intermediate appellate court is sometimes created to relieve the higher court of an undue pressure of business. Some of the supreme courts dispose of as many as 600 cases a year. Their opinions are, in all important causes, delivered in writing, and published in a series of state reports at the expense of the state, an official reporter being attached to each court. The practice in this respect is the same in the Supreme Court of the United States.

The opinions of the circuit court of appeals and of the circuit and district courts are published unofficially by private reporters. Those of all the courts of last resort in each of the states are likewise published unofficially in the same way, in advance of their appearance in the regular series of state reports. Selected current cases from the United States and state reports are also made the subject of two series of private reports known as the American State Reports and Lawyers' Reports Annotated.

Criminal Procedure. — Each state, as well as the United States, prosecutes for crimes against itself. In every state there are local prosecuting officers in the small political subdivisions of territory, such as counties, towns, cities, and boroughs, who institute criminal proceedings and conduct the hearing which follows the arrest.

The criminal procedure of the United States is in general based upon that of the respective states. A prosecution for a crime against the United States, com- mitted in Ohio, for instance, would be brought by a complaint and warrant such as are used in the state courts of Ohio under the law of that state, while in Kentucky the law and practice of Kentucky would be followed.

Arrests for violations of the law of the United States

are commonly made upon a warrant signed by a federal official, known as a district court commissioner; but a state magistrate has equal authority to sign such warrants. (United States Revised Statutes, sec. 1014.) If the law of the state requires a complaint under oath in prosecu- tions for offences against the state, complaints charging the commission in that state of a crime against the United States must be made under oath, otherwise not. In many states the local state prosecuting officer can com- plain as of his own knowledge, without annexing any statement or charge emanating from any other person, and thereupon a warrant issues. In such states the same power belongs to the district attorney of the United States, who is the public prosecutor for all offences against the laws of the United States.

Bail (in a sum fixed by the committing magistrate) is a matter of right in all cases where a sentence of death cannot be inflicted. {Ibid. sec. 1015.) In those where such a sentence can be, it may be allowed by one of the judges of the United States courts at his discretion. {Ibid. sec. 1016.)

These provisions govern proceedings instituted in the limits of any state.

Each territory fully organized by Act of Congress has its own legislative assembly, which regulates criminal procedure, subject only to the guarantees of individual rights found in the Constitution of the United States.

The District of Columbia has a system provided by Act of Congress, and founded on that formerly in use in the state of Maryland, out of which the territory forming this district was carved.

Equity. — The courts of the United States still maintain an absolute separation between actions at law and actions in equity. Procedure in the latter is settled by rules of court, and is substantially uniform throughout the United States. Procedure in the former follows in general the law of the state in which the court may be held. Some of the states also administer equitable relief only in strict and separate equitable proceedings. In most, beginning with New York in 1848, there is now but one kind of action, based on a plain statement of the facts constituting the plaintiff’s case, without any artificial restrictions of form. If a cause involving both legal and equitable causes of action is removed before trial from a state court,

where such a system obtains, into a circuit court of the United States, the plaintiff is obliged to re-plead and split his suit into two ; one in the form of a bill in equity, and one in the form appropriate to an action in such state brought on a legal demand only.

Factor. — Judge Story, both on the bench and in his work on Agency, adhered to the doctrine, held by the English courts until a recent period, that a factor under a del credere (or guarantee) commission was a mere surety for the purchaser, and only answerable to his principal, if payment were not made by the purchaser. The courts of several of the leading commercial states early took the opposite view, holding the factor liable at all events for the proceeds of the sale, and this, of late years, has become firmly established as the prevalent American view. (See Leivis Brothers v. Brehone, 33 Maryland Reports, 412; 3 American Reports, 190.) Legislation similar to the English Factors Act of 1825 has been had in several states. (See Allen v. St Louis Bank, 120 United States Reports, 20.)

Information. — A complaint charging a criminal offence, preferred by a public prosecutor, without any previous inquiry by a grand jury. In many American states an indictment is only necessary in capital cases ; in some it is entirely dispensed with. In the courts of the United States an indictment is required in all cases of crimes punishable by imprisonment in the penitentiary by force

of the yth Amendment to the Constitution. Quo warranto proceedings are also commonly brought by an information.

Injunction. — In the courts of the United States the writ of injunction remains purely an equitable remedy. It may be issued at the instance of the President to pre- vent any organized obstruction to inter-state commerce or to the passage of the mails. {In re Debs, 158 United States Eeports, 564.) Temporary restraining orders may be issued, ex parte, pending an

application for a temporary injunction. In the state courts temporary injunctions are often issued, ex parte, subject to the defendant's right to move immediately for their dissolution. Genera%, however, notice of an application for a temporary injunc- tion is required.

Jury. — The right of trial by jury, both in civil cases of a common-law nature and in criminal causes, is secured to all, with important exceptions, by constitutional provisions both as respects the United States and the several states. Some constitutions provide for dispensing with the rule of unanimity in civil causes. In some states a few petty offences may be finally disposed of by a single magistrate. In criminal causes, as juries can bring in a general verdict of "Not guilty," they have the actual power to acquit should they be of opinion that the statute under which the prosecution may be had is void. Their duty, however, is generally held to be to accept the law from the court, especially if it turn upon the effect of the Constitution. Jury trials in some states can be ordered in equitable causes or divorce cases ; in others, and in the courts of the United States, they can only be had in causes not of an equitable character, unless specially ordered for the infor- mation of the judge on a "feigned issue" — that is, a question of fact stated by the court for the purpose of obtaining a precise answer, by which the judgment of the court may or may not be guided according to its dis- cretion. In some states the judges are forbidden in criminal causes to give the jurors any direction as to how to find the law, or to express any opinion upon the evidence. In others such an opinion may be freely expressed, and they can be told that it is their duty to return a certain verdict if they find the controlling facts in a certain way (State v. Fetterer, 65 Connecticut Eeports, 287).

Lotteries. — The United States at an early period (1812) empowered the city of Washington to set up lotteries as a mode of raising money for public purposes ; but no lot- teries were ever directly authorized by Congress itself after the adoption of the Constitution of the United States. In 1890 it forbade the use of the mails for pro- moting any lottery enterprise by a statute so stringent that it was held to make it a penal offence to employ them to further the sale of Austrian Government bonds, issued under a scheme for drawing some by lot for pay- ment at a premium (see Horner v. United States, 147 United States Reports, 449). Lotteries of every sort were

formerly permitted in most of the American colonies and states, but of late years have been generally prohibited by state legislation (see Journal of the American Social Science Association, xxxvi. 17).

Perpetuities. — The common-law rule against perpetuities (as to the vesting of estates within one or more lives in being and twenty-one years afterwards, with a further allowance of nine months in favour of an unborn child) obtains in many of the states ; in others it has been re- placed or reinforced by statutory rules, such as limiting the postponement of future estates by two lives, &c. Con- ditions are not regarded here as subject to the common- law rule (Gray on Alienation, § 42). There is a difference of judicial opinion as to the application of this rule. By some courts it is held to concern itself only with the time within which an estate must vest, and to have nothing

to do with the time during which an estate which has once properly vested may continue. By others it is held to prohibit the creation of estates to continue longer than the period specified (see Gray on Perpetuities; Lovering V. Worthington, 106 Massachusetts Reports, 86). Chari- ties may be established in perpetuity, and provision may be made for an accumulation of the funds for a reasonable time, e.g., for 100 years (Woodruff y. Marsh, 63 Connecti- cut Reports, 125; 38 American State Reports, 346). The general tendency of American legislation and decision is to favour tying up estates for public purposes to a greater extent than was formerly approved.

Real Estate. — The tenure of land is generally allodial. Where estates tail are allowed by law, it is often on con- dition that they become absolute in the issue of the first donee. Real estate titles are secured, to a degree unknown in Great Britain, againstimpairment by legislation, through constitutional provisions, both state and national, particu- larly that against depriving any person of property with- out due process of law.

Registration. — American legislation favours the general policy of registering all documents in the contents of which the public have an interest, and its tendency has been steadily towards more and more full registration both of documents and statistics. From the early days of the colonial era it has been customary to record wills and con- veyances of real

estate in full in public books, suitably indexed, to which free access was given. During the last decade of the 19th century, three states — Illinois, Massa- chusetts, and Ohio — adopted the main features of the Torrens or Prussian system for registering title to land rather than conveyances under which title may be claimed. These are the ascertainment by public officers of the state of the title to some or all of the parcels of real estate which are the subject of individual property within the state ; the description of each parcel (giving its proper boundaries and characteristics) on a separate page of a public register, and of the manner in which the title is vested ; the issue of a certificate to the owner that he is the owner ; the ofiicial notation on this register of each change of title thereafter ; and a warranty by the Govern- ment of the title to which it may have certified. To make the system complete it is further requisite that every landowner should be compelled to make use of it, and that it should be impossible to transfer a title effect- ually without the issue of such a Government certificate in favour of the purchaser.

Constitutional provisions have been found to prevent or embarrass legislation in these directions in some of the states, but it is believed that they are nowhere such as cannot be obeyed without any serious encroachment on the principles of the new system (People v. Chase, 165 Illinois Reports, 527 ; State v. Guilbert, 56 Ohio State Reports, 675 ; People v. Simon, 176 Illinois Reports, 165 ; Tyler v. Judges, 173 Massachusetts Reports ; 55 North- Eastern Reporter, 812 ; Hamilton v. Brown, 161 United States Reports, 266).

Conveyances which have been duly recorded become of comparatively little importance in the United States. The party claiming immediately under them, if forced to sue to vindicate his title, must produce them, or account for their loss ; but any one deriving title from him can pro- cure a certified copy of the original conveyance from the recording oflScer, and rely on that. Equitable mortgages by a deposit of title-deeds are unknown.

The general prevalence of public registry systems has had an influence in the development of American juris- prudence in the direction of supporting provisions in wills and conveyances, which, unless generally known, might

tend to mislead and deceive, such as spendthrift trusts (Nichols V. Eaton, 91 United States Reports, 716).

Riparian Laws. — The common-la-w right of riparian proprietors on running streams to have the ~~water con~~ tinue to flow in its usual and natural course has been abrogated in many of the Western states in consequence of their physical geography and peculiar industries. In mining states and those having large stretches of arid lands, the use of all the water that can be got is of the greatest benefit. The upper proprietors are therefore allowed to divert water for mining or agricultural purposes to the prejudice of lower proprietors, even to the extent of virtually appropriating the entire stream, except in the wet season. The general rule is that priority of appropriation gives priority of right (Basey v. Oallagher, 20 Wallace's Eeports, 670). The state has a paramount right to regulate the use of rivers for public purposes in the public interest. In some states this is held to justify an appropriation of the water for a canal (People v. Canal Appraisers, 33 New York Eeports, 461. Cf. Kaukawia Co. v. Gh'een Bay Canal Co., 142 United States Reports, 254). It may be exercised to the prejudice of prior grants from the state for private purposes. These are taken subject to such future control (Water Power Co. v. Water Com- missioners, 168 United States Eeports, 349, 372). Second- ary rights are held subject to primary rights. The use of water for drinking is a primary right ; its use for manu- facturing a secondary one {City of Auburn v. Union Water Power Co., 93 Maine Eeports ; 38 Atlantic Eeporter, 561). Eights in water-courses through public lands are regu- lated by United States Eevised Statutes, §2476. The United States can restrain by injunction the appropriation of the upper waters tributary to a navigable river, if this would interfere VTith its navigability (United States v. Itio (Grande Irrigation Co., 174 United States Eeports, 690). They can improve the navigation of any navigable waters by erections in the water which cut off access to the channel of a riparian proprietor, without making com- pensation {Gibson v. United States, 166 United States Eeports, 269).

Succession Duty. — The United States imposed a succes- sion duty by the War Eevenue Act of 1898 on all legacies or distributive shares of personal property exceeding $10,000. It is a tax on the privilege of succession. Devises or distributions of land are not affected by it. The rate of duty runs from 75 cents on the $100 to $5 on the $100, if the legacy or share in question does not exceed $25,000. On those of over that value the rate is multi- plied 1-^ times on estates up to $100,000, twofold on those from $100,000 to $500,000, 2^ times on those from $500,000 to a million, and threefold for those exceeding a million. This statute has been supported as consti- tutional by the Supreme Court. Many of the states also impose succession duties, or transfer taxes; generally heavier on collateral and remote successions ; sometimes progressive according to the amount of the succession. The state duties generally touch real estate successions as well as those to personal property. If a citizen of state A own registered bonds of a corporation chartered by state B, which he has put for safe keeping in a deposit vault in state C, his estate may thus have to pay four succession taxes, one to state A, where he belongs and which, by legal fiction, is the seat of all his personal property ; one to state B, for permitting the transfer of the bonds to the legatees on the books of the corporation ; one to state C, for allowing them to be removed from the deposit vault for that purpose ; and one to the United States.

Treaty. — By the terms of Article VI. of the Constitution of the United States, all treaties made under their authority are the supreme law of the land. This gives them a new quality. They are no lon,i{er mere matters of contract. They stand on the same ground as an Act of Congress.

Any state constitution or law in conflict with them must give way. So must any prior Act of Congress. On the other hand, a later Act of Congress may abrogate a treaty ; for both are equally in their nature the supreme law of the land, and the latter of two laws prevails over the former. (s. e. b.)

Lawes, Sir John Bennet, Baet. (1814-1900)^ English agriculturist, was born at Eothamsted on 28th December 1814. Even before leaving Oxford, where he matriculated in 1832, he had begun to interest himself in growing various medicinal plants on the Eothamsted estates, which he inherited on his father’s death in 1822. About 1837 he began to experiment on the

effects of various manures on plants growing in pots, and a year or two later the experiments were extended to crops in the field. One immediate consequence was that in 1842 he patented a manure formed by treating phosphates with sulphuric acid, and thus started the artificial manure industry. In the succeeding year he enlisted the services of Sir J. H. Gilbert, with whom he carried on for more than half a century those experiments in raising crops and feeding animals which have rendered Eothamsted famous in the eyes of scientific agriculturists all over the world (see also Ageiculturb). In 1854 he was elected a Eellow of the Eoyal Society, which in 1867 bestowed a Eoyal medal on him and Gilbert jointly, and in 1882 he was created a baronet. In the year before his death, which happened on 31st August 1900, he took measures to ensure the continued existence of the Eothamsted experimental farm by setting aside £100,000 for that purpose and constituting the Lawes Agricultural Trust, which is composed of four members from the Eoyal So- ciety, two from the Eoyal Agricultural Society, one each from the Chemical and Linnsean Societies, and the owner of Eothamsted mansion-house for the time being.

Lawrence, a city of Kansas, U.S.A., capital of Douglas county, on the south bank of the Kansas river, at an altitude of 822 feet. It is on the main line of the Atchison, Topeka, and Santa Fe, and on the Kansas Pacific branch of the Union Pacific railways. Its site is level and its plan regular. The University of Kansas, situated here, had in 1899 a faculty of 69, and was at- tended by 1087 students, 413 of whom were women. Population (1890), 9997; (1900), 10,862, of whom 781 were foreign-born and 2032 were negroes.

Lawrence, a city of Massachusetts, U.S.A., capital of Essex county, on the Merrimac river. It is divided into six wards, is supplied with water pumped from the Merrimac and filtered, and is paved mainly with macadam and gravel. It is an important centre of the woollen and cotton goods trade, especially of the former. In 1900 it contained 546 manufacturing establishments, with an aggregate capital of $49,914,036, employing 22,358 hands, and with a product valued at $44,703,278. Of this total product, $25,584,744 was composed of woollen and worsted goods, $8,146,594 of cotton goods, and $1,608,224 of flouring and grist-mill products.]Ma- chines and machinery, paper, and food products were also prominent articles of manufacture. In 1900 the assessed valuation of real and personal

property was $39,841,697 ; the net debt was $1,830,300, and the rate of taxation was $15-60 per $1000. Population (1890), 44,654; (1900), 62,559, an increase of 40-1 per cent, dur- ing the preceding ten years. Of the population in 1900, 28,577 were foreign-born and 87 were negroes.

Lawrenceburg, a city of Indiana, U.S.A., capital of Dearborn county, on the Ohio river and the Baltimore and Ohio South-western, and the Cleveland, Cincinnati,

Chicago, and St Louis railways, at an altitude of 486 feet. It has varied manufactures and some commerce by rail and by river. Population (1890), 4284 ; (1900), 4326, of whom 413 were foreign-born.

Lawson, Cecil Cordon (1851-1882), English landscape painter, was the youngest son of William Lawson, of Edinburgh, esteemed as a portrait painter. His mother also was known for her flower pieces. He was born near Shrewsbury, 3rd December 1851. Two of his brothers (one of them, Malcolm, a clever musician and soHgwriter) were trained as artists, and Cecil was from childhood devoted to art with the intensity of a serious nature. Soon after his birth the Lawsons moved to London. In 1866 they were in Bloom sbury, in 1867 at Chelsea. Lawson's first works were studies of fruit, flowers, &c., in the manner of W. Hunt ; followed by riverside Chelsea subjects. His first exhibit at the Royal Academy (1870) was "Cheyne Walk," and in 1871 he sent two other Chelsea subjects. These gained full recognition from fellow-artists, if not from the public. Among his friends were now numbered Fred Walker, Pin well, and their associates. Eollowing them, he made a certain number of drawings for wood-engraving. Lawson's Chelsea pictures had been painted in some- what low and sombre tones ; in the " Hymn to Spring " of 1872 (rejected by the Academy) he turned to a more joyous play of colour, an expansion helped by work in more romantic scenes in North Wales and Ireland. Early in 1874 he made a short tour in Holland, Belgium, and Paris; and in the summer he painted his large "Hop Gardens of England." This was much praised at the Academy of 1876. But Lawson's triumph was with the great luxuriant

canvas ” The Minister’s Garden,” exhibited in 1878 at the Grosvenor Gallery, and now in the Man- chester Art Gallery. This was followed by several works conceived in a new and tragic mood. His health began to fail, but he worked on. He married in 1879 the daughter of Birnie Philip, and settled at Haslemere. His later subjects are from this neighbourhood (the most famous being ” The August Moon,” now in the National Gallery of British Art) or from Yorkshire. Towards the end of 1881 he went to the Eiviera, returned in the spring, and died at Haslemere 10th June 1882. Lawson may be said to have restored to English landscape the tradition of Gainsborough, Crome, and Constable, infused with an imaginative intensity of his own. Among English landscape painters of the latter part of the 19th century his is in many respects the most interesting name.

See Cecil Lawson, a Memoir, by E. W. Gosse, 1893. — Hesel- TiNB Owen. ” In Memoriam : Cecil Gordon Lawson,” Magazine of Art, 1894. (l. b.)

Lawson, Sir Wilfrid, 2nd Babt. (1829),

English politician and Temperance leader, son of the first baronet (d. 1867), was born 4th September 1829. He was always an enthusiast in the cause of total abstinence, and in Parliament, to which he was first elected in 1859 for Carlisle, he became its leading spokesman. In 1864 he first introduced his Permissive Bill, giving to a two- thirds majority in any district a veto upon the granting of licences for the sale of intoxicating liquors ; and though this principle failed to be embodied in any Act, he had the satisfaction of seeing a resolution on its lines accepted by a majority in the House of Commons in 1880, 1881, and 1883. He lost his seat for Carlisle in 1865, but in 1868 was again returned as a supporter of Mr Gladstone, and was member till 1885 ; though defeated for the new Cockermouth division of Cumberland in 1885, he won that seat in 1886, and he held it till the election of 1900, when his violent opposition to the Boer war caused his defeat. For all these years he was the champion of the

United Kingdom Alliance (founded 1853), of which he became president. An extreme Radical, he also supported disestablishment, abolition of the House of Lords, and disarmament. Though violent in the expression of his opinions. Sir Wilfrid Lawson remained very popular for his own sake both in and out of the House of Commons ; he became well known for his

humorous vein, his faculty for composing topical doggerel being often exercised on questions of the day.

Layard, Sir Henry Austen (1817-1894), British author and diplomatist, and the excavator of Nineveh, was born in Paris on 5th March 1817. The Layards were of Huguenot descent. His father, Henry P. J. Layard, of the Ceylon Civil Service, was the son of Charles Peter Layard, dean of Bristol, and grandson of Daniel Peter Layard, the physician. Through his mother, a daughter of Nathaniel Austen, banker, of Ramsgate, he inherited Spanish blood. This strain of cosmopolitanism must have been greatly strengthened by the circumstances of his education. Much of his boy- hood was spent in Italy, where he received part of his schooling, and acquired a taste for the fine arts and a love of travel ; but he was at school also in England, France, and Switzerland. After spending nearly six years in the oflB.ce of his uncle, Benjamin Austen, a solicitor, he was tempted to leave England for Ceylon by the prospect of obtaining an appointment in the Civil Service, and he started in 1839 with the intention of making an over- land journey across Asia. After wandering for many months, chiefly in Persia, and having abandoned his intention of proceeding to Ceylon, he returned in 1842 to Constantinople, where he made the acquaintance of Sir Stratford Canning, the British ambassador, who em- ployed him in various unofiicial diplomatic missions in European Turkey. In 1845, encouraged and assisted by Canning, Layard left Constantinople to make those ex- plorations among the ruins of Assyria with which his name is chiefly associated. This expedition was in fulfil- ment of a design which he had formed, when, during his former travels in the East, his curiosity had been greatly excited by the ruins of Nimroud on the Tigris, and by the great mound of Kuyunjik, near Mosul, already partly excavated by M. Botta. Layard remained in the neigh- bourhood of Mosul, carrying on excavations at Kuyunjik and Nimroud, and investigating the condition of various tribes, until 1847 ; and, returning to England in 1848, published Nineveh and its Remains : with an Account of a Visit to the Chaldcean Christians of Kurdistan, and the Yezidis, or Devil^wor shippers ; and an Inquiry into the Manners and Arts of the Ancient Assyrians (2 vols., 1848-1849). To illustrate the antiquities described in this work he published a large folio volume of Illustrations of the Monuments of Nineveh (1849). After spending a few months in England, and receiving the degree of D.C.L. from the University of Oxford,

Layard returned to Con- stantinople as attache to the British Embassy, and, in August 1849, started on a second expedition to the East, in the course of which he extended his investigations to the ruins of Babylon and the mounds of southern Meso- potamia. His record of this expedition. Discoveries in the Ruins of Nineveh and Babylon, which was illustrated by another folio volume, called A Second Series of the Monu- ments of Nineveh, was published in 1853. During these expeditions, often in circumstances of great difficulty, Layard despatched to England the splendid specimens which now form the greater part of the collection of Assyrian antiquities in the British Museum. Apart from the archaeological value of his work in identifying Ku- yunjik as the site of Nineveh (see the article Nineveh, Ency. Brit. vol. xvii. p. 511), and in providing a great

mass of materials for scholars to -work upon, these two books of Layard's are among the best-written books of travel in the language.

Layard now turned to politics. Elected as a Liberal member for Aylesbury in 1852, he was for a few weeks Under Secretary for Foreign Affairs, but afterwards freely criticized the Government, especially in connexion with army administration. He was present in the Crimea during the war, and was a member of the com- mittee appointed to inquire into the conduct of the expe- dition. In 1855 he refused from Lord Palmerston an office not connected with foreign affairs, was elected Lord Rector of Aberdeen University, and on 16th June moved a resolution in the House of Commons (defeated by a large majority) declaring that in public appoint- ments merit had been sacrificed to private influence and an adherence to routine. After being defeated at Aylesbury in 1857, lie visited India to investigate the causes of the Mutiny. He unsuccessfully contested York in 1859, but was elected for Southwark in 1860, and from 1861 to 1866 was Under Secretary for Foreign Affairs in the successive administrations of Lord Palmerston and Lord John Russell. In 1866 he was appointed a trustee of the British Museum, and in 1868 Chief Commissioner of Works in Mr Gladstone's Government and a member of the Privy Council. He retired from Parliament in 1869, on being sent as Envoy Extraordinary to Madrid. In

1877 he was appointed by Lord Beaconsfield ambassar dor at Constantinople, where he remained until Mr Gladstone's return to power in 1880, when he finally retired from public life. In 1878, on the occasion of the Berlin Conference, he received the order of the Grand Cross of the Bath. Layard's political life was a somewhat stormy one. His manner was brusque, and his advocacy of the causes which he had at heart, though always per- fectly sincere, was vehement to the point sometimes of recklessness. Layard retired to Venice, where he de- voted much of his time to collecting pictures of the Venetian school, and to writing on Italian art. On this subject he was a disciple of his friend Morelli, whose views he embodied in his revision of Kugler's Handbook of Painting, Italian Schools (1887). He wrote also an introduction to Miss Ffoulkes's translation of Morelli's Italian Painters (1892-3), and edited that part of Mur- ray's Handbook of Rome (1894) which deals with pic- tures. In 1887 he published, from notes taken at the time, a record of his first journey to the East, entitled Early Adventures in Persia, Susiana, and Babylonia. An abbreviation of this work, which as a book of travel is even more delightful than its predecessors, was pub- lished in 1894, shortly after the author's death, with a brief introductory notice by Lord Aberdare. Layard also from time to time contributed papers to various learned societies, including the Huguenot Society, of which he was first president. He died in London on 5th July 1894.

Lazarus, Henry (1815-1895), British clarinettist, was born in London, 1st January 1815, and was a pupil of Blizard, bandmaster of the Royal Military Asylum, Chelsea, and subsequently of Charles Godfrey, senior, bandmaster of the Coldstream Guards. He made his first appearance as a soloist at a concert of Mme Dulcken's, in April 1838, and in that year he was appointed as sec- ond clarinet to the Sacred Harmonic Society. From Will- man's death in 1840 Lazarus was principal clarinet at the opera, and all the chief festivals and orchestral concerts. His beautiful tone, excellent phrasing, and accurate execution were greatly admired. He was professor of the clarinet at the Royal Academy of Music from 1854 until within a short time of his death, and was appointed

to teach his instrument at the Military School of Music, Kneller Hall, in 1858. His last public appearance was at a concert got up for his benefit in St

James’s Hall, in June 1892, and he died 6th March 1895. (j. a. f. m.)

Lead, a city of Lawrence county, South Dakota, U.S.A. It is in the Black Hills, in a prosperous mining region, and is entered by two railways. Population (1890), 2581 ; (1900), 6210, of whom 2145 were foreign-born.

Lead .’ — In the last twenty years of the 19th century the lead-smelting industry underwent important changes. Most of these were the result of new condi- tions arising in the United States, where the ””* ”’’ treatment of the ores is carried out, not in small works near the mines, but in large centrally-situated smelting plants, to which the ores are shipped from various mining regions. As the competition is considerable, all the details of work have been greatly improved, the cost reduced, and the yield increased. Lead ores are smelted in the reverberatory furnace, the ore-hearth, and the blast-furnace. The use of the first two is restricted, as they are suited only for galena ores (the more common) or mixtures of galena and carbonate, which contain not less than 58 per cent, lead and not more than 4 per cent, silica ; further, ores to be treated in the ore-hearth should run low in or be free from silver, as the loss in the fumes is excessive. In the blast- furnace all lead ores are successfully smelted. Blast- furnace treatment has therefore become more general than any other.

To the two methods of working in the reverberatory furnace, represented by the English and Carinthian furnaces (described in Ency. Brit. vol. xiv. p. 375) a third, the Silesian, must be added. While by the former processes as much lead as possible is extracted in the furnace, with the Silesian method a very low tempera- ture is used, thus taking out about one-half of the lead and leaving very rich slags (50 per cent, lead) to be smelted in the blast-furnace, the ultimate result being a very much higher yield than by either of the other processes. The Silesian furnace has an oblong hearth, 16 feet by 8 feet 10 inches, sloping from the fire-bridge to the flue-bridge. This causes the lead to collect at the coolest part of the hearth, whence it is tapped, &c., as in the English furnace. A charge of 6180 pounds galena ore (70 per cent, lead) is worked in twelve hours with three men, 0-46 ton of coal being consumed per ton of ore charged. The loss in lead by the combined rever-beratory and blast-furnace treatment is only 3-2 per cent.

In the hearth process the blocks of cast-iron forming the sides and back of the Scottish furnace (see Ency. Brit. vol. xiv. p. 375) are now generally replaced in the United States by water-cooled shells (water-jackets) of cast-iron. In this way continuous working has been rendered possible, whereas formerly operations had to be stopped every twelve or fifteen hours to allow the over-heated blocks and furnace to cool down. The latest improvement (which somewhat changes the mode of working) is that by Moffett. While he also prevents interruption of the operation by means of water-jackets, he uses hot-blast, and produces, besides metallic lead, large volumes of lead fumes which are drawn off by fans through long cooling tubes, and then forced through suspended bags which filter off the dust, called blue powder. This, a mixture of lead sulphate (45 per cent.) and oxide (44 per cent.) with some sulphide (8 per cent.), zinc, and carbonaceous matter, is agglomerated by a heap-roast, and then Smelted in a slag-eye furnace Avith gray slag from the ore-hearth. The furnace has, however, in addition to the usual tuyeres near the bottom, a second set near the throat in order to effect a complete oxidation of all combustible niatter. Much fume is thus

produced. This is drawn off, cooled and filtered, and forms a white paint of good body, consisting of about 65 per cent, lead sulphate, 26 per cent, lead oxide, 6 per cent, zinc oxide, and 3 per cent, other substance. Thus in the Moffett method it is no matter whether metal or fume is produced, as in either case it is saved and the price is about the same.

In smelting at once in the same blast-furnace ores of different character, the old use of separate processes of precipitation, roasting and reduction, and general reduc- tion prevailing in the Harz Mountains (see Ency. Brit. vol. xiv. p. 376), Freiberg, and other places, to suit local conditions, has had to be abandoned. Ores are smelted raw if the fall of matte (metallic sulphide) does not exceed 5 per cent. ; otherwise they are subjected to a preliminary oxidizing roast to expel the sulphur, unless they run too high in silver, say 100 ounces to the ton, when they are smelted raw. The leading reverbera- tory furnace for roasting lead-bearing sulphide ores has a level hearth 14-16 feet wide and 60-80 feet long. It puts through 9-12 tons of ore in twenty-

four hours, re- ducing the percentage of sulphur to 2-4 per cent., and requires four to six men and about two tons of coal. In many instances it has been replaced by mechanical fur- naces, which are now very common in roasting sulphide copper ores. (See Acid and Alkali Manufacture.) A modern blast-furnace is oblong in horizontal section and about 24 feet high from furnace floor to feed floor. The shaft, resting upon arches supported by four cast- iron columns about 9 feet high, is usually of brick, red brick on the outside, fire-brick on the inside ; sometimes it is made of wrought-iron water-jackets. The smelting zone always has a bosh and a contracted tuyere section. It is enclosed by water-jackets, which are usually cast- iron, sometimes mild steel. The hearth always has an Arents siphon tap. This is an inclined channel running through the side-wall, beginning near the bottom of the crucible and ending at the top of the hearth, where it is enlarged into a basin. The crucible and the channel form the two limbs of an inverted siphon. While the furnace is running the crucible and channel remain filled with lead ; all the lead reduced to the metallic state in smelting collects in the crucible, and rising in the chan- nel, overflows into the basin, whence it is removed. The slag and matte formed float upon the lead in the crucible and are tapped, usually together, at intervals into slag- pots, where the heavy matte settles on the bottom and the light slag on the top. When cold they are readily separated by a blow from a hammer. The following ‘ table gives the dimensions of some well-known American lead-furnaces : —

Lead Blast-Furnace.

Locality.

Tear.

Tuyere Section.

Height, Tuyere to Throat.

‘ Inches,

Feet.

Leadville, Colorado

1880

33×84

14

Denver, ,, . .

1880

36×100

17

Durango, ,, . .

1882

36×96

12-6

Denver, ,, . .

1892

42 x 100

16

Leadville, ,, . .

1892

42 x 120

18

Salt Lake City, Utah .

1895

45×140

20

A furnace, 42 by 120 inches at the tuyeres, with a working height of 17-20 feet, will put through in twenty- four hours, with twelve men, 12 per cent, coke, and 2 fb blast-pressure, 85-100 tons average charge, i.e., one that is medium coarse, contains 12-15 per cent, lead, not over 5 per cent, zinc, and makes under 5 per cent, matte. In making up a charge, the ores and fluxes, whose chemical compositions have been determined, are mixed so as to form out of the components, not to be reduced to the metallic or sulphide state, typical slags (silicates of

ferrous and calcic oxides, incidentally of aluminium oxide, which have been found to do successful work). Such slags contain SiOj 30-33 per cent., Fe(Mn)0 27-50 per cent., Ca(Mg,Ba)0 12-28 per cent., and retain less than 1 per cent, lead and 1 ounce silver to the ton. The lead- ing products of the blast-furnace are argentiferous lead (base bullion), matte, slag, and flue-dust (fine particles of charge and volatilized metal carried out of the furnace by the ascending gas current). The base bullion (assay- ing 300 ± ounces per ton) is desilverized (see below) ; the matte (Pb 8-12 per cent., Cu 3^ per cent., Ag ~~J— ^ of the assay~~ value of the base bullion, rest Fe and S) is roasted and resmelted, when part of the argentiferous lead is recovered as base bullion, while the rest remains with the copper, which becomes concentrated in a copper- matte (60 per cent, copper) to be worked up by separate processes (see Coppbe). The slag is a waste product, and the flue-dust, collected by special devices in dust- chambers, is briquetted by machinery, with lime as a bond, and then resmelted with the ore-charge. The yield in lead is over 90 per cent., in silver over 97 per cent., and in gold 100 per cent. The cost of smelting a ton of ore in Colorado in a single furnace, 42 by 120 inches at the tuyferes, is about $3.

The lead produced in the reverberatory furnace and the ore-hearth is of a higher grade than that produced in the blast-furnace, as the ores treated are

purer and richer, and the reducing action is less powerful. The following analysis of blast-furnace lead of Freiberg, Saxony, is from an exceptionally impure lead: — Pb 96-088, Ag 0-470, Bi 0-019, Cu 0-226, As 1-826, Sb 0-958, Sn 1-364, Fe 0-007, Zn 0-002, S 0-051. Of the impurities, most of the copper, nickel and copper, considerable arsenic, some antimony, and small amounts of silver, are removed by liquation. The lead is melted down slowly, when the impurities separate in the form of a scum (dross), which is easily removed. The purification by liquation is' as- sisted by poling the lead when it is below redness. A stick of green wood is forced into it, and the vapours and gases set free stir it up and expose new surfaces to the air, which at this temperature has only a mildly oxidizing effect. The pole, the use of which is awkward, has been replaced by dry steam, which has a similar effect. In order to remove tin, arsenic, and antimony, the lead has to be brought up to a bright-red heat, when the air has a strongly oxidizing effect. Tin is removed mainly as a powdery mixture of stannate of lead and lead oxide, ar- senic and antimony as a slagged mixture of arsenate and antimonate of lead and lead oxide. They are readily withdrawn from the surface of the lead, and are worked up into antimony (arsenic) — tin-lead and antimony-lead alloys. Liquation, if not followed by poling, is carried on as a rule in a reverberatory furnace with an oblong, slightly trough-shaped inclined hearth ; if the lead is to be poled it is usually melted down in a cast-iron kettle. If the lead is to be liquated and then brought to a bright- red heat, both operations, for convenience' sake, are car- ried on in the same reverberatory furnace. This has an oblong, dish-shaped hearth of acid or basic fire-brick built into a wTought-iron pan, which rests on transverse rails supported by longitudinal walls. The lead is melted down at a low temperature and drossed. The tempera- ture is then raised, and the scum which forms on the surface is withdrawn until pure litharge forms, which only takes place after all the tin, arsenic, and antimony have been eliminated.

Silver is extracted from lead by means of the process of cupellation (see Ency. Brit. vol. xiv. p. 376). Formerly all argentiferous lead had to be cu- Desiiver- pelled, and the resulting litharge then reduced * "^' to metallic lead. In 1833 Pattinson invented his process

(ibid. p. 377) by means of -which practically all the silver is concentrated in 13 per cent, of the original lead to be cupelled, ~~while the rest becomes market lead. In 1842 Karsten (loc. cit.) discovered that lead could be desilverized by means of zinc. His invention, however, only took prac~~ tical form in 1850-62 through the researches of Parkes, “who showed how the zinc-silver-lead alloy formed could be worked, and the desilverized lead freed from the zinc it had taken up. In the Parkes process only 6 per cent, of the original lead need be cupelled. Thus, while cupellar tion still furnishes the only means for the final separation of lead and silver, it has become an auxiliary process to the two methods of concentration given. Of these the Pattinson process has become subordinate to the Parkes process, as it is more expensive and leaves more silver and impurities in the market lead. It holds its own, how-

ever, when base bullion contains bismuth in appreciable amounts, as in the Pattinson process bismuth follows the lead to be cupelled, while in the Parkes process it remains with the desilverized lead which goes to market, and lead of commerce should contain little bismuth. At Freiberg, Saxony, the two processes have been combined. The base bullion is imperfectly Pattinsonized, giving lead rich in silver and bismuth, which is cupelled, and lead low in silver, and especially so in bismuth, which is further desilverized by the Parkes process.

The effect of the two processes on the purity of the market lead is clearly shown by the two folio-wing analyses by Hampe, which represent lead from Lautenthal in the Harz Mountains, where the Parkes process replaced that of Pattinson, the ores and smelting process remaining practically the same : —

Process.

Pb.

Ou.

Sb.

As.

Bi.

Ag.

Fe.

Zn.

m.

Pattinson Parkes .

99-966200 99-983139

0-015000 0-001413

1-010000 0-005698

none none

0-000600 0-005487

0-002200 0-000460

0-004000 0-002289

0-001000 0-000834

1-001000 0-000680

The reverberatory furnace commonly used for cupelling

goes by the name of the English cupelling furnace. It is

oblong, and has a fixed roof and a movable iron

Cupelling, j^e^^^.]^ (t.gs^.^)_ formerly the test was lined with

bone-ash ; at present the hearth-material is a mixture of crushed limestone and clay (3 : 1), or Portland cement, either alone or mixed with crushed fire-brick ; in a few instances the lining has been made of burnt magnesite. In the beginning of the operation enough argentiferous lead is charged to fill the ca-vity of the test. After it has been melted down and brought to a red heat, the blast, admitted at the back, oxidizes the lead and drives the litharge formed towards the front, where it is run off. At the same time small bars of argentiferous lead, inserted at the ~~back, are slowly pushed forward, so that in melting down they may replace the oxidized lead Thus the level of the lead is kept approximately constant, and the silver becomes concentrated in the lead. In large works the sil~~ ver-lead alloy is removed when it contains 60-80 per cent, silver, and the eupellation of the rich bullion from several concentration furnaces is finished in a second furnace. At the same time the silver is brought to the required degree of fineness, usually by the use of nitre. In small works the eupellation is finished in one furnace, and the result- ing low-grade silver fined in a plumbago crucible, either by overheating in the presence of air, or by the addition of silver sulphate to the melted silver, when air or sulphur trioxide and oxygen oxidize the impurities. The lead charged contains about 1-5 per cent, lead if it comes from a Pattinson plant, from 6-10 per cent, if from a Parkes plant. In a test 7 feet by 4 feet 10 inches, and 4 inches deep, about 6 tons of lead are cupelled in twenty-four hours. A furnace is served by three men, working in eight-hours shifts, and requires about 2 tons of coal, which corre- sponds to about 110 gallons reduced oil, air being used as atomizer. The loss in lead is about 6 per cent. The latest cupelling furnaces have the general form of arev§rberatory copper-smelting furnace. The working door through which the litharge is run oif lies under the flue which carries off the products of combustion and the lead fumes, the lead is charged, and the blast is admitted near the fire-bridge. In the Pattinson process the argentiferous lead is melted down in the central cast-iron kettle of a series 8-16, placed one next to the other, each having a capacity of 9-15 tons and a separate

fireplace. The crystals of impoverished lead which fall to^ the bottom, upon coaling the charge, are taken out with a skimmer and discharged into the neighbouring kettle (say to the right) until about two-thirds of the

Pattinson process.

original charge has been removed; then the liquid en- riched lead is ladled into the kettle on the opposite side. To the kettle, two-thirds full of crystals of lead, is now added lead of the same tenor in silver, the whole is lique- fied, and the cooling, crystallizing, skimming, and ladling are repeated. The same is done with the kettle one-third filled with liquid lead, and so on until the first kettle con- tains market lead, the last cupelling lead. The interven- ing kettles contain leads with silver contents ranging from above market to below cupelling lead. The original Pat- tinson process has been in many cases replaced by the Luce-Eozan process (1870), which does away with arduous labour and attains a more satisfactory crystallization. The plant consists of two tilting oval metal pans (capacity 7 tons), one cylindrical crystallizuig pot (capacity 22 tons), with two discharging spouts and one steam inlet opening, two lead moulds (capacity 3^ tons), and a steam crane. Pans and pot are heated from separate fireplaces. Sup- posing the pot to be filled with melted lead to be treated, the fire is withdrawn beneath and steam introduced. This cools and stirs the lead when crystals begin to form. As soon as two-thirds of the lead has separated out in the form of crystals, the steam is shut off and the liquid lead drained off through the two spouts into the moulds. The fire underneath the pot is again started, the crystals are liquefied, and one of the two pans, filled with melted lead, is tilted by means of the crane and its contents poured into the pot. In the meantime the lead in the moulds, which has solidified, is removed with the crane and stacked to one side, until its turn comes to be raised and charged into one of the pans. The crystallization proper lasts one hour, the working of a charge four hours, six charges being run in twenty-four hours.

It is absolutely necessary for the success of the Parkes process that the zinc and lead should contain only a small amount of impurity. The spelter used must therefore be of a good grade, and the lead is usually first refined in a reverberatory furnace (the softening furnace) as described above. The capacity of the furnace must be 10 per cent, greater than that of the kettle

into which the softened lead is tapped, as the dross and skimmings formed amount to about 10 per cent, of the weight of the lead charged. The kettle is spherical, and is suspended over a fireplace by a broad rim resting on a wall ; it is usually of cast-iron. Most kettles at present hold 30 tons of lead ; some, however, have double that capacity. When zinc is placed on the lead (heated to above the melting-point of zinc), lique- fied, and brought into intimate contact with the lead

Parkes

process.

by stirring,_ gold, copper, silver, and lead -will combine with the zinc in the order given. By beginning with only a small amount of zinc, all the gold and copper and some silver and lead will be alloyed with the zinc to a so-called gold — or copper — crust, and the residual lead saturated with zinc. By removing from the surface of the lead this first crust and working it up separately (liquating, retorting, and cupelling), dore silver is ob- tained. By the second addition of zinc most of the silver will be collected in a saturated zinc-silver-lead crust, which, when worked up, gives fine silver. A third addition becomes necessary to remove the rest of the silver, when the lead will assay only 0-1 ounce silver per ton. As this complete desilverization is only possible by the use of an excess of zinc, the unsaturated zinc-silver-lead alloy is put aside to form part of the second zinck- ing of the next following charge. In skimming the crust from the surface of the lead some unalloyed lead is also drawn off, and has to be separated by an additional oper- ation (liquation), as, running lower in silver than the crust, it would otherwise reduce its silver content and in- crease the amount of lead to be cupelled. A zincking takes 5-6 hours ; 1-5-2-5 per cent, zinc is required for desilver- izing. The liquated zinc-silver-lead crust contains 5-10 per cent, silver, 30-40 per cent, zinc, and 66-60 per cent, lead. Before it can be cupelled it has to be freed from most of the zinc, which is accomplished by distilling in a retort made of a mixture similar to that of the plumbago crucible. The retort is pear-shaped, and holds 1000-1500 lb of charge,

consisting of liquated crust mixed with 1-3 per cent, of charcoal. The condenser commonly used is an old retort. The distillation of 1000 lb charge lasts 6-6 hours, requires 500-600 lb coke or 30 ± gallons re- duced oil, and yields about 10 per cent, metallic zinc and 1 per cent, blue powder — a mixture of finely-divided metallic zinc and zinc oxide. About 60 per cent, of the zinc used in desilverizing is recovered in a form to be used again. One man serves 2-4 retorts. The desilver- ized lead, which retains 0-6-0-7 per cent, zinc, has to be refined before it is suited for industrial use. The opera^ tion is carried on in a reverberatory furnace or in a kettle. In the reverberatory fu.rnace, similar to the one used in softening, the lead is brought to a bright-red heat and air allowed to have free access. The zinc and some lead are oxidized ; part of the zinc passes off with the fumes, part is dissolved by the litharge, forming a melted mixture which is skimmed off and reduced in a blast-furnace or a reverberatory smelting furnace. In the kettle covered with a hood the zinc is oxidized by means of dry steam, and incidentally some lead by the air which cannot be completely excluded. A yellowish powdery mixture of zinc and lead oxides collects on the lead; it is skimmed off and sold as paint. From the reverberatory furnace or the kettle the refined lead is siphoned off into a storage (market) kettle after it has cooled somewhat, and from this it is siphoned off into moulds placed in a semicircle on the floor. In the pro- cess the yield in metal, based upon the charge in the kettle, is lead 99 per cent., silver 100-f-per cent., gold 98- 100 per cent. The plus-silver is due to the fact that in assaying the base bullion by cupellation, the silver lost by volatilization and cupel-absorption is neglected. In the United States the cost of desilverizing a ton base bul- lion is about $6.

Statistics. — The world’s production of lead in 1899 was, accord- ing to The Mineral Industry (1900, p. 431), 803,273 metric tons, viz. : Austria, 9736 ; Belgium, 15,700 ; Canada, 9917 ; Chile, 171 ; Franoe, 15,981 ; Germany, 129,225 ; Greece, 19,059 ; Hungary, 2166 ; Italy, 20,543 ; Japan, 1989 ; Mexico, 84,656 ; New South Wales, 70,000 ; Russia, 250 ; Spain, 184,007 ; Sweden, 1606 ; United Kingdom, 41,500 ; United States, 196,938.

Authorities. —J. Pekct. The Metallurgy of Lead. London,

1870.— H. r. Collins. The Metallurgy of Lead and Silver. London, 1899, Part L “Lead.”— H. 0. Hofman. The Metallurgy of Lead, 6th edition. New York, 1901. — The Mineral Industry, begun in 1892, annually records the progress made in lead smelting. (h. o. h.)

Lead Poisoning. — Lead poisoning has become important from the administrative point of view. Its occurrence among persons working in various industries has for some years engaged the attention of the Factory Department of the British Home Office, and from time to time ” special rules ” have been drawn up in the United Kingdom for workshops and workpeople, with the object of minimizing or preventing it. Previous to 1895, when an Act was passed for the compulsory notification of all cases, the extent of the evil was not at all accurately known ; it could only be calculated from hospital records and from the Eegistrar-General’s mortality returns. The number of deaths directly ascribed to lead poisoning, or ” plumbism,” is a very imperfect measure of its influence on health, as it acts also indirectly by causing or promot- ing organic disease, particularly of the nervous and urinary systems. The Supplement to the Registrar-General’s 66th annual report contains the following table, showing the comparative mortality for 1890-91-92 in various industries : —

ti-,

jj^

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a

1

ill

« 3 P

o

IS

If

M

0 Q

s

o

Q

0″

K

Lead-worker .

211

161

232

148

272

397

File-maker .

75

104

212

4

402

204

423

Plumber

21

81

131

13

165

123

218

Painter and Glazier

18

83

132

9

232

147

225

Potter ....

17

63

123

1

333

227

668

Glass-maker .

12

63

155

9

295

157

445

Copper-worker

8

60

85

294

186

406

Coaohmaker .

7

68

105

“7

189

134

250

Gasiitter, Locksmith

6

50

108

5

223

104

205

Lead-miner .

5

41

62

380

142

325

Printer ....

3

52

98

“4

326

133

214

Cutler ....

3

56

91

382

167

518

Wool manufacturer

3

45

100

i

191

131

256

The table shows the association of plumbism with diseases of the urinary and nervous systems, and to a less degree with those of the circulatory system. Phthisis and respir- atory diseases, on the other hand, are not so associated. They are highest among potters, cutlers, and file-makers, and are undoubtedly due to the inhalation of dust.

The symptoms of lead poisoning vary within very wide limits, from colic and constipation up to total blindness, paralysis, convulsions, and death. They are thus de- scribed by Dr Arlidge {Diseases of Occupations) : —

The poison finds its way gradually into the whole mass of the circulating blood, and exerts its effects mainly on the nervous system, paralysing nerve-force, _ and with it muscular power. Its victims become of a sallow-waxy hue ; the functions of the stomach and bowels are deranged, appetite fails, and painful colic with constipation supervenes. The loss of power is generally shown first in the fingers, hands, and wrists, and the condition known as ” wrist-drop ” soon follows, rendering the victim useless for work. The palsy will extend to the shoulders, and after no long time to the legs also. Other organs frequently involved are the kidneys, the tissue of which becomes permanently damaged ; whilst the sight is weakened or even lost.

As a rule the poisoning is gradually established by accumulation, and persons may have lead in the system for years before any symptoms manifest themselves. Dr M'Aldowie, senior physician to the North Staffordshire Infirmary, states that " in the pottery trade lead is very slow in producing serious effects compared with certain other industries." In his experience the average period of working in lead before serious lesions manifest them- selves is 18 years for females and 22^ years for males.

But some individuals fall victims to the worst forms of plumbism after a few months' or even weeks' exposure to the danger. Young persons are more readily affected than those of mature age, and women more than men. In addition to age and sex influence, there seems to be an element of personal susceptibility, the nature of which is not understood. Some persons "work in the lead" for twenty, forty, or fifty years without the slightest ill effects ; others succumb rapidly and persistently to the poison, having repeated attacks whenever they are brought into contact with it. This is ascribed to " idio- syncrasy"— a long word of little meaning. Possibly tire difference is due to the general state of health; robust persons resist the poison successfully, those with impoverished blood and feeble constitution are mastered by it. The explanation is vague, but not without meaning if lead acts, as it is supposed to do, by destroying the red corpuscles in the blood. Robust persons, feeding heartily and keeping up an ample supply of red corpuscles, would naturally resist it better than the ill-nourished, weakly, and anaemic. The great susceptibility of pregnant women, whose nutritive functions are placed under a double strain, bears out this view, which points to the importance of good nutrition. But the different effects of contact with lead on different individuals have another explanation, which is probably more important than any factor of susceptibility — namely, the habits of the workpeople. Lead enters the body chiefly through the nose and mouth, being inspired in the form of dust or swallowed with food eaten with unwashed hands. It is very apt to get under the nails, and is possibly absorbed in this way through the skin. Personal care and cleanliness are therefore of the greatest importance. The dust may be minimized by

mechanical appliances and ventilation, but so long as lead particles get on the hands and person they will be liable to be swallowed by careless workpeople. A factory surgeon of great experience in the Potteries reckons that seventeen out of twenty cases of lead poison- ing in the china and earthenware industry are due to carelessness {Tlie Times, 8th October 1898). This is one of the largest and most important industries affected by lead, and the one to which most attention has been drawn, mainly because of a somewhat sensational agita- tion in 1898. It was based on the occurrence of recent cases of a very severe and rapid character among women and girls employed in certain processes of manufacture in the Potteries district. It has had the effect of stimu- lating reforms in the conduct of the industry, and, incidentally, of promoting a manufacturing development of much commercial interest. The health of workpeople in the Potteries had already been the subject of a special inquiry by a scientific committee on behalf of the Home Office in 1893. The committee stated that ” the general truth that the potteries occupation is one fraught with injury to health and life is beyond dispute,” and that ” the ill effects of the trade are referable to two chief causes — namely, dust and the poison of lead.” Of these the inhalation of clay and fiint dust is the more im- portant. It leads to bronchitis, phthisis, and pneumonia, which are by far the most prevalent disorders among potters, and responsible for 70 per cent, of the mortality. That from lead the committee did not attempt to estimate, but they found that plumbism was less prevalent than in past times, and expressed the opinion ” that a large part of the mortality from lead poisoning is avoidable ; although it must always be borne in mind that no arrange- ments or rules, with regard to the work itself, can entirely obviate the effects of the poison to which workers are exposed, because so much depends upon the individual and the observance of personal care and cleanliness.”

They recommended the adoption of certain special rules in the workshops, with the objects of protecting young persons from the lead, of minimizing the evils of dust, and of promoting cleanliness, particularly in regard to meals. Some of these recommendations were adopted and applied with good results. With regard to the suggestion that “only leadless glazes should be used on earthenware,” they did not ” see any immediate pros- pect of such glazes becoming universally applicable to pottery manufacture,” and therefore turned their attention to the question of ” fritting ” the lead. It may

be explained here that lead is used in china and earthenware to give the external glaze which renders the naturally porous ware watertight. Both “white” and “red” lead are used. The lead is added to other ingredients, which have been “fritted” or fused together, and then ground very fine in water, making a thick creamy liquid into which the articles are dipped. After dipping the glaze dries quickly, and on being ” fired ” in the kiln it becomes fused by the heat into the familiar glassy surface. In the manufacture of ware with enamelled colours, glaze is mixed with the pigment to form a flux, and such colours are used either moist or in the form of a dry powder, according to the style of goods. “Pritting” the lead means mixing it with the other in- gredients of the glaze beforehand and fusing them all together under great heat into a kind of rough glass, wJhich is then ground to make the glaze. Treated in this way the lead combines with the other ingredients and becomes less soluble, and therefore less dangerous, than when added afterwards in the raw state. The committee thought it “reasonable to suppose that the fritting of lead might ultimately be found universally practicable,” but declared that though fritting ” no doubt diminishes the danger of lead poisoning,” they ” could not regard all fritts as equally innocuous.”

In the annual report of the chief inspector of factories for 1897, published in 1898, it was stated that there had been “material improvement in dust conditions” in the potting industry, but “of lead poisoning unfortunately the same could not be said, the number of grave cases reported, and particularly cases of blindness, having ominously increased of late.” This appears to have been largely due to the erroneous inclusion among potting processes of ” litho-transfer making,” a new colour in- dustry in which girls are employed. New special rules were therefore imposed, prohibiting the employment of persons under fifteen years of age in the dangerous pro- cesses, ordering a monthly examination of all women and young persons working in lead by the certifying surgeon, with power to suspend those showing symptoms of poison- ing, and providing for the more effectual removal of dust and the better enforcement of cleanliness. At the same time a scientific inquiry was ordered into the practicability of dispensing with lead in glazes or of substituting fritted compounds for the raw carbonate. The scientific experts reported in 1899, recommending that the use of raw lead should be absolutely prohibited, and expressing the opinion that the

greater amount of earthenware could be successfully glazed without any lead at all. These views were in advance of the opinions held by practical potters, and met with a good deal of opposition. By the enterprise of certain manufacturers, who had been working at the problem for years, considerable progress had been made in diminishing the use of raw lead and towards the dis- covery of satisfactory leadless glazes, and the movement had been much stimulated by the public agitation pre- viously mentioned ; but it is a long step from individual experiments to the wholesale compulsory revolution of the processes of manufacture in so large and varied an indus- try, and in the face of foreign competitors hampered by no

such regulations. The materials used by each manufac- turer have been arrived at by a long process of experience, and they are such as to suit the particular goods he sup- plies for his particular market. He cannot change them suddenly without endangering the quality, and con- sequently risking the loss of the market. Nor does the experience of other manufacturers afford him much practical assistance, for a glaze which has been proved satisfactory for one class of goods may be quite unsuitable to another. And the varieties are endless, on account of differences in the composition of the ware and in firing. It is therefore difficult to apply a uniform rule without j eopardizing the prosperity of the industry, which supports a population of 250,000 in the Potteries alone. However, the bulk of the manufacturers agreed to give up the use of raw lead, and to fritt all their glazes in future, time being allowed to effect the change of process ; but they declined to be bound to any particular composition of glaze for the reasons indicated.

In 1901 the Home Office brought forward a new set of special rules. Most of these were framed to strengthen the provisions for securing cleanliness, removing dust, &c., and were accepted with a few modifications. Strong objection, however, was raised to three of the proposed rules — namely, No. 1, which prohibited the use of unf ritted lead ; No. 2, which provided that ” no glaze shall be used which yields to a dilute solution of hydrochloric acid more than 2 per cent, of its dry weight of a soluble lead compound calculated as lead monoxide ” ; and No. 6, which extended the

monthly examination of women and young persons working in lead processes, with power of suspension, to men. The manufacturers objected to No. 1 and No. 2 as impractic- able, and the workmen to No. 6 as unnecessary and a vexatious interference with their liberty. Arbitration between the Home Office and the objectors took place under the Factory Acts in November 1901. The arbi- trator. Lord James of Heretford, after hearing the case for the Home Office, ruled that the questions in dispute should be left open for eighteen months and come up for reconsideration at the end of that time.

The arbitrator was influenced in this decision by the great dim- inution of lead poisoning in the industry. The number of cases notified in 1899 was 249 ; 1900, 200 ; 1901, 106. This diminution is attributed mainly to the monthly examination and the removal of dust by ventilating fans. The number of cases of lead poison- ing notified in the various industries after the Act of 1895 was given in the annual report of the Chief Inspector of Factories for 1899 as follows : —

1896.

1897.

1898.

1899.

China and Earthenware

432

446

457

249

White Lead

239

370

332

399

Smelting .....

56

102

82

61

Tinning and Enamelling

35

36

24

24

Pile-making

20

39

46

41

Paints and Colours

93

35

59

75

Glass

14

23

19

8

Coachmaking ....

15

18

45

65

Electric accumulator works ■

11

32

Litho-transfer works (only classi-

fied in 1899) ....

11

Other Industries ■ ■ ■ • Total . . • •

126

145

203

293

1030

1214

1278

1258

These figures include all degrees of severity. In the return for 1899 they were classified, with the following result :—

Severe.

Moderate.

Slight.

Not stated.

Males • Females

Per cent.

32-0 21-0

Per cent.

13-6 17-6

Per cent.

50 ‘8 54-5

Per cent.

4-5 6-3

The proportions of each class vary greatly in .different indus- tries. Those with the largest proportion of severe cases were file-

cutting with 53-9 per cent., certain painting trades with 514 per cent., sheet lead with 44-3 per cent., coach-painting witli 43-1 per cent., paints and colours with 42-5 per cent. In the potting indus- try the majority of the oases were slight — namely, males 57 -1 per cent., females 60-4 per cent. The percentage of severe cases was — males 29-4, females 19-8. In the white lead industry the propor- tions are still more favourable, the percentage being — slight, inales 68-3, females 77-3 ; severe, males 23-2, females 13-6. In both these industries there is periodical examination of the workpeople. Out of the whole number of cases returned, 30-4 per cent, of the males and 21-5 per cent, of the females were classed as secondary attacks or chronic cases. In 1900 the percentages in the potting trade were — severe, males 18 ‘5, females 23-8 ; slight, males 57-6, females 43‘8. In 1901 they were — severe, males 33-8, females 20-4 ; slight, males 45 ‘6, females 61 -0.

The increase shown above in the annual returns since 1896 is largely due to a corresponding increase in the number of persons employed. For 1899 there was a very notable decrease — more than 45 per cent. — in the number of cases in the potting industry. It was partly due to the elimination of cases returned twice over, which unduly inflated the returns in previous years, and partly to the operation of the special rales established in 1898. The effect of the monthly examination of women was clearly shown by the fact that the female cases, which had previously exceeded the male, fell below them in 1899. The average number of examina- tions every month was 223, and of suspensions 10. In 1900 the average monthly number of suspensions was 8, and in 1901 it was 7.

The following notes refer to the more important of the other industries concerned. White Lead. — The increase of cases shown in 1899 was largely due to ~~the engagement at one factory of a number of Italians previously employed in smelting works, and already charged with lead, in whom the~~

~~white lead dust evoked active symptoms. New special rules were adopted in 1899 for the more efficient prevention of dust, promotion of cleanliness, and weekly examination of workers. The introduction of a new method of manufacture, called the Bischof process, whereby dust is avoided, promises to effect a large diminution of danger. File~~ cutting. — This is the most injurious of all the lead industries, and causes far more cases of paralysis than any other. The great majority of the cases are returned from Sheffield, where 2990 men are employed as hand cutters of flies. Smelting. — In this industry men are exposed to the fumes of lead and other metals, as well as to dust, sulphur, dioxide gas, and great heat. It is under special rules, but the physical difficulty of protecting workmen from fumes has not been surmounted. Printing. — The number of cases is very small, and far less than in Germany. Eating with un- washed hands is the chief cause. Tinning and Enamelling. — Carbonate of lead in powder is used in the best quality of en- amelling, and the process necessarily entails much scattering of the dust. The industry is under special rules. Fritted lead has been introduced in place of the raw carbonate. Paints and Colours. — The danger is the inhalation of dust, which is to some extent met by the provision of ventilating fans. It is a large industry, employing, in 1897, 6019 persons in 354 factories. Coach-painting. — The percentage of severe and chronic oases is exceedingly high. The danger lies largely in the process of sand-papering a coat of paint to obtain a surface for another coat. The apparent increase in the number of cases is explained by the fact that notification was not at first understood, particularly in some large railway carriage works. Souse-painters and Plumbers do not come under the Factory Acts, but a considerable number of cases are notified. There is no doubt that a great deal of serious lead poisoning occurs among house-painters, but unless it is con- tracted in factory or workshop, as in grinding or mixing paints, the factory inspectors cannot interfere.

The regulations against industrial lead poisoning in the United Kingdom appear to be very much more complete and stringent than in any Continental country or in the United States.

Leadville, a city of Colorado, U.S.A., capital of Lake county, on the east side of the Arkansas valley, near the head of the river, at an altitude of 10,000 feet. It is the largest city at such an elevation in the United States,

and probably in the world. It is situated on a gravel terrace, sloping westwards to the river, just north of Cali- fornia Gulch. It is regularly laid out, divided into three wards, and has a water-supply brought from the Arkansas river by gravity. It is entered by three railways, the Colorado Midland, the Denver and Eio Grande, and the Colorado Southern, which connect it with Denver, Colo- rado Springs, Pueblo, and Salt Lake. In 1869 gold in placers was discovered in California Gulch, just south of

the present city, and in the succeeding five years from $12,000,000, to f 15,000,000 worth was taken from it. Indeed, in the heyday of its prosperity California Gulch was as busy and populous as was Leadville twenty years later ; but on the exhaustion of its placers the region was almost deserted, 100 or 200 inhabitants, constituting the town of Oro, being all that were left. The accidental discovery here in 1878 of lead carbonates containing silver in vast quantities caused a mining excitement over the whole country, and a second stampede to California Gulch ensued, paralleled only by the first. Two years later, in 1880, Leadville had a population of 14,820. Many very rich mines were discovered and worked, and the district as a whole is still as produc- tive as ever. The ore is mainly a carbonate of lead, but with many accessory metals and combinations. It lies in beds or sheets, between old rock strata much broken by faults and dislocations. The yield of the mines is about f 13,000,000 in silver annually, besides a vast amount of lead and other metals. Most of the ore is smelted at Leadville, and the matte transported east for refining. Population (1890), 10,384 ; (1900), 12,456, of whom 3802 were foreign-born.

Leamington, Leamington Peioes, or Eoyal Leamington Spa, a municipal borough and inland water- ing-place of Warwickshire, England, on the Leam, 98 miles north-west of London by rail. In 1885 the boroughs of Warwick and Leamington were united in one constituency, returning one member to Parliament. The parish church of All Saints is mostly modern. Recent erections are a theatre and a town hall, containing a free library and

a school of art. There is a municipal technical school. There are iron-foundries and brickworks. Area of civil parish, 1595 acres. Population (1891), 26,930 ; (1901), 26,888.

Lear, Edward (1812-1888), English artist and humorist, was born in London on 12th May 1812. / His earliest drawings were ornithological. When he was twenty years old he published a brilliantly coloured selec- tion of the rarer Psittacidce. Its power attracted the attention of the 13th earl of Derby, who employed Lear to draw his Knowsley menagerie. He became a per- manent favourite with the Stanley family ; and Edward, 15th earl, was the child for whose amusement the first Book of Nonsense was composed. From birds Lear turned to landscape, his earlier efforts in which recall the manner of J. D. Harding ; but he quickly acquired a more individual style. About 1837 he set up a studio at Eome, where he lived for ten years, with summer tours in Italy and Sicily, and occasional visits to England. During this period he began to publish his Illustrated Journals of a Landscape Painter : charmingly written reminiscences of wandering, which ultimately embraced Calabria, the Abruzzi, Albania, Corsica, &c. His wider flights date from 1848-49, when he explored Greece, Constantinople, the Ionian Islands, the wildest recesses of Albania, Lower Egypt, and the desert of Mount Sinai. He returned to London, but the climate did not suit him. In 1854-55 he wintered on the Nile, and migrated successively to Corfu, Malta, and Eome, till he finally settled on the Eiviera, building himself a villa at San Eemo, where he closed a career of untiring industry. Erom Corfu Lear visited Mount Athos, Syria, Palestine, and Petra; and when over sixty, by the generous assistance of his inti- mate friend Lord Northbrook, then Governor-General, he saw the cities and scenery of greatest interest within a large area of India. Prom first to last he was, in what- ever circumstances of difficulty or ill-health, an indomi- table traveller. Before visiting new lands he studied their geography and literature, and then went straight for the mark ; and wherever he went he drew most inde-

fatigably and most accurately. His sketches are not only the basis of more finished works, but an exhaustive record in themselves. Some defect of technique or eye- sight occasionally left his larger oil painting, though.nobly conceived, crude or deficient in harmony ; but his smaller pictures and more elaborate sketches abound in beauty, delicacy, and truth.

Lear modestly called himself a topographical artist; but he included in the term the perfect rendering of all characteristic graces of form, colour, and atmosphere. The last task he set himself was to prepare for popular circulation a set of some 200 drawings, illustrating from his travels the scenic touches of Tennyson's poetry; but he did not live to complete the scheme, dying at San Eemo on 30th January 1888. Until sobered by age, his conversation was brimful of humorous fun. The paradoxical origin- ality and ostentatiously uneducated draughtsmanship of his numerous nonsense books appealed to a wider public, and won him a more universal fame than his serious work. He had a true artist's sympathy with art under all forms, and might have become a skilled musician had he not been a painter. Swainson, the naturalist, praised young Lear's great red and yellow macaw as " equalling any figure ever painted by Audubon in grace of design, per- spective, and anatomical accuracy." Murchison, exam- ining his sketches, complimented them as rigorotisly embodying geological truth. Tennyson's lines " To E. L. on his travels in Greece," mark the poet's genuine admiration of a cognate spirit in classical art. Euskin placed the Sook of Nonsense first in the list of a hundred delectable volumes of contemporary literature, a judgment endorsed by English-speaking children all over the world. (f. l*.)

Leavenworth, a city of Kansas, U.S.A., capital of Leavenworth county, on the west bank of the Missouri river, at an altitude of 765 feet. It is laid out regularly in the bottom-lands of the river, and is divided into six wards. It is the fourth city of the state in population, and one of the most important railway centres west of the Mississippi river, no fewer than nine railways entering it. These, with the steamboats on the river, give the city a large trade. Its manufactures are also prominent, and are varied in character. Two miles north of the city is Fort Leavenworth, a United States military post, associated with which is a military prison and a well-known military school. Population (1890), 19,768 ; (1900), 20,736, of whom 3402 were foreign-born and 2925 were negroes.

Lebanon. — Since 1875 great progress has been made in that part of the Lebanon which was made an independent sanjak under a Christian governor in 1861. The population has almost doubled, villages have largely increased in size, nearly all available ground has been brought under

cultivation, roads have been made, the Beirut-Damascus railway, opened in 1895, crosses the district, and a short line runs northwards along the coast from Beirut to Mameltein. The steady growth of pro- sperity has been accompanied by a rapid increase of pop- ulation, and this of late years has become larger than the land can support. The result has been emigration, which the Porte has vainly attempted to stop, of Druses to the Haurdn, and of Christians to the United States and Egypt. It has been estimated that the annual number of emigrants, chiefly from the sanjak, is 10,000, and that of these one- fifth settle abroad. The others return to their homes after having earned enough fortheir simple requirements. Since the British occupation of Egypt the emigration to that country has assumed large proportions. There the Syrians fill many of the minor posts in the ministries and local governments, are employed as interpreters to the army, and work on the staffs of the Arabic newspapers published

at Cairo and Alexandria. Population, about 400,000— Christians (including 230,000 Maronites and 54,000 Orthodox Greeks), 320,000; Druses, 60,000; Moslems, Sunni,And Metawile, 30,000.

See CniNET. Syrie, Liban, et Palestine. Paris, 1896.— Von Oppenheim. Vom Mittelmeer zum Persischen Golf. Berlin, 1900.— Post. Flora of Syria, Palestine, and Sinai, 1896.

(c. w. W.)

Lebanon, a city of Pennsylvania, U.S.A., capital of Lebanon county, on Swatara Creek, in Cumberland Valley, south of Blue ‘Mountain, at an altitude of 464 feet. Its site is rolling and its plan regular. It has three railways, the Philadelphia and Beading, the Corn- wall, and the Cornwall and Lebanon. It is an iron manufacturing city, containing blast-furnaces, rolling- mills, and foundries. Population (1890), 14,664; (1900), 17,628, of whom 618 were foreign-born.

Lebceuf, Edmond (1809-1888), French soldier, was born at Paris on the 6th of November 1809, and received his military training at the Artillery School at Metz, becoming colonel in 1852. He commanded the artillery of the 1st J'rench corps at the siege of Sebas- topol, and was promoted in 1855 to the rank of general, and in 1857 to that of general of division. In the Pranco-Italian war of 1859 he commanded the artillery, and by his action at Solferino materially assisted in the victory. In September 1866 he was despatched to Venetia to hand over that province, which had been ceded by Austria, to Victor Emmanuel. In 1869, on the death of Marshal Niel, General Lebceuf became Minister of War, and earned public approbation by his vigorous reorganization of the War Office and the civil departments of the service. In the spring of the fateful year 1870 he received the field-marshal's baton. On the declaration of war with Germany Marshal Lebceuf delivered him- self in the Corps Legislatif of the historical saying, " So ready are we, that if the war lasts two years, not a gaiter button would be found wanting." He took part in the campaign as major-general of the army of the Ehine, but after the reverses at Weissembourg and Woerth was de- prived of this command and placed at the head of the 3rd corps, distinguishing himself by his personal bravery at the battles of Noiseville and St Privat. Shut up with Bazaine in Metz, on its fall he was confined as a prisoner in Germany. On the conclusion of peace he returned to Prance and gave evidence before the commission of in- quiry into the surrender of that stronghold, when he strongly denounced Bazaine. After this he retired into private life to the Chateau du Moncel near Argentan, where he died on the 7th of June 1888.

Le Caron, Henri (whose real name was Thomas Miller Beach) (1841-1894), British secret service agent, was born at Colchester, 26th September 1841. He was of an adventurous character, and when nineteen years old went to Paris, where he found employment in business connected with America. Infected with the excitement of the American Civil War, he crossed the Atlantic in 1861 and enlisted in the Northern army, taking the name of Henri Le Caron when he did so. In 1864 he married a young lady who had helped him to escape from some Confederate marauders ; and by the end of the war he rose to be major. In 1865, through a companion in arms named O'Neill, he was brought into contact with Penian- ism, and having learnt of the Penian plot against Canada, he mentioned the designs when writing

home to his father. Mr Beach told his local M.P., who in turn told the Home Secretary, and the latter asked Mr Beach to arrange for further information. Le Caron, inspired (as all the evidence shows) by genuinely patriotic feeling, from that time till 1889 acted for the British Government as a paid

military spy. He was a proficient in medicine, among other qualifications for this post, and he remained for years on intimate terms with the most extreme men in the Fenian organization under all its forms. His services enabled the British Government to take measures which led to the fiasco of the Canadian invasion of 1870 and Kiel's surrender ia 1871, and he supplied full details concerning the various Irish-American associations, in which he himself was a prominent member. He was in the secrets of the " new departure " in 1879-81, and in the latter year had an interview with Parnell at the House of Commons, in the course of which the Irish leader spoke sympathetically of an armed revolution in Ireland. Por twenty-five years he lived at Detroit and other places in America, paying occasional visits to Europe, and all the time carrying his life in his hand. The Parnell Commis- sion of 1889 put an end to this. Le Caron was subpoe- naed by The Times, and in the witness-box the whole story came out, all the efforts of Sir Charles Eussell in cross- examination failing to shake his testimony or to impair the impression of iron tenacity and absolute truthfulness which his bearing conveyed. His career, however, for good or evil, was at an end. He published the story of his life, Twenty-five Years in tJie Secret Service, and it had an immense circulation. But he had to be constantly guarded, his acquaintances were hampered from seeing him, and he was the victim of a painful disease, of which he died on 1st April 1894. The report of the Parnell Commission is his monument.

Lecce, a town, episcopal see, and capital of the province of Lecce, Apulia, Italy, 24 miles south-east of Brindisi by rail. In the prefecture there are collections of antique vases, coins, inscriptions, &c. In 1889 a monu- ment of Victor Emmanuel II. by Maccagni was unveiled. The staple industry is the manufacture of tobacco. In 1900 Lecce was connected by electric tramway with San Cataldo, on the coast 6 miles to the east, where a small fishing port has been made. Population (1881),

22,051 ; (1901), 32,486.

Lecco, a town of the province of Como, Lombardy, Italy, on the east side of the south-east extension of Lake Como, and 27 miles north by east of Milan by rail. There are statues to Garibaldi (1881) and Manzoni (1891), whose house is called Galeotto, not Caleotto. Besides the silk, cotton, and iron industries, there are copper works, and factories for wax candles and tin boxes ; also a school of the indtistrial arts and sciences. Population (1881), 7775 ;

(1897), 6100.

Lech, a river of Bavaria, rising in the Vorarlberg Alps, at an altitude of 6120 feet. It winds out of the gloomy limestone mountains in a north-north-easterly direction, and enters the plains at Pilssen (2580 feet), where it forms rapids and a fall, then pursues a northerly course past Augsburg (where it receives the Wertach), and joins the Danube from the right just below Donau- worth (1330 feet). Its total length is 177 miles. Its drainage basin has an area of 2550 square mUes. It is not navigable, owing to its torrential character and the gravel beds which choke its channel. More than once great historic events have been decided upon its banks. On the Lechfeld, a stony waste some miles long, “be- tween the Lech and the Wertach, the Emperor Otho I. defeated the Hungarians in 955. Tilly, in attempting to defend the passage of the stream at Eain against the forces of Gustavus Adolphus, was fatally woimded, on 6th April 1632.

Lecky, William Edward Hartpole (1838- ~~), Irish historian and publicist, was born at New~~

town Park, near Dublin, on 26th March 1838, being

the eldest son of John Hartpole Lecky, whose family have for many generations been landowners in Ireland. He was educated at Kingstown, Armagh, and Chelten- ham College, and at Trinity College, Dublin, where he graduated B.A. in 1859 and M.A. in 1863, and where, with a view to becoming a clergyman in the Irish Protes- tant Church, he also went

through a course of divinity. In 1860 he published anonymously a small book entitled The Beligious Tendencies of the Age, but on leaving col- lege he soon abandoned his first intention and turned to historical work. In 1861 he published Tlie Leaders of Public Opinion in Ireland, a brief sketch of the lives and work of Swift, Flood, Grattan, and O'Connell, which gave decided promise of his later admirable work in the same field. This book, originally published anonymously, was republished in 1871 ; and the essay on Swift, rewritten and amplified, appeared again in 1897 as an introduction to a new edition of Swift's works. Two learned surveys of certain aspects of European history followed : A His- tory of the Rise and Influence of Rationalism in Europe (2 vols., 1865), and A JEistory of European Morals from Augustus to Charlemagne (2 vols., 1869). Some criticism was aroused by these books, especially by the last named, with its opening dissertation on " the natural history of morals," but both have been generally accepted as acute and suggestive commentaries upon a wide range of facts. Lecky then devoted himself to the chief work of his life, A History of England during the Eighteenth Century, vols, i. and ii. of which appeared in 1878, and vols. vii. and viii. (completing the work) in 1890. His object was "to disengage from the great mass of facts those which relate to the permanent forces of the nation, or which indicate some of the more enduring features of national life," and there can be no doubt that in the carrying out of this task Lecky displays many of the qualities of a great historian. The work is distinguished by the lucidity of its style, by the fulness and extent of the authorities referred to, and, above all, by the judicial impartiality maintained by the author throughout. These qualities are perhaps most conspicuous and most valuable in the chapters which deal with the history of Ireland, and in the cabinet edition of 1892, in 12 vols, (frequently re-printed) this part of the work is separated from the rest, and occupies five volumes under the title of A History of Ireland in the Eighteenth Centui-y. A volume of Poems, published in 1891, was characterized by a certain frigidity and by occasional lapses into commonplace, objections which may also be fairly urged against much of Lecky's prose-writing. In 1896 he published two volumes on contemporary politics, entitled Democracy and Liberty, in which he considered, with special reference to Great Britain, France, and America, some of the tendencies of modern democracies. The somewhat gloomy conclusions at which he arrived provoked much criticism both in Great Britain and America, which was renewed when he published

in a new edition (1899) an elaborate and very depreciatory estimate of Gladstone, then recently de- ceased. This work, though essentially different from the author's purely historical writings, has many of their merits, though it was inevitable that other minds should take a different view of the evidence. In Tlie Map of Liffi (1900) he discussed in a popular style some of the ethical problems which arise in everyday life. Though always a keen sympathizer with the Irish people in their misfortunes and aspirations, and though he had criticized severely the methods by which the Act of Union was passed, Lecky was from the first strenuously opposed to Gladstone's policy of Home Eule, and in 1895 he was returned to Parliament as Unionist member for Dublin University. In 1897 he was made a privy councillor; and among the Coronation Honours in 1902 he was

nominated an original member of the new Order of Merit. His university honours include the degree of LL.D. from Dublin, St Andrews, and Glasgow, the de- gree of D.C.L. from Oxford, and the degree of Litt.D. from Cambridge. In 1894 he was elected corresponding member of the Institute of Prance. He contributed occasionally to periodical literature, and two of his ad- dresses, The Political Value of History (1892) and The Empire, its Value and its Growth (1893), were published. He married in 1871 Elizabeth, baroness de Dedem, daugh- ter of baron de Dedem, a general in the Dutch service. Mrs Lecky has contributed to various reviews a number of articles, chiefly on historical and political subjects.

Lecocq, Alexandre Charles (1832- Prench musical composer, was born in Paris, 3rd June 1832. He was admitted into the Conservatoire in 1849, being already an accomplished pianist. He studied un- der Bazin, Halevy, and Benoist, winning the first prize for harmony in 1850, and the second prize for fugue in 1862. He first gained notice by dividing with Bizet the first prize in a competition for an operetta instituted by Offenbach. His operetta, Le Docteur Miracle, was per- formed at the Bouffes Parisiens in 1857. After that he wrote constantly for theatres, but produced nothing worthy of mention until Fleur de TIi6 (1868), which ran for more than a hundred nights. Les Cent Vierges (1872) was favourably received also, but all his previous successes were cast into the shade by La Fille de Madame Angot (Paris, 1873 ; London, 1873), which was performed for 400 nights consecutively, and has since gained and retained enormous popularity all

over the civilized world. Since 1873 Lecocq has produced a large number of comic operas, though he has never equalled his early triumph in La Fille de Madame Angot. Among the best of his pieces are Girofli-Girofla (Paris and London, 1874) ; Les Pres Saint Gervais (Paris and London, 1874) ; La Petite Mariie (Paris, 1875; London, 1876, revived as Tlie Scarlet Feather, 1897); Le Petit Due (Paris, 1878 ; London, as TJie Little Duke, 1878) ; La Petite Mademoiselle (Paris, 1879 ; London, 1880) ; Le Jour et la Nuit (Paris, 1881 ; London, as Manola, 1882) ; Le Cmur et la Main (Paris, 1882; London, as Incognita, 1893) ; La Princesse des Canaries (Paris, 1883 ; London, as Pepita, 1888). In 1899 a ballet by M. Lecocq, en- titled Le Cygne, was produced at the Opera Comique in Paris. Of late years his compositions, though produced somewhat less rapidly, have not equalled the success of his earlier works. His works have a finish, both as re- gards the vocal writing and the instrumentation, which it would be vain to seek in the productions of most of his contemporaries.

Leconte de Lisle, Charles Marie Rene

(1818-1894), the most scholarly of modern French poets, was born in the island of Eeunion, 23rd October 1818 ; he died at Paris, 17th July 1894. Most of his life, from at least his thirtieth year, was spent inParis, where he lived a quiet life among books. In 1873 he was made librarian at the Luxembourg ; in 1887 he was elected to the Academ y in succession to Victor Hugo. His Pohnes Antiques appeai-ed in 1862 ; the Po&mes Barbares, in their first form, in 1862 ; Les Erinnyes, a tragedy after the Greek model, in 1873 ; the Po&mes Tragiques in 1884; L'Apollonide, another classical tragedy, in 1888 ; and Derniers Po^mes, after his death, in 1899. In addition to his original work in verse, he published a series of admirable prose translations of Homer, Hesiod, ^Eschylus, Sophocles, Euripides, Virgil, Horace. In Leconte de Lisle the Parnassian movement seems to crystallize. His verse is clear, sonorous, dignified, deliber- ate in movement, classically correct in rhythm, full of exotic local colour, of savage names, of realistic rhetoric. It has

its own kind of romance, in its “legend of the ages,” so different from Hugo’s, so much fuller of scholarship and the historic sense, yet with so far less of human pity. Coldness cultivated as a kind of artistic distinc- tion seems to turn all his poetry to marble, in spite of the fire at its heart. Most of Leconte de Lisle’s poems are little chill epics, in which legend is fossil- ized. They have the lofty monotony of a single con- ception of life and of the universe. He sees the world as what Byron called it, ” a glorious blunder,” and de- sires only to stand a little apart from the throng, meditating scornfully. Hope, with him, becomes no more than this desperate certainty : —

” Tu te tairas, 6 voix sinistre des vivants 1 ”

His only prayer is to Death, ” divine Death,” that it may gather its children to its breast : —

” Affranchis-nous du temps, du nombre et de I’espace, Et rends-nous le repos que la vie a trouble I ”

The interval which is his he accepts with something of the defiance of his own Cain, refusing to fill it with the triviality of happiness, waiting even upon beauty with a certain inflexible austerity. He listens and watches, throughout the world, for echoes and glimpses of great tragic passions, languid with fire in the East, a tumul- tuous confiagration in the Middle Ages, a sombre darkness in the heroic ages of the North. The burning emptiness of the desert attracts him, the inexplicable melancholy of the dogs that bark at the moon ; he would interpret the jaguar’s dreams, the sleep of the condor. He sees nature with the same wrathful impatience as man, praising it for its destructive energies, its haste to crush out human life before the stars fall into chaos, and the world with them, as one of the least of stars. He sings the ” Dies Irse” exultingly ; only seeming to desire an end of God as well as of man, universal nothingness. He conceives that he does well to be angry, and this anger is indeed the personal note of his pessimism ; but it leaves him somewhat apart from the philosophical poets, too fierce for wisdom and not rapturous enough for poetry. (a. sy.)

Leech. — The group of leeches, Hirudinea, are now certainly known to be related to the Oligochaeta, and not, as was formerly thought, to the

Platyhelminths. They share with the Oligochaeta the following characters, the greater part of which are most pronounced in the genus Acanthobdella. The body is regularly seg- mented, and two ■^i or three segments

-■’ ‘ are modified into

a clitellum, which secretes the cocoon in which the eggs are contained. Paired setae are present on five of the anterior segments of Acan- thobdella (Eig. 1), which have the form of Oligochse- tous setae, and are much hooked at the tip and proportion-

FiG. 1. — Aaanthobdella, from the ventral surface, ately large, aS in

showing the five sets of setce (»St to S^) and the j.r „ +„•! „4.„ 4:4.^.

replacing setseC^-j to ^rj) behind them. The three tUe Tail setae 01 tUC

pairs of pigmented spots show the position of the earthworm Sfenus eyes on the dorsal surface. {Jfter Kowalewsky.) 7 , . m,

Onycaochceta. The existence of branchiae in BrancMohdella and Cystohran- cJius is paralleled in the Oligochaeta, the more complex gills of the former genus being comparable to those of Alma, and the simpler gills of Oystobranchus to

those of Branchiura and Hesperodilus. The universal sucker of the leeches and the chitinous jaws charac- teristic of many of them are to be found also in the undoubted Oligochsete family Discodrilidae. The gen- erative pores are median and single, the male pore being in front of the female pore. This is not so general in the Oligochaeta, but is found in various genera, and in the Eudrilid Polytoreutus there is the same relative position of male and female pore coupled with their median position. All leeches possess a ccelom (Fig. 2)

mdv

v.v

Fig. 2. — BecUon of Acanthobdella (after S’oical&iosky). c, ccelom ; c.c%, coelomic epithelium (yellow-cells) ; cy, glandular cells ; el, muscle cells of lateral line ; cp, pigment cells; ep, ectoderm ; g’, nerve cord; m, intestine; mc, circular muscle ; tuI, longitudinal muscl , ; vd, dorsal vessel ; w, ventral vessel.

which is (in the embryo, and permanently in the case of Acanthobdella) arranged in a series of chambers, separated by septa, as in the Oligochaetes. The large obliteration of the ccelom, in the majority of forms, led to the comparison of these animals with the Platyhelminths, where the ccelom seems to be limited to the intrargonadial chambers, and perhaps to a few scattered lacunae in the ” mesenchyme ” (though these latter spaces are possibly more comparable to a feeble and commencing vascular system). The nephridia are paired and of the same structure as in the Oligochaetes. There is a complex vascular system, consisting of at any rate a dorsal and a ventral trunk, with capillary networks in the body wall and upon the walls of the gut. In general this is comparable to that of the Oligochaeta. The organs of reproduction are at first sight different, and do differ in detail from those of the Oligochaeta. The testes are either a number of separate pairs of round bodies or (in Acanthobdella) a single pair of elongated structures lying along the sides of the body (Eig. 3). They lie in

mc

cch.M

-«/•

vv

cn>

FiQ. 3.— Section of Acanthobdella (after Kowalewsky) . Identical letters as in Fig. 2 ; in addition, en, nerve cord ; in, intestine ; nf, parts of nephridium ■ on external opening of nephridium ; ov, ova ; t, testis. ‘ ‘

chambers which are undoubtedly ccelomic,but their ducts are continuous with them. This is also the case with the ovaries

and oviducts. It seems to be possible that we have here to do with a state of affairs which is different from that of most earthworms, but comparable to what is found in the Eudrilidee. There is, in short, no salient feature which distinguishes all leeches from all earthworms. Indeed, even in the smallest particu- lars unexpected resemblances occur. Thus in both groups the epidermis may be invaded by blood capillar ries, and the structure of the muscle fibres once regarded as peculiar to the leeches is also characteristic of earth- worms. In the limited clitellum, which generally occupies segments ix., x., xi., in the forward position of the gonads, and the external apertures of their ducts, tenth and eleventh (seventh and eighth in Acantlioh- della), and in the limited number of segments of which the body is composed (not more than thirty -three), the leeches seem to be particularly like certain of the lower aquatic Oligochaeta.

The leeches are characterized by their form, which is generally somewhat or very much flattened, and wider at the posterior than at the anterior end. There are an anterior and a posterior sucker as a rule. The anus opens dorsally to the posterior sucker ; the mouth is in the middle of the anterior sucker. The characteristic form of the body is lost in Lumbricobdella, which lives in the soil and which has no posterior sucker at all.

The anterior end of the body is provided with eyes, which appear to be simply specializations of sense-organs found upon other segments of the body, and arranged with accurate reference to the segmentation. In the majority of leeches the body cavity is much modified, and reduced by the abundant growth of connective tissue in the body- wall to the state of a complex system of tubes. It has been asserted, denied, and reasserted, that this system of tubes which represents the coelom is in communication with the vessels of the vascular system. The observa- tions of Goodrich appear to have conclusively shown that this connexion exists. The leeches possess paired and metamerically-disposed nephridia. In Pontobdella alone, so far as is known, the nephridial system forms a network from segment to segment. It is interesting to note that in Branchiobdella the nephridia lie behind the limits of the coelom between the testes and the coelom. In the

Capitellidse the nephridia are in the same way retroperitoneal. A pervious funnel may or may not exist ; in Hirudo the representative of the funnel is a ” cabbage-head-like mass ” of cells which has not a coelomic orifice at all. In the more simple organized GlossipJionia there is a plain internal aperture.

The mouth cavity has or has not sharp-edged chitinous jaws ; the canal which follows is either more simple or complicated by lateral diverticula; in Aulastoma there is but one pair of these diverticula. The gonads, as already mentioned, are hollow and continuous with their ducts. Generally there are six to ten pairs of globular and metamerically-arranged testes, whose products are col- lected by means of a branch apiece into a longitudinal sperm duct which opens anteriorly into a muscular penis. A remarkable fact concerning the spermatophores has been discovered by Whitman. It appears that in Glossiphonia plana the spermatophore is attached anywhere to the body of another individual, and that the spermatozoa issuing therefrom find their way through the body-wall into the interior of the body. Like the OligocliEeta, leeches are hermaphrodite ; the ovaries are small rounded bodies or long masses of germinal tissue, and they are contained in a sac which communicates with a duct which becomes muscular before the external orifice, and constitutes a vagina. There are no structures corresponding to the spermathecae of Oligochaeta. A cocoon is not always, but is often, formed. Some leeches carry their eggs about

with them, and others deposit them upon stones and such like places.

The Hirudinea may be divided into three families : —

(1) RhynchobdellidEB. — A protrusiHe proboscis exists, but there are no jaws. The blood is colourless. Marine and fresh- water forms. Pontobdella, Fiscicola, Glossiphonia, Branchellion, Batrachobdella, &o.

(2) Gnathobdellidae. — Hirudinea with no proboscis, but with well-developed or vestigial jaws. The blood is red. Fresh-water or terrestrial. Trocheta Hirudo^ Aulastomum, Nephelis, Scema- dipsa, &o.

(.3) Acanthobdellidae. — A protrusible proboscis present, but short. On five anterior segments setse of the oligochsetous pat- tern are present,

accompanied by reserve setse. Male and female pores more anterior in position than in other families. Ccelom divided into twenty compartments by septa. Testes form a pair of continuous tubes. Acanthobdella, &o. (f. B. B.)

Leeds, a city (1893), municipal, county (1888), and parliamentary borough of Yorkshire, England, on the Aire, 25-|- miles by rail south-west of York, 185 miles by rail north-north-west of London ; station on the Great Northern, Midland, JSTorth-Eastern, JSTorth-Western, and Lancashire and Yorkshire railways. In 1885 the parliamentary borough was parcelled out into five divi- sions, returning each one member. In 1897 the chief magistrate was raised to the dignity of Lord Mayor. The city is practically cut into halves by the river Aire, over which there are now eight bridges. There are more than 60 Established and 7 Roman Catholic churches, and about 150 Dissenting places of worship. Yorkshire College, erected on its new site of 3|- acres in 1885 at a cost of £160,000 became in 1887 one of the constituent colleges of the Victoria University, Man- chester. Important additions, as well in its buildings as in its departments and equipments of study, include a hall of residence, an engineering department (1886), a central hall and library (1894), a medical department (1894), and a textile department. The attendance at the college during the session 1900-01 numbered 795 day and 339 evening students. Other educational institutions are a day training college (1891), as a branch of the Yorkshire College ; the Yorkshire Ladies' Council of Education, for the promotion of female education and the instruction of girls and women of the artisan class of domestic economy, &c. The School Board has 64 schools and 4 industrial schools under its control, with a number on roll of 54,750 and an average attendance of 49,100. There are also 39 National and lOCatholic schools. Amongst newer buildings may be mentioned the municipal ofSces (1884), costing £120,000 ; the city art gallery (1888) ; the Coliseum (1885) ; five sets of corporation baths (1895) ; corporation Turkish baths (1898) ; general post of&ce (1896) ; extension of general infirmary (1892), costing £48,671; Mauston Hall (97 acres), for fever patients, purchased 1896 ; cattle market (1886); meat market (1899), costing £42,000. The corporation has expended large sums of money on street improvements, clearing of insanitary areas, electrical equip- ment of tramways, and provision of additional parks and recreation grounds in various parts of the city. The city

fever and smallpox hospitals are being extended at a cost of upwards of £200,000. New general markets are also being built at the estimated cost of £100,000. Leeds is the largest producer of leather in England, though no sole leather is tanned. The largest source of supply of hides is British India, from which some 20,000 arrive every week half-tanned in India and finished in Leeds, and about 15,000 every week raw or ” arsenic-cured.” Other industries include machine-made clothing, hats and caps, boots and shoes, nails, and artificial silk. In 1891 there were 9208 persons engaged in the making of machinery; 7615 males and 9152 females in the manufacture of wool and worsted fabrics ; 1398 males and 784 females in the production of mixed materials ; 3204 persons in furriery, tannery, and

curriery ; 9229 persons in the iron and steel manufactures ; and 2520 in coal-mining. There are 6 daily newspapers. The rateable value of the city amounted (31st March 1901) to £1,741,373 ; and the income derived from the city rate, £174,457 ; from other sources, £84,423. The debt of the Urban District Council amounted (31st March 1901) to £7,218,816. Area of the municipal and par- liamentary borough, which are coextensive, 21,572 acres. Population (1881), 309,119; (1891), 367,605; (1901), 428,968. (c. N.)

Leek, a market town in the Leek parliamentary division of Staffordshire, England, 24 miles north by east of Stafford by rail. Modern erections are Established and Eoman Catholic churches, an institute (containing free library, lecture-hall, art galleries, and school of art), a technical school, and extensive almshouses. Sewing silk, braids, buttons of silk, &c., are manufactured. Area of civil parish (an urban district), 1440 acres. Population

(1881), 12,863; (1891), 14,128 ; (1901), 15,484.

Leeuwarden, capital of the Dutch province of Priesland, on the Ee, 31 miles west of Groningen. Of modern foundation are the museum of the Frisian Society, with its ethnographical and antiquarian collections, and a

commercial school. The law courts have been restored since 1895, and now contain the provincial library and archives. Population (1900), 32,203.

Leeward Islands, a group of British West India Islands, under one Governor-General, divided into five provinces, namely, Antigua (with Barbuda and Redonda), St Kitts (with Nevis and Anguilla), Dominica, Mont- serrat, and the Virgin Islands. There is one Federal Executive Council nominated by the Crown, and one Federal Legislative Council — ten nominated and ten elected members. Of the latter, four are chosen by the unofficial members of the local Legislative Council of Antigua, two by those of Dominica, and four by the non- official members of the local Legislative Council of St Kitts Nevis. In Antigua and Dominica the representa- tive element in the legislature was suppressed in 1898. The Federal Legislative Council meets once a year. For details see articles on the separate islands.

Legal Education. — In England the teaching of English law was until recent times exclusively profes- sional in character. It was left almost entirely in the hands of members of the legal profession. It is true that from the 12th century onwards law was taught in one or both of the great English universities. But the law so taught was the Roman law or the Canon law. Until Blackstone began to lecture at Oxford in 1754, the English universiti- es gave no assistance in the teaching or in the scientific exposition of English law. This may have been, as was suggested by Chief Justice Fortescue, because the laws of the land were to be learned in three tongues, the English, the French, and the Latin, while the universities conducted their teaching in the Latin tongue alone. It may have been because, for centuries after the reign of Edward I., the law of England was a technical and obscure craft, incapable of forming part of a scheme of liberal education. Whatever the reason, it is certain that in the craft of the law, as in other crafts, the training of students and apprentices was left to those who were themselves members of the craft. As long as there was a real corporate life among the members of the Inns of Court, the work of education was regarded as one of the most important of the duties of the fellows of the society of each Inn, and practising lawyers took part actively and personally in that work. Students came together to reside in the Inns of Court and

Inns of Chancery, which were established in the regions near Holborn and Temple Bar. The convenience of this situation was remarked by Fortescue. The Inns were placed iu the suburbs of the City, that the quietness of the students might not be disturbed, and near the King's Court, that students might daily have access thereto with- out weariness. Inns or hostels for students were certainly in existence in this quarter as "^ early as the reign of Edward III. When For- tescue wrote his treatise De Laudibus Legum Anglice iu the 15th century, the four Inns of Court and the ten Inns of Chancery were fully organized. A student entered first at an Inn of Chancery, and later, growing to ripe- ness, he was admitted to an Inn of Court. The Inns to- gether constituted, according to Fortescue, " an university or schoole of all commendable qualities requisite for noblemen." At the Inns of Court readings were delivered by the benchers, generally, it is to be observed, on a statute, rather than on fundamental legal principles. Such famous names as Littleton, Coke, and Bacon are to be found among the names of the readers. At the Inns of Chancery the education of students was undertaken by barristers from the Inns of Court. Besides the readings, there were regular moots and bolts, at which the acqui- sition of the art of advocacy was encouraged by the arguing of fictitious legal cases.

In the 16th and 17th centuries the corporate life of the Inns of Court became less and less active. The general decay of the organization of crafts and guilds showed itself among lawyers as among other craftsmen. Suc- cessful barristers, sharing in the general prosperity of the country, became less and less able and willing to devote their time to the welfare of their profession as a whole. The Inns of Chancery, though some of their buildings still remain — picturesque survivals in their " suburbs " — have long ceased to be used as places for the education of students. The benchers of the Inns of Court, until the revival towards the middle of the 19th century, had wholly ceased to concern themselves with the systematic teaching of law.

The modern system of legal education may be said to date from the establishment, in 1852, of the Council of Legal Education, a body of twenty judges and barristers appointed by the four Inns of Court to control the legal education of students preparing to be f°""/" "' called to the bar. The most important feature Edacation. is the examination which a student must pass before he can be called. The examination serves the double purpose of

fixing the compulsory standard which all must reach, and of guiding the reading of students who may desire, sooner or later, to carry their studies beyond this standard. The subjects in which the examination is held are divided into six groups : Eoman Law ; Constitutional Law and Legal History ; Evidence, Procedure, and Criminal Law ; Eeal and Personal Property ; Equity ; and Common Law. The subjects in the first three groups may be taken, either separately or together, earlier than the subjects in the last three groups. On each group of subjects a single paper of written questions is set, to be answered in three hours, and each candidate is also asked a few short questions vivd voce. The Council of Legal Education also appoint a body of Readers and Assistant Readers, nine in number, who deliver lectures and hold classes on the subjects of the examinations. The Reader and Assistant Reader in Roman Law also give part of their time to instruction in Jurisprudence and International Law, but the time given to these subjects is necessarily limited. The Readers and Assistant Readers are all practising barristers, and the in- struction given by them is intended not merely to enable their pupils to pass the examinations, but also to give them a practical preparation for actual work at the bar.

The lectures and classes, though primarily intended for students preparing for the bar, are open to persons who are not members of any Inn of Court. The Council of Legal Education also provide for occasional courses of evening lectures on special subjects, delivered by barristers who are recognized authorities on these sub- jects. These special courses of lectures are generally attended by large numbers of students, but they can hardly be said to form part of any definite system of education.

It is the general opinion of English lawyers that the best education in the principles and practice of the law is not and cannot be obtained from any lectures or formal instruction. Law, like other arts and sciences, is learnt rather than taught. For any one who is capable of learn- ing, the text-books which now cover the whole ground of legal study afford opportunities which did not exist when Littleton and Coke lectured. Still more important is the universal custom by which a student reads for a year or more as a

pupil in the chambers of some practising barrister. In the 18th century it first became usual for students to read with a solicitor or attorney, and after a short time the modern practice grew up of chambers' i"6ading in the chambers of a conveyancer, equity draftsman, or special pleader, or, in more recent times, in the chambers of a junior barrister. The value of the education so obtained varies in different cases. Some- times the advantages gained consist only in the insight obtained into actual work and into the manner in which an experienced lawyer deals with it. Sometimes the rela- tion between pupil and teacher gives rise to a close per- sonal intercourse of the highest educational value. Bead- ing in chambers is so far considered a necessary part of a barrister's education that it has been said that a barrister would no more think of beginning work at the bar with- out this previous training than a doctor would think of setting up in practice without having walked the hospitals. But before entering a barrister's chambers as a pupil, and still more before taking advantage of the courts them- selves as a school of law, it is important that a student should have acquired a sound knowledge of the element- ary principles of law, and the expression "legal education" is commonly used to signify the teaching, or the learning, of these elementary principles. It is the function of the Council of Legal Education to provide for instruction in these elementary principles. It does so almost entirely from a practical professional standpoint. It is very little concerned with instruction in what may be called non-professional law, with assisting in the philosophical study of jurisprudence, or the general principles of law as part of a liberal education. On the other hand, it takes no part in promoting the acquisition of the art of advocacy, but something is done, so far as fluent speaking is concerned, by debating societies, which carry on the traditions of the Oxford and Cambridge Unions. An attempt has been made to revive the ancient moots, and this experiment has been attended by a certain amount of success.

The education of solicitors suffered from the absence of any professional organization until the Incorporated Law Society was established in 1826 and the '"ted^"' following years. So far as any professional Society. education is provided for solicitors or required from them, this is due to the efforts of the Law Society. As early as IT-iQ it was required by statute that any person applying for admission as attorney or solicitor should submit to examination by one of the judges, who was to test his fitness and capacity

in con- sideration of a fee of one shilling. At the same time regular preliminary service under articles was required, that is to say, under a contract by which the clerk

was bound to serve for five years. The examination soon became, perhaps always was, an empty form. The Law Society, however, soon showed zeal for the education of future solicitors. In 1833 lectures were instituted. In 1836 the first regular examinations were established, and in 1860 the present system of examinations — preliminary, intermediate, and final — came into effect. Of these only the last two are devoted to law, and both are of a strictly professional character. The final examination is a fairly severe test of practical acquaintance with all branches of modern English law. The Law Society makes some provision for the teaching of students, but this teaching is designed solely to assist in preparation for the examinations.

At the Universities of Oxford and Cambridge there has, since 1850, been an attempt to promote the study of law. The curriculum of legal subjects in which lectures are given and examinations held is calculated to give a student a sound fundamental knowledge of general principles, as well as an elementary acquaintance with the rules of modern English law. Jurisprudence, Roman Law, Con- stitutional Law, and International Law are taught, as well as the Law of Eeal and Personal Property, the Law of Contract and Tort, Criminal Law, verities' Procedure, and Evidence. But the law tripos and the law schools do not attract a very large number of university students, and no doubt they suffer from remoteness from the law courts, and from the exclu- sively academical character of the teaching. Law is also taught, though not on a very large scale, at Owens College, Manchester, and at University College, Liver- pool. London University has encouraged the study of law by its examinations for law degrees, at which a comparatively high standard of knowledge is required ; and at University College, London, and King's College, London, some teaching is given in law and jurispru- dence. In the new University of London it is hoped that one day there may be a faculty of Law in which the Inns of Court will co-operate. In this way it is possible that an adequate national system of legal education may be established, in which due attention will be given both to professional law and to non-professional law. But at present the four Inns of

Court have declined to take any part in the new University, and the faculty of Law is not likely to be established in the immediate future. (a. ll. d.)

Leghorn, an Italian city, chief town of the pro- vince of the same name, seat of a bishopric and of a large naval academy — the only one in Italy — and the third largest commercial port in the kingdom, situated on the west coast, 15 miles south-west of Pisa by rail. It is built along the seashore upon a healthy and fertile tract of land, which forms, as it were, an oasis in a zone of Maremma. Several improvements were carried out in the city and port during the last two decades of the 19th century. The naval school formerly established partly at Naples and partly at Genoa has been transferred to Leghorn. Some of the navigable canals connecting the harbour with the interior of the city have been either modified or filled up. Several streets have been widened, and a road along the shore has been transformed into a promenade worthy of comparison with the Promenade des Anglais at Nice, being shaded by tamarisks, stone-pines, oleanders, aloes, and countless evergreen shrubs, and adorned with luxuri- ant flower-beds. For Leghorn is the principal sea-bathing resorl; in this part of Italy, the season lasting from the end of June to the end of August. The octroi circle has been enlarged, large school buildings erected, and a covered market built on a scale almost too grandiose for the needs of the city. Dredging operations have been continued.

and are now proceeding in both the old and the new harbour, but still without effecting any considerable in- crease in the depth. The new rectilinear mole, sanctioned in 1881, has been built out into the sea for a distance of 600 yards from the old Vegliaia lighthouse, and the dock- ing basin has been lengthened to 490 feet. Inside the breakwater the depth varies from 10 to 26 feet. In order partly to compensate the city for the losses occasioned by the abolition of the freedom of the port — a freedom which had rendered it one of the most flourishing in Italy — a bonded depot was established in 1881. The northern part of the old port was filled in, and upon the area thus created sheds and warehouses were built. Sufficient space was, however, left between the warehouses and the old breakwater to

form a wharf for the discharge of cargoes. The total trade of the port increased from £3,861,260 in 1891 to £5,191,670 in 1900, the ratio of imports to ex- ports being as three to two. The imports consist princi- pally of tobacco, coal, wheat, fish, and hides, and the exports of hemp, hides, olive oil, soap, coral, candied fruit, and marble and alabaster. Since the year 1885 the de- crease in the number of foreign vessels, which began towards the middle of the 19th century, has continued, although there has been a slight increase in the number of Italian vessels. In 1885 the total number of vessels that entered the port was 4281 of 1,434,000 tons ; of these, 1251 of 750,000 tons were foreign. 591,620 tons of mer- chandise were loaded and unloaded. In 1900, after con- siderable fluctuations during the interval, the total number that entered was 4747 vessels of 1,839,964 tons ; of these, 740 of 760,830 tons were foreign. In 1899, 901,726 tons of merchandise were loaded and unloaded, an increase of more than 300,000 tons over the total of 1885. A great obstacle to the development of the port is the absence of modern mechanical appliances for loading and unloading vessels. The older shipyards have been considerably ex- tended, and shipbuilding is actively carried on, while new industries — namely, glass-making and copper- and brass- founding — have been established. The population of the city proper has decreased, namely, from 82,976 in 1881 to 79,526 in 1901, but the population as a whole has in- creased : in 1881 it numbered 97,615, and in 1901, 98,505. The former British ” factory ” here was closed in 1826. The two villages of’ Ardenza and Antignano, which form part of the commune, have acquired considerable import- ance, the former in part for sea-bathing. (a. b*.)

LegnagO, a fortified town in the province of Verona, Lombardy, Italy, on the Adige, 29 miles by rail east of Mantua, one of the famous Quadrilateral fortresses. The present fortifications were planned and made in 1815, the older defences having been destroyed by Napoleon I. in 1801. There is a school of the industrial arts and sciences. It is the birthplace of G. B. Cavalcaselle, the art historian (1827-1897). Eice is extensively grown in the vicinity. Population (1881), 6448 ; (1897), about

3600.

Legnano, a town in the province of Milan, Lom- bardy, Italy, 17 miles north-west of Milan by rail. It is the seat of important cotton and silk indiistries, with machine-shops, boiler-works, and dyeing and printing of woven goods, and thread. Close by the Lombard League defeated Frederick Barbarossa in 1176 ; a monument in commemoration of the battle was erected on the field in 1876. Population (1881), 7153 ; (1897), about 5400.

Legouve, Gabriel Jean Baptiste Ernest

Wilfrid (1807), French dramatist, the son of the

poet Gabriel Legouve (1764-1812), was born in Paris on 5th ^February 1807. He was left an orphan at an

early age, his mother dying in 1810, and his father almost immediately afterwards being removed to a luna- tic asylum. The child, however, inherited a considerable fortune, and was very carefully educated. The cele- brated Jean Nicolas Bouilly (1763-1842) was his tutor, and early instilled into the young Legouv^ a passion for literature, to which, indeed, the example of his father and of his grandfather, J. B. Legouv^ (1729-1783), predis- posed him. As early as 1829 he carried away a prize of the French Academy for a poem on the discovery of print- ing ; and in 1832 he published a curious little volume of verses, entitled ies Marts Bizarres. In those early days M. Legouve brought out a succession of novels, of which one at least, Edith de Falsen, enjoyed a considerable suc- cess. In 1847 he began the work by which he will be best remembered, his contributions to the development and education of the female mind, by lecturing at the College of France on the moral history of women : these discourses were collected into a volume in 1848, and en- joyed a great success. M. Legouve wrote considerably for the stage, and in 1849 he collaborated with Scribe in Adrienne Lecouvreiir, one of the most admired and most widely accepted of modern French tragedies. M. Legouve now became a prolific writer for the theatre, and in 1865 he brought out his tragedy of MMie, the success of which had much to do with his election to the French Academy. He succeeded to the f auteuil of Ancelot, and was received , by Flourens, who dwelt on the plays of M. Legouve as his principal claim to consideration. As time passed on, however, M. Legouve became less and less prominent as a playwright, and more and more so as a lecturer and propagandist on

woman’s rights and the advanced educa- tion of children, in both of which directions he has been a pioneer in French society. His La femme en France au XIX^ si&cle (1864), reissued, much enlarged, in 1878 ; his Messieurs les enfants (1868), his Conferences Parisiennes (1872), his Nos files et nosfils (1877), and his Une Muca- tion de jeune file (1884) were works of wide-reaching influence in the moral order. In 1886-87 M. Legouve published, in two volumes, his Soixante ans de souvenirs, an excellent specimen of autobiography. He was raised in 1887 to the highest grade of the Legion of Honour, and held for many years the post of inspector-general of female education in the national schools. M. Legouve was always an advocate of physical training. He was long accounted one of the best shots in France, and although, from a conscientious objection, he never fought a duel, he made the art of fencing his lifelong hobby. In the beginning of 1900 M. Legouve was knocked down by a vehicle in the streets of Paris. The worst was feared for the results of this accident on a man of ninety-three, but the veteran was soon seen walk- ing and fencing as usual. After the death of Desire Nisard in 1888, M. Legouve became the ” father ” of the French Academy.

-), painter and etcher.

Legros, Alphonse(1837-

was born at Dijon on 8th May 1837. His father was an accountant, and came from the neighbouring village of Veronnes. Young Legros frequently visited the farms of his relatives, and the peasants and landscapes of that part of France are the subjects’of many of his pictures and etchings. He was sent to the art school at Dijon at an early age, with a view to qualifying for a trade, and was ultimately apprenticed to MaitreNicolardo, house decorator and painter of images. In 1851 Legros left for Paris to take another situation ; but passing through Lyons he worked for six months as journeyman wall-painter under the decorator Beuchot, who was painting the chapel of Cardinal Bonald in the cathedral. In Paris he studied with Cambon, scene-painter and decorator of theatres, an experience

whieli developed a breadth of touch such as Stanfield and Cox picked up in similar circumstances. At this time he attended the drawing-school of M. Lecoq de Bois- baudran. In 1865 Legros attended the evening classes of the :ficole des Beaux Arts, and perhaps gained there his love of drawing from the antique, some of the results of which may be seen in the Print Room of the British Museum. He sent two portraits to the Salon of 1867 : one was rejected, and formed part of the exhibition of protest organized by M. Bonvin in his studio ; the other, which was accepted, was a profile portrait of his father. This work was presented to the museum at Tours by the artist when his friend M. Cazin was curator. Champ- fleury saw the work in the Salon, and sought out the artist to enlist him in the small army of so-called ” Kealists,” comprising (round the noisy glory of Courbet) all those who raised protest against the academical trifles of the degenerate Komantics. In 1859 Legros’s “Angelas ” was exhibited, the first of those quiet church interiors, with kneeling figures of patient women, by which he is best known as a painter. ” Ex Voto,” a work of great power and insight, painted in 1861, now in the museum at Dijon, was received by his friends with enthusiasm, but it only obtained a mention at the Salon. Legros came to England in 1863, and in 1864 married an English wife, Miss Frances Eosetta Hodgson. At first he lived by his etching and teaching as before. He then became teacher of etching at the South Kensington School of Art, and in 1876 Slade Professor at University College, London. He was naturalized as an Englishman in 1881, and remained at University College seventeen years. His influence there was exerted to encourage a certain distinction, severity, and truth of character in the work of his pupils, with a simple technique and a respect for the traditions of the old masters, until then somewhat foreign to English art. He would draw or paint a torso or a head before the students in an hour or even less, so that the attention of the pupils might not be dulled. As students had been known to take weeks and even months over a single drawing, Legros ordered the positions of the casts in the Antique School to be changed once every week. In the painting school he insisted upon a good outline, preserved by a thin rub in of umber, and then the work was to be finished in a single painting, “premier coup.” Experiments in all varieties of art work were practised ; whenever the professor saw a fine example in the museum, or when a process interested

him in a workshop, he never resteduntil he had mastered the technique andhis students were trying their ‘prentice hands at it. As he had casually picked up the art of etching by watching a comrade in Paris working at a commercial engraving, so he began the making of medals after a walk in the British Museum, studying the masterpieces of Pisanello, and a visit to the Cabinet des M^dailles in Paris. Legros considered the traditional journey to Italy a very important part of artistic training, and in order that his students should have the benefit of such study he devoted a part of his salary to augment the income available for a travelling studentship. His later works, after he resigned his pro- fessorship in 1892, were more in the free and ardent manner of his early days — imaginative landscapes, castles in Spain, and farms in Burgundy, etchings like the series of ” The Triumph of Death,” and the sculptured fountains for the gardens of the duke of Portland at Welbeck.

Pictures and drawings by Legros, besides those already men- tioned, may be seen in the following galleries and museums. “Amende Honorable” (see Plate); “Dead Christ,” bronzes, medals, and twenty-two drawings, in the Luxembourg, Paris ; “Landscape,’’ “Study of a Head,” and portraits of Browning, Burne-Jones, Cassel, Huxley, and Marshall, at the Victoria and Albert IVTuseum, Kensington; “Femmes en prifere,” National

Gallery of British Art ; ” The Tinker,” and six other works from thelonides Collection, bequeathed to South Kensington ; ” Christen- ing,” “Barricade,” ” The Poorat Meat,” two portraits, and several drawings and etchings, collection of Lord Carlisle ; “Two Priests at the Organ,” ” Landscape,” and etchings, collection of Rev. Stopford Brooke; ” Head of a Priest, ” collection of Mr Vereker Hamilton ; ” The Weed-burner,” some sculpture, and a large col- lection of etchings and drawings, Mr Guy Knowles; “Psyche,” collection of Mr L. W. Hodson ; “Snow Scene,” collection of Mr G. P. Watts, R.A. ; thirty-five drawings and etchings, the Print Room, British Museum; “Jacob’s Dream” and twelve drawings of the antique, Cambridge ; ” Saint Jerome,” two studies of heads, and some drawings, Manchester; “The Pilgrimage” and “Study made before the Class,” Liverpool Walker Art Gallery ; “Study of Heads,” Peel Park Museum, Salford.

Legros had etched up to the year 1900 some 572 plates.

See Dr Hans W. Singer. ” Alphonse Legros,” Die graphischen Kunste (1898).— Leonce BtuiDiTE. ” Alphonse Legros, ” Bevue de VArt. Paris, 1900.— Cosmo Monkhodse. ” Professor Legros,” Magazine of Art (1882).

Legya, called by the Shans Lai-hka, a state in the eastern division of the southern Shan States of Burma, lying approximately between 20° 15′ and 21° 30′ N. and 97° 50′ and 98° 30′ E., with an area of 1433-15 square miles. The population was estimated at 30,000 in 1881. On the downfall of King Thibaw civil war broke out, and reduced the population to a total of only a few hundreds. In 1891 the estimated population was 8928, living in 203 villages. The population was made up as follows : — Shans, 6731 ; Tsungthus, 1613 ; Yang, 437; Shan-Chinese, 76; Burmans, 71. In 1898 the budget of the Sawbwa, or chief, showed 529 villages, with a total of 4946 houses, paying a revenue of Ils.15,845. About seven-ninths of the land under cultivation consists of wet paddy cultivation. A certain amount of upland rice is also cultivated, and cotton, sugar-cane, and garden produce make up the rest. Laihka, the capital, is noted for its iron-work, both the iron and the implements made being produced at Pang Long in the west of the state. This and lacquer- ware are the chief exports. The imports are chiefly cotton piece-goods and salt. The general char- acter of the state is that of an undulating plateau, with a broad plain near the capital and along the Nam Teng, which is the chief river, with a general altitude of a little under 3000 feet. The state was formerly very prosperous, and is rapidly recovering.

Leicester, a parliamentary, county, and municipal borough of England, capital of Leicestershire, on the river Soar, 96^ miles north-north-west of London. In 1891 the Midland Company built here a fine new station, and the Great Central Company have also built a station. Amongst the new churches, nearly all built of red brick with stone dressings, may be mentioned two chapels-of-ease to St Mary Magdalene, St Peter’s, St Hilda, the church of the Oxford martyrs, and St Michael and All Angels. St Martin’s was restored through several years ending with 1898. The Eoman Catholics have three churches, and there are numerous Nonconformist chapels and meeting- houses. The secular buildings erected since 1881

include the post office, the fire station, the poor-law offices, the Tivoli theatre of varieties, the Cook Memorial Hall, the Knighton public hall, the buildings of the Association for the Blind, the Yestry Street and Cossington Street baths, the children's hospital, and the isola- tion hospital. The institutions deserving of mention axe the free library, with 35,000 volumes and six branches ; the small but valuable town library, founded in the 17th century ; the permanent library (20,000 volumes) ; the Opera House (1877) ; the Theatre Koyal ; the Borough Lunatic Asylum, to which new wings were added in 1890 and 1900 ; the infirmary of 200 beds, first estab- lished in 1771 ; the Borough Isolation Hospital ; the children's hospital, opened in 1889 ; the Leicester Literary

"L'Amende Honorable." By Alphonse Legeos.

(In the Luxembourg Gallery. From a Photograph by Levy and Sons.)

and Philosophical Society (1835) ; the municipal techni- cal and art schools ; the Wyggeston schools, with which is incorporated Queen Elizabeth's grammar school, namely, the boys' grammar school and the girls' high school (opened in 1878); and Alderman Newton's Greencoat day school for boys. The School of Art has been adapted for municipal purposes. Roman pavements were discov- ered in 1882 and 1889. There are four public parks and several new recreation grounds. The town has an excel- lent water-supply. The main sewerage system was com- pleted in 1887. Since 1868 very extensive changes and alterations have been made in the river Soar and the canal ; the Newarke bridge was opened in 1898. Malting and brick-making should be included among the indus- tries of the town. In 1888 the municipal borough was for certain purposes made a county borough. On 1st January 1892 its bounds were extended so as to take in the old parishes of Aylestone, Belgrave, Braunstone, and New Found Pool, and the parishes of West Humberstone and North Evington, and part of Leicester Abbey, the whole being constituted one civil parish. Thus extended, it is governed by a mayor, 16 aldermen, and 48 council- lors. Area, 8586 acres. Birth-rate (1900), 28-3; death- rate (1900), 17-0. Population (1891), 174,624; (1901),

211,574.

See Records of the Borough of Leicester, edited by Makt Bate- son (1899).

Leicestershire. — One of the north midland coun- ties of England, bounded on the N. by Derby, Notting- ham, and Lincoln, on the E. by Lincoln and Rutland, on the S. by Northampton and Warwick, and on the W. by Stafford.

Area and Population. — In 1891 the area of the ancient (geo- graphical) county was 527,124 acres, and the population 373,584 persons, of whom 180,044 were males and 193,540 females, an increase of 52,566, or at the rate of 14 per cent., during the ten years 1881-91, as compared with an increase at the rate of 16-1 per cent, in the period 1871-81. In 1901 the population was 433,994. In 1891 there were 0-71 persons to an acre and 1-41 acre to a person. In the same year the area of the registration county was 551,845 acres, and the population 379,286 (183,003 males, 196,283 females), and in 1901, 440,907. Particulars of the birth- rate, death-rate, and the number of persons married per 1000 inhabitants, with illegitimacy rate per 1000 births, are contained in the following table : —

Birth-rate . Death-rate . Ulegitimaoy-rate Marriage-rate

18T1-S0. 1881-90. 1889-

37-2 21-8 52-0 16-6

84-0

18-4 46-0 14-6

81-6 17-4 43-0 15-4

1899.

80-1 17-1 41-0 16-3

In 1891 there were 497 persons of Scottish birth, 1697 of Irish birth, and 574 foreigners in the county ; also 281 blind persons, 166 deaf and dumb,

and 1327 Insane.

Administration. — For parliamentary purposes the ancient county is divided into four divisions (Eastern or Melton, Mid or Lough- borough, Western or Bosworth, Southern or Harborough), each returning one member, and the parliamentary borough of Leicester, returning two members. The administrative county includes the county borough of Leicester and the municipal borough of Lough- borough. It has one court of quarter sessions, and is divided into nine petty sessional divisions. The county borough of Leicester has a separate court of quarter sessions and a separate commission of the peace. The administrative county in 1891 contained 816 entire civil parishes and part of one other, and the county borough contained 17 entire civil parishes ; at the same date its area was 528,986 acres. But on 30th September 1897 the parishes of Chil- cote, Donisthorpe, Measham, Stretton-en-le-Field, and Willesley, and part of the parish of Appleby, amounting in all to 7831 acres, were transferred from Derbyshire to Leicestershire, and the parishes of Over and Nether Seal and Woodville were transferred from Leicestershire to Derbyshire ; whilst at the same time part of the parish of Little Bowden, amounting to 518 acres, was transferred from Northamptonshire to Leicestershire ; so that the area of the administrative county is 533,078 acres. Further, owing to changes made in the county borough of Leicester, the administrative county in 1900 contained 301 entire civil parishes

and parts of two others, and the county borough one civil parish. In 1891 the ancient county contained 239 entire ecclesiastical parishes or districts and parts of 13 others ; it is included partly in the dioceses of Peterborough, Southwell, and Worcester.

Education. — There is a Deaf School at Leicester. The number of elementary schools in the county on 31st August 1900 was 259, of which 36 were board schools, and 223 voluntary schools, the latter including 198 national Church of England schools, 5 Wesleyan, 9 Roman Catholic, and 11 British and “other.” The average attendance during the year was 34,960, out of 42,182 children on the registers. The total school board receipts for the year were £135,809, inclusive of £1399 income under the Agricul- tural Rates Act.

Agriculture. — Since 1885 there has been an increase in the areas of both the permanent pasture and the meadow land, and since 1880 a slight decrease in the area planted with green crops and a large decrease in the area under com crops and fallow. In 1900 a total of 417,114 acres was farmed by tenants, and 58,491 acres by the owners ; the corresponding figures for 1889 being 404,008 and 69,842 acres respectively, and for 1895, 404,984 and 67,329 acres respectively.

The table immediately following shows the areas under the different kinds of crops at the periods named : —

Tear.

Area in

Area under

Area under

Area of Bare

Cultivation.

Corn Crops,

Green Crops.

Fallow.

1880

472,720

94,090

21,885

15,709

1885

473,827

79,678

23,241

10,150

1890

473,485

73,182

21,784

8,662

1895

472,313

66,798

20,992

7,005

1900

475,605

67,340

20,847

5,131

The next table shows the numbers of live stock at the periods named : —

Tear.

Cows and Heifers.

other Cattle.

Total Cattle.

Horses.

Sheep.

Pigs.

1880 1885 1890 1895 1900

32,998 42,270 40,380 38,699 40,685

93,904 107,475 100,539

93,025 101,191

126,902 149,745 140,919 131,724 141,876

17,950 17,813 18,422 20,587 20,330

357,757 322,571 344,572 304,589 321,029

21,596 26,694 28,537 31,.321 24,569

Industries. — ^The total number of persons employed in factories and workshops in 1897 was 80,264. Of these, 24,568 or 30 per cent, were employed in the textile industries, chiefly in the manu- facture of hosiery(19,238), woollens, and cottons. The industry, however, which claimed the largest number of persons was the making of clothing, namely, 33,035 ; then came the making of machinery, tools, &c., with 5110 persons; bleaching and dyeing, with 2304; elastic webbing, &c., with 2098; tobacco, with 1623; paper and printing, with 1550 ; and wood industries, with 1400. In mines and quarries there were employed in 1900 a total of 11,157 persons. The output of the granite quarries amounted in the same year to 1,109,237 tons, of the coal mines to 2,106,443 tons, of iron ore to 750,708 tons, of clays to 527,542 tons, of lime- stone to 160,349 tons, and of gravel and sand to 17,345 tons. The value of all the minerals mined in the county in 1900 amounted to £1,558,977 (of which coal alone represented £1,140,936). In 1900 there were three blast furnaces active in the county (see Lincoln- shire).

AnTHOEiTiES. — See Records of the Borough of Leicester, ed. by Mary Bateson, revised by W. H. Stevenson and J. E. Stocks. London, 1899. — A. B. Evans. Leicestershire Words (English Dialect Society). Loudon, 1881. (j. T. be.)

ilieidy, Joseph (1823-1891), American naturalist, was born in Philadelphia on the 9th September 1823. He studied mineralogy and botany without an instructor, and graduated in medicine at the University of Penn- sylvania in 1844. Continuing his work in anatomy and physiology, he visited Europe in 1848, but both before and after this period of foreign study lectured and taught in American medical colleges. In 1853 he was appointed professor of anatomy in the University of Pennsylvania, paying special attention to comparative anatomy. In 1884 he promoted the establishment in the same institution of the department of biology, of which he became director, and meanwhile taught natural history in Swarlhmore Col- lege, near Philadelphia. His papers on biology and palae- ontology were very numerous, covering bothf auna and flora, and he was the recipient of various American and foreign

degrees and honours. His Cretaceous Reptiles of the United States (1865) and Contribvtions to the Extinct Vertebrate Fauna of the Western Territories (1874) were the most important of his larger works ; the best known and most widely circulated was an Elementary Treatise on Human Anatomy (1860, afterwards revised in new editions). He died in Philadelphia on the 30th April 1891. (c. r. E.)

Leigh, a municipal borough (1899) and market town in the Leigh parliamentary division of Lancashire, England, 6 miles south-east of Wigan by rail. Modern erections are a theatre and a technical school and public library. There are a town hall and public baths. Area, 6349 acres. Population (1881), 21,733 ; (1891), 30,816 ;

(1901), 40,001.

Leighton, Frederick Leighton, Baron (1830- 1896), English painter and sculptor, was born at Scar- borough on 3rd December 1830, the son of a physician. His grandfather. Sir James Leighton, also a physician, was long resident at the Court of St Petersburg. He was taken abroad at a very early age, and did not return to live in England till he was thirty yeal-s old. In 1840 he learnt drawing at Rome under Signor Meli. The family moved to Dresden and Berlin, where he attended classes at the Academy. In 1843 he was sent to school at Frankfort, and in the winter of 1844 accompanied his family to Florence, where his future career as an artist was decided. There he studied under Bezzuoli and Segnolini at the Accademia delle Belle Arti, and attended anatomy classes under Zanetti ; but he soon returned to complete his general education at Frankfort, receiving no further direct instruction in art for five years. He went to Brussels in 1848, where he met Wiertz and Gallait, and painted some pictures, including ” Cimabue finding Giotto,” and a portrait of himself. In 1849 he studied for a few months in Paris, where he copied Titian and Correggio in the Louvre, and then returned to Frankfort, where he settled down to serious art work under Edward Steinle, whose pupil he declared he was ” in the fullest sense of the term.” Though his artistic training was mainly German, and his master belonged to the same school as Cornelius and Overbeck, he loved Italian art and Italy, and the first picture by which he became known to the British

public was ” Cimabue’s Madonna carried in Procession through the Streets of Florence,” which appeared at the Eoyal Academy in 1855 (see Plate). At this time the works of the Pre-Eaphaelites almost ab- sorbed public interest in art — it was the year of Holman Hunt’s “Light of the World,” and the “Eescue,” by Millais. Yet Leighton’s picture, which was painted in quite a different style, created a sensation, and was pur- chased by Queen Victoria. Although, since his infancy, he had only visited England once (in 1851, when he came to see the Great Exhibition), he was not quite unknown in the cultured and artistic world of London, as he had made many friends during a residence in Rome of some two years or more after he left Frankfort in 1852. Amongst these were Giovanni Costa, Robert Browning, James Knowles, George Mason, and Sir Edward Poynter, then a youth, whom he allowed to work in his studio. He also met Thackeray, who wrote from Rome to the young Millais : ” Here is a versatile young dog, who will run you close for the presidentship one of these days.” During these years he painted several Floren- tine subjects — “Tybalt and Romeo,” “The Death of Brunellesehi,” a cartoon of ” The Pest in Florence accord- ing . to Boccaccio,” and ” The Reconciliation of the Montagues and the Capulets.” He now turned his attention to themes of classic legend, which at first

he treated in a “Romantic spirit.” His next picture, exhibited in 1856, was ” The Triumph of Music : Orpheus by the Power of his Art redeems his Wife from Hades.” It was not a success, and he did not again exhibit till 1858, when he sent a little picture of ” The Fisherman and the Syren” to the Royal Academy, and “Samson and Delilah ” to the Society of British Artists in Suffolk Street. He still lived abroad, but in 1858 he visited London and made the acquaintance of the leading Pre- Raphaelites — Rossetti, Holman Hunt, and Millais. In the spring of 1869 he was at Capri, always a favourite resort of his, and made many studies from nature, in- cluding a very famous drawing of a lemon tree. It was not till 1860 that he settled in London, when he took up his quarters at 2 Orme Square, Bayswater, where he stayed till, in 1866, he moved to his celebrated house in Holland Park Road, with its Arab hall decorated with Damascus tiles. There he lived till his death. He now began to fulfil the promise of his “Cimabue,” and by such pictures as ” Paolo e Francesca,” ” The Star of Bethlehem,” “Jezebel and Ahab taking Possession of ISTaboth’s Vineyard,” “Michael Angelo musing over his Dying Servant,” “A Girl feeding Peacocks,” and “The Odalisque,” all

exhibited in 1861-63, rose rapidly to the head of his profession. The two latter pictures were marked by the rhythm of line and luxury of colour which ‘ are among the most constant attributes of his art, and may be regarded as his first dreams of Oriental beauty, with which he afterwards showed so great a sympathy. In 1864 he exhibited ” Dante in Exile ” (the greatest of his Italian pictures), ” Orpheus and Eurydice,” and ” Golden Hours.” In the winter of the same year he was elected an Associate of the Royal Academy. After this the main effort of his life was to realize visions of beauty suggested by classic myth and history. If we add to pictures of this class a few Scriptural subjects, a few Oriental dreams, one or two of tender sentiment like “Wedded” (one of the most popular of his pic- tures, and well known by not only an engraving, but a statuette modelled by an Italian sculptor), a number of studies of very various types of female beauty, ” Teresina,” ” Biondina,” ” Bianca,” ” Moretta,” &c., and an occasional portrait, we shall nearly exhaust the two classes into which Lord Leighton’s work (as a painter) can be divided.

Amongst the finest of his classical pictures were — ” Syracusan Bride leading Wild Beasts in Procession to the Temple of Diana ” (1866), ” Venus disrobing for the Bath” (1867), “Electra at the Tomb of Agamemnon,” and ” Helios and Rhodos ” (1869), ” Hercules wrestling with Death for the Body of Alcestis ” (1871), ” Clytem- nestra” (1874), “The Daphnephoria” (1876), “Nausicaa” (1878), ” An Idyll ” (1881), two lovers under a spreading oak listening to the piping of a shepherd and gazing on the rich plain below ; ” Phryne ” (1882), a nude figui-e standing in the sun ; ” Cymon and Iphigenia ” (1884 ; see Plate), ” Captive Andromache ” (1888), now in the Manchester Art Gallery; with the “Last Watch of Hero” (1887), “The Bath of Psyche” (1890), now in the Chantrey Bequest collection ; ” The Garden of Hesperides ” (1892), ” Perseus and Andromeda ” and ” The Return of Perse- phone,” now in the Leeds Gallery (1891) ; and ” Clytie,” his last work (1896). All these pictures are characterized by nobility of conception, by almost perfect draughts- manship, by colour which, if not of the highest quality, is always original, choice, and effective. They often reach distinction and dignity of attitude and gesture, and occasionally, as in the ” Hercules and Death,” the ” Electra,” and the ” Clytemnestra,” a noble inten- sity of feeling. Perhaps, amidst the great variety of qualities which they possess, none is more universal and

‘Cimabue’s Madonna carried in Pkocession through the Streets of Florence.” By Lord Leighton.

(Buckingham Palace.)

‘Cymon and Iphigenia.” By Lord Leighton. (PuUished by permission o/the Fine AH Society, London.)

more characteristic than a rich elegance, combined with an almost fastidious selection of beautiful forms. It is the super-eminence of these qualities, associated with great decorative skill, that make the splendid pageant of the ” Daphnepho;~~ia ” the most perfect expression of his indi~~ vidual genius. Here we have his composition, his colour, his sense of the joy and movement of life, his love of art and nature at their purest and most spontaneous, and the result is a work without a rival of its kind in the British School.

Leighton was one of the most thorough draughtsmen of his day. His sketches and studies for his pictures are numerous and very highly esteemed. They contain the essence of his conceptions, and much of their spiritual beauty and subtlety of expression was often lost in the elaboration of the finished picture. He seldom succeeded _ in retaining the freshness of his first idea more completely than in his last picture— ” Clytie ” — which was left unfinished on his easel. He rarely painted sacred sub- jects. The most beautiful of his few pictures of this kind was the ” David musing on the Housetop ” (1865). Others were ” Elijah in the Wilderness ” (1879), « Eli- sha raising the Son of the Shunammite ” (1881), and a design intended for the decoration of the dome of St Paul’s Cathedral, ” And the Sea gave up the Dead which were in it” (1892), now in the Tate Gallery, and the terrible ” Eizpah ” of 1893. His diploma pic- ture was ” St Jerome,” ex- hibited in 1869. Besides these pictures of sacred sub- jects, he made some designs for Dalziel’s Bible, which for force of imagination excel the paintings. The finest of these are ” Cain and Abel,” and ” Samson with the Gates of Gaza.”

Not so easily to be classed, but among the most individ- ual and beautiful of his pictures, are a few of which the motive was purely aesthetic. Amongst these may specially be noted ” The Summer Moon,” two Greek girls sleeping on a marble bench, and ” The Music Lesson,” in which a lovely little girl is seated on her lovely young mother’s lap learning to play the lute. With these, as a work produced without any literary suggestion, though very different in feeling, may be associated the ” Eastern Slinger scaring Birds in the Harvest-time : Moon-rise ” (1875), a nude figure standing on a raised platform in a field of wheat.

Leighton also painted a few portraits, including those of Signor Costa, the Italian landscape painter, Mr F. P. Cockerell, Mrs Sutherland Orr (his sister). Amy, Lady Coleridge, Mrs Stephen Ealli, and (the finest of all) Sir Richard Burton, the traveller and Eastern scholar, which was exhibited in 1876 and is now in the National Portrait Gallery.

Like other painters of the day, notably Mr G. Y. Watts, Lord Leighton executed a few pieces of sculpture. His

Lord Leighton. (From apTiotograph by Elliott and Fry, London.)

“Athlete struggling with a Python” was exhibited at the Royal Academy in 1877, and was purchased for the Chantrey Bequest collection. An illustration of this fine work is given in the article Sculpture, Enq/. Brit. vol. xxi. p. 562. Another statue, ” The Sluggard,” of equal merit, was exhibited in 1886 ; and a charming statuette of a nude figure of a girl looking over her shoulder at a frog, called ” Needless Alarm,” was completed in the same year, and presented by the artist to Sir John Millais in acknow- ledgment of the gift by the latter of his picture, ” Shell- ing Peas.” He made the beautiful design for the reverse of the Jubilee Medal of 1887. It was also his habit to make sketch models in wax for the figures in his pictures, many of which are in the possession of the Royal Academy. As an illustrator in black and white he also deserves

to be remembered, especially for the cuts to Dalziel’s Bible already mentioned, and his illustrations to George Eliot’s Romola, which appeared in the Comhill Magazine. The latter are full of the spirit of Florence and the Flo- rentines, and show a keen sense of humour, elsewhere excluded from

his work. Of his decorative paintings, the best known are the ele- gant compositions (in spirit fresco) on the walls of the South Kensington Museum, representing ” The Industrial Arts of War and Peace.” There, also, is the refined and spirited figure of ” Cima- bue ” in mosaic. In Lynd- hurst church are mural decorations to the memory of Mr Pepys Cockerell, illustrating ” The Parable of the Wise and Foolish Virgins.”

Leighton’s life was through- out marked by distinction, artistic and social. Though not tall, he had a fine pre- sence and manners, at once genial and courtly. He was welcomed in all societies, from the palace to the studio. He spoke German, Italian, and French, as well as English. He had much taste and love for music, and considerable gifts as an orator of a florid type. His Presidential Discourses were full of elegance and culture (published, London, 1896). For seven years (1876-83) he commanded the 20th Middlesex (Artists) Rifle Volunteers, retiring with the rank of honorary colonel, and subsequently receiving the Volunteer Decoration. Yet no social attractions or successes diverted him from his devotion to his pro- fession, the welfare of his brethren in art, or of the Royal Academy. As president he was punctilious in the discharge of his duties, ready to give help and encouragement to artists young and old, and his tenure of the office was marked by some wise and liberal re- forms. He frequently went abroad, generally to Italy, where he was well known and appreciated. He visited Spain in 1866, Egypt in 1868, when he went up the Nile with Ferdinand de Lesseps in a steamer lent by the Khedive. He was at Damascus for a short time in 1873. It was his custom on all these trips to make little

lively sketches of landscape and buildings. These fresh little flowers of his leisure used to decorate the walls of his studio, and at the sale of its contents after his death realized considerable prices. It was when he was in the full tide of his popularity and success, and apparently in the full tide of his personal vigour also, that he was struck with angina pectoris. Eor a long time he struggled bravely with this cruel disease, never omitting except from absolute necessity any of his oflScial duties except during a brief

period of rest abroad, which failed to pro- duce the desired effect. His death occurred on 26th January 1896.

Leighton was elected an Academician in 1868, and suc- ceeded Sir Francis Grant as President in 1878, when he was knighted. He was created a baronet in 1886, and was raised to the peerage in 1896, a few days only before his death. He held honorary degrees at the Universities of Oxford, Cambridge, Dublin, Edinburgh, and Durham, was an Associate of the Institute of France ; a Com- mander of the Legion of Honour, and of the Order of Leopold. He was a Knight of the Coburg Order, ” Dein Verdienste,” and of the Prussian Order ” Pour le Merite,” and a member of at least ten foreign Academies. In 1859 he won a medal of the second class at the Paris Salon, and at the Exposition Universelle of 1889 a gold medal. As a sculptor he was awarded a medal of the first class in 1878 and the Grand Prix in 1889.

See Art Annual (Mrs A.Lang), 1884. Eoyal Academy Cata^ logue, Winter Exhibition, 1897. National Gallery of British Art Catalogue. — C. Monkhousb. British Contemporary Artists. Lon- don, 1899. — Ernest Rhys. Frederick, Lord Leighton. London, 1898, 1900. (c. MO.)

Leipa. See Bohmisch-Leipa.

Leipzig, a town of the kingdom of Saxony, Germany, situated 101 miles by rail south-south-west of Berlin, one of the most important commercial centres of Germany, a town of very considerable and growing industrial enter- prise, the seat of the Supreme Court of the empire and of one of the oldest and most influential of its univer- sities. During the last twenty years of the 19th century an unusual number of new public buildings were erected. On Augustus Platz are the museum, to which two spar cious wings were added in 1883-86 ; the post office, rebuilt in 1883 ; the university buildings, reconstructed in 1891-97 ; the Pauliner Kirche, also rebuilt in 1897- 99 ; and the monumental Mende fountain (1886). The museum contains a fine picture gallery and a collection of sculpture. The university was in 1900 attended by 3269 students, a number exceeded by only Berlin and Munich; the number of professors was 220. In 1896 the old Gewandhaus or concert hall was converted into a kind of market hall for use at the fairs, a new Gewand- haus having been built, to the south-west of

the old town, in 1880-84. Immediately opposite to it is the new university library (1891), which now contains some 600,000 volumes and 5000 MSS. Behind that again is the Academy of Art, one wing of which accommodates the iudustrial art school ; and close beside it are the industrial school and the conservatory of music. Be- tween the university library and the new Gewandhaus stands a monument of Mendelssohn (1892). Immedi- ately to the east of the industrial art school rises the supreme court of justice of the empire (Reichsgericht), a pile which compares with the great and monumental edifice of the Keichstag in Berlin. It was built in 1888- 95 from plans by Ludwig Hoffmann, and is distinguished for the symmetry and harmony of its proportions. It bears an imposing dome, 225 feet high, crowned by a bronze figure of Truth by 0. Lessing, 18 feet high. In the same quarter stands the Grassi Museum (1893-96) for industrial art and ethnology, and south from it the

Gothic Petri Kirche (1885). Farther towards the north come St Thomas's church (1496 ; rebuilt by Lipsius in 1885-89), with a lofty roof ; the historical musical mu- seum; and a bronze statue of Leibnitz (1883). A short distance away is the Renaissance building, of the Impe- rial Bank (1886) ; and the Markt Platz is adorned by a fine monument of Victory (war of 1870-71), designed by Siemering and put up in 1888. On the north side of the old town the new exchange (1884r-86) and the Reformed church (1896-99) stand close together. On the east the church of St John, in which is the tomb of J. S. Bach, and outside it the tomb of Gellert, was restored in 1894- 97. Opposite its main entrance is a bronze group of Luther and Melanchthon, by Schilling, unveiled in 1883 as a monument of the Reformation. A little farther to the east stand close together the German Booksellers' House, a German Renaissance structure (1886-1888), and the Book-trade House (opened in 1900). The former contains a booksellers' museum, with several fine speci- mens of early printiug. South-west of these buUdings, on the other side of the Johannisthal Park, are clustered together the medical institutes and hospitals of the uni- versity— the infirmary, women's and other hospitals, physico-chemical institute, pathological institute, physio- logical institute, ophthalmic hospital, pharmacological institute, the anatomy schools, chemical laboratory, the zoological institute, the physico-mineralogical institute, the botanical garden, and also the veterinary schools, deaf and dumb asylum, agricultural

college, and astro- nomical observatory (12° 23′ 30″ E., 61° 20′ 6″ IST.). In the Johanna Park are the Luther church (1883-86) and a bronze statue of Bismarck (1897) ; in the large park of Rosenthal (north of town) are the zoological gardens and monuments to Fechner (1897) and Gellert. It should also be mentioned that in 1897 the citadel of Pleissen- burg (1213) was pulled down, with the exception of the tower, which is to be used in the construction of a pro- jected town hall. The fiist commercial high school in Germany was opened here in 1898 (260 students in 1900). Since 1878 Leipzig has grown into an industrial town of the first rank. The book trades still maintain their pre- eminence, and in 1895 gave employment to over 15,000 persons. The iron and machinery trades employed 4500 persons in the same year ; the textile industries (cotton- and yarn-spinning, hosiery), nearly 6000 ; and the making of scientific and musical instruments, including pianos, 2650. Other industries, the manufacture of artificial flowers, wax-cloth, chemicals, ethereal oils and essences, beer, mineral water, tobacco and cigars, lace, indiarrubber wares, rush-work, paper, the preparation of furs, and numerous other branches. These industries are mostly carried on in the suburbs of Plagwitz, Reudnitz, Lin- denau, and Gohlis, all of which, along with Eutritzsch and Konnewitz, were incorporated with Leipzig in 1889-91. In respect of its commerce Leipzig ranks after Hamburg, and probably after Berlin also, but not after any other German town. The chief objects of traffic remain unal- tered, but to them there have been added paper and tobacco. The annual turnover of the fur trade is esti- mated at 3 to 34 million pounds sterling. Population (1885), 251,224 ; (1890), 296,025, or, including half a dozen suburban communes (1886), 364,899; (1895), 399,963; (1900), 455,089. (For Plan see p. 191.)

Leith, a municipal and parliamentary burgh, sea- port, fishing port, and commercial centre, Midlothian, Scotland, on the Firth of Forth. Up till near the middle of the 19th century Leith was separated from Edinburgh by nearly two miles of open country, but in the vicinity of the main thoroughfares the ground is now built over. A considerable area in the centre of the town in the

South Leith division, whicli contained many antique houses and tenements, has been cleared under an Improve- ment Scheme authorized by the Artisans' Dwellings Act. Open spaces for playgrounds, grass plots, shrubs, and trees were railed off, and an undoubted improvement was efEected, at a cost of about £120,000 Leith Links, one

of the homes of golf in Scotland, has under a Provisional Order been enclosed by railings and laid out as a public park. The old Leith High School, erected in 1806 on the south side of the links, has been demolished, and on its site the Leith School Board have erected the new Leith Academy. It is a handsome building.

Plan op Central Leipzig.

It has basement and three upper floors, and comprises physical, mechanical, and chemical laboratories. To the academy are drafted senior pupils from the other schools under the board for free instruction in the higher branches of education. The accommodation is for 946 pupils, exclusive of the science and art departments.. The work of the Leith Technical College, which in 1899 had enrolled 769 individual students in its numerous evening classes, is also carried on in the academy. The Leith School Board has under its care twelve schools, affording accommodation for a total of 13,428 pupils. Secondary education is given in Craighall Eoad School as in the

academy. Engineering, shipbuilding, wood-sawing, twine, rope, sailcloth, hosiery, soap and chemical manure manu- factures, flour-milling, biscuit-baking, are some of the industries that have made noteworthy progress ; but it is as a distributing centre that the town holds the more im- portant position. Imports of grain, flour, butter, cheese, eggs, wines, brandies, fruits, and timber increase from year to year. Exports of coal reach from seven to eight hundred thousand tons yearly. Leith is the largest centre of the whisky trade in Great Britain, and many wholesale houses have built up an export trade to the British colonies, the Continent, the United States, Canada, and

India. With the completion of the Edinburgh Dock in 1881, the dock accommodation of the port had reached nearly 43 acres, with ample quayage adjoining. The steady increase of the shipping trade, and the larger tonnage of steamers trading with the Baltic, the United States, and the British colonies, made it incumbent on the Dock Commission to anticipate in good time the varied requirements of the port. It has been found practicable to make substantial reductions in the rates or port dues from time to time, and for this reason the dock revenues are an inexact index of the progress of the port. An additional dock was projected in 1890, involving the reclamation from the sea on the east side of the piers of 76 acres of the beach. The cost of the new works, including the construction of two addi- tional graving docks, is expected to be close upon one million sterling. New works by the Leith Dock Com- mission have also been carried out at Newhaven, the well- known fishing village. On ground reclaimed from the sea a commodious fish market has been erected, and it is intended to carry the existing pier seawards into deep water, so that trawler steamers may have quay conveni- ences at any state of the tide. The value of fish landed at Newhaven and sold for the most part by auction in the early morning exceeds £40,000 yearly. The tonnage of the port of Leith in 1881 consisted of 189 vessels of 86,509 tons gross ; in 1899 it was 207 vessels of 193,749 tons gross. The number and tonnage of vessels entering and leaving the port with cargoes and in ballast during the year ending 15th May 1881 was 8797 vessels of 1,946,052 tons. For the year ending at same date in 1899 the figures were 12,676 vessels of 3,743,140 tons. The customs revenue collected at the port in 1881 was £479,805, and in 1900, £1,096,438. The dock rates on shipping for the year to 16th May 1899 yielded £30,066 ; on imported goods, £35,840; and on exported goods, £15,709; total, £81,615. The Dock Commission had also a revenue from graving docks, cranes, rails, bridges, ballast, rents, feus, &c., amounting to £27,860. In 1900 the imports amounted to £12,931,781, and the exports to £6,297,990. Population (1881), 59,486; (1891),

68,707; (1901), 76,667.

Leitmeritz, an episcopal see and chief town of a district of the same name in Bohemia, Austria. Steam navigation on the Elbe begins at this town, which has an important transit trade, as well as in the products (corn, fruits, hops,

and wines) of an exceptionally fertile agri- cultural district. The principal industries are brewing and the manufacture of malt, leather, tiles, straw hats, and flour. Population (1890), 11,342 ; (1900), 13,076.

LeitomischI, the chief town of a government dis- trict, Bohemia, Austria, on the right bank of the Louchna, near the Moravian frontier. It has a Renaissance ch§,teau of the 16th century, atid the oldest Piarist college in Bohemia. Its manufactures include linen, cloth, sugar, shoes, pianos, flour, and beer, and it has a trade in corn and flax as well as in those products. Population (1900), 8075, chiefly Czech.

Leitrim, a maritime county of Ireland, province of Connaught.

Population. — The area of the administrative county in 1900 was 376,510 acres, of which 76,879 were tillage, 216,467 pasture, 44 fallow, 3074 plantation, 20,488 turf-bog, 4070 marsh, 30,169 barren mountain, and 25,339 water, roads, fences, &c. The new adminis- trative county, under the Local Government (Ireland) Act, 1898, is identical with the old judicial county. The population in 1881 was 90,372, and in 1891, 78,618, of whom 39,716 were males and 38,903 females, divided as follows among the different religions : — Koman Catholics, 71,098 ; Protestant Episcopalians, 6447 ; Presby- terians, 246 ; Methodists, 784 ; and other denominations, 43. The

decrease of population between 1881 and 1891 was 13-00 per cent. The average number of persons to an acre was -20, and 172 to each square mile under crops and pasture. The population in 1901 was 69,201 (Roman Catholics, 62,604 ; Protestant Episcopalians, 5668; Presbyterians, 224; Methodists, 685; others, 20), being a decrease of 12-0 per cent. The following table gives the degree of education in 1891 : —

Males.

Females.

Total.

Percentage.

E.G.

Pr.Ep.

Presb.

Meth.

Read and write Read only Illiterate .

25,829 3,946 6,836

24,262 4,862 5,736

50,091

8,808

11,571

69-4 13 0 17-6

86-1 7-8 6-1

89-4 6-9 3-7

93-5 4-6 1-9

The percentage of Illiterates among Roman Catholics in 1881 was 24-1. In 1891 there were 3 superior schools with 67 pupils (Roman Catholics 55, and Protestants 12), and 193 primary schools with 13,570 pupils (Roman Catholics 12,145, and Protestants 1425). The number of pupils on the rolls of the National schools on 31st December 1900 vfas 14,153, of whom 12,747 were Roman Catholics and 1406 Protestants.

The following table gives the number of births, deaths, and marriages in various years : —

Year.

Births.

Deaths.

Marriages.

1881 1891 1900

1951

1776 1397

1084 1194 1668

245 302 275

In 1900 the birth-rate per 1000 was 20-2, and the death-rate 15-4 ; the rate of illegitimacy was -5 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 74,250, of whom 36,788 were males and 37,462 females. The only towns in the county which in 1891 had populations of over 1000 were Carrick-on-Shannon (1177) and Manor Hamilton (1061).

Administration. — The county is divided into two parliamentary divisions. North and South, the number of registered electors in 1901 being respectively 6561 and 7181. The rateable value in 1900 was £137,963, the smallest amount of any Irish county. By the Local Government (Ireland) Act, 1898, the fiscal and adminis- trative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises 5 rural sanitary districts.

Agriculture. — The following tables give the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1896, and 1900:—

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oo6

3

1881

306

18,T50

869

19,828

948

1668

46,338

82,697

1891

3T

11,687

680

16,302

1490

2876

60,113

82,635

1895

T

10,214

422

14,801

1804

1871

62,485

81,104

1900

13

8,254

889

18,441

879

2041

61,862

76,879

For 1900 the total value of the cereal and other crops was estimated at £496,762. The number of acres under pasture in 1881 was 208,644, in 1891, 209,711, and in 1900, 216,467.

Year.

Horses

and Mules.

Asses.

Cattle.

Sheep.

Pigs.

Goats.

Poultry.

1881 1891 1895 1900

4191 4910 4986 4849

7984 9042 9060

9S25

84,914 96,769 91,956 93,210

11,347 20,087

n,SS2 17,D21

19,302 27,321 27,886 25,864

6228 9407 9672 9816

811,920 844,922 873,106 428,822

The number of milch cows in 1891 was 87,092, and in 1900 36,116. It is estimated that the total value of cattle, sheep, and pigs for 1900 was £1,243,741. In 1900 the number of holdings not exceeding 1 acre was 803, between 1 and 5, 883 ; between 5 and 15, 5154 ; between 15 and 30, 5229 ; between 30 and 50, 1817 ; between 60 and 100, 669 ; between 100 and 200, 163 ; between 200 and 500, 44 ; and above 500, 6 ; total, 14,768. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901, was 1649, amounting to £264,614. The number of loans for agricultural improvements, sanctioned under sec. 31 of the Land Act, 1881, between 1882 and 1901, was 625, and the amount issued was £35,084. The total amount issued on loan for all classes of works, under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1901, was £76,506. (w. H. PC.)

L E I X 0 E S — L E M U E

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Leixoes, a seaport and harbour of refuge of Portu- gal, 3 miles north of the mouth of the Douro, being the outer port of Oporto. The harbour, which is of artificial construction, has an area of over 220 acres, and admits vessels of 6000 tons, the depth at the entrance being nearly 50 feet. The port is in the commune of Matos- inhos, which in 1900 had a population of 7680.

Leland, Charles Godfrey (1824-

. , ~~), Ameri~~

can author, son of a merchant, was born at Philadelphia, 15th August 1824, and educated at Princeton, where he graduated in 1846. He went to Europe, and studied at Heidelberg, Munich, and Paris. He was at Paris during the revolution of 1848, and took an active part in it. He then returned to Philadelphia, and after being ad- mitted to the bar in 1851, devoted himself to contributing to periodicals, editing various magazines, and writing books. At the opening of the Civil War he started at Boston the Continental Magazine, which advocated the emancipation of the slaves. In 1868 he became known as the humorous author of Hans Breitmann' s Ballads (1867-70), the work with which his name will be sub- stantially associated. These dialect poems, burlesquing the German American, at once became popular. In 1869 he left America for Europe, and till 1880 was occupied, chiefly in London, with literary work, and after return- ing to Philadelphia for six years in 1880, he again made his home in Europe, chiefly at Florence. Though his humorous verses were most Attractive to the public, Leland interspersed his lighter work with the serious study of folk-lore, particularly of the gypsies, his writ- ings on the latter {English Gypsies, 1872 ; Tlie Gypsies, 1883; Gypsy Sorcery, 1891, &c.) being recognized as in- valuable contributions to the literature of the subject.

Lemberg (Polish Lwdw), the capital of the Austrian crownland of Galicia, and now, according to its popula- tion, the fifth city of the Dual Monarchy (after Vienna, Budapest, Prague, and Trieste) and the fourth of Austria. The population in 1890 was 127,943; in 1900, 159,618 (Poles estimated at 82 per cent., Germans 10 per cent., and Euthenians 8 per cent. ; 52-6 per cent. Roman Catho- lic, 17 per cent. Greek Catholic, 28-4 per cent. Jewish, and 2 per cent. Protestant). Its garrison comprises 10,326 men. It is the seat of a Roman Catholic, a Greek, and an Armenian archbishop, and has 14 Roman Catholic churches, a Greek church, an Armenian church, and a Protestant church, two synagogues and 11 Hebrew houses of prayer, together with numerous Catholic and Greek religious communities, including 11 convents. In addi- tion to the university (with over lOO professors and 2058 students in 1901), in which Polish has been the lan- guage of instruction

since 1871^ educational requirements are provided for by a polytechnic (711 students in 1901), a Roman Catholic, and a Greek Catholic theological seminary, 5 gymnasia, a realschule, 2 training colleges, and 5 other technical and special schools. Its indus- tries now include the manufacture of machinery and iron wares, matches, stearin candles and naphtha, arrack and liqueurs, chocolate, chicory, leather, and plaster of Paris, as well as brewing, corn-milling, and brick and tile making. It has important commerce in linen, flax, hemp, wool, and seeds, and a considerable transit trade. It appears, from the statistics published by the munici- pal authorities, that the Jewish element is chiefly re- sponsible for the large proportion of illegitimate births. In 1892 there were 1944 legitimate and 685 illegitimate Roman Catholic births, as compared with 489 legiti- mate and 938 illegitimate Jewish births, a ratio which roughly agrees with that prevailing at Cracow. From 350 to 400 children are annually legitimized.

Lemgo, a town of Germany, principality of Lippe, 58 miles by rail south-west of Hanover. It has several old gable-ended houses of the 15th century, a church rebuilt in 1290, a town hall (1589), and several religious and philanthropic institutions, as well as production of meerschaum pipes, cigars, and woollens. Lemgo once belonged to the Hanseatic League. Population (1885),

6443 ; (1900), 8840.

Lemnos, a historic island of the ^Egean Sea, chief town of a sanjak of Turkey and the seat of a Greek bishop with jurisdiction over Lemnos and Aghios Strati. The valleys are fertile, and on the heights there is good grazing for sheep and goats. The chief exports are barley, sesame, cheese, and wool. Population, 27,079, mostly Greeks.

Lemoinne, John (1815-1892), French journalist, was born, of French parents, in London, 17th October 1815, and educated first at an English school and then in France. In 1846 he began writing for the Journal des Debats on English and other foreign questions, and under the Empire his brilliant pen was actively employed in holding up to admiration the free insti- tutions of England by contrast with Imperial methods. He became one of the most influential writers in Paris. After 1871 he supported Thiers, but his sympathies rather tended towards a Liberalized monarchy, until the

comte de Chambord's policy made such a develop- ment an impossibility, and he then ranged himself with the Moderate Republicans. In 1875 John Lemoinne was elected to the French Academy, and in 1880 he was nominated a life senator. Distinguished though he was for a real knowledge of England among the French journalists who wrote on foreign affairs, his tone towards English policy greatly changed in later days, and though he never shared the extreme French bitter- ness against England as regards Egypt, he maintained a critical attitude towards Great Britain which served to stimulate French Anglophobia. He was a frequent contributor to the Eevue' des Deux Mondes, and published several books, the best known of which is his Etudes Critiques (1862). He died in Paris 14th December 1892.

Lemur. — Important advances in our knowledge of the extinct members of this group have been made. In the first place, the French Necrolemur (Ency. Brit. vol. xiv. p. 444) has been identified generically with Micro- ckoerus of the Hampshire Tertiaries. Secondly, Adapis (I.e.) has been proved to be a true lemur, closely related in the structure of the tympanic region of the skull to the Malagasy lemurs, and thereby different from the African galagos. In the North American Eocene lemurs are represented by Anaptomorphus, now known to have large eye-sockets and triangular upper molars of the tri- tubercular type. But the most important discoveries have been made in the superficial deposits of Madagascar. Megaladapis, of which two species are known, is the largest of all lemurs. The skull is distinguished by its elonga- tion and the small size of the eye-sockets, the upper molars approximating to the tritubercular type, and pre- senting considerable resemblance to those of the living Lepidolemur. The brain is of a remarkably low type. In one species the approximate length of the skull is 250, and in the second 330 millimetres. Even more interest- ing are the two large species of Nesopithecus, which are likewise from Madagascar, and one of which was at first described as Globilemur. They show a very complicated type of brain, and were at first regarded as indicating Malagasy representatives of the Anthropoidea. In regard to the character of the tympanic region of the skull, this genus shows several features characteristic of the more typical Malagasy lemuroids; and the eye-sockets are

open behind, while the dentition is numerically the same as in some of the latter. On the other hand, in several features Nesopithems resembles the Anthropoidea; the upper incisors are not separated in the middle line, and the upper molars present the pattern found in the Cerco- pithecidce. The resemblances to apes are not confined to the skull, but are found in almost all the bones. Probably the genus may be regarded as a specialized lemuroid.

Lenbach, Franr von (1836-

-), German

painter, was born at Schrobenhausen, in Bavaria, on 13th December 1836. His father was a mason, and the boy was intended to follow his father's trade or be a builder. With this view he was sent to school at Lands- berg, and then to the polytechnic at Augsburg. But after seeing one day Hofner, the animal painter, executing some studies, he made various attempts at painting, which his father's orders interrupted. However, when he had seen the galleries of Augsburg and Munich, he finally obtained his father's permission to become an artist, and worked for a short time in the studio of Grafle, the painter ; after this he devoted much time to copying. Thus he was already accomplished in technique when he became the pupil of Piloty, with whom he set out for Italy in 1858. A few interesting works remain as the outcome of this first journey — " A Peasant seeking Shelter from Bad Weather" (1865), "The Goatherd" (1860, in the Schack Gallery, Munich), and " The Arch of Titus " (in the Palfy collection, Budapest). On returning to Munich, he was at once called to Weimar to take the ap- pointment of prof essor at the Academy, and there hebecame the friend of Begas, the sculptor, and of Bocklin. But he did not hold it long, having made the acquaintance of Count Schack, who commissioned him to paint a great number of copies for his collection. Lenbach returned to Italy the same year, and there copied Titian's " Sacred and Profane Love," his "Venus" in the Tribuna, and many other famous pictures. After copying, at Munich, Van Dyck's " Lady playing the Violoncello," he set out in 1867 for Spain.

There he copied not only the famous pictures by Velasquez in the Prado, but also some land- scapes in the museums of Granada and the Alhambra (1868), now in the Schack Gallery. In the previous year he had exhibited at the great Exhibition at Paris several portraits, one of which took a third-class medal. In 1878 he exhibited the ” Portrait of Canon Dollinger.” Lenbach exhibited frequently both at Munich and at Vienna, and in 1900 at the Paris Exhibition was awarded a Grand Prix for painting. He has painted many of the most remarkable personages of his time ; for instance, the king of Bavaria, the empress of Austria, the queen of Italy, the Emperor William I., Frederick III., the Emperor William II., Bismarck (q.v.), Moltke, Gladstone, Bocklin, Stuck, Liszt, Wagner, Billow, Andrassy, Count Schack (1870 and 1875), and Pope Leo XIII.

See Berlepsch. ” Lenbach,” Velhagen und Klasings Monats- hefte. Munich, 1891. — Beuouen. Les Portraits de Lenhach e I’ Exposition de Munich. Paris, 1899.— K. Knackfuss. Lenbach. Lei’pzig.- -Franz von Lenbach Bildnisse. Munich, 1900.

Lenormant, Francois (1837-1883), Assyriologist and archseologist, was born in Paris on 17th January 1837. His father, Charles Lenormant, distinguished as an archseologist, numismatist, and Egyptologist, was anxious that his son should follow in his steps. He made him begin Greek at the age of six, and the child responded so well to this precocious scheme of instruction, that when he was only fourteen an essay of his, on the Greek tablets found at Memphis, appeared in the Revue ArcMologique. In 1866 he won the numismatic prize of the Academic des Inscriptions with an essay entitled

Classification des Moyinaies des Lagides. In 1862 he became sub-librarian of the Institute. In 1859 he accom- panied his father on a journey of exploration to Greece, an expedition destined to end sadly, for Charles Lenormant succumbed to fever at Athens (24th November). In spite of this unhappy event, Lenormant returned to Greece three times during the next six years, and gave up all the time he could spare from his oflB-cial work to archaeological research.. These peaceful labours were rudely broken into by the war of 1870, when Lenormant served with the army and was wounded in the siege of Paris. In 1874 he was appointed professor of archaeology at

the National Library, and in the following j^ear he collaborated with Baron de Witte in founding the Gazette ArcMologique. As early as 1867 he had turned his attention to Assyrian studies, and was among the first to recognize in the cuneiform inscriptions the existence of a non-Semitic language, now known as Accadian. Lenormant's knowledge was of encyclopaedic extent, ranging over an immense number of subjects, and at the same time thorough, though somewhat lacking perhaps in the strict accuracy of the modern school. Most of his varied studies were directed towards tracing the origins of the two great civilizations of the ancient world, which were to be sought in Mesopotamia and on the shores of the Mediterranean. He had a perfect passion for exploration. Besides his early expeditions to Greece, he visited the south of Italy three times with this object, and it was while exploring in Calabria that he met with an accident which ended fatally in Paris on 9th December 1883, after a long ill- ness. The amount and variety of Lenormant's work is truly amazing when it is remembered that he died at the early age of forty-six. Probably the best known of his books are Les Origines de I'histoire d'aprks la Bible, and his ancient history of the East and account of Chaldean magic. Eor breadth of view, combined with extraordinary subtlety of intuition, he was probably un- rivalled, (a. z.)

Lenox, a town of Berkshire county, Massachusetts, U.S.A., containing an area of 22 square miles of hill country. The principal village in the town, of the same name as the town, is at an altitude of 1200 feet, and about it are high hills — Yokun Seat (2080 feet). South Mountain (1870 feet). Bald Head (1583 feet), and Eattle- snake Hill (1540 feet). Lenox contains the summer houses of many wealthy and prominent persons. The village is principally built along the main street, but the villas are scattered over the surrounding hills in all directions, with fine carriage roads to and among them. The season is in the fall of the year, when outdoor amusements, such as horse-racing, golf, tennis, and polo, are rife. Population

(1880), 2043 ; (1890), 2889 ; (1900), 2942.

Lens, town, arrondissement of Bethune, department of Pas-de-Calais, France, 12 miles south-east of Bethune by rail, on the Lens canal. It has important iron and steel foundries and forges, and manufactories of steel

cables, and occupies a central position in the coalfields of the department, which produced in 1900, 14,594,575 tons of coal. Population (1881), 10,487; (1891), 13,730; (1901), 24,370. Two and a half miles west-south-west lies LiEViN, likewise a centre of the coalfield, with a traffic in 1900 of 289,721 tons. Population (1881), 8281 ;

(1891), 11,704 ; (1901), 17,600.

Lentini (the ancient Leontini), a town of the province of Syracuse, Sicily, Italy, 36 miles by rail north-north-west of Syracuse, on a hill 1^ miles south-east of the marshy lake Lentini or Biviere. This lake is about 20 miles in circum- ference, and generally thronged with water-birds, and full of eels, mullet, &c. The town manufactures pottery, and produces cheese, lime, and olive oil, and has a technical

school. Lentini and its citadel were almost entirely destroyed by an earthquake in 1693. Population (1881), 12,740 ; (1899), 11,000. About one mile to the south-east and higher up lies the town of Caklentini, founded by Charles V., but greatly injured by the earthquake of 1693. Population (1881), 6530 ; (1897), 6600.

Leo XIII. [Vincent Joachim Eaphael Lewis Pecci]

(1810), Pope, reckoned the 257th successor of St

Peter, was born at Carpineto, 2nd March 1810. His, family was Sienese in origin, and his father had served in the army of Napoleon. His earliest education he re- ceived from the Jesuits at Viterbo and in Rome. In the jubilee year 1825 he was selected by his fellow-students to head a deputation to Pope Leo XII., whose memory he subsequently cherished and whose name he assumed in 1878. Weak health, consequent on over-study, pre- vented him from obtaining the highest academical honours, but he graduated as doctor in theology at the age of twenty-two, and then entered the ” Accademia,” a college in which clergy of aristocratic birth are trained

for the diplomatic service of the Eoman Church. IVo years later Gregory XVI. appointed him a domestic prel- ate, and bestowed on him, by way of apprenticeship, various minor administrative of&ces in the pontifical State. He was ordained priest 31st December 1837, and a few weeks later was made governor of Benevento, where he had to deal with brigands and smugglers, who enjoyed the protection of some of the noble families of the dis- trict. His success here led to his appointment in 1841 as governor of Perugia, which was at that time a centre of anti-papal secret societies. This post he held for eighteen months only, but in that brief period he obtained a reputation as a social and municipal reformer. In 1843 he was sent as Nuncio to Brussels, being first consecrated a bishop (19th February), with the title of archbishop of Damietta. During his three years' resi- dence at the Belgian capital he gained the esteem of Leopold I. and was presented to Queen Victoria of Eng- land and the Prince Consort. He also made the acquaint- ance of many Englishmen, Archbishop Whately among them. In January 1846, at the request of the magistrates and people of Perugia, he was appointed bishop of that city ; but before returning to Italy he spent the month of February in London (where he was present at one of Lord Palmerston's receptions), and the months of March and April in Paris. On his arrival in Rome he would, at the request of King Leopold, have been created cardinal but for the death of Gregory XVI. Seven years later, 19th December 1853, he received the red hat from Pius IX. Meanwhile, and throughout his long episcopate of thirty- two years, he foreshadowed the zeal and the enlightened policy later to be displayed in the prolonged period of his pontificate, building and restoring many churches, striving to elevate the intellectual as well as the spiritual tone of his clergy, and showing in his pastoral letters an unusual regard for learning and for social reform. His position in Italy was similar to that of Bishop Dupanloup in France ; and, as but a moderate supporter of the policy enunciated in the Syllabus, he was not altogether persona grata to Pius IX. But he protested energetically against the loss of the Pope's temporal power in 1870, against the confiscation of the property of the religious orders, and against the law of civil marriage established by the Italian Government, and he refused to welcome Victor Emmanuel in his diocese. Nevertheless, he remained in the compara- tive obscurity of his episcopal see until the death of Cardinal Antonelli ; but in 1877, when the important papal office of Camerlengo

became vacant, Pius IX. ap- pointed to it Cardinal Pecci, who thus returned to reside in Rome, with the prospect of having shortly responsi-

ble functions to perform during the vacancy of the Holy See, though the Camerlengo was traditionally regarded as disqualified by his office from succeeding to the papal throne.

When Pius IX. died (7th February 1878) Cardinal Pecci was elected Pope at the subsequent Conclave with comparative unanimity, obtaining at the third scrutiny (20tli February) forty-four out of sixty -one votes, or more than the requisite two-thirds majority. The Conclave was remarkably free from political infiuences, the attention of Europe being at the time engrossed by the presence of a Russian army at the gates of Constantinople. It was said that the long pontificate of Pius IX. led some of the cardinals to vote for Pecci, since his age (within a few days of sixty-eight) and health warranted the expectation that his reign would be comparatively brief ; but he had for years been known as one of the few “Papable” cardinals; and although his long seclusion at Perugia had caused his name to be little known outside Italy, there was a general belief that the Conclave had selected a man who was a prudent statesman as well as a devout churchman ; and Newman (whom he created a cardinal in the year following) is reported to have said, ” In the successor of Pius I recognize a depth of thought, a tender- ness of heart, a winning simplicity, and a power answei’- ing to the name of Leo which prevent me fi’om lamenting that Pius is no longer here.”

The second day after his election Pope Leo XIII. crossed the Tibev incognito to his former residence in the Falconieri Palace to collect his papers, returnin g at once to the Vatican , where he continued to regard himself as ” imprisoned ” so long as the Italian Government occupied the city of Rome. He was crowned in the Sistine Chapel 3rd March 1878, and at once began a reform of the papal household on austere and economic lines which found little favour with the entourage of the former Pope. To fill’ posts near his own person he summoned certain of the Perugian clergy who had been trained under his own eye, and from the first he was less accessible than his predecessor had been, either in public or private audience. Externally unevent- ful as his life henceforth necessarily was, it was marked chiefly by the reception of distinguished personages and of

numerous pilgrimages, often on a large scale, from all parts of the world, and by the issue of encyclical letters. The stricter theological training of the Roman Catholic clergy throughout the world on the lines laid down by St Thomas Aquinas was his first care, and to this end he founded in Rome and endowed an academy bear- ing the great schoolman's name, fui'ther devoting about £12,000 to the publication of a new and splendid edition of his works, the idea being that on this basis the later teaching of Catholic theologians and many of the specula- tions of modern thinkers could best be harmonized and brought into line. The study of Church history was next encouraged, and in August 1883 the Pope addressed a letter to Cardinals De Luca, Pitra, and Hergenrother, in which he made the remarkable concession that the Vatican archives and library might be placed at the disposal of persons qualified to compile manuals of history. His belief was that the Church would not suffer by the pub- lication of documents. A man of literary taste and cul- ture, familiar with the classics, a facile writer of Latin verses as well as of Ciceronian prose, he was as anxious that the Roman clergy should unite human science and literature with their theological studies as that the laity should be educated in the principles of religion ; and to this end he established in Rome a kind of voluntary School Board, with members both lay and clerical ; and the rivalry of the schools thus founded ultimately obliged the State to include religious teaching in their curriculum. The numerous encyclicals by which the pontificateof Leo XIII.

will always be distinguished were prepared and written by himself, but were submitted to the customary re- vision. His first (4th August 1879) was on the scholastic philosophy. In later ones, working on the principle that the Christian Church should superintend and direct every form of civil life, he dealt with the Christian Constitution of States (1st November 1895), with Human Liberty (20th June 1888), and with the Condition of the Working Classes (15th May 1891). This last, entitled Reniin novarum, was slightly tinged with modern socialism ; it was described as " the social Magna Charta of Catholi- cism," and it won for him the name of " the working- man's Pope." Trans- lated into the chief modern languages, many thousands

of copies were circu- lated among the working classes in Catholic countries. Other encyclicals, such as those on Christian Marriage (10th February 1880), on the Kosary (1st September ISSo, and again 5th Septem- ber 1898), and on Freemasonry (20th April 1884), dealt with subjects on which his predeces- sor had been accus- tomed to pronounce allocutions, and were on similar lines. It was the knowledge that in all points of religious faith and practice Leo XIII. stood precisely where Pius IX. had stood that served to render ineffectual others of his encyclicals, in which he dealt ear- nestly and effectively with matters in which orthodox Pi'O- testants had a sym- pathetic interest with him and might otherwise have lent an ear to his counsels. Such were the letters on the Study of Holy Scripture (18th November 1893), and on the Eeunion of Christendom (20th June 1894). He showed special anxiety for the return of England to the Koman Catholic fold, and addressed a letter ad Anglos, dated _14th April 1894. This he followed up by an encyclical entitled)Sutis Cognitnm, on the Unity of the Church (29th June 1896); and the question of the validity of Anglican ordinations from the Roman Catholic point of view having been raised iu Pome by Viscount Halifax, with whom the Abbe D.uchesne and one or two other French priests were in sympathy, a commission was appointed to consider the subject, and on 15th

Pope Leo XIII.

September 1896 a condemnation of the Anglican form as theologically insufficient was issued, and was directed to be taken as final.

The establishment of a diocesan hierarchy in Scot- land had been decided upon before the death of Pius IX., but the actual announcement of it was made by Leo XIII. On 25th July 1898 he addressed to the Scottish Catholic bishops a letter, in the course of which he said that "many of the Scottish people who do

not agree with us in faith sincerely love the name of Christ and strive to ascertain His doc- trine and to imitate His most holy ex- ample." The Irish and American bish- ops he summoned to Pome to confer with him on the subjects of Home Pule and of " Americanism " re- spectively. In India he established a dio- cesan hierarchy, with seven archbishoprics, the archbishop of Goa taking prece- dence with the rank of Patriarch.

With the Govern- ment of Italy his general policy was to be as concili- atory as was con- sistent with his oath as Pope never to surrender the “patri- mony of St Peter ” ; but a moderate at- titude was rendered difficult by partisans on either side in the press, each of whom claimed to re- present his views. In 1879, addressing a congress of Catholic journalists in Rome, he exhorted them to uphold the neces- sity of the temporal power, and to pro- claim to the world that the affairs of Italy would never prosper until it was restored; in 1887 he found it necessary to deprecate the violence with which this doctrine was advocated in certain journals. A similar counsel of moderation was given to the Canadian press in connexion with the Manitoba school question in December 1897. The less conciliatory attitude towards the Italian Government was resumed in an encyclical addressed to the Italian clergy (5th August 1898), in which he insisted on the duty of Italian Catholics to abstain from political life while the Papacy remained in its ” painful, precarious, and intoler- able position.” And in January 1902, reversing the policy which had its inception in the encyclical, Merum novarum, of 1891, and had further been developed ten

years later in a letter to the Italian bishops entitled Graves de communi, the ” Sacred Congregation of Extraor- dinary Ecclesiastical Affairs” issued instructions con- cerniug ” Christian Democracy in Italy,” directing that the popular Christian movement, which embraced in its programme a number of social reforms, such as factory laws for children, old-age pensions, a minimum wage in agricultural industries, an eight-hours’ day, the revival of trade guilds, and the encouragement of Sunday rest, should divert its attention from all such things as savoured of novelty and devote its energies to the restoration of the temporal power. The reactionary policy thus indicated gave the impression that a similar aim underlay the appointment about the same date of a commission to inquire into Biblical studies ; and in other minor matters Leo XIII. disappointed those who had looked to him for certain reforms in the devotional system of the Church. A revision of the breviary, which would have involved the omission of some of the less credible legends, came to nothing, while the recitation of the office in

honour of the Santa Casa at Loreto was imposed on all the clergy. The worship of Mary, largely developed during the reign of Pius IX., received further stimulus from Leo ; nor did he do anything during his pontificate to correct the superstitions connected with popular beliefs concerning relics and indulgences.

His policy towards all governments outside Italy was to support them wherever they represented Social order ; and it was with difficulty that he persuaded French Catholics to be united in defence of the Republic. In 1886 he successfully arbitrated between Germany and Spain in a dispute concerning the Caroline Islands. In Ireland he condemned the ” Plan of Campaign,” but he conciliated the ^Nationalists by appointing Dr Walsh archbishop of Dublin. His hope that his support of the British Govern- ment in Ireland would be met by the establishment of formal diplomatic relations between the Court of St James’s and the Vatican was disappointed. But the jubilee of Queen Victoria in 1887 and the Pope’s priestly jubilee a few months later were the occasion of friendly intercourse between Rome and Windsor, Mgr. Ruffo Scilla coming to London as special papal envoy, and the duke of Norfolk being received at the Vatican as the bearer of the congratulations of the queen of England. Similar courtesies were exchanged during the jubilee of 1897, and again in March 1902, when Edward VII. sent the Earl of Denbigh to Rome to congratulate Leo XIII. on reaching his ninety-third year and the twenty-fifth year of his pontificate.

The elevation of Newman to the College of Cardinals in 1879 was regarded with approval throughout the English- speaking world, both on Newman’s account and also as evidence that Leo XIII. had a wider horizon than his predecessor ; and his similar recognition of two of the most distinguished ” inopportunist ” members of the Vatican Council, Haynald, archbishop of Kalocsa, and Prince Ftlrstenberg, archbishop of Olmiitz, was even more noteworthy. Dupanloup would doubtless have received the same honour had he not died shortly after Leo’s ac- cession. Dollinger he attempted to reconcile, but failed. An Armenian schism was healed by him, and he laboured much to bring about the reunion of the Oriental Churches with the see of Rome, establishing Catholic educational centres in Athens and in Constantinople with that end in view. He used his influence with the Tsar, as also with the emperors of China and Japan and with the shah of Persia, to

secure the free practice of their religion for Roman Catholics within their respective dominions. Among the canonizations and beatifications of his pontifi- cate that of Sir Thomas More, author of the Utopia, is memorable. His encyclical issued at Easter 1902,

and described by himself as a kind of will, was mainly a reiteration of earlier condemnations of the Refor- mation, and of modern philosophical systems, which by their atheism and materialism are responsible for all existing moral and political disorders. Society, he earnestly pleaded, can only find salvation by a return to Christianity and to the fold of the Roman Catholic Church.

The personal appearance of Leo XIII. in his later years is thus described by Mr Thaddeus, who painted his portrait : — ” Pope Leo XIII. is of medium height. His attenuated figure is bent by study and the weight of years, but in every movement he is astonishingly quick and energetic. His head is a most remarkable one, once seen never to be forgotten, with its every feature out of strict proportion, yet with the harmony of the whole. The small, bright, rapid eyes, set close together, denote the man who is ever on the search ; the largely developed aquiline nose a capacity for domination. The mouth, when under a pleasing influence, forms into an exceed- ingly wide, sweet smile, its benevolent expression bright- ening the whole face, and sujDplying the benignity which is less observable in the eyes. . . . The skin is so thin that a perfect network of blue veins is visible over all the white ascetic face. He is gifted with the fire and the impulses of youth, without its accompanying physical strength.” Grave and serious in manner, speaking slowly, but with energetic gestures, simple and abstemious in his life, — his daily bill of fare being reckoned as hardly costing a couple of francs, — he distributed large sums in charity, and at his own charges placed costly astronomical instru- ments in the Vatican Observatory, providing also accom- modation and endowment for a staff of officials. He always showed the greatest interest in science and in literature, and he would have taken a position as a statesman of the first rank had he held office in any secular government. He may be reckoned the most illustrious Pope since Benedict XIV., and under him the papacy acquired a prestige unknown since the Middle Ages.

Leo ben, an old mining town, situated on a peninsula formed by the Mur river in Styria, Austria. Part of its old walls and towers still remain. It has a well-known academy of mining and a number of technical schools. Its extensive iron-works and trade in iron are a con- sequence of its position on the verge of the important lignite deposits of Upper Styria and in the neighbourhood of the iron mines and furnaces of Vordernberg and Eisenerz, with which it is connected by railway. The preliminary peace concluded at Leoben between Austria and France on the 18th of April 1797 is commem- orated by a monument. Population (1890), 8127 ; (1900),

10,204.

Leominster, a municipal borough and market town in the Leominster parliamentary division (since 1885) of Jlerefordshire, England, 12 miles north of Hereford by rail. A free library has been erected. The district is rich in orchards, hop gardens, and agricultural land, and there are cider works in the town. Area of borough, 8284 acres. Population (1891), 6675; (1901), 5826.

Leominster, a town of Worcester county, Massa^ chusetts, U.S.A., in a broken, hilly region, crossed by the New York, New Haven, and Hartford railroad. The principal village in the town bears the same name as the town, and is on the Nashua river. It has some manufac- tures of various kinds. Population (1880), 5772 ; (1890), 7269 ; (1900), 12,392, of whom 2827 were foreign-born.

Leon, an inland province in the north-west of Spain.

It is divided into 10 administrative districts and 234 parishes, covering 6166 square miles. The population was 384,197 in 1897, the average birth-rate being 3-89 percent., the death-rate 3-11 per cent., and the proportion of illegitimate births 4-69 per cent. The main railway- line from Madrid to Corunna passes through the province. Prom Leon City a branch runs to

Oviedo, and to Gijon on the north coast, with a sub-branch to Vierzo. The chief exports are cattle, mules, iron, leather, coal, and butter.

The province is very rich in mines, but only 53 (51 coal) are worked, while 418 are unproductive. The coal-mines developed considerably towards the end of the 19th century, and employ more than a thousand hands. Five companies had an output in 1898 of 144,700 tons of coal and 29,230 tons of coke, besides 40,500 tons of anthracite. In 1898 the live stock included 9623 horses, 3056 mules, 16,220 asses, 159,604 cattle, 452,320 sheep, 26,584 pigs, and 108,127 goats. Agriculture is important, 136,135 acres being devoted to wheat, 312,552 to rye, oats, barley, and maize, 9200 to pod fruit, 51,407 to vines, and 3500 to garbanzos or chick-pea.

Leon, the capital of the above province, had a population of 15,300 in 1897. About the middle of the 19th century it seemed to be decaying fast, but a revival has set in. The churches and convents have been repaired, especially the noble cathedral, thp res- toration of which took ten years. The local industries, particularly those connected with chemicals, leather, foundries, machinery, and railway rolling and fixed stock, have much developed, as has also the trade in agricul- tural products. The new town has spread beyond the dilapidated walls of the Roman and mediaeval boundaries. Leon has an institute, seminaries, and handsome munici- pal buildings and hospitals.

Leon, chief town of a province of Nicaragua, Central America, on the railway from Coriuto to Lake Managua, 50 miles north-west of Managua. Until 1855 Leon was the capital of Nicaragua, and suffered severely in the civil wars ; but owing largely to the advantage of railway communication, it has recovered much of its prosperity. Besides a large general trade, it has several extensive tanneries, which supply cheap leather for export. Popu- lation, about 34,000, or including that of the large Indian suburb of Subtiaba, from which the modern town had its origin, about 45,000.

Leonard, Hubert (1819-1890), Belgian violinist and teacher, was born at Bellaine on 7th April 1819. He studied under Habeneck at the Paris Conservatoire, gave concerts in the principal towns of Europe, and succeeded de Beriot as professor of the violin at the Brussels Con- servatoire in 1851. It is especially as a teacher that Leonard acquired fame.

He wrote a great deal for his instrument, and his published works include six con- certos, studies, fantasias, &c., besides many duets in collaboration with Litolff, Gregoire, and Servais. He died in Paris, 6th May 1890.

Leonforte, a town of the province of Catania, Sicily, Italy, 52 miles west by north of Catania (49 miles by rail). It has sulphur-mines and flour mills. Altitude, 3400 feet above sea-level. Population (1881), 15,645 ; (1897),

15,000.

Leopold II. (Leopold Louis Philippe Makie

Victor), king of the Belgians (1835), son of King

Leopold I. and Princess Louise, daughter of Louis Philippe, king of the French, was born at Brussels, 9th April 1835. In 1846 he was created duke of Brabant and appointed a sub-lieutenant in the army, in which he

served until his accession, by which time he had reached the rank of lieutenant-general. On attaining full age he was made a member of the Senate, and distinguished him- self by the keen interest he took in its proceedings, and especially in those which concerned the development of Belgium and its trade. On 22nd August 1853 he married Marie Henrietta, daughter of the late Archduke Joseph of Austria, and after making a tour round the chief towns of Belgium, the young duke and duchess travelled, in 1864-55, through Italy and Austria to Egypt, Palestine, and Greece. In 1860 the duke visited Constantinople, which, owing to the Crimean war, had necessarily been omitted from the programme in 1866; and two years later he went to Spain and Morocco, after spending a few days on the south coast of England. In the autumn of the same year he paid a second visit to Egypt, this time vid Algiers and Tunis, and, proceeding to Mount Sinai, did not return to Brussels until June 1863. In the following year he made the most distant and most not- able of his numerous journeys, visiting China and India. He returned in 1866 through London, in order to tender special thanks to Queen Victoria and the British Govern- ment for the courtesies received throughout the British dominions in Asia. On the death of his father, 10th December 1865, he succeeded to the crown as Leopold II., and on 28th January 1869 their majesties lost their only son, the Crown Prince

Leopold, whereupon the king's brother, Philip, count of Planders, became heir to the throne. During the Eranco-Prussian war King Leopold preserved a strict and honourable neutrality in a period of unusual diflSculty and danger. But the most notable and far-reaching event in his career was the foundation of the Congo Eree State. While still duke of Brabant, Leopold II. was the first to call the attention of the Belgians to the need of enlarging their horizon beyond sea, and as king he gave the first impulse towards the development of this idea, by founding in 1876 the Association Internationale Africaine. This was followed in 1878 by the formation of the Comite d'jStudes du Haut-Congo, which in its turn developed into the Congo Eree State. The history of these transactions, from 1878 to 1884, is given by Sir H. M. Stanley in The Congo and the Founding of its Free State (1885), which contains a full account of Stanley's explorations made under commission from King Leopold, who contributed £50,000 from his privy purse towards the expenses. It was in this connexion that King Leopold sought an interview with General Gordon in 1880, and obtained his promise, subject to the approval of the War Office, to enter the Belgian service on the Congo. Three years later his majesty claimed fulfilment of the promise, and Gordon was about to proceed to the Congo when the British Government claimed his services for the Sudan. An excellent linguist. King Leopold was also an ardent traveller, and a patron of art, literature, and science ; he founded in 1874 a yearly prize of 25,000 francs for the best work on a given subject announced five years in advance. As duke of Brabant he held aloof from politics, and after his accession be followed the strict constitutional line to which his father always adhered.

Leprosy is now included among the parasitic dis- eases. The cause is believed to be infection by the bacillus leprae, a specific microbe discovered by Hansen in 1871. This organism, which closely resembles the tubercle bacillus, is always found associated with leprosy, but all attempts to cultivate it and to produce the disease by experimental inoculation have failed or met with doubtful success. The proof of causation is, therefore, still incom- plete. It is worthy of note that tuberculosis is very common among lepers, and especially attacks the serous

LEPROSY

memlDraiies. The essential character of leprosy is a great multiplication of cells, resembling the ” granulation cells ” of lupus and ‘syphilis, in the tissues affected, which become infiltrated and thickened, with degeneration and destruction of their normal elements. The new cells vary in size from ordinary leucocytes to giant cells three or four times larger. The bacilli are found in these cells, sometimes in small numbers, sometimes in masses. The structures most affected are the skin, nerves, mucous membranes, and lymphatic glands.

The symptoms arise from the anatomical changes indi- cated, ^nd they vary according to the parts attacked. Three types of disease are usually described — (1) nodular, (2) smooth or anaesthetic, (3) mixed. In the first the skin is chiefly affected, in the second the nerves; the third combines the features of both. It should be , understood that this classification is purely a matter of convenience, and is based on the relative prominence of symptoms, which may be combined in all degrees. The incubation period of leprosy — assuming it to be due to infection — is unknown, but cases are on record which can only be explained on the hypothesis that it may be many years. The invasion is usually slow and inter- mittent. There are occasional feverish attacks, with the usual constitutional disturbance and other slight pre- monitory signs, such as changes in the colour of the skin and in its sensibility. Sometimes, but rarely, the onset is acute and the characteristic symptoms develop rapidly. These begin with an eruption which differs markedly according to the type of disease. In the nodular form dark red or coppery patches appear on the face, backs of the hands, and feet, or on the body ; they are generally symmetrical, and vary from the size of a shilling upwards. They come with one of the feverish attacks and fade away when it has gone, but only to re- turn. After a time infiltration and thickening of the skin become noticeable, and the nodules appear. They are lumpy excrescences, at first pink but changing to brown. Thickening of the skin of the face produces a highly characteristic appearance, recalling the aspect of a lion. The tissues of the eye undergo degenerative changes ; the mucous membrane of the nose and throat is thickened, impairing the breathing and the voice ; the eyebrows fall off ; the ears and nose become thickened and enlarged. As the disease progresses the nodules tend to break down and

ulcerate, leaving open sores. The patient, whose condition is extremely wretched, gradually becomes weaker, and eventually succumbs to exhaustion or is carried off by some intercurrent disease, usually in- flammation of the kidneys or tuberculosis. A severe case may end fatally in two years, but as a rule when patients are well cared for the illness lasts several years. There is often temporary improvement, but complete recovery from this form of leprosy rarely or never occurs. The smooth type is less severe and more chronic. The erup- tion consists of patches of dry, slightly discoloured skin, not elevated above the surface. These patches are the result of morbid changes affecting the cutaneous nerves, and are accompanied by diminished sensibility over the areas of skin affected. At the same time certain nerve trunks in the arm and leg, and particularly the ulnar nerve, are found to be thickened. In the further stages the symptoms are those of increasing degeneration of the nerves. Bullae form on the skin, and the- discoloured patches become enlarged; sensation is lost, muscular power diminished, with wasting, contraction of tendons, and all the signs of impaired nutrition. The nails be- come hard and clawed ; perforating ulcers of the feet are common; portions of the extremities, including whole fingers and toes, die and drop off. Later, paralysis be- comes more marked, affecting the muscles of the face and

limbs. The disease runs a very chronic course, and may last twenty or thirty years. Eecovery occasionally occurs. In the mixed form, which is probably the most common, the symptoms described are combined in varying degrees. Leprosy may be mistaken for syphilis, tuberculosis, ainhum (an obscure disease affecting negroes, in which the little toe drops off), and several affections of the skin. Diag- nosis is established by the presence of the bacillus leprae in the nodules or bullae, and by the signs of nerve degen- eration exhibited in the anaesthetic patches of skin and the thickened nerve trunks.

In former times leprosy was often confounded with other skin diseases, especially psoriasis and leucoderma ; the white leprosy of the Old Testament was probably a form of the latter. But there is no doubt that true leprosy has existed from time immemorial. Prescriptions for treating it have been found in Egypt, to which a date of about 4600 b.c. is assigned. The disease is described by Aristotle and by later Greek writers, but not by

Hippo- crates, though leprosy derives its name from his ” lepra ” or ” scaly ” disease, which was no doubt psoriasis. In ancient times it was widely prevalent throughout Asia as well as in Egypt, and among the Greeks and Eomans. In the Middle Ages it became extensively diffused in Europe, and in some countries — France, England,Germany, and Spain — every considerable town had its leper-house, in which the patients were segregated. The total number of such houses has been reckoned at 19,000. The earliest one in England was established at Canterbury in 1096, and the latest at Highgate in 1472. At one time there were at least 95 religious hospitals for lepers in Great Britain and 14 in Ireland (Sir James Simpson). During the 15th century the disease underwent a remarkable diminution. It practically disappeared in the civilized parts of Europe,, and the leper-houses were given up. It is a singular fact that this diminution was coincident with the great extension of syphilis (see Prostitution). The general disappearance of leprosy at this time is the more unintelligible because it did not take effect every- where. In Scotland the disease lingered until the 19th century, and in some other parts it has never died out at all. At the present time it still exists in Norway, Iceland, along the shores of the Baltic, in South Eussia, Greece, Turkey, several Mediterranean islands, the Eiviera, Spain, and Portugal. Isolated cases occasionally occur elsewhere, but they are usually imported. The Teutonic races seem to be especially free from the taint. Leper asylums are maintained in Norway and at two or three places in the Baltic, San Eemo, Cyprus, Constantinople, Alicante, and Lisbon. Except in Spain, where some increase has taken place, the disease is dying out. The number of lepers in Norway was 3000 in 1856, but has now dwindled to a few hundred. They are no longer numerous in any part of Europe. On the other hand, leprosy prevails exten- sively throughout Asia, from the Mediterranean to Japan, and from Arabia to Siberia. It is also found in nearly all parts of Africa, particularly on the east and west coasts near the equator. In South Africa it has greatly in- creased, and attacks the Dutch as well as natives. Leper asylums have been established at Eobben Island near Cape Town, and in Tembuland. In Australia, where it was in- troduced by Chinese, it has also spread to Europeans. In New Zealand the Maoris are affected ; but the amount of leprosy is not large in either country. A much more re- markable case is that of the Sandwich Islands, where the disease is believed to have been imported by Chinese. ‘ It was unknown before 1848, but in 1866 the number of lepers had risen to 230 and in 1882

to 4000 (Liveing). All attempts to stop it by segregating lepers in the settlement of Molokai appear to have been fruitless. In the West Indies and on the American continent, again, leprosy

has a ~~wide distribution. It is found in nearly all parts of South and Central America, and in certain parts of North America — namely, Louisiana, California (among Chinese), Minnesota, Wisconsin and Dakota (Norwe~~ gians), New Brunswick (French Canadians).

It IS difficult to find any explanation of the geograph- ical distribution and behaviour of leprosy. It seems to affect islands and the sea-coast more than the interior, and to some extent this gives colour to the old belief that it is caused or fostered by a fish diet, v^hich has been revived by Mr Hutchinson, but is not generally accepted. Leprosy is found in interiors where fish is not an article of diet. Climate, again, has obviously little, if any, influence. The theory of heredity is equally at fault, whether it be applied to account for the spread of the disease by transmission or for its disappearance by the elimination of susceptible persons. The latter is the manner in which heredity might be expected to act, if at all, for lepers are remarkably sterile. But we see it persisting among the Eastern races, who have been con- tinuously exposed to its selective influence from the earliest times, while it has disappeared among the Euro- peans, who were affected very much later. The opposite theory of hereditary transmission from parents to off- spring is also at variance with many observed facts. Leprosy is very rarely congenital, and no cases have occurred among the descendants to the third generation of 160 Norwegian lepers settled in the United States. Again, if hereditary transmission were an effective influ- ence, the disease could hardly have died down so rapidly as it did in Europe in the 15th century. Then we have the theory of contagion. There is no doubt that human beings are inoculable with leprosy, and that the disease may be communicated by close contact. Cases have been recorded which prove it conclusively ; for instance, that of a man who had never been out of the British islands, but developed leprosy after sharing for a time the bed and clothes of his brother, who had contracted the disease in the West

Indies. Other single cases of communication from person to person have been established ; and on a larger scale, the spread of the disease when introduced into countries by immigrants has been already noted. But a great number of observations go to show that the contagiousness of leprosy is very slight and quite personal. It seems, at any rate, insufficient to account for the rapid increase which has taken place in the Sandwich Islands in spite of the segregation. This case and some of the other facts noted, such as the extensive dissemi- nation of the disease in Europe during the Middle Ages, and its subsequent rapid decline, suggest the existence of some unknown epidemic factor. Poverty and insani- tatiou are said to go with the prevalence of leprosy, but they go with every malady, and there is nothing to show that they have any special influence. Vaccina- tion has been blamed for spreading it, and a few cases of communication by arm-to-arm inoculation are recorded. The influence of this factor, however, can only be tri- fling. Vaccination is a new thing, leprosy a very old one ; where there is most vaccination there is no leprosy, and where there is most leprosy there is little or no vaccination. In India 78 per cent, of the lepers are unvaccinated, and in Canton since vaccination was intro- duced leprosy has declined (Cantlie). On the whole we must conclude that there is still much to be learnt about the conditions which govern the prevalence of leprosy.

With regard to prevention, the isolation of patients is obviously desirable, especially in the later stages, when open sores may dissemiiiate the bacilli; but complete segregation, which has been urged, is regarded as im- practicable by those who have had most experience in

leprous districts. Scrupulous cleanliness should _ be exercised by persons attending on lepers or brought into close contact with them. In treatment the most essential thing is general care of the health, with good food and clothing. The tendency of modern therapeutics to attach increasing importance to nutrition in various morbid states, and notably in diseases of degeneration, such as tuberculosis and affections of the nervous system, is borne out by experience in leprosy, which has affinities to both ; and this suggests the application to it of modern methods for improving local as well as general nutrition by physical means. A large number of internal remedies haf e been tried with varying results ; those most recommended are chaulmoogra oil, arsenic, salicylate of soda, salol, and chlorate of potash. In

the later stages of the disease there is a wide field for surgery, which is able to give much relief to sufferers.

Lepsius,Carl Richard (1810-1884), Egyptologist, was born at Naumburg-am-Saale, 23rd December 1810, and in 1823 was sent to the ” Schulpforte ” school near Naumburg, where he came under the influence of Pro- fessor Lange. In 1829 he entered the University of Leipzig, and one year later that of Gottingen, where, under the influence of Otfried Mliller, he finally decided to devote himself to the archaeological side of philology. From Gottingen he went to Berlin in 1832, where he graduated as doctor with the thesis De tabulis Euguhinis. In the same year he proceeded to study in Paris, and was commissioned by the due de Luynes to collect material from the Greek and Latin writers for his work on the weapons of the ancients. In 1834 he took the Volney prize with his PalaograpMe als Mittel der Sprachfor- scJiung. Befriended by Bunsen and Humboldt, Lepsius threw himself with great ardour into Egyptological studies, and in 1835 presented to the Berlin Academy two dissertations on the Egyptian alphabet and numerals. Having greatly advanced his knowledge of hieroglyphics, he proceeded to Turin at the end of 1835. Here his meditative studies laid the foundation for his future splendid edition of the Book of the Dead (1842). It was by his advice that the Drovetti collection at Livorno was afterwards acquired for the Berlin Museum. In May 1836 he went to Rome, where Bunsen, who was engaged on his great work Aegypten’s Stelle in der Weltgeschichte, had his collaboration. In 1837 Lepsius addressed a remarkable letter to Eosellini on the hieroglyphic alpha- bet, and in the following year left Rome to study the Egyptian collections at Leyden and to visit England. He then returned to Germany, where Humboldt and Bunsen united their influence to make his projected visit to Egypt a scientific expedition with royal support. A prolonged stay at Memphis gave Lepsius the oppor- tunity of deep researches into early Egyptian history and chronology. At the end of 1846 he returned home, and the results of the expedition, consisting of some 1500 specimens and casts, far surpassed expectations. On 5th July 1846 he married Elisabeth Klein, and his appoint- ment to a professorship in the Berlin University in the following August afliorded him the leisure necessary for the completion of his work. In 1856 the twelve volumes of his vast Denkmaler ans Aegypten und Aethiopien were finished ; they comprise the entire archaeological, palae- ographical,

and historical results of the Egyptian ex- pedition, and their wealth of lithographed inscriptions renders them an indispensable corpus for the study of Egyptology. In the same year Lepsius detected the forgery of the lost work of Stephanus of Byzantium,

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Simonides attempted to palm off upon the Berlin Acad- emy for 2500 thalers. The next subject that engaged his

attention was metrology, but here the results of his in- vestigations were warmly contested by Oppert and the younger school of Assyriologists. His editorship of the Zeitung fur Aegyptische Sprache und Alterthumskunde soon raised that journal to the rank of an international organ. In 1866 Lepsius again went to Egypt, and brought back with him the famous Decree of Tanisor Table of Canopus, which was found among the ruins of San, one of the most important finds since the Eosetta Stone. In 1869 Lepsius visited Egypt for the third and last time, and in 1873 he succeeded Pertz as keeper of the Eoyal Library, Berlin, which, like the Berlin Museum, owes much to his care. About ten years later he was appointed Geheimer Oberregierungsrath. He died at Berlin, 10th July 1884. Lepsius was a fine specimen of the best type of German scholar, modest, patient, simple, and enthusi- astic, (g. f. b.)

Lercara, a town of the province of Palermo, Sicily, Italy, 49 miles south by west of Termini by rail, 2166 feet above sea^level. It has important sulphur mines and manufactures of macaroni and lime. Population (1881),

13,324 ; (1897), 14,000.

Lerici, a small seaport town and summer resort of the province of Genoa, Liguria, Italy, on the east side of the entrance to the Gulf of Spezia, 4 miles south-east of Spezia. It has an old castle and three churches, and is a place of some industry, chiefly lead and silver refining (at Pertusola, but in the

commune), shipbuilding, foundries, machine shops, macaroni factories, and olive-oil presses. “Within its commune is San Terenzo, where Shelley lived. Population (1881), 6675 ; (1897), 6000.

Lorida, a province of Spain, on the French frontier. It has an area of 4772 square miles, and is divided into eight administrative districts and 326 parishes. The population decreased somewhat between 1887 and 1897, namely, from 285,417 in the former year to 284,693 in 1897. The birth-rate is 3-07 per cent., the death-rate 2-74 per cent., and the proportion of illegitimate births only 0-90 per cent., the lowest provincial average in Spain. The railway from Saragossa to Barcelona runs across the province for 65 miles. The Spanish Government has entered into an agreement with France to carry another line, putting Lerida into communication with Tarragona and the Mediterranean coasts, to the mouth of an inter- national tunnel through the Pyrenees. Industries are in a more backward condition than in any other province of Catalonia, though there is abundant water power, and excellent wool is obtained. There are, however, 20 cotton and linen factories, 60 flour mills, 70 alcohol or liqueur manufactories, 18 paper mills, 16 soap works, 70 sawmills, and a few oil and leather factories. The local trade is active in wine, oil, wool, timber, cattle, mules, horses, and sheep. In 1898 the live stock included 2580 horses, 17,263 mules, 23,049 asses, 21,866 cattle, 168,915 sheep, 16,621 goats, and 16,815 pigs. Despite the backward state of agriculture, 129,736 acres were in 1898 devoted to the cultivation of wheat, 77,847 acres to barley, rye, oats, maize ; 10,900 acres to chick- peas and beans; 103,000 acres to vines; and 135,627 acres to olive plantations. Mining is as yet unimportant, only four mines being worked, but there are 68 registered (chiefly lignite), though unproductive. Lerida, the capital of the province, had a population of 21,337 in 1897. The aspect of the place has changed considerably since 1880, an extensive new suburb having sprung up on the left bank of the Segre, with broad, regular streets, squares, and promenades, forming a marked contrast to the old town on the right bank. There are good

schools, hospitals, public libraries, and some trade in the products of local industries and agriculture.

Leroy-Beaulieu, Henry Jean Baptiste

Anatole (1842-), French publicist, was born at

Lisieux in 1842. In 1866 he published Une troupe de comediens, and afterwards Essai sur la restauration de nos monuments Jiistoriques devant I'art et devant le budget, which deals particularly with the restoration of the cathedral of Evreux. He visited Russia in order to collect documents on the political and economic organization of the Slav nations, and on his return published in the Bevue des Deux Mondes (1882-89) a series of articles with the title "L'Empire des Tsars et les Russes." The work entitled Un Empereur, un Roi, un Pape, une Restauration, pub- lished in 1879, was an analysis and criticism of the pol- itics of the Second Empire. Un homme d'etat russe (1884) gave the history of the emancipation of the serfs by Alexander II. Other works are Les CathoUques Liberaux, I'JEglise et le Libiralisme (1890), La Papaute, le Socialisme et la Dimocratie (1892). In 1881 M. Leroy- Beaulieu was elected professor of contemporary history and Eastern affairs at the Ecole Libre des Sciences Pol- itiques, and in 1887 he became a member of the Academie de Sciences Morales et Politiques. From 1883 to 1891 he represented Auberive in the Conseil-General of the Haute- Marne.

Leroy-Beaulieu, Pierre Paul (1843-

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French economist, brother of the preceding, was born at Saumur on 9th December 1843, and educated in Paris at the Lycee Bonaparte and the Ecole de Droit. He afterwards studied at Bonn and Berlin, and on his return to Paris began to write for Le Temps, Revue Nationale, and Revue Contemporaine. In 1867 he won a prize offered by the Academy of Moral Science with an essay entitled " L'influence de I'etat moral et intel- lectuel des populations ouvri^res sur le taux des salaires." In 1870 he gained three prizes for essays on " La coloni- zation chez les peuples modernes," " L'administration en France et en Angleterre," and " L'impot foncier et ses consequences economiques." In 1872 Leroy-Beaulieu became professor of finance at the newly-founded Ecole Libre des Sciences Politiques, and in 1880 he succeeded his father-in-law, Michel Chevalier, in the chair of polit- ical economy in the College de France. Professor Leroy- Beaulieu is the author of several works which have made their mark beyond the borders of

his own country. Among these maybe mentioned his Recherches economiques, Jiistoriques et statistiques sur les guerres contemporaines, a series of studies published between 1863 and 1869, in which he calculated the loss of men and capital caused by the great European conflicts. Other works by him are — La question monnaie au dix-neuvi^me si^cle (1861), Le travail des femmes au dix-neuvi^me sii,de (1873), TraM de la science des finances (1877), Essai stir la repartition des richesses (1882), L'Algirie et la Tunisie (1888), Pricis d'iconomie politique (1888), and L'itat ^ moderne et ses fonctions (1889). He also founded the Economiste Fran- qais, on the model of the English Economist. Leroy- Beaulieu may be regarded as the leading representative in France of orthodox political economy, and the most pro- nounced opponent of protectionist and collectivist doc- trines. He has stood several times for election on the Municipal Council of Paris and the Chamber of Deputies, but always without success.

Lerwick, a burgh of barony, police burgh, and county town of Shetland, Scotland, on Bressay Sound, on the east- ern shore of Mainland (or Pomona), the principal island of the group. It consists of one narrow street a mile long, and is 115 mUes north-east of Kirkwall ^nd 340 miles from

Leith by steamer. There are county buildings and a new town hall, which has a Queen Victoria Jubilee com- memoration clock and chime of bells. Lerwick is an important fishing centre. (For statistics, see Shetland.) The other industries are connected with the retail trade among the islands and the knitting of woollen goods. There is steamer communication with Aberdeen, Leith, and Kirkwall. A new harbour has been built, giving 12 feet of water beside the pier at low tide. At the end of 1900, 38 vessels of 2111 tons were registered at the port. In 1888, 525 vessels of 85,826 tons entered; in 1900, 851 vessels of 135,180 tons. Exports were valued at £98,432 in 1888 and £449,746 in 1900. There is a secondary school with an elementary department. Popu- lation (1881), 4045 ; (1901), 4061.

Lesbos, or MiTTLENE (Turkish, Midullu), a Turkish island in the J5gean Sea, separated by a strait from 7 to 10 miles wide from the coast of Asia Minor, north of the Gulf of Smyrna, and a sanjak of the Archipelago vilayet. This beautiful island, surrounded by a sea teem- ing with fish, is rugged and mountainous, its highest point, Mount Olympus {Hagios Elias), rising to 3080 feet. The coast-line is broken on the south-east by Porto Zero or Olivieri, and on the south-west by the deeper inlet of Porto Kallone. The crops are almost exclusively olives, but figs, grapes, lemons, and oranges are also grown. Antimony, good marble, and a little coal are found in the island. The climate is healthy and tempe- rate ; the annual average rainfall is 26-6 inches, and the death-rate only 11 per 1000 inhabitants. The principal exports are olive oil, soap, and valonea. The total trade averages about £700,000 annually, the imports exceeding the exports by about £10,000. The population is about 130,000, of whom 13,000 are Turks and Moslems, and 117,000 Greeks.

Lesina (Slavonic, Hvar), an Austrian island in the Adriatic, off the Dalmatian coast, between the islands of Brazza in the north and Curzola in the south, and divided from the peninsula of Sabbioncello by the Narenta chan- nel. It is about 42 miles long, with a maximum breadth of less than 4 miles. It has a steep, rocky coast with a chain of thinly wooded limestone hills, of which the highest point, Monte San Nicolo, is about 2070 feet above the level of the sea. The climate is mild, and not only the grape and olive, but dates, figs, and the carob or locust-bean flourish. The cultivation of these fruits, boat- building, fishing, and the preparation of rosemary essence and liqueurs are the principal resources of the inhabitants. The chief town and harbour of the same name is the seat of the government district (which includes Cittavecehia, Lissa, and some small neighbouring islands, with a total population of 27,928) and a bishop. It is a station of the Austrian Lloyd, and contains an arsenal, an observatory, and some interesting old buildings of the 16th century. Population, 3828.

Leskovatz, a town in Servia, between Nish and Vranya, on the railway line from Nish to Salonica, 3^ miles to the east of the river Morava. It is the centre of the Servian hemp industry, the extensive plain in which the town lies growing the best flax and hemp in all the Balkan peninsula. The plain is not only the most fertile portion of Servia, but also the best cultivated.

Besides flax and hemp, excellent tobacco is grown. Pive valleys converge on the plain from different directions, and the in- habitants of the villages in these valleys are all occupied in growing flax and hemp, which they send to Leskovatz to be stored or manufactured into ropes. After Belgrade and Nish, Leskovatz is the most prosperous town in Servia. Population (1895), 12,989.

Leslie, Fred [Febdeeick Hobson] (1855-1892), English actor, was born at Woolwich, 1st April 1855. He began a connexion with the stage as an amateur in early life, and first appeared at a London theatre in 1878. He had a good voice, and gradually came to the front in light opera, and in 1882 made a great hit as Eip van Winkle in Planquette's piece of that name at the Comedy Theatre. In 1885 he appeared at the Gaiety as Jonathan Wild in the burlesque Little Jack Sheppard. His extraor- dinary success in this part determined his subsequent career, and thereafter he and Miss Nelly Farren were the pillars of Gaiety burlesque. Fred Leslie's Don Ceesar de Bazan in Buy Bias, or the Blase Boui, was perhaps the most popular of his later parts. In all of them it was his own versatility and entertaining personality which formed the attraction; whether he sang, danced, whistled, or " gagged," his performance was an unending flow of high spirits and ludicrous charm. Under the pseudonym of " A. C. Torr " he was acknowledged on the programmes as part-author of these burlesques, and their success at the Gaiety Theatre owed everything to him and Miss Farren, with whom he played in perfect association. Leslie acted on occasion in more serious comedy, for which he had undoubted capacity ; but his fame rests on his connexion with the Gaiety burlesque of the 'eighties. In spite of such clever imitators of his methods as E. J. Lonnen and others, Fred Leslie's death on 7th December 1892 really involved the transition of " Gaiety burlesque " into the " musical comedy " of the 'nineties — a form of entertainment depending much less on genuine originality.

Lesseps, Ferdinand de (1805-1894). — Few lives have had greater vicissitudes than, or experienced such a manifold succession of triumphs and misfortunes as, that of Ferdinand de Lesseps. His French compatriots treated him by turns as a demi-god and a criminal, although he had never been other than a great man, nor had ever merited the trials that overwhelmed him during his closing years. History will give him a place of

honour, for all his acts were dominated by an extraordinary zeal for the welfare of his fellow-men. The origin of his family has been traced back as far as the end of the 14th century. His ancestors, it is believed, came from Scotland, and settled at Bayonne when that region was occupied by the English. One of his great-grandfathers was town clerk and at the same time secretary to Queen Anne of ISTeuberg, widow of Charles II. of Spain, exiled to Bayonne after the accession of Philip V. From the middle of the ISth century the ancestors of Ferdinand de Lesseps followed the diplomatic career, and he himself occupied with real distinction several posts in the same calling from 1826 to 1849. His uncle was ennobled by King Louis XVI., and his father was made a count by Napoleon I.

Ferdinand de Lesseps was born at Versailles on the 19th of November 1805. His father, Mathieu de Lesseps, was a consul ; his mother, Catherine de Griv^gnee, was Spanish, and aunt of the countess of Montijo, mother of the Empress Eug&ie. His first years were spent in Italy, where his father was occvipied with his consular duties. He was educated at the College of Henry IV. in Paris. From the age of 18 years to 20 he was employed in the commissary department of the army. From 1825 to 1827 he acted as assistant vice-consul at Lisbon, where his uncle, Barth61emy de Lesseps, was the French charg^ d'affaires. This uncle was an old companion of La P^rouse and a survivor of the expedition in which that navigator perished. In 1828 Ferdinand was sent as an assistant vice-consul to Tunis, where his father was consul-general. He courageously aided the escape of Youssouff, pursued by the soldiers of the Bey, of whom he was one of the

officers, for Tiolation of the seraglio law. Youssoufe acknowledged this protection given by a Frenchman by distinguishing himself in the ranks of the French army at the time of the conquest of Algeria. Ferdinand de Lesseps was also entrusted by his father with missions to Marshal Count Clausel, general-in-chief of the army of occupation in Algeria. The marshal wrote to Mathieu dp Lesseps on the 18th of December 1830 : " I have had the pleasure of meeting your son, who gives promise of sustaining with great credit the name he bears." In 1832 Ferdinand de Lesseps was

appointed vice-consul at Alexandria. To the placing in quarantine of the vessel which took him to Egypt is due the origin of the great conception of a canal across the isthmus of Suez. In order to help him to while away the time at the lazaretto, M. Mimaut, consul-general of France at Alexandria, sent him several books, among which was the memoir written upon the Suez Canal, according to Bonaparte's instruc- tions, by the civil engineer Lapere, one of the scientific

members of the French ex- ^s

pedition. This work struck de Lesseps's imagination, and gave him the idea of piercing the African isthmus. This idea, moreover, was con- ceived in circumstances that were to prepare the way for its realization. Mehemet Ali, who was the viceroy of Egypt, owed his position, to a certain extent, to the re- commendations made in his behalf to the French Govern- ment by Mathieu de Les- seps, who was consul-general in Egypt when Mehemet Ali was a simple colonel. The Viceroy therefore welcomed Ferdinand affectionately, while Said Pacha, Mehemet's son, began those friendly relations that he did not forget later, when he gave him the concession for mak- ing the Suez Canal. In 1833 Ferdinand de Lesseps

was sent as consul to Cairo, and soon afterwards given the management of the consulate-general at Alexandria, a post that he held until 1837. While he was there a terrible epidemic of the plague broke out and lasted for two years, carrying off more than a third of the inhabitants of Cairo and Alexandria. During this time he went from one city to the other, according as the danger was more pressing, and constantly displayed an admirable zeal and an imperturbable energy. Towards the close of the year 1837 he returned to France, and on the 21st of December married Mile. Agathe Delamalle, daugh- ter of the Government prosecuting attorney at the court of Angers. By this marriage M. de Lesseps became the father of five sons. In 1839 he was appointed consul at Rotterdam, and in the following year transferred to Malaga, the place of origin of his mother's family. In 1842 he was sent to Barcelona, and soon afterwards promoted to the grade of consul-general. In the course of a bloody insurrection in Catalonia, which ended in the bombai'dment of Barcelona, Ferdinand de Lesseps showed the most persistent bravery, rescuing from death, without distinction, the men

belonging to the rival factions, and protecting and sending away not only the Frenchmen who were in danger, but foreigners of all nationalities.

From 1848 to 1849 he was minister of France at Madrid. In the latter year the Government of the French Eepublic confided to liim a mission to Rome at the moment when it was a question whether the expelled Pope would re- turn to the Vatican with or without bloodshed. Follow- ing his interpretation of the instructions he had received, de Lesseps began negotiations with the existing Govern- ment at Rome, according to which Pius IX. should peace- fully re-enter the Vatican and the independence of the Romans be assured at the same time. But while he was negotiating, the elections in France had caused a change in the foreign policy of the Government. His course was disapproved ; he was recalled and brought before the Council of State, which blamed his conduct without giving him a chance to justify himself. Rome, attacked by the French army, was taken by assault after a month's san- guinary siege. M. de Lesseps then retired from the diplomatic service, and never afterwards occupied any

public office. In 1853 he lost his wife and daughter at a few days' interval. Perhaps his energy would not have been sufficient to sustain him against these repeated blows of destiny if, in 1854, the accession to the viceroyalty of Egypt of his old friend. Said Pacha, had not given a new im- pulse to the ideas that had haunted him for the last twenty-two years concerning the Suez Canal. Said Pacha invited M. de Lesseps to pay him a visit, and on the 7th of November 1854 he landed at Alexandria ; on the 30th of the same month Said Pacha signed the con- cession authorizing M. de Lesseps to pierce the isth- mus of Suez.

A first scheme, indicated by him, was immediately drawn out by two French engineers who were in the Egyptian service, MM. Linant Bey and Mougel Bey. This project, differing from others that had been previously presented or that were in oppo- sition to it, provided for a direct communication be- tween the Mediterranean and the Red Sea. After being slightly modified, the plan was adopted in 1856 by an international commission of civil engineers to which it had been submitted. Encouraged by this approval, de Lesseps no longer allowed anything to stop him. He listened to no adverse criticism and receded before no obstacle. Neither the

opposition of Lord Palmerston, who considered the projected disturbance as too radical not to endanger the commercial position of Great Britain, nor the opinions entertained, in France as well as in England, that the sea in front of Port Said was full of mud which would obstruct the entrance to the canal, that the sands from the desert would fill the trenches, that the two seas were not of the same level — no adverse argument, in a word, could dishearten Ferdinand de Lesseps. His faith made him believe that his adversaries were in the wrong ; but how great must have been this faith, which permitted him to undertake the work at a time when mechanical appliances for the execution of such an undertaking did not exist, and when for the utilization of the proposed canal there was as yet no steam mercantile marine !

Ferdinand de Lesseps. {From a photograph by Elliott and Fry, London.)

Impelled by his convictions and talent, supported by the Emperor Napoleon III. and the Empress Eugenie, he succeeded in rousing the patriotism of the French and obtaining by their subscriptions more than half of the capital of two hundred millions of francs which he needed in order to form a company. The Egyptian Government subscribed for eighty millions’ worth of shares. The company was organized at the end of 1858. In 1859 the first blow of the pickaxe was given at Port Said, and on the 17th of ISTovember 1869 the canal was officially opened by the Khedive, Ismail Pacha. The machinery for dig- ging it had been invented. Great Britain gave to steam navigation an impulse {hat transformed into a colossal success the work that had been so much discussed, and the Port Said mud, the sands of the desert, and the difference in the level of the two seas became legends of the past. Great Britain showed her powerful vitality in preserving her supremacy upon the sea, although at first sight the new water-way would have seemed to favour, to her detriment, the peoples whose shores are washed by the Mediterranean. As soon as the Suez Canal was finished, the British nation, with its characteristic energy and inexhaustible resources, derived from this enterprise advantages that no other nation on the globe would have succeeded in securing, and this new route, so ardently opposed, gave to British commerce an impetus unequalled in the past and probably

not to be rivalled in the future. The opening of the Canal constitutes for the man who conceived and realized it an imperishable title to glory, and this was not forgotten when Ferdinand de Lesseps afterwards suffered so calamitously from the scheme for constructing a canal across the isthmus of Panama. Moreover, while in the interests of his canal he resisted the opposition of British diplomacy, he acted loyally towards Great Britain after Lord ISeaconsfield had acquired the Suez shares belonging to the Khedive, by frankly admitting to the board of directors of the com- pany three representatives of the British Government. The consolidation of interests which resulted, and which has been developed by the addition in 1884 of seven other British directors, chosen from among shipping merchants and business men, has augmented, for the benefit of all concerned, the commercial character of the enterprise.

Ferdinand de Lesseps steadily endeavoured to keep out of politics. If in 1869 he apped,red to deviate from this principle by being a candidate at Marseilles for the Corps Legislatif, it was because he yielded to the entreaties of the Imperial Government in order to strengthen its good- will for the Suez Canal. Once this good-will had been shown, he bore no malice towards those who rendered him his liberty by preferring Gambetta. JHe afterwards declined the other candidatures that were offered him : for the Senate in 1876, and for the Chamber in 1877. In 1873 he became interested in a project for uniting Europe and Asia by a railway to Bombay, with a branch to Peking. He subsequently encouraged Major Eoudaire, who wished to transform the Sahara desert into an inland sea. The king of the Belgians having formed an International African Society, de Lesseps accepted the presidency of the French committee, facilitated M. de Brazza’s explorations, and acquired stations that he subsequently abandoned to the French Government. These stations were the starting- point of French Congo. This function of acting as a patron of conceptions for bringing peoples together, by diminishing distances, improving their position, and ren- dering more easily attainable all articles of food, was a sufficiently noble employment tohave satisfied his ambition. The extraordinary popularity that he had acquired was, to his mind, a force that should be employed for the world’s progress. Might he not, therefore, have been able to

accomplish his mission without exposing himself to the misfortunes that befell him ? DIs aliter visum. In 1879 a congress assembled in the rooms of the Geographical Society at Paris, under the presidency of Admiral de la Ronciere le Noury, and voted in favour of the making of the Panama Canal. Public opinion, it may be declared, designated Ferdinand de Lesseps as the head of the enter- prise. It was upon that occasion that Gambetta bestowed upon him the title of Le Grand Fran^ais. He was not a man to shirk responsibility, and notwithstanding that he had reached the age of 74, he undertook to carry out the Panama Canal project. The history of this enterprise is too recent, too complicated, is bound up with too many disasters and has roused too much anger, to be fully treated here. Politics, which de Lesseps had always avoided, was his greatest enemy in this matter. The winding-np of the Panama Company having been declared in the month of December 1888, the adversaries of the French Republic, seeking for a scandal that would imperil the Government, hoped to bring about the prosecution of the directors of the Panama Company. Their attacks were so vigorously made that the Government was obliged, in self-defence, to have judicial proceedings taken against Ferdinand de Lesseps, his son Charles, and his co-workers Fontane and Cottu. Charles de Lesseps, a victim offered to the fury of the politicians, tried to divert the storm upon his head and prevent it from reaching his father. He managed to draw down upon himself alone the burden of the condemnations pronounced. One of the conse- quences of the persecutions of which he was the object was to oblige him to spend three years, from 1896 to 1899, in England, where his participation in the manage- ment of the Suez Canal had won for him some strong friendships, and where he was able to see the great respect in which the memory and name of his father were held by Englishmen.

As for the work executed at Panama, Sir William Russell has given an interesting appreciation of its value in the following letter, addressed to Ferdinand de Lesseps :

New York, 9th July 1889. Since visiting the work of the Panama Canal, and having mourned over it, being here on the way from the Pacific coast of South America, I have always desired to write to you. I was astounded by what I saw. I was angry at the idea that such false reports about the nature ami progress of the work should have been spread abroad. Naturally, I am

not an engineer, but the progress of the work appeared clearly before my eyes and free from the difficulties that I saw you overcome at the Salt Lakes, for example. I was surprised to find the work so far advanced. The suriDrise, however, was mingled with sorrow and pity in considering that the vast enterprise was in suspense. So many unproductive millions ! Silence and solitude where there should be active life and the utilization of so much capital, industry, and thought ! I cannot believe that this waste will last. It would be a dishonour for France and a loss for the whole world if the canal were not cut. For my own part, I am sure that it must be finished. I have heard repeated ad nauseam the old story about the lack of traffic, and about catastrophes and natural obstacles. I have replied to those who relate these stories that I had already heard the same objec- tions made with even more force and upon greater authority befoi'e you accomplished the opening of the Suez Canal. I was told a great deal about the peculation of the contractors, the prodigalities and thoughlless expenditures, and negligence in the supervision. I could not form an opinion as to the value of these reports, but I was able to see that there was, from one end of the canal to the other, a wealth of machinery of all kinds — elevators, drags, lighters, steamboats — in short, a complete flotilla ready to start at the first sign, except what had been destroyed by bad usage or negligence. I cannot help writing to you to tell you of my sympathy and hopes. I pray that you may live to see finished and accomplished the ojms maximum of your existence, so fertile in great works.

Ferdinand de Lesseps died at La Chenaie on the 7th of December 1894. He had contracted a second marriage in 1869 with Mile Autard de liragard, daughter of a former

magistrate of Mauritius ; and eleven out of twelve cliildren of this marriage survived him. M. de Lesseps was a member of the French Academy, of the Academy of Sciences, of numerous scientific societies, Grand Cross of the Legion of Honour and of the Star of India, and had received the freedom of the City of London. According to some accounts, he was unconscious of the disastrous events that took place during the closing months of his life.

Others report that, feeling himself powerless to scatter the gathered clouds, and aware of his physical feebleness, he had had the moral courage to pass in the eyes of his family, which he did not wish to afflict, as the dupe of the efforts they employed to conceal the truth from him. This last version would not be surprising if we relied upon the following portrait, sketched by a per- son who knew him intimately : — ” Simple in his tastes, never thinking of himself, constantly preoccupied about others, supremely kind, he did not and would not recog- nize such a thing as evil. Of a confiding nature, he was inclined to judge others by himself. This naturally affectionate abandonment that every one felt in him had procured him profound attachments and rare devotions. He showed, while making the Suez Canal, what a gift he possessed for levying the pacific armies he conducted. He set duty above everything, had in the highest degree a reverence for honour, and placed his indomitable cour- age at the service of everything that was beneficial with an abnegation that nothing could tire. His marvellous physical and moral equilibrium gave him an evenness of temper which always rendered his society charming. Whatever his cares, his work, or his troubles, I have never noticed in him aught but generous impulses and a love of humanity carried even to those heroic imprudences of which they alone are capable who devote themselves to the amelioration of humanity.” No doubt this eulogy requires some reservations. The striking and universal success which crowned his work on the Suez Canal gave him an absoluteness of thought which brooked no contra- diction, a despotic temper before which every one must bow, and against which, when he had once taken a reso- lution, nothing could prevail, not even the most authori- tative opposition or the most legitimate entreaties. He had resolved to construct the Panama Canal without locks, to make it an uninterrupted navigable way. All attempts to dissuade him from this resolution failed before his tenacious will. At his advanced age he went with his youngest child to Panama to see with his own eyes the field of his new enterprise. He there beheld the Oulebra and the Chagres ; he saw the mountain and the stream, those two greatest obstacles of nature that sought to bar his route. He paid no heed to them, but began the struggle against the Culebra and the Chagres. It was against them that was broken his invincible will, sweep- ing away in the defeat the work of Panama, his own fortune, his fame, and almost an atom of his honour. But this atom, only grazed by calumny, has already been restored to him by posterity, for he died poor, having been the

first to suffer by the disaster to his illusions. Political agitators, in order to sap the power of the Opportunist party, did not hesitate to drag in the mud one of the greatest citizens of France. Eut when the Panama ” scandal ” has been forgotten, for centuries to come the traveller in saluting the statue of Ferdinand de Lesseps at the entrance of the Suez Canal will pay hom- age to one of the most powerful embodiments of the cre- ative genius of the 19th century. (de b.)

Letters Patent. — It is a rule alike of common law and sound policy that grants of freehold interests, franchises, liberties, &c., by the sovereign to a subject should be made only after due consideration, and in a

form readily accessible to the public. These ends are attained through the agency of that piece of constitu- tional machinery known as “letters patent.’’ It is here proposed to consider only the characteristics of letters patent generally. The law relating to letters patent for inventions is dealt with under the heading Patents.

Letters patent (litterm patentes) are letters addressed by the sovereign ” to all to whom these presents shall come,” reciting the grant of some dignity, office, monopoly, franchise, or other privilege to the patentee. They are not sealed up, but are left open (hence the term “patent”), and are recorded in the Patent Eolls in the Eecord Office, or in the case of very recent grants, in the Chancery Enrolment Office, so that all subjects of the realm may read and be bound by their contents. In this respect they differ from certain other letters of the sovereign directed to particular persons and for particular purposes, which, not being proper for public inspection, are closed up and sealed on the outside, and are thereupon called writs dose (litterm clausce), and are recorded in the Close Rolls. Among grants made by letters patent the following may be enumerated : offices in the Heralds’ College ; the dignities of knight bachelor, a peerage, or a baronetcy ; the appointments of lord-lieu- tenant, eustos rotulorum of counties, justices of the High Court, king’s counsel. Crown livings ; the offices of attor- ney- and solicitor-general, commander-in-chief, master of the horse, keeper of the privy seal, postmaster-general, king’s printer ; grants of separate courts of quarter ses- sions, royal charters, royal pardons (which may now be granted under the sign-manual), and patents for inven- tions. Formerly letters patent were

always granted under the Great Seal. But now under the Crown Office Act, 1877, and the Orders in Council made under it, many letters patent are sealed with the wafer great seal. Letters patent for inventions are issued under the seal of the Patent Office. The procedure by which letters patent are obtained is as follows : — A warrant for the issue of letters is drawn up, and is signed by the Lord Chancellor; this is submitted to the law officers of the Crown, who countersign it ; finally, the warrant thus signed and countersigned is submitted to His jSIajesty, who affixes his signature. The warrant is then sent to the Crown Office and is filed, after it has been acted upon by the issue of letters patent under the great or imder the wafer seal as the case may be. The letters patent are then delivered into the custody of those in whose favour they are granted.

The construction of letters patent differs from that of other grants in certain particulars ; (i.) Letters patent, contrary to the ordinary rule, are construed in a sense favourable to the grantor (viz., the Crown), rather than to the grantee; although this rule is said not to apply so strictly where the grant is made for consideration, or where it purports to be made ex certd scientid et mero motu. (ii.) When it appears from the face of the grant that the sovereign has been mistaken or deceived, either in matter of fact or in matter of law, as, e.g., by false suggestion on the part of the patentee, or by misrecital of former grants, or if the grant is contrary to law or uncertain, the letters patent are absolutely void, and. may be cancelled (except as regards letters patent for inventions, which are revoked by a special procedure, regulated by § 26 of the Patents Act, 1883) still, it would appear, by the procedure known as scire facias, an action brought against the patentee in the name of the Crown with the fiat of the Attorney-General.

A word should be added on patents of precedence. A patent of precedence is a grant to an individual by letters patent of a higher social or professional position than the precedence to which his ordinary rank entitles him. The principal instance in modern times of patents of grants

of this description has been the grant of precedence to members of the bar. In tlie days when acceptance of the rank of king's counsel not only precluded a barrister from appearing against the Grown, but, if he was a mem- ber of Parliament, vacated his seat, a patent of prece- dence was resorted to as a means of conferring similar marks of honour on distinguished counsel without any such disability attached to it. The patents obtained by Mansfield, Erskine, Scott, and Brougham were granted on this ground. After the order of the Coif lost its exclusive right of audience in the Court of Common Pleas, it became customary to grant patents of precedence to a number of the serjeants-at-law, giving them rank immediately after counsel of the Crown already created and before those of subsequent creation. Mr Justice Phillimore was, on his appointment as a judge of the Queen's Bench Division (1897), the only holder of a patent of precedence at the bar, except Serjeant Simon, who died in that year, and who was the last of the Serjeants who held such a patent.

Under the Eevised Statutes of Ontario, 1897 (c. 173, § 9), the Lieutenant-Governor is empowered to confer on any member of the bar a grant of precedence in the courts by letters patent under the great seal of Canada ; and it was recently held by the Privy Council that this statutory provision was intra vires the provincial legislature.

As to letters patent generally, see Bacoh''s Abridgment ("Pre- rogative," P) ; Cbitty's Prerogative ; Hindmarsh on PoJenJs. As to patents of precedence, see P'ulling's Order of the Coif.

(a. w. E.)

Leven, a police burgh of Fifeshire, Scotland, on the Firth of Forth, at the mouth of the river Leven, 6 miles east of Thornton Junction by rail. A town hall was erected in 1892. A costly attempt to construct a wet dock has proved a failure, owing to the accumulation of sand. Flax-spinning and linen-weaving are carried on, and there are breweries, foundries, brick-works, and rope- works. In the immediate neighbourhood are large col- lieries. There is a fine golf course, and the town is much frequented by summer visitors. Population (1881),

3568; (1891), 4577; (1901), 5577.

Leven, Loch. — 1. A lake in Kinross county, Scot- land, .’^|- miles in extreme length and 2 miles in extreme breadth. The depth varies from 10 to 90 feet, the mean height above sea is 353 feet, and the area 3406 acres. It drains Kinross -shire by four streams, and the river Leven drains its surplus. There are seven islands, of which the largest, St Serf’s, was the site of a Culdee settlement, and contains the ruins of a priory. On the Castle island, connected with the land by a submerged causeway, are the ruins of the castle in which Queen Mary of Scotland was imprisoned in 1567. The loch is noted for its trout. The fishings are controlled by an Angling Association, and the average annual catch for the years 1895-99 was 16,746 trout of 11,421 pounds weight. 2. Ldcii Leveist is also the name of an arm of the sea opening east off Loch Linnhe, at the north of Argyllshire and the south of Inverness-shire. North and South l^iallachulisli, on opposite shores of the loch, are well- known villages. The latter is famed for its slate quarries, and is also the point of call for steamers conveying tourists to or from Glencoe.

Levi, Hermann (1839-1900), German orchestral conductor, was boru at Giessen on 7th November 1S;59, and was the son of a rabbi. He was educated at Giessen and Mannheim, and came under Vinccuz Lachner’s notice. From lfir>r, to 1858 Levi studied at the Leipzig Conserva- torium, and after a series of travels which took him to Paris, he obtained his first post as music director at Saarbrilcken, which post he exchanged for that at Mann-

heim in 1S61. From 1862 to 1864 he was chief conductor of the German Opera in Rotterdam ; then till 1872 at Carlsruhe, when he went to Munich, a post he held until 1896, when ill-health compelled him to resign. Levi’s name is indissolubly connected with the propagation of the knowledge of Wagner’s music. He conducted the first performance of Parsifal at Bayreuth in 1882, and was connected with the musical life of that place during the remainder of his career. He created a great impres- sion as a concert conductor on the occasion of his visit to London in 1895.

Levi, Leone (1821-1888), English jurist and statis- tician, was born of Jewish parents on 6th June 1821, at Ancona, Italy. After receiving an early training in a business house in his native town, he came to Liver- pool in 1844 in pursuit of commerce, became naturalized, and changing his faith,

joined the Presbyterian Church. Perceiving the necessity, in view ‘of the unsystematic condition of the English law on the subject, for the establishment of chambers and tribunals of commerce in England, he warmly advocated their institution in numerous pamphlets; and as a result of his strenuous labours the Liverpool Chamber of Commerce, of which Levi was made secretary, v.‘as founded in 1849. In 1850 Levi published his Commercial Law of the World, being an exhaustive and comparative treatise upon the laws and codes of mercantile countries. Appointed in 1852 to the chair of commercial law in King’s College, London, he proved himself a highly competent and popular instructor, and his evening classes were a most successful innovation. He was called to the bar at Lincoln’s Iim in 1859, and received from the University of Tubingen the degree of Doctor of Political Science. His magnum opus — History of British Commerce and of the Economic Progress of the British Nation, 1763-1870, is jjerhaps a rather too par- tisan account of British economic development, being a eulogy upon the blessings of Free Trade, but its value as a work of reference cannot be gainsaid. Among his other works are: Work and Pay; Wages and Earnings of the Working Classes; International Law, with Materials for a Code. He died on 7th May 1888.

Levis, the chief town of Levis county, Quebec, Canada, situated on the south bank of the St Lawrence, opposite Quebec city. It is the landing-place for trans- atlantic passengers, is on the Intercolonial railway, and is the eastern terminus of the Grand Trunk and Quebec Central railways. It contains a Dominion Government graving dock, 445 feet long, 100 feet wide, with a depth on the sill of 26|- and 20^ feet at high water spring and neap tide respectively. Population (1881), 7597 ;

(1891), 7301 ; (1901), 7783.

Lewes, a municipal borough (1881), market town and county town, in the Lewes parliamentary division (since 1885) of Sussex, England, on the Ouse, 50 miles south of London by rail. St Michael’s and St John’s churches have been restored, and the county hall enlarged. Modern erections are the town hall, the corn exchange, and the public library. Area, 1024 acres. Population (1881),

11,199 ; (1901), 11,249.

Lewis and Harris form together the Long Island of the Outer Hebrides, Scotland, the former being in Eoss-shire and the latter in Inverness-shire. Its area is 770 square miles, and it embraces in its civil parish St Kilda and a number of smaller islands. Though rents have been largely reduced by the Crofters' Commission, and considerable sums expended on improvements by Gov- ernment, the bulk of the crofters still live in miserable huts, and show little enterprise in the development of the fisheries ; but the fishermen on the east side have of late

years secured good boats of the newest type fitted with beam trawling gear. (For statistics, see Stobnoway.) The making of kelp is no longer followed. A harbour has been built at Carloway and a pier at Bracadale ; the harbour at Port Ness has been extended, and a road from Stornoway to Carloway was begun, but abandoned half- made. There are some good sheep farms in Harris. There are six parishes. Population of Lewis (1881), 24,876; (1891), 27,045, of whom 24,747 were Gaelic- speaking; (1901), 28,949 : of the parish of Harris (1881), 4814 ; (1891), 5024, of whom 4195 were Gaelic-speaking;

(1901), 5275.

Lewiston, a city of Androscoggin county, Maine, U.S.A., on the left bank of the Androscoggin river, at an altitude of 138 feet, on the Maine Central, the Grand Trunk, and the Portland and Eumford Palls railways. It has a fairly regular plan, is divided into seven wards, has a good water-supply obtained from Lake Auburn, and is also well sewered. By virtue of its fine water-power, it has great prominence in manufacturing, especially of cot- ton goods. In 1900 the total number of manufacturing establishments was 282, with a capital oJ f 10,984,871. They employed an average number of 7159 wage-earners, and their products were valued at $8,581,354; of this sum more than one-half ($4,638,115) represented cotton goods. Bates College, a Baptist institution situated here, had in 1899 a faculty of 24, and was attended by 307 students, more than one-third of whom were women.

Population (1890), 21,701; (1900), 23,761, of whom 9316 were foreign-born.

Lexington, a city of Kentucky, U.S.A., capital of Payette county, at an altitude of 946 feet. It is the meeting-place of five railways, the Chesapeake and Ohio, the Lexington and Eastern, the Louisville and Nashville, the Queen and Crescent Route, and the Southern. It is in the Blue Grass region, the home of Henry Clay, famous for its blooded horses and fine tobacco. In 1900 its manufactures were carried on by 271 establishments, with a capital of $1,532,378. They employed an average number of 1441 wage-earners, and their products were valued at $2,925,697. Lexington is the seat of Kentucky University, a Christian institution, founded in 1836. In 1899 this had a faculty of 35 and was attended by 425 students. The State Agricultural and Mechanical College is also situated here ; in the same year it had a faculty of 25 and an attendance of 480 students. There are also two collegiate institutions for women, the Hamilton Pemale College and the Sayre Female Institute. Popula- tion (1890), 21,567; (1900), 26,369, of whom 924 were foreign-born and 10,130 were negroes.

Lexington, a town of Middlesex county, Massachu- setts, U.S.A., 11 miles north-west of Boston. Its area comprises some 17 square miles, mainly level, but with occasional hills. It contains three villages, Lexington, East Lexington, and North Lexington. The village of Lexington was the scene of the first armed conflict of the Revolution. A British command, sent from Boston to de- stroy military stores collected at Concord by the colonists, was met, 18th April 1776, at Lexington by a small body of colonial militia. The latter were fired upon, and sev- eral were killed and wounded by the British soldiers, who then proceeded to Concord and destroyed the stores. On their return to Boston they were severely handled by the militia, who dogged their steps and picked them off as opportunity offered. Population (1880), 2460; (1890), 3197 ; (1900), 3831, of whom 959 were foreign-born.

Lexington, a city of Missouri, U.S.A., capital of Lafayette county, on the south bank of the Missouri river.

and the Atchison, Topeka, and Santa Fe’, and the Missouri Pacific railways, at an altitude of 813 feet. Its site is the face and summit of the river bluffs, and it has a regular plan. It is the seat of two colleges for women. During

the Civil War it was the scene of several minor military operations. Population (1880), 3906; (1890), 4537; (1900), 4190, of whom 283 were foreign-bom and 1170 were negroes.

Leyden, or Leiden, a city of the Netherlands, in the province of South Holland, 10 miles north-north-east of The Hague. The highways along the dunes and the Rhine here cross each other. Steam tramways have been laid to Katwyk, a watering-place 6 miles to the north-west on the North Sea, to Haarlem, and to The Hague. There is also steamboat communication with Katwyk, Amster- dam, and Gouda. Among modern erections are the ana- tomical and pathological laboratories of , the university, and the museum for geology and mineralogy has been restored ; a monument (1884) to Burgomaster Van der Werf, who defended the town during the Spanish siege of 1574, raised in the ” Ruine,’’ lately transformed into Van der Werf’s Park; and a new post of&ce (1897). A seamen’s training school is also of recent foundation. The local transit trade is still important, amounting annually to an average of 490 tons of butter and 690 tons of cheese. The woollen and linen manufactures employ about 1600 workmen. Population (1899), 53,658.

Lhasa. — The sources of information as to Lhasa which existed in 1876 were those derived from the records of Manning, who visited the city in 1811, and of the Jesuit fathers Hue and Gabet, who were there in 1844-46. In 1874 the Indian pundit Nain Singh paid his second visit, and his account of the city formed a most substantial addition to previous authorities. In 1879 the explorer A. K. (Kishen Singh), on his way to Koko Nor, remained for sotaie time in Lhasa ; and since then several European explorers have’ essayed to reach it, notably Bower in 1891, de Rhins in 1893, and Littledale in 1895. Littledale reached the Goring Tang valley after crossing the Goring La from the north, and was then within fifty miles of the walls of the sacred city. He probably approached closer than de Rhins or Bonvalot, who (with Prince Henri d’Orleans) had also adopted the northern route in 1890. All of them were equally un- successful. Neither Chinese passports nor English gold have availed to open the gates of that stronghold of Tibetan exclusiveness, and for half a century no European visitor has been seen in the streets of Lhasa. But where Euro- peans have failed native Indian explorers have again been successful. Sarat Chandra Das, of the Bengal

Educational Department, who was accompanied by a trained explorer, the Lama Ugyen, after crossing the Kanglachen pass on the western borders of Sikkim into Tibet, made his way to Tashilunpo (Shigatsi) in the autumn of 1881, and there remained for some months. During the summer of 1882 he paid a visit to Lhasa, travelling over the route which had been previously followed by Nain Singh, vid Gyantsi and the Yamdok uplands, to the Chushul ferry across the Tsanpo. Thenceforward the track passes up the Ky-i-chu valley, which is described as the worst part of the journey. A mile and a half of very difl&cult passage (called Gaglam) follows along the river banks, in no way resembling the Gyantsi section of the route, which is classed by Chandra Das as equal to an ordinary unmetalled Indian road. Over the Gaglam, however, two elephants which had been presented by the Sikkim Raja to the Grand Lama of Tibet had already passed, before Chandra Das bent his steps that way. Much of the Ky-i-chu valley route consists of open plain, with an occasional spread of highly

irrigated country covered with crops and trees, and this again is varied with marsh land and bogs. At the last stage before reaching Lhasa, accommodation is to be found in the Gyakhang, or Chinese Amban's circuit house, which Chandra Das compares to the residence of a Calcutta native gentleman, with its wide verandah bedecked with flowers in pots.

In the month of May the Nehusing — the plain on which Lhasa stands — is gay with grass and flowers, and the scattered groves of poplar and willow afford a refreshing shade from the rays of the early summer sun. Lhasa is then at its best. The western gate (the Pargo Kaling) leads straight under the shadow of the royal Potala, the hill palace of Lhasa, to a small bridge and a second gate- way called the Yutog Sampa, whereon is a guard-house, where the Korchaghas, headed by a monk sergeant, keep watch and ward. This is the real entrance to the city, and it is here that the chief difficulty lies with doubtful visitors. On the right of the road, before entering the city gates, on a low pedestal, stands the Doring monolith, eight to ten feet high, bearing an inscription in Chinese and Tibetan. The inscription is still legible, although it is nearly 1000 years old. The suburbs of Lhasa between the

Potala palace and the city walls abound in picturesque detail. The broad straight road flanked by ancient trees and the scattered groups of stone-built houses following the fashion of Chinese architecture with ” prismoidal ” windows, painted cornices, and bluish-gray tiled roofs and turrets, the festoons of inscribed and painted bannerets stretching from turret to turret — all in the clear atmosphere and under the blue sky of the Tibetan early summer, make up a pretty picture enough, apart from the grandeur and glitter of gilded domes and spires where the palace of Potala crowns the hill. Within the city walls the streets are lined with shops of Tibetan, Nepalese, and Chinese merchants, the Chinese especially making a brave show with ornamental ware, although the Nepalese shops, built in three storeys, appear to be the most imposing. In front of all shops are small pyramids of clay, on which dried juniper and cones are burnt, wafting through the air sweet fumes of incense, which apparently are much wanted in remoter parts of the town. Apart from the principal streets, Chandra Das confirms the reports of other visitors that the backways and alleys are indescribably filthy, and the jostling crowd of persistent beggars is probably not to be rivalled for loud aggressiveness anywhere in the East- ern world. Next to the Potala, the chief feature of religious interest is the Kilkhording (also called Cho Kang), the sacred shrine where stands the image of Buddha, said to have been constructed in Magadha during his life- time. According to Chandra Das, five sacred metals were used to form the alloy of which the figure (which represents Buddha as a prince — not as a priest) is made. The image is life size, well modelled and properly gilt. Pour dragon pillars, silver gilt, support the canopy above his sacred head, and the bronze images of Matreya and Manjusi stand on guard on either side. Beyond are images innumerable, including the twelve Bodhisattras and a host of minor saints. The shrine itself is a lofty three-storeyed edifice with a flat roof, exhibiting no trace of Chinese influence in its design. The shrine is situated about the centre of the city.

The palace of the Dalai Lama — the far-famed Potala, which covers with its imposing building a hill to the west of the city (see vol. xiv. p. 500) — proved to be a toilsome and difiicult place of approach owing to the innumerable steps and staircases which lead up to it. The ceremony of a divine service in honour of a departed Lama served as an opportunity for

the introduction of Chandra Das to the Dalai Lama, the incarnate head of Buddhism in Tibet. He is described as a child of eight, seated on a peat altar

resembling an Oriental throne, borne by lions carved in wood. “A yellow mitre hat covered the Grand Lama’s head, the pendent bands of which veiled his ears, a yellow mantle covered his person, and he sat cross-legged vsdth the palms of his hands joined together to bless us.” His com- plexion was bright and fair, with rosy cheeks, his eyes were large and penetrating, and his features remarkably Aryan in spite of the obliquity of his eyes. He was emaci- ated, and looked fatigued and weary. The Grand Lamas of Tibet traditionally die young. The reception hall is spacious — 40 feet by 30 by 16 high — lit by an open skylight. The roof is supported by three rows of wooden pillars, each row containing four pillars. Such in brief is the nature of that central light which illumines the mystic faith of Buddhism, the ” holiest of all living holies.”

Incidentally we have some new and interesting glimpses of the inner domestic life of the citizens from these latest explorers. The genial warmth of hospitality to strangers and the genuine character of the friendly interest which is taken in those who stand in the position of old friends ; the rigid asceticism of the monks, their devotion to study and their simple and frugal habits — all these things, combined with courtly formalities and the stately eti- quette which governs the social relations of the higher classes, are in welcome contrast to the weird tales of the ghastly surroundings of the enchanted city — the filthy outcast ragyabas (dagyeba of Kishen Singh), the loath- some corpse-eating swine, the gaunt and mangy dogs, and all the paraphernalia of misery, crime, and filth which seem inseparable from the villages and towns of all de- lectable mountains north of India.

On the whole the visits of these travellers fully support, if they do not largely increase, the information previously obtained, which has been so well epitomized in Sir H. Yule’s article in the earlier volumes bf this work. We have a more varied view of the inner life of Tibet, especially as connected with its sanctuaries, and some excellent geographical work executed by the Lama Ugyen (U. G.), though all visits have been of too ephemeral a character to add much to our stock of detailed knowledge. (x. h. h*.)

Libau, a seaport of Eussia, on the Baltic Sea, in the government of Courland, 143 miles by rail south-west of Eiga. Its population has more than doubled since 1881 (30,000), and attained 64,506 in 1897. New Libau, which is the centre of the industries, possesses several large fac- tories for the making of colours, explosives, transmission belts in paper-pulp, sails and ropes, tobacco, furniture, matches, as well as several iron works, agricultural machinery works, tin-plate works, soap works, saw-mills, and fiour mills. The number of ships yearly entering the port remains at about 1900 to 2000, but the exports have reached the annual value of from £3,600,000 to £4,000,000, oats being the chief item of export, while wheat is exported as flour. Plax, hay, spirit, eggs (from 45,000,000 to 56,000,000 a year), and swine meat are also important articles of foreign trade. Shipbuilding, including steamers for open-sea navigation, is also on the increase.

Libel, — Since the publication of the article on libel and slander in vol. xiv. of the E najdopKdia Britannica (9th edition) important legislation has been enacted relat- ing to the question of privilege as applied to newspaper reports. It was there shown that certain classes of defamatory statements exist which are called “privileged,” i.e., made on occasions when it is a man’s duty to speak or write freely. This privilege may be either absolute or qualified. An absolute privilege arises in cases where for the public good the fullest liberty of expression is allowed

by the law, e.g., papers published under the authority of Parliament. A qualified or partial privilege arises on occasions where the law considers it for the public benefit that freedom of publication should be permitted, provided that freedom is only used for the purpose for which it was given, e.g., an answer to an inquiry as to the character of a servant. For the plaintiff to succeed in an action where it is apparent that publication is under this qualified privilege, it is necessary that he should prove express malice or an intention to injure, departing from the general rule in ordinary libels, where the absence of express or actual malice is no defence save in mitigation of damages. To constitute express malice there must be

something in the act of the person to show that he published the libel, not with a view of doing that which was right or to punish a person because he deserved to be punished as an act of justice, but dishonourably and with a bye-motive of doing him an injury {Capital and Counties Bank v. Henty, Grove, J., 6 C.P.D.).

Both absolute and qualified privilege are given to news- paper reports under certain conditions by the Law of Libel Amendment Act, 1888. The reports must, however, be published in a newspaper as defined in the Newspaper Libel and Eegistration Act, 1881. Under this Act a newspaper must be published ” at intervals not exceeding twenty-six days.”

By section 3 of the Act of 1888 fair and accurate reports of judicial proceedings are absolutely privileged provided that the report is published contemporaneously with the proceedings, and no blasphemous or indecent matter is contained therein. By section 4 a limited privilege is given to fair and accurate reports (1) of the proceedings of a bonS,fide public meeting lawfully held for a lawful purpose and for the furtherance and discussion of any matter of public concern, even when the admission thereto is restricted ; (2) of any meeting, open either to the public or to a reporter, of a vestry, town council, school board, board of guardians, board of locail authority, formed or constituted under the pro- visions of any Act of Parliament, or of any committee appointed by any of these bodies ; or of any meeting of any commissioners authorized to act by letters patent, Act of Parliament, warrant under royal sign manual, or other lawful warrant or authority, select committees of either House of Parliament, justices of the peace in quarter sessions assembled for administrative or deliber- ative purposes ; (3) of the publication of any notice or report issued for the information of the public by any Government office or department, ofScer of state, commissioner of police or chief constable, and published at their request. But the privilege given in section 4 does not authorize the publication of any blasphemous or indecent matter ; nor is the protection available as a defence if it be proved that the reports or notices were published maliciously, in the legal sense of the word, or the defendant has been requested to insert in the newspaper in which the report was issued a reasonable letter or statement by way of contradiction or explanation, and has refused or neglected to do so. Moreover, nothing in section 4 is to interfere with any privilege then

existing, or to protect the publication of any matter not of public concern, or in cases where publication is not for the public benefit.

An alteration has also been made by the same Act in regard to criminal Ijiiel as affecting newspapers. As crim- inal proceedings for libel rest on the likelihood that a breach of the peace will result from the libel, no criminal prosecution should be commenced where the interests of the public are not affected. By the Law of Libel Amend- ment Act, 1888, sec. 8, no criminal prosecution for libel is to be commenced against any newspaper proprietor, publisher, or editor unless the order of a judge at cham- bers has been first obtained. This protection does not cover the actual writer of the alleged libel.

The law of slander has also been changed. In the former article it was shown that, save in a few cases, it is necessary in a slander action to prove special damage ; in other words, that substantial or real damage has been caused to the plaintiff by the defendant's statement. The exceptions to this rule were the imputation of a criminal offence, of certain infectious disorders, or of incompetence

in a trade, profession, or employment. Here damage is presumed as in libel. A fourth exception has been added, for by the Slander of Women Act, 1891, it is not necessary to prove special damage to support an action for slander where a woman has been accused of un- chastity. (h. s. s.)

Libellatici was the name given to a class of persons who, during the persecution of Decius, a.d. 250, evaded the consequences of their Christian belief by procuring documents which certified that they had satisfied the authorities of their orthodoxy (i.e., as heathens), and which thus exempted them from punishment. As thirty-eight years had elapsed since the last period of persecution, the Churches had become in many ways lax, and the number of those who failed to hold out under the persecution was very great. On the other hand, the procedure of the courts which had cognizance of the matter was by no means strict, and the judges and subordinate officials were often not ill-disposed towards Christians, so that evasion in one way or another was fairly easy. Many of those who could not hold out were able to secure certificates which gave them immunity without actually renouncing the faith, just as " Parliamentary certificates " of conformity

used to be given in England without any pretext of fact. It is to the persons who received such certificates that the name be- longed. To calculate their number would be impossible, but we know from the writings of Cyprian and other con- temporaries that they were a numerous class, and that they were to be found in Italy, in Egypt, and in Africa, and amongst both clergy and laity. Archbishop Benson is probably right in thinking that ” there was no syste- matic and regular procedure in the matter, ” and that the Ubelli, as the documents in question were called, may have been of very different kinds. They must, however, as a general rule, have consisted of a certificate /rom the author- ities to the effect that the accused person had satisfied them. [The name libellus has also been applied to another kind of document — to the letters which were given by con- fessors, or by those who were about to suffer martyrdom, to persons who had fallen, to be used to secure forgiveness for them from the authorities of the Church. With such libelli we are not here concerned.] The subject has acquired a fresh interest from the fact that two of these actual libelli have been recovered, in 1893 and 1894 respectively, both from Egypt : one is now in the Brugsch Pasha collection in the Berlin Museum ; the other is in the collection of pa- pyri belonging to the Archduke Kainer. The former is on a papyrus leaf about 8 by 3 inches, the latter on mere frag- ments of papyrus which have been pieced together. The former was first deciphered and described by Dr Fritz Krebs, the latter by Dr K. Wessely : both are given and commented upon by Dr Benson. There is a remarkable similarity between them : in each the form is that N. ” was ever constant in sacrificing to the gods” ; and that he now, in the presence of the commissioners of the sacrifices (oi ■Qp-qfiivoi Tu>v dva-Cwv), has both sacrificed and drunk [or has poured libations], and has tasted of the victims, in witness whereof he begs them to sign this certificate. Then follows the signature, with attestations. The former of the two is dated, and the date must fall in the year 250. It is, of course, impossible to prove that either of the two actually refers to Christians : they may have been given to pagans who had been accused and had cleared themselves, or to former Christians who had apostatized. But no doubt libelli in this same form were delivered, in Egypt at least, to Christians who secured immunity with- out actual apostasy ; and the form in Italy and Africa probably did not differ widely from this.

See Archbishop Benson. Cyprian, London, 1897 ; Tlieol. Liter- aturzeitung, 20th January and 17th March 1894. (w. E. Co.)

Liberia, a negro republic in West Africa, extending along the coast for about 300 miles between 4° and 7° N. This strip of coast, which is watered by a number of parallel streams, consists for the most part of country of moderate elevation, ending seawards in a fairly high coast-line, the lower courses of the rivers being, however, fringed for a few miles by swamps, while forest seems to occupy a large part of the interior. The soil of the low-lands is generally sandy, except along the course of streams, where deep black fertile soil is found. The surface of the interior plateaux, which fall in a succession of steps towards the coast, consists largely of laterite. For a tropical country the climate is fairly moderate, the heat beiug lessened by the sea-breeze, which blows reg- ularly during the day except in the Harmattan period. This lasts from December to the end of February, the Harmattan being a land wind marked by extreme dry- ness, with low temperature at night or in the early morning. The rainy season proper lasts from May to November, but no month passes without rain.

Coasts. — The coast of Liberia is much indented, though the lagoon formation so characteristic of other parts of the Guinea coast is little developed. Many of the capes rise abruptly from the sea. Cape Mount peninsula, on which Kobertsport is placed, rises to about 1000 feet at the highest part, and Capes Mesurado and Palmas are also bold headlands. The largest lagoon (Fisherman Lake) is that enclosed by the Cape Mount peninsula. It is gener- ally shallow. The remainder are mjich smaller, and are generally formed by expansions of the streams at their mouths. A tidal channel runs, however, behind Cape Mesurado parallel to the coasts as far as the mouth of the river Farmington — nearly 40 miles, connecting also with the river St Paul.

Interior. — Our knowledge of the interior of the country, and even of the courses of the main rivers, is still extremely scanty, and depends almost entirely on the journey of the negro Benjamin Anderson in 1868, and those of French explorers along the interior frontier. In the north-western half the head-streams of the rivers Lofa, D6, or St Paul, and probably also those of the Manoh (which iu part forms the frontier with Sierra Leone) , rise at a distance of 200 miles from the coast, their upper basins widening fan-wise, while their lower courses approach each other within 35 miles. Their general direction is at right angles to the coast. The same is apparently the case with most of the rivers of the south-east, which have, however, much shorter courses, as the upper basin of the Kavalli (which forms the boundary of Liberia on the south- east) lies behind them, and, as shown by recent explorations of M. Hostains and others (1897-1900), closely approaches the head- waters of the St Paul. The lower courses of many of the smaller streams were explored by Biittikofer in 1879-82, but in few cases does our knowledge extend more than 25 miles from the coast, except in the case of the Sinoe, which was ascended in 1869 to the neighbourhood of the Gedeye mountains. A range named Niete is also reported by M. Hostains west of the Upper Kavalli, and mountains are said to exist near the source of the rivers St John and Lofa. The courses of all the rivers are more or less broken by rapids, and even on the St Paul the limit of navigation is less than 50 miles from the sea. All have bars at their mouths, those of the Manoh, Lofa, and St Paul being almost impassable, communication between the sea and the last named being effected by a channel leading from the Mesurado lagoon.

Limits. — The boundaries, previously indefinite, have now been regulated by agreement with Great Britain and France. That towards Sierra Leone was laid down in 1887 as first following the left bank of the Manoh, and afterwards a continuation of the line to the north-east. The north-eastern and south-eastern frontiers were broadly defined by agreement with France in 1892 (ratified 1894). On the coast the boundary is the Kavalli, Liberian claims to the country east of its mouth being abandoned, while France waived her supposed rights to points within the Liberian limits. The interior frontier, running as it does through country unknown at the time of the Convention, had not in 1902 been demarcated, and may require revision. It was to follow the Kavalli to 6° 30′ N. (the river being supposed here to be

in 0 ” 62′ W.), and then to run west along that parallel to its intersection with 7° 40′ W. ; to follow this meridian to 7° N. and then run in a straight line to the inter- section of 8° 40′ W. with the parallel passing through Tembi Kuiida ; and finally to follow the latter to the Sierra Leone frontier. Certain stipulations, however, might prove inconsistent with the line thus laid down ; France, e.g., receiving the whole upper basin of the Nisor, as well as that of the Fodedugu, a supposed upper branch i>f Ihe Kavalli. The area of Liberia within the above limits is about 45,000 square miles.

Population. — Down to 1887 the American Colonization Society, which introduced the first settlement of freed slaves in 1820-22, is said to have spent over 2^ million dollars, and to have intro- duced from America some 12,000 coloured immigrants, over 1200 in addition having been brought by the Maryland Society. The number of the civilized negroes has been estimated at from 40,000 to 60,000, while the remaining black population is put down at a minimum of 2,000,000. The population of Monrovia, the capital, is about 5000 ; of Harper (with suburbs), 8000 ; of Buchanan (Grand Bassa) and Edina (on opposite sides of the river St John), 5000 ; and of Robertsport, 1200. At these ports, with Marshall (Junk river), Sesters Elver, Greenville, Settra Kru, and Half Cavalla, foreigners are allowed to trade.

Government. — The President and Vice-President of the Republic are elected by universal suffrage for a period of two years. The President controls the whole Government, and can dissolve the chambers at will ; the Vice-President presides over the Senate, but takes the place of the President in case of the latter dying or going out of office before the expiration of his proper term. The cabinet consists of seven members, who are at the head of the seven departments of State. The Senate consists of nine members, two each for the counties of Bassa, Sinoe, and Maryland, and three for that of Mesurado, which contains the capital. The House of Representatives consists of thirteen members, one more for each county than are returned for the Senate. At .the end of each session the two chambers meet jointly to pass the Bills which have been brought in before each of them. The judicial functions are discharged by four grades of officials, the local magistrates, the courts of common pleas, and the quarterly courts (one to each county town), and lastly the Supreme Court, presided over by the Chief Justice.

The local administration is in the hands of superintendents, one each to the counties of Bassa, Sinoe, and Maryland, and one to each of the districts into which Mesurado is divided. Many parts, however, even along the coast, and all the interior more than 50 miles from the sea, are almost entirely beyond the influence of the Government. Schools exist in all the towns and villages, but, except at the West African College at Monrovia, the education given is very indifferent. In 1894 the revenue was estimated at £33,096 and the expenditure at £31,661.

Products and Trade. — Coffee is still the principal product, but the great fall in price and the insufficient preparation of the crops have lately ruined many cultivators. Experiments have since been made with the planting of cacao and caoutchouc. Wild rubber exists in large quantities in the forests. There are no industries on a large scale, though various civilized trades are carried on by the Liberians. Gold is said to exist, as also agates, rubies, and other precious stones. The foreign trade, though showing a decline, is still considerable, the largest share being in the hands of the Germans, while most of the remainder is divided between Great Britain and Holland. The principal lines of steamers run from Hamburg and Liverpool. The imports consist of articles of dress, food, &c., for the civilized negroes, and cotton goods for the native tribes. The principal exports are coffee, rubber (a monopoly of the English company called the Liberian Rubber Syndicate), piassava or raphia fibre (used for making brooms), palm oil and kernels, and a small amount of African mahogany. In addition to the Krumen, who engage themselves as crews of vessels, a large number of the natives of Liberia, espe- cially the.Vais, Golos, Bassas, and some Mandingos, emigrate to other parts of West Africa for labour on plantations, or for railway construction, or as police or militia. The majority go to Cameroon and Congo Free State.

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Li bourne, chief town of arrondissement, department of (jrironde, France, 20 miles east-north-east of Bordeaux, on the railway from Paris to Bordeaux. Vineyards cover about 120,000 acres in the arrondissement. There are no textile manufactures of importance. The general coasting trade is brisk. In 1900, 283 coasting vessels entered and 30S cleared, total tonnage 20,939. Population (1881),

12,639; (1901), 19,175.

LIBRARIES.

THIS article is supplementary to that in the earlier volumes (ninth edition) of the Encydopcedia Britan- nica (1882), to which readers are referred for all historical particulars. The statistical tables appended to the articl’e in vol. xiv. supplied details of 779 libraries (exclusive of those in the United States), containing about 50,225,000 volumes. All the libraries in the United Kingdom and its colonies were noticed, including those established under the Public Libraries Acts ; but as regards the rest of the world, only those of 30,000 volumes and upwards, with a few exceptions, were described. The latter included 399 libraries, numbering 40,751,000 volumes. Taking the same limit of size, there were in 1902 outside the British islands, and excluding British colonies and the United States (see below), 595 libraries of 30,000 volumes and upwards, estimated to contain 61,378,000 volumes.

The following statistical abstract covers the same ground, with the same limitations and exceptions: —

Country.

IbSl.

lOUl.

Libs.

Vols.

Lilis.

Vols.

EuROPf; —

United Kingdom . <

380

9,474,000

677 064-

11,942,0001 6,528,0003

German Empire .

06

13,97ii000

138

19,008,000

France

70

6,857,000

113

10,702,000

Austria-Hungary .

56

4,357,000

70

6,425,000

Switzerland

18

1,082,000

23

1,773,000

Italy

64

5,874,1)00

79

8,2fn,000

Belgium

10

1,200,000

12

1,557,000

Holland

6

675,000

11

892,000

Denmark (and Iceland)

6

861,000

6

987,000

Norway and Sweden

6

885,000

17

1,754,000

Spain . . . .

16

1,052,000

26

1,661,000

Portugal

6

505,000

9

577,000

Greece . . . .

2

190,000

3

403,000

Russia .

13

2,358,000

27

4,842,000

Bulgaria

Nc

) return

1

30,000

Rumania

do.

3

208,000

Servia . . . .

do.

1

54,000

Turkey ....

do.

1

30,000

Africa —

Algeria — Algiers .

do.

2

80,000

Egypt — Cairo

1

40,000

1

40,000

ASIA^

India . . . .

12

192,000

24

658,000

China . . . .

1

3,000

2

14,000

Java ....

1

20,000

1

30,000

Japan

1

68,000

2

200,000

Russia . . . .

No

return

3

92,000

Philippines .

do.

1

30,000

A.MERICA —

Argentina

3

85,000

4

225,000

Brazil ....

1

120,000

1

252,000

Chile . . . .

1

65,000

2

127,000

Mexico ....

5

195,000

5

241,000

Nicaragua

1

15,000

1

18,000

Peru

1

syooo

1

35,000

Uruguay

1

17,’)00

1

37,000

Venezuela

1

2’. 1,000

1

35,000

Other libraries

No

return

3

100,000

1 Non-municipal. 2 including brandu.-,. s Municipal. See Minerva : Jahrbuch der Gelehrten Welt, heraug.v.K. Trubner, 1902 ; The Library Association Hecord, 18.’!)-1901 ; The Library, 1889-1901 ; Library Journal (New York), 1881-1901 ; Centralblatt /. Bibliothekswesen,li?:i-l^Ol.—E. Schultze. Freie offentl. Biblio- theken, 1900.— Annuaire des Bibliotheques, 1901.

The United Kingdom. The organized public libraries of Great Britain and Ireland in 1902 numbered 1311, containing 18,470,000 volumes ; of these 677 were governmental, or belonged to universities, colleges, cathedrals, or societies and insti- tutions, or were endowed or proprietary, and possessed 11 942 000 volumes. Since 1880 there has been an extra- ordinary growth in public libraries supported by the rates.

The number of towns and places possessing these insti- tutions in Great Britain and Ireland increased from 96 to 444. In 1881 not one of the capital towns of the three kingdoms had adopted the Public Libraries Acts,with the single exception of Westminster (London). Dublin possesses municipal libraries, Edinburgh has enforced the provisions of the Acts, and Greater London in 1902 had established 70 or 80 libraries or branches. In 1880-81, eighty -one libraries in the United Kingdom returned their contents at 1,448,192 volumes. The rate-supported libra^ ries and their branches in 1902 included about 6,528,000 volumes. Many of these libraries owe much to the munifi- cence of generous benefactors, among whom the names of Mr John Passmore Edwards ‘ and Mr Andrew Carnegie (g.v.) should not be forgotten. To some are attached art galleries and museums. In others courses of instruction are given and lectures delivered. Nearly all possess col- lections of books, pamphlets, and prints of local interest. Many have special juvenile and ladies’ rooms. Some kind of indicator to inform the reader whether the book he desires to borrow is available or not is largely used. In other libraries, notably at Clerkenwell (London) and Croydon (Surrey), a system of ” open access ” of readers to books has been found successful.

[Many interesting facts respecting British libraries, with tables of the progress and actual condition of municipal libraries, are to be found in the British Library Year Book, 1900-1, by T. Greenwood; also Jj J. Ogle, The Free Library (1897). Refer also to the article in these volumes on Social Progress, Libraries.’]

The following towns and places in the United Kingdom have adopted the general Acts, or have started libraries under local Acts ; the dates of adoption are given within parentheses. In some places special legislation

has been obtained to enable a higher rate than a penny in the pound (the authorized maximum) to be levied.

Aberdare (1901); Aberdeen (1884); Abergavenny (1900); Aber- ystwith (1874); Accrington (1899); Acton (1898); Airdrie (1853); Alloa (1885) ; Altrincham (1889) ; Andover (1896) ; Arbroath (1896); Arlecdon (1891) ; Ashton-on-Mersey (1896); Ashton-under- Lyme (1880) ; Aspatria (1902) ; Aston Manor (1877) ; Atherstone (1895); Ayr (1890); Banbridge(1890); Banff (1899); Bangor, Wales (1871) ; Barking (1888) ; Bamsley (1890) ; Barrow-in-Furness (1881) ; Barry and Cadoxton (1891) ; Bath {Local Act); Bebing- ton (1894); Bedford (1889) [Acts not put in force] ; Belfast (1882); Bexley, Kent (1896) ; Bideford (1877) ; Bilston (1870) ; Bingley (1890) ; Birkenhead (1856) ; Birmingham (1860) ; Blackburn (1853) ; Blackpool (1879) ; Blackrock (1900) ; Blaenau Festiniog

(1894) ; Bodmin (1895) ; Bolton (1852) ; Bolton Percy, Yorks (1895); Bootle (1884) ; Bournemouth (1893); Bradford (1871); Bray, Ireland (1899) ; Brechin (1890) ; Brentford (1889) ; Bridg- end (1901) ; Bridgwater (1860) ; Brierley Hill (1875) ; Brighouse (1897) ; Brighton (1850-91, Local Act) ; Bristol (1874) ; Bromley, Kent (1892) ; Broughton, Wrexham (1895) ; Brynmawr (1897) ; Buckley (1902) ; Burnley (1898); Burslem (1863); Burton-on-Trent

(1895) ; Burwell, Cambs (1895) ; Bury (1897) ; Bury St Edmunds (1895); Buxton (1886); Camborne (1894); Cambridge (1853); Campbeltown (1896); Canterbury (1858); Cardiff (1862) ; Carlisle (1890) ; Carlton, Notts (1888) ; Carnarvon (1887) ; Castle Douglas (1902) ; Chatham (1893) ; Cheltenham (1883) ; Chester (1874) ; Chesterfield (1875) ; Chesterton (1897) ; Chiswick (1890) ; Chorley

(1897) ; Clackmannan (1901) ; Claydon, East, andBotolph (1897) ; Claydon, Middle (1893) ; Claydon, Steeple (1901) ; Cleator Moor (1892) ; Cleethorpes (1900) ; Clitheroe (1878) ; Clonmel (1898) ; Clontarf, Dublin (1901) ; Coatbridge (1901) ; Colchester (1891) ; Coleraine (1881) [not carried into effect] ; Colhe (1894) ; Colwall

(1898) ; Conway (1899) ; Cork (1855-92) ; Corwen, Wales (1896) Coventry (1867) ; Creich (1899) ; Croydon (1888) ; Dalkey (1894) Dalton-in-Furness

(1899) ; Darlaston (1875); Darlington (1883) Darwen (1871); Denton and Haughton (1887) ; Derby (1870) Devonport (1880) ; Dewsbury (1887) ; Dingwall (1902) ; Don caster (1868) ; Douglas, I. of M. (1886) ; Drumcondra (1900)

1 Mr Passmore Edwards (born in Cornwall, 1824) was for some years proprietor of the London Echo, and from 1880 to 1885 sat as a Liberal in Parliament for Salisbury. In later life he was a prominent donor of funds not only for libraries but also for convalescent homes and hos- pitals.

Drumoak, N.B. (1893) ; Dublin (1877) ; Dudley (1878) ; Dukin- field (1894) ; Dumbarton (1881) ; Dumfries (1899) ; Dundalk (1856) ; Dundee (1866) ; Dunfermline (1880) ; Ealing (1883) ; East Ham (1896) ; Eastbourne (1896) ; Edinburgh (1886) ; Ed- monton (1891) ; Elgin (1891) ; Ellon (1899) ; Enfield (1892) ; Ennis (1860) ; Evesham (1897) ; Exeter (1869) ; Falkirk (1896) ; Falmouth (1893) ; Farsley (1899) ; Fleetwood (1887) ; Flint (1902) ; Folkestone (1878) ; Forfar (1870) ; Galashiels (1872) ; Gateshead (1880); Glasgow {Special Act, 1900); Glossop (1888); Gloucester (1894) ; Gorton (1897) ; Gosport and Alverstoke (1886) ; Grandborough (1896) ; Grangemouth (1887) ; Gravesend (1892) ; Grays Thurrock (1893) ; Greenock (1900) ; Grimsby (1899) ; Halifax (1881); Halkyn (1896); Halton (1895); Hamilton (1901); Hampton (1900); Handsworth (1876); Hanley (1884); Harlesden, see Willesden ; Harrington (1899) ; Harrogate (1886) ; Hartlepool

(1891) ; Hartlepool, West (1891) ; Haslingden (1900) ; Hawick (1878); Haworth (1898); Hayle (1896); Hemel Hempstead (1897); Hereford (1873); Hertford (1855); Heywood (1874); Hinckley (1888) ; Hindley (1887) ; Holyhead (1896) ; Holywell (1902) ; Hornsey (1896); Hove (1891); Huoknall Torkard (1884); Hudders- field (1897, Local Act) ; Hull (1892) ; Hyde (1893) ; Ibstock, Leicester (1895); Ilford (1892); Ilkeston (1901); Inoe-in-Maker- field (1898) ; Inverness (1877) ; Ipswich (1853) ; Jedburgh (1892) ; Keighley (1900); Kendal (1891) ; Kettering (1895); Kidderminster (1855) ; Kilburn, see Willesden ; Kilmarnock (1893) ; King’s Lynn (1899) ;

Kingston-on-Thames (1881, Local Act) ; Kings- town (1884) ; Kinning Park (1901) ; Kirkcaldy {Local Act) ; Kirkmichael (1895) ; Kirkwall (1890) ; Lancaster (1892) ; Larbert (1901) ; Larne (1897) ; Launceston (1897) ; Leadgate (1896) ; Leamington (1857) ; Leeds (1868) ; Leek (1887) ; Leicester (1870) ; Leigh (1892); Leominster (1899); Lewes (1897); Leyton (1891); Lichfield (1856) ; Limerick (1889) ; Lincoln (1892) ; Liskeard (1895); Liverpool (1852, Local Act); Llanelly (1898); Llantarnam (1897); Llanuwchllyn (1895); Lockerbie (1900).— London: Metro- politan Boroughs — Battersea (1887) ; Bermondsey : Bermondsey (1887), Eotherhithe (1887), St Olave's District-(1901); Camberwell (1889); Chelsea (1887); Finsbury : Clerkenwell (1887), Glass- house Yard (1891), St Sepulchre's (1891) ; Fulham (1886) ; Green- wich (1902) ; Hammersmith (1887) ; Hampstead (1893) ; Holborn : Holborn (1891), St Giles's- (1891) ; Kensington (1887); Lambeth (1886) ; Lewisham (1890) ; Lee (1901) ; Paddington : Kensal Town (1887); Poplar: Bow (1896), Bromley (1891), Poplar (1890); Shoreditch (1891) ; South wark : Christchuroh (1889), Newington (1890), St George-the-Martyr (1896), St Saviour's (1891); Stepney : Limehouae (1898), Mile End (1896), St George's-in-the-East (1896), Whitechapel (1889); Stoke Newington: South Hornsey (1898), Stoke Newington (1890) ; Wandsworth: Clapham (1887), Putney (1887), Streatham (1890), Wandsworth (1883) ; West- minster, City of : St George's, Hanover Square (1890), St James's (1901), St Martin's-in-the-Fields (1887), St Paul's, Covent Garden (1893), St Margaret's and St John's (1856), Strand District (1901) ; Tooting (1902) ; Woolwich : Eltham (1901), Plum- stead (1898), Woolwich (1895).— Londonderry (1898) ; Longttfn (1891); Lossiemouth (1901); Loughborough (1885); Louth (1898); Lowestoft (1891) ; Lurgan (1891) ; Luton (1894) ; Macclesfield (1875); Machynlleth (1897); Maidstone (1855); Manchester (18.H); Mansfield (1890); Maxwelltown (1899); Merthyr Tydvil (1899) ; Mexborough (1899) : Middlesbrough (1871) ; Middleton (1887); Middlewich (1889); Millom (1887); Mold (1902) ; Mon- trose (1901); Morley (1892); Moss Side (1887); Motherwell (1902) Nantwioh (1887) ; Neath (1897) ; Nelson (1889) ; Nenagh, Ireland (1895) ; Neston and Parkgate (1901) ; Newark-on-Trent (1882) Newburgh (1895) ; Newcastle-under-Lyme (1883) ; Newcastle-upon-Tyne (1874) ; New Mills (1893) ; Newmilns, N.B. (1900) Newport, Mon. (1870) ; Newry, Ireland (1895) ; Newton Abbot (1901) ; Newton, Montgomery (1898) ; Newtownards, Ireland (1895) ; North Walsham

(1901) ; Northampton (1860) ; North- wii;h (1883) ; Norton (1898) ; Norwich (1850) ; Nottingham (1807) ; Nuneaton (1895) ; Oldbury (1888) ; Oldham (1865, Local Act) ; Ossett (1897) ; Oswestry (1890) ; Oxford (1852) ; Padiham (1897); Paisley (1867); Penarth (1804); Penge (1891); Penrith (1882) ; Penzance (1893) ; Perth (1896) ; Peterborough (1891) ; Pfterhead (1890) ; Pleasley (1895) ; Plymouth (1871) ; Pontypridd (1887); Poole (188-’”.); Portmadoo (1899); Portsmouth (1878); Preston (1878); Prestonpans (1 902) ; Qur’enborough (1887); Kahi- ham (1896) ; liains^‘ate (1894) ; Kathmines (1887) ; Rawiiiarsh

(1892) ; Reading (1877) ; Redruth (1S94) ; Richmond, Surrey (1879) ; Rochdale (1870) ; Rochester (1894) ; Rotherham (1870) ; Rothwell (1894) ; Rugby (1890) ; Runcorn (1881) ; Rutherglcn (1901); St Albans (1882); St Austell (1895); St Helens, Lanes (1869, Local Act); St Ives (1895) ; Sale (1890); Sa.Uoi<\ (Museums Act, 1849; re-polled 1892); Salisbury (1890); Sclldrk (1889); Sheepshed (189i;) ; Sheffield (185:1) ; Shouldhara (1895) ; Sliruws- bury (1882) ; Sittingbourne (1887) ; Sligo (1880) ; Smelhwick (1877) ; South Shields (1871) ; Southampton (1887) ; Southport (1875) ; Sowerby Bridge (189.!) ; Stafford (1882) ; Stalybrid-e (1888) ; Steeple Claydon, see Claydon ; Stirling (1897) ; Stockport

(1860) ; Stockton-on-Tees (1874) ; Stoke-upon-Trent (1875) Stornoway (1898) ; Stratford-on-Avon (1902) ; Stretford (1893) Stromness (1900) ; Stroud (1896) ; Sunderland (1860 Local Act) Sutton-in-Ashfield (1898) ; Swansea (1870) ; Tain (1899) ; Tam- worth (1882) ; Tarbat (1899) ; Tarves (1883) ; Teddington (1896) ; Thornaby-on-Tees (1890) ; Thurso (1872) ; Tipton (1883) ; Tod- morden (1896); Tonbridge (1882); Tottenham (1891); Trimdon (1895) ; Trumpington (1898) ; Truro (1886) ; Tunbridge Wells

(1895) ; Tunstall (1885) ; Twickenham (1882); Tynemouth (1869); Wallasey (1898) ; Walsall (1857) ; Walthamstow (1892) ; War- rington (1848, Museums Act) ; Warwick (1865) ; Water Eaton

(1896) ; Waterford (1894) ; Waterloo-with-Seaforth (1892) ; Wa1> ford (1871) ; Wednesbury (1876) ; Welshpool (1887) ; West Brom- wich (1870) ; West Ham (1890) ; Weston-super-Mare (1886) ; Whitchurch (1900) ; Whitehaven (1887) ; Wick (1887) ; Widnes (1885) ; Wigan (1876) ; Willenhall (1877) ; Willesden (1891) [includes Kilburn, Harlesden, and

Willesden Green] ; Wimbledon (1883) ; Winchester (1851) ; Winsford (1887) ; Wolverhampton (1869) ; Wood Green (1891) ; Woolton (1890) ; Worcester (1879) ; Workington (1890) ; Worksop (1895) ; AVorthing (1892) ; Wrex- ham (1878) ; Yarmouth, Great (1885) ; York (1891).

[From list in Library Association Year Book, 1901, corrected to 1902.]

By the Public Libraries Act of 1892 all the Acts from that of 1865 to the AmeDclment Act of 1890 were consolidated in an amended form. This Act, which was promoted by the Library Association, j^^Jgl^ simplified the steps necessary for the establish- public rate- ment of libraries ; it also gave additional supported administrative powers to the library authority. It settled some difficult questions as to the polling of ratepayers for the adoption of the Acts and the levying and collection of the library rate. ITaeilities were also afforded whereby neighbouring localities might combine for library purposes. A short Act passed in 1893 pro- vided the first step towards placing directly in the hands of the elected representatives of the ratepayers the right of adopting the Acts, which had hitherto been subject to the popular vote. At first this change applied only to the urban district authorities, but the Local Government Act of 1 894 gave somewhat similar powers to rural parishes, and further extended the means for combination, particu- larly helpful in the case of small districts with limited financial resources. In 1898 an Act was passed to provide for good order and the punishment of offences in libraries. The following year (1899) saw the passing of the London Government Act, which, in creating the metropolitan borough councils, gave to them the power of putting the Library Acts into force. In 1901 an Act promoted by the Library Association was passed which removed some diffi- culties in regard to rating, gave power for the making of bye- laws, and applied the Museums and Gymnasiums Act of 1891 to the metropolis. In Scotland and Ireland library legislation has been dealt with principally by separate Acts, and the variety of enactments tends to create doubt and confusion. TheLibrary Association, with the help of Lord Avebury, Lord “Windsor, and others, has devoted many ef- forts towards remedying these and other defects, including the anomalous condition of the law in regard to libel as it affects libraries, and liability to assessment for rates and taxes. The penny rate limitation lies heavily upon

the majority of libraries, although by means of special and costly legislation some have been enabled to rid themselves of the restriction. .

Enactments and Jicgnlations.

Enoland and Walks. — Acts 55 and 56 Vict. cap. 53 (1892) ; 56 A'ict. cap. 11 (1893) ; (il and 62 Vict. cap. 53 (1898) ; 62 and 63 Vict. cap. 14 (1899) ; 1 Edw. VIL cap. 19 (1901).

Adiiption. — (1) In City of London by a poll of the voters (1892, § 21). (2) In metropolitan boroughs (1899, § 4) and urban districts (IMU:!, § 2) by a resolution of council. (3) In rural parishes by a parish meeting, or, if demanded, a poll of the voters by ballot (1894, §§ 7 and 19). AVhen adopted, notice must be sent to the Local Government Board (1901, § 8).

Library District. — City of London (1892, § 21), metropolitan boroughs (1899, § 4), urban districts (1892, § 1), parishes not in an urban district (1892, § 1).

Mate. — Not to exceed one penny in the £, with exceptions granted by local Acts of Parliament (1892, § 2). For list of these see Library, x. (1898), pp. 330-331. Museum expenses may be charged under the Museums and Gymnasiums Act, 1891, in addition to the penny rate (1901, § 7).

Authority.— In City of London : Common Council (1892, § 21). In metropolitan boroughs (1899, §4) and urban districts (1892, § 4) : the council. In parishes: parish council (1894, § 7), or where there is no parish council a committee (1894, § 19), or com- missioners (1892, § 4).

Combination.— (1) Vestries (1892, § 9). (2) Parish and library districts (1892, § 10). (3) Urban districts (1893, § 4). (4) Library districts (1901, § 5). (5) Library authority and Charity Com- missioners (1892, § 16).

Execution of Act. — Library authority may provide all or any : public libraries, public museums, schools for science, art galleries, and schools for art (1892, § 11).

Fees. — No charge for admission to library or museum or for use of lending library to the inhabitants of district, but use of lending library may be granted to persons not inhabitants of the district either gratuitously or for payment (1892, § 11).

Power to acquire and dispose of Land (1892, § 12).

General Management. — By library authority (1892, § 15). But an urban authority may appoint a committee, and delegate to it certain powers (1892, § 15). Persons appointed to be members of tlie committee need not be members of the urban authority (1892, § 16) nor of a London borough council (1899, § 8).

Expenses, how defrayed. — By a rate. See Bate.

Borrowing. — Authority may borrow onsecurity of rate (1892, § 19).

Accounts and Audit. — Urban authority, as under Public Health Acts (1892, § 20). Commissioners, or parish authority, by district auditor (1892, § 20). Metropolitan borough, as London County Council (1899, § 14).

Bye-laios. — Authority may make. Penalties may be recovered under the Summary Jurisdiction Acts (1901, § 3).

Offences. — See also Library Offences Act (1898).

Damage to Buildings by Subsidence. — Not to be paid out of the penny library rate (1901, § 10).

Scotland. — The Acts were amended and consolidated by the Public Libraries Consolidation (Scotland) Acts, 1887, 1894, and 1899.

Ireland. — The original Act, 18 and 19 Vict. cap. 40, passed 1855, with amending Acts (1877, 1894). An Amending Act was in 1902 before Parliament.

[M. W. PovAKGUE and J. J. Ogle. Public Library Legislation, 1893. Chambeks and Fovaegue, Public Library Law, 1899.]

The chief facts in the recent history of the great British national libraries may be briefly mentioned. The British Museum, which was estimated to include a Museum miHion and a half of printed volumes and 50,000 ”” “”’ MSS. in 1881, contained in 1902 upwards of two millions of printed volumes and 65,000 MSS., besides charters and rolls. The chief event in the later history of the institution was the completion in 1900 of the printing of the entire catalogue of the library, commenced in 1881. A supplement including the titles of all books added to the library while the general catalogue was in progress was also begun. Since 1888 the titles of new books are incorporated in the catalogue every fortnight. By the introduction of sliding presses in 1887 the space for the accommodation of books will eventually be more than doubled. The map catalogue has been completed; a revision of the rules for cataloguing has been issued. A special catalogue of English books printed before 1640 (1884), a synopsis of the French Eevolutionary tracts (1899), and various excerpts from the printed catalogue have been pub- lished. There has been a marked improvement in the printed guides to the exhibited portion of the collection since 1890. In 1892 a separate department of Oriental books and MSS. was formed. The valuable Subject Indexes of Modem Works, prepared by Mr G. K. Fortescue, and Mr Eobert Proctor’s Index to Early Printed Books (not an official work), deserve special mention. A subject-index of all the books in the library published between 1881 and 1900 was passing through the press in 1902, and the question of compiling class catalogues of the entire library was under consideration. In the department of MSS. there have been most important

acquisitions in all branches, especially in papyri of classical authors from Egypt, including “Aristotle on the Constitution of Athens,” ” Herondas,” ” Bacchylides,” published by the Trustees, numerous other papyri from Professor Plinders Petrie, Mr Jesse Haworth, and others. Among the most important of other acquisitions are the duke of Newcastle’s papers, presented by the earl of Chichester in 1886; the Hardwicke MSS., purchased from the earl of Hardwicke in 1899 ; the Asburnham MSS., chiefly historical, 1883 ; the Nelson papers of Vis- count Bridport, 1896-97;

the Gibbon papers, 1895; the Sforza Book of Hours, bequeathed by John Malcolm, Esq., of PoltaUoch, 1893 ; MSS. of Keats, from his sister Senora Llanos, and the autograph MSS. of some of George Eliot's works, from Mrs C. L. Lewes. The department has published catalogues of papyri, of Spanish MSS., of romances, and of seals. The Oriental department has published catalogues of Arabic and Indian books.

The Bodleian Library at Oxford contained in 1902 over 600,000 printed volumes and 31,000 MSS. The rate of increase is now considerably augmented, and the number of items received annually — including o'''"- separate maps, parts of periodicals, &c. — exceeds 60,000, equivalent to about 17,000 volumes. A special feature of it is the entire body of dissertations ortheses issued intheuni- versities of Germany, Holland, Norway, Sweden, Denmark, Switzerland, and Prance. Since 1881 the further develop- ment has been very considerable. The number of week-days in the year during which the entire library is closed has been reduced from 29 to 6. The open reference-libraries in both reading-rooms have been materially increased. A very minute shelf -classification for current accessions was begun in 1883, and the corresponding shelf-lists are virtually sub- ject-catalogues of the literature acquired since then. At the same time the preparation of a subject-catalogue of the entire library (compiled from a spare set of slips mani- folded for the ordinary catalogue) has made great progress. A rough catalogue of incunabula (the work of Mr E. Gordon Duff and Mr R. Proctor) has also been formed. Six more volumes of catalogues of MSS. have been pub- lished, and considerable additions have been made to the collections of Sanskrit, Armenian, Hebrew, and Tibetan MSS. All current accessions of MSS. are now divided by language, with a subdivision by subject in the case of English, Latin, and Greek. The coin collection — the second largest in the empire — has been almost entirely reorganized; it numbered over 60,000 pieces in 1902. During the period under review the Savile and Music School libraries were added to the Bodleian, five colleges deposited their MSS. in it, and an important deposit collection was Received from the Clarendon Press. The area occupied by the library includes the basements of the Sheldonian Theatre and of the Old Ashmolean building. The lending of volumes has been restricted by statute, so as to require the sanction of Convocation of the Univer- sity: it ma,y be said that printed books are never lent, and of

manuscripts (never of prime value) only some half-dozen a year. The number of readers, both ordinary students and those engaged in research, has largely increased. In 1889 the gallery of the EadclifEe Camera was opened as an addition to the reading-room in that building. The three-hundredth anniversary of the open- ing of the Bodleian Library was in October 1902.

The contents of the University Library at Cambridge are estimated (perhaps excessively) by the University Calendar at half a million of volumes, but no enumeration has been made officially. The ‘^■»™*’’’’&« incunabula are about 2160, being especially ” ^^’^^’^■ strong in books printed in Holland and Belgium and in Cologne. The MSS. numbep7872, exclusive of the Taylor- Schechter collection of Hebrew documents and fragments

from Cairo, and of the Buxton collection of Norfolk coiirt rolls, &c. The following catalogues of MISS, have been published : Persian (E. &. Browne), Syriac (W. Wright and S. A. Cook), Hebrew, vol. i. (8. M. Schiller-Szinessy), Hand-list of Mahommedan MSS. (E. G. Browne). Among recent additions are the Chinese library of the late Sir T. E. Wade, catalogued by Professor H. A. Giles ; the library of H. Bradshaw, 1870 and 1886 (Irish, chiefly before 1800, probably 7000 numbers) ; R. Bensly’s Oriental books and manuscripts, J. Venn’s logic collection, J. C. Adams’s collection of early printed mathematical works, Samuel Sandars’s incunabula, early English, liturgical, books on vellum, &c. , Volumes i. and ii. of the catalogue of English books before 1640, by C. Sayle (reaching No. 5909), had been published up to 1902.

The Advocates’ Library in Edinburgh now includes ■455,000 printed volumes and 3200 MSS. In 1884 an

addition was made to the building capable of Edinburgh, i^oi^ij^g 85^000 volumes, and in 1899 a further extension to accommodate 380,000 volumes. The Signet Library now includes about 100,000 volumes. The

third volume of the printed catalogue, with a subject index, was published in 1891.

The library of Trinity College, Dublin, in 1902 con- tained 255,000 volumes and 2027 MSS.; about 3000

volumes are added every year. The printed

catalogue of books acquired before 1872 was completed in 1887, and a summary catalogue of the manuscripts has been published (1890).

The most remarkable instance of a great library estab- lished by private munificence is that of the John Eylands

Library at Manchester, which was founded, Chester. erected, and endowed by Mrs E. A. Eylands in

memory of her husband, and is contained in a magnificent building opened in 1899. The collection was formed largely on the famous Althorp Library, made by Earl Spencer (40,000 volumes), one of the most re- markable collections of early printed books and rare Bibles ever brought together. The present number of volumes is about 80,000, of which 2500 are incunabula. Over 5000 volumes, including many of great rarity, were added in 1901. A short-title catalogue, 3 vols. 4to, and one of English books, have bpn published. A supple- ment, describing about 25,000 books, was begun.

Since 1880 the usefulness of public libraries has been increased by the work of the Library Association, founded in 1877, during the first International Library Conference held in London in October 1877. A charter of incorporation was granted to the association in 1898. It holds monthly and annual meetings, publishes a journal, conducts examinations, issues certificates, holds classes for instruction, and has greatly helped to improve the public library law. The Library Assistants' Association publishes a journal. A second International Library Conference was held at London in 1897. Library associations have been started in Germany and Switzerland. The Library Association of Australia held its third annual meeting in 1901.

British Colonies.

I. Australasia. — In the Australasian states and colo- nies there were 1361 libraries in 1902 receiving a Govern- ment grant, and containing 2,552,995 volumes.

1. Victoria has 424 libraries, with 1,029,74.3 volumes. The Melbourne Public Library is the largest in Australasia (178,ilOO vols.). Among other libraries in Melbourne are — The Library of Parliament, for the use oJ members ; the Supremo Court Library, with 24,000 vols., free to members of the leij^il profession; the Patent Office Library, with 7000 vols. ; the Libraries of the Uni- versity, the Royal Society, the Linnfean Society, the Royal Geographical Society, and other institutions.

2. New South Wales contains ~~350 libraries receiving Govern~~ ment aid, with 610,000 vols. ; Sydney Public Library (161,141

vols.) , with lending department for the benefit of country libraries ; Sydney University^ Library (50,000 vols.) ; School of Art Library (60,000 vols.); a circulating library for subscribers.

3. South Australia.—Adelaide Public Library (46,266 vols.), with circulating system of book boxes ; Parliamentary Library, Adelaide, for the use of members. Besides these, 160 country libraries with 220,538 vols.

4. Queensland contains 141 institutions, with 166,589 vols., mostly open to the public. Pending the opening of the Brisbane Public Library, the most important is the Parliamentary Library, Brisbane (31,835 vols.).

5. Tasmania has 45 libraries, with 90,000 vols. ; Tasmanian Public Library, Hobart, 19,000; Launceston Public Library, 22,000 vols. ; Parlimentary Library, for use of members.

6. West Australia has 55 literary institutions, with 24,000 vols. ; Victoria Public Library, Perth (43,940 vols.).

7. New Zealand has 304 libraries, with 409,604 vols. There are no state libraries, but they are partly supported by rates and partly by subscription. The largest are Auckland Public Library (34,000 vols.), containing Sir George Grey’s collection of 13,000 rare books and MSS. ; “Wellington

Public Library ; the Dunedin and Christchurch Libraries ; the Parliamentary Library of Welling- ton (40,000), and several university libraries.

The Parliament of the Commonwealth of Australia intends to establish a Federal Public Library in the new capital, containing as a special feature works on Australasian history.

II. Canada. — Between 1887 and 1902 the number of volumes accessible to the public in the Dominion increased by about 1,300,000. All the chief cities of the Dominion now possess fine public libraries. Two pro- vinces— Ontario and British Columbia — haved adopted a Public Libraries Act. Montreal has about thirty libraries, large and small, and Toronto about as many. Ottawa can draw upon the Parliamentary Library, which with those of the departments aggregate a quarter of a million volumes, and constitute the largest collection of books in the country.

The chief free public library in Canada is that of Toronto (110,000 vols.). The largest university library is that of Laval University, Quebec (110,000 vols.). Then follows M'Gill Uni- versity, Montreal (81,000), with about 30,000 vols, of theological and patristic literature in its affiliated colleges. Travelling libraries have been organized in British Columbia. The Aberdeen Association, founded in 1890 through the instrumentality of the countess of Aberdeen, collects books for distribution in monthly parcels among settlers in outlying parts of the country. Nova Scotia — Halifax: Legislative Library (32,500 vols.), Dalhousie University (19,760), Citizens' Free Library (2i,300), Garrison Library (15,000) ; Windsor : King's College (7500) ; Wolfville : Acadia College (8500). New Brunswick — St John : Free Library (12,000); Frederioton : Legislative Library (15,000), University of New Brunswick (8500) ; Sackville: Mount Allison College (8500). Quebec {Province) — Montreal : Fraser Institute (35,000), Chateau de Ramezay (6000), Montreal Free Library (20,000), Westmount Free Public Library (2500), Bibliothfeque Paroissiale de Notre Dame (16,000), Mechanics' Institute (14,000), Grand Trunk Literary and Scientific Institute (7000) ,]fccole Normale Jacques Cartier (12,600), M'Gill University (including medical works, 81,000), four college libraries affiliated with M'Gill Uni- versity, viz., Presbyterian (16,000), Congregational (3500), Diocesan (4700), Wesleyan (3000), Montreal College (Roman Catholic) (45,000), St

Mary’s (Jesuit) College (32,000), Seminary of St Sulpice (70,000), Natural History Society (6000), Advocates’ Library (17,000), New York Life Law Library (6600) ; Quebec (city) : Laval University (110,000), Legislative Library (50,000), Department of Public Instruction (11,000), Bar Library (13,000), Literary and Historical Society (19,000) ; Sherbrooke : Art Institute and Public Library (4000^ ; Knowlton : Pettes Memorial Library (1400) ; Lennoxville : Bishop’s Colle£;e (7500) ; Stan- stead : Public Library (3000) ; St Hyacinth : College de St Hyaointhe (26,000) ; Ste Anne de la Pocatifere : Collfege de Ste Anne (13,000) ; Tliree Rivers: Seminaire des Trois Rivieres (7000). Ontario — Toronto: Public Library (110,000), University Library (60,000), Legislative Library (70,000), Law Society of Ontario (30,000), Meteorological Office (Governmental) (6000) ; Kingston: Queen’s University (36,000); Ottawa: University (36,000), four Governmental libraries, viz., Library of Parliament (200,000), Geological and Natural History Survey (16,000), Supreme Court (19,500), Archives (10,000). Manitoba— Wiimeiieg: Legislative Library (17,500), Literary and Historical Society (15,000), Uni- versity of Manitoba (8000), Law Society (6000). North-West Territorii’s — Regina: Legislative Library (3500). British Columbia — Victoria: Legislative Library (0000), Law Library (2000), Public Library (6000) ; New Westminster: Public Library (1600) ; Vancouver: Public Library (1000).

Summary of Canadian Libraries.

Nova Scotia

Prince Edward Island ....

New Brunswick

Quebec

Ontario (including 5 Governmental libraries)

Manitoba .

North- West Territories .... British Columbia

Libraries.

Volumes.

9

90,000

2

7,500

6

50,500

47

690,500

444

1,537,500

4

46,500

1

3,500

5

17,000

2,443,000

III. Africa.— Cope Colony has 126 libraries, with 421,732 vols., the chief being those of Cape Town (66,753 vols.), Graham's Town, Port Elizabeth (25,073 vols.); King Williain's Town (16,987 vols.) ; Kimberley (23,843 vols.) ; East London (7774 vols.) ; Cradook (7147 vols.) ; and Graaff-Ileinet (8669 vols.). There is also a Parliamentary library In Cape Town (12,000 vols.).

Natal. — The Natal Society's library, Pietermaritzburg (11,500 vols.) ; a Parliamentary library, also at Pietermaritzburg ; and a public library at Durban (12,000 vols.). There are also small libraries in the country districts.

IV. West Indies. — The Institute of Jamaica (11,000 vols.) ; Trinidad Public Library (20,000 vols.) ; Nassau Public Library, Ba- hamas (13,000 vols.) ; Royal Agricultural and Commercial Society, British Guiana (20,000 vols.) ; Berbioe Reading Society (5000 vols.) ; the Public Library of Grenada (4000 vols.) : Public Library, St Lucia (3000 vols.).

V. Eastern Colonies. — Ceylon has 24 libraries, 4 of which are in Colombo. The Straits Settlements has 4 libraries (2 in Singapore and 2 in other parts of the colony). Hong-Kong has 2 libraries. Mauritius. — Public Library of Port Louis (12,000 vols.).

[See " The Libraries of Greater Britain," by J. R. Boos:fe, in The Library, 1901 ; for Canada paper by J. Bain (Public Library of Toronto) read at Montreal Library Conference 1900, with addi- tional information from G. H. Goold, M'Gill University Library, Montreal.]

Germany and Austeia-Hungarx.

There are two libraries in Germany, Berlin and Munich, of nearly a million volumes, one of 600,000 volumes (Hamburg), two possessing about half a million (Gottingen and Leipzig). The following contain between a quarter and half a million volumes : Bamberg, Bonn, Breslau, Darmstadt, Dresden, Frankfort on the Main, Freiburg in Bresgau, Heidelberg, Munich (Univ.

Lib.), Rostock, Stutt- gart, Tubingen, Wolfenbtittel, and Wiirzburg. Libraries extending from 200,000 to 250,000 are at Augsburg, Gotha, Halle, Jena, Kiel, Konigsberg, Mainz, Schwerin, and Weimar. Since 1892 the Eoyal Library at Berlin has issued a weekly accession list. A combined general catalogue of the great Prussian libraries, including since 1898 all the university libraries, is being compiled.

The largest collections in Austria-Hungary are the Eoyal Library (900,000 vols.) and the University Library (576,000) at Vienna, the Hungarian National Museum (400,000) ; and the University Library (222,000) at Buda- pest, and the Museum (200,000) and the University Library (269,000) at Prague.

France. The Bibliotheques Municipales in the various depart- ments are about 338, with an aggregate of 8,500,000 volumes. Within the period from 1879 to 1899 a million and a half of books and pamphlets were added. The various university libraries contain about 906,600 volumes. The number of Bibliotheques Populaires is a floating quantity, as many have but a brief existence. It is believed that the Bibliotheque Nationale possesses about three millions of volumes, a total which probably includes a great quantity of pamphlets reckoned as volumes. The separate entries in the catalogue of printed publications are close upon two millions. There are besides 250,000 maps, over 100,000 MSS., 250,000 engravings, and 150,000 coins and medals. The number of entries between 1879 and 1899 was 800,000. The most important work within recent years has been the preparation of the great general printed catalogue in octavo form, and the valuable

publications of M. Delisle on French and Latin MSS. The other great Paris libraries are: Bibliotheque de rUniversite de Paris (430,358 vols.) ; B. Sainte Genevieve (300,000 vols.); B. de I’Arsenal (250,000 vols.); B. Mazarine (200,000 vols.). (h. e. t.)

The United States.

The early history of public libraries in the United States, and the statistics down to 1876, will be found in the earlier article in vol. xiv. (p. 534) of the Ency. Brit, (ninth edition). The progress since that date has included an extraordinary activity (1) in the creation of additional rate-supported

libraries of the customary type ; (2) in the establishment of libraries by private gift, to be maintained wholly or in part by endowment; (3) in the extension of state aid to the estab- lishment of libraries designed for local service, and of the counsel of state authorities in their administration ; (4) in the construction of new library buildings of elaborate de- sign ; (6) in the organization of persons engaged in library work or interested in public libraries as a part of the educa- tional system of the country into associated effort for the study of library economy, for the discussion of problems of library administration, and for the furtherance in general of the library movement ; and (6) in the establishment of systematic instruction for library work.

Statistics. — Statistics of individual libraries of note are appended in a table. From time to time the United States Bureau of Education has compiled statistics of public, society, and school libraries in the United States, which show not only the wide extent of library facilities, but also a remarkable growth in recent years. Some of the main results of these inquiries may be noted.

Libraries of 1000 volumes and over.

Increase per cent.

Libraries of 300 volumes and over.

Year.

Number.

Volumes.

Number.

Volumes.

Number,

Volumes.

1875 1885 1891

18ti6

1900

2039 2988 3503 4026 5383

11,487,778 19,401,199 25,977,643 33,051,872 44,591,8611

46 -5 17-2 14-9 33-7

77 -6 33-9 27-2 .34-9

3648 5338

7184 9261

12,.S29,526

20,722,393

34,596,258 46,610,509

I Exclusive of pamphlets, reported as 7,503,5SS.

It will be noted that the libraries having 1000 volumes were about two and a half times as numerous in 1900 as twenty-five years previously, while in the same period their contents had increased nearly fourfold. The above statistics include society and school libraries, these being “public” and very generally free for reference use. Of the 5383 libraries of 1000 or more volumes reporting in 1900, 1979 were classed as “general,” 1725 as “school,” and 689 as “college.” Four had 500,000 volumes or over; three, 300,000 to 500,000; forty-seven, 100,000 to 300,000 ; ninety, 50,000 to 100,000 ; and the remainder fell below 50,000. The distribution by groups of states was as follows : North Atlantic, 2473 ; South Atlantic, 421 ; South Central, 374 ; North Central, 1728 ; Western division, 387. In general, through- out the United States there is one lilDrary having 1000 volumes for every 14,118 persons, though in the North Atlantic states they are as

many as one for every 8510, while in New England the number is still greater. New Hampshire leads with one library for every 2878. More significant perhaps are figures in relation to the books. In the country at large the libraries contain 69 books for every 100 people. In the North Atlantic states the books out- number the people, being 111 of the former for 100 of the latter; in Massachusetts, indeed, the number is as high as 236 for every hundred persons. In these comparisons with the population the extreme Western states as a group make a better showing than the average of the nation, while other groups fall below it. This is due in a large measure to the influence of California, which com- pares favourably with the Eastern states both in the number of its libraries and their size.

Income. — 988 libraries reported an income for the year 1900 of $2,213,765 from taxation ; 1016, an income of $2,349,294 from state, county, and city appropriations ; while 714 reported an income of $1,198,955. Other sources of income are reported, while a large number failed to specify the sources of income. The aggregate income reported by 3115 libraries was $7,812,406. 645 libraries reported endowment funds aggregating $26,267,643.

710 libraries reported the yalue of their buildings to be |47, 083, 805, while 2972 reported an expenditure for books during the year of

$2,056,675.

Use. — During the year 1900 the records of 2405 libraries show 48,410,128 books issued forborne use. The reference use is im- perfectly recorded. Free access to shelves, at least to reference eases, and to periodicals, make a comp.ete record impracticable, and there are only 783 libraries which make any report of books issued for use in the library (9,609,632). If all such use could be recorded and rej)orted, it seems probable that the books used in the buildings would e.tceed those used at home. Circulation for home use reaches its highest point in the large cities, especially where the free libraries have a number of branches. Thus in Philadelphia and Chicago the

circulation in 1900 reached one and three-fourth million books. The free circulating library of New York City circulated a million and a half of books, while the Boston Public Library and its branches had a circulation exceeding one and a quarter million. Several other city libraries have a circulation exceeding 500,000. These statistics, although imperfect, indicate a development unexampled in the history of education. This development has been fostered by legislation. In the fifty states and territories there were included in the report of 1900 before quoted only eleven in which libraries were not supported by taxation levied directly for such purpose. One of these — Delaware — has since jiassed a law authorizing taxation for the support of public libraries. The state of New Hampshire in 1897 enacted a law which, proceeding one step farther, made obligatory the establishment of free libraries by towns of a certain size. This carries to its extreme limit the theory, now generally accepted in the United States, that a free public library ranks with the common school as an agency for popular education whose maintenance is a duty of the community as a whole to its members. In certain towns the board of library commissioners is vested (by statute) with the authority to specify directly the amount to be levied for library purpdes, being limited only to a certain maximum per- centage of the assessed valuation. In general, however, the appropriations are made by the town councils.

Stale Library Commissions. — Twenty-one states, beginning with Massachusetts in 1890, have established commissions, which, acting on behalf of the state, encourage the formation of local libraries, particularly in towns and villages, and in many cases have authority to aid their establisliment by the grant out of the state funds of a certain sum (usually $100) towards the purchase of books, upon the appioi)riation of ^ similar sum by the local authorities. These commissions are prepared to aid further with select lists of desirable books, and with suggestions or advice in the problems of construction and maintenance. Such commissions are in existence in Connecticut, Delaware, Georgia, Idaho, Indiana, Iowa, Kansas, Maine, Massachusetts, Michigan, Minnesota, Nebraska, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Vermont, Washington, and Wisconsin. In Massachusetts the efforts of the commission have been so successful that of the 346 towns and cities in the state only seven at present lack public library privileges. The report of the commission for 1899,

together with the report of the Connecticut commission of 1895, atlbrds a very full statement ol the progress of the typical town library in New England. The result of fostering legislation is seen in the greater portion of free rate – supported libraries established since 1875, as against those established during the preceding twenty-five years. From 1850 to 1875 the number was but 257, as against 1983 professional, society, school, and college libraries. The present tendency is either to the discontinuance of proprietary libraries of the older type — excluding the Y. JI.C. A. and the fraternity libraries and those merely professional — or to their merger with the free town library. Those now remaining independently prosperous are to be found chiefly in the large cities — for example, the Boston Athenaeum, the Mercantile of New York, and the Brooklyn.

Travelling Libraries. — In certain of the states the state authorities, acting usually through the state commissions, main- tain at the expense of the state collections of books, which are desiiatched to various localities upon application from the local authorities, remaining during a fixed period in each locality for the benefit of the residents there, and then Iji'ing withdrawn and forwarded for service elsewhere. This system of travelling libraries, inaugurated in New York state, and having its most elaborate development there, is now in existence in at least twenty- one states — Alabama, Colorado, Delaware, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, New York, Ohio, Michigan, Minnesota, Missouri, New Jersey, Pennsylvania, Texas, and Wisconsin. To the service of books is sometimes added that of photographs, lantern-slides, and other illustrations. Communities are reached by these travelling libraries (as in Wisconsin) remote from the book centres, and either ignorant of the stimulus of books or unable to afford it.

Undowments. — The creation and endowment of public libraries by ijrivate gilt has kept pace with their establishment at the

public expense. An annual report of donations to libraries is] .resented at the meeting of the American Library Association. The report for 1900-1 showed money gifts in the United States for general library purposes of $3,616,962, and for buildings, $15,217,702. Giftsof material aggregated 145,361 volumes. The total money value of gifts and bequests of money,

buildings, and lands for library purposes since 1876 is estimated at nearly 160, 000, 000. Mr Carnegie's gifts alone have exceeded $20,000,000, and in 1901 he gave $5,200,000 to New York City for the erection of sixty-five branch .libraries. Among other notable gifts of individuals have been the following: — Enoch Pratt, gift to Baltimore, $1,083,333 ; Walter L. Newberry, bequest to Chicago, $3,000,000 ; Samuel J. Tilden, bequest to New York, $2,125,000 ; John Crerar, bequest to Chicago, $2,714,191 ; Seth Low, gifts to Columbia, say $1,000,000. The gift of Enoch Pratt to Baltimore was a lump sum towards the establishment of the library, construction of the buildings, &c., with the condition that the city should^ appropriate for maintenance expenses a certain sum annually. This is a favourite form of gift, and was followed by Mr Carnegie in most of his benefactions. The Tilden, Newberry, and Crerar bequests went to the foundation of libraries which, while free, are administered by private corporate bodies.

Library Buildings. — The multiplication of these, both by private gift and at the public expense, has been extraordinary. In the smaller towns library buildings, costing from $5000 to $50,000, have now become the most popular form of memorial ; pictures are given in the reports of the Massachusetts and Con- necticut library commissions. Of the large buildings the result of gift, some of the most prominent are the Columbia University Library at New York (the gilt of its president, at a cost of nearly $1,000,000) ; that of Pittsburg, a composite building, costing, with branches, $2,800,000, the gift of Mr Carnegie; the new library of Princeton University, costing $600,000, the gift of W. Taylor Pyne ; that of Cornell, costing $250,000, the gift of Henry W. Sage (who added an endowment of $300,000) ; and that for the public library at Providence, Rhode Island (the gift in part of Jolm Nicholas Brown). Of other buildings for libraries of intermediate size, those erected at Milwaukee and at Madison, Wisconsin, and at Newark, N.J., are specially interesting, from their provision for administrative needs complex in chaiaoter. Of larger buildings, erected at the expense of municipalities for municipal libraries, that at Boston (completed 1895) cost $2,500,000 ; that at Chicago (completed 1897), $2,000,000. The culmination of buildings of this type will be that for the New York Public Library — larger, more elaborate, and doubtless more costly than either of the foregoing. The most ambitious of exist- ing library

buildings is that erected by the Federal Government for the library of Congress at Washington, and opened in 1897. It covers 3J acres of ground, contains 10,000,000 cubic feet of space, and has possible accommodation for over four million volumes. Its cost was $6,500,000, or including the land, $7,000,000. It is the largest, most ornate and most costly building in the world yet erected for library purposes,. The library itself is now likely to become worthy of the building as the National Library of the United States. It contains already the largest mass of material of any library on the western hemi- sphere (see Table). The total appropriations in its behalf for the year 1900-1 reached $563,000. This included §75,000 for jirinting and binding, and §156,000 for furniture and shelving and the care and maintenance of the building and grounds. §71,000 was for the purchase of books and other material. The advantage of combining under one roof institutions cognate in aim or related in activity has led to the construction of certain buildings composite in character, containing provision fof museums, art galleries, and porliaps music halls and society rooms. Examples of such are at Allegheny, Buffalo, Madison, Milwaukee, Minneapolis, Pittsburg, and elsewhere. Not merely in number, but from an artistic standpoint, the library buildings erected since 1880 are, as a class, amongst the most notable achievements of American municipal architecture.

Administration. — In the Unite(l States the tendency is constant towards the removal of restrictions upon use. In almost no case is any credential required as a preliminary to reference use. The deposit or guarantee, formerly a condition precedent to the with- drawal of books for home use, is no longer universally exacted ; at Boston, for instance, a simple reference to a sec.ond resident (who assumes, however, no responsibility) is all that is required. In spite of this waiver of security, the annual loss to the library, out of a circulation of 1,200,000 volumes issued for home use, is less tlian 100 volumes unaccounted for, the money value of which would not exceed $100. Direct access to the shelves is increasingly granted, not merely for purpose of reference, but for the selection of books for home use. Special provision for younger readers is a feature in all of the libraries undertaking a popular service, and children’s reading-rooms, with direct access to a selected collection of books, are now provided in all the buildings erected for such libraries. A special educational service, highly developed of late

years, involves co-operation with the common schools in tlie supply to teachers and pupils of hooks, special topical lists, and special facilities for collateral and supplementary reading. In this way the library is closely associated with the common educa- tional system, becomes auxiliary to the schools, and develops a constituency of readers early trained to its use. In the larger cities the facilities of the central library are supplemented by branches and delivery stations ; the former containing permanent collections of books issued independently, the latter serving as conduits through which books are issued from the central collec- tion. The system of branches has been developed more particularly in Baltimore, Philadelphia, and Pittsburg ; that of delivery stations and branch reading-rooms at Chicago and St Louis, and a composite system at Boston. For Chicago there are pro- vided over forty delivery stations ; at Boston, ten branches— five brancli reading-rooms and thirteen delivery stations. Such cities support, therefore, not a mere library, but a system of libraries.

Library Associations. — The American Library Association, formed in 1876, has continued uninterruptedly, and now numbers over 500 members. It holds annual conferences at different places. It has done much to stimulate the interest in libraries, and to give form and expression to their needs. It has led to the formation of local clubs and associations, of which there now exist over twenty-five in the United States, with a total membership of more than 2000 persons. These, holding conferences at more frequent intervals than the A.L.A., have kept interest and enthusiasm active among smaller groups, and have been able to exert a potent influence in local library afl'airs. The publishing section of the A.L.A., among other undertakings, issues select lists for reading, and printed catalogue cards of current publications, and an index on cards of certain current scientific serials, compiled by five co-operating libraries. In general, efiort among librarians is constant towards the economy both of specialization (as regards material) and co-operation (as regards service).

Library Schools. — Education for library work has been advanced by the establishment of schools giving instruction in library economy, and in some

cases authorized to confer degrees (B.L.S.). The parent of these schools (now at Albany, N.Y.) was established in 1884. Others are now at Brooklyn, Philadelphia, the Univer- sity of Illinois, and elsewhere. Tlie admission requirements of two of them presuppose a college degree. The course covers a period varying from one to three years. The number of students graduating in a single year reaches perhaps twenty to each school.

Local Progress. — The multiplication and increasing elaboration of buildings for library uses is but suggestive of the general advance. The three largest cities in the United States no longer suHer the reproach of being without adequate library facilities. Chicago, besides its municipal (public) library system, has two liberally endowed free reference libraries, the Newberry and the Crerar, which divide in part the field of literature, the Crerar confining itself to science and the technical arts. Philadelphia has now a free library system, the central building of which will cost at least a million dollars, and which meanwhile surpasses all records in the number of books issued to its readers. New York has had for some years a system of free libiaries, enlarging by gift and appropriation, to the maintenance of which the city con- tributes, and which parallel in activity the system at Philadelphia. In 1895 there was brought about the notable consolidation of the Astor, Lenox, and Tilden foundations upon which the New York Public Library is to be based. This brought together two great reference collections, aggregating over 500,000 books, besides pamphlets, and endowments in buildings and funds aggregating more than $8,000,000. The city assigned to it a superb site of ample dimensions, appropriated $2,500,000 for the main building, and will doubtless contribute towards maintenance, at any rate upon the assumption by the library trustees of the work of the present free circulating libraries. The union of all these funds and forces will provide for New York City the most elaborate library system of any city in the world, the culmination to date of library progress in American municipalities.

AurHORiTiES. — Fletcher, William I. Public Libraries in America, 2ud edit., Boston, 1899. A convenient sketch and manual. The statistics are now compiled systematically by the Bureau of Education, and published in its special reports on the Public ■ Libraries of the United Stales and Canada, of which the first in 1876 has been followed by others in 1886, 1891, and

1896. On library administration the papers contributed to the Library Conference at the Chicago Exposition, 1892, summarize the best experience of American librarians at that date. See also Dana, John C. A Library Primer, Chicago, 1899. — Plummer, Mary W. Hints to Small Libi'aries, 2nd edit.. New York, 1898. — But the entire subject, historical, statistical, and administrative, is most amply covered in the files of the Library Journal (New York, September 1876, to date and current), a monthly. This is the official organ of the American Library Association, and includes its proceedings. See also the file of Public Libraries, a monthly, published at Chicago 1896, to date and current.

LIST OF THE PEINCIPAL LIBRARIES IN THE UNITED STATES,

Including the Two Largest Libraries of each State, and all others having 50,000 Volumes and Upwards.

The statistics are official, furnished in part by the libraries to date, in part taken from their latest accessible printed reports (1897- 1901) ; for the other libraries, marked *, they are taken from "Public, Society, and School Libraries," Washington, 1901 (advance sheets from the Annual Report of the United States Commissioner of Education, 1899-1900). Under printed volumes are included pamphlets ; when the number of the latter is large in proportion to the total it is noted under "Remarks." In that column libraries are also distinguished as T., supported by taxation ; E., maintained by endowment or special funds ; C, free circulating ; R., reference only ; C. and R., circulating and reference ; F.R., free for reference ; S., society or proprietary ; Sub., subscription : special character is noted when not self-evident, e.g.. Science. The list contains 224 libraries in all (including 67 libraries with 100,000 volumes and upwards). The reference " 1897 report " or "1901 report " in the "Remarks " column is to the statistics of the Bureau of Education.

Approximate

Approximate

Library.

Founded.

Printed Vols.

Annual Accessions.

Annual Income.

Remarks.

Alabama —

1

*State and Supreme Court Library, Montgomery

1828

32,152

+941

+1,500

T., F.R. +1897 rept.

*Spring Hill College, Spring Hill .

1836

+33,905

250

E., F.R. +Inch 8255 pams.

Arizona —

‘Territorial Library, Phoenix .

1870

16,000

T., C. & R.

*Uni versify of Arizona, Tucson

1891

7,000

ij’ooo

1,500

T., C. & R.

Arkansas —

‘Arkansas State Library, Little Rock

1840

75,000

+8,750

+1,100

T., C. & R. +1897 rept.

Arkansas Supreme Court Library, Little Rock

1836

+40,000

250

1,050

T., F.R. +Incl. 10,000 pams.

California —

Bancroft Library, San Francisco .

50,000

E., F.R. History.

California State Library, Sacramento

1852

113,600

4^895

44,693

T., F.R.

Leland Stanford University Library, Palo Alto

1891

+68,694

2,000

9,250

E., C. & R. +Incl. 24,000 pams.

*Los Angeles Public Library ....

1872

54,535

5,842

28,581

T., C. & R.

*San Francisco Mechanics’ Institute

1855

100,170

3,748

26,776

Sub., C. & R.

*San Francisco Mercantile Library .

1852

75,000.

Sub., C. &R.

*San Francisco Public Library ....

1879

131,274

l6’,315

55,791

T., C. & R.

Sutro Library, San Francisco ....

1883

220,000

F.R. Science.

University of California, Berkeley .

1868

+150,577

4,000

tl2,940

T., C. & R. +Incl. 7000 pams. J1901 rept.

S. VL — 25

Approximate

Approximate

Library.

Founded.

Printed Vols.

Animal Accessions.

Annual Income.

Bemarks.

Colorado —

$

*Colorado College, Coburn Library, Colorado

Springs

1880

t50,000

1,400

1,650

Sub., C. & R. +Incl. 25,000 pams.

*Denver Public Library

1886

81,000

3,000

27,514

T., C. & R.

Connecticut —

I

Connecticut Historical Society, Hartford

1825

+50,000

749

2,786

S., F.R. +Incl. 25,000 pams.

*Hartford Public Library ....

1892

67,000

5,692

15,317

T., C. & R.

*Hartford Theological Seminary— Case Memorial

Library .

1834

+115,247

3,921

2,418

E., C. +Incl. 39,355 pams.

*N’ew Haven Free Public Library

1886

54,824

+3,381

17,840

T., C. & R. +1897 rept.

*Silas Bronson Library, Waterbury .

1869

66.042

1,352

11,693

E., C. & R.

*Trinity College Library, Hartford .

1823

+67,071

1,054

2,000

E., C. & R. +Incl. 26,335 pams.

*‘Watkinson Library of Reference, Hartford

1858

52,117

-1,463

5,800

E., F.R.

*Wesleyan University Library, Middletown

1833

58,000

2,900

3,186

E., Sub., C. & R.

Yale University Library, New Haven .

1700

384,500

10,000

34,500

E., C. & R.

Delaware —

Delaware State Library, Dover

1830

+45,000

$200

300

T., F.R. +IncL 15,000 pams. J1901 rept.

‘Wilmington Institute Free Library

1788

39,912

3,197

14,941

T., C. & R.

District of Columbia —

‘Georgetown College . . . .

1789

+119,923

921

J3,843

E., C. & R. tlncl. 44,473 pams. J1897 rept.

Library of Congress

1800

+957,056

MSS. 26,500, maps 52,181,

32,000

1510,000

T., F.R. +Incl. pams. and dups. ifor 1900-1.

‘Supreme Council, 33° A.A.S.R. of Free-

music 277,465

masonry, S.J., U.S.A.

1880

75,000

S., C. &R.

United States Bureau of Education

1868

+325,967

2^173

2,‘251

T., C. & R. +Incl. 150,000 pams.

United States Department of Agriculture

1869

+96,720

4,000

11,960

T., C. & R. +Incl. 30,000 pams.

‘United States Department of State

1789

65,500

+1,487

2,000

T., C. & R. +1897 rept.

United States Geological Survey

1882

+125,532

maps 30,000

{6,600

§2,000

T., C. & R. +Incl. 80,000 pams. JIncl. 3,000 pams. §For books.

‘United States House of Representatives .

+200,000

T., F.R. +Public documents.

‘United States National Museum

1881

+55,000

1,005

T., F.R. +Inch 30,000 pams.

‘United States Patent Office

1836

74,140

1,721

1,600

T., F.R.

‘United States Senate

1868

+125,000

3,654

T., F.R. Printed documents.

‘United States Surgeon-General’s Office

1870

+364,604

3,186

10,000

T.,C. &R. tlucL 229,546 pams.

Florida —

‘John B. Stetson University, De Land

1886

10,000

660

692

E., C. & R.

‘Florida State Library, Tallahassee

11,500

T., F.R.

Georgia —

Georgia State Library, Atlanta

1847

60,000

■ +500

3,000

T., F.R. +1901 rept.

‘Georgia Historical Society, Savannah

1839

27,982

376

2,673

S., Sub., C. &R.

Idaho — ‘Idaho State Law Library, Boise ‘University of Idaho and Agricultural College,

1863

15,000

+340

+1,150

T., F.R. +1897 rept.

Moscow

1889

7,700

1,000

1,000

T., F.R.

Illinois —

‘Chicago Historical Society

1866

+75,000

S. , Sub. , R. +Incl. 60, 000 pams.

‘Chicago Pablic Library .

1872

306,601

12,911

272,790

T., C. & R.

‘Illinois State Library, Springfield .

1839

50,000

3,200

1,200

T., F.R.

‘John Crerar Library, Chicago .

1894

59,817

13,877

139,944

E., F.R. Science.

Newberry Library, Chicago .

1887

+220,928

7,729

E., F.R. +lncl. 63,628 pams.

‘Northwestern University,’ Evanston

1855

+70,182

2,899

E., C. & R. +Inol. 27,000 pams.

‘Peoria Public Library

1880

74,361

4,400

15^808

T., C. & R.

‘University of Chicago

1892

+479,778

$10,000

E.,Sub.,C. &R. +IncL 160,000

Indian Territory —

pams. J1897 rept.

‘Cherokee National Library, Tahlequah .

2,900

28

T., F.R.

‘Cherokee National Male Seminary, Tahlequah

1866

4,026

90

T., F.R.

Indiana —

‘Indianapolis Public Library ....

1873

95,007

7,462

48,000

T., C. &R.

‘University of Notre Darae(Leraonnier’s Library)

1866

60,000

2,500

350

E., F.

‘Wabash College, Crawfordsville

1832

+61,000

900

1:2,274

E.,C. &R. +Incl. 15,000 pams.

Iowa —

$1897 rept.

Iowa State Library, Des Moines

1838

65,093

2,500

7,000

T., F.R.

‘University of Iowa, Iowa City

1856

55,000

‘5,650

+4,960

T., C. & R. +1897 rept.

Kansas —

‘Kansas State Historical Society, Topeka

1876

+111,101

2,605

6,194

T., F.R. +Incl. 66,257 pams.

‘Kansas State Library, Topeka

1870

77,000

7,600

10,400

T., F.R.

Kentucky —

Kentucky State Library, Frankfort

1820

102,000

1.000

900

T., F.R.

‘Polytechnic Society of Kentucky, Louisville .

tl878

52,000

889

4,087

S., Sub., C. &R. +1897 rept.

LIBRARIES

219

Appi-oximate

Approximate

Library.

Foundeil.

Printed Vols.

Ann Hill Accessions.

Annual Income.

Remarks.

Louisiana —

9

*Fisk Free and Public Library, New Orleans .

1897

43,000

3,250″

11,993

T., C. & R.

*Howard Memorial Library, New Orleans

1887

38,000

2,046

7,500

E., F. & R.

Maine — ■

*Bangor Public Library ....

1883

56,697

1,425

5,769

C, F.R.

*Bowdoin College, Brunswick .

1794

67,164

2,059

2,9B5

E., C. & R.

Colby University, Waterville .

1820

t54,837

1,000

J430

E., C. & R., Sub. +Inol. 20,000 pams. $1901 rept.

*Maine State Library, Augusta

1861

63,000

2,800

4,300

T., C. & R.

Maryland — ■ •

*Baltimore New MeKcantile Library.

1888

67,540

2,083

6,352

E., C. & R., Sub.

*Enoch Pratt Free Library, Baltimore

1882

217,118

10,000

65,000

E., C. & R.

- Johns Hopkins University

1876

tl93,000

4,000

E., C. & R. +Inol. 100,000 pams.

Peabody Institute, Baltimore .

1857

149,542

2,687

21,428

E., F.R.

*Woodstock College . . . .

‘ 1869

t77,000

500

E., C. & R. +Incl. 10,000 pams.

Massachusetts —

American Antiquarian Society, Worcester

1812

150,000

+1,487

S., R. History. +1901 rept.

*Amherst College ....

1821

t92,000

2,500

$3,000

E., C. & R. +Incl. 10,000 pams. $1897 rept.

Andover Theological Seminary

1808

t77,000

1277

§530

E., C. & R. +Incl. 26,000 pams. $1901 rept. § For books only.

‘Boston Athenseum

1807

196,000

4,586

41,741

S., C. &R.

*Boston Public Library

1854

772,432

32,368

£02,457

T., C. & R.

*Brooklin6 Public Library ....

1857

54,570

4,441

20,068

T., C. & R.

Cambridge Public Library ....

1858

66,315

31,847

20,000

T., C. &R.

‘Congregational Library, Boston

1853

t91,105

1,003

6,824

S , F.R. +Incl. 48,747 pams.

Essex Institute, Salem ....

1848

+362,000

J2,976

139,600

E., C. & R. Science. +IncL 285,000 pams. $1901 rept.

Fall River Public Library

1861

57,419

2,185

13,3.36

T., C. &R.

*Forbes Library, Northamjiton

1894

81,296

8,191

21,780

E., C. &R.

Harvard University, Cambridge

1638

+956,337

23,745

62,000

E.,C. &R. +Inol. 427,822 pams.

‘Haverhill Public Library

1873

60,000

3,080

15,605

E. &T., C. &R.

‘Lawrence Free Public Library

1872

57,893

1,692

13,303

T., C. & R.

Lowell City Library

1844

59,650

1,523

15,761

T., C. & R.

Lynn Free Public Library

1862

64,574

2,486

8,666

T., C. & R.

Massachusetts Historical Society, Boston

1791

+144,000

3,000

S., C. & R. +Inol. 102,000 pams.

‘Massachusetts Institute of Teclmology, Boston

tl870

J68,000

4,000

E., C. & R. +1897 rept. $Incl. 16,000 pams.

‘Massachusetts State Library, Boston

1826

+193,567

4,084

8,300

T., F.R. tlncl. 87,216 pams.

New Bedford Free Public Library .

1852

80,681

1,347

17,773

T., C. & R.

‘New England Historic Genealogical Society,

Boston . ....

1845

+51,000

430

4,813

S., C. & R. +Incl. 24,000 pams.

Newton Free Library

1871

57,000

1,807

15,120

T. & E., C. & R.

‘Springfield City Library Association

1857

130,091

8,118

45,208

T., C. & R. ,

‘Tufts College, Tufts College .

1854

+68,701

2,331

E., C. & R. +Incl. 27,666 pams.

‘Watertown Free Public Library

1869

+51,000

482

4,925

T. , C. & R. +IncL 25,000 pams.

‘Wellesley College

1875

51,659

1,520

5,593

E., C. &R.

Williams College, Williamstown .

1793

+61,000

2,500

6,600

E.,C. &R. +Incl. 16,000 pams.

Worcester Free Public Library

1859

+128,196-

5,166

44,068

T., C. & R. +1901 rept.

Michigan —

‘Detroit Public Library

1865

157,510

6,905

66,046

T., C. & R.

Grand Rapids Public School Library

1861

60,171

2,099

9,346

T., C. & R.

‘Michigan State Library, Lansing .

tl828

100,000

3,299

7,500

T., C. &R. +1897 rept.

‘University of Michigan, Ann Arbor

1841

145,460

12,256

16,200

E., C. & R.

Minnesota —

‘Minnesota Historical Society, St Paul .

1849

+64,280

1,357

7,600

T., C. & R. +Incl. 32,200 pams.

‘Minneapolis Public Library ....

1885

114,000

7,165

61,295

T., C. & R.

*St Paul Public Library

1882

50,000

3,4.57

17,934

T., C. & R.

‘University of Minnesota, Minneapolis .

1868

65,000

+3,350

10,876

T., F.R. +1897 rept.

Mississippi —

‘Mississippi State Library, Jackson .

1838

79,090

+2,000

1,500

T., F.R. +1897 rept.

‘University of Mississippi, University

1848

17,000

200

1,000

E., C. & R.

Missouri—

‘Drury College, Springfield

1873

+55,000

557

129

E., Sub., C. & R. +Incl. 30,000

*St Louis Mercantile Library . ...

1846

128,587

5,021

52,839

E., Sub., C. & R.

*St Louis Public Library ....

1865

165,000

5,441

78,225

T., C. &R.

Montana—

‘Butte Free Public Library

1890

27,150

2,800

1,700

T., C. & R.

‘Helena Public Library

1868

44,710

1,788

9,640

T., C. &R.

Nebraska —

‘Omaha Public Library .....

1877

53,800

4,402

20,227

T., C. & R.

‘University of Nebraska, Lincoln .

1859

55,000

4,685

13,604

T., C. & R.

220

LIBRARIES

Approximate

Approximate

Library.

Founded.

Printed Vols.

Annuai Accessions.

Annual Income.

Remarks.

Nevada —

$

■“Miners’ Union Library, Virginia City .

1877

10,684

+299

S., C. & R. +1897 rept.

*Nevada State Library, Carson City

1865

45,000

1,500

2,947

T., C. & R.

jSTew Hampshire —

*Dartmoutli College, Hanover ....

1769

112,000

2,938

12,290

E., C. & R.

New Hampshire Historical Society, Concord .

1823

+94,111

t4,000

1,500

S., F.R. +Incl. 78,566 pams., Jincl. 3000 pams.

New Hampshire State Library, Concord

1820

+107,606

11,000

12,844

T., F.R. tlncl. 50,000 pams.

New Jersey —

*Drew Theological Seminary, Madison

1866

+106,388

9,767

850

Ej, C. & R. +IncL 47,585 pams.

*Gardner A. Sage Library, New Brunswick

1856

52,570

483

1,650

E., C. &R. Theology.

*Jersey City Free Public Library

1889

72,963

3,506

32,443

T., C. & R.

*Newark Free Public Library .

1888

74,687

6,600

49,960

T., C. &R.

*New Jersey State Library, Trenton

1796

58,500

2,000

7,600

T., F.R.

*Prineeton Theological Seminary

1812

+91,500

1,816

16,176

E., C. & R. +Incl. 27,000 pams. 11897 rept.

*Princeton University

1746

+151,149

12,000

25,000

E., C. & R. +Incl. 25,000 pams.

New Mexico —

*New Mexico College of Agriculture and

Mechanic Arts, Mesilla Park

1890

4,000

+960

760

T., Sub., C. & R. +1897 rept.

*New Mexico Territorial Library, Santa ¥6

1850

4,500

300

+2,600

T., F. & R. +1897 rept.

*University of New Mexico, Albuq^uerque

1892

5,200

96

500

T., F.R.

New York —

*Aguilar Free Library, New York City .

1886

76,779

13,009

+13,852

E. & T., C. & R. +1897 rept.

*Arthur W. Tams Music Library, New York

City .

1885

+1,500,000

25,000

Sub., C. & R. +IncL 1,000,000

Association of the Bar of the City of New York

1870

51,454

+1,819

77,171

pams. S.R. +1897 rept.

*Brooklyn Library

1857

168,676

3,623

21,893

S., Sub., C. & R.

*Biiffalo Public Library

1837

167,000

21,221

85,801

T., C. & R.

*College of St Francis Xavier, New York City .

1847

82,000

2,400

+800

E., C. & R. +1897 rept.

*Columbia University, New York City .

1754

310,000

22,000

+67,882

E., C. & R. +1897 rept.

*Cornell University, Ithaca

1868

+261,622

15,344

34,098

E., C. & R. +Inch 36,000 pams.

*Davenport Library, Bath ....

1889

90,138

+200

S., C. & R. +1897 rept.

*Grosvenor Library, Buffalo, N.Y. .

1859

56,766

5,059

25,786

T., F.R.

Hamilton College, Clinton ....

1812

+66,247

, 945

2,150

E., C. & R. +Incl. 24,894 pams.

*Long Island Historical Society

1863

64,683

2,161

8,281

S., Sub., R.

Maimonides Free Library, New York City

1852

64,802

10,961

10,375

T., C. & R.

*New York Academy of Medicine .

1847

+100,000

J2,039

14,500

S. , C. & R. +Incl. 20,000 pams., J1897 rept.

*New York City Free Circulating Library

1880

163,465

14,574

98,497

E. & T., C. & R.

*New York City Free Library of the General

Society of Mechanics and Tradesmen .

1820

109,955

+4,000

6,622

E. &T., C. & R. +1897 rept.

*New York Historical Society ....

1804

108,403

4,878

11,540

S., Sub., R.

*New York Law Institute ....

1828

62,373

2,123

16,636

S., C. &R.

New York City Mercantile Library Association

1820

293,943

3,664

26,316

S., C. k R.

New York Public Library, Astor, Lenox, and

Tilden foundations ‘ . . .

1895

+608,775

MSS. 50,000

51,182

144,678

E. & T., C. & R. +Incl. 129,416 pams.

*New York Society Libi’ary, New York City .

1754

100,000

+1,890

127,061

S., C. &R. +1897 rept.

*Nevv York State Law Library, Albany .

1818

64,296

1,684

T., F.R.

New York State Library, Albany .

1818

+539,741

MSS. 250,000

49,382

72’,‘351

T., F.R. +Incl. 128,975 pams.

*New York University Library, New York City

1831

55,000

4,466

6,413

E., F.R.

New York City Y. M. C. A. Li brary .

1852

76,864

14,400

S., R.

*Pratt Institute Free Library, Brooklyn .

1888

70,249

4,064

E., C. & R.

Syracuse University

1871

+61,611

2,700

3^557

E., C. & R. +Inol. 16,611 pams.

*Union Theological Seminary, New York City

1836

+10.5,000

766

4,772

E., C. & R. +Iucl. 30,000 pams. T., C. & R.

*U.S. Military Academy, West Point

1816

51,924

1,513

73,900

North Carolina —

North Carolina State Library, Raleigh .

1821

+40,000

2,267

J500

T., F.R. +lncl. 15,000 pams. 11901 rept.

■“University of North Carolina, Chapelhill

1800

+43,000

|1,250

E., C. & R. +Incl. 12,000 pams.

North Dakota —

J1897 rept.

*North Dakota Agricultural College, Agricul-

tural College

1890

8,200

+888

T., F.R. +1897 rept. T., F.R.

*North Dakota State Library, Bismarck

1 SS9

13,400

600

1,000

*University of North Dakota, University Ohio— *Ca8e Library, Cleveland ....

1884

7,000

+700

+1,000

T., F.R. +1897 rept.

1848

53,000

+2,250

15,507

E. Sub., C. & R. +1897 rept. T., C. &R.

•Cincinnati Public Library ....

1867

230,892

8,176

66,428

•Cincinnati Y.M. Mercantile Library

1836

63,000

1,020

7,600

Sub., C. & R., S.

■•Cleveland Public Library ....

1869

175,868

19,422

72,943

T., C. & R.

•Dayton Public Library

1855

51,362

2,458

14,259

T., C. & R.

•Mirietta College, Marietta

Ober in College

•Ohio Slate Library, Columbus

1835

65,000

18,100

+3,000

E., C. & K. +1897 rept.

1 833 1817

+95,350 68,215

5,000 6.875

15,120 14,640

E., C. & R. +Iucl. 49,360 pams. T., C. & R.

LIBRARIES

221

Approximate

Approximate

Library.

Pounded.

Printed Vols.

Annual Accessions.

Annual Income.

Remarks.

Oklahoma —

1

*Oklahoma Library, Guthrie ....

1893

8,000

300

2,300

T., F.R.

*University of Oklahoma, Norman .

1892

8,000

1,000

1,200

T., F.E.

Oregon —

*Oregon State Library, Salem ....

1850

25,000

500

1,500

T., C. &R.

Portland Library Association ….

1864

27,456

1,500

5,079

S., C. & R.

Pennsylvania —

*Academy of Natural Scienee of Philadelphia .

1812

t68,866

647

113,665

S., F.R. +Inch 18,646 pams. 11897 rept.

*Carnegie Library, Pittsburg ....

1895

112,487

29,113

93,739

E. & T., C. & R.

*Conege of Physicians of Philadelphia

1788

+96,384

2,655

5,169

S.,C. &R. +Incl 37,179 pams.

*FrankUn Institute Library, Philadelphia

1824

+87,156

1,579

18,600

E.,Sub.,C. &R. Science. +IncL 35,996 pams.

*Germau Society of Pennsylvania, Philadelphia

1817

51,200

500

746

K, C. & K.

*Lehigh University, South Bethlehem

1877

+112,158

1,350

15,590

E.,F. &R. +IncL 30,832 pams. 11897 rept.

*Philadelphia Free Library ....

1891

207,585

22,898

164,000

E. & T., C. & R.

*Philadelphia Library Company

1731

231,184

3,619

43,695

S., C. & R.

Philadelphia Mercantile Library

1821

194,011

2,506

15,000

S., C. &R.

Pennsylvania State Library, Harrisburg

1790

118,000

7,500

T., F.R.

*Pittsburg Library Association

1848

+50,000

“750

2,500

S., Sub., C. & R. +IncL 10,000

*Presbyterian Historical Society, Philadelphia

1852

‘ +70,000

t300

759

t],518

S., F.E. +Incl. 50,000 pams., |1897 rept.

University of Pennsylvania .

1749

+266,709

9,118

E.,C.&R. tlnel. 100,000 pams..

tl901 rept.

*Wilson’s Library, Philadelphia

1875

95,000

5,140

+11,750

Sub., C. +1897 rept.

Rhode Island —

*Brown University, Providence

1767

+140,000

5,438

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E., C. & R. +Incl. 30,000 pams.

Providence Atlienaeura

1836

66,711

1,200

9,392

S., C. & E..

*Providence Public Library

1878

+108,723

2,840

135,125

E. &T., C. & R. tlncL 20,000

*Rhode Island Historical Society, Providence .

1822

+65,000

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South Carolina —

pams.

*South Carolina College Library, Columbia

1805

32,783

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T., C. & R. ‘

*South Carolina State Library, Columbia

1816

+75,000

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T. , C. & R. +Inol. 25, 000 pams.

South Dakota —

*State Agricultural College, Brookings .

1885

+14,870

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E., F. & R. +Incl. 95,000 pams.

*State Normal School, Spearfish

1887

14,850

1,000

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E. & T., C. & R. +1897 rept.

Tennessee —

*Tennessee State Library, Nashville

tl854

40,000

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T., F. &R. +1897 rept.

*Vanderbilt University, Nashville .

1875

40,000

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E., Sub , C. & R.

‘University of the South, Sewanee .

42,536

612

1,564

E. Sub., E.

Texas— *Texas State Library, Austin ....

1839

21,800

705

1,990

T., F.R.

‘University of Texas, Austin ....

1884

+44,000

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E. , C. & R. +Incl. 10,000 pams.

Utah— ‘

*Salt Lake City Free Public Library

1897

14,498

1,661

6,660

T., C. & R.

‘University of’ Utah, Salt Lake City

tl869

130,000

1,300

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T., F.R. +1897 rept. JlncL 10,000 pams.

Vermont —

‘Fletcher Free Library, Burlington .

1874

40,000

760

3,165

T., C. & R.

University of Vermont, Burlington

1824

88,217

3,000

4,500

K, C. & R.

Virginia —

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‘University of Virginia, Charlottesville .

1819

50,694

9,144

450

E. & T., C. & R.

‘Virginia State Library, Richmond .

1823

98,500

389

+3,000

T., F.R. +1897 rept.

Washington —

‘Seattle Public Library ...

1891

+31,877

1,952

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T., C. & R. +IncL 12,000 pams.

‘Washington State Library, Olympia

1854

27,000

+2,767

+3,550

T., C. & R. +1897 rept.

West Virginia —

West Virginia University, Morgantown .

1867

16,500

2,200

3,6,56

E., C. &E., Sub.

‘Wheeling Public Library

1882

17,200

1,024

6,720

T., C. & E.

Wisconsin —

‘Milwaukee Public Library

1878

130,184

8,401

48,631

T., C. & E.

‘University of Wisconsin, Madison .

1850

+83,750

5,150

12,000

T.,C. &R. +Incl. 20,000 pams.

‘Wisconsin Historical Society, Madison .

1854

+215,000

3,560

12,326

T., F.R. +Incl. 105,000 pams.

Wyoming—

‘University of Wyoming, Laramie .

1891

+14,800

2,359

4,470

E., C.R. +Incl. 5500 pams.

‘Wyoming State Law Library, Cheyenne

1S72

15,000

T., F.R.

(H. P.)

222

L I C A T A — L I D D 0 N

Licata, a seaport town of the province of Girgenti, Sicily, Italy, on the south coast, at the mouth of the river Salso, 24 miles south-east of Girgenti (54 miles by rail). The town, which stands below the level of the sea, is ” a very miserable place to look at now, with its nooks and corners, its blind alleys and dark lanes, its dirty, ill-smelling, narrow, crooked streets ” (Vice-consul Giglio in 1896). It has a Gothic church, a technical school, and the ruins of two ancient castles ; one of these, San Angelo, was bought and repaired by the Italian Government in 1888, and equipped as a signalling tower. The people carry on live-stock breeding, the cultivation of fruits, flowers, and vegetables, cheese-making, sulphur mining and refin- ing, the manufacture of pottery (porous jars) and macaroni, flour-milling, brick- andtile-making,

and fish-curing, chiefly anchovies and sardines. Licata is one of the principal Sicilian ports for the exports of sulphur. In 1888 sulphur was exported to the value of £649,000; and £380,150 in 1898. The total exports were valued at £576,600 in 1888; £453,700 in 1899. The total imports fluctuate from £34,000 (1887) to £246,650 (1896) ; £125,600 in 1899. The port was cleared by an average of 933 vessels of 157,200 tons in the years 1893-99 inclusive. In 1896 the Government voted £66,730 for the improvement of the harbour (10-16 feet deep) ; and at the same time a concession was granted for the construction of an entirely new harbour, 2 miles from the old one, with every appli- ance of a firstclass port. Population (1881), 17,478 ;

(1899), 23,700.

Lichfield, a city, municipal borough, and county of itself in the Lichfield parliamentary division (since 1885) of Staffordshire, England, 118 miles north-west of London by rail. The restoration of the cathedral has been completed ; the old church of St Chad at Stowe and that of St Michael have been restored. The house in which Dr Johnson was born has been acquired by the corporation through the generosity of Alderman Gilbert, and opened to the public in a similar manner to Shakespeare's birth- place at Stratford-on-Avon. Area, 3421 acres. Popula- tion (1881), 8349 ; (1891), 7864 ; (1901), 7902.

Liddell, Henry George (1811-1898), English scholar and divine, eldest son of the Eev. Henry George Liddell, younger brother of the first Baron Eavensworth, was born at Binchester, 6th February 1811, but his father becoming soon afterwards rector of Boldon, between Newcastle-on-Tyne and Sunderland, most of his childhood and boyhood was passed there. When eight years old he was sent to a private school near Eipon, from which he proceeded at the age of twelve to Charterhouse, and seven years later, May 1830, to Christ Church, Oxford. Gaining a double first in 1833, Liddell became a college tutor, and pursuing the study of divinity, was ordained in 1838. In the same year Dean Gaisford appointed him Greek reader in Christ Church, and in May 1846 he was appointed to the headmastership of Westminster School. Meanwhile his life work,the great Lexicon (based on the German work of Passow), which he and Eobert Scott

began as early as 1834, had made good progress, and after about ten years of hard work the first edition, which may more properly be termed the first draft, appeared in 1843. It immedi- ately became the standard Greek-English dictionary and still maintains this rank, although, notwithstanding the great additions made of late to our Greek vocabulary from inscriptions, papyri, and other sources, scarcely any enlargement has been made since about 1880. It is nevertheless understood that Dean Liddell continued to labour upon it almost to the last day of his long life. As headmaster of Westminster Liddell enjoyed a period of great success, followed by trouble due to the outbreak

of fever and cholera in the school. When this was over he found time to write a History of Ancient Rome, and to take a very active part in the first Oxford University Commission. In 1855 he received the appointment of dean of Christ Church, with which his name will always be connected. His tall figure, fine presence, and aristocratic mien were for many years associated with all that was characteristic of Oxford life. Coming just at the transition period when the ” old Christ Church,” which Pusey strove so hard to preserve, was inevitably becoming broader and more liberal, it was chiefly due to Liddell that necessary changes were effected with the minimum of friction. With the buildings of Christ Church also his name will long be associated, especially with the much-needed restoration of the cathedral and the improvement of the services. In 1859 Dean Liddell welcomed the then prince of Wales when he matriculated at Christ Church, being the first holder of that title who had matriculated since Henry V. In conjunction with Sir Henry Acland, Dean Liddell did much to encourage the study of art at Oxford, and his taste and judgment gained him the admiration and friendship of Ruskin. In 1891, owing to advancing years, he resigned the deanery. The last years of his life were spent at Ascot, where he died 18th January 1898. Dean Liddell married in July 1846 Miss Lorina Peeve, by whom he had a numerous family.

Liddon, Henry Parry (1829-1890), English divine, was born at North Stoneham, Hampshire, on 20th August 1829. He was educated at King’s College School, London, and at Christ Church, Oxford. He graduated, taking a second class, in 1850. In 1854 he was made vice-principal of the Theological College at Cuddesdon. His influence over the students was

immense, and his sermons held some ten or twelve hearers as much enthralled as they afterwards did the vast congrega- tions in St Paul's Cathedral. In 1859 he resigned the vice-prinCipalship, in consequence of some divergence of opinion between hi:n and Bishop Wilberforce. He re- turned to Oxford, and became a growing force there among the undergraduates, exercising his influence in strong opposition to the Liberal reaction against Tractarianism, which had set in after Newman's secession in 1846. In 1864 Bishop Hamilton of Salisbury, whose examining chaplain he had been, appointed him prebendary of Salis- bury Cathedral. In 1866 he delivered his famous Bampton Lectures, in which, with a wide range of general know- ledge, with remarkable clearness, brilliancy, and logical coherence, as well as with a considerable store of theo- logical learning, he enforced and illustrated the doctrine of the Divinity of Christ. From that time his fame as a preacher, which had been steadily growing, may be con- sidered to have been established. In 1870 he was made canon of St Paul's. He had before this published Some Words for God, in which, with great power and eloquence, he combated the scepticism of the day. His preaching at St Paul's soon attracted vast crowds. The afternoon sermon, which fell to the lot of the canon in residence, had usually been delivered in the choir of the Cathedral. But soon after Liddon's appointment it became necessary to preach the sermon under the dome, where as many as 4000 persons, it was estimated, used to gather to hear the preacher. Few orators belonging to the Church of Eng- land have acquired so great a reputation as Canon Liddon. Others may have surpassed him in originality, learning, or reasoning power. But for grasp of his subject, clear- ness of language, lucidity of arrangement, felicity of illustration, vividness of imagination, elegance of diction, and above all, for sympathy with the intellectual posi- tion of those whom he addressed, he has hardly a rival

among the celebrated preachers of the Anglican com- munion. In the elaborate arrangement of his matter he is thought to have imitated the great French preachers of the age of Louis XIV. In 1870 he was also made Ireland Professor of Exegesis at Oxford. These two appointments combined

gave him extensive influence over the Church of England. Liddon at Oxford, and Liddon and Church at St Paul's, may be said to have restored the waning influence of the Tractarian school, and the former suc- ceeded in popularizing the opinions which, in the hands of Pusey and Keble, had appealed to thinkers and scholars. Some clouds in connexion with the Pusey House at Oxford, where Liddon considered that a departure was being made from the line of thought laid down by Pusey himself, disturbed the repose of his later days. Illness seized him in 1889, and on 9th September 1890 he passed away at Weston-super-Mare, in the full vigolir of his intellect and at the zenith of his reputation. He had undertaken an elaborate life of Dr Pusey, for whom his admiration was unbounded ; and this work was completed after his death by other hands. Canon Liddon's character was as much a force as his eloquence. His strong advocacy of Church views, which were somewhat " advanced," raised up a host of opponents and critics. But there was none who could fail to entertain respect for his honesty, sincerity, and devotion, as well as for a combination of personal gifts only too rarely found in any branch of the Church. (j. j. l*.)

Lie, Jonas Lauritz Edemil (1833-

~~), Nor~~

wegian novelist, was born on 6th November 1833 close to Hougsund (Eker,), near Drammen. In 1838, his father being appointed sheriff of Tromso, the family removed to that Arctic town. Here the future novelist enjoyed an untrammelled childhood among the shipping of the little ISTordland capital, and gained acquaintance with the wild seafaring life which he was afterwards to describe. In 1846 he was sent to the naval school at Frederiksveern to become a cadet, but his extreme near- sight unfitted him for service, and he was transferred to the Latin school at Bergen. In 1851 he went up to the University of Christiania, where Ibsen and Bjornsonwere among his fellow-students. Joijas Lie, however, showed at this time no inclination to literature. He pursued his studies as a lawyer, took his degrees in law in 1858, and settled down to practice as a solicitor in the little town of Kongsvinger. In 1860 he married his cousin, Thomasine Lie. In 1866 Lie published his first book, a volume of poems. Two years later, at the mature age of thirty-five, he abandoned the law, and came back

to Christiania to try his luck as a man of letters. As a journalist he had no success, but in 1870 he published a melancholy little romance. The Man with the Second Sight, which enjoyed some favour with the public. Lie proceeded to Eome, and published Tales in 1871, and The Three-master ” The Future,” a novel, in 1872. His first great book, however, was The Pilot and his Wife (1874), which placed Jonas Lie at the head of ISTorwegian novelists ; it was written in the little town of Rocca di Papa in the Albano mountains. Lie spent the next few years partly in Dresden, partly in Stuttgart, with frequent summer excursions to Berchtes- gaden in the Bavarian highlands. During his exile he produced the dran^a in verse called Faustina Strozzi (1876). Eeturning to Norway, Lie began a series of romances of modern life in Christiania, of which Thomas Boss (1878) and ^dam Schrader (1879) were the earliest. He returned to Germany, and settled first in Dresden again, then in Hamburg, until 1882, when he took up his abode finally in Paris. The novels of his German period are Rutland (1881) and Go Ahead ! (1882), tales of life in the Norwegian merchant navy. His later works, produced with great

regularity, have enjoyed an immense reputation in Norway. Two of the most successful of these have been The Com- modore’s Daughters (1886) and Niobe (1894), both of which have been presented to English readers in the International Library, edited by Mr Gosse. One of the best of Lie’s works is the romance called When the Sun goes down (1895). It has been said that ” Jonas Lie stands, as a novelist, with those minute and unobtrusive painters of con- temporary manners who defy arrangement in this or that school. He is with Mrs Gaskell or M. Ferdinand Fabre ; he is not entirely without relation with that old-fashioned favourite of the public, Fredrika Bremer. His truthful- ness, his simple pathos, his deep moral sincerity, have gradually conquered for him a place in the hearts of his countrymen and countrywomen which there is no one to dispute with him.” He is by far the most popular of the living novelists of Norway. Among his later works must be mentioned the powerful novel of Dyre Rein (1896), the fairy drama of Lindelin (1897), Faste For- land (1899), a romance, and When the Iron Curtain falls (1902). Jonas Lie has resided for many years in Paris, spending every summer in his villa at Berchtesgaden in Tirol.

Lie, Marius Sophus (1842-1899), Norwegian mathematician, was born at Nordf jordeif, near Bergen, on 12th December 1842, and was educated at the University of Christiania, where he took his doctor's degree in 1868 and became extraordinary professor of mathematics four years later. In 1886 he was chosen to succeed Klein in the chair of geometry at Leipzig, but as his fame grew his countrymen began to feel that it was not right that one so distinguished should be obliged to work in a foreign land, and a special post was therefore arranged for him in Christiania. This, however, he did not live to enjoy very long, for his health was broken down by too assiduous study, and he died at Christiania on 12th February 1899, six months after his return. Lie's work exercised a great influence on the progress of mathematical science during the later decades of the 19th century. His primary aim has been declared to be the advancement and elaboration of the theory of differential equations, and it was with this end in view that he developed his theory of transformation groups, set forth in his TJieorie der Transformationsgruppen (3 vols., Leipzig, 1888-93), a work of wide range and great originality, by which probably his name is best known. A special application of his theory of continuous groups was to the general problem of non-Euclidean geometry. The latter part of the book above mentioned was devoted to a study of the foundations of geometry, considered from the stand- point of Eiemann and Helmholtz ; and he intended to publish a systematic exposition of his geometrical inves- tigations, in conjunction with Dr G. Scheffers, but only one volume made its appearance {Qeometrie der Beruhr- iingstransformationen, Leipzig, 1896). The reader will find many references to Lie's work scattered through the mathematical articles in these volimies,e.g'.,DiFrEKENTiAL Equations ; Geometry, Line ; Geometry, Non-Eucli- dean ; Groups, Theory of. Lie was a foreign member of the Eoyal Society, as well as an honorary member of the Cambridge Philosophical Society and the London Mathematical Society, and his geometrical inquiries gained him the much-coveted honour of the Lobatchew- sky prize.

Lieben, a village and commune in the government district of Karolinenthal, Bohemia, north-east of Prague, and a station on the north-western and the Austro- Hungarian state railways. It immediately adjoins the Karolinenthal suburb, and is a busy industrial centre

with numerous textile and other factories, manufacturing among other things cliemicals, colours, oil, pipes, gloves, leather, machinery, bricks, tiles, and beer. Population (1890) of the village, 9000, and of its commune, 12,536 ; (1900), 21,300, almost exclusively Czech and Catholic.

Liebknecht, Wilhelm (1826-1900), German Socialist, was born in Giesseu, on 29th March 1826, of a respectable middle-class family. Left an orphan at an early age, he was educated at the gymnasium in his native town, and attended the universities of Giessen, Berlin, and Marburg. Before he left school he had be- come affected by the political discontent then so universal in Germany ; he had already studied the writings of St Simon, from which he gained his first interest in Com- munism, and had been converted to the extreme Eepub- lican theories of which Giessen had long been a centre. He soon came into conflict with the established authori- ties— no difficult matter in those days — and was expelled from Berlin apparently in consequence of the strong sym- pathy he displayed for the Poles, who were being tried for high treason. Like so many of his countrymen, he proposed in 1846 to migrate to America, but went instead to Switzerland, where he earned his living as a teacher in the Froebel Institute. As soon as the Revolution of 1848 broke out he hastened to Paris, but the attempt to organize a Republican corps for the invasion of Germany was pre- vented by the Government. In September, however, in concert with Struve, he crossed the Rhine from Switzer- land at the head of a band of volunteers, and proclaimed a Republic in Baden. The attempt collapsed; he was captured, and after suffering eight months' imprisonment, was brought to trial. Fortunately for him, a new rising had just broken out ; the mob burst into the court, and he was acquitted. During the short duration of the Revolutionary Government he was an active member of the most extreme party, but on the arrival of the Prussian troops succeeded in escaping to Prance. Thence he went to Geneva, where he came into intercourse with Mazzini; but, unlike most of the German exiles, he was already an adherent of the Socialist creed, which at that time was more strongly held in Prance. Expelled from Switzer- land, he went to London, where he lived for thirteen

years in close association with Karl Marx. Like most of the other exiles, he endured great hardships, but secured a livelihood by teaching and writing ; he was a correspond- ent of the Augsburger Allgemeine Zeitung. During his imprisonment in Freiburg he had won the affections of the gaoler's daughter, and in 1866 she came to London, where they were married. The amnesty of 1861 opened for him the way back to Germany, and in 1862 he ac- cepted the post of editor of the Norddeutsche Allgemeine Zeitung, the founder of which was an old revolutionist. Only a few months elapsed before the paper passed under Bismarck's influence. There is no more curious episode in German history than the success with which Bismarck acquired the services of many of the men of 1848. Liebknecht remained faithful to his principles, and resigned his editorship. He became a member of the Arbeiterverein, and after Lassalle's death was the chief mouthpiece in Germany of Karl Marx, and was in- strumental in spreading the influence of the newly- founded Iii.tP.rnatio'n.al. Expelled from Prussia in 1865, he settled at Leipzig, and it is primarily to his activity in Saxony among the m-wly-foriued unions of workers that the modern Social Democrat party owes its , origin. He was in 1867 elected member of the North German Reich-stag, but in opposition to Lassalle's followers refused all compromise with the "capitalists," and avowedly used his position merely for purposes of agitation and to take every opportunity for making the Parliament ridicu-

lous. He was strongly influenced by the "'great Ger- man " traditions of the Democrats of 1848, and, violently anti-Prussian, he distinguished himself by his attacks on the policy of 1866 and the " Revolution from above," and by his opposition to every form of militarism. The tra- ditions of 1848 are also seen in his dread of Russia, which he maintained to his death. His opposition to the war of 1870 (he and Bebel alone refused to vote for the war loan) exposed hirri to insults and violence, and in 1872, with Bebel, he was condemned to two years' imprison- ment in a fortress for treasonable intentions. The union of the German Socialists in 1874 at the Congress of Gotha was really a triumph of his influence, and from that time he was regarded as founder and leader of the party. He was till his death a member at the German Reichstag, and for many years also of the Saxon Parlia-ment. In all debates he was one of the chief spokesmen of the party, and he took a very important part in direct- ing their policy. In 1881 he was expelled from Leipzig, but took up his residence in a neighbouring village.

After the lapse of the Socialist law (1890) he became chief editor of the Vorwilrts, and settled in Berlin. In November 1896 he was condemned to four months' im- prisonment for Use majeste. If he did not always And it easy in his later years to follow the new developments, he preserved to his death the idealism of his youth, the hatred both of Liberalism and of State Socialism ; and though he was to some extent overshadowed by Bebel's greater oratorical power, he was the chief support of the orthodox Marxian tradition. Liebknecht was the author of numerous pamphlets and books, of which the most im- portant were — Soil Europa Kosakisch werden? JRobeii Blum imd seine Zeit, GeschicJite der Franzosischen Hevolu- tion, Die Emser Depesche, and Robert Owen. He died in Berlin on 6th August 1900.

See also Kuet Eisner. Wilhelm Liebknecht, sein Lehen und Wirken. Berlin, 1900.

Liechtenstein, the smallest independent state in Europe, save San Marino and Monaco, extending along the right bank of the Rhine, opposite Swiss territory between Sargans and Sennwald, while to the east it also comprises the upper portion of the Samina glen which debouches into the 111 valley at Frastanz, below Feldkirch. It is 12 miles in length, and has an area of 68-8 square miles. Its loftiest point rises on the crest of the Rhatikon range at the south-east angle of the state, and is called the Naafkopf or Eothe Wand (8426 or 8445 feet) ; on its summit the Swiss, Vorarlberg, and Liechtenstein frontiers join. Population (1886), 9593; (1896), 9600. Compul- sory military service was abolished in 1868, and the state now contains more men than women. The capital is Vaduz (1623 feet), which has 1100 inhabitants. Till the 17th century the Romonsch language was not extin- guished in the state, and many Romonsch place-names still linger, e.g'., Vaduz, Samina, Gavadura, &c. The con- stitution of 1862 was amended in 1878 and 1896. All males of twenty-four years are primary electors, but the twelve elected members of the Diet (holding their seats for four years) are elected indirectly through a second set of electors. The prince Jaas a lieutenant at Vaduz, wlience there is an appeal to the prince's court at Vienna, with (since 1884) a final appeal to the supreme court at Inns- bruck. The principality is joined with Vorarlberg from the customs point of view, and with Austria as regards postal and coinage arrangements. The

principality is ecclesiastically in the diocese of Coire. It has now no public debt, while in 1899 the receipts amounted to 281,548 florins and the expenses to 281,;i75 florins. According to the agreement of 1S52, by which Liechten- stein made a customs union with Austria, Austria must yearly pay it at least 20,000 florins.

See J. Falke's Geschichte d. furstlichm Hauses Liechtenstein, 3 vols. Vienna, 1868-83.— P. Kaisek. Geschichte d. Furstenthums Liechtenstein. Coire, 1847.— F. Umi.auft. Das Fiirstenthitm Liechtenstein. Vienna, 1891. — E. Waldek. Aus den Bergen. Zurich, 189G.— A. Waltenbeegbr. Algau, Vorarlherg, und Westtirol (Etes. 25 and 26). 8th edition, Innsbruck, 1896.

(w. A. B. C.)

Liege (Flemish, Luik), a province of Belgium, border- ing on Dutch Limburg, Ehenish Prussia, and the Belgian provinces of Luxembourg, Namur, Brabant, and Lim- bourg. The province is of very varied character, ranging in altitude from 300 to over 2000 feet, and distributed in part into four quite distinct regions — the highly agri- cultural Hesbaye, the pastoral Herve, the calcareous Condroz, and the schistose, uneven and picturesque Ardenne. The principal rivers are the Meuse and its affluent the Ouithe. A canal runs laterally by the Meuse from Lifege to Maastricht. The mineral pro- ductions are important : coal worked at seventy different places and occupying 30,000 workers ; zinc and lead ores (260 workers) ; iron ores (200 workers) ; building and paving-stone quarries at 240 places, and employing more than 6000 workers. The agricultural products are oats, wheat, potatoes, rye, beetroot. Woods cover 18 per cent, of the area. Agriculture and mining are the two special industries of the province. The metal industry is carried on in every branch : smelting, making of iron, steel, sheet-iron, rails, steam-engines, armoury, &c., employing altogether 40,000 workers, principally in the arrondisse- ment of Li^ge ; the other industries include wool-spinning and the making of woollen stuffs and cloths carried on in the arrondissement of Verviers, and employing 16,000 workers. The making of crystal is also an industry of important dimensions,

employing 4400 workers in the arrondissement of Liege. The province is divided into four administrative arrondissements, whose capitals are Li^ge (173,706 inhabitants) ; Huy (14,644 inhabitants) ; Verviers (62,203) ; Waremme (4000). Among other noteworthy places are Seraing (39,623 inhabitants), near Li^ge, famous for its vast metallurgic establish- ment founded in 1817 by John Cockerell, and the pretty town of Spa (8192 inhabitants), well known for its mineral waters. The province of Liege has an area of 1117 square miles, with a population of 861,486, or 762-3 to the square mile. The administrative arron- dissement of Lifege has the greatest density of popu- lation, namely, nearly 1700 inhabitants per square mile. In 1875 the population of the province numbered 645,000, and the increase since that date has been 30 per cent.

Liege, a city in the province of Liege, the seat of a bishopric, at the confluence of the Ourthe with the Meuse, 50° 38′ 48″ N. and 5° 34′ 30″ E. Since 1860 great works have been carried out, which, regulating the course of the river, prevent as far as possible the in- undations formerly frequent, and have brought about a complete transformation of the city. Along its whole course through the city the Meuse is bordered by quays. Its banks are connected by six bridges. A canal of very slight fall {canal de derivation), bordered with quays, receives the waters of the Ourthe and conducts them into the Meuse below the city, forming in so doing a long island on the right bank. A magnificent quarter has been laid out on the left bank, on the site of an old dock. Higher instruction is largely represented by a state uni- versity (with 1500 students), to which are annexed special institutes of botany, zoology, anatomy, physiology, phar- macy, and chemistry, an electro-technical institute, a school of mines, a school of arts and manufactures, and a rich library. At Li^ge there are also a Conservatoire de Musique and an observatory. Industry is brisk and

flourishing. The characteristic branches are coal-mining (employing 5000 workers), the working of which has had to be stopped in the galleries penetrating under the city and the river, and the manufacture of small arms, more than a million pieces being tried annually on the testing-bench, employing more than 3000 workers in the city, a great number of them working at home. Other industries are the smelting of metals, the making of mechanical works, tools, electrical machines, and rail- way material. Lifege

is, moreover, the centre of a con- siderable number of important industrial localities. Its lines of communication are the Meuse and the canal from Liege to Maastricht, and the railways running to Namur, to Brussels, to Hasselt and Limbourg, to Maastricht and Holland, to Aix-la-Chapelle and Germany, and to Luxembourg. Population (1875), 117,600; (1900), 173,706, ah increase in twenty-five years of 47-7 per cent.

Liegnitz, a town of Prussia, province of Silesia, 40 miles west of Breslau by rail. The Lutheran church of St Peter and St Paul was restored in 1892-94. The town has monuments to Frederick the Great (1869), Emperor William I. (1898), and the war of 3870-71 ; also an agricultural school and a deaf and dumb institute. The growing of vegetables, especially small cucumbers (gurkeii) and onions, is a speciality ; other industries are the making of machinery, pianos, sewing-machines, cloth, wool, and artistic turnery. Population (1885), 43,347 ;

(1900), 54,839.

Lien, — The word lie7i is literally the French for a band, cord, or chain, and keeping in mind that mean- ing we see in what respect it differs from a pledge on the one hand and a mortgage on the other. It is the bond which attaches a creditor’s right to a debtor’s pro- perty, but which gives no right ad rem, i.e., to property in the thing; if the property is in the possession of the creditor he may retain it, but in the absence of statute he cannot sell to recover what is due to him without the ordinary legal process against the debtor ; and if it is not in possession, the law would indeed assist him to seize the property, and will hold it for him, and enable him to sell it in due course and pay himself out of the proceeds, but does not give him the property itself. It is difficult to say at what period the term lien made its appearance in English law ; it probably came from more than one source. In fact, it was used as a convenient phrase for any right against the owner of property in regard to the property not specially defined by other better recognized species of title.

The possessory lien of a tradesman for work done on the thing, of a carrier for his hire, and of an innkeeper for his bill, would seem to be an inherent right which must have been in existence from the dawn, or before the dawn, of civilization. Probably the man who made or repaired weapons in the

Stone Age was careful, not to deliver them until he received what was stipulated for, but it is also probable that the term itself re- sulted from the infusion of the civil law of Home into the common law of England which the Norman Con- quest brought about, and that it represents the “tacit pledge” of the civil law. As might be expected, so far as the possessory lien is concerned, the common law and civil law, and probably the laws of all countries, whether civilized or not, coincide; but there are many differences with respect to other species of lien. For instance, by the common law — in this respect a legacy of the feudal system — a landlord has a lien over his tenant’s furniture and effects for rent due, which can be enforced without the assistance of the law simply by the landlord taking possession, personally or by his agent, and selling

enough to satisfy his claim ; whereas the maritime lien is more distinctly the product of the civil law, and is only found and used in Admiralty proceedings, the High Court of Admiralty having been founded upon the civil law, and still (except so far as restrained by the common law- courts prior to the amalgamation and co-ordination of the various courts by the Judicature Acts, and as affected by statute law) acting upon it. The peculiar effects of this maritime lien are discussed below. There is also a class of liens, usually called equitable liens {e.g., that of an unpaid vendor of real property over the property sold), which are akin to the nature of the civil law rather than of the common law. The word lien does not frequently occur in statute law, but it is found in the extension of the common law ” carriers’ or shipowners’ lien ” in the Merchant Shipping Act, 1894 ; in the definition, extension, and limitation of the vendor’s lien ; in the Factors Act, 1877, and the Sale of Goods Act, 1893 ; in granting a maritime lien to a shipmaster for his wages and disbursements, and in regulating that of the seamen in the Merchant Shipping Act, 1894 ; and in the Equity jurisdiction of the County Courts, 1888.

Common-Law Liens. — These may be either particular, i.e., a right over one or more specified articles for a par- ticular debt, or general, i.e., for all debts owing to the creditor by the debtor.

The requisites for a particular lien are, firstly, that the creditor should be in possession of the article ; secondly, that the debt should be incurred with reference to the article ; and thirdly, that the amount of the debt should be certain. It may be created by express contract, by implied contract (such as the usage of a particular trade or business), or as a consequence of the legal relation existing between the parties. As an example of the first, a shipowner at common law has a lien on the cargo for the freight ; but though the shipper agrees to pay dead freight in addition, i.e., to pay freight on any space in the ship which he fails to occupy with his cargo, the ship-owner has no lien on the cargo for such dead freight except by express agreement. The most usual form of the second is that which is termed a possessory lien — the right a ship-repairer has to retain a ship in his yard till he is paid for the repairs executed upon her,'- and the right a cobbler has to retain a pair of shoes till he is paid for the repairs done to them. But this lien is only in respect of the work done on, and consequent benefit received by, the subject of the lien. Hence an agistor of cattle has no lien at common law upon them for the value of the pasturage consumed, though he may have one by agreement ; nor a conveyancer upon deeds which he has not drawn, but which are in his possession for refer- ence. The most common example of the third is that of a carrier, who is bound by law to carry for all persons, and has therefore a lien for the price of the carriage on the goods carried. So much favoured is this lien that it has been held that even if the goods are stolen, and entrusted to the carrier l^y the thief, the carrier can hold them for the price of the carriage against the rightful owner. Of the same nature is the common-law lien of an innkeeper on the baggage of his customer for the amount of his account, he being under a legal obligation to enter- tain travellers generally. Another instance of the same class is where a person has obtained possession of certain things over which he claims to hold a lien in the exercise of a legal right. For example, when a lord of a manor has seized cattle as estrays, he has a lien upon them for the expense of their keep as against the real owner; but.

1 This right, ho-ivever, is not absolute, but depends on the custom of the port {Eaitt v. Mitchell, i Ciirap. 14G).

as before pointed out, the holder's claim must be specific, otherwise a general tender of compensation releases the lien.

A general lien is a right of a creditor to retain property, not merely for charges relating to it specifically, but for debts due on a general account. This not being a common-law right, is viewed by the English courts with the greatest jealousy, and to be enforced must be strictly proved. This can be done by proof either of an express or implied contract or of a general usage of trade. The first of these is established by the ordinary methods or by previous dealings between the parties on such terms ; the second is recognized in certain businesses, and it would probably be exceedingly dif&cult, if not impossible, to extend it at the present time to any other trades. When, however, a lien by general usage has once been judicially established, it becomes part of the Law Merchant, and the courts are bound to recognize and enforce it. The best known and most important instance is the right of a solicitor to retain papers in his hands belonging to his client until his account is settled. The solicitor's lien, though probably more commonly enforced than any other, is of no great antiquity in English law, the earliest reported case of it being in the reign of James II. ; but it is now of a twofold nature. In the first place there is the retaining lien. This is similar in kind to other pos- sessory liens, but of a general nature attaching to all papers of the client, and even to his money, up to the amount of the solicitor's bill, in the hands of the solicitor in the ordinary course of business. There are certain exceptions which seem to have crept in for the same reason as the solicitor's lien itself, i.e., general convenience of litigation ; such exceptions are the will of the client after his decease, and proceedings in bankruptcy. In this latter case the actual possessory lien is given up, the solicitor's interests and priorities being pro- tected by the courts, and it may be said that the giving up the papers is really only a means of enforcing the lien they give in the bankruptcy proceedings. In the second place there is what is called a charging lien — more correctly classed under the head of equitable lien, since it does not require possession, but is a lien the solicitor holds over property recovered or preserved for his client. He had the lien on an order by the court upon a

fund in court by the common law, but as to property generally it was only given by 23 and 24 Vict. c. 127, § 28; and it has been held to attach to property recovered in a probate action (ex parte Tweed, C. A. 1899, 2 Q.B. 167). A banker's lien is the right of a banker to retain securities belonging to his customer for money due on a general balance. Other general liens, which have been judicially established, are those of wharfingers, brokers, and factors (which are in their nature akin to those of solicitors and bankers), and of calico printers, packers of goods, fullers (at all events at Exeter), dyers, and millers ; but in all these special trades it is probable that the true reason is that the account due was for one continuous transaction. The calico would come to be printed, the goods to be packed, the cloth to be bleached, the silk to be dyed, and the corn to be ground, in separate parcels, it is true, and at differ- ent times, but all as one undertaking; and they are therefore, though spoken of as instances of general lien, only adaptations by the courts of the doctrine of particular lien to special peculiarities of business. In none of these cases would the lien exist, in the absence of special agree- ment, for other matters of account, such as money lent or goods sold.

Equitable Liens. — "Where equity has jurisdiction to enforce rights and obligations growing out of an executory contract," e.g., in a suit for specific performance, " this

equitable theory of remedies cannot be* carried out unless the notion is admitted that the contract creates some right or interest in or over specific property, which the decree of the court can lay hold of, and by means of which the equitable relief can be made efficient. The doctrine of equitable liens supplies this necessary element; and it was introduced for the sole purpose of furnishing a ground for these specific remedies which equity confers, operating upon particular identified property instead of the general pecuniary recoveries granted by courts of common law. It follows therefore that in a large class of executory contracts express and implied, which the common law regards as creating no property, right, nor interest analogous to property, but only a mere personal right to obligation, equity recognizes in

addition to the personal obligation a particular right over the thing with which the contract deals, which it calls a lien, and which though not property is analogous to property, and by means of which the plaintiff is enabled to follow the identical thing and to enforce the defendant's obligation by a remedy which operates directly on the thing. The theory of equitable liens has its ultimate foundation, therefore, in contracts express or implied which either deal with or in some manner relate to specific property, such as a tract of land, particular chattels or securities, a certain fund, and the like. It is necessary to divest oneself of the purely legal notion concerning the effects of such contracts, and to recognize the fact that equity regards them as creating a charge upon, or hypothecation of, the specific thing, by means of which the personal obligation arising from the agreement may be more effectively enforced than by a mere pecuniary recovery at law" (Pomeroy, 2 Eq. Jur. 232). This description from an American text-book seems to give at once the fullest and most concise definition and description of an equitable lien. It will be seen that it differs essentially from a common-law lien, inasmuch as in the latter possession or occupation is as a rule necessary for its existence, whereas in the equitable lien the person claiming the lien is seldom in possession or occupation of the property, its object being to obtain the possession wholly or partially. A special instance of such a lien is that claimed by a publisher over the copyright of a book which he has agreed to publish on terms which are not complied with — for example, the author attempting to get the book published elsewhere. It cannot perhaps be said that this has been absolutely decided to exist, but a strong opinion of the English Court of Ex- chequer towards the close of the 18th century was expressed in its favour (Brook v. Wentworth, 3 Anstruther 881). Other instances are the charging lien of a solici- tor, already referred to, and the lien of a person on improvements effected by him on the property of another who " lies by " and allows the work to be done before claiming the property. So also of a trustee for expenses lawfully incurred about the, trust property. The power of a limited liability company to create a lien upon its own shares was in 1901 established {Allen v. Oold Beefs, &c., C.A. [1900] 1 Ch. 656).

Maritime Liens. — Maritime lien differs from all the others yet considered, in its more elastic nature. Where a maritime lien has once attached to property — -and it may and generally does attach without possession — it

will continue to attach, unless lost by laches, so long as the thing to which it attaches exists, notwithstanding changes in the possession of and property in the thing, and notwithstanding that the new possessor or owner may be entirely ignorant of its existence ; and even if enforced it leaves the owner's personal liability for any balance unrealized intact (the Gemma, 1899, P. 285). So far as England is concerned, it must be borne in mind that the Courts of Admiralty were conducted in accordance with

the principles of civil law, and in that law both the pledge with possession and the hypothecation without possession were well recognized. The extreme convenience of such aright as the latter with regard to such essentially movable chattels as ships is apparent. Strictly speaking, a maritime lien is confined to cases arising in those matters over which the Courts of Admiralty had original jurisdiction, viz., collisions at sea, seamen's wages, sal- vage, and bottomry, in all of which cases the appropriate remedy is a proceeding in rem in the Admiralty Court. In the first of these — collisions at sea — if there were no maritime lien there would frequently be no remedy at all. When two ships have collided at sea it may well be that the innocent ship knows neither the name nor the nation- ality of the wrongdoer, and the vessel may escape with slight damage and not have to make a port of refuge in the neighbourhood. Months afterwards it is ascertained that she was a foreign ship, and in the interval she has changed owners. Then, were it not a fact that a mari- time lien invisible to the wrongdoer nevertheless attaches itself to his ship at the moment of collision, and con- tinues to attach, the unfortunate owner of the innocent ship would have no remedy, except the doubtful one of pursuing the former owner of the wrong-doing vessel in his own country in a personal action where such proceed- ings are allowed — which is by no means the case in all foreign countries. The same reasons apply, though not possibly with quite the same force, to the other classes of cases mentioned.

Between 1840 and 1873 the jurisdiction of the Admirally Court was largely extended. At the latter date it ceased to exist as a separate court, and was merged in the Pro- bate, Divorce, and Admiralty division of the High Court of Justice. Since the merger questions have arisen as to how far the enlargement of jurisdiction has extended the principle of maritime lien. An interesting article on this subject by J. Mansfield, barrister-at-law, will be

found in the Law Quarterly Review, vol. iv., October 1888. It must be sufficient to state here that where legislation has extended the already existing jurisdiction to which a maritime lien pertained, the maritime lien is extended to the subject matter, but that where a new jurisdiction is given, or where a jurisdiction formerly existing without a maritime lien is extended, no maritime lien is given, though even then the extended jurisdiction can be enforced by proceedings in rem. Of the first class of extended jurisdictions are collisions, salvage, and sea- men's wages. Prior to 1840 the Court of Admiralty only had jurisdiction over these when occurring or earned on the high seas. The jurisdiction, and with it the maritime lien, is extended to places within the body of a county in collision or salvage ; and as to seamen's wages, whereas they were dependent on the earning of freight, they are now free from any such limitation ; and also, whereas the remedy in rem was limited to seamen's wages not earned under a special contract, it is now extended to all seamen's wages, and also to a master's wages and disbursements, and the maritime lien covers all these. The new jurisdiction given over claims for damage to cargo carried into any port in England or Wales, and on appeal from the county courts over all claims for damage to cargo under £300, though it may be prosecuted by proceedings in rem, i.e., by arrest of the ship, yet confers no maritime lien ; and so also in the case of claims by material men (builders and fitters-out of ships) and for necessaries. Even though in the latter case the Admiralty Court had jurisdiction previously to 1840 where the necessaries were supplied on the high seas, yet as it could not be shown that such jurisdiction had ever been held to confer a maritime lien, no such lien is given. Even now there is much doubt as to whether towage confers a maritime lien or not, the

services rendered being pursuant to contract, and fre- quently to a contract made verbally or in writing on the high seas, and being rendered also to a great extent on the high seas. In these cases and to that extent the High Court of Admiralty would have had original juris- diction. But prior to 1840 towage, as now rendered by steam tugs expressly employed for the service, was prac- tically unknown, and therefore there was no established catena of

precedent to show the exercise of a maritime lien. It may be argued on the one hand that towage is only a modified form of salvage, and therefore entitled to a maritime lien, and on the other that it is only a form of necessary power supplied like a new sail or mast to a ship to enable her to complete her voyage expeditiously, and therefore of the nature of necessaries, and as such not entitled to a maritime lien. The matter is not of aca- demical interest only, for though in the case of an inward- bound ship the tug owner can make use of his statutory right of proceeding in rem, and so obtain much of the benefit of a maritime lien, yet in the case of an outward- bound ship, if she once gets away without payment, and the agent or other authorized person refuses or is unable to pay, the tug owner's claim may very likely, on the return of the ship to a British port, be met by an allega- tion of a change of ownership, which defeats his right of proceeding at all if he has no maritime lien ; whereas if he has a maritime lien he can still proceed against the ship and recover his claim, if he has not been guilty of laches.

A convenient division of the special liens other than possessory on ships may be made by classifying them as maritime, statutory-maritime or quasi-maritime, and statu- tory. The first attach only in the case of damage done by collision between ships on the high seas, salvage on the high seas, bottomry, and seamen's wages so far as freight has been earned ; the second attach in cases of damage by collision within the body of a county, salvage within the body of a county, life salvage everywhere, seamen's wages even if no freight has been earned, mas- ter's wages and disbursements. These two classes con- tinue to attach notwithstanding a change of ownership without notice of the lien, if there have been no laches in enforcing it (the Bold Buccleuch, 7 Moo. P.O. 267 ; the Kong Magnus, 1891, P. 233). The third class, which only give a right to proceed in rem, i.e., against the ship itself, attach, so long as there is no bond fide change of owner- ship, without citing the owners, in all cases of claims for damage to ship and of claims for damage to cargo where no owner is domiciled in England or Wales. Irrespective of this limitation, they attach in all eases not only of damage to cargo, but also of breaches of contract to carry where the damage does not exceed £300, when the suit must be commenced in a county court having Admiralty jurisdiction ; and in cases of claims for necessaries sup- plied elsewhere than in the ship's home port, for wages earned even under a

special contract by masters and mariners, and of claims for towage. As already ob- served, it is still doubtful whether the lien for towage is not, in some cases at all events, within the former classes. In all three classes the lien also exists over cargo where the suit from its nature extends to it, as in salvage and in some cases of bottomry or respon- dentia, and in cases where proceedings are taken against cargo by the shipowner for a breach of contract (cargo ex Argos and the Hewsons, L.E., 5 P.O. 134 ; the AUna, 5 Ex. Div. 227).

Elsewhere than in England, and those countries such as the United States which have adopted her jurispru- dence in maritime matters generally, the doctrine of maritime lien, or that which is substituted for it, is very differently treated. Speaking generally, those states

which have a,dopted the Napoleonic codes or jn edifications of them — France, Italy, Spain, Holland, Portugal, Belgium, Greece, Turkey, and to some extent Russia — have instead of a maritime lien the civil-law principle of privileged debts. Amongst these in all cases are found claims for salvage, wages, bottomry under certain restrictions, and necessaries. Each of these has a privileged claim against the ship, and in some cases against freight and cargo as well, but it is a matter of very great importance that, except in Belgium, a claim for collision damage (which as we have seen confers a maritime lien, and one of a very high order, in Great Britain) confers no privilege against the wrong-doing ship, whilst in all these countries an owner can get rid of his personal liability by abandoning the ship and freight to his creditor, and so, if the ship is sunk, escape all liability whilst retaining any insurance there may be. This, indeed, was at one time the law of Great Britain ; the measure of damage was limited by the value of the res; and in the United States at the present time a shipowner can get rid of his liability for damage by abandoning the ship and freight. A different rule prevails in Germany and the Scandinavian states. There claims relating to the ship, unless the owner has specially rendered himself liable, confer no personal claim at all against him. The claim is limited ah initio to ship and freight, except in the case of seamen’s wages, which do confer a personal claim so far as they have been earned on a voyage or passage completed prior to the loss of the ship. In all maritime states, however, except Spain, a provisional arrest of the ship is allowed, and thus

between the privilege accorded to the debt and the power to arrest till bail is given or the ship abandoned to cred- itors, a condition of things analogous to the maritime lien is established ; especially as these claims when the proper legal steps have been taken to render them valid — usually by endorsement on the ship's papers on board, or by registration at her port of registry — attach to the ship and follow her into the hands of a purchaser. They are in fact notice to him of the incumbrance.

Duration of Lien. — So long as the party claiming the lien at common law retains the property, the lien con- tinues, notwithstanding the debt in respect of which it is claimed becoming barred by the Statute of Limitations {Higgins v. Scott, 2 B. and Aid. 413). But if he takes proceedings at law to recover the debt, and on a sale of the goods to satisfy the judgment purchases them him- self, he so alters the nature of the possession that he loses his lien (Jacobs v. Lawton, 5 Bing. 130). An equi- table lien probably in all cases continues, provided the purchaser of the subject matter has notice of the lien at the time of his purchase. A maritime lien is in no re- spect subject to the Statute of Limitations, and contin- ues in force notwithstanding a change in the ownership of the property without notice, and is only terminated when it has once attached, by laches on the part of the person claiming it (the Kong Magnus, 1891, P. 223). There is an exception in the case of seamen's wages, where by 4 Anne c. 16 (Stat. Rev. 4 and 5 Anne c. 3) all suits for seamen's wages in the Admiralty must be brought within six years.

lianJcing of Maritime Liens. — It is clear from what has been said that at times there may be several claimants holding maritime and other liens on the same vessel. For example, a foreign vessel comes into collision by her own fault and is damaged and her cargo also ; she is assisted into port by salvors and ultimately under a towage agree- ment, and put into the hands of a shipwright who does necessary repairs. The innocent party to the collision has a maritime lien for his damage, and the seamen for their wages ; the cargo owner has a suit in rem or a statutory- lien for damage, and the shipwright a possessory lien for

the value of his repairs, while the tugs certainly have a right in rem and possibly a maritime lien also in the nature of salvage. It is highly probable that the value of the property will be insufficient to pay all, and it be- comes a matter of great consequence to settle whether any, and if so which, have priority over the others, or whether all rank alike and have to divide the proceeds of the property pro ratd amongst them. The following general rules apply : liens for benefits conferred rank against the fund in the inverse, and those for the repara^ tion of damage sustained in the direct order of their attaching to the res ; as between the two classes those last mentioned rank before those first mentioned of ear- lier date; as between liens of the same class and the same date, the lirst claimant has priority over others who have not taken action. The Courts of Admiralty, how- ever, allow equitable considerations, and enter into the question of marshalling assets. For example, if one claimant has a lien on two funds, or an effective right of action in addition to his lien, and another claimant has only a lien upon one fund, the first claimant will be obliged to exhaust his second remedy before coming into competition with the second. As regards possessory liens, the shipwright takes the ship as she stands, i.e., with her incumbrances, and it appears that the lien for sear men's wages takes precedence of a solicitor's lien for costs, under a charging order made in pursuance of 23 and 24 Vict. c. 127, § 28. Subject to equitable consid- erations, the true principle appears to be that services rendered under an actual or implied contract, which con- fer a maritime lien, make the holder of the lien in some sort a proprietor of the vessel, and therefore liable for damage done by her — hence the priority of the damage lien — but, directly it has attached, benefits conferred on the property by enabling it to reach port in safety bene- fit the holder of the damage lien in common with all other prior holders of maritime liens. It is less easy to see why of two damage liens the earlier should take prece- dence of the later, except on the principle that the res which came into collision the second time is depreciated in value by the amount of the existing lien upon her for the first collision, and where there was more than one damage lien, and also liens for benefits conferred prior to the first collision between the two collisions and subse- quent to the second, the court would have to make a special order to meet the peculiar circumstances, which happily do not often occur. The claim of a mortgagee naturally is deferred to all maritime liens, whether they are for benefits conferred on the property in which he is

interested or for damage done by it, and also for the same reason to the possessory lien of the shipwright, but both the posses- sory lien of the shipwright and the claim of the mortgagee take precedence over a claim for necessaries, which, as we have seen, only confers a statutory lien or a right to pro- ceed in rem in certain cases. In other maritime states possessing codes of commercial law, the privileged debts are all set out in order of priority in these codes, though, as has been already pointed out, the lien for damage by collision — the most important in English law — has no counterpart in most of the foreign codes.

Stoppage in Transitu. — This is a lien held by an unpaid vendor in certain cases over goods sold after they have passed out of his actual possession. It has been much discussed whether it is an equitable or common-law right or lien. The fact appears to be that it has always been a part of the Law Merchant, which, properly speaking, is itself a part of the common law of England unless in- consistent with it. This particular right was, in the first instance, held by a court of equity to be equitable and not contrary to English law, and by that decision this particular part of the Law Merchant was approved and

became part of the common law of England (see per Lord Abinger in Gibson v. Carrutliers, 8 M. and W., p. 336 et seq.). It may be described as a lien by the Law Merchant, decided by equity to be part of the common law, but in its nature partaking rather of the character of an equitable lien than one at common law. ” It is a right which arises solely upon the insolvency of the buyer, and is based on the plain reason of justice and equity that one man’s goods shall not be applied to the payment of another man’s debts. If therefore, after the vendor has delivered the goods out of his own possession and put them in the hands of a carrier for delivery to the buyer, he discovers that the buyer is insolvent, he may re-take the goods if he can before they reach the buyer’s possession, and thus avoid having his property applied to paying debts due by the buyer to other peo- ple ” {Benjamin on Sales, 2nd edition, 289). This right, though only recognized by English law in 1690, is highly favoured by the courts on accoiint of its intrinsic justice, and extends to quasi-vendors, or persons in the same position, such as consignors who have bought on behalf of a principal and forwarded the goods, and other similar cases. It is, however, defeated by a lawful trarisfer

of the document of title to the goods by the vendor to a third person, who takes it bond fide and for valuable consideration (Factors Act, 1889 ; Sale of Goods Act,

1893).

Assignment or Transfer of Lien. — A lien being a per- sonal right acquired in respect of personal services, it cannot, as a rule, be assigned or transferred ; but here again there are exceptions. The personal representative of the holder of a possessory lien on his decease would probably in all cases be held entitled to it; and it has been held that the lien over a client's papers remains with the firm of solicitors notwithstanding changes in the con- stitution of the firm (Oregory v. Cresswell, 14 L.J. Ch. 300). So also where a solicitor, having a lien on documents for his costs, assigned the debt to his bankers with the bene- fit of the lien, it was held that the bankers might enforce such lien in equity. But though a tradesman has a lien on the property of his customer for his charges for work done upon it, where the property is delivered to him by a servant acting within the scope of his employment, such lien cannot be transferred to the servant, even if he has paid the money himself ; and the lien does not exist at all if the servant was acting without authority in delivering the goods, except where (as in the case of a common car- rier) he is bound to receive the goods, in which case he retains his lien for the carriage against the rightful owner. On the other hand, where there is a lien on property of any sort not in possession, a person acquiring the property with knowledge of the lien takes it subject to such lien. This applies to equitable liens, and cannot from the nature of the case apply to those common-law liens in vv^hich pos- session is necessary. It is, however, true that by statute certain common-law liens can be transferred, e.g., under the Merchant Shipping Act a master of a ship having a lien upon cargo for his freight can transfer the possession of the cargo to a wharfinger, and with it the lien (Merchant Shipping Act, 1894, § 494). In this case, however, though the matter is simplified by the statute, if the wharfinger was constituted the agent or servant of the shipmaster, his possession would be the possession of the shipmaster, and there would be no real transfer of the lien ; therefore the common-law doctrine is not altered, only greater facilities for the furtherance of trade are given by the statute, enabling the wharfinger to act in his own name without

reference to his principal, who may be at the other side of the world. So also a lien may be retained, notwithstand- ing that the property passes out of possession, where it has to be deposited in some special place (such as the Custom-

House) to comply with the law. Seamen cannot sell or assign or in any way part with their maritime lien for wages (Merchant Shipping Act, 1894, § 156), but never- theless, with the sanction of the Court, a person who pays seamen their wages is entitled to stand in their place and exercise their rights (the Cornelia Henrietta, L.E. 1 A. and B. 51).

Waiver. — Any parting with the possession of goods is in general a waiver of the lien upon them ; for example, when a factor having a lien on the goods of his principal gives them to a carrier to be carried at the expense of his principal, even if undisclosed, he waives his lien, and has no right to stop the goods in transitu to recover it ; so also where a coach-builder who has a lien on a carriage for repairs allows the owner from time to time to take it out for use without expressly reserving his lien, he has waived it, nor has he a lien for the standage of the car- riage except by express agreement, as mere standage does not give a possessory lien. It has even been held that where a portion of goods sold as a whole for a lump sum has been taken away and paid for proportionately, the conversion has taken place and the lien for the residue of the unpaid purchase-money has gone (Gurr v. Cuthbert, 12 L.J. Ex. 309). Again, an acceptance of security for a debt payable at a future date is inconsistent with the ex- istence of a lien, as it substitutes the credit of the owner for the material guarantee of the thing itself, and so acts as a waiver of the lien. For the same reason even an agreement to take security is a waiver of the lien, though the security is not, in fact, given {Alliance Bank v. Broon, 11 L.T. 332).

Sale of Goods under Lien. — At common law the lien, as already pointed out, only gives a right to retain the goods, and ultimately to sell by legal process, against the owner ; but in certain cases a right has been given by statute to sell without the intervention of legal process, such as the right of

an innkeeper to sell the goods of his customer for his unpaid account (Innkeepers Act, 1878, § 1), the right of a wharfinger to sell goods entrusted to him by a shipowner with a lien upon them for freight, and also for their own charges (Merchant Shipping Act, 1894, §§ 497, 498), and of a railway company to sell goods for their charges (Eailway Clauses Act, 1845, § 97). Property affected by an equitable lien or a mari- time lien cannot be sold by the holder of the lien without the interposition of the Court to enforce an order, or judgment of the Court. In, Admiralty cases, where a sale is necessary, no bail having been given and the prop- erty being under arrest, the sale is usually made by the marshal in London, but may be elsewhere on application of the parties concerned showing that a better price is likely to be obtained.

American Law. — In the United States, speaking very generally, the law relating to liens is that of England, but there are some considerable differences occasioned by three principal causes. (1) Some of the Southern states, notably Louisiana, have never adopted the common law of England as their own. When that state became one of the United States of North America it had (and still pre- serves) its own system of law. In this respect the law is practically identical with the Code Napoleon, which, again speaking generally, substitutes privileges for liens, i.e., gives certain claims a prior right to others against par- ticular property. These privileges being strictissimce interpretationis, cannot be extended by any principle analogous to the English doctrine of equitable lions. (2) Probably in consequence of the United States and the several states composing it having had a niore demo- cratic government than Great Britain, until at all events recent years, certain liens have been created by statute in several states in the interest of the workintr classes

which have no parallel in Great Britain : e.g., in some states workmen employed in building a house or a ship have a lien upon the building or structure itself for their unpaid wages. This statutory lien partakes rather of the nature of an equitable than of a common-law lien, as the property is not in the possession of the workman, and it may be doubted whether the right thus conferred is more beneficial to the workman than the priority his wages have in bankruptcy proceedings in England. Some of the states have also practically extended the maritime lien to matters over which it was

never contended for in England. (3) By the constitution of the United States the Admiralty and inter-state jurisdiction is vested in the Federal as distinguished from the state courts, and these Federal courts have not been liable to have their juris- diction curtailed by prohibition from courts of common law, as the Court of Admiralty had in England up to the time of the Judicature Acts ; consequently the maritime lien in the United States extends farther than it does in England, even after recent enlargements ; that is to say, it covers claims for necessaries and by material men (see Maritime Lien), as well as collision, salvage, wages, bot- tomry, and damage to cargo.

Difficulties connected with lien occasionally arise in the Federal courts in Admiralty cases, from a conflict on the subject between the municipal law of the state where the court happens to sit and the admiralty law ; but as there is no power to prohibit the Federal court, its view of the admiralty law based on the civil law pre- vails. More serious difficulties arise where a Federal court has to try inter-state questions, where the two states have different laws on the subject of lien ; one for example, like Louisiana, following the civil law, and the other the common law and equitable practice of Great Britain. The question as to which law is to govern in such a case can hardly be said to be decided. ” The question whether equitable liens can exist to be enforced in Louisiana by the Federal courts, notwithstanding its restrictive law of privileges, is still an open one ” (Derris, Contracts of Pledge, 517 ; and see Burdon /Sugar Refining Co. V. Payne, 167 U.S. 127).

Beitish Colonies. — In those colonies which before the Canadian federation were known as Upper Canada and the Maritime Provinces of British Nortlr America, and in the several Australasian states where the English common law is enforced except as modified by colonial statute, the principles of lien, whether by common law or equitable or maritime, discussed above with reference to England, will prevail ; but questions not dissimilar to those treated of in reference to the United States may arise where colonies have come to the Crown of Great Britain by cession, and where different systems of municipal law are enforced. For example, in Lower Canada the law of France prior to the Revolution occupies the place of the common law in England, but is generally regulated by a code very similar to the Code Napoleon; in Mauritius and its dependencies the Code Napoleon itself is in

force except so far as modi- fied by subsequent ordinances. In the South African colonies, and to some extent in Ceylon and Guiana, Roman-Dutch law is in force ; in the island of Trinidad old Spanish law, prior to the introduction of the present civil code of Spain, is the basis of jurisprudence. Therefore it is by no means safe to assume that the English law of lien is in force in all British colonies. Each several sys- tem of law requires to be studied on the point ; but, speak- ing generally, apart from the possessory lien of workmen and the maritime lieu of the vice-admiralty courts, it may be assumed that the rules of the. civil law, giving a privilege or priority in certain specified cases rather than a lien as understood in English law, prevail in those col- onies where the English law is not in force. (f. w. ra.)

Lierre, or Lier, a town of Belgium, in the province and 10 miles south-east of Antwerp by rail. Among its numerous industries are the manufacture of boots and shoes, brushes, and cutlery. Population (1880), 17,133 ;

(1890), 20,133 ; (1900), 22,654.

Liestal, the capital (since 1833) of the half canton Basel-Stadt. It is 9J- miles by rail from Basel, and 16-|- miles from Olten. It is a well-built but uninteresting little town, the largest in the canton after Basel. In the Eathhaus is the drinking-cup of Charles the Bold of Burgundy, taken at the battle of Nancy in 1477. Popu- lation (1888), 4860 ; (1900), 5488.

Lievin. See Lens.

Life- Boat. — A very marked advance in the direction of improvement in design and suitability for practical service has been made in the life-boat since 1882, such de- velopment dating in some degree from the reorganization of the Royal National Life-boat Institution of Great Britain in 1883, but principally from the beginning of 1887, when, as the result of a serious accident iu December 1886 to two self-righting life-boats in Lancashire, twenty-seven out of twenty-nine of the men who manned them were lost in their efforts to render assistance to a vessel in distress. At this

time a permanent technical sub-committee was appointed by the Institution, whose object was, with the assistance of an eminent consulting naval architect — anew post created — and the Institution's official experts, to give its careful attention to the designing of improvements in the life-boat and its equipment, and to the scientific con- sideration of any inventions or proposals submitted by the. public, with a view to adopting them if of practical utility. Whereas, therefore, in 1881 the self-righting life-boat of that time was looked upon as the Institution's special life- boat, and there were only a very few of the 271 life-boats in the Institution's fleet which were not of that type, at the close of 1901 the 288 life-boats of the Institution stationed on the coast of the United Kingdom included only 228 boats of the self-righting type, the remaining 60 all being non-self-righting boats of various types, known by the following designations : — Steam life-boats 4, Cromer 3, Lamb and White 1, Liverpool 14, Norfolk and Suffolk 19, tubular 1, Watson 18. Of the 271 life-boats on the coast at the end of 1881, only 12 remained at the close of 1901, 259 having been replaced by boats of the latest types, provided with the newest improvements in equip- ment and gear. The self-righting life-boat of 1901 was a very different boat from that of 1881. The Institution's present policy is to allow the men who man the life-boats, after having seen and tried by deputation the various types, to select that in which they have the most confi- dence. In 1901 a steam-tug was placed at Padstow for use solely in conjunction with the life-boats on the north coast of Cornwall.

The present life-boat of the self-righting type (Fig. 1) differs materially, as already stated, from its prede- cessor, the stability being increased and the rightingpower greatly improved. The test of efficiency in this last quality was formerly considered sufficient if the boat would quickly right herself in smooth water without her crew and gear, but every self-righting life-boat now built by the Institution will right with her full crew and gear on board, with her sails set, and the anchor down. Most of the larger self-righting boats are furnished with " centre- boards" or "drop-keels" of varying size and weight, which can be used at pleasure, and materially add to their weather qualities. The drop-keel was for the first time placed in a life-boat in 1885.

Steam was first introduced into a life-boat in 1890, when

the Royal National Life-boat Institution, after very full inquiry and consideration, stationed on the coast a steel life-boat, 50 feet long and 12 feet beam, and a depth of 3 feet 6 inches, propelled by a turbine wheel driven by

DECK, PLAN,

BODV PLAN .

KIIOSHIP SECTISN

Fig. 1. — Plans , profile, and section of self-righting life-boat. A, deck ; B, relieving valves for automatic discharge of water off deck ; C, side air-cases above deck 5 D, end air compartments, usually called ” end-boxes,” an important factor in self-righting ; E, wale, or fender ; F, iron keel ballast, important in general stability and self-righting ; G, water-ballast tanks ; H, drop-keel.

engines developing 170 horse-power. It had been previ- ously held by all competent judges that a mechanically- propelled life-boat, suitable for service in heavy weather, was a problem surrounded by so many and great diffi- culties that even the most sanguine experts dared not hope for an early solution of it. This type of boat (Fig. 2)

DECK PLAN.

O

BODV PLAN

MIDSHIP SeCTIQM

Fig. 2.— Plans, profile, and section of steam life-boat. A, cockpit ; a, deck ; &, propeller hatch ; c, relief valves ; B, engine-room ; 0, boiler-room ; 1>, water-tight compartments ; E, coal-bunkers ; F, capstan ; 0, hatches to engine- and boiler-rooms ; H, cable reel ; I, anchor davit.

has proved very useful, and been the means of saving many lives. It is, however, on all hands fully recognized that boats of this description can

necessarily be used at only a very limited number of stations, and where there is a harbour which never dries out. The Institution has since built five other steam life-boats, the latest of which was completed in April 1901, the last .three being fitted with a protected screw-propeller. It had been hoped that

electrical propulsion and oil fuel might have been used in the steam life-boats, but the experiment with the latter, which had a fair trial in the earlier boats built, was not very successful, and it was not repeated in the later boats. The idea of employing electricity was, after the most careful consideration, regretfully abandoned. The highest speed attained by the first hydraulic steam life-boat was rather more than 9 knots, and that secured in the latest 9^ knots.

The other types of pulling and sailing life-boats are all non-self-righting, and are specially suitable for the require- ments of the different parts of the coast on which they are placed. Their various qualities will be understood by a glance at the illustrations (Figs. 3, 4, 5, 6, and 7).

The Institution continues to build life-boats of different sizes according to the requirements of the various points of the coast at which they are placed, but of late years the tendency has been generally to increase the dimensions of the boats as the smaller ones become worn out or obsolete.

BODY PLAN,

MIDSHIP SECTION.

Fig. 8.— Plans, profile, and aeotiou of Cromer type of life-boat. A, deck; B, relieving valvea for automatic discharge of water off deck ; C, Bide air-cases above deck ; E, wale, or fender ; G, water-ballast tanks.

This change of policy is mainly due to the great trans- formation which has taken place in the shipping of all the trading nations, the small coasters and

fishing-boats having in great measure disappeared, their places being taken by steamers and steam trawlers. The cost of the building and equipping of pulling and sailing life-boats has materi- ally increased, more especially since 1898, the increase being mainly due to improvements and the seriously aug- mented charges for materials and labour. In 1881 the average cost of a fully-equipped life-boat and carriage was £650, whereas at the end of 1901 it amounted to £1000, the average annual cost of maintaining a station having risen to more than £100.

The transporting-carriage continues to be a most important part of the equipment of life-boats, generally of the self-righting type, and is absolutely indispensable where it is necessary to convey the boats for the purpose of launching to any]ioint not in the immediate vicinity of the boat-house. Lt is not, however, usual to supply carriages to boats of larger dimensions than 37 feet in length by 9 feet beam, those in excess as regards length and beam being either launched by means of special slip- ways or kept afloat. The transx^orting-carriage of to-day is, however, an improvement on that used in 1881, and has been rendered particularly useful at places

where the beach is soft, sandy, or shingly, by the intro- duction in 1888 of Tipping's sand-plates. These very efficient adjuncts to easy and prompt launching are com- posed of an endless plateway or jointed wheel tyre fitted to the main wheels of the carriage, thereby enabling the boat to be transferred with rapidity and with greatly de- creased labour over beach and soft sand. Further effi- ciency in launching has also been attained at many stations

BODY PLAN

MIPSHIP SECTION.

Fig. 4. — Plans, profile, and section of Liverpool type of life-boat. A, B, C, E, G, as in Fig. 8 ; D, end air-compartments ; F, iron keel ; H, drop-keels.

by the introduction in 1890 of pushing-poles, attached to the transporting-carriages, and of horse launching-poles, first used in 1892. "Fig. 8 gives a view of the modern transporting-carriage fitted with Tipping's sand- or wheel- plates.

The life-belt has since 1898 been considerably im- proved, being now less cumbersome than formerly, and

Zm

BODY PLAN

MIDSHIP SECTION

Fig. 5. — Plans, profile, and section of Norfolk and Snfi'olk tvpe of life-boat. A, 13, E, F, G, H, as In Fig. 4 ; A, side dock ; I, cnblc-well.

more comfortable. The feature of the principal im- provement is the reduction in length of the corks under the arms of the wearer and the rounding-off of the upper portions, the result being that considerably more freedom is provided for the arms. The maximum extra buoyancy has thereby been reduced from 25 lb to 22 tt), which is more than sufficient to support a man heavily clothed with his head and shoulders above the water, or to enable him to support another person besides

himself. Numerous life-belts of very varied descriptions, and made of all sorts of materials, have been patented, but it is generally agreed that for life-boat work the cork life-belt of the Royal National Life-boat Institution has not yet been equalled.

Life-saving rafts, seats for ships' decks, dresses, buoys, belts, &c., have been produced of late years in all shapes and sizes, but nothing apparently has as yet been brought out which has been generally acknowledged to be indis- pensable. Those interested in life-saving appliances were hopeful that the great International Exhibition held at Paris in 1900 would have produced some life-saving in- vention which might prove a benefit to the civilized world, but so lacking in real merit were the life-saving exhibits that the jury of experts were unable, after three months' careful examination and consideration, to award to any of the 436 competitors the Andrew

Pollok prize of £4000 for the best method or device for saving life from ship- wreck.

History. — Since 1881 the necessity and importance of

MIDSHIP SECTION.

FiQ. 6.— Plan, profile, and section of Tubular type of life-boat. A, deck ; E, wale, or fender ; H, drop-keel.

the existence of a thoroughly efficient life-boat service have been more generally felt and acknowledged by the people not only of Great Britain, but also of those other countries on the European Continent which have a searboard, and of the British colonies — the countries which possessed such life-saving services having since greatly improved and enlarged their scope where necessary, while those which were not so provided have established life-boat services. All the foreign life-boat institutions and services have been founded more or less on the lines of the Royal National Life-boat Institution, which is regarded by them in the light of a foster-mother. The British Institution has greatly developed since its reorganization in 1883, both in its life-saving efficiency and financially, and has been spoken of in the highest terms as regards its management by successive Governments — a Select Committee of the House of Commons in 1897 reporting to the House that the thanks of the whole community were due to the Insti- tution for its energy and good management. At the close of 1901 the Institution's fleet consisted of 288 life-boats, and the total number of lives for the saving of which the committee of management had granted rewards since the establishment of the Institution in 1824 was 43,197. At this time there were only fifteen life-boats of any sort on the coast of the United Kingdom which did not belong to the Institution. In 1882 the total amount of

money received by the Institution from all sources was £67,797, lis. 9d., whereas in 1901 the total amount re- ceived had more than doubled, having increased to £107,293, 6s. lid. ; this latter sum was on three occasions considerably exceeded, namely, in 1894, 1896, and 1898.

In 1882 the Institution undertook, with the view of diminishing the loss of life annually occurring among the coast fishermen, to provide the masters and owners of fish- ing-vessels with trustworthy aneroid barometers, at about a third of the retail price, and in 1883 the privilege was ex- tended to the masters and owners of coasters under 100 tons burden. This action was highly appreciated, and at the end of 1901 as many as 4417 of these valuable instru- ments had been supplied. In 1889 the committee of management promoted a Bill in the House of Commons to provide for the removal of wrecks in non-navigable waters which might prove dangerous to life-boat crews and others. This Bill, under the title Removal of Wrecks Act, 1877, Amendment Act, 1889, became law on the 31st May 1889, and under its useful provisions numerous highly

BODY PLAN

MIDSHIP SECTION.

Fig. 7. — PlauB, profile, and section of Watson type of life-boat. Lettering as in Fig. 4, but C, side air-cases above deck and thwari:s.

dangerous wrecks have been removed. This Act was the first signed in 1889 by Queen Victoria, who, from 1837 until her death in January 1901, was the patron of the Institution, being then succeeded by King Edward VII., who as prince of Wales had been the president of the Institution for several years.

In 1893, at the instance of the committee of manage- ment, the chairman of the Institution moved a resolution in the House of Commons that, in order to decrease the serious loss of life from shipwreck on the coast, the British Government should provide either telephonic or telegraphic communication between all the coast-guard stations and signal stations on the coast of the United Kingdom ; and that on those parts of the coast where there are no coast- guard stations the post offices nearest to the life-boat sta- tions should be electrically connected, the object being to give the earliest possible information to the life-boat au- thorities at all times, by day and night, when the life-boats are required for service ; and further, that a Royal Com- mission should be appointed to consider the desirability of electrically connecting the rock lighthouses, light-ships, &c., with the shore.

The resolution was agreed to with- out a division, and since then its intention has been prac- tically carried out, the results obtained having proved most valuable and useful in the saving of life.

On the 1st of January 1898 a pension and gratuity

scheme was introduced by the committee of management, under which life-boat coxswains, bowmen, and signalmen of long and meritorioas service, retiring on account of old age, accident, ill-health, or abolition of office, receive special allowances as a reward for their good services. The adoption of this course gave the greatest satisfaction to the life-boat men all round the coast ; and while these payments act as an incentive and inducement to the men to do their utmost to discharge their duties satisfactorily, they at the same time assist the committee of manage- ment in their effort to obtain the best men for the work. For many years the Institution has given com- pensation to any who may have received injury while employed in the service, besides granting liberal help to the widows and dependent relatives of any in the service who lose their own lives when endeavouring to rescue others.

TRANSPORTING CARKIAOH ‘WITH WHEBL-PLATEa.

main bed. fore bed.

tipping’s wheel-plates.

END VIEW.

ELEVATION.

I I I I I ^

Fig. 8. — Life-boat transportingr-carriage with Tipping’s wheel-plates.

The rocket apparatus, which is under the management of the coast-guard, continues to render excellent service in life-saving. No alteration or improvement of any moment has of late years been made in the apparatus. During the year ended the 30th June 1901, 152 lives were thus saved, this number being 164 less than the average for the pre- vious ten years. The total number of lives saved by the life-saving apparatus between] 870 and 1901 was 7762. On the 30th June 1901 there were 217 life-saving com- panies, numbering in all 3770 volunteers, and there were six brigades with a total membership of 429.

The United States life-saving service, established in 1871, continues to be one of the chief life-saving services of the world. At the close of the fiscal year 30th June 1899 its' establishment embraced 266 stations. Of this number 193 were situated on the Atlantic and Gulf coasts, 66 on the coasts of the Great Lakes, 16 on the Pacific coast, and one at the falls of the Ohio, Louisville, Ken- tucky. Comparatively few of the stations are open all the year round as in Great Britain, local requirements apparently rendering it necessary for the great majority of the stations to be " active " only for periods ranging from

two to ten months. The number of disasters to docu- mented vessels within the field of station operations during the year was 428, and there were on board these vessels 3903 persons, of whom only 66 were lost. The estimated value of the vessels was $6,072,636, and that of their cargoes $2,032,005, making the total value of the property imperilled $8,104,640. Of this amount $6,261,900 was saved and $1,842,740 lost. In addition to these there were 294 casualties to undocumented craft — sailing boats, rowing boats, &c. — carrying 671 persons, seven of whom perished. The value of the property involved in these instances was estimated at $138,636, of which $129,285 was saved and $9250 lost ; 761 persons received assistance at the stations, the number of days' relief afforded aggre- gating 1460 ; 63 lives were lost within the scope of the service during the year — a larger number, with a single ex- ception, than in any year during the previous two decades. There were during the year 97 persons rescued from positions of danger otherwise than from vessels, who would in all probability have perished but for the aid of the surfmen. There were 691 stranded vessels floated off, repaired when damaged, piloted out of

dangerous positions, and in similar ways assisted by the station crews. Minor assistance was also afforded to 382 vessels and small craft. 1 93 vessels running into danger of stranding were warned off by the signals of the patrol-men, most of them having been thus saved from either serious danger or total loss. The surf-boat was used 773 times, making 1089 trips. The self-righting and self-bailing life-boat was used 132 times, making 163 trips. The gasoline launches (at City Point station) were used 80 times, making 90 trips. Smaller boats were used 432 times, making 626 trips. The river life-skiffs (at the Louisville station) were used 41 times, making 97 trips. The breeches buoy was used 11 times, making 55 trips. The wreck gun was employed 17 times, firing 29 shots, and the heavy stick was used 28 times. There were 949 persons landed by the surf -boat, 111 by the life-boat, 184 by the gasoline launches, 162 by the river skiffs, 151 by other station boats, and 65 by the breeches buoy. In addition to these, 11 persons were rescued by men wading out into the surf, 6 by a ladder from shore to a stranded vessel, 6 by a line from a sinking vessel to a pier, 2 by means of heaving lines, and 1 person was hauled through the surf on the whip-line when the hawser was not set up. The total cost of maintaining the United States life-saving service during the year ended 30th June 1899 was $1,649,411.

Life-boat Service in other Countries. — Good life-saving work continues to be done by the other life-boat services in Europe and elsewhere, most of these institutions having been formed on the lines of the Eoyal National Life-boat Institution of Great Britain. The services axe operating in the following countries : —

Supported entirely by Govern-

Belgium. — Establislied in 1838. ment.

Denmark. — Established in 1848

Sweden. — Established in 1856.

France. — Established in 1865. sisted by the Government.

Germany. — Established in 1885. voluntary contributions.

Turkey (Black Sea).— Established in 1868, dues.

Bussia. — Established in 1872. Voluntary receiving an annual grant from the Government

Italy. — Established in 1879. Voluntaiy association.

Spain. — Established in 1880. Voluntary association, receiving annually a grant of £1440 from Government.

Canada. — Established in 1880. Government service.

Holland. — Established in 1884. Voluntary association, assisted by a Government subsidy.

Norway. — Established in 1801. Volvmtary association, receiving a small annual grant from Government.

Government service. Government service. Voluntary association, but as- Supported entirely by Supported by association, but

but

but but

Portugal. — Established in 1898. Voluntary society. India {East CoasJ).— Voluntary association. Australia {South). — Voluntary association. New Zealand. — Voluntary association.

Japan. — The National Life-boat Institution of Japan was founded in 1889. It is a voluntary society, but is assisted by Gov- ernment. Its affairs are successfully managed and worked by a president and a vice-president, supported by a very influential council. The head office is at Tokyo, and numerous branches with local committees have been established. In June 1900 there were 17 rescue stations in full working order. The Imperial

Govern- ment contributes an annual subsidy of 20,000 yen (£2000) and also renders every possible assistance. The following are the sta- tistics of the lives and vessels saved during the years 1894 to 1898 inclusive : —

Veesela saved. Lives saved.

196

62

95

272

980

The council of the Institution are very sanguine that in the course of a few years they may, with the assistance of the Government, be able to establish as many as 113 rescue stations ;

1894 •

33

1895 •

17

1896 •

22

1897 •

60

1898 •

208

and these will, they think, be sufficient for the purposes of the objects of the Institution on the coast of Japan. The members of the Institution consist of three classes— honorary, ordinary, and sub-ordinary, the amount contributed by the member determining the class in which he is placed. Any member guilty of conduct detrimental to the credit of the Institution, or of delaying to pay his annual subscription, is deprived of his membership at the discretion of the council. The chairman and council are not, as in Great Britain, appointed by the sub- scribers, but by the president, who must always be a member of the imperial family. The institution bestows three medals :■ — (a) the medal of merit, to be awarded to persons rendering distinguished service to the Institution ; (6) the medal of mem- bership, to be held by honorary and ordinary members or sub- scribers ; and (c) the medal of praise, which is bestowed on those distinguishing themselves for special service in the work of rescue. (c. Di.)

Ligao, a town near the centre of the province of Albay, Luzon, Philippine Islands. The rich volcanic soil in its vicinity produces rice, hemp, Indian corn, fine sugar- cane, and indigo, agriculture being the sole occupation of its inhabitants. The language is Bicol. Population, 17,000.

LIGHT,

THE vievf that light is physically a disturbance pro- pagated through a subtle medium called the aether is now universally accepted. There are, no doubt, diffi- culties in realizing mentally the essential characteristics of this aether, but these are of a much less serious nature than those which beset any other supposition as to the mode of propagation of light. The simplicity and direct- ness with which the accepted theory explains the ordinary laws of reflection, refraction, polarization, and interference phenomena have been fully illustrated in the articles Light (Ency. Brit. vol. xiv.) and Wave Theoet {Id. vol. xxiv.). In the great majority of cases of ordinary experience the mere conception of light as a wave motion through the aether supplies a sufficient explanation, and that without any regard to the essential character of the aether or to the nature of its connexion with matter. It is sufficient to assume that the disturbances in the aether are in some sense transverse to the direction in which the light is being propagated, and that matter tends to increase the effective density of the aether in the region where it is present.

When, however, we pass to the consideration of the various phenomena that may be grouped under the head of ” Dispersion,” we are forced to inquire more particularly into the manner in which the particles of matter imbedded in the aether react upoa the vibratory motion that is being propagated through it. This inquiry leads almost im- mediately to the more fundamental questions, What is the constitution of the aether, and what is the mode of connexion between aether and matter ? In striving after an answer to these questions scientific men have indulged in a great deal of curious Speculation, and it is important in discussing the advances made in our knowledge of the laws and nature of light to bear in mind the speculative character of much of our modern theory. Apart alto- gether from theoretic considerations, however, new facts are being added daily to our stores of knowledge, together with a fresh and deeper acquaintance with old ones, and it may be safely said that no recent result of experiment has been out of harmony with the broad theoretic view that light is physically an undulatory disturbance in a medium. Curious and complicated phenomena have, it is true, been brought to light, but these have not materially increased the difficulties of the theorist, whose hold of the funda- mental principles has of late been greatly strengthened. It is the purpose of the present supplementary article to show how experiment and theory have aided each other

in deepening our knowledge of this important branch of physical science. (See .^thee.)

Photometry. — The great development of artificial lighting during the later years of the 19th century has given photometry an increased importance. Por example, electric lights are classified according Y”,tttf to their ” candle-power.” The candle, in terms of whose brightness the brightness of other sources of light is to be expressed, must, of course, fulfil the conditions demanded of all standards. It must give under definite and easily realizable conditions a definite and constant luminous effect, and it must be easily reproducible. . The earlier attempts to get a candle of constant brightness were not very satisfactory. The British standard is a sperm candle which weighs \ lb and loses in burning 120 grains per hour. It is found that these conditions are not sufficient to determine the luminous power of the candle, since the length and shape of the wick, the height of the flame, and the

composition, temperature, and humidity of the atmosphere all have an effect upon its brightness. The same is true of other similar sources of light — for example, the German standard candle, which is made of paraffin, has a diameter of 2 cm., and has its wick cut until the flame is 6 cm. high, but which with all pre- cautions suffers continual alterations in brightness. For ordinary practical purposes, however, these candles are steady enough. Other kinds of flame have also been used as a standard source of light. The oldest of these is the Prench Carcel lamp, which is provided with a cylindrical Argand burner, and gives the standard brightness when 42 grammes of colza oil are consumed per hour. The supply and draught are regulated by clockwork. Vernon Harcourt's Pentane standard, in which a mixture of gaseous pentane and air is burned so as to maintain a flame 2-5 inches high at ordinary barometric pressure, gives good results, and is readily adjustable to suit varied conditions. For accurate scientific purposes the best standard is the Hefner-Alteneck or amyl-acetate lamp. It is of simple construction, and gives the standard brightness when it burns in still air with a flame 4 cm. in height. The bright- ness is affected by change of humidity, but careful measure- ments show that it may be trusted to within 2 per cent.

Violle has proposed to use as standard the light emitted by a square centimetre of surface of platinum at its melting-point, but there are obvious practical difficulties in the way of realizing this suggested standard. Petavel,

who carefully examined the necessary conditions for pro- ducing it (Proc. Roy. Soc, 1899), finds that the platinum must be chemically pure, that the crucible must be made of pure lime, that the fusion must be by means of the oxy-hydrogen blow-pipe, that the gases must be thoroughly mixed in the proportion of 4 volumes of hydrogen to 3 of oxygen, and that the hydrogen must contain no hydro- carbons. Under these conditions the variation in the light emitted by the molten platinum would probably not exceed 1 per cent. Lumnier and Kurlbaum have proposed as a standard a strip of platinum foil

25 mm. ■wide and -015 mm. thick brought to incandescence by an electric current of about 80 amperes. The temperature is gradually increased until ^^-th of the total radiation is transmitted through a water trough 2 cm. in width. This ratio is determined by means of a bolometer, and so long as it is adjusted to jV^h the light is practically constant. For comparative photometric work the incandescent electric light is very convenient, having the one great advantage over candles and flames that it is not affected by atmospheric changes. So far, however, it has not been found possible to make to specification a glow-light of definite candle-power when a given current is passed through it. A standard glow-lamp is yet to be devised.

The illuminating powers of two sources of light are most simply compared by so adjusting their distances from a given point as to have at this point equal illumination from the two sources. In addition to the methods associated ■mih the names of Eitchie, Eumford, Bunsen, and Wheatstone (Ency. Brit. vol. xiv. pp. 583-84), there are several other methods, either new in principle or important modifications of those men- tioned, which have come greatly into use, or which have special advantages for particular kinds of work.

Swan's prism photometer invented in 1859 is a beauti- ful application of the same principle that is embodied in Bunsen's grease-spot photometer (see Trans. Roy. Soc. Ed. vol. xxi.). The instrument is essentially the same as that described by Lummer and Brodhun in 1889, and generally named after them. It consists of two equal rectangular

glass prisms placed with their diagonal faces to- gether so as to form a cube (Fig. l),and cemented together by a small patch of Canada balsam, which spreads out into a circle when the prisms are pressed together. In Fig. 1, which represents a cen- tral section of the bi-prism, the Canada balsam is re- presented by the letter N. The light from two illumi- nated surfaces, PQ, ES, is allowed to fall perpen- dicularly on the faces AB, AD. In each case that part of the light falling internally on the portion of the diagonal face which is not backed with the Canada balsam is totally reflected. On the other hand, the light which falls on the portion backed by the Canada balsam is almost wholly transmitted. Thus an eye placed in the position qtp receives light from both sources, the surface ES supplying nearly all the

light that seems to come from the patch N, and the surface PQ supplying all the light which seems to come from the region immediately surrounding N. The patch N will in general be visible ; but it will quite disappear when the luminosity of the ray Tt, which traverses the Canada balsam, is exactly equal to the

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q t p Fig. 1.

luminosity of the rays Py>, Qq, which have come after total reflection from the surface PQ. This condition of invisi- bility of N” is arrived at by adjusting the positions of the sources of light which illuminate the surfaces PQ, RS. The brightnesses of the two sources will then be as the squares of their distances from their respective screens.

The essential part of Lummer and Brodhun’s photometer is a combination of prisms very similar to Swan’s. In its most improved form the bi-prism or ” optical cube ” has one of its component prisms cut in a peculiar manner. The diagonal face is partly cut away, so that the central part only of this face can be brought into contact with the diagonal face of the other prism. The Canada balsam may be dispensed with if the surfaces are pressed closely together so that no layer of air is left between them. In order to make the instrument convenient for use with an optical bench, Lummer and Brodhun make the illuminated surfaces which are to be compared the opposite sides of an opaque screen set in the continuation of the diagonal (CA) of the bi-prism, the rays being brought by reflection from symmetrically situated mirrors so as to enter the sides AB and AD perpendicularly. An imj)ortant modi- fication, due also to Lummer and Brodhun, is the following : By means of a sand-blast a portion, which may be called r, is removed from one half of the diagonal face of the one prism, and from the other half of the same prism there is removed in like manner all but a part I corresponding to the part r. The portions which have not been removed are pressed close to the diagonal face of the other prism, and become the parts through which light is freely trans- mitted. On the other hand, the light which enters the second prism and falls on the portions of surface backed by the layers of air filling the cut-out parts is totally reflected. The general result is the production of two similar luminous patches I and r, each of which is sur- rounded by a field of the same intensity as the other patch. When the photometric match is made the whole region will be uniformly bright. But, by insertion of strips of glass so as to weaken equally the intensity in the surrounding fields, the match will be obtained when these fields are made of equal intensity and when at the same time the two patches difier equally in intensity from them. Under these conditions the eye is able to judge more certainly as to the equality of intensity of the two patches, and an untrained observer is able to effect a comparison with an accuracy which is impossible with most forms of photometer.

Joly’s diffusion photometer consists of two equal rect- angular parallelepipeds of a translucent substance like paraffin separated by a thin opaque disc. It is set between the sources of light to be compared in such a way that each paraffin block is illuminated by one only of the sources, and is adjusted until the two blocks appear to be of the same brightness. The

method is made more sensitive by mounting the photometer on an elastic vibrator so as to render it capable of a slight to-and-fro oscillation about a mean position.

When the sources of light differ in brightness, it is often convenient to cut down the intensity of the stronger by the interposition of an absorbing medium of neutral tint. A wedge of glass capable of a ”’”’‘“i’ to-and-fro adjustment across the path of the rays is a favourite device, or a set of translucent plates of glass, the absorbing powers of which have been carefully deter- mined. If light of intensity / is reduced by passage through such a plate to /’, the fraction transmitted by the plate is the ratio I’\I. Since every successive layer of given thickness through which the light passes reduces the intensity of the light incident upon it in a given ratio, it follows that the intensity of the light is

diminished in a geometrical progression as the distance travelled through increases in an arithmetical progres- sion; in other words, the rate at which the intensity- falls off per unit distance is proportional to the intensity, a law which is mathematically expressed by means of the exponential function. Thus after traversing thickness X the intensity / is reduced to /’ = /«”«* where e is the number 2-71828 . . . and a is known as the extinction-coefficient. Another method of cutting down the in- tensity of a ray in a given ratio is to make the beam intermittent by interposition of a rotating disc of which a sector has been removed. This was the method used by Swan in 1849 in his investigations on the “Gradual Production of Luminous Impressions on the Eye ” {Trans. R. S. E. vol. xvi.), and it has been employed with various modifications by many other experimenters. The pro- perties of plane polarized light may also with great advan- tage be used to effect the same purpose. Let the brighter beam be polarized by passage through an appropriate crystal, and then let a second polarizer be interposed. For certain positions of this polarizer nearly all the light will pass, and for certain other positions the light will be wholly cut off.

Between these limits any intermediate intensity of light may be obtained by simply rotating the polarizer into a particular position. If / is the maximum intensity of light which can pass, the intensity of the light transmitted when the polarizer is turned through an angle 4> IB I cos^ 4'.

So long as the lights to be compared are of the same or nearly the same tint, the photometric match obtained by different observers is practically the same, but if they are of distinctly different colours, not only do different observers obtain different results, but those obtained by the same observer at different times are not always in agreement. It is probable, how- ever, that when due precautions are taken to have all conditions identically the same the well-trained eye will obtain consistent results. To show the necessity for such precautions two points of physiological importance may be briefly touched upon. Suppose that two discs, coloured, say, red and blue, when viewed in a bright light, appear to the eye to be of the same intensity, the blue disc will appear to be brighter than the red when viewed in a less bright light. This phenomenon, which was first clearly described by Purkinje in 1825, is exemplified in the familiar fact that blue flowers are visible longer than red flowers in deepening twilight. In like manner the blue and violet end of a spectrum is more stimulating to the eye than the red end when the general luminosity is low, but at high luminosities the red gains relatively in brightness until it becomes more stimulating than the blue. Then, again, the condition of the eye must be taken into account. The judgment as to the relative intensities of two coloured discs will depend upon whether, previous to making the comparison, the eye has been resting in dark- ness or has been exposed to the influence of ordinary illumination. The eye adapts itself differently in darkness and in light, and it is found that the dark-adapted eye is more powerfully affected by the blue half of the spectrum, but to the light-adapted eye the yellow and red end is more stimulating. In short, the part of the spectrum which appears brightest to the eye shifts towards or from the violet end (1) as the general luminosity diminishes or increases, and (2) as the eye tends towards the dark- adapted state or towards the light-adapted state. It is evident, in fact, that in comparing the intensities of differently ~~coloured lights the eye supplies no criterion as to the relative amounts of energy in the rays. Physi~~ cally the energy in a given ray of light depends on the square of the amplitudes of the vibrations. Physiologi-

cally the sensitiveness of the eye depends partly upon the wave-length of the light, so that there is no simple relation between apparent intensity and energy. It is the physio- logical factor which renders the photometric comparison of differently-coloured lights difficult and uncertain. A few of the methods for overcoming these difficulties wiU now be described.

An ol)vious method of making a photometric com- parison between two lights of markedly different colour is to fill up the gap between them by means of a series of lights differing by small gradations of ^^^ “* tint. The relative intensities of each contiguous pair may then be determined by any of the usual photo- metric methods, and a final comparison effected by calcula- tion between the extremes. To facilitate the comparison of lights differing slightly in tint, A. M. Mayer designed a photometer in which the phenomenon of contrast colours was taken advantage of. The simplest experiment in contrast colours is made by an application of Eumford’s photometric method to the comparison of the shadows cast by two flames, one of which gives a white light and the other, say, a red light. Each flame will illuminate the part of the screen on which the shadow due to the other falls, and we might expect the one shadow to appear white and the other red. But when the experiment is made the one appears a beautiful green while the other appears red. The usual explanation of this striking effect is that the doubly illuminated surface of the screen gives a false criterion for white, compared with which the really white but less bright shadow thrown by the red flame appears green. This explanation seems to be hardly sufficient, in view of the fact established by Mayer that the same contrast of colours is observed even when no “doubly illuminated ” part of the screen can be seen by the eye of an observer quite unprepared for what is to be seen and quite ignorant of the arrangement of the apparatus. Mayer also describes some very beautiful contrast effects obtained by using as the one source of light the flash of an electric discharge {Phil. Mag., Aug. 1893). Put generally, the phenomenon of contrast colours consists in this, that a strong colour tends to impart its complementary tint to a neatral tint placed in juxtaposition, and to have a cor- responding effect upon a non-neutral tint of feeble hue. It is evident, then, that by juxtaposition of a strong colour we may appreciably alter the hue of a particular tint. This is the principle of the method devised by Mayer for bringing into a condition of apparent equality of tint two coloured surfaces which, when viewed without the presence of

the strong colour which induces the contrast tint, appear of distinctly different hue. Under these conditions the surfaces can be compared photometrically with greatly increased certainty.

When the intensities of two differently-coloured lights differ considerably there is no difficulty in judging which is the stronger. By making the one light pass through a fairly large range of brightness we may easily assign limits outside which the intensities are undoubtedly different. After some experience these limits get closer ; and many experimenters find it possible, by taking proper precau- tions, not only to effect a match, but to effect practically the same match time after time. According to Abney, whose memoirs on colour photometry {Phil. Trans., 1886 1892) form a most important contribution to the subject, the observer in making his judgment as to the equality of luminosity of two patches of colour placed side by side must not begin to think about it, but must let the eye act as unconsciously as possible. His method was to compare the coloured patch with white light given by a particular standard and cut down to the proper intensity by use of a rotating sector, which could be adjusted by means of a suit-

able meclianism while it was rotating. In this way the relative brightness of different parts of the spectrum was obtained, and thus a curve known as the luminosity- curve (Fig. 2) was constructed. Wave-lengths were measured horizontally, and the height of the luminosity curve above any point represented the luminosity of the light of the corresponding wave-length. The comparison of luminosity curves obtained by normal eyes and by colour-bhnd eyes is of great interest and importance, and brings out very clearly certain fundamental diiFerences between normal and abnormal vision. Abney has also given special attention to the manner in which the feeling of colour is lost when the light is cut down sufficiently in intensity. When, for example, the intensity of a beam of white light which has been drawn out into a spectrum is gradually diminished, the part of the spectrum which first loses its colour is the dark red, and the part which retains its colour longest is the orange. Next to the orange and yellow the green is most persistent. It is in accordance with these facts that the gray tints at

early dawn gradually assume colour as the dawn brightens ; yellow, orange, and blue flowers show in their true colours, while red flowers still remain black, and not tUl a certain brightness is reached do all the colours come out unmistakably in their appropriate tints. To express the matter in another way, a normal eye in feeble lights acts as an eye afflicted with red colour-blindness. A useful account of many of these colour phenomena is given in Sir W. de W. Abney's book on Colour Vision.

If two sources of light of different intensity or of different colour are presented to the eye in more or less rapid

alternation, and if the rate of alternation can be

bt^- adjusted at will, then for slow or moderate rates

metry. of alternation the eye will perceive a flickering,

which disappears when the alternation becomes rapid enough. Thus a singing flame announces its inter- mittent character to the ear, but appears perfectly steady to the eye. If the sources of light are to begin with of different colour and intensity, and if we gradually diminish the intensity of the more intense, we shall find that the rate of alternation at which flickering just disappears gets less as the intensities approach equality. When the intensities are equal the rate of alternation for which the flickering ceases reaches its minimum. With any change in the intensity of either the flickering reappears, and can be got rid of only by increasing the rate of alternation. The phenomenon was noticed by Plateau and its true meaning pointed out by Helmholtz. Kood was, however, the first to show how the phenomenon of flickering could be utilized for purposes of photometry (see Amer. Jour. Sci., 1893). Haycraft successfully employed what is at bottom the same principle in comparing the luminosities of different parts of the spectrum (Journ. Physiol, vol. xxi., 1897). The spectrum of an intermittent beam of light was viewed by the eye. Now intermission may be regarded as an alternation of light and darkness, and the brighter the light the more rapid must be the intermission for which flickering just disappears. Thus there will be a particular rate of intermission for which the less luminous red will appear quite steady, while the more luminous green, for example, will flacker. As the rate of

intermission is increased the non- flickering part of the spectrum will increase, and ultimately a rate will be reached at which flickering will be visible in a very narrow strip of the spectrum. This narrow strip will indicate by its position the most luminous part of the spectrum.

By varying the rate of intermission and noting the points in the spectrum which for each rate of intermission separated the flickering from the non-flickering regions, Haycraft obtained very jsimply curves of luminosity for the whole spectrum. Some of

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Fig. 2.

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these are reproduced in Fig. 2. The abscissse are wave-lengths, and the ordinates the rates of intermission. The three curves belong to experiments with different widths of slit, the lowest corresponding to the narrowest slit and the I& highest to the widest slit. Any point on a curve gives the rate ii of intermission at which light of the indicated wave-length 6 just ceased to flicker. The letters along the axis of wave-lengths indicate the positions of the colours, blue, green, yellow, red. – , — ~~^ The curves show the *’’° “• *°” nature of Purkinje’s phenomenon, the re~~ lative luminosity of the red increasing with increased brightness of the beam, and the point of maximum luminosity shifting towards the red end of the spectrum. The order of brightness is —

In the lower curve, green, yellow, blue, red.

In the middle ,, yellow, green, red, blue.

In the upper ,, yellow, red, green, blue.

According to Rood’s experiments, when a disc whose halves differ in tint but not in luminosity is rotated rather slowly, the eye of the observer sees no flickering such as is at once apparent when the halves differ slightly in lumi- nosity. Rood has himself suggested various forms of photometer based on this principle. In his latest form (see Amer. Jowr. Sci., Sept. 1899) the differently-coloured beams of light which are to be compared photometrically are made to illuminate the two surfaces of a prism of paper or of plaster of Paris set facing the eye. Between the prism and the eye is placed a cylindrical concave lens, which can be set in oscillation by means of a motor in such a way that first the one illuminated surface of the prism and then the other is presented to the eye in sufficiently rapid alternation. The one source of light is kept fixed, while the other is moved about until

the sensation of flicker disappears. From work with this form of instrument Rood concludes that ” the accuracy attainable with the flicker photometer, as at present constructed, and using light of different colours almost spectral in hue, is about the same as mth ordinary photometers using plain white light, or light of exactly the same colour.” A simple form of flicker photometer has been constructed by Whitman (see Physical Review, vol. iii., 1895-96), and his conclusions as to its accuracy and convenience fully corroborate Rood’s.

It appears that, when in the comparison of lights of different colour the flicker vanishes, the sensation of colour is greatly diminished, but increases markedly as soon as the balance is destroyed and the flicker reproduced. This suggests the possibility that the sensations of brightness and of colour are produced by different structures in the eye. It has long been recognized that the sensation of colour is much feebler when the retina is stimulated in regions re- moved from the yellow spot, which is also the part of the retina specially implicated in the production of clear vision. Another familiar fact is that the eye fails to appreciate colour when the luminosity is faint, as if a stronger stimulus were needed to affect the nerves which have to do with colour sensation than to affect those which have to do with luminosity. When a dark body is gradually heated up to a red heat, careful experiment shows that of the faint, colourless, unsteady radiation which is visible some time before the dull red glow begins to be seen, the eye seems unable to get a steady hold. When, with rising temperature, the body begins to emit the first dull red rays, the early fitful character of the luminosity quite disappears and the radiation becomes steady. Now there

are two well-known structures in the eye called the rods and cones ; and it has been suggested by von Kries that of these the rods are involved in producing the sensation of brightness, the cones the sensation of colour (see Lummer, Wied. Ann. 62, 1897). If this be so, and if the rods are the more sensitive to feeble radiations, it is probable that they also respond more

quickly to any particular stimulus. Hence the sensitiveness of the eye to flickering may depend ultimately on the rods, or at least on the structure that has to do with the luminosity sensation. Whatever truth there may be in this speculation, it is clear that flickering depends on the duration of the sensation after stimulation of the eye ; and according to Ferry (Am. Jour. Sci., 1892), the duration depends on the luminosity and not on the wave-length. See also a paper on persistence of vision by Allen {Physical Review, vol. xi., 1900), which contains important results bearing upon the theory of vision.

The spectrophotometer is an instrument which enables us to make photometric comparisons between the similarly- coloured portions of the spectra of two different Spectra- ggurces of light. In the earlier forms the diffi- culty of getting the two spectra actually to touch along their contiguous margins — an important condition, greatly increasing the accuracy of the comparison — was overcome by special optical contrivances. In the more recent forms the principle embodied in Swan's double prism photometer has been successfully applied. By means of a simple modification in the form of the two prisms. Brace (see Phil. Mag., Nov. 1899) makes the combined

prism serve to pro- duce the spectra as well as to effect the desired comparison. The compound prism ABC (Fig. 3) is made up of two equal rect- angular prisms ADB and ADC placed with their longer sides in contact, so that the whole forms an equi- lateral prism vrith three polished faces. Part of the interface AD is silvered, the silvering forming a narrow central strip running parallel to AD. Along the rest of the interface the two prisms are cemented together with Canada balsam or other material having as nearly as possible the same refractive index as the glass. Now suppose the two rays R S to enter symmetrically from opposite sides of the base of the compound prism as shown in the diagram. The ray E, will pass through the prism except where the silver strip intercepts it, and will form a part of a spectrum visible to the eye placed at R'. To the same eye there will be visible the similarly-dispersed ray SS' reflected from the silvered surface. Thus two systems of incident parallel rays of white light will form on emergence two spectra with corresponding rays exactly parallel. The aim of the experimenter is to make the two spectra of equal intensity by a method

which enables him to compare the original intensities of the sources. Now, in spectrophotometric work the relative intensities of the portions of the spectra being compared cannot conveniently be altered by varying the distances of the sources. Recourse is therefore generally had to one of the other methods already mentioned, such as the use of polarizing prisms or of rotating sectors. Under certain conditions Vierordt's method of allowing the two rays to pass through slits of different width leads to good results, but too great confidence cannot be placed upon it.

An important application of the spectrophotometer is to

measure the absorptive powers and extinction coefiicients of transparent substances for the differently-coloured rays of light. In such measurements the one spectrum is kept as steady in intensity as possible, though no standard of light has as yet been devised to give a steadiness comparable with the delicacy of the best spectrophotometric measure- ments. By appropriate means the intensities of chosen corresponding parts of the two spectra are made equal — in other words, a match is established. Into the path of the rays of the second spectrum the absorbent substance is introduced, and a match is again established, and a measure of the loss of luminosity due to the interposition of the absorbent substance is obtained.

It is evident that if the successive parts of two spectra are compared photometrically, we may by a process of summation obtain a comparison of the total luminosities of the lights which form the spectra. This process is far too tedious to be of any practical value, but sufficiently accTirate results may in certain cases be obtained by com- parison of two or more particular parts of the spectra, for example, strips in the red, green, and blue. Similar in principle is the method suggested % Mace de Lepinay, who matches his lights by looking first through a red glass of a particular tint and then through a chosen green. If R and G represent the corresponding ratios of the intensities, the required comparison is calculated from the

formula I = , , „ nno ,, ~~— rrB\~~ Crova, one of the earliest

1 ⊣ U'iiUo ^ 1 — IxKJ

workers in this subject, effects the photometric comparison of differently ~~coloured lights by matching those mono~~ chromatic rays from the two sources which have the same ratio of intensities as the whole collected rays that make up the lights. Careful experiment alone can determine this particular ray, but were it once ascertained for the various sources of light in use the method would have the merits of rapidity and accuracy sufficient for practical needs. Spectrophotometric observations are necessary to determine the position in the spectrum of the particular monochromatic ray, but when it has been determined, a coloured glass may be made which allows light in the neighbourhood of this ray to pass, and the photometric comparison may then be effected by looking through this glass.

Refraction and Dispersion. — The accurate determination of the refractive indices of various substances for rays of definite wave-length, and of the relative refrangibilities of different rays in particular substances, is of the utmost importance, not only in the construction of optical instru- ments of all kinds, but also in theoretic questions as to the nature of light and the interconnexion of sether and matter. In addition to the direct processes of making these determinations (see Ency. Brit. vol. xiv. pp. 590-92; and vol. xvii. pp. 800, 801), there are other processes, somewhat indirect but distinctly valuable and instructive. Some of these are based upon the phenomenon of total reflection, which occurs when a ray travelling in p./ „c■‘e’”” critical angle, whose value depends upon the two refractive indices. The critical angle is such that its sine is equal to the ratio of the smaller to the greater refractive index. Hence any convenient method for determining accurately this critical angle will give at once the ratio of the re- fractive indices of the two substances for the particular kind of light used. Wollaston was the first to use this method, which has been developed by Terquem, Trannin Kohlrausch, Pulfrich, and others. One arrangement, which is found to yield results of considerable accuracy, is to form an air cell boimded by two parallel plates of

glass of uniform thickness, cemented together at their edges by some material not acted upon by the liquid whose refractive index is to be

measured. This cell is then set with the glass walls vertical in the liquid, which is contained in a vessel fitted with parallel glass sides. A beam of parallel rays is passed horizontally through the vessel, liquid, and air cell, and viewed in a telescope placed on the opposite side of the vessel. The air cell is first set so as to receive the rays nearly at right angles to the glass walls, and it is then slowly rotated until the beam as viewed through the telescope vanishes. Another position of vanishing is found by rotating the air cell in the opposite direction.' The angle between these two positions can be measured with great accuracy, and is evidently double the value of the critical angle for the liquid and air, since the glass walls of the air cell with their parallel sides in no way affect the directions of the rays. When monochromatic light is used the vanish- ing of the transmitted beam takes place suddenly, so that the critical position of the air cell can be determined with great nicety. With white light the critical angle for the most refrangible rays is first reached ; consequently the blue, green, yellow, and red rays are cut off in suc- cession as the air cell is gradually rotated, so that the telescopic field changes first to yellow, then to orange, and lastly to red before disappearing entirely. In a similar way the refractive index of a solid may be deter- mined by immersing it in a liquid of greater refractive power and of known refractive index.

Wollaston's original method has been embodied very skilfully by Pulfrich in his total-reflectometer. To the upper plane hori- zontal surface of a glass cube or cylinder with axis vertical is cemented a glass tube whose function is to hold the liquid under examination. A slightly converging beam of light is introduced through the wall of the tube so as to impinge at grazing incidence on the upper surface of the glass cube or cylinder, which behaves

optically as a right- angled prism (Fig. 4). The rays which suffer refraction at the glass sur- face will all pass through the glass below a certain line. It is obvious from the diagram that the angle of refraction of this boundary ray as it enters the glass is the critical angle for the glass and the liquid. Its sine therefore measures the ratio of the refractive indices of the liquid and glass. The ray, as it passes on, impinges on the vertical wall of the glass prism, and then emerges into the air, making an angle i with the horizontal. At this second surface the sine of the angle of incidence (within the glass) is equal

to the cosine of the angle of refraction at the horizontal surface, that is, to the quantity

i-(m//)^

where p., n’ are the refractive indices of the liquid and glass

respectively. Hence

sin i = f>.’ sjl -{/i/n’y or

/x‘2-/t2 = sin»i.

The angle i can be determined with great accuracy by means of a telescope suitably mounted and directed so as to receive the emerging ray. By first filling the tube with distilled water at a definite temperature, for which /j, is known, we can measure |U’ ; and then knowing /i’ we can determine the value of fi for any liquid (and also for any solid) of less refractive power than the glass.

According to the wave theory of light (see Ency. Brit. vol. xiv. p. 605), the refractive index of any medium for any particular ray is inversely as the speed of propagation of the ray in the medium. Hence any method of deter- mining directly or indirectly the speed of propagation will

Fig. 4.

also determine the refractive index. The direct measure- ment of the velocity of light is an operation involving the highest experimental skill in the use of elaborate Refracto- and delicate apparatus, and practically we infer metry by the value of the speed of propagation in any Interter- given case from our knowledge of the value of ’”^‘ the refractive index. Nevertheless a very ingenious appli- cation of the principle of interference {Id. p. 606) has given us a remarkably delicate though indirect method of measuring slight alterations in the speed of propagation, and therefore corresponding slight changes of refractive power. To produce interference phenomena in light we must break up a given ray into two parts, and then bring them together again after the one has described a slightly longer path

than the other, or, at any rate, taken a longer time to describe its path. By this means the one set of crests and troughs lags behind the other set with which it was originally coincident. In the fundamental experiments devised by Young and Fresnel, and in the historical form of experiment known as Newton's rings, the interfering pencils of light travel in general along paths of different length. In Jamin's interferential refractometer, on the other, hand, the interference effects are produced by a relative retardation of the one ray, which is made to pass through a slightly denser medium than the other.

Two thick glass mirrors, exactly the same in all Tespects,,are arranged, as shown in Fig. 5, so that their similar surfaces form the opposite sides of a parallelogram whose acute angle is 45°. A ray of light (K) falling on o

the first mirror at an angle of 45° is partly reflected and partly reft-acted at the first surface. The refracted part, being reflected at the back of the mirror, emerges (in part) again into the air and pursues a path towards the second mirror parallel to the path pursued by the first reflected ray. These two rays falling on the second mirror suffer various reflections and refrac- tions. It will be seen, how- ever, from the diagram, that the part of the first reflected ray which enters the second

Fig. 5.

mirror and is reflected from its back, finally meets with that part of the second ray which is reflected from the first surface of the second mirror, and both proceed towards the eye of the observer at E. If the mirrors are exactly parallel, these two rays from the time of their separation to the time of their recombination will travel along paths of equal lengths, and since they have experienced the same reflections and refractions, although in differ- ent order, will be equally intense when they recombine. If, how- ever, the mirrors are not quite parallel, then, as first observed by Brewster, the two rays will meet after pursuing slightly different lengths of path, and interference bands will be seen. By adjusting the one mirror until the interference bands disappear we get the mirrors accurately parallel. When this has been done let a thin plate (P) of glass or other transparent medium be set in the path of one of the rays. At once interference bands will come into view because of the retardation of the one ray. In like manner we may

produce interference bands by introducing into the paths two exactly equal tubes with transparent ends and filled with liquids or gases differing slightly in density. The relative amount of retardation of the one ray is measured by means of a compensator, which retards the other ray by an equal amount so that the inter- ference bands disappear. This is usually a glass plate or a combination of narrow prisms capable of being manipulated so that the thickness of the material traversed by the ray may be varied in a definite manner. With this apparatus Jamin measured the refractive indices of various gases, and of dry and moist air, and studied the change of the refractive index of water with pressure and temperature.

In Jamin's apparatus the two rays which produce interference are separated by a distance proportional to the thickness of the mirrors, and since there is a practical limit to tliis thickness, it is not possible to separate the two rays very far. In Miohelson's form of refractometer this limitation is quite removed, and at the same time the experimenter is able to introduce any relative

retardation within wide limits, aud so to observe interference phenomena corresponding to large diiTerences of path. The essential parts of Michelson's instrument are shown in Fig. 6. P Q are two exactly similar glass plates set parallel to one another, and usually at an angle of 45° to the direction of the ray coming through the slit S. P is silvered on the back with a

semi-transparent film, so .5 that the part of the ray

reflected internally at this filmed surface is appro.ximately of the same intensity as the part which passes through the film. The reflected ray, deflected through a right angle, falls perpendicularly on the plane mirror M, placedT at a convenient distance, aud is conse- quently sent back along the original course to the plate P. The transmitted ray is similarly received by a mirror N, which we shall suppose placed at the same distance as M from the

point where the ray splits into two. and comes, passes twice two rays from their

#5 — i

i

Fig- 6.

Since the reflected through the plate

ray, as it j^ _ P, the paths of the

point of separation to their point of meeting would not be of the same effective length unless the transmitted ray had also to pass twice through the same thickness of glass. This is the reason for the presence of the plate Q, which simply acts as a compensator. The two rays having thus travelled the same length of path, meet again at the silvered surface of the plate P, and experience once more reflections and refractions. To an eye placed at E there will be transmitted through P part of the ray originally reflected at A, and there wiU be reflected part of the ray originally transmitted through P. ftus the two rays SAMAE, SANAE, having described paths of equal length, will be in a con- dition to produce interference phenomena, which will become apparent if any slight alteration in either path is made. Since the one ray has suffered reflection within the denser medium, and the other suffered reflection within the rarer medium, the phases of all the component vibrations will differ by half a period. Darkness will be produced, the conditions being the same as those which give rise to the black spot in Newton's rings. Any slight to or fro motion of either mirror will make the paths travelled by the two rays unequal, and interference bands will come into view. To facilitate the adjustment and make the instrument an instru- ment of precision one of the mirrors is provided with a fine screw, by which it can be moved through known distances perpendicular to its face. After the paths have been adjusted to equality, which is accomplished by slowly moving the one mirror so as to produce a widening out and final disappearance of the inter- ference bands obtained with monochromatic light, let a slight alteration be made in the density of the medium through which the one ray passes. At once the interference bands will come into

view, but they may be made to disappear again by moving the one mirror through the proper distance. This distance is measured in terms of the number of rotations that must be given to the screw by means of which the slow motion of the mirror is effected. The retardation or acceleration of phase is thus accurately determined, with the corresponding change of velocity and density. The instrument has been applied by Michelaou and others to a great variety of problems, some of which will be referred to later.

Of recent years a great deal of experimental work has been done in regard to the effect of changed physical con- ditions, such as pressure and tenq)erature, on Retraction refraction and dispersion in transparent bodies. aeasltr. These effects are too small to have any practical influence upon the optical properties of tele- scopes and microscopes, but the results are of high im- portance from a theoretical point of view. The wave theory of light would lead us to expect that any increase in the density of a substance should cause a decrease in the speed of propagation of light through it — that is, an increase in the refractive index. Gladstone and Dale long ago established a simple empirical law connecting the refractive index of a substance and its density, namely,

that the refractive index diminished by unity is propor- tional to the density. The ratio of the two (|U.~~1)/D is frequently called the molecular index, a name which is not, however, altogether satisfactory, since it suggests the rather crude theory that the molecules of a substance have a refractive index analogous to that possessed by the combined system of molecules which build up the sub~~ stance. Laplace showed that the corpuscular theory of light required the density to be proportional to the excess of the square of the refractive index over unity, and more recently H. A. Lorentz and L. Lorenz have independently deduced from special forms of the wave theory the formula —

M^l D’

— constant.

the investigations of the former being based upon Max- well’s electromagnetic theory of light. If we take a substance, say water, and

measure the refractive indices at two different pressures, any one of the three expressions enables us to calculate theoretically the ratio of the densities. But these may be measured directly by a purely dynamic process. Hence by comparing the measured change of density with that calculated from the assumed optical relation, we may test the applicabihty of this relation. This has been done with great elaboration by Quincke for water, glycerine, rape oil, almond oil, olive oil, oil of turpentine, carbon bisulphide, petroleum, alcohol, ether, and other substances; and in all Gladstone's em- pirical formula gave most satisfactory agreement. Lorentz's formula has, however, a much wider applicability, for it alone gives the same value for a given substance whether that substance be in the liquid or in the gaseous state.

It has not been found possible to establish any simple law connecting temperature and refractive index. If it were a mere question of density, then we should ogtractloa expect 'the refractive index of water at 4° C. aad (the temperature of the maximum density) to be tempera- a maximum also, but this it is not. According '"™' to Eiihlmann, the refractive index of water decreases steadily as the temperature rises from 0° C, and shows no peculiarity at or near the maximum density point. Miiller, Vogel, Offret, Arzruni, Dufet, and others have measured with great care the changes with temperature of the refractive indices of different kinds of glass and the more important crystals. In this direction one fact of a general nature seems to have been established by Pulf rich (Wied. Ann., 1892). Working with several kinds of glass, rock-salt, quartz, and fluorspar, he finds that the dispersion always increases with rise of temperature, in the cases in which the refractive index increases as well as in those in which it diminishes. In other words, when the refractive index increases with temperature, the change in the blue rays is greater than the change in the red rays, and when the refractive index diminishes with rise of tempera- ture the change in the blue is less than in the red. As a general rule the dispersion in liquids and gases diminishes with rise of temperature. In seeking for an explanation of these differences Pulfrich points out that in all cases of change of temperature not only must the accompanying change of density be taken into account, but there is also a probable change in the absorptive power of the body. As will be discussed more fuUy below, in connexion with anomalous dispersion, there is a close relation between absorption and

dispersion. To bring out more clearly the nature of the argument, let us take the case of heavy flint glass as given by Pulfrich. In the first row of the follow- ing table, under the lettets C D F G’, which represent the red, yellow, and blue rays corresponding to the so-named Fraunhofer lines ia the solar spectrum, there are entered the observed rates of increase per degree centigrade of

tte refractive indices of tlie four rays. In the second line are given the calculated values of what these refractive indices would be according to Gladstone’s law — in other words, the density effect. The third row contains the differences of the corresponding figures in the first and second rows, these being regarded as due to increase in absorptive power at the higher temperature. The increase of absorptive effect as we pass towards the more refran- gible end of the spectrum is, according to the various theories of the inter-relation of absorption, refraction, and dispersion, in harmony with an increase of refraction in- creasing towards the violet end — that is, with an increased dispersion.

Increase per Degree of the Refractive Index.

C.

D.

P.

G’.

Observed value . Density effect, calculation Absorption etfect

± -00001204 -2662 +3866

+ -00001447 -2699

-414fi

+ ■00002090

-2799 +4889

+ -00002810 – 2889 +6699

In general, then, when a rise of temperature takes place, the refractive index is diminished because of diminution of density, but is increased because of increase of absorp- tive power. The net result will be decrease or increase, according as the former preponderates or is overbalanced. In cases in which the cubical dilatation is small, the prob- ability is that the effect due to increase in absorptive power will preponderate ; and this is the case in the glasses and crystals studied by Pulfrich. Later experi- ments by Eeed {Wied. Ann. 65, 1898) bear out these conclusions. For example, the increase -with temperature of ~~dispersion in fluorspar is very small, *ment with the small absorbing power of this mineral, the blue and violet parts of the spectrum remaining sharp and distinct even to the highest temperatures. In the case of two kinds of glass experimented with, the dispersion in- creased only up to a certain limit, and began to decrease at high temperatures approaching the temperature at which softening set in.*~~

The wave theory of light in its most elementary form shows that a very close connexion must exist between the refractive index and the speed of propagation, f ***rf™'/'''*** *^^'^ although practically no refracted ray is con- medals, sidered as existing in the case of opaque sub- stances such as metals, nevertheless there may be in these cases also a truly refracted ray penetrating a short but measurable distance into the material. The simplest proof of this fact is that metallic films can be obtained thin enough to be transparent. First, however, it is convenient to draw attention to a phenomenon first observed by Newton and described by Stokes in these words : " When Nevrton's rings are formed between the under surface of a prism and the upper surface of a lens, or of another prism with a slightly convex face, there is no difficulty in increasing the angle of incidence on the under surface of the first prism till it exceeds the critical angle. On viewing the rings formed in this manner, it is found that they disappear on passing the critical angle, but that the central black pot remains." In other words, the*

phenomenon of total reflection seems to be fundament ally modified when the layer of air behind the reflecting surface is very thin. The explanation is that the dis- turbance in the air layer which, under ordinary conditions, penetrates a fraction of a wave-length into the rarer medium, is able to be transmitted as a progressive dis- turbance into the medium on the other side when the air layer is excessively thin. What takes place in this com- paratively simple case of total reflection at the boundary of two transparent media will certainly occur, but with more complex accompaniments, at the boundary of a trans-

parent medium and a highly absorbent and generally opaque metallic substance.

As already stated, metallic films when thin enough become transparent; and by direct measurements with thin metallic prisms of very acute angle Kundt obtained values of the refractive indices of the metals silver, gold, copper, platinum, iron, nickel, and bismuth, and also of some of their oxides. From these it appears that silver, gold, and copper are in general characterized by the possession of refractive indices less than unity, that there is very little dispersion in the case of silver, but that in the case of gold and copper the refractive index increases distinctly from the red to the blue end of the spectrum, becoming unity or very nearly unity for blue light. On the other hand, the refractive indices for the remaining four metals are greater than unity, and diminish in value as the wave-length of the incident light decreases. In other words, these four metals exhibit dispersion, but it is in the opposite direction to that exhibited by ordinary transparent media. Some of these results had already been indicated by indirect methods of testing the refrac- tive powers of metal (see Ency. Brit. vol. xiv. p. 613). One of these methods may be briefly referred to. Brew- ster's law asserts that the tangent of the polarizing angle is equal to the refractive index of the reflecting surface. Now, although metallic surfaces do not possess a polarizing angle in the strict sense of the term, there is a certain angle of incidence for which the intensity of light polar- ized perpendicularly to the plane of incidence is a mini- mum. The circumstance that the angle is found to increase with the wave-length of the incident light suggests that the refractive index is greater for the red than for the blue ray. These indications become precise on the now universally adopted theory of

metalKc reflection, in which the speed of propagation is taken as a complex constant ; and their most elaborate unification hitherto made has been in Drude's measurements of the optical constants of metals {Wied. Ann. 39, 1890). Experiment shows that if too thin films are used the optical properties and optical constants theoretically deducible from these become quite changed. This is, of course, not surprising. Whatever particular view be taken of the process of reflection of waves of light, the results of experiment vri.ll depend sensibly on the state of the transition layer, or on the presence of a thin layer of foreign matter, such as grease on the surface of water. According to Eayleigh's results, the deviation from theory would seem to be naturally accounted for by the effects of such tarnish, without the need of further assumptions.

The characteristic feature of metallic reflection is that it is selective. For example, gold leaf which has been beaten out so thin as to be transparent continues to retain its characteristic metallic lustre, but the ~~Se'ecMve light transmitted through it is green. Coloured glass, on the other hand, or the translucent petal of a flower, has the same colour, whether studied by means of reflected or transmitted light. In these and similar cases the light thrown back to the eye has been robbed by absorption of certain of its constituents, but in the case of metallic reflection the light that is thrown back contains rays which are not merely the residuum remaining after the absorption of their fellows, but have been selectively reflected before absorption has taken place. This selec~~ tively reflected light is but partially polarized by reflection ; hence there is no true polarizing angle in the case of metallic reflecting surfaces, but only an angle for which a maximum polarization is obtained.

The property of "metallic reflection" is, however, not con- fined to metals only, and it was from a study of certain substances showing similar characteristics of what has been

called surface colour that Stokes was led to some con- clusions of far-reaching importance. The aniline dyes are the most familiar of these non-

metallic substances which exhibit metallic reflection. In such cases the metallic reflection is confined to rays of a Kmited range of colour and wave-length, each substance being moderately trans- parent to rays of other colours. For these rays of selectively reflected light there is no true polarizing angle, but at considerable angles of incidence the light polarized perpendicularly to the plane of incidence becomes usually of a richer colour in consequence of the removal in great measure of the rest of the reflected light. This portion of the reflected light may also be removed or greatly weakened by the substance being brought into optical contact with a transparent substance of nearly the same refractive index, the rays due to metallic reflection being thus more strongly brought out. For example, when safilower-red (carthamine) is deposited on glass by means of water, and the water is allowed to evaporate, the film obtained reflects a yellowish- green Ught from the surface in contact with air, but from the surface in contact with the glass a "fine green inclin- ing to blue." Another substance studied by Stokes was crystallized permanganate of potash. When light reflected from a crystal at the polarizing angle is viewed through a Nicol prism, so placed as to extinguish the rays polarized in the plane of incidence, the appearance is green, and analysis by a prism shows five bright bands corresponding to the five dark bands in the spectrum of the light transmitted through a solution of the substance. When the Nicol is turned through a right angle so as to extin- guish the rays polarized perpendicularly to the plane ■of incidence, the bright bands are hardly or not at aU perceptible. In many cases the reflected light or surface colour and the transmitted light or substance colour of substances exhibiting metallic reflection are approximately ■complementary. For example, fuchsine transmits red and violet light and reflects green. As pointed out by Stokes, an accurate complementary relation between the reflected and transmitted lights could be looked for only in the 'Case of excessively thin films of the substance.

Although in this article we are mainly concerned with

the radiant energy which aflfects our organs of vision, it

must not be forgotten that there are other rays

^""i which, though invisible, are physically identical

rays. i^ nature with the visible rays. It is important occasionally to refer to these as presenting

■*characteristics fundamentally the same as those of light. Thus, with regard to these other rays — the dark heat or infra-red rays with longer wave-lengths than those of red Ught, and the invisible actinic or ultra-violet rays with wave-lengths shorter than -those of violet — substances may be transparent or opaque, or may exhibit selective reflection. Eock-salt, glass, quartz, and fluorspar are all .approximately equally transparent to ordinary light, but*

■*experiment shows that rock-salt is very transparent to the •dark- heat rays to which glass is powerfully opaque, and that quartz and fluorspar are remarkably transparent to the ultra-violet rays, a comparatively large fraction of the (energy of which is absorbed by glass. Glass seems to behave towards certain of the infrarred rays as an intensely opaque substance, for, after the radiation has been cut*

■*down by passage through a thin glass plate, a second iglass plate interposed has very little further effect. The principal absorption occurs at the first glass surface across*

which the radiations pass ; here the glass becomes strongly

heated, and becomes itself a radiator for heat rays of

comparatively low intensity. It is possible, however, that

isome of the incident heat rays are reflected without

■*evident absorption, just as in the case of metallic reflection*

JEor light. Selective reflection has not, so far, been estab-

lished for glass, but it has been observed in the case of certain transparent minerals, such as quartz, mica, sylvine, and fluorite. In the experiments of Rubens and E. F. Nichols the selectively reflected rays were isolated from the others by successive reflections from three or more sur- faces of the material. By this process all the rays which do not suffer metallic reflection are diminished so greatly in their intensity as to be practically non-existent, while those which do are left in sufficient intensity to be measurable by means of a^delicate thermoscope, such as a bolometer or radio-i^eremeter (see Physical Review, vols. iv. and v., 1896-97). They found that in quartz there are three narrow regions of metallic reflection, the maxima corre- sponding to wave-lengths 0-0085, 0-0090, and 0-0208 mm. These are also, of course, corresponding regions of apparent absorption in the transmitted radiations. The shortest wave-length of the three is about 11-2 times the wave- length of the light corresponding to Fraunhofer's line A in the dark red of the solar spectrum. In mica there are also three narrow regions of metallic reflection not far removed from those in quartz, and in fluorite (Rubens, Wied. Awn., 1899) there are two regions of metallic reflection in the neighbourhood of rays of wave-lengths 0-0244 mm. and 0-032 mm. No evidence of metallic reflection was found in the case of rock-salt, crown glass, flint glass, sulphur, potassium, alum, shellac, and Iceland spar. If it exist it must be for radiations of wave-length greater than 0-025 mm., beyond which, under the conditions of the experiment, it was impossible to go. For these heat rays of long wave-length metal surfaces reflect perfectly, whereas for green rays of wave-length 0-0005 mm. the percentage of the incident light which suffers reflection varies from about 55 for copper to 88 for silver. By direct comparison with silver, Rubens and Nichols de-

termined the percentage of reflection of these heat rays of long wave-length, from which, by the use of Fresnel's formula for reflection, the refractive indices for these rays could be calculated. In the case of rock-salt, sylvine, and chloride of silver the refraction could be studied directly by means of transmission through a prism.

The measurement of the refractive indices of transparent substances for rays of long wave-length is of great theoretic interest in its bearing on Clerk Maxwell's electro- magnetic theory of light. According to this $e^{*™<*'i}$ *theory, light is an electromagnetic phenomenon, dielectric and one of the simplest relations required by constant. the theory is the numerical identity of the specific inductive capacity of an insulating substance and the square of its refractive index for disturbances of long period. This particular refractive index cannot, of course, be determined directly, but we may gain some indication of its value from a knowledge of the refractive indices for rays of long wave-length in the neighbourhood of the lowest region of heavy absorption (see below, under Anomaloits Dispersion). The result of the comparison is given in the adjoining table, in which the top row of figures gives the calculated values of the refractive indices of the different substances for rays of infinite wave-length, and the bottom the means of various determinations of the specific in- ductive capacity or dielectric constant.*

Flint Glass.

Fluorite.

Quartz.

Hock-Salt.

Sylvine.

6-77 7-9

6-09 6-7

4-58 4-58

5-18 5-99

4-55 4-94

The remarkable agreement between the values for quartz, as compared with the corresponding values for the other substances, is explained by the fact that the positions of the chief absorption bands in the dark heat rays spectrum had been specially well determined, and is

evidence that there are no more in still lower regions. In his paper on the properties of quartz for rays of great wave- length, Nichols has given reasons for the conclusion that for wave-length 0-0074 mm. the refractive index of quartz becomes unity, and rapidly diminishes for longer wave-lengths until the value falls to 0-36fi for wave-length 0‘00805 mm., this result indicating the existence of a definite region of anomalous dispersion in the dark heat rays of long wave-length. Experimenting on the same lines Aschkinass has demonstrated the existence of regions of anomalous dispersion for infra-red rays in a number of substances, including quartz, mica, fluorite, gypsum, alum, sylvine, rock-salt {Drude’s Annalen, i., 1900).

The broad fact of dispersion is that the differently- coloured rays of light suffer different refractions as they pass at oblique incidence from one transparent medium to another. If the wave theory of light be adopted, this fact means that the speed of propagation of a particular ray of light through a material medium depends upon the wave-length associated with that ray. With all approximately colourless transparent media, such as water, glass, quartz, &c., the refrangibility increases as the wave-length diminishes ; this

relation has consequently come to be regarded as the normal one. The fact that the character and amount of dispersion vary considerably as we pass from medium to medium, and have no necessary relation to the amount of refraction, is of the greatest practical importance in the construction of achromatic lenses (see Ency. Brit. vol. xiv. p. 595 and xvii. p. 804). Wbatever form of the wave theory be adopted, whether the electromagnetic or the more purely elastic theory, the phenomena of refraction and dispersion must find their explanation in the discontinuity introduced into the aether by the presence of matter. There must be between the molecules of matter and the neighbouring portions of aether a mutual action of some kind, for only by such a sup- position can we explain the phenomena of the emission and absorption by different substances of their characteristic rays, or the less prominent but very striking phenomena of fluorescence, surface colour, and anomalous dispersion.

Stokes has shown that some idea of the action of the mechanism involved in the phenomenon of fluorescence (Ency. Brit. vol. xiv. p. 602) may be obtained from the study of a comparatively simple vibrat- ing system of particles acted on by a periodic disturbing force. If the period of the disturbing force be greater than the natural period of the system the disturb- ance is transmitted along the system and cannot accumu- late at the point where the disturbing force is acting. If, on the other hand, the period of the disturbing force be less than the natural period of the system, the dis- turbance is not transmitted, but assumes a permanent form as a local agitation, and the system vdll continue to vibrate after the exciting disturbance has ceased, the quickest vibration being the natural period already mentioned. This illustrates the law that the light due to fluorescence is always of slower vibration and longer wave-length than the exciting light (see Tait's Light, pp. 161-163).

The experimental investigation into the nature of anoma- lous dispersion is associated mainly with the names of Fox Talbot, Le Eoux, Christiansen, and Kundt. disDersion '^^^ theoretical explanation is associated histori- cally with the names of Rayleigh, Sellmeyer, Ketteler, and Helmholtz, although it now appears that the problem was first formulated and solved by Clerk Maxwell as early as 1869 (Phil. Mag., 1900). The principle at the base of the explanation is that of resonance, the same principle, in fact, which

Stokes first applied (about 1850) to explain the sodium absorption lines in the solar spectrum. The facts of spectrum analysis show that the molecules

Fluor- escence.

of matter have natural periods of oscillation, and any vibratory motion isochronous with one of these natural periods of vibration is powerfully absorbed by the corre- sponding molecules. Hence, if one of the natural periods of molecular vibration is identical with that of a particular ray of light, the substance will behave towards this particular ray and towards rays of nearly the same period after a fashion quite distinct from that in which it behaves towards rays not approximately isochronous with it. The general result indicated by the dynamical theory in any of its adopted forms is as follows : — When a train of Kthereal disturbances of period t is incident upon a region occupied by a connected group of particles having a period of free vibration t', the speed of propagation of the disturbance through the connected particles is greatly decreased if < is slightly greater than t', and greatly increased if < is slightly less than t'. When t and t' are equal there is almost complete reflection, so that in the transmitted light the ray of vibration period t will be almost entirely absorbed. That is to say, in the neighbourhood of an absorption band we may expect to find an increase of the refractive index immediately below the absorption band (i.e., towards the red) and a decrease of the refractive index above the absorption band. Now this is exactly the law which Kundt established by experiment. The effect has been detected in the neighbourhood of the two conspicuous lines in the spectrum of sodium vapour, the lines which correspond in position with the double D of the solar spectrum. In this case, however, the effect is compara- tively small ; it is best observed in preparations of fuchsine and other aniline dyes whose absorption spectra are characterized by one or more broad and dark absorption bands. The most recent measurements of the optical constants of fuchsine are those of Pfltiger (Wied. Ann. 56, 1895) and Bloch (Journ. de Phys. vii., 1898). The former worked with thin prisms of the material formed by evaporation of the alcohol from an alcoholic solution which had been dropped into the fine angle contained between a plane plate of glass and a small portion of a glass tube laid on it. His aim was to obtain direct measurements of deviations of rays passed through the semi-transparent substance. Bloch's aim. on the other hand, was to study

the phenomenon of metallic reflection and absorption, and he prepared thin collodion films saturated vsdth fuchsine. By means of interference bands he obtained some beautiful illustrations of the difference in the law of change of phase for reflection from transparent materials like glass and from surfaces showing metallic reflection. Thus, in the neighbourhood of the characteristic absorption band of fuchsine, the surface reflected in this respect like a metal, whereas towards the red and violet ends the reflection was of the ordinary vitreous character. Confining our attention more particularly to the phenomenon of anomalous dis- persion, we may reproduce Pfliiger's results for his fuchsine prisms.

The refractive indices were measured for eight well-known rays of definite wave-length, namely, the hydrogen lines h, and G, the strontium blue, the hydrogen F, the thallium green, the sodium D, the lithium red, and the darkest observable red (about wave- length O‘0O0671 mm.). The mean values obtained with four fuchsine prisms are given in the second row of the following table, the first row containing the wave-lengths of the corre- sponding rays, measured in millionths of a millimetre.

Wave-length, 410 434 461 486 535 689 671 703 Refractive index, 1-17 1-04 0-83 I’OS 1-95 2-64 2-34 2-30

The absorption band extends from between the F and G lines in the blue to beyond the D line in the yellow, and in some of the prisms it was not possible to obtain measurements’with the rays of wave-len^hs intermediate to these extremes. The results are shown graphically in Fig. 7, from which at a glance will be seen the broad features of anomalous dispersion. Thus the refrangibility of the blue and violet light is less than that of red

~5m

BOO’

Fig. 7.

and yellow. There is, in accordance with Kundt's law, a decrease of refractive index above the absorption band and an increase below the absorption band, the position of which in the diagram is shown by the thick line below the dispersion curve. An interesting feature is the measurement of a refractive index less than unity, just at the more refrangible end of the absorption

band. For this par- ticular cluster of rays the speed of propaga- tion is greater in the substance than in sether, a result which recalls the similar pro- perty possessed by silver. It is just here also that fuohsine

shows surface colour

700 and reflects like a, metal. The possibility of the refractive index becoming less than unity in the case of bodies like metals which are powerfully absorptive was shown by Helmholtz to be a natural result of the dynamic theory of light. Pfliiger investigated simi- larly a number of other substances, but of these Hofmann's violet was the only other one which gave a refractive index less than unity. He also described some beautiful colour phenomena obtained by reflecting light at various incidences from the sur- face of fuchsine in contact with glass. The layer of fuohsine was prepared by allowing a hot solution of it in alcohol to harden on to the surface of a strongly heated glass plate or prism. As the angle of incidence was increased the green surface colour obtained with smaller angles of incidence suddenly changed to the clear blue of the totally reflected rays at the higher angles of incidence.

As already pointed out, the explanation of anomalous dispersion depends upon the principle of resonance. For ordinary dispersion the first theory, that of Cauchy, de- pended simply on static discreteness of the medium ; but Kelvin showed that the number of molecules per wave- length (10^) is far too great to account for dispersion so intense as actually occurs. Thus a complete theory must from the start take into account not only the nature of the stresses acting between the different parts of the molecular and iBthereal system — whether they be due to relative motion, as in the case of frictional forces, or to relative configuration — but also the free vibration periods of these parts. The conditions when written down in the form of a differential equation lead mathematically to certain con- clusions which

give a sufficient explanation of the facts of anomalous dispersion. Take as an example the mode of attack from the standpoint of the electromagnetic theory.

The fundamental assumption is that the disturbance which is propagated as light is an electric disturbance, or rather a series of electric waves of definite wave-lengths and periodic times. In any material medium the molecules or molecular groups respond in some way to the periodic electric force acting in their immediate neighbourhood. Whatever the precise character of this action, it can at all events be mentally imaged as producing a displacement of electric charge. We may form the concrete conception of atomic charges or ions, each individual charge being associated always with a definite molecular mass, or' we may think of the electric displacement as occurring^ within the molecular group, but in such a manner as to involve movements of mass. • The former conception is more easily grasped and is capable of simpler treat- ment. The problem may then be stated thus. As the train of waves passes, a periodic electromotive force acts upon each ion, which has a period of its own about its position of equilibrium. This assumption taken along with the general equations of the electromagnetic field (see Electkccitt : Electric Waves) leads to an expression for the refractive index of the form

/i=Ao+-

:,+ ...

where \, \, \—. are the wave-lengths which correspond in period to the times of free vibration of the different sets of ions, X is the wave-length of the transmitted ray, and Mq and the M's are constants to be determined by experiment, but depending ulti- mately upon the electrical properties of the medium. Through any range of values of \ which is included between two of the values \, \, As-.., the dispersion is normal, and in the special case in which the values \, \, Xj… are much smaller than X the formula takes the form obtained by Cauchy. On

the other hand, when the range of values of X includes one or more of the quantities Xj, X^, X3… the dispersion becomes anomalous, for in this case the expression M/(X – X) changes abruptly from 4- 00 to – 00 as X

diminishes through the value . But physically the region in the neighbourhood of X, is a region of selective absorption. Hence, as we approach this region (supposed drawn out as a spectrum) from the side of longer wave- lengths the refractive index is abnormally increased, whereas if we approach from the side of shorter wave-lengths the refractive index is abnormally decreased. This is the law established experimentally by Kundt (see above).

Rotational Effects in Polarized Light. — The main char- acteristics of plane, circularly, and elliptically polarized light are fuUy expounded in the Ency. Brit. vol. xiv. pp. 611-13, where the usual methods are described by which these peculiar conditions are obtained. Of special importance for our present purpose is the discussion of the purely kinematical process by which the vibrations which constitute two rays of plane polarized light combine under suitable conditions to produce in general elliptic polarization. It thus appears that both circular and plane polarization are limiting forms of elliptic polarization. For the co-ordination of many phenomena this kinematical view suffices, and without committing ourselves to any dynamic theory of the constitution of the ffither we may assume the simplest conception of a transverse vibration of a simple harmonic type, and consider how far this assumption can lead us in discussing the various phenomena of what is called in somewhat elliptic language Kotatory Polarization. Under this term we group a variety of phenomena, the common feature of which is that the plane of polarization of a plane polarized ray is rotated when the ray is passed through a particular medium or reflected from a particular surface.

It was discovered by Arago in 1811 that when a plate of quartz cut perpendicularly to the optic axis is inserted between two crossed Nicols (that is, two Nicol prisms adjusted for complete extinction of light) a certain amount of light passes through. Should the plate of quartz be thick, say an inch or more, the transmitted light wUl not be changed appreciably in colour, but if it is thin enough an originally white beam of light will after transmission emerge coloured. The thinner the plate the more saturated the colour, which will change if either of the Nicols is rotated round the axis of the beam. The true nature of the phenomenon is at once demonstrated if instead of ordinary light we use homogeneous light, say, the yellow sodium

light obtained by burning common salt in a spirit flame. Let the Nicols be adjusted for extinction and the quartz plate inserted between them. Then as before a certain amount of light will be transmitted, but there will be no change of colour. By rotation of either Nicol through an angle depending on the thickness of the quartz plate this yellow light will be extinguished. For example, vsdth a quartz plate 1 mm. thick it will be necessary to rotate the one Nicol through an angle of about 21 'T" before the light disappears. For plates of other thick- nesses the required rotation is proportional to the thickness. The direction in which the second Nicol Or analyser must be turned depends upon the kind of quartz, which may be either right-handed or left-handed in its rotational effect. The distinction is important, but the nomenclature is to some extent conventional. It is usual now to define right-handed quartz as that kind which produces rotation of the plane of polarization in the direction which is right-handed with reference to the direction of propagation of the ray.

This experiment shows that the plane of polarization of a plane polarized ray of homogeneous light which has been transmitted through a piece of quartz in a direction parallel to the optic axis of the crystal suffers a definite

rotation for every unit thickness travelled through. With the further experimental fact that the angle of rotation increases with the refrangibility of the light used Rotatory ^g ^^^^ able at once to understand the change dispersion. ^^ ^^Jq^j. gf ^j^g transmitted beam when white light is used. There is, in fact, a rotational dispersion of composite light. When a plane polarized beam of composite light is passed through the quartz plate the planes of polarization of the differently ~~coloured con~~ stituents are rotated through different angles. Let the emergent beam be viewed through a second Nicol which polarizes light in a plane making angle a with the plane of polarization of the light before it entered the quartz ; and let 6 be the angle of rotation produced by the quartz upon the plane of polarization of a particular constituent of intensity I, which we assume to be proportional to the square of the amplitude of the associated vibration. Then the intensity of

this kind of light transmitted through the second Nicol will be I cos^ (a – 6). Hence a greater proportion of the light of a given colour will pass the nearer (a — 6) is to zero or to any multiple of two right angles. Consequently the prevailing tint will be deter- mined by the rays for which (a – 6) has the smallest value, or has values in the neighbourhood of even multiples of a right angle. As the second Nicol is rotated the prevailing tint wiU change, passing up the spectrum towards violet or down the spectrum towards red according to the direction of rotation. A beautiful and instructive method of making the experiment is to view the emerging beam through a spectroscope, the original beam having been passed through a narrow slit so as to obtain a fairly pure spectrum. When the quartz plate is inserted between the polarizer and analyser the spectrum will be seen crossed by a dark band, the centre of which marks by its position the particular coloured ray whose plane of polarization has been rotated so as to be perpendicular to the plane of polarization corresponding to the position of the second Nicol or analyser. If a thicker piece of quartz be used two or more bands may be seen, and if a very thick plate be interposed the spectrum will appear to be crossed by a large number of narrow bands.

In the following table for quartz (abridged from WiiLkelmann's Physik) the authority for the infra-red rays is Hussel, for the luminous and actinic rays Soret and Sarasin. The wave-lengths of the rays are given in the second columD, and the rotations of the plane of polarization in the third : —

Ray in Solar

Wave-length

Eotation in

Spectrum.

10-8 mm.

Degrees.

a

950

8

4671

Y

X

899 849-7

9 10

117 167

■ *infra-red.*

Z

822-6

10

939

A

759-4

12

668>

B

686-7

15

746

C

656-3

17

318

D

589-6

21

684

D

589-0

21

727

visible ■ *spectrum.*

E

527-0

27

543

F

486-1

32

773

G

430-8

42

604

h

410-2

47

481

H

396-9

51

193 J

K

393-3

52

155'

L

382-1

55

625

M

372-7

58

894

N

0

358-1 344-1

64 70

459 587

■ *ultra- viol*

P

336-1

74

571

Q

328-7

78

579

R

3180

84

972,

Blot's law that the rotation is inversely as the square of the wave-length is only approximately true. Tait suggested a series of inverse even powers ; and I'cddie showed {Proc. R. S. E., 1882) that with three terms the rotation could be represented with groat accuracy.

Similar rotatory power is possessed by other crystals, of

which may be mentioned cinnabar (32-5°), benzU (24-84°), hyposulphate of potash (8-39°), hyposulphate of lead (5-53°), chlorate of sodium (3-16°), and hyposulphate of calcium (2-09°). In these and similar cases the effect depends upon the crystalline arrangement of the molecules, for in amorphous conditions most of the substances lose their rotatory power. Thus fused quartz or quartz dissolved in potash has no rotatory effect on plane polarized light. Sulphate of strychnine and alum of amylamine are excep- tions to this rule, being active in both the crystallized and fused condition. The rotatory power is, however, much feebler in the fused condition.

In remarkable contrast to the action of crystals is the action of certain solutions which cannot be regarded as being other than isotropic in mass, but which yet have the same power as quartz in rotating the plane of polariza- tion of light passed through them. The effect is distinctly smaller than -with quartz, but it occurs to equal degree in all possible directions through the solution. With quartz and most other rotatory crystals, on the other

hand, the rotation is greatest when the light is „f ?"

. -. -I -I . . -, . 'O liquids.

transmitted along the optic axis, and is zero

when the ray is passed perpendicular to the axis. Obvi- ously the phenomenon in the case of solutions must depend upon the construction of the molecule, and Le Bel and van ‘t Hoff have connected it with the manner in which the carbon atom enters into combination -svith the other constituents of the molecule. The folio-wing table gives the rotation on red light produced by a few of these active substances, the thickness being one decimetre. The posi- tive sign means right-handed rotation, and the negative left-handed.

Essence of Seville orange 4-78-94

citron ‘ . . . . . +55-3

lavender) 2-02

aniseed . . . . . — 0-7

mint -16-14

turpentine -29-6

Solution of cane sugar, 50 per cent, in water . + 33 -64

, , quinine, 6 per cent, in alcohol . – 30

In none of these cases does the rotation amount to 1° per millimetre thickness. For sufficiently dilute solutions the rotation is approximately proportional to the quantity of the active substance contained in unit volume.

If unit mass of the solution contains in grammes of the active substance, and s is the density of the solution, 7ns will be the density of the active substance in the solution. Let a thick- ness t of the solution produce a rotation r, then the specific rotatory power is defined by the ratio rjtms. What is known as the molecular rotatory power is obtained from this by multiply- ing by the molecular weight W of the dissolved substance and dividing by 100, or

W jr^ ” 100 ■ tms’

In sugar solutions this quantity is approximately independent of the concentration. In no case, however, is it found to be absolutely constant, and in many cases it varies both with the concentration of the solution and with the nature of the solvent. Anomalous effects have also been obtained when two active sub- stances have been mixed in one solution. In cane sugar solutions the specific rotatory power is about 66° for yellow light ; in quartz it is 830°. According to Nasini, the specific rotatory power is especially great in solutions of santonin (202°), santouid (700°), and para-santonid (890°).

Various special forms of polarimeters, usually called sacchari- meters, have been constructed to facilitate the measurement of the rotation in the case of sugar solutions, the method being one of groat practical importance in sugar analysis. The end aimed at in all these instruments is to obtain an accurate determination of the position of the plane of polarization. A description of the ingenious combinations associated with the names of Stavart, Jcllett, Laurent, Soleil, Wild, and others, will be found in books specially devoted to the subject of sacoharimetry. There is, however, one important piece of apparatus, namely, the biquartz, which demands more than a passing mention. The biquartz consists of two semicircular discs of quartz placed in juxtaposition

so as to form one circular disc. Both are cut perpendicular to the axis and are of the same thickness, but they produce opposite rotations upon the plane of polarization of a given ray transmitted through them. The particular thickness chosen is that for which the plane of polarization of the brightest part of the spectrum, namely, the yellow, is turned through an angle of 90°. When such a biquartz is inserted between two parallel Nicols, this par- ticular yellow light will be cut out by both halves of the biquartz, and the tint will be the same grayish violet all over the field of view. A slight rotation of the analysing Nicol in either direction will cause a change of tint in both halves of the field, but it will be a change towards blue in the one

and towards red in the other. Thus the position in which the uniform tint is observed is deter- mined with great precision, and we then know that the plane of polarization of the light incident on the biquartz is perpendicular to the principal plane of the analyser.

Fresnel's explanation of the rotation of the plane of polarization depends on the fact that a plane polarized ray Theory ot ^^ light may be decomposed into two circularly rotatory polarized rays polarized in opposite directions. polarUa. Suppose, for example, that the aether vibration is taking place with simple harmonic motion along the line AOA' (Fig. 8), and that OP is the displacement at

any instant. If we take O' so that 00' = 0'P = |OA,

__, . ^P then OO' and O'P will rotate

*^ ^ " "~— -J ** ^^^ same rate in opposite*

- *B directions. O' will describe Pig. 8. a circle about O, and P will*

describe an equal circle, but in the opposite direction, about O'. These two circular motions combine to produce a resultant rectilinear motion along AA'. When a plane polarized ray falls perpen- dicularly upon the face of a disc of quartz cut perpen- dicular to the optic axis, the supposition is that the ray is decomposed into two circularly polarized components, polarized in opposite directions, and that these travel with different speeds through the quartz. If we follow in imagination the progress of the one circularly polarized ray and compare the simultaneous disturbances due to the two rays as they exist at any one place, we shall find that the difference in phase has changed by an amount which increases with the distance travelled. Consequently on emergence from the quartz the two circularly polarized rays which begin again to travel with the same speed will combine to form once more plane polarized light, but polarized in a plane which is displaced relatively to the original plane of polarization through an angle proportional to the thickness of the quartz plate. Thus if 00' and OT represent the combination that would have occurred had the two circularly polarized rays travelled with the same speed through the quartz, and if the angle PO'Q is the relative phase retardation produced as explained above

by the different speeds of propagation of the two rays, then on emergence the combination wiU be 00' and O'Q, and, since the corresponding circular motions will there- after be propagated with the same speed, they will conspire to produce the rectilinear motion BOB'. The angle of rotation of the plane of polarization vsdll evidently be AOB = POQ = I^PO'Q = half the relative phase retardation. The peculiar action on which this explanation is based is the transmission through the crystal or other active sub- stance of a circularly polarized ray with a speed which depends on the direction of rotation of the concomitant vibration. By a simple combination of quartz prisms, alternately right-handed and left-handed, Fresnel decom- posed and dispersed a plane polarized ray into two parts which were found to be circularly polarized in opposite directions, thus demonstrating the real existence of the decomposition. The explanation given by Fresnel is of course purely kinematical, but in all more ultimate theories which strive to exhibit optical phenomena as a direct result of dynamical reasoning based on some plausible

A try's spirals.

assumptions as to the forces which act between aether and matter, the only simple wave trains that can be propagated without change are two circularly polarized ones. The modification is attained by introducing into the equations of motion forces which have a rotational effect. Airy and MacCuUagh were the first to show how this might be done so as to co- ordinate the rotatory phenomena exhibited by quartz and solutions of active substances. To Airy also we owe the discussion of the remark- able phenomena of coloured rings and spirals, which are produced when polarized light is transmitted through quartz in a direction slightly inclined to the optic axis of the crystal. As the direction of transmission deviates from parallelism to the axis, Fresnel's circularly polarized components become eUiptically polarized, the major axes of the two associated vibrations being at right angles to each other. Airy established the fact by direct experiment, and found that the ratio of the minor to the major axis rapidly diminishes as the deviation from parallelism to the optic axis increases. So rapid is this diminution that when the angle of devia- tion exceeds 10° the elliptic polarization can with difficulty be distinguished from plane polarization. To put it other- wise : — ^A circularly polarized

ray is transmitted unchanged parallel to the optic axis, and a plane polarized ray is unchanged when transmitted perpendicular to the axis. For any other direction of transmission there are two par- ticular elliptically polarized rays which are transmitted unchanged. These have the same ellipticity, which rapidly diminishes as the direction of transmission deviates from coincidence with the optic axis, they are polarized in opposite directions, and the major axes are perpendicular to each other. On these principles, and with the further assumption that the wave surface in quartz con- sists of a spherical sheet wholly surrounding a prolate spheroidal sheet. Airy very successfully co-ordinated the remarkable phenomena observed when a convergent beam of polarized light is passed through a plate of quartz cut perpendicularly to the axis and then viewed through a Nicol's prism. As an illustration of the nature of the phenomenon, take the case in which the quartz plate is interposed between two crossed Nicols, the transmitted beam being convergent. Coloured rings are at once observed, recalling at first glance the similar phenomenon when a doubly refracting but non-rotating crystal is used instead of the quartz (see Uncp. Brit. voL xiv. p. 613). But the central black cross is absent. At a considerable distance, however, from the centre, the colour of which is determined by the thickness of the plate, four faint brushes make their appearance intersecting the rings in the same directions as the black cross in Iceland spar. When the one Nicol is rotated a small cross begins to appear in the centre, the brushes get fainter, and the rings change form and colour, becoming approxima,tely square when the Nicols are half way between the crossed and parallel positions. If the rotation is continued until the Nicols are parallel, the rings pass back into their circular form, while the brushes come out bright. When the incident light is circularly polarized the appearance is that of two spirals intertwined. Pocklington {Phil. Mag. vol. ii., 1901) has observed the spirals in crystals of sugar, a theoretical investigation based upon the electromagnetic theory of light having led him to look for such effects in bi-axal crystals of substances possessing rotatory power in the state of solution.

No natural bi-axal crystal is known to possess the power of rotating the plane of polarization. It has, however, been shown, especially through the experiments of Eeusch, that a pile of thin layers of mica suitably arranged over one another possesses optical properties

analogous to those of quartz. On the basis of these experiments Mallard has elaborated a theory of rotatory Reuscb's polarization applicable to crystals with one axis pile of of geometric symmetry. When a plane polar- mlca ized ray falls perpendicularly on a plate of

plates. mica, it is in general decomposed within the crystal into two components which travel with different speeds, and in consequence the emerging light is in general elliptically polarized. More generally, an elliptic- ally polarized ray, passed through a very thin layer of mica, will emerge still elliptically polarized, but with the ellipticity and the azimuth of the major axis slightly altered. Suppose now that a pile is formed of a number of similar sheets of mica so arranged that the principal sections of each successive pair make with one another the same angle measured in the same sense as we pass through the pile. Also let the number of sheets be such that one more, if added according to the same rule, will have its principal sections parallel to those of the first. Under these conditions it is found that a ray of elliptically polarized light of the kind just described will after trans- mission through the pile continue as an elliptically polar- ized ray of practically the same eUipticity, but with the azimuth of the major axis rotated through an angle which increases with the number of sheets of mica. A plane polarized ray will emerge slightly elliptical, but the ellip- ticity wiU be less pronounced the thinner the sheets that make up the pile. According to this theory, quartz is to be regarded as built up of doubly refracting layers, none of which possesses individually the rotatory power, but which collectively do possess that power by virtue of an arrangement similar to the arrangement in Keusch's piles of mica sheets. This theory implies that no bi-axal crystal can produce rotatory polarization, for the arrangement required necessarily involves uni-axal symmetry. It is able to explain all the phenomena as they are found in quartz and similar crystals, but it fails of direct applica- tion to the case of cubical crystals, such as chlorate or sidpho-antimoniate of sodium, in which the rotatory effect is produced in all directions. For the same reason it is inapplicable to the case of solutions. Eotatory power may also be induced in a substance by subjecting it to a

torsional strain. According to Ewell (American Jov/rnal of Science, vol. viii., 1899), the rotational effect in twisted glass and in gelatine is opposite to the twist.

Faraday's discovery in 1845 of the rotatory polarization associated with the magnetic field opened up a new line of research of deep theoretic importance. With the powerful magnetic fields now at our disposal there is no diffi- culty in repeating Faraday's experiment. Broadly stated, the general result is that when a ray of plane polarized light is transmitted through a substance set in a magnetic field codirectional with the ray, the plane of polarization is rotated by an amount which depends upon the nature of the substance, and which increases with the strength of the field and with the thickness of material passed through. The sense of the rotation is, with comparatively few exceptions, the same as the sense of revolution of the current which establishes the field — that is, it is right-

Magaetlc

handed with reference to the direction of mag- rotatory netization. In this particular the law of the polarlia- phenomenon is essentially different from that tioa. which holds in the case of quartz, sugar, and other

naturally active substances. In these instances of rotatory jiolarization the sense of rotation is the same relatively to the direction of propagation of the ray ; but in magnetic rotatory polarization the sense of rotation is determined by the direction of the magnetization. Thus, if the ray is by reflection at the one end made to pass to and fro along the active medium so as to emerge at the end

through which it entered, there is no final change in the position of the plane of polarization when the substance is one that possesses the rotatory power naturally; but when, on the other hand, the effect is due to magnetization, the plane of polarization of the doubly transmitted ray is rotated through double the angle through which it is rotated by single transmission through the magnetized substance. The phenomenon may be explained along the lines of Fresnel's hypothesis as due to a difference in the speeds of propagation in a magnetic field of two circularly polarized rays polarized in opposite directions. As a rule the greater speed is

possessed by the circularly polar- ized ray whose associated vibration is executed in the same sense as the helical current that establishes the field. Eighi has experimentally demonstrated the exist- ence of double refraction of circularly polarized light in a magnetized medium. The most powerful rotational effects per unit thickness of material have been obtained, as might have been expected, from thin transparent films of iron, nickel, and cobalt, the three ferromagnetic metals. Kundt estimates the rotation per millimetre in strongly magnetized iron to be 20,900°, and du Bois finds for nickel and cobalt the corresponding numbers 19,800° and 8900°. Ajiother peculiarity in connexion with these metals is that the rotation is greater for red rays than for blue rays — in other words, the dispersion is " anomalous."

Eotational effects are also produced, as was first shown by Kerr, when polarized light is reflected from the surface of these metals strongly magnetized. Even under the most favourable conditions the rota- I«f.<" tion is small and difficult to observe. The sense and amount of rotation depend upon the relation of tha magnetization to the aspect of the reflecting surface and to the angle of incidence of the ray, and upon the relation of the plane of polarization to the plane of incidence. In these experiments the effect is not a simple rotation of the plane of polarization, for a certain amount of elliptic polarization is produced even in the cases in which the plane of polarization is either perpendicular or parallel to the plane of incidence. The full discussion of the results belongs rather to magnetism than to light. The pheno- mena of the magnetic rotatory polarization of light are of great theoretic importance, forming as they do a strong argument in favour of Maxwell's theory that light is an electromagnetic phenomenon.*

In the original form of the electromagnetic theory of light, as it left Maxwell's hands, no explanation was afforded of dispersion, regular, anomalous, or rotatory. To take account of these phenomena it has been found expedient to introduce permanently charged molecules of matter, the so-called ions. A certain number of these are conceived as existing in every body, and as subject to vibratory and translational motions. Since such a moving charge of electricity will be influenced by a magnetic field, it is not difficult to see that the propagation of an electro- magnetic disturbance like light may influence and be in- fluenced by the presence of the moving ions.

Worked out along these lines, the electromagnetic theory of light has, in the hands of Helmholtz and others, led to formulae broadly similar to the formulae obtained on the elastic solid theory by taking into account the vibrations of the molecules.

In his Lehrbuch der Optik (1900) Drude assigns on theoretical grounds a formula for the rotatory dispersion of quartz, namely,

a^-X^^xT + xS,

where X is the wave-length of the transmitted ray, Xj the wave-length of the light whose period of vibration is equal to the period of the ions of a particular class, correspond- ing to which Aj is the dispersion constant. The constant h'

is the dispersion constant associated with groups of ions ■whose vibraticfn period is too slow to be comparable with the vibration period of any ray within the range of wave- lengths contemplated. When the value chosen for A, is that which has been found from experiments on prismatic dispersion, the formula just given represents very satis- factorily the observed rotations. This is shown in the following table, condensed from Drude, Xf being equal to 10,627, and the constants having the values k = 12,200,000, A' = 5,046,000:

Dispersion.

Wave-length.

Observed.

Calculated.

2140

1-60

1-57

1450

3-43

3-43

670-8

16-54

16-56

589-3

21-72

21-70

480-0

33-67

33-60

344-1

70-59

70-61

219-4

220-72

220-57

In 1896 Zeeman discovered that the spectral lines emitted by a flame charged with sodium vapour are altered when the flame is placed in a

strong magnetic y’” field. The effect as first observed was that the

effect. lines became broader ; but improved experi- mental means have shown that the effect is essentially a triplication or even higher multiplication of each line. The triplication is evident when the luminous source is viewed at right angles to the direction of the magnetic force acting on it, and in such a case the central line is polarized at right angles to the magnetic field, while the outer lines have their plane of polarization parallel to the magnetic field. Duplication only is seen when the light is viewed along the direction of the magnetic field, and the two lines so observed belong to rays of light circularly polarized in opposite direebions. These are the main facts, but there are various modifica- tions determined by the nature of the radiating substance. The amount of separation between the limiting lines pro- duced by triplication or multiplication of each originally single line of the spectrum of any one substance (e.g., cadmium) depends upon the wave-length as well as upon the strength of the magnetic field (Preston, Fhil. Mag. vol. xiv., 1898). The general explanation of the phenomenon follows at once from Maxwell’s electromagnetic theory of light, taken in conjunction with the obvious hypothesis, that in the molecules whose vibrations are the source of the radiations there are electrical vibrations which will respond to a magnetic force brought to bear upon them. Taking the simplest hypothesis as to the constitution of the ions, we may consider one of these to be describ- ing a small orbit about a position of equilibrium, and subject to a force directly as the distance from this position. If no extraneous force be in action, this orbit will be an ellipse described in a definite period, which will correspond to the period of one of the rays emitted. When a magnetic force is brought into action the ion will be acted upon by a force perpendicular both to the magnetic force and to the direction of motion of the ion, and pro- portional to the strength of the magnetic force and the speed of the ion conjointly. These conditions lead mathe- matically to the approximate result that the vibration period will be tripled. This very simple case cannot, of course, be expected to apply generally, but it indicates the character of the perturbation produced by the magnetic force upon the orbital motion of the ions, or whatever corresponds to them, in the electrical constitution of the . radiating body. Corresponding changes are observed in the absorption spectra of gases subjected to a strong mag- netic field. Theoretic considerations led Tait and others to look

for such an effect, -with less powerful instruments, many years ago {Proc. Boy. Soc. Edin., 1876).

Relative Motion of Matter and JEther. — The pheno- menon of aberration of Ught depends {Ency. Brit. vol. xiv. p. 584) upon the ratio of the earth's orbital speed to the speed of propagation of light as it enters the eye of the observer. The direction of propagation of a ray in an isotropic medium, such as we believe the sether to be, is at right angles to the wave-front, and to an observer passing through the aether parallel to this wave-front, the apparent direction of the ray will be deflected forwards in the direction of the observer's motion. The simplest assumption is that the earth moves through a quiescent sether. According to the view which regards the aether as transmitting vibrations like an elastic solid — a view which for present purposes may be taken as including Fresnel's theory — the speed of pro- pagation is inversely as the square root of the density. If V is the speed of light in free sether, of which we take the density as unity, and if V is the speed of light in a transparent material medium such as glass or water, that is, in sether loaded with matter so that its effective density as a transmitter of elastic vibration is D, then we have (VjY'y = D/1. Or, since V/V measures the refractive index n, we find D = n^. In words, the effective density of sether is increased by the presence of matter in the ratio of the square of the refractive index to unity. What is the mechanism of this increase? Is the sether really condensed, so that unit volume contains more of it within a region occupied by matter, or is the greater effective density the result of the entanglement of matter and aether, the former exerting a drag upon any motions that may exist in the latter? Both of these views can be made consistent with the hypothesis of a quiescent sether out- side the material substance, which the fact of aberration seems to demand. Now, experiment shows that the laws of reflection and refraction of light at and across the boundary of a transparent body moving with the earth, and therefore moving relatively to the sether outside it, are exactly the same as if there were no relative motion. The simplest explanation of this fact would, of speed of course, be that the »ther is partaking of the earth's motion — is, in short, at rest relatively to the earth. But this contradicts the hypothesis suggested by the fact of aberration. Fresnel showed, however, that it was possible to keep the hypothesis of the quiescent sether, and yet satisfy the ^

condition that reflection and refraction take place as if there were no relative motion of matter and sether. The nature of the argument may be indicated by taking a simple example. Suppose a ray of light (Fig. 9) to be passing through a transparent slab, which is moving parallel to itself with speed v, and suppose the ob- server to be moving ~~*with the slab. This is the same thing as if the slab were at rest and the sether moving with an equal but opposite velocity. For simplicity of calculation we may take the thickness of the slab to be measured by the quantity "V'(= V//«'), the speed of light in the slab when there is no relative motion of the slab and the sether. Let V be the speed of light in free sether, and let v be the speed of the ffither itself within the sub*~~ *stance, V being its speed outside. Take the point A at a distance V from the slab, and consider the path of a ray of light moving through the aether in a direction perpendicular to the velocity v. The ray ■will travel along AB, which makes -with the normal to the surface a small angle whose tangent is vjY*

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IlgJit In moving medium.

Fig. 9.

Its future course will be along BC, wMcli makes with the normal an angle whose tangent is f'/V. These angles are very small, and to this order of small quantity there is no experimental evidence of a change of the law of refraction due to relative motion of matter and sether. Consequently the ratio of the sines of the angles of in- cidence and refraction is equal to the refractive index, or

Y / y7 = /i = y7, whence v = fn-v .

Now superpose upon the system a velocity v in the direc- tion in which the slab was originally regarded as moving. This reduces the aether to rest, but the velocity of light through the moving slab is increased by an amount

equal to (1 ~~/i”^)’!’ in the direction of the velocity v of the slab. “We may follow Fresnel and speak of this as indicating a drag of aether with the body, but that view is not a neces~~ sity. There is no diiEculty in conceiving the possibility of the speed of propagation of a disturbance in aether being influenced by the action of matter through it. Poincare in his Theorie mathematique de la Iwmiere, vol. i. chap, viii., has shown how this may occur. Larmor has more recently discussed the problem on the basis of the electromagnetic theory of light (see jEther and Matter, 1900), and has obtained Fresnel’s expression on the assump- tion that there is a material polarization current depend- ing partly on the motion of the substance, together with an sethereal displacement current depending on strain in a fixed aether. (See tEther.)

The accuracy of Fresnel’s expression was proved experi- mentally by Fizeau, who found that the velocity of light was

accelerated in running water, but that the amount PIzeau’s q£ increase fell short of the velocity of the water. ment. The interference method used was that described

in the Ency. Brit. vol. xiv. p. 607. The experi- ment has been repeated in an improved form by Michelson, who finds that the fraction of the velocity of the water by which the velocity of light is increased is 0‘434 with a possible error of ± 0‘02. The value according to Fresnel’s expression is (1 – f-‘^) or 0‘437.

Direct experiments have been made to determine whether any real drag of Kther takes place when matter moves

swiftly through it. Lodge (Phil. Trans, vol. ^Th ”’ clxxxiv., 1893) studied the behaviour of a beam of matter. light which was divided into two portions by a

semi-transparent mirror as in Michelson’s inter- ferometer, these portions being made to travel by means of suitable reflections along equal paths, but in opposite directions, several times round the circumferential region enclosed between two large parallel steel discs which could be set in rapid rotation. Any appreciable drag of the ffither in this narrow region between

the discs would declare itself by an interference effect due to the one half of the original beam being accelerated with respect to the other. The result was negative, there being no appreci- able drag of »ther in the neighbourhood of small bodies in rapid motion near the earth. Zehnder (Wied. Ann. Bd. Iv., 1895) attempted to obtain a variation in the density of the »ther by the rapid to-and-fro motion of a piston in a chamber from which the air had been removed. To detect this possible variation an interference method was used. The result was negative. In these experi- ments, and others of a similar character, the sensitiveness is not sufficient unless the effect looked for depends on the first order of small quantities, those namely of the order vjY, and the hypothesis of a quiescent rether, which the fact of aberration seems to require, can be brought into harmony with these negative results by taking into account the one other positive result verified by Fizeau and Michel- son as to the acceleration of the velocity of light in a

moving medium. A further important step was taken in this inquiry when Michelson and Morley [Amer. Jowr. of Sci. vol. xxxi., 1886, vol. cliii., 1897 ; Phil. Mag., 1887) devised a method by which, on the assumption of a quiescent.aether, an effect depending on quantities of the oAier {vjYy would be appreciable.

*The principle of the experiment is to study the interference changes produced in the instrument sketched in Fig. 6, as it is moved into different orientations. This will ■^*

make the assumed rela- tive motion of the earth and the sether atfect differently the rays travelling along AM and AN". Let there be a drift of aether of velocity V in the direction AM. Then the ray from S which passes through P is reflected at N, and finally reflected at P will pursue a path SANBE (Fig. 10), and the ray that interferes with it will pursue the path SAMBE. The speed of the first ray- is , and the distance travelled is ANB or 2D, where D is the distance of both M and N from the middle point of P. Hence the time for the ray to travel over the path ANB is 2D/V(V2-H)). The ray AMB travels with speed V-l-ii along

AM^ = D + D^\ and with speed Y-ii along MB/^ = D-Dy

Hence the time taken to travel over the whole course is simply 2D/V. The ditference of these two times will give the time retar- dation of the one ray with respect to the other. The value to a first approximation is

2D/, A a>M-J\ 2D/. 1 , «= \ D 1?

Fig. 10.

*“V V-**

Now superpose the velocity — v upon the whole system so as to reduce the sether to rest and set the apparatus in motion through the «ther. Then the two paths wiU. differ in length by the

product of V and the time retardation, that is, by D-p- While

this motion through the asther is continuing, let the apparatus be rotated through a right angle, so that the path which was the longer in the first position now becomes the shorter. Then as the apparatus moves from the one orientation to the other there will occur a shift of the interference bands corresponding to a change 2’Dv’IY in the length of one path relative to the other. The ratio tfi/Y^ is about 10”^ if we take v to be the earth’s orbital velocity, and a wave-length of yellow light is 60 X 10~ metres. Hence the interference fringes will be displaced by an amount which will bear to the width of the fringe the ratio 2D/60. In Michelson’s second arrangement the distance D was multiplied by a series of reflections from sets of parallel mirrors until it was equal to about 11 metres, giving a displacement of nearly 0‘4 of a fringe. When all precautions were taken in carry- ing out this excessively difficult experiment, there was not the slightest indication of a displacement of the fringes as the apparatus was steadily veered round into diflferent orientations. The simplest explanation is that the sether in the vicinity of the earth moves with it, a conclusion which seems to be inconsistent with the fact of aberration. In other words, the hypothesis of the quiescent tether is inconsistent with Michelson’s and Morley’s experiment unless there be some comjiensating cause not taken into account. Fitzgerald and Lorentz have pointed out that a slight change in the dimensions of a body due to its motion through space would meet all difficulties.*

If we consider Michelson and Morley's experiment to prove that the earth and the aether near it have the same motion, then the phenomenon of aberration requires an explanation. Stokes as early as 1845 pointed out how one might be given by supposing the motion of the sether generated by the motion through it of the earth and other cosmical bodies to be of tlie kind known in hydrodynamics as irrotational. As Stokes himself recognized, there are

grave physical difficulties in giving tMs theory all-round consistency. Such difficulties, however, must almost cer- tainly arise in any incomplete theory of the constitution of the asther ; and there can be little doubt that no theory can be complete which does not take into account electrical and magnetic phenomena. (See JEthee.)

The literature of light and optics has grown enormously within recent years, chiefly in the form of scattered memoirs. Of English treatises may be mentioned Peeston's Theory of Light (2nd ed., 1895) ; Basset's Treatise on Physical Optics, 1892 ; and Heath's Geometrical Optics. Larmok's ^ther and Matter (1900) is an important discussion of the inter-relations of matter and aether, and Dkude's Lehrbuch der Optik (1900) is the most complete work we have in which the physical aide of the subject is treated con- sistently throughout from the standpoint of the electromagnetic tlieory. (o. g. K.)

Ligrhtfoot, Joseph Barber (1828-1889),

English theologian and bishop of Durham, was born at Liverpool on 13th April 1828. His father was a Liverpool accountant. He was educated at King Edward's School, Birmingham, under Dr James Prince Lee, afterwards bishop of Manchester, a great schoolmaster, who had under him, at the same time with Lightfoot, not only Westcott, Lightfoot's successor at Durham, but Benson, afterwards archbishop of Canterbury. In 1^47 Lightfoot went up to Trinity CoUege, Cambridge, and there read for his degree with Westcott, who had preceded him thither. He took a brilliant

degree, being senior classic and 30th wrangler, and was elected a fellow of his coUege. In 1857 he became tutor. His fame as a scholar grew rapidly. He was made Hulsean professor in 1860, and shortly afterwards, in rapid succession, chaplain to the Prince Consort and honorary chaplain in ordinary to the Queen. In 1866 he was Whitehall preacher, and in 1871 he became canon of St Paul's. His sermons were not remarkable for eloquence, but a certain solidity and balance of judgment, an absence of partisanship, a sobriety of expression combined with clearness and force of diction, attracted hearers and inspired them with confidence. As was written of him in The Times after his death, " his personal character carried immense weight, but his great position depended still more on the universally recognized fact that his belief in Christian truth and his defence of it were supported by learning as solid and comprehensive as could be found anywhere in Europe, and by a temper not only of the utmost candour but of the highest scientific capacity. The days in which his University influence was asserted were a time of much shaking of old beliefs. The disintegrating speculations of an influential school of criticism in Germany were making their way among English men of culture just about the time, as is usually the case, when the tide was turning against them in their own country. It was quite impossible, however, to assume that the verdict of real learning was on the side of the Tubingen school, when such a scholar as Dr Lightfoot, supported by his friend Dr Westcott, was convinced that it was on the side of the old beliefs. The peculiar service which was rendered at this juncture by the ' Cambridge School ' was that, instead of opposing a mere dogmatic opposition to the Tiibingen critics, they met them frankly on their own ground ; and instead of arguing that their conclusions ought not to be and could not be true, they simply proved that their facts and their premisses were wrong. It was a characteristic of equal importance that Dr Lightfoot, like Dr Westcott, never discussed these subjects in the mere spirit of controversy. It was always patent that what he was chiefly concerned with was the substance and the life of Christian truth, and that his whole energies were employed in this inquiry because his whole heart was engaged in the truths and facts which were at stake. He was not diverted by controversy to

side-issues; and his labour was devoted to the positive elucidation of the sacred documents in which the Christian truth is enshrined."

In 1872 a work appeared entitled Supernatural Se- ligion, in which the evidences of religion generally, and those for the authenticity of the New Testament in particular, were somewhat roughly handled. This work created considerable sensation. It was written anonymously, and attributed to various celebrities of the day. In a series of masterly papers in the Contemporary Review, between December 1874 and May 1877, Dr Lightfoot undertook the defence of the New Testament canon; and the writer of the book, though never dis- courteously treated, was handled with some severity, and, in the opinion of most impartial judges, overthrown. About the same time Lightfoot was engaged in contribu- tions to the Dictionary of Christian Biography and the Dictionary of the Bible, and he also joined the committee for revising the translation of the New Testament. In 1875 he became Lady Margaret Professor of Divinity in the place of Dr Selwyn. He had previously, in addition to the work mentioned above, written most able and learned commentaries on the Epistles to the Galatians, PhUippians, and Colossians, the notes to which were dis- tinguished by sound judgment and enriched from his large stores of theological learning. These commentaries may be described as to a certain extent a new departure in New Testament exegesis. Previously to Lightfoot's time commentaries, especially on the epistles, had not un- frequently consisted either of short homilies on particular portions of the text, or of endeavours to enforce foregone conclusions, or of attempts to decide with infinite industry and ingenuity between the interpretations of former com- mentators. Lightfoot, on the contrary, while not despising the labours of his predecessors, endeavoured to make his author interpret himself, and by considering the general drift of his argument to discover his meaning where it appeared doubtful. Thus he often recovered for the Church the meaning of a passage which had long been buried under a heap of contradictory glosses, and he founded a school in which Enghsh sobriety and common-sense were added to the industry and ingenuity of former commenta- tors. Such services to the Church could not long remain unrewarded. Accordingly, in 1879 Lightfoot was elevated to the bishopric of Durham. His moderation, good sense, wisdom, temper, firmness, and erudition made him as successful in this position as he had been when professor of theology, and he speedily surrounded himself with a band of intelligent and scholarly young men, who aided him in the work of his diocese. The bishop endeavoured to combine his habits of theological study vrith the practical work of government of an

import- ant diocese. He continued to work at his editions of the Apostolic Fathers. In 1885 he published an edition of the Epistles of Ignatius and Polycarp, and he collected a large store of valuable materials for an edition of Clemens Romanus, which was published after his death. His defence of the authenticity of the Epistles of Ignatius is one of the most important contributions to that very difficult controversy. His unremitting labours impaired his health and shortened his splendid career at Durham. That diocese enjoyed only nine years of his wise, fatherly, and sympathetic rule, and of an influence for good felt as much by the pitmen as by their more cultivatedijand more educated fellow -citizens. At the age of 65 he was prematurely snatched away from the diocese he had ruled so weU and wisely. He died at Bournemouth, 21st December 1889, and was succeeded in the episcopate by Westcott, his school-feUow and lifelong friend. (j. j. l.)*

LiaHTHOUSES.

THIS article is supplementary to that in the earlier volumes of this Encyclopaedia (ninth edition, vol. xiv.), and describes the principal developments which took place in lighthouse engineering — including fog-signalling, the construction of buoys and beacons, light-vessels, and subsidiary branches of coast lighting — during the last quarter of the 19th century. It will be convenient to divide the subject into sections as follows : —

1. Lighthouse structures.

2. Optical apparatus for lighthouses.

3. Lighthouse illuminants.

4. Unattended lights and beacons.

5. Light-vessels.

6. Illuminated buoys.

7. Pog signals.

8. Lighthouse administration.

1. Lighthouse Structures. During the period under review comparatively few isolated and wave-swept lighthouses on rock foundations were constructed, but among these are one or two of paramount importance. The general design of such structures has differed but slightly from preceding ex- amples of the class, but in important details considerable alterations and improvements have been effected. The following are among the chief examples of this branch of work : —

JEddystone Lighthouse. — The Corporation of Trinity House in 1877 determined on the erection of a new lighthouse in place of Smeaton's famous structure upon the Eddystone reef, near Plymouth. The site selected was 120 ft. south-south-east from Smeaton's lighthouse, where a suitable foundation was found, although a considerable section of the lower courses had to be laid below the level of low water. The vertical base is 44 ft. in diameter and 22 ft. in height. The tower is a concave elliptic frustum, and is solid, with the exception of a fresh-water tank, to a height

Fig. 1. — Plan of Entrance Floor, new Eddystono Lighthouse.

*of 25 ft. 6 in. above high-water level. The walls abc*6 this level vary in thickness from 8 ft. 6 in. to 2 ft. 3 in. under the gallery. All the stones are dovetailed, both horizontally and vertically and on all inner faces, the stones of the foundation course being secured to the rook by Muntz-metal bolts. The tower contains 02,133 cub. ft. of Cornish and Irish granite, weighing 4608 tons. The height of the structure from low water ordinary spring tides to the mean focal plane is 149 ft., and it stands 133 ft. above high water. The*

lantern is a cylindrical helically framed structure with domed roof. The astragals are of gun-metal and the pedestal of oast iron. The optical apparatus consists of two superposed tiers of refracting lens panels, 12 in each tier, of 920 mm. focal distance. The lenses sub- tend an angle of 92° vertically. The 12 lens panels are arranged in groups of two, thus producing a group flashing light showing two flashes of 2^ seconds' duration every

half minute, the apparatus revolving once in 3 minutes. The burners are of the Douglass 0-wiok mineral oil pattern, and are supplied with oil from pressure lamps. The intensity of the combined beam of light from the two apparatus is 79,000 candles. At the time of the completion of the lighthouse two bells, weighing 2 tons each, and struck by mechanical power, were installed for fog-signalling purposes, but since that date an explosive gun-cotton fog-signal has been erected, the bells being removed. The driving machinery which rotates the optical apparatus consists of a J-h.p. caloric engine. At a lower level in the tower are installed two 21 -inch parabolic silvered reflectors with 2-wick burners, throwing a fixed light of 12,000 candle-power over a danger known as the Hand Deeps. The work of preparing the foundation was begun on the 17th July 1878, the foundation-stone being laid by the late duke of Edinburgh on the 19th August 1879. The last stone was laid on the 1st June 1881, and the light exhibited for the first time on the 18th May 1882. The upper portion of Smeaton's tower, which was removed on completion of the new lighthouse, was re-erected on Plymouth Hoe, where it replaced the old Trinity House sea mark. One of the principal features in the design of the new Eddystone lighthouse tower is the solid vertical base. This construction was much criticized at the time, but experience has proved that heavy seas striking the massive cylindrical structure are immediately broken up and rush round to the opposite side, spray alone ascending to the height of th4 lantern gallery. On the other hand, the waves striking the old tower at its foundation ran up the surface, which presented a curved face to the waves, and unimpeded by any projection until arriving at the lantern gallery, were partially broken up by the cornice and then spent themselves in heavy spray over the lantern. The shook to which the cornice of the gallery was exposed was so great that stones were sometimes lifted from their beds. The new Eddy- stone tower presents one point of dissimilarity from Smeaton's structure, In that the stones forming the floors consist of single corbel stones built into the wall and constituting solid portions thereof. In Smeaton's tower the floors consisted of stone arches, the thrust being taken by the walls of the tower itself, which were strengthened for the purpose by building in chains in the form of hoops. The system of constructing corbelled stone floors was first adopted by Stevenson in the Bell Rock lighthouse. , Bishop Sock Lighthouse. — The lighthouse on the Bishop Rock, which is the westernmost landfall rock of the Scilly Islands, occupies perhaps a more exposed

situation than any other in the world. The first lighthouse erected there was begun in 1847 under the direction of the late Mr N. Douglass. The tower con- sisted of a cast and wrought iron open-work structure having the columns deeply sunk into the rock. On the 5th February 1850, when the tower was ready for the erection of the lantern and illuminating apparatus, a heavy storm swept away the whole of the structure. This tower was designed for an elevation of 94 ft. to the focal plane. In 1851 the erection of a granite tower was begun ; the light was first exhibited in 1858. The tower had an elevation to the focal plane of 110 ft., the lower 14 courses being arranged in steps, or oHsets, to break up the force of the waves. This structure also proved insufficient to withstand the very heavy seas to which it was exposed. Soon after its completion the 5-cwt. fog bell, fixed to the lantern gallery 100 ft. above high-water mark, was washed away, to- gether with the flagstaff and ladder. The tower vibrated con- siderably during storms, and it was found that some of the external blocks of granite had been split by the excessive stress to which they had been exposed. In 1874 the tower was strengthened by bolting continuous iron ties to the internal surfaces of the walls. In 1881, when further signs of damage appeared, it was determined to remove the upper storey or service-room of the lighthouse, and to case the structure from its base upwards with granite blocks securely dovetailed to each other and to the existing work. At the same time it was con- sidered advisable to increase the elevation of the light, and place the mean focal plane of the new apparatus at an elevation of 140 ft. above high-water mark. The work was begun in 1883, and the new apparatus was first illuminated on the 25th October 1887. During the operation of heightening the tower it was necessary to install a temporary light, consisting of a cylindrical lightship

lantern with catoptric apparatus ; this was raised from time to time in advance of the structure as the work proceeded. The additional masonry built into the tower amounts approximately

Fig. 2. — Bishop Rock LigMhouse.

~~to 3220 tons. Profiting by the experience gained after the con~~ *struction of the new Eddystone tower, Sir J. N. Douglass decided to build the lower portion of the improved Bishop Eock tower in the form of a cylinder, but with considerably increased eleva- tion (Fig. 2). The cylindrical base is 40 ft. in diameter, and rises ,to 25 ft. above high-water mark. The lantern is of the usual*

Trinity House cylindrical helically framed pattern, 14 ft. in diameter, the glazing being 15 ft. in height. The optical appara- tus consists of two superposed tiers of lenses of 1330 mm. focal distance, the lenses subtending a horizontal angle of 36° and a vertical angle of 80°. The apparatus consists of 5 groups of lenses, each group producing a double flashing light of one minute period, the whole apparatus revolving once in 5 minutes. The burners are of the 8-wiok Douglass pattern. The maximum aggregate

Fig. 8. — Biform Dioptric Apparatus, Bishop Rock Lighthouse.

candle-power of the flash is 170,500 candles. A gun-cotton ex- plosive fog-signal is attached to the lantern. The cost of the various lighthouses on the Bishop Kock has been as follows : —

1. Cast-iron lighthouse .	*£12,500 0 0*
2. Granite lighthouse	*34,559 18 9*
3. Improved granite lighthouse	*64,889 0 0*
Total .	*£111,948 18 9*

Sattray Head Lighthouse. — This lighthouse was constructed between the years 1892 and 1895 by the Northern Lighthouse Commissioners upon the

Ron Rock, lying about one-lifth of a mile off Rattray Head, Aberdeenshire. The focal plane is 91 ft. above high water, the building being approximately 113 ft. in height. In the tower there is a fog-horn worked by compressed air. The optical apparatus, which rotates on a roller carriage, gives 3 flashes in quick succession every 30 seconds. The lenses are arranged in 4 panels, each containing 3 faces, and their focal distance is 920 mm. The optical elements for a vertical height of 68° are the ordinary plano-convex Fresnel profile. Refraction is carried to a vertical height of 80° by means of equiangular prisms. The intensity of the beam is 44,000 candles.

Beachy Head Lighthouse. — A new lighthouse is under con- struction upon the foreshore at the foot of Beachy Head, near Eastbourne, to replace the existing structure on the cliff, having an elevation of 284 ft. above high-water mark. Experience has proved that this particular light is frequently obscured by banks of mist or fog, while at a lower level the transparency of the

atmosphere is considerably less impaired. The Trinity House therefore decided in the year 1899 to proceed with the con- struction of a granite tower upon the foreshore at a distance of some 570 ft. from the base of the cliff. The foreshore at this point consists of chalk, and the selected site just bares at low water ordinary spring tides. The foundation course has been laid at a depth of 10 ft. below the surface, the area being excavated within a coffer-dam. The tower, which will be 47 ft. in diameter at the base, will have an elevation to the focal plane above high water of 103 ft., or a total height from foundation course to gallery coping of 123 ft. 6 in. The lower or solid portion of the tower has its face stones constructed in vertical offsets or steps in a similar manner to that adopted at the Wolf Eook and elsewhere. The tower is constructed with a facing of granite, all the stones being dovetailed in the usual manner. The hearting of the base is largely composed of concrete.

Fastnet Lighthouse. — A new granite lighthouse is in course of erection upon the Fastnet Rock ofi the south-west coast of Ireland. In the year 1895

it was reported to the Irish Lights Commissioners that the existing structure, which was completed in 1854 and con- sists of a circular casWron tower 86 ft. in height on the summit of the rook, was considerably undermined. It was subsequently de- termined to proceed with the erection of a granite structure of increased height and founded upon a sound ledge of rock on one side of the higher, but now considerably undermined, portion of the reef. This lighthouse tower, which was commenced in the year 1899, has its foundation laid near high-water level. The focal plane will be at a level of 160 ft. above high-water mark.

Wolf Trap Lighthouse. — This building was erected during the years 1893 and 1894 on Wolf Trap Spit in Chesapeake Bay, near the site of the old open-work structure which was swept away by ice early in 1893. The new tower is formed upon a cast-iron caisson 30 ft. in diameter sunk 18 ft. into the sandy bottom. The depth of water on the shoal is 16 ft. at low water. The caisson was filled with concrete, and is surmounted by a brick super-structure 52 ft. in height from low water to the focal plane of ^he light. A somewhat similar structure was erected in 1885-87 on the Fourteen Foot Bank in Delaware Bay, at a cost of £24,700. The foundation was, however, shifting sand, and the caisson was carried to a greater depth.

Minots Ledge Lighthouse. — This tower, although constructed before the period within the scope of this article, is of such interest as to warrant some mention. The tower, which is 89 ft. in height, is built of granite upon a reef oH Boston Harbour, Mass., and occupied five years in construction, being completed in 1860, at a cost of £62,500. The rock just bares at low water. The stones are dovetailed vertically but not on their horizontal beds in the case of the lower 40 ft. or solid portion of the tower,

bonding bolts being substi- tuted for the horizontal dove- tailed joints used in the case of the Wolf and other English towers. The shape of the tower is a conical frustum.

Fowey Bocks Lighthouse, Florida. — This iron struc- ture, which was begun in 1875 and completed in 1878, stands on the extreme northern point of the Florida reefs. The height of the tower, which is founded on wrought-iron piles driven 10 ft. into the coral rock, is 110 ft. from high water to fo- cal plane. The iron open- work pyramidal structure en- closes a plated iron

dwelling for the accommodation of the keepers. The cost of construction amounted to £32,600.

Spectacle Beef Lighthouse, Lake Huron. — This is a struc- ture similar to that on Minots Ledge, standing on a lime- stone reef at the northern Fig. 4. — Alligator Eeof Lighthouse. end of the lake. The tower

was constructed with a view to withstanding the effects of ice massing in solid fields thousands of acres in extent and travelling at considerable velocity. The tower is in shape the frustum of a cone, 32 ft. in diameter at the base and 93 ft. in height to the coping of the gallery. The focal plane is at a level of 97 ft. above the base. The lower 34 ft. of the tower is solid. The work was completed in 1874, having occupied four years. The cost amounted to approximately £78,000.

St G-eorge's Beef Lighthouse, California.— This structure con- sists of a square pyramidal stone tower rising from the easterly end of an oval masonry pier, built on a rock to a height of 60 ft. above the water. The focal plane is at an elevation of 146 ft. above high water. The site is an exceedingly dangerous one, and the work, which was completed in 1891, cost approximately £144,000.

Alligator Beef Lighthouse, Florida. — This tower is one of the finest iron sea-swept lighthouse structures in the world. It con- sists of a pyramidal iron framework 135J ft. in height, standing on the Florida Reef in 8 ft. of water. Its cost was £37,000, and its construction is generally similar to the Fowey Kocks tower.

Bothersand Lighthouse. — This lighthouse, off the entrance to the river Weser (Germany), is a structure of great interest on account of the difficulties met with in its construction. The tower had to be founded on a bottom of shifting sand 20 ft. below low water and in a very exposed situation. Work was begun in May 1881, when attempts were made to sink an iron caisson under pneumatic pressure. Owing to the enormous scour removing the sand from one side of the caisson, it tilted to an alarming angle, but eventually it was sunk to a level of 70 ft. below low-water mark. In October of the same year the whole structure col- lapsed. Another attempt, made in May 1883, to sink a caisson of bi-convex shape in plan, 47

ft. long, 37 ft. wide, and 62 ft. in height, met with success, and after many difficulties the struc- ture was sunk to a depth of 73 ft. below low water, the sides being raised by the addition of iron plating as the caisson sank. The sand was removed from the in- terior by suction. Around the caisson foundation were placed 74,000 cubic yards of mattress work and stones, the interior being filled with concrete. Towards the end of 1885 the lighthouse was completed, at a total cost, including the first attempt, of over £65,000. It is an iron structure in the shape of a concave elliptic frustum, its base being founded upon the caisson foundation at about half-tide level (Fig. 5). The light is electric, the current being supplied by cable from the shore. The focal plane is 78 ft. above high water or 109 feet from the sand level. The total height from the foundation of the caisson to the top of the vane is 185 ft.

Land Structures for Lighthouses. — The erection of lighthouse' towers and other buildings on land presents no difSomlties of con- struction, and they are of ordinary architectural character. It will, therefore be unnecessary to refer to them in detail. Attention' should, however, be called to one of the most recent of Conti- nental lighthouse towers, that known as the Phare d'Eckmuhl; at Penmarc'h (Finist6re), completed in 1897. The cost of this magnificent structure, 207 ft. in height from the ground, was largely defrayed by a bequest of £12,000 left by the marquis de BlocquevUle. It is constructed entirely of granite, and is octagonal in plan. The total cost of the tower and other lighthouse buildings amounted to £16,000.

The tower at He Vierge (Finistfere), completed in 1'902, has an elevation of 247 ft. from the ground level to the focal plane^ and is probably the highest structure of its kind in the world..

Fig. 5.— Eothersand Lighthouse.

Table I. — Comparative Cost of Exposed Rock Towers.

Name of Structure.

Total Cost.

Cub. ft.

Cost per cub. ft.

Eddystone, Smeaton (1759) . Bell Rock, Firth of Forth

40,000

8.

0

d.

0

13,343

*£ s. d. 2 19 11^*

(1811) ....

55,619

12

1

28,530

1 19 0

Skerryvore, west coast of

Scotland (1844) . Bishop Rock, first granite

72,200

11

6

58,580

1 4 7|

tower (1858)

34,559

18

9

35,209

0 19 7i

Smalls, Bristol Channel

(1861) ....

50,124

11

8

46,386

1 1 1

Hanois, Alderney (1862)

25,296

0

0

24,542

1 0 74

Wolf Rock, Laud's End (1869)

62,726

0

0

59,070

*1 1 8^*

Dhu Heartach, west coast of

Scotland (1872) .

72,584

9

7

42,060

1 14 6

Longshlps, Land's End (1872)

43,869

8

11

47,610

0 18 5

Eddystone, Douglass (1882) .

59,255

0

0

65,198

0 18 2

Bishop Rock, second granite

tower (1887)

64,889

0

0

45,080

1 8 9

Great Basses, Ceylon (1873) .

63,560

0

0

47,819

1 6 7

Minots Ledge, Boston, Mass.,

(1860)

62,500

0

0

36,322

1 17 2

Spectacle Reef, Lake Huron

(1874) ....

78,125

0

0

42,742

1 16 2

Ar'meri, France (1881) .

36,000

0

0

32,453

2. Optical Apparatus. Feux-dclairs. — The most important development in tlie character of lighthouse illuminating apparatus that has occurred in recent years has been iu the direction of re- ducing the length of flash. The initiative in this matter was taken by the French lighthouse authorities, and in France alone forty lights of this type were established between 1892 and 1901. The feux-Mairs which have been designed by the French engineers Bourdelles, Eibifere, and others have usually a flash of i^ to ^ of a second duration, the intervals between the flashes being also small, 3 seconds to 7 seconds. In group-flashing lights of this character the intervals between the flashes are about 2 seconds, with periods of 7 to 10 or 15 seconds between the groups. The flashes are arranged in single, double, triple, or even quadruple groups, as in the older forms of apparatus. The use of short flash lights soon spread to other parts of the world, America, British colonies, China, Japan, and Grermany and other European countries. In England the lighthouse at Pendeen (com- pleted in 1901) exhibits a quadruple flash every 15 seconds, the flashes being about ^ second duration (Fig. 6), while the bivalve apparatus erected on Lundy Island (1897) shows two flashes of f second duration in quick succession every 20 seconds. The feu-Mair type of apparatus enables a far higher intensity of flash to be obtained than had hitherto been possible, without any corresponding increase in the luminous power of the burner or other source of light. This result depends en- tirely upon the greater ratio of condensation of light employed. _ Panels of greater angular breadth are used with a higher rotatory velocity.

Duration of Flash necessary for Physiological Perception. — The researches of numerous physiologists and physicists, among whom are Plateau, Helmholtz, Wundt, Bloch, and more especially Char- pentier, confirm completely the experimental result obtained hy M. Blondel at the D6p6t des Phares in Paris, that a flash of ^ second is sufficient for the purpose of impressing a ray of light upon the retina of the eye. His researches proved that the exact time of full perception varies from -08 to ~~*125 second. The French Lighthouse Service accordingly fixed the standard minimum duration of flash at ^ second. This length of flash thus repre*~~ *sents the standard of maximum efficiency of a light, and any increase in the duration naturally results, ceteris paribus, in a cor- responding diminution*

in the intensity. It should be pointed out that sometimes it is advisable to increase the length of flash some- what on account of local and practical considerations, but such in- crease need seldom be carried beyond i or \ second. It has been urged that such short flashes axe insufficient for taking bearings.

but the utility of a light in this respect does not seem to depend so much upon the actual length of the flash as upon its frequent re- currence at short intervals. At the Paris Exhibition of 1900 was exhibited a fifth-order flashing light giving short flashes at 1 second intervals ; this represents the extreme to which the movement towards the reduction of the period of flashing lights has yet been carried. Mr Wigham has advocated a pulsating or " scintillating "

Fig. 6. — Pendeen Apparatus.

light emitting a series of flashes in such rapid succession that the luminous impression does not entirely leave the retina in the intervals.

Mercury Floats. — It has naturally been found impracticable to revolve the optical apparatus of a light with its mountings, some- times weighing over 4 tons, at the high rate of speed required for feux-eclairs by means of the old system of roller carriages, though for some small revolving lights ball bearings have been successfully adopted. It has therefore become almost the uni- versal practice to carry the rotating portions of the apparatus upon a mercury float. This beautiful application of mercury rotation was the invention of the late M. Bourdelles, and is now utilized not only for the high-speed apparatus, but also generally for the few examples of the older type still being constructed. The arrangement consists of an annular cast-iron bath or trough of such dimensions that a similar but slightly smaller annular float immersed in the bath and surrounded by mercury displaces

a volume of the liquid metal whose weight is equal to that of the apparatus supported. Thus a comparatively insignificant quantity of mercury, say 2

cwt., serves to ensure the flotation of a mass of over 3 or 4 tons. Certain differences exist between the type of float usually constructed in France and those generally designed by English engineers. In all cases provision is made for lower- ing the mercury bath or raising the float and apparatus for examination.

Group-Mashing Lights. — One of the most useful distinctions for lighthouses consists in the grouping of two or more flashes separated by short intervals of darkness, the group being succeeded by a longer eclipse. Thus two, three, or more flashes of say ^ second duration each follow each other at intervals of 2 seconds and are succeeded by an eclipse of say 10 or 15 seconds, the sequence being completed in a period of say 20 or 30 seconds. In 1874 the late Dr John Hopkinson introduced the very valuable improvement of dividing the lenses of a dioptric revolving light and the panels of reflecting prisms above and below them, setting them at an angle to produce the 'group-flashing characteristic. The first apparatus of this type constructed were those now in use at Tampico, Mexico, and the Little Basses liglithouse, Ceylon (double flashing). The latter was exhibited at the Soutii Kensington Exhibition of 1876. The Casquets apparatus (triple flashing, 1877) was the first of the kind used in England. A group-flashing catoptric light had, how- ever, been exhibited from the Boyal Sovereign, light- vessel in 1875. A group-flashing distinction was proposed for gas lights by Mr Wigham of Dublin, who obtained it in the case of a revolving apparatus by alternately raising and lowering the flame. The first apparatus in which this method was employed was at Galley Head, Co. Cork (1878). At this lighthouse four of Wigham's large gas burners with four tiers of first-order revolving lenses, eight in each tier, were adopted. By successive lowering and raising of the gas fiame at the focus of each tier of lenses he produced the group- flashing distinction. This light shows, instead of one prolonged flash at intervals of one minute, as would be produced by the apparatus in the absence of a gas occulter, a group of short flashes varying in nnmber between six and sevens The uncertainty, how- ever, in the number of flashes contained in each group is found to be an objection to the arrangement. This device was adopted at other gas-illuminated stations in Ireland at subsequent dates. Dr Hopkinson's system has been very extensively used, all the group- flashing lights shown in the accompanying tables, except the gas lights and the light at Cape Byron, being designed

upon the general lines he introduced. A modification of the system consists in grouping two or more lenses together separated by equal angles, and filling the remaining angle in azimuth by a reinforcing mirror or screen.

Eclipsing Group-Flashing Lights. — In 1898 Dr Purvis proposed the use of single or double-panel apparatus combined with an occulting screen or eclipser to obscure the burner at certain intervals. By rotating the apparatus at high speed, a series of flashes are thrown on the horizon, and may be interrupted for any desired time by automatically closing the occulter and thus obscuring the light. In a 2-panel optic, revolving once in 5 seconds, the flashes are at intervals of 2^ seconds. If the occulter is closed during every alternate revolution, a group-flashing characteristic of two flashes in quick succession every 10 seconds is obtained, which effect could only be produced otherwise by the use of a 4-panel group-flashing apparatus, or some similar combination of the Hop- kinson system considerably less efiicient in luminous power than the 2-panel bivalve. A practical difficulty was found to exist with this arrangement in that the single occulting screen made it possible for an incorrect characteristic to be observed from certain positions in azimuth except within the limited angle of about 145°. To overcome this defect Dr Purvis and Mr A. Brebner independently invented an eclipsing screen constructed in two or more portions according as the apparatus is bivalve, trilateral, and so on. This device preserves the true characteristic of the light over the whole horizon, and was introduced in the first-order bivalve apparatus constructed in 1900-01 for New South Wales, and erected at Cape Byron lighthouse. In this apparatus, which consists of a 920-mm. focal distance bivalve, each lens having a horizontal angle of 152°, a double or divided eclipser is used which occults the light during every alternate revolution. The apparatus revolves once in 10 seconds, thus producing a characteristic of two flashes of ^ second duration and .5 seconds apart every 20 seconds. The light has an intensity of 145,000 candles, being illuminated by a 6-wick mineral-oil burner.

Flashing Lights indicating Numbers. — Captain F. A. Mahan, late Engineer-Secretary to the United States Lighthouse Board, has devised for that service a system of flashing lights to indicate certain numbers. The

apparatus installed at Miuots Ledge light- house near Boston Harbour, Massachusetts, has a flash indicating

the number 143, thus: ,the dashes indicating short

flashes. Each group is separated by a longer period of darkness than that between successive members of a group. The flashes in

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a group indicating a figure are about IJ seconds apart, the groups being 3 seconds apart. An interval of 16^ seconds' darkness occurs between each repetition. The number is repeated every 30 seconds. Two examples of this system were exhibited by the United States Lighthouse Board at the Chicago Exhibition in 1893, viz., the second-order apparatus just mentioned and a similar light of the first order for Cape Charles on the Virginian coast. The lenses are arranged in a somewhat similar manner to an ordinary group- flashing light, the groups of lenses being placed on one side of the optic, while the other is provided with a catadioptric mirror. This system of numerical flashing for lighthouses has been frequently proposed in various forms, notably by Lord Kelvin. The installa- tion of the lights described is, however, the first practical application of the system to large and important coast lights, and after eight years of actual service the lights have apparently given much assistance to navigators, who consider the system desirable. The great cost involved in the alteration of the lights of any country to comply with the requirements of a numerical system is an impediment to its general adoption.

Hyper-radial Apparatus. — In 1885 Messrs Barbier of Paris constructed the first hyper-radial apparatus (1330 mm. focal distance) to the designs of Messrs Stevenson. This had a height of 1812 mm. It was tested during the

South Foreland experi- ments in comparison with other lenses, and found to give excel- lent results with

burners of large , V

focal diameter which would be unsuited for use with smaller appa^ ratus. Apparatus of similar focal distance (1330 mm.) were subse- quently estab- lished at Round Island, Bishop Rock, and Spurn. Point in England, Fair Isle and Sule Skerry (Fig. 7) in Scotland, Bull Rock and Tory Island in Ireland, Cape d'Antifer in France, and at Pei Yil-shan in China. At the Paris Exhi- bition of 1900 a fine example of a tri- lateral hyper- radial apparatus was shown, con- sisting of three lenses 11 ft. 6 in. in diameter, each subtending a hori- zontal angle of 120°, the whole being mounted upon a mercury float. The total weight of the revolving part of the light amounted to 8^ tons, while the motive clock weight required to rotate this large mass at a speed of four complete revolutions a minute is only 11 cwt., and the weight of mercury required for flotation 594 R). The complete apparatus weighed 13 tons. The introduction of incan- descent and other burners of focal compactness and high intensity has rendered the use of optics of such large dimensions as the above, intended for burners of great focal diameter, unnecessary. It is now possible to obtain with a second-order optic (or one of 700 mm. focal distance), having a powerful incandescent petroleum burner in focus, a beam of equal intensity to that wliich would be obtained from the above- described apparatus having a 10-wick oil burner or 108-jet gas burner at its focus.

Stevenson"s Spherical Lenses and Eqttiangular Prisms. — Mr C. A. Stevenson in 1888 designed a form of lens spherical in the horizontal and vertical sections. This admitted of the construction of lenses of long focal distance without the otherwise correspond- ing necessity of increased diameter of lantern. A lens of this type and of 1330 mm. focal distance was constructed in 1890 for Fair Isle lighthouse (1892). The spherical form loses in efficiency if carried beyond an angle subtending 20° at the focus, and to obviate this loss Mr Stevenson designed his equiangular prisms, which have an inclination outwards. It is claimed by the inventor that the use of equiangular prisms results in less loss of light and less divergence

tlian is the case when either the spherical or Fresnel form is adopted. An example of this design is seen (Fig. 7) in the Sule Skerry apparatus (1895).

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Fig. 7. — Sule Skerry Apparatus.

High- Angle Vertical Lenses. — Messrs Chance of Birmingham have manufactured lenses having 92° of vertical amplitude, but this result was only attained by using dense flint glass of high refractive index for the upper and lower elements. The St Cathe- rine's lenses have even greater vertical angle prisms, 97°- Lenses of 92° angle were utilized for the apparatus established at Anvil Point (1881), the Eddystone (1882), and a few other stations. It is doubtful, however, whether the use of refracting elements for a greater angle than 80° vertically is attended by any material cor- responding advantage.

Occulting Lights. — During the last twenty-five years of the 19th century the disadvantages of fixed lights became more and more appreciated, and at the present day the practice of installing such, except occasionally in the case of the smaller and less important of harbour or river lights, has

practically ceased. The necessity for providing a distinctive characteristic for every light when possible has led to the conversion of many of the fixed-light apparatus of earlier years into occulting lights, and often to their supersession by more modern and powerful flashing apparatus. The occulting apparatus generally adopted consists of a cylindrical screen, fitting over the burner, rapidly lowered and raised by means of a cam wheel at stated intervals. The cam wheel is actuated by means of a weight or spring clock. Varying charac- teristics may be procured by means of such a contrivance — single, double, triple, or other systems of occultation. The eclipses or periods of darkness bear much the same relation to the times of illumination as do the flashes to the eclipses in a revolving or flashing light. In the case of a first-order fixed light the cost of conversion to an occulting characteristic does not exceed £250 to £300. With apparatus illuminated by gas the occultations may be produced by raising and lowering the gas at stated intervals.

Leading Lights. — In the case of lights intended to act as a lead through a narrow channel or as direction lights, it is unde- sirable to employ a flashing apparatus. Fixed-light optics are employed to meet such cases, and generally fltted with occulting mechanism. A typical apparatus of this description is that now in course of erection at Gage Roads, Fremantle, West Australia (Fig. 8). The occulting bright light covers the fairway, and is

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Fig. 8.— Gage Eoads Direction Light.

flanked by sectors of occulting red and green light marking dan- gers and intensified by vertical condensing prisms. A good example of a holophotal direction light was exhibited at the 1900 Paris Exhibition, and afterwards erected at Suzac lighthouse (France). The light consists of an annular lens 500 mm. focal distance, of 180° horizontal angle and 157° vertical, with a mirror of 180° at the back. The lens throws a beam of 3° amplitude in azimuth, and 300,000 candle-power, over a narrow channel. The illuminant is an incandescent petroleum-vapour burner with a mantle of 45 mm. diameter. Holophotal direction lenses of this type can only be applied where

the sector to be marked is of com- paratively small angle. The use of single direction lights fre- quently renders the construction of separate towers for leading lights unnecessary.

Coloured Lights. — Colour is used as seldom as possible as a distinction in lighthouses, entailing as it does a considerable reduction in the power of the light. It is necessary in some instances for differentiating sectors over dangers and for harbour lighting purposes. The use of coloured lights as alternating flashes

for lighthouse lights is not to be commended, on account of the unequal absorption of the coloured and bright rays by the atmo- sphere. When such distinction has been employed, as in the Wolf Rock apparatus, the red and white beams can be approxi- mately equalized in initial intensity by constructing the lens and prism panels for the red light of larger angle than those for the white beams. With the introduction of group-flashing charac- teristics the necessity for such distinction disappeared. The Northern Lighthouse Commissioners have, however, perpetuated the alternating red and white characteristic in the new dioptric apparatus now being erected at Bell Rock lighthouse to replace the old catoptric light installed there in 1811. Owing to the absorption by the red colouring, the power of a red beam is only from 30 per cent, to 40 per cent, of the intensity of the corre- sponding white light. When red or green sectors are employed they should invariably be reinforced by mirrors, azimuthal con- densing prisms, or other means to raise the coloured beam to approximately the same intensity as the white light.

3. Illuminants.

Electricity. — The first installation of electric light for lighthouse purposes in England took place in 1858 at the South Foreland, where the Trinity House established a temporary plant for experimental purposes. This installa- tion was followed in 1862 by the adoption of the illumi- nant at the Dungeness lighthouse, where it remained in service until the year 1874, when the electric plant was removed and an oil-lit apparatus substituted. The earliest of the permanent installations now existing in England is that at Souter Point, which was illuminated in 1871. There are in England four important coast lights illumi- nated by electricity, and one, viz., Isle of May,

in Scotland. Of the former St Catherine's in the Isle of Wight is the most powerful. Electricity was substituted as an illuminant for the then existing oil light on the 1st May 1888. The optical apparatus consists of a second-order 16-sided revolving lens giving flashes of 5 seconds' duration at intervals of 30 seconds. De Meritens alternators are installed. The Isle of May lighthouse, situated on an island at the mouth of the Eirth of Forth, was first illuminated by electricity in 1887. The optical apparatus

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Fig. 9. — Isle of May Apparatus.

consists of a second-order fixed-light lens vrith refracting prisms, and is surrounded by a revolving system of vertical condensing prisms which split up the vertically condensed beam of light into 8 separate beams of 3° in azimuth. The prisms are so arranged that the apparatus, making one complete revolution in the minute, produces a group characteristic of 4 flashes in quick succession every 30 seconds (Fig. 9). The fixed light is not of the ordinary Fresnel section, the refracting portion being confined to

an angle of 10°, and the remainder of the vertical section consisting of reflecting prisms. In Prance the old south lighthouse at La Tihve was lit by electricity in 1863, with very satisfactory results. This installation

Fifi. 10.— Ilo Viorgo Apparatus.

was followed in 1866 by a similar one at the north lighthouse, while in 1902 there were thirteen important coast lights in France illuminated by electricity. In other parts of the world, Macquarie lighthouse, Sydney, was

lit by electricity in 1883; Tino, in the Gulf of Spezia, in 1885 ; and JSTavesink lighthouse, at the entrance to New York Bay, in 1898. Electric apparatus wei-e also installed in the lighthouse at Port Said in 1809, on the

opening of the canal ; Odessa in 1871 ; and at the Eother- sand, North Sea, in 1885. There are several harbour and other lights of minor importance in various parts of the world illuminated by electricity.

The table (II.) on the opposite page gives particulars of some of the more important electric lighthouses of the world.

Electric Lighthouse Installations in France. — A list of the 13 lighthouses on the French coast equipped with electric light installations will he found in Table II. It has been already mentioned that the two lighthouses at La Hfeve were lit by electric light in 1863 and 1865. These installa- tions were followed within a few years by the es- tablishment of electricity as illuminant at Gris-nez. In 1882 M. Allard, the then Director-General of the French Lighthouse Service, prepared a scheme for the electric lighting of the French littoral by means of 46 lights distributed more or less uni- formly along the coast line. All the apparatus were to be of the same general type, the optics consisting of a iixed belt of 300 mm. focal distance, around the outside of which revolved a system of 24 faces of vertical lenses. These vertical panels condensed the belt of fixed light into beams of 3° amplitude in azimuth, producing flashes of about | second duration. To illumi- nate the near sea the vertical divergence of the lower prisms of the fixed belt was artificially increased. These optics are very similar to that in use at th^' Souter Point lighthouse, Sunderland. The intensities obtained were 120,000 candles in the case of fixed lights and 900,000 candles with flashing lights. As a re- sult of a nautical inquiry held in 1886, at which date the lights of Dunkirk, Calais, Gris-nez, La Canche, Baleines, and Planier had been lighted, in addition to the old apparatus at La H6ve, it was decided to limit the installation of electrical apparatus to important landfall lights— a decision which the Trinity House had already airived at in the case of the English coast— and to establish new apparatus at six stations only. These were Cr^ac'h d'Ouessant (Ushant), Belle-Ile, La Coubre at the mouth of the river Gironde, Barfleur, He d'Yeu, and Penmarc'h.i At the same time it was deter- mined to increase the powers of

*the existing electric lights. The scheme as amended in 1886 is now almost complete, the last lights of the series being in course of erection (1902). In 1901 one of the lights decided upon in 1886 and installed in 1888—Crgac'h d'Ouessan^- was replaced by a still more powerful twin apparatus exhibited at the 1900 Paris Exliibi- *A?,"" ;-* *^^ "Shts established under the Allard scheme, Gris-nez, La Canche, and Planier have been replaced by similar apparatus to that at Crfiac'h.*

All the electrically lit apparatus, in common with nearly all other new optics established in France since 1893, have been provided with mercury rotation. The four most recent electric lights have been constructed in the form of twin apparatus, two complete and distinct optics being mounted side by side upon the same revolving table and with corresponding faces parallel. It has been found that a far larger aggregate candle-power could be obtained from two lamps with 16 mm. carbons and a currant of 50 amperes than with one carbon of 23 mm. diameter in conjunction with a current of 100 amperes. A somewhat similar circumstance led to the choice of the twin . T, ,™'™s *0" the two very powerful non-electric apparatus at He Vierge (Figs. 10 and 11) and Ailly, particulars of which will be seen in Table III.*

For the present it is intended to retain the De Meritens magnito-electric machines which were laid down some years ago at the French electric lighthouses. All these machines have

ris^',"'i„ ?/'T+"«"«°"°"?i";^ 'i^"" 'replaced by the old BeUe-Ile (1890) lens. At Barfleur and BeUe-Ile are now being installed twm apparatus of the new Creac'h type. .ioiiMim

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LIGHTHOUSES

five induction coils, which, upon the installation of the twin optics, were separated into two distinct circuits, each consisting of 2^ coils. This modifioation has enabled the old plants to he used with success under the altered condition of lighting entailed by the use of two lamps. The generators adopted in the French Service for use at the later stations, where twin optics have been installed, differ materially from the old type of De Meritens machine. The Phare d’Eo^muhl (Penmarc’h) installation serves as

a type of the more modern machinery. The dynamos are alternating current two-phase machines, and are installed in duplicate. The two lamps are supplied with current from the same machine, the second dy- namo being held in reserve. The speed is 810 to 820 revolutions per minute. Plant of a similar description will in all probability be laid down at a future date in all the electric lighthouses of this type. The cost of a first-class electric lighthouse installation of the most recent type in Trance, including optical apparatus,

Fig. 11.— Plan of He Tlerge Lantern.

lantern, dynamos, engines, air compressors, siren, &c., but not buildings, amounts approximately to £5886. The lamp generally adopted is a combination of the Serrin and Berjot principles, with certain modifications. Clockwork mechanism with a, regulating electro-magnet moves the rods simultaneously and controls the movements of the carbons so that they are displaced at the same rate as they are consumed. It is usual to employ currents of varying power with carbons of corresponding dimensions according to the atmospheric conditions. In the French Service two varia- tions are used in the case of twin apparatus produced by currents of 25 and 50 amperes at 45 volts with carbons 11 mm. and 16 mm. diameter (in some cases 30 and 60 ampere currents with 14 and 18 mm. carbons), while in single optic apparatus currents of 25, 50, and 100 amperes are utilized with carbons of 11 mm., 16 mm., and 2.S mm. diameter. In England fluted carbons of larger diameter are employed with correspondingly increased current. Alternating currents have given the most successful results in all respects. Attempts to utilize continuous current for lighthouse arc lights have up to the present met with little suc- cess.

Efficiency of the Electric Light. — In 1883 the lighthouse author- ities of Great Britain determined that an exhaustive series of experiments should be carried out at the South Foreland with a view to ascertaining the relative suitability of electricity, gas, and oil as lighthouse illuminants. The experiments extended over a period of more than twelve months, and were attended by repre- sentatives of most of the lighthouse authorities of the world. The results of the trials tended to show that the rays of oil and gas lights suffered to about equal extent by atmospheric absorption, but that oil

had the advantage over gas by reason of its greater economy in cost of maintenance and in initial outlay on installa- tion. The electric light was found to suffer to a much larger extent than either oil or gas light per unit of power by atmospheric absorp- tion, but the infinitely greater total intensity of the beam obtain- able by its use, both by reason of the high luminous intensity of the

electric arc and its focal compactness, more than outweighed the higher percentage of loss in fog. The final conclusion of the com- mittee on the relative merits of electricity, gas, or oil as lighthouse illuminants is given in the following words : — " That for ordinary necessities of lighthouse illumination, mineral oil is the most suit- able and economical illuminant, and that for salient headlands, important landfalls, and places where a very powerful light is required, electricity offers the greatest advantages."

Incandescent electric lighting has been adopted for the illumina- tion of some lights-vessels in the United States, a few small har- bour and port lights, beacons, and in some cases buoys. The Cumbrae lighthouse in the Firth of Clyde is also lighted by incan- descent electric lamps.

Coal gas had been introduced in 1837 at the inner pier light of Troon (Ayrshire), and in 1847 it was in use at the Heugh light- house (West Hartlepool). In 1878 cannel coal gas was adopted for the Galley Head lighthouse, with 108-jet Wigham burners. Sir James Douglass introduced gas burners consisting of con- centric rings perforated on the npper edges, and from two to ten in number. These gave excellent results and high inten- sity of candle-power, 2600 in the case of the 10-ring burner with a flame diameter at the focal plane of 5f inches. These are in use at Bull Kock lighthouse, Haisboro' in Norfolk, and several other stations in England and Scotland. The use of multiple gas burners is not being further extended. Gas for lighthouse purposes generally requires to be specially made ; the erection of gasworks at the station is thus necessitated and a considerable outlay entailed, which is avoided by the use of oil as an illuminant.

Incandescent Burners. — The invention of the Welsbach mantle places at the disposal of lighthouse authorities the means of producing a light of high intensity combined with great focal compactness. For lighthouse purposes other gaseous illuminants than coal gas are as a rule more con- venient and

economical, and give better results with ‘ incan- descent mantles. Mantles have, however, been used with ordinary coal gas in many instances when a local supply is available.

Mineral Oil Burners. — Until the year 1846 the oil usually employed for lighthouse lamps was sperm. In that year colza or vegetable oil was introduced, and became the chief illumi- nant until the early ‘seventies, when mineral oil was largely substituted in Great Britain for lighthouse purposes. In 1872 mineral oil was introduced at the Flamborough Head light- house, and since that date it has been utilized almost uni- versally in cases where gas or electric light has not been installed. The large majority of lighthouses all over the world are now lit by mineral oil having a flash-point of over 140° F. The ” Doty ” burner was the first successful form of the multiple-wick type consuming mineral oil. Other improved oil burners have since been introduced, notably the patterns used in the English and French services, which , are made in several sizes, varying from 1 to 8 concentric wicks, and in intensity from 20 to over 1800 candle-power. The improved 5-wick (1894) pattern used by the Trinity House gives a flame Z\ inches diameter at the focal plane, and of 800 candle-power. The lamps used for supplying oil to the burner are of two general types, viz., those in which the oil is maintained under pressure by mechanical action, and the constant level lamp.

Incandescent Mineral Oil Burners. — Incandescent lighting with high-flash mineral oil was first introduced by the French Light- house Sei’vice in 1898 at L’lle Penfret lighthouse. The burners employed are all made on the same principle, but differ slightly in details according to the type of lighting apparatus for which they are intended. The principle consists in injecting the liquid petroleum in the form of spray mixed with air into a vaporizer heated by the mantle flame or by a subsidiary heating burner. A small reservoir of compressed air is used — charged by means of a hand-pump — for providing the necessary pressure for in- jection. On first ignition the vaporizer is heated by a spirit fiame to the required temperature. A reservoir air pressure of 85 lb per square inch is employed, a reducing valve supplying air to the oil vessel at 28 fb per square inch. The consumption of petroleum is as low as ‘015 oz. per hour per candle of light intensity in the mantle. The intensity of the mantle flame varies from 400

candles in the case of 80 mm. diameter mantles to over 1200 candles with 55 mm. mantles. Experimental burners similar to those described have been constructed by the Trinity House and by the Irish Lighthouse Board with satisfactory results.

The following table (prepared by Baron Q. de Rochemont) gives the intrinsic brightness in a horizontal direction of various light- house illuminants employed in France. The values are expressed in carcels (9 ‘6 candles) per centimetre of the mean horizontal focal plane of the luminous source : —

LIGHTHOUSES

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1 wiok Frencli mineral oil burner

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” ” 1) 1)

Incandescent lighting with compressed oil gas

Incandescent lighting with petroleum vapour

Incandescent lighting with acetylene

Crater of the electric arc

0-35 earcels

0-50 „

0-80 „

0-95 „

1-10 „

1-18 „

2‘00 „

2-60 „

4-00 „

900-00 ,,

The luminous intensity of a beam from a dioptric apparatus is, ceteris paribus, proportional to the intrinsic brightness of the luminous source of flame, and not to the total luminous intensity. The Intrinsic brightness of the flame of oil lamps increases only slightly with their focal diameter, consequently while the con- sumption of oil increases, the efiiciency of the burner for a given apparatus decreases. The illuminating power of the condensed beam can only be improved to a slight extent, and, in fact, is occasionally decreased, by increasing the number of wicks in the burner. The same argument applies to the case of multiple ring and multiple jet gas burners, which, notwithstanding their large total intensity, have comparatively small intrinsic brightness.

Incandescent Oil Gas Burners. — It has been mentioned that incandescence with low-pressure coal gas produces flames of com- paratively small intrinsic brightness. Coal gas cannot be com- pressed beyond a small extent without considerable injurious condensation and other accompanying evils. Recourse has there- fore been had to compressed oil gas, which is capable of under- going compression to 10 or 12 atmospheres without detriment, and can conveniently be stored in portable reservoirs. The burner employed resembles the ordinary Bunsen burner with incan- descent mantle, and the rate of consumption of gas is 27‘5 cubic inches per hour per candle. A reducing valve is used for supply- ing the gas to the burner at constant pressure. The burners can be left for even the whole night without attention. The system was adopted first in France, where it is installed at eight lights houses, among others the Ar’men Rock light, and has been ex- tended to other parts of the world, including several stations in Scotland. The mantles used in France are of 30 mm. diameter, and occasionally of larger dimensions. The 30 mm. mantle gives a candle-power of 400.

The use of oil gas necessitates the erection of gasworks at the lighthouse, or its periodical supply in portable reservoirs from a neighbouring station. A complete gasworks plant costs about £800. The annual expenditure for gas lighting in France does not exceed £72 where works are installed, or £32 where gas is supplied from elsewhere. In the case of petroleum vapour light- ing the annual cost amounts to about £26.

Acetylene. — The high illuminating power and intrinsic bright- ness of the flame of acetylene makes it a very suitable illuminant for lighthouses, provided the diflBculties attending its use can be overcome. At Grangemouth an unattended 21-day beacon has been illuminated by an acetylene flame for some time, and with considerable success. Acetylene has been used also in the United States, Germany, the Argentine, China, &c., for lighthouse and beacon illumination. Many buoys and beacons on the German and Dutch coasts have been supplied with oil gas mixed with 20 per cent, of acetylene, thereby obtaining an increase of over 100 per cent, in illuminating intensity. In France an incan- descent burner consuming acetylene gas mixed with air has been installed at the Chassiron lighthouse (1902), the flame intensity being 1300 candles with a 55 mm. mantle. The French Light- house Service has perfected an incandescent acetylene burner with a 55 mm. mantle having an intensity of over 2000 candle-power, with intrinsic brightness of 60 candles per square centimetre.

4. Unattended Lights and Beacons.

Until recent years no unattended lights were in exist- ence. The introduction of Pintsch's gas system in the early 'seventies provided a means of illumination for beacons and buoys of which large use has been made. Other illuminants are also in use to a limited extent.

Unattended Electric Lights. — In 1884 an iron beacon lighted by an incandescent lamp supplied with current from a secondary battery was erected on a tidal rock near Cadiz. A 28-day clock was arranged for eclipsing the light between sunrise and sunset and automatically cutting off the current at intervals to produce an occulting characteristic. Several small dioptric appa- ratus illuminated with incandescent electric lamps have been made by the firm of Barbier of Paris, and supplied with current

from batteries of Daniell cells, with electric clockwork mechanism for occulting the light. These apparatus have been fitted to beacons

and buoys, and are generally arranged for switching off the current during the daytime. They run unattended for periods up to two months. Two separate lenses and lamps are usually provided, with lamp changer, only one lamp being in circuit at a time. In the event of failure in the upper lamp of the two the current automatically passes to the lower lamp.

Oil Oas Beacons.~ln 1881 a beacon automatically lighted by Pintsch's compressed oil gas was erected on the river Clyde, and many of these structures have since been installed in Great Britain, America, and other parts of the world. The gas is con- tained in an iron or steel reservoir placed within the beacon structure, and is refilled by means of a flexible hose on the occa- sions of the periodical visits of the light tender. The beacons, which remain illuminated for periods up to three months, are charged to five atmospheres, the pressure in the storage receiver on the tender being greater. Many lights are provided with occulting apparatus actuated by the gas passing from the re- servoir to the burner automatically cutting off and turning on the supply. The Gar- vel beacon (1899) on the Clyde is shown in Fig. 12. The burner has seven jets, and is occulting.

Lindberg Lights. — In 1881-82 several beacons lighted auto- matically by volatile petroleum spirit on the Lindberg-Lyth and Lindberg-Trotter systems were estab- lished in Sweden. Many lights of this type were subse- quently placed in different parts of the world. The volatile spirit lamp burns day and night. Occulta- tions are produced by a screen or series of screens rotated round the light by the ascending ■ current of heated air and gases from the lamp acting upon a horizontal fan. The speed of rotation of the fan cannot be accurately adjusted, and the times of occultation therefore are liable to slight variation. The lights run unattended for periods up to four- teen or twenty-one days.

Benson-Lee Lamps. — An improvement upon the foregoing was the Benson-Lee lamp, in which a similar occulting arrangement is often used, but the illuminant is paraffin consumed in a special burner having carbon-tipped wicks which require no trimming. The flame intensity of the light is greater than that of the burner consuming light spirit. The introduction of paraflBn

also avoids the danger attending the use of the more volatile spirit. Twenty-one of these lights are in use on the Scottish coast, and many in other parts of Great Britain, America, Canada, and other countries.

Permanent Wick Lights. — About 1891 the French Lighthouse Service introduced petroleum lamps consuming ordinary high-flash lighthouse oil, and burning without attention for periods of several months. The burners are of special construction, pro- vided with a very thick wick, which is in the first instance treated in such a manner as to cause the formation of a deposit of carbonized tar on its exposed upper surface. This crust prevents further charring of the wick after ignition, the oil becoming vaporized from the under side of the crust. Many fixed, occult- ing, and flashing lights fitted with these burners have been established in France, and several in other countries. In the case

Fig. 12. — Garvel Beacon,

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~~of the occulting types a revolving screen is placed around the burner and is carried upon a miniature mercury float. The rotation is effected by means of a small Gramme motor on a ver- tical axis fitted with a speed governor, and supplied with current from a battery of primary cells. The oil reservoir is placed in the upper part of the lantern and connected with the burner by a tube, to which is fitted a constant level regulator foi? main- taining the burning level of the oil at a fixed height. In the flashing or revolving light types the arrangement is generally similar, the lenses being revolved upon a mercury float which is rotated by the electric motor. In the flashing apparatus recently established at Saint-Marooufi, the beam intensity is 1000 candle- power, and it is capable of ruiming unattended for three months. The electric current employed for rotating the apparatus is supplied by four Lalande and Chaperon primary cells, coupled in series, each giving about 0-15 amperes at a voltage of 0-65. The power required to work the apparatus is at the maximum about 0-165 ampere at 0-75 volt, the large surplus of power which is provided for the sake of safety being absorbed by a brake or governor connected with the motor.~~

~~Wigham Beacon Lights. — Mr Wigham has introduced an oil lamp for beacon and buoy purposes consisting of a vertical con-~~

~~tainer filled with ordinary mineral oil or paraffin, and carrying a roller immediately under the burner case, over which a long flat wick passes. One end of the wick is attached to a float which falls in the container as the oil is consumed, automatically draw- ing a fresh portion of the wick over the roller. The other end of the wick is attached to a free counterweight keeping it taut. The oil burns from the convex surface of the wick as it passes over the roller, a fresh portion being constantly passed under the action of the flame. The light is capable of burning without attention for thirty days. These lights are also fitted with occulting screens on the Lindberg system. The candle-power of the flame is small.~~

5. Light-vessels. The earliest light-vessel placed in English waters was that at the Nore in 1732, and before the end of the 18th century several more such ships were in use. Of modern light-vessels, many are built entirely of wood, others are composite, and some of iron. The wood and composite ships are sheathed with Muntz metal. Composite built vessels are considered most suitable for the service. The

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Fig. 18.— 8andetti6 Lightship.

length of English light-vessels varies from 80 to 105 ft., with beam of from 20 ft. to 23 ft., the tonnage ranging from 155 to 265 tons. The lanterns used in modern English light-vessels and others of the same class are 8 ft. in diameter, circular in form, with glazing 4 ft. in height. They are annular in plan, surrounding the mast of the vessel upon which they are hoisted for illumination ; they are lowered to the deck level during the day. Of the eighty -four light-vessels in British waters, including some few unattended light-vessels, eleven are in Ireland and five in Scotland. The others are on the coast of England and Wales. In the United States there are thirty-two light- vessels on the Atlantic seaboard and three on the Pacific coast. At the present time there are nearly 700 light- vessels in service throughout the world. The illuminating apparatus for almost all light-vessels is of catoptric form, the more modern vessels being fitted with a series of 21 in. or 24 in. silvered parabolic reflectors, having 1-, 2-, or 3-wick mineral oil burners in focus. The reflectors and lamps are hung in gimbals to preserve the horizontal direction of the beams. The following table gives the intensity of beam obtained by means of two types of reflector : —

21-inch Trinity HOuse Parabolic Reflector.

Service Inten. sity of Beam. Candles.

. 2715

Burners— 1 wick " Douglass "

~~2 ,, ,, (catoptric)~~

~~2 ,, „ (dioptric)~~

~~3 II n • • •~~

~~4004 5722 7528~~

~~24r-inch Northern Lighthouse Board Parabolic Reflector.~~

~~Service Inten- sity of Beam. Candles.~~

~~Burners — 1 wick "Doty" ..... 2177~~

~~1 ,, "Douglass" .... 4293~~

~~2 ,, ,, (catoptric) . . 4265 2 „ „ (dioptric) . . 7231~~

~~In revolving flashing lights two or more reflectors are arranged in parallel in each face. Three, four, or more faces or groups of mirrors are arranged around the lantern in which they revolve, and are carried upon a turntable rotated by clockwork. The intensity of the flashing beam is therefore equivalent to the combined intensities of the beams emitted by the several mirrors in each face. Group flashing characteristics can be produced by special arrange- ments of the reflectors. The two most powerful light- vessel lights in the British Isles are the Spurn and Swin Middle, the latter at the entrance to the Thames, each havin g a flash intensity of 20,000 candles. At the Swin Middle also was placed the first revolving lightship light in 1837.~~

~~Eog signals, where provided for light-vessels, are gener- ally in the form of reed-horns or sirens, the smaller reed- horns being of the manual type. In the Trinity HIouse Service many vessels are provided with steam plant for driving the air compressors. Oil engines have been recently introduced for this purpose. The approximate cost of a modern type of Trinity HIouse light-vessel with steam power compressed-air siren is £16,000. The cost of a similar vessel with oil engines is £15,200.~~

~~*LIGHTHOUSES*~~

~~*Electrical Illumination. — An experimental Installation of electric light was placed in one of the Mersey light-vessels in 1886 by the Mersey Docks and Harbour Board, but unfortunately proved unsuccessful. The United States Lighthouse Board in 1892 constructed a light-vessel pro- vided vyith a powerful electric light, and moored her on the Cornfield Point station at Long Island Sound. This vessel was subsequently placed off Sandy Hook (1894). Four other light- vessels have since been provided with incandescent electric lights — either with fixed or occulting characteristics — in the United States, at Nantucket Shoals (1896), Fire Island (1897), Diamond Shoals (1898), and Overfalls Shoal (1901).*~~

~~*Gas Illumination. — In 1896 the French Lighthouse Service completed the construction of a steel light-vessel (the ratal's), which was ultimately placed at the mouth of the Gironde. The construction of this vessel was the outcome of a long series of experi- ments carried out with a view to (1) regulate the stability of a light-vessel by avoiding all synchronism between its period of oscillation and that of the waves ;*~~

~~*(2) reduce the vessel's oscillations by the em- ployment of main and bilge keels of great depth ;*~~

~~*(3) produce an efficient light-vessel at moder- ate cost, and lit by a dioptric flashing light with incandescent oil gas burners. The con- struction of the Talais was followed by that of a second and larger vessel, the Snouw, on*~~

~~*similar lines, having a length of 65 ft. 6 ins., beam 20 ft, and a draught of 12 ft., with a dis- placement of 130 tons. The cost of this vessel complete with optical apparatus and gas holders, with accommodation for three men, was approxi- mately £5000, and the annual cost of upkeep is stated to be £400. The candle-power of the beam is 35,000 candles. The vessel was built in 1898-99. A third vessel was constructed in 1901-02 for the Sandetti^ bank on the general lines adopted for the preceding examples of her class, but of the following increased dimensions : Length, 115 ft. ; width at water line, 20 ft. 6 ins. ; and draught, 16 ft., with a displacement of 342 tons (Fig. 13). Accommodation is provided for a crew of eight men. The optical apparatus (Fig. 14) is dioptric, consisting of four panels of 250 mm. focal*~~

~~distance, carried upon a "Cardan" joint below the lens table, and counterbalanced by a heavy pendulum weight. The apparatus is revolved by clockwork and illuminated by com- pressed gas with incandescent mantle. The candle- power of the beam is 35,000. The gas is con- tained in three reservoirs placed in the hold. The apparatus is contained in a 6 ft. lantern con- structed at the head of a tubular mast 2 ft. 6 ins. diameter. A powerful siren is provided, with steam engine and boiler for working the air com- pressors. The total cost of the vessel, including fog signal and optical apparatus, was £13,600.~~

~~Unattended Light-vessels. — In 1881 an unat- tended light-vessel, illuminated with Pintsch's oil gas, was constructed for the Clyde, and is still in use at the Garvel Point. The light is occult- ing, and is shown from a dioptric lens fitted at the head of a braced iron lattice tower 30 ft. abdve water level. The vessel is of iron, 40 ft. long, 12 ft. beam, and 8 ft. deep, and has a storeholder on board containing oil gas under a pressure of six atmospheres capable of maintaining a light for three months. A similar vessel is placed off Calshot Spit in Southampton Water, and several have been constructed for the French Lighthouse Service. The latter are provided with deep main and bilge keels~~

~~similar to those adopted in the larger French gas-illuminated vessels. In 1901 a ligh1>vessel 60 ft. in length was placed off the Otter Rock on the west coast of Scotland : it is constructed of steel, 24 ft. beam, 12 ft. deep, and draws 9 ft. of water (Fig. 15). The focal plane is elevated 25 ft. above the water line, and the lantern is 6 ft. in diameter. The optical apparatus is of 500 mm. focal distance, and hung in gimbals with a pendulum balance and " Cardan " joint as in the Sandetti^ light- vessel. The illumi- nant is oil gas, with an occulting characteristic. The storeholder contains 10,500 cub. ft. of gas at eight atmospheres, sufficient to supply the light for ninety days and nights. A bell is provided, and is struck both by clappers moved by the roll of the vessel and by means of an automatic striking gear actuated by the gas on its passage to the burner. Thus the due action of the bell can be depended upon even in calm weather. The cost of the vessel complete was £2979.~~

Electrical Communication of Light-vessels with the Shore. — Experiments were instituted in 1886 at the Sunk light-vessel off the Essex coast for maintaining telephonic communication with the shore by means of a submarine cable 9 miles in length. The cable was landed at Walton-on-the-Naze. Great difficulties were experienced in maintaining communication during stormy weather, breakages in the cable being frequent. These difficulties have subsequently been overcome by the employment of larger vessels and special moorings. In addition, pile lighthouses and isolated

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Fig. 14. — Lantern of Sandetti6 Lightship.

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FiQ. 15.— otter Rook Light

rock and Island stations have been placed in electrical communi- cation with the shore. The Fastnet lighthouse has been electric- ally connected with the shore by means of a non-continuous cable, it being found impossible to maintain a continuous cable in shallow water near the rock owing to the heavy wash of the sea. A copper conductor is carried down from the tower to below low- water mark, and is separated from the cable proper laid on the

bed of the sea in a depth of 13 fathoms hy a distance of about 100 ft. The lighthouse is similarly connected to earth on the opposite side of the rock. The conductor terminates in a large copper plate, and to the cable end is attached a copper mushroom. Weak currents are induced in the lighthouse conductor by the main current in the cable, and messages can be received in the tower by the help of electrical relays.

The possibilites of setheric communication be- tween isolated lighthouses and lightships and the shore are as yet undeveloped. It is prob- able that the

~~solution of the difficulties now attending the maintenance of submarine com- munication in such cases will be found in some adaptation of the Marconi or other similar system. (See Telegkaphy, Wikeless.)~~

~~6. Illuminated Buoys.~~

~~The general question of buoying of coasts, rivers, and estuaries has been dealt with in the article Buoy. Pintsch's oil gas has been in use for the illumination of buoys since 1878. In 1883 an automatic occulter was perfected, worked by the gas passing from the re- servoir to the burner. The lights placed on these buoys burn con- tinuously for three or more months, and the buoys and lanterns are made in various forms and sizes. The spar buoy (Fig. 16) is sometimes adopted for situa- tions where strong tides or currents have to be contended with. Oil gas lights are frequently fitted to Court- ney whistling buoys and to bell buoys. A bell clapper for buoys has been introduced worked automatically by the gas as in the case of the Otter Eock light-vessel bell. One form of clapper actuated by the roll of the buoy (shown in Fig. 17) consists of a hardened steel ball placed in a horizontal phosphor-bronze cylinder provided with rubber buffers. Three of these cylinders are arranged around the mouth of the bell, which is struck by the balls rolling backwards and forwards as the buoy moves.~~

~~In the ordinary type of gas-buoy lantern the burner employed is either of the multiple-jet type or an Argand ring of 18 mm. diameter. It has been found impracticable to use in- candescent mantles for buoy lights. The lenses employed are of cylin- drical dioptric fixed-light form, 100 mm. to 300 mm. diameter. Some of the largest types of gas-buoy in use on the French coast have an elevation from water level to the focal plane of over 26 feet, with a beam intensity of more than 200 candles. Oil gas forms the most trustvforthy and efficient illuminant for buoy purposes yet introduced. The system has been largely adopted by lighthouse and harbour authorities,~~

~~and there are now some 1000 buoys fitted with these apparatus, in addition to 250 beacons, light-vessels, and boats. Several buoys have been fitted with electric light, both fixed and occulting, similar to those designed for~~

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~~*Fie. 16.— Spar Gas Buoy.*~~

~~*Fig. 17.— Buoy Bell.*~~

~~*beacon purposes. Seven electrically lit spar-buoys were laid down in the Gedney Channel, New York Lower Bay, in 1888. These were illuminated by 100 candle-power Swan lamps with continuous current supplied by cable from a power station on shore. The wear and tear of the cables has caused considerable trouble and expense. In 1894 alternating current was introduced and ten buoys lighted. These are still in service. Wigham's oil lamps have also been in some cases fitted to buoys.*~~

~~*7. Fog Signals.*~~

~~*The introduction of coast fog signals is of comparatively recent date. They were until the middle of the 19th century practically unknown except so far as a few isolated bells and guns were concerned. The increasing demands of navigation, and the application of steam power to the propulsion of ships resulting in an increase of their speed, drew attention to the necessity of providing suitable signals as aids to navigation during fog and mist. In times of fog the mariner can expect no certain assistance from even the most efficient system of coast lighting, since the beams of light from the most powerful electric light- house are frequently entirely dispersed and absorbed by the particles of moisture forming a sea fog of even moderate density, at a distance of less than a quarter of a mile from the shore. The careful experiments and scientific research which have been devoted to the subject of coast fog-signalling have produced much that is useful and valuable to the mariner, but unfortunately the prac- tical results so far have not been so satisfactory as might be desired, owing to (1) the very short range of the most powerful signals yet produced under certain unfavourable acoustic conditions of the atmosphere, (2) the difficulty experienced by the mariner in judging at any time how far the atmospheric conditions are against him in listening for the expected signal, and (3) the difficulty in locating the position of a sound signal by phonic observations.*~~

~~*Bells and gongs are the oldest and, generally speaking, the least efficient forms of fog signals. Under very favourable*~~

~~*acoustic conditions, however, the sounds may be audible at con- siderable ranges. On the other hand, the 2-ton bells formerly at the Eddystone have been inaudible at distances of a few hundred yards. The 1893 United ‘ States trials showed that a bell weighing 4000 lb struck by a 450 R) hammer was heard at a distance of 14 miles across a gentle breeze and at over 9 miles against a 10-knot breeze. Bells are frequently used for beacon and buoy signals, and in some cases at isolated rock and other stations*~~

where there is insufficient accommodation for sirens and horns. In the Trinity House Service their use is, generally speaking, restricted to these cases, but in other counti-ies they are more frequently employed. Gongs, usually of Chinese manufacture, have been in use at many English lightships until quite recently, and also at other stations. In the Trinity House Service these have been superseded by more powerful sound instruments.

Explosive Signals. — Guns were long used at many lighthouse and light-vessel stations in England, but the Trinity House has substi- tuted other explosive or wind signals for all formerly employed. Several guns are still in use as fog signals at Irish lighthouses and light-vessels, and in many instances abroad. No explosive signals are now in use on the coast of the United States. In 1878 sound rockets charged with gun-cotton were iirst used at Flamborough Head, and were soon afterwards supplied to many other stations. The nitrated gun-cotton or tonite signals now generally used in pref- erence to all other explosive signals are made up in 4 oz. charges and hung at the end of an iron jib or pole attached to the light- house lantern or other structure, and fired by means of a detonator and electric spark. These can be discharged within 12 ft. of a structure without danger. The cartridges may be stored for a con- siderable period without deterioration and with safety. This form of signal is now very generally adopted for rock and other stations in Great Britain, Canada, Newfoundland, northern Europe, and other parts of the world ; one type will be noticed in the illustra- tion of the Bishop Rock lighthouse, attached to the lantern (Fig. 2).

Whistles. — Whistles, whether sounded by air or by steam, are not used in Great Britain, except in two instances of harbour signals under local control. It has been objected that their sound has too great a resemblance to steamers' whistles, and they are wasteful of power. In the United States and Canada they have been, however, largely used. The whistle usually em- ployed consists of a metallic dome or bell against which the high-pressure steam impinges. Rapid vibrations are set up both in the metal of the bell and in the internal air, producing a shrill note. The Courtney buoy whistle, already referred to, is an American invention, and many of these

~~instruments are in use in the United States, France, Germany, and elsewhere.~~

~~Seed-Sorns. — These instruments in their original form were the invention of DaboU, an experimental horn of his manu- facture being tried in 1851 by the United States Lighthouse~~

~~Board. In 1862 the Trinity HIouse adopted the instrument for seven land and light-vessel stations. For compressing air for the reed-horns as well as sirens, caloric, steam, gas, and oil engines have been variously used, according to local circumstances. The reed-horn was much improved by the late Professor HIolmes, and many examples from his design are now in use in England and America. At the Trinity HIouse experiments with fog signals at St Catherine's (1901) several types of reed-horn were experimented with. The best of them was the " Stentor " horn, which ranked second only to the siren instruments under trial. The working press- ure is 120 R) per square in., and the nickel-steel reed 4| in. long by If in. wide. The reed made 265 vibrations per second, and the in- strument consumed 2 cubic feet of air (measured at atmospheric pressure) per second of blast. The Trinity HIouse Service horn with a somewhat smaller reed also gave satisfactory results, blowing at 15 R) pressure with a consumption of -67 cubic feet per second and 397 vibrations. A small manual horn of the Trinity HIouse type consumes -67 cubic feet of air at 5 lb pressure, and of its class is about the most satisfactory instrument yet produced. The horns or trumpets are of brass. Reed-horns, either power-driven or of the manual pattern, are in use in many Trinity HIouse light^vessels, and are also used in most other lighthouse services. An experi- mental reed-horn has been recently placed upon an isolated beacon near Vancouver, the reed of which is actuated automatically by electric current conveyed by a cable from a station on shore.~~

~~Sirens. — Undoubtedly the most powerful and eflScient of all wind fog-signals is the siren. The principle of this instrument may be briefly explained as follows : — It is well known that if the tympanic membrane is struck periodically and with sufficient rapidity by air impulses or waves, a musical sound is produced. Robinson was the first to construct an instrument by which successive puffs of air under pressure were ejected~~

~~from the mouth of a pipe. He obtained this efiect by using a stop-cock revolving at high speed in such a manner that 720 pulsations per second were produced by the intermittent escape of air through the valves or ports, a smooth musical note being given. Cagniard de la Tour first gave such an instrument the name of siren, and con- structed it in the form of an air chamber with perforated lid or cover, the perforations being successively closed and opened by means of a similarly perforated disc fitted to the cover and revolving at high speed. The perforations being cut at an angle, the disc was self-rotated by the oblique pressure of the air in escaping through the slots. Dov6 and Helmholtz introduced many improvements, and Brown of New York patented about 1870 a steam siren with two discs having radial perforations or slots. The cylindrical form of the siren now generally adopted is due to Mr Slight, who used two concentric cylinders, one revolving within the other, the sides being perforated with vertical slots. To him is also due the centrifugal governor largely used to~~

~~Table IV.~~

~~Cubic Feet of Air~~

~~Station.~~

~~Description.~~

~~YibrationB per Second.~~

~~Sounding~~

~~Pressure~~

~~in lb per~~

~~Square Incli.~~

~~used per Second of~~

~~Blast reduced to~~

~~Atmospheric~~

~~*Pressure.*~~

~~*Kemarks.*~~

~~*High.*~~

~~*Low.*~~

~~*High.*~~

~~*Low.*~~

~~*St Catherine's*~~

~~*Two 5" cylindrical*~~

~~*295*~~

~~*182*~~

~~*25*~~

~~*32*~~

~~*16*~~

~~*The air consumption*~~

~~*(Trinity House)*~~

~~*automatically driven sirens.*~~

~~*is for the two sirens.*~~

~~*Girdleuess*~~

~~*7" cylindrical siren.*~~

~~*234*~~

~~*100*~~

~~*30*~~

~~*130*~~

~~*26*~~

~~*(N.L.C.)*~~

~~*motor-driven*~~

~~*Casquets*~~

~~*7" disc siren, motor-*~~

~~*>••*~~

~~*98*~~

~~*25*~~

~~*36*~~

~~*(Trinity House)*~~

~~*driven*~~

~~*French pattern*~~

~~*6" cylindrical siren,*~~

~~*326*~~

~~...~~

~~*28*~~

~~*14*~~

~~*A uniform note of*~~

~~*siren*~~

~~*automatically driven*~~

~~*326 vibrations per second has now been adopted generally in France.*~~

~~*regulate the speed of rotation of the siren. Over the siren mouth is placed a conical trumpet to collect and direct the sound in the desired direction. In the English service these trumpets are generally of considerable length vertically, with bent top and bell mouth. Those at St Catherine's are of cast iron with copper bell mouth, and have a total axial length of 22 ft. They are 6 in. in diameter at the siren mouth, the bell mouth being 6 ft. in diameter. At St Catherine's the sirens are two in number, .5 in. in diameter, beisig sounded simultaneously, and in unison. Each siren is provided with ports for producing a high note as well as a low note, the two notes being sounded in quick succession once every minute. The trumpet mouths are separated by an angle of 120° between their axes. This double form has been adopted in certain instances where the angle desired to be covered by the sound is comparatively wide. In*~~

~~*Scotland the cylindrical form is used generally, either automatic- ally or motor-driven. By the latter means the admission of air to the siren can be delayed until the cylinder is rotating at full speed, and a much sharper sound is produced than in the case of the automatic type. The Scottish trtimpets are frequently con- structed so that the greater portion of the length is horizontal. The Girdleuess trumpet has an axial length of 16 ft., 11 ft. 0 in. being horizontal. The trumpet is capable of being rotated through an angle as well as dipped below the horizon. It is of oast iron, no bell mouth is used, and the conical mouth is 4 ft. in diameter. In France the sirens are cylindrical and very similar to the English self-driven type. The trumpets have a very short axial length, 4 ft. 6 in., and are of brass placed vertically, with bent bell mouth. Steam has been abandoned in France for working sirens, and all are now supplied with air*~~

~~*LIGHTHOUSES*~~

~~at a pressure of 28 lb per square inch. The Trinity House has recently reintroduced the use of disc sirens, with which experi- ments are still being carried out. The new Casquets siren has discs 7 in. in diameter and is motor driven ; satisfactory results have been obtained. For light-vessels and rock stations where it Is desired to distribute the sound equally in all directions the mushroom-head trumpet is occasionally used. The Casquets trumpet of this type is 22 ft. in length, of cast iron, with a mush- room top 6 ft. in diameter. In cases where neither the mushroom trumpet nor the twin siren is used, the single bent trumpet is arranged to rotate through a considerable angle. Table IV. gives particulars of a few typical sirens of the most recent form.~~

~~Since the first trial of the steam siren at the South Foreland in 1873 a very large number of these instruments have been estab- lished in Great Britain both at lighthouse stations and on board light-vessels. In all cases in Great Britain and France they are supplied with air compressed by steam or other mechanical power. In America and some other countries steam sirens are also in use.~~

~~The St Catherine's Experiments. — Extensive trials were carried out during 1901 by a committee of the Trinity House at St Catherine's lighthouse. Isle of Wight, with several types of sirens and reed-horns. The committee also experimented with several forms of trumpet, including some elliptical ones, the long axis being placed vertically. The conclusions of the committee may be briefly enumerated as follows : — (1) When a large arc requires to be guarded two fixed trumpets suitably placed are more effective than one large trumpet capable of being rotated. (2) When the arc to be guarded is larger than that effectively covered by two trumpets, the mushroom-head trumpet is a satis- factory instrument for the purpose. (3) A siren rotated by a separate motor yields better results than when self-driven. (4)~~

~~No advantage commensurate with the additional power required is obtained by the use of air at a higher pressure than 25 tb per square inch. (5) The number of vibrations per second produced by the siren or reed should be in unison with the proper note of the associated trumpet. (6) When two notes of different pitch are employed, the difference between these should, if~~

~~*possible, be an octave. (7) For calm weather a low note is more suitable than a high note, but when sounding against the wind and with a rough and noisy sea a high note has the greater range. (8) From causes which cannot be determined at the time or predicted beforehand, areas sometimes exist in which the sounds of fog signals may be greatly enfeebled or even lost altogether. This effect was more frequently observed during comparatively calm weather and at no great distance from the signal station. (It has often been observed that the sound of a signal may be entirely lost within a short distance of the source, while heard distinctly at a greater distance and at the same time.) (9) The siren was the most effective signal experimented with ; the reed-horn, although inferior in power, is suitable for situations of secondary importance. (No explosive signals were under trial during the experiments.) (10) A fog signal, owing to the uncertainty attending its audibility, must be regarded only as an auxiliary aid to navigation which cannot at all times be relied upon.*~~

~~*The following table (V.) gives the total numbers of fog signals of each class in use on 1st January 1902 in several countries. When two kinds of signals are employed at any one station, one being subsidiary, the latter is omitted from the enumeration. Buoy and unattended beacon bells and whistles are also omitted, but some local port and harbour signals not under the immediate jurisdiction of the various lighthouse boards are included, more especially in Great Britain.*~~

~~*Table V.*~~

~~*Explosive*~~

~~*sirens.*~~

~~*Horns, Trumpets, &c.*~~

~~*WTiiatles.*~~

~~*Signals (Tonite, &c.).*~~

~~*Rockets.*~~

~~*Guns.*~~

~~*Bells.*~~

~~*Gongs.*~~

~~*Total*~~

~~*Power.*~~

~~*Manual.*~~

~~*England and Channel Islands .*~~

~~*32*~~

~~*16*~~

~~*29*~~

~~*2*~~

~~*9*~~

~~*1*~~

~~*2*~~

~~*38*~~

~~*5*~~

~~*134*~~

~~*Scotland and Isle of Man*~~

~~*23*~~

~~*4*~~

~~>•*~~

~~*1*~~

~~*2*~~

~~*14*~~

~~*1*~~

~~*45*~~

~~*Ireland*~~

~~*10*~~

~~*2*~~

~~■—•÷~~

~~•—•÷~~

~~*7*~~

~~•~~

~~*5*~~

~~*12*~~

~~*5*~~

~~*41*~~

~~*France*~~

~~*13*~~

~~*4*~~

~~2~~

~~1~~

~~28~~

~~48~~

~~United States (excluding in-~~

~~land lakes and rivers) .~~

~~30~~

~~20~~

~~1~~

~~53~~

~~219~~

~~323~~

~~British North America (exclud-~~

~~ing inland lakes and rivers) .~~

~~6~~

~~29~~

~~63~~

~~24~~

~~12~~

~~1~~

~~14~~

~~148~~

~~8. lAgMhouse Administration.~~

~~Most countries possess organized and central authorities responsible for the installation and maintenance of coast lights and fog signals, buoys and beacons.~~

~~United Kingdom.— In England the Corporation of Trinity HIouse, or according to its original charter, "The M-ster, Wardens, and Assistants of the Guild, Fraternity, or Brotherhood of the most glorious and undivided Trinity and of St Clement, in the parish of Deptford Strond, in the county of Kent," existed in the reign of Henry "VII. as a religious house, with certain duties connected with pilotage, and was incorporated during the reign of Henry VIII. In 1565 it was given certain rights to maintain beacons, &c., but not ur-'il 1680 did it own any lighthouses. Since that date it has gradually purchased most of the ancient privately owned lighthouses and has erected many new ones. The Act of 1836 gave the Corporation control of English lights, with certain supervisory powers over the local lighting authorities, including the Irish and Scottish Boards. The Corporation now consists of a master, deputy-master, and 22 elder brethren (10 of whom are~~

~~*honorary), together with a number of younger brethren, who, however, perform no executive duties. In Scotland the lights are under the control of the Commissioners of Northern Light- houses, incorporated in 1798. There are several local light boards in Scotland, the principal being the Clyde Lighthouse Trustees. The lighting of the Irish coast is in the hands of the Irish Lights Board, though formerly an ancient corporation, the Dublin Ballast Board, had control. The three lighthouse boards of the United Kingdom are subordinate to the Board of Trade, which controls all finances. The coast and harbour lights of Great Britain and Ireland are upwards of 1000 in number, with over 215 fog signals.*~~

~~*United States. — The United States Lighthouse Board was con- stituted by Act of Congress in 1852. The Secretary of the Treasury is the ex-officio President. The Board consists of two oflSceers of the navy, two engineer officers of the army, and two civilian scientific members, with two secretaries, one a naval officer, the other an oflicer of engineers in the army. The members are appointed by the President of the United States. The coast-line*~~

~~*of the States, with the lakes and rivers, is divided into 16 executive districts for purposes of administration.*~~

~~*France. — The Lighthouse Board of France is known as the Commission des Phares, dating from 1792 and remodelled in 1811. It consists of four engineers, two naval officers, and one member of the Institute, one inspector-general of marine engineers, and one hydrographic engineer. The chief executive officers are the In- spector-General of Fonts et Chauss6es, who is director of the Board, and another engineer of the same corps, who is engineer- in-chief and secretary. The Board has control of about 700 lights, including those of Corsica, Algiers, &c. A similar system has been established in Spain.*~~

~~*English Colonies. — In Canada the coast lighting is in the hands of the Minister of Marine, and in most other colonies the Public Works Departments have control of lighthouse matters.*~~

~~*Other Countries. — In Denmark, Austria, Holland, and many other countries the Minister of Marine has charge of the lighting and buoying of*~~

coasts ; in Belgium the Public Works Department.

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ibid. vol. cxvii. — Salmond. "Tory Island Lighthouse," ibid. vol. cviii. — Brebner. "Lighthouse Lenses," ibid. vol. cxi. ; " Powers of Lighthouse Lights," ibid. vol. cxxii. — PuRVES. "Eqtiiangular Prisms," ibid. vol. cxxviii. — Douglass and PnEVES. "Dioptric Apparatus for Lighthouses," ibid. vol. cxxxvii. — Stevenson. " Isle of iMay Lighthouse," Proc. Inst. Mech. E., 1887.— Kbnward. "Lighthouse Work, 1837-1887," Nature, June 1887. — J. N. Douglass. " Beacon Lights and Pog Signals," Proc. Boyal Inst., 1889.— Ribiere. " Propri^tfe Optiques des Appareils de Phares," Annales des Fonts et Chaussees, 1894. — Prellee. " Coast Liglithouse Illumination in Prance," Engineering, 1896 ;" New Electric Lighthouse of Penmarc'h," ibid. 1898. — " Lnndy Island Lighthouse," Engineering, 1898.— " Lighthouse Engineering at the Paris Exhibition," The Engineer, 1900-1901.— Gedye. " Coast Fog Signals," ibid. 1902.

~~(w. T. D.)~~

~~Liguria, a territorial division of northern Italy, lying between the Ligurian Alps and Apennines on the N. and the Mediterranean on the S., and extending from the frontier of France in the W. to the Gulf of Spezia in the E. It embraces the two provinces of Genoa and Porto Maurizio, which have an area of 2037 square miles. Population (1881), 892,373; (1901), 1,080,944. Its principal products are wheat, maize, wine, oranges, lemons, fruits, olives, and potatoes, though the olive groves are being rapidly supplanted by flower-gardens, to grow flowers for export. Copper and iron pyrites are mined. The principal branches of industry are iron works, foundries, iron shipbuilding, engineering, and boiler works (Genoa, Spezia, Sestri, &c.), the production of cocoons, the manufacture of cottons and woollens. Owing to the sheltered situation and the mildness of their climate, many of the towns along this part of the Italian coast are chosen by thousands of foreigners for winter residence, whilst the Italians frequent them in summer for searbathing. The history is comprised under Genoa (q.v.) and in the art. LiGUEiA (9th edition).~~

~~See also Riviera ; also W. H. Bullock Hall, TTse Romans on the Riviera and the Rhone (London, 1898).~~

~~Li Hung Chang (1823-1901), Chinese statesman, was born on 16th February 1823 at Hofei, in Anhui. From his earliest youth he showed marked ability, and when quite young he took his bachelor degree. In 1847 he became a Ghi7ishih, or graduate of the highest order, and two years later was admitted into the Imperial Hanlin College. Shortly after this the Central Provinces of the Empire were invaded by the Taiping rebels, and in defence of his native district he raised a regiment of militia, with which he did such good service to the Imperial cause that he attracted the attention of TsSng Kwofan, the general- issimo in command. In 1859 he was transferred to the province of Fuh-kien, where he was given the rank of Taotai, or Intendant of Circuit. But Tsgng had not forgotten him^ and at his request Li was recalled to take part against the rebels. Fortunately for him, he found his cause supportedby the "Ever Victorious Army," which, after having been raised by an American named Ward, was finally placed under the command of Gordon. With this support Li gained numerous victories~~

~~*over the rebels, ending in the surrender of Soochow and the capture of Nanking. For these exploits he was made governor of Kiangsu, was decorated with a Yellow Jacket, and was created an earl. One incident connected with the sur- render of Soochow, however, has left a lasting stain upon his character. By an arrangement with Gordon the rebel Wangs, or princes, yielded the city on condition that their lives should be spared. In spite of the assurance given them by Gordon, Li ordered their instant execution. This breach of faith so aroused Gordon's indignation that he seized a rifle, intending to shoot the falsifier of his word, and would have done so had not Li saved himself by flight. On the suppression of the rebellion (1864) Li took tip his*~~

~~*duties as governor, but was not long allowed to remain in civil life. On the outbreak of the Nienfei rebellion (1866) he was ordered again to take the field, and after some misadventures he succeeded in suppressing the move- ment. A year later he was appointed viceroy of Hukwang, in which post he remained until 1870, when the occurrence of the Tientsin massacre necessitated his transfer to the scene of the outrage. He was, as a natural consequence, appointed to theviceroyalty of the metropolitan provinceof Chihli, and soon justified his appointment by the energy with -which he suppressed all attempts to keep alive the anti-foreign sentiment among the people. For his services in this respect he was made Imperial Tutor and member of the Grand Council of the Empire, and was decorated*~~

~~*Li Hung Chang. (From a photograph by J. Buasell and Sons, London.)*~~

~~*with many-eyed peacocks' feathers. To his duties as Viceroy were added those belonging to the Superintendent of Trade, and from that time to the day of his death, with some few intervals of retirement, he practically conducted the foreign policy of the Government. He concluded the Chefoo Convention with Sir Thomas Wade (1876), and thus brought to a close the incident of the murder of Mr Margary in Yunnan ; he arranged treaties with Peru and Japan, and he actively directed the Chinese policy in Korea. On the death of the Emperor T'ungchih in 1875 he, by suddenly introducing a large armed force into the capital, effected a coup d'itat by which the Emperor Kwang Sii was put on the throne under the tutelage of the two Dowager Empresses ; and in 1886, on the conclusion of the Franco-*~~

Chinese war, he arranged a treaty with France. Li was always strongly impressed with the necessity of strengthening the Empire, and when viceroy of Chihli he raised a large well-drilled and well-armed force, and spent vast sums both in fortifying Port Arthur and the Taku Forts and in increasing the navy. For years he had watched the successful reforms effected in Japan, and had

a -well-founded dread of coming into conflict with that empire. But in 1894 events forced his hand, and in con- sequence of a dispute as to the relative influence of China and Japan in Korea, war broke out. The result proved the wisdom of Li's fears. Both on land and at sea the Chinese forces were ignominiously routed, and in 1895, on the fall of Wei-hai-wei, the Emperor sued for peace. With characteristic subterfuge his advisers suggested as peace envoys persons whom the Mikado very properly and promptly refused to accept, and finally Li was sent to represent his Imperial master at the council which was assembled at Shimonoseki. With great diplomatic skill Li pleaded the cause of his country, but iinally had to agree to the cession of Formosa, the Pescadores, and the Liaotung peninsula to the conquerors, and to the payment of an indemnity of 200,000,000 taels. By a subsequent ar- rangement the Liaotung peninsula was restored to China, in exchange for an increased indemnity. A regrettable incident occurred during the peace discussions at Shimon- oseki. As Li was being borne through the narrow streets of the town a would-be assassin fired a pistol point-blank in his face. Happily the wound inflicted was not serious, and after a few days' rest he was able to take up again the suspended negotiations. In 1896 he was appointed to represent the Emperor at the coronation of the Tsar, and on that occasion he visited Germany, Belgium, France, England, and the United States of America. For some time after his return to China his services were demanded at Peking, where he was virtually constituted Minister for Foreign Affairs; but in 1900 he was transferred to Canton as viceroy of the two Kwangs. The Boxer move- ment, however, induced the Emperor to recall him to the capital, and it was mainly owing to his exertions that, at the conclusion of the outbreak, a protocol of peace was

~~signed in September 1901. For many months the health of the veteran statesman had been failing, and the diffi- culties he encountered in bringing about the terms of the settlement increased his indisposition. As the autumn advanced his' medical advisers recognized that the end was near, and he died on the 7th of JS'ovember 1901. He left three sons and one daughter. (k. k. d.)~~

~~See also China, History.~~

~~Lille, capital of French Flanders and the department of Nord. It is both a fortified place of the first order and an important industrial and commercial city, situated in a district remarkable for its natural fertility and for the high development of its agriculture. It is at the junction of several important railway lines, 153 miles from Paris. The Deule Canal places the river boats of neigh- bouring ports and Belgium in communication with the town. Flax-spinning occupies 31 factories, with 205,000 spindles, 12,000 workpeople, and an annual production valued at £2,000,000; cloth, table-linen, damask, ticking, canvas, linen tape, and flax velvet for upholsterers' use are manufactured to the value of £3,200,000 per annum ; 16 establishments, employing 3000 workpeople, manu- facture flax-thread for sewing and lace-making, valued at £1,200,000 per annum; woollen fabrics represent £160,000 to £200,000 a year; and cotton-spinning and the making of cotton-twist (750,000 spindles) of especially fine quality occupy 10,000 persons, who annually produce £2,000,000 worth of goods. Lille also possesses a very important printing establishment with more than 600 workpeople, a tobacco manufactory (1200 workpeople), and 29 breweries ; while chemical, oil and sugar works, bleaching grounds, dye-works, and establishments for the making of machinery employ 12,000 workmen. Great quantities of plant for sugar-works and distilleries, military stores, machinery, and bridges of all kinds are further notable manufactures. LiUe is also an interesting~~

~~town on account of its art collections, which rank among the richest in France. They are now collected in the Palais des Artes (1888-93). The church of jSTotre Dame de la Treille, a resort of pilgrims, is the finest in French Flanders. Its construction was resumed in 1892. There is a~~

~~*monument to General Faidherbe, one of Lille's most illustrious sons and a hero of the war of 1870. Popula- tion (1886), 143,135 ; (1901), 216,431.*~~

~~*Lima, a coast department of central Peru, with an area of 14,760 square miles and a population (1896) of 298,106. It is divided into six provinces : Chancay, Lima, — in which is the capital of the republic, the city of Lima, with its suburbs, Chorrillos (16,000), Miraflores (6000), and Barranca (6000), — Canete, Canta, Huarochiri, and Jauja. The town of Huancavelica, in the sierra, has a population of 8000.*~~

~~*Lima, the capital of Peru, situated on a sloping plain between the Andes and the Pacific, 6 miles inland from the latter, in about 12° S. lat. The national library suf- fered severely during the Chilian occupation in 1881-83, but was reopened in 1884. The construction of a new school of medicine was begun in the Botanical Garden in 1899. Lima possesses amongst her public institutions a school of mines and engineering (1874), with good collec- tions and laboratories ; an institute for the arts and trades ; a mint ; a naval and military institute ; the national museum of Peruvian antiquities ; and a geo- graphical society, founded in 1888. The university was attended by 650 students in 1898. The average summer temperature is 84° Fahr. ; the average winter temperature, 56°. During the latter season frequent mists make the air chilly and the streets muddy. In spite of a good system of underground drainage and an improved water- supply, Lima is not on the whole a healthy place : fevers, dysentery, and tuberculosis are all prevalent. Population (1891), 103,556 ; (1900), estimated at 113,000. Many of the well-to-do inhabitants live wholly or in part at Mira- flores, 6 miles south of the city, and Chorrillos, 7 miles south of the city, is much visited in summer for sea- bathing. Lima is the commercial as well as the admin- istrative centre of the country, but its foreign trade is conducted through the port of Callao, on the Pacific, 7 miles to the west. In 1900 this port was entered and cleared by an aggregate of 2752 vessels of altogether 1,338,984 tons. The imports consist principally of coal, wheat and flour, rice, machinery, and textiles; and the exports of chemicals, sugar, salt, hides, wool, and gro- ceries. (See further under Callao.)*~~

~~*Lima, a city of Ohio, U.S.A., capital of Allen county, on the Ottawa river, at an altitude of 872 feet and at the intersection of six railways. It is in the*~~

~~heart of the great petroleum and natural gas fields of (^Yao and Indi- ana, and is one of the most important points in the country for the storing, refining, and shipping of petro- leum. It has also railway repair works and extensive manufactures. It is the seat of Lima College, a Lutheran institution founded in 1893, which in 1899 had a faculty of 11 instructors and was attended by 171 students. Population (1890), 16,981 ; (1900), 21,723, of whom 1467 were foreign-born and 731 were negroes.~~

~~Limasol. See Cyprus.~~

~~Limbourg (Flemish, Limhurg), a province of Bel- gium, bordering on the Dutch provinces of Limburg and Brabant and the Belgian provinces of Antwerp, Brabant, and Lifege. Its rivers are the Meuse, forming its eastern frontier, and the Demer, falling into the basin of the Scheldt, to the west. Canals serve the purposes both of navigation and irrigation; the canal from Liege to Maastricht is prolonged northwards by the canal from~~

~~Maastriclit to Bois-le-duc, ■whence there branches off a junction canal from the Meuse to the Scheldt, ending at Antwerp. Prom this latter, again, are detached a branch to the military camp of Beverloo and another branch to Hasselt. Agriculture is folio-wed by more than a third of the population, the crops consisting more particularly of rye, oats, wheat, barley, and beetroot. Other branches of industry are the distillation of gin from grain, the fatten- ing of cattle, the manufacture of sugar from beetroot, and flour-milling. In 1901 a ne"w coalfield was discovered in the north-east of the province, in the district of La Cam- pine. The province is divided into three administrative arrondissements, the capitals of which are Hasselt (15,000), the capital of the province ; Tongres (9350) ; and Maeseyck. At Bourg-Leopold, in the midst of the vast heaths sur- rounding this commune, is set up the camp of Beverloo, designed for the instruction of the army. Limbourg is the smallest and one of the least populous of the provinces of Belgium. Its area is 931 square miles, and its popu- lation, 206,200 in 1876, was 244,139 in 1901, or 262 in- habitants per square mile, an increase of 18-4~~

~~*per cent., as compared with a 25 per cent, increase during the same period for the whole of Belgium.*~~

~~*Li m burg, the southernmost province of Holland, bordering in the east on Ehenish Prussia and in the south on Belgium. The north and the south of the province present a striking contrast. The south is more elevated, by from 300 to 650 feet, culminating near Vaals at 1056 feet. The rich soil {loess) around Maastricht and the coalfields in the neighbourhood of St Pietersberg have furnished a basis for a denser and more prosperous popu- lation, reminding one of Belgium rather than of Holland. The north of the province, on the other hand, sandy and covered with heath and fens, except near the Meuse, supports a poor and sparse population, of an aspect like that of North Brabant. Altogether about 40 per cent, of the surface is arable, 13 per cent, forest, 11 per cent, meadow and pasture, and 22 per cent, uncultivated. The Meuse being of too impetuous current in winter, and too shallow in summer, there is nowhere in the province any considerable navigation or commerce. There are stone quarries near Maastricht and at Valkenburg. The output of coal in 1899 was 212,972 metric tons. Population*~~

~~*(1899), 286,811.*~~

~~*Limerick, a maritime county of Ireland, province of Munster.*~~

~~*Population. — The area of the administrative county in 1900 was 662,973 acres, of which 160,191 were tillage, 427,367 pasture, 293 fallow, 9069 plantation, 9343 turf bog, 4067 marsh, 24,950 barren mountain, and 27,693 water, roads, fences, &o. The new adminis- trative county, under the Local Government (Ireland) Act, 1898, is identical with the old judicial county. The population in 1881 was 180.632, and in 1891, 158,912, of whom 78,607 were males and 80,305 females, divided as follows among the different religions : — Roman Catholics, 160,789 ; Protestant Episcopalians, 6673 ; Meth- odists, 629 ; Presbyterians, 426 ; and other denominations, 395. The decrease of population between 1881 and 1891 was 12-02 per •cent. The average number of persons to an acre for the whole ■county was 23. Of the total population 117,484 persons inhabited the rural districts, being an average of 129 persons to each square mile under crops and pasture. The population in 1901 was 146,018 (Roman*~~

~~*Catholics, 138,693 ; Protestant Episcopalians, 5777 ; Metho- dists, 704; Presbyterians, 400 ; others, 444), being a decrease of 8-1 per cent. The following table gives the degree of education in 1891 (excluding the city of Limerick) :—*~~

~~*Males.*~~

~~*Females.*~~

~~*Total.*~~

~~*Percentage. [*~~

~~*E.O.*~~

~~*Pr, F4..*~~

~~*92-6 3‘0 4-4*~~

~~*Pi-esb.*~~

~~*Metli.*~~

~~*Read and write Read only . Illiterate*~~

~~*43,002 4,052 8,068*~~

~~*41,481 4,347 9,505*~~

~~*84,483*~~

~~*8,399*~~

~~*17,573*~~

~~*76-0*~~

~~*7-7 16 ‘3*~~

~~96-9 2-1 2-0~~

~~91-8 4-7 3-5~~

~~superior schools, with 426 pupils (Roman Catholics 425 and Pro- testant 1), and 258 primary schools, with 21,139 pupils (Roman Catholics 20,678 and Protestants 461). The number of pupils on the rolls of the National schools on 31st December 1900 was 25,072, of whom 24,292 were Roman Catholics and 780 Protestants. The following table gives the number of births, deaths, and marriages in various years : —■~~

~~Tear.~~

~~Births.~~

~~Deaths.~~

~~3529 2801 3053~~

~~Marriages.~~

~~1881 1891 1900~~

~~4484 3637 3289~~

~~798 692 651~~

~~'The percentage of illiterates among Roman Catholics in 1881 was ■24-9. Excluding the city of Limerick, in 1891 there were 12~~

~~In 1900 the birth-rate per 1000 was 22-5, and the death-rate 20-9 ; the rate of illegitimacy was 3-9 per cent, of the total births. The total number of emigrants who left the county between 1st May 1857 and 31st December 1900 was 178,036, of whom 90,369 were males and 87,667 females. The chief towns in the county are Limerick, Newcastle, and Rathkeale.~~

~~Administration. — ^The county is divided into two parliamentary divisions. East and West, the number of registered electors in 1901 being respectively 8226 and 8533. The rateable value in 1900 was £539,052. By the Local~~

~~*Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises eight rural sanitary districts. The city of Limerick constitutes a separate county.*~~

~~*Agriculture. — The following tables give the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900 :—*~~

~~&:=’~~

~~*1*~~

~~*9 9*~~

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~~^*1*~~

~~*3 0*~~

~~*1881*~~

~~*7017*~~

~~*. 22,808*~~

~~8012~~

~~24,175~~

~~6605~~

~~4047~~

~~114,804~~

~~180,468~~

~~1891~~

~~5066~~

~~16,620~~

~~1037~~

~~18,846~~

~~4987~~

~~5073~~

~~109,624~~

~~161,203~~

~~1895~~

~~2202~~

~~16,782~~

~~475~~

~~16,687~~

~~*5018*~~

~~*4753*~~

~~*119,497*~~

~~*165,409*~~

~~*1900*~~

~~*2669*~~

~~*12,029*~~

~~*231*~~

~~*14,180*~~

~~*8871*~~

~~*4687*~~

~~*122,624*~~

~~*160,191*~~

~~*In 1900 the total value of the cereal and other crops was estimated at £968,047. The number of acres under pasture in 1881 was 405,483 ; in 1891, 425,256 ; and in 1900, 427,367.*~~

~~*Tear.*~~

~~*Horses and Mules.*~~

~~*Asses.*~~

~~*Cattle.*~~

~~*Sheep.*~~

~~*Pigs.*~~

~~*Goats.*~~

~~*Poultry.*~~

~~*1881 1891 1895 1900*~~

~~*17,426 19,950 20,088 18,342*~~

~~*8,830 10,815 11,612 13,144*~~

~~*203,840 241,911 220,995 282,181*~~

~~*49,644 79,600 54,246 58,384*~~

~~*58,136 58,924 49,088 44,696*~~

~~*9,527 14,856 13,128 16,362*~~

~~*436,688 446,074 465,667 509,789*~~

~~*The number of milch cows in 1891 was 101,652, and in 1900 101,312. It is estimated that the total value of cattle, sheep, and pigs for 1900 was £3,169,687. In 1900 the number of holdings not exceeding 1 acre was 4408 ; between 1 and 5, 1795 ; between 6 and 15, 2297 ; between 15 and 30, 3025 ; between 30 and 50, 2954 ; between 50 and 100, 2838 ; between 100 and 200, 1041 ; between 200 and 500, 242 ; and above 500, 33— total 18,633. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901, was 1358, amounting to £768,884. The number of loans for agricultural improvements sanctioned under section 31 of the Land Act, 1881, between 1882 and 1901, was 1105, and the amount isssued was £82,330. The total amount issued on loan for all classes of works under the Land Improve- ment Acts, from the commencement of operations in 1847 to Slst March 1901, was £397,499, the third largest amount in any county. Fisheries. — In the salmon-fishery district of Limerick 1742 persons were employed in 1900, and the sum of £2315 was*~~

~~paid as licence duty, the largest amount in any fishery district in Ireland. (yf. h. po.)~~

~~Limericic, a maritime city, county and parlia- mentary borough (returning one member), at the head of the estuary of the river Shannon, 120 miles west-south- west of Dtiblin by rail. It is the most important port on the west coast of Ireland, vessels of 3000 tons being able to discharge at the floating dock. The quays extend for about 1600 yards on each side of the river, and vessels of 600 tons can moor alongside at spring tides. In all 436 vessels (423 British and 12 foreign) of 168,240 tons entered in 1900, while 296 (all British except 4) of 78,860 tons cleared. The value of the foreign and colonial imports,~~

~~whicii included 1,220,600 cwts. of wheat and 915,100 cwts. of maize, was £868,190. In the same year the number of sailing and steam vessels registered in the port was 27, of 1245 tons, riour-milling is a flourishing industry, and the greater part of the south-west and north- west of Ireland is supplied with flour from Limerick. There is also an extensive trade in bacon, over 10,000 pigs being slaughtered weekly ; and the improvement in dairy-farming has led to the establishment of creameries and a large condensed-milk factory. The great Munster fair is held here four times a year. New waterworks were completed at a cost of £70,000. The salmon fisheries on the Shannon are the most valuable in Ireland, • and in 1900 gave employment to 1742 persons. In 1898 Limerick was constituted one of the six county boroughs which have separate county councils. The rateable value in 1900 was £69,008. Population (1881), 38,562 ; (1891), 37,155 ; (1901), 38,085. In 1891 there were 10 superior schools with 574 pupils (489 Eoman Catholics and 85 Protestants), and 44 primary schools with 5577 pupils (5050 Roman Catholics and 527 Protestants). The per- centage of illiterates among Eoman Catholics was 19-2, as compared with 25-1 in 1881.~~

~~Limnology. — In the last quarter of the 19th century the study of lakes made remarkable progress, and was raised to the rank of a special science,~~

~~mainly by the exertions of Prof. F. A. Forel, to whom is due the generally accepted name limnology. Limnology includes the complete study of lakes, geographical, physical, chem- ical, and biological, so conducted as to throw light on the mutual relations of all the natural conditions aifecting them. The lakes of Europe and of several of the other continents have been investigated with some approach to completeness. Professor Porel has himself produced the standard monograph on the Lake of Geneva, to the in- vestigation of which in all its aspects he has devoted his life. A Hungarian commission has explored Lake Balaton with equal fulness, and the Lake of Constance has been studied by an international committee of the five states which border it. The investigation of lakes has as a rule been entirely neglected by government surveyors, the departments charged with land and marine surveys alike declining to be responsible for the areas covered by fresh water. Hence in most countries private enterprise has endeavoured to fill the gaps on the large-scale maps. Amongst other workers M. Andre Delebecque in France has surveyed a large number of the lakes of the Alps, Vosges, and Pyrenees ; Professor Richter has surveyed many of those of Austria ; Drs Geistbeck, Ule, and Halb- f ass those of Germany ; frrof essor Anuchin several of those in Russia ; 0. Marinelli in Italy ; while some work has also been done on the lakes of Scandinavia and Finland. In Great Britain the lakes of the English Lake District were sounded and mapped by H. R. Mill and E. Heawood in 1893-94, under the auspices of the Royal Geographical Society ; and many of the fresh-water lochs in Scotland have been fully mapped by Sir John Murray and F. P. Pullar. After the death, by drowning, of the last-named worker, a scheme was set on foot in his memory by which Sir John Murray undertook, with the support of Mr Laurence Pullar, to complete the study of all the lakes of the British Islands. »~~

~~In Asia the lakes of Palestine, and some of those in Asia Minor and the Pamirs, have been sounded by travellers, and preliminary observations of much interest have been made in the great lakes of Africa, the survey of Lake Nyasa, indeed, being fairly complete. Of the lakes of Australia, New Zealand, and South America very little is yet known, but those of North America are being gradually surveyed. In the north of the United States |~~

~~*particularly very complete and systematic researches are being made into the geographical and biological nature of the lakes.*~~

~~*Limnology may be looked upon as oceanography in miniature, and its study in many cases throws light on the larger problems of oceanography, which in lakes may be handled almost on the scale of laboratory experiments. But it differs essentially from oceanography on account of the important physical peculiarities of fresh water, and by the immense diversity of the separate objects of study. The ocean is one and uniform, with all its parts in free communication, all at the same level, and affected by the proximity of land only on the margins. Lakes, on the other hand, are diverse and innumerable ; they occur at every level, from 1200 feet below that of the sea to over 20,000 feet above it. They are subject to the influence of the land in every part, and each lake, so far as its physical and biological conditions are concerned, is isolated and distinct from every other. Thus every lake has its own clearly- marked individuality, forming a microcosm which must be studied in detail before it can be . fully under- stood. The number of monographs on particular lakes and lake-groups has grown so much in recent years that it is now possible to draw some wide conclusions applicable to all lakes, and thus to afford a surer basis for particular researches. The following are the general con- siderations set forth by Professor Forel in his Handbook of Limnology.*~~

~~*A lake is defined as a depression enclosed by land on every side, and containing standing water which is not in communication with the sea. Tidal lagoons are thus ex- cluded. Lakes are divided into (1) lakes proper, which may be of any size if the water be deep enough to pre- vent the invasion of aquatic plants, (2) ponds, which are so shallow that plants may take root on the bottom on any part, and (3) marshes, which are ponds almost filled with vegetation.*~~

~~*The geographical conditions which affect a lake are chiefly its position in general, and particularly its latitude and altitude, on which depends the climate, and also to a great degree the character of the organisms living in the water. The area of a lake deter- mines the effect which its waters can exercise upon its banks, as it is only in large lakes that the wind is able to raise waves and currents capable of producing erosion. The depth also*~~

~~exercises an influence on the movement of the waters, and has a bearing on the distribution of life and on the theory of the origin of the lake- basin. If a lake-basin were a uniform funnel-shaped depression, its average depth would be one-third of the maximum, but as a rule a great part of the floor of a lake is a perfectly flat surface of sedi- mentation, and the average depth is usually one-half, or even a larger fraction, of the maximum. The typical lake-basin has the form of the frustum of an inverted cone. Limnimetric functions to which some importance is attached in classifying lakes are the development of the coast-line and the number and size of the islands. With regard to chemical and thermal conditions, the total volume of a lake is important, and the relation of the tributary drainage area to the area of the lake surface affords some clue to the probable variations of volume and consequent changes in level and in temperature, these being in close relation to the volume and variations of the inflowing streams. As to position in a river course, the fact of a stream flowing through a lake, or ending in it, may greatly affect the active or passive migration of aquatic plants and animals.~~

~~Meteorological conditions are even more important. The thermal changes of lake-water depend upon the atmospheric temperature almost entirely. Absolute humidity of the atmosphere determines the dew-point, on the relation of which to the temperature of the surface water the occurrence of condensation or evaporation depends. Relative humidity determines the amount of cloud and the frequency of precipitation, the former dictating the amount of solar radiation to the lake in the daytime and of radiation from the lake at night, the latter being vital to the supply of inflowing water. In the extreme case of dry air and great radiation salt lakes with no outlet are produced. Wind produces waves and currents which mix the water, and it also serves as the agent by which a large lake influences the climate of the surrounding~~

~~district. The general wind blowing across a lake, or sudden storms descending upon it, are of less interest than the local winds pro duced by its influence on the atmosphere. Effects analogous to land and sea breezes are~~

~~*produced around large lakes : at night in summer the land breeze blows in towards the centre of the lake, and by day the lake breeze blows outwards towards the land ; but in winter the land wind prevails also throughout the day. Local variations of barometric pressure are the cause of the effects known as seiches.*~~

~~*It is important to distinguish the different parts of a lake-basin. These typically consist of a flat floor surrounded by a relatively steep slope. The floor and the lower part of the slope form the deep area ; the upper part of the slope is the coastal area, and in this we may distinguish the banks, which form a ring round the lake and are washed over by the waves in heavy storms ; the beach, which is intermediate between the banks and the littoral zone, or belt in which the action of the waves produces an effect on the bed of the lake.*~~

~~*From whatever causes a lake may arise, the natural processes of its economy, the incoming and outgoing of its affluent and effluent waters, produce changes in its basins — the building of deltas, the scattering of fine sediment over the floor, and the down-cutting of the outlet, all ultimately tending to the extinction of the lake by filling up and natural draining. According to the stage to which these processes have advanced, the lake may be classed as young, mature, old, and finally as dead.*~~

~~*From having been the special study of geologists in its physical aspects, limnology is now rapidly becoming the peculiar study of biologists, and attempts are even being made to limit the meaning of the word to the study of organic life in lakes, which would be denoted more correctly as limno-biology.*~~

~~*AuTHOKiTiEs. — F. A. FoREL. Handbuch dsT SeenkuTide ,' Allge- meine Limnologie. Stuttgart, 1901. — F. A. Forel. Le Leman, Monographie limnologique. 3 vols. Lausanne, 1892-1902. — Bodensee-Forschungen der wissenschaftlichen Kommission der funf TJfer-Staaten. Lindau, 1893 and following years. — Besultate der wissenschaftlichen Erf orschung des Balaton {Flatten') Sees. Vienna, 1897 and following years. — A. Geistbeck. Die Seen der Deutschen Alpen. Leipzig, 1885. — A. Magnin. Les Lacs de Jttra. Paris, 1895. — ^A. Penck and E. Eichter. Atlas der osterreichischen Alpenseen. Vienna, 1895 and following years. — A. Delebecqce. Les Lacs*~~

francaises, avec Atlas. Paris, 1898. — H. E. Mill. " Bathymetrical Survey of the English Lakes." Geographical Journal, vol. vi. 1895. — J. Murray and F. P. Pullar. "Bathy- metrical Survey of the Fresh-water Lochs of Scotland," Geo- graphical Journal, vol. xv. 1900. (h. e. m.)

Limoges, chief town of department Haute-Vienne, Prance, 249 miles soutli-soutli-v?est of Paris by rail. It comprises two parts originally distinct — ^the city occupy- ing the lower slope of the hill, and the town proper the summit. Boulevards now replace the ancient fortifica- tions, and the suburbs are extending. Amongst modern public buildings are the Hotel de Ville (1882) and the National Establishment of Decorative Art, containing various collections ; there is also a statue of Gay-Lussac (1890), besides a monumental fountain (1893). There are about thirty factories for the manufacture of porcelain, and the production averages about £600,000 per annum. This and the cognate industries, together with the working of the quarries and the preparation of kaolin paste for foreign potteries, give employment to about 20,000 persons. The making of boots and shoes and clogs has made great advances as an industry, about 2000 per- sons being employed in bootmaking and from 300 to 400 in the manufacture of clogs. Population (1881), 55,580 ;

(1891), 60,890 ; (1901), 83,569.

Limon, or Pokt Limon, the chief Atlantic port of the republic of Costa Kica, Central America, situated on a bay of the Caribbean Sea, 103 miles from the capital, San Jos^ by rail. The first houses were built in 1871. Large expense has been incurred by the authorities in improving the sanitation of the town. The harbour has also been much improved, and is now protected by a sea-wall built along the low-water line. An iron pier affords accommodation for four large ocean steamers, and all that is required to render the port first-class is a breakwater from the harbour to a small island

about 1200 yards distant. There is an excellent water- supply from the hills above the harbour. Almost the entire coffee crop of Costa Eica is sent by rail for ship- ment at Port Limon to Europe and the United States. The port is now visited by about thirty steamers monthly from the United States,

~~Europe, the Spanish Main, and the West Indian Islands. There are ice factories and a brewery. Population (1897), 4000.~~

~~Limoux, chief town of arrondissement, department of Aude, France, 15 miles south-south-west of Carcassonne, on railway to Quillan and on the left bank of the Aude. The town was formerly the fortified capital of the comte of Prasey, and still preserves some vestiges of its ancient ramparts. The St Martin's church is a large Gothic edifice, founded on an earlier Eoman one. Two other churches were formerly attached to conventual establish- ments, and on a hill north of the town is the 14th-century church of Notre Dame de Marceille, with a black marble image of the Virgin. The town has also a general hospital, the asylum for the departments of Aude and Pyrenees-Orientales, and a tribunal of commerce. There is trade in wine, corn, and fodder, besides manufactures of hats and caps : the white wine known as " blanquette de Limoux " is held in high repute. Manganese, build- ing stone, gypsum, and marble are found in the vicinity. Population (1881), 4647; (1891), 4507; (1901), 7045.~~

~~Limpopo, a considerable river of South-East Africa, rising on the high plateau of the Southern Transvaal and flowing in a wide semicircular sweep round the northern frontiers of that country, finally entering the Indian Ocean through Portuguese territory in 25;~~ ~~° S. Surveys of the lower river by Portuguese officers in 1895-96 have shown that this may be utilized as a waterway to the interior by the employment of shallow-draught steamers, at least as far as Gungunyana's ford in 24° 41' S. The bar has been found less dangerous than was once sup- posed, but at low water (December) navigation is very difficult at certain points on the river, especially at the Uha Verde in 24° 53~~ ~~'. Below Gungunyana's ford (which seems itself to be passable) the passage is almost blocked by a bar of hard micaceous clay, through which, however, there is a channel with 2^ feet of water. The extreme high-water level on the lower course is more than 24 feet above that of low water, and when it is reached the whole plain bordering the Limpopo is flooded. At this period water communication seems to be established with the Nkomati river, which is crossed by the Delagoa Bay railway on the Transvaal frontier.~~

~~See Boletim Soc. Geogr. de lAshoa, xvi. (1897), p. 561, with map, and also map issued by the Ministerio da Marinha, 1897. — Da CosTA. Gaza, 1897-~~

~~98. Lisbon, 1899. — Grandjean in Bnh Soc. Neuchateloise de Geogr. 1899. (e. he.)~~

~~Linares, a town of Spain, in the province of Jaen. The population is decreasing somewhat, and was only 35,233 in 1897. The lead mine concessions on the register at the close of 1898 were 1075. Pour English companies are desilverizers and smelters as well as manu- facturers of lead sheets and pipes, and purchase most of the ore raised. The production in 1898 amounted to 81,250 tons of first-class ore and 20,223 tons of second-class ore. There is active trade in wine, oil (28,300 gallons in 1898), wheat (43,000 bushels), and barley (54,000 bushels). There are many new and handsome buildings, including the town hall, the theatre, casinos, the bull-ring, the savings bank, factories, and mining offices.~~

~~Linares, a province of southern Chile, situated between 35° 30' and 36° 30' S. and 70° 30' and 72° W.,~~

~~bounded on the N. by the province of Talca, on the S. by that of Nuble, and on the W. by that of Maule, •while on the E. the anticlinal line of the Andes is its border. Its area is 3589 square miles, and in 1895 its population was 101,858. The capital, Linares, has a population of 7331.~~

~~Lincoln, a north midland county of England, bounded on the N. by York, on the E. by the North Sea and Norfolk, on the S. by Cambridge, North-ampton, and Eutland, and on the W. by Leicester, Nottingham, and York.~~

~~Area and Population. — In 1891 the area of the ancient (geo- graphical) county was 1,693,547 acres, and the population 472,878, of whom 233,571 were males and 239,307 females, showing an increase of 2884, or •? per cent, since 1881, as compared with an increase of 7-7 per cent, in the ten years 1871-81. There were, in 1891, 0-28 persons to an acre and 3-58 acres to a person. In 1901 the population of the ancient county was 498,781. The area of the registration county in 1891 was 1,659,930 acres, and the population 467,281 ; and in 1901, 492,948, of whom 242,193 were males~~

~~*and 250,755 females. The subjoined table gives particulars of the birth-rate, death-rate, the number of per- sons married per 1000 inhabitants, and the illegitimacy-rate per 1000 births :—*~~

~~*1871-80.*~~

~~*1881-90.*~~

~~*18C9-98.*~~

~~*1899.*~~

~~*Birth-rate . Death-rate . Marriage-rate Illegitimacy-rate .*~~

~~*32-6*~~

~~*18-6*~~

~~*14-7*~~

~~*62*~~

~~*30-4*~~

~~*17-5*~~

~~*13-6*~~

~~*58*~~

~~*28-4*~~

~~*17-1*~~

~~*15-0*~~

~~*55*~~

~~*28-5 17-0 17-1*~~

~~*In 1891 the county contained 1230 persons of Scottish birth, 1454 of Irish birth, and 1295 foreigners. At the same date there were 385 blind persons, 190 deaf and dumb, and 1271 insane.*~~

~~*Administration.—For parliamentary purposes the county is divided into seven divisions, namely, WestLindsey orGainsborough, North Lindsey or Brigg, East Lindsey or Louth, South Lindsey or Horncastle, North Kesteven or Sleaford, South Kesteven or Stam- ford, and Holland or Spalding, and the parliamentary boroughs of Boston, Grantham, Grimsby, and Lincoln, each returning one member. The county embraces the three administrative counties of the parts of Lindsey, parts of Kesteven, and parts of Holland, together with the county boroughs of Lincoln and Grimsby. There are six municipal boroughs, Boston, Grantham, Grimsby, Lincoln, Louth, and Stamford. In the parts of Holland the borough of Boston has a separate commission of the peace, and there are two petty sessional divisions. In the parts of Kesteven the boroughs of Grantham and Stamford have each a separate commission of the peace and separate courts of quarter sessions, and there are 4 petty sessional divisions. In the parts of Lindsey the county boroughs of Grimsby and Lincoln have each a separate commission of the peace and a separate court of quarter sessions, whilst the municipal borough of Louth has a separate commission of the peace, and there are 14 petty sessional divisions. The three administrative counties contain respectively 55, 211, and 458 entire civil parishes, the county borough of Grimsby one entire civil parish, and the county borough of Lincoln 18 entire civil parishes ; these adminis- trative divisions taken conjointly also embrace 4 other entire civil parishes and parts of 2 others which are situated partly in other administrative counties. The ancient county contains 581 entire ecclesiastical parishes and districts, and parts of 4 others. It is mostly in the diocese of Lincoln, but in part also in the dioceses of Southwell and York.*~~

~~*Education.—Thsia is a diocesan training college for women teachers at Lincoln. The number of elementary schools in the county on 31st August 1900 was 592, of which 132 were board schools and 460 voluntary schools, the latter including 419 National Church of England schools, 20 Wesleyan,*~~

~~*11 Roman Catholic, and 10 British and " other." The average attendance during the year was 56,459 out of 69,437 on the register. The total school board receipts for the year ending 29th September 1900 were £74,074, of which £5383 was the income under the Agricultural Rates Act.*~~

~~*Agriculture. — Since 1880 there has been an increase in the area of the permanent pasture and of the meadow-land. The area devoted to both bare fallows and com crops has decreased since 1880. The number of acres farmed by tenants was 1,271,244 in 1889, 1,318,631 in 1895, and 1,358,862 in 1900; the number of acres farmed by the owners being 248,444, 199,058, and 159,333*~~

~~*The table immediately following shows the areas under the different kinds of crops for the periods named :—*~~

~~*Area under*~~

~~*Area under*~~

~~*Area of*~~

~~*Areaunder*~~

~~*Tear.*~~

~~*Cultiva-*~~

~~*Corn*~~

~~*Green*~~

~~*Bare*~~

~~*Permanent*~~

~~*tion.*~~

~~*Crops.*~~

~~*Crops.*~~

~~*Fallow.*~~

~~*Grass.*~~

~~*1880*~~

~~*1,494,461*~~

~~*611,684*~~

~~*238,239*~~

~~*37,656*~~

~~*1885*~~

~~*1,510,615*~~

~~*601,682*~~

~~*233,556*~~

~~*30,816*~~

~~*464,868*~~

~~*1890*~~

~~*1,522,425*~~

~~*586,749*~~

~~*229,319*~~

~~*28,246*~~

~~*487,761*~~

~~*1895*~~

~~*1,517,689*~~

~~*552,017*~~

~~*241,148*~~

~~*27,966*~~

~~*500,742*~~

~~*1900*~~

~~*1,518,195*~~

~~*562,504*~~

~~*249,247*~~

~~*18,.388*~~

~~*499,203*~~

~~*The next table shows the numbers of the live stock for the periods named:*~~
—

~~*Tear.*~~

~~*Cows and Heifers.*~~

~~*other Cattle.*~~

~~*Total Cattle.*~~

~~*Horses.*~~

~~*Sheep.*~~

~~*Pigs.*~~

~~1880 1885 1890 1895 1900~~

~~53,023 61,527 66,076 61,606 70,892~~

~~158,339 170,875 175,007 171,776 186,050~~

~~211,362 232,402 241,083 233,382 256,942~~

~~64,510 66,593 68,201 72,698 73,281~~

~~1,444,867 1,270,048 1,293,152 1,161,958 1,159,603~~

~~85,116~~

~~93,107~~

~~107,702~~

~~114,278~~

~~102,392~~

~~*Industries.* — In the year 1897, 29,273 persons were employed in factories and workshops, the majority in engineering, agri- cultural implement, and similar works, namely 1.3,052, or 44 per cent, of the whole. Next in importance comes the making of clothing, with 2394 persons ; then the metal trades, with 2302 ; and the preparation of food, with 1646. Iron ore (hsematite) and building stone are the principal products of the mines and quarries, the number of men employed in these and similar occupations in 1900 being 1231. In the same year 1,924,898 tons of iron ore were extracted, also 178,874 tons of clays, 47,147 tons of lime- stone, 42,917 tons of chalk, and 5797 tons of gravel. In 1895, 926,440 tons of ironstone, freestone, and sandstone, inclusive of Ancaster freestone, were quarried, to the value of £139,142. In 1900 there were 16 blast furnaces operative in the county ; these, together with 3 other furnaces in Leicestershire, yielded 388,745 tons of pig-iron.~~

~~*Ahthorities.* — W. Markat. HIstory of Lincolnshire, 3 vols, and fragments of vols. iv. and v. (Boston, 1814 et seqq.), dealing chiefly with the southern or~~

~~fen parishes. A list of local mono- graphs, some of them, like Thompson's Boston, Oldfieid's Waiv^ fleet, Stone's Isle of Axholm, of great value, is given in an appendix to vols. i. and ii. of Lincolnshire Notes and Queries (Hornceastle, 1888-91). See further under Eens. (j. t. Be.)~~

~~Lincoln, a parliamentary, county, and municipal borough of England, on the Witham, 130 miles north by west of London by rail. A monument (Decorated) to Bishop Wordsworth was unveiled in the cathedral in 1888, and the chapter-house was restored in 1889. As regards the other churches, the following have been built or re- built since 1870 : St Eaith's, St Matthias's, St Swithin's, and St Mary Magdalene's ; and the following have been enlarged or restored : St John's, St Peter's at Gowts, St Peter's in Eastgate, and St Andrew's. The Roman Catholic church of St Hugh's was consecrated in 1893. The old Assembly Eooms now shelter the Lincoln Public Library (1892) of some 7000 volumes. The public insti- tutions include science and art schools ; the county gaol ; the county pauper lunatic asylum ; the high school for girls (1892) ; the drill hall ; new grammar school, the old build- ings being given over to the Boys' Middle School. In the year 1884 the Blue Coat School (Christ's Hospital), was closed, its endowments going to the Middle School, and its buildings sold to the Church Institute. In 1884-91 a Roman burial-place, with funeral urns, was brought to light on the site of the old Angel Inn, a Roman altar under St Peter's at Gowts, a fragment of the east tovm wall, and remains of a Roman villa in Greetwell. In 1884 the county of Nottingham was transferred from this see tc the see of Southwell. The municipal borough is governed by a mayor, 6 aldermen, and 18 councillors. Area, 3747 acres. Population (1891), 41,491 ; (1901), 48,784.~~

~~See E. Venables and G. G. Peket, Diocesan Histoi-y of Lincoln (London, 1898) ; and Statutes of Lincoln Cathedral, arranged by H. Bradshaw and edited by C. Wordsworth, 3 vols. (Cambridge.~~

~~1898).~~

~~Lincoln, a city of Illinois, U.S.A., capital of Logan county, on the Peoria, Decatur, and Evansville, the Illinois~~

~~Central, and the Chicago and Alton railways, at an alti- tude of 591 feet. It is in an agricultural and coal-mining region. It is the seat of Lincoln University, a Cumber- land Presbyterian institution. Population (1890), 6725 ; (1900), 8962, of whom 940 were foreign-born and 238 were negroes.~~

~~Lincoln, a city of Nebraska, U.S.A., capital of Lan- caster county and of the state, at an altitude of 1147 feet. Its site is level and in some parts marshy, and its plan is regular, with broad well-shaded streets. The water- supply and sewerage system are good, and the city is divided into seven wards. Lincoln is at the intersection of five great railway systems, the Burlington and Missouri Eiver, the Chicago, Rock Island and Pacific, the Fremont, Elkhorn and Missouri Valley, the Missouri Pacific, and the Union Pacific ; and being the collecting and distribut- ing point for a large area of fertile agricultural lands, it has especial importance as a commercial city. Its manu- facturing establishments in 1900 numbered 250, with a total capital of $2,608,992. They employed 1736 hands (besides 244 salaried of&cials and clerks), and their pro- duct was valued at $4,105,951. The city has several educational institutions, the principal one being the Uni- versity of Nebraska, which in 1899 had a faculty of 100 and was attended by 1572 students. Its property was val- ued at $2,050,000, and its income was $199,500. In 1900 the assessed valuation of real property was $4,144,880, and of personal property $1,080,884 — the former on a basis of about one-fifth and the latter of about one-eighth of the full value. The net debt was $1,715,860, and the rate of taxation $77.40 per $1000. Population (1880), 13,003; (1890), 55,154; (1900), 40,169, of whom 5297 were foreign-born and 814 were negroes.~~

~~Lincoln Judgment, The. — In this celebrated ecclesiastical law-suit, the bishop of Lincoln (Dr King) was cited before his metropolitan, the archbishop of Canterbury (Dr Benson), to answer charges of various ritual offences committed at the administration of Holy Communion in the church of St Peter's at Gowts, in the diocese of Lincoln, on 4th December 1887, and in Lincoln Cathedral on 10th December 1887. The promoters were Ernest De Lacy Read, William Brown, Felix Thomas Wilson, and John~~

~~*Marshall, all inhabitants of the dio- cese of Lincoln, and the last two parishioners of St Peter's at Gowts. The case excited general interest while it was in progress, and it has a permanent importance in two respects. First, certain disputed questions of ritual were legally decided. Secondly, the jurisdiction of the arch- bishop of Canterbury alone to try one of his suffragan bishops for alleged ecclesiastical offences was considered and judicially declared to be well founded both by the Judicial Committee of Privy Council and by the arch- bishop of Canterbury with the concurrence of his assessors. The proceedings were begun on 2nd June 1888 by a petition presented by the promoters to the archbishop, praying that a citation to the bishop of Lincoln might issue calling on him to answer certain ritual charges, the nature of which will be stated presently. On 26th June 1888 the archbishop, by letter, declined to issue citation, on the ground that until instructed by a competent court as to his jurisdiction, he was not clear that he had it. The promoters appealed to the Judicial Committee of the Privy Council, to which an appeal lies under 25 Henry VIII. c. 19 for "lack of justice" in the Arch- bishop's Court.*~~

~~*The matter was heard on 20th July 1888, and on 8th August 1888 the committee decided (i.) that an appeal lay from the refusal of the archbishop to the Judicial Committee, and (ii.) that the archbishop had jurisdiction*~~

~~*to issue a citation to the bishop of Lincoln and to hear the promoters' complaint, but they abstained from ex- pressing an opinion as to whether the archbishop had a discretion to refuse citation — whether, in fact, he had any power of "veto" over the prosecution. The case being thus remitted to the archbishop, he decided to entertain it, and on 4th January 1889 issued a citation to the bishop of Lincoln.*~~

~~*On the 12th February 1889 the archbishop of Canter- bury sat in Lambeth Palace Library, accompanied by the bishops of London (Dr Temple), Winchester (Dr Harold Browne), Oxford (Dr Stubbs), and Salisbury (Dr Wordsworth), and the vicar-general (Sir J. Parker Deane) as assessors. The bishop of Lincoln appeared in person and read a " Protest" to the archbishop's jurisdiction to try him except in a court composed of the archbishop and all the bishops of the province as judges. The court adjourned in order that the question of jurisdiction might be argued. This*~~

~~*was done on 12th, 13th, 14th, 20th, 21st, 26th, and 27th March 1889, and on the 11th May the archbishop gave judgment to the effect that whether sitting alone or with assessors he had jurisdic- tion to entertain the charge. On 23rd and 24th July 1889 a further preliminary objection raised by the bishop of Lincoln's counsel was argued. The offences alleged against the bishop of Lincoln were largely breaches of various rubrics in the communion service of the Prayer Book which give directions to the "minister." These rubrics are by the Acts of Uniformity (1 Elizabeth c. 2, and 13 and 14 Charles II. c. 4) made legally binding. But it was argued that a bishop is not a " minister " so as to be bound by the rubrics. The archbishop, how- ever, held otherwise, and the assessors (except the bishop of Salisbury, who dissented) concurred in this decision. At this and subsequent hearings the bishop of Hereford (Dr Atlay) took the place of the bishop of Winchester as an assessor, and the bishop of Roch- ester (Dr Thorold), originally appointed an assessor, but absent from England at the outset, was present.*~~

~~*The case was heard on its merits on 4th, 5th, 6th, 7th, 20th, 21st, 22nd, and 25th February 1890, before the archbishop and all the assessors, and the archbishop delivered his judgment on 21st November 1890. The alleged offences were eight in number. No facts were in dispute, but only the legality of the various matters complained of. I. The bishop was Oivses charged with having mixed water with wine deeisioas. in the chalice during the communion service, and II. with having administered the chalice so mixed to the communicants. It was decided that the mixing of the water with the wine during service was illegal, because an additional ceremony not enjoined in the Prayer Book, but that the administration of the mixed chalice, the mixing having been effected before service, was in accordance with primitive practice and not for- bidden in the Church of England. III. The bishop was charged with the ceremonial washing of the vessels used for the holy communion, and with drinking the water used for these ablutions. It was decided that the bishop had committed no offence, and that what he had done was a reasonable compliance with the requirement of the rubric that any of the consecrated elements left over at the end of the celebration should be then and there consumed. IV. The bishop was charged with taking the eastward position (i.e., standing at the west side of the holy table with his face to the east and his back to the congregation) during the ante-*~~

~~*communion service (i.e., the part of the communion service prior to the consecration prayer). The ru- bric requires the celebrant to stand at the north side of the table. A vast amount of research convinced*~~

~~*the archbishop that this is an intentionally ambiguous phrase which may with equal accuracy be applied to the north end of the table as now arranged in churches, and to the long side of the table, which, in Edward VI.'s reign, was often placed lengthwise down the church, so that the long sides would face north and south. It was therefore decided (one of the assessors dissenting) that both positions are legal, and that the bishop had not offended in adopting the eastward position. V. The bishop was charged with so standing during the conse- cration prayer that the " Manual Acts " of consecration were invisible to the people gathered round. It should be stated that the courts (see Bidsdale v. Clifton, L.E. 1 P.D. 316 ; 2 P.D. 276) had already decided that the eastward position during the consecration prayer was legal, but that it might not be so used by the celebrant as to conceal the " Manual Acts." The archbishop held that the bishop of Lincoln had transgressed the law in this particular. VI. The bishop was charged with hav- ing, during the celebration of holy communion, allowed two candles to be alight on a shelf or retable behind the altar when they were not necessary for giving light. The archbishop decided that the mere presence of two altar candles burning during the service, but lit before it began, was lawful under the First Prayer Book of Ed- ward VI., and has never been made unlawful, and there- fore that the bishop was justified in what he had done. VII. The bishop was charged with having permitted the hymn known as Agnus Dei to be sung immediately after the consecration of the elements at a celebration of the holy communion. The archbishop decided that the use of hymns in divine service was too firmly established to be legally questioned, and that there was nothing to dif- ferentiate the use of this particular hymn at this point of the service from the use of other hymns on other occasions in public worship. VIII. The bishop was charged with making the sign of the Cross in the air with his hand in the benediction and at other times dur- ing divine service. The archbishop held that these cross-*~~

~~*ings were ceremonies not enjoined and therefore illegal, and that the bishop had offended in this particular. The judgment confined itself to the declarations of the law which have been summarized, and pronounced no moni- tion or other sentence on the bishop of Lincoln in respect of the matters in which he appeared to have committed breaches of the ecclesiastical law.*~~

~~*The promoters appealed to the Judicial Committee. The bishop did not appear on the appeal, which was therefore argued on the side of the promoters only. The appeal was heard on 10th, 11th, 12th, 15th, and 16th June, and 2nd, 3rd, 7th, and 8th July 1891, before Lords Halsbury, Hobhouse, Esher, Herschell, Hannen, and Shand and Sir Eichard Couch, with the bishop of Chi- chester (Dr Durnford), the bishop of St Davids (Dr Basil Jones), and the bishop of Lichfield (Dr Maclagan) as episcopal assessors. The points appealed were those above numbered II., III., IV., VI., VII. Judgment was given on 2nd August 1892, and the appeal failed on all points. As to II., III., IV., and VII. the Judi- cial Committee agreed with the archbishop. As to VI. (altar lights) the Judicial Committee held that as it was not shown that the bishop was responsible for the presence of lighted candles, the charge could not be sustained against him, and so dismissed it without con- sidering the general question of the lawfulness of altar lights dealt with in the archbishop's judgment. The Judicial Committee also held that the archbishop was within his right in pronouncing no sentence against the bishop, who, it should be added, conformed his practice to the archbishop's judgment from the date of its delivery.*~~

~~*(l. t. d.)*~~

~~*Lind, Jenny [Madame Lind-Goldschmidt] (1820- 1887), the famous Swedish singer, bom in Stockholm, 6th October 1820, was the child of a lace manufacturer. It was Mile Lundberg, an opera-dancer, who first dis- covered her musical gift, and induced the child's mother to have her educated for the stage; during the six or seven years in which she was what was called an " ac- tress pupil," she occasionally appeared on the stage, but in plays, not operas, until 1836, when she made a first attempt in an opera by Lindblad. She was regularly engaged at the operarhouse in 1837, and appeared in a great number of parts in pieces that are now forgotten.*~~

~~*Her first great success was in the part of Agathe, in Der Freischiitz, in 1838, and by 1841, when she started for Paris in order to enlarge her artistic views and to obtain advice upon the subject of her voice, she had already become identified with nearly all the parts in which she afterwards became famous. But her celebrity in Sweden was due in great part to her histrionic ability, and there is comparatively little said about her wonderful vocal art, which was only attained after a year's hard study under Manuel Garcia, who had to remedy many faults that had caused exhaustion in the vocal organs. On the completion of her studies she sang before Meyerbeer, in private, in the Paris Opera-house, and two years afterwards was engaged by him for Berlin, to sing in his Feldlager in SeMesien; but the part in- tended for her was taken by another singer, and her first appearance took place in Norma, 15th December 1844. She appeared also in Euryanthe and La Sonnambula, and while she was at Berlin the English manager, Alfred Bunn, induced her to sign a contract (which she broke) to appear in London in the following season. In De- cember 1846 she appeared at a Gewandhaus concert at Leipzig, and made the acquaintance of Mendelssohn, as well as of Joachim and many other distinguished German musicians. In her second Berlin season she added the parts of Donna Anna (Don Giovanni), Julia (VestaXin), and Valentine (Les Huguenots) to her repertory. She sang in operas or concerts at Aix-la-Chapelle, Hanover, Hamburg, Vienna, Darmstadt, and Munich during the next year, and took up two Donizetti roles, those of Lucia and "la Kglia del Eeggimento," in which she was afterwards famous. At last Lumley, the manager of Her Majesty's Theatre, succeeded in inducing Mile Lind to visit England, in spite of her dread of the penalties threatened by Bunn on her breach of the con- tract with him, and she appeared on 4th May 1847, in Robert le Diable. Her d6but had been so much discussed that the furore she created was a foregone conclusion. Still, it exceeded everything of the kind that had taken place in London or anywhere else, in the genuine enthu- siasm the singer made; the sufferings and struggles of her well-dressed admirers, who had to stand for hours to get into the pit, have become historical. She sang in several of her favourite characters, and in that of Su- sanna in Figaro, besides creating the part of Amalia in Verdi's unsuccessful opera, I Masnadieri, written for England and performed 22nd July. In the autumn she appeared in operas in Manchester and Liverpool, and in concerts at Brighton, Birmingham, Hull, Edinburgh, Glasgow, Perth, Norwich, Bristol,*~~

~~Bath, and Exeter. At Norwich began her acquaintance with Bishop Stanley, which was said to have caused her final determina- tion to give up the stage as a career. After four more ap- pearances at Berlin, and a short visit to Stockholm, she reappeared in London in the season of 1848, when she sang in L'Elisire d'Amore and IFuritani, in addition to her older parts. In the same year she organized a mem- orable performance of Elijah, with the receipts of which the Mendelssohn Scholarship was founded, and sang~~

~~at a great number of charity and benefit concerts. At the beginning of the season of 1849 she intended to give up operatic singing, but a compromise was effected by which she was to sing the music of six operas, performed without action, at Her Majesty's Theatre; but the first, a concert performance of II Flauto Magico, was so coldly received that she felt bound, for the sake of the manager and the public, to give five more regular representations, and her last stage performance was on the 10th May~~

~~1849, in Robert le Diahle. Her decision was not even revoked when the king of Sweden urged her to reappear in opera at her old home. She paid visits to Germany and Sweden again before her departure for America in~~

~~1850. Just before sailing she appeared at Liverpool, for the first time in England, in an oratorio of Handel, singing the soprano music in The Messiah with superb art. She remained in America for nearly two years, being for a great part of the time engaged by Barnum, the famous speculator. In Boston, on 5th February 1852, she married Mr Otto Goldschmidt, whom she had met at Lilbeck in 1850. For some years after her return to England, her home for the rest of her life, she appeared in oratorios and concerts, and her dramatic instincts were as strongly and perhaps as advanta^ geously displayed in these surroundings as they had been on the stage, for the grandeur of her conceptions in such passages as the " Sanctus " of Elijah, the intensity of conviction which she threw into the scene of the widow in the same work, or the religious fervour of " I know that my Redeemer liveth," could not have found a place in opera. In her later years she took an active interest in the Bach Choir, conducted by~~

~~*her husband, and not only sang herself in the chorus, but gave the benefit of her training to the ladies of the society. For some years she was professor of singing at the Eoyal College of Music, and throughout her life devoted herself to the cause of charity. She died at her cottage, Wynd's Point, Malvern, 2nd November 1887. The supreme position she held so long in the operatic world was due not only to the glory of her ringing voice, and the complete musicianship which distinguished her above all her contemporaries, but also to the naive simplicity of her acting in her favourite parts, such as Amina, Alice, or Agathe. In these and others she had the precious qual- ity of conviction, and identified herself with the charac- ters she represented with a thoroughness rarer in her day than in ours. Unharmed by the perils of a stage career, and unspoilt by the extraordinary furore of the British public, she was a model of rectitude, generosity, and straightforwardness, carrying the last quality into a certain blunt directness of manner that was sometimes rather startling to those who only knew her in her later years. (j. a. r. m.)*~~

~~*Lindau, Paul (1839-*~~

~~*-), German author, was*~~

~~*born at Magdeburg in 1839. After studying at the Universities of Halle and Berlin, he resided for some time in Paris ; on returning to Germany in 1863 he engaged at first in journalism, but gave his attention more specifically to Hellenistic literature. In 1869 he founded Das Neue Blatt, in 1871 Die Gegenwart, and in 1877 the well-known monthly Nord und Sud. His earli- est independent productions were some prettily con- ceived books of travel, Aus Venetien (1864) and Aus Paris (1865) ; but it was his critical sketches, notably Die harmlosen JBriefe eines deutschen Kleinstddters (1870) and Litterarische Bilcksichtlosigkeiten (1871), written in a light satirical vein, that first brought his name into prominence. His versatile pen also attempted with suc- cess various stage plays, which appeared under the title Theater in 1873-81. They are distinguished by bright-*~~

~~*ness of dialogue and action, but are not remarkable for originality. As a novelist he has published many charm- ing stories, such as Im Fieber (1890), Herr und Frau Buver (ninth edition, 1899), Helene Jung, &c.*~~

~~*Linden. See Hano vee.*~~

~~*Lindley, Nathaniel Lindley, Baeon (1828- -), English judge, eldest son of John Lindley, M.D.,*~~

~~*F.K.S., (see Ency. Brit, ninth edition, vol. xiv. p. 663), was born at Acton Green, Middlesex, in 1828. He was educated at University College School, and studied for a short time at University College, London, which, however, he left without taking a degree ; he then went to France, where he spent nearly a year. In September 1847 he entered as a student at the Middle Temple, where he was called to the bar on the 22nd of November 1850. In 1851 he went to Germany in order to learn German ; in 1854 he took chambers in Lincoln's Inn, and commenced practice in the Court of Chancery. In 1855 he published An Introduction to the Study of Jurisprudence, consist- ing of a translation of the general part of Thibaut's System des Pandekten Rechts, with copious notes and references to illustrative cases decided in English courts. In 1860 he published in two volumes his Treatise on the Law of Partnership, including its Application to Joint Stock and other Companies, and in 1862 a supplement including the Companies Act of 1862. This work has since been developed into two text-books well known to lawyers as Lindley on Companies and Lindley on Partnership, and has gone through several editions. Having practised for twenty-one years at the junior bar, Mr Lindley became a Queen's Counsel in January 1872, and took his seat in the court presided over by Vice-Chancellor Hall. In 1872 he was elected a bencher of the Middle Temple, of which he was treasurer in 1894. In 1875 Baron Pigott, a much-respected judge of the Court of Exchequer, died, and in order to fill his place Mr Justice Huddleston, better known by his later title of Baron Huddleston, was transferred to the Exchequer from the Court of Common Pleas. Mr Lindley, Q.C., was invited by the Lord Chancellor to fill the place thus vacant, and to become a justice of common pleas, the appointment of a chancery barrister to a common-law court being justified by the fusion of law and equity then shortly to be brought abou.t, in theory at all events, by the Judicature Acts. In the course of the changes made by these statutes Mr Justice Lindley became in the same year (1876) a justice of the Common Pleas Division of the High Court of Justice, and in 1880 of the Queen's Bench Division, distinctions perhaps a little confusing to the lay mind, but*~~

marking an important period of transi- tion in the constitution of English courts of justice. In 1881 he was raised to the Court of Appeal and made a privy councillor. In 1897, on the retirement of Lord Esher, Lord Justice Lindley was made Master of the Rolls, and in 1900 he was raised to the House of Lords as a Lord of Appeal in Ordinary with a life peerage and the title of Baron Lindley. Thus Lord Lindley as a puisne judge and Lord Justice of Appeal occupied a seat on the bench for twenty -five years, a slightly shorter period than did Lord Bramwell, whom he succeeded in the Court of Appeal. During this period he was distinguished as a judge gifted with great industry, learning, patience, and courtesy, and with a wide experience of law and equity acquired in a Chancery practice and as a common-law judge. He was the last sergeant-at-law to be appointed, and the last judge to wear the sergeant's coif, or rather the black patch representing it, on the judicial wig. Lord Lindley was made Hon. LL.D. of Edinburgh and Cam- bridge, and Fellow of the Royal Society. He married in 1858 Sarah Katherine, daughter of Edward John Teale.

Lindley, William (1808-1900), English engineer, was bom in London on 7tli September 1808, and became a pupil under Mr Francis Giles, whom he assisted in designing the Newcastle and Carlisle and the London and Southampton railwajrs. Leaving England about 1837, he was engaged for a time in railway work in various parts of the Continent, and then returned, as engineer-in-chief to the Hamburg-Bergedorf railway, to Hamburg, near which city he had received his early education, and to which he was destined to stand in much the same rela- tion as Haussmann to Paris. His first achievement was to drain the Hammerbrook marshes, and so add some 1400 acres to the available area of the city. His real opportunity, however, came with the great fire which broke out on 6th May 1842 and burned for three days. He was entrusted with the direction of the operations to check its spread, and the strong measures he adopted, including the blowing-up of the town hall, brought his life into danger with the mob, who professed to see in him an English agent charged with the destruction of the port of Hamburg. After the extinction of the fire he was appointed consulting

~~*engineer to the Senate and Town Council, to the Water Board, and to the Board of Works, and thus came to have an important share in the rebuilding of the city in its present form. He began with the construction of a complete sewerage system on principles which did not escape criticism at the time, but which experience showed to be good. Between 1844 and 1848 water-works were established from his designs, the intake from the Elbe being at Eothenburgsort. Subsi- dence tanks were used for clarification, but in 1853, when he designed large extensions, he urged the substitution of sand-filtration, which, however, was not adopted until the cholera epidemic of 1892-1893 had shown the folly of the opposition directed against it. In 1846 he erected the Hamburg gas-works ; public baths and wash-houses were built, and large extensions to the port executed according to his plans in 1854, and he supervised the construction of the Altona gas and water works in 1855. Among other services he rendered to the city may be mentioned the trigonometrical survey executed between 1848 and 1860, and the conduct of the negotiations which in 1852 resulted in the sale of the " Steelyard " on the banks of the Thames belonging to it jointly with the two other Hanseatic towns, Bremen and Lilbeck ; the site of this wharf is now occupied by Cannon Street station. In 1860 he left Hamburg, and during the remaining nineteen years of his professional practice he was responsible for many engineering works in various Continental cities, among them being Frankfort-on-the-Main, Warsaw, Pesth, Diisseldorf, Galatz, and Basel. In the first-named of these he constructed sewerage works on the same princi- ples as those he followed in Hamburg, and the system was widely imitated not only in Europe, but also in America. In the course of his life he was also consulted in regard to water-works at Berlin, Kiel, Stralsund, Stettin, and Leipzig; he advised the New Eiver Company of London on the adoption of the constant supply system in 1851 ; and he was commissioned by the British Gov- ernment to carry out various works in Heligoland, in- cluding the big retaining wall " Am Ealm." He died at Blackheath, London, on 22nd May 1900. (h. m. e.)*~~

~~*Lindo, Marie Prager (1819-1879), Dutch prose writer, of English-Jewish descent, was born in London, 18th September 1819. He went to Holland when only nineteen years of age, and his whole literary career was passed there, although at first he had no intention of set- tling in the Low*~~

~~*Countries. Yet, when once established there as a private teacher of the English language, he soon made up his mind to remain, and in 1842 passed*~~

~~*his examination at Arnhem, qualifying him as a pro- fessor of English in Holland, subsequently becoming a teacher of the English language and literature at the gymnasium in that town. In 1863 he was appointed in a similar capacity at the Royal Military Academy in Breda. Meanwhile Lindo had obtained a thorough grasp of the Dutch language, partly during his student years at Utrecht University, where in 1854 he gained the degree of doctor of literature. His proficiency in the two languages led him to translate into Dutch several of the works of then popular English authors, like Dickens, Thackeray, and others, and afterwards also of Fielding, Sterne, and Walter Scott. Some of Lindo's translations bore the imprint of hasty and careless work, and all were very unequal in quality. His name is much more likely to endure as the writer of humorous original sketches and novelettes in Dutch, which he published under the pseudonym of De Oude Herr Smits ("Old Mr Smits"). Among the most popular are : Brieven en Ontboezemingen (" Letters and Confessions," 1853, with three " Continua- tions ") ; Familie van 0ns (" Family of Ours," 1855) ; Bekentenissen eener Jonge Dame (" Confessions of a Young Lady," 1858) ; UittreJesels uit het Daghoek van Wijlen den Heer Janus Snor (" Extracts from the Diary of the late Mr Janus Snor," 1865) ; Typen (" Types," 1871) ; and, particularly, AfdruJcken van Indrukken (" Im- pressions from Impressions," 1854, reprinted many times). The last-named was written in collaboration with Lode- wyk Mulder, who contributed some of its drollest whim- sicalities of Dutch life and character, which, for that reason, are almost untranslatable. Lodewyk Mulder and Lindo also founded together, and carried on, for a consider- able time alone, the Nederlandsche Spectator (" The Dutch Spectator"), a literary weekly, still published at The Hague, which bears little resemblance to its English pro- totype, and which perhaps reached its greatest popularity and influence when Vosmaer contributed to it a brilliant weekly letter under the fanciful title of Vlugmaren (" Swifts "). Lindo's serious original Dutch writings he published under his own name, the principal one being De Opkomst en Ontwikkeling van het Engelsche Volk (" The Eise and Development of the British People," 2 vols. 1868-1874) — a valuable history. His friend Lodewyk Mulder published in the years 1877-1879 a collected edition of Lindo's writings in five volumes, and there has*~~

~~since been a popular reissue. Lindo was appointed an inspector of primary schools in the province of South Holland in 1866, a post he held until his death at The Hague on 9th March 1879. (h. ti.)~~

~~Lindsay, a town and port of entry of Ontario, Canada, and capital of Victoria county, situated on the Scugog river, 57 miles north-east of Toronto by rail, at the junction of the Port Hope and Haliburton branches and the Midland division of the Grand Trunk rail- way. It has steamboat communication, by way of the Trent canal, with Lake Scugog, and ports on the Trent system between Coboconk and Lakefield. It contains saw and grist mills, agricultural implement and carriage works, and tanneries. Population (1881), 5080 ; (1891),~~

~~6081 ; (1901), 7003.~~

~~Llnea, or La Linea de la Concbpcion, a town of Spain, in the province and diocese of Cadiz, lying between Gibraltar and San Eoque. It is a town of comparatively modern date, and was formerly looked upon as a suburb of San Eoque. It is now, however, a distinct frontier post, and headquarters of the Spanish commandant of the lines of Gibraltar. All the buildings are modern and offer nothing artistic. There are barracks, casinos, a theatre, and a bull-ring, much frequented by the inhabitants and garrison of Gibraltar. It has some trade in cereals,~~

~~fruit and vegetables. Population (1887), 13,862 ; (1897),~~

~~20,294.~~

~~Lingah. See Ban-dee Lijstgah.~~

~~Lingayen, a towu in the southern extremity of the Gulf of Lingayen, on the west coast of Luzon, Philip- pine Islands, the capital of the province of Pangasinan. It is a favourite resort during the hot season, on account of its coolness and healthfulness. It has good Govern- ment buildings, and a fine~~

~~*church and plaza. The rich agricultural lands in its vicinity produce rice, indigo, Indian corn, sugar-cane, and cotton, and alcohol is made from the juice of the nipa palm, which grows abundantly in the neighbouring swamps. The principal language is Pangasinan ; Ilocano is also spoken. Population, 19,000.*~~

~~*Lingen, a town of Prussia, province of Hanover, on the Ems Canal, 43 miles north-north-west of Milnster by rail. It was from 1686 to 1819 the seat of a university, and has now iron foundries, machinery factories, railway workshops, and a (female) prison. Population (1900),*~~

~~*7048.*~~

~~*Linkoping, a town of the province of Ostergotland, Sweden, 142 miles south-west from Stockholm on the railway to Malmo, and 29 miles west-south-west fro:n IsTorrkoping. The cathedral was restored in 1871-82, and in 1885 the Ostergotland Museum, with the Dahlgren col- lection of pictures was opened. At Stangabro (Stanga Bridge), close by, an obelisk was put up in 1898 to com- memorate the important battle of Stangabro (1598). A circle of stones, in the Iron Market of Linkoping, marks the spot where Sigismund's adherents were beheaded in 1600. The town has manufactures of tobacco, cloth, and hosiery. Population (1880), 8752 ; (1890), 12,649 ; (1900), 14,562.*~~

~~*Linlithgow, a royal and parliamentary burgh (Fal- kirk group) and the county town of Linlithgowshire, Scotland, 16 miles by rail west of Edinburgh. Shoe- making and currying and tanning are the staple industries. The ancient parish church has been restored. A Eoman Catholic chapel and a jubilee commemoration town hall have been erected. Population (1881), 3913; (1891),*~~

~~*4155; (1901), 4279.*~~

~~*Linlithgowshire, or West Lothian, a midland county of Scotland, bounded on the N. by the Firth of Forth, on the S.E. by Midlothian, on the S.W. by Lan- arkshire, and on the N.W. by Stirlingshire.*~~

~~*Area and Population.* — *In 1891 a small part of the parish of Dalmeny in Linlithgow was transferred to the parish of Cramond in Midlothian. The area of the county is 77,310 acres, or about 120 square miles. The population was in 1881, 43,510 ; in 1891, 52,808; in 1901, 65,699, of whom 35,212 were males and 30,487 females, the males outnumbering the females, as they have done at every census since 1831 in this county. Taking the land area only (76,807 acres or 120-0 square miles), the num- ber of persons to the square mile in 1891 was 440, and the number of acres to the person 1'4. In the registration county the pop- ulation increased between 1881 and 1891 by 21-4 per cent. Be- tween 1881 and 1891 the excess of births over deaths was 10,417, and the increase of the resident population 9443. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899:—*~~

~~*Year,*~~

~~*Deaths.*~~

~~*Marriaj^GS.*~~

~~*Births.*~~

~~*Per cent, of Illegitimate.*~~

~~*18X0*~~

~~*1890 1899*~~

~~*838 951*~~

~~*1022*~~

~~*293 399 399*~~

~~*1741 2058 2243*~~

~~*7-5*~~

~~*6-96*~~

~~*4-8*~~

~~*The following table givestlie birth-rate, death-rate, and marriage- rate per 1000 of the population for a series of years : —*~~

~~*isso.*~~

~~*1881-90.*~~

~~*1800.*~~

~~*1891-98.*~~

~~*1899.*~~

~~*Birth-rate . Death-rate . Marriage-rate*~~

~~*39‘75*~~

~~*19-13*~~

~~*6-69*~~

~~*40-09*~~

~~*18-71*~~

~~*6-85*~~

~~*39-07*~~

~~*18-06*~~

~~*7-57*~~

~~*37-87*~~

~~*16 -82*~~

~~*6-03*~~

~~35-82~~

~~16-32~~

~~6 -.37~~

~~In 1891 there were 486 Gaelic-speaking persons in the county, and 192 foreigners. Valuation in 1889-90 £292,108 ; 1899-1900, £355,123.~~

~~Administration.— The county returns a member to Parliament. Linlithgow, the county tovm, and Queensferry (881) are royal burghs, and belong respectively to Falkirk and Stirling groups of parliamentary burghs. Bo'ness (9100) and Bathgate (6786) are police burghs, and Broxburn (6270) is an important man- ufacturing centre. There are eleven civil parishes, and there is a combination poorhouse at Linlithgow. The number of pau- pers and dependants in September 1899 was 1267. Linlith- gow is part of the sheriffdom of the Lothians and Peebles, and there is a resident sheriff-substitute, who sits at Linlithgow and Bathgate.~~

~~Education.- — Thirteen school boards manage 33 schools, which had an average attendance of 8952 in 1898-99 ; and 8 voluntary schools (4 Roman Catholic) had 1879. There are academies at Linlithgow, Bathgate, and Bo'ness, and 14 other schools earned grants in 1898 for giving higher education. The County Secondary Education Committee receives the bulk of the "residue" grant from the local authorities, and subsidizes with it elementary technical classes (cookery, laundry, and dairy) and science and art and technological classes, furnishing equipment for such classes.~~

~~Agriculture. — In 1898, 76 per cent, of the area was under cultivation. The acreage under wood was 5206 in 1895. The farming is predominantly arable, and permanent pasture has for some years almost ceased to increase. Oats are the principal com crop ; the barley acreage is less than a third of the oat acreage, and the wheat acreage is half the barley. Of the 518 holdings in 1895 the average size was 114 acres. The percentage under 5 acres was 12-93 ; between 5 and 50 acres, 23-94 ; and over 50 acres, 63'13. The number of farms between 50 and 100 acres was 87 ; between 100 and 300, 210 ; between 300 and 500, 25 ; and there were 5 over 500.~~

~~*The following table gives the principal acreages at intervals of five years from 1880 : —*~~

~~*Tear.*~~

~~*Area under Crops.*~~

~~*Corn Crops.*~~

~~*Green Crops.*~~

~~*Clover.*~~

~~*Permanent Pasture.*~~

~~*Fallow.*~~

~~*1880 1885 1890 1895 1899*~~

~~*59,253 59,253 59,264 59,090 58,699*~~

~~*18,032 16,107 14,342 15,078 14,860*~~

~~*6857 6216 5838 6248 6152*~~

~~*12,850 16,664 20,086 13,792 15,054*~~

~~*21,163 20,051 18,678 23,824 22,456*~~

~~*333 215 299 116 150*~~

~~*The following table gives particulars of the live stock during the same years : —*~~

~~*Tear.*~~

~~*Total Horses.*~~

~~*Total Cattle.*~~

~~*Cows or*~~

~~*Heifers in*~~

~~*Milk or Calf.*~~

~~*f Sheep.*~~

~~*Pigs.*~~

~~*1880 1885*~~

~~*1890 1895 1899*~~

~~*2161 2064 2144*~~

~~*2282 2123*~~

~~*10,957 12,317 12,644 11,918 12,239*~~

~~*3687 4370 4540 4572 4936*~~

~~*19,585 19,647 30,395 25,173 26,476*~~

~~*1675 1580 1547 2085*~~

~~*]996*~~

~~*At the census of 1891, 1623 males and 353 females were returned as being engaged in agriculture.*~~

~~*Industries and Trade.— Th& working of coal, oil-shale, iron- stone, iire-clay, limestone, and sandstone gives employment, directly or indirectly, to at least half the population. In 1891, 13,775 males and 1562 females were connected with industrial pur- suits, and of these 7976 men and 269 women were engaged in industries connected with minerals. The following table shows the output of minerals for 1890 and 1899 : —*~~

~~*Tear,*~~

~~*Oil Shale.*~~

~~*Ci.al.*~~

~~*Ironstone.*~~

~~*Sandstone.*~~

~~*Tons.*~~

~~*Value.*~~

~~*Tons.*~~

~~*Value.*~~

~~*Tons.*~~

~~*Value.*~~

~~*Tons.*~~

~~*Value.*~~

~~*1890 1899*~~

~~*1,218,506 1,499,878*~~

~~*£374,844*~~

~~*7S‘2,f)4.’)*~~

~~*948,748*~~

~~*£204,142 £865,780*~~

~~*76,161*~~

~~*45,29s*~~

~~£84,272 £16,987~~

~~90’,686~~

~~f2i’.4^9~~

~~There were also obtained in 1899, 59,602 tons of fire-clay, valued at £5401 (as compared with 540 tons in 1885). There are oil works at Dalmeny, Broxburn, Philipstoun, Winchburgh, Uphall, Bathgate, and Armadale, blast furnaces near Bo’ness, iron foundries, and steel rolling mills. Fishing is prosecuted on a small scale at Queensferry. The exports are noticed under Bo’ness, the principal port. The total addition to the railway mileage during the last quarter of the 10th century was 15 • miles, three branches of that combined length on the North British system having been opened in 1890.~~

~~See Sir R. Sibbald. History of the Sheriffdoms of Linlithgoio and Stirlingshire. Edinburgh, 1710. — John P. Wood. Parish of Cramond. Edinburgh, 1794. ” ~~

~~, Penny. Historical Account~~

~~LINOS A — L I N Z~~

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~~of Linlithgow. Edinburgh, 1832.— G. Waldie. Walks along the Northern Boman Wall. Linlithgow, 1883. — J. Collie. The Palace of Linlithgow. Edinburgh (n.d.). — A. M. Bisset. Poets and Poetry of Linlithgow. Paisley, 1896.— R. J. H. Cunningham. Geology of the Lothians. Edinburgh, 1888.— J. Small. Castles and Mansions of the Lothians. Edinburgh, 1883.— J. M. Bell. The Castles of the Lothians. Edinburgh, 1893.— 27ie Scottish Mineral Oil Trade. Glasgow, 1893. (yf^_ yf^\~~

~~Linosa, an island of Italy. See Lampedusa.~~

~~Linotype. See Type-setting.~~

~~Linton, Eliza Lynn (1822-1898), English novelist, daughter of the Rev. J. Lynn, vicar of Crosthwaite, in Cumberland, was born at Keswick, 10th~~

~~February 1822. She early manifested independence of character, and in great measure educated herself from the stores of her father's library. Coming up to London about 1845 with a large stock of miscellaneous erudition, she turned this to account in her first novels, Azeth the Egyptian and Amymone, a romance of the days of Pericles. Her next story, Realities, a tale of modern life (1850), was not suc- cessful, and for several years she seemed to have aban- doned fiction. When, in 1865, she reappeared with Grasp your Nettle, it was as an expert in a new style of novel- writing — stirring, fluent, ably-constructed stories, retain- ing the attention throughout, but affording little to reflect upon or to remember. Measured by their immediate success, they gave her an honourable position among the writers of her day, and secure of an audience, she contin- ued to write with vigour nearly until her death. Lizzie Lorton of Oreyrigg (1866), Patricia Kemball (1874), Tlie Atonement of Leam Dundas (1877) are among the best examples of this more mechanical side of her talent, to which there were notable exceptions in Joshua Davidson (1872), a bold but not irreverent adaptation of the story of the Carpenter of Nazareth to that of the French Com- mune ; and Christopher KirMand, a veiled autobiography (1885). Mrs. Linton was even more thoroughly at home in journalism than in fiction; her articles on the "Girl of the Period " in the Saturday Review produced a great sensation, and she was long an influential contributor to the St James's Gazette, the Daily News, and other leading newspapers. Many of her detached essays have been collected. In 1858 she married W. J. Linton, the en- graver, but the miion was soon terminated by mutual consent ; she nevertheless brought up one of Mr Linton's daughters by a former marriage. A few years before her death she retired to Malvern, where she died on 14th July 1898. Her life has been written by Mr G. S. Layard. (e. g.)~~

~~Linton, William James (1812-1897), English wood-engraver, republican, and author, was born in London in 1812. He was educated at Stratford, and in his sixteenth year was apprenticed to the wood-engraver G. W. Bonner. His earliest known work is to be found in Martin and Westall's Pictorial Illustrations of the Bible (1833). Henceforth his talent received ample recognition, and he rapidly rose to a place amongst the foremost wood-engravers of the time. After working as a journeyman engraver with two or three firms, losing his money over a cheap political library called the " National," and writing a life of Thomas Paine, he went into partnership~~

(1842) with John Orrin Smith. The firm was immediately em- ployed on the Illustrated London Neios, just then pro- jected. The following year Orrin Smith died, and Linton, who had married a sister of Thomas Wade, editor of Bell's Weekly Messenger, found himself in sole charge of a business upon which two families were dependent. For years past he had concerned himself with the social and political problems of the time, and was now actively engaged in the republican propaganda. In 1844 he took a prominent part in exposing the violation by the

English post-office of Mazzini's correspondence. This led to a friendship with the Italian revolutionist, and he threw himself with ardour into European politics. HIe carried the first congratulatory address of English work- men to the French Provisional Government in 1848. HIe edited a twopenny weekly paper, The Cause of the People, published in the Isle of Man, and he wrote political verses for the Dublin Nation, signed " Spartacus." HIe helped to found the " International League " of patriots, and in 1850, with G. H. Lewes and Thornton Hunt, started Tlie Leader, an organ which, however, did not satisfy his advanced republicanism, and from which he soon withdrew. The same year he wrote a series of arti- cles propounding the views of Mazzini in The Red Re- publican. In 1852 he took up his residence at Brantwood, which he afterwards sold to John Euskin, and from there issued Tlie English Republic, first in the form of weekly tracts and afterwards as a monthly magazine — " a useful exponent of republican principles, a faithful record of republican progress throughout the world ; an organ of propagandism and a medium of communication for the active republicans in England." Most of the paper, which never paid its way and was abandoned in 1856, was written by himself. In 1852 he also printed for private circulation an anonymous volume of poems entitled T7ie Plaint of Freedom. After the failure of his paper he returned to his proper work of wood-engraving, which had been largely abandoned for political agitation. In 1857 his wife died, and in the following year he married Eliza Lynn (afterwards known as Mrs Lynn Linton) and returned to London. In 1864 he retired to Brantwood, his wife remaining in London. In 1867, pressed by finan- cial difficulties, he determined to try his fortune in America, and finally separated from his wife, with whom, however, he always corresponded affectionately. With his children he settled at Appledore, New Haven, Connec- ticut, where he set up a printing-press.

~~*Here he wrote Practical Hints on Wood-Engraving, 1879 ; James Watson, a Memoir of Cliartist Times, 1879 ; A History of Wood- Engraving in America, 1882 ; WoodrEngraving, a Manual of Instruction, 1884; The Masters of Wood-Engraving, for which he made two journeys to England, 1890 ; The Life of Whittier, 1893 ; and Memories, an autobiography, 1896. He died at New Haven on 29th December 1897, aged eighty-five. Linton was a singularly gifted man, who, in the words of his wife, if he had not bitten the Dead Sea apple of impracticable politics, would have risen higher in the world of both art and letters. As an en- graver on wood he reached the highest point of execution in his own line. He carried on the tradition of Bewick, fought for intelligent as against merely manipulative excellence in the use of the graver, and championed the use of the " white line " as well as of the black, believing with Kuskin that the former was the truer and more telling basis of aesthetic expression in the wood-block printed upon paper.*~~

~~*See also W. J. Linton, Memories; F. G. Kitton, article on "Linton" in English Illustrated Magazine (April 1891) ; G. S. La YARD, Life of Mrs Lynn Linton (1901). (q.. §_ ^*~~

~~*Linz, the capital of Upper Austria, on the right bank of the Danube, 20 miles north-north-west of Steyr. The population in 1890 was 47,685 ; in 1900, including Urfahr on the left bank of the Danu.be, 68,788, almost exclu- sively Catholic and German (estimated to have 1 per cent. Czech, 3 per cent. Protestant, and 1 per cent. Jewish). It has a garrison of 3502 men, composed of four battalions of infantry and an artillery regiment. Linz is now fairly provided with educational institutions, while its transit trade and industry have grown with the development of navigation on the river and its ex- tended railway communications. In addition to brewing.*~~

~~*boat-building, &c., it has a number of large printing establishments, machine factories, foundries, and other metal works, and cloth factories, and manufactures matches, leather, vinegar, liqueurs, and mineral waters.*~~

~~*Li pa, a town in the extreme south-eastern portion of the province of Batangas, Luzon, Philippine Islands, known for its cool and healthful climate. It is the centre of an extremely fertile agricultural region, which pro- duces sugar, Indian corn, cacao, tobacco, and indigo. There were formerly extensive coffee plantations in its vicinity, but they were completely destroyed in 1889-90 by an insect pest. The language is Tagalog. Population,*~~

~~*40,000.*~~

~~*Lippa, a market town in the Hungarian county of Temes, on the Maros, 22 miles east-south-east of Arad. Its trade, once very considerable, especially in salt and wood, has decayed, but its cattle fairs and its manufac- ture of pottery are still famous. It has several important educational institutions. Opposite lies the village of Maria-Eadna, with a double-towered monastery of the Franciscans, dating from 1761, which is visited thrice a year by a great number of pilgrims from all parts of the country. Population (1901), 7427.*~~

~~*Lippe, a principality of Germany, lying mainly between Westphalia and Hanover. Out of a total of 25,059 farms in 1895, no less than 16,109 were under 2^ acres each, 7327 between 2^ and 26 acres, 1586 between 25 and 250 acres, and only 37 exceeded 260 acres. Potatoes, beetroot (for sugar), hay, rye, oats, wheat, and barley are the principal crops. In 1900 the live stock consisted of 38,362 cattle, 86,513 pigs, 16,086 sheep, and 9477 horses. In 1900 the population was 139,238, giving on an area of 469 square miles a density of 296 persons to the square mile ; of this total, 67,113 were males and 72,125 were females. Except for 4332 Roman Catholics and 989 Jews, the peo- ple were in 1895 all Protestants. In 1885 the population was 123,212. For the year 1900-01 the state revenue was estimated at £69,760 and the expenditure at £70,400. The public debt amounted in 1900 to £58,400, and the contribution to the imperial exchequer to £67,916.*~~

~~*Lippstadt, a town of Prussia, province of West- phalia, on the river Lippe, and 20 miles by rail west by south of Paderborn. St Mary's church is a large building in the Transitional style, built in 1189 and 1290. Lipp- stadt itself*~~

~~dates from 1168. It carries on distilling, and manufacture of cigars, gingerbread, sausages, &c. Popu- lation (1885), 10,504 ; (1900), 12,534.~~

~~LIQUID GASES.~~

~~THIS article will be mainly confined to the dis- cussion of the properties of liquid atmospheric air and the so-called " permanent " gases — oxygen, nitrogen, and hydrogen — which are contained in it, the last, how- ever, being present in very minute quantities. In the earlier volumes of this Encyclopaedia it was stated (9th ed., vol. xii. p. 433) that all these permanent gases had been reduced to the liquid state by Cailletet and Pictet, working independently, and that the latter even suc- ceeded in solidifying hydrogen, the least condensible of all the substances then isolated by the chemist. These statements, at the time they were made, embodied what was generally accepted as a correct account of the facts. But in the course of the next decade widened knowledge rendered it evident that the achievements of those inves- tigators were not of so absolute and definite a character as had at first been supposed, and it became clear that if they were to be accepted at all it must be with certain important qualifications. In the first place, it was noted that what these experimenters obtained was at the best a " dynamic," not a " static " liquid ; that is, the gas was reduced to a form which bore the same relation to a true liquid that the partially condensed steam seen issuing from the funnel of a locomotive does to water standing in a tumbler. Thus Cailletet in 1877 compressed about 100 cc. of oxygen to about 200 atmospheres, at the same time cooling it to —29° C, and on suddenly taking off the pressure he saw momentarily in the interior of the tube into which the gas was expanded a mist (" brouillard "), from which he inferred the " presence of a vapour very near its point of liquefaction." A few days later he repeated the experiment with hydrogen, using a pressure of nearly 300 atmospheres, and observed in his tube a fine mist which vanished almost instantaneously. We know now this mist could not be liquid hydrogen drops, because the cooling produced by the adiabatic expansions would only give a theoretical temperature of 44° absolute, which is certainly above the true critical point of hydrogen. But neither of these gases, any more than nitrogen (of which, however, he claimed to obtain " droplets of appreciable size "), was he able to get in the~~

~~form of a true stable liquid. Pictet, again, on opening the tap of a vessel in which hydrogen was contained at a pressure of 650 atmospheres and a temperature of —140° C, saw issuing from the orifice an opaque jet, which he assumed to consist of hydrogen in the liquid form, or in the liquid and solid forms mixed, but he was not more successful than Cailletet in collecting any of the liquid. In the second place, some critics deny Cailletet and Pictet the credit of even this approximate liquefac- tion, and hold the opinion that the mist of the one and the liquid of the other, whatever else they may have been — whether ordinary air or impurities associated with the hydrogen used — were not composed of liquid hydrogen, since the means employed by these experimenters were quite inadequate to reduce the gas to what has more recently been ascertained to be its critical point, above which of course liquefaction is impossible. It need scarcely be added that if the liquefaction of hydrogen be rejected, a fortiori Pictet's claim to have effected its solidification falls to the ground.~~

~~After Cailletet and Pictet, the next important names in the history of the liquefaction of gases are those of Wroblewski and Olszewski, who for some years worked together at Cracow. In April 1883 the former announced to the French Academy that he had obtained oxygen in a completely liquid state, and (a few days later) that nitrogen at a temperature of — 136° C, reduced suddenly from a pressure of 150 atmospheres to one of 50, had been seen as a liquid which showed a true meniscus, but disappeared in a few seconds. But with hydrogen treated in the same way he failed to obtain even the mist reported by Cailletet. At the beginning of 1884 he performed a more satisfactory experiment. Cooling hydrogen in a capillary glass tube to the temperature of liquid oxygen, he expanded it quickly from 100 atmospheres to one, and obtained the appearance of an instantaneous ebullition. Olszewski confirmed this result by expanding from a pressure of 190 atmospheres the gas cooled by liquid oxygen and nitrogen boiling under reduced pressure, and even announced that he saw it running down the walls of the tube as a colourless liquid.~~

~~*Wroblewski, however, was unable to observe this phenomenon, and Olszewski himself, when seven years later he repeated the experiment in the more favourable conditions afforded by a larger apparatus, was unable to produce again the colourless drops he had previously reported: the phenomenon of the appearance of sudden ebullition indeed lasted longer, but he failed to perceive any jneniscus such as would have been a certain indication of the presence of a true liquid. Still, though neither of these investigators succeeded in reaching the goal at which they aimed, their work was of great value in elucidating the conditions of the problem and in perfecting the details of the apparatus employed. Wroblewski in particular devoted the closing years of his life to a most valuable investigation of the isothermals of hydrogen at low temperatures. From the data thus obtained he con- structed a van der Waals equation which enabled him to calculate the critical temperature, pressure, and density of hydrogen with very much greater certainty than had previously been possible. Liquid oxygen, liquid nitrogen, and liquid air — the last was first made by Wroblewski in 1885 — became something more than mere curiosities of the laboratory, and by the year 1891 were produced in such quantities as to be available for the purposes of scientific research. Still, nothing was added to the general principles upon which the work of Cailletet and Pictet was based, and the " cascade " method, to- gether with adiabatic expansion from high compression (see Condensation of Gases), remained the only means of procedure at the disposal of experimenters in this branch of physics.*~~

~~*In some quarters a certain amount of doubt appears to have arisen as to the sufficiency of these methods for the liquefaction of hydrogen. Olszewski, for example, in 1896 pointed out that the succession of less and less condensible gases necessary for the cascade method breaks down between nitrogen and hydrogen, and he gave as a reason for hydrogen not having been reduced to the condition of a static liquid the non-existence of a gas intermediate in volatility between those two. By 1894 attempts had been made inthe Royal Institution laboratories to manufacture an artificial gas of this nature by adding a small proportion of air to the hydrogen, so as to get a mixture with a critical point of about – 200° C. When such a mixture was cooled to that temperature and expanded from a high degree of com- pression into a vacuum vessel, the result was a white mass of solid air together with a clear liquid of very low density. This was in all probability*~~

~~hydrogen in the true liquid state, but it was not found possible to collect it owing to its extreme volatility. Whether or not this artificial gas would ultimately have enabled liquid hydrogen to be collected in open vessels it is impossible to say, for experiments with it were abandoned in favour of other measures, the employment of which led finally to a more assured success. VarMUTTi Vessels. — The problem involved in the lique- faction of hydrogen was in reality a double one. In the first place, the gas had to be cooled to such a temperature that the change to the liquid state was rendered possible. In the second, means had to be discovered for protecting it, when so cooled, from the influx of external heat, and since the rate at which heat is transferred from one body to another increases very rapidly with the difference between their temperatures, the question of efficient heat insulation became at once more difficult and more urgent in proportion to the degree of cold attained. The second part of the problem was in fact solved first. Of course packing with non-conducting materials was an obvious expedient when it was not necessary that the contents of the apparatus should be visible to the eye, but in the numerous instances when this was not the case such measures were out of the question. Attempts were made~~

~~to secure the desired end by surrounding the vessel that contained the cooled or liquid gas with a succession of other vessels, through which was conducted the vapour given off from the interior one. Such devices involved awkward complications in the arrangement of the apparatus, and besides were not as a rule very efficient, although some workers, e.g., Dr Kamerlingh Onnes, of Leyden, reported some success with their use. In 1892 it occurred to Dewar that the principle of an arrange- ment he had used nearly twenty years before for some calorimetric experiments on the physical constants of hydrogenium, which was a natural deduction from the work of Dulong and Petit on radiation, might be employed with advantage as well to protect cold sub- stances from heat as hot ones from cold. He there- fore tried the effect of surrounding his liquefied gas~~

~~,V«.rr-~~

~~"iiSr.~~

~~i^h~~

}'i

Fig. 1. — Vacuum or "Dewar" Vessels.

with a highly exhausted space. The result was entirely successful. Experiment showed that liquid air contained in a glass vessel with two walls, the space between which was a high vacuum, evaporated at only one-fifth the rate it did when in an ordinary vessel surrounded with air at atmospheric pressure, the convective transference of heat by means of the gas particles being enoWously reduced owing to the vacuum. Fig. 1 shows two of these vessels ; other forms may be seen in the Plate illustrating the lecture-table at the Eoyal Institution. But in addition these vessels lent themselves to an arrangement by which radiant heat could also be cut off, and it was found that when the inner wall was coated with a bright deposit of silver, the influx of heat was diminished to one-sixth of the amount existing without the metallic coating. The total effect, therefore, of the high vacuum and silvering is to reduce the in-going heat to one-thirtieth part. In making such vessels a mercurial vacuum has been found very satisfactory. The vessel in which the vacuum is to be produced is provided with a small subsidiary vessel joined by a narrow tube with the main vessel, and connected with a powerful air-pump. A quantity of mercury

having been placed in it, it is heated in an oil- or air-bath to about 200° C, so as to volatilize the mercury, the vapour of which is removed by the pump. After the process has gone on for some time, the pipe leading to the pump is sealed off, the vessel immediately removed from the bath, and the small subsidiary part immersed in some cooling agent such as solid carbonic acid or liquid air, whereby the mercury vapour is condensed in the small vessel and a vacuum of enormous tenuity left in the large one. The final step is to seal off the tube connecting the two. In this way a vacuum may be produced having a vapour pressure of about the hundred-millionth of an atmosphere at 0° C. If, however, some liquid mercury be left in the space in which the

~~*vacuum is produced, and the containing part of the vessel be filled with liquid air, the bright mirror of mercury which is deposited on the inside wall of the bulb is still more effective than silver in protecting the chamber from the influx of heat, owing to the high refractive index, which involves great reflecting power, and the bad heat-conducting powers of mercury.*~~

~~*Thermal Transparency at Low Temperatures. — The proposition, once enunciated by Pictet, that at low temperatures all substances have practically the same thermal transparency, and are equally ineffective as non-conductors of heat, is based on erroneous obser- vations. It is true that if the space between the two walls of a double-walled vessel is packed with substances like carbon, mag- nesia, or silica, liquid air placed in the interior will boil off even more quickly than it will when the space merely contains air at atmospheric pressure ; but in such cases it is not so much the car- bon, &o. , that bring about the transference of heat, as the air con- tained in their interstices. If this air be pumped out such substances are seen to exert a very considerable influence in stopping the in- flux of heat, and a vacuum vessel which has the space between its two walls filled with a non-conducting material of this kind pre- serves a liquid gas even better than one in which that space is simply exhausted of air. In experiments on this point double-walled glass tubes, as nearly identical in shape and size as possible, were mounted in sets of three on a common stem which communicated with an air-pump, so that the degree of exhaustion in each was equal. In two of each three the space between the double walls was filled with the powdered material it was desired to test, the third being left empty and used as the standard. The time re- quired for a certain quantity of liquid air to evaporate from the interior of this empty bulb being called 1, in each of the eight sets of triple tubes, the times required for the same quantity to boil off from the other pairs of tubes were as follows : —*~~

~~*‘ Charcoal . ‘, Magnesia .*~~

~~*5 2*~~

~~*Lampblack ‘.Silica*~~

~~*5 4*~~

~~*f Graphite . \ Alumina .*~~

~~*1-3 3-3*~~

~~*r Lampblack \ Lycopodium*~~

~~*4*~~

~~*2-5*~~

~~*f Calcium carbonate \ Calcium fluoride*~~

~~*2-5 1-25*~~

~~*f Barium carbonate \ Calcium phosphate .*~~

~~*1-3*~~

~~*2 ‘7*~~

~~■ *Phosphorus (amorphous) \ Mercuric iodide*~~

~~*1 1-5*~~

~~*f Lead oxide*~~

~~*\ Bismuth oxide .*~~

~~*2 6*~~

~~*Other experiments of the same kind made — (a) with similar vacuum vessels, but with the powders replaced by metallic and other, septa ; and (6) with vacuum vessels having their walls silvered, yielded the following results : —*~~

~~*‘ (a) Vacuum space empty 1 Three turns silver paper, bright sur- face inside . . 4 Three turns silver paper, bright sur- face outside . 4 Vacuum space empty 1 Three turns gold*~~

~~*paper, gold outside 4 Some pieces of gold- leaf put in so as to make contact between walls of vacuum-tube . . 0-3 (6) Vacuum space empty, silvered on inside surfaces . . .1 Silica in silvered vacuum space . 1-1*~~

~~*Vacuum space empty . 1 Three turns black paper,*~~

~~*black outside . . 3 Three turns black paper,*~~

~~*black inside . . 3*~~

~~*‘ Vacuum space empty . 1 Three turns, not touch- ing, of sheet lead . 4 Three turns, not touch- ing, of sheet alumi- nium . . . .4*~~

~~*Empty silvered vacuum 1 Charcoal in silvered vacuum . . . 1‘25*~~

~~*It appears from these experiments that silica, charcoal, lamp- black, and oxide of bismuth all increase the heat insulations to four, five, and six times that of the empty vacuum space. As the chief communication of heat through an exhausted space is by molecular bombardment, the fine powders must shorten the free path of the gaseous molecules, and the slow conduction of heat through the porous mass must make the conveyance of heat-energy more diliicult than when the gas molecules can impinge upon the relatively hot outer glass surface, and then directly on the cold one without interruption. (See Proc. Boy. Inst., vol. xv. pp. 821-826.)*~~

~~*Density of Solids and Coefficients of Expansion at Low Tem- peratures.—The facility with which liquid gases, like oxygen or nitrogen, can be guarded from evaporation by the proper use of vacuum vessels (now called Dewar vessels), naturally suggests that the specific gravities of solid bodies can be got by direct weighing when immersed in such fluids. If the density of the liquid gas is accurately known, then the loss of weight by fluid displacement gives the specific gravity compared to water. The metals and alloys, or substances that can be got in large crystals, are the easiest to manipulate. If the body is only to be had in small crystals, then it must be compressed under strong hydraulic pressure into coherent blocks weighing about 40 to 60 grammes. Such an amount of material gives a very accurate density of the body about the boiling point of air, and a similar density taken in a suitable liquid at the ordinary temperature enables the mean*~~

~~*coefficient of expansion between -|-15° C. and —185° C. to be determined. One of the most interesting results is that the density of ice at the boiling point of air is not more than 0-93, the mean coefficient of expansion being therefore 0 '000081. As the value of the same coefficient between 0° C. and —27° C. is 0-000155, it is clear the rate of contraction is diminished to about one-half of what it was above the melting point of the ice. This suggests that by no possible cooling at our command is it likely we could ever make ice as dense as water at 0° C, far less 4° C. In "other words, the volume of ice at the zero of temperature would not be the minimum volume of the water molecule, though we have every reason to believe it would be so in the case of the majority of known substances. Another substance of special interest is solid carbonic acid. This body has a density of 1-53 at — 78° C. and 1-633 at —185° C, thus giving a mean coefficient of expansion between these temperatures of 0-00057. This value is only about ^ of the coefficient of expansion of the liquid carbonic acid gas just above its melting point, but it is still much greater at the low temperature than that of highly expansive solids like sulphur, which at 40° C. has a value of 0.00019. The following table gives the densities at the temperature of boiling liquid air (— 185° C.) and at ordinary temperatures (17° C), together with the mean coefficient of expansion between those temperatures. In the case of a number of hydrated salts and other substances : —*~~

~~*Table I.*~~

~~*Mean co-*~~

~~*Density*~~

~~*at — 185°*~~

~~*C.*~~

~~*Density*~~

~~*at — 17°*~~

~~*C.*~~

~~*efflcieut of expansion be- tween -1S6° 0. and*~~

~~*+11° C.*~~

~~*Sulphate of aluminium (18)i*~~

~~*1-7194*~~

~~*1-6913*~~

~~*0-0000811*~~

~~*Biborate of soda (10)*~~

~~*1-7284*~~

~~*1-6937*~~

~~*0-0001000*~~

~~*Chloride of calcium (6)*~~

~~*1-7187*~~

~~*1-6775*~~

~~*0-0001191*~~

~~*Chloride of magnesium (6)*~~

~~*1-6039*~~

~~*1-5693*~~

~~*0-0001072*~~

~~*Potash alum (24)*~~

~~*1-6414*~~

~~*1-6144*~~

~~*0-0000813*~~

~~*Chrome alum (24)*~~

~~*1-7842*~~

~~*1-7669*~~

~~*0-0000478*~~

~~*Carbonate of soda (10)*~~

~~*1-4926*~~

~~*1-4460*~~

~~*0-0001563*~~

~~*Phosphate of soda (12)*~~

~~*1-5446*~~

~~*1-5200*~~

~~*0-0000787*~~

~~*Hyposulphite of soda (5) .*~~

~~*1-7635*~~

~~*1-7290*~~

~~*0-0000969*~~

~~*Ferrocyanide of potassium (3) .*~~

~~*1-8988*~~

~~*1-8533*~~

~~*0-0001195*~~

~~*Ferricyanide of potassium .*~~

~~*1-8944*~~

~~*1-8109*~~

~~*0-0002244*~~

~~*Nitro-prusside of sodium (4)*~~

~~*1-7196*~~

~~*1-0803*~~

~~*0-0001138*~~

~~*Chloride of ammonium*~~

~~*1-5757*~~

~~*1-5188*~~

~~*0-0001820*~~

~~*Oxalic acid (2) .*~~

~~*1-7024*~~

~~*1-6145*~~

~~*0-0002043*~~

~~*Oxalate of methyl*~~

~~*1-5278*~~

~~*1-4200*~~

~~*0-0003482*~~

~~*Paraffin*~~

~~*0-9770*~~

~~*0-9103*~~

~~*0-0003.507*~~

~~*Naphthalene*~~

~~*1-2355*~~

~~*1-1589*~~

~~*0-0003200*~~

~~*Chloral hydrate :*~~

~~*1-9744*~~

~~*1-9151*~~

~~*0-0001482*~~

~~*Urea :*~~

~~*1-3617*~~

~~*1-3190*~~

~~*0-0001570*~~

~~*Iodoform :*~~

~~*4-4459*~~

~~*4-1955*~~

~~*0-0002930*~~

~~*Iodine*~~

~~*4-8943*~~

~~*4-6631*~~

~~*0-0002510*~~

~~*Sulphur*~~

~~*2-0989*~~

~~*2-0522*~~

~~*0-0001152*~~

~~*Mercury*~~

~~*14-382*~~

~~*000008812*~~

~~*Sodium*~~

~~*1-0056*~~

~~*0-972*~~

~~*0-0001810*~~

~~*Graphite (Cumberland)*~~

~~*2-1302*~~

~~*2-n9!)0*~~

0-0000733

1 The figures within parentheses refer to the number of molecules of water of ciystallizatiou. ■2 —189° to — .SS”-.^C.

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It will be seen from this table that, with the exception of carbonate of soda and chrome alum, the hydrated salts have a coefBcient of expansion that does not differ greatly from that of ice at low temperatures. Iodoform is a highly expansive body like iodine, and oxalate of methyl has nearly as great a coefficient as paraflin, which is a very expansive solid, as are naphthalene and oxalic acid. The coeiScient of solid mercury is about half that of the liquid metal, while that of sodium is about the value of mer- cury at ordinary temperatures. Further details on the subject can be found in the Proc. Boy. Inst., 1895, and Proc. Boy. Soc, 1902.

Density of Gases at Low Temperatures. — The ordinary mode of determining the density of gases may be followed, provided that the glass flask, with its carefully ground stop-cook sealed on, can stand an internal pressure of about five atmospheres, and that all the necessary corrections for change of volume are made. All that is necessary is to immerse the exhausted flask in boiling oxygen , and then to allow the second gas to enter from a gasometer by open- ing the stop-cock until the pressure is equalized. The stop-cock being closed, the flask is now taken out of the liquid oxygen and left in the balance-room until its temperature is equalized. It is then weighed against a similar flask used as a counterpoise. Follow- ing such a method, it has been found that the weight of 1 litre of oxygen vapour at its boiling point of 90° -5 absolute is 4 -420 grammes, and therefore the specific volume is 226-25 cc. According to the ordinary gaseous laws, the litre ought to weigh 4-313 grammes, and the specific volume should be 231-82 co. In other words, the pro- duct of pressure and volume at the boiling point is diminished by 2-46 per cent. In a similar way the weight of a litre of nitrogen vapour at the boiling point of oxygen was found to be 3-90, and the inferred value for 78° absolute, or its own boiling point, would be 4-51, giving a specific volume of 221-3.

~~*Regenerative Cooling.* — *One part of the problem being thus solved and a satisfactory device discovered for ward ing off heat in such vacuum vessels, it remained to arrange some practically efficient method for reducing hydrogen to a temperature sufficiently low for liquefaction. To gain that end, the idea naturally occurred of using adiabatic expansion, not intermittently, as when gas is allowed to expand suddenly from a high compression, but in a con- tinuous process, and an obvious way of attempting to carry out this condition was to enclose the orifice at which expansion takes place in a tube, so as to obtain a constant stream of cooled gas passing over it. Bat further con- sideration of this plan showed that although the gas jet would be cooled near the point of expansion owing to the conversion of a portion of its sensible heat into dynamical energy of the moving gas, yet the heat it thus lost would be restored to it almost immediately by the destruction of this mechanical energy through friction and its consequent reconversion into heat. Thus the net result would be nil so far as change of temperature through the performance of external work was concerned. But the conditions in such an arrangement resemble that in the experiments of Thomson and Joule on the thermal changes which occur in a gas when it is forced under pressure through a porous plug or narrow orifice, and those experimenters found, as the former of them had predicted, that a change of temper- ature does take place, owing to internal work being done by the attraction of the gas molecules. Hence the effective result obtainable in practice by such an attempt at continu- ous adiabatic expansion as that suggested above is to be measured by the amount of the "Thomson-Joule effect," which depends entirely on the internal, not the external, work done by the gas. To Linde belongs the credit of hav- ing first seen the essential importance of this effect in connexion with the liquefaction of gases by adiabatic ex- pansion, and he was, further, the first to construct an industrial plant for the production of liquid air based on the application of this principle.~~

~~*The change of temperature due to the Thomson-Joule effect varies in amount with different gases, or rather with the temperature at which the operation is conducted. At ordinary temperatures oxygen and carbonic acid are cooled, while hydrogen is slightly heated. But hydrogen also is cooled if before being passed through the nozzle or plug it*~~

~~*is brought into a thermal condition comparable to that of other gases at ordinary temperatures — that is to say, when it is initially cooled to a temperature having the same ratio to its critical point as their temperatures have to their critical points — and similarly the more condensible gases would be heated, and not cooled, by passing through a nozzle or plug if they were employed at a temperature sufficiently above their critical points. Each gas has therefore a point of inversion of the Thomson- Joule effect, and this temperature is, according to the theory of van der Waals, about 6-76 times the critical temperature of the body. Olszewski has determined the inversion-point in the case of hydrogen, and finds it to be 192°-6 absolute, the theoretical critical point being thus . about 28°-5 absolute. The cooling effect obtained is small, being for air about 1° C. per atmosphere difference of pressure at ordinary temperatures. But the decrement of tem perature is proportional to the difference of pressure and inversely as the absolute temperature, so that the Thomson- Joule effect increases rapidly by the combined use of a lower temperature and greater difference of gas pressure. By means of the " regenerative " method of working, which was described by Siemens in 1857, developed and extended by Solvay in 1885, and subsequently ittilized by numerous experimenters in the construction of low temperature apparatus, a practicable liquid air plant was con- structed by Linde.*~~

~~*The gas which has passed the orifice and is therefore cooled is made to flow backwards round the tube that leads to the nozzle ; hence that portion of the gas that is just about to pass through the nozzle has some of its heat abstracted, and in consequence on ex- pansion is cooled to a lower temperature than the first por- tion. In its turn it cools a third por- tion in the same way, and so the re- duction of tempera- ture goes on pro- gressively until ulti- mately a portion of the gas is liquefied. Apparatus based on this principle has been employed not only by Linde in Germany, but also by Tripler in America and by H amp son and Dewar in England. The last-named ex- perimenter exhib- ited in December 1895 a laboratory machine of this kind (Fig. 2), which when supplied with oxygen initially cooled to -79° C, and at a pressure of 100-160 atmo- spheres, began to yield liquid in about a quarter of an hour after starting. The initial cooling is not necessary, but it has the advantage of reducing the time required for the operation. The efficiency of the Linde process is*~~

~~*Fig. 2. — Laboratory Liquid Aip Machine. A, air or oxygen inlet; B, carbon dioxide inlet; C, carbon dioxide Talve ; D, regenerator coils ; F, air or oxygen expansion valve ; G, vacuum vessel ■with liquid air or oxygen ; H, carbon dioxide and air outlet ; O, air coil ; O, carbon dioxide coil.*~~

~~*small, but it is easily conducted and only requires plenty of cheap power. When we can work turbines or other engines at low temperatures, so as to effect cooling through the performance of external work, then the economy in the production of liquid air and hydrogen will be . greatly increased.*~~

~~*This treatment was next extended to hydrogen. For the reason already explained, it would have been futile to experiment with this substance at ordinary temperatures, and therefore as a preliminary it was cooled to the tem- perature of boiling liquid air, about —190° C. At this temperature it is still 2^ times above its critical tem- perature, and therefore its liquefaction in these circum- stances would be comparable to that of air, taken at -(-60° C, in an apparatus like that just described. Dewar showed in 1896 that hydrogen cooled in this way and expanded in a regenerative coil from a pressure of 200 atmospheres was rapidly reduced in temperature to such an extent that after the apparatus had been working a few minutes the issuing jet was seen to contain liquid,*~~

~~*Fig. 3. — Hydrogen Jet Apparatus. A, cylinder containing compressed hydrogen : B and C, vacuum vessels containing- carbonic acid under exliauBtion and liquid air respectively ; D, regenerating coil in vacuum vessel ; F, valve ; G, pin-hole nozzle.*~~

~~*which was sufficiently proved to be liquid hydrogen by the fact that it was so cold as to freeze liquid air and oxygen into hard white solids. Though with this apparatus, a diagrammatic representation of which is shown in Pig. 3, it was not found possible at the time to collect the liquid in an open vessel, owing to its low specific gravity and the rapidity of the gas-current, still the general type of the arrangement seemed so promising that in the next two years there was laid down in the laboratories of the Royal*~~

~~*Institution a large plant — it weighs 2 tons and contains 3000 feet of pipe — which is designed on precisely the same principles, although its construction is far more elaborate. The one important novelty, without which it is practically impossible to succeed, is the provision of a device to surmount the difficulty of withdrawing the^ liquefied hydrogen after it has been made. The desideratum is really a means of forming an aperture in the bottom of a vacuum vessel by which the contained liquid may be run out. For this purpose the lower part of the vacuum vessel (D in Fig. 3) containing the jet is modified as shown in Fig. 4 ; the inner vessel is prolonged*~~

~~*Fro. 4. — Bottom of Vacuum Vessel.*~~

~~*in a fine tube, coiled spirally, which passes through the outer wall of the vacuum vessel, and thus sufficient elas- ticity is obtained to enable the tube to withstand without fracture the great contraction consequent on the extreme cold to which it is subjected. Such pecul- iarly shaped vacuum vessels were made by Dewar's directions in Germany, and have subsequently been supplied to and employed by other experimenters.*~~

~~*The external appearance of the liquid hydrogen machine is shown in Fig. 5, while on the Plate may be seen a gen- eral view of the liquid hydrogen plant in the Royal Institution. With this ap- paratus liquid hydrogen was for the first time collected in an open vessel on 10th May 1898. The gas at a pressure of 180 atmospheres was cooled to —205° C. by means of liquid air boiling in vacuo, and then passed through the nozzle of the regenerative coil, which was enclosed in vacuum vessels in such a way as to exclude external heat as perfectly as possible. In this way some 20 cc. of the liquid had been collected when the experi- ment came to a premature end, owing to the nozzle of the apparatus becoming blocked by a dense solid — air-ice resulting from the congelation of the air which was present to a minute extent as an impurity in the hydro- gen. This accident exemplifies what is a serious trouble encountered in the production of liquid hydrogen, the extreme difficulty of obtaining the gas in a state of suffi- cient purity, for the presence of 1 per cent, of foreign mat- ters, such as air or oxygen, which are more condensible than hydrogen, is sufficient to cause complete stoppage, unless the nozzle valve and jet arrangement is of special*~~

~~*construction. In subsequent experiments the liquid was obtained in larger quantities — on 13th June 1901 five litres of it were successfully conveyed through the streets of London from the laboratory of the Royal Institu- tion to the rooms of the Royal Society — and it may be said that it is now possible to produce it in any desired amount, subject only to the limitations entailed by ex- pense. Finally, the reduction of hydrogen to a solid state was successfully undertaken in 1899. A portion of the liquid carefully isolated in vacuum-jacketed vessels was suddenly transformed into a white mass resembling frozen foam, when evaporated under an air-pump at a pressure of 30 or 40 mm., and subsequently hydrogen was obtained as a clear transparent ice by immersing a tube containing the liquid in this solid foam.*~~

~~*The following are brief details respecting the more important liquefied gases that have become available for study within recent years. (For argon, neon, krypton, &c., see Aegon.)*~~

~~*Oxygen. — Liquid oxygen Is a mobile transparent liquid, possess- ing a faint blue colour. At atmospheric pressure it boils at — 181°-5 C. ; under a reduced pressure of 1 cm. of mercury its temperature falls to — 210° C. At the boiling point it has a density of 1-124 according to Olszewski, or of 1-168 according to "Wro- blewski ; Dewar obtained the value 1-1375 as the mean of twenty observations by weighing a number of solid substances in liquid oxygen, noting the apparent relative density of the liquid, and thence calculating its real density, Fizeau's values for the coeffi- cients of expansion of the solids being employed. The capillarity of liquid oxygen is about one-sixth that of water ; it is a non- conductor of electricity, and is strongly magnetic. By its own evaporation it cannot be reduced to the solid state, but exposed to the tempei-ature of liquid hydrogen it is frozen into a solid mass, having a pale bluish tint, showing by reflection all the absorption bands of tlie liquid. It is remarkable that the same absorption bands occur in the compressed gas. Dewar gives the melting-point as 38° absolute. The refractive index of the liquid for the D sodium ray is 1 -2236.*~~

~~*Ozone. — This gas is easily liquefied by the use of liquid air. The*~~

~~*Plant fok Liquefaction op Gases in Laboeatokies of Eoyal Institution, London.*~~

~~*Lectuke Table at Royal Institution, London, akeanged fok Lecture on Liquid Gases.*~~

~~*LIQUID GASES*~~

~~*285*~~

~~*liquid obtained is intensely blue, and on allowing the temperature to rise, boils and explodes about -120° C. About this temperature it may be dissolved in bisulphide of carbon to a faint blue solution. The liquid ozone seems to be more magnetic than liquid oxygen.*~~

~~*Nitrogen forms a transparent colourless liquid, having a density of 0-800 at its boiling point, which is -195° C. The refractive index for the D line is 1-2053. Evapo- rated under diminished pressure the liquid becomes solid at a temperature of —215° C, under a pressure of 64 mm.*~~

~~*Air. — Seeing that the boiling points of nitrogen and oxygen are different, it might be ex- pected that on the liquefaction of atmospheric air the two ele- ments would appear as two sepa- rate liquids. Such, however, is not the case ; they come down simultaneously as one homogene- ous liquid. Prepared on a large scale, liquid air may contain as much as 50 per cent, of oxygen when collected in open vacuum- vessels, but since nitrogen is the more volatile it boils off first, and as the liquid gradually be- comes richer in oxygen the tem- perature at which it boils rises from about —192° C. to about 182° C. At the former tem perature it has a density of about 0-910. It is a non-conductor of electricity. Properly protected from external heat, and subjected to high exhaustion, liquid air becomes a stiff transparent jelly-like mass, a magma of solid ni- trogen containing liquid oxygen, which may indeed be extracted from it by means of a magnet, or by rapid rotation of the vacuum vessel in imitation of a centri- fugal machine. The temperature of this solid under a vacuum of about li mm. is 216° At the still lower temperatures attain able by the aid of liquid hydro- gen it becomes a white solid hav- ing, like solid oxygen, a faint blue tint. The refractive index of liquid air is 1-2068.*~~

~~*Fluorine, prepared in the free state by Moissan's method of electrolysing a solution of potas- sium fluoride in anhydrous hydro- fluoric acid, was liquefied in the laboratories of the Eoyal Institution, London, in 1897. Exposed to the temperature of quietly — boiling liquid oxygen, the gas did not change its state, though it lost much of its chem- ical activity, and ceased to at- tack glass. But a very small vacuum formed over the oxygen was sufficient to determine lique- faction, a result which was also obtained by cooling the gas to the temperature of freshly-made liquid air boiling at atmospheric pressure. Hence the boiling point is fixed at about —187° C. The liquid is of a clear yellow colour, possessing great mobility. Its density is 1-14, and its capillarity rather less than that of liquid oxygen. The*~~

~~*liquid, when examined in a thickness of 1 cm., does not show any absorption bands, and it is not attracted by a magnet. Even when cooled to -210° C, it shows no sign of becoming solidified.*~~

~~*Hydrogen. — Liquid hydrogen is the lightest liquid known to the chemist, having a density slightly less than 0-07 as compared with*~~

~~*water, and being six times lighter than liquid marsh-gas, which is next in order of lightness. One litre weighs only 70 grammes, and 1 gramme occupies a volume of 14^15 cc. In spite of its extreme lightness, however, it is easily seen, has a well-defined meniscus,*~~

~~*Fig. 5.— Liquid Hydrogen Machine.*~~

~~*and drops well. At its boiling point the liquid is only 55 times denser than the vapour it is giving off, whereas liquid oxygen in similar condition is 258 times denser than its vapour, and nitrogen 177 times. Its atomic volume is about 14-3, that of liquid oxygen being 13-7, and that of liquid nitrogen 16-6, at their respective boiling points. Its latent heat of vaporization about the boiling*~~

~~point, as deduced from the vapour pressures and helium ther- mometer temperatures, is about 200 units, and the latent heat of fluidity cannot exceed 16 units, hut may be less. Liquid hydrogen has the greatest specific heat of any known body near its melting point, the average being about 6 between the boiling and freezing points. Its surface tension is exceedingly low, about one-fifth that of liquid air at its boiling point, or one-thirty-fifth that of water at ordinary temperatures, and this is the reason that bubbles formed in the liquid are so small as to give it an opalescent appearance during ebullition. The liquid is without colour, and gives no absorption spectrum. Electric sparks taken in the liquid betvveen platinum poles give a spectrum showing the hydrogen lines C.^nd F. bright on. a background of continuous spectrum. Its refractive index at the boiling point has theoretically the value 1-11. It was measured by determining the relative difference of focus for a parallel beam of light sent through a spherical vacuum vessel filled successively with water, liquid oxygen, and liquid hydrogen ; the result obtained was 1'12. Liquid hydrogen is a non-conductor of electricity. The precise determination of its boiling point is a matter of some diffi- culty. The first results obtained from the use of a platinum resist- ance thermometer gave —238° C, while a similar thermometer made with an alloy of rhodium-platinum indicated a value 8 degrees lower. Later, a gold thermometer indicated about —249° C, while with an iron one the result was only —210° C. It was thus evident that electrical resistance thermometers are not to be trusted at these low temperatures, since the laws correlating resistance and temperature are not known for temperatures at and below the boil- ing point of hydrogen, though they are certainly not the same as those which hold good higher up the thermometric scale. The same remarks apply to the use of thermo-electric junctions at such exceptional temperatures. Recourse was therefore had to a con- stant-volume hydrogen thermometer, working under reduced press- ure, experiments having shown that such a thermometer, filled with either a simple or a compound gas (e.g., oxygen or carbonic acid) at an initial pressure somewhat less than one atmosphere, may be relied upon to determine temperatures down to the respective boiling points of the gases with which they are filled. The result obtained was —252° C. Subsequently various other determinations were carried out in thermometers filled with hydrogen derived from different sources, and also with helium, the average value given by the experiments being —252-5° C. (See " The Boiling Point~~

~~of Liquid Hydrogen determined by Hydrogen and Helium Gas Ther- mometers," Proc. Boy. Soc, 7th February 1901.) The critical temperature is about 30° absolute (— 243°C.), and the critical pressure about 15 atmospheres. Hydrogen has not only the lowest critical temperature of all the old permanent gases, but it has the lowest critical pressure. Given a sufficiently low temperature, there- fore, it is the easiest gas to liquefy so far as pressure is concerned. Solid hydrogen has a temperature about 4 degrees less. By ex- haustion under reduced pressure a still lower depth of cold may be attained, and a steady temperature reached less than 16 degrees above the zero of absolute temperature. By the use of high ex- haustion, and the most stringent precautions to prevent the influx of heat, a temperature of 13° absolute (—260° C.) may be reached. This is the lowest steady temperature which can be maintained by the evaporation of solid hydrogen. The solid has a density of about 0'09. Solid hydrogen presents no metallic characteristics, such as were predicted for it by Faraday, Dumas, Graham, and other chemists, and neither it nor the liquid is magnetic.~~

~~Low Tbmpbbatuee Eesbakch.~~

~~The subjection of hydrogen completes the experi- mental proof that all substances can exist in the three states of solid, liquid, and gas, at least so far as concerns those in the hands of the chemist at the beginning of the last decade of the 19th century. But a year or so before hydrogen was obtained in the liquid form, a substance known spectroscopically to exist in the sun from re- searches carried out by Frankland and Lockyer so far back as 1868, was found by Professor W. Ramsay to exist on this earth, though in excessively small quantities, and experiment has shown helium, as the gas is named, to be much less condensible than hydrogen. It has been expanded from a pressure of 80 to 100 atmospheres at the temperature of solid hydrogen without the least indication of liquefaction being perceived, although in this connexion it must be remembered that its exceed- ingly low refractivity would render small drops of the liquid forming in the gas near its critical point very difficult to see. It may, however, be said without much doubt that helium has been cooled to 9° or 10° absolute~~

~~(264° or 263° below zero centigrade) without sign of liquefaction, and the inference is that its critical point is below 9° absolute. This means that its~~

~~*boiling point is about 6° absolute, or one-fourth that of liquid hydrogen. The hope of liquefying the gas must depend on subject- ing it to the same process that has succeeded with hydro- gen, but instead of liquid air under exhaustion being used as the primary cooling agent, liquid hydrogen under exhaustion must be employed, and the resulting liquid collected in vacuum vessels immersed in liquid hydrogen. The practical difficulties and cost of the operation will be very great, but, on the other hand, success would mean the command of a liquid probably boiling within 5 degrees of the absolute zero. If a gas of the same series, still unisolated, may exist (as is not impossible), which has an atomic weight half that of helium, this gas, liquefied in turn by the aid of liquid helium, would bring the ex- perimenter still closer to that zero. The following table embodies the results of experiments and of theory based on them. The third column shows the critical tempera- ture of the gas which can be liquefied by continuous ex- pansion through a regenerative cooling apparatus, the operation being started from the initial temperature shown in the second column, while the fourth column gives the temperature of the resulting liquid. It will be seen that by the use of liquid or solid hydrogen as a cool- ing agent, it should be possible to liquefy a body having a critical temperature of about 6° to 8° on the absolute scale, and a boiling point of about 4° or 6°, while with the aid of liquid helium at an initial temperature of 6° we could liquefy a body having a critical temperature of 2° and a boiling point of 1°.*~~

~~*Table II.*~~

~~*Substance.*~~

~~*Initial Tem- perature. Abs. Degrees.*~~

~~*Critical Tem- perature. Abs. Degrees.*~~

~~*Boiling Points. Abs. Degrees.*~~

~~*(Low red heat) .*~~

~~*(52° C.)*~~

~~*Liquid air under*~~

~~*exhaustion Liquid hydrogen . Solid hydrogen . Liquid helium*~~

~~*760*~~

~~*325*~~

~~*75 20 15*~~

~~*5?*~~

~~*304 130*~~

~~*30 8 6*~~

~~*2 ?*~~

~~*195 (CO2) 86 (Air)*~~

~~*20 (H) 5 (He ?)*~~

~~*4*~~

~~*1 ?*~~

~~*It is to be remarked, however, that even so the physicist would not have attained the absolute zero, and probably he can scarcely ever hope to do so. It is true he would only be a very short distance from it, but it must be remembered that in a thermodynamic sense one degree low down the scale, say at 10° absolute, is equivalent to 30° at the ordinary temperature, and as the experimenter gets to lower and lower temperatures, the difficulties of further advance increase, not in arithmetical but in geometrical progression. Thus the step between the liquefaction of air and that of hydrogen is, thermodynamically and practically, greater than that between the liquefaction of chlorine and that of air, but the number of degrees of temperature that separates the boiling points of the first pair of substances is less than half what it is in the case of the second pair. But the ratio of the absolute boiling points in the first pair of substances is as 1 to 4, whereas in the second pair it is only 1 to 3, and it is this value that expresses the difficulty of the transition.*~~

~~But though Ultima Thule may continue to mock the physicist's efforts, he will long find ample scope for his energies in the investigation of the properties of matter at the temperatures placed at his command by liquid air and liquid and solid hydrogen. Indeed, great as is the senti- mental interest attached to the liquefaction of these refrac- tory gases, the importance of the achievement lies rather in~~

~~the fact that it opens out new fields of research and enormously widens the horizon of physical science, ena- bling the natural philosopher to study the properties and behaviour of matter under entirely novel conditions. This department of inquiry is as yet only in its infancy, but speedy and extensive developments may be looked for, since within recent years several special cryogenic laboratories have been established for the prosecution of such researches, and a liquid air plant is becoming a common adjunct to the equipment of the ordinary chem- ical laboratory. We propose to indicate briefly the general directions in which these inquiries have so far been carried on, but before doing so will call attention to two important manipulative uses to which liquid gases may be turned.~~

~~Production of High Vacua. — The first use of liquid gases is in the production of exceedingly high vacua. If a vessel containing liquid hydrogen be freely exposed to the atmosphere, a rain of snow (solid air) at once sets in ; similarly, if one end of a sealed tube containing ordinary air be immersed in the liquid, the same process takes place, but as now there is no new sup- ply available to take the place of the portion that has solidified and fallen to the bottom of the tube, the pressure in the vessel is quickly reduced to something like one- millionth of an atmosphere, and a vacuum is readily formed of such tenuity that the electric discharge can only be made to pass with great difficulty. Liquid air may be used in the same manner if the tube before sealing is filled with some less volatile gas or vapour, such as sulphurous acid, benzol, or water vapour. The last is the most suita- ble substance to show this rapid production of high vacua by simple cooling. Provided a Geissler tube has platinum poles, and is filled with nothing but vapour of water, it is sufficient to cool a small area of its surface with a~~

~~*sponge containing liquid air to see it pass rapidly through all the phases of striation, and ultimately reach the phosphorescent glow.*~~

~~*Analytic Uses. — The second use of liquid gases is as analytic agents, and for this purpose liquid air is becoming an almost essential laboratory reagent. It is one of the most convenient agents for drying gases and for their purification. If a mixture of gases be subjected to the temperature of liquid oxygen it is obvious that all the con- stituents that are more condensible than oxygen will be reduced to liquid, while those that are less condensible will either remain as a gaseous residue or be dissolved in the liquid obtained. The bodies present in the latter may be separated by fractional distillation, while the contents of the gaseous residue may be further differentiated by the aid of still lower temperatures, such as are obtainable by liquid hydrogen. An apparatus such as the following can be used to separate both the less and the more volatile gases of the atmosphere, the former being obtained from their solution in liquid air by fractional distillation at low pressure, and separation of the condensible part of the distillate by cooling in liquid hydrogen, while the latter are extracted from the residue of liquid air, after the dis- tillation of the first fraction, by allowing it to evaporate gradually at a temperature rising only very slowly.*~~

~~*In Fig. 6, A represents a vacuum-jacketed vessel, containing liquid air ; tliis can be made to boil at reduced pressure and there- fore be lowered in temperature by means of an air-pump, which is in communication with the vessel through the pipe s. The liquid boiled away is replenished when necessary from the reservoir O, p being a valve, worked by handle q, by which the flow along r is*~~

~~*regulated. The vessel B, immersed in the liquid air of A, com- municates with the atmosphere by a ; hence when the temperature of A falls under exhaustion below that of liquid air, the contents of S condense, and if the stop-cock m is kept open, and n shut, air from the outside is continuously sucked in until B is full of liquid, which contains in solution the whole of the most volatile gases of the atmosphere which have passed in through a. At this stage of the operation m is closed and n opened, a passage thus being opened along 6 from A to the remainder of the apparatus seen on the left*~~

~~side of the figure. Here ^ is a vacuum vessel containing liquid hydrogen, and d a three-way cook by which communication can be established either between b and D, between b and e, the tube lead- ing to the sparking-tube g, or between D and e. If now d is ar- ranged so that there is a free passage from 6 to D, and the stop-cock n also opened, the gas dissolved in the liquid in B, together with some of the most volatile part of that liquid, quickly distils over into D, which is at a much lower temperature than B, and some of it condenses there in the solid state. When a small fraction of the contents of B has thus distilled over, d is turned so as to close the passage between D and b and open that between D and e, with the result that the gas in Z) is pumped out by the mercury-pump.~~

~~Jhpump~~

~~riQ. 6.— ApparatoB for Fractional Distillation.~~

~~shovm diagrammatically at F, along the tube e (which is immersed in the liquid hydrogen in order that any more condensible gas car- ried along by the current may be frozen out) to the spM:king-tube or tubes g, where it can be examined spectroscopically. When the apparatus is used to separate the least volatile part of the gases in the atmosphere, the vessel ^ and its contents are omitted, and the tube b made to communicate with the pump through a number of sparking-tubes which can be sealed off successively. The nitrogen and oxygen which make up the bulk of the liquid in B are allowed to evaporate gradually, the temperature being kept low so as to check the evaporation of gases less volatile than oxygen. When most of the oxygen and nitrogen have thus been removed, the stop- cock K is closed, and the tubes partially exhausted by the pump ; spectroscopic examination is made of the gases they contain, and repeated from time to time as more gas is allowed to evaporate from B. The general sequence of spectra, apart from those of nitro- gen, oxygen, and carbon compounds, which are never eliminated by the process of distillation alone, is as follows : — The spectrum of argon first appears, followed by the brightest (green and yellow) rays of krypton. Then the intensity of the argon spectrum wanes and it gives way to that of krypton, until, as Eunge observed, when a Leyden jar is in the circuit, the capillary part of the sparking- tube has a magnificent blue colour, while the wide ends are bright pale yellow. Without a jar the~~

~~*tube is nearly white in the middle and yellow about the poles. As distillation proceeds, the tempera- ture of the vessel containing the residue of liquid air being allowed to rise slowly, the brightest (green) rays of xenon begin to appear, and the krypton rays soon die out, being superseded by those of xenon. At this stage the capillary part of the sparking-tube is, with a jar in circuit, a brilliant green, and it remains green, though less brilliant, if the jar is removed.*~~

~~*An improved form of apparatus for the fractionation is repre- sented in Fig. 7. The gases to be separated, that is, the least volatile part of atmospheric air, enter the bulb B from a gasholder by the tube a with stop-cock c. B, which is maintained at a low temperature by being immersed in liquid hydrogen, A, boiling under reduced pressure, in turn communicates through the tube 6 and stop-cock d vnth a sparking-tube or tubes /, and so on*~~

~~*through e with a mercurial pump. To use the apparatus, stop- cock d is closed and c opened, and gas allowed to pass from the gasholder into B, where it is condensed in the solid form. Stop- cock c then being closed and d opened, gas passes into the ex- hausted tube /, where it is examined with the spectroscope. The vessel D contains liquid air, in which the tube e is immersed in order to condense vapour of mercury which would otherwise pass*~~

~~*Inlef*~~

~~*Topump,*~~

~~*Fig. 7. — Apparatus for continuous Spectroscopic Examination.*~~

~~*from the pump into the sparking-tube. The success of the opera- tion of separating all the gases which occur in air and which boil at different temperatures, depends on keeping the temperature of B as low as possible, as will be understood from the following con- sideration : —*~~

~~*The pressure p, of a gas Ot, above the same material In the liquid state, at temperature T, is given approximately by the formula*~~

~~*logp=^-^,*~~

~~*where A and B are constants for the same material, other gas G" the formula will be*~~

~~*For some*~~

~~*logpi;*~~

~~*and*~~

~~*T*~~

~~*log*~~

~~*—A-Ai+*~~

~~*Bi-B*~~

~~*Now for argon, krypton, and xenon respectively the values of A are 6-782, 6-972, and 6-963, and those of B are 339, 496-3, and 669-2 ; so that for these substances and many others A·Ai is*~~

~~*TD TD*~~

~~*always a small quantity, while — is considerable and increases*~~

~~*as T diminishes. Hence the ratio of p to pi increases rapidly as T diminishes, and by evaporating all the gases from the solid state, and keeping the solid at as low a temperature as possible, the gas that is taken off by the mercurial pump first consists mainly of the substance which has the lowest boiling point, in this case nitrogen, and is succeeded with comparative abruptness by the gas which has the next higher boiling point. Examination of the spectrum in the sparking-tube easily reveals the change from one gas to another, and when that is observed the reservoirs into which the gases are pumped can be changed and the fractions stored separately. Or several sparking-tubes may be arranged so as to form parallel communications between 6 and e, and can be successively sealed off at the desired stages of fractionation.*~~

~~*Chemical Action. — By extreme cold chemical action is enormously reduced, though it may not in all cases be entirely abolished even at the lowest temperatures yet attained; one reason for this diminution of activity may doubtless be sought in the fact that in such conditions most substances are solid, that is, in the state least favour- able to chemical combination. Thus an electric pile of sodium and carbon ceases to yield a current when immersed in liquid oxygen. Sulphur, iron, and other substances can be made to burn under the surface of liquid oxygen if the combustion is properly established before the sample is immersed, and the same is true of a fragment of diamond. Nitric oxide in the gaseous condition combines instantly with free oxygen, producing the highly-coloured gas, nitric*~~

~~*peroxide, but in the solid condition it may be placed in contact with liquid oxygen without showing any signs of chemical action. If the combination of a portion of the mixture is started by elevation of temperature, then detonation may take place throughout the cooled mass. The stability of*~~

~~*endothermic bodies like nitric oxide and ozone at low temperatures requires further investigation. The behaviour of fluorine, which may be regarded as the most active of the elements, is instructive in this respect. As a gas, cooled to —180° C. it loses the power of attacking glass; similarly silicon, borax, carbon, sulphur, and phos- phorus at the same temperature do not become incandes- cent in an atmosphere of the gas. Passed into liquid oxygen, the gas dissolves and imparts a yellowdsh tint to the liquid ; if the oxygen has been exposed to the air for some hours, the fluorine produces a vfhite floceulent pre- cipitate, which if separated by filtering deflagrates with violence as the temperature rises. It appears to be a hy- drate of fluorine. As a liquid at —210° fluorine attacks turpentine also cooled to that temperature with explosive force and the evolution of light, while the direction of a jet of hydrogen upon its surface is immediately followed by combination and a flash of flame. A far more severe test of chemical action would be effected by mixing liquid or solid fluorine and liquid hydrogen, but this experiment has yet to be made.*~~

~~*PhotogrwpMc Action. — The action of light on photo- graphic plates, though greatly diminished at —180°, is far from being in abeyance ; an Eastman film, for instance, remains fairly sensitive at —210°. At the still lower temperature of liquid hydrogen the photographic activity is reduced to about half what it is at that of liquid air ; in other words, about 10 per cent, of the original sensitivity remains. Experiments carried out with an incandescent lamp, a Rontgen bulb, and the ultra-violet spark from magnesium and cadmium, to discover at vrhat distances from the source of light the plates must be placed in order to receive an equal photographic impression, yielded the following results : —*~~

~~*Source of JAght.*~~

~~*Cooled Plate.*~~

~~*Uncooled Plate.*~~

~~*Ratio of Intensities at Balance.*~~

~~*16 C.P. lamp Rontgen bulb Ultra-violet spark*~~

~~20 in. 10 in. 22i in.~~

~~60 in. 24fin. 90 in.~~

~~1 to6 1 to6 ltol6~~

~~It appears that the photographic action of both the incandescent lamp and the Rontgen rays is reduced by the temperature of liquid air to 17 per cent, of that exerted at ordinary temperatures, while ultra-violet radiation retains only 6 per cent. It is possible that the greater dissipation of the latter by the photo- graphic film at low temperatures than at ordinary ones is due to its absorption and subsequent emission as a phosphorescent glow, and that if the plate could be developed at a low temperature it would show no effect, the photographic action taking place subsequently through an internal phosphorescence in the film during the time it is heating up. With regard to the transparency of bodies to the Eontgen radiation at low temperatures, small tubes of the same bore, filled with liquid argon and chlorine, potassium, phosphorus, aluminium, silicon, and sulphur, were exposed at the temperature of liquid air (in ordev to keep the argon and chlorine solid), in front of a photographic plate shielded with a sheet of aluminium, to an X-ray bulb. The sequence of the elements as mentioned represents the order of increasing opacity observed in the shadows. Sodium and liquid oxygen and air, nitrous and nitric oxides, proved much more transparent than chlorine. Tubes of potassium, argon, and liquid chlorine showed no very marked difference of density on the photographic~~

~~plates. It appears that argon is relatively more opaque to the Eontgen radiation than either oxygen, nitrogen, or sodium, and is on a level with potassium, chlorine, phos- phorus, aluminium, and sulphur. This fact may be re- garded as supporting the view that the atomic weight of argon is twice its density relative to hydrogen, since in general the opacity of elements in the solid state increases with the atomic weight.~~

~~/%ospftoresce?i.ce.— Phosphorescing sulphides of calcium, which are luminous at ordinary temperatures, and whose emission of light is increased by heating, cease to be luminous if cooled to — 80° C. But their light energy is merely rendered latent, not destroyed, by such cold, and they still retain the capacity of taking in light energy at the low temperature, to be evolved again when they are warmed. At the temperature of liquid air many bodies become phosphorescent which do not exhibit the pheno- menon at all, or only to a very slight extent, at ordinary temperatures, e.g., ivory, indiarubber, egg-shells, feathers, cotton-wool, paper, milk, gelatine, white of egg, &c. Of definite chemical compounds, the platinocyanides among the inorganic bodies seem to yield the most brilliant effects. Crystals of ammonium platinocyanide, if stimu- lated by exposure to the ultra-violet radiation of the electric arc, while kept moistened with liquid air, maybe seen in the dark to glow faintly so long as they are kept cold, but become exceedingly brilliant when the liquid air evaporates and the temperature rises. Among organic bodies the phenomenon is particularly well marked with the ketonic compounds and others of the same type. The chloro-, bromo-, iodo-, sulpho-, and nitro-compounds show very little effect as a rule. The activity of the alcohols, which is usually considerable, is destroyed by the addi- tion of a little iodine. Coloured salts, &c., are mostly inferior in activity to white ones. When the lower tem- perature of liquid hydrogen is employed there is a great increase in phosphorescence under light stimulation as compared with that observed with liquid air. The radio-active bodies, like radium, which exhibit self-luminosity in the dark, maintain that luminosity unimpaired when cooled in liquid hydrogen.~~

~~Some crystals become for a time self-luminous when placed in liquid hydrogen, because the high electric stimu- lation due to the cooling causes actual electric discharges between the crystal molecules. This phenomenon is very pronounced with nitrate of uranium and some platino- cyanides, and cooling such crystals even to the tempera- ture of liquid air is sufficient to develop marked electrical and luminous effects, which are again observed, when the crystal is taken out of the liquid, during its return to nor- mal temperature. Since both liquid hydrogen and liquid air are good electrical insulators, the fact that electric discharges take place in them proves that the electric potential generated by the cooling must be very high. A crystal of nitrate of uranium indeed gets so highly charged electrically that it~~

~~*refuses to sink in liquid air, although its density is 2-8 times greater, but sticks to the side of the vacuum vessel, and requires for its displace- ment a distinct pull on the silk thread to which it is attached. Such a crystal quickly removes cloudiness from liquid air by attracting all the suspended particles to its surface, just as a fog is cleared out of air by electri- fication. It is interesting to observe that neither fused nitrate of uranium nor its solution in absolute alcohol shows any of the remarkable effects of the crystalline state on cooling.*~~

~~*Cohesion. — The physical force known as cohesion is greatly increased by low temperatures. This fact is of much interest in connexion with two conflicting theories of matter. Lord Kelvin's view is that the forces that hold together the ultimate particles of bodies may be accounted*~~

~~*for without assuming any other forces than that of gravi- tation, or any other law than the Newtonian. An opposite view is that the phenomena of cohesion, chemical union, &c., or the general phenomena of the aggregation of mole- cules, depend on the molecular vibrations as a physical cause (Tolver Preston, Physics of the Ether, ^ p. 64). Hence at the zero of absolute temperature, this vibrating energy being in complete abeyance, the phenomena of cohesion should cease to exist and matter generally be reduced to an incoherent heap of " cosmic dust." This second view receives no support from experiment. Atmospheric air, for instance, frozen at the temperature of liquid hydrogen, is a hard solid, the strength of which gives no hint that with a farther cooling of some 20 degrees it would crumble into powder. On the contrary, the lower the scale of temperature is descended, the more powerful become the forces which hold together the particles of matter. A spiral of fusible metal, which at ordinary temperatures cannot support the weight of an ounce without being straightened out, will, when cooled to the temperature of liquid oxygen, and so long as it remains in that cooled condition, support several pounds and vibrate like a ste(4 spring. Similarly a bell of fusible metal at — 182° C. gives a distinct metallic ring when struck. Balls of iron, lead, tin, ivory, &c., thus cooled, exhibit an increased rebound when dropped from a height ; an indiarubber ball, on the other hand, becomes brittle, and is smashed to atoms by a very moderate fall. The following tables, which give the mean results of a large*~~

~~*number of experi- ments, show the increased breaking stress gained by metals while they are cooled to the temperature of liquid oxygen.*~~

~~*Table III.*~~

~~*Breaking stress in pounds diameter : —*~~

~~*Steel (soft) . Iron Copper . Brass . German silver Gold . Silver .*~~

~~*of metallic vrires 0-098 inch in*~~

~~*)- 1.5° C.*~~

~~*420 320 200 310 470 255 330*~~

~~*- 182° C.*~~

~~*700 670 ‘ 300 440 600 340 420*~~

~~*Table IV.*~~

~~*Breaking stress in pounds of cast metallic test-pieces ; diameter of rod — 0-2 incli.*~~

~~*+ 15° 0. — 182° C.*~~

~~*Tin*~~

~~*Lead .*~~

~~*Zinc*~~

~~*Mercury*~~

~~*Bismuth*~~

~~*Antimony*~~

~~*Solder .*~~

~~*Fusible metal (Wood)*~~

~~*200*~~

~~*77*~~

~~*35*~~

~~*0*~~

~~*60*~~

~~*61*~~

~~*300*~~

~~*140*~~

~~*390*~~

~~*170*~~

~~*26*~~

~~*31*~~

~~*30*~~

~~*30*~~

~~*645*~~

~~*450*~~

~~*In the second series of experiments the test-pieces were 2 inches long and were all cast in the same mould. It will be noticed that in the cases of zinc, bismuth, and antimony the results appear to be abnormal, but it may be pointed out that it is difficult to get uniform castings of crystalline bodies, and it is probable that by cooling such stresses are set up in some set of*~~

~~cleavage planes as to render rupture comparatively easy. In the case of strong steel springs the rigidity modulus does not appear to be greatly affected by cold, for although a number were examined, no measurable differences could be detected in their elongation under repeated additions of the same load. No quantitati-i^e experiments have been made on the cohesive properties of the metals at the temperature of boiling hydrogen (— 252°), owing to the serious cost that would be involved. A lead wire cooled in liquid hydrogen did not become brittle, as it could be bent backwards and forwards in the liquid.~~

~~Electrical Resistivity. — The first experiments on the con- ductivity of metals at low temperatures appear to have been made byWroblewski {Gomptes Senclus, vol. ci. p. 160), and by Cailletet and Bouty {Journ. de PJiys. 1886, p. 297). The former's experiments were undertaken to test the~~

~~15.000 -j~~

~~Fjo. 8.-~~

~~00 -250 -200 -150 -100 -50. 0 *W *m *ISO tZOO~~

~~TEMPERATURE TM PLATINUM DEGREES.'~~

~~-Chart of the Variation of Electrical Eesistance of Pure Metals and Alloys with Temperature. (Itewarand Fiemirif:.)~~

~~suggestion made by (]lausius that the resistivity of pure metals is sensibly proportional to the absolute tempera- ture; he worked with c.ojiper having a conductibility of 98 per cent., and carried out measurements at various temperatures, the lowest of which was that given by liquid nitrogen boiling under reduced pressure. HIs general conclusion was that the resistivity decreases much~~

more quickly than the absolute temperature, so as to approach zero at a point not far below the temperature of nitrogen evaporating in vacuo. Cailletet and Bouty, using ethylene as the refrigerant, and experimenting at temperatures ranging from 0° C.to -100° C. and 123° C, constructed formulae intended to give the coefScients of variation in electrical resistance for mercury, tin, silver, magnesium, aluminium, copper, iron, and platinum. Between 1892 and 189G Dewar and Fleming carried out a large number of experiments to ascertain the changes of conductivity that occur in metals and alloys cooled in liquid air or oxygen to —200° C. The method employed was to obtain the material under investigation in the form of a fine regular wire and to wind it in a small coil ; this was then plunged in the liquid and its resist ance determined. The accompanying chart (Fig. 8) gives the results in a compendious form, the temperatures being expressed not in degrees of the ordinary air- thermometer scale, but in platinum degrees as given by one particular platinum resistance thermometer which was used throughout the investigation. Atableshowingthe value of these degrees in degrees centigrade according to Dickson will be found in the Phil. Mag. for June 1898, p. 527 ; to give some idea of the relationship, it may be stated here that —100° of the platinum ther- mometer = -94°-2 C, -150° plat. = -140°-78 C, and —200° plat. = — 185°-53 C. In general, the resistance of perfectly pure metals was greatly decreased by cold- — so much so that, to judge by the course of the curves on the chart, it appeared probable that at the zero of abso- lute temperature resistance would vanish altogether and all pure metals become perfect conductors of electricity. This conclusion, however, has been rendered very doubt- ful by subsequent observations by Dewar, who found that with the still lower temperatures attainable with liquid hydrogen the increases of conductivity became less for each decrease of temperature, until a point was reached where the curves bent sharply round and any further diminution of resistance became very small ; that is, the conductivity remained finite. The reduction in resistance of some of the metals at the boiling point of hydrogen is very remarkable. Thus copper has only y-^th, gold -j\th, platinum ^ᵗ to xjf^, silver -j^jth the resistance at melting ice, but iron is only reduced to ^th part of the same initial resistance. Table V. shows the progressive decrease of resistance for certain metals and one alloy as the temperature is lowered from that of boiling water down to that of liquid hydrogen boiling under reduced pressure ; it also gives the " vanishing temperature," at which the

~~conductivity would become perfect if the resistance continued to decrease in the same ratio with still lower temperatures, the values being derived from the extrapolation curves of the relation between resistance and temperature, according to Callendar and Dickson. It will be seen that many of the substances have actually been cooled to a lower temperature than that at which their resistance ought to vanish.~~

~~In the case of alloys and impure metals, cold brings about a much smaller decrease in resistivity, and the continuations of the curves at no time show any sign of passing through the zero point. The influence of the presence of impurities in minute quantities is strikingly shown in the case of bismuth. Various specimens of this metal, prepared with great care by purely chemical methods, gave in the hands of Dewar and Fleming some very anomalous results, appearing to reach at —80° C. a maximum of conductivity, and thereafter to increase in resistivity with decrease of temperature. But when the determinations were carried out on a sample of really pure bismuth prepared electrolytically, a normal curve~~

~~was obtained corresponding to that given by other pure metals. As to alloys, there is usually some definite mixture of two pure metals which has a maximum resist- ivity, often greater than that of either of the constituents. It appears too that high, if not the highest, resistivity corresponds to possible chemical compounds of the two metals employed, e.g., platinum 33 parts with silver 66 parts = PtAg4 ; iron 80 with nickel 20 = 'E&^i ; plati- num 80 with iridium 20 = IrPti ; and copper 70 with manganese 30 = CujMn. The product obtained by adding~~

~~Table~~

~~a small quantity of one metal to another has a higher specific resistance than the predominant constituent, but the curve is parallel to, and therefore the same in shape as, that of the latter (cf. the curves for various mixtures of Al and Cu on the chart) . The behaviour of carbon and of insulators like guttapercha, glass, ebonite, &c., is in complete contrast to the metals, for~~

~~*their resistivity steadily increases with cold. The thermoelectric properties of metals at low temperatures are discussed in the article Thermoelectricity.*~~

~~*V.*~~

~~*Metals.*~~

~~*Platinum.*~~

~~*Platinum- rhodium Alloy.*~~

~~*GoW.*~~

~~*Sliver.*~~

~~*Copper.*~~

~~*Iron.*~~

~~*Resistance at 100° C. . . . .*~~

~~*39-655*~~

~~*36-87*~~

~~*16-10*~~

~~*8-336*~~

~~*11-572*~~

~~*4-290*~~

~~*0°C*~~

~~*28-851*~~

~~*31-93*~~

~~*11-58*~~

~~*5-990*~~

~~*8-117*~~

~~*2-765*~~

~~*,, carbonic acid .*~~

~~*19-620*~~

~~*,, liquid oxygen ....*~~

~~*7-662*~~

~~*22-17*~~

~~*3 -.380*~~

~~*1-669*~~

~~*1-589*~~

~~*0-633*~~

~~*,, ,, nitrogen ....*~~

~~*1-149*~~

~~*,, ,, oxygen under exhaustion .*~~

~~*4-634*~~

~~*20-73*~~

~~*,, ,, hydrogen ....*~~

~~*0-826*~~

~~*18-96*~~

~~*0-.381*~~

~~*0-244*~~

~~*0-077*~~

~~*0-356*~~

~~*,, ,, hydrogen under exhaustion*~~

~~*0-705*~~

~~*18-90*~~

~~*0-298*~~

~~*0-226*~~

~~*0-071*~~

~~*Resistance coefficients*~~

~~*0-008745*~~

~~*0-00.3607*~~

~~*0-003903*~~

~~*0-003917*~~

~~*0-004257*~~

~~*0-005515*~~

~~*Vanishing temperatures (centigrade) . . |*~~

~~*- 244° -50 -244° -15*~~

~~*- 543° -39*~~

~~- 530°-32~~

~~- 257°-90 -257° -8~~

~~- 252° -26~~

~~- 252°-25~~

~~- 225°-62 -226° -04~~

~~- 2.58°-40 C. -240°-80D.~~

~~*Magnetic Phenomena.* — Low temperatures have very marked effects upon the magnetic properties of various substances. Oxygen, long known to be slightly magnetic in the gaseous state, is powerfully attracted in the liquid condition by a magnet, and the same is true, though to a less extent, of liquid air, owing to the proportion of liquid oxygen it contains. A magnet of ordinary carbon steel has its magnetic moment temporarily increased by cooling, that is, after it has been brought to a permanent magnetic condition (" aged "). The effect of the first immersion of such a magnet in liquid air is a large diminution in its magnetic moment, which decreases still further when it is allowed to warm up to ordinary temperatures. A second cooling, however, increases the magnetic moment, which is again decreased by warming, and after a few repetitions of this cycle of cooling and heating the steel is brought into a condition such that its magnetic moment at the temperature of liquid air is greater by a constant percentage than it is at the ordinary temperature of the air. The increase of magnetic moment seems then to have reached a limit, because on further cooling to the temperature of liquid hydrogen hardly any further increase is observed. The percentage differs with the composition of the steel and with its physical condition. It is greater, for example, with a specimen tempered very soft than it is with another specimen of the same steel tempered glass hard. Aluminium steels show the same kind of phenomena as carbon ones, and the same may be said of chrome steels in the permanent condition, though the effect of the first cooling with them is a slight increase of magnetic moment. Nickel steels present some curious phenomena. When containing small percentages of nickel (e.g., 0-84 or 3-82), they behave under changes of temperature much like carbon steel. With a sample containing 7-65 per~~

~~cent., the phenomena after the per- manent state had been reached were similar, but the first cooling produced a slight increase in magnetic moment. But steels containing 18-64 and 29 per cent, of nickel behaved very differently. The result of the first cooling was a reduction of the magnetic moment, to the extent of nearly 50 per cent, in the case of the former. Warming again brought about an increase, and the final condition was that at the temperature of liquid air the magnetic moment was always less than at ordinary temperatures. This anomaly is all the more remarkable in that the behaviour of pure nickel is normal, as also appears to be~~

~~generally the case with soft and hard iron. Silicon, tungsten, and manganese steels are also substantially normal in their behaviour, although there are consider- able differences in the magnitudes of the variations they display (Proc. Boy. Sac. vol. Ix. pp. 67 et seq.y~~

~~Low temperatures also affect the permeability of iron, i.e., the degree of magnetization it is capable of acquiring under the influence of a certain magnetic force. With fine Swedish iron, carefully annealed, the permeability is slightly reduced by cooling to 186° C. Hard iron, how ever, in the same circumstances suffers a large increase of permeability. Unhardened steel pianoforte wire, again, behaves like soft annealed iron. As to hysteresis, low temperatures appear to produce no appreciable effect in soft iron ; for hard iron the observations are undecisive.~~

~~Biological Research. — The effect of cold upon the life of living organisms is a matter of great intrinsic interest as well as of wide theoretical importance. Experiment indicates that moderately high temperatures are much more fatal, at least to the lower forms of life, than are exceedingly low ones. Professor M'Kendrick froze for an hour at a temperature of -182° C. samples of meat, milk, &c., in sealed tubes ; when these were opened, after being kept at blood-heat for a few days, their contents were found to be 'quite putrid. More recently some more elaborate tests were carried out at the Jenner Institute of Preventive Medicine on a series of typical bacteria. These were exposed to the temperature of liquid air for twenty hours, but their vitality was not affected, their functional activitiesremainedunimpaired, andthecultures which they yielded were normal in every respect. The same result was obtained when liquid~~

hydrogen was substituted for air. A similar persistence of life has been demonstrated in seeds, even at the lowest temperatures ; they were frozen for over 100 hours in liquid air at the instance of Messrs Brown and Escombe, with no other effect than to aflB-ict their protoplasm with a certain inertness, from which it recovered with warmth. Subsequently commercial samples of barley, peas, and vegetable-marrow and mustard seeds were literally steeped for six hours in liquid hydrogen at the Eoyal Institution, yet when they were sown by Sir W. T. Thiselton Dyer at Kew in the ordinary way, the proportion in which germination occurred was no smaller than with other batches of the same seeds which had suffered no abnormal treatment. Mr. Harold Swithin- bank has found that exposure to liquid air has little or

no effect on the vitality of the tubercle bacillus, although by very prolonged exposures its virulence is modiiied to some extent ; but alternate exposures to normal and very cold temperatures do have a decided effect both upon its vitality and jts virulence. The suggestion once put for- ward by Lord Kelvin, that life may in the first instance have been conveyed to this planet on a meteorite, has been objected to on the ground that any living organism would have been killed before reaching the earth by its passage through the intense cold of interstellar space ; the above experiments on the resistance to cold offered by seeds and bacteria show that this objection at least is not fatal to Lord Kelvin's idea.

At the Jenner Institute of Preventive Medicine liquid air has been brought into use as an agent in bio- logical research. An inquiry into the intracellular con- stituents of the typhoid bacillus, initiated under the direction of Dr Allan Macfadyen, necessitated the sepa- ration of the cell-plasma of the organism. The method at first adopted for the disintegration of the bacteria was to mix them with silver-sand and churn the whole up in a closed vessel in which a series of horizontal vanes revolved at a high speed. But cer- tain disadvantages attached to this procedure, and ac- cordingly some means were sought to do away with the sand and triturate the bacilli per se. This was found in liquid air, which, as had long before

~~been shown at the Eoyal Institution, has the power of reducing materials like grass or the leaves of plants to such a state of brittleness that they can easily be powdered in a mortar. By its aid a complete trituration of the typhoid bacilli has been accomplished at the Jenner Institute, and the same process, already applied with success also to yeast cells and animal cells, is being extended in other directions.~~

~~Industrial Applications. — While liquid air and liquid hydrogen are being used in scientific research to an extent which increases every day, but few applications to industrial purposes can as yet be reported. The temperatures they give used as simple refrigerants are much lower than are generally required iiidustrially, and such cooling as is needed can be obtained quite satisfactorily, and far more cheaply, by refrigerating machinery employing more easily condensible gases. Their use as a source of motive power, again, is impracticable for any ordinary purposes, on the score of inconvenience and expense. Cases may be conceived of in which for special reasons it might prove advantageous to use liquid air, vaporized by heat derived from the surrounding atmosphere, to drive compressed- air engines, but any advantage so gained would certainly not be one of cheapness. No doubt the power of a waterfall running to waste might be temporarily con- served in the shape of liquid air, and thereby turned to useful effect. But the reduction of air to the liquid state is a process which involves the expenditure of a very large amount of energy, and it is not possible even to recover all that expended energy during the transition of the material back to the gaseous state. Hence to suggest that by using liquid air in a motor more power can be developed than was expended in producing the liquid air by which the motor is worked, is to propound a fallacy worse than perpetual motion, since such a process would have an efficiency of more than 100 per cent. Still, in conditions where economy is of no account, liquid air might perhaps, with effectively isolated storage, be utilized as a motive power, e.g., to drive the engines of submarine boats and at the same time provide a supply of oxygen for the crew ; even without being used in the engines, liquid air or oxygen might be found a convenient form in which to store the air necessary for respiration in such vessels. A use to~~

~~*which liquid air machines have already been put to a limited extent is for obtaining oxygen from the atmo- sphere. Although when air is liquefied the oxygen and nitrogen are condensed simultaneously, yet owing to its greater volatility the latter boils off the more quickly of the two, so that the remaining liquid becomes gradually richer and richer in oxygen. The production of such highly oxygenated air was the object Linde had in view in constructing his liquid air machines, and it would find important applications in metallurgical and other opera- tions, if only it could be produced at a sufficiently low cost. Pictet also has patented an apparatus designed to attain the same end, but no account of the practical results has api^eared. Mention may be made of one interesting though minor application of this denitro- genized air, which is substantially liquid oxygen. If it be mixed with powdered charcoal, or finely divided organic bodies, it forms a liquid oxygen sponge which can be made by the aid of a detonator to explode with a violence comparable to that of dynamite. This explosive, which might properly be called an emergency one, has the dis- advantage that it must be prepared on the spot where it is to be used and must be fired without delay, since the liquid evaporates in a short time and the explosive power is lost ; but, on the other hand, if a charge fails to go off it has only to be left a few minutes, when it can be with- drawn without any danger of accidental explosion. Satisfactory results are claimed for experiments carried out with this substance in a coal mine at Pensberg, near Munich, and it has been used in the Simplon Tunnel works between Brigue and Domo d'Ossola.*~~

~~*For further information the reader may consult Hakdin, Bise and Development of the Liquefaction of Gases (New York, 1899), and LEFivKE, La liquefaction des gaz et ses applications ; also the article Condensation of Gases in these volumes. But the literature of liquid gases is mostly contained in scientific periodicals and the proceedings of learned societies. Papers by Wroblewski and Olszewski on the liquefaction of oxygen and nitrogen may be found in the Comptes Bendus, vols, xcvi.cii., and there are im portant memoirs by the former on the relations between the gaseous and liquid states and on the compressibility of hydrogen in Wien. Alcad. Sitzher. vols. xciv. and xcvii. ; his pamphlet Comme I'air a ete liquefie (Paris, 1885) should also be referred to. For Dewar's work, see Proc. Boy. Inst, from 1878 onwards, including " Solid Hydrogen," 1900; also "The Nadir of*~~

~~*Temperature and Allied Problems" (Bakerian Lecture), Proc. Boy. Soc, 1901. The researches of Fleming and Dewar on the electrical and magnetic properties of substances at low temperatures are described in Proc. Boy. Soc. vol. Ix., and Proc. Boy. List., 1896; see also "Electrical Resistance of Pure Metals, Alloys, and Non-Metals at tlie Boiling-Point of Oxygen," Phil. Mag. vol. xxxiv. (1892) ; "Electrical Resistance of Metals and Alloys at Temperatures approaching the Absolute Zero," ib. vol. xxxvi. (1893) ; " Thermo- electric Powers of Metals and Alloys between the Temperatures of the Boiling-Point of Water and the Boiling-Point of Liquid Air," ib. vol. xl., 1895; and papers on the dielectric constants of various substances at low temperatures in Proc. Boy. Soc. vols. Ixi. and Ixii. Optical and spectroscopic work by Liveing and Dewar on liquid gases is described in Pliil. 3Iag. vols, xxxiv. (1892), xxxvi. (1893), xxxviii. (1894), and xl. (1895); for papers by the same authors on the separation and spectroscopic examina- tion of the most volatile and least volatile constituents of atmo- spheric air, see Peoc. iilo!/. jSoc. vols. Ixiv., Ixvii., and Ixviii. An account of the influence of very low temperatures on the germina- tive power of seeds is given by Brown and EscoarsE in Proc. Boy. Sue. vol. Ixii., and by Thiselton Dtek, ib. vol. Ixv., and their effect on bacteria is discussed by Maopadyen, ib. vol. Ixvi. (j. Djj.)*~~

~~*Liquor Laws. — No period in history has been so fruitful in progressive liquor legislation as the decades since about 1880. The laws enacted, as well as the pro- posed legislation agitated before nearly every civilized government, reflect both a growing public consciousness of the evils of the drink traffic and determined efforts to overcome them. The modern tendency is to combat these evils by restrictive measures rather than by attempting a*~~

~~*mono- polies.*~~

~~*general suppression of the sale of intoxicants, and to give the local community the right to choose between licence and the prohibition of the traffic, instead of applying prohibitory laws to entire states or countries.*~~

~~*The liquor laws meriting special attention may be referred to three categories : I. the group of wholly new depart- ures in the form of private or state monopolies ; II. local option laws; and III. the various groups of licence laws.*~~

~~*I. The Scandinavian experiments, commonly designated as the Gothenburg System, the most widely known of Private modern liquor laws, afford a remarkable illus- aad state tration of the power of wise national legislation combined with national temperance efforts to reduce the consumption of liquor. Although the original Gothenburg plan dates from 1865, it was not generally introduced throughout Sweden until 1880 ; the Norwegian adoption of it followed some time later. In both countries the central principle of the system is the elimination of private profit from the drink traffic by granting a monopoly of the retail sale of spirits to local corporations, under restrictions which prevent it from becoming a source of private enrichment, and which generally safeguard public interests both from the temper- ance and pecuniary point of view. In Norway especially the law of 1894, which expresses the advanced temperance opinion of the country, has enhanced the usefulness of the liquor corporations (samlag) and minimized the danger of abuses in administration. The non-inclusion of malt beverages and wine under the monopoly is perhaps the most serious obstacle to the success of the system as a means of combating intemperance. Nevertheless it is mainly due to the monopoly that the annual consumption of spirits in Sweden has been reduced to a third of what it was in 1850, and in Norway to a third of what it was in 1876. The Gothenburg plan has been followed in Finland, and has been experimented with by private associations in Great Britain.*~~

~~*The Government spirit monopoly in Russia owes its inception to Emperor Alexander III. It was, however, not introduced until January 1895, and then experimentally in four of the eastern provinces. The law became appli- cable to the entire empire in 1896, and is operative in about forty provinces with a total population of about seventj^- five millions. The introduction of the monopoly, which was hastened by the famine of 1891 and the lamentable conditions it revealed, was not, it has been officially declared, for the purpose of increasing the drink revenue, but in order (1) " to save the peasantry from ruin " by protecting it from exploitation by persons*~~

~~*licensed to sell spirits, and (2) to diminish drunkenness. Under the monopoly, which controls only the sale of spirituous liquors, spirits are retailed at the shops and depots of the Government and at traktirs (establishments supplying both food and drink), restaurants and private resorts which sell on a Government commission. Except at a few restaurants of the highest class in cities and at rail- way stations, spirits are sold only in sealed bottles for consumption off the premises. In 1898 the Government licensed 357 wholesale and 17,240 retail shops. A sweep- ing reduction of places where liquor may be sold has everywhere followed the introduction of the monopoly. In several provinces the Goverrunent has endeavoured to establish tea-houses as counter-attractions to the grog-shops, by granting small subsidies to be expended by local temperance committees. In an address to the Emperor, under date of January 1899, the Russian minister of finance, having referred to the fact that as the people become accustomed to the new regime the consumption of spirits, which at first diminished, is reverting to the former figures, nevertheless continues: "The reports*~~

~~*addressed to your majesty by the governors of the prov- inces where the new system is in force, and the accounts communicated to the minister of finance by the highest ecclesiastical authorities, by the officials of the nobility, by the zemstvos, and by the municipalities, are almost unanimous in bearing evidence to the salutary effects of the reform. . . . Drunkenness has perceptibly dimin- ished." The revenue from the system is much larger than was anticipated, the net profit in 1898 being about £3,000,000.*~~

~~*The Dispeyisary System, which is peculiar to the United States, takes either the form of a State monopoly of the retail traffic in alcoholic liquors, as in South Carolina, or the form of a local monopoly, as in North Carolina, Georgia, and Alabama, where the local communities can adopt the system or not, as they may determine. Under both forms the retail rate of alcoholic drink is taken out of private hands and carried on in dispensaries. In South Carolina, under an Act of 1892, variously amended from time to time, the state monopoly is man- aged by a state board of control of five members elected by the General Assembly : it appoints the county boards of control as well as a state commissioner, from whom all liquors sold by the local dispensers must be pur- chased. Liquors may only be sold for cash, between*~~

~~*sunrise and sundown, in sealed packages containing not less than one half-pint or more than five gallons. Similar restrictions apply to the sale of malt beverages. The state virtually controls the distillation of spirits within its borders. The monopoly has a twofold aim : (1) to reduce the evil of the drink traffic by taking it out of private hands, and (2) to retain the entire profit for state and municipal purposes. Determined hostility to the system, mismanagement of its affairs, and adverse court decisions with regard to its constitutionality, have at different times come perilously near wrecking the monopoly. Now that the Dispensary Act has been upheld by the United States Supreme Court, the permanency of the system seems fairly well assured. Whatever the difference of opinion may be concerning the effect of the system on the consumption of spirits and public intoxica- tion, it undoubtedly possesses some advantages of great merit which are more or less incident to any system that eliminates from the trafficthe element of private profits. It has effected numerous administrative reforms of far-reach- ing consequence; it has abolished the saloon with its many dangerous accessories, and with it the domination of whisky rings in politics has become a thing of the past. A wise adjustment of the relation of the state to the local community is difficult under the South Carolina system, as under any state monopoly. As a revenue producer the system has not fulfilled expectations.*~~

~~*The Swiss Alcohol MonoiMly of 1897 controls the importation, manufacture, and wholesale distribution of spirits in quantities of not less than 40 litres. The sale of liquor in smaller quantities is not regulated by the monopoly, but is subject to taxes imposed by the various cantons. In general the taxes are about three times higher than before 1887. The monopoly has suppressed the evil of the many small stills in agricultural districts, whose product, owing to primitive methods of manufac- ture and lack of rectification, found no market, but was consumed where produced, and caused much drunkenness. By abolishing cantonal and communal duties on beer and wine, as well as by removing other restrictions on their sale in quantities of more than two litres, the Government has carried out its policy of supplanting the use of spirits by that of fermented beverages. In consequence, a notable increase has taken place in the consumption of beer, while the consumption of spirits has decreased about 25 per cent. The law requires that one-tenth of the*~~

~~option laws.~~

~~revenue from the monopoly shall be applied to counteract alcoholism.~~

~~II. The princijDal of local option, or the right of the local community to forbid the sale of liquor within its own borders, has gained wide recognition and Local sanction, particularly in the United States,~~

~~where it may be said to have become the alter- native system to state prohibition and is sup- planting the latter in popular favour. The right of choice between licence and local prohibition does not, however, imply an exercise of this right. All states with local option have some form of licence, the right to prohibit the traffic being exercised only in certain locali- ties, even if applicable to all. In seventeen states local option is by direct popular vote applicable to all locali- ties, both urban and rural ; in six states by direct popular vote applicable to certain localities, or rural districts only; nine states have indirect local option, i.e., through discretionary powers vested in city councils and other elective bodies ; and in five states the right to vote is by " remonstrance," and by requiring the consent of quali- fied electors, property -holders, &c. Within the particular areas to which it has been applied, local option has, on the whole, been a success. It has banished the liquor traffic from immense areas. Moreover, the enforcement of the popular will as expressed in the vote has generally been free from the demoralizing effects attending attempts to suppress the traffic in cities under state prohibition. The value of local prohibition in populous centres, except where they have a safety valve through adjoining towns under licence, remains to be demonstrated.~~

~~In the Dominion of Canada, under the so-called Scott Act of 1878, which is a Federal law, counties and cities can by a majority vote prohibit the retail sale of liquor within their boundaries. Several provincial laws also recognize the principle of local option, but can only be taken advantage of by localities that have refused to adopt the prohibitory clauses of the Scott Act. Under provin- cial legislation, local option is usually exercised through~~

~~*discretionary powers vested in the licensing authorities. Local prohibition is successfully enforced throughout wide rural districts of the Dominion.*~~

~~*In Norway local vote on the retail traffic in spirits has been exercised in rural districts since 1845. By the law of 1894, however, which requires all retail trade in spirits to be placed under the monopolies (samlag), the establish- ment of a new samlag, or even the continuance of an old one, is made dependent upon a general vote of all resi- dents in the district, both men and women, over twenty- five years of age ; and the decision is binding for five years. All rural districts and about one-half of the towns are now under local prohibition. Practically the whole of rural Sweden is under local prohibition by virtue of a law of 1855.*~~

~~*New Zealand and Queensland are the two Australasian colonies granting full powers of local op)tion, but little advantage has been taken of the privilege. Limited option prevails in the other colonies, with the exception of Tasmania. There are, of course, numerous examples in other parts of the world of the more or less successful adoption of local prohibition, but not as the result of expressed popular will.*~~

~~*III. Outside the United States and Canada, there have been few innovations in licensing methods or elaborations of licence systems deserving mention. In the laws.^ "^ United States the scheme known as the high- licence has claimed great attention ; it was first introduced in Nebraska in 1881. In general, high-licence systems may be said to have two objects : (1) to reduce the volume of the traffic and place it under better control by charging high fees, (2) to divorce the trade as much as*~~

~~*possible from politics by selecting the proper licensing authorities. Massachusetts (law of 1888), Pennsylvania (law of 1888), and New York (Liquor Tax Law of 1896) furnish the most conspicuous examples of the working of high-licence. The Massachusetts law combines a very high fee (not less than f 1000 for a licence to sell for consumption on the premises) with statutory limitation of the number of licensed places according to population (1 to 1000 inhabitants in all places outside Boston, where the ratio is 1 to 500 inhabitants). Licences are u^ally issued by special commissioners. In Pennsylvania all licences are granted by the Court of Quarter Sessions in such number as it may deem necessary, with full*~~

~~*powers to revoke any or all at the end of twelve months. The New York law centralizes the control of the excise busi- ness in a "State Commissioner of Excise," who issues tax receipts in place of the old-time licences, which are practically obtainable by all who can pay for them and are willing to conform to certain regulations. Under high-licence the restrictive measures and regulations are usually numerous and elaborate, with severe penalties for infraction. In the Canadian provinces it is sought to hold the liquor traffic in check not so much by the high-licence fees as by statutory limitations, and by requiring the applicant to obtain the consent of a majority, or even two- thirds, of the qualified voters of the electoral district in which he wishes to sell liquor. Especially drastic are the laws of Ontario and Nova Scotia, in respect both of the requirements before a licence can be issued and the regulations governing sales. Under any form of licence it has been found impossible to divorce drink-selling from politics. HIgh-licence systems particularly give the com- munities too large a pecuniary interest in the traffic ; and since he is obliged to pay a very high fee, the interest of the ordinary dealer in pushing sales is intensified. (See also under Social Peogeess.)*~~

~~*Authorities. — British Foreign Of&oe Keports. Miscellaneous Series, Nos. 154 (1890), 324 (1894), 465, 480 (\898). — Bulletin Biisse de Statistique Financiere et de Legislation, Nos. 10-li, October, December, 1898. — Annual Reports of Commissioner of Excise, Albany, N.Y. — Cyclopaedia of Temperance and Prohibition. New York, 1891 : Funk, Wagnalls and Co. — Fanshawe, E. L. Liquor Legislation in the United States and Canada. Cassell and Co., London, 1893, pp. 432. — Gould, E. R. L. The Gothenburg System of Liquor Traffic. Fifth Special Report of the Com- missioner of Labour. Washington, 1893, pp. 253. — Gould, E. R. L. Popular Control of the Liquor Traffic. The Friedenwald Press, Baltimore, 1895, pp. 102. — Liquor Laws of the United States, 1888. National Temperance Society, New York. — Mackenzie, F. A. Sober by Act of Parliament. London, 1896 : Swan Sonnenschein and Co. — Milliet, W. "Alcohol Question in Switzerland." Annals of the Am. Acad, of Pol. and Soc. Science, vol. iii. No. 4. — Milliet, W. Apergu sur le monopole de Valcohol en Suisse. Basel : Reinhardt and Co., 1895. — Official Reports. On the Swiss Alcohol Monopoly, 1894. On Liquor Traffic Legisla- tion since 1889 in the United States, 1894. — Rowntree, Joseph. Temperance Legislation. — Rowntree, Joseph, and*~~

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Liria, a town of Spain, in the province of Valencia, on the left bank of the river Guadalaviar, 15 miles north- west of Valencia. It is situated in a fertile plain which produces much wheat, wine, olives, and esparto grass.

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There are several fine squares, and some ruins of an older city. The town hall and hospital are handsome structures. The parish church contains the family tombs of the dukes of Berwick and Liria. Population (1897), 8617.

Lisbon, the capital of the kingdom of Portugal, on the right bank of the Tagus, 10 miles above its mouth. Owing to the extreme irregularity of its surface, funic- ular railways and lifts are much used for communicat- ing between the upper and lower parts of the citj'. Amongst the improvements of the last tw^enty years of the 19th century is the fine promenade, the Avenue of Liberty, with a monument of the deliverance from the yoke of Spain in 1640. Modern buildings include the central penitentiary, the new water-works, the central railway station, the medical school, and the " Figueira " market. The most notable of the museums are the colonial museum and the artillery museum. The city also possesses zoological gardens and an aquarium. One of the chief charms of Lisbon is the number of its public gardens, planted with tropical plants ; and the Polytechnic

~~*School has a good botanical garden. The leading learned and scientific societies are the Society of Medical Sciences, the Geographical Society, the Academy of Sciences, the Association of Civil Engineers, the Academy of Fine Arts, the Artists' Union, the Royal Society of the Lovers of Music, the Royal Conservatory of Music, and the Commercial Athenaeum. The educational insti- tvTtions include the medico-surgical school, polytechnic school, military and naval schools, commercial, agricul- tural, and industrial institutes, trades' schools, school of the fine arts, a central lyceum, normal school, &c. There are hospitals for women, for contagious diseases, and a quarantine establishment. Lisbon is the seat of a commercial tribunal, and of the cardinal-patriarch of Lisbon. The port, which includes the out-ports of Nazareth and Setubal, was in 1897 entered and cleared by an aggregate of 5926 vessels of 7,087,815 tons. In 1899 the total aggregate of vessels was 6233 of 6,861,142^ tons in Lisbon itself. In 1898 it had a fishing fleet' of 593 vessels, manned by 2405 men, who took fish to the value of £115,780. The chief branches of in- dustry carried on are the manufacture of pottery (21 factories), woollens, linens, cottons, and silks (36 fac- tories), soap (13), chemicals (7), paper (6), alimentary pastes (12), glass (2), and factories for preserved foods, fruit, and fish, tobacco, phosphorus, &c. The growth of the population is shown in the following table : —*~~

~~*Extent in acres.*~~

~~*Population,*~~

~~*1878.*~~

~~*Population,*~~

~~*1890.*~~

~~*Population,*~~

~~*1900.*~~

~~*Former area Present ,,*~~

~~2,938 11,152~~

~~187,404 242,297~~

~~240,712 301,206~~

~~357lb00~~

~~The district of Lisbon has an area of 16,900 square miles, and population 611,160 (1890), and 708,750 (1900), showing 42 inhabitants to the square mile. Wine is the most important product, the vintages including the wines of Collares, Torres, Bucellas, Lavradio, Carcavellos, and Setubal. In 1892 the vineyards covered 66,100 acres, and yielded 8,621,000 gallons of wine, valued at £449,350. In 1898 the wine production reached 31,751,799 gallons. Wheat and millet, olive oil, fruits, vegetables, and cattle are the other chief products. Mineral waters are plenti- ful (see Esteemaduka). In addition to the industries of the city, there are in the district factories' for biscuits, sardines, porcelain, dyeing, cottons, woollens, linen, and jute, cement, and corks. (e. de v.)~~

~~Lis burn, a town, and urban sanitary district, in the province of Ulster, Ireland, on the river Lagan, 8 miles south-south-west of Belfast by rail. Ifr ceased to be a~~

~~parliamentary borough in 1886, and in 1898 the portion situated in Down was added to Antrim. Sir Richard Wallace presented a people's park to the town. Popula- tion (1881), 10,834 ; (1901), 11,459.~~

~~Liskeard, a municipal borough, market town, and railway station, in the Bodmin parliamentary division (since 1885) of Cornwall, England, 18' miles west-north- west of Plymouth. St Martin's church has been restored. A cottage hospital and public buildings (containing a literary institute and a school of art) and a public library have been erected. The Caradon copper mines are no longer worked. There are a woollen mill and a foundry. Area, 2704 acres. Population (1881), 4536; (1901), 4011.~~

~~Lissa, an Austrian island in the Adriatic, belonging to the province of Dalmatia. Population (1890), 8674 ; (1900), 9918. The chief town, of the~~

~~same name, has a population of 5261. Its harbour is strongly fortified. Comisa, on the west side, in a deep bay, is also a steam- ship station. Population, 4657.~~

~~7,~~

~~Lister, Joseph Lister, 1st Baeon (1827- English surgeon, was born at Upton, in Essex, on the 5th of April 1827. His father, Joseph Jackson Lister, F.R.S., was eminent in science, especially in optical science, his chief claim to remembrance being that by certain improvements in lenses he raised the compound microscope from the position of a scientific toy, " distorts ing as much as it magnified," to its present place as a powerful engine of research. Other members of Lord Lister's family were eminent in natural science. In his boyhood Joseph Lister was educated at Quaker schools ; first at Hitchin in Hertfordshire, and afterwards at Tottenham, near London. In the year 1844 he entered University College, London, as a student in arts, and took his B.A. degree at the University of London in 1847. He continued at University College as a medical student, and became M.B. and F.R.C.S. in 1862. Lister had a natural bent to science, which brought him into intimate association with some of the ablest men of the staff of his teachers, among whom, at this period of his life, Graham, Sharpey, and Wharton Jones may be specially mentioned. The keen young student was not long in bringing his faculties to bear upon pathology and the practice of medicine. While house-surgeon at University College Hospital, he had charge of certain cases during an outbreak of hospital gangrene, and care- fully observed the phenomena of the disease and the effects of treatment upon it. He was thus early led to suspect the parasitic nature of the disorder, and searched with the microscope the material of the spreading sore, in the hope of discovering in it some invading fungus ; he soon convinced himself of the cardinal truth that its causes were purely local. He also minutely investigated cases of pyaemia, another terrible scourge of hospitals at that time, and made camera lucida sketches of the appear- ances revealed by the microscope.~~

~~To realize Lister's work it is necessary to remember the condition of surgical practice at that date. About the middle of the 19th century the introduction of anaes- thetics had relieved the patient of much of the horror~~

~~of the knife, and the surgeon of the duty of speed in his work. The agony of the sufferer had naturally and rightly compelled the public to demand rapid if not slap- dash surgery, and the surgeon to pride himself on it. Within decent limits of precision, the quickest craftsman was the best. This rivalry was as unfortunate as it was unavoidable. The operation once begun was hurried through with the utmost rapidity, while there was little time to deliberate upon the conditions revealed, or for niceties of adaptation. With anaesthetics this state of~~

~~things at any rate was changed. The pain of the opera- tion itself no longer counted, and the surgeon was enabled not only to be as cautious and sedulous as dexterous, but also to venture upon long, profound, and intricate opera- tions which before had been out of the question. Yet unhappily this new enfranchisement seemed to be but an ironical liberty of Nature, who with the other hand took away what she had given. Direct healing of surgical wounds (" by first intention "), far from being the rule, was a piece of luck too rare to enter into the calculations of the operator ; while of the graver surgical undertakings, however successful mechanically, the mortality by sepsis was ghastly. At all times suppuration, phagedaena, and septic poisonings of the system carried away even the most promising patients and followed even trifling operations. Often, too, these diseases rose to the height of epidemic pestilences, so that patients, however extreme their need, dreaded the very name of hospital, and the most skilful surgeons distrusted their own craft. New hospitals or new wards were built, yet after a very short time the new became as pestiferous as the old ; and even scrupulous care in ventilation and house- maids' cleanliness failed to prevent the devastation. Surgery had enlarged its freedom, but only to find the weight of its new re- sponsibilities more than it could bear.~~

~~When Lister was ap- pointed to the chair of surgery in Glasgow the in- firmary of that city was a < hotbed of septic disease ; so much so that his hospital visits evidently distressed him greatly. Windows were widely opened, piles of clean towels were supplied, but still the pestilence stalked through the wards. The building stands to-day as it stood then, with no~~

substantial alteration; but by the genius of Lister its surgical wards are now as free from septic accidents as the most modern hospital in the land. James Simpson, early in the 'sixties, pathetically de- nounced the awful mortality of operations in hospitals, and indeed uttered desperate protests against the hospital system itself; yet, not long afterwards. Lister came to piove that it was not in the hospital that the causes of that mortality lay hidden, but in the operator himself, his tools, and his assistants. Happily this beneficent discovery was made in time to preserve the inestimable boon of the hospital system from the counsels of despair. When Lister took up the task speculation was on the wrong tack ; the oxygen of the air was then supposed to be the chief cause of the dissolution of the tissues, and to pre- vent access of air was impossible. For instance, a simple fracture, as of a bone of the leg, would do perfectly well, while in the very next bed a compound fracture — one, that is, where the skin is lacerated, and access to the seat of injury opened out — would go disastrously wrong. If the limb were amputated, a large proportion of such cases of amputation succumbed to septic poisoning — the fell and occult foe.

Lord Listee. (From, a photograph iy EUhdt and Fry, London.')

On graduation as bachelor of medicine. Lister went to Edinburgh, where he soon afterwards became house- surgeon to Mr Syme ; and he was much impressed by the skill and judgment of this great surgeon, and also by the superiority of his method of dressing recent wounds with dry lint, as compared with the " water dressing " in use at University College. Yet under these more favourable conditions the amelioration was only one of degree ; in most wounds indeed "union by first intention" was rendered impossible by the presence of the silk ligatures employed for arresting bleeding, for these could come away only by a process of suppuration. On the expiry of his house-surgeoncy in Edinburgh, Lister started in that city an extra-academical course of lectures on surgery ; and in preparation for these he entered on a series of in- vestigations into inflammation and allied subjects. These

researches, which were de- tailed fully in three papers in Phil. Trans., 1859, and in his Croonian lecture to the Eoyal Society in 1863, testi- fied to an earnestness of pur- pose, a persevering accuracy of observation and experi-

~~ment, and an insight of scientific conception which show that if Lister had never developed the aseptic method of surgery, he would have taken a very high place in pathology. In any case his earlier work was an indis- pensable preliminary to his later labours. In his speech in Paris at the Thirteenth International Congress of Medicine in 1900, Lord Lister said that he had done no more than seize upon Pasteur's discoveries and apply them to surgery. But though Lister saw the vast importance of the discoveries of Pasteur, he saw it because he was watching on the heights ; and he was watch- ing there alone. Erom Pas- teur Lister derived no doubt two fruitful ideas : first, that decomposition in organic substances is due to living " germs " ; and, secondly, that these lowly and minute forms of vegetable life spring always, like higher organ- isms, from parents like themselves, and cannot arise de novo in the animal body. After his appointment to the C lasgow chair in 1860, Lister had continued his researches on inflammation ; and he had long been led to suspect that decomposition of the blood in the wound was the main cause of suppuration. The two great theories estab- lished by Pasteur seemed to Lister to open out the possibility of what had before appeared hopeless — namely, the prevention of putrefaction in the wound, and conse- quently the forestalling of suppuration. To exclude the oxygen of the air from wounds was impossible, but it might be practicable to protect them from microbes.~~

~~The first attempt to realize this idea was made upon compound fractures ; and the means first employed was carbolic acid, the remarkable efficacy of which in deodoriz- ing sewage made Lister regard it as a very powerful germicide. It was applied to the wound undiluted, so as to form with the blood a dense crust, the surface of which was painted daily with the acid till all danger had~~

~~passed. The results, after a first failure, were in the highest degree satisfactory, so that, as Lister said in his presidential address to the British Association in Liver- pool, he "had the joy of seeing'these formidable injuries follow the same safe and tranquil course as simple fractures." The caustic property of undiluted carbolic acid, though insignificant in~~

~~*comparison with the far greater evils to be avoided in compound, fracture, made it quite unsuited for general surgery. In order to make it applicable to the treatment of abscesses and incised wounds, it was necessary to mitigate its action by blending it with some inert body; and the endeavour to find the best medium for this purpose, such as to combine perfect antiseptic efficiency with the least possible irritation of the tissues, formed the subject of experiments continued for many years in the labora- tory and in the ward. At one stage in these inquiries an attempt was made to provide an atmosphere free from living organisms by means of a fine spray of a watery solution of carbolic acid; for it was then sup- posed by Lister to be necessary not only to purify the surgeon's hands and instruments and the skin of the patient about the seat of operation, but also to wage war with the microbes which, as Pasteur had shown, people every cubic inch of the air of an inhabited room. Under the use of the spray better results were* obtained than ever before, and this success encouraged its use. But researches carried on for several years into the rela- tions of the blood to micro-organisms led Lister to doubt the harmful ness of the atmospheric dust. At the London Congress in 1881 he narrated experiments which proved that the serum of the blood is a very unfavourable soil for the development of the bacteria diffused through the air, and others which showed that the cells of an organizing blood-clot have a very remarkable power of disposing of microbes and of limiting their advance. HIence he con- sidered it probable that in surgical operations the atmo- sphere might be disregarded altogether.^ As long, how- ever, as this was only a matter of probability, he did not dare to discard the spray. But at length, at the Berlin Congress in 1890, he was able to announce that the certainty he had so long desired had been arrived at. A careful consideration of the physical constitution of the spray had shown him that the microbes of the dust involved in its vortex could not possibly have their vitality destroyed or even impaired by it. Such being the ease, the uniform success obtained when he had trusted the spray implicitly as an aseptic atmosphere, abandoning completely certain other pre- cautions which he had before deemed essential, proved conclusively to his mind that the air might safely be left entirely out of consideration in operating.^ Thus he learnt that not the spray only, but all antiseptic irriga- tions or washings of the wound also, with their attendant irritation of the cut surfaces, might be dispensed with — a great simplification, indirectly due to experiments with the spray. The spray had also served a very useful*~~

~~*pur- pose by maintaining a pure condition of the entourage of the operation ; not indeed in the way for which it was devised, but as a very mild form of irrigation. And Lister took care to emphasize the necessity for redoubled vigilance on the part of the surgeon and his assistants when this " unconscious caretaker," as he called it, had been discarded.*~~

~~*The announcement that he had given up the spray was absurdly interpreted in some quarters to mean that he had virtually abandoned his theory and his antiseptic methods. The truth is that the spray was only one of*~~

~~*1 See Trans, of the International Medical Congress, 1881, vol. ii. p. 373.*~~

~~*2 See Verhandlungen des X intemationalen Congresses, Bd. i. p. 33.*~~

~~*many devices tried for a while in the course of the long- continued endeavour to apply the antiseptic principle to the best advantage, and abandoned in favour of something better. Two main objects were always kept steadily in view by him — during the operation to guard the wound against septic microbes by such means as existing know- ledge indicated, and afterwards to protect it against their introduction, avoiding at the same time all needless irri- tation of the tissues by the antiseptic. Upon the techni- cal methods of attaining these ends this is not the place to enlarge ; suffice it to say that the endowments and the industry of the discoverer, as seen in the rapidity and flexibility of mind with which he seized upon and selected the best means, were little less remarkable than the activity of the same faculties in his original ideas.*~~

~~*To illustrate this opinion, his work on the ligature may be taken. It had long been the universal practice of surgeons to employ threads of silk or flax for tying arteries, long ends being left to provide escape of the pus (invariably formed during the tedious process of the sepa- ration of the ligature) together with the portion of the arterial coats included in the knot. Lister hoped that if, by antiseptic means, the thread were deprived of living microbes, it would no longer cause suppuration, but might be left with short cut ends to become embedded perma- nently among the tissues of the wound, which thus would be allowed to heal by primary union tlirougliout. A trial of this method upon the carotid artery of a horse having proved perfectly successful, he applied it in a case of aneurysm in the human*~~

~~subject ; and here again the imme- diate results were all that could be desired. But a year later, the patient having died from other causes, the necropsy showed remnants of the silk thread incompletely absorbed, with appearances around them which seemed to indicate that they had been acting as causes of disturb- ance. Thus was suggested to him the idea of employing for the ligature some material susceptible of more speedy absorption ; and the antiseptic treatment of contused wounds having shown that dead tissue, if protected from putrefaction, is removed by the surrounding structures without the intervention of suppuration, he resolved to try a thread of some such nature. Catgut, which is pre- pared from one of the constituents of the small intestine of the sheep, after steeping in a solution of carbolic acid, was used in a preliminary trial upon the carotid artery of a calf. The animal was killed a month later, when, on dissection, a very beautiful result was disclosed. The catgut, though removed, had not been simply absorbed ; pari passu with its gradual removal, fibrous tissue of new formation had been laid down, so that in place of the dead catgut was seen a living ligature embracing the artery and incorporated with it. The wound meanwhile had healed without a trace of suppuration. This success appeared to justify the use of the catgut ligature in the human subject, and for a while the results were entirely satisfactory. But though this was the case with the old samples of catgut first employed, which, as Lister was afterwards led to believe, had been "seasoned" by long keeping, it was found that when catgut was used fresh as it comes from the makers, it was unsuited in various ways for surgical purposes. The attempt by special pre- paration to obtain an article in all respects trustworthy engaged his attention from time to time for years after- wards. To quote the words of Sir Hector Cameron, who was for several years assistant to Lord Lister, it required "labour and toilsome investigation and experiment of which few can have any adequate idea."~~

~~In 1869 Lister succeeded his father-in-law, Syme, in the chair of clinical surgery of Edinburgh. In 1877 he accepted an invitation to the chair of surgery at King's College, London, in the anticipation that here he would be~~

~~*more centrally placed for communication with the surgical ■world at home and abroad, and might thus exercise his beneficent mission to more immediate advantage. In 1896 Lister retired from practice, but not from scientific study. From 1895 to 1900 he was President of the Koyal Society. In 1883 he was created a baronet, and in 1897 he was raised to the peerage as Baron Lister of Lyme Regis. Among the Coronation honours in 1902, he was nominated an original member of the new Order of Merit.*~~

~~*In England Lister's teaching was slow in making its way. The leading surgeons of Germany were among the first to seize upon the new idea with avidity and practical success ; so early as 1875, in the course of a tour he made on the Continent, great festivals were held in his honour in Munich and Leipzig. The countrymen of Pasteur did not lag far behind ; and it is no exaggeration to speak of Lister's appearances in foreign countries at this time as triumphal, not in respect of formal honours only, but also of an enthusiasm almost stupendous.*~~

~~*The relation of Semmelweiss to Lister is of historical importance. Lister's work on the antiseptic system began in 1864; his first publication on the subject was in March 1867. At this date, and for long afterwards, the very name of Semmelweiss was unknown, or ignored, not only by Erench and Germans, but also by his own Hungarian people ; and this neglect broke his heart. The Prench Academy pronounced against his opinions, and so did the highest pathological authority in Germany. In England, till long after his death, probably his name was not so much as mentioned. In the early 'seventies Lister's method was in full operation in Hungary as elsewhere, yet none of the surgeons of Budapest ever mentioned Semmelweiss ; not even when, i;i 1883, they gave a great banquet to Lister, followed by a torchlight procession of the students. It was after this occasion that Dr Duka, a Hungarian physician practising in London, wrote a biography of Semmelweiss, which he sent to Lister, and thus brought the name of Semmelweiss before him for the first time. Thenceforth Lister generously regarded Sem- melweiss as in some measure his forerunner ; though we may point out that Semmelweiss was not aware of the microbic origin of*~~

~~*septic poisons, nor were his methods, magnificent as was their success in lying-in hospitals, suitable for surgical work.*~~

~~*In public Lord Lister's speeches were simple, clear, and graceful, avoiding rhetorical display, earnest for the truth, jealous for his science and art, forgetful of himself. His writings, in like manner plain, lucid, and forcible, scarcely betray the labour and thought of their produc- tion. With the courtesy and serenity of his carriage he combined a passionate humanity, so often characteristic of those who come of the Society of Friends, and a simple love of truth which showed itself in his generous encour- agement of younger workers.*~~

~~*Liszt, Franz (1811-1886), Hungarian pianist and composer, was born on 22nd October 1811, at Raiding, in Hungary. His appeal to musicians was made in a three- fold capacity, and we have, therefore, to deal with Liszt the unrivalled pianoforte virtuoso (1830^8) ; Liszt the conductor of the " music of the future " at Weimar, the teacher of Tausig, 1 iillow, and a host of lesser pianists, the eloquent writer on music and musicians, the champion of Berlioz and Wagner (1848-61) ; and Liszt the prolific composer, who for some five-and-thirty years continued to put forth pianoforte pieces, songs, symphonic orchestral pieces, cantatas, masses, psalms, and oratorios (1847-82). As virtuoso he held his own for the entire period during which he chose to appear in public ; but the militant con- ductor and prophet of Wagner had a hard time of it.*~~

~~*and the composer's place is still in dispute. Liszt's father, a clerk to the agent of the Esterhazy estates and an ama- teur musician of some attainment, was Hungarian by birth and ancestry, his mother an Austrian-German. The boy's gifts attracted the attention of certain Hungarian mag- nates, who furnished a sum of 600 gulden annually for some years to enable him to study music at Vienna and Paris. At Vienna he had lessons in pianoforte playing from Carl Czerny of " Velocity " fame, and from Salieri in harmony and analysis of scores. In his eleventh year he began to play in public there, and Beethoven came to his second con- cert in April 1823. During the three years following he played in Paris, the Erench provinces, and Switzerland, and paid three visits to England. In Paris he had composition lessons from Paer, and a six months' course of lessons in*~~

~~*counterpoint from Eeicha. In the autumn of 1825 the handsome and fascinating enfant gdti of the salons and ateliers — "La ueuvieme merveille du monde " — had the luck to get an operetta (Don SancJio) performed three times at the Academie Eoyale. The score was accident- ally destroyed by fire, but a set of studies d, la Czerny and Cramer, belonging to 1826 and published at Marseilles as 12 fitudes, op. i., is extant, and shows remarkable preco- city. After the death of his father in 1828 young Liszt led the life of a teacher of the pianoforte in Paris, got through a good deal of miscellaneous reading, and felt the influence of the religious, literary, and political aspira- tions of the time. He attended the meetings of the Saint-Simonists, lent an ear to the romantic mysticism of Pere Enfantin, and later to the teaching of Abbe Lamennais. He also played Beethoven and Weber in public — a very courageous thing in those days. The appearance of the violinist Paganini in Paris, 1831, marks the starting-point of the supreme eminence Liszt ultimately attained as a virtuoso. Paganini's marvellous technique inspired him to practise as no pianist had ever practised before. He tried to find equivalents for Paganini's effects, transcribed his violin caprices for the piano, and perfected his own tech- nique to an extraordinary degree. After Paganini he received a fresh impulse from the playing and the compo- sitions of Chopin, who arrived in 1831, and yet another impulse of equal force from a performance of Berlioz's " Symphonic Eantastique, episode de la vie d'un artiste," in 1832. Liszt transcribed this work, and its influence ultimately led him to the composition of his " Poemes sym- phoniques " and other examples of orchestral programme- music. From 1833 to 1848 — when he gave up playing in public — he was greeted with frantic applause as the prince of pianists. Five years (1835^0) spent in semi- retirement in the company of Madame la Comtesse D'Agoult (George Sand's friend and would-be rival, known in literary circles as Daniel Stern) in Switzer- land and Italy, were devoted to further study in playing and composition, and were interrupted only by occa- sional appearances at Geneva, Milan, Florence, and Rome, and by annual visits to Paris.. During one of these visits the famous contest with Thalberg took place (1837). The enthusiasm aroused by Liszf's play- ing and his personality — the two are inseparable — reached a climax at Vienna and Budapest in 1839-40, when he received a patent of nobility from the emperor of Austria, and a sword of honour from the magnates of Hungary in the name of the nation. During the eight years following he was*~~

~~heard at all the principal centres — including London, Leipzig, Berlin, Copenhagen, St Petersburg, Moscow, Warsaw, Constantinople, Lisbon, and Madrid. He gained much money, and gave large sums in charity. His munificence with regard to the Beethoven statue at Bonn made a great stir. The sub- scriptions having come in but sparsely, Liszt. took the matter in hand, and the monument was completed at his~~

~~expense, and unveiled at a musical festival conducted by Spohr and himself in 1846. In 1848 he settled at Weimar with Madame la Princesse Say n-Wittgenstein, and remained there till 1861. During this period he acted as conductor at court concerts and on special occasions at the theatre, gave lessons to a number of pianists, wrote articles of permanent value on certain works of Berlioz and the early operas of Wagner, and produced those orchestral and choral pieces upon which his reputation as a composer mainly depends. His ambition to found a school of composers as well as a school of pianists met with complete success on the one hand and partial failure on the other. His efforts on behalf of Wagner, who was then an exile in Switzerland, culminated in the first performance of Lohe-ngrin on 28th August 1850, before a special audience assembled from far and near. Among the works produced for the first time or rehearsed with a view to the fur- therance of musical art were Wagner's Tannhdufser, Der fliegende Holldnder, Das Lie- besmahl der Apostel, and Eine Faust Owrtiire, Berlioz's Ben- venuto Cellini, the Symplionie Fantastique, Harold en Italie, Romio et Juliette, La Dam- nation de Faxist, and L'En- fance du Christ — the last two conducted by the com- poser — Schumann's Geno- veva, Paradise and the Peri, the music to Manfred and to Faust, Weber's Euryanthe, Schubert's Alfonso und Es- trella. Raff's Koriig Alfred, Cornelius's Der Barbier von Baghdad, and many more. It was Liszt's habit to re- commend novelties to the public by explanatory articles or essays, which were written in French (some for the Journal des Dibats and the Gazette Musicale of Paris) and translated for the journals of Weimar and Leipzig, — thus his two**

~~masterpieces of sympathetic criticism, the essays Lohen- grin et Tannhduser d, Weimar, and Harold en Italie, found many readers and proved very~~

effective. They are now included, together with articles on Schumann and Schubert, and the elaborate and rather high-flown essays on Chopin and Des BoMmiens et de leur musique en Hongrie (the latter certainly, and the former probably, written in collaboration with Madame de Wittgenstein), in his Gesammelte Schriften (6 vol- umes, Leipzig). The compositions belonging to the period of his residence at Weimar comprise two piano-forte concertos, in E flat and in A, the " Todtentanz," the " Concerto pathetique " for two pianos, the solo sonata "An Robert Schumann," sundry "Etudes," fifteen "Rhapsodies Hongroises," twelve orchestral "Poemes symphoniques," "Eine Faust Symplionie," and "Eine Symphonie zu Dante's 'Divina Commedia,'" the " 13th Psalm " for tenor solo, chorus, and orchestra, the choruses to Herder's dramatic scenes " Prometheus," and the "Missa solennis" known as the "Graner Fest Messe." Liszt retired to Rome in 1861, and joined the Franciscan order in 1866. From 1869 onwards Abbe' Liszt divided his time between Rome and Weimar, where during the summer months he received pupils — gratis as formerly — and, from 1876 up to his death at Bay-

Franz Liszt. (From a photograph hy EUiott and Fry, London.)

reuth on the 31st July 1886, he also taught for several months every year at the Hungarian Conservatoire of Budapest.

About Liszt's pianoforte technique in general it naay be said that it derives its efficiency from' the teaching of Czerny, who brought up his pupil on Mozart, a little Bach and Beethoven, a good deal of Clementi and Hummel, and a good deal of his (Czerny's) own work. Classicism in the shape of solid, respectable Hummel on the one hand, and Carl Czerny, a trifle flippant, perhaps, and inclined to appeal to the gallery, on the other — these gave the musical parentage of young Liszt. Then appears the Parisian Incroyable and grand seigneur — "Monsieur Lits," as the Parisians called him. Later, we find him imitating Paganini and Chopin, and at the same time making a really passionate and deep study of Beethoven, Weber, Schubert, Berlioz. Thus

gradually was formed the master of style — whose com- mand of the instrument was siapreme, and who played like an inspired poet. Liszt's strange musical nature was long in maturing its fruits. At the pianoforte his

~~*achieve- ments culminate in the two books of studies, twice re- written, and finally published in 1862 as Etudes d'exicution transcendante, the Etudes de concert, and the Paganini Studies; the two concertos and the Todtentanz, the Sonata in B minor, the Hungarian Rhapsodies, and the fine transcriptions of Beethoven's symphonies (the 9th for two pianofortes as well as solo), and of Berlioz's Symphonie fantastique, and the sym- phony, Harold en Italie. In his orchestral pieces Liszt appears — next to Berlioz — as the most conspicuous and most thorough-going repre- sentative of programme music, i.e., instrumental music expressly contrived to illustrate in detail some poem or some succession of ideas or pictures. It was Liszt's aim to bring about a direct alliance or amalgamation of instrumental music with poetry. To effect this he made use of the means of musical expression for purposes of illustration, and relied on points of support outside the pale of music proper. There is always danger of failure when an attempt is thus made to connect instrumental music with conceptions not in themselves musical, for the order of the ideas that serve as a programme is apt to interfere with the order which the musical exposition naturally assumes — and the result in most cases is but an amalgam of irre- concilable materials. In pieces such as Liszt's " Poemes symphoniques," Ce qu'on entend sur la montagne (1848- 1856) — after a poem by Victor Hugo — and Die Ideale (1853-67) — after a poem by Schiller — the hearer is be- wildered by a series of startling orchestral effects which succeed one another apparently without rhyme or reason. The music does not conform to any sufficiently definite musical plan — it is, in fact, hardly intelligible as music without reference to the programme. Liszt's masterpiece in orchestral music is the Dante Symphony (1847-56), the subject of which was particularly well suited to his temperament, and offered good chances for the display of*~~

~~*his peculiar powers as a master of instrumental effect. By the side of it ranks the Faust Symphony (1854—67), in which the moods of Goethe's characters — Faust, Gretchen, and Mephistopheles — are depicted in three instrumental movements, with a chorus of male voices, supplying a kind of comment, by way of close. The method of pre- sentation in both symphonies*~~

~~*is by means of representa- tive themes {Leitmotif), and their combination and inter- action. Incidents of the poem or the play are illustrated or alluded to as may be convenient, and the exigencies of musical form are not unfrequently disregarded for the sake of special effects. Of the twelve Poemes Symphoniques, OrpMe is the most consistent from a musical point of view, and is exquisitely scored. Melodi- ous, effective, readily intelligible, with a dash of the commonplace, Les PrMudes, Taaso, Mazeppa, and Fest-Klange bid for popularity. In these pieces, as in almost every production of his, in lieu of melody Liszt offers fragments of melody^touching and beautiful, it may be, or passionate, or tinged with triviality ; in lieu of a rational distribution of centres of harmony in accordance with some definite plan, he presents clever combinations of chords and ingenious modulations from point to point ; in lieu of musical logic and consistency of design, he is content with rhapsodical improvisation. The power of persistence seems wanting. The musical growth is spoilt, the development of the themes is stopped, or prevented, by some reference to extraneous ideas. Everywhere the programme stands in the way. In much of Liszt's vocal music, particularly in the songs and choral pieces written to German words, an annoying discrepancy is felt to exist between the true sound of the vfords and the musical accents. The music is generally emotional, the expression direct and passionate ; there is no lack of melodic charm and originality, yet the total effect is frequently dis- appointing. In the choral numbers of the five masses, and in the oratorios Die Heilige Elizabeth and Christus, the rarity of fugal polyphony acts as a drawback. Its almost complete absence in some of these works makes for monotony and produces a sense of dulness, which may not be inherent in all the details of the music, but is none the less distinctly present.*~~

~~*A thematic catalogue of Liszt's works was published during his lifetime. The rather indiscriminate and verbose biography by Lina Ramann (3 vols., Leipzig) is trustworthy as to facts and dates.*~~

~~*Omitting trifles and all publications that have been cancelled, the following list of compositions may be taken as fairly compre- hensive : —*~~

~~*Pianoforte Pieces. — Etudes d'ex^oution transoendante ; ifetudes de concert ; Zwei Btuden, Waldesrauschen, Gnomentanz ; Ab Ii'ato ; Paganini*~~

~~*Studies ; Annies de P^lerinage, .3 sets ; Harmonies pofetiques et religieuses, 1-10 ; Consolations, 1-6 ; Ave Maria in E ; Sonata in B minor ; Konzert-Solo in E minor ; Scherzo und Marsch; Ballades, I., II.; Polonaises, I., II. ; Apparitions, 1-3; Berceuse ; Valse impromptu ; Mazurka brillant ; 3 Caprices Valses ; Galop chromatique ; Mephisto-Walzer, I., II., III., and Polka ; Zwei Legenden, " Die Vogelpredigt," " Der heilige Fran- cisous auf den Wogen schreitend" ; " Der Weihnachtsbaum," 1-12 ; Sarabande und Chaconne (" Almira") ; Elegies, I., II., and III. ; La lugubre Gondola ; Dem Andenken Petofl's ; Mosonyi's Grab- geleit ; Romance oubli^e ; Valses oubli^es, 1-3 ; Liebestraume, 1-3 (originally songs) ; Hexameron ; Rhapsodies Hongroises, 1-18.*~~

~~*Pieces for Two Pianos. — Concerto path^tique (identical with the Konzert-Solo in E minor) ; Dante symphony ; Faust symphony ; Pofemes symphoniques, 1-12 ; Beethoven's !)tli symphony.*~~

~~*Pianoforte with Orchestra. — Concertos I. in E flat, II. in A ; Todtentanz; Fantasie ueber Motif aus Beethoven's "Uuinenvon Athen " ; Fantasie ueber Ungarische National Melodien ; Schubert's Fantasia in C ; Weber's Polaoca in E.*~~

~~*Fantaisies de Concert for Piano Solo. — Don Juan ; Norma ; Son- nambula ; I Puritani; Lucia, I., IL ; Luorezia, I., II. ; La Juive ; Robert le Diable ; Les Huguenots ; Le Prophfete, 1-4. Paraphrases, Auber, Tarantella di bravura (Masaniello) ; Verdi, liigoletto, Ernani, II Trovatore ; Mendelssohn, " Hochzeitsmarsch und Elfenreigen " ; Gounod, Valse de Faust, Les Adieux de Rom6o et .Juliette ; Tschai- kowsky, Polonaise ; Dargomiyski, Tarantelle ; Cui, Tarantella ;*~~

~~*Saint-Saens, Danse macabre ; Schubert, Soirges de Vienne, Valses caprices, 1-9.*~~

~~*Transcriptions. — Beethoven's Nine Symphonies ; Berlioz's ' ' Sym- phonic fantastique," " Harold en Italic " ; Benediction et Serment (Benvenuto Cellini) ; Danse des Sylphes (Damnation de Faust) ; Weber's overtures, Der Freischiitz, Euryanthe, Oberon, Jubilee ; Beethoven's and Hummel's Septets ; Schubert's Divertissement k la Hongroise ; Beethoven's Concertos in C minor, G and E flat (orchestra for a second piano) ; Wagner's Tannhauser*~~

~~*overture, march, romance, chorus of pilgrims ; Lohengrin, Festzug und Brautlied, Lisa's Brautgang, Elsa's Traum, Lohengrin's Verweiss an Elsa ; Fliegender Hollander, Spinnlied ; Rienzi, Gebet ; Rhein- gold, Walhall; Meistersinger, "Am stillen Herd"; Tristan, Isolde's Liebestod ; Chopin's six Chants Polonais ; Meyerbeer's Schillermarsoh ; Bach's six organ Preludes and Fugues ; Prelude and Fugue in G minor ; Beethoven, Adelaide ; 6 miscellaneous and 6 Geistliche Lieder ; Liederkreis ; Rossini's Les Soirees musicales ; Schubert, 59 songs ; Schumann, 13 songs ; Mendelssohn, 8 songs ; Robert Franz, 13 songs.*~~

~~*Organ Pieces. — Missapro organo ; Fantasia and Fugue, " Ad nos, ad salutarem undam " ; B-A-C-H Fugue; Variations on Bach's Basso continuo, " Weinen, Klagen"; Bach's Introduction and Fugue, "Ich hatte viel Bekttmmemiss " ; Bach's Choral Fugue, "Lob und Ehre " ; Nicolai's Kirchliche Festouvertiire, "Ein feste Burg " ; AUegri's Miserere ; Mozart's Ave Verum ; Arcadelt's Ave Maria ; Lasso's Regina Coeli.*~~

~~*Orchestral Pieces. — Eine Symphonic zu Dante's " Divina Com- media" ; Eine Faust Symphonic ; Pofemes symphoniques: 1. "Ce qu'on en tend sur la montagne" ; 2. Tasso ; 3. Les Preludes ; 4. Orphee ; 5. Prom^thge ; 6. Mazeppa ; 7. Fest-Klange ; 8. Hfero'ide funfebre ; 9. Hungaria ; 10. Hamlet ; 11. Hunnenschlacht ; 12. Die Ideale ; Zwei Episoden aus Lenau's Faust : I. Der nachtliche Zug, II. Der Tanz in der Dorfschenke ; Marches, Rakoczy, Goethe, Hul- digung, " Vom Fels zum Meer " (for a military band) ; Ungarischer, Heroischer, and Sturmmarsch ; Le Triomphe funfebre du Tasse ; " Von der Wiege bis zum Grab" ; six Hungarian rhapsodies ; four marches ; four songs, and Die Allmacht, by Schubert.*~~

~~*Vocal Music. — Oratorios : " Die Legende von der Heiligen Elisa- beth," "Christus," "Stanislaus" (unfinished). Masses: Missa solennis for the inauguration of the cathedral at Gran ; Ungarische Kronungs-messe ; Missa choralis (with organ) ; Missa and Requiem for male voices (with organ) ; Psalms, 13, 137, 23, and 18 ; 12 Kirchen-Chor-Gesange (with organ). Cantatas : Prometheus-chore ; "Beethoven Cantata"; "An die Kiinstler " ; Die Glocken des Strassburger Milnsters ; 12 Chore fur Mannergesang ; Songs, 8 books ; Scena, Jeanne d'Arc au bficher.*~~

~~*Melodramatic Pieces for Declamation, with Pianoforte Accom- paniment.— Leonore (Burger) ; Der traurige Monch (Lenau) ; Des todten Dichter's Liebe (Jokai) ; Der blinde Sanger (Tolstoy) .*~~

~~*Editions, Text and Variants. — Beethoven's Sonatas ; Weber's Concertstuok and Sonatas ; Schubert Fantasia, 4 Sonatas, Im- promptus, Valses, and Moments musicaux. (e. da.)*~~

~~*Litchfield, a city of Montgomery county, Illinois, U.S.A., at the intersection of six railways and at an altitude of 664 feet. Its site is on the level prairie, its plan is regular, and it has Holly water-works and other municipal improvements. It is in a region of coal, natural gas, and petroleum. Population (1880), 4326; (1890), 5811 ; (1900), 5918, of whom 521 were foreign- born and 156 were negroes.*~~

~~*Lithgow, town, Australia, New South Wales, in the county of Cork, 96 miles west of Sydney by rail. Coal is found in the district, which has also ironworks, brick- works, and a large pottery. Altitude, 3000 feet. Popu- lation (1881), 2112 ; (1891), 3865 ; (1901), 5269.*~~

~~*Lithography. See Engraving.*~~

~~*Litin, a district town of Russia, government of Podolia, on the Bug river, 67 miles south-south-west of Zhitomir, and 19 miles from Vinnitsa railway station. It is an old town, which existed under the name of Lytyn in the first half of the 15th century. It has brisk trade in grain, timber, and wooden goods. Population, 11,162.*~~

~~*Littleborough, a town in the Middleton parlia- mentary division of Lancashire, England, on the Eochdale canal, 3 miles north-east of Rochdale by rail. There are an endowed free school (founded 1727) and a teclinical institute. The industries are cotton and woollen manu- factures and dyeing; in the neighbourhood there are*~~

~~*collieries and quarries. Area of urban district, 7736 acres. Population (1881), 10,406 ; (1891), 10,878 ; (1901),*~~

~~*11,166.*~~

~~*Little Falls, a city of Minnesota, U.S.A., capital of Morrison county, on the east bank of the Mississippi river, on the Northern Pacific railroad, at an altitude of 1117 feet. It has excellent water-power, which has been made use of in lumber manufacture, the principal industry of the city. Population (1880), 508; (1890), 2354; (1900), 5774, of whom 1559 were foreign-born.*~~

~~*Little Falls, a city of Herkimer county, New York, U.S.A., on the Mohawk river, the Erie canal, the New York Central and Hudson Eiver, the West Shore, and the Little Palls and Dolgeville railways, at an altitude of 376 feet. It is irregularly built on a steep slope. The fine water-power furnished by the falls in the Mohawk river has been turned to account in a variety of manu- factures. Population (1890), 8783; (1900), 10,381, of whom 1915 were foreign-born.*~~

~~*Littlehampton, a parish, town, and seaport in the Eastbourne parliamentary division of Sussex, England-j at the mouth of the Arun, 59 miles south-south-west of London, with a station on the London, Brighton, and South Coast railway. The town is an attractive seaside resort. The church of St Mary the Virgin was reconstructed in 1899, and a chapel of ease (a wooden structure) was erected in 1877. The Koman Catholic church, built in 1864, was enlarged in 1884. There are Congregational, Methodist, and other places of worship. The town is provided with a public hall, excellent golf-links, and a field of 11 acres for sports, presented by the duke of Norfolk in 1897. The harbour is easily accessible in all weathers, and in 1900 was entered and cleared by an aggregate of 802 vessels of 65,660 tons, the trade being valued at about £53,000. Area of urban district, 2325 acres. Popular tion (1891), 5772 ; (1901), 7363.*~~

~~*Little Rock, a city of Arkansas, U.S.A., capital of Pulaski county and of the state, of which it is the largest city, on the south bank of the Arkansas river, at the east base of the Ozark Hills, at an altitude of 263 feet. It has a level site, a regular plan with broad streets, a good water-supply and sewerage system, and is divided into eight wards. It is on the St Louis, Iron Mountains*~~

~~*and Southern, the St Louis South- western, the Choctaw and Memphis, and the Little Eock and Hot Springs Western railways, which, with steamboats on the river, give it a large trade. In 1890 its manufacturing establishments numbered 124, with a total capital of $2,265,324. They employed 1534 hands, and their product was valued at $3,120,677. The leading products were cotton-seed oil and oil-cake, valued at $937,963, and lumber, valued at $324,000. Little Eock is the seat of Philander Smith University, a Methodist Episcopal institution, founded in 1877. The assessed valuation of real and personal property in 1900, on a basis of about 40 per cent, of the full value, was $14,845,458; the net debt of the city was only $217,719, and the rate of taxation was $22 per $1000. Population (1890), 25,874 ; (1900), 38,307, of whom 2099 were foreign-born and 14,694 were negroes.*~~

~~*Littlestone-on-Sea. See Eomnbt, New.*~~

~~*Liverpool, a city, municipal, county, and parlia- mentary borough and seaport of Lancashire, England, 201 miles north-west of London by rail, on the right bank of the Mersey, about three miles from the open sea. The city extends about six miles along the east bank of the estuary, which here runs nearly north and south and is about one mile in breadth. On the north*~~

~~*the city is bounded by the borough of Bootle, along which the line of docks is continued, and on the south by the township of Garston. In 1891 the population was 517,980; in 1901 it had reached 686,332. The birth- rate for 1901 was 32-2, and the death-rate 21-6 per thousand. An extension of the city boundaries took place on 9th November 1895, when an estimated popular tion of 134,234 and an area of 8026 acres of land and 2016 acres of water space were added. At the same time the number of the wards was increased to 28, and the num- ber of aldermen to 28 and councillors to 84. In 1899 a fresh ward with 1 alderman and 3 councillors was added, a similar increase also taking place in 1900. The total area now stands at 16,262 acres, comprising 30 wards, with 30 aldermen and 90 councillors. In 1893 the title of mayor was raised to that of Lord Mayor. The rate- able value in 1890 was £3,221,771 ; in 1895, £3,168,316; in 1900, £3,711,986. The decrease in 1895 was due to the demolition of a large quantity of insanitary property, while the marked increase in 1900 was largely due to*~~

~~*the extension of the boundaries. In 1886 the number of members of Parliament was increased to nine by the creation of six new wards.*~~

~~*The following table gives particulars of the chief suburbs on the east side of the river : —*~~

~~*Rateable*~~

~~*Value.*~~

~~*£504,311*~~

~~*24,296*~~

~~*4,092*~~

~~*121,178*~~

~~*45,000*~~

~~*31,456*~~

~~*42,689*~~

~~*5,358*~~

~~*13,044*~~

~~*24,352*~~

~~*109,932*~~

~~*Since 1882 several of the city churchyards have been laid out in gardens. A playground containing 108 acres in Wavertree was presented in 1895 by an anonymous donor. The total area of the public parks and gardens now amounts to 7721 acres. In 1884 a new County Sessions House, adjoining the Walker Art Gallery oppo- site St George's Hall, was opened for public business. In 1889 a wholesale fish market in Great Charlotte Street was opened, and in 1896 the new Liverpool Cotton Exchange. In 1899 the new*~~

~~*post office in Victoria Street was completed. Considerable alterations in the internal structure of the town hall have been made, and the council chamber is now extended so as to pennit of the enlarged council meeting without discomfort, and pro- vides seating accommodation for 124 members. The Shakespeare Theatre was opened in 1888. The Free Library has steadily increased in size and usefulness, and now contains upwards of 120,000 volumes in the reference department. There are nine lending libraries and read- ing-rooms under control of the central library, and in these the total number of volumes is nearly 92,000. The basement of the Brown Library (central reference) has been reconstructed to provide additional book space, to establish a special newspaper files and patent department, and to provide a central lending library.*~~

~~*The Walker Art Gallery, spacious though it was, as originally constructed, began to prove inadequate to meet the requirements of the recurring exhibitions and the housing of the steadily grow- ing permanent collection very shortly after its opening in 1877, and a scheme was sanctioned by the council for the enlargement of the building to almost twice its original size by an addition on the north side. This improvement was completed and opened in 1884, the entire cost of the additions being borne by Sir Andrew Walker, Bart. The permanent collection now numbers upwards of 750 works, including sculpture. An important addition was made in 1894, when the examples of early Italian art, numbering altogether*~~

~~*Population,*~~

~~*1901.*~~

~~*Bootle (borough of)*~~

~~*. 58,556*~~

~~*AUerton*~~

~~*. 1,100*~~

~~*Childwall*~~

~~219~~

~~Garston~~

~~17,288~~

~~Great Crosby~~

~~. 7,555~~

~~Huyton-cum-Eoby~~

~~. 4,661~~

~~Litherland .~~

~~. 10,592~~

~~Little Crosby~~

~~563~~

~~Little Woolton~~

~~. 1,091~~

~~Much Woolton~~

~~. 4,7.31~~

~~Waterloo-oum-Seaforth~~

~~. 23,102~~

~~302~~

~~LIVEKPOOL~~

~~about 180 pictures, collected at the beginning of the 19th century by William Rosooe, were deposited in the gallery. They had for- merly been~~

~~*housed at the Royal Institution, Colquit Street.*~~

~~*Museums. — Very extensive alterations in tlie structure and arrangement of the William Brown Museum have been undertaken. The ground on which the building stands falls somewhat sharply*~~

~~*Scale of One Mile*~~

~~*Plan op LtvBitpooL.*~~

~~*in a westerly direction, and the Corporation have extended the galleries previously in existence by building an addition at the west end equal in size to the whole of the previous museum and library building as presented by Sir William Brown. By ex- cavating the slope from d. face perpendicular to the west wall of the old museum down to the level of Byrcjm Street (a thoroughfare running north and south some fifty yards away at the foot of the slope), accommodation has been found for a large central technical*~~

~~*school below the level of the museum, with an entrance from Byrom Street distinct from the museum entrance. The former levels in the museum are maintained, and the new galleries, which are extended in a westerly direction over the technical school, fit into the old, and together they form immense horse-shoe galleries, each about 500 feet long by 35 feet wide ; and it is possible now to arrange the magnificent collection in the possession of the Corporation logically and comprehensively, so that a regular sequence of ideas may be obtained. In addition to this, a fine series of labora- tories for biological investigation has been constructed and fitted with all the latest appliances, in which original re- search may be carried on, in addition to the usual dissection for museum exhibits and the ordinary mounting of specimens. Municipal Tedinical Schools. — The building for the Central Municipal Technical School in Byrom Street, the upper part of which, as stated aljove, is devoted to museum galleries, was opened in October 1901, the cost of the building, exclusive of the site and equipment, being over £112,000. The Nautical College established by the Corporation in 1892 is now carried on in this building, which comprises a small astronomical observatory in addi- tion to the usual lecture rooms, labora- tories, and workshops. The Corporation have also built two branch technical schools in the north and east districts of the city, and conduct*~~

~~*classes also in other buildings which have been adapted for the purpose in the other districts.*~~

~~*Colleges and Schools. — University College received its charter of incor- poration on the 18th October 1881, and on the 15th November 1884 was ad- mitted as a college of the Victoria Uni- versity. Since its foundation a sum of upwards of £500,000 has been raised by voluntary contribution, in addi- tion to £33,708 contributed by public bodies. Twenty-seven chairs have been endowed, and the university buildings very largely extended. There are at present 24 professors and 24 lecturers. The average attendance of students in 1899-1900 amounted to 409 in the arts and science and 154 in the medical school. The number of students attend- ing evening classes amounted to 717. Early in 1900 a supplemental charter extended the powers of self-govern- ment, and brought the college into close relations with the authorities of the city and with local institutions, by providing for their fuller representa- tion on the court of governors. The authorities of the college are the presi- dent, the vice-presidents, the court of governors, the council, the treasurer, and the senate. The general maniiiit- ment is conducted by tlie council, which is composed of the president, tlie vice-presidents, the treasurer, the prin- cipal and three professors of the college chosen by the senate, fifteen persons chosen by the court of governors, and three persons chosen by the municipal council. The School Board was intro- duced in 1870, and the first Board elected on the 25th November in that year. At that time the number of scholars under the Board (average attendance) amounted to 47,590, and the number of schools to 80. The figures for the month of June 1901 were as follows : — 32 per- manent and 18 temporary board schools, and 108 voluntary schools, with an average attendance at the former of 41,855 and at the latter of (i4,440. During the year ending 30th June 1901 the municipal expenditure was £128,000, while the various Government grants amounted to £71,069.*~~

~~*Churches. — The various denominations have nearly all seen an*~~

~~*' Stanford^ Beogi*~~

~~*lEsUbt*~~

~~*LIVERPOOL*~~

~~increase in the number of cliuroh.s attached to them. The numbers now stand approximately as follows : — Established Church, 103 Roman Catholic, 34 ; Welsh Nonconformists, 29 ; Wesleyan, 25 Presbyterian, 22 ; Methodists, 21 ; Baptist, 17 ; Congregational, 13 Unitarians, 5 ; others, 25. None of the new churches call for any special notice.~~

~~Railways. — A new railway route to Southport viU the Cheshire lines was opened for traffic in 1884, and the Mersey Tunnel, con- necting Birkenhead with Liverpool, in 1885. The Exchange Station in Tithebarn Street, which was formerly approached by a long flight of steps, was brought down to the level of the street and opened for passenger traffic in 1896. An extension of the Mersey railway, bringing Wallasey, Hoylake, and New Brighton into direct communication with Liverpool, was completed in 1888. The Elec- tric Overhead railway, running along the line of docks from Sea- forth to the Dingle, was formally opened in 1893. In 1895 the riverside station at the Princes Dock was completed, giving direct access from the landing-stage to the London and North- Western system.~~

~~Tramways. — The Corporation in 1896 purchased the property, rights, powers, and privileges of the Liverpool Electric Supply Com- pany, and in the following year the undertaking of the Liverpool Tramway Company, which they formally took over in the autumn of the same year. Since that date a large and extended system of electric tramways has been laid down, which has led to a very re- markable increase in the receipts and the number of passengers carried. The following table shows how rapidly the tramways have spread during 1897-1901 : —~~

~~Year.~~

~~Passengers.~~

~~Miles run,~~

~~Receipts.~~

~~1897~~

~~*38,409,084*~~

~~*6,013,182*~~

~~*£290,743*~~

~~*1898*~~

~~*41,772,034*~~

~~*6,279,758*~~

~~*314,207*~~

~~*1899*~~

~~*63,771,450*~~

~~*7,600,546*~~

~~*359,929*~~

~~*1900*~~

~~*82,367,958*~~

~~*9,100,866*~~

~~*417,574*~~

~~*1901*~~

~~*101,108,780*~~

~~*10,970,063*~~

~~*468,383*~~

~~*The mileage under the electric system is 95 miles of single track.*~~

~~*Lighting.* — *A steady improvement in lighting has taken place, especially since the .Corporation took it over in 1 894. The follow- ing comparative table of the old city area will show this more clearly : —*~~

~~*Year.*~~

~~*1890 1901*~~

~~*No. of Lamps.*~~

~~*Mileage.*~~

~~*Courts.*~~

~~*Passage Lamps.*~~

~~*Candle-power.*~~

~~*Cost.*~~

~~*11,330 ,11,905*~~

~~*272 275*~~

~~*1761*~~

~~*1084*~~

~~*1045*~~

~~*744J millions*~~

~~*2261*~~

~~*£39,000*~~

~~*31,187*~~

~~*The second table shows the improvement in the extended area added to the city in 1895 : —*~~

~~*Year.*~~

~~*No. of Lamps.*~~

~~*Mileage.*~~

~~*Candle-power.*~~

~~*Cost.*~~

~~*1895 1901*~~

~~*2789 3493*~~

~~*128 144*~~

~~*137J millions 623 „*~~

~~*£7194*~~

~~*7900*~~

~~*The increased candle-power and decreased cost have been mainly brought about by the introduction of a system of incandescent gas burners. Electric light is also used in many of the main thorough- fares, and has been installed in all the principal shops and many of the better-class dwelling-houses.*~~

~~*Water Supply.— The Pivington reservoirs in Lancashire (8 in number), with a total capacity of 4,105,000,000 gallons, continue to supply Liverpool with water, supplemented by several of the old wells bored in the pebble beds of the New Red Sandstone. The main supply, however, is drawn from Lake Vyrnwy in Mont- gomeryshire and Rivington. The scheme for utilizing the water from the Vyrnwy district was adopted by the City Council in 1879, and the necessary powers obtained in the following year. The works were begun in 1881, and completed eleven years later. The impounding of the*~~

~~*water was commenced on the 28th of November 1888, and the overflow was not reached until the 25th of November 1889, the process of filling, therefore, occupy- ing almost twelve months. A temporary supply was obtained from Lake Vyrnwy in July 1891, as it was urgently needed, and the permanent aqueduct was completed shortly afterwards. The total area of the gathering-grounds of Rivington and Vyrnwy from which the Corporation can impound water is 32,742 acres. (See Water-Sdpplt and Aqueducts.) The consumption of water per head of the population has gradually increased, the figures being— 1846, 8-24 gallons per head ; 1881, 24-84 ; 1891, 25-25 ; 1901, 30-62.*~~

~~*Trade and Shipping. — Though Liverpool is essentially a port, and the main industries are those dependent on shipping, several other forms of industrial enterprise have made rapid strides during the period. The confectionery trade is a case in point, several large works having been built, no doubt induced by the prospect of cheap sugar directly from the Liverpool quays. The cutting, blending, and preparing of crude tobacco have also led to the erection of several large factories employing several thousands of hands. Two large mills, fitted with the latest and most improved machinery for expressing oil from various oleaginous seeds and for the production of feeding cake for cattle, have also added to the general prosperity. One of these latter has grown from the employment of only a few hands to that of nearly a thousand, and the works now rank among the largest in the world for this class of business. As will be seen from the figures given below, the general trade of the port has steadily grown. The figures for the port of Manchester have been introduced as they are im- portant for the sake of comparison, representing trade which has passed through Liverpool.*~~

~~*Exports of Produce and Manufacture of United Kingdom.*~~

~~*1HS,5.*~~

~~*1895.*~~

~~*1900.*~~

~~*Liverpool Manchester .*~~

~~*£79,765,100*~~

~~*£78,126,746*~~

~~*8,836,999*~~

~~*£87,488,183*~~

~~*7,416,873*~~

~~*Exports of Foreign and Colonial Merchandise.*~~

~~*1885.*~~

~~*1895.*~~

~~*1900.*~~

~~*Liverpool Manchester*~~

~~*£10,189,272*~~

~~*£12,493,722*~~

~~*165,935*~~

~~*£15,084,707*~~

~~*407,394*~~

~~*Imports of Foreign and Colonial Merchandise.*~~

~~*1885.*~~

~~*1895.*~~

~~*1900.*~~

~~*Liverpool Manchester .*~~

~~*£94,912,069*~~

~~*£95,630,489*~~

~~*4,220,792*~~

~~*£124,713,436*~~

~~*16,159,954*~~

~~*The following table shows the increase in the shipping :-*~~

~~*1885.*~~

~~*1S95.*~~

~~*1900.*~~

~~*1885.*~~

~~*1895.*~~

~~*1900. 1*~~

~~*Entered — Liverpool Manchester*~~

~~*Vessels*~~

~~*14,018*~~

~~*Tonnage.*~~

~~*7,070,245*~~

~~*Vessels.*~~

~~*19,457 1,752*~~

~~*Tonnage.*~~

~~*8,675,049 589,159*~~

~~*Vessels.*~~

~~*20,300 2,900*~~

~~*Tonnage.*~~

~~*9,815,674 1,280,784*~~

~~*Cleared — Liverpool Manchester*~~

~~*Vessels.*~~

~~*12,966*~~

~~*Tonnage.*~~

~~*6,624,272*~~

~~*Vessels.*~~

~~19,261 1,809~~

~~Tonnage.~~

~~8,525,185 636,305~~

~~Vessels.~~

~~19,6-20 2,926~~

~~Tonnage.~~

~~9,15S,.332~~

~~1,249,463~~

~~It is the docks, however, that indicate the growth and extent of Liverpool's trade (see Docks). In September 1881 the opening of the newly-completed Langton and Alexandra Docks at the extreme north end of the river frontage indicated a substantial advance towards the completion of the great scheme of dock extension for which parliamentary powers had been obtained in 1873. That scheme may be said to have been fully completed in 1889, the Hornby Dock at the north end, and the Harrington, Toxteth, and Union Docks-at the south end, bringing up the water area of the docks at Liverpool, which in 1882 was 343 acres, to 380 acres in 1889 (not including Birkenhead). Since the latter date the advances which the port has made in the matter of dock accommodation are not to be measured so much by the figures of water area and quayage, although these have both increased, but by the augmented depths of docks, entrances, water approaches, and the increased width of entrances, improvements in the align- ment of the quays, in the class of sheds provided on them for the accommodation of goods, and in the facilities for handling ships and goods generally. Thus in 1889 an important scheme of improve-~~

~~ment at the Canada and Huskisson Docks was commenced, which comprised the alteration of the Canada Dock and lock, the con- struction of a new branch dock of about 7 J acres area, with sheds of the newest type, and a large new graving dock capable of receiving the very largest steamer.~~

~~This graving dock is 925J feet long, 94 feet wide at entrance, and has 34 feet depth of water on its sill on spring tides. In addition to the works above mentioned, the scheme comprised deepening and other improvements at Huskisson Dock, and the provision of a large new half-tide dock on the site of Sandon Basin and Wellington half-tide dock. Within a few years of their deciding to improve the Canada-Huskisson system, so great and rapid was the development of shipping that the Mersey Docks and Harbour Board found that the alterations provided by the scheme of 1891 would be quite inadequate, and in 1898 they sought and obtained powers to supplement it by large additions at the north and south ends of their estate. Under these powers the Sandon graving docks are being obliterated and a new branch dock constructed, and the construction of another large graving dock is contemplated. The scheme of 1898 also provides for a~~

~~reconstruction in a deepened and otherwise improved form of the whole of the Queen's- Wapping group of docks, and the provision of deep-water approaches thereto hy means of new river entrances at Brunswicli; Dock, deepening of Brunswick Dock and the passage between it and the Queen's Dock. Four new branch docks and two graving docks were provided for. In 1895 a great improvement was made in the facilities for passenger traffic by the construction of a railway station on the river side of the trinces Dock, and the extension of railway lines from the London and North- Western Railway Company's trunk and other systems to that point, so that passengers disembarking from Atlantic liners at the landing-stage could enter trains at once and proceed to their destinations. The landing-stage was extended to 2460 feet in length. A very fine group of wool warehouses was constructed on the east side of Great Howard Street, and was opened in 1896. A block of warehouses, having fourteen floors in all and a total floor area of 36 acres, has been constructed for the storage of tobacco, the stock of which in the port is about 100,000 hogsheads, and such a stock can be accommodated in the group of warehouses at the Stanley Dock, consisting of the new warehouse above referred to and the old warehouses. A large part of the George's Dock has been sold to the Corporation ; on the other~~

~~hand, about twelve acres of land hitherto in the hands of the Manchester Ship Canal Company, owners of the Duke's Dock property, has been acquired by the Board. No account of the port would be complete without men- tion being made of the unique dredging operations (see Dredging) which have taken place at the bar of the Queen's Channel, which have enabled the largest ocean liners to enter the river at all hours, except upon the rarest occasions. The dredging at the bar was commenced as an experiment in September 1890 by two of the Board's ordinary hopper barges of 500 tons capacity each. The result was favourable, and in 1892 the Board decided to order a new hopper dredger larger than any hitherto built. This vessel, which cost about £60,000, was set to work in July 1893. Then another vessel of like size was built, and in November 1895 put to work on the bar ; and as the result of all these operations, up to the 17th November 1900 there had been removed over 25,773,000 tons of sand. Before dredging was commenced the depth of water at dead low water of spring tides was only 11 feet ; now there is, under the same conditions, about 27 feet. The space over which dredging has been carried on at the bar measures about 7000 feet by 1250 feet wide, the latter being the average width of the buoyed cut or channel through the bar. Dredging has also taken place on shoals and projections of sand-banks in the main sea channels, and from these the sand pump dredgers have removed over 26,086,500 tons. The total expenditure in connexion with the dredging operations up to the Ist of July 1900, not including capital cost of plant, interest, or depreciation on capital, was about £192,283. The expenditure in like terms for the year ending the 1st July 1900 was £24,400. (w. F. I.)~~

~~Liversedge, a township, urban district, and railway station in the Spen Valley parliamentary division of Yorkshire, England, 3 miles north-west of Dewsbury. The industries , are chiefly the manufacture of woollen goods, the making of machinery, chemical manufactures, and coal mining. Area, 2130 acres. Population (1881),~~

~~12,757 ; (1901), 13,978.~~

~~Livingstone (or Kinga) Mountains, a band of highlands in German East Africa, forming the eastern border of the rift valley of Lake Nyasa, at the northern end of the lake. In parts these highlands present rather the~~

~~*character of a plateau than of a true mountain range, but the latter name may be justified by the fact that they form a comparatively narrow belt of country, which falls considerably to the east as well as to the west. The northern end is well marked in 8° 50′ S. by an escarp- ment falling to the Ruaha valley, which is regarded as a north-eastern branch of the main rift valley. Southwards the Livingstone range may be considered to terminate in the deep valley of the E-uhuhu in 10° 30′ S., the first decided break in the highlands that is reached from the north, on the east coast of Nyasa. Geologically the range is formed on the side of the lake by a zone of gneiss running in a series of ridges and valleys generally parallel to its axis. The ridge nearest the lake (which in ,Mount Chamembe, 9° 41′ S., rises to an absolute height of 7870 feet, or 6200 feet above Nyasa) falls almost sheer to the water, the same steep slope being continued beneath the surface. Towards the south the range appears to have a*~~

~~*width of some 20 miles only, but northwards it widens out to about 40 miles, though broken here by the depres- sion, drained towards the Ruaha, of Buanyi, on the south side of which is the highest known summit of the range, reaching a height of 9600 feet. North and east of Buanyi, as in the eastern half of the range generally, table-topped mountains occur, composed above of horizontally bedded quartzites, sandstones, and conglomerates. The uplands are generally clothed in rich grass, forest occurring prin- cipally in the hollows, while the slopes towards the lake are covered with poor scrub. Native settlements are scattered over the whole range, and German mission sta- tions have been established at Bulongwa and Mtandala, a little north of the north end of Nyasa, at the former of which European crops have been cultivated with success. The climate is here healthy, and night frosts occur in the cold season.*~~

~~*See BoRNHAKDT in Verh. Gesells. Erdk., Berlin, 1899, No. 10.*~~

~~*(e. He.)*~~

~~*Livonia, or Livland (Liflandia of the Russians), one of the three Baltic provinces of Russia. Its area, with the islands, but without Lake Peipus, covers 17,070 square miles. ‘The population in 1897 was 1,300,640 (as against 1,121,000 in 1882), out of whom 670,038 were women, and 376,040 lived in towns. In 1896, out of a total population of 1,274,531, the peasants*~~

~~*numbered 1,146,658 ; artisans, 98,366 ; noblemen, 8275 ; clergy, 3135 ; merchants, 5898 ; foreigners, 10,317 ; and various, 1882 ; to which 36,147 military had to be added. The bulk of the population consisted of Letts (552,860) and Esthonians (609,243), Germans, Russians, Jews, and Poles coming next in the order named.*~~

~~*Agriculture has reached a high degree of perfection, especially on the estates of the landlords. The fields are drained, and no fewer than .300 artesian wells are used for irrigation ; 41 per cent, of the total surface is under artificial meadows and pastures, in- cluding dried-up marshes. Dairy-farming has been rapidly grow- ing, and factories for the utilization of raw produce, derived from improved cattle-rearing, have been on the increase. The average crops of the years 1895-99 were : rye, 4,775,000 cwt. ; wheat, 360,000 ; oats, 3,926,000 ; barley, 4,188,000 ; all cereals, 13,566,000 cwt. Gardening is on the increase. Fishing in Lake Peipus gives occupation to nearly 100,000 persons. The industries are rapidly developing, the aggregate yearly returns of the factories reaching £8,824,000 in 1897. Woollen, cloth, cotton, and flax mills, steam flour and saw mills, distilleries and breweries, machinery works, paper mills, furniture, tobacco, soap, candle, and hardware works are among the chief industrial establishments. Education stands on a much higher level than elsewhere in Russia, no less than 87 per cent, of the children receiving regular education. Of higher educational institutions there are Dorpat University, Riga poly- technicum, and a high school for the clergy. There are also 16 gymnasia for boys, and 11 high schools for girls, and a considerable number of general and professional schools. The government is divided into eleven districts, the chief towns of which, and their population in 1897, are : — Riga, capital of the government (256,197, as against 104,200 in 1881); Arensburg, In the island of Oesel (4621) ; Dorpat, now named officially Yuriev (42,421) ; Eellin (7659); Lamsall (2425); Pernau (12,850); Schlock (2011); Walk (10,139) ; AVenden (6327) ; Werro (4154) ; and Wolmar (5112). (p. A. K.)*~~

~~*Llandrindod Wells, a health resort of Wales, near the middle of Radnorshire, situated amid somewhat bare surroundings, 46 miles by rail west-north-west of Hereford. Its medicinal waters — chalj'beate, sulphurous, and saline — attract some thousands of visitors annually, and*~~

~~the place is equipped with three pump-houses, a public hall, golf-course, park, and electric light. The waters have been long known, and were visited in the 18th century. Population (1901), 1827.~~

~~Llandudno, a parish and favourite seaside resort in the Arfon parliamentary division of Carnarvonshire, AA'ales, 227 miles north-west of London by rail. There are several public halls, two theatres, two hospitals, a library,~~

~~and hydropathic establishments, and a new town hall and assembly rooms were opened in February 1902. The pier is 1250 feet long. Area of urban district, 3034 acres. Population (1881), 4807; (1891), 7348: (1901),~~

~~9307.~~

~~Llanelly, a seaport of Carmarthenshire, "Wales, 10 miles west-north-west of Swansea by rail. It unites with Carmarthen to send one member to Parliament. Modern erections include a new town hall, a hospital, a higher-grade school, a theatre, and a parish hall. There is an intermediate and technical college. In 1888, 1228 ves- sels of 167,646 tons entered, and 1233 of 168,864 tons cleared ; in 1898, 1068 vessels of 181,288 tons entered, and 1666 vessels of 181,211 tons cleared. Area of the urban district, 2107 acres. Population (1891), 21,360;~~

~~(1901), 24,213.~~

~~Llanes, a picturesque coast town of northern Spain, in the province of Oviedo, on the river Carrocedo. The population in 1897 was 19,224. The streets are mostly narrow and irregular, and contain some curious and interesting old houses. The parish church is a fine Gothic structure. The old Augustine convent has been turned into a school, with gymnasium, meteorological station, adult and commercial classes, and a library. The district is much frequented in summer. Llanes is a second-class port for light-draught vessels ; but the en- trance is narrow, and rather difficult in~~

~~rough weather. The trade is chiefly in agricultural products, timber, butter, and fish.~~

~~Llerena, a town and railway station of-Spain, in the province of Badajoz, near the Seville frontier. The population was 6181 in 1897. Remains of the old walls and towers still survive. The local markets are import- ant. The surrounding districts produce wheat, chick- peas, wine, oil ; and live stock is extensively reared. The local industries are chiefly the manufactures of soap, linen, and coarse woollen stuffs.~~

~~-), English tenor, was~~

~~Lloyd, Edward (1845- born in London, 7th March 1845, his father, Eichard Lloyd, being vicar choralist at Westminster Abbey. Erom 1862 to 1860 he sang in the Abbey choir, and was thoroughly trained in music, eventually becoming solo tenor at the ChapelEoyal. He began singing at concerts in 1867, and in 1871 appeared at the Gloucester Musical Festival. His fine evenly-produced voice and pure style at once brought him into notice, and he gradually took the place of Sims Eeeves as the leading English tenor of the day, his singing of classical music, and especially of Handel, being particularly admired. At the Handel Fes- tivals after 1888 he was the principal tenor, and even in the vast auditorium at the Crystal Palace his silver-trumpet tones triumphed over acoustic difficulties. In 1888, 1890, and 1892 he paid successful visits to the United States ; but by degrees he appeared less frequently in public, and in 1900 he formally retired from the platform.~~

~~Lloyd's. See Insueancb.~~

~~Loanda, or Slo Paulo db Loanda, a city and episcopal see of Portuguese West .Africa, capital of the province of Angola, situated on a bay between the rivers Bengo and Quanza. It is a good port, with a floating dock, and possesses a meteorological observatory, hospital, public garden, tramways, gas-works, statues to Salvador Correia de Sa, who wrested the colony from the Dutch, and to Pedro Alexandrino, a former governor, and is the terminus of the railway (190 miles) inland to Ambaca. The district of Loanda stretches along the Atlantic from the river Loge to the Tapado, and has a population of~~

~~190,867, exclusive of Libollo and Songo. The trade reaches an annual value of 1^ millions sterling, as com- pared with less than half a million sterling in 1888.~~

~~Lobanof-Rostofskl, Alexis Borlsovitch,~~

~~Peince (1824-1896), Eussian statesman, was born on 30th December 1824, and educated, like Prince Gortcha- koff and so many other eminent Russians, at the lyceum of Tsarskoe Selo. At the age of twenty he entered the diplomatic service, and rose in the usual way till he became Minister at Constantinople in 1859. In 1863 a regrettable incident in his private life made him retire temporarily from the public service, but four years later he re-entered it and served for ten years as adlatus to the Minister of the Interior. At the close of the Eusso-Turkish war in 1878 he was selected by the emperor to fill the post of ambassa- dor at Constantinople, and for more than a year he carried out with great ability the policy of his Government, which aimed at re-establishing tranquillity in the Eastern Ques- tion, after the volcanic disturbances produced by the reck- less action of his predecessor. Count Ignatief. In 1879 he was transferred to London, and in 1882 to Vienna ; and in March 1895 he was appointed Minister of Foreign Affairs in succession to M. de Giers. In this important position he displayed much of the caution of his prede- cessor, but adopted a more energetic policy in European affairs generally and especially in the Balkan Peninsula. At the time of his appointment the attitude of the Eussian Government towards the Slav nationalities had been for several years one of extreme reserve, and he had seemed as ambassador to sympathize with this attitude. But as soon as he became Minister of Foreign Affairs, Eussian influence in the Balkan Peninsula suddenly revived. Servia received financial assistance; a large consignment of arms was sent openly from St Petersburg to the prince of Montenegro; Prince Ferdinand of Bulgaria became ostensibly reconciled with the Tsar, and his son Boris was received into the Eastern Orthodox Church ; the Eussian embassy at Constantinople tried to bring about a reconciliation between the Bulgarian Exarch and the OEcumenical Patriarch ; Bulgarians and Servians pro- fessed, at the bidding of Eussia, to lay aside their mutual hostility. All this seemed to foreshadow the creation of a Balkan confederation hostile to Turkey, and the Sultan had reason to feel alarmed. In reality Prince Lobanof was merely~~

~~trying to establish a strong Eussian hegem- ony among these nationalities, and he had not the slight- est intention of provoking a new crisis in the Eastern Question so long as the general European situation did not afford Eussia a convenient opportunity for solving it in her own interest without serious intervention from other Powers. Meanwhile he considered that the integrity and independence of the Ottoman Empire must be maintained so far as these other Powers were concerned. Accordingly, when Lord Salisbury proposed energetic action to protect the Armenians, the Cabinet of St Petersburg suddenly assumed the role of protector of the Sultan, and vetoed the proposal. At the same time efforts were made to weaken the Triple Alliance, the principal instrument em- ployed being the entente with France, which Prince Loba- nof helped to convert into a formal alliance between the two Powers. In the Far East he was not less active, and became the protector of China in the same sense as he had shown himself the protector of Turkey. Japan was com- pelled to give up her conquests on the Chinese mainland, so as not to interfere with the future action of Eussia in Manchuria, and the financial and other schemes for increasing Eussian influence in that part of the world were vigorously supported. Strange to say, all this activity, though combined with a haughty tone towards foreign Governments and diplomatists, did not produce~~

~~much, general apprehension, probably because there was a widespread conviction that he desired to maintain peace, and that his great ability and strength of character would enable him to control the dangerous forces which he boldly set in motion. However this may be, before he had time to mature his schemes, and when he had been the director of Kussian policy for only eighteen months, he died suddenly of heart disease when travelling with the emperor on 30th August 1896. Personally Prince Lobanof was a grand seigneur of the Eussian type, proud of being descended from the independent princes of Kostof, and at the same time an amiable man of wide culture, deeply versed in Russian history and genealogy, and perhaps~~

~~the first authority of his time in all that related to the reign of the Emperor Paul. (d. m. w.)~~

~~Lobatchewsky, Nicolas Ivanovitch (1793- 1856), Eussian mathematician, was born at Makarief, ISrijni-Novgorod, in 1793. HIs father died about 1800, and his mother, who was left in very poor circumstances, removed to Kazan with her three sons, who went to school at the gymnasium of that town. In 1807 Nicolas, the second boy, entered as a student in the University of Kazan, then recently established. Pive years later, having completed the curriculum, he began to take part in the teaching, becoming assistant professor in 1814 and ex- traordinary professor two years afterwards. In 1823 he succeeded to the ordinary professorship of mathematics, and retained the chair until about 1846, when he seems to have fallen into official disfavour. At that time his connexion with the university to which he had devoted his life practically came to an end, except that in 1855, at the celebration of its jubilee, he brought it as a last tribute his Pang^.omitrie, in which he summarized the results of his geometrical studies. HIe died on 24th Feb- ruary (IST.S.) 1856. Lobatchewsky's fame has probably become much greater since his death than ever it was in his lifetime. HIe was one of the first thinkers to apply a critical treatment to the fundamental principles of geometry, which, as laid down by Euclid, had been ac- cepted almost without question for two thousand years, and he thus became a pioneer of that modern geometry which deals with space other than as defined by Euclid's postulates. HIs first contribution to the theory of hyper- geometry is believed to have been given in a lecture at Kazan in 1826, but the subject is treated in many of his subsequent memoirs, among which may be mentioned the Oeometrische Uritersuchaiigen ziir TJieurie der Parallellinen (Berlin, 1840), and the Pangiom&trie already referred to, which in the sub-title is described as a precis of geometry founded on a general and rigorous theory of parallels. (See Geometry, Non-Euclidban.) In addition to his geometrical studies, he made various contributions to other branches of mathematical science, among them being an elaborate treatise on algebra (Kazan, 1834). Besides being a geometer of power and originality, Lobatchewsky possessed the gift, not vouchsafed to every great mathematician, of being an excellent man of busi- ness. Under his administration the University of Kazari prospered as it had never done before ; and he not only organized the~~

~~*teaching staff to a high degree of efficiency, but arranged and enriched its library, furnished instru- ments for its observatory, collected specimens for its museums, and provided it with proper buildings. In order to be able to supervise the frcotiou of the last, he studied architecture, with such effect, it is said, that he was able to carry out the plans at a cost considerably below the original estimates.*~~

~~*Ldbau, a town of Germany, on the Lobau water, 12 miles south-east of the town and in the circle of Bautzen, kingdom of Saxony, on the Dresden-Gorlitz railway, with*~~

~~*lines to Oberoderwitz and Ebersbach. There are three Protestant churches, one Catholic church, a seminary for teachers, a real, a commercial, and a burgher school. It has dye, agricultural implement, pianoforte, and button works, and a considerable trade in grain, yarns, linens, and stockings. Population (1890), 7523 ; (1900), 9627.*~~

~~*Lob- nor, or Lop-nor, a lake of Central Asia, in the Gobi Desert, between the Altyn Tagh on the south and the Kurruk Tagh on the north. Previous to 1876 it was placed in nearly all maps at 42° 30' IST., a position which agreed with the accounts of ancient Chinese geographers. In the year mentioned the Eussian Prjevalsky discovered two closely connected lake-basins, Kara-Buran and Kara- Koshun, fully one degree farther south, and considerably to the east of the site of the old Lop-nor, which lake- basins he nevertheless regarded as being identical with the old Lop-nor of the Chinese. But the water they contained he pronounced to be fresh water. This identi- fication was disputed by baron von Eichthofen, on the ground that the Lop-nor, the " Salt Lakes " of the Chinese geographers, could not be filled with fresh water ; more- over, being the gathering basin of the desert stream the Tarim, it was bound to be salt,, more especially as the lake had no outflow. Prjevalsky visited the Lop-nor region again in 1885, and adhered to his opinion. But ten years later it was explored anew by Dr Sven Hedin, the Swedish traveller, who ascertained that the Tarim empties part of its waters into another lake, or rather string of lakes (Avullu-koll, Kara-koll, Tayek-koU, and Arka-koll), which are situated in 42° 30' N., and thus so far justified the views of von Eichthofen, and confirmed the Chinese accounts. At the same time he advanced reasons for believing that*~~

~~*Prjevalsky's lake-basins, the southern Lop-nor, are of quite recent origin — indeed, he fixed upon the year 1720 as the date of their formation. Besides this, he argued that there exists a close inter- relation between the northern Lop-nor lakes and the southern Lop-nor lakes, so that as the water in the one group increases, it decreases to the same proportion and volume in the other. He also argued that the four lakes of northern .Lop-nor are slowly moving westwards under the incessant impetus of wind and sandstorm (buran). These conclusions were afterwards controverted by the Eussian geograjjher, M. Kozloff, who visited the Lop-nor region in 1893-94 — that is, before Dr Sven Hedin's exam- ination. Finally, in 1900 the Swedish explorer, following up the course of the Kum-daria, discovered at the foot of Kurruk Tagh the basin of a desiccated salt lake, which he holds to be the true Lop-nor of the Chinese geographers ; and at the same time he found that the Kara-Koshum or Lop-nor of Prjevalsky had extended towards the north, but shrunk in the south. Thus the old Lop-nor no longer exists, but in place of it there are a number of much smaller lakes of newer formation. From all this it may fairly be inferred that, owing to the uniform level of the region, the sluggish flow of the Tarim, its tendency to divide and reunite, conjoined with the violence of the winds (mostly from the east and north-east), and the rapid and dense growth of the reed-beds in the shallow marshes, the drainage waters of the Tarim basin gather now in greater volume in one depression, and now in greater volume in anothp' ; and this view derives support from the extreme shallowness of the lakes in both Dr Sven Hedin's northern Lop-nor and Prjevalsky's southern Lop-nor.*~~

~~*See the accomits (in Russiiin) of Prjevalsky's first (1876-77) and second (lHHIr>) journeys. — Yos Riciithofen. " Bemerkungen zu den Ergebnissen von Oberst-Lieutenant Prjewalskis Reise nach dem Lop-noor," in Verhandl. der Geach. f. Erdknnde zu Berlin, 1878, pp. 121 et seq. — Sven Hedin. Through Asia (London, 1808), vol. i. pp. 16 et seq., and vol. ii. pp. 801 et seq. (j. t. Be.)*~~

~~*LOCAL GOVERNMENT (ENGLAND AND WALES).*~~

~~*LOCAL Government maybe defined as the government of a local area as distinguished from the kingdom at large. It is that part of the government of*~~

~~the State which the supreme legislature has thought fit to delegate to local authorities or bodies, and it is therefore restricted not merely in respect of area, but in respect of the char- acter and extent of the powers and duties entrusted to the local body. The system of local government now exist- ing in England may be said to have been founded in 1888, when the Local Government Act of that year was passed. Since then the entire system of the government of districts and parishes has been reorganized with due regard to the preceding legislation. The largest area of local govern- ment is the county ; next to that the sanitary district, urban or rural, including under this head municipal boroughs, all of which are urban districts. The parish is, speaking generally, the smallest area, though, as will hereafter be seen, part of a parish may be a separate area for certain purposes ; and there may be united districts or parishes for certain purposes. It will be convenient to follow this order in the present article. But before doing so, it should be pointed out that all local bodies in Eng- land are to some extent subject to the control of central authorities, such as the Privy Council, the Home Office, the Board of Agriculture, the Board of Trade, the Board of Education, or the Local Government Board.~~

~~The subject of the Poor Law is separately treated, and the functions and duties of the Local Government Board as the successors of the Poor Law Board need not here be a °a. referred to. In 1848, pursuant to the Public Health meat" ' ‘^ °^ *^^' J'^^^'i *'^^ General Board of Health was Board. established, and it continued in existence until 1854,~~

~~when it was reconstituted. The existence of the new board, which was originally limited to one year, was extended from year to year until 1858, when it was allowed to expire, its powers under the various Acts for the prevention of diseases being transferred to the Privy Council, while those which related to the control of local authorities passed to the Secretary of State for the Home Department, to whose department the staff of officers and clerks formerly under the General Board of Health was trans- ferred. This state of affairs continued until 1871, when the Local Government Board was constituted. It consists of a president appointed by His Majesty, and of the following ex-officio members : the president of the Privy Council, all the principal Secretaries of State for the time being, the Lord Privy Seal, and the Chancellor of the Exchequer. The board, as thus constituted, has~~

~~power to appoint such secretaries, assistant-secretaries, inspectors, auditors, clerks, messengers, and other officers, as they may with the sanction of the Treasury determine. The president and one of the secretaries may sit in Parliament. To the board were transferred all the powers of the Secretary of State under the Public Health Act, 1848, and the numerous Acts relating to sanitary matters and the government of sanitary districts which had passed subse- quently ; together with all the powers and duties of the Privy Council under the Acts relating to the prevention of epidemic disease and to vaccination. Its powers and duties have been largely added to by subsequent legislation. A mere enumeration of them would be profitless. In so far as they affect local authori- ties, they will be mentioned hereafter under various heads.~~

~~Tlie Administrative County. — For purposes of local gov- ernment the geographical and the administrative county are generally the same. But this is not always ladth”” *^ the case. Thus each of the three Eidings of couaty Yorkshire is an administrative county, as also council. j^g QQ^ch of the three divisions of Lincolnshire, the eastern and western divisions of Sussex, the eastern and western divisions of Suffolk, the Isle of Ely and the residue of the county of Cambridge, the Soke of Peter- borough and tlie rest of the county of Northampton. The metropolis forms the county of London. The adminis- trative county includes all places within its area, with~~

~~two important exceptions. The first of these consists of the county borough. The second is the quarter sessions borough, which forms part of the county for certain speci- fied purposes only. But the county includes all other places, such as liberties and franchises, which before 1888 were exempt from contribution to county rate. For each administrative county a county council is elected. For purposes of election the entire county is divided into divi- sions corresponding to the wards of a municipal borough, and one councillor is elected for each electoral division. The electors are the county electors, i.e., in a borough the persons enrolled as burgesses, and in the rest of the county the persons who are registered as county • electors, i.e., those persons Who possess in a Couoty county the same qualification as burgesses elections. must have in a borough, and are registered.~~

~~*The qualification of a burgess or county elector is substantially the occupation of rated property within the borough or county, residence during a qualifying period of twelve months within the borough or county, and payment of rates for the qualifying prop- erty. A person so qualified is entitled to be enrolled as a burgess, or registered as a county elector (as the case may be), unless he is alien, has during the qualifying period received union or parochial relief or other alms, or is disentitled under some Act of Parlia- ment such as the Corrupt Practices Act, the Felony Act, &o. The lists of burgesses and county electors are prepared annually by the overseers of each parish in the borough or county, and are revised by the revising barrister at courts holden by him for the purpose in September or October of each year. When revised they are sent to the town clerk of the borough, or to the clerk of the peace of the county, as the case may be, by whom they are printed. The lists are conclusive of the right to vote at an election , although on election petition involving a scrutiny the vote of a person disquali- fied by law may be struck off, notwithstanding the inclusion of his name in a list of voters.*~~

~~*The qualification of a county councillor is similar to that required of a councillor in a municipal borough, with some modifications. A person may be qualified in any one of the following ways : viz., by being (1) enrolled as a county elector, and possessed of a prop- erty qualification consisting of the possession of real or personal property to the amount of £1000 in a county having four or more divisions, or of £500 in any other county, or the being rated to the poor rate on an annual value of £30 in a county having four or more divisions, or of £15 in any other county ; (2) enrolled in the non-resident list, and possessed of the same property qualification (the non-resident list contains the names of persons who are quali- fied for enrolment in all respects save residence in the county or within seven miles thereof, and are actually resident beyond the seven miles and within fifteen miles) ; (3) entitled to elect to the office of county councillor (for this qualification no property quali- fication is required, but the office of a councillor elected on this qualification only becomes vacant if for six months he ceases to reside within the county) ; (4) a peer owning property in the county ; (5) registered as a parliamentary voter in respect of the ownership of property in the county. Clerks in holy orders and ministers of religion are not disqualified as they are for being borough councillors, but in other respects*~~

~~*the persons disqualified to be elected for a county are the same as those disqualified to be elected for a borough. Such disqualifications include the holding of any office or place of profit under the council other than the office of chairman, and the being concerned or interested in any contract or employment with, by, or on behalf of the council.*~~

~~*County councillors are elected for a term of three years, and at the end of that time they retire together. The ordinary day of election is the 8th. March, or some day between the 1st and 8th March fixed by the council. Candidates are nominated in writing by a nomination paper signed by a proposer and seconder, and subscribed by eight other assenting county electors of the division ; and in the event of there being more valid nominations than vacancies, a poll has to be taken in the manner prescribed by the Ballot Act, 1872. Corrupt and illegal practices at the election are forbidden by a statute passed in the year 1894, which imposes heavy penalties and disqualifications for the offences which it creates. These offences include not only treating, undue influence, bribery and personation, but certain others, of which the following are the chief : — Payment on account of the conveyance of electors to or from the poll ; payment for any committee room in excess of a prescribed number ; the incurring of expenses in and about the*~~

~~*election beyond a certain maximum ; employing, for the conveyance of electors to or from the poll, hackney carriages or carriages kept for hire ; payments for bands, flags, cockades, &c. ; employing for payment persons at the election beyond the prescribed number ; printing and publishing bills, placards, or posters which do not disclose the name and address of the printer or publisher ; using as committee rooms or for meetings any licensed premises, or any premises where food or drink is ordinarily sold for consumption on the premises, or any club premises where intoxicating liquor is sup- plied to members. In the event of an illegal practice, payment, em- ployment, or hiring, committed or done inadvertently, relief may be given by the High Court, or by an Election Court, if the validity of the election is questioned on petition ; but unless such relief is given (and it will be observed that it cannot be given for a corrupt as distinguished from an*~~

~~*illegal practice) , an infringement of the Act may avoid the election altogether. The validity of the election may be questioned by election petition. Indeed, this is the only method when it is sought to set aside the election on any of the usual grounds, such as corrupt or illegal practices, or the disqualification of the candidate at the date of election.. Election petitions against county councillors and members of other local bodies (borough councillors, urban and rural district councillors, members of school boards and boards of guardians) are classed together as municipal election peti- tions, and are heard in the same way, by a commissioner who must be a barrister of not less than fifteen years' standing. The petition is tried in open court at some place within the county, the expenses of the court being provided in the first instance by the Treasury, and repaid out of the county rates, except in so far as the court may order them to be paid by either of the parties. If a candidate is unseated a casual vacancy is created which has to be filled by a new election. A county councillor is required to accept office by mak- ing and subscribing a declaration in the prescribed form that he will duly and faithfully perform the duties of the office, and that he possesses the necessary qualification. The declaration may be made at any time within three months after notice of election. If the councillor does not make it within that time, he is liable to a fine the amount of which, if not determined by bye-law of the council, is £25 in the case of an alderman or councillor, and £50 in the case of the chairman. Exemption may, however, be claimed on the ground of age, physical or mental incapacity, previous service, or payment of the fine within five years, or on the ground that the claimant was nominated without his consent. If during his term of office a member of the council becomes bankrupt, or compounds with his creditors, or is (except in case of illness) con- tinuously absent from the county, being chairman for more than two months, or being alderman or councillor for more than six months, his office becomes vacant by declaration of the council. In the case of disqualification by absence, the same fines are payable as upon non-acceptance of office, and the same liability arises on resigna- tion. Acting without making the declaration, or without being qualified at the time of making the declaration, or after ceasing to be qualified, or after becoming disqualified, involves liability to a fine not exceeding £50, recoverable by action.*~~

The councillors who have been elected come into office on the 8th March in the year of election. The first quarterly meeting of the newly-elected council is held on the 16th or on such aalrmaa, ^ji^gp ^^^ within ten days after the 8th as the county council may fix. The first business at that meeting is the election of the chairman, whose office corresponds to that of the mayor in a borough. He is elected for the ensuing year, and holds office until his successor has accepted office. The chairman must by a fit person, elected by the council from their own body or from persons qualified to be councillors. He may receive such remuneration as the council think reasonable. He is by virtue of his office a justice of the peace for the county. Having elected the chairman, the meeting proceeds to the election of aldermen, whose number is one-third of the number of councillors, except in London, where the number is one-sixth. An alderman must be a councillor or a person qualified to be a councillor. If a councillor is elected he vacates his office of councillor, and thus creates a casual vacancy in the coaiioil. In every third year one-half of the whole number of aldermen go out of office, and their places are filled by election, which is conducted by means of voting papers. It will be observed, therefore, that while a county councillor holds office for threo years, a county alderman holds office for six. The council may also appoint a vice-chairman who holds office during the term of office of the chairman ; in London the council have power to appoint a paid deputy chairin;m.

It may be convenient at this point to refer to the officers of the county council. Of these, the chief are the clerk, the treasurer, Officers. ”” ^^^ surveyor. Before 1888 tlie clerk of the peace was appointed in a county by the cuxtos rotulorum. He held office for life or good conduct, and had power to act by a sufficient deputy. Under the Act of 1888 existing clerks of the peace became clerks of the councils of their counties, holding office by the same tenure as formerly, except in the county of London,

where the offices were separated. Thereafter a new appointment to the offices of clerk of the peace and clerk of the county council was to be made by the standing joint-committee, at whose pleasure he is to hold oifice. The same committee appoint the deputy- clerk, and fix the salaries of both officers. The clerk of the peace was formerly paid by fees which were fixed by quarter sessions, but under recent enactments he is now generally if not

~~in every case paid by salary, the fees received by him being paid into the county fund. The county council may also employ such other officers and servants as they may think r.ecessary.~~

~~Subject to a few special provisions in the Local Government Act of 1888, the business of the county council is regulated by the pro- visions laid down in the Municipal Corporations Act, Business 1882, with regard to borough councils. There are four quarterly meetings in every year, the dates of which may be fixed by the council, with the exception of that which must be held on the 16th March or some day within ten days after the 8th of March as already noticed when treating of elections. Meetings are con- vened by notices sent to members stating the time and place of the meeting and the business to be transacted. The chairman, or in his absence the vice-chairman, or in the absence of both an alderman or councillor appointed by the meeting, presides. All questions are determined by the votes of the majority of those present and voting, and in case of equality of votes the chairman has a casting vote. Minutes of the proceedings are taken, and if signed by the chairman at the same or the next meeting of the council are evidence of the proceedings. In all other respects the business of the council is regulated by standing orders which the council are authorized to make. Very full power is given to appoint committees, which may be either general or special, and to them may be delegated, with or without restrictions or conditions, any of their powers or duties except that of raising money by rate or loan. Power is also given to appoint joint-committees with other county councils in matters in which the two councils are jointly interested, but a joint-committee so appointed must not be confounded with the standing joint-committee of the county council and the quarter sessions, which is a district statutory body and is elsewhere referred to. The finance committee is also a body with distinct duties.~~

~~In order to appreciate some of the points relating to the finance of a county council, it is necessary to indicate the relations between an administrative county and the boroughs vsrhich are locally situate f^'^tioa oi within it. The Act of 1888 created a new 'trough's. division of boroughs into three classes ; of these the first is the county borough. A certain number of boroughs which either had a population of not less than 50,000, or were counties of themselves, were made counties independent of the county council and free~~

~~*from the payment of county rate. In such boroughs the borough council have, in addition to their powers under the Municipal Corporations Act, 1882, all the powers of a county council under the Local Government Act. They are independent of the county council, and their only relation is that in some instances they pay a contribution to the county — e.g., for the cost of assizes where there is no separate assize for the borough. The boroughs thus con- stituted county boroughs are enumerated in the schedule to the Local Government Act, 1888, but to the list therein contained there must now be added Grimsby, Oxford, and Newport (]Mon.), which have been made county boroughs since 1888.*~~

~~*The larger quarter sessions boroughs, i.e., those which had, according to the census of 1881, a population exceed- ing 10,000, form part of the county, and are subject to the control of the county council, but only for certain special purposes. The reason for this is that while in counties the powers and duties under various Acts were entrusted to the county authority, in boroughs they were exercised by the borough councils. In the class of boroughs now under consideration these powers -and duties are retained by the borough council ; the county council exercise no jurisdiction within the borough in respect of them, and the borough is not rated in respect of tliem to the county rate. The Acts referred to include .those relating to the diseases of animals, destructive insects, explosives, fish conservancy, gas meters, margarine, police, reformatory*~~

~~*und industrial schools, riot (damages), sale of food and drugs, weights and measures. But for certain purposes these boroughs are part of the county and rateable to county rate — e.g., main roads, cost of assizes and sessions, and in certain cases pauper lunatics. The county council lors elected for one of these boroughs may not vote on any matter involving expenditure on account of which the borough is not assessed to county rate.*~~

~~*The third class of boroughs comprises those which have a separate court of quarter sessions, but had accord- ing to the census of 1881 a population of less than 10,000. All such boroughs form part of the county for the pur- poses of pauper lunatics, analysts, reformatory and indus- trial schools, fish conservancy, explosives, and, of course, the purposes for which the larger*~~

~~quarter sessions boroughs also form part of the county, such as main roads, and are assessed to county rate accordingly. And in a borough, whether a quarter sessions borough or not, which had in 1881 a population of less than 10,000, all the powers which the borough council formerly possessed as to police, analysts, diseases of animals, gas meters, and weights and measures cease and are transferred to the county council, the boroughs bec6ming in fact part of the area of the county for these purposes.~~

~~It will be seen therefore that for some purposes, called in the Act general county purposes, the entire county, including all boroughs other than county boroughs, is assessed to the county rate ; while for others, called special county purposes, certain boroughs are now assessed. This explanation is necessary in order to ap- preciate what has now to be said about county finance. B^.it before leaving the consideration of the area of the county it may be added that all liberties and franchises are now merged in the county and subject to the jurisdic- tion of the county council.~~

~~The county council is a body corporate with power to hold lands. Its revenues are derived from various sources which will presently be mentioned, but all nance, receipts have to be carried to the county fund, either to the general county account if applicable to general county purposes, or to the special county account if applicable to special county purposes. The county council may, with the consent of the Local Government Board, borrow money on the security of the county fund or any of its reveaues, for consolidating the debts of the county ; purchasing land or buildings ; any perma- nent work or other thing, the cost of which ought to be spread over a term of years ; making advances in aid of the emigration or colonization of inhabitants of the county ; and any purpose for which quarter sessions or the county council are authorized by any Act to borrow. If, however, the total debt of the council will, with the amount proposed to be borrowed, exceed one-tenth of the annual rateable value of the property in the county, the money cannot be borrowed unless under a provisional order made by the Local Government Board and con- firmed by Parliament. The period for which a loan is made is fixed by the county council with the consent of the Local Government Board, but may not exceed thirty years, and the mode of repayment may be by equal yearly or half-yearly instalments of principal or of principal and interest combined,~~

~~*or by means of a sinking fund invested and applied in accordance with the Local Government Acts. The loans authorized may be raised by debentures or annuity certificates under these Acts, or by the issue of county stock, and in some cases by mortgage.*~~

~~*The county council must appoint a finance committee for regu- lating and controlling the finance of the county, and the council cannot make any order for the payment of money out of the county fund save on the recommendation of that committee. Moreover, the order for payment of any sum must be made in*~~

~~*pursuance of an order of the council signed by three members of the finance committee present at the meeting of the coimcil, and countersigned by the clerk. The order is directed to the county treasurer, by whom authorized payments are then made.*~~

~~*The accounts of the receipts and expenditure of the county council are made up for the twelve months ending, the 31st March in each year, and are audited by a district auditor. The form in which the accounts must be made up is prescribed by the Local Government Board. The auditor is a district auditor appointed by the Local Government Board under the District Auditors Act, 1879, and in respect of the audit the council is charged with a stamp duty, the amount of which depends on the total of the ex- penditure comprised in the financial statement. Before each audit the auditor gives notice of the time and place appointed, and the council publish the appointment by advertisement. A copy of the accounts has to be deposited for public inspection for seven days before the audit. The auditor has the fullest powers of investigation ; he may require the production of any books or papers, and he may require the attendance before him of any person accountable. Any owner of property or ratepayer may attend the audit and object to the accounts, and either on such objection or on his own motion the auditor may disallow any payment and surcharge the amount on the persons who made or authorized it. Against any allowance or surcharge appeal lies to the HIgh Court if the question involved is one of law, or to the Local Government Board, who have jurisdiction to remit a sur- charge if, in the circumstances, it appears to them to be fair and equitable to do so. It will be seen that this is really an effective audit.*~~

~~*The sources of revenue of the council are the Exchequer con- tribution, income from property and fees, and rates. Before 1888 large grants of money had been made annually to local authorities in aid of local taxation. Such grants repre- "evenue o/ sented a contribution out of taxation for the most part """"ty arising out of property other than real property, while """"" • local taxation fell on real property alone. By the Act of 1888 it was provided that for the future such annual grants should cease, and that other payments should be made instead thereof. The Commissioners of Inland Eevenue pay into the Bank of England, to an account called " the local taxation account," the sums ascer- tained to be the proceeds of the duties collected by them in each county on what are called local taxation licences, which include licences for the sale of intoxicating liquor, licences on dogs, guns, establishment licences, &c. The amount so ascertained to have been collected in each county is paid under direction of the Local Govern- ment Board to the council of that county. The Commissioners of Inland Revenue also pay into the same account a sum equal to one and a half per cent, on the net value of person al property in respect of which estate duty is paid. Under the Customs and Inland Revenue Act, 1890, certain duties imposed on spirits and beer are also to be paid to " the local taxation account." The sums so paid in respect of the duties last above mentioned, and in respect of the» estate duty and spirits and beer additional duties, are distributed among the several counties in proportion to the share which the Local Government Board certify to have been received by each county during the financial year ending the 31st March 1888, out of the grants theretofore made out of the Exchequer in aid of local rates. The payments so made out of " the local taxation account " to a county council are paid to the county fund, and carried to a separate account called "the Exchequer contribution account." The money standing to the credit of this account is applied : (i.) in paying any costs incurred in respect thereof or otherwise charge- able thereon ; (ii.) in payment of the sums required by the Local Government Act, 1888, to be paid in substitution for local grants ; (ill.) in payment of the new grant to be made by the county council in respect of the costs of union officers ; and (iv.) in repaying to "the general county account" of the county fund the costs on account of general county purposes for which the whole area of the county (including boroughs other than county boroughs) is liable to be assessed to county contribution'. Elaborate pro- vision is*~~

~~made for the distribution of the surplus (if any), with a view to securing a due share being paid to the quarter sessions boroughs.~~

~~The payments which the county council have to make in substi- tution for the local grants formerly made out of Imperial funds include payments for or towards the remuneration of the teachers in poor-law schools and public vaccinators ; school fees paid for children sent from a workhouse to a public elementary school ; half of the salaries of the medical ofBcer of health and the inspectors of nuisances of district councils ; the remuneration of registrars for births and deaths ; the mamtenance of pauper lunatics ; half of the cost of the pay and clothing of the police of the county, and of each borough maintaining a separate police force. In addition to the grants above mentioned, the county council is required to grant to the guardians of every poor-law union wholly or partly in their county an annual sum for the costs of the officers of the union and of district schools to which the~~

~~union contributes. Another source is the income of any property belonging to the council, but the amount of this is usually small. The third source of revenue, consists of the fees received by the dif- ferent officers of the county councils or of the joint-committee. For example, fees received by the clerk of the peace, inspectors of weights and measures, and the like. These fees are paid into the county fund, and carried either to "the general county account" or, if they have been received in respect of some matter for which part only of the county is assessed, then to the special account to which the rates levied for that purpose are carried. The remaining source of income of a county council is the county rate, the manner of levying which is hereafter stated.~~

~~Of the powers and duties of county councils, it may be convenient to treat of these first, in so far as they are~~

~~transferred to or conferred on them by the transferred Local Grovernment Act, 1888, under which they from were created, and afterwards in so far as they~~

~~quarter have been conferred by siibsequent legislation.~~

~~Before the passing of the Local Government Act, 1888, the only form of county government in England was that of the justices in quarter sessions. Quarter sessions were originally a judicial body, but being the only body having jurisdiction over the county as a whole, certain powers were conferred and certain duties imposed upon them with reference to various matters of county government from time to time. The principal object of the Act of 1888 was to transfer these powers and duties from the quarter sessions to the new repre- sentative body — the county council ; and it may be said that substantially the whole of the administrative business of quarter sessions was thus transferred.~~

~~The subjects of such transfer include (i.) the making, assessing, and levying of county, pohce, hundred, and all rates, and the appli- cation and expenditure thereof, and the making of orders for the payment of sums payable out of any such rate, or out of the county stock or county fund, and the preparation and revision of the basis or standard for the county rate. With regard to the county rate, a few words of description may be sufficient here. The council appoint a committee called a county rate committee, who from time to time prepare a basis or standard for county rate — that is to say, they fix the amount at which each parish in the county shall contribute its quota to the county rate. As a general rule the poor- law valuations are followed, but this is not universally the case, some county councils adopting the assessment to income tax, schedule A, and others forming an independent valuation of their f)wn. The overseers of any parish aggrieved by the basis may appeal against it to quarter sessions, and it is to be noticed that this appeal is not interfered with, the transfer of the duties of justices relating only to administrative and not to judicial business. When a contri- bution is required from county rate, the county council assess the amount payable by each parish according to the basis previously made, and send their precept to the guardians of the unions compris- ing the several parishes in the county, the guardians in their turn re- quiring the overseers of each parish to provide the necessary quota of that parish out of the poor rate, and the sum thus raised goes into the county fund. The police rate is made for the purpose of defray- ing the expenses of the county police. It is made on the same basis as the county rate, and is levied with it. The~~

~~hundred rate is seldom made, though in some counties it may be made for purposes of main roads and bridges chargeable to the hundred as distinguished from the county at large ; (ii.) the borrowing of money ; (iii.) the pass- ing of the accounts of and the discharge of the county treasurer ; (iv.) shire halls, county halls, assize courts, the judges' lodgings, lock-up houses, court houses, justices' rooms, police stations and county buildings, works, and property ; (v.) the licensing under any general Act of houses and other places for music or for dancing, and the granting of licences under the Racecourses Licensing Act, 1879 ; (vi.) the provision, enlargement, maintenance, and manage- ment and visitation of, and other dealing with, asylums for pauper lunatics ; (vii.) the establishment and maintenance of, and the con- tribution to, reformatory and industrial schools ; (viii.) bridges and roads repairable with bridges, and any powers vested by the High- ways and Locomotives Amendment Act, 1878, in the county authority. It may be observed that bridges have always been at common law repairable by the county, although, with regard to bridges erected since the year 1805, these are not to be deemed to be county bridges repairable by the county unless they have been erected under the direction or to the satisfaction of the county sur- veyor. The common-law liability to repair a bridge extends also to the road or approaches for a distance of .300 feet on each side of the bridge. Of the powers vested in the county authority under the~~

~~Highway Act, 1878, the most important are those relating to main roads, which are specially noticed hereafter, (ix.) The table of fees to be taken by and the costs to be allowed to any inspector, analyst, or person holding any office in the county other than the clerk of the peace and the clerks of the justices; (x.) the appointment, re- moval, and determination of salaries of the county treasurer, the county surveyor, the public analysts, any officer under the Explosives Act, 1875, and any officers whose remuneration is paid out of the county rate, other than the clerk of the peace and the clerks of the justices ; (xi.) the salary of any coroner whose salary is payable out of the county rate, the fees, allowances, and disbursements allowed to be paid by any such coroner, and the division of the county into coroners' districts and the assignments of such districts ; (xii.) the division of the county into polling districts for the purposes of parliamentary elections, the appointment of the places of election, the places of holding courts for the~~

~~*revision of the lists of voters, and the costs of and other matters to be done for the registration of parliamentary voters ; (xiii.) the execution as local authority of the Acts relating to contagious diseases of animals, to destructive insects, to fish conservancy, to wild birds, to weights and measures, and to gas meters, and of the Local Stamp Act, 1869; (xiv.) any matters arising under the Riot (Damages) Act, 1886. Under this Act compensation is payable out of the police rate to any person whose property has been injured, stolen, or destroyed by rioters ; (xv.) the registration of rules of scientific societies, the registration of charitable gifts, the certifying and recording of places of religious worship, the confirmation and record of the rules of loan societies. These duties are imposed under various statutes.*~~

~~*In addition to the business of quarter sessions thus transferred, there was also transferred to the county council certain business of the justices of the county out of session, that is to say, in petty or special sessions. This business consists of the licensing of houses or places for the public performance of stage plays, and the execu- tion, as local authority, of the Explosives Act, 1875. Power was given by the Act to the Local Government Board to provide, by means of a provisional order, for transferring to county councils any of the powers and duties of the various central authorities which have been already referred to ; but although such an order was atone time prepared, it has never been confirmed, and nothing has been done in that direction.*~~

~~*Apart from the business thus transferred to county councils, the Act itself has conferred further powers or imposed further duties with reference to a variety of other matters, some of which must be noticed. But before passing to them it Police. is necessary here to call attention to one important subject of county government which has not been wholly transferred to the county council, namely, the police. It was matter of considerable discus- sion before the passing of the Act whether the police should remain under the control of the justices, or be transferred wholly to the con- trol of the county council. Eventually a middle course was taken. The powers, duties, and liabilities of the quarter sessions and jus- tices out of session with respect to the county police were vested in the quarter sessions and the county council jointly, and are now ex- ercised through the standing joint-committee of the*~~

~~two bodies. That committee consists of an equal number of members of the county council and of justices appointed by the quarter sessions, the number being arranged between the two bodies or fixed by the Secretary of State. The committee are also charged with the duties of appoint- ing or removing the clerk of the peace, and they have jurisdiction in matters relating to justices' clerks, the provision of accommodation for quarter sessions or justices out of session, and the like, and their expenses are paid by the county council out of the county fund. The standing joint-committee have power to divide their county into police districts, and, when required by Order in Council, are obliged to do so. In such a case, while the general expenditure in respect of the entire police force is defrayed by the county at large, the local expenditure, i.e., the cost of pay, clothing, and such other expenses as the joint-committee may direct, are defrayed at the cost of the particular district for which it is incurred (see also Police) .~~

~~Among the powers and duties given to county councils by the Local G(jvernment Act, 1888, the first to be mentioned, following the order in the Act itself, is that of the appointment of county coroners. The office of coroner is a very ^l^ners ancient one, and was formerly of much greater dignity and importance than it is at present. The duties of a coroner are now limited to the holding of inquiries into cases of death from causes suspected to be other than natural, and to a few miscellane- ous duties of comparatively rare occurrence, such as the holding of inquiries relating to treasure trove, and acting instead of the sheriff on inquiries under the Lands Clauses Act, &c., when that officer is interested and thereby disabled from holding such in- quiries. The office of coroner is a freehold one, that is to say, it is held for life or good conduct, and in a county the salary of the coroner is paid out of the county fund. Formerly he was elected by the freeholders of the county in pursuance of a writ de coronatore eligi'iidu. The power of appointment is now given to the county~~

~~council, who may appoint any fit person, not being a county alder- man or county councillor, to lill the office, and in the case of a county divided into coroners' districts, may assign him a district. It has been decided, however, that the power hereby conferred does not extend to the appointment of a~~

~~*coroner for a liberty or other franchise who would not under the old law have been appointed by the freeholders. It may be mentioned that though a coroner may have a district assigned to him, he is nevertheless a coroner for the entire county throughout which he has jurisdiction.*~~

~~*It was provided by the Higlvway Act, 1878, that every road which was disturnpiked after the 31st December 1870 should be deemed „ . to be a main road, the expenses of the repair and main-*~~

~~*roads, tenance of which were to be contributed as to one-lialf*~~

~~*thereof by the justices in quarter sessions, then the county authority. By another section of the same Act it was pro- vided that where any highway in a county was a medium of com- munication between great towns, or a thoroughfare to a railway station, or otherwise such that it ought to be declared a main road, the county authority might declare it to be a main road, and there- upon one-half the expense of its maintenance would fall upon the county at large. Once a road became a main road it could only cease to be such by order of the Local Government Board. As already stated, the powers of the quarter sessions under the Act of 1878 were transferred to the county council under the Local Government Act of 1888, and that body alone has now power to declare a road to. be a main road. But the Act of 1888 made some important changes in the law relating to the maintenance of main roads. It declared that thereafter not only the half but the whole cost of maintenance should be borne by the county. Provision is made for the control of main roads in urban districts being retained by the urban district council. In urban districts where such control has not been claimed, and in rural districts, the county council may either maintain the main roads themselves or allow or require the district councils to do so. The county council must in any case make a payment towards the costs incurred by the district council, and if any difference arises as to the amount of it, it has to be settled by the Local Government Board. In Lancashire the cost of main roads falls upon the hundred, as distinguished from the county at large, special provision being made to that effect. Special provision has also been made for the highways in the Isle of Wight and in South Wales, where the roads were formerly regulated by special acts, and not by the ordinary Highway Acts.*~~

The county council have the same power as a sanitary authority to enforce the provisions of the Rivers Pollution Prevention Acts in relation to so much of any stream as passes through or Rivers jjy ^^^y pj^j,). ^f their county. Under these Acts a sani-

pollutlott j.g^j.y authority is authorized to take proceedings to re-preventloa. gj^^i^ interference with the due flow of a stream or the pollution of its waters by throwing into it the solid refuse of any manufactory or quarry, or any rubbish or cinders, or any other waste, or any putrid solid matter. They may also take proceed- ings in respect of the pollution of a stream by any solid or liquid sewage matter. They have the same powers with respect to manu- facturing and mining pollutions, subject to certain restrictions, one of which is that proceedings are not to be taken without the con- sent of the Local Government Board. The county council may not only themselves institute proceedings under the Acts, but they may contribute to the costs of any prosecution under the Acts instituted by any other county or district council. The Local Gov- ernment Board is further empowered by provisional order to consti- tute a joint-committee representing all the administrative counties through or by which a river passes, and confer on such committee all or any of the powers of a sanitary authority under the Acts.

*A county council has the same power of opposing Bills in Parlia- ment and of prosecuting or defending any legal proceedings * necessary for the promotion or protection of the Parllamea- interests of the inhabitants of a county as are con- taryand f erred on the council of a municipal borough by the legal costs. 3oj.o,jgh Funds Act, 1872, with this difference, that in order to enable them to oppose a Bill in Parliament at the cost of the county rate, it is not necessary to obtain the consent of the owners and ratepayers within the county. The power thus conferred is limited to opposing Bills. The council are not authorized to promote any Bill, and although they frequently do so, they incur the risk that if the bill should not pass the members of 'the council will be surcharged personally with the costs incurred if they attempt to charge them to the county rate. Of course if the Bill passes, it usually contains a clause enabling the costs of promotion to be paid out of the county rate. It must not be supposed, however, that the county council have no power to institute or defend legal proceedings or oppose Bills save such*

as is expressly conferred upon them by the Local Government Act. In this respect they are in the same position as all other local author- ities, with respect to whom it has been laid down that they may without any express power in that behalf use the funds at their disposal for protecting themselves against any attack made upon

their existence as a corporate body or upon any of their powers or privileges.

The county council have also the same powers as a borough council of making bye-laws for the good government of the county and for the suppression of nuisances not already punishable Dy^.i^ws under the general law. This power has been largely acted ^ ' upon throughout England, and the courts of law have on several occasions decided that such bye-laws should be benevolently inter- preted, and that in matters which directly arise and concern the people of the county, who have the right to choose those whom they think best fitted to represent them, such representatives may be trusted to understand their own requirements. Such bye-laws will therefore be upheld, unless it is clear that they are uncertain, repugnant to the general law of the land, or manifestly unreason- able. It may be mentioned that, while bye-laws relating to the good government of the county have to be confirmed by the Secre- tary of State, those which relate to the suppression of nuisances have to be confirmed by the Local Government Board. Such confir- mation, however, though necessary to enable the council to enforce them, does not itself confer upon them any validity in point of law.

The county council have power to appoint and pay one or more medical officers of health, who are not to hold any other appoint- ment or engage in private practice without the express ju di i written consent of the council. The council may make officers arrangements whereby any district council or councils may have the services of the county medical officer on payment of a contribution towards his salary, and while such arrangement is in force the duty of the district council to appoint a medical ofiicer is to be deemed to have been satisfied. Every medical officer, whether of a county or district, must now be legally qualified for the practice of medicine, surgery, and midwifery. Besides this, in the case of a county, or of any district or

~~combination of districts of which the population exceeds 50,000, the medical officer must also have a diploma in public health, unless he has during the three consecutive years before 1892 been medical officer of a dis- trict or combination having a population of more than 20,000, or has before the passing of the Act been for three years a medical officer or inspector of the Local Government Board.~~

~~The only other powers and duties of a county council arising under the Local Government Act itself which it is necessary to notice are those relating to alterations of local areas. It may be convenient here to state that certain altera- 'Alterations tions of areas can only be effected through the medium '> ">'~~ ~~' of the Local Government Board after local inquiry. These oases include the alteration of the boundary of any county or borough, the union of a county boi'ough with a county, the union of any counties or boroughs or the division of any county, the making of a borough into a county borough. In these cases the order of the Local Government Board is provisional only, and must be confirmed by Parliament. The powers of a county council to make orders for the alteration of local areas are as follows : When a county council is satisfied that a primU facie case is made out as respects any county district not a borough, or as respects any parish, for a proposal for all or any of the things hereafter mentioned, they may hold a local inquiry after giving such notice in the locality and to such public departments as may be pre- scribed from time to time by the orders of the Local Government Board. The things referred to include the alteration of the boundary of the district or parish ; the division or union thereof with any other district or districts, parish or parishes ; the con- version of a rural district or part thereof into an urban district, or vice versd. In these cases, after the local inquiry above referred to has been held, the county council, being satisfied that the pro- posal is desirable, may make an order for the same accordingly. The order has to be submitted to the Local Government Board, and that Board must hold a local inquiry in order to determine whether the order should be confirmed or not, if the council of any district affected by it, or one-sixth of the total number of electors in the district or parish to which it relates, petition against it. The Local Government Board have power to modify the terms of the order whether it is petitioned agauist or not, but if there is no petition, they are bound to confirm, subject only to such modifica- tions. Very large powers are conferred upon county councils for the purpose of giving full effect to orders made by them under these provisions. A considerable extension of the same powers was made by the Local Government Act, 1894, which practically required every council to take into consideration the areas of sanitary districts and parishes within the entire administrative county, and to see that a parish did not extend into more than one sanitary~~

~~district ; to provide for the division of a district which did extend into more than one district into separate parishes, so that for the future the parish should not be in more than one county district ; and to provide for every parish and rural sanitary district being within one county. An enormous number of orders under the Act of 1894 was made by county councils, and, speaking generally, it will now be found that no parish extends into more~~

~~than one county or county district. Other powers and duties of the county council under the Act of 1894 will be noticed hereafter.~~

~~Of the statutes affecting county councils passed subse- quent to 1888 mention need only be made of the chief.~~

~~Under the Technical Instruction Acts a county council are authorized out of the county fund to supply or aid the supply of technical or manual instruction. The amount to he Technical j-ajged in any one year is not to exceed the sum of one t°oa "*' penny in the £. The county council is also empowered to make contributions foi'the purpose of technical educa- tion out of the sums received by them in respect of the residue of the English share of the local taxation (Customs and Excise) duties already referred to. Such contributions may be made over and above the limited amount which may be raised by rates. Provi- sion is also made enabling the managers of any school for science and art or of any institution in the nature of a literary and scientific institution to transfer the school or institution to the county council.~~

~~Part of the business transferred from quarter sessions to the council was that which related to pauper lunatics, but the whole subject of lunacy was consolidated by an Act of the Lunatics, year 1890, which again has been amended by a later Act. The councils of all administrative counties and county boroughs and the councils of a few specified quarter sessions boroughs, which before 1890 were independent areas for purposes of the Lunacy Acts, are local authorities for the purposes of the Lunacy Acts, and each of them is under an obligation to provide asylum accommodation for pauper lunatics. This accommodation may be provided by one council or by a combination of two or more, and such council or combination may~~

~~*provide one or more asylums. The county council exercise their powers through a visit- ing committee, consisting of not less than seven members, or, in the case of a combination, of a number of members appointed by each council in agreed proportions. In the case of a. combination the expenses are defrayed by the several councils in such proportion as they may agree upon, and the proportion may be fixed with reference to either the accommodation required by each council or the population of the district. A county borough may also, instead of providing an asylum of its own, contract with the visiting committee of any asylum to receive the pauper lunatics from the borough. Private patients may be accommodated in the asylums provided by a county council, and received upon terms fixed by the visiting committee. The expenses of lunatic asylums are defrayed in the following manner : The guardians from whose union a lunatic is sent have to pay a fixed weekly sum, which may not exceed 14s. a week. A larger charge is made for lunatics received from unions outside the county, as these do not, of course, contribute anything towards the provision or up-keep of the asylum itself. In addition to the payments by guardians, there is a contri- bution of 4s. a week from " the Exchequer contribution account" already mentioned, and the remaining expenses are defrayed out of the county rate.*~~

~~*Under the Allotments Acts, if a district council fail to provide allotments upon being required so to do, application may be made to the county council, who may thereupon take upon themselves the powers of a district council and provide the allotments required in the district whose council have made default. Moreover, the county council under these Acts may give compulsory powers of purchase to a district council if the latter cannot obtain a sufficient quantity of suitable land by agree- ment. They cannot, however, make orders for this purpose except after local inquiry, and, in the event of objection, their orders must be confirmed by the Local Government Board. If the county coun- cil refuse to make an order, the Local Government Board may make it after holding local inquiry.*~~

~~*A county council may, under the Small HIoldings Act, 1892, acquire land by agreement, and improve and adapt it for the pur- pose of providing small holdings for persons who desire holdinas *° "^^^ saa\y holdings for cultivation. Such holdings ■ must not exceed 50 acres in extent or £50*~~

~~annual value. The purchaser has to pay down at least one-fifth of the purchase money ; the balance is charged on the holding and may be repaid by instalments extending over a period not exceeding fifty years. A county council may borrow for purposes of the Act referred to. Under the Isolation Hospitals Act, 189.3, a county council may provide for the establishment of isolation hospitals for the reception of patients suffering from infectious diseases on the Hospitals, application of any local authority within the county, or on the report of the medical oflSceer of the county that hospital accommodation is necessary and has not been pro- vided. The council by their order constitute a hospital district and form a committee for its administration. The committee have power to purchase land, erect a hospital, provide all necessary appli- ances, and generally administer a hospital for the purposes above mentioned.~~

~~Allot- meats.~~

~~The powers and duties of a county council under the Local Government Act, 1894, are numerous and varied, and the chief of them are mentioned hereafter in connexion with parish councils. The county council may establish a parish councils. council in a parish which has a population of less than 300, and may group small parishes under a common parish council ; in every case they fix the number of members of the parish council. They may authorize a parish council to acquire land compulsorily, subject to confirmation of their order by the Local Government Board if it is petitioned against. They may make an order authorizing a parish council to hire land com- pulsorily for allotments. They may authorize the borrowing of money by a parish council, and they may lend money to a parish council. They may hear complaints by a parish council that a district council has failed to provide sufficient sewerage or water- supply, or has failed to enforce the provisions of the Public Health Acts in their district, and on such complaint they may transfer to themselves and exercise the powers of the defaulting council, or they may appoint a person to perform those duties. They may make orders for the custody and preservation of public books, writings, papers, and documents belonging to a parish. They may divide a parish into wards for purposes of elections or of parish meetings. They may authorize district councils to aid persons in maintaining rights of common. They may, on the petition of a district council, transfer to~~

themselves the powers of a district council who have refused or failed to take the necessary proceedings to assert public rights of way or protect roadside wastes. They may dispense with the disqualification of a parish or district councillor arising only by reason of his being a shareholder in a water company or similar company contracting with the council, and, as has above been stated, they have large powers of altering the boundaries of parishes.

*Among the powers and duties of quarter sessions transferred to county councils were those arising under the Acts relating to contagious diseases of animals. These Acts ”’^^^^^ °’ were consolidated and amended by a statute of 1894, *” ””^ *’ and the county council remain the local authority for the execution of that Act in counties.*

Under the Light Railways Act, 1896, a county council may be authorized by order of the Light Railway Commissioners to con- struct and work or contract for the construction or working of a light railway, lend money to a light rail- t-lgbt way company, or join any other council in these ”^”“‘sys. matters.

Among other statutes conferring powers or imposing duties upon county councils, mention may be made of such Acts as those relating to sea fisheries regulation, open spaces, police superannuation, railway and canal traffic, shop ‘plscel- hours, weights and measures, fertilizing and feeding ^“eous. stuffs, wild birds’ protection, land transfer, locomotives on high- ways, and the acquisition of small dwellings. Sufficient has been said to indicate that the Legislature from time to time recognizes the important position of the county council as an administrative body, and is continually extending their functions.

*A municipal borough is a place which has been incor- porated by royal charter. In the year 1835 the Muni- cipal Corporations Act was passed, which _^*

J ^. J, ,, ,. J. J The muni-

made provision tor the constitution and govern- cipai bor- ment of certain boroughs which were enumer- ou^/i and ated in a schedule. That Act was

~~*from time to ””* borough time amended, until in 1882 by an Act of that year the whole of the earlier Acts were repealed and con- solidated. A few ancient corporations which were not enumerated in the schedule to the Act of 1835 continued to exist after that year, but by an Act of 1883 all of these, save such as should obtain charters before 1886, were abolished, the result being that all boroughs are now subject to the Act of 1882. A place is still created a borough by royal charter on the petition of the inhab- itants, and when that is done the provisions of the Act of 1882 are applied to it by the charter itself. The charter also fixes the number of councillors, the boundaries of the wards (if any), and assigns the number of councillors to each ward, and provides generally for the time and manner in which the Act of 1882 is first to come into operation. The charter is supplemented by a scheme which makes provision for the transfer to the new borough council of the powers and duties of existing authorities, and generally for the bringing into operation of the Act of 1882. If the scheme is opposed by the prescribed pro-*~~

~~*portion (one-twentieth) of the owners and ratepayers of the proposed new borough, it has to be confirmed by Parliament. The governing body in a borough is the council elected by the burgesses.*~~

~~*The qualification of a burgess has heen incidentally mentioned in connexion with that of a county elector, and need not be further noticed. A borough councillor must be qualified in the same manner as a county councillor, and he is disqualified in the same way, with this addition, that a peer or ownership voter is not qualified as such, and that a person is disqualified for being a borough councillor if he is in holy orders or is the regular minister of a Dis- senting congregation. Borough councillors are elected for a term of three years, one-third of the whole number going out of office in each year, and if the borough is divided into wards, these are so arranged that the number of councillors for each ward shall be three or a multiple of three. The ordinary day of election is the 1st November. At an election for the whole borough the return- ing ofiicer is the mayor ; at a ward election he is an alderman assigned for that purpose by the council. The nomination and election of candidates and the procedure at the election are the same as*~~

~~*have already been described in the case of the election of county councillors. The law as to corrupt and illegal practises at the election is also similar, and the election may be questioned by petition in exactly the same way. A borough councillor must, within five days after notice of his election, make a declaration of acceptance of ofiSce under a penalty, in the case of an alderman or councillor of £50, and in the case of a mayor of £100, or such other sums as the council may by bye-law determine. A councillor may be disqualified in the same way as a county councillor, by bank- ruptcy or composition with creditors, or continuous absence from the borough (except in case of illness). In short it may be said that as the provisions relating to the election of borough coun- cillors were merely extended to county councillors by the Local Government Act of 1888 with a few modifications, these provisions, as already stated when dealing with county councils, apply gener- ally to the election of borough councillors. After the annual election on the 1st November the first quarterly meeting of the council is held on the 9th, and at that meeting the mayor and aldermen are elected. The election of the mayor and aldermen is again the same as has already been described in connexion with the election of the chairman and aldermen of a county council. The officers of a borough council are the town clerk Officers. and the treasurer, but the council have power to appoint such other officers as they think necessary. All these officers receive such remuneration as the council from time to time think fit, and hold office during pleasure. The provisions with respect to the transaction of the business of the council are also the same in the case of a borough as in that of a county council.*~~

~~*The entire income of the borough council is paid into the borough fund, and that fund is charged with certain payments, which are specifically set out in the 5th schedule to the Act of 1882. These include the remuneration of the mayor, recorder, and oificers of the borough, overseers' expenses, the expenses of the administration of justice in the borough, the payment of the borough coroner, police expenses, and the like. An order of the council for the payment of money out of the borough fund must be signed by three members of the council and countersigned by the town clerk, and any such order may be removed into the King's Bench Division of the HIgh Court of Justice by writ of certiorari, and may be wholly or partly dis- allowed or confirmed on the hearing. This is really the only way in which the validity*~~

~~of a payment by a borough council can be questioned, for, as will be seen hereafter, the audit in the borough is not an effective one. The borough fund is derived, in the first instance, from the property of the corporation. If the income from such property is insufficient for the purposes to which it is applicable, as usually is the case, it has to be supplemented by a borough rate, which may be a separate rate made by the council or may be levied through the overseers as part of the poor rate by means of a precept addressed to them. In the event of the borough fund be'mg more than sufficient to meet the demands upon it without recourse to a borough rate, any surplus may be applied in payment of any expenses of the council as a sanitary authority or in improving the borough or any part thereof by drainage, enlargement of streets, or otherwise. The borough treasurer is required to make up his accounts half-yearly, and to submit them, with the necessary vouchers and papers, to the borough auditors. These auditors are three in number— two of them elected annually by the burgesses. An elective auditor must be qualified to be a councillor, but may not be a member of the council. The third auditor is appointed by the mayor and is called the mayor's auditor. The auditors so appointed are charged with the duty of auditing the accounts of the treasurer, but they have no power of disallowance or surcharge, and their audit is therefore quite ineffective.~~

~~Finance audit~~

~~Where a borough has not a separate court of quarter sessions, but has a separate commission of the peace, the justices of the county in which the borough is situate have a concurrent jurisdiction with the borough justices in all matters Jurisaic- arising within the borough. Where, however, the /""^i^g. borough has a court of quarter sessions, the county quarter' justices have no jurisdiction within the borough. In sessions. all cases, whether the borough has quarter sessions or a separate commission or not, the mayor, by virtue of his office, is a justice for the borough, and continues to be such justice during the year next after he ceases to be mayor. HIe takes precedence over all justices acting in and for the borough, and is entitled to take the chair at all meetings at which he is present by virtue of his office of mayor. A separate commission of t^e peace may be granted to a borough on the petition of the council. A borough justice is required to take the oaths of allegiance and the judicial oaths before acting ; he must while acting reside~~

~~*in or within seven miles of the borough, or occupy a house, warehouse, or other property in the borough ; but he need not be a burgess nor have the quali- fication by estate required of a county justice. Where the borough has a separate commission, the borough justices have power to ap- point a clerk, who is now paid by salary, the fees and costs pertain- ing to his office being paid into the borough fund, out of which his salary is paid. The council may by petition obtain the appointment of a stipendiary magistrate for the borough. The Crown may also on petition of the council grant a separate court of quarter sessions for the borough, and in that event a recorder has to be appointed by the Crown. He must be a barrister of not less than five years' standing, and he holds office during good behaviour ; he receives a yearly salary. The recorder sits as sole judge of the court of quar- ter sessions of the borough. He has all the powers of a court of quarter sessions in a county, including the power to hear appeals from the borough justices ; but to this there are a few exceptions, notably the power,to grant licences for the sale of intoxicating liquor. The grant of a separate court of quarter sessions also involves the appointment by the council of a clerk of the peace for the borough. It should be added that the grant of a court of quarter sessions to any borough other than a county borough after the passing of the Local Government Act, 1888, does not affect the powers, duties, or liabilities of the county council as regards that borough, nor ex- empt the parishes in the borough from being assessed to county rate for any purposes to which such parishes were previously liable to be assessed.*~~

~~*When a borough is a county of itself the council appoint a sheriff on the 9th November in every year. And where the borough has a separate court of quarter sessions the oouncQ appoint a fit and proper person, not an alderman or councillor, to Sheriff, be the borough coroner, who holds office during good coroner. behaviour. If the borough has a civil court the recorder, if there is one, is judge of it. If there is no recorder, the judge of the court is an officer of the borough appointed under the charter.*~~

~~*The provisions of the Municipal Corporations Act, 1882, relate chiefly to the constitution of the municipal corporation. It does not itself confer many powers or impose many duties upon the council as a body. It does, however, enable a arara/re municipal corporaiion to acquire corporate land and*~~

~~*land. buildings, the buildings including a town hall, council house, justices' room, police stations and cells, sessions house, judges' lodgings, polling stations, and the like. The council may borrow money for the erection of such buildings ; they may acquire and hold land in mortmain by virtue of their charter or with the consent of the Local Government Board. Corporate land cannot be alienated without the consent of the same board. The council may convert corporate land, with the approval of the Local Govern- ment Board, into sites for workmen's dwellings.*~~

~~*Another duty imposed upon a borough council by the Act of 1882 is the maintenance of bridges within the borough which are not repairable by the county in which the borough is locally situate. It may here be mentioned that a city Borough*~~

~~*or borough which is a county of itself is liable at*~~

~~*bridges.*~~

~~*common law to repair all public bridges within its limits. In a borough which is not a county of itself the inhabitants are only liable to repair bridges within the borough by immemorial usage or custom.*~~

~~*Of the other powers possessed by the council of a borough under the Act of 1882, one of the most important is the power to make bye-laws lor the good rule and government of the borough, and for the prevention and suppression of Bye-laws. nuisances not already punishable in summary manner by virtue of an Act in force throughout the borough. It will be observed that these bye-laws are of two classes. The former do not come into force until the expiration of forty days after a copy of them has been sent to the Secretary of State, during which forty days the Sovereign in council may disallow any bye-law or part thereof. The latter require to be confirmed by the Local Government Board.*~~

~~*Under the Act of 1882 every municipal borough might have its own separate police force. As has already been stated when dealing*~~

~~with county councils, boroughs having a population of less than 10,000 according to the census of 1881 can no longer have a separate police force. But for some time before that year it had Police. become the rule not to grant to any new borough with~~

~~a population of less than 20,000 a separate police force. The sub- ject of police is separately treated in the Mncycloprndia Britannica, and it is not necessary to supplement what is there stated. Under an Act of 1893 the borough police may, in addition to their ordi- nary duties, be employed to discharge the duties of a fire brigade.~~

~~The powers and duties of a borough council in the Municipal Corporations Act do not arise or exist to any great extent under that Act. In a few cases, and the those namely of county boroughs, the councils district have the powers of county councils. In the council. quarter sessions boroughs other than county boroughs they have some only of these powers. But in every case the council of the borough have the powers and duties of an urban district council, and, except where they derive their authority from local Acts, it may be said that their principal powers and duties consist of those which they exercise or perform as an urban council. These will now be considered.~~

~~Before the year 1848 there was not outside the municipal boroughs any system of district government in England. It is true that in some populous places which were not corporate boroughs local Acts of Parliament had been passed appointing improvement commissioners for the government of these places. In many boroughs similar Acts had been obtained conferring various powers relating to sanitary matters, streets and highways, and the like. But there was no general system, nor was there, save by special legislation, any means by which sanitary districts could be constituted. In the year 1848 the first Public HIealth Act was passed. It provided for the formation of local boards in boroughs and populous places, such places outside boroughs being termed local government districts. In boroughs the town council were generally appointed the local board for purposes of the Act. It was not, however, until 1872 that a general system of sanitary districts was adopted. By the Public HIealth Act of that year the whole~~

~~*country was mapped out into urban and rural sanitary districts, and that system has been maintained until the present time, with some import- ant changes introduced by the Public Health Act, 1875, and the Local Government Act, 1894.*~~

~~*The whole of England and Wales is divided into districts, which are either urban or rural. Urban districts include boroughs and places which were formerly under the j urisdiction of local Constitu- boards or improvement commissioners. The power to district constitute new urban districts is now conferred upon councils. county councils, as already stated. There is a concurrent power in the Local Government Board under the Public Health Act, 1875, but that power is now rarely exercised, and new urban districts are in practice created only by orders of county councils made under the Local Government Act, 1888, section 57. Rural districts were first created in 1872. Before that time there was practically no sanitary authority outside the urban district, for although the vestry of a parish had in some cases power to make sewers and had also some other sanitary powers, there was no authority for such a district as now corresponds to a rural district. There were, indeed, highway boards and burial boards which had powers for special purposes, but district authority in the sense in which it is now understood there was none. Before the year 1894 the rural district consisted of the area of the poor-law union, exclusive of any urban district which might be within it, and the guardians of the poor were the rural sanitary authority. Since 181)4 this has been changed. By the Local Government Act of that year the guardians ceased to be the rural sanitary authority. The union was preserved as the rural sanitary district, with this qualification, that if it extended into more than one county it was divided so that no rural district should extend into more than one county. Rural district councillors are elected for each parish in the rural district, and they become by virtue of their office guardians of the poor for the union comprising tlie district, so that there is now no election of guardians in a rural district. Guardians are still elected as such for urban districts, but the rural district coun- cil have ceased to be the same body as the guardians and are now wholly distinct. A district councillor, whether urban or rural, holds*~~

~~*office for a term of three years. One-third of the whole council retire in each year, the annual elections being held in March, but there may be a*~~

~~*simultaneous retirement of the whole council in every third year if the county council at the instance of the district council so order. The qualification and disqualification of district councillors, whether urban or rural, now depend upon the Local Government Act, 1894. Property qualification is abolished. Any person may be elected who is either a parochial elector of some parish within the district or has during the whole of the twelve months preceding his election resided in the district, and no person is disqualified by sex or marriage. The electors both in urban and rural districts are the body called the parochial electors. These are practically the persons whose names appear in the Parliamentary Register or in the Local Government Register as being entitled to vote at elections for members of Parliament or county or parish councillors as the case may be. The election takes place subject to rules made by the Local Government Board, these rules being largely founded upon adaptations of the IMunicipal Corporations Act, 1882. The rules issued 1st January 1898 will be found in the Statutory Rules and Orders, 1898, pp. 264, 302. The election is by ballot on the same lines as those prescribed for a municipal election, and the Corrupt Practices Act, the provisions of which have been referred to when dealing with county councils, applies to tlie elections of district councils. The provisions with reference to election petitions, the grounds upon which they may be presented and the procedure upon them, are the same in every respect as have already been mentioned when dealing with county councils. It may be convenient here to state that the Local Government Board has power to unite any number of dis- tricts or parts of districts into what is called a united S^f'^i district for certain special purposes such as water-supply, * nets.*~~

~~*sewerage, or the like. This is done by means of a provisional order made by the board and confirmed by Parliament. In such a united district the governing body is a joint board constituted in manner provided by the order, and it has under the order such of the powers of a district council as are necessary for the purposes for which the united district is created. Thus a joint sewerage board would generally be invested by the order with all the powers of a district council relating to the provision and control of sewers and the disposal of sewage. It may also be convenient here to mention another special liind of district authority, that is, a port sanitary authority. It is also constituted by order ,^*~~

of the Local Government Board, and it may include one ^i,„ J!fty or more sanitary districts or parts of districts abutting upon a port. In this case also the authority consists of such members and is elected in such manner as the order determines, and it has such of the powers of an ordinary district council as the order may confer upon it. These relate for the most part to nuisances and infectious disease, having special reference to ships. It has been thought convenient to deal here viith district councils, whether urban or rural, together, but the powers of the former are much more extensive than those of the latter, Powers of and as the consideration of the subject proceeds it will "„-gf ^ be necessary to indicate what powers and duties are councils conferred or imposed upon urban district councils only, compared. It must be pointed out, however, that when the necessity arises for Conferring upon a rural district council any of the powers exercisable only by an urban district council, that can be done by means of an order of the Local Government Board. The necessity for this provision arises because it sometimes happens that in a district otherwise rural there are some centres of popula- tion, hardly large enough to be constituted urban districts, wliioh nevertheless require the same control as an urban district. Thus it may be desirable to confer upon a rural district council in respect of sucli a populous area the power to make up private streets, or to make bye-laws relating to new streets and buildings, and similar purposes.

A district council may from time to time make regulations with respect to summoning, notice, place, management, and adjourn- ment of their meetings and generally with respect to

the transaction and management of their business.

Business

Three members must be present to constitute a quorum. At the annual meeting, which is held as soon as convenient after the 15th April in each year, a chairman for the succeeding year has to be appointed. He presides at all meetings, and in his absence another member appointed by the meeting takes his place. Ques- tions are determined by the majority present and voting, the chairman having the casting vole. Minutes are taken and, if signed at the meeting or the next ensuing meeting, are made evidence. The officers of the council consist of a clerk, a medical officer, a surveyor, one

or more inspectors of nuisances, and a treasurer. Of these all but the medical officer of health and in- spectors of nuisances hold office at pleasure and receive such re- muneration as the council may determine. If the urban district is a borough, the town clerk and borough treasurer fulfil the same office for purposes of the Public Health Acts. The salaries of the medical

Com- mittees

officer of health and inspectors of nuisances are, as to one moiety thereof, paid out of " tlie Exchequer contribution account" by the county council, if they are appointed in accordance with the require- ments of the Local Uoverniiient Board as to qualification, appoint- ment, duties, salary, and tenure of office. The orders of the Local Government Board as to these matters are set out in the Statutory Bules and Orders, 1891, pp. 527, hA'.). District councils may also employ such other officers and servants as may be necessary and proper for the fulfilment of their duties. Officers and servants are proliibited from being concerned or interested in any bargain or con- tract made with their council, and from receiving under cover of their ofBce or employment any fee or reward whatsoever other than their proper salaries, wages, and allowances, under penalty of being rendered incapable of holding office under any district conncil, and of a pecuniary penalty of £60. There are some exceptions to this provision somewhat similar to those already mentioned with respect to the disqualification of members of the council. It may be mentioned here that by an Act, called the Public Bodies' Corrupt Practices Act, 1889, severe penalties are imposed alike upon mem- bers and officers of public bodies for corruption in office.

A district council may appoint committees consisting wholly or partly of members of their own body for the exercise of any powers which in their opinion can properly be exercised by such committees. Such committees do not, however, hold office beyond the next annual meeting of the council, and their acts must be submitted to the council for their approval. If they are appointed for any purposes of the Public Health or Highway Acts, the council may authorize them to institute any proceedings or do any act which the council might have instituted or done, other than the raising of

any loan or the malcing of any rate or contract. A rural district council may delegate their entire powers in any parish to a parochial committee. Such committee may consist wholly of meipbers of their own body or of members of the parish council, or partly of members of both. Such a committee may be subject to any regula- tions and restrictions imposed upon it by the rural district council. In dealing with the powers and duties of district councils it will be convenient to treat of these first as they arise under the Public Health Acts, and afterwards as they arise under other H ith statutes. In so far as such powers and duties are com-

*Acts ™°° *° ‘^8’° ”^ rural district councils alike they will*

be referred to as appertaining to district councils. When reference is made to any power or duty of an urban council it is to be understood that the rural council have no such power or duty unless conferred or imposed upon them by order of the Local Government Board. And it must be borne in mind that in a borough the borough council are the urban district council,

The district council are required to cause to be made such sewers as may be necessary for effectually draining their district. This duty may be enforced by the Local Government Board on Sewerage complaint made to them that the council have failed in performing it, and in the case of a rural district by the county council on complaint of the parish council. All sewers, whether made by the council, by their predecessors, or by private persons, vest in the district council — that is to say, become their property, with some exceptions, of which the principal is sewers made by a person for his own profit. The owner or occupier of any premises is entitled as of right to cause his drain to be connected with any sewer, on condition only of his giving notice and comply- ing with the regulations of the council as to the mode in which the communication is to be made, and subject to the control o’f any person appointed by the council to superintend the work. Moreover, the owner or occupier of premises without the district has the same right, subject only to such terms and conditions as may be agreed or, in case of dispute, settled by justices or by arbitration. If a house does not possess a sufficient drain, the occupier may be required to provide one, and to cause it to discharge into a sewer if there is one within 100 feet of the house, otherwise into a cesspool, as the council may direct. In the case of new

~~*houses, these may not be built or occupied in an urban district without their being first provided with sufficient drains as the council may require ; and in an urban district it is forbidden to cause any building to be newly erected over a sewer without the consent of the council. For the purpose of sewage disposal a district council may construct any works and contract for the use or purchase or lease of any land, buildings, engines, materials, or apparatus, and contract to supply for a period not ex- ceeding twenty-five years any person with sewage. It may be pointed out here that these expressions are defined by the Act, the effect of the definitions being shortly that a drain is a conduit for the drainage of one buildiiig or of several within the same curtilage, while a sewer comprises every kind of drain except that which is covered by the definition of a drain as above stated. The result has been that district councils frequently find themselves in the position of being responsible for the repair and condition of drains which, by reason of having been laid for more than one house, are sewers vested in and repairable by them. An attempt was made to remedy this state of things by the Public Health Amendment*~~

~~*and drainage.*~~

~~*Act, 1890, section 19, but the remedy so provided was very partial, and may be said to be confined to the case where two or more houses belonging to different owners are drained into a common drain laid under private land, and ultimately discharging into a sewer in a road or street.*~~

~~*The district council are charged with the duty of enforcing the provision of proper sanitary accommodation (water-closets, privies, ashpits, &c.) for all dwelling-houses, new or old, and for factories, and the maintenance of such conveniences gccommo- in proper condition. The urban council have power to j^^ioa tor provide and maintain and make provision for the houses. regulation of urinals, water-closets, earth-closets, privies, ashpits, and other similar conveniences for public accom- modation. In the event of a complaint being made in a district council that any drain, closet, privy, ashpit, or cesspool is a nuisance or injurious to health, the council may empower their surveyor to enter and examine the premises, and, if the complaint is well founded, they may require the owner to do the necessary works. The district council are not bound to undertake the removal of house*~~

~~refuse from premises, or the cleansing of closets, privies, ashpits, and cesspools. They may, R^p'o^^l of however, undertake tliese duties, and, if the Local "'"'**• Government Board require, they must do so. An urban council and a rural council, if invested with the requisite power by the Local Government Board, may, and when required by order of that Board must, provide for the proper cleansing of streets, and may also provide for the proper watering of streets. When they have undertaken, or are required to perform these duties, a penalty is imposed upon them for neglect. If they do not undertake these duties, they may make bye-laws imposing on the occupiers of premises the duty of cleansing footways and pavements, the removal of house refuse, and the cleansing of earth-closets, privies, ashpits, and cesspools ; and an urban council may also make bye-laws for the prevention of nuisances arising from snow, filth, dust, ashes, and rubbish, and for the prevention of the keeping of animals on any premises so as to be injurious to health. The keeping of swine in a dwelling-house, or so as to be a nuisance, is made an offence punishable by a penalty in an urban district, as also is the suffering of any waste or stagnant water to remain in any cellar, or within any dwelling-house after notice, and the allowing of the contents of any closet, privy, or cesspool to overflow or soak therefrom. Provision is also made for enforcing the removal of accumulations of manure, dung soil, or filth from any premises in an urban district, and for the periodical removal of manure or other refuse from mews, stables, or other premises.~~

~~With regard to water-supply, district councils have extensive powers. They may provide their district or any part of it with a supply of water proper and sufficient for public and private purposes, and for this purpose they may con- struct and maintain waterworks, dig wells, take on lease or hire any waterworks, purchase waterworks or water, or right to take or convey water either within or without their district, and any rights, powers, and privileges of any water company, and contract with any person for the supply of water. They may not, however, commence to construct waterworks within the limits of supply of any water company empowered by Act of Parliament or provisional order to supply water without giving notice to the com- pany, and not even then so long as the company are able and will- ing to supply the necessary water. Any dispute as to whether the company are able and willing has to be settled by arbitration. Where the council do~~

~~supply water, they have the same powers of carrying mains under streets or through private lands as they have with respect to the laying of sewers, as already mentioned. They can charge water rents which depend upon agreements with con- sumers, or they may charge water rates assessed on the net annual value of the premises supplied. It is to be observed that they are not bound to charge for a supply of water at all, unless they are required to do so in an urban district by at least ten persons, rated to the poor rate, or in a parish in a rural district by at least five persons so rated in the parish. Even tlien the amount of the rate is left to the council, any deficiency in the cost of the water, in so far as it is not defrayed out of water rates or rents, being borne in an urban district by the general district rate, and in a rural district by the separate sanitary rates made for the parish or contributory place supplied. For the purpose of enabling them to supply water, most of the provisions of the Waterworks Clauses Acts are incor- porated with the Public Health Act, and are made available for the district council. They are empowered to supply water by measure if they think fit, and may charge a rent for water-meters. The power of the district council to supply water is strictly limited to their own district, but they may, with the sanction of the Local Govern- ment Board, supply water to the council of an adjoining district on such terms as may be agreed upon, or as, in case of dispute, may be settled by arbitration. If any house is without a sufficient supply, and it appears that a supply can be furnished at a reasonable cost, as defined in the Public Health Act and the Public Health Water~~

~~Water- supply.~~

~~Act, 1878, the owner may be required to provide the supply, and, if he fails, the council may themselves provide the supply and charge the owner with the cost. All public sources of water-supply, such as streams, pumps, wells, reservoirs, conduits, aqueducts, and works used for the gratuitous supply of water to the inhabitants of the district are vested in the council, who may cause all such works to be maintained and plentifully supplied with pure and wholesome water for the gratuitous use of the inhabitants, but not for sale by them. The council may supply water to public baths or wash- houses, or for trade or manufacturing purposes. In the case of the former~~

~~*the supply may be gratuitous. In the latter case it is to be on terms agreed between the parties. The urban council are required to cause fire-plugs, and all necessary works, machinery, and assist- ance for securing a supply of water in case of fire, to be provided and maintained, and for this purpose they may enter into an agree- ment with any water company or person. Provision is made for preventing the pollution of water by gas refuse and enabling a district council, with the sanction of the Attorney-General, to take any proceedings they may think fit for preventing the pollution of any stream in their district by sewage. The district council are also empowered to obtain an order of justices directing the closing of any well, tank, or cistern, public or private, or any public pump the water from which is likely to be used for drinking or domestic purposes, or for manufacturing drinks for the use of man, if such water is found to be so polluted as to be injurious to health.*~~

~~*Power is given to prohibit the use as dwellings of any cellars, vaults, or underground rooms built or occupied after 1875, and with*~~

~~*regard to such cellars as were occupied as dwellings rf*";II before 1875, the continued occupation of these is also dwellings, foj-jji^^en unless they comply with certain stringent requirements as to the height of the rooms, height of the ceilings above the surface of the street, open areas in front, effectual drainage, sanitary conveniences appurtenant to the cellars, and the provision of fireplaces.*~~

~~*District councils are required to keep a register of the common lodging-houses in their district. No person is allowed to keep a*~~

~~*common lodging-house unless he is registered, and a lodrhi'" house may not be registered until it has been inspected bouses.' ^^^ approved for the purpose by an officer of the council.*~~

~~*Further, the council may refuse to register a keeper unless he produces a certificate of character in a prescribed form. The council are empowered to make bye-laws for fixing the number of lodgers and separating the sexes therein, promoting cleanliness and ventilation, giving of notices and taking precautions in case of any infectious disease, and generally for the well-ordering of such houses. The keepers of common lodging-houses are*~~

~~required to limewash their walls and ceilings in the months of April and October in every year, and if paupers or vagrants are received to lodge, they may be required to report as to the persons who have resorted thereto. They must give notice of any infectious disease to the medical officer of health and to the poor-law relieving officer, and they must give free access for inspection. There is no definition of the expression "common lodging-house" in the Public Health Act, and at one time the courts decided that shelters for the destitute kept by charitable persons were not common lodging- houses. That idea is now exploded, and the Act applies to charitable institutions which receive persons of the class ordinarily received into common lodging-houses.~~

~~Bye-laws may also be made relating to houses let in lodgings~~

~~which are not common lodging-houses. These bye-~~

~~Houses ig^^g 3^j.g jj]^ practice limited to those inhabited by~~

~~lodflans ^^^ poorer classes, although the Act imposes no such~~

~~■ restriction.~~

~~The Public Health Act, 1875, contains elaborate provisions for~~

~~dealing with nuisances. Those which are dealt with summarily~~

~~are thus enumerated :■ — (1) any premises in such a state " ^^" "^^^ as to be a nuisance or injurious to health ; (2) any pool, ditch, gutter, watercourse, privy, urinal, cesspool, drain, orashpit so foul or in such a state as to be injurious to health ; (.3) any animal so kept as to be a nuisance or injurious to health ; (4) any accumulation or deposit which is a nuisance or injurious to health ; (5) any house or part of a house so overcrowded as to be dangerous or injurious to the health of the inmates, whether or not members of the same family ; (6) any factory, workshop, or workplace not already under the operation of any general Act for the regulation of factories or bakehouses not kept in a cleanly state or not ventilated in such a manner as to render harmless as far as practicable any gases, vapours, dust, or other impurities generated in the course of the~~

~~*work carried on therein that are a nuisance or injurious to health, or so overcrowded while work is carried on as to be dangerous or injurious to the health of those employed therein ; (7) any fireplace or furnace which does not as far as practicable consume the smoke arising from the com- bustible used therein, and which is used for working engines by steam or in any mill, factory, dye-house, brewery, bakehouse, or gas work, or in any manufacturing or trade process whatsoever, and (8) any chimney not being the chimney of a private dwelling-house*~~

~~*sending forth black smoke in such quantity as to be a nuisance. The nuisances above enumerated are said to be nuisances liable to be dealt with summarily. It is the duty of every district council to inspect their district with a view to the discoverv of any such nui- sances. In the event of such discovery by them or of information given to them of the existence of any such nuisance, the district coun- cil are required to serve a notice requiring the abatement of the nuisance on the person by whose act, default, or sufferance it arises or continues, or, if such person cannot be found, on the owner or occupier of the premises at which the nuisance arises. The notice must require the abatement of the nuisance within a specified time, and must prescribe the works which in the opinion of the council are necessary to be done. If the nuisance arises from the absence or de- fective construction of any structural convenience, or if there is no occupier of the premises, the notice must be sei-ved upon the owner. If the person who causes the nuisance cannot be found, and it is clear that the nuisance does not arise or continue by the act, default, or sufferance of the owner or occupier of the premises, the local authority may themselves abate the nuisance without further order. If the person on whom the notice is served objects to give effect to it, he may be summoned before justices, and the justices may make an order upon him to abate the nuisance or prohibiting the recurrence of the nuisance if this is likely, and directing the execution of the nec- essary works. If the nuisance is such as to render a dwelling-house unfit for human habitation, the justices may close it until it is ren- dered fit for that purpose. Disobedience under the order of justices involves a penalty and a daily penalty for every day during which default continues. Private persons may complain to justices in re- spect of nuisances by which they are personally aggrieved, and if the district council make default in doing their duty, the Local Govern- ment Board may authorize any officer*~~

~~*of police to institute any necessary proceedings at the cost of the defaulting council. The district council may, if in their opinion proceedings before justices afford an inadequate remedy, take proceedings in the high court, but in that case, if the nuisance is of a public nature, they must proceed by action in the name of the Attorney-General. The pro- visions as to nuisances are extended to ships by an Act of 1885.*~~

~~*It is forbidden to establish within an urban district without the consent of the council any offensive trade, business, or manufacture. With regard to any offensive trade which has been established or may be consented to in any urban district, if it is verified by the medical officer or any two legally qualified medical practitioners, or by any ten inhabitants of the district, to be a nuisance or injurious to health, the urban district council are required to take pro- ceedings before magistrates with a view to the abatement of the nuisance complained of.*~~

~~*Any medical officer or inspector of nuisances may inspect any meat, &c., exposed for sale or deposited in any place for the purpose of sale or of preparation for sale and intended for the food of man. This power of inspection is, in districts Unsound where the Public Health Act, 1890, has been adopted, ™*^" extended to all articles intended for the food of man. If upon such inspection the meat, &c., appears to be diseased, unsound, or unwholesome, it may be taken before a justice for the purpose of being condemned, and the person to whom the meat, &c., belongs or in whose possession it was found is liable to a penalty or, in the discretion of the justices, to imprisonment for three months without the option of a fine.*~~

~~*The Public Health Acts contain important provisions relating to infectious disease. Local authorities may require premises to be cleansed and disinfected ; they may order the destruc- tion of bedding, clothing, or other articles which have Infectious been exposed to infection ; they may provide proper ""^^^^• places for the disinfection of infected articles free of charge ; they may provide ambulances, &c. In the case of a person found suffering from ' infectious disease who has not proper lodging or accommodation, or is lodging in a room occupied by more than one family, or is on board any ship or vessel, such person may by means of a justice's order be removed to a hospital ; and any pei'son exposing himself or any other in his charge*~~

~~while suffering from infectious disease, or exposing infected bedding, clothing, or the like, is made liable to a penalty. Owners and drivers of public con- veyances used for the carriage of persons suffering from infections disease are required to disinfect them ; but any person who enters a public conveyance while so suffering or takes an infected person into it without notifying the fact to the driver is liable to a penalty. It is also forbidden to let houses or rooms in which infected persons have been lodging, or to make false statements to persons negotiating for the hire of such rooms. An Act was passed in the year 1890, called the Infectious Diseases Prevention Act, which may be adopted by any local authority. When adopted it enables an urban or district council to obtain the inspection of dairies where these are suspected to be the cause of infectious disease, with a view to prohibiting the supply of milk from such dairies if the fact is established. The Act also forbids the keeping for more than forty-eight hours of the body oE a person who has~~

~~died of infectious disease in a room used at the time as a dwelling- place, sleeping-place, or workshop. It provides for the bodies of persons dying of infectious diseases in a hospital being removed only for burial, and gives power to justices in certain cases to order bodies to be buried. The diseases to which the Act applies are smallpox, cholera, membranous croup, erysipelas, scarlatina or scarlet fever, typhus, typhoid, enteric, relapsing, continued or puerperal fever, and any other infectious disease to which the Act has been applied by the local authority of the district in the pre- scribed manner. The most important provision, however, relating to infectious disease is that contained in the Infectious Disease Notification Act, 1889. That was originally an adoptive Act, but it is now extended to all districts in England and Wales. It requires the notification to the medical ofBcer of health of the dis- trict of every case in which a person is suffering from one of the diseases above mentioned. The duty of notification is imposed upon the head of the family, and also upon the medical practitioner who may be in attendance on the patient. The medical attendant is entitled to receive in respect of each notification a fee of 2s. 6d. if the case occurs in his private practice, and of Is. if the case occurs in his practice as medical officer of any public body or institution. These fees are paid by the urban or rural~~

~~*district council as the case may be. The provisions as to notification are applied to eveiy ship, vessel, boat, tent, van, shed, or similar structure used for human habitation in like manner as nearly as may be as if it were a building. Exception is made, however, in the case of a ship, vessel, or boat belonging to a foreign government. It is not too much to say that this Act has been one of the most effectual means of preventing the spread of infectious disease in modern times.*~~

~~*The district council are empowered to provide hospitals or tem- porary places for the reception of the sick. They may build them. Hospitals "ont'^^.ct for the use of them, agree for the reception of the sick inhabitants of their district into an existing hospital, or combine with any other district council in providing a common hospital. As has already been mentioned when dealing with county councils, if a district council make default in provid- ing hospital accommodation, the county council may put in opera- tion the Isolation Hospitals Act. The power given to provide hospitals must be exercised so as not to create a nuisance, and much litigation has taken place in respect of the providing of hospitals for smallpox. Up to the present time, however, the courts have refused to accept as a principle that a smallpox hospital is neces- sarily a source of danger to the neighbourhood, and for the most part applications for injunction on that ground have failed.*~~

~~*Where any part of the country appears to be threatened with or Is affected by any formidable epidemic, endemic, or infectious disease, the Local Government Board may make regula- ^"" tions for the speedy interment of the dead, house-to-*~~

~~*demlcs. iiouse visitation, the provision of medical aid and accommodation, the promotion of cleansing, ventilation, and dis- infection, and the guarding against the spread of disease. Such regulations are made and enforced by the district councils. The provisions of the Public Health Acts relating to infectious disease are for the most part extended to ships by an Act of the year 1885. District councils may and, if required by the Local Government Board, are required to provide mortuaries, and they may make bye-laws with respect to the management and charges for the use of the same. Where the body of a person who has died of an infectious disease is retained in a room where persons live or sleep, or the retention of any dead body may*~~

~~*endanger health, any justice on the certificate of a medical practitioner may order the removal of the body to a mortuary and direct the body to be buried within a time limited by the friends of the deceased or in their default by the relieving officer. A district council may also provide and maintain a proper place (otherwise than at a workhouse or at a mortuary) for the reception of dead bodies during the time required to conduct any post mortem examination ordered by a coroner.*~~

~~*Under an Act of 1879 the district council have power to provide and maintain a cemetery either within or without their district, and they may purchase or accept a donation of land Cemeteries. ^^^ ^^^^ purpose. The provisions of the Cemeteries Clauses Act, 1847, apply to a cemetery thus provided. These can- not all be referred to here, but it may be noted that no part of the cemetery need be consecrated, but that if any part is, such part is to be defined by suitable marks, and a chapel in connexion with the Established Church must be erected in it. A chaplain must also be appointed to oflBciate at burials in the consecrated portion. The power to provide a cemetery under the Act under consideration must not be confounded with that of providing a burial ground under the Burial Acts. These Acts will be mentioned later in connexion with the powers of parish councils, for in general they are adopted for a parish, part of a parish, or combination of parishes, and are administered by a burial board, except where that body has been superseded by a parish council or joint committee. It may be mentioned, however, that under the Local Government Act, 1894,*~~

~~*Mor- tuaries.*~~

~~*where a burial board district is wholly in an urban district, the urban council may resolve that the powers, duties, and liabilities of the burial board shall be transferred to the council, and there- upon the burial board may cease to exist. And it is provided by the same Act that the Burial Acts shall not hereafter be adopted in any urban parish without the approval of the urban council. The distinction between a burial ground provided under the Burial Acts and a cemetery provided under the Act of 1879 is important in many ways, of which one only need be mentioned here — the expenses under the Burial Acts are paid out of the poor rate, while the expenses*~~

~~*under the Act of 1879 are paid in an urban district out of the general district rate, the incidence of which differs materially from that of the poor rate, as will be seen hereafter.*~~

~~*In an urban district the urban council have always had all the powers and duties of a surveyor of highways under the Highway Acts. But before 1894 a rural district council had no Hjau-ravs power or duty in respect of highways except in a few * '*~~

~~*cases where, by virtue of a provision in the Highway Act, 1878, the rural sanitary authority of a, district coincident in area with a highway district were empowered to exercise all the powers of a highway board. Except in these cases the highway authority in a parish was the surveyor of highways, elected annually by the inhabitants in vestry, or in a highway district consisting of a num- ber of parishes united by order of quarter sessions, the highway board composed of waywardens representing the several parishes. By the Local Government Act, 1894, there were transferred to the district council of every rural district all the powers, duties, and liabilities of every highway authority, surveyor, or highway board within their district, and the former highway authorities ceased to exist. The highway authority in every district, rural as well as urban, is therefore the district council. Of the chief duties of a district council with regard to highways, the first and most obvious is the duty to repair. This duty was formerly enforceable by indict- ment of the inhabitants of the parish, but it is not quite clear whether this procedure is applicable, now that the liability to repair is transferred to a council representing a wider area. Under the Highway Acts it is enforceable by summary proceedings before justices and by orders of the county council, but in either case, if the liability to repair is disputed, that question has to be decided on indictment preferred against the highway authority alleged to be in default. In a rural district any parish council may complain to the county council that the district council have made default in keeping any highway in repair, and the county council may there- upon transfer to themselves and execute the powers of the district council at the cost of the latter body, or they may make an order requiring the district council to perform their duty, or they may appoint some person to do so at the cost of the district council. It is important to observe, however, that an action does not lie against a district council in respect of the failure to repair a highway*~~

~~*even at the suit of a person who has thereby been injured. The reason assigned for this doctrine is that the council as highway surveyor stand in the same position as the inhabitants of the parish, against whom such an action would not lie. The district council are, however, liable for any injury caused through negligence on the part of their officers or servants in carrying out the work of repair.*~~

~~*But while rural as well as urban district councils have the powers and duties of surveyors of highways, the provisions of the Public Health Acts relating to streets apply only in urban districts, except in so far as the Local Government '** *'*~~

~~*Board may by order have conferred urban powers upon a rural district council. These provisions have now to be referred to. It may be convenient to state that the expression "street" is here used in a sense much wider than its ordinary meaning. It is defined by the Act to include any highway and any public bridge (not being a county bridge), and any road, lane, footway, square, court, alley, or passage, whether a thoroughfare or not. Eor cer- tain purposes streets as thus defined are divided into two classes, viz., those which are and those which are not highways repairable by the inhabitants at large. But it has to be borne in mind that it is not every highway that is repairable by the inhabitants at large. Before the year 1836 as soon as a way was dedicated to public use and the public had by user signified their acceptance of it, it became without more notice repairable by the parish. There- fore every highway — whether carriage-way, driftway, bridleway, or footway — which can be shown to have been in use before 1836, is presumably repairable by the inhabitants at large, the only excep- tions being such highways as are repairable by private persons or corporate bodies ratione clausuras, rations tenurm ,or by prescription. But in the year 1886, when the HIghway Act, 1835, came into operation, the law was altered. It was possible, just as formerly, to dedicate a way to the use of the public, and it thereupon became a highway to all intents and purposes. But mere dedication did not make the way repairable by the public. That result was not to follow unless certain stringent requirements were fulfilled. When it is shown, therefore, that a highway has been dedicated after 1836, it is not repairable by the inhabitants a't large unless*~~

~~it can be shown that these provisions have been complied with, or that it has been declared to be repairable under provisions of the Public Health Acts presently to be mentioned. (There was also power given to justices by the Highway Act, 1862, to declare a private road or occupation road in a liighway district to be a public highway repairable by the parish ; but this power does not appear to have been acted upon to any extent.)~~

~~All streets being highways repairable by the inhabitants at large within an urban district, are vested in and under the control of the urban council. After much litigation it has now been established that this provision does not give the council an absolute property in the soil of the street, but merely such a qualified property in the surfaces as enables them to exercise control. The urban council are required from time to time to cause all such streets to be made up and repaired as occasion may require, and they are empowered to raise, lower, or alter the soil of the street, and to place and keep in repair fences and posts for the safety of foot-passengers. The other class of streets consists of those which are not highways repairable by the inhabitants at large. Under the Public Health Act, 1875, such streets may be dealt with in manner following : — If any suchi street or part thereof is not sewered, levelled, paved, metalled,fiagged, channelled, made good, or lighted to the satisfaction of the council, the council may cause it to be made up at the expense of the owners of premises fronting the street in proportion to their several front- ages. When all or any of the works aforesaid have been executed in the street, and the council are of opinion that the street ought to become a highway repairable by the inhabitants at large, they^may by notice to be fixed up in the street declare it to be a highway re- pairable by the inhabitants at large, and the declaration will be effective unless, within one month after the notice has been put up, the majority of the owners in the street object thereto. An alterna- tive procedure has been provided by the Private Street Works Act, which may be adopted by any urban council. One important point of difference is that under the latter Act the council may resolve that the expenses shall be apportioned among the owners not merely according to frontage, but according to the greater or less degree of benefit to be derived by any premises from the works.~~

~~*Where a house or building in a street is taken down to be re- built, the urban district council may prescribe the line to which it is to be rebuilt, paying compensation to the building owner for any damage which he may sustain consequent upon the requirement. Save to this extent, no power is given by the general law to a dis- trict council to prescribe a building line. But under an Act of 1888 it is provided that it shall not be lawful in any urban district without the consent of the urban authority to erect or bring for- ward any house or building in any street or any part of such liouse or building beyond the front main wall of the house or building on either side thereof in the same street.*~~

~~*The control exercised by an urban district council over streets and buildings is to a very large extent exercised through bye-laws which they are empowei-ed to make for various purposes relating to the laying out and formation of new streets, the erection and con- struction of new buildings, the provision of sufficient air-space about buildings to secure a free circulation of air, and the provision of suitable and sufficient sanitary conveniences. The manner in which such bye-laws are made and confirmed will be hereafter noticed. In general, the bye-laws require plans of new streets to be submitted to the council, and they are required to approve or disapprove of these plans within a month. They cannot disapprove of a plan unless it contravenes the provisions of some statute or bye-law ; but if a person builds otherwise than according to an approved plan he does so at the risk of having his work pulled down or destroyed. Among the miscellaneous powers of an urban coun- cil with respect to streets may be mentioned the power to widen or improve, and certain powers incorporated from the Towns Improve- ment Clauses Act, 1847, with respect to naming .streets, numbering houses, improving the line of streets, removing obstructions, pro- viding protection in respect of ruinous or dangerous buildings, and requiring precautions to be taken during the construction and re- pair of sewers, streets, and houses. An urban council may also provide for the lighting of any street in their district, and may con- tract with any person or company for that purpose. If there is no company having statutory powers of supply within their district, they may themselves undertake the supply of gas, and they may purchase the undertaking of any gas company within their district.*~~

~~*An urban council may acquire and maintain lands for the pur- pose of being used as public walks or pleasure-grounds, and may support or contribute to the support of such walks or grounds if provided by any other person. They may also contribute to the cost of laying out, planting, or improvement of lands provided for this purpose by any person, in their own district or outside that district, if it appears that the walks or grounds could eventually be used by the inhabitants of that district. An urban council may also provide public clocks or pay for the reasonable cost of repairing and maintaining any pub- lic clocks in the district, though not vested in them.*~~

~~*Public parks.*~~

~~*Where an urban council are the council of a borough, and in other cases with the consent of the owners and ratepayers of the district, they may provide market accommodation for their district. They may not, however, establish any 'MarAete market so as to interfere with any market already f^„^jj^er- established in the district under a, franchise or char- houses. ter. For purposes of markets certain provisions of the Markets and Fairs Clauses Act, 1847, are incorporated with the Public Healtli Act. The only one of these that need be noticed is that which provides that after the market is opened for public use every person, other than a licensed hawker, who shall sell or ex- pose for sale in any place within the district, except in his own dwelling-place or shop, any articles in respect of which tolls are authorized to be taken shall be liable to a penalty. The tolls which may be taken by an urban council must be approved by the Local Government Board ; and any bye-laws which they make for the regulation of the market must be confirmed by the same body. An urban council may also provide slaughter-houses and make bye- laws with respect to the management and charges for the use of them. Where they do not provide slaughter-houses, all previously existing slaughter-houses have to be registered and new ones licensed ; and no person may lawfully use a slaughter-house which is not either registered or licensed. Licences may be suspended by justices in the event of their being used contrary to the provisions of the Act or of the bye-laws, and on a second conviction the licence may be revoked. On a conviction of selling or exposing for sale, or having in his possession or on his premises, unsound meat, the court may also revoke the licence.*~~

~~*Certain police regulations contained in the Town Police Clauses Act, 1847, are by virtue of the Public Health Act, 1875, in force in all urban districts. These relate to obstructions and nuisances in streets, fires, places of public resort, hack- "acJtnej' ney carriages, and public bathing. An urban council ^^.^ ' may also license proprietors, drivers, and conductors of horses, ponies, mules, or asses standing for hiring in the district in the same way as in the case of hackney carriages, and they may also license pleasure-boats and vessels, and the boatmen or persons in charge thereof, and they may make bye-laws for all these purposes.*~~

~~*Every district council may enter into such contracts as are neces- sary for carrying into execution the various purposes of the Public Health Acts. A district council being a corporation, the general law applies in the case of a rural council Contracts, that they must contract under their common seal, the P”™”^^ exception to this rule including the doing of acts very frequently recurring or too insignificant to be worth the trouble of affixing the common seal. In the case of an urban council certain stringent regulations are laid down. A contract made by an urban council, whereof the value and amount exceed £50, must be under seal, and certain other formalities must be observed, some of which are imperative ; for example, the taking of sureties from the con- tractor, and the making provision for penalties to be paid by him in case the terms of the contract are not observed. Every local authority may also, for purposes of the Act, purchase or take on lease, sell or exchange, any lands. Such lands as are not re- quired for the purpose for which they were purchased must, unless the Local Government Board otherwise direct, be sold. Powers of compulsory purchase of lands are also given under the Lands Clauses Acts, but before these can be put in operation certain conditions must be observed. The Local Government Board must make in- quiry into the propriety of allowing the lands to be taken, and the power to acquire the lands compulsorily can only be conferred by means of a provisional order confirmed by Parliament.*~~

~~*With regard to the bye-laws which district councils may make for many purposes, the subjects of which have been already from time to time mentioned, it is only necessary to state that these require to be confirmed by the Local Government ”^^^- Board. Such confirmation does not, however, give validity to a bye-law which cannot be justified by the provisions of the Act, and many bye-laws which have been so confirmed have been held to be invalid under the general law as being uncertain, unreasonable, or repugnant to the law of the realm. For the guidance of local authorities, the Local Government Board have from time to time issued model series of bye-laws dealing with the various subjects ioT which bye-laws may be made, and these are for the most part followed throughout England and Wales.*~~

~~*As a general rule, all the expenses of carrying into execution the Public Health Acts in an urban district fall upon a fund which is called the general*~~

~~district fund, and tliat fund is pro- vided by means of a rate called the general district rate. “»”«•~~

~~To this there are some exceptions. First, in the case of boroughs wliere from the time of the first adoption of the Sanitary Acts these expenses have been paid out of the borough rate, the ex- penses continue to be so paid ; and in an urban district which was formerly subject to an Improvement Act, the expenses may be payable out of the improvement rate authorized by that Act. The~~

~~general rule, however, prevails over by far the greater part of Eng- land and Wales. The general district rate is made and levied on the occupiers of all kinds of property for the time being assessable to any rate for the relief of the poor, subject to a few exceptions and conditions. Of these the first is that the owner may be rated instead of the occupier, at the option of the urban authority, where the value of the premises is under £10, where the premises are let to weekly or monthly tenants, or where the premises are let in separate apartments, or the rents become payable or are collected at any shorter period than quarterly. When the owner is rated he must be assessed upon a certain proportion only of the net annual value of the premises. The owners or occupiers of certain specified pro- perties are assessed in respect of the same in the proportion of one- fourth part only of the net annual value thereof. These properties include tithes, tithe commutation rent charge, land used as arable, meadow or pasture ground only, or as woodlands, market gardens or nursery grounds, orchards, allotments, any land covered with water such as the reservoir of a waterworks company, or used only as a canal or towing-path of the same, or as a railway con- structed under the powers of any Act of Parliament for public conveyance. The reason for these partial exemptions apparently is that sanitary arrangements are made chiefly for the benefit of houses and buildings, while the properties just enumerated do not receive the same amount of benefit. The’ only other point to be noticed in this connexion is that an urban council may divide their district into parts for all or any of the purposes of the Act, rating each part separately for those purposes. The expenses of highways in an urban district fall as a rule upon the general~~

~~district rate, but under certain conditions, which need not be here set out, a separate highway rate may have to be levied. The urban council have extensive powers of amending the rate, and the rate is collected in such manner as the urban authority may appoint.~~

~~The expenses of a rural district council are of two kinds. Of these the first is called general expenses, and it includes the expense of the establishment and officers of the council, of disinfection, providing of conveyance for infected persons, and the expenses of highways. These expenses are payable out of a common fund which is raised out of the poor rate of the several parishes in the district, according to the rateable value of each. Special expenses include the expenses of the construction and maintenance and cleansing of sewers, providing water supply, and all other expenses incurred or payable in respect of a parish or contributory place within the district determined by order of the Local Government Board to be special expenses. The expression ‘ ‘ contributory place ” means a place other than a parish chargeable with special expenses. For the most part it has reference only to what is called a special drainage district — that is to say, a district formed out of one or more parishes or parts of parishes for the purpose of the provision of a common water supply, or scheme of sewerage, or the like, and in the event of such a district including part only of a parish, the remaining portion would, so far as the special expenses for which the district was created are concerned, be a separate contributory place. These special expenses are charge- able to each parish or contributory place, and they are defrayed by means of special sanitary rates, such rates being raised on all property assessed to the relief of “the poor, but with the same exemptions of certain properties as have been mentioned under the head of general district rate in urban districts.~~

~~District councils are empowered to borrow with the sanction of the Local Government Board, subject to certain restrictions and regu- lations. The money must be borrowed for permanent Borrow ng yj.(jg jjjg expenses of which ought in the opinion of the Dowers. LQgal Government Board to be spread over a term of years which must not exceed sixty. The sums borrowed must not exceed, with the outstanding loans, the amount of the assessable value for two years of the district for which the money is borrowed; and if the sum borrowed would, with the outstanding loans,~~

exceed the assessable value for one year, the sanction of the Local Govern- ment Board may not be given except after local inquiry. The money may be repaid by equal instalments of principal, or of principal and interest, or by means of a sinking fund.

Where the urban council are the council of a borough, their accounts as urban council are made up and audited in the same ineffective manner as has already been mentioned in the case of the accounts of the council under the Muni- cipal Corporations Act, but each of the borough auditors receives remuneration for auditing the accounts of the council as urban district council. Where the urban council are not the council of a borough, the accounts are made up annually, and audited by the district auditor in the same effective manner as has already been mentioned in the case of the accounts of a county council. The accounts of a rural district council are made up half-yearly, and are audited in the same way.

The Public Authorities Protection Act, 1893, was passed to repeal the numerous provisions contained in many Acts of Parlia^ ment, whereby, before legal proceedings could be taken against a

of the working

public body, notice of action had to be given and the proceedings commenced within a certain limited time. The Act applies to all public authorities, including, of course, district councils, and it provides in effect that where any action or legal proceed- proceeding is taken against a council for any act done g^/ggt in pursuance or execution, or intended execution, of an district Act of Parliament, or of any public duty or authority, couacells. the action must be commenced within six months next after the act, neglect, or default complained of, or in the case of a continuance of injury or damage, within six months next after the ceasing thereof. And it provides further that, in the event of the judgment of the court being given in favour of the coimcil, the council shall be entitled to recover their costs taxed as between solicitor and client. Notice of action is abolished in every case.

Among other Acts which are either incorporated with the Public Health Acts or have been passed subsequently to them, one of the most important is

~~*the Housing of the Working Classes Act, 1890. It contains three distinct parts. Under Housing the first an urban district council may, by means of a scheme, acquire, rearrange, apd reconstruct an area which has been proved to be insanitary. The scheme has to be confirmed by the Local Government Board, and carried out by means of a provisional order. The second part of the Act deals with unhealthy dwelling-houses, and requires the urban district council to take steps for the closing of any dwelling-houses within their district which are unfit for human habitation. The third part of the Act deals with what is called in the Act working-class lodging- houses. But the expression is a little misleading, for it includes separate houses or cottages for the working classes, whether contain- ing one or several tenements, and the expression "cottage" may include a garden of not more than half an acre, provided that the esti- mated annual value of such garden shall not exceed £3. This part of the Act may be adopted by a rural district council, but an urban dis- trict council can carry it into execution without formal adoption. Land may be acquired for erecting lodging-houses as above defined, and these, when erected, may be managed and let by the council.*~~

~~*The urban district council may adopt the provisions of the Baths and Washhouses Acts, and thereunder provide public baths, wash-houses, open bathing-places, covered swim- Baths and ming baths, which they may close in the winter months ^Q^gls and use as gymnasia.*~~

~~*Under the Tramways Act, 1870, the urban district council may obtain from the Board of Trade a provisional order authorizing the construction of tramways in their district by them- selves. Any private persons, and any corporation or "'"waj's. company, may, with the consent of the council, obtain the like authority, but the Board of Trade have power in certain cases to dispense with the consent of the local authority. Where the order is obtained by a person or body other than the district council, the council may purchase the undertaking at the end of twenty-one years after the tramways have been constructed or at the expira^ tion of every subsequent period of seven years, and the terms of purchase are that the person or company must sell the undertaking upon payment of the then value, exclusive of any allowance for past or future profits of the undertaking, or any compensation for com- pulsory sale or other consideration whatsoever of the tramway, and all lands, buildings, works, materials, and plant*~~

~~*suitable to and used for the purposes of the undertaking. It should be observed, however, that although the' local authority may themselves con- struct, and may acquire from the original promoters, a system of tramways, they may not themselves work them without special authority of the legislature, and must in general let the working of the undertaking to some person or company.*~~

~~*Under the Borough Funds Act, 1872, the urban district council may, if in their judgment it is expedient, promote or oppose any local and personal Bill or Bills in Parliament, or may prosecute or defend any legal proceedings necessary for ?"'?. '" the promotion or protection of the interests of the '^™^™«- "' district, and may charge the costs incurred in so doing p^^^^ to the rates under their control. The power to incur j„gg^ parliamentary costs, however, is subject to several im- portant restrictions. The resolution to promote or oppose the Bill must in the first instance have been carried by an absolute majority of the whole number of the council at a meeting convened by special notice, and afterwards confirmed by the like majority. The resolution must have been published in newspapers circulated in the district, and must have received the consent of the Local Government Board or of a Secretary of State, if the matter is one within its jurisdiction ; and further, the expenses must not be incurred unless the promotion or opposition has been assented to by the owners and ratepayers of the district assembled at a meeting convened for the purpose of considering the matter, and if neces- sary, signified by a poll. Moreover, the expenses must, before they can be charged to the rates, be examined and allowed by some person authorized by a Secretary of State or the Local Government Board, as the case may be.*~~

~~*Under the Pawnbrokers Act, 1872, the licences to pawnbrokers, which were formerly granted by justices, are now granted by district councils.*~~

~~*Under the Sale of Pood and Drugs Acts certain important duties devolve upon medical officers and inspectors of nuisances who are officers of district councils. But for the most part the Adulteta- Acts do not impose upon district councils themselves "'"'■ any special powers or duties, although, as a matter of*~~

fact, prosecations for offences are usually undertaken by the district councils, and the expenses of the execution of the Acts are paid out of their funds. In quarter sessions boroughs, however, where the council have the duty of appointing a public analyst, they are under an obligation to put the Acts in force from time to time, as occasion may arise. The Acts themselves must be con- sulted for the procedure, beginning with the taking of samples and ending with the conviction of an offender. —

The powers and duties of a district council under the Rivers Pollution Prevention Act, 1876, have been incidentally ^'jff. noticed when dealing with county councils, whose pollution, povyers under the Acts are precisely the same.

Under the Electric Lighting Acts the Board of Trade may license

any district council to supply electricity, or may grant to them a

provisional order for the- same purpose. A similar

Electric licence or order may be granted to a private person or

lighting.

company to supply electricity within the district of a

Allot- ments,

district council, but in that case the consent of the district council must be given, unless the Board of Trade, for special reasons, dispense with such consent. These licences are now ra^rely applied for or granted, and the provisions which were formerly contained in the provisional orders have now been consolidated by the Electric Lighting Clauses Act, 1899, the effect of which will be to make provisional orders uniform for the future. It is now almost the exception, at least in urban districts, to find a district council which has not obtained a provisional order under these Acts, and for the most part the undertakings of local authorities in the way of supplying electricity have been very prosperous.

~~*Under the Allotments Acts district councils are empowered to provide allotments for the labouring population of their district, if they are satisfied that there is a demand for allotments, that these cannot be obtained at a reasonable rent by voluntary arrangement, and that the land can be let at such a price as will not involve a loss to the council. The district council may acquire land, let it and regulate it, and they may, in certain oases, provide common pasture.*~~

~~*The urban district council execute the Public Libraries Acts for their district, and the rate for the expenses of the Acts, which may not exceed Id. in the £, is in a borough in the nature iih I °^ ^ borough rate, and in any other urban district in*~~

~~*libraries. ^^^ nature of a general district rate. Under the Acts not only public libraries, but also public museums, schools for science, art galleries, and schools for art, with the necessary buildings, furniture, fittings, and conveniences, may be provided for the inhabitants of the .district. Land may be acquired, and money borrowed, for the purposes of the Acts.*~~

~~*A great number of other statutes confer powers or impose duties upon district councils, such as the Acts relating to town gardens, agricultural gangs, fairs, petroleum, infant life protection, commons, open spaces, canal boats, factories and .workshops, margarine, sale of horse-flesh, and shop hours.*~~

~~*Before the passing of the Local Government Act, 1894, there was really nothing in the form of local govern- The parish ment for a parish. It is trtie that the inhab- and the itants in vestry had certain powers. They parish could adopt various Acts, which will be more particularly referred to hereafter, and they could appoint the persons who were to carry these Acts into execution. They elected the churchwardens and overseers, the highway surveyor, if the parish was a separate unit for highway purposes, and the waywardens if it was included in a highway district. But there was nothing in the nature of a representative body exercising any powers of government in the parish regarded as a separate area. Under the Act of 1804 this was changed. In every rural parish, that is to say, in every parish which is not included within an urban district, there is a parish meeting, which consists of the parochial electors of the parish. As already stated, these are the*~~

~~*persons whose naines are on the parliamentary and local government registers. If the parish has a population exceeding 300, a parish council must be elected. If it has a population of 100 or upwards, the county council are bound to make an*~~

~~*order for the election of a parish council if the parish meeting so resolves. Where there is no parish council, as will be seen hereafter, the various powers conferred upon a council are exercised by the parish meeting itself. Two or more parishes may be grouped together under a common parish council by order of the county council if the parish meetings of each parish consent. An annual parish meeting in every rural parish must be held on the 25th day of March or within seven days before or after that date ; and if there is no parish council, there must be at least one other parish meeting in the year. At the annual parish meeting the parish council, if there is one, is elected, and the members of the council, who originally held office for one year only, now, under a subsequent Act, hold office for three years. Any person who is a parochial elector, or who has for twelve months preceding the election resided in the parish, or within three miles thereof, may be elected parish councillor, and the number of councillors is to be fixed from time to time by the county council, not being less than five nor more than fifteen. Women, whether married or single, are eligible.*~~

~~*The council are elected in manner provided by the rules of the Local Government Board. The rules now in force will be found in the Statutory Rules and Orders for 1898, p. 692. They are very similar to those which are in force with reference to the elections of district councils, which have already been noticed. If a poll is demanded, it must be taken under the Ballot Act, as applied by the Rules, and for all practical purposes it may be taken that the election proceeds in the same manner as that of a district council. The parish council elects a chairman annually. He may be one of their own number, or some other person qualified to be a parish councillor. The council is a body corporate, may hold land in mortmain, and can appoint committees for its own parish or jointly with any other parish council. Among the powers conferred upon a parish council are those of appointing overseers and of appointing and revoking the appoint- Po'f^'ers to ment of assistant overseers. In future, churchwardens *""" ' " are no longer to be overseers, and the parish council may appoint as overseers a*~~

~~*number of persons equal to the number formerly appointed as overseers and churchwardens. It may be useful to mention here that for purposes of the administration of the poor law, overseers no longer act, their duties in that respect having been superseded by the guardians. They remain, however, the rating authority so far as regards the poor rate and nearly all other rates, the exceptions being the general district rate in an urban district and the borough rate in a borough, made by the town council. They still have power to give relief to poor persons in case of sudden and urgent necessity, but their principal duty is that of rating authority, and they are bound to make out the lists for their parishes of jurors aad electors. No payment is made to them. Tiie office is compulsory, but certain persons are privileged from being elected to it. The assistant'overseer, who was formerly nominated by the inhabitants and vestry and then formally appointed by justices, is now, as has been stated, appointed by the parish council. He holds office at pleasure, and receives such remuneration as the council fix, and he performs all the duties of an overseer, or such of them as may be prescribed by the terms of his appointment. There may be in a parish a collector of rates appointed by the guardians. In that event, an assistant overseer cannot be appointed to perform the duties of collector of rates, but, on the other hand, the parish council may invest the collector with any of the powers of an overseer. The parish council may appoint a clerk, who may be either one of their own number without payment, or the assistant overseer, rate collector, or some other fit person, with remuneration.*~~

~~*Among the duties transferred to parish councils may be mentioned the provision of parish books and of a vestry room or parochial office, parish chest, fire engine or fire escape, the holding or management of parish property, other than Powers property relating to affairs of the church or held for an and duties ecclesiastical charity, the holding or management of ofpar/s/i village greens or of allotments, the appointment of ”””’”^ *• trustees of parochial charities other than ecclesiastical charities in certain cases, and certain limited powers with reference to the supply of water to the parish, the removal of nuisances, and the acquisition of rights of way which are beneficial to the inhabitants.*~~

~~Among the most important of the matters which concern a rural parish is the administration of what are commonly called the adoptive Acts. These include the Lighting and Watching Act, the Baths and Washhouses Acts, the Burial Acts, the Public Improvement Act, and the Public Libraries Acta. The Lighting~~

~~and Watching Act was formerly adopted for a parish, or part o£ a parish, by the inhabitants in vestry, who elected lighting inspectors, of whom one-third went out of office in Lighting every year. The inspectors took the necessary steps for IvateA/mr leaving the parish lighted (the provisions as to watch- y^gf^ Ing having been obsolete for many years), and the ex-~~

~~penses of lighting were raised by the overseers upon an order issued to them by the inspectors. The owners and occupiers of houses, buildings, and property, other than land, pay a rate in the £ three times greater than that at which the owners and occupiers of land are rated and pay for the purposes of the Act. Mow this Act, like the other adoptive Acts, can only be adopted by the parish meeting, and where adopted for part only of a parish, must be adopted by a parish meeting held for that part. After the adoption of the Act, it is carried into execution by the parish council, if there is one, and if not, by the parish meeting, and the expenses are raised in the same manner as heretofore. Batbsand rpj^g Baths and Washhouses Acts have already been bouses referred to in dealing with district councils, and it is Acts. sufficient to say that they are now adopted and ad-~~

~~ministered in a rural parish in the manner pointed out with reference to the Lighting and Watching Act. The same may B I I ^^ said of the Burial Acts, but these are sufficiently~~

~~^^^ Important to require special notice. These Acts con-~~

~~tain provisions whereby burials may be prohibited in urban districts, and churchyards or burial grounds already existing may be closed when full. Formerly, when the Acts had been adopted by the vestry, it was necessary to~~

~~*appoint a burial board to carry the Acts into execution and provide and manage burial grounds. Now, in a rural parish which is co-extensive with an area for which the Acts have been adopted, the burial board is abolished and the Acts are administered by the parish council ; and the Acts cannot be adopted in a rural parish save by the parish meeting. If the area under a burial board in 1894 was partly in a rural parish and partly in an urban district, the burial board was superseded, and the powers of the board are exercised by a joint committee appointed partly by the urban dLstrict council and partly by the parish council, or parish meeting, as the case may be. In a rural parish where there is no parish council, though the Acts are adopted by the parish meeting, it is still necessary to elect the burial board, and that board will be elected by the parish meeting. The dis- tinction between a burial ground under the Burial Acts and a cemetery provided under the Public HIealth Acts has already been noticed. A burial ground, properly so called, has to be divided into consecrated and unconsecrated portions, and the former really takes the place of the parish churchyard ; and the incumbent of the parish church, the clerk, and the sexton continue to receive the same fees upon burials in the consecrated portion as they would have done in the parish churchyard. It has been mentioned that a portion of the burial ground must be left unconsecrated. But this is subject to one important exception, that the parish meeting may unanimously resolve that the whole of the burial ground shall he consecrated. In that case, however, the parish council may, within ten years thereafter, determine that a separate unconsecrated burial ground shall also be provided for the parish. The expenses of the execution of the Burial Acts are provided by the overseers out of the poor rate upon the certificate of the body entrusted with the execution of them. In the event of the Acts being adopted for a portion only of a rural parish, the burial board, or the parish meeting, may by resolution transfer all the powers of the board to the parish council.*~~

~~*The Public Improvement Act, when adopted, enables a parish*~~

~~*council to purchase or lease, or accept gifts of land for the purpose*~~

~~*of forming public walks, exercise or play grounds, and*~~

~~*Public ^ j^Q provide for the expense by means of a parish*~~

~~eat'AcL improvement rate. Before any such rate is imposed, however, a sum in amount not less than at least half of the estimated cost of the proposed improvement must have been raised by private subscription or donation, and the rate must not exceed sixpence in the £.~~

~~The Public Libraries Acts enable the authority adopting them to provide public libraries, museums, schools for science, art galleries, and schools for art. The expenses in a rural parish are Ih' " I defrayed by means of a rate raised with, and as part of, A^^ the poor rate, with a qualification to the effect that agricultural land, market gardens, and nursery grounds are to be assessed to the rate at one-third only of their rateable value.~~

~~The expenses of a parish council may not, without the consent of a parish meeting, exceed the amount of a rate of threepence in the £ for the financial year ; but vrith the consent of the Finance: parish meeting the limit may be increased to sixpence, expenses exclusive of expenses under the adoptive Acts. If it of parish ^ necessary to borrow, the consent of the parish council. meeting and of the county council must be obtained.~~

~~The expenses are payable out of the poor rate by the overseers on~~

~~*the precept of the parish council.*~~

~~*One of the most important powers conferred upon a parish council is that which enables them to prevent stoppage or diversion of any public right of way without their consent and without the approval of the parish meeting. The council may also complain to the county council that the district council have failed to sewer their parish or provide a proper water supply, or generally to enforce the provisions of the Burial Acts ; and upon such complaint, if ascertained to be well founded, the county cotmcil may transfer to themselves the powers and duties of the district council, or may appoint a competent person to perform such powers and duties. In a parish which is not sufficiently large to have a parish council, most of the powers and duties conferred or imposed on the parish council are exercised by the parish meeting. It may be convenient here to add that where, under the Local Government Act, 1894, the powers of a parish council are not already possessed by an urban district council, the Local Government Board may by order confer such powers on the urban council. This has been done almost universally, as far as regards the power to appoint overseers and assistant overseers, and in many cases urban councils have also obtained powers to appoint trustees of parochial charities.*~~

~~*The foregoing is a sketch of the scheme of local government carried out in England and Wales. No attempt has been made to deal with poot law (q.v.) or education (q.v.). The local administra^ General tion of justice devolving upon the justices in "ions!'"' quarter or petty sessions is hardly a matter of local government, although in one important respect, that, namely, of the licensing of premises for the sale of intoxicating liquors, it may be thought that the duties of justices fall within the scope of local government. It will be seen that the scheme, as at present existing, has for its object the simplification of local government by the abolition of unnecessary independent authorities, and that this has been carried out almost completely, the principal exception being that in some cases burial boards still exist which have not been superseded either by urban district councils or by parish councils or parish meetings. There are also some matters of local administration arising under what are called commissions of sewers. These exist for the purpose of regulating drainage, and providing defence against water in fen lands or lands subject to floods from rivers or tidal*~~

waters. The commissioners derive their authority from the Sewers Commission Acts, which date from the time of Henry VIII., from the Land Drainage Act, 1861, and from various local Acts. It is unnecessary, however, to con- sider in any detail the powers exercised by commissioners of sewers in the few areas under their control.

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Loch, Henry Brougham Loch, 1st Babox (1827-1900), British administrator, son of i\Ir James Loch, M.P., of Drylaw, Midlothian, was born on 23rd jMay 1827. At first destined for a naval career, he soon quitted the navy for the East India Company's military service, and in 1842 obtained a commission in the Bengal Light Cavalry. On the outbreak of the Sikh war in 1845 he was given an appointment on the staff of Sir Hugh Gough, and served throughout the Sutlej campaign, where he displayed the cool courage and unshakeable resolution which con- tinued to characterize his subsequent career. In 1852 he became second in command of that famous corps. Skinner's Horse. At the outbreak of the Crimean war in 1854

Loch, eager for service at the front, severed his connexion with India, and obtained leave to raise a body of irregular Bulgarian cavalry, which he

~~*commanded throughout the war. In 1857 he was appointed attache to Lord Elgin's mission to the East, was present at Tientsin, and brought home the Treaty of Yedo in the following year. He now abandoned his military career, and in 1859 went out again as secretary to Lord Elgin's second mission to China. Here he was involved in an adventure which came near costing him his life. He had advanced with a small guard to a place called Tungchow, to arrange the preliminaries for the negotiations, when he found that the Chinese had treacherously gathered a great army to surprise the British forces. He rode back to warn Sir Hope Grant, and then returned through the enemy's lines to rejoin his com- panions, Bowlby and Parkes. Before they could effect their retreat, the battle had begun ; they were seized by the beaten Chinese, and hurried off to Peking, where they were put into cages and subj ected to other indignities. Loch was rescued in the nick of time. Returning home, he was made C.B., and for a while occupied the less adventurous post of private secretary to Sir George Grey, who was then at the Home Offi.ce. In 1863 he was appointed Lieutenant-Governor of the Isle of Man. His long and successful tenure of this post coincided with a period of active progress in the island. It was during this time that the House of Keys was transformed into an elective assembly, the first line of railway was opened, and the influx of tourists began to bring fresh prosperity. In 1882 Sir H. Loch, who had become K.C.B. in 1880, accepted a Commissionership of Woods and Forests, and two years later was made Governor of Victoria, where he won the esteem of all classes. In 1889 he succeeded Sir Hercules Robinson as Governor of Cape Colony and High Com- missioner of South Africa. His term of office coincided with a period of unrest that called for a firm hand. Immediately after his arrival he held a conference with President Kruger, and concluded the Swaziland Convention of 1890, which oifered the Transvaal an outlet to the sea at Kosi Bay on condition of its joining the South African Customs Union. The Banyailand " trek " of 1891 was nipped in the bud by his prompt action. When the com- mandeering difficulty of 1894 had roused the Uitlanders in the Transvaal to a dangerous pitch of excitement, he travelled to Pretoria to use his personal influence with President Kruger. He was received with a memorable outburst of enthusiasm, and, with characteristic prudence, cancelled his projected visit to Johannesburg, for fear his presence might be the signal for excesses that could only injure the Uitlanders. Sir H. Loch, by the firm attitude he took up, obtained the withdrawal of the ob- noxious*~~

~~*commandeering regulations ; but a memorandum, pressing for redress of the Uitlanders' whole position, was cancelled at the last moment by order of the Colonial Secretary, Lord Ripon. In the following year he entered a strong protest against the new franchise law ; and find- ing that President Kruger had not fulfilled the conditions of the Swaziland Convention, he declared it abrogated, and annexed the Zambaan and Umbegesa territories to the British Crown. This was the last important act of his administration. He had, by his openness of mind and his personal charm of manner, won the goodwill of British and Dutch alike, including President Kruger himself. At critical moments he had behaved with coolness and resolu- tion, and, both at the time of the Banyailand " trek " and during the Johannesburg agitation, had not hesitated to make such military dispositions as he believed necessary for the safeguarding of Imperial interests. But, whether from his own fault, or from dissensions on Imperial ques- tions in the Home Government, he had contented himself with a settlement of each separate difficulty as it arose.*~~

~~*while the general situation assumed year by year a more threatening aspect. Mr Rhodes, then Prime Minister of Cape Colony, was strongly in favour of a more energetic policy, and in 1895 the High Commissioner, finding himself out of touch with his ministers, resigned his office and returned home. In the same year he was raised to the peerage. He died in London on 20th June 1900. (h. sy.)*~~

~~*Loches, chief town of arrondissement, department of Indre-et-Loire, Prance, on the river Indre, 26 miles south- east of Tours by rail. The castle of Loches was in the Middle Ages afortress of thefirst class. The outer enclosure, nearly two miles in circumference, surrounds (1) a collegiate church (now the parish church), founded in the 10th cen- tury, and in some respects unique in French architecture; (2) a royal lodge (now the sub-prefecture), built by Charles VII. over subterranean chambers, rediscovered in 1869 ; and (3) the fortress proper, which eventually came to be used as a state prison, the terrors of which almost equalled those of the Bastille. Population (1901), 6161.*~~

~~*Lochgel ly, a police burgh and railway station of Fife- shire, Scotland, 7A miles north-east of Dunfermline. The town, which takes its name from a*~~

~~small lake, half a mile to the south-east, is of modern origin, and owes its prosperity to its iron-works and the large collieries in the immediate vicinity. The majority of the houses are small, but the town is regularly built, and the water and sewerage arrange- ments are satisfactory. There are some good shops, and the public buildings include a music hall, a co-operative hall, and a commodious and handsome drill hall. To the north-west of the lake is Lochgelly House, a seat of the Earl of Minto. Population (1881), 2601 ; (1900), 6472.~~

~~Lockerbie, a police burgh and market town of Annandale, Dumfriesshire, Scotland, 14^ miles east-north- east of Dumfries by rail. It is an important centre for the dispersal of lambs — 126,000 were sold in the autumn of 1899. There is an ancient square tower — once a family seat, and afterwards for many years a gaol, — a town hall, and a mechanics' hall. Population (1881), 2029 ; (1901),~~

~~2368.~~

~~Locker — Lampson, Frederick (1821-1895), better known as Feederick Looker, English man of letters, was born, on the 29th of May 1821, at Greenwich Hospital. His father, who was Civil Commissioner of the Hospital, was Edward Hawke Locker, youngest son of that Captain William Locker who gave Nelson the memorable advice, " to lay a Frenchman close, and beat him." His mother, Eleanor Mary Elizabeth Boucher, was a daughter of the Rev. Jonathan Boucher, vicar of Epsom and friend of George Washington. After a desultory education, Frederick Locker began life in a colonial broker's office. Soon deserting this uncongenial calling, he obtained a clerkship in Somerset House, whence he was transferred to Lord Haddington's private office at the Admiralty. Here he ultimately became deputy-reader and prMs writer. In 1850 he married Lady Charlotte Bruce, daughter of the Lord Elgin who brought the famous marbles to England, and sister of Lady Augusta Stanley. After his marriage he left the Civil Service, in consequence of ill-health. In 1857 he published London Lyrics, a slender volume of 90 pages, which, with subsequent extensions, constitutes his poetical legacy. Lyra Elegan- tiarum (1867), an anthology of light and familiar verse, and Patchwork (1879), a book of extracts, were his only other publications. In 1872 Lady Charlotte Locker died. Two years later~~

~~*Locker married Miss Hannah Jane Lampson, the only daughter of Sir Curtis Miranda Lampson, Bart., of Rowfant, Sussex, and in 1886 took*~~

~~*his wife's surname. At Eowfant lie died, 30th May 1895. Chronic ill-health debarred Locker from any active part in life, but it did not prevent his delighting a wide circle of friends by his gifts as a host and raconteur, and from accumulating many treasures as a connoisseur. His books are catalogued in the volume called the Bowfant Library, 1886, to which an appendix (1900) was added, after his death, under the superintendence of his eldest son. As a poet, Locker belongs to the choir who deal with the gay rather than the grave in verse — with the polished and witty rather than the lofty or emotional. His good taste kept him as far from the broadly comic on the one side as his kind heart saved him from the purely cynical on the other. To something of Prior, of Praed, and of Hood he added qualities of his own which lent his work distinction — a distiiiction in no wise diminished by his unwearied endeavour after directness and simplicity. A posthumous volume of Memoirs, entitled My Confidences (1896), and edited by his son-in-law, Mr Augustine Bir- rell, gives an interesting idea of his personality and a too modest estimate of his gifts as a poet. (a. d.)*~~

~~*Lockhart, Sir William Stephen Alexander*~~

~~*(1841-1900), British general, was born in Scotland, 2nd September 1841, his father being a Lanarkshire clergy- man. He entered the Indian army in 1858, in the Bengal native infantry, and rose to be captain (1868), lieut.-colonel (1879), major-general (1891), lieut.-general (1894), and general (1896). He served in the Indian Mutiny, the Bhutan campaign (1864-66), the Abyssinian expedition (1867-68 ; mentioned in despatches), the Hazara Black Mountain expedition (1868-69 ; mentioned in despatches). From 1869 to 1879 he acted as deputy-assistant and assist- ant quartermaster-general in Bengal. In 1877 he was military attache with the Dutch army in Acheen. He served in the Afghan war of 1878-80, was mentioned in despatches and made a C.B., and from 1880 to 1885 was D.Q.Gr. in the intelligence branch at headquarters. He commanded a brigade in the*~~

~~*Burmese war (1886-87), and was made K.C.B., C.S.I., and received the thanks of the Government. An attack of fever brought him to England, and he was employed as assistant military secretary for Indian affairs ; but in 1890 he returned to India to take command of the Punjab frontier force, and for five years was engaged in various expeditions against the hill tribes. After the Waziristan campaign in 1894-95 he was made K.C.S.I. In 1897 he was given the command against the Afridis and Mohmands, and conducted the difBcult Tirah campaign (q.v.) with great skill. He was made G.C.B., and in 1898 became commander-in-chief in India. His career was cut short, however, by his death on 18th March 1900. Sir William Lockhart was not only a first-rate soldier, but also had a great gift for dealing with the native tribesmen. Among the latter he had the sobriquet of Amir Sahib, on account of their respect and affection for him.*~~

~~*Lock Haven, a city of Pennsylvania, U.S.A., capital of Clinton county, on the west branch of the Susque- hanna river, on the Pennsylvania canal and the Pennsyl- vania and the Beechcreek (part of the New York Central system) railways, at an altitude of 579 feet. It is in a lumber region, has several saw-mills, and ships annually large quantities of lumber. Population (1880), 5845; (1890), 7358 ; (1900), 7210, of whom 618 were foreign- born and 122 negroes.*~~

~~*Lockport, a village of Will county, Illinois, U.S.A., on the Des Plaines river, five miles above Joliet, on the Chicago and Alton, and the Atchison, Topeka, and Santa Fe railways, at an altitude of 570 feet. Population*~~

~~*(1880), 1679; (1890), 2449; (1900), 2659.*~~

~~*Lockport, a city of New York, U.S.A., capital of Niagara county, on the Erie canal, and on the Erie and the New York Central and Hudson River railways, at an altitude of 594 feet. The locks in the Erie canal, from which the city derives its name, are ten in number, five for ascending and five for descending the 60-feet rise in the canal at this point. The surplus water from Tona- wanda creek, after supplying the canal, furnishes an excellent water-power, which has been put to use in a variety of manufactures. Among them are plants for the Holly heating system, by which steam is supplied through street mains to homes and other buildings from a central*~~

~~generator. Population (1890), 16,038 ; (1900), 16,581, of whom 2936 were foreign-bom and 160 were negroes.~~

~~Lockroy, Edouard [Etienne-Auguste-Edouard~~

~~Simon] (1838), French politician, son of Joseph~~

~~Philippe Simon (1803-1891) dramatist and actor (who took the name of Lockroy), was born in Paris, 18th July 1838. He began by studying as an artist, but in 1860 took part in Garibaldi's expedition to Sicily, and, after acting as secretary to Eenan on his tour in Palestine (1864), took to journalism in Paris as a fierce opponent of the Empire. He commanded a battalion during the siege of Paris in 1870, and in 1872 was elected deputy for the Seine. During the stormy period that followed he was several times imprisoned for his violent articles in the press, but his name became known to the public, and he was elected deputy for Bouches-du-Khone in 1873, and in 1876 for Aix. He continued afterwards to be returned to the Chamber, and took a prominent part in affairs as one of the Extreme Left. In 1877 he had married the widow of Victor Hugo's son. He was minister of commerce in the cabinets of M. Freycinet and M. Goblet (1886-87), minister of education under M. Floquet (1888-89), and minister of marine under M. Bourgeois (1895-96), under M. Brisson (1898), and M. Dupuy (1898-99). He devoted both his pen and his policy to the reorganization of the French navy on modern lines, and became the best-known advocate of naval reform in France ; and the activity shown in French naval matters towards the end of the century was largely owing to his persisteH<3e.~~

~~Lockwood, Sir Frank (1846-1897), English law- yer, was born at Donoaster in 1846. His grandfather and great-grandfather were mayors of Doncaster, and the former for some years filled the office of judge on the race-course. He was educated at a private school, at Manchester Grammar School, and Caius College, Cam- bridge. Called to the bar at Lincoln's Inn in 1872, he joined the old Midland circuit, afterwards going to the north-eastern, and did well enough to make in his first year 120 guineas, and in the next 265 guineas. From that time he had a career of uninterrupted success. In 1882 he was made a Queen's Counsel, in 1884 he was made Recorder of Sheffield, and in 1894 he became Solicitor-General in Lord Rosebery's ministry, and was knighted, having first entered Parliament as member for~~

~~York in 1885, after two unsuccessful attempts, the one at King's Lynn in 1880, the other at York in 1883. He was Solicitor-General for less than a year. In 1896 Lord Chief Justice Coleridge, Mr Montague Crack anthorpe, and Sir Frank Lockwood went to the United States to attend, as specially invited guests, the nineteenth meeting of the American Bar Associ- ation, and to represent the power, learning, and humour of the English bar thereat. On this trip Sir Frank Lockwood sustained the reputation which he enjoyed in England as a humorous after-dinner speaker, and helped to strengthen the bond of friendship which unites the bench and bar of the United States with the bench and bar of England. He died in London on 18th December 1897.~~

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~~L 0 C K Y E R-.'ij 0 D Z~~

~~A brief epitome of Sir Frank Lockwood's legal achieve- ments can give no idea of his unique personality, and of the manner in which it contributed to his success. He was a big, cheery, rubicund Yorkshireman, with a jovial manner, a sonorous voice, a ready tongue, and a sense of humour that never deserted him. No one can doubt that Frank Lockwood owed his success in a grave profession as much to this sense of humour and to his power to excite merriment as to any of his other qualities. His first brief was in the Rolls Court, a solemn tribunal now no more. "What brings you here ?" asked Lord Eomilly, as he rose to address the court. " Three and one, my Lord," replied young Lockwood, after an eloquent glance at the fee marked in guineas on his brief. The precise effect of the answer on the Master of the EoUs is not recorded, but the story clung to Lockwood as long as he remained at the bar, among hundreds of others, some possibly apocryphal, all enhancing his reputation for quick retort and imperturbable coolness. He had, moreover, consid- erable talent for drawing, inherited from his father, which he employed chiefly for the amusement of himself and his friends, in the making of admirable caricatures in pen and ink, and of sketches of humorous incidents, real or imag- inary, relating to the topic nearest at hand, many of which, being made in court, found their way into the possession of his friends and others near him, sometimes of the judge who tried the case. An exhibition of them was held soon after his death.~~

~~*Many have been repro- duced, some in Mr Augustine Birrell's excellent little biography, and more in The Frank Lockwood Sketch-Book (1898). Sir Prank Lockwood neither was nor pretended to be a profound lawyer, but he was an advocate who would influence juries, an incisive and ready cross-exam- iner, an eloquent and, as a rule, tactful speaker, with great power of bringing his adversary's case or witness into ridicule and contempt, where such a course seemed likely to prove effective. In these circumstances, al- though he was engaged in many heavy cases, such as the Parnell Commission, he won his reputation at the bar mainly in the class of trial popularly defined as causes cil&bres, in thi^.Divorce Court, in trials connected with the turf, in the exposure of fraud, in the prosecution, and still more in the defence, of prisoners. In private life he had a vast number of friends and no enemies. With inherited tastes for sport, he was fond of riding, of shooting, and of the race-course; in early life he was very fond of acting, and, although he perhaps never seriously contemplated adopting the theatrical profession, he went on tour with his friends, Mr and Mrs Kendal, and always took considerable interest in the stage. He was a great admirer of Dickens, and a lecture on " The Law and Lawyers of Pickwick," delivered by him at York, and afterwards at the Morley Hall, Hackney, to some of the constituents of his friend. Sir Charles Russell (after- wards Lord Chief Justice), was published by the Rox- burghe Press, with a sketch of Sergeant Buzfuz by the author as a frontispiece. Sir Frank Lockwood married, in 1874, Julia, second daughter of Mr Sails Schwabe, by whom he had a family. (b. a. ar.)*~~

~~*Lockyer, Sir Joseph Norman (1836-*~~

~~*-),*~~

~~*English astronomer, was born at Rugby on the 17th May 1836. After completing his education on the Continent, he obtained a clerkship in the War Ofiice in 1857. His leisure was devoted to the study of astronomy, and the proofs of scientific skill and of business capacity which he gave led to his appointment as secretary of the duke of Devonshire's commission on science in 1870. In 1876 he was transferred to the Science and Art Department at South Kensington, and on the foundation of the Royal College of Science he*~~

~~*became Director of the Solar Physical Observatory and Professor of Astronomical Physics. He was leader of the British Government expeditions for observation of the solar eclipses occurring from 1870 to 1897. In 1874 he received the Rumford medal of the Royal Society, of which he became a Fellow in 1869, for his spectroscopic researches on the sun and on the chemical elements. In 1868 he was able to communicate to the Royal Society and the Paris Academy a report of his successful observations of the solar prominences in broad daylight by the aid of the spectroscope. It hap- pened that Dr Janssen, who had observed the spectra of the prominences during the total eclipse of August 1868, had applied his instrument to them on the follow- ing day, and his report reached the Paris Academy of Sciences a few days after that body had received Lock- yer's communication. But, as Sir Joseph Hooker, the President of the Royal Society, said, when handing Lockyer the Rumford medal, "nothing interferes with the perfect independence with which the two physicists established the possibility of detecting the prominences at any time." The names of both astronomers appear on a medal which was struck by the French Government in 1872 to commemorate the discovery. In addition to numerous contributions to the Proceedings of the Royal and the Royal Astronomical societies. Sir Norman Lockyer is the author of several popular books on astronomy, and also of some ambitious treatises in which he passes from the explanatory to the theoretical. Emi- nent as a spectroscopist, although in this department some of his conclusions are not established, he has, in the Dawn of Astronomy, The Meteoritic Hypothesis, Tlie Sun's Place in Nature, and other works, propounded various theories which have failed to commend themselves to the majority of astronomers ; dissent has been especially expressed by competent spectroscopists and physicists from his theory of the origin of cosmical systems, namely, that all the varied orders of bodies which the heavens present to view are alike composed of meteorites, "the chief difference between the several orders being due either to the degree of aggregation of meteorites in the swarm, or, in the case of consolidated swarms, to the time which has elapsed since their complete evap- orization." His later investigations into an assumed re- lation between sun-spots and rainfall on the globe remain in the speculative stage. He was created K.C.B. in 1897.*~~

~~*Lode, Le, a town in the Swiss canton of Neuchatel, 231 miles by rail north-west of NeuchStel. The watch- mAing industry dates from 1680. The subterranean mills of the Col des Roches (the railway now traverses this gorge by means of four tunnels) in the neighbourhood, as also the Lac des Brenets, and waterfall of the Doubs on the French frontier, are worth a visit. The population has risen from 10,215 in 1870 to 10,387 in 1880 and 12,624 in 1900, mainly Protestants and French-speaking. The church (built in 1521) is the only old building in the town.*~~

~~*'Isodz ("fidd^, and more correctly fiodzia), a manufac- turing town of Russian Poland, government Piotrkdw, 87 miles by rail south-west of Warsaw. It is situated on the iodz plateau, which at the beginning of the 19th century was covered with impenetrable forests. Now it is the centre of quite a group of industrial towns — Zger, 'Siijczica, Pabianice, &c., and is connected by a branch rail- way with the main line from Warsaw to Vienna, and five macadamized main roads radiate from it. Chiefly owing to a considerable immigration of German capitalists and workers, "Lodz has grown with American-like rapidity. It consists chiefly of one main street, 6 miles long, and is a sortofPolishManchester, manufacturing cottons, woollens.*~~

~~*and mixed stuffs. One of the very few educational in- stitutions is a professional school. The population, which was only 50,000 in 1872, reached 316,209 in 1897, the Poles numbering about 40 per cent., Germans 33 per cent., and Jews 27 per cent.*~~

~~*Lofoten and Vesteraalbn, two groups of islands on the west coast of Nor- way. The permanent population is 35,000 to 40,000, and about the same number are added in the fishing season (January- April). There are factories for fish guano at the fishing-stations of Henningvser, Kabelvaag,and Svolvseron Ost-Vaag Island, at Lodingen on Hind Island, and at Bret- tesnas on South Molla. The total trade is valued at £20,000 to £70,000 annually. The violent tempests which sweep over the Vest Fjord are graphically described in Jonas Lie's Den Fremsynte (1870) and in H.*~~

~~*Schultze's Udvalgte Skrifter (1883), as the Maelstrom, which is near the southern end of the group, is imagina- tively by Edgar Allan Poe.*~~

~~*Log. — On leaving the land and before the position of a ship can be ascertained by astronomical observations, the intermediate positions are required for the safe navigation of the ship. For this purpose speed indica^ tors were introduced, known as the common and patent logs ; the number of revolutions made by the engines may also, in favourable circumstances, be utilized for this purpose.*~~

~~*Common Log. — With high speeds the reel held by men has been superseded by a fixed reel with winch for heav- ing in the log line, and fitted with a brake to check the line when running out. In a steamer running at high speed on an ocean route, engines working smoothly and uniformly, a careful officer, with correct log line and glass, will attain most accurate results from the common log (see Log, Ency. Brit. vol. xiv. p. 769).*~~

~~*Patent Log. — Under this heading may be placed the pressure and electric logs now discarded, and the present screw or fan log, known generally as the patent log. The crude germ of the latter invention, with the substitution of wheels in a closed box for a rotating screw, is probably due to Humphry Cole about 1570. Foxon of Deptford in 1772, Guerimand of Middlesex in 1776, and Gower in*~~

~~*1792 by mechanical means practically de- monstrated the regis-*~~

~~*the wheels, and be lubricated with suitable oil through a hole in the case. Alexander Bain in 1846 suggested enclosing the wheelwork in the rotator. With quick passages and well-surveyed coasts, the problems in*~~

~~*FiQ. 2,— The Cherub Log.*~~

~~*coastal navigation required a patent log that could be readily consulted from the deck, and one from which the distance run in thick weather under vary- ing speeds could be quickly ascertained. To meet this requirement in 1878 Walker introduced the Cherub log (Fig. 2), a taffrail one, which, however, is not as a rule used for speeds over 18 knots. Owing to the increased friction produced by a rotator making approximately 900*~~

~~*revolutions per mile, towed at the end of a line varying from 40 fathoms for a 12-knot speed to 60 fathoms for 20 knots, the pull of the line and rotator is borne by cone rollers, having their out- lines tapering to a common point in their rotation, thus giving a broad rolling surface. Strong worms and wheels are also substituted for the light clockwork. In Fig. 2 the shoe H is secured to the taffrail, the rotator in the water is hooked to the eye of the spindle M by the hook D. The case A contains the registering wheelwork and a sounding bell. The half gimbal B pivoting in the socket of the base C allows the regis- ter to receive the (strain in the direct line. The bearings*~~

~~*and rollers are lubri- r™- S-Neptune Pattern for securtog Eotator.*~~

~~*cated with castor-oil every twelve hours through holes in the sliding case E, and can be examined by unscrew- ing the case E and the eye]\I. When not in use, the register is removed from the shoe by lifting a small screw button near C. The tow-line is usually plaited, and to*~~

~~*Fig. 1.— The Al Harpoon Ship Log.*~~

~~*tration of a vessel's speed ; the method in*~~

~~*1807 of Viscount de Vaux was with water*~~

~~*pressure. In 1802 Edward Massey produced*~~

~~*a patent log (Log, 9th edition), which came*~~

~~*into general use in 1836 and continued until*~~

~~*1861 ; in the latter year Walker's harpoon*~~

~~*or frictionless log was introduced. The*~~

~~*wheelwork was enclosed in a cylindrical case*~~

~~*of the same diameter as the body of the*~~

~~*rotator or fan, and the latter brought close*~~

~~*up to the register, thus forming a compact*~~

~~*machine and avoiding the previous use of the*~~

~~*6-feet line. Two years later a heart-shaped*~~

~~*float plate was attached to the case, and the*~~

~~*log was called the Al Harpoon ship log (Fig. 1) , the one*~~

~~*usually employed for towing. The log should be washed*~~

~~*in fresh water when practicable, to prevent oxidization of*~~

~~*Fig. 4.— Walker's Neptune Log.*~~

~~*avoid a knot close to the rotator, the latter is secured to the former by a knot inside an egg-shaped shell (Fig. 3, Neptune pattern). Walker's Neptune log (Fig. 4)*~~

~~*is used for vessels of high speed. Case A contains the wheelwork, E the spindle and steel bearings; in each case are openings, closed by sliding tubes, for examina- tion and lubrication. In Fig. 4 the cases A and E are shown open. Fig. 5 shows the dial-plate. In Fig. 6 the ball bearings are shown unscrewed from the body of the*~~

~~*log, with eye, cap, and spindle. The ball bearings con- sist of two neck-laces of balls rolling*~~

~~*/ //?^9*^waArs WN^IVV^ in two pairs of V ' ' " I T^ ■' -T V ^. ^ races or grooves.*~~

~~*The outer pair receive the strain of the rotator, and the inner are for adjustment and to prevent lateral movement. The balls and races are enclosed in a skeleton cage (Fig. 7), unscrewing from the cap F (Fig. 4) for*~~

~~clean- ing or renewal ; the adjustment of the bearings is made by screwing up the cage cap h, locked by a special washer and the two screws a, a (Figs. 6, 7). If the outer races become worn, the complete cage and bearings are reversed ; the strain of the line is then transferred to what had previously been the inner with practically unworn balls and races. It is for this purpose that the skeleton cage is screwed internally at both ends, fitting a screwed ring inside the cap F (Fig. 4). Walker's Eocket log (Fig. 8) is a taftrail one, with bearings of hardened steel, and is intended to be slung or secured to the taffrail by a line ; the gimbal pattern has a fitting for the deck. In taffrail logs the movement of the line owing to its length becomes spasmodic and jerky, increasing the vibration and friction ; to obviate this a governor or fly-wheel is introduced, the hook of the tow-line K (Fig. 9) and the eye of the register M being secured to the governor. Fig. 9 represents the arrangement fitted to the Nep- tune log; with the Cherub log a~~

~~Fig. 5.— Dial-plate of Neptune Log.~~

~~Fio. 6.— Ball Bearings of Neptune Log.~~

~~Fio. T.— Ball Bearings of Neptune Log in Skeleton Case.~~

~~small piece of line is introduced between the governor and the eye of the register. Tlie two principal American taffrail logs are the Negus and Bliss (Messrs Norie and Wilson). The former bears a general resemblance to the Cherub log, but the dial-plate is horizontal and the faces turn upwards. The main shaft bearings are in two sets and composed of steel balls running in steel cones and cups ; the governor is an iron rod about 16~~

~~inches long, with 1-inch circular balls at the extremities. The Bliss resembles the Eocket log in shape, and is secured to the taffrail by a rope, or slung. A governor is not employed. The blades of the rotator are adjust- able, being fitted into its tube or body by slits and holes~~

~~Fi&. 8.— Eocket Log.~~

~~and then soldered. The outer ends of the blades are slit (Fig. 10) to form two tongues, and with the wrench (Fig. 10) the angle of the pitch is altered. All patent logs have errors, which should be ascertained by shore~~

~~*observations when passing a well-surveyed coast in tide- less waters on a calm day. Constant use, increased friction (more especially at high speeds), and damage to the rotator will alter an ascertained log error ; head or following seas, strong winds, currents, and tidal streams affect the correctness of a patent log.*~~

~~*Fi&. 9. — Neptune Log fitted with GoTemor.*~~

~~*Log Book is a marine or sea journal, containing, in the Eoyal Navy, the speed, course, leeway, direction and force of the wind, state of the weather, and barometric and thermometric observations. Under the heading "Ee-marks " are noted (for vessels with sail power) making, shortening, and trimming sails ; and (for all ships) em- ployment of crew, times of passing prominent land- marks, altering of course, and any subject of interest or importance. The deck log-book, kept by the officers of the watch in pencil, is copied in ink into the ship's log- book by the navigating officer, and the latter is an official journal. Fig. lo.-Biiss Log.*~~

~~*In steam vessels a rough and fair engine-room register are kept, giving information with regard to the engines and boilers. In the British mercantile marine all ships (except those employed exclusively in trading between ports on the coasts of Scotland) are compelled to keep an official log-book in a form approved by the Board of Trade. A mate's log and engine-room register are not compulsoiy, but are usually kept. (j. w. d.)*~~

~~*Logan, John Alexander (1826-1886), Ameri- can soldier and politician, was born in Jackson county, Illinois, on the 9th of February 1826. As a boy he was disinclined for schooling, and in the Mexican war he be- came lieutenant in an Illinois regiment. I^ater he studied and practised law, but soon drifted into politics as a Democrat, and served several terms in the State Legisla- ture. In 1.S58 and 1860 he was elected to Congress, but at the outbreak of the Civil "War he resigned his seat and*~~

~~*entered the Union array as colonel of volunteers. As a iighting of&cer his career was distinguished. In Grant's campaigns, terminating at Vicksburg, he rose to the rank of major-general, and under Sherman he commanded an army corps, and eventually the army of the Tennessee. When the war closed Logan resumed his political career, but as a member of the Republican party, and served in Congress, with but slight intermission (1877-78-79), from 1866 till his death at Washington on the 26th of Decem- ber 1886. He was always a violent partisan. In 1868 he was one of the managers in the impeachment of President Johnson, and in the Senate he was identified with the Radical wing of his party. This latter fact contributed to his nomination for Vice-President in 1884. His impetuous oratory, though popular on the platform, was less adapted to the halls of legislation.*~~

~~*Logan, a city of Utah, U.S.A., capital of Cache county, in Cache Valley, at the west base of Bear River Range, at an altitude of 4606 feet. It is regularly laid out on a level site, and is on a branch of the Oregon Short Line railway. Its inhabitants are almost entirely Latter Day Saints. The surrounding region is highly cultivated, being supplied with water for irrigation from the numerous streams coming out of the mountains. Population (1880), 3396 ; (1890), 4566 ; (1900), 6451, of whom 1440 were foreign-born.*~~

~~*Logansport, a city of Indiana, U.S.A., capital of Cass county, at the junction of the Wabash and the Eel rivers, at an altitude of 724 feet. It is on the Wabash and Erie canal, and on the Pittsburg, Cincinnati, Chicago and St Louis, the Vandalia, and the Wabash railways. It has extensive manufactures of varied description. Population (1890), 13,328 ; (1900), 16,204, of whom 1432 were foreign-born.*~~

~~*Logia (Aoyta 'Irja-ov : " Sayings of our Lord "). — Several early Christian writers speak of Adyta rov KvpCov, or ra KvpiaKo Adyta, i.e., oracles of (or concerning) the Lord. For example. Poly carp speaks of those " who pervert the oracles of the Lord " (Philipp. 7), and Papias, according to Eusebius (Hist. Eccl. iii. 39), wrote a work with the title, "Expositions of the Oracles of (or concerning) the Lord." The expression has been variously interpreted. It need mean no more, as Lightfoot has shown {Essays on Supernatural Beligion, 172/.), than "narratives of (or concerning) the Lord*~~

~~” ; this would be fully in accordance with the existing Jewish usage, and it is probable that Papias uses it in this sense. It is capable, however, of a more definite meaning. Resch has endeavoured to prove that there was a primitive gospel, written in Hebrew, containing a narration of the miracles and discourses of the Lord, and known as Adyta ‘liqa-ov (tiv:. O^i”!), or the like {Agrapha) ; whilst others have surmised that the Logia consisted of a collection of sayings of our Lord, which formed the nucleus of the four canonical Gospels. In these circumstances, great interest was roused by the publication in 1897, by Messrs B. P. Grenfell and A. S. Hunt, of some eight ” Sayings of the Lord ” (or possibly seven : Dr Swete thinks that the fourth Adytov is really part of the third). They were found amongst the great mass of papyri acquired by the Egyptian Exploration Fund from the ruins of Oxyrhynchus, one of the chief early Christian centres in Egypt, situated some 120 miles south of Cairo. This fragment, which the editors believe to have been written “not much later than a.d. 200,” certainly before 300, is numbered 11, so that it was pre- ceded by ten other leaves, which may probably have con- tained ” Sayings ” of the same kind. No others, however, have as yet been discovered. The Logia have been much~~

~~discussed, without, however, any very determinate result being reached. It is generally agreed that they do not take us behind the existing canonical Gospels, but that they are themselves based on them and on later writings, known and unknown. Harnack maintains that they are excerpts from the lost Gospel of the Egyptians. Anyhow, their chief interest on external grounds lies in the evidence that they supply that such collections were really made. The eight ” Sayings ” have, however, no little intrinsic interest. They are given as follows, in their revised form, by the discoverers : —~~

~~1. . . . Kal rbre Si.ap\4fei.s ^K/SaXetc rb Kdp8aKiuf ToO dSeXcpod aov.~~

~~2. A^7et ‘It^o-oOs iav fiij vynTTeiaffiXetav tov 6€0\j • Kal idv fiij aa^ariiniTe rb (TiijS^aTov ovk &\peade rbv iraT^pa.~~

~~.3. A^7et ^iTftrovs e[(r]rT7;’ iv fj^ea^ tov Kbtr/xov Kal iv trapKl itKfttfTjv avToiSi Kal €?ipov Tdvras fied^iovras Kal oiid^va etipov di^wpra iv airroty, Kal Tovei i] ** /tAou iirl Tois uioty twv dvSpiijirojv, Stc TV~~

~~4. [Illegible : possibly joins on to S] ... . [t† irToixelav.~~

~~5. [A^]ei [‘IijffoCs &Tr’\ov idv Cktlv [/3, oi5k] e[Z(ri]i’ &6eoi- Kal [6· \irov e[?s] iiTTiv fibpoff, [X^]7t(j,~~ ~~yoi el/ii fier~~ ~~aljT[ou] • €7ei[/5]op rbv \idov KdKet eitp-qaets /j.€, cr;^f~~

~~6. A^yei ‘Ii/trovtr o^k fiTTiv deKrbs irpo^‘finjs iv ttj TrarpiSi a^T[o]i/, ovdi larpbs irotei Bepairelas els roijs ytvuxTKOvras ainbv.~~

~~7. A^7et “I’qffovs olKo5op/qfxivT) iir” &Kpov 6pous i^ijXoO Kal icTTtipty- fiivT] oijTe 7re[_a-^eLV bivarai oijre Kpv\^^^Tjvai.~~

~~8. A^7e ^Itjeovs dKoiets [e]ts rb ^v litrlov~~

~~Letters in brackets are missing in the original : letters wliieh are dotted beneath are doubtful. No. 5 is Dr Blass’s recon- struction, No. 8 that of Dr Swete.~~

~~1. “. . . and then shalt thou see clearly to cast out the mote that is in thy brother’s eye.”~~

~~2. “Jesus saith, Except ye fast to the world, ye shall in no wise find the kingdom of God ; and except ye make the sabbath a real sabbath, ye shall not see the Father.”~~

~~3. “Jesus saith, I stood in the midst of the world and in the flesh was I seen of them, and I found all men drunken, and none found I athirst among them, and my soul grieveth over the sons of men, because they are blind in their heart, and see not. ...”~~

~~4. “. . . poverty ...”~~

~~6. “Jesus saith. Wherever there are two, they are not without God, and wherever there is one alone, I say, I am with him. Raise the stone and there thou shalt find me, cleave the wood and there am I.”~~

~~6. ” Jesus saith, A prophet is not acceptable in his own country, neither doth a physican work cures upon them that know him.”~~

~~7. “Jesus saith, A city built upon the top of a high hill and stablished can neither fall nor be hid.”~~

~~8. “Jesus saith, Thou hearest with one ear [but the other ear hast thou closed].”~~

~~The greater number of these are clearly based upon, or parallel with, passages in the Gospels ; but the second, third, and the latter part of the fifth have a sjjecial interest, because of their novelty. The second can only be our Lord’s if it is to be understood metaphorically. Dr J. B. Mayor has adduced parallels from Clement of Alexan- dria which are so to be understood, but it may be doubted whether this does not rather come from some Ebionitic sect which unduly exalted fasting and the sabbath. The third may be taken from some unknown apocryphal work, and its language appears to be based upon Baruch iii. 38. The fifth is perhaps the most interesting of all. Various in- terpretations have been suggested: that the Lord is in all things, since in Him they are made ; that the emphasis is to be laid on the difficulty of the acts, and their danger ; or that the Stone and the Wood are types of Him. Some modification of the second view is strongly suggested by Eccl. X. 9 : ” Whoso removeth stones shall be hurt therewith, and he that cleaveth wood shall be endangered thereby ” ; on the other hand, the first is by no means impossible.~~

~~Authorities. — B. P. Grenfell and A. S. Hunt. AOriA \nCOY {Sayings of our Lord), London, 1897 ; and The Oxyrhynchus Papyri, vol. i., Egyptian Exploration Fund, 1898.— A. Harnack. TIeber die jilngst entdeckten Sprilche Jesu, Freiburg-i-B. 1897 ; and papers by H. B. Swete, C. Taylor, &c. (we Co)~~

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~~L 0 a I c.~~

~~§ 1. General Tendencies op Eecent Logic.~~

~~THERE are several grounds for hope in the logic of onr day. In the first place, it tends to take up an intermediate position between the extremes of Kant and Hegel. It does not, with the former, regard logic as purely formal~~

~~*in the sense of abstracting thought from being, nor does it follow the latter in amalgamating meta- physics with logic by identifying being with thought. Secondly, it does not content itself with the mere formulae of thinking, but pushes forward to theories of method, knowledge, and science ; and it is a hopeful sign to find this epistemological spirit, to which Eugland was accus- tomed by Mill, animating German logicians such as Lotze, Duhring, Schuppe, Sigwart, and Wundt. Thirdly, there is a determination to reveal the psychological basis of logical processes ; not merely to describe them as they are in adult reasoning, but to explain also how they arise from simpler mental operations and primarily from sense. This attempt is connected with the psychological turn given to recent philosophy by Wundt and others, and is dangerous only so far as psychology itself is hypo- thetical. Unfortunately, however, these merits are usu- ally connected with a less admirable characteristic — contempt for tradition. Writing his preface to his second edition in 1888, Sigwart says : — " Important works have appeared by Lotze, Schuppe, Wundt, and Bradley, to name only the most eminent ; and all start from the con- ception which has guided this attempt. That is, logic is grounded by them, not upon an effete tradition, but upon a new investigation of thought as it actually is in its psychological foundations, in its significance for know- ledge, and its actual operation in scientific methods." How strange ! The spirit of every one of the three reforms above enumerated is an unconscious return to Aristotle's Organon. Aristotle's was a logic which steered, as Tren- delenburg has shown, between formalism and metaphy- sics ; it was a logic which in the Analytics investigated the syllogism as a means to understanding knowledge and science ; it was a logic which, starting from the psy- chological foundations of sense, memory, and experience, built up the logical structure of induction and deduction on the profoundly Aristotelian principle that "there is no process from universals without induction, and none by induction without sense." Wundt's comprehensive view that logic looks backward to psychology and forward to epistemology was hundreds of years ago one of the many discoveries of Aristotle.*~~

~~*§ 2. Judgment.*~~

~~*(1) Judgment and Conception. — The emphasis now laid on judgment, the recovery from Hume's confusion of beliefs with ideas and the association of*~~

~~*ideas, and the distinction of the mental act of judging from its verbal expression in a proposition, are all healthy signs in recent logic. The most fundamental question, before proceed- ing to the investigation of inference, is not what we say but what we think in making the judgments which, whether we express them in propositions or not, are both the premisses and the conclusion of inference; and, as this question has been diligently studied of late, but has been variously answered, it will be well to give a list of the more important theories of judgment as follows : —*~~

~~*(a) It expresses a relation between the content of two ideas, not a relation of these ideas (Lotze).*~~

~~*(b) It is consciousness concerning the objective validity*~~

~~*of a subjective combination of ideas, i.e., whether between the corresponding objective elements an analogous com- bination exists (Ueberweg).*~~

~~*(c) It is the synthesis of ideas into unity and conscious- ness of their objective validity, not in the sense of agree- ment with external reality but in the sense of the logical necessity of their synthesis (Sigwart).*~~

~~*(d) It is the analysis of an aggregate idea {Gesammtvor- stellung) into subject and predicate; based on a previous association of ideas, on relating and comparing, and on the apperceptive synthesis of an aggregate idea in conse- quence ; but itself consisting in an apperceptive analysis of that aggregate idea ; and requiring will in the form of apperception or attention (Wundt).*~~

~~*(e) It requires an idea, because every object is con- ceived as well as recognized or denied ; but it is itself an assertion of actual fact, every perception counts for a judgment, and every categorical is changed into an exis- tential judgment without change of sense (Brentano, who derives his theory from- Mill except that he denies the necessity of a combination of ideas, and reduces a cate- gorical to an existential judgment).*~~

~~*(/) It is a decision of the validity of an idea requiring will (Bergmann, following Brentano).*~~

~~(g) Judgment (Urtheil) expresses that two ideas be- long together: "by-judgment" (Beurtheilung) is the reaction of will expressing the validity or invalidity of the combination of ideas (Windelband, follov/ing Berg- mann, but distinguishing the decision of validity from the judgment).~~

~~(/i) Judgment is consciousness of the identity or difference and of the causal relations Of the given ; naming the actual combinations of the data, but also requiring d, priori categories of the understanding, the notions of identity, difference, and causality, as principles of thought or laws, to combine the plurality of the given into a unity (Schuppe).~~

~~(i) Judgment is the act which refers an ideal content recognized as such to a reality beyond the act, predicating an idea of a reality, a what of a that; so that the subject is reality and the predicate the meaning of an idea, while the judgment refers the idea to reality by an identity of content (Bradley and Bosanquet).~~

~~(&) Judgment is an assertion of reality, requiring com- parison and ideas which render it directly expressible in words (Hobhouse, mainly following Bradley).~~

~~These theories are of varying value in proportion to their proximity to Aristotle's point that predication is about things, and to Mill's point that judgments and pro- positions are about things, not about ideas. The essence of judgment is belief that somethius' is (or is not) deter- mined, either as existing (e.g., "lam," "A centaur is not"), or as something in particular (e.g., " I am a man," " I am not a monkey "). Neither Mill, however, nor any of the later logicians whose theories we have quoted, has been able quite to detach judgment from conception ; thej' all sup- pose that an idea, or ideas, is a condition of all judgment. But judgment starts from sensation (Empjindung) and feeling (Gefiihl), and not from idea (Vor.^ttelhing). When I feel pleased or pained, or when I use my senses to perceive a pressure, a temperature, a flavour, an odour, a colour, a sound, or when I am conscious of feeling and perceiving, I cannot resist the belief that something sensible is present ; and this belief that something exists is already a judgment, a judgment of existence, and, so far as it is limited to sense without inference, a true judgment. It is a matter of words whether or not we should call this sensory belief a judgment; but it is no matter of choice to the logician.~~

~~who regards all the constituents of inference as judg- ments; for the fundamental constituents are sensory- beliefs, which are therefore judgments in the logical sense. Sense is the evidence of inference ; directly of analogical and inductive, directly or indirectly of deduc- tive, inference ; and therefore, if logic refuses to include sensory beliefs among judgments, it will omit the funda^ mental constitaients of inference, inference will no longer consist of judgments but of sensory beliefs plus judg- ments, and the second part of logic, the logic of judgment, the purpose of which is to investigate the constituents of inference, will be like Hamlet without the Prince of Den- mark. If, then, all the constituents of inference are judgments, there are judgments of sense (the judicia sensus of the Epicureans) ; and the evidence of the senses means that a judgment of sense is true, while a judgment of inference is true so far as it is directly or indirectly concluded from judgments of sense. Now a sensory judgment, e.g., that a sensible pressure is existing, is explained by none of the foregoing theories, because it requires nothing but sensation and belief. It requires no will, but is usually involuntary, for the stimulus forces one's attention, which is not always voluntary : not all judgment then requires will, as Wundt supposes. It requires no reference to reality beyond the sensible pressure, so long as it is merely a belief that this exists without inference of the external stimulus or any inference at all: not all judgment then requires the reference of subjective to objective supposed by Ueberweg, or the consciousness of logical necessity supposed by Sigwart. It requires, in addition to the belief that something exists, no consideration as to whether the belief itself be true, because a man who feels pressure believes in the thing without further question about the belief : not all judg- ment then requires a decision of validity, as Bergmann supposes. It requires nothing beyond the sensation, and belief in the given existence of the given pressure : not all judgment then requires categories of imderstanding, or notions of identity, difference, and causality, or even of existence, such as Schuppe supposes. It requires no com- parison in order to express it in words, for a j udgment need not be expressed, and a sensory judgment of pressure is an irresistible belief that a real pressure exists, without wait- ing for words, or for a comparison which is wanted not to make a sensation a judgment, but to turn a judgment into language : not all judgment then requires comparison with a view to its expression, as supposed by~~

~~*Hobhouse. Lastly, all the authors of the above-quoted theories err in suppos- ing that all judgment requires conception ; for even Mill thinks a combination of ideas necessary, and Brentano, who comes still nearer to the nature of sensory judgment when he says, "Every perception counts for a judgment," yet thinks that an idea is necessary at the same time in order to understand the thing judged. In reality, the sensation and the belief are sufficient ; when I feel a sensible pressure, I cannot help believing in its reality, and therefore judging that it is real, without any tertiwmquid — an idea of pressure, or of existence, or of pressure existing — intervening be- tween the sensation and the belief. Only after sensation has ceased does an idea, or representation of what is not presented, become necessary as a substitute for a sensa- tion and as a condition not of the first judgment that there is, but of a second judgment that there was, some- thing sensible. Otherwise there would be no judgment of sensible fact, for the first sensation would not give it, and the idea following the sensation would be still farther off. The sensory judgment then, which is nothing but a belief that something sensible exists at the moment of sense, is a proof that not all judgment requires concep- tion, or synthesis or analysis of ideas, or decision about the content, or about the validity, of ideas, or reference*~~

~~*of an ideal content to reality, as commonly, though vari- ously, supposed in the logic of our day. Curiously enough, the origin of the fallacy that conception is necessary to judgment lurks in the very tradition which recent logi- cians despise. By piecing together different statements of Aristotle, not he, but his interpreters, arrived at the imagination that we have first sensations, then ideas, then judgments, finally inferences. But had our logicians probed the foundation on which they unconsciously rest, they would have found that they are accepting without proof a fancied order of thought, not certified by con- sciousness, but arising from interpretation. Aristotle himself did not separate sensation from judgment. He defines sensation as a congenital critical power. He says, indeed, in the De Interpretatione that a name is the sign of a conception without the alternative of true or false which requires composition and division, and the addition of being or not-being. He says also in the De Anima that conception does not admit falsity, and that the alternative of false or true requires composition of con- ceptions. But he never identified combinations of con- ceptions with all judgment. On the contrary, he rightly recognized*~~

~~*that there is a judgment in sense ; that a sen- sation of its special object is always true ; that sense is a kind of knowledge — knowledge of a particular, not of a universal; that sensations are the data of all inference; and that sense is the origin of science, though not science itself. Judgment of and from sense is the true tradition of Greek logic : to insert ideas between sense and judg- ment is the work of scholastic interpretation surviving, largely through Cartesian influences, in modern logic, because "the evil that men do lives after them."*~~

~~*Not, however, that all judgment is sensory : after the first judgments of sense follow judgments of memory, and memory requires ideas. Yet memory is not mere concep- tion, as Aristotle, and Mill after him, have perceived. To remember, we must have a present idea ; but we must also have a belief that the thing, of which the idea is a representation, was (or was not) determined; and this belief is the memorial judgment, e.g., " Csesar was mur- dered." Originally such judgments arise from sensory judgments followed by ideas, and are judgments of memory after sense that something sensible existed : afterwards come judgments of memory after inference. Finally, most judgments are inferential. These are conclusions which primarily are inferred from sensory and memorial judg- ments ; and so far as inference starts from sense of some- thing sensible in the present, and from memory after sense of something sensible in the past, and concludes similar things, inferential judgments are indirect beliefs in being and in existence beyond ideas. When from the sensible pressures between the parts of my mouth, which I feel and remember and judge that they exist and have existed, I infer another similar pressure (e.g., of the food which presses and is pressed by my mouth in eating), the infer- ential judgment with which I conclude is a belief that the latter exists as well as the former (e.g., the pressure of food without as well as the sensible pressures within). Inference, no doubt, is closely involved with conception. So far as it depends on memory, an inferential judgment presupposes memorial ideas in its data; and so far as it infers universal classes and laws, it produces general ideas. But even so the part played by conception is quite subordinate to that of belief. In the first place, the remembered datum, from which an inference of pressure starts, is not the conceived idea, but the belief that the sensible pressure existed. Secondly, the conclusion in which it ends is not the gen- eral idea of a class, but the belief that a class, represented by a general*~~

~~*idea, exists, and is (or is not) otherwise de- termined (e.g., that things pressing and pressed exist and move). Thirdly, there are questions which have never*~~

~~*been answered about inference. How far do we infer without memory and ideas, by combining sensory judg- ments present together (e.g., from different pressures felt at once)? How far can we form ideas of the things which we judge inferentially to exist? We infer the existence of molecules, of aether, of God, and the infer- ential judgment produces some idea, but how far does it produce an adequate idea of the thing as we infer it? The answers to these questions are desiderata of modern logic. But whatever may be the answers, two things are certain about inferential judgment: one, that when inference is based on sense and memory, inferential judgment starts from a combination of sensory and memorial judgments, both of which are beliefs that things exist ; the other, that in consequence inferential judgment is a belief that similar things exist. There are thus three primary judgments : judgments of sense, of memory after sense, and of inference from sense. All these are beliefs in being and existence, and this belief is first in sense, and afterwards transferred to memory and inference. Moreover, it is transferred in the same irre- sistible way : frequently we cannot help either feeling pressure, or remembering it, or inferring it ; and as there are involuntary sensation and attention, so there are in- voluntary memory and inference. Again, in a primary judgment existence need not be expressed; but if ex- pressed, it may be expressed either by the predicate, e.g., "I exist," or by the subject, e.g., "I who exist think." There are indeed differences between primary judgments, in that the sensory is a belief in present, the memorial in past, and the inferential in present, past, and future existence. But these differences in detail do not alter the main point that all these are beliefs in the existing, in the real as opposed to the ideal, in actual things which are not ideas. A primary judgment does not always even require an idea, because sensation produces judgments prior to any ideas, and inference produces judgments about things prior to ideas of those*~~

~~*things. Memory, it is true, requires ideas, yet it is a belief in things ; and inference from sense and memory concludes, not from ideas, but from sensory and memorial judgments which are beliefs in things, and with an inferential judgment which is a belief in things. In short, a primary judgment is a belief in something existing apart from our idea of it ; and not be- cause we have an idea of it, or by comparing an idea with, or referring an idea to, reality ; but because we have a sensation of it, or a memory of it, or an inference of it. Sensation, not conception, is the origin of judgment.*~~

~~*(2) Different Significations of Being in different Kinds of Judgment. — As Aristotle remarked both in the De Interpretatione and in the Sophistici Elenchi, " not-being is thinkable " does not mean " not-being exists." In the latter treatise he added that it is a fallacia a dicto secun- dum quid ad dictum simpUciter to argue from the former to the latter; "for," as he says, "it is not the same thing to be something and to exist absolutely." Without realizing their debt to tradition, Herbart, Mill, and re- cently Sigwart, have repeated Aristotle's separation of the copula from the verb of existence, as if it were a modern discovery that " is " is not the same as " exists." It may be added that they do not quite realize what the copula exactly signifies : it does not signify existence, but it does signify a fact, namely, that something is (or is not) determined, either absolutely in a categorical judg- ment, or conditionally in a conditional judgment. Now we have seen that all primary judgments signify more than this fact ; they are also beliefs in the existence of the thing signified by the subject. But, in the first place, primary judgments signify this existence never by the copula, but sometimes by the predicate, and sometimes by the subject ; and, secondly, it does not follow that all*~~

~~*judgments whatever signify e^xistence. Besides inference of existence there is inference of non-existence, of things inconsistent with the objects of primary judgments. Hence secondary judgments, which no longer contain a belief that the thing exists, e.g., the judgment, "not-being is thinkable," cited by Aristotle ; the judgment, " A square circle is impossible," cited by Herbart ; the judg- ment, " A centaur is a fiction of the poets," cited by Mill. These secondary judgments of non-existence are partly like and partly unlike primary judgments of existence. They resemble them in that they are beliefs in being signified by the copula. They are beliefs in things of a sort ;*~~

~~for, after all, ideas and names are things ; their objects, even though non-existent, are at all events things conceivable or nameable; and therefore we are able to make judgments that things, non-existent but conceivable or nameable, are (or are not) determined in a particular manner. Thus the judgment about a centaur is the belief, " A conceivable centaur is a fiction of the poets," and the judgment about a square circle is the belief, " A so-called square circle is an impossibility." But though beliefs that things of some sort are (or are not) deter- mined, these secondary judgments fall short of primary judgments of existence. Whereas in a primary judgment there is a further belief, signified by subject or predicate, that the thing is an existing thing in the sense of being a real thing (e.g., a man), different from the idea of it as well as from the name for it ; in a secondary judgment there is no further belief that the thing has any existence beyond the idea (e.g., a centaur), or even beyond the name (e.g., a square circle) : though the idea or name exists, there is no belief that the thing conceived or named exists. Starting, then, from this fundamental distinction between judgments of existence and judgments of non-existence, we may hope to steer our way between two extreme views which emanate from two important thinkers, each of whom has produced a flourishing school of psychological logic.~~

~~On the one hand, early in the 19th century Herbart started the view that a categorical judgment is never a judgment of existence, but always hypothetical; on the other hand, in the latter part of the century Brentano started the view that all categorical judgments are existential. The truth lies between these contraries. The view of Herbart and his school is contradicted by our primary judgments of and from sense, in which we cannot help believing existence ; and it gives an inadequate account even of our secondary judgments in which we no longer indeed believe existence, but do frequently believe that a non-existent thing is (or is not) somehow determined unconditionally. It is true, as Herbart says, that the judgment, " A square circle is an impossibility," does not contain the belief, " A square circle is existent " ; but when he goes on to argue that it means, " If a square circle is thought, the conception of impossibility must be added in thought," he falls into a noti-sequitur. To be categorical, a judgment does not require a belief in exist- ence, but only that something, existent or not, is (or is not) determined ; and there are two quite different atti- tudes of mind even to a non-existent thing, such as a square circle, namely, unconditional~~

~~and conditional belief. The judgment, " A non-existent but so-called square circle is an impossibility," is an unconditional, or categorical judg- ment of non-existence, quite different from any hypo- thetical judgment, which depends on the conditions "if it is thought," or " if it exists," or any other " if." On the other hand, the view of Brentano and his school is contra- dicted by these very categorical judgments of non-exist- ence ; and while it applies only to categorical judgments of existence, it does so inadequately. To begin with the latter objection, Brentano proposed to change the four~~

~~Aristotelian forms of judgment, A, E, I, 0, into the following existential forms: — :~~

~~A. "There is not an immortal man."~~

~~E. " There is not a live stone."~~

~~I. " There is a sick man."~~

~~0. " There is an unlearned man." This reconstruction, which merges subject and predicate in one expression, in order to combine it with the verb of existence, is repeated in similar proposals of recent English logicians. Venn, in his Symbolic Logic, proposes the four forms, a;y=0,a;?/=0, xy>0, xy>0 (where ^ means "not-y"), but only as alternative to the ordinary forms. Bradley says that " ' S-P is real ' attributes S-P, directly or in- directly, to the ultimate reality," and agrees with Bren- tano that " ' is ' never stands for anything but ' exists ' " ; while Bosanquet, who follows Bradley, goes so far as to define a categorical judgment as " that which affirms the existence of its subject, or, in other words, asserts a fact." Now, it is true that our primary judgments do contain a belief in existence ; but they do not all contain it in the same way, but are beliefs sometimes that something is determined as existing, and sometimes that something existing is particularly determined. Brentano's forms do not express such a judgment of existence, as " All existing men are mortal." Nor does Bradley's form, "Eeality includes S-P." Metaphysically, all realities are parts of one~~

~~*ultimate reality; but logically, even philosophers think more often only of finite realities, existing men, dogs, horses, &c. ; so that the normal form of a judgment of existence is either " S is a real P," or " A real S is P." Hence the reconstruction of all categorical judgments by merging subject and predicate, either on Brentano's or on Bradley's plan, is a misrepresentation even of normal categorical judgments of existence. Secondly, it is much more a misrepresentation of categorical judg- ments of non-existence. No existential form suits a judgment such as " A centaur is a fiction," when we do not believe that there is a centaur, or that reality includes a centaur. As Mill pointed out, it cannot be implied that a centaur exists, since the very thing asserted is that the thing has no real existence. In a correspon- dence with Mill, Brentano rejoined that the centaur exists in imagination; Bradley says, "inside our heads." According to one, then, the judgment becomes " There is an imaginary centaur " ; according to the other " Reality includes an imaginary centaur." The rejoinder, how- ever, though partly true, is not to the point. The idea of the centaur does exist in our imagination, and inside our heads, and the name of it in our mouths. But the point is that the centaur conceived and named does not exist beyond the idea of it and the name for it; it is not, like a man, a real thing which is neither the idea of it nor the name for it; it is not an existing thing in the ordinary sense. Accordingly, no amount of subtlety will remove the difference between a categorical judgment of existence, e.g., "An existing man is mortal," and a categorical judgment of non-existence, e.g., " A con- ceivable centaur is a fiction," because in the former we believe and mean that the thing exists beyond the idea, and in the latter we do not. If, contrary to usage, we choose to call the latter a judgment of existence, there is no use in quarrelling about words; but we must insist that new terms must in that case be invented to express so fundamental a difference as that between judgments about real men and judgments about ideal centaurs. So long, however, as we use words in the natural sense, and call the former judgments of existence, and the latter judgments of non-existence, then "is" will not be, as Bradley supposes, the same as " exists," for we use " is " in both judgments, but " exists " only in the first kind. Bosanquet's definition of a categorical judgment contains*~~

~~*a similar confusion. To assert a fact and to affirm the existence of a subject are not, as he makes out, the same thing: a judgment often asserts a fact*~~

~~*and denies existence in the same breath, e.g., "Jupiter is non-exist- ent." Here, as usual in logic, tradition is better than innovation. All categorical judgment is an unconditional belief in the fact, signified by the copula, that a thing of some sort is (or is not) determined ; but some categorical judgments are also beliefs that the thing is an existing thing, signified by the subject or by the predicate, while others are not beliefs that the thing exists at all, but are only beliefs in something conceivable, or nameable, or in something or other, without particularizing what. Judgment then always signifies beiag, but not always existence.*~~

~~*(3) Particular and Universal Judgments. — Aristotle, by distinguishing affirmative and negative, particular and universal, made the fourfold classification of judgments, A, E, I, and O, the foundation both of opposition and of inference. With regard to inference, he remarked that a universal judgment means by " all," not every individual we know, but every individual absolutely ; so that, when it becomes a major premiss, we know in it every individual universally, not individually, and often do not know a given individual individually until we add a minor premiss in a syllogism. Whereas, then, a particular judgment is a belief that some, a universal judgment is a belief that all the individuals of a kind, or total of similar individuals, are similarly determined, whether they are known or unknown individuals. Now, as we have already seen, what is signified by the subject may be existing or not, and in either case a judgment remains categorical so long as it is a belief without con- ditions. Thus, "Some existing men are poets," "All existing men are mortal," " Some conceivable centaurs are human in their forequarters," "All conceivable cen- taurs are equine in their hindquarters," are all categorical judgments. Nevertheless these obvious applications of Aristotelian traditions have been recently challenged, especially by Sigwart, who holds in his Logic (sees. 27, 36) that while a particular is a categorical judgment of existence, a universal is hypothetical, on the grormd that it does not refer to a definite number of individuals, or to individuals at all, but rather to general ideas, and that the appropriate form of " all M is P " is " if any- thing is M it is P." This view, which has influenced not only German but also English logicians, such as Venn, Bradley, and Bosanquet, destroys the fabric of inference, and reduces scientific laws to mere hypotheses. In reality, however, particular and uni«versal judgments are too closely connected to have such different*~~

~~imports. In opposition, a categorical particular is the contradictory of a universal, which is also categorical, not hypothetical, e.g., "not all M is P" is the contradictory of "all M is P," not of "if anything is M it is P." In inference, a particular is an example of a universal, which in its turn may become a particular example of a higher universal. For instance, in the history of mechanics it was first inferred from some that all terrestrial bodies gravitate, and then from these as some that all ponderable bodies, terrestrial and celestial, gravitate. How absurd to suppose that here we pass from a particular categorical to a universal hypothetical, and then treat this very conclusion as a particular categorical to pass to a higher universal hypothetical! Sigwart, indeed, is deceived both about particulars and universals. On the one hand, some particulars are not judgments of existence, e.g., "some imaginary deities are goddesses"; on the other hand, some universals are not judgments of non-existence, e.g., "every existing man is mortal." Neither kind is always a judgment of existence, but each is sometimes the one and sometimes the other. In no~~

~~case is a universal hypothetical, unless we think it under a condition ; for in a universal judgment about the non- existing, e.g., about all conceivable centaurs, we do not think, " If anything is a centaur," because we do not be- lieve that there are any; and in a universal judgment about the existent, e.g., about all existing men, we do not think, " If anything is a man," because we believe that there is a whole class of men existing at different times and places. The cause of Sigwart's error is his miscon- ception of " all." So far as he follows Aristotle in saying that " all " does not mean a definite number of individuals he is right ; but when he says that we mean no indi- viduals at all he leaves Aristotle and goes wrong. By " all " we mean every individual whatever of a kind ; and when from the experience of sense and memory we start with particular judgments of existence, and infer uni- versal judgments of existence and scientific laws, we further mean those existing individuals which we have experienced, and every individual whatever of the kind which exists. We mean neither a definite number of in- dividuals, nor yet an infinite number, but an incalculable number, whether~~

experienced or inferred to exist. We do not mean existing here and now, nor yet out of time and place, but at any time and place (semper et uhique) — past, present, and future being treated as simply existing, by what logicians used to call suppositio naturalis. We mean then by " all existing " every similar individual whatever, whenever, and wherever existing. Hence Sig- wart is right in saying that " All bodies are extended " means " Whatever is a body , is extended," but wrong in identifying this form with " If anything is a body it is extended." " Whatever" is not "if anything." Eorthe same reason it is erroneous to confuse "all existing" with a general idea. Nor does the use of abstract ideas and terms make any difference. When Bosanquet says that in " Heat is a mode of motion " there is no reference to individual objects, but " a pure hypothetical form which absolutely neglects the existence of objects," he falls far short of expressing the nature of this scientific judgment, for in his Theory of Heat Clerk Maxwell describes it as "believing heat as it exists in a hot body to be in the form of kinetic energy." As Bacon would say, it is a belief that all individual bodies qua hot are individually but similarly moving in their particles. When, again, Bradley and Bosanquet speak of the universal as if it always meant one ideal content referred to reality, they forget that in universal judgments of existence, such as " All men existing are mortal," we believe that every individually existing man dies his own death individu- ally, though similarly to other men ; and that we are thinking neither of ideas nor of reality, but of all existent individual men being individually but similarly deter- mined. A universal is indeed one whole ; but it is one whole of many similars, which are not the same with one another. This is indeed the very essence of distribution, that a universal is predicable, not singly or collectively, but severally and similarly of each and every individual of a kind, or total of similar individuals. So also the essence of a universal judgment is that every individual of the kind is severally but similarly determined. Finally, such a judgment is often a judgment of existence; but whether it is so or not it remains categorical, so long as it introduces no hypothetical antecedent about the exist- ence of the thing signified by the subject. It is true that even in universal judgments of existence there is often a hypothetical element ; for example, " All men are mortal " contains a doubt whether every man whatever, whenever, and wherever existing, must die. But this is ouly a doubt whether all the things signified by the subject are similarly*

~~*determined as signified by the predicate, and not a doubt whether there are such things at all.*~~

~~*Hence the hypothetical element is not a hypothetical antecedent " If anything is a man," but an uncertain conclusion that " All existing men are mortal." In other words, a categorical universal is often problematic, but a problematic is not the same as a hypothetical judgment.*~~

~~*(4) The Judgment and the Proposition. — Judgment in general is the mental act of believing that something is (or is not) determined. A proposition is the consequent verbal expression of such a belief, and consists in assert- ing that the thing as signified by the subject is (or is not) determined as signified by the predicate. But the expression is not necessary. Sensation irresistibly pro- duces a judgment of existence without needing language. Children think long before they speak ; and indeed, as mere vocal sounds are not speech, and as the apprehen- sion that a word signifies a thing is a judgment, judg- ment is originally not an effect, but a cause of significant language. At any rate, even when we have learnt to speak, we do not express all we think, as we may see not only from the fewness of words known to a child, but also from our own adult consciousness. The principle of language is to speak only so far as to understand and be understood. Hence speech is only a curtailed expression of thought. Sometimes we express a whole judgment by one word, e.g., "Fire!" or by a phrase, e.g., "What a fire ! " and only usually by a proposition. But even the normal proposition in the full logical form tertii adjacentis, with subject, predicate, and copula, is seldom a complete expression of the judgment. The consequence is that the proposition, being different from a judgment, arising after judgment, and remaining an imperfect copy of judgment, is only a superficial evidence of its real nature. Fortu- nately, we have more profound evidences, and at least three evidences in all : the linguistic expression of belief in the proposition ; the consciousness of what we mentally believe ; and the analysis of reasoning, which shows what we must believe, and have believed, as data for inference. In these ways we find that a judgment is both different from, and more than, a proposition. But recent logicians, although they perceive the difference, nevertheless tend to make the proposition the measure of the judgment. This makes them omit sensory judgments, and count only those which require ideas, and even general*~~

~~ideas expressed in general terms. Sigwart, for example, gives as instances of our most elementary judgments, "This is Socrates," " This is snow," — beliefs in things existing beyond our- selves which require considerable inferences from many previous judgments of sense and memory. Worse still, logicians seem unable to keep the judgment apart from the proposition. Herbart says that the judgment "A is B " does not contain the usually added thought that A is, because there is no statement of A's existence ; as if that mattered. So Sigwart, in order to reduce universals to hypotheticals, while admitting that existence is usually thought, argues that it is not stated in the universal judgment ; so also Bosanquet. But in the judgment the point is not what we state, but what we think ; and so long as the existence of A is added in thought, the judg- ment in question must contain the thought that A exists as well as that A is B, and therefore is a judgment that something is determined both as existing and in a particular manner. The statement only affects the proposition ; and whenever we believe the existence of the thing, the belief in existence is part of the judgment thought, whether it is part of the proposition stated or not.~~

~~Here Sir William Hamilton did a real service to logic in pointing out that " Logic postulates to be allowed to state explicitly in language all that is implicitly contained in the thought." Not that men should or can carry this logical postulate out in ordinary life ; but it is necessary in~~

~~the logical analysis of judgments, and yet logicians neglect it. This is why they confuse the categorical and the uni- versal with the hypothetical. Taking the carelessly ex- pressed propositions of ordinary life, they do not perceive that similar judgments are often differently expressed, e.g., " I, being a man, am mortal," and " If I am a man, I am mortal " ; and conversely, that diiferent judgments are often similarly expressed. In ordinary life we may say, " All men are mortal," " All centaurs are figments," "All square circles are impossibilities," "All candidates arriving five minutes late are fined " (the last proposition being an example of the identification of categorical with hypothetical in Keynes's Formal Logic). But of these universal propositions the first imperfectly ex- presses a~~

~~*categorical belief in existing things, the second in thinkable things, and the third in nameable things, while the fourth is a slipshod categorical expression of the hypothetical belief, " If any candidates arrive late they are fined." The four judgments are different, and therefore logically the propositions fully expressing them are also different. The judgment, then, is the measure of the proposition, not the proposition the measure of the judgment. On the other hand, we may go too far in the opposite direction, as Hamilton did in proposing the universal quantification of the predicate. If the quantity of the predicate were always thought, it ought logically to be always stated. But we only sometimes think it. Usually we leave the predicate indefinite, because, as long as the thing in question is (or is not) determined, it does not matter about other things, and it is vain for us to try to think all things at once. It is remarkable that in Barbara, and therefore in deducing lower from higher laws in science, to think the quantity of the predicate is not to the point either in the premisses or in the conclusion; so that to quantify the propositions, as Hamilton proposes, would be to express more than a rational man thinks and judges. In judgments, and therefore in propositions, indefinite predicates are the rule, quantified predicates the excep- tion. It follows also that a normal judgment is not an equation. The symbol of equality (=) is not the same as the copula (is); it means "is equal to," where " equal to " is part of the predicate, leaving " is " as the copula. Now, in all judgment we think "is," but in few judgments predicate " equal to." In quantitative judg- ments we may think x=:y, or, as Boole proposes, x = vy =*~~

~~*jry, or, as Jevons proposes, x = xy, or, as Venn proposes,*~~

~~*X which is not t/ = 0 ; and equational symbolic logic is useful whenever we think in this quantitative way. But it is a byway of thought. In most judgments all we believe is that X is (or is not) y, that a thing is (or is not) de- termined, and that the thing signified by the subject is a thing signified by the predicate, but not that it is the only thing, or equal to everything signified by the predi- cate. The symbolic logic, which confuses " is " with " is equal to," having introduced a particular kind of predicate into the copula, falls into the mistake of reducing all predication to the one category of the quantitative ; whereas it is more often in the substantial, e.g., " I am a man," not " I am equal to a man," or in the qualitative, e.g., " I am*~~

~~*white," not " I am equal to white," or in the relative, e.g., " I am born in sin," not " I am equal to born in sin." Predication, as Aristotle saw, is as various as the cate- gories of being. Finally, the great difiiculty of the logic of judgment is to find the mental act behind the linguis- tic expression, to ascribe to it exactly what is thought, neither more nor less and to apply the judgment thought to the logical proposition, without expecting to find it in ordinary propositions. Beneath Hamilton's postulate there is a deeper principle of logic — A rational being*~~

~~*thi)ik.*~~

~~*§ 3. Infbeence.*~~

~~*(1) False Views of Syllogism arising from False Views of Judgment. — The false views of j udgment, which we have been examining, have led to false views of inference. On the one hand, having reduced categorical judgments to an existential form, Brentano proposes to reform the syllogism, with the results that it must contain four terms, of which two are opposed and two appear twice ; that, when it is negative, both premisses are negative ; and that, when it is affirmative, one premiss, at least, is negative. In order to infer the universal affirmative that every professor is mortal because he is a man, Brentano's existential syllogism would run as follows : —*~~

~~*There is not a not-mortal man. There is not a not-human professor. .■. There is not a notr-mortal professor.*~~

~~*On the other hand, if on the plan of Sigwart categorical universals were reducible to hypotheticals, the same inference would be a pure hypothetical syllogism, thus : —*~~

~~*If anything is a man it is mortal. If anything is a professor it is a man. . ■. If anything is a professor it is mortal.*~~

~~*But both these unnatural forms, which are certainly not analyses of any conscious process of categorical reasoning, break down at once, because they cannot explain those moods in the third figure, e.g., Darapti, which reason from universal premisses to a particular conclusion. Thus, in order,*~~

~~*to infer that some wise men are good from the example of professors, Brentano's syllogism would be the following non-sequitur : —*~~

~~*There is not a not^good professor. There is not a iiot^wise professor. There is a wise good (non-sequitur) .*~~

~~*So Sigwart's syllogism would be the following non- sequitur : —*~~

~~*If anything is a professor, it is good.*~~

~~*If anything is a professor, it is wise.*~~

~~*Something wise is good (non-sequitur).*~~

~~*But, as by the admission of both logicians these recon- structions of Darapti are illogical, it follows that their respective reductions of categorical universals to existen- tials and hypotheticals are false, because they do not explain an actual inference. Sigwart does not indeed shrink from this and greater absurdities ; he reduces the first figure to the modus ponens and the second to the modus tollens of the hypothetical syllogism, and then, finding no place for the third figure, denies that it can in- fer necessity ; whereas it really infers the necessary con- sequence of particular conclusions. But the greatest absurdity is that, if all universals were hypothetical, Barbara in the first figure would become a purely hypo- thetical syllogism — a consequence which seems innocent enough until we remember that all universal affirmative conclusions in all sciences would with their premisses dissolve into mere hypothesis. No logic can be sound which leads to the following analysis : —*~~

~~*If anything is a body it is extended.*~~

~~*If anything is a planet it is a body.*~~

~~*.-. If anything is a planet it is extended.*~~

~~*Sigwart, indeed, has missed the essential difference be- tween the categorical and the hypothetical construction of syllogisms. In a categorical syllogism of the first figure, the major premiss, "Every M*~~

~~*whatever is P," is a universal, which we believe on account of previous evidence without any condition about the thing signified by the subject M, which we simply believe sometimes to be existent (e.g., "Every man existent"), and sometimes*~~

~~*not {e.g., "Every centaur conceivable"); and the minor premiss, " S is M," establishes no part of the major, but adds the evidence of a particular not thought of in the major at all. But in a hypothetical syllogism of the ordinary mixed type, the first or hypothetical premiss is a conditional belief, e.g., " If anything is M it is P," con- taining a hypothetical antecedent, " If anything is M," ■which is sometimes a hypothesis of existence (e.gr., "If anything is an angel "), and sometimes a hypothesis of fact {e.g., " If an existing man is wise ") ; and the second pre- miss or assumption, " Something is M," establishes part of the first, namely, the hypothetical antecedent, whether as regards existence {e.g., " Something is an angel"), or as re- gards fact {e.g., " This existing man is wise "). These very different relations of premisses are obliterated by Sigwart's false reduction of categorical universals to hypotheticals. But even Sigwart's errors are outdone by Lotze, who not only reduces " Every M is P " to " If S is M, S is P," but proceeds to reduce this hypothetical to the disjunctive, " If S is M, S is P^ or F' or P^" and finds fault with the Aristotelian syllogism because it contents itself with inferring " S is P " without showing what P. Now there are occasions when we want to reason in this disjunctive manner, to consider whether S is P' or P^ or P^, and to conclude that " S is a particular P " ; but ordinarily all we want to know is that " S is P " ; e.g., in arithmetic, that 2+2 are 4, not any particular 4, and in life that all our contemporaries must die, without enumerating all their particular sorts of deaths. Lotze's mistake is the same as that of HHamilton about the quantification of the predicate, and that of those symbolists who held that reasoning ought always to exhaust all alternatives by equations. It is the mistake of exaggerating exceptional into normal forms of thought, and ignoring the principle that a rational being thinks only to the point.*~~

~~*(2) QiMsi-syllogisms. — Besides reconstructions of the syllogistic fabric, we find in recent logic attempts to extend the figures of the syllogism beyond the syllogistic rules. An old error that we may have a valid syllogism from merely negative premisses (ex omnibus negativis), long ago answered by Alexander and Boethius, is now revived by Lotze, Jevons, and Bradley, who do not perceive that the supposed second negative is really an affirmative contain- ing a "not" which can only be carried through the syllogism by separating it from the copula and attaching it to one of the extremes, thus : —*~~

~~*The just are not unhappy (negative). The just are not-veoognized (affirmative). .-. Some not-recognized are not unhappy (negative).*~~

~~*Here the minor being the infinite term " not-recognized " in the conclusion, must be the same term also in the minor premiss. Schuppe, however, who is a fertile cre- ator of quasi-syllogisms, has managed to invent some ex- amples from two negative premisses of a different kind : —*~~

~~*(I) No N is P. S is not M. .•. Neither S nor M is P.*~~

~~*(2)*~~

~~*No M is P.*~~

~~*S is not M.*~~

~~*•. S may be P.*~~

~~*(3)*~~

~~*No V is M.*~~

~~*S is not M.*~~

~~*.-. S may be P.*~~

~~*But (1) concludes with a mere repetition, (2) and (3) with a contingent " may be," which, as Aristotle says, also " may not be," and ther(;fore nihil*~~

~~ceii.o colllgitur. The same answer applies to Schuppe's supposed syllogisms from two particular premisses : —~~

~~(1)~~

~~Some M is P. Some S is M. , Some S may be P.~~

~~(2)~~

~~Some M is P. Some M is S. , Some 8 may be P.~~

~~The only difference between these and the previous examples (2) and (3) is that, while those break the r\ile .against two negative premisses, these break that against~~

~~undistributed middle. Equally fallacious are two other attempts of Schuppe to produce syllogisms from invalid moods :-~~

~~(1) 1st Fig. All M is P. No S is M. . S may be P.~~

~~(2) 2nd Fig. Pis M. SisM. . S is partially identical with P.~~

~~In the first the fallacy is the indifferent contingency of the conclusion caused by the non-seqidtur fvom a negative premiss to an affirmative conclusion; while the second is either a mere repetition of the premisses if the conclu- sion means " S is like P in being M," or, if it means " S is P," a non-sequiiur on account of the imdistributed middle. It must not be thought that this trifling with logical rules has no effect. The last supposed syllogism, namely, that having two aifirmative premisses, and en- tailing an undistributed middle in the second figure, is accepted by Wundt under the title " Inference by Com- parison " (Vergleichungsschluss), and is supposed by him to be useful for abstraction and subsidiary to induction, and by Bosanquet to be useful for analogy. Wundt, for example, proposes the following premisses : —~~

~~Gold is a shining, fusible, ductile, simple body. Metals are shining, fusible, ductile, simple bodies.~~

~~But to say from these premisses, " Gold and metal are similar in what is signified by the middle term," is a mere repetition of the premisses ; to say, further, that " Gold may be a metal " is a non-sequitur, because, the middle being undistributed, the logical conclusion is the contingent " Gold may or may not be a metal," which leaves the question quite open, and therefore there is no syllogism. Wundt, who is again followed by Bosanquet, also supposes another syllogism in the third figure, under the title of " Inference by Connexion " {Verbindungsschluss), to be useful for induction. He proposes, for example, the following premisses : —~~

~~Gold, silver, copper, lead, are fusible. Gold, silver, copper, lead, are metals.~~

~~Here there is no syllogistic fallacy in the premisses ; but the question is what syllogistic conclusion can be drawn, and there is only one which follows without an illicit pro- cess of the minor, namely, " Some metals are fusible." The moment we stir a step farther with ^^'undt in the di- rection of a more general conclusion {ein allgevieinerer Satz), we cannot infer from the premisses the conclusion desired by Wundt, " Metals and fusible are connected " ; nor can we infer "All metals are fusible," nor "Metals are fusible," nor " Metals may be fusible," nor " All metals may be fusible," nor any assertory conclusion, deter- minate or indeterminate, but the indifferent contingent, " All metals may or may not be fusible," which leaves the question undecided, so that there is no syllogism. We do not mean that in Wundt's supposed " inferences of re- lation by comparison and connexion " the premisses are of no further use ; but those of the first kind are of no syllogistic use in the second figure, and those of the second kind of no syllogistic use beyond particular con- clusions in the third figure. What they really are in the inferences proposed by Wundt is not premisses for syllogism, but data for induction parading as syllogism. We must pass the same sentence on Lotze's attempt to extend the second figure of the syllogism for inductive purposes, thus : —~~

~~SisM. QisM. R is M. .-. Every S, which is common to S, Q, R, is M.~~

~~We could not have a more flagrant abuse of the rule Ne esto])h(s minufiqiie in conclusione qvam in proemissis. As we see from Lotze's own defence, the conclusion cannot be~~

~~drawn without another premiss or premisses to the effect that " S, Q, K, are 2, and 2 is the one real subject of M." But how is all this to be got into the second figure? Again, \Vundt and B. Erdmann propose new moods of syllogism with convertible premisses, containing defini- tions and equations. Wundt's Logic has the following forms : —~~

~~(1) l8t Fig.~~

~~Only M is P. No S is M.~~

~~(3) 2nd Fig.~~

~~x=y. z=y.~~

~~(S) 8rd Fig~~

~~y=x. y=z.~~

~~No S is P.~~

~~. • . x=z.~~

~~. ■ . x=ii.~~

~~Now, there is no doubt that, especially in mathematical equations, universal conclusions are obtainable from con- vertible premisses expressed in these ways. But the question is how the premisses must be thought, and they must be thought in the converse way to produce a logical conclusion. Thus, we must think in (1) "All P is M" to avoid illicit process of the major, in (2) "All y is z" to avoid undistributed middle, in (3) " All x is y" to avoid illicit process of the minor. Indeed, it is the very essence of a convertible judgment to think it in both orders, and especially to think it in the order necessary to an infer- ence from it. Accordingly, however expressed, the syllo- gisms quoted above are, as thought, ordinary syllogisms, (1) being Oamestres iu the second figure, (2) and (3) Barbara in the first figure. Aristotle, indeed,~~

~~*was as well aware as German logicians of the force of convertible premisses ; but he was also aware that they require no special syllogisms, and made it a point that, in a syllo- gism from a definition, the definition is the middle, and the definitum the major in a convertible major premiss of Barbara in the first figure, e.g. : —*~~

~~*The interposition of an opaque body is (essentially) deprivation*~~

~~*of light. The moon suffers the interposition of the opaque earth. . ■ . The moon suffers deprivation of light.*~~

~~*It is the same with all the recent attempts to extend the syllogism beyond its rules, which are not liable to excep- tions, because they follow from the nature of syllogistic inference from universal to particular. To give the name of syllogism to inferences which infringe the general rules against undistributed middle, illicit process, two negative premisses, non-sequitur from negative to affirmative, and the introduction of what is not in the premisses into the conclusion, and which consequently infringe the special rules against affirmative conclusions in the second figure, and against universal conclusions in the third figure, is to open the door to fallacy, and at best to confuse the syllogism with other kinds of inference, without enabling us to understand any one kind.*~~

~~*(3) Analytic and Synthetic Deduction. — Alexander the Commentator defined synthesis as a progress from prin- ciples to consequences, analysis as a regress from conse- quences to principles ; and Latin logicians preserved the same distinction between the progressus a principiis ad principiata, and the regressus a prijicipiatis ad principia. ~So distinction is more vital in the logic of inference in general and of scientific inference in particular; and yet none has been so little iinderstood, because, though analy- sis is the more usual order of discovery, synthesis is that of instruction, and therefore, by becoming more familiar, tenfis to replace and obscure the previous analysis. The distinction, however, did not escape Aristotle, who saw that a progressive syllogism can be reversed thus : —*~~

~~*1. Progression.*~~

~~*2. Beg*~~

~~*(1)*~~

~~*session.*~~

~~*(2)*~~

~~*All M is P.*~~

~~*All S is M.*~~

~~■ *. All S is P.*~~

~~*AH P is M.*~~

~~*All S is P.*~~

~~*.• . All S is M.*~~

~~*All S is P.*~~

~~*All M is S*~~

~~*.• . All M is P*~~

~~*miss for the other premiss, so as to deduce the latter as conclusion, is what he calls circular inference; and he remarked that the process is fallacious unless it con- tains propositions which are convertible, as in mathe- matical equations. Further, he perceived that the differ- ence between the progressive and regressive orders extends from mathematics to physics, and that there are two kinds of syllogism : one progressing A priori from real ground to consequent fact (6 rau Sidrt o-uXXoyter/aos), and the other regressing d posteriori from consequent fact to real ground (o tot) on*~~

~~*2. Begression. What waxes is spherical. The moon waxes.* ■ *. The moon is spherical.*~~

~~*1. Progression. What is spherical waxes. The moon is spherical. The moon waxes.*~~

~~*Proceeding from one order to the other, by converting one of the premisses, and substituting the conclusion as pre-*~~

~~*These two kinds of syllogism are synthesis and analysis in the ancient sense. Deduction is analysis when it is regres- sive from consequence to real ground, as when we start from the proposition that the angles of a triangle are equal to two right angles, and deduce analytically that therefore (1) they are equal to equal angles made by a straight line standing on another straight line, and (2) such equal angles are two right angles. Deduction is synthesis when it is progressive from real ground to consequence, as when we start from these two results of analysis as principles and deduce synthetically the proposition that therefore the angles of a triangle are equal to two right angles, in the order familiar to the student of Euclid. But the full value of the ancient theory of these processes cannot be appreciated until we recognize that as Aristotle planned them Newton used them. Much of the Principia consists of synthetical de- ductions from definitions and axioms. But the discovery of the centripetal force of the planets to the sun is an an- alytic deduction from the facts of their motion discovered by Kepler to their real ground, and is so stated by jSTewton in the first regressive order of Aristotle — P-M, S-P, S-M. Newton did indeed first show synthetically what kind of motions by mechanical laws have their ground in a centri- petal force varying inversely as the square of the distance (all P is M) ; but his next step was, not to deduce synthetically the planetary motions, but to make a new start from the planetary motions as facts established by Kepler's laws and as examples of the kind of motions in question (all S is P) ; and then, by combining these two premisses, one mechanical and the other astronomical, he analytically deduced that these facts of planetary motion have their ground in a centripetal force varying inversely as the squares of the distances of the planets from the sun (all S is M). (See- Pi-incipia I. prop. 2 ; 4 coroll. 6 ; III. Phsenomena, 4-5 ; prop. 2.) What Newton did, in short, was to prove l3y analysis that the planets, re- volving by Kepler's astronomical laws round the sun, have motions such as by mechanical laws are consequences of a centripetal force to the sun. This done, as the maj or i s con- vertible, the analytic order — P-M, S-P, S-M — was easily inverted into the synthetic order — M-P, S-M, S-P ; and in this progressive order the deduction as now taught begins with the centripetal force of the sun as real ground, and deduces the facts of planetary motion*~~

~~as consequences. Thereupon the Newtonian analysis, which preceded this synthesis, became forgotten; until at last Mill in his Logic, neglecting the Principia, had the temerity to distort Newton's discovery, which was really a pure example of analytic deduction, into a mere hypothetical deduction ; as if the author of the saying " Hypotheses non jingo " started from the hypothesis of a centripetal force to the sun, and thence deductively explained the facts of planetary motion,~~

~~which reciprocally verified the hypothesis. This gross misrepresentation has made hypothesis a kind of logical fashion. Worse still, Jevons proceeded to confuse ana- lytic deduction from consequence to ground with hypo- thetical deduction from ground to consequence under the common term " inverse deduction." Wundt attempts, but in vain, to make a compromise between the old and the new. He re-defines analysis in the very opposite way to the ancients ; whereas they defined it as a regressive pro- cess from consequence to ground, according to Wundt it is a progressive process of taking for granted a proposition and deducing a consequence, which being true verifies the proposition. He then divides it into two species : one categorical, the other hypothetical. By the categorical he means the ancient analysis from a given proposition to more general propositions. By the hypothetical he means the new-fangled analysis from a given proposition to more particular propositions, i.e., from a hypothesis to conse- quent facts. But his account of the first is imperfect, because in ancient analysis the more general propositions, with which it concludes, are not mere consequences, but the real grounds of the given proposition ; while his addi- tion of the second reduces the nature of analysis to the utmost confusion, because hypothetical deduction is pro- gressive from hypothesis to consequent facts, whereas analysis is regressive from consequent facts to real ground. There is indeed a sense in which all inference is froni ground to consequence, because it is from logical ground (jrrhicipium cognoscendi) to logical consequence. But in the sense in which deductive analysis is opposed to deduc- tive synthesis, analysis is deduction from real consequence as logical ground (principiatum as priHcipium cognoscendi)~~

~~*to real ground (principium essendi), e.g., from the conse- quential facts of planetary motion to their real ground in centripetal force to the sun. Hence Sigwart is undoubtedly right in distinguishing-analysis from hypothetical deduc- tion, for which he proposes the name " reduction." We have only further to add that many scientific discoveries about sound, heat, light, colour, and so forth, which it is the fashion to represent as hypotheses to explain facts, are really analytical deductions from the facts to their real grounds in accordance with mechanical laws. Recent logic does scant justice to scientific analysis.*~~

~~*(4) Induction. — As induction is the process from par- ticulars to universals, it might have been thought that it would always have been opposed to syllogism, in which one of the rules is against using particular premisses to draw universal conclusions. Yet such is the passion for one type that from Aristotle's time till now constant attempts have been made to reduce induction to syllo- gism. Aristotle himself invented an inductive syllogism in which the major (P) is to be referred to the middle (M) by means of the minor (S), thus : —*~~

~~*A, B, C magnets (S) attract iron (P). A, B, C magnets (S) are all magnets whatever (M). .-. All magnets whatever (M) attract iron (P).*~~

~~*As the second premiss is supposed to be convertible, he reduced the inductive to a deductive syllogism as follows : —*~~

~~*Every S is P.*~~

~~*Every S is M (convertibly).*~~

~~*Every M is P.*~~

~~*Every S is P. Every M is S. Every M is P.*~~

~~*In the reduced form the inductive syllogism was described by Aldrich as " Syllogismus in Barbara cujus minor (i.e., every M is S) reiicetitr." Whately, on the other hand, proposed an inductive syllogism with the major sup- pressed, that is, instead of the minor premiss above, he supposed a major premiss, " Whatever belongs to A, B, C magnets belongs to all." Mill*~~

~~thereupon supposed a still more general premiss, an assumption of the uniformity of~~

~~nature. Since Mill's time, however, the logic of induction tends to revert towards syllogisms more like that of Aristotle. Jevons supposed induction to be inverse de- duction, distinguished from direct deduction as analysis from synthesis, e.g., as division from multiplication ; but he really meant that it is a deduction from a hypothesis of the law of a cause to particular effects which, being true, verify the hypothesis. Sigwart declares himself in agreement with Jevons ; except that, being aware of the difference between hypothetical deduction and mathe- matical analysis, and seeing that, whereas analysis (e.g., in division) leads to certain conclusions, hypothetical deduc- tion is not certain of the hypothesis, he arrives at the more definite view that induction is not analysis proper but hypothetical deduction, or " reduction," as he proposes to call it. Reduction he defines as " the framing of possible premisses for given propositions, or the construction of a syllogism when the conclusion and one premiss is given." On this view induction becomes a reduction in the form : all M is P (hypothesis), S is M (given), .-. S is P (given). The views of Jevons and Sigwart are in agreement in two main points. According to both, induction, instead of inferring from A, B, C magnets the conclusion " Therefore all magnets attract iron," infers from the hypothesis, " Let every magnet attract iron," to A, B, C magnets, whose given attraction verifies the hypothesis. According to both, again, the hypothesis of a law with which the process starts contains more than is present in the particular data : according to Jevons, it is the hypothesis of a law of a cause from which induction deduces particular effects ; and according to Sigwart, it is a hypothesis of the ground from which the particular data necessarily follow according to universal laws. Lastly, Wundt's view is an interesting piece of eclecticism, for he supposes that induction begins in the form of Aristotle's inductive syllogism, S-P, S-M, M-P, and becomes an inductive method in the form of Jevons's inverse deduction, or hypothetical deduction, or analysis, M-P, S-M, S-P. In detail, he supposes that, while an " inference iDy comparison," which he erroneously calls an affirmative syllogism in the second figure, is pre- liminary to induction, a second " inference by combination," which he erroneously calls a syllogism in the third figure with an in determinate conclusion , is the inductive syllogism itself. This is**

~~*like Aristotle's inductive syllogism in the arrangement of terms ; but, while on the one hand Aristotle did not, like Wundt, confuse it with the third figure, on the other hand Wundt does not, like Aristotle, suppose it to be practicable to get inductive data so wide as the con- vertible premiss, " All S is M, and all M is S," which would at once establish the conclusion, " All M is P." Wundt's point is that the conclusion of the inductive syllogism is neither so much as all, nor so little as some, but rather the indeterminate "M and P are connected." The question therefore arises, how we are to discover " All M is P," and this question Wundt answers by adding an inductive method, which involves inverting the inductive syllogism in the style of Aristotle into a deductive syllogism from a hypothesis in the style of Jevons, thus : —*~~

~~*(1)*~~

~~*S is p. SisM. M and P are connected.*~~

~~*(2)*~~

~~*Every M is P. S is M. . -. S is P.*~~

~~*He agrees with Jevons in calling this second syllogism analytical deduction, and with Jevons and Sigwart in calling it hypothetical deduction. It is, in fact, a common point of Jevons, Sigwart, and Wundt that the universal is not really a conclusion inferred from given particulars, but a hypothetical major premiss from which given particulars are inferred, and that this major contains pre- suppositions of causation not contained in the particulars.*~~

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~~*It is noticeable thatWundt quotesNewton's discovery of the centripetal force of the planets to the sun as an instance of this supposed hypothetical, analytic, inductive method ; as if Newton's analysis were a hypothesis of the centripetal force to the sun, a deduction of the given facts of planetary motion, and a verification of the hypothesis by the given facts, and as if*~~

~~*such a process of hypothetical deduction could be identical with either analysis or induction. The abuse of this instance of Newtonian analysis betrays the whole origin of the current confusion of induction with deduction. One confusion has led to another. Mill confused Newton's analytical deduction with hypothet- ical deduction ; and thereupon Jevons confused induction with both. The result is that both Sigwart and Wundt transform the inductive process of adducing particular examples to induce a universal law into a deductive pro- cess of presupposing a universal law as a ground to deduce particular consequences. But we can easily extricate ourselves from these confusions by comparing induction with different kinds of deduction. The point about induction is that it starts from experience, and that, though in most classes we can experience only some particulars individually, yet we infer all. Hence induc- tion cannot be reduced to Aristotle's inductive syllogism, because experience cannot give the convertible premiss, "Every S is M, and every M is S"; that "All A, B, G are magnets " is, but that " All magnets are A, B, C " is not, a fact of experience. For the same reason induction cannot be reduced to analytical deduction of the second kind in the form, S-P, M-S, .-. M-P ; because, though both end in a universal conclusion, the limits of expe- rience prevent induction from such inference as —*~~

~~*Every experienced magnet attracts iron. Every magnet whatever is every experienced magnet. .•. Every magnet wliatever attracts iron.*~~

~~*Still less can induction be reduced to analytical deduc- tion of the first kind in the form— P-M, S-P, .-. S-M, of which Newton has left so conspicuous an example in his Principia. As the example shows, that analytic process starts from the scientific knowledge of a universal and con- vertible law (every M is P, and every P is M), e.g., a mechan- ical law of all centripetal force, and ends in a particular application, e.g., this centripetal force of planets to the Sun. But induction cannot start from a known law. Hence it is that Jevons, followed by Sigwart and Wundt, reduces it to deduction from a hypothesis in the form " Let every M be P, S is M, .. S is P." There is a superficial resem blance between induction and this hypothetical deduction. Both in a way use given particulars as evidence. But in induction the given particulars are the evidence by which we discover the universal, e.g., particular magnets attract- ing iron are the origin of an inference that all do ; in hypothetical*~~

~~*deduction, the universal is the evidence by which we explain the given particulars, as when we sup- pose undulating aether to explain the facts of heat and light. In the former process, the given particulars are the data from which we infer the universal ; in the latter, they are only the consequent facts by which we verify it. Or rather, there are two uses of induction : inductive dis- covery before deduction, and inductive verification after deduction. But neither use of induction is the same as the deduction itself : the former precedes, the latter follows it. Lastly, the theory of Mill, though frequently adopted, e.g., by B. Erdmann, need not detain us long. Most in- ductions are made without any assumption of the uni- formity of nature ; for, whether it is itself induced, or h priori, or postulated, this like every assumption is a judgment, and most men are incapable of judgment on so universal a scale, when they are quite capable of induc- tion. The fact is that the uniformity of nature stands to*~~

~~*induction as the axioms of syllogism do to syllogism; they are not premisses, but conditions of inference, which ordinary men use spontaneously, as was pointed out in Physical Realism, and afterwards in Venn's Empirical Logic. The axiom of contradiction is not a major pre- miss of a judgment: the dictum de omni et nulla is not a major premiss of a syllogism : the principle of uni- formity is not a major premiss of an induction. In- duction, in fact, is no species of deduction; they are opposite processes, as Aristotle regarded them except in the one passage where he was reducing the former to the latter, and as Bacon always regarded them. But it is easy to confuse them by mistaking examples of deduction for inductions. Thus Whewell mistookKepler's inference that Mars moves in an ellipse for an induction, though it required the combination of Tycho's and Kepler's observations, as a minor, with the laws of conic sections discovered by the Greeks, as a major, premiss. Jevons, in his Principles of Science, constantly makes the same sort of mistake. Por example, the inference from the similarity between solar spectra and the spectra of various gases on the earth to the existence of similar gases in the sun, is called by him an induction ; but it really is an analytical deduction from effect to cause, thus : —*~~

~~*Such and such spectra are efiects of various gases. Solar spectra are such spectra. . •. Solar spectra are effects of those gases.*~~

~~*In the same way, to infer a machine from hearing the reg- ular tick of a clock, to infer a player from finding a pack of cards arranged in suits, to infer a human origin of stone implements, and all such inferences from patent effects to latent causes, though they appear to Jevons to be typical inductions, are really deductions which, besides the minor premiss stating the particular effects, require a major pre- miss inducing the general kind of effects of a general kind of cause. B. Erdmann, again, has invented an induc- tion from particular predicates to a totality of predicates which he calls " ergdnzende Induction," giving as an example, "This body has the colour, extensibility, and specific gravity of magnesium ; therefore it is magnesium." But this inference contains the tacit major, " What has a given colour, &c., is magnesium," and is a syllogism of recognition. A deduction is often like an induction, in inferring from particulars ; the difference is that deduc- tion combines a law in the major with the particulars in the minor premiss, and infers syllogistically that the particulars of the minor have the predicate of the major premiss, whereas induction uses the particulars simply as instances to generalize a law. An infallible sign of an induction is that the subject and predicate of the universal conclusion are merely those of the particular instances generalized; e.g., " These magnets attract iron, .-. all do." This brings us to another source of error. As we have seen, Jevons, Sigwart, and Wundt all think that induction contains a belief in causation, in a cause, or ground, which is not present in the particular facts of experience, but is contributed by a hypothesis added as a major premiss to the particulars in order to explain them by the cause or ground. Not so ; when an induction is causal, the particular instances are already beliefs in particular causes, e.g., " My right hand is exerting pressure reciprocally with my left," "A, B, C magnets attract iron " ; and the problem is to generalize these causes, not to introduce them. Induction is not introduction. It would make no difference to the form of induction, if, as Kant thought, the notion of causality is ct priori; for even Kant thought that it is contained in experience. But whether Kant be right or wrong, Wundt and his school are decidedly wrong in supposing "supplementary notions which are not contained in experience itself, but are*~~

~~gained by a process of logical treatment of this experi- ence " ; as if our belief in causality could be neither A posteriori nor d priori, and beyond experience wake up in a hypothetical major premiss of induction. Eeally, we first experience that particular causes have particular effects ; then induce that causes similar to those have effects similar to these ; finally, deduce that when a particular cause of the kind occurs it has a particular effect of the kind by synthetic deduction, and that when a particular effect of the kind occurs it has a particular cause of the kind by analytic deduction with a convertible premiss, as when Newton from planetary motions, like terrestrial motions, analytically deduced a centripetal force to the sun like centripetal forces to the earth. Moreover, causal induction is itself both synthetic and analytic: according as experiment combines elements into a compound, or resolves a compound into elements, it is the origin of a synthetic or an analytic generalization. Not, however, that all induction is causal ; but where it is not, there is still less reason for making it a deduc- tion from hypothesis. When from the fact that the many crows in our experience are black, we induce the probability that all crows whatever are black, the belief in the particulars is quite independent of this universal. How then can this universal be called, as Sigwart, for example, calls it, the ground from which these particulars follow ? I do not believe that the crows I have seen are black because all crows are black, but vice versd. Sigwart simply inverts the order of our knowledge. In all induction, as Aristotle said, the particulars are the evidence, or ground of our knowledge (principium cogno- scendi), of the universal. In causal induction, the particu- lars contain the cause, or ground of the being (principium essendi), of the effect, as well as the ground of our inducing the law. In all induction the universal is the conclusion, in none a major premiss, and in none the ground of either thebeing orthe knowingof the particulars. Induction is simply generalization. It is not syllogism in the form of Aristotle's or Wundt's inductive syllogism, because, though .starting only from some particulars, it concludes with a universal ; it is not syllogism in the form called inverse deduction by Jevons, reduction by Sigwart, inductive method by Wundt, because it often uses particular facts of causation to infer 'universal laws of causation ; it is not syllogism in the form of Mill's syllogism from a belief in uniformity of nature, because few men have~~

~~*believed in uniformity, but all have induced from particulars to universals. Bacon alone was right in altogether opposing induction to syllogism, and in finding inductive rules for the inductive process from particular instances of presence, absence in similar circum- stances, and comparison. But how from some particulars of experience do we infer all universally ? The answer to this question is still a desideratum of logic.*~~

~~*(5) Inference in Oeneral. — There are three types : —*~~

~~*CO Sylloq-ism.*~~

~~*(2) Induction.*~~

~~*(^) Analogy.*~~

~~*Every M is P.*~~

~~*S is P.*~~

~~*SI is P.*~~

~~*SisM.*~~

~~*Every M i.s similar to S.*~~

~~*iS- is similar to SI.*~~

~~*S is P.*~~

~~*. •. Every M is P.*~~

~~*. bi-i is P.*~~

~~*Different as they are, the three kinds have something in common : they are all processes from similar to similar ; they are all processes from judgment to judgment, whether expressed in propositions or not ; and, as a judgment is a belief in being, they are all processes from one belief in being to another. Inference, in short, is any process from a given judgment, or belief that something is (or is not) determined, to a concluding judgment, or belief*~~

~~*that some- thing else which is similar in one or more respects is (or is not) similarly determined. Nevertheless, simple as this account appears, it is opposed in every point to recent logic. In the first place, the point of Brad-*~~

~~*ley's logic is that " similarity is not a principle which works. What operates is identity, and that identity is a universal." This view makes inference easy : induction is all over before it begins ; for, according to Bradley, " every one of the instances is already a universal pro- position ; and it is not a particular fact or phenomenon at all," so that the moment you observe that this magnet attracts iron, you ipso facto know that every magnet does so, and all that remains for deduction is to identify a second magnet as the same with the first, and conclude that it attracts iron. In dealing with Bradley's works we feel inclined to repeat what Aristotle says of the discourses of Socrates : they all exhibit excellence, clever- ness, novelty, and inquiry, but their truth is a difficult matter ; and the Socratic paradox that virtue is know- ledge is not more difficult than the Bradleian paradox that as two different things are the same inference is identification. The basis of Bradley's logic is the fallacious dialectic of Hegel's metaphysics, founded on the supposition that two things, which are different, but have something in common, are the same. For example, according to Hegel, being and not-being are both inde- terminate, and therefore the same. "If," says Bradley, "A and B, for instance, both have lungs or gills, they are so far the same." The answer to Hegel is that being and not-being are at most similarly indeterminate, and to Bradley that each animal has its own different lungs, whereby they are only similar. If they were the same, then in descending, two things, one of which has healthy and the other diseased lungs, would be the same ; and in ascending, two things, one of which has lungs and the other has not, but both of which have life, e.g., plants and animals, would be so far the same. There would be no limit to identity either downwards or upwards ; so that a man would be the same as a man-of-war, and all things would be the same thing, and not different parts of one universe. But a thing which has healthy lungs and a thing which has diseased lungs are only similar individuals numerically different. Each individual thing is the same only with itself, although related to other things ; and each individual of a class has its own individual, though similar, attributes. The con- sequence of this true metaphysics to logic is twofold : on the one hand, one singular or particular judgment, e.g., " this magnet*~~

~~attracts iron," is not another, e.g., "that magnet attracts iron, and neither is universal ; on the other hand, a universal judgment, e.g., " every magnet attracts iron," means, distributively, that each individual magnet exerts its individual attraction, though it is similar to other magnets exerting similar attractions. A universal is not " one identical point," but one distributive whole. Hence in a syllogism, a middle term, e.g., magnets, is " absolutely the same," not in the sense of " one identical point" making each individual the same as any other, as Bradley supposes, but only in the sense of one whole class, or total of many similar individuals, e.g., magnets, each of which is a magnet, not magnet in general. Hence also induction is a real process, because, when we know that this individual magnet attracts iron, we are very far from knowing that all alike do so similarly ; and the question of inductive logic, how we get from some similars to all similars, remains, as before, a difficulty, but not to be solved by the fallacy (hat inference is identification.~~

~~Secondly, a subordinate point in Bradley's logic is that there are inferences which are not syllogisms ; and this is true. But when he goes on to propose, as a complete independent inference, " A is to the right of B, B is to the right of C, therefore A is to the right of C," he confuses two different operations. When A, B, and C are objects of sense, their relative positions are matters, not of inference, but of observation ; when they are not, there is~~

~~an inference, but a syllogistic inference with a major premiss, induced from previous observations, " whenever of three things the first is to the right of the second, and the second to the right of the third, the first is to the right of the third." To reply that this universal judgment is not expressed, or that its expression is cumbrous, is no answer, because, whether expressed or not, it is required for the thought. As Aristotle puts it, the syllogism is directed " not to 'the outer, but to the inner discourse," or as we should say, not to the expression but to the thought, not to the proposition but to the judgment, and to the inference not verbally but mentally. Bradley seems to suppose that the major premiss of a syllogism must be explicit, or else is nothing at all. But it is often thought without being expressed, and to judge the~~

~~*syllogism by its mere explicit expression is to commit an ignoratio elenchi ; for it has been known all along that we express less than we think, and the very purpose of syllogistic logic is to analyse the whole thought necessary to the conclusion. In this syllogistic analysis two points must always be considered : one, that we usually use premisses in thought which we do not express ; and the other, that we sometimes use them unconsciously, and therefore infer and reason unconsciously, in the manner excellently described by Zeller in his Vortrdge, iii. pp. 249-55. Inference is a deeper thinking process from judgment to judgment, which only occasionally and partially emerges in the linguistic process from proposition to proposition. We may now then reassert two points about inference against Bradley's logic : the first, that it is a process from similar to similar, and not a process of identification, because two different things are not at all the same thing ; the second, that it is the mental process from judgment to judgment rather than the linguistic process from proposition to proposition, because, besides the judgments expressed in propositions, it requires judgments which are not always expressed, and are sometimes even unconscious.*~~

~~*Our third point is, that as a process of judgments infer- ence is a process from one belief in being to another, and not an ideal construction, because a judgment does not always require ideas, but is always a belief about things, existing or not. This point is challenged by aU the many ideal theories of judgment already quoted. If, for ex- ample, judgment were an analysis of an aggregate idea as Wundt supposes, it would certainly be true with him to conclude that " as judgment is an immediate, inference is a mediate, reference of the members of an aggregate of ideas to one another." But really a judgment is a belief that something, existing, or thinkable, or nameable, or what not, is (or is not) determined; and inference is a pro- cess from one to another of such beliefs in being. Hence the fallacy of those who, like Bosanquet, or like Paulsen in his Einleitung in die Philosophie, represent the real- istic theory of inference as if it meant that knowledge starts from ideas and then infers that ideas are copies of things, and who then object, rightly enough, that we could not in that case compare the copy with the original, but only be able to infer from idea to idea. But there is another realism which holds that inference is a process neither from ideas to ideas, nor from ideas to things, but from beliefs to beliefs, from judgments about things in the premisses to judgments about similar things*~~

~~*in the conclusion. Logical inference never goes through the impossible process of premising nothing but ideas, and concluding that ideas are copies of things. More- over, as we have shown, our primary judgments of sense are beliefs founded on sensations without requiring ideas, and are beliefs, not merely that something is determined, but that it is determined as existing ; and, accordingly, our primary inferences from these sensory judgments of*~~

~~*existence are inferences that other things beyond sense are similarly determined as existing. First press your lips together and then press a pen between them : you will not be conscious of perceiving any ideas : you will be conscious first of perceiving one existing lip exerting pressure reciprocally with the other existing lip ; then, on putting the pen between your lips, of perceiving each lip similarly exerting pressure, but not with the other; and consequently of inferring that each existing lip is exerting pressure reciprocally with another existing body, the pen. Inference then, though it is accompanied by ideas, is not an ideal constmction, nor a process from idea to idea, nor a process from idea to thing, but a process from direct to indirect beliefs in things, and sometimes in existing things. Logic cannot, it is true, decide what these things are, nor what the senses know about them, without appealing to metaphysics and psy- chology. But, as the science of inference, it can make sure that inference, on the one hand, starts from sensory judgments about sensible things and logically proceeds to inferential judgments about similar things beyond sense, and, on the other hand, cannot logically go beyond the similar. These are the limits within which logical inference works, because its nature essentially consists in proceeding from one judgment to another about similar things, existing or not.*~~

~~*Finally, though sensory judgment is always true of its sensible object, inferential judgments are not always true, but are true so far as they are logically inferred, however indirectly, from sense ; and knowledge consists of sense, memory after sense, and logical inference from sense, which, we must remember, is not merely the outer sense of our five senses, but also the inner sense of ourselves as conscious thinking persons. We come then, finally, to the old question — What is truth ? It will be said that Kant has proved that real truth, in the sense of the "agreement of knowledge with the*~~

~~*object," is unattain- able, because we could compare knowledge with the object only by knowing both. Sigwart, indeed, adopting Kant's argument, concludes that we must be satisfied with consistency among the thoughts which presuppose an existent ; this, too, is the reason why he thinks that induction is reduction, on the theory that we can show the necessary consequence of the given particular, but that truth of fact is unattainable. But Kant's criticism and Sigwart's corollary only derive plausibility from a false definition of truth. Truth is not the agreement of knowledge with an object beyond itself, and therefore ex hypothesi unknowable, but the agreement of our judg- ments with the objects of our knowledge. A judgment is true, whenever it is a belief that a thing is determined as it is known to be by sense, or by memory after sense, or by inference from sense, however indirect the inference may be, and even when in the form of inference of non-exist- ence it extends consequentially from primary to secondary judgments. Thus the judgments " this sensible pressure exists," " that sensible pressure existed," " other similar pressures exist," "a conceivable centaur does not exist but is a figment," are all equally true, because they are in accordance with one or other of these kinds of know- ledge. Consequently, as knowledge is attainable by sense, memory, and reason, truth is also attainable, because, though we cannot test what we know by something else, we can test what we judge by what we know. Not that all inference is knowledge, but it is sometimes. The aim of logic in general is to, find the laws of all infer- ence, which, so far as it obeys those laws, is always con- sistent, but is true or false according to its data as well as its consistency ; and the aim of the special logic of knowledge is to find the laws of direct and indirect inferences from sense, because, as sense produces sensory*~~

~~*judgments which are always true of the sensible things actually perceived, inference from sense produces inferen tial judgments which, so far as they are consequent on sensory judgments, are always true of things similar to sensible things, by the very consistency of inference, or, as we say, by parity of reasoning. We return then to the old view of Aristotle's Analytics that*~~

~~*logic analyses inference as a means to knowledge, and to the old defini- tion of logic, Logica est ars ratiocinancli, ut discernatur verurn a f also.*~~

~~*In conclusion, the logic of the last quarter of the 19th century may be said to be animated by a spirit of inquiry, marred by a love of paradox and a corresponding hatred of tradition. But we have found, on the whole, that logical tradition rises superior to logical innovation. There are two old logics which still remain indispensable, Aristotle's Organon and Bacon's Novum Orgaimm. If, and only if, the study of deductive logic begins with Aristotle, and the study of inductive logic with Aristotle and Bacon, it will be profitable to add the works of the following recent German and English authors : —*~~

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~~Logrofio, an inland province of northern Spain. With an area of 1945 square miles, it is divided into nine administrative districts and 184 parishes. The popula- tion was 181,465 in 1887, and 186,223 in 1897, when the birth-rate was 4-10 per cent., the death-rate 3-78 percent., and illegitimacy 2-49 per cent. A railway line along the right bank of the Ebro connects the province with Saragossa, and from Miranda there is railway communi- cation with Madrid, Bilbao, and France. Public educa-~~

~~tion is in a somewhat unsatisfactory condition, except in the larger towns. The industries and commerce grew considerably in importance during the last twenty years of the 19th century. Wine is the principal export, much as it has been reduced in consequence of the French im- ports of Spanish wine falling off, since 1892, by about 75 per cent. Great efforts have been made to keep a hold upon French and English markets with light red and white Rioja wines. JSTo less than 128,000 acres are covered with vines, and 21,000 with olive groves. About 72,000 acres are devoted to wheat, 88,877 acres to barley, rye, oats, maize, and 4000 to pod fruit. The mines, almost~~

~~without exception, are unproductive, but many of them (chiefly iron) could be worked profitably if the means of communication were improved.~~

~~Logrono, the capital of the above province, stands on the right bank of the Ebro, and had a population in 1897 of 19,475. The squares and public promenades have fine trees and are fringed with handsome modern houses and new buildings, contrasting with the older and narrow streets. The bull-ring holds 11,000 spectators. The see of Calahorra was transferred to Logrono in 1890.~~

~~Lohardaga, or Eanchi, a district of British India, in the Chota JSTagpur division of Bengal. Area, 714() square miles; population (1881), 1,058,169; (1891), 1,128,- 885, showing an increase of 7 per cent. ; average density, 155 persons per square mile. In 1901 the population was 1,188,562, showing a further increase of 6 per cent. The land revenue and rates are Es.1,02,442 ; number of police, 419 ; number of boys at school (1896-97), 18,132, being 21-9 per cent, of the male population of school-going age; registered death-rate (1897), 46-48 per thousand, this high mortality being due to drought and high prices of grain, which also seriously affected the attendance at school. In addition to relief .works, the Government sanctioned a bounty on the importation of grain. The administrative headquarters are at Ranchi (20,306), where there is a lac factory, employing 60 hands, with an out-turn valued at Ks.25,000. There is a small military cantonment at Doranda. The German Evangelical Lutheran mission maintains several schools and a printing-press. The S.P.G. mission is also active. Tea cultivation has been introduced, but does not flourish. In 1897 there were 21 gardens, with 2438 acres under tea, employing 1132 persons, and producing an out-turn of nearly one million pounds. There is no railway in the district, though surveys have been made to connect with the Bengal- Nagpur line. In January 1900 some of the aboriginal tribe of Mundas rose and committed several murders, chiefly of native Christians and policemen ; but the rising was promptly suppressed by military force.~~

~~Loharu, a native state of India, within the Punjab, situated in the south-east corner of the province, between HIssar district and Rajputana. Area, 226 square miles ; population (1881), 13,754; (1891), 20,139; (1901), 15,233 ; average density, 67 persons per square mile ; estimated gross revenue, Es.~~

~~66,077 ; military force, 94 men. The chief, whose title is nawab, is a Mahommedan, of Afghan descent. The nawab Arair-ud-din Ahmad Khan, K.C.I.E., who is a member of the Viceroy's Legis- lative Council, is also administrator of the state of Maler Kotla. The town of Loharu is situated in 28° 24' N. and 75° 52' E. ; population, 2038.~~

~~Loire, a river of France, rising in the department of Ard^che, and flowing north, north-west, and west to the Bay of Biscay, which it enters below Nantes. The total area drained is 207,060 square miles. The river is navigable only in a very limited sense, and, except in the two last sections of its course, by small boats only.~~

~~Below the confluence of the Maine facilities for navigation are increased, and the channel is capable of improvement. Thedisabilities do not apply to the Loire Maritime, as the section below Nantes is called. Great improvements have been effected by dredging and dyking operations, extend- ing over several series of years between 1859 and 1892, resulting in the deepening of the channel, 82 yards wide, to about 15 feet. The most important work, however, was the construction of the Maritime Canal of the Loire. This work, decided on in 1879, was begun in 1881, and on 1st September 1892 the canal was opened for traffic, the undertaking having been successfully com- pleted at a cost of about £1,000,000. The canal begins at Martinifere, 1-2 mile below Nantes, and extends to Paimboeuf. At each end is a lock, 180 yards long by 19-6 yards wide. The canal has a total length of 9^ miles, width at surface 24^ yards, depth 19^ feet, capable of being increased to 24 feet. Since the opening of the canal, large ships can ascend to Nantes. Navigation is interrupted by ice on the average ten days in the year. The Loire is classed as flottable from Vorey (Haute Loire) to Noirie (Loire), 35 miles, and as navigable from Noirie to the sea, 613 miles ; but in the upper course, for about 96 miles, there is neither flottage nor navigation.~~

~~Loire, a department in Central France, traversed by the mountains of Forez and of Lyonnais, and watered by the Loire, running through the middle of~~

~~*the department from south to north, and on its south-eastern boundary by the Rh5ne.*~~

~~*Area, 1853 square miles, divided among 30 cantons and 332 communes. The population, 603,384 in 1886, had increased to 644,532 in 1901. Births in 1899, 14,592, of which 771 were illegitiP mate ; deaths, 12,955. The chief towns are St ifetienne, witla 146,671 inhabitants in 1901, Montbrison (7520), Roanne (34,568), Rive-de-Gier (16,087), and St Chamond (15,469). In 1896 there were 1130 primary schools, with 95,000 pupils, and 3 per cent, of the population were illiterate. The land under cultivation in 1896 amounted to over 1,028,000 acres ; but the plough-land occupied only 573,000 acres, and the vineyards 44,480 acres. The wheat crop in 1899 produced the value of £582,000; rye, £400,000. Loire is one of the departments distinguished for the production of potatoes, yielding in 1899 a value of £520,000, and for natural pastures and grass lands, in which in 1899 the department returned the value of £880,000. Its vineyards produced the value of £216,000 in 1899. The live stock in 1899 included 14,800 horses, 158,810 cattle, 86,510 sheep, 63,360 pigs, and 47,890 goats. The coal basin of the Loire covers over 54,000 acres, divided among 28 companies. Its production in 1898 exceeded 3,850,000 metric tons, of the value of £2,200,000. During that year the industry in metals yielded 23,000 metric tons of cast-iron, 314,000 tons of iron, and 74,000 tons of steel, of a total value altogether of £2,200,000. St Etienne, St Chamond, and Rive-de-Gier are the centres of the mining and metallurgy. The manufacture of ribbons at St Etienne and its environs is carried on on a large scale, giving a yearly return of not less than 6 millions sterling. The weaving of muslins employs many hands in the zone of the Loire. According to the amount of horse-power it engages, Loire ranks as the third department in France. Its annual revenue is estimated at £14,000,000.*~~

~~*Loire, Haute, a department of Central France, traversed by the mountains of Velay (Mont Mezenc), and containing the upper waters of the Loire.*~~

~~*Area, 1931 square miles. From 320,063 in 1886 the population decreased to 306,671 in 1901. Births in 1899, 7561, of which 244 were illegitimate ; deaths, 6672 ; marriages, 2317. In 1896 there were 987 schools, with 50,000 pupils, and not more than 3 per cent, of the population were*~~

~~*illiterate. The land under cultivation was in 1896 estimated at 1,027,900 acres, but of this about 494,000 acres were covered with grass and forest, the plough-land occupy- ing only 526,000 acres and the vineyards 17,300 acres. Wheat yielded in 1899 only £184,000 ; but the rye crop of the same year exceeded £693,000, while barley returned more than £159,000. Potatoes in 1899 produced the value of £357,000, and the natural pastures £1,180,000. The live stock is also relatively considerable, including (1899) 14,810 horses, 186,740 cattle, 306,750 sheep, 81,140 pigs, and 10,860 goats. The milk of the department yields a revenue of over £700,000 per annum. Haute-Loire possesses coal-pits, from which in 1898 it extracted 224,000 metric tons. It has also various metalliferous deposits, such as copper and lead.*~~

~~*but the industry in metals is not correspondingly extensive. The manufacture of lace occupies a number of hands. Le Puy, the capital, had 20,570 inhabitants in 1901.*~~

~~*Loire-Inferieure, a department of the west of France, at the mouth of the Loire.*~~

~~*Area, 2695 square miles. The population increased from 643,884 in 1886 to 656,998 in 1901. Births in 1899, 13,771, of which 649 were illegitimate ; deaths, 11,638 ; marriages, 4848. The schools numbered in 1896, 789, with 89,000 pupils, and the illiterate formed 6 per cent, of the population. The land under cultivation amounts to 1,575,272 acres, of which 961,274 acres are plough-land, 308,890 acres natural pastures and grass lands, and 69,291 acres vineyards. Wheat, oats, and buckwheat are the only cereals largely cultivated. Their total produce in 1899 reached the value of £1,910,000. The vines reached the value of £1,582,000 ; mangold-wurzel, £224,000 ; natural pastures, £1,080,000. Hemp, yielding in 1899 a value of £24,000, and linen £15,500, supply the raw material to considerable industries. Apples, besides, gave a revenue of £240,000. The live stock includes 47,850 horses, 319,240 cattle, 91,700 sheep, and 113,500 pigs. The value of milk products in 1899 was £1,040,000. Loire-Inffirieure in 1898 produced 20,000 metric tons of coal, 15,000 tons of peat, 10,530 tons of iron, and 48,000 tons of sea-salt, of a value altogether of £40,000. Metallurgy is in an advanced state around Nantes and St Nazaire, in the*~~

~~*making of machines and ship engineering. In 1898 it produced 55,000 metric tons of cast- iron, 9500 tons of iron, and 49,000 tons of steel, to the value altogether, inclusive of industries in other metals, of £760,000. Industries connected with alimentation are in a thriving state along the course of the Loire, as is spinning in the interior. Distillation produces little more than 33,000 gallons a year. Nantes, the capital, had 128,349 inhabitants in 1901.*~~

~~*Loiret, a department of Central France, watered by the Loire, the Loing, and the Loiret.*~~

~~*Area, 2630 square miles. The population, 374,875 in 1886, only numbered 363,812 in 1901. Births in 1899, 7204, of which 606 were illegitimate ; deaths, 6943 ; marriages, 2557. With 724 schools in 1896, attended by 53,000 pupils, 3 per cent, of the popu- lation were illiterate. The area under cultivation in 1896 amounted to 1,671,646 acres ; 1,116,956 acres arable, 252,050 acres under wood, and only 49,422 acres under vines. The wheat crop was in 1899 estimated at £1,204,000 ; oats, £780,000 ; rye, £180,000 ; meslin, £112,000 ; barley, £128,000. The vintage of 1899 was valued at £212,000 ; mangold-wurzel at £144,000 ; natural pas- tures at £104,000. In 1899 the yield of beetroot was valued at £88,000, the department thus standing in 1899 the eleventh in France in this respect. In 1899 the live stock included 44,340 horses, 142,690 cattle, 320,790 sheep, and 37,750 pigs. Poor in minerals, Loiret has no extensive industry in metals. Much more important are its distilleries, sugar-refineries, and textile industries, more particularly hosiery. Orleans, the capital, in 1901 had 67,539 inhabitants.*~~

~~*Loir-et-Cher, a department of Central France, watered by the Loire, the Loir, and the Cher.*~~

~~*Area, 2479 square miles. The population decreased from 279,214 in 1886 to 274,836 in 1901. Births in 1899, 5334, of which 358 were illegitimate ; deaths, 5229 ; marriages, 2121. There were in 1896, 668 primary schools, with 41,000 pupils, and 5 per cent, of the population were illiterate. The area under cultivation in 1896 comprised 1,462,916 acres, of which 916,790 were plough-land and 93,903 acres vineyards. In 1899 the produce of wheat was valued at £970,000 ; rye, £112,000 ; barley, £72,000 ; oats,*~~

£580,000 ; vines, £680,000. The green crop and grass lands give but a moderate return, as do also colza, rape, oil-poppy, hemp, flax, &c. The live stock included (1899) 37,770 horses, 91,050 cattle, 234,190 sheep, 47,580 pigs, and 20,900 goats. Mining and metallurgy are not advanced. Distillation hardly produces more than a thousand hectolitres. Blois, the capital (23,793), has important hosiery manufactures.

Lolos, the name given by the Chinese to a large tribe of aborigines who inhabit the greater part of south- ern Szechuen. Under this heading we give a short account of the various non-Chinese races scattered over south-western China.

Exclusive of Tibetans, there are three principal ethnological varieties : the Miaotze of Kweichow, the Lolos of Szechuen, the Shans of Yunnan. The Miaotze or Miautze were de- scribed in the earlier volumes (xv. 223) of this Encyclopaedia (ninth edition), and need not further be referred to, save to say that they still maintain a semi-independence in their moun- tain homes, but appear to be a decaying race, gradually giving way before the more vigorous Chinese. The Lolos are a more

numerous and more important race. Their home is in the moun- tainous country called Taliang shan, which lies between the Yangtse river on the east and the Kien ch'ang valley on the west, in south Szechuen, hut they are to he found in scattered com- munities as far south as the Burmese frontier, and west to the Mekong. The origin of the Lolos is not known, but there seems no reason to doubt that they were, like the Miaotze, one of the aboriginal tribes of China, driven southwards by the advancing flood of Chinese. The name is said to be a Chinese corruption of Lulu, the name of a former chieftain of a tribe who called them- selves Nersu. They possess a written language which, like the Chinese, is monosyllabic and probably ideographic, and the charac- ters employed bear a certain resemblance to Chinese. No literature, however, worthy of the name is known to exist, and the art of reading and writing is confined to a few. Politically they are divided into tribes, each under the government of a hereditary chieftain.

~~*The community consists of three classes, the "black- bones" or nobles, the " whitebones" or plebeians, and the watze or slaves. The last are mostly Chinese who have been captured in forays, or the descendants of such captives. Within the con- fines of Lolo-land proper, which extends to some 11,000 square miles, the Chinese Government exercises no jurisdiction. The people are independent and even aggressive, making frequent raids on their unarmed Chinese neighbours. They cultivate wheat, barley, and millet, but little rice. They have some knowledge of metals, making their own tools and weapons. Women are said to be held in respect, and may become chief of the tribe. They do not intermarry with Chinese. The Shans, the third race men- tioned, are to be found all over the province of Yunnan and in the borderland between China and Burma. Slian is the Burmese name by which these tribes are known, and it has been generally adopted by Europeans, but they call themselves Tai, Punong, &o. The Chinese designate them usually Pai or Pai-yi. They are the descendants of a once powerful nation known in Chinese history as Yueh chang. They were masters at one time of a large part of what are now the provinces of Kwangsi and Yunnan, and were ex- pelled only during the Yuan dynasty (1260-1368). The Examina- tion Hall at KweUin is said to be built on the ruins of an old Shan palace. Politically the Shan tribes, where not under the direct control of Chinese magistrates, are organized under their own chiefs, who are recognized by the Chinese Government and endowed with official rank and title. In Burmese such native chiefs are termed " Tsaubwa." Besides the three races just described, there are to be found in western Szechuen other native tribes who are variously termed by the Chinese Mantze, Sifan, and Kutsung. All these are in language, dress, and physique akin to the Tibetans, and may be regarded as offshoots of that race. They do not, as a rule, mix with the Chinese, but form semi-independent commu- nities under tribal chiefs of their own choosing, whose authority is recognized by the Chinese officials.*~~

~~*See E. C. Baeer. Boyal Geog. Society Sup. Papers, vol. i. London, 1882.— F. S. A. Bourne. Blue Book, Cliina, No. 1. 1888. — A. HosiE. Three Tears in Western China. London, 1897. (g. j.)*~~

~~*Lombardy, a territorial division of northern Italy, embracing the middle portion of the valley of the Po, viz., the region contained between that river and the Swiss frontier, the lakes, and the Alps. It inclndes the prov- inces of*~~

~~Bergamo, Brescia, Como, Cremona, Mantua, Milan, Pavia, and Sondrio, and has an area of 9386 square miles, and a population of 3,680,615 (1881), and 4,278,188 (1901). Its principal crops are maize, wheat, rice, flax, hemp, wine, chestnuts, and potatoes. The only, metals mined are zinc and iron. Lombardy is one of the busiest industrial regions in Italy. In parts of the region the peasantry suffer much from pellagra. The principal towns are Milan, Brescia, Bergamo, Pavia, Cremona, Como, Mantua, Lodi, and Monza.. Pavia is the seat of a university. On the shores of the Alpine lakes and in the Alpine valleys there are a number of summer resorts, such as Trescore Balneario, Sondrio, Itormio, Varese, Gardone, Salo, and San Pellegrino. For the history see Milan, Mantua, and Italy.~~

~~Lombok, by the natives called Sassak, one of the Lesser Sunda islands, in the East Indian Archipelago, east of Java, between 8° 12' and 9° 1' S. and 115° 46' and 116° 40' E., with an area of 3136 square miles. Since the war of 1894 the island has been placed under the direct government of the Dutch, the people being, how-~~

~~ever, left in undisturbed exercise of their own laws, religions, customs, and institutions. Lombok is now a division of the residency of Bali and Lombok, and since 1898 has been divided into West, Middle, and East Lombok. Its chief towns are Mataram, Praya, and Sisi. On the west coast the harbour of Ampanam is the most frequented, though, on account of heavy breakers, it is often difficult of approach. The island is traversed by two mountain chains. The northern chain is of volcanic formation, and contains the peak of Lombok, 11,810 feet high, one of the highest volcanoes in the Archipelago. It is surrounded by a plateau (with lower summits, and a magnificent lake, Segara Anak) 8200 feet high. The southern chain is only a little over 3000 feet high. Be- tween the two chains is a broad valley or terrace with a range of low volcanic hills. The small rivers serve only for irrigation and the growing of rice. The mountains are covered with forest. The plains grow rice of superior quality ; also, for export, coffee, indigo, maize, and sugar, katyang (native beans), cotton, and tobacco. The Baliuese and Sassaks profess respectively HInduism and Islamism, and their conflicts resulted in the war referred to below. The Sassaks are estimated at 320,000; the Balinese at 50,000; the Europeans (1897) at 39; the Chinese at 305; the~~

~~*Arabs at 172. The residency of Bali and L ombok has an area of 4063 square miles, and population (1896) of 1,044,767.*~~

~~*Eor geography and statistics see Van Eck, " Schets van het Eiland Lombok," in Tijdschrift Bat. Gen. xxii. — Jacobs, Eenigen Tijd onder de Baiters, 1883. — Bijvanck, in De Gids, 1894-96. — NiiEB and Asbeck Bkusse. Naar Lombok, 1898. (c. m. K.)*~~

~~*History. — In July 1894 a Dutch expedition landed at Ampanam, and advanced towards Mataram, the capital of the Balinese sultan, who had defied Dutch authority and refused to send the usual delegation to Batavia. The objects of that expedition were twofold, to punish Mataram and to redress the grievances of the Sassaks, the aborigines of Lombok, whom the Balinese held in cruel subjection. The first Dutch expedition met with various reverses, and ultimately the invaders were forced back upon Ampanam, with the loss of several guns, and 9 ofBcers and 90 men killed, 17 oflBlcers and 265 men wounded. The Dutch at once despatched a much stronger expedition, which landed at Ampanam in September. Mataram was bom- barded by the fleet which had transported the troops, and these stormed the Sultan's stronghold, andTjakra Negara, another chieftain's citadel, both after a desperate resist- ance. The old sultan of Mataram was captured, and he and other Balinese chiefs were exiled to different parts of the Malay Archipelago, whilst the siLltan's heir fell at the hands of his warriors. Thus ended the Balinese domination of Lombok, and the island was placed under direct Dutch-Indian control, an assistant resident being appointed, who resides with a staff and a small garrison at Ampanam. Lombok is now administered from Bali by the Dutch resident on that island. The Sassaks, who are Mahomraedans and distinct in many other respects from the Balinese Hindus, who vanquished but could not convert them, had their native rulers restored to them. They are far more numerous than the Balinese invaders, and disturbances between them and the Lombok Balinese frequently occur.*~~

~~*For recent history consult AVallace's Malay Archipelago, in whose famous "Kividing Line" Lombok plays an important part; Zollinger's Travels (in Dutch), published by the Dutch-Indian Government; Guillemard's Cruise of the IMarchesa (2nd volume), and Captain W. Cool's Lombok Expedition, a*~~

~~*naiTative of the events sketched above, and published in 1896, in Dutch and English (Amsterdam and London). Wallace stayed some time at Ampanam, and gives many curious details, also a description of Mataram. Cool's book also contains many particulars about the folklore and dual religions of Lombok, which, with the adjacent Bali, forms the last stronghold of Hinduism east of Java. (h. Ti.)*~~

~~*LOMBROSO — LONDON*~~

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~~*Lombroso, Cesare (1886—), Italian crimi- nologist, was born in November 1836 at Venice. After making himself known by his medical and anthropological studies, he was in 1862 appointed professor at Pavia, then director of the lunatic asylum at Pesaro, and finally professor at Turin. His works include L'JJomo delin- quente (1876), La Pellagra in Italia (1880), Lezioni di medielna legale (1886), L'JJomo di genio (1888), translated into English, and, in collaboration with G. Perrero, La Donna delinquente (1893), also translated. Lombroso, like Bovio, Perri, and Colajanni, well-known Italian criminol- ogists, has been strongly influenced by Auguste Comte, and owes to him an exaggerated tendency to refer all mental facts to biological causes. In spite of this, how- ever, and a serious want of accuracy and discrimination in handling evidence, his work has made an epoch in crimi- nology ; for he has surpassed all his predecessors by the wide scope and systematic character of his researches, and by the practical conclusions he draws from them. Their net theoretical result is that the criminal population ex- hibits a higher percentage of physical, nervous, and men- tal anomalies than non-criminals ; and that these anomalies are due partly to degeneration, partly to atavism. The criminal is a special type of the human race, standing midway between the lunatic and the savage. This doc- trine of a " criminal type " has been gravely criticized, but is admitted by all to contain a substratum of truth. The practical reform to which it points is a classification of offenders, so that the born criminal may receive a dif- ferent kind of punishment from the offender who is tempted into crime by circumstances. Lombroso's bio- logical principles are much less successful in his work on Genius, which he explains as a morbid, degenerative con-*~~

~~*dition, presenting analogies to insanity, and not altogether alien to crime.*~~

~~*Lomond, Loch, the largest of Scottish lakes, is situated in the counties of Stirling and Dumbarton. It is 20| miles long in a straight line, and its greatest width is a mile, the area about 27 square miles, and the greatest depth 105 fathoms. It contains 30 islands, the largest of which is Inchmurrin, a deer park belonging to the duke of Montrose. The level of the loch is 23 feet above sea ; it forms part of the route of one of two projected Porth and Clyde ship canals. The fish are sea-trout, lake-trout, pike, and perch. Part of the shore is skirted by the West Highland railway, opened in 1894, which has stations at Tarbet and Ardlui on the loch. There is a graceful waterfall at Inversnaid, which is also the point of arrival and departure for the Trossachs coaches. The country surrounding Inversnaid teems with Bob Key memories. The ascent of Ben Lomond is made from Eowardennan. (See also Teossachs.)*~~

~~*^Omzha (Lomza in Polish), a government of Russian Poland, to the north-east of Warsaw. Its population in 1897 was 585,781, of whom 279,279 were women, and 69,834 lived in towns. Out of a population of 626,582 on 1st January 1895 (including 15,940 military and 30,978 temporary inhabitants), there were 505,016 Catho- lics, 111,526 Jews, 6270 Protestants, and 3770 Orthodox Greeks. The industries are limited to a few breweries and potteries. The province is divided into seven dis- tricts, of which the chief towns are: liomia, capital of the province (26,075), Kolno (4941), Mak6w (7232), Mazowiec (4931), Ostrolenka (8679), Ostrdw (11,264), and Szczuczyn (5725).*~~

~~*LONDON.*~~

~~*LONDON, the capital of England and of the British Empire, is situated on both banks of the river Thames, about 50 miles from its mouth, St Paul's Ca- thedral being 61° 30' 48" N. and 0° 5' 48" W. The name "London," strictly speaking, belongs only to the City and liberties, and up to the end of the 18th century the distinction was always made between London and Westminster and Southwark, although a larger London included in the " Bills of Mortality " was also officially acknowledged. By Act of Parliament in 1888 the ad- ministrative county of London was formed, so that since*~~

~~that date it is legally correct to describe all places in- cluded in the county as parts of London. The ” ”■ area of the administrative county (including~~

~~the City — 673 acres) consists of 74,839 acres. This area includes 31,662 acres taken from the geographical county of Middlesex, 23,123 acres from Surrey, and 20,064 acres from Kent. No portion of Essex is included in the county. As the City of London is of greater antiquity than the county of Middlesex, it really never formed a part of Middlesex. The boundary divisions of the administrative county of London are: on the north — Hampstead, St Pancras (including portion of Highgate), Islington, Stoke Newington, and Hackney; on the east — Bow, Bromley, and Poplar ; on the south-east — Green- wich, Charlton, Woolwich, and Plumstead ; on the south — Eltham, Lee, Lewisham, Camberwell, Lambeth, Streat- ham. Tooting, Wandsworth, and Putney; on the west — Fulham, Hammersmith, Kensington, and Paddington. The registration county, the area of the School Board, and the metropolitan poor-law area are the same as the administrative county. The Central Criminal Court district contains 269,148 acres. Greater London (con-~~

~~sisting of the Metropolitan Police and City Police districts) contains 443,420 acres. The Metropolitan Police district contains the county of London, the whole of the county of Middlesex, and parts of the counties of Surrey, Kent, Essex, and Hertfordshire. The limits of the postal district are regulated by the Postmaster- General.~~

~~London is divided for parliamentary purposes into thirty parliamentary boroughs. Those on the north of the Thames are — Bethnal Green, Chelsea, City, Finsbury, Fulham, Hackney, Hammersmith, ”’ “^ Hampstead, Islington, Kensington, part of bomughs. Hornsey division of Middlesex, Paddington, St George’s Hanover Square, St Marylebone, St Pancras, Shoreditch, Strand, Tower Hamlets, Westminster. Those on the south of the Thiames are Battersea and Clapham, Camberwell, Deptford, Greenwich, Lambeth, Lewisham, Newington, Southwark part of north-eastern division of Wimbledon district of Surrey, Wandsworth, Woolwich.~~

~~The table on the following page gives the population of the parliamentary boroughs for the decennial periods 1881, 1891, and 1901, and the number~~

~~*of houses in 1901, divided between inhabited, uninhabited, and in course of building.*~~

~~*In accordance with the provisions of the London Government Act of 1899, vestries disappeared, and were replaced by borough councils. The first election of borough councils took place on 9th November 1900.*~~

~~*There are twenty-eight metropolitan boroughs in the administrative county of London, including the City of Westminster, but excluding the City of London. The new boroughs, although to a great extent the same as the parliamentary boroughs, are somewhat differently bounded.*~~

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~~*LONDON*~~

~~*The parliamentary boroughs of the Strand and St George's, Hanover Square, are in the metropolitan borough of Westminster ; the one parliamentary borough of Southwark is divided into tvsro metropolitan boroughs — Southwark and Bermondsey ; the parliamentary borough of Newington is in- cluded in the metropolitan borough of Southwark. The*~~

~~*Metcopoll*~~

~~*tan*~~

~~*boroughs.*~~

~~*metropolitan borough of Stoke Newington is included in the parliamentary borough of Hackney; the metro- politan boroughs of Poplar and Stepney are included in the parliamentary borough of Tower Hamlets. The average area of the boroughs is a little over 4 square miles, but the areas are very unequal. The smallest metropolitan borough is Holborn, with an area of 409*~~

~~*Parliamentary Boroughs.*~~

~~*Area in*~~

~~*Population.*~~

~~*Houses, 1901.*~~

~~*Acres.*~~

~~*1881.*~~

~~*1891.*~~

~~*1901.*~~

~~*Inhabited.*~~

~~*Uninhabited.*~~

~~*Building.*~~

~~*North of the Thames —*~~

~~*1. City of London*~~

~~*673*~~

~~*50,569*~~

~~*37,702*~~

~~*26,923*~~

~~*3,865*~~

~~*6,199*~~

~~*166*~~

~~*2. Bethnal Green .*~~

~~*755*~~

~~126,961~~

~~129,132~~

~~129,727~~

~~14,124~~

~~663~~

~~61~~

~~3. Chelsea ....~~

~~805~~

~~88,128~~

~~96,253~~

~~95,086~~

~~11,710~~

~~784~~

~~18~~

~~4. Finsbury (part of) (a)~~

~~996~~

~~198,077~~

~~182,139~~

~~164,675~~

~~14,233~~

~~*3,208*~~

~~*122*~~

~~*5. Fulham ....*~~

~~*1,702*~~

~~*42,900*~~

~~*91,639*~~

~~*137,249*~~

~~*18,521*~~

~~*827*~~

~~*299*~~

~~*6. Hackney .*~~

~~*3,929*~~

~~*186,462*~~

~~*229,542*~~

~~*253,291*~~

~~*36,960*~~

~~*1,172*~~

~~*90*~~

~~*7. Hammersmith .*~~

~~*2,289*~~

~~*71,939*~~

~~*97,239*~~

~~*111,970*~~

~~*15,198*~~

~~*642*~~

~~*91*~~

~~*8. Hampstead*~~

~~*2,247*~~

~~*45,452*~~

~~*68,416*~~

~~*82,329*~~

~~*11,359*~~

~~*787*~~

~~*116*~~

~~*9- Islington ....*~~

~~*3,108*~~

~~*282,865*~~

~~*319,143*~~

~~*335,238*~~

~~*38,675*~~

~~*1,518*~~

~~*45*~~

~~*10. Kensington*~~

~~*2,188*~~

~~*163,151*~~

~~*166,308*~~

~~*173,073*~~

~~*21,784*~~

~~*1,891*~~

~~*35*~~

~~*11. Middlesex (part of Hornsey*~~

~~*division of) (a)*~~

~~*230*~~

~~*16,892*~~

~~*16,703*~~

~~*2,319*~~

~~*62*~~

~~*12. Paddington (part of) (a) .*~~

~~*1,255*~~

~~*107,058*~~

~~*177,846*~~

~~*127,328*~~

~~*14,995*~~

~~*963*~~

~~*32*~~

~~*13. St George's, Hanover Sq. .*~~

~~*1,121*~~

~~*89,573*~~

~~*78,364*~~

~~*76,734*~~

~~*9,017*~~

~~*1,095*~~

~~*24*~~

~~*14. St Marylebone .*~~

~~*1,506*~~

~~*154,910*~~

~~*142,404*~~

~~*132,295*~~

~~*13,466*~~

~~*1,457*~~

~~*131*~~

~~*15. St Pancras*~~

~~*2,672*~~

~~*236,363*~~

~~*234,379*~~

~~*234,912*~~

~~*23,636*~~

~~*1,516*~~

~~*22*~~

~~*16. Shoreditoh*~~

~~*648*~~

~~*126,591*~~

~~*124,009*~~

~~*117,706*~~

~~*12,647*~~

~~*1,426*~~

~~*35*~~

~~*17. Strand ....*~~

~~*613*~~

~~*80,036*~~

~~64,733~~

~~53,297~~

~~4,827~~

~~1,923~~

~~88~~

~~18. Tower Hamlets~~

~~4,092~~

~~439,186~~

~~451,931~~

~~467,259~~

~~53,973~~

~~2,302~~

~~113~~

~~19. Westminster .~~

~~824~~

~~60,175~~

~~55,774~~

~~50,790~~

~~4,457~~

~~450~~

~~42~~

~~South of the Thames —~~

~~20. Battersea and Clapham .~~

~~3,309~~

~~143,642~~

~~194,256~~

~~223,230~~

~~32,125~~

~~1,080~~

~~328~~

~~21. Camberwell (part of) (6) .~~

~~4,449~~

~~205,243~~

~~255,344~~

~~259,425~~

~~36,557~~

~~1,279~~

~~194~~

~~22. Deptford ....~~

~~1,574~~

~~*76,752*~~

~~*101,286*~~

~~*110,122*~~

~~*15,763*~~

~~*423*~~

~~*91*~~

~~*23. Greenwich*~~

~~*3,842*~~

~~*65,411*~~

~~*78,167*~~

~~*95,578*~~

~~*14,216*~~

~~*439*~~

~~*182*~~

~~*24. Lambeth ....*~~

~~*3,938*~~

~~*253,699*~~

~~*275,203*~~

~~*298,951*~~

~~*41,192*~~

~~*1,813*~~

~~*146*~~

~~*25. Lewisham*~~

~~*7,006*~~

~~*67,500*~~

~~*88,653*~~

~~*128,346*~~

~~*22,977*~~

~~*1,602*~~

~~*598*~~

~~*26. Newington*~~

~~*631*~~

~~*107,850*~~

~~*115,804*~~

~~*122,172*~~

~~*13,225*~~

~~*487*~~

~~*19*~~

~~*27. Southwark*~~

~~*1,998*~~

~~221,946~~

~~223,549~~

~~215,085~~

~~23,455~~

~~1,789~~

~~41~~

~~28. Surrey (part of north-~~

~~eastern division of Wim-~~

~~bledon district of) (c) .~~

~~29. Wandsworth .~~

~~8,136~~

~~66,792~~

~~113,244~~

~~179,‘877~~

~~29,409~~

~~1,862~~

~~978~~

~~30. Woolwich~~

~~Total .~~

~~8,299~~

~~*74,963*~~

~~*98,966*~~

~~*117,170*~~

~~*18,083*~~

~~*410*~~

~~*517*~~

~~*74,835*~~

~~*3,833,194*~~

~~*4,308,317*~~

~~*4,536,541*~~

~~*571,768*~~

~~*40,069*~~

~~*4,624*~~

~~*(a) Remainder of the parliamentary borough is in the administrative county of Middlesex.*~~

~~*(6) „ „ „ Kent.*~~

~~*(c) Formerly a detached part of Mitcham civil parish, now part of Tooting Graveney civil parish.*~~

~~*acres, and the largest, Wandsworth, which consists of 9130 acres. The following is a table of the metro- politan boroughs, with their size in acres and population in 1891 and 1901 :—*~~

~~*North of the Thames.*~~

~~*Population*~~

~~*Population*~~

~~*1891.*~~

~~*1901.*~~

~~*City of Westminster*~~

~~*2502 aorea*~~

~~*201,969*~~

~~*183,011*~~

~~**Bethnal Green*~~

~~*759 ,,*~~

~~*128,929*~~

~~*129,680*~~

~~**Chelsea*~~

~~*660 ,,*~~

~~*72,954*~~

~~*73,842*~~

~~*Finsbury*~~

~~*589 ,,*~~

~~*109.981*~~

~~*101,463*~~

- ~~*Fulham .*~~

~~*1703 ,,*~~

~~*91,790*~~

~~*137,289*~~

~~**Hackney*~~

~~*3289 ,,*~~

~~*199,606*~~

~~*219,272*~~

~~**Hammersmith*~~

~~*2286 ,,*~~

~~*97,283*~~

~~*112,239*~~

~~**Hampstead*~~

~~*2265 ,,*~~

~~*68,126*~~

~~*81,942*~~

~~*Holborn*~~

~~*405 ,,*~~

~~*66,781*~~

~~*59,405*~~

~~*Islingtnn~~

~~3091 ,,~~

~~319,1.W~~

~~334,991~~

~~*Kensington~~

~~2291 .,~~

~~170,071~~

~~176,628~~

~~*Paddington .~~

~~1356 ,,~~

~~135,!lf.5~~

~~143,976~~

~~Popkr .~~

~~2328 ,,~~

~~166,880~~

~~168,822~~

~~*St Marylebone~~

~~1473 ,,~~

~~144,083~~

~~133,301~~

~~*St Pancras~~

~~2694 ,,~~

~~234,749~~

~~235,317~~

~~*Shoreditch~~

~~658 ,,~~

~~124,727~~

~~118,637~~

~~Stepney .~~

~~1765 ,,~~

~~285,116~~

~~298,600~~

~~Stoke Newington .~~

~~863 ,,~~

~~47,988~~

~~51,247~~

~~South of the Thames.~~

~~Area.~~

~~Population~~

~~1891.~~

~~*Population*~~

~~*1901.*~~

~~**Battersea*~~

~~*2160 acres*~~

~~*150,166*~~

~~*168,907*~~

~~*Bermondsey .*~~

~~*1499 ,,*~~

~~*136,014*~~

~~*130,760*~~

~~**Camberwell .*~~

~~*4480 ,,*~~

~~*233,706*~~

~~*259,339*~~

- ~~*Deptford*~~

~~*1663 ,,*~~

~~*101,770*~~

~~*110,398*~~

~~*Greenwich*~~

~~*3862 ,,*~~

~~78,493~~

~~95,770~~

~~*Lanibeth~~

~~4080 ,,~~

~~278,393~~

~~301,895~~

~~Lewisham~~

~~7014 ,,~~

~~88,933~~

~~127,495~~

~~Southwark~~

~~1131 ,,~~

~~202,479~~

~~206,180~~

~~Wandsworth .~~

~~9130 ,,~~

~~155,524~~

~~232,034~~

~~Woolwich~~

~~8277 ,,~~

~~*98,994*~~

~~*117,178*~~

~~*The boronghs to the names of which an asterisk (*) is prefixed consist of single parishes.*~~

~~*For purposes of convenience the Post Office divided London into eight districts, to which the following letters have been attached : — E.C. (East Central), W.C. (West Central), W. (West), S.W. (South- West), S.E. (South-East), E. (East), N. (North), N.W. (North- West). The following table shows the number of letters delivered and registered, telegrams handed in, and the number of persons employed in the London postal districts for the four years 1896-97 to 1900-01 :—*~~

~~*Postal districts.*~~

~~*LONDON*~~

~~*345*~~

~~*S. VI. — 44*~~

~~*346*~~

~~*LONDON*~~

~~*Tear.*~~

~~*Letters Delivered.*~~

~~*Letters Registered.*~~

~~*4,999,428 4,789,067 6,174,092 6,665,644 5,921,288*~~

~~*Telegrams.*~~

~~*Persons Employed.*~~

~~*Total.*~~

~~*Males.*~~

~~*Females.*~~

~~*1896-1897 1897-1898*~~

~~*1S98-1899*~~

~~*1899-1900 1900-1901*~~

~~*655,200,000 590,900,000 617,700,000 632,600,000 664,800,000*~~

~~*26,645,407 27,419,241 28,468,242 29,971,384 29,365,734*~~

~~*29,688 30,842 31,891 32,185 33,876*~~

~~*5013 6293*~~

~~*6652 6956 6299*~~

~~*34,701 36,135 87,643 38,141 40,174*~~

~~*Tele- phones,*~~

~~*Up to the year 1901 the National Telephone Company was practically the sole owner of telephone exchange com- munication in London, although the Post Office owned all the trunk lines connecting the various telephone areas of the company, and also worked a few exchanges outside London. The Select Committee on Telephones, appointed in 1898, reported the same year that " general immediate and effective " competition by either the Government or local authority was necessary. The result of this was that the Post Office was entrusted with the work, and most of the Post Office exchanges are now in working order. The area of the competitive tele- phone service is about 630 square miles, extending to Romford, Enfield, Harrow, ifec. en the north, and to Epsom, Eeigate, and Dartford on the south. The service is divided under three headings : A, exclusive lines ; B, party lines ; C, public call office. The charge under A is for (1) un- limited*~~

~~*user and (2) limited user. In the first class £17 per annum for one line and £14 extra for each additional line ; in the second class the charge is £4 or £5 per annum, with a charge of Id. or 2d. a message. Under B the charge is £2 or £3 per subscriber, with the same charge per message as in A. In C the charge is 2d. per message to subscribers on any exchange.*~~

~~*The total area in London under crops and grass in 1899 was 12,548 acres, and in 1900, 12,054 acres. It was divided as follows : —*~~

~~*Agriculture.*~~

~~*Tear.*~~

~~*Corn Crops.*~~

~~*Green Crops.*~~

~~*Clover.*~~

~~*Permanent Pasture.*~~

~~*Small Fruit.*~~

~~*Fallow.*~~

~~*1899 1900*~~

~~*629 481*~~

~~*2456 2201*~~

~~*148 142*~~

~~*8922*~~

~~*8775*~~

~~*350 351*~~

~~43 104~~

~~The following figures show the live stock for the same years : —~~

~~Tear.~~

~~Horses.i~~

~~Cattle.~~

~~Cows and Heifers.~~

~~Sheep.~~

~~Pigs.~~

~~1899 1900~~

~~805 806~~

~~6866 6409~~

~~5467~~

~~5846 2462~~

~~2607 2518~~

~~In 1870 the value of the land not used for buildings was set down at £118,836, while in 1894 it was estimated at £67,560.~~

~~The population of the area now included in the adminis- trative county of London in 1831 was 1,655,099, but in 1901 the number had risen to 4,536,541. This increase has taken place chiefly in the outer dis- tricts, as the central districts have decreased in population. The population of the City in 1801 was 128,129; in 1831 it was 122,491; in 1851, 127.819. Since 1851 the number has uniformly decreased, and in 1901 it stood at 20,923. The decrease in the other central districts between 1851 and 1896 was as follows : —■~~

~~*Popula- tion.*~~

~~*Ilolhorn .*~~

~~*. 47,090 to 31,000*~~

~~*St Giles's .*~~

~~*. 51,000 ,, 38,000*~~

~~*St James's*~~

~~*3l),000 ,, 23,000*~~

~~*St Martin's*~~

~~*. 2.-1,000 ,, 13,000*~~

~~*St Mar^'lebone .*~~

~~*. 153,000 .. 141,000*~~

~~*Strand*~~

~~*44,000 ,, 24,000*~~

~~*Westminster*~~

~~*65,000 ,, 53,000*~~

~~*^ By horses is meant horses used solely for agricultural purposes, and unbroken horses.*~~

~~*55,000 ,, 253,000*~~

~~*. 12,000 ,*~~

~~*114,000*~~

~~*. 67,000 ,*~~

~~*, 176,000*~~

~~*. 54,000 ,*~~

~~*, 213,000*~~

~~*. 18,000 ,*~~

~~*104,000*~~

~~*. 12,000 ,*~~

~~*, 75,000*~~

~~*95,000 ,*~~

~~*337,000*~~

~~*. 44,000 ,*~~

~~*, 170,000*~~

~~*. 139,000 ,*~~

~~*, 295,000*~~

~~*. 16,000 ,*~~

~~*270,000*~~

~~*The increase of population in the outer districts between 1851 and 1896 was as follows : —*~~

~~*Battersea 11,000 to 165,000*~~

~~*Camberwell*~~

~~*Fulham .*~~

~~*Greenwioh*~~

~~*Hackney .*~~

~~*Hammersmith*~~

~~*Hampstead*~~

~~*Islington .*~~

~~*Kensington*~~

~~*Lambeth .*~~

~~*Lewisham*~~

~~*These figures are those given by Sir John Wolfe Barry in November 1898, before the creation of the metropolitan boroughs (Journal Society of Arts, vol. xlvii. p. 10).*~~

~~*Births, Deaths, and Marriages.*~~

~~*The registration of births, deaths, and marriages is under the direction of the Registrar — General, but is directly carried out by the several boards of guardians, and the figures relating to this subject are to be found in the annual report of the Registrar-General.*~~

~~*The following table shows the marriage-, birth-, and death- rate per thousand of the population, with the percentage of illegitimate births, for a series of years : —*~~

~~*1870-79.*~~

~~*1880. 18-1*~~

~~*1880-89.*~~

~~*1890.*~~

~~*1889-98.*~~

~~*1899.*~~

~~*Marriage-rate .*~~

~~*19-2*~~

~~*17-6*~~

~~*17-6*~~

~~*17-6*~~

~~*18-4*~~

~~*Birth-rate*~~

~~*35-4*~~

~~*35-3*~~

~~*33-7*~~

~~*30-7*~~

~~*30-7*~~

~~*29-3*~~

~~*Death-rate*~~

~~*22-8*~~

~~*217*~~

~~*20-5*~~

~~*21-0*~~

~~*19-3*~~

~~*19-4*~~

~~*Percentage of illegiti-*~~

~~*macy .*~~

~~*3-9*~~

~~*3-9*~~

~~*3-9*~~

~~*3-8*~~

~~*3-7*~~

~~*3-6*~~

~~*The following table gives the number of marriages, births, and deaths, with the number of illegitimate births, in 1880, 1890, 1899 :—*~~

~~*Year.*~~

~~*Marriages.*~~

~~*Births.*~~

~~*Deaths.*~~

~~*Illegitimate Births.*~~

~~*Males.*~~

~~*Females.*~~

~~*1S80*~~

~~*1890 1899*~~

~~*34,144 36,762*~~

~~*41,876*~~

~~*133,310 128,161 133,134*~~

~~*81,832 87,689 88,063*~~

~~*2627 2492 2495*~~

~~*2546 2410 2254*~~

~~*Emigration and Immigration.*~~

~~*1891. 1899. 1900. 1901.*~~

~~*Emigrants embarking at the*~~

~~*Port of London . . 29,140 23,329 26,236 25,010 Alien immigrants arriving at*~~

~~*the Port of London . . 17,476 26,840 33,039 29,729*~~

~~*" Emigrants " comprise passengers leaving London for places outside Europe.*~~

~~*Nationality of Aliens arriving at the Port of*~~

~~*London*~~

~~*1900.*~~

~~*1901.*~~

~~*Russians and Poles*~~

~~*17,939*~~

~~*15,968*~~

~~*Norwegians, Swedes, and Danes*~~

~~*1,226*~~

~~*1,143*~~

~~*Germans ....*~~

~~*2,818*~~

~~*3,693*~~

~~*Dutch*~~

~~*1,617*~~

~~*1,685*~~

~~*I”rench*~~

~~*468*~~

~~*549*~~

~~*Austrians and Hungarians*~~

~~*2,174*~~

~~*1,724*~~

~~*Italians*~~

~~*241*~~

~~*143*~~

~~*Otlier nationalities*~~

~~*4,110*~~

~~*2,275*~~

30,593

27,070

Add seamen .....

2,441

2,655

33,034 29.725

The number of foreigners in London in 1891 was 95,063, and in 1901, 135,377.

The total expenditure in London for the relief of the poor, exclusive of the operation of the poor fund, was, according to the return of the Local Government Board, in 1899-1900, £;^,446,132. There are ”’°”” - thirty-one boards of guardians, five boards of managers of school districts, and two boards of managers of sick asylum districts. The parishes and unions which favour outdoor relief, and which have a majority of paupers in receipt of

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outdoor relief on their books, are Poplar, Lewisham, Woolwich, Camberwell, Wandsworth and Clapham, St Olave’s, Hackney, and Islington. The following have more indoor than outdoor paupers : Whitechapel, St George’s- in- the -East, Stepney, Strand, Kensington, Chelsea, and St George’s, Hanover Square.

The following table gives the number of paupers : —

1897-98. 1898-99. 1899-1900.

Indoor paupers Outdoor paupers . Vagrants Pauper lunatics Paupers of all classes

~~68,089 59,259 59,359~~

~~39,039 38,907 38,987~~

~~1,322 1,302 1,297~~

~~13,784 14,387 14,887~~

~~118,647 120,265 120,912~~

~~1897. 1898. 1899.~~

~~Admission to casual wards 181,728 183,138 174,362 Average number on Friday nights —~~

~~Men .... 815 825 789~~

~~Women. ... 210 216 199~~

~~Children ... 20 23 21~~

~~Total . . 1045 1064 1009~~

~~The amount spent in London in 1899-1900 on in-main- tenance was £920,936 ; outdoor relief, £223,624 ; mainten- ance of lunatics in asylums and licensed houses, £414,963 ; salaries and superannuation allowances, £767,262 ; loans repaid and interest, £524,099. The remainder is described as " other expenses of, or immediately connected with, relief." The Metropolitan Asylums Board is a central authority created by the Metropolitan Poor Act of 1867, to provide accommodation for the infectious sick and the harmless insane. There are seventy-three managers, fifty- five of whom are elected by the boards of guardians, and eighteen are nominated by the Local Government Board.~~

~~The County Council, as the central health authority of London, is entrusted by the Legislature with important powers of action in default of local sanitary authorities. The death-rate per thousand living in 1900 was 18-6, as against 19-3 in 1899. Of the sanitary districts showing a rate below this there were : — Battersea (17-8), Camberwell (17-0), Chelsea (18-5),~~

~~*Fdham (17-7), Greenwich (18‘1), Hackney (16‘7), Hammersmith (17-1), Hampstead (11-“4), Islington (17-‘1), Kensington (15‘8), Lambeth (18‘2), Lee (13-4), Lewisham (14-1), Paddington (16‘3), Plumstead (16‘0), St George’s, Hanover Square (14-5), St James’s (15-8), St Martin’s-in-the-Fields (17-7), Stoke Newington (13-2), and Wandsworth (14-2). The sanitary districts having the highest death-rates were : — Bermondsey (23‘6), Bethnal Green (21‘8), Clerkenwell (22-0), Holborn (25‘7), Limehouse (26-4), City of London (21‘6), Newington (22-4), Poplar (22-6), Kotherhithe (22-9), St George’s-in-the-East (24-4), St George’s, South-wark (27-3), St Luke’s (28-6), St Olave’s (21-6), St Saviour’s, Southwark (25-6), Shoreditch (22‘0), Strand (22-4), and Woolwich (22-1).*~~

~~*The death-rate per thousand living from 1881 to 1900 was as follows : —*~~

~~*1881*~~

~~*21-3*~~

~~*1886*~~

~~*20-6*~~

~~*1891*~~

~~*21-0*~~

~~*1896 18-1*~~

~~*1882*~~

~~*21-5*~~

~~*1887*~~

~~*20-3*~~

~~*1892*~~

~~*20-3*~~

~~*1897 17-7*~~

~~*1883*~~

~~*20-8*~~

~~*1888*~~

~~*19-3*~~

~~*1893*~~

~~*21-0*~~

~~*1898 18-2*~~

~~*1884*~~

~~*20-9*~~

~~*1889*~~

~~18-4~~

~~1894~~

~~17-4~~

~~1899 19-3~~

~~1885~~

~~20-4 •~~

~~1890~~

~~21-4~~

~~1895~~

~~19-5~~

~~1900 18-6~~

~~The following table gives the total births and deaths, and the deaths from zymotic diseases, 1881 to 1900 : —~~

~~Deaths from Zymotic Diseases and from, all Causes, 1881-1900.~~

~~Year.~~

~~Total Births.~~

~~Total Deaths.~~

~~Deaths of In- fants under One Year.~~

~~Deaths from Principal Zymotic Diseases.~~

~~Percentage of~~

~~Deaths from~~

~~*Principal*~~

~~*Zymotic*~~

~~*Diseases.*~~

~~*Total.*~~

~~*Smallpox.*~~

~~*Measles.*~~

~~*Scarlet Fever.*~~

~~*Diphtheria.*~~

~~*Whooping Congh.*~~

~~*Fever. Diarrhoea. Cholera.*~~

~~*1881 1891 1896 1897 1898 1899 1900*~~

~~*132,904 134,484 133,833 134,187 132,849 133,134 130,868*~~

~~*81,120 90,595 82,390 81,119 84,154 89,705 86,007*~~

~~*20,907 20,776 21,615 21,286 22,192 22,287 26,927*~~

~~*13,681 9,839 14,046 11,674 12,700 11,394 10,302*~~

~~*475 8 9 16 1 3 4*~~

~~*1501 1807 3662 1909 3073 2134 1936*~~

~~*3073 598 916 782 582 398 361*~~

~~*541 1435 2657 2273 1766 1951 1568*~~

~~*3438 2872 2904 1839 2160 1720 1948*~~

~~886 613 598 594 602 811 765~~

~~3767 2435 3207 4146 4385 4225 3654~~

~~71~~

~~93~~

~~116~~

~~131~~

~~152~~

~~76~~

~~16-9~~

~~10-8~~

~~17-0~~

~~14-4~~

~~15-09~~

~~12-70~~

~~11-98~~

~~Streets.~~

~~Various attempts to improve the thoroughfares of London have been made since the formation of Regent Street in 1813-20, but they have proved to be quite inade- quate to relieve the constantly increasing conges- tion. The greatest improvement was the construction of the Thames Embankment, which at once restored the river to its proper position as the prominent feature of the town that originally grew up by its shores. The Victoria Embankment, on the north bank, from Blackfriars to Westminster, and the~~

Albert Embankment on the south bank, from Westminster Bridge to Vauxhall, were both opened in 1870. The Chelsea Embankment, on the north bank, from Battersea Bridge to Chelsea Bridge, was finished in 1874. The dates of the chief improvements in the thoroughfares of London during the latter half of the 19th century are as follows: — 1854, Cannon Street ; 1864, Southwark Street; 1870, Holborn Viaduct; 1871, Hamilton Place, Queen Victoria Street ; 1876, Northumber- land Avenue; 1882, Tooley Street; 1883, Hyde Park Corner; 1884, Eastcheap ; 1886, Shaftesbury Avenue; 1887, Charing Cross Eoad ; 1890-92, Eosebery Avenue. The great improvement of a new road running north to south from Holborn to the Strand is under construction. The chief streets are all too narrow, especially the Strand and Fleet Street. These are being widened, but there seems to be little hope of any adequate relief of the congestion until a drastic system of readjustment is carried out. One of the

chief causes of obstruction is due to the crossing of main thoroughfares. Sir John Wolfe Barry, when chairman of the Council of the Society of Arts, proposed in his opening address to the Society in 1899 a series of crossings of east and west, and north and south traific, by means of bridges over and tunnels under the streets at six of the important places of intersection: — 1, Hyde Park Corner; 2, Picca- dilly Circus ; 3, Ludgate Circus ; 4, Oxford Street and Tottenham Court Road ; 5, Wellington Street and Strand ; 6, Southwark Bridge and Upper Thames Street.

Bridges aokoss the Thames. Property of the Corporation of the City of London. Tower Bridge (opened 1894). London Bridge (opened 1831). Southwark Bridge (opened 1819). Blackfriars Bridge (opened 1869).

Property of the London County Council. ■Waterloo Bridge (opened 1817). Charing Cross footbridge (opened 1878) ; the railway bridge is

the property of the South-Eastern Railway Company. Westminster Bridge (opened 1860-62). Lambeth Bridge (completed 1862).

Vanxhall Bridge (opened 1816 ; new bridge in course of erection). Victoria or Chelsea Bridge (opened 1858). Albert Bridge (completed 1873). Battersea Bridge (opened 1890). Wandsworth Bridge (opened 1880). Putney Bridge (opened 1886). Hammersmith Bridge (opened 1887).

~~The bridges referred to as the property of the Metropolitan Board of Worlds became so under the terms of the Metropolis Toll Bridge Act, 1877 (40 and 41 Vict. c. 99), and on the passing of the Local Government Act, 1888, they were transferred to the London County Council, which expends a sum of £10,000 per annum on their maintenance. Besides bridges, there are several tunnels under the Thames.~~

~~Thames Tunnel (2 miles below London Bridge) was coramenc-ed in 1825, and opened for public trafBo in 1843. It was sold in 1865 to the East London Railway for £200,000. The original cost was over £600,000.~~

~~Tower Subway, a tunnel from Tower Hill to Tooley Street, was constructed in 1869-70 at a cost of £16,000. The tunnel is reached at each end by a shaft about 60 feet deep.~~

~~Blackwall Tunnel, connecting Poplar with Greenwich, was con- structed by the London County Council, in accordance with an Act passed in 1887, at a total cost of £869,476. The tunnel was opened by the prince of Wales, 22nd May 1897. In addition to the cost of making the tunnel, the Council has spent a sum of £350,000 in the acquisition of property, £70,000 in erecting dwellings for persons of the working classes who have been dis- placed in the carrying out of the scheme, and £64,000 in making the approach roads from Lower Woolwich road to the tunnel. With other minor works and incidental expenses the Blackwall Tunnel Scheme necessitated an expenditure approximating to £1,383,502. The annual cost of maintenance is about £6300.~~

~~Greenwich Tunnel (from Greenwich to Millwall). An Act was passed in 1897 authorizing the County Council to construct a sub- way for the use of pedestrians only, to connect the Isle of Dogs and Greenwich. It was opened in 1902.~~

~~Rotherhithe Tunnel (between Rotherhithe and Ratoliff), author- ized under local act 1900, was in 1902 under construction.~~

~~*Woolwich free ferry was constructed under the powers of the Metropolitan Board of Works (Various Powers) Act, 1885, and was opened by the earl of Rosebery on 23rd March 1889. The total cost incurred by the Council in forming and improving the ferry (including the formation of approach roads, river walls, piers, ac()uisition of land, &c.) and building the ferry-boats was £182,775, and the annual working expenses are £18,405. The number of passengers using the ferry in 1900 was 5,319,070, and the number of vehicles 437,961.*~~

~~*The chief means of communication from place to place in London are supplied by omnibuses, tramways, Means of jaJi^^yg^ j^^j steamboats, the statistics of which cation. ^^® given in the following tables. The average number of omnibuses running during the first half of 1900 belonging to the London General Omnibus Company was 1372, and 480 to the Koad Car Company. The number of passengers carried by the London General*~~

~~*Omnibus Company in 1900 was 199,575,-529; by the Eoad Car Company in the same year, 64,948,339.*~~

~~*Receipts.*~~

~~*Expenditure.*~~

~~*Gross Profits.*~~

~~*London General Omnibus*~~

~~*Company, 1899 .*~~

~~*£1,205,644*~~

~~*£1,116,357*~~

~~*£89,287*~~

~~*London General Omnibus*~~

~~*Company, 1900 .*~~

~~*1,245,174*~~

~~*1,157,918*~~

~~*87,256*~~

~~*London Road Car Com-*~~

~~*pany, 1899 .*~~

~~*381,784*~~

~~*337,053*~~

~~*44,731*~~

~~*London Road Car Com-*~~

~~*pany, 1900 .*~~

~~*383,575 351,364*~~

~~*32,211*~~

~~*Tramways. — When the County Council was formed, there were thirteen tramway companies in existence. The Council set to work to secure possession of these under- takings in virtue of its powers under the Tramways Act of 1870, and will ultimately be in possession of all the tramways of London. There are twelve companies having running powers in the county, with a total length of line — 115 miles within, and 33 miles out-side the county. The County Council owns 48 miles of line, at present worked by the North Metropolitan Tramways Company, the standard gauge being 4 feet 8| inches.*~~

~~*The gross receipts and expenditure for the year 1898-99 were as follows : —*~~

~~*Gross receipts .*~~

~~*Total working expenditure*~~

~~*. £1,376,148*~~

~~*1,086,386*~~

~~*Gross profits*~~

~~*Number of passengers in the same year Number of miles run by cars ,, Number of horses Number of cars . Number of omnibuses*~~

~~*£289,762*~~

~~*. 294,002,749*~~

~~*28,699,059*~~

~~*14,114*~~

~~*1,489*~~

~~*111*~~

~~*Electrical tramways and light railways (1901) operated or authorized : —*~~

~~*Barking Town .*~~

~~*East Ham*~~

~~*London United Tramways*~~

~~*9 miles*~~

~~*10 ,,*~~

~~*82 ,,*~~

~~*Railways (Metropolitan),*~~

~~*Slst December 1899.*~~

~~*Length nf Line in Miles open on 31st*~~

~~*Dec. ISiiti.*~~

~~*Passengers (exclusive of Season and Periodical Tickets).*~~

~~*Holders of*~~

~~*Season and*~~

~~*Periodical*~~

~~*Tickets.*~~

~~*Total Re- ceipts from Passengers.*~~

~~*Receipts*~~

~~*(gross) from*~~

~~*Goods*~~

~~*Traffic.*~~

~~*1st Class.*~~

~~*2nd Class.*~~

~~*3rd Class.*~~

~~*Total.*~~

~~*Jletropolitan ....*~~

~~*73*~~

~~*2,877;431*~~

~~*8,151,866*~~

~~68,943 147~~

~~79,972,444~~

~~36,594~~

~~£743,648~~

~~£99,430~~

~~Metropolitan District (including~~

~~Richmond, Ealing, and Ful-~~

~~ham Extensions, and Houns-~~

~~low and Metropolitan) (a)~~

~~19~~

~~2,838,090~~

~~5,961,376~~

~~32,712,130(6)~~

~~41,511,596~~

~~26,503~~

~~428,402~~

~~4,361~~

~~Metropolitan and Metropolitan~~

~~District (City lines and ex-~~

~~tensions) ....~~

~~*2*~~

~~*20,913*~~

~~*111,722*~~

~~*1,274,308*~~

~~*1,406,943*~~

~~*93*~~

~~*35,005*~~

~~*North Loudon.*~~

~~*12*~~

~~*660,766*~~

~~*3,248,900*~~

~~*34,429,078*~~

~~*38,338,744*~~

~~*88,505*~~

~~*33,423*~~

~~*35,741*~~

~~*City and Brixton .*~~

~~*4 miles*~~

~~*authorized*~~

~~*Great Northern and Strand .*~~

~~6i „~~

~~North-West London~~

~~4i „~~

~~ij~~

~~(a) The Whitechapel and Bow Railway (2J miles), built jointly by, and connecting, the M.-tropolitan Pistrict and the London, Tilbury, and Southend~~

~~Railways, was opened in June IDOi. {h) Including 0,528,701 workmen conveyed at reduced fares.~~

~~Electrical Hailways in Operation,~~

~~City and South London (commenced 1890), 5 J miles ; number of passengers (exclusive of season ticket holders) ibr half-year ended June 1900, 4,169,717.~~

~~Waterloo and City (commenced 1898), IJ miles ; number of passengers for half-year ended June 1900, 1,868,737.~~

~~Central London (commenced 1900), 6^ miles.~~

~~Electrical Railways under Gonstruciion or Authorized.~~

~~Baker Street and Waterloo . about 6 miles constructing Charing Cross, Euston, and~~

~~Hampstead . ... 6 ,, >>~~

~~Great Northern and City . 'il ,, ,,~~

~~Brompton and Piccadilly , 2| ,, authorized~~

~~Steamboats. — From various ca\ises, pier dues being the chief, the steamboat service on the Thames has greatly declined. It has been proposed~~

~~that the service should be undertaken by the London (jounty Council. The London, Westminster, and Vaux- liidl Steamboat Company established in 1840 a service of seven steamboats between Lomion Bridge and Vauxhall. This company was bought up by the Citizen and Iron Steamboat Companies in 1865. The City Steamboat Company, established in 1848, began with eight boats, and by 1865 had incresised their fleet to seventeen, running from London Bridge to Chelsea. This company was taken over by the London Sicaniboat Company in 1875. The sinking of the Prin/:ess Alice in 1878 was a serious blow to the London Steamboat~~

~~Company, which collapsed, aud was succeeded by the River Thames Steamboat Navigation Company, which went into liquidation in 1887. The fleet of thirty-three vessels was bought by a syndicate and sold to the Victoria Steamboat Association. In recent years the service has been run by the Thames Steamboat Company with a fleet of 36 boats, but early in 1902 the Company announced that their service of boats would be discontinued. The County Council in 190i promoted a Bill in Parliament to empower them to run a service of boats on the Thames, but the Bill was thrown out.~~

~~The inadequacy of the dock accommodation for modern ships has long been realized, and London is losing its share of the carrying trade of the country largely from this cause. In 1901 a Eoyal Commission was appointed " to inquire into the present administration of the Port of London and the water ap- proaches thereto ; the inadequacy of the accommodation provided for vessels, and the loading and unloading thereof ; the • system of charge for such accommodation, and the arrangements for warehousing dutiable goods ; and to report whether any change or improvement in regard to any of these matters is necessary for the pro- motion of trade in the public interest."~~

~~The chief authorities concerned in the government of the Port of London are : —~~

~~*1. Thames Conservancy. — For conservancy purposes, regulation of navigation, removal of obstruction, dredging, (fee. The area of its jurisdiction differs in limits for various purposes.*~~

~~*2. City Corporation. — Port sanitary purposes from Teddington Lock seawards.*~~

~~*3. Trinity House. — Pilotage, lighting, and buoying from London Bridge seawards.*~~

~~*4. The Watermen's and Lightermen's Company. — The licensing authority for watermen and lightermen.*~~

~~*Besides these authorities, the London County Council, the Board of Trade, the Admiralty, the Metropolitan and City Police, police of riparian boroughs, Kent and Essex Fisheries Commissioners, all the dock companies, and others, play some part in the government and public services of the port.*~~

~~*The Thames Conservancy receipts and expenditure for the year 1900 were as follows : —*~~

~~*Receipts, Lower Navigation . . . £104,388*~~

~~*,, Upper Navigation . . . 33,640*~~

~~*Expenditure, Lower Navigation . . 88,806*~~

~~*,, Upper Navigation . . 38,535*~~

~~*The dock companies are partly consolidated, and revenues and expenditure for 1899 were : —*~~

~~*Total revenue £2,311,302*~~

~~*,, expenditure .... 1,644,999*~~

~~*the*~~

~~*Balance carried forward towards in- terest and dividends*~~

~~*£666,303*~~

~~*The Elvers Committee of the London County Council reported in January 1901 on the need of improvement*~~

~~*in the Port of London, and recommended (a) the deepening and improvement of the Thames on the lines indicated in the report of the Lower Thames Navigation Commission and in the evidence given before the Eoyal Commission by Sir Alexander Binnie (then the Council's engineer, who estimated the cost at less than £2,000,000 spread over several years) ; (6) the improvement of the docks, their equipment and approaches. The committee further recommended that all administrative control should be absolutely left to a statutory authority to be called "The Port of London Committee," of not more than thirty members, of whom ten should be from the Council, two from the City Corporation, ten should be representa- tives of the shipowners and merchants, and the other members to be appointed by Government departments.*~~

~~*The wholesale supply of food to London is chiefly carried on through the authorized markets. There are a few retail markets, but these are little more Pooa than the informal markets established by coster- mongers in the public streets. These were formerly more common than at present.*~~

~~*The principal markets are under the administration of the Corporation of the City of London. They are^*~~

~~*London Central Markets at Smithfield (meat, poultry, provisions, fruit, vegetables, flowers, and fish).*~~

~~*Leadeuhall Market (meat and poultry).*~~

~~*Billingsgate Market (fish).*~~

~~*Smithfield Hay Market (hay).*~~

~~*Metropolitan Cattle Market at Islington (cattle).*~~

~~*Deptford Cattle Market (foreign cattle).*~~

~~*Coal Market (coal).*~~

~~*The total debt on the City markets on 31st December 1898 was as follows : —*~~

~~*London Central Markets .... £1,758,500*~~

~~*Leadenhall Market Billingsgate Market . Metropolitan Cattle Market Deptford Cattle Market*~~

~~*247,800*~~

~~*274,500*~~

~~*396,600*~~

~~*21,000*~~

~~*£2,698,400*~~

~~*There are also three markets either directly or indirectly con- trolled by local authorities. They are —■*~~

~~*Whitechapel Hay Market, under control of trustees ; Borough Market, under control of trustees, including the overseeis of St. Saviour's, Southwark ; Woolwich Market, under control of Wool- wich Local Board, now the metropolitan boi'ough of Woolwich.*~~

~~*There are also a few markets m tlie liands of private owners, namely, Covent Garden and Spitalfields Markets (fruit, vegetables, and flowers); Cumberland Market(hay) ; and Shad well Market(fish).*~~

~~*There are also informal and street markets held in various parts of London.*~~

~~*Fish delivered in London.*~~

~~*Billingsgate (a) Shadwell*~~

~~*Total . . . 191,370 191,688 Fish seized and condemned . . 870 780*~~

~~*(ft) Farringdon Market is supplied through Billingsgate.*~~

~~*1899.*~~

~~*Tons.*~~

~~*179,983*~~

~~*11,387*~~

~~*1900.*~~

~~*Tons.*~~

~~*187,684 4,004*~~

~~*Taile of Cattle, Sheep, and Piys in the London Markets.*~~

~~*Cattle.*~~

~~*Sheep.*~~

~~*Pigs. -^*~~

~~*H6ine*~~

~~*Foreign Supply.*~~

~~*Home Supply,*~~

~~*Foreign Supply.*~~

~~*Home Supply,*~~

~~*Foreign Supply.*~~

~~*Metro- politan Cattle Market.*~~

~~*Metro- politan Cattle Market.*~~

~~*Foreign Cattle Market.*~~

~~*Total.*~~

~~*Total.*~~

~~*Metro- politan Cattle Market.*~~

~~*Metro- politan Cattle Market.*~~

~~*Foreign Cattle Market.*~~

~~*Total.*~~

~~*Total.*~~

~~*Metro- politan*~~

~~*Cattle Market.*~~

~~*Metro- politan*~~

~~*Cattle Market.*~~

~~*Foreign Cattle Market.*~~

~~*Total*~~

~~*Total.*~~

~~*1880*~~

~~*178,290*~~

~~*50,170*~~

~~*120,196*~~

~~170,366~~

~~348,656~~

~~789,010~~

~~77,800~~

~~668,899~~

~~736,759~~

~~1,525,769~~

~~940~~

~~30~~

~~23,864~~

~~23,894 ! 24,884 1~~

~~1890~~

~~119,868~~

~~27,039~~

~~185,117~~

~~212,156~~

~~332,022~~

~~639,195~~

~~38,860~~

~~120,802~~

~~169,662~~

~~798,857~~

~~4,728~~

~~1,169~~

~~1,169~~

~~5,897~~

~~1891~~

~~107,188~~

~~14,222~~

~~154,127~~

~~168,349~~

~~275,637~~

~~727,370~~

~~48,900~~

~~196,570~~

~~246,580~~

~~972,900~~

~~6,176~~

~~;.~~

~~6,170~~

~~*1892*~~

~~*94,2«*~~

~~*8,181*~~

~~*140,188*~~

~~*148,849*~~

~~*242,598*~~

~~*785,684*~~

~~*8,230*~~

~~*976*~~

~~*9,205*~~

~~*744,789*~~

~~*4,011*~~

~~*4,011*~~

~~*1893*~~

~~*114,512*~~

~~*117,063*~~

~~*117,063*~~

~~*231,575*~~

~~*877,170*~~

~~*10,508*~~

~~10,608~~

~~887,678~~

~~3,408~~

~~3,408~~

~~1894~~

~~105,332~~

~~174,884~~

~~174,884~~

~~280,216~~

~~772,310~~

~~73,120~~

~~62,835~~

~~185,055~~

~~908,265~~

~~625~~

~~625~~

~~1805~~

~~103,045~~

~~40~~

~~150,928~~

~~150,968~~

~~263,613~~

~~610,470~~

~~132,270~~

~~230,202~~

~~362,472~~

~~972,942~~

~~2,972~~

~~2~~

~~2~~

~~2,974~~

~~1890~~

~~82,195~~

~~211,551~~

~~211,551~~

~~293,746~~

~~680,110~~

~~890~~

~~284,537~~

~~286,427~~

~~924,637~~

~~6,642~~

~~5,642~~

~~1897~~

~~80,413~~

~~224,8S1~~

~~224,831~~

~~305,214~~

~~594,685~~

~~288,660~~

~~288,660~~

~~888,145~~

~~4,650~~

~~4,550~~

~~1898~~

~~80,245~~

~~222,853~~

~~222.853 803,098~~

~~538,160~~

~~351,204~~

~~351,204~~

~~889,364~~

~~1,535~~

~~460~~

~~450~~

~~1,985~~

~~1899~~

~~80,701~~

~~168,019~~

~~168,069 254,770~~

~~546,060~~

~~297,200~~

~~207,200~~

~~844,160~~

~~20~~

~~20~~

~~1900~~

~~81.670~~

~~170,752~~

~~170,752 ‘ 252,822~~

~~494,410~~

~~150,786~~

~~159,786~~

~~654,190~~

~~6,670~~

~~6,670~~

~~350~~

~~LONDON~~

~~London has always been famous for its squares and open spaces, but with, the immense increase in the area it has been difficult to keep pace with the needs Opea q£ ^.jjg enormous population, and large districts~~

~~spaces. ^^^ deficient in open spaces. In the county of London the area of commons consists of 2162 acres, of parks and gardens 1654: acres, and of royal parks 1249 acres. The royal parks are St James's Park and Green Park ; Hyde Park and Kensington Gardens ; and Eegent's Park. Among the chief open spaces under the control of the London County Council may be mentioned Battersea Park (opened 1858); Blackheath (transferred 1871); Postal Heath, &c. (purchased 1877-94); BrockweU Park (pur- chased 1890); Clapham Common (rights purchased 1877); Clissold Park (purchased 1889); DuJwich Park (pre- sented to the Metropolitan Board of Works by Dulwich College); Finsbury Park (1857); Hampstead Heath, Golder's Hill, and Parliament Hill (1871-99); Lee, open space (1902); Peckham Eye Park, Plumstead Common (1878); Southwark Park (1864); Streatham Common, Tooting Bee, and Tooting Graveney Common (1873-75); Victoria Park (1842); Wandsworth Common (1871); Waterlow Park, Highgate (1892); Wormwood Sorubbs (1879).~~

~~Besides these parks, commons, &c., there are the gardens of the Thames embankments, playgrounds, disused church- yards, &c. The London County~~

~~*Council are anxious to preserve wild birds in London, and in January 1900 they obtained from the then HIome Secretary (Sir]\I. W. Eidley, afterwards Viscount Eidley) an order for wild birds' protection (county of London), which was given in pursuance of powers conferred upon the HIome Secretary by the Wild Birds' Protection Acts, 1880-96. The order protects birds and their eggs in the various London pastures under penalties.*~~

~~*Cemeteries ivithin the County of London.*~~

~~*Size in Acres.*~~

~~*Date of first Interment.*~~

~~*1840*~~

~~*1860*~~

~~*1840*~~

~~*1856*~~

~~*1855*~~

~~*Abney Park, Stoke Newington . . 32*~~

~~*Battersea (St Mary's) ...*~~

~~*Brompton or West London*~~

~~*Camberwell, Peckham live . . 29J*~~

~~*Charlton, S.E. . " . .*~~

~~*City of London and Tower HIamlets*~~

~~*Deptford (St Paul's) JMile End, Luwisham*~~

~~*Fulham*~~

~~*Greenwich ..... Greenwich Hospital, Westcombe, S.E. Hammersmith .... Hampstead (Fortune Green) Highgate (St James's) Kensal Green (All Souls')*~~

~~*,, St Mary's Roman Catholic*~~

~~*Lambeth (Tooting Graveney) . Lee, Hither Green, S.E. Lewishani ..... Norwood (South Metropolitan) Nunhead (All Saints') .*~~

~~*Plumstead, S.E*~~

~~*Putney (St Mary's) ...*~~

~~*"Wandsworth ....*~~

~~*Woolwich ..... o^*~~

~~*The total acreage of London cemeteries is 608^,*~~

~~*The most important change made in the lieart of London has been caused by the destruction of a large district in order to form the new road north of the Strand to Holboni. The destruction of Holywell Street has made the widening of the Strand a possibility, and the north side of that thoroughfare from the courts of law to Wellington Street has been entirely altered. The chief of the newly-constructed buildings have been hotels and theatres. No feature of London life has undergone so radical change of late years as that connected with*~~

~~*33*~~

~~*1841*~~

~~*17*~~

~~*1858*~~

~~*12i*~~

~~*1865*~~

~~15~~

~~6~~

~~1857~~

~~16^~~

~~1869~~

~~19i~~

~~1876~~

~~38~~

~~1839~~

~~69|~~

~~1833~~

~~30~~

~~1858~~

~~41~~

~~1854~~

~~10~~

~~1873~~

~~154~~

~~1858~~

~~40~~

~~1838~~

~~50~~

~~1840~~

~~3-2i~~

~~1890~~

~~3~~

~~1855~~

~~12~~

~~1878~~

~~32~~

~~1856~~

~~the improvement of hotels and the supply of palatial buildings such as the Cecil, the Carlton, and the Hotel Eussell in EusseU Square. The rebuilding of Her Majesty's Theatre and the construction of the Carlton Hotel to form one architectural whole has made a great change in the Haymarket and Pall Mall. In these alterations the well – known opera colonnade has dis-appeared. The increase of comfort in the newest London theatres has been very marked, and Her Majesty's Theatre stands at the head of the theatres of London on account of the improved arrangements for the accommodation of the i^ublic. Another marked change in the appearance of the streets has been caused by the building of flats in all parts of London.~~

~~Twenty -five boroughs have adopted the Baths and Wash-houses Acts. In seventeen of these boroughs the Acts are in force throughout the whole borough, and in eight the Acts are only in force in parts of the borough.~~

~~The number of bathers and washers at the public baths and wash-houses during 1897-98 reached a total of 5,090,990; of these, 4,463,109 were~~

~~bathers, and the remaining 627,881 were women who used the wash-houses. The number of bathers was made up as follows : —~~

~~Public baths.~~

~~Bathers in private baths —~~

~~1st class 650,338~~

~~2nd class 1,697,620~~

~~2,347,958~~

~~Bathers in swimming baths- 1st class 2nd class~~

~~705,456 1,409,695~~

~~2,115,151~~

~~4,463,109~~

~~The expenditure on water forms a considerable item in the accounts of baths and wash-houses authorities. The total cost of water supplied at twenty-six establishments which were open during the year 1897-98, and which were supplied wholly by one or other of the eight companies, was £12,522. In no case in London is an establishment carried on so as to produce a surplus, though there are many instances where the actual deficit is less than the charge in respect of the repayment and interest on debt. Prior to the rebuilding of the Marylebone Baths in 1895, there was a surplus for several years, which was paid over to the relief of the rates. There was no actual charge on the rates for the year 1897-98 in respect of either St James's, Westminster, or St George's-in-the-East establish- ments, lout there were deficits to the extent of £660 and £184 respectively, which were met by corresponding de- creases in balances.~~

~~The following is a summary of the receipts and expenditure for 1897-98 of the thirty-four authorities administering the Baths and Wash-houses Acts in London : —~~

~~*JSxpenditure.*~~

~~*Interest and repayment of loans ... . £62,563*~~

~~*Buildings — Repairs, rents, rates, and taxes, &c. . . 16,881 Working Expenses — Coals, gas, water, salaries, &c. . 7S,9'J7*~~

~~*Total expenditure . £158,371*~~

~~*Receipts in Aid.*~~

~~*Tickets sold— Baths, £55,991 ; Laundries, £14,027 . £70,018 'arious — Soap, soda, towels, &c. ..... 5,293*~~

~~*Total receipts in aid of expenditure . £75,311 Resulting charge falling on rates .... £83,060*~~

~~*The public and domestic lighting of London has been*~~

~~*long in the hands of the Gas Companies, but since 1886 a Llgbtlag. ^^^^^ number of electric light companies have come into existence. At the end of 1901, 15 local authorities and 16 companies possessed statutory powers to supply electricity. The following table gives*~~

~~*some statistics of the electricity supplies of the various local authorities and companies which were in working order in 1900-01 ; that is to say, in the case of the borough councils up to 31st March 1901 and the companies tUl 31st December 1900:—*~~

~~*Number of Customers.*~~

~~*Supply commenced.*~~

~~*Number ot Units sold.*~~

~~*Amount of Loans out- standing.*~~

~~*Public.*~~

~~*Private.*~~

~~*Total*~~

~~*Borough GouTwils—*~~

~~*Fulham (1901) .*~~

~~*170*~~

~~*June 1901*~~

~~*Hammersmith*~~

~~*847*~~

~~*June 1897*~~

~~*288,524*~~

~~*914,259*~~

~~*1,202,‘783*~~

~~*£13‘9,‘456*~~

~~*Hampstead .*~~

~~*2060*~~

~~*Oct 1894*~~

~~*179,562*~~

~~*1,579,685*~~

~~*1,769,147*~~

~~*119,884*~~

~~*Islington*~~

~~*578*~~

~~*Jan. 1896*~~

~~*1,135,236*~~

~~*1,188,821*~~

~~*2,324,057*~~

~~*322,600*~~

~~*Poplar .*~~

~~*176*~~

~~*Oct 1900*~~

~~*130,200*~~

~~*74,119*~~

~~*204,319*~~

~~*99,068*~~

~~*St. Pancras .*~~

~~*1438*~~

~~*Nov. 1891*~~

~~*712,095*~~

~~2,296,386~~

~~3,008,481~~

~~239,913~~

~~Shoreditch .~~

~~676~~

~~June 1897~~

~~661,751~~

~~1,695,258~~

~~2,257,009~~

~~202,208~~

~~Southwark .~~

~~179~~

~~July 1899~~

~~175,047~~

~~309,384~~

~~484,431~~

~~65,500~~

~~Stepney~~

~~/ Information \ not available~~

~~Dec. 1899~~

~~*202,769*~~

~~*360,321*~~

~~*563,080*~~

~~*78,831*~~

~~*Companies^*~~

~~*Capita) raised.*~~

~~*Blaokheath and Greenwich .*~~

~~*342*~~

~~*Feb. 1900*~~

~~*161,778*~~

~~*£158,972*~~

~~*Brompton and Kensington .*~~

~~*2395*~~

~~*Jan. 1889*~~

~~*1,494,106*~~

~~*208,305*~~

~~*Charing Cross and Strand*~~

~~*3049*~~

~~*1891*~~

~~*139^921*~~

~~*4,857J260*~~

~~*4,997,181*~~

~~*600,000*~~

~~*Chelsea ....*~~

~~*2241*~~

~~*Sept. 1889*~~

~~*1,672,026*~~

~~*370,968*~~

~~*City of London*~~

~~*9855*~~

~~*Dec. 1891*~~

~~*1,206,000*~~

~~*11,2721968*~~

~~*12,472,968*~~

~~*1,666,453*~~

~~*County of London and Brush*~~

~~*Provincial —*~~

~~*1*~~

~~*County of London (North)*~~

~~^ r~~

~~*Sept. 1897*~~

~~*,, ,, (Northern*~~

~~*Information J*~~

~~*Extensions) .*~~

~~*r not available 1*~~

~~*Mar. 1898*~~

~~*1,976,651*~~

~~*Holborn and St Giles's .*~~

~~*1 1*~~

~~*1899*~~

~~*- 900,000*~~

~~*Camberwell Southwark Wandsworth .*~~

~~*1 Information J f not available 1*~~

~~*July 1899 July 1899 Jan. 1897*~~

~~*1,013,'487*~~

~~*J*~~

~~*Crystal Palace District .*~~

~~*250*~~

~~*Feb. 1893*~~

~~*268; 657*~~

~~103,519~~

~~Kensington and Knights-~~

~~bridge ....~~

~~2324~~

~~Jan. 1887~~

~~2,630,482~~

~~265,000~~

~~London ....~~

~~/ Information 1 \ not available j~~

~~1885~~

~~3,646,461~~

~~832,200~~

~~Metropolitan~~

~~/ Information \ \ not available /~~

~~1889~~

~~9,856,175~~

~~1,397,185~~

~~NottingHill~~

~~1191~~

~~May 1891~~

~~782,215~~

~~172,000~~

~~St James's and Pall Mall~~

~~2137~~

~~AprU 1889~~

~~143;027~~

~~4,984^748~~

~~5,127,775~~

~~450,000~~

~~South London~~

~~751~~

~~Nov. 1899~~

~~928,131~~

~~325,000~~

~~Westminster~~

~~5572~~

~~Nov. 1890~~

~~7,281,109~~

~~797,600~~

~~Woolwich District~~

~~150~~

~~Sept. 1893~~

~~253,651~~

~~36,000~~

~~Electric lighting is also carried ont by companies and local authorities in districts immediately around the county of London, as Acton, Barking, Ealing, Harrow, West Ham, Wimbledon, &c.~~

~~Mr A. H. Preece's paper on " The Electricity Supply of London " read before the Institution of Civil Engineers in 1898 (Proceedings, vol. cxxxiv. pp. 121-205) contains a large amount of information up to the date of its" publication, but the years 1900 and 1901 are~~

~~specially memorable for the large increase in the supply of electrical power.~~

~~Gas. — Gas is supplied mainly by three companies — the Gas Light and Coke Company, the South Metropolitan Company, and the Commercial Company. Some other companies supply the outer districts of the county. Gas has to be supplied at sixteen- candle illuminating power, and is officially tested by the Chemists' department of the Cotmty Council.~~

~~Gas Companies, 1899.~~

~~Capital paid up at end of Year.~~

~~Price per~~

~~1000 Cubic~~

~~Feet.~~

~~Length of Mains.~~

~~Number of Consumers on 81st Dec.~~

~~*Profits.*~~

~~*Share.*~~

~~*Loan.*~~

~~*Gas Light and Coke .*~~

~~*South Metropolitan .*~~

~~*Commercial*~~

~~*Brentford .*~~

~~*Crystal Palace .*~~

~~*Hornsey .*~~

~~*Mitcham and Wimbledon*~~

~~*Wandsworth and Putney*~~

~~*£*~~

~~*22,685,840(a)*~~

~~*6,072, 971(a) 813, 441(a) 848, 880(a) 621, 931(a) 145, 206(a) 116,567(a) 198,222(a)*~~

~~*£*~~

~~*4,434,175(((*~~

~~*l,796,160(a) 238,287(a) 162,300(a) 97,651(a)*~~

~~*36,301 25,000 22,674*~~

~~*s. d. /3 0(5)\ 12 1©/*~~

~~*2 1*~~

~~2 6~~

~~2 11~~

~~2 6~~

~~3 0 3 8 2 2~~

~~Miles.~~

~~2044~~

~~930~~

~~279~~

~~312~~

~~144J~~

~~63~~

~~85~~

~~75~~

~~353,740~~

~~189,618 34,823 39,959 24,654 6,517 4,267 12,626~~

~~£~~

~~1,262,896~~

~~353,181 109,130 91,797 38,478 14,743 14,618 19,708~~

~~Total~~

~~31,503,058 i 6,811,548~~

~~3,932|~~

~~666,204~~

~~1,904,450~~

~~(a) Including premiums.~~

~~(6) North of Thames.~~

~~(c) South of Thames.~~

~~The chief courts for the trial of criminal cases are, in London, the Central Criminal Court (which takes the place of the Assizes in the provinces) and the Crime. Qq^t-^ of Quarter Sessions. There are twelve sessions of the central criminal court in the year, while the sittings of the court of quarter sessions are~~

~~held thirty-six times in the year. The inferior criminal courts are the courts of summary jurisdiction or police courts.~~

~~'The following table shows the number of crimes known to the police, 1893-99, and the number of persons apprehended for indictable and non-indictable offences : —~~

~~352~~

~~LONDON~~

~~Tear.~~

~~Average~~

~~Daily Strength~~

~~of Police.~~

~~Crime known~~

~~*to Police.*~~

~~*Indictable Offences.*~~

~~*Non-indictable Offences.*~~

~~*Persons apprehended.*~~

~~*Total Number appre- hended.*~~

~~*Persons summoned.*~~

~~*Persons appre- hended.*~~

~~*Total.*~~

~~*Persons summoned.*~~

~~*Persons appre- hended.*~~

~~*Total.*~~

~~*Offences Summarily determined.*~~

~~*Persons committed*~~

~~*Con- victed or held to bail.*~~

~~*Dis- charged.*~~

~~*Total.*~~

~~*Con- victed.*~~

~~*Acquitted and Bills ignored.*~~

~~*Total (a)*~~

~~*1893 1894 1895 1896 1897 1898 1899*~~

~~14,074 14,099 14,260 14,282 14,836 14,412 14,647~~

~~23,294 23,480 22,116 20,817 21,081 22,060 20,602~~

~~243 208 208 241 218 196 171~~

~~16,172 15,046 14,049 13,729 13,973 16,162 14,192~~

~~16,416 16,268 14,267 13,970 14,191 16,368 14,863~~

~~60,634 60,701 68,669 70,498 71,164 81,756 88,966~~

~~72,692 76,634 75,083 80,109 91,860 106,195 106,254~~

~~183,126 137,236 133,762 150,607 163,014 186,961 194,220~~

~~67,770 69,718 68,222 60,966 71,727 83,864 86,064~~

~~23,747 26,196 24,329 26,469 27,696 29,017 27,249~~

~~81,617 84,914 82,661 87,424 99,423 113,471 112,303~~

~~2758 2664 2636 2396 2464 2669 2622~~

~~486 619 628 618 678 669 641~~

~~8244 3180 8183 2920 3036 3234 3072~~

~~84,761 88,107 86,763 90,423 102,526 116,778 115,660~~

~~(a) The difference is made up of persons who absconded or died while awaiting trial.~~

~~Police. — The following table shows the condition of the metro- politan police force on 31st December 1899, as compared with the previous year : —~~

~~Employed on Special Duties.~~

~~*Employed on Ordinary Duties.*~~

~~*Total Force.*~~

~~*1898.*~~

~~*1899.*~~

~~*1898.*~~

~~*1899.*~~

~~*1898.*~~

~~*1899.*~~

~~*Superin- tendents Inspectors Sergeants Constables*~~

~~*Total*~~

~~*4*~~

~~*54*~~

~~*203*~~

~~*1600*~~

~~*5*~~

~~*52*~~

~~*210*~~

~~*1662*~~

~~*27*~~

~~*624*~~

~~*1,727*~~

~~*11,555*~~

~~*27*~~

~~*519*~~

~~*1,739*~~

~~*11,551*~~

~~*31*~~

~~*578*~~

~~*1,930*~~

~~*13,155*~~

~~*32*~~

~~*571*~~

~~*1,949*~~

~~*13,213*~~

~~*1861*~~

~~*1929*~~

~~*13,833*~~

~~*13,836*~~

~~*15,694*~~

~~*15,765*~~

~~*Accounts for the Year 1900-01.*~~

~~*Expenditure*~~

~~*Receipts in aid*~~

~~*Amount borne by Corporation estates Net expenditure falling on taxation . Expenditure falling on the rates Rates raised .....*~~

~~*Metropolitan.*~~

~~*£2,159,641*~~

~~*398,272*~~

~~*l,76i,‘369*~~

~~*840,932 914,3441*~~

~~*City.*~~

~~*£157,689*~~

~~*10,577*~~

~~*42,091*~~

~~*105,021*~~

~~*105,018*~~

~~*113,105*~~

~~*The total niimber of elementary day scliools on the 31st August 1900 was 975, of which 484 were board and 491 voluntary, made up of 342 National Church of England, 16 Wesleyan, 101 Roman Catholic, 32 British and others. The average number of attend- ances was 616,918.*~~

~~*The expenditure of the School Board for London, for the year ended 25th March 1900, was £3,387,666 (an increase on the previous year of £182,554), leaving a balance for the year of £312,182. The rate levied was 13‘37d. for the entire year.*~~

~~*The Board of Education was formed under the provi- sions of the Board of Education Act, 1899. On the 6th of April 1900 the Board issued a minute, which was approved by Parliament, enabling the Board to recognize a new class of public elementary schools termed " higher elementary schools."*~~

~~*The report of the Board of Education, 1900-01, deals with secondary education, which is divided under technical instruction and science and art instruction. The Board is authorized to inspect any school supplying secondary education and desiring to be so inspected.*~~

~~*Considerable changes have been made in the foundation schools of London. St Paul's School has been removed to Hammersmith, Charterhouse School to Godalming (Merchant Taylors' School taking its place at Charter-house), King's College School to Wimbledon, Christ's Hospital to Horsham, and the City of London School to Victoria Embankment.*~~

~~*Examinations in technology have been conducted by the City and Guilds of London Institute for the Advance- ment of Technical Education for several years. In 1880 the number of subjects was 24 ; the number of centres of examination, 89 ; and the number of candidates, 816.*~~

~~*‘ Including Government contribution under the Agricultural Rates Act.*~~

~~*In 1899 the number of subjects had increased to 63; the number of centres to 397 ; and number of candi- dates to 14,004. The number of registered classes in 1899 was 1764, and of students in attendance, 34,176. The gross expenditure in 1899 was £33,720, of which £12,229 was expended on the Central Technical College; £9835 on the Technical College, Finsbury ; £7272 on the Leather Trades School; and £1204 on administration. The net cost, after deducting students' fees, was £22,373. The University of London was first incorporated by Royal Letters Patent, dated 28th November 1836. It had hitherto been an examining body for conferring degrees, but was reorganized in 1900 in accordance with statutes and regulations drawn up*~~

~~*by the Royal Commis- sion appointed under the University of London Act, 1898. It now undertakes teaching as well as examination, and is divided into the faculties of theology, arts, law, music, medicine, engineering, and economics and political science. The governing body consists of the senate (including chancellor, vice-chancellor, and chairman of convocation), and 54 appointed members. The University has been removed from Burlington Gardens to the Imperial Institute, South Kensington, the eastern vring and central portion of which have been transferred to the University. Accommodation for examinations in physics and chemistry will be found in the new buildings of the Eoyal College of Science.*~~

~~*Museums, (fee. — The Victoria and Albert (late South Kensington) Museum, and Bethnal Green Branch Museum ; the Museum of Practical Geology, Jermyn Street ; the Geological Survey of the United Kingdom ; and the committee of Solar Physics, are dealt with in the Report of the Board of Education, 1899-1900, in con- nexion with secondary education.*~~

~~*British Museum and Natural History Museum, South Kensing- ton. The Parliamentary vote for 1901-02 was for the Bloomsbury establishment, £151,686; and for Natural History Museum, £62,121.*~~

~~*The Royal United Service Institution has been removed from Whitehall Yard to the Banqueting House, "Whitehall.*~~

~~*AH. — National Gallery and Tate Gallery, Parliamentary vote, 1901-02, £24,808. The Tate Gallery or National Gallery of British Art, Millbank, was opened in 1897, and extended in 1899. Wallace Gallery, Hertford House, Manchester Square, was opened 1900 ; the Parliamentary vote, 1901-02, was £32,313. The National Portrait Gallery in St Martin's Place was opened in 1896 ; the Parliamentary vote, 1901-02, was £7760. Leighton House, 2 Holland Park Road, Melbury Road, Kensington, presented to the nation by Lord Leighton's sisters, contains 370 original drawings, paintings, and studies by Lord Leighton ; open daily. Exhibitions of pictures are held at the Royal Academy, Burlington House, Piccadilly ; the New Gallery, 121 Regent Street (established 1888); the Grafton Gallery, Grafton Street, built 1893 ; the Fine Art Society, 148 New Bond Street ; the Art Gallery of the Corporation of London, Guildhall, established in 1885, &c., &o. There are also a large number of Art Societies which hold exhibitions.*~~

~~*Statues erected in London since 188Z.*~~

~~*Anne (Queen), St Paul's Churchyard, after Bird by Boehm. Boadicea, Victoria Embankment, Westminster. Burns (Robert), Victoria Embankment Gardens. Carlyle (Thomas), Chelsea Embankment Gardens. Cromwell (Oliver), Old Palace Yard.*~~

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~~*Forster (Rt. Hon. W. E.), M.P., Victoria Embankment Gardens.*~~

~~*Frere (Sir Bartle), Victoria Embankment Gardens.*~~

~~*Gordon (General), Trafalgar Square.*~~

~~*Stratbnairn (Field-Marshal Lord), Knightsbridge. i*~~

~~*Raikes (Robert), Victoria Embankment Gardens.*~~

~~*Tyndale (William), Victoria Embankment Gardens.*~~

~~*Victoria (Queen), Blackfriars Bridge.*~~

~~*Wellington (Duke of), Hyde Park Corner.*~~

~~*Wesley (John), graveyard of the City Road Chapel.*~~

~~*(For London Fire Brigade, see Fire.)*~~

~~*Authorities. — G. Lauebnoe Gomme, F.S.A. London in the Reign of Victoria, 1837-97. Blackie and Son, 1898.— J. Eenwiok Seager, L.C.C. The Government of London under the London Government Act, 1899. P. S. King and Co. — Edward Lloyd. The London Manual (yearly). — London Statistics. London County Council (yearly). — Statistical Abstract for London. London County Council (yearly). — Meturn, Public Baths and Washhouses and Public Libraries. London County Council, 1899. — Tramway Return. Parliamentary Paper (yearly). (h. B. W*.)*~~

~~*Government and Administeation.*~~

~~*The revolution effected in London administration by the legislation of 1888 and 1899 is intelligible only in the light of the history of the local government of the dis- trict now known as the county of London before the year 1888. Until 1855 there can hardly be said to have been a system of local government for London outside the City (as to the City, see the earlier volumes of the Encyclo- poedia Britannica, 9th ed., xiv. 818). For a distance of many miles outside the City there was a belt of very thickly populated country, governed, as in the most rural and most sparsely populated districts, by the inhabitants of the parish in vestry assembled, except where the parishes had availed themselves of the pro- visions of Hobhouse's Act (1 and 2 WUl. IV. o. 60), and had elected a select vestry. The vestry (whether open or select) had, however, no powers of what is known as town management. To meet the needs of particular localities, commissioners or trustees having powers of town management were from time to time created by local Acts. The chaos resulting from this piecemeal legis- lation is summarized in Sir B. Hall's speech on introducing the Metropolis Management Bill in 1855 (Hansard, vol. cxxxvii. pp. 705, 899). From his speech it appears that in 1855 the number of local Acts in force in the metro- polis was 250, administered by not less than 300 different bodies ; the number of persons serving on these bodies was computed at 10,448. These persons were either self- elected, or elected for life, or both, and therefore in no degree responsible to the ratepayers. In addition there were two bodies having jurisdiction over the whole metro- polis except the City, — the one being the officers appointed under the Metropolitan Building Act of 1844, and the other the Metropolitan Commissioners of Sewers, appointed under the Commissioners of Sewers Act, 1848. Neither body was responsible to the ratepayers. To remedy this chaotic state of aifairs, the Metropolis Management Act, 1855, was passed. Under that Act a vestry elected by the ratepayers of the parish was established for each parish in the metropolis outside the City. The vestries so elected for the twenty-two larger parishes were con- stituted the local authorities. The fifty six smaller parishes were grouped together in fifteen districts, each under a district board, the members of which were elected by the vestries of the constituent parishes. Wool wich, which had previously become a local government district under a local board, was left untouched, and therefore not subject to*~~

~~*the law applicable to the rest of the metropolis. A central body, styled the Metro- politan Board of Works, having jurisdiction over the whole metropolis (including the City) was also established, the members of which were elected by the Common Council of the City, the vestries and district boards, and the local*~~

~~*board of Woolwich. Further, the area of the metropolis for local government purposes was for the first time de- fined, the area adopted being the same as that included in the Commissioners of Sewers Act, 1848, which in its turn had been taken from the area of the weekly bills of mortality. To the Metropolitan Board of Works was assigned the duty of constructing and maintaining the main drainage of London, in which work they superseded the old Commissioners of Sewers ; the Board was also given certain powers of supervision over the vestries and district boards, and by an Act of the same session was constituted the central authority for the administration of the Building Acts. The vestries and district boards became the authori- ties for sewering (except so far as related to main drain- age), and for paving, lighting, repairing, and maintaining streets and highways, and for the removal of nuisances, superseding the commissioners and trustees created by local Acts, the surveyors of highways, and (by an amend- ing Act 1 9 and 20 Vict. c. 112) all existing vestries, whether open or select. The City of London remained as before a county of a city governed by an unreformed Corporation. Between 1855 and 1888 many additional powers and duties were conferred on the Metropolitan Board of Works and on the vestries and district boards. The constitution of the Board of Works, however, was open to objection on the ground that the system of election was indirect in the case of all its members and doubly indirect in the case of those elected by the district boards, and the sense of responsibility was proportionately weakened. Some of its acts were open to such suspicion that a Royal Commission was appointed to inquire into certain matters connected with the working of the Board.*~~

~~*An attempt was made in 1884 by Sir WUliam Harcourt to constitute the metropolis a municipal borough under the government of a single council, to which it was pro- posed to transfer the existing powers of the Metropolitan Board of Works and of the vestries and district boards, and the administrative powers of justices. But it was not until 1888 that the next*~~

~~*step in advance towards the solution of the problem of London local government was definitely taken. The Local Government Act of that year dealt with the area of the metropolis as if isss it were a Separate county, both for administrative and for non-administrative purposes. For non-administra^ five purposes — quarter sessions, justices, militia, coroners, sheriffs, &o. — so much of the counties of Middlesex, Surrey, and Kent as lay within the metropolis (or in other words, the whole of London exclusive of the City) was constituted a county at large, with an organization corresponding to that of other counties in England, ex- cept so far as that organization is modified by the exist- ence of the central criminal court, the metropolitan police, the metropolitan police courts and their magistrates, and a paid chairman of quarter sessions. The position of the City as a county of a city was left almost untouched, except that the right of appointing a sheriff for Middlesex was taken away. For administrative purposes the whole of the metropolis, including the City, was constituted an administrative county, having, as in other counties, a county council as the central administrative body, differ- ing only from other county councils in that the number of councillors and the electoral divisions were fixed by the Act, and that the aldermen number not less than one- sixth, instead of one-third, of the councillors. The total number of councillors is 118, four members being elected for the City, and two for each of the other parliamentary boroughs and divisions in London. The City for adminis- trative purposes was treated as quarter sessions boroughs with a population exceeding 10,000 were treated else- where in England, the powers of the council of a borough*~~

~~*of that class being either transferred or reserved to the Common Council. To the County Council, in addition to the administrative powers conferred on it as on the .councils of other counties, there were transferred the extensive powers of town government previously vested in the Metropolitan Board of Works, including not only direct administrative functions, but also various powers of control over the action of the subordinate local*~~

~~*authorities. Most of the powers so transferred were exercisable only outside the City, but some (for example, main drainage) extended to the area of the City. How great these powers were may be appreciated from the following sum- mary of what the defunct Board had effected. It had "constructed a main drainage system at a cost of more than six millions and a half ; embanked the Thames ; freed most of the bridges from toll ; constructed vast arteries of street communication ; established and main- tained a metropolitan fire brigade ; provided and main- tained 2603 acres of parks and open spaces free to the public for ever ; exercised a controlling jurisdiction over the half-million buildings of London ; cleared vast in- sanitary areas ; and in many other ways discharged under more than 120 Acts of Parliament important municipal functions in London." The County Council thus not only obtained large powers of town government over the whole area of the administrative county with the exception of the City, but also powers and functions within the City which no other county council exercises in a borough lying within its administrative area. On the other hand, the Corporation of the City retained rights and powers which by ancient privilege or special legislation extended beyond the area of the City and applied to or affected the whole of London, such, for instance, as market rights and powers as to foreign cattle and as port sanitary authority. The area within which these powers were exercisable was not curtailed, and their exercise connects the City vn.th the administrative county of London in a way in which no ordinary borough is connected with the administrative county in which it lies. In spite of these anomalies, the broad fact remains that under the Act of 1888 the in- habitants of the metropolis acquired for the first time a direct control over the most important matters of muni- cipal work. But in another direction the Act was con- fessedly incomplete in dealing both with the county of London and with the other counties of England. It con- templated the establishment by some future Act of sub- sidiary district councils in London and elsewhere. This intention was carried into effect as respects all places outside London by the Local Government Act, 1894. But the framers of that Act were content, in respect of London, with abolishing the property qualification of vestrymen,- extending the franchise to all parochial electors, and removing the right of the incumbents of parishes to be ex officio chairmen of vestries.*~~

The larger and more wealthy parishes became dis- contented with the form of local government to which they remained subject. The evil associations which still cling to the terms " vestry " and " vestryman " perhaps deterred the persons best qualified from seeking seats on the governing body. Accordingly in 1897 Kensington and Westminster petitioned to he created boroughs by the grant of charters under the Municiiial Corporations Acts. But these Acts are inapplicable to London, and to make them applicable special Icf^aslation would have been re- quired. It was then decided that, in constituting new local authorities in London, it would be advis- able to follow the lines indicated by the report of the Commissioners appointed in 1893 to inquire into the conditions under which the amalgamation of the county and City could bo eti'ected, aud that the

Actot

1899.

form of local government should be homogeneous through- out London outside the City, and that it would be inex- pedient to have boroughs dotted about here and there in London, as woidd have been the result of the grant of charters under the Municipal Corporations Acts. The result of this decision is embodied in the London Govern- ment Act, 1899. This Act divided London into twenty- eight districts of very various sizes, ranging, at the date of the passing of the Act, in population between 336,764 and 50,377, in area between 9106 acres and 409 acres, in rateable value between £4,977,802 and £320,089. Each of these districts is called a metropolitan borough — a terminology which may cause difficulties and misconceptions in the future, the term " borough " having hitherto been (in reference to local government) a term of art, meaning a borough under the Municipal Corporations Acts. One of the most notable features of the Act is the revival of the old city and liberties of Westminster, embracing the parishes of St Margaret and St John, St George Hanover Square, St James's, St Martin -in -the — Fields, the district of the Strand Board of Works, and the close of the Collegiate Church of Westminster. This large area, vrith a rateable value exceeding that of the City, is formed into a single metropohtan borough. Each borough is governed by a council consisting of a mayor, aldermen, and councillors, the number of aldermen

~~*being one-sixth of that of the councillors. The qualifications and mode of election of the mayor and aldermen are assimilated to those of the chairman and aldermen of county councils. The franchise is left unaltered, and in other respects the law relating to the vestries is applied to the new councils (except that women are disqualified for holding office either as mayors, aldermen, or councillors). Woolwich is brought into hne with the other districts in London. The accounts of the new councils are made subject to Government audit. To the new coancils are transferred all the powers of the old vestries and district boards, of the commissioners of public libraries and baths and wash-houses, and of burial boards, and certain minor powers of the London County Council. A few additional powers and duties, including a power to promote and oppose Bills in Parliament, are given to and imposed on the new councils. Power is also given to the Local Government Board to transfer in the future, by provisional orders, powers and duties from the County Council to the borough councils and from the borough councils to the County Council, but the consent of the County Council and of a majority of borough councils is necessary in every case. A similar power of transfer similarly exercisable is given with respect to the powers and duties of the County Council and the Common Council of the City.*~~

~~*The Act leaves the City practically untouched, but a local Act passed in 1897 abolished the old Commissioners of Sewers for the City and vested their powers and duties in the Corporation of the City, acting through the Common Council. The Common Council thus became the sanitary authority for the City. The coal duties leviable by the Corporation were abolished in 1889 by 52 and 53 Vict. c. 17.*~~

~~*Much has been done to simplify and systematize the local government of London, but it remains anomalous, and perhaps from the nature of the case it must be anomalous. As the supreme authority there is a County Council which exercises, in addition to the powers of an ordinary county council, various powers of town government exercisable elsewhere by the councils of boroughs ; in the centre is the City, an area governed by an unret'ormcil Corporation exercising the powers exercisable else- where by the councils of quarter sessions boroughs of over 10,000 inhabitants, but also having some powers which extend far beyond the City area ; the rest of the county*~~

~~*is divided into boroughs, which are not boroughs in the ordinary acceptation of the word, and whose constitution resembles in some respects municipal boroughs, in others county councils, and in others urban district councils.*~~

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~~*Powers. — In distributing powers between the central and local authorities the principle observed has been to give all powers and duties which require uniformity of action throughout the whole of London to the County Council, and powers and duties that can be locally administered to the local authorities, uniformity in some cases being secured by giving the County Council power to regulate the administration by by-laws. Of late the tend- ency has perhaps been to give to the County Council powers which might with advantage have been given to the local authorities. However, the conference of representatives of the local authorities which was held in 1895-96 to discuss what powers might be transferred from the County Council to the local authorities, found but few, and these comparatively unimportant, which could be so transferred. The Act of 1899 carried into effect such of the recommendations of this con- ference as were approved by the County Council. The result is that the County Council is the authority to deal with the following matters : — main sewers, tramways, embankments and the prevention of floods, fire brigade, metropolitan com- mons, parks and open spaces (with a few exceptions), the naming and numbering of streets, the formation and width of new streets, the line of frontage in streets, the pollution of rivers (except the Thames and the Lea), the licensing of theatres (except those within the jurisdiction of the Lord Chamberlain), music halls and racecourses, technical instruction, the making of by-laws as to the rule and good government of London as to overhead wires, &c. , *bridges, *locomotive traffic, *street improvements, *constant water supply, *infant life protection, *storage &c. of petroleum and explosives, *contagious diseases of animals, *coroners, *gas testing, *asylums, 'reformatory and industrial schools, *shop hours, 'weights and measures testing, 'dangerous and neglected structures, *the housing of the working classes, 'common lodging houses, 'licensing of offensive trades*~~

~~*and slaughter-houses. This list does not pretend to be complete. A useful summary of the powers of the County Council will be found in Appendices VII. and IX. of the report of the Unification Commission in 1894 (C. 7493 II.), and in the report of the conference of local authorities referred to above. The matters marked with an asterisk are in the City under the control of the Common Council. The Common Council of the City and the new metropolitan borough councils are the authorities for paving, lighting, cleansing, and watering streets, for making and maintaining the local sewers, for removing nuisances, for providing and maintaining public libraries, baths and wash-houses, and burial grounds, and for acting generally as the sanitary authorities ; they can also exercise concurrently with the County Council some of the powers of that Council.*~~

~~*Expenditure. — The performance of such numerous and important functions involves heavy expenditure. The following table shows the sums expended by the various authorities on the municipal administration of London in 1898-99, and the manner in which such expenditure was met : —*~~

~~*Woolwich, and of burial boards and commissioners of baths and wash-houses and public libraries, £4,802,519.*~~

~~*Amounts Raised.*~~

~~*Metropolitan Board of Works, 1866-88*~~

~~*LoDdon County Council, 1889-98*~~

~~*Total*~~

~~*6,779,626 1,188,766*~~

~~*7,968,280*~~

~~*u a 9*~~

~~*sSg*~~

~~*£*~~

~~15,363,374 1,292,423~~

~~16,666,797~~

~~£~~

~~2,351,806 1,640,406~~

~~3,991,711~~

~~5PB g~~

~~.92 2~~

~~W~~

~~£~~

~~1,549,176 1,029,600~~

~~2,678,776~~

~~£~~

~~650,646 766,476~~

~~1,416,122~~

~~n S~~

~~£~~

~~487,606 471,368~~

~~958,974~~

~~State of Indebtedness.~~

~~Date~~

~~Total Amount raised.~~

~~Loans to~~

~~Other~~

~~Anthorities~~

~~outstanding.~~

~~Amount Applied to repay Debt.~~

~~Net Liability after deduct- ing Assets.~~

~~3l9t Dec. 1888 Slat Mar. 1899~~

~~£~~

~~37,449,728 61,617,488~~

~~£~~

~~8,723,986~~

~~16,760,480~~

~~£~~

~~9,669,806 10,784,750~~

~~£~~

~~16,972,469 21,562,018~~

~~Authority.~~

~~Expendi- ture.~~

~~Receipts in Aid from~~

~~*Amounts*~~

~~*Raised by*~~

~~*Rates.*~~

~~*Imperial Taxation.*~~

~~*Indirect*~~

~~*Local Taxation.*~~

~~*Other Sources.*~~

~~*County Council*~~

~~*Metropolitan Asylums Board*~~

~~*Metropolitan Police (London proportion)*~~

~~*City Corporation .*~~

~~*Sanitary Authorities (includ- ing the Common Council of the City) . . . .*~~

~~*Commissioners of Baths and Wash-houses and Public Libraries and Burial Auth- orities*~~

~~*Total .*~~

~~*£*~~

~~*2,511,316 603,686*~~

~~*1,688,714 732,421*~~

~~*3,533,188 206,463*~~

~~*£*~~

~~*130,896*~~

~~*nil*~~

~~*653,223*~~

~~*nil*~~

~~*nil nU*~~

~~*£*~~

~~*620,505*~~

~~*nil*~~

~~*31,769 153,366*~~

~~*7,451 36,667*~~

~~*£*~~

~~*341,648 1,810*~~

~~*281,633 503,064*~~

~~*654,386 69,629*~~

~~*£*~~

~~*1,519,303 636,460*~~

~~*671,630 126,914*~~

~~*a2,831,191*~~

~~*100,175*~~

~~*9,176,787*~~

~~*743,118*~~

~~749,767~~

~~1,762,160~~

~~6,883,663~~

~~Rates.~~

~~(o) Of this sum £947,076 was defrayed out of the county rate.~~

~~Besides the annual expenditure, large sums have been borrowed to defray the cost of works of a permanent nature. The debtof London, like that of other municipalities, has considerably In- creased, and shows a tendency to go on increasing. Of the tables in the next column, the first shows the total amounts raised for various purposes by the Metropolitan Board of Works and the London County Council, and the second, the state of indebted- ness of those authorities at the time when the powers of the former were transferred to the latter and at the close of the financial year 1898-99. .~~

~~The net liabilities of the County Councfl, after deducting assets, on 31st March 1899 were £21,562,018*; of this amount the sum of £2,131,576 represented remunerative expenditure. In 1899 the indebtedness of the Corporation of the City was £5,750,983 ; of the vestries and district boards, and of the local board of~~

~~In addition to tte provisions already noticed, the London Government Act, 1899, simplifies administration in two respects. The duties of overseers in London have been performed by most diverse bodies. In some parishes over- seers were appointed in the ordinary manner ; in others the vestry was, by local Acts and by orders under the Local Government Act, 1894, appointed to act as, or empowered to appoint, overseers ; in others local Acts constituted various statutory bodies to perform the func- tions of overseers, whilst in Chelsea the guardians acted as overseers. The Act of 1899 swept away all these distinctions, and constituted the new borough councils in every case the overseers for every parish within their respective boroughs, except that the town clerk of each borough performs the duties of overseers with respect to the registration of electors.^ Again, with regard to rates, there were in aU cases three diflferent rates leviable in each parish —~~

~~*the poor rate, the general rate, and the sewers rate — whilst in many parishes in addition there was a separate lighting rate. From the sewers rate and lighting rate, land, as opposed to buildings, was entitled to certain exemptions. Under the Act of 1899 aU these rates are consolidated into a single rate, called the general rate, which is assessed, made, collected, and levied as the poor rate, but the interests of persons previously en- titled to exemptions are safeguarded. Further, every precept sent by an authority in London for the purpose of obtaining money which has ultimately to be raised out of a rate within a borough is sent direct to the council of the borough instead of filtering through other authorities before reaching the overseers. The only exceptions to this rule are (1) precepts issued by the Local Government Board for raising the sums to be contributed to the metropolitian common poor fund ; and (2) precepts issued by poor-law authorities represent- ing two or more poor-law unions : in both these cases the precept has of necessity to be first sent to the guardians. With the object of equalizing rates in different parts of London, the richer parts are required under various enact- ments to contribute towards the expenses of the adminis- tration of the poorer parts. By the Metropolitan Poor Act, 1867, the metropolitan common poor fund, to which each union in London contributes in proportion to*~~

~~*' Over 200 local Acts have been repealed by schemes made under the Act of 1899.*~~

~~*its rateable value, was established. Out of this fund certain expenses of guardians in connexion with the main- tenance of indoor paupers and lunatics, the salaries of officers, the maintenance of children in poor-law schools, valuation, vaccination, registration, &.C., are paid. The payments amounted in 1898-99 to £1,336,986. Under the Local Government Act, 1888, the County Council makes grants to boards of guardians, sanitary autho- rities, and overseers in London in respect of certain services. This grant is in lieu of the grants formerly made out of the Exchequer grant in aid of local rates, and amounted in 1898-99 to £566,738. Finally, in 1894, the fund called the Equalization Fund was established. This fund is raised*~~

~~by a rate of 6d. in the £ levied annually on the whole county of London, and redistributed amongst the sanitary authorities on the_ basis of population. It amounted in 1898-99 to £915,118. The amount of parish, union, and district expenses so paid out of rates levied on the whole of London (including a small grant by the Metropolitan Asylums Board) was in 1898-99 £2,822,735, equal to about 27 '2 per cent, of the local expenditure raised by Tates; and out of a total of £10,401,441 raised by rates, £7,363,829 was raised by rates levied over the whole county. But, in spite of these attempts at equalization, rates remain very unequal in London, and varied in 1899 between 5s. 3d. in St James's, Westminster, and 8s. 8d. in Kotherhithe.~~

~~AtTTHOEiTiEs. — FiKTH. Municipal Lcmdon. London, 1876. — FlP-TH and Simpson. London, Government under the Local Govern- ment Act, 1888. London, 1888. — Hunt. London Local Govern- ment. London, 1897 ; London Government Act, 1899. London, 1899. — WooLRYCH. Metropolis Local Management Ads. London, 1888. — Jenkin. London Government Act, 1899. London, 1899. — Tbery and MoRLE. Lmulon Government Act, 1899. London, 1899. — Maomorran, Lushington, and Maldrbtt. London Govern- ment Act, 1899. London, 1899. — Report {with Minutes of Evidence and Appendix) of the Commissioners appointed to Enquire into the Existing State of the City of London, &c. London, 1854. — Report [with Minutes of Evidence and Appendices) of the Commissioners appointed to Consider the Proper Conditions under which the Amalga- mation of the City and County of London can be effected. London,~~

~~1894.~~

~~Sanitation.~~

~~The original statutes relating to public health applied to London equally with the rest of England, but when in 1875 these statutes were consolidated and amended, London was expressly excluded from the scope of the new Act, and remained under the old law. The law applicable to London was consolidated and amended in 1891, and differs from that in force elsewhere mainly in three direc- tions : — (1) The London County Council is a central sanitary authority, and as such deals with main drainage, the housing of the working classes, infant life ^'"rim protection, contagious diseases of~~

~~*animals, In London, common lodging-houses and shelters, and other matters where uniformity of administration is essential or desirable. (2) The County Council to a certain extent controls and supervises the work of the local sanitary authorities for the purpose of promoting uniformity and efficiency of administration. Uniformity of administration is promoted by means of the by-law- making power of the Council. The Council may make by-laws regulating the construction of local sewers, and the construction, cleansing, and repair of all pipes, drains, (fee. ; as to sanitary conveniences, cesspools, and ashpits ; prescribing the times for the removal of fascal or offensive matter and refuse ; regulating offensive businesses, slaughter-houses, and dairies; and for the prevention of nuisances not otherwise preventible by the local authorities. Efficiency of administration is promoted chiefly in two ways. The Council not only appoints a*~~

~~*medical officer of health for the whole county, but pays half the salaries of the medical officers of health and the sanitary inspectors of the local authorities. The Council may also act where local sanitary authorities ‘ make default with respect to the removal of any nuisance, the institu- tion of any proceedings, or the enforcement of any by- laws, and may make representations to the Local Govern- ment Board as to the failure of the local authorities to perform their duties. Further, if the Local Government Board are satisfied that a local sanitary authority has failed to perform its duties, the Board may direct the County Council to withhold the whole or any part of any payment due to the authority under the Equalization of Rates Act, 1894. (3) The Metropolitan Asylums Board, though originally established in 1867 as a purely poor-law authority for the relief of sick, insane, and infirm paupers in London, has since become a central hospital authority for infectious diseases, having power to receive into its hospitals persons, who are not paupers, suffering from fever, smallpox, or diphtheria. The Metropolitan Asylums Board and the County Council have also, for the purpose of the epidemic regulations, such powers and duties of a sanitary authority as may be assigned to them by those regulations.*~~

~~*For the purpose of the local administration of the sanitary laws London is divided into sanitary districts, each district being under the jurisdiction of a local sanitary authority having, subject to the above-mentioned limitations, much the same powers as sanitary authorities elsewhere in England. The*~~

~~City and the various metropolitan boroughs are the sanitary districts, and the Corporation (acting through the Common Council) and the metropolitan borough councils constitute the local sanitary authorities.~~

~~The system of main drainage inaugurated by the Com- missioners of Sewers in 1849, and carried out by the Metropolitan Board of Works from 1856 to 1888, has since 1889 been maintained, completed, and "■"*■«'*• improved by the London County Council. The most im- portant improvement effected by the latter body has been the erection of pumping machinery and stations in low- lying localities to prevent flooding in times of storm. The London main sewers receive, besides the sewage from London, that from West Ham, Penge, Tottenham, and Wood Green, and from parts of Beckenham, Hornsey, Croydon, Willesden, East Ham, and Acton. The length of the main intercepting sewers in London now exceeds 87 miles ; their construction has cost nearly eight million pounds. The systems on the north and south of the Thames are distinct. The sewage on the north side is dealt with at the Barking outfall works, that on the south side at Crossness. The sewage at these outfall works is treated with lime and proto-sulphate of iron. By means of this treatment the sewage is transformed into a clear innocuous effluent and sludge. The effluent is allowed to flow into the Thames, the sludge is taken fifty miles out to sea, a service on which six sludge ships are constantly employed ; the sludge so carried amounted to 2,344,000 tons in 1898-99. The total amount of sewage treated exceeds 76,876,250,000 gallons a year, and the annual cost of the maintenance of the main drainage system (exclusive of any charge for the payment of interest or repayment of capital) approaches £200,000. The sanitary authorities are concerned only with the super- vision of house drainage and the construction and mainten- ance of local sewers discharging sewage into the County Council's main sewers.~~

~~The London County Council have pursued (asdid their pre- decessors the Metropolitan Board of Works) an active policy~~

~~' This power may not be exercised in the case of the City.~~

~~*Housings*~~

~~*Tinder the Artisans' Dwellings and Housing of the Working Classes Acts, having from 1856 to 1898 incurred a capital expenditure of £2,578,776 for the pur- pose. Under Part I. of the Act of 1890 (which consolidated the previous enactments) large insanitary areas may be cleared and accommodation provided for the labouring classes displaced ; Part II. makes similar pro- visions with respect to smaller areas ; Part III. enables accommodation to be provided for the working classes*~~

~~*irrespective of displacement. Schemes under Part I. are carried out by the County Council, schemes under Part II. by either the County Council or by the local sanitary authority, usually with a contribution from the Council to the local authority or vice versd, as the case may be. Part III. may be adopted either by the County Council or the local sanitary authority. The following table gives the details as to the principal schemes carried out or in course of being carried out : —*~~

~~*Improvement Schemes under the Artisoms' and Laboti/rers' Dwellings Improvement Acts and the Housing*~~

~~*of the Working Classes Act in London.*~~

~~*Name of Scheme.*~~

~~*Commenced.*~~

~~*Estimated Net Cost.*~~

~~*Actual Net*~~

~~*Expenditure*~~

~~*to Date.*~~

~~*Persons displaced.*~~

~~*Persons*~~

~~*for whom*~~

~~*Accommodation*~~

~~*is provided.*~~

~~*£y Metropolitan Board of Works : —*~~

~~*£*~~

~~*£*~~

~~*Whitechapel and Tiimehouse*~~

~~*1876*~~

~~*54,400*~~

~~*151,763*~~

~~*3,669*~~

~~*3,600*~~

~~*GouJston Street, and Flower and Dean Street*~~

~~*1877*~~

~~*147,773*~~

~~*279,491*~~

~~*4,004*~~

~~*3,702*~~

~~*St George-the-Martyr, Southwark*~~

~~*1877*~~

~~*33,353 •*~~

~~*52,443*~~

~~*1,266*~~

~~*1,906*~~

~~*Bedfordbury, St Martin's-in-the-Fields .*~~

~~*1877*~~

~~*63,995*~~

~~*75,510*~~

~~*797*~~

~~*720*~~

~~*Great Wild Street, St Giles's .*~~

~~*1877*~~

~~*49,540*~~

~~*105,650*~~

~~*1,903*~~

~~*1,620*~~

~~*Pear Tree Court, Clerkenwell .*~~

~~*1877*~~

~~*5,050*~~

~~*20,869*~~

~~*410*~~

~~*1,362*~~

~~*Whitecross Street, St Luke's .*~~

~~*1877*~~

~~*98,786*~~

~~*314,943*~~

~~*3,687*~~

~~*3,740*~~

~~*High Street, Islington .... Old Pye Street, Westminster .*~~

~~*1877*~~

~~*7,960*~~

~~*38,187*~~

~~*547*~~

~~*800*~~

~~*1877*~~

~~*5,830*~~

~~*49,896*~~

~~*1,333*~~

~~*1,700*~~

~~*Bowman's Buildings, Marylebone*~~

~~*1878*~~

~~*40,700*~~

~~*36,458*~~

~~*806*~~

~~*1,288*~~

~~*Essex Road, Islington ....*~~

~~*1878*~~

~~*77,100*~~

~~*97,899*~~

~~*1,796*~~

~~*3,866*~~

~~*Little Coram Street, St Giles's and St Pancras*~~

~~*1879*~~

~~*58,890*~~

~~*13,488*~~

~~*858*~~

~~*840*~~

~~*Wells Street, Poplar*~~

~~*1879*~~

~~*71,047*~~

~~*64,119*~~

~~*1,029*~~

~~*1,392*~~

~~*Great Peter Street, Westminster*~~

~~*1879*~~

~~*7,500*~~

~~*212*~~

~~*179*~~

~~*532*~~

~~*Windmill Row, Lambeth ....*~~

~~*1883*~~

~~*21,400*~~

~~*9,778*~~

~~*459*~~

~~*460*~~

~~*Tabard Street, Newington*~~

~~*1884*~~

~~*16,100*~~

~~*8,229*~~

~~*220*~~

~~288~~

~~Totals~~

~~Begun by M.B. W., completed by L.0.0. : —~~

~~759,424~~

~~1,318,935~~

~~22,963~~

~~27,816~~

~~Tench Street, St George's-in-the-East~~

~~1883~~

~~28,100~~

~~51,991~~

~~1284~~

~~(a)~~

~~Brook Street, Limehouse ....~~

~~1883~~

~~18,480~~

~~19,617~~

~~562~~

~~306~~

~~Trafalgar Road, Greenwich~~

~~*1883*~~

~~*18,500*~~

~~*17,285*~~

~~*378*~~

~~*306*~~

~~*Hughes Fields, Deptford .... Castle Street, Shadwell ....*~~

~~*1884*~~

~~*61,000*~~

~~*80,386*~~

~~*1786*~~

~~*906*~~

~~*1886*~~

~~*46,300*~~

~~*40,834*~~

~~*970*~~

~~*796*~~

~~*Shelton Street, St Giles's ....*~~

~~*1886*~~

~~*55,550*~~

~~*68,269*~~

~~1208~~

~~616~~

~~Totals~~

~~By the L.C.G. under Fart I. of the Housing of the~~

~~227,930~~

~~278,382~~

~~6188~~

~~2930~~

~~Working Classes Act, 1890 : —~~

~~Boundary Street, Bethnal Green ....~~

~~1890~~

~~300,000~~

~~5,719~~

~~5,524~~

~~Churohway Street, St Pancras ^. . . .~~

~~1895~~

~~51,650~~

~~1,095~~

~~708~~

~~Clare Market, Strand~~

~~*1895*~~

~~*216,500*~~

~~*3,172*~~

~~*2,250*~~

~~*Garden Row, &c., St Luke's*~~

~~*1899*~~

~~*144,850*~~

~~*1,193*~~

~~*1,296*~~

~~*Webber Row, &c., St George-the-Martyr, Southwark .*~~

~~*1899*~~

~~*152,950*~~

~~*903*~~

~~*1,750*~~

~~*Aylesbury Place and Union Buildings, Clerkenwell,*~~

~~*Holborn*~~

~~*1899*~~

~~*189,800*~~

~~*1,402*~~

~~*1,400*~~

~~*Barford's Court, &c.. Poplar*~~

~~*1899*~~

~~*13,300*~~

~~*269*~~

~~*269*~~

~~*(6) Nightingale Street, Marylebone ....*~~

~~*1899*~~

~~*6,000*~~

~~*576*~~

~~*576*~~

~~*By the L. C. C. under Part II. of the Sousing of the*~~

~~*Working Classes Act, 1890 : —*~~

~~*Brooke's Market, Holborn*~~

~~*1891*~~

~~*(c) 5,950*~~

~~*55*~~

~~*60*~~

~~*Mill Lane, Deptford*~~

~~*1892*~~

~~*(c) 39,500*~~

~~715~~

~~959~~

~~Ann Street, Poplar~~

~~Falcon Court, Borough~~

~~1893~~

~~(c) 8,800~~

~~261~~

~~475~~

~~1895~~

~~(c) 15,500~~

~~800~~

~~678~~

~~Totals ....~~

~~■~~

~~2,132,154~~

~~55,283~~

~~46,691~~

~~Note. — The above figures as to cost represent the net cost of clearing the land only, i.e., the cost of the land less its value for housing purposes, (a) Site devoted to purposes of an open space. (&) To he carried out at the expense of Lord Portman.~~

(c) The local authority concerned contributes one-half the net cost.

The County Council in 1899 passed a resolution in favour of providing dwellings under Part III. of the Act apart from the re- housing required in connexion with clearance and improvement schemes, provided that no charge was placed on the county rate thereby. Seven schemes under this part of the Act have already been, or are in the course of being carried out by the County Council. Under the Totterdown Fields scheme it is proposed to provide accommodation for 11,000 persons, and under the Millbank Estate scheme for 4434. It is estimated that the rents received will be sufficient to repay the interest on the capital expended, and the sinking fund charges.

The provisions of the Infectious Diseases (Notification and Prevention) Acts, which for London are embodied in

the Public Health (London) Act, 1891, are carried out by the local sanitary authorities, but the hospitals for the reception of infectious cases are provided and maintained by the Metropolitan Asylums Board. "'e'"<"'s In the execution of this duty the Board has estab- lished eleven hospitals (including a convalescent hospital) vs^th accommodation for 4500 patients, and two hospital ships and a convalescent hospital at Darenth for the treat- ment of 1500 smallpox cases. The admissions to the Board's hospitals in 1898 numbered 21,063. The Board also maintains an ambulance service for infectious diseases

throughout London ; the mileage run of this service in 1898 was 214,677 miles. The Board's expenditure on the common charges account was, in 1898-99, £603,686, in addition to the sums contributed by the various boards of guardians in London for the maintenance of patients chargeable to their several unions. It is impossible to distinguish what proportion of the sum of £603,686 should be classified as sanitary expenditure and what as expendi- ture on poor relief.

~~*The other duties of sanitary authorities, such as the removal of nuisances, scavenging, the cleansing of streets, and the like, are performed by the local sanitary authorities. The efficiency with which these bodies have performed their duties varies enormously. It is difficult, however, to discover any criterion by which to gauge their respective efficiency, especially as their accounts have hiiiherto not been made up on any uniform principle. But, speaking broadly, the tendency has distinctly been towards a better administration of the law. The number of sanitary in- spectors appointed has steadily grown, and in 1898 reached 256, an increase of thirty as compared with the previous year.*~~

~~*The Thames Conservancy Board, originally consti- tuted in 1857 and reconstituted in 1866, was further*~~

~~*remodelled in 1894. The Board under the Act fnc^.*~~ ~~**'^" ^^ 189** *(5'^ ^^^ 58 Vict. c. 187) now contains*~~

~~*nominees or representatives of the Admiralty, the Board of Trade, the Trinity House, the Corporation of the City, the London County Council, the councils of the counties and chief boroughs through which the river flows, ship-owners, owners of barges, lighters, and tugs, dock owners, wharfingers, and the metro politan water companies. The Act of 1894 further enlarged the powers of the Board, chiefly by extending their control of pollution to the whole watershed of the river. Much has been done by the Board to purify the Thames by the detection and prohibition of sources of pollution. So far has the purification proceeded that a project has been initiated for the reintroduction of salmon into the river. The Lea has been similarly improved under the Lea Conservancy Board. The chief sources of impurity have been removed by the reception into the London sewers (under the Lea Purification Act, 1886, and the Wood Green Sewage Act, 1891) of the sewage from Tottenham and Wood Green.*~~

~~*See Annual Reports of the Local Oovernment Board. London, annually since 1872. — Annual Reports of the Proceedings of the London County Council. London, annually since 1889. — Annual Reports of the Medical Officer of Health of the Administrative County of London. London, annually since 1889.*~~

~~*Watbe Supply.*~~

~~*In spite of the reports of many commissions and com- mittees recommending that the water supply of London should be improved and vested in a body representative of the consumers, and in spite of various attempts to carry such recommendations into eifect, the eight metropolitan water companies still maintain their position, and the Thames and the Lea remain the chief sources of supply.*~~ ^

~~*In the case of a provincial town the transfer of the water under- taking of a company to the corporatioa is a comparatively simple matter, even if the corporation is in consequence authorized to supply water to a small district outside their borough. In London the problem is complicated by the fact that of the area of 620 square miles within which the eight companies are authorized to supply water only 121 square miles are within the county of London, and of the 5,814,219 persons supplied by the companies in 1898 only some 4,526,500 resided in London. Consequently the efforts of the London County Council to purchase the undertakings of the companies have been opposed not only by the companies, but also by the councils of the surrounding counties, parts of which are within what is known as " Water London." These councils*~~

~~^ *A Bill was introduced hy the Government in 1902, in order to constitute a water board, and to transfer to the board the undertakings of the metropolitan water companies.*~~

~~*demand that, in the event of the purchase by the London County Council of the companies' undertakings, not only the means of dis- tribution within their respective areas should be made over to them, but also that a portion of the sources of supply should be allotted to them, so that they should not be dependent on the London County Council for their water supply. The London County Council is pledged, in the event of the Council purchasing the undertakings of the companies, to make such an apportion- ment. But the Eoyal Commission presided over by Lord Llandaff reported that " although severance of the works and sources of supply of the several companies, and the division thereof be- tween the councils of the six counties within the limits of supply, are not actually impracticable, they would be veiy difficult and highly undesirable." Many attempts have also*~~

been made to solve the difficulty by constituting a body representative of the various authorities interested, but such attempts have met with but little favour. Lord LlandafTs Commission proposed the creation of a Water Trust as the only method by which the purchase of the water companies could be effected. The price to be paid to the com- panies constitutes another obstacle to purchase. The companies contend that they should be bought out on the same terms as have almost invariably been given to water companies in the provinces, that is to say, that the price to be paid should be settled by agree- ment, and failing agreement, by compulsory arbitration under the Lands Clauses Acts. The London County Council, on the other hand, contend that the price so fixed would be exorbitant, and that in assessing the value of the undertakings regard should be had to the prospective liability of the companies to provide new works and new sources of supply, and that no allowance should be made for compulsory sale. To the present sources of supply objection is taken both on the ground of the quality and of the quantity of the water derived from those sources. By the construction of sub- sidence reservoirs and filter-beds much has of late years been done to improve the quality of the London water, and the Commission presided over by Lord Balfour of Burleigh in 1893 reported that, though not blind to the fact that the provisions as to filtration and subsidence differed enormously in different companies, and in some were quite inadequate, they considered that the water as supplied to the consumer in London was of a very high standard of excel- lence and purity. And this opinion was endorsed by Lord LlandafFs Commission. Both these Commissions also came to the conclusion that if the present sources of supply were utilized to their utmost by the construction of large storage reservoirs, 420,000,000 gallons daily might be drawn from them, whilst leaving a sufficient supply of water for the navigation of the Thames and Lea. This would supply 35 gallons a head to 12,000,000 persons, and would suffice till 1941. Doubt has been thrown on the conclusions of the Balfour Commission as to the capacity of the present sources, but the Llandaff Commission accepted their conclusions. Both Commissions pronounced in favour of a scheme for the coii.«truction of large storage reservoirs in the Thames valley at an estimated cost of from £9,000,000 to £10,000,000. This scheme has already been begun to be carried out by three of the companies, the New River Company, the West Middlesex Company, and the Grand Junction Company, which are jointly constructing large storage reservoirs

~~at Staines. The London County Council, on the other hand, is in favour of bringing the necessary additional supply from Wales, and it has for the past few years yearly introduced Bills authorizing the Council to acquire two large catchment areas in Wales, and to impound the head-waters of the Wye, the Towy, and the Usk. The part of the County Council's scheme which would give approximately the same amount of water as the Thames valley scheme is estimated to cost something over £10,000,000, but if the accumulated interest during the construction of the works and for pumping charges is taken into account, it would bring the cost up to over £15,000,000. This cost, in the opinion of Lord Llandaff s Commission, was prohibitive.~~

~~The system of constant supply has been extended almost uni- versally throughout "Water Loudon," but the droughts in the summers of 1895 and 1898 compelled the East London Company to suspend the supply of water between certain hours during several months in each of those years. As during the same period some of the other companies had a surplus of water beyond their own requirements, an Act was passed in 1899 (62 and 63 Vict. c. 7) providing for the interconnexion of the systems of the various companies, and for the supply of water from one company to another.~~

~~Parliament has lately imposed stringent restrictions on the raising of new capital by the companies. Since 1878 the increase of share capital has in no case been authorized ; further capital, if required, has to be raised by the issue of debenture stock, the debenture stock has to he sold by public auction, and the premiums, if any, realized by the sale applied as capital money. Again, since 1886 a clause, known as the sinking fund clause, has been inserted in all Bills authorizing the creation of new capital. Under this clause a certain percentage on the new capital has annually to be paid by the company to the Chamberlain of the~~

~~City, who accumulates the money so paid to him with a view to providing a fund for the ultimate purchase of the undertakings~~

~~*Finances of London Water Companies.*~~

~~*Date.*~~

~~*1*~~

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~~*1880-81 1888*~~

~~*1S98*~~

~~*9,087,917*~~

~~*10,042,916*~~

~~*f 10,268,668*~~

~~*\ SO.OOOa*~~

~~*£*~~

~~*8,448,981 4,101,408 6,463,716*~~

~~3,492,464a~~

~~£~~

~~12,636,898 14,144,323~~

~~16,712,284 \ 8,622,464a/~~

~~£~~

~~12,612,589 14,488,464~~

~~17,607,838~~

~~£~~

~~1,632,784 1,743,171~~

~~2,248,974~~

~~£~~

~~610,899 647,682~~

~~974,290~~

~~921,886 903,144~~

~~982,164~~

~~of the companies. The funds in the hands of the Chamberlain of the City from this source amounted in 1901 to over £70,000. A Committee of the House of Commons reported in 1896 that the insertion of such provisions in the Acts of the companies tended to weaken the enterprise of the companies as private concerns, whilst the consumer was left without that care of his interests which would be ensured by placing supply under a representative body.~~

~~*Of the accompanying tables, the first shows the financial condition of the water companies in 1880, 1888, and 1898 ; the second affords a comparison between the supply, &c., of the companies in 1898, as compared with the figures given in vol. xiv. p. 825.*~~

~~*(a) Authorized but not raised.*~~

~~*Details of Supply.*~~

~~*Date.*~~

~~*Authorized Daily Supply from Thames.*~~

~~*Average Daily Supply from Thames,*~~

~~*Other Sources.*~~

~~*Number of Houses supplied.*~~

~~*Houses on Constant Supply.*~~

~~*Estimated Population supplied.*~~

~~*Capacity of Subsidence Reaervoirs.*~~

~~*Acreage*~~

~~*of Filter*~~

~~*Beds.*~~

~~*Miles of Mains in London.*~~

~~*Miles of*~~

~~*Mains*~~

~~*constantly*~~

~~*supplied.*~~

~~*1880 1898*~~

~~*Gallons.*~~

~~*110,000,000 185,500,000*~~

~~*Gallons.*~~

~~*68,000,000*~~

~~*117,382,448*~~

~~*Gallons,*~~

~~*72,000,000 86,671,507*~~

~~*622,000 871,949*~~

~~*186,000 799,782*~~

~~*4,600,000 5,814,219*~~

~~*Gallons.*~~

~~*1,264,350,000 2,548,600,000*~~

~~*46 (o)*~~

~~*1314*~~

~~*2707 3480*~~

~~*750*~~

~~*1793 Ifi)*~~

~~*(a) Filtered storage.*~~

~~(6) Number of miles of streets in which mains constantly supplied are laid.~~

~~Authorities. — Ceipps. The Position of the London Water Companies. London, 1892. — Richakds and Payne, London Water Supply. London, 1899, — Clifford, History of Private Bill Legislation. London, 1885, — Report {with Minutes of Evidence) of the Committee of the House of Commons on the Metropolis Water Supply Bills. London, 1852, — Report {with Minutes of Evidence and Appendices) of the Royal Commission on Water Supply. London, 1869, — Report {with Minutes of Evidence and Appendices) of the Royal Commission appointed to inquire into the Water Supply of the Metropolis. London, 1893, — Final Report {with Minutes of Evi- dence and Appendices) of the Commissioners appointed to inquire into the Water Supply within the Limits of the Metropolitan Water Com- panies. London, 1899, (See also Westminster,) (p. p. l,)~~

~~London, a city and port of entry of Middlesex county, Ontario, Canada, situated 105 miles south-vi'est of Toronto, on the river Thames and on the Grand Trunk, Canadian Pacific, and Lake Erie and Detroit River Eail- ways. It has an electric street railway, and does a large wholesale trade in dry goods, groceries, &c,, and export trade in manufactures, live stock, and farm produce. Two hospitals, a normal school, and collegiate institute are among the newer public buildings. The factories had in 1898 an output valued at $8,726,170, and employed 6000 hands. Total assessment in 1902, $18,350,360; acreage within the city limits, 4478 acres ; exports in the year 1898-99, $1,490,989 ; imports, $3,883,805, Popula- tion (1881), 19,746; (1891), 31,977; (1901), 37,981, or, including suburbs of London Junction and Ealing, 45,000,~~

~~Londonderry, a maritime county of Ireland, pro- vince of Ulster,~~

~~Populaiion. — The area of the administrative county in 1900 was 513,388 acres, of which 176,663 were tillage, 219,269 pasture, 367 fallow, 4484 plantation, 25,944 turf bog, 4232 marsh, 58,352 barren mountain, and 24,077 water, roads, fences, &o. The new administrative county under the Local Government (Ireland) Act, 1898, does not include the city of Londonderry, now a separate county. The population in 1881 was 164,991 ; in 1891, 152,009 ; and in 1901, 144,329, of whom 69,013 were males and 75,316 females, divided as follows among the different religions : Roman~~

~~*Catholics, 65,308; Presbjrterians, 45,828; Protestant Episcopalians, 27,687; Methodists, 1440 ; and other denominations, 4066, The decrease of population between 1881 and 1891 was 7‘87 per cent,, and between 1891 and 1901, 5‘1 per cent. The average number of persons to an acre in 1891 was ‘29 of the total population, and 109,168 persons inhabited the rural districts, being an average of 187 persons to each square mile under crops and pasture. The following table gives the degree of education in 1 891 : —*~~

~~*Males.*~~

~~*Females.*~~

~~*Total,*~~

~~*Percentage.*~~

~~*B.C.*~~

~~*Pr.Ep.*~~

~~*Presb.*~~

~~*Meth.*~~

~~*Kead and write Read only Illiterate*~~

~~*47,737 8,567 9,220*~~

~~*48,397 12,546 10,283*~~

~~*96,134 21,113 19,503*~~

~~*60-5 17-6 21 ‘9*~~

~~*71-0 16-9 12-1*~~

~~*81-3*~~

~~*12-5*~~

~~6-2~~

~~91-2 5-0 3-8~~

~~The percentage of illiterates among Roman Catholics in 1881 was 27‘3. In 1891 there were 16 superior schools with 995 pupils (Roman Catholics, 174, and Protestants, 821), and 296 primary schools with 18,411 pupils (Roman Catholics, 7032, and Pro- testants, 11,379), The number of pupils on the rolls of the National schools on 31st December 1900 was 23,521, of whom 10,000 were Roman Catholics and 13,521 Protestants. The following table gives the births, deaths, and marriages : —~~

~~Tear,~~

~~Births,~~

~~Deaths.~~

~~3106 2810 2828~~

~~Marriages,~~

~~1881 1891 1900~~

~~4199 3574 3219~~

~~800 772 797~~

~~In 1900 the birth-rate per thousand was 22”3, and the death-rate 19‘6 ; the rate of illegitimacy was 3‘8 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 102,776, of whom 57,926 were males and 44,850 females. The chief towns in the county are Londonderry (39,873 in 1901), Coleraine (6929 in 1901), Limavady (2692 in 1901).~~

~~Administration. — The county is divided into two parliamentary divisions, North and South, the number of registered electors in 1901 being respectively 10,175 and 8922. The rateable value in 1899 was £414,755. By the Local Government (Ireland) Act, 1898, the fiscal and administrative~~

~~*duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises two urban and four rural sanitary districts.*~~

~~*Agriculture. — The following tables show the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900 : —*~~

~~*H*~~

~~*1*~~

~~*O*~~

~~*&§1*~~

~~*HS,*~~

~~*i*~~

~~*1*~~

~~*Pi*~~

~~*‘5*~~

~~*1*~~

~~*b a » 2 S a.*~~

~~*OC5D*~~

~~*111*~~

~~*Total.*~~

~~*1881*~~

~~*1817*~~

~~74,668~~

~~3102~~

~~84,487~~

~~12,491~~

~~18,940~~

~~3389~~

~~38,047~~

~~186,891~~

~~1891~~

~~1114~~

~~69,090~~

~~1896~~

~~30,286~~

~~14,249~~

~~11,920~~

~~2635~~

~~43,829~~

~~174,869~~

~~1896~~

~~697~~

~~72,788~~

~~1809~~

~~30,370~~

~~II,743~~

~~13,621~~

~~1438~~

~~47,667~~

~~183,133~~

~~1900~~

~~1084~~

~~68,471~~

~~1838~~

~~28,681~~

~~16,163~~

~~8,284~~

~~3123~~

~~60,029~~

~~176,663~~

~~For 1900 the total value of the cereal and other crops was estimated at £1,403,629. The number of acres under pasture in 1881 was 203,483 ; in 1891, 202,986 ; and in 1900, 219,269.~~

~~*Tear.*~~

~~*Horses*~~

~~*and Mules.*~~

~~*Asses.*~~

~~*Cattle.*~~

~~*Sheep.*~~

~~*Pigs.*~~

~~*Goats.*~~

~~*Poultry.*~~

~~*1881 1891 1895 1900*~~

~~*20,776 21,631 22,212 20,766*~~

~~*462 636 694 696*~~

~~*96,693 111,860 112,148 114,279*~~

~~*30,161 70,640 61,229 67,321*~~

~~*23,946 38,091 39,676 34,417*~~

~~*4666 6694 6664 6736*~~

~~*868,436 459,462 626,122 588,349*~~

~~*The number of milch cows in 1891 was 42,077, and in 1900, 41,176. It is estimated that the total value of cattle, sheep, and pigs for 1900 was £1,595,918. In 1900 the number of holdings not exceeding 1 acre was 1484 ; between 1 and 5, 1497 ; between 5 and 15, 5129 ; between 15 aud 30, 4570 ; between 30 and 50, 2298 ;*~~

~~between 50 and 100, 1459 ; between 100 and 200, 426 ; between 200 and 500, 124; and above 500, 32— total, 17,019. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901 was 5319, amounting to £1,282,266. The number of loans for agricultural improvements sanctioned under sec. 31 of the Land Act, 1881, between 1882 and 1901, was 147, and the amount issued £10,815. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations in 1847 to 31st March 1901 was £75,157.~~

~~Fisheries. — In the deep-sea and coast fishery districts of Moville (co. Donegal) 211 boats were registered in 1900, employing 891 hands. In the salmon fishery district of Coleraine,ontheriverBann, 784 persons were employed in the same year. (w. h. Po.)~~

~~Londonderry, a maritime city, county and par- liamentary borough (returning one member), on the river Eoyle, 144 miles north-north-west of Dublin. It is an ex- tensive railway centre, being served by the Great Northern, the Belfast and Northern Counties, and the Londonderry, Letterkenny, and Lough Swilly railways, all of which are in direct connexion with the harbour. The Protestant cathedral was enlarged and restored in 1887, and has now a length of 140 feet, exclusive of the tower and vestibule. Shirt-making is the chief industry, and it is estimated that £500,000 is annually expended in wages. The harbour, which is under the jurisdiction of the Irish Society, has now a depth of 33 feet of water at high tide and 12 feet at low tide. The number of vessels registered in the port in 1900 was 22 of 10,323 tons. In the same year the total number of vessels that entered was 1564 of 297,352 tons; 928 of 185,959 tons cleared. The total foreign and colonial imports, which included 1,102,300 cwts. of maize, amounted to £329,932. There are valuable salmon fisheries on the Foyle, which in 1900 employed 891 persons. In 1898 Londonderry was constituted one of the six county boroughs which have separate county councils.~~

~~*Population (1881), 29,162 ; (1891), 33,200; (1901), 39,873. The rateable value in 1900 was £99,887.*~~

~~*Long Branch, a city of Monmouth county. New Jersey, U.S.A. It is on the east coast, a short distance south of New York Bay, and is reached by lines of the Pennsylvania and the Central of New Jersey railways, and, in the summer, by steamboats from New York. It is a very popular seaside resort. The city lies back from the edge of a cliff, 25 to 30 feet high, at the foot of which extends a magnificent beach five miles in length. ' Most of the city is built on Ocean Avenue, which follows the edge of the cliff and forms a drive five miles long. The city contains many fine private residences, several large hotels, and multitudes of boarding-houses. Population (1880), 3833 ; (1890), 7231 ; (1900), 8872, of whom 1431 were foreign-born and 987 were negroes.*~~

~~*Longford, an inland county of Ireland, province of Leinster.*~~

~~*Population. — The area of the administrative county in 1900 was 257,770 acres, of which 62,953 were tillage, 140,427 pasture, 129 fallow, 3595 plantation, 30,642 turf bog, 4842 marsh, 1511 barren mountain, 13,671 water, roads, fences, &c. The new administra- tive county under the Local Government (Ireland) Act, 1898, is identical with the old judicial county. The population in 1881 was 61,009 ; in 1891, 52,647 ; and in 1901, 46,581, of whom 23,765 were males and 22,816 females, divided as follows among the different religions : — Koman Catholics, 42,(i09 ; Protestant Episcopalians, 3400 ; Presbyterians, 261 ; Methodists, 194 ; and other denominations, 61. The decrease of population between 1881 and 1891 was 13-70 per cent., and between 1891 and 1901, 11-5. The average number of persons to an acre in 1891 was 0-20, and of the total population, 48,820 inhabited the rural districts, being an average of 155 persons to each square mile under crops and pasture. The following table shows the degree of education in 1891 :—*~~

~~*Males.*~~

~~*Females.*~~

~~*Total.*~~

~~*Percentage.*~~

~~*E. C.*~~

~~*Pr.Bp.*~~

~~*Presb.*~~

~~*Meth.*~~

~~*Read and write Read only Illiterate .*~~

~~*16,938 3,192 4,110*~~

~~*15,991 3,586 3,962*~~

~~*32,929 6,778 8,072*~~

~~*67-0 15-0 18-0*~~

~~*89-0 5-4 5-6*~~

~~*92-7 1-9*~~

~~*5-4*~~

~~*96-3 1-6 21*~~

~~*I*~~

~~*The percentage of illiterates among Roman Catholics in 1881 was 24-8. In 1891 there were 4 superior schools, with 92 pupils (all Roman Catholics), and 117 primary schools, with 7597 pupils (Roman Catholics, 6805, and Protestants, 792). The number of pupils on the rolls of National schools on 31st December 1900 was 7941, of whom 7198 were Roman Catholics and 743 Protestants.*~~

~~*The following table gives the number of births, deaths, and marriages in the years specified : —*~~

~~*Tear.*~~

~~*Births.*~~

~~*Deaths.*~~

~~*Marriages.*~~

~~*1881 1891 1900*~~

~~*1734*~~

~~*1065*~~

~~*929*~~

~~*1050 811 963*~~

~~*270 193 186*~~

~~*In 1900 the birth-rate per 1000 was 19-9, and the death-rate 20-7 ; the rate of illegitimacy was -3 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 56,305, of whom 28,597 were males and 27,708 females. The chief towns in the county, with their populations in 1901, were Longford, 3733 ; Granard, 1700.*~~

~~*Administration. — The county is divided into two parliamentary divisions. North and South, the number of registered electors in 1901 being respectively 5043 and 5311. The rateable value in 1900 was £153,098. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises two urban and three rural sanitary districts.*~~

~~*Agriculture. — The following tables show the acreage under crops, including meadow and clover, and the amount of live stock, in 1881, 1891, 1895, and 1900 :—*~~

~~*Tear.*~~

~~*Wheat.*~~

~~*Oata.*~~

~~*Barley, Eape, Beans,*~~

~~*i*~~

~~*1*~~

~~*other Green Crops.*~~

~~*Total.*~~

~~*1881 1891 1395 1900*~~

~~*807 397 164 271*~~

~~*18.670 14,168 12,605 10,898*~~

~~*469 808 205 126*~~

~~*18,102*~~

~~*11,782*~~

~~*10,449*~~

~~*9,818*~~

~~*2621 2666 2105 1840*~~

~~*16SS*~~

~~*2171 1670 2051*~~

~~*87,899 89,286*~~

~~*S7,5S2*~~

~~*88,460*~~

~~*74,756 70,718 64,783 62,954*~~

~~*In 1900 the total value of the cereal and other crops was esti- mated at £390,288, the smallest amount of any Irish county. The number of acres under pasture in 1881 was 125,830 ; in 1891, 130,866 ; and in 1900, 140,427.*~~

~~*Tear.*~~

~~*Horses*~~

~~*and Mules.*~~

~~*Asses.*~~

~~*Cattle.*~~

~~*Sheep.*~~

~~*Pigs.*~~

~~*Goats.*~~

~~*Poultry.*~~

~~*1S81*~~

~~*1891 1895 1900*~~

~~*7526 8848 8904 8039*~~

~~*3066 8668 8854 4198*~~

~~*51,657 68,189 68,404 66,226*~~

~~24,140 88,880 27,068 81,621~~

~~17,900 22,660 21,871 22,781~~

~~797S~~

~~9079~~

~~7S90~~

~~8010~~

~~282,824 251,896 272,856 309,478~~

~~The number of milch cows in 1891 was 17,580, and in 1900, 17,024. It is estimated that the total value of cattle, sheep, and pigs for 1900 was £917,502. In 1900 the numljer of holdings not exceeding 1 acre was 1172 ; between 1 and 5, 857 ; between 5 and 15, 2464; between 15 and 30, 2676; between 30 and 50, 1185 ; between 50 and 100, 588 ; between 100 and 200, 186 ; between 200 and 500, 72 ; and above 500, 7— total, 9207. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901, was 1873, amounting to £416,903. The number of loans for agricultural improve- ments sanctioned under section 31 of the Land Act, 1881, between 1882 and 1901, was 334, and the amount issued was £26,133. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations in 1847 to 31st March 1901 was £184,151. (w. H. Po.)~~

~~Long Island City, formerly a city of New York state, U.SA., capital of Queens county, now a part of the borough of Queens, one of the five boroughs which compose the city of New York. It is near the western end of Long Island, in the south-eastern part of the state. It was incorporated in the city of New York, 1st January 1898, and constitutes the first ward in Queens borough. With a water front of ten miles on East River and~~

~~LONGSTREE T — L 0 N N R 0 T~~

~~Long Island Sound, it has some commerce, but it is known chiefly as a manufacturing place. In 1890 it contained 325 manufacturing establishments, with a capital of $12,823,594. They employed 4691 persons, and paid in wages $3,066,132, while the products had a total value of $16,200,226. The principal manu- facturing industries are oil-refining, the making of chemicals, asphalt, and carpets. Population (1880), 17,129 ; (1890), 30,506 ; (1900), 48,272, of whom 15,899 were foreign-born.~~

~~Longstreet, James (1821), American gen- eral in the Confederate army, was born on 8th January 1821 in Edgefield district. South Carolina, and graduated at West Point in 1842. He served through the Mexican war with distinction, was twice breveted for conduct, and severely wounded at Churubusco. When the Southern States seceded he resigned, and became a brigadier-general in the Confederate army. His brigade fought in the battle of Bull Eun (July 1861). Divisions were not~~

~~formed in the Confederate army until that autumn, and corps not until a year later. Longstreet's division, already distinguished in many battles, became the nucleus of the 1st corps, which he commanded until the end of the war. At Gettysburg he disapproved of the attack because of the exceptionally strong position of the Federal forces. He has been charged with tardiness in getting into the action, but his delay was in part authorized by Lee to await an absent brigade, and in part was the result of instructions to conceal his movements, which caused circuitous marching. The most desperate and most conspicuous fighting in the battle was conducted by Longstreet. In September 1863 he took his corps to Georgia, where he made the successful assault upon Eoseerans at Chickamauga. In November he commanded the expedition against Knoxville, which proved a failure. In 1864 he rejoined Lee's army in Virginia, and on 6th May arrived upon the field of the Wilderness as the Confederate right had been turned and routed. His attack was a model of impetuosity and skill, and drove the enemy back until their entire force upon that flank was in confusion. At this critical moment, as~~

~~*Longstreet in person, at the head of fresh troops, was pushing the attack in the forest, he was fired upon by mistake by a flanking force of his own men, and desper- ately wounded by a shot through the neck. This mis- chance stayed the Confederate assault for four hours, and enabled the enemy to provide effective means to meet it. In October 1864 he resumed command of his corps, which he retained until the surrender, although paralysed in his right arm. During what is known as the Eeconstruction Period, Longstreet advised acceptance of terms of re- admission into the Union which disfranchised the leading men of the South, himself among them. HIe believed that if these were rejected harder terms would be enforced. In fact, the ballot was afterwards given to the recently emancipated slaves, and the state governments were turned over to them. For this advice Longstreet was bitterly assailed by most of the Southern press. But as time assuaged prejudice, he regained the respect and affection of former days, when his soldiers, proud of his record, called him "General Lee's War-horse." Longstreet's merit lay in sound strategic judgment, in instinctive appreciation of what it was possible for his soldiers to do, and in a stubborn courage rising highest when all seemed lost. After the war he held several important civil offices, among them those of minister to Turkey under President Grant, and Commissioner of Eailways under Presidents McKinley and Eoosevelt.*~~

~~*Longton, a municipal borough and market-town of Staffordshire, England, 2^ miles by rail south-east of Stoke-upon-Trent, within which parliamentary borough it is included. There are a town-hall, public baths, a theatre, a technical institute and public library, a public park, and a good secondary school ; also an organized school of science and a school of art. The town is in the Potteries district, and in the neighbourhood of coal and iron mines. Area, 1934 acres. Population (1881), 29,915 ;*~~

~~*(1891), 34,327; (1901), 35,825.*~~

~~*Longwy, a fortified town and railway station, arron- dissement of Briey, department of Meurthe-et-Moselle, France, 63 miles in direct line west-north-west of Nancy on the railway from Longuyon to Arlon, and on a plateau overlooking the Chiers, a right-bank afftuent of the Meuse, near the frontiers of Belgium and Luxemburg. It com- prises an upper and a lower*~~

town ; the former, a strong place on a hill, 390 feet above the Chiers valley, com- mands the Luxemburg road, and is strengthened by out- lying fortifications. There is garrison accommodation for 5000 men and 800 horses. The lower town is the indus- trial centre. The 17th-century church has a lofty square tower, the Hotel de VUle dates from 1730, and there is a fine hospital. Iron is extensively mined in the district, and supplies numerous blast furnaces. Several important iron and steel works are in operation, and metal utensils and porcelain are manufactured. Longwy (Longus vicus) has been fortified since the 17th century. It was the first border stronghold captured by the Prussians in 1792, and was again taken in the wars of 1815 and 1871. Popula- tion (1881), 3701 ; (1891), 4729; (1901), 9235.

Lbnnrot, Elias (1802-1884), the Finnish philo- logist and discoverer of the Kalevala, was born at Nyland in Finland on 9th April 1802. He began life as„an apothecary's assistant, but entered the university of Abo in 1822, and after taking his successive degrees, became a physician in 1832. But before this, as early as 1827, he had begun to publish contributions to the study of the ancient Finnish language, and to collect the national ballads and folk-lore, a field which was at that time wholly uncultivated. In 1833 he settled as a doctor in the country district of Kajana, and began to travel

throughout Finland and the adjoining Eussian provinces in his leisure time, garnering the harvest of songs and legends. In this way he was able to put together, as described in vol. ix. pp. 219-220, the great epic of Fin- land, the Kalevala, the first edition of which he published in 1835 ; he continued to add to it, and in 1849 issued a much larger and completer text. In 1840 Lonnrot issued his very important collection of the Kanteletar, or folk-songs of ancient Finland, which he had taken down from oral tradition. The Proverbs of Finland followed in 1842. In 1853, on the death of Castren, Lonnrot became professor of the Finnish language and literature at the high school of Helsingfors ; he retired from this chair in 1862. His whole life,

~~which closed on 19th March 1884, was dedicated to the study and the elucidation of the obscure and diflScult native language of Finland, and his contributions to phOology, and particularly to folk-lore, place Lonnrot in the first rank of modern European scholars. (b. g.)~~

~~Lorain, a city of Lorain county, Ohio, U.S.A., on Lake Erie, at the mouth of the Black river, and the Cleveland, Lorain, and Wheeling, and the ISTew York, Chicago, and St Louis railways, at an altitude of 609 feet. It has a good harbour and considerable lake com- merce, especially in coal. Population (1880), 1595 ; (1890), 4863; (1900), 16,028, of whom 4730 were foreign-born and 329 were negroes.~~

~~Lorca, a town of Spain, in the province of Murcia. The population in 1897 was 69,624. The old part of the town, with narrow, irregular streets, contrasts with the modem part, which has broad streets and squares, and many fine public buildings — the bishop's palace, theatre, town-house, hospitals, courts of justice, and a new bridge over the river Sangonera. There is an important trade in agricultural products and live stock, as well as manu- factures of woollen stuffs, leather, and porcelain.~~

~~Lorenzo Marques, or LouEBNgo Maequbs, capital of Portuguese East Africa, or Mozambique, on Delagoa Bay, close to the mouth of the Espirito Santo or English river. Since the opening in 1888 of the railway to Pre- toria the town has increased in commercial and material prosperity. Extensive harbour-works, estimated to cost over a million of money, were begun at the end of the 19th century. Meanwhile vessels generally discharge into lighters, though there are three piers (two only small). The district of Loebm^zo Maequbs has a population of 3000 Europeans and 200,000 natives.~~

~~LoretO, a famous pilgrimage centre and episcopal see of the province of Ancona, the Marches, Italy, 15 miles south-south-east of Ancona by rail to Brindisi. The shrine of the Virgin's HOuse (Casa Santa) is visited annu- ally by some 50,000 pilgrims, the chief festival being held on 7th and 8th September. Population (1881),~~

~~5183; (1900), 5000.~~

~~*LoretO, an interior department of northern Peru, with an area of 32,727 square miles, and in 1896 a population of 70,676. It contains four provinces — Alto- Amazonas, Bajo-Amazonas, Moyobamba, and Huallaga. The town of Moyobamba has a population of 10,000.*~~

~~*Lorient, chief town of arrondissement and railway station, department of Morbihan, France, 37 miles west by north of Vannes ; a military port of the first class, a forti- fied place of the third class, and the first port for naval construction in France. The Government ship- building yards on the Caudan peninsula cover an area of about 38 acres, and contain nine slips for ships and frig- ates, and two others for smaller vessels, besides forges with twenty-eight furnaces, and workshops for iron ship- building ; on the right bank of the river are the graving*~~

~~*dock, called Clermont-Tonnerre, a covered slip 232 feet by 81, and three other slips. In all, eighty furnaces are connected with the dockyard. The roadstead is provided with eight lighthouses. In 1900, 98 vessels of 17,694 tons entered, and 111 vessels of 17,584 tons (British three- fourths) cleared, in addition to the coasting trade. Popu- lation (1881), 30,602 ; (1891), 34,620; (1901), 44,082.*~~

~~*Loris-Melikof, Michael Tarielovitch, Coukt (1825 (?)-1888), Eussian statesman, son of an Armenian merchant, was born at Tiflis in 1825 or 1826, and educated in St Petersburg, first in the Lazaref School of Oriental Languages, and afterwards in the Guards' Cadet Insti- tute. He joined a hussar regiment, and four years after- wards (1847) he was sent to the Caucasus, where he remained for more than twenty years, and made for himself during troublous times the reputation of a distin- guished cavalry ofiicer and an able administrator. In the latter capacity, though a keen soldier, he aimed always at preparing the warlike and turbulent population commit- ted to his charge for the transition from military to nor- mal civil administration, and in this work his favourite instrument was the schoolmaster. In the Eusso-Turkish war of 1877-78 he commanded a separate corps d'armee on the Turkish frontier in Asia Minor. After taking the fortress of Ardahan, he was repulsed by Mukhtar Pasha at Zevin, but subsequently defeated his opponent at Aladja Dagh, took Kars by storm, and laid siege to Erze- rum. For these services he received the title of*~~

~~Count. In the following year he was appointed temporary gov- ernor-general of the region of the Lower Volga, to combat an outbreak of the plague, and the measures he adopted proved so effectual that he was transferred to the provinces of Central Eussia to combat an epidemic of a still more dangerous kind, the revolutionary agitation of the Nihil- ists and Anarchists, who had adopted a policy of terrorism, and had succeeded in assassinating the governor of Khar- koff. His success in this struggle led to his being ap- pointed chief of the Supreme Executive Commission which had been created in St Petersburg for the purpose of dealing with the revolutionary agitation in general. Here, as in the Caucasus, he showed a decided preference for the employment of ordinary legal methods rather than exceptional extra-legal measures, and an attempt on his own life soon after he assumed office did not shake his convictions. In his opinion the best policy was to strike at the root of the evil by removing the causes of popular discontent, and for this purpose he recommended to the Tsar a large scheme of administrative and economic re- forms. Alexander II., who was beginning to lose faith in the efficacy of the simple method of police repression hitherto employed, lent a willing ear to the suggestion; and when the Supreme Commission was dissolved in August 1880, he appointed Count Loris-M^likof Minister of the Interior with exceptional powers. The proposed scheme of reforms was at once taken in hand, but it was never carried out. On the very day in March 1881 that the emperor signed a ukaz creating several commissions, composed of officials and eminent private individuals, who should prepare reforms in various branches of the adminis- tration, he was assassinated by Nihilist conspirators ; and his successor, Alexander III., at once adopted a strongly reactionary policy. Count Loris-Melikof immediately resigned, and lived in retirement until his death, which took place at Nice on 22nd December 1888. (d. m. w.)~~

~~Lorrach, a town of Germany, grand-duchy of Baden, in the valley of the Wiese, 6 miles by rail north-east of Basel. It is the seat of considerable industry — calico and shawl printing, cloth, silk, chocolate, cotton, hard- ware, furniture, and dyeing, and a trade in wine, fruit, and timber. Population (1885), 6795 ; (1900), 10,347.~~

~~LORRAINE — LOT-ET-GARONNE~~

Lorraine. See Alsace-Lokbaine, and the French departments Meusb and Meubthe-et-Moselle.

Los Angeles, a city of California, U.S.A., capital of Los Angeles county, on Los Angeles river, near the foot of San Gabriel range, in the southern part of the state, at an altitude of 300 feet. It is the largest and most important city of southern California, and the second in size in the state. Its site is, in the main, level, and the plan is quite regular, with broad streets, well paved in the business section, and shaded with eucalyptus and pepper trees. The residential portions are in the main constructed in detached cottages and villas, and contain many fine houses, with ample grounds beautified with tropical vegetation. The city derives its water supply by gravity from Los Angeles river, and is well sewered. It is divided into nine wards. Situated only 14 miles from the Pacific coast, and under the influence of prevailing westerly winds from the ocean, the atmos phere is necessarily heavily charged with moisture, but the annual rainfall is small and occurs in the winter. On account of this slight rainfall and the balmy temperature Los Angeles and its neighbourhood enjoy a great repu- tation as a health resort, especially for consumptives. This has done much in the way of settling and develop- ing the region. The death-rate in 1900 was 18-01 ; in 1890 it was 20. The city is situated upon the Southern Pacific and the Atchison, Topeka, and Santa Fe railways. The surrounding region is, when irrigated, extremely fertile, producing oranges, lemons, figs, and other semi- tropical fruits. As surface water for irrigation is scarce, thousands of artesian wells have been bored to secure a supply from the underlying gravels. Indeed, the region between San Bernardino and Los Angeles is the most important artesian well country in the world. Los Angeles had, in 1900, 1416 manufacturing establish- ments, with a total capital of $11,742,838. They em- ployed 8044 hands, and 939 salaried ofiicials and clerks, and their products were valued at $21,297,637. These products were very varied in character. Among the edu- cational institutions of the city are Occidental College, a Presbyterian school, founded in 1887, and St Vincent's College, Roman Catholic, founded in 1865. The assessed valuation of real and personal property in 1900, on a basis of about 60 per cent, of the full value, was $67,599,920 ; tbfe net debt of the city was $1,417,791, and the rate of

~~taxation was $28-70 per $1000. Population (1880), 11,183; (1890), 60,395; (1900), 102,479, of whom 19,964 were foreign-born and 2131 were negroes. There were, in 1900, 28,608 persons of school age (6 to 20 years in- clusive). Out of 33,049 males of voting age, 886 were illiterate (unable to write).~~

~~Losoncz, a corporate town of Upper Hungary, in the county of Ndgrad, 101 miles by rail north-north-east of Budapest, with 8225 inhabitants in 1891 and 9530 in 1901. Its chief industries include enamelling, cloth, and glue factories, and a steam mill. It possesses an upper gymnasium, a normal school, a theatre, and a pub- lic library. It was almost totally destroyed in 1849 by the Russians, but is again flourishing. The first Hun- garian state railway was laid from Budapest to Losoncz, and this is still the main line connecting central Hungary with Berlin.~~

~~Lossiemouth, a police burgh of Elginshire, Scotland, embracing the three villages of Lossiemouth, Branderburgh, and Stotfield, at the mouth of the Lossie river, 5|- miles by rail north-north-east of Elgin, of which it is the port. The harbour, which has an area of nearly 6 acres, and a depth varying from 8 to 20 feet, is acces- sible to vessels of 600 tons, having been deepened at a cost (by Government loan) of £20,000. There are a~~

~~town-hall and swimming-baths. Water is supplied. The industries are boat-building and fishing; in 1898 the vahie of the fish caught was £14,275. The port is the leading one in the district. The churches are Estab- lished, United Free, Baptist, and Episcopal. A public school had an average attendance of 822 in 1898-99. There is an excellent golf-course. Population (1881),~~

~~3497; (1901), 3889.~~

~~Lossing, Benson John (1813-1891), American historical writer, was born in Beekman, New York, on 12th February 1813. After editing newspapers in Pough- keepsie he became an engraver on wood, and removed to New York in 1839 for the practice of his profession, to which he added that of drawing illustrations for books and periodicals. He likewise wrote or edited the text of numerous publications in a long and active career as a writer. His Pictorial Field-Book of the Revolution (first issued in 30 parts, 1860-52,~~

~~and then in 2 volumes) was a pioneer work of value in American historical literature. In its preparation he travelled some 9000 miles during a period of nearly two years; made more than a thousand sketches of extant buildings, battlefields, &c. ; con- versed with local authorities ; and presented his accumu- lated materials in a form serviceable to the topographer and interesting to the general reader. Similar but less characteristic and less valuable undertakings were a Pictorial Field-Booh of the War of 1812 (1868), and a Pictorial History of the Civil War in the United States of America (3 vols. 1866-69). His other books, between 1840 and his death, were numerous : an Outline History of the Fine Arts; many illustrated histories, large and small, of the United States ; popular descriptions of Mount Vernon and other localities associated with famous names ; and biographical sketches of celebrated Americans, of which The Life and Times of Major-Oeneral Philip Schuyler (2 vols. 1860-73) was the most consider- able. He died at Dover Plains, New York, on 3rd June 1891. (c. F. B.)~~

~~Lot, a department of the south-west of France, watered by the Lot and the Dordogne.~~

~~Area, 2018 square miles. Prom 271,514 in 1886 the population decreased to 223,736 in 1901. In 1899 the hirths numbered only 8849 against 5630 deaths, 97 of the births being illegitimate ; mar- riages numbered 1570. In 1896 there were 841 schools, with 31,000 pupils, and only 2 per cent, of the population was Oliterate. The area under cultivation, confined by the rooks of the high plateaux, measured in 1896 only 1,023,052 acres, of which 588,132 acres were arable land and 69,190 acres vineyards. The land in wheat re- turned in 1899 a value of £643,000 ; rye, £83,000 ; oats, £86,000 ; vines, £189,000. The natural pastures yielded £215,900 in 1898. Chestnuts were then valued at £61,200, and walnuts at nearly as much. The rearing of sheep is carried on in a specially important degree. While the horses of the department in 1899 numbered only 9530, its asses 5220, and its cattle 72,630, its sheep amounted to 428,600 — a number exceeded by only ten other departments of France. In 1898, 4000 tons of coal and 9200 tons of iron were mined. Metallurgy is in a backward state. Tanning and the manufacture of coarse cloths are more advanced. Cahors, the chief town, has a population of 13,981 (1901).~~

~~*Lot-et-Caronne, a department of the south-west of France, watered by the two rivers naming it.*~~

~~*Area, 2079 square miles. The population declined from 307,437 in 1886 to 276,607 in 1901. In 1899 the births numbered 4143, of which 145 were illegitimate ; deaths, 6132 ; marriages, 1987. The schools in 1896 numbered 747, with 31,000 pupils, and the illiterate constituted 5 per cent, of the population. In 1896, out of 1,181,206 acres of cultivated land, 733,929 acres were plough- land and 135,912 acres vineyards. The wheat crop of 1899 was valued at £888,000 ; the other cereals returned light values — potatoes, £448,000 ; natural pastures, £324,000 ; tobacco, £140,000. Lot^et-Garonne in 1899 yielded plums to the value of £198,000. Its vines in 1899 returned the value of £564,090. The live stock of that year included 21,950 horses, 269,220 cattle, 156,530 sheep, and 65,200 pigs. In 1898 there were mined 25,500 tons of iron, and 20,050 metric tons of cast-iron*~~

~~*were produced, valued at £64,000. The alimentary industries, particularly the rearing of pigs, are in a very thriving state. Agen, the capital, had 22,482 inhabitants in 1901.*~~

~~*Loti, Pierre [the pen-name of Louis Maeie Julien*~~

~~*Viaud] (1850), French author, was born at Eoche*~~

~~*f ort on the 14th of January 1850. The Viands are an old Protestant family, and Pierre Loti has consistently adhered, at least nominally, to the faith of his fathers. Of the picturesque and touching incidents of his child- hood he has given a very vivid account in Le Roman d'un Enfant (1890). HIs education began in Rochefort, but at the age of seventeen, being destined for the navy, he entered the great French naval school, Le Borda, and gradually rose in his profession. HIs pseudonym is said to be due to his extreme shyness and reserve in early life, vehich made his comrades call him after le Loti, an Indian flower which loves to blush unseen. HIe was*~~

~~never given to books or study (when he was received at the French Academy, he had the courage to say, " Loti ne salt pas lire "), and it was not until his thirtieth year that he was persuaded to write down and publish some curious experiences at Constantinople, in Azii/adi, a book which, like so many of Loti's, seems half a romance, half an autobiography. He proceeded to the South Seas, and onleaving Tahiti published the Polynesian idyl, originally called Rarahu, which was reprinted as Le Mariage de Loti (1880), and which first introduced to the wider public an author of remarkable originality and charm. He now became extremely prolific, and in a succession of volumes chronicled old exotic memories or edited the journal of new travels. Le Roman dhm Spahi, a record of the melancholy adventures of a soldier in Senegambia, belongs to 1881. In 1882 Loti issued a collection of short studies under the general title of Fleurs d' Ennui. In 1883 he achieved the widest celebrity, for not only did he publish Mon Frhre Yves, a novel describing the life of a French bluejacket in all parts of the world — perhaps, on the whole, to this day his most characteristic production — but he was involved in a public discussion in a manner which did him great credit. While taking part as a naval officer in the Tongking war, Loti had exposed in a Parisian newspaper a series of scandals which followed on the capture of Hue, and, being re- called, was suspended from the service for more than a year. He continued for some time nearly silent, but in 1886 he published a novel of life among the Breton fisher-folk, called P&cheur d'Islande, which has been the most popular of all his writings. In 1887 he brought out a volume of extraordinary merit, which has never received the attention it deserves; this is Propos d'Exil, a series of short studies of exotic places, in his peculiar semi-autobiographic style. The fantastic novel of Japanese manners, Madame Chrysanth&me, belongs to the same year. Passing over one or two slighter produc- tions, we come in 1890 to Au Maroc, the record of a journey to Fez in company with a French embassy. A collection of strangely confidential and sentimental remini- scences, called Le Livre de la Pit%6 et de Id Mort, belongs to 1891. Loti was on board his ship at the port of Algiers when news was brought to him of his election, on the 21st of May 1891, to the French Academy. After he became an Immortal the literary activity of Pierre Loti somewhat declined. In 1892 he published Fan- i(5?ned'0ne)/i, another dreamy study of life in Constan- tinople, a sort of continuation of AziyadL He has described a visit to the Holy Land, somewhat too copi- ously, in three volumes (1895-96),~~

~~*and has written a novel, Ramuntcho (1897), a story of manners in the Basque province, which is quite on a level with his best writings. In 1900 he visited British India, with the view of describing what he saw, but it was understood that he*~~

~~*was disappointed ; in 1901 he was writing from Peking his impressions of China after the war. At his best, Pierre Loti is unquestionably the finest descriptive writer of the day. In the delicate exactitude with which he reproduces the impression given to his own alert nerves by unfamiliar forms, colours, sounds, and perfumes, he is without a rival. But he is not satisfied with this exterior charm ; he desires to blend with it a moral sensibility of the extremest refinement, at once sensual and ethereal. Many of his best books are long sobs of remorseful memory, so personal, so intimate, that an English reader is amazed to find such depth of feeling compatible with the power of minutely and publicly recording what is felt. In spite of the beauty and melody and fragrance of Loti's books, it is not to be denied that his mannerisms are apt to pall upon the reader, and that his more recent books of pure description have been rather empty. HIs greatest successes were gained in the species of confes- sion, half-way between fact and fiction, which he essayed in his earlier books. When all his limitations, however, have been rehearsed, Pierre Loti remains, in the mech- anism of style and cadence, one of the most original and most perfect writers of the second half of the 19th cen- tury. Whether his matter is worthy of the form in which he sets it is a question which must be left to the tempera^ ment of the individual reader.*~~

~~*-), President of the*~~

~~*Loubet, Emile (1888- French Republic, son of a peasant proprietor at Mar- sanne, in the department of the Drome, was born on 31st December 1838. He studied law, and established himself at the small town of Montelimar, of which he was mayor in 1870 and parliamentary representative in 1876. He steadily supported the Moderate Repub- lican party ; in 1885 he was elected to the Senate, and in 1887 received the portfolio of public works in the Tirard cabinet, but resigned in the following year. In 1892 he himself formed a ministry at the request of President Carnot, but the excitement of the Panama scandals over- threw his administration in the winter of the*~~

same year — a circumstance which his political opponents iised against him when he was elected President. That no imputation rested upon M. Loubet personally was shown by his election to the highly honourable office of Presi- dent of the Senate in 1895 ; and the prestige th^s acquired contributed to his elevation to the presidency of the Republic on the sudden death of President Faure in February 1899. Coming to office at a very difficult period, when the nation was rent by the Dreyfus contro- versy, and the upper classes of Society seemed united with large sections of the Church and the Army in oppo- sition to the Republic, M. Loubet underwent severe trials, and was exposed to unexampled insults, over which he gradually triumphed by dint of patience, forti- tude, and the exhibition of a perfect simplicity of life. IIe retained his predecessor's advisers as long as possible ; but when a reconstruction eventually became necessary, he called upon Republicans of all shades to concentrate for the salvation of the Republic, and for the first time Moderates and Socialists were seen sharing in the same Administration. The cabinet thus formed by M. Waldeck- Rousseau displayed unexpected vitality, though no doubt much assisted by the general aversion from dis- turbance during the great Exhibition of 1900. IM. Loubet had the satisfaction of seeing " I'affaire Dreyfus " at last driven into the background, and the Nationalist and anti- Semite agitation discomfited by a resolute vindication of republican institutions. On 22nd September 1900 a successful monster banquet in Paris to the provincial mayors gave occasion for a great demonstration of loyalty of the country as a whole to its Government ; and in

September 1901 M. Lonbet's triumph was signalized by the visit to France of the Tsar and Tsarina of Russia, on which occasion the alliance of the two countries was once more proclaimed.

Loughborough, a municipal borough (incorporated 1888) and market-town, in the Loughborough parliamen- tary division of Leicestershire, England, on the Soar, 11 miles north by west of Leicester by rail. Modern erec- tions are a free library, a philharmonic hall, a theatre, Queen's memorial baths,

~~*and a drill hall. The infirmary has been enlarged. Area, 3045 acres. Population (1881),*~~

~~*14,552; (1891), 18,196; (1901), 21,508.*~~

~~*Louisiade Archipelago. See Melanesia and New Guinea.*~~

~~*Louisiana, one of the southern states of the Amer- ican Union. It is composed of 59 parishes or counties. In 1880 the population was 939,946; in 1890 it was 1,118,587. In 1900 it was 1,381,625. The increase be- tween 1890 and 1900 was 23-5 per cent. The density of population in 1890 was 24-6 ; in 1900 it was 30-4. In 1890 there were 559,350 males and 659,23.7 females; 658,395 white and 660,192 coloured; 1,068,840 native- born and 49,747 foreign-born. There are 104 incorporated cities, towns, and villages in the state, of which only 7 had in 1900 more than 5000 inhabitants, and 3 more than 10,000. These three were New Orleans, with 287,104 inhabitants ; Shreveport, with 16,013 ; and Baton Rouge, with 11,269.*~~

~~*Education. — The number of children enrolled in public schools in 1896 was 169,947. In 1899 the number was 196,169. Of these 121,936, or 62 per cent., were white, and 74,233, or 38 per cent., were coloured. The number of pupils reported as attending private schools in 1899 was 14,694, of whom 11,896 were white and 2798 were coloured. To these may be added 10,000 children not re- ported. The number of children of school age in 1900 was 404,757. Thus the percentage of children educated was 54. The average attendance in the public schools was, whites, 90,187; coloured, 56,136 ; total, 146,323. The number of public school teachers em- ployed was 4157 ; the number of private teachers was 645. The average length of school session was six months. Of the state tax of six mills on the dollar, \ mills are devoted to the public schools, or^\ of the gross income of the state revenue. In addition to this, every male inhabitant of twenty-one years and over is obliged to pay a poll-tax of one dollar for the support of the schools. The revenue in 1899 was $1,126,112. There are about thirty high schools ; an industrial college at Euston, and one at Lafayette ; a state normal school at Natchitoches ; the Southern University for negroes at New Orleans ; the State University and Agricultural and Mechanical College at Baton Rouge ; and the Louisiana Chau- tauqua at Huston. A textile school will be established in the state, as well as a biological station for fish and fisheries.*~~

~~*The Tulane University of Louisiana at New Orleans includes departments of medicine and law, a college of arts and sciences, and one of tech- nology, the Newcomb College for "Women, a department for teachers, and a university department for graduate study. ■ There are two colleges of Jesuits, a number of schools and convents of the Catholic denomination ; Centenary College, Methodist ; Silli- man Collegiate Institute, Presbyterian ; Keachie College, Baptist ; and in New Orleans three sectarian colleges for negroes.*~~

~~*Public Institutions. — There are an insane asylum at Jackson, a lepers' home in Iberville parish, and an institution for the blind and one for the deaf at Baton Rouge. There is a charity hospital at Shreveport, and one at New Orleans. The hospital at New Or- leans had, in 1899, 9141 resident patients, and 21,803 patients were treated in the dispensary.*~~

~~*Beligion.—T:h.e chief denominations are as follows : — Catholics, 355,000; Baptists, 107,200; Southern Methodists, 28,000; Pres- byterians, 6590 ; Episcopalians, 7704 ; Jews, 11,000. There are also a number of Lutherans and Unitarians. The Protestant denominations count as members of the church only those who have made profession of faith.*~~

~~*Agriculture. — About 4,000,000 acres of land are cultivated. There are 3,000,000 acres of state public lands and large areas of United States public lands subject to homestead entry. The crops produced yearly are valued at $75,000,000. In 1890 the product of Indian corn was 13,081,954 bushels ; of oats, 297,271 bushels ; of tobacco, 46,845 lb ; of rice, 75,645,433 ft (clean rice) ; of Irish potatoes 376,842 bushels ; of sweet potatoes, 1,912,080 bushels ;*~~

~~*of cow-pease, 78,682 bushels ; and of broom com, 11,420 lb. In 1900 the product of rice was 902,857 bushels, rough; of com, 12,759,277 bushels ; of oats, 408,170 bushels ; of hay, 328,817 bales ; of potatoes, 1,275,989 bushels ; of sorghum, 13,132 bushels ; the num- ber of horses and mules was 275,802 ; of cattle, 338,-369 ; of sheep, 133,944 ; of hogs, 198,490. Oranges, lemons, figs, olives, and grapes are also produced, and the fish and oysters are famous.*~~

Sugar. — Of sugar there were produced in 1880, 121,886 tons of 2240 ft ; in 1890, 215,843 tons ; in 1898, 245,511 tons. Of molasses there were produced in 1898, 24,952,188 gallons.

Cotton. — Louisiana ranks seventh as a cotton-producing state. In 1890 the cotton acreage was 1,270,154, and the number of bales produced 659,180. In 1897-98 there were 1,245,000 acres produc- ing 740,000 bales, or an average of -f^ bales per acre ; in 1898-99 there were 1,292,000 acres producing 590,000 bales, or an average of ^ bales per acre. The falling-off in the average yield per acre was due to unfavourable weather. In 1898-99 there were 1595 looms and 65,352 spindles. In 1899-1900 there were 1673 looms and 67,878 spindles. The number of bales of cotton con- sumed was 16,420.

Lumber.' — The timber indigenous to the state consists of yel- low pine, cypress, and native southern hardwoods. The eastern pine belt is composed of the longleaf pine, interspersed with some loblolly. It covers an area of about 3900 square miles. The south-western pine belt contains the heaviest growth of longleaf pine timber in the world, covering an area of about 4200 square miles. It merges into the shortleaf forest, which occupies an area of about 7000 square miles, and is in places intermixed with loblolly pine and deciduous hardwoods. The cypress forests of the alluvial and overflowed lands in the southern portions of the state are among the largest and the most heavily timbered in the world. They produce annually about 300,000,000 board feet of lumber. The hardwoods are found in the river bottoms throughout the state. The manu- facture of lumber aggregates 600,000 board feet each year, valued at about $6,000,000.

Minerals. — There is a sulphur bed in Calcasieu parish of an average thickness of 100 feet. At a depth of about 425 feet the production in 1896 was 4200 tons, and in 1897 a little over 1000 tons ; in 1900 it was closed. A salt mine at Petite Anse produced, in 1890, 39,978 short tons of salt of remarkable purity ; and in 1896, 24,236 tons.

Manufactures. — The condition of manufactures in 1890 and 1900 is shown by the following table : —■

1890.

~~*1900.*~~

~~*Per cent, of increase.*~~

~~*Number of establish- ments*~~

~~*Capital*~~

~~*Salaried officials, clerks, &c. . . .*~~

~~*Salaries*~~

~~*Wage-earners . . .*~~

~~*Total wages . . .*~~

~~*Miscellaneous ex- penses ....*~~

~~*Cost of materials used*~~

~~*Value of products*~~

~~*2,613 $34,754,121*~~

~~*3,5241 $3,036,9951 28,377 $10,122,569*~~

~~*$3,760,753 $33,282,724 $57,806,713*~~

~~*4,350 $113,084,294*~~

~~*3,944*~~

~~*$3,090,185*~~

~~*42,210*~~

~~*$15,385,715*~~

~~*$7,999,870*~~

~~$82,299,893~~

~~$121,181,683~~

~~66-5 225-4~~

~~11-9~~

~~1-8~~

~~48-7~~

~~52-0~~

~~112-7 147-3 109-6~~

~~The manufacturing industries are for the most part closely re- lated to the products of the soil, as is shown by the following sta^ tistics : —~~

~~Industry.~~

~~Capital.~~

~~Wage- earners.~~

~~Products.~~

~~Sugar and molasses refining Lumber and timber products Cotton-seed oil and cake . Rice, cleaning and polishing~~

~~$.52,799,105~~

~~20,093,044~~

~~4,622,-569~~

~~1,818,144~~

~~6,504~~

~~*10,171*~~

~~*1,317*~~

~~*412*~~

~~*$47,891,691*~~

~~*17,408,513*~~

~~*7,026,452*~~

~~*5,736,451*~~

~~*New Orleans is the principal centre of manufacturing, the number of establishments, number of wage-earners and value of products for this city constituting 35-1, 46-2, and 52-5 per cent, respectively of the totals for the entire state.*~~

~~*Debt and Assessed Valuation. — The total bonded debt of Louisiana, bearing interest in 1899, was $10,877,800 ; the floating debt was $914,397. The total valuation of real and personal property in 1890 was $495,301,597. The assessed valuation in 1890 was $234,350,791 ; and, in 1899, $267,723,052. The rate of tax- ation is six mills on the dollar of the assessed valuation, which should have yielded in 1899 a revenue of some $1,606,338, less 8J per cent, to cover cost of collection and also non-collections.*~~

~~*1 Includes proprietors and firm members, with their salaries.*~~

~~*Banks. — The state bank examiner gives the following figures for state banks in Louisiana in October 1900 : —*~~

~~*Capital stock .... $7,015,210*~~

~~*Deposits Real estate Specie Currency Sailways. — The total length of railways in 1*~~

~~*36,378,809 1,803,071 2,258,834 2,302,716*~~

~~*I was 652 miles ;*~~

~~*in 1890, 1740 miles ; in 1899, 2410 miles. The chief lines are the Southern Pacific, with a total mileage operated of 437 ; the Texas and Pacific, with 358 ; the Kansas City Southern rail way, with 222 ; the Vicksburg, Shreveport, and Pacific, with 170 ; the Yazoo and Mississippi Valley, with 170 ; the St Louis, Iron Mountain and Southern railway, with 144.*~~

~~*Newspapers. — In 1900 there were 218 newspapers, including daily, 22 ; tri-weekly, 1 ; semi-weekly, 3 ; weekly, 178 ; semi- monthly, 4 ; monthly, 10.*~~

~~*Commerce. — Exports from New Orleans, for year ended 30th June 1900, $114,702,493 ; imports, $17,498,434. Vessels entered and cleared at port of New Orleans, 3097 ; tonnage, 4,643,064.*~~

~~*Levees. — The revenue by which the levee system is maintained comes from the United States Government, from a state tax of one mill for a general engineer fund, and from revenues from the thirteen levee districts. From 1898 to 1900 the cubic yardage of work done was 18,792,526, the cost of which was $2,994,957. More than half of the work was done by the United States.*~~

~~*History and Administration. — In 1877 the period of recon- struction ended, owing to the efforts of the White League, and from that time the state has enjoyed a free government and has greatly prospered. In 1890 an attempt was made to renew the charter of the Louisiana State Lottery Company, which offered a large sum annually for the privilege. Governor NichoUs and the Anti-Lottery party resisted the renewal strenuously, but the Bill was passed by the legislature. The United States Government, however, forbade the Lottery Company the use of the mails, and the company withdrew its offer. In 1898 a new constitution was adopted, which superseded that of 1879. Under it the number of representatives in the House may not be more than 116 nor less than 98 ; and the number of senators not more than 41 nor less than 36. The General Assembly meets every two years on the second Monday of May, and the sessions are limited to sixty days. The governor is elected for four years, and is not again eligible before the expiration of one or more terms. The treasurer is not eligible as his own immediate successor. The judiciary consists of a supreme court of five members appointed for twelve years ; of courts of appeal, district courts, and justices of the peace. In New Orleans, besides the courts of appeal and the district courts (civil and criminal), there are city courts and recorder's courts. Lotteries and sales of lottery tickets are pro- hibited. The leasing or hiring of convicts was prohibited after 1st March 1901. A railway commission of three members is established. The establishment of district schools and district school districts is authorized. No person less than sixty shall vote at any election who shall not have paid a poll-tax for the two preceding years. A code of criminal law ordered by the Constitution has been prepared. A State Board of Charities and Correction has been established to visit institutions and make such suggestions to the governor and legislature as may be necessary. Upon questions submitted to taxpayers women taxpayers have the right to vote, without registration, in person or by their agent. Factories and mines are encouraged by exemption from taxation for ten years from 1st January 1900. As a qualification for voting every citizen must be able to read and write, or must be bonII fide owner of property assessed in the state for not less than $:M0. This practically disfranchises the negro, and relieves the state from the unfortunate results of the fifteenth amend- ment to the National Constitution. An exception is made with regard to the educational or property qualifications in favour of persons who were voters in any state*~~

~~on 1st January 1867, in favour of their sons and grandsons, and of persons who were naturalized prior to 1st January 1898 ; provided they shall have been residents of the state for five years preceding the date of registration, and shall have registered prior to 1st September 1898. The Australian ballot system is in operation. In 1900 the election for state officers resulted in an overwhelming majority for the Democratic party. An important white Republican party was subsequently formed. (j^^^ T?o.)~~

~~Louisiana, a city of Pike county, Missouri, U.S.A., 'On the west bank of the Mississippi river, below the mouth of the Salt river, in the eastern part of the state, at an alti- tude of 458 feet. Its site is on the river banks, and it has af airly regular plan. It is entered by the Chicago, Burling- ton and Quincy, and the Chicago and Alton railways. Population (1880), 4326 ; (1890), 5090 ; (1900), 5131.~~

~~Louisville, the largest and most important city of Kentucky, U.S.A., capital of Jefferson county, in the northern part of the state, on the south bank of the Ohio river at the Falls. The city is regularly laid out, with broad streets, most of which are paved with granite blocks, bricks, cobble-stones, or macadam. It is openly built, with numerous parks, and has a good water supply and sewer system. Three bridges connect it with Jeffersonville and New Albany, on the north bank of the Ohio. The railway development has been remark- able. It is entered by ten railways — the Baltimore and Ohio South-Western ; the Chesapeake and Ohio ; the Chicago, Indianapolis and Louisville; the Cleveland, Cincinnati, Chicago and St Louis ; the Illinois Central ; the Louisville and Nashville; the Louisville, Evans- ville and St Louis Consolidated ; the Louisville, Hender- son and St Louis ; the Pittsburg, Cincinnati, Chicago and St Louis ; and the Southern. These, with boats on the Ohio, afford excellent facilities for internal com- merce, and give the city a large trade. The manufactures, aided by the enormous water-power supplied by the falls in the Ohio, are of great importance. In 1900 the number of establishments was 2307, with a capital of $49,344,701, and an average number of 29,926 hands, whose annual wages amounted to $10,945,720. The cost of materials used was $41,016,391, and the value of products was $79,286,390. The products were in great variety, the following being the principal : — men's clothing (factory product and custom work), $4,710,447 ; foundry and machine-shop products, $3,233,222 ; leather,~~

~~*$3,114,731; liquors, $4,691,167; cotton-seed oil and cake, $4,683,343 ; slaughtering (wholesale), $4,771,608 ; tobacco, cigars, and snuff, $15,790,366. The total assessed valuation of real and personal property in 1900, on a basis of about 60 per cent, of the full value, was $121,000,000, the net debt was $7,755,071, and the rate of taxation $22-65 per $1000. The total municipal receipts were $4,785,744, and the expenditure $4,459,970. In March 1890 the city was visited by a tornado, which swept across it, killing 76 persons and destroying $3,000,000 worth of property. Population (1890), 161,129 ; (1900), 204,731, of whom 21,437 were foreign-born and 39,139 were negroes.*~~

~~*Louie, a town of Portugal, in the district of Faro, 10 miles north-north-west of Faro. It has a trade in palms, agaves, and esparto grass, and manufactures porcelain and leather. Population (1900), 22,511.*~~

~~*Lourdes, a town, arrondissement of Argfeles, depart- ment of Hautes-Pyrenees, France, 11 miles, in direct line, west-south-west of Tarbes, on the railway from Toulouse to Bayonne. It is a fortified place of the second class, com- manding the defile Gave de Pan. A new quarter of the town has grown up near the famous grotto. It stretches for some distance, and comprises the Church of the Rosary, built in 1886-89, a hospital, convents, hotels, and houses for the accommodation of the numerous visitors resorting to the shrine, said to exceed in number 500,000 a year. Population (1881), 4970 ; (1901), 8708.*~~

~~*Louth, a municipal borough and market-town in the Louth parliamentary division of Lincolnshire, England, on the Lud, 26 miles east-north-east of Lincoln by rail. A hospital has been erected, also a number of almshouses. The Roman Catholic church has been restored. Area of municipal borough, 2749 acres. Population (1881), 10,691 ;*~~

~~*(1891), 10,040 ; (1901), 9518.*~~

~~*Louth, a maritime county of Ireland, province of Leinster.*~~

~~*Population. — The area of the administrative county in 1900 was 202,174 acres, of which 82,394 were tillage, 89,398 pasture, 190 fallow, 4624 plantation, 1138 turf bog, 1219 marsh, 12,924 barren*~~

~~mountain, and 10,387 water, roads, fences, &c. The new adminis- trative county under the Local Government (Ireland) Act, 1898, includes the former county of the town of Drogheda. The popula- tion in 1881 was 77,684 ; in 1891, 71,038 ; and in 1901, 65,741, of whom 32,623 were males and 33,118 females, divided as follows among the different religions : — Roman Catholics, 60,133 ; Protestant Episcopalians, 4188 ; Presbyterians, 987 ; Methodists, 275 ; and other denominations, 158. The decrease of population between 1881 and 1891 was 8-56 per cent., and between 1891 and 1901, 8-6 per cent. The average number of persons to an acre in 1891 was '35, and of the total population, 44,649 inhabited the rural districts, being an average of 168 persons to each square mile under crops and pasture.~~

~~The following table gives the degree of education in 1891, excluding the town of Drogheda, which was then a separate county : —~~

~~Males.~~

~~Pemales.~~

~~Total.~~

~~Percentage.~~

~~K. C.~~

~~Pr.Ep.~~

~~Presb.~~

~~Meth.~~

~~Read and write Read only Illiterate~~

~~18,106 3,098 5,548~~

~~*17,210 3,567 5,915*~~

~~*35,316*~~

~~*6,665*~~

~~*11,463*~~

~~*63-6 13-3*~~

~~*23-1*~~

~~*91-7 4-5 3-8*~~

~~*92-5 3-0 4-5*~~

~~*94-7 2-0 3-3*~~

~~*The percentage of illiterates among Roman Catholics in 1881 was 32-3. In 1891 (including Drogheda) there were 11 superior schools with 622 pupils (Roman Catholics, 426, and Protestants, 196), and 128 primary schools with 11,073 pupils (Roman Catholics, 10,151, and Protestants, 922). The number of pupils on the rolls of the National schools on 30th December 1900 was 9301, of whom 8642 were Roman Catholics and 659 Protestants.*~~

~~*The following table gives the number of births, deaths, and marriages in the years specified : —*~~

~~*Tear.*~~

~~*Births.*~~

~~*Deaths.*~~

~~*Marriages.*~~

~~*1881 1891 1900*~~

~~*2252 1526 1324*~~

1716 1291 1250

392 268 269

In 1900 the birth-rate per thousand was 20-1, and the death-rate 19-0 ; the rate of illegitimacy was 2-6 per cent, of the total births. The total number of emigrants who left the county between 1st May 1857 and 31st December 1900 was 42,682, of whom 20,812 were males and 21,870 females. The chief towns in the county are Dundalk (13,067 in 1901), Drogheda (12,765 in 1901), Ardee (1882 in 1901).

Administration. — The county is divided into two parliamentary divisions, North and South, the number of registered electors in 1901 being respectively 6011 and 5158. The rateable value in 1900 was £244,327. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises two urban and three rural sanitary districts.

Agriculture. — The following tables show the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900. The figures for 1900 are for the new ad- ministrative county.

i

*i-^*

i

S,

Other

Meadow

Tear.

Oats.

~~.a a «~~

~~1~~

~~a~~

~~Green~~

~~and~~

~~Total.~~

~~A~~

~~a~~

~~Crops.~~

~~Clover.~~

~~ISSl~~

~~8382~~

~~26,644~~

~~21,928~~

~~11,856~~

~~9906~~

~~1696~~

~~22,582~~

~~97,889~~

~~1S91~~

~~1048~~

~~24,0S6~~

~~14,844~~

~~10,824~~

~~8391~~

~~1874~~

~~23,493~~

~~83,660~~

~~1S95~~

~~877~~

~~24,864~~

~~15,298~~

~~10,471~~

~~9896~~

~~1418~~

~~26,170~~

~~88,489~~

~~1900~~

~~655~~

~~20,789~~

~~*15,206*~~

~~*9,881*~~

~~*9382*~~

~~*1633*~~

~~*24,889*~~

~~*82,394*~~

~~*For 1900 the total value of the cereal and other crops was estimated at £508,421. The number of acres under pasture in 1881 was 73,185 ; in 1891, 89,099 ; in 1900, 89,398.*~~

~~*Tear.*~~

~~*Horses*~~

~~*and Mules.*~~

~~*Asses.*~~

~~*Cattle.*~~

~~*Sheep.*~~

~~*Pigs.*~~

~~*Goats.*~~

~~*Poultrj'.*~~

~~*1881 1891 1895 1900*~~

~~*11,044 10,301 12,084 10,688*~~

~~*1549 1570 1664 1682*~~

~~84,739 41,520 46,247~~

~~4T,285~~

~~83,367 55,888 41,086 50,099~~

~~10,471 19,644 18,492 15,967~~

~~4841 5744 6022 4787~~

~~241,466 240,779 259,881 294,609~~

~~The number of milch cows in 1891 was 9507, and in 1900, 10,212. It is estimated that the total value of cattle, sheep, and pigs for 1900 was £734,047, the smallest amount in any Irish county. In 1900 the number of holdings not exceeding 1 acre was 1990 ; between 1 and 5, 1284 ; between 5 and 15, 2423 ; between 15 and 30, 1400 ; between 30 and 50, 604 ; between 50 and 100, 481 ; between 100 and 200, 231 ; between 200 and 600, 114 ; and above~~

~~500, 12— total, 8539. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901, was 276, amounting to £105,272. The number of loans sanctioned for agricultural improvements under sec. 31 of the Land Act, 1881, between 1882 and 1901 was 80, and the amount issued was £8895. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations in 1847 to 31st March 1901 was £48,294.~~

~~Fisheries. — The number of vessels registered in the deep-sea and coast fishery district of Dundalk in 1900 was 206, employing 743 hands. The number of persons employed in the salmon fishery districts of Drogheda and Dundalk in the same year was 932. (w. H. PC.)~~

~~Louvain, one of the largest towns of Belgium, in the province of Brabant, 27 miles east of Brussels. It is connected by rail with Brussels, Malines, Liege, and other important centres, and is chiefly noted for its university and its~~

~~*beer. It has considerable breweries, and factories for boots and shoes and clocks. Population (1880),*~~

~~*35,893 ; (1900), 42,070.*~~

~~*Lowe, Johann Karl Gottfried (1796-1869), German composer, was born at Lobejtin, near Halle, SOth November 1796, and was a choir-boy at Kothen from 1807 to 1809, when he went to the Tranke Institute at Halle, studying music with Tilrk. The beauty of Lowe's voice brought him under the notice of Madame de Stael, who procured him a pension from Jer6me Bonaparte, then king of Westphalia ; this stopped in 1813, on the flight of the king. He entered the University of Halle as a theological student, but was appointed cantor at Stettin in 1820, and director of the town music in 1821, in which year he married Julie von Jacob, who died in 1823. His second wife, Auguste Lange, was like himself an accom- plished singer, and they appeared together in his oratorio performances with great success. He retained his office at Stettin for 46 years, when, after a stroke of paralysis, he was somewhat summarily dismissed. He retired to Kiel, and died 20th April 1869. He undertook many concert tours during his tenure of the post at Stettin, visiting Vienna, London, Sweden, Norway, and Paris. His high soprano voice (he could sing the music of the " Queen of Night" in Die Zauberflote as a boy) had been re- placed by a fine tenor. Lowe was a voluminous composer, and wrote five operas, of which only one. Die drei WUnsche, was performed at Berlin, in 1834, without much success ; seventeen oratorios, many of them for male voices unaccompanied, or with short instrumental interludes only; choral ballads, cantatas, three string quartets, a pianoforte trio; a work for clarinet and piano, published posthu- mously ; and some piano solos. But the branch of his art by which he is now remembered, and in which he must be admitted to have attained perfection, is the solo ballad with pianoforte accompaniment. His treatment of long narrative poems, in a clever mixture of the dramatic and lyrical styles, was undoubtedly modelled on the ballads of Zumsteeg, and has been copied by many composers since his day. They require a cultivated singer to do them justice, but such things as his setting of the " Erlkonig," a very early example ; " Archibald Douglas," " Heinrich der Vogler," " Edward," and " Die Verfallene Muhle," belong to the music that must impress every intelligent hearer. The best of these have been sung in England with great*~~

~~*success by Henschel, Gura, Bispham, and almost every distinguished conceri>singer. (j. a. f. m.)*~~

~~*Lowell, a city of Massachusetts, U.S.A., capital of Middlesex county, at the junction of the Merrimac and Concord rivers, in the north-eastern part of the state. The city is irregularly laid out, and its business streets are paved with granite blocks, while the others are mac- adamized or gravelled. Its water supply is pumped from the Merrimac. It is divided into nine wards, and it has*~~

~~*railway facilities by branches of the Boston and Maine, and of the New York, New Haven, and Hartford rail- ways. It is one of the chief cities of the country for textile, mainly cotton, manufactures. ITor this the water power of the Pawtucket Falls in the Merrimac has been utilized, supplemented by steam power. In 1900 the city contained, in all branches of manufacture, 981 establishments, with a total capital of $46,578,193. These employed an average number of 31,377 hands, and the total product was valued at $44,774,525. Of these establishments, eight were cotton mills, with a capital of $21,354,927. In them were employed 13,730 hands, and the product was valued at $17,038,576, or about 38 per cent, of all manufactured products. The product of woollen and worsted goods was valued at $4,689,265 ; of foundry and machine shop products, $4,258,047 ; of hosiery and knitted goods, $3,148,110 ; and of patent medicines and compounds, $1,784,338. The assessed valuation of real and personal property in 1900 was $71,529,516, the net debt was $3,217,731, and the rate of taxation was $18-80 per $1000. Population (1890), 77,696; (1900), 94,969, of whom 40,974 were foreign-born. The death-rate in 1900 was 19-8 ; in 1890 it was 25-9.*~~

~~*Lowell, James Russell (1819-1891), American author and diplomatist, was born at Elmwood, in Cam- bridge, Massachusetts, on 22nd February 1819.1 He was brought up in a neighbourhood bordering on the open country, and from his earliest years he found a companion in nature ; he was also early initiated into the reading of poetry and romance, hearing*~~

Spenser and Scott in childhood, and introduced to old ballads by his mother. He had for schoolmaster an Englishman who held by the traditions of English schools, so that before he entered Harvard College he had a more familiar acquaintance with Latin verse than fell to the lot of most of his fellows — a familiarity which showed itself later in his mock-pedantic accompaniment to T7ie Biglow Papers and his macaronic poetry. He was a wide reader of literature, but a somewhat indifferent student in college, graduating at Harvard without special honours in 1838. During his college course he wrote a number of trivial pieces for a college magazine, and shortly after gradu- ating printed for private circulation the poem which his class asked him to write for their graduation festivities. He was uncertain at first what vocation to choose, and vacillated between business, the ministry, medicine, and law. He decided at last to practise law, and after a course at the Harvard law school, was admitted to the bar. While studying for his profession, however, he continued the pursuit of literature in a random fashion, contributing poems and prose articles to various maga/- zines. At this period he was in a somewhat wayward mood, conscious of a latent power, deeply enamoured of letters, a student of the art of literature, but uncertain just how to direct his impulses. He cared little for the

1 The ancestry of James Russell Lowell was of miiifiled Englisli and Scottish strain. On his father's side he was descended from Percival Lowell or Lowle, who emigrated from Somersetshire, England, in Kili!), to Massiuaiusetts Bay. The descendants of Percival remained in Bos- ton and its vicinity down to James Russell, and contained among them more than one man of note. John J^owell, the grandfather of 'James Russell, was a judi^e of the federal court appointed by Washington, and took a conspicuous part in the framing of the Massachusetts con- stitution; and Charles Lowell, the father, was Ioiih' honoured as a minister in Boston ; Francis Cabot Lowell, an uncle of James Russell, was the organizer of the industries ou the banks of the Merrimac which resulted in the building of the city of Lowell, and a sou of Francis Cabot was the founder of the Lowell Institute, a centre of dif- fusmg light in Boston. On his mother's side Lowell was descendcil from the Spences and Traills, who made their home in the Orkney Isles, his great-grandfather, Robert Traill, returning to England upoii the breaking out of hostilities in 1775.

~~profession of law, regarding it simply as a distasteful means of livelihood, yet his experiments in writing could not greatly encourage him to trust to this for support. An unhappy adventure in love deepened his sense of failure, but a new and profound experience sud- denly steadied his purpose, and helped besides to fashion and guide certain vague tendencies which he felt towards the reform movements then stirring in the society about him. He became betrothed to Maria White in the autumn of 1840, and the next twelve years of his life were deeply affected by her influence. She was herself a poet of delicate power, but she was also possessed of a lofty enthusiasm, a high conception of purity and justice, and of a practical temper which led her to concern herself actively in the movements directed against the evils of intemperance and slavery. Lowell was already looked upon by his companions as a man marked by wit and poetic sentiment ; Miss White was admired for her beauty, her character, and her intellec- tual gifts, and the two became thus the hero and heroine among a group of ardent young men and women, who set them upon a dais, as it were, and bestowed their homage. The first-fruits of this passion was a volume of poems, published in 1841, entitled A Tear's Life, which was in- scribed by Lowell in a veiled dedication to his future wife, and was a record of his emotions under this new experience, with a backward glance at the preceding period of depression and irresolution. The betrothal, moreover, stimulated Lowell to new efforts towards self- support, and though nominally maintaining his law office, he threw his energy into the establishment, in company with a friend, Robert Carter, of a literary journal, to which the young men gave the name of The Pioneer. It was to open the way to new ideals in literature and art, and the writers to whom Lowell turned for assistance — Hawthorne, Emerson, Whittier, Poe, Story, and Parsons, none of them yet possessed of a wide reputation — indi- cate the acumen of the editor. Lowell himself had already turned his studies in dramatic and early poetic literature to account in another magazine, and continued the series in Tlie Pioneer, besides contributing poems ; but after the issue of three monthly numbers, beginning in January 1843, the magazine came to an end, partly because of a sudden disaster which befell Lowell's ej-es, partly through the inexperience of the conductors and unfortunate business connexions.~~

~~The venture confirmed Lowell in his bent towards literature. At the close of 1843 he published a collection of his poems, and a year later he gathered up certain ma- terial which he had printed, sifted and added to it, and produced Conversations on some of the Old Poets. The dialogue form was used merely to secure an undress man- ner of approach to his subject ; there was no attempt at the dramatic. The book reflects curiously Lowell's mind at this time, for the conversations relate only partly to the poets and dramatists of the Elizabethan period; a slight suggestion sends the interlocutors off on the discus- sion of current reforms in church aud state and society. Literature and reform were dividing the author's mind, and continued to do so for the next decade. Just as this book appeared Lowell and Miss White were married, and spent the winter and early spring of 1845 in Philadelphia. Here, besides continuing his literary contributions to magazines, Lowell had a regular engagement as an edi- torial writer on Tfie Pennsylvania Freeinan, a fortnightly journal devoted to the Anti-Slavery cause. In the spring of 1845 the Lowells returned to Cambridge and made their home at Elmwood. On the la.st day of the year their first child, Blanche, was born, but she lived only fifteen months. A second daughter, Mabel, was born six months after Blanche's death, and lived to survive her~~

~~father ; a third, Eose, died an infant. Lowell's mother meanwhile was living, sometimes at home, sometimes at a neighbouring hospital, with clouded mind, and his wife was in frail health. These family troubles and the tie of a narrow income conspired to make Lowell almost a recluse in these days, but from the retirement of Elmwood he sent forth writings which show how large an interest he took in affairs. He contributed poems to the daily p*ss, called out by the Slavery question ; he was, early in 1846, a correspondent of the London Daily News, and in the spring of 1848 he formed a connexion with the National Anti-Slavery Standard of New York, by which he agreed to furnish weekly either a poem or a prose article. The poems were most fre- quently works of art, occasionally they were tracts ; but the prose was almost exclusively concerned with the public men and questions of the day, and forms a series of incisive, witty, and some- times prophetic diatribes. It~~

~~was a period with him of great mental activity, and is represented by four of his books which stand as admirable witnesses to the Lowell of 1848, namely, the second series of Poems, con- taining among others " Columbus," " An Indian Summer Reverie," " To the Dandelion," "The Change- ling " ; A Fable for Critics, in which, after the manner of Leigh Hunt's The Feast of the Poets, he character- izes in witty verse and with good-natured satire Ameri- can contemporary writers, and in which, the publica- tion being anonymous, he included himself; The Vision of Sir Launfal, a romantic story suggested by the Arthurian legends — one of his most popular poems ; and finally TTie Biglow Papers.~~

~~Lowell had acquired a reputation among men of letters and a cultivated class of readers, but this satire at once brought him a wider fame. The book was not premedi- tated ; a single poem, called out by the recruiting for the abhorred Mexican war, couched in rustic phrase, and sent to the Boston Courier, had the inspiriting dash and elec- trifying rat-tat-tat of this new recruiting-sergeant in the little army of Anti-Slavery reformers. Lowell himself discovered what he had done at the same time that the public did, and he followed the poem with eight others either in the Courier or the Anti-Slavery Standard. He developed four well-defined characters in the process — a country farmer, Ezekiel Biglow, and his son Hosea ; the Rev. Homer Wilbur, a shrewd old-fashioned country minister ; and Birdofredum Sawin, a ISTorthern renegade who enters the army, together with one or two subordinate characters; and his stinging satire and sly humour are so set forth in the vernacular of New England, as to give at once a historic dignity to this form of speech. (Later he wrote an elaborate paper to show the survival in New England of the English of the early 17th century.) He embroidered his verse with an entertaining apparatus of notes and mock criticism. Even his index was spiced with wit. The book, a caustic arraignment of the course taken in connexion with the annexation of Texas and the~~

~~James Ktjbsell Lowell. (From a photograph by ElHoU and Fry, London,)~~

~~war with Mexico, made a strong impression, and the political philosophy secreted in its lines became a part of household literature. It is curious to observe how re- peatedly this arsenal was drawn upon in the discussions in~~

~~*America about the " Imperialistic " developments of 1900. The death of Lowell's mother, and the fragility of his wife's health, led Lowell, with his wife, their daughter Mabel, and their infant son Walter, to go to Europe in 1851, and they went direct to Italy. The early months of their stay were saddened by the death of Walter in Rome, and by the news of the illness of Lowell's father, who had a slight shock of paralysis. They returned in November 1862, and Lowell published some recollections of his journey in the magazines, col- lecting the sketches later in a prose volume. Fireside Travels. He took some part also in the editing of an American edition of the British Poets, but the low state*~~

~~*of his wife's health kept him in an uneasy condition, and when her death (27th October 1853) released him from the strain of anxiety, there came with the grief a readjustment of his nature and a new intellectual activ- ity. At the invitation of his cousin, he delivered a course of lectures on English poets before the Lowell In- stitute in Boston in the winter of 1855. This first formal appearance as a critic and historian of literature at once gave him a new stand- ing in the community, and was the occasion of his elec- tion to the Smith Professor- ship of Modern Language in Harvard College, then vacant by the retirement of Long- fellow. Lowell accepted the appointment, with the pro- viso that he should have a year of study abroad. He spent his time mainly in Germany, visiting Italy, and increasing his acquaintance with the Erench, German, Italian, and Spanish tongues. He returned to America in the summer of 1856, and entered upon his college duties, retaining his position for twenty years. As a teacher he proved himself a quickener of thought amongst students, rather than a close and special in- structor. His power lay in the interpretation of litera- ture rather than in linguistic study, and his influence over his pupils was exercised by his own fireside as well as in the relation, always friendly and familiar, which he held to them in the classroom. In 1856 he married Miss Erances Dunlap, a lady who had since his wife's death had charge of his daughter Mabel.*~~

~~*In the autumn of 1857 The Atlantic Monthly was established, and Lowell was its first editor. He at once gave the magazine the stamp of high literature and of bold speech on public affairs. He held this position only till the spring of 1861, but he continued to make the magazine the vehicle of his poetry and of some prose for the rest of his life ; his prose, however, was*~~

more abun- dantly presented in the pages of The North American Beview during the years 1862-72, when he was associated with Mr Charles Eliot Norton in its conduct. This maga- zine especially gave him the opportunity of expression of political views during the eventful years of the War of

the Union. It was in The Atlantic during the same period that he published a second series of The Biglow Papers. Both his collegiate and editorial duties stimu- lated his critical powers, and the publication in the two magazines, followed by republication in book form, of a series of studies of great authors, gave him an important place as a critic. Shakespeare, Dryden, Lessing, Rousseau, Dante, Spenser, Wordsworth, Milton, Keats, Carlyle, Thoreau, Swinburne, Chaucer, Emerson, Pope, Gray — these are the principal subjects of his prose, and the range of topics indicates the catholicity of his taste. He wrote also a number of essays, such as " My Garden Acquaint- ance," " A Good Word for Winter," " On a Certain Con- descension in Foreigners," which were incursions into the field of nature and society. Although the great bulk of his writing was now in prose, he made after this date some of his most notable ventures in poetry. In 1868 he issued the next collection in Under the Willows and other Poems, but in 1865 he had delivered his " Ode recited at the Harvard Commemoration," and the successive Cen- tennial historical anniversaries drew from him a series of stately odes.

In 1877 Lowell, who had mingled so little in party politics that the sole public office he had held was the nominal one of elector in the Presidential election of 1876, was appointed by President Hayes minister resident at the court of Spain. He had a good knowledge of Spanish language and literature, and his long-continued studies in history and his quick judg- ment enabled him speedily to adjust himself to these new relations. Some of his despatches to the home government were published in a posthumous volume — Impressions of Spain. In 1880 he was transferred to London as American minister, and remained there till the close of President Arthur's

~~*administration in the spring of 1885. As a man of letters he was already well known in England, and he was in much demand as an orator on public occasions, especially of a literary nature ; but he also proved himself a sagacious publicist, and made himself a wise interpreter of each country to the other. Shortly after his retirement from public life he published Democracy and other Addresses, all of which had been delivered in England. The title address was an epigrammatic confession of political faith as hopeful as it was wise and keen. The close of his stay in Eng- land was saddened by the death of his second wife in 1885. After his return to America he made several visits to England. His public life had made him more of a figure in the world ; he was decorated with the highest honours Harvard could pay officially, and with degrees of Oxford, Cambridge, St Andrews, Edinburgh, and Bologna. He issued another collection of his poems. Heartsease and Rue, in 1888, and occupied himself with, revising and rearranging his works, which were published in ten volumes in 1890. The last months of his life were attended by illness, and he died at Elmwood on 12th August 1891. After his death his literary executor, Charles Eliot Norton, published a brief collection of his poems, and two volumes of added prose, besides editing his letters.*~~

~~*The spontaneity of Lowell's nature is delightfully dis- closed in his personal letters. They are often brilliant, and sometimes very penetrating in their judgment of men and books ; but the most constant element is a pervasive humour, and this humour, by turns playful and senti- mental, is largely characteristic of his poetry, which sprang from a genial temper, quick in its sympathy with nature and humanity. The literary refinement which marks his essays in prose is not conspicuous in his verse, which is of a more simple character. There was an apparent conflict in him of the critic and the creator, but the conflict was*~~

~~*superficial. The man behind both critical and creative work was so genuine, that through his writings, and speech, and action he impressed himself deeply upon his generation in America, especially upon the thoughtful and scholarly class who looked upon him as especially their representative. This is not to say that he was a man of narrow sympathies. On the contrary, he was democratic in his thought, and outspoken in his rebuke of whatever seemed to him antagonistic to the»highest freedom. Thus, without taking a*~~

~~very active part in political life, he was recognized as one of the leaders of independent political thought. He found expression in so many ways, and was apparently so inexhaustible in his resources, that his very versatility and the ease with which he gave expression to his thought sometimes stood in the way of a recognition of his large, simple political ideality and the singleness of his moral sight.~~

~~Writings. — The Works of James Mussell Lowell, in ten volumes (Boston and New York, Houghton, Mifflin, and Co.), 1890 ; latest Literary Essays and Addresses, 1891 ; The Old English Dramatists, 1892 ; Conversations on some of the Old Poets (Philadelphia, David M'Kay) (reprint of the volume published in 1843, and subsequently abandoned by its author), 1893; The Power of Sound : a Bhymed Lecture (New York, privately printed), 1896 ; Lectures on English Poets (Cleveland, The Rowfant Club),~~

~~1899.~~

~~Memoirs. — Letters of James Bussell Lowell, edited by Charles Eliot Norton, in two volumes (New York, Harper and Brothers), 1899. — Life of James Bussell Lowell, by Horace E. Scuddeb (Houghton, Mifflin, and Co.), 1901. (h. e. S*.)~~

~~Lowenberg, a town of the province of Silesia, Prussia, 39 miles east of Gorlitz by rail. It is one of the oldest towns in Silesia, its town hall dating from the 16th century, and a Roman Catholic church from the 13th century (restored in 1862). In the town park there is a marble bust of Blilcher (1841) by Rauch, and a monument of the war of 1813 has been erected near by. There are sandstone and gypsum quarries, linen, cotton, and woollen mills, and cultivation of fruit and vegetables. Population (1901), 5293.~~

~~Lowestoft, a watering-place, seaport, and municipal borough in the Lowestoft parliamentary division of Sufiiolk, England, 23 miles south-west of Norwich by rail. In 1885 the town was incorporated, and it is now governed by a mayor, 8 aldermen, and 24 councillors. Technical schools have been built, the town is provided with electric light, and it is proposed to lay down municipal electric tramways. The new town, or South Lowestoft, has an esplanade which, joining the south pier of the harbour, forms a long promenade. The trawl basin was extended in 1892, nearly~~

~~doubling its size. About 600 smacks and fishing boats belong to the port. Altogether the harbour has between 6000 and 7000 feet of wharfage, and an area of about 50 acres, and the depth is 15-16 feet. The total value of the imports of foreign and colonial merchandise in 1900 was £148,883 ; of exports, £150,569. The port was entered and cleared by an aggregate of 1577 vessels of 226,079 tons in 1900. Population of municipal borough (2306 acres) (1881), 19,702; (1891),~~

~~23,347 ; (1901), 29,842.~~

~~Lozere, a department of the south-east of France, traversed by the Cevennes Mountains and watered by the Lot, the Tara, and the Allier.~~

~~Area, 1996 square miles. The population, 141,264 in 1886, had decreased to 124,049 in 1901. Births in 1899, 3438, of which 154 were illegitimate ; deaths, 2690 ; marriages, 839. There were in 1896, 848 schools, with 29,000 pupils, the illiterate constituting 3 per cent, of the population. Out of 1,361,600 acres of cultivated land in 1896, 387,960 acres constituted all the plough-land, the rest of the department being almost all occupied by mountain pastures. The wheat crop of 1899 was valued at only £64,000 ; meslin, £32,000 ; rye, £172,000; the other cereals at much smaller~~

~~values. The produce of the natural pastures and grass lands amounted in 1899 to the value of £312,000. The industrial crops (colza, rape, flax, &c.) make no figure in the official returns of 1899. The production of chestnuts, however, was valued at £41,000. Though in the returns of 1899 the production of mulberry leaves is left blank, yet the same year is credited with the production of 1685 cwts. of silk-worm cocoons. The live stock included in 1899, 317,670 sheep, 71,610 cattle, and 30,030 pigs, but domestic animals of other species were poorly represented. Mining in 1898 produced 900 tons of iron and 2600 tons of lead, while the metallurgic production reached a value of £1200. The industries are in a back- ward state. Mende, the capital, had, in 1901, 7319 inhabitants.~~

~~*Luang Prabang, capital of the Lao state of that name, situated on the Me Kong river in 19° 64' IS", and 102° 9' E. It nestles round the pagoda hill which rises about 200 feet above the plain on the promontory of land round which the Nam Kan winds to the main river. It has a population of about 9000 people. In 1887 it was taken and sacked by the Haw or Black Flags. In 1893 Siam was compelled to renounce her claims to the whole left bank of the Me Kong, including Luang Prabang andthemagnificent highlands of Chieng Kwang, which thus now form part of the French Indo-Chinese possessions. That portion of the state which was on the right bank of the Me Kong was not affected by the treaty, except in so far as a portion of it fell within the sixteen miles' zone within which Siam agreed not to keep troops. What trade there is, is in the hands of a few Chinese or Sham traders ; hill rice and other jungle products are imported from the surround- ing districts by the Ka or hill people. The exports, which include gum benjamin, silk, wax, sticklac, cutch, carda^ mom, a little ebony, cinnamon, indigo, rhinoceros and deer horns, ivory, and fish roe, formerly all passed by way of Paklai to the Me Nam, and so to Bangkok, but have now almost entirely ceased to follow that route, the object of the French Government being to deflect the trade through French territory. The whole annual trade of the district does not probably exceed £80,000 in value. (See Laos.)*~~

~~*Lubao, a town in the south-western portion of the province of Pampanga, Luzon, Philippine Islands. It lies in a low, fertile, and extensive plain, which is especially suited to the growing of sugar. Many of its inhabitants occupy themselves in the neighbouring nipa swamps, either preparing the nipa leaves for use in house construc- tion, or distilling alcohol from the juice secured by tapping the blossom stalks. Lubao has good water communication with Manila by means of tidal streams and Manila Bay, so that its products are readily marketed. The language is Pampangan. Population, 21,000.*~~

~~*LiJbben, a tovni of Prussia, province of Branden- burg, on the Spree, 47 miles by rail south-south-east of Berlin. It is the chief town of the Spreewald, and has saw-mills, shoe factories, &c., and is famous for its gurken, or small pickling cucumbers. Population (1900), 6818.*~~

~~*LiJbeck, a state and city of the German empire, situated on an arm of the Baltic Sea, between Mecklen- burg and Holstein. (1) The city stands on the river Trave, 10 miles above its entrance into the Bay of Lubeck. In spite of the tendency to modernize its streets and private houses, Liibeck, owing to its churches, town hall (restored), and one or two other public buildings, still preserves something of the character of a mediaeval town. The entrance hall of the Hospital of the Holy Ghost is a 13th-century chapel, restored in 1866, and painted by Olbers in 1898. Of modern buildings and institutions the most noteworthy are the law courts (1895), the Roman Catholic church (1889-91), the (Gothic) museum (1892), the synagogue (1880), the imperial post office (1885), the gymnasium (1891), the commercial institute, technical*~~

~~*school, school of navigation, teachers' seminary, deaf and dumb asylum, lunatic asylum, zoological gardens, a statue of the poet Geibel (1889), and a fountain (1875) com- memorative of the war of 1870-71. Geibel (1815-1884), like the painter Overbeck (1789-1869), was a native of Liibeck. This city is famous for the number as well as wealth of its charitable institutions. Its prosperity depends, and has always depended, principally upon its commerce. But its position as the first German emporium of the west end of the Baltic is being to some extent impaired by Hamburg and Bremen since the construction of the North Sea and Baltic Canal, and by the rapid growth and enterprise of Stettin. In order to counter- balance their rivalry, at all events to some extent, the quays have been extended, a canal (opened in 1900) has been constructed to connect the Trave with the Elbe, the river up to the wharves has been deepened to 25 feet or more (begun in 1900), and the harbour generally has been improved and enlarged. The river is kept open in winter by powerful ice-breakers. A new harbour was made in 1899-1900 on the Wakenitz Canal for boats engaged in inland traffic, more especially on the Elbe and Elbe-Trave Canal. Also, a new railway station is under construction on the right bank of the Trave, near the entrance to the port. Liibeck trades principally with Denmark, Sweden, Finland, Russia, the eastern provinces of Prussia, Great Britain, and the United States. The imports have increased in annual value from £9,721,700 in 1875 to £12,917,500 in 1895 and to £16,327,000 in 1899. The exports have likewise increased, namely, from £8,015,700 in 1875 to £10,553,000 in 1895 and to £12,975,000 in 1899. The number of vessels which entered the port*~~

~~increased from 2301 of 311,457 tons in 1880, to 2316 of 486,820 tons in 1895 and to 2820 of 556,650 tons in 1900. In this last year the merchant fleet numbered 26 vessels of 8830 tons. The industries are steadily growing in importance, the chief being breweries and distilleries, saw-mills and planing-mills, shipbuilding, fish-curing, the manufacture of machinery, engines, bricks, resin, preserves, enamelled and tin goods, cigars, furniture, soap, and leather. Population (1885),~~

~~55,399; (1895), 69,874; (1900), 82,098.~~

~~(2) The Free State (area, 115 square miles) embraces the city of Liibeck, the town of Travemtinde (population, 1800), and various villages, situated partly around and between these two, and partly as exclaves in Lauenburg and Holstein, the total population being 83,324 in 1895 and 96,775 in 1900, of whom 47,784 were males and 48,991 females. The people are nearly all (97-5 per cent.) of the Lutheran faith. The state income was £296,500 in 1900-1, and the expenditure £311,000. About one-half of the income is derived from direct and indirect taxes, and the other half from domain lands, from interests and dividends, and from contributions from Imperial taxes and customs (Lubeck joined the Zollverein in 1868). The state debt amounted in 1900 to £1,617,300. In 1900 the state's contribution to the empire amounted to £41,965. Liibeck has one vote in the Federal Council of the empire, and sends one representative to the Imperial Diet. In 1900 the state possessed 4003 horses, 8542 cattle, 10,485 pigs, and 3175 sheep. Hay, potatoes, oats, rye, and wheat are the principal crops cultivated. The breweries in 1899 produced 2,706,000 gallons of beer. (j. t. Be.)~~

~~Lublin, a province of Russian Poland, bounded on the north by Siedlce, on the east by Volhynia, on the south by Galicia, and on the west by Radom. Area, 6499 square miles. The surface is an undulating plain, built up of Cretaceous deposits, 800 to 900 feet in altitude, and reaching in one place 1060 feet ; it is covered with thick forests of oak, beech, and lime, is intersected by countless ravines, and is thinly inhabited. A wide marshy lowland spreads between the Vistula and the Wieprz. It is drained by the Vistula in the west and by the Bug along its eastern frontier, as well as by their tribu- taries— Wieprz, San, Tanew, and Kushva. Parts of the~~

~~province, being covered with black earth, are very fertile, but other parts are sandy. Owing to this fertility and the vicinity of good markets, agriculture is in a good condition and improving. Many Germans settled in the province before immigration was stopped by the law of~~

~~1887.~~

~~Nearly one-third of the total area is under forests ; meadows and pastures cover nearly 320,000 acres, and the remainder is under the plough. Rye, oats, wheat, and potatoes are the chief crops, rye and wheat being considerable items of export. Flax, hemp, and beetroot are also cultivated. There were in 1894, 194,191 horses, 377,465 horned cattle, and 368,827 sheep, of which a great number were of finer breeds. In 1897 the population was 1,201,549, of whom 604,886 were women. The Greek Orthodox (chiefly Little Russians in the south-east) numbered 241,523, Roman Catholics (i.6., Poles), 754,693; Jews, 170,541; Protestants, 83,669; and Baptists, 1086. The urban population was 148,196 in 1897. There were 34,107 military. The factories and other industrial establishments, 1538 in number, employ about 7000 workers, and consist chiefly of distilleries, sugar-works, steam flour-mills, tanneries, saw-mills, and factories of bent-wood furniture. Domes- tic industries are widely developed in the villages. The navigation of the rivers occupies a considerable portion of the population. There were in 1895, 610 schools, in which 30,183 children (7879 girls) received education, there being one school for every 1954, and one pupil for every 40 inhabitants. There was an agricultural institute at Nowa-Alexandrya, 1 seminary for teachers, 1 theological seminary, 6 gymnasia, 482 primary schools, and 105 Jewish heders. The government is divided into nine districts, the chief tovfns of which are Lublin, capital of the province (50,152 inhabitants in 1897) ; Bilgoray (6286) ; Chetm (19,236, with archaeological museum) ; HrubieszOw (10,699) ; Jan(5w (7927) ; Krasnystaw (8879) ; Lubartow (5249) ; Nowa-Alexandrya or Putawy (3892) ; and Tomaszow (21,041). (p. a. k.)~~

~~*Lubny, a district town of Russia, government of Pol- tava, 14 miles from the Eomodan station of the Kharkov- N"ikolaev railway. It is a very old town, being mentioned in 1107. Almost from its foundation gardening has been a favourite occupation of the inhabitants, and Peter I. founded here a botanic garden for the cultivation of medical plants. Gardening and the preparation of jam, dried and pickled vegetables, &c., are carried on as a trade. The town has a meteorological observatory, two gymnasia, a lower agricultural school, &c., and has lately been growing. Population (1897), 10,108, or 12,445 with the suburbs.*~~

~~*Lubrication. — Our knowledge of the action of oils and other viscous fluids in diminishing friction and wear between solid surfaces has within recent years under- gone a complete revolution, and from being purely empi- rical has become a connected theory, based on the known properties of matter, subjected to the definition of mathe- matical analysis and verified by experiment. The theory was published in 1886 (Phil. Trans. Boy. Soc, 1886, pt. i. pp. 157-2.34) ; but it is the purpose of this article not so much to explain its application, as to give a brief account of the introduction of the misconceptions that so long prevailed, and of the manner in which their removal led to its general acceptance.*~~

~~*A revolution of ideas in physical science can result only from some discrepancy between the actual results observed, in certain circumstances, and the conclusions arrived at for the same circumstances by means of geometrical and physical analyses. Such discrepancies are evidence that some circumstance has been left out of account in the previous analyses, and indicate the need for an extension of the theory, though they do not, of necessity, furnish any clue to the particular circumstance omitted or indi- cate the character of the extension required. The circum- stance, in respect of friction and lubrication, of which account was only taken after the year 1883, is altogether singular in the history of physics, since up to that year no one had any idea that our knowledge was other than purely empirical, involving no theoretical analysis, and*~~

~~*hence subject to no discrepancy. Priction, or resistance to tangential shifting of matter over matter, whatever the mode and arrangement, differs greatly according to the materials, but, like all material resistance, is*~~

~~*essentially limited. The range of the limits in available materials has a primary place in determining mechanical possi- bilities, and from the earliest times they have demanded the closest attention on the part of all who have to do with structures or with machines, the former being con- cerned to find those materials and their arrangements which possess the highest limits, and the latter the materials in which the limits are least. Long before the reformation of science in the 15th and 16th centuries both these limits had formed the subject of such empirical research as disclosed numerous definite although discon- nected circumstances under which they could be secured ; and these, however far from the highest and lowest, satis- fied the exigencies of practical mechanics at the time, thus initiating the method of extending knowledge which was to be subsequently recognized as the only basis of physical philosophy. In this purely empirical research the con- clusion arrived at represented the results for the actual cir- cumstance from which they were drawn, and thus afforded no place for theoretical discrepancies. However, in the attempts at generalization which followed the reformation of science, opportunity was afforded for such discrepancies in the mere enunciation of the circumstances in which the so- called laws of friction of motion are supposed to apply. The circumstances in which the great amount of empirical research was conducted as to the resistance between the clean, plane, smooth surfaces of rigid bodies moving over each other under pressure, invariably include the presence of air at atmospheric pressure around, and to some extent between, the surfaces ; but this fact had received no notice in the enunciation of these laws, and this constitutes a theoretical departure from the conditions under which the experience had been obtained. Also, the theoretical division of the law of frictional resistance into two laws — one dealing with the limit of rest, and the other asserting that the friction of motion, which is invariably less in similar circumstances than that of rest, is independent of the velocity of sliding — involves the theoretical assump- tion that there is no asymptotic law of diminution of the resistance, since, starting from rest, the rate of sliding in- creases. The theoretical substitution of ideal rigid bodies with geometrically regular surfaces, sliding in contact under pressure at the common regular surface, for the aerated surfaces in the actual circumstances, and the theoretical substitution of the absolute independence of the resistance of the rate of sliding for the limited independence in the actual circumstances, prove the general acceptance of the conceptions —*~~

~~*(1) That matter can slide over matter under pressure at a geometrically regular siirface ; (2) That, however much the resistance to sliding under any particular pressure (the coeflBcient of friction) may depend on the physical properties of the materials, the sliding under pressure takes place at the geometrically regular surface of contact of the rigid bodies ; and (3) as the consequence of (1) and (2), That whatever the effect of a lubricant, such as oil, might have, it could be a physical surface effect. Thus not only have these general theoretical conceptions, resulting from the theoretical laws of friction, failed to afford any indication that the lubricant may diminish the resistance by the mere mechanical separation of the surfaces, but they have absolutely precluded the idea that such might be the case. The result was that, notwithstanding the soundness of the method employed in the early start, and the continued efforts demanded by practical mechanics, all subsequent attempts to reduce the empirical facts, where a lubricant was used, to such general laws as might reveal the separate*~~

~~*functions of the somewhat complex circumstances on which lubrication depends, and so afford guidance for further extension, completely failed. Thus in the early- part of the year 1883 the science of lubrication had not advanced beyond the empirical stage.*~~

~~*This period of stagnation was terminated by an acci- dental phenomenon observed by Mr Beauchamp Tower, while engaged on his memorable research on the friction of the "journals" of railway carriages. His observa- tion led him to a line of experiments which afforded conclusive evidence that in these experiments the general function of the lubricant was the mechanical separation of the metal surfaces by a layer of fluid of finite thickness, thus upsetting once for all the preconceived ideas as expressed in the laws of the friction of motion. On the publication of Mr Tower's reports (Proc. Inst. M. E., November 1883), it was at once recognized by several physicists (B. A. Report, 1884, pp. 14, 626) that the evidence they contained afforded a rational basis for further study of the actions involved, indicating, as it does in no uncertain manner, the circumstances — namely, the properties of viscosity and cohesion possessed by fluids — account of*~~

~~*which had not been taken in the previous theoretical conclusions. When this was rec- ognized it also became apparent that continuous or steady lubrication, such as that of Mr Tower's experi- ments, is only secured when the solid surfaces sepa- rated by the lubricant are so shaped that the thickness at the ingoing side is greater than that at the outgoing side. With respect to what has already been said of the singular obscurity of the circumstances which were overlooked in the laws of friction, it is important to notice that the accidental circumstances which produced the phenomenon observed by Mr Tower are such as in all probability had never occurred before, so that their subse- quent recurrence was equally improbable. Moreover, up to the present time these circumstances are unique in respect of the evidence they afford as to the mechanical action of the lubricant, the thickness of the film of which, although finite, is much too small to admit of direct measurement.*~~

~~*Thus it was the discovery by Mr Tower that the lubricant separated the solid surfaces, which put an end to the period of stagnation ; while the appreciation of the significance of this discovery, which immediately followed, was the result of the preparation of the ground by the study of the properties of resistance possessed by all fluids to rates of distortional motion^ The analyses of the viscous properties of fluids, and of the motions of fluids, when these viscous resistances are taken into account, have exercised the highest powers of mathematicians, even when no boundaries had to be considered. When the general equations of viscous fluids had, as the result of the labours of Navier (1822),^ Cauchy,^ Poisson,^ St Venant,^ and in 1845 of Sir G. Gabriel Stokes,^ been shown to involve no other assumption than that the stresses, other than the pressure equal in all directions, are linear functions of the distortional rates of strain multiplied by a constant coefficient, it was found that the only solutions of which the equations admitted, when applied to fluids flowing between fixed boundaries, as water in a pipe, were singular solutions for steady or steady periodic motion, and that the conclusions they entailed, that the resistance would be proportional to the velocity, were for the most part directly at variance with the common experience that the resistances varied with the square of the velocity. This discrepancy was sometimes supposed to be the result*~~

~~1 M4m. de l'Acad.,yo. vi. p. 389.~~

~~2 M4m,. des Sav. Strang., vol. 1. p. 40.~~

~~s M^m. de I' Acad., vol. x. p. 345. < B. A. Report, 1846.~~

~~6 Cambridge Phil. Trans., 1845 and 1857.~~

~~of eddies in the fluid, but it was not till the year 1883 that it was discovered by experiments with colour bands that, in the case of geometrically similar boundaries the existence or non-existence of such eddies depended upon a definite relation between the mean velocity (U) of the fluid, the distance between the boundaries, and the ratio of the coefficient of viscosity to the density {p./p), ex- pressed by UD/3//j,=K, where K is a physical constant in- dependent of units, which has a value between 1900 and 2000, and for parallel boundaries D is four times the area of the channel divided by the perimeter of the section {Phil. Trans. B. S. part iii., 1883, pp. 935-982). K is thus a criterion at which the law of resistance to the mean flow changes suddenly (as U increases), from being proportional to the flow, to a law involving higher powers of the velocity at first, but as the rates increase approaching an asymptote in which the power is a little less than the square.~~

~~This sudden change in the law of resistance to the flow of fluid between solid boundaries, depending as it does on a complete change in the manner of the flow — from direct parallel flow to sinuous eddying motion — serves to deter- mine analytically the circumstances as to the velocity and the thickness of the film under which any fluid having a particular coefficient of viscosity can act the part of a lubricant. Por as long as the circumstances are such that UD/d//«, is less than K, the parallel flow is held stable by the viscosity, so that only one solutionis possible. — that in which the resistance is the product of ft. multiplied~~

~~by the rate of distortion, as u, — ; in this case the fluid~~

~~dy~~

~~has lubricating properties. But when the circumstances are such that TJDp/iJ. is greater than K, other solutions become possible, and the parallel flow becomes unstable, breaks down into eddying motion, and the resistance varies as pu", which approximates to pu^-"^ as the velocity increases ; in this state the fluid has no lubricating pro- perties. Thus, within the limits of the criterion, the rate of displacement of the momentum of the fluid is in- significant as compared with the viscous resistance, and may be neglected; while outside this limit the direct effects of the eddying motion completely dominate the viscous resistance, which in its turn may be neglected. Thus K is a criterion which separates the flow of fluid between solid surfaces as definitely as the flow of fluid is separated from the relative motions in elastic solids, and it is by the knowledge of the limit on which this distinction depends that the theory of viscous flow can with assurance be applied to the circumstance of lubrication.~~

~~Until the existence of this physical constant was discovered, any theoretical conclusions as to whether in any particular circumstances the resistance of the lubricant would follow the law of viscous flow or that of eddying motion was impossible. Thus Mr Tower, being unaware of the discovery of the criterion, which was published in the same year as his reports, was completely thrown off the scent in his endeavour to verify the evi- dence he had obtained as to the finite thickness of the film by varying the velocity. He remarks in his first report that, " according to the theory of fluid motion, the resistance would be as the square of the velocity, whereas in his results it did not increase according to this law." That such a discrepancy, had it not been immediately removed by the recognition of the existence of the criterion, must still have obscured the subject, affords a proof that Mr Tower's discovery occurred at the earliest time that physical science was ready for its full apprecia- tion. The rational theory of lubrication does not, how- ever, depend solely on the viscosity within the interior of fluids, but also depends on the surface action between the~~

~~fluid and the solid. In many respects tlie surface actions, as indicated by surface tension, are still obscure, and there has been a very general~~

~~*tendency to assume that there may be discontinuity in the velocity at the common sur- face. But whatever these actions may be in other respects, there is abundant evidence that there is no appreciable discontinuity in the velocity at the surfaces as long as the fluid has finite thickness. HIence in the case of lubri- cation the velocities of the fluid at the surfaces of the solids are those of the solid. In as far as the presence of the lubricant is necessary, such properties as cause oil in spite of its surface tension to spread even against gravity over a bright metal surface, while mercury will concentrate into globules on the bright surface of iron, have certainly an important place in securing lubrication where the action is intermittent, as in the escapement of a clock. If there is oil on the pallet, although the pressure of the tooth causes this to flow out laterally from between the surfaces, it goes back again by surface tension during the intervals ; hence the importance of using fluids with low surface tension like oil, or special oils, when there is no other means of securing the presence of tiie lubricant.*~~

~~*The differential equations for the equilibrium of the lubricant are what the differential equations of viscous fluid in steady motion become when subject to the conditions necessary for lubrication as already defined — (1) The velocity is below the critical value ;*~~

~~*(2) At the surfaces the velocity of the fluid is that of the solid ;*~~

~~*(3) The thickness of the film is small compared with the lateral dimensions of the surfaces and the radii of curvature of the surfaces. By the first of these conditions all the terms having p as a factor may be neglected, and the equations thus become the equations of equilibrium of the fluid ; as such, they are applicable to fiuid whether incompressible or elastic, and how- ever the pressure may affect the viscosity. But the analysis is greatly simplified by omitting all terms depending on compres- sibility, and by taking jm constant ; this may be done without loss of generality in a qualitative sense. With these limitations we have for the differential equation of the equilibrium of the lubricant : —*~~

~~*^ dp o . , . du dv dw*~~

~~*Q=p.*~~

~~'^\dy dxj' '~~

~~(1)~~

~~These are subject to the boundary conditions (2) and (3). Taking x as measured parallel to one of the surfaces in the direction of relative motion, y normal to the surface, and z normal to the plane of xy by condition (3), we may without error disregard the effect of any curvature in the surfaces. Also H is small compared with u and w, and the variations of u and w in the directions x and z are small compared with their variation in the direction y. The equations (1) reduce to~~

~~f._dp dho ^~di'^df>~~

~~_ dp d'^w "dz~'^dAf'~~

~~n — — 4. — I ^1 ~ dx dy dz '~~

~~Q=PyX~~

~~^dy'~~

~~0=Pyz-/^-~~

~~dw~~

~~(2)~~

~~J'»=0.~~

~~For the boundary conditions, putting f(x, z) as limiting the lateral area of the lubricant, the conditions at the surfaces may be expressed thus : —~~

~~when2/ = 0, M=Uo, w=0, v=0~~

~~Tf/h.eny = h, m=U], w=0, when /(a!, z) = 0, p~~

~~TT dh .-~~

~~r •~~

~~(3)~~

~~Then, integrating the equations (2) over y, and determining the constants by equations (3), we have, since by the second of equations (2) p is independent of y,~~

~~(4)~~

~~Then, differentiating equations (4) with respect to x and z respectively, and substituting in the 4th of eqiia.tions (2), and integrating from y = 0 to y=h, so that only the values of v at the~~

~~surfaces may be required, we have for the differential equation of normal pressure at any point x, z, between the boundaries : —~~

~~^.(^f)-l(^f)=«4(^o.U,g.2y.} . (5)~~

~~Again differentiating equations (4), with respect to x and z respectively, and substituting in the 5th and 6th of equations (2), and putting /a; and/j for the intensities of the tangential stresses at the lower and upper surfaces : —~~

~~"h^2dx~~

~~/.—~~

~~.hdp~~

~~(6)~~

~~Equations (5) and (6) are the general equations for the stresses at the boundaries at x, z, when A is a continuous function of x and z, fj, and p being constant.~~

~~For the integration of equations (6) to get the resultant stresses and moments on the solid boundaries, so as to obtain the con- ditions of their equilibrium, it is necessary to know how x and z at any point on the boundary enter into h, as well as the equation f(x, z) = 0, which determines~~

~~*the limits of the lubricating film. If y, the normal to one of the surfaces, has not the same direc- tion for all points of this surface, in other words, if the surface is not plane, x and z become curvilinear co-ordinates, at all points perpendicular to y. Since, for lubrication, one of the surfaces must be plane, cylindrical, or a surface of revolution, we may put x = 'R.B, 2/=r-E, and z perpendicular to the plane of motion. Then, if the data are sufficient, the resultant stresses and moments between the surfaces are obtained by integrating the intensity of the stress and moments of intensity of stress over the surface.*~~

~~*This, however, is not the usual problem that arises. What is generally wanted is to find the thickness of the film where least (Aq), and its angular position with respect to direction of load, to resist a definite load with a particular surface velocity. If the surfaces are plane, the general solution involves only one arbitrary constant, the least thickness (fi^) ; since in any par- ticular case the variation of h with x is necessarily fixed, as in this case lubrication affords no automatic adjustment of this slope. When both surfaces are curved in the plane of motion there are at least two arbitrary constants, A,,, and*~~

~~*The integrations necessary for the solutions of these problems are practicable — complete or approximate — and have been effected for circumstances which include the chief cases of practical lubrication, the results having been verified by reference to Mr Tower's experiments. In this way the verified theory is available for guidance out- side the limits of experience as well as for determining the limiting conditions. But it is necessary to take into account certain subsidiary theories. These limits depend on the coefiicient of viscosity, which diminishes as the temperature increases. The total work in overcoming the resistance is spent in generating heat in the lubri- cant, the volume of which is very smaU. Were it not for the escape of heat by conduction through the lubricant and the metal, lubrication would be impossible. Hence a knowledge of the empirical law of the variation of the viscosity of the lubricant with temperature, the coefiicients of conduction of heat in the lubricant and in the metal, and the application of the theory of the flow of heat in the particular circumstances, are necessary adjuncts to the theory of lubrication for determining the*~~

~~*limits of lubrication. Nor is this all, for the shapes of the solid surfaces vary with the pressure, and more particularly with the temperature.*~~

~~*The theory of lubrication has been applied to the explanation of the slipperiness of ice. See Manchester Memoirs, 7th February 1899. (o. R.)*~~

~~*LuCCaf a town, archiepiscopal see, and capital of the province of Lucca, Tuscany, Italy, 13 miles by rail north- east of Pisa. In the city, which is still encircled by its*~~

~~*mediaaval -walls, there is a marble monument to Duchess Maria Louisa, - who in 1820 built the aqueduct of 459 arches which brings water from the Pisan hills. The cathedral treasures embrace sculptures and other artistic objects, and a collection of 4000 MSS. In San Francesco, one of the seventy churches, are the tomb of Castruccio Castracane and the mausoleum of the Guidiccioni ; while the figure of the archangel which crowns San Michele is the most conspicuous object within the city walls. There are also a technical school and an institute of music. The river Serchio affords water-power for numerous factories. The most important branches of industry are the manu- facture of jute goods, tobacco, silks, and cottons. Lucca was the birthplace of the sculptor Civitale (1436-1501), whose masterpieces adorn the cathedral and the church of the Santa Trinita. Population (1881), 68,063; (1901),*~~

~~*74,718.*~~

~~*Ltjoca, Baths of. — The sketch in Heine's Reisehilder : II. Italien, should be mentioned. Population (1881),*~~

~~*8241 ; (1898), 9000.*~~

~~*LuCCflcl, a town of Spain, in the province of Cor- doba. The population in 1897 was 21,087. The local trade in agricultural products is still important, but the industries have greatly declined, except the manufactures of brandy,*~~

~~*matches, and earthenware, especially the large jars used to contain oil or wine, some of which hold over 300 gallons. ,*~~

~~*Lucerne, one of the cantons of Switzerland, ranking next to Zurich and Bern. Its total area is 579 square miles; woods occupying 119 square miles; vineyards, •1 ; and arable or pasture land, 408| square miles. The loftiest point in the canton is Pilatus (6995 feet), to near the summit of which a cog-wheel railway runs from Alpnach-Stad, while on the other side of the lake is the equally accessible and famous ridge of the E,igi (5906 feet). The population of the canton in 1880 was 134,708, and in 1900, 146,912. In 1900 there were 253 in- habitants to the square mile. The Protestants had risen from 3823 in 1870 to 12,406 in 1900; in 1888 there were 201 Jews, and in 1900, 336 ; the rest of the popu- lation was Romanist. Practically the whole population is German-speaking; there were 2302 Italians and 781 French- speaking persons in 1900. The cantonal constitution of 1875 has only been slightly modified. There is a legisla- ture, elected in the fifty-fi.ve electoral circles by a popular vote, and holding oflSce for four years, as does the executive of seven members, elected by the legislature. Five thousand citizens can demand a " facultative referendum" as to all legislative projects, or the revision of the cantonal constitution, and can also end the mandate of the cantonal legislature before its term of office has expired. In 1893 a cantonal vote refused to sanction the introduction of proportional representation as to the election of members of the cantonal legislature. The state revenue of Lucerne in 1897 was 2,115,860 francs (a rise of 33J per cent, since 1885) ; and the state expenditure, 2,116,112 francs (a rise of 32^ per cent, since 1885); but in 1898 there was a deficit of 35,792 francs. In 1897 the public debt of the canton was 6,789,000 francs.*~~

~~*See Geschichtsfreund (organ of the Hist. Soo. of the Four Forest Cantons). From 1844.— Ton Liebenau. Das alte Luzern. Lucerne, 1881. — PFYFrER. Geschichte d. Sladt u. JCant. Luzern. New edition, 2 vols. Lucerne, 1861. — VoN Segessee. EecUsge- schichte d. Staat u. Repuhlik Luzern. 4 vols. Lucerne, 1850-58 ; and 45 Jahre (1841-1887) im Luzernischen Staatsdienst. Bern,*~~

~~*1887. Sowerby. Tlie Forest Cantons of Switzerland. London,*~~

~~*1892! (w. A. B. c.)*~~

~~*Lucerne, the chief town of the Swiss canton of that name. Lucerne is the tourist capital of Switzerland, being on the main route between Basel (59 miles distant*~~

~~*by rail) and Italy vid the St Gothard Railway. Its prosperity has always been bound up with the St Gothard Pass, so that the successive improvements effected on that pass (mule path in the 13th century, carriage road in 1820-30, railway in 1882) have always had much influence on its growth. In 1880 the population of the town was 17,768, and in 1900 it was 29,600. The inhabitants are mostly Romanist and German — speaking. In 1888 there were 2757 Protestants (as against 1912 in 1880) and 182 Jews, while 293 persons were French- speaking and 285 Italian-speaking.*~~

~~*The prehistoric antiquities, trophies from Sempach, &c., are all in the Eathhaus, not in the Cantonal Museum. It is the town (not the cantonal) library that is so rich in works relating to Swiss history ; it is now the official centre wherein are gathered all such works or MSS. dating from before the Beformation. Next to the Lion Monument is the " Glacier Garden," a series of potholes worn in the rock bed of an ancient glacier by the action of water which whirls round stones ; some of the actual stones still exist in situ.*~~

~~*The Lake of Litceene (Vierwaldstdttersee) is often called the "Lake of the Four Forest Cantons" (i.e., Uri, Schwyz, Unter- walden, and Lucerne), but this is a mistranslation, for "wald" does not here mean "forest," but is a historical corruption of " vallis," so that the name simply means the four Alpine valleys that lie round the lake. The area of the lake is 44i square miles ; of this 16J square miles belong to the canton of Lucerne, 13 square miles to Nidwalden, 1 square mile to Obwalden, 7J square miles to Uri, and 74 square miles to Schwyz. Its height above the sea- level is 1434 feet, whQe its maximum depth is 702 feet. The Biirgenstein is properly the Biirgenstock, and thither a funicular railway leads up from Kehrsiten, while from Alpnach-Stad a line runs up to Pilatus, and from Vitznau another to the Eigi. Fliielen is the port of Altdorf, and Brunnen of Schwyz — in each case both places are on the St Gothard Railway. It is possible (though authentic history is silent on the point) that meetings on the GrUtli (properly Eiitli, i.e., the little "clearing" in the forest) may have taken place*~~

~~*before the first league of 1291, or the second (after Morgarten) in 1315. But the date of 1307 was invented by Tschudi, and is historically quite impossible. (w, a. b. C.)*~~

~~*Luchu ArchipelagfO, The (called alsoRiuKiu,*~~

~~*Loo-CHOO, and Lixjkiu), a long chain of islands stretch- ing from a point 80 mUes south of Kiushiu to a point 73 miles distant from the north-eastern coast of Formosa, and lying between 24° and 30° N. and 123° and 130° E. The almost equal proximity of the islands to Japan on the north and to the formerly Chinese island of Formosa on the south accounts for the dual allegiance their inhabitants paid for many years to the two neighbour- ing empires, and also for the mixture of Japanese and Chinese elements in their civilization. The islanders themselves carry their histoiy far back into the ages, but we do not find ourselves upon unquestionably solid ground until the beginning of the 17th century, when the feudal chief of Satsuma, resenting an attempt on the part of the islanders to sever relations with Japan, invaded Luchu and annexed the northern section of the archipelago. China, on the other hand, though receiving periodically from the Luchuans presents which she interpreted as tribute, and though taking a benevolent interest in the welfare of the islanders, never made any display of force or attempted to bring them under her military sway. The practical incongruity of that state of affairs did not force itself upon Japan's attention so long as her own empire was divided into a number of semi-independent principalities. But in 1879 the Japanese Government, treating Luchu as an integral part of the Mikado's dominions, dethroned its prince, pensioned him as the other feudal chiefs had been pensioned, and converted Luchu into a prefecture under the narne of Okinawa. This name signifies " extended rope," and alludes to the lengthy attenuated nature of the archipelago. China remonstrating, a conference was held in Peking, when plenipotentiaries of the two empires signed an agree- ment in the sense that the archipelago should be*~~

~~divided equally between the claimants. The Chinese Government, however, refused to ratify this compromise, and the Japanese, abandoning all hope of an amicable settlement, continued their measures for the effective administration of all the islands. Ultimately (1895) Formosa also came into Japan's possession, and her title to the whole chain of islands is no longer disputed.~~

~~Japanese cartographers reckon the Luchu islands as 55, having a total coast-line of 768 miles, an area of 935 square miles, and a population of 453,550 (1898). They divide them into three main groups, of which the northern is called Oshima-shoto ; the central, Okinawa-gunto ; and the southern, Sakishima-retto. The terms shotd, guntd, and rettd signify " archipelago," " cluster of islands," and " string of islands " respectively. The last-named group is subdivided into Miyako-gunto and Yayeyama-gunto. The principal islands of these various groups are : —~~

~~Anami-Oshima Tokuno-shima~~

~~Okinawa-jima Kume-jima Okinoerabu-jima Ihaya-jima~~

~~Oshima-shotd —~~

~~34 miles long and 17 broad 16 11 11 8J ,,~~

~~OTcinawa-guntd —~~

~~63J miles long and 14J broad 9f „ „ 7^ „~~

~~"^ 11 11 " 11~~

~~5 ,, „ 2^ ,,~~

~~MiyaJco-guntd —~~

~~12J miles long and 12 broad~~

~~Miyako-jima Erabu-jima~~

~~Yayeyama-guntd — Ishigaki-jima . . 24^ miles long and 14^ broad Iriomote-jima . . 14 J ,, ,, 14 ,,~~

~~Yonakuni-jima . . 7| „ ,, 3J ,,~~

~~The remaining islands of the archipelago are of very small size. Almost at the extreme north of the chain there are two islands with active volcanoes : Nakano-shima (3485 feet), and Suwanose- jima (2697 feet), but the remaining members of the group give no volcanic indications, and the only other mountain of any size is Yuwan-dake (2299 feet) in Anami-Oshima. The capital town is Shuri in Okinawa, with a population of 24,809. The scenery of Luchu is unlike that of Japan. Though so close to the tropics, the islands cannot be said to present tropical features : the bamboo is rare ; there is no high grass or tangled undergrowth ; open plains are numerous ; the trees are not crowded together ; lakes are wanting ; the rivers are insignificant ; and an unusual aspect is imparted to the scenery by numerous coral crags. The climate is, of course, much warmer than that of Japan, the mean normal temperature in Nafa, the chief town of Okinawa, being 22° 5' C, whereas that in T6ky6 is only 14° C. The maximum range of the thermometer during summer does not greatly differ in the two places ; but while the lowest reading for T6ky6 . in winter is — 6° 4' C, the corresponding figure at Nafa is 8° 3' C, a difference of over 14° C.~~

~~Luchu is noted for the production of particularly durable vermilion-coloured lacquer, which is much esteemed for table utensils in Japan. The islands also manufacture certain fabrics which are considered a speciality. These are BiuJciu-tsumugi, a kind of fine pongee ; the so-called Satsuma-gasuri, a cotton fabric greatly used for summer wear ; basho-fu, or banana^cloth (called also aka-basho), which is woven from the fibre of a species of banana ; and hoso-jofu, a particularly fine hempen stuff, made in Miyako-jima, and demanding such difficult processes that six months are required to weave and dye a piece 9J yards along.~~

~~It has been generally agreed by competent observers that although the upper classes in Luchu and Japan resemble each _ other almost to identity, there are palpable diHer- tlo'n'aa'tl ^noes between the lower classes, the Luohuans being customs. shorter and better proportioned than the Japanese, having higher foreheads, eyes not so deeply set, faces less~~

~~*flattened, arched and thick eyebrows, better noses, less marked cheek-bones, and much greater hairiness. The last characteristic has been attributed to the presence of Ainu blood, and has suggested a theory that when the Japanese race entered south-western Japan from Korea, they drove the Ainu north- wards and southwards, one portion of the latter finding their way to Luchu, the other to Yezo. Women of the upper class never appear in public in Luchu, and are not even alluded to in conversation, but women of the lower orders go about freely with uncovered faces, attending market, carrying loads on their heads, and doing their share of agricultural labour. The Luchu costume*~~

~~*resembles that of Japan, the only marked difference being that the men use two hairpins, made of gold, silver, pewter, or wood, according to the rank of the wearer. Young men shave their faces until the age of twenty-five, after which moustache and beard are allowed to grow, though the cheeks are kept free from hair. Their burial customs are peculiar. The ooi-pse, immedi- ately after death, is concealed by curtains and guarded by relatives, who also accompany it to the grave. The mourning, however, is done by professionals, who on the way to the tomb groan, stagger, and weep as though they were completely over- come with grief. Sepulchres are generally mitre-shaped, and are scattered all over the country, according to Chinese fashion. In the third year after interment, the nearest of kin wash the bones and deposit them " in earthenware urns of curious make, orna.- mented with the lotus and other emblems that bear witness to a formerly penetrating Buddhist influence, now almost extinct. The remains of married couples rest together in the same large urn. Bachelors and spinsters — but Luchu harbours few such — have urns half the size. All the urns of a family are ranged round the interior of the vault on shelves, in order of precedence." The marriage customs are still more peculiar. Preliminaries are negotiated by a middleman, as in China and Japan, but the subsequent procedure takes the following form: — "The bride is escorted to the man's house at one or two o'clock in the morning, surrounded by all her relations. . . . She and the bridegroom exchange cups of sake" — precisely the Japanese custom — "after which she is at once led home again. This brief ceremony is repeated three nights running, after which she re- mains three days with her parents, while the bridegroom is carried off by his friends to a brothel, where they hold high revel. The object of this step, so far as the*~~

~~*man is concerned, is that he may, on the very threshold of matrimony, prove his independence of wifely leading-strings, while to the woman it gives an opportunity to display freedon^from jealousy, which is considered the worst of all feminine vices. After three days spent in this manner, the bridegroom goes home, being joined by the bride, who keeps house with him for another period of three days, at the expira- tion of which the bride goes to her parents' home, whither the bridegroom follows her. Her relations await his arrival with a pestle, painted and ornamented to represent a horse, on which he rides in, while all the boys of the neighbourhood greet his advent with drums and tomtoms and anything that will make a noise. A grand family feast then takes place, after which the happy couple return home, and the long wedding ceremonies are at last concluded."*~~

~~*The chief staple of the people's diet is sweet potatoes, and pork is the principal luxury, as in China. An ancient law, still in force, requires each family to keep four pigs. In times of scarcity a species of sago (obtained from the Cycas revoluta) is eaten. The country is infested with venomous snakes called habu (Trimere- sunis), which attain a length of from 6 to 7 feet and a diameter of from 2J to 3 inches. Their bite generally causes speedy death, and in the island of Anami-Oshima they claim many victims every year. There is a remarkable absence of religious influence in Luchu. Places of worship are scarcely to be seen, and the only function now discharged by Buddhist priests seems to be to officiate at funerals. On the other hand, the people are dis- tinguished by gentleness, courtesy, and docility, as well as by marked avoidance of crime and practical love of peace. With the exception of petty thefts, their Japanese administrators find nothing to punish, and for nearly three centuries no such thing as a lethal weapon has been known in Luchu. Professor Chamberlain records his opinion that the Luchuan language resembles the Japanese in about the same degree as Italian resembles French, and says that a little investigation proves the two to be sister tongues, many words being identical, others differing only by letter changes which follow certain fixed analogies, and sentences in the one being capable of translation into the other word for word, almost syllable for syllable. (p. by.)*~~

~~*Luckenwalde, a town of Prussia, on the Nuthe, 30 miles south of Berlin by rail, in the circle of Jliterbog- Luckenwalde, government district of*~~

~~Potsdam, province of Brandenburg. It has three Protestant churches, a Catholic church, a rea?-progymnasium, a higher-grade school, cloth, hat, bronze- ware, paper, and enamel factories, wool-spinning, and machinery works. Population (1890),~~

~~18,398 ; (1900), 20,986.~~

~~Lucknow, a city, district, and division of British India, the capital of Oudh, mainly on the right bank of the winding river G-umti, which is crossed by two railway and three road bridges, 364 feet above the sea ; 46 miles by rail north-east of Cawnpore, and 610 miles from Calcutta. Area,~~

~~about 13 square miles. Population (1881), 261,303; (1891), 273,028 ; (1901), 263,951, being the fifth largest city in India. The municipality of Lucknow, with a popu- lation of 267,910, is governed by a board of 32 members, of whom 24 are elected, with the district magistrate as ex officio chairman. The municipal income in 1897-98 was Rs.3,96,439, of which Rs.2,70,961 was derived from octroi; incidence of taxation, E.l:2:2 per head. The water-works supply annually about 350,000,000 gallons of filtered water, at a total cost of about 6 annas per thousand gallons. During 1897-98, Es.66,788 was expended on water-supply, Es.6856 on drainage, and Es.29,666 on other public works. The death-rate in 1897 was 56-03 per thousand, compared with an average of 42*47 for the previous five years. The chief educa- tional institution is the aided Canning College, with an Oriental department; the number of students in 1896-97 was 268. There are also two unaided colleges, the Christian and the Women's, with a total of 34 students ; the Colvin School, for sons of Taluqdars, the landlords of Oudh, with 32 piipils, of whom 14 were Mahommedans ; the Crosthwaite Girls' School, for the higher education of native ladies, under an English lady superintendent, supported by an endowment of about Es.2,00,000, with 19 pupils ; the Martinifere, where about 160 soldiers' children are educated entirely free of expense out of a foundation left by General Claude Martin in 1800 ; and several high schools. Mention should also be made of the Lady Lyall Hospital, with an endowment of about Es.1,00,000 ; and of the~~

~~*Government lunatic asylum, with 247 inmates. There are about 140 printing-presses, issuing 3 English and 30 vernacular newspapers. The largest manufactory is a paper-mill, eniploying 660 hands, with an out-turn valued at Es. 7,60,000. There are also a fiour-mill, and factories for ice and mineral waters. The native manufactures of gold and silver brocade, muslins, embroidery, glasswork, and moulding in clay maintain their reputation. Lucknow is the centre of the Oudh and Eohilkhand railway system, with large workshops. Lines radiate to Cawnpore, Bareilly, Gonda, Paizabad, and Eae Bareli. In 1898 the last line was extended to Benares, 139 miles. Lucknow is the headquarters of the Oudh military division. The cantonments, 3 miles east of the city, usually contain 3 batteries of artillery, and both European and native regiments of cavalry and infantry.*~~

~~*The district of Lucknow lies on both sides of the river Gumti. Area, 967 square miles ; population (1881), 696,824 ; (1891), 774,163 ; and (1901), 793,334, showing an increase of 11 per cent, between 1881 and 1891, and of 2-47 per cent, between 1891 and 1901 ; average density, 820 persons per square mile ; land revenue and rates, Ks. 7,65,965, the incidence of assessment being E.l:7:0 per acre ; cultivated area, 277,183 acres, of which 108,611 were irrigated from wells, &o. ; number of police, 2591 ; number of vernacular schools (1896-97), 76, with 3244 pupils; death-rate (1897), 43-38 per thousand.*~~

~~*The division of Lucknow contains the western half of Oudh. It comprises the six districts of Lucknow, Unao, Sitapur, Rae Bareli, Hardoi, and Kheri. Area, 12,040 square miles ; popula- tion (1881), 5,325,601 ; (1891), 6,856,559; and (1891), 5,977,116, showing an increase of 10 per cent, between 1881 and 1891, and of 2-06 per cent, between 1891 and 1901 ; average density, 496 persons per square mile. (j. s. Co.)*~~

~~*Lucon, a French town in the arrondissement of Eontenay-le-Comte, department of Vendee, 19 miles south- east of La Eoche sur Yon, on the railway from Kantes to Bordeaux, and on the canal of Lucon (9 miles long), which affords communication with the sea in the Bay of Aiguillon. Between Lucon and the sea stretch wide marshy plains, the bed of the former gulf, partly drained by numerous canals, and in the reclaimed parts yielding excellent pasturage, while in other parts are productive salt-marshes, and*~~

~~*ponds for the rearing of mussels and other shell-fish. Lucon is the seat of a bishopric, estab-*~~

~~*lished in 1317, and held by Eichelieu from 1607 to 1624, but the cathedral church, partly of the 11th century and partly of various later periods, was originally an abbey church. The faqade and the clock tower date from about 1700, and the tower is surmounted by a notched spire rising to a height of 275 feet above the ground, attributed to the architect Francois Leduc of Tuscany. In the choir, which dates from the 14th century, are some remains of mural paintings. The cloisters are of the 15th or 16th century. Adj acent is the bishop's palace, with a theological library of 30,000 volumes, and there is a very fine public garden. The town has some small industries, including the manufacture of liqueurs, mustard, clogs, and boot- heels, and iron and copper founding. Population (1881),*~~

~~*6836 ; (1901), 6767.*~~

~~*LiJdenscheid, a town of Prussia, province of Westphalia, 19 miles by rail south-south-east of Hagen. It is the seat of various hardware manufactures (metal- plated and tin-plated goods, buckles, fancy nails, &c.), iron-foundries, and machine shops, and has a couple of churches, and monuments to the Emperor William I. and the war of 1870-71. Population (1885), 15,067 ; (1900),*~~

~~*25,520.*~~

~~*Ludhiana, a town and district of British India, in the Jullundur division of the Punjab. The town is 8 miles from the present left bank of the Sutlej, 228 miles by rail north-west of Delhi. Population (1881), 44,163 ; (1891), 46,134; municipal income (1897-98), Es.84,381; death- rate (1897), 46 per thousand. It is an important centre of trade in grain, and has manufactures of shawls, &c., by Kashmiri weavers, and of scarves, turbans, furniture, and carriages. The municipality has raised a loan of Es.38,000 for sewerage works. There is an American Presbyterian mission, besides a medical school for Chris- tian women, founded in 1894, with a staff of four lady doctors and 24 students in 1896-97 ; three high schools, including a Christian boys' boarding-school; 2 middle schools; a Sanskrit school; and an industrial school, opened in 1896, with 77 pupils. There are ten printing-*~~

~~*presses, issuing five newspapers and periodicals, and four religious and educational associations.*~~

~~*The district of Ludhiana lies south of the river Sutlej, and north of the native states of Patiala, Jbind, Nabha, and Maler Kotla. Area, 1453 square miles; population (1881), 618,835; (1891), 648,722; (1901), 673,502, showing an increase of 5 per cent, between 1881 and 1891, and of 3-82 per cent, between 1891 and 1901 ; average density, 463 persons per square mile. The land revenue and rates in 1897-98 were Rs.ll, 16,131, the incidence of assessment being R.l:4:2 per acre; cultivated area, 669,236 acres, of which 275,292 were irrigated from wells, &c., including 91,383 from Government canals; number of police, 507 ; number of schools (1896-97), 275, attended by 9489 boys, being 16 per cent, of the boys of school-going age; death-rate (1897), 34-7 per thousand. The principal crops are wheat, millet, pulse, maize, and sugar-cane. The district is crossed by the main line of the North- Western railway from Delhi to Lahore, 35 miles. Part of it is watered by the Sirhind canal.*~~

~~*Ludington, a city of Michigan, U.S.A., capital of Mason county, on the western shore of the Lower Peninsula of Michigan, on the Pere Marquette railroad, at an altitude of 587 feet. It has an excellent harbour and much lake commerce. It contains several saw-mills and other wood-working establishments. Population*~~

~~*(1880), 4190; (1890), 7517; (1900), 7166.*~~

~~*Ludinovsk, a town of Eussia, government of Kaluga, 27 miles by rail from the Zhukovka station of the Orel and Smolensk railway. It belongs to the group of iron and glass works, the so-called " Maltsoff's Works." It was founded in 1755, but attained its present import- ance after 1875, when iron works and large locomotive and railway-carriage works were opened. Population (1897),*~~

~~*12,000.*~~

~~*L U D W I G II.*~~

~~*Ludwig II., Otto Friedrich Wilhelm, king of Bavaria (1846-1886), was born at Munich, on the 25th of August 1845, as eldest son of Prince Maximilian, son and heir to the king, Ludwig I. His mother was Maria, daughter of Prince William of Prussia (brother of King Priedrich William III.), and therefore first cousin to the Emperor William I. ; she joined the Roman Catholic Church iu 1874, and died in 1889. During the revolu- tion of 1848 Ludwig I., whose passion for Lola Montez had caused a temporary quarrel between him and his subjects, abdicated; he lived in retirement till 1868. Maximilian, who then succeeded, died on the 10th of March 1864 ; Ludwig therefore came to the throne at the early age of eighteen. From both his father and grand- father he had inherited a keen interest in art, and almost the first use which the young king made of his power was to summon Richard Wagner to Munich. Admira- tion for his musical genius became the basis for a warm personal friendship, which was looked on with much dis- pleasure by the people of Munich, and especially by the Clerical party, who declared that Wagner was a Prussian agent. Tbe king caused his operas to be performed, and formed great projects of establishing a new school of music under Wagner's direction, as well as of enabling the musician to realize his dream of a magnificent festi- val-house for opera and concerts, a plan to which he was naturally attracted by his hereditary taste for building. He was, however, compelled to give way before the opposition of his ministers and subjects, and had eventu- ally to request Wagner to leave Munich. The friendship thus begun continued till Wagner's death ; on more than one occasion the king visited him privately in Switzer- land, and he gave valuable support and assistance to the erection of the opera-house at Bayreuth. From the first Ludwig's interest in political affairs was spasmodic and uncertain; he showed at times much intelligence and insight, but after the first year of his reign he avoided appearing in public, and caused much inconvenience to his ministers by prolonged absence. His strongest feel- ing was dislike to the Ultramontanes, and in tbis he continued the policy of his house, but it was increased by their opposition to Wagner. He took no part and apparently little interest in the crisis of 1866, though the very existence of Bavaria was in danger, but after the war was over he gave his warm support to the Liberal ministry of Hohenlohe, and characteristically, as a symbol of the new alliance with Prussia, offered the Prussian king the joint*~~

~~ownership of the castle of Nuremberg, the ancient home of the Hohenzollems. When Hohenlohe was defeated in the election of 1869 the king refused to accept his resignation, and would not receive a deputation from Parliament which called to present an address praying him to dismiss his ministers : he reprimanded those members of the royal family, in- cluding his uncle Prince Luitpold, who had voted against his ministers. He was obliged eventually to accept Hohenlohe's resignation, but his dislike of the Ultramon- tanes was of much value to Germany, when in 1870 he came for a short term into a position of great political importance. A considerable party in Bavaria would gladly have refused the assistance which by treaty they were bound to give to Prussia; the king, however, by promptly ordering the mobilization of the army, ensured the fidelity of Bavaria to the German cause. As in 1866, he took no part in the campaign, and he was one of the very few German princes who never appeared at Ver- sailles ; Bavaria was represented by Prince Luitpold. As ruler of the chief of the German states, it fell to Ludwig, in the name of the German princes, to invite the king of Prussia to assume the title of emperor. This he did in a letter of 17th November to the king and in a circular~~

~~despatch to the rulers of the other states. His name thereby was closely associated with the foundation of the empire, and the reputation of a patriotic prince added to the popularity which his artistic interests, his personal appearance, and his romantic habits had already secured him. Both letters; as is now known, were copied from drafts sent to him by Bismarck, for the king was unable to bring himself without assistance to take this step. While he acquiesced in the new position which Bavaria occupied, he did not always succeed in veiling the jealousy with which he regarded the new greatness of the Hohenzollems. In the following years he continued his support to the Liberals, though he scarcely ever spoke to his ministers, and protected the Old Catholics and DoUinger, who had been his tutor, when they refused to accept the Papal infallibility. As years went on the marks of the mental disease to which he finally fell a victim became more apparent. A visit to Paris in 1874 stirred up afresh the .passion for building. He seems to have taken Louis XIV. and Louis XV. as his models. Already he had made great additions to the castle of Hohenschwangau, which had been erected by his father ; he built two magnificent palaces at Neu Schwanstein and Lindenhof in the Bavarian highlands ; then he began~~

~~a fourth, which was to be an imitation of Versailles, not only in style but in magnificence, on an island in the Chiemsee. Financial difficulties caused by this profuse expenditure made it necessary to interfere. An inquiry ordered by the ministers disclosed abundant evidence of insanity, of which the most marked symptom was the avoidance of all human intercourse, and on 10th June 1886 a proclamation was published creating Prince Luit- pold regent on the ground that the king was incapable of reigning. The procedure was that required by the constitution. After some difficulty Ludwig, who at- tempted to resist, was placed in confinement in Berg, one of the royal palaces. On 13th June he was allowed to go out walking with a single medical attendant ; in the evening both were discovered drowned in the lake adjoining the castle. It is probable that the king had attempted to escape by swimming across the lake, and that the doctor had been drowned in the attempt to pre- vent this.~~

~~Ludwig was unmarried, an engagement to the Duchess Sophie, daughter of Maximilian, duke of Bavaria, having been broken off. He was therefore succeeded by his only brother. Otto (born 1848). As the new king had since 1872 suffered from an incurable mental disease. Prince Luitpold was reappointed regent. He was born on the 12th of March 1821, and was the third son of King Ludwig I., the second being Otto, king of Greece, who had died without issue. Though more favourably inclined to the Clerical party than his nephew had been, he made no sudden change in the Government, but he gradually brought to an end the long struggle over the Old Catholics. While a loyal adherent of the imperial constitution, he showed himself able to maintain the privileges and dignity of Bavaria as an equal ally of Prussia. In case of the death of King Otto the succes- sion rested with him or his sons. He married a daughter of Leopold II., grand duke of Tuscany, and his two eldest sons, Ludwig and Leopold, were also married to Austrian princesses, one to Marie of Modena, the other to Gisela, daughter of the emperor of Austria ; both had numerous families, so that the continuance of the succes- sion appears secured.~~

~~See L. V. Kobell. TJnter den vier ersten Konigen Bayerns and Konig Ludwig II. und Fiirst Bismarck im Jahre 1870. — Carl v. Heigel. Konig Ludwig II. v. Bayern. — C. Beyek. Konig Lud- wig II. V. Bayern. — Fk^noes Geeakd. The Bomance of Ludwig II. of Bavaria. (j. vsr. he.)~~

~~*Ludwig, Carl Friedrich Wilhelm (1816-1895), German physiologist, was born at Witzenhausen, near Cassel, on 29th December 1816. After attending the gymnasium at Hanan, he studied medicine at Erlangen and Marburg, taking his doctor's degree at the latter university in 1839. He made Marburg his home for the next ten years, studying and teaching anatomy and physi- ology, first as prosector to Pick (1841), then as privat-docent (1842), and finally as extraordinary professor (1846). In 1849 he was chosen professor of anatomy and physi- ology at Zurich, and six years afterwards he went to Vienna as professor in the Josephinum (school for mili- tary surgeons). In 1866 he assumed the duties of the newly-created chair of physiology at Leipzig, and con- tinued to perform these for thirty years, until his death on 23rd April 1895. Ludwig's name is prominent in the history of physiology, and he had a large share in bring- ing about the change in the method of that science which took place about the middle of the 19th century. Together with his friends Helmholtz, Brticke, and du Bois-Eeymond, whom he met for the first time in Berlin in 1847, he rejected the assumption then generally accepted that the phenomena of living animals depend on special biological laws and vital forces different from those which operate in the domain of inorganic nature ; and, insisting that they are to be defined in physical and chemical terms, he sought to explain them by reference to the same laws as are applicable in the case of physical and chemical phenomena. This point of view was expressed in his celebrated Text-Book of Human Physiology (1852-56), which was dedicated to the three friends mentioned above, but it is as evident in his earliest paper (1842) on the process of urinary secretion as in all his subsequent work. As an original investigator, Ludwig exercised enormous influence on the progress of physiology, not only by the discoveries he made, but also by the new methods and apparatus he introduced to its service. Thus in regard to secretion, he showed that secretory glands, such as the submaxillary, are something more than mere filters, and that their secretory action is attended by chemical and thermal changes both in themselves and in the blood passing through them. He demonstrated the existence of a new class of secretory nerves that control this action, and by showing that if the nerves*~~

~~are appropriately stimu- lated the salivary glands continue to secrete, even though the animal be decapitated, he initiated the method of experimenting with excised organs. In studying the movements of the blood and lymph in the body, he devised the kymograph as a means of obtaining a written record of the variations in the pressure of the blood in the blood-vessels ; and this apparatus not only conducted him to many important conclusions respecting the mechanics of the circulation, but afforded the first instance of the use of the graphic method in physiological inquiries, to which it has since been widely applied. For the purpose of his researches on the gases in the blood, he designed the mercurial blood-pump which in various modifications has come into extensive use, and by its aid he made many investigations on the gases of the lymph, the gaseous interchanges in living muscle, the significance of oxidized material in the blood, &c. There is indeed scarcely any branch of physiology, except the physiology of the senses, to which he did not make important contributions. He was also a great power as a teacher and the founder of a school. A keen judge of the abilities of his pupils, he had also a remarkable faculty for awakening their en- thusiasm and for inciting them to do the best of which they were capable. Under him the Phy siological Institute at Leipzig became an organized centre of physiological research, whence issued a steady stream of original work ; and though the papers containing the results usually bore the name of his pupils only, every investigation was inspired by him and carried out under his personal direc- tion. Thus his pupils gained a practical acquaintance with his methods and ways of thought, which could scarcely have been acquired by mere attendance at lectures, and, coming as they did from all parts of Europe, they returned as apostles to their own countries to spread and extend his doctrines. It need scarcely be added that Ludwig was no anti-vivisectionist. Possessed himself of extraordinary manipulative skill, he abhorred rough and clumsy work, and he insisted that experiments on animals should be planned and prepared with the utmost care, not only to avoid the infliction of pain (which was also guarded against by the use of an anaesthetic), but to ensure that the deductions drawn from them should have their full scientific value. (h. m. e.)~~

~~Ludwigsburg, a town of Germany, in Wtirtem- berg, 9 miles north of Stuttgart by rail. It contains the magnificent palace of the kings of~~

~~*Wtirtemberg. In 1882 the sculptor Hofer presented to the town a marble statue of Schiller. It has developed considerable industrial activity in organs, chemicals, cloth, linens, cottons, gold and silver wire, and beer. Population (1886), 16,201 ;*~~

~~*(1900), 19,359. /*~~

~~*Ludwigshafen, a rapidly-growing industrial town of Bavaria, Germany, on the left bank of the Ehine, immediately opposite to Mannheim, in the Palatinate district. It has a fast-increasing trade in iron, timber, coal, and agricultural products, a trade which is fostered by a free harbour (opened in 1897) ; and also large factories for aniline dyes and soda, iron-foundries, and production of cellulose, artificial manure, artificial wool, vehicles, flour and malt, saw-mills and breweries. The place, which was first founded in 1843, was only made a town in 1859. Population (1885), 21,042 ; (1900), 61,906.*~~

~~*Ludwigslust, a town of Germany, grand-duchy of Mecklenburg-Schwerin, 22 miles by rail south by east of Schwerin. The castle, built by Duke Christian Ludwig in 1772-79, was the favourite autumn residence of the grand-duke. There are also a couple of other ducal residences, a fine park, and a monument of the Grand-Duke Frederick Francis I. (1869). The parish church is in the form of a Greek temple. Population (1900), 6634.*~~

~~*Lugano, the most important town in the Swiss canton of Tessin or Ticino, though Bellinzona is the sole political capital. It is 124|- miles by the St Gothard railway from Lucerne, and 48^ miles from Milan. The ancient church of San Lorenzo has since 1888 been the see of the bishop of Lugano, which is held for the present with that of Basel. There are railways from Lugano (902 feet) up Monte San Salvatore, and up Monte Generoso opposite. Population (1888), 7097 ; (1900), 9553.*~~

~~*Lugano, Lake of, has an area of 19-4 square miles, of which 7-5 square miles belong to Switzerland and 11-9 square miles to Italy. It is 899 feet above the level of the sea, while its greatest depth is 945 feet. It is traversed between Melide and Bissone by a great stone dam (with openings at each end), over which the high road and the St Gothard railway are carried.*~~

~~*Lugansk (also LtigaS and Luganskit Zaeod), a district town of Russia, government and 143 miles north- east of Ekaterinoslav, on the Catherine railway. It has a gymnasium, a technical railway school, and a first-class meteorological observatory, besides cast-iron, steel, and cartridge works belonging to thQ Crown, distilleries, breweries, tanneries, soap and candle works, and steam flour-mills. Population (1897), 20,419.*~~

~~*Luganskaya, Cossack village of Eussia, province of the Don Cossacks, on Lake Stanichuoye, 70 miles east of Bakhmut railway station. It is a wealthy village, with considerable trade in corn and exports of different kinds of raw produce, &c. Population (1897), 20,381.*~~

~~*Lugo, a town of the province of Eavenna, Emilia, Italy, 18 miles west of Eavenna, on a branch line which joins the Bologna-Brindisi railway at Faenza. An important fair is held during September. There are manu- factures of ropes, furniture, and ironmongery. Population,*~~

~~*17,600.*~~

~~*Lugo, a maritime province in the north-east of Spain. Its area is 3787 square miles, divided into 11 adminis- trative districts and 64 parishes. The population is increasing, despite the flow of emigrants to Portugal and South America, and numbered 459,119 persons in 1897. The birth-rate is 3-31 per cent, and the death-rate 2-86 per cent. ; the proportion of illegitimate births is very high — 10 30 per cent. The means of communication are in- sufficient, though there are 98 miles of first-class roads, and the railway from Valencia to Corunna runs through the province. The only important industries are those connected with leather, preserves, coarse woollen and linen stuffs, timber and osier work. About 250 coasting vessels are registered at the ports, and about as many boats constitute the fishing fleet, which brings in lampreys, soles, tunny, and sardines, the last two being salted and tinned for export. The mountainous parts are still well wooded. Agriculture is in a very backward condition, mainly owing to the extreme division of land that prevails throughout Galicia, and cattle-rearing*~~

~~*has declined in consequence of the cessation of the export trade to Great Britain. The live stock numbered in 1898, 11,306 horses, 2213 mules, 1880 asses, 120,793 cattle, 136,612 sheep, 30,885 goats, and 108,263 pigs. There were only six productive mines in 1898, four of coal and two of antimony, while the unproductive mines numbered 132.*~~

~~*Lugo, town in Spain, on the Minho, 51 miles east by north of Santiago, capital of the province of the same name. It has extended much beyond the fine old Eoman walls. The chief local industries are tanning and the manufacture of linen and woollen stuff. Nine new suburbs, thickly peopled, have sprung up around the old city. Population (1897), 25,668.*~~

~~*Luitpold, OF Bavaeia. See Ludwig II.*~~

~~*Lu lea, a seaport town of Sweden, capital of the county of Norrbotten, on the peninsula of Sando, at the mouth of the Lulea (river Lule), near the north-west corner of the Gulf of Bothnia, connected at Boden (22 miles to the north) with the main line of railway from Stockholm to the north of Finland, and the seaward terminus of the Lulei-Ofoten railway. It is the shipping place of the iron ore mined at Gellivare, 127 miles north by west. The quantity of iron exported increased from 21,000 tons in 1880 to 1,064,675 tons in 1900. The only other export of moment is timber, of which 4 to 7 million cubic feet are exported annually (over 7 million cubic feet in 1899). The port was cleared by 191 vessels of 79,300 tons in 1887 and by 446 vessels of (;;i0,.'-)03 tons in 1900, of which 126 of 212,668 tons were British. As a rule, the port is closed to navigation by ice from November to the end of May. The southern entrance to the harbour was in 1893 deepened to admit vessels drawing 23 feet, and in 1901 a beginning was made with the widening of it to double its present width, and with the construction of additional quays. The town was almost entirely burnt down in 1887, and its buildings are new — the church (1888-93), the Norrbotten Museum, and a technical*~~

~~*school being the most important. Population (1880), 3120; (1890), 4756; (1900), 9484. The district between Lule^ and Boden is well cultivated, and had in 1897 a population of about 20,000.*~~

~~*In the years 1884-87 a railway line was laid temporarily from Lulea to Gellivare (127 miles ; to tlie mines, 131 miles) by an English company ; but in 1889 the company failed, and in 1891 the line was taken over by the Swedish Government, who paid £362,210 for it, and completed the line in 1892-94 at a further cost of £155,560. In 1898 the Swedish Parliament voted £1,194,350 for the continuation of the line from Gellivare, past the iron-fields of Kirunavaara and Luossavaara (68 miles farther north) to the Norwego-Swedish frontier, a distance of 147 miles from Gellivare. In the same year the Norwegian Parliament voted £472,220, and in 1900 an additional sum of £180,500, for the building of the Norwegian section of the line from Victoria Harbour (or Narvik) on Ofoten Fjord up to the frontier, a distance of 26 miles; Lulea to Victoria Harbour, 300 miles. When the Gellivare-Ofoten portion of the line is finished, it will enable the iron ore to be shipped in winter on the Norwegian side.*~~

~~*Lumbering. See Forests and Foebstby.*~~

~~*Lunacy. See Insanity.*~~

~~*Lund, a university town of Sweden, 11 miles north- east from Malmo, on the railway to Stockholm. • In 1899 the university was attended by 626 students, there being about 110 professors and lectors. In 1897 the university library numbered about 163,000 volumes and 4900 MSS. Important buildings include the botanical museum, with gardens, an astronomical observatory (55° 41' 52" N. and 13° 11' 16" E.), built in 1866, though observations had been carried on since 1760 ; the university hall (1878-82) ; the academic union of the students (1851), containing an art museum; the museum (1882) of the History of Civilization (K-ulturhistorie) Society, with valuable ethnographical and industrial art collections, illustrating life in southern Sweden from early times; All Saints' Church (1887-91) ; a diocesan school (1896), normal school for women, deaf and dumb school, and technical school. The industries are chiefly sugar-refining, iron-works, brick-works, and manufacture of furniture and gloves. Population (1880), 14,304; (1900), 16,621.*~~

~~*-), Danish*~~

~~Lund, Troels Frederik (1840- historian, was born in Copenhagen on the 6th of Septem- ber 1840. His father's first wife was the sister of the celebrated philosopher, Soren Kierkegaard, who exercised a considerable influence on the early years of the historian. Troels Limd was long in discovering the bent of his own mind. He entered the university as a student in 1858, read Plato, wrote verses, and vaguely determined to be- come a zoologist. Circumstances enabled him to prolong his youth in dreams and the contemplation of outdoor life. About the age of thirty he took a post under Government, which brought before his notice the treasures of the secret archives of Denmark. Curiosity awakened in him an overpowering interest; he pushed his researches farther and farther until he became a historian. His first work, however. Historical Sketches fro7n Unpublished SoK.rces, did not appear until 1876, but after that time his activity was stupendous. In 1879 was published the first volume of his History of Daihj Life in Denmark and Norway at the Close of the 16th Century, of which the fourteenth volume appeared in 1901. Troels Lund was the pioneer of the remarkable generation of young historians who came forward in the North about 1880, and he re- mained the most original and most conspicuous of them. His principal peculiarity, in which he is already imitated by a school not only at home, but in Germany, Sweden, and Norway, is his neglect of purely political history. Saying very little about kings, armies, and governments, he concentrates his attention on the life, death, employ- ments, pleasures, and prejudices of the ordinary men and~~

~~women of the age with which he deals, using to illustrate his theme a vast body of documents hitherto neglected by the official historian. The penultimate volume of his great work — called Tlie Illumination of Life — treats a wider theme than any of the preceding, and aims at a rapid study of the advance of moral light after the Renaissance. The other writings of Dr Troels Lund are either polemical, or are chips from his central workshop. He has the charm of a singularly animated and lucid style, which reminds the English reader in some degree of that of Froude. Dr Lund was appointed historiographer-royal to the king of Denmark and comptroller of~~

~~*the Order of the Dannebrog. There was probably no living man to whom the destruc- tion of the archives, when Christiansborg Castle was accidentally burned in 1884, was so acute a matter of dis- tress. But his favourite and peculiar province, the MSS. of the 16th century, was happily not involved in that calamity.*~~

~~*Lundenburg (Czech, Breclava), a town in South Moravia, on the Thaya river, on the border of Lower Austria. In the Middle Ages it was the Moravian capital and ducal residence. A short distance from Lundenburg is an estate of Prince Liechtenstein (Eisgrub), with a park over a hundred square miles in area, containing two small towns and several villages, together with various ornamental buildings, including a chateau in the style of Windsor Castle. Lundenburg has important markets, a considerable industry (sugar, starch, brewing, and dis- tilling), and trade in timber. Population (1890), 5968 ; (1900), 6776, chiefly German.*~~

~~*Luneburg, a town of Prussia, province of Han- over, on the river Ilmenau (a tributary of the Elbe), 30 miles by rail south-east of Hamburg. A museum (1891) with industrial, art, and natural science collections, and the bronze statue of the Emperor William I. (1898) are the principal new features. Besides its salt-works, brine spring, and gypsum quarries, Liineburg has lime-kilns, cement factories, iron-works, carpet and artificial manure factories. It is also noted for its gardening, and has a trade in wine. Population (1885), 19,336 ; (1900) , 24,693.*~~

~~*Lunel, a town, arrondissement of Montpellier, depart- ment of Herault, France, 15 miles east-north-east of Montpellier, on the railway from that place to Tarascon, and at the head of the Lunel canal, which connects it with the itang of Maugio on the Mediterranean, and with the Cette-EhSne canal. The church, partly Eomanesque, contains some old paintings, and in the Place de la Eepublique is a small copy of Bertholdi's statue, " Liberty enlightening the World." Absinthe is distilled, and trade is still carried on in wine, but the ravages of the phylloxera have greatly reduced the production in the district. The trafi&c on the Lunel canal in 1900 was represented by 338 boats, carrying over 9000 tons of merchandise, chiefly agricultural products and provisions. Population (1881), 6066; (1901), 7532.*~~

~~*Luneville, chief town of arrondissement, department of Meurthe-et-Moselle, France, 17 miles east-south-east of Nancy, on the railway from Paris to Strasburg. The War Monument, commemorative of 1870-71, stands opposite the Hotel de Ville, and there are statues of the Conven- tional Abbd Gregoire (d. 1831) and of General Lasalle (d. 1809). The gardens around the chateau now form a public promenade. Manufactures are very important, and include, among other things, cotton and silk hosiery, watch-glasses, porcelain, toys, fruit essences, and automo- biles There are salt-works and glass-works in some of the suburbs. Population (1881), 14,379 ; (1891), 16,530 ;*~~

~~*(1901), 23,269.*~~

~~*Lungchow, a town in the province of Kwangsi, China, situated in 22° 21' N. and 106° 45' E., near the Tongking frontier. It was selected as the seat of frontier trade by the French convention of 1886, and was opened in 1889, but the overland trade so far has been insignifi- cant. In 1898 the total value amounted to only H. taels 134,000 (£20,000), and in 1899 to H. taels 86,000 (£12,700). It is proposed to extend the Tongking system of railways, which is completed as far as Langson, to Lungchow, and thence to the large Chinese town of Nan- ning on the West river. Lungchow is a Chinese military station of some importance. It has a civilian population of about 22,000.*~~

~~*Lushai Hills, The, a district of British India, in the south of Assam. It consists of two tracts, formerly known as the North and South Lushai Hills, the latter of which was transferred from Bengal to Assam in 1898.*~~

~~*The Lushais or Kukis are a numerous tribe, who differ from their neighbours in recognizing hereditary chiefs. Some of them live in the Chittagong Hill. Tracts, and a few have settled in Assam. But their home is the mountainous region that extends from Tipperah in Bengal to the Chin Hills of Burma. Order is now maintained by a military police force of 1000 men, with its headquarters at Aijal. The area of the North Lushai Hills is estimated at 3500 square miles. The population of the district (North and South Lushai Hills) was 82,344 in 1901. A house-tax is levied at the rate of Rs.2 per house, yielding Bs. 15,263 in 1897-98. Each house is also liable to supply one coolie to work for ten days in the year, being paid 8 annas a day.*~~

~~*In 1897-98 the quantity of labour thus impressed was equal to 65,393 days. The total expenditure on public works, chiefly roads, was Es.l, 10,303. Two missionaries, who handed over their work in 1898 to the Welsh Calvinistio Mission, have established a school at Aijal, with 68 boys, and have also reduced the Lushai language to writing, a dic- tionary and handbook having been printed by the Government press at Shillong.*~~

~~*Lussin, a small but important island in the Quaruero, in the Austrian crownland of Istria, lying west and south of Cherso, with which it is connected by a turn-bridge. It is 24 miles in length, and is little more than 300 yards in breadth at its narrowest point. Together with the adjacent islands of Cherso and Veglia it forms the gov- ernment district of Lussin. Population of the island (1890), 11,838 ; (1900), 11,615 ; of the government dis- trict (1890), 39,989 ; (1900), 41,030, of whom about one- fifth were Italian, the remainder Serbo-Croatian. Lus- siN-PiccoLO, the chief town and principal harbour, is the most important trading centre of the Quarnero islands. It is one of the largest and most frequented harbours of the monarchy, a steamship station of the Austrian Lloyd, and a popular winter resort, with a climate resembling that of Nice. Population (1890), 7634; (1900), 7207. Lussin-Gbande, on the east side of the island (2349 inhabitants), has an old Venetian palace and a shipbuild- ing wharf.*~~

~~*Lutherans. — Although since 1871 the German empire has been united for military and foreign purposes, and although since the 1st of January 1900 a certain par- tial unification of laws has taken place throughout the em- pire, yet each of the smaller states still retains its own reign- ing sovereign, its parliament, and its own Evangelical Church. Moreover, even where smaller states have been absorbed into the kingdom of Prussia as provinces, e.g., Nassau or Hanover, their old distinct church establishments continue under the title of provincial churches, and the original church of the kingdom itself is known as that of " Old " Prussia. There is thus no corporate unity yet sub- sisting between the various state Evangelical bodies, and even the more strictly separated" Old " Lutherans still con- tinue to maintain distinct from the state their "Evangelical Lutheran " congregations. Within each state church the two schools exist side by side, Orthodox and Reformed, or*~~

conservative and liberal, as they are called. It depends upon accidental circumstances of appointment or election whether the teaching in any parish is of one kind or the other ; sometimes, where there is more than one minister, it may be of both. With the growth of rationalism the liberal theology of the Evangelical churches has become scarcely distinguishable from Unitarianism, so that even within the limits of any "State Evangelical United Church" (Evangelische Unirte LandesJcirche) the widest differences of doctrine may and do prevail. In the meantime a voluntary biennial conference is held at Eisenach, where matters of general interest may be dis- cussed ; but its resolutions have no necessarily unifying influence, and certainly have no binding force. A com- mittee was in 1902 formed at Gotha, at the instance of the G-erman emperor, to inquire into the feasibility of a general union of the (about) thirty Evangelical sects.

Evangelicals may be said to form about 58 per cent, of the popu- lation of the German empire, which in 1895 was 52,250,000, as against 39 per cent, of Roman Catholics. These are the two leading religions of Germany, about 3 per cent, only of the popula- tion in general being members of other religious bodies. The figures vary very much, as there is a continuous change going on from one to the other, and as there is a large emigration to coun- tries beyond the seas. Since the formation of the empire, inland migration from one state to another has been much greater than before, a thing due to the wide appointment of officials and the dispersion of the army, to the vast increase of opportunities of industrial employment, to the greatly developed facilities of travel between the states, and other causes. This migration has brought about an increasing frequency of intermarriages between Protes- tants and Catholics, which forms a very important factor in religious change. It would appear that Catholicism increases in Eastern Prussia, Bavaria, Saxony, and Wiirtemberg, whilst Evangelicalism, at least nominally, is increasing in large cities and in general throughout the resit of Germany. It has been calculated that in Prussia alone Evangelical ministry must be provided for persons speaking twenty different languages.

~~*The Evangelical theory still holds that in each state the sovereign is the religious ruler or summus episcopus. He appoints a minister of public worship, and through him nominates the members of a governing body, called in the older states an Oberkirchenrath or Supreme Church Council, and in the newer states a Oonsistorium. This governing body deals with property, patronage, and other ruling and legal matters. Each parish, on the other hand, elects its own parish council for parochial affairs, church tax assessments, &c. , and this council possesses legal rights. Delegates from these parish councils form the Landessynode or National Synod, which is a liind of church parliament. In cases that call for it, committees of the consistory and synod confer. Those who are entitled to vote for parochial councils do not, however, take very great part in the elections, except in Alsace-Lorraine, where nearly half the voters go to the poll.*~~

~~*The income of the Evangelical churches is derived from four sources. The state makes an annual provision for clergy stipends, officers' salaries, church maintenance, &c., and sometimes makes special grants for improvement of stipends, supply of assistant- clergy, for widows and orphans of clergy, for preaching seminaries, &o. Then there are endowments or bequests of various kinds, twenty-four such in Prussia alone, administered by the Supreme Council ; these relate to foreign missions, pensions of aged clergy, supply of books to clergy, &c. A third source of income are the various voluntary collections, which in England are made by the Church societies and even by individual appeals, such as those for building churches, parsonages, mission-rooms, institutes, &c. ; these are in Germany all swept into the common income of the national churches, and are regulated by the Supreme Council or Consistory. Fourthly, each parish is entitled by law to levy a church rate upon its adherents, and the proceeds are applied to certain objects defined by the same law.*~~

~~*Appointment to benefices lies in the hands of the state (with sometimes the consent of parishes), of private patrons, and of local parish councils. The number of benefices increases yearly ; in 1897 there were in all Germany 16,400, or 300 more than in 1890. Of these the state appoints to 56 per cent., private and municipal patrons to 34 per cent., the local congregations to 10 per cent. Customs vary in different states; e.g., in Schleswig –*~~

~~*Holstein, although the parish elects, the state nominates ; in Alsace and Lorraine all clergy are appointed by the consistory (here called the pirectorium'), with the approval of the statthalter or viceroy ; and in Baden, although the state appoints, the congregation electa one out of six names put forward by the Government.*~~

~~*Aspirants for the Evangelical ministry, having passed through the secondary schools and the customary matriculation examination, attend at least six lecture terms in the theological department of a university. They then pass the examination for a preaching licence ("pro licentia concionandi"), after which two years elapse, during one of which the "candidates" study at a preachers' seminary. Then follows the examination "pro ministerio," after which they are eligible for election to cures or assistant-cures of souls. Before entering upon work they are ordained at a public service in church, with laying on of hands by the general superintendent and one other minister. About 27 per cent, of the clergy come from families of better position, but there is a great falling off in general in the number of candidates. In Old Prussia the number of students during the decade 1888-98 went down by one-half, and the number of ordinations showed a decrease of 28 per cent.*~~

~~*The union of two forms of Protestant Christianity in the Evan- gelical churches has resulted in vagueness of teaching and principle in most cases, and in a very widespread freedom of thought. Many of both clergy and laity do not believe in the miraculous birth of Christ ; many criticize very freely the narrative of the New Testa- ment, and cannot accept the statements of the Apostles' Creed. Under the name of Higher Criticism many sceptical views are pub- lished and preached, denying the doctrine of the Holy Trinity. Prom this arises a general vagueness which is a source of weakness to the Evangelical religion. On the one hand, there is a general unity in promoting good works : hospitals, homes, refuges, nursing societies, associations for assisting the young of both sexes and the like, for which Germany is conspicuous. But, on the other hand, in respect of faith evidences are less clear. Thus church-going is looked upon more as a duty to one's neighbour than as worship of God, and attendance on ordinary Sundays varies from 14 per cent, to a mere 2 per cent, of the population. Baptisms, marriages, and burials keep up their due proportion ; there is*~~

~~only a slight falling off in confirmation (which must not be mistaken in any way for the English or Roman rite) ; but these things are so much required by law and system that they lose their voluntary character. The number of communicants, however, is seldom more than halt of those entitled to receive tlie Holy Sacrament, even at great feasts ; and it often goes below one-tenth. Of the communicants, men are fewer than women, being in some cases much less than one-third of the whole number.~~

~~See also Piepee, Kirchliche Statistik, 1899. (e. j. t.)~~

~~Luton, a municipal borough (extended 1896) and market town in the Luton parliamentary division of Bedfordshire, England, 30 miles north-north-west of Lon- don by rail. Modern erections are two churches, a Baptist and three Methodist chapels, a theatre, and a children's sick and convalescent home. There are public baths, a free library, and a technical school, supported by the town and county councils, and devoted partly to teaching the straw-plait industry. Electric light was installed in 1901, and in the same year a new sewage scheme was completed. Population on 2613 acres (1881), 23,960 ; (1891), on ex- tended area of 3134 acres, 30,066 ; (1901), 36,404.~~

~~LUttringhausen, a town of Prussia, in the Rhine province, 6 miles south-east of Elberfeld by rail. It is the seat of various iron and other metal industries, and cloth, calico, and silk mills. Population (1885), 10,216 ;~~

~~(1900), 11,261.~~

~~Luxembourg, province of Belgium, bordering on Rhenish Prussia, the grand-duchy of Luxemburg, France, and the Belgian provinces of Namur and Lifege. It comprises a part of the mediaeval duchy of Luxemburg, which, under French domination (1795-1814), constituted the department des ForSts, and in 1816, under the title of the grand-duchy, was conferred on the prince of Orange, king of the Netherlands, and, lastly, in 1831 was divided into two parts — a western part forming the present province of the kingdom of Belgium, and an eastern part remaining, under the title of the grand- duchy of Luxemburg, in the possession of the House of Orange. In its entirety the most elevated of the pro- vinces of Belgium, Luxembourg is in large part included in the region of the Ardennes. It presents elevated~~

plateaux of from 1300 to 2300 feet high, stretching towards the north-east ; some wooded, others marshy or covered with

heath, and intersected by deep and picturesque valleys such as those of the Semois, the Lesse, the Ourthe, affluents of the Meuse, and of the Sure (in German, Sauer), an afluent of the Moselle. In general of scant fertility, the soil of the province is calcareous in the north, schistose in the zone of the Ardennes, calcareous, clayey, and sandy in the south. Its products are iron in small quantity and manganese ; slate, the quarrying of which employs 900 •workmen; building, paving, and limestone. It rears the Ardennes horse, small in size, bvit very hardy. Of wild animals there are the boar, wolf, and deer. Woods cover 34 per cent, of the surface of the province. Its industry is not of much account. There are steel-works and blast- furnaces in the arrondissement of Arlon. Saw-mills and the making of wooden shoes employ 400 workers. The province is divided into five administrative arrondisse- ments. The towns are of scant population. The princi- pal are Arlon (8000), the capital ; Bastogne (3600) ; and Marche (3600). This province has the largest extent of territory among the provinces of Belgium — 1706 square miles — and is the least populated, having only 222,154 inhabitants in 1900, or 130 to the square mile. The arrondissement of Arlon has the densest population — ^259 inhabitants to the square mile. The population increased from 209,472 in 1875, that is, an increase of 54 per cent., against an increase of 25 per cent, in the same time in the whole kingdom.

Luxemburg, Grand-Duchy of, a neutral and independent state of Europe, bounded on the E. and N.E. by Prussia, S. by Alsace-Lorraine, and W. by the Belgian province of Luxembourg. It had in 1900 a population of 236,543 (of whom 122,002 were males and 114,541 fe- males), showing a density of 237 persons to the square mile. The increase over the population in 1895 (18,960 in all) was exclusively in the mining districts, whereas in certain communes of the Ardennes there was an actual decrease. In 1900 the population included 14,240 Ger- mans, 6700 Italians, 4250 Belgians, and 3500 Erench. All except about 1 per cent, are adherents of the Eoman

~~*Catholic Church. The House of Representatives now consists of forty-five members, elected directly by the cantons, one-half every three years. The state revenue was in 1901 estimated at £483,960, and the expenditure at £498,880 ; and the public debt amounted to £462,420 in 1900. The state possesses 294 miles of railway, and 596 miles of telegraph line, with 1187 miles of wire. In 1899 the iron-mines (71 worked), blast-furnaces (28), and foundries (7) employed 10,600 work-people, and gave an output of 6,995,400 tons of iron ore, 982,930 tons of cast iron, and 166,210 tons of steel.*~~

~~*The Grand Duke, Adolphus William August Charles EREDEKiCK,'was born at Biebrich 24th July 1817, succeed- ing his father as duke of Nassau 20th August 1839. He showed himself imbued with Liberal ideas, and skilfully steered his land through the troubles of the revolutionary period of 1848. In 1849 he took part in the campaign against Denmark at the head of a contingent. After the conclusion of this war he took a serious interest in German federal politics, and in the fateful year 1866 openly sided with Austria. As a result, the duchy of ISTassau was annexed by Prussia, the duke unwillingly receiving a sum of about £1,275,000 as compensation for the loss of his dominions. Owing to the marriage of his daughter Hilda to the hereditary grand duke of Baden in 1885, his feud with the Prussian royal house may be said to have come to an end, and the rapprochement was finally sealed by a meeting with the Emperor William II. at Mainau in 1888. On the death of King William III. of the Netherlands on 23rd Novem- ber 1890, Duke Adolphus, as nearest agnate of the House*~~

~~*of Orange, became reigning grand duke of Luxemburg. He was twice married : (a) to Elizabeth, daughter of the Grand Duke Michael of Eussia, and (6) to Adelaide, daughter of Prince Erederick of Anhalt, by whom he had a son, William, born 22nd April 1852, who married Princess Anna of Braganza.*~~

~~*Luxemburg, or Lutzelbukg, capital of the inde- pendent grand-duchy of the same name, and an episcopal see, 43 miles by rail north of Metz. The public insti- tutions include an athenasum, a theological seminary, a collection of antiquities, a small picture-gallery, normal schools, a deaf and dumb asylum, a library, and an eques- trian statue of Grand Duke William II.*~~

~~(1884). Amongst the industries may be mentioned tanneries, breweries, distilleries, glove, hat, tobacco, cotton, and linen factories. Population (1881), 17,964; (1900), 20,928.~~

~~Luxeuil-les-Bains, a Erench town in the arron- dissement of Lure, department of Haute-Saone, 17 miles north-east of Vesoul, on the railway from Lure to Aille- villers, and on the Breuchin. It has a church dating from the 14th century, containing a curious 17th-century organ loft in the form of an immense bracket supported by a colossal figure of Hercules. There are also several mansions and houses dating from various periods from the 14th to the 16th century. The Maison Carree, or Hotel de Ville, an interesting specimen of 15th-century architecture, was built by the father of Cardinal Jouffray (died 1473), a native of the town. The fine modern Grammont Hospital is in the style of Louis XIII. Lux- euil is renowned for its mineral springs, of which there are eighteen, two being ferruginous, and the rest charged with chloride of sodium, yielding together about 14,000 gallons in the twenty-four hours, and of temperatures ranging from 70° to 156° Eahr. The water is employed for medicinal drinks and for baths. The bathing establish- ment is well appointed and stands in a fine park. Lux- euil, the ancient Lixovium, was frequented for bathing by the Eomans, and contained many fine buildings at the time of its destruction by the Huns under Attila in 461. In 690 St Columban founded here a monastery, which rose rapidly to importance, but in the 8th century it was destroyed by the Saracens ; afterwards rebuilt, monastery and town were again devastated by the barbarian hordes in the 9th century. In the 18th century the present bathing establishment was inaugurated by the ecclesias- tics. Population (1881), 4163 ; (1901), 5294.~~

~~Luzon. See Philippine Islands.~~

~~-), Italian economist and~~

~~Luzzatti, Luigi (1841- financier, was born at Venice on 11th March 1841. After completing his studies at Padua University, he attracted the attention of the Austrian police by his lectures on political economy, and was obliged to emigrate. In 1863 he obtained a professorship at the Milan Technical Insti- tute, in 1867 was appointed professor of constitutional law at Padua, whence he was eventually transferred to the University of Rome. Gifted with~~

eloquence and remarkable energy, he popularized in Italy the economic ideas of Schultze-Delitzsch, worked for the establishment of a commercial school at Venice, and, by indefatigable propaganda, contributed greatly to the spread of people's banks throughout the country. In 1869 he was appointed by Minghetti secretary-general of the ministry of agri- culture and commerce, in which capacity he abolished Government control over commercial companies and pro- moted a state inquiry into the condition of industry. Though theoretically a free trader, he was largely instru- mental in creating the Italian protective system. In 1877 he participated in the commercial negotiations with

France, in 1878 compiled the Italian customs tariff, and subsequently took a leading part in tlie negotiation of all the commercial treaties between Italy and other countries. Appointed Treasury minister in the first Eudini cabinet of 1891, he endeavoured to grapple with the difficult financial situation, but imprudently abolished the system of frequent clearings of bank-notes between the state banks, a measure which inadvertently facilitated the duplication of part of the paper currency and hastened the bank crisis of 1893. In 1896 he entered the second Eudini cabinet as Treasury minister, and by timely legis- lation helped to save the Bank of Naples from failure. After his fall from office in June 1898, his principal achievement was the negotiation of the Franco-Italian commercial treaty, though, as deputy, journalist, and professor, he continued to take an exceedingly active part in all the political and economic manifestations of Italian public life.

Lycaonia. — After the defeat of Antiochus the Great, Lycaonia was given by the Eomans to Eumenes II., king of Pergamos. About 160 e.g. part of it, the " Tetrarchy of Lycaonia," was added to Galatia ; and in 129 B.C. Lycaonia proper was given to Cappadocia as an eleventh strategia. In the readjustment of the Pro- vincise, 64 b.c, by Pompey after the Mithradatic wars, he gave the northern part of the tetrarchy to Galatia and the eastern part of the eleventh strategia to Cappa^docia. The remainder was attached

~~*to Cilicia. In 371 Lycaonia was first formed into a separate province. It now forms part of the Konia vilayet.*~~

~~*See Ramsay, Historical Geography of Asia Minor. Historical Commentary on the Galatians.*~~

~~*Lyck, or LvK, a town of Prussia, province of East Prussia, 112 miles by rail south-east of Konigsberg, and close to the frontier of Poland, beside a lake of the same name. It is the chief town of the region known as Masuria, and has a new parish church and an old castle (on an island in the lake) of the Teutonic order, dating from 1273, but now used as a prison. The industries embrace iron foundries, distilleries, breweries, tanneries, paper mills, flour mills, &c. Population (1885), 8624;*~~

~~*(1900), 11,419.*~~

~~*Lynchburg, a city of Virginia, U.S.A., on the south bank of the James river, at an altitude of 524 feet. Though within the limits of Campbell county, and con- taining the court-house, it is independent of county gov- ernment. It is situated partly on the bottom-land of the river, and partly on the slopes and summit of the bluffs, which afford fine and commanding building sites for the many beautiful private residences of the city. The rail- ways entering Lynchburg are the Southern, the Norfolk and Western, and the Chesapeake and Ohio. The manu- factures are important and varied. Lynchburg has long been one of the chief points of tobacco manufacture, and iron manufacture has also become of great importance. The Norfolk and Western railway has works here. It is the seat of Eandolph-Macon Women's College. Popu- lation (1890), 19,709 ; (1900), 18,891, of whom 251 were foreign-born and 8254 were negroes.*~~

~~*Lynmouth. See Lynton.*~~

~~*Lynn, King's Lynn, or Lynn Eegis, a municipal borough, parliamentary borough (co-extensive, since 1885 returning only one member), market town, and seaport of Norfolk, England, on the Great Ouse, 97 miles north by west of London by rail. Modern erections are the Stanley Library and the municipal buildings. An inner dock was constructed in 1884. The harbour has an area of 30*~~

~~*acres, with an average depth of 10 feet. There is also good anchorage in the roads leading from the Wash to the docks. The registered shipping in 1888 consisted of 90 vessels of 7055 tons ; in 1900, of 58 vessels of 3601 tons. In 1888, 1031 vessels of 146,669 tons entered and 1002 of 142,628 tons cleared; in 1900, 962 vessels of 224,869 tons entered and 980 of 226,854 tons cleared. In the latter year the imports (timber, minerals, coal, grain, and seeds) were valued at £1,141,867 and the exports at £130,469. Area, 3100 acres. Population (1881), 18,539 ;*~~

~~*(1891), 18,360; (1901), 20,289.*~~

~~*Lynn, a city and seaport of Essex county, Massar chusetts, U.S.A., on the north shore of Massachusetts Bay, 9 miles north-east of Boston, in the north-eastern part of the state. It is on a branch of the Boston and Maine railroad, and the Boston, Eevere Beach, and Lynn railroad. The more closely built portions are on level ground, while the suburbs are rocky and broken. The plan is very irregular, the streets narrow and paved with macadam or gravelled, the water-supply is drawn from ponds in the neighbourhood by pumping, and the city is divided into seven wards. Lynn is chiefly known for its manufacture of boots and shoes, an industry to which the place is as completely devoted as Gloi^cester is to fishing, and, indeed, a large proportion of the footgear of the people of the United States is made here. The total number of manufacturing establishments in the city in 1900 was 776. They had a capital of $17,011,761, employed 17,492 hands, and turned out products valued at $41,633,845. There were 123 boot and shoe factories, with $5,570,928 capital, 8652 hands, and products valued at $16,830,733, besides 60 factories manufacturing cut stock for boots and shoes, which employed 1049 hands, and turned out products valued at $7,385,106. There were also 12 leather factories, with a capital of $1,031,025 and products valued at $2,451,423. There were 3 factories for electrical apparatus and supplies, which employed 3166 hands and turned out products valued at $5,840,668. The patent medicines and compounds manufactured were valued at $1,338,833. The rocky, picturesque peninsula of Nahant, a part of Lynn, is a fashionable resort for the people of Boston and neighbouring cities, many of whom have summer homes there. The assessed valuation of real and personal property in 1900 was $51,655,186, the net debt was $3,632,398, and the rate of taxation $18 per $1000.*~~

~~Population (1890), 55,727; (1900), 68,513, of whom 17,742 were foreign-born and 784 were negroes. The death-rate was 16-4.~~

~~Lynn Canal, a noble fjord in Alaska, forming orographically a continuation of the trough of Chatham Strait, between 58° 12' and 60° N. Its width averages 6 miles, and its length about 100 miles. It is divided by islands near its entrance, and at the north by a long peninsula, named by Vancouver in 1793 Seduction Tongue. Its shores are for the most part mountainous, with numerous glaciers, of which Eagle, in 58° 30' N. on the east shore, and Davidson, in 69° 05' N. on the west, are the most important. Berners Bay, in 68° 40' N., indents the mainland shore, and is the seat of some mining operations. To the west of Seduction Tongue the fork of Lynn Canal is known as Chilkat Inlet. It receives at its head, over broad flats, the waters of the Chilkat river; and on its western extremity is a snug anchorage known as Pyramid Harbour, the seat of a salmon cannery. The valley of the Chilkat, inhabited by Indians of the same name, is the entrance to a practicable trail, known as the Dalton trail, to the Yukon, over which cattle are taken to the Klondike region. East of Sedvic- tion Tongue the fjord is continued as Chilkoot Inlet, and farther on as Taiya (Dyea) Inlet, terminating in two small~~

~~bays, Skagway and Taiya. These are the entrances to the two passes over the range to the head-waters of the Yukon, the White and the Chilkoot passes. The latter is the shorter and about 1000 feet higher. Wide flats make the access by water to Dyea less easy than to Skagway. A telpherage line was constructed in 1898 to carry goods over the summit, and many thousands of men and animals passed by this route over the range in 1896-99, bound for the Klondike. Now that Skagway has been con- nected by the Yukon and White Pass railway with Lake Bennett, all inward Klondike traffic passes by this route over the range. The principal settlements on Lynn Canal and its branches are Seward City, near Berners Bay; Pyramid Harbour; the Haines Mission at the northern end of Seduction Tongue ; Skagway, and Dyea. The region is alpine in character, and subject to storms~~

~~*of extraordinary violence in winter, but not so cold that navigation is interrupted by ice at any time.*~~

~~*Lynton and Lynmouth, seaside villages of Devon- shire, England, on the shore of the Bristol Channel, 17 miles by coach east of Ilfracombe, and 27 miles by rail- way north-east of Bideford. Lynmouth lies on the sea, at the mouth of the little rivers East Lyn and West Lyn, and Lynton stands on the edge of the cliffs, 430 feet above. The two are connected by a cliff railway or lift, and are lighted by electricity. The local improvements owe much to Sir George Newnes. A short distance up the Lyn is the picturesque Watersmeet, and the Doone Valley is not far off. Lynton is approached by a railway from Barnstaple. Population of Lynton (1901), 1641.*~~

~~*Lyons, the second town, in respect of population, of Prance, capital of the department of the Rhone, at the confluence of the EhSne and Saone, 311 miles from Paris by rail. Notwithstanding the competition of Milan, it is the chief silk market. In 1893 the special office which determines the weight and nature of the silk examined nearly 6000 tons of silk in 90,000 bales. Prance fur- nished barely one-tenth of this quantity ; two-thirds came from China and Japan, the rest from Italy and the Levant. The traders of Lyons re-export seven-twelfths of these silks, the industries of the town employing the remainder. An almost equal quantity of cotton, wool, and waste-silk threads is mixed with the silk. A large proportion of the silk workers have left the town for its environs. Sixteen or seventeen thousand hand-looms are still worked in the town, more especially producing the richest materials, 50,000 or 55,000 in the surrounding districts, and 20,000 or 22,000 machine looms in the suburbs and environs. The total value of these looms is £4,000,000. Allied industries, such as dyeing, finishing, and printing, employ 12,000 workers. With the weavers, loom-builders, and other indispensable workers, 300,000 workpeople depend upon the silk industry. The value of the manufacture in 1899 was apportioned thus : —*~~

~~*Pure silk textures, plain .... £5,028,000*~~

~~*do. do. figured .... 956,000 Textures of silk mixed with gold and silver,*~~

~~*for the Levant 204,000*~~

~~*Textures of silk mixed with other materials,*~~

~~*plain 4,714,000*~~

~~*Textures of silk mixed with other materials.*~~

~~*figured 818,000*~~

~~*Textures of floss-silk and silk handkerchiefs 2,240,000*~~

~~*Coarse silk (bourrettes) for furniture . . 60,000*~~

~~*Gauzes and grenadines .... 220,000 Crapes, summer shawls (crepes de Chine),*~~

~~*and muslins 2,260,000*~~

~~*Nets (tulles) and laces ... . 880,000*~~

~~*Passementerie 640,000*~~

~~*Embroidery 20,000*~~

~~*Total . . £18,040,000*~~

~~*In 1898 the total value was £16,600,000. The raw material represents half the value, and the value of the labour the remaining half. Thirty or forty per cent, of the silk goods of Lyons finds a market in Prance. Great Britain imports them to the value of £4,000,000, and the United States to the value of £2,400,000, notwithstand- ing the heavy duty. The dyeing industry and the manu- facture of chemicals have both developed considerably to meet the requirements of the silk trade. The annual production of chemicals is as follows : — Mineral colour- ing matters, £240,000; vegetable colouring matters, £200,000 ; glue and gelatine, £240,000 ; superphosphates for manure, £240,000; phosphorus (the only Prench source of supply), £100,000; picric acid, £200,000; tartaric acid, £80,000 ; sulphuric and hydrochloric acids, sulphates of iron and copper, salts of soda, and manure, £680,000; pharmaceutical products, £240,000. Lyons does a large trade in metals, iron, and copper, and utilizes them in numerous workshops in the*~~

manufacture of iron buildings, framework, bridges, machinery, railway mate- rial, scales, metal cables, pins and needles, copper-found- ing, and the making of clocks and bronzes, the entire metallurgical industry employing 12,000 workmen and producing £3,000,000. Gold and silver working is of importance, especially for articles used in religious cere- monies. Other flourishing industries are those of print- ing, the manufacture of glass windows, the preparation of hides and skins (occupying 20,000 workmen), those connected with the miller's trade, the manufacture of various forms of dried flour-paste (macaroni, vermicelli, &c.), brewing, hat-making, the manufacture of chocolate, and the pork-butcher's industry. Apart from the rail- way traffic, the river traffic is important — -in 1899 amounting to 600,000 tons on the Ehone and 725,000 tons on the Saone.

Lyons is the seat of important financial companies ; of the Credit Lyonnais, which does business to the amount of £200,000,000 annually in Lyons alone ; also of coal and metallurgical companies and gas companies, the former extending their operations as far as Russia, the latter lighting numerous towns in Prance and foreign countries. There are several important technical schools, schools of weaving and industrial chemistry, and a school of the fine arts. Since 1870 the fortifications have be^n recon- structed, and form an entrenched camp 43 miles in cir- cumference. The old wall of 1840, on the left bank of the Ehone, has been carried farther back. It describes a semicircle more than 7 miles long, which encloses the commune of Villeurbanne and part of the communes of Brou j,nd Venissieux. An iron bridge, 262 feet high and 655 feet long, will unite Pourvi^re and La Croix Eousse. Perhaps the most interesting modern enterprise has been the building of the new church of Pourviere. In 1872 it was begun, and in 1884 completed as regards the masonry, but its decoration was not finished until 1894. The total cost exceeded £320,000. The style recalls the Byzantine and Sicilian. It is flanked at each of the four corners by an octagonal tower, and ends in an apse shaped like a horse-shoe, surrounded by a porch which opens on the town to the east. Prom the loggia the archbishop of Lyons solemnly blesses the town on the 8th of Septem- ber, the day of the Nativity of the Virgin. The 8th of December is also a fSte, when all the streets are illumi- nated. The roof above the apse is surmounted by a colossal bronze group, 23 feet high, representing St Michael slaying the dragon. The towers are 159 feet high. The north-western is used as an observatory by the Pree

Paculty of Science. The north-eastern is furnished with a circular painting on lava, showing all the points visible on the horizon, with their distance and height. In clear weather a fine panorama of the Alps is visible from this tower.

The south-eastern tower contains a great bell weighing 6i- tons, and the soutli-western, a carillon of thirteen bells. The church is 282 feet long from end to end, and 62 feet across the interior, and 88 feet high under the vaulting. A crypt, dedicated to St Joseph, and divided into three vaulted bays, extends under the church, which is built of magnificent materials and adorned on both the inside and outside with a profusion of marble and costly works of art. The high altar is of Carrara marble, supported by four angels ; the mural decoration is of Venetian mosaic. In the park of T§te d'Or, a fine promenade, universal exhibitions were held in 1872 and 1894. Population (1S8G), 314,124 ; (1896), 398,867 ; (1901), 453,145.

Lyons, Richard Bickerton Pemell Lyons,

~~1st Earl (1817-1887), British diplomatist, was the son of the first Baron Lyons, the celebrated admiral, and was born at Lymington, 26th April 1817. He entered the diplomatic service, and in 1858 became British minister at Washington, where, after the outbreak of the Civil War, the extremely important negotiations connected with the arrest of the Confederate envoys on board the British mail-steamer Trent devolved upon him. After a brief service at Constantinople, he succeeded Lord Cowley at the Paris embassy in 1867. In the war of 1870 he used his best efforts as a mediator, and accompanied the provisional government to Tours. He continued to hold his post with universal acceptance until November 1887, but succumbed to a paralytic stroke on 1st December 1887, the title becoming extinct.~~

~~Lyttelton, seaport, Selwyn county, Canterbury dis- trict, South Island, New Zealand, 5 miles south-east by east of Christchurch, with which it is connected by rail, on the inlet called Port Lyttelton, in the north side of Banks Peninsiila. The harbour-accommodation has been very much improved, and vessels of any size can anchor beside the wharves, where the depth of water is 26 feet. The harbour has an area of over 105 acres, and possesses a graving dock which can be entered by vessels of 6000 tons. The tonnage of shipping entered inwards in 1900 was 55,308 ; outwards, 118,333. The harbour board's re- ceipts for 1899 were £32,392; expenditure, £36,859. The total trade for 1883 was £3,344,141; for 1893, £3,135,973; for 1900, £4,293,641. Population (1881),~~

~~4127; (1901), 4023.~~

~~Lytton, Edward Robert Bulwer-Lytton, 1st~~

~~Eakl of (1831-1891), English diplomatist and poet, was the only son of the first Baron Lytton (Ency. Brit. vol. XV. p. 121). He was born in Hertford Street, Mayfair, on 8th November 1831. Kobert Lytton and his sister were brought up as children principally by a Miss Green. In 1840 the boy was sent to a school at Twicken- ham, in 1842 to another at Brighton, and in 1845 to Harrow. From his earliest childhood Lytton read vora- ciously and wrote copiously, quickly developing a genuine and intense love of literature and a remarkable facility of expression both in prose and verse. His letters to his father from school show maturity of thought and of style unusual at~~

~~*that age, and his wish at this period was to devote his life to literary studies and the production of poetry. He had little taste for the, ordinary amusements of boyhood, and obtained no scholastic distinction. In 1849 he left Harrow, and studied for a year at Bonn with an English tutor, and on his return with another tutor in England. In 1850 he entered the diplomatic service as unpaid attache to his uncle. Sir Henry Bulwer, who was then minister at Washington. His advance in the diplomatic service was continuous, his successive ap- pointments being: as second secretary — 1852, Florence (under Lord Normanby) ; 1854, Paris (Lord Cowley) ; 1857, The Hague; 1859, Vienna (Lord Bloomfield) ; as*~~

~~*first secretary or secretary of legation — 1863, Copenhagen (Sir A. Paget) ; 1864, Athens (Mr Erskine) ; 1865, Lisbon (Sir A. Magennis); 1868, Madrid; 1868, Vienna; 1873, Paris (Lord Lyons); as minister — 1875, Lisbon. In 1887 he was appointed to succeed Lord Lyons as ambassador at Paris, and held that office until his death in 1891. This rapid promotion from one European court to another for a period of twenty-three years indicates the esteem in which Lytton was held by successive foreign secretaries. In 1864, immediately before taking up his appointment at Athens, he married Edith, daughter of Edward Villiers, brother of the earl of Clarendon, and iu 1873, upon the death of his father, he succeeded to the peerage and the estate of Knebworth in Hertford- shire, devised to his father by his grandmother, the last heiress of the family of Lytton.*~~

~~*Early in 1875 Lord Lytton declined an offer of ap- pointment as governor of Madras, and in November of that year he was nominated governor-general of India by his father's old friend and colleague, Mr Disraeli. The moment was critical in the history of India. Disraeli, securely established in power for the first and last time, was set upon reversing the tradition of the preceding ten years, and proving to the world that Great Britain was not afraid either of imperial greatness or international responsibility. In Central Asia the advance of Russia had continued so steadily and so rapidly that Sher Ali, the Amir of Afghanistan, had determined to seek safety as the vassal of the Tsar as quickly as circumstances should permit. Lytton went out to India with express instructions from the British Government to recover the friendship of the Amir if possible, and if not so to arrange matters on the North- West frontier as to be able to be indifferent*~~

~~*to his hostility. For eighteen months Lytton and his Council made every effort to conciliate the friendship of the Amir, but when a llussian agent was established at Kabul, while the mission of Sir Neville Chamberlain Was forcibly denied entrance into the Amir's dominions, no choice was left between acknowledging the right of a subsidized ally of Great Britain to place himself within Russian control and de- priving him of the office which he owed to British patron- age and assistance. The inevitable war began in November 1878, and by the close of that year the forces prepared by Lytton for that purpose had achieved their task with ex- traordinary accuracy and economy. Sher Ali fled from Kabul, and shortly afterwards died, and once more it fell to the Indian Government to make provision for the future of Afghanistan. By the treaty of Gundamuk in May 1879 Yakub Khan, a son of Sher Ali, was recog- nized as Amir, the main conditions agreed upon being that the districts of Kuram, Pishin, and Sibi should be "assigned" to British administration, and the Khyber and other passes be under British control ; that there should be a permanent British Resident at Kabul, and that the Amir should be subsidized in an amount to be afterwards determined upon. The endeavour of the Ind- ian (iovernment was to leave the internal administra- tion of Afghanistan as little affected as possible, but considerable risk was run iu trusting so much, and especially the safety of a British envoy, to the power and the goodwill of Yakub Khan. For the conclusion of this treaty Lytton received the thanks of both Plouses of Par- liament in August of the same year. Sir Louis Cavagnari, the British envoy, entered Kabul at the end of July, and was, with his staff, massacred in the rising which took place on the 3rd September. The war of 1879-80 immediately began, with the occupation of Kandahar by Stewart and the advance upon and capture of Kabul by Roberts, and the military operations which followed were not con- cluded when Lytton resigned his office in April 1880.*~~

~~*A complete account of Lytton's viceroyalty, and a lucid exposition of the principles of his government and the main outlines of his policy, may be found in Lord Lytton's Indian Administration, by his daughter, Lady Betty*~~

~~*Bal- four (London, Longmans, 1899). The frontier policy which he adopted, after the method of a friendly and united Afghanistan under Yakub Khan had been tried and had failed, was that the Afghan kingdom should be destroyed. The province of Kandahar was to be occupied by Great Britain, and administered by a vassal chief, Sher Ali Khan, who was appointed " Wall " with a solemn guarantee of British support (unconditionally withdrawn by the Government succeeding Lytton's). The other points of the Indian frontier were to be made as secure as possible, and the provinces of Kabul and Herat were to be left absolutely to their own devices. In consequence of what had been said of Lytton by the leaders of the Parlia- mentary Opposition in England, it was impossible for him to retain his oiRce under a Government formed by them, and he accordingly resigned at the same time as the Beaconstield ministry. This part of his policy was there- upon revoked. Abdur Rahman, proving himself the strongest of the claimants to the throne left vacant by Yakub Khan's deposition, became Amir as the subsidized ally of the Indian Government.*~~

~~*The two most considerable events of Lytton's vice- royalty, besides the Afghan wars, were the assumption by Queen Victoria of the title of Empress of India on the 1st January 1877, and the famine which prevailed in various parts of India during the same year. The Durbar at Delhi, at which the Queen was proclaimed empress, was the dramatic completion of the transfer of the Indian government in 1858 from the East India Company to the sovereign of the United Kingdom. It was a pag- eant of unprecedented splendour, and at the same time a, gathering of more or less dependent native princes and chiefs such as had never previously been held. To the famine of 1876-78 Lytton devoted a great part of his time and thoughts. Having personally witnessed in different parts of India the application of the methods then adopted for dealing with such a catastrophe, he satisfied himself that periodical famines must be ex- pected in Indian history, and that constant prepara- tion during years of comparative prosperity was the only condition whereby their destructiveness could be modified. Accordingly he proposed and obtained the appointment of the Eamine Commission of 1878, to inquire, upon lines laid down by him, into available means of mitigation. Their report, made in 1880, is the founda- tion of the later system of irrigation, development of communications, and "famine insurance." The equalizar tion and reduction of the salt duty were effected,*~~

~~*and the abolition of the cotton duty commenced, during Lytton's term of office, and the system of Indian finance profoundly]nodified by decentralization and the regulation of provin- cial responsibility, in all which matters Lytton enthusias- tically supported Sir John Strachey, the financial member of his Council.*~~

~~*Upon Lytton's resignation in 1880 an earldom was con- ferred upon him in recognition of his services as viceroy. He returned home, and lived at Knebworth until 1887, in which year he was appointed to succeed Lord Lyons as ambassador at Paris. For this great office it was considered that his wide knowledge of European diplomacy and re- markable command of the French language gave him altogether exceptional qualifications, and the general ex- pectation of his success was not disappointed. British diplomatic relations with France were never on a more thoroughly satisfactory footing than during the four years of Lytton's embassy. They were the last years of his life. He died at Paris on 24th November 1891, of a clot of*~~

~~*blood in the heart, when apparently recovering from a serious illness.*~~

~~*Lytton is probably better known as a poet — under the pen-name of "Owen Meredith" — than as a statesman. The list of his published works is as follows : Clytem- nestra, and other Poems, 1855 ; Tlie Wanderer, 1858 ; Lucile, 1860 ; Serbski Pesme, or National Songs of Servia, 1861 ; Tannhduser (in collaboration with Mr Julian Fane), 1861 ; Chronicles and Characters, 1867; Orval, or The Fool of Time, 1868 ; Fables in Song (2 vols.), 1874 ; Glenaveril, or The Metamorphoses, 1885 ; After Paradise, or The Legends of Exile, and other Poems, 1887 ; Marah, 1892 ; King Poppy, 1892. The two last-mentioned volumes were published posthumously. A few previously un- published pieces are included in a volume of Selections published, with an introduction by Lady Betty Balfour, in 1894 (Longmans and Co.). His metrical style was easy and copious, but not precise. It often gives the impression of having been produced with facility, because the flow of his thought carried him along, and of not having undergone prolonged or minute polish. It was frequently suggestive of the work of other poets, especially in his earlier productions. The friend who wrote the inscription for the monument to be erected to him at St Paul's described him as " a*~~

~~*poet of many styles, each the expression of his habitual thoughts." Lucile, a novel in verse, presents a romantic style and considerable wit ; and Qlenaveril, which also contains many passages of great beauty and much poetic thought, has much of the same narrative character. Beside his volumes of poetry, Lytton published in 1883 two volumes of a biography of his father. The second of these contains the beginning of the elder Lytton's unfinished novel, Greville, and his life is brought down only to the year 1832, when he was twenty-six years of age, so that the completion of the book upon the same scale would have required at least four more volumes. The executrix of Lytton's mother chose to consider that the publication was injurious to that lady's memory, and issued a volume purporting to contain Bulwer-Lytton's letters to his wife. This Lytton suppressed by injunction, thereby procuring a fresh ex- position of the law, that the copyright in letters remains in the writer or his representatives, though the property in them belongs to the recipient. Lytton's appointment to the Parisian embassy caused the biography of his father to be finally laid aside.*~~

~~*Lytton was physically well-proportioned, delicately made, and rather below than above the average size. He had no aptitude for outdoor sports, and was probably at no time rgbust in health or given to any considerable bodily activity. As a young man he was extremely hand- some, his head being well-shaped and thickly covered with closely curling hair, which he retained all his life. In middle age the marked characteristics of his features were intelligence and extreme vitality. His ordinary con- versation arrested notice at once by its humour, its wide comprehensiveness, its flexibility, and its startling candour. But in business matters the vigour and swiftness of his intellect were what most distinguished him. The prompt- ness with which he seized and mastered the essential points of the matter under discussion, and the incisive force with which his own view of it was expressed, demonstrated at once and without question that he was a man of the highest ability. With a strong regard for all the conven- tions of life as such, he entirely refused to govern his conduct by those which he conceived not to be appli- cable to himself, and there were people who resented this side of his character. His dress, without being start- ling, was usually distinctive, and his choice of clothes in private life was regulated principally by a regard for hisown comfort. He would address any one, in any station of life,*~~

~~for whom he felt a regard, as " dear ," and both in con- versation and in correspondence made far more frequent use of the superlative " dearest " than is at all usual in England. Though he had considerable eloquence, his main methods of expression were conversation and writing. His prose style was extraordinarily lucid and powerful,~~

~~but his minutes and despatches were very seldom short. During the interval between his Indian government and his embassy at Paris he lived at Knebworth, where, out of filial affection, he preserved sedulously much of his father's embellishment of the house, and added considerably to the fabric. (h. s*.)~~

~~Maasin, a town on the coast in the extreme south- western portion of the island of Leyte, Philippine Islands. It is an important port for the shipment of abac^ (Musa textilis), and the low, fertile plains in its vicinity also produce cotton, pepper, tobacco, and rice in considerable quantities. It is the only point on the western coast of Leyte where a court of justice is held. The language is Visayan. Population, 18,000.~~

~~Macao, a Portuguese possession, situated near the estuary of the Can-ton river, China. During the south-west (summer) monsoon great quantities (67 inches) of rain fall, especially in July and August. The mean temperature is 74-3° Fahr. ; in July, the hottest month, the temperature is 84-2° ; in February, the coldest, it is 69°. On the whole the climate is moist. Hurricanes are frequent. Its area is 4 square miles. Population (1896), Chinese, 74,568 ; Portuguese, 3898 ; and other national- ities, 161 — total, 78,627. Of the Portuguese more than three-fourths were natives of Macao — a race very inferior in point of physique to their European ancestors. Macao is connected with the colony of Hong-Kong by a daily steamer. Being open to the south-west sea breezes, it is a favourite place of resort from the oppressive heat of Hong-Kong. It is ruled by a governor, and, along with Timor (East Indies), constitutes a bishopric, to which belong also the Portuguese Christians in Malacca and Singapore. There are a lyceum, seminary, and college (Santa Eosa de Lima). Silks, mats, tobacco,~~

~~paper, pre- served foods, rugs, timber, opium, and goldsmiths' work are the principal articles manufactured or prepared. The trade, mostly transit and in Chinese hands, increased in value from £2,269,260 in 1880 to £3,771,615 in 1898, the commodities mostly dealt in being oj^ium, tea, rice, oil, raw cotton, fish, and silk. Macao is hardly of any account, however, as a port of foreign trade. In fishing 920 boats and 8700 men and boys are employed. Fish was exported to the value of £882,200 in 1896.~~

~~Although Macao is, de facto, a colonial possession of Portugal, the Chinese Government persistently refused to recognize the claim of the Portuguese to territorial rights, alleging that tliey were merely lessees or tenants at will. This diplomatic difficulty prevented the conclusion of a commercial treaty b'etween China and Portugal for a long time, but an arrangement for a treaty was come to in 1887 on the following basis: — (1) China confirmed perpetual occupation and government of Macao and its de- pendencies by Portugal. (2) Portugal engaged never to alienate Macao and its dependencies without the consent of China. (3) Portugal engaged to co-operate in opium revenue work at Macao in the same way as Great Britain at Hong-Kong. The formal treaty was signed in the same year, and arrangements were come to whereby the Chinese Imperial Customs were able to collect duties on vessels trading with Macao in the same way as they had already arranged for their collection at the British colony of Hong-Kong.~~

~~Macarsca (also spelt MaJcarslca), a seaport town in the Austrian crownland of Dalmatia, opposite the island of Brazza, and about 32 miles south-east of Spalato. Some of the best Dalmatian wine is grown in the district, and the town has a considerable trade in corn, figs, and other fruit. It is a station of the Austrian Lloyd. In 1890 it had a population of 10,309, and in 1900, 11,016, chiefly Serbo-Croatian.~~

~~Macassar.~~

~~See Celebes.~~

~~M'Carthy, Justin (1830-~~

~~-), Irish politician.~~

~~*historian and novelist, was born in Cork, 22nd November 1830, and was educated at a school in that town. He began his career as a journalist at the age of eighteen, in Cork. From 1863 to 1859 he was in Liverpool, on the staff of the Northern Daily Times, during which period he married (in March 1866) Miss Charlotte Allman. In 1860 he removed to London, as parliamentary reporter to the Morning Star, of which he became editor in 1864. In 1868 he gave up this post, and, after a lecturing tour in the United States, joined the staff of the Daily News as leader-writer in 1870. He lectured again in America in 1870-71, and again in 1886-87. He represented Co. Longford in Parliament as a Liberal and Home Euler from 1879 to 1886 ; North Longford, 1885-86 ; London- derry, 1886-92 ; and North Longford from 1892 to 1900. He was chairman of the Anti-Parnellites from the fall of Mr Parnell in 1890 until January 1896 ; but his Nation- alism was of a temperate and orderly kind, and though his personal distinction singled him out for the nominal chairmanship he was in no sense the political leader. His real bent was towards literature. His earliest pub- lications were novels, some of v^hich, such as A Fair Saxon (1873), Dear Lady Disdain (1876), Miss Misan- thrope (1878), Donna Quixote (1879), attained consider- able popularity. His most important work is his History of Our Own Times (vols, i.-iv. 1879-80; vol. v. 1897), which treats of the period between Queen Victoria's Accession and her Diamond Jubilee. Easily and de- lightfully written, these volumes form a brilliant piece of narrative from a Liberal standpoint. He also started on a History of the Four Georges (1884-1901), of which the latter half was written by his son, Justin Huntly M'Carthy (born 1860), who is the author of various novels, plays, and short histories. Justin M'Carthy, amongst other works, wrote biographies of Sir Eobert Peel (1891), Pope Leo XIII. (1896), and W. E. Gladstone (1898), and published his Reminiscences, in 2 vols., in 1899.*~~

~~*McClellan, George Brinton (1826-1885), soldier and author, was born in Philadelphia, Pa., 3rd December 1826. After passing two years (1840-42) in the University of Pennsylvania, he entered the U.S. mili- tary academy, from which he graduated with high honours, July 1846. Sent as a lieutenant of engineers to the Mexican war, he took part in the battles under General Scott, and won brevets of first lieutenant and captain for gallantry; he was afterwards detailed as assistant-instruc- tor at West Point, and upon explorations at the south-west and in Oregon. Promoted in 1855 to captain*~~

of cavalry, he served on a military commission sent to Europe to study the Crimean vt^ar, and furnished an able and interesting report. Eesigning his commission in 1857, McClellan became successively chief engineer and vice- president of the Illinois Central railroad (1857-60) and president of the St Louis and Cincinnati railroad, with his residence in Cincinnati. When the Civil War broke out, he was, in April 1861, made major-general of three months' militia by the governor of Ohio; but General Scott's favour at Washington promoted him rapidly, 14th May, to major-general, U.S.A., with a military de- partment north of the Ohio river. Pursuant to orders. 26th May, McClellan sent a small force acj-oss the Ohio river to Pliilippi, dispersed the Confederates there in early

June, and aided immensely the movement of the Unionist forces in that region by rapid and brilliant military successes, gained, 11th to 13th July, with Eoseerans next in command, at Eich Mountain and Carrick's Ford. These operations, though comparatively trivial as the Civil War developed, brought great results, in permanently dividing old Virginia, by the erection of the loyal state of West Virginia, and in presenting the first sharp, short, and wholly successful campaign of the war. Soon after the Bull Eun disaster, he was summoned to Washington, and the Union hailed him as chieftain and preserver. .Only thirty-four years old, and with military fame and promotion premature and quite in excess of positive experience, he reached the capital, 26th July, and assumed command. At first all was deference and compliance with his wishes. The veteran Scott retired that this young hero might have the operations of the whole Union within his closer control. McCJellan proved himself a grand organizer, and created that famous army of the Potomac, which idolized him with the devotion of a first faith. But he soon showed petulance towards the civil authorities, from whom he came to differ concerning the political ends in view. His army grew rapidly in numbers and discipline but did not go forward. Autumn and winter passed, and nothing was done until the spring of 1862. McClellan now found severe critics who doubted his capacity for the aggressive; but the Government yielded to his plans for an oblique instead of direct

movement upon Eichmond and the opposing army. By 5th April his invading column of 121,500 was safely transported to Fortress Monroe; and other troops were sent later at his earnest request, some being retained to cover Washington. McClellan laid slow siege to Yorktown, not breaking the thin line first opposed to him, but giving Johnston full time to reinforce and then evacuate. !N"ext at Williamsburg, 5th May, came, an undirected battle, accidentally brought on during his pursuit. Eichmond was in danger; but McClellan had made the York rather than the James river his line of approach, and with White House Landing for a base of supplies, he found himself compelled to divide his immense force by the malarial stream of the Chickahominy. At " Seven .Pines " (or "Fair Oaks") was fought, 31st May, a bloody battle, ending the following day in a Confederate repulse. Johnston being severely wounded, Lee came to command on the southern side. Long storms now hindered operations, until, with a newly recruited army, Lee despatched two-thirds of his entire force to the north of the Chickahominy to strike McClellan's isolated right wing. The Seven Days' Battles began 26th June, with Lee's assault strenuously resisted by General Fitz-John Porter at Mechanicsville, and then at Gaines's Mill, after which, on the night of the 27th, McClellan announced his purpose to transfer his base to the James river. This change was promptly executed in a masterly manner, but at Glendale and Malvern Hill fierce battles were fought, and all was retreat, without effort to outflank Lee or move by the inner line upon Eich- mond. Operations nearer Washington having changed the theatre of conflict. General Halleck, who was now general- in-chie'f, ordered McClellan and his army back from the peninsula to reinforce General Pope in the region of Manassas. The order was obeyed reluctantly. Pope's disastrous defeat (29th and 30th August) brought McClel- lan a new opportunity to retrieve his fame, for President Lincoln, against the earnest remonstrance of Stanton and others of his cabinet, now placed him once more in com- mand, and sent him to oppose Lee, who crossed the Potomac into Maryland in early September. At Antietam, on the 17th, was fought a great battle, in which Lee was worsted, McClellan having profited by an order which

fell into his hands, disclosing his enemy's whole plan of invasion. But the Confederates safely recrossed the Potomac, and McClellan showed his former faults in a tardy pursuit and aggression. Having by 7th November

~~*reached the full limit of experiment. President Lincoln now superseded McClellan in command of the army of the Potomac. McClellan was never again ordered to active command, and the political elements opposed to the general policy of this administration united on him for President in 1864, on a platform which denounced the war as a failure and proposed negotiating with the South for peace. McClellan, while accepting his candidacy, repudiated the platform, like a soldier and patriot. At the polls, 8th November, Lincoln was triumphantly re- elected President. On the day of election McClellan resigned his high commission in the army, and soon afterwards went to Europe, where he remained until 1868. Upon his return he took up his residence in New York City, where (1868-69) he engaged in superintending the construction of an experimental floating battery. In 1870-72 he was engineer-in-chief of the city's department of docks. With Orange, N.J., next as his principal residence, he became Democratic governor of New Jersey (1878-81). During his last years he made several tours- of Europe, visited the East, and wrote much for the magazines. He also prepared monographs upon the Civil War, defending his own action. He died suddenly at Orange, of heart disease, 29th October, 1885.*~~

~~*McClellan was a clear and able writer and effective speaker, and his Ovm Story, edited by a friend and pub- lished soon after his death, discloses an honourable character, sensitive to reproach, and conscientious, even morbidly so, in his patriotism. He carried himself well while in civil station and was of irreproachable private conduct. During the Civil War, however, he was promoted too early and rapidly for his own good, and the strong personal magnetism he inspired while so young developed an inordinate self-esteem and exaltation, injurious to a full measure of success and usefulness, despite his splendid opportunities. The reasons for his final displacement in 1862 were both civil and military, and the President had been forbearing with him. As a soldier McClellan was a marvellous organizer and moulder of the raw material of an army, and could inspire those under him to fight. But he was slow and feeble, perhaps too tender-hearted, in handling armed masses for action ; and though admirable for defensive war and a safe strategist, he showed himself iinfitted to take the highly essential initiative, both because of temperament and his habitual exaggeration of obstacles and opposing numbers. (j. sch.)*~~

~~*Macclesfield, a municipal borough and market town in (since 1885) the Macclesfield parliamentary division of Cheshire, England, on the river Bollin, 17 miles south by east of Manchester by rail. The County Lunatic Asylum has been enlarged to accommodate epileptic patients, and in 1894 the town was presented with the Victoria Park (13 acres). There is a technical school. "Macclesfield Forest" is now nearly treeless. Hand-looms are still largely used in the silk-throwing mills. Population (1881), 37,514 ; (1901), 34,635. The parish of Sutton stretches 4 miles south-south-east of the town, and is partly contained in the municipal borough.*~~

~~*M'Clintock, Sir Francis Leopold (1819-*~~

~~*), Arctic explorer, was born at Dundalk in 1819.*~~

~~*He entered the navy at the age of twelve, and spent some fifteen or sixteen years on foreign service. His first experience of Arctic travel was gained on H.M.S. Enterprise, in an expedition despatched by the Admiralty in 1848, at the time when the greatest anxiety was entertained concerning the fate of Sir John Franklin's*~~

~~*expedition. In 1860 he served with a similar expedition, on H.M.S. Assistance, and in the summer of that year saw, at Cape Kiley, some traces of the lost explorers. In the following spring he made a sledge journey of 760 miles, and reached the most westerly point then explored in the Arctic. On his return, in 1851, he was promoted to the rank of commander, and in 1852 returned to the Arctic in command of H.M.S. Intrepid, one of five vessels sent in that year to continue the search for Franklin. This time he was away for two years, in the course of which he dis- tinguished himself by another long sledge journey of exploration, and by the discovery and rescue of a body of explorers who, under Captain M'Clure, had been missing for three years. In 1867, having now reached the rank of captain, he took command of the search expedition equipped by Lady Franklin, and, in the ship Fox, suc- ceeded in discovering on the shore of King William Land a record of the death of Sir John Franklin and the fate of his men and ships.*~~

~~*For his services in this connexion he was knighted (in 1859), and received the freedom of the City of London as well as marks of honour frorn various universities. From 1859 to 1865 he was on foreign service, and from 1865 to 1868 was commodore at Jamaica. From 1868 to 1871 (when he was promoted to rear-admiral) he was a naval aide-de-camp to Queen Victoria; from 1872 to 1877 admiral superintendent of Portsmouth dock- yard ; after which, reaching the rank of vice-admiral, he served as commander-in-chief of the North American and West Indian station from 1879 to 1882. In 1884 he retired as full admiral, and became an elder brother of the Trinity HIouse. In 1887 he was awarded a special pension for his services, and was created K.C.B. in 1891. HIe published, in 1859, his narrative of his search for Sir John Franklin, under the title of The Voyage of the "Fox" ; it reached a fifth edition in 1881. HIe married, in 1870, Annette Elizabeth Dunlop.*~~

~~*MacCormac, Sir William, Bart. (1836-1901), Irish surgeon, was born at Belfast, 17th January 1836, being the son of Dr HIenry Mac Cormac. HIe was edu- cated in medicine and surgery at Belfast, Dublin, and Paris, and graduated in arts, medicine, and surgery at the Queen's University of Ireland, in which he afterwards became an examiner in surgery. HIe started practice in Belfast, where he became surgeon to the General HIospital, but left it for London on his marriage in 1861 to Miss Katherine M. Charters. In the Franco-German war of 1870 he was surgeon-in-chief to the Anglo-American Ambulance, and was present at Sedan; and he also went through the Turco-Servian war of 1876. HIe became in this way an authority on gun-shot wounds, and besides being highly successful as a surgeon was very popular in society, his magnificent physique and Irish temperament making him a notable and attractive person- ality. In 1881 he was appointed assistant-surgeon at St Thomas's HIospital, London, and for twenty years continued his work there as surgeon, lecturer, and con- sulting surgeon. In 1881 he acted as hon. secretary- general of the International Medical Congress in London, and was knighted for his services. In 1883 he was elected member of the Council of the College of Surgeons, and in 1887 a member of the Court of Examiners; in 1893 he delivered the Bradshaw lecture, and in 1896 was elected president, being re-elected to this office in 1897, 1898, 1899, and 1900 (the centenary year of the College), an unprecedented record. In 1897 he was created a baronet, and appointed surgeon-in-ordinary to the prince of Wales ; and in 1898, in recognition of*~~

~~his attendance on the prince at the time of an accident to H.R.H.'s knee-cap, he was made K.C.V.O. His foreign distinc- tions and orders were also numerous. In 1899 he was~~

~~Hunterian Orator. In the same year he volunteered to go out to South Africa as consulting surgeon to the forces, and from November 1899 to April 1900 he saw much active service both in Cape Colony and Natal, his assistance being cordially acknowledged on his return. In 1901 he was appointed honorary serjeant-surgeon to the King. But during 1898 he had suffered from a pro- longed illness, and he had perhaps put too much strain on his strength, for on 4th December 1901 he died somewhat suddenly at Bath. Besides treatises on Surgical Opera- tions and Antiseptic Surgery, and numerous contributions to the medical journals, Sir William MacCormac was the, author of Worh under the Red Cross and of an interesting volume commemorating the centenary of the Eoyal College of Surgeons in 1900. The latter contains bio- graphical notices of all the masters and presidents up to that date. (h. ch.)~~

~~McCormick, Cyrus Hall (1809-1884), American inventor of grain-harvesting machinery, was born at Walnut Grove, Eockbridge county, Va., U.S.A., 15th February 1809. His father was a farmer who had invented numerous labour-saving devices for farm work, but after repeated efforts had failed in his attempts to construct a successful grain-cutting machine. In 1831, Cyrus, then twenty-two years old, took up the problem, and after careful study constructed a machine which was successfully employed in the late harvest of 1831 and patented in 1834. The McCormick reaper came into use slowly for many years, but after further improvements proved a complete success ; and in 1847 the inventor removed to Chicago, where he established large works for manufacturing his agricultural machines. William H. Seward has said of McCormick's invention, that owing to it " the line of civilization moves westward thirty miles each year." Numerous prizes and medals were awarded for his reaper, and he was elected a corresponding member of the French Academy of Sciences, " as having done more for the cause of agriculture than any other living man." He died in Chicago, 13th May 1884.~~

M'Cosh, James (1811-1894), educator and philo- sophical writer, was born at Carskeoch, in Ayrshire, on the 1st of April 1811. He studied at Glasgow and Edinburgh, receiving at the latter his M.A., at the sugges- tion of Sir William Hamilton, for an essay on the Stoic philosophy. He became a minister of the Established Church of Scotland, and took part in the Free Church movement of 1843. In 1852 he was appointed professor of logic and metaphysics in Queen's College, Belfast ; and in 1868 was chosen president of the College of New Jersey, at Princeton, a post which he filled with much acceptance until his resignation in 1888. The list of his philosoph- ical, religious, and controversial (against Mill, Huxley, and Tyndall, in particular) writings began with The Method of the Divine Government, Physical and Moral (1850), which was cordially received by conservative theo- logians, and ended with The Religious Aspects of Evolution (1888). His general philosophical attitude and method were Hamiltonian ; he insisted on severing religious and philosophical data from merely physical ; and though he added little to original thought, he clearly restated and vigorously used the conclusions of others. He died at Princeton on the 16th of November 1894. (o. v. r.)

M'Culloch, Sir James (1819-1893), Australian statesman, son of George M'Culloch, was born in Glasgow in 1819. He entered the house of Dennistoun Brothers, became a partner, and went to Melbourne to open a branch. In 1854, shortly after his arrival in Victoria, he was appointed a nominee member of the Legislative Council, and in the first Legislative Assembly under the new con-

stitution was returned for the electorate of the Wimmera. In 1857 he was appointed Minister of Trade and Cus- toms in the second ministry of Mr Haines, which lasted till 1858, and subsequently, while representing East Melbourne, he became Treasurer in the Nicholson admin- istration, which held office from October 1859 to Novem- ber 1860. After its resignation Mr M'CuUoch revisited Europe, and on his return to Victoria he re-entered the Assembly as member for Mornington. In June 1862 the third O'Shanassy ministry was defeated by a com- bination between a section of its

~~supporters led by Mr M'Culloch and the Opposition proper under Mr Heales, and Mr jM'Culloch became Premier and Chief Secretary. Hitherto he had been regarded as a Conservative, and a supporter of the landed, squatting, and importing in- terests, but the coalition ministry introduced a number of measures which at the time were regarded by the propertied classes in the colony as revolutionary. In addition to passing a land Bill, which extended the principle of free selection and deferred payments, the ministry announced their intention of reducing the duties on the export of gold and the import duties upon tea and sugar, and of supplying the deficiency by the im- position of duties ranging from 6 to 10 per cent, upon a number of articles which entered into competition with the local industries, thus introducing protection. The mercantile community took alarm at the proposal, and at the general election of 1864 the ministerial policy was warmly opposed. But a majority was returned in its favour, and a new tariff was carriSd through the popular branch of the Legislature. There was no probability of its being assented to by the Council, which, under the constitution, had the power of rejecting, although it could not amend, any money Bill. The Government therefore decided upon tacking the tariff to the Appropri- ation Bill, and compelling the Council either to agree to the new fiscal proposals or to refuse to pay the public creditors and the civil servants. The Council accepted the challenge, and rejected the tacked Appropriation Bill. But Mr M'Culloch and his colleagues would not give way. They continued to collect the new duties under the authority of the Assembly, and took advantage of a clause in the Audit Act which directed the Governor to sign the necessary warrants for the payment of any sum awarded by verdicts in the Supreme Court in favour of persons who had sued the Government. Mr M'Culloch borrowed £40,000 from the London Chartered Bank, of which he was a director, to meet pressing payments, and the bank at his instigation sued the Government for the amount of the advance. The Attorney-General at once accepted judgment, and the Governor, who had placed himself unreservedly in the hands of his ministers, signed the necessary warrant, and the Treasury repaid to the bank the amount of its advance, plus interest and'costs. In the next session of Parliament the tariff was again sent up to the Council, which promptly rejected it, whereupon the ministry dissolved the Assembly and appealed to the country. The result of the general election was to increase Mr M'Culloch's majority, and the tariff was again sent to the Council, only to~~

~~be again rejected. Mr M'Culloch resigned, but no member of the Opposition was willing to form a ministry, and he resumed oflftce. Eventually a conference between the two Houses was held, and the Council passed the tariff, after a few modifications in it had been agreed to by the Assembly. Just at the mo- ment that peace was restored, the Governor, Sir Charles Darling, was recalled by the Home Government, on the ground that he had displayed partisanship by assisting Mr M'Culloch's Government and their majority in the Assembly to coerce the Council. In order to show their gratitude to the dismissed Governor, the Assembly de-~~

~~cided to grant a sum of £20,000 to Lady Darling. The Home Government intimated that Sir Charles Darling must retire from the Colonial service if this gift were accepted by his wife, but Mr M'Culloch included the money in the annual Appropriation Bill, with the result that it was rejected by the Council. The new Governor, Viscount Canterbury, was less complaisant than his predecessor, but after an unsuccessful attempt to obtain other advisers, his Excellency agreed to recommend the Council to pass the Appropriation Bill with the £20,000 grant included. The Upper House declined to adopt this course, and again rejected the Bill. A long and bitter struggle between the two Chambers ended in another general election in 1868, which still further in- creased the ministerial majority; but Lord Canterbury, in obedience to instructions from the Colonial Office, de- clined to do anything to facilitate the passage of the Dar- ling grant. Mr M'Culloch resigned, and after protracted negotiations Sir Charles Sladen formed from the minority in the Assembly a ministry which only lasted two months. The deadlock seemed likely to become more stringent than ever, when a communication was received from Sir Charles Darling, that neither he nor his wife could receive anything like a donation from the people of Victoria. The attempt to pass the grant was therefore abandoned, and in July 1868 Mr M'Culloch resumed office with different colleagues, but resigned in the follow- ing year, when he was knighted. He formed a third ministry in 1870. During this third administration he passed a measure through both Houses which secured a life annuity of £1000 per annum to Lady Darling. Additional taxation being necessary, Sir James M'Culloch was urged by his protectionist supporters to increase the import duties, but he refused, and proposed to provide for the deficit by levying a tax upon town, suburban, and country property. This proposal was defeated in the~~

~~Assembly ; Sir James resigned in June 1871, and was appointed Agent-General for Victoria in London. He held that appointment till 1873, was created K.C.M.G. in 1874, returned to the colony the same year, and was elected for Warrnambool. In 1875 he formed his fourth and last ministry, which kept power till May 1877, when his party was defeated at the general election. During his eighteen months of office he had to encounter a per- sistent opposition from Mr Berry and his followers, who systematicallj' obstructed the business of the Assembly, on the ground that the Acting Governor, Sir William Stawell, had improperly refused a dissolution. Sir James M'Culloch, to counteract this obstruction, invented the closure, which was afterwards introduced with some modification into the House of Commons. After his de- feat in 1877 Sir James retired from public life and returned to England, where he died on 30th January 1893 at Ewell, Surrey. He was twice married — first, in 1841, to Susan, daughter of the Eev. James Eenwick, of Muirton, Scot- land ; secondly, in 1867, to Margaret, daughter of William Inglis, of Walflat, Dumbartonshire. He left the house of Dennistoun Brothers in 1862, and founded a new firm at Melbourne in conjunction with Leishman, Inglis and Co. of London, under the title of M'Culloch, Sellars and Co. He held several important commercial positions, and was Presi- dent of the Melbourne Chamber of Commerce, (g. c. l.)~~

~~Macdonald, George (1824-~~

~~), Scottish~~

~~novelist and poet, was born at Huntly, Aberdeenshire, in 1824 ; his father, a farmer, was one of the Macdonalds of Glencoe, and a direct descendant of one of the fam- ilies that suffered in the massacre. Macdonald's youth was passed in his native town, under the immediate influence of the Congregational Church, and in an atmo- sphere strongly impregnated with Calvinism. He took~~

~~*his degree at Aberdeen University, and migrated thence to London, studying at Highbury College for the Congre- gational ministry. In 1860 he was appointed pastor of Trinity Congregational Church, Arundel, and, after resign- ing his cure there, was engaged in ministerial work in jNIanchester. His health, however, was unequal to the strain, and after a short sojourn in Algiers he settled in London and adopted the profession of literature. In 1856 he published his first book. Within and Without, a dramatic poem ; following it in 1857 with a volume of Poems, and in 1868 by the delightful " faerie romance " Phantastes. His first conspicuous success was achieved in 1862 with David Elginhrod, the forerunner of a number of popular novels, which include Alec Forbes of Howglen (1865), Annals of a Quiet Neighbourhood (1866), Robert Falconer (1868), Malcolm (1875), Tlie Marquis of Lossie (1877), and Donal Grant (1883). He was for a time editor of Good Words for the Young, and lectured success- fully in America in 1872-73. He also wrote several stories for the young, and published some striking volumes of sermons. Both as preacher and as lecturer on literary topics (notably on Shakespeare — his study of Hamlet being particularly interesting) George Macdonald's great sincerity and moral enthusiasm, amounting at times to something akin to inspiration, exercised great influence upon thoughtful minds. His verse is homely and direct, and marked by religious fervour and simplicity. As a portrayer of Scottish peasant-life in fiction he was the precursor of a large school, which has benefitted by his example and surpassed its original leader in popularity. The religious tone of his novels is relieved by tolerance and a broad spirit of humour, and the simpler emotions of humble life are sympathetically treated. They show considerable insight into character, and several of his stories turn upon the development of the individual nature under the sway of spiritual ascendancy. Their tone throughout is wholesome and elevating. In 1877 George Macdonald was given a Civil List pension.*~~

~~*Macdonald, Sir John Alexander (1815-1891), first Premier of the Dominion of Canada, and the most conspicuous figure that Canadian politics produced in the 19th century, was born in Glasgow on the 11th of January 1815. His father was Hugh Macdonald, a native of Sutherlandshire ; his mother's maiden name was Helen Shaw ; among the five children of their family the future statesman was the third. The family emigrated to Canada in 1820, settling first at Kingston, Ontario, and later, on the failure of*~~

~~*various undertakings, removing in succession to two of the small neighbouring towns. The father, an unpractical man in matters of business, died in 1841. The energy and capacity dis- . played by the mother in holding the family together seem to have made a deep impression on her brilliant son. Five years spent at the Kingston Grammar School con- stituted the lad's only formal education. At the age of fifteen he entered the law office of Mr George Mackenzie of Kingston ; he studied there for six years, was called to the bar in 1836, and began in the same town the practice of his profession. This was a particularly critical period in the history of Canada, and one calculated to stimulate political thought in a young and active mind. It was the year before the rebellion of 1837: the condition of the whole country was very unsettled, and it seemed well-nigh impossible to reconcile tlid differences arising from racial and political antagonisms. During the rebellion young Macdonald volunteered for active service, but the up- rising was easily crushed, and his military career never went farther than drilling and marching. The year 1844 saw his entry into political life. In his first address to the electors of Kingston a sentence occurs which strikes*~~

~~*the dominant note of his subsequent political faith and public career : — " I therefore need scarcely state my firm belief that the prosperity of Canada depends upon its permanent connexion with the mother CQuntry, and that I shall resist to the utmOst any attempt (from whatever quarter it may come) which may tend to weaken that union." For forty-six years of public life this idea gave the main direction to his policy. HIe was elected by a large majority, and took his seat on 28th November 1844 as a supporter of the Draper Government. In 1847 he was made Receiver-General, with a seat in the Executive Council. The Government of which he thus became a member held office for only ten months, and then, on appealing to the country, was placed in a hopeless minority. The Rebellion Losses Bill, passed by the victorious Liberals and assented to by Lord Elgin in circumstances that provoked a riot ending in the burning of the HIouses of Parliament, caused much indignation among the hitherto ultra-loyal Conservative party, and many of its members at this period signed a document favouring annexation to the United States. Macdonald, on the other hand, took steps to form a British American League, having for its object the confederation of all the provinces, the strengthening of the connexion with the mother country, and*~~

~~*the adoption of a national com- mercial policj^ He remained in Opposition till 1854, and then, as a consequence of the fierce dissensions con- nected with the secularization of the clergy reserves in Ontario and the abolition of seigniorial tenure in Quebec, he planned a Coalition of the Conservatives and the moderate Reformers, among whom was a large Erench Canadian element. Out of this union grew the Liberal-Conservative party, of which until his death Macdonald continued to be the most prominent figure. He was Attorney-General for Upper Canada from 1854 to 1857, and then, on the retirement of Colonel Tache, he was himself called on to form a ministry. So closely were parties divided at this time that defeat and reinstatement of Governments followed each other in rapid succession.*~~

~~*The experiment of applying responsible government on party lines to the two Canadian provinces at last seemed to have come to a deadlock. Two general elections and the defeat of four ministries within three years had done nothing to solve the difficulties of the situation. At this . critical period a proposal was made for a coalition of parties in order to carry out a broad scheme of British American confederation. The immediate proposal is said to have come from George Brown ; the large political idea had long been advocated by Macdonald and Alexander Gait in Upper Canada — by Joseph Howe and others in the Maritime Provinces. The close of the American Civil War, the Fenian raids across the American border, and the dangers incident to the international situation, gave a de- cisive impulse to the movement. Macdonald, at the head of a representative delegation from Ontario and Quebec, met the public men of the Maritime Provinces in con- ference at Charlottetown in 1864, and the outline of confederation then agreed upon was filled out in detail at a conference held at Quebec soon afterwards. The con- stitution then framed was submitted to the Imperial Parlia- ment in the autumn of 1866, and passed early in the following year. On 1st July 1867 the Act by which Canada was confederated as a Dominion under the Crown was proclaimed. In all the discussions leading up to this great step in colonial development Macdonald took the leading part, and thus he naturally became the first Premier of the Dominion. He was made at this time K.C.B. in recognition of his services to the empire.*~~

~~*The difficulties of organizing the new Dominion, the questions arising from diverse claims and the varied con-*~~

~~ditions of the country, called for infinite tact and resource on the part of the Premier. Federal rights were to be safeguarded against the jjrovincial governments, always jealous of their privileges. The people of Nova Scotia in particular, dissatisfied with the way in which their pro- vince had been drawn into the Union, maintained a fierce opposition to the Ottawa Government, until their leader, Joseph Howe, fearing an armed rising, came to an agree- ment with Macdonald and accepted a seat in his cabinet. The establishment of a supreme court also occupied the attention of Sir John, who had a strong sense of the necessity of maintaining the purity and dignity of the judicial office. The pledge made at confederation with regard to the building of the Intercolonial railway was fulfilled. The North-West Territories were secured as a part of confederated Canada by the purchase of the rights of the Hudson Bay Company, and the establishment of Manitoba as a province in 1870. Canada's interests were protected during the negotiations which ended in the Treaty of Washington in 1871, and in which Sir John took part as one of the British delegates. In this year British Columbia entered the confederation, one of the provisions of union being that a transcontinental railroad should be built within ten years. This was declared by the Opposition to be im- possible. It was possible only to a leader of indomita- ble will. Charges of bribery against the Government in connexion with the contract for the building of this line led to the resignation of the cabinet in 1874, and for four years Sir John was in Opposition. But he was by no means inactive. During the summer of 1876 he travelled through Ontario addressing the people on the subject of a commercial system looking to the protection of native industries. This was the celebrated " National Policy " which had been in his thoughts as long ago as the formation of the British American League in 1850. The Government of Mr Alexander Mackenzie refused to consider a protection policy, and determined to adhere to Pree Trade with a tariff for revenue only. On these strongly-defined issues the two parties appealed to the people in 1878. The Liberal party was almost swept away, and Sir John, on his return to power, put his policy into effect with a thoroughness that commanded the admiration even of his opponents. He also undertook the~~

~~*immediate con- struction of the Canadian Pacific railway, which had been postponed by the former Government. The line was begun late in 1880, and finished in November 1885 — an achievement which Sir John ranked among his greatest triumphs. " The faith of Sir John," says one of his biographers, "did more to build the road than the money of Mount-Stephen."*~~

~~*During the remaining years of his life his efforts at administration were directed mainly towards the organiza- tion and development of the great North-West. Prom*~~

~~*Sir John A. {From a photograph by Wm.*~~

~~*1878 until his death in 1891 Sir John retained his posi- tion as Premier of Canada. Por forty-six years of stormy political life he remained true to the cardinal policy that he had announced to the electors of Kingston in 1844. "A British subject I was born; a British subject I will die," says his last political manifesto to the people of the Dominion. At his advanced age the anxiety and excite- ment of the contested election of 1891 proved too great. An illness followed from which he never recovered. On the 29th of May he suffered a stroke of paralysis, which caused his death eight days later (6th June).*~~

~~*An intelligent view of the career of Sir John Macdonald is only possible when considered in connexion with the political history of Canada and the conditions of its*~~

~~*government during the latter half of the 19th century. Trained in a school where the principles of responsible government were still in an embryonic state, where the adroit management of coali- tions and cabals was essential to the life of a political party, and where plots and counterplots were looked upon as a regular part of the political game, he acquired a dexterity and skill in manag- ing men that finally gave him an almost autocratic power among his political followers. But great per- sonal qualities supplemented his political dexterity and sagacity. A strong will en- abled him to overcome the passionate temper which marked his youth and, later in his career, a habit of intemperance, which he at first shared with many pub- lic men of his time. He was a man of strong ambi- tions, but these were curbed by a*~~

shrewd foresight which led him for a long time to submit to the nominal leadership of other and smaller men. Politics he made his business, and to this he devoted all his energies. He had the gift of living for the work in hand, without feeling the dis- traction of other interests. He had a singular faculty for reading the minds and the motives of men, and to this insight he perhaps owed the power of adaptability (called by his opponents shiftiness) which characterized his whole career. To this power the successful guidance of the Dominion through its critical formative period must be ascribed. Pew political leaders have ever had such a number of antagonistic elements to reconcile as presented themselves in the first Canadian Parliament after confederation. The man who could manage to rule a congeries of jealous factions, including Irish Catholics and Orangemen, French and English anti-federationists and agitators for independence. Conservatives and Re-formers, careful economists and prodigal expansionists, was manifestly a man of unusual power, superior to small prejudices and without strong bias towards any creed or section. Such a man Sir John proved himself to be. His personality stands out at this period as the central power in which each faction chiefly reposed trust, and under which it could join hands with the others in the

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service of the State. His singleness of purpose, personal independence, and indomitable energy enabled him to achieve triumphs that to others seemed impossible. After the " Pacific Scandal " of 1874, the leader of the opposite party declared that "John A." (as he was generally called) "has fallen, never to rise again." Yet he not only cleared his own character from the charges laid ' against him, but succeeded four years later in achieving his most signal party triumph. His natural urbanity allowed him to rule without seeming to rule. When baffled in minor objects he gave way with a good-

~~natured flexibility which brought upon him at times charges of inconsistency. Yet Canada has seen states- men of more contracted view insist on such small points, fall, and drag down their party with them. He lived at a time when the exigencies of state seemed to require the peculiar talents which he possessed. Entering politics at the dreariest and least profitable stage in Canadian his- tory, he took the foremost part in the movement which made of Canada a nation ; he guided that nation through the nebulous stages of its existence, and left it united, strong and vigorous, a monument to his patriotic and far- sighted statesmanship. In the cryjpt of St Paul's Cathedral a memorial has rightly been placed to him as a states- man, not merely of Canada, but of the Empire. In unveiling that memorial. Lord Eosebery fitly epitomized the meaning of his life and work when he said : " We recognize only this, that Sir John Macdonald had grasped the central idea that the British Empire is the greatest secular agency for good now known to mankind ; that that was the secret of his success ; and that he determined to die under it, and strove that Canada should live under it."~~

~~The authorized and most trustworthy biography of Sir John A. Macdonald is one written by his private secretary, Joseph Pope (2 vols., Arnold). Others have been written by his nephew, Colonel J. Pennington Macpherson, and by Mr J. E. Collins. A bright and amusing anecdotal life has also been compiled by Mr E. J). Biggar (Montreal, J. Lovell and Sons). (g. b. p.)~~

~~McDowell, Irvin (1818-1885), American soldier, was born in Columbus, Ohio, on 15th October 1818, and after early training in France graduated at the United States Military Academy in 1838. He was adjutant and instructor at West Point, 1841^5, won brevet rank in the Mexican war, and served as adjutant-general, chiefly at Washington, until 1861, being promoted to major in 1856. While inspector on General Scott's staff and occupied in mustering volunteers at the capital, he was made brigadier-general in May 1861, and placed in com- mand during the premature Virginian campaign of July, which ended in the defeat at Bull Run. Under McClellan he became a corps commander and major-general of volun- teers (March 1862). When the Peninsular campaign began, McDowell's column was detained against McClel- lan's wishes, and, eventually united with General John Pope, engaged at Cedar Mountain, Rappahannock~~

~~Station, and the second Bull Run. McDowell was relieved of duty in the field (September 1862), sharing Pope's odium, and served at the Pacific coast 1864-68. He became (November 1872) major-general of regulars, was retired in 1882, and died at San Francisco, California, on 4th May 1885. His military merits during the Civil War have provoked much discussion. He appears to have been a faithful, unselfish, energetic soldier, in patriotic sympathy with the lAdministration, and capable of the highest achieve- ment as commander when well sustained. But he was perhaps too ready to brave great risks at the instance of his superiors, and hence lost instead of gained by his early opportunities. (j. sch.)~~

~~Macduff, a police burgh, burgh of barony, seaport, watering-place, and railway station, 1^ miles east of Banff, Scotland. It is an important centre for the herring fishing, and has a good bathing beach and a mineral well ; also a town hall. The harbour, constructed by the duke of Fife, was transferred to the burgh in 1898. Population (1881),~~

~~3650 ; (1901), 3418.~~

~~MACEDONIA.~~

~~THE name Macedonia is now generally given to that portion of European Turkey which is bounded on the 'N. by the Kara-Dagh mountain range and the frontier of Bulgaria, on the E. by the river Mesta, on the S. by the jEgean Sea and the frontier of Greece, and on the W. by an ill-defined line coinciding with the chains of Shar, Grammos, and Pindus. The limits thus marked out do not correspond with those of any Turkish administrative division or with any ethnical boundary. In Macedonia are included the vilayets of Selanik (SalonicaV the eastern and greater portion of the vilayet of Monastir (sanjaks of Monastir, Servia, and part of that of Kortcha), and the south-eastern portion of the vilayet of Kossovo (sanjakof Uskllb). The coast-line is broken by the remarkable peninsula of Chalcidice, with its three promontories of Athos (anc. Acte), Longos (SitJionia), and Cassandra (Pallene). The country is divided into two almost equal portions by the river Vardar (anc. Axios), the valley of which has always constituted the principal route from Central Europe to the ^gean. The other important rivers are the Struma (Strymon) and Mesta (Nestos), to the east, running almost parallel to the Vardar, and the Bistritza (anc. Haliacmon) to the~~

south, all falling into the jEgean. The Struma runs through a narrow defile till within a short distance of the sea ; the valleys of the other rivers and their tributaries broaden here and there into fertile upland basins, which were formerly lakes. Of these the extensive plateau of Monastir (Vitolia), drained

by the Tcherna, is the most remarkable. The principal lakes are Ochrida, on the confines of Albania ; Prespa, separated from Ochrida by the Galinitza mountains ; Os- trovo, midway between Prespa and the Vardar ; Tachino, on the lower course of the Struma ; and Beshik (Bolbe), separating the Chalcidian peninsula from the mainland. The surface of the country is generally mountainous. The great chain of Rhodope, continued to the north by the Rilska and Osogovska Planina, forms a natural boundary on the north ; the principal summit, Musalla (2924 metres), is just over the Bulgarian frontier. Between the upper courses of the Mesta and Struma is the Perim Dagh, or Pirin Planina (anc. Orbelos), with Elin (2681 metres), con- tinued to the south by the Bozo Dagh ; between the Struma and the A^ardar are the Belasitza, Krusha, and other ranges ; west of the Vardar the lofty Shar chain, terminating at its eastern extremity in Liubotrn, supposed to be the highest mountain in the peninsula (3050 metres), continues the natural boundary, which is prolonged to- wards the south by the Grammos and Pindus ranges. Between the Vardar and the plain of Monastir the Nija range culminates in Kaimakzolan (2317 metres) ; south- west of Monastir is Mount Peristeri (2350 metres), over- looking Lake Prespa ; between Lake Ostrovo and the lower Bistritza are the Bermios and Kitarion ranges, with Doxa (1600 metres) and Turla (about 1000 metres). South of the Bistritza are the Cambanian mountains, forming the boundary of Thessaly, and terminating to the east in the

imposing mass of Elymbos, or Olympus (2985 metres). Lastly, Mount Athos, at the extremity of the peninsula of that name, reaches the height of 1936 metres. The general aspect of the country is bare and desolate, espe- cially in the neighbourhood of the principal routes ; the trees have been destroyed, and large tracts of land remain uncultivated. Magnificent forests,

however, still clothe the slopes of Ehodope and Pindus. The well-wooded and cultivated districts of Grevena and Kastoria, which are mainly inhabited by a Vlach population, are remark- ably beautiful, and the scenery around Lakes Ochrida and Prespa is exceedingly picturesque. The climate is severe ; the spring is often rainy, and the melted snows from the encircling mountains produce inundations in the plains. The natural products are in general similar to those of southern Bulgaria and Servia — ^the fig, olive, and orange, however, appear on the shores of the Mgean, and in the sheltered valleys of the southern region. The best tobacco in Europe is grown on the southern declivity of Rhodope in the Kavala district.

The population of Macedonia may perhaps be estimated at 2,200,000. Of this number about 1,300,000 are Chris- tians, belonging to various churches and nation- ti^n”’”’ alities ; more than 800,000 are Mahommedans, and about 75,000 are Jews. Of the Christians, the great majority profess the Eastern Orthodox faith, owning allegiance either to the Greek patriarchate or the Bulgarian exarchate. Among the Orthodox Christians are reckoned some 4000 Turks. The small Catholic minority is composed chiefly of ” Uniate ” Bulgarians (about 3600), occupying the districts of Kukush and Doiran ; there are also some 2000 Bulgarian Protestants, principally inhabit- ing the valley of Eazlog. The Mahommedan population is mainly composed of Turks (about 600,000). In ad- dition to these there are some 130,000 Bulgars, 120,000 Albanians, 36,000 gypsies, and 14,000 Greeks, together with a smaller number of Vlachs, Jews, and Circassians, who profess the creed of Islam. The Turkish statistics, which are entirely untrustworthy, take religion, not na- tionality, as the basis of classification. All Moslems, to whatever race they may belong, are included in the millet, or nation, of Islam. The Rum, or Roman (i.e., Greek) millet comprises all those who acknowledge the authority of the OEcumenical Patriarch, and consequently includes, in addition to the Greeks, the Servians, the Vlachs, and a certain number of Bulgarians ; the Bulgar millet com- prises the Bulgarians who accept the rule of the exar- chate ; the other millets are the Katolik (Catholics), Ermeni (Gregorian Armenians), Musevi (Jews), and Prodesdan (Protestants). The population of Macedonia, at all times scanty, has undoubtedly diminished in recent years. The prevailing insecurity, the exactions of the Turkish oflB.cials, the severities practised by the authori- ties in the repression of political

~~agitation, the prevar lence of brigandage, authorized and unauthorized, and the ravages of Albanian marauders in the western districts, have all tended to this result. Eor many years there has been a continual outflow of the Christian population in the direction of Bulgaria, Servia, and Greece, and a corresponding emigration of the Turkish peasantry to Asia Minor. Many of the smaller villages are being abandoned by their inhabitants, who migrate for safety to the more considerable 'towns — the latter are. usually situated at some point where a mountain pass descends to the outskirts of the plains. In the agricultural dis- tricts the Christian peasants, or rayas, are either small proprietors or cultivate holdings on the estates of Turk- ish landowners, receiving a certain portion of the pro- duct, after the payment of the tithe and other taxes to the Government. The upland districts are thinly inhab- ited by a nomad pastoral population.~~

~~Inhabited by a variety of races, Macedonia possesses a peculiar importance as the principal theatre of the struggle of nationalities in Eastern Europe. All the races which dispute the reversion of the Turkish *^^; possessions in Europe are represented within its borders. Here are centred the rival aspirations of the various states which during the 19th century became detached from the Ottoman empire. The Macedonian problem may therefore be described as the quintes- sence of the Eastern Question. The Turks, the ruling race, form less than a quarter of the entire population, and their numbers are steadily declining. The first Turkish immigration from Asia Minor took place under the Byzantine emperors before the conquest of the country. The first purely Turkish town, Yenije-Vardar, was founded on the ruins of Vardar in 1362. After the capture of Salonica (1430), a strong Turkish population was settled in the city, and. similar colonies were founded in Monastir, Ochrida, Serres, Drama, and other important places. In many of these towns half or more of the population is still Turkish. A series of military colonies was subsequently established at various points of strategic importance along the principal lines of communication. Before 1360 large numbers of nomad shepherds, or Yuruks, from the district of Konieh, in Asia Minor, had settled in the country ; their descendants are still known as Konariotes. Further immigration from this region took place from time to time up to the middle of the 18th century. After the establish- ment of the feudal system in 1397, many of the Seljuk noble families came over from Asia Minor ; their descend- ants may be recognized among the~~

~~beys or Moslem land- owners in southern Macedonia. At the beginning of the 18th century the Turkish population was very considerable, but since that time it has continuously decreased. A low birth-rate, the exhaustion of the male population by military service, and great mortality from epidemics, against which Moslem fatalism takes no precautions, have brought about a decline which has latterly been hast- ened by emigration. On the other hand, there has been a considerable Moslem immigration from Bosnia, Servia, Bulgaria, and Greece, but the newcomers, or mohajirs, do not form a permanent colonizing element, and most of them remain housed in miserable dwellings on the outskirts of the larger towns. The Turkish rural population is found in three principal groups : the most easterly extends from the Mesta to Drama, Pravishta, and Orfano, reaching the searcoast on either side of Kavala, which is partly Turkish, partly Greek. The second, or central, group begins on the sea- coast, a little west of the mouth of the Strymon, where a Greek population intervenes, and extends to the north-west along the Kara-Dagh and Belasitza ranges in the direction of Strumnitza, Veles, Shtip, and Radovisht. This long line of Turkish colonies was probably designed to protect the Vardar valley, and to separate the Christian i population into two divisions. The third, or southern, group is centred around Kailar, an entirely Turkish town, and extends from Lake Ostrovo to Selfije (Servia). The second and third groups are mainly composed of Konariot shepherds. Besides these fairly compact settlements there are numerous isolated Turkish colonies in various parts of the country. The Christian Turks already alluded to are resident at Zeliachovo, in the Bozo Dagh ; they are prob- ably descendants of the earliest colonists introduced by the Byzantine emperors. The Turkish rural population is quiet, sober, and orderly, presenting some of the best characteristics of the race. The urban population, on the other hand, has become much demoralized, while the official classes, from the gendarmes to the highest function- aries, are as a rule corrupt and avaricious, and seem to have parted with all scruple in their dealings with the~~

~~*Christian peasantry. The Turks, though still numerically and politically strong, fall behind the other nationalities in point of intellectual culture, and the contrast is daily becoming more marked owing to the educational activity of the Christians. Originally a nomad race, they have never become rooted in the soil, and remigration ^to Asia Minor -will probably be their ultimate destiny.*~~

~~*The Greek and Vlach populations are not always easily distinguished, as a considerable proportion of the latter*~~

~~*has been Hellenized. Both show a remarkable The Greeks aptitude for Commerce; the Greeks have main- Viachs. tained their language and religion, and the*~~

~~*Vlachs their religion, with greater tenacity than any of the other races. From the date of the Ottoman conquest until comparatively recent times, the Greeks occupied an exceptional position in jMacedonia, as else- where in the Turkish empire, owing to the privileges conferred on the patriarchate of Constantinople, and the influence subsequently acquired by the great Phanariot families. All the Christian population belonged to the Greek millet and called itself Greek ; the bishops and higher clergy were exclusively Greek ; Greek was the language of the upper classes, of commerce, literature, and religion, and Greek alone was taught in the schools. The sujDremacy of the patriarchate was consummated by the suppression of the autocephalous Slavonic churches of Ipek in 1766, and Ochrida in 1767. In the latter half of the 18th century Greek ascendancy in Macedonia was at its zenith ; its decline began with the War of Inde- pendence, the establishment of the Hellenic kingdom, and the extinction of the Phanariot power in Constantinople. The patriarchate, nevertheless, maintained its exclusive jurisdiction over all the Orthodox population till 1870, when the Bulgarian exarchate was established, and the Greek clergy continued to labour with undiminished zeal for the spread of Hellenism. Notwithstanding their venality and intolerance, their merits as the only dif- fusers of culture and enlightenment in the past should not be overlooked. The process of Hellenization made greater progress in the towns than in the rural districts of the interior, where the non-Hellenic populations pre- served their languages, which alone saved the several nationalities from*~~

~~*extinction. The typical Greek, with his superior education, his love of politics and commerce, and his distaste for laborious occupations, has always been a dweller in cities. In Salonica, Serres, Kavala, Kastoria, and other towns in southern Macedonia the Hellenic element is strong ; in the northern towns it is insignificant, except at Melnik, which is almost exclu- sively Greek. The Greek rural population extends from the Thessalian frontier to Kastoria and Verria (Beroea) ; it occupies the whole Chalcidian peninsula and both banks of the lower Strymon from Serres to the sea, and from Nigrita on the west to Pravishta on the east ; there are also numerous Greek villages in the Kavala district. The Mahommedan Greeks, known as Valachides, occupy a con- siderable tract in the upper Bistritza valley near Grevena and Liapsista. The purely Greek population of Mace- donia may possibly be estimated at a quarter of a million. The Vlachs, or Eumans, who call themselves Aromuni or Aromdiii (i.e., Romans), are also known as Kutzovlachs and Tzintzars: the latter two appellations are, in fact, nicknames, "Kutzovlach" meaning "lame Vlach," while " Tzintzar " denotes their inability to pronounce the Ru- manian cii-icl. (five). The Vlachs are styled by some writers " Macedo-Iiumans," in contradistinction to the "Daco- Rumans," who inhabit the country noi-th of the Danube. They are, in all probability, the descendants of the Thracian branch of the aboriginal Thraco-Illyrian popu- lation of the Balkan peninsula, the Illyrians being repre- sented by the Albanians. This early native population,*~~

~~*which was apparently Hellenized to some extent under the Macedonian empire, seems to have been Latinized in the period succeeding the Roman conquest, and probably received a considerable infusion of Italian blood. How- ever this may be, the Latin origin of the Vlach language is indisputable. There is evidence to show that Latin was generally spoken by the peasantry of the interior before the Slavonic invasion. The Latin- speaking race was expelled from the plains by the Slavonic immigrants, and took refuge in the mountainous districts, where it still remains. The Vlachs are for the most part either high- land shepherds or wandering owners of horses and mules. Their settlements are scattered all over the mountains of Macedonia : some of these consist of permanent dwellings, others of huts occupied only in the summer. The com- pactest groups are found in the Pindus and Agrapha mountains (extending into Albania and Thessaly), in the neighbourhood of Mon astir, Grevena, and Kastoria, and in the district*~~

~~of Meglen. The Vlachs who settle in the lowland districts are excellent husbandmen. The urban population is considerable ; the Vlachs of Salonica, Mona- stir, Serres, and other large towns are, for the most part, descended from refugees from Moschopolis, once the principal centre of Macedonian commerce. At the be- ginning of the 18th century this Vlach city numbered 80,000 inhabitants ; it was plundered by the Albanians in 1769, and ultimately destroyed by Ali Pasha in 1788. The towns of Metzovo, on the confines of Albania, and Klisura, in the Bistritza valley, are almost exclusively Vlach. The urban and most of the rural Vlachs are bilingual, speaking Greek as well as Rumanian ; a great number of the former have been completely Hellenized, partly in consequence of mixed marriages, and many of the wealthiest commercial families of Vlach origin are now devoted to the Greek cause. The Vlachs of Macedonia possibly number 90,000, of whom only some 3000 are Mahommedans. The Macedonian dialect of the Rumanian language differs mainly from that spoken north of the Danube in its vocabulary and certain phonetic peculiari- ties ; it contains a number of Greek words which are often replaced in the northern speech by Slavonic or Latin synonyms.~~

~~The Albanians, called by the Turks and Slavs Arnauts, by the Greeks 'kpfiavh-ai, and by themselves Slikyipetar, have always been the scourge of western INIace- donia ; even before the Turkish conquest these Albanians, predatory mountaineers were accustomed to circas- devastate the fertile valleys inhabited by the ‘“^^ *'^- agricultural Slavonic population. After the first Turkish invasion of Albania many of the chiefs or beys adopted Mahommedanism, but the conversion of the great bulk of the people took place in the 16th and 17th centuries. This change of faith was productive of serious conse- quences to their Christian neighbours. Professing the creed of the dominant Power and entitled to bear arms, the Albanians were enabled to push forward their limits at the expense of the defenceless population around them, and their encroachments have continued to the present day. They have not only advanced themselves, but have driven to the eastward numbers of their Christian com- patriots and a great portion of the once-prosperous Vlach population of Albania. The indulgence extended to them hj the I'orte has been requited by constant rebellions' : with the decline of the Ottoman power in the 18th cen- tury the arrogance of the Albanian chieftains increased, and their military energies were as often~~

employed in combating the Turkish authority as in prosecuting local feuds or raiding the Christian peasantry. The ravages of Ali Pasha of Tepelen, who maintained a practically independent sovereignty at lannina from 1788 to 1832, will long be remembered in Macedonia r in his time the

Albanians established themselves in the district of Kortcha and on the southern shores of Lake Ochrida, ejecting the Slavonic population. In 1830 Arslan Bey and other Albanian chiefs, who had revolted and invaded Macedonia, ^ were invited to Monastir under pretext of an armistice by the Grand Vizier, Eeshid Pasha, and were massacred with 600 of their followers as they were about to partake of a banquet prepared by their host. A little later an Albanian invasion under Mustafa Pasha of Scutari was repulsed by the Grand Vizier, and the Slavonic population was re-established in the district of Ochrida. In recent years Albanian revolts and disturb- ances have been frequent along the western confines of Macedonia, especially in the neighbourhood of Dibra: the Slavonic peasants have been the principal sufferers from these troubles, while the Porte, in pursuance of the "Islamic policy" adopted by the Sultan Abdul Hamid II., deals tenderly with the recalcitrant believers. An invincible repugnance to the payment of taxation, and an equally strong aversion from regular military service are the main causes of Albanian discontent and the principal obstacles to a farther advance of the race into Macedonia. While confined to their mountains the tribesmen escape both these obligations, and enjoy greater facilities for plundering the populations of the plains. In southern Macedonia the Albanians of the Tosk race extend over the upper Bistritza valley as far west as Kastoria, and reach the southern and western shores of Lakes Prespa and Ochrida: they are also numerous in the neighbourhood of Monastir. In northern Macedonia the Albanians are of the Gheg stock : they have advanced in large numbers over the districts of Dibra, Kalkandele, and Usktib, driving the Slavonic population before them. The total number of Albanians in Macedonia may be estimated at about 120,000, of whom some 10,000 are Christians (chiefly Orthodox Tosks). Without a national literature, a common religion, or any of the elements of unity, the

Albanians, notwithstanding their remarkable self-assertiveness, cannot be regarded as an important political factor in Macedonia. (For the origin, language, and institutions of this singular race, see Albania, vol. XXV.) The Circassians, who occupy some villages in the neighbourhood of Serres, now scarcely number 3000 : their predatory instincts may be compared with those of the Albanians. The Jews had colonies in Macedonia in the time of St Paul, but no trace remains of these early settlements. The Jews now found in the country descend from refugees who fled from Spain during the persecutions at the end of the 16th century : they speak a dialect of Spanish, which they write with Hebrew characters. They form a flourishing com- munity at Salonica, which numbers more than half the population : their colonies at Monastir, Serres, and other towns are poor. A small proportion of the Jews, known as Beunmi by the Turks, have embraced Mahom- medanism.

With the exception of the southern and western dis- tricts already specified, the principal towns, and certain j.^^ isolated tracts, the whole of Macedonia is in-

*siavottic habited by a race or races speaking a Slavonic popuia- dialect. *If language is adopted as a test, the ”””■ great bulk of the rural population must be de-*

scribed as Slavonic. The Slavs first crossed the Danube at the beginning of the 3rd century of our era, but their great immigration took place in the 6th and 7th centuries. They overran the entire peninsula, driving the Greeks to the shores of the ^gean, the Albanians into the Mirdite country, and the Latinized population of Macedonia into the highland districts, such as Pindus, Agrapha, and Olympus. Slavonic place-names, occurring in regions where every other trace of the immigration has now dis-

appeared, bear witness to the multitude of the invaders and the permanency of their settlements. The Slavs, a primitive agricultural and pastoral people, were often unsuccessful in their attacks on the fortified towns, which remained centres of Hellenism. In the outlying parts of the peninsula they were absorbed, or eventually driven back, by the original populations, but in the central region they probably assimilated a considerable propor- tion of the Latinized races. The western portions of the peninsula were occupied

~~*by Serb and Slovene tribes : the Slavs of the eastern and central portions were conquered at the end of the 7th century by the Bulgarians, a Ugro-Finnish horde, who established a despotic political organi- zation, but being less numerous than the subjected race, were eventually absorbed by it. The Mongolian physical type, which prevails in the districts between theBalkans and the Danube, is also found in central Macedonia, and may be recognized as far west as Ochrida and Dibra. In general, however, the Macedonian Slavs differ somewhat both in appearance and character from their neighbours beyond the Bulgarian and Servian frontiers : the peculiar type which they present is probably due to a considerable ad- mixture of Vlach, Hellenic, Albanian, and Turkish blood, and to the influence of the surrounding races. Asiatic colonization under the Byzantine emperors from the 9th to the 13th century has perhaps in some degree affected the Slavs as well as the other races in the southern half of Macedonia. Almost all independent authorities, however, agree that the bulk of the Slavonic population of Macedonia is Bulgarian. The principal indication is furnished by the language, which, though resembling Servian in some respects {e.g., the case-endings, which are occasionally retained), presents most of the characteristic features of Bulgarian (see Bulgaria, Part III. vol. xxvi.). Among these may be mentioned the sufl&x-article, the nasal vowels (retained in the neighbourhood of Salonica and Kastoria, but modified elsewhere as in Bulgarian), the retention of I (e.g., vulk "wolf," hel "white"; Servian vuk, beo), and the loss of the infinitive. There are at least four Slavonic dialects in Macedonia, but the sufiix-article, though varying in form, is a constant feature in all. The Slavs of western Macedonia are of a lively, enterprising character, and share the commercial aptitude of the Vlachs : those of the eastern and southern regions are a quiet, sober, hard-working agricultural race, more obviously homogeneous with the population of Bulgaria. In upper Macedonia large family communities, resembling the Servian and Bulgarian zadntga, are commonly found : they sometimes number over 60 members. The whole Slavonic population of Macedonia may be estimated at about 1,160,000, of whom about 1,000,000 are Christians of the Orthodox faith. The majority of the latter now own allegiance to the Bulgarian exarchate, but a certain minority still remains faithful to the Greek patriarchate. The Moslem Bulgarians form a considerable element: they are found principally in the valley of the upper Mesta and the Ehodope district, where they are known as PomaTcs or*~~

~~"helpers," i.e., auxiliaries to the Turkish army. Other groups exist in the neighbourhood of Uskilb and Dibra. The conversion of the Pomaks took place at various intervals from the 16th to the 18th century : for a long period these mountaineers, a remarkably fine race, main- tained a position of absolute independence under their beys and agas. One of their principal villages, Dospat, was destroyed by raiders from over the Bulgarian frontier in 1896.~~

~~The embittered struggle- of the rival nationalities in Macedonia dates from the middle of the 19th century. Until that period the Greeks, owing to their superior cul- ture and their privileged position, exercised an exclusive influence over thewhole population professingthe Orthodox~~

~~faith. All Macedonia was either Moslem or Orthodox Christian, -without distinction of nationalities, the Catholic~~

~~or Protestant millets being inconsiderable. The The racial first opposition to Greek ecclesiastical ascend- gan'da. ancy came from the Bulgarians. The Bulgarian~~

~~literary revival, which took place in the earlier part of the 19th century, was the precursor of the ecclesiastical and national movement which resulted in the establishment of the exarchate in 1870 (see Bul- GAEiA, Parts II. and III.). In the course of the struggle some of the Bulgarian leaders entered into negotiations with Rome ; a Bulgarian uniate church was recognized by the Porte, and the jiope nominated a bishop, who, however, was mysteriously deported to Russia a few days after his consecration (1861). The first exarch, who was elected in 1871, was excommunicated with all his followers by the patriarch, and a considerable number of Bulgarians in Macedonia — the so-called " Bulgarophones " — fearing the reproach of schism, or influenced by other considerations, refrained from acknowledging the new spiritual power. Many of the recently converted uniates, on the other hand, offered their allegiance to the exarch. The firman of the 28th February 1870 specified a number of districts within the~~

present boundaries of Bulga,ria and Servia, as well as in Macedonia, to which Bulgarian bishops might be appointed ; other districts might be subjected to the exarchate should two-thirds of the inhabitants so desire. In virtue of the latter provision the districts of Veles, Ochrida, and Uskllb declared for the exarchate, but the Turkish Government refrained from sanctioning the nomination of Bulgarian bishops to these dioceses. It was not till 1891 that the Porte, at the instance of Stamboloff, the Bulgarian prime minister, whose demands were supported by the Triple Alliance and Great Britain, issued the berat, or exequatur, for Bul- garian bishops at Ochrida and Usktlb ; the sees of Veles and Nevrokop received Bulgarian prelates in 1894, and those of Monastir, Strumnitza, and Dibra in 1898. The Bul- garian position was further strengthened in the latter year by the establishment of " commercial agents " rep- resenting the principality at Salonica, Uskub, Monastir, and Serres. During this period (1891-1898) the Bul- garian propaganda, entirely controlled by the spiritual power and conducted within the bounds of legality, made rapid and surprising progress. In latter years the interference of the Macedonian committee at Sofia, in which the advocates of physical force predominate, has done much to injure the movement ; the hostility of the Porte has been provoked and the sympathy pf the Powers alienated by a series of assassinations and other crimes. According to the official figures, the Bulgarian schools, which in 1893 were 554, with 30,267 pupils and 853 teachers, were, in 1898, 762 (including 68 secondary schools), with 39,466 pupils and 1778 teachers. The Rumanian movement comes next to the Bulgarian in order of time. The Vlachs had shown greater suscep- tibility to Greek influence than any of the other non- Hellenic populations of Macedonia, and, though efforts to create a Rumanian propaganda ^v'ere made as early as 1855, it was not till after the union of the princi- palities of Wallachia and J^oldavia in 1861 that any indications of a national sentiment appeared amongst thein. In 1886 the principal apostle of the Rumanian cause, a priest named Muvgaritis, founded a gymnasium at ^lonastir, and the movement, countenanced by the Porte, supported by the Fi-ench Catholic missions, and to some extent encouraged by Austria, hiis made no inconsiderable progress since that time. There are now about forty Rumanian schools in Macedonia, including two gymnasia, and large sums are devoted to their main- tenance by the ministry of education at Bucharest, which

also provides qualified teachers. The Rumanian and Servian movements are at a disadvantage compared with the Bulgarian, owing to their want of an ecclesias- tical organization, the orthodox Vlachs and Serbs in Tur- key owning allegiance to the Greek patriarchate. The Governments of Bucharest and Belgrade have therefore endeavoured to obtain the recognition of Vlach and Ser- vian millets, the former demanding the establishment of a Rumanian bishopric at Monastir, while the latter seeks the restoration of the patriarchate of Ipek and the ap- pointment of a Servian metropolitan at Uskilb. Their efforts, however, have hitherto been unsuccessful. The Servian movement in Macedonia is of comparatively recent date. Previously to 1878 the hopes of the Ser- vians were centred on Bosnia, Herzegovina, and the vila- yet of Kossovo; but when the Berlin Treaty assigned Bosnia and Herzegovina to Austria, the national aspira- tions were directed to Macedonia, the Slavonic popula- tion of which was declared to be Servian. The strained relations existing between Russia and Bulgaria from 1886 to 1895 were to the advantage of the Servian pro- paganda, which since 1890 has made remarkable progress. Great expenditure has been incurred by the Servian Gov- ernment in the opening and maintenance of schools. At the beginning of 1899 there were stated to be 178 Ser- vian schools in the vilayets of Usktib, Salonica, and Monastir (including fifteen gymnasia), with 321 teachers and 7200 pupils. The Albanian movement has not yet taken definite shape, and its future development seems doubtful. Some of the Albanian chiefs have demanded the establishment of schools in which their language will be taught, but their request has been persistently refused by the Porte. Notwithstanding the encroach- ments of their rivals, the impoverishment of the patri- archate, and the injury sustained by their cause in 1897, the Greeks still maintain a large number of schools ; according to statistics prepared at Athens there were in 1901, 927 Greek schools in the vilayets of Salonica and Monastir (including five gymnasia), with 1397 teachers and 67,607 pupils. The great educational activity dis- played by the proselytizing movements in Macedonia, while tending to the artificial creation of parties, daily widens the contrast between the progressive Christian and the backward Moslem populations, and must sooner or later bring about a change in the present system of government. Meanwhile the reforms stipulated by Arti- cle XXIII. of the Berlin Treaty have neither been carried out by the Porte nor insisted upon by the Powers.

~~Macedonia, like the neighbouring Balkan countries, still awaits exploration ; as yet we possess but scanty indications of the earlier developments of civilization in these regions. This is especially true with regard '""«""'*• to the most primitive epoch, although there can be little doubt that the ancient indigenous population has left traces behind it which will one day be brought to light. The numerous tumuli which occur in the plains, more particularly in the valley of the Vardar, have not yet been systematically investigated; excavations, however, have been made by Korte and Pranke at Niausta and near Salonica (see Kretschner, Einleituug in die GescJn'chie cler griechischeii Sjirache, pp. 176, 42i),*and fragments of primitive pottery, with peculiar characteristics, have been found by M. Perdrizet at Tchepelje, on the left bank of Lake Taeldno. The oldest archaeological monuments of iMacedonia are its coins, for which the mines of Crenides (the later Philippi), at the foot of Mount Pangseus, of Chalcidice, of the island of Thasos, and of the mountains between Lake Prasias and the ancient Macedonian kingdom (Herod, v. 17), furnished abundance of metal. From the reign of Alexander I., the epoch of the Persian wars, the Macedonian dynasty issued silver coins of a purely Greek~~

~~style. The Thracian communities around Mount Pan- gseus also produced a variety of coins, especially at the beginning of the 5th century. The great octodrachms of this period were perhaps struck for the purpose of paying tribute to the Persians when the country between the Strymon and the Nestos was in their possession ; most of the specimens have been found in Asia Minor. These large pieces present many characteristics of the Ionian style ; it is evident that the Thracians derived the arts of minting and engraving from the neighbouring Thasos, itself a colony from the Ionian Paros. The monarchs of Pella were enthusiastic admirers of Hellenic culture, and their court was doubtless frequented by Greek sculptors as well as men of letters, such as Herodotus and Eurip- ides. At Pella has been found a funerary stele of the late 5th or early 4th century representing a Macedonian lietmrus — a beautiful specimen of the • best Greek art, now preserved in the Imperial Ottoman Museum at Con- stantinople. To the~~

~~*Hellenic period belong the vaulted tombs under tumuli discovered at Pella, Pydna, Palatitza, and other places ; the dead were laid in marble couches ornamented with sculptures, like those of the so-called sarcophagus of Alexander at Constantinople. These tombs doubtless received the remains of the Macedonian nobles and hetoeri ; in one of them a fresco representing a con- flict between a horseman and a warrior on foot has been brought to light by Kinch. Similarly-constructed places of sculpture have been found at Eretria and elsewhere in Greece. At Palatitza the ruins of a remarkable structure, perhaps a palace, have been laid bare by Heuzey and Daumet. Unlike Greece, where each independent city had its acropolis, Macedonia offers few remnants of ancient fortification ; most of the country towns appear to have been nothing more than open market-centres. The most interesting ruins in the country are those of the Eoman and Byzantine epochs. Salonica (Thessaloniea) in the time of the Low Empire was one of the greatest cities in the world. Of its two triumphal arches, one, the "Vardar Gate," which marked the end of the Via Egnatia, has been recently demolished ; the other, which has been proved by Kinch to commemorate the victories of Galerus, is one of the largest structures of the kind in existence. Between these stood the beautiful monument with caryatides known as Las Escantadas, the fragments of which have been conveyed to Paris, and have latterly been put together at the Louvre. For the unique Byzan- tine churches of Salonica, with their interesting mosaics, the work of Texier and Pullan should be consulted. The celebrated marble ambon of the church of St George, with reliefs representing the adoration of the Magi, was removed to Constantinople in 1899. The conversion of these churches into mosques has preserved them from destruction, though not from disfigurement. The walls of Salonica are among the most interesting constructions of Byzantine military architecture; they have been re- paired at various epochs, and numerous sarcophagi and fragments of Greek and Eoman temples are built up in the masonry. The Byzantine fortifications and aqueduct of Kavala are also remarkable. At Verria (Beraa) may be seen some Christian remains, at Melnik a palace of the age of the Comneni, at Serres a Servian fortress built by Dushan. The remains at Eilibejik (Philippi) are principally of the Eoman and Byzantine periods; the numerous ex voto rock-tablets of the acropolis are espe- cially interesting. The Eoman inscriptions found in Macedonia are mainly funerary, but include several ephe- bic lists. The funerary tablets afford convincing proof*~~

~~*of the persistence of the Thracian element, notwithstand- ing Hellenization and Latinization ; many of them, for instance, represent the well-known Thracian horseman hunting the wild boar.*~~

~~*Mount Athos.*~~

~~*The picturesque promontory of Mount Athos (Greek 'Ayiov 'Opos, Turkish Aineros, Italian Monte Santo) pos- sesses a peculiar interest, owing to its unique group of monastic communities with their mediaeval customs and institutions, their treasures of Byzantine art and rich collections of manuscripts. The promontory is about 40 miles in length, with a breadth varying from 4 to 7 miles ; its whole area belongs to the various monasteries. It was inhabited in the earliest times by a mixed Greek and Thracian population ; of its five cities mentioned by Herodotus few traces remain ; some inscriptions dis- covered on the sites have been published by Leake. The legends of the monks attribute the first religious settle- ments to the age of Constantine, but the hermitages are first mentioned in historical documents of the 9th cen- tury. It is conjectured that the mountain was at an earlier period the abode of anchorites, whose numbers were increased by fugitives from the iconoclastic perse- cutions (726-842). The "cenobian" rule to which many of the monasteries still adhere was established by St Athanasius, the founder of the great monastery of Laura, in 969. Under a constitution approved by the Emperor Constantine Monomachos in 1046, women and female animals were excluded from the Holy Mountain. In 1060 the community was withdrawn from the authority of the Patriarch of Constantinople, and a monastic re- public was practically constituted. Owing to the timely submission of the monks to the Turks after the capture of Salonica (1430), their privileges were respected by successive sultans : a tribute is paid to the Turkish Gov- ernment, which is represented by a resident kaimakam, and the community is allowed to maintain a small police force. Under the present constitution, which dates from 1783, the general affairs of the commonwealth are en- trusted to an assembly (crvva^is) of twenty members, one from each monastery ; a committee of four members, chosen in turn, styled epistates (emo-TaTat), forms the executive. The president of the committee (o rrpSiTos) is also the president of the assembly, which holds its sittings in the village of Karyes. The twenty monas teries, which all belong to the order of St Basil, are : Laura (;7*~~

~~AaBpa), founded in 963; Vatop^di (BaTOTrikov), said to have been founded by the Emperor Theodosius ; Eossikdn (Puxra-iKov), the Eussian monastery; Chili- andari (XtXiavTaptoi/ : variously derived from lXioi avBpes and x' "* A.£ovTapta), founded by the Servian prince Stephen Nemanya; Iveron (-7 fi.ovrj t5>v 'l^rjpwv), founded by Iberians, or Georgians ; Esphigmenu {tov 'Ea-ffjiyfievov : the name is derived from the confined situation of the monastery) ; Kutlumush (KovTAoti/ioijo-ij) ; Pandocra-toros (tov navTOKjodropos) ; Philotheu (^iXoOiov) ; Cara- callu (tov KapaxaXXov) ; St Paul (tov ayiov IlavXov) ; St Denis (tov ayiov AtovDo-MJu) ; St Gregory (jov ayiov Tpyjyo- piov) ; Simdpetra (SiynoVerpa) ; Xeropotamu (tov "BripoTroTd- P-ov); St Xenophon (tov ayiov Hevoc^iovTos) ; Dochiariu (Aoxe'apeiov) ; Constamouitu (KoiverTafjiovLTov) ; Zographu (tov Zuiypdrf>ov) ; and Stavronikitu (tov SravpoviKtVov). The "cenobian" monasteries (Kowojiui), each under the rule of an abbot (i^yowyncvos), are subjected to severe discipline; the brethren are clothed alike, take their meals (usually limited to bread and vegetables) in the refectory, and possess no private property. In the " idiorrhythmic " monasteries (IScoppvOpiKa), which are governed by two or three annually elected wardens (iTTLTpowoi), a less stringent rule prevails, and the monks are allowed to supplement the fare of the monastery from their private incomes. Dependent on the several monasteries are twelve sketes (o-k-^tm, acrKriT-^pia), or monastic settlements, some of considerable size, in which~~

~~a still more ascetic mode of life prevails: there are, further, several nietochs or farms (;u,£To;;^ta), and many hundred hermitages (KeXAta). The monasteries, with the exception of Rossikon (St Panteleimon) and the Serbo-Bulgarian Chiliandari and Zographu, are occupied exclusively by Greek monks. The large skete of St Andrew and some others belong to the Russians ; there are also Eunianian and Georgian sketes. The great mon-astery of Eossikon, which numbers nearly a thousand inmates, has been under a Russian abbot since 1876 ; it is regarded as one of the principal centres of the Russian politico-religious propaganda in the Levant. The~~

tasteless style of its modern buildings is out of har- mony with the quaint beauty of the other monasteries. Furnished with ample means, the Russian monks neglect no opportunity of adding to their possessions on the Holy Mountain; their encroachments are resisted by the Greek monks, whose wealth, however, has been much diminished by the secularization of their estates in Greece and Rumania. The population of the Holy Mountain numbers from 6000 to 7000; about 3000 are monks (KaXoyepoi), the remainder being lay brothers (koMSS. in some of the sketes or those in the libraries of Lauri and Vatopedi, of which catalogues (hitherto unpublished) have been prepared by resident monks. The Slavonic and Georgian MSS. have not been catalogued. Apart from the illuminated MSS., the mural paintings, the mosaics, and the goldsmiths' work of Mount Athos are of infinite interest to the student of Byzantine art. The frescoes in general date fr(jm the 15th or 16th century : some are attributed by the monks to I'anselinos, " the Raphael of 1 iyzantine painting," who apparently flourished in the time of the Paleologi. Most of them have been indifferently restored by local artists, who fol- low mechanically a kind of hieratic tradition, the princi- ples of which are embodied in a work on iconography by the monk Dionysius, a pupil of Panselinos, The same spirit of conservatism is manifest in the architecture

of the churches, which are all of the mediseval Byzaatine type.

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~~*Macedoine. Berlin, 1899. — " Odysseus." Turkey in Europe. London, 1900. — Kunchoff. 3Iakedonia : etnografla i statistika. Sofia, 1900.*~~

~~*For the antiquities and Mount Athos see Heuzet et Daumet. Blission archeologique en Macedoine. Paris, 1865. — Dcchesne et Bayet. Memoire sur une Mission en Macedoine et au Mont Athos. Paris, 1876. — Texier and Pullan. Byzantine Architecture. London, 1864. — Baeclay V. Head. Catalogue of Greek Coins: Macedonia. London, 1879. — Kinch. Varc de triomphe de Salonique. Paris, 1890 ; Beretnung om en archaeologisk Seise i Makedonien. Copenhagen, 1893. — Mommsen. Suppl. to vol. iii. Corpus inscript. latinarum. Berlin, 1893. — Peedeizet. Articles on Macedonian archseology and epigraphy in Bulletin de Corres- pondance hellenique since 1894. — Dimitsas. ij 'Siamdovla in XWois. Athens, 1896. — Langlois. Le Mont Athos et ses monasteres (with a complete bibliography). Paris, 1867. — Beockhaus. Die Kunst in den Athos-Klostern. Leipzig, 1891. — Eiley. Athos, or the Mountain of the Monks. London, 1887. — ^Lambeos. Catalogue of the Greek Manuscripts on Mount Athos, 2 vols. Cambridge, 1895 and 1900. — Gedeon. 6 'A9a>s. Constantinople, 1885. (j. D. B.)*~~

~~*Mace rata, a town, bishop's see, and capital of the province of the same name, the Marches, Italy, between the Apennines and the Adriatic, 43 miles by rail south of Ancona. It has a fine prefecture (formerly palace of the Gonzaga), a town hall, a university (1290), with a law faculty and special classes in medicine (11 professors, 310 students, in 1898), an agricultural school, and an industrial institute. The industries comprise the making of bricks, matches, terra-cotta, and chemicals. Popula- tion (1881), 20,249; (1901), 22,806.*~~

~~*Macfarren, Sir George Alexander (1813- 1887), English composer, was born in London, 2nd March 1813, and entered the Royal Academy of Music in 1829. A symphony by him was played at an Academy concert in 1830, and another in 1831 ; for the opening of the Queen's Theatre in Tottenham Street, under the management of his father, in the latter year, he wrote an overture, and various similar works were provided for theatrical and other occasions. His Clievy CJiase over- ture, the orchestral Avork by which he is perhaps best known, was written as early as 1836, and in a single night. On leaving the Academy in 1836, ^SLacfarren was for about a year a music*~~

~~teacher in the Isle of IMan. Undeterred by the untoward fate of an opera projected two years before, he wrote another, ultimately called El Mfdeclior, which was no more fortunate, three successive managers of theatres becoming bankrupt after they had promised to produce it. In 1837 he was appointed a professor at the Academy, and wrote his Borneo and Juliet overture. In the following year he brought out The DeriVs Ojicra, one of his best works ; for Queen Victoria's marriage in 1840 he joined his father in preparing an " Emblematical Tribute " for Drury Lane. Five years afterwards he became conductor at Covent Garden, producing .the Antigone with Mendelssohn's music ; he finished an opera on Don Qiii.vote in the same year, and it was produced under Bunn at Drury Lane iii 1846 ; his~~

~~macgrego r — m achine guns~~

~~401~~

~~subsequent operas include Qiarles II. (1849), Robin Hood (1860), She Stoops to Conquer (1861), and Helvellyn (1864) ; a number of other dramatic works were either of such smaller calibre as Jessy Lea (1863) (for the German Eeeds) ; Freya's Gift, a masque in honour of the prince of Wales's marriage (1863) ; or works that for one reason or another never saw the light, such as Allan of Aberfeldy (1851) and Kenilworth (1880), his last opera. A gradual failure of his eyesight, which had been de- fective from boyhood, resulted in total blindness in 1866, but he overcame the diflaculties by employing an amanuensis in composition, and made hardly a break in the course of his work. He was made principal of the Royal Academy of Music in succession to Sterndale Bennett in February 1875, and in March of the same year Professor of Music in Cambridge University. Shortly before this he had begun a series of oratorios, which were the most ambitious, if not the most im- portant, works of his later years; St John the Baptist (Bristol, 1873) ; Resurrection (Birmingham, 1876) ; Joseph -(Leeds, 1877) ; and King David (Leeds, 1883). In spite of their solid workmanship, and the skill with which the ideas are treated, it is difficult to hear or read them through without smiling at some of the touches of quite unconscious humour often resulting from the way in which the Biblical narratives have been, as it were, dramatized. The list of his other works includes many~~

~~*cantatas, eight symphonies, many overtures, concertos, chamber compositions, anthems, &c. He delivered many lectures of great and lasting value, and his theoretical works, such as the Rudiments of Harmony, and the treatise on counterpoint, will probably be remembered longer than many of his compositions. A most important work of his is the first (historical) part of the article Music in the earlier volumes of this Encyclopaedia, ninth edition. He was knighted in 1883, and died suddenly in London, 31st October 1887.*~~

~~*An excellent memoir by H. C. Banister appeared in 1891.*~~

~~*(j. A. F. M.)*~~

~~*MacGregor, John ["Rob Roy"] (1825-1892), Scottish canoeist, traveller, and philanthropist, son of General Sir Duncan MacGregor, K.C.B., was born at Gravesend, 24th January 1825, and educated at different schools, according to his father's changes of station. He combined a roving disposition with a natural taste for mechanics and for literature. In 1839 he went to Trinity College, Dublin, and in 1844 to Trinity, Cambridge, where he was a wrangler. He was called to the bar in 1851, but being financially independent, he did not pursue his profession. He travelled a great deal in Europe, Egypt, Palestine, Russia, Algeria, and America, and between 1853 and 1863 was largely occupied with re- searches into the history and methods of marine pro- pulsion. He was the pioneer of British canoeing. In 1865 he started on a first long canoeing cruise in his "Rob Roy" canoe, and in this way made a prolonged water tour through Europe, a record of which he published in 1866 as A Thousand Ifiles in the Rob Roy Canoe. This book, which was succeeded by others of the same sort, made MacGregor and his canoe famous. He made similar voyages in later years in the North Sea and in Palestine, and was the author of the article on Canoeing in vol. iv. of this Encyclopaedia (ninth edition). He did not, however, confine his energies to travelling. He was active in charity and philanthropic work, one of the founders of the Shoe-black Brigade, vice-president of the Ragged School Union, honorary secretary of the Protestant Alliance, and a supporter of the Open-air Mission, British and Foreign Bible Society, and Reformatory and Refuge Union. In 1870 and again in 1873 he was elected on*~~

~~*the London School Board. He died at Boscombe, 16th July 1892.*~~

~~*Machine Guns. — In the article Gun-making in vol. xi. of this work (ninth edition) will be found a descrip- tion of the machine guns in use in the British service up to the year 1880. It will be noticed that all of them are worked by hand-power applied to a lever or winch-handle, the motion of this lever being translated by suitable mechan- ism into those by which the cartridges are loaded, fired, extracted, and ejected — the cycle continuing as long as the •lever is worked and there are cartridges in the " hoppers " which feed the gun. In the modern " automatic " machine gun the loading, firing, extracting, and ejecting are all performed automatically by the gun itself, either by the recoil of its barrel, or by a small portion of the gases of explosion being allowed to escape through a minute hole in the barrel near the muzzle. It is obvious, therefore, that as the due performance of the cycle of operations above mentioned is dependent on the explosion of the cartridge, a " hang-fire " merely causes a delay and nothing more, whereas, with a hand-worked gun, a cartridge which has "hung fire" must be extracted, and may explode in and derange the mechanism. Again, since no hand-power is applied, no disturbance of aim, due to this cause, can arise. Guns of this class can be worked by one man, although two at least are generally employed.*~~

~~*The idea of using the recoil, or a portion of the gases of explosion, for the working of the breech mechanism is by no means new, the latter system having been proposed and patented (certainly in a very crude and probably un- workable form) by Mr, afterwards Sir Henry, Bessemer in 1854 ; but whatever might be discovered by a search in old patent and other records or in museums, there can be no doubt that Sir Hiram Maxim was the first to produce a finished automatic gun of practical value. His patents in connexion with this particular class of weapon date back to 1884, and his gun on the recoil system was, after extensive trials, adopted into the British army in 1889 and into the navy in 1892. It is very possible that Bessemer's idea did not bear fruit earlier because the fouling left by the old forms of "black" or smoky powders was apt to clog the moving parts and to choke any small port. "With the modern smokeless powders this difficulty does not arise.*~~

~~*The Maxim gun, as will he seen from Figs. 1 and 2, consists of two parts, the barrel casing (a) and breech casing (d), secured firmly- together. The former (a), which is cylindrical in form, contains the barrel (6), and the water surrounding it to keep down the very high temperature attained by rapid fire, and 'Wax'™- the steam tube (c), which by the action of a sliding valve allows of the escape of steam but not of water. The barrel has asbestos packings at its front and rear bearings in the casing, which allow of its sliding in recoil without the escape of water. The breech casing (d) is a rectangular oblong box, and contains the lock and firing mechanism. At its rear end it has handles (e) by which the gun is directed, and the thumb-piece (m) by which the trigger is actuated. Its top is closed by a lid, hinged at (i) in front, and pro- vided with a spring catch. At its front is a recess holding the feed- block (/) through which the belt of cartridges (g) is fed to the gun.*~~

~~*Attached to the rear of the barrel- (6) on either side are two side plates (ft), between which in guides 0 works the aggregation of parts D, F, J, K, L, P, T, and V, which constitute the lock, and (in bearings) the crank-axle E, crank E', and connecting rod I (See Eigs. 2 to 6.)*~~

~~*The connecting rod I joins the look and crank, being attached to the side levers J of the former by means of the " interrupted " screw U, which enables the look to be readily detached as a whole, and removed from the mechanism.*~~

~~*The crank-axle E extends through both sides of the breech casing (d), slots (k, Eig. 1) allowing it a longitudinal movement of about an inch. To its left-hand end, outside the breech casing, is attached the fusee chain Y of the recoil spring X (see dotted lines in Eig. 1), and to its right-hand end a bell trunk lever, B B' ; the arm B, which terminates in a knob, being turned by the crank handle, the arm B' working against the buffer stop C.*~~

~~*In Figs. 2, 3, and 5 the breech is shown closed, and it will he nqticed that the crank pin I' is above the straight line joining the axis of the barrel, the striker T, and the crank axle E. As the crank is prevented from further movement upwards by the crank handle B taking against the check-lever G (Fig. 1), it is clear that the pressure on discharge of the cartridge cannot cause the crank axle to rotate, and so open the breech as shown in Figs. 4 and 6.*~~

~~*The withdrawal of the lock and opening of the breech are effected as follows :— The total travel in recoil of the barrel is about one inch, but on discharge, the barrel, the side plates, and lock all recoil together for about a quarter of an inch without any disturbance of the locking as explained above, and by the time this short travel is completed the hullet has left the muzzle. The arm B' of the crank handle then engages the buffer stop C and causes the crank axle E to*~~

~~*Figs. 1 and 2. — Mechanism of Maxim G-un.*~~

~~*rotate and the crank E' to fall and so draw back the look from, and open, the breech. At the same time the fusee chain Y is wound up round the left-hand end of the crank axle E and the spring X extended. In the meantime the knob of the buffer handle B swings over, and just as the lock reaches its rearmost position (as in Figs. 4 and 6) strikes^ the flat buffer spring H, and, rebounding, assists the crank in revolving in the reverse direction ; the spring X also contracts, and, unwinding the fusee chain, draws back the lock again, and closes the breech, a fresh cartridge having been placed in the barrel as explained below.*~~

~~*Fig. 3. —Maxim Gun Mechanism,*~~

~~*The gun is fired by means of the trigger F, which is actuated by the projection (I) on the trigger bar (S), the latter being drawn back when the button (m) on the push-lever (») is pressed forwards. If, therefore, the button be kept permanently pressed, the projection(Z) will always lie in the path of the trigger F just as the lock reaches its forward position and the breech is closed, and the gun will fire automatif.ally, and continue to do so as long as there are cartridges in the belt.*~~

~~*The loading, extraction, and ejection of the cartridges are effected as follows : — The left-liand side-plate is extended forwards a little beyond the breech, and communicates the reciprocating motion of the barrel to a lever on the feed-block, which causes the cartridges in the belt to be fed forward one by one by a " step-by-step " pawl action, the cartridge which is next to be taken from the belt being arrested exactly above the breech, the ejector-tube Q being below in the same vertical plane.*~~

~~*The extractor D (see Figs. 3 to 6) which performs the operations of inserting, extracting, and ejecting the cartridges, travels verti- cally in guides on the face of the lock. Projecting outwards from each side of its top are horns N (Figs. 3 and 4). These travel round the edges of the cams M (Fig. 2) situated on each side of the breech casing, and in conjunction with the spring W (Fig. 2), compel the top of the extractor to take the path shown by the dotted lines and arrows in Figs. 3 to 6.*~~

~~*The extractor (Figs. 5 and 6) is recessed to take a movable plate (u) termed a "gib," behind which is a spring (v). In the face of the gib is a recess (to) into which the base of a cartridge can just enter. On either side of the gib the face of the extractor has under-cut flanges, open at the top and bottom, between which the base of a cartridge can fit the rim, being held in the undercuts (Figs. 3 and 4).*~~

~~*It is clear from this arrangement that the base of the cartridge having been introduced between the flanges at the top of the extractor, can be pushed down, the spring (d) yielding, till arrested at the recess (w) ; and, as the lower edges of this recess are slightly sloped, further pressure will make it leave the recess (w) and slide over the face of the gib, leave it, and take up a position in front of the hole for the point of the striker (k), being now only prevented from slipping out of the extractor by the ex- tractor spring (y). If this last be clear of the extractor stop (z) it will yield to pressure and the cartridge will be free. This is the action in the gun except that the cartridge is held firm and the extractor pushed against it. In Fig. 4, the extractor holds a cartridge (»•) and a fired case (g) ready to be pushed into the empty breech and ejector-tube Q respectively. In the latter there is already a fired case (p), which will be driven by the fired case (g) beyond the ejector spring R. As soon as the lock reaches the face of the breech, the cartridge ()•) and*~~

~~case (g) are deposited in the breech and ejector-tube respectively, and the extractor D rines under the action of the levers L and J, slides, as already explained, by the bases of the cartridges (r) and case (g), and then over the base of the cartridge (s) in the belt (g). Assuming the push-lever (?i) to be pressed, the gun fires immedi- ately this has occurred, and the bullet of the cartridge ()•) is expelled. The position is now that shown in Fig. 3. The barrel now recoils and the lock is withdrawn, taking with it the fresh cartridge (s) from the belt and the now fired case ()•). The extractor travels horizontally for a time and then drops (as shown by the dotted line~~

~~and arrows), assuming the position shown in Fig. 6, which is exactly similar to that m Fig. 4 but with different cartridges ; continuing the action, the position shown in Fig. 5 is arrived at. It will thus be seen that each cartridge nialies two complete journeys with the extractor ; the first as a live cartridge from the belt to the breech, the second from the breech to the ejector-tube, the forward journey being always on a lower level than that of the backward one. The sections in Figs. 5 and (j clearly show the cooking and firing mechanism and the safety ar- rangement. The lock is cocked, after firing, by the arm of the " tumbler " K, being pressed down by the side lever J as it swings down when following the crank ,E'. Safety against firing before the breech is closed is provided by the projection on the safety lever "V, which does not clear the striker T until lifted by the side lever J at the top of its travel, that is, when the crank E' has passed the axial line as already explained.~~

~~The lock in its rearmost position is kept in place by the block Z on the underside of the cover of the breech~~

~~casing. When in this position it is clear of the guides 0 on the side plates, and if the cover be opened, it can be turned up, unscrewed by a turn through an eighth of a circle (the screw- thread U being interrupted in four' places) and removed. To~~

~~*The Hotohkiss gun. Figs. 9 to 12, which has been adopted by the French army and navy, depends for its action on the use of a small portion of the gases of the cartridge itself. The barrel A is*~~

~~*Fig. 5. — Maxim Gun Mechanism.*~~

~~*prepare the gun for firing, the crank handle is pushed over by hand to the buffer-spring, thus withdrawing the extractor, and held in this position ; the tongue on the end of a filled belt is then pushed through the feed-block from the left and pulled as far as it will go from the opposite side. This places a cartridge above the breech ready to be seized by the extractor. The crank handle is now released and the look flies forwards. The crank handle is now again pushed over and let go, and the first cart- ridge thus taken from the belt and placed in the breech. The gun is ready to fire.*~~

~~*To remove a partially filled belt, the crank handle must be pushed over, thus freeing the extractor from the belt, and the latter withdrawn after pressing a spring catch under the feed block which releases*~~

~~*the pawls. The gun now has two live cart- ridges in it — both in the extractor. Let- ting go the crank handle, one of them is*~~

~~*deposited in the ejector-tube, and again*~~

~~*pushing over and letting go the crank*~~

~~*handle does the same with the second. Figs. 7 and 8 show the feed-block and*~~

~~*method of packing the cartridge belts.*~~

~~*The greatest number usually carried in*~~

~~*a belt is 250. The gun is sighted to 2500 yards and*~~

~~*has a folding tangent sight as shown. Its weight varies from 50*~~

~~*to 60 a, and it can fire about 450 rounds per minute. The diagrams have been made from drawings, by permission of*~~

~~*Messrs Vickers, Sons, and Maxim.*~~

~~*Fi&. 4. — Maxim Gun Mechanism.*~~

~~*firmly attached to the receiver or frame B, the latter containing*~~

~~*the breech and firing mechanism. Under the barrel A, .*~~

~~*and communicating with it by a port (c) near the “ <"™*'**'*~~

~~*muzzle is a cylinder or tube C. When the gun is fired, and the bullet has passed the port (c), a portion of the gases of explosion pass into the cylinder C and drive back the piston F contained in it, a lug on the under part of the piston compressing the spring M, the latter, when the trigger N is pulled, driving back the piston again. The reciprocating motion of the piston performs all the processes of loading and firing the gun, and the action is continuous as long as the trigger is kept pressed back.*~~

~~*The piston F, enlarged and suitably shaped at the rear, actuates the breech-block H and firing pin or striker J ; and, by suitable cam grooves (/) at about the centre of its length, works the larger feed-wheel U of the feed-box S ; the smaller wheel U on the same axis in turn imparting a step-by-step motion to the metal feed-strips (see Fig. 12), each containing 30 cartridges, so that fresh cartridges are placed one by one before the face of the breech-block ready to he*~~

~~*pushed into the breech when the fired cartridge has been extracted*~~

~~*and ejected. On the under surface of the piston F, in rear, is a recess or sear*~~

~~*(J) in which the nose of the trigger N engages, holding back the*~~

~~*Fig. 6. — Maxim Gun Mechanism.*~~

~~*piston when it has been driven back by the gases. As already stated, a lug on the under surface just in rear of the cam (/) engages with the front of the mainspring. Taking first the position shown in Fig. 10 with the breech closed*~~

~~and looked, and the cartridge fired, it will be seen that the breech~~

~~is locked by the upper cam (f-), on the end of the piston F, having~~

~~caused the movable locking-dog (ft) to fall and bear against the recoil blocks Z (see Fig. 9 also) on the walls of the receiver or frame B. Consequently the brefech is not unlocked until the piston has moved sufficiently to the rear for the lower cam (/i) to lift the locking-dog (h) clear of the recoil blocks Z. As the piston T is not actuated by the gases until the bullet has passed the port (c), and then has to move a short distance before the locking- dog is raised, the bullet, travelling at some 2000 feet per second, is clear of the muzzle before the breech is unlocked.~~

~~As the piston continues to recoil it draws back the striker J and then the breech — block II, and is then caught and retained by the engagement of the sear~~

~~(f) with the trigger N, and the position assumed is that shown in~~

~~Fig. 9.~~

~~From the head or nose-piece I of the breech-block projects the~~

~~Fig. 7. — Maxim, Feed-block.~~

~~claw K of a spring extractor which, as the cartridge is pushed home by the breech-block, rides up over the rim of rimmed, or over the base into the grooves of rimless cartridges, and thus attaches itself~~

~~Fig. 8. — Maxim, Cartridge-packing.~~

~~to the cartridge, extracting the fired case when the breech-block is withdrawn. Ejection of the fired case is effected by means of the ejector L (Fig. 11) which catches against the base of the case, on the opposite side to the extractor claw, and so throws it sideways~~

~~*MOTCHIKISS AUTOMATIC MACHINE GUN, Longitudinal SecLion Breech open.*~~

~~*Figs. 9, 10, 11. — Hotchkiss Gun Mechanism.*~~

~~*through the oblong-pointed opening in the receiver just in rear of the breech (see Fig. 9).*~~

~~*The platform on the top of the feed-box through which the teeth of the smaller feed-wheel U project, and on which the feed-*~~

~~*Fig. 12.— Hotclikiss Cartridge Feed-strips.*~~

~~*Strips rest, lies below the axial line of the breech-block H, so that the face or nose-piece I of the latter only engages a portion of the base of the cartridge in the feed-strip as it pushes the cartridge into the breech, ttie bullet of the cartridge being guided into the breech by the incline at the opening of the latter. This point should be specially noted, the object of the arrangement being to enable the under surface of the breech-block to clear the clips which hold the cartridges in the feed-strips. The cartridge*~~

~~*therefore, being extracted in the line of the axis of the block, is ejected through an opening above its plane of entry in the feed- strip.*~~

~~*Returning to the position shown in Fig. 9, if the trigger be pulled, the compressed spring M reacts and drives the piston forwards, carrying the breech-block with it, the latter in turn driving a cartridge in front of it out of the feed-strip. "When the block and cartridge are home, and not till then, the piston com- pletes its travel, the upper cam (/i) locking the dog (ft), and the firing pin protrudes and fires the cartridge. Anything, therefore, which prevents the breech-block from being home against the breech, or the locking-dog from falling in front of the recoil blocks Z, renders firing of the cartridge impossible. Clearly if the trigger be kept depressed the action becomes automatic.*~~

~~*A special feature of this gun is the absence of a separate spring to actuate the firing-pin ; the recoil spring M performing this function, in addition to that of driving the piston forwards.*~~

~~*The feed-strips have holes in them in which the teeth of the smaller feed-wheel U engage. The engagement of this feed with the piston F can be released by pulling out the feed arbor W, so that the strips can be removed at any time.*~~

~~*Under the feed-box is a spring stop V, which is depressed when there is a feed-strip in the block, but, when this is not the case, engages with and holds back the piston F when in its rear position. When, therefore, the last shot in a feed-strip has been fired, the stop V at once acts and holds the piston and block ready for a fresh feed-strip to be inserted. As the stop V acts quite independently of the trigger, this action takes place even if the*~~

~~*trigger be still depressed after the last cartridge in a strip has ■been fired.*~~

~~*To cocli the gun, when in the locked position, a cocking handle G is provided. This has a long arm projecting to the front with a catch which takes against the front of the lug on the under side of*~~

~~*the piston. To prepare the gun for action the gun is cocked, and a feed-strip is pushed into the feed-block.*~~

~~*The pressure of the gas on the piston is regulated by the regu- lator screw D, by means of which the space in the cylinder C in front of the piston F can be reduced or increased.*~~

~~*A safety lock R is furnished, which is a "half round" pin which*~~

~~*can be turned so as to enter the semicircular slot just in front of the sear (/), and so hold back the piston when in the cocked position.*~~

~~*Radiation' of the heat, generated in the barrel by rapid fire, is facilitated by the radiator (a), which consists of rings on the barrel close to the breech, which offer an increased surface to the air.*~~

~~*The gun is sighted to 2000 yards, with the ordinary flap back- sight, weighs about 53 lb, and can fire from 500 to 600 rounds per minute.*~~

~~*The diagrams have been made from drawings, by permission of the Hotchkiss Ordnance Company.*~~

~~*The Colt automatic gun, which has been adopted by the American army and navy, depends for its action, similarly to the Hotchkiss, on the escape of a small portion of the gases „ „*~~

~~*of explosion through a port in the barrel a short dis- tance from the muzzle. Figs. 13 and 14 give a plan, and side elevation with the left side plate removed, respectively. Into the recess in the ban-el (92) just below the port fits the piston (35), capable of slight motion round the pivot (36), by which it is attached to the gas lever (29). The latter is a bell crank lever pivoted at (34), its short arm being attached at (46) by a pivot to a long link with a cross head, termed the retracting connexion (45). This link extends from a point close to the figures (44), where the arms of the cross head bear against the ends of two long spiral retracting springs, (37) and (38), contained in two tubes, (39) and (40), which are slotted for a few inches of their length to allow the cross head to follow up and compress the springs. (Only (38) and (40) are shown, (87) and (39) lying in the same plane of projection.)*~~

~~*When the gun fires, and the bullet has passed the port, the gases drive the piston (35) and gas lever (29) downwards, and the momentum imparted causes them to swing back round the pivot (36), as shown by the dotted circle. The gas lever is brought up now by the bottom plate (91) ; and the*~~

~~*retracting springs, com- pressed by the cross head of the long link (45) owing to the forward motion of the short arm of the gas lever, react, and drive the gas lever into its forward position again.*~~

~~*The rotary movement of the gas lever is converted into a reciprocating movement of the slide (86) by means of the gas lever connexion rod (31) pivoted at (32) to the gas lever, and at (87) to the slide.*~~

~~*The slide (86) is a nearly flat bar, travelling in guides in the receiver, extending from (14) to (87). It is slotted completely through longitudinally for nearly the whole of its length, this slot affording an opening through which work the cartridge extractor*~~

~~*(82) and carrier (21). At its rear end it engages by means of a pin (14) in a cam slot (97) in the bottom rib of the bolt (13), and at*~~

~~*(83) it bears the pivot of the cartridge extractor (82). Its rear end is enlarged below to form a cam lug (98), and on its right side are two projections (95) and (96), which work the feed lever (66).*~~

~~*The feed wheel (61), over which passes the belt containing the cartridges, is actuated by a pawl " step-by -step " gear by means of the feed lever (66).*~~

~~*The carrier (21) is a long trip lever pivoted at (22), and pro- vided with a spring dog (23) pivoted at (24).*~~

~~*The bolt (13) is a cylinder with a guide rib extending from its under surface. It is actuated by the slide by means of the pin (14) and cam slot (97) as already stated, and is bored through to take the striker or firing pin (18). The rear end of the latter pro- jects slightly beyond the rear face of the bolt, being retained in this position by the spring (19). When this projecting end is pushed into the bolt, the point protrudes from the front of the bolt and fires the cartridge. The bolt, when the breech is locked, is held firm by two recoil blocks on the receiver (not shown) as is explained later. Attheffontof the boltisan extractor (15) withaspringclaw for extracting the fired case. (This is of course quite distinct from the cartridge extractor (82)). Ejection is effected by means of an ejector projecting into the path of the fired case*~~

~~*in a manner simi- lar to that employed in the Hotchkiss gun as already described.*~~

~~*The firing of the gun is performed by the cylindrical hammer (6) hollowed out in rear to contain the mainspring (7). When pushed back and cocked as shown in Fig. 14, it is held during a portion of the operations of the mechanism by two detents working independently of each other — ^the sear (10) and the nose of the trigger (8). The former is automatically released by a trip lever (not shown) as soon as the breech is locked, leaving the hammer held by the trigger only. This is the position shown in Fig. 14. The necessity for the two detents is explained later.*~~

~~*The hammer, when cocked, can also be permanently locked by the handle lock (2) actuated by a thumb piece on the outside of the receiver. The air compressed in rear of the hammer, as the latter is driven back, passes through the tube (99) to the breech ; and a puff of air is therefore blown through the barrel after every shot, clearing out any loose fouling, or grains of unconsumed powder, from the cartridge chamber, and assisting to an appreciable extent to keep down the temperature of the barrel.*~~

~~*Taking the position shown in Fig. 14, the hammer is only held back by the trigger nose, the sear (10) having been released as stated above. A belt of cartridges (not shown) has been placed on the feed-wheel, and the cartridge next to be used after the one (not shown) now in the breech has its rim (or base with rimless cartridges) just above the hook on the extractor (82). If now the*~~

~~*FiQ. 15.— Colt Gun mounted.*~~

~~*trigger be pulled, the hammer flies forwards, strikes the protruding end of the firing pin, and the cartridge fires ; the gases cause the gas lever to swing round and drive back the slide. The pin (14) working in the cam groove (97) causes the rear of the bolt to rise and clear itself from the recoil blocks (not shown) on the receiver, and then to move rearwards*~~

~~*horizontally, driving the hammer back until the latter is caught and held by the sear and trigger. In the meantime the extractor (82) has pulled a cartridge from*~~

~~*Fio. 16,— Hotchklss Gun mounted.*~~

~~*the belt, and, assisted by two spring cartridge guides (80)and(81), of which only (80) is shown, deposits it on the carrier (21); the projection (95) strikes the feed-lever (66), and moves the feed mechanism so as to prepare to revolve the feed-wheel and place a fresh cartridge ready for the next round ; and, as the slide com- pletes Its travel backwards, the cam (98) strikes the dog (23) and slightly depresses it (the spring (25) yielding), the carrier and cartridge on it consequently rising a little and falling again (this latter action is Incidental only to the form of the parts, and is not a necessity).*~~

~~*The retracting springs now react and pull the slide forwards ; the cam (98) strikes the dog (23), which, as the spring arrange- ment is of the "non-return" class, does not yield but is de- pressed, and the front of the carrier and the cartridge on it are therefore raised sharply, and the latter placed in the path of the bolt. The bolt being now pulled forwards, the cartridge is driven off the carrier into the breech, and the bolt locked by the pin (14), causing the bolt to drop in front of the recoil blocks ; the carrier is pushed down flat by the advance of the cam lug (98), the trip re- leases the sear (10), and the projection (96) pushes back the feed lever, completing the action of feeding a fresh cartridge forward. The position shown in Pig. 13 is now resumed.*~~

~~*It is clear that were the trigger kept permanently pulled the gun would fire immediately the bolt was locked and the sear (10) de- pressed, and the action would become automatic.*~~

~~*The object of two detents, though now probably obvious, may here be explained. The whole action of the gun depends upon the hammer, after it is pushed back by the bolt, being held back until the bolt has gone completely forwards and looked the breech. If only the trigger detent existed, and that were kept pressed down, the hammer, after being pushed back by the bolt, would imme- diately follow up the latter, and might fire the cartridge*~~

~~prema- turely, or fail to fire it at all ; hence the use of the sear in addition to the trigger.~~

~~To cock the lock, or work the mechanism by hand, the gas lever is pulled round by the pin (30) provided for the purpose, and by this means the gun is prepared for firing. A brass tongue on the end of the belt is pushed through the opening above the feed- wheel and then pulled from the other side of the gun as far as it will go. This places a cartridge in front of the extractor, and if the gas lever be now pulled right back and let go, this cartridge is placed in the breech as already described, and the gun is ready for firing. If it be desired to remove a belt from the feed, a button (68) is pressed and the feed-wheel is then free to revolve back- wards.~~

~~The gun is sighted with the ordinary rifle pattern sights, up to 2000 yards or more if required. It weighs about iOlb, and can fire about 400 rounds per minute as usually adjusted, though this rate can be increased. There is no means of altering the gas pressure in the field as with the Hotchkiss.~~

~~The diagrams have been made from drawings, by permission of the Colt Gun Company.~~

~~Comparing the principle of employing a recoiling barrel with that of using a portion of the gas, the advantages of the former are that the recoil is made to do useful work instead of straining the gun and mounting in its absorp- tion; the latter system, however, has undoubtedly the advantage in simplicity of mechanism (the Hotchkiss is extraordinarily simple in construction for an automatic gun), and in the large margin of power for working the mechanism with certainty in all conditions of exposure to climate, dust, and dirt. While inferior in this respect, it is nevertheless the fact that the Maxim has proved itself in the field to be a very efficient and powerful weapon.~~

~~The great difficulty which has to be met in all single- barrel machine guns is the heating of the barrel. How great this heat is may be gathered from the fact that the 7^ pints of water in the water-jacket of the Maxim gun are raised to boiling point by 600 rounds of rapid fire, — i.e., in about 1^^ minutes, — and if firing be continued, about 1+ pints of water are evaporated for every 1000 rounds. Assuming that the operation is~~

~~continuous, the rate of waste of energy due to heat expended on the water alone is equivalent to about 20 horse-power (294 foot tons per minute). The water-jacket acts well in keeping down the temperature of the barrel ; but apart from the complications entailed by its use, the provision of water for this purpose is at times exceedingly trouble- some on service. In the Hotchkiss and Colt guns, which have no water-jacket, an attempt is made to meet the heating, in the one by the radiator, and in the other by a very heavy barrel.~~

~~For military and naval purposes the automatic gun is, under certain conditions, of great value. For the sweeping of defiles, the warding off of the attacks of masses of men in close formation, or the pouring in of an immense number of bullets into a rapidly advancing torpedo boat, it is a most valuable weapon, and in addition its moral effect is~~

~~lyi A 0~~

~~great; but against men scattered over a wide front there is no doubt it is very wasteful for the effect ob- tained. It is by no means easy to proportion the fire to the target, as there are only two rates of fire, viz., rapid automatic and slow single shots. To fire a single shot requires some practice, since the gun will tire some 7 shots in one second, and to press the trigger and remove the finger or thumb instantly, and at the same time be ready to traverse to a fresh target, requires considerable skill. The result of these diflaculties is that the target~~

~~S/DE ELEVATION.~~

~~Fig. 17. — Maxim Gun mounted.~~

~~when struck is often riddled with bullets, when a few or even one would have sufficed. The aiming of the gun, when rapid fire is taking place, is also difl&eult even on firmly fixed mountings, as the vibration, d^ie to the~~

~~rapidly repeated similar impulses, is very great. Figures 15 to 17 show these guns on three classes of mounting which are in common use. (h. w. b.)~~

~~Mackay, Charles (1814-1889), Scottish writer, was born at Perth, 27th March 1814. He was educated at the Caledonian Asylum, London, and in Brussels ; and in 1830, being engaged as private secretary to a Belgian ironmaster, he began writing articles and verses for local newspapers. Eeturning to London, he devoted himself to literary and journalistic work, and was attached to the Morning Chronicle (1835^4). He published a book called Memoirs of Extraordinary Public Delusions (1841), and gradually made himself known as an industrious and prolific journalist. In 1844 he was made editor of the Glasgow Argus, and two years later was given the degree of LL.D. by the university. His literary reputation was made by the publication in 1846 of a volume of verses. Voices from the Crowd, some of which (among them " The Good Time Coming ") were set to music by Henry Eussell and became very popular. In 1848 Mackay returned to London and worked for the Illustrated London News, of which he became editor in 1862. In it he published a number of songs, set to music by Bishop and Eussell, and in 1855 they were collected in a volume ; they included the popular « Cheer, Boys ! Cheer ! " It was as a song- writer that he was best known, bu.t he was also a prolific author in prose, and after his severance from the Illustrated London News in 1858 he started two periodicals which turned out unsuccessfully, and also acted as special corre- spondent for Tlie Times in America during the Civil War from 1862 to 1865. Among his publications must be mentioned the well-known Thousand and One Gems of English Poetry (1867). Mackay died in London, 24th December 1889. His son, Ekic Mackay (1851-1899), is known as a writer of verse, particularly by his Love Letters of a Violinist (1886).~~

~~Mackay, a seaport town, Queensland, Australia, in the county of Carlisle, on the Pioneer river, 625 miles north-west of Brisbane. The harbour is not a good one. Sugar, tobacco, and coffee thrive in the district, which is dotted with hundreds of sugar-farms. There are several important sugar-mills, and one of these, the largest in Queensland, is capable of an annual output of 8000 tone. Eum is distilled. Workable coal is found in the district. This is the port of the Mount Orange and Mount Gott- hart copper mines, and the Mount Britten and Eungella~~

~~gold-fields. It is a calling station for the Queens- land Eoyal Mail steamers. Population (1901), 5157.~~

~~M'Keesport, a city of Allegheny county, Penn- sylvania, U.SjA., on the Monongahela river, at the mouth of theYoughiogheny river — both of which are navigable — 14 miles south- east of Pittsburg, in the south-western part of the state, at an altitude of 763 feet. It is entered by the Pennsylvania, the • Balti- more and Ohio, and the Pittsburg and Lake Erie railways. It has water- works owned by the city, and its business streets are paved largely with bricks and granite blocks. It is in the midst of the coking coal region, and has an abundance of natural gas. Its industries consist mainly in iron and steel manu- facture. In 1890 it contained a total of 118 manu- facturing establishments, with a capital of $10,979,812, employing 6292 men, and with a product valued at f 17,432,721. Not less than ||ths of this consisted of iron and steel goods. The assessed valuation of real and personal property in 1900 (on a basis in the case of the former of about three-fourths of the full value) was f 17,604,560, the net debt of the city was $705,148, and the rate of taxation $20.25 per $1000. Population (1880), 8212 ; (1890), 20,741 ; (1900), 34,227, showing a rapid rate of increase, due to the development of the city's manufactures of iron and steel.~~

~~M'Kees Rocks, a borough of Allegheny county, Pennsylvania, U.S.A., on the south bank of the Ohio river, opposite Allegheny city, in the south-western part of the state. It is entered by the Pittsburg and Lake Erie, and the Pittsburg, Charleston, and Youngstown rail- ways. The leading industries of the town are iron and glass manufacturing. Population (1890), 1687; (1900), 6362, of whom 1264 were foreign-born and 20 were negroes.~~

~~Mackenzie, ariver of the North-West Territories, Canada, discharging the waters of Great Slave Lake into the Arctic Ocean ; discovered and first navigated by Alex- ander Mackenzie (1789). It has an average width of one mile ; an average fall of six inches to the mile ; an approxi- mate discharge, at a medium stage, of 500,000 cubic feet per second ; and a total length, including its great tributary the Peace, of 2360 miles. The latter rises, under the name of the Finlay, in the mountains of British Columbia, and flows north-eastwards and then south-eastwards, in the great intermontane valley that bounds the Eocky Mountains on the west, to its confluence with~~

~~the Parsnip. Prom the confluence the waters of the combined rivers, now called~~

~~the Peace, flow eastwards tkroTigli the Eocky Mountains, and then north-eastwards to unite with the river which dis- charges the waters of Lake Athabasca ; thence to Great Slave Lake it is known as Slave river. The principal tributaries of the Peace are : Omineca, Nation, Parsnip, Halfway, Xorth Pine, South Pine, Smoky, Battle, and Loon rivers. The only considerable streams draining into Lake Athabasca are the Black, William, and Athabasca, and into Great Slave Lake the La Martre, Yellowknife, Lockhart — -draining Aylmer, Clinton-Colden, and Artillery lakes — Du Eoclier, Slave, and Hay. The principal tribu- taries of the i\Iackenzie are the Liard, 660 miles long, which rises near the sources of the Pelly — west of the Eocky Mountains — and breaks through that range on its way to join the parent stream, Great Bear river, which discharges Great Bear Lake, Nahanni, Dahadinni, Arctic Eed and Peel rivers. The Mackenzie and its continuation. Slave river, are navigable from the Arctic Ocean to Port Smith, a distance of over 1200 miles, and between the latter and the head of Lesser Slave Lake, a further dis- tance of 625 miles, there is only one obstruction to navi- gation, the Grand Eapids near Fort McMurray. The Mackenzie is navigable from about 10th June to 20th October, and Great Slave Lake from about 1st July to the end of October.~~

~~Mackenzie, Alexander (1822-1892), Cana- dian statesman, was born in Perthshire, Scotland, 28th January 1822. HIs father was a builder, and young Mackenzie emigrated to Canada in 1842 and worked in Ontario as a stone-mason, setting up for himself later as a builder and contractor at Sarnia with his brother. In 1852 his keen interest in questions of reform and Liberal politics led to a connexion with a local paper, which brought him to the front, and in 1861 he became a member of the provincial parliament, where he at once made his mark and was closely connected with the Liberal premier, George Brown. HIe was elected for Lambton to the first Dominion HIouse of Commons in 1867, and soon became the recognized leader of the Liberal Opposition ; from 1871 to 1872 he also sat in the Ontario~~

~~*provincial assembly. In 1873 his attack on Sir John Macdonald's ministry with regard to the Pacific railway charter resulted in their defeat, and Mackenzie formed a new Government, taking the portfolio of public works and becoming the first Liberal premier of Canada. He remained in power till 1878, when industrial depression led to a reaction against the Liberal free-trade policy and enabled Sir John Macdonald to return to oflELce on a protectionist programme. In 1875 ^Mackenzie paid a visit to Great Britain, and was received at Windsor by Queen Victoria ; he was offered a knighthood, but declined it. After his defeat he suffered from failing health, but though he resigned the leadership of the Opposition, he retained a seat in parlia- ment till his death at Toronto on 17th April 1892. (See also Canada.)*~~

~~*Mackenzie, Sir Alexander Campbell*~~

~~*(1847), British composer, son of an eminent Edin- burgh violinist and conductor, was born 22nd August 1847. On the advice of a member of Gung'l's band who had taken up his residence in Edinburgh, one Bartel, the young Mackenzie was sent for his musical education to Bartel's native place, Sondershausen, where he entered the Conservatorium under Ulrich and Stein, remaining there from 1857 to 1861, when he entered the ducal orchestra as a violinist. It was at this time that he made Liszt's acquaintance. On his return home he won the King's Scholarship at the Eoyal Academy of Music, and remained the usual three years in the institution, after which he established himself as a teacher of the piano, &c..*~~

~~*in Edinburgh. He appeared in public as a violinist, taking part in Chappell's quartette concerts, and starting a set of classical concerts. He was appointed precentor of St George's Church in 1870, and conductor of the Scottish Vocal Music Association in 1873, at the same time getting through a prodigious amount of teaching. He kept in touch with his old friends by playing in the orchestra of the Birmingham Festivals from 1864 to 1873. The most important compositions of this pe- riod of Mackenzie's life were the Quartette in E flat for piano and strings. Op. 11, and an overture Cervantes, which owed its first performance to the encourage- ment and help of von Btilow. On the advice of this great pianist, he gave up his*~~

~~Edinburgh appointments, which had quite worn him out, and settled in Flor- ence in order to com2)ose. The cantatas Tlie Bride (Worcester, 1881) and Jason (Bristol, 1882) belong to this time, as well as his first opeta. This was com- missioned for the Carl Eosa Company, and was writ- ten to a version of Merimee's Colomba prepared by Dr Franz Hueffer. It was produced with great success in 1883, and was the first of a too short series of modern English operas ; Mackenzie's second opera, TJie Troubadour, was produced by the same company in 1886 ; and his third dramatic work was His irnjesty, an excellent comic opera, given at the Savoy Theatre in 1897. In 1884 his Hose of Sharon was given with very great success at the jSTorwich Festival ; in 1885 he was appointed conductor of Novello's ora- torio concerts ; The Story of Sayid came out at the Leeds Festival of 1886 ; and in 1888 he succeeded Macfar- ren as principal of the Eoyal Academy of Music. Tlie Dream of Jubal was produced at Liverpool in 1889, and in London very soon afterwards. A fine setting of the hymn " Veni, Creator Spiritus " was given at Birmingham in 1891, and the oratorio Bethlehem in 1894. From 1892 to 1899 he conducted the Philharmonic Concerts, and was knighted in 1894. Besides the works mentioned he has written incidental music to plays, as, for instance, to Bavenswood, Tlie Little Minister, and Coriolanus ; con- certos and other works for violin and orchestra, miich orchestral music, and many songs and violin pieces. The romantic side of music appeals to Mackenzie far more strongly than any other, and the cases in which he has conformed to the classical conventions are of the rarest. In the orchestral ballad. La Belle Dame sans Merci, he touches the note of weird pathos, and in the nautical overture Britannia his gift of a strong sense of humour stands revealed. If his single comic opera was one of the least successful of the productions at the Savoy Theatre, it was certainly not the least humorous, and it had many passages of real and lasting beauty. In the two " Scottish Ehapsodies " for orchestra, in the music to The Little 3Ti)iister, and in a beautiful fantasia for pianoforte and orchestra on Scottish themes, he has seized the essential, not the accidental, features of his native miisic.~~

~~Mackenzie, Sir Moreli (1837-1892), British physician, son of Stephen ^lackenzie, surgeon (d. 1851),was born at Leytonstone, Essex, 7th July 1837. After going through the course at the London Hospital, and becoming F.E.C.S. in 1858, he studied abroad at Paris, Vienna, and Pesth ; and at~~

~~Pestli he learnt the use of the newly- invented laryngoscope under Professor Czermak. Eeturn- ing to London in 1862, he worked at the London Hospital, and took his degree in medicine. In 1863 he won the Jacksonian prize at the Eoyal College of Surgeons on " Pathology of the Larynx," and he then devoted himself to becoming a specialist in diseases of the throat. In 1863 the Throat Hospital in King Street, Golden Square,~~

~~was founded, largely owing to his initiative, and by his work there and at the London Hospital (where he was one of the physicians from 1866 to 1873) Morell Mackenzie rapidly became recognized throughout Europe as a leading authority, and acquired an extensive practice. So great was his reputation that in May 1887, when the Crown Prince of Germany (afterwards the Emperor Frederick III.) was attacked by the affection of the throat of which he ultimately died, Morell Mackenzie was specially summoned to attend him. The German physicians who had attended the Prince since the begin- ning of March (Gerhardt, and subsequently Tobold, von Bergmann, and others) had diagnosed his ailment on 18th May as cancer of the throat; but Morell Mackenzie insisted (basing his opinion on a microscopical examina- tion by Virchow of a portion of the tissue) that the disease was not demonstrably cancerous, that an operation for. the extirpation of the larynx (planned for 21st May) was unjustifiable, and that the growth might well be a benign one and therefore curable by other treatment. The question was one not only of personal but of political importance, since it was doubted whether any one suffer- ing from an incapacitating disease like cancer could, according to the family law of the HohenzoUerns, occupy the German throne ; and there was talk of a renunciation of the succession by the Crown Prince. It was freely hinted, moreover, that some of the doctors themselves were influenced by political considerations. At any rate, Morell Mackenzie's opinion was followed: the Crown Prince went to England, under his treatment, and was present at the Jubilee celebrations in June. Morell Mackenzie was knighted in September 1887 for his services, and decorated with the Grand Cross of the Hohenzollern Order. In November, however, the German doctors were again~~

~~called into consultation, and it was ultimately admitted that the disease really was cancer ; though Mackenzie with very questionable judgment, more than hinted that it had become malignant since his first examination, in consequence of the irritating effect of the treatment by the German doctors. The Crown Prince (see Feedeeick III.) became Emperor on 9th March 1888, and died on 15th June. During all this period a violent quarrel raged between Sir Morell Mackenzie and the German surgeons and medical world, both as to the diagnosis and also as to the treatment both before and after the existence of a malignant growth was determined; and the discussion as to the part played by Mackenzie was carried on in a wider circle with much display of feeling after the Emperor's death. The German doctors published an account of the illness, to which Mackenzie replied by a work entitled Hie Fatal Illness of Frederick the Noble (1888), the publication of which caused him to be censured by the Eoyal College of Surgeons. After this sensational episode in his career, the remainder of Sir Morell Mackenzie's life was uneventful, and he died somewhat suddenly in London, 3rd February 1892. He pub- lished several books on laryngoscopy and diseases of the throat. A full discussion of the much-contro- verted details about Mackenzie's treatment of the Emperor Frederick will be found in The Times of 16th October 1888. (h. ch.)~~

~~McKiniey, William (1843-1901), twenty-fifth President of the United States, was born in ISTiles, Trum- bull county, Ohio, on 29th January 1843. His ancestors on the paternal side were of Scottish-Irish origin. His great-great-grandfather settled in York county, Pennsyl- vania, about 1743, whence his greatgrandfather, David McKiniey, moved to Ohio in 1814. David's son James had preceded him, having gone to Columbiana county.~~

~~Ohio, in 1809. William McKiniey, father of the Presi- dent, was the son of this James McKiniey, and was born in 1807. He was married in 1829 to Nancy Campbell Allison, of Columbiana county, Ohio, and to them were born nine children, of whom William, the President, was the seventh. In 1852 William McKiniey, senior, took his family from Niles, Trumbull county, to Poland, Mahoning county, where the younger William was placed at school in the Union Seminary. At seventeen he was sent to Meadville, Pa., to enter the junior class of Allegheny College. He studied beyond his strength, however, and did not remain to finish his course, but returned to~~

~~*Poland, where for a time he taught in a neighbouring country school. When the Civil AVar broke out in 1861 he was eighteen years old, and promptly enlisted as a private soldier. He served until the end of the war, and was mustered out with his regiment 26th July 1865, with the brevet rank of major. Army life had changed the rather pale and sickly lad of eighteen into a man of superb figure and health at twenty-two. His regiment was the 23rd Ohio Volunteer Infantry, of which Eutherford B. Hayes was the first colonel. Mr Hayes became a general, and McKiniey was for some time a member of his staff. Throughout General Hayes's subsequent career as member of Congress, Governor of Ohio, and President of the United States, he was deeply devoted to the younger man, who was destined to follow a like career as Congressman, Governor, and President.*~~

~~*After the war McKiniey returned to Poland, and bent all his energy upon the study of law. He completed his preparatory reading at the Albany (N.Y.) Law School, and was admitted to the bar at Warren, Ohio, in March 1867. He was now twenty-four years old, and ripened and disciplined by experience. On the advice of an elder sister, who had been for several years a teacher in Canton, Ohio, he began his law practice in that place, which was to be his permanent home. He identified him- self immediately with the Eepublican party, and took part in the campaign work on behalf of Grant's Presidential candidature in 1868. In the following year, in spite of the fact that his county (Stark) had almost invariably given Democratic majorities, he was elected prosecuting attorney — a position with which the public careers of many American statesmen have begun. He served in this position for two years, when, failing to obtain re-election by a narrow margin, he devoted himself to his profession, while not relaxing his interest in politics. He was married in 1871 to Miss Ida Saxton, daughter of a banker of Canton.*~~

~~*In 1876 Mr McKiniey was elected to Congress. Con- ditions both in Ohio and in Congress had placed him, and were to keep him so for twenty years, in an attitude of aggressive and uncompromising partisanship. His con- gressional district was naturally Deinocratic, and its boundaries were changed two or three times by Demo- cratic legislatures — "gerrymandered," to use an estab- lished American expression — for the purpose of so grouping Democratic strongholds as to cause his defeat. But*~~

he overcame what had threatened to be adverse majorities on all occasions from 1876 to 1890. Mr McKinley's was a manufacturing district, and his home town of Canton was growing by reason of its industrial enterprises. As a strong believer in the essential relation of the protective tariff policy to the growth of American industries, Mr McKiniey soon became known in Congress as one of the most diligent students of industrial policy and questions affecting national taxation. In his first term he took part in the debates over the Wood Tariff Bill, proposing lower import duties. In his second term he was appointed to a position on the Ways and Means Committee. He was

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prominent in tlie debate which resulted in the defeat of the Democratic Morrison Tariff Bill in 1884, and he took an even more notable part in the defeat of the tariff revision project known as the Mills Bill. Soon after the opening of the fifty-first Congress in 1889, Mr McKinley became the chairman of the Ways and Means Committee, and Eepublican leader in the House. Party feeling was exceptionally intense at that time, and Mr McKinley's name as chairman of the Ways and Means Committee made him the most conspicuous among the framers of the new Republican tariff measure. His name was popularly at- tached to it, and he could not evade the storm of controversy which raged in Con- gress and throughout the country. The Democrats made a concentrated effort to prevent his return to Congress (1890), and they were successful. But Mr McKinley, in the darkest hours of the unpopularity of the McKinley tariff, continued to express his belief in its value. His defeat for Con- gress was accom- plished chiefly by an extraordinary gerry- mandering of his dis-

~~on account of the fact that the Ohio delegation had been instructed to urge the nomination of John Sherman. In 1892 Governor McKinley was the presiding officer of the National Convention ; but he had concurred in the opinion that President Harrison ought to be renominated, and this view prevailed, although in spite of all his efforts a large number of delegates cast their votes for him.~~

~~It had been supposed that the tariff question would again play a leading part in the campaign of 1896, and~~

~~such would probably~~

~~trict, and he won a moral victory in view of the fact that more Republican votes were cast for him than had ever been cast for any Republican candidate before in the history of the counties which were now aggregated to form the district. The Republicans of the state at once proceeded to cham- pion him and his tariff views by according him the unaniipous nomination for the~~

~~Governorship. His four years as chief of the executive of Ohio nmst be regarded as important, largely by reason of the valuable training they afforded in execu- tive as distinguished from legislative work.~~

~~Mr McKinley had now become a public man of the first rank. He had been for some time a prominent figure at the quadrennial conventions which bring together the leading Republicans of the entire nation to adopt a plat- form and nominate a President, and he had also been looked upon in the light of a possible Presidential candi- date. In 1888 he was chairman of the platform com- mittee, and leader of the delegation from Ohio, and found a condition prevailing in the convention which would un- questionably have given him the Presidential nomination, but for his absolute refusal to permit his name to be used.~~

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~~but for the vast pro- M ‘ I portions assumed in~~

the West and South by the propaganda for the free coinage of silver. In 1873, pre- paratory to a resump- tion of specie pay- ments, the currency and coinage system of the United States had been revised, the silver dollar, which had formerly been the un- limited legal standard jointly with the gold dollar, being demo- netized, and the gold dollar becoming the sole monetary standard. Subse- quently the great de- velopment of silver- mining and the de- cline in the price of silver bullion gave rise — first among the silver miners, and afterwards among the Western farmers — to a movement for the remonetization of silver. At first this movement was irre- spective of party lines. It was generally hoped that a large use of silver in the coinage and currency system with ultimate gold redemption would help the silver bullion market, and that meanwhile European nations might be persuaded to join the United States in some plan of international bimetallism. Mr McKinley had been heartily in favour of a restoration of free silver, provided it could be brought about safely and honour- ably ; and this view had been very general among leading public men of all parties. At length, how- ever, the Democratic party of the West and South assumed the position that the mints ought to be opened to the free coinage of silver, irrespective of European action, and the Eepublican party found itself resisting this movement. In the convention at St Louis, 1896, which nominated Mr McKinley for President, the Re- publicans declared themselves firmly for the existing gold standard until such time as silver might be rehabili- tated with the co-operation of leading commercial nations.

President MoKinley. {From a Photograph by Parker, Washington, B. (7.)

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The Democratic Convention met a few days later at Chicago, and nominated Mr William J. Bryan for the Presidency, on a platform of the immediate opening of the mints to the free and unlimited coinage of silver at the old ratio with gold of 16 to 1. The Republicans were thus diverted from their expected advocacy of high pro- tection as the principal issue to the defence of the gold standard. The popular vote for McKinley electors in the ensuing election was 7,104,779, and that for Bryan electors about

~~*600,000 less. Mr McKinley received 271 votes in the Electoral College, and Mr Bryan 176.*~~

~~*Immediately after his inauguration on 4th March 1897, President McKinley issued a proclamation calling Con- gress to assemble in an extra session on 15th March. The Democratic tariii in 1893 had been enacted as part of the general revenue measure which included an income- tax. The income-tax having been declared unconstitu- tional by the Supreme Court, the measure had failed to produce a sufficient revenue, in consequence of which Mr McKinley's predecessor had been obliged to increase the public debt. Mr McKinley's message to the new Congress dwelt upon the necessity of an immediate revision of the tariff and revenue system of the country, and the so- called Dingley Tariff Bill was accordingly passed through both houses, and was approved by the President on 24th July.*~~

~~*The regular session of Congress which opened in December was occupied with the situation in Cuba. A formidable rebellion of the Cuban patriots against the Spanish Government had begun in 1895, and the unavail- ing attempts of Spain to subdue it had been upon a large military scale, accompanied by measures of harshness to- wards the entire population, women and children included, that were resulting in wholesale starvation. A popular demand had arisen throughout the United States for in- tervention. The already strained situation was rendered worse by an explosion on 15th February 1898, in the harbour of Havana, which resulted in the destruction with great loss of life of the United States battleship Maine. The increasing difficulties of the situation led early in March to the unanimous vote in both Houses of Congress of $50,000,000, to be placed at the disposal of the President, and to be used at his discretion for the national defence. On 23rd March an ultimatum was presented to the Spanish Government by direction of President McKinley, setting forth the intolerable condition that existed in Cuba, and calling upon Spain to relinquish its sovereignty and withdraw from the island. A period of negotiation followed which culminated in Mr McKinley's message to Congress of 25th April recommending a declaration of war against Spain. Such a declaration was immediately passed by both Houses of Congress and approved by the President.*~~

~~*As commander-in-chief of the army and navy of the United States, Mr McKinley prosecuted a brief but vigorous war in which a volunteer army of nearly a quarter of a million men was called into existence, and two Spanish fleets were destroyed — one by the Asiatic squadron under Admiral Dewey in Manila Harbour, the other by the North Atlantic squadron under Admiral Sampson near the harbour of Santiago de Cuba. These victories at sea, together with the surrender to an Ameri- can expeditionary force of the city of Santiago, in eastern Cuba, led to the signing of a peace protocol on 12th August, which was followed by the signature at Paris on 10th December of articles of peace. After a long dis- cussion the peace treaty was ratified by the United States Senate, 6th February 1899; and in accordance with its terms Porto Eico, the Philippine Archipelago, and a portion of the Ladrone Islands were transferred*~~

~~*by Spain to the sovereignty of the United States, while Cuba came under American jurisdiction pending the establishment there of an independent government. Two days before the ratification of the peace treaty, a con- flict took place between armed Filipinos under the leader- ship of Emilio Aguinaldo and the American forces that were in possession of Manila. The six months that had elapsed between the signing of the peace protocol and the ratification of the treaty had constituted a period of virtual interregnum, Spain's authority having been practically destroyed in the Philippines and that of the United States not having begun. In this period a formidable native Filipino army had been organized and a provisional government created. The warfare waged by these Filipinos against the United States, while having for the most part a desultory and guerilla character, was of a very protracted and difficult nature. Sovereignty over the Filipinos having been accepted by virtue of the ratification of the Paris treaty. President McKinley was not at liberty to do otherwise than assert the authority of the United States and use every endeavour to suppress the insurrection. There was, how- ever, a wide difference of opinion in the United States whether or not it had been wise to accept responsibility for so distant a territorial possession. In the foreign relations of the United States, as directed by President McKinley, the most significant change was the cordial understanding established with the British Government. Under no previous American administration since the establishment of Independence had the*~~

~~*relations between the two Governments been so free from difficulty or embarrassment.*~~

~~*The elements which had supported Mr Bryan in 1896 had not been disheartened by their defeat, but had imme- diately organized for a new campaign in 1900 under the same candidate and with the same platform. The Demo- cratic Convention, held on 4th July at Kansas City, again nominated Mr Bryan and again declared for the free coin- age of silver. But the Republican policy of "imperial- ism" was declared to be "the paramount issue," and Mr Bryan, during a campaign of incessant travel and public speech, constantly denounced the course that had been pursued under Mr McKinley's leadership. The latter was unanimously renominated by the National Republican Con- vention which met in Philadelphia on 19th June. In 1896 Garret A. Hobart, of New Jersey, had been elected Vice-President, but had died in 1899. At the Philadelphia Convention of 1900, Governor Theodore Roosevelt, of the State of New Yoik, was nominated for the Vice-Presidency. The Republican Convention demanded the maintenance of the gold standard, and pointed to the fulfilment of some of the most important of the pledges given by the Repub- lican party four years earlier. The intervening period had been one of very exceptional prosperity in the tJnited States, foreign commerce having reached an unprecedented volume, and agriculture and manufactures having made greater advancement than in any previous period of the country's history. The tendency towards the concentra- tion of capital in great industrial corporations had been active to an extent undreamt of, with incidental con- sequences that had aroused much apprehension; and the Democrats accused President McKinley and the Repub- lican party of having fostered the " trusts." As the result of the polling in November, 292 Republican Presidential electors were chosen, while 165 Democratic electors, chiefly in the Southern States, represented the final strength of the Bryan and Stevenson ticket. The Repub- lican popular vote was about 7,208,000, and the Democratic about 6,358,000. Since the re-election of Mr Lincoln in 1864, and of General Grant in 1872, no American Presi- dent had succeeded in securing a second consecutive term*~~

until Mr McKinley's re-election for the first quadrennial period of the 20th century.

In the term of Congress immediately following the Presidential election it was found possible to reduce materially the war taxes which had been levied on the outbreak of the Spanish-American war. Arrangements were perfected for the termination of the American mili- tary occupation of Cuba and the inauguration of a Cuban Republic as a virtual protectorate of the United States, the American Government having arranged with the Cuban Constitutional Convention for the retention of a series of naval stations on the Cuban coast. In the Philippines advanced steps had been taken in the substi- tution of civil government for military occupation, and a governor-general had been appointed and sent to Manila. Progress had been made towards the final solution of the preliminary problems affecting the construction of a ship canal across the isthmus connecting North and South America, a very important commission of engineers ap- pointed by Mr McKinley having completed its investiga- tions, while negotiations with Great Britain had resulted in a new convention setting aside the Clayton-Bulwer treaty and providing for a canal under American control. Prosperity at home was great, and foreign relations were free from complications. The problems which had de- volved upon Mr McKinley's Administration had been far advanced towards final settlement. He retained without change the cabinet of his first Administration. After an arduous and anxious term, which had included the war with Spain, the war against the Philippine insurgents, and participation in the joint expedition to Peking, Mr McKinley had reached a period that promised to give him comparative repose and freedom from care. He had se- cured, through the co-operation of Congress, the perma- nent reorganization of the army and a very considerable development of the navy. The public revenues were superabundant, and the nation's outlook had never been so full of promise for peace and general progress. In these circumstances, in accordance with a long-anticipated plan. President McKinley, accompanied by the greater part of his cabinet, set forth in the early summer on a tour to visit the Pacific coast, where he was to witness the launching of the battleship Ohio at San Francisco. The route chosen was through the Southern States, where many stops were

~~*made, and where Mr McKinley delivered brief addresses. The heartiness of the welcome accorded him seemed to mark the disappearance of the last vestige of sectional feeling that had survived the Civil War, in which Mr McKinley had participated ^s a young man. After his return he spent the happiest and most restful month of his long period of ofl&cial life in a visit at his old home in Canton, Ohio. At the end of this visit, by previous arrangement, he visited the city of Buffalo, New York, in order to attend the Pan-American Exposi- tion and make a public address. This address, which was delivered on 5th September 1901, was a public utter- ance designed by Mr McKinley to affect American opin- ion and public policy. It declared that henceforth the progress of the nations must be through harmony and co-operation, in view of the fast-changing conditions of communication and trade, and it maintained that the time had come for wide-reaching modifications in the tariff policy of the United States, the method preferred by Mr McKinley being that of commercial reciprocity arrange- ments with various nations. On the following day, 6th September 1901, a public reception was held for President McKinley in one of the buildings of the Exposition, all sorts and conditions of men being welcome. Advantage of this opportunity was taken by a young man of Polish parentage, by name Leon Czolgosz, to shoot at the Presi- dent with a revolver at close range. One of the two*~~

~~*bullets fired penetrated the abdomen. After the world had been assured that the patient was doing well and would recover, he collapsed and died on the 14th. The assassin, who professed to hold the views of that branch of Anarchists who believe in the assassination of rulers and persons exercising political authority, was promptly seized, and was subsequently convicted and executed. Mr McKinley's conduct and utterances in his last days revealed a loftiness of personal character that everywhere elicited admiration and praise. Immediately after his death Vice-President Eoosevelt took the oath of oflBce, announcing that it would be his purpose to continue Mr McKinley's policy, while also retaining the cabinet and the principal officers of the Government. Mr McKin- ley's funeral took place at Canton, Ohio, on 19th Sep- tember, the occasion being remarkable for the public manifestations of mourning, not only in the United States, but in Great Britain and other countries.*~~

~~*(a. Sw.)*~~

~~*M 'Kinney, a city in the north-east of Texas, U.S.A., capital of Collin county, at the intersection of the Houston and Texas Central, and the Sherman, Shreveport, and Southern railways. It is in a cotton-growing region, and is a compressing and shipping point for that staple. Population (1880), 1479 ; (1890), 2489 ; (1900), 4342— 50 foreign-born and 917 negroes.*~~

~~*Macleod, Henry Dunning (1821-1902), Scot- tish political economist, was born in Edinburgh in 1821, and educated at Eton, Edinburgh University, and Trinity College, Cambridge, where he graduated in 1843. He travelled in Europe, and in 1849 was called to the English bar. He was employed in Scotland on the work of poor- law reform, and devoted himself to the study of economics. In 1856 he published his Tlieory and Practice of Banking, in 1858 Elements of Political Economy, and in 1859 a Dictionary of Political Economy. In 1873 appeared his Principles of Economist Philosophy, and other books on economics and banking were published later. Between 1868 and 1870 he was employed by the Government in digesting and codifying the law of bills of exchange. Macleod's principal contribution to the study of econom- ics consists in his work on the theory of credit, to which he was the first to give due prominence. Eor a judicious discussion of the value of Macleod's writings, see an article on " The Revolt against Orthodox Economics " in the Quarterly Review for October 1901 (Xo. 388). He died on 16th July 1902.*~~

~~*MacMahon, Marie Edme Patrice Maurice*~~

~~*de, Due DE Magenta (1808-1893), French ilarshal and President of the Republic, was born on 13th July 1808 at the chateau of Sully, near Autun. He was a descend- ant of an Irish family who went into exile with James II. Educated at the military school of St Cyr, in 1827 he entered the army, and soon saw active service in the French campaign in Algeria, where his ability and bravery became conspicuous. He was in the engagement at the Col de Terchia, and was subsequently sent on a difficult and dangerous mission to the general in command at Blida. This he successfully accomplished. Being recalled to France, he gained renewed distinction in the expedition to Antwerp in 1832. He became captain in 1833, and in that year returned to Algeria. He led daring cavalry charges across plains*~~

~~*infested with Bedouin, andespecially distinguished himself at the siege of Constantine in 1837. From then until 18”);”) he was almost constantly in Algeria, and rose to the rank of general of division. During the Crimean war MacIMahon was given the command of a division, and in September 1855 he successfully con- ducted the assault upon the Malakoff redoubt which led to the fall of Sebastopol. After his return to France honours*~~

~~*were showered upon him, and he was made a senator. Desiring a more active life, however, and declining the highest command in France, he was once more sent out, at his own request, to Algeria, where he completely- defeated the Kabyles. After his return to France he voted as a senator against the unconstitutional law for general safety, which was brought forward in conse- quence of Orsini’s abortive attempt on the emperor’s life. MacMahon greatly distinguished himself in the Italian campaign of 1869. Partly by good luck and partly by his boldness and sagacity in pushing forward without orders at a critical moment at the battle of Magenta, he enabled the French to secure the victory. For his brilliant services MacMahon received his mar- shal’s baton and was created due de Magenta. In 1861 he represented France at the coronation of William I. of Prussia, and in 1864 he was nominated governor-general of Algeria. MacMahon’s action in this capacity formed the least successful episode of his career. Although he did institute some reforms in the colonies, complaints were so numerous that twice in the early part of 1870 he sent in his resignation to the emperor. When the ill-fated Ollivier Cabinet was formed the emperor abandoned his Algerian schemes, and MacMahon was recalled.*~~

~~*War being declared between France and Prussia in July 1870, MacMahon was appointed to the command of the First Army Corps, his mission being to defend Alsace. On 6th August MacMahon was in chief command at Woerth, having under him a total of 60,000 men, and he occupied a strong position on the slopes of the Vosges. The Germans numbered about 120,000 men. The Marshal fought valiantly, and his courage in braving death again and again extracted the admiration even of his foes. But all was in vain,*~~

~~*and the superior strength and strategy of the Germans triumphed. MacMahon was compelled to retreat upon Nancy, leaving in the enemy's hands 4000 prisoners, 36 cannon, and 2 standards. He fell back upon Saverne, and from thence proceeded in succession to Toul, Rheims, and Eethel. Though he suffered further losses in the course of his retreat, his movements were so ably con- ducted that the emperor confided to him the supreme com- mand of the new levies which he was mustering atChSlons, and he was directed to effect a junction with Bazaine. This operation he undertook against his will. He had an army of 120,000 men with 324 guns ; but large num- bers of the troops were disorganized and almost entirely without discipline. On 26th August the Germans ascer- tained that MacMahon was endeavouring to effect a union with Bazaine at Metz, and altered their plans in order to circumvent him. When the Marshal reached Sedan with his dispirited troops, it was only to find that he was sur- rounded by the enemy, who by vigorous forward move- ments had captured the bridges over the Mouse and the commanding positions round the town. Early on 1st September the fierce and decisive battle of Sedan began. After some hours of sanguinary fighting MacMahon was dangerously wounded in the thigh, and resigned his com- mand to General Wimpffen, who soon found he had no choice but to surrender. MacMahon shared the captivity of his comrades in Germany, and resided at Wiesbaden until the conclusion of peace.*~~

~~*In March 1871 the Marshal was appointed by Thiers commander-in-chief of the army of Versailles ; and in that capacity he suppressed the Communist insurrection, and successfully conducted the second siege of Paris. In the following December the Marshal was invited to become a candidate for Paris in the elections to the National Assembly, but declined nomination. On the resigna- tion of M. Thiers as President of the Republic, on 24th May 1873, MacMahon was elected to the vacant*~~

~~*office by an almost unanimous vote, being supported by 390 members out of 392. The Marshal accepted the Presidency in a manly and dignified letter. The due de Broglie was empowered to form a Conservative administration, but the President also took an early opportunity of showing that he intended to uphold the sovereignty of the National Assembly. On 6th November 1873 General Changarnier presented a motion in the Assembly to confirm*~~

~~*MacMahon's powers for a period of ten years, and to provide for a commission of thirty to draw up a form of constitutional law. The Marshal consented, but in a message to the As- sembly he declared in favour of a confirmation of his own powers for seven years, and expressed his deter- mination to use all his influence in the maintenance of Conservative principles. After prolonged debates the Septennate was adopted on 19th November by 378 votes to 310. There was no coup d'etat in favour of " Henri V.," as had been expected, and the President resolved to abide by " existing institutions." One of his earliest acts was to receive the finding of the court-martial upon his old comrade in arms. Marshal Bazaine, whose death sentence he commuted to one of twenty years' imprisonment in a fortress. Though MacMahon's life as President of the Republic was of the simplest possible character, his term of ofB.ce was marked by many brilliant displays, while his wife was a leader in all works of charity and benevolence.*~~

~~*The President was very popular in the rural districts of France, through which he made a successful tour shortly after the declaration of the Septennate. But in Paris and other large cities his policy soon caused great dissatisfaction, the Republican party especially being alienated by press prosecutions and the at- tempted suppression of Republican ideas. Matters were at a comparative deadlock in the National Assembly, until the accession of some Orleanists to the Moderate Republican party in 1876 made it possible to pass various constitutional laws. In May 1877, however, the constitu- tional crisis became once more acute. A peremptory letter of censure from MacMahon to Jules Simon caused the lat- terto resign withhis colleagues. The ducde Broglieformed a ministry, but Gambetta carried a resolution in the Chamber of Deputies in favour of parliamentary govern- ment. The President declined to yield, and being sup- ported by the Senate, he dissolved the chamber, by decree, on 26th June. The prosecution of Gambetta followed for a speech at Lille, in which he had said " the Marshal must, if the elections be against him, se souniettre ou se dimettre." In' a manifesto respecting the elections, the President referred to his successful government, and ob- served, " I cannot obey the injunctions of the demagogy ; I can neither become the instrument of Radicalism nor aban- donthe post in which the constitution has placed me." The confidence of the Marshal in the result of the elections was misplaced. Notwithstanding*~~

the great pressure put upon the constituencies by the Government the elections in Octo- ber resulted in the return of 335 Republicans and only 198 anti-Republicans, the latter including 30 MacMahonists, 89 Bonapartists, 41 Legitimists, and 38 Orleanists. The President endeavoured to ignore the significance of the elections, and continued his reactionary policy. Asa last resort he called to power an extra-parliamentary cabinet under General Eochebouet, but the Republican majority refused to vote Supplies, and after a brief interval the President was compelled to yield, and to accept a new Republican ministry under M. Dufaure. The prolonged crisis terminated on 14th December 1877, and no further constitutional difficulties arose in 1878. But as the senatorial elections, held early in 1879, gave the Republicans an effective working majority in the Upper

Chamber, they now called for the removal of the most conspicuous anti-Republicans among the generals and officials. The Marshal refused to supersede them, and declined to sanction the law brought in with this object. Perceiving further resistance to be useless, however, the ^larshal resigned the Presidency on 30th January 1879, and M. Jules Grevy was elected as his successor.

Marshal MacMahon now retired into private life, hav- ing already passed his seventieth year. Relieved from the cares of state, his simple and unostentatious mode of existence enabled him to pass many years of dignified repose. IIe died at Paris on 17th October 1893, in his eighty-sixth year. A fine, tall, soldierly man, of a thoroughly Irish type, in private life the Marshal was universally esteemed as generous and honourable ; as a soldier he was brave and able, without decided military genius ; as a politician he was patriotic and well-inten- tioned, but devoid of any real capacity for statecraft.

(g. b. s.)

Macomb, a city of Illinois, U.S.A., capital of McDonough county, on the Chicago, Burlington, and Qiiincy railway, in the western part of the state.

~~Popu- lation (1890), 4053 ; (1900), 6375.~~

~~Macon, a city of Georgia, U.S.A., capital of Bibb county, on the Ocmulgee river, at the head of navigation, in the central part of the state, at an altitude of 334 feet. It is the intersecting point of six railways, which make it, after Atlanta, the most important railway junction of the state. It is situated in the cotton belt, and has a large cotton trade. In 1900 its manufacturing establish- ments numbered 182, with a capital of $5,076,005, and products valued at $6,495,767. They employed an average number of 3700 wage-earners, who received $1,047,437 total wages. The principal article of manu- factu.re (rapidly growing) was cotton goods, the product of which was valued at $1,237,125. Other products of importance are railway cars, lumber, and foundry and machine-shop products. Macon is the seat of a number of educational institutions, among which are Mercer Uni- versity, which in 1899 had 15 instructors and 252 students, and Wesleyan Female College, with 20 instruc- tors and 185 students. The assessed valuation of real and personal property in 1899 was $14,023,942, the net debt of the city was $752,193, and the rate of taxation was $26.50 per $1000. Population (1890), 22,746 ; (1900), 2.3,272, of whom 478 were foreign-born and 11,550 — almost one-half of the total — were negroes.~~

~~Macquarie, a British island in the South Pacific, about 600 miles south- west of New Zealand, in 54° 30' S. and 158° 50' E. It is about 20 miles long, and covered with a grassy vegetation, with some trees or shrubs in the sheltered places which afford food to a parrot of the genus Cyanorhamphus, allied to those of the Auckland Islands. Although it has no settled population, Mac- quarie is constantly visited by sailors in quest of the seals which abound in its waters.~~

~~Madach, Imre (1829-1864), HIungarian dramatist, was born at Als6-.Sztregova in 1829. HIe took part in the great revolution of 1848-49, was imprisoned, and on his return to his small estate in the county of Ndgrttd, he found that his family life had meanwhile been completely wrecked. This only increased his natural tendency to melancholy, and he withdrew fi'om public life till 1861, devoting his time mainly to the composition of his great work, Az ember tragoedidja (The Trwjedi/ of Man) . John Arany, then at the height of his fame as a poet, at once recognized~~

~~*the great merits of that peculiar drama, and Madach enjoyed a short spell of fame before his untimely death of heart disease in 1864. In Tlie Trar/edy of 3/”«)t Madach takes us from the hour when Adam and Eve*~~

~~*were innocently walking in the Garden of Eden, to the times of the Pharaohs ; then to the Athens of Miltiades ; to sinking Rome ; to the period of the Crusaders ; into the study of the astronomer Kepler; thence into the horrors of the French Revolution ; into greed-eaten and commerce-ridden modern London; nay, into the ultra- Socialist state of the future, when all the former ideals of man will by scientific formulae be shown up in their hollowness; still further, the poet shows the future of ice-clad earth, when man will be reduced to a degraded brute dragging on the misery of his existence in a cave. In all these scenes, or rather anticipatory dreams, Adam, Eve, and the arch-fiend Lucifer are the chief and con- stantly recurring personce dramatis. So, in the end, Adam, despairing of his race, wants to commit suicide, when in the critical moment Eve tells him that she is going to be a mother by him. Adam then prostrates himself before God, who encourages him to hope and trust. The diction of the drama is elevated and pure, and although not meant for the stage, it has proved very effective at several public performances. Concerning Madach there is an ample literature, consisting mostly of elaborate articles by Charles Szasz (1862), Augustus Greguss (1872), B. Alexander (1871), M. Palagyi (1890), and others.*~~

~~*(e. RE*.)*~~

~~*Madagascar, an important island in the Indian Ocean, and the third largest island in the world, about 300 miles from the south-east coast of Africa. It is 985 miles in length from north to south, and about 250 miles in average breadth, although near the centre it is nearly 350 miles across ; its area is about 230,000 square miles. In 1902 the governor. General Gallieni, proposed to remove the capital from Antananarivo in the interior to Tamatave on the east coast. Since the French conquest of Mada- gascar in 1895 great advances have been made in the triangulation, surveying, and mapping of the interior ; and although detailed surveys have still to be made of the greater portion, the country has been traversed in many directions by French military officers and other travellers ; and the*~~

~~provinces of Imerina and Betsileo, as well as several of the chief river valleys, have been mapped very minutely. The south-western corner of the island is now the only large portion still unexplored.~~

~~The geology is far from being completely known, but much has been done towards the examination of the rocks of the interior northern provinces, as well as of those of the coast plains of the northern half. A considerable collection of ° ”^’ fossils has been made, and a large number of rock sections prepared for polarlscopic investigation. From the information thus obtained it may be affirmed that ” by far the greater part of the north-eastern half of Madagascar consists of gneiss and other crystalline rocks, although gneiss very largely predominates. Granite occurs frequently in the form of bosses, and in some places apparently intercalated with the crystalline schists. Diorite is also frequently met with, but gneiss is certainly the prevailing rock.” “The region occupied by these crystalline (chiefly metamorphic) rocks has a length of about 730 miles, and an average breadth of prob- ably not less than 150,” with a total area of 100,000 or possibly 130,000 square miles. ” Among the accessory minerals existing in the gneiss are magnetite, iron-pyrites, clay slate, hornblende, actinolite, mica-, chlorite-, and cyanite-schists, crystalline lime- stone, quartzite, graphite, and many varieties of quartz. Granite forms some of the most remarkable of the mountains and hill ranges of the interior.” ‘ Vast portions of the country are covered by red soil, which resembles and is often described as clay, but is really decomposed rock, chiefly gneiss, reddened with oxidized magnetite. The lower portions of Madagascar, chiefly situated in the west and south, which do not apparently much exceed 600 feet in height above the sea-level, consist of sedimentary rocks, the fossils of which show that they belong to the Jurassic, Cretaceous, and Eocene systems. In the north-west of the island sandstone covers a vast extent of country, beds of clay and shale are common,~~

~~1 The above extracts are from a paper by the Rev. R. Baron, F.G.S., in Quart. Jour. Geol. Soc, May iSSi); to him we owe most of our knowledge of the geology as well as of the botany of Madagascar.~~

~~and there are extensive deposits of limestone. Lignite has been discovered in the same part of the island, but hitherto no true coal has been found. As regards metals, gold has been worked in many parts of the central and north-western regions, but not in large quantities in any one place. Lead is obtained from galena, and nickel and copper are also found in certain localities. Iron is found in abundance as magnetite, also as haematite and ironstone. Sulphur, saltpetre, bitumen, and lime are also procured, the last-named from the travertine springs of Antsirabfe ; while corundum, sapphires, spinel, rutile, and tourmaline are among the more precious, products. In addition to the Secondary and Tertiary strata already mentioned, there are also beds of a much more modem date (Quaternary), containing fossils of recently extinct birds, mammals, and reptiles (see section on Palaeontology).~~

~~Observations have shown that the yearly rainfall of the interior averages about 53 inches, while that of the east coast is about 95 inches. On the north-west coast the rainfall is slightly in excess of that of the interior.~~

~~About 4100 flowering plants, of which a large proportion (about three-fourths) is endemic, are now known to botanists. The forest belt which extends round the island is densest on the Flora. eastern side, where it averages 30 miles in width, but~~

~~on the north-east it attains a breadth of 50 to 60 miles ; it is from 1500 to 1600 miles long. On the western side the woods are thinner and more scattered. It is estimated that there are probably 35,000 square miles of forest-covered country in Madagascar, or about one- seventh of its whole surface. The hard-wooded and valuable timber trees contained in these forests include various species of Wein-mannia(Laldna),^Hlceocarpus{VoaHana),Dalbergia{V6ambdana), Nuxia (Valanirana), Podocarpus, a pine, the sole species in the island (^Iletatra) , Tambourissa (Ambora), Neobaronia {Hhrahara), Ocotea {Varbngy'), and probably ebony, species of Diospyros, &o. Then, besides those species described in the ninth edition of this work on account of their peculiar characteristics, the tall fir-like Casuarina equisetifolia, or beef-wood tree, is very prominent on the eastern coast, as well as several species of screw-pine {Pan- danus). On the western coast dense thickets of mangrove line the~~

~~shores of all creeks and rivers, and on all the coast lagoons and lower reaches of the rivers the 'i'lha (Typhonodorum Undley- nnum), a gigantic arum endemic to Madagascar, grows in great profusion to a height of 14 or 15 feet, and has a large white spathe of more than a foot in length, ^bout 70 additional species of ferns have been discovered, making the total number as yet col- lected some 320. Two of the several beautiful orchids found strike the attention of every traveller on the east coast during the months of June and July by their abundance. One of these, Angrcecum superbum, has a number of spikes of pure white flowers ; the other, A sesquipedale, has larger but fewer flowers and has a remark- ably long spur. The Rev. R. Baron, F.L.S., divides the flora into three distinctly-marked "regions." These run in a longitudinal direction, following approximately the longer axis of the island, and are termed respectively eastern, central, and western. Of these, the central includes the elevated plateaux of the interior, while the eastern and western occupy the two sides of the island, including the forest belts and most of the wooded country. The divisions between the eastern and western regions in the extreme north and south are almost arbitrary, and cannot be defined with much accuracy. The flora of the extreme south-west is least known, but appears to be marked by numerous spiny plants adapted to its very dry climate. Of the 4100 known plants composing the Madagascar flora, there are Dicotyledons, 3492 ; Monocotyledons, 248 ; Acotyledons, 360. Of these, the orders most largely represented (together with their species) are Legum- inosae, 346 ; Filices, 318 ; Compositse, 281 ; Euphorbiaceae, 228 ; Orchideae, 170 ; Cyperaceae, 160 ; RubiaceEe, 147 ; Acanthaceae, 131 ; Gramineae, 130. The number of endemic genera now known is 148. Of the 3178 species of plants whose localities have been determined, 35 per cent, are peculiar to the eastern region, 27'5 per cent, to the central, and 22 per cent, to the western. One natural order, Chlcenacece, is strictly confined to Madagascar.~~

~~Fauna. — Thirty-nine species of Lemuroida are now known to exist in the island, while more than 260 species of birds have been classified. Madagascar may also be considered one of the head- quarters of the Chamelionidce, for of the 50 known species no fewer than 25, or half of them, have already been described from the island. Many of these are of curiousform, with remarkable develop- ments of the plates of the head and projecting horns and spines.~~

~~Closely connected in interest with the animal life at present found in Madagascar is that of the extinct fauna. Researches in various parts of the island have revealed the existence Pats jq quite recent deposits, in a sub-fossil state, of the~~

~~ontology, ijonesof numerous birds of the family iSJn(Jfc'(?CB. These have been arranged in twelve species, belonging to two genera, JBpyornis and Mullerornis, and vary in size from that of a bustard~~

~~1 The words in parentheses are the native Malagasy names.~~

~~to that of birds much exceeding an ostrich, and rivallmg the recently extinct Moa of Kew Zealand, one or two species being about 10 feet high. One species of these great wingless birds laid an egg which is the largest known, being 12J inches by 9J inches. Associated with these remains are found those of a large rail and a wild-goose, but much larger than any now inhabiting Madagascar. In the same beds the remains of probably three extinct species of hippopotamus have been found, about two-thirds the size of the living African species ; also the bones and carapace, &c., of gigantic tortoises, the bones of a species of swine, as well as of a river-hog, and also of a slender-legged form of zebu-ox. Near the south- west coast the skull of a large extinct lemuroid animal has been discovered by Mr J. T. Last, much longer in shape than that of any living lemur, the animal being probably three times the size of any known lemuroid. Most, if not all, of the above-mentioned birds and animals were probably contemporaneous with the earliest human inhabitants of Madagascar. The remains of an animal which appears to form a link between the apes and the lemurs have been discovered ; and in 1899 the bones of another gigantic lemuroid, much larger than that just mentioned, were found by M. A. Grandidier.2 In the deposits of a much more remote era than those already spoken of — the Jurassic — the bones of some enormous terrestrial lizards have been found by Mr Last, belong- ing to two if not three species ; these are described as belonging to a Sauropodous Dinosaur of the genus Bothriospondylus. And in the beds of the Lower Oolite the Rev. R. Baron had previously discovered fragments of the skull of a reptile resembling the gavial of the Ganges ; from these a new genus has been founded by Mr R. B. Newton, which he calls Steneosaitrus. The mammals, birds, and reptiles here described —~~

~~*twenty-six or twenty-seven in number ■ — comprise all that is at present known of the ancient vertebrate fauna of Madagascar. A complete list of all the fossils of the island then known is given by Mr Nevrton in Quar. Jour. Geol. Soc, February 1895. These, omitting the vertebrates already described, number 140, and belong to the MoUusoa, Foraminifera, Echinoder- mata, Actinozoa, and PlantEe.*~~

~~*History. — The year 1882 was important as marking the begintiing of a great change in the history of the island. Towards the middle of the year the relations _ between the native government and that of Malagasy France became much strained, and many com- war ot plaints were made by the latter against the "x'^-o"- Malagasy, together with demands for compensation. In order to settle, if possible, these causes of dispute, two Hova ofB.cers of high rank were sent to France as ambas- sadors, but as they were not authorized to concede any territory, their visit accomplished very little. They sub- sequently concluded treaties with Great Britain, Germany, and America, giving improved facilities for trade with Madagascar, but before their return matters had come to a crisis in the island. In May 1883 an ultimatum was sent to the Malagasy queen, requiring immediate compliance with the demands oi France ; and as these were refused by the Hova Government, the town and defences of Tamatave were bombarded by a French squadron and were then occupied by the marines, the Malagasy soldiers retiring. Several of the other ports were bombarded from time to time, and the war continued in a desultory fashion for many months ; but no serious attempt was made to invade the interior ; and at length, in 1885, terms of peace were agreed to. By a treaty signed on 12th December it was agreed that the foreign relations of Madagascar should be directed by France ; that a Resident should live at the capital, with a small guard of French soldiers ; and that the Bay of Diego Suarez, together with surrounding territory, should be ceded to France. These were the most important provisions, but the word " pro- tectorate" was carefully excluded from the wording of the treaty, although doubtless the French envoys intended that this should be its practical issue. It was at the same time agreed that there should be no foreign inter- ference with the internal government of the country, and that the queen should retain her former position, with all its honours and dignity.*~~

2 ” Nombreux ossements de l^muriens disparus, dent la taille e’tait enorme, plus grande aue celle d’un homme.” — La Giographie, Januarv 1900, p. 80.

Por about nine years this treaty continued in force : several French Residents successively represented rrance at Antananarivo; but these found themselves teS” ”/™’ l^it^ unable to obtain that influence in the 1885-94.’ country which the home authorities thought they had a right to demand. The Malagasy prime minister was not disposed to give any advantage to Prance beyond what he could help, and at the same time he continued to arm and train, by the help of British officers, a large body of native soldiers. It was inevitable that this state of tension and irritation could not last, and at length, towards the close of 1894, the French Government sent an ultimatum to the Malagasy sovereign, with the following demands : (1) The Malagasy Govern- ment to have no dealings with other Powers except through the Resident-General. (2) All concessions to be void unless approved and registered by the Eesident- General. (3) The French Government to have power to place soldiers in Madagascar as it may consider necessary. (4) The French Government to have power to carry out works of public utility. (6) French text of treaties alone to be authoritative. These demands were refused by the native Government, and other conditions were offered ; but the French envoy, together with the Resident’s escort, left the capital, as also did the French traders and others. Preach la- including the large Jesuit mission. As soon rasioa and as all these had left the island, the chief ports conquest, were occupied by French troops, and an expe- I89S. ditionary force under General Duchesne was*

afterwards landed on the north-west coast at Mojanga, with the object of advancing into the interior and break- ing the Hova authority. Owing to the necessity of making a road for the passage of artillery and military stores, many months were spent on the way in the early part of 1895, and there was considerable loss of life by fever and other disease among the invading troops. But no effectual resistance was made by the Malagasy, and at length, on the 30th September, the French forces appeared on the heights to

~~the north and east of Antananarivo, bombarded the city, which surrendered in the afternoon, and on the evening of the same day the French entered the capital.~~

~~The result of this event was that the protectorate of France was re-established in the central provinces, but the queen was still allowed to retain her position. fsge'Tad"'^^ the early part of the following year (1896), gradual however, a serious rebellioi»broke out in several subjection parts of Imerina, and soon gained ground. This ^tfce movement was not only anti-French and anti-~~

~~foreign, but also distinctly anti-Christian. The French troops gradually broke up the power of the re- bellion in the central provinces, but as there appeared to be considerable unrest in many other parts of the island, General Gallieni, an officer with a reputation for vigour and ability in the Sudan and Tongking campaigns, was sent out to relieve the then Resident-General.~~

~~General Gallieni had a difficult task before him in establishing the authority of France throughout the island jrf«f„;c among numbers of tribes who had never sub- tration of mitted to any control from others. Among the Oeaerai first steps he took were to put the country under Oaiiieni. martial law, to abolish royalty and all semblance of Hova government, and to declare Madagascar to be henceforth a colony of France. Queen Ranavalona III. was exiled to Reunion, and subsequently to Algeria. Mean-while carriage roads were commenced to connect all the chief centres, and the military posts were gradually ex- tended farther and farther from the central provinces, so as effectually to put down all opposition and to consoli- date French rule over all the outlying tribes. French Residents and numerous other officials were placed at every~~

~~important town, and various projects were started for the civilization of the Malagasy in accordance with French ideas. The area of the disturbed and unsettled parts of the country was lessened month by month, until, at the close of 1899, General Gallieni was able to report that only portions of the west and south-west remained to be brought into submission. In January 1899 three- fourths of the island was still under military administra- tion. According to the French budget of 1900, the troops in Madagascar~~

~~amounted to 11,305, of whom 7500 were natives. Diego Suarez, at the northern extremity of Madagascar, held as a French colony from 1885, was in 1896 placed under the authority of the Governor-General.~~

~~In the absence of any census, or registration of births, deaths, and marriages, it is impossible to give accurate statistics as to the movement of population ; and trustworthy figures of commerce, &c., are likewise very difficult to obtain. General It is believed that the population of the whole of condition Madagascar does not exceed 3,000,000, of whom prob- " * ably nearly one-third inhabit Imferina. Antananarivo sMIsUcs contains 60,000 people, but the number is very variable. Notwithstanding repeated proclamations assuring the people that perfect religious liberty was guaranteed by Trance, the Jesuit missions have made strenuous efforts to break up the numerous Protestant village churches. The French Protestant churches, too, began to take part in 1896 in the missionary work carried on in the new colony, and nearly half the area for long occupied by the London Missionary Society has been transferred to the Paris Society. The bulk of the Malagasy converts are still Protestants, i.e., some three-fourths, probably, of the 150,000 people confessing Chris- tianity. Since 1897 high schools, medical and technical schools, and a few primary schools have been formed by the Government, but the bulk of the educational work is still carried on by the various missionary societies. The Jesuit mission is making strenu- ous efforts to control education, but the Protestant missions are not less strenuous in maintaining and adding to their primary and high schools and colleges. No statistics can be given as to education, but it is probable that 100,000 children are now being instructed. Information about the people, their language, and their civilization has become fuller, but nothing has been discovered materially to modify the conclusions formerly arrived at.' With regard to "ranks of society," slavery was abolished by the French in 1896, and by this act the third great class of the andevo or slaves has become merged in the second, that of the Hova or commoners. The division between the Andriana or nobles and the Hova remains unaltered, notwithstanding that royalty has been abolished. In the other tribes chieftainship is still retained in the administration of the country under the surveillance of French officials. The local budget for 1897 was 4,269,000 francs (about £178,000), which practically covered the expenditure apart from the cost of civil and military administration, for which a sum of~~

~~15,170,000 fr. (about £632,000) was voted by the French Chambers ; in 1898 these sums were respectively 9,437,000 fr. (£393,000) and 20,185,000 fr. (£841,000). In 1899 the estimated revenue was 11,136,000 fr. (£445,440), including 1,800,000 fr. (£72,000) sub- vention from France. The cost of Madagascar to France for 1900 was estimated at over 25,000,000 fr. (£1,000,000). The con- verted debt of Madagascar stood at 20,000,000 fr. (£800,000) at 2J per cent, in 1900. 1898 many parts of Imferina suffered severely from famine, which was largely due to the depopulation of large portions of the country by the rebellion of 1896, and the destruction by the rebels of the stores of rice. Agriculture is being encouraged by the formation of jardins d'essai near every village ; but, on the whole, the agriculture of the Malagasy has been only slightly influenced by political changes, the chief differ- ence being the more extended cultivation of European vegetables and fruits. Their handicrafts have, however, been less exercised, partly through the demands made on the people for Government service (corece), and partly through the greater employment of foreign textile fabrics. The use of sun-dried and of burnt bricks and tiles for all kinds of building has greatly extended, and has much altered the appearance of every town and village in the central provinces. As in all French colonies, very heavy duties are levied upon all imports and exports coming from and going to other countries than France, and this has naturally greatly diminished British as well as American trade with the island, while increasing I'rench imports and exports. The total imports in 1888 were valued at £162,000 ; in 1898 at £865,640. The United Kingdom's share in the total for 1888 was estimated at £101,000 ; in that for 1897 at £179,000 ; for 1898 at £42,000— a great drop. Further, the sum for 1897 included £146,000 for cotton piece goods, an amount which, in consequence of the heavy duties imposed, dwindled to £35,000 in 1898. On the other hand, the figures for~~

~~the import of cotton piece goods from France were £19,000 in 1897, but £220,000 in 1898. Imports from the United States were valued at £99,000 in 1896, when those from the United Kingdom totalled £270,000. The total~~

~~exports in 1888 were valued at £174,000 ; in 1898 the total was £198,400. Exports to the United Kingdom rose' from £43,000 in 1888 to £139,000 in 1895, only to fall again to £62,000 in 1896 and £32,920 in 1898. Exports to France rose from £17,000 in 1895 to £74,680 in 1898. The chief exports are cattle, caoutchouc, and hides. In 1898, 6061 vessels of 879,362 tons entered and cleared the ports, the hulk heing French. The car- riage roads from the east and north-west to connect the interior with the chief ports are making steady progress, and arrangements are also heing made for the construction of railways and canals. There is interior telegraphic communication between Antananarivo and Tamatave and Mojangil, which is now being extended to the B6tsil6o province. French coin is now the only legal currency, and French weights and measures alone are legal.~~

~~Adtiioeities. — A very large number of books, pamphlets, and magazine articles have been published upon Madagascar since 1882. General : A. Geandidiek. Ilistoire naturelle, physique, et politique de Madagascar. Paris, 1882-99 (many volumes and portions, both of text and plates ; still in progress). — Sibeee and Baeon (eds.). Antananarivo Annual. Antantoarivo, 1882-1900. — Notes, Reconnaissances, et Explorations, revue mensuelle. Tana- narive, 1897 e« seg. — SiBREE. A Madagascar Bibliography. Anta- nanarivo, 1885. — Vaissi^ee. Histoirede Madagascar. Paris, 1884; Vingt ans a Madagascar. Paris, 1885. — Olivee. Madagascar : an Historical and Descriptive Account. London, 1886 ; Drury's Madagascar (new ed.). London, 1890. — Cousins. Madagascar of To-day. London, 1895. — Bulletin de la Comite de Madagascar (monthly). Paris, 1895 et seq. — Sibeee. Madagascar before the Conquest. London, 1896. — Catat. Voyage a Madagascar. Paris, 1895 ; Annuaire de Madagascar. Tananarive, 1898 et seq. — Baeon. Tere Years" lieview of Mission Work in Madagascar. Antananarivo, 1891. — GaLheni. Bapport d'ensemble sur la situa- tion generate de Madagascar. 2 vols. Paris, 1899. — Bevue de Mada- gascar, mei\suelle, i\laslT&, 1S96 et seq. Political: Olivbe. True Story of the French Dispute in Madagascar. London, 1885. — Shaw. Madagascar and France. London, 1885. — Saillens. Nos Droits sur Madagascar. Paris, 1885. — Coelay. JVotre Campagne a Madagascar. Paris, 1896. — Knight. Madagascar in War-time. London, 1886. — Bueleigh. Two Campaigns: Ashantee and Madagascar. London, 1896. — Caeol. Chezles Hovas. Paris, 1898. Ethnology : Feeeand. Les Mussulmans a Madagascar et aux~~

IlesComores. Paris, 1891. — Beethiee. " Rapport ethnographique sur les Races de Madagascar, ' ' Notes, Beconnaissances, et Explora- tions, Sept. 1898. — JuLLY. "L'Habitation k Madagascar," op. cit. Juil. 1898. Philology : Riohaedson. Malagasy for Beginners. Antananarivo, 1883; A New Malagasy — English Dictionary. Antananarivo, 1885. — Cousins and Paeeett. Malagasy Proverbs. Antananarivo, 1885. — Causseque. Grammaire Malgache. Anta- nanarivo, 1886. — Abinal et Malzae. Dictionnaire Malgache- Frangais. Tananarive, 1889.^Beandstettee. " Die Beziehungen des Malagasy zum Malaiischen ' ' ; Malaio-polynesische Forschungen, pt. 2. Lucerne, 1893. — Dahle. "Studies in the Malagasy Language," Antan. Annual, 1884, 1887. Botany, Geology, and Zoology: Baeon. "The Flora of Madagascar," Linn. Soc. Journ. Bot. vol. xxv. 1889 ; " Notes on the Geology of Madagascar," Quar. Journ. Geol. Soc. May 1889. — Coetese. " Osservazioni geognostiche sul Madagascar," Bol. B. Oomit. Geol. Italia, vol. xviii. 1887; "Appunti geologici sull' Isol?, di Madagascar," op. cit. vol. xix. 1888.— Gautiee. "Mission Emile Gautier k Mada- gascar," Ann.de Geog. No. 7, 1893; " Madagascar occidentale, " op. cit. Nov. 1895.— Baron. " Geological Notes of a Journey in Madagascar," Quar. Journ. Geol. Soc. Feb. 1895. — Bullee Newton. " On a Collection of Fossils from Madagascar," op. cit. Feb. 1895. — Sibeee. "Madagascar Ornithology," Antan. Annual, 1889, 1890, 1891, 1892; a,r\d Ibis, April, July, Oct. 1891, Jan. April 1892 ; " The Mammals of Madagascar," op. cit. (A. A.) 1893, 1895, 1896, 1897. (j. si.)*

French Wars in Madagascar. — In 1882 the TTrench claimed a protectorate over the north-west coast of Mada- gascar, based on alleged treaties with chiefs of the Sakalava tribes which inhabit that part of the island. Queen Eauavalona II. denied the validity of the claim, and, after fruitless endeavours by the British Government to effect a peaceable settlement, hostilities commenced in 1883. Eear-Admiral Pierre bombarded several coast towns and occupied Mojanga, in the north-west, a port which is the key to the province of Imerina, and Tamatave, the chief town on the east coast. Eanavalona II. died on 13th July 1883, and was succeeded by her niece, Eanavalona III. Reinforcements having arrived from France and Reunion,

~~Eear-Admiral Galiber, who had succeeded to the command, after unsuccessful negotiations with the Hova Government, destroyed a number of towns on the eastern seaboard and blockaded others, but was too weak to attempt any inland expedition. An Englishman named Willoughby, who had raised and commanded some irregular horse in the Zulu war, was made first adjutant-general and, later, commander-in-chief of the Malagasy army, which he reorganized. With 10,000 men he occupied a very strong entrenched position at Manjakandrianombana, about five miles from Tamatave. In the meantime, in April 1884, Eear-Admiral Galiber was succeeded by Eear-Admiral Miot, who blockaded the ports, but was defeated in June in an attack in force on Manjakandrianombana. Towards the end of the year Admiral Miot occupied Diego Suarez and adjacent ports after some fighting, and a sharp and successful action at Andraparany on the 6th December placed the whole of the north-east of the island in his hands. His troops, however, suffered so severely from malarial fever that the reinforcements which he received from France, Eeunion, and Tongking were only sufiB.cient to make good the " waste." In 1885 Willoughby formed a camp of exercise covering Antananarivo, the capital, and an unsuccessful attempt was made to recapture Mojang4 from the French. On 26th August a sharp action was fought at Ambodimadiron, near Passandava Bay, which was claimed as a victory by both sides ; Marovoay was bombarded, and on the 10th September an unsuccessful attack was made by the French on the Hova position at Farafette, Admiral Miot personally leading a column. In November negotiations were commenced, which resulted in a treaty of peace, by which Madagascar became politi- cally a French protectorate. The treaty was ratified by the Senate in March 1886, but was not recognized by the British Government until August 1 890. In 1893 conflicts between the Hovas and the French led to a partial blockade of the ports by the French in 1894 and, at the end of that year, to an open rupture, followed by the occupation of Tamatave and, in January 1895, by the bombardment and occupation of Mojanga. The French Government then organized an expedition under General of Division Duchesne, consisting of two brigades commanded by Generals of Brigade Metzinger and Voyron, in all some 8400 men. Duchesne arrived at Mojang4 in May, and found that Metzinger had already captured Marovoay and Midiani by storm, and that Ambohimarin^ had been occupied after severe fighting. Early in June Duchesne crossed the Betsiboka and captured Mevatanana, but experienced~~

such great difficulties from insufficient transport and heavy mortality from sickness amongst his troops that it was not until the 12th August that he arrived near Andriba, which he captured on the 22nd. Here he formed an advanced base and organized a flying column to march on Antananarivo. In com- mand of this column he defeated the Hovas with great loss at Tsinainondry, and after a sharp action captured Antananarivo, the capital, on the 30th September, when he dictated terms of peace. The campaign, although successful in attaining its object, was a problem in trans- port and hygiene which cannot be said to have been satisfactorily solved. The so-called "pacification" of Madagascar was very thoroughly carried out after Sep- tember 1896 by General Gallieni. (a. h. v.)

Madava Rao, Sir Raja T. (1828-1891), native Indian statesman, was born at Combaconum in Madras in 1828. Madava Eao created a new type of minister adapted to the modern requirements of a progres- sive native state, and he grafted it upon the old stock. He linked the past with the present, using the advantages of heredity, tradition, and conservatism to effect reforms

in the public administration and in Indian society. He attained the position of Diwan of Travancore in 1857, and died on the 4th April 1891. Sprung from a Maratha Brahman stock, the son of a Diwan of Travancore, he was educated in the strictest tenets of his sacred caste. But he readily imbibed the new spirit of the age. To mathe- matics, science, and astronomy he added a study of English philosophy and international law, and a taste for art and pictures. Although a devout student of the Shastras, he advocated female education and social reform. B,efusing to cross the sea and so break caste by appearing before a Parliamentary commission, he yet preached religious toleration. A patron of the Indian Congress, he borrowed from the armoury of British administration every reform which he introduced into the native states. He was respected alike by Europeans and natives, and received titles and honours from the British Government. As tutor of the

~~*Maharaja of Travancore, and then as revenue officer in that state, he showed firmness and ability, and became prime minister in 1857. He found the finances disorganized, and trade cramped by monopolies and oppressive duties. He co-operated with the Madras Government in carrying out reforms, and, when his measures led to misunderstandings with the Maharaja, he preferred honourable resignation to retention of a lucra- tive office in which he was powerless for good. In 1872 he was engaged at Indore in laying down a plan of reform and of public works which he bequeathed to his successor, when a grave crisis at Baroda demanded his talents there. The Gaekwar had been deposed for scandalous misrule, and an entire reorganization was needed. Aided by Sir Philip Melvill, Madava Eao swept away the corrupt officials, privileged sardars, and grasping contractors who had long ruined Baroda. He wrote able minutes defending the rights and privileges of the Gaekwar from fancied encroachment, and justifying the internal reforms which he introduced. He resigned office in 1882, and in his retirement devoted his leisure to reading and writing upon political and social questions, (w. i.-w.)*~~

~~*Madeira, a group of islands in the Atlantic, belonging to Portugal, situated about 500 miles south- west from Lisbon, 3^ days' steaming from Southampton, and 5 days from Liverpool. The capital is Eunchal, the seat of a bishop (a suffragan of Lisbon), with 37,011 inhabitants (1900). The district of Funchal, which em- braces the entire archipelago, i.e., the islands of Madeira, Porto Santo, the Desertas (Ghao, Deserta, Grande, and Bugio), and the two Selvagens, has an area of 315 square miles, and population (1890), 134,040 and (1900) 150,528. There is a medical school at Eunchal ; also a lyceum. The principal products are wine, sugar, corn, vegetables, potatoes, chestnuts, yams, oranges, honey, walnuts, lemons, wax, olive oil, spirits, bananas, apples, and mangoes. The area planted with vines in 1892 was 24,620 acres, which yielded 867,250 gallons of wine (a fairly average year), valued at £34,000; but since then more land has been replanted with vines. In 1899 the wine exported was valued at £173,333. Sugar, spirits, soap, straw hats, ale, leather, eml^roidery, baskets, wooden wares, butter, linen, and woollens are manufactured. In 1898 there were 1336 persons engaged in fishing; they used 496 boats, and caught fish to the value of £8i00. The total trade increased in value from £428,000 in 1893 to £628,000 in 1900, wine being the principal export, with*~~

~~*embroidery, vegetables, fruits, and wicker goods. Between 1860 and 1900 the export of wine increased from 104,880 gallons to 587,880 gallons, the value in the latter year being £137,800. In the year 1899 a total of 1635 vessels of 4,692,264 tons entered and cleared the island ports. There are some 580 miles*~~

~~*of roads in Madeira. The chief island is coming more into repute as a winter station.*~~

~~*Madeira River. See Amazon.*~~

~~*Madhu Sudan Datta (or Michael Madhu Sudan Datta, as he was called after he had embraced the Christian religion) (1824-1873), the greatest poet of India in the 19th century, was born at Sagandari, in the district of Jessor in Bengal, in 1824. His father was a pleader in Calcutta, and young Madhu Sudan received his education in the Hindu College of Calcutta, and was the foremost among the distinguished young students of his day, many of whom lived to make their mark in the literature and social progress of their country. Madhu Sudan left the college in 1842, and in the following year ran away from his father to avoid a marriage to which his father wished to force him, and embraced the Christian religion. Continuing his study now in the Bishop's College, Madhu Sudan learnt Greek and Latin and some modern European languages, and in 1848 went to Madras. There he wrote English verses, and married the daughter of a European indigo-planter, but was soon separated from her. He then united himself with an English lady, the daughter of an educational officer ; and she remained true to him through life amidst all his misfortunes, and was the mother of the children he left. Madhu Sudan returned to Calcutta with his English wife in 1856, and soon discov- ered that the true way for winning literary fame and dis- tinction was by writing in his own language, not by com- posing verses in English. His three classical dramas — Sarmishtha, Padmavati, and Krishna Kumari — appeared between 1858 and 1861, and were recognized as works of merit. But his great ambition was to introduce blank verse into Bengali. His knowledge of Sanskrit poetry, his appreciation of the Greek and Latin epics, and his admiration of Dante and of Milton, impelled him to break through the fetters of the Bengali rhyme, and to attempt a spirited and elevated style in blank verse. His first poem in blank verse, the Tilottama,*~~

was only a partial success ; but his great epic which followed in 1861, the MegJianad-Badha, took the Indian world by surprise, and at once established his reputation as the greatest poet of his age and country. He took his story from the old Sanskrit epic, the Ramayana, but the beauty of the poem is all his own, and he imparted to it the pathos and sweetness of Eastern ideas and the vigour and loftiness of Western thought. In 1862 Madhu Sudan left for Europe. He lived in England for some years, and was called to the bar ; and in 1867 returned to his country to practise as a barrister in Calcutta. But the poet was un- fitted for a lawyer's vocation ; his liabilities increased, his health failed, his powers declined. He still wrote much, but he wrote nothing that will be remembered. His brilliant but erratic life ended in a Calcutta hospital on 29th June 1873. Among IMadhu Sudan's most intimate friends may bementioned the great reformer IswarChandraVidyasagar, who often helped him in his difficulties, and the poet Hem Chandra Banerjea, who wrote an appreciative critique on his great epic. Among the young Indians who were studying in England in the 'sixties with Madhu Sudan, a few rose to distinction subsequently. One of them, Satyendra Nath Tagore, was the first Indian who entered the Civil Service of India ; and two others, Mano Mohan Ghosh and Umesh Chandra Bonnerjee, were called to the bar, rose to a considerable practice in Calcutta, and were honoured leaders among their countrymen. (e. c. d.)

Madison, a city of Indiana, U.S.A., capital of Jefferson county, on the Ohio river and the Pittsburg, Cincinnati, Chicago, and St Louis railway, in the south- eastern part of the state, at an altitude of 450 feet. It has

much commerce by rail and river, and varied manufactures. Population (1890), 8936 ; (1900), 7835.

Madison, a city of Wisconsin, U.S.A., capital of the state and of Dane county, on the peninsula between Lakes Monona and Mendota, in the southern part of the state, at an altitude of 870 feet. It is regularly laid out on an undulating site, and is divided into eight wards. It is on three railways — the Chicago and North-Western, the Chicago, Milwaukee, and

~~*St Paul, and the Illinois Central. It is the seat of Wisconsin state university, which in 1900 had 137 instructors and 1841 students. Population (1890), 13,426; (1900), 19,164, of whom 3362 were foreign-born and 69 were negroes.*~~

~~*Madras Presidency, a province of British India,*~~

~~*under the administration of a governor. It occupies the entire south of the peninsula. Politically, it includes the Laccadive Islands, off the Malabar coast, in the Indian Ocean. Total area (including native states), 150,798 square miles; population (1891), 39,331,062; (1901), 42,;:!98,931, showing an increase of 7-7 per cent. The capital is Madras city, from which the province takes its name. The "agency" tracts in the hilly interior of the northern Circars are administered on a special system, and for revenue purposes a considerable difference still prevails between the zamindari estates scattered through- out the presidency and the ordinary rayatwari lands.*~~

~~*The following table gives the area and population of the several districts and native states of Madras in 1891 and 1901 :—*~~

~~*Area and Population of Madras Presidency, 1891 and 1901.*~~

~~*Population, 1901.*~~

~~*Density of*~~

~~*Area In Square Miles.*~~

~~*Population,*~~

~~*1891.*~~

~~*Population to Square Mile,*~~

~~*Males.*~~

~~*Females.*~~

~~*Total.*~~

~~*1901.*~~

~~*British Distkicts —*~~

~~*Ganjam ....*~~

~~*8,370*~~

~~*1,896,803*~~

~~*964,282*~~

~~*1,047,206*~~

~~*2,011,488*~~

~~*240*~~

~~*Vizagapatam*~~

~~*17,242*~~

~~*2,802,992*~~

~~*1,451,660*~~

~~*1,481,877*~~

~~*2,9.33,537*~~

~~*170*~~

~~*Godavari .*~~

~~*7,857*~~

~~*2,078,782*~~

~~*1,134,107*~~

~~*1,169,388*~~

~~*2,308,495*~~

~~*293*~~

~~*Kistna*~~

~~*8,397*~~

~~*1,855,582*~~

~~*1,091,218*~~

~~*1,063,981*~~

~~*2,155,199*~~

~~*257*~~

~~*Nellore*~~

~~*8,765*~~

~~*1,463,736*~~

~~*763,612*~~

~~*744,184*~~

~~*1,497,796*~~

~~*170*~~

~~*Karnul*~~

~~*7,514*~~

~~*817,811*~~

~~*441,186*~~

~~*431,237*~~

~~*872,423*~~

~~*116*~~

~~*Bellary*~~

~~*5,975*~~

~~*900,126*~~

~~*481,422*~~

~~*465,907*~~

~~*947,329*~~

~~*159*~~

~~*Cuddapah .*~~

~~*8,722*~~

~~*1,272,072*~~

~~*6-36,799*~~

~~635,104~~

~~1,291,903~~

~~148~~

~~North Arcot~~

~~7,016~~

~~2,180,487~~

~~1,101,722~~

~~1,106,669~~

~~2,208,391~~

~~289~~

~~South Arcot~~

~~5,217~~

~~2,162,851~~

~~1,168,654~~

~~1,181,711~~

~~2,350,365~~

~~460~~

~~Salem~~

~~7,529~~

~~1,962,591~~

~~*1,086,147*~~

~~*1,119,751*~~

~~*2,205,898*~~

~~*293*~~

~~*South Canara*~~

~~*3,902*~~

~~*1,056,081*~~

~~*549,274*~~

~~*585,350*~~

~~*1,134,624*~~

~~*290*~~

~~*Malabar .*~~

~~*5,585*~~

~~*2,652,565*~~

~~*1,.377,566*~~

~~*1,410,477*~~

~~*2,788,043*~~

~~*499*~~

~~*Nilgiris r, .*~~

~~*967*~~

~~99,797~~

~~60,507~~

~~50,882~~

~~111,449~~

~~116~~

~~Coimbatore~~

~~7,860~~

~~2,004,839~~

~~1,083,698~~

~~1,118,614~~

~~2,202,312~~

~~280~~

~~Tinnevelly~~

~~5,387~~

~~1,916,095~~

~~1,002,487~~

~~1,058,272~~

~~2,060,759~~

~~382~~

~~Madura~~

~~*8,808*~~

~~*2,608,404*~~

~~*1,368,293*~~

~~*1,473,811*~~

~~*2,8-32,104*~~

~~*321*~~

~~*Tanjore*~~

~~*3,709*~~

~~*2,228,114*~~

~~*1,066,752*~~

~~*1,178,609*~~

~~*2,245,361*~~

~~*605*~~

~~*Trichinopoly*~~

~~*3,631*~~

~~*1,372,717*~~

~~*700,303*~~

~~*744,815*~~

~~*1,445,118*~~

~~*398*~~

~~*Chingleput*~~

~~*2,842*~~

~~*1,136,928*~~

~~*661,940*~~

~~*650,782*~~

~~*1,312,722*~~

~~*462*~~

~~*Anantapur*~~

~~*5,275*~~

~~*708,549*~~

~~*404,037*~~

~~*384,859*~~

~~*788,896*~~

~~*149*~~

~~*Madras City*~~

~~*29*~~

~~*452,518*~~

~~*257,298*~~

~~*252,099*~~

~~*509,397*~~

~~17,566~~

~~Total British Territory~~

~~141,189~~

~~35,630,440~~

~~18,853,021~~

~~19,355,585~~

~~38,208,609~~

~~270~~

~~Native States —~~

~~Travanoore~~

~~6,730~~

~~2,557,736~~

~~1,490,509~~

~~1,460,529~~

~~2,951,038~~

~~438~~

~~Cochin ....~~

~~1,362~~

~~722,900~~

~~407,010~~

~~*408,208*~~

~~*815,218*~~

~~*598*~~

~~*Pudukota ....*~~

~~*1,101*~~

~~*373,096*~~

~~*180,884*~~

~~*199,698*~~

~~*380,582*~~

~~*345*~~

~~*Banganapalli (Karnul)*~~

~~*255*~~

~~*35,496*~~

~~*16,252*~~

~~*16,027*~~

~~*32,279*~~

~~*125*~~

~~*Sandur (Bellary) Total Native States*~~

~~*161*~~

~~*11,388*~~

~~*5,658*~~

~~*5,547*~~

~~*11,205*~~

~~*69*~~

~~*9,609*~~

~~*3,700,622*~~

~~*2,100,313*~~

~~*2,090,009*~~

~~*4,190,-322*~~

~~*436*~~

~~*Grand Total*~~

~~*150,798*~~

~~*39,331,062*~~

~~*20,953,337*~~

~~*21,445,594*~~

~~*42,398,931*~~

~~*281*~~

~~*Between 1881 and 1891 the population increased by more than 15 per cent, in British territory, and by more than 10 per cent, in native states, and between 1891 and 1901 by 7-2 and 13-2 per cent, respectively. The high rate of increase in the earlier period is to be attributed mainly to recovery from the famine of 1876-78, and partly to more accurate enumeration in the*~~

~~*"agency" tracts. The average density ranges from 605 persons per square mile in the fertile delta of Tanjore to only 116 in the barren uplands of Karnul and in the Nilgiris.*~~

~~*Classified according to religion, and excluding native states, Hindus numbered 31,998,309 in 1891, or 90 per cent, of the total population, being a higher proportion than in any other province. Mahommedans numbered 2,250,386, or only 6 per cent., though they have increased more rapidly than Hindus. Christians numbered 865,528, or 2-4 per cent., of whom 13,462 were Europeans and 26,642 Eurasians, leaving 825,424 for native converts, chiefly in the southern districts of Tinnevelly, Madura, Tanjore, Trichinopoly, and South Canara. In the native*~~

~~*states the proportion of Christians rose as high as 19 per cent. Jains, with whom Buddhists are included, numbered 28,461 ; "others," 487,756, chiefly aboriginal tribes in the "agency" tracts. The languages spoken — all of the Dravidian family — are Telugu in the north-east, Tamil in the south, Malayalam in the west, and Canarese in the central plateau.*~~

~~*Agricultural statistics are not available for the zamindari estates, which occupy nearly 27 per cent, of the total area of the presi- dency, paying an average revenue of E. 0.4.3 per acre. On rayat- wari lands the average incidence of land revenue is 11.1.14.4 per assessed acre and Rs.2.4.10 per cultivated acre. In 1897-98 the total cultivated area was 24,247,617 acres, of which 2,961,377 acres were cropped more than once. The irrigated area was 5,875,374 acres, of which nearly one-half was irrigated from Gov- ernment canals. The principal crops are rice (grown chiefly along the coast) ; the tWo kinds of millet (here called cholum and cumbu) ; ragi (Eleusine corocana), chiefly in the uplands ; pulse, oil-seeds, cotton, indigo, sugar-cane, and tobacco. In 1897-98 the area under coffee was 64,402 acres, chiefly in the districts of the Nilgiris, Malabar, Salem, and Madura ; the area under tea was 7722 acres, almost entirely in the Nilgiris.*~~

~~*The Madras system of irrigation has been most successful in*~~

~~*the case of the three great eastern rivers, the Godavari, Kistna, and Cauvery. Each of these is intercepted by an anient or dam at the head of its delta, from which canals diverge on each side for navigation as well as irrigation. The scheme for diverting the waters of the Tungahhadra (a tributary of the Kistna) over the thirsty uplands of Karnul has proved a failure, and the full result of the bold project of leading the Periyar river through a tunnel across the watershed of the Travancore hills on to the plain of Madura remains to be, seen. In 1897-98 the total receipts from nine "major" works amounted to Ils.73,37,055, and the working expenses to Rs.17,90,996, showing a profit of Rs.55,46,059, or an average of 8-4 per cent, on a capital outlay of Es.6, 18,72.013. In ' addition, 27 " minor" works yielded a profit of Rs.7, 52,785, or 4 per cent, on a capital outlay of Rs.1,69,73,752.*~~

~~*Madras possesses no special industry, like the cotton of Bombay or the jute of Bengal. In 1897 the total number of factories under inspection was 71, employing 31,197 operatives, of whom 2892 were women and 2216 children. Cotton-mills numbered 11, with 1705 looms and 274,254 spindles, employing 12,099 hands. The out-turn of yarn was 32,515,445 lb, chiefly of counts between Nos. 10 and 21; the out-turn of woven goods was 5,320,781 tb, chieily tea-cloths, &o. There is one hemp mill at Vizagapatam, employing 823 hands ; three breweries on the Nilgiri Hills, with an out-turn of 341,000 gallons ; a flourishing sugar factory in Ganjam ; and several tile-works on the Malabar 'coast. The manufacture of cigars has become an important industry in the districts of Madura and Trichinopoly. One factory alone produces 15 million cigars a year, valued at Rs.4,50,000.*~~

~~*The presidency is well supplied with railways, which naturally have their centre in Madras city, the chief seaport. The Madras railway connects with Bombay and Bangalore, and also crosses the peninsula to Calicut on the western coast. The South Indian serves the extreme south, with its terminus at Tuticorin. The Southern Mahratta traverses the Deccan districts ; and the East Coast line, through the Northern Circars, has brought Madras into direct com- munication with Calcutta.*~~

~~*As might be expected from its double line of coast, the sea-borne trade of the presidency is less concentrated at its capital than is the case with either*~~

~~Bengal or Bombay. Only about 43 per cent, of the total is conducted at the port of Madras, the Malabar coast having 26 percent., the Northern Circars 12 per cent, and Tin- nevelly district 12 per cent. The following table gives the value (in tens of rupees) of th e foreign exports and imports of merchandise only for the years 1877-78 and 1897-98 :—~~

~~Imports.~~

~~Exports.~~

~~1877-78 .~~

~~. Rx.3,694,712~~

~~Rx.5,565,549~~

~~1897-98 .~~

~~7,003,974~~

~~11,432,396~~

~~Thus both imports and exports approximately doubled in twenty years, showing a more rapid increase than either Bengal or Bombay. But the rate of increase was highest during the first half of the period, exports in particular having been checked by the bad seasons of 1896-98.~~

~~The following is the value (in the tens of rupees) of each of the principal articles of import and export in 1897-98 : —~~

~~Imports : — Cotton piece-goods, Rx.l, 813,411 ; cotton twist, Ex. 1,027,642 ; railway materials, Rx.665,248 ; wrought metals, Rx.573,402 ; machinery, Rx.,322,351 ; mineral oils, Rx.274,608 ; spices, Rx.232,291; liquors, Rx.202,271 ; apparel, Rx.194,964 ; hardware and cutlery, Rx.172,031 ; provisions, Rx.128,000. Exports :— Hides, Rx.3,106,102 ; coffee, Rx.1,494,261 ; rice, Ex.1, 207,247; indigo, Rx.1,066,445 ; raw cotton, Rx. 8.52,399 ; cotton goods, IJ.i:. 768,302 ; oil-seeds, Rx.360,706 ; spices, Rx.314,996; sugar, Rx.263,690 ; oils, Rx.248,984 ; coir manufactures, Rx. 237,356.~~

~~*As compared with previous years, the imports of cotton goods show little change. Piece-goods reached their maximum (Rx.2,546,196) in 1894-95, and twist (Rx. 1,156,548) in 1888-89. Railway materials, wrought metals, machinery, mineral oils, hard- ware, and cutlery all increased steadily during the ten years ending 1898. The foreign imports of coal suddenly dropped by one-half, owing to competition from the Bengal mines, which now supply 80 per cent, of the amount consumed in the railways and factories of Madras. Among metals (wrought and unwrought) iron accounts for Rx. 334,418, copper for Rx. 178,828, and steel for Rx.60,088.*~~

~~*Under exports, the most noticeable feature is the large proportion of the total (more than one-fourth) contributed by hides, which doubled in the last ten years of the 19th century. The exports of rice, which are mainly to Ceylon, have also doubled. Coffee and indigo, though variable crops, are both fairly maintained. Raw cotton shows a heavy decline, which was continuous during the four years ending 1897-98. It reached its maximum (Rx.2,40.5,773) In 1889-90. Cotton goods, which [consist chiefly of coloured cloth sent to Ceylon, the Straits Settlements, and Burma, are fairly well maintained. Sugar shows a heavy decrease, due to a bad season.*~~

~~*The United Kingdom has maintained its trade with Madras more successfully than with Bombay. The imports from the United Kingdom increased during the ten years 1887-88 to 1897-98, though the proportion to the total fell from 85 to 78 per cent. The exports to the United Kingdom actually decreased, and the propor- tion to the total fell from 60 to 43 per cent. The special feature of Madras trade is the large exportation to Ceylon, which more than doubled between 1888 and 1898, and now forms 20 per cent, of the total. It consists mainly of cotton piece-goods, rice, fish, and other provisions.*~~

~~*The value of the coasting trade of Madras in 1897-98 was as follows (in rupees) :• — Ports within the presidency — imports Rs.1,77,54,948 ; exports, Rs.l, 79,63, 838. Ports outside the presi- dency—imports, Rs.4,24,29,976 ; exports, Rs.3,27,18,949. Total —imports, Rs.6,01,84,924 ; exports, Es.5,06,82,787.*~~

~~*The administration of the Madras presidency is conducted by a governor and a council, consisting of two members of the civil service, who are*~~

~~appointed by the Crown for a term of five years. The secretariat includes a chief secretary, a secretary, two under- secretaries, and an assistant. There is a board of revenue of three members. The number of districts is 22, each under the charge of a collector, with sub-collectors and assistants. The districts are not grouped into divisions or commissionerships, as in other provinces. In 1898 the number of covenanted civilians on the Madras establishment was 162. The total number of civil and revenue judges was 310, and of magistrates of all sorts, 725. The total strength of the police was 22,747 oflicers and men, being 1 policeman to every 8 square miles of area and to every 2167 of the population.~~

~~Since the reorganization of the Indian army in 1894 the Madras command, under a lieutenant-general, comprises Burma, Mysore, Haidarabad, and Belgaum in Bombay, in addition to the Madras presidency, with headquarters at Ootacamund in the Nilgiri Hills. It consists of two first-class and six second-class military districts, of which Madras and the southern district alone lie entirely within the presidency. In 1898 the strength of the Madras command was 12,447 Europeans and 29,410 natives ; total, 41,857. In addition, there were 5710 enrolled volunteers.~~

~~Eor legislative purposes the council of the governor is augmented by additional members, not exceeding 20, who are nominated by the governor for a term of two years. Of these not more than 9 may be ofBcials, and 7 are nominated on the recommendation of the Madras corporation, groups of municipalities and district boards, selected public associations, and the senate of the Madras University. Members of this legislative council enjoy the right of interpellation and of discussing the annual financial statement.~~

~~Excluding Madras city, the number of municipalities in the presidency is 58, with an aggi-egate population of 1,687,563 in 1891. In 1898 the total number of members was 868, of whom 367 were elected by the ratepayers, and 727 were natives. The aggregate municipal income (including loans) was Rs. 29,21, 107, of which Rs.7, 09,610 was derived from rates, Rs.3,58,951 from tolls, and Rs.2, 86,403 from Government contributions. The average in- cidence of taxation (including tolls) was 14 annas per head. The aggregate expenditure was Rs .35,02,705, of which Rs.10,41,099 was devoted to public works (including water-supply), Rs.lO, 16,941 to~~

~~medical services and sanitation, Rs.3,42,801 to education, and Es. 2,57,579 to lighting and miscellaneous.~~

~~The principle of local devolution is carried somewhat farther in Madras than in other provinces. At the bottom are union panchayats or village committees, whose chief duty is to attend to sanitation. In 1898 these numbered 376, with 3551 members. Above them come 80 taluk or sub-divisional boards, with ll'-'2 members. At the head of all are 21 district boards, with 647 members, of whom 296 were elected by the taluk boards. In 1897-98 the aggregate income of local funds (including loans) was Rs. 88, 27, 640, of which Es.63,66,768 was derived from rates and Rs. 3, 15,143 from a provincial grant. The aggregate expen- diture was K.s.83,93,060, of which Rs.35,29,227 was devoted to public works, Rs. 18, 73,480 to medical and sanitary purposes, and Rs.10,95,782 to education.~~

~~The total net revenue of Madras for 1897-98 (in tens of rupees, distributed under the three heads of imperial, provincial, and local, was i;x.7,304,601, Ex.2,811,486, and Rx. 1,049,068 re- spectively, or a total of Rx.11,165,155, the corresponding totals for the expenditure being Rx.3,371,870, Ex.2,811,684, Rx. 1,048,870, and Rx.7,232,424.~~

~~The following table gives the gross revenue under five principal heads for the years 1887-88 and 1897-98 :—~~

~~18SY-SS.~~

~~Land . . Rx.4,527,937~~

~~Stamps . . 597,161~~

~~Excise . . 973,906~~

~~Forests . . 137,492~~

~~Assessed taxes 168,146~~

~~1897-98.~~

~~Rx.4,937,748~~

842,026

1,402,010 213,649 266,446

MADEAS CIT Y — M A D E A Z 0

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These figures show steady progress, especially under excise and assessed taxes. The increase of land revenue is the more notice- able as 1897-98 was a had season.

The following table gives the chief statistics of education in Madras for the years 1886-87 and 1896-97 : —

1886-87.

1896-97.

Schools.

Pupils.

Schools.

Pupils.

Colleges

Secondary schools Primary schools Special schools . Private institutions .

35

747

14,060

82

~~*1,788*~~

~~*3,323*~~

~~*60,856*~~

~~*384,888*~~

~~*3,022 30,853*~~

~~*43*~~

~~*748*~~

~~*20,792*~~

~~*122*~~

~~*5,167*~~

~~*4,423*~~

~~*90,610*~~

~~*617,886*~~

~~*5,386 104,548*~~

~~*Total .*~~

~~*16,717*~~

~~*488,942*~~

~~*26,872*~~

~~*822,853*~~

~~*It is noticeable that pupils have increased more rapidly than insti- tutions, especially in the case of secondary schools, which tends to make the*~~

~~*stronger institutions more efficient. If we compare the number of pupils with the estimated population of school-going age (15 per cent, of the total population), the increase during the ten years was from 10-6 to 15-4 per cent. Taking girls alone, the num- ber at school increased from 65,137 to 116,747, while the proportion to the female population of school-going age rose from 2-8 to 4-3 per cent. A peculiarity of the Madras system is that English is taught even in primary classes, so that the total number of pupils learning English in 1896-97 was 141,625, being one in every 38 of the population of school-going age. Another feature is the extent to which Brahmans take advantage of the opportunities open to them. Out of every 16 Hindus in colleges, 15 are Brahmans ; and out of 103 Hindus in high schools, 94 are Brahmans.*~~

~~*The following table gives the expenditure on education for the same years, according to sources: —*~~

~~*1886-87.*~~

~~*1896-97.*~~

~~*Provincial revenues*~~

~~*Es. 13,48,923*~~

~~*Es.18,75,783*~~

~~*Local funds .*~~

~~*5,55,762*~~

~~*. 8,74,237*~~

~~*Municipal funds .*~~

~~*1,63,560*~~

~~*2,83,373*~~

~~*Fees*~~

~~*14,98,366*~~

~~*20,22,226*~~

~~*Other sources*~~

~~*9,95,969*~~

~~*16,81,605*~~

~~*Total*~~

~~*45,62,580*~~

~~*66,87,224*~~

~~*Expenditure has not grown quite so fast as the number of pupils. But here, as in other provinces, the larger share of the increased expenditure has come from fees and "other sources," which mainly consist of mission contributions. Altogether, the proportion of the total borne by public funds has fallen from 45'3 to 44-6 per cent. In secondary schools alone public funds contribute less than one-fourth.*~~

~~*Madras has been fortunate in almost entirely escaping the plague, despite serious outbreaks in Mysore and the border district of Dharwar in Bombay. The total number of deaths from plague recorded throughout the presidency down to April 1899 was only 1804. Madras was little affected by the famine of 1899-1900. In April 1900 the total number of persons in receipt of relief was only 18,000, chiefly in the Deccan districts, which had suffered severely in the famine of*~~

~~*1896-97.*~~

~~*For 1897 the total number of deaths registered was 827,525, of which 292,292 were ascribed to fevers and 143,445 to cholera. The death-rate was 25 '4 per thousand, compared with a mean of 20-4 during the previous five years. The registered birth-rate was 28-7 per thousand. The number of persons successfully vaccinated was 1,067,319. (j. s. Co.)*~~

~~*Madras City, the capital of Madras presidency and chief seaport on the eastern coast of India, situated in 13° 4']Sr. and 80° 17' E. The city, with its suburbs, ex- tends nine miles along the sea and nearly four miles inland, intersected by the little river Cooum. Area, 29 square miles; population (1881) 406,848; (1891), 452,518; (1901), 609,397; showing an increase of 11 per cent, between 1881 and 1891 and of 12-57 per cent, between 1891 and 1901. Madras is thus the third city in India. Classified according to religion, Hindus in 1891 numbered 358,997, or 79 per cent. ; Mahommedans, 63,184, or 12 per cent. ; Christians, 39,742, or 9 per cent., of whom 4229 were Europeans and 11,943 Eurasians, leaving 23,570 for native converts; Jains (including Buddhists), 410; and "others," 185.*~~

~~*Madras possesses no special industries. There are four cotton-mills, with 1595 looms and 125,220 spindles, employing 6031 hands ; a large cement work, several iron-foundries, and two cigar factories. Large sums of money have from time to time been spent upon the har- bour works, but without any great success. The port still remains practically an open roadstead, and the P. andO. steamers ceased to call in 1898. Madras conducts about 56 per cent, of the foreign trade of the presidency, but a much smaller share of the coasting trade. In 1897-98 the total searborne trade, both merchandise and treasure, was valued at Rs.12,98,85,783, of which Es.10,50,17,710 represents foreign trade. The number of vessels that entered and cleared with cargo in the foreign trade was 279, with an aggregate tonnage of 523,713. Including coasting trade, the number of vessels was 711, with a tonnage of 1,158,897, which paid dues to the amount of Es. 1,09,495. The total income of the har- bour trust was Es. 7,20,000, and the total expenditure Es.7,30,000, including Es.2,24,000 for interest and Es. 1,00,000 for repayment of advances.*~~

~~*The municipal government of the city was framed by an Act of the Madras legislature, passed in 1884. The governing body consists of 32 commissioners, of whom 24 are elected by the ratepayers, together with a paid president. The number of registered voters in 1898 was 5720, being 12-5 per thousand of the total inhabitants. At contested elections in ten wards about half the regis- tered voters exercised the franchise. In 1897-98 the total income (excluding loans, &c.) was Es.13,60,000, of which Es. 10,30,000 was derived from rates and taxes, the incidence of taxation being*~~

Es.2-27 per head. The principal tax is a rate of 10 per cent, on houses and lands. The total expenditure was Es.17,03,000, of which Es.7,97,000 was devoted to public works, including a new drainage scheme ; Es.3,83,000 to sanitation and medical purposes ; Es. 11,890 to education ; and Es.2,06,000 to interest and repayment of debt. The total amount of debt outstanding was Es. 12,18,400, almost all raised for water-works and drainage. A new system of water-supply is projected. The old system supplied 480 million cubic feet of water during the year.

The Madras University was constituted in 1867, as an examining body, on the model of the University of Lon- don. During the five years ending 1897 the total number of candidates w ho matriculated was 5546, while 2401 gradu- ated B.A., 538 passed examinations in law, 233 in medicine, and 38 in engineering. The chief educational institutions in Madras city are : the Presidency College (with 395 students in 1897), six missionary colleges and one native college ; the medical college, the law college, the college of engineering, the teachers' college, and the college of agriculture (in the suburb of Saidapet), all maintained by Government ; the Government school of arts (with 674 pupils learning drawing) ; 18 high schools for boys, one of which is maintained by Government for Mahomme- dans; 11 high schools for girls. In 1896-97 the total number of pupils under instruction was 40,315, the pro- portion to the population of school-going age being 89 per cent, for boys and 30 per cent, for girls. Eor 1897 the death-rate was 35-8 per thousand, compared with a mean of 40-2 during the previous five years; the birth- rate was 41-6 per thousand. (j. s. co.)

Madrazo y Kunt, Don Federico de (1815- 1894), Spanish painter, was born in Eome on 12th Febru- ary 1815. He was the son of the painter Madrazo y Agudo (1781-1859), was baptized at St. Peter's, Eome, and received his first instruction from his father. While still attending the classes at the Academy of San Pernando, he painted his first picture, " The Eesurrection of Christ "

(1829), whicli was purchased by Queen Christina. Not long afterwards he painted "Achilles in his Tent," and subsequently presented to the Academy " The Continence of Scipio," which secured him admission as a member " for merit." 'While decorating the palace of Vista Alegre, he took up portraiture. In 1862 he went to Paris, where he studied under Winterhalter, and painted portraits of "Baron Taylor" and of " Ingres." In 1837 he was com missioned to produce a picture for the gallery at Versailles, and painted " Godfrey de Bouillon proclaimed King of Jerusalem," which was finished in 1839. The artist then went to Rome, where he worked at various subjects, sacred and profane — among others, " The Three Holy Women at the Sepulchre." Then he painted "Maria Christina in the Dress of a Nun by the Bedside of Ferdinand III." (1843); "Queen Isabella," "The Duchess of Medina-Coeli," and "The Countess de Vilehes" (1845-47), besides a number of portraits of the Spanish aristocracy : " King Don Francisco," the Duchesses of Alba and of Seville, the Countess de Eobert- sart, and P. de Madrazo ; some of these portraits were sent to the Exhibition of 1856. He had received a third- class medal in 1838, two first-class medals in 1845 and 1856, and the decoration of the Legion of Honour in 1846. He had been corresponding member of the Paris Academy of Fine Arts since 10th December 1853, and in 1873, on the death of Schnorr the painter, he was chosen foreign member. After his father's death he succeeded him as director of the Prado Gallery and president of the Academy of San Fernando. He assisted his brother, Don Pedro, in preparing the catalogue of the Gallery which was published in 1873. He originated in Spain the production of art reviews and journals, such as El Jirtista, El Renacimlento, and El Semanario Pintoresco. He was corresponding member of the Academies of Belgium and of St Luke at Rome, and was the writer of various historical and critical papers. He died at Madrid on the 11th of June 1894. His brother, Don Louis de Madeazo, is also known as a painter, chiefly by his "Burial of Saint Cecilia" (1855). Don Federico's best-known pupil is his son, Don Kaimundo DE Madeazo, born in 1841. (h. pr.)

Madrid, a province of central Spain; area, 2997 square miles. The population rose from 682,644 in 1887 to 737,444 in 1897. The average 'density of the popular tion is thus about 246 per square mile, but the majority of the inhabitants are within the municipal boundaries of the capital, and the density outside is barely 62 per square mile. The birth-rate

~~*averages 38-3 per thousand, the death-rate, 38-4, and the proportion of illegitimate births only 2-63 per cent. About 1100 emigrate annually. The province is divided into 18 administrative districts and 196 parishes. It is included for military purposes within the first army corps commanded by the captain- general of Madrid; for judicial purposes in the Court of Appeal of Madrid, and for ecclesiastical in the diocese of Madrid Alcala. Besides the local lines, all the great rail- ways in the kingdom converge in this province, and it contains in all 221 miles of line. No province in Spain contains a greater number of persons paying the industrial and commercial rates. Local industries, not only in the town and suburbs of Madrid, but in the rest of the province, have developed very much, especially manu-factures of chocolate, alcohol, porcelain and pottery, soap, flour, glass, candles, paper, iron, tanning, and saw-milling. Agriculture and wine-growing have also progressed ; vines have been extensively planted near the capital, and agricultural methods and machinery improved. Efforts have been made by the various authorities to cover the large stretches of waste ground and commons with pines and other trees.*~~

~~*Much timber is extracted from the forests of the northern and north-eastern part of the province for building purposes and for firewood and charcoal. The royal domains of Bsourial, Aranjuez, and El i'ardo and the preserves of the nobility are all well wooded, and contain much game. In 1898 the province had 14,094 horses, 23,473 mules, 8463 asses, 19,3ii6 cattle, 260,462 sheep, 37,638 goats, and 11,695 pigs. The south-eastern districts are the best irri- gated, and produce in abundance fruit, vegetables, wheat, olives, esparto grass, and excellent wine, red and white. There are more than 60,000 acres well irrigated, and over two millions and a quarter well cultivated, wheat being grown on 167,389 acres, other cereals on 203,252 acres, leguminous crops on 36,922 acres, vines on 158,502 acres, and olives on 18,415 acres.*~~

~~*Madrid, the capital of the above province, and of the kingdom of Spain, situated on the left bank of the river Manzanares. Its population increased to 472,228 in 1887, and to 612,160 in 1897. In the latter year the births were 15,413 (7833 males, 7580 females), being an average for the twelvemonth of 31-85 per thousand in- habitants. The deaths in 1897 were 14,694 (7679 males, 7016 females), 6111 being those of children under ten*~~

years of age, the average for the year per thousand inhabitants being 40-50. There is a very great differ- ence between the death-rate in winter and in summer. In the former season it is often as high as 80 daily, dropping to between 20 and 30 in summer. The death- rate is lower than that of 22 provincial capitals. The average proportion of illegitimate births in 1897 was 6-86 per cent., but in the most populous district there were 1636 illegitimate births against only 1339 legitimate.

The public buildings were extensively restored and improved between 1886 and 1900. Foremost must be mentioned the Biblioteca National, standing near the Mint on the Paseo de E-ecoletos, of which the first stone was laid in 1866, and which was only completed in 1892. Not only the National Library, with its important col- lections of MSS. and documents, biit the Archseologieal Museum, the Museums of Modern Painting and Sculpture, and the Fine Arts Academy of San Fernando, are within its walls. The total cost of the building was £640,000. The art exhibition in connexion with the celebration of the fourth centenary of the discovery of America by Columbus was held within it in 1892. The royal carpet and tapestry manufactory has been transferred to a site in the Pacifico suburb. A large and handsome building has been erected near the Ketiro Park for the Ministers of Public Works, Agriculture, Industry, Commerce, and Fine Arts, and Education ; and nearly opposite stands the new station of the Southern Rail- way Company. The Great Northern and the Spain to Portugal railway companies have also replaced their ugly old stations by very spacious handsome structures, much resembling those of Paris. In 1896 the Royal Exchange was installed in a large monumental build- ing with a fine colonnade facing the Dos de Mayo monu- ment, not far from the Museum of Paintings. In the same part of the city, the jNledina-Coeli Palace has dis- appeared to make room for new streets. In the Salon del Prado the duke of Sexto's palace at the corner of Alcala Street, opposite the War Ofiice, has made way for the new offices of the Bank of Spain, a heavy, imposing building 290 yards long. At each extremity of the Prado two large circular " squares " have been made out of the older and irregular ones, and the fountains of Cibeles and Neptune have been moved to the centre of the Plazas de Castelas and de Canovas. The north and north-east of the city — the new suburbs — have developed jiast the Retire Park as far as the Bull- ring, built in 1874 to hold 1 6,000 spectators, and have covered all the vast

~~*space included between the Retire, the Bull- ring, the long Castellana Drive to the race-course, and the Exhibition building. On the slopes of the other side of the Castellana, and away along what were the northern*~~

~~*limits of Madrid in 1875, the modern suburbs have extended to the vicinity of the fine cellular prison that was built at the close of the reign of King Alphonso XII. to replace the gloomy building known as El Saladero. It can hold nearly 1000 male prisoners, and serves also as a house of correction for offenders undergoing short terms of im- prisonment. The prison for females calls for considerable improvement. The new parts of the capital, with their broad streets and squares, and their villas sometimes sur- rounded with gardens, the noble mansions of the upper classes, the boulevards lined with rather stunted trees, and the modern public buildings, all resemble the similar features of other European capitals, and contrast with the old Madrid that has preserved so many of its traits in architecture, popular life, and habits. Some of the streets have been widened slightly, and in many thoroughfares new houses are gradually studding the background formed by the ugly irregular dwelling-places of the 18th and earlier centuries. This contrast is to be seen especially in and about the Calle Mayor, the Plaza Mayor, the Calle Toledo, the Rastro, and the heart of the city. There are, however, several buildings, dating from times long past, which are worthy of admiration — grand, old-world resi- dences of the ancient nobility, massive convents, the episcopal palace, the Town Hall opposite the palace of the Lujanes, the Government House, the house of the seven chimneys that was the residence of Charles I. of England and Buckingham in 1623, and the many ministerial offices installed in old conventual buildings. The churches of Madrid underwent alteration in the last quarter of the 19th century. When the capital was separated from the archiepiscopal see of Toledo, and erected into a bishopric, styled of Madrid Alcala, the church of San Isidro was made the cathedral. The church of the old Franciscan convent, San Francisco el Grande, has been splendidly restored by the State at con- siderable expense. Its dome, chapels, and walls were covered with remarkable works, frescoes, and paintings by most of the*~~

~~leading Spanish artists of the last half of the 19th century. The modern chapels and churches of the capital are not worth noticing, except the church of the Almudena, founded by King Alphonso XII. close to his palace, which, however, has progressed so slowly that only its crypt and the base of its massive walls and columns of solid granite were complete in 1901. The Campo de Moro, as the slope below the palace down to the river road is styled, was greatly improved by the Queen Mother (Maria Christina). Some noble timber has been sacrificed, and a modern park and gardens substituted. Little progress has been made in the reconstruction of the historic church of the Virgin of Atocha, which it was at one time intended to make a pantheon for the worthies of modern Spain, several of whom, like Castanos and Palafox, the heroes of the War of Independence against Napoleon I., and Prim, the chief of the Revolution of 1868, had found there a last resting-place. The Courts of Justice are still held in the 17th-century convent of Las Salesas Reales. The Houses of Parliament are in separate buildings. The Congreso, or House of Deputies, which has met since 1843 in a large handsome structure in the Carrera San Geronimo, has a very im- portant library; the Senate is in an old convent of the Augustine order (restored), and has fine modern paintings, and also a library of 20,000 volumes. The squares of the Spanish capital are adorned with many statues of kings, statesmen, soldiers of the War of Inde- pendence, and great writers like Calderon and Cervantes ; and not a few of the residences or birthplaces of emi- nent men have been redeemed from oblivion and dis- tinguished by slabs of marble with inscriptions. There are no less than fourteen theatres and two circuses, besides the Eoyal Opera House and the Eetiro Gardens,~~

~~also with a theatre that is the chief summer resort at night.~~

~~Tew capitals have more extensively developed their electric and horse tramways, gas and electric light companies, and telephones. Much was done to improve the sanitary conditions of the city in the last twenty years of the 19th century. The streets are deluged three times a day with fire-hose, hut even that has little effect upon the dust. Unfortunately the water-supply, which iised to be famed for its abundance and purity, is now wholly insufBcient owing to the growth of the city. The reservoirs of the Lozoya canal, 32 miles long, are quite Inadequate for the requirements of modern~~

~~Madrid, and they have been kept in such an unsatisfactory state that in 1898 and 1899 for several months the water not only was on the point of giving out, but at times was of such inferior quality that the people had recourse to the many wells and fountains still extant in the ten districts of the Spanish capital. A decided Improvement has been made in the burial customs. No bodies are allowed to be interred in the churches and convents. Some of the older burial grounds in the northern suburbs have been closed altogether, and in those which remain open, few cofiBns are placed in the niche vaults in the depth of the thick walls, as was once the practice. A large modern necropolis has been established a few miles to the north-east, where most burials now take place, and the older cemeteries must all be closed at no distant date. Madrid had a British cemetery more than thirty years before the end of the 19th century. The city contains also a British Embassy chapel, a German chapel, and several Spanish Protestant chapels attended by over 1200 native Protestants, while the Protestant schools, chiefly supported by British, German, and American contributions, are attended by more than 2500 children.~~

~~The first Protestant bishop of Madrid was ordained in 1895 by Archbishop Plunkett of Dublin. The Spanish educational estab- lishments have also been considerably improved. The university had in 1897 a staff of 102 professors and 21,500 students. Of these 11,500 belonged to the faculty of law, 8000 to that of medicine, 150 to that of science, 1650 to pharmacy, and 200 to philosophy and literature. Besides the special superior schools there are a self-supporting Institute for preparing girls for the higher degrees and for certificates as primary teachers, and two institutes for secondary education, one attached to the university and the other conducted chiefly by ecclesiastics. There are now more than 120 primary, State, and municipal schools, educating 58,000 boys and 49,500 girls. The Jesuit schools of Chamartin and the Scolapian fathers are conspicuous among private institutions. The charita^ ble institutions have been remarkably improved. The Princess Hospital has been completely restored on modem methods, and can accommodate several hundred patients. The old contagious diseases hospital of San Juan de Dios has been pulled down and a fine new hospital built in the suburbs beyond the Eetiro Park, to hold 700 patients. The Military Hospital has also been demolished and a very good one built in the suburbs. The old Provincial Hospital, to hold 1200 patients, is,~~

~~*however, in anything but a satisfactory condition. There are now in all twenty hospitals in Madrid, and a lunatic asylum on the outskirts of the capital, founded by one of the most eminent of Spanish surgeons, and conducted by him on a scale which enables the institute worthily to compare with those in other European capitals. The rate of mortality in the three foundling hospitals is high, the services being seriously crippled by lack of funds. New buildings have been provided for the orphanages, and for the asylums for the blind, deaf and dumb, incurables, and aged paupers. There are hospitals supported by the French, Italian, and Belgian colonies ; these are old and well-endowed foundations. Public charity generally is very active. In Madrid, as in the rest of Spain, there has been an unprecedented increase in convents, monasteries, and religious institutions, societies, and Catholic workmen's clubs and classes.*~~

~~*Apart from private institutions for such purposes, the State maintains in the capital a savings bank for the poorer classes, and on the other hand acts the role of pawnbroker for their benefit. The commerce of the capital is chiefly important in the retail trade, and the mercantile and industrial classes are organized in "guilds," which themselves collect the lump sum of taxation exacted by the exchequer and the municipality, from each gremio or class of taxpayers. The working classes also have commercial and industrial circulos or clubs that are obeyed by the guilds with great esprit de corps, a chamber of commerce and industries, and associations of "productions" to defend their economic interests. The industries of the capital have developed extra- ordinarily since 1890. In the town and within the municipal boundaries in the suburbs many manufactories have been established, giving employment to more than 30,000 hands, besides the 4000 women and girls of the Tobacco Monopoly Company's factory. Among the most important factories are those which make every article in leather, especially cigar and card cases, purses and pocket-books, all duly stamped Paris, London, and*~~

~~*Vienna, to be sold more profitably in the shops of Madrid. Next come the manufactures of fans, umbrellas, sun-shades, chemicals, varnishes, buttons,*~~

~~*wax candles, beds, cardboard in all shapes, porcelain, coarse pottery, matches, baskets of all kinds, sweets and preserves, gloves, guitars, biscuits, furniture, carpets, corks, cards, carriages, jewellery, drinks of all kinds, plate, and plated goods. There are also tanneries, saw and flour mills, glass and porcelain works, soap works, brickfields, paper mills, zinc, bronze, copper, and iron foundries. The working classes are strongly imbued with Socialistic ideas, and are organized in large societies. The union of masons alone numbers 15,000 members. The strikes of these workmen and their May Day demonstrations have often been troublesome. Order is kept by a garrison of 12,500 men in the barracks of the city and cantonments around, and by a strong force of civil guards or gendarmes quartered in the town itself. The civil and municipal authorities can employ besides the gendarmes the police, about 1400 strong, and what is called the guardias urbanos, another police force whose special duty it is to regulate the street traffic and prevent breaches of the municipal regulations. There is not, on the average, more crime in Madrid than in the provinces. (a. e. h.)*~~

~~*Madridejos, a town of Spain, in the province of Toledo, on the borders of Ciudad Real, 65 miles south, of Madrid. The surrounding country is fertile, producing wheat, wine, oil, and hemp. There are mines of copper and lead in the neighbourhood. The industries are leather and alcohol. Population (1887), 6679 ; (1897), 6387.*~~

~~*Madura, a city and district of British India, in the Madras presidency. The city is on the right bank of the river Vaigai, and is a station on the South Indian railway, 346 miles south-east of Madras. Population (1881), 73,807 ; (1891), 87,428 ; (1901), 105,601. The municipal income in 1897-98 was Rs.1,81,470. It has two aided colleges, with 120 students in 1896-97 ; three aided high schools, with 1410 pupils ; Jesuit and American Protestant missions ; eight printing-presses, issuing one English newspaper and two mission periodicals ; five reading-rooms and literary institutes ; and a cotton- mill, with 36,344 spindles, employing 1750 hands.*~~

~~*The district of Madura has an area of 8808 square miles. Population (1881), 2,108,680 ; (1891), 2,608,404 ; (1901), 2,832,104, showing an increase of 20 per cent, after the famine of 1876-77, which was felt here but slightly, and of 8-58 per cent, between 1891 and 1901 ; average density,*~~

~~*321 persons per square mile. The land revenue and rates in 1897-98 were Rs.34,28,552, the incidence of assessment being R.1.12 per acre; cultivated area, 1,009,253 acres, of which 276,170 were irrigated from tanks, &c., including 34,835 from Government canals ; number of police, 1225 ; boys at school (1896-97), 50,328, being 27 per cent, of the male population of school-going age ; registered death-rate, 23 -7 per thousand. The principal crops are millet, rice, other food-grains, oil-seeds, cotton. Coffee is grown on the Palni Hills, to the extent of 6161 acres ; tobacco chiefiy in the neighbourhood of Dindigul, whence it is exported to Trichinopoly to be made into cigars. There are five cigar factories in the district, one of which employs 1000 hands, with an annual out-turn valued at Rs.4,.”)0,000, and 149 saltpetre refineries. The only other large industry is that of coffee-cleaning. Madura is traversed by the main line of the South Indian railway. It has four small seaports, whose total trade (chiefly with Ceylon) was valued in 1897-98 at Rs.20,12,204. The most important irrigation work is that known as the Periyar project, which consists of a tunnel through the Travancore Hills, to convey the rainfall across the watershed, at a capital cost of Rs.85, 29,000. In 1897-98 the irrigated area was 28,051 acres; the receipts were Rs.l, 30,822, compared with an expenditure (including interest) of Rs. 4,35, 969.*~~

~~*Madura, an island of the East Indian Archipelago, separated by the strait of that name from the east end of Java. Being a continuation of the limestone range of northern Java, the island is of the same geological structure as Rembang and Surabaya. The formation of the coast and plains is Tertiary and recent alluvium. There are hills and ranges 1300 to 1600 feet high. The soil being poor, fishing and cattle-rearing are the chief means of sub-sistence. The cattle exceed 550,000, outnumbering the stock of cattle in any other residency of Java, and yield- ing an excess for export to Surabaya and east Java.*~~

~~*Besides rice, which is not grown in sufficient quantity for home consumption, and maize, Madura yields cocoaruutoil and jati. There is no agriculture carried on for European proprietors or for the Government, but the manufacture of salt for the Government, abolished in other places, still continues in Madura. The Madurese often emigrate in thousands to other residencies of Java, The chief group of islands belonging to Madura are the*~~

~~*Kangean and Sapudi Islands, yielding timber, trepang, turtle, pisang, and other products. Area, 1770 square miles. Popula- tion (1897), 1,652,680, of whom 1,646,071 were natives, 4262 Chinese, and 658 Europeans.*~~

~~*.SeeVETH. Java, vol. iii. — Kielstra, " Het Eiland Madoera, " in De Gids, 1890. — Van Lennep, " De Madoereezen," in De Indische Gids, 1895, with detailed bibliography.*~~

~~*Madvig, Johan Nicolai (1804-1886), Danish philologist, was born on the island of Bornholm, 7th August 1804. He was educated at the Classical School of Frederiksborg and the University of Copenhagen. In 1826 he graduated with a dissertation Emendationes in Ciceronis libros de legibus et Academica, and afterwards gained the doctor's degree with a thesis on some of the ancient commentators of Cicero. In 1828 he became reader, and in 1829 professor, of Latin language and literature at Copenhagen, and in 1832 was appointed university librarian. In 1848 Madvig began to take an active part in politics. He entered parliament as a member of what was called the "Eider-Danish" party, because they desired the Eider to be the boundary of the country. When this party came into power, Madvig be- came Minister of Education, and retained this post till 1851. In 1852 he became Director of Public Instruction. Some years later, from 1856 to 1863, Madvig was presi- dent of the Danish parliament and leader of the National Liberal party. With these brief interruptions the greater part of his life was devoted to the study and teaching of Latin and the improvement of the classical schools, of which he was chief inspector. As a critic he was dis- tinguished for learning and acumen. He devoted much attention to Cicero, and revolutionized the study of his philosophical writings by an edition of De Finibus, pub- lished in 1839. He also edited De Senectute and De Amicitia, and several of the Orations. In 1860 he pub- lished his Emendationes Liviance, followed by an edition of Livy, in which he and Ussing collaborated. He also worked at Lucretius and Juvenal, and published two volumes of emendations with the title Adversaria critica ad scriptores Groecos et Latinos. Perhaps his most widely known works are those on Latin grammar and Greek syntax, especially his Latin grammar for schools. In 1874 his sight began to fail, and he was forced to give up much of his work. He still, however, continued to lecture, and in 1879, when the University of Copenhagen celebrated its 400th anniversary, he was*~~

~~chosen rector for the sixth time. In 1880 he resigned his professorship, but went on with his work on the Roman Constitution, which was completed and published before his death. In this book INladvig takes a strongly conservative stand- point, and attacks Mommsen's views on Caesar's programme of reforms. It is a clear exposition of its subject, though rather too dogmatic and without sufficient regard for the views of other scholars.]\Iadvig died at Copenhagen on 13th December 1886. (a. z.)~~

~~Maestricht (in Dutch Maastricht), capital of the Dutch province of Limburg, at the influx of the Geer into the Maas, 19 miles by rail north-north-east of Li^ge. The railway, Maastricht-Aken, was in 1898 taken over by the State. Maestricht has a small museum of antiquities, and geological and paleeontological collections; also several~~

~~technical schools. The industrial establishments embrace an earthenware and glass factory employing 3000 hands, factories for paper, firearms, and - woollens, breweries, and distilleries. Population (1901), 34,182.~~

~~Maeterlinck, Maurice. See Belgium. {Lit- erature).~~

~~Mafe Icing, a town of British South Africa, formerly the head kraal of the Barolong branch of the Bechuana nation, and still their largest station, but now chiefly important as the administrative centre of British Bechuanaland. It lies close to the Transvaal frontier, about the sources of the Molopo river, 96 miles north of Vryburg, on the Cape to Bulawayo. trunk line, of which it is one of the busiest stations. It is situated nearly 200 miles due east of Johannesburg, and is memorable in South African warfare both as the point from which Dr Jameson started on his famous Raid on 28th December 1895, and still more for its heroic defence under Colonel (afterwards General) Baden- Powell against the Boers. The siege, which began soon after the outbreak of hostilities on 11th October 1899, lasted till 18th May 1900, when the place was relieved by Colonel Mahon.~~

~~Magdeburg, a town and first-class fortress of Prussia, capital of the province of Saxony, on the river Elbe, 88 miles by rail west-south-west of Berlin, an important railway junction, and one of the principal commercial and industrial towns in North Germany, as well as the head- quarters of the 4th German Army Corps. It now includes also the fifth suburb of Wilhelmstadt on the west. Since the fortifications were pushed out in 1866 and 1888, new quarters have grown up on the north, south, and west, and the narrow crooked streets of the old town are being widened and straightened as occasion offers ; but the principal thoroughfare, Der Breite Weg, still retains its 17th-century gable-ended houses. In the last years of the 19th century several new parks were laid out in the suburbs. Amongst the various modern buildings may be mentioned the post oflftce, Imperial Bank, royal con- sistory hall (1891), and the municipal offices and library. A new building has been erected for the industrial art, natural science, and other collections, formerly housed in the Prince's Palace. The church of Our Lady was com- pletely restored in 1890-91. The city is adorned with various monuments — an equestrian statue of the Emperor William I. (1897) by Siemering, one to Luther (1886), and another to Immermann (1899). It also possesses a couple of theatres, a branch (1889) of the Halle Agricultural College, an art school, a commercial school, an imperial orphanage, a teachers' seminary, a meteorological observatory, and a gaol. The first place amongst the industries is taken by the ironworks (one being a branch of the Krupp firm, the Grusonwerke, employing 3500 men), which produce naval armour, caissons, cannon, cranes, &c. Of almost equal importance are the sugar refineries and chicory factories. Then come factories for tobacco, chocolate, artificial manure, cement, varnish, chemicals, and pottery, rope- walks, distilleries, breweries, and various other branches. Magdeburg is the central market in Germany for sugar and chicory, but trades extensively also in cereals, fruit and vegetables (grown close to the city), groceries, cattle and horses, wool, cloth, yarn, leather, coals, iron wares, fats, and books. A new winter harbour, made at a cost of £400,000, is intended to promote the river traffic up and down the Elbe. Alto- gether an aggregate of 2f million tons of merchandise passes Magdeburg, going upstream, and over | million tons, going downstream, annually. Population (1885), 159,520; (1890), 202,234; (1900), 229,663. In 1887 the suburbs of Buckau and Neustadt were incorporated.~~

~~*Magee, William Connor (1821-1891), bishop of Peterborough and archbishop of York, was born at Cork in 1821. His father was curate of the parish attached to the Protestant cathedral in that city. Young Magee entered Trinity College, Dublin, at the early age of thirteen, but nevertheless succeeded in obtaining a scholarship. His reading at college was rather discursive than profound, but he passed a brilliant examination in gaining Archbishop King's prize. He was instrumental in resuscitating the Trinity College Historical Society, which has done so much good work since. He was ordained to the curacy of St Thomas's, Dublin, but after two years evinced symptoms of con- sumption, and was sent for a time to Malaga. On his return he took a curacy at Bath, where his reputation rapidly grew. He was nominated to the incumbency of Kensington Chapel, Bath, but the appointment was vetoed by his rector, who is reported to have said, " I brought Magee here to fill my church. If he goes to Kensington Chapel he will empty it." He was, however, speedily appointed to the Octagon Chapel, where his fame continued to spread, and his extraordinary powers as a platform orator were displayed on many occa- sions. Some years afterwards he was made prebendary of Wells Cathedral, and in 1860 he had the offer of the important post of Quebec Chapel in London, on the resig- nation of Dr Goulburn, afterwards dean of Norwich. The delicate state of his health caused him to accept the living of Enniskillen almost immediately afterwards. In 1864 he was made dean of Cork and chaplain to the lord- lieutenant. Here he manifested those great gifts which ultimately raised him to a more exalted station: a powerful grasp of mental, moral, and political problems, combined with eloquence of a high order, illuminated with the most brilliant flashes of wit. In 1868 the question of the Dis- establishment of the Irish Church came to the front, and Magee threw himself into the task of its defence with his usual energy and vivacity. The success of his orations caused Mr Disraeli to offer him the bishopric of Peter- borough in a characteristic letter. He justifiedhis appoint- ment by his magnificent speech when the Disestablish- ment Bill reached the House of Lords in 1869, and then plunged into diocesan and general work in England. Here he was everywhere in request, and preached and published sermons on a variety of subjects, the most celebrated, perhaps, of these being his three remarkable Sermons on Christian Evidence, in Norwich Cathedral in 1871. He took up the temperance question, andelectrified the country by a declaration in the House of Lords that he would rather see "*~~

~~England free than England compulsorily sober," an utterance which the extreme advocates of total abstinence commented on most severely, leaving out, in a manner not uncommon with men in whom the judicial faculty is weak, the qualifying word " compulsorily," and representing the bishop as having cast a slur on sobriety. He was also a supporter of the movement for abolishing the recitar tion of the Athanasian Creed in the public services of the Church of England, believing, as he said, that the " pre- sence" of the damnatory clauses, "as they stand and where they stand, is a real peril to the Church and to Christianity itself," and that those clauses "are no essential part" of the creed. The project was laid aside in consequence of the hostility of a large body of the clergy, reinforced by the threat of Dr Pusey and Canon Liddon to abandon their offices if it were carried. The bishop, moreover, took a prominent part in the Eitual con- troversy, opposing what he conceived to be Romanizing excess in ritual, as well as the endeavour of the opposite party to " put down Ritualism," as Mr Disraeli expressed it, by the operation of the civil law. In short, there was no subject affecting the Church or the moral well-being of~~

~~the people in which his influence was not felt, and in which his remarkable insight and acumen would not have done much service, could he have carried his colleagues with him. His incisive way of putting things earned for him the title of " the Militant Bishop," but, as he himself remarked in relation to this title, his efforts were ever for peace. Unfortunately for the Church, he was not elevated to the see of York until his energies were exhausted. He died on 5th May 1891, about four months after his appointment, leaving the Church the poorer for the loss of a statesman. His family were left impoverished by the heavy fees in- cident on his installation as archbishop. These were ultimately defrayed by a subscription — a tardy acknow- ledgment of a combination of gifts rare in the history of the English Church. His manifold activities, his capability as an administrator, his sound judgment, and his remarkable insight into the ecclesiastical problems of his time, may be best studied in the self-revelation of the man to~~

~~his lifelong friend, Dr M'Donnell, formerly dean of Cashel, who published an account of the archbishop's life along with his correspondence. (j. j. l*.)~~

~~Magenta, a town of the province of Milan, Lom- bardy, Italy, situated in the midst of ricetields, 17 miles west of Milan by rail. It manufactures silks and matches, but is famous for the battle (1869) in which the allied French and Piedmontese defeated the Austrians. A monument was erected on the battlefield in 18C2. Popu- lation, about 5500.~~

~~Maggiore, LagO, a lake of northern Italy and Switzerland, lying at the foot of the Lepontine Alps, due north from ISTovara. According to Marinelli, its area is 82 square mUes, its altitude above sea-level 643 feet, and its maximum depth 1221 feet. Between midnight and morning it is usual for a northerly wind to blow, the Tramontana, whilst the Inverna, a southerly wind, pre- vails from noon until about four o'clock in the afternoon.~~

~~See 0. Marinelli, in Geografia per Tutti (1894) ; "k. Ritter, in Le Globe : Memoires, vol. vii. (1896), ; and, for a discussion of tlie liydrograpliio problems connected with the lalie, G. Fantoli, Sul Begime Idraulico dei Laghi (Milan, 1897).~~

~~Magic (including Conjuring and Legerdemain). — The article on White Magic in the earlier volumes of this work (ninth edition, vol. xv.) concludes with a description of Maskelyne's "box-trick" — a trick which others had only partially succeeded in imitating, and the secret of which has never been thoroughly elucidated. In dealing with the more recent history of magic and conjuring, we may conveniently take up the story at the poiat where the previous article leaves it.~~

~~Modern magic has given rise to many interesting developments, but none perhaps attracted a larger share of public attention than the legal battle in the last years of the century over the old box-trick, invented by Mr Maskelyne in 1860. The case had a special interest in England, from the fact that it was the only one in which a trick had ever occupied the attention of the House of Lords. The litigation arose in this way. Mr Maskelyne had been in the habit of offering a considerable reward to any one who could produce a correct imitation of his box- trick. The offer was a direct challenge to imitators, and was intended to show — as nothing else could~~

~~*have done — that the tricks sold and exhibited as "correct imita- tions" were not what they professed to be. Two amateur mechanicians, having made or procured a box externally resembling Mr Maskelyne's, gave a private performance before a few friends, and then claimed the reward. Mr Maskelyne refused to pay, his contention being that hundreds of people had already escaped from locked and corded boxes resembling his in appearance. Indeed, it was*~~

~~*for that very reason that he had been compelled to make the offer. The claimants then brought an action to recover £500 — the amount offered. Mr Maskelyne pro- duced his box in court, and challenged the plaintiffs to expose the secret, contending that they could not pos- sibly imitate correctly a trick of which they did not know the secret. Their point, however, was that they had nothing to do with the secret, and that a box-trick was not a trick-box. The jury, being unable to decide whether a mechanical trick is a piece of mechanism or the effect it produces, could not agree, and were dis- charged. In a second trial, the jury, after much delibera- tion, found for the plaintiffs. Mr Maskelyne appealed against the verdict. His appeal occupied the court for three days, and was dismissed. Finally he carried the case to the House of Lords, and lost it. The majority of the law lords, while fully admitting that the secret had never been discovered, were of opinion that the trick had been correctly " imitated." To people dealing with mechanical devices this decision is bound to appear not a little curious. A mechanical trick is a mechanical invention, and, when we have two absolutely different inventions, although they may produce more or less similar results, one is by no means an imitation of the other — to say nothing of a " correct imitation." Applied to inventions generally, such a ruling would produce dis- astrous results.*~~

~~*To those interested in magic, however, one effect of the litigation was to intensify the mystery surrounding the original box-trick. The whole matter has been publicly thrashed out. It has been learned that the trick, generally, consists of a movable panel fastened by a secret catch. Provided that the rope be not too severely knotted over the panel, the performer can escape ; but otherwise failure is inevitable. Further, it is known that the original trick has never failed, even under the most severe tests, whereas the imitations have failed repeatedly. There can only be one reason for this — a*~~

~~*great difference in the mechanical principles employed. What that difference may be can only be decided by future disclosures.*~~

~~*Like most forms of refined entertainment, magic appears to have kept well abreast of the times. Certainly, at no period of the world's history has it ever been so popular as at present. As a natural consequence, so many skilled exponents of the art hav.e never before existed. Yet there is one respect in which at the present day magic shows no advance upon the records of earlier times. The one great peculiarity in connexion with magic, at every period, has been the limited number of those who prove themselves capable of originating magical effects. This peculiarity has never been more thoroughly emphasized than at present. Since the days of Eobert Houdin, only two men have attained any remarkable degree of promi- nence — Mr Maskelyne and M. Buatier de Kolta. There are many who, as entertainers, are entitled to rank with the highest, but to those two only can prominence be justly given as originators. The only logical conclusion to be drawn is that to invent original illusions is a matter of no ordinary difficulty, and, indeed, all who have attempted work of that kind will admit that such is the case. When, however, an original principle has been invented, it may be utilized in produciug many and apparently quite distinct effects. As an example of this, Maskelyne's " Cleopatra's Needle," invented in 1879, may be mentioned. The trick consisted of a piece of mechan- ism representing an exceedingly light model of the famous obelisk. So light was it, in fact, that it could easily be lifted with one hand. Upon an isolated stand, previously examined by the audience, a sheet of ordinary brown paper was laid, and on this the " needle " was placed. Thus during the performance communication with the obelisk*~~

~~*Avas obviously impossible. Yet from within it human beings emerged in a most startling manner. The secret consisted in the fact that the " needle " was capable of being_ lifted by invisible means, and from the outset contained two or three persons concealed within it. Notwithstanding the fact that this illusion was one of Mr Maskelyne's simplest devices, it puzzled even experts for a considerable time. When at last the secret leaked out, the*~~

~~*principle was seized upon with avidity and utilized in a variety of ways — for example, by M. Buatier de Kolta in his beautiful illusion, " The Cocoon," first produced at the Egyptian Hall, London, in 1887. In this case de Kolta had the advantage of Mr Maskelyne's assistance in perfecting the mechanical details. De Kolta's smaller tricks have for years sup- plied the whole army of ordinary conjurors with novel- ties. In 1886, at the Eden Theatre, Paris, he introduced his famous illusion kno^vn as "The Vanishing Lady." This mystery, performed as he alone could perform it, was one of the most effective tricks ever exhibited. Hundreds of " imitations " were, of course, produced ; but, like the imitations of Mr Maskelyne's box, they sink into insignificance when compared with the original ; and in this case, unfortunately for the originator, the reputation of the original was speedily ruined by clumsy exponents, who only succeeded in exposing the principle. The effect produced by de Kolta was as follows: — Taking from his pocket what appeared to be an ordinary newspaper, folded, he opened it out and laid it upon the stage. Then a chair was shown, front and back, to the audience, and placed upon the paper. Madame de Kolta, in ordinary evening dress, then took her seat upon the chair, and a large piece of black silk was thrown over her, enveloping her from head to foot. Then de Kolta would shout, "I'll throw you in the air ! " — or words to that effect — and to all appearance he grasped her round the waist, lifted her above his head, and she vanished, covering and all, at his finger-tips. The trick, as performed by imitators, is well known, and is described in many works upon conjuring, e.rj., in Hoffman's Magic.*~~

~~*Among the illusions depending for their effect upon sudden disappearance, perhaps the most inexplicable was that produced by Mr Maskelyne in 1891 under the appro- priate title of " Oh ! " — that being an expression frequently used by spectators upon witnessing the startling effect. In the illusion the performer whose disappearance was to be effected seated himself upon a raised couch, above which a kind of canopy was supported upon brass rods. Erom the canopy depended curtains capable of being raised or lowered. The right hand of the performer was strapped to one end of this couch, and the left hand was secured by means of a strap attached to one end of a stout cord. The other end of the cord, having been passed through a hole in the framework of the canopy, was securely held by a member of the audience. The curtains were then lowered to within 18 inches*~~

~~*of the ground, and through an aperture in the front curtain the performer's right hand was passed. This hand, again, was held by a second member of the audience. EinaUy, a sheet of iron was placed beneath the couch, to prevent any possibility of the performer's escape being effected through a trap in the stage. Thus, with the performer's right hand in full view, his left drawn upwards by the cord attached to it, and a clear space below the couch, escape seemed impos- sible ; yet, upon the word " Go ! " the right hand disap- peared, the cord became slack in the hands of the holder, the curtains were instantly raised, and the performer had vanished. The secret of this mystery, like many others associated with the Egyptian Hall, has been well pre- served. Having a theatre to himself, and being sur-*~~

~~*rounded by trusty assistants, Mr Maskelyne possesses a great advantage. Those of his confreres who are obliged to perform at variety theatres and elsewhere must neces- sarily expose their secrets to stage hands. But, apart from this fact, some of Mr Maskelyne's effects are so elaborate in their mechanism that many weeks are occupied in making the stage arrangements. Such effects therefore would be quite impracticable for the purposes of the peri- patetic illusionist.*~~

~~*In 1886 M. Buatier de Kolta, in conjunction with Mr Maskelyne, presented at the Egyptian Hall, Lon- don, a series of illusionary effects upon an entirely novel principle, to which they gave the naine of " Black Magic." The main idea was based upon the fact — obvious when once it is pointed out — that visible form cannot exist in the absence of shadow or varying tint. In other words, we can only distinguish forms when they exhibit either variations in colour or shade. Abso- lute uniformity must, necessarily, mean invisibility. To bring about this uniformity, the entire stage was draped in black velvet, giving it the appearance of a dark and immensely deep cavern. There were no lights within it, though from the front it was brilliantly illuminated. Upon the stage, thus prepared, the most startling appearances and disappearances took place, within a few feet of the footlights. The illusions were produced by the simple method of covering any- thing to be concealed by screens of black velvet. These could be brought almost to the front of the stage, and yet would remain invisible ; thus, in an instant, persons or articles would appear, apparently from space, or would disappear into it. The principle involved in the production of these illusions*~~

~~was adopted subsequently by many conjurors, and has served to produce an almost endless variety of effects.~~

~~The production of innumerable blossoms from a sheet of paper was undoubtedly the prettiest of M. Buatier de Kolta's smaller tricks. A small sheet "W cartridge-paper is twisted into a cone, which is shown to be empty, but immediately artificial blossoms begin to pour ont of it, until quite a bushel of them are piled up. Unfortunately for the inventor, the first time he introduced the trick at the Eden Theatre, Paris, one or two of the " blossoms " were carried by a draught of air into the auditorium. These were at once sold to a manufacturer of conjuring appliances, and within a few days de Kolta's " Spring Blossoms " were upon the market.~~

~~Another startling trick, by the same inventor, is " The Flying Cage." A live bird is imprisoned within a small cage, held between the performer's hands, when suddenly, by a quick movement of the arms, both bird and cage vanish. The cage simply collapses, and is drawn by a string up the coat-sleeve, the unfortunate bird being sometimes maimed, if not killed outright. The Society for the Prevention of Cruelty to Animals once took action in the matter, and sought to prevent the performance of the trick at one of the London music-halls ; but the conjuror in this case invited the ofl&cials to witness a private demonstration, and was clever enough to convince them that there was no cruelty. Conjuring with animals has a great charm for young folk, and happily it is very seldom that a trick involves any cruelty whatever. The animals, as a rule, quickly become accustomed to the business, and appear thoroughly to understand what is required of them.~~

~~In recent years the mystery known as " Second Sight " has been vastly improved. The old system, invented by Pinetti in 1785, and brought to great perfection by Robert Houdin, has almost disappeared. It consisted of an elaborate code of signals, given by means of subtle variar tions in the questions put to the supposed clairvoyant;~~

~~*the form in which the question was put conveying the appropriate answer. Now it is customary to avoid speech altogether. The information is conveyed by means of gesture or slight sounds at varying intervals. This business requires an enormous amount of practice, and an abnormal memory on the part of those who become expert.*~~

~~*But there are certain tricks of this class which require little or no skill and a very small amount of practice. These are generally introduced by impostors who claim or tacitly suggest the possession of supernatural powers. The following is a very familiar example of the kind of trick employed by such persons. The performers are usually a man and a woman. The man first appears, and informs the audience that he will shortly introduce a lady possessing extraordinary powers. Not only can she read the thoughts of any person whose mind is en rapport with hers, but also she can foretell the future, trace missing friends, discover lost property, ifec. In order to display the lady's capabilities, he requests that any members of the audience who have questions they would like answered will write them secretly. For convenience in writing, slips of paper, pencils, and squares of thick millboard are passed round, the millboard squares being for use as writing-desks. The writers are particularly cautioned to allow no one to see what is written, but to fold up the papers and retain them in their own possession. Further, the writers are instructed that, when the clairvoyant appears, the thoughts of each must be kept intently fixed upon what he has written. The pencils and millboards are then collected, and the preparations being so far complete, other portions of the entertainment are pro- ceeded with. Finally, as the last item in the pro- gramme, the clairvoyant is introduced. A handkerchief, upon which some liquid has been poured, is held over the lady's nose and mouth, and apparently she falls into a trance. Then ■ she proceeds to describe the appearance of certain of the writers, the position they occupy in the room, and the nature of the questions they have written, giving to those questions more or less plausible answers. The trick never faUs to produce the most profound astonishment, and by its means several persons have made rapid strides to fortune. But the whole business is an impudent imposture. Therefore it cannot be too often or too thoroughly exposed. It is accomplished as follows. Some of the millboards passed round for con- venience in writing are built up of a number of thick- nesses, fastened together at the edges only. Beneath the outer layer a sheet of*~~

~~carbon paper is concealed, so that the pressure of the pencil causes a reproduction in dupli- cate to be impressed upon an inner layer of cardboard. These prepared pads are handed round by attendants, who note the dress and appearance of the persons by whom the questions are written. That information, together with the prepared pads, is subsequently con- veyed to the clairvoyant. She requires a certain amount of time in order to memorize the questions and the description of the writers ; consequently she is not intro- duced to the audience until, say, an hour has elapsed. Of course, it would not be discreet to have all the mill- boards prepared. Many of them, perhaps the majority, are really what they appear to be ; but, needless to say, the questions written upon these are never answered. It is carefully pointed out beforehand that the clairvoyant can only read the questions of those whose minds are in sympathy with hers. That statement, naturally, serves to account for her inability to read or answer questions written by those who have used the plain millboards.~~

~~In connexion with this trick a further imposture is carried out by inviting strangers to send, by post, any~~

~~questions they wish to have answered. Such an invita- tion appears to be quite straightforward and genuine, but those who are sufficiently credulous or sufficiently curious to respond to it lend themselves to the perpetration of an ingenious fraud. In reply to any such communication, the writer is informed that it is necessary for him to attend one of the public performances, and endeavour to bring his mind into harmony with that of the clairvoyant. Enclosed is a complimentary ticket entitling him to attend any performance he pleases. The procedure, then, is simply this. Each ticket bears a private mark, and a corresponding mark is put upon the letter written by the person to whom it is sent. When any marked ticket is presented, the attendant notes the dress and appearance of the visitor and the seat he occupies. That information is given to the clairvoyant, together with the ticket. She refers to the letter bearing the mark corresponding to the ticket, and ascertains what that particular visitor wishes to know. Thus to the public she appears to read and answer a question which has not been written down, but merely thought of by a total stranger. There are numerous methods of obtaining information by means similar to those already described. Sufficient, however, has been said to show that such devices are~~

~~*of the simplest, and require nothing more than a callous effrontery to carry them into effect. Of course, all kinds of mischances are bound to occur. But, when one is supposed to be dealing with undiscovered laws of nature, it does not require much ingenuity to wriggle out of any situation, however difficult.*~~

~~*In reference to that branch of conjuring known as " Legerdemain " or " Sleight-of-hand," which relies mainly upon dexterity of the fingers, for many years little advance was made. But recently some new sleights were intro- duced from America. These consist in an amplification of the method of concealing coins and cards at the back of the fingers. The principle has received the incongruous title of " back-palming." By means of this method both back and front of the hand alternately can be shown empty, while, notwithstanding its apparent emptiness, the hand nevertheless conceals a coin or card. The first and fourth fingers are caused to act as pivots, upon which the concealed articles are turned from front to back, and vice versd, the turning being performed by the second and third fingers. The movement is very rapid, and is accom- plished in the act of turning over the hand to show the two sides alternately. The sleight requires an enormous amount of practice. It has been brought to the highest state of perfection by Herr Valadon.*~~

~~*In all ages a very popular magical effect has been the apparent floating of a person in empty space. An endless variety of ingenious apparatus has been invented for the purpose of producing such effects, and the present article would be incomplete without some reference to one or two of the more modern examples. A very pretty illusion of this kind is that originally produced under the title of " Astarte." A lady is brought forward, and after making lier bow to the audience she retires to the back of the stage, the whole of which is draped with black velvet and kept in deep shadow. There she is caused to rise in the air, to move from side to side, to advance and retire, and to revolve in all directions. The secret consists in an iron lever, covered with velvet to match the background, and therefore invisible to the audience. This lever is passed through an opening in the back curtain and attached to a socket upon the metal girdle worn by the performer. The girdle consists of two rings, one inside the other, the inner one being capable of*~~

~~turning about its axis. By means of this main lever and a spindle passing through it and gearing into the inner~~

~~ring of tte girdle, the various movements are produced. A hoop is passed over the performer with a view to demonstrate her complete isolation, but the audience is not allowed to examine it. It has a spring joint which allows it to pass the supporting lever. Among illusions of this class there is probably none that will bear comparison with the "levitation" mystery produced by Mr Maskelyne. A performer, in a recumbent position, is caused to rise several feet from the stage, and to remain suspended in space while an intensely brilliant light is thrown upon him, illuminating the entire surroundings. Persons walk completely round him, and a solid steel hoop, examined by the audience, is passed over him, backwards and forwards, to prove the absence of any tangible connexion. The most skilled experts have failed to give any adequate explana- tion of this mystery, of which the secret has been well preserved. (g. fa. ; j. n. m.)~~

~~Magrliani, AgOStino (1824-1891), Italian poli- tician and financier, was born at Laurino, Salerno, in 1824. Entering the Neapolitan financial administration,~~

~~he showed such aptitude as to be selected by Sella in 1862 for the post of secretary general of the Italian Ministry of Finance. Shortly after the advent of the Left he was created senator, and appointed by Depretis Minister of Finance (1877), a position which he held, in spite of attacks, for eleven years. More than any other Italian poHtioian, Magliani represented the "democratic finance" of the Left, arranging for the repeal of the grist tax, reducing the price of salt, and contracting a foreign loan for the abolition of the forced paper currency ; but at the same time he seriously burdened the lower classes by increasing indirect taxation to the extent of £1 2,000,000 per annum, and ir.iugurating a policy of exaggerated pro tection. The abolition of the forced currency gained for him temporary popularity ; but as the metallic currency gradually proved unequal to the strain of the financial situation, his prestige declined, and he was obliged to resign in~~

~~December 1888. Unduly optimistic in tempera^ ment and lax in administration, he contributed to create the desperate financial position of 1888-1893, but died on 21st February 1891, before realizing the worst con- sequences of his policy. (h. w. s.)~~

~~MAGNETISM.~~

~~THE present article contains a short account of the general experimental work in magnetism which has been carried out since the publication of the important treatise in the ninth edition of the Encyclopaedia Britannica, vol. XV. pp. 219-276. In an introductory section a few elementary formul® relating to matters of fundamental importance are collected, and definitions are given of the principal terms in common use. Repetition has, as far as possible, been avoided, and this article must be regarded as merely supplementary to the former one. Some special branches of the subject are dealt with in separate articles under the headings Measuring Instru- ments, Electric ; Electromagnets ; Magneto Optics ; and Magnetism, Terrestrial. These should be con sulted by the reader who desires to acquaint himself with recent advances in the directions indicated.~~

~~Terminology and Elementary Principles.~~

~~In what follows, the C.G.S. electromagnetic system of units will be generally adopted, and, unless otherwise stated, magnetic substances will be . assumed to be isotropic.~~

~~Magnetic Classification of Substances. — According to the dis- covery of Faraday, all substances are either attracted or repelled by the pole of a sufficiently powerful magnet. The metals iron, nickel, and cobalt, togethe; with some of their alloys and compounds, exhibit the phenomenon of attraction in a particularly striking manner. These form a class by themselves, and are spoken of as ferromagnetic, or, when confusion is not likely to arise, simply as magnetic substances. Those bodies which are attracted, but in a very much less degree, are termed paramagnetic; while those which exhibit repulsion are known as diamagnetic.~~

~~Unit Magnetic Pole. — A pole of unit strength is that which acts on an equal pole at a distance of one centimetre with a force of one dyne. A pole~~

which points north is reckoned positive, one which points south negative. If ot^ and m^ are the strength of two poles, d the distance between them expressed in centimetres, and /the force in dynes, then /= mi^n^/rf^ The poles at the ends of an infinitely thin magnet, or magnetic filament, would act as definite centres of force. An actual magnet may be regarded as a bundle of magnetic, filaments, and those portions of the surface of the magnet where the magnetic filaments terminate, and so- called " free magnetism " appears, may be conveniently called poles or polar regions.

Magnetic Field. — The strength or intensity of a magnetic field at any point is measured by the force in dynes which a unit pole will experien ,e when placed at that point, the direction of the field being the direction.in, which a positive pole is urged. The

field strength at any point is also called the magnetic force at that point ; it is denoted by H, or, when it is desired to draw attention to the fact that it is a vector or directed quantity, by the block letter H or the German character §.' A line of force is a line drawn through a magnetic field in the direction of the force at each point through which it passes. A uniform Tuagnetic field is one in which H has everywhere the same value and the same direction, the lines of force being therefore straight and parallel. A magnetic field is produced either by a conductor carrying an electric current or by the pole of a magnet. ,The direction of the magnetic field due to a long straight wire in which a current is flowing is at every point at right angles to the plane passing through it and through the wire. Its strength at any point distant r centimetres from the wire is

H = 2i/r,

i being the current in C.G.S. units.^ The lines of force are evidently circles concentric with the wire and in planes at right angles to it. The field at the centre of a circular conductor of radius r through which a current is passing is

H = 2iri/r,

the direction of the field being along the axis. The field strength in the interior of a long uniformly wound coil containing n turns of wire and

~~*having a length of I centimetres is (except near the ends)*~~

~~*H = irin/l.*~~

~~*In the middle portion of the coil the strength of the field is very nearly uniform, but towards the ends it diminishes, and at the ends themselves is reduced to one-half. The direction of the field is parallel to the axis of the coil, and is related to the direc- tion of the current circulating through the wire in the same manner as the thrust of a corkscrew is related to its rotation. If the coil has the form of an endless ring of mean radius r, the length will be 2irr, and the field inside the coil may be expressed as*~~

~~*H = 2m/n*~~

~~*The uniformity of the field is not in this case disturbed by the influence of ends, but its strength at any point varies inversely as the distance from the axis of the ring. When, therefore, sensible uniformity is desired, the radius of the ring should be large in relation to that of the convolutions, or the ring should have the form of a short cylinder with thin walls. The strongest magnetic fields employed for experimental purposes are obtained by the use of electromagnets. For many experiments the field due to the earth's magnetism is sufficient ; this is practically quite uniform throughout considerable spaces, but its total*~~

~~*^ Maxwell employed German characters to denote vector quantities. J. A. Fleming first recommended the use of block letters, as being more convenient both to printers and to readers. In the article Maqnbtibm {Ency. Brit. 9th ed.) Old English characters are used.*~~

~~*^ The C.G.S. unit of current=10 amperes.*~~

~~*intensity is less than half a unit. Magnetic force is sometimes, and perhaps more suitably, termed magneiic intensity ; it corre- sponds to the intensity of*~~

~~*gravity g in the theory of heavy bodies (see Maxwell, Electricity and Magnetism, § 12 and § 68,' foot- note).*~~

~~*Magnetic Induction or Magnetic Flux. — "When magnetic force acts on any medium, whether magnetic or diamagnetic or neutral, it produces within it a phenomenon of the nature of a flux called magnetic induction (Maxwell, loc. cit. % 428). Magnetic induction, like other fluxes, such as electric, thermal, or fluid currents, is defined with reference to an area ; it satisfies the same conditions of continuity as the electric current does, and in isotropic media it depends on the magnetic force just as the electric current depends on the electromotive force. The magnitude of the flux produced by a given magnetic force difl^ers in different media. In a uniform magnetic field of unit intensity, formed in empty space, the induction or magnetic flux across an area of 1 square centi- metre normal to the direction of the field is arbitrarily taken as the unit of induction. HIence, if the induction per square centi- metre at any point is denoted by B (or by B or S3 when the vector quality is to be attended to), then in empty space B is numerically equal to H ; moreover, in isotropic media both have the same direction, and for these reasons it is often said that in empty space (and practically in air) B and H are identical. Their numerical equality is, however, a mere accident, depending upon the capricious selection of a definition by the framers of the C.G.S. electromagnetic system of units (see Eleotbicity, § iv., Electric Units). The magnetic flux per square centimetre at any point (B, B, or SB) is briefly called the induction, or, especially by electrical engineers, ilx^ flux-density. The direction of magnetic induction may be indicated by lines of induction ; a line of induc- tion is always a closed curve. Lines of induction drawn through every point in the contour of a small surface form a re-entrant tube bounded by lines of induction ; such a tube is called a tube of induction. The cross-section of a tube of induction may vary in different parts, but the total induction across any section is everywhere exactly the same. A special meaning has been assigned to the term "lines of induction. " Suppose the whole space in which induction is taking place to be divided up into unit tubes, such that the surface integral of the induction over any cross-section of a tube is equal to unity, and along the axis of each tube let a line of induction be drawn. These axial lines constitute the system of lines of induction which are so often referred to in the specification of a field. WTiere the induction*~~

~~*is high, the lines will be crowded together ; where it is weak, they win be widely separated, the number per square centimetre cross- ing a normal surface at any point being always equal to the numerical value of B. The induction may therefore be specified as B lines per square centimetre. The direction of the induction is also of course indicated by the direction of the lines, which thus serve to map out space in a, convenient manner. Lines of induction are frequently but inaccurately spoken of as lines ot force.*~~

~~*Magnetic Moment and Magnetization. — The inoment of «• uni- formly and longitudinally magnetized bar magnet is the pro- duct of its length into the strength of one of its poles. The intensity of magnetization, or, more shortly, the magnetization of a uniformly magnetized body, is defined as the magnetic moment per unit of volume (1 cubic centimetre), and is denoted by I, I, or 3f. When induction or magnetic flux takes place in a ferromagnetic metal, the metal becomes magnetized, but the magnetization at any point is proportional not to B, but to B — H. If the C.G.S. electromagnetic system of units is adopted, the factor of proportionality will be l/47r, so that*~~

~~*I = (B-H)/4t, or B = H-H4irI.*~~

~~*Unless the path of the induction is entirely inside the metal, free magnetic poles are developed at those parts of the metal where induction enters and leaves, the polarity being south at the entiy and north at the exit of the flux. These free poles product! a magnetic field which is coexistent with that arising from otlier sources. The resultant magnetic field, therefore, is compounded of two fields, the one being due to the poles, and the other to the external causes which would be operative in the absence of the magnetized metal. The intensity (at any point) of the field due to the magnetization may be denoted by Hj, that of the external field by Hq, and that of the resultant field by H. In certain oases, as, for instance, in an iron ring wrapped uniformly round with a coil of wire through which a current is passing, the induc- tion is entirely within the metal ; there are, consequently, no free poles, and the ring, though magnetized, constitutes a poleless magnet. Magnetization is usually regarded as the direct effect of magnetic force, which is therefore often termed the Tnagnetizing force.*~~

~~*Permealility and Susceptibility. — The ratio B/H is called the permeability of the medium in which the induction is taking*~~

~~place, and is denoted by ii. The ratio I/H is called the suscepti- bility of the magnetized substance, and is denoted by k. Hence B=/iHand I=kH.~~

~~Also /i==r= — Tf^ — =l + i-irK,~~

~~iir~~

~~H~~

~~and~~

~~Since in empty space B has been assumed to be numerically equal to H, it follows that the permeability of a vacuum is equal to 1. The permeability of most material substances differs very slightly from unity, being greater in paramagnetic and less in diamag- netic substances. In the case of the ferromagnetic metals and some of their alloys and compounds, the permeability has gener- ally a much higher value. Moreover, it is not constant, being an apparently arbitrary function of H or of B ; in the same specimen its value may, under different conditions, vary from less than 2 to upwards of 5000. The magnetic susceptibility k expresses the numerical relation of the magnetization to the magnetizing force. From the equation K=(/t- l)/47r, it follows that the magnetic susceptibility of a vacuum (where A'=l) is 0, that of a diamagnetic substance (where /x\) is positive. No substance has yet been discovered having a negative susceptibility sufficiently great to render the permeability (= 1-1- 47r/c) negative.~~

~~Hysteresis, Coercive Force, Retentiveness. — It is found that when a piece of ferromagnetic metal, such as iron, is subjected to a magnetic field of changing intensity, the changes which take place in the induced magnetization of the iron exhibit a tendency to lag behind those which occur in the intensity of the field — a phenomenon to which Ewing {Phil. Trans, vol. clxxvi. p. 524) has given the name of hysteresis (from iarepioi, to lag behind). Thus it happens that there is no definite relation between the magnet- ization of a piece of metal which has been previously magnetized and the strength of the field in which it is placed. Much depends upon its antecedent magnetic condition, and indeed upon its whole magnetic history. A well-known example of hysteresis is presented by the case of permanent magnets. If a bar of hard steel is placed in a strong magnetic field, a certain~~

~~intensity of magnetization is induced in the bar ; but when the strength of the field is afterwards reduced to zero, the magnetization does not entirely disappear. That portion which is permanently retained, and which may amount to considerably more than one-half, is called the residual onagnetization. The ratio of the residual mag- netization to its previous maximum value measures the retentive- ness of the metal.^ Steel which is well suited for the construction of permanent magnets is said to possess great "coercive force." To this term, which had long been used in a loose and indefinite manner, Hopkinson supplied a precise meaning (Phil. Trans. vol. clxxvi. p. 460). The coercive force of a material is that reversed magnetic force which, while it is acting, just suffices to reduce the residual induction to nothing after the material has been temporarily submitted to any great magnetizing force. A metal which has great retentiveness may at the same time have small coercive force, and it is the latter quality which is of chief importance in permanent magnets.~~

~~Demagnetizing Force. — It has already been mentioned that wheh a ferromagnetic body is placed in a magnetic field, the resultant magnetic force H, at a point within the body, is compounded of the force H^, due to the external field, and of another force, H;, arising from the induced magnetization of the body. Since H; generally tends to oppose the external force, thus making H less than Hq , it may be called the demagnetizing force. Except in a few special cases, when a uniform external field produces uniform mag- netization, the value of the demagnetizing force cannot be calcu- lated, and an exact determination of the actual magnetic force within the body is therefore impossible. An important instance in which the calculation can be made is that of an elongated ellipsoid of revolution placed in a uniform field H,,, with its axis of revolution parallel to the lines of force. The magnetization at any point inside the ellipsoid will then be~~

~~1 =~~

~~1-f kN~~

~~where~~

~~^i-^)(W^.-^\~~

~~*e being the eccentricity (see Ency. Brit. vol. xv. pp. 246, 232). Since I = kH, we have*~~

~~*kH-I-icNI = kH„, or H = H„-NI,*~~

~~*NI being the demagnetizing force Hj. N may be called, after du Bois [Magnetic Circuit, p. 33), the demagnetizing factor, and*~~

~~*‘ Hopkinson specified the retentiveness by the numerical value of the “residual induction” (= 47rl).*~~

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~~*the ratio of the length of the ellipsoid 2c to its equatorial diameter 2a (= cja), the dimensional ratio, denoted by the symbol m.*~~

~~*Since*~~

~~*the above expression for N may be written*~~

~~*N =*~~

~~*4lr*~~

~~*i*~~

~~*iw*~~

~~*xsi’*~~

~~*-l*~~

~~*/•IL*~~

~~■*log*~~

~~*m + ^m? — 1*~~

■^W

log (m + \Jm'^

-)

)-)•

-,(^log2m-l).

from which the value of N for a given dimensional ratio can be calculated. When the ellipsoid is so much elongated that 1 is negligible in relation to ni", the expression approximates to the simpler form

m^

The demagnetizing force inside a cylindrical rod placed longi- tudinally in a uniform field Hq is not uniform, being greatest at the ends and least in the middle part. Denoting its mean value by Hj, and that of the demagnetizing factor by N, we have

H = H„-Hj=Ho-NI. Du Bois has shown that when the dimensional ratio tn (= length/ diameter) exceeds 100, Nin'^=constant=45, and hence for long thin rods

N=45/m2.

From an analysis of a number of experiments made with rods of different dimensions, du Bois has deduced the corresponding mean demagnetizing factors. These, together with values of m^N for cylindrical rods, and of N and m^N for ellipsoids of revolution, are given in the foUowiug very useful table (loo. cit. p. 41) : —

Demagnetizing Factors.

m.

Cylinder.

~~*Ellipsoid.*~~

~~*if.*~~

~~*m'^N.*~~

~~*N.*~~

~~*mm.*~~

~~*θ*~~

~~*12-566*~~

~~*θ*~~

~~*12-5664*~~

~~*θ*~~

~~*0-5*~~

~~—~~

~~—~~

~~*6-5864*~~

~~—~~

~~*1*~~

~~–~~

~~*4-1888*~~

~~.—~~

~~*5*~~

—

—.

~~0-7015~~

—

~~10~~

~~0-2160~~

~~21-6~~

~~0-2549~~

~~25-5~~

~~15~~

~~0-1206~~

~~27-1~~

~~0-1350~~

~~30-5~~

~~20~~

~~0-0775~~

~~31-0~~

~~0-0848~~

~~34-0~~

~~25~~

~~0-0533~~

~~33-4~~

~~0-0579~~

~~36-2~~

~~30~~

~~0-0393~~

~~35-4~~

~~0-0432~~

~~38-8~~

~~40~~

~~0-0238~~

~~38-7~~

~~0-0266~~

~~42-5~~

~~50~~

~~0-0162~~

~~40-5~~

~~0-0181~~

~~45-3~~

~~60~~

~~0-0118~~

~~42-4~~

~~0-0132~~

~~47-5~~

~~70~~

~~0-0089~~

~~43-7~~

~~0-0101~~

~~49-5~~

~~80~~

~~0-0069~~

~~44-4~~

~~0-0080~~

~~51-2~~

~~90~~

~~0-0055~~

~~44-8~~

~~0-0065~~

~~52-5~~

~~100~~

~~0-0045~~

~~45-0~~

~~0-0064~~

~~64-0~~

~~150~~

~~0-0020~~

~~45-0~~

~~0-0026~~

~~58-3~~

~~200~~

~~0-0011~~

~~45-0~~

~~0-0016~~

~~64-0~~

~~300~~

~~0-00050~~

~~45-0~~

~~0-00075~~

~~67-5~~

~~400~~

~~0-00028~~

~~45-0~~

~~0-00045~~

~~72-0~~

~~500~~

~~0-00018~~

~~45-0~~

~~0-00030~~

~~75-0~~

~~1000~~

~~0-00005~~

~~45-0~~

~~0-00008~~

~~80-0~~

~~*In the middle part of a rod which has a length of 400 or 500 diameters the effect of the ends is insensible ; but for many experiments the condition of endlessness may be best secured by giving the metal the shape of a ring of uniform section, the magnetic field being produced by an electric current through a coil of wire evenly wound round the ring. In such cases Hj=0 and H = Ho.*~~

~~*The residual magnetization I^ retained by a bar of ferromag- netic metal after it has been removed from the influence of an external field produces a demagnetizing force NI„ which is greater the smaller the dimensional ratio. Hence the difficulty of im- parting any considerable permanent*~~

~~*magnetization to a short thick bar not possessed of great coercive force. The magnet- ization retained by a long thin rod, even when its coercive force is small, is sometimes little less than that which was produced by the direct action of the field.*~~

~~*Demagnetization by Reversals.— la the course of an experiment it is often desired to eliminate the effects of previous magnetiza- tion, and, as far as possible, wipe out the magnetic history of a specimen. In order to attain this result it was formerly the practice to raise the metal to a. bright red heat, and allow it to*~~

~~*cool while carefully guarded from magnetic influence. This operation, besides being very troublesome, was open to the objec- tion that it was almost sure to produce a material but uncertain change in the physical constitution of the metal, so that, in fact, the results of experiments made before and after the treatment were not comparable. Ewing introduced the method (Phil. Trans, vol. clxxvi. p. 539) of demagnetizing a specimen by subject- ing it to a succession of magnetic forces which alternated in direction and gradually diminished in strength from a high value to zero. By means of a simple arrangement, which will be described farther on, this process can be carried out in a few seconds, and the metal can be brought as often as de.sired to a definite condition, which, if not quite identical with the virgin state, at least closely approximates to it.*~~

~~*The laws of the magnetic circuit are discussed under the heading Electromagnet.*~~

~~*Magnetic Measurements.*~~

~~*Measurement of Magnetization and Induction. — The magnetJB condition assumed by a piece of ferromagnetic metal in diflferent circumstances is determinable by various modes of experiment wliich. may be classed as magneto metric, ballistic, and traction methods. When either the magnetization I or the induction B corresponding to a given magnetizing force H is known, the other mav be found by means of the formula B = 47rl + H.*~~

~~*Magnetometric Methods. — Intensity of magnetization is most directly measured by observing the action which a magnetized body, generally a long straight rod, exerts upon a small magnetic needle placed near it. The mag netic needle may be cemented horizontally across the back of a little plane or concave mirror, about ;^ or f inch in diameter, which is suspended by a single fibre of unspun sUk ; this arrangement, when enclosed in a case with a glazed front to protect it from currents of air, constitutes a simple but efficient magnetometer. Deflections of the suspended needle are indicated by the movement of a narrow beam of light which the mirror reflects from a lamp and focusses upon a graduated cardboard scale placed at a distance of a few feet ; the angular deflection of the beam of light is, of course, twice that of the needle. The sus pended needle is, in the absence of disturbing causes, directed solely by the horizontal component of the earth's field of magnetic force H^, and therefore sets itself approximately north and south. The magnetized body which is to be tested should be placed in such a position that the force Hp due to its poles may, at the spot occupied by the suspended needle, act in a direction at right angles to that due to the earth — that is, east and west. The direction of the resultant field of force -will then make, with that of H^, an angle 9, such that Hp/H^ = tan d, and the suspended needle will be deflected through the same angle. We have therefore*~~

~~*H^=H^ tan B.*~~

~~*The angle 6 is indicated by the position of the spot of light upon the scale, and the horizontal intensity of the earth's field H„ is known ; thus we can at once determine the value of Hp, from which the magnetization I of the body under test may be calculated.*~~

~~*In order to fulfil the requirement that the field which a mag- netized rod produces at the magnetometer shall be at right angles to that of the earth, the rod may be conveniently placed in any one of three different positions with regard to the suspended needle.*~~

~~*(1) The rod is set in a horizontal position level with the sus pended needle, its axis being in a line _ n*~~

~~*which is perpendicu- ~· '^ ; ?*~~

~~*lar to the magnetic A' r^r B*~~

~~*meridian, and which*~~

~~*passes through the pjg^j*~~

~~*centre of suspension*~~

~~*of the needle. This is called the "end -on" position, and is*~~

~~*indicated in Fig. 1. AB is the rod and C the middle point*~~

~~*of its axis ; NS is the magnetometer needle ; AM biaex:ts the*~~

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~~*vmdeflected needle NS at right angles. Let 21= the length of the rod (or, more accurately, the distance between its poles), D=it3 volume, m and — m the strength of its poles, and let d=the distance OM. For most ordinary purposes the length of the needle may be assumed to be negligible in comparison with the distance between the needle and the rod. We then have approximately for the iield at M due to the rod*~~

~~*„ m m idl*~~

~~*'{d-lf {d + lf {d'-Pf*~~

~~*Therefore*~~

~~*And*~~

~~*1ml=*~~

~~*1 =*~~

~~*{d?-pfYL _(d:'-p)m^t3,Tie.*~~

~~2d~~

~~2ml_((P~ffE^V ~~ 2dv~~

~~2d~~

~~tan 0~~,

~~whence we can find the values of I which correspond to different angles of deflection.~~

~~(2) The rod may be placed horizontally east and west in such a position that the direction of the undeflected suspended needle bisects it at right angles. This is known as the " broadside-on " position, and is represented in Fig. 2. Let the distance of each pole of the rod AB from the centre of the magnetometer needle = d. Then, since H„ the force at M due to m and — m, is the resultant~~

~~of Tj and — ^ we have~~

~~m IP~~

~~2Z d~~

~~or the~~

~~direction~~

~~H = being parallel to AB~~

~~2ml d'~~

~~An~~

~~d~~

~~j_ cPHp~~

~~d'n~~

~~;tan i~~

~~(3) In the third position the test rod is placed vertically with one of its poles at the level of the magnetometer needle, and in the~~

~~line drawn perpendicularly to the undeflected needle from its centre of suspension. The arrangement is shown in Fig. 3, where AB is the vertical rod and M indicates the position of the magneto- meter needle, which is supposed to be perpendicular to the plane of the paper. Denoting the distance AM by d^, BM by d^, and AB by /, we have for the force at M due to the magnetism of the rod~~

~~Hp~~

~~-^-horizontal component of -^ di «2~~

~~Therefore~~

~~and~~

~~1 =~~

~~H, _ d,m^~~

~~d;' d.^ \dj~~

~~;tan e,~~

~~•{-O'}~~

~~tan 6.~~

~~This last method of arrangement is called by Ewing the "one-pole " method, because the magnetometer deflection is mainly caused by the upper pole of the rod {Magnetic Induction, p. 40). For experi- ments with long thin rods or wires it has an advantage over the other arrangements in that the position of the poles need not be~~

~~*known with great accuracy, a small upward or downward displace- ment having little eff'eot upon the magnetometer deflection. On the other hand, a vertically-placed rod is subject to the incon- venience that il; is influenced by the earth's magnetic field, which is not the case when the rod is horizontal and at right angles to the magnetic meridian. This extraneous influence may, however, be allowed for, or it may preferably be eliminated by surrounding the rod with a coil of wire carrying a current such as will produce in the interior a magnetic field equal and opposite to the vertical component of the earth's field.*~~

~~*If the cardboard scale upon which the beam of light is reflected by the magnetometer mirror is a flat one, the deflections as indicated by the movement of the spot of light are related to the -actual deflections of the needle in the ratio of tan 28 to $. Since 6 is always small, sufficiently accurate results may generally be obtained, and much trouble saved, if we assume that tan 26 = 2 tan 6. If the distance of the mirror from the scale is equal to n scale divisions, and if a deflection $ of the needle causes the reflected spot of light to move over s scale divisions, we shall have*~~

~~*s/» = tan 28 exactly, s/2»= tan 8 approximately.*~~

~~*We may therefore generally substitute s/2re for tan 8 in the various expressions which have been given for I.*~~

~~*Of the three methods which have been described, the first two are generally the most suitable for determining the moment or the magnetization of a permanent magnet, and the last for studying the changes which occur in the magnetization of a long rod or wire when subjected to various external magnetic forces, or, in other words, for determining the relation of I to II. A plan of the apparatus as arranged by Ewing for the latter purpose is shown dlagrammatically in Fig. 4. The cardboard scale SS is placed*~~

~~*L*~~

~~*= -^B,*~~

~~*Fig. 4*~~

~~above a wooden screen, having in it a narrow vertical slit wnich permits a beam of light from the lamp L to reach the mirror of the magnetometer M, whence it is reflected upon the scale. A is the upper end of a glass tube, half a metre or so in length, which is clamped in a vertical position behind the magnetometer. The tube is wound over its whole length with two separate coils of insulated wire, the one being outside the other. The inner coil is supplied, through the intervening apparatus, with current from the battery of secondary cells Bj ; this produces the desired magnetic field inside the tube. The outer coil derives current, through an adjustable resistance R, from a constant cell Bj ; its object is to produce inside the tube a magnetic field equal and opposite to that due to the earth's magnetism. C is a " compensating coil " consisting of a few turns of wire through which the magnetizing current passes ; it serves to neutralize the eflect produced upon the magnetometer by the magnetizing coil, and its distance from the magnetometer is so adjusted that when the circuit is closed, no ferromagnetic metal being inside the magnetizing coil, the magnetometer needle under- goes no deflection. K is a commutator for revei-sing the direction of the magnetizing current, and G a galvanometer for measuring it. The strength of the magnetizing current is regulated by adjusting the position of the sliding contact E upon the resistance DF. In Swing's experiments the resistance employed was a liquid one, but except when variations of the current are required to be absolutely continuous, it is less troublesome to use a spiral of bare German silver wire wound rather closely upon a long insulating cylinder. The current increases to a maximum as E approaches F, and diminishes to almost nothing when E is brought up to D ; it can be completely interrupted by means of the switch H.~~

~~The specimen upon which an experiment is to be made generally consists of a wire having a " dimensional ratio " of at least 300 or 400 ; its length should be rather less than that of the magnetizing coil, in order that the field H„, to which it is subjected, may be approximately uniform from end to end. The wire is supported inside the glass tube A with its upper pole at the same height as the magnetometer needle. Various currents are then passed through the magnetizing coil, the galvanometer readings and the simul- taneous magnetometer deflections being noted. From the former~~

we deduce Hq, and from the latter the corresponding value of I, using the formulae H|,=47ri7i/Z and

I = —

di'B^

2mrr'

{'-{!)■}

xs,

where s is the deflection in scale-divisions, n the distance in scale- divisions between the scale and the mirror, and r the radius of the wire.

The curve, Fig. 5, shows the result of a typical experiment made upon a piece of soft iron (Ewiug, Phil. Trans, vol. clxxvi. plate 59), the magnetizing field Hq being first gradually increased and then diminished to zero. When the length of the wire exceeds 400 diameters, or thereabouts, H, may generally be considered as

1

^

-^

1

soo zso

1

a

i

K

»/

s a

0 £

i 3

0 3.

5 ♦

0 fS

Pig. 5.

magnetic field Ug

equivalent to II, the actual strength of the field as modified by the magnetization of the wire ; but if great accuracy is desired, the value of Hi (= NI) may be found by the help of du Bois's table and subtracted from Hj. For a dimensional ratio of 400, N = 0-00028, and therefore II = II^ — 0 -00028 I. This correction may be indicated in the diagram by a straight line drawn from 0 through the point at which the line of 1 = 1000 intersects that of II = 0-28 (Rayleigh, Phil. Mag. vol. xxii. p. 175), the true value of II for any point on the curve being that measured from the sloping line instead of from the vertical axis. The effect of the ends of the wire is, as Ewing remarks, to shear the diagram in the horizontal direction through the angle which the sloping line makes with the vertical.

Since the induction B is equal to II + 4irl, it is easy from the results of experiments such as that just described to deduce the relation between B and II ; a curve indicating such relation is called a curve of induction. The general character of curves of magnetization and of induction will be discussed later. A notable feature in both classes of curves is that, owing to hysteresis, the ascending and descending limbs do not coincide, but follow very different courses. If it is desired to annihilate the hysteretic effects of

~~*previous magnetization and restore the metal to its original con- dition, it may be demagnetized by reversals. This is effected by slowly moving the sliding contact E (Fig. 4) from F to D, while at the same time the commutator K is rapidly worked, a series of alternating currents of gradually diminishing strength being thus caused to pass through the magnetizing coil.*~~

~~*Several pieces of apparatus in which a magnetometer is employed have been devised for comparing the magnetic quality of a sample with that of a standard iron rod by a zero method analogous to that of the Wheatstone bridge. An excellent instrument of the class is Ewing's "permeability bridge," a description of which will be found under Elbotromagnet.*~~

~~*Ballistic Methods. — ^The so-called " ballistic " method of measuring induction is based upon the fact that a change of the induction through a closed linear conductor sets up in the conductor an electromotive force - which is proportional to the rate of change. (See Uncy. Brit., Elbcteicity, vol. viii. p. 75 ; and Magnetism, vol. xv. p. 240.) If the conductor consists of a coil of wire the ends of which are connected with a suitable galvanometer, the integral electromotive force due to a sudden increase or decrease of the induction through the coil displaces in the circuit a quantity of electricity Q = SBnsj'R, where SB is the increment or decrement of induction per square centimetre, s is the area of the coil, n the number of turns of -wire, and E the resistance of the circuit. Under the influence of the transient current, the galvanometer needle undergoes a momentary deflection, or "throw,"*~~

~~*which is proportional to Q, and thet-efore to SB, and thus, if we know the deflection produced by the discharge through the galvanometer of a given quantity of electricity, we have the means of determining the value of 5B.*~~

~~*The galvanometer which is used for ballistic observa- tions should have a somewhat heavy needle with a period of vibration of not less than five seconds, so that the transient current may have ceased before the swing has well begun ; an instrument of the d'Arsonval form is re- commended, not only because it is unafiected by outside magnetic influence, but also because the moving part can be instantly brought to rest by means of a short-circuit key, thus efifecting a great saving of time when a series of observations is being made. In practice it is usual to standardize or "*~~

~~*calibrate " the galvanometer by causing a known change of induction to take place within a standard coil connected with it, and noting the corresponding deflec- tion on the galvanometer scale. Let s be the area of a single turn of the standard coil, n the number of its turns, and r the resistance of the circuit of which the coil forms part ; and let S, N, and E. be the corresponding constants for a coil which is to be used in an experiment. Then if a known change of induction SB^ inside the standard coU is found to cause a throw of d scale-divisions, any change of induction SB through the experimental coU will be numerically equal to the corresponding throw D multiplied by snRBJSNrd. For a series of experiments made with the same coil this fraction is constant, and we may write 8B = ^D. Rowland and others (Uncy. Brit. vol. xv. p. 255) have used an earth coil for calibrating the galvano- meter, a known change of induction through the coU being produced by turning it over in the earth's magnetic field, but for several reasons it is preferable to employ an electric current as the source of a known induction. A primary coil of length I, having n turns, is wound upon a cylinder made of non-conducting and non-magnetic material, and upon the middle of the primary a secondary or induction coil is closely fitted. When a current of strength i is suddenly interrupted in the primary, the increment of induction through the secondary is sensibly equal to ^irinjl units. All the data required for standard- izing the galvanometer can in this way be determined with accuracy.*~~

~~*The ballistic method is largely employed for deter- mining the relation of induction to magnetizing force in samples of the iron and steel used in the manu- facture of electrical machinery, and especially for the observation of hysteresis effects. The sample may have the form of a closed ring, upon which are wound the in- duction coil and another coil for taking the magnetizing current ; or it may consist of a long straight rod or wire which can be slipped into a magnetizing coil such as is used in magnetometric experiments, the induction coil being wound upon the middle of the wire. With these arrangements there is no demagnetizing force to be con sidered, for the ring has not any ends to produce one, and the force due to the ends of a rod 400 or 500 diameters in length is quite insensible at the middle portion ; H therefore is equal to H^.*~~

~~*Induction and Hysteresis Curves. — Some typical in- duction curves, copied from a paper by Ewing (Proc. Inst. C.E. vol. cxxvi.), are given in Figs. 6, 7, and 8. Fig. 6 shows the relation of B to H in a specimen which has never before been magnetized. The experiment may be made in two different ways : (1) the magnetizing current is increased by a series of sudden steps, each of which produces a ballistic throw, the value of B after any one throw being proportional to the sum of that and all the previous throws; (2) the magnetizing current having been brought to any desired value, is suddenly reversed*~~

~~*and tlie observed throw taken as measuring twice the actual induction. Fig. 7 shows the nature of the course taken by the curve when the magnetizing current, after having been raised to the value corresponding to the point a, is diminished by steps until it is nothing, and then gradually increased in the reverse direction. The dovm- ward course of the curve is, owing to hysteresis, strikingly different from its upward course, and when the magnetizing*~~

~~*force has been reduced to zero, there is still remaining an induction of 7500 units. If the operation is again reversed, the upward course will be nearly, but not exactly, of the form shown by the line d e a, Fig. 8. After a few repeti- tions of the reversal, the process becomes strictly cyclic, the upward and downward curves always follomng with precision the paths indicated in the figure. In order to establish the cyclic condition, it is sufficient to apply alter- nately the greatest positive and negative forces employed in the test (greatest H = about + 5 C.G.S. units in the case illustrated in the figure), an operation which is performed by simply reversing the direction of the maximum magnet- izing current a few times.*~~

~~*The closed figure acdea is variously called a hysteresis curve or diagram or loop. The areayHdB enclosed by it represents the work done in carrying a*~~

cubic centimetre of the iron through the corresponding magnetic cycle ; ex- pressed in ergs this work is — — / HdB.^ To quote an ex-

ample given by Fleming, it requires about 18 foot-pounds of work to make a complete magnetic cycle in a cubic foot of wrought iron, strongly magnetized first one way and then the other, the work so expended taking the form of heat in the mass.

Fig. 9 shows diagrammatioally a convenient arrangement de- scribed by Ewing (see Proc. Inst. 0, E. vol. oxx vi. , and Pliil. Trans. , 1893a, p. 987) for carrying out ballistic tests by which either the simple B-H curve (Fig. 6) or the hysteresis curve (Figs. 7 and 8) can be determined. The sample under test is prepared in the form of a ring A, upon which are wound the induction and the magnetizing coils ; the latter should be wound evenly over the whole ring, though for the sake of clearness only part of the wind- ing is indicated in the diagram. The magnetizing current, which is derived from the storage battery B, is regulated by the adjust- able resistance E and measured by the galvanometer G. The current passes through the rocking key K, which, when thrown over to the right, places a in contact with c and b with il, and when thrown over to the left, places a in contact with e and b with /. "When the switch S is closed, K acts simply as a commutator or current-reverser, but if K is thrown over from right to left while S

' Warburg, Wied. Ann. vol. xiii. (1881), p. 141 ; Ewing, Phil. Trans., 1885, vol. ii. p. 649 ; Hopkinson, Phil. Trans., 1885, vol. ii. p. 466. For a simple proof, see Ewing, Magnetic Indwtion (London, 1900), p. 99. Hopkinson pointed out that the greatest dissipation of energy which can be caused by a to-aud-fro reversal is approximately represented by

Coercive force x maximum indudiun jw.

is opened, not only is the current reversed, but its strength is at the same time diminished by the interposition of the adjustable resistance Rj. The induction coil wound upon the ring is connected to the ballistic galvanometer G, in series with a large permanent resistance Rj. In the same circuit is also included the induction coil E, which is used for standardizing the galvanometer ; this secondary coil is represented in the diagram by three turns of wire wound over a much longer primary coil. The short-

~~circuit key F is kept closed except when an observation is about to be made ; its object is to arrest the swing of the d'Arsonval galvanometer Gj. By means of the three-way switch C the battery current may be sent either into the primary of E, for the purpose of calibrating the galvanometer, or into the magnetizing coil of the ring under test. When it is desired to obtain a simple curve of induction such as that in Fig. 6, S is kept permanently closed, and corresponding values of H and B are deter- mined by one of the two methods already described, the strength of the batteiy — current being varied by means of the adjustable resistance E. When a hysteresis curve is to be obtained, the procedure is as follows : — the current is first adjusted by means of B to such a strength as will fit it to pi'oduoe the greatest + and — values of the magnetizing force which it is intended to apply in the course of the cycle ; then it is reversed several times, and when the range of the galvanometer throws has become constant, half the extent of an excui-sion indicates the induction corresponding to the extreme value of H, and gives the point a in the curve Fig. 7. The reversing key K having been put over to the left side, the short-circuit key S is suddenly opened ; this inserts the resistance E, which has been suitably adjusted beforehand, and thus reduces the current and therefore the magnet- izing force to a known value. The galvanometer throw which results from the change of current measures the amount by which the induction is reduced, and thus a second point on the curve is found. In a similar manner, by giving different values to the re- sistance E, any desired number of points between a and c in the curve can be determined. To continue the process, the key K is turned over to the right-hand side, and then, while S is open, is turned back, thereby not only reversing the direction of the~~

~~Fig. 9.~~

~~current, but diminishing its strength by an amount depending upon the previous adjustment of R.,. In this way points can be found lying anywhere between c and d of Fig. 7, and the determination of the downward limb of the curve is therefore completed. As the return curve, shown in Fig. 8, is merely an inverted copy of the other, no separate determination of it is necessary.~~

~~In Fig. 10 (Fleming, Mmjnets and Electric Currents, p. 193) are shown three very different types of hysteresis curves, characteristic of the special qualities of the metals from which they ^^'ere respectively obtained. The dis- tinguishing feature of the first is the steepness of its outlines ; this indicates that the induction increases rapidly in relation to the magnetic force, and hence the metal is well suited for the construction of dynamo magnets. The second has a very small area, showing that the work done~~

~~in reversing the magnetization is small ; the metal is therefore adapted for use in alternating current trans- formers. On the other hand, the form of the third curve, with its large intercepts on the axes of H and B, denotes that the specimen to which it relates possesses both~~

~~Fig. 10~~

~~retentiveness and coercive force in a high degree ; such a metal would be chosen for making good permanent magnets.~~

~~Steinmetz (Electrician, vol. xxvi. p. 261 ; vol. xxviii. pp. 384, 408, 426) has called attention to a simple relation which appears to exist between the amount of energy dissipated in carrying a, piece of iron or steel through a magnetic cycle, and the limiting value of the induction reached in the cycle. Denoting by W the work in ergs done upon a cubic centimetre of the metal~~

~~= — I HrfB or / Yldl j, he finds 'W=i)B"^ approximately, where 17~~

~~is a number, called the Jiysteretic constant, depending upon the metal, and 15 is the maximum induction. The value of the con- stant Tj ranges in different metals from about O'OOl to 0'04 ; in soft iron and steel it is said to be generally not far from 0 '002. Stein- metz's formula may be tested by taking a series of hysteresis curves between different limits of B, measuring their areas by a planimeter, and plotting the logarithms of these divided by 4ir as ordinates against logarithms of the cori-esponding maximum values of B as abscissae. The curve thus constructed should be a straight line~~

~~*inclined to the horizontal axis at an angle 8, the tajigent of which is 1‘6. Ewing and Klaassen (Phil. Trans., 1893a, p. 1017) have in this manner examined how nearly and within what range a formula of the type ‘W=7;B’ may be taken to represent the facts. The results of an example which they quote in detail maybe briefly summarized as follows : —*~~

~~*Tiimits of B.*~~

~~*HIysteretic*~~

~~*Constant.*~~

~~*1*~~

~~*Index. e(= tane)*~~

~~*Degrees.*~~

~~*e*~~

~~*200 to 500*~~

~~*500 to 1000*~~

~~*1000 to 2000*~~

~~*2000 to 8000*~~

~~*8000 to 14000*~~

~~*0-oi*~~

~~*0-00134*~~

~~*1-9*~~

~~*1-68*~~

~~*1-55*~~

~~1-475~~

~~1-70~~

~~62-25 59-25 57-25 55-75 59-50~~

~~It is remarked by the experimenters that the value of the index e is by no means constant, but changes in oon-espondence with the successive well-marked stages in the process of magnetization. But though a fommla of this type has no physical significance, and cannot be accepted as an equation to the actual curve of W and B, it is nevertheless the case that by making the index 6=1-6, and assigning a suitable value to r;, a formula may be obtained giving an approximation to the truth which is sufficiently close for the ordinary purposes of electrical engineers, especially when the limit- ing value of B is neither very great nor very small. Mr Alexander Siemens {Journ. Inst. Elec. Eng., 1894, p. 229) states that in the hundreds of comparisons of test pieces which have been made at the works of his firm, Steinmetz's law has been found to be prac- ticaDy correct.^An interesting collection of W-B curves embody- ing the results of actual experiments by Ewing and Klaassen on different specimens of metal is given in Fig. 11. It has been shown by Kennelly {Electrician, vol. xx-viii. p. 666) that Steinmetz's~~

~~' Some experiments by Baily showed that hysteresis ceased to increase when B was carried beyond 23,000. This value of B corre- sponds to 1 = 1640, the saturation point for soft iron. — Brit. Assoc. iJcp., 1895, p. 636.~~

~~fonnula gives approximately correct results in the case of nickeL Working with two different specimens, he found that the hyster- esis loss in ergs per cubic centimetre (W) was fairly represented by 0-00125B^-° and 0-OOlOlB'-* respectively, the maximum induction ranging from about 300 to 3000. The applicability of the law to cobalt has been investigated by Fleming {Phil. Mag., Sept. 1899, p. 271), who used a ring of cast cobalt containing about 96 per cent, of the pure metal. The logarithmic curves which accompany~~

~~!e,000~~

~~8fi00~~

~~4;000~~

~~apoo~~

~~12(100~~

~~moo~~

~~FiQ. 11. — a. Fine steel wire 0-257 mm. diam. ; 6, fine iron wire 0-34 ttitti diara. ; c, fine iron wire 0-24V5 mm. diam.; d, thin sheet iron 0-47 mm. tliicle ; e, iron wire 0-602 mm. diam. ; /, iron wire 0-976 mm. diam. ; 5, sheet iron 1-96 mm. thick ; A, thin sheet iron 0-367 mm. thick ; i, very soft iron wire,~~

~~his paper demonstrate that within wide ranges of maximum induc tion W=0-01Bi-<'=0-527P-«2 very nearly. Fleming rightly regards it as not a little curious that, for materials differing so much as this cast cobalt and soft annealed iron, the hysteretic exponent should in both oases be so near to 1 '6. After pointing out that, since the magnetization of the metal is the quantity really con- cerned, W is more appropriately expressed in terms of I, the magnetic moment per unit of volume, than of B, he suggests an experiment to determine whether the mechanical work required to effect the complete magnetic reversal of a crowd of small compass needles (representative of magnetic molecules) is proportional to the 1 -6th power of the aggregate maximum magnetic moment before or after completion of the cycle.~~

~~The diagram, Fig. 12, contains examples of ascending induction curves characteristic of wrought iron, cast iron.~~

~~mooo-~~

~~H too~~

~~cobalt, and nickel. These are to be regarded merely as typical specimens, for the details of a curve depend largely upon the physical condition and~~

purity of the material ; but they show at a glance how far the several metals

differ from and resemble one another as regards their magnetic properties. Curves of magnetization (which express the relation of I to H) have a close resemblance to those of induction ; and indeed, since B = H + 4rf, and 47rl (except in extreme fields) greatly exceeds H in numerical value, we may generally, without serious error, put I = Bjiir, and transform curves of induction into curves of magnetiza- tion by merely altering the scale to which the ordinates are referred. A scale for the approximate transformation for the curves in Fig. 1 2 is given at the right-hand side of the diagram, the greatest error introduced by neglecting H/47r not exceeding 0‘6 per cent. A study of such curves as these reveals the fact that there are three distinct stages in the process of magnetization. During the first stage, when the magnetizing force is small, the magnet- ization (or the induction) increases rather slowly with increasing force ; this is well shovra by the nickel curve in the diagram, but the effect would be no less con- spicuous in the iron curve if the abscissae were plotted to a larger scale. During the second stage small increments of magnetizing force are attended by relatively large incre- ments of magnetization, as is indicated by the steep ascent of the curve. Then the curve bends over, forming what is often called a "knee," and a third stage is entered upon, during which a considerable increase of magnetizing force has little further effect upon the magnetization. When in this condition the metal is popularly said to be " saturated." Under increasing magnetizing forces, greatly exceeding those comprised within the limits of the diagram, the magnetization does practically reach a limit, the maximum value being attained with a magnetizing force of less than 2000 for wrought iron and nickel, and less than 4000 for cast iron and cobalt. The induction, how- ever, continues to increase indefinitely, though very slowly. These observations have an important bearing upon the molecular theory of magnetism, which will be referred to later.

Curves of Permeability and of Susceptibility. — The relations of /x (= B/H) to B, and of « (= I/H) to I, may be instructively exhibited by means of

~~*curves like those constructed by Rowland (see £!ncí/. Brit., Magnetism, vol. XV. p. 256). Recent experiments show that if the magnetizing force is carried far enough, the permeability*~~

~~*7»*~~

~~*21000*~~

~~*teoo*~~

~~ł~~

~~*/-!*~~

~~A~~

~~*1*~~

~~*i*~~

~~*1 1*~~

~~*. \ «»*~~

~~*H*A~~

~~*lOpOO*~~

~~*Fig. 13.*~~

~~*IliOOO*~~

~~*KVnO*~~

~~*curve always becomes convex to the horizontal axis, instead of meeting it in the manner indicated in Rowland's diagrams. In Fig. 13 a curve given by an experiment in which the highest magnetizing force was 58-5 is compared with Rowland's curve for iron (Bidwell, Proc. Roy. Soc. vol. xl. (1886), p. 495). Rowland's exj)eriment was carried only as far as the point marked X,*~~

~~corresponding to a magnet- izing force of 65 and an induction of nearly 17,000, In~~

~~the other experiment, though the magnetizing force was further increased no less tha,n ninefold, the induction reached only 19,80 J. It is seen that soon after the limit of Rowland's observations is passed, the curve, instead of continuing in an almost straight line to meet the horizontal axis, bends off asymptotically, the ultimate value of the permeability still being as much as 33'9.~~

~~Ballistic Method with Yoke. — Hopkinson {Phil. Trans., 1885, part ii. p. 455) introduced a modification of the usual ballistic arrangement which presents the following advan- tages : — (1) very considerable magnetizing forces can be applied with ordinary means ; (2) the samples to be tested, having the form of cylindrical bars, are more easily pre- pared than rings or wires ; (3) the actual induction at any time can be measured, and not only changes of induction. On the other hand, a very high degree of accuracy is not claimed for the results. Fig. 14 shows the apparatus by which the ends of the bar are prevented from exerting any material demagnetizing force, while the permeance of the magnetic circuit is at the same time increased. AA, called the "yoke," is a block of annealed vsTought iron about 18 inches long, 6J inches wide, and 2 inches thick, through which is cut a rectangular opening to receive the two magnetizing coils BB. The test bar CC, which slides through holes bored in the yoke, is divided near the middle into two parts, the ends which come into contact being faced true and square. Between the magnetizing coils is~~

~~Fig. 14~~

~~a small induction coil D, which is connected with a ballistic galvanometer. The induction coil is carried upon the end of one portion of the test bar, and when this portion is suddenly drawn back, the coil slips olf and is pulled out of the field by an india-rubber spring. This causes a ballistic throw proportional to the induction through the bar at the moment when the two portions were separated. With such an arrangement it is possible to submit the sample to any series of magnetic forces, and to measure its magnetic state at the end. The uncertainty with which the results are afiected depends chiefly upon the imperfect contact between the bar and the yoke and also~~

between the ends of the divided bar. It is probable that HopkinSon did not attach sufficient importance to the demagnetizing action of the cut (cf. Ewing, Phil. Mag., Sept. 1888, p. 274), and that the values which he assigned to H are consequently somewhat too high. He applied his method with good effect, however, in testing a large number of commercial specimens of iron and steel, the magnetic constants of which are given in a table accom- panying his paper. When it is not required to determine the residual magnetization, there is no necessity to divide the sample bar, and ballistic tests may be made in the ordinary way — by steps or by reversals — the source of error due to the transverse cut thus being avoided. Ewing has devised an arrangement in which two similar test bars are placed side by side ; each bar is surrounded by a magnetizing coil, the two coils being connected to give opposite direc- tions of magnetization, and each pair of ends is connected by a short massive block of soft iron having holes bored through it to fit the bars, which are clamped in position by

set-screws. Induction coils are wound on tlie middle parts of both bars, and are connected in series. With this arrangement it is possible to find the actual value of the magnetizing force, corrected for the effects of joints and other sources of error. Two sets of observations are taken, one when the blocks are fixed at the ends of the bars, and another when they are nearer together, the clear length of the bars between them and of the magnetizing coils being reduced to one -half. If Hj and H, be the values of .nil

iirinjl and iwi -^ -^ for the same induction B, it can be

shown that the true magnetizing force is H = Hj — (H.^ — Hj). The method, though tedious in operation, is very accurate, and is largely employed for determining the magnetic quality of bars intended to serve as standards.

Traction Methods. — The induction or the magnetization may be measured by observing the force required to draw apart the two portions of a divided rod or ring when held together by their mutual attraction. If a transverse cut is made through a bar whose magnetization is I and the two ends are

~~*placed in contact, it can be shown that this force is 2×1^ dynes per unit of area (see Magnetism, Ency. Brit. vol. XV. p. 243) ; and if the magnetization of the bar is due to an external field II produced by a magnetizing coil or otherwise, there is an additional force equal to III. Thus the whole force, when the two portions of the bar are surrounded by a loosely-fitting magnetizing coil, is*~~

~~*F = 27rI2-fIH*~~

~~*expressed as dynes per square centimetre. If each portion of the bar has an independent magnetizing coil wound tightly upon it, we have further to take into account the force due to the mutual action of the two magnetizing coils, which assists the forces already considered. This is equal to II^/Stt per unit of sectional area. In the case supposed therefore the total force per square centimetre is*~~

~~*H2*~~

~~*8ir*~~

~~*F = 27rP4-HI-l-*~~

~~*(47rI + H)^ Stt*~~

~~*The equation F = B^/Stt is often said to express " Max- well's law of magnetic traction " (Maxwell, Electricity and Magnetism, §§ 642-646). It is of course true for per- manent magnets, where II = 0, since then F = 2jrl^ ; but if the magnetization is due to electric currents, th.^ formula is only applicable in the special case when the mutual action of the two magnets upon one another is supplemented by the electrodynamic attraction between separate magnetizing coils rigidly attached to them.^*~~

~~*The traction method was first employed by Bidwell iProc. Boy. Sac. vol. xl. p. 486), who in 1886 published an account of some experiments in which the relation of magnetization to magnetic field was deduced from obser- vations of the force in grammes weight which just sufficed to tear asunder the two halves of a divided ring electro- magnet when known currents were passing through the coils. IIe made use of the expression*~~

~~*F = W(7 = 27rI2-(-III, where W is the weight in grammes per square centimetre of sectional area, and g is the acceleration due to gravity, which was taken as 981. The term for the attraction between the coils was omitted as negligibly small (see Phil. Mag. vol. xxix. p. 440). The values assigned to II were calculated from II = 2nijr, and ranged from 3-9 to 58.5,*~~

~~*1 Since in most practicable experiments II' is negligible in com- parison with B", the force may be taken as B^Svr without sensible error.*~~

~~*but inasmuch as no account was taken of any demagnetizing action which might be due to the two transverse cuts, it is probable that they are somewhat too high. The results nevertheless agree very well with those for annealed wrought iron obtained by other methods. Below is given a selection from Bidwell's tables showing corresponding values of magnetizing force, weight supported, magnetiza- tion, induction, susceptibility, and permeability: —*~~

~~*H*~~

~~*W*~~

~~*I*~~

~~*B*~~

~~*K*~~

~~*M*~~

~~*3-9*~~

~~*2,210*~~

~~*587*~~

~~*7,390*~~

~~*151-0*~~

~~1889-1~~

~~57~~

~~3,460~~

~~735~~

~~9,240~~

~~128-9~~

~~1621-3~~

~~10-3~~

~~5,400~~

~~918~~

~~11,560~~

~~89-1~~

~~1121-4~~

~~22-2~~

~~8,440~~

~~1147~~

~~14,450~~

~~51-7~~

~~650-9~~

~~40~~

~~9,680~~

~~1226~~

~~15,460~~

~~30–7~~

~~386–4~~

~~115~~

~~12,170~~

~~1370~~

~~17,330~~

~~11–9~~

~~150–7~~

~~208~~

~~13,810~~

~~1452~~

~~18,470~~

~~7–0~~

~~88–8~~

~~362~~

~~14,740~~

~~1489~~

~~19,080~~

~~4-1~~

~~527~~

~~465~~

~~15,275~~

~~1508~~

~~19,420~~

~~3-2~~

~~41-8~~

~~585~~

~~15,905~~

~~1530~~

~~19,820~~

~~2-6~~

~~33-9~~

~~A few months later Bosanquet (Phil. Mag. vol. xxii. p. 535) experimented on the relation of tractive force to magnetic induction. Instead of a divided ring he em- ployed a divided straight bar, each half of which was provided with a magnetizing coil. The joint was sur- rounded by an induction coil con- nected with a ballistic galvanometer, an arrangement which enabled him to make an independent measurement of the induction at the moment when the two portions of the bar were separated. HIe showed that there was, on the whole, a fair agreement between the values determined ballis- tically and those given by the formula B = J^sttY. The greatest weight sup- ported in~~

~~*the experiments was 14,600 grammes per square cm., and the corresponding induction 18,500 units. Taylor Jones more recently found a good agreement between the theo- retical and the observed values of the tractive force in fields ranging up to very high intensities (Phil. Mag. vol. xxxix. (1895), p. 254, and vol. xU. (1896), p. 153).*~~

~~*Permeameters Several instrumenta in*~~

~~*which' the traction method is applied have*~~

~~*been devised for the rapid measurement of*~~

~~*induction or of magnetization in commercial*~~

~~*samples of iron and steel. The earliest of*~~

~~*these is S. P. Thompson's permeameter*~~

~~*(Joum. Sci. Arts, vol. xxxviii. (1890), p.*~~

~~*885), which consists of a rectangular block*~~

~~*of iron shaped like Hopkinson's yoke, and*~~

~~*slotted out in the same way to receive a ,*~~

~~*magnetizing coil (Fig. 15) ; the block is*~~

~~*bored through at the upper end only, and pig_ 15_*~~

~~*its inner face opposite the hole is made*~~

~~*quite flat and smooth. The sample has the form of a thin rod,*~~

~~*one end of which is faced true ; it is slipped into the magnetizing*~~

~~*coil from above, and when the current is turned on, its smooth end*~~

~~*adheres tightly to the surface of the yoke. The force required to*~~

~~*detach it is measured by a registering spring balance, which is*~~

~~*clamped to the upper end of the rod, and thence the induction or*~~

~~*the magnetization is deduced by applying the formula*~~

~~*where P is the pull in grammes weight, S the sectional area of the rod in square cm., and 5f=981. If the pull is measured in pounds and the area in square inches, the formula may be written B = 1317x ,^P/S + II. The instrument exhibited by Thompson would, without undue heating, take a current of 30 amperes, which was sufficient to produce a magnetizing force of 1000 units. A testing*~~

~~apparatus of a similar type devised by Kapp {Journ. Inst. EUc. Eiuj. vol. xxiii. p. 199) differs onlyin a fev7 details from Thompson's permeameter. Ewing hag described an arrangement in which the test bar has a soft-iron pole piece clamped to each of its ends ; the pole pieces are joined by a long well-litting block of iron, which is placed upon them (like the "keeper" of a magnet), and the in- duction is measured by the force required to detach the block. In all such measurements a correction should be made in respect of the demagnetizing force due to the joint, and unless the fit is very accurate the demagnetizing action will be variable. In the mag- netic balance of du Bois {Magnetic Circuit, p. 346) the uncertainty arising from the presence of a joint is avoided, the force measured being that exerted between two pieces of iron separated from each other by a narrow air-gap of knoAATi width. The instrument is represented diagrammatieally in Fig. 16. The test-piece A, surrounded by a niagnetizing coil, is clamped between two soft- iron blocks B, B'. YY' is a soft -iron yoke, which rocks upon knife-edges K, and constitutes the beam of the balance. The yoke has two projecting pieces C, C at unequal distances from the knife-edges, and separated from the blocks B, B' by narrow air-gaps. The play of the beam is limited by a stop S and a screw R, the latter being so adjusted that when the end Y of the beam is held down the two air-gaps are of equal width. W is a~~

~~£r.~~

~~A~~

~~Y C~~

~~A~~

~~Y'~~

~~Av^~~

~~e~~

~~A,~~

~~1 ”~~

~~llll^llll~~

~~B~~

~~A~~

~~B’~~

~~r”~~

~~Fig. 16.~~

~~weight capable of sliding from end to end of the yoke along a graduated scale. “When there is no magnetization, the yoke is in equilibrium ; but as soon as the current is turned on, the block C is drawn downwards as far as the screw B, will allow, for though the attractive forces F between B and C and between B’ and C are equal, the former has a greater moment. The weight W is moved along the scale until the yoke just tilts over upon the stop S ; the distance of W from its zero position is then, as can easily be shown, proportional to F, and therefore to B^, and approximately to V. The scale is graduated in such a manner that by multiplying the reading by a simple factor (generally 10 or 2) the absolute value of the magnetization is obtained. The actual magnetizing force H is of course less than that due to the coil ; the corrections required are effected automatically by the use of a set of demagnetization lines drawn on a sheet of celluloid which is supplied with the instrument. The celluloid sheet is laid upon the squared paper, and in plotting a curve horizontal distances are reckoned from the proper demagnetization line instead of from the vertical axis. An improved but somewhat more complex form of the instrument is described in Ann. d. Pliys. vol. ii. (1900), p. 317.~~

~~In Ewing’s magnwtic balance {Journ. Inst. Elec. Eng. vol. xxvii. p. 526) the value of the magnetic induction corresponding to a single stated magnetizing force is directly read off on a divided scale. The specimen,~~

which has the form of a turned rod, 4 inches long and J inch in diameter, is laid across the poles of a horseshoe electromagnet, excited by a current of such strength as to produce in the rod a magnetizing force H = 20. One pole has a V-shaped notch for the rod to rest in ; the surface of the other is slightly rounded, forming a portion of a cylinder, the axis i)f which is per- pendicular to the direction of the length of the rod. The rod touches this pole at a single point, and is pulled away from it by the action of a lever, the long arm of which is graduated and carries a sliding weight. The position of the weight at the moment when contact is broken indicates the induction in the rod. The standard force H = 20 was selected as being sufficiently low to dis- tinguish between good and bad specimens, and at the same time sufficiently high to make the order of merit the same as it would be under stronger forces.

Measurement of Field HIreiujih. Ejploririg Coil. — The old method of measuring field intensity l)y means of an induction coil with a standardized ballistic giilvano- meter (see Ency. JJril. vol. xv. p. 240) is still the one most generally employed. Convenient arrangements have been devised whereby the coil is suddenly reversed or withdrawn from the field by the action of a spring.

Bismuth Resistance. — The fact, which will bo referred to later, that the electrical resistance of bismuth is very

greatly affected by a magnetic field has been applied in the construction of apparatus for measuring field intensity. A little instrument, supplied by Hartmann and Braun, con- tains a short length of fine bismuth wire wound into a flat double spiral, half an inch or thereabouts in diameter, and attached to a long ebonite handle. Unfortunately the effects of magnetization upon the specific resistance of bismuth vary enormously with changes of temperature ; it is therefore necessary to take two readings of the resist- ance, one when the spiral is in the magnetic field, the other when it is outside.

Electric Circuit. — If a coil of insulated wire is sus- pended so that it is in stable equilibrium when its plane is parallel to the direction of a magnetic field, the trans- mission of a known electric current through the coil will

~~*cause it to be deflected through an angle which is a function of the field intensity.*~~

~~*Among recent applications of this principle one of the neatest is that described by Edser and Stansfield (Phil. Mag. vol. xxxiv.p. 186), and used by them to test the stray fields of dynamos. An oblong coil about an inch in length is suspended from each end by thin strips of rolled German silver wire, one of which is connected with a spiral spring for regulating the tension, the other being attached to a torsion-head. Inside the torsion-head is a commutator for automatically reversing the current, so that readings may be taken on each side of zero, and the arrangement is such that when the torsion-head is exactly at zero the current is interrupted. To take a reading the torsion-head is turned until an aluminium pointer attached to the coil is brought to the zero position on a small scale ; the strength of the field is then proportional to the angular torsion. The small current required is supplied to the coil from a single dry cell. The advantages of portability, very considerable range (from H = 1 upwards), and fair accuracy are claimed for the instrument.*~~

~~*Polarized Light. — The intensity of a field may be measured by the rotation of the plane of polarization of light passing in the direction of the magnetic force through a transparent substance. If the field is uniform, H = OJimI, where 6 is the rotation, d the thickness of the substance arranged as a plate at right angles to the direction of the field, and (o Verdet's constant for the substance.*~~

~~*For the practical measurement of field intensity du Bois has used plates of the densest Jena flint glass. These are preferably made slightly wedge-shaped, to avoid the inconvenience resulting from multiple internal reflections, and they must necessarily be rather thin, so that double refraction due to internal strain may not exert a disturbing influence. Since Verdet's constant is somewhat uncertain for different batches of glass even of the same quality, each plate should be standardized in a field of known intensity. As the source of monochromatic light a bright sodium burner is used, and the rotation, which is exactly proportional to H, is measured by an accurate polarimeter. Such a plate about 1 mm. in thickness is said to be adapted for measuring fields of the order of 1000 units. A part of one*~~

~~surface of the plate may be silvered, so that the polarized ray, after having once traveled the glass, is reflected back again ; the rotation is thus doubled, and moreover, the arrangement is, for certain experiments, more convenient than the other.~~

~~Magnetization in Strong Fields.~~

~~Fields due to Coils. — The most generally convenient arrangement for producing such magnetic fields as are required for experimental purposes is undoubtedly a coil of wire through which an electric current can be caused to flow. The field due to a coil can be made as nearly uniform as we please throughout a considerable space ; its intensity, when the constants of the coil are known, can be calculated with ease and certainty and may be varied at will through wide ranges, while the apparatus required is of the simplest character and can be readily constructed to suit special purposes. But when exceptionally strong fields are desired, the use of a coil is limited by the heating effect of the magnetizing current, the quantity of heat generated per unit of time in a coil of given dimensions increasing as the square of the magnetic field produced in its interior. In experiments on magnetic strains carried out by Nagaoka and Honda (Phil. JIag. vol. xlix. (1900),~~

~~329) the intensity of the highest field reached in the interior of a coil was 2200 units. The coil used was 30 cm. in length, and was wound with twelve layers of wire having a total resistance of 0-63 ohm, the field produced by 1 ampere having the intensity of 38 units. The current employed must therefore have been nearly 60 amperes, and the quantity of heat generated per second upwards of 500 calories. This is probably the strongest field produced by a coil which has hitherto been employed in experi- mental work. There are indeed few purposes for which the field thus obtained would be available, because, if the circuit were closed for more than a brief period, the heat generated would quickly destroy the insulation of the wire. In 1890 some experiments in which a coil was used were made by du Bois (Phil. Mag. vol. xxix. pp. 253, 293) on the magnetization of iron, nickel, and~~

~~*cobalt under forces ranging from about 100 to 1250 units. Since the demagnetizing factor was 0”052, the strongest field due to the coil was about 1 340 ; but though arrange- ments were provided for cooling the apparatus by means of ice, great difficulty was experienced owing to heating. Du Bois’s results, which, as given in his papers, show the relation of H to the magnetic moment per unit of mass, have been reduced by Ewing to the usual form, and are indicated in Fig. 17, the earlier portions of the curves being sketched in from other data.*~~

~~*1*~~

~~*r ro*~~

~~*n*~~

~~*A*~~

~~*t200*~~

~~*f*~~

~~*nit*~~

~~*BOO*~~

~~*X*~~

~~*f*~~

~~*f*~~

~~*f*~~

~~*Nic*~~

~~*Hel*~~

~~*i*~~

~~-A~~

~~*1*~~

~~*400 eoo*~~

~~*Fig. 17.*~~

~~*woo jj [ZOO*~~

~~*Fields dne to Electromagnets. — The problem of deter- mining the magnetization of iron and other metals in the strong fields formed between the poles of an electromagnet was first attacked by Ewing and Low. An account of their preliminary experiments by what they call the isthmus method was published in 1887 {Proc. Roy. Soc. vol. xlii. p. 200), and in the following year they described a more complete and perfect series (Phil. Trans, vol. cLxxx. p. 221).*~~

~~*The sample to he inserted between the magnet poles was prepared in the form of a bobbin resembling an ordinary cotton reel, with a short narrow neck (constituting the "isthmus") and conical ends. Upon the central neck was wound a coU consisting of one or two layers of very fine wire, which was connected with a baUistio galvanometer for measuring the induction in the iron ; outside this coil, and separated from it by a small and accurately determined distance, a second coil was wound, serving to measure the induction in the iron, together with that in a small space surrounding it. The difference of the ballistic throws taken with the two coils measured the intensity of the field in the space around the iron, and it also enabled a correction to be made for the non-ferrous space between the iron neck and the centre of the thickness of the inner coil. The pole-pieces of the electromagnet (see Fig. 18) were furnished with a pair of truncated cones b b, of soft iron forming an extension of the conical ends of the bobbin c. The most siutable form for the pole faces is investigated in tlie paper, and the conclusion arrived at is that to produce the greatest concentration of force upon the central neck, the cones should have a common vertex in the middle of the neck with a semi- vertical angle of 54° 44', whQe the condition I*~~

~~*for a unifoi-m field is satisfied when the cones have a semi-vertical angle of 39° 14' ; in the latter case the magnetic force in the air just outside is sensibly equal to that within the neck. A jiair of cones having a semi-vertical angle of 45° were considered to com- bine high concentrative powe-r with a sufficient approximation to uniformity of field. In most of the experi- ments the measure- ments were made by suddenly withdraw- ing the bobbin from its place between the pole — pieces. Two groups of observa- tions were recorded, one giving the induc- tion in the inner coil and the other that in the outer coO. The value of the residual induction which per- sisted when the bobbin was drawn out was added to that of the induction mea- sured, and thus the total induction in the iron was determined. The highest induction reached in these experiments was 46,350 units, more than twice the value of any previously recorded. The corresponding intensity of the outside field was 24,500, but, owing to the wide angle of the cones used (about 2 x 63°), this was probably greater than the value of the magnetic force within the metal. The following table shows some results of other experiments in which H was believed to have sensibly the same value inside as outside the metal. Values of I are derived from (B — H)/47r and of /i from B/H.*~~

~~*Metal.*~~

~~*H*~~

~~*B*~~

~~*I*~~

~~*/»*~~

~~*f*~~

~~*1,490*~~

~~*22,650*~~

~~*1680*~~

~~15‘20~~

~~^ 2i~~

~~6,070~~

~~27,130~~

~~1680~~

~~4-47~~

~~8,600~~

~~30,270~~

~~1720~~

~~3-52~~

~~^^~~

~~19,450~~

~~40,820~~

~~1700~~

~~2-10~~

~~19,880~~

~~41,140~~

~~1700~~

~~2-07~~

~~1~~

~~*4,560*~~

~~*20,070*~~

~~*1230*~~

~~*4-40*~~

~~*13,460*~~

~~*28,710*~~

~~*1210*~~

~~*2-13*~~

~~*16,200*~~

~~*30,920*~~

~~*1170*~~

~~*1-91*~~

~~*I*~~

~~*16,900*~~

~~*31,760*~~

~~*1180*~~

~~*1-88*~~

~~A~~

~~*6,210*~~

~~*25,480*~~

~~*1530*~~

~~*4-10*~~

~~*1*~~

~~*9,970*~~

~~*29,650*~~

~~*1570*~~

~~*2-97*~~

~~*OQ .*~~

~~*12,170*~~

~~*31,620*~~

~~*1550*~~

~~*2-60*~~

~~*o*~~

~~*14,660*~~

~~*34,550*~~

~~*1580*~~

~~*2-36*~~

~~*H I*~~

~~*15,530*~~

~~*35,820*~~

~~1610~~

~~2-31~~

~~r~~

~~2,220~~

~~7,100~~

~~390~~

~~3-20~~

~~■^~~

~~4,440~~

~~9,210~~

~~380~~

~~2-09~~

~~ea o —~~

~~7,940~~

~~12,970~~

~~400~~

~~1-63~~

~~w^~~

~~14,660~~

~~19,640~~

~~400~~

~~1-34~~

~~16,000~~

~~21,070~~

~~400~~

~~1-32~~

~~/~~

~~1,350~~

~~16,000~~

~~1260~~

~~12-73~~

~~J~~

~~4,040~~

~~18,870~~

~~1280~~

~~4-98~~

~~0~~

~~8,930~~

~~23,890~~

~~1290~~

~~2·82~~

~~14,990~~

~~30,210~~

~~1310~~

~~2·10~~

~~These results are of extreme interest, for they show that under sufficiently strong magnetizing forces the intensity of magnetization I reaches a maximum value, as required by Weber's theory of molecular magnetism. There appears to be no definite limit to the value to which the ind action B may be raised, but the magnetiza- tion I attains a true saturation value under magnetizing forces which are in most cases comparatively moderate. Thus the magnetization which the sample of Swedish iron received in a field of 1490 was not increased (beyond the limits of experimental error) when the intensity of the field was multiplied more than 1 3-fold, though the induc- tion was nearly doubled. When the saturation value of I has been reached, the relation of magnetic induction to magnetic force may be expressed by B = II -f constant.~~

~~The annexed table gives the saturation values of I for the par- ticular metals examined by Ewing and Low : —~~

~~Saturation Value of I.~~

~~Wrought iron 1700~~

~~Cast iron 1240~~

~~Nickel (0'75 per cent, iron) , . . 615~~

~~„ (0·56 „ „) . . . 400~~

~~*Cobalt (1-66 „ „)... 1300*~~

~~*It is sho"mi in the paper that the greatest possible force which the isthmus method can apply at a point in the axis of the bobbin is*~~

~~*F = ll'137I.logi„^,*~~

~~*Is being the saturation value of the magnet poles, a the radius of the neck on which the cones converge, and b the radius of the bases of the cones.*~~

~~*Some experiments made by du Bois {Phil. Mag. vol. xxix. p. 293) -with an electromagnet specially designed for the production of strong fields, confirm Ewing's results for iron, nickel, and cobalt. The method employed did not admit of the production of such high magnetizing forces, but was of special interest in that both B and I veere measured optically — B by means of the rotation of a polarized ray inside a glass plate, as before described, and I by the rotation of a polarized ray reflected from the polished surface of the magnetized metal (see " Kerr's constant," Magneto-Optics). H (= B – i-rrl) was calculated from corresponding values of I and B.*~~

~~*In 1896 Taylor Jones {Wied. Ann. vol. Ivii. p. 258, and Phil. Mag. vol. xxix. p. 293), working with du Bois's electromagnet and using a modification of the isthmus method, succeeded in pushing the induction B up to 74,200 with H = 51,600, the corresponding value of I being 1798, and of /u. only 1-44. The diameter of the isthmus was 0'241 mm., and the electromagnet was excited by a current of 40 amperes.*~~

~~*Tractive Force of a Magnet. — Closely connected with the results just discussed is the question what is the greatest tractive force that can be exerted by a magnet. In the year 1852 Joule {Phil. Mag. [4], vol. iii. p. 32) expressed the opinion that no " force of current could give an attraction equal to 200 K) per square inch," or 14,000 grms. per square centimetre, and a similar view prevailed among high authorities more than twenty years later. For the greatest possible " lifting power " of permanent magnets this estimate is probably not very far from the truth, but it is now clearly understood that the force which can be exerted by an electromagnet, or by a pair of electromagnets with opposite poles in*~~

~~*contact, is only limited by the greatest value to which it is practically possible to raise the magnetizing force H. This is at once evident when the tractive force due to magnetiza- tion is expressed as ^ttP + HI. For fields of moderate intensity the first term of the expression is the most im- portant, but when the value of H exceeds 12,000 or there- abouts, the second preponderates, and with the highest values that have been actually obtained, HI is several times greater than 2?rI2. If H could be increased without limit, so also could the tractive force. The following table shows the greatest "lifting powers" experimentally reached at the dates mentioned : —*~~

~~*Observer.*~~

~~*Kilos per sq. cm.*~~

~~*Lb. per sq. in.*~~

~~*Date*~~

~~*Joule Bidwell . Wilde . T. Jones .*~~

~~*12-3*~~

~~*16-9*~~

~~*26-8*~~

~~*114-9*~~

~~*175*~~

~~*226*~~

~~*381*~~

~~*1634*~~

~~*1862 1886 1891 1896*~~

~~*Magnetization in Very Weak Fields.*~~

~~*Some interesting observations have been made of the effects produced by very small magnetic forces. It was*~~

~~*first pointed out by Baur {Wied. Ann. vol. xi. (1880), p. 399) that in weak fields the relation of the magnetization I to the magnetizing force H is approximately expressed by an equation of the form*~~

~~*I=aH + 5H2, or*~~

~~*K = |j=as|-JH,*~~

~~*whence it appears that within the limits of Baur's experi- ments the magnetization curve is a parabola, and the susceptibility curve an inclined straight line, k being therefore a known function of H. If these equations could be assumed to hold when H is indefinitely small, it would follow that k has a finite initial value, from which there would be no appreciable deviation in fields so weak that bJL was negligibly small in comparison with a. Such an assumption could not, however, without dangerous extrapolation, be founded upon the results of Baur's experiments, which did not go far enough to justify it. In some experiments carried out in 1887, Eayleigh {Phil. Mag. vol. xxiii. p. 225) approjiched very much more nearly than Baur to the zero of magnetic force. Using an un- annealed Swedish iron wire, he found that when H was gradually diminished from 0-04 to 0-00004 C.G.S. unit, the ratio of magnetization to magnetizing force remained sensibly constant at 6-4, which may therefore -with great probability be assumed to represent the initial value of k for the specimen in question. Experiments with annealed iron gave less satisfactory results, on account of the slowness with which the metal settled do-wn into a new magnetic state, thus causing a " drift " of the magnetometer needle, which sometimes persisted for several seconds. Apart from this complication, it appeared that I was proportional to H when the value of H was less than 0"02.*~~

~~*The observations of Baur and Kayleigh have been confirmed and discussed by (among others) Schmidt (Wied. Ann. vol. liv. p. 655), who found the limiting values of k to be 7 '6 to 9 -5 for iron, and 11-2 to 13-6*~~

~~*for steel, remaining constant up to II= 06 ; by Cul mann {EleM. Zeit. vol. xiv. p. 345 ; Wied. Ann. vol. Ivi. p. 602) ; and by HIolbom {Bcrl. Ber. 1897, p. 95, and Wied. Ann. vol. Ixi. p. 281). The latter gives values of the constants a and J for different samples of iron and steel, some of which are shown in the following table : —*~~

~~*MeiaL*~~

~~*a*~~

~~*J*~~

~~*English tungsten*~~

~~*steel*~~

~~*8-90*~~

~~*0-264*~~

~~*Tungsten steel, hardened .*~~

~~*2-23*~~

~~*0-032*~~

~~*Silver steel*~~

~~*8-66*~~

~~*0-384*~~

~~*Tool steel .*~~

~~*8-30*~~

~~*0-400*~~

~~*Refined steel .*~~

~~*11-28*~~

~~*1-92*~~

~~*Cast iron .*~~

~~*3-16*~~

~~*0-236*~~

~~*Soft iron .*~~

~~*16-6*~~

~~*18-6*~~

~~*Hard drawn iron*~~

~~*5-88*~~

~~*1-76*~~

~~*For most samples of steel the straight-line law was found to hold approximately up to H = 3 ; in the case of iron and of soft steel the approximation was less close.*~~

~~*The behaviour of nickel in weak fields has been observed by E-wing {Phil. Trans, vol. clxxix.A (1888), p. 325), who found that the initial value of k was 1-7, and that it remained sensibly constant until H had reached a value of about five units. While therefore the initial susceptibility of nickel is less than that of iron and steel, the range of magnetic force within which it is approximately constant is about one hundred times greater. Ewing has also made a careful study {Proc. Roy. Sue. vol. xlvi. (1889), p. 269) of " magnetic viscosity " under small forces — the cause of the magnetometer " drift " referred to by Eayleigh. On the application of a small magnetizing force to a bar of soft annealed iron, a certain intensity of magnetization is instantly produced ; this, however, does not remain constant, but slowly increases for some seconds or even minutes,*~~

~~*and may ultimately attain a value nearly twice as great as that observed immediately after the force waa*~~

~~*applied. 1 When the magnetizing current is broken, the magnetization at once undergoes considerable diminution, then gradually falls to zero, and a similar sudden change followed by a slow one is observed when a feeble current is reversed. Ewing draws attention to a curious conse- 'quence of this time-lag. By the alternate application and withdrawal of a small magnetizing force a cyclic condition may be established in an iron rod. If now the alterna- tions are performed so rapidly that time is not allowed for more than the first sudden change in the magnetization, there will be no hysteresis loss, the magnetization exactly following the magnetizing force. Further, if the alterna- tions take place so slowly that the full maximum and minimum values of the magnetization are reached in the intervals between the reversals, there will again be no dissipation of energy. But at any intermediate frequency the ascending and descending curves of magnetization will enclose a space and energy will be dissipated. It is re- markable that the phenomena of magnetic viscosity are much more evident in a thick rod than in a thin wire, or even in a large bundle of thin wires. In hardened iron and steel the eflfect can scarcely be detected, and in weak fields these metals exhibit no magnetic hysteresis of any kind.*~~

~~*Changes of Dimensions attending Magnetization.*~~

~~*It is well known that the form of a piece of ferro- magnetic metal is in general slightly changed by mag- netization. The phenomenon was first noticed by Joule, whose experiments are described in papers published in 1842 and 1847. For nearly forty years nothing of im- portance was added to Joule's results, with the exception of Barrett's discovery that a nickel bar contracts when magnetized, and the short statement in Ency. Brit. vol. xv. p. 268, included nearly all that was known on the subject down to the year 1883. Much new light has, however, been recently thrown upon a class of phenomena which cannot fail to have an important bearing upon*~~

~~any com- plete molecular theory of magnetism.^ According to Joule's observations, the length of a bar of iron or soft steel was increased by magnetization, the elongation being propor- tional up to a certain point to the square of the intensity of magnetization ; but when the " saturation point " was approached the elongation was less than this law would require, and a stage was finally reached at which further increase of the magnetizing force produced little or no eflfect upon the length. From data contained in Joule's paper it may be calculated that the strongest external~~

~~' The slime phenomenon is exhibited in a less marked degree when soft iron is magnetized in stronger fields (Ewing, Phil. Trans, vol. clxxvi. (1885), p. 569.~~

~~2 Publications since 1883 are: — Bidwell, Fhil. Trans, vol. clxxix.A (1888), p. 205 ; Proc. Royal Soc. vol. xl. (1886) pp. 109, 257, vol. xliii. (1888) p. 406, vol. xlvii. (1890) p. 469, vol. II. (1892) p. 495, vol. Iv. (1894) p. 228, vol. Ivi. (1894) p. 94 ; Nature, vol. Ix. (1899), p. 222. — Cantone, Mem. d. Acc. d. Lincei, vol. vi. (1889), p. 487 ; Rend. d. Acc. d. Lincei, vol. vi. (1890), p. 252. — Berqet, C. R. vol. cxv. (1892), p. 722.— Van Adbel, Jmm. dePhys. [3], vol. i. (1892), p. 424.— LOOHNER, PhU. Mag. vol. xxxvi. (1893), p. 498. — Nagaoka, PhU. Mag. vol. xxxvii. (1894). p. 131 ; Wied. Ann. vol. liii. (1894), p. 487.— Rosing, Phil. Mag. vol. xxxix. (1895), p. 226.— Knott, Proe. Roy. Soc. Ed. (1890-91), p. 315 ; Phil. Mag. vol. xxxvii. (1894), p. 141 ; Trans. R. S. Ed. vol. xxxviii. (1896), p. 527 ; vol. xxxix. (1898), p. 457.— Knott and Shand, Proe.R. S.Ed. (1891-92), pp. 85, 249 ; (1893-94), p. 295.— More, Phil. Mag. vol. xl. (1895), p. 345. — Gallandet, Johns Hopkins Oniv. Thesis, 1896. — Klingen- BERG, Rostock Univ. Thesis, Berlin, 1897. — Taylor Jones, Phil. Trans, vol. clxxxix.A (1897), p. 189.— Brackett, Phys. Rev. vol. V. (1897), p. 257. — Naoaoka and Honda, PhU. Mag. -vol. xlvi. (1898), p. 261 ; vol. xlix. (1900), p. 329 ; Joum. Coll. Sci. T6ky6, vol. xiii. (1900), p. 57. — Stevens, Phys. Rev. vol. vii. (1898), p. 19. — Rhoads, Phys. Rev. vol. vii. (1898), p. 65 ; Phil. Mag. vol. ii. (1901), p. 463.— Shakespbar, Phil. Mag. vol. xlvii. (1899), p. 539. —Honda, Joum. Coll. Sci. T6ky6, vol. xiu. (1900), p. 77.— Austin, Phys. Rev. vol. x. (1900), p. 180.~~

~~*field H„ produced by his coil was about 126 C.G.S. units, but since the dimensional ratio of his bars was compara- tively small, the actual magnetizing force H must have been materially below that value. In 1885 it was shown by Bidwell, in the first of a series of papers on the subject, that if the magnetizing force is pushed beyond the point at which Joule discontinued his experiments, the extension of the bar does not remain unchanged, but becomes gradually less and less, until the bar, after first returning to its*~~

~~*Fig. 19.*~~

~~*original length, ultimately becomes actually shorter than when in the unmagnetized condition. The elongation is generally found to reach a maximum under a magnetizing force of 50 to 120 units, and to vanish under a force of 200 to 400, retraction occurring when still higher forces are applied. In order to meet the objection that the phenomenon might be due to electromagnetic action , between the coU and the rod, Bidwell made some experi- ments with iron rings, and found that the length of their diameters varied under magnetization in precisely the same manner as the length of a straight rod. Fig. 19 shows the changes observed in the dimensions of two iron rings and an iron rod in fields up to 450 units. Experi- ments were afterwards made with rods of iron, nickel, and cobalt, the external field being carried up to the high value of 1500 units. The results are indicated in Fig. 20. It*~~

~~*r*~~

~~*cogJi-*~~

~~^~~

~~^^~~

~~^*Jrm:*~~

~~^^^~~

~~*Nickel*~~

~~*H*~~

~~*Sm 760*~~

~~*Fig. 20.*~~

~~*mo*~~

~~*appears that the contraction which followed the initial extension of the iron reached a limit in fields of 1000 or 1100. Nickel exhibited retraction from the very begin- ning (as observed by Barrett), its greatest change of length considerably exceeding that undergone by iron ; in a field of 800 the original length was diminished by as much as 1/40,000 part, but stronger forces failed to produce any further effect. The curve for cobalt is a very remarkable one. Little Or no change of length was observed until the strength of the field Hq reached about 50 ; then the rod began to contract, and after passing a minimum at*~~

~~*S. VI._56*~~

~~*Hq = 400, recovered its original length at Hg = 750 ; beyond this point there was extension, the amount of which was stUl increasing fast when the experiment was stopped at Hq= 1400. Similar results were obtained with three different samples of the metal. Eoughly speaking, therefore, cobalt behaves oppositely to iron.*~~

~~*Joule and others experimented with hardened steel, but failed to find a key to the results they obtained, which are rather complex, and have been, thought to be inconsistent. The truth appears to be that a hardened steel rod generally behaves like one of iron or soft steel in first undergoing extension under increasing magnetizing force, and recover- ing its original length when the force has reached a certain critical value, beyond which there is contraction. But this "critical value" of the force is found to depend in an unexpected manner upon the hardness of the steel*~~

~~*; the critical value diminishes as the hardness becomes greater up to a certain point, corresponding to a yellow temper, after which it increases and with the hardest steel becomes very high. For steel which has been made red-hot, suddenly cooled, and then let down to a yellow temper, the critical value of the magnetizing force is smaller than for steel which is either softer or harder ; it is indeed so small that the metal contracts like nickel even under weak magnetizing forces, vsdthout undergoing any preliminary extension that can be detected.*~~

~~*Joule also made experiments upon iron wires under tension, and appears to have formed the conclusion (which has been often quoted as if it were a demonstrated fact) that under a certain critical tension (differing for different specimens of iron but independent of the magnetizing force) magnetization would produce no effect whatever upon the dimensions of the wire." What actually happens when an iron wire is loaded with various weights is clearly shown in Fig. 21. Increased tension merely has the*~~

~~*axkiUn*~~

~~*Fig. 21.*~~

~~*effect of diminishing the maximum elongation and hasten- ing the contraction ; with the two greatest loads used in the experiment there was indeed no preliminary extension at all." The effects of tension upon the behaviour of a nickel wire are of a less simple character. In weak fields the magnetic contraction is always diminished by pulling stress ; in strong fields the contraction increases under a small load and diminishes under a heavy one. Cobalt, curiously enough, was found to be quite unaffected by tensile stress.*~~

~~*Certain experiments by Knott on magnetic twist, which will be referred to later, led him to form the conclusion that in an iron wire carrying an electric current the*~~

~~*^ In JSnci/. Brit. vol. xv. p. 269 it is stated that in the case of a certain wire loaded mth a weight of 600 lb there was neither extension nor*~~

~~*contraction, even with a very large current. This, however, was merely a conjecture of Joule's which an experiment would have dis- proved.*~~

~~*' The loads were successively applied in decreasing order of magni- tude. They are indicated in Fig. 21 as kilos per sq. cm.*~~

~~*magnetic elongation would be increased. This forecast was shown by Bidwell to be well founded. The effect produced by a current is exactly opposite to that of tension, raising the elongation curve instead of depressing it. In the case of a vsdre 0-75 mm. in diameter the maximum elongation was nearly doubled when a current of two amperes was passing through the iron, while the "critical value" of the field was increased from 130 to 200. Yet notwithstanding this enormous effect in iron, the action of a current upon nickel and cobalt turned out to be almost inappreciable.*~~

~~*Some experiments were next undertaken vpith the view of ascertaining how far magnetic changes of length in iron were dependent upon the hardness of the metal, and the unexpected result was arrived at that softening produces the same effect as tensile stress ; it depresses the elon- gation curve, diminishing the maximum extension, and reducing the "critical value" of the magnetizing force. A hard drawn wire showed a maximum elongation of 45 ten-mUlionths, the critical field being (by extrapolation) 560. After the wire had been annealed, its maximum elongation was only 7 and the critical field 140. A thoroughly well annealed ring of soft iron showed no extension at all, beginning to contract under the smallest magnetizing forces ; in a field of 506, when the experiment had to be stopped owing to the heating of the coU, the retraction had reached 75 ten-miUionths, and appeared to be still far from its limiting value. A ring made of the same iron, but unannealed, showed a maximum elongation of 33, the critical value of the field being 420. The experiments were not sufficiently numerous to indicate whether, as is possible, there is a critical degree of hardness for which the height of the elongation curve is a maximum.*~~

~~*Finally, experiments were made to ascertain the effect of magnetization upon the dimensions of iron rings in directions perpendicular to the magnetization, and upon the volume of the rings. Four brass rods were*~~

hard- soldered to a short cylindrical iron ring, two of them forming prolongations of a diameter, while the other two were attached to the edges, opposite to one another and parallel to the axis of the ring. The first pair served to communicate to the measuring instrument the effects of changes along the lines of magnetization, the other pair those perpendicular to the magnetization. It was found that the curve showing the relation of transverse changes of dimensions to magnetizing force was similar in general character to the familiar elongation curves, but the signs were reversed ; the curve was inverted, indicating at first retraction, which, after passing a maximum and vanishing in a critical field, was succeeded by elongation. The curve showing the circumferential (or longitudinal) changes was also plotted, and from the two curves thus obtained it was easy, on the assumption that the metal was isotropic in directions at right angles to the magnetization, to calculate changes of volume ; for if circumferential elonga- tion be denoted by Zj, and transverse elongation by l.; then the cubical dilatation (+ or –) = / i 2^^ approxi- mately. If Zj were exactly equal to — 2/^ for all values of the magnetizing force, it is clear that the volume of the ring would be unaffected by magnetization. In the case of the ring in question, the circumferential changes were in weak fields less than twice as great as the transverse ones, while in strong fields they were more; under increasing magnetic force therefore the volume of the ring was first diminished, then it regained its original value (for II = 90), and ultimately increased. It was also shown that annealing, which has such a large effect upon circumferential (or longitudinal) changes, has almost none upon transverse ones. IIence the changes of volume undergone by a given sample of wrought iron under

increasing magnetization must depend largely upon the state of the metal as regards hardness ; there may be always contraction, or always expansion, or first one and then the other.

Many of the above described experiments have been repeated, and the results confirmed by other workers. As regards the effect of magnetization

~~*upon volume there are some discrepancies. Nagaoka and Honda, employing a fluid dilatometer, found that the volume di several specimens of iron and steel was always slightly increased, no diminution in low fields being indicated. Ehoads, finding that the height of the elongation curve is greater for strips of sheet iron cut parallel to the direction of the fibrous structure than for strips cut at right angles to it, conjectures that in perfectly isotropic iron there would be no change of volume. In order to avoid complications arising from imperfect homogeneity and isotropy, by which metallic solids must always be in some degree affected, Hurmuzescu experimented with solutions of salts of iron, and found that their volume was diminished by the action of a magnetic field. Nickel, according to Cantone's ob servations, appeared to be slightly diminished in volume by magnetization ; and a similar result was at first obtained by Nagaoka and Honda, but when they afterwards tested a specimen of greater purity a small increase of volume was observed. The question again arises how far these results are dependent upon the physical condition of the metal. Knott has carried out an exhaustive series of experiments on the strains produced in iron, steel, nickel, and cobalt tubes in the magnetic field. Tulses of various dimensions were subjected to fields of various intensities, and measurements were made of changes in (1) volume of the bore, (2) length of the tube, (3) volume of the material of the tube, (4) external changes of volume when the tube was plugged. The important results obtained are of too complex a nature to be fully described here ; the following are the general conclusions drawn : — (i.) the strain is one in which there is comparatively little change of volume, but considerable change of form ; (ii.) except in the case of very thin walls, a circular element in any transverse plane perpendicular to the axis of the cylinder becomes, when the cylinder is magnetized parallel to its axis, an ellipse with its major axis pointing towards the axis of the tube. When the walls are thin, the ellipse has its minor axis pointing towards the axis of the tube. The ellipse in both cases increases in eccentricity as the distance from the axis diminishes. It may be added that the measurements of class (3) showed that in iron there was always a slight increase of volume, and in nickel and cobalt a slight decrease. Honda subjected tubes of iron, steel, and nickel to the simultaneous action of longitudinal and circular fields, and observed the changes of length which occurred when one of the fields was varied, while the other*~~

remained constant at different successive values from zero upwards. The experimental results agreed in sign though not in magnitude with those calculated from the changes produced by simple longitudinal magnetiza- tion, discrepancies being partly accounted for by the fact that the metals employed were not actually isotropic. The complicated hysteresis effects which attend the mag- netic elongation and contraction of iron, nickel, and cobalt have been studied by Nagaoka.

Attempts have been made to explain magnetic deforma- tion by various theories of magnetic stress, ^ notably that 1 For a discussion of theories of magnetic stress, with copious refer- ences, see Nagaoka, Rap. du Congris International de Phydgue, Paris, 1900, vol. ii. p. 536. Also Nagaoka and Jones, PhU. Mag. vol. xli. (1896), p. 454. As to the disputed question whether there exists a compressive stress equal to B^'/Stt or (B" — H2)/8ir, see letters by Chree, Jones, Ewing, and Wilberforce, Nature, vol. liii. (1896). Also More, Kliugenberg, and Bratkett, loc. cit.

elaborated by Kirchhoff {Wied. Ann. voL xxiv. (1885), p. 52, and vol. xxv. p. 601), but so far without any great success. Taylor Jones showed in 1897 that only a small proportion of the contraction exhibited by a nickel wire when magnetized could be accounted for on Kirchhoff's theory from the observed effects of puUing stress upon magnetization ; and in a more extended series of observa- tions Nagaoka and Honda foun4 wide quantitative diver- gences between the results of experiment and calculation, though in nearly all cases there was agreement as to quality. They consider, however, that Kirchhoff's theory, which assumes change of magnetization to be simply proportional to strain, is still in its infancy, the present stage of its evolution being perhaps comparable with that reached by the theory of magnetization at the time when the ratio I/H was supposed to be constant. In the light of future researches further development may reasonably be expected.

Effects of Mechanicai, Stress upon Magnetization.

Certain effects of traction, compression, and torsion in relation to magnetism have been noticed in Ency. Brit. vol. XV. pp. 269-271. Since the publication of the ninth edition, the behaviour of the magnetic metals under various kinds of stress has formed the subject of much patient

~~*investigation, especially at the hands of Ewing, Nagaoka, and Knott. The results of their experiments embrace a multiplicity of details of which it is impossible to give a brief summary. Only a few of the most im- portant can be mentioned here ; the reader who vrishes for fuller information should consult the original papers.*~~

~~*It was first discovered by Villari in 1868 that the magnetic susceptibiUty of an iron wire was increased by stretching when the magnetization was below a certain value, but diminished when that value was exceeded ; this phenomenon has been termed the " Villari reversal," and the value of the magnetization for which stretching by a given load produces no effect is known as the "Villari critical point" for that load. The Villari critical point for a given sample of iron is reached with a smaller magnetizing force when the stretching load is great than when it is small ; the reversal also occurs with smaller loads and with weaker fields when the iron is soft than when it is hard. The following table shows the values of I and H corresponding to the VUlari critical pioint in some of Evsdng's experiments : —*~~

~~*Soft Iron.*~~

~~*Hard Iron.*~~

~~*Kilos per sq. mm.*~~

~~*I.*~~

~~*H.*~~

~~*Kilos per sq. niTn.*~~

~~*I*~~

~~*H.*~~

~~*2-15 4-3 8-6 12-9*~~

~~*1220*~~

~~1040~~

~~840~~

~~690~~

~~7-3 4-3 3-4 3-05~~

~~27-6 32-2 37-3 42-5~~

~~1180 1150 1110 1020~~

~~34 32 29 25~~

~~The effects of pulling stress may be observed either when the wire is stretched by a constant load while the magnetizing force is varied, or when the magnetizing force is kept constant while the load is varied. In the latter case the first application of stress is always attended by an increase — often a very great one — of the magnetiza- tion, whether the field is weak or strong, but after a load has been put on and taken off several times the changes of magnetization become cyclic. From experiments of both classes it appears that for a given field there is a~~

~~2 EwTNG, PhU. Trans, vol. clxxvi. (1885), p. 580; vol. clxxix. (1888), p. 333 ; Magnetic Induction (1900), ch. ix. — Ewing and Cowan, PhU. Trans, vol. clxxix.A (1888), p. 325. — Nagaoea, Phil. Mag.\o. xxvii. (1889), p. 117 ; vol. zxiz. (1890), p. 123.— Knott, Trans. R. S. Ed. vol. xxxii. (1882-83), p. 193 ; vol. xxxv. (1889), p. 377 ; vol. xxxvi. (1891), p. 485 ; Proc. R. S. Ed., 1899, p. 586. — Nagaoka and HOnda, Journ. Coll. Sci. TSkyd, vol. xiii. part 2 (1900), p. 263.~~

~~certain value of the load for which the magnetization is a maximum, the maximum occurring at a smaller load the stronger the field. In very strong fields the maximum may even disappear altogether, the efifect of the smallest stress being to diminish the magnetization ; on the other~~

~~hand, with very weak fields the maximum may not have been reached with the greatest load that the wire can support without permanept deformation. When the load on a hardened wire is gradually increased, the maximum value of I is found to correspond with a greater stress than when the load is gradually diminished, this being an effect of hysteresis. Analogous changes are observed in the residual magnetization which remains after the wire has been subjected to fields of different strength. The effects of longitudinal pressure are opposite to those of traction ; when the cyclic condition has been reached, pressure reduces the magnetization of iron in weak fields and increases it in strong fields (Ewing, Magnetic Induc- tion (1900), p. 223).~~

~~The influence of traction in diminishing the suscepti- bility of nickel was first noticed by Kelvin (Thomson), and has been more recently investigated by Ewing and Cowan. The latter found the effect to be enormous, not only upon the induced magnetization, but in a still greater degree upon the residual. Even under so " moderate " a load as 33 kilogrammes per square mm., the induced magnetiza- tion of a hard-drawn nickel wire in a field of 60 fell from 386 to 72 units, while the residual was reduced from about 280 to 10. Ewing has also examined the effects produced by longitudinal compression upon the suscepti- bility and retentiveness of nickel, and found, as was to be expected, that both were greatly increased by pressure. The maximum susceptibility of one of his bars rose from 5 "6 to 29 under a stress of 19'8 kilos per square mm. There were reasons for believing that no VUlari reversal would be found in nickel. Ewing and Cowan looked carefully for it, especially in weak fields, but failed to discover anything of the kind.^ In some experiments by Heyd- weiller (Wied. Ann. vol. lii. (1894), p. 462, and Electrician, vol. xxxiv. p. 143) the magnetization of a nickel wire in weak fields (corresponding to 1 = 5 or thereabouts) was first diminished and then augmented under increasing tensile stress ; but since a cyclic condition does not appear to have been even approximately established before the observations were made, they can hardly be regarded as demonstrating a true Villari effect. Nagaoka and Honda {Phil. Mag. vol. xlvi. (1898), p. 26) found that the magnetization of a nickel rod under feeble pulling stress was increased by a little more than half a unit in a weak field. The loads applied were equal to 0'19 and 0'38 kilo- gramme per square mm.,~~

~~*the smallest employed by Ewing having been 5 “5. If, therefore, a Villari reversal does occur in the case of nickel, the phenomenon is a very inconspicuous one.*~~

~~*The effects of longitudinal pressure upon the magnetiza- tion of cobalt have been examined by Chree {Phil. Trans. vol. clxxxi. (1890), p. 329) and also by Ewing {Magnetic Induction (1892), p. 210). Chree’s experiments were undertaken at the suggestion of J. J. Thomson, who, from the results of Bidwell’s observations on the magnetic deformation of cobalt, was led to expect that that metal would exhibit a Villari reversal opposite in character to that observed in iron. The anticipated reversal was duly found by Chree, the critical point corresponding, under the moderate stress employed, to a field of about 120 units.*~~

~~*^ Tomlinson found a critical point in the “temporary magnetiza- tion” of nickel (Proc. Phys. Soc. vol. x. (1890), pp. 367, 445), but this does not correspond to a Villari reversal. Its nature is made clear by Ewing and Cowan’s curves (Phil. Trans, vol. clxxix. (1888), places 15, 16).*~~

~~*Ewing’s independent experiments showed that the magneto ization curve for a cobalt rod under a load of 16 “2 kilos per square mm. crossed the curve for the same rod when not .loaded at H = 53. Both observers noticed analogous effects in the residual magnetization. Meyer (Wied. Ann. vol. lix. (1896), p. 134) appears to have found a Villari effect of the opposite sign in feebly magnetized cobalt under pulling stress (I = 3‘64).*~~

~~*It has been shown by J. J. Thomson {Applications of Dynamics to Physics and Chemistry, p. 47) that on dyna- mical principles there must be a reciprocal relation between the changes of dimensions produced by magnetization and the changes of magnetization attending mechanical strain. Since, for example, stretching diminishes the magnetization of nickel, it follows from theory that the length of a nickel rod should be diminished by magnetization and conversely. So, too, the Villari reversals in iron and cobalt might have been predicted — as indeed that in cobalt actually was — from a knowledge of the changes of length which those metals exhibit when magnetized. 2'*~~

~~*Nagaoka and Honda (Phil. Mag. vol. xlvi. (1898), p. 261) have investigated the effects of hydrostatic pressure upon magnetization, using the same pieces of iron and nickel as were employed in their experiments upon magnetic change of volume. In the iron cylin- der and ovoid, which expanded when magnetized, compression caused a diminution of magnetization ; in the nickel rod, which contracted when magnetized, pressure was attended by an increase of magnetization. The amount of the change was in both cases exceedingly small, that in iron being less than O'l C.G.S. unit with a pressure of 250 atmospheres and H = 54. It would hardly be safe to generalize from these observations ; the effects may possibly be dependent upon the physical condition of the metals. In the same paper Nagaoka and Honda describe an important experiment on the effect of transverse stress. An iron tube, having its ends closed by brass caps, was placed inside a compress- ing vessel into which water was forced until the pressure upon the outer surface of the tube reached 250 atmospheres. The experi- ment was the reverse of that made by Kelvin with a gun-barrel (Eiicy. Brit. vol. xv. p. 269), and the results were also the reverse. Under increasing magnetizing force the magnetization first increased, reached a maximum, and then diminished until its value ultimately became less than when the iron was in the unstrained condition.*~~

~~*The relations between torsion and magnetization have been discussed in Ency. Brit. vol. xv. p. 270. Some of the curious phenomena there referred to are direct con- sequences of the known effects of longitudinal stress upon magnetization and of magnetization upon form. An ex- planation due to Maxwell {Electricity and Magnetism, § 448) is given of the fact discovered by G. Wiedemann, that if an electric current is passed through a longitudin- ally magnetized iron wire which is fixed at one end and free at the other, the free end twists in a certain direction. According to Maxwell, the wire becomes helically magnetized, and the expansion of the iron along the lines of magnetiza- tion causes the twst. This explanation was not accepted by Wiedemann {Phil. Mag., July 1886, p. 50), who thought the effect was to be accounted for by molecular friction. Now nickel contracts instead of lengthening when it is magnetized longitudinally, and an experiment made by Knott showed, as he expected, that ceteris paribus a nickel wire twists in a sense opposite to that in*~~

which iron twists. Further, although iron lengthens in fields of moderate strength, it contracts in strong ones ; and if the wire is stretched, contraction occurs with smaller magnet- izing forces than when it is unstretched. Bidwell {Phil. il/(«/., September 1886, p. 251) accordiogly found upon trial that the Wiedemann twist of an iron wire vanished when the magnetizing force reached a certain rather high value, and was reversed when that value was exceeded ; he also found that the vanishing point was reached with lower

" In JEncy. Brit. vol. xv. p. 271, the first footnote is equivalent to a prediction of the changes of length in magnetized iron which were afterwards observed.

values of the magnetizing force when the wire was stretched by a weight. These observations have been verified and extended by Knott, who has also studied the effect in cobalt, and has brought to light a large number of additional facts, all of which are in perfect harmony with Maxwell's explanation of the twist.

More experiments have been made by Ewing,' Knott,^ Zehnder,' and Nagaoka, on the polarity developed in a circularly magnetized wire by torsion, and on the transient electric currents, indicative of circular magnetization, induced when a longitudinally magnetized wire is twisted ; it is noteworthy that both these effects have op- posite directions in iron and in nickel. The effects of magnetization upon the torsion of a previously twisted wire have been further studied by F. J. Smith ° and by Moreau.* Nagaoka' has described the remarkable influence of combined torsion and tension upon the susceptibility of nickel, and has made the extraordinary observation that, under certain conditions of stress, the magnetization of a nickel wire may have a direction opposite to that of the magnetizing force. It is not easy to co-ordinate these results with any other known phenomena of magnetism.*

~~*The mutual relations between torsion and magnetization in iron and nickel wires have recently been investigated by Nagaoka and Honda, who have succeeded in showing that all the experimental results contained in the following parallel statements are in qualitative agreement with an extension of Kirohhoff's theory : —*~~

~~*Effects of Stress on Magnetization.*~~

~~*(i.) Twisting a longitudinally magnetized wire gives rise to circular magnetization.*~~

~~*(ii.) Twisting a circularly magnetized wire gives rise to longitudinal magnetization.*~~

~~*(iii.) Up to moderate fields, the transient current (due to circular magnetization) or the longitudinal magnetization pro- duced by twisting a longi- tudinally or circularly magnet- ized iron wire respectively, is opposite to that in nickel.*~~

~~*(iv.) The transient current produced by twisting a longi- tudinally magnetized iron or nickel wire reaches a maximum in low fields.*~~

~~*(v.) In strong fields the direc- tion of the transient current produced by twisting a longi- tudinally magnetized iron wire is reversed and is in the same direction as in nickel.*~~

~~*Strains produced hy Magnetization.*~~

~~*(1) A longitudinally magnet- ized wire is twisted by circular magnetization.*~~

~~*(2) A circularly magnetized wire is twisted by longitudinal magnetization.*~~

~~*(3) Up to moderate fields, the twist produced by the longi- tudinal and circular magnetiza- tions of an iron wire is opposite to that in nickel.*~~

~~*(4) The twist due to longi- tudinal magnetization of a cir- cularly magnetized iron or nickel wire reaches a maximum in low fields.*~~

~~*(5) In strong fields the twist due to longitudinal magnetiza- tion of a circularly magnetized iron wire is reversed and takes place in the same direction as in nickel.*~~

~~*Effects of Tempeeatuee upon Magnetism.*~~

~~*High Temperature. — It has long been known that iron, when raised to a certain "critical temperature" corre- sponding to dull red heat, loses its susceptibility and becomes magnetically indifferent, or, more accurately, is transformed from a ferromagnetic into a paramagnetic body. Eecent researches have shown that other im- portant changes in its properties occur at the same critical temperature. Abrupt alterations take place in its specific heat, thermo-electric quality, electrical conductivity, tem- perature-coefRcient of electrical resistance, and in some at least of its mechanical properties. Ordinary magnetizable iron is in many respects an essentially different substance from the non-magnetizable metal into which it is trans- formed when its temperature is raised above a certain point (see Brit. Assoc. Report, 1890, p. 145). The first exact experiments demonstrating the changes which occur in the permeability of iron, steel, and nickel when heated up to high temperatures were those of Hopkinson (Phil.*~~

~~*1 Proc. Roy. Soc. 1883, p. 117. ^ loc. cit.*~~

~~*s Wied. Ann. vol. xxxviii. (1889), p. 68.*~~

- ~~*Phil. Mag. vol. xxix. (1890), p. 123.*~~

~~*^ Phil. Mag. vol. xxxii. (1891), p. 383.*~~

~~*« C. R. vol. cxxii. (1896), p. 1192; vol. cxxvi. (1898), p. 463.*~~

~~*' Phil. Mag. vol. xxvii. (1889), p. 117.*~~

~~*Trans, vol. clxxx. (1889), p. 443 ; Proc. Roy. Soc. vol. xliv. (1888), p. 317). The metal to be tested was prepared in the form of a ring, upon which were wound primary and secondary coils of copper wire insulated with asbestos. The primary coil carried the magnetizing current ; the*~~

~~*secondary, which was wound inside the other, could be connected either with a ballistic galvanometer for deter- mining the induction, or with a Wheatstone's bridge for measuring the resistance, whence the temperature was calculated. The ring thus prepared was placed in a cast-iron box and heated in a gas furnace. The following are the chief results of Hopkinson's experiments : For small magnetizing forces the magnetization of iron steadily in- creases with rise of temperature till the critical tempera- ture is approached, when the rate of increase becomes very high, the permeability in some cases attaining a value of about 11,000; the magnetization then with remarkable suddenness almost entirely disappears, the permeability falling to about 1'14. For strong magnetizing forces (which in these experiments did not exceed H = 48'9) the permeability remains almost constant at its initial value (about 400), until the temperature is within nearly 100° of the critical point ; then the permeability diminishes more and more rapidly until the critical point is reached and the magnetization vanishes. Steel behaves in a similar manner, but the maximum permeability is not so high as in iron, and the fall, when the critical point is approached, is less abrupt. The critical temperature for various samples of iron and steel ranges from 690° C. to 870° C. ; it is the temperature at which Barrett's " recalescence " occurs. The critical temperature for the specimen of nickel examined (which contained nearly 5 per cent, of impurities) was 310° C. Lydall and Pocklington found that the critical temperature of nearly pure iron was 874° C. (Proc. Roy. Soc. vol. Hi. (1893), p. 228).*~~

~~*An exhaustive research into the effects of heating on the magnetic properties of iron has been carried out by D. K. Morris (Proc. Phys. Soc. vol. xv. (1897), p. 134; and Phil. Mag. vol. xliv. (1897), p. 213), the results being embodied in a paper containing twelve pages of tables and upwards of 120 curves. As in Hopkinson's experiments, ring magnets were employed ; these were wound with primary and secondary coils of insulated platinum wire, which would bear a much higher temperature than copper without oxidation or fusion. A third platinum coU, wound non-inductively between the primary and the secondary, served to carry the current by which the ring was heated ; a current of 4-6 amperes, with 16 volts across the termi- nals, was found sufficient to maintain the ring at a tem- perature of 1150° C. In the ring itself was embedded a platinum-*~~

thermometer wire, from the resistance of which the temperature was determined. The whole was wrapped in several coverings of asbestos and placed in a glass vessel from which the air was partially exhausted, additional precautions being taken to guard against oxidation of the iron.

Some preliminary experiments showed the striking difference in the effects of annealing at a red heat (840° C.) and at a low white heat (1150° C). After one of the rings had been annealed at 840°, its maximum permeability at ordinary temperatures was 4000 for H = l-84; when it had been subsequently annealed at 1150°, the maximum permeability rose to 4680 for H = 1 '48, while the hysteresis loss for B= +4000 was under 500 ergs per ccm. As regards the effects of temperature, Morris's results are in general agreement with those of HIopkinson, though no doubt they indicate details with greater clearness and accuracy. Specimens of curves showing the relation of induction to magnetic field at various temperatures, and of permeability to temperature with fields of different intensitie^ are given in Figs. 22 and 23. The most striking feature presented by these is the enormous value, 12,660, which, with H = 0-153 is attained by the permeability at 766° C, followed by a drop so pre-cipitous that when the temperature is only 15° higher, the value of the permeability has become quite insignificant. The critical

temperatures for three different specimens of iron were 795°, 780°, and 770° respectively. Above these temperatures the little permeability that remained was found to be independent of the magnetizing

12,000

IQpOO

epoo epoo

■tfiOO

~~spoo~~

~~I37V~~

-

~~y’~~

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~~/~~

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~~7(W‘5~~

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~~h~~

~~A~~

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~~775'~~

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~~y~~

~~” ‘~~

~~Tar’s~~

- ~~5~~

~~*Fig. 22.*~~

~~*9 H*~~

~~*force, but it appeared to vary a little with the temperature, one specimen showing a permeability of 100 at 820°, 2-3 at 950°, and 17 at 1060°. These last observations are, however, regarded as*~~

~~*/I*~~

~~*i4poa*~~

~~*tZflOO*~~

~~*10.000*~~

~~*epoo*~~

~~*epoo*~~

~~*4000*~~

~~*BflOO*~~

~~*A*~~

~~*X*~~

~~*fl-tOi*~~

~~*~\7*~~

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~~\~~

~~*B.g-*~~

~~*20*~~

~~/~~

~~*E‘0-1B3*~~

~~*/em>.*~~ ~~_A~~

~~A~~

~~*0°C 200°*~~

~~*too’ 600'*~~

~~*Fig. 23.*~~

~~*800*~~

~~*ipoo’*~~

~~*uncertain. The efifects of temperature upon hysteresis were also carefully studied, and many hysteresis loops were plotted. The results of a typical experiment are given in the annexed table, which shows how greatly the hysteresis loss is diminished as the critical temperature is approached. The coercive force at 764-5° is stated to have been little more than O’l C.G.S. unit; above the critical temperature no evidence of hysteresis could be obtained. HIysteresis Loss in Ergs per ccra. JIax. II=+G”83.*~~

~~*Temp. C°.*~~

~~*Ergs.*~~

~~*Temp. 0°. BrRS.*~~

~~*764-5*~~

~~*120*~~

~~*467 2025*~~

~~*748*~~

~~*328*~~

~~*352 2565*~~

~~*730*~~

~~*426*~~

~~*249 3130*~~

~~*695*~~

~~*797*~~

~~*137-5 3500*~~

~~*634*~~

~~*1010*~~

~~*24 3660*~~

~~*554*~~

~~*1345*~~

~~*Experiments*~~

~~*on*~~

~~*the effect of high*~~

~~*temperatures have also been*~~

~~*made by Ledeboer,*~~

~~*Tomlirigon*~~

~~*^ Curie*~~

~~*,3 Wilde,' Kunz,!^ and Wills."*~~

~~*1 Q. R. vol. cvi. (1888), p. 129. ^ Proc. Phys. Soc. vol. ix. (1888), p. 181.*~~

~~*' C. M. vol. cxv. (1892), p. 805 ; and vol. oxviii. (1894), pp. 796, i59. ■■ Proc. Roy. Soc. vol. 1. (1891), p. 109. ' EUU. Zdts. vol. XV. (1894), p. 194. 8 Phil. Mag. vol. 1. (1900), p. 1.*~~

~~*Low Temperature. — Fleming and Dewar {Proc. Roy. Soc. vol. Ix. (1896), p. 81) have conducted a unique series of experiments on the permeability and hysteresis of iron at low temperatures down to that of liquid air (– 186° C). Induction curves of an annealed soft-iron ring were taken first at a temperature of 15° C, and afterwards when the ring was immersed in liquid air, the magnetizing force ranging from about 0·8 to 22. After this operation had been repeated a few times, the iron was found to have acquired a stable condition, and the curves corresponding to the two temperatures became perfectly definite. They showed that the permeability of this sample of iron was considerably diminished at the lower temperature. The maximum permeability (for H = 2) was 3400 at 15°, and only 2700 at – 186°, a reduction of more than 20 per cent. ; but the percentage reduction became less as the magnetizing force departed from the value corresponding to maximum permeability. Observations were also made of the changes of permeability which took place as the temperature of the sample slowly rose from – 186° to 15°, the magnetizing force being kept constant throughout an experiment. The values of the permeability corresponding to the highest and lowest temperatures are given in the following table. Most of the permeability -temperature*~~

~~*Sample of Iron.*~~

~~*H.*~~

~~*^ at 15°.*~~

~~*fi at – 186".*~~

~~*Annealed Swedish .*~~

~~*1-77*~~

~~*2835*~~

~~*2332*~~

~~*Unannealed , ,*~~

~~*1-78*~~

~~*917*~~

~~*1272*~~

~~*9-79*~~

~~*1210*~~

~~*1293*~~

~~*Hardened ,,*~~

~~*2-66*~~

~~*56*~~

~~*132*~~

~~*4-92 11-16 127-7*~~

~~*106-5 447-5 109*~~

~~*502 823*~~

~~*124*~~

~~*Steel wire*~~

~~*7-50 20-39*~~

~~curves were more or less convex towards the axis of tem- perature, and in all the experiments, except those -with annealed iron and steel wire, the permeability was greatest at the lowest temperature." The hysteresis of the soft annealed iron turned out to be sensibly the same for equal values of the induction at — 186° as at 15°, the loss in ergs per ccm. per cycle being approximately represented by 0-002Bi=8 when the maximum limits of B were ± 9000. Experiments with the sample of unannealed iron failed to give satisfactory results, owing to the fact that no constant magnetic condition could be obtained.~~

~~Permanent 2laf/nets. — The same experimenters (loc. cit. p. 57) also investigated the changes which occurred in permanently magnetized metals when cooled to the temperature of liquid air. The metals, which were pre- pared in the form of small rods, were magnetized between the poles of an electromagnet and tested with a magneto meter at temperatures of — 186° and 5°. The first im- mersion into liquid air generally produced a permanent decrease of magnetic moment, and there -was sometimes a further decrease when the metal was warmed up again ; but after a few alternations of temperature the changes of moment became definite and cyclic. When the permanent magnetic condition had been thus established, it was found that in the case of all the metals, except the two alloys containing large percentages of nickel, the magnetic moment was temporarily increased by cooling to — 186°. The folio-wing table shows the principal results. It is suggested that a permanent magnet might conveniently be "aged" (or brought into a constant condition) by dipping it several times into liquid air.~~

~~' Thiessen {Phys. Ra<. vol. viii. (1899), p. 65) and Claude (G. R. vol. cxxix. (1899), p. 409) found that for considerable inductions (B =16,000) the permeability and hysteresis — loss remained nearly constant down to — 186° ; for weak inductions both notably diminished with temperature.~~

~~447~~

~~Metal.~~

~~Percentage Gain or Loss of Moment at — 186° C.~~

~~First Effect.~~

~~CycUc Effect.~~

~~Carbon steel, hard .... „ „ medium . „ „ annealed . Chromium steels (four samples) Aluminium steels (three samples) . Nickel steels, up to 7-65 per cent. . 1, „ „ 19-64 per cent. 11 II ,j 29 per cent.~~

~~Pure nickel~~

~~Silicon steel, 2-67 per cent. .~~

~~Iron, soft~~

~~„ hard~~

~~Tungsten steel, 15 per cent. . „ „ 7-5 per cent. . „ j> 1 per cent.~~

~~-6~~

~~Decrease~~

~~-33~~

~~Increase~~

~~-2~~

~~Small~~

~~-50~~

~~-20~~

~~*Decrease*~~

~~*None Decrease*~~

jj

~~*+ 12 + '22 + 33 + 12 + 10 + 10 -25 -10 + 3 + 4 + 2-5 + 10 + 6 + 10 + 12*~~

~~*Other experiments relating to the effect of temperature upon permanent magnets hare been carried out by Ashworth,"- who showed that the temperature coefficient of permanent magnets might be reduced to zero (for moderate ranges of temperature) by- suitable adjustment of temper and dimension ratio ; also by Pictet'^ and by Durward.***~~

~~*Alloys of Nickel and Iron. — ^A most remarkable effect of temperature was discovered by Hopkinson {Proc. Roy. Soc. vol. xlvii. (1890), p. 23; vol. xlviii. (1891), p. 1) in 1889. An alloy containing about 3 parts of iron and 1 of nickel — both strongly magnetic metals — is under ordi- nary conditions practically non- magnetizable (/i=l-4:for any value of H). If, towever, this non-magnetic sub- stance is cooled to a temperature a few degrees below freezing-point, it becomes as strongly magnetic as average cast-iron (/li = 62 for H = 40), and retains its magnetic properties indefinitely at ordinary temperatures. But if the alloy jis heated up to 580° C, it loses its susceptibility — rather suddenly when H is weak, more gradually when H is strong — and remains non-magnetizable till it is once more cooled down below the freezing-point. This material can therefore exist in either of two perfectly stable con- ditions, in one of which it is magnetizable, while in the other it is not. When magnetizable, it is a hard steel, having a specific electrical resistance of 0'000052 ; when non-magnetizable, it is an extremely soft, mild steel, and its specific resistance is 0'000072. Alloys containing different proportions of nickel were found to exhibit the phenomenon, but the two critical temperatures were less widely separated. The following approximate figures are deduced from Hopkinson's curves : —~~

~~*Percentage of*~~

~~*Susceptibility lost*~~

~~*Susceptibility gained*~~

~~*NickeL*~~

~~*at temp. C.*~~

~~*at temp. C.*~~

~~*0-97*~~

~~*890*~~

~~—~~

~~*4-7*~~

~~*820*~~

~~*660*~~

~~*4-7*~~

~~*780*~~

~~*600*~~

~~*24-5*~~

~~*680*~~

~~*-10*~~

~~*80-0*~~

~~*140*~~

~~*125*~~

~~*33-0*~~

~~207~~

~~193~~

~~73-0~~

~~202~~

~~202~~

~~Gnillaume* has further investigated the properties of nickel- steels, and found that the temperature at which magnetic suscepti- bility is recovered is lowered by the presence of chromium ; a certain nickel-chromium alloy was not rendered magnetic even by immersion in liquid air. Experiments on the subject have also been carried out by Dumont' and Osmond. °~~

~~AiiLOYS AND Compounds of Ieon.~~

~~In 1885 Hopkinson {Phil. Trans, vol. clxxvi. (1885), p. 455) employed his yoke method to test the magnetic properties of thirty-five samples of iron and steel, among~~

~~1 Proc. Roy. Soc. vol. Ixii. (1898), p. 210.~~

~~2 G. R. vol. cxx. (1895), p. 263.~~

~~" Amcr. Jour. Scien. vol. v. (1898), p. 245. ^ C. R. voL cxxiv. '1897), p. 1515 ; Joum. de Phys. vol. vii. (1898), p. 262.~~

~~5 C. R. vol. cxxvi. (1898), p. 741.~~

~~« Ibid. vol. cxxviii. (1899), pp. 304, 1395.~~

~~which were steels containing substantial proportions of manganese, silicon, chromium, and tungsten. The results, together with the chemical analysis of each sample, are given in a table contained in his paper, some of them being also represented graphically. The most striking phenomenon which they bring into prominence is the effect of any considerable quantity of manganese in an- nihilating the magnetic~~

~~*property of iron. A sample of Hadfield's manufacture, containing 12 '3 6 per cent, of manganese, differed hardly at all from a non-magnetic substance, its permeability being only 1-27. According to Hopkinson's calculation, this .sample behaved as if 91 per cent, of the iron contained in it had completely lost its magnetic property.^ Another point to which attention is directed is the exceptionally great effect which harden- ing has upon the magnetic properties of chrome steel ; one specimen had a coercive force of 9 when annealed, and of no less than 38 when oil-hardened. The effect of the addition of tungsten in increasing the coercive force is very clearly shown ; in two specimens contain- ing respectively 3' 4 4 and 2 '35 per cent, of tungsten the coercive force was 64'5 and 70'7. These high values render hardened tungsten-steel particularly suitable for the manufacture of permanent magnets. Hopkinson {Proc. Roy. Soc. vol. xlviiL (1890), p. 1) also noticed some peculiarities of an unexpected nature in the magnetic properties of the nickel-steel alloys already referred to. The permeability of the alloys containing from 1 to 4'7 per cent, of nickel, though less than that of good soft iron for magnetizing forces up to about 20 or 30, was greater for higher forces, the induction reached in a field of 240 being nearly 21,700. The induction for consider- able forces was found to be greater in a steel containing 73 per cent, of nickel than in one with only 33 per cent., though the permeability of pure nickel is much less than that of iron.*~~

~~*The magnetic qualities of various alloys of iron have been submitted to a very complete examination by Barrett, Brown, and Hadfield {Trans. Roy. Dub. Soc. vol. vii. (1900), p. 67; Jom-n. Inst. Elec. Eng., 1902).^ More than fifty different specimens were tested, most of which contained a known proportion of manganese, nickel, tungsten, aluminium, chrominm, copper, or silicon ; in some samples two of the sub- stances named were present. Of the very numerous results published, a few of the most characteristic are collected in the following table. The first column contains the symbols of the various elements which were added to the iron, and the second the percentage pro- portion in which each element was present ; the sample containing 0'03 per cent, of carbon was a specimen of the best commercial iron, the values .obtained for it being given for comparison. All the metals were annealed.*~~

~~*Per Cent.*~~

~~*B*~~

~~*B*~~

~~*1^*~~

~~*Coercive*~~

~~*for H=45.*~~

~~*residual.*~~

~~*for H=8.*~~

~~*Force.*~~

~~*e*~~

~~*0-03*~~

~~*16800*~~

~~*9770*~~

~~*1625*~~

~~*1-66*~~

~~*Cu*~~

~~*2-5*~~

~~*14300*~~

~~*10410*~~

~~...~~

~~*5-4*~~

~~*Mn*~~

~~*2-25*~~

~~*14720*~~

~~*10460*~~

~~*1080*~~

~~*6-0*~~

~~*Mn*~~

~~*15-2*~~

~~*0*~~

~~*Ni*~~

~~*3-82*~~

~~*16190*~~

~~*9320*~~

~~*1375*~~

~~*2-76*~~

~~*Ni*~~

~~*19-64*~~

~~*7770*~~

~~*4770*~~

~~90~~

~~20-0~~

~~Ni~~

~~31-4~~

~~4460~~

~~1720~~

~~357~~

~~0-5~~

~~W~~

~~7-5~~

~~15230~~

~~13280~~

~~500~~

~~9-02~~

~~Al~~

~~2-25~~

~~16900~~

~~10500~~

~~1700~~

~~1-0~~

~~*Cr*~~

~~*3-25*~~

~~*12-25*~~

~~*Si*~~

~~*2-6*~~

~~*16420*~~

~~*4080*~~

~~*1680*~~

~~*0-9*~~

~~*Si*~~

~~*5-5*~~

~~*15980*~~

~~*3430*~~

~~*1630*~~

~~*0-85*~~

~~*‘ See also Hopkinson, Joum. Inst. Elect. Ejig. vol. xix. p. 20 and Ewing, Phil. Trans, vol. clxxx. (1889), p. 239. ‘ ‘ ‘*~~

~~^ *Many of the figures which, through an error, were inaccurately stated in the first paper are corrected in the second.*~~

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~~*MAGNETISM*~~

~~*A few among several interesting points should be specially noticed. The addition of 15-2 per cent, of manganese produced an enormous effect upon the magnetism of iron, while the presence of only 2”25 per cent, was comparatively unimportant. “When nickel was added to the iron in increasing quantities, the coercive force increased until the proportion of nickel reached 20 per cent. ; then it diminished, and when the proportion of nickel was 32 per cent, the coercive force had fallen to the exceedingly low value of 0‘5. In the case of iron containing 7 ‘5 per cent, of tungsten (W), the residual induction had a remarkably high value ; the coercive force, however, was not very great. The addition of silicon in small quantities considerably diminished permeability and in- creased coercive force ; but when the proportion amounted to 2‘5 per cent, the maximum permeability (/i = 5100 for H = 2) was greater than that of the nearly pure iron used for comparison, while the coercive force was only 0‘9.^ A small percentage of aluminium produced still higher permeability (/x= 6000 for H = 2), the induction in fields up to 60 being greater than in any other known substance, and the hysteresis-loss for moderate limits of B far less than in the purest commercial iron. Certain non-magnetiz- able alloys of nickel, chromium-nickel, and chromium-manganese were rendered magnetizable by annealing.*~~

~~*A number of iron alloys have been examined by Mme. Sklodowska-Curie {Bull. Soc. d’ Encouragement, 1898, pp. 36—76), chiefly witli the object of determining their suit- ability for the construction of permanent magnets. Her tests appear to show that molybdenum is even more effective than tungsten in augmenting the coercive force, the highest values observed being 70 to 74 for tungsten- steel, and 80 to 8.5 for steel containing 3‘5 to 4 per cent, of molybdenum. For additional information re- garding the composition and qualities of permanent mag- net steels, reference may be made to the publications cited below.2 Useful instructions have been furnished by Barus {Terrestrial Magnetism, vol. ii. (1897), p. 11) for the preparation of magnets calculated to withstand the effects of time, percussion, and ordinary temperature varia- tions. The metal, having first been uniformly tempered glass-hard, should be annealed in steam at 100° C. for twenty or thirty hours ; it should then be magnetized to saturation, and finally ” aged ” by a second immersion in steam for about five hours.*~~

~~*Miscellaneous Effects of Magnetization.*~~

~~*Electrical Conductivity. — The specific resistance of many electric conductors is known to be temporarily changed by the action of a magnetic field, but except in the case of bismuth the efi'ect is very small.*~~

~~*Gray and T. Jones {Proc. Boy. Soc. vol. Ixvii. (1900), p. 208) found that the resistance of a soft iron wire was increased by about 1/700 in a field of 320 C.G.S. units. The effect appeared to be closely connected with the intensity of magnetization, being approximately proportional to I". Barlow {Proc. Roy. Soc, 1902), experimenting with wires of iron, steel, and nickel, showed that the change of resistance was proportional to a function aV + tl' + cl^, where tx, b, and c are constants for each specimen. Tomlinson {Phil. Trans., Part I., 1883, p. 153) discovered in 1881 that the resistance of a bismuth rod was slightly increased when the rod was subjected to longitudinal magnetic force, and a year or two later Eighi {Atti M. A. Lincei [3], vol. xix. p. 545) showed that a more considerable alteration was produced when the magnetic force was applied transversely to the bismuth conductor ; he also noticed that the effect was largely dependent upon tem- perature. (See also Lenard, IFied. Ann. vol. xxxix. (1890), p. 619.) The most complete series of experiments yet made on the influence of magnetic force at different temperatures are those of Henderson and of Dewar and Fleming. Henderson {Phil. Maq. vol. xxxviii. p. 488) used a little spiral of the pure electrolytic bismuth wire prepared by Hartmann and Braun ; this was placed between the pole-pieces of an electromagnet and subjected to fields of various strengths up to nearly 39,000 units. At constant temperature the*~~

~~*^ The marked effect of silicon in increasing the permeability of cast iron has also been noticed by Caldwell, Elect. World, vol. xxxii. (1898), p. 619.*~~

~~*2 Trowbridge and Sheldon, Phil. Mag. vol. xxix. (1890), p. 136. — Peeeoe, Journ. Inst. Mlect. Eng. (1890), p. 62 ; also Elect riiyinn, vol. XXV. (1890), p. 546. — Klemencic, Wien. Ber. vol. cv. Ila. (1896), p. 635. — Peirce, Am. Jown. Sci. vol. ii. (1896), p. 347.— Abt, Wied. Ann. vol. Ixvi. (1898), p. 116.— Osmond, C. R. vol. cxxviu. (1899), p. 1513.*~~

~~*resistance increased with the field ; the changes in the resistance of the spiral when the temperature was 18° C. are indicated in the annexed table, from which it will be seen that in the strongest*~~

~~*H.*~~

~~*B.*~~

~~*H.*~~

~~*R.*~~

~~*θ*~~

~~*1-000*~~

~~*27450*~~

~~*2-540*~~

~~*6310*~~

~~*1-253*~~

~~*32730*~~

~~*2-846*~~

~~*12500*~~

~~*1-630*~~

~~*38900*~~

~~*3-334*~~

~~*20450*~~

~~*2-160*~~

~~*transverse field reached the resistance was increased more than threefold. Other experiments showed the relation of resistance to temperature (from 0° to about 90°) in different constant fields. It appears that as the temperature rises the resistance decreases to a minimum and then increases, the minimum point occurring at a higher temperature the stronger the field. For H = ll,500 the temperature of minimum resistance was about 50° ; for much lower or higher values of H the actual minimum did not occur within the range of temperature dealt with. Dewar and Fleming {Proc. Hoy. Soc. vol. Ix. p. 425) worked with a similar specimen of bismuth, and their results for a constant temperature of 19° agree well with, those of Henderson. They also experimented with constant temperatures of – 79°, – 185°, and – 203°, and found that at these low temperatures the effect of magnetization was enormously increased. The following table gives some of their results, the specific resistance of the bismuth being expressed in C.G.S. units.*~~

~~*Field Strength.*~~

~~*Temp.*~~

~~*19° C.*~~

~~*Temp. –*~~

~~*185° C.*~~

~~*Spec. Ees.*~~

~~*Comp. Res.*~~

~~*Spec. Res.*~~

~~*Comp. Ees.*~~

~~*θ*~~

~~*116200*~~

~~*1-000*~~

~~41000~~

~~1-00~~

~~1375~~

~~118200~~

~~1-017~~

~~103300~~

~~2-52~~

~~2750~~

~~123000~~

~~1-059~~

~~191500~~

~~4-67~~

~~8800~~

~~149200~~

~~1-284~~

~~738000~~

~~18-0~~

~~14150~~

~~186200~~

~~1-602~~

~~*1730000*~~

~~*42-2*~~

~~*21800*~~

~~*257000*~~

~~*2-212*~~

~~*6190000*~~

~~*151*~~

~~*At the temperature of liquid air (—185°) the application of a field of 21,800 multiplied the resistance of the bismuth no less than 150 times. Fig. 24 shows the variations of resistance in relation to*~~

~~*600,000*~~

~~*U^OflOO*~~

~~*•.= 300,000*~~

~~*800° -150° -100° -50° -0° +20°*~~

~~*Temperature' in decrees centigrade Fig. 24.*~~

~~*temperature for fields of different constant values. It will be seen that for H = 24.50 and H = 5500 the minimum resistance oocui-s at temperatures of about — 80° and — 7° respectively.*~~

~~*Hall Effect. — If an electric current is passed along a strip of thin metal, and the two points at opposite ends of an equipotential line are connected with a galvanometer, its needle will of course not be deflected. But the application of a magnetic field at right angles to the plane of the metal causes the equipotential lines to rotate through a small angle, and the points at which the galvanometer is connected being no longer at the same*~~

~~*potential, a current is indicated by the galvanometer. (See Ency. Brit. vol. xv. p. 273.) The transverse electro- motive force is equal to KCH/D, where C is the current, H the strength of the field, D the thickness of the metal, and K a constant which has been termed the rotatory •power or rotational coefficient. (See Hopkinson, Phil. Mag. vol. X. (1880), p. 430.) The following values of K for different metals are given by Hall (Phil. Mag. vol. xix. (1885), p. 419), the positive sign indicating that the electromotive force is in the same direction as the mechanical force acting upon the conductor. Ettinghausen*~~

~~*MeUI.*~~

~~*KxlOis.*~~

~~*Metal.*~~

~~*Kxioie.*~~

~~*Antimony*~~

~~*+ 114000*~~

~~*^°or*~~

~~*-520*~~

~~*Steel*~~

~~*+ 12060*~~

~~*-660*~~

~~*Iron*~~

~~*+ 7850*~~

~~*Nickel*~~

~~*- 14740*~~

~~*Cobalt*~~

~~*+ 2460*~~

~~*Bismuth '*~~

~~*- 8580000*~~

~~*Zinc*~~

~~*+ 820*~~

~~*and Nernst (Wien. Ber. vol. xciv. [2] (1886), p. 560) have found that the rotational coefficient of tellurium is more than fifty times greater than that of bismuth, its sign being positive. Several experimenters have endeavoured to find a Hall effect in liquids, but such results as have been hitherto obtained are by no means free from doubt. Marx {Ann. d. Phys. vol. ii. (1900), p. 798) observed a well-defined Hall effect in incandescent gases.*~~

~~*Electro -Thermal Relations. — The Hall electromotive force is only one of several so-called " galvano-magnetic effects " which are observed when a magnetic field acts normally upon a thin plate of metal traversed by an electric current. It is remarkable that if a flow of heat be substituted for a current of electricity, a closely allied group of " thermo-magnetic effects" is presented. The two classes of phenomena have been collated by Lloyd {Am. Journ. Sci. vol. xii. (1901), p. 57) as follows: —*~~

~~*Galvano- Magnetic Effects.*~~

~~*(1) A transverse difference of electric potential (Hall effect).*~~

~~*(2) A transverse difference of temperature (Ettinghausen effect).*~~

~~*(3) Longitudinal change of electric conductivity.*~~

~~*(4) Longitudinal difference of temperature.*~~

~~*Thermo-Magnetic Effects.*~~

~~*(i.) A transverse difference of electric potential (Nernst effect).*~~

~~*(ii.) A transverse difference of temperature (Leduc effect).*~~

~~*(iii.) Longitudinal change of thermal conductivity.*~~

~~*(iv.) Longitudinal difference of electric potential.*~~ ^

~~*If in the annexed diagram ABCD represents the metallic plate through which the current of electricity or heat flows in the direction AB, then effects (1), (2), (i.), and (ii.) are exhibited at C and D, effects (4) and (iv.) at A and B, and effects (3) and (iii.) along AB. The transverse effects are i reversed in direction when either the magnetic fleld or the primary current (electric or thermal) is reversed, but the longitudinal effects are independent of the direction of the field. Bismuth is the only metal in which all the phenomena of both classes have yet been observed. It has been shown by Moreau {G. R. vol. cxxx. (1900), pp. 122, 412, 562) that if K is the coefficient of the Hall effect (1) and K' the analogous coefficient of the Nernst effect (i.) (which is constant for small values of H), then K' = Ko-//), o- being the coefficient of the Thomson effect for the metal and p its specific resistance. He considers that Hall's is the fundamental phenomenon, and that the Nernst effect is*~~

~~*1 The large Hall effect in bismuth was discovered by Righi (Journ. de Phys. [2], vol. iii. (1884), p. 127).*~~

~~*2 Eeferenoes. — (2) Ettinghausen, Wied. Ann. vol. xxxi. (1887), p. 737. — (4) Neenst, ibid. p. 784. — (i.) and (iv.) Ettinghausen and Nernst, Wied. Ann. vol. xxix. (1886), p. 343. — (ii.) and (iii.) Righi, Rend. Ace. Line. vol. iii., part ii. (1887), p. 6, and part i. p. 481 ; and Leduc, Journ. de Phys. vol. vi. (1887), p. 78. Additional authorities are quoted by Lloyd, loc. cit.*~~

~~*essentially identical with it, the primary electromotive force in the case of the latter being that of the Thomson effect in the unequally heated metal (Ency. Brit. vol. viii. p. 97), while in the Hall experiment it is derived from an external source.*~~

~~*Thermo-electric Quality. — According to Kelvin (Thomson) the thermo-electric quality of iron is affected by longi- tudinal magnetization in such a manner that the thermo- electric current flows from the unmagnetized to the magnetized metal through the hot junction ; or, in other words, longitudinal magnetization renders iron less positive (Ency. Brit. vol. xv. p. 273). It has been found that when the magnetizing force is increased, this effect passes a maximum, and in a sufficiently strong field would probably even be reversed.* Ewing (Phil. Trans. vol. clxxvii. p. 373) has shown that tensile stress diminishes the thermo-electric effect of magnetization and reverses it when the load is great ; nickel always becomes more positive when magnetized ; Tomlinson (Proc. Roy. Soc. vol. xxxix. (1885), p. -513) found that cobalt in a magnetic field of 44 units was negative to unmagnetized cobalt. If it should turn out that the effect upon cobalt is reversed in a weak field, the interesting fact would be established that the changes produced by magnetization in the thermo-electric qualities of the ferromagnetic metals are exactly parallel to those which it causes in their dimensions. A comprehensive series of experiments by Lownds (Ann. d. Phys. vol. iv. (1901), p. 776) shows conclusively, in opposition to the view long held, that the thermo-electric quality of bismuth is entirely unaffected by a magnetic field.*~~

~~*Elasticity. — The results of experiments as to the effect of magnetization upon elasticity were until quite lately dis- cordant and inconclusive, sufficient care not having generally been taken to protect the specimen under test from the heat radiated by the magnetizing coil. Recent researches, however, indicate pretty clearly that for iron and nickel both Young's modulus and the rigidity are materially increased when the metals are subjected to a magnetic field.* Day, finding that in very strong fields the rigidity continued to increase long after magnetic saturation had been reached, concludes that the phenomena of magnetic intensity and of magnetic rigidity are quite distinct, a practical limit to the former being reached in com- paratively weak fields. This observation is of*~~

~~*interest in relation to the changes of length produced by magnetism, though, as Barus remarks, the rigidity, unlike the length, never passes a maximum. Tangl's delicate experiments show that Young's modulus for a magnetized wire depends not only upon the magnetizing force, but also upon the tensile stress. The effects are very complex, and require further investigation.*~~

~~*Chemical and Voltaic Effects. — If two iron plates, one of which is magnetized, are immersed in an electrolyte, a current will generally be indicated by a galvanometer connected with the plates.*~~

~~*As to whether the magnetized plate becomes positive or negative to the other, different experimenters are not in agreement. It has, however, been shown by Hurmuzescu (Ua.'p. du Congris Int. de Phys., Paris, 1900, p. 561) that the true effect of magnetization is liable to be disguised by secondary or parasitic phenomena, arising chiefly from polarization of the electrodes and from local variations in the concentration and magnetic condition of the electrolyte ; these may be avoided by working with weak solutions, exposing only a small surface in a non-polar region of the metal, and sub-*~~

~~*2 Chassaqny, C. R. vol. cxvi. (1893), p. 977. — Lala and Fournier, C. R. vol. cxxiii. (1896), p. 801. — Houlevigne, Journ. de Phys. vol v. (1896), p. 53.*~~

~~*^ Day, Am. .Toum. Sci. vol. iii. (1897), p. 449. — Stevens and DoRSAT, Phys. Rev. vol. ix. (1899), p. 116, and vol. x. (1900), p. 161. — Barus, Am. Journ. Sci. vol. x. (1900), p. 407. — Tangl, Ann. d, Phys. vol. vi. (1901), p. 34.*~~

~~*stituting a capillary electrometer for the galvanometer generally used. When such precautions are adopted it is found that the "electromotive*~~

~~*force of magnetization" is, for a given specimen, perfectly definite both in direction and in magnitude ; it is independent of the nature of the corrosive solution, and is a function of the field — strength alone, the curves showing the relation of electromotive force to field-intensity bearing a rough resemblance to the familiar I-H curves. The value of the E.M.F. when H = 2000 is of the order of 1/100 volt for iron, 1/1000 volt for nickel, and 1/10,000 for bismuth. When the two electrodes are ferro-magnetic, the direction of the current through the liquid is from the unmagnetized to the magnetized electrode, the latter being least attacked ; with diamagnetic electrodes the reverse is the case. Hurmuzescu shows that these results are in accord with theory. Applying the principle of the conservation of internal energy, he demonstrates that for iron in a field of 1000 units and upwards the E. M. F. of magnetization is*~~

~~*E =*~~

~~*approximately,*~~

~~*I being the electrochemical equivalent and S the density of the metal. Owing to the difficulty of determining the magnetization I and the susceptibility k with accuracy, it has not yet been possible to submit this formula to a quantitative test, but it is said to afi'ord an indication of the results given by actual experiment. It has been discovered by Nichols and Franklin (Am.. Journ. Sci. vol. xxxiv. (1887), p. 419 ; vol. xxxv. p. 290) that the transition from the "passive" to the active state (see Unci/. Brit. vol. xiii. p. 279) of iron immersed in strong nitric acid is facilitated by mag- netization, the temperature of transition being lowered. This is attributed to the action of local currents set up between unequally magnetized portions of the iron. Similar results have been obtained by Andrews {Proc. Soy. Soc. vol. xlviii. (1890), p. 116).*~~

~~*Feebly Susceptible Substances.*~~

~~*Water. — The following are recent determinations of the magnetic susceptibility of water : —*~~

~~*Observer.*~~

~~*It X 106.*~~

~~*Publication.*~~

~~*Quincke*~~

~~*-0-797 at 18° C.*~~

~~*Wied. Ann. vol. xxiv. p. 387, 1885.*~~

~~*Du Bois*~~

~~*-0-837 (1-0-0026!; -16°*~~

~~*Wied. Ann. vol. xxxv. p. 137, 1888.*~~

~~*Curie*~~

~~*-0-790 at 4° C.*~~

~~*C. E. vol. cxvi. p. 136,*~~

~~*1893.*~~

~~*Townsend*~~

~~*-0-77*~~

~~*Phil. Trans, vol. clxxxvii. p. 544, 1896.*~~

~~*Fleming and*~~

~~*-0-74*~~

~~*Proc. Soy. Soc. vol.*~~

~~*Dewar*~~

~~*lxiii. p. 311, 1898.*~~

~~*Koenigsberger*~~

~~*-0-803 at 21°G.*~~

~~*Wied. Aim. vol. Ixvi. p. 698, 1898.*~~

~~*Jager and*~~

~~*-0-689(1-0-00160*~~

~~*Wied. Ann. vol. Ixvii.*~~

~~*Meyer*~~

~~*707, 1899.*~~

~~*Oxygen and Air. — The best modern determinations of the value of k for gaseous oxygen agree very fairly well with that given by Faraday in 1853. (See Sncy. Brit. vol. XV. p. 267.) Assuming that for water k = — O'S x 10"^, his value of k for oxygen at 15° C. reduces toO'lSxlO"*. Important experiments on the susceptibility of oxygen at different pressures and temperatures have been carried out by P. Curie (C H. vol. cxv. p. 805 ; vol. cxvi. p. 136 ; Journ. de Phys. [3], vol. iv. p. 204). IIe found that the susceptibility for unit of mass, K, was independent of both pressure and magnetizing force, but varied inversely as the absolute temperature, 0, so that 10^K = 33700/5. Since the mass of 1 cub. cm. of oxygen at 0° C. and 760 mm. pressure is 0 -00141 grm., the mass at any absolute temperature 0 is by Charles's law 0-00141×273/(9 = 0-3849/^ grm. ; hence the susceptibility per unit of volume at 760 mm. will be*~~

~~*K= 10-6×0-3849×33700/62 = 10-6×12970/(92.*~~

~~*Atl5°C.6=273-i- 15 = 288,andthereforeK = 0-156 X 10-8, nearly the same as the value found by Faraday. At 0° C, K = 0-174x 10-". For air Curie calculated that the susceptibility per unit mass was 10*K = 7830/5; or, taking the mass of 1 c.c. of air at 0° C. and 760 mm. as*~~

~~*0-001291 grm., k= 10-« x 2760/52 for air at standard atmospheric pressure. It is pointed out that this formula may be used as a temperature*~~

~~*correction in magnetic determinations carried out in air.*~~

~~*Fleming and Dewar determined the susceptibility of liquid oxygen {Proc. Roy. Soc. vol. Ix. (1896), p. 283 ; vol. Ixiii. p. 311) by two different methods. In the first experiments it was calculated from observations of the mutual induction of two conducting circuits in air and in the liquid ; the results for oxygen at — 182° C. were*~~

~~*/*= 1-00287, K = 228xl0-«.*~~

~~*In the second series, to which greater importance is attached, measurements were made of the force exerted in a diver- gent field upon small balls of copper, sUver, and other substances, first when the balls were in air and afterwards when they were immersed in liquid oxygen. If V is the volume of a ball, H the strength of the field at its centre, and K its apparent susceptibility, the force in the direc- tion X is /= k'VH X dHjdx ; and if «'« and k'„ are the apparent susceptibilities of the same ball in air and in liquid oxygen, k'„ — «'„ is equal to the difference between the susceptibilities of the two media. The susceptibility of* air being known — practically it was negligible in these experiments — that of liquid oxygen can at once be found. The mean of 36 experiments with 7 balls gave*~~

~~*/i= 1-00407, K = 324xl0-6.*~~

~~*A small but decided tendency to a decrease of suscepti- bility in very strong fields was observed. It appears, therefore, that liquid oxygen is by far the most strongly paramagnetic liquid known, its susceptibility being more than four times greater than that of a saturated solu- tion of ferric chloride. On the other hand, its suscepti- bility is about 50 times less than that of Hadfield's 12 per cent, manganese steel, which is commonly spoken of as non-magnetizable.*~~

~~*Bismuth. — Bismuth is of special interest, as being the most strongly diamagnetic substance known, the mean value of the seven determinations of its susceptibility given in Ency. Brit. vol. xv. p. 268, being — 14-6 x 10-6. The magnetic properties of the metal at different tempera tures and in fields up to 1350 units have been studied by P. Curie*~~

~~{loc. cit.), who found that its "specific suscepti- bility " (K) was independent of the strength of the field, but decreased with rise of temperature up to the melting- point, 273° C. HIs results appear to show the relation~~

~~-Kxl06 = l-381-0-00155r.~~

~~Assuming the density of Bi to be 9-8, and neglecting corrections for heat dilatation, his value for the suscepti- bility at 20° C. is equivalent to k= — 13-23 x 10"". As the temperature was raised up to 273°, k gradually fell to D'SSxlO*^, rising suddenly when fusion occurred to — 0-37 X lO"", at which value it remained constant when the fluid metal was further heated. Fleming and Dewar give for the susceptibility the values — 13-7 x 10-^ at 15° G. and- 15-9 X 1(3-8 at- 182°, .j jg latter being approxi- mately equivalent to K x 10‘ = — 1 -62. Putting f = — 182 in the equation given above for Curie's results, we get Kxl08= -1-66, a value sufficiently near that obtained by Fleming and Dewar to suggest the probability that the diamagnetic susceptibility varies inversely as the tempera- ture between — 182° and the melting-point.~~

~~Other Diamagnetics. — The following table gives Curie's determinations (Journ. de Phys. vol. iv. (1895), p. 204) of the specific susceptibility K of other diamagnetic sub- stances at different temperatures. It should be noted that K = K/density.~~

~~Substance.~~

~~Temp. ° C.~~

~~Water~~

~~15-189~~

~~Rock salt~~

~~*16 — 455*~~

~~*Potassium chloride*~~

~~*18-465*~~

~~*„ sulphate*~~

~~*17-460*~~

~~*nitrate (fusion 350°) .*~~

~~*18-420*~~

~~*Quartz ....*~~

~~*18 — 430*~~

~~*Sulphur, solid or fused*~~

~~*18 — 226*~~

~~*20 — 200*~~

~~*„ fused ....*~~

~~*240-415*~~

~~*Tellurium*~~

~~*20 — 305*~~

~~*Bromine ...*~~

~~*20*~~

~~*Iodine, solid or fused .*~~

~~*18-164*~~

~~*Phosphorus, solid or fused .*~~

~~*19-71*~~

~~*,, amorphous .*~~

~~*20-275*~~

~~*Antimony, electrolytic*~~

~~*20*~~

~~*•> . . .*~~

~~*540*~~

~~*Bismuth, solid ....*~~

~~*20*~~

~~*273*~~

~~*,, fused ....*~~

~~*273 — 405*~~

~~*-KxlOS.*~~

~~*■790*~~

~~*-580*~~

~~*•550 •430 •330*~~

~~*-441*~~

~~*■610*~~

~~*-320 -307 -311*~~

~~■410 ■386 •920 •730 •680 •470 •350 •967 •038~~

~~For all diamagnetic substances, except antimony and bismuth, the value of K was found to be independent of the temperature.~~

~~Paramagnetic Substances. — Experiments by Henderson (Phil. Trans, vol. clxxxvii. (1896), p. 533) sho-w that the susceptibility of solutions of salts of iron is indepen- dent of the magnetizing force, and depends only on the quantity of iron contained in unit volume of the liquid. If W is the weight of iron present per c.c. at about 10° C, then for ferric salts~~

~~10«K = 266W-0^77~~

~~and for ferrous salts~~

~~10eK = 206W-0^77,~~

~~the quantity — 0-77 arising from the diamagnetism of the water of solution. Annexed are values of IO^k for the different salts examined, w being the weight of the salt~~

~~FejClg . Fe2(S04)3 .~~

~~io6K+o-7r.~~

~~91 -6w 74-6!« 61 -5m)~~

~~Salt.~~

~~FeClj FeSOi~~

~~106«+0-T7. 90 -8 w , 74-9M)~~

~~per c.c. of the solution. Susceptibility was found to diminish greatly -with rise of temperature. According to Jager and Meyer (Wien. Akad. Sitz. vol. cvi. II.o., p. 623, and vol. cvii. Il.a, p. 5) the atomic susceptibilities h of the metals nickel, chromium, iron, cobalt, and manganese in solutions of their salts are as follows : —~~

~~*Metal. Ni . Cr . Fe(l)*~~

~~*Jcxios.*~~

~~*4·95 = 2·5×2 6·25 = 2·5×2·5 7·5 =2·5×3*~~

~~*Metal. Co*~~

~~*Fe(2) Mn*~~

~~*ifcxioo*~~

~~*10·0 = 2·5×4 12·5 = 2·5×5 16·0 = 2·6×6*~~

~~*re(l) is iron contained in FeClg and Fe(2) iron contained in FeSO^ and Fe3(N03)e.*~~

~~*Curie has shown, for many paramagnetic bodies, that the specific susceptibility K is inversely proportional to the absolute temperature 6. Du Bois believes this to be an important general law, applicable to the case of every paramagnetic substance, and suggests that the product K^ should be kno-wn as " Curie's constant " for the substance.*~~

~~*Elementary Bodies and Atomic Susceptibility. — Among a large number of substances the susceptibilities of which have been determined by Koenigsberger (Wied. Ann. vol. Ixvi. (1898), p. 698) are the folio-wing elements: —*~~

~~*Element.*~~

~~*KX106.*~~

~~*Element.*~~

~~*KX108.*~~

~~*Copper .*~~

~~*-0·82*~~

~~*Tellurium*~~

~~*-2-10*~~

~~*Silver .*~~

~~*-1-51*~~

~~*Graphite*~~

~~*+2*~~

~~*Gold*~~

~~*-3-07*~~

~~*Aluminium*~~

~~*+1-80*~~

~~*Zino*~~

~~*-0-96*~~

~~*Platinum*~~

~~*+22*~~

~~*Tin*~~

~~*+0-46*~~

~~*Palladium*~~

~~*+50 to 60*~~

~~*Lead*~~

~~*-1-10*~~

~~*Tungsten*~~

~~*+ 14*~~

~~*Thallium*~~

~~*-4-61*~~

~~*Magnesium .*~~

~~*+ 4*~~

~~*Sulphur .*~~

~~*-0-86*~~

~~*Sodium*~~

~~*+ 2-2*~~

~~*Selenium (red)*~~

~~*-0-60*~~

~~*Potassium*~~

~~*+ 3-6*~~

~~*In a table accompanying Koenigsberger's paper the elements are arranged upon the periodic system and the atomic susceptibility (product of specific susceptibility into atomic weight) is given for each. It appears tha,t the elements at about the middle of each row are the most strongly paramagnetic; towards the ends of a row the susceptibility decreases, and ultimately becomes negative. Thus a relation between susceptibility and atomic weight is clearly indicated. Tables similarly arranged, but much more complete, have been published by Meyer (Wied. Ann. vol. Lxviii. (1899), p. 325, and vol. Ixix., p. 236), whose researches have filled up many previously existing gaps. The values assigned to the atomic susceptibilities of most of the known elements are appended. According to*~~

~~*the notation adopted by Meyer the atomic susceptibility k = KX atomic-weight/ (density x 1000).*~~

~~*El*~~

~~*106*;*~~

~~*El*~~

~~*Wk*~~

~~*El*~~

~~*108S;*~~

~~*Be*~~

~~*+ 0-72*~~

~~*Cu*~~

~~*-0-006*~~

~~*Cs*~~

~~*-0-031*~~

~~*B*~~

~~*+ 0^05*~~

~~*Zn*~~

~~*-0-010*~~

~~*Ba*~~

~~*-0-021*~~

~~*C*~~

~~-0^05~~

~~Ga~~

-

~~La~~

~~+13-0~~

~~N~~

~~?~~

~~Ge~~

~~Ce~~

~~+34-0~~

~~θ~~

+

~~As~~

~~?~~

~~Pr~~

~~+1 bo~~

~~Fl~~

~~-0-011~~

~~Se~~

~~-0-025~~

~~*Nd*~~

~~*+ g*~~

~~*Br*~~

~~*-0-033*~~

~~*Sa Gd*~~

~~*+ J»*~~

~~*Na Mg Al*~~

~~*-0-0051*~~

~~*+ 0-014*~~

~~+~~

~~*Rb Sr*~~

~~*0-021'*~~

~~*-0-021*~~

~~*Er*~~

~~*+ 41^8(?)*~~

~~*Si*~~

~~*+ 0-002 -0-007*~~

~~*¥*~~

~~*+ 3-2(?)*~~

~~*-0-014*~~

~~*P*~~

~~*Zr*~~

~~*Yb*~~

~~*+ (?)*~~

~~*S*~~

~~*-0-011*~~

~~*Nb*~~

~~*+ 0-49(?)*~~

~~*Ta*~~

~~*+ l-02(?)*~~

~~*Cl*~~

~~*-0^02i*~~

~~*Mo*~~

~~*+ 0-024*~~

~~*W*~~

~~*+ 0-1*~~

~~*Ru*~~

~~*+*~~

~~*Cs*~~

~~*+ 0-074*~~

~~K~~

~~-O^OOl'~~

~~Rh~~

~~+~~

~~Ir~~

~~+~~

~~Ca~~

~~-0-0031~~

~~Pd~~

~~+-0-55~~

~~Pt~~

~~+-0-227~~

~~Se~~

~~?~~

~~tl~~

~~-0^016~~

~~An~~

~~-0-031~~

~~Ti~~

~~+-0-09~~

~~-0^015~~

~~Hg~~

~~-0-030~~

~~V~~

~~+-0-17~~

~~In~~

~~-O^Oli~~

~~Tf~~

~~-0-93~~

~~Cr~~

~~+-l~~

~~Sn~~

~~+-0-0041~~

~~Pb~~

~~-0-025~~

~~Mn~~

~~+~~

~~&0~~

~~Sb~~

~~-0-069~~

~~*Bi*~~

~~*-0-023*~~

~~*Fe*~~

~~+~~

~~*Ip*~~

~~*Te*~~

~~*-0-039*~~

~~*Co*~~

~~*Ni*~~

~~+~~

~~*I*~~

~~*-0-040*~~

~~*Th U*~~

~~*+ 16-0(?)*~~

~~*+ 0-21*~~

~~*Meyer thinks that the susceptibilities of the metals praseodidy- mium, neodidymium, ytterbium, samarium, gadolinium, and erbium, when obtained in a pure form, will be found to equal or even exceed those of the well-known ferromagnetic metals. Many of their compounds are very strongly magnetic, erbium, for example, in Er203 being four times as strong as iron in the familiar magnetite or lodestone, FcjOs. The susceptibilities of some hundreds of inorganic compounds have also been determined by the same in- vestigator [loc. cit.). Among other recently published researches relating to atomic and molecular magnetism are*~~

those of Liebkneoht and Wills (Ann. d. Phys. vol. i. (1900), p. 178), du Bois and Liebknecht {ibid. p. 189), and Meyer {ibid. p. 668). An excellent summary of the present state of knowledge regarding the magnetic properties of matter, with many tables and references, has been compiled by du Bois {Report to the Congres Int. de Phys., Paris, 1900, vol. ii. p. 460).

Molecular Theory op Magnetism.

According to Weber's theory, the molecules of a ferro- magnetic metal are small permanent magnets, the axes of which under ordinary conditions are turned indifi'erently in every direction, so that no magnetic polarity is exhibited by the metal as a whole ; a magnetic force acting upon the nietal tends to turn the axes of the little magnets in one direction, and thus the entire piece acquires the properties of a magnet. If, however, the molecules could turn -with perfect freedom, it is clear that the smallest magnetizing force would be sufficient to develop the highest possible degree of magnetization, which is of course not the case. Weber therefore supposed each molecule to be acted on by a force tending to preserve it in its original direction, the position actually assumed by the axis being in the direction

•" Calculated.

of the resultant of this hypothetical force and the applied magnetizing force. Maxwell {Electricity and Magnetism, § 444), recognizing that the theory in this form gave no account of residual magnetization, made the further assump- tion that if the deflection of the axis of the molecule exceeded a certain angle, the axis would not return to its original position when the deflecting force was removed, but would retain a permanent set. Although the amended theory as worked out by Maxwell is in rough agreement with certain leading phenomena of magnetization, it fails to account for many others, and is in some cases at variance with observed facts.

~~*Ewing {Proc. Roy. Soc. vol. xlviii. (1890), p. 342) has demonstrated that it is quite unnecessary to assume either the directive force of Weber, the permanent set of Maxwell, or any kind of f rictional resistance, the forces by which the molecular magnets are constrained being simply those due to their own mutual attractions and repulsions. The effect of these is beautifully illustrated by a model consisting of a number of little compass needles pivoted on sharp points and grouped near to one another upon a board, which is placed inside a large magnetizing coil. When no current is passing through the coU and the magnetic field is of zero strength, the needles arrange themselves in positions of stable equilibrium under their mutual forces, pointing in many different directions, so that there is no resultant mag- netic moment. This represents the condition of the mole- cules in unmagnetized iron. If now a gradually increasing magnetizing force is applied, the needles at first undergo a stable deflection, giving to the group a small resultant moment which increases uniformly with the force ; and if the current is interrupted while the force is still weak, the needles merely return to their initial positions. This illustrates the first stage in the process of magnetization, when the moment is proportional to the field and there is no hysteresis or residual magnetism (see ante, p. 436). A somewhat stronger field will deflect many of the needles beyond the limits of stability, causing them to turn round and form new stable combinations, in which the direction assumed by most of them approximates to that of the field. The rearrangement is completed within a compara- tively small range of magnetizing force, a rapid increase of the resultant moment being thus brought about. When the field is removed, many of the newly formed combina- tions are but slightly disturbed, and the group may consequently retain a considerable resultant moment. This corresponds to the second stage of magnetization, in which the susceptibility is large and permanent mag- netization is set up. A still stronger magnetizing force has little effect except in causing the direction of the needles to approach stiU more nearly to that of the field ; if the force were infinite, every member of the group would have exactly the same direction, and the greatest possible resultant moment would be reached; this illustrates " magnetic saturation " — the condition approached in the third stage of magnetization. When the strong magnetiz- ing field is gradually diminished to zero and then reversed, the needles pass from one stable position of rest to another through a*~~

~~*condition of instability ; and if the field is once more reversed, so that the cycle is completed, the needles again pass through a condition of instability before a posi- tion of stable equilibrium is regained. Now the unstable movements of the needles are of a mechanically irreversible character ; the energy expended in dissociating the members of a combination and placing them in unstable positions assumes the kinetic form when the needles turn over, and is ultimately frittered down into heat. Hence in performing a cycle there is a waste of energy corresponding to what has been termed hysteresis-loss.*~~

~~*Supposing Swing's hypothesis to be correct, it is clear*~~

~~*that if the magnetization of a piece of iron were reversed by a strong rotating field instead of by a field alternating through zero, the loss of energy by hysteresis should be little or nothing, for the molecules would rotate with the field and no unstable movements would be possible.^ Some experiments by F. G. BaUy {Phil. Trans, vol. clxxxvii. (1896), p. 715) show that this is actually the case. With small magnetizing forces the hysteresis was indeed some- what larger than that obtained in an alternating field, probably on account of the molecular changes being forced to take place in one direction only ; but at an induction of about 16,000 units in soft iron and 15,000 in hard steel the hysteresis reached a maximum and afterwards rapidly diminished. In one case the hysteresis loss per cubic centimetre per cycle was 16,100 ergs for B = 15,900, and only 1200 ergs for B = 20,200, the highest induction obtained in the experiment; possibly it would have vanished before B had reached 21,000.^ These experiments prove that actual friction must be almost entirely absent, and, as Baily remarks, the agreement of the results with the pre- viously suggested deduction aff'ords a strong verification of Evring's form of the molecular theory. Ewing has himself also shown how satisfactorily this theory accords with many other obscure and complicated phenomena, such as those presented by coercive force, diff'erences of magnetic quality, and the effects of vibration, temperature, and stress ; while as regards simplicity and freedom from arbitrary assumptions it leaves little to be desired.*~~

~~*The next problem which awaits solution concerns the origin of molecular magnetism. Why is it that the molecules or atoms of iron, nickel, cobalt, and perhaps one or two of the rarer metals, have the properties of little magnets, while those of other substances are magnetic only in an immensely inferior degree, or not at all ? Ampfere's hypothesis that an electric current constantly circulates around each magnetic molecule (Encyclopaedia Britannica, vol. viii. p. 76) still holds its ground, though in a somewhat modified form. Eowland, carrying out in 1876 an experiment which had been proposed by Maxwell a few years earlier, showed that a revolving electric charge produced the same magnetic effects as a current, and it has been supposed that molecular magnetism may be due, not to currents in the sense contemplated by Ampfere, but to the rapid revolution of electrostatic charges. Such a hypothesis has acquired additional probability from the researches of J. J. Thomson and others. Thomson has demonstrated the existence, under many different conditions, of particles more minute than anything previously known to science. The mass of each is about a thousandth part of that of a hydrogen atom, and with each is indissolubly associated a charge of negative electricity equal in quantity to about 6×10-1" C.G.S. electrostatic unit. These particles, which were termed by their discoverer corpuscles, are more commonly spoken of as electrons,^ the particle thus being identified with the charge which it carries. ' With every material atom in a neutral condition there is linked, as Thomson believes, one or more detachable corpuscles, the number depending*~~

~~*' This deduction from Ewing's theory appears to have beeu first suggested by J. Swinhurne. See Industries, 1890, p. 289.*~~

~~*•■^ Beattie (Phil. Mag. vol. i. (1901), p. 642) has found simUar effects in uickel and cobalt.*~~

~~*' The charge associated with a corpuscle is the same as that carried by a hydrogen atom. Stoney in 1881 (Phil. Mag. vol. xi. p. 387) pointed out that this latter constituted the indivisible "atom of electricity," or natural unit charge ; later he proposed (Trans. Roy. Dub. Soc. vol. w. (1891), p. 583) that such unit charge should be called an " electron. " The application of this term to Thomson's corpuscle implies, rightly or*~~

~~*wrongly, that, notwithstanding its apparent mass, the corpuscle is in fact nothing more than an atom of electricity. The question whether a corpuscle actually has a material gravitating nucleus is undecided.*~~

~~*upon the valency of the atom: if the atom loses a corpuscle, it becomes positively electrified; if it receives additional corpuscles, it is negatively electrified. The process of electric conduction in metals consists in the movement of detached corpuscles, and many other phe- nomena, both electrical and thermal, can be more or less completely explained by their agency. Attempts have been made to account quantitatively for the magnetic properties of iron and other substances on the supposition that the corpuscles or electrons revolve like satellites in orbits around the atoms with which they are associated. The period of revolution would necessarily be almost evanescent. It has been calculated by Lang (Ann. d. Phys. vol. ii. (1900), p. 483) that if the iron atom is regarded as divalent, the electrons must travel at a speed compar- able with that of light, completing at the lowest estimate more than a trillion revolutions in a second. Such methods of explaining magnetic phenomena are not free from difficulties, and so far they have failed to give any clear indication of a physical cause for the sharply defined difference which exists between ferromagnetic and other bodies. But though at the time of writing no detailed hypothesis has met with general acceptance, it can hardly be doubted that by further researches upon the lines of those to which reference has been made, much new light will in the near future be thrown upon some of the most obscure problems of magnetism.*~~

~~*Authorities. — In addition to the works already cited in text and footnotes, the following may be mentioned : — Mascabt and JouBERT. Electricity and Magnetism. Trans, by Atkinson. London, 1883. — J. 0. Maxwell. Electricity and Magnetism. 3rd edit. Oxford, 1892. — J. A. Ewing. Magnetic Induction in Iron and other Metals. 3rd edit. London, 1900. — J.J.Thomson. Recent Researches in Electricity and Magnetism. Oxford, 1893. — H. DU Bois. The Magnetic Circuit. Trans, by Atkinson. London, 1896. — A. Gkay. Treatise on Magnetism and Electricity.*~~

~~*London, 1898. — J. A. Fleming. Magnets and Electric Currents. London, 1898. — C. Maurain. Le Magnetisme du Per. Paris [1899]. — E. Schmidt. Die Magnetische Untersuchung des Eisens und verwandter Metalle, Halle a. S., 1900. — Rapports du Congrha International de Physique, vol. ii. Paris, 1900. (s. Bi.)*~~

~~*Magrnetism, Terrestrial. — § 1. Intheearher*~~

~~*volumes of the Encyclopcedia Britannica Dr Balfour Stewart treated terrestrial magnetism as part of the sub- ject of Meteorology (ninth edition, vol. xvi. p. 159). For brevity his article is distinguished here by the letter S. For the same reason the letters R and T are employed to denote respectively the Repertoriimi fiir Meteorologie, and the journal Terrestrial Magnetism, edited by Dr Bauer.*~~

~~*§ 2. The instruments mentioned in S are still those in most general use, but a variety of new forms have been employed during recent years. Amongst these maybe mentioned "earth-inductors," or rotating coils, for determining the inclination by induc- tion methods, magnetometers and magnetographs with small magnets i^Ann. du Bureau Central Meteorologique de France, vol. i. 1884, p. B57,*~~

~~*Instru- ments,*~~

~~*as well as with English inclinometers, and many questions relating to the determination of constants, have been dis- cussed by Wild himself (R, vol. viii. No. 7 ; vol. xvi. No. 2 ; vol. xvii. No. 6 ; Mem. de I'Acad. des Sciences de St Petersbourg, vol. xxxiv. No. 1 1 ; vol. xxxvi. No. 1 ; vol. xxxvii. No. 4 and No. 6 ; vol. xxxviii. No. 3, &c.). Investigations on these and cognate matters have also been published by Kohlrausch (Wied. Ann. vol. xv. p. 545 ; vol. xxii. p. 411 ; vol. xxxi. p. 609, &c.), Mielberg(R, vol. X. No. 1), Leyst (R, vol. x. Nos. 5 and 11), Mascart {Ann. du Bureau Central Meteorologique, vol. i. 1890, p. Bjjg; Brit. Assoc. Report for 1898, p. 741,*~~

~~*§ 3. At a magnetic observatory provision must be made for accommodating both absolute and self-recording instru- ments. In the case of the former there must*~~

~~be no artificial disturbance, whether due to f*^”~~

~~, . ‘ _ , — vatoiies,~~

~~magnets or to electric currents, in tne case ot~~

~~the latter a constant source of disturbance, such as the proximity of a fixed magnet of unvarying strength, though objectionable, is not fatal, but it is essential that all variable disturbances should be excluded. As changes of tempera- ture influence magnets, and temperature corrections are difficult to determine accurately, uniformity of temperature greatly facilitates magnetic work. In recently-constructed magnetic chambers, at first-class observatories, every pre- caution is taken to exclude magnetic materials and to secure uniformity of temperature, and the moments and relative positions of the different magnets are carefully arranged so as to avoid mutual interference. For par- ticulars the reader is referred to descriptions of the magnetic chambers at Pavlovsk, Washington, Potsdam, and Pare St Maur (see report by Ensign Marsh, U.S. Navy ; Appendix I. to Washington Observations for 1887, U.S. Naval Observatory; T, vol. i. 1896, p. 96, and vol. iii. 1898, p. 1), and to an elaborate description of an ideal building by Wild (T, vol. iv. p. 169, see also p. 153). Of late years the development of electric railways and tramways has complicated the question. With the arrange- ments customary in electric traction, when the cars are running the effects on delicate magnetic instruments are visible at a distance of several mUes. By having properly insulated returns, and taking other precautions, these dis- turbing effects can probably be so much reduced as to safeguard the usefulness of many existing observatories. These precautionary measures entail, however, some addi- tional expense, and the pecuniary interests concerned are so powerful that the rapid development of an enlightened public opinion is much to be desired. In the meantime several magnetic observatories — e.g., those at Washington, Toronto, Batavia, and Vienna — have been completely upset, and most of those situated near large cities are in imminent danger (T, vol. ii. 1897, p. 125, and voL iii. 1898, p. 145; Brit. Assoc. Report for 1898, p. 758; Edler, Verhandl. der Deutschen Phys. Gesell. Jahr. 1899, p. 174, &c.).~~

§ 4. Magnetic changes are often very abrupt ; in half an hour the needle may execute a to-and-fro movement much larger than the mean ampHtude of its movement during the day. It is usual to confine measurements of the records from ^^'^ords. magnetographs to exact hours (whether local, Gottingen, or Green- wich time). Consequently a good deal may depend on the precise time of occurrence of large erratic movements. The mean curve of the diurnal variation, for so long a period as a month even, might at certain seasons be considerably affected by accidents of this kind. In extreme cases the trace may go off the photographic sheet, leaving the observer nothing to draw on but his imagination. It has thus long been customary to exclude conspicuously large move-

ments in considering many species of magnetic phenomena, and many anthorities have sought to exclude even comparatively small irregular movements. Sabine (S, § 48) proposed to exclude any observed value wliich differed by more than a certain specified amount from the monthly mean of the element in question for that particular hour. The observations so excluded were pretty numerous, as the limits were usually narrow ; they were regarded as disturbed. The so-called disturbances were found by Sabine (S, §§ 63-59) and other investigators to occur more frequently at certain seasons of the year and at certain hours of the day than at others ; thus their exclusion modified the diurnal inequality curves. In view of the great variation in the number and amplitude of magnetic disturbances from year to year, and from station to station, Sabine's method of treatment is unquestionably arbitrary, as wUl be obvious from the following facts. In England in the course of a day it is extremely rare to have a range of 1 J° in the declination, or of -005 G.G.S. units in the horizontal or vertical components. But in polar regions, as was very fully demonstrated by the international work done during the years 1882-83, larger disturbances are frequent. At the British station. Fort Eae, a range of 11 J° was observed one day in the declination, and on ten days in the year the range exceeded 5°. At the

~~*Geiman station, Kingua Fjord, the range exceeded 5° on each of seven consecutive days in November, and also on twelve other occasions. At the Finnish station, Sodankyla, the declination range never reached 5° ; but on the other hand the horizontal force range exceeded '01 C. G.S. on fifteen occasions, as against thirteen such occasions at Fort Eae and three at Kingua Fjord. At the Russian station, Ssagyster, on the Lena, the declination range exceeded 6° on only five occasions, and the horizontal force range only once reached '01 G.G.S. ; but on the other hand the vertical force range exceeded O'l on about four days on the average out of five, and on one occasion it attained the enormous value of -268 G.G.S. units.*~~

~~*§ 5. During recent years Sabine's method has been largely abandoned in favour of a suggestion of Wild's to ••n It" ®®^^°* ^o"" ^^'^^ month a few specially quiet or days. normal days, and to employ th^se alone for*~~

~~*many purposes. Where the time and staff avail- able for reducing the records is limited, this plan has obvious economic advantages. Largely for this reason, two British observatories, Kew and Falmouth, during the decade 1890-1900 confined their attention to quiet days alone. To secure uniformity, the quiet days em- ployed — five a month — were selected at the end of each year by the Astronomer Royal. At some seasons it is exceptional to meet with a day's curve entirely free from sinuosities. At the English observatories, when sinuosities occur on a selected quiet day, the portion of*~~

~~*the curve aflfected is replaced by a pencil line of contimions curvature drawn freehand. At St Petersburg the smooth- ing process appears to be much more elaborate. This is not the only side on which the quiet-day system is open to criticism. A comparison of the results from normal (quiet) days and all days (exceptionally large movements alone excluded) between 1873 and 1885 at St Petersburg and Pavlovsk, by Muller (R, vol. xii., No. 8, 1889), showed a systematic difference between the mean annual values of certain of the magnetic elements as calculated from the two sets of data. An examination by Ellis (Brit. Assoc. Report for 1898, p. 80) of the Greenvsdch data for the years 1889 to 1896 presented similar*~~

~~*features. Table I. gives the average excesses found in these two researches for the quiet day over the a^^-day means, taken alge- braically.*~~

~~*Table I. — Differences, Quiet less AWrday Means.*~~

~~*station.*~~

~~*Declination + to West.*~~

~~*Horl. Force.*~~

~~*trnit = IX 10-6 0. G.S.*~~

~~*Vertical Force.*~~

~~*Unit = lxlO”6C.&.8.*~~

~~*Inclination.*~~

~~*St Petersburg Greenwich .*~~

~~*+ 0’-24 + 0’-08*~~

~~*+ 32 + 33*~~

~~*-8 -9*~~

~~*■23*~~

~~*In the case of the declination, horizontal force, and in- clination, the sign of the difference was the same for every year examined by Muller. The magnitude, however, varied, with a tendency apparently to be largest numeri- cally in years of maximum magnetic disturbance (or sun- spot maxima). Thus the secular changes from year to year, or the mean change for a short period of years, deduced from quiet days only, may differ slightly from those deduced from all days.*~~

~~*§ 6. A second unexpected feature of quiet days was dis-*~~

~~*Table II. — (Non-cyclic Increment).*~~

~~*station.*~~

~~*Epoch.*~~

~~*Declina- tion.*~~

~~*Horl. Force.*~~

~~*Vertical Force.*~~

~~*Inclina- tion.*~~

~~*Kew . Greenwich . Colaba .*~~

~~*1890-95 1894-97*~~

~~*+ 0’-07 + 0’-03*~~

~~*+ o’-io*~~

~~*+ 36 + 43 + 53*~~

~~*-8 -19*~~

~~*-0’-26*~~

~~*covered by Chree, viz., that the diurnal variation of certain of the elements as deduced from them is conspicuously*~~

~~*Table III. —*~~

~~*Mean Diurnal Inequality of Westerly Declination*~~

~~*[+ Movement to West).*~~

~~*station .*~~

~~*Jan Mayen.*~~

~~*St Petersburg and Pavlovsk.*~~

~~*Greenwich*~~

~~*Kew.*~~

~~*Pare St Maur (Paris).*~~

~~*48" 49' ISr.*~~

~~*Tiflis.*~~

~~*Colaba.*~~

~~*Batavia.*~~

~~*Mauritiu.s.*~~

~~*Latitude .*~~

~~*71" 0*~~

~~*N.*~~

~~*69" 41' N.*~~

~~*61° 28' N.*~~

~~*61° 28'*~~

~~*41° 43' N.*~~

~~*18° 64' N.*~~

~~*6" 11' S.*~~

~~*20° 6' 8.*~~

~~*Longitude*~~

~~*8° 28*~~

~~*W.*~~

~~*30″ 29′ E.*~~

~~*0°*~~

~~*0′*~~

~~*0″ 19′ W.*~~

~~*2″ 29′ B.*~~

~~*44″ 48′ E.*~~

~~*72″ 49′ E.*~~

~~*100° 49′ B.*~~

~~*67″ 83′ E.*~~

~~*Epoch .*~~

~~*1882*~~

~~*-83.*~~

~~*1873-86.*~~

~~*1890*~~

~~*-94.*~~

~~*1890-94.*~~

~~*1883-97.*~~

~~*1898-90.*~~

~~*1894-97.*~~

~~*1883-94.*~~

~~*1876-90.*~~

~~*Hour.*~~

~~“■■~~

~~*8.*~~

~~*u.. q.*~~

~~*u.*~~

~~*3-*~~

~~*3-*~~

~~*a.*~~

~~*a.*~~

~~«•~~

~~*a.*~~

~~*a.*~~

~~*1*~~

~~*-6-6*~~

~~*-4-2*~~

~~*-1-3-0-7*~~

~~*-1-6*~~

~~-1-0~~

~~-1-0~~

~~-1-4~~

~~-0-8~~

~~-0-2~~

~~+-0-1~~

~~+-0-1~~

~~2~~

~~-10~~

~~5~~

~~-6-4~~

~~-1~~

~~2-0-8~~

~~-1~~

~~6~~

~~-1~~

~~0~~

~~-1-0~~

~~-1~~

~~2~~

~~0~~

~~7~~

~~0 2~~

~~0 1~~

~~+ 0~~

~~1~~

~~3~~

~~16~~

~~2~~

~~7 8~~

~~1~~

~~2 1 0~~

~~1~~

~~4~~

~~1~~

~~1~~

~~1 1~~

~~1~~

~~2~~

~~0~~

~~7~~

~~-0-1~~

~~-0-1~~

~~+-0~~

~~1~~

~~4~~

~~-16~~

~~9~~

~~-8-4~~

~~-1~~

~~4-1-3~~

~~-1~~

~~6~~

~~-1~~

~~4~~

~~-1-6~~

~~-1~~

~~2~~

~~-0~~

~~6~~

~~0 1~~

~~0 0~~

~~+ 0~~

~~2~~

~~5~~

~~17~~

~~0~~

~~8 1~~

~~1~~

~~7 1 8~~

~~1~~

~~9~~

~~1~~

~~8~~

~~2 0~~

~~1~~

~~6~~

~~0~~

~~8~~

~~0 2~~

~~0 0~~

~~+ 0~~

~~3~~

~~6~~

~~-13~~

~~7~~

~~-7 0~~

~~-1~~

~~9 -2 3~~

~~-2~~

~~3~~

~~-2~~

~~4~~

~~-2 5~~

~~-1~~

~~9~~

~~-1~~

~~4~~

~~-0 7~~

~~+ 0 1~~

~~+0~~

~~4~~

~~7~~

~~-9~~

~~3~~

~~-5-1~~

~~-2~~

~~2-2-8~~

~~-2~~

~~7~~

~~-3~~

~~0~~

~~-3-1~~

~~-2~~

~~4~~

~~-2~~

~~1~~

~~-1-1~~

~~+0-6~~

~~+0~~

~~6~~

~~8~~

~~-6~~

~~8~~

~~-3-2~~

~~-2~~

~~6-3-2~~

~~-2~~

~~8~~

~~-3~~

~~3~~

~~-3-4~~

~~-2~~

~~7~~

~~-2~~

~~8~~

~~-1-3~~

~~+1-3~~

~~+1~~

~~1~~

~~9~~

~~-3~~

~~7~~

~~-0-6~~

~~-2~~

~~3-3-0~~

~~-2~~

~~2~~

~~-2~~

~~7~~

~~-2-8~~

~~-2~~

~~3~~

~~-2~~

~~6~~

~~-0-8~~

~~+1-7~~

~~+1~~

~~8~~

~~10~~

~~-2~~

~~4~~

~~+2-1~~

~~-1~~

~~0-1-7~~

~~-0~~

~~4~~

~~-0~~

~~9~~

~~-0-8~~

~~-0~~

~~5~~

~~-1~~

~~1~~

~~0-0~~

~~+1-5~~

~~+1~~

~~9~~

~~11~~

~~-0~~

~~6~~

~~+4-6~~

~~+1~~

~~0+0-4~~

~~+2~~

~~2~~

~~+1~~

~~7~~

~~+1-8~~

~~+2~~

~~0~~

~~+0~~

~~9~~

~~+1-0~~

~~+0-9~~

~~+1~~

~~3~~

~~Noon~~

~~+2~~

~~6~~

~~+ 6-6~~

~~+ 3~~

~~1 +2-7~~

~~+ 4~~

~~5~~

~~+ 4~~

~~1~~

~~+ 4-3~~

~~+ 4~~

~~2~~

~~+ 2~~

~~7~~

~~+ 1-4~~

~~+ 0-1~~

~~0~~

~~0~~

~~1~~

~~+ 3~~

~~7~~

~~+ 7-3~~

~~+ 4~~

~~6 +4 3~~

~~+ 5~~

~~5~~

~~+ 5~~

~~1~~

~~+ 5 3~~

~~+ 5~~

~~3~~

~~+ 3~~

~~6~~

~~+ 1 2~~

~~-0 6~~

~~-1~~

~~1~~

~~2~~

~~+ 6~~

~~4~~

~~+ 7 1~~

~~+ 4~~

~~9 +4-6~~

~~+-5~~

~~2~~

~~+-4~~

~~7~~

~~+-4-9~~

~~+-4~~

~~9~~

~~+-3~~

~~5~~

~~+-0-8~~

~~-1-1~~

~~-2~~

~~0~~

~~3~~

~~+-7~~

~~4~~

~~+-5-9~~

~~+-4~~

~~1 +3-6~~

~~+ 3~~

~~9~~

~~+ 3~~

~~4~~

~~+ 3 6~~

~~+ 3~~

~~7~~

~~+ 2~~

~~7~~

~~+ 0 2~~

~~-1 3~~

~~-2~~

~~3~~

~~4~~

~~+ 8~~

~~5~~

~~+ 4 3~~

~~+ 2~~

~~7 +2 3~~

~~+ 2~~

~~6~~

~~+2~~

~~0~~

~~+2-0~~

~~+2~~

~~3~~

~~+1~~

~~7~~

~~-0-2~~

~~-1-2~~

~~-1~~

~~8~~

~~5~~

~~+10~~

~~6~~

~~+3-0~~

~~+1~~

~~5+1-3~~

~~+1~~

~~2~~

~~+0~~

~~9~~

~~+0-8~~

~~+1~~

~~1~~

~~+0~~

~~8~~

~~-0-1~~

~~-0-9~~

~~-0~~

~~9~~

~~6~~

~~+14~~

~~2~~

~~+2-3~~

~~+0~~

~~6+0-7~~

~~+0~~

~~3~~

~~+0~~

~~3~~

~~+ 0 -2~~

~~+ 0~~

~~2~~

~~+ 0~~

~~3~~

~~+ 0 -1~~

~~-0 -6~~

~~0~~

~~1~~

~~7~~

~~+ 15~~

~~2~~

~~+ 2 -2~~

~~0~~

~~0 +0 -4~~

~~-0~~

~~3~~

~~0~~

~~0~~

~~-0-1~~

~~-0~~

~~4~~

~~+-0~~

~~1~~

~~+-0-2~~

~~-0-4~~

~~+-0~~

~~1~~

~~8~~

~~+-15~~

~~8~~

~~+-2-6~~

~~-0~~

~~4+0-2~~

~~-0~~

~~8~~

~~-0~~

~~3~~

~~-0-4~~

~~-0~~

~~9~~

~~-0~~

~~1~~

~~+-0-2~~

~~-0-2~~

~~+-0~~

~~1~~

~~9~~

~~+-13~~

~~2~~

~~+-2-6~~

~~-1~~

~~0-0-0~~

~~-1~~

~~2~~

~~-0~~

~~6~~

~~-0‘6~~

~~-1~~

~~3~~

~~-0~~

~~4~~

~~+-0-2~~

~~0-0~~

~~+-0~~

~~1~~

~~10~~

~~+-7~~

~~4~~

~~+-2-0~~

~~-1~~

~~4-0-2~~

~~-1~~

~~4~~

~~-0~~

~~7~~

~~-0-7~~

~~-1~~

~~5~~

~~-0~~

~~7~~

~~+0-1~~

~~+0-1~~

~~+0~~

~~1~~

~~11~~

~~+1~~

~~1~~

~~+0-5~~

~~-1~~

~~6-0-4~~

~~-1~~

~~6~~

~~-0~~

~~9~~

~~-0-9~~

~~-1~~

~~6~~

~~-0~~

~~*8*~~

~~*0-0*~~

~~*+0-1*~~

~~*+0*~~

~~*1*~~

~~*12*~~

~~*-3-6*~~

~~*-1-8*~~

~~*-1-6 -0-6*~~

~~*-1-7*~~

~~*-1-1*~~

~~*-1-1*~~

~~*-1-6*~~

~~*-0-8*~~

~~*-0-1*~~

~~*+0-1*~~

~~*+0-1*~~

~~*MAGNETISM, TERRESTRIAL*~~

~~*Table IV. — Meam, Biwrnal Inequality of Horizontal Force (unit= 1 x 10 ~^ G.G.S.).*~~

~~*455*~~

~~*station .*~~

~~*Jan Mayen.*~~

~~*St Petersburg and Pavlovsk*~~

~~*Greenwich.*~~

~~*Kew.*~~

~~*Pare StMaur.*~~

~~*Tiflis.*~~

~~*Colaba.*~~

~~*Batavia.*~~

~~*Mauritius.*~~

~~*Epocli ,*~~

~~*1882-83.*~~

~~*1873-85.*~~

~~*1890-94.*~~

~~*1890-94.*~~

~~*1883-97.*~~

~~*1893-95.*~~

~~*1894-97.*~~

~~*1883-94.*~~

~~*1883-90.*~~

~~*Hour.*~~

~~*a, q.*~~

~~*q.*~~

~~*K. q.*~~

~~*9-*~~

~~*a.*~~

~~*a.*~~

~~*9-*~~

~~*a.*~~

~~*a.*~~

~~*1*~~

~~*-57 -22*~~

~~*+ 4 +5*~~

~~*+ 5 +5*~~

~~*+ 5*~~

~~*+ 5*~~

~~*+ 4*~~

~~*-12*~~

~~*-11*~~

~~*-3*~~

~~2~~

~~-64 -24~~

~~+ 4 +4~~

~~+ 4 +4~~

~~+“4~~

~~+ 5~~

~~+ 4~~

~~-12~~

~~-10~~

~~-1~~

~~3~~

~~-74 -25~~

~~+ 4 +4~~

~~+ 3 +3~~

~~+ 4~~

~~+ 5~~

~~+ 4~~

~~-12~~

~~-8~~

~~+ 1~~

~~4~~

~~-69 −24~~

~~+4 +4~~

~~+3 +3~~

~~+5~~

~~+5~~

~~+5~~

~~-11~~

~~-7~~

~~+2~~

~~5~~

~~-60 −22~~

~~+5 +4~~

~~+3 +3~~

~~+5~~

~~+6~~

~~+5~~

~~-11~~

~~-5~~

~~+3~~

~~6~~

~~-37 -19~~

~~+4 +4~~

~~+1 +1~~

~~+3~~

~~+4~~

~~+5~~

~~-8~~

~~-1~~

~~+4~~

~~7~~

~~-15 -15~~

~~+2 +2~~

~~-3 -3~~

~~-1~~

~~+1~~

~~+2~~

~~-3~~

~~+5~~

~~+7~~

~~8~~

~~-1 -13~~

~~-3 -4~~

~~-10 -10~~

~~-7~~

~~-5~~

~~-3~~

~~+8~~

~~+14~~

~~+9~~

~~9~~

~~+8 -12~~

~~-10 -10~~

~~-18 -17~~

~~-15~~

~~-12~~

~~-9~~

~~+20~~

~~+24~~

~~+9~~

~~10~~

~~+17 -12~~

~~-16 -16~~

~~-22 −22~~

~~-20~~

~~-17~~

~~-11~~

~~+30~~

~~+31~~

~~+9~~

~~11~~

~~+32 -10~~

~~-19 −20~~

~~-21 −21~~

~~-20~~

~~-16~~

~~-7~~

~~+35~~

~~+35~~

~~+9~~

~~Noon.~~

~~+49 -4~~

~~-17 -18~~

~~-15 -15~~

~~-15~~

~~-12~~

~~-1~~

~~+31~~

~~+31~~

~~+8~~

~~1~~

~~+65 +8~~

~~-12 -13~~

~~-7 -8~~

~~-8~~

~~-7~~

~~+4~~

~~+23~~

~~+22~~

~~+7~~

~~2~~

~~+78 +22~~

~~-6 -6~~

~~-1 -1~~

~~-3~~

~~-4~~

~~+5~~

~~+13~~

~~+10~~

~~+2~~

~~3~~

~~+89 +37~~

~~0 0~~

~~+3 +3~~

~~+1~~

~~-1~~

~~+3~~

~~+4~~

~~-1~~

~~-2~~

~~4~~

~~+83 +48~~

~~+3 +3~~

~~+6 +5~~

~~+3~~

~~0~~

~~-2~~

~~-3~~

~~-9~~

~~-6~~

~~5~~

~~+68 +49~~

~~+5 +5~~

~~+8 +8~~

~~+6~~

~~+2~~

~~-5~~

~~-7~~

~~-13~~

~~-7~~

~~6~~

~~+37 +43~~

~~+6 +6~~

~~+10 +10~~

~~+8~~

~~+4~~

~~-6~~

~~-9~~

~~-14~~

~~-7~~

~~7~~

~~+13 +30~~

~~+7 +7~~

~~+11 +11~~

~~+10~~

~~+6~~

~~-5~~

~~-10~~

~~-15~~

~~-7~~

~~8~~

~~-11 +15~~

~~+ 8 +8~~

~~+ 10 +10~~

~~+ 9~~

~~+ 7~~

~~-2~~

~~-12~~

~~-16~~

~~-8~~

~~9~~

~~-33 +1~~

~~+ 9 +9~~

~~+ 9 +9~~

~~+ 8~~

~~+ 7~~

~~+ 1~~

~~-12~~

~~-16~~

~~-8~~

~~10~~

~~-36 -10~~

~~+ 8 +9~~

~~+ 8 +7~~

~~+ 7~~

~~+ 6~~

~~+ 3~~

~~-12~~

~~-16~~

~~-8~~

~~11~~

~~-40 -16~~

~~+ 7 +8~~

~~+ 7 +7~~

~~+ 6~~

~~+ 6~~

~~+ 4~~

~~-12~~

~~-15~~

~~-7~~

~~12~~

~~-51 -20~~

~~+ 6 +6~~

~~+ 6 +6~~

~~+ 5~~

~~+ 6~~

~~+ 4~~

~~-12~~

~~-13~~

~~-5~~

~~non-cyclic (Brit. Assoc. Heports, 1895, p. 209 ; and 1896, p. 231). On the average, from 1890 to 1895, the hori- zontal force at Kew increased 21 x 10”^ C.G.S. units a year, so that its value at the second midnight of an average day exceeded its value at the first midnight by approximately 6 x 10”’^ C.G.S. On the average quiet day, however, the horizontal force increased 36 x 10”^ C.G.S. Similar phenomena at Greenwich were discussed by Ellis (Brit. Assoc. Reports, 1896, p. 238; and 1898, p. 80), and they are apparent in the records of other observatories, e.g., Falmouth, Pare St Maur (Paris), and Colaba (Bom- bay), where the Astronomer Eoyal’s quiet days have been tabulated. Table II. gives mean values for the non-cyclic increment during twenty-four hours from midnight to mid- night. Declination is taken + to the west, and the unit of force is 1 X 10-8 C.G.S. rpj^g ^^^ ^^^ g^.^ ^^^ Q,T:%enr wich were given by Chree and EUis (^.c); those for~~

~~*Colaba are deduced from Mag. and Met. Observations made at the Govt. Obs., Bombay (Appendices to years*~~

~~*1896-97).*~~

~~*As magnetic force is usually measured to 1 x 10”’ C.G.S. unit, and angular movement to 0“1, non-cyclic changes such as appear in Table II. are far from negli- gible. The non-cyclic effect would introduce a fictitious element into the diurnal inequality. Chree and EUis eliminate it on the provisional hypothesis that it takes place uniformly throughout the twenty-four hours. Pheno- mena closely analogous to, if not identical with, the non- cyclic effect have been detected by van Bemmelen in the case of days near times of large magnetic disturbances {Meteorologische Zeitschrift, September 1895).*~~

~~*§ 7. The values of the magnetic elements at any given station are in a state of constant change. Part of the change arises from causes of a periodic character, and of*~~

~~*Table V. — Diurnal Inequality of Vertical Force (unit = l x 10 ^ C.G.S.).*~~

~~*Station .*~~

~~*Jan Mayen.*~~

~~*St Petersbrag and Pavlovsk.*~~

~~*Greenwiclx.*~~

~~*Pare St Maur (Paris).*~~

~~*Tiflis.*~~

~~*Batavia.*~~

~~*Mauritius.*~~

~~*Epocli .*~~

~~1882-83.~~

~~1873-85.~~

~~1890-94.~~

~~1883-97.~~

~~1898-96.~~

~~1883-94.~~

~~1884-90.~~

~~Hour.~~

~~a. q.~~

~~q.~~

~~u,. q.~~

~~a.~~

~~a.~~

~~a.~~

~~a.~~

~~1~~

~~+ 65 +3~~

~~-7 -1~~

~~-3 -1~~

~~θ~~

~~+3~~

~~+7~~

~~+2~~

~~2~~

~~+65+2~~

~~-7-1~~

~~-4-1~~

~~0~~

~~+2~~

~~+5~~

~~+2~~

~~3~~

~~+56-1~~

~~-7-1~~

~~-4 0~~

~~-1~~

~~+2~~

~~+4~~

~~+2~~

~~4~~

~~+37-5~~

~~-6 0~~

~~-3 +1~~

~~0~~

~~+2~~

~~+3~~

~~+2~~

~~5~~

~~+16-7~~

~~-5 0~~

~~-2 +2~~

~~0~~

~~+3~~

~~+2~~

~~+2~~

~~6~~

~~-7-8~~

~~-4 0~~

~~-1 +2~~

~~+1~~

~~+4~~

~~+1~~

~~+2~~

~~7~~

~~-17 -6~~

~~-3 0~~

~~0 +3~~

~~+1~~

~~+4~~

~~0~~

~~+3~~

~~8~~

~~-14 -4~~

~~-2 0~~

~~0 +2~~

~~0~~

~~+3~~

~~-3~~

~~+4~~

~~9~~

~~-9 -0~~

~~-3 -1~~

~~-3 -2~~

~~-4~~

~~-1~~

~~-11~~

~~+ -5~~

~~10~~

~~-6 +5~~

~~-2 -2~~

~~-7 -6~~

~~-8~~

~~-7~~

~~-20~~

~~+ -3~~

~~11~~

~~-6 +10~~

~~-3 -4~~

~~-10 -10~~

~~-12~~

~~•12~~

~~-26~~

~~θ~~

~~Noon~~

~~-10 +16~~

~~-3 -5~~

~~-10 -11~~

~~-12~~

~~-13~~

~~-27~~

~~-4~~

~~1~~

~~-13 +21~~

~~-1 -4~~

~~-6 -8~~

~~-9~~

~~-11~~

~~-21~~

~~-7~~

~~2~~

~~-24 +23~~

~~+2 -1~~

~~-1 -3~~

~~-3~~

~~-7~~

~~-13~~

~~-9~~

~~3~~

~~-31 +20~~

~~+8 +2~~

~~+4 +2~~

~~+2~~

~~-3~~

~~-4~~

~~-8~~

~~4~~

~~-40 +13~~

~~+9 +3~~

~~+8 +4~~

~~+6~~

~~+1~~

~~+4~~

~~-5~~

~~5~~

~~-48 +2~~

~~+10 +3~~

~~+10 +6~~

~~+7~~

~~+3~~

~~+10~~

~~-3 •~~

~~6~~

~~-53 -9~~

~~+10 +3~~

~~+10 +6~~

~~+8~~

~~+4~~

~~+13~~

~~0~~

~~7~~

~~-47 -18~~

~~+ 9 +3~~

~~+ 9 +5~~

~~+ 7~~

~~+ 4~~

~~+ 14~~

~~0~~

~~8~~

~~-36 -20~~

~~+ 8 +3~~

~~+ 7 +4~~

~~+ 6~~

~~+ 4~~

~~+ 14~~

~~+ 1~~

~~9~~

~~-7 -19~~

~~+ 6 +2~~

~~+ 5 +3~~

~~+ 5~~

~~+4~~

~~+14~~

~~+2~~

~~10~~

~~+18 -13~~

~~+3 +2~~

~~+2 +2~~

~~+3~~

~~+4~~

~~+13~~

~~+2~~

~~11~~

~~+42 -5~~

~~-2 0~~

~~0 +1~~

~~+2~~

~~+4~~

~~+11~~

~~+2~~

~~12~~

~~*+ 54 0*~~

~~*-5 -1*~~

~~*-2 0*~~

~~*+ 1*~~

~~*+ 3*~~

~~*+ 9*~~

~~*+ 2*~~

~~*456*~~

~~*MAGNETISM, TERRESTRIAL*~~

~~*Table VI. — Diurnal Inequality of Inclination.*~~

~~*station . . .*~~

~~*Jan Mayen.*~~

~~*St Petersburg.*~~

~~*Kew.*~~

~~*Pare St Maur (Paris).*~~

~~*North.*~~

~~*Tiflis.*~~

~~*Batavia.*~~

~~*Mauritius.!*~~

~~*End Dipping .*~~

~~*North.*~~

~~*North.*~~

~~*North.*~~

~~*North.*~~

~~*South.*~~

~~*South.*~~

~~*Epoch . . .*~~

~~*1882-83.*~~

~~*1873-86.*~~

~~*1891-95.*~~

~~*1883-97.*~~

~~*1893-96.*~~

~~*1883-94.*~~

~~*1884-90.*~~

~~*Hour.*~~

~~*q.*~~

~~*(i. q.*~~

~~*q*~~

~~*a.*~~

~~*a.*~~

~~a.~~

~~a.~~

~~1~~

~~+4~~

~~6+1-5~~

~~-0~~

~~5-0-3~~

~~-0-3~~

~~-0-3~~

~~-0-1~~

~~+0-9~~

~~+0-3~~

~~2~~

~~+5~~

~~0+1-6~~

~~-0~~

~~5-0-3~~

~~-0~~

~~3~~

~~-0~~

~~3~~

~~-0-1~~

~~+-0~~

~~8~~

~~+-0-2~~

~~3~~

~~+-6~~

~~6+1-6~~

~~-0~~

~~5-0-3~~

~~-0~~

~~3~~

~~-0~~

~~3~~

~~-0-2~~

~~+-0~~

~~6~~

~~0-0~~

~~4~~

~~+-5~~

~~0 +1-5~~

~~-0~~

~~4 -0-3~~

~~-0~~

~~2~~

~~-0~~

~~4~~

~~-0-2~~

~~+-0~~

~~5~~

~~0-0~~

~~5~~

~~+-4~~

~~2 +1-4~~

~~-0~~

~~5 -0-3~~

~~-0~~

~~2~~

~~-0~~

~~4~~

~~-0-2~~

~~+-0~~

~~3~~

~~-0-1~~

~~6~~

~~+-2~~

~~4+1-2~~

~~-0~~

~~4-0-3~~

~~-0~~

~~1~~

~~-0~~

~~3~~

~~-0-1~~

~~+-0~~

~~1~~

~~-0-2~~

~~7~~

~~+-0~~

~~7+0-9~~

~~-0~~

~~2-0-1~~

~~+-0~~

~~2~~

~~0~~

~~0~~

~~0-0~~

~~-0~~

~~2~~

~~-0-3~~

~~8~~

~~-0~~

~~1+0-8~~

~~+-0~~

~~1+0-3~~

~~+-0~~

~~6~~

~~+-0~~

~~4~~

~~+-0-3~~

~~-0~~

~~8~~

~~-0-4~~

~~9~~

~~-0~~

~~7+0-8~~

~~+-0~~

~~6+0-6~~

~~+-1~~

~~0~~

~~+-0~~

~~7~~

~~+-0-5~~

~~-1~~

~~7~~

~~-0-4~~

~~10~~

~~-1~~

~~2+0-9~~

~~+-1~~

~~0 +1-0~~

~~+-1~~

~~3~~

~~+-0~~

~~9~~

~~+-0-4~~

~~-2~~

~~7~~

~~-0-5~~

~~H~~

~~-2~~

~~2 +0-8~~

~~+1~~

~~2 +1-2~~

~~+-1~~

~~2~~

~~+-0~~

~~7~~

~~-0-1~~

~~-3~~

~~3~~

~~-0-6~~

~~Noon~~

~~-3~~

~~4+0-4~~

~~+1~~

~~1+1-1~~

~~+-0~~

~~8~~

~~+-0~~

~~4~~

~~-0-5~~

~~-3~~

~~1~~

~~-07~~

~~1~~

~~-4~~

~~5-0-2~~

~~+-0~~

~~7+0-7~~

~~+0~~

~~4~~

~~+0~~

~~2~~

~~-0-7~~

~~-2~~

~~4~~

~~-0-8~~

~~2~~

~~-5~~

~~6-1-2~~

~~+0~~

~~4+0-4~~

~~+0~~

~~2~~

~~+0~~

~~2~~

~~-0-6~~

~~-1~~

~~3~~

~~0 6~~

~~3~~

~~6~~

~~3 2 2~~

~~+ 0~~

~~2 +0 1~~

~~0~~

~~0~~

~~+ 0~~

~~2~~

~~0 3~~

~~0~~

~~2~~

~~0 3~~

~~4~~

~~6~~

~~1 2 9~~

~~0~~

~~0 0 1~~

~~0~~

~~1~~

~~+0~~

~~2~~

~~+0-1~~

~~+0~~

~~7~~

~~+0-1~~

~~5~~

~~-5~~

~~1-3-2~~

~~-0~~

~~1-0-3~~

~~-0~~

~~3~~

~~+0~~

~~1~~

~~+0-4~~

~~+1~~

~~3~~

~~+0-4~~

~~6~~

~~-3~~

~~1-2-9~~

~~-0~~

~~2-0-3~~

~~-0~~

~~4~~

~~0~~

~~0~~

~~-1-0-6~~

~~+-1~~

~~5~~

~~+-0-5~~

~~7~~

~~-1~~

~~7-2-2~~

~~-0~~

~~3-0-4~~

~~-0~~

~~6~~

~~-0~~

~~2~~

~~+0-5~~

~~+1~~

~~6~~

~~+0-5~~

~~8~~

~~+0~~

~~3-1-3~~

~~-0~~

~~3-0-5~~

~~-0~~

~~6~~

~~-0~~

~~3~~

~~+0-3~~

~~+1~~

~~6~~

~~+0-6~~

~~9~~

~~+2~~

~~0-0-3~~

~~-0~~

~~4-0-6~~

~~-0~~

~~6~~

~~-0~~

~~3~~

~~+0-1~~

~~+1~~

~~6~~

~~+0-6~~

~~10~~

~~+2~~

~~5+0-5~~

~~-0~~

~~5-0-6~~

~~-0~~

~~5~~

~~-0~~

~~3~~

~~0-0~~

~~+-1~~

~~5~~

~~+-0-6~~

~~11~~

~~+-3~~

~~0+1-0~~

~~-0~~

~~5-0-6~~

~~-0~~

~~5~~

~~-0~~

~~3~~

~~0-0~~

~~+-1~~

~~4~~

~~+-0-5~~

~~12~~

~~+-4-0+1-3~~

~~-0-5 -0-4~~

~~-0-4~~

~~-0-3~~

~~-0-1~~

~~+ 1-2~~

~~+ 0-4~~

~~I Calculated from results for horizontal and vertical components in Tables IV. and V.~~

~~•■”’•\~~

~~\~~

~~jj~~

~~\~~

~~I~~

~~I 1 f~~

~~‘. 1~~

~~x>~~

~~\~~

~~Kew~~

~~the periods the soiar day is the most conspicuous (of. S, §§ 36-45, 68, (fee). The amplitude of the diurnal inequality of any magnetic element varies with the season of the year~~

~~*and the position of the year in the sun-spot*~~

~~*cycle, and is probably modified by other*~~

~~*causes : while the hours at which*~~

~~*,1 . T . . Diurnal In-*~~

~~*tne maxima and minima occur, „,i*i.,*~~

~~*. ‘ equalities.*~~

~~*though less variable, are by no means constant. It is thus’ impossible to give more than a general idea of the pheno- mena as observed at a few representative ^■* stations.*~~

~~*Tables III. to YI. give the mean diurnal in- equalities of the declination, horizontal and vertical force components, and inclination for one or a series of specified years. Of the stations selected, Jan Mayen was the Austrian polar station. Pavlovsk is close to St Petersburg, and succeeded it as the central Russian magnetic observatory. The data are derived from the official publications of the respec- tive stations, or from special papers as follows : — Jan Mayen (‘ ‘ Die Internationale Polarforschung, 1882-83 ; Die Oesterreichische Polar Station. . . .” k. Akad. der IFiss. II. Bd., II. Abth.) ; St Peters- burg-Pavlovsk (MuUer, E, vol. xii., No. 8, 1889); Greenwich (Ellis, Brit. Assoc. Report, 1898, p. 80) ; Kew (Brit. Assoc. Report, 1895, p. 209, and Repor/s of Kew Observatory Cttee.) ; Pare St Maur (Mou- reaux, Ann. du Bureau Central M4t4orologiquc de France for 1897, p. B^) ; Tiflis {Beob. des Tiflisser Physik. Observatoriums for years 1893 to 1896) ; Colaba (Mag. and Met. Obserratwns, Bombay, years 1896 and 1897) ; Batavia (Ubscrratiovs made at the Mag. and Met. Observatory at Batavia, App. vol. xvi., for 1893) ; Mauritius (Meldrum and Claxton, Magnetical Hcdnclimis. Mauritius, 1899). Data from quiet days only are distinguished by the letter q ; those from all days (except those of exceptional disturbance) by the letter a.*~~

~~*§ 8. The difference between all and quiet days’ results, so conspicuous at Jan Mayen in all the elements, is considerable even at Pavlovsk and*~~

~~*Greenwich in the case of the vertical force. At some stations the times of occurrence of the maxima, minima, and mean values vary considerably throughout the year. This is more especially true of the declination in tropical .stations. In fact, according to Sabine (see S, §§ 42, 43), at a station near the magnetic equator, while the declination diurnal inequality during summer*~~

~~*resembles that of temperate stations in its own hemisphere, the inequality during winter is of the type characteristic of the opposite hemisphere. This is perhaps rather an extreme way of stating the facts. It is true, however, that the contributions to the hourly means from different months may to a considerable extent neutralize one another, and that a more correct idea of the phenomena is obtained by considering the winter and summer months separately. For this reason, winter and summer curves of declination are shown side by side on the left-hand side of Fig. 1. They are based on the results for the years specified in Tables III. to V. The uppermost of the right- hand curves shows the inequality of vertical force at Greenwich from all and from quiet days. The next curves on the same side show the horizontal force inequalities at Kew during summer and winter, while the remaining curves show the mean annual inequalities of horizontal and vertical force at Batavia and Mauritius. The curves relating to the same element are all drawn to the same scale, and the scales for the horizontal and vertical force inequalities are identical. The hours are counted from midnight, which answers to 0 or 24.*~~

~~*§ 9. Two other methods of illustrating diurnal in- equalities may be mentioned. The first, which has been employed by Airy, Lloyd, and others, consists in drawing curves to represent disturbing forces to which the inequalities of declination and hori- zontal force may be ascribed. Such curves are sometimes*~~

~~*Orapblc methods^*~~

~~*termed vector diagrams. The radius vector, from the origin O, represents the forces in question both in magni- tude and direction. The hours to which individual radii refer are marked on the curve. It is immaterial what we take as our initial line, or our rectangular axes, so long as the directions are known. It is desirable to show the geographical meridian as well as the mean magnetic meridian of the station for the epoch dealt with.*~~

~~*Fig. 2 is the vector diagram for Kew at midsummer (June and July) for quiet days during 1890-94 {Brit. Assoc. Report for 1895). Fig. 3 refers to all, Fig. 4 to quiet days in May to July of 1883 at Jan Mayen, the Austrian polar station. The data on which they are based are given by Liideling [Sitz. der k. Preuss. Akad. der Wiss. 1898, p. 524; and 1899, p. 236). In the diagrams MM represents the magnetic meridian. As shown by the arrows, Fig. 2 is described in the direction of the hands of a watch — the normal direction in temperate latitudes, both for all and for quiet days. The quiet-day diagram at Jan Mayen is also mainly described clock-*~~

~~*wise (Fig. 4), but the all-day diagram is described anti-clockwise (Fig. 3). Liideling found this peculiar difference between all and quiet days to be common to the other polar stations excepting Kingua Fjord, where both diagrams were described clockwise. Liideling has also employed vector diagi-ams to represent the differ- ence between the diurnal variations in all and in quiet days at the polar stations ; here again the diagrams are described anti-clock- wise, except that for Kingua Fjord.*~~

~~*The other graphical method is closely analogous to Bauer's method of showing secular change, illustrated by*~~

~~*Fig. 3.*~~

~~*Fig. 5. Starting with an imaginary needle freely suspended by its centre of gravity, it combines the diurnal changes of declination and inclination in a curve traced on the plane perpendicular to the mean position of the needle. This method has been employed by Eiicker ("Kede Lecture," Nature, vol. Ivii. pp. 160 and 180), and by Capello {Brit. Assoc. Beport for 1898, p. 750). Capello M*~~

~~*Fig. 4.*~~

~~*gives curves for St Petersburg, Kew, Paris, Perpignan, and Lisbon. In the case of the first three mentioned stations the motion is wholly clockwise. The Perpignan and Lisbon curves illustrate a transition, the anti-clockwise movement being very decidedly predominant at Lisbon. § 10. Owing to the influence of the season on the type of the*~~

~~*inequalities, the mean amplitude obtained by combining hourly values from the whole year is necessarily less than the arithmetic mean of the amplitudes found for any series of equal subdivisions of the year. At some observatories it is customary to measure the difference between the greatest and least of the hourly values, or even between the greatest and least values met with anywhere in the twenty-four hours, tabulating the result under some such heading as diurnal range. Diurnal ranges so calculated are, it should be noticed, entirely different — especially in disturbed times — from the amplitudes of ordinary diurnal inequalities. Even in the case of monthly means, variability in the times of occurrence of undisturbed maxima and minima should not be lost sight of*~~

~~*Again, it should be noticed that as the mean times of occurrence of maxima and minima seldom coincide with exact hours, the ampli- tudes of inequalities deduced directly from hourly measurements may be sensibly too small. At some stations attempts are made to rectify this, the hourly measurements being either made the basis of continuous curves, or employed in the calculation of Fourier's series with jieriods of twenty-four hours or their submultiples. The maxima and minima and their exact times of occurrence can then be determined very accurately. This procedure is, however, ex- ceptional, so the amplitudes dealt with in Table VII. are simply the differences between the greatest and least of the mean hourly values. The mean of the twelve monthly amplitudes is taken as unity.*~~

~~*Table VII. — lielative Values of Ainplitudcs of Diurnal Inequalities throughout the Year.*~~

~~*Station.*~~

~~*Epoch.*~~

~~*Element.*~~

~~*Jan.*~~

~~*Feb.*~~

~~*March.*~~

~~*April.*~~

~~*May.*~~

~~*June.*~~

~~*July.*~~

~~*August.*~~

~~*Sept.*~~

~~*Oct.*~~

~~*Nov.*~~

~~*Dec.*~~

~~*Xew*~~

~~*1890-94*~~

~~*Declination*~~

~~*•56*~~

~~•63~~

~~1^09~~

~~1^26~~

~~1-34~~

~~1-26~~

~~1^26~~

~~1-37~~

~~V17~~

~~■95~~

~~■66~~

~~•45~~

~~J)~~

~~;j~~

~~Hor. force~~

~~■57~~

~~•64~~

~~■88~~

~~1-19~~

~~1-29~~

~~*r34*~~

~~*1^37*~~

~~*r35*~~

~~*1^17*~~

~~*•99*~~

~~*■76*~~

~~*■45*~~

~~*.)) • ‘*~~

~~*1891-95*~~

~~*Inclination*~~

~~*•61*~~

~~*•65*~~

~~*■87*~~

~~*1‘13*~~

~~*1-24*~~

~~*1-31*~~

~~*1^35*~~

~~*V38*~~

~~*f20*~~

~~*■95*~~

~~•86~~

~~■46~~

~~Tiflis .~~

~~1880-90~~

~~Declination~~

~~•41~~

~~•57~~

~~1^07~~

~~1^42~~

~~1^36~~

~~rss~~

~~1^33~~

~~1-38~~

~~1^27~~

~~•93~~

~~•51~~

~~•36~~

~~I)~~

~~1893-96~~

~~Hor. force~~

~~■67~~

~~■79~~

~~■73~~

~~1^06~~

~~1^24~~

~~ro9~~

~~1-36~~

~~r48~~

~~1-34~~

~~“75~~

~~•78~~

~~•71~~

”

jj

~~Vert, force~~

~~■58~~

~~■76~~

~~■97~~

~~1^36~~

~~1^35~~

~~*1-21*~~

~~*1-36*~~

~~*l^SO*~~

~~*1^06*~~

~~■*86*~~

~~■*70*~~

~~•*50*~~

~~*Batavia*~~

~~*1883-94*~~

~~*Declination*~~

~~*1^15*~~

~~*1^35*~~

~~*V02*~~

~~■*84*~~

~~■*69*~~

~~•*60*~~

~~■*66*~~

~~■*88*~~

~~*1-06*~~

~~*1^27*~~

~~1^28~~

~~1^21~~

~~a ‘ *~~

~~Hor. force~~

~~•96~~

~~•92~~

~~1-07~~

~~1^20~~

~~1-00~~

~~•96~~

~~•99~~

~~1^05~~

~~1^17~~

~~1^04~~

~~■85~~

~~■79~~

~~J,~~

~~Vert, force~~

~~1-05~~

~~1^21~~

~~*1-23*~~

~~*1^19*~~

~~■*77*~~

~~■*80*~~

~~■*83*~~

~~■*70*~~

~~*1-04*~~

~~*1-30*~~

~~*1^03*~~

~~■*86*~~

~~*}j*~~

~~*Inclination*~~

~~*vol*~~

~~*MO*~~

~~*1-18*~~

~~*T20*~~

~~■*87*~~

~~■*86*~~

~~■*88*~~

~~■*85*~~

~~*1-09*~~

~~*1^19*~~

~~■*96*~~

~~•*81*~~

~~*Mauritius*~~

~~*1876-90*~~

~~*Declination*~~

~~*1^07*~~

~~*1^26*~~

~~*1^30*~~

~~•*97*~~

~~■*85*~~

~~■*60*~~

~~■*70*~~

~~*l^Ol*~~

~~*1^03*~~

~~*1-14*~~

~~*1^01*~~

~~*1^05*~~

~~”~~

~~1883-90~~

~~Hor. force~~

~~1^02~~

~~•76~~

~~l^Ol~~

~~l^ll~~

~~■97~~

~~1-02~~

~~■99~~

~~I^IO~~

~~■99~~

~~1”02~~

~~1^04~~

~~■98~~

~~it~~

~~1884-90~~

~~Vert, force~~

~~•75~~

~~1^04~~

~~1-20~~

~~*roc*~~

~~■*94*~~

~~•*82*~~

~~■*97*~~

~~*1-36*~~

~~*1-31*~~

~~*1-05*~~

~~■*86*~~

~~■*71*~~

~~*Generally speaking, there is a distinct minimum amplitude in December in the northern and in June in the southern hemisphere. There are usually two approximately equal maxima in summer, with an intermediate badly defined minimum. At Kew the mode of variation of the amplitude throughout the year is fairly similar in all the elements, but this is exceptional. For instance, at Batavia and Mauritius the diurnal variation of the horizontal force is much less variable than that of the declination or vertical force.*~~

~~*§ 11. There seems little doubt that a small lunar diurnal in- equality really exists, though some of the data in S, §§ 95-99, Lunar ®^®™ contradictory. Figee has analysed the Batavia*~~

~~*diurnal all-day observations between April 1883 and March Inequality. 1^^^>-* “*^-^^^ found a lunar diurnal inequality in all the elements, showing two maxima and two minima. The mean values found for the amplitudes are: declination, 0’^17 ; inclination, 0’-06; horizontal force, 17×10-8 C.G.S. units; vertical force, 9 x 10-* C.G.S. According to Figee, the lunar influence on*~~

~~*disturbances is relatively large. (See Appendix, Observations . . . at the. Mag. and Met. Observatory at Batavia, vol. xvii. 1894.) Utilizing observations a,t Bombay and Trevandrum, G. Chambers {Phil. Trans, vol. clxxviii. A (1887), p. 1) Calculated lunar diurnal inequalities answering to different phases of the moon at different seasons of the year, and concluded ‘ ‘ that the bulk of the phenomenon dealt with is, properly speaking, ... a solar diurnal variation that depends on the relative positions of the sun and moon.” The cor- rect way of regarding such data is open to some doubt (see § 14).*~~

~~*§ 12. The secular changes in the magnetic elements seem to proceed at slightly different rates at different seasons of the year (see S, §§ 64-67). The term annual inequality is here applied to that part of the annual change in the /””..^ absolute values that remains unaccounted for by a ’”^^uallty. secular change taking place at a uniform rate throughout the year. Table VIII. gives some recent results. The letters a and q dis- tinguish results based on all and on quiet days.*~~

~~*Table VIII. — Annual Inequality.*~~

~~*Declination (-(-to West).*~~

~~*Horizontal Force (t above the mean) unit lxlO”6 C.G.S.*~~

~~*Kew,*~~

~~*1890-9-1.*~~

~~*St Trtprshurg*~~

~~*and Pavlnvsk,*~~

~~*1873-86.*~~

~~*ci. 3.*~~

~~*Titlis,*~~

~~*1879-87.*~~

~~*a.*~~

~~*Batavia,*~~

~~*188t-93.*~~

~~*a.*~~

~~*Mauritius,*~~

~~*1880-97.*~~

~~*a-*~~

~~*Kew,*~~

~~*1890-94. 9-*~~

~~*St Petersburg, Pawlowslt,*~~

~~*1873-85.*~~

~~*q.*~~

~~*Batavia,*~~

~~*1SS4-93.*~~

~~*a.*~~

~~*Mauritius,*~~

~~*1883-97.*~~

~~*9-*~~

~~*January*~~

~~*February*~~

~~*March*~~

~~*April*~~

~~*May .*~~

~~*June .*~~

~~*July .*~~

~~*August*~~

~~*September*~~

~~*October*~~

~~*November*~~

~~*December*~~

~~*-fO’^4 -(-•2 -•2 -•5 -■6 -•6 -•3 + ■1*~~

~~*+ ■2 + -i + ■&*~~

~~*-0’^2 O’-O -■2 -■! -■1 -0 + -1 ■o + -i +-2*~~

~~*+ -i ■o*~~

~~*+ ■1 +-1 + ■2 +■! + •2 +-1 -•2 •O*~~

~~*— -5 — -2*~~

~~*-■i — -2*~~

~~*-0 -1*~~

~~*-•2 -■1 + ■1 + ■1 + ■2 + ■2*~~

~~*+ ■2 -•1 -•3 -•2*~~

~~-1-0' ^2 + ■2 -•1 -•1 -•3 -•1 -•1 -■2 l^l ■0 -fl + •3~~

~~-l-O'^l~~

~~+ ■3 + -S~~

~~+ ■3~~

~~■fl~~

~~-•2~~

~~—4~~

~~–'4~~

~~-■1~~

~~•0~~

~~•0~~

~~-fl~~

~~-1 -1 -1~~

~~-i-2~~

~~-1-6~~

~~•i-6 -i-4~~

~~0 -4 -5 -4 -2~~

~~-1 -1 -2 -2~~

~~-fl -1-2~~

~~-1 -1~~

~~-f3 -1-1 + i +2~~

~~+ 5 +3 + 1 0 -2 -3 -4 -4 -2 -1 + 1 +1~~

~~+ 5 + 2~~

~~0 -4 -7 -1~~

~~0 -1-3 -2 -2~~

~~0 + 7~~

~~+ S~~

~~+ i~~

~~-4 -4 -5 -1-3 -3 _ 2~~

~~-2 0~~

~~-1-2~~

~~-f5~~

~~The data are from the following sources : Kpw {Brit. Assoc. Report, 1895) ; St Petersburg (Muller, R, vol. xii. No. 8, 1889 ; see also Leyst, R, vol. xvii. No. 1, 1894) ; Tiflis (Rykatchew, R, vol. xiv. No. 1, 1890 ; see also Mielberg, R, vol. xvii. No. 11, 1894) ; Batavia (Appendix to Observations made at the . . Observatory at Batavia, vol. xvi. for 1893); Mauritius {Mniiritiiis MiKiveticalHrkiic- tions, edited by T. F. Claxton, Mauritius, 1899). The data in Table VIII. have been smoothed, except in the oas(; of Batavia and Mauritius. As Batavia and Mauritius are south of the equator, we see that, when allowance is made for a uniform secular change, the horizontal force is above its mean value in summci- at all the stations. Sohwalbe has observed this phenomenon in the data for South Georgia. As regards the declination, it is doubtful whether the figures jnove more than that the secular change takes place at a nearly uniform rate throughout tlie year. All-Aa,y results for Pavlovsk, Tiflis and Moscow agree fairly in character, but differ somewhat~~

markedly from tlie results at Kew. Not unlikely a good deal may depend on the epoch chosen, and according to the Pavlovsk data there is a difference between all and quiet days. (See Walker's Terrestrial and Cosmical ilaiintstism, pp. 72-79 ; S, §§ 65 67 • and Schwalbe, Met. Zeit., December 1898, p. 449.) Muller gives also annual inequality results in vertical force and inclination at St Petersburg and Pavlovsk, but the vertical force data for different epochs differ widely.

§ 13. Of longer periods the sun-spot, or as it is often termed eleven-years' period, is much the most certain and most important (see S, §§ 46-50). Of late years various researches have thrown further light on ""ser the subject. W. Ellis (Proc. Roy. Soc. vol lxiii. "'■""'^• 1898, p. 64) has extended his earlier investigations so as

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to include Greenwich data from 1841 to 1896. After allowing for the variations in amplitude depending on the season of the year, he finds for the times of maximum and minimum amplitude of the diurnal inequality at Greenwich, as compared with the times of maximum and minimum sun-spot frequency (according to Wolf), the figures given in Table IX.

Table IX.

Magnetic Bpoohg,

Snn-spot Epoch.

1800+

Phase.

Declination.

Horizontal Force,

~~*Mean.*~~

~~*1800+*~~

~~*1800+*~~

~~*1800 +*~~

~~*Minimum*~~

~~*44-3*~~

~~*42-9*~~

~~*43-60*~~

~~*43-5*~~

~~*Maximum*~~

~~*48-1*~~

~~*49-0*~~

~~*48-55*~~

~~*48-1*~~

~~*Minimum*~~

~~*57-2*~~

~~*65-1*~~

~~*56-15*~~

~~*56-0*~~

~~*Maximum*~~

~~*60-6*~~

~~*60-2*~~

~~*60-40*~~

~~*60-1*~~

~~*Minimum*~~

~~*67-5*~~

~~*67-6*~~

~~*67-55*~~

~~*67-2*~~

~~*Maximum*~~

~~*70-8*~~

~~*70-9*~~

~~*70-85*~~

~~*70-6*~~

~~*Minimum*~~

~~*79-0*~~

~~*78-7*~~

~~*78-85*~~

~~*79-0*~~

~~*Maximum*~~

~~*84·0*~~

~~*83·8*~~

~~*83·90*~~

~~*84·0*~~

~~*Minimum*~~

~~*89·5*~~

~~*90·0*~~

~~*89·75*~~

~~*90·2*~~

~~*Maximum*~~

~~*93·5*~~

~~*94·0*~~

~~*93·75*~~

~~*94·0*~~

~~*In S, the conclusion was drawn from earlier work by Stewart, Ellis, and others that the magnetic maxima and minima lagged behind those of the sun-spots ; but, as EUis remarks, this is not confirmed by the more extensive data embodied in Table IX.*~~

~~*§ 14. Bigelow(U.S. Weather Bureau Bulletin, No. 11, Part II. 1895, p. 500, &c.) claims to have established the existence of a magnetic period of 26·68 days, and this period was even employed instead of the calendar month in the magnetic tables published by the U.S. Naval Observatory for 1894. Hayward (T, vol. iv. 1899, p. 7) has examined magnetic data from*~~

~~*several stations, with a view to determining whether they show a 428-days period (Chandler's*~~

~~*period), but with no definite result. Leyst (R, vol. xvii. No. 1, 1894), from an analysis of seventeen years' data at St Petersburg and Pavlovsk, has concluded that aU the principal planets sensibly influence the earth's magnetism. Except in the case of Mercuiy, Leyst confined his attention to the declination. According to his figures, all the planets except Mercury (whose influence is in the opposite direction to that of the others) when nearest the earth increase both the absolute value of the westerly declination (at St Petersburg) and also the amplitude of the solar diurnal inequality, the latter effect being the more conspicuous. Some relative numerical results wQI be found in Leyst's tables xxv. and xlviii. Schuster in several papers has considered the question of periodicities from a critical standpoint (T, vol. iii. p. 13 ; Nature, vol. liii. 1896, p. 318, &c.). He shows the diificulty of proving the existence of periodicities of small amplitude, unless observations extend over a very large number of periods. He also shows how spurious periodicities may arise. A spurious period of about 26-1 days, for instance, may very likely present itself when we deal with one or two complete years' observations of an element affected by an ordinary lunar period of 29-53 days. Schuster obtains formuliE which he applies to the data advanced by Broun, Homstein, Liznar and others in favour of a 26 days' period in magnetic phenomena (see S, § 86 ; also Wien. Ber. vol. xoi. 1885, p. 474, and vol. xciv. 1887, p. 834). The evidence is, he thinks, in no single case conclusive, but there is a consensus of favourable evidence from so many different sources as to create a presumption that something more than pure chance is concerned. The evidence advanced by Leyst in favour of sensible planetary influence appears to Schuster insufficieut.*~~

~~*§ 15. Various tables of data may be found in S, §§ 30-35. One gives the mean declination in 1882 at Kew Observa- tory as 18° 44'-8 W. In 1900 it was 16° 52'-7 W. Table X. gives mean annual changes during two periods at Kew, Pare St Maur (Paris), and Pavlovsk (St Petersburg), the latter based on papers by Moureaux {Mem. du Bureau Central Met. for 1897, p. Bgj) and Wild {Mem. de I'Acad. de St Petersbourg, vol. ix. No. 7, 1900).*~~

~~*Secular changes.*~~

~~*Table X. — Mean Annual Changes of Magnetic Elements.*~~

~~*Declination.*~~

~~*IncUnation.*~~

~~*(Hor. Force)xl05 C.6.8. ! (Vert. Force)xl05 C.G.S.*~~

~~*1883-90.*~~

~~*1890-97.*~~

~~*1883-90.*~~

~~*1890-97.*~~

~~*1883-90.*~~

~~*1890-97.*~~

~~*1883-97.*~~

~~*Kew .... Pare St Maur Pavlovsk*~~

~~*-7’-l*~~

~~*-6’-0*~~

~~*-4’-l*~~

~~*-6’-3 -5' -7*~~

~~*-5’-5*~~

~~*-I’-l*~~

~~*-l’-2*~~

~~O’-O~~

~~-2’-0~~

~~-1’-6~~

~~-0’-6~~

~~+ 21 + 18 + 6~~

~~+ 24~~

~~+ 25 + 14~~

~~– 1~~

~~+ 1 + 16~~

~~The — sign represents diminution in westerly declination. In western Europe generally the changes are very similar to those at Kew and Pare St Maur. The agonic lines (or loci where the declination is zero) both in Europe and North America are moving westwards ; the European line passed through St Petersburg about 1892. For fuller particulars see van Bemmelen {k. Ahad. van Weten. te Arnsterdam, 30th November 1895, and Supplement to Batavia Observations, vol. xxi.) and Schott (T, vol. ii. p. 123). The rate of movement of the needle to the east appears to be diminishing in western Europe, though greater there than in southern or eastern Europe. In some Asiatic stations {e.g., Irkutsk, Bombay, HIong Kong, Batavia) in 1900 the needle was moving to the west. The inclination has been diminishing for some time in western Europe at an apparently increasing rate ; in St Petersburg, however, it increased up to about 1886. The horizontal force is increasing all over Europe, but at most European stations the vertical force appears nearly stationary. A table of annual values of the magnetic elements at most magnetic observatories has appeared in the Proc. Roy. Sac. as Appendix I A. to the aimual Reports of the Kew Observatory Committee since 1895.~~

§ 1 6. The secular changes in the declination D and inclination I at a number of American stations have been represented with consider- able accuracy by Schott (TJ. S. Ooast and Geodetic Survey Beport for 1895, App. I. &c.)byformulseof thetypeDor I=n!|, + aiSiu(?ra<+m); where t is the time since a given epoch, while a,,, Oj, m and n are constants for the particular place. When observations extend over

only a short term of years it is better to use formulae of the type D or i = a + bt+a". Littlehales (T, voL i. pp. 62 and 89, vol. ii. p. 68) has calculated secular change formulae for a variety of stations scattered over the globe. Thus for the Cape of Good Hope he finds :

Declination= 14°-63 + 15°-00sin {0-61(<- 1850)+ 77°-8}, (North)
Inclination = -49° -11+ 8°-75sin{0-8 (f-1850) + 214°-3}, where t is the date in years.

Bauer has introduced a convenient method of showing secular change graphically. From the centre of a sphere he draws radii

parallel to the direction of the freely dipping needle and produces them to intersect the tangent plane drawn at the point which answers to the mean position of the needle during the epoch under consideration. The curve formed by these points of intersection

disturb ances.

shows the particulars of the secular change. Fig. 5 is the curve for London (slightly modified from Nature, vol. Ivii. p. 181). As shown by the arrow, it is being described clockwise. In his original work Bauer found no actual exception to this mode of description, though he observed indications suggestive of exceptions on the Pacific coast. Schott and Littlehales have found a considerable number of cases where the direction of description is open to doubt, while in some stations on both the east and west shores of the Pacific it seems clearly an ti – clockwise.

~~*Fritsche dealing with the secular changes from 1600 to 1885 — as given by his calculated \Su\wiS of the magnetic elements — at 204 points of intersection of equidistant lines of latitude and longitude, found only sixty-three cases in which the motion was unmistakably clockwise, as against twenty- one cases in which it was clearly the reverse {Die Elemente des Erd- magnetismus, pp. 104-8).*~~

~~*§ 17. As already mentioned in § 4, disturbances show periodic variations, but the laws followed depend somewhat on the point of view adopted. We may accept Laws of Sabine's or some similar definition of a disturb- ance, distinguish between positive and negative disturbances, and trace the laws observed by the number or by the mean magnitude of either species ; or we may simply take the differences between all- and quiet-day mean values, without going into further details. The con- clusions at which Sabine arrived are described in S, §§ 54, &c. The most important of these conclusions, e.g., the existence of times of maximum disturbances at the equinoxes, and the approximate coincidence of years of maximum disturbance with those of sun-spot maxima, are in accord with recent analyses of results from St Peters- burg, Pare St Maur, Potsdam, and Greenwich, made respectively by MuUer (K, vol. x. No. 3), Moureaux (T, vol. iv. p. 149), Liideling (T, vol. i. p. 147), and EUis (^Monthly Notices of the Royal Astronomical Society, December, 1899, p. 142), in whose papers many further interesting details will be found. If the results of investi- gations such as Sabine's depend slightly on the definition of a distv/rbance, those of the second point of view described above depend in their turn on the definition of a quiet day, for Sabine's and Wild's quiet days were found by Whipple to show small but decided differences in their mean diurnal inequalities (Brit. Assoc. Report for 1886, p. 71). The second point of view is, however, probably the simpler, and it lends itself readily to graphical treatment ; thus we can exhibit diurnal inequalities of disturbances in the form of curves of the types 1 or 2. Fig. 6, which is a*~~

~~*Mid-*~~

~~*-niqht*~~

~~*Wester/yOecJins tion*~~

~~*Hor' Force Fig. 6.*~~

~~*Vent I For-ce*~~

~~*slight modification of curves given by Ellis (Brit. Assoc. Report for 1898, p. 8.3), shows the algebraical excess of the mean all-day over the mean quiet-day hourly values of the magnetic elements at Greenwich for the epoch 1890-94, thus representing the diurnal inequalities of the dixturl)-ances from the second point of view. It will be i|)ticcd that the disturbance inequalities in the declination and vertical force are well marked, while that in the horizontal force is insignificant. This latter fact is not incoiiKistcnt with the result observed by, for instance, Moureaux at Pare St Maur, that positive and negative horizontal force*~~

~~*disturbances, when treated separately after Sabine's method, show well-marked diurnal inequalities.*~~

~~*§ 18. That large magnetic disturbances occur simul- taneously, or nearly so, over large European areas, was known in the time of Gauss, on whose initiative glmul- observations were taken at 5-minutes' intervals at tanelty of a number of stations on certain pre-arranged term dlsturb- days. During March 1879 and August 1880 ^""*- there were some large disturbances, and W. G. Adams took the opportunity of comparing the magnetic curves from a number of observatories fitted with Kew pattern instru- ments (B. A. Reports for 1880, p. 201 ; and for 1881, p. 463). IIe found that the more characteristic movements in the case of any element took place, so far as could be judged, simultaneously at all the stations. At com- paratively near stations, such as Stonyhurst and Kew, or Coimbra and Lisbon, the curves were in general almost duplicates. At Kew and St Petersburg there was usually considerable difi'erence in detail, and occasionally the movements were in opposite directions. The differences between Toronto, Melbourne, or Zi-ka-wei and the Euro- pean stations were still more pronounced. In 1896, on the initiative of Eschenhagen, eye observations of declina- tion and horizontal force were made at Washington, Batavia, Manila, Melbourne, and nine European stations, at 5-seconds' intervals during pre-arranged hours. The data from one of these occasions, 28th February, were published by Eschenhagen (Anhang Ergebnisse der Mag. Beob. in Potsdam, 1896). The results were similar to*~~

those met with by Adams, but the diflferences in the construction and sensitiveness of the instruments proved a source of trouble. That simultaneity of occurrence is not peculiar to large disturbances was observed by Adams, and any number of examples are afforded by the magnetograms from stations such as Kew and Falmouth, a few hundred miles apart. Probably the most conclusive evidence of practical simul- taneity yet afforded is that obtained from observations with bifilar magnetometers of very short period at Potsdam and Wilhelmshaven (see Eschenhagen, T, vol. i. p. 55), taken between 6 and 7 P.M. on six successive days in March 1895. There was no conspicuous disturbance, but a number of small movements, as many as 112 turning- points being observed in the course of an hour. It was found that practically every movement was common to the two stations, and the simultaneity of occurrence was established to within a second or two. A similar inter- comparison of Potsdam, Wilhelmshaven, and Charlotten- burg in June 1895 led to similar results.

§ 19. The records from ordinary Kew pattern magnetographs not infrequently show a repetition of regular or nearly regular small rhythmio movements, lasting sometimes for hours ^ .

(of. van Bemmelen, Kon. Akad. van JFetcnsch., Amstcr- '^^^° rfam, 22nd November 1899). The space from crest to crest """ " usually answers to an interval of from 2 to 5 minutes. "*" In 1882 Kohlrausoh detected with a very sensitive instrument wave-like variations of magnetic force at intervals of about 12 seconds (irifd. Aim. vol. Ix. p. 336). Eschenhagen has observed small wave-like variations of horizontal force with a period of about 30 seconds {Sitz. der l\ Pretiss. Akad. der ll'iss., '24th June 1897, &c.). According to Eschenhagen, these elementary waves usually occur at night, and their passage may last several hours. In rejily to criticisms by Cleveland Abbe, who ascribes the phenomenon to the apparatus, Eschenhagen says that he has obtained])ractioally identical results when employing magnets of dillorent periods of oscillation.

§ 20. Since 1880 there have been detailed investi- gations into the values of the magnetic elements in several countries. Of these we may mention

~~*the surveys of Great Britain and Ireland by fj^”^”” Riicker and Thorpe (P/u’L Trans, vol. clxxxi., ”””^^^ A, 1890, p. 53; and vol. clxxxviii.. A, 1896), of France and Algeria by Moureaux (Ann. du Bureau Central Met.*~~

~~*de France, vol. i., for years 1884, and 1887 to 1895), of Kussia by Smirnow, von Tillo, and others (E, vol. viii. No. 2, 1881 ; and vol. ix., Nos. 4 and 5, 1885), of Japan by Knott and Tanakadate (Journal Coll. of Science Im,p. University, Japan, vol. ii. p. 163), of Italy by Chistoni and Palazzo (Ann. dell’ Uff. Centrale Met. e Geod. vol. xiv. part 1, 1892, p. 57), of Switzerland by Batelli (Ann. dell’ Uff. Centr. Met. vol. xiv. part 1, p. 83), of the Nether- lands by van Kyckevorsel (A Magnetic Survey of the Netherlands for the Epoch lit January 1891, Kotterdam, 1895), of South Sweden by Gyllenskold (kg. Svenska Vet- Akad. Handlingar, vol. xxvii. No. 7, 1895 ; and T, vol. i. p. 200), of Austria by Liznar (Denkschriften der Math.- Naturivias. Classe der k. Alcad. der Wiss. Wien, vol. IxiL, 1895; and vol. Ixvii. 1899), and of Maryland, U.S., by Bauer (Maryland Geological Survey Special Publication, vol. i. part 5). The successful accomplishment of a mag- netic survey requires that observations in the field be supplemented by records from fixed observatories, the latter being employed to determine the corrections neces- sary to reduce the field observations to a common epoch. Irregular magnetic changes are usually simultaneous and of similar amplitude over considerable areas, while secular changes and diurnal inequalities (allowing for differences of local time) are also very similar. Thus a comparatively small number of well distributed magnetic observatories should suffice to supply the data of this character required for a survey. Unfortunately, however, the distribution of magnetic observatories is seldom ideal (see von Bezold and Kykatcheff, Brit. Assoc. Report, 1898, p. 743 ; and Schmidt, T, vol. ii., p. 27). Thus in the United Kingdom, Greenwich, Kew, and Falmouth differ little in latitude, whilst during Eiicker and Thorpe’s surveys there was no magnetograph in Scotland or Ireland. Apart from ob servatories, secular changes can be found only by repeating observations at a series of*~~

~~*stations after a considerable interval of time. As the instruments employed in a survey are exposed to the vicissitudes of travel, it is desirable to compare them occasionally with standard instruments at a fixed observatory ; such comparisons also provide the means of eliminating the peculiarities of different instru- ments. (For results of recent inter-comparisons by van Eyckevorsel, Moureaux; and others, see T, vol. ii. p. 133 ; vol. iii. ; pp. 186, 187 ; and Brit. Assoc. Report, 1896, p. 87.)*~~

~~*§ 21. The survey most likely to mterest readers of this article is that of Eiicker and Thorpe. After reducing their data to a common epoch, they proceeded as follows : — Dividing the United Kingdom into districts, from all the observations in a particular district they calculated a mean value for each element, answering to an imaginary central station, and also mean values for the changes in each element per degree of latitude or longitude through- out the district. From these data they calculated values of the elements for points defined by whole degrees of longitude and half degrees of latitude. Thence they found where isogonals, isoclinals, &c, cut the lines of latitude. The curves obtained by joining these successive points of intersection on a map are called district lines or curves. Eiicker and Thorpe's next step was to obtain formulae giving smooth curves of continuous curvature, approximating as closely as possible to the district lines. These smooth curves are called terrestrial isomagnetics ; they may be supposed to show what the magnetic ele-ments would be in the absence of disturbances peculiar to special parts of the survey area or its immediately coter- minous regions. The component magnetic forces answer- ing to the isomagnetics may be regarded as representing the normal field, and when we subtract them from the components actually observed, we obtain forces answering*~~

~~*to a residual field, which may be ascribed to regional disturbances. When the vertical disturbing force is down- wards, i.e., the observed vertical component larger than that answering to the isomagnetics, Eiicker and Thorpe regard it as positive, and the lines which are the loci where the largest positive values occur are termed by them ridge lines. Almost without exception, the resultant of the horizontal components of the disturbing forces pointed towards these ridge lines throughout a consider-able area on both sides. The phenomena are similar to what would occur*~~

if ridge lines indicated the position of the summits of underground masses of magnetic material, magnetized so as to attract the N. seeking pole of a magnet. Eiicker and Thorpe are inclined to believe in the real existence of these subterranean mountains, even when there is no directly confirmatory geological evidence. They point out that if subterranean magnetic rocks are the cause of the phenomena, they must be of considerable extent, for theory and experiment alike indi cate that thin basaltic sheets or dykes, or limited masses of trap rock, produce no measurable effect except in their immediate vicinity. In support of their conclusion, Eiicker and Thorpe dwell on the fact that in the United Kingdom large masses of basalt, such as occur in Skye, Mull, Antrim, North Wales, or the Scottish coal-field, are invariably centres of attraction for the N.seeking pole of a magnet, while they did not find a single clear case where a large mass of igneous rock acted as a centre of repulsion. One of the smaller anomalies observed by Eiicker and Thorpe in the Thames valley, near London, is supposed by Moureaux (Ann. du Bureau Central Meteoro logique de France, 1890, tome i. p. Bgj) to be probably associated with interesting anomalies which he has detected in the Paris basin.

§ 22. In some instances regional magnetic disturbances are associated with geodetic anomalies. This is the case in an elongated area including Moscow, surveyed mag- netically by Fritsche (Bull. Soc. Imp. des Naturalistes de Moskau, No. 4, 1893, p, 381 ; also T, vol. i. p. 50). Again, Eschenhagen has detected magnetic anomalies in an area including the Harz mountains, where deflections of the plumb line from the normal had been observed (Forsch. zur deutschen Landes. . . . Elfter Bd., Heft 1, 1898 ; also T, vol. iii. p. 77). Eschenhagen found a magnetic ridge line running approximately parallel to the line of no deflection of the plumb line. In these cases the disturbed areas are considerable, but the disturbances are comparatively small. On the other hand, enormous disturbances have been observed over certain limited areas. One of the most remarkable of these is an area, about 3 miles long hy \ miles at its widest, near Port Walcott, off the north-west Australian coast. The results of a survey made here by H.M.S. Penguin have been dis- cussed by Captain Creak (PAi^.^rajis. vol. clxxxvii. A, 1896, p. 345). Within the narrow area specifled the declination varied from 26° W. to 56° E , and the inclination

~~from 50° to nearly 80°, the observations being taken some 80 feet above sea bottom. Similar extraordinary anomalies in the province of Kursk, Eussia, have been examined and discussed by Moureaux (Ann. du Bureau Central Met. de France for 1897, p. B35).~~

~~§ 23. If we assume that the magnetic forces on the earth's surface are derivable from a potential V, we can express V in terms of two series of solid spherical harmonics, one containing negative, the other positive, integral powers of r, the """*'*" radius vector from the earth's centre. . Let X denote ""","t- east longitude from Greenwich, and let fL= cos (7r/2 — 1), where I is latitude. Also let~~

~~h:=(i-m==)?[/^"-~~

~~(n-rnXn—m-l) '^- 2(271-1) ^~~

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~~■where n and m denote any positive integers, m being not greater than n. Then denoting by R the earth's mean radins, -we have~~

~~V/E = S(R/r)"+l[H:G: cos mX + A^ sinmX)] + 2(r/E)"[H"(^_™ cos m\ + h-n sin mX)] ; ■where 2 denotes snmmation of m from o to » inclusive, and then summation of » from o to oo . In this equation gn>n> 9 n> -n are constants, the former pair representing ■what are generally termed Gaussian constants.~~

~~The series ■with negative po^wers of r ans^wera to forces whose origin is vfithin the earth's surface, that viith positive powers to forces with an external origin. Gauss found that forces of this latter class if existent were very small, and usually they have been left out of~~

~~account.~~

~~oil There are three Gaussian constants of the first order g^, g^^, h^,~~

~~five of the second order, seven of the third, and so on. The co- efficient of a Gaussian constant of the nth order is a spherical har- monic of the 7!,th degree. It is perhaps most usual to take K as the unit length, in Avhich case the first order terms may be written~~

~~Y =r'^{g" sin I +(g cos X (/t' sin X) cos l.~~

~~In reality the earth is not a perfect sphere, and in the elaborate work on this subject by J. C. Adams it is treated as a spheroid. It is usual, however, to treat the earth as a sphere, and for sim- plicity we shall here treat it as such. We then have for components of force~~

~~X= r\l-ii?)i{dY/dfi) towards the north.~~

~~\l~lj?-) IIYIdk~~

~~west.~~

~~Y= —~~

~~Z= — dY/dr vertically do^wnwards.~~

~~Over the surface r=E, and the expressions for the components of force are functions only of X and ^a. Supposing all the Gaussian constants for any given epoch known, the above expressions would supply the values of X, Y, and Z all over the earth's surface. 'To determine the Gaussian constants for any given epoch we proceed in the reverse direction, i.e., we equate observed values of X, Y, and Z~~

~~to the theoretical values involving g,^ , &c.~~

~~If we knew the value of the component forces at regularly distri- buted stations all over the earth's surface, we could determine each Gaussian constant independently of the others. Different ways of doing this have been indicated by J. C. Adams and Schuster. Our knowledge, however, of either Arctic or Antarctic regions is scanty, and in jiractice recourse must be had to methods in which the constants are not determined independently. The consequence, unfortunately, is that the values found~~

~~*for some of the less important constants, even of the lower orders, may depend very sensibly on how large a portion of the polar regions is excluded from the calcula- tion, and on the number of constants of the higher orders which are retained. This is shown very clearly by W. G. Adams [Brit. Assoc. Report for 1898, p. 109) in discussing the results found by J. C. Adams for the two epochs 1845 and 1880, notably in the case of the*~~

~~*θ*~~

~~*constant g*~~

~~*W. G. Adams devotes several tables to the values of the Gaussian constants as foimd by Erman- Petersen for 1829, by Gauss for 1830, by J. C. Adams for 1845 and 1880, and by Neumayer, Schmidt, and Fritsche for 1885. The most recent of these data for the con- stants of the first order are as follows : —*~~

~~*Table XI. — Gaussian Constants of the First Order.*~~

~~*Constant*~~

~~*Adams.*~~

~~*1880.*~~

~~*NeuTnayer.*~~

~~*1885.*~~

~~*Schmidt.*~~

~~*1885.*~~

~~*Pritsche.*~~

~~*1886.*~~

~~*g. . ■ g. . .*~~

~~*+ -316843 1 -024273 — -060300*~~

~~*I -316720*~~

~~*+ -024814 — -060258*~~

~~*+ -317346 + -023556 — -059842*~~

~~*+ •31635 + •02414*~~

~~*— -05914*~~

~~*The agreement is closer than might have been expected, consider- ing that the number of constants retained was different in each case, ISTeumayer, for instance, neglecting all but tlio first twenty-four, as against fifty retained by AilaiiiH. Even in the ciiko of the higher constants there are few instances of differences in si^n. Still the last two of these figures at least had better be regarded as ornamental. It should he noticed that writers differ in the sign they give to V, and that, owing to a difference in his definition of a surface harmonic, Schmidt's values for the Gaussian constants, as given elsewhere by himself, require multiplication by factors as explained by W. (.;. Adams {loo. cit. pp. 134-136).*~~

~~*§ 24. The neglect of the second series in our original expression for V is, as already stated, one source of uncertainty, and a scroud is the possibility that some part of the magnetic forces may not arise*~~

~~*from a potential. J. C. Adams made some calculations according to which g^ /g is very small, Wtg^,^ came out somewhat large. Schmidt's calculations led him to conclude that about one-fortieth of the force on the average arose from a potential answering to external forces, and that an even larger part had no potential. This would imply that the line integral of the magnetic force round closed areas on the earth's surface does not in general vanish. The physical concomitant would be vertical earth-air electric currents. Schmidt's final estimate of the average intensity of these currents at the epoch 1885 appears to be 0-17 ampere per square kilometre (Abhand. der layer. Akad. der Wiss. Bd. xix. 1895). An earlier paper put it at O'l {Brit. Assoc. Repm-t for 1894, p. 570). Bauer (T, vol. ii. p. 11), employing the same experimental data as Schmidt, reached a sinjilar conclusion from the differences between integrals, taken round parallels of latitude at intervals of 5° from 60° N. to 60° S. Bauer found a very asymmetrical distribution, the current being downwards between 5° and 45° N. and between 15° and 40° S., while elsewhere it was upwards. Von Bezold also took line integrals round parallels of latitude, and comparing their values with the potential ranges as given by Schmidt's figures, obtained evidence favourable to the existence of vertical currents {Sitz. Tc. Akad. der Wiss., Berlin, 1897, No. xviii. ; also T, vol. iii. p. 191). Fritsche has treated the problem similarly, but has con- sidered a larger number of parallels, and at two sej)arate epochs, viz., 1842 and 1885 {Die Elemente des Erdmagnetismus, p. 103). The values of the integrals round the same parallel at the two epochs seldom agreed closely, and sometimes differed in sign. As a large alteration in the phenomena in the course of forty-three years seems improbable, the most natural conclusion is that the values of line integrals round parallels of latitude are too uncertain to afford a satisfactory criterion as to the real existence of earth-air currents. Similar negative results seem to flow from the calculation of line integrals round the best surveyed areas in Europe (see von Bezold, I.e. ; Riicker, T, vol. i. p. 77, and Nature, vol. Wi. pp. 160 and 180 ; Liznar, Met. Zeit. for 1898, p. 175 ; and von Gyllenskold, k. Svenska Vet. Akad. Sandlingar, vol. xxvii. Wo. 7, 1895). There are somewhat serious physical difficulties in the way of cur- rents of the size calculated by Schmidt (see Atmospheeio Elec- tricity, Ency. Brit. vol. xxv. § 13).*~~

~~§ 25. The forces arising from terms in the Gaussian potential which depend on constants of the w* order vai-y as r~”-^, where r is the distance from the earth’s centre. If F represent ^^^ jji/j„ei,ce value at sea-level of any component of force answering ^^ altitude to Gaussian constants of the .m* order, the value F + 5F at height A is given by (F + 5F)/F= {R/{R + h)}”’, where R is the earth’s radius. Thus so long as 7i/R is small we have very approxi mately 5F/F = -{n + 2)hfR. As we have seen, the tei-ms depend- ing on Gaussian constants of the first order (i.e., »=1) are much the most important ; thus on the Gaussian theory we should have approximately~~

~~5X/X = 5Y/Y = 5Z/Z=-3A/R.~~

~~Thus all the components should decrease as we go upwards at the same rate, the declination and inclination remaining unaffected. Liznar has compared this equation with the results of his Austrian survey {Sitz. der k. JCais. Akad. der Wiss. Wien., Math. Nat. Classe, Bd. cvii. Abth. ii., 1898). Subdividing his stations into three groups according to altitude, he concluded that the westerly component and the declination increased with the altitude, and that while the northerly and vertical components decreased, they did so at thrice the rate indicated by theory. Tliese conspicuous departures from theory have been ascribed to electrical currents in the atmosphere, some of which would have to be horizontal. Geitel has pointed out serious difficulties in the way of this ex])lanation (T, vol. iv. p. 63). Tan Ryckevorsel and van Bem melen found the horizontal force on the Rigi to decrease slightly with the altitude, while the vertical force increased in somewhat larger measure ; but the differences were so small that they were indisposed to regard their conclusions as final (T, vol. ii., 1897, p. 76). It should be noticed that Liznar’s theoretical foi-mula, like tlie Gaussian analysis — so long as only lower order terms are re- tained— applies only to the earth’s field as freed from all local or even regional disturbances ; and that presumably a good deal of the material above sea-level in Austria is by no means non-magnetic. According to Liznar’s -views, diurnal variation phenomena should vary sensibly ^^■ith the height : if this be the case, his advocacy of the institution of some high-level magnetic observatories is worthy of support.~~

~~§ 26. Schuster has attempted to obtain a potential analogous to the Gaussian potential from which the regular diurnal changes of thi: magnetic elements all over the earth may be found by differ- entiation (PW. 'Trans., A, vol. clxxx. 1889, p. 467). From the mean summer and winter diurnal variations of the northerly and easterly components of force during 1870 at Greenwich, Lisbon, St Peters- burg, and Bombay, he calculated the values of eight constants analogous to Gaussian constants, and from considerations as to the times of occurrence of the diurnal maxima and minima of vertical~~

~~Normal field.~~

~~force he concluded that his potential must, unlike the Gaussian, proceed in positive powers of r. This would ascribe the diurnal variations to a source external to the earth. Schuster found, how- ever, that the amplitude of the diurnal vertical force inequality calculated from his potential did not accord with observation. His iinal conclusion was that the principal cause of the diurnal variations is probably electric currents in the atmosphere, but that there are also induced currents inside the earth which increase the horizontal components and diminish the vertical component. Von Bezold has based on Schuster's results a series of vector diagrams showing the mean diurnal variation for the summer of 1870, in a variety of latitudes (Sitz. dor k. Preuss. Akad., 1897, No. xviii. See also Met. Zeit., February 1898). A repetition of Schuster's calculations for a more recent epoch, making use of the best avail- able data, and a critical comparison with the phenomena at a, variety of stations, seems desirable.~~

~~§ 27. Employing V as before for the Gaussian potential, von Bezold puts V=V„-^To, where V„ is the mean value of V for the parallel of latitude, while V„ is the anomaly [Sitz. der k. Preuss. Akad., No. xviii., 1895, p. 363). He found that approximately T„ = V^ where V|.=Kx sin latitude, with K a constant. Von Bezold calls V„ the evi- pirical normal, and V,/ the theoretical normal potential. He regards V, as answering to disturbances, and constructs is- anomaly curves (along which V^ is constant), from~~

~~*which he draws conclusions as to the character of the disturbing forces. The fact that Vn and Vv are nearly equal simply means, as pointed out*~~

~~*by Schmidt, that ^° is much the largest Gaussian constant of*~~

~~*the type y". Von Bezold mentions this in a second paper, where he compares observed magnetic forces with those calculated from V^, accepting the Neumayer-Petersen value '31572 for g (Sitz. der k. Preuss. Akad., No. 50, 1895, p. 1119). Bauer seems originally to have taken the same definition of normal field as von Bezold, re- cognizing, however, what seems to have escaped von Bezold, that Vi/ simply answers to a uniform magnetization parallel to the earth's axis [Amer. Jour, of Sc. vol. 1. pp. 109, 189, 314). In a second paper Bauer takes for the earth's normal field that depending on the Gaussian constants of the first order (T, vol. i. p. 169). This field also answers to a uniform magnetization, but it is parallel to a diameter whose direction cosines relative to the earth's rotation axis and to two perpendicular axes, one in, the other perpendicular*~~

~~*to the Greenwich meridian, are proportional to g , g , and h . Accepting the Neumayer- Petersen figures, Bauer calculates the component forces answering to his normal distribution, and attri- butes the difference between them and the observed values, as tabulated by Schmidt, to a residual or disturbing magnetization whose nature he illustrates diagrammatically. In a third paper he*~~

~~*follows a similar course, but takes Schmidt's values for gf^, g^, h^, and compares the corresponding theoretical values of the component forces with the observed values at 1800 points, instead of at 84 as previously (T, vol. iv., 1899, p. 33). Bauer concludes that if his residual field arises from electric currents, these must be inside the earth. He is inclined apparently to associate the residual field intimately with the irregularities in temperature distribution on the earth's surface, owing to a resemblance between his curves and the lines of isabnormal temperature in Harm's Atlas der*~~

~~*Eiicker (T, vol. iv. p. 113) falls in with the view that the "magnetic field of the earth may be regarded as that primarily due to a uniformly*~~

~~*magnetized globe disturbed by some secondary causes." In reference, however, to Bauer's suggestion, he points out that Hanu's isabnormals of temperature relate to a purely surface phenomenon, whereas over the greater part of the earth it is the temperature at the bottom of the ocean that would naturally influence magnetic phenomena. Though differing so far from Bauer, Riicker is himself disposed to regard temperature as a not improbable cause of the secondary field. He had been struck by the fact that Wilde had succeeded in reproducing some of the most conspicuous features of the earth's magnetization by a contrivance called a magnetarium, consisting essentiaDy of a globe representing the earth's surface inside which is a concentric globe, round which wire is coiled in planes inclined at 23° to the equator. Between the two globes is a spherical shell of wire gauze, round which another wire is coiled in planes perpendicular to the geographical axis. Currents are sent through the two circuits. By making the axis of the inner globe describe a cone of constant angle about that of the outer, Wilde claims to imitate the secular change met with on the earth. If the two currents in the magnetarium be regarded as answering to the normal field, the chief substitute for the secondary field would seem to be a coating of thin sheet iron put by Wilde over those parts of the interior surface of the outer globe which correspond to oceans. Pursuing this idea, Eiicker points out that in tropical oceans the low temperature at the bottom must increase*~~

~~*the local thickness of the stratum whose temperature is low enough to permit of magnetic material remaining magnetic. Riicker's calculations, however, as applied to Bauer's figures for the secondary field, seem to show that this explanation will not suffice unless the permeability of sub-oceanic strata largely ex- ceeds that of ordinary ba3altic rocks or even magnetite.*~~

~~*§ 28. The magnetic poles where the horizontal component vanishes do not, it is believed, lie on one diameter, and the same is true of the two points where the total force is a maximum ; thus the term magnetic axis could not correctly jifg/raetlc be applied to a diameter passing through any one ^^.^^^ of these points. The term has, however, been applied to that diameter which is parallel to the field which depends on the Gaussian constants of the first order {i.e., Bauer's normal field). The position of*~~

~~*this diameter varies with the values of the Gaussian constants as shown in Table XII.*~~

~~*Table XII. — Oo-ordinates of*~~

~~*North End of Magnetic Axis.*~~

~~*Epoch.*~~

~~*Authority.*~~

~~*North Latitude.*~~

~~*Longitude West of Greenwich.*~~

~~*1650*~~

~~*Fritsohe .*~~

~~*82° 50'*~~

~~*42° 55'*~~

~~*1836*~~

~~*1)*~~

~~*78 27*~~

~~*63 35*~~

~~*1845*~~

~~*Adams (for Gaus-*~~

~~*sian constants) .*~~

~~*78 44*~~

~~*64 20*~~

~~*1880*~~

~~*78 24*~~

~~*68 4*~~

~~*1885*~~

~~*Neumayer — Petersen and Bauer .*~~

~~*78 3*~~

~~*67 3*~~

~~*1885*~~

~~*Neumayer-Schmidt*~~

~~*78 34*~~

~~*68 31*~~

~~*According to the table, the magnetic axis has been moving from east to west, inclined at a nearly constant angle to the earth's geographical axis. Other axes possessing more complicated pro- perties in relation to the earth's magnetism, for which distinctive terms seem desirable, have had their positions determined by Schmidt (T, vol. i., 1896, p. 18).*~~

~~*§ 29. If a sphere be uniformly magnetized, the potential at a distance r from its centre, in a direction inclined at an angle 5 to the magnetic axis, is M cosSr""^, where M is the mag- M^iraetic notic moment. Comparing this with the expression moment. in § 23 for the earth's potential V, we see that the earth's magnetic moment answering to the Gaussian constants of the first order is given by M = R' | {g^ + (J) + (aJ)^]- ', where R*~~

~~*is the earth's radius. M is known as the earth' s magnetic moTnent. The following are some of the numerical results found for M/R' :—*~~

~~*Table Xlll.— Value ofU/W in G.G.S. Units.*~~

~~*MonientT-(Barth'a BadiuB)3.*~~

~~*Epoch.*~~

~~*Authority.*~~

~~*1650*~~

~~*Fritsche*~~

~~*•3260*~~

~~*1830*~~

~~*Gauss (for constants)*~~

~~*•3309*~~

~~*1836*~~

~~*Fritsche*~~

~~*•3262*~~

~~*1845*~~

~~*Adams (for constants)*~~

~~*•3282*~~

~~*1880*~~

~~„ „ • • ,~~

~~*•3234*~~

~~*1885*~~

~~*Neumayer-Petersen and Bauer*~~

~~•3224~~

~~1885~~

~~Schmidt~~

~~•3230~~

~~The table suggests a slight diminution in the moment since 1845, but the degree of accuracy attributable to the figures, especially the earlier ones, is extremely doubtful.~~

~~§ 30. Folgheraiter has found that old vases from Etruscan and other sources are magnetic, and from combined observation and experiment he believes that the magnetization they possess was acquired during the cooling which followed their baking, and has remained unaltered since that epoch {R. Accad. Lincei Atti viii. 1899, pp. 69, 121, 176, 269 ; also previous volumes ; see also Siances de la Soc. Franf. de Physique, 1899, p. 118). Experiment has supplied him with formulae connecting the magnetization shown by clay vases with their orientation when cooling in known magnetic fields, and the application of these formulae to the magnetic phenomena presented by old vases leads him to assign definite values to the magnetic inclination at the time and place of their manufacture. According to Folgheraiter, the in- clination in central Italy was southerly for at least two centuries prior to 600 B.C., when it changed sign. In 400 B.C. it was about 20° N. Since 100 B.C. the change has been relatively small. If Folgheraiter's conclusions should be confirmed from other sources, we may expect similar reasoning to apply to rocks of volcanic origin which have cooled rapidly. This would certainly open a wide field for inquiry.~~

~~Authorities. — Edward Walker. Terrestrial and Cosmical Magnetism : the Adams Prize Essay for 186S. Cambridge and London, 1866. — Humphry Lloyd. A Treatise on Magnetism, General and Terrestrial. London, 1874. — E. Masoart. Traiti deMagnitisme Terrestre. Paris, 1900. — Report of the International~~

~~*MAGNET 0-0 P T I C S*~~

~~*Meteorological Congress at Chicago (Bull. No. 11, Part II. U.S. Department of Agriculture. Washington, 1895). — Repertorium filr Meteorologie. St Petersburg, vols, i.xvii. — Terrestrial Magnetism : an International Quarterly Journal. Editor, L. A. Bauer (vol. i. 1896, and subsequent volumes). — Meteorologische Zeitschrift. Vienna. — British Association's Committee for the Comparison and Reduction of Magnetic Observations. Annual Reports. — Annates de I' Obserratoire Physique Central (I. Partie). St Petersburg. — Annates du Bureau Central Mitiorologique de France (T. 1, Memoires). Paris. — U.S. Coast and Geodetic Sur vey's Reports. Washington. — Also publications of individual magnetic observatories, more especially of Kew, Greenwich, Copenhagen, Utrecht, Potsdam, Vienna, Pola, Lisbon, Coimbra, Nice, Tiflis, Colaba (Bombay), Mauritius, Batavia, Manila, Hong Kong, Zi-ka-wei (China), Melbourne, Washington, Toronto.*~~

~~*(c. Ch.)*~~

~~*MagfnetO- Optics. — The first relation between magnetism and light was discovered by Faraday,^ who proved that the plane of polarization of a ray of light was rotated when the ray travelled, through certain substances, parallel to the lines of magnetic force. This power of rotating the plane of polarization in a magnetic field has been shown to be possessed by all refracting substances, whether they are in the solid, liquid, or gaseous state. The rotation by gdses was established independently by H. Becquerel,^ and Kundt and Eontgen,^ while Kundt* found that films of the magnetic metals, iron, cobalt, nickel, thin enough to be transparent, produced enormous rotations, these being in iron and cobalt mag- netized to saturation at the rate of 200,000° per cm. of thickness, and in nickel about 89,000°. The direction of rotation is not the same in all bodies. If we call the rota^ tion positive when it is related to the direction of the mag- netic force, like rotation and translation in a right-handed screw, or, what is equivalent, when it is in the direction of the electric currents which would produce a magnetic field in the same direction as that which produces the rotation, then most substances produce positive rotation. Among those that produce negative rotation are*~~

~~*ferrous and ferric salts, ferri- cyanide of potassium, the salts of lanthanum, cerium and didymium, and chloride of titanium.* ^~~

~~*For slightly magnetizable substances the amount of rotation in a space PQ is proportional to the difference between the magnetic potential at P and Q ; or if 9 is the rotation in PQ, S)p, fig, the magnetic potential at P and Q, then*~~

~~*d=^ R^lap — fin),*~~

~~*where R is a constant, called Verdet's constant, which depends upon the refracting substance, the wave-length of the light, and the temperature. The following are the values of R (when the rotation is expressed in circular measure) for the D line and a, temperature of 18° C. : —*~~

~~*Substance. Rxl05, Observer.*~~

~~*Carbon-bisulphide . .{ \^ '^i^I^^'Zlf""*~~

~~*Water / '^^ -^™"*~~

~~*• 3808 Rodger and Watson.8*~~

~~*Alcohol. . . . -330 Du Bois.>»*~~

~~*Ether .... -315 Du Bois."*~~

~~*Oxygen (at 1 atmosphere) '000179 Kundt and Rbntgen (Z.c).*~~

~~*Faraday's heavy glass . 1 738*~~

~~*The variation of Verdet's constant with temperature has been determined for carbon-bisulphide and water by Rodger and Watson (I.e.). They find ifRt, Rq are the values of Verdet's constant at t°G. and 0°C. respectively, then for CS^ R, = E„ (l- '0016961), and for HjO R, = Ro (1 — - OOOGSOSi! — -OOOOOSOSi^).*~~

~~*For the magnetic metals Kundt found that the rotation did not increase so rapidly as the magnetic force, but that as this force was increased the*~~

~~rotation reached a maximum value. This suggests that the rotation is proportional to the intensity of magnetization, and not to the magnetic force.~~

~~The amouat of rotation in a given field depends greatly upon the wave-length of the light ; the shorter the wave-length the greater the rotation, the rotation varying a little more rapidly than the inverse square of the wave-length. Verdet " has compared in the cases of carbon bisulphide and creosote the rotation gi\en by the formula~~

~~8 = mty~~

~~cV di\~~

~~with those actually observed ; in this formula 8 is the angular rotation of the plane of polarization, m a constant depending on the medium, \ the wave-length of the light in air, and i its index of refraction in the medium. Verdet found that though the agreement is fair, the differences are greater than can be explained by errors of experiment.~~

~~Verdet ^^ has shown that the rotation of a salt solution is the sum of the rotations due to the salt and the solvent ; thus, by mixing a salt which produces negative rotation with water which produces positive rotation, it is possible to get a solution which does not exhibit any rotation. Such solutions are not in general magnetically neutral. By mixing diamagnetic and paramagnetic substances we can get magnetically neutral solutions, which, however, produce a finite rotation of the plane of polarization. The relation of the magnetic rotation to chemical consti- tution has been studied in great detail by Perkin,!^ Wachs- muthji* Jahn,!^ and Schonrock.^^~~

~~The rotation of the plane of polarization may con- veniently be regarded as denoting that the velocity of propagation of circular-polarized light travelling along the lines of magnetic force depends upon the direction of rotation of the ray, the velocity when the rotation is related to the direction of the magnetic force, like rotation and translation on a right-handed screw being difi'erent from that for a left-handed rotation. A plane-polarized ray may be regarded as compounded of two oppositely~~

~~circularly-polarized rays, and as these travel along the lines of magnetic force with difi^erent velocities, the one will gain or lose in phase on the other, so that when they are again compounded they will correspond to a plane-polarized ray, but in consequence of the change of phase the plane of polarization will not coincide with its original position.~~

~~Reflection from a Magnet. — Kerr^^ in 1877 found that when plane-polarized light is incident on the pole of an electromagnet, polished so as to act like a mirror, the plane of polarization of the reflected light is rotated by the magnet. Further experiments on this phenomenon have been made by Righi,i^ Kundt, i^ Du Bois," Sissingb,! Hall,^^ Hurion,^^ Kaz,* and Zeeman.^ The simplest case is when the incident plane-polarized light falls normally on the pole of an electromagnet. When the magnet is not excited the reflected ray is plane -polarized ; when the magnet is excited the plane of polarization is rotated through a small angle, the direction of rotation being opposite to that of the currents exciting the pole. Righi found that the reflected light was slightly elliptically polarized, the axes of the ellipse being of very unequal magnitude. A piece of gold-leaf placed over the pole entirely stops the rotation, showing that it is not produced in the air near the pole. Rotation takes place from magnetized nickel and cobalt as well as from iron, and is in the same direction (Hall). Eighi has shown that the rotation at reflection is greater for long waves than for short, whereas, as we have seen, the Faraday rotation is greater for short waves than for long. The rotation for difi'erent coloured light from iron, nickel, cobalt, and magnetite has been measured by Du Bois ; in magnetite the direction of rotation is opposite to that of the other metals. When the light is incident obliquely and not normally on the polished pole of an electromagnet, it is elliptically polarized after reflection, even when the plane of polarization is parallel or at right angles to the plane of incidence. According to Righi, the amount of rotation when the plane of polarization of the incident light is perpendicular to the plane of incidence reaches a maxi- mum when the angle of incidence is between 44° and 68°, while when the light is polarized in the plane of incidence the rotation steadily decreases as the angle of incidence is increased. The rotation when the light is polarized in the plane of incidence is always less than~~

~~when it is polarized at right angles to that plane, except when the incidence is normal, when the two rotations are of course equal.~~

~~Reflection from Tangentially Magnetized Iron. — In this case Kerr ^^ found : — (1) When the plane of incidence is per- pendicular to the lines of magnetic force, no rotation of the reflected light is produced by magnetization; (2) no rotation is produced when the light is incident normally ; (3) when the incidence is oblique, the lines of magnetic force being in the plane of incidence, the reflected light is elliptically polarized after reflection, and the axes of the ellipse are not in and at right angles to the plane of incidence. When the light is polarized in the plane of incidence, the rotation is at all angles of incidence in the opposite direc- tion to that of the currents which would produce a mag- netic field of the same sign as the magnet. When the light is polarized at right angles to the plane of incidence, the rotation is in the same direction as these currents when the angle of incidence is between 0° and 75° according to Kerr, between 0° and 80° according to Kundt, and between 0° and 78° 54' according to Righi. When the incidence is more oblique than this, the rotation of the plane of polarization is in' the opposite direction to the electric currents which would produce a magnetic field of the same sign.~~

~~The theory of the phenomena just described has been dealt with by Airy,^^ C. Neumann,^* Maxwell, ^^ Fitz- gerald, 3» Rowland,3i H. A. Lorentz,^^ Voight,^^ Ketteler,* van Loghem,^ Potier,^^ Basset, ^^ Goldhammer,^^ Drude,^' J. J. Thomson,*" and Leatham ; ^^ for a critical discussion of many of these theories we refer the reader to Larmor's *2 British Association Report. Most of these theories have proceeded on the plan of adding to the expression for the electromotive force terms indicating a force similar in character to that discovered by Hall (see Magnetism) in metallic conductors carrying a current in a magnetic field, i.e., an electromotive force at right angles to the plane containing the magnetic force and the electric current, and proportional to the sine of the angle between these vectors. The introduction of a term of this kpd gives rotation of the plane of polarization by transmission~~

~~through all refracting substance, and by reflection from magnetized metals, and shows a fair agreement between the theoretical and experimental results. The simplest way of treating the questions seems, however, to be to go to the equations which represent the propagation of a wave travelling through a medium containing ions. A moving ion in a magnetic field will be acted upon by a mechanical force which is at right angles to its direction of motion, and also to the magnetic force, and is equal per unit charge to the product of these two vectors and the sine of the angle between them. For the sake of brevity we will take the special case of a wave travelling parallel to the magnetic force iu the direction of the axis of z.~~

~~Then supposing that all the ions are of the same kind, and that there are n of these each with mass m and charge e per unit volume, the equations representing the field are (see art. Elbctkicity, Electric Waves, vol. xxviii. p. 71) : —~~

~~» dt dt dz~~

~~dz~~

~~da . dz ‘~~

~~dYo_ dz~~

~~dfi^’^dt”’~~

~~dg,~~

~~” dt ‘~~

~~dr]~~

~~da ^~~

~~“dt ‘~~

~~iir S\ „ dri + ^e^y + He^^~~

~~*ai= (X„*~~

~~*where IIis the external magnetic field, Xj, Yo the components of the part ol the electric force in the wave not due to the charges on the atoms, a and /3 the components of the magnetic force, f and r) the co-ordinates of an ion, Rj the coefficient of resistance to the motion of the ions, and a the force at unit distance tending to bring the ion back to its position of equilibrium, K^ the specific inductive capacity of a vacuum. If the variables are pro- portional to e'^^'"'^^ we find by substitution that m is given by the equation*~~

~~*q -K(,y " p2 — IIVy ·· • P2 — IIV^r" where*~~

~~*P=(a—^?iЄ^ J -fEjip-mp^.*~~

~~*If Sj, j| are the roots of this equation, then corresponding to q-i we have Xo=iYo and to q^ X|)= — iYq. We thus get two oppo- sitely circular-polarized rays travelling with the velocities pjq^ and plq^ respectively. The rotation of the plane of polarization per unit length is t/Ij — mj ; and this can, if we neglect terms in II^, be shown to be equal to*~~

~~*(M'-l)yII liiimey^*~~

~~*where ii is the refractive index for light of period, p, and V,, is the velocity of light through a vacuum. We see from the equations that the rotation is very large for such a value of jd as makes P = 0 : this value corresi)onds to a free period of the ions, so that the rotation ought to be very large in the neighbourhood of an absorp- tion band. This has been verified for sodium vapour by Macaluso and Corbino.**~~

~~*If plane-polarized light falls normally on a plane face of the medium containing the ions, then if the electric force iu the incident wave is parallel to x and is equal to the real part of*~~

~~*Ac , if the reflected beam in which the electric force is*~~

~~*parallel to x is represented by Be and the reflected beam*~~

~~*in which the electric force is parallel to the a-xis of y by*~~

~~*Ce'^' , then the conditions that the magnetic force parallel to the surface is continuous, and that the electric forces parallel to the surface in the air are continuous with Yj,, Xj in the medium, give*~~

~~*A ^ B ^ iC*~~

~~*(? + 3i) (?+?2)~(!?2i?2)~?(??2?i) or approximately, since in and m^ are nearly equal, iC _ m{m^ — mj) _ (m^ — 1)pH*~~

~~*Thus in transparent bodies for which ij. is real, C and B diflTer in phase by ir/2, and the reflected light is elliptically polarized, the major axis of the ellipse being in the plane of polarization of the incident light, so that in this case there is no rotation, but only elliptic polarization ; when there is strong absorption so that ju contains an imaginary term, C/B will contain a real part so that the reflected light will be elliptically polarized, but the major axis is no longer in the plane of polarization of the incident light ; we should thus have a rotation of the plane of polarization superposed on the elliptic polarization.*~~

~~*Zeeman's Effect. — Faraday, after discovering the effect of a magnetic field on the plane of polarization of light, made numerous experiments to see if such a field influenced the nature of the light emitted by a luminous body, but with- out success. In 1885 Fievez,** a Belgian physicist, noticed that the spectrum of a sodium flame was changed slightly in appearance by a magnetic field, but his obser- vation does not seem to have attracted much attention, and was probably ascribed to secondary efiects. In 1896 Zeeman*^ saw a distinct broadening of the lines of lithium and sodium when the flames containing salts of these metals were between the poles of a powerful electro- magnet ; following up this observation, he obtained some exceedingly remarkable and interesting results, of which those observed with the blue-green cadmium line may be taken as typical. IIe found that in a strong magnetic field, when the lines of force are parallel to the direction of propagation of the light, the line is split up into a doublet, the constituents of which are on opposite sides of the undisturbed position of the line, and that the light in the constituents of this doublet is*~~

~~circularly polarized, the rotation in the two lines being in opposite directions~~

~~S. VI. — 59~~

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~~MAGNET 0-0 P T I C S~~

~~When the magnetic force is at riglit angles to the direction of propagation of the light, the line is resolved into a triplet, of which the middle line occupies the same position as the undisturbed line ; all the constituents of this triplet are plane-polarized, the plane of polarization of the middle line being at right angles to the magnetic force, while the outside lines are polarized on a plane parallel to the lines of magnetic force. A great deal of light is thrown on this phenomenon by the following considerations due to H. A. Lorentz.*”~~

~~Let us consider an ion attracted to a centre of force by a force proportional to the distance, and acted on by a magnetic force parallel to the axis of z : then if m is the mass of the particle and e its charge, the equations of motion are~~

~~cPx -, dy~~

~~at’ at~~

~~d’^y -._. dx~~

~~d^~~

~~m-rpi + az = 0. dl-~~

~~The solution of these equations is~~

~~x= A. cos (pjt + §) + ‘& cos (pj, + |8j)~~

~~2/ = A sin (pjt + (3) — B sin (p^t + jS^)~~

~~*z = Caos{pt + y)*~~

~~*where a — mp-^ = — Hepj*~~

~~*a — mp^ = 'iiep^*~~

~~*p^ = a/m,*~~

~~*or approximately Pi=P^*~~

~~*,He*~~

~~*P2 = p-i .*~~

~~*Thus the motion of the ion on the xy plane may be regarded as made up of two circular motions in opposite directions described with frequencies p^ and p^ respectively, while the motion along z has the period p, which is the frequency for all the vibrations when H = 0. Now suppose that the cadmium line is due to the motion of such an ion ; then if the magnetic force is along the direction of propagation, the vibration in this direction has its period unaltered, but since the direction of vibration is perpendicular to the wave front, it does not give rise to light. Thus we are left with the two circular motions in the wave front with frequencies Pi and p^ giving the circularly-polarized constituents of the doublet. Now suppose the magnetic force is at right angles to the direction of propagation of tlie light ; then the vibration parallel to the magnetic force being in the wave front produces luminous effects and gives rise to a plane-polarized ray of undisturbed period (the middle line of the triplet), the plane of polarization being at right angles to the magnetic force. The components in the wave- front of the circular orbits at right angles to the magnetic force will be rectilinear motions of frequency ^;j smip^sX right angles to the magnetic force — so that they will produce plane-polarized light, the plane of polarization being parallel to the magnetic force ; these are the outer lines of the triplet.*~~

~~*If Zeeman's observations are interpreted from this point of view, the directions of rotation of the circularly-polarized light in the doublet observed along the lines of magnetic force show that the ions which*~~

~~*produce the luminous vibrations are negatively electrified, while the measurement of the change of frequency due to the magnetic field shows that ejm is of the order 10". This result is of great interest, as this is the order of the value of e/m in the negatively electrified particles which constitute the Cathode Rays (see Electricity, Electric Discharge, Ency. Brit. vol. xxviii.). Thus we infer that the " cathode particles " are found in bodies, even where not subject to the action of intense electrical fields, and are in fact an ordinary constituent of the molecule. Similar particles are found near an incan- descent wire, and also near a metal plate illuminated by ultra-violet light.*~~

~~*A more extended study of the behaviour of the spectro- scopic lines has aiforded examples in whicli the eflfects produced by a magnet are more complicated than those we have described. Thus Preston*'^ and Cornu"8 have shown that under the action of a transverse magnetic field one of the D lines splits up into four, and the other into six*~~

~~*lines ; Preston has given many other examples of these quartets and sextets, and has shown that the change in the frequency, which, according to the simple theory indicated, should be the same for all lines, actually varies consider- ably from one line to another, many lines showing no appreciable displacement. The splitting up of a single line into a quartet or sextet indicates, from the point of view of the ion theory, that the line must have its origin in a system consisting of more than one ion. A single ion having only three degrees of freedom can only have three periods. When there is no magnetic force acting on the ion these periods are equal, but though under the action of a magnetic force they are separated, their number cannot be increased. When therefore we get four or more lines, the inference is that the system giving the lines must have at least four degrees of freedom, and there- fore must consist of more than one ion. The theory of a system of ions mutually influencing each other shows, as we should expect, that the effects are more complex than in the case of a single ion, and that the change in the frequency is not necessarily the same for all systems. Preston *^ has proved that in some cases at any rate the change in the frequency of the different lines is of such a character that they can be grouped into series such that each line in the series has the same change in frequency for the same magnetic*~~

~~force, and moreover that homologous lines in the spectra of different metals belonging to the same group have the same change in frequency. Thus the behaviour of the spectrum in the magnetic field pro- mises to throw great light on the nature of radiation, and perhaps on the constitution of the elements. The study of these effects has been greatly facilitated by the inven- tion by Michelson ^^ of the echelon spectroscope.~~

~~There are some interesting phenomena connected vrith the Zeeman effect which are more easily observed than the eflject itself. Thus Cotton i found that if we have two Bunsen flames A and B coloured by the same salt, the absorption of the light of one by the other is diminished if either is placed between the poles of a magnet : this is at once explained by the Zeeman efi^ect, for the times of vibration of the molecules of the flame in the magnetic field are not the same as those of the other flame, and thus the absorption is diminished. Similar considerations explain the phenomenon observed by Egoroff and Geor- giewsky,^^ that the light emitted from a flame in a trans- verse field is partially polarized in a plane parallel to the magnetic force ; and also Righi's ^^ observation that if a sodium flame is placed in a longitudinal field between two crossed Nicols, and a ray of white light sent through one of the Nicols, then through the flame, and then through the second Nicol, the amount of light passing through the second Nicol is greater when the field is on than when it is off. For further information on the Zeeman effect the reader is referred to a valuable report by Yoight.*~~

~~' Experimental Heseardies, Series 19, ^ Cotnptes Rendus, 88, p. 709. » Wied. Ann. 6, p. 332; 8, p. 278; 10, p. 257. " Wied. Ann. 23, p. 228 ; 27, p. 191. " Wied. Ami. 31, p. 941. " Phil. Trans. A. 1885, Ft. 11, p. 343. ' Wied. Ann. 26, p. 456. 8 Phil. Trans. A. 1895, Pt. 11, p. 621. ' Wied. Ann. 24, p. 161. 1" Wied. Ann. 31, p. 970. " Comptes Rendus, 57, p. 670. 12 Cmnptes Jtendiis, 43, p. 529 ; 44, p. 1209. " Joum. Cliem. Soc. 1884, p. 421; 1886, p. 177; IBS", pp. 362 and 808; ISSS, p. 561 ; 1889, pp. 680 and 750 ; 1891, p. 981 ; 1892, p. 800 ; 1893, pp. 75, 99, and -188. " Wied. Ann. 44, p. 377. ^^ Wied. Ann. 43, p. 280. i" Zeilschri/t f. physikal. Clinn. 11, p. 753. " Phil. Mag. [5] 3, p. 321. '8 j„„ ^^ p;„„,^ gj ^^ p;,^^^^ [gj -1, p. 433; 9, p. 65; 10, p. 200. '^ Wied. Ann. 23, p. L"_'S ; 27, p. 191. -" Wied. Ann. 39, p. 25. ' Wied. Ann. 42, p. 115. '~~ ~~'2 Phil. Mng. [5] 12, p. 171. 2' Joum. de Phys.~~

~~1884, p. 360. ** Bfibliitler zu Wied. Ann. 1885, p. 275. ‘ Messungen iiber d. Krrr’sche /ircheiniing. Inaugural Dissert. Leyden, 1893. ‘^ Phil. Mag. [5] 5, p. 161. ” Phil. .Mag. [3] 28. p. 469. “-^ Die magn. Drehung d. Polarisationsebene dcsLichis, Ualle, 1863 ^ Eleetricity~~

~~and Magnetism, chap. xxi. o p/ ^^ Trans. 1880 (2), p. 691. ‘1 Phil. Mag. (5) 11, p. 254, 188]. ^ Arch. Neerl. 19, p. 123. ^ Wkd. Ann. 23, p. 493 ; 67, p. 345. ^ Wied. Ann. 24, p. 119. ■”^ Wied. Beiblatter, 8, p. 869. ‘^ Comptes Rendits, 108, p. 510. ” Phil. Tnias. 182, A. p. 371, 1892; Physical Optics, p. 393. ^ Wied. Ann. 46, p. 71 ; 47, p. 345 ; 48, p. 740 ; 50, p- 722. ^ Wied. A an. 46, p. 353 ; 48, p. 122 ; 49, p. 690. ■”> Recent Re- searches, p. 489 et seq. *’ Phil. Trans. A. 1897, p. 89. *- Brit. Assoc. Report, 1893. ” Comptes Rendus, 127, p. 648. ” null. de I’Acad. des Sciences Belg. (3) 9, pi>. 327, 381, 1885 ; 12, p. 30, 1886. “*■’ CtHiunimications from tlie Physical Labitratory, Leyden, No. 83, 1896 ; Phil. Mag. 43, p. 226 ; 44, pp. 65 and 255 ; and 45, p. 197. « Arch. Nierl. 25, p. 190. ” PhU. Mag. 45, p. 325 ; 47, p. 165. ^ Oomptes Rendus, 126, p. 181. * PhU. Mag. 46, p. 187. =» Phil. Mag. 45, p. 348. ^^ Oomptes Rendus, 125, p. 865. 52 Comptes Rendus, pp. 748 and 949, 1897. ^^ Comptes Rendus, 127, p. 216 ; 128, p. 45. ” Physikalische Zeitschrift, December 1899. /j. j. t.)~~

~~Ma.g’nitna.ya., a Cossack village of Russia, govern- ment of Orenburg, district Verkhneuralsk, on the Ural river. It w^as formerly a small frontier fort, but, owing to its advantageous position for trade vpith the Steppes, it has grown into a place of 10,100 inhabitants, and has an important cattle fair.~~

~~Mag’ we, a district in the Minbu division of Upper Burma, with an area of 3331 square miles and a popula- tion (1891) of 219,190, and (1901) 216,740, showing an increase of 12‘38 per cent., and an average density of 74 inhabitants to the square mile. Magwe may be divided into two portions : the low, flat country in the Taung- dwingyi subdivision, and the undulating high ground extending over the rest of the district. In Taungdwingyi the soil is rich, loamy, and extremely fertile. The plain is~~

~~*about 4-5 miles from north to south. At its southern extremity it is about 30 miles vsdde, and lessens in width to the north till it ends in a point at Natmauk. On the east are the Pegu Yomas, which at some points reach a height of 1500 feet. A number of streams run from this westwards to the Irrawaddy, and are used for navigation purposes. The Yin and the Kn, which form the northern boundary, are the chief, and receive the others. The only perennial stream is the Yanpe. Rice is the staple product, and considerable quantities are exported. Sesamum of very high quality, maize, and millet are also cultivated, as well as cotton in patches here and there over the whole district.*~~

~~*In this district are included the well-known Yenangyaung petroleum wells. The state wells have been leased to the Burma Oil Company. The amount of oil-bearing lands is estimated at 80 square miles, and the portion not leased to the company has been demarcated into blocks of one square mile, and offered on lease. The remaining land belongs to hereditary Burmese ow-ners called Twinsa, who dig wells and extract their oil hy the rope and pulley system as they have always done. There are 319 square miles of forest reserves in the district. Lacquered wood trays, bowls and platters, and cart-wheels, are the only industries of any note in the district. There were 759 villiiges in the district, paying Rs.5,02,694 in 1898-99. Of a total of l-,864,209 acres, 343,765 were cultivated in that year, 255,360 were under forests, 154,898 acres were available for cultivation. There were 56,396 acres of current fallow, and 1,053,790 acres were not available for cultivation. The rainfall in the year 1898-99 was 27 '74 inches. The maximum temperature rises to a little over 100° in the hot weather, and falls to an average minimum of 63° and 54° in the cold weather. In 1891 the population was made up of 216,931 Buddhists and Jains, 725 Mahommedans, 714 Hindus, 581 Karens and Chins, and 239 Christians, 142 of whom were natives. Magwe, the headquarters of the district, has a population of about 7000.*~~

~~*Mahadev Govind Ranade (1842-1901),*~~

~~*native Indian lawyer, educationist, author, and reformer, was born on the 16th January 1842, at Niphad, in the Nasik district, his family having been for nine generations in state service. When his father was minister at*~~

~~*Kolha- pur, Mahadev attended the Anglo-vernacular school in that town, and joined the Elphinstone Institute in Bombay*~~

~~*at the age of fourteen. Along with Dr Ramkrishna Gopal Bhandarkar, Bal Mangesh Wagle, and Yaraan Abaji Modak, all of whom distinguished themselves in after life, he appeared at the first examinations held by the Bombay University (established 1859). HIe took the degree of B.A. in 1862, M.A. in 1863, and LL.B in 1866 with high distinction, and his teachers, Professor Harkness and Sir Alexander Grant, moved the University to award him special prizes. HIe was now known as the " Prince of Graduates," and was soon appointed assistant professor at the Elphinstone College, where his learned and thoughts ful lectures drew some of the English professors to hear him. HIaving entered the Government service in 1866 as a translator, he became prime minister of Kolhapur state in 1868, assistant reporter to the Bombay HIgh Court in 1869, presidency magistrate and then fourth judge of the Small Cause Court at Bombay in 1871, first-class sub-judge at Poena and then at Nasik and Dhuliain 1873, and judge of Poena Small Causes Court in 1884, after which, as special judge under the Deccan Agriculturists' Relief Act from 1887, he came into close contact with the difiiculties of the agrarian classes. HIe was raised to be a judge of the Bombay HIgh Court in 1893. In 1886 he was a member of the Finance Committee appointed to report on the expenditure, both imperial and provincial, with a view to retrencliment. This service won him the decoration of CLE. HIe became a member of the legislative council to the governor of Bombay in 1 885, and occupied that position until he was raised to the HIgh Court Bench. Being an energetic social reformer, he directed his effprts against infant marriages, the shaving of widows, the heavy cost of marriages and other social functions, and the caste restric- tions on travelling abroad. HIe strenuously advocated widow remarriage and female education, and considered state legislation necessary for the social well-being of the country. HIe was the father of the Social Conference movement, which he supported tiU his death. In the political sphere he founded the Poona Sarvajanik Sabha, through which he frequently helped the Government with his sound advice. HIe was one of the originators of the Indian National Congress, and invariably attended its meetings. In Bombay University, where he held the ofiices of syndic and dean in arts, he*~~

displayed much organizing power and great intimacy with the needs of the student class. Himself a thorough Marathi scholar, he encouraged the translation of standard English works, and tried, with some success, to promote scholarships in vernacular lan- guages by introducing them into the University curriculum. He was one of the managers of the Victoria Technical Institute. By birth a Chitpavan Brahmin, he was reared in the strictest tenets of Hinduism ; but his deep religious feeling and trained intellect craved something higher and broader than he could find in the traditional forms and orthodox teaching of his race. The same spiritual want being felt by many enlightened Hindus, he joined with his friends, Dr Atmaram Pandurang, Bal Mangesh Wagle, and Vaman Abaji Modak, in founding a new sect in Bombay known as the " Pearthana Samaj." This community resembles, in all essential points, the Brahmo Samaj of Bengal. Its principles of enlightened theism are based on the ancient Vedas. He married twice, his second wife being Eamabai, an enlightened and accomplished lady, who proved a fitting helpmate to him. He died childless, after a short illness, on the 16th January 1901, at the age of fifty-eight.

It was the task of Mr Eanade and his band of native reformers to guide and direct the rising force of general education in the second half of the 19th century in India in such a way as to preserve what was best in the past and adapt it to the present. He was therefore the friend, guide, and philosopher of all

sections and communities, parties and opinions, as he worked on lines of least resistance. It is no exaggeration to say tliat there was hardly any good movement in the Bombay Presidency, or more or less in the whole of India — political, social, religions, or industrial — that was not welded by his brain and nurtured by his spirit. He could therefore find no time to write any work on a large scale. Still, the annual addresses he delivered before the Social Conference for the fifteen years he was its general secretary, will long remain as landmarks of the intellect, moral courage, and high ideals of educated India, and he was a frequent contributor to

~~*the journal of the Poona Sarvajanik Sabha and the journal of the Bombay branch of the Royal Asiatic Society. HIs essays on Indian economics were published a few years before his death, and shortly before that event he issued a. few chapters of the HIstory of the Mahrattas — a work of much original research and thought, which had been left to him as a legacy by his pupil and friend Mr Justice K. T. Telang. (n. b. w.)*~~

~~*Mahallat, a small province of central Persia, situ- ated, between Kaslian and Irak. It has a population of about 20,000, and pays a yearly revenue of about £2500. Until 1890 it was one of the five "central provinces" (the other four being Irak, Ferahan, Kezzaz, and Savah), ■which were under a governor appointed by the Shah; since then it has formed part of the Isfahan government. It is traversed by the Anarbar or Kum river, and com- prises the city of Mahallat, divided into upper and lower, or Kivkan and Zanjirvan, and twenty-two flourishing villages. It was known in former times as Anar, the Anarus of Peutinger's tables. The city, capital of the province, is situated at an elevation of 6850 feet in 33° 51′ N. and 50° 30′ E., and has a population of about*~~

~~*9000.*~~

~~*-), American*~~

~~*Mahan, Alfred Thayer (1840- naval ofB.cer, strategist, and historian, was born in New York City on the 27th of September 1840. _ HIe graduated at the United States ISTaval Academy, Annapolis, Mary- land, in 1859 ; became lieutenant in 1861, and served on the Congress, Pocahontas, Seminole, and James Adger during the Civil War, meanwhile acting as instructor at the Naval Academy for a year. At the close of the struggle he was made lieutenant-commander (commander in 1874), and subsequently, following the usual fortune of a naval ofl&cer, saw service in the Gulf of Mexico, the South Atlantic coast, the Pacific, and Asia, and did shore duty at Boston, New York, and Annapolis. In 1885 he became captain, and in 1886 president of the Naval War College at Newport, Khode Island. Between 1889 and 1892 he was engaged in special service for the Bureau of Navigation, and in 1893 was made commander of the CJiicago, of the European squadron. In 1896 he retired from active service, but was a member of the naval board of strategy during the war*~~

~~between the United States and Spain (1898), and the Peace Congress at The Hague in 1899. This long and varied service gave him extensive opportunities for observation, which he accompanied by constant study of naval authorities and reflection on the interpretation of the problems of maritime history. His first book was a modest and compact story of the doings in T%e Gulf and Inland Waters (1883), in a series of volumes by various writers, entitled TJie Navy in the CivilWar ; but in 1890 he suddenly acquired fame by the appearance of his masterly work entitled The Influence of Sea-Power upon History, 1660-17S3. Having been impressed by the historian Mommsen's failure to allow for the influence of sea^power upon the career of Hanni- bal, he was led to make prolonged investigations of this general theme, especially for the period of time named in the title. The reception accorded the volume was instant and hearty; in England, in particular, it was deemed almost an epoch-making work, and was studied by naval specialists. Cabinet Ministers, and journalists, as well as by a large part of the general public. It was followed by The Influence of Sea-Power upon the French~~

~~Revolution and Empire (2 vols. 1892) ; Tlie Life of Nelson, Hie Embodiment of the Sea-Power of Great Britain (1897) ; and The Interest of America in SeOrPower, Present and Future (a smaller and more fragmentary collection of chapters, 1897). The author's general aim in these ■wovks — some of which have been translated into French, German, and Japanese — was to make the consideration of maritime matters paramount to that of military, polit- ical, or economic movements, without, however, as he himself says, "divorcing them from their surroundings of cause and effect in general history, but seeking to show how they modified the latter, and were modified by them." He selected the year 1660 as the beginning of his narrative, as being the date when " the sailing-ship era, with its distinctive features, had fairly begun." The series as a whole has been accepted as finally authoritar five, supplanting its predecessors of similar aim, and almost — in the words of Theodore Eoosevelt — founding a new school of naval historical writing. Lesser works by the author are a Life of Admiral Farragut (1892), and a collection of articles grouped under the title of Lessons from the Spanish War, and other Papers (1899). Captain Mahan, in addition to other~~

~~*honours, received the degree of D.C.L. from Oxford, and that of LL.D. from Cam- bridge.*~~

~~*Mahanoy City, a borough of Schuylkill county, Pennsylvania, U.S.A., in the valley of Mahanoy river, in the eastern part of the state, at an altitude of 1240 feet. It has a level site, on which it is laid out regularly. It is on branches of the Lehigh Valley and the Philadelphia and Reading railways. Mahanoy is in the anthracite coal region, is surrounded by mines, and its industries are' closely associated with mining and shipping coal. Population (1890), 11,286 ; (1900), 13,504, of whom 3877 were foreign-born.*~~

~~*Mahi Kantha, a political agency or collection of native states in India, within the Gujarat division of Bombay. The number of separate states is thirty-nine, many of which are under British administration. The only important one is Idar. Total area, 9300 square miles. Population (1881), 517,485; (1891), 681,568; (1901), 361,608, showing an increase of 12 per cent, between 1881 and 1891, but a decrease of 37-8 per cent, between 1891 and 1901 ; average density, 39 persons per square mile; estimated gross revenue, Rs.12,69,463, of which Ils.82,194 were expended on public works in 1897-98 ; tribute (mostly to the Gaekwar of Baroda), Rs. 1,43,743; number of stipendiary police, 1723, main- tained at a cost of Rs.1,89,126 ; number of schools, 106, with 6911 pupils. Many of the inhabitants belong to the wild tribes of Bhils and Kolis. In 1897 a metre-gauge railway was opened from Ahmedabad through Parantij to Ahmednagar; total length, 55 miles. At Sadra (population, 1839), is the Scott College for the education of the sons of chiefs on the lines of an English public school. In 1896-97 there were 35 boys, main- tained at a total cost of E.s.3,135. There are also Anglo- vernacular schools at Sadra, Idar, and Mansa. The fam- ine of 1899-1900 was severely felt in this tract.*~~

~~*Mahommed Ahmed [The Mahdi] (1848-1885), the Sudanese tyrant, was born in Dongola in 1848. HIe was at first in the Egyptian Civil Service, but had dis- putes with his superior officials, and then took up slave- dealing. HIe settled on Abba Island, and acquired a reputation for sanctity which he used for stirring up disaffection with Egyptian rule. The Egyptian officials attempted to suppress him, but a force sent in 1881 for that*~~

~~purpose was resisted and defeated, and Mahommed Ahmed proclaimed himself the Mahdi (or Messiah), being~~

~~assisted by Abdullah (q.v.) as his Khalifa or vicegerent. The revolt in the Sudan spread, and the Mahdi was soon at the head of a powerful force; and 6000 Egyptian troops under Yusef Pasha, advancing from Fashoda, were nearly annihilated in June 1882. By the end of 1882 the whole of the Sudan south of Khartum was in rebellion, with the exception of the Bahr-el-Ghazal and the Equatorial Provinces. In November 1883 General Hicks's force of 10,000 men was destroyed at Kashgil, and in the same year the Mahdi's lieutenant, Osman Digna, raised the tribes in the eastern Sudan, and besieged Sinkat and Tokar, near Suakin, routing General Baker's force of 2500 men at El Teb. The military operations undertaken by Great Britain in face of this state of affairs are narrated under Egypt. It need only be added here that General Gordon (q.v.) was entangled at Khartum, and that he was killed and Khartum captured by the Mahdists on 26th January 1885. The Mahdi himself died at Omdurman a few months later (22nd June 1885), and was succeeded in power by the Khalifa, Abdullah.~~

~~Mahommedan Law. — The Mahommedan law is always spoken of by Mahommedans as a sacred law, and a|S contained in the Koran. But the Koran itself could not have supplied the wants even of the compara- tively rude tribes to whom it was first addressed. Still less has it proved sufficient to satisfy the requirements of successive generations. No doubt the great veneration which Mahommedans have for the Koran has caused them to be less progressive than members of other religious creeds. But ia human affairs some change is inevitable, and the law of the Koran, like other sacred laws, has had to undergo the supplementary and transforming influence of custom and interpretation, though not of legislation. This direct method of changing the law by human agency, natural and simple as it appears to us, is scarcely acknow- ledged by Orientals even in the present day, except iuthe rare instances in which it has been forced upon them by Western authority. But besides custom and~~

~~*interpreta- tion, another influence of a special kind has been brought to bear upon Mahommedan law. Besides those utterances which the Prophet himself announced as the inspired message of God, whatever he was supposed to have said and whatever he was supposed to have done have been relied upon as furnishing a rule for guidance. This tradition (sunnah) is only to be accepted if it can be traced up to a narrator at first hand, though it would be rash to say that the chain of evidence is alwaj^s very strong. Mahommedans also, in support of a legal rule for which there is no direct authority, resort to the argument from analogy Qciyas). The principle involved in a rule for which authority can be quoted is extended so as to cover other analogous cases. There have also been accepted amongst Mahommedans, as authoritative, certain opinions on points of law delivered by those who were actual companions of the Prophet ; these opinions are spoken of collectively under the name of ijmaa. Some of these methods of extending and modifying the law have produced changes which it would be very difficult to reconcile with a strict adherence to the language of the Koran.*~~

~~*Still, so far as it speaks at all, the text of the Koran remains the basis of Mahommedan law ; and probably the Koran has had more practical effect on the lives and actions of those who accept it than any other revelation accepted by a portion of the human race as inspired. In comparison with the Jewish or Vedic scriptures, the Koran may be properly described as a modern book. We know exactly when, where, and how it was pro- duced. The divine message was not written down by*~~

~~*the Prophet himself. Some passages may have been written down at the time they were delivered by his hearers ; others were committed to memory. But a written collection was begun shortly after the Prophet's death (a.d. 632), and was completed within three years of that event. Eifteen years later, however, it being found that there were already considerable differences between the various copies of the Koran then in exist- ence, a recension of the text was ordered, and measures were taken to destroy all previous copies as spurious. The authenticity of the text then constructed has never been seriously disputed. Whether in the operation of gathering together the scattered fragments from " palm leaves, skin, bladebones, and the hearts of men," and in preparing them for*~~

~~publication, the exact words used by the Prophet may not have undergone some change, it wo\ild be difficult to say. Having regard to the cir- cumstances above stated, it is not surprising to find that the development of the Mahommedan law has not, in the great variety of peoples who have accepted the Mahommedan faith, proceeded always upon the same lines. Naturally also political differences have not been without their influence in these divergences of opinion, and of these political differences the most im- portant of all was that which split the whole of %"^""^s."°" Islam into the two great divisions of Sunnis and Shiahs. These terms represent the two great parties into which Mahommedans were divided by the disputes as to the succession to the caliphat, which commenced very shortly after the death of the Prophet. These disputes culminated in the massacre of the descendants of Ali, the son-in-law of the Prophet, and the fourth caliph, by Yezid, who represented the rival or Omeyyad line. But the defeated party were not entirely destroyed, and, under the name of Shiahs, have still maintained their authority. Other Mahommedans, to distinguish them, are called Sunnis, and, except in Persia, the Sunnis are the prevailing sect, the Shiahs only being found else- where in scattered families. The dynastic quarrel which gave rise to the schism has long been dead ; the memory of it only survives in the anniversary of the Mohurrum, when Mahommedans still bewail the massacre of more than twelve hundred years ago. But the doctrinal differ- ences involved in it still survive, and the legal systems of the Sunnis and Shiahs differ in many important particulars. The Sunnis themselves are divided into four great sects or schools, each being called after the most conspicuous early exponent of its doctrines. These are the Hanafite school, called after Hanafa, who died in 702 ; the Malikite school, called after Mai ik-Ibn-Anas, who died in 812 ; the Shafaite school, called after Mahommed-as-Shafi, who died in 826 ; and the Hanbalite school, called after Ahmad-Ibn-Hanbal, who died in 863.~~

~~Of the various existing forms of Mahommedan law, the one that has attained the greatest degree of coherence is that which prevails in India. Mahommedan law is admin- istered in India to more than sixty millions of Mahomme- dans. If reference is made to the article Hindu Law, it will be seen how it was that the Mahommedan law came to be administered by British courts of justice in India. The legislative enactments there quoted~~

do not indicate exactly the limits of the application; practically the topics to which it is applied are the family relations, ownership, succession, and those religious questions in which civil rights are also involved. The Mahommedans of India generally are Sunnis of the Hanafite school. The two prin- cipal authorities on Mahommedan law to which recourse is had by the courts in India are the Hedaya and the Eutwa Alumgiri. The Hedaya was translated into English by Mr Hamilton. The Eutwa Alumgiri was compiled under the orders of the Emperor Aurungzib Alumgir. It is a

collection of the opinions of learned Mahommedans on points of law. It lias not been translated, but it forms the basis of the Digest of MaJiommedan Law compiled by Mr Neil Baillie. The Mahommedan law, like the Hindu law, is a personal law. It is essentially so in its nature. Persons of any other religion are to a large extent outside its pale. And in India, in civil matters, its appli- cation has been expressly limited to Mahommedans. At one time endeavour was made to administer the Mahom- medan criminal law as the general territorial law of India, but it had constantly to be amended, and it was at length abolished and the penal code substituted. To be a Mahommedan, and so to claim to be governed by the Mohammedan law, it is necessary to profess the Mahom- medan faith.

All that we find on the subject of intestate succession in the Koran are certain directions as to the shares which certain members of the family are to take in the estate of their deceased relative. So far as they go, these are rules of distribution — ^that is to say, they depend, not on consanguinity only, but on certain equitable considerations, by which rules founded on consanguinity are modified. But these latter rules, though nowhere laid down in the Koran, still play a large part in Mahommedan law. There can be no doubt that they represent the pre-existing Arabian custom, which it was not the intention of the Prophet to

~~*displace, but only to modify. The claimants under these rules take whatever is left after the specific shares assigned by the Koran to individual members of the family have been satisfied; if in any case there are no such shares, they take the whole. The Arabic term for this class of heirs is asabah, which literally means persons connected by a ligament. The term, used by English writers is " residu- aries," but this description of them has the disadvantage that it entirely loses sight of the connexion on which the claim to succeed is based. They would be more correctly described as the " agnates " of the deceased, but the term " residuaries " is too firmly established to be displaced. Those persons who take a share of the propei-ty, under the specific rules laid down in the Koran, we call " sharers," and this word has acquired a technical meaning ; it is not used to describe those who can claim a portion of the estate in any other way. It is hardly likely that females, or relatives through females, had any claim to the succes- sion under any Arabian custom, nor, except so far as they are made sharers, are they recognized by the Koran as hav- ing a title to succeed. The proper description of this class of persons is zavi-ul-arham, i.e., "uterine kindred," and they have, in default of other heirs, established a claim to succeed. English writers have erroneously called them " distant kindred," but distance has nothing to do with the matter.*~~

~~*There is no right of primogeniture under Mahommedan law; there is a general preference of males over females, and if males and females take together as residuaries by an express provision of the Koran, each male takes as much as two females. Females are also expressly forbidden by the Koran to take more than two-thirds of the property ; but in the application of these two rules the shares of the mother and the wife are not included. No person can claim to take any portion of the property who traces his relationship to the deceased through a living person, but this rule does not apply to brothers and sisters whose mother is alive. If several persons all stand in the same degree of relationship to the deceased, they take equally, per caput and not per stirpem.*~~

~~*It will now be convenient to state the rules for finding which of the agnates take as residuaries of the deceased. These are, in ordinary circumstances, the male agnates only, and the rule in question depends upon a classification*~~

~~*of the male agnates which is common in other parts of the world. Every family consisting of several generations of male agnates may be broken up into groups, each of which has a separate common ancestor of its own. Thus, suppose A to be the person from whom the descent is to be traced. A belongs to a large group of persons, all of whom are males descended from a common ancestor D. But A and his or her own male descendants form a smaller group, which we may call the group A. This is the first class of male agnates of A. Then suppose A to be the son or daughter of B, excluding those who are descendants of A, and as such included in the first class, the remaining male descendants of B will form the second class of male agnates of A. In like manner we get a third class of male agnates of A who are descendants of C, excluding those who are descendants of A or B; and a fourth class of male agnates of A who are de- scendants of D, excluding those who are descendants of A, B, or C. This classification can obviously be carried through as many generations as we please. Mahom- medan lawyers adopt this classification with only one difference. Between the first and second classes they interpose a class consisting entirely of the direct male ancestors, which they call the " root," so that the male descendants of A (the person whose heirs are in question) would be the first class of residuaries. B, C, D, &c. would be the second class of residuaries ; the male de- scendants of B, other than the descendants of A, would be the third class of residuaries ; the male descendants of C, other than the descendants of B and A, would be the fourth class of residuaries, and so on. In order to find the residuaries who are to succeed, we have only to take the classes in their order, and of the highest class which is represented to select the nearest to the deceased. If there are several who are equidistant, they will take equally ^er caput.*~~

~~*The sharers are, of course, those to whom a share is assigned by the Koran. They are (1) the father, (2) lineal male ancestors, whom Mahommedans call the "true grandfathers," (3) uterine half-brothers, i.e., the half-brothers by the mother, (4) daughters, (5) daughters of a son, or other direct male descendant, whom we call daughters of a son how low and soever, (6) the mother, (7) true grandmothers, i.e., female ancestors into whose line no male except a lineal male ancestor enters, (8) full sisters, (9) consanguine half-sisters, i.e., half-sisters by the father, (10) uterine half-sisters, (11) the husband, (12) the wives. The right to a*~~

share and the amount of it depends upon the state of the family. Under Mahom- medan law not only, as elsewhere, the nearer relative excludes the more remote, but there are special rules of total or partial exclusion arising out of the equitable considerations upon which all rules of distribution are based.

These rules are best shown by taking the case of each member of the family in turn, and at the same time it will be useful to explain the general position of each member. First, the sons. They take no share, but they are first in the first class of residuaries, and their position is a very strong one ; they exclude entirely sisters and daughters from a share, and they reduce considerably the shares of the husband, the widows, and the mother. The position of the other male descendants is very similar to that of the sons. They are not sharers ; they are residu- aries of the first class, and will take as such if the inter- mediate persons are dead. They reduce the shares of some of the sharers, but not to the same extent as the sons. The father is a residuary of the second class, and the first in that class, liut he is also a sharer, and as such is entitled to a share of one-sixth. IIe can take in both capacities. The father's father is also a residuaiy of

the second class, and he is a sharer, entitled to a share of one-sixth, but of course he cannot take either as sharer or residuary if the father is alive. The position of any true grandfather is analogous. An only daughter takes as sharer one-half of the property, two or more daughters take one-third between them. But sons exclude daughters from a share, and they would get nothing. Naturally this was considered unjust, and a remedy has been found by making the daughters what are called " resid- uaries in right of their brothers," each daughter taking half of what a son takes. The mother gets a share of one-sixth when there is a child of the deceased, or a child of any son how low and soever ; also when there are two or more brothers or sisters. In any other case her share is one-third. If, however, the wife, or the hus- band (as the case may be), and the father are alive, the share of the mother is only one-third of what remains after deducting the share of the husband or the wife. The brother is never a

~~*sharer. He is a residuary of the third class, and he excludes some sharers. The daughters of a son how low and soever get a share of two-thirds between them if there are several ; if there is only one she gets one-half. But the daughters of a son are ex- cluded by any direct male descendant who is nearer to the deceased than themselves, or at the same distance from him. If, however, they are excluded by a person who is at the same distance from the deceased as themselves, Mahommedan lawyers again say that they come in as residuaries in right of that person, each female as usual taking half as much as each male. Of course the daugh- ters of a son may also be excluded by the daughters hav- ing exhausted the two-thirds allotted to females. A single sister takes a share of one-half ; several sisters take two-thirds between them. Sisters are excluded from a share by any residuary of the first class, and their own brothers also exclude them, but in the latter case they take as residuaries in right of their brothers, each sister taking half what a brother takes. So, again, the sisters may be excluded from a share by the daughters or daughters of sons having exhausted the two-thirds allotted to females, and the residue would go to the nearest male agnate — that is, the uncle or the nephew of the deceased, or some more distant relative. To prevent this Mahommedan lawyers say that in this case the sisters are residuaries, basing their assertion upon a somewhat vague tradition. The share of the husband in the property of the wife is one-fourth if there are surviving children, one-half if there are none. The share of the widow in the property of her deceased husband is one-eighth if there are surviving children, one-fourth if there are not. The nearest true grandmother takes a share of one-sixth. If there are several equidistant, they take one-sixth between them. The uterine half-brothers take a share of one-third when there is only one, but they are excluded by any direct descendant and by any direct male ascendant. Uterine half-sisters are in the same position as uterine half- brothers. Consanguine half-brothers are residuaries of the same class as brothers, but only take in default of full brothers. Consanguine half-sisters take a share of two- thirds, or if there is only one she takes a share of one- half. But if there is a full sister also, the full sister takes one-half, and the consanguine sisters one-sixth between them. The consanguine half-sisters, like the full sisters, are excluded from a share by the children and the father of the deceased, and also by full*~~

~~*brothers and consanguine brothers; but in the last case they come in again as residuaries, taking half what a brother takes.*~~

~~*The sharers must, of course, unless excluded, be all satisfied before anything is taken by the residuaries. But the sharers may not only exhaust the property ;*~~

~~*there may not be enough to satisfy all the claimants. Thus, if a man died leaving a wife, a mother, and two daughters, the shares are one-fourth, one-sixth, and two-thirds, and the sum of the shares being greater than unity, they cannot all be satisfied. The difficiilty is met by decreasing the shares rateably, in other words, by increasing the common denominator of the fractions so as to produce unity ; hence the process is called the " increase." The converse case arises when the shares of the sharers do not exhaust the property, but there are no residuaries to take what remains. It has been doubted whether the residue does not fall to the Government as bona vacantia. But it is now settled that the surplus is to be divided rateably amongst the sharers in proportion to their shares. The process is called the " return." The husband and the wife are excluded from the benefit of the return. If there are no sharers, the whole estate will go to the residuaries. If there are neither sharers nor residu- aries, it will go to the (so-called) distant kindred. Their claim is strong on equitable grounds, as some of them are very near relations ; such, for example, as a daughter's children or a sister's children. Nevertheless their claim has been doubted, and it must be admitted that there is no very clear ground upon which it can be based. They are not mentioned as sharers in the Koran, and it is not very clear how, as cognates, they could have been recog- nized by any ancient Arabian custom. However, their claim is now well established, and, in default of both sharers and residuaries, they succeed on a plan somewhat resembling that on which male agnates are classified as residuaries. If aU the claimants fail the property goes to the Government, but there is one peculiar case. Suppos- ing a man dies leaving a widow, or a woman dies leaving a husband, and no other relative. There is then a residue and no one whatever to take it, as the husband and wdfe are excluded from the return. Strictly speaking it would fall to the Government as bona vacantia, but the claim is never*~~

~~*made, and would now be considered as obsolete, the husband or wife being allowed to take the property.*~~

~~*Under Mahommedan law there are certain grounds upon which a person who would otherwise succeed as heir to a deceased person would be disqualified. These grounds are — (1) that the claimant slew the deceased by an act which, under Mahommedan law, would entail expiation or retaliation, and this would include homicide by mis- adventure ; (2) that the claimant is a slave ; (3) that he is an infidel, i.e., not of the Mahommedan faith. The second impediment cannot now have any application in India; the third has been removed by Act 21 of 1850. There is a rule of Mahommedan law that if two persons die in circumstances which render it impossible to deter- mine which died first, as, for example, if both went down in the same ship, for the purposes of succession it is to be assumed that both died simultaneously.*~~

~~*Mahommedan lawyers appear always to have re- cognized the validity of wills, and they are said to be recognized by a passage in the Koran. But the res*a- power of testamentary disposition is restricted mentary within very narrow limits. It only extends to succes- one-third of the property after the payment of * ""■ debts and funeral expenses. There is no hint of this re- striction in the Koran, and it rests upon tradition. If the one-third has been exceeded the legacies must be reduced rateably. The heirs, however, by assenting to the legacies, may render them valid even though they exceed the pre- scribed amount.. There is no restriction as to the form of making a will ; it may be either oral or written. A legacy cannot be given to an heir. Mahommedan law contains some very simple and wise provisions for preventing the reckless and often unjust dispositions of property which persons are apt to make upon the approach of death. A*~~

~~*mail who is " sick," that is, who is suffering from illness which ends in death, can only give away one-third of his property; and if he has also made a will containing legacies, the gifts and the legacies must be added together in the computation of the disposable one-third. So long as slaves*~~

~~had a money value, the value of the slaves liberated by a man on his deathbed was also included, which reminds us of the Lex Fuiia Caninia of the Koman law. Another transaction by which the restriction on the testamentary power might be eluded is that called mohabat. By this is meant a transaction in the form of a sale, but which, from the inadequacy of the price named, is obviously intended as a gift. If such a transaction is entered into during " sickness," the loss to the estate would have to be reckoned in computing the disposable one-third. But the mohabat transaction takes precedence of legacies. Another obvious mode of eluding the restriction on the testamentary power is the acknowledgment by a man on his deathbed of a fictitious debt ; and it would seem that such acknowledgments ought to have been put under restriction. But Mahommedans, like other Orientals, have a useful, though possibly a superstitious, dread of leaving the debts of a deceased person unpaid, and it is this, no doubt, which has prevented their questioning the deathbed acknowledgment of a debt, even though there is every reason to believe it to be fictitious. All that has been done is to prescribe that debts of health should be paid before debts of sickness, and that debts cannot be acknow- ledged by a sick man in favour of an heir.~~

~~When a Mahommedan dies, the funeral expenses and the creditors must first be paid ; then the legatees, then~~

~~the claims of the sharers, and, lastly, those of Admiais- j j^g residuaries ; or, if there are neither sharers~~

~~nor residuaries, those of the (so-called) distant kindred. The administration of the estate need present no difBlculties if there are no disputes, and if there is some one empowered to take possession of the property, to get in the debts, to satisfy the creditors, and distribute the assets amongst the various claimants ; and such a per- son may be appointed by a Mahommedan in his will, who will perform these duties. He is called a wasi, and he is in a position very similar to an executor under English law. But if there is no wasi, even if there are no disputes, there may be a good deal of trouble. It would have been in accordance with the spirit of Ma- hommedan law, and with general principles of equity, if an officer of the courts established under British rule had been~~

~~*regularly empowered to take possession of the property, and to take such measures as were necessary to ensure all the claimants being satisfied in their proper order. But this view of their powers has not been taken by the courts in India ; recently, however, they have been enabled by legislation to grant the power of administer- ing the estate to a single person.*~~

~~*There is scarcely any part of Europe or Asia where the creation of fictitious relationships is altogether unknown.*~~

~~*In many cases the object of the creation is Fictitious simply to obtain an heir. This is the object '^sMps."' o^f adoption amongst modern Hindus, and it is*~~

~~*this, no doubt, which has led some persons to speak of Hindu adoption as a rudimentary will. But adop- tion, as such, has never obtained a footing in Mahomme- dan law. The fictitious relationships which that law recognizes are based upon a different idea. There was in early times a widespread notion that every man must belong to some family either as a freeman or a slave. The family to which a slave belongs is always that of his owner, and that of a freeman is generally indicated by his birth. But a liberated slave has no family, at least no r.ecognized family ; and as he cannot stand alone, it was necessary to attach him to some family. Now, just*~~

~~*as in Eoman law the freedman became a member of his master's family under the relationship of patronus and diens, so in Mahommedan law a liberated slave becomes a member of the master's family under the relation- ship called mawalat. The object, of course, was to make the master's family liable for the consequences of the wrongful acts of the freed slave. As a compensation for the liability undertaken by the master's family, in default of residuaries of the slave's own blood (who can only be his own direct descendants), the master's family are en- titled to succeed as what are called "residuaries for special cause." Of course the relationship of master and slave cannot now be created, and it is scarcely probable that any case of inheritance could arise in which it came into question. The relationship of mawalat may, under Mahommedan law, also be created in a case where a freeman is converted to Islam. From a Mahommedan point of view he then stands alone, and would be required*~~

~~*to attach himself to some Mahommedan family. The form of the transaction exactly indicates the nature of it. The party wishing to attach himself says to the person ready to receive him, " Thou art my kinsman, and shaft be my successor after my death, paying for me any fine or ransom to which I may be liable." In this case also the family of the person who receives the convert is entitled, in default of other residuaries, to succeed to him as " residuaries for special cause." But this transaction can have no meaning under English law, which does not recognize the joint responsibility of the family, and it is therefore also obsolete. In the case of mawalat the rights of the persons concerned are not reciprocal. The person received gains no right of inher- itance in the family into which he enters, and incurs no responsibility for their acts. An important part may still be played in Mahommedan law by the creation of relationships by acknowledgment. Any such relationship may be created, provided that the parentage of the person acknowledged is unknown ; a person of known parentage cannot be acknowledged. The age, sex, and condition of the person acknowledged must also be such that the rela- tionship is not an impossible one ; for, as was said in the Eoman law, Jictio naturam imitatur. The relationship thus constituted is, in the case of a father, mother, child, or wife, complete, and must be treated for all purposes as having a real existence. But in any other case the acknow- ledgment, although good as between the parties thereto, has no effect upon the rights of other parties. The acknow- ledgment which we have just been considering contem- plates the possibility at any rate, and in most cases the certainty, that the relationship is entirely fictitious, andhas no connexion with any rule of evidence in whatever sense the term is understood. But there is a rule of Mahomme- dan law that, in cases where the paternity of a child is in dispute, the acknowledgment of the child by the father is conclusive. Whether this would now be maintained in face of the Evidence Act, 1870, which deals with cases of conclusive evidence, and expressly repeals all previously existing rules of evidence, may be doubtful.*~~

~~*Marriage is a transaction based upon consent between a manandawoman, or between persons entitled to represent them. The result of the transaction is that ct'vtain family relationships involving legal rights and duties are created by the law, and these are not wholly*~~

~~*under the control of the parties. But as to some of them, to some extent they may be regulated by agreement, and it is customary amongst Mahommedans at the time of a marriage to come to such an agreement. The only condition necessary to the constituting of a valid marriage between persons of full age is the consent of the parties. It is, however, the practice to conclude the transaction in the presence of two males, or one male and*~~

~~*two female witnesses ; and the omission of this formality would always throw a doubt upon the intention of the parties finally to conclude a marriage. It is even said that the absence of such witnesses would justify a judge in annulling the marriage. Minors of either sex may be given in marriage by their guardian, and the transaction will be irrevocable if the guardian be the father or any direct male ascendant. In any other case the marriage may be repudiated when the minor arrives at the age of puberty, but the repudiation is not effectual until con- firmed by a judge of the civil court. A marriage may be conducted through agents. A woman can have only one husband ; a man can have four wives ; if he married a fifth the marriage would be annulled by a judge on the appli- cation of the woman. Mahommedans have a table of pro- hibited degrees within which parties cannot marry not very dissimilar to that in force in Great Britain. Nor can a man be married at the same time to two women nearly related to each other, as to two sisters. It is also considered that if a woman take a child to nurse she contracts a sort of m aternity towards it, and that if a boy and girl are nursed by the same woman they become brother and sister, and, in a general way, it is said " that whatever is prohibited in consanguinityisprohibitedinfosterage"; but itisdoubtful whether the law goes so far. The widow, or a divorced woman, is not allowed to marry again during her iddut. This is a period of chastity which a woman is bound to observe in order to avoid confusion of issue. If she is pregnant it lasts until the child is born ; if not, then in case of divorce it lasts through three periods of menstrua- tion ; if she is a widow it lasts for four months and ten days. A Mahommedan man cannot marry*~~

~~an idolatress, but Jews and Christians are not thereby excluded, because, although infidels, they are not idolatresses. A woman is forbidden by Mahommedan law to marry any one who is not a Mahommedan ; but if the marriage took place in conformity with the Act of 1872 it might be valid, if it amounibed to a repudiation by the woman of her Mahommedanism. It is important to remember, when considering the validity of a Mahommedan marriage, that a distinction is drawn between marriages which are simply void (batil) and those which can only be annulled by judicial decision (farid), for such a decision has no retro- spective effect, so that the children already born are legiti- mate ; and if no step is taken to obtain such a decision during the existence of the marriage, it cannot be ques- tioned afterwards. What marriages are absolutely void, and what are only capable of being declared void, is not very clearly settled, but the evident leaning of Mahommedan law is against absolute invalidity, and there is strong authority for the opinion that no mar- riages are absolutely void except a marriage by a woman who has a husband living and such as are declared to be iucestuous.~~

~~A Mahommedan has the absolute right to divorce his wife whenever he pleases without assigning any reason whatever for doing so. There are, however. Divorce. ^^^^^ strong social reasons which have consider- able influence in restraining the arbitrary exercise of the power. The power to divorce remains notwithstanding any formal promise by the husband not to exercise it, and it is even said that a divorce pronounced in a state of in- toxication, or by a slip of the tongue, or under coercion, is valid. The divorce can, however, be revoked by the husband, but not after it has been three times pronounced, or after the iddut has been passed by the woman. Nor can the husband remarry his divorced wife unless she has been again married, and has been again divorced or become a widow, and the intermediate marriage must have been consummated. The power to divorce a wife may be en- trusted by the husband to an agent acting on his behalf,~~

~~and this contrivance is sometimes made use of to enable a woman's friends to rid her of her husband if he ill-treats , her. The husband may even empower the wife to divorce herself. If the husband or the wife should happen to die whilst the divorce is still revocable, he or she will~~

~~*inherit ; and even a triple repudiation pronounced during " sick- ness," that is death-sickness, will not deprive the woman of her inheritance if the iddttt has not been passed. Of course there is nothing to prevent the husband and the wife from agreeing to a divorce, and to the terms on which it is to take place, and such an arrangement is very common. The treatment of the wife by the husband is not a ground upon which the marriage can be dissolved, but the im- potence of the husband is a ground of dissolution. The courts in India consider that they have the power under Mahommedan law to grant a decree for the restitution of conjugal rights.*~~

~~*Dower in Mahommedan law is in the nature of a gift from the husband to the wife on the marriage, like the donatio propter nuptias of the Roman law, or the morgengabe of Teutonic nations. It may be "”'*"*~~■

~~*either " prompt," that is, payable at once, or the payment of it may be deferred, or it may be partly the one and partly the other. The amount of the dower and the time of payment ought to be settled by agreement before the marriage takes place ; if this is not done there is some trouble in ascertaining the rights of the parties. It seems clear that a woman is entitled as a matter of right to what is called a " proper " dower. If the dower is payable at once the woman may, before consummation, refuse herself to her husband unless it is paid ; whether she can do so after consummation is doubtful. If the husband capri- ciously repudiates the wife before consummation, or the wife before consummation repudiates the husband for his misconduct, then half the dower agreed on must be paid. If it is her misconduct which has caused the repudiation, she is not entitled to anything. Deferred dower becomes payable on the dissolution of the marriage either by death or by divorce. Probably a judge, when called upon to dissolve or annul a marriage, could make reasonable stijjulations as to the dower. The dower is the wife's own property, and, as the wife is entirely independent of the husband in regard to her property, she can sue him or his representatives for the dower like any other creditor. Mahommedans generally before marriage enter into a formal contract which regulates not only the dower, but various other matters under the control of the parties, such as the visits the wife is to pay or receive, the amount of liberty which she is to have, and so forth.*~~

The right of pre-emption under Mahommedan law is the right of a third person, in certain circumstances, to step in and take the place of a buyer, at the same price and on the same conditions as the buyer ”””,! has purchased. It applies only to the purchase ™” of real property, and it can only be exercised upon one of the three following grounds: — (1) That the claimant is owner of property contiguous to that sold ; (2) That he is a co-sharer in the property of which a share is being sold ; (3) that he is a participator in some right over the pro- perty, such, for example, as a right of way over it. The claimant must announce his claim as soon as he hears of the sale, and he must follow up this announcement by a . further claim in the presence of witnesses and of the seller , or, if possession has been transferred, of the buyer.

Mahommedan law, so far as it is administered by the courts of British India for Sunnis of the Hanafite school — that is, for the great bulk of Mahommedans — has attained a fair degree of precision, owing to the care bestowed on their decisions by the judges of those courts, and the assistance derived from Mahommedan lawyers.

But much difficulty is experienced as soon as we come to deal -with Mahommedans of any other description. No doubt in India any clearly-established custom prevalent amongst a well-defined body of persons would be recog- nized, or any rule of law founded upon texts which they accepted as authoritative. But it is not always easy to determine when these conditions have been satisfied. And to allow Mahommedans to set up a standard of rights and duties different from that of the bulk of their correligionists without this proof would lead not only to confusion but injustice. There is the further difficulty that Mahommedan law, as applied to any Mahommedans except those of the Hanafite school, has as yet been comparatively little studied by modern lawyers, so that very little that is certain can be said

~~*about it. There is, however, a considerable ^"siem hody of Shiahs in India whose legal system*~~

~~*undoubtedly differs in some material particulars from that of the Sunnis. The Mahommedans of Oudh are generally Shiahs, and Shiah families, mostly of Persian descent, are to be found in other parts of India. The following points seem clear. A marriage which the parties agree shall last for a fixed time, even for a few hours only, is a valid marriage, and at the expiration of the time agreed on the marriage ceases to exist. The relatives of the deceased, whether male or female, and whether tracing their connexion through males or females, may be sharers or residuaries. Both as sharers and re- siduaries the children can claim to take the place of their parents in the succession upon the principle of what we call representation. If there are parents or descendants of the deceased, and the sharers do not exhaust the property, the surplus is distributed amongst the sharers of that class in proportion to their shares. If the property is not suffi- cient to pay in full the shares of all the sharers, the shares do not abate rateably ; e.g., as between daughters and the parents, or the husband, or the wife of the deceased, the whole deduction is made from the daughters' share.*~~

~~*Authorities. — Neil Baillie. Digest of MahommeAan Law. London, 1805. — Sir R. K. Wilson. Introduction to the Study of Mahommedan Law. London, 1894 ; Digest of Anglo-Mahommedan Law. London, 1895. — Charles Hamilton. The Hedaya translated. London, 1791. — Syed Ameer All Lectures on Mahommedan Law, 2 vols. Calcutta, 1891, 1894. — Mahomed Ytisoof. Tagore Law Lectures. Calcutta, 1895. — Alfred v. Kremer. CuUur- geschichte des Orients, 2 vols. Vienna, 1875. (w. ma.)*~~

~~*Maidenhead, a municipal borough and market- town in the Wokingham parliamentary division of Berk- shire, England, on the Thames, 24-^ miles west of London by rail. A technical school has been opened ; the remains of a Koman villa have been discovered in the neighbour- hood ; a richly-wooded recreation ground (14 acres) and Kid wells Park (12 acres) have been presented to the town. Population (1881), 8220 ; (1901), 12,980.*~~

~~*Maidstone, a municipal and parliamentary borough and the county town of Kent, England, in the Medway parliamentary division of the county, 47 miles south-south- east of London by rail,, on the river Medway. It is the headquarters of a military district. The Bently Art Gallery was presented to the town in 1890, and the West Kent and General Hospital extended. There are an oil mill, rope, sacking, and twine factories, and cement, lime, and brick works. Famous hop gardens are in the district. Population (1881), 29,623 ; (1901), 33,516.*~~

~~*Maihar, a native state of Central India, in the Baghelkhand agency. Area, about 400 square miles. Population (1881), 71,709 ; (1891), 77,546, showing an in- crease of 8-1 per cent. The estimated revenue is Rs.71,000. The number of schools in 1897-98 was 8, with 247 pupils. The chief, whose title is Raja, is a Hindu of the Jogi sect. The state suffered severely from famine in 1896-97. The*~~

~~*town of Maihar (about 6500) is on the East Indian rail- way, 97 miles north of Jubbulpore.*~~

~~*Malmansingh. See MYMisKTsme.*~~

~~*Maine, the most north-easterly state of the American Union, and by far the largest of the New England states. The development of its resources since 1880 has not produced much change in the tendency of its population, which in 1890 was 661,086, and in 1900 was 694,466, an increase of 6 per cent. The total land surface of the state is about 29,895 square miles, and the average number of persons to the square mile was there- fore 22-1 in 1890 and 23-2 in 1900. The death-rate in 1900 was 17-5. There were in 1900 twenty-five places having a population of more than 4000 inhabitants each and a total population of 251,685. The urban population in 1900, including in this class all persons in cities of more than 8000 inhabitants, was 164,639, or 23-7 per cent, of the total population, as compared with 130,346, or 19-7 per cent., in 1890. There were in 1900 nine of such cities, of which the most important, with their population, were : Portland (50,145), Lewiston (23,761), and Bangor (21,850). Of the total population in 1900, 350,995 (50-5 per cent.) were males and 343,471 were females ; 601,136 (86-6 per cent.) were native-born, and 93,330 foreign-born ; 692,226 (99-7 per cent.) were white, and*~~

~~2240 (only 0-3 per cent.) coloured, including 1319 negroes, 119 Chinese, 4 Japanese, and 798 Indians. Of the total native-born population, it is calculated that 588,000 were Maine-born. There were 215,000 Maine-born people residing in other states. Of the total foreign-born, it is estimated that 53,000 were from the adjacent British provinces, and 11,500 from Ireland. The French-speaking population numbers about 50,000. They are of two quite distinct classes. One, numbering about 15,000, includes those who became citizens by the establishment of the northern boundary in 1842, and their descendants. They are largely of Acadian stock, are good citizens, feeling pride in their allegiance to the Union, and are coming more and more under the iafluence of the public schools. The state has established among them a well-appointed training school for teachers, conducted in the English language, the graduates of which render excellent service in the common schools. The other class is of French-Canadian immigrants, who find profitable employment in the manufacturing centres. With their savings they are building homes and buying abandoned farms. Very few have any desire to return to Canada, or anythoughtof establishing a "French Empire" in New England. At the same time, their numbers are felt in the communities where they reside, and as they show a disposition to become naturalized citizens, their political weight is considerable. Parochial schools are encouraged by their Church, the Roman Catholic, but the young people incline towards the public schools. The colony of Swedes established by the state near its north-eastern border in 1869 has proved in every way successful. These people, who number about 2000, are already in sympathy with American institutions, and their steady increase will go far to make good the loss by removal of some of the best native stock. The shores of Maine, as also its lakes and woods, have become great resorts for tourists and summer residents. It is esti- mated that these sojourners number 250,000 annually, and that their expenditure in the state amounts to $12,000,000.~~

~~FuUic Works. — Tlie United States Government has done much in deepening harbours and river cliannels, removing obstructions, and marlcing the approaches by lights, buoys, and beacons. The state has provided for » thorougli topographical survey, in co- operation witli tlie surveys by the United States. Tlie general government has also given~~

special attention to coast and harbour defences. Obsolete worlcs have been replaced by modei'n fortifica-

tions of the most effective order. The defences of the approaches to Portland have been also greatly extended, so as perfectly to guard the magnificent anchorage-grounds behind the sheltering islands. A coaling station and naval rendezvous has been established on Frenchman's Bay, east of Mount Desert.

Property and Taxes. — The state assessors' valuation of property for purposes of taxation for 1900 was $287,691,790, of which the real estate was 78 per cent., and the personal, 22. The annual increase in the value of real estate during several preceding years averaged over |o,000,000, mostly in buildings and improvements. The increase in personal property was at a much lower rate, and chiefly in value of live stock. The state debt ui 1900 amounted to $2,153,000. The state tax is 2| mills on the doUar, while the average local rate is ten times this.

Banks, <&c. — There were in 1900 thirty-two national banks, with a capital of $10,971,000, and for that year surplus and undivided profits of $4,260,722, and total resources of $41,992,070 ; fifty-one savings banks, with deposits of $71,076,212, by 177,600 depositors ; seventeen trust companies, with capital stock of $1,651,400, and total resources of $11,802,257 ; thirty two loan and building associa tions, with total resources of $2,975,766. The legal rate of inter- est is 6 per cent., but safe investments do not often return more than 4 or 5 per cent. There is no legal limit to rate by contract.

Industries. — The various branches of agriculture still constitute the leading industry of the state. In 1900 there were 59,299 farms, containing 6,299,946 acres, of which about 38 per cent, was improved land. The total value of farm property was $122,410,904, made up as follows : land, improvements, and buildings, $96,502,150; Implements and machinery, $8,802,720; live stock, $17,106,034. The total value of farm products for

~~*the preceding year was $37,113,469. The number and value of the most important farm animals in 1900 were : 173,592 dairy cows, $5,060,048 ; 165,255 other neat cattle, $2,525,497 ; 106,299 horses, $7,058,989 ; 252,213 sheep (excluding lambs), .§751,777 ; 79,018 swine, $516,015. The principal crops and their values in 1899 were: oats, $1,374,573; hay and forage, $10,641,546 ; potatoes, $3,711,999; miscellaneous vegetables, $1,207,075; and orchard fruits, $833,634.*~~

~~*'Mechanical industries have grown in extent and in productive power. General good feeling between employers and workmen prevailing, strikes have not been common. Shipbuilding has re- vived. It IS now carried on at advantageous points, with concen- tration of capital and large use of machinery, and is chiefly directed to vessels for heavy domestic trade. Building is going on at the rate of 5000 tons a month. Iron ships are successfully built at Bath. The Bath Iron Works have a continuous line of contracts for Gov- ernment ships, and keep 1000 men at work all the year. In the cotton factories the employes are mostly French-Canadians, in the woollen factories mostly natives. There are two flourishing plush factories, using the hair of the Angora goat of Asiatic Turkey, and California and Oregon, and of the llama of South America, with some native wools. These goods find a large market in Russia and Japan. There are quarries of granite, of lime, and of slate. Ice is a staple product, amounting in some years to over 3,000,000 tons. A growing industry is sardine-packing, largely carried on in the south-eastern part of the state. The general statistics of manu- factures are shown by the following table :—*~~

~~*Per cent.*~~

~~*1890.*~~

~~*1900.*~~

~~*of Increase.*~~

~~*Number of establish-*~~

~~*ments*~~

~~5,010~~

~~6,702~~

~~33-8~~

~~Capital~~

~~$80,419,809~~

~~$122,918,826~~

~~52-8~~

~~Salaried officials, clerks.~~

;

~~&c~~

~~5,406 1~~

~~3,329~~

~~58-42~~

~~Salaries~~

~~$3,563,635 1~~

~~$3,171,433~~

~~11-02~~

~~Wage-earners (average~~

~~number) ,~~

~~70,374~~

~~*74,816*~~

~~*6-3*~~

~~*Total wages .*~~

~~*$22,962,582*~~

~~*$28,527,849*~~

~~*24-2*~~

~~*Miscellaneous expenses*~~

~~*$5,394,694*~~

~~*$7,774,216*~~

~~*44-1*~~

~~*Cost of materials*~~

~~*$51,520,589*~~

~~*$68,863,408*~~

~~*33-7*~~

~~*Value of products*~~

~~*$95,689,500*~~

~~*$127,361,485*~~

~~*33-1*~~

~~*The following table shows statistics of six leading industries : –*~~

~~*Industry.*~~

~~*Number of Establish- ments.*~~

~~*Wage- earners.*~~

~~*Talue of Products.*~~

~~*Boots and shoes . Cotton goods*~~

~~*Fish, canning and preserving Lumber and timber products Paper and wood pulp . Wool manufactures*~~

~~*48 15 117 838 35 79*~~

~~*6,432 13,723 5,567 6,834 4,851 7,155*~~

~~*$12,295,847 14,631,086 4,779,733 13,489,401 13,223,275 13,412,784*~~

~~*1 Includes proprietors and firm members, with their salaries. 2 Decrease.*~~

~~*Lumber and Wood Pulp. — There are 21,000 square miles of forest. The pine region of the south-west is well cut over, and owners of these lands are taking pains to promote new growth. Spruce is now the chief tree. This is worked into long lumber to the extent of 250,000,000 feet a year, and into pulp for paper to the extent of 350,000,000 feet. In the former great advance has been made in the process of manufacture, chiefly by economies in ma^ chinery and motive power. The pulp industry has advanced rapidly. Large tracts of timber lands have been bought and ex- tensive mills built. Some of the finest of book-paper is made here. The advent of this immense pulp industry has given rise to fears of the rapid destruction of the forests, with serious detriment to nat- ural conditions, such as rainfall, water-storage, climate, &c. ; but the necessity of securing a long supply of material for such costly plants will lead to the adoption of rigid and intelligent economy, so that, as one consequence of the pulp operations, a system of forestry will supersede the reckless waste of old lumber operations under "permits" from distant owners.*~~

~~*Railways. — The total mileage of steam railways in Maine in 1901 was 1919 miles. The capitalization of these within the state is $63,955,121.*~~

The gross earnings within the state for the year ending 30th June 1901 amounted to ■510,930,003. Numerous elec- tric street railways have been constructed, with a total mileage on 30th June 1901 of 286 miles, and an investment value of about eight million dollars. The gross earnings for the year were over one million dollars ; and the number of passengers carried was nearly twenty millions. The principal railway systems are the Boston and Maine, Maine Central, Grand Trunk, Canadian Pacific, Bangor and Aroostook, Rumford Falls, and Washing- ton County lines. Several new lines connecting with the Maine Central are being built. The most remarkable of interior develop- ments has been brought about by the Bangor and Aroostook rail- way opening up in the three north-eastern counties an area of over 4,000,000 acres — almost equal to that of the state of Massachu- setts. These lands are fertile, well wooded and watered, with abundant water-power. Every available tract of timber on the line of this railway lias been taken up for the purpose of some form of manufacture. Mills have been erected with an annual capacity of 125,000,000 feet of long lumber. Other wood products have been transported by this railway amounting to 226,000 tons a year. A pulp and paper mill is under construction, of an annual capacity of 120,000 tons. The soil in this region is well adapted to the raising of grain, in which there is accordingly a rapid increase. Five mill- ion bushels of potatoes go out to market each season, and fifty starch factories in Aroostook county consume three million bushels more. Every industry feels the stimulus of better facilities for moving products. This railway has already 325 miles in operation, and is pushing its branches wherever opportunities offer.

Trade, Domestic and Foreign. — Foreign trade is mostly for the foreign account, and is carried on in foreign ships. Much of this is for the Canada trade connected with the Grand Trunk railway. The value of the exports through the port of Portland for the year ending 30th June 1900 is seen in the following items : do- mestic, $9,731,373; foreign (Canada), $8,3.33,407 ; from frontier ports, $14,708,285 ; a total of $32,773,065. The value of the imports for the same period was : domestic consumption, $782,863 ; in transit, $8,254,064 ; a total of $9,036,927, and grand total of business, 541,809,992. The amount of duties assessed at this port was $5,524,707, of which only $98,297 was collected here, the balance being settled in other ports. The total amount of collections here, however, for

~~*the fiscal year 1900 from all sources was $129,271, an increase over the same for the previous year of $30,000. A very large amount of foreign business is done here which is without pecuniary benefit to the United States revenue, and which does not appear in any reports published by the Government.*~~

~~*Education. — The percentage of illiterates in this state is very low, and among the families of the original stock is almost inap- preciable. Among the native-bom adult males, 5671, out of a total of 178,931, or 3-2 per cent, were unable to write; while among the foreign-born, 8281, out of a total of 38,732, or 21-4 per cent., were unable to write. Out of all adult males, 6-4 per cent, were unable to write. The laws requiring school attendance for at least 16 weeks in each year of children under 15 years of age employed in factories are strictly enforced. The number of pupils in the public schools is about 200,000 ; the teachers number 6500; the annual school expenditure is §1,600,000. There are four normal schools for the training of teachers, with a total average attendance of 485. Besides the high schools connected with the public school system, there are thirty- seven academies for secondary instruction, with a permanent investment of nearly $50,000 and an average attendance of 2400. Great advance has been made in the means and methods of superior instruction. The leading colleges in the state are Bowdoin, Colby, Bates, and the University of Maine (College of Agriculture and Mechanic Arts). They have a total annual at- tendance of students averaging 1033, with 88 academic instructors*~~

~~*and a total endowment of $3,059,200. They are receiving generous gifts from friends, especially for libraries and laboratories. Not less than half a million dollars have lately been so given to Bovp- doin. The Congregationalists have a theological seminary at Bangor, and the Free Baptists one at Lewiston. A law school has been established at Bangor connected with the University at Orono. The Maine Medical School, attached to Bowdoin College, is an institution of the first class. Free public libraries are rapidly extending through the towns.*~~

~~*Charitable Institutions. — Among institutions of a charitable or remedial nature are the Maine General Hospital at Portland, and similar establishments at Lewiston and Bangor ; the Asylum for the Insane at Augusta, and another at Bangor ; the Eye and Ear Infirmary, and School for the Deaf at Portland. Other institutions of similar general character are the Soldiers' Orphans' Home at Bath ; the Industrial School for Girls at Hallowell ; the Good Will Farm at Fairfield ; and perhaps to be classed here, the Reform School for Boys at Portland, although this is in some aspects a penal institution. The National Home for Volunteer Soldiers at Togus and the Marine Hospital at Portland are institutions of the national Government.*~~

~~*Military. — There is an effective militia organization in the state, from which a volunteer regiment of infantry and four batteries of artillery — an aggregate of 1821 officers and men — were furnished for the Spanish war, in addition to detachments for the U.S. Volunteer Signal Service, Engineers, and Naval Reserve, and others for the regular army.*~~

~~*Liquor Laws. — The prohibitory liquor law, although supported by a recent constitutional amendment to a similiar effect, labours under the disadvantage of all laws not vigorously sustained by general public sentiment. For the most part it is executed to the degree demanded by local sentiment in the several municipalities, thus operating in practice much the same as a " local option " law. This is not through default of moral sense among the people ; it is simply a question of expediency as to what measures will best, with least attendant evil, restrain indulgence in intoxicating liquors. On this the judgment of fair-minded citizens is divided. The present ■ law looks to checking the demand by preventing the supply ; and since habitual reliance on the stringency of law tends to the neglect of other influences for the removal of evils from the community, the citizens seem to absolve themselves from personal responsibility both for the execution of the law and for the exist- ence of the evil itself. At the same time, the existing law sets a standard of moral conduct for the community, which is supposed to express its best sentiment ; and even though it fails fully to effect its immediate object, the people would probably be unwilling to repeal the legal and constitutional prohibition. (See Liquor Laws.)*~~

~~*Seligion. — The most prominent religious denominations are the Congregationalists, who have 250 churches and 21,600 members ; the Baptists, with 249 churches and 20,051 members ; the Method- ists, 304 churches and 19,483 members ; the Free Baptists, 240 churches and 13,703 members ; and the Roman Catholics, who report 86 churches and a Catholic population of 96,400. Re- ligious tendencies are towards practical rather than dogmatic questions — towards a liberalizing of the scholastic creeds and closer fellowship of all Christians. (j. l. c.)*~~

~~*Maine, Sir Henry James Sumner (1822- 1888), the principal founder in Great Britain of tlie historical and comparative study of jurisprudence, was born on 16th August 1822. He was at school at (Jhrist's Hospital, and thence went up to Pembroke College, Cambridge, in 1840. At Cambridge he was one of the most brilliant classical scholars of his time. Some of his Greek translations from English poetry are preserved in Arundines Omni. He took a*~~

~~*in the later editions of Village Communities, which was the first characteristic evidence of his genius. Mean- while he had become one of the Readers appointed by the Inns of Court, in the first of their many half-hearted attempts at legal education, in 1852. Lectures delivered by Maine in this capacity were the groundwork of Ancient Law, published in 1861, the book by which his reputation was made at one stroke. Its object, as mod- estly stated in the preface, was "to indicate some of the earliest ideas of mankind, as they are reflected in Ancient Law, and to point out the relation of those ideas to modern thought." Within a year of its pub- lication the post of Legal Member of Council in India was offered to Maine, then a junior member of the Bar with little practice, few advantages of connexion, and no political or official claims ; in short, with none of the common qualifications. He declined once, on grounds of health ; the very next year the office was again vacant. This time Maine was persuaded to accept, not that his health had improved, but that he thought India might not make it much worse. It turned out that India suited him much better than Cambridge or London. His work, like most of the work done by Englishmen in India in time of peace, was not of a showy kind ; its value is shown by the fact that he was asked to prolong his ser- vices beyond the regular term of five years, and returned to*~~

~~England only in 1869. The subjects on which it was his duty to advise the Government of India were as much political as legal. They ranged from such problems as the land settlement of the Punjab, or the introduction of civil marriage to provide for the needs of unorthodox Hindus, to the question how far the study of Persian should be required or encouraged among European civil servants. On the civil marriage question in particular, and some years earlier on the still more troublesome one of allowing the remarriage of native converts to Christi- anity, his guidance, being not only learned but statesman- like, was of the greatest value. Plans of codification, moreover, were prepared, and largely shaped, under Maine's direction, which were carried into effect by his successors Fitzjames Stephen and Mr Whitley Stokes. The results are open to criticism in details, but form on the whole a remarkable achievement in the conversion of unwritten and highly technical law into a body of written law sufficiently clear to be administered by officers to many of whom its ideas and language are foreign. All this was in addition to the routine of legislative and consulting work, and the establishment of the legislative depart- ment of the Government of India on substantially its present footing.~~

~~Maine's power of swiftly assimilating new ideas and appreciating modes of thought and conduct remote from modern Western life came into contact with the facts of Indian society at exactly the right time, and his colleagues and other competent observers expressed the highest opinion of his work. In return Maine brought back from his Indian office a store of knowledge which enriched all his later writings, though he took India by name for his theme only once. This essay on India was his contribu- tion to the composite work entitled Tlie Reign of Queen Victoria (ed. T. H. Ward, London, 1887). Not" having been se])arately published, it is perhaps the least known of]\laine's writings ; but its combination of just perception and large grasp with command of detail is not easily matched outside Bishop Stubbs's prefaces to some of the chronicles in the Rolls series. As vice-chancellor of the University of Calcutta Maine commented, with his usual pregnant ingenuity, on the results produced by the con- tact of Eastern and Western thought. Three of these addresses were published, wholly or in part, in the later editions of Village Communities ; the substance of others~~

~~is understood to be embodied in the Cambridge Eede lecture of 1875, which is to be found in the same volume. The practical side of M;une's experience was not long lost to India ; he became a member of the Secretary of State's council in 1871, and remained so for the rest of his life. In 1869 Maine was appointed to the chair of historical and comparative jurisprudence newly founded in the University of Oxford by Corpus Christi College. Residence at Oxford was not required, and altogether the election amounted to an invitation to the new professor to resume and continue in his own way the work he had begun in Ancient Law. During the next eight years he published the principal matters of his lectures in a care- fully revised literary form : Village Communities in the East and the West, 1871 ; Early HIstory of Institutions, 1875 ; Early Law and Custom, 1883. In all these works the phenomena of societies in an archaic stage, whether still capable of observation or surviving in a fragmentary manner among more modern surroundings or preserved in contemporary records, are brought into line, often with quite peculiar felicity, to establish and illustrate the normal process of develop- ment in legal and political ideas.~~

~~In 1877 the Mastership of Trinity HIall, Cambridge, where Maine had formerly been tutor, became vacant. There were two strong can- didates whose claims were so nearly equal that it was difficult to elect either ; the difficulty was solved by a unanimous invitation to Maine to accept the post. HIs acceptance entailed the resignation of the Oxford chair, though not continuous residence at Cambridge. Ten years later considerations of a somewhat similar kind led to his election to succeed Sir William HIarcourt as Whe- well professor of international law at Cambridge. HIs all~~

~~too short performance in this office is represented by a posthumous volume which had not received his own final revision (International Law, 1888).~~

~~*Meanwhile Maine had published in 1885 his one work of speculative politics, a volume of essays on Popular Government, designed to show that democracy is not in itself more stable than any other form of government, and that there is no necessary connexion between democracy and progress. The book was deliberately unpopular in tone ; it excited much controversial comment and some serious and useful discussion.*~~

~~*In 1886 there appeared in the Quarterly Review (clxii. 181) an article on the posthumous work of J. F. M'Lennan, edited and completed by his brother, entitled "The Patriarchal Theory." The article, though neces- sarily unsigned, was Maine's reply to the M'Lennan brothers' attack on the historical reconstruction of the Indo-European family system put forward in Ancient Law and supplemented in Early Law and Custom. Maine was generally averse from controversy, but showed on this occasion that it was not for want of controversial power.*~~

~~*Sir Heney (From aphotograjjh l)y Fredk, IToUyer*~~

~~*He carried the war back into the invader's country, and charged J. F. M'Lennan's theory of primitive society with owing its plausible appearance of universal validity to general neglect of the Indo-European evidence and mis- apprehension of such portions of it as M'Lennan did attempt to handle.*~~

~~*Maine's health, which had never been strong, gave way towards the end of 1887. He went to the Riviera under medical advice, and died at Cannes on 3rd February 1888. He left a wife and two sons, of whom the elder died soon afterwards.*~~

~~*An excellent summary of Maine's principal writings may be seen in Sir Mountstuart Grant Duff's memoir. The prompt and full recognition of Maine's genius by Continental publicists must not pass unmentioned even in the briefest notice. France, Germany, Italy, Russia*~~

~~*have all contributed to do him honour ; this is the more remarkable as one or two English publicists of an older school signally failed to ap- preciate him. Maine warned his countrymen against the insularity which results from ignorance of all law and in- stitutions save one's own ; his*~~

example has shown the benefit of the contrary habit. His prominent use of Roman law and the wide range of his observation have made his works as intelligible abroad as at home, and thereby much valuable information — for ex- ample, concerning the nature of British supremacy in India, and the position of native in- stitutions there — has been made the property of the world of letters instead of the peculiar and obscure pos- session of a limited class of British public servants. For- eign readers of Maine have perhaps understood even bet- ter than English ones that he is not the propounder of a system but the pioneer of a method, and that detailed criticism, profitable as it may be and necessary as in time it must he, will not leave the method itself less valid or diminish the worth of the master's lessons in its use. The rather small bulk of lilaine's published and avowed work may be accounted for partly b3' a fine literary sense which would let nothing go out under his name unfinished, partly by the drawbacks incident to precarious health. Maine's temperament was averse from the labour of minute criti- cism, and his avoidance of it was no less a matter of prudence. But it has to be remembered that Maine also wrote much which was never publicly acknowledged. Before he went to India he was one of the original con- tributors to the Saturday Review, founded in 1855, and the inventor of its name. Like his intimate friend Fitzjames Stephen, he was an accomplished journalist, enjoyed occasional article-writing as a diversion from official duties, and never quite abandoned it. The prac- tice of such writing probably counted for something in the freedom and clearness of Maine's style and the effec- tiveness of his dialectic. His books are a model of scientific exposition which never ceases to be literature.

Maine. of the painting by Lowes Dickinson.)

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~~*Diet. Nat. Biogr. Lond. 1893. — "Sir Henry Maine as a Jurist," JEdin. Mev., July 1893. (r. PC.)*~~

~~*Maine-et-Loire, a department of the west of Prance, watered by the Loire and its affluent the Maine, which is itself formed by the confluence of the Mayenne and the Sarthe.*~~

~~*Area, 2812 square miles. From 527,680 in 1886 the population decreased to 513,208 in 1901. The births in 1899 numbered 9404, of which 595 were illegitimate; deaths, 10,054; marriages, 3843. There were in 1896, 979 primary schools, with 62,000 pupils, the illiterate constituting 5 per cent, of the population. The area under cultivation amounted (1896) to 1,624,193 acres, of which 1,132,738 acres were plough-land and 99,323 acres vineyards. Of consider- able agricultural wealth, the department in 1899 produced wheat valued at £1,718,000; barley, £104,000; oats, £312,000; vines, £600,000; potatoes, £340,000; mangold-wurzel, £132,000; hemp, in harl and in seed, £56,000 ; flax, in harl and in seed, £34,000 ; walnuts, £16,000. The live stock included (1899) 63,620 horses, 277,220 cattle, 59,250 sheep, and 100,000 pigs. Mining in 1898 produced 14,600 tons of coal, but there is no industry in metals. The slate quarries of Angers are noted for their abundance and quality. The manufacture of hempen and other textile stuffs is in an advanced state. Angers, the capital, in 1901 had 82,966 inhabitants.*~~

~~*Mainpuri, a town and district of British India, in the Agra division of the North- West Provinces. The town is on the Agra branch of the Grand Trunk road, 36 miles from the station of Shikohabad. Population (188]), 20,236; (1891), 18,651. Eegistered death-rate (1897), 41-8 per thousand. The municipal income in 1897-98 was B.s.16,580, the incidence of taxation being 12 annas per head. It has a speciality of wooden articles inlaid with wire. The American Presbyterian mission manages a high school.*~~

~~*The district of Mainpuri lies in the central Doab. Area, 1701 square miles; population (1881), 801,216; (1891), 762,163; (1901), 829,350, showing a decrease of 5 per cent, between 1881 and 1891, and an increase of 8-8 between 1891 and 1901 ; average density, 487 persons per square mile. The land revenue and rates are Rs.l4,86,83o, the incidence*~~

~~*of assessment being R.1.2.4 per acre; cultivated area (1896-97), 494,779 acres, of which 395,831 were irrigated from wells, &c., including 176,754 from Government canals ; number of police, 2392 ; number of vernacular schools (1896-97), 121, with 3744 pupils. The registered death-rate in 1897 was 36 per thousand. The district is watered by two branches of the Ganges canal, and is traversed for 23 miles by the main line of the East Indian railway, with two stations. Indigo is an important crop, grown on 35,000 acres, with an out-turn valued at Rs.4,71,000.*~~

~~*Mainz, in French Mayence, a first-class fortress, river port, and bishop's see of Germany, grand-duchy of Hesse- Darmstadt, on the left bank of the Rhine (q.v.), almost directly opposite the influx of the Main, though the fortress, manned by a garrison of 8000 men, belongs to the empire. Since the defensive works were pushed back in 1871, a new quarter of straight wide streets, intersecting at right angles, has been built on the north of the old town, room being also found for two spacious harbours, completed in 1887 at a cost of a quarter of a million sterling. The river front has been converted into a fine promenade, over 300 feet wide, and planted with trees. From the middle of it an equally wide and hand- some street, the Kaiserstrasse, goes from the Rhine to the new central railway station (1884), and at the same time separates the new town from the old town. In 1881-85 a new bridge of five arches (the centre arch with a span of 335 feet) was thrown across the Rhine to the opposite suburb of Kastel. The concert hall (a handsome Renais- sance building) on the Rhine promenade, the concert hall (1890) of the Mainz Musical Society, the new classical*~~

~~*school (gymnasium), the imperial bank (1894), and the offices of the Hesse-Ludwig Railway Company, and Christ Church (1899-190()) are the more noteworthy of modern public buildings. Oi the older, the church of St Stephen's (1257-1328 ; restored in 1857) and St Emmeran's (restored in 1881) should be mentioned. Mainz has theological seminaries and an industrial art school. There is a very considerable trade, by river and rail, principally in wine, cereals and flour, timber, petroleum, paper, iron and steel, and vegetables. The industries are chiefly concerned with the production of artistic furniture and leather goods, carriages, vegetables*~~

~~*(asparagus, &c.), preserved foods for the army, tobacco, boots, pianos, varnishes, books, &c. Population (1885), 65,852 ; (1900), 84,336.*~~

~~*Maitland, East and West, adjoining munici- palities, in New South Wales, Australia, in the county of Northumberland, 120 miles north of Sydney by rail, on the Hunter river about 4 miles above the limit of navigation for steamers. They are the centre of the agricultural district of the Hunter valley. Public build- ings include a large town hall (1890), court-house, and new masonic hall. West Maitland is protected from floods by stone embankments built at a cost of £30,000, and flood-gates costing £12,000 have been erected on Wallis Creek at East Maitland. Population of West Maitland (1881), 6703 ; (1901), 6798 ; of East Maitland*~~

~~*(1881), 2302 ; (1901), 3287.*~~

~~*Majorca, or Malloeca. See Balearic Islands.*~~

~~*Makart, Hans (1840-1884). See Schools of Painting (Austria).*~~

~~*Malabar, a district of British India, in the Madras presidency. Geographically the name is sometimes extended to the entire western coast of the peninsula. Properly it should apply to the strip below the Ghats, which is inhabited by people speaking the Malayalam language, a branch of the Dravidian stock, who form a peculiar race, with castes, customs, and traditions of their own. It would thus be coextensive with the old kingdom of Chera, including the modern states of Travancore and Cochin, and part of Kanara. In 1891 the total number of persons speaking Malayalam was 5,428,250.*~~

~~*The district of Malabar extends for 145 miles along the coast, running inland to the Ghats for a breadth varying from 70 to 25 miles. The administrative headquarters are at Calicut. Area, 5585 square miles; population (1881) 2,365,035; (1891), 2,652,565; (1901), 2,788,043, showing an increase of 12 per cent, between 1881 and 1891, and of 5-1 per cent, between 1891 and 1901 ; average density, 499 persons per square mile, being the second highest in the province. The land revenue and rates in 1897-98 were Rs.23,41,854, the incidence of assessment being Es.2.2.9 per acre; cultivated area, 959,239 acres, of which 39,344*~~

~~were irrigated from tanks, &c. ; number of police, 1463; boys at school (1896-97), 66,274, being 33-6 of the male population of school-going age; girls at school, 18,499, being 9-2 per cent. ; registered death-rate (1897), 30-2 per thousand, the mortality from cholera alone having been 10-4 per thousand. The one staple crop is rice, the next most important product being cocoa-nuts. Coffee is grown on 17,872 acres, chiefly in the upland track known as the Wainad, where also there are 855 acres under tea. The chief means of communi- cation is by the backwaters or lagoons, which form almost a com- plete chain along the coast. The Madras railway crosses the district for 90 miles, and is being extended from Calicut to Canna- nore (62 miles). There are 11 seaports, of which the principal are Calicut, Tellioherry, Cannanore, and Cochin. In 1897-98 the sea- borne trade was valued at Rs.6,27,14,875, the principal exports being coSee, cocoa-nut products, and timber. There are factories for cleaning coffee, pressing coir and making matting, making tiles, sawing timber, and weaving cotton.~~

~~Malacca, a town situated on the west coast of the Malay Peninsula, in 2° 14' N. and 102° 12' E., which gives its name to the strait dividing the island of Sumatra from the mainland. Its name, which is more correctly transliterated Mgl^ka, means a species of jungle fruit,~~

~~and is also borne by a river on the right bank of which the old Dutch town stands, being connected by a bridge with the business quarter on the left bank, which is inhabited almost exclusively by Chinese, Eurasians, and Malays.~~

~~Malacca, now a somnolent little town, visited by few ships, and holding the least important position of all the three settle- ments in that strait, has a remarkable history. An account of it given in 1503 by a Roman youth, Ludovigo Barthema, called Vertomannus in Eden's translation of 1576, shows that even at that time Malacca was one of the most important centres of trade in the East. Its Malay sultan was perhaps the most considerable chief of his race, and was certainly more powerful than any~~

other ruler then living in the Peninsula. Malacca is also one of the oldest European settlements in eastern Asia, it having been wrested from Sultan Muhammad Shah by Albuquerque in 1511, in punishment for an attack made in 1509 on his lieutenant Sequeira. It was held by the Portuguese until 1641, when the Dutch, with the help of the Aohinese, succeeded in capturing the citadel, several attempts to take it having previously been made without success. It was under the Portuguese Government that St Francis Xavier started a mission in Malacca, the first Christian mission to Malayan lands. The Dutch held Malacca until 25th August 1795, when it was taken from them by a British expedition, and the Dutch Government was dissolved on 4th December of the same year. The British administration under Admiral Mainwaring abolished the system of monopoly in the Straits, as Raffles did afterwards throughout Malaya in 1813. In 1818 Malacca was restored to the Dutch under the Treaty of Vienna, but in 1824 it came finally into the hands of Great Britain, being exchanged by a treaty with Holland for the East India Company's settlement of Bencoolen and a few other unimportant places on the western coast of Sumatra. By this treaty the Dutch were precluded from interference in the affairs of the Malay Peninsula, and Great Britain from similar action in regard to the states of Sumatra, with the sole exception of Acheen, the right to protect which state was not abandoned by Great Britain until 1872 by the treaty concluded with Holland in that year. It was not until 1833 that the whole territory lying to the back of Malacca was finally brought under British control, and as late as 1887 the NSgri SSmbilan, or Nine States, which adjoin Malacca territory on the ea^t and north-east, were completely independent. They now, with the state of Sungei Ujong, form part of the Federated Malay States under British protection. Malacca is administered by a resident councillor, who is responsible to the governor of the Straits Settlements, and by a number of district officers and other officials under his direction. The population of the town and territory of Malacca in 1901 was 95,487, of whom only 74 were Europeans and Americans, 1598 were Eurasians, the rest being Asiatics (chiefly Malays, with a considerable sprinkling of Chinese). The population in 1891 was 92,170. The birth-rate in 1898 was 35 per thousand, the death- rate 28-97. The revenue for 1898 amounted to •$376,335, and the expenditure to $393,411. In 1900 the imports totalled §2,322,036, and the exports $2,787,128. During 1898, 1503 ships, with an

~~aggregate tonnage of 306,580, entered the port of Malacca ; this will serve to show how completely the trade of this once ilourishing port has declined, most of the vessels being merely coasting craft, and no large line of steamers holding any communication with the place. This is accounted for partly by the shallowness of the har- bour, and partly by the fact that the ports of Penang and Singapore, at either entrance to the Strait of Malacca, draw all the trade and shipping to themselves. Malacca is chiefly remarkable for the number of wealthy retired Chinese merchants who resort thither to pass the years of their old age in preference to returning to China, where they would become a prey to the avarice of Chinese officials.~~

~~See Newbolt. History of Malacca (long out of print). — Ca.iieeon. Our Tropical Possessions in Malayan India. — Dudley Hekvey. Journal of the Straits Branch of the Royal Asiatic Society, Singapore. — Straits Directory, 1900, Singapore.~~

~~(h. cl.)~~

~~Malacostraca. — Under the zoological title Mala- costraca are included several groups of Crustacea {q.v.), united by characters which attest their common origin, though some, and probably all of them, were already separated in distant geological ages, and some have now attained a peculiar isolation. Throughout the whole, the researches made since 1860 have not only added a great throng of new species, genera, and families, but have thrown a flood of light upon questions of their phylogeny, systematic arrangement, horizontal and bathymetric distribution, organization, habits of life, and economic importance. There are at least seven~~

~~orders : the stalk-eyed Brachyura, Macrura, Schizopoda, Stomatopoda, and the sessile-eyed Sympoda, Isopoda, Amphipoda. An ocular segment claimed by the former division is not present or in no case demonstrable in the latter. In neither does the terminal segment or telson, whether large or obsolescent, whether articulated or coalescent, carry appendages, unless occasionally in fusion with itself. Between the eyes and the tail-piece in all the orders nineteen segments are counted, the proof of a segment's existence depending on its separateness, com- plete or partial,~~

or on a sutural indication, or else on the pair of appendages known to belong to it. All these marks may fad, and then the species must be proved to be Malacostracan by other evidence than the number of its segments ; but if some exceptions exhibit fewer, none of the Malacostraca exhibit more than 19 (-)-lor|-2) segments, unless the Nebaliidae be included. Of the corresponding pairs of appendages thirteen belong to the head and trunk, two pairs of antennae, one pair of mandibles, two pairs of maxillae, followed by three which may be all maxillipeds or may help to swell the number of trunk-legs to which the next five pairs belong. The abdomen or pleon carries the remaining six pairs, of which from three to five are called pleopods and the remainder uropods. Underlying the diversity of names and functions and countless varieties of shape, there is a common standard to which the appendages in general can be referred. In the maxillipeds and the trunk-legs it is common to find or otherwise easy to trace a seven-jointed stem, the endo- pod, from which may spring two branches, the epipod from the first joint, the exopod from the second.^ The first antennae are exceptional in branching, if at all, at the third joint. In the mandibles and maxillae some of the terminal joints of the stem are invariably wanting. In the rest of the appendages they may either be wanting or indistinguishable. The latter obscurity results eitherfrom coalescence, to which all joints and segments are liable, or from subdivision, which occasionally affects joints even in the trunk-legs. The carapace, formerly referred only to the antennar-mandibular segments, may perhaps in fact contain elements from any number of other segments of head and trunk, Huxley, Alcoek, Bouvier giving support to this opinion by the sutural or other divisional lines in Potamobhis, NepJirops, Thalassiita, and various fossil genera. Not all questions of classification internal to this division are yet finally settled. Between the Brachyura and Macrura some authors uphold an order Anomura, though in a much restricted sense, the labours of Huxley, Boas, Alcoek, and conjointly Alphonse Milne-Edwards and Bouvier, having resulted in restoring the Dromiidea andEaninidae to the Brachyura, among which de Haan long ago placed them. The French authors argue that from the macruran lobsters (Nephropsidce) anciently diverged two lines, one leading through the Dromiidea to the genuine Brachyura or crabs, the other independently to the Anomura proper, which may conveniently be named and classed as Macrura anomala.

~~Spence Bate maintained that the Schizopoda ought not to form a separate order but to be ranged as a macruran tribe, " more nearly allied to the degraded forms of the Penseideathan to those of any other group" {"Challenger" Reports, "Macrura," p. 472, 1888). According to Sars, the Sympoda (or Cumaceans), in spite of their sessile eyes, have closer affinities with the stalk- eyed orders. H. J. Hansen and others form a distinct order Tanaidea for the decidedly anomalous group called by Sars Isopoda chelifera.~~

~~Brachyuea. — For the present, as of old, the true Brachyura are divided into four tribes : — Cyclometopa, with arched front as~~

~~1 In Huxley's terminology the first two or three joints of the stem constitute a " protopodite," from which spring the " endopodite " and " exopodite."~~

~~in the common eatable crab ; Catometopa, with front bent down as in the land-crabs and the little oyster-crab ; Oxyrhyncha, with sharpened beak-like front- as in the various spider-crabs ; Oxystomata, including the Raninidae, and named not from the character of the front but from that of the buccal frame which is usually narrowed forwards. In these tribes the bold and active habits, the striking colours, or the fantastic diversities of structure, have so long attracted remark that recent investigations, while add- ing a multitude of new species and supplying the specialist with an infinity of new details, have not materially altered the scientific standpoint. New light, however, has been thrown upon the "intellectual " capacity of Crustacea by the proof that the spider- crabs deliberately use changes of raiment to harmonize with their surroundings, donning and doffing various natural objects as we do our manufactured clothes. Others have the power of producing sounds, one use to which they put this faculty being apparently to signal from their burrow in the sand that they are "not at home " to an inopportune visitor. Deep-sea exploration has shown that some species have an immensely extended range, and still more, that species of the same genus and genera of the same family,~~

~~*though separated by great intervals of space, may be closely allied in character. A curious effect of parasitism, well illustrated in crabs, though not confined to them, has been expounded by Professor Giard, namely, that it tends to obliterate the secondary sexual characters. Modern research has discovered no crab to sur- pass Maorocheira Jcdmpferi, de Haan, that can span between three and four yards with the tips of its toes, butattheother end of the scale it has yielded Oollodes malabaricus, Aloock, " of which the carapace, in an adult and egg-laden female, is less than one-sixth of an inch in its greatest diameter." The most abyssal of all crabs yet known is Ethusina abyssicola, Smith, or what is perhaps only a variety of it, E. challengeri, Miers. Of the latter the Albatross obtained a specimen from a depth of 2232 fathoms (Faxon, 1895), of the former from 2221 fathoms, and of this S. I. Smith remarks that it has "distinctly faceted black eyes," although in them " there are only a very few visual elements at the tips of the immobile eye-stalks."*~~

~~*The Brachyura anomala or Dromiidea "have preserved the external characters and probably also the organization of the Brachyura of the Secondary epoch " (Milne-Edwards and Bouvier, 1901). They agree with the true crabs in not having appendages (uropods) to the sixth segment of the pleon, the atrophy being complete in the Homolidse and Homolodromiidse, whereas in the Dromiidse and Dynomenidee a pair of small plates appear to be vestiges of these organs. In the family Homolidse stands the strange genus Latreillia (Roux), with long slender limbs and triangular carapace after the fashion of oxyrhynch spider-crabs. In Homola the carapace is quadrilateral. Between these two a very interesting link was discovered by the Challenger in the species Lalreillopsis bispinosa, Henderson. Bouvier (1896) has shown that Palceinachus longipes, Woodward, from the Forest Marble of Wiltshire, is in close relationship, not to the oxyrhynch InachidsB, but to the genera Hom^olodromia and Dicranodromia of the Homolodromiidae, and that the Jurassic crabs in general, of the family Prosoponidse (Meyer), are Dromiidea.*~~

~~*2. Macrura. — The Macrura anomala, or Anomura in restricted sense, are popularly known through the hermit-crabs alone. These only partially represent one of the three main divisions Paguridea, Galatheidea,*~~

~~*Hippidea. The first of these is subdivided into Parjurinea, Lithodinea, Lomisinea, each with a literature of its own. Among the Pagurinea is the Birgus latro or robber-crab, whose expertness in climbing the cocoanut palm need no longer be doubted, since in recent years it has been noted and photo- graphed by trustworthy naturalists in the very act. Alcock "observed one of these crabs drinking from a runnel of rain-water, by dipping the fingers of one of its chelipeds into the water and then carrying the wet fingers to its mouth." Hermits of the genus CrjenobUa he found feeding voraciously on nestling sea-terns. That pagurids must have the usually soft pleon or abdomen pro- tected by the shell of a mollusc is now known to be subject to*~~

~~*be equal to the demand, and Nature has not arranged that the borrowed tenement shall continue to grow with the growth of its new tenant. To meet these defects it is found that numerous species encourage or demand the companionship of various zoophytes, simple or colonial. These sometimes completely absorb the shell on which they are settled, but then act as a substitute for it, and in any case by their outgrowth they extend the limits of the dwelling, so that the inmate can grow in comfort without having to hunt or fight for*~~

~~*Fig. 1. — N&oUthodes grimaldii, A. Milne-Edwards and Bouvier.*~~

~~*a larger abode. Among the Lithodinea or stone-crabs, besides important readjustments of classification (Bouvier, 1895, 1896), should be noticed the evidence of their cosmopolitan range, and the species Neolithodes agassizii (Smith) and N. grimaldii, Milne- Edwards and Bouvier, which carry to an extreme the spinosity characteristic of the group (Fig. 1). S. I. Smith's investigations on the early stages of Hippa talpoida. Say, were published in 1877.*~~

~~*With regard to the accessions to knowledge in the enormous group of the genuine Macrura, reference need only be made to the extensive reports in which Spence Bate, S. I. Smith, Faxon, Wood-Mason, Alcock, and others have made known the results of celebrated explorations. Various larval stages have been successfully investigated by Sars. Alcock (1901) describes from his own observation the newly hatched Phyllosoma larva of Thenus orientalis (Fabricius). An admirable discrimina- tion of the*~~

larval and adult characters of the genus Sergestes has been given by H. J. Hansen (Proc. Zool. Svc, London, 1890). Singularity excites our wonder in Tliaumastocheles zaleucus (v. Willemoes Suhm), which makes up for its vanished eyes by its extraordinary elongate and dentated claws ; in Psalidopus hiix- leyi, Wood-Mason and Alcock (1892), bristling with spikes from head to tail ; in the Nematooarcinidaj, with their long thread-like limbs and longer antennee ; in species of Aristceopsis reported by Chun from deep water off the east coast of Africa, bright red prawns nearly a foot long, with antennse about five times the length of the body. That certain species, particularly many from deep water, have disproportionately large eggs, is explained by the supposition that the young derive the advantage of being hatched in an advanced stage of development.

3. ScmzopoDA. — This order of animals, for the most part delicately beautiful, has for the moment five families — Lopho- gastridse, Euoopiidse, Euphau- siidfe, Mysidfe, and Anaspididse. In the Euphausiidee the digiti- form-arborescent branchiEe, as if conscious of their own extreme elegance, remain wholly un- covered. In the two preced- ing families they are partially covered. In the Mysidse the branchia3 are wanting, and some would form this family into a separate order, Mysidacea. In Anaspides, a peculiar fresh-water genus discovered in 1892 by G. BI. Thomson on Mount Welling- ton, in Tasmania, the gills are not arborescent, and there are seven segments of the trunk free of the carapace (Fig. 2). A membranaceous carapace separates the Eucopiidse from the more solidly invested Lophogastridse. Among many papers that the student will find it necessary to consult may be mentioned the

Fig. 2. — Anaspides ta^mani(r, Tlioinson.

" Challenger"" Report on Schizopoda, by Sars, 1885, dealing with the order at large; "British Schizopoda," by Norman, Ann. Nat. Hist., 1892; "Deoapoden und Schizopoden," Plankton-Expedi- tion, Ortmann, 1893; " Euphausiidi=e, " by Stebbing, Proc. Zool. .SVic. , London, 1900 ;

~~*Mijsidce of the Russian Empire, by Czerniavski, 1882-83 ; and ilysidx of the Caspian, by Sars, 1893-95-97.*~~

~~*4. Stomatopoda. — This order, at one time a medley of hetero- geneous forms, is now confined to the singularly compact group of the SquillidEe. Here the articulation of the ocular segment is unusually distinct, and here two characters quite foreign to all the preceding groups come into view. The second maxillipeds are developed into powerful prehensile organs, and the branchiae, in- stead of being connected with the appendages of head and trunk, are developed on the pleopods, appendages of the abdomen. At least three segments of the trunk are left uncovered by the cara- pace. The developing eggs are not carried about by the mother, but deposited in her subaqueous burrow, " where they are aerated by the currents of water produced by the abdominal feet of the parent." An excellent synop.sis of the genera and species is pro- vided by R. P. Bigelow {Proc. U.S. Mus. vol. xvii., 1894). For the habits and peculiarities of these and many other Crustaceans, Ver-*~~

~~*• rill and Smith on the Invertebrates of Vineyard Sound should be consulted (1874). The general subject has been illuminated by the labours of Claus, Miers, Brooks (" Challenger"" Report, 1886), and the latest word on the relationship between the various larvae and their respective genera has been spoken by H. J. Hansen {Plank- ton-Expedition Report, 1895). The striking forms of Alima and Erichthus, at one time regarded as distinct genera, are now with more or less certainty affiliated to their several squillid parents.*~~

~~*5. Sympoda. — This order of sessile-eyed decapods was abso- lutely unknown to science till 1779. A species certainly belong- ing to it was described by Lepekhin in 1780, but the obscure Gammarus esca, "food Gammarus" beloved of herrings, de- scribed by J. C. Fabricius in the preceding year, may also be one of its members. Nutritious possibilities are implied in Diastylis rathkii (Kroyer), one of the largest forms, which, though slender and rarely an inch long, in its favourite Arctic waters is found "in incalculable masses, in thousands of specimens" (Stuxberg, ISSO). Far on in the 19th century eminent naturalists were still debating whether in this group there were eyes or no eyes, whether the eyes were*~~

~~stalked or sessile, whether the animals observed were larval or adult. The American Say in 1818 gave a good description of a new species and founded the premier genus Diastylis, but other investigators derived little credit from the subject till more than sixty years after its Introduction by the Russian Lepekhin. Then Goodsir, Kroyer, Lilljeborg, Spence Bate, and one or two others made considerable advances, and in I860 a memorable paper by G. O. Sars led the way to the great series of researches which he has continued to the present day. The name Oumacea, however, which he uses cannot be retained, being founded on the preoccupied name Cuma (Milne-Edwards, 1828). The more recent name Sympoda (see Willey, Results, part V. p. 609, 1900) alludes to the huddling together of the legs, which is conspicuous in most of the species. Ten families are now distinguished — Diastylidae, Lampropidae, Platyaspidae, Pseud ocumidae, all with an articulated telson; without one, the Bodotriidae (formerly called Cumidoe), Vaunthompsoniidae, Leu-conidae, Nannastacidae, Campylaspidse, Procampylaspidae. AII the Leuoonidae and Procampylaspidas are blind, and some species in most of the other families. Usually the sides of the carapace are strangely produced into a mock rostrum in front of the ocular lobe, be It oculiferous or not. The last four or five segments of the trunk are free from the carapace. The slender pleon has always six distinct segments, the sixth carrying two-branched uropods, the preceding five armed with no pleopods in the female,- whereas in the male the number of pairs varies from five to none. The resemblance of these creatures to miniature Macrura is alluded to in the generic name Nannastacus, meaning dwarf-lobster. In this genus alone of the known Sympoda the eyes sometimes form a pair, in accordance with the custom of all other malacostracan orders except this and of this order Itself in the embryo (Sars, 1900). The most but not the only remarkable character lies in the first maxillipeds. These, with the main stem more or less pedi- form, have the epipod and exopod modified for respiratory pur- poses. The backward-directed epipods usually carry branchial vesicles. The forward-directed exopods either act as valves or form a tube (rarely two tubes), protensile and retractile, for regu- lating egress of water from the branchial regions. This meclian- ism as a whole is unique, although, as Sars observes, the epipod of the first maxillipeds has a respiratory function also in the Lophogastrid® and Mysidse and in the chellferous isopods. As a rule~~

~~*armature of the carapace is much more developed in the com- paratively sedentary female than in the usually more active male. Only in the male do the second antennae attain considerable length, with strong resemblance to what is found in some of the Amphi- poda. About 150 species distributed among thirty-four genera*~~

~~*are now known, many from shallow water and from between tide- marks, some from very great depths. H. J. Plansen concludes that "they are all typically ground animals, and as yet no species has been taken under such conditions that it could be reckoned to the pelagic plankton." As they have been found in all zones and chiefly by a very few observers, it is probable that a great many more species remain to be discovered. In recent years thirteen species, all belonging to the same genus Pseudocuma (Fig. 3), have*~~

~~*Fra. ^.—Pseudocuma Pectinaium, Sowlnsky.*~~

~~*been recorded by Sars from the Caspian Sea. A bibliography of the order is given in that author's Crustacea of Norway, vol. iii.,*~~

~~*1899-1900.*~~

~~*6. IsopoDA. — This vast and populous order can be traced far back in geological time. It is now represented in all seas and lands, in fresh-water lakes and streams, and even in warm springs. It adapts Itself to parasitic life not only in fishes, but in its own class Crustacea, and that in species of every order, its own in- cluded. In this process changes of structure are apt to occur, and sometimes unimaginable sacrifices of the normal appearance. The order has been divided into seven tribes, of which a fuller summary than can here be given will be found in Stebbing, History of Crustacea, 1893. The first tribe, called Chelifera, from the usually chelate or claw-bearing first limbs, may be re- garded as Isopoda anomala, of which some authors would form a separate order, Tanaidea. Like the genuine isopods, they have seven pairs of trunk-legs, but instead of having seven segments of the middle body (or peraeon) normally free, they have the first one or two of its segments coalesced with the head. Instead of the breathing organs being furnished by the appendages of the pleon with the heart in their vicinity, the respiration is controlled by the*~~

~~*maxillipeds, with the heart in the peraeon (see Delage, Arch. Zool. exper. et gen. vol. ix., 1881). There are two families, Tanaidae and Apseudidse. Occasionally the ocular lobes are articulated.*~~

~~*The genuine Isopoda are divided among the Flabellifera, in which the terminal segment and uropods form a fiabellum or swimming fan ; the Epicaridea, parasitic on Crustaceans ; the Valvifera, in which the uropods fold valve-like over the branchial pleopods ; the Asellota, in which the first pair of pleopods of the female are usually transformed into a single opercular plate ; the Phreatoicidea, a fresh-water tribe, known as yet only from sub- terranean waters in New Zealand and an Australian swamp nearly 6000 feet above sea-level ; and lastly, the Oniscidea, which are terrestrial. Only the last of these, imder the contemptuous desig- nation of wood-lice, has established a feeble claim to popular recognition. Few persons hear without surprise that England itself possesses more than a score of species in this air-breathing tribe. Those known from the world at large number hundreds of species, distributed among dozens of genera in six families. That a wood-louse and a land-crab are alike Malacostracans, and that they have by different paths alike become adapted to terres- trial life, are facts which even a philosopher might condescend to notice. Of the other tribes which are aquatic there is not space to give even the barest outline. Their swarming multitudes are of enormous importance in the economy of the sea. If in their relation to fish it must be admitted that many of them plague the living and devour the dead, in return the fish feed rapaciously upon them. Among the most curious of recent discoveries is that relating to some of the parasitic Cymothoidce, as to which Bullar has shown that the same individual can be developed first as a male and then as a female. Of lately-discovered species the most striking is one of the deep-sea Cirolanidae, Bathynomus giganteus, A. M. Edwards, 1879, which is unique in having supplementary ramified branchiae developed at the bases of the pleopods. Its eyes are said to contain nearly 4000 facets. The animal attains what in this order is the monstrous size of 9 inches by 4. A general uniformity of the trunk-limbs in Isopoda justifies the ordinal name, but the valviferous Astacillidae, and among the Asellota the Munnopsidae, offer some remarkable exceptions to this charac- teristic. Among many essential works on this group may be named the Monogr. Gymothoarum of Schiodte and Meinert, 1879- 1883;*~~

~~" CAaZieregrej- " iJcport, Beddard, 1884-86 ; Cirolanidce.n. J. Hansen, 1890; Isopoda Terrestria, Budde-Lund, 1885; Bopy- ridce, Bonnier, 1900; Crustacea of Norway, vol. ii. (Isopoda), Sars, 1896-99, while their multitude precludes specification of important contributions by Benedict, Bovallius, Chilton, Dohrn, DoUfus, Fraisse, Giard and Bonnier, Harger, Haswell, Kossmann'~~

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~~MALAGA~~

~~Miers, M'Murrich, Norman, Harriet Eichardson, Ohlin, Studer, G. M. Thomson, A. 0. Walker, Max Weber, and many others.~~

~~7. Amphipoda. — As in the genuine Isopoda, the eyes of Amphi- poda are always sessile, and generally paired, and, in contrast to crabs and lobsters, these two groups have only four pairs of mouth- organs instead of six, but seven pairs of trunk-legs instead of five. From the above-named isopods the present order is strongly differentiated by having heart and breathing organs not in the pleon, but in the perseon, or middle body, the more or less simple branchial vesicles being attached to some or all of the last six pairs of trunk- legs. Normally the pleon carries six pairs of two -branched appendages, of which the first three are much articulated flexible swimming feet, the last three few-jointed com- paratively indurated uropods. There are three tribes, Gammari- dea, CaprelUdea, Hyperiidea. The middle one contains but two families, the cylindrical and often thread-like skeleton shrimps, Caprellidse, and their near cousins, +he broad, flattened, so-called whale-lice, Cyamidse. This tribe has the pleon dwindled into insignificance, whereas in the other two tribes it is powerfully developed. The Hyperiidea are distinguished by having their maxillipeds never more than three-jointed. In the companion tribes these appendages have normally seven joints, and always more than three. The order thus sharply divided is united by an intimate interlacing of characters, and forms a compact whole at present defying intrusion from any other crustacean group. Since 1775, when J. C. Fabrioius instituted the genus Qammarus for five species, of which only three were~~

~~amphipods, wliile he left five other amphipods in the genus Oniscus, from this total of eight science has developed the order, at first very slowly, but of late by great leaps and bounds, so that now the Gammaridea alone comprise more than 1300 species, distributed among some 300 genera and 39 families. They burrow in the sands of every shore ; they throng the weeds between tide-marks ; they ascend all streams ; they are found in deep wells, in caverns, in lakes ; in Arctic waters they swarm in numbers beyond computation ; they find lodgings on crabs, on turtles, on weed-grown buoys ; they descend into depths of the ocean down to hundreds or thousands of fathoms ; they are found in mountain streams as far above sea- level as some of tlieir congeners live below it. The Talitridee, better known as sandhoppers, can forego the briny shore and content themselves with the damp foliage of inland forests or casual humidity in the crater of an extinct volcano. Over the ocean surface, as well as at various depths, float and swim in- numerable Hyperiidea — the wonderful Phronima, glass-like in its glassy barrel hollowed out of some Tunicate ; the Cystisoma, 4 or 5 inches long, with its eye-covered head ; the Bhabdosoma, like a thin rod of glass, with needle-like head and tail, large eyes, but limbs and mouth-organs all in miniature, and the second antennse of the male folding up like a carpenter's rule (Fig. 4).~~

~~Fig. 4. — Bhabdosoma Piratv/m, Stebbing.~~

~~On jelly-fishes are to be found species of Hyperia and their kindred, so fat and wholesome that they have been commended to ship- wrecked men in open boats as an easily procurable resource against starvation. Many of the amphipoda are extremely voracious. Some of them are even cannibals. The Cyamidie afiBict the giant whale by nibbling away its skin ; the Chelura terebrans is de- structive to submerged timber. But, on the other hand, tliey largely help to clear the sea and other waters of refuse and carrion, and for fishes, seals, and whales they are food desirable and often astoundingly copious. From the little flea-like species, scarcely a tenth of an inch long, up to the great and rare but cosmopolitan Eurythenes gryllus (Lichtenstein), and the still larger AUcella gigantea, Chevreux, nearly half a foot long, captured by the prince of Monaco froip a depth of 2936 fathoms, not one of these ubiquitous, uncountable hordes has ever been accused of assailing man. For the naturalist they have the~~

~~*recommendation that many are easy to obtain, that most, apart from the very minute,*~~

~~*are easy to handle, and that all, except as to the fleeting colours, are easy to preserve. A nearly complete bibliography of the order down to 1888 will be found in the ^'■Challenger" Reports, vol. xxviii., and supplementary notices in della Valle's Monograph of the Gammarini, 1893, the scope of his work, however, not cover- ing the Hyperiidea and Oxyoephalidse of Bovallius, 1889, 1890 ; but since these dates very numerous additions to the literature have been made by Birula, Bonnier, Norman, Walker, and others, especially the Crustacea of Norway, vol. i. {Amphipoda), Sars, 1890-95, demanding attention, and the quite recent Ainphipoda of the Hirondelle, Chevreux, 1900, and Hyperiidea of the Plankton- Expedition, Vosseler, 1901. (t. k. e. s.)*~~

~~*Malaga, a maritime province of southern Spain. It has an area of 2823 miles, and had a population of 619,977 in"1887 and 490,331 in 1897. It is divided into 14 administrative districts and 103 parishes. The birth- rate is 3-95 per cent., the death-rate 3-49 per cent., and the proportion of illegitimate births 3-42 per cent. The decrease in population was due to emigration to Brazil, the Argentine, and French Algeria. Communication by- state, provincial, and municipal roads has been somewhat improved since 1890, but only very slightly. There are only 50 miles of first-class roads. A railway has been built from Bobadilla to Algeciras, and other lines have been planned. The province is one of the most backward as regards education. Agriculture has not much improved, despite the fertility of the soil. In 1895, 330,380 acres were devoted to wheat, 21,250 to chick-peas and beans, and 35,000 to vines. Beetroot and sugar-cane alone have been grown in larger proportion to meet the demands of the manufacturers, which increased greatly on the loss of the colonial imports of sugar. The live stock in 1896 included 5504 horses, 9769 mules, 11,835 asses, 19,499 cattle, 62,366 sheep, 77,951 goats, 29,185 pigs. In 1898 eight iron mines had an output of 26,142 tons. There is little other mining industry, but 182 mines (141 iron) are registered, though unproductive. Manufactures have advanced somewhat, especially distilling, since the almost prohibitive duties were laid on foreign alcohols. The sugar factories are some of the most prosperous in Spain.*~~

~~*The fisheries are important, giving occupation to about 300 boats, which bring in annually 18,000,000 lb of fish, nearly 26 per cent, of which is exported.*~~

~~*Malaga, the capital of the above province, is a rapidly growing seaport and a busy railway terminus. Its population was 134,016 in 1887, and in 1897, 125,434. The popularity of the town as a winter resort has increased with the spread of well-built subm-bs into the rich, beauti- ful country that lies all around, invalids attracted by the climate being at last able to find, in the new quarters, abodes that are both healthy and pleasant. There are fine, broad streets and squares, gardens, promenades, and other improvements, due as much to private enterprise as to the municipal authorities. On the outskirts, too, are several factories that have been started for many local industries : iron foundries, distilling, and manu- factures of textiles, sugar, soap, and chemicals. The trade, however, is chiefly in agricultural products, wine, and minerals. The movement of shipping in the port is con- siderable. In 1898 the shipping totalled 1874 vessels of 1,404,531 tons (1412 of 905,117 tons Spanish). Of the foreign shipping nearly half was British. Among the principal imports in 1898 were 27,847 tons of coal, 5897 tons of pod fruit, 3877 tons of guano, 1012 of iron of all kinds, and 396 tons of machinery. The principal exports in 1898 were olive oil 30,547 tons, almonds 1613 tons, barley 3212 tons, chick-peas 1660 tons, lemons 5056 tons, oranges 1265 tons, raisins 6516 tons, lead 23,132 tons. The quantity of wine exported was 2,234,855 gallons, a slight increase on 1897. Lemons, oranges, and wine went mostly to England ; lead to France. The raisin crop was 600,000 boxes, and the*~~

~~*olive also increased remarkably. The wine trade has fallen off considerably, owing to a variety of reasons, but latterly the demand for the better class of least- adulterated wines has increased. After much of the general trade of the port had been lost, the harbour works have been so far completed as to enable ships of con- siderable size to discharge on the quays directly, and to load, as a line of railway connects them with the*~~

~~*main system. The average depth of the harbour is 30 to 32 feet, the minimum 23 feet. The local corporations have turned into a " park " and public promenade several acres of land redeemed from the sea, have extended the use of electric light, and have developed the tramways.*~~

~~*Malakoff, town, arrondissement of Sceaux, depart- ment of Seine, Prance, lying south by west of Paris, close to the fortifications and on the road to Montrouge. The church contains a painting by Philippe de Champagne of " The Plight into Egypt." The town is quite modern, having its origin in a village named California, founded about 1848, but owing its present name to a building erected by a local benefactor, Alexander Chauvelot, which he called the Tower of Malakoff, in commemoration of that captured at Sebastopol by MacMahon. This tower was taken down in 1870, lest it should serve as a mark for the Prussians. After the war the place grew rapidly, and in 1884 it became a separate commune. Popular tion (1896), 10,796; (1901), 14,341.*~~

~~*Malan, Solomon Caesar (1812-1894), divine and Orientalist, was by birth a Swiss descended from an exiled French family, and was born at Geneva, 22nd April 1812, where his father, Dr Caesar Malan, enjoyed a grea!t reputation as a Protestant divine. Prom his earliest youth he manifested a remarkable faculty for the study of languages, and when he came to Scotland as tutor in the marquis of Tweeddale's family at the age of 18 he had already made progress in Sanskrit, Arabic, and Hebrew. In 1833 he matriculated at St. Edmund's Hall, Oxford ; and English being almost an unknown tongue to him, he petitioned the examiners to allow him to do his paper work of the examination in French, German, Spanish, Italian, Latin, or Greek, rather than in English. But his request was not granted. After gaining the Boden and Pusey and Ellerton scholarships, he graduated 2nd class in Lit. Hum. in 1837. He then proceeded to India as classical lecturer at Bishop's College, Calcutta, to which post he added the duties of secretary to the Bengal branch of the Eoyal Asiatic Society ; and although compelled by illness to return in 1840, laid the foundation of a knowledge of Tibetan and Chinese. After serving various curacies, he was presented in 1845 to the living of Broadwinsor, Dorset, which he held until 1886. During this entire period he continued to augment his linguistic knowledge, which he carried so far*~~

~~*as to be able to preach in that most difficult language, Georgian, on a visit which he paid to Nineveh in 1872. HIs translations from the Armenian, Georgian, and Coptic were numerous ; he also applied his Chinese learning to the determination of important points connected with Chinese religion, and published a vast number of parallel passages illustrative of the Book of Proverbs. In 1880 the University of Edinburgh conferred upon him the honorary degree of D.D. No modern scholar, perhaps, has so nearly ap- proached the linguistic omniscience of Mezzofanti; but, like Mezzofanti, Dr Malan was more of a linguist than a critic. HIe made himself conspicuous by the vehemence of his opposition to Westcott and HIort's text of the New Testament, and to the transliteration of Oriental languages, on neither of which points did he in general obtain the suffrages of scholars. HIs extensive and valuable library, some special collections excepted, was presented by him*~~

~~*in his lifetime to the Indian Institute at Oxford. HIe died at Bournemouth, 25th November 1894. HIs life has been written by his son. (b. g.)*~~

~~*Malar, a lake of Sweden, lying immediately west of Stockholm, with an area of 449 square miles, of which 189 square miles are covered by the numerous islands which stud its waters. Length, 73 miles ; breadth, one-third mile to 30 miles. Area of drainage basin, 8789 square miles, of which 1224 are occupied by lakes. The shores are deeply indented, running out in places into long winding arms. Two channels connect the lake with the Baltic — Norrstrom, 7\ feet deep at low water, on the north of the old " town " of Stockholm ; and Soderstrom, U\ feet deep, on the south of the same, where the out- flow is regulated by a sluice (1630). The former is the channel used by vessels up to but not exceeding 350 tons. A proposal has been made to cut a new channel out of the lake at Danvik, 3f miles below the Soderstrom sluice, where the oldest dam was constructed by Gustavus Vasa in the middle of the 16th century. The difference of level between the lake and Saltsjo (the arm of the Baltic immediately below the city) is so slight (11 inches) that not infrequently the Baltic water flows into the lake. The bottom of the lake consists of a series of basins, separated by ridges ; greatest depth, 200 feet ; minimum depth, 30 feet. The lake is fed by several rivers, all small, and is connected with Lake HIjelmar to the south-west (i.) by the Arboga river and the HIjelmar*~~

canal, and (ii.) by the Eskilstuna river and the Thorshalla canal (1856-1860). It also has navigable connexion with the Baltic through the Sodertelge canal (10 feet minimum depth). On the shores of Lake Malar stand, besides Stockholm, the historic cities of Sigtuna, Vester§,s, and Strengnas ; further, the royal castles of Drottningsholm (on Lof Island) and Gripsholm, the former built in the 17th century, the latter in 1537. Gripsholm is now, however, a museum of antiqtdties.

See G. Neeman, in Tmer (1897) ; and Bihang till Kong. Svensk. Vetensk. Akad. Handlingar (1895 and 1896) ; also, for the forcing of the Norrmalm (Stoksund) hy St Olaf, king of Norway, in the year 1007, Heimskringla, chap. iv.

Malaria.— From the time of Hippocrates onwards the malarial or periodical fevers have engaged the atten- tion of innumerable observers, who have suggested various theories of causation, and have sometimes anticipated — vaguely, indeed, but with surprising accuracy — the results of modern research; but the true nature of the disease remained in doubt until the closing years of the 19th century. It has now been demonstrated by a series of accurate investigations, contributed by many workers, that malaria is caused by a microscopic parasite in the blood, into which it is introduced by the bites of certain species of mosquito. Many points still remain to be explained, and the mosquito theory has not yet been universally accepted as covering the whole ground ; but the main fact that malaria is so caused has been estab- lished beyond question, and it goes far to explain much that has hitherto been obscure. The discovery has also greatly stimulated the general study of this destructive group of diseases, particularly in the direction of pre- vention.

The successive steps by which the present position has been reached form an interesting chapter in the history of scientific progress. The first substantial link in the actual chain of discovery was contributed ^''»'y <>' in 1880 by Laveran, a French army surgeon “”'‘>'■ serving in Algeria. On the 6th of November in that year he plainly saw the living parasites under the micro- scope in the blood of a malarial patient, and he shortly afterwards communicated his observations to the Paris*

~~*Academie de Medecine. They were confirmed, but met with little acceptance in the scientific world, which was preoccupied with the claims of a subsequently discredited Bacillus malaricB. In 1885 the Italian pathologists came round to Laveran's views, and began to work out the life-history of his parasites. The subject has a special interest for Italy, which is de-s-astated by malaria, and Italian science has contributed materially to the solution of the problem. The labours of Golgi, Marchiafava, Celli, and others established the nature of the parasite and its behaviour in the blood; they proved the fact, guessed by Easori so far back as 1846, that the periodical febrile paroxysm corresponds with the development of the organisms ; and they showed that the different forms of malarial fever have their distinct parasites, and con- sequently fall into distinct groups, defined on an etiologi- cal as well as a clinical basis — namely, the mild or spring group, which includes tertian and quartan ague, and the malignant or " sestivo-autumnal " group, which includes a tertian or a semi-tertian and the true quotidian type. Three distinct parasites, corresponding with the tertian, quartan, and malignant types of fever, have been de- scribed by Italian observers, and the classification is generally accepted; intermediate types are ascribed to mixed and multiple infections. So far, however, only half the problem, and, from the practical point of view, the less important half, had been solved. The origin of the parasite and its mode of introduction into the blood remained to be discovered. An old popular belief cur- rent in different countries, and derived from common observation, connected mosquitoes with malaria, and from time to time this theory found support in more scientific quarters on general grounds, but it lacked demonstration and attracted little attention. In 1894, however, Man- son, arguing with greater precision by analogy from his own discovery of the cause of filariasis and the part played by mosquitoes, suggested that the malarial para- site had a similar intermediate host outside the human body, and that a suctorial insect, which would probably be found to be a particular mosquito, was required for its development. Following up this line of investigation, Ross in 1895 found that if a mosquito sucked blood con- taining the parasites they soon began to throw out fla- gellae, which broke away and became free ; and in 1897 he discovered peculiar pigmented cells, which*~~

~~*afterwards turned out to be the parasites of eestivo-autumnal malaria in an early stage of development, within the stomach- wall of mosquitoes which had been fed on malarial blood. He further found that only mosquitoes of the genus Anopheles had these cells, and that they did not get them when fed on healthy blood. Then, turning his attention to the malaria of birds, he worked out the life-history of these cells within the body of the mosquito. " He saw that they increased in size, divided, and became full of filiform spores, then ruptured and poured out their multitudinous progeny into the body-cavity of their insect host. Finally, he saw the spores accumulate within the cells of the salivary glands, and discovered that they actually passed down the salivary ducts and along the grooved hypopharynx into the seat of puncture, thus causing infection in a fresh vertebrate host" (Sambon). To apply these discoveries to the malaria of man was an obvious step. In working out the details the Italian school have again taken a prominent part.*~~

~~*Thus we get a complete scientific demonstration of the causation of malaria in three stages : (1) the discovery of the parasite by Laveran ; (2) its life-history in the human host and connexion with the fever demonstrated by the Italian observers ; (3) its life-history in the alternate host, and the identification of the latter with a particular species of mosquito by Ross and Manson. The conclusions derived*~~

~~*from the microscopical laboratory were confirmed by actual experiment. In 1898 it was conclusively shown in Italy that if a mosquito of the Anopheles variety bites a person suffering from malaria, and is kept long eat!' enough for the parasite to develop in the salivary gland, and is then allowed to bite a healthy person, the lat- ter will in due time develop malaria. The converse propo- sition, that persons efS.ciently protected from mosquito bites escape malaria, has been made the subject of several remarkable experiments. One of the most interesting was carried out in 1900 for the London School of Tropical Medicine by Dr Sambon and Dr Low, who went to reside in one of the most malarious districts in the Roman Campagna during the most dangerous season. Together with Signor Terzi and two Italian servants, they lived from the beginning of July until the 19th of October in a specially protected hut, erected near Ostia. The sole precaution taken was to confine them- selves, between sunset and sunrise, to their mosquito- proof dwelling. All escaped malaria, which was rife in the immediate neighbourhood. Mosquitoes caught by the experimenters, and sent to London, produced mala-ria in persons who submitted themselves to the bites of these insects at the London School of Tropical Medi- cine. Experiments in protection on a larger scale, and under more ordinary conditions, have been carried out with equal success by Professor Celli and other Italian authorities. The first of these was in 1899, and the subjects were the rail way men employed on certain lines running through highly malarious districts. Of 24 pro tected persons, all escaped but four, and these had to be out at night or otherwise neglected precautions ; of 38 un- protected persons, all contracted malaria except two, who had apparently acquired immunity. In 1900 further experiments gave still better results. Of 52 protected persons on one line, all escaped except two, who were careless ; of 62 protected on another line, all escaped, while of 51 unprotected persons, living in alternate houses, all suffered except seven. Out of a total of 207 persons protected in these railway experiments, 197 escaped. In two peasants' cottages in the*~~

~~Campagna, protected with wire netting by Professor Celli, all the inmates^lO in number — escaped, while the neighbours suffered severely; and three out of four persons living in a third hut, from which protection was removed, owing to the indifference of the inmates, contracted malaria. In the malarious islet of Asinara a pond of stagnant water was treated with petroleum and all win- dows were protected with gauze. The result was that the houses were free from mosquitoes, and no malaria occurred throughout the entire season, though there had been 40 cases in the previous year. Eight Red Cross ambulances, each with a doctor and attendant, were sent into the most malarious parts of the Cam- pagna in 1900. By living in protected houses and wearing gloves and veils at night, all the staff escaped malaria except one or two attendants. These and other experiments, described by Dr Manson in the Practitioner for March 1900, confirming the laboratory evidence as they do, leave no doubt whatever of the correctness of the mosquito-parasitic theory of malaria. It is pos- sible, though not probable, that malaria may also be contracted in some other way than by mosquito bite, but there are no well-authenticated facts which require any other theory for their explanation. The alleged occurrence of the disease in localities free from mos- quitoes or without their agency is not well attested ; its absence from other localities where they abound is accounted for by their being of an innocent species, or — as in England — free from the parasite. The old theory of paludism or of a noxious miasma exhaled from the ground~~

~~is no longer necessary. The broad facts on which it is based are sufficiently accounted for by the habits of mosquitoes. For instance, the swampy character of malarial areas is explained by their breeding in stagnant water ; the effect of drainage, and the general immunity of high-lying, dry localities, by the lack of breeding facilities ; the danger of the night air, by their nocturnal habits; the comparative immunity of the upper storeys of houses, by the fact that they fly low ; the confinement of malaria to well-marked areas and the diminution of danger with distance, by their habit of clinging to the breeding-grounds, and not flying far.~~

~~*Similarly, the sub- sidence of malaria during cold weather and its seasonal prevalence find an adequate explanation in the condi- tions governing insect life. At the same time it should be remembered that many points await elucidation, and it is unwise to assume conclusions in advance of the evidence.*~~

~~*With regard to the parasites which are the actual cause of malaria in man, an account of them is given under p . the heading of Pathology {Parasitic Diseases), and little need be said about them here. They belong to the group of Protozoa, and, as already explained, have a double cycle of existence : (1) a sexual cycle in the body of the mosquito, (2) an asexual cycle in the blood of human beings. They occupy and destroy the red corpuscles, converting the haemoglobin into melanin ; they multiply in the blood by sporulation, and produce accessions of fever by the liberation of a toxin at the time of sporulation (Ross). The number in the blood in an acute attack is reckoned by Ross to be not less than 250 millions. A more general and practical interest attaches to the insects which act as their intermediate hosts. These mosquitoes or gnats — the terms are synonymous — ^belong to the family Culicidce and the genus Anopheles, which was first classified by Meigen in 1818. It has a wide geographical distribution, being found in Europe (includ- ing England), Asia Minor, Burma, Straits Settlements, Java, China, Formosa, Egypt, West, South, and Central Africa, Australia, South America, West Indies, United States, and Canada, but is generally confined to local centres in those countries. About fifty species are recognized at present. It is believed that all of them may serve as hosts of the parasite. The species best known in connexion with malaria are A. macidipennis (Europe and America), A. funestus, and A. costales (Africa). In colour Anopheles is usually brownish or slaty, but sometimes buff, and the thorax frequently has a dark stripe on each side. The wings in nearly all species have a dappled or speckled appearance, owing to the occurrence of blotches on the front margin and to the arrangement of the scales cover- ing the veins in alternating light and dark patches (Austen). The genus with which Anopheles is most likely to be confounded is Oulex, which is the commonest of all mosquitoes, has a world-wide distribution, and is generally a greedy blood-sucker. A distinctive feature is the position assumed in resting; Culex has a hump- backed attitude, while in*~~

~~*Anopheles the proboscis, head, and body are in a straight line, and in many species inclined at an angle to the wall, the tail sticking outwards. In the female of Culex the palpi are much shorter than the proboscis; in Anopheles they are of the same length. The wings in Culex have not the same dappled appear- ance. Anopheles is also a more slender insect, with a smaller head, narrower body, and thinner legs. There are further differences in the other stages of life. Mosquitoes go through four phases : (1) ovum, (2) larva, (3) nympha, (4) complete insect. The ova of Anopheles are tiny black rod-shaped objects, which are deposited on the water of natural puddles, ponds, or slowly-moving streams, by pre- ference those which are well supplied with vegetation;*~~

~~*they float singly or attached to other objects or clustered together in patterns. They can live in brackish, and even in sea water. The lava has no breathing-tube, and floats horizontally at the surface, except when feeding; it does not frequent sewage or foul water. The ova of Culex, on the other hand, are deposited in any stagnant water, including cesspools, drains, cisterns, or water col- lected in any vessel; they float in boat-shaped masses on the surface. The lava has a breathing-tube, and floats head downwards; when disturbed, it wriggles to the bottom (Christy). Some observers maintain that Ano- pheles does not "sing" like the common mosquito, and its bite is much less irritating. Only the females suck blood ; the act is believed to be necessary for fertilization and reproduction. Anopheles rarely bites by day, and then only in dark places. In the daytime " the gorged females rest motionless on the walls and ceilings of rooms, choosing always the darkest situations for this purpose" (Austen). In temperate climates the impreg- nated females hibernate during the winter in houses, cellars, stables, the trunks of trees, &c., coming out to lay their eggs in the spring. The four phases are passed in thirty days in a favourable season, and consequently there are ordinarily four or five generations from April to September (Celli).*~~

~~*The most important question raised by the mosquito- parasitic theory of malaria is that of prevention. This may be considered under two heads : (1) individual prophylaxis ; (2) administrative prevention on a large scale.*~~

(1) In the first place, common sense suggests the avoid- ance, in malarious countries, of unhealthy situations, and particularly the neighbourhood of stagnant water. Among elements of unhealthiness is next to be laxL. ^' reckoned the proximity of native villages, the inhabitants of which are infected. In the tropics " no European house should be located nearer to a native village than half a mile " (Manson) ; and since children are almost universally infected, " the presence of young natives in the house should be absolutely interdicted" (Manson). When unhealthy situations cannot be avoided, they may be rendered more healthy by destroying the breeding-grounds of mosquitoes in the neighbourhood. All puddles and collections of water should be filled in or drained ; as a temporary expedient they may be treated with petroleum, which prevents the development of the larvae. When a place cannot be kept free from mosquitoes the house may be protected, as in the experiments in Italy, by wire gauze at the doors and windows. The arrangement used for the entrance is a wire cage with double doors. Failing such protection mosquito curtains should be used. Mos- quitoes in the house may be destroyed by the fumes of burning sulphur or tobacco smoke. According to the experiments of Celli and Casagrandi, these are the most effective culicides ; when used in sufficient quantity they kill mosquitoes in one minute. The same authorities recommend a powder composed of larvicide (an aniline substance), chrysanthemum flowers, and valerian root, to be burnt in bedrooms. Anointing the skin with strong- smelling substances is of little use in the open air, but more effective in the house ; turpentine appears to be the best. Exposure at night should be avoided. All these prophylactic measures are directed against mosquitoes. There remains the question of protection against the parasite. Chills are recognized as predisposing both to primary infection and to relapses, and malnutrition is also believed to increase susceptibility ; both should therefore be avoided. Then a certain amount of immunity may be acquired by the systematic use of quinine. Manson re- commends five to ten grains once or twice a week ; Eoss recommends the same quantity every day before breakfast.

~~*tratlve measures.*~~

~~*There is some evidence that arsenic has a prophylactic effect. An experiment made on the railway staff at Bovino, a highly malarious district on the Adriatic, gave a striking result. The number of persons was 78, and they were divided into two equal groups of 39 each. One group was treated with arsenic, and of these 36 escaped altogether, while three had mild attacks; the remaining 39, who were not treated, all had fever. In a more extended experiment on 657 railway-men, 402 escaped. This was in 1889, but in spite of the encourag- ing results the use of arsenic does not appear to have made any further progress. Experiments in immuniz- ing by sero-therapeutic methods have not as yet met with success.*~~

~~*(2) Much attention has been directed in scientific circles to the possibility of " stamping out " epidemic malaria by administrative measures. The prob- Adminis- lem is One of great practical importance, espe- cially to the British empire. There are no data for estimating the damage inflicted by malaria in the British colonies. It is, indeed, quite incalculable. In Italy the annual mortality from this cause averages 16,000, which is estimated to represent two million cases of sickness and a consequent loss of several million francs. In British tropical possessions the bill is incom- parably heavier. There is not only the heavy toll in life and health exacted from Europeans, but the virtual closing of enormous tracts of productive country which would otherwise afford scope for British enterprise. The " deadly " climates, to which so much dread attaches, generally mean malaria, and the mastery of this disease would be equivalent to the addition of vast and valuable areas to the empire. The problem, therefore, is eminently one for the statesman and administrator. A solution may be sought in several directions, suggested by the facts already explained. The existence of the parasite is maintained by a vicious interchange between its alternate hosts, mosquitoes and man, each infecting the other. If the cycle be broken at any point the parasite must die out, assuming that it has no other origin or mode of existence. The most effective step would obviously be the extermination of the Anopheles mosquito. A great deal may be done towards this end by suppressing their breeding-places, which means the drying of the ground. It is a question for the engineer, and may*~~

~~*require differ- ent methods in different circumstances. Put compre- hensively, it involves the control of the subsoil and surface waters by drainage, the regulation of rivers and floods, suitable agriculture, the clearing of forests or jungles, which tend to increase the rainfall and keep the ground swampy. The city of Eome is an example of what can be done by drainage ; situated in the midst of malaria, it is itself quite healthy. A systematic campaign for the destruction of breeding-places has been inaugurated in the British West African colonies, with encouraging results. The planting of eucalyptus trees is out of favour at present, but it appears to have been successful in Portugal, not from any prophylactic virtues in the plant, but through the great absorption of moisture by its deep roots, which tend to dry the subsoil. Treating the breeding-ponds with petroleum or similar preparations seems to be hardly applicable on a large scale, and in any case can only be a temporary expedient. Short of suppressing mosquitoes, the parasi- tic circle may theoretically be broken by preventing them from giving the infection to man or taking it from him. The means of accomplishing the former have been already pointed out, but they are obviously difficult to carry out on a large scale, particularly in native communities. It is one thing to protect individuals from mosquito bites, another to prevent the propagation of th(^ parasite in a whole community. Perhaps the converse is more feasible*~~

~~*in some circumstances — that is to say, preventing mos- quitoes from having access to malarial persons, and so propagating the parasite in themselves. It could be car- ried out where the infected persons are few, by isolating and protecting them, but not where many are infected, as in native villages. Koch has suggested that the disin- fection of malarial persons by quinine would have the desired effect, but other authorities of greater experi- ence do not consider it practicable. In spite of the difficulties, however, there is no doubt that a great deal can be done to reduce, if not stamp out, malaria by the methods indicated, which should be applied according to circumstances. An encouraging example is afforded by the remarkable fact that malaria, which was once rife in certain districts of England, has now died out, although the Anopheles maculipennis mosquito still exists there. The parasitic cycle has been broken, and the insect is no longer infected. The suggested causes are (1) reduction of insects by drainage, (2) reduced popular tion, (3) the use of*~~

~~*quinine. Dr Manson has suggested that the problem of stamping out malaria may be assisted by the discovery of some at present unknown factors. HIe has pointed out that certain areas and certain islands are entirely free from the disease, while neighbouring areas and islands are devastated. This immunity is appar- ently not due to the absence of favourable conditions, but rather to the presence of some inimical factor which prevents the development of the parasite. If this factor could be discovered it might be applied to the suppression of the disease in malarious localities.*~~

~~*A few other points may be noted. The pathological changes in malaria are due to the deposition of melanin and the detritus of red corpuscles and hgemoglobin, and to the congregation of parasites in certain sites (Boss). In chronic cases the eventual effects are anaemia, melanosis, enlargement of the spleen and liver, and general cachexia. Apparently the parasites may remain quiescent in the blood for years, and may cause relapses by fresh sporulation. Recent discoveries have done little or nothing for treatment. Quinine still remains the one specific. In serious cases it should not be given in solid form, but in solution by the stomach, rectum, or — better — hypodermically (Manson). Accord- ing to Boss, it should be given promptly, in sufficient doses (up to 30 grains), and should be continued for months. Euquinine is by some preferred to quinine, but it is more expensive. The nature of immunity is not known. Some persons are naturally absolutely immune (Celli), but this is rare ; immunity is also sometimes acquired by infection, but as a rule persons once infected are more predisposed than others. Races inhabiting malarious districts acquire a certain degree of resistance, no doubt through natural selection. Children are much more susceptible than adults.*~~

~~*Blackwater fever is a disease occurring in tropical countries and elsewhere, which is often classed with malaria. It is characterized by irregular febrile par- oxysms, accompanied by rigors, bilious vomiting, jaun- dice, and haemoglobinuria (Sambon). It has a wide geoL;'raphical distribution, including tropical Africa, parts of Asia, the West Indies, the southern United States, and — in Europe — Greece, Sicily, and Sardinia ; but its range is not coextensive with malaria. Malarial parasites have occasionally been found in the blood. Some authorities believe it to be*~~

~~caused by the excessive use of quinine, taken to combat malaria. This theory has the support of Koch, but is not generally accepted. If it were correct, one would expect blackwater fever to be regularly prevalent in malarial countries and to be more or less coextensive with the use of quinine, which is not at all the case. It often resembles yellow fever, but the characteristic black ^'omit~~

~~of yellow fever rarely occurs in blackwater fever, while the black urine from which the latter derives its name is equally rare in the former. According to the new school of tropical parasitology, blackwater fever is neither a form of malaria nor produced by quinine, but a specific disease due to a protozoal parasite not yet identified, but akin to that which causes the redwater fever of cattle.~~

~~Malaria in the Lower Vertebrates. — Birds are subject to malaria, which is caused by blood parasites akin to those in man and having a similar life-history. Two species, affecting different kinds of birds, have been identified. Their alternate hosts are mosquitoes of the Culex genus. Oxen, sheep, dogs, monkeys, bats, and probably horses also suffer from similar parasitic diseases. In the case of oxen the alternate host of the parasite is a special tick (Smith and Kilborne). In the other animals several parasites have been described by different observers, but the alternate hosts are not known.~~

~~AuTHOKiTiES. — Celli. Malaria. — Cheisty. Mosquitoes and Malaria. — Manson. Tropical Diseases. — Appendix to Allbutt's System of Medicine. — Ross. "Malaria," Quain's Dictionary of Medicine, 3rd edition. — The Practitioner, March 1901 (Malaria Number).~~

~~Malatia, or Aspuzu, the chief town of a sanjak of the same name in the Memuret el-Aziz vildiyet of Asia Minor, and a military station on the Samsiin-Sivas- Diarbekr road, altitude 2900 feet, situated about 10 miles south-west of the junction of the Tokhma Su with the Euphrates, near the south end of a fertile plain. It has been rebuilt since the earthquake of~~

~~*1893, contains fine public buildings, and is noted for its fruit orchards. There are Protestant (American) and Eoman Catholic missions. During the massacres of 1895 about 3000 Gregorian and Protestant Armenians perished, and many churches and houses were destroyed. The population comprises 26,800 Moslems, Kurds, and Kizilbash, and 3200 Armenians. Old Malatia (Melitene), which lies 5 miles to the north-east, is deserted. The earliest site was possibly Arslan Tepe, where " Hittite " remains have been found.*~~

~~*Malay Archipelago. — The Malay, or Indian, Archipelago, as now restricted, ethnogeographically in- cludes the Sunda Islands, the Moluccas, New Guinea, and the Philippine Islands, but excludes the Andaman- Nicobar group. Politically the whole of the archipelago (except a moiety of Borneo (British) and of Timor (Portu- guese), New Guinea, east of the 141st meridian (British and German), and the Philippine Islands), belongs to the Netherlands. The Philippine Islands, which had been for several centuries a possession of the Spanish Crown, passed in 1898 by conquest to the United States of America.*~~

~~*In regard to the extent and population of the archi- pelago, the area of the Dutch possessions has been com- puted to be rather less than formerly stated; but the population has greatly increased.*~~

~~*Area.*~~

~~*Population.*~~

~~*1S97.*~~

~~*1900.*~~

~~*Sunda Islands Moluccas, with Celebes New Guinea Philippine Islands*~~

~~*459,578*~~

~~*115,334*~~

~~*151,789*~~

~~*11,440*~~

~~*32,500,000*~~

~~*2,397,000*~~

~~*800,000*~~

~~*7,450,000*~~

~~*32,632,400*~~

~~*3,000,000*~~

~~*800,0001*~~

~~*8,000,000*~~

~~*In regard to physical geography, the result of investiga- tions in the island of Celebes, which was considered to belong to the eastern (or Austro-Malayan) biological sub- region, proves it to have a somewhat closer affinity with the Indian region, so that it would seem to have been*~~

~~*1 Estimate.*~~

~~*connected longer with Asian than with the Australasian lands.*~~

~~*The most notable fact in the geological history of the archipelago is the discovery in Java of the fossil remains of Pithecanthropus erectus, a form intermediate between the higher apes and man. In its structure and cranial capacity it is entitled to a higher place in the zoological scale than any anthropoid, for it walked almost certainly erect ; and, on the other hand, in its intellectual powers it must have been much below the lowest of the human race at present known. The strata in which it was found belong to the Miocene or Upper Pliocene. Another notar ble event, unprecedented even in the history of so vol- canic a region as the archipelago, was the disastrous eruption of Krakatoa in 1883, a little island-crater situ- ated in the Strait of Simda, between Java and Sumatra. The effects of the eruption were recognizable over a wider area of the*~~

~~*globe than any other on record. The noise of the final explosion travelled farther than any previous sound is known to have reached. The marine and aerial waves generated by it travelled several times round the globe, and some of the debris projected into the atmos- phere — causing ia many parts of the world very brilliant sunset effects — fell even in Europe.*~~

~~*Ethnologically some considerable advances in our knowledge of the races of the Indian Archipelago have been made. The Malays (q.v.) predominate in the Sunda Islands, and have spread sporadically over the eastern half of the archipelago, in which the Melanesian is now the race of the soil. " The Malays, as known to us in the purer Atjinese and Sundanese — a race developed through the commingling of Caucasian and predominating Mongol blood in Indo-China — were tha last incursionists into the region. They followed an earlier pure Caucasian migra- tion, known as Polynesians, whose last remnants in the archipelago linger in the Mentawi Islands on the west coast of Sumatra, who drove the Negrito autochthones of the archipelago out into the remote interior of the Philippine and other islands, and were themselves over- whelmed by the half-breeds of Mongol and predominating Caucasian blood, now known as Indonesians, of whom the Battaks and Dyaks are survivors. In like manner the Melanesians of the Solomon and New Hebrides Islands, migrating westwards over the eastern part of the archi- pelago, partly supplanted, partly commingled with the Negrito autochthones and these Caucasian (Polynesian) pre-incursionists, whose strain appears still in many of the people, as well in their language as in their customs." (Forbes.)*~~

~~*Here we shall deal with the Dutch East Indies as a whole, the different islands being considered under their own headings.*~~

~~*The Dutch possessions in Asia lie between 6° N. and 11° S. and 95° E. and 141° E. Politically they are divided into lands under the direct government of the Netherlands, vassal lands, and con- federated lands. Administratively they are further divided into residencies, divisions, regencies, districts, and dessas or villages. They are often described as of two groups, Java and Madura forming one, and the other consisting of Sumatra, Borneo, Eiouw- Lingga Archipelago, Banoa, Billiton, Celebes,*~~

~~*Molucca Archi- pelago, the small Sunda Islands, and a part of New Guinea — the Outposts as they are collectively named. A governor-general holds the superior administrative and executive authority, and is assisted by a council of five members, partly of a legislative and partly of an advisory character, but with no share in the executive work of the government. The governor-general not only has supreme executive authority, but can of his own accord pass laws and regulations, except in so far as these, from their nature, belong of right to the home government, and as he is bound by the con- stitutional principles on which, according to the Regulations for the Government of Netherlands India, passed by the king and States-General in 1854, the Dutch East Indies must be governed. The following table gives the area and population of Java (includ- ing Madura) and of the Outposts : —*~~

~~*t*~~

~~*§3*~~

~~*Population*~~

~~*Density per*~~

~~*in 1897.*~~

~~*Square Mile.*~~

~~*Java and Madura*~~

~~*50,554*~~

~~*26,125,053*~~

~~*517*~~

~~*! Sumatra, West Coast*~~

~~31,649~~

~~1,353,5151~~

~~42~~

~~o g~~

~~Sumatra, East Coast~~

~~35,312~~

~~335,4322~~

~~9~~

~~t; s J~~

~~Bencoolen~~

~~9,399~~

~~158,767’ –‘~~

~~17~~

~~ee a~~

~~Lampong .~~

~~11,284~~

~~137,5011~~

~~12~~

~~^,r7i~~

~~Palembang~~

~~*53,497*~~

~~*692,3171*~~

~~*13*~~

~~*Atjeh*~~

~~*20,471*~~

~~*531,7052*~~

~~*26*~~

~~*Riouw-Lingga Archipelago*~~

~~*16,301*~~

~~*107,8612*~~

~~*6*~~

~~*Banca*~~

~~*4,446*~~

~~*93,6001*~~

~~*21*~~

~~*Billiton ....*~~

~~*1,863*~~

~~*41,5581*~~

~~*22*~~

~~*Borneo, West Coast .*~~

~~*55,825*~~

~~*370,7752*~~

~~*6*~~

~~*Borneo, South and East*~~

~~*Districts .*~~

~~*156,912*~~

~~*809,8038*~~

~~*5*~~

~~*Island of f Celebes Celebes \ Menado*~~

~~*49,390*~~

~~*1,448,7223*~~

~~*29*~~

~~*22,080*~~

~~*549,1383*~~

~~*25*~~

~~*Molucca Islands .*~~

~~*43,864*~~

~~*399,2082*~~

~~*9*~~

~~*Timor Archipelago*~~

~~17,698~~

~~119,2392~~

~~6~~

~~Bali and Lombok~~

~~4,065~~

~~1,044,757"~~

~~256~~

~~New Guinea to 141° E. long.*~~

~~151,789~~

~~200,0003~~

~~1~~

~~Total~~

~~736,399~~

~~34,518,9516~~

~~40~~

~~The total number of Europeans and persons assimilated to them at the beginning of 1896 was 35,489 males and 27,826 females ; of these 33,055 males and 27,222 females were Dutch, of whom 25,351 males and 23,648 females were born in the East Indies ; of the re- mainder, 1192 were German, 300 French, 318 English, 184 Swiss, 292 Belgians ; the remainder being mostly Austrians and Arme- nians. Of the remaining population about 469,500 were Chinese, 24,400 Arabs, and 11,600 other Orientals, and the rest natives.~~

~~*The movement of population between Europeans and persons assimilated to them was as follows : —*~~

~~*Marriages.*~~

~~*Births.*~~

~~*Deaths.*~~

~~*1 Qon f Java and Madura ^”*’^t Outposts.*~~

~~*443*~~

~~*2126*~~

~~*1473*~~

~~*122*~~

~~*626*~~

~~*904*~~

~~*1 aQ,(/ J3.va and Madura ”*t Outposts.*~~

~~*541*~~

~~*2343*~~

~~*1192*~~

~~*109*~~

~~*691*~~

~~*387*~~

~~*1 QQQ / Java and Madura ”’“t Outposts.*~~

~~647~~

~~1916~~

~~1227~~

~~111~~

~~489~~

~~484~~

~~The population of the principal towns~~

~~in January 1897 was : —~~

~~Europeans.~~

~~Natives.~~

~~Chinese.~~

~~Arabs.~~

~~Other Orientals.~~

~~Total.~~

~~Batavia Samarang Surabaya '^ . Surakarta Jokjokarta . Palembang .~~

~~9423 3355 6988 1870 2240 248~~

~~76,751 67,286 121,075 79,802 54,219 46,655~~

~~26,488 11,870 12,183 4,571 8,886 4,468~~

~~2828 765~~

~~2382 85~~

~~8G~~

~~1797~~

~~132 1040 462 246 142 126~~

~~116,567 84,266~~

~~142,980 86,074 60,528 58,288~~

~~Beligion and, Instruction. — Entire liberty is granted to the mem bers of all religious confessions. In 1899 the Reformed Church counted 37 ministers and 24 assistants, the Roman Catholic 31 curates and 17 priests, not salaried out of the public funds. The number of Christians among the natives and foreign Orientals was : —~~

~~In Java and Madura in 1873 . 5,673, and in 1890 . 19,193 ,, the Outposts ,, . 148,672 ,, ,, . 290,065~~

~~In 1900, 141 missionaries of various societies were working to propagate Christianity in the Dutch East Indies. In 1899, 7694 natives went to Mecca on pilgrimage, of whom 0652 returned.~~

~~For the education of Europeans and persons assimilated with them there were, in 1899, 7 public middle-class schools, with 1051 pupils and 118 teachers. The cost of these schools to the Govern- ment in the same year was 591,332 guilders, and the revenue out of the school fees 87,211 guilders. In 1899 there were for Euro- peans 135 mixed public elementary schools, and 30 for girls only, with 20 private schools, or a total of 185 elementary schools. The 165))ublic schools had a teaching staff of 546, and an attendance of 15,132 pupils, whereof 1026 were natives; and the 20 private~~

~~1 Tolerably accurate. 2 Approximately. « Mere conieoture. Wew Guinea belongs to the residency ol Ternate, Molucca Islands.~~

~~» Approximate total. The population of several unexplored countries IS not mcluded.~~

« This is presumably the population of the town of Surabava and its environs.

schools a teaching staff of 166, and an attendance of 3270 pupils. The cost of the public elementary schools was, in 1899, 2,546,529, and the income 284,095 guilders.

The following statement relates to schools for natives : — In 1899 Dutch India had 5 normal schools, with 27 teachers and 144 pupils ; besides, there were 4 schools for sons of native chiefs, with 202 pupils. The elementary schools for natives were, for Java and Madura, in 1875 : 104 Government schools with 14,906 pupils, and 132 private schools with 6978 pupils ; and in 1899, 232 Government schools with 40,956 pupils, and 236 private schools with 26,524 pupils.' In the Outposts in 1881, 281 Government schools with 21,388 pupils, and 205 private schools with 10,696 pupils ; and in 1898, 297 Government schools with 44,259 pupils, and 546 private schools with 26,847 pupils.

In 1875 the Government spent 803,906 guilders for the educa- tion of natives, and in 1899, 1,501,291 guilders. For foreign Orientals there were in 1899, 434 schools with 7637 pupils.

Justice and Crime. — The administration of justice is based on the principle that Europeans and persons assimilated with them are subject to laws nearly similar to those of the mother country, while the natives are subject to their own customs and institutions. The administration of justice for Europeans is entrusted to Euro- pean judges, while for natives their own chiefs have a large share in the trial of cases. There is a High Court of Justice at Batavia — courts of justice at Batavia, Samarang, Surabaya, Padang, and Macassar — resident and regent courts, courts of circuit, district courts, and courts of priests. There are about 300 prisons ; their population was 24,712 at the end of 1898. The relations of the state to pauperism are limited to subvention to Protestant and Catholic orphan houses ; for this purpose the budget contains about 100,000 guilders yearly.

Finance. — The local revenue is derived from land, taxes on houses and estates, from licences, customs duties, personal imposts, the Government

~~*monopolies of salt and opium, railways, and a number of indirect taxes. But the chief part of the large profits is indirect, being obtained by the sale of a vast amount of coffee, grown under the "culture system," and sold in India and Europe.*~~

~~*The following table shows the revenue and expenditure for 1880, 1890, and 1900 :—*~~

~~*Year.*~~

~~*Revenue.*~~

~~*Expenditure.*~~

~~*Surplus or Deticit.*~~

~~*1880 1890 1900*~~

~~*Guilders.*~~

~~*146,838,000 137,789,482 141,989,008*~~

~~*Guilders.*~~

~~*146,936,000 127,736,739 147,766,255*~~

~~*Guilders.*~~

~~*98,000 + 10,052,743 — 5,777,247*~~

~~*About one-third of the annual expenditure is for the army and navy, and another third for the general administration, both in Java and in the Netherlands.*~~

~~*Defence. — The army is purely colonial, and comprised at the end of 1899, 1345 officers and 39,388 non-commissioned officers and men,, of whom 14,960 were Europeans, 45 Africans, 4251 Amboi- nese, and 20,132 natives. The number of horses was 1346. No portion of the regular army of the Netherlands is allowed to be sent on colonial service, but*~~

~~individual soldiers are at liberty to enlist, by permission of their commanding officers, and they form the nucleus of the army of Dutch India. Native and European soldiers are generally mixed togetlier in the same battalions, though in separate companies. The artillery is composed of European gunners, with native riders, while the cavalry are Europeans and natives. A military academy is established at Meester Cornells, near Batavia. Schools for soldiers are attached to every battalion. Unlike the army, which is purely colonial, the navy in Dutch India is partly colonial, partly belong- ing to the royal navy, and its expenses are therefore borne partly by the mother country and partly by the colony. The personnel in the Dutch Indies numbered in 1899 about 3300 men, thus divided : 1300 Europeans and 700 natives with the Indian marine (20 ships) ; about 1100 Europeans and 200 natives with the auxiliary squadron (4 ships).~~

~~Productiiin and Indnsti-y. — The greater part of the soil of Java is claimed as Government property, and it is principally in the residencies in the western part of Java that there are private estates, chiefly owned by Europeans and by Chinese. The bulk of the people are agricultural labourers. The Government or private landowners can enforce one day's gratuitous work out of seven, or more, from all the labourers on their estates ; in 1S82 the greater part of these enforced services for the Government was abolished, in return for the payment of one guilder per head yearly. Great power is vested in the Resident and his European and native officials to enforce a strict adherence to all the laws regulating labour.~~

~~' The returns of six private schools are not included in this total.~~

~~The extent of the soil of Java and Madura regularly cultivated by the natives was, in 1899, 6,935,300 acres (Ij acre=l bahu). The total areas in acres under the several crops in 1899 were as follows : — rice, 5,199,160 ; maize, araohis, cotton and various plants, 4,,331,330; sugar-cane, 265,380 ; tobacco, 265,810; indigo, 61,000. Thus the total area under these kinds of cultivation was 10,122,680 acres.~~

~~*Owing to the " agrarian law " (1870), which has afforded oppor- tunity to private energy for obtaining waste lands on hereditary lease (eviphyteusis) for seventy-five years, private agriculture has greatly increased both in Java and in the Outposts. In 1899 there were ceded to 785 companies and Europeans, 967,155 acres; to 52 Chinese, 33,292 acres ; to 6 natives, 2319 acres — total, 1,002,766 acres. Since 1810 no land in Java has been alienated by the Government. The lands now the property of Europeans have an extent of 2,241,170 acres ; of Chinese, 470,810 acres ; and of other foreign Orientals, 35,650 acres.*~~

~~*In 1891 the government ceased to cultivate sugar. The sugar is grown on lands hired from the natives, or on lands held on em- phyteutic tenure from the Government, or on private properties. In 1891 the number of sugar estates was 211 ; in 1899, 207. The yield of sugar since 1894 has been as follows : —*~~

~~*Year.*~~

~~*Pounds.*~~

~~*Year.*~~

~~*Pounds.*~~

~~*Tear.*~~

~~*Pounds.*~~

~~*1894 1895*~~

~~*1,0^6,431,400*~~

~~*1,230,003,700*~~

~~*1896 1897*~~

~~*1,126,774,900 1,220,605,200*~~

~~*1898 1899*~~

~~*1,538,701,400 1,608,718,400*~~

~~*The production of coffee in Dutch India in the years 1894- was, in pounds : —*~~

~~*Tear.*~~

~~*Government Lands.*~~

~~*Free Cultiva- tion by Natives.*~~

~~*Lands on Em- phyteusis and on Lease.*~~

~~*Private Lands.*~~

~~*Total.*~~

~~*1894 1895 1896 1897 1898 1899*~~

~~*52,048,2.52 48,888,858 42,164,666 68,888,400 17,676,800 82,988,538*~~

~~*15,671,148 18,564,994 10,663,066 12,947,200 9,814,800 7,884,800*~~

~~*60,840,919 48,559,186 58,309,883 70,228,600 27,978,600 69,646,000*~~

~~*8,277,181 8,765,289 4,928,000 4,994,666 5,104,400 7,609,467*~~

~~*181,882,600 114,228,277 116,066,065 156,503,866 60,569,600 118,128,800*~~

~~*In 1890, 8 Government plantations produced 588,018 R) of cinchona ; 118 plantations held on emphyteusis, 5,360,025 R) ; 2 private plantations, 58,472 lb. In 1899 the 8 Government planta- tions produced 878,891 lb ; 85 plantations held on emphyteusis, 8,997,238 lb ; and 5 private plantations, 1,261,508 lb. Of tobacco, 31,630,211 R) were produced from 102 plantations in Java in 1890 ; in Sumatra (Deli, &c.), 46,237,261 lb from 276 plantations. In 1899, 53,582,600 lb were produced from 131 plantations in Java, and 52,708,410 lb from 130 plantations in Sumatra (Deli, &c.). Java further produced 9,083,870 R) of tea in 1893, and*~~

~~*11,996,100 in 1899 (110 plantations) ; also 1,398,895 lb of indigo in 1890, and 1,722,890 R) in 1899 (129 plantations). The tin mines of Banca are worked by the Government, those of Billiton and Riouw by private enterprise. The total yield increased from 12,212 tons in 1890-91 to 16,460 tons in 1899-1900. The principal coal mines in Java, Sumatra, and Borneo yielded only 5489 tons in 1890, but 128,849 tons in 1895, and, with a steady increase, 185,636 tons in 1899, of which 181,325 tons, or 98 per cent, of the whole, came from the Ombilien coalfields in Sumatra. The production of the principal mineral oil enterprises was 1,627,560 gallons in 1891, of which 997,920 gallons came from the east coast of Sumatra ; and 66,021,560 gallons in 1898, of which 45,635,480 gallons came from the east coast of Sumatra, and 20,381,020 gallons from Java (Rembang and Surabaya) ; but in 1899 the total production fell to 43,903,860 gallons.*~~

~~*At the end of 1895 there were in Java in all about 2,643,000 buffaloes, 2,572,000 oxen and cows, and 485,500 horses. HIorses are never used in India for agricultural purposes.*~~

~~*In 1899 there were 49 printing offices, 70 ice and soda water manufaoturies, 29 soap factories, 9 arrack distilleries, 15 saw-mills, and 91 rice mills.*~~

~~*Commerce. — The values of the imports and of the exports in 1885, 1895, and 1899 are given below in guilders : —*~~

~~*18S5.*~~

~~*1895.*~~

~~*1899.*~~

~~*Imports Exports*~~

~~*138,867,785 188,071,688*~~

~~*161,530,294 225,087,810*~~

~~*191,322,270 250,923,258*~~

~~*The principal articles of export are sugar, coffee, tea, rice, indigo, cinchona, tobacco, and tin. With the exception of rice, about one-half of which is shipped to Borneo and China, nearly four-fifths of these exports go to the Netherlands.*~~

~~*Shipping. — The following table shows the navigation at the various ports of Netherlands India in 1897 and 1898, and the share of Great Britain in it : —*~~

~~*Tear.*~~

~~*Description of Vessel.*~~

~~*Entered.*~~

~~*Whereof, from Great Britain.*~~

~~*Number.*~~

~~*Tons.*~~

~~*Number.*~~

~~*Ton.?.*~~

~~*1895 1 1899 1*~~

~~*Steamers Sailing vessels Steamers Sailing vessels*~~

~~*3418 215*~~

~~*3661 389*~~

~~*1,366,077*~~

~~*139,223*~~

~~*1,635,689*~~

~~*84,452*~~

~~*370 33*~~

~~*330 24*~~

~~*416,607 50,177*~~

~~*527,209 27,915*~~

~~*Communications. — At the end of 1899 the total length of rail- ways (state and private) opened for traffic was about 1300 English miles ; the revenues were 17,278,000 guilders. There are about 220 post-offices ; the number of letters carried in 1899 for internal intercourse was 10,674,898, while 6,774,5.34 newspapers, samples, &c., for the interior passed through the various post-offices in the Dutch Indies during the same year. In the same year 1,567,483 letters were carried for foreign postal intercourse. There were 4310 miles of telegraph lines in Dutch India in 1899, with 114 offices ; the number of messages was 672,892. In December 1896 Batavia, Samarang, and Surabaya were connected by telephone.*~~

~~*Money and Credit. — The Java Bank, established in 1828, has a capital of 6,000,000 guilders and a reserve of about 1,200,000 guilders. The Government has a control over the administration. Two-fifths of the amount of the notes, assignats, and credits must be covered by specie or bullion. In March 1900 the value of the notes in circulation was 60,591,000 guilders, and of the bank operations 32,623,000. There are two other Dutch banks, besides branches of British banks. In the savings banks, including the postal savings bank, there were in the same year 22,327 depositors, with a deposited amount of £236,499, or £10, lis. lOd. to the credit of each depositor. (h. O. f. ; I. p. A. B.)*~~

~~*Recent Political HIstory. — The chief political events in the Malay Archipelago since 1850 have centred in and been dominated by the Grondwet or fundamental law of the Netherlands, passed in 1848. Por*~~

~~*Netherlands India as for Holland it marked the beginning of a new era. It still recognized, it is true, the king as the sovereign of the colonies, bnt it also introduced for the first time the principle of the Dutch people's responsibilities towards Holland's dependencies in the Far East. It not only laid upon the Crown the obligation of presenting an annual report on the state of the colonies to the States-General, it likewise conferred upon the Dutch legislature the right to fix the colonial budgets periodically, and to settle the bases of colonial government. It was to carry out these • new stipulations of the Grondwet that Mr Pahud, the Colonial Minister in the cabinet of Dr van Hall, which came into oflB.ce after the fall of Thorbecke, in 1854 presented a Bill providing for the administration of the Dutch East Indies. That Bill, the so-called Biglement, or Government Rules, became law, and has remained in essence, although modified more than once in some of its provisions, the Grondwet or constitution of the Dutch colonies. The Riglement was virtually a compromise between two extreme parties, one pleading for the long- neglected rights of the natives and against the continuation of the so-called " culture system," involving the corvie on Government and seigniorial lands ; the other maintaining the principle that the colonies exist to benefit the mother country, and not the mother country to benefit the colonies. The latter party gained the day, and Pahud had to make considerable concessions to get his Bill through. But although the B^glement did not answer the expectations and aspirations of the Eeform Party, foremost among whom was Baron van Hoevell, the lifelong and most capable advocate of native rights, yet it was a most im- portant step on the road of progress and administrative reform in the Dutch East Indies. It substituted statutory regulations for administrative and military despotism. It created the Governor-General the Tooan-Begar ("Great Lord ") of the natives, who, although possessing viceregal powers, yet, assisted by an Indian Council, is a functionary responsible for his acts to the Minister for the Colonies at The Hague, and bound to carry out the latter's instructions. It also instituted a supreme court at Batavia, which*~~

~~controls the -wliole judicial machinery of Netherlands India, and constitutes the final court of appeal. It abolished slavery in Java, as from 1st January 1860; it introduced freedom of the press up to a certain point, and elementary education for the natives as well. It provided for the leasing of forest lands to Europeans, made a first attempt to settle the corvie question on a reasonable basis, and left the door open for future reforms. Of course the JR^glement was largely an experiment, and where so much depended upon interpretation the results were not, and could not be, always satisfactory, as all the contradictory policies of diverging Ministers for the Colonies in Holland reflected themselves in conflicting edicts of Liberal or anti-Liberal Governors-General at Batavia. It was perhaps in the vexed question of the heerendiensten or corv4e that those vacillating methods of policy were most manifest and most mischievous. But, upon the whole, their tendency, despite repeated sets- back, has been towards the gradual emancipation of the natives both from the thraldom of the " culture system," of which nothing is left but the Government cultivation of coffee, and from the feudal serfdom of their native rulers. That serfdom existed in many forms all over the archipelago, but among the most curious must be reckoned the pandelingschap or "pledgedom," which originated in Borneo, atid according to which a man had the power to make his debtors temporarily his serfs until their debts were paid, when they resumed their freedom. This abuse, and many other old abuses, have been permanently swept away, and the election of the heads of dessas or kampongs (districts or villages) by the population has at last become more of a genuine guarantee to the natives than in the post- EafB.es days.~~

~~Until 1860 the colonial reform movement in Holland had been somewhat erratic, but it then became much more powerful. The chief cause of this change may be traced to the influence exercised by a remarkable book of Douwes Dekker (q.v.), Max Havelaar, which he published in 1860, with the help of Jan van Lennep, the novelist, then at the height of his literary fame, under the pseudonym of Multatuli (" I bore much "). In Dutch literature this book created a school which still endures ; in the political arena it had the effect of a bombshell. The upholders of the old colonial system denied the truth of its allega- tions, but the friends of reform as~~

~~*violently hailed Douwes Dekker as a "Daniel come to judgment," and denounced the persecutions to which the author had been exposed as a Government ofiicial in Java, whilst endeavouring to palliate or uproot the abuses which Max Havelaar describes. The most sober-minded party men soon recognized that the palpable exaggerations of the author could not destroy some of his hardest facts, and thus the colonial reform movement made rapid strides in the decade which preceded the death of Thorbecke, who already in 1849, des^jite Groen van Prinsterer's opposition, had advocated necessary reforms in the Dutch administration of Insulinde, and insisted upon the duties of the motherland towards its colonies.*~~

~~*One of the great names connected with the Indian reform movement in the 'sixties was that of Mr Fransen Van de Putte, who, formerly a so-called " sugar lord " in Java, eaily in 1863 became Minister for the Colonies in Thorbecke's second ministry. To him the Dutch East Indies owe the annual introduction of a colonial budget, the most important measure concern ing the Dutch colonies after the M^glement. It for the first time enabled the States-General effectively to control the ways and means of Holland's possessions over-sea, and it must be con- sidered the precursor of the abolition of the batig slot or yearly surplus yielded up to the treasury at The Hague*~~

~~*by the Dutch-Indian revenues, although that abolition only came in the year 1876. The same minister, Mr Fransen Van de Putte, in 1865 carried his Bill lessening materially the differentiation of import duties in favour of Dutch goods which existed previously in Netherlands India, whilst Dr Sloet Van de Beele, the then Governor- General at Batavia, introduced various reforms (see Java). It is true that his successor, Dr Myer, a reactionary sent out by the Van Zuylen cabinet to reverse Fransen Van de Putte's reform policy, tried to undo a good deal, yet even Dr Myer was compelled to leave many things as he found them, and he was powerless to restore the corvee to its former dimensions. In 1870 De Waal, then Minister for the Colonies in a Liberal cabinet, brought about two im-portant colonial reforms. One of the statutes which he passedprovided for the restriction of all Government sugar plantations carried on with forced native labour as from 1878, and for their total suppression in 1890, after which year only the Government coffee plantations were to rem ain, the*~~

~~*cultivation of pepper, cochineal, cinnamon, and indigo for Government account having ceased before 1870. The other statute was the so-called Indian Agrarian Law of 1870, which contained many important provisions. It enacted, among other things, that Europeans could lease for 76 years forest lands belonging to the Crown, and that natives could secure proprietary rights in the soil cultivated by them. In 1872 Mr Fransen Van de Putte, once again Colonial Minister in the cabinet which succeeded Thorbecke's last ministry, was able to carry his Bill abolishing all differentiation in a new Dutch-Indian tariff, and establishing a uniform import duty of 6 per cent., with a certain number of free ports all over the Malay Archipelago, rather in- creasing in latter years than diminishing. That import duty was considered so moderate that, when in 1886 the Dutch-Indian revenues required strengthening, an in- crease was readily assented to.*~~

~~*These reforms produced the results that had been prog- nosticated by their advocates. On the one hand, individual enterprise by European capitalists and planters was fostered in the same proportion as the hampering competition of the State was removed. Private plantations and factories arose everywhere, and in 1895 they produced an aggregate of 9,770,000 piculs^ of sugar, 332,000 pieuls of coffee, 3,960,000 kilogrammes of tea, 7,200,000 kilogrammes of tobacco (mainly in Sumatra), 3,570,000 kilogrammes of cinchona bark (grown from Peruvian seedlings by free labour from the beginning in 1852), 475,000 kilogrammes of cacao, and 144,000 kilogrammes of indigo — although it cannot be gainsaid that many of the private planters had a hard struggle, with the low prices ruling for their produce, and a certain number had to succumb. On the other hand, the natives, better protected by the Govern- ment against their former oppressors, were undoubtedly benefited to a large extent, as is perhaps best demonstrated by the enormous increase in their numbers. Thus the population of Java and Madura, computed at . barely 10,000,000 in 1849, had increased to nearly 27,000,000 by the end of the 19th century.*~~

~~*Dutch power and political authority have immensely grown since 18.')0, not only in Java (q.v.), the principal colony, but also in Sumatra (q.v.), Celebes (q.r.), where the important districts of Gorontalo have been*~~

~~*incorporated (since 1889) with Menado, the residency of the so-called Minahassa, among the earliest and most remarkably suc- cessful Dutch settlements in Celebes, the Moluccas (q.v.), Borneo (q.v.) (where the sultanate of Banjermassin was added to the Dutch direct dominions in the 'sixties, not, however, until after 'a protracted warfare, and where*~~

~~*1 A picul is equal to 133i ft.*~~

~~*Kootany, on the east coast, formerly a semi-independent state, has since 1897 become a rising and prosperous administrative division of Dutch Borneo), the large islands to the east of Java, and New Guinea (q.v.). The fact of course remains that both in Borneo and in New Guinea the Dutch have had to divide their sway with the British or the Germans. Naturally, in the course of time, many armed expeditions had to be sent out to various islands to maintain or extend their political influences and connex- ions, the most important of such expeditions being those to Acheen and to Lombok in 1894, which ended with the almost complete incorporation of that large island within Holland's colonial dominion. Necessarily the Dutch- Indian army and navy, which are both quite distinct from the army and navy at home, and largely consist of native troops, have had to be materially reinforced from time to time to carry on these distant operations. In the Dutch- Indian army the proportion of Europeans to natives has constantly grown, and the number of European troops (now mostly Dutchmen) has been as high as 16,000 on a total of 40,000 men.*~~

~~*The almost endless and very costly warfare in Acheen had a disastrous bearing upon Dutch-Indian finances, coinciding as it did, at the most critical juncture, with the earnest efforts of the Dutch statesmen in the 'seventies to render Holland financially independent of her colonies, and to make the latter self-supporting. A great portion of such war expenses had to be made good by Dutch- Indian loans, guaranteed by the Dutch Government ; yet additional taxation,^ mainly levied upon the European residents in the Malay Archipelago, had to be resorted to from time to*~~

~~*time also, to provide for the large and increasing outlay occasioned by the construction of vari- ous important public works. In particular, state railways, commenced in Java by virtue of an Act passed in 1875, but virtually though indirectly inaugurated at a much \ earlier date, through the medium of state-guaranteed private companies, have since that year been extended to other islands. By these means the revenues of the Dutch-Indian colonies, only 76,000,000 guilders in 1849, had been raised fifty years later to nearly double that amount, whereas expenditure, which was but 53,000,000 guilders in 1849, had almost trebled by the year 1899. War expenses and considerable outlays for public works — among which should be mentioned the improvement of harbours, the subsidizing of steamboat lines between Holland and Java, as well as between Java and the adjacent islands, the construction of vast irrigation works, of roads and telegraphs, by land and by sea — were largely but not altogether accountable for that increased expenditure. Civil administration, police, the administration of justice, last yet not least, education, have all had their much extended claims largely satisfied out of revenue. A great deal has also been done in the way of encouraging arts and sciences, the better study of some remarkable antiquities (Boro Boodoor was officially inspected and described in 1863), the Government support of geological and other surveys, also of various scientific expeditions into the unknown parts of Borneo, Sumatra, Timor, &c.*~~

~~*It has to be noted that coffee alone, among the old Government cultures introduced by Governor-General Van den Bosch, contributed in 1898 some 21,000,000 guilders to the revenue of Netherlands India, the other Govern- ment crops having been abolished in succession, after yielding 481,000,000 guilders to the Dutch treasury in the years 1849-66, and 139,000,000 guilders more in the*~~

~~*1 It includes, since 1898, a tax on petroleum, now found in large quantities in Java, Sumatra, and elsewhere ; likewise an import duty on foreign matches. Both yield an increasing revenue.*~~

~~*years 1867-76. Nor was the Government cultivation of coffee in 1898 to be compared to what it had been fifty years before. The area of the Government coffee districts everywhere had been much restricted (in the*~~

~~*Minahassa, the northern district of Celebes, referred to above, the Government coffee monopoly was abolished in 1899), and the scope of private coffee-planting correspondingly extended. The native labourers on the Government coffee plantations were, at the end of the 19th century, very much better treated and paid than they had been in 1849, or, for that matter, in 1889. In 1892 a resolution was carried in the second chamber of the Dutch States-General, directing the Minister for the Colonies to do away with the Govern- ment growing of coffee, too, but that resolution remained without effect, the Dutch Government then declaring that the revenue from coffee could not yet be spared. On the other hand, the export duty on coffee (and on indigo) was abolished in 1902 ; this, it was hoped, might help to tide over the difficulties of the private planters.*~~

~~*For literature coucerning the recent history of the Malay Archi- pelago, consult the works mentioned under Holland and Java ; also the AardrijkaTcundig en Statistisch WoordenboeJc van Neder- landsch-Indie ("Geographical and Statistical Dictionary of Nether- lands-India"), Amsterdam, 1869, 3 vols. ; the Staatsalmanak van Nederlandsch-IndiS (Government annual publication, published at Hsdavia.) , a,nd the Encyclopmdie van Nederlandsch- Indie ("Ency- clopaedia of the Dutch East Indies," Ley den and The Hague, 1895, et. seq.), the most comprehensive and most authoritative work existing on the subject, but stiU incomplete, although several volumes have already been issued, to 1902. Its great drawback is the absence of maps and illustrations. (h. Ti.)*~~

~~*Malay Peninsula (called by the Malays Tdnali Mdldyu, i.e., the Malay Land), a lozenge-shaped strip of land projecting into the China Sea, and forming the most southerly portion of the continent of Asia. Geographi- cally, the peninsula begins at the isthmus of Kra, 7° 14' N., at which point it is only between 60 and 70 miles in width, and the distance from sea to sea is further dimin- ished by a large irregular salt-water inlet. Politically and anthropologically, however, this upper portion must be regarded as a continuation of the kingdom of Siam rather than as a section of Mal§.ya. Erom the isthmus of Kra the peninsula extends south with a general inclination towards the east, the most southerly point being Tanjong Bulus in 1° 16^' N. A line drawn diagonally down the centre from the isthmus of Kra to Cape Bomania (Ea- munya) gives the extreme length at*~~

~~*about 510 miles. The breadth at the widest point, from Tanjong Pgn-unjut inTrSngganu to Tanjong Hantuin the Dindings territory, is about 200 miles. The area is estimated at about 70,00() square miles. The peninsula is bounded on the north by Siam, on the south by the island and strait of Singapore, on the east by the China Sea, and on the west by the strait of Malacca.*~~

~~*A range of granite mountains stretching from the eastern shoulder in 6° 40' N. to the west coast in 2° 25' N., irregularly following the parallel 101° 40' E., form.s a backbone which divides the peninsula into two unequal portions, Physical the larger of which lies to the east and the smaller to ”^^ractej^ the west of the chain. Smaller ranges run parallel to * ”^’ the main mountain chain in many places, and there are numerous isolated spurs which have no connexion with either. The country is covered with limestone in many parts, and large isolated bluffs of this formation stand up in the plains both on the eastern and the western slopes. The descent from the summits of the range into the plain is somewhat less abrupt on the western than it is on the eastern side, and between the foot of the mountains and the strait of Malacca the largest known alluvial deposits of tin are situated. On the eastern side of the range, after a steep descent, the granite formation speedily gives place to slates of vast depth, intersected here and there by fissures of quartz containing gold, and in many places covered by limestone which has been superimposed upon the slates. The highest known peak in the main range is that of Gflnong Korbu, 7217 feet above sea^level. The highest mountain is believed to be Gianong Tahan, which forms part of an isolated*~~

~~*range on the eastern side, between Pahang and Kelantan, and is estimated at about 8000 feet. The west coast throughout its whole length is covered to a depth of some miles with mangrove swamps, with only a few isolated stretches of sandy beach, the dim foliage of the mangroves and the hideous mud flats presenting a depressing spectacle. On the east coast the force of the north-east monsoon, wliich beats upon the shores of*~~

the Chi na Sea annually from November to February, has kept the land for the most part free from man- groves, and the sands, broken here and there by rocky headlands thickly wooded, and fringed by casuarina trees, stretch for miles without interruption. The islands on each coast present the fea- tures of the shores to which they are adjacent. On both the east and the west coast the islands are thickly wooded, but whereas the former are surrounded by beautiful sands and beaches, the latter are fringed by mangrove swamps. The whole peninsula may be described as one vast forest, intersected in every direction by count- less streams and rivers which together form the most lavish water- system in the world. Only an insignificant fraction of these forests has ever been visited by human beings, the Malays and even the aboriginal tribe having their homes on the banks of the rivers, and never, even when travelling from one part of the country to another, leaving the banks of a stream except for a short time when passing from one river-system to another. The bulk of the jungle, therefore, which lies between stream and stream, has never been trodden by the foot of man. The principal rivers on the west coast are the P§rak, the BSrnam, and the Muar. The first-named is far finer than its fel- lows, and is navigable for steamers for about 40 miles from its mouth, and for native craft for over 250 miles. It is exceedingly shallow, however, and is not of much importance as a waterway. The Bernam runs through flat swampy country for the greater part of its course, and steam-launches can penetrate to a distance of over 100 miles from its mouth, and it is therefore probably the deepest river. The country which it waters, however, is not of any value, and it is not much used. The Muar waters a very fertile valley, and is navigable for native boats for over 150 miles. On the east coast the principal streams are the Pgt^ni, Telubin, K61antan, B§sut, TrSng- ganu, Dungun, KSm^man, Kuantan, Pahang, Rompin, Endau, and Sed61i, all guarded by difficult bars at their mouths, and dangerous during the continuance of the north-east monsoon. The deepest rivers are the Kuantan and Rompin ; the largest are the K61antan and the Pahang, both of which are navigable for native boats for a distance of over 250 miles. The TrSngg§.nu river is obstructed by impassable rapids at a distance of about 30 miles from its mouth. The rivers on the east coast are practically the only highways, the Malays always travelling by boat in preference to walking, but they serve their purpose very indifferently, and their great beauty is their chief claim to

~~*distinction. Magnificent oaves are found on both slopes of the peninsula, those at B§,tu in SSlSngor being the finest on the west coast, while those of ChSdu and K6to Glanggi in Pahang are the most extensive yet visited by Europeans on the east coast. They are all of limestone formation. The minerals produced are tin, gold, iron, galena, and others in insignificant quantities. Only two tin lodes are being worked, however, and both are situated on the east coast, the one at Kuantan in Pahang, the other at Bandi in Treng- g§,nu territory. On the west coast no true lode has yet been dis- covered, though the vast alluvial deposits of tiu found there seem to make such a discovery probable in the future. Since 1890 the tin produced from these alluvial beds has supplied between 50 and 75 per cent, of the tin of the world. Gold is being worked with success in Pahang, and has been exploited from time immemorial by the natives of that state and of Kglantan. Small quantities have also been found on the western slope in Perak.*~~

~~*It was formerly the custom to speak of the Malay Peninsula as an unhealthy climate, and even to compare it with the west coast of Africa. It is now generally admitted, however, that Ateteoro- though hot, it compares favourably with that of Burma. clfmate &c '^^^ chief complaint which Europeans make concerning ' ■ it is the extreme humidity, which causes the heat to be more oppressive than is the case where the air is dry. On the other hand, the thermometer, even at Singapore on the southern coast, which is the hottest portion of the peninsula, seldom rises above 98° in the shade, whereas the mean for the year at that place is generally below 80°. On the mainland, and more especially on the eastern slope, the temperature iscooler, the thermometer seldom rising above !I3° in the shade, and falling at night below 70°. On an aver- age day in this part of the peninsula the temperature in a European house ranged from 88° to 68°. The number of rainy days through- out the peninsula varies from KiO to over 200 in each year, but vio- lent gusts of wind, called " Sumatras," accompanied by a heavy downpour of short duration, are more common than persistent rain. The rainfall on the west coast varies from 75 to 120 inches per an- num, and that of the east coast, where the north-east monsoon breaks with all its fury, is usually about 155 inches per annum. Malarial fevers make their appearance in places where the forest has been recently felled, or where*~~

~~*the surface earth has been dis- turbed. It is noticed that labourers employed in deep mines worked*~~

~~*by shafts suffer less from fever than do those who are engaged in stripping the alluvial deposits. This, of course, means that a new station, where clearing, digging, and building are in progress, is often unhealthy for a time, and to this must be attributed the evil reputation which the peninsula formerly enjoyed. To Europeans the climate is found to be relaxing and enervating, but if, in spite of some disinclination for exertion, regular exercise is taken from the beginning, and ordinary precautions against chills, more espe- cially to the stomach, are adopted, a European has almost as good a chance of remaining in good health in the peninsula as in Europe. A change of climate, however, is imperatively necessary every five or six years, and the children of European parents should not be kept in the peninsula after they have attained the age of four or five years. The Chinese immigrants suffer chiefly from fever of a malarial type, from beri-beri, a species of tropical dropsy, and from dysentery. The Malays formerly suffered severely from smallpox epidemics, but in the portion of the peninsula under British rule vaccination has been introduced, and the ravages of the disease no longer assume serious dimensions. Occasional outbreaks of cholera occur from time to time, and in the independent states these cause terrible loss of life, as the natives fly from the disease and spread the infection in every direction. As a whole, the Malays are, how- ever, a remarkably healthy people, and deformity and hereditary disease are rare among them. There is little leprosy in the penin- sula, but there is a leper hospital near Penang on Pula D6raja, and another is about to be formed on an island on the west coast for the reception of lepers from the Federated Malay States.*~~

~~*The soil of the peninsula is remarkably fertile both in the plains and on the mountain slopes. In the vast forests the decay of vege- table matter during countless ages has enriched the soil to the depth of many feet, and from it springs the {^o™ ano most marvellous tangle of huge trees, shrubs, bushes, ‘“aa. underwood, creepers, climbing plants, and trailing vines, the whole hung with ferns, mosses, and parasitic growths, and bound together by rattans and huge rope-like trailers. In most places the jungle is so dense that it is impossible to force a way through it without*~~

~~the aid of a wood-knife, and even the wild beasts use well-worn game-tracks through the forest. In the interior brakes of bamboos are found, many of which spread for miles along the river banks. Good hard-wood timber is found in plenty, the best being the merabau, penak, rasok, and chengal. Orchids of countless varieties abound. The principal fruit trees are the duri-an, mangosteen, custard-apple, pomegranate, rambut-an pOlas-an, langsat, rambai, jack-fruit, cocoanut, areca nut, sugar-palm, and banana. Coffee, tobacco, sugar-cane, rice, pepper, gambler, cotton, and sago are culti- vated with success. The principal jungle products are gutta and rubber of several varieties, and many kinds of rattan. The mangrove grows on the shores of the west coast in profusion. Agila-wood, the camphor tree, and ebony are also found in smaller quantities.~~

~~The fauna of the peninsula is varied and no less profuse than is the vegetable life. The Asiatic elephant ; the sel&dang, a bison of a larger type than the Indian gaur ; two varieties of rhinoceros ; the honey bear (brUang) , the sambhur (rusa) ; the speckled deer (kyang) , three varieties of mouse-deer (napoh, plhndok, and kanchil); the gibbon (Sngka or wawa'), the siamang, another species of anthropoid ape, the brok or cocoanut monkey, so called because it is trained by the Malays to gather the nuts from the cocoanut trees, the lotong, kra, and at least twenty other kinds of monkey ; the binturong (arctictis binturong), the lemur ; the Asiatic tiger, the black panther, the leopard, the large wild cat (Jianmau (ikar), several varieties of jun- gle cat ; the wild boar, the wild dog ; the flying squirrel, the flying fox ; the python, the cobra, and many other varieties of snake, in- cluding the hamadryad ; the alligator, the otter, and the gavial, as well as countless kinds of squirrel, rat, &c., are found throughout the jungles of the peninsula in great numbers. On the east coast peafowl are found, and throughout the interior the argus pheasant, the firebacked pheasant, the blue partridge, the adjutant-bird, several kinds of heron and crane, duck, teal, cotton-teal, snipe, wood-pigeon, green-pigeon of several varieties, swifts, swallows, pied-robins, horn-bills, paroquets, fiycatchers, nightjars, and many other kinds of bird are met with frequently- A few specimens of solitary goose have been procured, but the bird is rarely met with. The forests literally swarm with insects of all kinds, from cicada: to beautiful butterflies, and from stick- and leaf-insects to endless varieties of ants. The scorpion and the centipede are both common. The study of the in- sect life of the peninsula~~

opens a splendid fieldfor scientific research, and the profusion and variety of insects found in these' forests pro- bably exceed those to be met with anywhere else in the world.

Politically the Malay Peninsula is divided into three sections : — 1. The Federated Malay States ; 2. The Independent State of Johor, which is within the British sphere of influence ; •'5. The Independent States of the Peninsula which are Political actually or nominally under the dominion of Siam. •Wv'^'o" The Federated Malay States, under British protec- ^"figa'"'" tion, are four in number, viz., Pgrak, SelS,ngor, and the N6gri Sgmbilan on the west coast, and Pahang on the east coast.*

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Johor is the only Malay state in the portion of the peninsula lying within the British sphere of influence which has been allowed to remain under native rule.

The Malay states which either nominally or actually are under the dominion of Siam are as follows : — Palean, Satun, Paiit, and K6dah on the west coast ; P6tani, JSring, Sai, L6geh, KSlantan, and TrSngganu on the east coast ; and jaior and Eaman inland. The aggregate area of these states is roughly estimated at about 20,000 square miles, and the population, chiefly Malayan, may be placed at about 200,000. Once in three years the rulers of these states send tribute to Siam in the form of flowers fashioned from gold and silver {bUnga dmas), and presents from the king at Bangkok of approximately the same value are returned by the messengers who bear the tribute.

Kedah is situated on the west coast of the Malay Peninsula, between parallels 5" 2' and 6° 42' N. The coast-line is only about 66 miles long, and the greatest distance from north to south is about 116 miles, and the greatest breadth at the widest point is about 47 miles. The area may be estimated at about 5000 square miles, and the population, 75 per cent, of whom are Malays, at about 45,000. According to the native tradition, K6dah was at one time a tributary of Malacca, and was subsequently

~~conquered by the Acheenese. Later, the natives of K6dah invaded and conquered P§rak, but they eventually withdrew. In the middle of the 18th century, if not earlier, K6dah fell under the dominion of Siam,~~

~~„ and has continued from that time to send the bUnga~~

~~‘ dmas (tribute) to Bangkok every three years. Until recently this tribute seems to have formed the only right exercised by Siam with regard to her Malayan dependencies, ‘ and it is open to question whether this gift did not partake of the nature of a con- ciliatory present to a powerful neighbour rather than of that of a direct admission of sovereignty. Be this how it may, it is certain that the cession of Penang to the East India Company in 1785 and of Province Wellesley In 1798 was granted by the then sultan of K6dah without the approval of Siam being sought or given. Of late years, however, spurred thereto by the growing influence of the British in the Malay Peninsula, Siam has been at great pains to tighten her hold over the Malayan states which have for so long been nominally under her dominion, and in no part of the peninsula has this been done to greater effect than in Kedah. The sultan of that state, nominated and installed by the king of Siam, and granted a Siamese title, is now no better than a governor appointed by Siam to rule the state which is his birthright, and during the visit of the king to the peninsula, in 1890, the sultan was forced to follow his suzerain about as one of the least considered of his nobles. The state is not much better governed than other Malayan countries which are not under European management, the Siamese concerning themselves but little with the details of administration, and displaying in their own land the deplorable lack of political purity and love of justice which seemingly are flaws from which no Oriental government has the power to free itself. A little alluvial tin is worked in K6dah, but the chief products are agricultural, the Malays of this state growing a, considerable quantity of rice with some success.**

~~Palean, Sd,tun, and PQlit are three small states on the west coast, lying to the north of K6dah. Like S6ngg6ra on the east coast, they form part of Lower Siam, and can hardly be regarded as an integral portion of the Malayan Peninsula. They are not of any Pal&aa, political or commercial~~

~~*importance, and are under the Satun, jujg Qf tjjg Siamese governor of Junkseylon. The*~~

~~*Pallt resident councillor of Penang for the time being is the*~~

~~*consul-general for KSdah and for these Siamese states on the west coast.*~~

~~*Petctni is the name properly applied to a small state situated on the north-east shoulder of the Malay Peninsula, but it is usually employed to include the small states of Jering, Sai, Jaior, and RSraan also. Each of these little states, however, is under its own Malay ruler, and all are directly under the influence and control of Siam. Speaking of P6tani in the wider application of the name, it may be said to be bounded by the China Sea on the N. and E., by Pgrak and L6geh on the S., and by K6dah on the AV. It is situated between 5° 34' and 6° 52' N. and 100° 54' and 101° 58' E. Its total area is about 4000 square miles. A portion of Raman is claimed by Pgrak, and has formed the subject Petanl. ^j dispute since 1882. The population, which is*~~

~~*unusually thick for the peninsula, is estimated at about 20,000, of whom about 5000 are Chinese and Siamese. Pgtani is historically important as having been the scene of the first factory established by the East India Company in the peninsula. P6tani is also remarkable as having for an extended period of time been governed by a Malay queen, the only recorded instance of female government in the history of the peninsula. To-day Pgtani, under the rule of Siam, is a place of little importance. Its native rajas exert little influence over their people, and the petty jealousies which exist between the rulers of the various tiny states give rise to constant quarrels between them and their adherents. The natives of Pgtani are skilled in the art of catching and taming elephants.*~~

~~*The chief industry of the country along the coast is the evaporation of salt from sea-water.*~~

~~*Keiantan is the name of a large native state on the east coast of the peninsula. It is bounded on the N. and N.E. by the China Sea, on the S. by Pahang, on the E. by Trgngganu, and on the W. by Pgrak. It lies between parallels 4° 48' and 6° 20' N. and 101° 33' and 102° 45' E. The*~~

greatest distance from north-east to south-west is 108 miles, and the gi-eatest breadth from east to west is 68 miles. The total area of the state is about 7000 square miles. Next to the Pahang, the Kelantan Kgig„tan river is the largest on the east coast. It is shallow, and the upper reaches are somewhat obstructed by rapids, but it is navigable for native trading boats for a distance of nearly 200 miles. Its principal tributaries are Galas, N6ng^ri, Pergai, and Lebir rivers. The Galas valley is rich in alluvial gold, and there is every reason to believe that lodes also exist. A Chinese colony, chiefly composed of Ho-Kien and Te-Chow Chinese, has existed at Pulai in this valley from time immemorial, the original founders of the settlement having been attracted thither by gold mines. The community is ruled by a Kapitan China, appointed by the sultan. The Lebir valley is almost entirely peopled by fugitives from Pahang, who sought refuge from the constant civil wars which raged in that state. The Nenggiri valley is largely peopled by aborigines, men of the Mon-Annam stock, who from time to time have carried on a desultory warfare with the Malays. The Pergai is also rich in gold, and forms the principal highway into the state of L6geh.

Kglantan is nominally under the control of Siam, and since the death in 1889 of the old sultan, Mulut Mgrah (The Eed-Mouthed), who for more than sixty years ruled the country with great force and cruelty, the strife for the throne which has been carried on by his grandchildren has led to each pretender seeking to strengthen his individual position by enlisting the sympathies of Siam. This has enabled the king to obtain a more definite hold over the country than was possible during the reign of Mulut M§rah, and in 1892 an issue of postage stamps was put in circulation in K61antan bearing the portrait of the king of Siam, and a Malay, born in Bangkok, was sent to K6ta Bharu, the capital of the state, to act as post-master and Siamese representative. Since that time the influence of Siam in Kelantan has steadily increased, and now the flag of the white elephant floats at the mouth of the river.

The country in the vicinity of the capital is more open than is usual in the Malayan lands. Broad stretches of grazing-ground are found, and the breed of cattle and sheep which thrives there is the best in the peninsula. Considerable quantities of live stock are exported to Singapore. The

whole of the state is very fertile, and the natives, who physically are of a somewhat larger type than most Malays, are more hardworking than those of any other state in the peninsula. Since Pahang was placed under British protection, and the lives of immigrants were rendered safe thereby, a large number of Kelantan Malays have made their way into that country, and people of that tribe now supply 70 per cent, of the Malay labour there obtainable. As compared with other Malay states, Kelantan has always enjoyed the reputation of being ex- ceedingly populous, and even now, when the population has been diminished by cholera, smallpox, and emigration, it can safely be estimated at 75,000 souls. A round tin coin, with a hole in the centre, like a Chinese " cash," is issued by the sultan, and the old pillar dollar is the standard coin, Mexican dollars being reckoned as being less valuable by one-third. Until quite recently the latter were received with the utmost reluctance. The ruling family of Kelantan belongs to a clan bearing the title of Wan, and is not regarded by other Malay ruling families as belonging to any royal stock. The title of sultan was assumed only about 1885 for the first time. Kelantan, if well governed, would probably be one of the most prosperous states in the peninsula, but under native rule all manner of abuses exist, which cannot but discourage commerce and immigration. The natives of Kelantan are addicted to prize-fight- ing, and also keep rams and buffalo-bulls for similar purposes.

Trenggclnu is the name of a large state on the east coast of the peninsula. It is bounded on the N.E. and E. by the China Sea, on the S. by Pahang, and on the W. by Kelantan and _ Pahang. It lies between parallels 4° 4' and 4° 46' N. T^i^engganu. and 102° 30' and 103° 26' E. The greatest distance from north to south is 120 miles ; the greatest breadth from east to west is 50 miles. It has a coast-line 130 miles in length, and the esti- mated area of the state is about 6000 square miles. The principal rivers of the state are the Besut, Stlu, Trengganu, Dflngun, and Kgmaman, each of which waters a district of some importance, the revenues of which are drawn by one or another of the sultan's many relatives. The sultan himself derives his revenues from the district lying immediately around his capital at Kuala Trgngganu, but these represent so small a proportion of the revenues of the state that he is probably the poorest ruler in the peninsula. The B6sut district is inhabited entirely by Malays, and was

~~reduced by a war conducted about 1875 by Baginda Umar, the grand-father of the present (1902) sultan. It is chiefly remarkable as~~

~~having sufiered more than any other district on the coast from a typhoon which raged during 1882 and felled the forest for miles. Later the dead timber generated fire, and for some miles inland the traces of this double calamity are still visible. The Stiu river is a long, muddy, and very deep inlet, and is chiefly famous for the number and boldness of the alligators vfhich infest it. The TrenggS.nu district is very thickly inhabited for the first 30 miles of the river's course from its mouth to the impassable falls knovfu as Lata KSlgmang. Above this point the population only numbers about 500 souls, the falls, which are 5 miles long, presenting a barrier to trade which has effectually prevented the development of the rich interior. Even above the falls the river is difficult, owing to the size of the rapids with which it is beset, and the TrSnggSnu proper, above the point where it is joined by the KSrbat, is quite impassable for boats of any kind. The consequence of this is that the whole population of the TrenggSnu valley is concentrated within the narrow strip of country lying between the sea and the KglSmang Falls, and almost every inch of the country is cultivated with a thoroughness which is unlike anything to be seen anywhere else in the peninsula. The Dungun takes its rise in the hills, whence the T6mb61ing river flows into Pahang. It is noted for the amount of gutta which is annually exported from the valley. The Kgmaman river waters a valley bordering on Kuantan in Pahang territory, and has the reputation of being rich in tin. A lode is being worked by a European company at Bandi in this district. The people of Trengganu, owing to the enlightened policy of the late BSginda Umar, who introduced skilled artisans to teach his people, are the best workers in metal and wood on the coast. They build excellent boats of a European type, weave all manner of native silks and cotton stuffs, make weapons and brass and nickel ware, and are especially famous for their skill in producing spurious articles which so closely resemble the originals that detection is well-nigh impossible.~~

The TrSnggSnu sultanate is one of the most ancient in the peninsula, and ranks with that of Riau. The country was con- quered by Baginda Umar in 1837, the then sultan, the son of the conqueror's elder brother, subsequently dying while flying from his uncle. The present sultan is the grandson of the Baginda. HIe is very religiously inclined, and the people of this state are more fanatical Mahommedans than are to be found elsewhere in the peninsula.

Legeh is the name of a small state which is more directly under the rule of Siam than KSlantan. It is said to contain gold in payable quantities. It is not of much political importance. Its area is about 2000 square miles.

Excluding the Tai, or Siamese, who are undoubtedly recent intruders from the north, there are three races which for an ex- tended period of time have had their home in the Den/o«i/a. ^^^^y Peninsula. These are the S6mang-or Pangan, the Sakai or jakun, and the Malays. The S6mang, as they are most usually called by the Malays, are Negritos — a small, very dark people , with features of the negroid type, very prognathous, and with short, woolly hair clinging to the scalp in tiny crisp curls. These people belong to the race which would seem to be the true aboriginal stock of southern Asia. Representatives of it are found scattered about thei islands from the Andaman group southwards. The state of civilization to which they have attained is very low. They neither plant nor have they any manufactures except their rude bamboo and rattan vessels, and the bows, blow-pipes, and bamboo spears with which they are armed. They are skilful hunters, however, catch fish by ingeniously-constructed traps, and live almost entirely on jungle-roots and the produce of their hunting and fishing. The most civilized tribe of these people is found in Upper P§rak, and the members of this clan have acquired some knowledge of the art of planting, &c. They cannot, however, be taken as typical of their race, and other specimens of this people are seldom seen even by the S§,kai. From time to time tliey have iDeen raided by the latter, and many Negritos are to be found in captivity in some of the Malayan villages on the eastern side of the peninsula. The mistake of speaking of the S3,kai tribes as prac- tically identical with the S§mang or Pangan has very frequently been made, but as a matter of fact the two races are absolutely ■distinct from one another. It has also been*

customary to include the sakai in the category of Malayan races, but this too is undoubt- edly incorrect. The Sakai still inhabit in greatest numbers the •country which forms the interior of Pahang, the Plus and Kinta districts of P§rak, and the valley of NSnggiri in K61antan. Repre- sentatives of their race are also found scattered among the Malayan villages throughout the country, and also along the coast, but these have intermixed so much with the Malays, and have acquired so many customs, &c., from their more civilized neighbours, that they ■can no longer be regarded as typical of the race to which they belong. The pure Sakai in the interior have a good knowledge of planting rice, tapioca, &c., fashion pretty vessels from bamboos, which they decorate with patterns traced by the aid of fire, make loin-cloths (their only garment) from the bark of the trap and ipoh trees ; are very musical, using a rude lute of bamboo, and «, nose-flute of a

Archseo- logy.

very sweet tone, and singing in chorus very melodiously ; and altogether have attained in their primitive state to a higher degree of civilization than have the S6mang. They are about as tall as the average Malay, are slimly built, light of colour, and have wavy fine hair. In their own language they have only three numerals, viz., na-nun, one ; na\ two ; and ne\ three ; all higher arithmetical ideas being expressed by the word kerpn, which means "many." Among the more civilized, however, the Malay numerals up to ten are adopted by the SSkai. An examination of their language seems to indicate that it belongs to the Mon-Annam family of languages, and the anthropological information forthcoming concerning the SSikai points to the conclusion that they show a greater afSnity to the people of the Mon-Annam family of races than to the Malayan stock. Though they now use metal tools imported by the Malays, it is noticeable that the names which they give to those weapons which most closely resemble in character the stone implements which are found in such numbers all over the peninsula are native- names wholly unconnected with their Malay equivalents. On account of this, it has been suggested that in a forgotten past the sakai were themselves the fashioners of the stone implements, and certain it is that all tools which have no representatives among the stone kelts are knovsm to the Sakai by

~~*obvious corruptions of their Malayan names. The presence of the Sakai, a people of the Mon- Annam stock, in the interior of the peninsula has also been con- sidered as one of many proofs that the Malays intruded from the south, since had they swept down from the north, being driven thence by the people of a stronger breed, it might be expected that the fringe of country dividing the two contending races would be inhabited by men of the more feeble stock. Instead, we find the Sakai occupying this position, thus indicating that they have been driven northwards by the Malays, and that the latter people has not been expelled by the Mon-Annam races from the countries now represented by Burma, Siam, and French Indo-China. The Sakai population is dying out, and must eventually disappear. (With regard to the Malay, see Malays.)*~~

~~*The only ancient remains found in the peninsula are the stone implements, of which mention has already been made, and some remarkable ancient mines, which are situated in the Jelai valley in Pahang. The stone implements are generally of one or two types : a long rectangular adze or wedge rudely pointed at one end, and used in conjunction with a mallet or flat stone, and a roughly triangular axe-head, which has evidently been fixed in the cleft of a split stick. A few stones, which might perhaps be arrow-heads, have been found, but they are very rare.*~~

~~*The mines, which have been constructed for the purpose of work- ing quartz lodes containing gold, are very extensive, and argue a high stage of civilization possessed by the ancient miners. They consist of a number of circular or rectangular pits sunk from the cap of a hill, and going down to a depth of in some cases as much as 120 feet, until in fact the miners have been stopped by being un- able to cope with the quantity of water made when the level of the valley was reached. The shafts are placed so close together that in many instances they are divided by only a couple of feet of solid ground, but at their bases a considerable amount of gallery work has been excavated, though it is possible that this was done by miners who came after the people who originally sank the shafts. Native tradition attributes these mines to the Siamese, but not much im- portance can be attached to this, as it is very general for the Malays to give this explanation for anything which is obviously not the work of their*~~

own ancestors. A theory, which seems to have some pro- bability in its favour, is that these mines were worked by natives of India during the period when the whole of the Malayan Archipelago was more or less overrun by the Hindu races, but the absence of all remains which might aid in the identification of the ancient miners renders it impossible at the present time to give any authoritative opinion on this point.

The Malay Peninsula was known to the ancients as the Aurea Chersonesus, and there can be no doubt that from a very early time a constant trade was maintained between the people ^

of the peninsula and archipelago and the natives of History. Arabia, Persia, and India. Cloves, nutmegs, and other spices are believed to have formed the chief articles of commerce, and to have come almost entirely from Malayan lands, reaching Europe vi& Arabia. At one period in its history the archipelago was overrun by Hindus from India, and traces of their presence are found to this day in .Tava and other islands of the archipelago, the people of Bali, for instance, still professing a kind of Hinduism. There is no evidence to show, however, that the influence of the Hindus ever extended to the peninsula itself. The wave of Mahommedan- isra which later swept over the peninsula and archipelago was a peaceful, not a warlike invasion. The first Mahommedan mission- aries were the traders who, following in the steps of their forebeara, acted as the middle-men by whose agency the trade of the East Indies found its way into Europe. The raja of Acheen in Sumatra was the first convert of note. He publicly embraced the new creed

in 1206. The sultan of Malacca became a Mahommedan in 1276, but it is probable that long before that date the faith of the Prophet had won a sure foothold among the Malays of his kingdom and of the west coast generally. Vasco da Garaa rounded the Cape of Good Hope in 1496, but the peninsula itself does not appear to have been visited until the time of Magellan. Malacca was visited by the Portuguese Sequeira in 1509, and was conquered by Albu- querque in 1511, this being the earliest European

~~*settlement on the mainland of the peninsula. Drake was the first Englishman to make a journey to the Malayan Archipelago, coming from the east of the Moluccas, and calling at Bantam in 1578. Ten years later Cavendish followed the same route. In 1592 Lancaster left Zan- zibar in February and called at Penang (" Pulo Pinaom "), where he remained till the end of August. This was the first British trading expedition to the East Indies. The Dutch under HIoutman visited Bantam in 1595-96. In 1600 the East India Company was formed in London, principally for the purpose of trading with Malaya, and the first fleet belonging to tlie company was sent out under Lancaster's command in 1601. During Captain HIppon's voyage in 1612-13 the peninsula was first rounded by a British ship, and in the latter year a factory was established in PStani, and the first president. Captain Jourdain, was killed in 1620 in a naval engage- ment with the Dutch in P6tS,ni Roads. It was in tlie course of various voyages to Mal9,ya that attention was first attracted by the mainland of India, and the commerce which had progressed favourably in Malayan waters ultimately led to the establishment of the Indian Empire. Malacca was wrested from the Portuguese by the Dutch in 1641. The principal stations of the East India Company in Malayan lands were on the island of Sumatra, and it was not until 1795 that Malacca was taken by the British from the Dutch. It was restored to the Dutch by the treaty of 1818, and it did not come finally into British hands until 1824, when it was exchanged for Bencoolen in Sumatra. Penang was purchased from K6dah in 1786, and Singapore from the then sultan of Johor in 1819. The native state of Perak was placed under British pro- tection in 1874, and between that date and 1888 the other native states which now form the federation were also placed under pro- tection. The Straits Settlements were ruled from India until 1867, when they became a Crown colony.*~~

~~*See Journal of the Straits Branch of the Boyal Asiatic Society, Singapore ; Journal of the Malay Archipelago, Singapore.- — Weld, Maxwell, Swettenham, and Clifford,, in the Journal of the Boyal Colonial Institute, London. — Clifford, Geographical Jour- nal, London, 1896. — M'Nair, Sarong and Kris, London, 1880.*~~

~~*(h. Cl.)*~~

~~Malays, the name given by Europeans to the people calling themselves Orang Maldyu, i.e., Malayan folk, who are the dominant race of the Malay Peninsula and of the Eastern Archipelago. Broadly speaking, all the brown races which inhabit the portion of Asia south of Siam and Indo-China, and the islands from the Philippines to Java, and from Sumatra to Timor, may be described as belong- ing to the Malayan family, if the aboriginal tribes, such as the Sakai and SSmang in the Malay Peninsula, the B&taks in Sumatra, and the MUruts in Borneo, be excepted. Eor the purposes of this article, however, only those among these races which bear the name of Orang MalS,yu, speak the Malayan language, and represent the dominant people of the land, can be included under the title of Malays. These people inhabit the whole of the Malayan Peninsula to the borders of Lower Siam, the islands in the vicinity of the mainland, the shores of Sumatra and some portions of the interior of that island, Sarawak and Brflnei in Borneo, and some parts of Dutch Borneo, Batavia, and certain districts in Java, and some of the smaller islands of the archipelago. Though in these lands they have for not less than a thousand years en- joyed the position of the dominant race, they all possess a tradition that they are not indigenous, and that their first rulers " came out of the sea," with a large band of Malayan warriors in their train. In the peninsula espe- cially, where the presence of the Malays is more recent than elsewhere, many traditions exist which point to a comparatively recent occupation of the country. It has been remarked that there is evidence that the Malays had attained to a certain stage of civilization before ever they set foot in MalSya. Per instance, the names which they give to certain fruits, such as the dUri-an, the**

rambuPan, and the pIHlas-an, which are indigenous in the Malayan countries, and are not found elsewhere, are all compound words meaning respectively the thorny, the hairy, and the twisted fruit. These words are formed by the addition of the substantial affix " an," the use of which is one of the recognized methods by which the Malays turn primitive words into terms of more complex meaning. This may be taken to indicate that when first the Malays became acquainted with the fruits which are indigenous in Malayan lands, they already possessed a language in which most primary words were represented, and also that their tongue had attained to a stage of development which provided for the formation of

~~com pound words by a system sanctioned by custom and the same linguistic instinct which causes a Malay to-day to form similar compounds from European and other for- eign roots. Por any aboriginal race inhabiting these countries, such important articles of diet as the dAri-an, &c., could not fail to be among the first natural objects to receive a name, and thus we find primary terms in use among the S§,kai and S6mang, the aborigines of the Penin- sula, to describe these fruits. The use by the Malays of artificially constructed terms to denote these things may certainly be taken to strengthen the opinion that the Malays arrived in the lands they now inhabit at a com- paratively late period in their history, and at a time when they had developed considerably from the original state of primitive man.~~

~~Until recently many eminent scientists held the theory that the Malayan peoples were merely an offspring of the Mongol stock, and that their advance into the lands they now inhabit had taken place from oforiein the cradle of the Mongolian race — that is to say, from the north. In the fifth edition of his Malay ArchL pelago, p. 591, A. E. Wallace notes the resemblance which he traced between the Malays and the Mongolians, and others have recorded similar observations as to the physical appearance of the two races. To-day, however, fuller data are available than when Wallace wrote, and the more generally accepted theory is that the Malayan race is dis- tinct, and came from the south, until it was stayed by the Mongolian races living on the mainland of southern Asia. The cranial measurements of the Malays and an examina- tion of their hair sections seem to bear out the theory that they are distinct from the Mongolian races. Their lan- guage, which is neither monosyllabic nor tonic, has nothing in common with that of the Mon-Annam group. It has, moreover, been pointed out that had the Malays been driven southwards by the stronger races of the mainland of Asia, it might be expected that the peoples inhabiting the country nearest to the border between Siam and Malaya would belong to the Malayan and not to the Mon- Annam stock. As a matter of fact the Sakai of the interior of the peninsula belong to the latter race. It might also be anticipated, were the theory of a southward immigration to be sustained, that the Malays would be new- comers in the islands of the archipelago, and have their oldest settlements on the Malayan Peninsula. The facts, however, are in exact contradiction~~

to this ; and accord- ingly the theory now most generally held by those who have studied the question is that the Malays form a distinct race, and had their original home in the south. Where this home lay it is not easy to say, but the facts recorded by many writers as to the resemblance between the Poly- nesian and the Malayan races, and the strong Malayan element found in the languages of the former (see Tregear's Maori and Comparative Polynesian Dictionary, London, 1891), have led some students to think that the two races may have had a common origin. John Crawford, in the Dissertation to his Dictionary of the Malay Language, published in 1840, noted the prevalence of Malayan terms

in the Polynesian languages, and attributed the fact to the casting away of ships manned by Malays upon the islands of the Polynesian Archipelago. The appearance of the same Malayan words in localities so widely separated from each other, however, cannot be satisfactorily accounted for by any such explanation, and the theory is now more generally held that though the two races are ethnologically distinct, they may, at some remote period of history, have shared a common home. It has been suggested that their separation did not take place until after the continent which once existed in the north Pacific had become submerged, and that the Malays wandered northwards, while the Polynesian race spread itself over the islands of the southern archipelago. All this, however, must necessarily be of the nature of the purest speculation, and the only facts which we are able to deduce in the present state of our knowledge of the subject may be summed up as follows: (a) That the Malays ethnologically belong to a distinct race ; (6) that the theory formerly current, to the effect that the SS-kai, Orang Bgnua, 6rang Laut, and other similar races of the peninsula and archipelago belonged to the Malayan stock, cannot be maintained, since recent investigations tend to identify them with the Mon-Annam family of races ; (c) that the Malays are, comparatively speaking, newcomers in the lands which they now inhabit ; (d) that it is almost certain that their emigration took place from the south ; (e) and that, at some remote period of their history, they came into close contact

~~*with the Polynesian race, prob- ably before its dispersion over the extensive area which it now occupies.*~~

~~*The Malays to-day are Sunni Mahommedans of the school of Shafl'i, and they habitually use the terms Orang Mdld,yu, i.e., a Malay, and Orang IslQm, i.e., a Mahommedan, as Rellgloa synonymous expressions. Their conversion from pagan- ism took place during the 13th, 14th, and 15th centuries of our era, the earliest recorded conversion of a Malay ruler being that of the RSja of Acheen in northern Sumatra in 1206, and the latest that of the Biigis people of Celebes in 1495. The sultan of Malacca, whose conversion occurred in 1276, was the first ruler of the peninsula to embrace the Mahommedan religion. Upon the bulk of the Malayan peoples their religion sits but lightly. Few are found to observe the law concerning the Five Hours of Prayer, and many fail to put in an appearance at the Friday con- gregational services in the mosques. The Fast of Ramathan, how- ever, is generally observed with some faithfulness. Compared with other Mahommedan peoples, the Malays are not fanatical, though occasionally an outbreak against those of a different creed is glori- fied by them into a holy war. The reason of such outbreaks, how- ever, is usually to be found in political and social rather than in religious grievances. Prior to their conversion to Mahommedanism, tlie Malays were subjected to a considerable Hindu influence which reached them by means of the traders who visited the archipelago from India. In the islands of BSli and Lombok the people still profess a form of Hinduism, and Hindu remains are to be found in many other parts of the archipelago, though their traces do not extend to the peninsula. Throughout, however, the superstitions of the Malays show indications of this Hindu influence, and many of the demons whom their medicine-men invoke in their magic practices are clearly borrowed from the pantheon of India. For the rest, a substratum of superstitious beliefs which survives from the days when the Malays professed only their natural religion is to be found firmly rooted in the minds of the people, and the influence of Mahommedanism, which regards such things with horror, has been powerless to eradicate this. Mr W. W. Skeat's ilalay Magic (Macmillan, London, 1900) is a compilation of all the writings on the subject of Malay superstitions by the best authorities.*~~

~~*The Malays of the coast are a maritime people, and were long famous for the daring character of their acts of piracy. They are now peaceable fisher-folk, who show considerable in- genuity in their calling. Inland the Malays live by preference on the banks of rivers, building houses on piles some feet from the ground, and planting groves of oocoanut, betel-nut, sugar-palm, and fruit-trees around their dwellings. Behind their villages ttie rice-flelds usually spread, ami rice, which is the staple food of the people, is the principal article of agriculture among them. Sugar-cane, maize, tapioca, and other similar pro- ducts are grown, however, in smaller quantities. In planting rice three methods are in use : the cultivation of swamp-rice in irrigated*~~

~~*and super, stitlons.*~~

~~*Mode ot life, &c.*~~

~~*fields ; the planting of ploughed areas ; and the planting of hill- rice by sowing each grain separately in holes bored for the purpose. In the irrigated fields the rice plants are first grown in nurseries, and are subsequently transplanted when they have reached a certain stage of development. The Malays also work jungle produce, of which the most important are gutta, rattans, agila wood, camphor wood, and the beautiful MmUning wood which is used by the natives for the hilts of their weapons. The principal manufactures of the Malays are cotton and silk cloths, earthenware and silver vessels, mats, and native weapons. The best cotton cloths are those manufactured by the Biigis people in Celebes, and the b&tek cloths which come from Java and are stamped with patterns. The best silks are produced by the natives of Pahang, Kfilantan, and Johor in the Malay Peninsula. Lord Leighton pronounced the silver ware from Malaya to be the most artistic of any exhibited at the Colonial Exhibition held in London in 1886. The pottery of the Malays is rude but curious. When the first Europeans visited the Malay Archipelago the Malays had already acquired the art of manufacturing gunpowder and forging cannon. The art of writing also appears to have been independently invented by the Malayan races, since numerous alphabets are in use among the peoples of the archipelago, although for the writing*~~

~~*of Malay itself the Arabic character has been adopted for some hundreds of years. The Malays are excellent boat-builders.*~~

~~*While the Malays were famous almost exclusively for their piratical expeditions, they naturally bore an evil reputation among Europeans, but now that we have come into closer contact with them, and have learned to understand j}^™ *"' them better, the old opinions concerning them have been greatly modified. They used to be described as the most cruel and treacherous people in the world, and they certainly are callous of the pain suffered by others, and regard any strategy of which their enemies are the victims with open admiration. In ordinary circumstances, however, the Malay is not treacherous, and there are many instances recorded in which men of this race have risked their own lives on behalf of Europeans who chanced to be their friends. As a, race they are exceedingly courteous and self- respecting. Their own code of manners is minute and strict, and they observe its provisions faithfully. Unlike many Orientals, the Malays can be treated with a friendly familiarity without such treatment breeding lack of respect, or leading to liberties being taken with the superior. The Malays are indolent, pleasure-loving, improvident beyond belief, fond of bright clothing, of comfort, of ease, and they dislike toil exceedingly. They have no idea of the value of money, and little notion of honesty where money is con- cerned. They would always borrow rather than earn money, and they feel no shame in adopting the former course. They wfll fre- quently refuse to work for a wage when they most stand in need of cash, and yet at the invitation of one who is their friend they will toil unremittingly without any thought of reward. They are much addicted to gambling, and formerly were much given to fighting, though they never display that passion for war in the ab- stract which is characteristic of some of the white races, and their courage on the whole is not high if judged by European standards. It is notorious, however, on the coasts that a Malay gang on board a ship invariably gets the better of any fight which may arise between it and the Chinese crew. The sexual morality of the Malays is very lax, but prostitution is not common in consequence. Polygamy, though allowed by their religion, is practised for the most part among the wealthy classes only. The Malays are an intensely aristoeratic people, and show a marvellous loyalty to their rSjas and chiefs. Their respect for rank is not marred by any vulgarity or*~~

~~*snobbery. The ruling classes among them display all the vices of the lower classes, and few of the virtues except that of courtesy. They are for the most part cruel, unjust, selfish, and improvident.*~~

~~*Much has been written concerning the acts of homicidal mania called (Xmoh, which word in the vernacular means to attack. It was formerly believed that these outbursts were to be attributed to madness pur et simple, and some cases of clmok can certainly be traced to this source. These are not, however, in any sense typical, and might equally have been perpetrated by men of another race. The typical Umok is usually the result of circum- stances which render a Malay desperate. The motive is often inadequate from the point of view of a European, but to tlie Malay it is sufBcient to make him weary of life and anxious to court death. Briefly, where a man of another race might not improbably commit suicide, a Malay runs Amok, killing all whom he may meet until he himself is slain.*~~

~~*The nervous affliction called Mah, to which many Malays are subject, is also a curious trait of the people. The victims of this aiHiotion lose for the time all self-control and all sense of their own identity, imitating the actions of any person who chances to rivet their attention. Accounts of these manifestations will be found in Swettenham's Malay Sketches (London, 1895, Lane) and Clifford's Studies in Brown Humanity (London, 1897, Richards).*~~

~~*The Malays wear a loose coat and trousers, and a cap or head- kerchief, but the characteristic item o£ their costume is the s&rong, a silk or cotton cloth about two yards long by a yard weaoo'as ”^ ^ quarter wide, the ends of which are sewn together, ^c. ' forming a kind of skirt. This is worn round the waist folded in a knot, the women allowing it to fall to the ankle, the men, when properly dressed in accordance with ancient custom, folding it over the hilt of their waist-weapon, and draping it around them so that it reaches nearly to the knee. In the hall of a raja on state occasions a head-kerchief twisted into a peak is worn, and the coat is furnished with a high collar extending round the back of the neck only.*~~

~~*This coat is open In front, leaving the chest bare. The trousers are short and of a peciiliar cut and material, being coloured many hues in parallel horizontal lines. The strong is of Celebes manufacture and made of cotton, to the surface of which a high polish is imparted by friction with a shell. The typical fighting costume of the Malay is a sleeveless jacket with texts from the Koran written upon it, short tight drawers reaching to the middle of the thigh, and the strong is then bound tightly around the waist, leaving the hilt of the dagger worn in the girdle exposed to view. The principal weapon of the Malays is the Icris, a short dagger with a small wooden or ivory handle, of which there are many varieties. The blade of a kris may either be wavy or straight, but if wavy the number of waves must always be uneven in number. The Tcris most prized by the Malays are those of Bugis (Celebes) manufacture, and of these the kind called tucisek are of the greatest value. Besides the short kris the Malays use long straight kris with very narrow blades, shorter straight kris of the same form, short broad swords called sundang, long swords of ordinary pattern called pedang, somewhat shorter swords curved like scimitars with curiously carved handles called chenangkas, and short stabbing daggers called tUmiok IMa. The principal tools of the Malays are the parang or golok, a heavy knife used in the jungle, without which no peasant ever stirs abroad from his house, the beltong or native axe, and the ptsau raut, which is used for scraping rattan. Their implements are very primitive, con- sisting of a plough fashioned from a fork of a tree, and a rude harrow. Reaping is usually performed by the aid of a curious little knife which severs each ear of grain separately. The fisher- folk use many kinds of nets, which they manufacture themselves. Sails, paddles, oars, and punting-poles are all in use.*~~

~~*The Malayan language is the lingua franca used throughout the archipelago, but in its purest forms it is spoken in the native states of the Malay Peninsula and in the Malay districts Language. ^^ Sumatra. It is a wordy language, having a vocabu- lary estimated at over 15,000 words exclusive of local terms. The grammar is very simple, the formation of the sentence requiring the nominative to precede the verb, the accusative to follow it, and the adjective and demonstrative pronoun to follow the noun they qualify. The possessive is best formed by placing the word indicating the possessor immediately after the word indicating the thing possessed.*~~

There are no inflexions of case or number, but when the plural requires to be emphatically expressed the noun is duplicated. Tenses are indicated by the use of auxihary verbs, and occasionally merely by the context, yet, though this would appear to be a loose mode of expression, there is never any difiiculty experienced in conveying the exact shade of meaning. The language is not easy to speak correctly, on account of its extremely idiomatic nature. In many instances slight shades of meaning are indicated by completely different words — e. g. , pXkul, to carry on the shoulder ; JM ((Jons', to carry on the head ; (?fiA;on^, to carry on the back ; beban, to carry on the back as a burden ; kandong, to carry at the waist or in the womb ; kandar, to carry suspended from a stick carried over the shoalder ; and many other words all indicating to carry. Instances of this kind of minuteness of expression might be multi- plied indefinitely. To the educated ear the use of the wrong term is as offensive as a false quantity in Latin. A further difficulty is presented by the number of words to indicate the first person singular, each of which has its complementary pronoun to indicate the second person. Malays attach great importance to the correct use of these terms in polite conversation. In addition to this the idiomatic expressions of the Malays are often somewhat obscure, and cannot be made to bear any meaning if literally translated into a European tongue, though in the vernacular they are exceedingly expressive. Thus it comes to pass that though Malay is a tongue with which it is easy to acquire sufficient familiarity for ordinary conversation, such as is required for simple business transactions and the like, it is found, when a closer knowledge of it is sought, to be a most difficult language for a European to acquire in any perfection. For further information as to the language, see the article Malays in the earlier volume of the Encyclopoedia Britannica (ninth edition). The Malays cannot, strictly speaking, he said to possess a litera- ture, for none of their vyritings can boast any literary beauty or value. Their most characteristic literature is to be found not Literature. ^^ their writings but in the folk-tales which are trans- mitted orally from generation to generation, and repeated by the

wandering minstrels called by the people Peng-lipor Lam, i.e., " Soothers of Care." Some specimens of these are to be found in the Journal of the Straits Branch of the Asiatic Society (Singapore). The collections of

~~*Malay Proverbs made by Klinkert, Maxwell, and Clifford also give a good idea of the literary methods of the Malays. Their verse is of a very primitive description, and is chieily used for purposes of love-making. There are numerous rhymed fairy tales which are much liked by the people, but they are of no literary merit. The best Malay story is that of Hang THah.*~~

~~*AuTHOEiTrES. — Hugh Clifford. In Court and Kampong. London, 1897 ; Studies in Broron Humanity. London, 1898 ; In a Corner of Asia. London, 1899. — Cliffoed and Swettenham. Dictionary of the Malay Language, Parts i. to iv. A-F. Taiping, Perak, 1894-98. — John Crawford. History of the Indian Archi- pelago, .iYols. Edinburgh, 1820 ; Grrammar and Dictionary of the Malay Language, 2 vols. London, 1852 ; A Descriptive Dictionary of the Indian Islands and Adjacent Countries. London, 185t). — Journal of the Indian Archipelago, 12 vols. Singapore, 1847-62. — Journal of the Straits Branch of the linyal Asiatic Society, 3.3 Nos. Singapore, 1878-1900. — H. C. Klinkert. Nieuw Maleisch-Xeder- landisch Woordenboek. Leyden, 1893. — John Leyden. Malay Annals. London, 1821. — William Marsden. The History of Sumatra. 'LonAon, WW; Malay Dictionary. London, 1824. — Sir William Maxwe ll. A Manual of the Malay Language. London , 1888. — T. J. Newbold. Political and Statistical Account of the British Settlements in the Straits of Malacca. — Sir Frank Swetten- HAM. Malay Sketches. London, 1895 ; The Beat Malay. London, 1899. — H. VON DE Wall, edited by H. N. van der Tuuk. Maleisch- NederlandiBch Woordenboek. Batavia, 1877-80. (h. Cl.)*~~

~~*Malay States (Federated), the name borne by the native states of the Malay Peninsula which are under the protection of the British Government, though they do not officially form an integral portion of the empire. They are P^rak, Seldngor, and the confederation of small states known as the Negri SembUan (nine states) on the west coast of the peninsula, and the state of Pahang on the east coast. Each state is under the rule of a sultan, who is assisted in his legislative duties by a state council upon which the Resident has a seat, and which is composed of native chiefs, with Chinese members nominated by the sultan with the advice of the Resident. The administrative, work of each state is carried*~~

~~on by the Resident and his staff of European officials, aided by the Malay chiefs and village headmen. The sultan in each case is bound by treaty with the British Government to accept the advice of the Resident, who is therefore practically paramount, though due deference is paid to the wishes of the sultan and his chiefs, and the British officials are pledged not to interfere with the religious affairs of the Mahommedan community. The sultan and his chiefs receive from Government monthly allowances paid from the revenue collected, but all the financial affairs of the country are in the hands of the British officers. The federation of the four states was agreed to by the sultans and chiefs in 1896-96, and the actual federation dates from 1st July 1896, when a Resident^General was appointed to super- vise the work of all the Residents, he being responsible to the HIgh Commissioner, who is the Governor of the colony of the Straits Settlements for the time being.~~

~~The estimated aggregate area of the Federated Malay States is about 28,000 square miles; the population in 1901 was 517,337, composed as follows: — Europeans, 6589; Eurasians, 7057; Chinese, 227,989; Malays, 213,073 ; Indians, 68,927 ; other nationalities, 3702. The actual revenue for the year 1898 amounted to $15,609,807, the total expenditure being $12,728,930. The excess of income over expenditure is all the more remarkable as large sums were expended during the year on railway con- struction, for which purpose a loan of £500,000 has been sanctioned, but the necessity for drawing upon it has not yet arisen. The trade of the federation for 1900 amounted to the following values : — Imports, $38,402,581 ; exports, $60,361,045; total, $98,763,626. Since 1883 large alluvial deposits of tin ore have been worked in Pgrak. Selangor, and the Nggri SSmbilan with marked success.~~

~~Perak.~~

~~*Prior to tliat date tin was also exported from these states in considerable quantities, but lack of facilities for trans port, &c., checked the output to a great extent. In 1883 the first railways were constructed, and by 1889 the out- put of tin from the states averaged half the total produc- tion of this metal throughout the world. Since then the increase has been considerable, and at the present time the Federated Malay States produce annually nearly 75 per cent, of the tin of the globe. The total output in 1900 was 713,058 piculs or 42,442 tons, as against 644,205 piculs or 38,2261 tons in 1899.*~~

~~*The whole of the Malay Peninsula is one vast forest, through which countless streams flow forming together the most lavish water system in the world. The rivers, though many of them are imposing in appearance, are uniformly shallow, only a few of them on the west coast being navigable by ships for more than 40 miles from their mouths. (For information on the botany, geology, &c., of the Malay states see Malay Peninsula.)*~~

~~*Ferak is situated between the parallels 3° 37′ and 6° 05′ N. and 100° 3′ to 101° 51′ E. on the western side of the Malay Peninsula. It is bounded on the N. by the British possession of Province Welles- ley and the Malay state of K6dah ; on the S. by the protected native state of Sfilangor ; on the E. by the protected native state of Pahang and the independent states of KSlantan and PetElni ; and on the W. by the Straits of Malacca. The coast-line is about 90 miles in length. The extreme distance from the most northerly to the most southerly portions of the state is about 1 72 miles, and the greatest breadth from east to west is about 100 miles. The total area of the country is estimated at about 10,000 square miles. The Pgrak river, which runs in. a southerly direction almost parallel with the coast for nearly 150 miles of its course, is navigable for small steamers for about 40 miles from its mouth, and by native trading boats for nearly 200 miles. The Plus, Batang, Padang, and Kinta rivers are its principal tributaries, all of them falling into the Perak on its left bank. The other principal rivers of the state are the Krian, Kurau, LSrut, and Bruas to the north of the mouth of the pgrak, and the BSrnam to the south. None of these rivers are of any great importance as waterways, although the BSrnam river is navigable for small steamers for nearly 100 miles of its*~~

~~*course. The mountain ranges, which cover a considerable area, run from the north-east to the south-west. The highest altitudes attained by them do not exceed 7500 feet, but they average about 2500 feet. They are all thickly covered with Jungle. The ranges are two in number, running parallel to one another, with the valley of the PSrak between them. The larger is a portion of the main chain which runs down the peninsula from north to south. The lesser is situated in the district of LSrut. There are several hill sanatoria in the state at heights which vary from 2500 to 4700 feet above sea-level, but the extreme humidity of the atmosphere renders the coolness thus obtainable the reverse of enjoyable.*~~

~~*Mr Leonard Wray, the curator of the Perak museum, writes as follows on the subject of the geological formation of the state : — " There are really only four formations represented — ueo ogy. flrstly, the granitic rock ; secondly, a large series of beds of gneiss, quartzite, schist, and sandstone, overlaid in many places by thick beds of crystalline limestone ; thirdly, small sheets of trap rock; and fourthly, river-gravels and other Quaternary deposits. The granites are of many varieties, and also, in all probability, of several different geological periods. The series of quartzites, schists, and limestone are of great age, but as no fossils have ever been found in any of them, nothing definite can be stated as to their exact chronological position. Their lithological characteristics and the total absence of all organic remains point to the Archaean period. The failure to discover signs of life in them is, of course, merely negative evidence, and the finding of a single fossil would at once upset it. However, until this happens they may be conveniently classed as Laurentian. It is at present impossible to form anything approaching an accurate estimate of the thickness of this extensive series, but it is probable that it is somewhere between 4000 and 6000 feet. Unconformability has been noticed between the limestones and the beds beneath, but whether this is sufficient to separate them or not is a matter for future investigation. . . . The taller hills are exclusively composed of granite, as also are some of the lower ones. . . . The ores of the following metals have been found in the formations named : — granite — tin, lead, iron, arsenic, tungsten, and titanium ; Lauren- tian — tin, gold, lead, silver, iron, arsenic, copper, zinc, tungsten, manganese, and bismuth ; Quaternary — tin, gold, copper, tungsten, iron, and titanium. This is not*~~

~~*to be considered a complete list, as small quantities of other metals have also been found."*~~

~~*The early history of Pgrak is obscure, the only information on the subject being obtained from native traditions, which are alto- gether untrustworthy. According to these authorities, mstofy however, a settlement was first made by Malays in pgrak at Brfias, and the capital was later moved to the banks of the pgrak river, the site chosen being a little village called T6mong, which lies some miles up stream from Kuala Kangsar, the present residence of the sultan. "When the Malacca sultanate fell owing to the invasion of the Portuguese iu 1511, a member of that royal house is said to have migrated to Pgrak, and the present dynasty claims to have been descended from him. As this boast is also made by almost every ruling family in the peninsula, the tradition is not worthy of any special attention. What is more certain is the tradition that Pgrak was twice invaded by the Acheenese, and its rulers carried off into captivity, one of them. Sultan Mansur Shah, subsequently becoming the ruler of Acheen. The first European settlement in Pgrak was made by the Dutch in 1650, under a treaty entered into with the Acheenese, but the natives of the country rose against the Dutch again and again, and it was abandoned in 1783, though it was afterwards reoccupied, the Dutch being finally ejected by the British in 1795. In 1818 the Siamese conquered Pgrak, but its independence was secured by a treaty between the British and Siamese Governments in 1824. Prom that date until 1874 Perak was ruled by its own sultans, but in that year, owing to internal strife. Sultan Abdullah applied to the then Governor of the Straits Settlements, Sir Andrew Clarke, for the assistance of a British Resident. The treaty of Pangkor was con- cluded on 20th January 1874, and the first Resident, Mr J. W. W. Birch, was murdered on 2nd November 1875. A punitive expedi- tion became necessary ; Sultan Abdullah and the other chiefs concerned in the murder were banished, the actual murderers were hanged, and Raja Muda Jusuf was declared regent. Sir Hugh Low was appointed Resident, a position which he held until 1889, when he was succeeded by Sir Prank Swettenham. Since then the history of Pgrak has been one of continuous peace and growing prosperity and wealth.*~~

~~*By the census taken on 5th April 1891 the population of Perak was shown to be as follows : — Europeans, 366 ; Eurasians, Jews, and Armenians, 293 ; Malays, 96,719 ; Chinese, 94,345 ; Tamils, 13,086 ; aborigines, 5779 ; other nationalities, 3666 ; thus making a grand total of 214,254, of whom 156,408 were males and 57,846 were females. The estimated popu- lation in 1898 was 277,461, but owing to the disparity of the proportions between the sexes the deaths in each year largely out^ number the births, and the increase in the population is accounted for solely by the number of iramigiants, chiefly from the mainland of China, -and to a lesser extent from India also.*~~

~~*The revenue of Pgrak in 1874 amounted to only $226,333. That for 1900 amounted to 17,636,126. Of this latter sum .83, 670,631 was derived from duty on tin exported, §1,017,618 from rail- way receipts, $351,451 from land revenue, and §89,857 ^^^^^ ^^_ from postal and telegraphic revenue. The balance is mainly derived from the revenue farms which are leased to Chinese capitalists for a term of years, being for the right to collect import duties on opium and spirits, and to keep licensed gambling and pawnbroking shops. The expenditure for 1900 amounted to $6,144,774. Of this sum $2,417,990 was expended upon railway upkeep and construction, and $1,229,295 on public works. The value of the imports during 1900 was $14,741,148 ; that of the exports, $29,190,663; total, $43,931,811. Tin is the principal ex- port from the state. The following table shows the amount exported between 1896 and 1900, with the Singapore price of refined tin at the time of export, and the value of each year's output : —*~~

~~*Popula- tion.*~~

~~*Tear.*~~

~~*Tods,*~~

~~*Price per Picul.*~~

~~*Value.*~~

~~*1896 1897 1898 1899 1900*~~

~~22,811 20,949 19,708 18,960 21,166~~

~~$32-20 36 09 42-96 72-52 74-15~~

~~$12,339,909 12,701,695 14,177,101 23,099,506 26,032,000~~

~~The diminished output is stated not to be due to the exhaustion of the tin resources of the state — that will not come for many years yet — but to the scanty labor supply. The latter is ascribed to increased demand for Chinese labour in China and French Indo- China, and the Dutch colonies, and also to the low price which has ruled for some years. In 1000 the price of tin rose higher than in any year of the decade 1891-1900. The sugar exported from Pgrak in 1898 was valued at $1,214,701, and the coffee at $48,664.~~

~~Although so much has been done to develop the resources of pgrak, by far the greater portion of the state is still covered by dense forest. In 1898 it was calculated that only _ , 330,240 acres of land were occupied or cultivated out of " a total acreage of 6,400,000. A line of railway connects the port of~~

~~Tgluk Anson with the great mining district of Kinta, whence the line runs on to Kuaia Kangsar, the residence of the sultan ; and an extension thence to L^rut and from L^rut to Province Wellesley, opposite Penang, is in course of construction. There are also sev- eral hundred miles of excellent metalled roads. For administrative purposes the state is divided into six districts ; — Upper Pgrak, Kuaia Kangsar, and Lower Perak, on the Pgrak river ; Kinta ; L^rut, and Krian. Of these, LS,rut and Kinta are the principal mining centres, while Krian is the most prosperous agricultural district. The districts on the P§rak river are mostly peopled by Malays. The administrative capital is Taiping, the chief town of L^rut. Kuaia Kangsar is chiefly memorable as having been the scene of the first federal meeting of native chiefs, who, with the British Residents from each state, met together in 1897 for friendly discus- sion of their common~~

~~interests for the first time in history, under the auspices of the HIgh Commissioner, Sir Charles H. B. Mitchell. This, in the eyes of those who are acquainted with the character of the Malays and of the relations which formerly subsisted between the rulers of the various states, is perhaps the most signal token of the changes which British influence has wrought in the peninsula. SelBngor is situated between the parallels 2° 32' and 3° 37' N. and 100" 38' and 102° E., on the western side of the Malay Peninsula. It is bounded on the N. by the protected native state of PSrak, on the S. by the protected states of the N6gri SSmbilan, on the E. by Pahaug and the NSgri S6mbilan, and on the W. by the Straits of Malacca. The coast-line is aljout 100 miles in length, greatest length about 104 miles, and greatest breadth about 48 miles, total area estimated at about 3000 square miles. The state consists of a narrow strip of land between the mountain range which forms the backbone of the peninsula and the Straits of Malacca. Compared with other states in~~

~~the peninsula, S6iangor is poorly watered. The prin-~~

~~SelSngor.~~

~~cipal rivers are the SSiangor, the Klang, and the L§-ngat. The principal port of the state is situated at the mouth of the Klang river, and is connected with the capital, Ku§,la Lfimpor, by a rail- way. The geology of the state closely resembles that of Pgrak. The state is possessed of most valuable deposits of alluvial tin, and mining for this metal is the chief industry of the population.~~

~~According to native tradition, the ruling house of SSltogor is descended from a Bfigis r3,ja, who, with two of his brothers, settled~~

~~in the state in 1718, the son of the youngest brother HIstory. eventually becoming ruler of the country. In 1783 the then sultan of S61&ngor joined with the lang-di-pgr-Tfian MUda of Eiouw in an unsuccessful attack upon the Dutch who then held Malacca. In retaliation the Dutch, under Admiral Van Braam, invaded Sglangor and drove the sultan out of his country. In 1785, aided by the BendahSra of Pahang, Sultan Ibrahim of S6iangor reconquered his state ; but the Dutch blockaded his ports, and eventually forced him to enter into a treaty whereby he consented to~~

~~acknowledge their sovereignty. The earliest British political communication with S61S.ugor began in 1818, when a commercial treaty was concluded with the Governor of Penang. In 1867 Sultan Abdul Samad of Sel^ngor appointed his son-in-law, Tdngku Kudin, to be viceroy ; and this gave rise to a civil war which lasted almost without intermission till 1873, when the enemies of Tiingku Kudin were finally vanquished, largely by the agency of the B6n- dahara of Pahang, who, at the invitation of the Governor of the Straits Settlements, sent a warlike expedition to the assistance of the viceroy. In 1874 the occurrence of an atrocious act of piracy off the mouth of the L^ngat river led to the Governor, Sir Andrew Clarke, appointing, at the request of the sultan, a British Resident to aid him in the administration of his kingdom. Since that date there has been no further breach of the peace, and the prosperity of Selingor has increased annually.~~

~~By the census taken on 6th April 1891 the population of Sel^u- gor was shown to be as follows : — Europeans, 190 ; Eurasians,~~

~~167 ; Malays, 23,750 ; Chinese, 50,844 ; aborigines. Papula- 1224 ; Tamils, 3082 ; other nationalities, 2335, thus ”’”’• making a total of 81,592, of whom 67,051 were males~~

~~and 14,541 were females. It will be noted that the population of this once Malayan state is now Chinese to the extent of more than 60 per cent, of the whole. The estimated population in 1898 amounted to 150,000, and of this probably 75 per cent, at the least was Chinese, the increase of the population being due entirely to the influx of labourers from the mainland of China attracted by the richness of the alluvial tin mines. Here, as elsewhere in the Malay Peninsula, the deaths annually far outnumber the births recorded, the disproportion of the female to the male sections of the population being greater in Seiangor than in other parts of the colony and Federated States. The development of planting enter- prise in Seiangor, and more especially the cultivation of coffee, has led to a certain immigration of Tamil coolies, but the number of Tamils is still insignificant if compared with that of the Chinese population.~~

~~The revenue of SfilSngor in 1875 amounted to only $115,656 ; m 1900 it had increased to $6,303,166. Of this latter sum $2,695,828~~

~~was derived from duty on tin exported, $1,072,378 from railway receipts, $256,899 from land revenue, and $67,9:;7 from postal and telegraphic revenue. The balance is chiefly derived from the revenue farms, which include the right to collect im- f^g^g ^c. port duty on opium and spirits. The expenditure for ‘~~

~~1900 amounted to $4,944, 160, of which sum $2,276, 510 was expended upon railways and $833,722 on public works. The value of the imports in 1900 was $18,406,570, and that of the exports was $21,798,444, makmg a total of £40,205,014. Tin is the principal export. The amouut exported in 1898 was 16,301 tons, but in 1900 it was 16,041 tons. The decrease is attributed by the Resident to scarcity of labour rather than to any deficiency of good mining ground. The total area of alienated mining land at the end of 1898 amounted to 39,532 acres, and it was estimated that 50,000 Chinese were employed in the mines. Coffee, rice, pepper, and gambler are all grown with success in Sfilelngor, but the state practically exists at the present time only as a mining country. Had it to depend upon its agricultural products for its revenue, it would speedily become bankrupt. Every effort is being made, however, to stimulate planting enterprise against the day, probably far dis- tant still, when the alluvial tin deposits will become exhausted. No true lode has hitherto been discovered in S6iangor.~~

~~The total length of railway line open to traffic at the end of 1898 was 77J miles, and on 1st January 1899 a further section of 5J miles was declared open. There is now railway com- munication not only between the port of Klang and the enera .~~

~~capital, KuSila Liampor, but between that place and Ulu S§13.ngor, a distance of 36 miles, and Ulu L^ngat, a distance of nearly 20 miles. Railways are also in course of construction which will eventually join the S61angor system to that of Perak on the north and that of the N6gri SSmbilan on the south. Frequent communi- cation is maintained by steamer between Klang and Singapore, and by coasting vessels between the former port and those on the coast of the peninsula.~~

~~For administrative purposes S613,ngor is divided into six districts — KuS,la Ldmpor, in which the capital and the principal tin-fields are~~

~~*situated ; Ulu S61S,ngor, which is also a prosperous mining dis- trict ; KuSla SelSngor, which is agricultural, and poorly populated by Malays ; Ulu L§.ngat, mining and agricultural ; Kuaia Lfingat, the residence of the late sultan Abdul Samad, agricultural ; and Klang, the only prosperous port of the state. Much money has been expended upon the capital, Ku3,la Lflmpor, which possesses some fine public buildings, water- works, &c., and where the prin- cipal residence of the Resident-General is situated. In some sort Kuala Lumpor is the capital not only of S6iangor, but also of the whole federation. Its scenery is very attractive.*~~

~~*Negri Sembilan (the Nine States) is a federation of small native states which is now treated as a single entity, being under the con- trol of a British Resident, and is situated between parallels 2° 28' and 3° 18' N. and 101° 45' and 102° 45'* ^^*'L, E., on the western side of the Malay Peninsula. It is* ^^ " *bounded on the N. by the protected state of Pahang, on the S. by the territory, of Malacca, on the E. by Pahang and the inde- pendent state of Johor, and on the W. by the Straits of Malacca. The coasWine is about 28 miles in length, and the extreme dis- tance from north to south is 55 miles, and that from east to west about 65 miles. The estimated area is about 3000 square miles. Arang-Arang, or Port Dickson, is the only port on the coast. It is connected with the capital, S6r§mban, by a railway 24 miles in length. Most of the states comprising the federation depend largely for their prosperity upon agriculture, but in some of the districts tin is being worked in considerable quantities, with good results.*~~

~~*As is the case with the history of most Malayan states, much rests upon no surer ground than tradition, in so far as the records of the Negri Sembilan are concerned. At the same time the native story that the states which now form History. the federation of the Negri SSmbilan were originally peopled by tribes of SSkai, or aborigines of the peninsula, who descended from the mountains of the interior and peopled the valleys, is supported by much corroborative evidence. Not only does the Malay's con- tempt for the Sakai make it exceedingly unlikely that the tradi- tion, which is hardly a matter for pride, should have been preserved if it were not true, but also many of the laws and cus- toms inf orce in these states are wholly foreign to those of the Malays, and can plainly be traced to the*~~

aborigines. As an instance, the custom of inheriting rank and property through the mother instead of through the father may be mentioned. Tradition further relates that towards the end of the 18th century a rS,ja of the royal house of M6nangkabu came from Sumatra to rule over the federa^ tion of small states, each of which continued to be governed in all its local affairs by its own chief and by the village and other councils sanctioned by ancient custom. The Sumatran rSja took the title of lang-di-pgr-Tiian of Sri Menanti. Although they bore the name of the "Nine States," only six seem to have belonged to the federation during the time of which history speaks. These are

Plnaace and trade.

Sri Menanti, Johol, Tampin, Rembau, Jel6bu, and Sfingei Ujong. Later the two latter separated themselves from the oonfederatlon. Ancient tradition says that the names of the nine states were originally Klang, Jelebu, Sungei Ujong, Johol, SSg§,mat, P^sir BBsar, NSning, RSmbau, and J61ai. Of these Klang was annexed by SSiangor, SSgamat and PSsir BSsar by Johor, and Naning by Malacca. Daring the last years of the 18th century the lang-di- pSr-Tiian appointed an lang-di-pgr-Tuan Muda to rule RSmbau, and the state of Tampin was created to provide for the family of the new chief. In 1887 the Governor of the Straits Settlements sent Mr Martin Lister to the NSgri SSmbilan, which had become disintegrated, and by his influence the ancient federal system was revived under the control of a Resident appointed by the Governor. The states which formed this new confederation were Johol, Ulu Milar, JSmpol, TSrSchi, Inas, Gunong Pasir, RSmbau, Tampin, and GemSncheh. Prior to this, in 1873, owing to a civil war in Sungei Ujong, Sir Andrew Clarke sent a military force to that state, put an end to the disturbances, and placed the country under the control of a British Resident. JelSbu was taken under British protection in 1886, and was thenceforth managed by a magistrate under the orders of the Resident of Stingei Ujong. In 1896, when the federation of all the Malayan states under British control was effected, Sungei Ujong and JSlSbu were reunited to the confedera- tion of

small states from which they had so long been separated, and the whole, under the old name of the NSgri SSmbilan, or Nine States, was placed under one Resident.

The population of the NSgri SSmbilan, according to the census taken in April 1891, amounted to 70,730. It is now estimated . _ that the population has increased to 85,000, but no tlim "" trustworthy figures on the subject are obtainable. In 1898, however, the number of arrivals at the ports of the state exceeded the departures by 3646. The births regis- tered slightly exceed the deaths, there being a large Malayan population in these states, among whom there is a fair proportion of women to men, a condition of things which is not found in the states most visited by Chinese immigrants.

The revenue of the NSgri SSmbilan amounted to only $223,435 in 1888. In 1898 it had increased to $701,334, and in 1900 amounted to .11,251,366. The revenue of 1900 was derived mainly as follows — land revenue, $125,168; railway receipts, $83,180 ; duty on tin, $692,519 ; the balance being chiefly due to the revenue farms. The expenditure in 1900 amounted to $1,009,318. The trade returns for 1900 show a total value of $11,3.30,000. Of this sum two-fifths is represented by the value of the exports, $4,281,457 being the value of the tin exported, and .^1,065,000 the value of agricultural produce exported. The latter is chiefly coffee, jungle produce, pepper, and gambler. The output of tin in 1900 amounted to 74,300 piculs. At the end of that year'there were 15,000 persons working in the tin mines.

The only line of railway open to traflic at the end of 1898 was that from Port Dickson to SSrSmban, which is 24J miles in length. „ . During the year 223 miles of cart-road and 174 miles of bridle-paths were open to traffic. A railway is now in course of construction which, when completed, will join SSrSmban to Malacca on the south and to KuSla Liimpor on the north. Fre- quent communication with the ports of the colony and of the native states on the Straits of Malacca by coasting vessels is maintained.

For administrative purposes the NSgri SSmbilan is divided into five districts, viz., the SSrSmban District, the Coast District, JSlSbu, Kuala

~~*Pllah, and Tampin. Each of these is under the charge of a European district officer, who is responsible to the Resident. The lang-di-pSr-Tdan lives at Kuaia Pilah, but the capital of the federation is at SSrSmban in Sfingei Ujong, where the Resident is stationed. The hereditary chiefs of the various states aid in the government of their districts, and have seats upon the state council, over which the lang-di-pSr-Tdan presides. The watering- place of Magnolia Bay, where excellent sea-bathing is obtainable, is one of the pleasure resorts of this part of the peninsula.*~~

~~*Pahanrj, on the east coast of the peninsula, is situated between parallels 2° 28' and 3° 45' N. and 101° 30' and 103° 30' E. It is bounded on the N. by the independent native states of KSlantan and TrSnggSnu ; on the S. by the NSgri SSmbilan and Johor ; on the E. by the China Sea ; and on the W. by the pro- tected states of Perak and Seiangor. The coast-line is about 112 miles in length ; the greatest length is about 210 miles, and greatest breadth about 130 miles. The state is the largest in the peninsula, its area being estimated at 16,000 square miles. The ports on the coast are the mouths of the Endau, Rompin, Pahang, and Kuantan rivers, but during the north-east monsoon the coast Pahaaz ^^ ""^ '^^^ °^ approach, and the rivers, all of which *■ are guarded by difficult bars, are impossible of access except at high tides. The principal river of the state is the Pahang; from which it takes its name. At a distance of 180 miles from the coast this river is formed by two others named respect- ively the JSlai and the TSmbSling. The former is joined 20 miles farther up stream by the Lipis, which has its rise in the mountains*~~

~~*which form the boundary with Pgrak. The Jelai itself has its rise also in a more northerly portion of this range, while its two prin- cipal tributaries above the mouth of the LIpis, the TSlom and the SSrau, rise, the one in the plateau which divides P6rak from Pahang, the other in the hills which separate Pahang from KSlantan. The TSmbSling has its rise in the hills which divide Pahang from KSlantan, but some of its tributaries rise on the TrSngganu frontier, while the largest of its confluents comes from the hills in which the Kuantan river takes its rise. The Pahang is navigable for large boats as far as Kuala Lipis, 200 miles from the mouth, and light- draught launches can also get up to that point. Smaller boats can be taken some 80 miles higher up the JSlai and TSlom. The river, however,*~~

as a waterway is of little use, since it is uniformly shallow. The Rompin and Kuantan rivers are somewhat more easily navigated for the firet 30 miles of their course, but taken as a whole the waterways of Pahang are of little value. The interior of Pahang is chiefly noted for its auriferous deposits. Giinong T§,han is situated on the boundary between Pahang and KSlantan. Its height is estimated at 8000 feet above sea^-level, but it has never yet been ascended. Pahang, like the states on the west coast, is covered almost entirely by one vast forest, but in the Lipis valley, which formerly was thickly populated, there is a considerable expanse of open grass plain unlike anything to be seen on the western sea-board. The coast is for the most part a sandy beach fringed with casuarina trees, and there are only a few patches of mangrove-swamp throughout its entire length.

The ancient name of Pahang was Indrapiira. It is mentioned in the history of HIang Tuah, the great Malacca brave, who flourished in the 16th century, and who succeeded in abducting a daughter of the then ruling house of Pahang for his HIstory. master, the stiltan of Malacca. Prior to this, Pahang had been ruled by the Siamese. When Malacca fell into the hands of the Portuguese in 1511 the sultan, Muhammad Shah, fled to Pahang, and the present ruling house claims to have been descended from him. The title of the ruler of Pahang was BSndShara until 1882, when the present (1902) ruler. Wan Ahmad, assumed the title of sultan, taking the name of Sultan Ahmad Maatham Shah. Up to that time the BSndah9,ra had been installed on his accession by the sultan of Riau, and held his office by virtue of that chief's letter of authority. About 1855 the father of the present sultan died at PSkan, and his son BSndShara Korish, who succeeded him, drove Wan Ahmad from the country. After making three unsuccessful attempts to conquer the land and to dethrone his elder brother. Wan Ahmad at last succeeded in 1805 in invading the state and wresting the throne from his nephew, who had succeeded his father some years earlier. From that time, in spite of two attempts to shake his power by invasions from Selangor which were undertaken by his nephews Wan Aman and Wan Da, BSndShSra Ahmad ruled his country with a rod of iron. In 1887 he consented to enter into a treaty with the Governor of the Straits, by which he accepted a Consular Agent at his court. This treaty was finally signed on 8th October 1887. In

~~February of the following year a Chinese British subject was murdered at PSkan in circumstances which pointed to the responsibility of the sultan for the crime, and in October 1888 a Resident was appointed to assist the sultan in the administration of his country, that being, in the opinion of the British Government, the only guar- antee for the safety of the life and property of British subjects which it could accept. In December 1891 disturbances broke out in Pahang, the nominal leaders of which were certain of the sultan's most trusted chiefs. The sultan himself took no part in the outbreak, but it undoubtedly had his sympathy, even if it was not caused by his direct commands. The rebels were driven to seek safety in flight in November 1892, but in June 1894 they gathered strength for a second disturbance, and raided Pahang from KSlantan, in which state they had been given shelter by the Mahommedan rulers. This event, added to the occurrence of other raids from across the border, led to an irregular expedition being led into TrSngg^nu and Kelantan by the Resident of Pahang (Mr Hugh Clifford) in 1895, and this had the desired result. The rebel chiefs were banished to Siam, and no further breach of the peace has troubled the tranquillity of Pahang since that time. Pahang joined the Federated Malay States by a treaty signed in 1895, and the sultan and his principal chiefs were present at the federal durbar held at Kuaia Kangsar in PSrak in 1897.~~

~~The census taken in Pahang in April 1891 was neither complete nor trustworthy, the country being at that time newly acquired territory, and the machinery for taking such statistics by pn i . no means efficient. The figures then obtained gave the jj' "' total population of the state as 57,642, of whom 50,627 were Malays, 3241 Chinese, and 2032 Sakai, or aboriginal tribes. Of the latter it is estimated that several thousands escaped enu- meration, and at least 3000 Malays also escaped the census. It is estimated that the population at the present time, which has been augmented since 1891 by the influx of both Chinese and foreign~~

~~*Malays, exceeds 80,000. In former days Pahang was far more thickly populated than in modem times, but the long succession of civil wars which racked the land after the death of B6ndahara Ali caused thousands of Pahang Malays to fly the country. To-day the valley of the L6bir river in K61antan and the upper portions of several rivers on the Pgrak and SSlSngor boundaries are inhabited by Pahang Malays, the descendants of these fugitives. The Pahang natives are almost all engaged in agriculture. The work of the mines, &c., is performed by Chinese and foreign Malays. In the LIpis valley the descendants of the Kawa Malays, who at one time possessed the whole of the interior in defiance of the Pahang rljas, still outnumber the people of the land.*~~

~~*The revenue of Pahang in 1889 amounted to only $62,077 ; in 1899 it was $300,000, and in 1900 had increased to $419,150. The Piaaace expenditure in 1900 amounted to $630,678. Pahang aad trade. '^ "^ ^ source of expense to the federation, its pro- gress having been retarded by the disturbances which lasted from December 1891 until 1895, with short intervals of peace ; but the revenue is now steadily increasing, and the ultimate financial success of the state is considered to be secure. Pahang owes something over $3,600,000 to SSUngor, which has financed it now for some years out of surplus revenue. The value of the imports in 1900 was $973,405, that of the exports was $2,322,950, thus making a total trade value of $3,295,355. The most valuable export was gold, worth $680^000. The tin ore exported amounted to 15,728 piculs.*~~

~~*The geological formation of the states lying to the eastward of the main range of mountains which splits the peninsula in twain differs materially from that of the western states. At eaera . ^ distance of about a dozen miles from the summits of the mountains the granite formation is replaced by slates, which in many places are intersected by fissures of quartz, and in others are overlaid by vast thicknesses of limestone. Those of the quartz fissures which have been exploited are found to be auriferous, and several European mining companies are now working these deposits of gold with some success. The Raub mine, near the foot of the mountains, is said to be likely to take rank as a fine gold-mine, and there is every reason to believe that Pahang possesses other gold-mines of*~~

equal value. These mines are now being worked by electric power generated by water-power, and transmitted by overhead wires for a distance of 7 miles. A magnificent road over the mountains, with a ruling grade of 1 in 30, joins Ku§,la LIpis, the administrative capital of Pahang, to Kuaia Kubu, the nearest railway station in SSlSngor. The road measures 82 miles in length. PSkan, where the sultan has his residence, was the capi- tal of Pahang until the middle of 1898, when the administrative headquarters were transferred to the interior as being more central. None of these towns is of any size or importance. In the Kuantan valley, which lies parallel to the Pahang river, a European company is working tin lodes with considerable success. These lodes are the only mines of the kind being worked in the Federated Malay States. Pahang is fertile and well suited for agriculture of many kinds. The rainfall is heavy and regular. The climate is cooler than that of the west coast, and the full force of the monsoon is felt from October to February in each year. For administrative purposes Pahang is divided into four districts — Ulu Pahang, in which the present capital is situated ; T6m8rloh, which includes 80 odd miles of the Pahang valley and the S6man- tan river ; P6kan, which includes the coast rivers down to Endau ; and Kuantan. Each of these is under the charge of a district officer, who is responsible to the Resident. The boundary with Johor and the Nggri Sembilan was rectified by a commission which sat in London in 1897-98.

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Malayir, a small province of Persia, situated be- tween Hamadan and Buriijird. It has a population of about 70,000, and, together with the district Tiisirkan, pays a yearly revenue of about £13,000. Its capital and

~~*seat of government is Doletabad (Dowlet^bad), a thriving and prosperous little city, with a population of about 6000, situated, at an elevation of 5680 feet, 38 miles from Hamadan and 32 miles from Buriijird. It has post and telegraph offices.*~~

~~*Malchin, a town of Germany, grand-duchy of Mecklenburg-Schwerin, on the river Peene, between Lakes Malchin and Kummerow, 28 miles by rail north-west of Neu-Brandenburg. It is, alternately with Sternberg, the place of assembly of the Mecklenburg Diet. Here are the ch§,teaux of Kemplin, Basedow, and Schlitz; a 4th-century church, and a large town hall. Population (1900), 7449.*~~

~~*Malda, a district of British India, in the Bhagalpur division of Bengal. The administrative headquarters are at English Bazar, near the town of Old Malda.*~~

~~*Area, 1902 square miles; population (1881), 711,487; (1891), 814,919; (1901), 884,443, showing an increase of 15 per cent, between 1881 and 1891, and of 8-5 between 1891 and 1901 ; average density, 464 persons per square mile. Classified according to reli- gion, Hindus in 1891 numbered 409,136 ; Mahommedans, 384,661 ; Christians, 72, of whom 23 were Europeans; "others," 21,060. The land revenue and rates in 1897-98 were Es.4,66,863 ; number of police, 278 ; number of boys at school (1896-97), 13,181, being 22 per cent, of the male population of school-going age ; registered death-rate (1897), 33-6 per thousand. The two principal industries are indigo and silk, but both are declining. There are two indigo concerns, and four factories, employing about 3000 persons, with an out-turn of 1600 maunds, valued at Rs.2,00,000 ; and two silk filatures, employing 1000 persons, with an out-turn of 50,000 lb, valued at Rs. 3,00,000. No railway touches the district, but the communications by water are good.*~~

~~*Maiden, a city of Middlesex county, Massachusetts, U.S.A., in the eastern part of the state. It is 6 miles north of Boston, of which it is a suburb. Its plan is irregular, it is divided into seven wards, it derives its water supply from Spot Pond, and few of its streets are paved. It is on the Boston and Maine railroad. It is largely a residential city, and its manufactures are not extensive. In 1900 its manufacturing establishments numbered 242,*~~

with a capital of f 6,906,279. They em ployed an average number of 3082 hands, and their pro- duct had a value of $7,959,292. The assessed valuation of real and personal property in 1900 was $27,287,540, the net debt of the city was f 1,522,944, and the rate of taxation was |16-70 per flOOO. Population (1880), 12,017 ; (1890), 23,031 ; (1900), 33,664, of whom 9613 were foreign-born and 446 were negroes. The death-rate in 1900 was 14-4.

Maldive Islands, an archipelago in the Indian Ocean, lying between 7° 6' N. and 0° 42' S. and 72° 33' and 73° 44' E. The group was again visited and sur- veyed in 1899-1900 by Mr J. Stanley Gardiner and Mr C. Forster Cooper, who found that as many as 300 of the atolls were at that time inhabited. The natives, who are estimated at about 30,000 Mahommedans, are classed by these observers in four ethnological divisions. 1. Those of the northern atolls, which are separated from the rest by the Kardiva channel, 35 miles broad and exposed to strong cross-currents during the monsoons. Here the reefs are less perfect, seldom forming complete central lagoons, and as they were formerly exposed to the constant attacks of the Mopillah pirates from India, the people are hardier and more vigorous than their less warlike southern neighbours. They annually visited the coasts of India or Ceylon, concluded treaties with the rajahs against the corsairs, and often married Indian wives, thus acquiring distinct racial characters of an approximately Dravidian type. 2. Those of the central division, comprising ten atolls crowded together between North Male and Haddu- mati, who are under the direct rule of the sultan, and have been more exposed to Arab influences. They for- merly traded with Arabia and Malaysia, and many Arabs settled amongst them, so that they betray a strong strain of Semitic blood in their features. 3 and 4. The natives of Suvadiva, Addu, Mulaku, and theother southern clusters who have had little communication with the Central Male

people, and probably preserve more of the primitive type, approximating in appearance to the Singhalese villagers of Ceylon. They are an intelligent and industrious people, growing their own crops,

~~manufacturing their own cloth and mats, and building their own boats, while many read Arabic more or less fluently, although still believers in magic and witchcraft. Mr Gardiner also visited the hith- erto little known Minikoi atoll, which lies in 8° 15' JST. and 73° E., 110 miles from the Laccadives, 71 miles from the Maldives, and 215 miles from the nearest point on the coast of India. The atoll, which is pear-shaped and dis- posed in the direction from south-west to north-east, is 6 miles long, with an extreme breadth of nearly three miles, with a large but shallow lagoon approached from the north by a passage 2 fathoms deep. At present the atoll is grow- ing outwards on every side, and at one place rises 19 feet above sea-level. The population, which numbered a little over 3000 in 1899, is sharply divided into five castes, of which the highest three are pure Maldivan, the lower two the same as the rest of the Laccadives. All are centred in a small village opposite Mou Eambu Point on the west or lagoon side ; but most of the men are generally absent, many being employed with the Lascar crews on board the large liners plying in the Eastern seas. The numerous wrecks on its reefs, its lighthouse, and its position on the track of all eastward-bound vessels makeMinikoi a familiar sight to seafarers in those waters.~~

~~See Proceedings of the Cambridge Philosophical Society, vol. xi. Pt. 1. (1900). (a. h. k.)~~

~~Maler Kotia, a native state of India, within the Punjab. It ranks as one of the cis-Sutlej states, which came under British influence in 1809. The territory lies south of Ludhiana. Area, 162 square miles ; population (1891), 75,755 ; average density, 467 persons per square mile. In 1901 the population was 77,506, showing an increase of 2 per cent. The estimated gross revenue is E,s.3,02,000 ; the military force numbers 280 men; and there is no tribute. The chief, whose title is nawab, is an Afghan. In consequence of his insanity, the adminis- tration is conducted by the nawab of Loharu. It is pro- posed to construct a railway through the state, and partly out of its revenues, from Ludhiana to Jhakhal on the Southern Punjab line. In 1896-97 the number of schools was 22, attended by 837 pupils, of whom 60 were girls ; the proportion of boys at school was as high as one in 48 of the total male population. The town of Malee Kotla is 30 miles south of Ludhiana. Population (1891), 21,754.~~

~~*Mallarme, Stephane (1842-1898), French poet and theorist, was born at Paris, 18th March 1842. HIs life was simple and without event. HIs small income as professor of English in a French college was sufficient for his needs, and, with his wife and daughter, he divided the year between a fourth-floor flat in Paris and a cottage on the banks of the Seine. HIs Tuesday evening receptions, which did so much to form the thought of the more inter- esting of the younger French men of letters, were almost as important a part of his career as the few carefully elaborated books which he produced at long intervals. L'Apr&s-viifU (Vim Fauue (1876) and other fragments of his verse and prose had been known to a few people long before the publication of the I'tx'sirs complMes of 1887, in a facsimile of his clear and elegant hand-writ- ing, and of the Pages of 1891 and the I>) .s et Prose of 1892. HIs remarkable translation of tlin poems of Poe appeared in 1888, the " Raven " having been published as early as 187r>, with illustrations by Manet. Divaqa- tions, his own final edition of his prose, was published in 1897, and a more or less complete edition of the Poesies,*~~

~~*posthumously, in 1899. HE died at Valvins, Fontaine- bleau, 9th September 1898. All his life Mallarme was in search of a new aesthetics, and his discoveries by the way were often admirable. But he was too critical ever to create freely, and too limited ever to create abundantly. HIs great achievement remains unfinished, and all that he left towards it is not of equal value. There are a few poems and a few pieces of imaginative prose which have the haunting quality of Gustave Moreaii's pictures, with the same jewelled magnificence, mysterious and yet defi- nite. HIs later work became more and more obscure, as he seemed to himself to have abolished limit after limit which holds back speech from the expression of the abso- lute. Finally, he abandoned punctuation in verse, and in- vented a new punctuation, along with a new construction, for prose. Patience in the study of so difficult an author has its reward. No one in our time has vindicated with more pride the self-sufficiency of the artist in his struggle with the material world. To those who knew him only by his writings, his eonversati*in was startling in its clearness ; it was always, like all his work, at the service of a few dignified and misunderstood ideas. (a. st.)*~~

~~*Malleco, a province of Southern Chile, situated between 37° 46' and 38° 30' S. and 71° 40' and 73° 10' W., and bounded by the province of Bio-Bio on the N. and E., by that of Cautin on the S., and by the province of Arauco on the W. It has an area of 2867 square miles, and had a population in 1895 of 98,032. It is divided into four departments — Angol, Traiguen, Mariluan, and Collipulli. Its capital is Angol (7056).*~~

~~*Mallorca. See Balearic Islands.*~~

~~*Mallow, a town in the county of Cork, Ireland, on the river Blackwater, 150 miles south-west of Dublin by rail. It ceased to be a parliamentary borough in 1885. It is governed by town commissioners, but under the Local Government (Ireland) Act, 1898, can apply to be constituted an urban sanitary district. Population (1881),*~~

~~*4437 ; (1901), 4549.*~~

~~*Malmesbury, James Howard Harris, 3rd*~~

~~*Eael of (1807-1889), English statesman, son of the 2nd Earl, was born 25th March 1807, and educated at Eton and Oriel College, Oxford. He led a life of travel for several years, making acquaintance with famous people; and in 1841 he had only just been elected to the House of Commons as a Conservative, when his father died and he succeeded to the peerage. His political career, though not one which made any permanent impression on history, attracted a good deal of contemporary attention, partly from his being Foreign Secretary in 1852 and again in 1858-59 (he was also Lord Privy Seal in 1866-68 and in 1874-76), and partly from' his influential position as an active Tory of the old school in the House of Lords at a time when Lord Derby and Mr Disraeli were, in their different ways, moulding the Conservatism of the period.]\Ioreover his long life — he survived till 18th May 1889, — and the publication of his Memoirs of an Ex-]\[iiiisfer in 1SS4, contributed to the reputation lie enjoyed. These Memoirs, charmingly written, full of anecdote, and containing much interesting material for the history of the time, remain his chief title to remem- brance. Lord Malmesbury also edited his grandfather's Diaries a)i(J Correspondence (184 ^), and in 1870 published The First Lord Malmesbury and His Friends : Letters from 1745 to 1S:20.*~~

~~*Malmo, a seaport town and important industrial centre of Sweden, on a small bay of the Sound, 384 miles by rail south-south-west of Stockholm. It is the terminus*~~

~~*of more than half a dozen railways, and since October 1895 has been connected with Copenhagen (17^ miles west by north) by steam-ferry, the Sound being kept free from ice in winter by an ice-breaker. Moreover, since the sum- mer of 1899 it has been the first important station in Sweden on the Sassnitz (island of Rllge.n)-Trelleborg ex- press route (opened 30th April 1897) between Stockholm and Berlin. In 1895 the total imports (in great part coal) amounted to £1,917,000, and the exports (9 per cent, of the exports of the kingdom) to £1,572,260. The latter consisted principally of bacon and beef, butter, chalk, flour, live-stock, and matches. The shipping, which is mostly under the Swedish and Danish flags, averaged 3943 vessels of 817,500 tons cleared annually in the period 1886-96 ; but in 1897 it jumped up to 5093 vessels of 1,421,590 tons, and in 1900 reached 5582 vessels of 1,712,191 tons. The harbour consists of two inner basins, admitting ves- sels of 21 feet draught, and an outer harbour of 22 feet depth ; and in 1896 a further scheme of improvement was agreed upon. There are also a dry dock, 236 feet long, and a patent slip, 400 feet long. The port owns a mer- chant fleet of over 50 vessels of 20,000 tons aggregate. Here Charles XV. died in 1872. St Peter's Church (1319-46) was restored in 1847-53, and again in 1889-90. There are, further, the lt5h-century house of the burgo- master Jorgen Kock, a small museum, a prison (single-cell system), a technical school, new barracks (1897), and a colossal statue of Charles X. (1896). Population (1880),*~~

~~*38,054 ; (1890), 48,504 ; (1900), 60,857.*~~

~~*Malone, a village of New York, U.S.A., capital of Franklin county, in the northern part of the state, at an altitude of 766 feet. It is at the intersection of three railways, the New York Central and Hudson River, the Ogdensbui'g and Lake Champlain, and the St Lawrence and*~~

~~*Adirondack. The adjacent region contains iron ore and lumber. Population (1890), 4986; (1900), 5935, of whom 910 were foreign-born.*~~

~~*Malstatt-Burbach, a town of Prussia, in the Rhine province, on the right bank of the Saar, nearly opposite to Saarbrllcken. It has large ironworks, brick- works, breweries, and manufactures of cement, machinery, and railway carriages; also iron mining. Population*~~

~~*(1885), 14,960 ; (1895), 23,677 ; (1900), 31,200.*~~

~~*Malta, an important naval and military station belonging to Great Britain, situated in the Mediter- ranean Sea, about 60 miles south of Sicily. The area, including the islands of Gozo and Comino, is 117,117 square miles. Malta is a Crown colony, administered by a governor, who is generally a soldier, an executive council, and a legislative council, termed "the Council of Government." The executive council consists of the governor, the senior military officer, of six other ofiicial members, and such other persons as the Crown may select. So far as possible, however, the old practice is maintained of giving seats on the council to elected members of the council of government. This body con- sists of the governor, the vice-president, six official mem- bers, and thirteen elected members. Of these ten are elected by the general electors, who require a small pro- perty qualification, and three by the " special electors." These "special electors" are the nobility and lauded proprietors, the university graduates, and the members of the exchange. The fourth body of special electors, the ecclesiastical, is no longer represented, and has there- fore ceased to be. The votes of eight elected members are necessary for the rejection of any vote in connexion with finance, and the rule forbidding officials to vote on such questions has been abrogated. In spite, however.*~~

~~*of these provisions, the practice of the elected members to refuse supplies, and generally to obstruct the Govern- ment, led to the free use of what was termed " the safety valve" of the 1887 Constitution, viz., the power of the Imperial authorities to legislate over the heads of the elected members by means of Orders in Council. When the elected members have refused to vote supplies, the rule has been, where purely local interests were concerned, to allow their constituents to suffer for such refusal. But where imperial questions, or local questions of such im- portance as to*~~

~~*become imperial, were concerned, to impose the taxation required by Orders in Council. By this means alone was it found possible, up to 1902, to continue some form of popular government, in an island which, from the point of view of British interests, is solely a fortress, essential to the British position in the Mediter- ranean, without neglecting the warning contained in the duke of Wellington's well-known saying that to give a constitution to Malta was like giving a constitution to a man-of-war. At the same time it should be noted that the electorate consists of only one-eighteenth of the total population, and that of this restricted number only a small proportion takes the trouble to vote.*~~

~~*The local laws are based on the Roman law and Con- tinental codes. Considerable difficulty has arisen from the uniform use of the Italian language in the law courts. It had been substituted for Latin as the official language in 1815, with the general consent, but circumstances had greatly altered. At the last census, the number of Mal- tese natives speaking English was almost equal to the number of those speaking Italian, while the increase in the British garrison and of visitors rendered more apparent the inconvenience of the sole use of Italian in the courts. Matters were brought to a head in February 1898 by the case of a British officer, who was at first sentenced to three days' imprisonment for contempt of court, because he had refused to sign the translation in Italian of his evidence given in English, not being satis- fied that it was correct. To meet this state of things, an Order in Council (1899) was passed, under which in future, in criminal cases, when the accused was British the trial should be conducted in English. In civil cases, when either party was British, an option was given to such party, or to any person appearing in the case in any capacity, to use English. A further Order in Council (1899) was issued, declaring the intention of the Govern- ment to make English in fifteen years {i.e., in 1914) the official language of the courts. This period of time was subsequently extended to twenty years. In deference, however, to the feeling aroused in Italy, this proclamation was withdrawn in 1902.*~~

~~*The question of the language of the law courts was closely connected with the question of education. Educa- tional experts generally recognized that it was impossible to teach a child more than one foreign language ; and*~~

~~*Italian being a foreign language in Malta as well as English, it followed that, if Italian were to be generally taught, it must be at the expense of English. But the practical convenience of a knowledge of English to the Maltese was obvious. In this state of things an Order in Council was passed in 1899 giving parents and guardians the power to choose which language shall be taught their children in addition to Maltese. At first no less than 98 per cent, chose English, and though, under the pressure of agitation, the proportion sank to 75 per cent., it again increased. Although undoubtedly the provisions of this law aroused the fierce opposition of those who wished to maintain the Italian characteristics of Maltese civiliza- tion and culture, there can be no question but that they represented the fixed determination of the British Govern- ment. In fact, this freedom of choice was to be extended*~~

~~*to the parents of students in the Lyceum and University, except in the case of the faculty of theology, where the supremacy of Italian is preserved.*~~

~~*In deference to the religious feelings of the population, the institution of civil marriages has not been established. Difficulties have sometimes arisen from the mixed mar- riages of Koman Catholics and Protestants, and, in cer- tain cases, from the inability to obtain legitimate mar- riage.*~~

~~*The following are the figures of the revenue and expenditure : —*~~

~~*Eevenue, Expenditure.*~~

~~*1881 . . £185,957 £188,039*~~

~~*1891 . . 275,125 281,870*~~

~~*1900 . . 356,758 .365,943*~~

~~*There is no public debt. There is no direct taxation, and the main sources of revenue are the Customs duties. Taxation is about £1 7s. 6d. per head,*~~

~~*as against about £4 13s. in the United Kingdom in 1901.*~~

~~*The trade tends to decrease, owing to the competition of other Mediterranean ports. The number of steamers entering the port and the amount of their tonnage was in —*~~

~~*steamers. Tonnage.*~~

~~*1881 . . 3885 3,673,753*~~

~~*1891 . . 3286 3,988,397*~~

~~*1900 . . 2549 3,473,576*~~

~~*The imports in 1900 were £7,434,289, and the exports £6,471,567. The civil population was (1881), 149,782; (1891), 165,037; (1900), 183,679. The population of the capital, Valetta, is almost stationary, nearly 24,000, but the neighbouring suburbs have increased greatly. In 1891 Floriana had a population of 6575. Of the several cities and suburbs forming, on the borders of the two harbours, an almost uninterrupted line of inhabited localities, the most populous are "The Three Cities," namely, Vittoriosa (6902), Conspicua (12,065), and Senglea (7770). In 1891, 73,876 persons resided in the urban districts and 72,608 in the rural, which include the old city of Notabile. The average density of the population was 1570 to a square mile in 1901, as compared with 1487 in 1891 and 1332 in 1881.*~~

~~*Malta is an example of la petite culture. There were, at the time of the census of 1891, about 10,000 holdings, the average ex- tent of which was 4-4 acres. About 30 per cent, of the whole culti- vated area is under corn crops. Vegetables are grown on irrigated land throughout the year. The rent of irrigated land is from £3 per acre. Potatoes and onions are largely grown for exportation. The area under potatoes is about 5000 acres. Oranges are also grown for export. The average rainfall for the 15 years ending 1898 was 19-7 inches. The rainfall for 1900 was 16-3. The climate, although very hot in summer, appears on the whole healthy. The death-rate, which is about 27 per thousand, is increased by the neglect of proper sanitary measures.*~~

~~*Besides a university (77 students in 1900) and a lyceum, there are two secondary schools, one in Malta for girls and one in Gozo for boys ; a technical and manual school ; 38 elementary day schools for boys, 40 for girls, 20 for infants, 17 miscellaneous, and 34 night elementary schools ; the elementary schools being attended by about 11,500 children. In addition there are about 130 private schools and colleges with more than 4200 scholars. Maltese only is taught in the inferior standards. In the next two standards either English or Italian is taught. The general prosperity of the islanders is indicated by the fact that at the end of 1900 there were 6960 depositors in the Maltese savings bank, with £535,. 071 standing to their credit, or an average of £76 19s. for each depositor. The main importance of Malta to Great Britain lies in its harbour and fortifications, which have been of late years greatly strengthened and adapted to new conditions. Besides a permanent garrison of six companies of Royal Artillery and six battalions of infantry, there are the local corps, supported in part by the imperial Government. A railway 8 miles long was opened in 1892, and has proved financially very successful.*~~

~~*The tradition may be accepted which regards the cathedral as occupying the site of Publius's palace. A public church appears to have been erected, after the general peace in the 4th century, on the spot where private worship had been carried on. This church survived the period of Mahommedan dominion, and was exten- sively repaired by Roger the Norman. The exploration and survey*~~

~~*of St Paul's catacombs in 1894 has thrown light on the question of early Christian burial in Malta. It is true that direct evidence from documents or epitaphs is lacking, but the representation of a scene of martyrdom is still clearly discernible in the basement of an arched tomb, and the palm-leaf, the ordinary emblem of martyrdom, is engraved on several tombs in the same capel. More- over, the analogy of the Roman catacombs is altogether convincing. Malta, as an allied city, not far removed from the seat of empire, must have felt the effect of the imperial decree of a. d. 64, " non licet esse Christianos," while " as a matter of evidence, from the similar mode of construction and economy of place, internal arrangement of details, and distribution of graves analogous to the Roman cata-*~~

~~*combs, from the same devices contrived for concealment, it is clearly apparent that our Christian forefathers had then to follow the same recondite cemeterial system, sunk under ground, as in Rome." The same authority adds, "The topographical situation of the ancient burial grounds, extra urbem, along the high roads, was strictly Roman, and the individual areas, both of our ancient pagan tombs and of our Christian cemeteries, defined by deter- minate boundaries conformably to the provisions of the then common law, were private properties of the natives."*~~

~~*The manner in which successive civilizations have occupied the same site at Notabile accounts for Greek and Roman remains being now found only in excavations. As late as 1647 relics of old buildings could still be seen in the streets, but the work of de- struction has gone on. The remains of the temple of Apollo were discovered in 1747.*~~

~~*See Ancient Pagan Tombs and Christian Cemeteries in the Island of Malta, Explored and Surveyed from 1881 to 1897, by Dr A. A. Carkdana. Malta, 1898. — For the language question, see Mr Chamberlain's speech, in House of Commons, 28th January 1902.*~~

~~*(h. e. Eg.)*~~

~~*Ma I ton, a market town in the Thirsk and Malton parliamentary division (since 1886) of Yorkshire, Eng- land, on the river Derwent, 22 miles north-east of York. In 1894 Old and New Malton were formed into one civil parish (an urban district). Population (1901), 4758.*~~

~~*Malvern, a health resor-t of England, 10 miles south- west from Worcester, in the Bewdley parliamentary divi- sion of Worcestershire. It consists of a string of little towns and villages, situated partly at the eastern foot of the Malvern Hills (1000-1440 feet), partly on their slopes, overlooking the valley of the Severn and the Vale of Evesham. At the foot of the hill are Great Malvern, Malvern Link, Malvern Wells, and Little Malvern, and higher up JSTorth Malvern and West Malvern. Owing to their pure and invigorating air, they enjoy great repute as places of residence and as health-resorts, latterly for the " open-air cure " for consumptive patients. The water, so noted for its purity, is now collected*~~

~~*and stored for public use in waterworks. In addition there are mineral springs (two at Great Malvern, one above Malvern Wells, and one near West Malvern). Malvern College and other schools make the place of some importance as an educational centre. Population (1801), 819; (1901), 16,448.*~~

~~*Mamiani della Rovere, Terenzio, Count (1799-1885), Italian writer and statesman, was born at Pesaro in 1799. Taking part at Bologna in the outbreaks arising out of the accession of Pope Gregory XVI., he was exiled and went to France; but he returned after the amnesty of 1846, and in 1848 was made president of the council by Pius IX. This post, however, he 'only held for a few months, his political views being the reverse of papal. HIe retired to Genoa and there worked for Italian unity, and in 1860 became minister of education under Cavour. In 1861 he was made ambassador to Greece, and in 1865 to Switzerland. Meanwhile, he had founded at Genoa in 1849 the Academy of Philosophy, and in 1855 had become professor of the history of philosophy at Turin ; and he published several volumes, not only on philosophical and social subjects, but of poetry, among them Einnovamento dvlla filosophia antica italiana (1836), Teoria della lieJkjinne e dello stato (1869), Kant e I' Ontologia (1879), Religione delP avenir (1880), Poems (1843, 1857). HIe died at Rome, 21st May 1885.*~~

~~*505*~~

~~*MAMMALIA.*~~

~~*IN few branches of zoology have greater advances been made than in the Mammalia since the date of the appearance of the article in the earlier volumes (ninth edition) of the Encyclopcedia Britunnica. These advances, noticeable alike in the morphological, palaeontological, and taxonomic aspects of the subject, are, in fact, so great as to have altered our whole conception of the relations of the group. Moreover, what may be regarded as prac- tically a revolution in nomenclature has taken place, including the introduction of the principle of trino- mialism.*~~

~~*In regard to the dental system (vol. xv. p. 352), it has been found that when only a single series of teeth is developed, they may belong to the*~~

~~*milk or deciduous, and not to the permanent series ; this is the case with the Cetacea and the Marsupialia (with the exception of the single replacing tooth in each jaw) . Again, the statement (vol. XV. p. 364) that the cheek-teeth of Marsupials do not correspond serially with those of Placentals has not been found to hold good, and it now appears that in both groups the typical number of premolars (whether perma- nent or deciduous^) is four, behind which there are three (occasionally more) molars. The section of the earlier article devoted to the placenta (vol. xv. pp. 368, 369) requires considerable modification, owing to the discovery by Caldwell in 1884 that the Monotremata are oviparous, and to Hill's announcement in 1897 of the existence of a true placenta in the Marsupial genus Perameles. These and other discoveries have had an important bearing on the general scheme of classification of the Mammalia, and it has been suggested that, instead of dividing the class into the equivalent subclasses Prototheria, Metatheria, and Eutheria, the division should be into two subclasses only, viz., Prototheria and Eutheria, the latter of which is divisible into the sections Marsupialia and Placentalia. Palaeontological discoveries in the early Secondary rocks of South Africa and North America have had an important bearing on the question of the origin of the Mammalia, and it is now generally conceded that the class is derived from the Labyrinthodontia, or Stegocephalia, of the Permian and Carboniferous, which were Amphibian-like creatures with completely roofed skulls. Between the Stegocephalia and the Mammalia may probably be inter- calated the group of Triassic and Permian Reptiles known as the Anomodontia, certain members of which present remarkable mammalian resemblances in their skeletons and teeth, while others come very close to the Stego- cephalia. It is true that no small forms (ancestral mammals must necessarily have been diminutive) have hitherto been discovered which can be regarded as ancestral types of the Mammalia (Hypotheria or Promammalia), but the probability is that such were included among the Anomodontia. The question whether the Prototheria and Eutheria had a single or dual (diphyletic) origin from the Anomodontia (or Hypotheria) must for the present remain in abeyance, although there are good grounds for thinking that the latter alternative may prove the true solution of the problem. Much depends upon future investi- gations in regard to the structure of the Eutherian ovam ; and if this proves to be amphibian in*~~

~~*character the argument for a dual origin will be overwhelming, since the Monotreme (Prototherian) egg is certainly of a rep- tilian type.*^~~

~~*1 It has been found convenient to speak of the milk-molars as " milk-premolars."*~~

~~*2 See a paper on the Origin of Mammals, by Prof. H. F. Osborn, m the Prnceediuf/x of the International Congress of Zoology, 1898.*~~

~~*Prototheria. — Turning to the extent and characters of the subclass Prototheria (vol. xv. pp. 371, 377), this is now generally taken to include not only the existing order Monotremata (as represented by the Ornithorhynchidoi and Echidyddm), but also an extinct group — the Multituber- culata — of which the genus Playia/dax (vol. xv. p. 376, Figs. 20, 21) and probably Stereognathtis (ibid. Fig. 17) are representatives. These Multituberculata, which were abundant in the Jurassic and Cretaceous rocks and sur- vived till the Eocene Tertiary, appear to have been intimately connected with certain Anomodont Reptiles, such as the South African Tritylodon (long regarded as a mammal) ; and this relationship, in spite of a theory as to the splitting-up of the multituberculate molar, speaks strongly in favour of the dual origin of the Prototheria and Eutheria, since it seems certain that the primitive carnivorous and insectivorous forms of the latter group cannot be derived from animals with a dentition of the type of Tritylodon and the Multituberculata. The Triassic Microlestes (vol. xv. p. 375) is probably a relative of Tritylodon.*~~

~~*As already mentioned, it has been ascertained that the females of the Monotremata lay eggs, which develop in the same manner as those of Birds and Reptiles, a portion only of the yoke segmenting to form the embryo, while the remainder serves for the nutriment of the latter. In the case of Ornithorhynchus it has been said that two eggs are laid in the chamber at the end of the burrow,' but those of the EchidnidoB are carried about in. the pouch on the abdo- men of the female, which becomes enlarged duringthe time of incubation. The temperature of the Monotremata has also been found to be lower than that of other mammals. The existence of true teeth in Ornithorhynchus is another discovery made since 1883. Three pairs of these teeth are developed in the*~~

~~*upper, and three in the lower jaw ; after being for some time in use, they gradually become worn away, and are finally shed. Under and around the teeth are developed the horny plates, or cornules, which gradu- ally grow round them and assume their function, the hollows on the surface of the cornules indicating the positions of the teeth. In form these teeth make a distant approximation to the molars of some of the extinct Multituberculata.*~~

~~*Marsupialia. — The discovery of a rudimentary placenta in Perameles, together with that of vestiges of a second series of teeth, suggests that the Marsupialia are a de- generate rather than a primitive type, although probably one of great antiquity. Instead of the one deciduous tooth developed in certain living genera (vol. xv. p. 378, Fig. 23) being the only one corresponding to the milk-series of the Placentalia, it is its successor which alone represents the permanent premolar of the latter ; this successional tooth being the third permanent premolar of the typical series of four premolars, and the one immediately behind it the fourth milk-premolar. Hence only the three last teeth, in cases when there are seven in the cheek-series, are the molars. Accordingly, in all cases where the dental formula of the Marsupialia is given in the original article as p |, in J, it should be amended to mp+pp |, m f . (See Proc. Zool. Soc. Lond. 1899, p. 922.)*~~

~~*Mr B. A. Bensley (American Naturalist, 1901), starting with the well-known fact that the group simulates most of the placental orders, states that its evolution, or " radia- tion," has taken place within its present habitat. Reasons*~~

~~*8 There does not appear to be authentic evidence that the eggs in this genus are actually laid.*~~

~~*are given for regarding the Banded Anteater (Myrmeco- hius) as a degraded type ; and if this view be accepted, all the other types can be derived, both as regards their dentition and their feet, from the American Opossums, the ancestors of which are regarded as the proximate pro- genitors of the group. All the Australian Marsupials thus appear to have had an arboreal ancestry ; and when, in spite of the specialization of certain forms, the primi- tive character of the whole group is borne in mind, it seems evident that the date of the " radiation " is com- paratively recent. Hence the author is inclined to side with those who consider that Marsupials first entered Australia during the Tertiary period, although he thinks their arrival was later than has previously been considered possible. As to whether their immigration was from the north or from the south he is undecided, although he states that "there is at least some justification for the view that it was from the northward," i.e., by way of Asia.*~~

~~*Of all the palaeontological discoveries, few are more interesting than the occurrence of extinct Marsupials in the Miocene of South America allied to the Australian Dasyuridce. Two of the best- known genera are Prothylacinus and AmpMproviverra, the former being an animal agreeing closely in size and dentition with the Thylacine, but having two pairs of milk-premolars in each jaw replaced by permanent premolars. In this respect the extinct form departs one step less from the placental type than does its existing analogue, and these and other fossil forms, such as Bor- hyosna, seem to indicate an intimate relationship between the Polyprotodont Marsupials and the Creodont Carnivora, as repre- sented by Hycenodon (vol. xv. p. 442, Fig. 122) ; the dental formula of the two, according to the new method of notation, being, so far as the cheek-teeth are concerned, identical, save for the fact that all the premolars of the Creodontia belong to the second or per- manent series. On this view the Creodontia have retained a tooth-change which is lost in the modern Marsupials; and both may be descended from Mesozoic forms like Triconodon and Amphi- therium, in the former of which all four premolars were replaced.*~~

~~*Fig. 1. — Marsupial Mole {N'oioryctee typhlops).*~~

~~*An additional family (Notoryctidce) of Polyprotodont Marsupials is represented by the Marsupial Mole {Notoryctes typhlops), from the deserts of central South Australia (Fig. 1). This is a small burrowing animal, of a pale golden-yellow colour, with long silky hair, a horny shield on the nose, and a stumpy leathery tail. The feet are five-toed, and the third and fourth toes of the front pair armed with enormous claws adapted for digging. Neither ear- conchs nor eyes are visible externally. There are but three pairs of incisor teeth in each jaw, and the upper molars are tricuspid. This animal spends most of its time burrowing in the sand in search of insects and their larvse, but occasionally makes its appearance on the surface.*~~

~~*Of even greater interest than Notoryctes is the discovery of a family (EpanorthidcB) of Diprotodont Marsupials in South America, the majority of the members of which are extinct, their remains being found in the Miocene of Patagonia, although one existing genus (Gcenolestes) survives in Ecuador and Colombia. One of the two living species was, indeed, described so long ago as the year 18(>.!, under the preoccupied name of Hyracodon, but attracted little or no attention, as its affinities were not fully recognized. Externally Ccenolestes has a shrew-like appearance. The elongated skull (Fig. 2) has four pairs of upper incisors and long upper canines, while in the lower jaw there is a single pair of procumbent incisors, followed by several small teeth representing the canine and earlier pre- molars. The three pairs of molars in each jaw are, like the last premolar, quadritubercular oblong teeth. The five-toed feet are of normal structure, and the rat-like tail is prehensile towards the tip. The female has a small pouch. The extinct members of the family are represented by the genera Epanorthus, Acdestis,*~~

~~*Garzonia, &o. In a second family — Ahderitidm — also from the Patagonian Miocene, the penultimate premolar is developed into an enormous tooth, with a tall, secant, and grooved crown, some- what after the fashion of the enlarged premolar of Plagiaulax. From the structure of the skull it is thought probable that Abderites had an elongated snout, like that of many Insectivora.*~~

As regards other discoveries in connexion with the Marsupialia, it must suffice to say that complete skeletons of the extinct

Fig. 2.— Skull of Cwnolesiee obscurua.

Australian Diprotodon (vol. xv. p. 383) have been disinterred and described by Dr Stirling, from which it has been ascertained that in the structure of the feet this genus shows resemblances both to the Phalangeridm and the Fhascolomyidce, but comes nearer to the former. Phascolonus {Sceparnodon), from the same deposits, was a giant Wombat. It may be added that a large mammal (Pyrotherium) , with cheek-teeth like Diprotodon, from the Miocene of Patagonia, may possibly prove to be a Diproto- dont Marsupial, although this is not very likely.

Edentata. — The result of recent discoveries has been to discount the supposed isolation of the Edentata (vol. XV. p. 383), and to bring them more into line with other Placentals. The connecting forms are a group of Eocene mammals termed Ganodontia, as represented by the genera Psittacotherium, Calamodon, Hemiganus, Stylinodon, &c., all of which are typically North American. In this group front teeth were present, and the cheek-teeth of the earlier types were rooted and invested to a considerable extent with enamel, their unworn crowns being tricuspid. An approximation to the true Edentata is revealed in the later types by the gradual abortion of the incisors, and of the roots of the cheek-teeth ; the latter grow from persistent pulps, and have their enamel restricted to vertical bands. Among the Edentata of the family Mega[lo]theriid(jn , especial interest attaches to the discovery in a cave in South Patagonia of remains of the genus Glossotherium, or Grypotherium (vol. xv. p. 385), a near relative of Mylodon, which include a considerable portion of the skin with the hair attached. Ossicles somewhat resembling large coffee-berries had been previously found in associa- tion with the bones of Mylodon, and in Glossotherium nearly similar ossicles occur embedded on the inner side of the thick hide. The coarse and shaggy hair is somewhat like that of the Sloths. The remains, which include not only the skeleton and skin, but likewise the droppings, were found buried in grass which appears to have been chopped up by man, and it thus seems not

only evident that these (rround-Sloths dwelt in tlie cave, but that there is a con- siderable probability of their having been kept there in a semi-domesticated state by the early human inhabitants of Patagonia. The extremely fresh condition of the remains has given rise to the idea that Glossotherium may still be living in the wilds of Patagonia, but this is improbable.

Although a few of the Pleistocene Ground-Sloths, such as Nothropus and Nothrotherimn (= Cceiodore, vol. xv. p. 385) were of comparatively small size, in the Miocene of Patagonia few of the representatives of the family much exceeded the modern Sloth in size. The best-known generic types are Eucholeeops (Hapalops) and Pseudahalops, of which considerable portions of the skeleton

have been disinterred. In these diminutive Ground-Sloths the crowns of the cheek-teeth approached the prismatic form char- acteristic of Megallo-\therium, as distinct from the subcylindrical type occurring in Mylodon, Olossotkerium, &c. It should be added that the North American Tertiary forms described as Edentates under the name of Moropus and Morotherium (vol. xv. p. 385) are now ascertained to be aberrant Ungulates allied to Ohalico- therium.

In addition to the discovery of certain new types of Pleistocene Armadillos (Dasypodidce) , one of which is far larger than any species previously known, important advances have of late years been made in our knowledge of the allied extinct South American family Olyptodontidce (vol. xv. p. 388, where it is termed Hoplo- phoridae), now ascertained to date at least from the Miocene. Here it has to be mentioned that the restoration of Olyptodon copied from Owen (vol. xv. p. 387, Fig. 39) is quite incorrect, that which is made to do duty for the entire tail being the terminal portion of the tail-sheath of a totally different genus. In Qlyptodon (with which Schistopleurum is identical) the tail-sheath consists of a series of coronet-like rings, gradually diminishing in diameter from base to tip. Dcedicurus, in which the tail-sheath is in the

~~*form of a huge solid club, is the largest member of the family ; in Panochthua and Lomaphorus (Hoplophorus) the tail-sheath con- sists basally of a small number of smooth rings, and terminally of a tube. In some specimens of these genera the horny shields covering the bony scutes of the carapace have been preserved, and since the foramina, which often pierce the latter, stop short of the former, it is evident that these were for the passage of blood-vessels and not receptacles for bristles. All the above are of Pleistocene and perhaps Pliocene age, but in the Miocene of Patagonia there occur the two curious genera Propalceo hoplophorus and Peltephilus, the former of which is a primitive and generalized type of Glyp- todont, while the latter seems to come nearer to the Armadillos. Both are represented by species of comparatively small size. In Propalceohoplophorus the scutes of the carapace, which are less deeply sculptured than in the larger Glyptodonts, are arranged in distinct transverse rows, in three of which they partially overlap near the border of the carapace after the fashion of the Armadillos. The skull and limb-bones exhibit several features met with in the latter, and the vertebrae of the back are not welded into a con- tinuous tube. There are eight pairs of teeth, the first four of which are simpler than the rest, and may perhaps therefore be regarded as premolars. More remarkable is Peltephilus, on ac- count of the fact that the teeth, which are simple, with a chevron-shaped section, form a continuous series from the front of the jaw backwards, the number of pairs being seven. Accordingly, a modification of the character, even of the true Edentata, as given in the earlier article, is rendered necessary. The head bears a pair of horn-like scutes, and the scutes of the carapace and tail, which are loosely opposed or slightly overlapping, form a number of transverse rows.*~~

~~*The so-called Old-World Edentata — the families Jfanidce and Orycteropodidce (vol. xv. p. 388) — have been assigned to an order apart, under the name of Effodientia. Orycter- opus has been ascertained to possess milk-teeth, and fossil representatives of the genus have been obtained from the Pliocene of Persia, Greece, and Samos. The presumed extinct Edentata of the Old World mentioned on p. 388 of the earlier article have proved to be Ungulata, and are referred to below.*~~

~~*Sirenia and Getacea. — As regards the former order, it will suffice to say that in the Manatee the number of teeth has been proved to be at least twenty pairs in each jaw, and may possibly be as many as thirty; and that Trichechus is now taken as the name of the genus, the Walrus being termed Odobcenus. In the palseontological history of the Cetacea some important items have been furnished by the Tertiary strata of Patagonia. In the first place, a small Sperm Whale, tentatively assigned to the extinct European genus Physodon, has a full series of enamelled teeth in the upper jaw, and therefore, unless it be made the type of a separate family, entails a modification in the definition of the Physeteridce (vol. xv. p. 395). Even more interesting is Argyrocetus, also from the Miocene of Chubut, on account of the fact that the occipi- tal condyles, instead of being adpressed to the skull, are as prominent as in any ordinary mammal, and that the nasals are squared bones covering the hinder part of the nose-chamber. The latter feature was pre-*~~

~~*viously unknown among the Toothed Whales, and its occurrence in the Patagonian genus removes one of the objections which have been urged against the pos- sibility of the Whalebone Whales tracing their descent to the aforesaid group. Yet another Chubut Cetacean — Prosqualodon — indicates a distinct type of Squalodontidce, characterized by the shortness of the skull, the nasal bones in this genus also roofing over the chamber of the nose to a small extent. Eecent researches tend to show that the extinct Zeuglodon was furnished with bony armour.*~~

~~*Bodentia. — Since no very remarkable discoveries of new forms — either living or extinct — have been made in the orders Insectivora and Chiroptera, these may be passed*~~

~~*Fig. 8. — Idiv/rus Zenkeri.*~~

~~*over with the observation that considerable modifications have been made in the taxonomy and nomenclature of the latter group. Among the Eodentia, on the other hand, not only are the taxondmic and nomenclatural changes greater, but many interesting new forms have been dis- covered. The Tillodontia'(vol. xv. p. 432), as typified by Tillotherium, but including Esthonyx and other forms, all of which occur in the Eocene of North America, are now generally regarded as a*~~

~~*primitive section of the order, to which in taxonomic series the Dulplicidenta will comenext. In these Tillodonts the skull, although to a great extent Eodent-like, exhibits archaic features in the form and size of the brain-cavity, as it does in the retention of small*~~

~~*canines and the anterior premolars. On the other hand, the incisors — especially one pair — exhibit an approxima- tion to the scalpriform character of those of modern Rodents, this being less apparent in the earlier Esthonyx than in the later Tillotherium.*~~

~~*For the modifications in the taxonomy of the true Rodents, the reader may consult a paper by 0. Thomas in the Proc. Zool. Soc. London for 1896, and a monograph of the order by T. TuUberg, published at Upsala in 1899 ; the views of these writers are by no means altogether in accord. All are now agreed that the Anoma- Vuridm (vol. xv. p. 417) are markedly different from the Squirrels. Two new West African representatives of the group — Idhtrus (Fig. 3) and Zenkerella (Fig. 4) — have been discovered, the second of these*~~

~~*Fir;, i. — Zenkerella insign/is.*~~

~~*being devoid of a flying membrane. From the Miocene of North America has been described the extinct family MylagauUdce, allied to the Gastoridce. In the Muridae a host of new existing forms have been found, among the more interesting being Xeromys, Leptomys, and Ohrotomys, allied to the previously isolated Australian genus Hydromys, which is restricted to the Philippines and Australia. Other peculiar Philippine Murines are Batomys, Cmyomys, Bhyn- chomys, and C'rateromys, all being confined to the mountains of Luzon ; the third is remarkable for its Shrew-like muzzle, and the fourth for its huge size and long hair. The JBathyergidce (vol. xv. p. 419) have been separated as a family from the Spalacidce, and the HeteromyidcB from the Geomyidm. From a distributional point of view the discovery of a Jumping Mouse (Zapus) in north-eastern Asia is important. The Cape .Tumping Hare (Pedetes, vol.*~~

xv. p. 420) is now removed to the Hystrioomorpha, where it forms a family by itself, in the neighbourhood of which some consider the Anomaluridce should find a place. From the Old-World HystricidcE the American Porcupines have benn separated as a distinct family, under the name of Erethizontidos. The Hystrico- morpha have always been strongly represented in South America, and a number of extinct types more or less intimately related to the existing representatives of the group have been recorded from the Miocene of Patagonia. None of these demand, however, special mention, with the exception of Megamys, which was a huge Uodent allied to the Capybara, estimated to have rivalled an ox in bulk.

Vngulala. — Very great has been the advance in our knowledge of the past history of this order sinci^ 1883, more especially as regards the South American Miocene

forms, and it is now no longer practicable to subdivide the order into the two groups of Ungulata Vera and Subungulata (vol. xv. p. 422). The most primitive representatives of the grouji are the Eocene forms constituting the suborder Condylarthra, of which the North American Phenacodus and Hyracoxis are the best known. In these small and generalized Ungulata, which are but little differentiated from the ancestral Carni-vora, the brain is small and smooth, the cheek-teeth are short-crowned and tuberculated, with the premolars less complicated than the molars, the number of the teeth being usually the typical forty -four. The articular heads of the bodies of the vertebrae are fiat, the lower end of the humerus is perforated on the inner side, and the feet, which are more or less plantigrade, are five-toed, with the median digit the largest of the series. In the carpus the bones of the upper and lower row are arranged in vertical lines, without being alternated (vol. xv. p. 422, Fig. 100). Teeth resembling those of Phenacodus occur in the Swiss Eocene bone-beds.

Hyracoidea. — All the existing representatives of this suborder are now termed Pi-ocavia, instead of being classed in two genera as Hyrax and Dendrohyrax. More im- portant is the occurrence of an extinct genus — Plioliyrax — in the Pliocene of Greece and Samos, its lower jaw hav- ing long ago been described under the preoccupied name Leptodon. A skull

~~*from the Miocene of Patagonia has been named Archoeohyrax, and, if really referable to the present group, is of much interest, especially if, as seems probable, some of the under-mentioned Toxodonts are re- lated to the Hyracoidea.*~~

~~*Toxodontia. — As the description of the suborder Ambly- poda requires but little amendment, it must sufBce to say that the proper title of its typical family is Uintatheriidce. At the conclusion of the notice of the Amblypoda in the earlier article (vol. xv. pp. 426, 427) mention is, however, made of several extinct South American Ungulates whose position was left uncertain. Later discoveries have done much towards elucidating the true relationships of these and other forms, which are now assigned to several distinct suborders of Ungulata, showing more or less marked signs of affinity with the Perissodactyla. It may eventuadly become a question whether it will not be advisable to ex- tend the limits of the latter suborder to include all these extinct groups, together with the existing Hyraces.*~~

~~*Under the suborder Toxodontia may be included not only the typical Toxodon, but the more aberrant Typotherium (or Meso- therium) (vol. xv. p. 427, Fig. 106) of the Pleistocene of Buenos Aires, and the smaller Pachyrunis and Hegetotherium of the Pata- gonian Miocene. All the members of the suborder have tall- crowned and curved cheek-teeth, some or all of which have persistent pulps, while at least one pair of incisors are rootless. The bodies of the cervical vertebrae have flat articular surfaces, the bones of the two rows of the carpus alternate, and in the tarsus the navicular articulates with the caloaneum, which, as in the Artiodaotyla, is articulated to the fibula, while the astra- galus, which is slightly grooved above, is formed on the Perisso- dactyle plan. The number of toes varies between three and five, of which the middle one is the largest, and the femur may or may not have a third trochanter. The Typotheriidce and Pachynicidm are remarkable among the Ungulates for the retention of clavicles, and for their curious approximation in dentition and certain char- acters of the skeleton to the Eodentia. The dental formula of Typothei-htm is given in vol. xv. p. 427 ; that of the smaller Patagonian forms differs by the larger number (|) of premolars. The toes*~~

~~were unguiculate rather than ungulate. Certain allied Patagonian forms appear to show distinct affinity to the Hyraces.~~

~~The Toxiidontid(Z differ from the preceding family by the loss of the clavicles, and the reduction of the digits to three in each foot. The typical genus Toxodon is represented by animals the size of a Rhinoceros, of which the entire skeleton is now known. The teeth, of which the approximate formula is given in vol. XV. p. 427, all grow from persistent pulps; those of the cheek-series are very tall, highly curved, and with a simplified crown-structure. In the Miocene Nesodon, on the other hand,~~

~~the cheek-teeth are shorter-crowned, and depart less widely from a generalized Perissodaotyle type, the total number of teeth being forty-four, and there being scarcely any gap in the series. Very remarkable changes occur in the dentition as age advances, most of the teeth eventually developing roots. Although the complete skeleton is not yet known, it is ascertained that the femur differs from that of Toxodon in the retention of a third trochanter.~~

~~Astrapotheria. — Another group of Ungulates confined to the Miocene of Patagonia is typified by the genus Astra- potherium, represented by huge animals with cheek-teeth singularly like those of a Rhinoceros, and an- enormous pair of tusk-like upper incisors, recalling the upper canines of Machmrodus on an enlarged scale. In the lower jaw are two large tusk-like canines, between which are three pairs of curiously-formed spatulate incisors, and in both jaws there is a long diastema. The dental formula ap- pears to he i ^, c ^,p j , m f .~~

~~Here may be provisionally placed the genus Homalodontotherium, of which the imperfect skull was alone known In 1883 (vol. xv. p. 427). The teeth have much lower crowns, and are of a less decidedly Rhinocerotic type than in Astrapotherium, and the whole dentition forms an even and unbroken series. The bodies of the cervical vertebrae are short, with flattened articular surfaces, the humerus has an enormous deltoid crest,~~

suggestive of fossorial powers, and the femur is flattened, with a third trochanter. Ac- cording to the Argentine palseontologists, the carpus is of the alter- nating type, and the terminal phalanges of the pentedactyle feet are bifid, and very like those of Edentata. Indeed, this type of foot shows many Edentate resemblances. The astragalus issquare and flattened, articulating directly with the navicular, although not with the cuboid, and having a slightly convex facet for the tibia. From the structure of the above-mentioned type of foot, which is stated to have been found in association with the skull, it has been suggested that Homalodontotherium should be placed in the Perissodaotyle family Chalicotheriidoe ; but, to say nothing of the different form of the cheek-teeth, all the other South Ameri- can Miocene Ungulates are so distinct from those of other countries that this seems unlikely. It may be suggested that we have rather to deal with an instance of parallelism — a view supported by the parallelism to the EquidcB presented by certain members of the next group.

Litoptema. — A fuller study of the remains of the South American Pleistocene genus Macrauchenia (vol. xv. p. 428) shows that it can no longer be included in the Perissodac- tyla, as at present understood, and that it typifies a sub- order containing a number of Miocene forms. All were digitigrade forms, recalling in general build the Llamas and Horses ; they have small brains, and a facet on the calcaneum for the fibula. The cheek-dentition approxi- mates more or less to the Perissodaotyle type. Both the terminal faces of the cervical vertebrae are flat, the femur carries a third trochanter, the bones of both the carpus and tarsus are arranged in linear series, and the number of toes, although commonly three, is stated to vary be- tween one and five, the third or middle digit being in- variably the largest. Of the two families, the first is the ProterotherUdoB, which exhibits, in respect of the reduc- tion of the digits, a curious parallelism to the equine line among the Perissodactyla ; in this feature, as well as in the reduction of the teeth, it is more specialized than the second family.

The molar teeth approximate to the Palmotherium type, hut have a more or less strongly developed median longitudinal cleft. The three-toed type is represented by Diadiaphorus, in which the dental formula is f ^, c f , p |,

m |, and the feet are very like those of Hipparion. The cervical vertebras are of normal form, the orbit (as in the second family) is encircled by bone, the last molar has a third lobe, the single pair of upper incisors are somewhat elon- gated, and have a gap between and behind them, while the outer lower incisors are larger than the inner pair, the canines being small. The skull has a short muzzle, with elongated nasals. Re- mains of this and the other representatives of the group are found in the Patagonian Miocene. In Proterotherium, which includes smaller forms having the same, or nearly the same, dental formula, the molar teeth differ from those of Diadiaphorus by the deeper median longitudinal cleft, which completely divides the crown into an inner and an outer moiety, the two cones of the inner half being united. According to the description given by Argentine palaeon-

tologists, this genus is also three-toed, the single-toed representa^ tive of the family being separated as Thoatherium, but further information with regard to this point is desirable. It is, however, certain that there is a monodactylate representative of the family, in which the lateral metapodials, or splint-bones, are even more reduced than in the Equidce.

In the second family — Macrauclieniidm — the dentition is complete (forty-four) and without a gap, the crowns of nearly all the teeth being of nearly uniform height, while the upper molars are distinguished from those of the ProterotheriidcB by a peculiar arrangement of their two inner cones, and the elevation of the antero- posterior portion of the cingulum so as to form an extra pit on the crown. To describe this arrangement in detail is impossible here, but it may be stated that the two inner cones are closely approximated, and sepa- rated by a narrow V-shaped notch on the inner side of the crown. The elongated cervical vertebrae are peculiar in that the arch is perforated by the artery in the same manner as in the Llamas. In the Miocene of Patagonia the family is represented by the gen- eralized genus OxyodontotJierium (in which TJieosodon may apparently be included). It includes animals ranging up to the size of a Tapir, in which the nostrils were more or less in the normal anterior position, and the cheek-teeth were short-crowned with the inner cones of the upper molars well developed and separated by a notch, and the pits of moderate depth. The last upper premolar is simpler than the

~~*molars, and the canine, which may be double-rooted, is like the earlier premolars. The radius and ulna, like the tibia and fibula, are distinct, and the metapodials are rudimentary. On the other hand, in Macrauchenia, which was a much larger Llamarlike animal, the skull is elongated and nar- row, with rudimentary nasals, and the aperture of the nose placed nearly on the line of the eyes and directed up- wards, the muzzle not improbably having terminated in a short trunk. Deep pits on the forehead probably served for the attachment of special muscles connected with the lat- ter. Very curious is the structure of the cheek-teeth, which are high-crowned, with the two inner cones reduced to mere points, and the pits on the crown-surf ace large and funnel- shaped. In fact, the Perissodaotyle type is almost lost by the specialization. The cervical vertebrae and limb-bones are very long, the radius and ulna being completely and the tibia and fibula partially united. The typical M. patagonica is a Pleistocene form as large as a Camel, ranging from Patagonia to Brazil, but remains of smaller species have been found in the Pliocene (?)of Bolivia and Argentina. It remains to add that the imperfectly known Scalabrhna of the Argentine Pliocene appears to occupy a position intermediate between Oxyodontotherium and Macrauchenia, having the nasal aperture situated in the middle of the length of the skull, and the crowns of the cheek-teeth nearly as tall as in the latter, but with the lower molars furnished with a projectiag process in the hinder valley, similar to one occurring in those of the former.*~~

~~*Perissodactyla. — Since 1883 it has been discovered that the teeth described from the Upper Tertiary deposits of Europe, India, and North America as Chalicotherium (vol. XV. p. 429) belong to the same group of animals as the Edentate-lik e limb-bones to which the names Macrotherium, Ancylotheritim, Moropus, and Morotherium have been assigned. In spite of the Edentate-like feet, the teeth are so like those of Titanotherium, while the cervical vertebrae and upper limb-bones are so essentially Perissodaotyle in character, that it seems best to regard the CJialicotheriidce as a branch of the Perissodactyla, in which the feet have acquired (or ? retained) an unguiculate character. Some palaeontologists prefer, however, to regard them as a distinct suborder, under the nam e of Ancylopoda. In this connexion it is important to observe that remains of Titanotlierium*~~

~~(vol. XV. p. 429) have been recorded from the Balkans, and that the North American Tertiary genera Palmosyops, Limnosyops, and Limnotherium indicate a family (LimnotheriidcB) closely allied in dental character to the TitanotheriidcB, but with a less complex fourth upper premolar, and no horn-like protuberances on the skull. Great advances have been made in our knowledge of the extinct Perissodactyla forming the ancestral stocks from which the existing representatives of the suborder have originated.~~

~~Artiodactyla. — Somewhat similar observations apply in the case of the Artiodactyla, the working out by American palaeontologists of the complete descent of the Camels, from materials supplied by the Tertiary deposits of their own country, being one of the most important discoveries. Remains of true Camels (Camelus), it may be mentioned, have been obtained from the Pliocene of North Africa, Russia, and Rumania. Agriochoerus, an ally of the Oreodonts, from the North American Mio- cene, is now known to have had claws like phalanges, the limbs having been described as Artionyx and Mesonyx. The Giraffe family, for which the name Giraffidce is now adopted in place of Camelopardalidoe (vol. XV. p. 432), is now known to include the living African Okapi (Ocapia), together with a number of extinct types. The Okapi (see coloured Plate), discovered by Sir H. Johnston in the Semliki forest, between Lakes Albert and Albert Edward, is known by two skins, two skulls, and a slightly incomplete skeleton. The skull and denti- tion (only partially described at the date of writing) are distinctly Giraffe-like, the former being much more depressed than in the Giraffe. The general form of the animal is also Giraffe-like, but the neck and limbs are proportion- ately much shorter, and the ears are very large and broad. The immature specimen in the British Museum stands about 6 feet at the withers. Very remarkable is the coloration. Most of the upper parts are chocolate-brown, with a purplish tinge ; but the sides of the face are pale puce, the forehead and ears reddish, and the nose and muzzle blackish, while the upper portion of the fore-limbs, and the buttocks, thighs, and~~

~~*upper part of the hind-legs are marked with wavy horizontal black stripes on a buff ground. Except for a black ring on the fetlocks, the hind-legs below the hocks are uniformly buff, but the fore-legs. below the knees have in addition a longitudinal black stripe in front. The only reason that can be suggested for this strange type of coloration is that the forest is clear of foliage up to about the height of the animal's thighs. In the British Museum specimen rudiments of a pair of horns are visible on the forehead, and other specimens show that in the adult state both sexes are horned. Ocapiaia aAliedto Palmotragus (from which Samotherium is probably inseparable), of the Pliocene of Greece, Samos, and Persia, in which the males were horned and the females hornless. Helladotherium, from the Grecian Pliocene, is an apparently hornless type. Sivatherium, Hydaspitherium, and Bramathcrinm from the Indian, and Libythermm from the North African Pliocene, are now known to be gigantic giraffoids, in the males of which one pair of horns at least were branched. In Sivatherium a simple pair of nasal horns stand in advance of the large branched, while in Bramatherium an occipital pair are placed behind the branched frontal horns.*~~

~~*Proboscidea. — The origin and birthplace of the Pro- boscidea have long been a puzzle to students of evolution and distribution, the Mastodons suddenly making their*~~

~~*appearance in the middle part of the Miocene, without our having hitherto had the slightest clue as to their connexion with more generalized types. The puzzle has, in a great degree, been solved by Dr C. W. Andrews, who, while travelling in the Fayum district of Egypt with Mr H. J. L. Beadnell, came across two Tertiary deposits which have yielded a previously unknown vertebrate fauna, a part of which is described in the Geological Magazine (September 1901). Prom the upper beds, provisionally regarded as Lower Oligocene, were obtained remains of a small Mastodon-like animal {Paloiomastodon), differing from Mastodon by the simpler last molar and*~~

~~*Fia. 5. — D&nM^OTi ot MoRriiherium lyorwi. One-fourth natnral size. (A) Upper teeth; (B) front of snout, showing the tusk-like second incisors*~~

; (C) left ramus of mandible from outer side. (From the Geological Magazine).

by having five pairs of cheek-teeth simultaneously in use. The other remains are from a lower horizon, perhaps Upper Eocene, but possibly newer. Most remark- able is a primitive proboscidean (Maeritherium) , with a nearly full series of front- and cheek-teeth, the latter being of a generalized Ungulate type. That this animal is an ancestor of the mastodons and elephants may be inferred from the enlargement of the second pair of incisors in both jaws and the small upper canines (Fig. 6). All the six pairs of cheek-teeth were in use at the same time. More problematical are the affinities of a huge Ungulate described as Bai- ytherium, which in many respects resembles Dinotherhim, but in others seems to approach the gigantic Uintatheriuvi of the North American Tertiaries.

Carnivora. — The palaeontological history of the Carni- vora "'‘era (vol. xv. p. 433) shows that the triple division of the order into the sections ^luroidea, Cynoidea, and Arctoidea is no longer tenable. The Canidce, which is one of the most primitive families of the group, passes imperceptibly into the Ursidce, while the Mustelidai are just as intimately connected with the Viverridce. The ^EluridcB (Aihiridce, vol. xv. p. 441) are now generally included in the Procyonidce; and remains of a large species of the typical genus ^4?/»r!(shave been discovered in the Pliocene of England and the Continent. Moreover, from the study of the skeleton. Professor Ray Lankester (Travis. Linn. Soc. — Zool. 1901) has shown that, instead of being a bear, ^Eluropus (vol. xv. p. 441, Fig. 121) is nearly allied to ^lurus.

Primates. — Two very remarkable extinct lemuroids of large size have been discovered in the superficial deposits of Madagascar, in one of which (Megaladapis) the upper

MAMMALIA.

The Okapi (Immatvire).

MAN, ISLE OF

~~cheek-teeth are of a'tritubercular type (Fig. 6), while in the second and smaller form (Nesopithecus) the dentition makes a notable approximation to that of the Cercopithecidoe. Possibly these gigantic lemuroids were living in the times of the early voyagers. Dr F. Major has also discovered a remarkable similarity in the structure of the internal ear between the existing Malagasy lemurs and Adapts of the European Oligocene. From the Miocene of Patagonia have been obtained remains of a genus {Homunculus) nearly allied to the existing CeUdce. Much interest has been attracted by the discovery in a bed of volcanic ash in~~

~~Fig. 6. — Skull and hinder upper cheek-teeth of Megaladapis.~~

~~Java of the imperfect roof of a skull, together with two molar teeth and a thigh-bone, supposed to indicate a very low type of man-like creature, for which the name Pithec- anthropus erectus has been suggested. The forehead is extremely low, with beetling brow-ridges, and the whole calvarium presents a curiously gibbon-like aspect. Although the capacity of the brain-case is estimated to have equalled but two-thirds that of an average modern man, the creature still appears to have been a member of the family Hominidoe — assuming that all the remains are~~

~~associated.~~

~~(E. L*.)~~

~~Man, Isle of, the ancient Mona, an island in the Irish Sea, 33 miles west of England, 30 miles east of Ireland, 16 miles south of Scotland, and 66 miles north of Wales ; greatest breadth 12 miles ; length, north-east to south-west, 33 miles.~~

~~Climate. — Recent observations enable us to give more accurate and detailed climatic statistics than were possible in 1882. The mean annual temperature of the 70 years between 1828 and 1897 was 49-0°, that of the summer being 57-2° and of the winter 42-0°. The mean variation between the warmest month (August), 58-5°, and the coldest (January), 41-4°, was 17°. The annual rainfall varies greatly in the different districts, the~~

~~*calculated mean of 70 years (1828-97) giving 61 inches on the summit of Snaefell, 47 inches at Eamsey, 46 inches at Douglas, 38 inches at Peel, 34 inches at Castletown, 28 inches at the Point of Ayre, and 25 inches at the Calf of Man. Observations of bright sunshine show the Isle of Man to be one of the sunniest places in the British Isles.*~~

~~*Minerals. — In 1899 the value of the lead obtained was £59,210 ; of the zinc, £24,701 ; and of the silver, £8236. The value of the granite quarried was £2445.*~~

~~*Agriculture. — In 1900 the total acreage under all kinds of crops, bare fallow, and grass was 92,184, of which*~~

~~*21,890 acres were under corn crops (oats, 13,393 ; barley, 7382; wheat, 814; rye, beaus, and peas, 301), 10,938 acres under green crops, 39,238 acres under rotation grasses, and 20,118 acres under permanent grass, &c. There were also 25,781 acres of mountain pasture and 1026 acres of orchards, woods, and market-gardens. Horses, 3399 of which were used solely for agriculture, numbered 5139 ; cows, 21,988 ; sheep, 75,047 ; and pigs,*~~

~~*2679.*~~

~~*Trade. — In 1900 the tonnage of vessels cleared for coastwise traffic was 717,150, and for foreign and colonial traffic, 668. The number of vessels (other than fishing- boats) registered as belonging to the Isle of Man in 1900 was 91, and their tonnage was 13,233. In the same year there were 308 fishing-boats aggregating 5103 tons, which employed 1470 men and 212 boys.*~~

~~*Internal communication has been much facilitated by the provision of tramways along Douglas Bay ^ (1883), between Douglas and Laxey ^ (1895), between Laxey and the summit of Snaefell ^ (1896), in Douglas => (1897), and between Laxey and Ramsey" (1898).*~~

~~*Population has remained almost stationary since 1881. Total (1891), 55,608 ; (1901), 64,758. In 1901 the popula- tion of Douglas was 19,149 ; of Eamsey, 4672 ; of Peel, 3306; and of Castletown, 1963.*~~

~~*Births, Marriages, and Deaths. — The following are the rates per thousand of the population for five-year periods between 1884 and 1898 : —*~~

~~*Births.*~~

~~*Marriages.*~~

~~*Deaths.*~~

~~*1884-88 1889-93 1894-98*~~

~~*28‘1 26-4 25-6*~~

~~*6-97 6-81 7-10*~~

~~*20-6 19-8 19-4*~~

~~*Language. — The Manx language still lingers, the census of 1901 showing that there were still about 4400 people who under- stood something of it. There is now no one who does not speak English.*~~

~~*Elementary Education. — Total number of schools 53, 42 being Board and 11 denominational (6 Church of England, 3 Wes- ley an, 2 Roman Catholic). Percentage of attendance, 85”41 ; average attendance, 8206. Amount of Government grant per child, 19s. 8-4d. Receipts from rates, £8794 ; total expenditure, £30,222.*~~

~~*Bateable Value. — The rateable annual value of the parishes, towns, and villages was £892,528 in 1900.*~~

~~*Revenue for the year ending 31st March 1902 was £78,382, and the expenditure £76,542. The present debt is £160,224. The largest revenue raised was £91,339 in 1901, and the debt reached its maximum amount, £219,531, in 1894.*~~

~~*Poor Belief. — ^The total number of persons in receipt of poor relief in 1900 was 934, and its cost was £4842.*~~

~~*Lunatics numbered 206 in 1901 ; their cost was £4168.*~~

~~*History.*~~

~~*Constitutional.—On the departure of the duke of AthoU in 1829 the Tynwald Court had no control over the surplus revenue, and this continued to be the case till 1866, when it gained, if not the sole control of this revenue,* at least a substantial share in the disposal of it. Since 1866 it has also obtained a real instead of a nominal voice in fixing the customs duties, subject to the veto of Parliament or the Treasury ; and of late years it has become the practice for this court to elect a com- mittee of its members to advise the Governor in financial matters.*~~

~~*The change of the House of Keys in 1866 from a self- elected to a representative body has already been referred to (vol. XV. p. 452). In 1880 it established its right to regulate its own sittings, which had been disputed. The*~~

~~*1 Horse. 2 Electric. ^ Cable traction.*~~

~~*^ In the article iu vol. xv. it was stated in error that the Kejs. gained the control of the surplus revenue in 1866.*~~

~~*property qualification of tlie members of the House of Keys was abolished in 1892. In 1881 the franchise was lowered and extended to women, being conferred upon every person who (1), being a male, or a spinster or widow, is the owner of real estate of the annual value of not less than £4 ; or (2), being a male, is the occupier of real estate of the annual value of not less than £4 ; or (3), being a male, occupies lodgings of the annual rental of not less than £ 10. In 1892 women who were occupiers of real estate worth not less than £4 annually were also given a vote.*~~

~~*In 1883 the whole Manx judicial system was trans- formed. Law and equity were fused, and the whole legal and equitable jurisdiction of the*~~

various courts was trans- ferred to the High Court of Justice. The effect of this and other changes has been virtually to assimilate, with very few exceptions, the Manx practice in the administra- tion of justice to the English. The of&ce of Water-Bailiff was done away with in 1885.

Ecclesiastical. — In 1878 a Sodor and Man Theological School was established for the training of candidates for holy orders. This school has been affiliated to Durham University. In 1880 four rural deaneries were estab- lished, and commissioners were constituted as trustees of endowments for Church purposes. In 1896 a cathedral chapter, with four canons, was constituted under the name of the " Dean and Chapter of Man," the bishop being the dean of the cathedral church. A Church Sus- tentation Fund was established by Bishop Straton in 1894, with a view to supplementing the incomes of the clergy, which had been greatly reduced on account of the low price of corn. Since 1884 the jurisdiction of the Church courts has almost disappeared, all that now remains having refer- ence to affiliation questions, the swearing in of church- wardens, and the granting of faculties. There have been several Acts giving Nonconformists equal rights with Churchmen. Among these are the Burial Acts of 1881 and 1895, which permit burials to take place in church- yards without the rites of the Church of England, and allow any burial service, provided it be Christian, in mor- tuary chapels.

Social and Economic. — It was not till 1872, when the insular Legislature passed the Public Elementary Educa^ tion Act, that the Manx State undertook any direct responsibility for education. This Act differed from the English Act of 1870 in three important particulars : (1) It at once constituted every town and parish a school district under a school board ; (2) the attendance of children was made compulsory ; and (3) every elementary school, those in connexion with the Church of Rome excepted, was obliged to provide for non-sectarian instruc- tion in religious subjects, and for the reading of the Bible accompanied by suitable explanation. Since the date of this Act education has made extraordinary strides. It became free in 1892, and a higher-grade school was established in Douglas in 1894. In 1876 vaccination was made compulsory, as also was the registration of births, marriages, and deaths in 1878. It was not till 1884 that the sanitation of the towns was seriously

~~taken in hand, but ten years more elapsed before the sanitary condition of the island was dealt with by the passing of an Act which constituted parish and village districts, with com- missioners elected by the people, who had, in conjunction with a board elected by the Tynwald Court and an inspector appointed by it, to attend to all questions relating to sanitation and infectious diseases. As a result of these measures the death-rate has been greatly reduced. In 1888 a permissive poor law was established ; it has been adopted by all the towns except Peel and by six of the seventeen country parishes. Prior to this date the poor had been dependent on voluntary relief, which broke down owing to the growth of a temporarily em-~~

~~ployed class occupied in administering to the wants of the summer visitors. In 1829 the insular harbours were practically unprotected from inshore winds, there was no low-water landing accommodation, and no regular communication with England by steamer. But since 1860 extensive harbour works have been constructed which give great, though still inadequate, protection, and nearly all the landing accommodation required ; and steamers run to aud from England on every week-day during the year. Since 1844 numberless absurd and complicated regulations, which hampered trade, have been revoked, and, while the duties on spirits have been increased, those on articles of beneficial and universal consumption have either disappeared or have been greatly reduced. In 1853 the infamous licence system, by which only limited quantities of such articles as spirits, tea, coffee, tobacco, and salt could be imported, and then only by a few merchants, who, having obtained a licence, com- bined and charged what prices they pleased to the unfor- tunate consumers, was abolished.~~

~~Manx textile industries have, generally speaking, declined since 1880, being unable to compete with the larger and more completely organized manufactories elsewhere. Agriculture has, on the whole, improved since 1882, and its average condition in 1902 was not much inferior to what it was in England and Scotland. In 1900 commissioners appointed to inquire into the condition of local industries noted that there was need for better and more complete cultivation of the land, and that, as regards the crops, " neither Manx wheat nor barley is as good on a,n average as~~

~~English ; but that oats, the largest crop, is on the whole fully equal to what is grown on the mainland." They stated that the Government premiums for stallions and bulls, which had been established in 1889, had been beneficial in improv- ing the breed of horses and cattle, biit that dairying was in a very unsatisfactory condition and butter " very unequal in quality." The fishing industry is a declining ^ one. Efforts to deal with this state of affairs have been confined to the making of bye-laws regulating the sea- fisheries in 1894, and to the erection of a hatchery for lobsters and flatfish at Port Erin in 1902. Mining, on account of the low price of metals, is also on the wane. The discovery of an excspllent quarry of granite at the Dhoon has led to the pi'oduction of paving setts on a large scale. But there is one industry, for so it may really be called, that of providing for summer visitors, which has greatly prospered; and"~The Isle of Man has be- come the most popisto holiday resort in the north of England. On the whole, it may fairly be said that the Manx people in 1902 formed a prosperous and contented community.~~

~~During the ten years 1891-1901 a considerable number of books relating to the history, law, antiquities, language, folklore, and philology of the Isle of Man have been issued- The chief of them are mentioned in the list given below The most popular literary associations of the island, how- ever, are those which centre round the novels of Mr Hall Caine, who, in his Deemster, Manxman, &c., has exploited the " local colouring " of the island in a way which has undoubtedly added to its general interest.~~

~~Authorities. — History and Law • Spencer Walpole. Tlie Land of Home Mule. An essay on the history and constitu tion of the Isle of Man. London, Longmans, Green and Co., 1893.— A. W. Moore, M.A. The Diocese of Sodor and 2Ian. S.P.C.K.'s series of Diocesan Histories, 189.'5 ; ^4 Histury of the Me of Man, 2 vols. London, T. Fisher Unwin, 1900 ; The Statutes of the Isle of Man from 1317 to 1S95. Gill's edition, 6 vols. Vol. i. 1883 to vol. v'i. 1897. London, Eyre and Spottis- woode. — Richard Sherwood (Deemster), Manx Laid Tenures. Being a short treatise on the law relating to real estate in the Isle of Man. Douglas, Robinson Bros., 1899. Archaeology and~~

~~M A N A C 0 R — M ANCHESTER~~

~~Folklore : P. M. C. Kermode, F.S.A. A Catalogue of the Manx Crosses with Bunic Inscriptions, &c. Ramsey, Courier office, 1892. — A. W. Moore, M. A. The Folklore of the Isle of Man. London, D. Nutt, 1891. Language and Philology: The Book of Common Prayer in Manx Gaelic. Being translations made by Bishop Piiillips in 1610 and Ijy the Manx clergy in 1765. Edited by A. W. MooKE, M.A., and Joiim Knvs, M.A., LL.D. Together with the Outlines of the Phonology of Manx Gaelic, by John Rhts. Oxford, University Press, 2 vols., 1893-94. — Manx National Songs, with English words, from the MS. collection of the Deemster Gill, Dr J. Clague, and W. H. Gill, and arranged by W. H. Gill. London, Boosey and Co., 1896. — Manx Ballads and Music, edited by A. W. Moore, M.A. Douglas, G. and R. Johnson, 1896. — A. W. Moore, M.A. The Surnames and Place Names of the Isle of Man. London, Elliot Stock, 1890. (a. w. M.)~~

~~Manacor, a town, in the island of Majorca, 11 miles from its eastern shore, and connected with Palma by rail. Its population was 16,461 in 1887, and 11,579 in 1897. A suburb of some importance has sprung up by the sea, styled Colonia del Carmen, with good modem houses.~~

~~Managua, the capital of Nicaragua, Central America, situated 1 mile from the foot of Lake Managua, 32 miles south-east of Granada, with which it is connected by rail. There is communication with Momotombo at the head of the lake by small steamers, and thence by rail 58 miles to the port of Corinto. It was chosen as the capital of Nica- ragua in 1856, and on account of the improved railway communication with Corinto and with the interior its com- mercial importance has considerably increased, its chief trade being in coffee, of which the plantations in this district have almost superseded those of cotton. The principal building is the Palacio National, in the Corin- thian style. A modern addition is the national, industrial, and scientific museum. Population about 18,000.~~

~~Manahiki~~

~~See Polynesia.~~

~~*Manaoag, a town in the north central portion of the province of Pangasinan, Luzon, Philippine Islands. There is rich agricultural land in its vicinity, which is level for the most part, and its inhabitants devote them- selves almost exclusively to rice-culture. The principal language is Pangasinan. Population, 17,000.*~~

~~*Manaos, a town in Brazil, at the mouth of the Rio Negro, and capital of the province of Amazonas, with a population estimated at between 30,000 and 50,000. It is an important commercial mart, especially for the fine Upper Amazon rubber, large quantities coming from Bolivia. Some 8200 tons of this commodity were ex- ported in 1899-1900. It is connected with Par^ by a cable down the Amazon, and a railway is projected up the Eio Madeira, which will greatly increase the business of Manaos. Though the town is of recent origin, it already possesses electric tramways, waterworks, electric street- lighting, and a fine opera-house.*~~

~~*Manbhum, a district of British India, in the Chota Nagpur division of Bengal. The administrative headquarters are at Purulia.*~~

~~*Area, 4147 square miles ; population (1881), 1,058,228 ; (1891), 1,193,325 ; (1901), 1,303,583, showing an increase of 13 per cent, between 1881 and 1891, and of 9-24 per cent, between 1891 and 1901 ; average density, 314 persons per square mile. Classified according to religion, Hindus numbered 972,509 in 1891 ; Mahom- medans, 53,25-5 ; Christians, 1532, including 78 Europeans ; aborigines, 166,029. The land revenue and rates in 1897-98 were Rs.l, 47,403 ; number of police, 353 ; number of boys at school (1896-97), 17,283, being 19-4 per cent, of the male popula- tion of school-going age ; registered death-rate (1897), 32-74 per thousand. Manbhum contains the Jherriah coalfield, in the Damodar valley, where a large number of mines have been opened since 1894. Some of these are very small ; but three employ more than 1000 persons each, with an output of more •than 100,000 tons. The United Free Church of Scotland has a mission at Pakheria, with a printing-press that issues a monthly journal in Sonthali. The district is traversed by the Bengal- JNagpur railway, with another line to the coalfield.*~~

~~*Mane he, a department of the north-west of France, forming the peninsula of Cotentin, washed by the English Channel.*~~

~~*Area, 2475 square miles. The population, 520,865 in 1886, decreased to 488,631 in 1901. Births in 1899, 10,867, of which 790 were illegitimate ; deaths, 10,696 ; marriages, 3620. The schools numbered in 1896, 1233, with 71,000 pupils, and the illiterate constituted 3 per cent, of the population. Out of 1,284,994 acres of cultivated land in 1896, 778,409 acres were plough-land and 420,094 acres natural pastures and grass lands. The wheat of 1899 yielded the value of £718,000 ; barley, £312,000; buckwheat, £.348,000; oats, £188,000. Its chief wealth, however, consists in its vast natural pastures and grass lands, which in 1899 returned a value of £2,080,000, and in respect of which Manohe holds a front rank among the depart- ments of France. Apples rendered in 1898 the value of £837,000. The live stock of 1899 included 81,780 horses, 316,750 cattle, 179,350 sheep, and 112,870 pigs. The total value of the milk of the department was in 1899 £2,600,000. Manche has, how- ever, no industries of importance, with the exception of paper factories and some spinning mills. Saint L6, the capital, had 11,604 inhabitants in 1901 ; but Cherbourg (42,952 in 1901) is the largest town.*~~

~~*Manchester, a county of itself, city, parliamentary and municipal borough and parish, in the south-east of the county of Lancashire, England, the commercial centre of the English cotton district. With the borough of Salf ord, with which it is continuous, Manchester is about 180 miles north-east of London, in 53° 29' N. and2°14'23" W. Theystand on a level plain and on the rising ground to the north. The rivers are the Irwell, Medlock, Irk, and Tib. There are stations on the London and North- Western, the Mid- land, Great Northern, and Great Central railways. There are about fifty passenger stations in the two boroughs, which are connected by rail with every part of the kingdom. The parliamentary and municipal boroughs of Manchester are not conterminous. The city boundaries were enlarged in 1885 from 4294 acres to 5933 by the inclusion of Bradford and Rusholme. In 1890 the addition of Blaekley, Kirkmanshulme, Moston, Newton Heath, Openshaw, and West Gorton, with some minor readjustments in 1894, made the municipal area 12,911 acres. The population of the city was 605,368 in 1891, and 643,969 in 1901. The parliaipentary borough contains 7945 acres, and had a population of 454,509 in 1891 and 475,456 in 1901, divided amongst six divisions. The parliamentary and municipal boundaries of Salford are identical, the*~~

area being 6170 acres, and the population 198,139 in 1891 and 220,956 in 1901. Both boroughs have as neighbours populous towns and urban districts. Tramways, as well as railways, run from Manchester to Oldham, Ashton, Eccles, Stockport, &c., with which places the city is con- nected by continuous lines of street. The length of the streets in the city of Manchester is 694 miles, and in the same area there are 78 miles of tramways.

Parks and Statues. — There are in Manchester thirty- nine parks and open spaces. Some of these are small, and the total area is 1103 acres. Boggart Hole Clough, where great efforts have been made to preserve the natural features, is 76 acres in extent, and was the largest until 1902, when Heaton Park, containing 692 acres, was purchased at a cost of £230,000. It was formerly the seat of the earls of Wilton, and includes Heaton House, one of Wyatt's structures. In the Queen's Park there is a museum, and periodical exhibitions of works of art are held. There, too, is a statue of Benjamin Brierley, a well- known writer in the Lancashire dialect. The Salford parks have an area of about 130 acres. The largest is Peel Park, in which there is a museum, library, and art gallery. The last- named, built from the bequest of Mr E. E. Langworthy, contains some notable paintings. The statues are not numerous. There are several in the Manchester town hall. In Piccadilly are statues of Sir Robert Peel, Dr Dal ton, and

the Duke of Wellington. In Albert Square are statues of the Prince Consort, Bishop Fraser, John Bright, Gladstone, and Oliver Heywood. In St Ann's Square is a statue of Cobdeu. A statue of Dr J. P. Joule in the town hall should also be named. The Whitworth Park occupies an exceptional position, as it is not the property of the Manchester corporation, but of the Whitworth Institute, a

~~*corporate body originating from the liberal bequests of Sir JosephWhitworth. The Institute contains avaluable collec- tion of works of art, and stands in the centre of the park, which is maintained as a woodland park and pleasure- ground. In the park is a sculpture group of Christ and the Children by George Tin worth from the designs of Mr E. D. Darbishire, by whom it was presented. A Diamond Jubilee*~~

~~*Plan op Manouestkr.*~~

~~*statue of Queen Victoria stands in Piccadilly, and another statue of her Majesty by Princess Louise, Duchess of Argyll, is placed on the new porch of the Cathedral.*~~

~~*Public Buildings. — The chief public buildings are the Royal Infirmary, which occupies a central position in Piccadilly, and the Town Hall, erected at a cost, including interest, of £1,062,565. Around the great hall are a series of twelve mural paintings by Mr Ford Madox Brown. The organ cost .£5269, and the bells and clock £f)985. The town hall was opened in 1877, and contains 314 rooms. There are also eleven district town halls and public rooms belonging to Manchester. Salford, Pendle- ton, and Broughton have each a town hall. The Man-*~~

~~*chester post office, Brown Street, is a handsome building,, completed in 1887. It suffers, like many other fine structures in the city, from being hemmed in by streets, which prevent the proportions from being seen to advantage. Other public buildings are the Free Trade Hall, the Royal Exchange (1869), the Assize Courts (1864), and the city police courts (1871). The Royal Institution was transferred to the corporation in 1882, and the permanent collection of works of art then existing has been considerably in- creased by purchases, to which purpose £2000 is yearly devoted. It is known as the City Art Gallery.*~~

~~*Manchester Ship Canal. — The most important event in the modern history of the district is the creation of the ship canal, br*~~

~~■*which Manchester and Salford have a direct communication with the sea at Eastham, near Liverpool. The idea of maliing Man- chester a port was an old one. After various schemes had been proposed, and after a long and costly parliamentary struggle, the work of construction was begun in November 1887 under the superintendence of Mr (afterwards Sir) Edward Leader Williams, as engineer. Mr T. A. Walker, who was the contractor, died in 1889, and the completion of the work was taken over from his executors by the company and finished under contracts. The canal was opened for traffic in January 1894. The official opening ceremony was on 21st May 1894, when Queen Victoria visited Manchester. The total expenditure on capital account has been £15,173,402, including £1,224,451 paid for land and compen sation and £1,786,313 for the Bridgewater canal, now absorbed in the greater undertaking. The original share capital of £8,000,000 and £1,812,000 raised by debentures having been exhausted, the corporation of Manchester advanced on loan a further sum of £■"1,000,000. (For the engineering features see Canals : Ship Canala.) The Manchester canal is a remarkable example of con- structive skill ; and whilst the original shareholders have not received the anticipated returns from these investments, the canal has had a beneficial influence on the trade and the district. Since the opening for traffic the yearly tonnage has been : —*~~

~~*1894.*~~

~~*Tons.*~~

~~*1S95. Tons.*~~

~~*1896.*~~

~~*Tons.*~~

~~*1897.*~~

~~*Tons.*~~

~~*Sea-borne traffic Barge traffic Total*~~

~~686,158 239,501~~

~~1,087,443 271,432~~

~~1,509,658 316,579~~

~~1,700,479 365,336~~

~~925,659~~

~~1,358,875~~

~~1,826,237~~

~~2,065,815~~

~~1698.~~

~~1899.~~

~~19U0.~~

~~1901.~~

~~Sea-borne traffic Barge traffic Total .~~

~~2,218,005 377,580~~

~~2,429,108 348,940~~

~~2,784,843 275,673~~

~~2,684,833 257,560~~

~~2,595,585~~

~~2,778,108~~

~~3,060,516~~

~~2,942,393~~

~~Water-supply. — 'i^\ie. water-supply is controlled by the corpora- tion. The works at Longdendale, begun in 1848, were completed, with extensions in 1884, at a cost of £3,147,893. The area supplied by Manchester waterworks was about 85 square miles, in- habited by a million people. The increase of trade ajid population led to the obtaining of a further supply from Lake Thirlmere, at the foot of HIelvellyn and 96 miles from Manchester. The water- shed is about 11,000 acres. The engineering difficulties of the alteration of the level of the lake and the conveyance of the water so great a distance were skilfully overcome. The daily consump- tion is over 32 million gallons. Manchester supplies in bulk many local authorities in the district between Thirlmere and the city. The Manchester corporation have also established works for the supply of hydraulic power for various trade purposes.~~

~~Lighting. — ^The gas lighting of ManchesCer has been in the hands of the corporation for many years. Salford has separate gasworks, also under municipal control. It is possible that the value and excellence of the gasworks may have retarded the introduction of the electric light. I'owers were sought in 1882 ; but differences arose between the corporation and the Board of Trade, and a pro- visional order was not obtained until 1890. Electricity works have been erected, the light is supplied in the central area of the city, and large extensions are in progress for the remainder of Man- chester and the adjoining urban districts.~~

~~Sanitary Condition. — Although continuous efforts have been made, and the social condition of the mass of the people has very greatly improved, Manchester and Salford have high death-rates. Dr John Tatham has constructed a Manchester life-table based on the vital statistics of the decennium 1881-90 ; and from this it appears that while in England and Wales of 1000 men aged 25 nearly 800 survive to be 45, and of 1000 aged 45, 569 survive to be 65, in the city of Manchester the survivors are only 732 and 414 respectively. The expectation of life, at 25, is for England and Wales 36-12 years, and for Manchester 30-69 years. The city death-rate in 1891 was 26-0 per thousand living ; in 1894 it was 19-8 ; in 1898, 21-2. For the 10 years ending 1900 the average death-rate was 23-4, that~~

~~*of Salford 24-1. The reports of the medical officers show that whilst the densityyDf the population, the impurity of the atmosphere, and the pollution of the streams are difficult elements in the sanitary problem, great efforts have been made towards im- proving the health of the people.*~~

~~*Churches. — Manchester Cathedral, which was built as a parish and collegiate church and dates from the 15th century, with traces of much older work, has been extensively restored, under Mr Champ- neys. The old churchyard has again been encroached upon to allow of the widening of Victoria Street. A new porch has been built in harmony with the rest of the structure. The Gordon memorial window and the recumbent statues of Bishop Eraser and Mr Hugh Birley, M.P., should be named. In 1847 Manchester was created a bishopric. The wardens and fellows were converted into deans and*~~

~~*canons, and the parish church became the cathedi-al. The first bishop, James Prince Lee, died in 1870 ; the second, James Eraser, died in 1885. He was succeeded by Dr James Moorhouse, for- merly bishop of Melbourne. Including the cathedral, there are more than 100 Anglican churches in Manchester and Salford. Sal- ford is a Roman Catholic see. With Salford Cathedral there are, in the two boroughs, about 40 places of worship belonging to the Church of Rome. The other religious denominations include the Armenian Church, Baptist, Bible Christian, Catholic Apostolic Church, Christadelphian Ecclesia, United Friends, Congregation- alists, German Protestant, Greek, Independent Methodists, Jews, Labour Church, Methodist New Connection, New Jerusalem Church, Presbyterians, Primitive Methodist, Salvation Army, Society of Friends, Unitarians, United Methodist Free Church, Welsh Calvinistic Methodists, and Wesleyan Methodists. The Secularists and the Positivists have also congregations.*~~

~~*Philanthropic Institutions. — In addition to the Royal Infirmary, the Salford Hospital, St Mary's Hospital, and other institutions of that type, mention may be made of the Boys' and Girls' Refuges, and the Charter Street Ragged School and Working Girls' Home — both of which are large and important.*~~

~~*Literature, Science, and Art. — Numerous societies and institu- tions exist for the cultivation of learning. The Literary and Philosophical Society is one of the oldest in the kingdom, and has a high reputation. The Lancashire and Chester Antiquarian Society, the Record Society, and the Chetham Society, have their headquarters in the city. There are nine daily papers, and many weekly papers and periodicals. The Manchester Quarterly is issued by the Manchester Literary Club. The success of the Art Treasures Exhibition in 1857 was repeated in the Jubilee Exhibi- tion of 1887. In 165 days there were 4,765,137 admissions. The Manchester Academy of Fine Arts is a society of artists, and holds an annual exhibition in the city art gaUery.*~~

~~*University and Schools. — The educational arrangements of the city are on an extensive scale. There are 74 board schools, 55 belonging to the Church of England, 25 Roman Catholic, 5 British, and 5 Wesleyan. In Salford there are 24 board schools, 1 British, 29 Church of England, 11 Roman Catholic, and 3 Wesleyan. The Moss Side School Board has two schools. The two corporations have taken an active interest in secondary education. The Man- chester Municipal School of Technology is large and well equipped. The School of Art forms one department, and in connexion with this there is an Arts and Crafts Museum. The Salford Technical School adjoins Peel Park, and is a handsome building, erected at a cost of £84,000. The Manchester Grammar School, founded in 1515, has earned a high reputation. It is connected by scholarships with Oxford University and the Victoria University. The foundation of WiUiam Hulme maintains a grammar school at Alexandra Park. There are also four high schools for girls. The Victoria University received its charter in 1880, and in 1883 a supplementary charter conferring the power of granting degrees in medicine as well as in science and arts. Owens College, which was at first the only one in the univer- sity, has since been joined by University College, Liverpool, and the Yorkshire College of Science, Leeds. A new educational type — that of a federal teaching university — was thus created ; but in consequence of the application of Liverpool for a separate charter, there is a probability that the Victoria University will develop into three civic universities of Manchester, Liverpool, and Leeds. The original endowment of Owens College, founded under the bequest of John Owens, was about £100,000, but this has been greatly in- creased by*~~

other benefactors. Mr Thomas Ashton's gifts are estimated at £80,000. Dr Richard Copley Christie, formerly a professor, gave the building known as the Christie Library, which cost £21,000, and devoted £50,000 of the funds at his disposal as a legatee of Sir Joseph Whitworth to the erection of the Whitworth Hall. These, with the building containing the Manchester Museum (an admirably arranged collection illustrating geology, biology, and anthropology), complete the quadrangle of the main college build- ings. There are various large denominational colleges in the district, and many of those preparing for the ministry receive their arts training at Owens College. The Royal College of Music is another educational institution which should not be overlooked. The various authorities have a working agreement for the co- ordination of the educational work of the district.

Libraries and ilfuseams.— The district has many libraries. Chet- ham's Hospital contains a blue-coat school for 100 boys and a public library. The Salford Museum and Library was founded in 1849. This includes reference library, 5 lending libraries, and 2 reading-rooms. The central building contains also the museum and art gallery. The Manchester Free Library was opened in 1862. There is now a large reference library, containing probably the best working collection of books in the North of England, 13 lending libraries, and 5 reading-rooms. The stock of books amounts to 292,000. By the generosity of Mrs Enriqueta Rylands the city received in 1899 an endowed library of a remarkable character— the John Rylands Library, which has been erected by his widow to

the memory of a well-known Manchester worthy. The building is a noble and beautiful structure, and the library is large and im- portant. It includes the famous Althorp collection; which was bought from Earl Spencer and incorporated by Mrs Rylands into her scheme. The regulations for use of the Rylands Library are similar to those in force at the British Museum. Moss Side, which is in the parliamentary limits, but has its own urban council, has a municipal library, and also a small park and recreation ground.

Recreation. — The recreation of the population is provided for in many ways. There are eleven theatres, mostly large in size. The concerts of classical music and other musical entertainments have more than local celebrity. The Bellevue Zoological Gardens is a, favourite holiday place for working people. The Anooats Recre- ation Committee have since]882 had Sunday lectures, and occa- sional exhibitions of pictures, window gardening, &o. The Ancoats Art Museum was iounded to carry out the educational influences of art and culture generally. In addition to works of art, there are concerts, lectures, reading circles, &o. The museum is worked in connexion with a university settlement.

Manufactures and Commerce. — Manchester, whilst the centre of the cotton industry, is also the seat of large engineering and chemi- cal trades. The central area is more and more occupied by ofBoes and warehouses, and the works and factories are grouped outside. This process has been carried out so largely that the real Manches- ter is difficult of definition. From one point of view the whole of south-east Lancashire, and some portions even of Cheshire and Derbyshire, may be regarded as one vast urban district, having many interests and characteristics in common, although split up into separate areas of local government. The annual value of the city of Manchester increased from £2,943,545 in 1896 to £3,394,879 in 1901 ; that of Salford from £835,455 to £967,727. In the dis- tricts where there was more room for expansion the increase is also striking. Thus the annual value of Stretford has risen from £143,956 to £194,366 within the years named ; the corresponding figures for similar urban districts adjoining Manchester are equally demonstrative of the increase of trade and population. The amount passing through the Manchester bankers' clearing-house in 1890 was £162,849,544 ; in 1899, £222,563,348 ; in 1900, £247, 206,000 ; in 1901, £235,487,000. Manchester is the headquarters of the Wholesale Co-operative Society.

Municipality. — Manchester received a municipal charter in 1838, received the title of city in 1853, and became a county borough in 1889. The city is divided into 25 wards, and the corporation con- sists of 26 aldermen and 78 councillors. The mayor received the title of Lord Mayor in 1893. The municipal charter of Salford was granted in 1844. There are

~~16 wards. Sixteen aldermen and 48 councillors constitute the Town Council. Salford became a county borough in 1889.~~

~~By the Reform Bill of 1832 Manchester received two and Salford one representative. In 1868 this was increased to three for Man- chester (each voter, however, having only two votes) and two for Salford. At present Manchester sends six and Salford three mem- bers to the House of Commons.~~

~~Authorities. — W. A. Shaw. Manchester, Old and New, 1894. — W. E. A. Axon. Annals of Manchester, 1885. — Hakry Rawson. Historical Record of some Recent Enterprises of the Corporation of Manchester, 1894 ; Official Manual of Manchester and /Salford, 1902. — J. 1'. Earwaker. Court List Records of Manchester, 1552-1686, 17S1-1S46 (1884-90), 12 vols. ; Constable's Ac- counts, 1612-47, 1743-76 (1891-92), 3 vols.; Manchester Muni- cipal Code, 1894-99, 5 vols. — George Saintsbury. Manchester, 1887. — Handbook and Guide to Manchester. Edited by J. Howson Ray, F.R.C.S. 1902. (w. E. A. A.)~~

~~Manchester, a township of Hartford county, Con- necticut, U.S.A., north-east of the centre of the state, a few miles east of Hartford, containing an area of 21 square miles and including the villages of Manchester, South Manchester, Manchester Green, and Buckland. Its manufactories include silk, paper, cotton, and needle mills, and factories of electric machinery and appliances. The total capital invested in manufacturing in 1900 Avas $7,330,806, and the various establishments employed 3118 wage-earners, and had products valued at f 5,939,043. Population (1890), 8222 ; (1900), 10,601, of whom 3771 were foreign-born.~~

~~Manchester, a city of New Hampshire, U.S.A., capital of Hillsboro county. It is on the Merrimac river, at Amoskeag Falls, which furnish water-power for its manufactures. Its manufacturing establishments had in 1900 a capital of $22,426,125, employed an average num- ber of 19,032 wage-earners, and produced goods valued at~~

~~$26,607,600. Of this total product, cotton goods were valued at $11,723,608, boots and shoes at $4,052,204, hosiery and knitted goods at $834,343, and foundry and machine-shop products at $611,208.~~

~~*Manchester is the seat of St Anselm's College, a Eoman Catholic institution founded in 1893. In 1899 this had 19 instructors, and was attended by 61 students. The assessed valu- ation of real and personal property in 1900, on a basis of about 70 per cent, of the full value, was $32,706,794, the net debt of the city $1,627,026, and the rate of taxation $19.60 per $1000. Population (1890), 44,126; (1900), 66,987, of whom 24,267 were foreign-born and only 28 were negroes. The death-rate in 1900 was 19-2, the same as in 1890.*~~

~~*Manchester, a city of Virginia, U.S.A., on the south bank of the James river, opposite Eichmond, with which it is connected by bridges. Though within the limits of Chesterfield county, it is independent of county government. It is on the Atlantic Coast Line, the Sea- board Air Line, and the Southern railways. It is a manufacturing city of some importance, using the water- power from the falls of James river at this point. Population (1880), 5729 ; (1890), 9246 ; (1900), 9715, of whom 138 were foreign-born and 3338 were negroes.*~~

~~*Manchuria. — The three provinces of China lying outside the Great Wall, generically known as Manchuria, were described in the earlier volumes (xv. 465) of this Encyclopedia (ninth edition). Since 1883 the country has made considerable progress. Immigrants from the older and over-populated parts of China have been flock- ing thither in great numbers, and much new land has been brought under cultivation. The general progress is exemplified in the returns of trade passing through the treaty-port of Newchwang. The total value of the trade in 1880 was H. taels 6,726,000, and in 1899 it had risen to H. taels 48,357,000 ; but in 1900, owing to the dis- turbed state of the country, it fell to £1,023,260, or H. taels 38,116,450. The population is estimated as follows for each of the three divisions : —*~~

~~*Province of Shengking (Eeng Tien) . . 4,000,000*~~

~~*„ „ Kirin 6,500,000*~~

~~*„ „ Hei lung Chiang . . . 2,000,000*~~

~~*Total .... 12,500,000*~~

~~*The original population was entirely Manchu, but they are rapidly being elbowed out by the more industrious Chinese. Their number is estimated at from 2 to 3 mil- lions, or about 25 per cent, of the whole population. Nearly all of them are officials or hangers-on at the various civil and military establishments, and but for the official support they receive in the shape of pay or perquisites, they would rapidly be squeezed out. Gold mines are worked at several places in the northern part of Manchuria, of which the principal are on the Muho river, an affluent of the Amur, and near the Russian fron- tier. Mines are also worked at Kwanyin-shan, opposite the Russian frontier toAvn of Radevska, and at Chia-pi-kou, on an affluent of the upper Sungari. Manchuria has been claimed by Russia as her particular sphere of interest, and in the course of the disturbances of 1900, Russian troops occupied various parts of the country (see China). Eventu- ally a Manchurian Convention was arranged between China and Russia, by which Russia was to evacuate the province; but various difficulties arose, and no actual ratification of this convention had been made by Russia up to June 1902. The Anglo-German agreement of October 1900, to which Japan also became a party, and by which it was agreed to " maintain undiminished the territorial condition of the Chinese empire," was considered by Great Britain and Japan not to exclude Manchuria ; but Germany, on the*~~

~~*other hand, declared that Manchuria was of no interest to her. The Anglo-Japanese treaty of 1902, however, was ostensibly directed towards the preservation of Manchuria in Chinese hands. Railways are in course of construction by Russian capital from Port Arthur northwards vid Mukden, to connect with the Siberian main line to Vladi- vostok. British capital has been invested in the exten- sion of the Chinese Northern railway to Newchwang, and the fact was officially recognized by an agreement between Great Britain and Russia in 1899.*~~

~~*Vide Blue Book, China, No. 2 (1899), and "Report on Man- churia," by Colonel Browne, military attach^, Blue Book, China, No. 1 (1899).*~~

~~*Mancini, Pasquale Stanislao (1817-1888), Italian jurist and statesman, was born at Castel Baronia, in the province of Avellino, on 17th March 1817. At Naples, where he studied law and displayed great literary activity, he rapidly acquired a prominent position, and in 1848 was instrumental in persuading Ferdinand II. to participate in the war against Austria. Twice he declined the offer of a portfolio in the Neapolitan Cabinet, and, upon the triumph of the reactionary party, under- took the defence of the Liberal political prisoners. Threatened with imprisonment in his turn, he fled to Piedmont, where he obtained a university professorship and became preceptor of the Crown Prince Humbert. In 1860 he prepared the legislative unification of Italy, opposed the idea of an alliance between Piedmont and Naples, and, after the fall of the Bourbons, was sent to Naples as administrator of justice, in which capacity he suppressed the religious orders, revoked the Concordat, proclaimed the right of the State to Church property, and unified civil and commercial jurisprudence. In 1862 he became Minister of Public Instruction in the Rattazzi Cabinet, and induced the Chamber to abolish capital punishment. Thereafter, for fourteen years, he devoted himself chiefly to questions of international law and arbitration, but in 1876, upon the advent of the Left to power, became Minister of Justice in the Depretis Cabinet. His pronounced Liberal tendencies found expression in the extension of press freedom, the repeal of imprisonment for debt, and the abolition of ecclesiastical tithes. During the Conclave of 1878 he succeeded, by negotiations with Cardinal Pecci (afterwards Leo XIII.), in inducing the Sacred College to remain in Rome, and, after the election of the new pope, arranged for his temporary absence from the Vatican for the purpose of settling private business. Resigning office in March 1878, he resumed the practice of law, and secured the annulment of Garibaldi's marriage. The fall of Cairoli, in consequence of the occupation of Tunis by France in 1881, led to Mancini's appointment to the Foreign Office (April 1881), where he conducted the negotiations for and concladed the Triple Alliance, and promoted a closer understanding between Italy and Great Britain, although, partly through lack of military prepara- tion, he declined to join in the British expedition to Egypt. In 1885, however, he undertook an expedition to Massawa with the consent of Great Britain, and thus inaugurated Italian colonial policy. During the cholera epidemic of 1885 he accompaniedKing Humbert to Naples, and displayed great*~~

~~*courage and activity in organizing measures of relief. In June 1885 he was succeeded at the Foreign Office by Count di Robilant, and died at Rome on 26th December 1888. A man of extra- ordinary versatility and of facile though verbose eloquence, Mancini possessed for many years considerable ascend- ancy over the Italian Chamber, and, while not a great statesman, left an indelible mark upon the history of his country.*~~

~~*(h. w. s.)*~~

~~*Mandalay, formerly the capital of independent Burma (q.v.), now the headquarters of the Mandalay divi- sion and district, as well as the chief town in Upper Burma. The DIVISION includes the districts of Mandalay, Bhamo, Myit Kyina, Katha, and Ruby Mines, with a total area of 25,767 square miles, and a population (1891) of 641,466, (1901), 778,255, giving an average density of 30 in- habitants to the square mile. There were 2950 towns and villages in 1898-99, and the revenue paid was Rs.16,52,036. The Mandalay district has an area of 2071 square miles, and a population (1891) of 375,055, (1901) 367,230, showing a density of 177 inhabitants to the square mile. It is divided into five subdivisions, with seven townships and 786 villages. About 600 square miles of the district along the Irrawaddy river are flat land, nearly all cultivated. To the north and east of the district there are some 1500 square miles of high hills and table-lands, forming geographically a portion of the Shan table- land. Here the fall to the plains averages 3000 to 4000 feet in a distance of 10 miles. This part of the district is well wooded and watered. The rainfall in the plain is scanty. The Maymyo subdivision has very fine plateaus of 3000 to 3600 feet in height. The highest peaks are between 4000 and 5000 feet above sea-level. The Irra^ waddy, the Myit-nge, and the Madaya are the chief rivers. The two last come from the Shan States, and are navi- gable for between 20 and 30 miles. There are many canals in the district, most of which have fallen greatly into disrepair, and the Aungbinle, Nanda, and Shwepyi lakes also supply water for cultivation. A systematic irrigation scheme is being carried out by Government. The Sagyin hills near Madaya are noted for their alabaster, and rubies are also found, but in no great quantity. There are 285^ square miles of forest reserve in the district, but there is little teak, and its quality is not great. The tracts are chiefly reserved for bamboos and the ordinary kinds of timber. The*~~

climate of the district is dry and healthy. During May and June and till August strong winds prevail. The thermometer rises to about 107° in the shade in the hot weather, and the minimum in the month of December is about 55°. The rainfall is small, the average being under 30 inches (23-77 in 1898-99). Epidemic^ are rare.

Mandalay Town stands on the left hank of the Irrawaddy, in 21^ 58′ N. and 96° 8′ E. Its height above mean sea^level is 315 feet. Its area is — town, 18-51 square miles, cantonment, 6-14 square miles ; total, 24-65. Mandalay is quite a modern town, and was built in 1856-57 by King Minddn. It is now divided into the municipal area and the cantonment. The town covers an area of six miles from north to south and three from east to west, and has well-metalled roads lined with avenues of trees and regularly lighted and watered. The cantonment consists of the area inside the old city walls, and is now called Fort Dufferin. In the centre stands the palace, a group of wooden buildings, many of them highly carved and gilt, resting on a brick plat- form 900 feet by 500 feet, and 6 feet high. The greater part of it is now utilized for military and other offices. The garrison consists of one regiment of British infantry, one British moun- tain battery, and two regiments of native infantry. There are many fine pagodas and monastic buildings in the town. The pop- ulation was 188,815 in 1891, and 182,498 in 1901, showing a de- crease of 3-36 per cent. The population is very mixed. Besides Burmese there are Zerbadis (Burman Mahommedans, the offspring of a Mahommedan with a Burman wife), Mahommedans, Hindus, Suratis, Jews, Chinese, Shans, and Manipuris, called Kathe Kachins and Palaungs. The chief classes in the district in 1891 were Buddhists and Jains, 343,376 ; Mahommedans, 18,693 ; Hindus, 9613 ; and native Christians, 2230. Trains run from Mandalay to Rangoon, Myit Kyina, and up the Mandalay-Kunlong railway, now in part open. The steamers of the Irrawaddy Flotilla Company also ply in all directions. The chief public buildings are the court-house, the courts of the commissioner and judicial commissioner, telegraph oflBce, post office and general hospital. There are twenty bazaars, the chief of which, the Zegyo, was burnt in 1897, but is rebuilt.

(j. G. Sc.)

~~Mandaue, a town on the eastern coast of the island of Cebu, Philippine Islands, in 10° 26' N. Its climate is very hot, but healthful. The principal occu- pation of its inhabitants is rice-culture. Cebii-Visayan is the language. Population, 15,000.~~

~~Mandi, a native state of India, within the Punjab. It ranks as the most important of the hill states to which British influence extended in 1846 after the first Sikh war. The territory lies among the lower ranges of the Himalaya, between Kangra and Kulu.~~

~~Area, 1131 square miles; population (1881), 147,017; (1891), 166,923 ; (1901), 174,045 ; average density, 158 persons per square mile ; estimated gross revenue, Ils.4,30,000 ; tribute, Ils.1,00,000 ; military force, 691 men. Tlie chief, whose title is raja, is a Rajput of old family. Owing to infirmity, he is assisted in administration by a British official. Considerable sums have been expended on roads and bridges. An important product of the state is salt, which is mined in two places. The British Government manages the mines, and pays to the raja 13 annas on every maund of salt sold, which yielded him Es. 1,01, 264 in 1897-98. The town of Mandi is on the left bank of the Beas, which is here a mountain torrent, 2991 feet above the sea. Population about 5000.~~

~~M and I a, a town and district of British India, in the Jubbulpore division of the Central Provinces. The town is on the river ISTerbudda, 1787 feet above the sea. Population (1881), 4732 ; (1891), 5057.~~

~~The district of]VIandla, among the Satpura hills, has an area of 5056 square mUes ; population (1881), 301,760 ; (1891), 339,373; (1901), 297,454, showing an increase of 12 per cent, between 1881 and 1891, and a decrease of 12-36 per cent, between 1891 and 1901 ; average density, 58 persons per square mile ; land revenue, Rs.1,46,000, being little more than one anna per acre ; cultivated area (1897-98), 446,923 acres, of which only 1078 were irrigated; number of police, 815 ; boys at school (1896-97), 2290, being 8-9 per cent, of the male population of school-~~

~~going age, the lowest rate in the province ; registered death-rate (1897), 96‘24 per thousand, showing the results of the famine. The principal crops are rice, wheat, other food grains, pulse, and oil-seeds. There is a little manufacture of country cloth. There is no railway, and few roads. The district suffered most severely from the famine of 1896-97, partly owing to its inaccessibility, and partly from the shy habits of the aboriginal tribes. Tor an interesting account of the special difficulties of famine relief in Mandla see Appendix to the Report on the Famine in the Central Provinces (Nagpur, 1898). The famine of 1900 was scarcely felt.~~

~~Mandsaur, or MAifDEStiR, a town of India, in the native state of Gwalior, on the Eajputana railway, 31 miles south of Neemuch. Population (1881), 22,596 ; (1891), 27,785. It gave its name to the treaty with Holkar, which concluded the Maratha-Pindari war in 1818. It is now a centre of the Malwa opium trade. In 1897-98 the exports of opium amounted to 4574 chests, paying a duty of Ks. 25,32,400. It has a school and dispensary.~~

~~Mandvi, a seaport of India, in the native state of Cutch, within the Crujarat province of Bombay, 36 miles from Bhuj, and 182 miles by sea from Karachi. Popula- tion (1881), 35,980 ; (1891), 38,155. It is a weekly port of call for steamers of the British India line, though vessels of 70 tons cannot come any nearer than 500 yards. The pilots and sailors of Mandvi have a high reputation.~~

~~Manet, Edouard (1 832-1883), French painter, who is regarded as the most important master of the Im- pressionist school (q.v.), was born in Paris in 1832. After spending some time under thi^ tuition of the Abbe Poiloup, he entered the College Eollin, where his passion for drawing led him to neglect all his other lessons. His studies finished in 1848, he was placed on board the ship Giiadeloiipp, voyaging to Tlio de Janeiro, and during the passage never ceased sketching everything he saw. On his return he first studied in Couture’s studio (1851), where his independence often infuriated his master. For six years he was an inteiraittent visitor to the studio, constantly taking leave to travel, and going first to Cassel,~~

~~Dresden, Vienna, and Munich, and afterwards to Plorence, Eome, and Venice, where he made some stay. Some im- portant drawings date from~~

~~*this period, and one picture, "A Nymph Surprised." Then, after imitating Couture, more or less, in " The Absinthe-drinker " (1866), and Courbet in "The Old Musician," he devoted himself almost exclusively to the study of the Spanish masters in the Louvre. A group was already gathering round him — -Whistler, Legros, and Pantin-Latour haunted his studio in the Rue Guyot. His "Spaniard playing the Guitar," in the Salon of 1861, roused much animad- version. Delacroix alone defended Manet, but, this notwithstanding, his "Fifer of the Guard" and "Break- fast on the Grass" were refused by the jury. Then the "Exhibition of the Rejected" was opened, and round Manet a group was formed, including Bracque- mond, Legros, Jongkind, Whistler, Harpignies, and Fantin-Latour, the writers Zola, Duranty, and Duret, and Astruc the sculptor. In 1863, when an amateur, M. Martinet, lent an exhibition-room to Manet, the painter exhibited fourteen pictures ; and then, in 1864, contributed again to the Salon "The Angels at the Tomb" and "A Bull-fight." Of this picture he after- wards kept nothing but the toreador in the foreground, and it is now known as " The Dead Man." In 1865 he sent to the Salon " Christ reviled by the Soldiers " and the famous " Olympia," which was hailed with mockery and laughter. It represents a nude woman reclining on a couch, behind which is seen the head of a negress who carries a bunch of flowers. A black cat at her feet empha- sizes the whiteness of the sheet on which the woman lies. This work is now in the Luxembourg, to which it was pre- sented by a subscription started by Claude Monet (1890). It was hung in 1897 among the Caillebotte collection, which includes the "Balcony," and a study of a female head called " Angelina." This production, of a highly in- dependent individuality, secured Manet's exclusion from the Salon of 1866, so that he determined to exhibit his pic- tures in a place apart during the Great Exhibition of 1867. In a large gallery in the Avenue de 1' Alma, half of which was occupied by Courbet, he hung no fewer than fifty paintings, and among them, besides the works already mentioned, "The Child with a Sword," "A Matador," " Lola of Valence" (from a poem by Baudelaire), " A Monk at Prayer," "A Spanish Dance," "A Vase of Flowers," " Views of the Sea," " A Young Woman in a Spanish Cos- tume " reclining, and many others now scattered through public and private galleries. C)nly one important picture was absent, " The Execution of the Emperor Maximilian " ; its exhibition was prohibited by the authorities. From that time, in spite of the fierce*~~

~~hostility of some adver- saries, Manet's energy and that of his supporters began to gain the day. His " Young Girl " (Salon of 1868) was justly appreciated, as well as the portrait of Lola; but the "Balcony" and the "Breakfast" (1869) were as severely handled as the " Olympia " had been. In 1870 he exhibited " The Music Lesson " and a portrait of Mile E. Gonzales. Not long before the Franco-Pru.ssian war, Manet, finding himself in the country with a friend, feu- the first time discovered the true value of open air to the effects of painting in his picture " The Garden," which gave rise to the " open air " or plein air school. After fighting as a gunner, he returned to his family in the Pyrenees, where, he painted " The Battle of the Kearsarge and the Alabanui." His pictures were now bought by collectors — j\IM. Duret, Gerard, Faure, Heeht, Ephrussi, and De Bellio. His " BonBock" (1873) created a, furore. But in 1875, as in 1869, there was a fresh out- burst of abuse, this time of the " Piailroad," " Polichi- nelle," and "Argenteuil," and the jury excluded the artist, who for the second time arranged an exhibition in his~~

~~studio. In 1877 his "Hamlet" was admitted to the Salon, but " Nana" was rejected. The following works were exhibited at the Salon of 1881 : " In the Conserva- tory," " In a Boat," and the portraits of Eochefort and Proust; and, the Cross of the Legion of Honour was con- ferred on the painter on 31st December in that year. Manet died in Paris on 30th April 1883. He left, besides his pictures, a number of pastels and engravings. He illustrated Les Ghats by Champfleury, and Edgar Allan Poe's Raven.~~

~~Authorities. — Zola. Manet. Paris, 1867. — E. Bazirb. Manet. Paris, 1884. — G. Geffkov. La vie artistique. 1893. (h. Fr.)~~

~~Mangaldan, a town in the northern portion of the province of Pangasinan, Luzon, Philippine Islands, about two miles from the shore of the Gulf of Lingayen. Most of its inhabitants are engaged in rice-culture, for which the low and fertile fields in its vicinity are espe- cially adapted. The principal language is Pangasinan; Ilocauo is also spoken. Population, 16,000.~~

~~*Mangaldas Nathoobhai, Sir (1832-1890), Seth or head of the Kapole Bania section of Bombay, a caste of Hindus well known for their thrift and keen commercial instincts, was born on the 15th of October 1832 of a family whose ancestors emigrated from the island of Diu to Bombay soon after the town came into British possession. His grandfather, Eamdas Manoredas, amassed a considerable fortune, which, owing to the pre-mature death of his father, came into the sole possession of Mangaldas at the age of eleven. He had consequently to take charge of the business in early life, though he gave some of his time to English studies under a private tutor. He was married at sixteen to Sethanee Rukminbai, and had three sons and two daughters. After a happy wedded life of sixteen years, his wife died, when Mangaldas estab- lished a dispensary at Kalyan in her memory at a cost of about Rs. 70,000, and built a special female ward in con- nexion with the David Sassoon Hospital in Poena at a heavy cost. As a merchant Mangaldas was upright and successful. In social matters he stood forth as a reformer, and to him the change to election from hereditary suc- cession to the headship of the caste is due. In the tur- moil caused by the attacks of Karsondas Mulji (q.v.) on the proceedings of the Vallabhacharyan maharajas, Mangaldas was his firm supporter. From early years he espoused the cause of education. In 1862 he founded a fellowship in Bombay University to allow graduates to spend some years in Europe. A bequest in his will of a great sum enabled the University to establish seven other similar scholarships. He took keen interest in learning, and in such institutions as the Asiatic and Geographical Societies. In 1866 he was nominated to the Legislative Council, and sat there till 1874, his industry and inde- pendent character being reflected in the debates. When failing health compelled him to retire, the local govern- ment expressed " the strong sense it entertained of his attention to business and devotion to the interests of the public." In 1867 he revived the Bombay Association, a native political body, over which he presided for a time. In 1872 he was made C.S.I., and in 1875 the dignity of Knight Bachelor was also conferred on him. On the 25th November 1875 the Prince of Wales, being then in Bombay, honoured with his presence the marriage cere- monies of two of Mangaldas's sons. Besides a large dona- tion to the Irish Famine Fund, Sir Mangaldas is known to have expended Rs. 75,00,000 on Indian charities. He died at Bombay on the 9th March 1890. (n. b. w.)*~~

~~*Mangalore, a seaport town of British India, administrative headquarters of the South Kanara district of Madras. Population (1881), 32,099; (1891), 40,922;*~~

~~*(1901), 43,821; municipal income (1897-98), Rs.47,430. The harbour is formed by the backwater of two small rivers. Vessels ride in 24 to 30 feet of water, and load from and unload into lighters. In 1897-98 the total sea-born trade of the district was valued at Rs.1,77, 04,146 ; 79 vessels entered and cleared for foreign trade, with an aggregate burthen of 11,897 tons. The chief exports are coffee, cocoarnut products, timber, rice, and spices. There is a small shipbuilding industry. In 1897-98, 1 9 vessels were registered, of an aggregate burthen of 377 tons. It has a large Roman Catholic population, with a European bishop, several churches, a convent, and a college. It is the headquarters of the Basel Lutheran mission, which possesses one of the most active printing- presses in southern India, and has also successfully intro- duced the industries of weaving and the manufacture of tiles. Two colleges, (Government and St Aloysius) had 164 students in 1896-97. Besides, there are four high schools, with 1016 pupils, as well as training schools for masters and mistresses. Five printing-presses issue three vernacular periodicals, and there are four libraries and literary associations.*~~

~~*Mang L6n, a state in the northern Shan states of Burma. It is the chief state of the Vtl or Wa tribes, some of whom are head-hunters, and Mang Lon is the only one which in 1901 had submitted to the British Government. The state bestrides the Salween, and extends from about 21° 30' to 23° N,, or for 100 miles along the river. Its width varies greatly, from a mile or even less on either side of the river to perhaps 40 miles at its broadest part near Taktlt, the capital. It is divided into East and West Mang Lon, the boundary being the Salween. There are no Vu or Wa in West Mang Lon. Shans form the chief population, but there are Palaungs, Chinese, and Yanglam, besides Lahu. The bulk of the popiUation in East Mang Lon is Vtl, but there are many Shans and Lahu. Both portions of the state are very hilly, and the only flat land is along the banks of streams in the valleys, and here the Shans are settled. There are, however, pros- perous settlements and bazaars at Nawng IIkam and Mong Kao in West Mang Lon. The Vil of the eastern half have long since*~~

given up head-hunting, and many profess to be Buddhists. The population does not probably exceed 6000 or 7000, and about 5000 of these are Vil. The capital, Takilt, is perched on a hiU-top 6000 feet above sea-level. The Sawbwa is a Vil, and has control over two sub-states, Mot Hai to the north and Maw Hpa to the south.

Manila, the capital and chief port of the Philippine Islands, situated on the west coast of Luzon. Its cathe- dral is in 14° 35' 31" N. and 120° 58' 03" E. Included within the municipality are Manila proper, sometimes called " Old Manila" or " Intramuros," and the wards or districts known as Binondo, Tondo, Trozo or San Jose, Santa Cruz, Sampaloc, Quiapo, San Miguel, Ermita, Paco, and Arroceros. The important suburb of Malate, although continuous with Ermita, lies outside the city limits. Manila proper is enclosed by walls which were constructed about 1690 and are in a very perfect state of preservation. The surrounding moat is choked with vegetation. Bronze smooth-bore cannon for centuries crowned the ramparts, but have all been removed. Only a saluting battery remains. Atthenorth-westangleof the wall is situated Fort Santiago, called the Black Hole of Manila, on account of the suffoca- tion of a number of native prisoners in one of its foul dungeons during the revolt which began in 1896. Within the walls are a fine cathedral, the cloisters of the Augus- tinian, Franciscan, Dominican, and Recollect friars, and of the Jesuits, spacious churches belonging to each of these orders, the mission church of the Capuchins, and a con-

vent and church belonging to the order of Santa Clara; the Ayuntamiento, a fine building formerly occupied by municipal officers, and under American rule the head- quarters of the military government ; the Intendencia, or treasury building; Saint Thomas University, San Jose Medical and Pharmaceutical College, and a school for primary and secondary instruction, known as San Juan de Letran, all in charge of the Dominicans ; the Ateneo Municipal, a school for primary and secondary instruc- tion, in charge of the Jesuits ; a nautical school, in charge of an officer of the United States navy ; the so-called College of Santa Isabel,

~~*which is a school for girls ; a large civil hospital, known as San Juan de Dios ; the official residence of the archbishop; the Audiencia, or Supreme Court building ; a Government mint, capable of coining 12,000 large coins and 11,000 small coins in a day of six hours ; large and well-appointed barracks ; several poor hotels, and a considerable number of residences. Business within the walls is confined to a few small shops. The streets are so arranged that one side is always in the shade, and the more important of them are paved. The population of the Intramuros district is estimated at 14,000. Between its walls and the bay runs a fine drive, extending southwards from the monument erected in honour ot Simon de Anda on the Passig river, to the Luneta, an oval promenade by the sea, which is crowded with carriages every fine evening. The batteries of heavy modern guns, which formerly lay in front of the city wall and at the southern end of the Luneta, were all removed in 1900. Immediately to the east of the Luneta is an open field, called Bagumbayan, the scene of public executions in Spanish days. To the southward of the Luneta and Bagumbayan are situated Ermita and Malate, the most desirable residential districts, on account of the sandy soil and the cool breezes from the bay. In Ermita there is a fine building belonging to the Jesuits, in which are thoroughly equipped meteorological, seismological, and magnetic observatories, and a normal school. Adjacent to this building is a fairly good astronomical observatory, also owned by the Jesuits.*~~

~~*Paco has a few fine residences, numerous native houses, and a large municipal cemetery, where the dead are buried in niches in two concentric circular walls. The remaining districts of the city are on the north side of the Passig river, which is spanned by three bridges, known respectively as the Bridge of Spain, the Suspension Bridge, and the Ayala Bridge. These structures are inadequate to meet the necessities of the public, and a fourth bridge was begun in 1900. The central span of the Ayala Bridge rests on an island, where are situated an insane asylum and an orphanage. At its southern end is the large new "Germinal" tobacco factory. At the northern end of the suspension bridge is a good cold-storage plant, opened to the public in 1900 ; at its southern end is the Government ice and cold-storage plant, which Is capable of producing 60 tons of ice daily, and has 433,440 cubic feet of cold storage, divided between ten refrigerating rooms for meat, sufficient for 5000 carcases of*~~

~~*beef, 7000 of sheep, and 107 tons of pork, and two rooms for game, fruits, and vegeta- bles. Binondo, on the north bank of the Passig, is the most important district of the city and the centre of its great business interests. Its more important buildings are the post oiBce, the custom-house, the Hotel de Oriente, and "La Insular" to- bacco factory. All the large foreign commercial houses and the banks are in Binondo. Two of its streets, the Escolta and the Eosario, are the most important business streets of the city. In the former are situated the best shops, while the latter is lined from end to end with the shops of Chinese merchants. Tondo lies immediately to the north of Binondo. It is a native residen- tial quarter, but has some unimportant shops and " La Rosa " tobacco factory. Many of the houses are of nipa. The greater part of this district was burned over by insurgents on the night of 22ud February 1899, and the most important market in the city was destroyed. In its place has arisen a very large modern fireproof structure of iron and cement. Tondo church is one of the most conspicuous buildings in the city. In this district are the only cotton-mills in the Philippines and the Manila station of the only railway. Santa Cruz and Quiapo are occupied chiefly by the residences and shops of the middle class. There*~~

~~*is a large tobacco factory in the latter district. One of the finest churches in the city is situated in San Sebastian ; also a large distillery. In San Miguel many of the finest residences are to be found, including the palace of the governor-general. The only brewery in the Philippines is in this district. In Trozo are situated a large gaol and penitentiary and the leper hospital, San Lazaro.*~~

~~*The ground on which Manila is built is flat, and at no point rises more than 15 feet above water-level at high tide. As a consequence, whole districts are often flooded during typhoons. Esteros, or creeks, connecting with the river, ramify through the city in various directions, and when improved will afford a valuable means of transpor- tation. They have always been used to a considerable extent by small native craft. Only a few of the principal streets are paved, but many others have been macadamized since the American occupation. The city has good water-works, and is well lighted by electricity. Under Ameri- can administration it has been thoroughly cleaned ; two crematories for the destruction of*~~

~~*garbage have been erected, and a third begun. No rapid transit facilities ex- ist. There are two short tram lines, on which small cars are drawn by native ponies, the service thus afforded being wretchedly inadequate. There are six theatres, in two of which European companies sometimes appear. With the exception of the churches, no high buildings have been constructed in Manila, on account of danger from earth- quakes. The better residences have a lower story of stone or brick and a second story of wood, with roof of tiles or corrugated iron. Window-glass is little used, its place being taken by thin squares of oyster shell set in sliding wooden frames. Lower-story windows are barred with iron. Small steamers engaged in the coasting trade can enter the Passig river, but large vessels are forced to lie in the bay, which is too large to afford them any pro- tection. Under Spanish administration, millions of dol- lars were expended on two breakwaters designed to cut off an extensive basin from the bay immediately south of the mouth of the river. The completion of these break- waters and the dredging of the basin thus formed will give excellent harbour facilities. A million dollars in gold were appropriated by the United States in September 1900 for the carrying out of this work. The relative commercial importance of Manila, as compared with other ports of entry in the Philippines, is set forth in the fol- lowing table of entrances and clearances of vessels for the year ending 30th June 1900 : —*~~

~~*Foreign*~~

~~*Trade.*~~

~~*Entered.*~~

~~*Tonnag:e.*~~

~~*Cleared.*~~

~~*Tonnage.*~~

~~*Manila*~~

~~*All other entry ports .*~~

~~412 154~~

~~541,158 125,155~~

~~348 153~~

~~511,522 130,453~~

~~Coastwise Trade.~~

~~Entered.~~

~~Tonnage.~~

~~cleared.~~

~~Tonnage.~~

~~Manila~~

~~All other entry ports .~~

~~1280 2006~~

~~241,193~~

~~217,882~~

~~1310 2356~~

~~255,004 226,998~~

~~The volume of trade is increasing rapidly. The largest receipts from customs under Spanish sovereignty were 15,888,330 in 1807. For the fiscal year ending 30th June 189'.) the receipts were $9,770,431. The population of]\lanila is estimated at 250,000 souls, of whom about 50,000 are Chinese. (d. c. w.)~~

~~See also Philippines and SpANisn-AMEBio.\N Wah.~~

~~*Maning, Frederick Edward (1812-1883), New Zealand judge and author, son of Frederick Maning, of Johnville, county Dublin, was born on the 5th of July 1812. His father emigrated to Tasmania in the ship*~~

~~*Ardent in 1824, and took up a grant of land there. Young Maning served in the fatuous expedition which attempted to drive in the Tasmanian blacks by sweeping with an un- broken line of armed- men across the island. Soon after- wards he decided to try the life of a trader among the wild tribes of New Zealand, and, landing in the beautiful inlet of Hokianga in 1833, took up his abode among the Ngapuhi. With them the tall Irish lad — he stood*~~

~~*Manipur, a native state on the north-east frontier of India, in political subordination to the chief commis- sioner of Assam. Estimated area, 8000 square miles ; estimated population (1881), 221,070; (1901), 283,957. The records of the census of 1891 were destroyed in the disturbances of that year.*~~

~~*The country is called Kasse or Kathe by the Burmese, and the proper name of the capital is Imphal. Disputed successions have always been a cause of trouble. The raja, Chandra Kirti Singh, died in 1886, and was succeeded by his eldest son, Sura Chandra Singh, who appointed his next brother, Kula Chandra Dluiya Singh, jubraj or heir apparent. In 1890 another brother, the senaputti (or commander-in-chief) Takendrajal Singh, de- throned the raja, and installed the jubraj as regent, the ex-raja returning to Calcutta. At the end of February 1891 the chief com- missioner of Assam (Mr Quinton) marched to Manipur with 400 Gurkhas, in order to settle the question of succession. His purpose was to recognize the new ruler, but to remove the senaputti. After some futile negotiations with a view to the holding of a durbar, Mr Quinton sent an ultimatum requiring the surrender of the senaputti, by the hands of the political resident, Mr F. Grimwood ; but no result followed. An attempt was then made to arrest the senaputti, but after some sharp fighting, in which Lieut. Bracken- bury was killed, he escaped ; and the Manipuris*~~

~~then attacked the British residency with an overwhelming force. Mr Quinton was~~

~~compelled to ask for a parley, and he. Colonel Skene, Mr Grim- wood, Mr Cossins, and Lieut. Simpson, unarmed, went to the fort to negotiate. They were all there treacherously murdered, and when the news arrived the Gurkhas retreated (25th March) to Cachar, Mrs Grimwood and the wounded being with them. This led to a militaiy expedition, which did not encounter much resistance. The various columns, converging on Manipur, found it deserted ; and the regent, senaputti, and others were captured during May. After a formal trial, the senaputti and one of the generals of the rebellion were hanged, and the regent transported to the Andaman Islands. But it was decided to preserve the existence of the state, and a child of the ruling family, named Chura Chand, of the age of five, was nominated raja. He was sent to be educated in the Mayo College at Ajmere. Meanwhile the administration was con- ducted under British supervision. In 1897-98 the total revenue was R.s.3,^6,709, of which Ks.1,94,348 was derived from land and Es. 97,640 from house tax. The expenditure included Rs. 75,810 for public works, lis. 58,901 for police, and a tribute of Rs. 50,000 imposed after the rebellion. The police force numbers 338 men. A Gurkha battalion is permanently stationed at Manipur. There are ten schools, with 594 pupils. Three roads are maintained — to Cachar, to Kohima in the Naga Hills, and to Tammu on the Burma frontier. In 1897-98 the total imports were valued at Rs. 1,65,000, chiefly piece goods, mineral oil, betel-nuts, and dried fish. The exports were Rs.93,000, chiefly cattle, tea-seed, and rice. During five years the rainfall averaged 80-55 inches.~~

~~See Gbimwood, Mrs Ethel St Clair. My Three Tears in Manipur. London, 1891. — Manipur: compiled from the columns of the Pioneer, Allahabad, 1891.~~

~~Manisa, the ancient Magnesia ad Sipylum, the chief town of the Saru- kh^n sanjak of the Aidin (Smyrna) vilayet of Asia Minor, situated in the valley of the Gediz Chai, Hermus, at the foot of Mount Sipylus, and con- nected by railway with Smyrna, Ala-shehr, and Konia. Manisa is an important commercial centre, and contains interesting buildings dating~~

~~*from the times of the Seljiik and early Osmanli sultans. It is the seat of a flourishing American mission. The population amounts to 38,000 (Moslems 22,000, Christians 15,000, Jews 1000). In 1204 Manisa was occupied by John Ducas, who, when he became emperor, made it the Byzantine seat of govern- ment. In 1313 the town was taken by Saru Khan, and in 1398 it submitted to the Osmanli sultan Bayezid I. In 1419 it was the scene of an insurrection, which was crushed by Prince Murad, whose residence in the town as Murad II., after twice abdicating the throne, is one of the most romantic stories in Turkish history. In the 17th century Manisa became the residence of the power- ful Dere Bey family, Kara Osman Oghlu.*~~

~~*Manistee, a city of Michigan, U.S.A., capital of Manistee county, on the shore of Lake Michigan, at the mouth of Manistee river, on the west side of the Lower Peninsula, at an altitude of 600 feet. It is irregularly laid out, is divided into seven wards, and has sewerage and water works (the Holly pumping system). It is entered by three railways — the Pere Marquette, the Manistee and Grand Rapids, and the Manistee and North-Eastern. It has extensive salt manufactures from salt springs, and large lumber mills, including saw, shingle, and planing mills. It has also an extensive lake com- merce. Population (1890), 12,812; (1900), 14,260, of whom 4966 were foreign-born.*~~

~~*Manitoba, a province of Canada, bounded on the S. by the United States, on the W. by Assiniboia and Saskatchewan, on the N. by Saskatchewan and Kee- watin, and on the E. by Keewatin and Ontario. (For the geology, fauna, and flora, see Canada.) Cold winters and warm summers, with a clear, bracing atmo- sphere, and small rainfall and snowfall, are the salient features of the climate. The table on the next page gives the normal temperature and precipitation at a number of places : —*~~

~~*Elevation. Feet.*~~

~~*Average Temperature.*~~

~~*Average*~~

~~*Precipitation.*~~

~~*Inches.*~~

~~*Summer.*~~

~~*Winter.*~~

~~*Winnipeg Portage la Prairie . Brandon Russell . Fort EUioe . Sourisford*~~

~~*764*~~

~~*854*~~

~~*1194*~~

~~*1830*~~

~~*850*~~

~~*1464*~~

~~*59-7° 61-7° 58-4^ 55-8° 57-9° 63-8°*~~

~~*1-5° 0-7° 0-2° -2-4° 3-5° 2-4°*~~

~~*20-67 18-84 16-20 18-04 16-07 13-57*~~

~~*Area and Population. — The area covers 73,966 square miles, of which 64,066 are land and 9890 water. The population in 1871 was 18,995; 1881, 62,260; 1891, 162,506; and 1901, 264,947 (138,332 males, 116,615 females). The principal cities and towns are: Winnipeg (42,340), Brandon (5380), Portage la Prairie (3901), St Boniface (2019), West Selkirk (2188), and Morden (1622). In 1901, 49,102 families inhabited 48,415 houses, and the proportion of the urban population to the rural was 27-5 to 72-5.*~~

~~*In 1891 there were 34,574 persons en- gaged in agricultural pursuits ; in domestic and personal service, 6712 ; manufactures and mechanical industries, 6267 ; professional, 2096 ; trade and transportation, 6336 ; non-productive, 932. Classified according to place of birth, the principal nationalities were as follows in 1901 : — Canada, 180,863; England, 20,392; Scotland, 8099 ; Ireland, 4537 ; other British possessions, 490 ; Germany, 2291 ; Iceland, 6403 ; Austria, 11,570 ; Eussia and Poland, 8854 ; Scandinavia, 1772 ; United States, 6922 ; other countries, 4028. In 1901 the Indians num- bered 6827 ; half-breeds, 10,372.*~~

~~*Government. — The province is under a lieutenant-governor, ap- pointed for a term of five years, with an executive council of five members, responsible to the local legislature, which consists of forty members. It is represented in the Dominion Parliament by four senators and seven members in the HOuse of Commons.*~~

~~*Religion. — Classified according to religion, the various denomina- tions were, In 1901, as follows : — Presbyterians, 65,310 ; Episco- palians, 44,874 ; Methodists, 49,909 ; Roman Catholics, 35,622 ; Baptists, 9098 ; Lutherans, 16,473 ; Mennonites, 15,222 ; Greek Catholics, 7898 ; other denominations, 9903 ; not specified, 638.*~~

~~*Education. — The dual system of education, established in 1871, was abolished in 1890, and the administrative machinery consoli- dated under one superintendent and a council of public instruction. This act was amended in 1897 to meet the wishes of the Roman Catholic minority, but separate schools were not re-established, nor was the council divided into denominational committees. In 1901 there were 1352 schools with 1669 teachers (618 males and 1151 females) ; the school population was 63,881, and the number of pupils registered was 51,888; the average attendance was 27,550. There are collegiate institutes for more advanced education at Winnipeg, Brandon, and Portage la Prairie, with a total of 1094 pupils enrolled. There is also a normal school at Winnipeg for the training of teachers. The total receipts during the year were $1,310,805, Government grant, $113,402, and municipal taxes, §';5:3,359 ; expenditure, $1,272,617 ; assets, $2,440,804 ; liabilities, §1,455,420; value*~~

~~of schools, lands, &c., $1,050,338. There are four denominational colleges and a university for higher education.~~

~~Finance. — The principal sources of revenue are the annual sub- sidy from the Dominion Government, fees for registration of land titles, liquor licences, sale of lands, &c. The chief items of revenue and expenditure for 1901 were as follows : —~~

~~I'.evcnue.~~

~~Expenditure.~~

~~Dominion Govt, subsidy $463,637 Land titles ofUco, fees . 85,49.5 Provincial lauds, sales . 120,566 Asylums, &c. . 54,427 Interest .... 86,733 M iacellaneous . . . 227,745~~

~~*1,0fm,053~~

~~Civil government . . $174,748 Administration of iustice . 89,252 Education .... 168,998 Ag:riculturo and immigration 137,459 Public works . . . 30,944 Miscellaneous . . . 400,650~~

~~lt9sS,251~~

~~The gross debt on 31st December 1901 was $10,240,488; total assets, $9,390,384. The Dominion Government debt allowance was $3,707,19!'. ; other assets, not including buildings and land, were §-'.,(;8.'!,]88,~~

~~Agricidtnre. — The principal crops are wheat, oats, and barley. The manufacture of butter and cheese is rapidly increasing in im- portance. The number of beef cattle exported is also increasing, and mixed farming is becoming more general. The following table gives statistics of field crops for the years specified : —~~

~~18S3.~~

~~1890.~~

~~1894.~~

~~*1901.*~~

~~*Bushels.*~~

~~*Bushels.*~~

~~*Bushels.*~~

~~*Bushels.*~~

~~*Wheat .*~~

~~*5,686,355*~~

~~*14,665,769*~~

~~*17,172,883*~~

~~*60,502,085*~~

~~*Oats*~~

~~*9,478,965*~~

~~*9,513,443*~~

~~*11,907,854*~~

~~*27,796,588*~~

~~*Barley .*~~

~~*1,898,430*~~

~~*2,069,415*~~

~~*2,981,716*~~

~~*6,536,155*~~

~~*Flax*~~

~~*No statistic*~~

~~*s collected.*~~

~~*366,000*~~

~~*5i66,420*~~

~~*Rye*~~

~~*5)*~~

~~*59,924*~~

~~*62,261*~~

~~*Peas*~~

~~*18,434*~~

~~*16,349*~~

~~*Potatoes*~~

~~*))*~~

~~*51*~~

~~*2,035,336*~~

~~*4,797,433*~~

~~*Other roots .*~~

~~*55*~~

~~*55*~~

~~*1,841,942*~~

~~*2,925,362*~~

~~*In 1901 there were 2,952,002 acres under crop as follows : — wheat, 2,011,835; oats, 689,951; barley, 191,009; flax, rye, and peas, 24,664 ; potatoes, 24,429 ; and other roots, 10,214 ; average yield of wheat, 26-1 bushels per acre. An experimental farm of 670 acres is supported by the Dominion Government at Brandon ; the local government maintains a dairy school, and makes special efforts to encourage the manufacture of cheese and butter.*~~

~~*Fisheries. — The fisheries are all fresh- water, principally white- fish, pickerel, and pike. The total value of the catch — including the adjoining portions of the North- West Territories — in 1900 was $718,159 ; the value of vessels, nets, &c., was §300,980 ; of exports,*~~

~~*$211,748.*~~

~~*lU anufactures. — The following table shows the growth of the manufacturing interests : —*~~

~~*1831.*~~

~~*1891.*~~

~~*Number of establishments*~~

~~*344*~~

~~*1031*~~

~~*Number of employes*~~

~~*1921*~~

~~*4403*~~

~~*Capital invested ....*~~

~~*$1,383,331*~~

~~*$5,684,237*~~

~~*Wages paid*~~

~~*$755,507*~~

~~*§1,905,981*~~

~~*Cost of raw materi;.!*~~

~~*$1,924,821*~~

~~*§5,688,151*~~

~~*Finished product ....*~~

~~*§3,413,026*~~

~~*$10,155,182*~~

~~*Commerce. — The table below gives statistics of exports, &c. , for the period 1874 to 1901, at intervals of five years : —*~~

~~*Tear.*~~

~~*Exports.*~~

~~*Imports.*~~

~~*Duty.*~~

~~*1874*~~

~~*$797,762*~~

~~*$1,797,033*~~

~~*§67,472*~~

~~*1879*~~

~~*512,899*~~

~~*1,140,871*~~

~~*274,235*~~

~~*1884*~~

~~*722,730*~~

~~*3,734,573*~~

~~*664,038*~~

~~*1889*~~

~~*782,606*~~

~~*2,191,083*~~

~~549,458~~

~~1894~~

~~1,864,964~~

~~2,353,768~~

~~602,466~~

~~1899~~

~~2,092,988~~

~~5,695,715~~

~~1,140,052~~

~~1901~~

~~1,084,992~~

~~5,396,189~~

~~1,016,973~~

~~Bailwmjs. — In 1901 there were 2141 miles of railway in the pro- vince, which constituted 11-6 per cent, of the railway mileage of Canada. The principal railways are the Canadian Pacific, Northern Pacific and Manitoba, and Canadian Northern. There was 1 mile of track to 20-9 square miles of area of the province.~~

~~(j. WII*.)~~

~~Manitoba, a lake of the province of the same name, ('anada, situated between 50° 11' and 51° 48' N. and 97° 56' and 99° 35' W. It has an area of 1711 square miles, a length of shore-line of 535 miles, and is at an altitude of 810 feet above the sea. It has a total length of 119 miles, a maximum width of 29 miles, dis- charge of 14,833 cubic feet per second,~~

and an average depth of 12 feet. The Waterhen river, which carries the discharge of Lake AVinnipegosis, is the only considerable stream entering the lake. It was discovered by Chevalier de la Yereudrye in 1739.

Manitowoc, a city of Wisconsin, U.S.A., capital of Manitowoc county, on the western shore of Lake Michigan, at an altitude of 592 feet. It lias a regular plan, is divided into seven wards, and has three railways, the Chicago and North-AVestern, the Pere Marquette, and the AVisconsin Central. It has a large lake commerce and some manufactures. Population (1890), 7710; (1900), 11,786, of whom 2998 were foreign-born. The death-rate in 1900 was 14-3.

Mankato, a city of l\Iinnesota, U.S.A., capital of Blue Earth county, on the Minnesota river, at its southward bend, in the southern part of the state, at an altitude of 778 feet. It is irregularly laid out, with si?c wards, and has four railways — the Chicago and North-

Western, the Chicago, Milwaukee and St Paul, the Chicago, St Paxil, Minneapolis and Omaha, and the Chicago Great Western. It is in a rich farming region, and has consider- able trade and manufactures. Population (1890), 8838; (1900), 10,599, of whom 2578 were foreign-born and 7 were negroes.

Mannheim, a town of Germany, grand-duchy of Baden, on the Ehine, at the confluence of the Neckar, 39 miles by rail north of Carlsruhe. It stands at the head of effective navigation on the Rhine, and is not only the largest port on the upper course of that stream, but the principal emporium for south Germany of such commod- ities as cereals, coals, petroleum, timber, sugar, and tobacco, with an added large trade in hops, wine, and other south German produce. Owing to the rapid increase in the traffic, it was found necessary to make a new harbour on the other side of the Neckar, which was opened in 1898. The total volume of the trade, by river and rail combined, increased from about 1^ million tons in 1875 to very nearly 9 million tons in 1898. The traffic by the Khine

~~increased from 6648 vessels of 6,604,800 tons arrived and cleared in 1895 to 12,935 vessels of 9,737,200 tons in 1899 ; and to this must be added the traffic up and down the Neckar, which also increased from 6243 vessels of 908,300 tons in 1895 to 5566 vessels of 946,100 tons in 1899. In addition to the large harbour opened in 1875, a new commercial harbour was built on the opposite side of the Ne'ckar in the last years of the 19th century, and a third harbour made at Eheinau, three miles above the town. The last was entered by 3408 vessels of 573,130 tons in 1900, as compared with 2404 vessels of 388,621 tons in the preceding year. Mannheim is also the seat of very active and extensive industries, producing especially flour, ironware, machinery, agricultural implements, iron ships, chemicals, oils, cigars, wood-pulp and cellulose articles, carpets, sugar, soap, cement, aniline dyes, furni- ture, shoes, vehicles, clothing, books, beer, and spirits ; it has also several saw and planing mills. A new bridge was thrown across the ISTeckar in 1890-91. The town has been adorned with a monument to the Emperor William I. (1894) and two fountains (1898) in the palace courtyard, a monument of the war of 1870-71 (1896), and a monument to Bismarck (1900) near the principal railway station. Population (1885), 61,273; (1890),~~

~~79,058; (1900), 140,384.~~

~~Manning, Henry Edward (1808-1892), English Roman Catholic cardinal, was born at Totteridge, Hert- fordshire, on the 16th July 1808,^ being the third and youngest son of William Manning,aWestIndianmerchant, who was a director of the Bank of England and governor, 1812-13, and who sat in Parliament for some thirty years, representing in the Tory interest Plympton Earle, Lymington, Evesham, and Penryn consecutively. His mother, Mary, daughter of Henry Leroy Hunter, of Beech Hill, Reading, was of a family said to be of Erench extraction. Manning's boyhood was mainly spent at Coombe Bank, Sunridge, Kent, where he had for compan- ions Charles and Christopher Wordsworth, afterwards bishops of St Andrews and of Lincoln. He was educated at Harrow, 1822-27, Dr Butler beingthen the headmaster, but obtained no distinction beyond being in the cricket eleven in 1825. He matriculated at Balliol College, Oxford, in 1827, and soon made his mark as a debater at the Union, where Gladstone succeeded him as president in 1830. At this date he was~~

~~*ambitious of a political career, but his father, having sustained severe losses in business, found*~~

~~*1 Purcell's assertion that the year of his birth was 1807 rests on no trustworthy evidence.*~~

~~*himself no longer in a position to leave his sons free of any necessity to earn their living, and in these circum- stances Manning, having graduated in first-class honours in 1830, obtained the year following, through Viscount Goderich, a post as supernumerary clerk in the Colonial Office. This, however, he resigned in 1832, his thoughts having been turned towards a clerical career under Evan- gelical influences, which affected him deeply throughout life. Returning to Oxford, he was elected a Eellow of Merton College, and was ordained ; and in 1833 he was presented to the rectory of Lavington with Graffham in Sussex by Mrs Sargent, whose granddaughter, Caroline, he married on 7th November of that year, the ceremony being performed by the bride's brother-in-law, Samuel Wilberforee, afterwards bishop of Oxford and of Win- chester. Manning's married life was of brief duration. HIs young and beautiful wife was of a consumptive family, and died childless (24th July 1837). The last- ing sadness that thus early overshadowed him tended to facilitate his acceptance of the austere teaching of the Oxford Tracts ; and though he was never an acknowledged disciple of Newman's, it was due to the latter's influence that from this date his theology assumed an increasingly HIgh Church character, and his printed sermon on the " Rule of Faith " was taken as a public jjrofession of his alliance with the Tractariaus. In 1838 he took a leading part in the Church education movement, by which diocesan boards were established throughout the country ; and he wrote an open letter to his bishop in criticism of the recent appointment of the ecclesiastical commission. In Decem- ber of that year he paid his first visit to Rome, and called on Dr Wiseman in company with Mr Gladstone. In January 1841 Shuttleworth, bishop of Chichester, ap- pointed him archdeacon, whereupon he began a personal visitation of each parish within his district, completing the task in 1843. In 1842 he published a treatise on Tlie Unity of the Church, and his reputation as an eloquent and earnest preacher being by this time considerable, he was in the same year appointed select preacher by his*~~

~~University, thus being called iipon to fill from time to time the pulpit which Newman, as vicar of St Mary's, was just ceasing to occupy. Eour volumes of his sermons appeared between the years 1842 and 1860, and these had reached the 7th, 4th, 3rd, and 2nd editions respectively in 1850, but were not afterwards reprinted. In 1844 his portrait was painted by Richmond, and the same year he published a volume of University sermons, in which, how- ever, was not included the one on the Gunpowder Plot. This sermon had much annoyed Newman and his more ad- vanced disciples, but it was a proof that at that date Manning was loyal to the Church of England as Protestant. Newman's secession in 1845 placed Manning in a position of greater responsibility, as one of the High Churchleaders, along with Pusey and Keble and Marriott ; but it was with Gladstone and James Hope (afterwards Hope-Scott) that he was at this time most closely associated. In the spring of 1847 he was seriously ill, and that autumn and the follow- ing winter he spent abroad, chiefly in Rome, where he saw Newman "wearing the Oratorian habit and dead to the world." He had public and private audiences with the Pope on 9th April and 11th May 1848, but recorded next to nothing in his diary concerning them, though numerous other entries show an eager interest in every- thing connected with the Roman Church, and private papers also indicate that he recognized at this time grave defects in the Church of England and a mysterious attractiveness in Roman Catholicism, going so far as to question whether he might not one day be a Roman Catholic himself. Returning to England, he protested, but with moderation, against the appointment of Hampden as bishop of Hereford, and continued to take an active~~

~~part in the religious education controversy. Through the influence of Samuel Wilberforce, he was offered the post of sub-almoner to Queen Victoria, always recognized as a stepping-stone to the episcopal bench, and his refusal of it was honourably consonant with all else in his career as an Anglican dignitary, in which he united pastoral diligence with an asceti- cism that was, at any rate in those days, quite excep- tional. In~~

~~*1860 the decision of the Privy Council, that the bishop of Exeter was bound to institute the Rev. G. C. Grorham to the benefice of Brampford Speke in spite of the latter's acknowledged disbelief in the doctrine of baptismal regeneration, brought to a crisis the position within the Church of England of those who believed in that Church as a legitimate part of the in- fallible Ecdesia docens. Manning made it clear that he regarded the matter as vital, though he did not act on this conviction until no hope remained of the decision being set aside or practic- ally annulled by joint action of the bishops. In July he addressed to his bishop an open letter on "The Ap- pellate Jurisdiction of the Crown in Matters Spiritual," and he also took part in a meeting in London wliich protested against the de- cision. In the autumn of this year (1850) was the great popular outcry against the " Papal aggression " (see Wiseman), and Manning, feeling himself imable to take part in this protest, resigned, early in December, his benefice and his arch- deaconry; and writing to Mr Hope-Scott, who a little later became a Roman Catholic with him, stated his conviction that the alter- native was " either Rome or licence of thought and will." He was received into the Roman Catholic Church by Father Brownbill, S.J., at the church in Farm Street, on Passion Sunday, 6th April 1851. On the following Sunday he was confirmed and received to communion by Cardinal Wiseman, who also, within ten weeks of his reception, ordained him priest. Manning thereupon proceeded to Rome to pursue his theological studies, residing at the college known as the "Academy for Noble Ecclesiastics," and attending lectures by Perrone and Passaglia among others. The Pope frequently received him in private audience, and in 185-t conferred on him the degree of D.D. During his visits to England he was at the disposal of Cardinal Wiseman, who through him, at the time of the Crimean war, was enabled to obtain from the Government the concession that for the future Roman Catholic army chaplains should not be regarded as part of the staff of the Protestant chaplain-general. In 1857 the Pope, prnprio motu, appointed him provost (or head of the chapter) of Westminster, and the same year he took up his residence in Bayswater as superior of a community known as the "Oblates of St Charles," an association of secular priests on the same lines as the institute of the Oratory, but with this difference, that they are by their constitution at the beck and call of the bishop in whose diocese they live. The community was thus of the greatest service to Cardinal*~~

~~*Wiseman, whose right-hand man Manning thencefor- ward became. During the eight years of his life at Bayswater he was most active in all the duties of the priesthood, preaching, hearing confessions, and receiv- ing converts; and he was notably zealous to promote in England all that was specially Roman and papal, thus giving offence to old-fashioned Catholics, both clerical and lay, many of whom were largely influ- enced by Gallican ideas, and had with difficulty accepted the restoration of the hierarchy in 1850. In 1860 he delivered a course of lectures on the Pope's temporal power, at that date seriously threatened, and shortly afterwards he was appointed a papal "Domestic Prelate," thus becoming a " Monsignor," to be addressed as " Right Reverend." He was now generally recognized as the able and eifective leader of the Ultramontane party among English Roman Catholics, acting always, however,*~~

~~*in subordination to Cardinal Wiseman ; and on the latter's death (16th February 1866) it was felt that, if Manning should succeed to the vacant archbishopric, the triumph of Ultramontanism would be secured. Such a consumma- tion not being desired by the Westminster chapter, they submitted to the Pope three names, and Manning's was not one of them. Great efforts were made to secure the succession for the titular archbishop Errington, who at one time had been Wise- man's coadjutor with that right reserved to him, but who had been ousted from that position by the Pope acting under Manning's in- fluence. In such circum- stances . Pius IX. could hardly ignore nation,*~~

~~*than*~~

~~*Cardinal Manning. (From, a photograph by Elliott and Fry, London.)*~~

~~*do otherwise Errington's nomi- as he also ignored the nomination of Clifford, bishop of Clifton, and of Grant, bishop of South- wark ; and, by what he humorously described as " the Lord's own coup d'itat," he appointed Manning to the archiepiscopal see. Consecrated at the pro- cathedral at Moorfields (since destroyed) by Dr Ullathorne, bishop of Birmingham (8th June 1865), and enthroned there (6th November), after receiving the pallium in Rome, Manning began his work as archbishop by devoting himself especially to the religious education of the poor and to the establishment of Catholic industrial anct re- formatory schools. He*~~

~~steadily opposed whatever might encourage the admission of Catholics to the national universities, and so put his foot down on Newman's project to open a branch house of the Oratory at Oxford with himself as superior. He made an unsuccessful and costly effort to establish a Catholic university at Kensing- ton, and he also made provision for a diocesan seminary of strictly ecclesiastical type. Jealous of the exclusive claims of the Roman Church, he procured a further con- demnation at Rome of the " Association for the Promotion of the Unity of Christendom," which advocated prayers for the accomplishment of a kind of federal union between the Roman, Greek, and Anglican Churches, and in a pastoral letter he insisted on the heretical assumption implied in such an undertaking. He also worked for the~~

~~due recognition of the dignity of the secular or pas- toral clergy, whose position seemed to be threatened by tlie growing ascendancy of the regulars, and especially of the Jesuits, whom, as a practically distinct organiza- tion within the Church, he steadily opposed. In addition to his diocesan synods, he presided in 1873 over the fourth provincial synod of Westminster, which legis- lated on " acatholic " universities, church music, mixed marriages, and the order of a priest's household, having previously taken part, as theologian, in the provincial synods of 1853 and 1859, with a hand in the preparation of their decrees. But it was chiefly through his strenu- ous advocacy of the policy of defining papal infallibility at the Vatican council (1869-70) that Manning's name obtained world-wide renown. In this he was instant in season and out of season. He brought to Rome a peti- tion in its favour from his chapter at Westminster, and during the progress of the council he laboured incessantly to overcome the opposition of the " inopportunists," his belief in the importance of the definition for the welfare of the Church being as deep as it was sincere. And he never ceased to regard it as one of the chief privileges of his life that he had been able to take an active part in securing the definition, and in having heard with his own ears that doctrine proclaimed as a part of divine revelation. In 1875 he published a~~

~~reply to Gladstone's attack on the Vatican decrees ; and on 15th March in that year he was created cardinal, with the title of SS. Andrew and Gregory on the Coelian. He was present at the death of Pius IX. (7th February 1878); and in the subsequent conclave, while some Italian cardinals were prepared to vote for his election to fill the vacant chair, he himself supported Cardinal Pecci, afterwards known as Leo XIII. With him, however, Manning found less sympathy than with his predecessor, though Manning's advocacy of the claims of labour attracted Leo's atten- tion, and influenced the encyclical which he issued on the suV)ject. After the Vatican council, and more especially after the death of Pius IX., Manning devoted his atten- tion mainly to social questions, and with these his name was popularly associated during the last fifteen years of his life. From 1872 onwards he was a strict teetotaller, not touching alcohol even as a medicine, and there was some murmuring among his clergy that his teaching on this subject verged on heresy. But his example and his zeal profoundly influenced for good the Irish poor forming the majority of his flock ; and the " League of the Cross " which he founded, and which held annual demonstrations at the Crystal Palace, numbered nearly 30,000 members in London alone in 1874. He sat on two royal commissions, the one on the housing of the working classes (1884), and the other on primary educa- tion (1886) ; and in each case the report showed evident marks of his influence, which his fellow-commissioners recognized as that of a wise and competent social re- former. In the cause of labour he was active for many years, and in 1872 he set an example to the clergy of all the churches by taking a prominent part in a meeting held in Exeter Hall on behalf of the newly- established Agricultural Labourers' Union, Joseph Arch and Charles Bradlaugh being among those who sat with him on the platform. In later years his strenuous advo- cacy of the claims of the working classes, and his declaration that "every man has a right to work or to bread, " led to his being denounced as a Socialist. That he was such he denied more than once (Lemire, Le Cardinal Manning et son Action Sociale, Paris, 1893, p., 210), nor was he ever a Socialist in principle; but he favoured some of the methods of Socialism, because they alone seemed to him practically to meet the case of that pressing poverty which appealed to his heart.~~

~~*He took a leading part in the settlement of the dockers' strike in the autumn of 1889, and his patient and effectual action on this and on similar occasions secured for him the esteem and affection of great numbers of working men, so that his death on 1-lth January 1892, and his funeral a week later, were the occasion for a remarkable demonstration of popular veneration. The Roman Catholic cathedral at Westminster is his joint memorial with his predecessor. Cardinal Wiseman.*~~

~~*Whatever may have been the value of Manning's services to the Roman Catholic Church in England in bringing it, as he did, up to a high level of what in earlier years was commonly denounced as Ultramontanism, it is certain that by his social action, as well as by the earnestness and holiness of his life, he greatly advanced in the minds of his countrymen generally their estimate of the character and value of Catholicism. Pre-eminently he was a devout ecclesiastic, a " great priest " ; and his sermons, both Anglican and Catholic, are marked by fervour and dignity, by a conviction of his own authoritative mission as preacher, and by an eloquent insistence on considerations such as warm the heart and bend the will rather than on such as force the intellect to assent. But many of his instincts were those of a statesman, a diplomatist, a man of the world, even of a business man ; and herein lay, at least in part, the secret of his influence and success. In- tellectually he did not stand in the front rank. He was neither a philosopher nor a literary genius. Among his many publications, written, it is only fair to admit, amidst the urgent pressure of practical work, there is barely a page or even a sentence that bears the stamp of immortality. But within a somewhat narrower field he worked with patience, industry, and self-denying zeal; his ambition, which seemed to many personal, was rather the outcome of his devotion to the cause of the Church; and in the later years of his life espe- cially he showed that he loved righteousness and hated iniquity, and that he realized as clearly as any one that the service of God was incomplete without the service of man.*~~

~~*The publication in 1896 of Manning's Life, by Purcell, was the occasion for some controversy on the ethics of biogi'aphy. EdwardPurcell was an obscure, inaccurate, and small-minded Catholic journalist, to whom*~~

~~*Manning, late in life, had entrusted, rather by way of charitable bequest, his private diaries and other confidential papers. It thus came to pass that in Purcell's voluminous biography much that was obviously never intended for the public eye was, perhaps inadvertently, printed, together with a good deal of ungenerous comment. The facts disclosed which mainly attracted attention were — (1) that Manning, while yet formally an Anglican, and while publicly and privately dissuading others from joining the Roman Catholic Church, was yet within a little convinced that it was his own duty and destiny to take that step himself; (2) that he was continually intriguing at the back-stairs of the Vatican for the furtherance of his own views as to what was desira- ble in matters ecclesiastical; (3) that his relations with Newman were very unfriendly; and (4) that, while for the most part he exhibited towards his own clergy a frigid and masterful demeanour, he held privately very cordial relations with men of diverse religions or of no theological beliefs at all. And certainly Manning does betray in these autobiographical fragments an unheroic sensitiveness to the verdict of posterity on his career. But independent critics (among whom may specially be named M. Franqois de Pressense) held that Manning came well through the ordeal, and that Purcell's Life has great value as an unintentionally frank revelation of character. (a. w. hc.)*~~

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~~*MANCEUYRES, MILITARY*~~

~~*Manoeuvres, Military. — Manoeuvres maybe de- fined as the higher training for war of troops of all arms in large bodies, and have been carried out in most coun- tries ever since the first formation of standing armies. In England no manoeuvres or camps of exercise appear to have been held till the beginning of the 19th century, when Sir John Moore trained the famous Light Brigade at the camp of Shorncliffe. In France, however, under Louis XIV., large camps of instruction were frequently held, the earliest recorded being that of 18,000 troops at Compiegne in 1666 ; and these were continued at intervals under his successor. At these French camps much time was devoted to ceremonial, and the mancEuvres performed were of an elementary description. Still their*~~

~~*effect upon the training of the army for war was far-reaching, and bore fruit in the numerous wars in the first half of the 18th century. Other countries followed suit, but it was reserved for Frederick the Great to inaugurate a system of real manoeuvres, and to develop on the training-ground the system of tactics which bore such good fruit in his various campaigns. The numbers of troops assembled were large ; for example, at Spandau in 1753, when 36,000 men caxried out manoeuvres for twelve days. The king laid the greatest stress on these exercises, and took im-mense pains to turn to account the experience gained in his campaigns. Great secrecy was observed, and before the Seven Years' War no stranger was allowed to be pres- ent. The result of all this careful training was shown in the Seven Years' War, and after it the Prussian manoeuvres gained a reputation which they have main- tained to this day. But with the passing away of the great king they became more and more pedantic, and the fatal results were shown in 1806. After the Napoleonic wars, yearly manoeuvres became the custom in every large Continental army. Great Britain alone thought she could dispense with them, perhaps because of the constant practical training her troops and officers received in the various Indian and colonial wars ; and it was not till 1853 that, by the advice of the Prince Consort, a body of troops were gathered together for a camp of exercise on Chobham Common, and that eventually a standing camp of exercise was evolved out of the temporary camp formed during the Crimean War at Aldershot.*~~

~~*Most Continental armies have, since the great successes of the Germans in 1870, copied more or less their system of military training; hence it is appropriate to consider their methods first. The whole training of the army is based on a yearly programme of gradual progression, from the joining of the recruits in October to the training by squads, companies, battalions, and regiments, the latter finishing their field training about the middle of August, when the manoeuvre period begins. First of all, the brigades go through five working days of drills on flat ground, to get them under the hand of their commanders and prepare them for mancEuvres. Then follow ten working days of manoeuvres in new and varied ground, of which four are "brigade," four " divisional," and two "corps" manoeuvres, in each case the unit named being divided into two portions of all arms, which manoeuvre against one another. Each year two or*~~

more army corps carry out manoeuvres before the Emperor, working against one another, the largest body ever assembled having been four corps, 117,000 men, near Honi- burf; in 1897. The chief feature of the German manoeuvres is the free hand allowed to leaders of sides. Of course, for reasons of supply and transport, it is nece.ssary to kopp the troops within a certain area, but the general and special ideas are so framed that, while retaining their own initiative, the leaders of sides have to give such orders as will suit the arrangements made by the director of manoeuvres for supply. The faculty of quarti^ing troops on jirivate individuals to any extent, and the fact of the troops being provided with portable tent equipment, give great latitude to the German leaders in their choice of quarters for troops, and so increase the similitude of manoeuvres to war. The Austrian and Italian manoeu- vres are a close copy of the German, but those of the French pre- sent the peculiarity of a certain amount of prearrangement, especially at grand manoeuvres, when it is frequently laid down beforehand which side is to be victorious. Thus a series of pictures of war is presented, but the manoeuvres are hardly a test of the skill of

the rival leaders. In Russia the climatic and social conditions, and the distribution of the army, necessitate a quite peculiar system. The troops leave their barracks and move into standing camps generally in May, and in these for about three months their training up to that in battalions is carried out on the drill ground. Camps of mixed units are then formed for a month, and from them, but always over the same ground, the manoeuvres of regi- ments, brigades, and divisions are performed. Then follow the so-called mobile manoeuvres, which last for ten days or a fortnight. At some of these large masses are assembled, as in Volhinia in 1890, when 194 battalions, 140 squadrons, and 82 batteries were engaged. Of all European manoeuvres these are perhaps the nearest approach to war, for the sides start a great distance apart, and ample time is allowed for cavalry reconnaissance. Besides, the Eussian soldier does not require elaborate arrangements for supply ; hence the director is not so tied down by consideration of this matter as in other armies.

In England the military authorities have long been hampered in the organization of manoeuvres by the necessity of carrying them out on very

~~*limited portions of Government land or on areas lent as a favour by, or hired from, private individuals. There has been no want of recognition by the military authorities of the necessity for, and value of, manoeuvres, and the training at the camps of instruction has been supplemented as far as possible by small manoeuvres on such portions of country as could be made available. But, with the exception of spasmodic efforts in 1871 and 1872, it was not until 1897 that the Government allowed itself to be convinced by its military advisers, and passed a Military Manoeuvres Act, by which certain districts could be "proclaimed " for purposes of manoeuvres, and troops in consequence could traverse all ground. In 1898 the first manoeuvres under this Act were held in Wilts and Dorset, and were intended to be repeated at fixed intervals in future years. In addition, every eflort was made to add to the existing permanent training grounds for troops, and ground was acquired on Salisbury Plain with the intention of developing it into a second Aldershot. But the training on those well known grounds, excellent as it is in itself as a preparation, is not "manoeuvres," and never can do away with the necessity for them, with a more or less free hand given to the leaders over fresh country.*~~

~~*Much misconception prevails as to the nature and limitation of the military instruction to be imparted at manoeuvres. ManeBuvres are a school for th^e leaders, in a less degree for the led, and con- sequently the minor details of instruction must be completed, and the troops fully trained as units, before they can take part in them with advantage. The time during which large bodies of troops can be kept together for manoeuvres is too short, and the expense too great, to justify time being spent on exercises which might as well be carried out in the ordinary stations or at the great training camps. Therefore it may be laid down as a principle that manoeu- vres, properly so-called, should be begun with units not smaller than a brigade of infantry on each side, with a due proportion of the other arms attached. It is useful if these can precede the manoeuvres of larger bodies, as the training Is then progressive and the result more satisfactory.*~~

~~*The choice of ground is of great importance. Its extent should be proportionate to the force to be employed and the nature of the instruction to be imparted. It should not be too hilly nor yet too flat, but*~~

~~both descriptions should be judiciously combined ; and regard must be had to the water supply, and the road and railway net for the convenience of the supply service. Once the ground has been selected, the general and special ideas must be so framed that the troops are thereby confined to the chosen ground without seeming to tie the hands of the leaders of sides. It is of great advantage if the same idea can be maintained throughout each series of operations, as thereby the interest of all concerned and the likeness to actual warfare are increased ; and, if possible, the "state of war" should be continuous also. Within the limits of the special idea, the utmost latitude should be left to leaders ; but if the orders of one or both sides seem to render a collision unlikely, the director should so modify the special idea, as to compel one or other to re-cast his orders in such a way that contact is brought about. Such interference will scarcely be necessary after the first issues of orders in each series. In war the number of marching days vastly outnumbere those of fighting, but in manoeuvres this must not be allowed ; tactical instruction is what is desired, and a manamvre day in which none is imparted is not fully utilized. It is not necessary that all the troops should be engaged, but at least the advanced bodies must come into conuct, and the rest must carry out marches as on active service. Each action should be fought to its end, " Cease firing" being sounded when the crisis has been reached ; and on a decision being piven by tlie director, one side should retire and the fight be broken oft in a proper military manner. The troops should place outposts each day, and act in all respects as if on active service.~~

~~MANOR~~

~~527~~

~~The quartering and supply of troops are the chief difficul- ties in the arrangement of manceuvres, and afford ample oppor- tunity for the practising of the officers and departments responsible for these matters. In England, where in peace it is not possible to billet troops on private individuals, quartering must be replaced by encampments or bivouacs, and the selection of ground for them affords invaluable practice. If possible, their position should be selected to conform to the military situation ; but if it is found necessary, for reasons of water or food supply,~~

~~*to withdraw troops to positions other than such as they would occupy in real warfare, time should be allowed them on the following day to regain the positions they would otherwise have occupied. It is next to impossible, for various reasons, financial and other, to organize the food supply in manceuvres as it would be in war. Sufficient transport cadres cannot be kept up in peace, and conse- quently recourse must be had to hired transport, which cannot be treated as a military body. Again, food cannot be requisitioned, and local purchase at the time cannot be trusted to ; so depflts of supplies must be formed beforehand in the manoeuvres area, which more or less tie the hands of the supply service. Still, with a judicious choice of the points at which these are formed, much may be done to approximate to service conditions, and the more nearly these are realized the more instructive for the supply will the manceuvres become.*~~

~~*Finally, a word must be said as to the umpire staff, which represents the bullets. The most careful selection of officers for this Important duty is necessary, and they must have sufficient authority and be in sufficient number to make their influence everywhere felt. Their principal object should be to come to a decision quickly, so as to prevent the occurrence of unreal situa- tions ; and by constant intercommunication they must eusui'e uni- formity in their decisions, and so maintain continuity of the action all over the manoeuvres battlefield. (j. m. ge.)*~~

~~*Manor. — It will be most convenient to describe a typical English manor in its best known period, the 13th century, and to indicate briefly the modifications of the type which varying conditions may produce. Topographically such a manor consisted partly of the houses of the inhabitants more or less closely clustered together, and surrounded by the arable land divided into large fields, two or three in number. Each of these fields was divided again into shots or furlongs, and each of the shots was broken up into cultivated strips a pole wide, each containing an acre, separated by narrow balks of turf. There were also certain meadows for supplying hay; and beyond the cultivated land lay the wood and waste of the manor. Portions of arable or meadow land might be found apart from the organization of the remainder ; the lord of the manor might have a park, and each householder a garden, but the land of the manor was the open fields, the meadows, and the wastes or common. The condition of*~~

~~*the inhabitants of such a manor is as complex as its geography. At the head of the society came the lord of the manor, with his hall, court, or manor- m':^?™"' house, and the land immediately about it, and his demesne both in the fields and in the meadow land. The arable demesne consisted of certain of the acre strips lying scattered over the various furlongs ; his meadow was a portion assigned to him each year by the custom of the manor. IIe had also rights over the surrounding waste paramount to those enjoyed by the other inhabitants. Part of his demesne land would be granted out to free tenants to hold at a rent or by military or other service ; part wquld be in the lord's own hands, and cultivated by him. Each part so granted out will carry with it a share in the meadow land and in the profits of the waste. These rights of the free tenants over the waste limited the lord's power over it. IIe could not by enclosure diminish their interest in it. The statute of Merton (20 IIenry III.) and the second statute of Westminster (Edwarrd I.) marked the utmost limit of en-closure allowed in the 13th century. Below the lord and the free tenants came the villeins, natives, bondmen, or holders of virgates or yard-lands, each holding a house, a fixed number of acre strips, a share of the meadow and of the profits of the waste. The number of strips*~~

~~*lord aad tenants.*~~

~~*so held was usually about thirty ; but virgates of fifteen acres or even eighty are not unknown. In any one manor, however, the holdings of all the villeins were equal. Normally the holder of a virgate was yif,ei„° unfree ; he had no rights in the eye of the law against his lord, who was protected from all suits by the exceptio villenagii ; he could not without leave quit the manor, and could be reclaimed by process of law if he did; the strict contention of law deprived him of all right to hold property; and in many cases he was subject to certain degrading incidents, such as merchet, a payment due to the lord upon the marriage of a daughter, which was regarded as a special mark of unfree condition. But there are certain limitations to be made : firstly, all these incidents of tenure, even merchet, might not effect the personal status of the tenant; he might still be free, though holding by an unfree tenure ; secondly, even if unfree, he was not ex- posed to the arbitrary will of his lord, but was protected by the custom of the manor as interpreted by the Manor Court. Moreover, he*~~

~~*was not a slave ; he was not bought and sold apart from his holding. The hardship of his condition lay in the services due from him. As a rule a villein paid for his holding in money, in labour, and in kind. In money he paid, firstly, a small fixed rent called rent of assize ; and, secondly, dues under various names, partly in lieu of services commuted into money payments, and partly for tlje privileges and profits en- joyed by him on the waste of the manor. In labour he paid more heavily. Week by week he had to come with his own plough and oxen to plough the lord's demesne ; when ploughing was done he had to harrow, to reap the crops, to thresh and carry them, or do whatever might be required of him, until his allotted number of days' labour in the year was done. Beyond this his lord might request of him extra days in harvest or other seasons of emergency, and these requests could not be denied. Further, all the carriage of the manor was provided by the villeins, even to places as much as a hundred miles away from the manor. The mending of the ploughs, hedging, ditching, sheep-shearing, and other miscellaneous work, also fell upon him, and it is sometimes hard to see what time re- mained to him to work upon his own holding. In kind he usually rendered honey, eggs, chickens, and perhaps a ploughshare, but these payments were almost always small in value. Another class of inhabitants remains to be mentioned — the cotters. These are the poor of the manor, who hold a cottage and garden, or perhaps one acre or half an acre in the fields. They were unfree in condition, and in most manors their services were modelled upon those of the villeins. From their ranks were usually drawn the shepherd of the manor, the bee-keeper, and other minor officials of the manor.*~~

~~*A complicated organization necessarily involves admin- istrators. Just as the services of the tenants and even their names vary from manor to manor, so does the nature of the staff. HIghest in rank came the steward ; he was attached to no manor in particular, but controlled a group, travelling from one to another to take accounts, to hold the courts, and generally represent the lord. Under him are the officers of the several manors.*~~ [۷۸]

~~*First came the bailiff or beadle, the representative of the lord in the manor ; his duty was to collect the rents and services, to gather in the lord's crops, and account for the receipts and expenditure of the manor.*~~

~~*Closely connected with him was the "messor" or reaper; in many cases, indeed, "reaper" seems to have been only another name for the bailiff. But the villeins were not without their own officer, the provost or reeve. His duty was to arrange the distribution of the services due from the tenants, and, as their representative, to assist the bailiff in the management*~~

~~*Cotters.*~~

~~*of the manor. Sometimes the same man appears to have united both oiHces, and we find the reeve accounting to the lord for the issues of the manor. To these important ofl&cials may be added a number of smaller ones, the shep- herd, the swine-herd, the bee-keeper, the cow-herd, the ploughman, and so on, mostly selected from the cotters, and occupying their small holdings by the services ex- pressed in their titles. The number varies with the con- stitution and needs of each estate, and they are often replaced by hired labour.*~~

~~*The most complicated structure in the system is the Manor Court. The complication is, indeed, partly the work of lawyers interpreting institutions they did not under- stand by formulae not adapted to describe them. But*~~

~~*beyond this there remain the facts that the ^nor court was the meeting-point of the lord and the*~~

~~*tenants both free and unfree, that any question touching on the power and constitution of the court was bound to affect the interests of the lord and the tenants, and that there was no external power capable of settling such questions as did arise. Amid this maze a few clear lines can be laid down. In the first place, so far as the 13th century goes, all the discussion that has collected about the terms court-leet, court-baron, and courtcustomary may be put aside ; it relates to ques- tions which in the 13th century were only just emerg- ing. The Manor Coui't at that date*~~

~~*exercised its criminal, civil, or manorial jurisdictison as one court ; its names may differ, the parties before it may be free or unfree, but the court is the same. Its president was the lord's steward ; the bailiff was the lord's representative and the public prosecutor; and the tenants of the manor, both free and unfree, attended at the court and gave judgment in the cases brought before it. To modern ears the constitution sounds unfamiliar. The president of the court settled the procedure of the court, carried it out, and gave the final sentence, but over the law of the court he had no power. All that is comprised in the word "judgment" was settled by the body of tenants present at the court. This attendance was, indeed, com- pulsory, and absence subjected to a fine any tenant owing and refusing the service known as " suit of court." It may be asked who in these courts settled questions of fact. The answer must be that disputed questions of fact could only be settled in one vrsij, by ordeal; and that in most manorial courts the method employed was the wager of law. The business of the court may be divided into criminal, manorial, and civil. Its powers under the first head depended on the franchises enjoyed by the lord in the particular manor; for the most part only petty offences were triable, such as small thefts, breaches of the assize of bread and ale, assaults, and the like; except under special conditions, the justice of great offences remained in the king. But offences against the custom of the manor, such as bad ploughing, improper taking of wood from the lord's woods, and the like, were of course the staple criminal business of the court, tinder the head of manorial business the court dealt with the choice of the manorial officers, and had some power of making regulations for the management of the manor ; but its most important function was the recording of the sur- renders and admittances of the villein tenants. Into the history and meaning of this form of land transfer it is not necessary to enter here. But it must be noted that the conveyance of a villein's holding was effected by the ven- dor surrendering his land to the lord, who thereupon admitted the purchaser to the holding. The same pro- cedure was employed in all cases of transfer of land, and the transaction was regularly recorded upon the rolls of the court among the records of all the other business transacted there. Finally, the court dealt with all suits*~~

~~*as to land within the manor, questions of dower and inheritance, and with civil suits not connected with land. But it need hardly be said that in an*~~

ordinary rural manor very few of these would occur.

It will be clear on consideration that the Manor Court as here described consisted of confiicting elements of very different origin and history. Founded partly on express grants of franchises, partly on the inherent right of a feudal lord to hold a court for his free tenants, partly on the obscure community traceable among the unfree in- habitants of the manor, it is incapable of strict legal definition. AII these elements, moreover, contain in them- selves reasons for the decay which gradually came over the system. The history of the decay of the manorial juris- dictions in England has not yet been written. On the one hand were the king's courts, with new and improved pro- cesses of law ; on the other hand the gradual disintegra- tion which marks the history of the manor during the 14th and 15th centuries. The criminal jurisdiction was the first to disappear, and was closely followed by the civil jurisdiction over the free tenants; and in modern times all that is left is the jurisdiction over the customary ten- ants and their holdings, and that in an attenuated form.

A few words must be given to the legal theories of the 15th century on the Manor Court. It would seem to have become the law that to the existence of the manor two courts were necessary — a court customary for customary tenants, and a court baron for free tenants. In the court customary the lord's steward is the judge ; In the court baron the freeholders are the judges. If the freeholders in the manor diminish to less than two in number the court baron cannot be held, and the manor perishes. Nor can it be revived by the grant of new freehold tenures, because under the statute of Quia Emptores such new freeholders would hold not of the lord of the manor, but of his lord. The customary tenants and the court customary may survive, but the manor is only a reputed manor. Of the 13th century all this is untrue, but even at that date the existence of free tenants was in a measure essential to the existence of the Manor Court. If there were none the jurisdiction of the court over free tenants of course collapsed ; but in addition to this the lord also lost his power of exercising the highest criminal franchises, even if he otherwise possessed them ; he could, for instance, no longer hang a murderer on his own gallows. Perhaps it may be said that to the exercise of the feudal

~~power and of the royal franchises the presence of free tenants was necessary. But it is clear that no such condition was necessary to the existence of the manor.~~

~~Apart from the change in the court of the manor, the most im- portant thread in its history is the process which converted the villein into the copyholder. Here again the subject is imperfectly explored, and part of it is still subject to controversy. In the strict view of contemporary lawyers the holding of the villein tenant of the ISth century was at the will of the lord, and the king's courts of law would not protect him in his possession. If, however, the villein were a tenant on the king's ancient demesne his condition was improved. The writs of monstraverunt and the little writ of right close protected him from the improper exaction of services and from ejection by the lord. But in ordinary manors there was no such immunity. That ejection was common cannot be believed, but it was legally possible ; and it was not until the well-known decision of Danby, C.J., and Bryan, C.J., in 7 Edw. IV., that the courts of law would entertain an action of trespass brought against his lord by a customary tenant. From that date the courts both of law and equity begin to intervene ; and the records of the Courts of Star Chamber and Requests show that in the Tudor period equitable suits brought by tenants against their lords are not infrequent. Side by side with the alteration in the legal condition of the manor there went on an economic change. The labour rents and other services slowly disappeared, and were replaced by money payments. The field divisions gave way before enclosures, effected sometimes by the lords and sometimes by the tenants. Change in legal and agri- cultural practice went on side by side, and finally the manor ceased to be an important social form, and became only a peculiar form of land tenure and the abode of antiquarian curiosities.~~

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~~Manresa, a town of Spain, in the province of Bar- celona, 30 miles from Barcelona. Its population, 22,685 in 1887, increased to 25,931 in 1897, with the develop- ment of the local industries — manufactures of woollen, cotton, and linen goods, ribbons, hats, leather, soap, paper, chemicals, alcohol, and flour, and iron-founding — which have thriven since 1892. A new town has sprung up on the right bank of the river Cardonero. A canal 18 miles long connects with the river Llobregat.~~

~~Mans, Le, chief town of department Sarthe, and headquarters of the 4th Army Corps, France, 133 miles south-west of Paris by the railway to Brest. The suburb of Pr^ on the right bank of the river covers an area three times that of the old town, and in its westward extension embraces the former town of St Pavin-des-Champs. Steam tramways connect the town with several outlying places. Population (1881), 43,178 ; (1901), 63,272.~~

~~Mansfield, a municipal borough (1891) in the Mansfield parliamentary division of Nottinghamshire, England, in Sherwood Forest, on the river Mann or Maun, 17 miles north by west of Nottingham by rail. A free library has been opened. The manufacture of boots is important. Population (1891), 15,925 ; (1901), 21,441.~~

~~Mansfield, a city of Ohio, U.S.A., capital of Eich- land county, in the northern part of the state, at an altitude of 1151 feet. It has a regular plan, is divided into ten wards, and has three railways, the Baltimore and~~

~~*Ohio, the Erie, and the Pennsylvania. It has extensive manufac- tures, especially of agricultural implements. Population (1890), 13,473 ; (1900), 17,640, of whom 1781 were foreign- born, and 123 were negroes.*~~

~~*Mansurah, a town of Lower Egypt, capital of the province of Dakahlieh, near the west side of Lake Men- zaleh, an important railway station on the Cairo-Damietta line, with population (1900) 27,000. It dates from 1221, and was famous in the wars of the Crusaders, Louis IX. having been imprisoned here after his disastrous retreat and capture in 1250. It has several cotton-ginning, cotton, linen, and sail-cloth factories.*~~

~~*Mantes, chief town of arrondissement and railway station, department of Seine-et-Oise, France, 27 miles north- west of Versailles, on the left bank of the Seine, which separates it from Limay. The 15th-century auditorium of the cathedral church of Notre Dame is now the seat of the civil tribunal, the Hotel de Ville dates from the 17th century, and there is a beautiful fountain of the Renais- sance period. The principal manufactures are musical instruments and artificial incubators. Poultry-rearing is an important industry, and there is commerce in cereals, fruits, and vegetables. In 1087 William the Conqueror, when besieging the town, met with the accident which cost' him his life. The castle, demolished in 1721, was visited by several sovereigns. Population (1881), 6847 ;*~~

~~*(1901), 8034.*~~

~~*ManteufFel, Edwin Hans Karl von, Fbei- HEBB (1809-1885), Prussian field-marshal, son of the president of the Superior Court of Magdeburg, was born at Dresden on the 24th February 1809. He was brought up with his cousin, Otto von Manteuffel (1806- 1882), the Prussian statesman, entered the Dragoon*~~

~~*Guards at Berlin in 1827, and was promoted lieutenant in 1828. After attending the War Academy for two years, and serving successively as adjutant to General von MuflBing and to Prince Albert of Prussia, he was promoted captain in 1843 and major in 1848, when he became aide-de-camp to Frederick William IV., whose confidence he enjoyed. Promoted lieutenant-colonel in 1862, and colonel to com- mand the 6th Uhlans in 1863, he was sent on important diplomatic missions to Vienna and St*~~

~~*Petersburg. In 1857 he became major-general and chief of the military cabinet, an invidious post, in which he had to deal with the personal merits of the officers of the army, and pro- mote or weed them out as he thought desirable. He gave hearty support to the Prince Eegent's plans for the reorganization of the army. In 1861 he was violently attacked in a pamphlet by Herr Twesten, a Liberal leader, whom he wounded in a duel. He served as lieutenant-general in the Danish war of 1864, and at its conclusion was appointed civil and military governor of Schleswig. He took the initiative in the Austrian war of 1866 by ejecting the Austrians from Holstein, commanded a division under Vogel von Falkenstein in the Hanoverian campaign, and succeeded him, in July, in command of the army of the Main. His success- ful operations ended with the occupation of Wtirzburg, and he then went on a diplomatic mission to St Petersburg, where he was persona grata, and succeeded in gaining Russia's assent to the new position in North Germany. He was appointed to the command of the ninth army corps in 1866, and transferred to the first corps in 1868. In the Franco-German war of 1870-71 he commanded the first army corps under Steinmetz, distinguishing himself in the fighting round Metz — in the battles of Colombey and Neuilly, and especially in the repulse of Bazaine at Noisseville. He succeeded Steinmetz in October in the command of the first army, won the battle of Amiens against General Farre, and occupied Eouen, but was less fortunate again stFaidherbe at Pont Noyelles and Bapaume. In January 1871 he commanded the newly-formed army of the south, which he led, in spite of hard frost, through the C6te d'Or and over the plateau of Langres, cut oif Bourbaki's army of the east (80,000 men), and, after the action of Pontarlier, compelled it to cross the Swiss frontier, where it was disarmed. The southern army was disbanded, and Manteuffel commanded, first, the second army, and, from June 1871, the army of occupa- tion left in France until 1873, showing great tact in a difficult position. He was made a field-marshal for his services, went on several diplomatic missions, was for a time governor of Berlin, and in 1879 was appointed governor-general of Alsace-Lorraine ; and this office he held until his death at Karlsbad, Bohemia, on 17th June 1886. * (e. h. v.)*~~

~~*Mantlnea. — The site of Mantinea was excavated by M. Fougeres, of the French School at Athens, in 1888. The plan of the agora and adjacent*~~

buildings has been recovered, and the walls havebeencompletely investigated. Thetown was situated in an unusual position for a Greek city, on a flat marshy plain, and its walls form a regular ellipse about 4 kilometres in circumference. When the town was first formed in 470 b.c. by the " synoecism " of the neighbouring villages, the river Ophis flowed through the midst of it, and the Spartan king Agesipolis dammed it up below the town and so flooded out the Mantineans and sapped their walls, which were of unbaked brick. Accordingly, when the city was rebuilt in 370 b.c, the river Ophis was divided into two branches, which between them encircled the walls ; and the walls themselves were constructed to a height af about 3 to 6 feet of stone, the rest being of unbaked brick. These are the walls of which the remains

are still extant. There are towers about every 80 feet ; and the gates are so arranged that the passage inwards usually runs from right to left, and so an attacking force would have to expose its right or shieldless side. Within the walls the most conspicuous landmark is the theatre, which, unlike the majority of Greek theatres, consists entirely of an artificial mound standing up from the level plain. Only about a quarter of its original height remains. Its scena is of rather irregular shape, and borders one of the narrow ends of the agora. Close to it are the

foundations of several temples, one of them sacred to the hero Podaros. The agora is of un symmetrical form ; its sides are bordered by porticoes, interrupted by streets, like the primitive agora of Elis as described by Pausanias, and unlike the regular agoras of Ionic type. Most of these porticoes were of Roman period — the finest of them were erected, as we learn from inscriptions, by a lady named Epigone ; one, which faced south, had a double colonnade, and was called the BatVij ; close to it was a large exedra. The foundations of a square market hall of earlier date

~~were found beneath this. On the opposite side of the agora was an extensive Buleuterion or senate-house. Traces remain of paved roads both within the agora and leading out of it ; but the whole site is now a deserted and feverish swamp. The site is interesting for comparison with Megalopolis ; the nature of its plan seems to imply that its main features must survive from the earlier " synoecism," a century before the time of Epaminondas.~~

~~See Bulletin de Correspondance Jrlellenique, 1890, G. Pougferes ; Mantinee et VArcadie orientate, Paris, 1808. (e. gr.)~~

~~Mantua (Italian Mantova), a fortified town and capital of the province of Mantua, Italy, on the river Mincio, 71 miles east-south-east of Milan by rail. It possesses an antiquarian museum, which ranks as one of the most important in North Italy. The educational institutions embrace also a chemical laboratory, a botanical garden, and a mineralogical museum. Amongst the industries are iron-works, tanneries, printing, furriery, doll-making, and flour-mills. The cliampion of Tyrolese liberty, Andreas Hofer, was shot at Mantua by the French in 1810. Population (1881), 1'8,048 ; (1901), 29,160.~~

~~Manures. See Agbicultukb.~~

~~Manzanares, a town of Spain, in the province of Ciudad Real. Its population was 9700 in 1887, and~~

~~10,447 ia 1897. An ancient castle dates from the 13th century. Manzanares is the seat of an active trade in wine, aniseed, saffron, wheat, and alcohol ; local industries include manufactures of chalk, bricks, and soap, and distilling.~~

~~Manzanillo, an important commercial city of Cuba, situated at the mouth of the Rio Cauto in Santiago province. It exports large quantities of sugar, hides, tobacco, and bees-wax. The last battle of the Spanish-American war was in progress here when the protocol of peace was signed. Population (1899), 14,464.~~

~~*Map. — Since 1876 topographical surveys have gained much in accuracy, and thus, whilst formerly it was deemed sufficient if a topographical map answered the requirements of the soldier, such a map, before it can be accepted as satisfactory at the present day, must equally meet the interests of the civil engineer and of the man of science. Various processes for the production of maps have been perfected and are extensively employed. Photography, including heliogravure, has in this manner largely superseded the more tedious processes of engrav- ing on copper or stone, and the time thus gained may fairly be considered to compensate for a less attractive appearance when printed. Topographical maps of the*~~

~~*more perfect type are still exceedingly rare. As a rule, maps of this kiud are based upon the cadastral plans adjusted to a trigonometrical survey, the additional de- tails required for military purposes being filled in with the aid of plane-table and tacheometer. The contours (Isopyrese) are merely sketched in, and are dependent upon a limited number of altitudes determined with more or less accuracy. Where cadastral plans are not available recourse is had to the plane-table, and occasionally, but only in mountainous districts, to photographic surveying or photogrammetry.*~~

~~*Topographical Surveys. — The year 1855 marks an entirely new departure in the work of the Ordnance Survey of the United Kingdom, for in that year it was determined that cities and towns should thenceforth be surveyed on a scale of 1 : 600 (10-foot scale) or 1 : 1056 (5-foot scale), agri- cultural districts on a scale of 1 : 2500 (25-inch scale), and that the old 6-inch scale (1 : 10,660) should be retained for uncultivated hilly districts and for a general map of the whole kingdom. The contour lines inserted upon these large scale maps or plans are based upon instrumental measurement. As regards Great Britain, the whole of this survey was completed and published in 1895. This rapid publication was rendered possible by substituting zincography for the tedious process of copper engraving. It is upon maps of this minute accuracy that the*~~

~~popular " New Series " of the 1-inch scale (1 : 63,360) is based. This 1-inch map, in outline, including contours at intervals of 50 or 100 feet, was completed for the whole of the United Kingdom in 1896, and many sheets of it have since been thoroughly revised and brought up to date. In the second edition the hills are hachured in black. There are also in progress an edition with the hills in brown hachures and contours, another printed in five colours, and a third showing distinctly the bounda- ries of all civil parishes. The department has likewise had in hand since 1898 a 4-mile map (1 : 263,440) of Great Britain, which is mainly intended to show five classes of roads. Taken as a whole, these Ordnance maps may fairly challenge comparison with the maps of any other country in the world ; and if the hill hachures of the 1-inch maps are not quite satisfactory, this de- ficiency is in a large measure compensated for by the presence of absolutely trustworthy contours (see BepoH on the Ordnance Survey, annually presented to Parliament, and Colonel Sir J. Farquharson in the Geographical Jour- nal, XV., 1900).~~

~~The famous Carte de France de VEtat-major (1 : 80,000) was completed in 273 sheets in 1880. It has served as a basis for a Carte de la France on a scale of Prance. ^ . ^QQ^oOO, published by the Service Vicinal, and of a general map on a scale of 1 : 200,000, in 81 sheets, which is printed in colours and was completed in 1888. Meanwhile the question of producing an entirely new map of France was referred to a committee, presided over by General De la Noir, in 1897 ; and if the recommendations of this committee axe carried out, the result will be a map equal in accuracy to the British Ordnance Survey map, and possibly superior to it in attractiveness. There is to be an entirely new cadastral survey, connected with the triangulation of France. These cadastral plans are to be reduced to a scale of 1 : 10,000, or, in the case of mountain regions, of 1 : 20,000, and upon them the features of the ground are to be inserted by means of contours at intervals of 5 metres. Ultimately these minutes are to be published on a scale of 1 : 10,000, as also a general map of the whole country on a scale of 1 : 50,000. This latter is to be printed in colours, and the hills are to be shown by clearly marked contours and shading in chalk. Hachures are to be discarded, mainly owing to the great expense involved.~~

~~*For the greater part of Germany there are now avail- able maps on a scale of 1 : 25,000 — Messtischhlutter, called Positionsbldtter in Bavaria. Most of these are merely plane-table sections, with contours ^”””‘“y- sketched in. The older among them leave very much to be desired on the point of fidelity and artistic finish, but those of later date exhibit much improvement, as, for instance, the kingdom of Saxony (since 1879), the grand- duchy of Baden (since 1876), and more especially the new topographical map of Wtirtemberg. This last is a reduc- tion of the cadastral survey on a scale of 1 : 2500 ; and the features of the ground are shown by contours based upon 300 to 800 measured altitudes to each square mile, and shading in chalk. The older maps of the separate states have now been nearly superseded by the new Karte des Deutschen Eeiches in 674 sheets (610 published), on a scale of 1 : 100,000. This is an excellent map of its kind, engraved on copper, the hills being shown by hachures. The Prussian Government, moreover, acquired in 1874 Reymann’s Spezialkarte von Mittel-Europe, on a scale of 1 : 200,000, which will ultimately consist of 796 sheets. A new topographical map (1 : 200,000), printed in three colours, was begun in 1900.*~~

~~*The Spezialkarte of Austria-Hungary, on a scale of 1 : 75,000 (763 sheets), was completed in 1889 and pub- lished in heliogravure. This map is based upon triangulation and cadastral surveys, where “ “f!!, available, but it was produced far too rapidly to meet modern requirements as to accuracy, and in 1896 the director of the military geographical establishment at Vienna, Field-Marshal von Steeb, initiated what may be called an “epoch of exact measurements.” The new map will be based upon a primary triangulation completed in 1890, and upon 11,610 miles of spirit-levelling. The cadastral plans are to be reduced to a uniform scale of 1 : 26,000, and the necessary details filled in with the aid of a plane-table and a tacheometer. A photogrammeter is to be used only in mountain districts. The hills are to be hachured, and the whole of the survey is to be completed in 75 years. The Austrian Government has its General- karte von Mittel-Europe (a very useful map, in 283 sheets), on the same scale as Reymann’s map (1 : 200,000), but covering a different area, including nearly the whole of the Balkan Peninsula.*~~

The mountainous nature of Switzerland has always challenged the skill of the cartographer to give it true expression, and certainly among the maps pro- duced in this Alpine region there are several which claim a prominent place on account of their truth to nature. Whether the maps of the new Topographical Atlas of Switzerland — the so-called Sieg- fried Atlas, in 552 sheets — will universally be recognized as one of the most successful efforts of which the carto- graphic art is capable, may well be doubted. The maps constituting that atlas are the plane-table sections from which Dufour's famous map of Switzerland (1 : 100,000) was produced. They are on a scale of 1 : 25,000 for the hills and plains, and of 1 : 50,000 for the Alpine regions ; they show the hills by contours drawn at inter- vals of 10 or 30 metres, and are printed in many colours. Lovers of maps will do well to study some of the so- called "Relief Karten" of the different cantons, which claim to delineate the ground in such a way as to give the impression of a relief. '

The new survey of Belgium was completed in 1872, and there have now been published the plane-table sections {planchettes') on a scale of 1 : 20,000, and a „ , . " Carte topographique de la Belgique," on a an/'"™ scale of 1 : 40,000. The Netherlands likewise Neiher- have long since published their topographical '"'"*■ maps, on scales of 1 : 25,000, 1 : 50,000, and 1 : 200,000.*

SwHzer- land.

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MAP

and

Norway.

Denmark since 1890 has completed its Oeneralstdbens

Kaart, on a scale of 1 : 100,000, as also plane- Deamark. ^^^q sections (Maalebordsblade) , on a scale of 1 : 20,000. A Oeneralstahens Kaart of

~~*Jutland, 1 : 40,000, is approaching completion. The generalstabenskarta of*~~

~~*Sweden (1 : 100,000) is still in progress. It Sweden only enabraces the country to 66° N., and is to*~~

~~*consist of 234 sheets. The northern kingdom*~~

~~*(Karta ofver Norra Suerige) has been mapped on a scale of 1 : 200,000. In the sister kingdom of Nor- way a topographical map, on a scale of 1 : 100,000, is in progress, in 354 sheets. Neither the Amtskarter (1 : 200,000) nor the generalkart of southern Norway (1 : 400,000) have yet been completed.*~~

~~*Proceeding into southern Europe, we find that a plane- table survey on a scale of 1 : 20,000 has been in progress*~~

~~*ever since 1870, but that of the map of Spain fp^ If in 1080 sheets (1 : 50,000), which has been in*~~

~~*progress since 1884, only about 117 sheets had up till 1901 been published by the Depdsito de la Guerra. Meanwhile reference may be made to B. F. Coello's Atlas de Espana (1848-90), the maps in which are on a scale of 1 : 200,000. Portugal has completed her Gharta choro-graphica (1 : 100,000, 37 sheets) since 1856. In Italy . . a Carta del Regno d'Italia (1 : 100,000) and*~~

~~*^' Tavolette rilevate (1 : 25,000 and 1 : 60,000) have*~~

~~*been in progress since 1873. The former will consist of 277 sheets.*~~

~~*Greece, although the most ancient seat of civilization in Europe, is still dependent upon foreigners for its maps,*~~

~~*among which the Cg.rte de la Qrice (1 : 200,000), Pentnsuia. from rapid surveys made by General Palet in*~~

~~*1828, was published in a new edition in 1880. A similar map, mainly based upon surveys made by Austrian ofRcers and revised by Henri*~~

~~*Kiepert (1 : 300,000), was published by the Military-Geograph- ical Institute of Vienna in 1885. Ear superior to these preliminary maps are the Karten von Attika, based upon careful surveys made by Prussian officers, and pub- lished by Curtius and Kaupert on behalf of the German Archaeological Institute in Athens. It is not long since the inhabitants of the Balkan Peninsula were indebted to foreigners for such maps as they made use of. This is the case no longer, for the kingdom of Servia has been surveyed (1880-91) by officers of the General Staff, and the map, on a scale of 1 : 76,000, has been published; whilst the triangulation was begun in Rumania in 1874, and a topographical survey in 1878. The results are being published on scales of 1 : 10,000 and 1 : 200,000. For the greater part of our know- ledge of the topography of the Balkan Peninsula we are, however, still indebted to Austrian and Rus- sian officers. The work of the former has already been referred to. The Russians in 1877-79 triangu- lated and surveyed a great part of the country, and the maps published include one of Turkey in Europe, 1 : 420,000 (1879-84), a map of Bulgaria and eastern Rumelia, 1 : 210,000 (1880-83), with contours at intervals of 70 feet, and a map of the eastern part of the Balkan Peninsula, 1 : 126,000 (1883). In 1899 a map of Turkey in Europe (1 : 218,000) was published by the Turkish General Staff, and there is some talk of beginning a reg- ular survey.*~~

~~*Of Russia in Europe only the more densely peopled governments have been surveyed in the manner of other European countries, while for vast territories we have as yet only so-called "military surveys," or even mere itinerary surveys, the interior details being filled in from information collected on the spot. The most readily available map of the whole country is the 10-verst map (1 : 420,000) known as General Strelbitzki's,*~~

~~*Russia.*~~

~~*and published 1866-80. A 3-verst military topographical map (1 : 126,000) now embraces the whole of western Russia, with Poland, and seems ultimately to be designed to be extended over the whole empire. Of this map 607 sheets have been published. It is engraved on copper, the hills are hachured, and on the sheets recently published contoiirs at intervals of 70 feet are indicated. Certain governments — Moscow, Kief,*~~

~~*Kaluga, &c. — ^have been published on a scale of 1 : 84,000, whilst Finland, as faj- as 61° N., was re-surveyed in 1870-95, and a map on a scale of 1 : 42,000 is approaching completion. Surveys in Asiatic Russia are conducted by the topographical departments organized at Tiflis, Orenburg, Tashkent, Omsk, and Yakutsk ; and that of Tiflis deserves credit for having produced a 6-verst map of the Caucasus from actual surveys made since 1866, which answered general requirements, but was found so defective in the mountain regions that a new and more accurate survey was begun in 1886. The maps of other parts of the empire are on too small a scale to be styled " topographical." Among them may be mentioned, however, the maps of Orenburg (1858-79), Ferghana (1882), western Siberia (1880), and Lake Baikal (1886), all on a scale of 1 : 420,000. A map of the whole of western Siberia (1 : 680,000) was published in 1880-86, and one of the whole of Asiatic Russia (1 : 4,200,000) in 1883.*~~

~~*In Asiatic Turkey several districts of historical interest have been surveyed by foreign associations, and surveys have likewise been made in the interest of rail- ^ , ways, but there is no such thing as a general survey carried on under the direction of the Government. Of this part of the world our maps, such as the Russian general map (1 : 630,000, published 1880-86), or the various maps by the late Dr H. Kiepert (for instance, western Asia Minor, 1 : 260,000, published in 1890), still remain compilations from materials very widely differ- ing in value. A new map (1 : 210,000) of Turkey in Europe, based upon the Austrian map, has been published by the Turkish General Staff. Of Cyprus an excellent map on a scale of 1 mile to the inch, from surveys by Major H. (afterwards Lord) Kitchener, was published in*~~

~~*1884.*~~

~~*In the case of Persia we are still dependent upon com- pilations produced by the Russian and the Anglo-Indian Governments, such as the map by Colonel Sir T. H. Holdich (Simla, 1897), or the Russian Staff map (1 : 840,000), published in 1886.*~~

~~*British India, including Ceylon, can boast of a survey which in most respects is quite equal to those of most of the European states. The*~~

surveys are made on various scales, according to the necessities of the case or the nature of the country, and they are extended as occasion offers beyond the boundaries of India proper. Apart from plans of towns and villages on a large scale, the survey department publishes topo- graphical maps of the provinces and native states on a scale of 1 inch to the mile, and the more generally useful Indian Atlas on a scale of 4 miles to 1 inch, which includes Ceylon and the Malay Peninsula, and will ulti- mately consist of 177 full sheets, of which 120 have now been published. The sheets of this atlas are kept up to date, and re-engraved as the results of fresh surveys become available.

In Siam a regular survey, initiated by Mr J. M'Carthy, a former official of the Indian Survey, has been begun (see Survey- ing in and Exploration in iSiam, published by the Royal Geographical Society). In French Indo-China a cadas- indo- tral survey has been in progress since 1881, whilst the chlaa.

Bureau Topographique has published a general map of Indo-China in 45 sheets (1 : 200,000, 1895), as also separate maps of tlie provinces of Tongking, Annam, and Cochin-China, on a scale of 1 . 500,000.

Persia.

M A P

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In China we are still largely dependent upon the labours of the Jesuits during the 18th century, and native maps of the interior. China '^^^ results of the coast surveys and of numerous local

Jaoaa surveys will be found embodied in Baron F. von

Kichthofen's ylttas TOM C/w'«a (1:750,000; Berlin, 1890), and in Bretschneider's M(ii> of China (1:4,600,000), a new edition of which appeared at St Petersburg in 1896. Japan may boast of a regular survey department originated by Europeans and success- fully carried on by natives. The primary triangulation was com- pleted in 1880, and in

~~addition to maps on a large scale, there are in course of publication an agronomical map (1:100,000) and geological maps (1:200,000 and 1:400,000).~~

~~Of Java we possess an excellent topographical map, completed in 1887 (1: 100,000). A similar map has been in progress for Sumatra since 1883, whilst the maps of the remaining Dutch ^”” Indies are still based almost exclusively upon flymg~~

~~Indies. surveys. For general purposes J. N. Stemfoort’s and~~

~~J. J. ten Siethoff’s Atlas cler Nederlandsche Bezittingen in Oost-Indie, of which a new edition has been in progress since 1900, may be consulted with confidence.~~

~~In Africa regular surveys up till now only extend over a small proportion of its vast area. In Egypt excellent work is done by Africa ^ survey department in charge of Major H. G. Lyons,~~

~~R.E., which has published provincial irrigation maps (1:100,000), and has extended its operations into the Egyptian Sudan. Algeria and Tunis have been in course of survey since 1868. The topographical map is being published on a scale of 1:60,000, in addition to which there is a carte de reconnaissance on a scale of 1:200,000. Eritrea, the Italian colony on the Red Sea, has been regularly surveyed since 1884, and the results have been published on scales of 1:50,000 and, as a carta dimostrativa, 1:250,000 (16 sheets, 1897-1900). In Madagascar a regular sur- vey has been begun by the French. In British South Africa a careful triangulation has been carried far into Bechuanaland, but as yet there are no comprehensive regular surveys, and maps are therefore mostly compilations from the plans prepared by the surveyors-general of the various colonies. Amongst these may be mentioned the map of the police districts of Cape Colony (1: 627,- 800, 1887), Jeppe’s Map of the Transvaal (1:476,000 ; Winterthur, 1899), Herfst’s official Kaart van de Oranje Vrijstaat (1:460,000, 1890), Stanford’s Map of Mashonaland and Rhodesia (1 : 1,000,000, 1900). In other parts of Africa explorations and partial surveys are carried on with considerable vigour, but the time seems to have arrived now for organizing at least a reconnaissance~~

~~*sui'vey embracing the entire continent, which, in the opinion of so com-petent a judge as Colonel Sir T. Holdich, might be carried on at no greater expense than is involved now in numerous exploratory ex-peditions, and certainly much more efficiently.*~~

~~*What has been said of South Africa applies in an almost equal degree to the Australian colonies. In all of these cadastral surveys conducted by surveyors-general have been in Australia. pj.Qgj.ggg fgj. juany years past, as also trigonometrical surveys (West Australia excepted), whilst the publication of parish and township or county maps keeps pace with the settlement of the country ; but none of the colonies is as yet in possession of a topographical map equal in accuracy to similar maps pub- lished in Europe. Among more general maps may be mentioned those of Queensland (4 miles to the inch, 1897-99), New South Wales (8 miles to the inch, 1898), Victoria (1:443,520), South Australia (1:1,100,000, 1894) and West Australia (1:560,000,*~~

~~*1897).*~~

~~*In America, Canada and the United States take the lead in the production of topographical maps. The surveys in Canada are carried- on by the Commissioners of Crown Lands in Canada. Quebec, the Dominion Land Office (which lays out townships as in the United States, but with greater accuracy), the Surveyor-General's office attached to the Department of the Interior, and the Geological Survey. The last publishes its regular service maps on a scale of 4 miles to an inch, and recon- naissance or preliminary maps on half that scale. The maps of the Surveyor-General are on various scales (1:40,000, 1:190,000, &c.), and the photographic apparatus is successfully employed in the Kocky Mountain surveys. Among more comprehensive maps is one of the north-western part of the Dominion (3 miles to the inch, 1898), and another of the Yukon districts (1:380,000, 1898). The older maps are kept up to date.*~~

~~*In the United States the topographical maps produced since 1882 by the U.S. geographical surveys supersede all older maps, including the very imperfect ones of the Land Office. United They are based upon a triangulation by the U.S.*~~

States. Coast and Geodetic Survey, and the details are

considered sufficient to admit of the selection of general routes for railways and other public works. The maps of the more densely peopled parts of the Union are published on a scale of 1:62,500 (1 inch to the mile), and those of the remainder of the country on half that scale. The hills are shown by contours.

The survey progresses at the rate of about 40,000 square miles annually. There are, of course, many maps of the separate states, based on older surveys, as also a general map by H. Gannett and H. King (1:2,500,000; Washington, 1900). Maps of the islands of Cuba and of Puerto Kioo were published in 1898 by the War Department on a scale of 1 : 250,000.

In Mexico the surveys are in charge of a Comisidn Geografica-exploradora attached to the Secretaria de Fomenta, but up till now only about fifteen sheets of the Carta general de la Eepublica, on a scale of 1 : 100,000, have been '^J'J^g^^^^ published. There is also a Carte general of the state A„erlca of S. Luis Potosi (1 : 250,000, 1894) and oue of the environs of Puebla (1 : 20,000). These maps are excellent of their kind, but the slow progress of their publication is to be regretted. None of the other states of America can be said to possess a topographical survey department organized on a comprehensive basis. In the Argentine a geographical institute was established in 1879, but neither Seelstrang's Atlas (1892) nor Hoskold's Mapa topograflca (1:2,000,000, London, 1895), which were published by it, nor any of the numerous provincial maps, are based upon scientific surveys. In Brazil little or nothing is done by the central government, but the progressive states of Sao Paulo and Minas GerSes have Comisaos Geographicos e Geologicos charged with the production of detailed topographical maps. In Chile a Comision Topograflco was appointed as long ago as 1848, but the map produced under its auspices by Prof. A. Pissis (1:250,000, 1870-77) leaves much to be desired. A pro- posal for a cadastral and topographical survey made in" 1895 by M. A. Bertrand has not as yet been acted upon. A Mapa del Peru based upon explorations made by A. Raimondi, 1850-69, has been in course of publication at Paris since 1889 on a scale of 1:500,000. Most of our maps are all dependent upon partial exploration, and it is satisfactory

~~*in these circumstances that the Service G^ographique of the French army should have commenced (in 1900) the publication of a map of the whole of America on the scale of 1:1,000,000. It may also be mentioned that the same department is publishing a map of Asia on the same scale, and that the British Intelligence Department has in hand a like map of Africa. Thus the proposal of Prof. Penck to produce a map of the whole world on a scale of 1 : 1,000,000 will be realized, at least in part.*~~

~~*The publication of maps on smaller scales than those enumerated above, as also of maps for special purposes, — physical, political, or historical, — has, as a rule, been left to private firms, among whom Perthes in Germany, Ilyin in Russia, Hblzl in Austria, Hachette in France, Bartholomew, Philip, and Stanford of the United Kingdom, and the Matthews-Northrup Company in the United States, are the best known.*~~

~~*Hydkographic Surveys.*~~

~~*Hydrographio surveys have been in progress since the early Middle Ages, but even now only a portion of the world's coast- lines have been surveyed in a definite manner. Much of this work has been done by the survey departments of the different states concerned, but the British Hydrographic Office may justly claim the credit of having contributed the lion's share of the work lying outside the limits of civilized states, and British Admiralty charts (see Charts) are consequently most in demand throughout the world. Great Britain has taken the lead in those deep-sea explorations which reveal to us the configuration of the sea bottom, and enable us to construct charts of the ocean bed corre- sporiding to the contoured maps of dry land yielded by detailed topographical surveys.*~~

~~*For geological maps, see Geoloot.*~~

~~*History of Maps. — The development of cartography since the time of the revival of Ptolemy has been set forth in the most brilliant manner by Nordenskiold in his Facsimile-atlas till Kartograjlens dldsta historia, innehSllande af bildningar af de vigtigaste Kartor tryckta fore dr 1600 (Stockholm, 1889). Other collections of reproductions of old and rare maps have been prepared by Dr. K. Miller (Die altesten Weltharten, Stutt- gart, 1895, which only contains maps not influenced by the ideas of*~~

Ptolemy) , Gabriel Marcel (Beproductions de Cartes et de Globes relatives a la decouverte de I Amerique du XVI' au XVJII' iSiecle, Paris, 1893), E. H. Coote {BemarL-able Maps of the XVth, XVIth, and XVIIth Centuries, reproduced in their original size. I.-VI., published by F. Mtiller, Amsterdam, 1894-97), and Bibliotheca Lindesiana, with facsimiles of the "Harleian" and other Dieppese maps of the 16th century. The large maps of Mercator, found anew in Breslau ; the map of Europe, 1554 ; of Great Britain, 1564 ; and the map of the world, 1569, were pub- lished in facsimile in 1891 by the Berlin Geographical Society ; and we owe an excellent synopsis of all known terrestrial and celestial globes to Matteo Fiorini (Sfere terrestri e celesti di Autore italiano oppnre fatte o conservate in Italia, Roma, 1899).

The old "compass" charts have attracted the attention of

students. So long as maritime cartography was confined to the Mediterranean and its immediate environment, and there was no practical need for determining the relation of the longi- tudinal axis of this sea to the circumference of the whole earth, nautical geography was satisfied with the registration of the distance in miglia between two coast points, and entered in the yaluations in the sheets of the map. After numerous measure- ments Prof. Wagner has come to the conclusion that the miglie, in terms of which distances were measured on the old nautical maps, amounted to only about 1250 metres, i.e., 230 metres less than the Eoman mile. He further concludes that this small nautical mile reaches back a long way beyond the year a. d. 1000, and is therefore much older than the oldest nautical maps extant, and that in all probability we have here a measure handed down from antiquity and continued in use among the mariners. On the other hand, on the Pisan map (of the 13th century) the Eoman mile of 1480 metres was applied to the measurement of the Atlantic seaboard. The smaller sea mile (= | of the nautical mile) has in the Frisian waters maintained its validity to the present day. Obviously the Mediterranean maps are much older than the maps of the Atlantic coasts. But, without taking in hand the task of reduction, the ancient

~~cartographers joined together the different sheets of the Mediterranean and the Atlantic into a collective representation, not troubling their minds about the error thus originated. The false orientation of their maps, shown especially in the primary orientation line from west to east, does not, however, proceed from the magnetic misdirection ; but there are typical errors demonstrable in the representa- tions of the Mediterranean such as may be found in Ptolemy him- self, a fact pointing also to the connexion between Ptolemy and the nautical maps. Thus Ptolemy places Rhodes and Argos on the same parallel of latitude; Mount Athos and Cape Malea on the same meridian. These errors appear also after 1318 on the maps of Vesconte. The projection, however, employed by Ptolemy is not applied in the Italian nautical maps. It is impos- sible to draw over these nautical maps either the equidistant azimuthal projection or the Mercator's projection. The only net- work of degrees capable of being brought into conformity with these maps is that of an oblong plane-chart. This fact serves to confute the often uttered but never proven assertions that Henry the Navigator had already introduced graded maps, and so had substantially advanced the development of cartography. After the investigations made down to this date, it may be taken as authenticated that the mediseval nautical maps were first designed in Italy, in the land where navigation attained its highest development, and that we are not, as in his great work. The Periplus, Nordenskiold has endeavoured to maintain, to look for the origin of these topographical maps among the Cata- lonians. The two oldest maps of the world, designed in Cata- lonian style, which only again became known in modern times, are the production of an Italian, Angelino Dalorto, whence it maj' be concluded that Catalonian cartography received its first im- pulses from Italy.~~

~~Many old nautical maps have been republished, such as those by Th. Fischer (Sammlung mittelalterlicher Weli-u-See Karten — "A collection of maps of the mediaeval world and nautical maps"; Venice, 1886) ; K. Kretschmer (Atlas zur Entdeckung Americas — "Atlas illustrating the discovery of America," Berlin, 1892) ; G. Marcel (Choix de Cartes et He Mapjiemondes des XIV et XVe Siecles — "A selection of maps, and maps of the world of the 14th and 1.5th centuries," Paris, 1896) ; and Nordenskiold (Pert- plus, Stockholm, 1807). In addition to these collections, there are single maps published in geographical works and maps published separately in great number, not~~

~~*to mention that all the original works preserved in libraries have not yet been made fully known. It is therefore impossible to give a list of them here, or to supplement lists already published.*~~

~~*For a fairly complete list of modern maps of all parts of the world, we refer the reader to Mr J. G. Bartholomew's " Mapping of the World " (ficoUish Geographical ilagaziiie, 1890 and 1891) ; for reports on the progress of cartography, to the Geographisches Jahrbuch, published by Perthes of Gotha, and for announcements of new publications to the Oeographical Journal.*~~

~~*(s. R. ; B. G. E.)*~~

~~*Maracaibo, capital of the state of Zulia, Vene- zuela, South America, on the western shore of Lake Maracaibo. It is one of the most important and most progressive cities in the republic, with a population of over 35,000 inhabitants. The bar which closes the gulf will not allow vessels drawing more than 12 feet to cross, but inside the bar there is a depth of 30 feet and more close^ to the town. Maracaibo maintains valuable com- mercial relations with foreign markets and with the in-*~~

~~*terior, and is the port of transit for goods intended for Colombia. It is the starting-point also for passenger and freight steamers and the railway lines of the Trujillo and Tachira sections of the state of Los Andes. The most important buildings are the public market, the executive mansion, legislative palace, municipal buildings, the Baralt theatre, university, new gaol, and six churches. There is a dockyard for the construction of sailing vessels. The town is equipped with electric lighting, telegraphs, tele- phones, tramways, &c. The import duties collected in the year ending 30th June 1896 amounted to £252,769, the imports of domestic products, salt, &c., for same period amounting to £86,736. The amount of coffee ex- ported in 1896 was 28,211 tons, and in 1900, 20,050 tons. The export of hides is rapidly increasing, amounting in 1900 to 34,793 hides, besides 121,392 goatskins. Cocoa, fustic, dividivi, sugar, and copaiba are the chief of the remaining exports. The imports in 1898 amounted to £196,787, and exports to £842,600. In 1898 there entered 302 foreign vessels of 29,220 tons.*~~

~~*Maramarossziget, a corporate town of Hungary, with 15,210 inhabitants in 1891, and 17,445 in 1901. Among its educational establishments are a law academy, a state upper school for girls, &c. It is an important centre for the timber industry, with large steam mill, saw-mills, furniture factories, &c.*~~

~~*Maranhao, or Makanham, a state of north-east Brazil, with a coast-line of about 300 miles, in which the Atlantic receives the waters of six large rivers, all navi- gable by steamers. Its area covers 177,566 square miles. The population in 1872 was 359,010, and in 1890 it was 459,040. The capital, San Luis, is a finely-built city of 38,000 inhabitants. Other towns are Caxias (24,000), Alcantara (15,000), Carolina (10,000), Yianna, Grajahu, Itapicurii-mirim, and Turyassii.*~~

~~*Maranon. See Amazon.*~~

~~*Marash (Assyrian Maras, Eoman Germanicia, By- zantine Marasion), the chief town of a sanjak of the same name in the Aleppo vilayet of Asiatic Turkey, altitude 2600 feet, situated north of the Jihun river, at the foot of Mount Taurus. The sanjak lies almost wholly in Mount Taurus, and includes the Armenian town of Zeitiin. Marash is prosperous, and has a large trade in Kurd carpets and embroideries. The climate is good, except in summer. Of the population (40,000), about half are Armenians. There are a college, churches, and schools belonging to the American mission, and a Jesuit establishment. Marash occupies an ancient site on which " Hittite" inscriptions have been found. It was seized by the Crusaders after their march across IMount Taurus, became an important town of Lesser Armenia, and was taken by the Seljiiks in 1147. In the 16th century it was added to the Osmanli empire by Selim I.*~~

~~*Marathon. — The tumulus or " Soros" at Marathon was excavated by M. Stais in 1891 and 1892. A slight previous excavation had brought to light some prehistoric implements, and so it was supposed that the mound had no connexion with the battle ; but it has now been dis- covered that the presence of those prehistoric things was accidental. Underlying the mound was found a stratum about 85 feet long by 20 broad, consisting of a layer of sand, above which lay the ashes and bones of many corpses ; together with these were the remains of many lecythi and other vases,*~~

~~some of them contemporary with the Persian wars, some of them of much earlier style, and probably taken in the emergency from neighbouring cemeteries. It is conjectured with some probability that a large vase containing ashes may have been used as the burial urn of one of the Athenian generals who fell. There was also, in~~

~~the middle of the stratum, a trench for funeral offerings about 30 feet by 3 ; it contained bones of beasts, with ashes and fragments of vases. There can therefore be no doubt that the tumulus was piled up to commemorate the lyii Athenians who fell in the battle, and that it marks the place where the carnage was thickest. A selection from the contents of the tumulus has been placed in the National Museum at Athens.~~

~~See ‘ ApxaioXoyiKbv AeXrlov, 1891, pp. 67 sqq. Cr, gk.)~~

~~Marbella, a town and seaport of Spain, on the Mediterranean coast, in the province of Malaga. The town is well built, with clean, regular streets. An old castle crowns the height above, and the parish church has been restored. The local industries include the manufactures of alcohol, porcelain, and sugar, besides founding, and lead and iron mining. The port admits vessels drawing 18 to 20 feet; but there is good anchorage in deep water about half a mile from shore. There is a pier 1060 feet long, with a railway for bringing down and loading ores, and a lighthouse. Fish, grain, raisins, figs, cork, and iron ore are exported, but the trade is not of great extent. Population about 10,000.~~

~~Marblehead, a town of Essex county, Massachu- setts, U.S.A., on a peninsula on the east side of Salem harbour on the north shore of Massachusetts Bay. The principal occupation of the permanent inhabitants is the manufacture of shoes. The town has become a popular summer resort and summer home for people of Boston. It has a public library, reading-room, and art gallery. Population (1890), 8202 ; (1900), 7682, of whom 973 were foreign-born.~~

~~*Marburg, the second town in the Austrian duchy of Styria, a German enclave in a Slovene district. Population, with suburbs (1900), 24,501, German and Catholic, excepting 16 per cent. Slovenes and 1 per cent. Protestants. The garrison numbers 1343 men.*~~

~~*Marburg, a town of Prussia, province of Hesse- Nassau, on the right bank of the Lahn, 60 miles north of Prankfort-on-Main by the railway to Cassel. It is the seat of a university with (1900) 1184 students and 93 professors. A new villa quarter has grown up at the south foot of the castle hill. In the years 1873-91 a university building of sandstone was erected in the Early Gothic style. In 1884 the " Teutonic " house was converted into the zoological and mineralogical institutes of the univer- sity. The Lutheran church was restored in 1893. The university library contains about 160,000 volumes. The castle was restored in 1866-84 ; it contained the collections of the Hessian Historical Society. There are further a new post office (1882-84), various scientific institutes belonging to the university, an agricultural school, and a botanical garden. The industries include tanning and manufacture of machinery, pottery, tobacco, and toys. Population (1886), 12,668 ; (1900), 17,627.*~~

~~*March, a market town in the Isle of Ely parlia- mentary division of Cambridgeshire, England, 14 miles north-west by north of Ely ; a junction station on the Great Eastern and Great Northern Joint railway. There is a public hall (1896). Population of parish (an urban dis- trict, 1894) (1891), 6988 ; (1901), 7566.*~~

~~*Marches, The, a territorial division of Italy, bordering on the Adriatic, and lying between Abruzzi on the S. and Emilia on the N. It embraces the provinces of Ancona, Ascoli-Piceno, Macerata, and Pesaro and Urbino, with an area of 3763 square miles, and a population of 983,670 (1881), and 1,064,749 (1901). Its principal crops are wheat, maize, wine, and tobacco. Except building*~~

~~*stone and sulphur, there are no minerals of value. The silk industries, making of strawplait and straw hats, rear- ing of silkworms and cocoons, with some sugar refining, tobacco, terra-cotta, and paper manufacture, brickworks, and iron-works, furnish the chief occupations of the people, next after agriculture and pastoral pursuits. The prin- cipal towns are*~~

~~*Ancona (which is the chief seaport), Pesaro, Macerata, Urbino, Jesi, Ascoli, Camerino, Fano, Fermo, Fabriano, Recanati, and Senigallia. This division belonged down to 1860 to the Papal States.*~~

~~*Mardin, the chief town of a sanjak of the same name in the Diarbekr vilayet of Asiatic Turkey, and a military station, situated on the Diarbekr-Mosul road. Half of the population, 12,000, are Christian. During the Armenian massacres of 1895 Mardin was attacked by Kurds, who were driven off by the garrison. It is the seat of an American mission, with church, schools, and medical officer.*~~

~~*Maree, Loch, one of the most beautiful of Scot- tish lakes, situated in Gairloch parish. Wester Eoss. It is 32 feet above sea-level, 12|- miles long, and from 3 furlongs to 2^ miles broad, with a general depth of 360 feet. Skirted by lofty mountains, it contains twenty-s^en islands, and is drained by the river Ewe. The fish are salmon, sea-trout, yellow trout, and char.*~~

~~*Margate, municipal borough, seaport, and market- town in the Isle of Thanet division of Kent, England, 4 miles west of North Foreland, and 90 miles by rail east of London. The old pier is used chiefly by fishermen and colliers ; the landing-place has received several additions. Municipal offices have been presented to the town, and a theatre erected. The town has grown largely, especially in the part called Cliftonville, on the eastern side. There are electric trams running between Margate, Broadstairs, and Kamsgate. Dane Park (33 acres) was presented to the town in 1898. Population (1891), 18,662; (1901), 23,067. The visiting population in summer is very numerous. Westgate-on-Sea, 2 miles west by south and practically a suburb, has a station on the South-Eastern and Chatham railway. It atti-acts a somewhat higher class of visitors than Margate. Population, 3000. Birch- iNGTON, a little farther to the west, is also a growing resort.*~~

~~*Margherita Maria Teresa, op Savoy (1851), dowager-queen of Italy, daughter of Ferdi- nand, duke of Genoa, and of Elisabeth of Saxony, was born at Turin on 20th November 1861. Until eight years of age she lived with her mother, the widowed duchess of Genoa, at Stresa, on Lago Maggiore, but in 1859 returned to Turin, occupying a small apartment in the royal palace. Educated simply under the care of a Viennese governess,*~~

~~she took little part in court life until her marriage. Gifted with beauty and great personal charm, she acquired wide- spread popularity, and exercised her duties as princess royal with unfailing tact. Shortly after the occupation of Rome in 1870 she, with her husband, the crown prince, took up her residence in the Quirinal, where she continued to reside throughout the reign of King Humbert. A few months after the accession of her husband to the throne in January 1878 an attempt upon his life, committed at Naples by a lunatic named Passanante, produced a deep impression upon her mind, and, though she displayed the utmost fortitude at the moment, left for some years un- pleasant traces upon her nervous system. An exemplary wife and devoted mother, she combined with these quali- ties a full perception of her rights and duties as queen, and ever discharged with assiduous alacrity the functions of her royal station. Thoroughly conversant with Latin,~~

~~Greek, and music, speaking several modern languages with fluency, widely read, and keenly interested in all manifestations of art, Queen Margiierita holds a foremost place among the many distinguished women of the house of Savoy. (See also Humbekt.)~~

~~Mariana, or Maeiannb Islands. See Miceonesia.~~

~~Marianao, a residential suburb on the shore of Cuba, to the west of the city of Havana, with which it is connected by means of a steam tram. Population (1899),~~

~~6416.~~

~~Maria Theresiopel. See Szabadka.~~

~~Mariazell, a village and place of pilgrimage in the duchy of Styria, Austria. It is estimated that the shrine is visited by about 200,000 pilgrims annually. The prin- cipal resource of the inhabitants is the entertainment~~

~~*of visitors and the sale of rosaries, pictures, medals, and other souvenirs. Population (1890), 1116; (1901), 1341.*~~

~~*Marienbad, a celebrated watering-place in Bo- hemia, Austria. The permanent population in 1890 was 2119, and in 1900, 4688, mostly Catholic and German. The public buildings now include two hospitals for the poor, a convalescent home, a Russian church, a synagogue, the iStadthaus (containing the post and telegraph offices, the custom-house, a concert and ball room, a restaurant, and reading and assembly rooms), new bathing establishments, &c. It is visited annually by about 17,000 patients.*~~

~~*Marienberg, a town of Germany, 16 miles south- east of Chemnitz, in the circle of Zwickau, kingdom of Saxony, on the Floha-Keitzenhain railway. It has a central school, a non-commissioned officers' school, and a preparatory school ; and the industries comprise wool- spinning, flax-dressing, the making of lace, toys, and cigars, and silver-mining. Population (1890), 6300;*~~

~~*(1900), 7108.*~~

~~*Marienburg, a town of Prussia, province of West Prussia, on the Nogat, an eastern arm of the Vistula, crossed here by a fine railway bridge (1892), 32 miles by rail south-east of Danzig. It is famous for the great castle and fortress of the Teutonic order. Its newer buildings embrace a couple of churches and the post ofBce (1894). It possesses an agricultural school, a seminary for male and another for female teachers, and a deaf and dumb asylum ; its industries include saw-mills, flour- mills, factories for cotton and wool, potteries, machine- shops, wool-cleansing, brick-making, and breweries. Pop- ulation (1885), 10,136 ; (1900), 10,732.*~~

~~*Marienwerder, a town of Prussia, province of West Prussia, near the right bank of the Vistula, 23 miles south of Marienburg by rail. The town was founded in the year 1233 by the Teutonic order. It has a cathedral of the same century, a triple Gothic edifice, restored in 1874 ; a (Gothic) town hall (1880) ; a Roman Catholic basilica (1858) ; a non-commissioned officers' school ; a monument of the war of 1870-71 (1897) ; an archaeological collection ; and a seminary for female teachers. The*~~

~~*industries include iron-foundries, saw- mills, breweries, and printing works. Population (1886),*~~

~~*8079 ; (1900), 9685.*~~

~~*Marietta, a city of Ohio, U.S.A., capital of Wash- ington county, on the Ohio river, at the mouth of the Muskingum, in the south-eastern part of the state, at an altitude of 600 feet. It has a large river commerce, and is entered by four railways, the Paltimore and Ohio South- Western, the Cleveland and Marietta (part of the Pennsylvania), the Toledo and Ohio (Central, and the Ohio and Little Kanawha. It has iron-works, saw-mills, and agricultural implement works. It is the seat of*~~

~~*Marietta College, a non-sectarian institution, founded in 1835, which had, in 1899, 18 instructors and 198 students, 72 of whom were women. The limits of the city were enlarged in 1890 by the addition of Harmar. Popula- tion (1890), 8273; (1900), 13,348, of whom 679 were foreign-born and 361 were negroes.*~~

~~*Mariinsic, a district town of Russia, West Siberia, government of Tomsk, on the bank of the Kiya river, 147 miles by rail east of Tomsk. It is built of timber, but has a stately cathedral and a town hospital. Its inhabi- tants, 8300 in 1897, live by agriculture, small tanneries, and soap-works, and especially by the currying trade. It is an entrepot for the gold mines, and a centre from which the miners start in summer.*~~

~~*Marine Insurance. See Insueance.*~~

~~*Marines, formerly (1694) styled mariners, are sea soldiers — that is, troops appropriated and specially adapted to the requirements of maritime war. This force is in origin, use, and application peculiarly British. The only other nation possessing a special force dis- charging exactly similar functions is the United States.*~~

~~*The origin of the marine force was an Order In Council 1664, directing " 1200 Land souldgers to be forthwith rayzed to be in readiness to be distributed in His Majesty's fleete prepared for sea service." This body was named the "Admiral's regiment." At this period land warfare had*~~

~~developed a system, and was waged by men organized, disciplined, and trained. Sea warfare was left " to every man's own conceit." War-sbips were built to be manned in a hurry, by "the press," when needed. Men were thus obtained by force and grouped without organization or previous training in ships. When no longer required they were turned adrift. The administration of England's fleet was "a prodigy of wastefulness, corruption, and indolence ; no estimate could be trusted, no contract was performed, no check was enforced." Such oflBcers as had been " bred to the sea seemed a strange and savage race." They robbed the king and cheated the seamen. As regards land force, it was a violation of the law to keep at home in the king's pay " any other body of armed men, save as a guard for the royal person." On the other hand, it was "illegal to land press men" in a foreign country, but soldiers " only required a little persuasion to land." Thus by thrusting into naval chaos and confusion a nucleus of disciplined, trained, and organized land troops, an expedient was found which offered a solution of the many political and administrative difficulties of the time. This "Admiral's regiment" was the germ which by a constant process of evolution during a period of over 23-5 years has produced not merely the marine forces, but the royal navy, organ- ized, disciplined, and trained as it is to-day. In 1668 the experi-ment of the Admiral's regiment was extended. At a Council held "to discourse about the fitness for entering men presently for manning the fleete," King Charles II. "cried very civilly, 'If ever you intend to man the fleet without being cheated by the captains and pursers, you may go to bed and resolve never to have it manned.'" This seems to throw some light on the Council's order a few days later "to draw out and furnish such numbers of His Majesty's Foot Guards for His Majesty's service at sea this summer, as H. R.H. the Duke of York, Lord High Admiral of England, shall from time to time desire." The men were to be paid and accounted for by their own officers. This maritime force subsequently disappeared, but two new regiments of "marines" were raised in 16'.)4, the House of Commons directing they " were to be employed in the service of the navy only." One regiment only was to be on shore at a time, and to be employed in the dockyards with extra pay. None of the officers were to be sea commanders, save two colonels. The intention was to make these regiments feeders for the navy, captains being ordered to report periodically "the names of such soldiers as shall in any measure be made~~

~~seamen, and how far each of them is qualified toward being an able seaman." In 1697 these regiments were disbanded, but early in the reign of Queen Anne a number of regiments of marines were raised, and independent companies of marines were also enlisted in the West Indies. At the Peace of Utrecht (1713) the marines were disbanded, but reappeared in 1739 as part of the army ; and in 1740 three regiments of marines were raised in America, the colonels being appointed by the Crown, the captains by the provinces. In 1747 the marine regiments were transferred from the control of the Secretary of War to that of the Admiralty, and the next year once more wholly disappeared on the Treaty of Aix la Chapeile (1748).~~

~~During the preceding period of fifty-four years the marine force appeared and disappeared with war. It was a military body, applied to naval purposes. Its main functions were threefold— (1) for fighting in ships ; (2) for seizing and holding land positions necessary or ad- vantageous to the naval operations of war ; (3) for main- taining discipline of the ships, and by "expertness in handling arms to incite our seamen to the imitation of them." Incidentally the force came to be regarded as so good a feeder for the navy that Admiral Vernon (1739) urged " the necessity of converting most of our marching regiments into marines, and if, as they became seamen they were admitted to be discharged as such, that would make a good nursery for the breeding of them."~~

~~The organization of the force was purely military. Regiments were embarked in fleets, and distributed in the ships. The officers were interchangeable with those of the guards and line. John Churchill (afterwards Duke of Marlborough) and George Rooke (afterwards Admiral Sir George Rooke) were together at one time ensigns of marines. During this period the marines were never regarded as a reserve for the fleet. The navy in peace did without them. The necessities of maritime war demanded a mobile military force adapted to naval conditions and at naval disposal, and so in all naval operations during these eighty-four years the marines played a conspicuous part. The navy had been slowly~~

groping towards a system. For example, sea officers had been granted a uniform, and a naval academy (1729) had been established for the education of young gentlemen for the sea service. But in its main features the navy remained in 1748 as it was in 1664. The sailor was kidnapped and forced into ships, to become an outcast when no longer wanted. The marine when not in a ship was oomfoi't- ably housed and looked after by his officers in barracks on shore.

In 1755 the marine force once more reappeared under the Ad- miralty, and from that date its history has been continuous. But the regimental system was abandoned, and an entirely new princi- ple of organization was applied. Companies were raised, and these companies were grouped into great dep6ts, called divisions, at Portsmouth, Plymouth, and Chatham. At these divisions this force could be increased and reduced at pleasure, without disturb- ing the basis of organization, and from them could be supplied as many or as few sea soldiers as fleets or ships needed, while preserv- ing in the varying units so provided all the essentials of uniformity of system, drill, training, ties of comradeship, and esprit de corps. This force then and for ninety-eight years afterwards was the only continuously trained, disciplined, and organized fighting force placed by the country at the disposal of naval officers. On the establishment of this new marine force the purchase of commissions was abolished, but interchange with the army was for a time per- mitted. When embarked, marines were under the naval code of discipline ; when on shore, under the marine Mutiny Act, identical with that of the army. When the seamen of the fleet mutinied at the Nore, at the close of the 17th century, and turned their officers out of the ships, the marines, undaunted, stood firm by theirs.

Mutiny lurked beneath the deck of many a ship before and long years after that dramatic event. .The control of admirals and captains over their own men was precarious in the extreme. This was the natural result of the country's neglect of its seamen. The discipline of the fleet in those days rested on the firm bayonets of the marines. What England owes to them may be gathered from Lord St Vincent's recorded testimony : ' ' There never was an appeal made to them for honour, courage, or loyalty, that they did not more than realize my highest expectation. If ever real danger

~~*should come to England, the marines will be found the country's sheet anchor." At his earnest solicitation the marines were made a royal corps in 1802. It is worthy of note that in those days of masts, yards, sails, and pure seamanship, this greatest of naval statesmen, this matchless naval strategist, whose practical experi- ence of maritime war was unrivalled, strenuously advocated as the true policy for England what in these days of steam and mastless ships would be scouted and ridiculed. It was to make service afloat as marines a part of the duty of every regiment of the line in rotation.*~~

~~*Down to 1804 the marines were an infantry force ; the improve- ment in artillery towards the close of the century had necessitated the occasional putting into the fleet of detachments of Eoyal Artillery. This, as regards gunnery duties in the fleet, was repeating on a smaller scale the expedient adopted in the time of Charles II. So much friction arose between the naval and the artillery officers that a special corps of Royal Marine Artillery was raised in 1804, on the recommendation of Nelson. This special corps fulfilled the expectations of its founders. It was charged with the care, equipment, and working of the larger ordnance*~~

~~*afloat and field guns ashore, and was employed also as a body of gunnery instructors to the fleet. In 18.31, a certain number of naval officers being thought to be sufficiently trained in gunnery, this corps, of which Napier wrote, " Never in my life have I seen soldiers like the Royal Marine Artillery," was, without warning, abolished. Then the marine force ceased to be composed of two corps, artillery and infantry, and it reverted to a single one of infantry. Very soon afterwards, however, the Admiralty began to build up what they had so suddenly and ruthlessly destroyed, by ordering the conversion of one company of each infantry marine division into artillery. The number of these artillery companies gradually increased, and were grouped in a separate dep6t. Just as the wars from Charles II. to George III. had demanded marines, so the Crimean war led to their increase. Thus in 1859 the artillery companies of marines were formed into a separate division, and in 1862 the old name of Eoyal Marine Artillery was restored.*~~

~~*The marines thus became once more and still remain two corps, the official designation of the whole being Royal Marine Forces. In 1855 the marine infantry corps became light infantry, and in 1869 the Woolwich division (added in 1805) was abolished ; and more recently a marine dep6t, as a feeder of the other divisions, was established at Walmer. The headquarters of the R.M.A. are at Eastney, Southsea. The divisions R. M.L.I, are at Gosport, Chatham, and Devonport. Tlie uniform of the R.M.A. is blue with red facings, that of R. M.L.I, red with blue facings. The badge of both corps is the globe surrounded with the laurel wreath, with the motto "Per mare per terram." The Royal Marine Forces share with the 3rd Battalion Grenadier Guards, the East Kent Regiment (formerly the Buffs), and the Royal London Militia the privilege of marching through the City of London with colours flying, bands playing, and bayonets fixed. This is due to a com- mon original association with the London train bands.*~~

~~*War Services. — To describe these would be to review the wars waged by England by sea and by land for over 200 years. In every sea fight, great or small, marines have taken part, and on every continent they have served in big and little wars, sometimes as part of the army, sometimes with naval contingents, sometimes alone. The varied nature of the work done by the marines afloat and ashore during the Napoleonic war may be shortly illustrated by quoting the record of war services of one single marine officer, who died wholly unnoticed within the memory of many men now living. HIs name was NicoUs, but in official or public regard it had no honoured place. " With 1.3 volunteers in a boat of the Blanche frigate, he boarded and captured on 3rd November 1803 the French armed cutter Albion from under the guns of Monte Cristi, San Domingo ; in this action he was severely wounded by a musket ball, which, entering the abdomen and coming out at his right side, lodged in the arm. On board the Standard at the passage of the Dardanelles on 19th February 1807. On 26th June 1808, with a boat's crew he boarded and captured the Italian gun- boat Volfe near Corfu. Present at the reduction of the island of Anholt in May 1809. Severely wounded at the attack on Fort Bowyer 15th September 1814. Was frequently employed in boat and battery actions. In 1808 was in a boat at the capture of a French brig ; in 1804 he commanded the Royal Marines during the siege of Curagoa, and for*~~

~~*twenty-eight consecutive days was exposed to several attacks of the enemy. At the passage of the Dardanelles he captured the Turkish flag, and was honourably mentioned. In 1807 he was at the blockade of Corfu and the expedition to Egypt. In North America he raised and commanded a regiment of Indians, and was senior major of all the troops engaged in the attack on New Orleans in 1814. Was also governor of the islands of Anholt and Ascension. During the above service he had his left leg broken and right leg severely wounded, was shot through the body and right arm, received a severe sabre cut in the head, was bayoneted in the chest, and lost the sight of an eye in his 107th action with the enemies of his country. He was frequently mentioned in despatches, and received a sword of honour from the Patriotic Fund."*~~

~~*During the Crimean war, mortar-boat flotillas in the Baltic and Black seas were commanded and manned by R.M.A., while com- rades in the same corps served with the Royal Artillery in the trenches before Sebastopol — a marine infantry brigade occupying the heights of Balaklava. During the Indian Mutiny marines (artil- lery and infantry) served with the Naval Brigade under Peel. In the China wars batteries and brigades of the marine force played a prominent part, and likewise were represented in all the Egyptian and Sudan campaigns, 1881 to 1898. In one action the R.M.A. gunners came to the relief of the Royal Horse Artillery when exhausted, and fought their guns ; in another the R.M.A., out of the debris of the enemy's Krupp guns captured, built up one com- plete gun and fought it with effect ; in the final campaign gunboats were brought up in pieces, put together, and fought by a detach- ment of the R.M.A.*~~

~~*In 1899 in the Boer war the marine artillery and infantry took part with the Naval Brigade, maintaining their historic*~~

~~*reputation, and at the battle of Enslin their losses were excep- tionally severe.*~~

~~*Characteristics of Marine System.— The recruit first goes to the depot at Walmer, and is trained as a soldier before joining his division to complete instruction as a marine. His division is his permanent military home, from which he goes on service and to which he returns at its conclusion. Restrictions on marriage, necessary under the army system, are not necessary in the marine forces. The permanent home of the wife and family is not broken up by the marine going abroad ; the wife thus can continue any local goodwill in any business her industry may secure. This fixed home enables a marine to learn a trade in the workshops of his division which supply the clothing, &c., to the corps. Marines are enlisted for 12 years, and if of good character they can re-engage to complete 21 years, entitling to pension. The periods of service abroad for marines are shorter (generally 3 years), but more constantly recurrent than for the army. The administrative, as distinct from the instructional, staff necessary for a marine division is more simple and less expensive than that of a numerical army equivalent expressed in regiments. The system of pay and accounts is also less complex. The following table shows the relative proportions of marine forces to the whole navy at different periods :^*~~

~~*Tear.*~~

~~*Navy*~~

~~*proper.*~~

~~*Officers*~~

~~*and Men.*~~

~~*Marines.*~~

~~*Officers*~~

~~*and*~~

~~*Men.*~~

~~*Grand Total.*~~

~~*Maritime.*~~

~~*Peace or*~~

~~*War.*~~

~~*Percent. Marines to Total Forces.*~~

~~*Nature of Ships.*~~

~~*1805*~~

~~*1838 1858*~~

~~*18T8*~~

~~*1898*~~

~~*90,000*~~

~~*23,165 40,219*~~

~~*42,046*~~

~~*78,441 1*~~

~~*80,000*~~

~~*9,000 14,919*~~

~~*18,727*~~

~~*17,099*~~

~~*120,000*~~

~~32,165~~

~~55,188~~

~~56,773 95,640~~

~~War (Trafalgar)~~

~~Y Peace~~

~~25~~

~~28 27~~

~~24~~

~~17~~

~~Sailing.~~

~~Sailing.~~

~~Sailing with aux- iliary- steam.~~

~~Steam with aux- iliary sail.~~

~~Steam and mast- less ships.~~

~~The above table indicates a gradual change in naval policy and practice as regards marines. It will be observed that, concurrently with the gradual disappearance of masts, sails, and yards, the proportion of marines has steadily declined. Down to very recent times the marine spent more time ashore than afloat. Now the reverse is the case. There are 10,806 afloat and only 7745 on shore, and the latter figure includes the whole of the administrative and instructional staff and all the recruits under training.~~

~~By the introduction of the Continuous Service Act, 1853, the blue-jacket was placed on exactly the same footing as the marine in respect of conditions of service and pension, and now the blue-jacket vs^hen not~~

~~afloat is quartered in barracks. The main difference between the blue-jacket and marine is the dress and the pay. The blue-jacket is better paid than the marine. As regards opportunity of discipline, there is now no difference; and in short, all the reasons for the existence of a marine force have dis- appeared except as regards duties on shore incidental to naval operations of war, e.g., the holding of ports and the seizing of minor positions necessary to prosecution of maritime war. The facts that modern ships cannot now as formerly carry a supernumerary force sufficient for such purposes, and are more dependent on fixed bases of supply and repair than in old days, point to a difEerent method of using and applying the marine force to the sole purpose for which they are now necessary as a distinct branch of the naval service. If employed at the headquarters of a naval station, their efficiency as marines could be pre- served by occasional embarkation of the officers and men in rotation. The substitution of marine for army garrisons at coaling stations would also relieve the army of a class of duties incidental to naval w^arfare which the marine force formerly performed, and which prejudicially affects the organization and arrangement of the army as a mobile field force.~~

~~Marine Corps, United /States.— This is the oldest force in the American service. It was formed in 1775, and it has a history of brilliant services rendered by land and sea in all the wars of America since that date. The~~

~~1 Includes 22,289 of the engineer branch providing the locomotion of modern ships— just as seamen from 1805-58 provided it for ships of the past.~~

~~headquarters of the corps are at Washington, and the strength of the corps was fixed by Act of Congress (rfrd March 1899) at 211 officers and 5920 non-commissioned officers and men. Its organization and system are based on the British model, and the dress corresponds to that of the United States army. A brigade of three battalions served in the Philippines in 1899. (j- c- e- c.)~~

~~Marine Salvage. See Salvage.~~

~~Marinette, a city of Wisconsin, U.S.A., oapita,l of Marinette county, on the shore of Green Bay, Lake Michi- gan, at the mouth of the Menominee~~

river, in the eastern part of the state, at an altitude of 611 feet. It is opposite Menominee, Michigan, with which it is connected by bridges over the Menominee river. It has an excellent harbour, and a large lake commerce, principally in lumber and iron ore. It has three railways, the Chicago and North- Western, the Chicago, Milwaukee, and St Paul, and the Wisconsin and Michigan. Its manufacturing establish- ments consist in great part of saw, shingle, and planing mills, and paper and pulp mills. Population (1880), 2750; (1890), 11,523; (1900), 16,195, of whom 5542 were foreign-born. The death-rate in 1900 was 14-3.

Marino, a town of the province of Rome, Italy, on a spur (1422 feet) of the Alban hills, 15 miles south-east of Eome. It occupies the site of the ancient Castrimaenium. In the Middle Ages it was a stronghold, first of the Orsini, then of the Colonna. It has a cathedral, and possesses soap factories, ironworks, and tanneries, and is famous for its wine. Population, about 6000.

Mario, Giuseppe, Count of Candia (1810- 1883), Italian singer, the most famous tenor of the 19th century, son of General di Candia, was bom at Cagliari in 1810. HIs career as a singer was the result of accidental circumstances. While serving as an officer in the Sardinian army he was imprisoned at Cagliari for some trifling offence. When his period of confinement was over, he resigned his commission. HIs resignation was refused, and he fled to Paris. There his success as an amateur vocalist produced an offer of an engagement at the Opera. HIe studied singing for two years under M. Ponchard and Signor Bordogni, and made his dSbut in 1838 as the hero of Meyerbeer's Robert le Diahle. HIs success was immediate and complete, but he did not stay long at the Opera. In 1839 he joined the company of the The3,tre Italien, which then included jMalibran, Sontag, Persiani and Grisi, Eubini, Tamburini, and Lablache. HIs first appearance here was made in the character of Xemorino in Donizetti's Elisir cVAmore. HIe sang in London for the first time in the same year. HIs success in Italian opera far surpassed that which he had won in French, and in a short time he acquired a European reputation. HIe had a handsome face and a graceful figure, and his voice, though less powerful than that of Eubini or that of Tamberlik, had a velvety softness and richness which have never been equalled. Experience gave him ease

~~as an actor, but he never excelled in tragic parts. IIe was an ideal stage lover, and he retained the grace and charm of youth long after his voice had begun to show signs of decay. IIe created very few new parts, that of Ernesto in Don FasquaJe (184;!) being perhaps the only one deserving of mention. Among the most successful of his other parts were Otello in Eossini's opera of that name, Gennaro in Lucrczia Bonjia, Almaviva in U Barhiere di iSiviglia, Fernando in La Favnrita, and Maurico in 11 Troratore. Mario made occasional appearances in oratorio, singing at the Birmingham Eestival of 1840 and at the IIereford Festival of 1856, and undertook various concert tours in the United Kiugdoni, but his name is principally~~

~~"A ViLLAdii Scene." By Jacob Mauis.~~

~~associated with triumphs in the theatre. In 1856 he married G-iulia Grisi, the famous soprano, by whom he had five daughters. Mario bade farewell to the stage in 1871. IIe died at Eome in reduced circumstances, 11th December 1883. (r. a. s.)~~

~~Marion, a city of Indiana, U.S.A., capital of Grant county, 67 miles north-east of Indianapolis, towards the north-eastern part of the state, on the Cleveland, Cincin- nati, Chicago and St Louis, the Pittsburg, Cincinnati, Chicago and St Louis, and the Toledo, St Louis and Western railways, at an altitude of 811 feet. It is in an agricultural and natural gas region, and its manufacturing establishments include glass-works, flour-mills, and steel rolling mills. It is the site of a national soldiers' home. Population (1880), 3182; (1890), 8769; (1900), 17,337, of whom. 564 were foreign-born and 650 were negroes.~~

~~Marion, a city of Ohio, U.S.A., capital of Marion county, a little north of the centre of the state, on the Cleveland, Cincinnati, Chicago and St Louis, the IIocking Valley, the Columbus, Sandusky and IIocking, and the Erie railways, at an altitude of 979 feet. It is in a rich agricultural region, and its manufactures consist mainly of agricultural tools and~~

~~*machinery. Population (1880), 3899 ; (1890), 8327 ; (1900), 11,862, of whom 782 were foreign-born and 112 were negroes.*~~

~~*Maris, Jacob (1837-1899), Dutch painter, first studied at the Antwerp Academy, and subsequently in Hebert's studio during a stay in Paris from 1866 till 1871. He returned to Holland when the Franco-Prussian war broke out, and died there in August 1899. Though he painted, especially in early life, domestic scenes and inte- riors invested with deeply sympathetic feeling, it is as a landscape painter that Maris will be famous. He was the painter of bridges and windmills, of old quays, massive towers, and level banks ; even more was he the painter of water, and misty skies, and chasing clouds. In all his works, whether in water or oil-colour, and in his etchings, the subject is always subordinate to the effect. His art is suggestive and realistic rather than decorative, and his force does not seem to depend on any preconceived method, such as a synthetical treatment of form or gradations of tone. And yet, though his means appear so simple, the artist's mind seems to communicate with the spectator's by directness of pictorial instinct, and we have only to observe the admirable balance of composition and truthful perspective to understand the sure knowledge of his busi- ness that underlies such purely impressionist handling. Maris has shown all that is gravest or brightest in the land- scape of Holland, all that is heaviest or clearest in its atmosphere — for instance, in the " Grey Tower, Old Am- sterdam," in the " Landscape near Dordrecht," in the " Sea- weed Carts, Scheveningen," in " A Village Scene " (see Plate), and in the numerous other pictures which have been exhibited in the Royal Academy, London, Edinburgh (1885), Paris, Brussels, and Holland, and in various private collections. " ISTo painter," says M. Philippe Zilcken in his work on the modern painters of the Netherlands, "has so well expressed the ethereal effects, bathed in air and light through floating silvery mist, in which painters delight, and the characteristic remote horizons blurred by haze ; or again, the grey yet luminous weather of Holland, unlike the dead grey rain- of England or the heavy sky of Paris."*~~

~~*See Max Rooses. Dutch Painters of the Nineteenth Century. London, 1899. — R. A. M. Stevenson. "Jacob Maris," Magazine of Art, 1900. — Ph. Zilcken. Feintres Hollandais Jlodernes. Am- sterdam, 1893. — Jan*~~

~~*Veth. "Een Studie over Jacob Marls," Onze Kunst. Antwerp, 1902. (o. M*.)*~~

~~*Maritime Province (Primorskaya Oblast), a pro- vince of Eussia, representing a strip of territory along*~~

~~*the Pacific coast of Russian Manchuria and East Siberia, from the Korean town Kyghen-nu (42° 38′ N.) to Bering Strait. Area, 715,990 square miles. The population in 1898 was 228,824, of whom only 73,455 were women, and 50,585 lived in towns, while the remainder were distrib- uted as follows :— South Usuri, 98,711 (and 29,185 at Vladivostok) ; North Usuri Cossacks, 20,917. The popu- lation of the Khabarovsk district is 12,692 (and 15,082 in the town of Khabarovsk) ; of Udskoi district, 10,032 (and 5726 at Nikolaievsk) ; Okhotsk district, 4615 (and 199 at Okhotsk town) ; Petropavlovsk district (Kamchatka), 8010, and 398 at the town of same name ; Ghizhiga dis- trict, 7571 ; Commander Islands, 653 ; Anadyr district (Chukchi Land), 12,425; mining district, 2608. The Russians number 128,946 ; the natives (Chukchi, Tungus, Orochons, Golds, &c.), 44,705; the Koreans, both Rus- sian and Korean subjects, 23,279; the Chinese, 29,284 (only 453 women) ; the Japanese, 2030 ; various, 680. The yearly increase during the years 1896-97 was from 2438 to 3170. Commander Islands — Bering, Myednyi (Copper), and Tyuleniy — are important as the centre for seal-hunting. In the years 1871 to 1891 an average of 30,000 seals (occasionally 50,000) were killed on these islands every year. But as the American and British hunters kill the seals at distances of from 30 to 150 miles from the islands, the number of seals obtained on Commander Islands fell to an average yearly catch of only 13,000.*~~

~~*Hunting remains an important branch of income, the yearly items being about 5800 sable furs, 15 beaver, 2700 fox, 65,000 squirrel, 1830 bear, and so on. Fishing (salmon and other fish) is considerable in Kamchatka, the Sea of Okhotsk, and along the Manchurian coast, as also in the Amur, the Usuri, and other rivers. Active measures were taken in 1883-97 for increasing the Russian population in the.Soiith Usuri district, the result being that 29,093 immigrants, chiefly Little Russian peasants, trans- ported on board ships from Russia, settled there, although 501 of*~~

them chose to return to Russia. Besides, 3788 Cossacks from the Don and Orenburg (1746 women) came to settle among the Usuri Cossacks. The immigration of Koreans to the Usuri region, which was especially strong after the famine in Korea in 1869, has now been stopped by law. Agriculture is gradually developing in the South Usuri region, where 127,600 acres were under grain crops in 1897, but it shows slow progress among the Cossacks, who had only 18,900 acres under crops. It is estimated that there were in the same year 39,215 horses, 58,070 horned cattle, 1250 sheep, 168,700 reindeer, and 32,130 trail-dogs in the Maritime Province. Gold-mining has been started in the province on the Amguii, a tributary of the Amur, and from 264 lb in 1889 it attained 4660 lb in 1897. Coal is found on the Muravioff-Amursky peninsula, near Vladivostok, as well as in Kamchatka. Maritime trade has been on the increase, the number of ships visiting Nikolaievsk, at the mouth of the Amur, being 86 (chiefly Japanese), and Vladivostok, 246 (chiefly German), in 1897. The total imports were : 14,340,000 roubles in 1806, and 6,299,000 in 1897 (mostly for the Crown). As to river steamers, 120 were afloat in the same year in the system of the Anmr, and this number has increased since. But when the Amur is frozen, there is no communication between Khabarovsk and Blagovyestchensk or Nikolaievsk, except on sledges along the river, or on horseback when the ice is not safe. Roads exist only in the South Usuri district. At present a railwa}' line runs from Vladivostok to Nikolsk (69 miles), and thence to Khabarovsk along the right bank of the Usuri (400 miles). At Kikolsk begins the Manchurian railway, which, notwithstanding the delay occar-sioned by the Boxer rising, is ready now as far as Transbaikalia, and is open for service and partly for private traffic.

See Maritime Province (Primorskaya Oblast), by P. Tn. Untee- eerger. St Petersburg, 1900. — Memoirs of Russ. Geogr. Soc, Statistics, vol. viii. (p_ j^_ j^)

-), English jurist,

Marlcby, Sir William (1829-

the fourth son of the Rev. William HHenry Markby, rec- tor of Duxford St Peter's, was born at Duxford, Cam- bridge, in 1829. HHe was educated at

~~*Bury St Edmunds and Merton College, Oxford, where he took his degree in 1850. In 1856 he was called to the bar, and in 1865 he became recorder of Buckingham. In 1866 he went to India as judge of the HIgh Court of Calcutta. This post he held*~~

~~*for twelve years, and on his retirement was appointed Eeader in Indian Law at Oxford. In 1892 he was a member of the Commission to inquire into the adminis- tration of justice at Trinidad and Tobago. Besides Lect- ures on Indian Law, he wrote Elements of Law considei-ed with reference to the General Principles of Jurisprudence. The latter, being intended in the first place for Indian students, calls attention to many difficulties in the defini- tion and application of legal conceptions which are usually passed over in text-books, and it ranks as one of the few books on the philosophy of law which are both useful to beginners and profitable to teachers and thinkers. In 1897 appeared Tlie Lidian Evidence Act, with Notes. Sir William Markby also contributed to the law magazines articles on Law and Fact, German Jurists and Roman iaw. Legal Fictions, &c., several of which are embodied in the later editions of the Elements. HIe was made D.C.L. of Oxford in 1879, and K.C.I.E. in 1889.*~~

~~*Market. — This term is used in two well-defined senses: —*~~

~~*(1) It means a definite place where traders who are retail sellers of a specific class of commodity or commodi- ties are in the habit of (a) awaiting buyers every day in shops or stalls ; or (h) proceeding to the place in ques- tion on specified days at more or less frequent regular intervals. Covent Garden market for fruit and flowers, and Leadenhall market for meat and poultry, are good examples in London of the kind of institution included in class (a). They are a very ancient economic phenomenon, dating from the earliest period of the development of or- ganized communities of human beings, and in general char- acteristics have changed little since they began to exist.*~~

~~*Markets of the type of class (&) are also of very ancient origin (see Faiks, vol. viii.), but inasmuch as they are con- stituted essentially by the presence of persons, many of whom assemble from various places outside the place of meeting, they were capable of a little more development than those belonging to class (a), owing to increased facili- ties for locomotion. The nature of an ancient market of class (a) , whither a citizen, say of Athens, or his chief slave, proceeded daily to make household purchases, differs little from the group of shops visited by the wives of the poor or less wealthy citizens of modern states. In many places abroad, and not a few in England, actual markets still exist. It may be said that the huge collections of shops, such as the various co-operative stores, are only a revival of the old "market-place," with its shops or booths gathered round a central area, adapted to the needs of modern big cities.*~~

~~*(2) The term " market " has come to be used in another and more general sense in modern times. According to Jevons, a market is " any body of persons who are in intimate business relations, and carry on extensive trans- actions in any commodity." He adds that " these m arkets may or may not be localized," and he instances the money market as a case in which the term " market " denotes no special locality. As a rule, however, most of the business of a market is transacted at some particular place, such as the London Stock Exchange, the Baltic, the Bourse of Paris, the Chicago " Wheat-pit." Even in the case of the London money market, merchants still meet twice a week at the Royal Exchange to deal in foreign bills, although a considerable part of the dealings in these securiti* is arranged daily at offices and counting-houses by personal visits or by telegraphic or telephonic communication. The markets in any important article are all closely intercon- nected. The submarine cable has long ago made Chicago as important an influence on the London corn market as Liverpool, or rather both London and Liverpool affect and are simultaneously affected by Chicago and other foreign*~~

~~*markets. In like manner the Liverpool cotton market is influenced by the markets in New Orleans and other American cities separated from it widely in space. In a. minor degree the dealers in all places where a cotton market exists affect the bigger markets to some extent. What is true of the cotton market is also true to some extent of all markets, though few*~~

~~*markets are so highly organized or show such large transactions as that for cotton. Among other markets of the first class may be mentioned those for pig-iron, wheat, copper, coffee, and sugar. There are many articles the markets for which are of considerable dimensions at times, but are of an intermittent character, such as the London Wool Sales, which take place now in five " series " during the year. Formerly the number of " series " was four.*~~

~~*Chakacteeistics of Mabkets.*~~

~~*The conditions required in order that the operations of a trading body may display the fully-developed features of a modern market, whether for commodities or securities, are : —*~~

~~*(1) A large number of parties dealing.*~~

~~*(2) A large amount of the commodities or securities to be dealt with.*~~

~~*(3) An organization by which all persons interested in the commodity or security can rapidly communicate with 6ne another.*~~

~~*(4) Existence and frequent publication of statistical and other information as to the present and probable future supply of the commodity or security.*~~

~~*The movements which take place in prices in any market, whether fully organized or not, depend largely on changes of opinion among buyers and sellers. The changes of opinion may be caused by Move- erroneous as well as by correct information, prices"' They may also be the result of wrong inferences drawn from correct information. In markets for commodities of the first importance such as wheat, cotton, iron, and other articles which are dealt in daily, the state of opinion may vary much during a few hours. The broad characteristics of markets of this class are similar. There is a tendency in all of them to show phenomena of annual periodicity, due partly to the seasons, the activity of certain months being in normal years greater in the case of any given market than that of other months. This tendency was always liable to be interfered with by the special forces at work in particular years ; and the great increase in the facilities of communication between dealers by telegraph, and of*~~

~~transportation of commodities between widely distant points, which wasone of themarked features of the development of the economic organism in all actively commercial countries during the last thirty years of the 19th century, has still further interfered with it. Never- theless, a tendency to annual periodicity is still perceptible, especially in markets for produce of the soil, the supply of which largely depends on the meteorological conditions of the areas where they are grown on a scale sufficient to furnish an appreciable proportion of the total produce.~~

~~Periodicity of another kind known as " cyclic," and due to a different set of causes, is believed to exist by many persons competent to form a judgment; but althouo-li the evidence for this view is, in the <^.>'«'e"- opinion of the present writer, very strong, the theory expounding it is not yet in a sufficiently advanced state to admit of its being regarded as established.~~

~~Pheisjomena op Markets.~~

~~Bagehot said of the money market that it is " often very dull and sometimes extremely excited." This classical~~

~~Disturbance of equilibrium.~~

~~description of the market for non-specialized wealth ap- plies to a large extent to all markets.~~

~~Every market is at every moment tending to an equilibrium between the quantity of commodities offered and that of commodities desired ; supposing Tendency equilibrium to have been attained in a given tibrium. market, and that for some appreciable period it is not disturbed, the price for the com- modity dealt in in the market will remain practically unchanged during that period. Not that there will be no transactions going on, but that the amounts offered daily will be approximately equal to the amounts de- manded daily.~~

~~*We have briefly described the statical condition of a market ; we must now briefly examine its dynamics. Disturbance may take place through a change in — ^1) Supply, or opiuion as to future probable supply.*~~

~~*(2) Demand, or opinion as to future probable demand.*~~

~~*(3) In both simultaneously, but such a change that demand is increased or decreased more than the supply, or vice versd.*~~

~~*A moderate disturbance caused by one of the above changes, or a combination of them, will produce an im- mediate effect on the price of the commodity, which again will tend to react on both the supply and the demand by altering the opinions of sellers and buyers. If no further change tending to disturb the market takes place, the market will gradually settle down again to a state of equilibrium. But if the disturbance has been consider- able, a relatively long time may elapse before the market becomes quiet ; and very likely the level of price at which the new equilibrium is established will be very different from that ruling before the disturbance set in. Further scientific investigation of the dynamics of a market is in any case very difficult, and is impossible without a complete analysis of the statical condition, such as is found at length in the text-books of mathematical economics; but it is possible to describe briefly certain dynamical phenomena of markets which are of a compara- tively simple character, and are also of practical interest. Every great market is organized with a view not merely to the purchase and sale of a commodity at once, or " on the spot," but also with a view to the future requirements of buyers and sellers. This or- ganization arises naturally from the necessities of business, since modern industry and commerce are carried on continuously, and provision has to be made for the requirements, say, of a spinning-mill, by arrang- ing for the delivery of successive quantities of cotton, wool, or silk over a period of months " ahead." In the case of cotton " forward deliveries " can be purchased six or seven months in advance, and the person who under- takes to deliver the cotton at the times stated is said in the language of the market to " sell forward."' If the quantity of cotton produced each year were always the same, no very remarkable results would follow from this mode of doing business except the economy resulting to the spinner from not being*~~

~~compelled to lock up part of his capital in raw material before he could use it. But as the cotton and other crops vary considerably from year to year, some curious consequences follow from the practice of "selling forward." The seller, of course, makes his bargain in the belief that he will be able to " cover " the sale he has made at a profit — that is, he hopes to be able to buy the cotton he has to deliver at a lower price than he undertook to deliver it at. If so, all is well for both parties, for the buyer has had the ad- vantage of having insured a supply of cotton. But sup- posing something has happened to raise the price con- siderably, such as a great " shortage " of the crop, the~~

~~seller may lose. If a great many other persons have taken the same mistaken view of the probabilities of the market, a condition of things may arise in which they may be " cornered."~~

~~A " corner " in an exchangeable article is an abnormal condition of the market for it, in which, owing to a serious miscalculation of probable supply, ^ „~~

~~many traders who have made contracts to de- liver at a certain date are unable to fulfil them. In most cases the fact that the market is " oversold " be- comes known some time before the date for the com- pletion of the contracts, and other traders take advantage of the position to raise the price against those who are " short " of the article. A corner is therefore usually a result of the failure of a speculation for the fall. Theo- retically a trader who has undertaken to deliver 100 tons of an article, but cannot, after every endeavour -, obtain more than 90 tons, could be made to pay his whole capi- tal in order to be relieved from the bargain. In practice he gets off more easily than this. Frequently when many traders have sold largely " forward " other traders deliberately try to use that position as a basis for creat- ing a " corner." Generally, however, they only succeed in causing great inconvenience to all parties, themselves included, for as a rule they are only able to make the " corner " effective by buying up so much of the article that when they have compelled their opponents to pay largely to be relieved of contracts to deliver, they are left with so big a stock of the article that they cannot sell it except at a loss, which is~~

~~sometimes big enough to absorb the gain previously secured. In the case of very small markets " corners " may be complete, but in big markets they are never complete, something always hap- pening to prevent the full realization of the operators' plans. The idea of a " corner " is, however, so fascinat- ing to the commercial mind, especially in the United States, that probably no year passes without an attempt at some operation of the kind, though the conditions may in most cases prevent any serious result.~~

~~" Corners " have what is called a " moral " aspect. It is curious to note that the indignation of the " market " at the disturbance to prices which results from opera- tions of this kind is generally directed against the specu- lators for the fall, while that of the public, including trade consumers, is directed against the operator for the rise. The operator for the fall, or " bear," is denounced for " selling what he has not got," a very inaccurate de- scription of his action, while the " bull " or operator for the rise is spoken of by a much wider circle as a heart- less person who endeavours to make a profit out of the necessities of others. From a strict ethical standpoint there is really nothing to choose between the two.~~

~~The Monet Market.~~

~~There is one market which presents features of so peculiar a character that it is necessary to describe it more particularly than other phenomena of the kind, and that is the money market. The term money is here ustd to denote non-specialized wealth, a form of wealth which has existed from early times, but not in great abundance until within the last two or three hundred years. Immense wealth has existed in certain countries at various epochs, owing to the fertility of the soil, success in trade, or the plunder of other communities, and all states which have been great have at the time of their greatness possessed wealth ; but the wealth which the countries, or a few for- tunate individuals belonging to them, owned consisted largely of what is still called real property — that is, land and buildings — and of the produce of the soil or of mines. The balance consisted partly of merchandise of various kinds and shipping, and to a large extent of the precious metals,~~

~~*in the form of coin or bullion, or of precious stones and jewellery. Where no settled government was established no one could become or remain very wealthy who was not in a position to defend himself by the strong hand, or allied with those who were ; and as a rule the only peo- ple who could so defend themselves were possessors of large areas of rich land, who were able to retain the ser- vices of those who dwelt on it either through their per- sonal military qualities or in virtue of habit and custom. The inhabitants of wealthy cities were able to protect themselves to some extent, but they nearly always found it necessary to ally themselves with the neighbouring land-owners, whom they aided with money in return for military support.*~~

~~*A money market in the modern sense of the word could only exist in a rudimentary form under these conditions. There was a sort of money market, for there was a changing rate of interest and a whole code of law relating to it (Macleod, Banking, 3rd ed. p. 174) in republican Eome ; but although large lending and borrowing trans- actions were part of the daily life of the Roman business world, as well as of those of the Greek cities and of Carthage and its dependencies, none of these communities presented the phenomena of a highly organized niarket. Money-lending was also a regular practice in Egypt, Chaldea, and other ancient seats of civilization, as recent discoveries show. It was only in comparatively recent times, however, when Europe had formed itself into more or less organized states, with conditions fairly favourable to the steady growth of trade and industry, that organized money markets came into existence in places such as Venice, Genoa, Augsburg, Basel, the Hanse towns, and various cities in the Low Countries, Spain and Portugal, as well as in London. The financial strength of these rudimentary money markets was not very great, and as it depended a good deal on the possession by individuals of actual cash, the existence of these markets was precarious. " Hoarded ducats " were too often an attraction to needy princes, whose- unwelcome attentions a rich merchant, even when an influential burgher of a powerful city, was less able to resist than the violence of a vulgar house- breaker, against whom strong vaults and well-secured chests situated in defensible mansions were a good pro- tection. The necessitous*~~

~~*potentate could often urge his desire for a " loan " by very persuasive methods. Occa- sionally, if his predecessors had acquired the confidence of the banking class sufficiently to induce them to place their cash reserves in one of his strong places " for safety," an unscrupulous ruler could help himself, as Charles II. helped himself to the stores of the London goldsmiths which were left in the Mint. The power of the banking class continued to grow, however, and a real market for money had come into existence in many cities of Europe by the middle of the 17th century. The Bank of England was founded in 1694. " Banks " of a sort had existed in various countries certainly since the beginning of the 15th century ; and it is claimed for Child and Co. that they existed as a bank in 1659, and Martin's can trace their origin equally far as " goldsmiths." The Bank of Amster- dam was founded about 1614, and a bank was established in Barcelona in 1400 (Turner, IJanA; of Eiiijhind, p. 2) ; but until the 17th century it was difficult to distinguish mer- chants from bankers, who in England were usually known as goldsmiths. Eeaders who are interested in the early history of banking in London may be referred to Mr Hilton Price's Handbook of London Banki'm, and Mr John B. Martin's Grasshopper in Lombard Street.*~~

~~*In the 18th century the "money market" consisted of the Bank of England and various banks and merchants, the distinction between the two being still not complete. Towards the end of that century arose an important*~~

~~*class of dealers in credit, the bill-brokers, and with their appearance the modern money market of London may be said to have assumed its present form, for though the process of development has not Tbeeariy ceased, the changes have been of the nature market of growth and not of the acquisition of new organs. The formation of joint-stock banks and discount companies, however, and the reconstitution of the Bank of England by the Act of 1844, exercised an important influence on the way in which the money market of London has developed. It must be explained that in the everyday talk of the City "the market" has a special meaning, by which only the banks and discount houses are denoted, as in the phrases constantly seen in the daily reports published in the newspapers towards the end of a quarter, " the market has to-day*~~

~~borrowed largely from the Bank of England," or, "the market was obliged to renew part of the loans which fell due to the Bank to-day." But this use of the term in a special sense, thoroughly understood by those to whom it is habitual, and resulting in no ambiguity in practice, is not in accord with the requirements of economic analysis. It may be as well to add that the charge for interest on loans and for the discount of bills is always quoted as a rate per cent, per annum, and the sum actually payable is arrived at " by calculating the number of days during ^^^ which the loan, or bill, runs. modem~~

~~The working organs of the money market of money London at the beginning of the 20th century market of were : —~~

~~A. (1) The Bank of England.~~

~~(2) Banks, joint-stock and private, including several~~

~~great foreign banks.~~

~~(3) Discount houses and bill-brokers.~~

~~B. (4) Certain members of the Stock Exchange. (5) Certain great merchants and finance houses.~~

~~The institutions included in group A are the most con- stantly active organs of the money market ; those included in group B are intermittently active, but in the case of section (4), though their activity is greater at some times than others, they are never wholly outside the market. Even in the case of (6) a certain amount of qualification is needed, which is indicated by the fact that most of the great merchant houses are " registered " as bankers, though they do not perform the functions usually associated with that term in the United Kingdom. Several of the great houses were originally and still are nominally merchants, but are largely concerned with finance business — that is, with the making of loans to foreign governments and the issue of capital on behalf of companies. During the Boer war (1899-1902) their assistance was freely given to the British Government in order to provide funds for the military operations in South Africa. These power- ful capitalists often have large amounts of~~

~~money tem- porarily in their hands, and lend it in the money market or on the Stock Exchange ; one or two of them are large buyers of bills from time to time, and generally the mem- bers of this group may be said to be in sufficiently close touch with the active organs of the money market to form part of it.~~

~~The actual working of the money market has been described by that original and powerful thinker 'Walter Bagehot in his Lombard Street, a work which _ ._~~

~~has attained the rank of a classic. jMost of ing of the what he said in 1873 is true now, but in certain money minor respects developments have taken place, ""^**'- the most important being the greater extent to which money is "used up "every day, or rather every night. InBagehot's time the discount houses only quoted " allowance " rates for "loans at call and short notice" based on the rate~~

~~M A E K E T~~

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~~" allowed " by the banks for loans at seven days' notice ; but since then the bill-brokers have been obliged (1) occasionally to fix their terms independently of the banks, and (2) to " allow " a rate for " money for the night." This latter practice became usual about 1888 or 1889. The change it introduced was not a vital one, but has some importance from the point of view of the historian. A good deal of the " money " thus dealt with is derived from the group of traders included in class (6). It is (a) money which is temporarily in the hands of houses or institutions which have just received subscriptions to loans or other capital offered to the public ; (b) balances left temporarily with finance houses or banks on behalf of foreign govern- ments or other parties who have payments to make in London. In the former case the " money " is almost in- variably only available for a short time, probably only for a few days ; in the latter case also it probably will be only available for a few days, but may be available for months. Money derived from either of these sources is usually to be had cheap, but is not in the slang of the City " good," because it is uncertain how long loans at call obtained from either of them will remain~~

~~*undisturbed. Nevertheless there has been at times so much "money" of this fugitive character, and derived from such varied sources since about 1888, that its cheapness has been an attraction to the less wealthy bill-brokers, who have occasionally been able to go on using it profitably for many continuous weeks or even months in their business. The risk run by employing it is, of course, the certainty that it will be " called " from the borrower sooner or later, and probably at a time when it is very inconvenient to repay it. The more wealthy houses take money of this kind when it suits them, but never rely on it as a basis for business.*~~

~~*Since Bagehot wrote, the growth of the big joint-stock banks has been enormous, not so much through the in- creased business done by banks generally, though Thegreat ^j^g expansion in banking has been consider- able, as by the absorption of a great number of small banks by three or four large institutions (see Banking). It will probably be found in the future that the growth of these large institutions will tend to facilitate combination for purposes of common concern among banks generally — e.g., to support the Bank of Eng- land in maintaining its reserve, which is the sole reserve of all the banks, at a proper level, and thus render the money market more stable. Two or three of the banks have for a long time, owing to their large holding of bills, had much more influence than the Bank of England over the foreign exchanges, on which the foreign bullion move- ments chiefly depend ; and since 1890 persons of weight in the joint-stock banking body have implicitly, though not explicitly, admitted a certain degree of responsibility in the matter on behalf of their institutions. It is, how- ever, characteristic of British business arrangements that the question of the responsibility for the reserve of the Bank of England, the ultimate reserve of the whole country, is still in as nebulous a condition, so far as explicit acceptance of responsibility by any institution is concerned, as it was in 1870. There has been no improvement in theory, though in practice there has been real improvement, since Bagehot's time.*~~

~~*The following is a statement of the total deposits of the joint-stock banks of the United Kingdom (with one or two unimportant exceptions), and of such private banks as publish accounts, for the end of December 1901 (not in- cluding the deposits of the Bank of England) ; with the cash in*~~

~~*hand and money at call and short notice held by them at the same date (taken from the banking supplement of the Economist of 17th May 1902); with the figures for corresponding dates at the end of 1896 and 1891, the*~~

~~*reserve in the banking department of the Bank of England on 24th December 1901, 23rd December 1896, and 23rd December 1891, and the amounts cleared by the London Bankers' Clearing HIouse in 1901, 1896, and 1891.*~~

~~*Deposits.*~~

~~*Banks,*~~

~~*Decerabor 1901.*~~

~~*December 1390.*~~

~~*ileceiober 1691.*~~

~~*England and*~~

~~*Wales . Scotland . Ireland*~~

~~*£*~~

~~*584,842,000 107,321,000 49,117,000*~~

~~*£*~~

~~*495,233,000 95,695,000 45,552,000*~~

~~*£*~~

~~*391,900,000 92,368,000 39,451,000*~~

~~*Total deposits*~~

~~*741,280,000*~~

~~636,480,000~~

~~523,719,000~~

~~Cash in hand and at call.~~

~~Banks.~~

~~December 1901.~~

~~December 1890.~~

~~December 1891.~~

~~England and~~

~~Wales . Scotland . Ireland~~

~~Total cash in hand and at call .~~

~~Reserve in the Banking De- partment of the Bank of England~~

~~Amount of "paid clearing" of London clear- ing bankers .~~

~~£~~

~~153,943,000 26,870,000 10,797,000~~

~~£~~

~~115,870,000 22,005,000 9,423,000~~

~~£~~

~~91,038,000~~

~~*20,682,000 9,520,000*~~

~~*191,610,000*~~

~~*147,298,000*~~

~~*121,240,000*~~

~~*19,685,000 9,561,169,000*~~

~~*24,068,000 7,574,853,000*~~

~~*^4,011,000*~~

~~*6,847,506,000*~~

~~*With regard to the above figures, it may be pointed out that the proportion borne by the "cash in hand, &c.," to the total deposits was 25-8 per cent, in 1901, 23-1 per cent, in 1896, and 23-1 per cent, in 1891. The proportion of the reserve of the Bank of England to the total deposits was 2-7 per cent, in 1901, 3-8 per cent, in 1896, and 2-7 per cent, in 1891. The last return in December always shows a reserve below the average for the year. Although the proportion as shown by the above figures is the same as in 1891, there has really been some improvement, because the statement of deposits in that year does not include many banks, now included, which did not publish balance-sheets in the former year. The earlier proportion was therefore really smaller than it appeared to be. The Bank of England's average weekly reserve now is, moreover, much larger than it used to be before 1890. For 1889 the average weekly reserve was only £13,228,000, against liabilities probably nearly as great as those of 1891. (See Banking.) Of the "cash in hand, &c.," more than half, judging by the thirteen big banks whose accounts are analysed every month in The Times, must be in " cash in hand and at the Bank of England." It is to be regretted that all banks do not give this item separately from "cash at call and notice."~~*

The discount houses, though an important body of institutions, are not of so much importance as they were before 1866, when they suffered a serious blow through the failure of " Overend's," from which ™e as a body they have never fully recovered. The to^e" five large concerns which still exist are, however, very powerful, and exercise considerable influence on the market. They hold considerable quantities of bills at all times ; occasionally their holdings are very large ; but they turn out the contents of their bill cases readily if they think fit. Their business is _ different in practice from that of the smaller " bill-brokers," who usually are what their name suggests, namely, persons who do not hold many bills, but find them for banks who need them, charging a small commission. The small bill-brokers borrow from the Bank of England much more freely than the big discount houses. The latter only " go to the bank " in ordinary times perhaps once or twice a year. During the South African war, which disturbed the money market very much, they obtained accommodar*

tion from the Bank more frequently than usual. The small brokers almost always have to borrow from the Bank at the end of every quarter, when money is scarce owing to the regular quarterly requirements of business, and also, to some extent, because certain of the banks make it a practice to call in loans at the end of each month in order to show a satisfactory cash reserve iu their monthly balauce-sheet. This practice is not approved by the best authorities, for although it does no great harm in quiet times, the banks who follow it might find it difficult, or even impossible, to call in their loans in times of severe stringency.

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~~London and New York. — George Clare. A Money Market Primer and Key to the Exchanges. Effingham Wilson. — ■ John Stuakt Mill. Principles of Political Economy, book iii. chaps, i.-vi. (yf. Ho.)~~

~~Market Harborough, a manufacturing and mar- ket-town and parish iu the Harborough parliamentary division of Leicestershire, England, 14 miles south-east of Leicester by rail, traversed by the Grand Union Canal. There are, malt-houses and boot, shoe, and stay factories. The town is also an important hunting centre. Population of urban district (Market Harborough with Great and Little Bowden) (1891), 5876 ; (1901), 7735.~~

~~Markham, Sir Clements Robert (1830-~~

~~),~~

~~English traveller, geographer, and author, son of the late Eev. David E. Markham, canon of Windsor, and of Cathe- rine, daughter of Sir "^. Milner, Bart., of Nunappleton, Yorkshire, was born on 20th July 1830 at Stillingfieet, near York, and educated at Westminster School. He en- tered the navy in 1844, and was appointed naval cadet on board H.M.S. Collingwood. He served under Sir George Seymour on the Pacific station, became midshipman in 1846, and passed for a lieutenant in 1851. In 1850-51 he served on the Eranklin search expedition in the Arctic regions, under Captain Austin. He retired from the navy in 1852, and in 1852-54 travelled in Peru and the forests of the eastern Andes. He visited South America again in 1860-61, in order to arrange for the introduction of the cinchona plant into India, a service of the highest value to humanity. In 1865-66 he visited Ceylon and India, in order to inspect and report upon the Tinnevelly pearl-fishery and the cinchona plantations. On the Abyssinian expedition of 1867-68 he served as geo- grapher, and was present at the storming of Magdala. In 1874 he accompanied the Arctic expedition under Sir George ISTares as far as Greenland. In later years Sir Clements Markham travelled extensively over Europe, and also in western Asia and the United States. He also held various official and honorary positions at home. In 18;")5 he became a clerk in the Board of Con- trol. Erom 1862-G4 he was private secretary to J\Ir T. G. Barin;.f, afterwards the earl of Northbrook. From 1867-77 he was in charge of the geographical department of the India Office. He was secretary to the~~

~~*Hakluyt Society from 1858-87, and became its president in 1S90. Erom 1863-88 he acted as secretary to the Royal Geo- graphical Society, and on his retirement received the society's gold medal for his distinguished services to geography. IIe was elected president of the same society in 1893, and took an active share in the work of the society and in increasing its usefulness in various direc-*~~

~~*tions. It was almost entirely due to his unwearied exer- tions, extending over several years, that the funds were obtained for the National Antarctic Expedition under Captain Robert Scott, which left England in the summer of 1901. IIe was president of the International Geo- graphical Congress which met in London in 1895. Sir Clements Markham conducted the Geographical Magazine from 1872-78, when it became merged in the Proceedings of the Royal Geographical Society. Among his other pub- lications may be mentioned the following: Franklin^ s Footsteps, 1852 ; Cuzco and Lima, 1856 ; Travels in Peru a7id India, 1862; A Qnichua Grammar and Dictionary, 1863; Spanish Irrigation, 1867; A IIistory of the Abys- sinian Expedition, 1869 ; A Life of the Great Lord Fair- fax, 1870; Ollanta, a Quichua Drama, 1871; Memoir on the Indian Surveys, 1871 (2nd ed. 1878) ; General Sketch of the IIistory of Persia, 1873 ; The Tlireshold of the Un- knoivn Region, 1874 (4 editions); A Memoir of the Connt- ess of ChinchoII, 1875 ; Missions to Thibet, 1877 (2nd ed. 1879); Memoir of the Indian Surveys; Peruvian Bark, 1880; Pern, 1880; The War between Chili and Peru, 1879-81 (3rd ed. 1883); The Sea Fathers, 1885; The Fighting Veres, 1888; Paladins of King Edwin, 1896; Life of John Davis the Navigator, 1889; also lives of Admiral Fairfax, Admiral John Markham, Columbus, and Major Rennell ; a IIistory of Peru ; editions with intro- ductions of twenty works for the Hakluyt Society, of which fourteen were also translations ; sixty-seven papers in the Royal Geographical Society's Journal ; the Reports on the Moral and Material Progress of India for 1871-72 and 1872-73 ; Memoir of Sir John Harington for the Roxburghe Club, 1880 ; the Peruvian chapters for Win- sor's IIistory of America, and the chapters on discovery and surveying for Clowes's IIistory of the Navy. Sir Clements Markham was elected a Fellow of the Royal Society in 1873, and became an honorary member of the principal geographical societies ; he was created C.B. in 1871, and K.C.B. in 1896 ; in 1874 he was created a Commander*~~

~~of the Portuguese Order of Christ, and a Chevalier of the Brazilian Order of the Rose ; in 1898, Commander (first-class) of the Swedish Order of the North Star.~~

~~Marlboro, a city of Middlesex county, Massachu- setts, U.S.A., in the central part of the state, with an area of about 22 square miles, diversified with hills and ponds, and traversed by the Fitchburg, and the New York, New Haven and Hartford railways. In 1900 there were 142 manufacturing establishments, with a capital of $2,191,860, an average number of 2780 hands, and pro- ducts valued at $4,986,399. The chief industry is the manufacture of boots and shoes. Marlboro was formerly a town, but was chartered as a city in 1890. Population (1890), 13,805; (1900), 13,609, of whom 3311 were foreign- born.~~

~~Marlborough, a municipal borough and market town in the Devizes parliamentary division (since 1885) of Wiltshire, England, 11 miles south by east of Swindon by rail. Marlborough College is now divided into three schools, the upper, modern, and lower. In the upper a classical education, preparatory for the universities, is mainly given ; in the modern, mathematics, science, and modern languages are specially taught, and there are separate classes for army and navy pupils. Foundation scholarships preserve the original purpose of the school — that it should be for the education of the sons of clergy- men. Several important additions have been made to the school buildings, inclu.ding a museum (1883), a handsome chapel (1886), north classroojns (1893), and a memorial readini,'-room (1900). In 1901 the number of scholars was 600. Population (1891), 3012 ; (1901), 3046.~~

~~Marlow, Great, a town and railwaj'- station in the Wycombe parliamentary division (since 1885) of Buckinghamshire, England, 5 miles north by west of Maidenhead, on the Thames, which is here crossed by a pretty suspension bridge. It formerly returned two mem- bers to Parliament, but in 1885 its representation was merged in that of the~~

~~*county. Since 1896 it has been governed by an urban district council. Population of urban district (created 1893) (1891), 4212 ; (1901), 4526.*~~

~~*Marmande, chief town of arrondissement, de- partment of Lot-et-Garonne, 35 miles north-west of Agen, on railway from Bordeaux to Cette. The church, a Gothic edifice, dating in part from the 13th century, contains a fine 17th-century altar-piec^ and some good modern glass. Local institutions comprise the communal college, hospital, library, tribunal of commerce, and con- sultative chamber of agriculture. Brandy and liqueurs are manufactured, and there is considerable commerce in grain, flour, wine, hemp, and prunes. The town, which dates from the 6th century, suffered severely during the war of the Albigenses. In 1214, and again in 1219, it surrendered to the De Montforts, and on the latter occasion many of the inhabitants were massacred in cold blood. Population (1881), 6117 ; (1901), 9184.*~~

~~*Marmier, Xavier (1809-1892), French author, was born at Pontarlier in 1809. HIe had a passion for travelling, and this he combined throughout his life with the production of literature. After journeying in Switz- erland, Belgium, and HIolland, he was attached in 1835 to the Arctic expedition of the Recherche; and after a couple of years at Eennes as professor of foreign literar ture, he visited (1842) Russia, (1845) Syria, (1846) Algeria, (1848-49) North and Southi America, and numerous volumes from his pen were the result. In 1870 he was elected to the Academy, and he was for many years prominently identified with the Sainte-Genevi6ve library. HIe died at Paris in 1892.*~~

~~*Marne, a department of the north-east of France, watered by the Marne.*~~

~~*Area, 3168 square miles. The population, 429,494 iu 1886, had increased to 432,850 in 1901. In 1899 the deaths, numbering 9559, exceeded the births, 9544, of which 950 were illegitimate ; marriages numbered 3260. There were in 1896, 1042 primary schools, with 64,000 pupils, the illiterate forming 3 per cent, of the population. The area under cultivation in 1896 amounted to 1,910,193 acres, of which 1,336,888 acres were plough-land and 34,595 acres vineyards. The land in wheat in 1899 yielded the value of £1,186,000; rye, £440,000; barley, £251,000; oats, £260,000 ; mangold-wurzel, £136,000. Green crops (trefoil, lucem, and*~~

~~*sainfoin) yielded £260,000, and natural pastures £380,000. Of the industrial cultures, beetroot, producing the value of £189,000, is alone worth mentioning. The vine, however, notwithstanding the very limited surface it covers, yet by virtue of the quality of its wine (champagne) returned in 1899 the value of £1,612,000. The live stock in 1899 numbered 48,300 horses, 119,990 cattle, 294,150 sheep, and 64,410 pigs. Agriculture is the main occupa- tion of this department. There is some peat-cutting (1300 metric tons in 1898), and some mining of iron and limestone. The metal- lurgic production is inconsiderable. The textile industry, however, particularly that of wool, is in a very forward state around Reims, the department counting 8000 power-looms and 270,000 spindles. Chalons, the capital, had a population in 1901 of 21,487 ; Reims,*~~

~~*107,773.*~~

~~*Marne, Haute-, a department of the east of France, watered by the Marne.*~~

~~*Area, 2416 square miles. The population, 247,781 in 1886, had decreased to 224,888 in 1901. In 1899, out of 4157 births, 260 were illegitimate ; there were 5058 deaths ; marriages numbered 1563. There were in 1896, 850 primary schools, with 32,000 pupils, not more than 1 per cent, of the population being illiterate. The area under cultivation amounted in 1896 to 1,453,032 acres, 800,649 acres in arable land and 32,124 acres in vines. A large extent of the department is covered with wood. The wheat crop of 1899 amounted to the value of £987,000; oats, £698,000;*~~

~~*vines, 237,000 ; potatoes, £88,000 ; natural pastures, £280,000. In 1899 Haute- Marne owned 48,820 horses, 98,410 cattle, 122,330 sheep, and 99,900 pigs. The department possesses important iron mines, which in 1898 produced 147,000 metric tons. Its metal- lurgy (in a very forward state, especially aroand Langres) registered in 1898, 44,000 metric tons of cast iron, 67,500 tons of iron, and 32,400 tons of steel, of a total value of £975,000. The other industries are less iihportant, the forges and blast furnaces consuming 6289 horse-power out of a total of 8697. Chaumont, the capital, had 14,622 inhabitants in 1901.*~~

~~*Marocco. See Morocco.*~~

~~*Marochetti, Carlo, Baeon (1805-1867), Italian sculptor, was born at Turin in 1806. After studying under Bosio, he went in 1827 to France, and his statue of "A Young Girl playing with a Dog" won a medal in 1829 at Paris. HIs "Fallen Angel" was exhibited in 1831. In 1848 Marochetti removed to London, and there he lived till his death on 28th December 1867. Among his chief works were statues of Queen Victoria, Lord Clyde (the obelisk in Waterloo Place), Richard CcBur-de-Lion (Crystal Palace), Emmanuel Philebert (1833, Turin), the tomb of Bellini (Pere la Chaise), and the altar in the Madeleine. HIs style was vigorous and effective, but rather popular than artistic. Marochetti, who was created a baron by the king of Sardinia, was also a Chevalier of the Legion of HIonour.*~~

~~*Maros-Vasarhely, a municipality of HIungary, in the county of Maros-Torda, with 15,264 inhabitants in 1891 and 19,091 in 1901. It was once the capital of the " Sz^kelys " (Siculians). In the beautiful Gothic Cal-vinist church, built about 1446, situated in the old fort, was held, in the presence of Prince John Sigismund, in the year 1571, the famous diet which, for the first time in Europe, enacted the perfect liberty of religion. In its Protestant college Farkas Bolyai, the celebrated mathe- matician, was a leader.*~~

~~*Marquardt, Joachim (1812-1882), German scholar, was born at Danzig, 19th April 1812. HIe studied at Berlin and Leipzig, held various educational appointments from 1833 onwards at Berlin, Danzig, and Posen, and became in 1859 head of the " gymnasium " in Gotha. HIs Romische Staatsverwaltung (1873-78) and Privatleben der Romer (1879-82), which formed a part of Mommsen and Marquardt's revised edition of Becker's HIandbuch der Romischen Alterthiimer, were widely recognized as valuable contributions to classical learning. HIe died at Gotha, 30th November 1882.*~~

~~*Marquesas Islands. See Tahiti.*~~

~~*Marquette, a city of Michigan, U.S.A., capital of Marquette county, on Marquette harbour, on the south shore of Lake Superior, in the upper peninsula, at an altitude of 621 feet. The city is irregularly laid out, is*~~

~~*divided into eight wards, and is the terminus of branches of the Duluth, South Shore, and Atlantic railway. It is the principal shipping point for ports on the lower lakes, and for Pittsburg, Pa., of the iron ores of the Marquette district, the richest iron region in the world. For hand- ling the ores cheaply many great ore docks have been constructed, by means of which railway cars are unloaded directly into the holds of vessels. There is also a large trade in lumber. Population (1890), 9093; (1900), 10,058, of whom 3460 were foreign-born and 62 were negroes. The death-rate in 1900 was 16·6.*~~

~~*Marrakesh, sometimes erroneously called Morocco City, the second imperial city of Morocco, lying at the foot of the Great Atlas, 96 miles east-south-east of Safii. Scottish missionaries and a few European traders have become established here, but no other changes have taken place for centuries. Population, 50,000 to 60,000.*~~

~~*MARRIAGE.*~~

~~*I. United Kingdom and European Countries.*~~

~~*SINCE 1883, when the earlier volume of this En- cyclopsedia (ninth edition) containing the article on marriage was published, few subjects have been more discussed and few branches of the law have aeaerai undergone such significant changes. From that year itself dates the coming into operation of the Married Women's Property Act of 1882, the great charter which now regulates the position of married women in England in regard to their property and their contractual capacity generally. It was the outcome of a long struggle which led first to the Act of 1870, a tenta- tive enactment passed to secure married women's earnings against appropriation by the husband, and in 1871 to an amending Act for the protection of the husband against debts of his wife contracted prior to the marriage, and ultimately, in 1882, to the complete emancipation of the wife's property from marital control (see more fully below). In the course of ten years English legislation in the matter of*~~

~~*married women's property progressed from perhaps the most backward to the foremost place in Europe. By a curious contrast, the only two other European countries where, in the absence of a settlement to the contrary, independence of the wife's property is recognized, are Eussia and Italy (Italian Civil Code, Art. 1425 et seq.).*~~

~~*Among other countries, in France a law of 1881 em- powered the married woman to open a deposit account at the Post Office Savings Banks, but inasmuch as the husband can lodge a caveat to prevent withdrawal of the money, and can lay hands on the money as soon as an application is made by the wife to take it out, the protection is illusory. It must not, however, be supposed that the position of married women in Prance in respect of their property is abnormally hard. Their position is only regulated from a different point of view, and in several respects it is an exceptionally privileged one. It is mainly owing to this that progress, in the sense of the recognition of separate property, will probably be slower in Prance than elsewhere. Thus, though by ante-nuptial marriage contract the paraphernal system of emancipa- tion of the wife's property may be secured, it is seldom resorted to, because in the absence of an ante-nuptial marriage contract — and in Prance, as elsewhere, marriage contracts are uncommon among the mass of the popula- tion — the wife is owner of one-half of all property saved or personal property acquired by succession or otherwise, after the marriage, by either husband or wife. The hus- band during coverture certainly has the absolute control of the whole of this joint fortune, but on dissolution of the marriage the half of it can be claimed by the wife or her heirs and assigns.*~~

~~*This system of community of property is engrained in French institutions and custom as the common law of the country, and there is no movement to follow the example of Italy and adopt the paraphernal system as the common law in its place. Among the French middle class the wife, owing to her ownership of half the fortune acquired by her husband, takes a moi'e active part in his business life and holds a higher business status generally than she does in other countries. 8he is her husband's partner in all his enterprises, and has an equal interest with him in all their proceeds. Sometimes wonder is expressed that the bulk of French women seem so indifferent to agitation for an increase of their independence, but*~~

~~*isolated cases ,of hardship are not considered a ground for altering a law on*~~

~~*which the whole social economy of the nation is based, and which gives the French married woman a position in her household and in her family surpassing in dignity and prestige that of women in any other country.*~~

~~*In Scandinavia there is a marked tendency towards contractual emancipation, but as yet it has not gone farther than the married woman's earnings. Sweden adopted a law on this subject in 1874, Denmark in 1880, Norway in 1888. Germany followed the Civil Code which came into operation in 1900 (Art. 1367), providing that t*ie wife's wages or earnings shall form part of her Vorbehaltsgut or separate property, which a previous article (1365) placed beyond the husband's control. As regards property accruing to the wife in Germany by succession, will, or gift inter vivos, it is only separate property where the donor has deliberately stipulated exclusion of the husband's right.*~~

~~*In several other branches of the law of marriage the United Kingdom is not as much to the front. This applies to prohibition of marriage with a deceased wife's sister (see below), to breaches of promise of marriage, perhaps even to the facility generally with which marriage is contracted and the absence of specialized control through a civil authority which might introduce more order and system into the working of the chief social institution.' Still marriage holds its own, though severely criticized by different contemporary writers, and the number of those entering the state of matrimony does not diminish, in spite of warnings of its probable unhappiness. There is, in fact, no significant change in the proportion of those who marry to those who (acting on Mr Punch's advice) " don't." The following table shows that the tendency is to increase rather than diminish : —*~~

~~*Persons married in the United Kingdom — Annual Rates per Thousand of Population.*~~

~~*1890 .*~~

~~*. 14-5*~~

~~*1895 .*~~

~~*14-3*~~

~~*1891 .*~~

~~*. 14-6*~~

~~*1896*~~

~~*15-0*~~

~~*1892 .*~~

~~*. 14-5*~~

~~*1897 .*~~

~~*15-2*~~

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~~*In other countries the aggregate experience of marriage seems no less favourable to it.*~~

~~*Marriages in Chief Continental Countries — Annual Rates per Thousand**~~

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- ~~*Compiled from British olBcial abstracts.*~~

~~*1 The existing system of imtional registration was introduced by Lord .Tolin T!nssfll*s Ai-t of ls:iii. Sir Spencer Walpole, in his Life of Lord John Knxxi'll (vol. i. p. 2li0), observes that " Ills own views were enlarged and strengthened by the experience of a long lifetime, andhe lived to record his opinion tliat it will be a matter for consideration whether the future law, instead of recognizing the marriage registers of every Christian communion and every Jewish synagogue, should not be founded on the same principle as the laws of JFrance and Italy, constituting ci^■il marriages the only bond recognized by the State,*~~

Here again the trend of the figures is towards increase.

Comparing the British figures (which we must halve to

bring them to the same term of comparison) with the

Continental, Great Britain shows a fair average, higher

than Scandinavia and lower than Germany, Austria,

Hungary, and Russia.

In 1886 an Act was passed in the British Parliament

to remove doubts which had been entertained as to the

validity of certain marriages solemnized in England when

one of the parties was resident in Scotland.

tegfsiatioa !"■ the Same year an Act was passed extending

concetaing the hours within which marriage may be law-

"'eaeraf^ ^^^^J solemnized from 8 a.m. to 12 to between geaera y. g ^^^ ^^^ ^ ^^^ ^^^^ ^^^^ Foreign Marriage

Act of 1892, see below.) The Summary Jurisdiction (Married Women) Act of 1895 enabled a wife whose husband is convicted of an assault on her, or who has been deserted by him, or been obliged owing to his cruelty to live apart from him, to apply to tlie justices, who are empowered by the Act to make an order for separation and grant the wife the custody of children u.nder 16 years of age. The justices may also make an order for payment by the husband to his wife of such weekly sum, not exceeding two pounds, as, having regard to the means both of husband and wife,

~~*they may consider reasonable. The Marriage Act, 1898, authorized the celebration of marriages in places of worship duly registered for the solemnization of mar- riages under the Marriage Act of 1836 without the presence of the registrar, on condition of their being solemnized in the presence of a person duly authorized by the governing body of the place of worship in question. It also made further provision for the due recording of all marriages in the general registers. Lastly, the Marriages Validity Act of 1899 removed doubts as to the yalidity of marriages in England on Irish banns and in Ireland on English banns. The next enactment will probably be one for the purpose of regu- lating the solemnization in England of marriages between Euglish women and foreign men, which may be invalid in the country of the latter.*~~

~~*The property of married women is now governed in England by the Married Women's Property Act, 1882.*~~

~~*Under the common law of England all the Married personal property which devolved upon or was property, acquired by the wife passed to her husband, who*~~

~~*could, immediately on its, falling into posses- sion, deal with it as his own. He was even entitled to the rents and produce of his wife's real property. The wife could not bind herself by contract except in a few special cases (e.g., if she carried on trade within the City of London). Even her personal wages and earn- ings could be lawfully appropriated by her husband. " The very being or legal existence of woman is sus- pended during her marriage, or at least it is incorporated and consolidated into that of her husband, under whose wing, protection, and cover she performs everything," wrote a learned commentator on the old law. The Court of Chancery, it is true, protected trust dispositions securing to the wife the use of her separate property, but this afforded no protection to the great mass of married women, who continued to be the victims of antiquated principles of the old law till 1870, when the legislature made the first great breach in it. Half measure though it was, it went, as we have seen, as far as, if not farther than, most Continental legislatures ventured to advance up to 1902. It excluded the husband from control*~~

~~*over the wife's personal wages and earnings, and the invest- ments of such independent wages and earnings, and by*~~

~~*and leaving to the parties concerned to add any religious ceremony or ceremonies they may think proper."*~~

~~*it contractual capacity to the extent of this independent property was necessarily by implication granted to her. The Act of 1882 was practically the extension of the operation of this Act from one kind of married women's property to the whole of it. The married woman thence- forth became capable of acquiring, holding, and disposing by will or otherwise of all her real or personal property, as if she were unmarried, and without the intervention of any trustee, and her contractual capacity and liability were extended to the whole of her separate property. She also became liable, like anybody else, to the bank- ruptcy laws. As a consequence of these provisions, investments standing in the wife's name are deemed to form part of her separate property till the contrary is proved, and she can transfer her stock and receive the dividends or interest of it on her sole signature. This is the regime under which she now lives in Great Britain and Ireland.*~~

~~*Scottish Acts (40 and 41 Vict. c. 29, and 44 and 45 Vict, c. 21) placed her in a similar but not identical position in Scotland. The Married Women's Property (Scotland) Act,*~~

~~*1881, does not, in fact, give the wife as much indei^eudence as the English Act of 1882. It extends the operation of a previous one of 1877, which secured to her the sole and exclusive disposal of her earnings, to personalty owned by her at the date of her marriage or which may come to her by bequest, but, while giving her the disposal of the income of it, it precludes her from assigning the pro- spective income and from disposing of the fund itself without her husband's consent.*~~

~~*There is an unfortunate omission in the othe^^^■ise excellent English Act of 1882. It does not deal with the devolution of the wife's property on intestacy. The sur- viving husband's rights therefore remain unalteied, and he remains exclusively entitled to all her personal estate, though, no property acquired by the wife (since the Act of 1882) vesting in the*~~

husband, he has to take out letters of administration to get possession of it.

An Act of 1884 made husband and wife competent wit- nesses in criminal proceedings against each other under the 1882 Act.

A further Act in 1893 repealed two clauses in that of

1882, the exact bearing of which had been a subject of controversy. It provided specifically that every contract thereafter entered into by a married woman, otherwise than as an agent, should be deemed to be a contract entered into by her with respect to and be binding upon her sepa- rate property, whether she was or was not in fact possessed of or entitled to any separate property at the time when she entered into such contract, that it should bind all separate property which she might at any time or there- after be possessed of or entitled to, and that it should be enforceable by process of law against all property which she might thereafter, while discovert, be possessed of or entitled to.

One of the most interesting and significant changes in the law affecting married women was that introduced by the Guardianship of Infants Act, 1886 (49 and 50 Viet. c. 27), providing that the mother of any ^^'■'■'‘; infant may by deed or will appoint any person powers la or persons to be guardian or guardians of her appoint- child after the death of herself and the father g.^JcuLs. of such infant, and that where guardians are appointed by both parents they shall act jointly, and that the mother of any infant may by deed or will pro- visionally nominate some fit person or persons to act as guardian or guardians of such infant after her death jointly with the father of such infant. The Court, after her death, if it be shown to its satisfaction that the father .is for any reason unfitted to be the sole guardian of his children, may confirm the appointment of such guardian

or guardians, who thereupon are authorized and empowered so to act. (See also Infants.)

~~*In spite of active and ceaseless agitation on behalf of the legalization in England of marriage with a de- ceased wife's sister, the advocates of the aboli- wltha^^ tion of the existing disability had not succeeded deceased up to 1902 in Carrying any measure for its '1'*~~ ~~*'^ removal through both Houses of Parliament.*~~

~~*In all the self-governing colonies, on the other hand, with the exception of Newfoundland, the restric- tion has ceased to exist. The first Act legalizing marriage with a deceased wife's sister was adopted by South Australia. The royal assent, however, was not given till the Parliament of that state had five times passed the Bill. In quick succession similar statutes followed in Victoria, Tasmania, New South Wales, Queensland, New Zealand, West Australia, Barbados, Canada, Nauritius, Natal, and Cape Colony. As regards the Channel Islands, marriages of the kind in question were made legal some years ago in Jersey, but neither in the other islands, nor in the Isle of Man, has similar progress been made.*~~

~~*In England the Bill to render marriage with a deceased wife's sister valid was first adopted by the House of Commons in 1850, and rejected by the House of Lords in 1851. It was subsequently brought before the legislature in 1855, 1856, 1858, 1859, 1861, 1862,*~~

~~*1866, 1869, 1870, 1871, 1872, 1873, 1875, 1877*~~

~~*and 1878 (Colonial Bills), 1879 (6th May, when in the House of Lords the prince of Wales and the duke of Edinburgh voted in favour of it), 1880, 1882, 1883, 1884, 1886, 1888, 1889, 1890, 1891, 1896, and 1898 and 1900 (Colonial Bills). In most cases it has been passed by the House of Commons and rejected in the House of Lords. In fact, few subjects have such power of exciting interest among the Peers as the Marriage with a Deceased Wife's Sister Bill. It was observed that they mustered to deal with it as if the destiny of the nation depended on its rejection. (See Annual Register, 1901, p. 121.) The Bill of 1896, however, which was judi- ciously drafted to avoid the compulsory celebration by clergymen of marriages against which they had con- scientious scruples, was carried in the Lords. Both the prince of Wales and the duke of York were among the " ayes." The prime minister and eighteen bishops, including the two archbishops, voted against the Bill, the Earl of Kosebery and Lord*~~

~~*Kimberley for it. At the third reading the Bill was carried by 142 to 104 votes. Its promoters, however, did not succeed in getting an opportunity of bringing it before the House of Commons.*~~

~~*Erom 1896 to 1901 no further direct steps were taken, but in 1898 and again in 1900 (28th May) the subject was brought forward in the House of Lords by Lord Strathcona in the form of a Bill under which marriages with a deceased wife's sister contracted in any British colony should be deemed valid for all purposes within the United Kingdom. In 1898 the Bill was carried on the second reading by 129 to 46 votes, the prince of Wales, the duke of Devonshire, and most of the Liberal Unionist peers voting in the majority, and on the third reading without a dissentient vote. The House of Com- mons took no action. In 1900 the Bill was supported by Lord Carrington, a former colonial governoi -, and Lord Kimberley, a former colonial secretary, and in spite of the opposition of the Lord Chancellor and the archbishop of York, it was carried on the second reading by 116 to 31 votes, and on the third reading again with- out a dissentient vote. The House of Commons, how- ever, again took no action. An Imperial Bill reached a second reading in the House of Commons in 1901 and*~~

~~*again in 1902, but it was blocked by the opponents of the measure when attempts were made to get it to the committee stage (5th Eebruary and 6th June).*~~

~~*The Foreign Marriage Act, 1892, has consolidated the English law relating to marriages celebrated abroad, and brings it into harmony with the current tendencies of marriage law reform generally, (""•'ate Under it a marriage between British subjects uonaUaw. on land abroad is as valid as a marriage duly solemnized in England (as heretofore), if celebrated in accordance with the local law or in the presence of a " marriage officer." " Marriage officers " are diplomatic or consular agents who are appointed to act as such. The old fiction of assimilation of a British embassy to British soil can no longer be relied upon to uphold a marriage at a British embassy solemnized by an or- dained clergyman. An Order in Council of 28th Octo- ber 1892, moreover, provides that in the case of any marriage under the Act, if it appears to the marriage officer*~~

~~*that the woman about to be married is a British subject, and that the man is an alien, he must be satis- fied that the marriage will be recognized by the law of the foreign country to which the alien belongs.*~~

~~*A marriage may be solemnized on board one of His Majesty's ships at a foreign station, provided a warrant of a secretary of state has authorized the commanding officer to be a marriage officer. At sea, marriages on British public or private ships seem still valid at com- mon law, if performed by an episcopally-ordained min- ister. The Merchant Shipping Act, 1894 (sect. 240), provides that the master of a ship for which an official log is required shall enter in it every marriage taking place on board, with the names and ages of the parties.*~~

~~*Again, under the Eoreign Marriage Act all marriages solemnized within the British lines by a chaplain or officer or other person officiating under the orders of the commanding officer of a British army serving abroad, are as valid in law as if they had been solemnized within the United Kingdom subject to due observance of all forms required by law.*~~

~~*The principle of the English law of marriage, that a marriage contracted abroad is valid if it has been solem- nized according to the lex loci, may be now taken to apply just as much to a marriage in a heathen as in a Christian country. Whether the marriage has or has not been cele- brated according to Christian laws has no bearing upon the question, provided it is a monogamous marriage — a marriage which prevents the man who enters into it from marrying any other woman while his wife continues alive.' In Hyde v. Hyde and Wolmansee Lord Penzance refused relief on the ground that Morm on marriages are polygamous, although both parties were single at the time the marriage was contracted; and in Bethell v. HUdyard, Stirling J. decided against the validity of the marriage on the ground that the marriage which Mr Bethell intended to contract was not a marriage in the Christian sense, but a marriage in the sense in which the term was used among the Baro- longs, which implies the power of taking another wife — that it was, in fact, a polygamous marriage. In Brinkley V. Tlie Attorney-Gi'iieral, on a petition to establish the validity of amarriage between a British subject, temporarily resident in Japan, and a Japanese woman in Japan, accord- ing to the forms*~~

~~*required by the law of the latter country, the marriage was upheld, the President of the Court observing that the phrase " Christian marriage " had been used, only for convenience' sake, to express the idea that*~~

~~*' Compare the duke o£ Argyll's somewhat tempestuous assertion, iu the debate of 1896 on the Marriage with a Deceased Wife's Sister Bill, that marriage as understood all over the Christian world was the product of Christianity and of Christianity alone.*~~

~~*the only marriage recognized in Christian countries is marriage of the exclusive kind, which the Japanese marriage was proved to be.*~~

~~*Authorities. — Eversley. The Law of Domestic Belations,2nd ed. London, 1896. — Lush. The Law of Husband and Wife. London, 1896. — Crawley. The Law of Husband and Wife. London, 1892. — Geary. Marriage and Family Belations. Lon- don, 1892. — Griffiths. Married Women's Property Acts. Lon- don, 1891. — Vaizley. Law of Settlements of Property made on Marriage. London, 1887. — Bishop. (America) Marriage, Divorce, and Separation. Chicago, 1892. — David Murray. (Scotland) The Law relating to the Property of Married Persons. Glasgow, 1892. — Watkins. Holy Matrimony. 1895. — Hath. Marriage of Near Kin. London, 1887. — Leckt. Democracy and Liberty, vol. ii. London, 1896. — H. N. Hutchinson. Marriage Customs in Many Lands. London. — Joseph Cook. Boston Monday Lectures. Cambridge, U.S.A. — Thomas Barclay. La femme anglaise. Paris, 1896. — Publications of the Marriage Law Re- form Association, 2 Dean's Yard, Westminster (Sec. Mr. F. Paynter Allen) : — The Bishops and Marriage with a Deceased Wife's Sister. " The Other Side." — Proceedings in the Colonial Confer- ence, 14th April 1897. Subject: "Marriage with a Deceased Wife's Sister." — A Preliminary List of Distinguished Biblical Scholars and Authorities who have severally declared that Marriage with a Deceased Wife's Sister is not therein forbidden. — One hundred and one Seasons for repealing the Law against Marriage with a Deceased Wife's Sister. 1892. — Opinions of the Hebrew and Greek Professors of Bible Bevisers regarding Marriage*~~

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II. United States.

If we define marriage as a physical, legal, and moral union between man and woman in complete community of life for the establishment of a family,^ it is possible to discriminate between three stages in the history of the institution — the animal or physical stage, the proprietary or legal stage, and the personal or moral stage. In the first or physical stage the relation of the sexes was un- regulated, and in many cases of brief duration. In the second or legal stage greater permanence was secured in marriage by assigning the husband a property right in his wife or wives. In the last stage the proprietary relation falls more and more into the background, and the relation of husband and wife approximates that of two individuals entirely equal before the law. Although in the history of marriage these three stages have been roughly successive, the order of their entering the conscious experience of the individual is usually the reverse of their order in the development of the race ; and in the solemnization of a marriage based upon affection and choice the growth of the relation begins with the moral, advances to the legal, and

~~*culminates in the physical union, each one of these deriv- ing its meaning and its worth from the preceding. It seems probable that in the United States marriage has*~~

~~*1 It is doubtless true, as anthropologists have pointed out, that in the history of the race " marriage is rooted in the family rather than the family in marriage " (Westermarck, History of Human Marriage, p. 22) ; but in that conscious experience of the individual with which law and ethics are especially concerned, this relationship is reversed, and the family originates in marriage.*~~

~~*advanced into this personal or moral stage farther than it has in many countries, and certain of its characteristic features as a social relation flow from this fact. Thus it is probable that the equality of property rights between husband and wife is established in America more com- pletely than in any other civilized country. Indeed, in many states the movement has gone so far as to give the wife in matters of property and in reference to divorce greater privileges than the husband. Thus a husband is often liable for a wife's debts where a wife would not be, mutatis mutandis, for a husband's ; and a wife may usually obtain a decree of divorce for any ground on which one may be awarded to the husband, and, in addition, for neglect to provide sustenance or support. Emphasis on the personal or moral relation of the parties in marriage tends to throw into the background the legal aspects and requirements ; and in the United States, where the separation of Church and State is probably as complete as in any civilized country, it tends also to minimize, so far as the State is concerned, the religious and sacramental aspect of marriage. In distinction from these two, the purely personal aspects of the relation are brought into the foreground. Marriage tends to become a relation established by parties between themselves, and one in which the consent of the parties becomes the only con- stitutive element. In the theory of American law no ceremony is essential to create the marriage relation. The dictates of social expediency find expression mainly in certain prohibitions, as upon the marriage of persons under a certain limit of age, of persons within certain degrees of relationship, of persons already married, or of persons incapable for any reason of entering into marriage. Under such a theory of the law, persons marry them- selves,*~~

and it might be claimed as a legitimate corollary of this theory that they should be allowed to divorce themselves. But while in theory of law parties marry themselves, and a ceremony is unnecessary, this position has never been endorsed by any considerable proportion of the community, and in fact probably J-^. and perhaps j^^- of the marriages in the United States are con- tracted through some ceremony. In every state, too, some legal decree is necessary in order to terminate the marriage relationship, although in all but two a complete separation of the parties continued for from one to five years is a legal ground of divorce.

The prevalence of the institution of marriage in a community is best measured by the percentage of the population of marriageable age who are married. Accord- ing to the United States census, the earlier limit of mar- riageable age is twenty ; but in the best practice elsewhere it is fifteen, and in 1890 about 330,000 persons in the United States between fifteen and twenty were married. It seems wise therefore to assign fifteen as the earlier limit of marriageable age. Of all persons in the United States over fifteen in 1890, 65-3 per cent, were reported as married ; if we add those who were reported as widowed or divorced, the percentage is raised to 63. As a measure of the prevalence of marriage these figures are too low, owing to the fact that a very large number of persons who are unmarried between fifteen and thirty marry in later years. Few marriages are contracted after the age of forty-five, and such as do occur are less important socially than those contracted earlier and when the like- lihood of parentage is greater. Of the total population in the United States over the age of forty-five in 1890, 93 per cent, were or had been married. This proportion in the United States is greater than in any of the countries in Western Europe. In European countries generally the proportion of elderly spinsters is greater than the proportion of elderly bachelors, but in the United States the reverse is true. This difference is due mainly to the

unequal distribution of the sexes. Among tlie adults in western Europe there is an excess of females, in the United States generally an excess of

males ; and there- fore the likelihood of a man's marrying is somewhat greater in western Europe, and that of a woman's marry- ing is somewhat greater in the United States. The same difference appears within the limits of the United States itself, for in the states of the Atlantic coast women out- number the men, while in the rest of the country the reverse is true. Consequently, states on the Atlantic coast from Maine to the Carolinas have the largest per- centage of spinsters among the women between fifty-five and sixty-five, and the states west of the Mississippi have the smallest percentage. On the contrary, the percentage of bachelors among the men between fifty-five and sixty- five is largest in the Rocky Mountain states, in some of which it is nearly or quite one-third, and smallest in the southern states east of the Mississippi.

Regarding the age of marriage in the United States we have little direct evidence. In Massachusetts the average age at which men marry for the first time was in 1897 rather over twenty-seven, and the average age at which women marry for the first time was 241 years ; but in other parts of the country, and especially in the southern states, marriage occurs much earlier. For in Massachusetts in 1890 the percentage of girls between fifteen and twenty who were married was less than 4, and below that of any other state, while in the states of the far south the per- centage ranged from 15 to 20. In Massachusetts, of the men between twenty and twenty-five, about 15 per cent, were returned in 1890 as married, while in the states of the far south the ratio was more than twice as great. Nor is this due to the many coloured people in the southern states, for, although they marry earlier than the whites, the whites also marry earlier than the whites in the north. While the percentage of married persons in the United States is probably greater than in most countries of western Europe, the tendency in this as in most other social respects is for the conditions on the two sides of the Atlantic to approximate. So far as fragmentary returns from certain states enable one to judge, the percentage of persons over fifteen in the United States who are married tends to decrease, and the age at which marriage occurs tends to rise. In Massachusetts the percentage of married persons among those over fifteen decreased by 4 between 1875 and 1895, and the average age at which marriage oc- curred increased nearly a year for each sex between 1871 and 1897. One reason for the decreasing marriage- rate

~~*characteristic of most industrial countries calls for more attention than has thus far been given it by social students, and that is a tendency to establish a separation of the sexes whereby a decided excess of women is found in industrial or manufacturing towns, offset more or less completely by an excess of men in the rural districts. For example, in the United States there are more women than men in the 1522 cities of over 2500 inhabitants taken as a whole, and in nearly all states east of the Mississippi the excess is marked. In the rural districts, on the contrary, there are over a millionand a half more males than females. Under such conditions a certain number of women in cities and of men in the country will be debarred from marriage.*~~

~~*One inference derivable from the figures of the census of 1890 is that in the large cities girls do not marry so early as they do in the rural districts of the same states. For example, in Chicago among the young women between fifteen and twenty years of age about 6 per cent, are married, but in the rest of the state the percentage of the married at those ages is about 7^. This early marriage of the young women in the rural districts is not paralleled by d similarly early marriage of young men, for in two-*~~

~~*thirds of the largest cities in the country the proportion of married men between twenty and twenty-five years of age was smaller than in the state at large. The early mar- riage of women in the rural districts is probably closely connected with the excess of men, which makes women more in demand. The same influence may be traced in the differences between the several states. As one passes westwards, the percentage of males in the total population increases ; and in a general way it is also true that as one passes west the percentage of women between fifteen and twenty who are married increases ; while the percentage of men between twenty and twenty-five who are married diminishes — that is, the sex in the minority marries in larger numbers and at earlier ages than the sex which is in the majority. (w. f. w.)*~~

~~*Mars. See Astkonomt, vol. xxv.*~~

~~*Marsala, a seaport town of the province of Trapani, Sicily, Italy, on the west coast, 19 miles by rail south of Trapani. It is the centre of the production of " Marsala " wine, and has also iron works, cooperages, and*~~

~~*macaroni factories. There is an export trade (declining) in wine (£227,000 to £533,000), wine lees, cheese, &c., to the aver- age value of £465,000 annually ; and an import trade to the annual value of £20,000 to £50,000. In 1899 the port was cleared by 1072 vessels of 230,400 tons. In 1898 the construction of a mole was begun to protect the har- bour against west and south-west winds. Population (1881), 19,732 ; (1900), about 37,000.*~~

~~*M arse i 1 1 es , capital of the department of the Bouches- du-Rhone, France, 516 miles from Paris by rail. It is the headquarters of the 15th army corps, of a rear-admiral in commandof the local naval defences, and of an episcopal see.*~~

~~*Population. — The census of 1900 has shown that i\Iar- seilles, by distancing Lyons to the extent of 27,000 in- habitants, has become the second town of France. Of its 498,610 inhabitants, 98,835 are foreigners, comprising 91,536 Italians and 469 British subjects, including the Maltese and British seamen in the port.*~~

~~*Trade and Commerce. — Since the opening of the Suez Canal, Marseilles has been the French gate of the Far East, in addition to being the western emporium for the Levant trade. But, as large ships now discharge cargo at all small ports, Marseilles is no longer the storehouse for the western Mediterranean. It has also suffered from the competition of Genoa since the opening of the St Gothard railway route to Switzerland and Germany. But its local industries — its oil mills, soap manufactories, sugar refineries, and others of minor importance — provide commercial activity to its port. Marseilles has suffered from the monopolies of the Dock Company and the Paris- Lyons-lNIediterranean Railway Company. The Dock Com- pany's warehouses, built at a time when goods were stored for prolonged periods, are no longer needed, and the company's rates for working cargo are far in excess of the rates charged by the Chamber of Commerce on the free quays. This obstruction to the full development of trade is being met (1) by the gradual increase of the quay space under the control of the Chamber of Commerce ; (2) by the gradual completion of the seventh dock, the Bassin de la Pinede ; and (3) by the proposal to make the Old Port accessible to steamers drawing 24 feet. The Chamber of Commerce proposes to deepen it to 24 feet 7 inches, to widen the quays,*~~

and connect them with the Joliette dock by rail. The monopoly of the "P.L.M." Railway Company is to be met by the construction of a ship canal from Marseilles to the Rhone at Aries. The competition will bring about a reduction in the exorbitant railway rates. The Chamber of Deputies voted 91,400,000 francs for the canal in January 1902. A large anchorage basin is to be constructed to the west of the Bassin de

la Pin^de by utilizing tte small stream of La Madrague. The proposed canal will start from this Bassin de la Madrague, and, communicating by a passage 100 metres long with the Bassin de la Finfede, will pass under the Estaque mountain range by a tunnel to Port de Bouc, on the famous ifitang de Berre ; thence to Aries on the Ehone. The canal which connects the Etang de Berre with the sea, near the mouths of the Rhone, will be enlarged, and the Etang de Berre will become a great port of refuge for the protection of naval and mercantile shipping in time of war. The utility of the Marseilles-Aries canal will be ultimately enormously enhanced by the construction of a canal parallel to the Rhone from Aries to Lyons. The Chamber has also voted 123,000,000 francs for the construction of a canal to connect the Phone with the Loire, which will place Marseilles in connexion with the north of Prance. The canal to Aries was first planned by Vauban, and the terrain surveyed by skilled engineers in the early part of the 19th century, and mapped out as now proposed by Guerard in 1879. Owing to the un- healthy and swampy nature of the Rhone delta, Mar- seilles was not built at the mouth of that river, but on a sheltered bay facing west, a little to the east of the river mouth, separated from it by a high range of hills and a dangerous bit of sea round Cape Couronne. Hence the urgent need for this canal.

Education. — Marseilles has a lycee (grammar school) for boys and one for girls, a school of medicine, a law college, a higher school of commerce (with a colonial section and a mercantile marine section attached to it), and, since 1899, a lower-grade commercial school for the training of boys from 12 to 15.

~~*Public Health. — Marseilles has for many years been free from the epidemics which in former days gave it an unenviable reputation. The extensive drainage works, on the tout d, Vigout system, were completed in 1898, and the sewage is carried miles away to sea beyond Cape Croisette. The old harbour frequented by yachts is no longer pol- luted by drainage. Every house is fitted with sanitary appliances on the flush system, the adoption of which was rendered feasible by the completion of the Durance canal, which brings the water of that river across a range of granite mountains to Marseilles and its once arid suburbs. Marseilles has a Pasteur-Anti-Rabic-Vaccina- tion Institute, and three large hospitals. But owing to the rapid increase of the population, hospital accommo- dation is still lamentably deficient.*~~

~~*Public Buildings. — The Roman Catholic cathedral, built in Byzantine style, and overlooking the Joliette dock, was opened for public worship in 1893. All Saints', an English church, has been built in the Rue de Belloi, close to the Cours Pierre Puget, the heart of the fashionable quarter of the town. The town has extended principally on the south-eastern slope of the Notre-Dame-de-la-Garde hill, between the southern end of the Rue Paradis and the Prado avenues, which is more protected than most other quarters from the mistral that blows down the Rhone valley, and where in summer the temperature is always a little lower than in the centre of the town.*~~

~~*Industries. — Marseilles produces sugar, soap, seed, oil, oil-cake, tiles and bricks, candles, flour, bran, macaroni and other pastes, semolina, and liqueurs. It exported during 1901, 4584 tons of almonds and nuts, 17,987 tons of bran, 10,618 tons of bricks and tiles, 4916 tons of candles, 1390 tons of dried and preserved fruits, 22,930 tons of grain and flour, 28,828 tons of semolina, 14,989 tons of crushed ochre, 7246 tons of castor oil, 5672 tons of cocoanut oil, 4149 tons of cotton-seed oil, 10,664 tons of olive oil, 64,364 tons of oil-cake, 24,146 tons of potatoes, 19,509 tons of soap, 52,360 tons of refined sugar, 12,748 tons of cotton tissues, 8,019,412 gallons of wine, 4436*~~

~~*tons of raw wool, &c. There were imported during 1901, 1,200,338 head of cattle and sheep, 1,110,262 tons of coal, 21,900 tons of coffee, 14,292*~~

~~*tons of raw cotton, 469,236 tons of grain, 16,602 tons of hides, 162 tons of indigo, 77,467 tons of maize, 37,375 tons of cotton-seed oil, 15,112 tons of palm oil, 26,866 tons of castor-oil seed, 80,468 tons of copra, 65,817 tons of gingelly, 126,976 tons of ground-nuts, 10,575 tons of linseed, 8825 tons of palm-nuts, 11,352 tons of rice, 4966 tons of raw silk, 5703 tons of floss silk, 31,969 tons of sugar, 1617 tons of sulphate of copper, 1278 tons of tea, 11,447,744 gallons of wine, 29,319 tons of wool, &c. Marseilles has also a branch of the Porges et Chantiers de la Mediterranee, where boilers and engines are turned out for the navy and merchant ships, and a shipbuilding yard, the Chantiers de Provence, where large liners are built.*~~

~~*Communications. — Marseilles is the terminus of three lines of railway, all forming part of the Paris-Lyons- Mediterranean system, viz., a main line to Paris, vid Lyons ; a main line to Nice and Italy ; a branch line to Aix, Grenoble, and the Alps. There are five stations, three of which are practically confined to the service of the port. There are also four suburban stations. The sta- tion in the Old Port belongs to an English, the others to the " P.L.M." company. Thirty-six shipping companies make the city a port of call in their regular service, besides those whose headquarters are at Marseilles. The Messageries Maritimes has a fieet of 52 vessels, of a total tonnage of 96,517 net. Their mail boats leave for the Far East every fortnight, and twice monthly for Zanzibar, Madagascar, Reunion, and Mauritius; and there is a weekly service to the Levant, and also to London. Other well-known companies are the Fraissinet Company, the Societe Generale des Transports Maritimes, and the Navi- gation Mixte Company. Of British companies touching at Marseilles the most important are the Peninsular and Oriental, the Orient-Pacific, the British India, the Anchor Line, and the Bibby Line.*~~

~~*Shipping. — Marseilles is the chief port of France, having accom- modation for over 2500 vessels at one time. During 1901 the number of ships entered and cleared amounted to 16,478, whereof 11,558 were French, 1355 British, 1296 Italian, 801 Spanish, and 327 Austro- Hungarian. The total tonnage of ships entering and clearing during 1901 was 13,040,814 net, of which French ship- ping claimed only 6,573,373 tons, and foreign shipping 6,467,441 tons. British shipping amounted to 3,264,698 tons, more than a quarter of the total tonnage of the port, and*~~

half the tonnage of all foreign nations combined. Thevolume of merchandise loaded and discharged during 1902 amounted to 5,763,553 tons, whereof 1,085,701 went to the credit of British shipping. The water space available for shipping purposes at Marseilles comprises some 297 acres, inclusive of the various canals of communication between the different harbours. The length of quay space for purposes of loading and discharging cargo is 42,988 feet in all at present. Of this some 3000 feet belong to the Old Port. The Joliette dock has 5260 feet, the Lazaret and Arenc docks 7483 feet, the Gare Mari- time dock 7000 feet, the National dock has 12,316 feet of quay space in length. For the storage of merchandise there are 3,400,000 square feet of space available. Of this total 261,383 feet arearound the old harbour and the Canal des Douanes. The Joliette dock has 339,246 square feet; the " Stationnement " dock, annexed to it, another 25,000 feet ; the Lazaret and Arenc docks have together 754,283 square feet ; the Gare Maritime dock, 586,671 feet ; the National dock, the most commodious of all, has 1,000,000 square feet; the graving dock, 50,000 square feet ; and the Outer harbour has 341,730. The Chamber of Commerce owns and works appli- ances for manipulating cargo on the Gare Maritime and National docks, and the old harbour. (m. c. q

Marsh, Othniel Charles (1831-1899), Ameri- can paleeontologist, was born in Lockport, New York, on 29th October 1831. He graduated at Yale College in 1860, and having from boyhood been deeply interested in collecting birds, insects, minerals, and fossils, spent five years after his college graduation in studying (in the Sheffield Scientific School, New Haven, and in Germany)

geology, palaeontology, and mineralogy. Becoming pro- fessor of vertebrate palaeontology at Yale in 1866, lie continued his researches, particularly in the fossil deposits of the western states, greatly aided by a private fortune from his uncle, George Peabody, whom he also induced to establish the Peabody Museum of Natural History (especially devoted to zoology, geology, and mineralogy) in the college. In May 1871 he

~~*discovered the first pterodactyle remains found in America, and in subsequent years he brought to light other important objects, most of which he described in monographs of periodical articles. His discovery in 1872 of remains of the toothed bird Hesperornis and of Ichthyornis, a cretaceous bird with biconcave vertebrae, and of various fossil maitimalia in Wyoming, aroused active discussion, and in some cases led to real or alleged proof of the existence of hitherto unknown ancestors of extant mammalia, or to the estab- lishment of extinct transitional links between existent birds and reptiles. Still more earnest discussion followed, in 1874 and in later years, on his discoveries of remains of peculiar fossil horses in America. On becoming vice-pre- sident of the American Association for the Advancement of Science in 1875 he gave an address on the " Introduction and Succession of Vertebrate Life in America,"summarizing his conclusions, to that date, in the branch to which his life was devoted. He repeatedly organized, and often accompanied, scientific exploring expeditions in the Rocky Mountains, not infrequently at personal risk ; and their results, as set forth in his writings, tended in an important degree to support the doctrines of natural selection and evolution. Although he failed to complete several works of importance, he published many papers in addition to those mentioned, and found time — besides that necessarily given to the accumulation and care of the most extensive collection of fossils in the world — to write Odontornithes : A Monograph on the Extinct Toothed Birds of North America (1880), and Dinocerata: A Monograph on an Extinct Order of Gigantic Mammals (1886). He was long in charge of the division of vertebrate palaeontology in the United States Geological Survey, and received many scientific honours, medals, and degrees, American and foreign. He died in New Haven on 18th March 1899. (c. F. E.)*~~

~~*Marshall, a city of Missouri, U.S.A., capital of Saline county, on the high prairie, near the Salt Fork of Lamine river, a little west of the centre of the state, at an altitude of 570 feet. Its site is undulating and its plan regular. It is at the intersection of the Missouri Pacific and the Chicago and Alton railways. Marshall is the seat of Missouri River College, a Presbyterian institution, founded in 1889, which in 1899 had 14 instructors and 222 students, 95 of whom were women. Population*~~

~~*(1890), 4297 ; (1900), 5086, of whom 129 were foreign-born and 724 were negroes.*~~

~~*Marshall, a city of Texas, U.S.A., capital of Har- rison county, in the north-eastern part of the state, on the Texas and Pacific and the Texas Southern railways, at an altitude of 366 feet. It is in an agricultural and lumber region, and contains works of the Texas and Pacific rail- way, saw and planing mills, and other manufactories. It is the seat of Wiley University, a Methodist Episcopal in- stitution, opened in 1873, which had in 1899 a faculty of 9 and an attendance of 54 students. Population (1890), 7207 ; (1900), 7855, of whom 258 were foreign-born and 3769 were negroes.*~~

~~*Marshall Islands, an island group in the North Pacific, belonging to Germany since 1886. The group consists of a number of atolls ranged in two almost par- allel lines, which rim from north-west to south-east.*~~

~~*between 4° and 15° N. The north-east group, with fifteen islands, is called Ratak, the other, numbering eighteen, Ralik. These atolls are of coralline formation and of ir- regular shape. They rise but little above high- water mark. The highest elevation occurs on the island of Likieb, but is only 33 feet. The lagoon is scarcely more than 150 feet deep, and is accessible through numerous breaks in the reef. On the outward side the shore sinks rapidly to a great depth. The surface of the atolls is covered with sand, except in a few places where it has been turned into soil through the admixture of decayed vegetation. The reef in scarcely any instance exceeds 600 feet in width. The climate is moist and hot, the mean temperature being 80-50° Pahr. Easterly winds prevail all the year round. There is no difference between the seasons, which, though the islands belong to the northern hemisphere, have the highest tem- perature in January and the lowest in July. Vegetation, on the whole, is very poor. There are many cocoanut palms, bread-fruit trees (Artocarpus incisa), and pandanus, of which the natives eat the seeds. From the bark of another plant they manufacture mats. Animals are scarce. Pigs, cats, dogs, rats are imported. There are a few pigeons and aquatic birds, few butterflies and beetles. Crustacea and fish abound on the reefs. The natives are of dark brown colour, though lighter shades occur. They*~~

~~*belong to the Micronesian races. Their hair is not woolly, but straight and long. They are expert navigators, and construct curious charts of little sticks. Their canoes carry sails, and are made of the trunk of the bread-fruit tree. The people are divided into four classes, of which only two are allowed to own land. They prac- tise tattooing, and consequently wear few clothes. The islands lie entirely within the German sphere of interest, and the boundaries were agreed upon between Great Britain and Germany on the 10th April 1889. Their area is esti- mated at 150 square miles, with 15,000 inhabitants, who are apparently beginning to increase again, though the contrary was long believed. In 1899 there were 79 Euro- peans (50 German). The administrator of the islands is at present the Governor of German New Guinea, but a number of ofiicials reside on the islands. There is no mili- tary force, the natives being of peaceful disposition. The chief island and seat of government is Jaluit. The most populous island is Majeru, with 2600 inhabitants. The natives are pagans. A Roman Catholic mission has been established, and the American Mission Board maintains coloured teachers on many of the islands. There is com- munication with Sydney by private steamer, and a steamer sails between Jaluit and Ponape to catch the French boats for Singapore. The islands belong to the Postal Union. The chief products for export are copra, tortoise-shell, mother-of-pearl, sharks' fins, and trepang. For consump- tion Nature offers the bread-fruit, various kinds of bananas, taro, yams, the bulbous roots of the Tacca pinnatifida, and the seeds of a pandanus. Cereals are entirely unknown. The natives plant cocoarpalms in yearly increasing numbers. Cattle do not thrive on these islands, and even fowl are scarce. The natives are clever boat-builders, and sell their canoes not only on their own but to neighbouring islands. They have made such progress in their art that they have even built seaworthy little schooners of from 30 to 40 tons. The only other things they make are a few shell ornaments. In 1898-99 the value of the imports was 465,700 marks; exports, 900,000 marks, mainly copra. (j. VON P.)*~~

~~*Marshall, John (1818-1891), British surgeon and physiologist, was born at Ely, 11th September 1818, his father being a lawyer of that city. IIe entered Univer- sity College, London, in 1838 (M.R.C.S. 1844, F.R.C.S. 1849). In 1847 he was appointed assistant-surgeon at*~~

~~the hospital, and in 1866 surgeon and professor of surgery. He was professor of anatomy at the Eoyal Academy from 1873 till his death. In 1882 he was pre- sident of the College of Surgeons, also Bradshaw lecturer (on " Nerve-stretching for the relief or cure of pain "), Hunterian orator in 1885, and Morton lecturer in 1889. In 1867 he published his well-known text-book The Out- lines of Physiology in two volumes. He died 1st January 1891. " Marshall's fame," wrote Sir W. Mac Cormac in his volume on the Centenary of the College of Surgeons (1900), " rests on the great ability with which he taught anatomy in relation to art, on the introduction into modern surgery of the galvano-cautery, and on the opera- tion for the excision of varicose veins. He was one of the first to show that cholera might be spread by means of drinking water, and issued a report on the outbreak of cholera in Broad Street, St James's, 1854. He also in- vented the system of circular wards for hospitals, and to him are largely owing the details of the modern medical student's ediication."~~

~~Marshalltown, a city of Iowa, U.S.A., capital of Marshall county, on the Iowa river, near the centre of the state, at an altitude of 895 feet. It is at the intersection of the Chicago Great Western, the Chicago and ISTorth-Western, and the Iowa Central railways. It is in a rich agricultural region, and has grain elevators and varied manufactures. Population (1890), 8914 ; (1900), 11,544, of whom 1590 were foreign-born and 148 were negroes.~~

~~Marshfleld, a city of Wood county, Wisconsin, U.S.A., in the central part of the state, on three railway lines. It is in a timber region, and has extensive manu- factures of furniture, barrels, and other wooden goods. Population (1890), 3450; (1900), 5240, of whom 1161 were foreign-born.~~

~~Marsivan, or Merzifun, a town in the Amasia sanjak of the Sivas vilayet of Asia Minor, situated at the foot of the Tavshan Dagh. It is a centre of American missionary and educational enterprise, and is the seat of Anatolia College, a theological seminary, and schools. In November 1895~~

~~*many Armenians were massacred. Popu- lation, 30,000, one-third Armenian.*~~

~~*Marston, Philip Bourice (1850-1887), English poet, was born in London on 13th August 1850. His father, John Westland Maeston (1819-1890), of Lin- colnshire origin, the friend of Dickens, Maoready, and Charles Kean, was the author of a series of metrical dramas which held the stage in succession to the ambi- tious efforts of Tobin, Talfourd, Bulwer, and Sheridan Knowles. His chief plays were The Patrician's Daughter (1841), Strathmore (1849), A Hard Struggle (1868), and Donna Diana (1863). He was looked up to as the up- holder of the outworn tradition of the acted poetic drama, but his plays showed little vitality, and Marston's reviews for the Athenceum, including one of Swinburne's Atalanta in Calydon, and his dramatic criticisms embodied in Our Recent Actors (2 vols. 1888) will probably claim a more enduring reputation. The son, Philip Bouekb, was born in a literary atmosphere. His sponsors were Philip James Bailey and Dinah Mulock (Mrs Craik). At his father's house near Chalk Farm he met authors and actors of his father's generation, and subsequently the Eossettis, Swinburne, Arthur O'Shaughnessy, and Irving. From his earliest years his striking literary precocity was overshadowed by misfortunes which make his career one of the most pathetic in literary history. In his fourth year, in part owing to an accident, his sight began to decay, and he gradually became almost totally blind. His mother, who had devoted herself to him, died in 1870.*~~

~~*His promised bride, Mary Nesbit, died in 1871; his closest friend, Oliver Madox Brown, in 1874; his sister Cicely, his amanuensis and second self, in 1878 ; in 1879 his remaining sister, Eleanor, who was followed to the grave after a brief interval by her husband, the poet O'Shaughnessy (1846-1881), and her two children. In 1882 the death of his chief poetic ally and inspirer, Rossetti, was followed closely by the tragedy of another kindred spirit, the sympathetic pessimist, James Thom- son, who was carried dying from his blind friend's rooms, whither he had sought refuge from his latest miseries early in June of the same year. It is said that Marston came to dread making new friendships, for fear of evil coming to the recipients of his affection. In the face of such calamities it is not surprising that Marston's verse, in which a plaintive minor key was*~~

always apparent, became more and more persistently sorrowful and melancholy. The idyls of flower-life, such as the early and very beautiful " The Eose and the Wind," were succeeded by longing dreams of sleep and the repose of death. These qualities and gradations of feeling, reflect- ing the poet's successive ideals of action and quiescence, are traceable through his three published collections, Songtide (1871), All in All (1875), and Wind Voices (1883). The first and third, containing his best work, went out of print, but Marston's verse was collected in 1892 by Mrs Louise Chandler Moulton, a most loyal and devoted friend, and herself a poet. Marston read little else but poetry, and of poetic values, especially of the intenser order, his judgment could not be surpassed in sensitiveness. As a creative artist he rarely approached supreme excellence, though in delicate facility and melodious prettiness and, it must be added, diffuseness, he was a prince among minor poets. He was saturated with Eossetti and Swin- burne, and his imitative power was most remarkable. His tendency was ever to transpose into a minor key, and there was an absence of the " masculine bass " in all that he wrote. In his later years he endeavoured to make a little money by writing short stories, and succeeded in finding a market for them in Home Chimes and other American magazines, through the agency of Mrs Chandler Moulton. His popularity in America far exceeded that in his own country. With an outlook more and more sombre owing to the loss of friends, the narrowing of resources, and the development of insomnia, Marston gradually lost the buoyancy which he had retained through grievous mis- fortunes. His health showed definite signs of collapse from 1883 ; in January 1887 he lost his voice, and suffered intensely from the failure to make himself understood. He died on 13th February 1887 at his lodgings, 191 Euston Eoad, and, like his friend "B. V." (Thomson), he was by express desire buried in unconsecrated ground in Highgate cemetery. He was commemorated in Dr Gordon Hake's " Blind Boy," and in a fine sonnet by Swinburne, commencing " The days of a man are three score years and ten." There is an intimate sketch of the blind poet by a friend, Mr Coulson Kernahan, in Sorrow and Song (1894), p. 127. (t. SE.)

Marte! de Janville [Sibylle-Gabrielle-Maeie- Antoinette de Eiqueti de Mikabeau], Comtesse de (best known as " Gtp "), French writer, was born in 1850 at Koetsal in the Morbihan. Her father, who was grand- son of

~~*Mirabeau Tonneau, and great-nephew of the orator, served in the Papal Zouaves, and died during the cam- paign of 1860. Her mother, the comtesse de Mirabeau, in addition to some graver compositions, contributed to the Figaro and the Vie Parisienne, under various pseudonyms, papers in the manner successfully developed by her daughter. Under the pseudonym of " Gyp " Madame de*~~

~~*Martel, who was married in 1869, sent to the Vie Parisienne, and later to the Revue des Deux Mondes, a large number of social sketches and dialogues, afterwards reprinted in volumes. Her later work includes stories of a more formal sort, essentially differing but little from the shorter studies. The following list includes some of the best known of Madame de Martel's publications, nearly seventy in number : Petit Bob (1882) ; Autour du mariage (1883) ; Ce que femme veut (1883) ; Le monde d, c6t6 (1884) ; Sans voiles (1885) ; Autour du divorce (1886) ; Dans le train (1886) ; Mademoiselle Loulou (1888) ; Boh au Salon (1888-89) ; L'education d'un prince (1890) ; Passionette (1891) ; Ohe! La grande vie (1891) ; Une election d, Tigre- sur-Mer (1890), an account of " Gyp's " experiences in sup- port of a Boulangist candidate ; Mariage civil (1892) ; Ces bons docteurs (1892) ; Du haut en bas (1893) ; Mariage de cJiiffon (1894) ; Leurs dmes (1895) ; Le coeur d'Ariane (1896); Le bonheur de Ginette (1896); Totote (1897); Lune de mid (1898); Israel (1898); L'entrevue (1899); Le pays des champs (1900) ; Trop de chic (1900) ; Le Friquet (1901). From the first "Gyp," writing of a society to which she belonged, displayed all the qualities which have given her a distinct, if not pre-eminent, posi- tion among writers of her class. Those qualities in- cluded an intense faculty of observation, much skill in innuendo, a mordant wit combined with some breadth of humour, and a singular power of animating ordinary dialogue without destroying the appearance of reality. Her Parisian types of the spoiled child, of the precocious schoolgirl, of the young bride, and of various masculine figures in the gay world, have become almost classical, and may probably*~~

survive as faithful pictures of luxuri- ous manners in the 19th century. Some later produc- tions, inspired by a violent anti-Semitic and ISTationalist bias, deserve little consideration. An earlier attempt to dramatize Autour du mariage was a failure, not owing to the audacities which it shares with most of its author's works, but from lack of cohesion and incident. " Gyp's " successes are indeed all achieved without a trace of dra^ matic faculty. In 1901 Madame de Martel furnished a sensational incident in the Nationalist campaign during the municipal elections in Paris. She was said to have been the victim of a kidnapping outrage or piece of horseplay provoked by her political attitude, but though a most cir- cumstantial account of the outrages committed on her and of her adventurous escape was published, the affair was never clearly explained or verified.

Martel I O Tower. — The name is a corruption of Mortella, and the large adoption of towers so styled for purposes of coast defence is due to incidents in the war of the French Revolution. In September 1793, Commodore Linzee, in command of the line-of-battle ships Alcide, Courugeux, Ardent, with the frigates Lowestoffe and Nemesis, was ordered by Lord Hood, then in possession of Toulon, to support the Corsican insurgents under General Paoli, who had sought British assistance. Linzee deter- mined to attack Pornielli, and in the first place to take a tower on Cape Mortella which commanded the only secure anchorage in the Gulf of San Fiorenzo. This tower, according to James, was named " after its inventor " ; but the real derivation appears to be the name of a wild myrtle which grew thickly on the spot. The tower, which mounted one 24-pounder and two 18-pounders on its top, was bom- barded for a short time by the Lowestoffe and Nemesis frigates, was then deserted by its little garrison, and occupied by a landing party of 30 men under Lieutenants Gibbs and Annesley. The attack on Fornielli failed, and the tower was abandoned, and afterwards retaken by the French from the Corsicans. So far it had done nothing to justify its subsequent reputation. Early in 1794, how-

ever, a fresh attempt was decided upon by Lord Hood and Major-General Dundas, to support the Corsican insurgents. On the 7th February, 1400 troops were landed in a bay to the west of Cape Mortella, and the tower

~~was attacked by land and sea on the following day. The Fortitude and Juno kept up a bombardment for 2^ hours and then hauled off, the former being on fire, and having 62 men killed and wounded. The fire from the batteries on shore produced no impression, until a hot shot set fire to the "bass junk with which to the depth of 5 feet the immensely thick parapet" of the tower "was lined." The garrison of 33 men under Ensign Le Tellier then surrendered. The armament was found to consist only of two 18-pounders and one 6-pounder, and the strong resistance offered by these three guns seems to have led to the conclusion that towers of this description were specially formidable. There appears to be nothing in the circumstances to justify this conclusion. As a result of the invasion scares which it was Napoleon's policy to pro- mote and maintain, Martello towers were built in large numbers, and at heavy expense, along the shores of England, especially on the southern and eastern coasts, which in certain parts are lined with these species of fortification placed at short intervals. Their principal characteristics are solid masonry containing vaulted rooms in the interior for the garrison, and providing a platform at the top for two or three guns, firing over a low masonry parapet. Access, as in the far older Irish towers, is provided by a wooden ladder, communicating with a door about 20 feet above the ground. In some cases a deep ditch is provided around the base of the tower ; in others, the ditch is absent. It is interesting to note that the towers of Linz begun in 1833 by the Arch- duke Maximilian were similar in conception, as also was the Malakoff tower built by subscription among the mer- chants of Sebastopol, which was the one completed exam- ple of permanent fortification existing on the south side when the Allies commenced the siege. The Malakoff tower proved a positive disadvantage to the defence by adding greatly to the losses of the defenders of the ex- temporized redoubt which was built round it. "While the Martello tower owes its reputation as a work of defence and its widespread adoption in Great Britain to the misconception arising out of a single incident of war, the round masonry structure entered by a single door raised high above the base is far older than the events of 1794. Such structures are to be found in many lands, and are amongst the earliest examples of masonry fortification. (g. s. c.)~~

~~*Martensen, Hans Larsen (1808-1884\ Danish bishop and theologian, was born at Flensburg on 19th August 1808. He was ordained in the Danish Church, and ultimately became professor of theology at Copen- hagen, as well as court preacher. His life was unevent- ful, but his contributions to theological literature were neither few nor unimportant. Among them were treatises on Christian ethics and dogmatics, on moral philosophy, on baptism, and a sketch of the life of the celebrated mystic Jacob Bohme, who exercised so marked an influence on the mind of the great English theologian of the 18th century, William Law. Martensen was a distinguished preacher, and his works were translated into various languages. His treatises on Christian ethics and dogmatics, in particular, have been widely read in Great Britain. He was made bishop of Zealand in 1854, and died at Copenhagen on 4th February 1884. He was a man of original mind, departed in many ways from the strict standards of Lutheran orthodoxy, and showed a disposition towards mysticism in many of his works. The " official " eulogy he pronounced upon Bishop Mynster, on*~~

~~*the death of this dignitary in 1854, brought down upon his head the scathing invectives which the philosopher Kierkegaard poured forth on the text, " A witness of the truth." (j. J. L*.)*~~

~~*Martial Law. — "Martial law" is an unfortunate term, and in a sense a misnomer. It describes a suspen- D // III ^^^^ °^ ordinary law, rendered necessary by cir- ■ cumstances of war or rebellion. The confusion arose from the fact that the Marshal's Court administered military law before the introduction of articles of war, which were in their turn merged in the Army Act. But martial law is not a law in the proper sense of the terra. It is the exercise of the will of the military commander, who takes upon himself the responsibility of suspending ordinary law in order to ensure the safety of the State. It is declared, by a proclamation issued by the executive, that ordinary law is inadequate to cope with the actual circumstances, and provides exceptional means of arrest and punishment of persons who resist the Government, or who aid and abet the enemy.*~~

~~*But such a proclama- tion, whilst it is invariably issued in order to give pub- licity to the suspension of ordinary law, does not invest the step with the force of law. In short, martial law arises out of the will of the commander, and he acts from necessity, and in order to deal more summarily with civilians. It is simply military authority exercised in accordance with the laws and usages of war, and is limited by military necessity. Yet in reality it is part of common law which justifies acts done by necessity for the defence of the Commonwealth when there is war. Halleck in his work on International Law (vol. i. p. 544), says, " Martial law originates either in the prerogative of the Crown, as in Great Britain, or from the exigency of the occasion, as in other states : it is one of the rights of sovereignty, and is essential to the existence of a state, as is the right to declare or to carry on war."*~~

~~*This opinion, however, must be read, as regards the British Empire, with the passage in the Petition of iiight which is reproduced in the preamble of each annual Army Act, and asserts the illegality of martial law in time of peace in the following terms: — "No man shall be fore- judged or subjected in time of peace to any kind of punish- ment within this realm by martial law." Therefore, whilst martial law is declared illegal in time of peace, it is indirectly declared lawful in time of war and intestinal commotion when the courts are closed, or when there is no time for their cumbrous action. Clode, in Military Forces of the Crown, argues that the words of the Petition of Right and of the Military Act since the reign of Anne are plain in this respect " that . . . the Crown possesses the right of issuing commissions in war and rebellion." But he rightly adds that the military commander may permit the usual courts to continue their jurisdiction upon such subjects as he thinks proper. Legislative enactments have also sanctioned this special jurisdiction at various times, notably in 1798, 1799, 1801, and in 1803. These enactments lay down that exceptional powers may be exercised " whether the ordinary courts shall or shall not be open." As an invariable rule an Act of Indem- nity has been passed on the withdrawal of martial law, but that has been done only to protect any person in charge of the execution of martial law who has exceeded his powers in good faith, honestly believing his action was necessary for the safety of the country.*~~

~~*There has been much discussion as to whether, in districts where martial law has not been proclaimed, a person can be sent for trial from such district into a district where martial law was in operation. It is argued that if the ordinary courts were open and at work in the non-proclaimed district recourse should be had to them.*~~

~~*The Privy Council in 1902 (re Marais) refused leave to appeal where the Supreme Court of Cape Colony had declined to issue a writ of Habeas Corpus in these cir- cumstances. Mr Justice Blackburn in his charge in Queen v. Eyre says, " I have come to the conclusion that, looking at what martial law was, the bringing of a person into the proclaimed district to be tried might, in a proper case, be justified." The learned judge admits that there should be a power of summary trial, observing all the substantials of justice, in order to stamp out an insur- rection by speedy trial.*~~

~~*Whilst martial law is the will of the commanders, and is only limited by the customs of war and the discretion of those who administer it, still, as far as practicable, the procedure of military law is followed, and a military court is held on the same lines as a court-martial. Charges are simply framed without technicalities. The prisoner is present, the evidence of prosecution and prisoner is taken on oath, the proceedings are recorded, and the sentence of the court must be confirmed according to the rules of the Army Act. Sentences of death and penal servitude must be referred to headquarters for confirmation. In the South African war (1899-1902) these limits of procedure were observed, and when pos- sible will always be.*~~

~~*Entering more into detail, the term martial law has been employed in several senses : — (1) As applied to the military forces of the Crown, apart from the military law under the old Mutiny Acts, and ^ppff^J the present annual Army Acts. (2) As applied tions ot to the enemy. (3) As applied to rebels. (4) As martial applied to civilian subjects who are not in rebel- ^' lion, but in a district where the ordinary course of civil life cannot be maintained owing to war or rebellion.*~~

~~*1. In regard to the military forces of the Crown, the superseding of justice as administered under the Army Act could only occur in a time of great need ; e.g., mutiny of five or six regiments in the field, with no time to*~~

~~*take the opinion of any executive authority. The officer in command would then be bound to take measures for the purpose of suppressing such mutiny, even to putting soldiers to death if necessary. It would be a case where necessity forced immediate action.*~~

~~*2. Martial law as applied to the enemy or the popula- tion of the enemy's country is, in the words of the duke of Wellington, "the wall of the general of the army, though it must be administered in accordance with the customs of war."*~~

~~*3. 4. But it is as affecting the subjects of the Crown in rebellion that the subject of martial law really obtains its chief importance ; and it is in this sense that the term is generally used; i.e., the suspension of ordinary law and the temporary government of the country, or parts of it, or all of it, by military tribunals. It has often been laid down that martial law in this sense is unknown to the law of England. Mr Dicey, for instance, restricts martial law to only another expression for "the common right of the Crown and its servants to repel force by force, in the case of invasion, insurrection, or riot, or generally of any violent resistance." But more than this is understood by the term martial law.*~~

~~*When the proposition was laid down that martial law in this sense is unknown to the law of England, it is to be remembered that fortunately in England there never had been a state at all similar to that prevailing in Cape Colony in 1900-1902, and it may perhaps be ques- tioned whether the statement would have been made with such certainty if similar events had been present to the writers' minds.*~~

~~*In the charge delivered by Mr Justice Blackburn in the Jamaica case, which has already been cited, the law as*~~

~~*affecting the general question of martial law is well set out.*~~

~~*"By the laws of this country," said Mr Justice Blackburn, "beginning at Magna Charta and getting more and more estab- lished, down to the time of the Revolution, when it was finally and completely established, the general rule was that a subject was not to be tried or punished except by due course of law ; all crimes are to be determined by juries subject to the guidance of the judge ; that is the general rule, and is established law. But from the earliest times there was this also which was the law, and is the law still, that when there was a foreign invasion or an insurrection, it was the duty of every good subject, in obedience to the officers and magistrates, to resist the rebels, ... in such a case as that of insurrection prevailing so far that the courts of law cannot sit, there must really be anarchy unless there is some power to keep the people in order, . . . before that principle the Crown claimed the prerogative to exercise summary proceedings by martial law ... in time of war when this disturbance was going on, over others than the army. And further than that, the Crown made this further claim against the insurgents, that whilst it existed, pending the insurrection and for a short time after- wards, the Crown had . . . the power to proclaim martial law in the sense of using summary proceedings, to punish the insurgents and to check and stop the spread of the rebellion by summary proceedings against the insurgents, so as ... to stamp out the rebellion. Now no doubt the extent to which the Crown had power to do that has never been yet decided. Our law has been declared from time to time and has always been a practical science, that is, the judges have decided so much as was necessary for the particular case, and that has become part of the law. But it never has come to be decided what this precise power is."*~~

~~*So far as the United Kingdom is concerned, the need has never arisen. It has always been found possible to employ the ordinary courts directly the rebels have been defeated in the field and have been made prisoners or surrendered. "Fortunately in England only three occa- sions have arisen since the Eevolution when the author- ity of the civil power was for a time, and then only partially, suspended," 1T15, 1745 and 1780. Clode, Mili- tary Forces, vol. ii. p. 163, says : " Upon the threat of invasion followed by rebellion in 1715, the first action of the Government was to issue a proclamation authorizing all officers, civil and military, by force of arms (if neces- sary) to suppress the rebellion." This, therefore, would*~~

~~*only seem to fall within the limited sense in which Mr Dicey understands martial law to be legal, "the right of the Crown and its servants to repel force by force." There was no attempt to bring persons before courts-martial who ought to be tried by the common law, and all the extraordinary acts of the Crown were sanctioned by Parliament. After the rebellion had been suppressed two statutes were passed, one for indemnity and the other for pardon. Before the revolution of 1745 similar action was adopted, a proclamation charging civil magis- trates to do their utmost to prevent and suppress all riots, and Acts of Parliament suspending Habeas Cor- pus, providing for speedy trials ; and of indemnity. In the Gordon Riots of 1780 a very similar course was pursued, and nothing was done which would not fall within Mr Dicey's limitation. No prisoners were tried by martial law.*~~

~~*In Ireland the ordinary law was suspended in 1798- 1801 and in 1803. In 1798 an Order in Council was issued to all general officers commanding H.M. forces to punish all persons acting in, aiding, or in any way assisting the rebellion, according to martial law, either by death or otherwise, as to them should seem expedient for the suppression and punishment of all rebels ; but the order was communicated to the Irish Houses of Parliament, who expressed their approval by addresses to the viceroy. It was during the operation of this order that Wolfe Tone's case arose. Tone, a subject of the king, was captured on board a French man-of- war, and condemned to death by a court-martial. Curran, his counsel, applied to the King's Bench at Dublin for a*~~

~~*Habeas Corpus, on the grounds that only when war was raging could courts-martial be endured, not while the Court of King's Bench sat. The court granted his applica- tion ; but no ultimate decision was ever given, as Tone died before it could be arrived at.*~~

~~*In 1799 application was made to Parliament for exjaress sanction to martial law. The preamble of the Act declared that "The Rebellion still continues . . . and stopped the ordinary course of justice and of the common law ; and that many persons . . . who had been taken by H.M. forces . . . had availed them- selves of such partial restoration of the ordinary course of the common law to evade the punishment of their*~~

~~*crimes, whereby it had become necessary for Parliament to interfere." The Act declared that martial law should prevail and be put in force whether the ordinary courts were or were not open, &c. And nothing in the Act could be held to take away, abridge, or eliminate the acknowledged prerogative of war, for the public safety to resort to the exercise of martial- law against open enemies or traitors, &c.*~~

~~*After the suppression of the rebellion an Act of In- demnity was passed in 1801.*~~

~~*In 1803 a similar Act was passed by the Parliament of the United Kingdom as it was after the Act of Union. In introducing it Mr Pitt stated, "The Bill is not one to enable the Government in Ireland to declare martial law in districts where insurrection exists, for that is a power which His Majesty already possesses — the object will be to enable the Lord Lieutenant, when any persons shall be taken in rebellion, to order them to be tried immediately by a court-martial."*~~

~~*During the 19th century martial law was proclaimed by the British Government in the following places : —*~~

~~*1. Barbados, 1805-16.*~~

~~*2. Demerara, 1823. .3. Jamaica, 1831-32—1865.*~~

~~*4. Canada, 1837-38.*~~

~~*5. Ceylon, 1817 and 1848.*~~

~~*6. Cephalonia, 1848.*~~

~~*The proclamation was always based on the grounds of necessity, and where any local body of a representative character existed it would seem that its assent was given, and an Act of Indemnity obtained after the suppression of the rebellion. (jno. S.)*~~

~~*Martin, Bon Louis Henri (1810-1883), French historian, was born on the 20th of February 1810 at St Quentin (Aisne), where his father was a*~~

~~*judge. Trained as a notary, he followed this profession for a while, but having by his twentieth year achieved success with a historical romance, Wolftliurm (1830), applied himself seriously to historical research. Becoming associated with Paul Lacroix (" le Bibliophile Jacob "), he planned with him a history of France, which was to consist of excerpts from the chief chroniclers and historians, with original matter filling up the gaps in the continuity. The first volume, which appeared in 1833, encouraged the author to make the work his own, and his Histoire de France, in fiifteen volumes (1833-36), was the result. This magnum opus, rewritten and further elaborated (1837-54), gained for the author in 1856 the first prize of the Academy, and in 1869 the grand biennial prize of 20,000 francs. A popular abridgment in seven volumes was published in 1867. This, together with the continuation, Histoire de France moderne depuis 1789 jusqu'd, nos jours, gives a complete history of France, and superseded Sismondi's Histoire des Frangais. Henri Martin's reputation is that of a conscientious, impartial, and scrupulously accurate writer, although he can hardly be ranked among the world's great historians. He sat in the Assembly as deputy for Aisne in 1871, and was elected life senator for*~~

~~*7. Cape of Good Hope, 1834-*~~

~~*1849-51.*~~

~~*8. St Vincent, 1863.*~~

~~*9. Jamaica, 1805.*~~

~~*10. South Africa, 1899-1901.*~~

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~~*the same province in 1878, but he did not leave any real mark as a politician. He died in Paris on 14th December*~~

~~*1883.*~~

~~*Amoftg minor works which proceeded from his pen may be men- tioned . Dr la France, de son genie et de ses destinries (1847), La Mussie et V Europe (1866), Les Napoleon et lesfrontieresdela France*~~

~~*Martin, Helena Saville (1817-1898), English actress, best known under her maiden name as Helen Faucit, was born in London in 1817. Her stage ddbut was made in January 1836 at Covent Garden Theatre, as Julia in Hie Hunchback. Her success in this was so definitely confirmed by her subsequent acting of such parts as Juliet, Lady Teazle, Beatrice, Imogen, and Hermione, that within eighteen months from her first appearance she was engaged by Macready as leading lady at Covent Garden. There, besides appearing in several Shakespearian characters, she " created " the heroine's part in Lytton's Duchess de la Valli&re (1836), Lady of Lyons (1838), Richelieu (1839), The Sea Captain (1839), Money (1840), and Browning's Strafford (1837). After a visit to Paris and a short season at the Haymarket Theatre, she joined the Drury Lane company under Macready early in 1842. At Drury Lane she played for the first time the parts of Lady Macbeth, Constance in King John, Desdemona and Imogen, and took part in the first production of Westland Marston's Patrician's Daughter (1842) and Browning's Blot in the 'Scutcheon (1843). The next two years were occupied with tours in England, Scotland, and Ireland, her acting meeting everywhere with unstinted praise, and a visit to Paris (in the winter of 1844-46), when she acted with Macready in several Shakespearian plays. After six more years passed almost entirely in acting in various parts of the United Kingdom, she was married in August 1861 to Mr (afterwards Sir) Theodore Martin. She did not re- linquish her profession after marriage, but appeared on the stage at frequent intervals during the next twenty years, until her definite retirement in 1871. After that she would only consent to act in public for charitable purposes. In 1881 there appeared in Blackwood's Magazine the first of her Letters on Some of Shakespeare's Heroines, which were ultimately published in book form (under the title of On Some of Shakespeare's Female Characters) in 1885. The latter years of her life were spent in a seclusion which increased as her health declined, but was marked by numerous marks of honour and ad- miration from the highest personages and the greatest intellects in the land. She died at her home in Wales on 31st October 1898. (e. f. s.)*~~

~~*Martin, Sir Theodore (1816-*~~

~~*-), author and*~~

~~*translator, the son of a solicitor, was born in Edinburgh on 16th September 1816, and educated at the Eoyal HIgh School and the University, from which he subsequently received the honorary degree of LL.D. HIe practised for some time as a solicitor in Edinburgh, but in 1846 went to London, where he became senior partner in the firm of Martin and Leslie, parliamentary agents. HIe early contributed to Fraser's Magazine and Tait's Magazine, under the signature of "Bon Gaultier," and in 1856, in conjunction with Professor Aytoun, he published the Book of Ballads under the above pseudonym. This work at once obtained popular favour. In 1858 he published a volume of translations of the Poems and Ballads of Goethe, and this was followed by a rendering of the Danish poet HIenrik HIertz's noble lyric drama, King Ren&'s Daughter. The principal character in this drama, lolanthe, was sustained by Miss HIelen Faucit, who in 1851 became the author's wife. Martin's translations of Ohlenschlager's dramas, Correggio (1854), and*~~

~~*Aladdin, or the Wonderful Lamp (1857), widened the fame of the great Danish poet in England, and materially assisted in familiarizing readers with his dramatic master- pieces. In 1860 appeared Martin's metrical translation of the Odes of HIorace; and in 1870 he wrote a volume on HIorace for the series of " Ancient Classics for English Eeaders." In 1882 his HIoratian labours were concluded by a translation of the poet's whole works, with a life and notes, in two volumes. A poetical translation of Catullus was published in 1861, followed by a privately printed volume of Poems, Original and Translated, in 1863. Then came translations of the Vita Nuova of Dante, and the first part of Goethe's Faust. A metrical translation of the second part of Faust appeared in 1866. Martin wrote a memoir of his friend Aytoun in 1867, and while engaged upon this work he was requested by Queen Victoria to undertake the Life of HIs Royal HIghness the Prince Consort. The first volume of this well-known work was published in 1874. In 1878 Martin's translation of HIeine's Poems and Ballads appeared. Two years later the Life of the Prince Consort was brought to a successful conclusion by the publication of the fifth volume.*~~

~~*A knighthood was then conferred upon Martin, whose asso- ciation with the Queen added to the influence which his literary position had already achieved. In the following November he was elected Lord Rector of the University of St Andrews. Martin's Life of Lord Lyndhurst, .based on papers furnished by the family, was published in 1883. In 1889 appeared The Song of the Bell, and other Trans- lations from Schiller, Goethe, Uhland, and Others; in 1894 Madonna Pia, a Tragedy, and three other Dramas, and in 1900 he published a biography of his accomplished wife. All Sir Theodore Martin's translations are distinguished for their singular fidelity to the originals, but perhaps the finest and most spirited are those from Goethe and Horace.*~~

~~*Martin, Sir William Fanshawe (1801-1896), British admiral, son of Admiral of the Fleet Sir Thomas Byam Martin, Comptroller of the Navy, and grandson, on the mother's side, of Captain Eobert Fanshawe, who commanded the Namur under Rodney on 12th April 1782, was born on 6th December 1801. Entering the navy at the age of twelve, his father's interest secured his rapid promotion : he was made a lieutenant on 15th December 1820; on 8th February 1823 he was pro- moted to be commander of the Fly sloop, his good service in which in support of the interests of British merchants at Callao during one of the continually recurring civil wars gave the Admiralty a legitimate excuse — if one had been needed — for promoting him to be captain on 5th June 1824. He after- wards served in the Mediterranean and on the home station, but without any opportunities of distinction, though known in the navy as a good officer. In 1849-52 he was commodore commanding the Channel squadron, and at once gave evidence of a remarkable aptitude for command — of being a man who knew what he wanted and how to get it done. He was made rear- admiral in May 1863, and for the next four years was superintendent of Portsmouth dockyard. He was made vice-admiral in February 1868, and after a year as a Lord of the Admiralty, was appointed commander-in-chief in the Mediterranean. The discipline of the navy was just then at a very low ebb. It was an evil tradition, sprung from the wholesale shipment of gaol-birds during the old war, that the men were to be treated as brute beasts ; and though the practice was better than the theory, it was still very bad. At this time, too, the ships had*~~

been largely filled up with " bounty men " — men who had been bought into the service with a £10 note, without being sailors or having

even an elementary notion of cleanliness or obedience. Out of this very unpromising material Martin formed the fleet which was at the time the ideal of excellence, and may be said to have laid the foundations of the magnificent organization of a later day. It is solely in this connexion that his name stands out among the naval officers of the century, for he had no war service, and, beyond the Italian disturbance of 1860-61, no opportunity for showing any diplomatic ability. But his memory will deservedly live as that of the reformer of discipline and the originator of a comprehensive system of steam manoeuvres. He became an admiral in November 1863, and on 4th December succeeded to the baronetcy which had been originally conferred on his grandfather. His last appointment was the command at Plymouth, 1866-69, and in 1870 he was put on the retired list. In 1873 the G.C.B. was conferred on him, and in 1878 he was made rear-admiral of the United Kingdom. He died at Upton Grey, near Winch- field, on 24th March 1895. He was twice married, and left, besides daughters, one son, who succeeded to the baronetcy. (j. k. l.)

Martineau, James (1805-1900), English phi- losopher and divine, was born at Norwich, 21st April 1805, the seventh child of Thomas Martineau and Eliza- beth Eankin, the sixth, his senior by almost three years, being his sister Harriet {Ency. Brit. vol. xv. pp. 583-584). He was descended from Gaston Martineau, a Huguenot surgeon and refugee, who married in 1693 Marie Pierre, and settled sooa afterwards in Norwich. His son and grandson — respectively the great-grandfather and grand- father of James Martineau — were surgeons in the same city, while his father was a manufacturer and merchant. Affinity of faith made the French Huguenot an English Presbyterian, and the Martineaus could not fail to share the discipline, the culture, and the intellectual changes of the society within which they lived. James was educated at Norwich Grammar School under Edward Valpy, as elegant a classic and as fastidious a scholar as his better-known brother Eichard. But the boy proving too

~~sensitive for the rough-and-tumble life of a public day school, was sent to Bristol to the private academy of Dr Lant Carpenter, a conscientious master, an earnest philanthropist, and a laborious divine, well known for his part in the Socinian controversies of the day, under whom he studied for two years. On leaving there he was apprenticed to a civil engineer at Derby, where he acquired " a store of exclusively scientific conceptions," ' but where he also experienced the hunger of mind which forced him to look to religion for satisfaction. Hence came his " conversion," and the sense of vocation for the ministry which impelled him in 1822 to enter Manchester College, then lodged at York. Here he " woke up to the interest of moral and metaphysical speculations." Of his teachers, one, the Kev. Charles Wellbeloved, was, Martineau said, "a master of the true Lardner _Eiiry. Brit. vol. xiv. p. 313] type, candid and catholic, simple'and thorough, humanly fond indeed of the counsels of peace, but piously serving every bidding of sacred truth." " He never justi- fied a prejudice ; he never misdirected our admiration; he never hurt an innocent feeling or overbore a serious judg- ment ; and he set up within us a standard of Christian scholarship to which it must ever exalt us to aspire."^ The other, the Rev. John Kciirick, he described as a man so learned as to be placed by the late Dean Stanley "in the same line with Blomfield and Thirl- wall,"" and as "so far above the level of either vanity~~

~~1 Tijppx of Klhkal Theory, i. 8.~~

~~2 Exmtiis, Rniiews, and Jddresses, ix. 54. 8 Ibid. i. 397.~~

~~or dogmatism, that cynicism itself could not think of them in his presence." *~~

~~On leaving the college in 1827 Martineau returned to Bristol to teach in the school of Lant Carpenter ; but in the following year he was ordained for a Unitarian church in Dublin whose senior minister was a relative of his own. But his career there was in 1832 suddenly cut short by difiiculties growing out of the " Regium donum," which had on the death of the senior minister fallen to him. He conceived it as " a religious monopoly," to which " the nation at large contributes " while " Presbyterians alone receive," and which placed him in " a relation to the~~

~~*State ” so ” seriously objectionable ” as to be ” impossible to hold.”* The invidious distinction it drew between Presbyterians on the one hand, and Catholics, Priends, freethinking Christians, unbelievers, and Jews on the other, who were compelled to support a ministry they ” conscientiously disapproved,” offended his always deli- cate conscience ; while possibly the intellectual and ecclesiastical atmosphere of the city proved uncongenial to his liberal magnanimity. Prom Dublin he was called to Liverpool, and there for a quarter of a century he exercised extraordinary influence as a preacher, and achieved a high reputation as a writer in religious phi- losophy. In 1840 he was appointed professor of mental and moral philosophy and political economy in Manchester New College, the seminary in which he had himself been educated, and which had now removed from York to the city after which it was named. This position he held for forty-five years. In 1853 the college removed to London, and four years later he followed it thither. In 1858 he was called to occupy the pulpit of Little Portland Street Chapel in London, which he did at first for two years in conjunction with the Rev. J. J. Tayler, who was also his colleague in the college, and then for twelve years alone. In 1866 the chair of the philosophy of mind and logic in University College, London, fell vacant, and Martineau became a candidate. But potent opposition was offered to the appointment of a minister of religion, and the chair went to George Croom Robertson — then an untried man — between whom and Martineau a cordial friendship came to exist. Prom 1869 to 1880 he was one of the most active, as he was possibly the most distinguished philo- sophical, member of the famous Metaphysical Society, which, though it might contribute little to thought or knowledge, yet accomplished the immense indirect good of making eminent men, who held diverse views in religion and philosophy, personally acquainted. In 1885 he retired, full of years and honours, from the principal- ship of the college he had so long served and adorned. It ought to be recorded, were it only as significant of the happier spirit of the time, that Martineau, who was in his youth denied the benefit of a university education, yet in his age found famous universities eager to confer upon him their highest distinctions. He [was made LL. D. of Harvard in 1872, S.T.D. of Leyden in 1874, D.D. of Edinburgh in 1SS4, D.C.L. of Oxford in 18S8. and D.Litt. of Dublin in 1891. He died in London on 11th January 1900.*~~

The life of Martineau was so essentially the life of the thinker, and was so typical of the century in which he lived and the society within which he moved, that he can be better understood through his spoken mind than through his outward history. He was a man happy in his ancestry : he inherited the dignity, the reserve, the keen and vivid intellect, and the picturesque imagination of the Prench Huguenot, though they came to him chastened

^ Fs.'mj/fi, Rrvien).' *, and Addri?. isr.* *,]. 419. 6 M;u'tineau's "Leiter to the Dissi^iitiii" Street" (Dublin).*

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and purified by generations of Puritan discipline exercised under the gravest ecclesiastical disabilities, and of culture maintained in the face of exclusion from academic privileges. He had the sweet and patient temper which knew how to live, unrepining and unsoured, in the midst of the most watchful persecution, public and private ; and it is wonderful how rarely he used his splendid rhetoric for the purposes of invective against the spirit and policy from which he must have suffered deeply, while, it may be added, he never hid an innuendo under a metaphor or a trope. He had the advantage of being educated by men who had no inducement to seek know- ledge, save such as came from love of truth ; and though he knew how much he had lost by never having lived within a learned society full of the great traditions of ancient and modern scholar- ship, yet he would have been the first to claim that he who has had to follow in feebleness, and amid storm and stress, the truth that drew him on, has received an education that may do more than the discipline of any college to dignify the conscience, to quicken the intellect, and to enrich the imagination. For these and similar reasons he was lifted above the temptations which beset the mere scholar or the thinker bound to main- tain his formulated beliefs. He was fundamentally too much a man of strong con- victions to be correctly de- scribed as open-minded, for if nature ever determined any man's faith, it was his ; tlie root of his whole

~~*in- tellectual life, which was too ■deep to be disturbed by any superficial change in his philosophy, being the feeling for God. IIe has, indeed, described in graphic terms the greatest of the more superficial changes he underwent; how he had " carried into logical and ethical problems the maxims and postulates of physical knowledge," and had moved within the narrow lines drawn by the philosophical instructions of the classroom "interpreting human phenomena by the analogy of external nature " ; how he served in willing captivity " the ' empirical ' and ' necessarian ' mode of thought," even though " shocked " by the dogmatism and acrid humours " of certain distinguished representatives " ; ^ and how in a period of " second education " at Berlin, " mainly under the admirable guidance of Professor Trendelenburg," he experienced " a new intellectual birth " which " was es- sentially the gift of fresh conceptions, the unsealing of hidden openings of self-consciousness, with un-measured corridors and sacred halls behind; and, once gained, was more or less available throughout the history of philosophy, and lifted the darkness from the pages of Kant and even IIegel." ^ But though this momentous change of view illuminated his old beliefs*~~

~~*James Martineatt. {From a phoiograjph by Ellioit a/nd Fry, ^London.)*~~

~~*1 Types of Ethical Theory, i. pp. vii.-ix.*~~

~~*2 Ibid. p. xiii.*~~

~~*and helped him to re-interpret and re-articulate them, yet it made him no more of a theist than he had been before. And as his theism was, so was his religion and his philosophy. Certainly it was true of him, in a far higher degree than of John IIenry Newman, that the being of God and himself were to his mind two absolutely self-luminous truths — though both his God and his self were almost infinitely remote from Newman's. And as these truths were self-evident, so the religion he deduced from them was suflB.cient, not only for his own moral and intellectual nature, but also for man as he con- ceived him, for history as he knew it, and for society as*~~

~~*he saw it.*~~

~~*We may, alternatively, de- scribe Martineau's religion as his applied philosophy, or his philosophy as his explicated re- ligion, and both as the expres- sion of his singularly fine ethical and reverent nature. But to understand these in their mutual and explanatory relations, it will be necessary to exhibit the conditions under which his thought grew into consistency and system. HIs main func- tion made him in his early life a preacher even more emphati- cally than a teaclier. In all he said and all he thought he had the preacher's end in view. HIe was, indeed, no mere orator or spealier to multitudes. HIe addressed a comparatively small and select circle, a congregation of thoughtful and devout men, who cultivated reverence and loved religion all the more that their own beliefs were limited to the simplest and sublimest truths. HIe felt the majesty ot these truths to be the greater that they so represented to him not only the most funda- mental of human beliefs, but also all that man could be reason- ably expected to believe, though to believe with his whole reason. HIence the beliefs he preached were never to him mere specu- lative ideas, but rather the ul- timate realities of being and thought, the final truths as to the character and ways of God Interpreted into a law for the government of conscience and the regulation of life. And so he became a positive religious teacher by virtue of the very ideas that made the words of the HIebrew prophets so potent and sublime. But he did more than interpret to his age the significance of man's ultimate theistic beliefs, he gave them vitality by reading them through the consciousness of Jesus Christ. HIis religion was what he conceived the personal religion of Jesus to have been ; and HIe was to him more a person to be imitated than an authority to be obeyed, rather an ideal to be revered than a being to be worshipped.*~~

~~*Martineau's mental qualities fitted him to fulfil these high interpretative functions. HIe had the imagination that invested with personal being and ethical qualities the most abstruse notions. To him space became a mode of divine activity, alive with the presence and illumined by the vision of God : time was an arena where the divine hand guided and the divine will reigned. And though he did not believe in the Incarnation, yet he held deity to be in a sense manifest in HIumanity ; its saints and heroes became, in spite of innumerable frailties, after a sort divine ; man underwent an apotheosis, and all life was touched with the dignity and the grace which it owed to its source. The 19th century had no more reverent*~~

thinker than Martineau ; the awe of the Eternal was the very atmosphere that he breathed, and he looked at man with the compassion of one whose thoughts were full of God.

To his function as a preacher we owe some of his most char- acteristic and stimulating works, especially the discourses by

which it may be said he won his way to wide and influential recognition — Endeavours after the Christian Life, 1st series, 1843 ; 2nd series, 1847 ; Hours of Thought, 1st series, 1876 ; 2nd series, 1879; the various hymn-books he issued at Dublin in 1831, at Liverpool in 1840, in London in 1873 ; and the Home Prayers in 1891. But besides the vocation he had freely selected and assiduously laboured to fulfil, two more external influences helped to shape Martineau's mind and define his problem and his work ; the awakening of English thought to the problems which underlie both philosophy and religion, and the new and higher opportunities offered for their discussion in the periodical press. The questions which lived in the earlier and more formative period of his life concerned mainly the idea of the Church, the historical interpretation of the documents which described the persons who had created the Christian religion, especially the person and work of its Founder ; but those most alive in his later and maturer time chiefly related to the philosophy of religion and ethics. In one respect Martineau was singularly happy ; he just escaped the active and, on the whole, belittling period of the old Socinian controversy. When his ministry began its fires were slowly dying down, though the embers still glowed. We feel its presence in his earliest notable work. The Rationale of Religious Enquiry, 1836 ; and may there see the rigour with which it applied audacious logic to narrow premisses, the tenacity with which it clung to a limited literal supernaturalism which it had no philosophy to justify, and so could not believe without historical and verbal authority. This traditional conservatism survived in the statement, which, while it caused vehement discussion when the book appeared, was yet not so much characteristic of the man as of the school in which he had been trained, that "in no intelligible sense can any one

who denies the supernatural origin of the religion of Christ be termed a Christian," which term, he explained, was used not as " a name of praise," but simply as " a designation of belief." ^ He censured the German rationalists " for having preferred, by convulsive efforts of interpre- tation, to compress the memoirs of Christ and His apostles into the dimensions of ordinary life, rather than admit the operation of miracle on the one hand, or proclaim their aban- donment of Christianity on the other." ' The echoes of the dying controversy are thus distinct and not very distant in this book, though it also offers in its larger outlook, in the author's evident uneasiness under the burden of inherited beliefs, and his inability to reconcile them with his new standpoint and accepted principles, a curious forecast of his later development, while in its positive premisses it presents a still more instructive contrast to the conclusions of his later dialectic. Nor did the sound of the ancient controversy ever cease to be audible to him. In 1839 he sprang to the defence of Unitarian doctrine, which had been assailed by certain Liverpool clergymen, of whom Fielding Ould was the most active and Hugh M'Neile the most famous. As his share in the controversy, Martineau published five discourses, in which he discussed " the Bible as the great autobiography of human nature from its Infancy to its perfection," "the Deity of Christ," " Vicarious Redemption," " Evil," and "Christianity without Priest and without Kitual."* He remained to the end a keen and vigilant apologist of the school in which he had been nursed. But the questions proper to the new day came swiftly upon his quick and susceptible mind — enlarged, deepened, and developed it. Within his own fold new light ■^yas breaking. To Channiog, whom Martineau had called ' ' the inspirer of his youth," Theodore Parker had succeeded, introducing more radical ideas as to religion and a more drastic criticism of sacred history. Blanco White, "the rationalist A, Kempis," who had dared to appear as " a religious sceptic in God's presence," had found a biographer and interpreter in Martineau's friend and colleague, John Hamilton Thom. Within the English Church men with whom he had both personal aud religious sympathy rose — ^Whately, of whom he said, " We know no living writer who has proved so little and disproved so much" ;* and Arnold, "a man who could be a hero without romance " ; ^ Maurice, whose character, marked by "religious realism," sought in the past "the witness to eteriial truths, the manifestation by time-samples of infinite

~~*realities and unchanging relations";^ and Kingsley, "a great teacher," though one "certain to go astray the moment he becomes didactic."' Beside these may be placed men like Pusey, and Newman, whose mind Martineau said was "critical, not prophetic, since without immediateness of religious vision," and whose faith is "an escape from an alternative scepticism, which receives the veto not of his reason but of his will,"^ as men for whose teachings and methods he had a potent and*~~

~~*1 Rationale, 2rd ed., preface, p. vii. ^ md, p. 133.*~~

- ~~*They stand as Lectures ii., v., vi., xi., xii. iu the volume Uni-iarianism Defended, 1839.*~~
- ~~*Bxsays, Reviews, and Addresses, vol. ii. p. 10.*~~

~~*6 IMd. i. p. 46. 6 fbid. i. pp, 258, 262.*~~

~~*' Ibid. ii. p. 285. s jj^id, i. p. 233.*~~

~~*stimulating antipathy. The philosophic principles and religious deductions of Dean Mansel he disliked as much as those of Newman, but he respected his arguments more. Apart from the Churches, men like Carlyle and Matthew Arnold — with whom he had much in common. — influenced him ; while Herbert Spencer in England and Comte in France afforded the antithesis needful to the dialectical development of his own views. He came to know German philosophy and criticism, especially the criticism of Baur and the Tiibingen school, which affected profoundly his construction of Christian history. And these were strengthened by French influences, notably those of Eenan and the Strasburg theologians. The rise of evolution, and the new scientific way of looking at nature and her creative methods, compelled him to rethink and reformulate his theistic principles and conclusions, especially as to the forms under which the relation of God to the world and His action within it could be conceived. Under the impulses which came from these various sides Martineau's mind lived and moved, and as they successively rose he promptly, by appreciation of criticism, responded to the dialectical issues which they raised.*~~

~~*In the discussion of these questions the periodical press supplied him with the opportunity of taking an effective part. At first his literary activity was limited to sectional publications, and he addressed his public, now as editor and now as leading contributor, in The Monthly Repository, The Christian Reformer, The Pro- spective, The Westminster, and The National Review. Later, especially when scientific speculation had made the theistic problem urgent, he was a frequent contributor to the literary monthlies. And when in 1890 he began to gather together the miscellaneous essays and papers written during a period of sixty years, he expressed the hope that, though " they could lay no claim to logical consistency," they might yet show "beneath the varying complexion of their thought some intelligible moral continuity," "leading in the end to a view of life more coherent and less defective than was presented at the beginning." ' And though it is a proud as well as a modest hope, no one could call it unjustified. For his essays are fine examples of permanent literature appearing in an ephemeral medium, aud represent work which has solid worth for later thought as well as for the speculation of their own time. There is hardly a name or a movement in the religious history of the century which he did not touch and illuminate. It was in this form that he criticized the " atheistic mesmerism" to which his sister Harriet had committed herself, and she never forgave his criticism. But his course was always singularly independent, and, though one of the most affectionate and most sensitive of men, yet it was his fortune to be so fastidious in thought and so conscientious in judgment as often to give offence or create alarm in those he deeply respected or tenderly loved.*~~

~~*The theological and philosophical discussions which thus ap- peared he later described as "the tentatives which gradually prepared the way for the more systematic expositions of the Types of Ethical Theory and TTie Study of Religion, and, in some measure, of Tlie Seat of Authority in Religion."""^" These books expressed his mature thought, and may be said to contain in what he conceived as , a final form the speculative achieve- ments of his life. They appeared respectively in 1885, 1888, and 1890, and were without doubt remarkable feats to be performed by a man who had passed his eightieth year. Their literary and speculative qualities are indeed exceptionally brilliant; they are splendid in diction, elaborate in argument, cogent yet reverent, keen while fearless in criticism. But*~~

~~they have also most obvious defects : they are unquestionably the books of an old man who had thought much as well as spoken and written often on the themes he discusses, yet who had finally put his material together in haste at a time when his mind had lost, if not its dialectic vigour, yet its freshness and its sense of propor- tion ; and who had been so accustomed to amplify the single stages of his argument that he had forgotten how much they needed to be reduced to scale and to be built into an organic whole. In the first of these books his nomenclature is unfor- tunate ; his division of ethical theories into the "unpsycho- logical," " idiopsychological," and the " hetero-psychological," is incapable of historical justification ; his exposition of single ethical systems is, though always interesting and suggestive, often arbitrary and inadequate, being governed by dialectical exigencies rather than historical order and perspective. In the second of the above books his idea of religion is somewhat of an anachronism ; as he himself confessed, he "used the word in the sense which it invariably bore half a century ago " as denoting "belief in an ever-living God, a divine mind and will ruling the universe and holding moral relations with mankind." As thus used, it was a term which governed the problems of speculative theism rather than those connected with the historical origin.~~

- ~~Essays, Reviews, and Addresses, i., iii. 1^ IbUL iii., preface, p. vi.~~

~~the evolution and the organization of religion. And these are the questions which are now to the front. These criticisms mean that his most elaborate discussions came forty years too late, for they were concerned with problems which agitated the middle rather than the end of the 19th century. But if we pass from this criticism of form to the actual contents of the two books, we are bound to confess that they constitute a wonderfully cogent and persuasive theistic argument. That argument may be described as a criticism of man and his world used as a basis for the construc- tion of a reasoned idea of nature and being. Man and nature, thought and being, fitted each other. What was implicit in nature had become explicit in man ; the problem of the individual was one with the~~

~~*problem of universal experience. The interpretation of man was therefore the interpretation of his universe. Emphasis was made to fall on the reason, the conscience, and the will of the finite personality ; and just as these were found to be native in him they were held to be immanent in the cause of his universe. What lived in time belonged to eternity ; the microcosm was the epitome of the macrocosm ; the reason which reigned in man in- terpreted the law that was revealed in conscience and the power which governed human destiny, while the freedom which man realized was the direct negation both of necessity and of the opera- tion of any fortuitous cause in the cosmos.*~~

~~*It was not possible, however, that the theistic idea could be dis- cussed in relation to nature only. It was necessary that it should be applied to history and to the forces and personalities active vrithin it. And of these the greatest was of course the Person that had created the Christian religion. What did Jesus signify ? What authority belonged to Him and to the books that contain His history and interpret His person ? This was the problem which Martineau attempted to deal with in The Seat of Authority in Religion. The workmanship of the book is very unequal : his- torical and literary criticism had never been Martineau's strong point ; for years he had deserted it, and when as an old man he returned to it he found its problems changed from what they had been in his earlier manhood. Nor did he allow himself time to digest the new material ; indeed, he had lost the inclination to occupy the later points of view or follow the exacter critical methods. In its speculative parts the book is quite equal to those that had gone before, but in its literary and historical parts it is in an even higher degree than they the book of an old man in whom a long-practised logic had become a rooted habit. It does not represent a mind that had throughout its history lived and worked in the delicate and judicial investigations he here tried to conduct.*~~

~~*Martineau's theory of the religious society or Church was that of a dreamer rather than of a statesman or practical politician. He stood equally remote from the old Voluntary principle, that "the State had nothing to do with religion," and from the sacerdotal position that the clergy stood in an apostolic succes- sion, and either constituted the Church or were the persons into whose hands its guidance had been*~~

~~*committed. He hated two things intensely, a sacrosanct priesthood and an enforced uniformity. He may be said to have believed in the sanity and sanctity of the State rather than of the Church. States- men he could trust as he would not trust ecclesiastics. And so he would have rejoiced in any scheme that would have repealed uniformity, taken the Church out of the hands of a clerical order, and allowed the co-ordination of sects or churches under the State. Not that he would have allowed the State to touch doctrine, to determine polity or discipline ; but he would have had it to recognize historical achievement, religious character and capacity, and endow out of its ample resources those societies which had vindicated their right to be regarded as making for religion. His ideal may have been academic, but it was the dream of a mind that thought nobly both of religion and of the State. (a. m. f.)*~~

~~*Martinique, a French West Indian colony, one of the Antilles, 50 miles from St Vincent, 33 miles south of Dominica and 22 miles north of St Lucia. It has an area of about 390 square miles, and wzs. considered, previously to the disaster of 1902 (see below), one of the most fertile parts of the West Indies ; it was regarded almost as a pet colony by the French. Apart from other circumstances, Martinique is historically interesting as being the birth place and early home of the Empress Josephine, and also the residence for some years of FranQoise d'Aubigne, who married Scarron, and was afterwards celebrated as Madame de Maintenon. The island has had more than an ordinary share of tropical visitations. In 1767, 1600 persons perished in a terrible hurricane, whereby M. de la Pagerie, the father of the empress, was practically ruined; on*~~

~~*11th January 1839 the island experienced another severe storm ; and in 1891, on 18th August, a hurricane devas- tated town and country, with the loss of 600 lives ; and within recent years an epidemic of small-pox and several large fires have added to its misfortune. The greatest disaster of all, however, was that caused by the erup- tion of Mont Pel^e in May 1902, by which the entire town of St Pierre and some 30,000 persons were destroyed in an incredibly short space of time. An account of this disaster is given below. Martinique is adminis- tered by a governor, assisted by a privy council, and controlled by an elective general council of 36 members. According to the state of things before May 1902 there was a*~~

~~*court of appeal at Fort de France, and an assize court was held at St Pierre ; there are two tribunals of first instance, and nine justices of the peace. The local budget for 1900 balanced at £229,190, the expenditure of France being £101,230. At Fort de France there is a law school; at St Pierre there was a lycie for boys and one for girls, and in the island there are primary schools with 11,500 pupils. Between 1893 and 1902 the bishop resided at St Pierre. The island is divided into 2 arrondissements— Fort de France and St Pierre — 9 can- tons, and 32 communes, regulated by the French law of 1884.*~~

~~*In 1888 the population was estimated at 175,863 ; in 1894 it was 187,692 ; and in 1902, 203,781. The num- ber of Indian labourers had fallen from 13,000 in 1883 to 4700 in 1898 ; the women numbered 67,000 ; in the whole population blacks and half-breeds predominate. The towns, with their populations in the latter year, were Fort de France (17,274), with a harbour, said to be the finest in the Antilles, defended by three forts ; St Pierre (25,792), the commercial town of the island (see below) ; Laurentin (10,854V Pilote River (7092), Francois (10,310), Robert (8066). About 180 square miles, or rather less than half the island, are under cultivation. The most important product is the sugar-cane. In 1875 the yield of sugar amounted to 50,000 tons ; but the output after- wards decreased, as in all the Antilles, and in 1898 the quantity was between 37,000 and 38,000 tons. There were in 1901 in all 564 sugar works, of which 88 employed steam power. Sugar growing and refining in 1901 con- tributed about 85 per cent, of the exports, and even after the disasters of May 1902 it was estimated that 80 per cent, of the plantations and factories remained intact. About 38,000 acres are devoted to cereal crops. The yield of cocoa has since 1887 amounted annually to about 500 tons ; but that of coffee fell to about 5\ tons. The cocoa plantations in the north of the island were overwhelmed by the eruption of 1902, but the coffee plantations were mostly uninjured. Tobacco and cotton are no longer grown, but indigo, mahogany, cinnamon, plums, and cherries figure among the products of the island. An agricultural laboratory was instituted at St Pierre in 1884. The cultivation of caoutchouc is being encouraged. The difficulty of transport is a serious hindrance to the cutting of the forests. The island contains about 60,000 head of live-stock, of which 20,000 are cattle, 20,000 pigs, and the remainder sheep, horses,*~~

~~*and mules. The industries, besides the preparation of sugar, comprise the manufacture of arrack and rum (about 2\ millions of gallons), and of tiles and earthenware. The trade in 1882 amounted to £2,360,000; in 1898 to £7,868,640, the imports from France being of the value of £476,000, and the exports to France £752,000, the combined value being £1,228,000, the lowest during the century. After France, the United States carries on the most active trade with Martinique. In 1901 the total imports amounted to £1,078,940, and the total exports to £953,100. In 1898 the shipping entered and cleared with cargoes consisted of 168 vessels.*~~

~~*aggregating 67,000 tons. Of the vessels, 81 were foreign. The roads are 165 miles long. As yet there is no railway. Fort de France is connected by regular monthly services with Bordeaux, St Nazaire, Marseilles, and Colon or Cayenne ; there is also an English service connecting it with Southampton, and an American with New York. A cable connects Fort de France with the United States and with South America ; a French cable was laid in 1890 between Martinique and Guadeloupe.*~~

~~*The following contemporary account of the eruption of Mont Pelee and the destruction of St Pierre in May 1902 was given in a letter to The Standard by Mr F. H. Watkins, the Commissioner of Montserrat. We quote from it in this article as giving the best available story of the disaster in the circumstances. From the geological point of view the conditions still remained to be investi- gated, but at the date when it was necessary for this volume to go to press no scientific report was to hand.*~~

~~*" St Pierre, nearly a mile in length, lay to the north-east of the island, in a cup-shaped valley enclosed by well-defined spurs of hills running down to the sea. It contained a fine cathedral, a bishop's palace, a governor's residence, and spacious barracks. Towering over the back of St Pierre rose the lofty, solitary, and majestic peak, Mont Pel^e (4428 feet high). For three months prior to the great outburst signs of active disturbance were mani- fest, and on 25th April 1902, at 8 a.m., the neighbourhood was darkened as by a total eclipse of the sun. A shower of fine white ashes fell steadily for two hours, covering the district north of St Pierre to the depth of nearly half an inch. When the fall of ashes ceased the weather remained gloomy and calm, and the crater still continued to emit smoke. Excessive heat was experienced through- out the West Indies at this time. The volcano Increased in activity until 2nd and 3rd May, when a tremendous outburst of fire and lava overwhelmed the large Gu^rin sugar estate situated to the north of St Pierre, burying, it is estimated, more than 150 persons. Although the fall of ashes did not cease and some of the inhabitants left for St Lucia, most persons in Martinique were in hopes that this was the culminating effort of Mont Pel^e ; and these hopes were heightened on Wednesday, 7th May, by the news that the St Vincent soufriere was in eruption, and by the thought that the Martinique volcano would thereby be relieved. After the destruc- tion of the Gu^rin and other estates to the north the terrified and destitute labourers crowded into St Pierre to the number of 5000, thus adding considerably to those destined to meet their fate in the crowning act of destruction.*~~

~~*" The morning of 8th May dawned on St Pierre with nothing to distinguish it from the others of the previous week. With the exception of smoke issuing from Mont Pel6e, no signs of impending disaster was apparent. Being Ascension Day, a fete d^ obligation, the^ stores and shops were closed. In the roadstead lay about seventeen vessels of different sizes, among them being the Boraima, a fine steamer of the Quebec line. To the north, opposite what had been the Gu§rin estate, the cable-ship Grappler was busily restoring telegraphic communication with the northern islands. About seven o'clock the Scrutton steamer Boddam steamed up, but owing to some quarantine difficulties she was ordered to the place set apart for ships in quarantine, and one anchor had been let*~~

~~*go about eight o'clock. By being thus moored slightly out of the full force of the eruption the Boddam probably escaped the fate of the other vessels. In a moment, without warning, came the awful catastrophe. Those who survived stated that the whole side of the mountain seemed to gape open, and from the fissure belched a lurid whirlwind of fire, wreathing itself into vast masses of flame as it descended with terrible speed upon the doomed town. Before the true extent of their peril could be grasped the fiery mass swept like a river over the town, and, pushing the very waters of the sea before it, set the ships ablaze. In a few seconds, when the flames of the volcano had spent themselves, molten masses of lava and ashes, accompanied by a densf sulphurous vapour, asphyxiated those who had escaped death by fire and shock. The sulphurous fumes hung over the town for some minutes before being dissipated by a faint breeze, and then succeeded utter darkness, illumined by the burning houses and ships, from which proceeded the shrieks of the few survivors. The Cfrappler was the first ve.sscl to catch fire, and was soon seen to turn over and disappear, capsized probably by a sort of tidal wave caused by the force of the explosion. Rome of those down in the hold and in the forepart of the Roraima managed to escape, but the steamer was burned to a mere shell. The JioiMd'in alone escaped. Soon after her anchoring in the quarantine ground the eruption took place, and immediately afterwards molten lava fell on the ship. In a few minutes a second explosion took place, causing the sea to become a raging cauldron.*~~

~~*and this appears to have parted her anchor and caused her to drift. On board were fifteen labourers from Grenada looking after the cargo, seven of whom were roasted alive on the deck, and eight jumped overboard. The chief engineer, the first and second officers, and the supercargo lost their lives. Of forty persons who left St Lucia only ten or twelve returned alive, after taking nine hours to steam about 40 miles. Severely burned on his hands and face, Captain Freeman managed to bring his vessel to port.*~~

~~*" The French cruiser Suchet landed search parties at 1 a.m. on the 9th, but they were unable to penetrate into the town, which was still in flames. Some of the streets were lined with corpses. The only person in the town reported to be saved was a prisoner condemned for murder, who was discovered two days afterwards in his cell."*~~

~~*Consternation was caused not only in the West Indies, but in France and throughout the world, by this awful occurrence, and at first it was seriously suggested that the island should be totally evacuated, but no countenance was lent to this proposal by the French Government. Belief measures were at once undertaken, voluntary sub- scriptions raised, and it was considered probable in July 1902 that, with subsidies from the Government, the effects of the disaster might gradually be repaired. The material losses were estimated at £4,000,000 ; but, though St Pierre was destroyed, only one-tenth part of the island had been devastated, and the economic situation was fairly reassuring. The Bank of Martinique (which actually profited by the destruction of a large amount of its bank- notes) was sound, and in the absence of further eruptions or similar disasters the agricultural resources of the island bade fair to reassert themselves in time. During July, however, further activity was reported on the part of the volcano, and more destruction was done, and it remained doubtful what the future of the island was to be.*~~

~~*See Henrique. Les Colonies Franqaises. Paris, 1890. — Henri MouET. La Martinique. Paris, 1892. — Levasseue. La France, t. ii. Paris, 1893. — VAnnee Coloniale, 1900. (p. l.)*~~

~~*Martinsburg, a city of West Virginia, U.S.A., capital of Berkeley county, in the Shenandoah valley, in the north-eastern part of the state, on the Baltimore and Ohio and the Cumberland Valley railways, at an altitude of 435 feet. It has railway repair works and varied manufactures, with (1900) a capital of $1,633,024, 1105 wage-earners, and products valued at $1,410,514. Popu- lation (1890), 7226; (1900), 7564, of whom 197 were foreign-born and 678 were negroes.*~~

~~*Martins Ferry, a city of Belmont county, Ohio, U.S.A., on the Ohio river, opposite '\^^leeling, West Virginia, in the eastern part of the state, at an altitude of 668 feet. It is on the Cleveland, Lorain and Wheeling, the Pennsylvania, the Wheeling and Lake Erie, and the Wheeling Terminal railways. Its manufactures, which are extensive, consist mainly of iron and steel goods. The city has also a large river trade. Population (1890), 6260 ; (1900), 7760, of whom 1033 were foreign-born and 253 were negroes.*~~

~~*Martin Vaz. See Trinidad (Brazil).*~~

~~*MartOS, a town of Spain, in the province of Jaen, to the south-west of the town of that name. Its much- frequented sulphurous springs and bathing establishment have been improved. The local trade is almost exclu- sively agricultural, and in the neighbourhood much live stock is reared. Population (1887), 16,356; (1897),*~~

~~*17,086.*~~

~~*MartOS, Christino (1830-1893), Spanish politician, was born at Granada 13th September 1820. He was educated in his native town, and at Madrid University, where his Radicalism soon got him into trouble, and he narrowly escaped being expelled for his share in student*~~

~~*riots and other demonstrations against the governments of Queen Isabella. He distinguished himself as a journalist on El Tribuno. He joined O'Donnell and Espartero in 1854 against a revolutionary cabinet, and shortly after- wards turned against O'Donnell to assist the Democrats and "Progressists under Prim, Rivero, Castelar, and Sagasta iu the unsuccessful movements of 1866, and was obliged "to go abroad. His political career had not prevented Martos from rising into note at the bar, where he was very successful for forty years. After remaining abroad three years, he returned to Spain to take his seat in the Cortes of 1869 after the revolution of 1868. Through- out the revolutionary period he represented in cabinets with Prim, Serrano, and Euiz Zorilla, and lastly under King Amadeus, the advanced Radical tendencies of the men who wanted to give Spain a Democratic monarchy. After the abdication of Amadeus of Savoy Martos played a prominent part in the proclamation of the federal republic, in the struggle between the executive of that republic and the permanent committee of the Cortes, backed by the generals and militia, who very nearly put an end to the executive and republic in April 1873. When the republicans triumphed Martos retired into exile, and soon afterwards into private life. He reappeared for a few months after*~~

~~*General Pavia's coup d'etat in January 1874, to join a coalition cabinet formed by Marshal Serrano, with Sagasta and Ulloa. Martos again returned to the bar in May 1874, and quietly looked on when the restoration took place at the end of that year. He stuck to his Democratic ideals for some years, even going to Biarritz in 1881 to be present at a sort of republi- can congress presided over by Ruiz Zorilla. Shortly afterwards Martos joined the dynastic Left organized by Marshal Serrano, General Lopez Dominguez, and Moret, Becerra, Balaguer, and other quondam Revolu- tionaries. He sat in several parliaments of the reign of Alphonso XII. and of the regency of Queen Christina, joined the dynastic Liberals under Sagasta, and gave Sagasta not a little trouble when the latter allowed him to preside over the House of Deputies. Having failed to form a rival party against Sagasta, Martos subsided into political insignificance, despite his great talent as an orator and debater, and died in Madrid 16th January 1893. (a. e. h.)*~~

~~*Marx, Heinrich Karl (1818-1883), the greatest theorist of modern revolutionary Socialism, and head of the International Working Men's Association, was born on the 5th of May 1818 in Treves (Rhenish Prussia). His father, a Jewish lawyer, in 1824 went over to Christianity, and he and his whole family were baptized as Christian Protestants. The son went to the high grammar school at Treves, and from 1835 to the univer- sities of Bonn and Berlin. He studied first law, then history and philosophy, and in 1841 took the degree of doctor of philosophy. In Berlin he had close inti- macy with the most prominent representatives of the young Hegelians — the brothers Bruno and Edgar Bauer and their circle, the so-called "Freien." He at first intended to settle as a lecturer at Bonn University, but his Radical views made a university career out of the question, and he accepted work on a Radical paper, the Rheinische Zeitung, which expounded the ideas of the most advanced section of the Rhenish Radical bourgeoisie. In October 1842 he became one of the editors of this paper, which, however, after an incessant struggle with press censors, was suppressed in the beginning of 1843. In the summer of this year Marx married Jenny von West- phalen, the daughter of a high government official. Through her mother Jenny von Westphalen vra-^ a lineal descendant of the earl of Argyle, who was beheaded under*~~

~~*James II. She was a most faithful companion to Marx during all the vicissitudes of his career, and died on the 2nd of December 1881, he outliving her only fifteen months.*~~

~~*Already in the Rheinische Zeitung some Socialist voices had been audible, couched in a somewhat philosophical strain. Marx, though not accepting these views, refused to criticize them until he had studied the question thoroughly. Eor this purpose he went in the autumn of 1843 to Paris, where the Socialist movement was then at its intellectual zenith, and where he, together with Arnold Ruge, the well-known literary leader of Radical Hegelian- ism, was to edit a review, the Deutsch-Franzosische Jahr- biicher, of which, however, only one number appeared. It contained two articles by Marx — a criticism of Bruno Bauer's treatment of the Jewish question, and an intro- duction to a criticism of Hegel's philosophy of the law. The first concluded that the social emancipation of the Jews could only be achieved together with the emancipation of society from Judaism, i.e., commercialism. The second declared that in Germany no partial political emancipation was possible ; there was now only one class from which a real and reckless fight against authority was to be ex- pected, namely, the jjroletariate. But the proletariate could not emancipate itself except by breaking all the chains, by dissolving the whole constituted society, by recreating man as a member of the human society in the place of established states and classes. " Then the day of German resurrection will be announced by the crowing of the Galilean cock." Both articles thus relegated the solution of the questions then prominent in Germany to the advent of Socialism, and so far resembled in principle other Socialist publications of the time. But the way of reasoning was different, and the final words of the last quoted sentence pointed to a political revolution, to begin in France as soon as the industrial evolution had created a sufficiently strong proletariate. In contradis- tinction to most of the Socialists ■ of the day, Marx laid stress upon the political struggle as the lever of social emancipation. In some letters which formed part of a correspondence between Marx, Ruge, Ludvng Feuerbach, and Michael Bakounine, published as an introduction to the review, this opposition of Marx to Socialistic " dog- matism " was enunciated in a still more pronounced form: " Nothing prevents us," he said, " from combining our criticism with the criticism of*~~

~~politics, from participating in politics, and consequently in real struggles. We will not, then, oppose the world like doctrinarians with a new principle : here is truth, kneel down here ! We expose new principles to the world out of the principles of the world itself. We don't tell it : ' Give up your struggles, they are rubbish, we will show you the true war-cry.' We explain to it only the real object for which it struggles, and consciousness is a thing it Tnust acquire even if it objects to it."~~

~~In Paris Marx met Fkiedrich Engels, from whom the Deutsch-Franzosische Jahrbiiclierhsidtwoaxtioles — a power- fully written outline of a criticism of political economy, and a letter on Carlyle's Past and Present. Engels, the son of a wealthy cotton-spinner, was born in 1820 at Barmen. Although destined by his father for a com- mercial career, he attended a classical school, and during his apprenticeship and whilst undergoing in Berlin his one year's military service, he had given up part of his free hours to philosophical studies. In Berlin he had fre- quented the society of the "Freien," and had written Jetters to the Rheinische Zeitung. In 1842 he had gone to England, his father's firm having a factory near Man- chester, and had entered into connexion with the Owenite and Chartist movements, as well as with German com- muuists. He contributed to Owen's New Moral World~~

~~and to the Chartist Northern Star, gave up much of his abstract speculative reasoning for a more positivist con- ception of things, and took to economic studies. Now, in September 1844, on a short stay in Paris, he visited Marx, and the two found that in regard to all theoretical points there was perfect agreement between them. Prom that visit dates the close friendship and uninterrupted collaboration and exchange of ideas which lasted during their lives, so that even some of Marx's subsequent works, which he published under his own name, are more or less also the work of Engels. The first result of their collaboration was the book Die heilige Familie oder Kritik der kritischen Kritik, gegen Bruno Bauer und Konsorten, a scathing exposition of the perverseness of the high-sounding speculative Eadicalism of Bauer and the other Berlin~~

~~*"Preie." By aid of an analysis, which though not free from exaggeration and a certain diffuse- ness, bears testimony to the great learning of Marx and the vigorous discerning faculty of both the authors, it is shown that the supposed superior criticism — the " critical criticism " of the Bauer school, based upon the doctrine of a " self-conscious " idea, represented by or incarnated in the critic — was in fact inferior to the older Hegelian idealism. The Socialist and working-class movements in Great Britain, Prance, and Germany are defended against the superior criticism of the " holy " Bauer family.*~~

~~*In Paris, where he had very intimate intercourse with Heinrich Heine, who always speaks of him with the greatest respect, and some of whose poems were sug- gested by Marx, the latter contributed to a Radical magazine, the Vorwarts, but in consequence of a request by the Prussian Government, nearly the whole staff of the magazine soon got orders to leave Prance. Marx now went to Brussels, where he shortly afterwards was joined by Engels. In Brussels he published his second great work. La mis^re de la philosophie, a sharp re- joinder to the Philosophie de la mis&re ou contradictions iconomiques of J. P. Proudhon. In this he deals with Proudhon, whom in the former work he had defended against the Bauers, not less severely than with the latter. It is shown that in many points Proudhon is inferior to both the middle-class economists and the Socialists, that his somewhat noisily proclaimed discoveries in regard to political economy were made long before by English Socialists, and that his main remedies, the " constitution of the labour-value " and the establishment of exchange bazaars, were but a repetition of what English Socialists had already worked out much more thoroughly and more consistently. Altogether the book shows remarkable knowledge of political economy. In justice to Prou- dhon, it must be added that it is more often his mode of speaking than the thought underlying the attacked sentences that is hit by Marx's criticism. In Brussels Marx and Engels also wrote a number of essays, wherein they criticized the German literary representatives of that kind of Socialism and philosophic Radicalism which was mainly influenced by the writings of Ludwig Peuer- bach, and deduced its theorems or postulates from speculations on the " nature of man." They mockingly nicknamed this kind of Socialism " German or True Socialism," and ridiculed the idea that by disregarding historical*~~

~~*and class distinctions a conception of society and Socialism superior to that of the English and French workers and theorists could be obtained. Some of these essays were published at the time, two or three, curiously enough, by one of the attacked writers in his own magazine ; one, a criticism of Feuerbach himself, was iij. a modified form published by Engels in 1885, but others have remained in manuscript. They were at first in- tended for publication in two volumes as a criticism of post-Hegelian German philosophy, but the revolution*~~

~~*of 1848 postponed for a time all interest in theoretical discussions.*~~

~~*In Brussels Marx and Engels came into still closer con- tact with the Socialist working-class movement. They founded a German workers' spciety, acquired a local German weekly, the Briisseller Deutsche Zeitung, and finally joined a communistic society of German workers, the " League of the Just," a secret society which had its main branches in London, Paris, Brussels, and several Swiss towns. For this league, which till then had adhered to the rough-and-ready communism of the gifted German workman Wilhelm Weitling, but which now called itself "League of the Communists," and gave up its leanings towards conspiracy and became an educa- tional and propagandistic body, Marx and Engels at the end of 1847 wrote their famous pamphlet, Manifest der Kommunisten. It was a concise exposition of the history of the working-class movement in modern society according to thgir views, to which was added a critical survey of the existing Socialist and communist literature, and an explanation of the attitude of the communists towards the advanced opposition parties in the different countries. Scarcely was the manifesto printed when, in February 1848, the Revolution broke out in France, and "the crowing of the Galilean cock" gave the signal for an upheaval in Germany such as Marx had prophesied. After a short stay in France, Marx and Engels went to Cologne in May 1848, and there with some friends they founded the Neue Rheinische Zeitung, with the sub-title " An Organ of Democracy," a political daily paper on a large scale, of which Marx was the chief editor. They took a frankly revolutionary attitude, and directed their criticism to a great extent against the middle-class democratic parties, who, by evading all decisive issues, delayed the achievement of the up- heaval. When in November 1848 the king of*~~

~~Prussia dissolved the National Assembly, Marx and his friends advocated the non-payment of taxes and the organization of armed resistance. Then the state of siege was de- clared in Cologne, the Neue Rheinische Zeitung was suspended, and Marx was put on trial for high treason. He was unanimously ^acquitted by a middle-class jury, but in May 1849 he was expelled from Prussian territory. He went to Paris, but was soon given the option of either leaving France or settling at a small provincial place. He preferred the former, and went to England. He settled in London, and remained there for the rest of his life.~~

~~At first he tried to reorganize the Communist League ; but soon a conflict broke out in its ranks, and after some of its members had been tried in Germany and condemned for high treason, IMarx, who had done everything to save the accused, dissolved the Communist League altogether. Nor was a literary enterprise, a review, also called the Neue Rheinische Zeitung, more successful; only six num- bers of it were issued. It contained, however, some very remarkable contributions ; and a series of articles on the career of the French Revolution of 1848, which first ap- peared there, was in 1896 published by Engels in book form under the title of Die Klassenhimpfe in Frankreich von 1848 "by Karl ISIarx." Carlyle's Latter Day Pamphlets, published at that time, met with a very vehement criti- cism in the Neue Rheinische Zeitung. The endeavours of Ernest Jones and others to revive the Chartist movement were heartily supported by Marx, who contributed to several of the Chartist journals of the period, mostly, if not wholly, without getting or asking payment. He lived at this time in great financial straits, occupied a few small rooms in Dean Street, Soho, and all his children then born died very young. At length he was invited to write letters for the New York Tribune, whose staff consisted of~~

~~advanced democrats and Socialists of the Foiirierist school. For these letters he was paid at the rate of a guinea each. Part of them, dealing with the Eastern Question and the Crimean war, were republished in 1897 (London, Sonnenschein). Some were even at the time reprinted in~~

pamphlet form. The co-operation of Marx, who was determinedly anti-Russian, since Russia was the leading reactionary power in Europe, was obtained by David Urquhart and his followers. A number of Marx's articles were issued as pamphlets by the Urqu- hartite committees, and Marx wrote a series of articles on the diplomatic history of the 18th century for the Urquhartite Free Press (Sheffield and London, 1856-57). When in 1859 the Eranco-Austrian war about Italy broke out, Marx denounced it as a Franco-Russian in- ■^ trigue, directed against Germany on the one hand and the revolutionary movement in France on the other. IIe opposed those democrats who supported a war which in their eyes aimed at the independence of the Italian nation and promised to weaken Austria, whose superiority in Germany was the hindrance to German unity. Violent derogatory remarks directed against him by the well- known naturalist Karl Vogt, gave occasion to a not less violent rejoinder, IIerr Vngt, a book full of interesting material for the student of modern history. Marx's con- tention, that Vogt acted as an agent of the Bonapartist clique, seems to have been well founded, whilst it must be an open question how far Vogt acted from dishonour- able motives. The discussions raised by the war also resulted in a great estrangement between Marx and Ferdinand Lassalle. Lassalle had taken a similar view of the war to that advocated by Vogt, and fought tooth and nail for it in letters to Marx. In the same year, 1869, Marx published as a first result of his renewed economic studies the book Zur Kritik der poUtischen Oekonomie. It was the first part of a much larger work planned to cover the whole ground of political economy. But Marx found that the arrangement of his materials did not fully answer his purpose, and that many details had still to be worked out. IIe consequently altered the whole plan and sat down to rewrite the book, of which in 1867 he published the first volume under the title Das Kapital.

In the meantime, in 1864, the International Working Men's Association was founded in London, and Marx be- came in fact, though not in name, the head of its general council. All its addresses and proclamations were penned by him and explained in lectures to the members of the council. The first years of the International went smoothly enough. Marx was then at his best. IIe dis- played in the International a political sagacity and tolera- tion which compare most favourably with the spirit of some of the

~~*publications of the Communist League. He was more of its teacher than an agitator, and his exposi- tions of such subjects as education, trade unions, the working day, and co-operation were highly instructive. He did not hurry on extreme resolutions, but put his pro- posals in such a form that they could be adopted by even the more backward sections, and yet contained no con- cessions to reactionary tendencies. But this condition of things was not permitted to go on. The anarchist agita- tion of Bakounine, the Franco-German war, and the Paris Commune created a state of things before which the International succumbed. Passions and prejudices ran so high that it proved impossible to maintain any sort of centralized federation. At the Congress of The Hague, September 1872, the general coirncil was removed from London to N'ew York. But this was only a makeshift, and in July 1876 the rest of the old International was formally dissolved at a conference held in Philadelphia. That its spirit had not passed away was shown by sub-*~~

~~*sequent international congresses, and by the growth and character of Socialist labour parties in different countries. They have mostly founded their programmes on the basis of its principles, but are not always in their details quite in accordance with Marx's views. Thus the programme which the German Socialist party accepted at its Con- gress in 1876 was very severely criticized by Marx. This criticism, reprinted in 1891 in the review Die Neue Zeit, is of great importance for the analysis of Marx's conception of Socialism.*~~

~~*The dissolution of the International gave Marx an opportunity of returning to his scientific work. He did not, however, succeed in publishing further volumes of Das Kapital. In order to make it, and especially the part dealing with property in land, as complete as pos- sible, he took up, as Engels tells us, a number of new studies, but repeated illness interrupted his researches, and on the 14th of March 1883 he passed quietly away.*~~

~~*From the manuscripts he left Engels compiled a second and a third volume of Das Kapital by judiciously and elaborately using complete and incomplete chapters, rough copies and excerpts, which iVIarx had at different times written down. Much of the copy used dates back to the*~~

~~*'sixties, i.e., represents the work as at first conceived by Marx, so that, e.g., the matter published as the third volume was in the main written much earlier than the matter which was used for compiling the second volume. The same applies to the fourth volume. Although the work thus comijrises the four volumes promised in the preface to the book, it can only in a very restricted sense be regarded as complete. In substance and demon- stration it must be regarded as a torso. And it Is perhaps not quite accidental that it should be so. Marx, if he had lived longer and had enjoyed l)etter health, would have given the world a much greater amount of scientific work of high value than is now the case. But it seems doubtful whether he would have brought Das Kapital, his main work, to a satisfactory conclusion.*~~

~~*Das Kapital proposes to show up historically and critically the whole mechanism of capitalist economy. The first volume deals with the processes of producing capital, the second with the circu- lation of capital, the third with the movements of capital as a, whole, whilst the fourth gives the history of the theories concern- ing capital. Capital is, according to Marx, the means of appropri- ating surplus-value as distinguished from ground rent (rent on every kind of terrestrial property, such as land, mines, rivers, &c., based upon the monopolist nature of such property) . Surplus- value is created in the process of production only, it is this part of the value of the newly created product which is not given to the work- man as a return — the wage — of the labour force he expended in working. If at first taken by the employer, it is in the different phases of economic intercourse split up into the profit of industrial enterprise, commercial or merchants' profit, interest, and ground rent. The value of every commodity consists in the labour ex- pended on it, and is measured according to the time occupied by the labour employed on its production. Labour in itself has no value, being only the measure of value, but the labour-force of the workman has a value, the value of the means required to maintain the worker in normal conditions of social existence. Thus, in distinction to other commodities, in the determination of the value of labour-force, besides the purely economical, a moral and historical element enter. If to-day the worker receives a wage which covers the bare necessaries of life, he is underpaid — he does not receive the real value of his labour-force. For the value of any commodity is*~~

~~determined by its socially neces- sary costs of production (or in this case, maintenance). " So- cially necessary " means, further, that no more labour is embodied in a commodity than is required by applying labour-force, tools, &c., of average or normal efficiency, and that the commodity is produced in such quantity as is required to meet the effective demand for it. As this generally cannot be known in advance, the market value of a commodity only gravitates round its (ab- stract) value. But in the long run an equalization takes place, and for his further deductions Marx assumes that commodities ex- change according to their value.~~

~~That part of an industrial capital which is employed for in- stallations, machines, raw and auxiliary materials, is called by Marx constant capital, for the value of it or of its wear and tear reappears in equal proportions in the value of the new product. It is otherwise with labour. The new value of the product must by necessity be always higher than the value of the employed labour-force. Hence the capital employed in buying labour-force, i.e., in wages, is called variable capital. It is the tendency of capitalist production to reduce the amount spent in wages~~

~~and to increase the amount invested in machines, &c. For with natural and social, legal and other limitations of the working day, and the opposition to unlimited reduction of wages, it is not possible otherwise to cheapen production and beat competition. According to the proportion of constant to variable capital, Marx distinguishes capitals of lowest average and highest composition, the highest composition being that where proportionately the least amount of variable (wages) capital is employed.~~

~~The ratio of the wages which workmen receive to the surplus- value which they produce Marx calls the rate of surplus-value ; that of tlie surplus-value produced to the whole capital employed is the rate of profit. It is evident, then, that at the same time the rate of surplus-value can increase and the rate of profit decrease, and this in fact is the case. There is a continuous tendency of the rates of profit to decrease, and only by some counteracting forces is their decrease temporarily interrupted,~~

~~*protracted, or even some- times reversed. Besides, by competition and movement of capitals the rates of profit in the different branches of trade are pressed towards an equalization in tlie shape of an average rate of profits. This average rate of profits, added to the actual cost price of a given commodity, constitutes its price of production, and it is this price of production which appears to the empirical mind of the business man as the value of the commodity. The real law of value, on the contrary, disappears from the surface in a society where, as to-day, commodities are bought and sold against money and not exchanged against other commodities. Nevertheless, according to Marx, it is also to-day this law of value ("labour- value ") which in the last resort rules the prices and profits.*~~

~~*The tendency to cheapen production by increasing the relative proportion of constant capital — the fixed capital of the classical economist plus that portion of the circulating capital which con- sists of raw and auxiliary materials, &c. — leads to a continuous increase in the size of private enterprises, to their growing con- centration. It is the larger enterprise that beats and swallows the smaller. The number of dependent workmen — " proletarians " — is thus continually growing, whilst employment only periodi- cally keeps pace with their number. Capital alternately attracts and repels workmen, and creates a constant surplus-population of workmen — a reserve-army for its requirements — which helps to lower wages and to keep the whole class in economic dependency. A decreasing number of capitalists usurp and monopolize all the benefits of industrial progress, whilst the mass of misery, of oppression, of servitude, of depravation, and of exploitation in- creases. But at the same time the working class continuously grows in numbers, and is disciplined, united, and organized by the very mechanism of the capitalist mode of production. The centralization of the means of production and the socialization of the mode of production reach a point where they will become incompatible with their capitalist integument. Then the knell of capitalist private property will have been rung. Those who used to expropriate will be expropriated. Individual property will again be established, based upon co-operation and common ownership of the earth and the means of production produced by labour.*~~

These are the principal outlines of Das Kapital. Its purely economic deductions are dominated throughout by the theory of surplus-value. Its leading sociological principle is the materialist conception of history. This theory is in J)as Kapital only laid down by implication, but it has been more connectedly explained In the preface of Zur Kritik and several works of Engels. Accord- ing to it the material basis of life, the manner in which life and its requirements are produced, determines in the last instance the social ideas and institutions of the time or historical epoch, so that fundamental changes in the former produce in the long run also fundamental changes in the latter. A set of social institutions answers to a given mode of production, and periods where the institutions no longer answer to the mode of production are periods of social revolution, which go on until sufficient adjustment has taken place. The main subjective forces of the struggle between the old order and the new are the classes into which society is divided after the dissolution of the communistic or semi-communis- tic tribes and the creation of states. And as long as society is divided into classes a class war will persist, sometimes in a more latent or disguised, sometimes in a more open or acute form, accord- ing to circumstances. In advanced capitalist society the classes between whom the decisive war takes place are the capitalist owners of the means of production and the non-propertied or wage-earning workers, the " proletariate." But the proletariate cannot free itself without freeing all other oppressed classes, and thus its victory means the end of exploitation and political repres- sion altogether. Consequently the state as a repressive power will die out, and a free association will take its place.

Almost from the first Das Kapital and the publications of Marx and Engels connected with it have been subjected to all kinds of criticisms. The originality of its leading ideas has been disputed, the ideas themselves have been declared to be false or

only partially true, and consequently leading to wrong conclusions ; and it has been said of many of Marx's statements that they are incorrect, and that many of the statistics upon which he bases his deductions do not prove what he wants them to prove. In regard to the first point, it must be .conceded that the disjecta membra of Marx's value theory and of his materialist conception of history are already to be found in the writings of

~~*former Socialists and sociologists. It may even be said that just those points of the Marxist doctrine which have become popular are in a very small degree the produce of Marx's genius, and that what really belongs to Marx, the methodical conjunction and elaboration of these points, as well as the finer deductions drawn from their application, are generally ignored. But this is an experience repeated over and over again in the history of deductive sciences, and is quite irrelevant for the question of Marx's place in the history of Socialism and social science.*~~

~~*It must further be admitted that in several places the statistical evidence upon which Marx bases his deductions is insufficient or inconclusive. Moreover, and this is one of the most damaging . admissions, it repeatedly happens that he points out all the phenomena connected with a certain question, but afterwards ignores some of them and proceeds as if they did not exist. Thus, e.g., he speaks at the end of the first volume, where he sketches the historical tendency of capitalist accumulation, of the decreasing number of magnates of capital as of an established fact. But all statistics show that the number of capitalists does not decrease, but increase ; and in other places in Das Kapital this fact is indeed fully admitted, and even accentuated. Marx was, as the third volume shows, also quite aware that limited liability companies play an important part in the distribution of wealth. But he leaves this factor, too, quite out of sight, and confuses the concentration of private enterprises with the centralization of fortunes and capitals. By these and other omissions, quite apart from developments he could not well foresee, he announces a coming evolution which is very unlikely to take place in the way described.*~~

~~*In this and in other features of his work a dualism reveals itself which is also often observable in his actions in life — the alternat- ing predominance of the spirit of the scholar and the spirit of the Radical revolutionary. Marx originally entitled his great social work Criticism of Political Economy, and this is still the sub-title of Das Kapital. But the conception of critic or criticize has with Marx a very pronounced meaning. He uses them mostly as identical with fundamentally opposing. Much as he had mocked the "critical criticism" of the Bauers, he is in this respect yet of their breed and relapses into their habits. He re- tained*~~

~~*in principle the Hegelian dialectical method, of which he said that in order to be rationally employed it must be "turned upside down," i.e., put upon a materialist basis. But as a matter of fact he has in many respects contravened against this prescription. Strict materialist dialectics cannot conclude much beyond actual facts. Dialectical materialism is revolutionary in the sense that it recognizes no finality, but otherwise it is neces- sarily positivist in the general meaning of that term. But Marx's opposition to modern society was fundamental and revolu- tionary, answering to that of the proletarian to the boxirgeois. And here we come to the main and fatal contradiction of his work. He wanted to proceed, and to a very great extent did pro- ceed, scientifically. Nothing was to be deduced from precon- ceived ideas ; from tire observed evolutionary laws and forces of modern society alone were conclusions to be drawn. And yet the final conclusion of the work, as already noted, is a preconceived idea; it is the announcement of a state of society logically opposed to the given one. Imperceptibly the dialectical move- ment of ideas is substituted for the dialectical movement of facts, and the real movement of facts is only considered so far as is com- patible with the former. Science is violated in the service of speculation. The picture given at the end of the first volume answers to a conception arrived at by speculative socialism in the 'forties. True, Marx calls this chapter " the historical tendency of capitalist accumulation," and "tendency" does not neces- sarily mean realization in every detail. But on the whole the language used there is much too absolute to allow of the interpretation that Marx only wanted to give a speculative picture of the goal to which capitalist accumulation would lead if unhampered by Socialist counteraction. The epithet "his- torical " indicates rather that the passage in question was meant to give in the main the true outline of the forthcoming social revolution. We are led to this conclusion also by the fact that, in language which is not in the least conditional, it is there said that the change of capitalist property into social property will mean "only the expropriation of a few usurpers by the mass of the people." In short, the principal reason for the undeniable contradictions in Das Kapital is to be found in the fact that where Marx has to do with details or subordinate subjects he mostly notices the important changes which actual evolution had*~~

~~brought about since the time of his first Socialist writings, and thus himself states how far their presuppositions have been corrected by facts. But when he comes to general conclusions, he adheres in the main to the original propositions based upon the old uncorrected presuppositions. Besides, the complex character of modern society is greatly underestimated, so that, e.g., such impoi-tant features as the influence of the changes of traffic and aggregation on modern life are scarcely considered at all ; and industrial and political problems are viewed only from the aspect of class antagonism, and never under their ad-ministrative aspect. With regard to the theory of surplus-value and its foundation, the theory of labour-value, so much may be safely said that, its premisses accepted, it is most ingeniously and most consistently worked out. And since its principal contention is in any case so far true that the wage-earning workers as a whole produce more than they receive, the theory has the great merit of demonstrating in an admirably lucid way the relations between wages and surplus-produce and the growth and movements of capital. But the theory of labour-value as the determining factor of the exchange or market value of commodities can with justification be disputed, and is surely not more true than those theories of value based on social demand or utility. Marx him- self, in placing in the third volume what he calls the law of value in the background and setting out the formation of the " price of production " as the empirical determinator of prices in modern society, justifies those who look upon the conception of labour- value as an abstract formula which does not apply to individual exchanges of commodities at all, but which only serves to show an imagined typical example of what in reality to-day is only true with regard to the production of the whole of social wealth. Thus understood, the conception of labour-value is quite un- objectionable, but it loses much of the significance attributed to it by most of the disciples of Marx and occasionally by Marx himself. It is a means of analysing and exemplifying surplus labour, but quite inconclusive as to the proof of the surplus value, or as an indication of the degree of the exploitation of the workers. This becomes the more apparent the more the reader advances in the second and third volumes of Das Kapital, where commercial capital, money capital, and ground rent are dealt with. Though full of fine~~

~~*observations and deductions, they form, from a revolutionary standpoint, an anti-climax to the first volume. It is difficult to see how, after all that is explained there on the functions of the classes that stand between industrial employers and workers, Marx could have returned to those sweeping conclusions with which the first volume ends.*~~

~~*The great scientific achievement of Marx lies, then, not in these conclusions, but in the details and yet more in the method and principles of his Investigations in his philosophy of history. Here he has, as is now generally admitted, broken new ground and opened new ways and new outlooks. Nobody before him had so clearly shown the role of the productive agencies in historical evolution ; nobody so masterfully exhibited their great deter- mining influence on the forms and Ideologies of social organisms. The passages and chapters dealing with this subject form, not- withstanding occasional exaggerations, the crowning parts of his works. If he has been justly compared with Darwin, it is in these respects that he ranks with that great genius, not through his value theory, ingenious^though it be. With the great theorist of biological transformation he had also in common the indefatigable way in which he made painstaking studies of the minutest details connected with his researches. In the same year as Darwin's epoch-making work on the origin of species there appeared also Marx's work Zur Kritik der politischen Okonomie, where he explains in concise sentences in the preface that philo- sophy of history which has for the theory of the transformation or evolution of social organisms the same significance that the argument of Darwin had for the theory of the transformation of biological organisms.*~~

~~*The main writings of Karl Marx and Friedrioh Engels are as follows (we give only the titles of the original works and of their English translations): — 1. Of Karl Marx alone : La misere de la philosophie, reponse a La philosophie de la misere de M. Proudhon, Paris, 1847, new edition, 1892 ; English edition, 7%e Poverty of Philosophy, London, 1900. Lohnarbeit und Kapital, pamphlet, written 1848, new edition, Berlin, 1891 ; English edition, Wage-Labour and Capital, London, 1900. Die Klassenkampfe in Frankreich, 1S4S to 1850, Berlin, 1895. Der Achtzehnte Srumaire des Louis Bonaparte, New York, 1852, 3rd edition,*~~

~~*Hamburg, 1889; English edition, New York, 1889. Enthullungen uber den Kdlner Kommunistenprozess, Basel, 1852 ; new edition, Ziirich-Berlin, 1885. Eiiropean Bevolutions and Counter-Bevolutions (reprints from the New York Trihime, 1851- 1852), London, 1896. The Eastern Question (reprints from the New York Tribune, 1853-56), London, 1898. Zur Kritik der politi- schen Okonomie, Berlin, 1859; new edition, Stuttgart, 1897. Herr Vogt, London, 1860. Inaugural Address of the Inter-*~~

~~*national Working Men's Association, London, 1864. Value, Price, and Profit; written 1865, published London, 1898. Das Kapital, Kritik der politischen Okonomie, 3 vols., Hamburg, 1867, 1885, and 1895 ; English edition of 1st vol. 1886. The Civil War in France, 1871, London, 1871 ; new edition, 1894. L Alliance de la democratie socialist", London, 1873. Articles printed or reprinted in Bheinische Zeitung, 1842-43 ; Deutsch-Franzosische Jahrbilcher, Paris, 1844 ; Das Westphalische Dampf- boot, Bielefeld und Paderborn, 1845-48 ; Der Oesellschaflsspiegel, Elberfeld, 1846 ; Deutsche Briisseler Zeitung, Bruxelles, 1847 ; Neue Bheinische Zeitung (daily), Cologne, 1848-49 (monthly), Hamburg, 1850. The People, London, 1852-58 ; Tlie New York Tribune, New York, 1853-00 ; TheFree Press, Sheffield and London, 1856-57 ; Das Volk, London, 1859 ; Der Vorbote, Geneva, 1866-75 ; Der Volkstaat, Leipzig, 1869-76 ; Die Neue Zeit, Stuttgart, 1883, sqq. ; Sozialistische Monatschefte, Berlin, 1895, sgq. — 2. Of Fried- rich Engels alone : Die Lage der arbeitenden Klassen in England, Leipzig, 1845, new edition, Stuttgart, 1892 ; English edition, London, 1892. Zur Wohnungsfrage, Leipzig, 187.3-74 ; new edition, Zurich-Berlin, 1887. Serrn Eugen Duhrings Umwdlzung der Wis- senschaft, Leipzig, 1877 ; 3rd edition, Stuttgart, 1894. Three chap- ters of the first^named are published in English under the title Socialism, Utopian and Scientific, London, 1892. Der Ursprung des Eigenthums, der Familie und des Staates, Zurich and Stuttgart, 1885 and 1892. Ludwig Feuerbach und der Ausgangder Klassischen deutschen Philosophie, Stuttgart, 1886. Introductions to most of the posthumous works of K. Marx and articles in the same periodicals as Marx. — 3. Of Karl Marx and Friepp.ich Engels together : Die Heilige Familie Oder Kritik der Kritischen Kritik, Frankfurt, 1845. Manifest der Kommunistischen Partei, London, 1848 ; English edition, 1848 and 1888. — 4. With regard to Marx generally, his theory and his school, see J. Stammhammer,*~~

~~*Bibliographic des Sozialismus und Kommunismus, Jena, 1893 ; and Th. G. Masaryk, Die philosophischen und soziologischen Grund- lagen des Marxismus, Vienna, 1899. Much biographical and bibliographical information on Marx and Engels is to be found in Dr Franz Mehring, Gfeschichte der deutschen Sozialdf^mokratic, Stuttgart, 1897-98, and in the collection, edited also by Dr Fr. Mehring, Aus dem literarischen Nachlass von Karl Marx, Fried- rich Engels und Ferdinand Lassalle, Stuttgart, 1902. Of the criticisms of Marx's economics, one of the most comprehensive is E. VON Boehm-Bawerk's Karl Marx and the Close of his System, London, 1898. Marx's historic theory is, apart from Masaryk, very exhaustively analysed by R. Stammler in Wirthschaft und Jtecht, Leipzig, 1896. (e. bn.)*~~

~~*Maryborough, town, Queensland, Australia, in the county of March, 25 miles from the mouth of the river Mary, about 180 miles north of Brisbane by rail. It is the port of shipment for a wide agricultural district yield- ing maze and sugar, and also for the Gympie goldfield. Large smelting works are 5 miles distant, in which ore from all the states is treated. There are also foundries and a large shipbuilding yard. Population (1891), 9700 ;*~~

~~*(1901), 10,159.*~~

~~*Maryborough, a borough of Victoria, Australia, in the county of Talbot, 112 miles by rail north-west of Melbourne. It is an important railway centre, and has extensive railway workshops. The gold-mining of the district is deep alluvial. Population (1901), 5623.*~~

~~*Maryland, one of the original states of the American Union, bounded on the N. by Pennsylvania and Delaware, on the E. by Delaware and the Atlantic Ocean, and on the S. and W. by Virginia and West Virginia. It is divided into three physiographic areas known as the Coastal Plain, the Piedmont Plateau, and the Appalachian Eegion. The Coastal Plain, embracing about 6000 square miles, represents in its formations the various epochs of geological history from the late Jurassic or early Cretaceous to the present time. The trough of the Chesapeake Bay was cut across the Coastal Plain by the predecessor of the present Susquehanna river, the bay being only the submerged lower valley of that*~~

~~*stream. The Piedmont Plateau borders this plain on the west, and, extending to the base of the Catoctin Mountain, includes about 2500 square miles. The most widely extended formation of this area is the gneiss, enfolded with which are quartz-schist and marble bands and several types of*~~

~~*igneous rocks. The Appalachian Eegion extends from the Piedmont Plateau to the western limits of the state, and comprises about 2000 square miles. This region is divided into three distinct physiographic districts based upon clearly defined geological differences, i.e., an eastern (Blue Eidge and Great Valley), a central (Alleghany Eidges), and a western (Alleghany Plateau) division. Dr William Bullock Clark says the " Great Appalachian Valley, commonly known in Maryland as the Hagerstown Valley, is underlain by the Shenandoah limestone of late Cambrian and early Silurian age, which also outcrops to the east of the Catoctin Mountain in the Frederick Valley. Beyond the Great Valley there is a succession of sharp ridges and deep valleys formed of the folded sediments of Silurian, Devonian, and Carboniferous age, the Silurian and Devonian rocks predominating in the eastern ridges, and the Devonian and Carboniferous in the west. The coal deposits of the Carboniferous occupy a succession of troughs to the west of Cumberland, and are the most important geological deposits from a commercial stand- point within the limits of the state."*~~

~~*The total area of Maryland is 12,210 square miles, of which 2350 are water. The total land area is 9860 square miles, and is divided among the counties of the state as follows : —*~~

~~*Square Miles.*~~

~~*388 240 281 490 482 376 372 362 286 458 365 487*~~

~~*Population. — The figures of the decennial census from 1880 to 1900 are as follows for the whole state : —*~~

~~*County.*~~

~~*Square Miles.*~~

~~*County.*~~

~~*Allegany .*~~

~~*. 442*~~

~~*Harford .*~~

~~*Anne Arundel .*~~

~~*. 425*~~

~~*Howard .*~~

~~*Baltimore*~~

~~*656*~~

~~*Kent*~~

~~*Baltimore City .*~~

~~*. 30*~~

~~*Montgomery*~~

~~*Calvert .*~~

~~*222*~~

~~*Prince George's*~~

~~*Caroline .*~~

~~*. 320*~~

~~*Queen Anne's .*~~

~~*Carroll*~~

~~*. 437*~~

~~*St Mary's .*~~

~~*Cecil*~~

~~*. 360*~~

~~*Somerset .*~~

~~*Charles .*~~

~~*451*~~

~~*Talbot*~~

~~*Dorchester*~~

~~*. 608*~~

~~*"Washington*~~

~~*Frederick .*~~

~~*. 662*~~

~~*Wicomico*~~

~~*Garrett*~~

~~*. 660*~~

~~*"Worcester*~~

~~*Tear.*~~

~~*Population.*~~

~~*Increase.*~~

~~*Percentage of Increase.*~~

~~*1880 1890 1900*~~

~~*934,943 1,042,390 1,188,044*~~

~~*154,049*~~

~~*107,447 145,654*~~

~~*19-7 11-5 14-1*~~

~~*In 1900 the total white population amounted to 952,424, of whom 473,119 were male and 479,305 female. The total negro popula- tion at the same date was 235,064, of whom 115,617 were male and 119,447 female. There were also 544 Chinese, 9 Japanese, and 3 Indians taxed. The native-born population amounted to 1,094,110 ; the foreign-bom to 93,934. There were" within the state only five cities with a population in 1900 of over 6000 — namely, Baltimore, 508,957 ; Cumberland, 17,128 ; Hagerstown, 13,591 ; Frederick, 9296; and Annapolis, 8525. The urban population was 46-9 per cent, of the total population. The average number of persons to the square mile was 120-7 in 1900, as compared with 105-7 in 1890. In 1901 the registered voters of the state (males twenty-one years of age and over) numbered 272,231, as against 293,389 voters in 1900. Education. — Maryland has an excellent system of free public schools supported by state, county, and municipal taxation. In 1899 the number was as follows : — Schools in Baltimore city, 185 ; in the counties, 23.34; pupils in Baltimore city, 80,146; in the counties, 142,227 ; teachers in Baltimore city, 1802 ; in the counties, 3314; cost of maintenance in Baltimore city, $1,218,734; in the counties, $1,469,063. Total number of schools, 2519; total number of pupils, 222,373 ; total number of teachers, 5116 ; total cost, $2,687,797. The State Normal School, St John's College, "Western Maryland College, Maryland Agricultural College, "Wash- ington College, Frederick School for the Deaf and Dumb, St Mary's Female*~~

~~*Seminary, Charlotte Hall Academy, and Maryland Institute, with a total of 1353 students and 110 teachers, received from the state in 1899 an aggregate of $139,400. Thirteen other schools and academies, with a total of 1289 students, received aid from the state to the amount of $6900. The chief educational institution of the state is the Johns Hopkins University (including a graduate school, a college, and a medical school), which had (in 1900) 131 professors and instructors and 661 enrolled students.*~~

~~*Also situated in Baltimore city are the "Woman's College, the City College, the University of Maryland (including a law school, a medical school, and a school of dental surgery), the College of Physicians and Surgeons, College of Dental Sui-gery, Baltimore Medical College, &c.*~~

~~*Libraries.— Vae Peabody Library in Baltimore contains 135,000 volumes, designed especially for students, and is well catalogued. It is open daily, without charge. The Enoch Pratt Free Library, also in Baltimore (income $50,000 per annum), is a free circulating library, with branches throughout the city, and numbers upwards of 200,000 volumes. There are also in Baltimore the library of the Johns Hopkins University, 94,000 volumes ; the Maryland His- torical Society's Library, 30,000 volumes ; the New Mercantile Library, 50,000 volumes ; the Bar Library, 17,000 volumes ; the Medical and Chirurgical Library, 14,000 volumes ; and the library of the Maryland Institute, 23,000 volumes. The State Library at Annapolis contains 60,000 volumes.*~~

~~*Charities.— The Maryland Hospital for the Insane at Catonsville treats and cares for an average of 635 patients, and reports 4 per cent, of cures of those treated. The second hospital for the insane, situated in Sykesville, annually treats an average of 206 patients. These two institutions received from the state $50,000 in 1900. The State Lunacy Commission reports a total of 2531 insane con- fined in almshouses, gaols, penitentiary, public and private institu- tions, in 1899. The Sheppard and Enoch Pratt Hospital for Mental and Nervous Diseases was founded by Moses Sheppard, and became the residuary legatee of the estate of Enoch Pratt. The design of the founder, based on the belief that many cases of curable insanity become chronic through lack of proper care and treatment, was for a home treatment on the principle of non-restraint, and the removal of*~~

~~*all features suggestive of an asylum. By reason of the plan, the scope is necessarily limited. From 1892 to 1899, 553 patients were admitted and 462 discharged, of whom 99 were cured and 166 greatly improved. The Maryland Asylum and Training School for Feeble-Minded, at Owings Mills, cares for an average of 100 annually. A large number of the leading charitable institutions — hospitals, asylums, and training schools — are private corpora- tions, which are made the almoners of the state's charity by annual legislative appropriations, while they are supported in part by endowments of their own and by private subscription. In 1900 the state gave $263,000 to 48 institutions of this character.*~~

~~*Penal Institutions. — The new penitentiary, completed at a cost of $1,000,000, is a model of its kind. Its inmates number 918 men and 48 women. The institution is self-supporting, and annually yields a surplus to the state treasury. In addition to learning trades, all convicts are allowed to work overtime, and the amount thus made is credited to them when they leave the institution. In 1899 the convicts earned for themselves in this way $22,697. The Maryland House of Correction, a prison for minor offences, is supported by an annual legislative appropriation of $25,000 and the labour of the inmates. The average number of committals yearly is 1483. The House of Refuge at Baltimore had, in 1900, 223 boys committed. Manual training is given to all inmates. The female House of Refuge had 127 inmates, who are taught useful occupations, and are supplied with homes at the expiration of their detention.*~~

~~*Banks. — The national banks presented the following statement of their condition in September 190(5\ —*~~

~~*Number.*~~

~~*Capital Stock paid in.*~~

~~*Individual Deposits.*~~

~~*Counties Baltimore*~~

~~*53 19*~~

~~*$4,014,400 11,108,260*~~

~~*$13,912,473 29,029,006*~~

~~*Seventeen state banks reported in 1900 shares of stock assessed at $1,718,130, and owned real estate valued at $226,442. The aggregate deposits of the 35 savings banks amounted in 1899 to $56,140,168. The real estate owned by these banks was assessed at $1,045,271. The bank clearances in Baltimore city amounted in 1887 to $659,346,471, rose in 1896 to $720,089,733, and In 1899 to $1,209,777,742.*~~

~~*Agriculture. — The total number of farms in 1900 was 46,012 ; occupied by owners, 30,565, occupied by tenants, 16,447. The total value of farms was $204,645,407. Total acreage of farms, 5,170,075; improved, 3,516,352; unimproved, 1,653,723. Value of implements, &c., $8,611,220; live stock, $20,865,877. Value of farm products (1899), $43,823,419. Horses (1900), 179,486; mules, 19,325 ; neat cattle on farms, 292,646 ; sheep, 194,076 ; swine, 359,812. Amount paid to farm labourers, $6,715,520.*~~

~~*Coal Mining. — The total production of coal in the state in 1901 was 4,481,403 long tons, and the value of mines and equipments was $20,000,000; paid for labour, $1,464,826. In 1898 the ship- ments of coal by the companies operating in George's Creek region amounted to 4,120,870 tons, and the number of men employed was*~~

~~*4651.*~~

~~*MAKYPOET — MASSACHUSETTS*~~

~~*569*~~

~~*Oysters. — Bming the season of 1898-99 the quantity of oysters ofBcially inspected was 5,547,793 bushels, but this did not include all the products of the beds of Chesapeake Bay.*~~

~~*Tobacco. — The tobacco received for inspection at the state ware- houses in 1898 amounted to 36,219 hogsheads.*~~

~~*Manufactures. — The number of manufacturing establishments reporting in 1900 was 9880, with an aggregate capital of $163,422,260. Number of labourers, 108,361. Total wages, .$38,761,561. Salaried employes, 7589 ; salaries paid, $7,383,263. Cost of materials used, $144,539,680. Value of products, $242,752,990. The greater part of the manufacturing is carried on in Baltimore. There were in this city 6361 manufacturing establishments, with a capital of $117,869,175, products valued at $161,945,811, and 79,084 wage- earners (exclusive of salaried officials, clerks, &c.), who received wages amounting to $29,304,520.*~~

~~*Commerce. — The size of the foreign commerce is seen in the following statistics relating to Baltimore city, the chief port : —*~~

~~*Exports for the year ending 30th June 1901 . . $106,239,081*~~

~~*Imports „ „ „ . 18,899,473*~~

~~*Custom house receipts, 1898 . . .$1,870,038*~~

~~*„ „ 1899 . . . 2,549,725*~~

~~*Internal revenue collections, 1898 . . 6,657,360*~~

~~*„ „, 1899 . . 8,667,652*~~

~~*Immigration through Baltimore, 1898 . 12,853*~~

~~*„ „ 1899 . 20,283*~~

~~*Finances. — The funded debt amounted on 1st January 1899 to $6,009,326. As an offset to this the state held interest-bearing securities and cash to the credit of the sinking funds amounting in value to $3,121,283, leaving the net debt $2,888,043. The value of the property assessed for taxation in 1899 was $611,539,646. In 1890 this value was $482,184,824.*~~

~~*History, &c. — Since 1895 the two great parties — Democratic and Republican — have been nearly equal in numbers, and the control of the state government is sometimes with one and sometimes with the other.*~~

~~*The statutory law of the state was codified in 1888, and a supplement to the code, erfibracing the subsequent statutes, was adopted in 1900. The most important work relating to the history of the state is the Maryland Archives, published by the Maryland Historical Society under the authority of the legislature (1882 to date) . Twenty volumes have so far appeared, containing principally the proceedings of the executive and legislative departments in the 17th and 18th centuries. The annual reports of the Maryland Geo- logical Survey, beginning in 1897, convey the result of much origi- nal investigation relating to the soils and the physical features.*~~

~~*(w. T. B.)*~~

~~*Maryport, market-town and seaport in tlie Cocker- mouth parliamentary division of Cumberland, England, at the mouth of the river Ellen, 25 miles west-south-west of Carlisle by rail. The harbour is easy of access, and with the river ofifers 3800 feet of quayage. In 1892 it became an independent port with Workingtoa, White- haven, and Millom subordinate to it. In 1888, 1459 ves- sels of 239,981 tons entered and 1456 of 244,501 tons cleared; in 1898, 3171 vessels of 606,922 tons entered and 3164 of 612,022 tons cleared. The registered shipping in 1898 totalled 26 vessels of 17,826 tons. Steel rails and coal are exported ; timber, iron-ore, and grain imported. Population (1891), 12,410; (1901), 11,896.*~~

~~*Mascara, a town of Algeria, department of Oran, 60 miles south-east of the town of Oran. The principal industry is wine, for which it has a high repute. Over 3000 acres in the neighbourhood have been planted with vines, and, notwithstanding an attack of phylloxera, the area of vineyards is extending. Population (1886), 15,400 ; (1896), 20,410, of whom 10,104 were French.*~~

~~*Maseru. See Basutoland.*~~

~~*Mashonaland. See Ehodesia (South).*~~

~~*Mason City, a city of Iowa, U.S.A., capital of Cerro Gordo county, on the Shell Eock river, in the northern part of the state, at an altitude of 1132 feet. It is on the Chicago, Milwaukee, and St Paul, the Iowa Central, the*~~

Mason City and Fort Dodge, the Mason City and Clear Lake, and the Chicago and North-western rail- ways. It is in a rich agricultural region, for which it serves as a collecting and distributing point. Population

(1890), 4007; (1900), 6746, of whom 914 were foreign- >■ born and 55 were negroes.

Massa, a town, bishop's see, and capital of the province of Massa and Carrara, Tuscany, Italy, situated near the Mediterranean coast, 27 miles north-west of Pisa by rail. Like Carrara, it is a centre of the marble industry, in which some 11()0 men were employed in 1898. It also carries on the manufacture of cotton, silk, and to- bacco. Population (1881), 16,246 ; (1901), 26,325.

Massachusetts, one of the New England states of the American Union, bounded on the N. by New Hampshire and Vermont, on the W. by New York, on the S. by Connecticut and Ehode Island, and on the E. by the Atlantic.

Population.— The population in 1890 was 2,238,943, and in 1900 it was 2,805,346, an increase during 1890-1900 of 25-2 per cent. With the exception of Rhode Island, it is the most densely settled state in the Union, the average number of persons to the square mile at the census of 1900 being 348'9, and the urban population being 76-0 per cent, of the total population. In 1900 females constituted 51-3 per cent, of the total population. Only 1'3 per cent, of the population was coloured. The percentage of the population that was foreign-born in 1885 was 27-13, and in 1900 It was 30'2. Ireland contributed the largest proportion of the foreign-born population, although since 1875 the numbers bom in that country and living in Massachusetts have increased but slowly. The Irish-bom proportion of the population of the state, which in 1875 was 14j2j^ per cent., was in 1895, 10^ per cent. In 1895 a very nearly similar percentage were immigrants from British America. These were chiefly of French origin, and large numbers of them found employment in the textile industries. Other countries which in 1895 contributed more than 15,000 each to the population were England, Sweden and Norway, Germany, Scotland, and Italy, in the order named. During the period 1885-90 the largest proportional increase from any foreign country was

~~*from Italy. For the year ending 30th September 1899 the number of passengers arriving from foreign ports was 72,682. Of these there were aliens from the Dominion of Canada to the number of 24,084, and aliens from transatlantic ports to the number of 20,065. A large part of the transatlantic immi- grants pass speedily to permanent homes in the West, but by far the greater part of the Canadian influx remains, and may become citizens. According to the census of 1900, there were 33 incor- porated cities in Massachusetts, of which 8 had between 12,000 and 20,000 inhabitants ; 5 between 20,000 and 25,000 ; 10 between 25,000 and 60,000 ; 7 between 60,000 and 100,000 ; and 3 more than 100,000 inhabitants, namely, Boston (560,892), Worcester (118,421), andFall River (104,863). In 1890 the urban population (classing as such all persons in places of more than 8000 inhabitants) was 69-9 per cent, of the total population ; in 1900 it was 76 per cent. The aggregate number of state, city, and town poor (including the insane) remaining In institutions was, on 30th September 1899, 12,795. The total number of prisoners was 6772, a reduction of 679 from the year before. The birth-rate in 1895 was 27-02 per thousand, and was the highest in any census year since 1860. In 1898 it is estimated to have been 27-37. Of all the children bom in Massachusetts in 1898, 32-35 per cent, were of native-bom parents, 48-24 per cent, were of foreign-born parents, 19-02 per cent, were of parents of whom one was foreign-born, and -39 per cent, were of unreported parentage. The death-rate in 1895 was 19-01 per thousand, which is less than in any census year since 1870. The death-rate of 1900 was 17-7.*~~

~~*Politics. — Since 1820 the payment of at least a poll-tax had been one of the pre-requisites to the exercise of the suffrage, but this requirement was annulled by a constitutional amendment adopted by the people in 1891. An educational test is exacted for the privilege of voting, every voter being required to read the constitution of the commonwealth in the English language, and to write his name. The number of legal voters in 1895 was 560,802. In the Presidential election of 1896, when an unpre- cedentedly large vote was cast, the number of voters registered was 490,554, or nearly 20 per cent, of the population, and of these 401,568 actually voted, or nearly 82 per cent. Massachusetts is one of the only two states in the Union in which elections for state officers are now held annually. In 1896 two amendments to the constitution, establishing biennial elections of*~~

state officers and of members of the general court, were defeated by a large majority. At all elections official ballots are furnished, and are marked and cast by the voter under provisions of the so-called Australian Ballot Act, which ensure absolute secrecy. A limited suffrage was conferred upon women in 1879. At the present time every female citizen having the qualifications of a male voter may vote in the

city and town elections for members of the school committee. This privilege has not been very generally exercised. In 1899 there vrere 36,110 registered women voters, and of these only 35^"^ per cent, voted, whereas of the registered male voters 77| per cent, voted. In the city of Boston, however, where much interest was felt in the election, 61-f^ of the registered women voted, a larger proportion than that of men who voted at the state election a month earlier. Efforts are annually made to extend female suffrage to the election of other municipal officers and to state officers, but these efforts have not proved successful. In 1895 all persons qualiiied to vote for the school committee were given an opportunity to vote upon the question, "Is it expedient that municipal suffrage be granted to women ? " with the following results : —

Yes. No.

Male voters . . 87,000 186,976

Pemale „ . . 22,204 861

Since 1880, with the exception of 1883, and of 1891-94, Massa^ ohusetts has annually elected a Republican governor, and the majority of the Republican party in both branches of the legis- lature has usually been very large. The division in the Demo- cratic party, due to its declaration in favour of the free coinage of silver at the ratio to gold of 16 to 1, has tended to increase the Republican preponderance.

~~*Liquor Lwpk. — In 1881 a local option law was passed, providing for the granting of licences for the sale of liquor only in cities and towns voting at the annual election to authorize their issue. In 1888 the number of licences which may be granted in munici- palities voting in favour of their issue was limited to one for each 1000 inhabitants, except in Boston, where one licence may be issued for every 500 inhabitants. The vote varies from year to year, and it is not unusual for a certain number of municipalities to change from "licence" to "no licence," smA vice verscL. The general result has been that centres of population, especially where the foreign element is large, usually vote " Yes," while those in which native population predominates, as well as the smaller towns, usually vote " No." Through a growing acquies- cence in the operation of the local option law, the relative im- portance of the vote of the Prohibition party has of late years diminished.*~~

~~*Patents and Post. — The number of patents for inventions issued was in 1898 one to every 1428 persons in the population, this ratio being exceeded in Connecticut only. The total postal receipts for 1898 were $5,759,154, an amount exceeded in Illinois, New York, and Pennsylvania only.*~~

~~*Finances. — The aggregate valuation made by local assessors of property, real and personal, was, in 1899, .$2,876,021,222. Certain descriptions of personal property — of which the largest items are the taxable excess of the valuation of corporations over their visible and tangible property which is locally taxed, and the taxable savings banks deposits — are not subject to valuation by municipal assessors, but are made to contribute to the revenues of the com- monwealth. If these descriptions of property are included, the valuation in 1899 was: real estate, §2,247,094,547; personal property, $1,515,605,757 ; total, $:?,702, 700,304. The total valua- tion of the capital stock of corporations in 1899 was $707,183,138, an increase of $81,588,118 over that of 1898. The aggregate net state debt, i.e., after deduction of the several sinking funds, has increased rapidly from $6,140,380 in 1896 to $16,869,171 in 1900. This increase has been chiefly due to the erection of important public buildings, to the construction of state highways and metro- politan park roadways, to the improvement of Boston harbour, to the abolition of grade*~~

~~crossings of railways, and to the expenses incurred in the Spanish war of 1898. The aggregate net debt of the municipalities was, in 1899, $128,051,487, or if^ per cent, of the local valuation, a proportion greater than that in any other year subsequent to 1879, when it was the same.~~

~~Banks. — The increase in savings banks deposits in 1899 over those of the previous year was $29,559,124, the greatest gain in any year since 1834, when reports were first required by law. In 1895 the average deposit to each account was $337, and to each person of the population, $175 ; both of these proportions are steadily mounting, and furnish an accurate test of the general prosperity and thrift. In 1899, when the deposits aggregated $518,202,048, there were 1,477,447 accounts, with an average of .$350 to each. The number of national banks in operation in Massachusetts on 31st October 1899 was 250, a number exceeded only in New York, Pennsylvania, and Ohio. The paid-up capital of these banks was $80,827,500, second only to the amount so Invested in New York. There are 36 trust companies transacting business, with deposits of $129,652,632 and total assets of~~

~~$150,.337,419.~~

~~liaiJuiays. — The total length of railway lines within the com- monwealth in 1899 was 2107. The total length of main track of street railways worked by electricity was 1537, and is increasing~~

~~rapidly. The aggregate capital stock of the 46 railway corpora- tions, 30th June 1899, was $213,255,282. The aggregate capital stock of the 116 street railway companies, 30th September 1899,~~

~~$41,380,143.~~

~~Commerce. — In the magnitude of its foreign commerce Boston is the second port in the United States, being surpassed only by New York. For the year ending 30th June 1900, the total value of exports was $143,708,232, or nearly one-tenth of the total exports of the United States. The total value of imports for the same period was $61,452,370.~~

~~*Manufactures.— In 1900 Massachusetts ranked third among the states of the Union in the amount of capital invested in manu- factures and in the number of hands employed, and fourth in the value of manufacturing products. In the textile industry Massa- chusetts continues to be the foremost state in the Union. In 1900 its textile products exceeded those of Pennsylvania, the state rank- ing next to it, by 35 -2 per cent. The growth of manufactures during the decade 1890-1900 is shown by the following general statistics : —*~~

~~*Per cent.*~~

~~*1890.*~~

~~*1900.*~~

~~*of Increase.*~~

~~*Number of establish-*~~

~~*ments*~~

~~*26,923*~~

~~*29,180*~~

~~*8-4*~~

~~*Capital*~~

~~*$630,032,341*~~

~~*$823,264,287*~~

~~*30-7*~~

~~*Salaried officials.*~~

~~*clerks, &c.*~~

~~37,9121~~

~~27,860~~

~~26-52~~

~~Salaries~~

~~33,826,1721~~

~~831,257,630~~

~~7-62~~

~~Wage-earners~~

~~447,270~~

~~497,448~~

~~11-2~~

~~Total wages~~

~~$205,844,337~~

~~$228,240,442~~

~~10-9~~

~~Miscellaneous expenses~~

~~$63,083,782~~

~~$73,209,015~~

~~161~~

~~Cost of materials used~~

~~*$473,199,434*~~

~~*$-552,717,955*~~

~~*16-8*~~

~~*Value of products*~~

~~*$888,160,403*~~

~~*$1,035,198,989*~~

~~*16-6*~~

~~*The following table shows the statistics of the principal manu- facturing industries, with the number of establishments, capital, average number of wage-earners (exclusive of salaried offlcials, clerks, &c.), and the value of products: —*~~

~~*1-^-•*~~

~~*Industries.*~~

~~*d M II*~~

~~*Capital.*~~

~~*Wage- earners.*~~

~~*Value of Products,*~~

~~*Boot and shoe cut stock*~~

~~*270*~~

~~*$5,476,277*~~

~~*4,390*~~

~~*$18,288,922*~~

~~*Boots and shoes, factory*~~

~~*product ....*~~

~~*640*~~

~~*87,577,630*~~

~~*53,645*~~

~~*117,115,243*~~

~~*Boots and shoes, rubber*~~

~~*6*~~

~~*13,157,821*~~

~~*5,250*~~

~~*16,490,016*~~

~~*Carriages and waggons*~~

~~*888*~~

~~*5,694,939*~~

~~*8,164*~~

~~*6,118,121*~~

~~*Clothing, men's*~~

~~*194*~~

~~*3,798,174*~~

~~*8,333*~~

~~*9,880,954*~~

~~*,, women’s*~~

~~*119*~~

~~*1,616,991*~~

~~*8,448*~~

~~*5,201,660*~~

~~*Confectionery-*~~

~~*249*~~

~~*2,213,889*~~

~~*2,943*~~

~~*7,014,532*~~

~~*Cordage and twine*~~

~~*19*~~

~~*7,697,484*~~

~~*8,803*~~

~~*9,685,671*~~

~~*Electrical apparatus and*~~

~~*supplies ....*~~

~~*54*~~

~~*8,259,612*~~

~~*5,202*~~

~~*10,490,861*~~

~~*Foundry and machine-shop*~~

~~*product^ ....*~~

~~*825*~~

~~*62,498,989*~~

~~*82,284*~~

~~*66,290,169*~~

~~*Furniture, factory product .*~~

~~*120*~~

~~*10.9ST,220*~~

~~*6,092*~~

~~*11,244,503*~~

~~*Iron and steel*~~

~~*8*~~

~~*)3,73S,.593*~~

~~*6,125*~~

~~*13,491,169*~~

~~*Jewellery ....*~~

~~138~~

~~4,917,106~~

~~6,696~~

~~10,315,334~~

~~Leather — tanned, curried,~~

~~and finished~~

~~119~~

~~15,817,940~~

~~7,010~~

~~26,067,714~~

~~Liquors, malt~~

~~40~~

~~18,186,628~~

~~1,651~~

~~11,255,618~~

~~Lumber~~

~~696~~

~~10,878,208~~

~~6,202~~

~~12,818,611~~

~~*Paper and wood pulp . Printing and publishing Rubber and elastic goods*~~

~~*93*~~

~~*26.r,92.922*~~

~~*9,1161*~~

~~*22,141,461*~~

~~*9S1*~~

~~*19,825,966*~~

~~*10,859*~~

~~*28.961,680*~~

~~*TO*~~

~~*11,818,660*~~

~~*5,944*~~

~~*13,886,059*~~

~~*Slaughtering and meat-pack-*~~

~~*ing, wholesale .*~~

~~*11*~~

~~*9,016,672*~~

~~*2,837*~~

~~*27,606,69?*~~

~~*Sugar and molasses, refining*~~

~~7~~

~~13,974,045~~

~~592~~

~~19,626,882~~

~~Textiles~~

~~512~~

~~274,332,129~~

~~149,846~~

~~214,600,980~~

~~The textile industries employed 30 per cent, of the wage-earners engaged in manufactures, and the products were valued at 20-7 per cent, of the total value of the products. Of these industries the most important subdivisions, with the value of their products, are the following : carpets and rugs, $6,966,237 ; cotton goods, in- cluding cotton smallwares, §111,125,175; dyeing and finishing textiles, $8,868,290 ; hosiery and knitted goods, $6,620,257 ; silk and silk goods, $5,957,532; woollen goods, $30,888,104; and worsted goods, $40,557,363.~~

~~Agriculture, itc. — In 1900 there were 37,715 farms, containing 3,147,064 acres, of which 41-1 per cent, was improved land. The total value of farm property was $182,646,704, and was made up as follows: land, improvements, and buildings, $158,019,290; imple- ments and machinery, $8,828,950 ; livestock, $15,798,464. During the preceding year the expenditure for labour was $7,487,280; and for fertilizers, $1,320,600. Of the total number of farms 90-4 per cent, were worked by the owners, 8-3 per cent, by cash tenants,~~

~~1 Includes proprietors and firm members, with their salaries.~~

~~2 Decrease.~~

~~*and 1-3 per cent, by share tenants. The total value of farm products in 1899 was $42,298,274 ; the acreages, quantities, and values of the principal crops are shown by the following table : —*~~

~~*Products.*~~

~~*Acres.*~~

~~*Quantity.*~~

~~*Value.*~~

~~*Indian corn .*~~

~~*39,1.31*~~

~~*1,539,980 bushels*~~

~~*.?77 1.277*~~

~~*Hay and forage*~~

~~*610,023*~~

~~*856,505 tons*~~

~~*9,056,854*~~

~~*Tobacco .*~~

~~*3,827*~~

~~*6,406,570 lb*~~

~~*956,399*~~

~~*Potatoes .*~~

~~*27,521*~~

~~*3,346,590 bushels*~~

~~*1,800,937*~~

~~*.Small fruits .*~~

~~*8,.346*~~

~~*...*~~

~~*1,493,714*~~

~~*Orchard fruits*~~

~~*57,268*~~

~~*3,158,781 bushels*~~

~~*1,170,868*~~

~~*Forest products*~~

~~*1,944,714*~~

~~*Flowers and plants*~~

~~*584*~~

~~*1,6,39,760*~~

~~*The most important orchard fruit was apples ; in 1900 the number of trees was 1,852,046, which yielded the preceding year 3,023,436 busliels of fruit. The number and value of farm animals in 1900 were as follows : — 184,562 dairy cows, $6,546,954 ; 101,382 other neat cattle, $1,583,963*~~

~~; 75,034 horses, $5,826,457 ; 33,869 sheep (not including lambs), $142,076 ; 78,925 swine, $.549,617.~~

~~The amount of capital invested in the fishing industry in 1895 was $5,338,828, and the value of the products $5,703,143.~~

~~Education. — The aggregate sum raised by taxation and ex- pended upon the public schools was, in 1899, $13,624,814, or an average amount for each child in the average membership of the public schools of $34. The ratio of pupils in high schools to the whole number in all the schools is 8^ per cent., and is increas- ing. The ratio of private school pupils to all the pupils in the state is less than 1 to 7. Fifty cities and towns maintain free evening schools. The proportion of women employed as teachers in tlie public schools to that of men so employed is about 10 to 1. The average pay of male teachers per month is .$136, of female teachers .?51. The average number of months (20 school days each) during which the public schools are kept open is 9^^. The commonwealth maintains ten normal schools. In 1894 manual training was made a part of the school system of all municipalities having 20,000 inhabitants. By a recent law, cities in which there are in operation 450,000 spindles may maintain textile schools, the commonwealth contributing, up to $25,000, a sum equal to the amount appropriated for the purpose by such city or paid by individuals. Two such schools in Lowell and New Bedford are already in successful operation. The commonwealth maintains on board the U.S.S. Enterprise a nautical training-school for instruc- tion in the science and practice of navigation. The regular course is two years, and the average number of pupils is rather over 100. During the Spanish war more tlaan 50 per cent, of the graduates and cadets of this school enlisted in the United States service. Of the 3oo cities and towns only five, representing less than one- half of 1 per cent, of the population, are without free library privileges, and in three of these there are association libraries which charge a small fee. The Boston Public Library is the largest free municipal library in the world, and the Harvard University Library is exceeded in the United States only by this and by the Congressional Library at Washington. Of the adult male popula- tion of the state in 1900, 6-4 per ceut. were illiterate (unable both to read and write). Of the 53,694 persons in this class, 48,615 were foreign-born.~~

~~*Charitable Institutions. — The Massachusetts reformatory for men at Concord was opened in December 1884 ; the reformatory prison for women at Sherborn in October 1877. In both the reformation of the inmates is the principal purpose of the discipline and in- struction, ratlier than mere punishment or detention. In 1892 the Massachusetts hospital for dipsomaniacs and inebriates was established, to which justices are authorized to commit patients for a period of two years. The average number of inmates is about 175. In 1898 a separate hospital for epileptics was opened, and in the same year, in the central portion of the state and at an eleva- tion of 1200 feet, the Massachusetts hospital for consumptives and tuberculous patients, the first public hospital for tuberculous patients in the United States. It receives about 200 patients in such stages of the disease as admit of arrest or cure, the chief feature of the treatment, both in summer and winter, being what is known as hyperaeration.*~~

~~*Public Enterprises. — During recent years the commonwealth has undertaken certain noteworthy enterprises, as the agent of the several municipalities in the immediate vicinity of Boston con- stituting what is known as the Metropolitan District. The greatest single enterprise ever undertaken by the commonwealth is the bringing to this metropolitan district of the water of the Nashua river from Clinton, at a distance of 40 miles from Boston. The original estimate of the cost of this work was $27,000,000. In 1898 the daily average quantity of water consumed by each io habitant in the district was 103 gallons. The commonwealth joined the city of Boston in the construction of a subway beneath the most congested portion of the city for the passage of electric*~~

~~*oars. For the better accommodation of the increasing commerce of the port of Boston, the commonwealth has bought a considerable frontage upon the harbour lines, has begun the construction of a dock capable of receiving the largest vessels, and has supplemented the work of the United States Government in deepening the approaches to the wharves. It has secured as public reservations the summit and sides of Greylock (almost 3500 feet high) in the north-western comer of the state, and of Wachusett (2018 feet) near the centre. Since 1885 a large expenditure has been incurred in the abolition of grade crossings of railways and highways,*~~

which the increasing density of the population rendered a grave danger. The usual allotment of the cost of this work is as follows : — 65 per ceut. is paid by the railway company, 25 per cent, by the com- monwealth, and 10 per cent, by the municipaUty in which the crossing is located. Since 1894, when the work was begun, the commonwealth has spent $3,000,000 in the construction and main- tenance of state highways, the cost being apportioned between the commonwealth and the country in the proportion of 3 to 1.

The attempt to exterminate the Gipsy Moth, Ocneria (or more properly Porthetria) dispar, has attracted much attention. This notorious pest was introduced into Massachusetts in 1869 by a French naturalist, who was conducting experiments with various silk-producing insects with a view to the commercial value of the cocoon. Being allowed to escape, the Gipsy Moth multiplied until its increasing depredations wei'e deemed too serious to be dealt with by individuals or even by towns, and in 1890 the commonwealth entered upon the task of extermination. Since then a large force of men has been annually employed in the work, and an aggregate of $1,155,000 expended ; but though the area infested has been restricted, extermination has not yet been accomplished.

Legislation. — In 1885, owing to certain local conditions, the legislature placed the administration of the police department of Boston, including the granting of liquor licences, in the hands of a board of three commissioners appointed by the governor; and in 1894 a similar board was created for Fall River. In each case the result has been an improvement in administration ; but it is generally conceded that only exceptional conditions can justify this interference on the part of the state with the duty and right of local self-government, and two subsequent measures establishing such boards in other cities were defeated by executive veto. State boards of registration in pharmacy, in dentistry, and in medicine have been established, to determine and certify the qualifications of applicants. Since 1886 a state board of arbitra- tion and conciliation has existed for the peaceful settlement of controversies between employers and employed. An Act was passed in 1895 providing for the imposition of indeterminate sentences on all convicts sentenced to the state prison otherwise than for life or as habitual criminals. Under

~~*this Act a maximum and a minimum term are established, and upon the expiration of the latter a revocable permit to be at liberty may be issued. The Habitual Criminals Act provided that a person convicted of a felony, who has previously served two sentences of not less than three years each, shall be deemed a habitual criminal, and shall be punished by imprisonment for twenty-five years. In 1898 electrocution was substituted for hanging in all cases where the death penalty is imposed. For the purpose of preventing the products of prison labour from entering into injurious competition with the products of free labour, legislation of increasing stringency has limited the number of prisoners who may be employed in specific industries. The employment of prisoners is no longer determined by its financial result. Clothing for use in the different institutions of the state is made in the prisons from cloth woven on hand-looms, and other processes are performed without the use of machinery. Authority has been given by the legislature for the purchase of waste land, not exceeding 1000 acres, for the purpose of reclaiming it by the labour of prisoners from the gaols and houses of correction. The so-called Torrens or Australian system for the registration of land titles has been adopted, and a court created for its administration. The hours of labour of women and children in mills and factories have been limited by legislation, and in 1899 eight hours were made to constitute a day's work for all labourers, workmen, and mechanics employed by or on behalf of any city or town adopting the Act at an annual election. Acts have been passed extending the common-law liability of employers, prohibiting the manufacture and sale of clothing made in unhealthy places (known as sweating-sliops) , and authorizing cities and towns to provide free lectures and to maintain public baths, gymnasia, and playgrounds. The referendum has been sparingly used in matters of local concern. In the case of all quasi-public corporations, rigid' laws have been enacted prohibiting the issue of stock or bonds unless the par value is first paid in, prohibiting the declaration of any stock or scrip dividend, and requiring that new stock shall be offered to stockholders at not less than its market value, to be determined by the proper state officials, any shares not so subscribed for to be sold at public auction. These laws are aimed at preventing fictitious*~~

~~*MASSAGE*~~

~~*capitalization and " stoclr-watering." What is known as civil service reform legislation was first applied to the public service of Massachusetts in 1884. By subsequent legislation it has been pro- vided that veterans of the War of the Rebellion passing the required examination shall be appointed in preference to a person not a veteran, and that the appointing power may, in its discretion, appoint a veteran without examination.*~~

~~*The Spanish War. — The formal declaration of war with Spain, adopted by Congress 2uth April 1898, was made to date from the 21st. On the very day after war was thus formally declared the First Regiment Heavy Artillery, M.V.M., fully armed and equipped, was sent to Fort Warren in Boston harbour, then almost wholly unprotected by national troops, upon which it vvas thought, for a brief time, that a hostile attack might be made. In response to the calls of the President, Massacliusetts contributed to the national service the regiment above named, five infantry regiments, and nearly its entire naval brigade, which saw active service in the blockading squadron and in coast defence duty. The total number furnished by Massachusetts to the national Government was 11,780. The quota assigned in the President's calls was 7388. The several militia regiments entered the U.S. service with such equipment in arras, clothing, tentage, and commissary and surgical supplies as placed them among the most thoroughly-equipped regiments furnished by any state during this brief war. Two of the infantry regiments, the 2nd and 9th, were a part of the force engaged in the reduction of Santiago, and suffered severely through disease and hardship. The 6th regiment took part in the peaceful occupation of Porto Rico. The other two infantry regiments were stationed at camps in the southern states, but the early close of the war prevented their being ordered out of the country. A most important work in furnishing supplies and medical stores to regi- ments in camp and to soldiers in hospital was performed by the Massachusetts Volunteer Aid Association. This association also equipped a hospital ship — purchased by the commonwealth — with every appliance which could minister to the comfort and recovery of those committed to its care. In addition to the amount allowed by the U.S. Government, the commonwealth provided for the payment of $7 per month to every non-commissioned officer, soldier,*~~

~~*or marine entering the service of the United States as a part of the quota of the commonwealth. (e. wo.)*~~

~~*IVSassage. — The word massage has of late years come into general use to signify the method of treating disease or other physical conditions by manipulating the muscles and joints. According to Littre, the word is derived from the Arabic mass, and has the specific mean- ing of "pressing the muscular parts of the body with the hands, and exercising traction on the joints in order to give suppleness and stimulate vitality." It was probably adopted from the Arabian physicians by the French, who have played a leading part in reviving this method of treatment, which has been practised from time immemorial, and by the most primitive people, but has from time to time fallen into disuse among Western nations. In the Odyssey the women are described as rubbing and kneading the heroes on their return from battle. In India, under the name " shampoo " (tshdm-pud), the same process has formed part of the native system of medicine from the most remote times ; pro- fessional massers were employed there by Alexander the Great in 327 B.C. In China the method is also of great antiquity, and practised by a professional class ; the Swedish gymnastic system instituted by Ling is derived from the book of Cong-Fou, the bonze of Tao-Sse. Hip- pocrates describes and enjoins the use of manipulation, especially in cases of stiff joints, and he was followed by other Greek physicians. Oribasius gives an account of the application of friction with the bare hands, which exactly corresponds with the modern practice of massage. It is worthy of note that the treatment, after being held in high esteem by the leading Greek physicians, fell into disrepute with the profession, apparently on account of its association with vicious abvises. The sa.me drawback has made itself felt in the present day, and can only be met by the most scrupulous care in the choice of agents and the manner of their employment. Among the Greeks, Romans, Egyptians, and, later, the Turks, massage came to be part of the ordinary procedure of the bath without*~~

~~*any special therapeutic intention, and the usage has sur- vived until to-day ; but that mode of application was no doubt a refinement of civilized life. Medical rubbing is older and more elementary than bathing, as we see from its employment by savages. Probably it was evolved*~~

~~*independently among different races from the natural instinct — shared by the lower animals — which teaches to rub, press, or lick any part of the body in which uneasi- ness is felt, and is therefore the oldest of all therapeutic means. Its systematic use among savages, not only for the removal of fatigue, but also for the treatment of disease, is sufficiently attested by Captain Cook's experi- ence with the Pacific islanders. The interesting account of his treatment by the natives of Tahiti, for an attack of sciatica, is worth quoting : —*~~

~~*The manner in which our commander was freed from a rheumatic complaint, that consisted of a pain extending from the hip to the foot, deserves to be recorded. Otoo's mother, his three sisters, and eight other women went on board for the express purpose of undertaking the cure of his disorder. He accepted of their friendly offer, had a bed spread for them on the cabin floor, and submitted himself to their directions. Being desired to lay himself down amongst them, then, as many of them as could get round him, began to squeeze him with both hands, from head to foot, but more particularly in the part where the pain was lodged, till they made his bones crack, and his flesh became a perfect mummy. After undergoing this discipline about a quarter of an hour, he was glad to be released from the women. The operation, however, gave him immediate relief ; so that he was encouraged to submit to another rubbing down before he went to bed ; the consequence of which was that he was tolerably easy all the succeeding night. His female physicians repeated their prescription the next morning and again in the evening; after which his pains were entirely removed and the cure was perfected. This operation, which is called romee, is universally practised among these islanders, being sometimes performed by the men, but more generally by the women. — Third Voyage.*~~

~~*According to Weiss, the therapeutic use of massage was revived in Europe by Pabricius ab Aquapendente, who applied it to stiff joints and similar conditions. Para- celsus, in his De Medicina ^gyptiorum (1591), gives a description of methodical massage as practised by the Egyptians quite on modern lines. Thereafter it appears to have been adopted here and there by individual prac- titioners, and various references are made to it, especially by French writers. The word " massage " occurs in an essay*~~

~~*written by Piorry for a large encyclopaedia which appeared in 1818, but it was probably used before. The practice was gradually advocated by an increasing num- ber of medical men. In Great Britain it was called " medical rubbing," and at Edinburgh Beveridge had a staff of eight trained male rubbers. A book published by Estradfere in 1863 attracted much attention, but the man who contributed most to the modern popularity of massage was Metzger of Amsterdam, who began to use it tentatively in 1853, and then proceeded to study and apply it methodically. He published an essay on the subject in 1868. The modern refinements of the treat- ment are chiefly due to him. At the same time, its application by Weir Mitchell to hysterical and other nervous conditions, in coujunction with the "rest cure," has done much to make it known.*~~

~~*Massage, as now practised, includes several processes, some of which are passive and others active. The former are carried out by an operator, and consist of rubbing and kneading the skin and deeper tissues with the hands, and exercising the joints by bending the patient's limbs. The active movements consist of a special form of gymnastics, designed to exercise particular muscles or groups of muscles. In what is called " Swedish massage " the oper- ator moves the limbs while the patient resists, thus bringing the opposing muscles into play. Some writers insist on confining the word " massage " to the rubbing processes,*~~

~~*and use the general term " manipulation " to cover all the movements mentioned ; but this is a verbal subtlety of no importance. It is evident that alike among the Greeks, the Orientals, and savage races, the two processes have always been applied as part of the same treatment, and the definition quoted above from Littre goes to show that the word " massage " is properly applied to both.*~~

~~*Rubbing has been subdivided into several processes, namely, (1) stroking, (2) kneading, (3) rubbing, and (4) tapping, and some practitioners attach great importance to the application of a particular process in a particular way. As a rule, oils and other lubricants are not used. But, however it may*~~

~~*be applied, the treatment acts essentially by increasing circulation and improving nutrition. It has been shown by Lauder Brunton that more blood actually flows through the tissues during and after rubbing. The number of red corpuscles, and, to some extent, their haemoglobin value, are also said to be increased (Mitchell). At the same time the movement of the lymph stream is accelerated. In order to assist the flow of blood and lymph, stroking is applied oentripetally, that is to say, upwards along the limbs and the lower part of the body, downwards from the head. The effects of the increased physiological activity set up are numerous. Functional ability is restored to exhausted muscles by the removal of fatigue products and the induction of a fresh blood supply ; congestion is relieved ; collections of serous fluid are dispersed ; secretion and excretion are stimulated ; local and general nutrition are improved. These effects indicate the conditions in which massage may be usefully applied. Such are various forms of paralysis and muscular wasting, chronic and subacute affections of the joints, muscular rheumatism, sciatica and other neuralgias, local congestions, sprains, contractions, insomnia and some forms of headache, in which downward stroking from the head relieves cerebral congestion. It has also been used in ansemia, hysteria and "neurasthenia," disorders of the female organs, melancholia and other forms of insanity, morphinism, obesity, constipation, inflammatory and other affections of the eye, including even cataract. General massage is sometimes applied, as a form of passive exercise, to indolent persons whose tissues are overloaded with the products of incomplete metabolism.*~~

~~*As with other methods of treatment, there has been a tendency on the part of some practitioners to exalt it into a cure-all, and of others to ignore it altogether. Of its therapeutic value, when judiciously used, there is no doubt, but it is for the physician or surgeon to say when and how it should be applied. HIe will be guided by the condition of the patient, and the effect he desires to produce in directing the employment of light and superflcial friction, or deep and firm pressure, locally or generally, for a short or a long time, at long or short intervals. Affections to which it is not applicable are fevers, pregnancy, collections of pus, acute inflamma- tion of the joints, inflamed veins, fragile arteries, wounds of the skin, and, generally speaking, those conditions in which it is not desirable to increase the circulation, or in which the patient cannot bear handling. In*~~

~~such conditions it may have a very injurious and even dangerous effect, and therefore should not be used in a haphazard manner without competent advice.~~

~~The revival of massage in Europe and America has called into existence a considerable number of professional operators, both male and female, who may be regarded as forming a branch of the nursing profession. Some of these are trained in hospitals or other institu- tions, some by private practitioners, and some not at all. Similarly, some are attached to organized societies or institutions, while others pursue their calling independently. Without going so far as to make massing a closed profession, it is obviously desirable to have some guarantee of competency. Several things are required for a good operator. One is physical strength. Deep massage is very laborious work, and cannot be carried on for an hour, or even half an hour, without unusual muscular power. Feeble persons cannot practise it effectively at all. The duration of a sitting may vary from five or ten minutes to an hour. For general massage at least half an hour is required. The Tahitian women completed a heroic operation on Captain Cook in a quarter of an hour, but there were twelve of them, and no doubt they took turns. A single masser should have strength enough to do the work without too obvious ■exhaustion, which gives the patient an unpleasant impression. A second requirement is tactile and muscular sensibility. A person not endowed with a fine sense of touch and resistance is liable to exert too great or too little pressure ; the one hurts the patient, the other is ineffective. Then skill and knowledge, which can only be acquired by a course of instruction, are necessary, Finally, some guarantee of cleanliness and character is almost indispensable. Independent massers may possess all these qualifications in a higher degree than those connected with an institution, but they may also be totally devoid of them, whereas connexion with a recognized hospital or society is a guarantee for a certain standard of efl[ioienoy . Jn London there are several such institutions, which train and send**

out both male and female massers. The fee is 5s. an hour, or from two to four guineas a week. On the Continent, where trained massers are much employed by some practitioners, the fee is con- siderably lower ; in the United States it is higher (see Nursing). For reasons mentioned above, it

~~*is most desirable that patients should be attended by operators of their own sex. If this is not insisted upon, a valuable therapeutic means will be in danger of falling into disrepute both with the medical profession arid the general public.*~~

~~*Massa Marittima, a town and bishop's see of the province of Grosseto, Tuscany, Italy, 24 miles north- north-west of Grosseto. It has a cathedral, and mines of iron, mercury, lignite, and copper, with foundries, iron-works, and olive-oil mills. At Follonica, on the coast, but in this commune, are the furnaces in which are smelted the iron ore of Elba. There are also mineral springs and jets of boracic acid vapour. Population (1899), 3500.*~~

~~*Massawa. See Ebitbea.*~~

~~*Massenet, Emile Frederic Jules (1842-*~~

~~*), one of the most individual of modern French*~~

~~*composers, was born at Montaud, 12th May 1842. IIe studied at the Paris Conservatoire, where he obtained the Grand Prix de Eome in 1863 with the cantata David Bizzio. IIe has composed the following operas : La Ch-ande Tante, one act, Opera Comique, 1867 ; Don Cesar de Bazan, three acts. Opera Comique, 1872 ; Le Roi de Lahore, five acts, Opera, 1877; Hirodiade, five acts, Brussels, 1881 ; Manon, five acts, Opera Comique, 1884 ; Le Cid, four acts. Opera, 1885 ; Esdarmonde, four acts. Opera Comique, 1889 ; Le Mage, five acts, Op^ra, 1891 ; Werther, four acts, Vienna, 1892; ThaU, three acts, Opera, 1894; Le Portrait de Manon, one act, Op^ra Comique, 1894 ; La Navarraise, two acts, Covent Garden, 1894; Sapho, Opera Comique, 1897; Cendrillon, Opera Comique, 1900 ; Orisilidis, Opera Comique, 1901 ; Le Jongleur de Notre Dame, Mentone, 1902. Massenet's other works include Marie Madeleine, sacred drama (1873) ; Eve, a mystery (1875) ; La Vierge, sacred legend (1880); six orchestral suites entitled Sc&nes IIongroises, Scenes Pittoresques, Scdnes Dramatiques, Seines Napoli- taines, Sc&nes de Fierie, /Seines Alsaciennes ; music to the tragedy Les Erynnies, to Theodora, Le Crocodile, L'IIetman ; a requiem, Narcisse; an idyll, JBihlis; a Seine Antique; several sets of songs, entitled Poime d'Avril, Poime d' Amour,*~~

~~*Poime d'Hiver, Po&me d'Octobre, Poime Pastoral, Poime du Souvenir; also a large number of detached songs. The foregoing list will sufl&ce to show that Massenet is one of the most prolific composers of his time. He was professor of composition at the Conservatoire from 1878 to 1896. Among his pupils the following have already distinguished themselves: Hillemacher, Marty, Bruneau, Vidal, Pierne, Leroux, and Charpentier. Massenet undoubtedly possesses a style of his own, one which it is impossible to mistake. He is at his best in music descriptive of the tender passion, and many of the love scenes in his operas are very beautiful. Like all individual composers, he has his mannerisms, and these have not lacked imitators. His ideas with regard to operatic construction do not appear to be absolutely de- fined. At any rate, he has never given a strict adherence to the forms of either the old-fashioned opera or the modern lyrical drama, usually preferring to compromise between the two. Manon is perhaps his most popular opera.*~~

~~*Massey, Gerald (1828), English poet, was*~~

~~*born near Tring, Hertfordshire, on the 29th of May 1828. His parents were in humble circumstances, and Massey was little more than a child when he was set to hard work in a silk faxitory, which he afterwards deserted for the equally laborious occupation of straw-plaiting. These early years were rendered gloomy by much distress and*~~

~~*deprivation, against whicli the young man strove with increasing spirit and virility, educating himself in his spare time, and gradually cultivating his innate taste for literary work. He was attracted by the movement known as Christian Socialism, into which he threw himself with whole-hearted vigour, and so became associated with Maurice and Kingsley. His first public appearance as a writer was in connexion with a journal called Tlie Spirit of Freedom, of which he became editor, and he was only twenty-two when he published his first volume of poems, Voices of Freedom and Lyrics of Love. These he followed in rapid succession by Tlie Ballad of Babe Christabel (1854), War Waits (1855), Havelock's*~~

~~*March (1860), and A Tale of Eternity (1869). Many years afterwards, in 1890, he collected the best of the contents of these volumes, with additions, into a two-volume edition of his poems called My Lyrical Life. He also published works dealing with spiritualism, the study of Shakespeare's sonnets, and theological speculation. It is generally understood that he was the original of George Eliot's Felix Holt. Massey's poetry has a certain rough and vigorous element of sincerity and strength which easily accounts for its popularity at the time of its production. He treated the theme of Sir Eichard G-renville before Tennyson thought of using it, and handled it with much force and vitality. Indeed, Tennyson's own praise of Massey's work is still its best eulogy, for the Laureate found in him " a poet of fine lyrical impulse, and of a rich half-Oriental imagination." The inspiration of his poetry is essentially British ; he was a patriot to the core. Crudities of expression and melody are only to be expected in a talent reared among such unpoetic surroundings ; but even where, as Tennyson said, he makes the " good old English tongue crack and sweat," the inequality of tone is leally due to a superabundance of force, irresisti- ble and infectious, if not always under control. He has the true lyric ring, the note of natural and spontaneous melody, and his virile and buoyant verse deserves a more emphatic recognition than it would seem to have received at the hands of a younger generation.*~~

~~*Massillon, a city of Stark county, Ohio, U.S.A., situated on the Tuscarawas river, north-east of the centre of the state, at an altitude of 952 feet. It is on the Ohio canal, and on the Cleveland, Lorain and Wheeling, the Peinisylvania, and the Wheeling and Lake Erie railways. It is in a farming, coal, and building-stone region, and has large manufactories, including iron and steel works, agri- cultural implement works, paper-mills and glass-works. Population (1890), 10,092 ; (1900), 11,944, of whom 1693 were foreign-born and 83 were negroes.*~~

~~*Masson, David (18*~~

~~*?'>*~~

~~*-), Scottish man of*~~

~~letters, was born at Aberdeen, 2nd December 1822, and educated at Marischal College. Intending to enter the Church, he proceeded to Edinburgh University, where he studied theology under Dr Chalmers, whose friendship he enjoyed until the divine's death in 1847. HOwever, abandoning his project of the ministry, he returned to his native city to undertake the editorship of The Banner, a weekly paper devoted to the advocacy of Eree Kirk prin- ciples. After two years he resigned this post and went back to the capital, bent upon pursuing a purely literary career. There he wrote a great deal for the firm of Messrs W. and R. Chambers, several of the volumes of their well-known "Educational Course" being Masson's work, besides contributing to Fra.ser's Mar/azine, DiiliUn University Magazine (in which appeared his essays on Chatterton), and other periodicals. In 1847 he came to London, where he found wider sooi.ie for his untiring energy and ample knowledge. HIs sympathy with Liberal~~*

~~principles was manifested by his accepting the secretary- ship of the " Eriends of Italy," a society which did much to promote Italian liberty, one of its leading members being Mr Stansfeld. In 1852 he was appointed professor of English literature at University College, London, in succession to A. H. Clough, and from 1868 to 1866 he edited Macmillan's Magazine. In 1866 he was selected for the chair of English literature at Edinburgh, and this post he retained till 1895. In 1879 he became editor of the Register of the Scottish Privy Council, and in 1893 was appointed Historiographer Royal for Scotland. HIs magnum opus is his Life of Milton, in six volumes, the first of which appeared in 1868 and the last in 1880. He also edited De Quincey's Collected Works; and among his other publications are Essays, Biographical and Critical (1856, reprinted with additions, 1874), British JSfovelists and their Styles (1859), Drummond of Hawthornden (1873), and Edinburgh Sketches (1892).~~

~~Masulipatam, or Bandae, a seaport town of British India, administrative headquarters of the Kistna district of Madras, on one of the mouths of the river Kistna, 215 miles north of Madras city. Population (1881), 35,056 ; (1891), 38,809 ; municipal income (1897- 98), Es.65,710. It is a centre of the weaving industry, and was formerly famous for printed chintzes and coloured kerchiefs. It is a station of the Church Mis- sionary Society. The port is only a roadstead, where vessels anchor 6 miles out. In 1897-98 the~~

~~*total sea- borne trade of the district was valued at Rs. 27,51,324. It is proposed to construct a branch line from Bezwara on the Southern Mahratta Railway. Noble College had 74 students in 1896-97, and there are two high schools, with 633 pupils. There are a club and two literary asso- ciations, and four printing-presses, issuing a district gazette and three vernacular periodicals. Memories of Mrs Draper, Sterne's " Eliza," are still cherished.*~~

~~*Matabeleland. See Rhodesia (South).*~~

Matanzas, an important commercial city of Cuba and capital of Matanzas province, situated on the north coast, about 60 miles east of Havana. There are many large warehouses, rum distilleries, sugar-mills, and railway machine-shops. It is the chief outlet for an extensive sugar region to the south, the normal exports of sugar amounting to nearly $15,000,000 per annum. It is con- sidered the healthiest city in the island. The streets are well laid out and paved ; there are several handsome ornamental plazas, and the better houses are large, com- modious two-storey buildings. There are several club- houses, churches, and a large theatre. Near it are two of the most noted natural resorts of Cuba, the valley of the Yumuri, about two miles west, and the caves of Bellamar, a few miles east of the city. Railways run from Matanzas south, east, and west, making it the centre of communica- tion. The population in 1899 was 36,374. In the Spanish- American war of 1898 JNIatanzas was bombarded by the United States warships, and much amusement was created in Europe by the telegraphic announcement that one mule had been injured. The Matanzas mule has become pro- verbial.

Mataro, a town of Spain, in the province of Barce- lona, on the Mediterranean coast, and on the railway running from Barcelona to France. Its population was 19,918 in 1897. The local industries consist of manu- factures of linen and cotton goods, soap, paper, cremor, chemicals, starch, glass, leather, chocolate, liqueurs and alcohols, and flour- and saw-milling. Like most of the more progressive Catalan towns, Mataro has good modern public buildings and schools.

Fig. 1.

CALCULATING MACHINES, designed for the mechanical performance of numerical calculations, have in modern times come into ever- increasing ml^binlsf ^se. They may be classified as follows :— (i.) Addition machines ; the first invented by Pascal (1642). (ii.) Addition machines modified to facilitate multiplication ; the first by Leibnitz

(1671). (iii.) True multiplication machines; Leon Bolles (1888), Steiger (1894). (iv.) Difference machines ; Mtiller (1786), Babbage (1822). (v.) Analytical machines ; Babbage (1834). The number of distinct machines of the first three kinds is remarkable and is being constantly added to, old machines being improved and new ones invented; Pro- fessor R. Mehmke has counted over eighty distinct machines of this type. The fullest published account of the subject is given by Mehmke in the JSncyclopcedie der Mathematischen Wissenschaften, article " Nximerisches Eechnen," vol. i., heft 6 (1901). It contains historical notes and full references. Dyck's Catalogue also con- tains descriptions of various machines. We will confine ourselves to explaining the principles of some leading types, without giving an exact description of any particular one.

Practically all calculating machines contain a " counting ■work," a series of " figure discs " consisting in the original form of horizontal circular discs (Pig. 1), on which the figures 0, 1, 2 to 9 are marked. Each disc can turn about its vertical axis, and is covered by a fixed plate with a hole or " window" in it through which one figure can be seen. On turning the disc through one-tenth of a revolution this figure will be changed into the next higher or lower. Such turn- ing is called a " step," and this step is positive if the next higher and negative if the next lower figure ap- pears. Each positive step therefore adds one unit to the figure under the window, while two steps add two, and so on. If a series, say six, of such figure discs be placed side by side, their windows lying in a row, then any number of six places can be made to appear, for instance 000373. In order to add 6425 to this number, the discs, counting from right to left, have to be turned 5, 2, 4, and 6 steps respectively. If this is done the sum 006798 will appear. In case the sum of the two figures at any disc is greater than 9, if for instance the last figure to be added is 8 instead of 5, the sum for this disc is 11 and the 1 only will appear. Hence an arrangement for " carrying " has to be introduced. This may be done as follows. The axis of a figure disc contains a wheel with ten teeth. Each figure disc has, besides one long tooth which when its 0 passes the window turns the next wheel to the left, one tooth forward, and hence the figure disc one step. The actual mechanism is not quite so simple, because the long teeth as described would gear also into the wheel to the right, and besides would

~~*interfere with each other. They must therefore be replaced by a some-what more complicated arrangement, which has been done in various ways not necessary to describe more fully. On the way in which this is done, however, depends to a great extent the durability and trustworthiness of any arithmometer ; in fact, it is often its weakest point. If to the series of figure discs described arrangements are added for turning each disc through a required number of steps, we have an addition machine, essentially of Pascal's type, in which each disc had to be turned by hand. Key-*~~

~~*boards have been introduced by Stettner (1882), Max Mayer (1887), and in the comptometer by Dorr Z. Felt of Chicago.^ In the comptograph also by Felt and in " Bourrough's Eegistering Accountant " the result is printed. These machines require that for each figure of the number to be added a key be pressed down; and multiplication, as repeated addition, becomes somewhat laborious, depending for rapid execution essentially on the skill of the operator. The figure discs described may, of course, be replaced by cylindrical discs thick enough to receive the figures on the rim, and may then be mounted on one common axis, greatly to the advantage of com- pactness.*~~

~~*To adapt an addition machine, as described, to rapid multiplication the turnings of -the separate figure discs are replaced by one motion, commonly the turning of a handle. As, however, the different discs have to be turned through different steps, a contrivance has to be inserted which can be " set " in such a way that each disc is moved by one turn of the handle through a number of steps equal to the number of units which is to be added on that disc ; and this may be done by making each of the figure discs receive on its axis a ten-toothed wheel, called hereafter the A-wheel, which is acted on either directly or indirectly by another wheel (called the B-wheel) in which the number of teeth can be varied from 0 to 9. This variation of the teeth has been effected in different ways. Theoretically the simplest seems to be to have on the B-wheel nine teeth which can be drawn back into the body of the wheel, so that at will any number from 0 to 9 can be made to pro- ject. This idea, previously mentioned by Leibnitz, has been reinvented by Bohdner in the" Brunsviga." Another way, also due to Leibnitz, consists in inserting*~~

~~*between the axis of the handle bar and the A-wheel a " stepped " cylinder. This may be considered as being made up of ten wheels large enough to contain about twenty teeth each ; but most of these teeth are cut away so that these wheels retain in succession 9, 8, ... 1, 0 teeth. If these are made as one piece they form a cylinder with teeth of lengths from 9, 8 . . . times the length of a tooth on a single wheel.*~~

~~*In the diagrammatic vertical section of such a machine (Fig. 2) FF is a figure disc with a conical wheel A on its axis. In the covering plate HK is the window W. A stepped cylinder is shown*~~

~~*at B. The axis Z, which runs along the whole machine, is turned by a handle, and itself turns the cylinder B by aid of conical wheels. Above this cylinder lies an axis EE with square section along which a wheel D can be moved. The same axis carries at E'*~~

~~*1 For a fuller description of the manner in which a mere addition machine can be used for multiplication and division, and even for the extraction of square roots, see an article by C. V. Boys in Nature, 11th July 1901.*~~

~~*a pair of conical wheels C and C, whirh can also slide on the axis so that either can be made to drive the A-wheel. The covering plate MK has a slot above the axis EE allowing a rod LL' to be moved by aid of a button L, thus carrying the wheel D with it. Along the slot is a scale of numbers 0 1 2 ... 9 corresponding with the number of teeth on the cylinder B, with which the wheel D will gear in any given position. A series of such slots is shown in the top middle part of Steiger's machine (Fig. 3). Let now the handle driving the axis Z be turned once round, the button being set to 4. Then four teeth of the B-wheel will turn T> and with it the A-wheel, and consequently the figure disc will be moved four steps. These steps will be positive or forward if the wheel C gears in A, and consequently four will be added to the figure showing at the window W. But if the wheels GC are moved to the right, C will gear with A moving backwards, with the result*~~

~~*that four is subtracted at the window. This motion of all the wheels C is done simultaneously by the push of a lever which appears at the top plate of the machine, its two positions being marked ‘ ‘ addition ” and ” subtraction.” The B-wheels are in fixed positions below the plate MK. Level with this, but separate, is the plate KH with the window. On it the figure discs are mounted. This plate is hinged at the back at H and can be lifted up, thereby throwing the A-wheels out of gear. When thus raised the figure discs can be set to any figures ; at the same time it can slide to and fro so that an A-wheel can be put in gear with any C-wheel forming with it one “element.” The number of these varies with the size of the machine. Suppose there are six B-wheels and twelve figure discs. Let these be all set to zero with the exception of the last four to the right, these showing 14 3 2, and let these be placed opposite the last B-wheels to the right. If now the buttons belong- ing to the latter be set to 3 2 5 6, then on turning the B-wheels all once round the latter figures will be added to the former, thus showing 4 6 8 8 at the windows. By the aid of wheels not shown in the diagram, this turning of the B-wheels is performed simul- taneously by the movement of one handle. We have thus an addition macliine. If it be required to multiply a number, say 725, by any number up to six figures, say 357, the buttons are set to the figures 725, the windows all showing zero. The handle is then turned, 725 appears at the windows, and successive turns add this number to tlie first. Hence seven turns show the product seven times 725. Now the plate with the A-wheels is lifted and moved one step to the right and the handle is turned twice, thus adding twenty times 725' to the product obtained. Fin- ally, by moving the plate again, and turning the handle three times, the required pro- duct is obtained. To this another product may bo added. If the machine has six B-wheels and twelve discs the product of two six-figure, numbers can be obtained. Division is performed by re- peated subtraction. The lever regulating the C-wheel is set to subtraction, producing negative steps at the discs. The dividend is set up at the windows and the divisor at the buttons. Each turn of the handle subtracts the di- visor once. To count the*~~

~~*number of turns of the liandle*~~

~~*a second set of windows is*~~

~~*arranged between and in front of the first, with number discs below.*~~

~~*These have no carrying arrangement, but the one which happens to*~~

~~*be near the handle is turned one step for each turn of the handle.*~~

~~*It will be seen that this arrangement is really an addition macliine. The machine described is essentially that of M. Thomas of Colmar, which was the first that came into practical use. Of earlier machines those of Leibnitz, MUUer (1782), and Hahn (1809) deserve to be mentioned (see Dyck, Catalogue). Thomas's machine has had many imitations, botli in England and on the Continent, with more or less important alterations. Mr Juseph Edniondson of Halifax has given it a circidar form, which has many advantages. The accuracy and durability of the machine depend to a great extent on the manner in which the carrying machine is con-structed. No wheel must be capable of moving in any other way than that required ; hence every pnrt must be locked and be released only when required to move. Further, any disc must carry to the next only after the carrying to itself has been eonipleted. If all were to carry at the same time a considerable force would be required to turn the handle, and serious strains would be intro- duced. It is for this reason that the B-wheels or cylinders have the greater part of the circumference free from teeth. Again, the*~~

~~*carrying acts generally as in the machine described, In one sense only, and this involves that the handle be turned always in the same direction. Subtraction therefore cannot be done by turning it in the opposite way, hence the two wheels C and C are intro- duced. These are moved all at once by one lever acting on a bar shown at R in section (Fig. 2).*~~

~~*In the Brunsviga, the figure disc is replaced by a cylinder with the figures at the rim ; the wheel mounted beside it i.s acted on directly by the B-wheel. By an ingenious contrivance the teeth are made to appear from out of the rim to any desired number. The carrying mechanism, too, is different, and so arranged that the handle can be turned either way, no special setting being required for subtraction or division. It is extremely handy, taking up much less room than the others. Professor Selling of Wiirzburg has invented an altogether different machine, which has been*~~

~~*made by Max Ott, of Munich. The B-wheels are replaced by lazy-tongs. To the joints of these the ends of racks are pinned ; and as they are stretched out the racks are moved forward 0 to 9 steps, according to the joints they are pinned to. The racks gear directly in the A-wheels, and the figures are placed on cylinders as in the Brunsviga. The carrying is done continuously by a train of epicycloidal wheels. The working is thus rendered very smooth, without the jerks which the ordinary carrying tooth produces ; but the arrangement has the disadvantage that tlie resulting figures do not appear in a straight line, a figure followed by a 5, for instance, being already carried half a step forward. This is not a serious matter in the hands of a mathematician or an operator using the machine constantly, but it is serious for casual work. Anyhow, it has prevented the machine from being a commercial success, and it is not any longer made. For ease and rapidity of working it surpasses all others. Since the lazy-tongs allow of an extension equivalent to five turnings of the handle, if the multiplier is 5 or under, one push forward will do the same as five (or less) turns of the handle, and more than two pushes are never required.*~~

~~*The Steiger-Egli machine is a multiplication machine, of which Fig. 3 gives a picture as it appears to the manipulator. The lower part of the figure contains, under the covering plate, a carringo W with two rows of windows for the figures marked ff and gg. On presiiing down the button W the carriaje can be moved to right or left. Under each window is a figure-disc, as in the Thomas machine. The upper part has three sections. The one to the right*~~

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~~*Or*~~

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~~M 0~~

~~Fig. 3.~~

~~contains the handle K for working the machine, and a button U for setting the machine for addition, multiplication, division, or subtraction. In the middle section a number of parallel slots are seen, with indices which can each be set to one of the numbers 0 to 9. Below each slot, and parallel to it, lies a shaft of square section on which a toothed wheel slides to and fro with the index in the slot. Below these wheels again lie 9 toothed racks. By setting the index in any slot the wheel below it comes into gear witli one of these racks. On moving the rack, the wheels turn their shafts and, as in the Thomas machine, the figure-discs gg ojiposite~~

~~*to them. The dimensions are such that a motion of a rack through 1 cm. turns the figure-disc through one " step " or adds 1 to the figure under the window. The racks are moved by an arrangement contained in the section to the left of the slots. There is a vertical plate called the multiplication table block, or more shortly, the block. From it project rows of hori- zontal rods of lengths varying from 0 to 9 centimetres. If one of these rows is brought opposite the row of racks and then pushed forward to the right through 9 cm., each rai'k will move and add to its fii;ure-disc a number of units equal to the number of centi- metres of the rod which operates on it. The block has a square*~~

~~*face divided into a hundred squares. Looking at its face from the right — i.e., from tlie side where the racks lie — suppose the hori- zontal rows of these squares numbered from 0 to 9, beginning at the top, and the columns numbered similarly, the 0 being to the right ; then the multiplication table for numbers 0 to 9 can be placed on these squares. The row 7 will therefore contain the numbers 63, 56, . . . 7, 0. Instead of these numbers, each square receives two "rods" perpendicular to the]ilate, which may be called the units-rod and the tens-rod. Instead of the number 63 we have thus a tens-rod 6 cm. and a units-rod 3 cm. long. By aid of a lever H the block can be raised or lowered so that any row of the block comes to the level of the racks, the units-rods being opposite the ends of the racks.*~~

~~*The action of the machine will be understood by consider ing an example. Let it be required to form the product 7 times 385. The indices of three consecutive slots are set to the numbers 3, 8, 5 respectively. Let the windows gg opposite these slots be called a, b, c. Then to the figures shown at these win- dows we have to add 2], 56, 35 respectively. This is the same thing as adding first the number 165, formed by the units of each place, and next 2530 corresponding to the tens ; or again, as adding first 165, and then moving the oarriiige one step to the right, and adding 253. The first is done by moving the block with the units-rods opposite the racks forward. The racks are then put out of gear, and together with the*~~

~~*block brought buck to their noi-mal position ; the block is moved sideways to bring the tens-rods opposite the racks, and again moved forward, adding the tens, the carriage having also been moved forward as required. This complicated movement, together with the necessary carrying, is actually performed by one turn of the handle. During the first quarter-turn the block moves forward, the units-rods coming into operation. During the second quarter-turn the carriage is put out of gear, and moved one step to the right while the necessary carrying is performed ; at the same time the block and the rar-ks are moved back, and the block is shifted so-as to bring the tens- rods opposite the racks. During the next two quarter-turns the process is repeated, the block ultimately returning to its original position. Multiplication by a number with more places is per- formed as in the Thomas. The advantage of this machine over the Thomas in saving time is obvious. Multiplying by 817 re- quires in lhe Thomas 16 turns of the handle, but in the Steiger- Egli only 3 turns, with 3 settings of the lever II. If the lever II is set to 1 we have a simple addition machine like the Thomas or the Brunsviga. The inventors state that the product of two 8-figure numbers can be got in 6-7 seconds, the quotient of a 6-figure number by one of 3 figures in the same time, while the square root to 5 places of a 9-fi^'ure number requires 18 seconds.*~~

~~*iMachines of far greater powers than the arithmometers mentioned have been invented by Babbage and by Scheutz. An account of tiiese is given in the article Calculating Machines (Sncy. Brit. vol. iv.), but without any description of the mechanism ; in fact, such description is impossible without elaborate drawings. Of Babbage's Difference Machine, however, the following account will afford some idea of its working. Imagine a number of striking clocks placed in a row, each with only an hour hand, and with only the striking apparatus retained. As the hand comes opposite a number on the*~~

~~*dial of the first clock, it strikes that number of times. Let this clock be connected with the second in such a manner that by each stroke of the first the hand of the second is moved from one number to the next, but can only strike when the first comes to rest. If the second hand stands at 5 and the first strikes 3, then when this is done the second will strike 8 ; the second will act similarly on the third, and so on. Let there be four such*~~

~~clocks with hands set to the numbers 6, 6, 1, 0, respectively. Now set the third clock striking 1, this sets the hand of the fourth clock to 1 ; strike the second (6), this puts the third to 7 and the fourth to 8. Next strike the first (6) ; this moves the other hands to 12, 19, 27, respectively, and now repeat the striking of the first. The hand of the fourth clock will then give in succession the numbers 1,- 8, 27, 64, &c., being the cubes of the- natural numbers. The numbers thus obtained on the last dial will have the differences given by those shown in succession on the dial before it, their differences by the next, and so on till we come to the constant difference on the first dial. A function~~

~~y=a + hx+cx" + da?+ei^~~

~~gives, on increasing x always by unity, a set of values for wliich the fourth difference is constant. We can, by an arrangement like the above, with five clocks calculate y for x=\, 2, 3, ... to any extent. This is the principle of Babbage's difference machine. The clock dials have to be replaced by a series of dials as in the arith- mometers described, and an arrangement has to be made to drive the whole by turning one handle by hand or some other power. Imagine further that with the last clock is connected a kind of type- writer which prints the number, or, better, impresses the number in a soft substance from which a stereotype casting can be taken, and we have a machine which, when once set for a given formula like the above, will automatically print, or prepare stereotype plates for the printing of, tables of the function without any copying or typesetting, thus excluding all possibility of errors.~~

~~With regard to Babbage's Analytical Machine, the statement in the article referred to, that Babbage left complete plans, is incorrect. The committee of the British Association appointed to consider the possibility of having it made came to the conclusion {Brii. Assoc. Report, 1878, pp. 92-102) that no detailed working drawings existed at all, but that the drawings were only diagrammatic and not nearly sufficient to put into the hands of a draughtsman for making working plans ; and " that in the present state of the design it is not more than a theoretical possibility." A full account of all the work done by Babbage in connexion with calculating machines,~~

~~*and much else published by others in connexion therewith, is con- tained in a work published by his son, General Babbage.*~~

~~*Slide rules are instruments for performing logarithmic calculations mechanically, and are extensively used, espe- cially where only rough approximations are required. They are almost as old as logarithms themselves. Edmund Gunter, the colleague of Briggs at Gresham College, drew a " logarithmic line " on his "Scales" as follows (Fig. 4) : — On a line AB lengths are set off to scale to represent the common logarithms of the*~~

~~*Slide rules.*~~

~~*1 3 9 10*~~

~~*1^*~~

~~*I I I I I*~~

~~*il zl J] it s\ Is It la 1»*~~

~~*I*~~

~~*7 8 a 10*~~

~~*1,1 il.iM,*~~

~~*J^w i*~~

~~■^~~

~~*fi k' I9I*~~

~~*';ff;t f f t ? ?*~~

~~*TJTOT — i \ \ i \ I i i I I I I I I I il I I I I I I I nVi I li'iViWi'iYif/i'Vf V|'i ' 1 I'l'i'i h I iiih nil|*~~

~~*1 2 3 ♦ 5 fl 7 a i H*~~

~~I I III I 1,1,1 ,1 III I I I III I I \ I I I I I I I III M I ll lU I I fill ill I llf,l i f V| I I 1 I I I I 1 I I I I ill III I~~

~~Fig. 4.~~

~~numbers 1 2 3 ... 10, and the points thus obtained are marked with these numbers. As Ig 1 = 0, the begin- ning A has the number 1 and B the number 10, hence the unit of length is AB as Ig 10 = 1. The same division is repeated from B to C. The distance 1,2 thus represents Ig 2, 1,3 gives Ig 3, the distance between 4 and 5 gives Ig 5 — Ig 4 = Ig. I", and so for others. In order to multiply two numbers, say 2 and 3, we have Ig 2 x 3 = Ig 2) Ig 3. HIence, setting off the distance 1,2 from 3 forward by the aid of a pair of compasses will give the distance Ig 2 1 Ig 3, and will bring us to 6 as the required product. Again, if it is required to find 4 of 7, set off the distance between 4 and 5 from 7 backwards, and the required number will be obtained. In the actual scales the spaces between the numbers are subdivided into 10 or even more parts, so that from two to three figures may be read. The numbers~~

~~2, 3 ... in the interval BC give the logarithms of 10 times the same numbers in the interval AB ; hence, if the 2 in the latter means 2 or '2, then the 2 in the former means 20 or 2.~~

~~Soon after Gunter's publication (1620) of these "logar- ithmic lines," Wingate (1872) constructed the slide rule by repeating the logarithmic scale on a tongue or " slide," which could be moved along the first scale, thus avoiding the use of a pair of compasses. A clear idea of this device can be formed if the scale in Fig. 4 be copied on the edge of a strip of paper placed against the line A C. If this is now moved to the right till its 1 comes opposite the 2 on the first scale, then the 3 of the second will be opposite 6 on the top scale, this being the product of 2 and 3 ; and in this position every number on the top scale will be twice that on the lower. For every position of~~

~~*the lower scale the ratio of the numbers on the two scales which coincide will be the same. Therefore multiplications, divisions, and simple proportions can be solved at once.*~~

~~*Many different forms of slide rules are now on the market. The handiest for general use is the Gravet rule made by Tavernier-Gravet in Paris, according to instruc- tions of the mathematician M. Mannheim of the Ecole Polytechnique in Paris. It contains at the back of the slide scales for the logarithms of sines and tangents so arranged that they can be worked with the scale on the front. An improved form is now made by Davis and Son of Derby, who engrave the scales on white celluloid instead of on box-wood, thus greatly facilitating the readings. These scales have the distance from one to ten about twice that in Fig. 4. Tavernier-Gravet makes them of that size and longer, even ^ metre long. But they then become some- what unwieldy, though they allow of reading to more figures. To get a handy long scale Professor G. Fuller has con- structed a spiral slide rule drawn on a cylinder, which admits of reading to three and four figures. The handiest of aU is perhaps the " Calculating Circle " by Boucher, made in form of a watch. For various purposes special adapta- tions of thCj slide rules are met with — for instance, in various exposure meters for photographic purposes. General Strachey has introduced slide rules into the Meteorological Office for performing special calculations. At some blast furnaces a slide rule is used for determining the amount of coke and flux required for any weight of ore. Near the balance a large logarithmic scale is fixed with a slide which has three indices only. A load of ore is put on the scales, and the first index of the slide is put to the number giving the weight, when the second and third point to the weights of coke and flux required.*~~

~~*In order to measure the length of a curve, such as the road on a map, a wheel is rolled along it. For one revolu- tion of the wheel the path described by its point Carvo- q£ QQuta^Qt js equal to the circumference of the meters. , t mi -c*~~

~~*wneel. inus, if a cyclist counts the number oi*~~

~~*revolutions of his front wheel he can calculate the distance ridden by multiplying that number by the circumference of the wheel. An ordinary cyclometer is nothing but an arrangement for counting these revolutions, but it is gradu- ated in such a manner that it gives at once the distance in miles. On the same principle depend a number of instru- ments which, under various fancy names, serve to measure the length of any curve ; they are in the shape of a small meter chiefly for the use of cyclists. They all have a small wheel which is rolled along the curve to be measured, and this sets a hand in motion which gives the reading on a dial. Their accuracy is not very great, because it is difficult to place the wheel so on the jiaper that the point of contact lies exactly over a given point ; the beginning and end of the readings are therefore badly defined. Besides, it is not easy to guide the wheel along the curve to which it should always lie tangentially. To obviate this defect more com- plicated curvometers or kartometers have been devised. The handiest seems to be that of Coradi. He uses two wheels ; the tracing-point, halfway between them, is guided along the curve, the line joining the wheels being kept normal to the curve. This is pretty easily done by eye ; a constant deviation of 8° from this direction produces an error of only 1 per cent. The sum of the two readings gives the length. E. Fleischhauer uses three, five, or more wheels arranged symmetrically round a tracer whose point is guided along the curve ; the planes of the wheels all pass through the tracer, and the wheels can only turn in one direction. The sum of the readings of all the wheels gives approximately the length of the curve, the approxima- tion increasing vidth the number of the wheels used. It is stated that with three wheels practically useful results can*~~

~~*Plaal- meters.*~~

~~*be obtained, although in this case the error, if the instru- ment is consistently handled so as always to produce the greatest inaccuracy, may be as much as 5 per cent.*~~

~~*Planimeters are instruments for the determination by mechanical means of the area of any figure. A pointer, generally called the " tracer," is guided round the boundary of the figure, and then the area is read oflf on the recording apparatus of the instru- ment. The simplest and most useful*~~

~~*is Amsler's (Fig. 5). It consists of two bars of metal OQ and QT, which are hinged together at Q. At O is a needle-point which is driven in the drawing board, and at T is the tracer. As this is guided round the boundary of the figure a wheel W mounted*~~

~~*on QT rolls on the paper, and the turning of this wheel measures, to some known scale, the area. We shall give the theory of this instrument fully in an elementary- manner by aid of geometry. The theory of other plani- meters can then be easily understood.*~~

~~*Consider the rod QT with the wheel "W, without the arm OQ. Let it be placed with the wheel on the paper, and now moved per- pendicular to itself from AC to BD C D (Fig. 6). The rod sweeps over, or*~~

~~*generates, the area of the rect- angle ACT)B = lp where I denotes the length of the rod and ^ the distance AB though which it has been moved. This distance, as measured by the rolling of the wheel, which acts as a curvometer,*~~

~~*will be called the "roll" of the*~~

- ~~*B wheel and he denoted w. In this*~~

~~*Pig_ g. case p=w, and the area P is given*~~

~~*by ?=■»?. Let the circumference of the wheel be divided into say a hundred equal parts u ; then ii> registers the number of us rolled over, and w therefore gives the number of areas lu contained in the rectangle. By suitably select- ing the radius of the wheel and the length 1, this area lu may be any convenient unit, say a square inch or square centimetre. By changing I this unit will be changed.*~~

~~*Again, suppose the rod to turn (Fig. 7) about the end Q, then T will describe an arc of a circle, and the rod will generate an area ^Pe, where B is the angle AQB through which the rod has turned. The wheel will roll over an arc c9, where c is the dis- tance of the wheel from Q. The "roll " is now w = c8 ; hence the area generated is*~~

~~*e*~~

~~*and is again deter- mined by u;*~~

~~*Next let the rod be moved parallel to itself, but in a direction not perpendicular to itself (Fig. 8). The wheel will now not simply roll. Consider a small motioil of the rod from QT to Q'T'. This may be resolved into the motion to RR' perpendicular to the rod, whereby the rectangle QTR'R is generated, and the sliding of the rod along itself from RR' to Q'T. During this second step no area will be generated. During the first step the roll of the wheel will give QR, whilst during the second step there will be no roll at all. The roll of the wheel will therefore measure the area of the rectangle which equals the parallelogram QTT'Q'. If the whole motion of the rod be considered as made up of a very great number of small steps, each resolved as stated, it will be seen that the roll again measured the area generated as in the first case. But it has to be noticed that now the wheel does not only roll, but also*~~

~~*Fig. 7.*~~

~~*slips, over the paper. This, as will be pointed out later, may*~~

~~*introduce an error in the reading.*~~

~~*y , We can now inves-*~~

~~*tigate the most general motion of the rod. We again resolve the motion into a number of small steps. Let AB be one position, CD the next after a step so small that the arcs AC or BD over which the ends have passed may be con- sidered as straight lines. The area gene- Pig_ 8_ rated is ACDB. This*~~

~~*motion we resolve*~~

~~*into a step from AB to CB', parallel to AB and a turning*~~

~~*about C from CB' to CD, steps such as have been investigated.*~~

~~*During the first, the "roll "will be over J3 the altitude of the*~~

~~*parallelogram ; during*~~

~~*the second it will be c9. D*~~

~~*Therefore*~~

~~*w=p + c8.*~~

~~*The area generated is lp + iP8, or, expressing p in terms of w, lie + (iP-lc)e. For a finite motion we get the area equal to the sum of the areas generated dur- ing the different steps. But the wheel will con- tinue rolling, and give the whole roll as the sum of the rolls for the successive steps. Let then w denote the whole roll (in Fig 10),*~~

~~*pj and let a denote the sum of all the small turnings 9 ; then the area is*~~

~~*V = lw+(,iP-lc)a.*~~

~~*Here a is the angle which the last position of the rod makes with the first. In all applications of the planimeter the rod is brought back to its original position. Then the angle a is either zero, or it is 2ir if the rod has been once turned quite round.*~~

~~*Fig. 9.*~~

~~*Fig. 10. Hence in the first case we have*~~

~~*(1)*~~

~~*and IV gives the area as in case of a rectangle. In the other case*~~

~~*V = lw + IG . . . . (2)*~~

~~*where C = (JZ — c)2Tr, if the rod h as once turned roun d. The number C wUl be seen to be always the same, as it depends only on the dimensions*~~

~~*of the instrument. Hence now again the area is deter- mined by w if C is known.*~~

~~*Thus it is seen that the area generated by the motion of the rod can be measured by the roll of the wheel ; it remains to show how any given area can be generated by the rod. Let the rod move in any manner but return to its original position. Q and T then describe closed curves. Such motion may be called cyclical. Here the theorem holds -.—If a rod QT perfm-ms a cyclical motion, then the area generated equals the difference of the areas enclosed by the paths of T and Q respectively. The truth of this pro-*~~
~~*Kg. 11.*~~

~~*position will be seen*~~

~~*from a figure. In Fig. 11 the different positions of the moving rod QT have been marked, and its motion can be easily followed. It wUl be seen that every part of the area TT BB' will be passed over once and always by a forward motion of the rod.*~~

~~*whereby the wheel will increase its roll. The area AA'QQ' will also be swept over once, but with a backward roll ; it must there- fore be counted as negative. The area between the curves is passed over twice, once with a forward and once with a backward roll ; it therefore counts once positive and once negative ; hence not at all. In more complicated figures it may happen that the area within one of the curves, say TT'BB', is passed over several times, but then it will be passed over once more in the forward direction than in the backward one, and thus the theorem will still hold.*~~

~~*To use the planimeter, place the pole 0 on the paper outside the figure to be measured. Then the area generated by QT is that of*~~

~~*Fig. 12.*~~

~~*the figure, because the point Q moves on an arc of a circle to and fro enclosing no area. At the same time the rod comes back without making a complete rotation. We have therefore in formula (1), a=o, and hence*~~

~~*P=lw,*~~

~~which is read off. But if the area is too large the pole 0 may be placed within the area. The rod describes the area between the boundary of the figure and the circle with radius r=OQ, whOst the rod turns once com- pletely round, making a—lir. The area meas- ured by the wheel is by for- mula (2), Zmj-II (4? — Zc)25r. To this the area of the circle ir'fi must be added, so that now~~

~~'?=lw + {\V-lc)'2.Tr--nr^> or~~

~~P=Z«) + C, where C = (JP — Zc)27r 1 iri^ is a constant, as it de- pends on the dimensions of the instrument alone, strument.~~

~~Amsler's planimeters are made either with a rod QT of fixed length, which gives the area therefore in terms of a fixed unit, say in square inches, or else the rod can be moved in a sleeve to which the arm OQ is hinged (Fig. 13). This makes it possible to change the unit lu, which is proportional to I.~~

~~Fig. 13. This constant is given vrith each in-~~

~~Fig. 14.~~

~~In the planimeters described the recording or integrating apparatus is a smooth wheel rolling on the paper or on some other surface. Amsler has described another recorder, viz. , a wheel with a sharp edge. This will roll on the paper but not sIIp. Let the rod QT carry with it an arm CD perpendicular to it. Let there be mounted on it a wheel W, which can slip along and turn about it If now QT is moved parallel to itself to Q'T', then W will roll without sIIpping parallel to QT, and slip along CD. This amount ot shppmg will equal the perpendicular distance between QT and~~

~~Fig. 15.~~

~~*Q'T', and therefore serve to measure the area swept over like the wheel in the machine already described. The turning of the rod will also produce slipping of tlie wheel, but it will be seen without difficulty that this will cancel during a cyclical motion of the rod, provided the rod does not perform a whole rotation. Messrs Hine and Robertson, New York, have constructed a planimeter on this principle, which, however, is only a slight modification of one described by Amsler in 1856. The end Q of the rod ends in a button which slides along a V-groove.*~~

~~*The first planimeter was made on the following principles : — • A frame FF (Fig. 15) can move in the direction OX. It carries a*~~

~~*rod T'T movable in its own length, hence the tracer T can be guided along any curve ATB. When the rod has been pushed back to Q'Q, the tracer moves along the axis OX. As the frame is moved a cone VCC mounted on it turns about its axis.' The latter is slanting so that its top edge is horizontal and parallel to the rod ; its vertex is opposite to Q'. A wheel W is mounted on the rod at T', or on an axis parallel to and rigidly connected with it. This wheel rests on the top edge of the cone. If now the tracer T, when pulled out through a distance y above Q, be moved par-allel to OX through a, distance dx, the frame moves through an equal distance, and the cone turns through an angle dB proportional to dx. The wheel W rolls on the cone to an amount again pro- portional to dx, and also proportional to y, its distance from V. Hence the roll of the wheel is proportional to the area ydx described by the rod QT. As T is moved from A to B along the curve the roll of the wheel will therefore be proportional to the area AA'BB'. If the curve is closed, and the tracer moved round it, the roll will measure the area independent of the position of the axis OX, as will be seen by drawing a figure. The cone may with advantage be replaced by a horizontal disc, with its centre at V; this allows of y being negative. It may be noticed at once that the roll of the wheel gives at every moment the area A'ATQ. It*~~

~~*will therefore allow of registering a set of values of / V^^ for ^"7*~~

~~*values of x, and thus of tabulating the values of any indefinite integral. In this it differs from Amsler's planimeter. Planimeters of this type were first invented in 1814 by the Bavarian engineer Hermann, who, however,*~~

~~*published nothing. They were re- invented by Prof. Tito Gonnella of Florence in 1824, and by the Swiss engineer Oppikofer, and improved by Ernst in Paris, the astronomer Hansen in Gotha, and' others (see Henrioi, British Association Report, 1891). But all were driven out of the field by Amsler's simpler planimeter.*~~

~~*Altogether different from the planimeters described is the hatchet planimeter, invented by Captain Prytz, a Dane, and made by Herr Cornelius Knud- son in Copenhagen. It consists of a single rigid piece like Fig. 16. The one end T is the tracer, the other Q has a sharp hatchet-like edge. If this is placed with QT on the (_\ paper and T is moved along any curve, Q will follow, describing a "curve of pursuit." In consequence of the sharp edge, Q can only move in the direction of T, but the whole can turn about Q. Any small step forward can therefore be considered as made up of a motion along QT, together with a turning about Q. The latter motion alone generates an area. If therefore a line OA = QT is turning about 0, always keeping parallel to QT, it will sweep over an area equal to that generated by the more general motion of QT. Let now (Fig. 17) QT be placed on OA, and T? be guided round the closed curve in the sense of the arrow. Q will describe a curve OSB. It maybe made visible by putting a piece of "copying paper" under the hatchet. When T has returned to A the hatchet has the position BA, The line turning from OA about 0*~~

~~*Fig. 16.*~~

~~*Fig. 17.*~~

~~*kept parallel to QT will describe the circular sector OAC, which*~~

~~*is equal in magnitude and sense to AOB. This therefore*~~

~~*measures the area generated by the motion of QT. To make this*~~

~~*motion cyclical, suppose the hatchet turned about A till Q comes*~~

~~*from B to 0. Hereby the sector AOB is again described, and*~~

~~*again in the positive sense, if it is remembered that it turns about*~~

~~*T. The whole area now generated is*~~

~~*therefore twice the area of this sector,*~~

~~*or equal to OA . OB, where OB is*~~

~~*measured along the arc. According*~~

~~*to the theorem given p. 579, this*~~

~~*area also equals the area of the given*~~

~~*curve less the area OSBO. To make*~~

~~*this area disappear, a slight modifica- tion of the motion of QT is required.*~~

~~*^et the tracer T be moved, both from*~~

~~*the first position OA and the last BA*~~

~~*of the rod, along some straight line*~~

~~*AX. Q describes curves OF and BH*~~

~~*respectively. Now begin the motion*~~

~~*with T at some point R on AX, and*~~

~~*move it along this line to A, round*~~

~~*the curve and back to R. Q will*~~

~~*describe the curve DOSBED, if the*~~

~~*motion is again made cyclical by*~~

~~*turning QT with T fixed at A. If*~~

~~*R is properly selected, the path of Q*~~

~~*will cut itself, and parts of the area*~~

~~*will be positive, parts negative, as*~~

~~*marked in the figure, and may there- fore be made to vanish. When this is done the area of the curve will equal tvfice the area of the sector RDE. It is therefore equal to the arc DE multiplied by the length QT ; if the latter equals 10 inches, then 10 times the number of inches contained in the arc DE gives the number of square inches contained within the given figure. If the area is not too large, the arc DE may be replaced by the straight line DE.*~~

~~*To use this simple instrument as a planimeter requires the possibility of selecting the point R. The geometrical theory here given has so far failed to give any rule. In fact, every line through any point in the curve contains such a point. The analytical theory of the inventor, which is very similar to that given by Mr F. W. Hill {Phil. Mag. 1894), is too complicated to repeat here. The integrals expressing the area generated by QT have to be expanded in a series. By retaining only the most important terms a result is obtained which comes to this, that if the mass-centre be taken as R, then A may be any point on the curve. This is only approximate. Capt. Prytz gives the following instruc- tions : — Take a point R as near as you can guess to the mass- centre, put the tracer T on it, the knife-edge Q outside ; make a mark on the paper by pressing the knife-edge into it, guide the tracer from E along a straight line to a point A on the boundary, round the boundary, and back from A to R ; lastly, make again a mark with the knife-edge, and measure the distance c between the marks, then the area is nearly cZ where Z = QT. A nearer approxima- tion is obtained by repeating the operation after turning QT through 180° from the original position, and using the mean of the two values of c thus obtained. The greatest dimension of the area should not exceed" \ I, otherwise the area must he divided into parts which are determined separately. This condition being fulfilled, the instrument gives very satisfactory results, especially if the figures to be measured, as in the case of indicator diagrams, are much of the same shape, for in this case the operator soon learns where to put the point R.*~~

~~Integrators serve to evaluate an integral, and especially~~

~~r ^~~

~~a definite integral J f{x)dx, where f{x) is given grapidc-~~

~~ally, or, if given by a formula, is first represented graphically. If we plot out the curve whose equation is~~

~~y=/(^), the integral I ydx between the proper limits~~

~~represents the area of a figure 1 munded by the curve, the axis of x, and the orci 1 1 1 ites at a; = a, X = J. HIence if the curve if drawn, any planimeter maybe used for finding the vi 'le of the integral. In this sense planimeters are inte-ators. In fact, a plani- meter may often be used with ad\ ntage to solve problems more complicated than the detei i ■ tnation of a mere area, by converting the one problem gr,- iphically into the other. We give an example : —~~

~~Let the problem be to determine for the figure ABG (Fig. 18), not only the area, but also the first and second moment with~~

~~Integrators.~~

~~MATIHEMATICAL INSTRUMENTS~~

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~~regard to the axis XX. At a distance a draw a line, CD', parallel to XX. In the figure draw a number of lines parallel to AB. Let CD be one of them. Draw C and D vertically upwards to CD', join these points to some selected point 0 in XX, and mark the points CiDj where 00' and OD' out CD. Do this for a sufficient number of lines, and join the points CjDi thus obtained. This gives a new curve, which may be called the iirst derived curve. By the same process get a new curve from this, the second~~

~~derived curve. By aid of a planimeter determine the areas P, Pj, Pj, of these three curves. Then, if x is the distance of the mass- centre of the given area from XX ; x' the same quantity for the first derived figure, and~~

~~I = AF the moment of inertia of the first figure, k its radius of gyration, with regard to XX as axis, the following relations are easily proved : —~~

~~Pa!=aPi; Pi£!;j=aP2 ; l=aP^Xi = a'^V^V^; lc"=xx^,~~

~~which determine P, x and I or Ic. Amsler has constructed an integrator which serves to determine these quantities by guiding a tracer once round the boundary of the given figure (see below). Again, it may be required to find the value of an integral~~

~~h~~

~~'x)dx between given limits where 0(a;) is a simple function like~~

~~sin nx, and where y is given as the ordinate of a curve. The har- monic analysers described below are examples of instruments for evaluating such integrals.~~

~~Amsler has modified his planimeter in such a manner that instead of the area it gives the first or second moment of a figure about an axis in its plane. This instrument, known as the Amsler's integrator or moment – planimeter, has one tracer but three recording ■wheels. It is mounted on a car- riage which runs on a straight rail (Fig. 19). This carries a horizontal disc A, movable about a vertical axis Q. Slightly more than half the circumference is circular with radius 2a, the other part with radius 3a. Against these gear two discs, B and C, with radii a ; their axes are fixed in the carriage. The first part ex- tends to the left to a rod OT of length I, on which a record- ing wheel W is mounted. The discs B and C have also record- ing wheels, Wj and 'W2. The centres of the three discs are in a line perpendicular to the rail. If now T is guided round a figure F, 0 will move to and fro in a straight line. This part is therefore a simple plani- meter, in which the one end of the arm moves in a straight line instead of in a circular arc. Consequently, the "roll" of W will record the area of the figure. Imagine now that the discs B and C also receive~~

~~arms of length I from the centres of the discs to points Tj and T2, and in the directions of the axes of the wheels. Then these arms with their wheels~~

~~will again be planimeters. As T is guided round the given figure F, these points Tj and Tj will~~

~~describe closed curves, Fj and Fj, and the " rolls " of Wj and W, will give their areas A, and Aj. Let XX (Fig. 20) denote the line, parallel to the rail, on which 0 moves ; then when T lies on this line, the arm BTj is perpendicular to XX, and CTj parallel to it. If OT is turned through an angle 8, clockwise.~~

~~Pig. 20.~~

~~BTi will turn counter-clockwise through an angle 20, and CT^ through an angle ZB, also counter-clockwise. If in this position T is moved through a distance x parallel to the axis XX, the points Ti and T^ will move parallel to it through an equal distance. If now the first arm is turned through a small angle dd, moved back through a distance x, and lastly turned back through the angle dB, the tracer T wOl have described the boundary of a small strip of area. We divide the given figure into such strips. Then to every such strip will correspond a strip of equal length x of the figures described by Tj and T2. The distances of the points, T, Ti, T2, from the axis XX may be called y, y-^, y^. These have the values~~

~~y=l sin $, yi = l cos 29, y^= — 2 sin Z9, from which~~

~~dy=lcose.de, dyi= -11 sai2e.de, dy^^ -31 cos 39. dO.~~

~~Fig. 19. The areas of the three strips are respectively~~

~~dk=xdy, dAi=xdyi, dA^=xdy2. Now dyi can be written dy^ = -il sin 6 cos 9d9= — 4 sin~~

~~therefore whence~~

~~dA^ = — 4 siu S.dA = — yydA ; if i —~~

~~■wh^e A is the area of the giren figure, and y the distance of its mass-centre from the axis XX. But Ai is the area of the second figure Fi, which is proportional to the reading of Wi. Hence we may say _~~

~~Aj^=CiWi,~~

~~where Cj is a constant depending on the dimensions of the instrument. The negative sign in the expression for Aj is got rid of by numbering the wheel "Wi the other way round. Again~~

~~dy^= — Zl cos e{i cos^ 9 — S}de= — 3{4 cos^ 6 — S}dy~~

~~which gives~~

~~and~~

~~= -s{if-Syy,~~

~~12~~

~~dA^= —^yHA + QdA,~~

~~A,=~~

~~'fy'dA~~

~~+ 9A.~~

~~But the integral gives the moment of inertia I of the area A about the axis XX. As A^ is proportional to the roll of lOa A to that of W, we can write~~

~~I = Cw — CgiOj, A^=CiM)i,~~

~~A = C(|W.~~

~~If a line be drawn parallel to the axis XX at the distance y, it will pass through the mass -centre of the given figure. If this represents the section~~

~~*of a beam subject to bending, this line gives for a proper choice of XX the neutral fibre. The moment of inertia for it will be I I Ay". Thus the instrument gives at once all those quantities which are required for calculating the strength of the beam under bending. One chief use of this integrator is for the calculation of the displacement and stability of a ship from the drawings of a number of sections. It will be noticed that the length of the figure in the direction of XX is only limited by the length of the rail.*~~

~~*This integrator is also made in a simplified form without the wheel Wj. It then gives the area and first moment of any figure.*~~

~~*While an integrator deter- mines the value of a definite integral, hence a mere constant, Intesrranbs ^^ integraph gives*~~

~~*definite integral, which is a function of x. Analytically if y is a given function /(x) of x and*~~

~~*E,—"*~~

~~*This ^ is easily constructed for any given point on the y-cnrve : — From the foot B' (Fig. 21) of the ordinate y=B'B set off, as in the figure, B'D=ffi, then angle BDB' = 0. Let now DB' with a, per- pendicular B'B move along the axis of x, whilst B follows the 2/-curve, then a pen P on*~~

~~*B'B will describe the .'*~~

~~*y — curve provided it moves at every moment in a direction parallel to BD. The object of the integraph is to draw this new curve when the tracer of the instrument is guided along the in- curve.*~~

~~*The first to describe such instruments was Abdank — Abakanowicz, who in 1889 published a book in which a variety of mechanisms to obtain the object in question are described. Some years later Coradi, in Zurich, carried out his ideas. Before this*~~

~~*B Fig. 21.*~~

~~*was done, Mr C. V. Boys, without knowing of Abdank-Abakano- wicz's work, actually made an integraph which was exhibited at the Physical Society in 1881. Both make use of a sharp edge wheel. Such a wheel will not slip sideways ; it will roll forwards along the line in which its plane intersects the plane of the paper, and while rolling will be able to turn gradually about its point of contact. If then the angle between its direction of rolling and the x-axis be always equal to , the wheel will roll along the Y-curve required. The axis of x is fixed only in direction ; shifting it parallel to itself adds a constant to Y, and this gives the arbitrary constant of integration.*~~

~~*In fact, if Y shall vanish for x=c, or if*~~

~~*'<'*~~

~~*ydx,*~~

~~*then the axis of x has to be drawn through that point on the 2/-ourve which corresponds to x=c.*~~

~~*In Coradi's integraph a rectangular frame FJF2F3F4 (Fig. 22) rests with four rollers R on the drawing board, and can roll freely in the direction OX, which will be called the axis of the instrument.*~~

~~*Y =*~~

~~*I ydx or Y= I ydx + const.*~~

~~*the function Y has to be deter- mined from the condition*~~

~~*dx ^'*~~

~~*Graphically y=f(x) is either*~~

~~*given by a curve, or the graph*~~

~~*of the equation is drawn : y,*~~

~~*therefore, and similarly Y, is a*~~

~~*rfY*~~

~~*length. But r is in this case*~~

~~*dx*~~

~~*a mere number, and cannot*~~

~~*equal a length y. Hence we*~~

~~*introduce an arbitrary constant*~~

~~*length a, the unit to which the*~~

~~*integraph draws the curve, and*~~

~~*write*~~

~~*— = and aY= \ydx. dx a J*~~

~~*dY Now for the Y-curve — = tan*~~

~~*tangent to the curve, and the axis of x. Our condition therefore becomes „*~~

~~*tan 0=2 a*~~

~~*Fig. 22.*~~

~~*On the front edge F1F2 travels a carriage AA' supported at A' on another rail. A bar U B can turn about D, fixed to the frame in its axis, and slide through a point B fixed in the carriage AA'. Along it a block K can slide. On the back edge F3F4 of the frame another carriage C travels. It holds a vertical spindle with the knife-edge wheel at the bottom. At right angles to the plane of*~~

~~*the wheel, the spindle has an arm GH, which is kept parallel to a similar arm attached to K perpendicular to DB. The plane of the knife-edge wheel r is therefore always parallel to DB. If now the point B is made to follow a curve whose y is measured from OX, we have in the triangle BDB', with the angle*~~

~~*According to K. Kahle and "W. "Wien, the electromotive force of the H form of Clark cell is 1-4322 volts at 15° C.*~~

~~*PlaUnum Wire^*~~

~~*Platinum Wire,*~~

~~*Fig. 4.*~~

~~*MEASURING INSTRUMENTS, ELECTRIC 595*~~

~~*power can be constructed on tHe same plan as a Siemens dynamometer or a Kelvin ampere — balance, with this difference, that in a wattmeter the two circuits, fixed and movable, have separate terminals. One of these circuits, generally the fixed one, is traversed by the current passing through the power-absorbing circuit, and the movable coil is constructed of a fine high-resistance wire, the terminals of which are connected across the ends of the power-absorb- ing circuit. In these circumstances the fixed coil is traversed by a current which is the current through the power-absorbing circuit, and the movable coil is traversed by a current which is proportional to the potential difference of the ends of the power-absorbing circuit. If the circuit is inductive and the currents periodic, these two currents differ in phase. In any case, the mechanical couple that must be apphed to the movable coil to bring it back to a fixed position with respect to the fixed coil is proportional to the mean value of the product of the instantaneous values of the currents at equidistant intervals of time during the period. But this last mean product is a measure of the mean power ; hence the mechanical couple, and therefore the twist of the torsion head, required to restore the movable coU to its original position becomes a measure of the mean power taken up in the circuit tested.*~~

~~*If at any instant the current through the fixed coil is i, and the current through the movable coil is ij, then the torque to be applied to the movable coil to keep it in its zero position is proportional to the product iij. Hence the mean value of the torque is pro- portional to the value of ii^ duriug the phase, or is equal to*~~

~~*1 /“t*~~

~~*jj^ / iijdt where T is the periodic time. If, therefore, the*~~

~~*twist of the upper end of the spiral spring is 8, and D is a constant*~~

~~*1 pt called the dynamometer constant, Dff =Tp”/ ihdt.*~~

~~*If r is the resistance of the movable coil circuit, and e the*~~

~~*1 /“t potential difference of its ends, then rD9 = 7ir/ iedt. The inte- gral on the right-hand side is the expression for the mean power P given to the circuit. Hence*~~

~~*It has been shown that a power-measuring instrument, or wattmeter constructed in this manner, is available for the measurement not only of continuous but of alternating current-power. In measuring the power taken up in inductive circuits supplied at very high electric pressure, in which the difference of potential between the extremities of the circuit is, say, 2000 volts or upwards, an additional device is necessary in order to reduce the current passing through the movable coil to a convenient value. Either a sufficiently large non-inductive resistance may be put in series with the movable coil, or a closed iron circuit step- down transformer may be employed. The property of such a transformer is that a periodic electromotive force applied to its primary terminals produces a periodic electromotive force in the secondary circuit, which follows the same law of variation, but is reduced in absolute value by any required amount. Hence in employing a dynamometer wattmeter to measure power taken up in an alternating current circuit when the electromotive force is high, it is usual to join across the terminals of the circuit the step- down transformer, which reduces the voltage to any required amount, and to connect the movable coil of the wattmeter in series with the secondary*~~

~~circuit of this trans- former if necessary through a resistance which preferably takes the form of one or more incandescent lamps.~~

~~The function of another important class of electric meters is to measure either the electric energy supplied to a circuit, or the electric quantity. If the pressure and current are uniform and unvarying, the electric energy is simply measured by the product of the electric power and~~

~~After the platinum wires have been sealed through the glass, a little aqua regia is placed in the cell legs until bubbles of gas arise from the platinum, when it is thrown out and replaced by a solu- tion of mercurous nitrate. Then by the use of an- other piece of platinum as anode, mercury is eleotrolytically deposited upon the platinum, which may also be amalgamated by making it white hot in a Bunsen ilame and plunging it in mercury. To prepare the cadmium amalgam, one part of pure cadmium is dis- solved in six parts of pure mercury, and the product while warm and fluid is placed in one limb of the cell and warmed, to ensure perfect contact~~

~~with the platinum wire. The cadmium sulphate solution is pre- pared by digesting a saturated solution of cadmium sul|ihate with cadmium hydroxide to remove free acid, care being taken not to raise the temperature above 70° C, and then by digesting it still further with mercurous sulphate until no more precipitation occurs. The cadmium sulphate solution must be saturated and have free crystals of the salt in it. The mercurous sulphate must be free from acid, and made neutral by triturating with finely-divided mercury. In making the paste, so much cadmium sulphate must be added that a saturated solution of that salt is formed and is present in the cell. The cell has the electromotive force above stated if the amalgam of cadmium has from 6 to 13 parts of mercury to 1 of cadmium. The German investigators seem to have a great preference for the H form of cell, but it is clear that a narrow tubular cell of the British Board of Trade form not only comes more quickly to the temperature of the water bath in which it is placed, but is more certain to be wholly at one temperature.~~

~~In cases when great accuracy is not required, a Daniell cell can be used as a standard of electromotive force. The form designed by J. A. Fleming~~

~~*(Phil. Mag. vol. xx. p. 126) consists of a U tube, one leg of which contains a rod of pure amalgamated zinc, and the other a rod of freshly-electrotyped copper. The legs are filled with solutions of zinc sulphate and copper sulphate, the zinc rod being in the zinc sulphate and the copper rod in the copper sulphate. When so made, the cell has an electromotive force of 1 '072 volts and no sensible temperature variation. The solutions are made by dissolving the purest reorystallized sulphate of copper and sulphate of zinc in distilled water. For the zinc solution, take 55 '5 parts by weight of crystals of zinc sulphate (ZnS0470H2) and dissolve in 44 "5 parts by weight of distilled water ; the resulting solution should have a specific gravity of 1 '200 at about 20° C. For the sulphate of copper solution, take 16'5 parts by weight of pure crystals of copper sulphate (CuS0450Hj) and dissolve in 83 "5 parts by weight of water ; the resulting solution should have a specific gravity of I'lOO at 20° C. The solutions should be adjusted exactly to these densities and kept in stock bottles, from which the reservoirs of the cell should be filled up as required.*~~

~~*Instruments for the measurement of electric power are called wattmeters. The electric power taken up in a*~~

~~*circuit traversed by a continuous current is 'fg measured in watts by the product of the current*~~

~~*flowing through the circuit in amperes, and the difference of potential between the extremities of the circuit measured in volts. If the current is alternating, and the circuit is truly non-inductive or approximately inductionless, the mean value of the power taken up in the circuit is obtained by multiplying together the root-mean- square value of the current and the root-mean-square value of the potential difference. If, however, the circuit is in- ductive, as in an electromagnet or a transformer, then the mean power taken up in it is not given simply by the pro- duct of the above-mentioned root-mean-square values, but by this product multiplied by a fraction called the power- factor. If we are dealing with simple periodic or alternat- ing currents, the variations in instantaneous value follow a simple sine law, and the power -factor becomes the cosine of the angle of lag or phase-difference angle between*~~

~~*the current and the electromotive force (see Electricity, III.). An instrument for the measurement of electric*~~

~~*time and the electric quantity is measured by the product of the electric current and the time. If the current is variable, the electric energy and the electric quantity are measured by the time-integrals of the power and the current respecV ively. Instruments which automatically measure these time-integrals are called energy meters and Energy nua/ntitv meters, and of this kind are aU those*~~

~~*tnCtGFSt J. " '*~~

~~*appliances which are also called electric hxnise- meters, since they are used for measuring the supply of electric energy or electric quantity from public electric supply stations to customers connected therewith.*~~

~~*One simple form of energy meter is that of Mengarini, an instru- ment of the wattmeter type. It has a fixed coil traversed by the current passing into the energy-absorhing circuit or house, and a movable coil suspended by a bifilar arrangement with its axisat right angles to the fixed coil. The movable coil carries an index-pen moving over a revolving drum covered with paper, which is driven uniformly by clockwork. If it is connected to the terminals of the power-absorbing circuit, and the fixed coil traversed by the current, then it is deflected through an angle which is nearly pro- portional to the mean power being given to the circuit ; the pen, therefore, will trace a line upon the drum, and when the paper is removed and laid out flat, the area of the curve included between the base line and the two vertical ordinates is proportional to the time-integral of the power supplied to the circuit. The instrument can therefore be easily calibrated so that the measurement of this area gives the power supplied to the circuit in any time in joules or Board of Trade units. ^ Another self-integrating wattmeter of thi-s kind is that due to Elihu Thomson. It consists of a small electric motor, the armature and the field of which contain no iron. The former is a simple drum-wound armature, wound with fine wire and connected through a resistance with the terminals of the power- absorbing circuit ; the field magnet consists of two coils of*~~

~~*thick wire in series with the power-absorbing circuit. The armature shaft carries a copper disc which revolves between the poles of fixed permanent magnets, and is geared with a counting mechanism which records the number of its revolutions. When the instrument is connected up to the circuits, the mechanical driving power on the motor is proportional to the mean electric power taken up in the circuit measured, while the eddy currents set up in the copper disc exercise a retarding effect proportional to its speed. Hence the speed of the motor, if left to itself, is constant when the currents passing through it are unvarying, and varies as the meau power being taken up in the circuit to which it is connected. Accordingly, the number of revolutions in a given time are a measure of the total electric energy imparted to the circuit in that time. A similar motor-meter has been devised by Evershed. Another much-used form of energy meter or watt-hour meter is that of Aron. In this instrument tliere is a fixed coil, through which passes the whole cui-rent entering the power-absorbing circuit or house. Suspended over this is a movable coil which forms the bob of a clock pendulum, and this is wound with fine wire which is a shunt across the terminals of the power-absorbing circuit. The pendulum regulates a clock, which drives, through a differential gearing, a recording hand registering on a dial or dials the difference in the rate of this and another comparison clock with an ordinary pendulum and clock mechanism. The rate at which a pendulum vibrates being determined by its length and by the force acting on the bob, the rate of the first pendulum is controlled partly by gravity and partly by the force created by the attraction due to the currents in the fixed and movable coils. But this second quantity is proportional to the product of the values of the two currents in the two coils, that is, to the power passing through the instrument ; hence the rate at which tne clock movement governed by this pendulum gains or loses on the comparison clock is a measure of the power passing through the meter, and the total gain or loss of one clock over the other in any time is a measure of the totnl energy in watt-hours or Board of Trade units imparted to the circuit in that time.*~~

~~*Quantity meters are meters which measure the time- integral of a current in either ampere-hours or coulombs.*~~

~~*The simplest type depends upon electrolysis ; i^antHy gj^g^ja^'g electrolj^ic meter is an example. In*~~

~~*this instrument the current to be integrated passes through a dilute solution of sulphuric acid contained in a glass tube, the current entering and leaving by platinum electrodes. Since every ampere-hour which passes through the instrument liberates from the electrolyte 0'29829 of a*~~

~~*' A joule is 10" ergs, and a British Board of Trade imit ia 1000 watt-hours, or 3600 joules.*~~

~~*gramme of oxygen and 0-03738 of a gramme of hydrogen gas, and therefore diminishes the bulk of the electrolyte by a fixed amount, the total amount of electrolyte destroyed in any given time can be estimated by the fall in level of the liquid as seen in a gauge-glass. The electrolyte is prevented from evaporating by a little paraffin oil placed upon it, and the tube can be calibrated to show at once in Board of Trade units the amount of electric energy which has passed through the instrument, on the assumption that the potential difference between the two sides of the circuit is constant. The meter of course really records the total electric quantity which has passed through it, but on the supposition that that quantity is supplied at a constant voltage, the instrument may be used as an energy meter.*~~

~~*One of the earliest forms of electric house meters devised by Edison was based on the electrolytic principle. In the Edison meter a fraction of the current to be measured is passed through a zinc voltameter, consisting of two zinc plates in a solution of ziuc sulphate, which is shunted by a. German silver wire across the mains leading into the house. The passage of this fraction of current through the sulphate of zinc removes the zinc from one plate and puts it on the other, and from the measured gain in weight of the one plate or loss in weight of the other, the total electric quantity or time-integral of the current can be estimated. To keep the shunt ratio of the meter constant, Edison employed a copper coil, called a compensating coH, in series with the zinc voltameter, so adjusted that rise or fall in temperature altered its resistance as much in one direction as it altered that of the solution in the other. Another meter of the same kind now in use is the Long-Schattner prepayment meter. In this a certain*~~

~~*fraction of the current supplied to any house or circuit is caused to pass through a solution of cupric sulphate contained in a copper box, in which hangs a copper plate suspended from a balanced arm, and as it passes, it removes copper from the suspended plate and deposits it upon the inner surface of the copper box. In this way the weight of the suspended plate is gradually dinunished until, when a certain definite weight has been lost, the balance is destroyed and the arm flies up, breaking the main circuit by means of a mercury switch. When this has happened, the main circuit can be closed again by depositing in a slot of the meter a coin of a certain weight and value, say one shilling. The current then passes again, apd again reduces the weight of the suspended plate, so that when an amount has been removed equal to the weight of the shilling, the balanced arm flies up and once more opens the main circuit. The whole apparatus is contained in a locked-up box, provided only with a slot and carrying tube for conveying a suitable coin into a bucket hung on the balanced arm. The meter can be so adjusted that the weight of the coin deposited provides the user of the meter with electric energy equal to the value of the coin. Thus the deposit of one shilling in the meter can be made to cause the circuit to remain closed until tlie customer has had say two Board of Trade units of electric euergy ; when that amount has been delivered, the supply is automatically cut off. The necessary cal- culations for designing the meter can be made from a knowledge of the electrochemical equivalent of copper, one ampere-hour of electric quantity passed through a solution of sulphate of copper removing from the anode 1 '17700 granmies of copper.*~~

~~*Other quantity meters in use are those of Ferranti, Chamberlain and Hookham, Johnson and Phillips, and Schallenberger. The Ferranti continuous-current ampere-hour meter consists of an electromagnet, with its core formed of mild steel, having a certain retentivity for magnetism ; this is worked at such a low flux density that its magnetization is always nearly proportional to the strength of the magnetizing current. In this core there is a, disc-shaped cavity, which is lined with an insulating material and filled with mercury. The main current flows through the electromagnet coils, and, entering the mercury at the periphery of the disc-shaped cavity, flows inwards radially in all directions to the centre of the mercury, whence it goes to the other terminal of the meter. Under*~~

these conditions the mass of mercury is set in rotation, but its motion is retarded by radial grooves formed in the sides of the chamber. The mechanical force driving it is proportional to the square of the strength of the current, and the force retarding it is proportional to the square of the speed ; hence it follows that the number of rotations in any given time is proportional to the total quantity of electricity which has passed through the mercury. A little vane immersed in the mercury is used to register the rotations, the counting mechanism being so devised that the dials read off elec- tric energy in Board of Trade units, on the assumption that the voltage of the circuit remains constant. The meter of Chamberlain and Hookham is of a very similar character, but the rotating portion consists of a copper disc fixed to a shaft, w'hich carries another copper disc moving between the poles of an eleotiomagnet. The first copper

disc is immersed in a chamber filled with mercury, and the current to be measured passes radially through it from the circumference to the centre. Under the influence of the magnetic field which is created in a direction perpendicular to the plane of the disc, this disc is set in rotation ; the associated disc is also rotating in the magnetic field, and is retarded by tlie so-called magnetic friction due to eddy currents set up in its mass. In these circumstances the speed of rotation of the two discs can be adjusted to be propor- tional to the current passing through the instrument, and hence the number of rotations in a given time is a measure of the electric quantity passed through the meter. Mordey and Fricker have designed an ingenious meter of a very simple character. A slate disc has a number of soft iron wires inserted in it. This is attached to the escapement wheel of a clock which has no pendulum or hair- spring. The disc is included within a coU through which the current to be measured passes. When the current flows, it creates a magnetic field which pulls the iron wires into line with it, and owing to the inertia of the disc an oscillating motion is produced. The rotate of going of the clock is therefore proportional to the current, and its registration to the electric quantity which has

JiUermittent Integrating Meters. — All the above forms of house meters are called continuously integrating meters, in that the operation of

~~*recording or obtaining ths time-integral of the current or the power is continuous. There is, however, a large class of meters known as intermittent integrating meters, which consist of two parts. The first is simply an ammeter or a wattmeter, while the second is simply a clock, provided with a mechanism by which the deflection of the ammeter or wattmeter is recorded at regular tiuie-intervals, and the records added up. A good example of such an instrumciut is that of Johnson and Phillips. This instrument comprises an electrically-driven clock, which operates a counting mechanism through a gearing whose ratio is controlled by the current passing into the circuit. The ammeter part of the instru- ment is a coil of wire, through which the current to be integrated passes, and into which a soft iron plunger is drawn down by the magnetic force. The degree to which this plunger is sucked in regulates the amount by which the clock mechanism advances the recording mechanism at each revolution ; hence the number of revolutions of the counting dials in any time is proportional to the time and to the deflection of the ammeter needle — that is, to the total quantity of electricity which has passed through the meter.*~~

~~*Different opinions are held by electricians as to the relative advantages of quantity and energy meters. Generally speak- ing, quantity meters have the advantage of simplicity of con- struction ; but energy meters must be employed if true electric power is to be measured on a circuit where the voltage is constantly fluctuating. Intermittent integrating meters' are not suitable for use in cases in which the current is liable to suffer very large yaria- tions in strength enduring but a short time, as in the case'of the electric supply to a theatre. The ampere-hour meters as a rule absorb less energy internally than the watt-hour meters. Watt- hour meters must, however, be employed if the supply is by alter- nating currents and the power-absorbing devices are inductive, such as electric motors.*~~

~~*Instruments for the measurement of electric resistance are called either Bridges or Ohmmeters. The simplest and most common form of resistance balance is that known as Wheatstone's bridge. As generally used in the laboratory, it consists of a box containing three sets of resistance coils ; two of these sets are called the two ratio arms, while the third is the measuring arm. These coils are all joined up in series. In one ordinary*~~

~~*form of Wheatstone's bridge, known as the series pattern plug-resistance bridge, there are a series of coils, two 1-ohm coils, two 10-ohm coils, two 100-ohm coils, and two 1000-ohm coils. These are joined up in series in the order 1000, 100, 10, 1 ; 1, 10, 100, 1000, and the junctions between each pair are connected to brass blocks, a series of which are mounted upon an ebonite slab that forms the top of the box. The blocks are bored out with a hole partly in one block and partly in the other, so that they can be connected by accurately-, fitting conical plugs. When the blocks are interconnected by the plugs, all the coils are short-circuited ; but if the plug or plugs are taken out, then a current flowing from one end of the series to the other is compelled to pass through the corresponding coils. In series with this set of coUs is another set, the resistances of which are generally*~~

~~*1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300, 400, 1000, 2000,*~~

~~*Obtnmeters,*~~

~~*3000, 4000 ohms. These form the measuring arm, and tie junction between each pair of coils is connected as above described to a block, the blocks being interconnected by plugs. This series of coils is joined up with the re- sistance to be measured, and a galvanometer and a battery are added, as shown in Fig. 5.*~~

~~*This arrangement of six conductors joining four points is technic- ally termed a Wheatstone's bridge arrangement. The values of the resistances forming the four arms of the bridge can then be so adjusted that if their values are called P, Q, R, and S, then when P : Q : : R : S a galvanometer circuit joined in between the junction of (P and Q) and (R and S) will not be traversed by any current when a battery is connected to a junction between (P and R) and (Q and S). To prove this statement, let the conductors P, Q, R, S, be arranged in a parallelogram form, and let B and G be the battery and the galvanometer circuit (Fig. 5), and let these letters stand for the resist- ances of these circuits respectively. Let E be the E.M.F. of the battery, and let (x + y) be the current along P, y that along Q, and 2 that along B, then by Kirehhoff's laws*~~

~~(R-I-S-hB) z-R (x + y)-S,y = E, (P-l-G-hR) x + y-Gy-'&.z = 0, (Q + G4-S)j/-G(x-l-2/)-Sz =0.~~

~~Rearranging the terms and solving for x, the current through the galvanometer, we obtain a!=E5/A where 5=(QR-PS) and A is a function of P, Q, R, S, B, G, which does not concern us. Hence when P : Q=R : S we have x = o, or the galvanometer current is zero.~~

~~An ordinary laboratory form of Wheatstone's bridge, as shown in Fig. 6, is known as the dial pattern. Ten brass blocks are~~

~~Fig. 6~~

~~arranged round a central brass block, and by means of a plug which fits into holes bored partly out of the central block and partly out of the surrounding blocks, any one of the latter can be connected with the central one. A series of nine equal resistances, say nine 1-ohm coils, or nine 10-ohm coils, or nine 100-ohm coils, are joined in between these circumferential blocks (Fig. 7). It~~

~~Kg. 7.~~

~~will be seen that if a plug is placed so as to connect any out- side block with the central block, the current can only pass from the zero block to the central block by passing through a certain number of the resistance coUs. Hence according to the magni-~~

~~tude of each coil the total resistance may be made anything from 1 to 9, 10 to 90, or 100 to 900 ohms, &c. Three or four of the "dials" thus composed are arranged side hy side, the brass blocks being mounted on a slab of ebonite and the coils contained in the box underneath, and they are so joined up that the central block of one dial is connected to the outside block of the next marked 0. This arrangement forms the measuring arm of the bridge, the ratio arms being construi ted on the series plug pattern just describeil. A bridge of this pattern has the advantage that the insertion or removal of a plug in the measuring arm~~

does not tend to tighten or loosen all tlie rest of the plugs ; moreover, there are fewer plugs to manipulate, and each plug is always occupied. The resistance coils themselves are generally wound on brass or copper bobbins, with silk-covered manganin wire, which should first be aged by heating for about ten hours to a temperature of 140° C, to remove the slight tendency to change in resistivity which would otherwise present itself. For the accurate comparison of resistance coils it is usual to make use of the Matthiessen and Hookin bridge, and to employ the method of differential compari- son due to Carey Foster.^ On a board is stretched a uniform metallic wire {a b), generally of platinum silver. The ends of this wire are connected to co^lper blocks, which themselves are con- nected to a series of four resistance coils, A,B, and P,Q (Fig. 8).

A and B are the coils to be compared, P and Q are two other coils of convenient value. Over the stretched wire moves a contact- maker S, which makes contact with it at any desired point, the position of which can be ascertained by means of an underlying scale. A battery C of t«o or three cells is connected to the ex- tremities of the slide wire, and the sensitive galvanometer G is connected in between the contact-maker and the junction between the coils P and Q. The observer begins by moving the slider until the galvanometer shows no current. The position of the coils A and B is then interchanged, and a fresh balance in position on the bridge is obtained. It is then easily shown that the difference between the resistance of the coils A and B is equal to the resist- ance of the length of the slide wire intercepted between the two places at which the balance was found in the two observations. Let the balance be supposed to be attained, and let x be the posi- tion of the slider on the wire, so that x and Z-ajare the two sections of the slide wire, then the relation between the resist- ances is

*A + X ^ P B-rL-a; " Q**

Next, let the position of A and B be interchanged, and the slide- wire reading be a;', then

B + x" P A-t-L-a;f~ Q'

~~*Hence it follows that A-B = a;-a;', or the difference of the resistances of the coils A and B is equal to the resistance of that length of the slide wire between the two points where balance is obtained.*~~

~~*Various plans have been suggested for effecting the rapid inter- change of the two coils A and B ; one of the most convenient was designed by J. A. Fleming in 1880, and has been since used by the British Association Committee on Electrical Units for making comparison between standard coils with great accuracy (.see Phil. Mag., Feb. 1880, and Proc. Pliys. Soc, Doc. 1879). In all very exact resistanf-e measurements the chief difficulty, however, is not to determine the resistance of a coil, but to determine the tempera- ture of the coil nt the time when the resistance measurement is made. The difficulty is caused by the fact that the coil is heated by the current used to measure its resistance, which thus alters in value. In aeccurate comparisons, therefore, it is necessary that the coils to be compared should be immersed in melting ice, and that suflieient time should be allowed to elapse between the measurements for the heat generated in the coil to be removed.*~~

~~*The standard resistance coil employed as a means of comparison*~~

~~^ *" On a Modified Form of Whcrtstone's Bridge, and Methods of Measuring Small Resistances," by Prof. G. Carey Foster, Proc. Soc. Telegraph Engineers, vol. i., May 1872.*~~

~~*by which to regulate and check other colls consists of a wire, generally of manganin or platinum silver, insulated with silk, and wound on a brass cylinder (Fig. 9). This is soldered to two*~~

~~*Fig. 9.*~~

~~*thick terminal rods of copper, and the coil is enclosed in a water- tight brass cylinder so that it can be placed in water, or preferably in paraffin oil, and brought to any required temperature. In the form of standard coil recommended by the Berlin Eeichsanstalt the coil is immersed in an insulating oil which is kept stirred by means of a small electric motor during the time of making the measurement. The temperature of the oil can best be ascertained by means of a platinum resistance thennometer.*~~

~~*For the measurement of high resistance, such as the insulation resistance of house wiring, or of cables, we may employ either an ohmmeter or a direct method, in which the current sent through the insulation resistance by a large electromotive force is measured on a galvanometer. For example, if it is required to measure the insulation resistance of a length of cable such as is used for electric lighting purposes, the coil of cable, which should not be too short, is placed in a tank filled with water. Its copper conductors are then twisted together and connected to one terminal of a sensitive mirror galvanometer, whose other terminal is joined up with a battery of 200 to 300 secondary cells, which should be well insu- lated. The other terminal of the battery is connected to the tank. In these circumstances the battery will force a current through the insulating material with which the cable is covered, and this current will flow through the galvanometer. In order to prevent a leakage current also passing through the galvanometer, it is advisable to twist round the insulated conductor, at a short distance from the ends of the insulation nearest to the copper terminals, a, fine wire, called a guard wire, which is connected to the junction between the battery and the galvanometer. Any leakage of cur- rent, therefore, taking place over the surface of the insulation will be conducted by the guard wire back to the battery, and prevented from passing through the galvanometer. In cable factories it is customary to employ a series of Leolanch^ cells varying from 100 to 1000 cells. The test is then made by applying the stated volt- age to the conductor for a given time, generally one minute, and observing the current flowing through the galvanometer at the end of that time. Owing to the fact that the resistance of the dielec- trics or insulators increases with the time of application of the electromotive force, it is necessary to state the time during which the electromotive force has been apiplied before the reading of the current is taken. AVith many dielectrics the resistance diminishes as the electromotive force is increased, even though applied in all cases for the same time. In the above measurement it is of course necessary that the galvanometer shall first be standardized ; that is to say, we must discover the deflection produced by a known cur- rent. This is most easily done by sending through it a measured current, such as may be obtained by inserting in series with it a known high resistance, e.g., a megohm, and applying a known electromotive force from a stSiindard cell. For the details of these measurements standard treatises*~~

~~on electric measurement and testing must be consulted. In the ohmmeter of Evershed there are two coils at rif,'bt angles, one of which is traversed by the current passing through the resistance to be measured, and the other by a current proportional to the fall of potential down that resistance. Hence a sofb iron needle hung in the common field of the two coils will indicate by its direction the ratio of potential fall to current — in other words, the resistance of the conductor.~~

~~Many measurements peculiar to alternating currents have frequently to be made. One of the most important is the determination of the tuave form. In the case~~

~~Wave form.~~

~~of periodic electric currents, if the periodic time be large number of these effects are closely connected with the fonn of supposed to be divided into an equal number of parts, the wave of alternating current or electromotive force. DuddeU which are represented by equal divisions on a straight line, and if the value of the current or the electromotive force at each of these instants is represented by the magnitude of a line drawn perpen- dicularly to the time line at the corresponding instant, then a curve drawn through the tops of aU these perpen- diculars will be a wave curve or periodic curve representing the wave form of the current. A very large number of devices have been invented for delineating this wave form. One of the oldest and simplest, due to Joubert, consists in attaching to the shaft of the alternating-current generator an insulating disc having inserted in its edge a metallic slip. This slip is touched by a pair of steel springs or brushes, with which it makes contact once every revolu- tion. The brushes are carried on a rocking arm, which can be moved into any position round an axis concentric with the shaft of the alternator. The current from the generator is passed through a non-inductive resistance, across the terminals of which an electrostatic voltmeter is joined, the circuit, however,. being interrupted by the above- described rotating contact-maker. The terminals of the voltmeter are short-circuited by a condenser. When the alternator is in operation, the contact-maker connects the voltmeter with the ends of the non-inductive resistance at~~

~~*regular intervals corresponding to some fixed point in the cycle. After a few revolutions the condenser becomes charged to a constant potential, and the voltmeter there- fore indicates by its deflection this potential difierence, which is the instantaneous potential difference of the ex- tremities of the non-inductive resistance corresponding to a certain fixed point in the periodic time. By rocking over, the contact-maker springs into different angular posi- tions, as indicated on a scale of degrees ; and reading the corresponding deflection of the voltmeter, it is possible to plot out a curve which represents the variation of the volt fall down the non-inductive resistance, taken at equidistant intervals during the period. This, therefore, enables us to delineate the wave form of the alternating current. Numerous modifications of this point-by-point method have been devised by various experimentalists, but owing to its extreme tediousness the process has now been superseded by the use of an instrument called an Oscillograph.*~~

~~*This was originally invented by M. Blondel, but it has been improved by Duddell and others. In principle it is merely a dead- beat galvanometer having a needle or coil with a very small peri- odic time. Duddell's form consists of an electromagnet excited by a constant current which provides a steady strong magnetic field (Fig. 10), in which is stretched a pair of loops of fine wire, each consisting of a single half-turn in the shape of a hairpin. These two wires are at right angles to the direction of the field ; and when a current passes, one of them is forced forward and the other back- ward, owing to the tendency of a conductor conveying a current to move across the lines of force of a field. To the wires is attached a small mirror of silvered glass, by means of which a ray of light*~~

~~*from an electric arc lamp can be reflected upon another mirror and*~~

~~*thence upon a screen. This-second mirror is kept in vibration by*~~

~~*d, small alternating current motor so as to be in step with the*~~

~~*alternating current under examination ; if it were at rest, the light*~~

~~*reflected from the first mirror, owing to its simple to-and-fro vibra- tion, would, in consequence of the persistence of vision, appear as*~~

~~*a straight line upon the screen. The displacement of the spot of*~~

~~*light at its zero position at any instant is proportional to the*~~

~~*strength of the current flowing at that instant through the oscillo- graph wires. If, then, the second mirror is set in vibration*~~

~~*synchronously, the spot of light will be displaced in a direction at*~~

~~*right angles, and the combination of the two motions will produce*~~

~~*a wavy line of light, which is the optical representation of the wave*~~

~~*form of the current. In order to secure dead-beatness, the mirrors*~~

~~*vibrate in a chamber filled with transparent oil. In testing alter- nating currents which have a periodic time of about 100, it is*~~

~~*necessary to employ an oscillograph having a mirror whose periodic*~~

~~*time is anything between l/2000th and 1/10, 000th of a second.*~~

~~*The oscillograph in its modern form is a very perfect instrument*~~

~~*for the examination of alternating-current phenomena, since a very*~~

~~*Fig. 10*~~

~~*has designed a form of portable oscillograph by means of which the wave form of any alternating current can be inspected by the eye.*~~

~~*The exact measurement of the mean power given to an inductive circuit by an alternating current is an important matter. In this case the mean power cannot be estimated simply by the product of the root-mean-square values of the current and terminal difference of ™™*" potential, commonly called the apparent watts or „gti,ofi apparent power. If the circuit is inductive, this quantity is always greater than the true watts or true power, and this ratio of the true watts to the apparent watts, or of the true power to the apparent power, is called the power-factor of the circuit.*~~

~~*Hence special means are necessary for the measurement of alternating power. In the three-voltmeter method due to Ayrton and Sumpner this measurement is carried out in the following manner : — In series with the inductive circuit another non-inductive circuit is joined, and the two circuits are traversed by an alternating current. A suitable voltmeter, preferably elec- trostatic, is then employed to measure the volt fall down each of these two conductors separately, and down the two taken together. This may of course be done simultan- eously by three separate voltmeters, but on account of the difficulty of obtaining three absolutely identical instru-*~~

~~*ments, it is in every way preferable to employ one volt meter, and to make the three measurements with it as quickly as possible one after the other, maintaining the current during the time perfectly constant.*~~

~~*If R is the resistance of the non-inductive resistance in ohms, and if Vi \ and V3 are the voltmeter readings over the ends of the inductive, non-inductive, and total resistances, then the power in watts P absorbed in the inductive portion is*~~

~~*The three-voltmeter method involves, however, a possibility of producing a larger difference of potential than that which would be required to send the same current through the inductive resist- ance if it were employed alone. For instance, in measuring the power taken up in an alternating-current transformer worked say at 2000 volts pressure, in order to get accurate results it would be necessary to add in series a non-inductive resistance, and to employ a total electromotive force of about 4000 volts. It may not always be convenient to do this. Hence a modification was suggested by Fleming in which the current measurements are made either simul- taneously with three ammeters or successively with one ammeter. The theory of the three-voltmeter method is as follows : — In the case of the three-voltmeter method let Vj be the fall in potential down the inductive resistance, v^ that down the non-inductive resistance, and U3 that down the two together at any instant, then we have always*~~

~~t)3 = i'l -f »2 . • . %2 = Wi^ + ^i + 2i,jl,2.~~

~~Let R be the resistance of the non-inductive portion and i the current through it, then iK=v^, and we have~~

~~or ^"1 = — W-V-V)-~~

~~Hence, taking root-mean-square values throughout a period and calling these Vj Vj V3, we have for the mean power P taken up in the inductive portion~~

~~M(^,~~

~~-Vi^-V^^).~~

~~As a general rule, by far the most convenient and accu- rate method of measuring alternating-current power is by~~

~~a suitable alternating-current wattmeter — an in- Trans- strument constructed on the same lines as the testing. Siemens dynamometer already described. One~~

~~of the coUs, say the fixed one, is traversed by the current which flows into the power-absorbing circuit ; the other movable coil is traversed by a current which must be in step with the difference of potential at the extremities of the power-absorbing circuit. When the voltage em- ployed to transmit the current through this circuit is at a high pressure, say 2000 volts or more, then the most convenient method of obtaining a current in step is to employ an alternating-current transformer, which must be of the closed magnetic circuit type, without magnetic leak- age. If the primary circuit of this transformer is connected across the terminals of the power-absorbing circuit, then the electromotive force in the secondary circuit is exactly in opposition as regards phase with this diflference of potential ; hence if the movable coil of the wattmeter is practically non-inductive, and is joined in series with a non- inductive circuit and with the secondary circuit of the transformer (called the Auxiliary Transformer), then the current through the movable coil of the wattmeter is in step with the difference of potential between the ends of the power-absorbing~~

~~*circuit. Hence the reading of the wattmeter is proportional to the mean value of the product of the instantaneous values of the current through the power-absorbing circuit and the difference of potential between its ends — in other words, is proportional to the mean power taken up in that circuit. The wattmeter can best be standardized by emplo3dng it to measure the known power taken up in an inductionless circuit, such as a bank of incandescent lamps. The measurement of the power taken up in polyphase transformers or motors involves some special arrangements, but can be effected by the use*~~

~~*of two or three wattmeters. If the motor or transformer circuits are stor-connected, the best plan is to employ three suitable alternating-current wattmeters simultaneously in each branch. If, however, they are iie^«a-connected, then two wattmeters must be employed, with their series coils in two of the line vidres and their shunts connected between these two and the third. If the power-absorbing circuit is inductive, then these two wattmeters will not give identical readings, and the real power taken up in the whole circuit is the sum or difference of their readings, according as the lag of current behind the voltage in each mesh circuit (assumed equal) is less or greater than 60°. The subject of power measurement in circuits of small power factor involves diflSculties of a special kind, concerning which technical manuals must be consulted. For further in-formation on the subject of transformer testing, see Teansfoemees. See also the article Weights and Measures. (j. a. f.)*~~

~~*IVIea.th, a maritime county of Ireland, province of Leinster.*~~

~~*Population. — The area of the administrative county in 1900 was 577,743 acres, of which 114,812 were tillage, 414,837 pasture, 498 fallow, 9811 plantation, 8649 turf bog, 2369 marsh, 347 barren mountain, and 26,420 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, is identical with the old judicial county. The population in 1881 was 87,469 ; in 1891, 76,987 ; and in 1901, 67,463, of whom 34,717 were males and 32,746 females, divided as follows among the different religions : — Roman Catholics, 62,663 ; Protestant Episcopalians, 4369 ; Presbyterians, 323 ; Methodists, 61 ; and other denominations, 57. The decrease of population between 1881 and*~~

~~*1891 was 11-98 per cent., and between 1891 and 1901, 11 '4 per cent. The average number of persons to an acre in 1891 was "13, and of the total population 70,597 persons inhabited the rural districts, being an average of 85 persons to each square mile under crops and pasture. The following table gives the degree of education in 1891 : —*~~

~~*Males.*~~

~~*Females.*~~

~~*Total.*~~

~~*Percentage.*~~

~~*B.C.*~~

~~*Pr.Ep.*~~

~~*Presb.*~~

~~*Meth.*~~

~~*Read and write Read only Illiterate*~~

~~*26,350 3,529 5,882*~~

~~*25,103 3,655 5,573*~~

~~*51,453*~~

~~*7,184*~~

~~*11,455*~~

~~*72·0 10·8 17·2*~~

~~*91·9 3·5 4·6*~~

~~*96·3 1·6 2·1*~~

~~*98·5 1·5*~~

~~*The percentage of illiterates among Roman Catholios in 1881 was 24‘7. In 1891 there were four superior schools with 135 pupils (Roman Catholics 119, and Protestants 16), and 183 primary schools with 11,590 pupils (Roman Catholics 10,844, and Protestants 746). The number of pupils on the rolls of the National schools on 31st December 1900 was 12,091, of whom 11,424 were Roman Catholics and 667 Protestants.*~~

~~*The following table gives the number of births, deaths, and marriages in various years : —*~~

~~*Year.*~~

~~*Biiths.*~~

~~*Deaths.*~~

~~*Marriages.*~~

~~*1881 1891 1900*~~

~~*1355 1467 1259*~~

~~*1116 1407 1291*~~

~~*247 238 264*~~

~~*In 1900 the birth-rate per thousand was 18 “7, and the death-rate 19 ‘1 ; the rate of illegitimacy was 1 ‘4 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 64,943, of whom 33,997 were males and 30,946 females. The chief towns in the county, with their populations in 1901, are — Navan, 3839 ; Kells, 2427 ; Trim, 1493.*~~

~~*Administration. — The county is divided into two parliamentary divisions — North and South — the number of registered electors in 1901 being respectively 5814 and 6284. The ratable value in 1900 was £550,529. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises three urban and eight rural sanitary districts.*~~

~~*AgrimMure. — The following tables show the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1901:—*~~

~~*MEAUX — MEDIATION*~~

~~*601*~~

~~*1*~~

~~*^ J*~~

~~*1*~~

~~*a*~~

~~*Other*~~

~~*Meadow*~~

~~*Tear:*~~

~~*Oats:*~~

~~*iM*~~

~~*3*~~

~~*Green*~~

~~*and*~~

~~*TotaL*~~

~~*P5*~~

~~A~~

~~*Crops:*~~

~~*Clover:*~~

~~*1881*~~

~~*3119*~~

~~*32,099*~~

~~*2097*~~

~~*12,711*~~

~~*7048*~~

~~*3372*~~

~~*85,893*~~

~~*146,834*~~

~~*1891*~~

~~*1897*~~

~~*23,681*~~

~~*1184*~~

~~*10,941*~~

~~*6728*~~

~~*2843*~~

~~*78,984*~~

~~*124,768*~~

~~*643*~~

~~*23,187*~~

~~*1034*~~

~~*10,380*~~

~~*5914*~~

~~*2630*~~

~~*77,895*~~

~~*121,088*~~

~~*1901*~~

~~*739*~~

~~*18,219*~~

~~*682*~~

~~*8,781*~~

~~*4989*~~

~~*2964*~~

~~*76,343*~~

~~*112,667*~~

~~*In 1900 the total value of the cereal and other crops was estimated at £634,306. The number of acres under pasture in 1881 was 386,374, in 1891, 405,912, and in 1900, 414,837.*~~

~~*Year.*~~

~~*Horses*~~

~~*and*~~

~~*Mules.*~~

~~*Asses.*~~

~~*Cattle.*~~

~~*Sheep.*~~

~~*Pigs.*~~

~~*Goats.*~~

~~*Poultry.*~~

~~*1881 1891 1896 19011*~~

~~*15,831 17,714 19,038 16,046*~~

~~*3174 2945 3236 3223*~~

~~*173,341 192,864 201,089 211,745*~~

~~*156,099 223,035 177,178 222,184*~~

~~*13,780 18,258 15,216 11,477*~~

~~*6968 8887 7677 6968*~~

~~*812,034 360,649 380,942 404,638*~~

~~*The number of milch cows in 1891 was 15,431, and in 1901, 15,863. It is estimated that the total value of cattle, sheep, and pigs for 1901 was £3,345,709, the largest amount of any county in the province. In 1900 the number of holdings not exceeding 1 acre was 3008 ; between 1 and 5, 1774 ; between 5 and 15, 2512 ; between 15 and 30, 1874 ; between 30 and 50, 1192 ; between 50 and 100, 1220 ; between 100 and 200, 921 ; between 200 and 500, 555 ; and above 500, 89— total, 13,145. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901 was 492, amounting to £345,533. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, between 1882 and 1901, was 304, and the amount issued was £38,752. The total amount issued on loan for all classes of works under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1901, was £213,470. (y^^ II. Po)*~~

~~*Mea,UX, chief town of arrondissement and railway station, department of Seine-et-Marne, 32 miles north-north- east of Melun. At its wool market some 200,000 fleeces are dealt in annually. A statue of General Eaoult was erected in 1891. Population (1891), 11,350; (1901), 12,228.*~~

~~Mechlin, or Malines, a city of Belgium, on the Dyle, an important railway junction in the province of Antwerp, and the seat of an archbishopric. It lies in a level fertile plain, and is surrounded by promenades which have taken the place of the ancient ramparts. In contrast with other famous Flemish towns, Mechlin has no high towers, no grand buUdings dominating the city, except the church belfries. In the 15th and 16th centuries the seat “>f important cloth manufactures, it has now for its prin- cipal branches of industry cabinet-making and carpentry, which employ 1200 workmen ; chair-making, horticulture, and agriculture. It also contains extensive railway work- shops of the State railways. Population (1875), 40,200 :~~

~~(1900), 55,705.~~

~~IVIeckienburg^, the common designation of two grand -duchies of the German empire, known as (i.) Mecklenburg -Schwerin and (ii.) Mecklenburg -Strelitz.~~

~~(i.) Mecklenbueg-Schweein has an area of 5135 square miles, and population (1900), 607,835, giving a density of 118 inhabitants to the square mile. The population con- sisted of 300,419 males and 307,416 females. In 1895, 55‘3 per cent, were rural and 44‘7 per cent, urban; by religion nearly all the inhabitants are Protestant. The grand-duchy in 1895 embraced 97,069 farms, of which 65,531 were each less than 2^ acres in extent, 21,633 between 2^ and 25 acres, 8604 between 25 and 250 acres, and 1301 over 250 acres. The principal crops are potatoes, hay, wheat, oats, beetroot, rye, barley, and a little tobacco. The live stock in 1900 numbered 526,711 sheep, 452,635 pigs, 327,785 cattle, and 101,818 horses. The methods of farming have greatly improved since 1885. There is an agricultural experimental station at Eostock. In~~

~~‘ The figures for 1901 have not been revised.~~

~~1899-1900 the sugar factories of the two grand-duchies together produced 78,807 tons of sugar; the breweries, 10,494,000 gallons of beer; and the distilleries, 962,800 gallons (in 1897) of pure alcohol. The mercantile marine in 1900 numbered 65 sea-going vessels of 39,267 tons. Eostock, Warnemiinde, and Wismar are the chief ports. There is a university at~~

~~*Eostock. The budget of the grand duke and estates together balanced in the year 1900-01 at £1,330,650. In 1900 the public debt amounted to £5,551,650 ; and in 1900 the state contribu- tion to the imperial exchequer was fixed at £300,880. There were 730 mUes of railway in 1900.*~~

~~*(ii.) Mecklenbueg-Steelitz has an area of 1131 square miles, and population (1900), 102,628, of whom 50,870 were males and 51,758 females : density, 91 inhabitants to the square mile. With the exception of less than 1000, all the people belong to the Evangelical Lutheran ChurcL The number of farms in 1895 was 17,921, of which 13,844 were each less than 2| acres in extent, 3846 between 2J and 250 acres each, and 231 over 250 acres. The crops principally grown are potatoes, hay, wheat, rye, oats, beetroot, barley, and a little tobacco. •In 1897 the live stock embraced 135,127 sheep, 61,598 pigs, 49,988 cattle, and 18,560 horses. The sugar, beer, and alcohol production are included in the returns for Meck- lenburg-Schwerin. No statement of public revenue and expenditure is published ; the state contribution to the imperial treasury was in 1900 fixed at £51,135 ; the public debt is estimated at £300,000. This duchy possessed only 154 miles of railway in 1900.*~~

~~*Medals. See Numismatics.*~~

~~*Medellin, a city of the United States of Colombia, Central America, capital of the state of Antioquia, and also the seat of a bishopric. It is finely situated in a beautiful vaUey of a high plateau and on the Porce, a tributary of the Cauca, 150 miles north-west of Bogota. Founded as early as 1674, Medellin, after some centuries of comparative obscurity, has rapidly increased in wealth and importance, owing to the development of gold and silver mining, carried on mainly by British enterprise. While this has promoted a large general trade, many of the inhabitants are also employed in jewellery and other work in precious metals. The main hindrance to the growth of the city has been the lack of railway communication with the Magdalena river, only a small portion of the line from Puerto Berris being yet completed. The city possesses a university, a chemical laboratory, an elementary school, and other important educational institutions ; also a mint, a theatre, a well-equipped hospital,*~~

and other public build- ings. The streets are wide and regular, but badly paved. The principal exports are gold and silver, coffee, and hides. Population, about 50,000.

Medford, a city of Middlesex county, Massachu- setts, U.S.A., on the Mystic river, 5 miles north of Boston, of which it is practically a suburb. It has large and varied manufactures, with (in 1900) a capital of 11,328,106, and products valued at $1,907,624. Tufts College, a Uni- versalist institution, situated here, had, in 1899, 93 in- structors, and was attended by 568 students, 148 of whom were women. Its property had a value of $1,980,000, and its income was $105,000. Population (1890), 11,079 ; (1900), 18,244, of whom 4327 were foreign-born and 244 were negroes.

Mediation, in the international sense, is the inter- vention of a third Power, on the invitation or with the con- sent of two other Powers, for the purpose of arranging differences between the latter without recourse to war. Mediation may also take place after war has broken out

with a view to putting an end to it on terms. In either case the mediating Power negotiates on behalf of the parties who invoke or accept its aid, but does not go further. Unlike an arbitrating Power, the mediator pro- nounces no decision, but limits his intervention to sugges- tion and advice. His action is liable to be arrested at any time at the will of either party unless otherwise agreed, in which last case to arrest it prematurely would be a breach of good faith. The difference between media^ tion and arbitration may be stated in the words of the Digest (lib. iv. tit. 8, § 13) : " Eecepisse autem arbitrium videtur, ut ait Pedius, qui judicis partes suscepit finemque se sua sententia controversiis impositurum pollicetur. Quod si hactenus intervenit ut experiretur an concilio suo vel auctoritate discuti litem paterentur, non videtur arbitrium recepisse."

~~*Some writers distinguish mediation from " good offices," but the distinction is of little practical value. We may, if we please, regard "good offices" as inchoate mediation, and "mediation" as good offices brought to the birth. Thus we may say that a third Power renders " good offices " when it brings the parties together so as to make diplomatic negotiations between them possible ; whilst if it takes an active part in those negotiations it becomes for the time being a mediator, whatever the result of its intervention may be.*~~

~~*There have been many instances of successful media- tion; e.g., of Great Britain, in 1826, between Portugal and Brazil ; of France, in 1849-50, when differences arose between Great Britain and Greece; of the Great Powers, in 1868-69, when the relations of Greece and Turkey were strained to breaking-point by reason of the insurrection in Crete ; of Pope Leo XIII. , in 1885, between Germany and Spain in the matter of the Caroline Islands. In these cases mediation averted war, but it has been also resorted to for the purpose of putting an end to war already begun. The Austro-Prussian war of 1866, the war between Chile and Peru in 1882, and that between Greece and Turkey in 1897, not to mention other in- stances, were brought to a close through the mediation of neutral Powers. Mediation has also been occasionally employed where differences have arisen as to the interpre- tation of treaties or as to the mode in which they ought to be carried out, as when Great Britain mediated between Prance and the United States with regard to the treaty of Paris of 4th July 1830. In one case at least media- tion has been successful after a proposal for arbitra- tion had failed. In 1844, when war between Spain and Morocco was threatened by reason of the frequent raids by the inhabitants of Amalet el Eif on the neigh- bouring Spanish settlement of Ceuta, Spain declined arbi- tration on the ground that her rights were too clear for argument. But both she and Morocco subsequently accepted joint mediation at the hands of Great Britain and France.*~~

~~*The cause of mediation was considerably advanced by the Declaration of Paris of 1856. The plenipotentiaries of Great Britain, France, Austria, Russia, Sardinia, and Turkey then and there recorded in a protocol, at the in- stance of Lord Clarendon, their joint wish that "states between which*~~

~~*any misunderstanding might arise should, before appealing to arms, have recourse so far as circum- stances might allow {en tant que les rirconstances I'admet- traient) to the good offices of a friendly Power." Article 8 of the treaty of Paris, which was concluded in the same year, embodied this principle in a formal shape. The article stipulated that " if there should arise between the Sublime Porte and one or more of the other signing Powers any misunderstanding which might endanger the mainten- ance of their relations, the Porte and each of such Powers, before having recourse to the use of force, shall afford the*~~

~~*other contracting parties the opportunity of preventing such an extremity by means of mediation." These prece- dents (in which it will be seen that " good offices " and " mediation " are used interchangeably) were followed in the general Acts agreed to at the Conference held at Berlin in 1885 and 1890, the object of which was to secure reli- gious and commercial liberty and to limit warlike operar tions in the regions watered by the Congo and its affluents.*~~

~~*The proviso above quoted, "so far as circumstances might allow," obviously leaves open a door of escape when- ever two states in difference are bent on war. Accordingly, during the War of Secession between the northern and southern states of the American Union, offers of mediation, tendered by Eussia in 1861 and by France in 1862, were courteously declined by Mr Seward. On the strength of the protocol of 1856, Great Britain made a similar oSer both to France and Prussia in 1870 when war between these countries was imminent ; but the emperor of the French replied that the same protocol expressly left dis- cretion unfettered where the dignity of a nation was con- cerned. Again when, in 1877, Turkey appealed to her co-signatories of the treaty of Paris to mediate between her and Eussia, her appeal was rejected on the ground that oppression of the Christian populations under her sway had led to so many revolts on their part as to menace the peace of Europe. In fact, nations on both sides of the Atlantic have hitherto shown no more disposition to per- mit questions they deem vital to be dealt with by medlar tion than to permit them to be dealt with by arbitration.*~~

~~A special form of mediation was proposed by a delegate from the United States at the Peace Conference held at The Hague in 1899, and was approved by the representa- tives of the Powers there assembled. The clause in which this proposal was embodied provided in effect that, when- ever there is danger of a rupture between two Powers, each of them shall choose a third Power to which these differences shall be referred, and that, pending such refer- ence, for a period not exceeding thirty days (unless the time is extended by agreement) the Powers at issue shall cease to negotiate with each other and leave thie dis- pute entirely in the hands of the mediating Powers. It will be seen that the Powers thus appealed to occupy a position analogous to that of seconds in a duel, who are authorized to arrange an " affair of honour " between their principals. This novel device has the advantage of ton- ing down, if not of eliminating, personal and national prejudices by which controversy is frequently embittered. It also gets over the difficulty, so often met with in arbi- tration, of choosing a common referee who shall be satis- factory to both parties. The closer the relations between states become, the more their commercial interests are intertwined, the larger the part which mediation seems destined to play in the future. It is true that states which have accepted the intervention of a mediator re- main free to adopt or reject any advice he may give, but the advice of a disinterested Power must always add considerable moral weight to the side towards which it inclines.~~

~~For authorities on the subject see Arbitration, Interna- tional, (m. H. C.)~~

~~Mediatization. — The unification of Germany, which began with the formation of the Confederation of the Ehine (1806) and was continued by the treaty of Vi- enna (1815), entailed the " mediatization " (or deprivation of their sovereign power) of a number of princely houses, formerly "immediate" {reichsunmitteJbar, i.e. holding directly of the emperor). To such were, however, re- served certain privileges and equality of personal rank with the princes of reigning houses ; cf. Ency. Brit. (9th edition), article Germany, vol. x. p. 492.~~

~~*Geeat Britain and Ireland.*~~

~~*TTP to 1858 each University, Eoyal College of Physi- LJ cians or of Surgeons, and Apothecaries' Hall in Great Britain and Ireland laid down its own regulations for study and examination, and granted its degree or licence without any State supervision. In that year, pursuant to the Medical Act, 21 and 22 Vict. c. 90, the General Medical Council of Medical Education and Registration was established, consisting of twenty-three members, of whom seventeen were appointed by the various licensing bodies and six by the Crown. This number was increased by the amended Act of 1886 to twenty-nine, three of the six additional members being elected by the profession as "direct" representatives. The object of the Act was "to enable persons requiring medical aid to distinguish qualified from unqualified practitioners." To this end the "Medical Register" was established, on which no person's name could be inscribed who did not hold a diploma or licence from, one or more of the licensing bodies after examination. By the 1886 Act a qualifying examination was defined as " an exami- nation in medicine, surgery, and midwifery, " conducted by universities or by medical corporations, of which one must be capable of granting a diploma in medicine, and one in surgery. The powers of the Council over medical education consist in being authorized to require from the licensing bodies information as to courses of study and examinations, and generally as to the requisites for obtaining qualifications; and to visit and inspect examinations either personally or by deputy. If the visitors are of opinion that the course of study and examination of any licensing body is not sufficient to secure the possession by candidates obtaining its qualifi- cation of the requisite knowledge and skill for the efficient practice of their profession, on a report being made in these terms to the Council, the Council may represent the same to the Privy Council. Should the Privy Council be satisfied that the charge is substantial, it may, if it sees fit, deprive the accused body of its power to grant registrable qualifications. Prom this statement it will be seen that the powers of the Council are very limited; nevertheless, by their cautious applica- tion, and by the loyal manner in which the licensing bodies have acted on the recommendations and sug- gestions which have from time to time been made, the general condition of medical education has been materi- ally improved; and although there*~~

~~*is not a uniform standard of examination throughout the United King- dom, the Council has succeeded in ensuring that the minimum requirements of any licensing body shall be sufficient for the production of trustworthy practitioners. One of the first subjects the Council applied itself to was the establishment of a system of examinations in general knowledge. Such examinations have to be passed before commencement of medical study. On pres- entation of a certificate to the registrars of the Council, and on evidence being produced that the candidate is six- teen years of age, his name is inscribed on the " Stu- dents' Register. " At present the subjects of examina- tion are : — (a) English language, including grammar and composition (marks not exceeding 5 per cent, of the total obtainable in this section may be assigned to candidates who show a competent knowledge of shorthand); (6) Latin, including grammar, translation from specified authors, and translation of easy passages not taken from such authors ; (c) mathematics, comprising arithmetic ;*~~

~~*algebra, as far as simple equations inclusive ; geometry, the subject matter of Euclid, Books I., II., and III., with easy deductions; (d) one of the following optional sub- jects— Greek, French, German, Italian, or any other modern language. Certificates are accepted from all the universities of Great Britain and Ireland, from the lead- ing Indian and colonial universities, from Government examination boards, and from certain chartered bodies. The German Abiturienten-Examen of the gymnasia and reaZ-gymnasia, the French diplomas of Bachelier 6s Lettres and Bachelier ha Sciences, and corresponding entrance examinations to other Continental universities are also accepted. Whilst anxious to raise the general standard of preliminary examinations, the Council has not found it expedient to do so. In point of fact, the condition of secondary education in Great Britain and Ireland is so moderate in character as to render it inadvisable to set a higher minimum test, inasmuch as depletion of the pro- fession might be produced to an extent detrimental to the public interest. On the other hand, it is right to state that only a moderate proportion of registered students pass on to the register on mere minimum requirements.*~~

~~*As regards professional education, the Council divided its resolutions into " requirements " and " recommenda- tions " ; the former consisting of demands on the licens- ing bodies, non-compliance with which renders them liable to be reported to the Privy Council as not con- forming to conditions necessary to secure sufficient knowledge and skill for the efficient practice of medicine, surgery, and midwifery ; the latter are regarded merely as suggestions for the general conduct of education and examination. The requirements may be summarized as follows : — (a) Registration as a medical student, (6) Five years of bondjide study between the date of reg- istration and the date of the final examination for any diploma entitling the holder to be registered under the Medical Acts, (c) In every course of professional study and examinations the following subjects must be con- tained, the Council offering no opinion as to the manner in which they should be distributed or combined for the purposes of teaching or examination, this being left to the discretion of the bodies or of the student : — (i.) Physics, including the elementary mechanics of solids and fluids, and the rudiments of heat, light, and electric- ity; (ii.) chemistry, including the principles of the sci- ence, and the details which bear on the study of medicine ; (iii.) elementary biology ; (i v.) anatomy ; (v.) physiology; (vi.) materia medica and pharmacy ; (vii.) pathology ; (viii.) therapeutics ; (ix.) medicine, including medical anatomy and clinical medicine; (x.) surgery, including surgical anatomy and clinical surgery ; (xi.) midwifery, including diseases peculiar to women and to new-born children ; (xii.) theory and practice of vaccination ; (xiii.) forensic medicine ; (xiv.) hygiene ; (xv.) mental disease.*~~

~~*(d) The first of the four years must be passed at a school or schools of medicine recognized by any of the licens- ing bodies ; provided that the first year may be passed at a university or teaching institution where the subjects of physics, chemistry, and biology are taught ; and that graduates in arts or science of any university recognized by the Council, who shall have spent a year in the study of these subjects, and have passed in them, shall be held to have completed the first of the five years of medical study.*~~

~~*(e) The study of midwifery practice must consist of three months' attendance on the indoor practice of a lying-in hospital, or the student*~~

must have been present at not less than twenty labours, five of which shall have been

conducted throughout under the direct supervision of a registered practitioner.

The fifth year of s_,tudy is intended to be devoted to clinical work, and may be passed at any one or more public hospitals or dispensaries, British or foreign, recog- nized by the licensing authorities; six months of this year may be passed as a pupil to a practitioner possess- ing such opportunities of imparting practical knowledge as shall be satisfactory to the medical authorities. This latter method of study is very rarely employed by students.

The "recommendations" of the Council contain sug- gestions which may or may not be acted on by the bodies. For the most part they are complied with in connexion with the system of practical and clinical teaching.

The Council satisfies itself that its requirements are acted on, and that the examinations are " sufficient," by cycles of inspection, which occur about every five years. The examination of each licensing body is visited by an inspector, who forwards his report to the Council, which sends each report to the body for its information and remarks. As yet it has never been the duty of the Coun- cil to report to the Privy Council that any examination has not been found suilicient. As a rule, suggestions have been accepted and acted on, and thus a high order of professional exajpination has been attained through- out the kingdom by gradual pressure.

Most of the universities exact attendance at more classes than the colleges and halls ; for instance, botany and natural history are taught to their students, who are also examined in them. But with these exceptions the system of professional educati.on is fairly uniform. Since 1875 attendance on " practical " classes has been called for in all subjects. Under this

~~system the larger classes in which the subjects are taught systematically are broken up, and the students are taught the use of appara^ tus and the employment of methods of investigation and observation. Tutorial instruction is superimposed on teaching by lecture. Much the same plan is adopted in respect of clinical instruction: not only is the student taught at the bedside by the lecturer, but he receives, either from the house-surgeon or house-physician, or from a specially-appointed clinical tutor, an insight into methods of examination of diseases, and learns practically the use of the stethoscope and other aids to diagnosis, and of surgical and obstetrical instruments. In fact, it may be said that each subject of instruction is duplicated. If this is taken into account, it must be evident that the time of the student is fully occupied, and the belief is rapidly growing that five years is too short a period of study. As a matter of fact, the average time taken to obtain a British licence to practise is upwards of six years. The probability is that the solution of the difficulty will be found in the inclusion of such subjects as physics, biology, and chemistry in a "preliminary scientific" ex- amination, which may have to be undertaken before regis- tration as a medical student, thus leaving the whole five years to be devoted to purely professional study.~~

~~Geemany.~~

~~The German regulations in regard to professional study are few. They are those for the Staats Examen, for which the university degree is no longer a preliminary requisite. The regulations for the admission of candidates to the Staats Examen are contained in the royal pro- clamations of 22nd June 1883. They comprise — (a) Certificate of a course of study at a classical gymnasium of the German empire. In exceptional cases, the same from a classical gymnasium outside the German empire may be considered sufficient. (For full details of the course of study and examinations, see Minutes of the~~

~~General Medical Council, vol. xxvii., Appendix 3.) (b) Certificate from a university, certifying a course of medical study of at least nine half-years at a university of the German empire, (c) Certificate that the candidate has passed, entirely at a German university, the medical Vorprufung, and thereafter has attended for at least four half-years the medical studies of a~~

~~*university. (cT) The special testimony of the clinical directors bearing witness that the candidate has taken part as Praktikant (clerk or dresser) during two half-years at the medical, surgical, and gynaecological clinics ; has himself delivered two cases of labour in the presence of his teachers or assistant physicians ; and has attended for a half-year as Praktikant the clinic for diseases of the eye. The medical Vorprufung referred to is necessary alike for the Staats Examen and the degree of Doctor of Medicine. It takes place at the end of the second year (fourth semester), and includes the subjects of experi- mental physics, chemistry, botany, zoology, anatomy, and physiology. It is conducted by a board appointed yearly by the Minister of Education.*~~

~~*Feance.*~~

~~*No one can practise medicine in France who does not possess the diploma of Doctor of Medicine of a French university. The qualification of Officier de sante is no longer granted. Before he can inscribe as a student of medicine the applicant must have obtained the diploma of Bachelier 6s Lettres, and the diploma of Baclielier is Sciences. Although the course of professional study may be completed in four years, a longer time is gen- erally taken before the student proceeds to the final examination for the doctor's degree. Each year is divided into four trimestres ; at each trimestre the student must make a new inscription. The trimestres are (1) November and December, 56 days ; (2) January, February, March, 86 days ; (3) April, May, June, 86 days ; (4) July, August, 56 days. Practically there are no regulations determining the division of the various subjects, or the number of lectures in each course, or requiring the student to attend the courses. The medical faculty of each university puts before the student a scheme recommending a certain order of studies (Division des itudes) for each of the four years of the medical course, and, as a matter of fact, this order of study is enforced by the system of intermediate exaniinar tiovis (Examens du Jin d'annie). All the lecture courses are free, as also are the clinics and the hospital service, and there is no system of ascertaining the regularity of attendance at lectures, or of certificate of attendance. If, however, the student fails to pass the Examen du Jin d'annie he is debarred from making the next trimestral inscription, and thus loses three months. The lectures are, however, closely attended.*~~

~~*In contrast to the free- dom in regard to attendance on systematic lectures, there are strict direction and control in regard to hospital attendance and practical courses. The student is required to sign a register ad hoc each time he goes in and out. From the beginning of the third year, e.g., from the ninth quarterly inscription, hospital attendance is enforced till the end of the fourth year. No one can renew his trimestral inscription without producing a schedule of his last trimestral stage, showing that during it he had not absented himself more than five times without explanation, l^ractical work is obligatory during each of the four years. Besides systematic course of lectures, Confirences are held by the assistant-professors {Agrvges) in natural history, physiology, general pathology, internal pathology, external pathology. At the end of the first year the" student is examined in physics, chemistry, natural history, osteology, myology, and the elements of physiology ; at the end of*~~

~~*the second year, in anatomy and physiology in all their branches ; at the end of the third year, in medicine and surgery ; at the end of the fourth year, an examination is held over the whole field of study.*~~

~~*Denmark.*~~

~~*No one is allowed to enter on the study of medicine without passing the Artium Examen of a secondary school. This is the equivalent of the German Abiturien- ten-Examen of a classical gymnasium. After study for two semeatres an examination must be passed in psychol- ogy, logic, and history. The special professional exam- inations consist of (1) preliminary scientific, in botany, zoology, physics, chemistry ; (2) first special or profes- sional, anatomy (orally and by dissections), physiology, and pharmacology; (3) second special or professional, written examinations in medicine, surgery, medical juris- prudence ; practical and oral in operative surgery, in clini- cal medicine, and clinical surgery ; and oral in pathological anatomy, medicine, surgery, and midwifery.*~~

~~*Authorities. — The history of the development of medical edu- cation from the earliest times down to 1894 will be found treated of generally in Puschmann's Oeschichte des medicinischen Unter- richts (Leipzig, 1889), translated by E. H. Hare (London, 1891). Those desiring more special information on the subject in regard to the details of British institutions should consult the annals of the various universities and colleges of Great Britain and Ireland. The following works supply much interesting information regarding the gradual rise and development of teaching and examination ; — An- nals of the Barber Surgeons, by Stduet Yoong, 1890. — History of the Royal College of Surgeons of Ireland, by Cameron, 1886. — Early Days of the Boyal College of Physicians of Edinburgh, by Peel Ritchie, 1899. — Historical Sketch of the Boyal College of Surgeons of Edinburgh, by Gairdnek, 1860. — Memorials of the Faculty of Physicians and Surgeons of Glasgow, by Duncan, 1896. — The Story of the University of Edinburgh, by Sir A. Grant, 1884. — University of Glasgow, by Stewart, 1891. (j, b. T.)*~~

~~*United States.*~~

~~*In 1870 and even in 1880 medical education in the United States was in a deplorable condition. In the early history of the country, before and shortly after the beginning of the 19th century, the few medical colleges that were in existence had shown a disposition to require a liberal education on the part of those who entered upon their courses, and some effort also was made, through the agency of state boards, to control the licence to practise. But as the country increased in popular tion and wealth, so far from this good beginning being followed out, preliminary requirements were practically abolished, the length of the courses given each year was shortened to four or five months or less, and in the second and final year there was simply a repetition of the courses given during the first year. This unfortunate condition of affairs is to be attributed mainly to the fact that there was no general national or state supervision of medical training. Medical colleges could obtain incorporation under state laws without difficulty, and brought consid- erable advantages in the way of prestige and increased practice to those concerned. That the existence of a college depended solely upon the fees of the students en- couraged the tendency to make both entrance and grad- uation*~~

~~*requirements as easy as possible, especially as there was no state supervision, and the mere possession of a diploma entitled the holder to practise. Fortunately, during this period the practical character of the clinical instruction given in the better colleges fitted the grad- uates in some measure for the actual necessities of practice, while the good traditions of medicine as. a learned profession exerted a stimulating influence upon those who adopted it as a career, so that in the main the body of practitioners deserved and held the confidence and respect of the community. From the middle of the*~~

~~*19th century to the present time there has been a con- stant agitation on the part of the physicians themselves for an improvement in medical education. The first notable result of this agitation was an increase in the time of instruction from two to three years (Chicago Medical College, 1859 ; Harvard Medical School, 1871), the lengthening of each session to six months or more, and the introduction of graded courses instead of a repetition of the same lectures every year. The im- provement thus begun became very marked during the decade 1890-1900, amounting in fact almost to a revo- lution in the rapidity with which the course of instruc- tion was amplified. Many factors co-operated to produce this desirable result: general development of scien- tific instruction in the colleges and secondary schools, the influence of the large number of medical graduates who completed their training by study in European schools, the adoption by many states of stringent regulations regarding the licence to practise within their borders, the good examples set by many leading schools in voluntarily raising their requirements for entrance and graduation, and, perhaps above all in its general effect, the agitation continually maintained by several national or state associations which in a measure have exerted the general regulating control that in other countries has been enforced by national legislation. Among the most influential of these asso- ciations are the American Medical Association, the American Academy of Medicine, the Association of American Medical Colleges, the Illinois State Board of Health, and the University of the State of New York.*~~

~~*The conditions at present are improving rapidly, but are difficult to describe except in general terms, as the requirements for matriculation*~~

and graduation vary greatly in the different states of the Union, and the arrange- ment of the courses follows no uniform plan. There are 166 medical schools in the United States, of which 10 are graduate schools. Of these, 122 are classed as so-called regular schools, 21 as homoeopathic, 7 as eclectic, and 3 as physio-medical. In 1885 out of the 102 existing schools, only 5 offered a course of three years. In 1897, 99 schools required a course of four years, while in 1899, 141 of the 166 undergraduate schools announced a course of four years as necessary to graduation. There is a gratifying tendency also to increase the standard of preliminary requirements for entrance to the medical schools. The colleges comprising the Association of American Medical Colleges, 82 in number, have agreed upon uniform entrance requirements that are practically equivalent to the completion of one year's study in a high school. In New York and Illinois there is a uniform minimal requirement equivalent to the completion of a high-school course of four years, and other states have announced that a similar requirement will be made in the future. The Johns Hopkins Medical School from its foun- dation in 1893 has admitted as students only those who are graduates of a recognized college, and has required, moreover, that the candidate shall possess a reading knowledge of French and German, and have had a year's training in physics, chemistry, and biology. The Harvard Medical School since 1901 has also required a degree in arts, sciences, literature, or philosophy as a condition for entrance, while the Eush Medical College (University of Chicago) and the medical departments of the University of Michigan and the University of California have an- nounced entrance requirements that will practically de- mand two years of collegiate work. Following the ini- tiative of the Johns Hopkins, these schools have specified that the preliminary training must include courses in physics, chemistry, biology, French, and German. The

medical department of the Western Reserve University (Cleveland) requires certificates showing the completion of at least three years in a recognized college. The good examples set by these and other schools will

doubtless result soon in a general increase in entrance requirements to the point that those entering upon the study of medicine must give evidence of a preliminary training equivalent at least to that required for matriculation in a college of good standing.

In regard to the medical curriculum itself there has been of late years much dissatisfaction, directed, it may be said, not so much towards the contents of the curriculum as towards the methods of instruction. The relative merits and demerits of the laboratory and the lecture system are being constantly debated, and such discussion, together with the practical trials of the two systems, will doubt- less eventually lead to a substantial improvement in the character of medical instruction. As an outcome of this agitation the following general tendencies may be noted. A large number of the best medical colleges have entered into close affiliation with the leading universities, and there seems to be a distinct appreciation of the value of this organic union with institutions devoted to the higher learning. In a number of cases this affiliation has led to the development of what are known as combined courses, by means of which the total time required for obtaining both the collegiate and the professional degree is reduced by one or two years. The reduction is made possible by the acceptance on the part of the college faculty of the scientific work done in the first year or two of the medical course as fulfilling part of the requirements for the baccalaureate degree. There can be no doubt that this recognition of the scientific instruction in the medical schools is not only a testimonial to its thoroughness, but amounts to a guarantee that this work will be committed to the care of trained and capable specialists. It is probable, in fact, that in some instances the experiment will be made of leaving the instruction in the preparatory medical sciences entirely in the hands of the college faculty.

Some of the medical schools are making an effort to break away from the rigid system of graded courses that prevails generally, and instead to offer various alter- native studies, particularly in the third and fourth years, adapted to meet the needs and stimulate the interests of individual students. In general, however, it ma^ be said that the system of instruction for the required/ four years of medical study tends to follow the general lines laid down by HIuxley in his well-known address upon "

~~*Universities, Actual and Ideal ” (1874) — that is, the first two years are given up to the study, largely by laboratory methods, of what may be called the pre- paratory sciences, while in the last two years attention is directed mainly to practical instruction in the science and art of medicine in the hospital, the clinic, and the dispensary.*~~

~~*Authorities. — J. M. Towek. Contributions to the Annals of Medical Progress and Medical Ediicdluin in, the United States, before and during the War of Independence: Washington (Govern- ment Printing OfSoe), 1874. — N. S. Davis. History of Medical Education and Institutions in the United States. Chicago, 1851 ; Contributions to the History of Medical Education and Medical Institutions in tlie United States. Washington (Government Printing Office), 1877.— J. B. Beck. An Historical Sketch of the State of Mfdicine in the American Cohmies. Albany, 1850. — Bulletins of the American Academy of Medicine. The Chemical Publishing Co., Easton, Pa.— H. L. Taylor. “Professional Educa- tion in the United States.” College Department, University of the State of New York ; Bulletin 5, i.v.‘A’y, and Bulletin S, WOO. ” Courses of Study in Medical Schools.” Report of the Commis- sioners of Education. Washington (Government Printing Office), 1899.— F. E. Packard, M.D. The History of Medicine in the United States. 1901. (^ff ^ jj n*~~

~~*Medical Jurisprudence, or Forensic Medi- cine, is the science which deals with the application of medicine to certain questions of civil and criminal law, for the determination of which evidence derived from medical experience is required. During recent years no fundamental changes have been made in its principles as laid down in the older books upon the subject, but close observation, fresh experience, and more modern methods of investigation have thrown new light upon various branches, and have thus tended to place the whole subject upon a more scientific basis than formerly. The present article is confined to supplementing the topics dealt with in the ninth edition of the Uncyclopcedia under this heading and that of Poisons.*~~

~~*I. The Signs of Death. — The determination of the actual existence of death assumes a certain importance in tropical countries, where the necessity for speedy inter- ment may involve a risk of burial alive. Such*~~

~~*an acci- dent cannot well occur where a medical man confirms the existence of death, and in the United Kingdom, where burial rarely takes place before the lapse of forty-eight hours, such changes usually occur in the body as to ren- der any error practically impossible. Within a varying period, usually not more than twelve hours, the body be- comes rigid, owing to the development of rigor mortis or post-mo7-tem rigidity. The blood, which during life is equally distributed throughout the body, gravitates to the most dependent parts and develops a discoloration of the skin which is known as post-moHem lividity or post- mortem staining. At a variable period of time, depend- ent on the cause of death, also the temperature and moisture of the air to which the body is exposed, decom- position or putrefaction sets in. These changes which a body undergoes after death are of great importance, not only as affording certain proof of death, but also because they furnish valuable information as to the probable time at which it occurred, and from the fact that they may alter or destroy evidence as to the cause of death.*~~

~~*II. Identity. — In the case of the living, identification is rather a matter for the police officer than for the medical man. Bertillon and Galton have each devised methods for the identification of criminals which are much more certain than those formerly relied on (see also Anthro- pometry). Bertillon's system consists in taking certain anthropometrical measurements of the cranium and face, and recording other general characteristics. Galton's method consists in taking impressions of the skin mark- ings of the thumb and fingers, which give definite and distinctive patterns for each individual, so that by means of a proper system of classification it is possible to identify an individual within a few minutes. This system is largely used in India. Medical evidence may, however, be necessary to decide a question of identity in the living, as in the Tichborne case, where the deletion of tattoo marks, or the existence of scars, had to be determined. In the dead, identification is eflrected by means of clothes, bodily chai'acteristics or peculiarities, photography, &c., or the body itself may be preserved for identification by keeping it at a low temperature, as in the Morgue at Paris.*~~

~~*III. Injuries or Wounds. — These include in a medico- legal sense not only those characterized as incised, punctured, contused, lacerated, stab*~~

~~*wounds, but also burns, injuries produced by firearms, fractures, dis-locations, &c. One of the chief questions which have to be decided in all forms of violent death is whether it was the result of accident, suicide, or murder. In cases of fatal wounding, among the points to be noted, which will help to decide the question, are the situation, direction, and extent of the wound, the position in which the body*~~

~~*and any weapon may be found, together with the presence and distribution of any blood marks and the signs of a struggle. In wounds caused by firearms the injury, if suicidal, is usually situated in a vital and accessible part of the body, the temple, mouth, and chest being the favourite situations; but such an injury also presents, as a rule, the characteristic appearances resulting from the discharge of the weapon close to the body, viz., besides the wound of entrance of the bullet, there is singeing of the cuticle and hair, and blackening of the area immediately surrounding the wound, from particles of unconsumed powder being driven into the skin and from the smoke of the discharge. These effects are naturally not produced when the weapon is discharged at a distance exceeding 2 or 3 feet, as usually happens in cases of homicidal shooting. They may also be wanting in undoubted suicidal wounds produced by revolvers and cartridges filled with amberite or other smokeless powders. Death from burning is generally accidental, very rarely suicidal, and when homicidal, is usually employed to conceal traces of other violence inflicted upon the body. In large conflagrations death is not always due to burning. Charred bodies may be found presenting various injuries due to the fall of beams, crushing, the trampling of others trying to escape, &c., or fractures and lacerations may be due simply to the action of the heat. Death may result from such injuries, or from suffocation by the gases of combustion, before the victim is aifected by the actual fire. Spon- taneous combustion of the body has been stated to occur, but the evidence upon which the cases rest is not well authenticated.*~~

~~*IV. Death from, Asphyxia. — Amongst the forms of violent death due to this cause are drowning, hanging, strangulation, garotting, smothering,*~~

~~*suffocation from choking, mechanical interference with the expansion of the chest walls, as when persons are crushed together during a panic in a fire, breathing poisonous gases, such as carbonic acid or carbonic oxide. In connexion with the last form of death, which in the United Kingdom usually results accidentally from an escape of lighting gas, the danger has been much increased in many towns owing to the addition of carburetted water-gas to the ordinary supply. Carbonic oxide gas is contained in ordinary lightiug gas to the extent of about 6 to 8 per cent., and is extremely fatal when inhaled. Carburetted water-gas contains about 28 per cent., and when mixed with ordinary lighting gas the percentage of carbonic oxide is thus very much increased.*~~

~~*V. Criminal Abortion. — This crime consists in unlaw- fully procuring the expulsion of the contents of the gravid uterus at any period short of full term. It must be noted that while this definition may be held to recognize the induction of premature labour by medical men in certain circumstances, yet, when the operation is necessary, a medical man should always protect himself from possible misconstruction of his action (i.e., criminal intent) by having a consultation with another practitioner. The means employed in criminal abortion to procure the desired result may be classed under three heads: (1) general violence to the body, (2) administration of drugs supposed to have abortifacient qualities, (3) instrumental inter- ference with the contents of the womb. Amongst the drugs frequently employed for the purpose, although by no means always successfully, are ergot, strong purgatives, iron, rue, pennyroyal, savin.*~~

~~*VI. Infanticide. — The killing of a recently-born infant which has been " born alive," i.e., has lived after being completely born, is termed infanticide, and the crime amounts to murder. The Crown takes upon itself the onus of proving in every case that the child has been*~~

~~*born alive. This is often a matter of difficulty, and hence an alternative charge of concealment of birth in England, or concealment of pregnancy in Scotland, is usually preferred in such cases, and, if proved, may entail a penalty of two years' imprisonment. The chief medical questions to be determined from an examination of the body of an infant in connexion with a charge of infanticide are: (1) as to its maturity, (2) whether it has*~~

~~*breathed or not, (3) whether it was " born alive," (4) how long it survived its birth, (5) what was the cause of death. The proof of respiration having taken place is of prime importance, although it does not necessarily follow when a positive result is obtained that the child was " born alive." The fact of the hings having respired is determined by their appearance and consistence, and by the hydrostatic test, which depends upon the difference in the specific gravity of the lungs before and after the entrance of air into them through respiration.*~~

~~*VII. Rape consists in the carnal knowledge of a woman by force and against her will. It is rape if the crime be perpetrated with consent obtained by a fraud, such as the impersonation of a woman's husband, or by producing mortal terror. Since the passing of the Criminal Law Amendment Act, 1885, it is a felony, entailing the same punishment as rape, to have carnal knowledge of a girl under thirteen years, whether she consent or not. Between thirteen and sixteen years of age it is a criminal offence punishable by two years' imprisonment, whether consent is given or not, and even if there be solicitation. Above sixteen years of age no offence is committed, if consent be given, provided the woman is not an idiot or an imbecile. The administration of any drug or matter, with intent, by producing stupor, to facilitate the accomplishment of the crime, is an offence punishable by two years' imprisonment. In all charges of rape, the woman and her assailant should be examined as soon as possible by a medical man, but such examination, it is important to remember, can only be carried out with the free consent of the party to be examined.*~~

~~*VIII. Blood Stains. — The examination of blood stains is a frequent and important operation in criminal charges. Blood stains when fresh and abundant can be recognized without difficulty, but when old, or after being acted upon by certain substances, their identity is not readily determined. The tests which may be applied to a suspected stain consist of : — (1) The microscopic test. A portion of the stain is soaked in a drop of some fluid which will soften and cause separation of the dried blood corpuscles without altering their characteristic appearance. Such fluids are solutions of glycerine and water of a specific gravity of 1028, or 30 per cent, caustic potash. The recog- nition of blood corpuscles affonds*~~

evidence of the nature of the stain. (2) Chemical tests, (a) Heat applied to a solution obtained by soaking some of the stained fabric in cold water. A blood solution is red, and loses its red colour on application of heat, while at the same time a buff-coloured precipitate is formed. (6) On applying a drop of freshly prepared tincture of guaiacum and then some ozonic ether or peroxide of hydrogen to the stain, a blue colour is obtained if blood be present. Many other substances, however, give the same reaction, (c) If, even to the smallest particle of dried blood, a fragment of common salt and some glacial acetic acid be added, and the latter is then heated to ebullition and allowed to evaporate away, small brown rhomboid crystals — hsemin crystals — will be found to have formed, and they can be recognized under the microscope. (3) Spectroscopic test. A solution of blood obtained from a stain will show a spectrum having two dark bands between Fraunhofer's lines D and E (oxy haemoglobin). On adding ammonium sulphide to the

solution tlie haemoglobin is reduced and only one broad dark band is seen (reduced haemoglobin). On adding caustic potash to a solution of blood, alkaline heematin is formed, and this again is transformed on the further addition of ammonium sulphide into reduced hsematin or hsemochromogen, which gives a very characteristic spec- trum of two dark bands situated in the yellow part of the spectrum. The production of these three different spectra from a red-coloured solution is characteristic of blood. Old blood stains are insoluble in water, whereas recent stains are readily soluble in cold water, yielding a red solution. The application of hot water or washing with soap tends to fix or render blood stains insoluble. Vegetable dyes may likewise give red solu- tions, but they may be distinguished from blood by the addition of ammonia, which alters the colour of the former, but rather intensifies the red colour of a blood solution. The differentiation between human blood stains and those produced by the blood of other animals, more especially domestic animals, is a matter of great im- portance to the medical jurist. When the blood stain is fresh, measurement of the corpuscles may decide the

~~*question, but in the case of dry and old stains it is im- possible to make the distinction. A method has been discovered, however, which enables the distinction to be made not only between human blood and that of other animals (with the exception of Simiidce), but also between the bloods of diiferent animals. The method depends upon the fact that if an animal (A), such as a dog or rabbit, is inoculated with the blood or serum of another animal (B), then the blood or serum of A is found to pro- duce a specific reaction (namely, the production of a cloudiness or precipitate) when added to a solution of the blood of a similar animal to B, and that species of animal only. If, therefore, human blood serum is injected into an animal, its blood after a time affords an " anti-serum " which produces the specific reaction only in human blood solutions and not in those formed from the blood of other animals.*~~

~~*IX. Poisoning'.— There is no exact definition of a poison. Popularly, substances which destroy or endanger life when swallowed in small quantity are called poisons, but a scien- tific definition would also include many substances which are injurious to health in large doses or only after repeated administration, and which act not only when swallowed, but also when taken into the system through other channels, e.g., the skin or the lungs. The branch of science which relates to poisons, their nature, methods of detection, the symptoms produced by them, and treat- ment of poisoning, is called Toxicology, and is one of the most important subjects included under the term Medical Jurisprudence.*~~

~~*Poisons may be classified according to their effect upon the system. Those poisons which produce local action upon the tissues with which they come in contact, corroding or destroying them, are known under the name Corrosive Poisons; such are the concentrated mineral acids, sulphuric, nitric, and hydrochloric, the alkalies, potash, soda, and ammonia, and their carbonates, corrosive sublimate, butter of antimony, carbolic acid, and oxalic acid. Some of these, in addition to a local action, produce toxic symptoms due to a remote action upon other organs, the result of their absorption into the blood. Among the latter may be mentioned carbolic acid, which not only corrodes the tissues with which it comes in contact, but also causes rapid unconsciousness and death due to respi- ratory and cardiac paralysis. Poisoning by this substance, which is usually accidental*~~

or suicidal, rarely homicidal, has become very frequent, a rapid and progressive increase in deaths from it being observable year by year. In England and Wales from 1888 to 1897 it caused the deaths

of 547 males and 684 females from suicide and 190 males and 130 females from accident or negligence. The total number of deaths in ten years thus amounted to 1461. / The chief cause of the increasing frequency of deaths from this cause is to be traced to it's common use as a house- hold disinfectant. Some poisons, again, may be classed as Irritants, because one of their chief symptoms and effects on being swallowed is irritation of the stomach and intes- tines. In this class are included various metals and their salts, e.g., arsenic, antimony, lead, and copper ; non- metallic elements, e.g., phosphorus ; a large number of vegetable substances, e.g., castor-oil, colocynth, elaterium, &c. ; and some animal substances, e.g., cantharides. In another class of poisons there is little or no local action, the symptoms produced being chiefly referable to an action on the brain and spinal cord ; such poisons have been called Neurotics. Examples of this class are to be found in opium, prussic acid, belladonna, strychnine, and aco- nite. A few poisons may be further classified as Gaseous, since they act while in a vaporous condition, some pro- ducing a local irritant action upon the lining membrane of the air passages, e.g., ammonia and chlorine ; others, again, being absorbed through the lungs into the blood and producing their poisonous effects in this way, e.g., chloroform, sulphuretted hydrogen.

The medical evidence in cases of poisoning rests upon — (1) the symptoms produced during life ; (2) the post- mortem appearances ; (3) the chemical analysis and de- tection of the substance in the body, or in the excretions and vomited matters, or in articles of food; (4) experi- ments on animals in the case of certain poisons where other conclusive evidence is difficult to obtain. The treatment of cases of poisoning will vary according to the substance taken, but the general principles which should be followed are : (a) to get rid of the poison by means of the stomach pump, or by washing out the stomach with water through a soft rubber tube, or by giving an emetic such as mustard, sulphate of zinc, ipecacuanha; (6) to neutralize the poison by giving a substance which will form with it an innocuous compound {e.g., in the case of the strong acids

~~by administering magnesia or common whiting), or which has an opposite physiological action (e.g., atropine in opium poisoning) ; (c) to promote the elimination from the body of the poison which has been already absorbed; (d) general treatment of any dangerous symptoms which appear, as by stimulation in collapse or artificial respiration in asphyxia.~~

~~Many plants owe their poisonous properties to the presence in them of basic bodies called aZfcaZoicfe, which are mostly solid, crystalline, and non-volatile, only a few (e.g., Conine and nicotine) being liquid and volatile. They are generally active poisons in minute doses, and the proof of their administration in criminal cases is surrounded with special difficulty, owing to the fact that they produce no very characteristic symptoms or marked changes in the body, while the chemical detection of the poison in the tissues is by no means easyor always successful. Amongst the many well-known alkaloids may be mentioned mor- phine, obtained from opium, strychnine and brucine from nux vomica, atropine from belladonna, cocaine from Eiy- throxylon coca, nicotine from tobacco, conine from the spotted hemlock. The power of manufacturing alkaloids is not confined to plants ; they are also formed in the living body as a result of physiological processes, and in dead bodies as a result of the action of putrefactive bacteria. It is mainly owing to the investigations of Selmi and of Brieger that our knowledge of these animal alkar loids or ptomaines has assumed definite shape. The dis- covery that they may be formed in the body after death by the action of putrefactive bacteria was at first thought to be a great obstacle to the proof of criminal poisoning~~

~~by means of vegetable alkaloids, but investigation has shown that this is not so, since it is found that, although many ptomaines are formed after death, yet practically very few possess active poisonous properties, e.g., neurin and mydalein, and these do not appear until a considerable time after death, and then only in minute quantities. In addition, ptomaines do not respond to all the various tests and reactions which are characteristic of vegetable alkaloids.~~

~~*Food Poisoning (see also Adulteration). — Foods may prove noxious from a variety of causes : — (1) The presence of metallic poisons, as in peas artificially coloured with copper salts, in tinned foods from dissolved tin salts, &c. (2) The contamination of any food with the specific germs of disease, as for example milk infected with the germ of enteric fever. (3) The presence in meat of parasites, such as the Trichina spiralis, or of disease in animals, capable of transmission to man, such as tuber-culosis, or the presence of poison in the flesh of animals which have fed on substances harmless to them but poisonous to human beings. Grain may be infected with parasitic fungi of a poisonous character, as for example Claviceps purpurea, causing epidemics of ergotism. (4) Foods of various kinds may contain saprophytic bacteria which elaborate certain poisons, either before or after the food is taken. It is chiefly in relation to food poison- ing from the last-mentioned cause that our knowledge has been increased in recent years.*~~

~~*Many cases of food poisoning, previously of mysterious origin, can now be explained by the action of bacteria and the products which they give rise to — tox-albumoses, ptomaines, toxins — by splitting up proteid substances. It is not necessary that the food should show evident signs of putrefaction. It may not do so, and yet on being eaten produce violent symptoms of gastro-intes- tinal irritation almost immediately, followed by various nervous symptoms. In such cases a chemical poison, developed by putrefactive bacteria before the food was eaten, quickly acts upon the system. On the other hand, symptoms may not appear for many hours after ingestion of the food, and then come on suddenly and with great severity — there has been a period of incubation. In such cases the food when swallowed has contained the bacteria, but the poisonous toxin has been elaborated by them afterwards in the system during the period pre-ceding the onset of symptoms. In both varieties of poisoning the symptoms are similar, consisting of gastro- intestinal irritation — vomiting, purging, and pain in the abdomen — together with great prostration, fever, mus-cular twitchings, disturbances of vision, delirium, and coma. The varieties of meat which have most frequently given rise to poisoning (Botulismus) are pork, ham, veal, sausages, brawn, various kinds of meat pies, and potted meats. Pig flesh appears to be specially liable to become infected. A point of considerable interest, which has sometimes given rise to doubt as*~~

~~*to the poisonous character of meat in certain instances, is, that the same food may be poisonous at one time and not at another. Thus it may be harmless when freshly pre- pared, cause fatal effects if eaten a day or two after- wards, and shortly after that again prove perfectly innocuous. This is explained by the fact that the toxic substances take some time to develop, and after develop- ment are still further split up by the bacteria into other bodies of a harmless nature.*~~

~~*In some fish, e.g., Trachimts draco or sea weaver, the poison is a physiological product of certain glands. In others the poison is not known, as in the family Scombridce, to which the disease Kakk^ has been attributed. In the United Kingdom the poisonous effects produced by fish are due to bacterial agency after death, and instances have*~~

~~*occurred from the eating of herrings, mackerel, dried salt cod-fish, caviare, tinned salmon, and tinned sardines. Shell-fish may produce poisonous effects from putrefactive changes or from the development in them (oysters and mussels) of ptomaines. Brieger discovered a ptomaine in poisonous mussels to which he gave the name mytilotoxin. It is now fully proved that oysters and mussels may be- come contaminated with the organism of enteric fever if placed in specifically polluted water, and thus transmit the disease to human beings. Milk, as already stated, may be contaminated and convey the infection of scarlet fever and other diseases. It may also contain substances of bacterial origin, which are possibly the cause of in- fantile diarrhcea, and others, having a fatal effect upon adults. Cheese has frequently caused poisoning. Vaughan discovered a toxic substance in milk and cheese — tyro- toxicon — ^but there are other toxic substances of bacterial origin sometimes present in cheese to which poisonous effects have probably been due. Mushroom poisoning results from the eating of poisonous fungi in mistake for the edible mushroom. The poisonous element in most cases is either muscarin contained in the fungus Amanita muscaria, or phallin in Amanita phalloides.*~~

~~*For death from starvation, cold and exposure, and from light- ning and electrical currents, and for a discussion of questions with regard to pregnancy, delivery, sterility, and impotence, see Medi- cal*~~

~~JnRispRnDENCE {Ency. Brit. vol. xv.). For mental unsound- ness, insanity, and testamentary capacity, see Insanity {Ency. Brit. vol. xiii.). See also under Suicide. Further information may be found m the following works : — Taylor. The Principles and Practice of Medical Jurisprudence. London, 1894. — Dixon Mann. Forensic Medicine and Toxicology. London, 1902. — Wynter Blyth. Poisons : Their Effects and Detection. London, 1895. — ALLBnxT. A System of Medicine. Vol. ii. "Intoxica- tions." London, 1897. — Vaughan. Twentieth Century Practice of Medicine, vol. xiii., article, "Ptomaines, Toxins and Leuoo- maines." London, 1898. — Maschka. Handhuch der Gerichtlichen Medicin. Tubingen. (1881-82. — Hofmann. Lehrbuch der Gerichtlichen Medicin. Wien, 1898. — Strassmann. Lehrbuch der Gerichtlichen Medicin. Stuttgart, 1895. — Kunkel. Hand- buch der Toxikologie. Jena, 1899. — Bkouakdel. L'lnfanti- cide. La Pendaison, &c. Paris, 1897. (h. h. l.)~~

~~Medici, Ciacomo, Marquis of the " Vascello " (1817-1882), Italian patriot and soldier, was born at Milan in January 1817. Exiled in 1836, he fought in Spain against the Carlists between 1836 and 1840, and in 1846 joined Garibaldi at Montevideo in the war with the dictator Eosas. Eeturning to Italy with Garibaldi in 1848, he raised a company of volunteers to fight against Austria, and commanded the volunteer vanguard in Lom- bardy, proceeding thence to Eome, where he gained dis- tinction by his defence of the " Vascello," a position near the Porta San Pancrazio. During the siege he himself was wounded. In the war of 1859 he commanded a volunteer regiment, and was sent by Cavour into the Tirol. In 1860 he tried to dissuade Garibaldi from the Marsala expedition, but, after his chief's departure, sailed for Sicily with the second expedition, taking part in the whole campaign, during which he forced Messina to capitulate after an eight days' siege. Joining the regular army, he was appointed military commandant of Pa- lermo, in which capacity he facilitated the abortive Garibaldian campaign of 1862. In 1866 he commanded the division which invaded Trent, but the effect of his victories was neutralized by the conclusion of peace. Ee- turning to Palermo with instructions to suppress brigand- age and crush the Mafiia, he became involved in a quarrel with the procurator-general Tajani, and relinquished his post. Created senator in 1870, and marquis of the " Vas-~~

cello " and first aide-de-camp to the king in 1876, he exercised the latter functions until his death on 9th March 1882. (h. w. s)

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MEDICINE.

IK the admirable survey of the history of Medicine in the ninth edition of this work the author carried the subject down to the middle of the 19th century. To appreciate and compare the various tendencies and achievements of our contemporaries in so large a sphere as that of medicine is very difficult, and in some sense impossible ; yet at the beginning of the 20th century an attempt must be made to indicate the main lines on which medicine is advancing, and probably will advance. The progress of medicine, as of other arts depending directly on physical science, has been prodigious; both through the purgation and reform of its methods and through the discovery of new knowledge of wide practical bearings and of immediate utility. Medicine in the past has been variably dominated by three tendencies : in certain periods its professors pursued their study as naturalists — for example, HIppocrates, Sydenham, and Graves ; or again as dialecticians, or reasoners in abstract terms — for example, the school of the " Methodists," the vitalist school of Mont-pellier, the animists, the iatro-physical school in which the body was regarded as an engine, the iatro-chemical in which it was regarded as an alembic, the Brunonian, and so forth. Finally, the modern school, though still naturalistic in its methods of clinical observation, has founded its methods more securely upon the tests of verification, after the example of Harvey and indeed of Galen himself, adding to experience the experientia qucesita without which natural observation is incomplete. We shall not forget that the most scientific physician of our own day may fall into sophistry, and that the most abstract dialecticians of other times have deviated occasionally into positive methods, but it is mainly true that the prevailing bent of successive schools has varied after this fashion and that. Medicine, like other depart- ments of human activity, has taken its colour from the character of the thought of the times. If sometimes medicine has seemed curiously independent of the philo- sophy of its age,

~~*it has never been really independent of it, nor could it possibly have such an independence. In our own day the positive bent of modern knowledge and methods in other spheres of science and thought, and especially in biology, has influenced medicine profoundly. Minuter accuracy of observation was inculcated by the labours and the teaching of the great anatomists of the 17th century ; and, for modern times, experimental physiology was instituted by Harvey, anatomy having done little to interpret life in its dynamic aspects. For medicine in England Harvey did what Gilbert did for physics and Boyle for chemistry : he insisted upon direct interrogation of natural processes, and thereby annihilated the ascendancy of mere authority, which, while nations were in the making, was an essential principle in the welding together of heterogeneous and turbulent peoples. The degradation of medicine between Galen and Harvey, if in part it consisted in the blind following of the authority of the former physician, was primarily due to other causes ; and its new development in the last two centuries is not due to the discovery of the experimental method alone : social and political causes also are concerned in the advance even of the exact sciences. Among such contributory causes is the more familiar intercourse of settled nations which we enjoy in our own day ; the ideas of one nation rapidly permeate neighbouring nations, and by the means of printed books penetrate into remoter provinces and into distant lands. Hence in this article the description of the advance of medicine in western Europe and America*~~

~~*may be taken as a whole, without that separate treatment, nation by nation, which in the history of earlier times was necessary. Italy lost the leading place she had taken in the new development of science. The several influences of modern Germany, France, and America became of the first importance to English medicine ; but these tides, instead of pursuing their courses as independent sti-eams, have become confluent. The work of Schwann, Milller, Virchow, and Ludwig in Germany, of Laennec and Bernard in France, was accepted in England, as that of Matthew Baillie, Charles Bell, Bright, Graves, and others of the British school, quickly made itself felt abroad. Our survey of the medicine of the latter half of the 19th century then will not be divided into national histories; though in passing some special features in the work of each nation may have due notice.*~~

~~*General Pkogeess.*~~

~~*The character of modern medicine cannot be summed in a word, as, with more or less aptness, that of some previous periods may be. Modern medicine, _ like modern science, is as boldly speculative as it mental has been in any age, and yet it is as observant as method in any naturalistic period ; its success lies in the «”«■”’«<'• addition to these qualities of the method of verification ; the fault of previous times being not the activity of the speculative faculty, without which no science can be fertile, but the lack of vigilant reference of all and sundry pro- positions, and parts of propositions, to the test of experi- ment. In no department is the experimental method more continually justified than in that of the natural history of disease ; which at first sight would seem to have a certain independence of it and a somewhat exclusive value of its own. Hippocrates had no opportunity of verification by necropsy, and Sydenham neglected pathology ; yet the clinical features of many but recently described diseases, such, for example, as that named after Graves, and myx- oedema, both associated with perversions of the thyroid gland, lay as open to the eye of physicians in the past as to our own. Again, to the naturalist the symptoms of tabes dorsalis were visible enough, had he noted them. No aid to the trained eye was necessary for such observa- tions, and for many other such ; yet, if we take Sir Thomas Watson as a modern Sydenham, we find in his lectures no suspicion that there may be a palsy of muscular co-ordina- tion apart from deprivation of strength. Indeed, it does not seem to have occurred to any one to test the muscular strength in the various kinds of paraplegia. Thus it was, partly because the habit of acceptance of authority, waning but far from extirpated, dictated to the clinical observer what he should see ; partly because the eye of the clinical observer lacked that special training which the habit and influence of experimental verification alone can give, that physicians, even acute and practised physicians, failed to see many and many a symptom-group which went through its evolutions conspicuously enough, and needed for its appreciation no unknown aids or methods of research, nor any farther advances of pathology. We see that the practice of the experimental method endows with a new vision both the experimenter himself and, through his influence, those who are associated with him in medical science, even if the latter be not*~~

~~*themselves engaged actually in experiment ; a new discipline imposed upon old faculties, which is seen as well in other sciences as in those on which medicine more directly depends. And it is not only the perceptions of eye or ear which tell, but*~~

~~*also the association of concepts behind these adits of the mind. It was the concepts derived from the experimental methods of Harvey, Lavoisier, Liebig, Claude Bernard, Helmholtz, Darwin, Pasteur, Lister, and others, which, directly or indirectly, trained the eyes of clinicians to observe more closely and accurately ; and not of clinicians only, but also of pathologists, such as Matthew Baillie, Cruveilhier, Eokitansky, Bright, Virchow — to name but a few of those who, with (as must be admitted) new facilities for necropsies, began to pile upon us discoveries in morbid anatomy and histology. If at first in the 18th century, and in the earlier 19th, the discoveries in this branch of medical knowledge had a certain isolation, due perhaps to the prepossessions of the school of Sydenham, they soon became the property of the physician, and were brought into co-ordination with the clinical phenomena of disease. The great Morgagni, the founder of morbid anatomy, himself set the example of carrying on this study parallel with clinical observation ; and always insisted that the clinical story of the case should be brought side by side with the revelations of the necropsy. In pathology, indeed, Virchow's influence in the transfiguration of this branch of science may almost be compared to that of Darwin and Pasteur in their respective domains (see Pathology). In the last quarter of the 19th century the conception grew clearer that morbid anatomy for the most part demonstrates disease in its static aspects only, and also for the most part in the static aspect of final demolition ; and, as pathology and clinical medicine became more and more thoroughly integrated, it became manifest that the processes which initiate and are concerned in this dissolution were not revealed by the scalpel.*~~

~~*Again, the physician as naturalist, though stimulated by the pathologist to delineate disease in its fuller manifestations, yet was hampered in a measure by the didactic method of constructing " types " which should command the attention of the disciple and rivet them- selves on his memory ; thus too often those incipient and transitory phases which initiate the paths of dissolution were missed. Not only so, but the physician, thus fasci- nated by " types," and impressed by the silent monuments of the pathological museum, was led to localize disease too much, to isolate the acts of nature, and to forget not only the continuity of the phases which lead up to the exemplary forms, or link them together, but to forget also that even between the types themselves relar tions of affinity must exist — and these oftentimes none the less intimate for apparent diversities of form, for types of widely different form may be, and indeed often are, more closely allied than types which have more superficial resemblance — and to forget, moreover, how largely negative is the process of abstraction by which types are imagined. Upon this too static a view, both of clinical type and of posUmortem, room pathology, came a despairing spirit, almost of fatalism, which in the contemplation of organic ruins lost the hope of cure of organic diseases. So prognosis became pessimistic, and the therapeutics of the abler men negative, until fresh hopes arose of stemming the tides of evU at their earliest flow.*~~

~~*Such was medicine, statically ordered in pathology, statically ordered in its clinical concepts, when, on the 24th of November 1859, the Origin of Species Influence -j^as published. It is no exaggeration to say that this epoch-making work brought to birth a world of conceptions as new as the work of Copernicus. For the natural philosopher the whole point of view of things was changed ; in biology not only was the anthropocentrio point of view banished, but the notion of perpetual flux was brought home to ordinary men, and entered for good into the common framework*~~

~~*of DanrlB.*~~

~~*of thought. The study of comparative pathology, yet in an inchoate stage, and of embryology, illuminated and enlarged biological conceptions, both normal and abnormal; and the ens reale suhsistens in corpore disappeared for ever — at any rate from physiology and medicine. Before*~~

~~*Darwin — if the name of Darwin may be used to signify the transfiguration of thought of which he was the chief artificer — natural objects were regarded, not in medicine and pathology only, as a set of hidebound events ; and natural operations as moving in fixed grooves, after a fashion which it is now difficult for us to realize. With the melting of the ice the more daring spirits dashed into the new current with such ardour that for them all traditions, all institutions, were thrown into hotchpot; even elderly and sober physicians took enough of the infection to liberate their minds, and, in the field of the several diseases and in that of post- mortem pathology, the hoUowness of classification by superficial resemblance, the transitoriness of forms, and the flow of processes, broke upon the view. Thus it came about not only that classifications of disease based on superficial likeness — such as jaundice, dropsy, inflam- mation — were broken up, and their parts redistributed, but also that even more set diseases began to lose their settlements, and were recognized as terms of series, as transitory or culminating phases of perturbations which might be traced to their origins, and in their earlier stages perhaps withstood.*~~

~~*The doctrine of heredity in disease thus took a larger aspect ; the view of morbid series was no longer bounded even by the life of the individual ; and the propagation of taints, and of morbid varieties of man, from genera^ tion to generation proved to be no mere repetition of fixed features but, even more frequently, to be modes of development or of dissolution betraying themselves often in widely dissimilar forms, in series often extending over many lives, the terms of which at first sight had seemed wholly disparate. Thus, for example, as generations succeed one another, nervous disorders appear in various guise; epilepsy, megrim, insanity, asthma, hysteria, neurasthenia, a motley array at first sight, seemed to reveal themselves as terms of a morbid series ; not only so, but certain disorders of other systems also appeared to be members of the series, such as certain diseases of the skin, and even peculiar susceptibilities or immunities in respect of infections from without. On the other hand, not a few disorders proved to be alien to classes to which narrower views of causation had referred them ; of such are tabes dorsalis, neuritis, infantile palsy, or tetanus, now removed from the category of primary nervous diseases and placed in one or other of the*~~

series of infections ; or, conversely, certain forms of disease of the joints are now regarded with some certainty as members of more than one series of diseases chiefly manifest in the nervous system. In the effects of simpler poisons the recognition of unity in diversity, as in the affiliation of a peripheral neuritis to arsenic, illustrated more definitely this serial or etiological method of classifying diseases. On the other hand, in- heritance was dismissed, or survived only as a " suscepti- bility," in the cases of tubercle, leprosy, and some other maladies now recognized as infectious ; while in others, as in syphilis, it was seen to depend upon a translation of the infectious element from parent to offspring. These new conceptions of the multiplicity in unity of disease, and of the fluidity and continuity of morbid processes, might have led to vagueness and over- boldness in speculation and reconstruction, had not the experimental method been at hand with clues and tests for these series. Against such dangers the rise and wonderful extension of the science of bacteriology also furnished no inconsiderable safeguard.

In the disease of the scalp called favus, Schonlein had

discovered a minute mycelial fungus — a remarkable dis- covery; for it was the first conspicuous step in the attribution of diseases to the action of minute parasites. Schonlein thus did somethingto intro- duce new and positive conceptions and exacter methods into Germany ; but unfortunately his own mind retained the abstract habit of his country, and his abilities were dissipated in the mere speculations of Schelling. Similarly Karl Hoffmann of Wllrzburg wasted his appreciations of the newer schools of developmental biology in fanciful notions of human diseases as reversions to normal stages of lower animals ; scrofula being for him a reversion to the insect, rickets to the mollusc, epilepsy to the oscillaria, and so forth. Even that dis- tinguished physiologist Johannes

~~*Miiller remained a staunch vitalist. Fortunately Germany, which at the beginning of the century was delivered over to Brownism and vitalism and was deaf to Bichat, was rescued from this sort of barrenness by the brilliant experimental work of Claude Bernard and Pasteur in France — work which, as regards the attenuated virus, was a develop- ment of that of Edward Jenner, and indeed of Schwann — Koch worthily following Pasteur with his work on the bacillus of anthrax and with his discovery of that of tuberculosis ; and by the cellular doctrine and abun- dant labours in pathology of Virchow (see Pathology). Brieger then discovered the toxins of certain infections ; and Behring completed the sphere of the new study by his discovery of the antitoxins of diphtheria and tetanus. Although in practical medicine the subse- quent results of Behring and his followers have hitherto been somewhat disappointing, for in diphtheria alone have these discoveries attained a signal therapeu- tical success (indeed toxic action and capacity for com- bining with antitoxin are unfortunately not identical), yet in transforming our conceptions of nosology, and in destroying the last strongholds of vitalism and teleology, they have been most fertile. If the striking conceptions of Ehrlich continue to prove as fertile in inspiring and directing research as at present they seem to be, another wide sphere of conceptions will be opened out not in bacteriology only, but also in pathological chemistry, and in molecular- physics. Again, besides giving us the clue to the nature of many diseases and to the continuity of many morbid series, by bacteriology certain diseases, such as actinomycosis, have been recognized for the first time.*~~

~~*As the prevalence of the conceptions signified and inspired by the word " phlogiston " kept alive ontological notions of disease, so the dissipation of vitalistic Fevers aad conceptions in the field of physics prepared tions. men's mmds m pathology for the new views*~~

~~*opened by the discoveries of Pasteur on the side of pathogeny, and of Cohnheim and of Metschnikoff on the dynamical side of histology. Of the older ontological notions of disease the strongest were those of the essence of fever and of the essence of inflammation. Broussais had done much to destroy the notion of fever as an entity, but by extravagances in other directions he had discredited the value of his main propositions. Yet,*~~

~~although, as Andral and other French physicians proved, it was extra-vagant to say that all fevers take their origin from some local inflammation, it was true and most useful to insist, as he vehemently insisted, that " fever " is no substance, but a generalization drawn from symptoms common to many and various diseases springing from many, various, and often local causes ; from diseases agreeing perhaps only in the factor of elevation of the temperature of the body. To the establishment of this new conception the improvement and general use of the clinical ther- mometer gave invaluable advantages. This instrument.~~

~~now indispensable in our daily work at the bedside, had indeed long been known both to physiologists (Haller) and to clinicians. In the 19th century de Haen, and, in the United Kingdom, Cleghorn of Dublin and Currie, carried on the use of the thermometer in fevers ; and on the Con- tinent in later years von Barensprung and Traube did the same service ; but it is to the work of Wunderlich that we owe the establishment of this means of precision as a method of regular observation both in pathology and in clinical medicine. By his almost exhaustive comparison of febrile movements as symptomatic processes Wunderlich dealt the last blow to the expiring doctrine of the " entity " of " fever " ; while on the clinical side Bretonneau and Louis, in 1862-72, by their careful clinical and patho- logical studies of forms of fever, relieved the new doctrine of the extravagances of Broussais, and prepared the way for the important distinction of enteric from typhus fever by A. P. Stewart,William Jenner, Budd, Murchison, Louis, Autenrieth, Magnus of Philadelphia, Huss, Gerhard, and others. By the learned and accomplished Trousseau British and German influences were brought into France. Meanwhile Cohnheim and Metschnikoff were also engaged in destroying the ontological conception not of fever only, but also of inflammation, of which, as a local event, an onto- logical conception was no less strongly implanted. By his researches on the migration of the white corpuscles of the blood Cohnheim, on the bases laid by Virchow, brought the processes of inflammation within the scope of the normal, seeing in them but a modification of normal pro- cesses under perturbations of relatively external inci- dence; even the formation of abscess was thus brought by him within the limits of perversion of processes not differing essentially from those of health ; and " new formations," " plastic exudations," and~~

other discontinuous origins of an " essential " pathology, fell into oblivion. And it is not alien from the present point of view to turn for a moment to the light thrown on the cardio-arterial pulse and the measurement of its motions by the more intimate researches into the phenomena of the circulation by many observers, among whom in the 19th century Hope, Marey, and Ludwig will always take a leading place. By them the demonstration of Harvey that the circulation of the blood is in large part a mechanical process, and nowhere inde- pendent of mechanical laws, was considerably enlarged and extended. In particular the fluctuations of the pulse in fevers and inflammations were better understood, and accurately registered ; and we can scarcely realize now that before Harvey the time of the pulse seems not to have been counted by the watch. Discovery in these various directions then led physicians to regard fever and in- flammation not as separable entities, but as fluctuating symptom-groups, due to swervings of function from the normal balance under contingent forces.

As to such reforms in our conceptions of disease the advances of bacteriology profoundly contributed, so under the stress of consequent discoveries, almost pro- digious in their extent and revolutionary effect, △'J',f „ the conceptions of the etiology of disease under- "mo. ' went no less a transformation than the conceptions of disease itself. It is proper to point out here how inti- mately a pathology thus regenerated modified current conceptions of disease, in the linking of disease to oscilla- tions of health, and the regarding many diseases as modifi- cations of the normal set up by the impingementof external causes ; not a few of which indeed may be generated within the body itself — "autogenetic poisoning." The appreciation of such modifications, and of the Working of such causes, has been facilitated greatly by the light thrown upon normal processes by advances in physiology; so dependent is each branch of knowledge upon the advances of contiguous and incident studies. To physiological*

chemistry we have been deeply indebted during the latter half of the 19th century. In Wilrzburg, in 1872, Hoppe Seyler gave a new beginning to our knowledge of the chemistry of secretion and of excretion ; and later students have increased the range of physiological and pathological chemistry by investigations not only into the several stages of albuminoid material and the transi- tions which all food-stuffs undergo in digestion, but even into the structure of protoplasm itself. Digestion, re- garded a generation ago as little more than a trituration and " coction " of ingesta, to fit them for absorption and transfer them to the tissues, now appears as an elabora- tion of peptones and kindred intermediate products which, so far from being always bland, and mere bricks and mortar for repair or fuel for combustion, pass through phases of change during which they become so unfit for assimilation as to be positively poisonoiis. The formation of prussic acid at a certain period of the vital processes of the lotus may be given as a simple example of such phases ; and poisons akin to muscarin seem to arise frequently in development or regression, both in animals and plants. Thus the digestive function, in its largest sense, is now seen to consist not only in prepara- tion and supply, but in no small measure also of pro- tective and antidotal conversions of the matters submitted to it ; coincidently with agents of digestion proper are found in the circuit of normal digestion " anti-substances " which neutralize or convert peptones in their poisonous phases ; an autochthonous ferment, such as rennet for instance, calling forth an anti-rennet, and so on. Now as our own bodies thus manipulate substances poisonous and antidotal, if in every hour of health we are averting self-intoxication, so likewise are we concerned with the various intruding organisms, whose processes of diges- tion are as dangerous as our own ; if these destructive agents, incessantly no doubt gaining admission to our bodies, do not meet within us each its appropriate com- pensatory defensive agent, dissolution will begin. Thus, much of infection and immunity are proving to be but special cases of digestion, and teleological conceptions of protective processes are modified.

Under the name of chemotaxis (Pfeffer) are desig- nated certain of the regulative adaptations by which such ends are attained. By chemical warnings Natural ^jjg (Jefensive processes seem to be awakened, or summoned ; and when we think of the infi- nite variety of such possible

~~*phases, and of the multitude of corresponding defensive agents, we may form some dim notion of the complexity of the animal blood and tissues, and within them of the organic molecules. Even in normal circumstances their play and counterplay, attractive and repellent, must be manifold almost beyond conception ; for the body may be regarded as a col- lective organization consisting of a huge colony of micro- organisms become capable of a common life by common and mutual arrangement and differentiation of function, and by toleration and utilization of each other's peculiar products ; some organs, such as the liver, for example, being credited with a special power of neutralizing poisons, whether generated under normal conditions or under abnormal, which gain entrance from the intestinal tract. As a part of these discoveries has arisen another but kindred doctrine, that of "internal secretions" of juices prepared, not for excretion, or even to be poured into channels of partial excretion, but for the fulfilment of physiological ends in the processes of metabolism. It is probable not only that the secreted juices of spe- cialized cells are thus set one against another in the body, but also that the blood itself in its cellular and fluid parts contains elements potent in the destruction of bacteria and of their secretions. Thus endowed, the*~~

~~*blood, unless overwhelmed by extraordinary invasions, does not fail in stability or self-purification, and bacteria are not detected in its current. So various are the con- ditions of self-regulation in various animals, both in respect of their peculiar and several modes of assimilat- ing different foods, and of protecting themselves agaihst particular dangers from without, that, as we might have expected, the bloods taken from different species, or even perhaps from different individuals, are found to be so different that the healthy serum of one species may be, and often is, poisonous to another ; not in respect of adventitious substances, but because the phases of physi- ological change in different species do not harmonize, each by its peculiar needs having been modified in dif- ferent ways until, in their several conditions of life, they vary so much about the mean as to become almost if not quite alien one to another.*~~

~~*In the preservation of immunity then, in its various degrees and kinds, not only is the chemistry of the blood to be studied, but also its histology. By his emi- nent labours in cellular pathology Virchow, and Metsch- nikoff*~~

later, gave the last blow to the mere humoral pathology which, after an almost unchallenged preva- lence for some two thousand years, now finds a resting- place only in our nurseries. Now the cellular pathology of the blood, investigated by the aid of modern staining methods, is as important as that of the solid organs ; no clinical investigator, indeed, apart from research, no practitioner at this day, can dispense with examination of the blood for purposes of diagnosis ; its coagulability and the kinds and the variations of the cells it contains being evidence of many definitely morbid states of the body. Again, not only in certain diseases may strange cells be found in the blood (e.g., in Myelogenic Leu- caemia), but parasites also, certain protozoa (malaria), and even certain higher forms of animal life (Pilaria, Tsetse disease, Texas fever) having been discovered therein, to the great advantage of medicine (see Pa- thology : Parasitic Diseases). It is interesting to note that even the large and well-known parasites of the intestinal canal come into line with the microbes, for it is now suspected that even the Bothriocephalus latus, for example, is not merely a mechanical irritant, or a mere competitor for nutriment, but is injurious to its host by an intoxication.

It is obvious that the results of such advances prescribe for the clinical physician methods which cannot be pur- sued without expert assistance ; a physician engaged in busy practice cannot himself undertake even the verifica- tions required in the conduct of individual cases. Skill in modern laboratory work is as far out of the reach of the untaught as performance on a musical instrument. In spite, therefore, of the encyclopaedic tradition which has persisted from Aristotle through the Arab and mediaeval schools down to Mr Herbert Spencer, it is forced upon us in our own day that in a pursuit so many-sided as medicine, whether in its scientific or in its practical aspect, we have to submit more and more to that division of labour which has been a condition of advance in all other walks of life. It is now fully rec- ff^'^" ognized that diseases of infants and children, of the insane, of the generative organs of women, of the larynx, of the eye, have been brought successively into the light of modern knowledge by " specialists," and by them distributed to the profession ; and that in no other way could this end have been attained. That the division of labour, which may seem to disintegrate our calling, really unites it, is well seen in the clinical laboratories which were initiated in

~~the later 19th century, and which are destined to a great future. By the approach of skilled pathologists to the clinical wards, a link is~~

~~forged between practitioners and the men of science who pursue pathology disinterestedly. The first clinical laboratory seems to have been that of von Ziemssen at Munich, founded in 1886 ; and, although his example has not yet been followed as it ought to have been, enough has been done in this way, at Johns Hopkins University and elsewhere, to prove the vital importance of the system to the progress of modern medicine. At the same time provision must be made for the integration of knowledge as well as for the winning of it by several adits. A conspicuous example of the incalculable evil wrought by lack of integration is well seen in the radical divorce of surgery from inner medicine, which is one of the most mischievous legacies of the Middle Ages — one whose mischief is scarcely yet fully recognized, and yet which is so deeply rooted in our institutions, in the United Kingdom at any rate, as to be hard to obliterate. That the methods and the subject matter of surgery and of medicine are substantially the same, and that the ad- vance of one is the advance of the other, the division being purely artificial and founded merely on accidents of personal bent and skill, must be insisted upon at this time of our history. The distinction was never a scien- tific one, even in the sense in which the word science can be used of the Middle Ages; it originated in social conceits and in the contempt for mechanical arts which came of the cultivation of " ideas " as opposed to con- verse with " matter," and which, in the dawn of modern methods, led to the derision of Boyle by Oxford human- ists as one given up to " base and mechanical pursuits." Had physicians been brought into contact with facts as hard as were the surgeons of the 16th century (cf. Ambrose Pare, Subgbbv, Ency. Brit. vol. xxii. p. 676), our art would not have lain so long in degradation. It is under this closer occupation with mechanical condi- tions that surgery to-day is said — not without excuse, but with no more than superficial truth — to have made more progress than medicine. Medicine~~

~~*and surgery are but two aspects of one art; yet even the history of modern medicine is thus divided, and it is from another article that the reader must learn how by the brilliant services of modern surgeons have been enforced the same methods and truths as we are learning in the field of medicine proper ; how Pasteur shed light on both surgery and medicine, and how Lister, his disciple, penetrated into the secrets of wound fevers and sep- ticaemia, whereby he illuminated surgery and medicine alike, and, in the one sphere as in the other, co-operated in the destruction of the idea of " essential fevers " and of inflammation as an " entity " (see Listek). Together, then, with the necessary multiplication of specialism, one of the chief lessons of the latter moiety of the 19th century was the unity of medicine in all its branches — a unity strengthened rather than weakened by special researches, such as those into " medical " and " surgical " pathology, which are daily making more manifest the absurdity of the distinction. Surgeons, physicians, ocu- lists, laryngologists, gyneecologists, neurologists and the rest, all are working in allotments of the same field, and combine to a common harvest.*~~

~~*While pathology then, which is especially the " science of medicine," was winning territory on one side from*~~

~~*physiology, of which in a sense it is but an ilali^g. aspect, and on another by making ground of*~~

~~*its own in the post-mortem room and museum of morbid anatomy, and was fusing these gains in the laboratory so as to claim for itself, as a special branch of science by virtue of peculiar concepts, its due place and provision — provision in the establishment of chairs and of special laboratories for its chemical and biological sub- divisions — clinical medicine, by the formal provision of*~~

~~*disciplinary classes, was illustrating the truth of the ex- perience that teaching and research must go hand in hand, the one reinforcing the other ; that no teacher can attain great success unless he be engaged in research also : nay, that for the most part even the investigator needs the encouragement of disciples. Yet it was scarcely until the last quarter of the 19th century that the apprentice- ship system, which was a mere initiation into the art and mystery of a craft, was recognized as antiquated; in its*~~

~~*virtual exclusion of academic study, even mischievous ; and that in place of it systematic clinical classes became part of the scheme of every ef&cient school of medicine. A condition of this advance was the need of a preliminary training of the mind of the pupil in pure science, even in physics and chemistry ; that is to say, before his intro- duction into his professional studies. The founding of new teaching universities, in which England, and even France, had been at some disadvantage as compared with Scotland and Germany, strengthened the movement in favour of enlarging and liberalizing technical training, and of anticipating technical instruction by some broader scientific discipline ; though, as in all times of transition, something was lost temporarily by a departure from the old discipline of the grammar school before a new scheme of training the mind in scientific habits and conceptions was established or fully apprehended. Yet on the whole, even from the beginning, the revolt was useful in that it shook the position of the "learned physician," who took a literary, fastidious, and meditative rather than an experimental interest in his profession, and, as in great part a descendant of the humanists, was never in full sympathy with natural science. At the risk no doubt of some defects of culture, the newer education cleared the way for a more positive temper, awoke a new sense of accuracy and of verification, and created a sceptical atti- tude towards all conventions, whether of argument or of practice. Among the drawbacks of this temper, which on the whole made for progress, was the rise of a school of excessive scepticism, which, forgetting the value of the accumulated stores of empiricism, despised those de- grees of moral certainty that, in so complex a study and so tentative a practice as medicine, must be our portion for the present, and even for a long future; however great the triumphs of medicine may become. This scep- ticism took form in the school, most active between 1860 and 1880, known as the school of " Expectant Medicine." These teachers, genuinely touched with a sense of the scantiness of our knowledge, of our confidence in abstract terms, of the insecurity of our alleged " facts," case-his- tories, and observations, alienated by traditional dogma- tisms and disgusted by meddlesome polypharmacy — enlightened, moreover, by the issue of cases treated by means such as the homoeopathic, which were practically "expectant" — urged that the only course open to the physician, duly conscious of his own ignorance and of the mystery of nature, is to put his patient under*~~

diet and nursing, and, relying on the tendency of all equilib- riums to recover themselves under perturbation, to await events {Vis medicatrix natures). Those physicians who had occupied themselves in the study of the exacter sciences, or more closely or more exclusively of the wreck- age of the post-mortem room, were the strongest men of this school, whether in England or abroad.

But to sit down helpless before human suffering is an unendurable attitude. Moreover, the insight into origins, into initial morbid processes revealed by the pathologists, awoke more and more the hope of peStc's. dealing with the elements of disease, with its first beginnings ; and in the field of therapeutics, chemical andbiological experiment was rapidly simplifying remedies and defining their virtues (Pharmacology), as in the case

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of digitalis, mercury, and the iodides, so that these agents could be used at the bedside with more precision. Fur- thermore, the aversion from drugging had the advantage of directing men's minds to remedies taken from the region of the physical forces, of electricity (Duchenne), of gym- nastics (Ling), of hydropathy (Priessnitz), of massage (Weir Mitchell), of climate (Sir James Clarke), of diet (Todd, King Chambers, &c.), and even of hypnotism (Baird) ; while with the improvement of the means of locomotion came the renewal of the old faith and the es- tablishment of new methods in the use of mineral springs. These and such means, often in combination, took much of the place formerly given to the use of drugs.

Again, a like spirit dictated the use of the physical or " natural " methods on a larger scale in the field of pre- „ vention. From the new regard given by phy-

ygene. geologists and pathologists to the study of origins, and in the new hopes of thus dealing with disease at its springs, not in individuals only

~~*but in cities and nations, issued the great school of Preventive Medicine, initiated in England (Parkes, Simon, Richardson, Acland, Buchanan), and forwarded in Germany by Pettenkofer. Hygiene became for pathology what "milieu" is for physiology. By the modification of physical conditions on a national scale a prodigious advance was made in the art of preventing disease. The ghastly roll of infantile mortality was quickly purged of its darkest features (Ballard and others) ; aided by bacteriology, sanitary measures attained some considerable degree of exactness ; public medicine gained such an ascendancy that special training and diplomas were offered at universities ; and in 1875 a consolidated Act was passed for the United Kingdom establishing medical officers of health, and re-sponsible lay sanitary authorities, with no inconsiderable powers of enforcing the means of public health in rural, urban, port, and other jurisdictions, with summary methods of procedure. A department of public health was formed within the precincts of the Local Government Board ; Government laboratories were established, and machinery was devised for the notification of infectious diseases. The enormous growth of towns during the second half of the 19th century was thus attended with comparative safety to these great aggregates of mankind ; and the death-rates, so far from being increased, relatively decreased in substantial proportions. In 1878 an Act was passed giving like powers in the case of the infectious diseases of animals. The establishment in England of the Register of qualified practitioners and of the General Medical Council (in 1868) did something, however im- perfectly, to give unity to the profession, unhappily bi- sected by " the two colleges " ; and did much to organize, to strengthen, and to purify medical education and quali- fication. In 1876 women were admitted to the Register kept by the Council. In 1871 the Anatomical Act of 1832 was amended ; and in 1876 the Vivisection Act was passed, a measure which investigators engaged in the medical sciences of physiology and pathology resented as likely to prevent in England the advance of knowledge of living function, both in its normal balance and in its aberrancies, and moreover to slacken that habit of inces- sant reference of propositions to verification which is as necessary to the clinical observer as to the experimental- ist. However the opinion of later generations may stand in respect of the Vivisection Act, it will surely appear to them that the other Acts, largely based upon the results of experimental methods, strengthening and consolidat- ing the*~~

medical profession, and fortifying the advance of medical education, led directly to a fundamental change in the circumstances of the people in respect of health. The intelligent classes have become far better educated in the laws of health, and less disposed

to quackery ; the less intelligent are better cared for and protected by municipal and central authority. Thus the housing of the poor has been improved, though this difficult problem is yet far from solution ; not the large towns only, but the larger villages also, are cleansed and drained; food has been submitted to inspection by skilled officers; water supplies have been undertaken on a vast scale; personal cleanliness has been encour- aged, and with wonderful success efforts have been made to bring civilized Europe back from the effects of a long wave of Oriental asceticism, which in its neglect and contempt of the body led men to regard filth even as a virtue, to its pristine cleanliness under the Greeks and Romans. During the latter half of the 19th century the death-rate of many towns was reduced by something like 60 per cent. Some plagues, such as typhus fever, have been dispelled ; others, such as enteric fever, have been almost banished from large areas ; and there is much reason to hope that cholera and plague, if intro- duced, could not get a footing in western Europe, or in any case could be combated on scientific principles, and greatly reduced. Temperance in the use of alcohol has followed the demonstration not only of the gross exag- geration of its nutritive value, but also of its harmful- ness, save in very small quantities. In the earlier part of the 19th century, and in remoter districts even in its later years, the use of alcohol was regarded not as a mere indulgence, but as essential to health : the example of teetotallers, as seen in private life and in the returns of the insurance offices, has undermined this mischievous belief. From the time of Plato medicine has been accused of ministering to the survival of unfit persons, aud to their propagation of children. But bodily defect is largely a result of evil circumstances, in the preven- tion of which the physician is not unsuccessfully engaged. Thus the mean standard of health will be raised, perhaps enormously.

In the tropics, as well as in Europe, such methods and such researches threw new light upon the causes and paths of the terrible infections of these climates. In 1880, two years before Koch discovered the bacillus of

tubercle, Laveran discovered the amoeba of malaria, and truly con- ceived its relations to the disease ; thus within two years were made two discoveries either of which was sufficient to make the honour of a century. Before the end of the 19th century this discovery of the blood parasite of malaria was crowned by the hypothesis of Manson, proved by Ross, that malaria is propagated by a certain genus of gnat, which acts as an intermediate host of the parasite. The 20th century, by means of this illumination of one of the darkest regions of disease, may diminish human suffering enormously, and may make habitable rich and beautiful regions of the earth's surface now, so far as man's work is concerned, condemned to sterility. More- over, freedom of trade and of travel has been promoted by a reform of the antiquated, cumbrous, and too often futile methods of quarantine — a reform as yet very far from complete, but founded upon a better rmderstanding of the nature and propagation of disease.

Special Depaktments.

Hitherto we have presented a survey of the progress of the science and practice of medicine on general lines ; it remains to give some indication of the advance of these subjects of study and practice in parti- cular departments. As regards infections, it is not to be supposed that our knowledge of these maladies has been advanced by pathology and bacteriology only. In the clinical field also it has received a great enlargement. Diphtheria, long no doubt a plague among mankind, was not carefully described until by Bretonneau in 1826 ; and

since his time our conception of this disease has been extended by the study of later, secondary, and incidental phases of it, such as neuritis, which had always formed part of the diphtheritic series, though their intimate con- nexion with it had not been suspected. Influenza, again, was well known to us in 1836-40, yet clinical observers had not traced out

~~those sequels which, in the form of neuritis and mental disorder, have impressed upon our minds the persistent malignity of this infection, and the manifold forms of its activity. By the discovery of the bacillus of tubercle, the physician has been enabled to piece together a long and varied list of maladies under several names, such as scrofula and lupus, many of them long suspected to be tuberculous, but now known to be of the same series. It is on clinical grounds, for their respective specific agents are as yet unknown, that syphi- lis, beriberi, scarlet fever, measles, &c., are recognized as belonging to the same class, and evolving in phases which differ not in intimate nature but in the more superficial and inessential characters of time, rate, and polymor- phism. On clinical grounds also the impression is gain- ing strength that acute rheumatism belongs to the group of the infections ; and that certain sore throats, chorea, and other maladies apparently distinct, are terms of this series. Thus the field of disease arising not from essen- tial defect in the body, but from external contingencies, is enlarging ; while on the other hand the great varia- bility of individuals in susceptibility explains the very variable results of such extrinsic causes. Coincidently therewith, the hope of neutralizing infections by fortify- ing individual immunity has grown brighter, for it ap- pears that immunity is not a very radical character, but one which, as in the case of vaccination, admits of modi- fication and accurate adjugtment in the individual, in no long time and by no very tedious methods. In a few years we may be able to do for other infections what we have done already for smallpox, for diphtheria, and per- haps for typhoid fever and cholera. The field of anti- toxic treatment will also prove wider and wider as one disease after another falls into the category of contin- gent infection. Leprosy, for instance, is now traced to its own bacillus, and, the fatalist notion of heredity being thereby dispelled, the hope of prevention, based on a discovery of the nature of the infection, is awakened. Cholera seems to be falling into the power of the patho- logist (Haffkine), and evidence is accumulating which may end in the explanation and perhaps in the preven- tion of the direst of human woes — cancer itself.~~

~~When, leaving the infections, we look for evidence of progress in our knowledge of more or less local diseases, .we may begin with the nervous system. It is in this department, from its abstruseness and complexity, that~~

we should expect the advance of anatomy and physiology — normal and morbid — to be most delayed. If we consult the medical works even of the middle of the 19th century we shall find that, in the light of the present time, accurate knowledge in this sphere, whether clinical, pathological, or therapeutical, could scarcely be said to exist. Even in the hands of Lockhart Clarke, one of the earliest investigators of nervous pathology, the improve- ment of the compound microscope had not attained the achromatism, the penetration, and the magnification which have since enabled Schroder von der Kdlk, Kolliker, Ramon i Cajal, Golgi, and others to reveal the minute anatomy of the nervous centres ; while the discrimination of tissues and morbid products by stains, as in the silver and osmic acid methods, and in those known by the names of Weigert or Marchi, had scarcely begun. In England the Hospital for the Paralysed and Epileptic was founded in 1859, when Brown-Sequard, Hughlings-Jackson, Buzzard, Bastian, Gowers, and Ferrier found an adequate field for the

clinical and pathological parts of their work. In France, in the wards of the Hotel Dieu, Duchenne of Boulogne, in association with Trousseau and in his private clinic, pursued his memorable clinical and therapeutical re- searches into the diseases of the nervous system ; and Charcot in that great asylum for the wreckage of huinan- ity — the Salpetriere — discovered an unworked mine of chronic nervous disease. Romberg and Meynert also were pioneers in the study of nervous diseases, but it was not till later in the century that Germany took a high place in this department of medicine. The dis- coveries of the separate paths of sensory and motor impulses in the spinal cord, and consequently of the laws of reflex action, by Charles Bell and Marshall Hall respectively, in their illumination of the phenomena of nervous function, may be compared with the discovery in the region of the vascular system of the circulation of the blood ; for therein a key to large classes of normal and aberrant functions and a fertile principle of interpre- tation were obtained. Nor was the theory of reflex action confined to the more " mechanical " functions. By G. H. Lewes and others the doctrine of " cerebral reflex " was established, whereby actions, at first achieved only by incessant attention, become organized as habits ; as for instance in the playing on musical or other instru- ments, when acts even of a very

~~*elaborate kind may follow directly the impulses of sensations, conscious adaptation and the deliberate choice of means being thus economized. This law has important ethical and political bearings j but in the province of disease this advance of what may be called the interlocking of points and signals has had wide influence not only in altering our conceptions of disease itself, but also in enlarging our views of all per- turbations of function. The paths whereby such impulses travel and become associated in the nervous system have been made out by the physiologist working on the healthy animal, as well as by the record of disease ; and not by spontaneous disease alone, for the artiflcial institution of morbid processes in animals has led to many such dis- coveries, as in the method of Waller, who tracked the line of nervous strands by experimental sections, and showed that when particular strands are cut off from their nutritive centres the consequent degeneration follows the line of the separated strands. By similar methods nature, unassisted, betrays herself but too often ; in many instances — prob- ably originating primarily in the nervous tissues them- selves — the course of disease is observed to follow certain paths with remarkable consistency, as for instance in diseases of particular tracts of the spinal cord. In such cases the paths of degeneration are so neatly defined that, when the tissues are prepared after death by modern methods, they are plainly to be seen running along certain columns, the subdivisions of which in the normal state are not to be distinguished one from another : some run in strips along the periphery of the spinal cord, at its anterior, middle, or posterior segments, as the case may be ; or in other cases such strips occur within its substance, whether along columns of cells or of white matter. It is needless to point out how such paths of disease, in their association with characteristic symptoms, have illuminated the clinical features of disease as well as the processes of normal function.*~~

~~*Not, however, all diseases of the nervous system conduct themselves on these definite paths, for some of them pay no attention to the geography of function, but, as one may say, blunder indiscriminately among the several parts; others, again, pick out particular parts definitely enough, but not parts immediately continuous, or even contiguous. Diseases of the latter kind are especially interesting, as in them we see that parts of the*~~

nervous structure, separated in space, may nevertheless be associated in function ; for

instance, wasting of a group of muscles associated in function may depend on a set of central degenerar tions concurring in parts which, in spite of dissociation in space, we thus infer to be connected. The undis-criminating diseases, on the other hand, we suspect not to be primarily of nervous origin, but to depend rather on the agency of other constituent tissues of this system, as of the blood-vessels or the connective elements. Thus, arguing inversely, we may learn something of the respec- tive natures of these influences and of the way in which the nervous system is affected secondarily.

Even the distribution of toxic matters by the blood is not necessarily followed by general and indiscriminate injury to the nervous elements. In infantile palsy, for example, and in tabes dorsalis, there is good reason to believe that, definitely as the traces of the disease are found in certain physiologically distinct nervous strands, they are due nevertheless to toxic agents arriving by way of the blood. HIere we enter upon one of the most inter- esting chapters of disorders and modes of disorder of this and of other systems. It has come out more and more clearly of late years that poisons do not betray even an approximately indifferent affinity for all tissues, which indeed a little reflection would tell us to be d, priori im-probable, but that each tends to fix itself to this cell group or to that, picking out parts for which they Anchorage severally have an affinity. Neither chemical, molecules, physiological, nor pathological research has ex- plained the secret of these more refined kinds of " anchorage " of molecules. In 1880 Drs Crum Brown and Fraser demonstrated the remarkable fact that by substitution of molecules in certain compounds a stimu- lant could be converted into a sedative action ; thus by the addition of the methyl group CHj to the molecule of strychnine, thebaine, or brucine, the tetanizing action of these drugs is converted into a paralysing

~~*action. The number of these instances, and the variety of them, are now known to be very large; and it is supposed that what is true of these simpler agents is true also of far more elaborate phases of vital metabolism. Now, what is remarkable in these and many other reactions is not only that effects apparently very opposite may result from minute differences of molecular construction, but also that, whatever the construction, agents not wholly indifferent to the body or part tend to anchor themselves to organic molecules in some way correlated with them. Highly complex as are all animal tissues, or nearly all, yet in this category of high complexity are degrees higher and higher again of which we can form little conception ; so elaborate they are, so peculiar in their respective properties, and probably so fugitive. It is this wide range of dynamic peculiarities above the common range of known chemical molecules which excites our wonder ; and a reflection of these peculiar properties is seen in their affinities for this or that toxic or constructive agent, whereby the peculi- arity, for example, of a particular kind of nerve cell may be altered, antagonized, reinforced, or converted. On the other hand, the reagents by which such modifications are apt to be produced are not necessarily simple ; many of them likewise are known to be of very high degrees of complexity, nearly as complex perhaps as the molecules to which they are akin. Of such probably are the toxins and antitoxins of certain infections, which, anchoring them- selves not by any means indiscriminately, but to particu- lar and concerted molecules, antagonize or convert them by such anchorage to favourable or unfavourable issues. Toxins, thus finding an anchorage in certain tissue mole- cules, may become so closely keyed into their correspond- ing atom groups, as for instance in tetanus, that they are no longer free to combine with the antitoxin ; or, again, an antitoxin injected before a toxin may anticipate the*~~

~~*anchorage of the latter and, preventing its mischievous adhesion, may dismiss it for excretion. In the mutual behaviour of such cells, toxins and antitoxins, and again of microbes themselves, we may demonstrate even on the field of the microscope some of the modes of such actions, which seem to partake in great measure at any rate of a chemical character (agglutinins, coagulins, chemotaxis)! It is convenient here to add that such reactions and modifications, if more conspicuous in the nervous*~~

system, are of course not confined to it, but are concerned in their degree in all the processes of metabolism, being most readily perceived by us in the blood.

Many other diseases formerly regarded as primarily diseases of the nervous system are not such; but, by means of agents either introduced into the body or modified there, establish themselves after the affinities of these in contiguous associated parts of the structure, as in vessels, membranes, or indeed in distant and peripheral parts; the perturbations of nervoas function being second- ary and consequential. Of such are tetanus and diph- theria, now known to be due to the establishment from without of a local microbic infection, from which focus a toxin is diffused to the nervous matter. The terrible nervous consequences of some forms of inflammation of the membranes of the brain, again, are due primarily to microbic invasion rather of the membranes than of their nervous contents ; and many other diseases may be added to this list. The grave palsies in such diseases as influenza, diphtheria, beriberi, or ensuing on the absorption of lead, are not mainly central, but due to a symmetrical peripheral neuritis.

Among diseases not primarily nervous, but exhibited in certain phenomena of nervous disorder, are diseases of the blood-vessels. Much light has been throvra. upon the variations of arterial and venous blood ladividuai pressures by Ludwig and his many followers : disease. by them not only the diseases of the circulatory system itself are elucidated, -but also those of other systems — the nervous, for instance — which depend intimately on the mechanical integrity of the circulation of the blood as well as on the chemical integrity of the blood itself. With changes of the pressures of the blood in arteries, veins, or capillaries, and in the heart itself and its respective chambers, static changes are apt to take place in these parts ; such as degeneration of the coats of the arteries, due either to the silent tooth of time, to persistent high blood pressures, or to the action of poisons such as lead or syphilis. Syphilitic lesion of the arteries, and likewise of other fibrous tissues, often involves grave consequential damage to nervous structures fed or supported by such parts. Some of the most successful of the advances of medicine as a healing art have followed the detection of syphilitic disease of the vessels, or of the

~~*supporting tissues of nervous centres and of the peripheral nerves ; so that the treatment of paralytic, convulsive, and other terrible manifestations of nervous disease thus secondarily induced is now undertaken in early stages with definite prospect of cure, by means of specific medication.*~~

~~*Not of less importance in this respect, and in other disorders, many of them of grave incidence, is the know- ledge of the phenomena of embolism and of thrombosis, also gained during the latter half of the 19th century (Kirkes, Virchow). By embolism is meant the more or less sudden stoppage of a vessel by a plug of solid matter carried thither by the current of the blood, be it a little clot from the heart or, what is far more pernicious, an infective fragment from some centre of infection in the body, by which messengers new foci of infection may be scattered about the body. Thrombosis is an accident of not dissimilar character, whereby a vessel is blocked not*~~

~~*by a travelling particle, but by a clotting of the blood in situ, probably on the occasion of some injury to the epithelial lining of the vessel. Such injuries are apt to occur in syphilitic endarteritis, whereby an artery may be blocked permanently, as if with an embolus, and the area supplied by it, in so far as it was dependent upon this vessel, deprived of nutrition. These events, although far more injurious in the brain, the functions of which are far-reaching, and the collateral circulation of which is ill-provided, are seen very commonly in other organs also.*~~

~~*It is in the structure of the brain itself that modern research has attained the most remarkable success. In 1861 the centre of speech was detected, by a combination of clinical and pathological researches, by Broca. By these means also, in the hands of HIughlings-Jackson, and more*~~

~~*conclusively by experimental research initiated by Fritsch and Hitzig, but pursued independently and far more systematically and thoroughly by Ferrier and his disciples, it has been proved that large areas of the cerebrum are occupied by many such centres, which preside over the formulation of sensations into purposive groups of motions (kinsesthesis of Bastian). The results of Ferrier's experimental researches on the constitution of the brain have transformed our conceptions of cerebral physiology, and thrown a flood of light on the phenomena of the diseases of the brain. Not only so, but this accu- rate mapping of the brain in areas of function now often enables the clinical physician to localize the position of dis- ease ; and, in a certain few cases of tumour or abscess, so precisely that he may be enabled to open the skull above the part affected and to extirpate it — an operation which is surely a triumph of science and technical skill (Lister, Macewen, Horsley). For the bearings of the conception of the neuron on physiology, and so on pathological processes, the reader is referred to the article under Physiology, VI.*~~

~~*In mental diseases little of first-rate importance has been done. The chief work has been the detection of chronic changes in the cortex of the brain, by staining and other histological methods, in degenerative affections of this organ (Meynert, Griesinger, Bevan Lewis) ; and in the separation from insanity as a primary disease of nerve substance of such diseases as general paralysis of the in- sane, which probably arise, as we have said, in contiguous structures — such as blood-vessels and connective elements ■ — and invade the nervous matter secondarily. Further- more, it has become more and more probable that general paralysis of the insane, like tabes dorsalis, belongs to the class of the infections, and of these to the syphilitic series. Other infections in like manner seem to injure the mental fabric ; and moreintrinsictoxic processes also are suspected on the detection of neurin and cholin in the fluids of the brain (Mott). Truer conceptions of normal psychology have transformed for us those of the morbid (Pinel, G-riesinger, Maudsley, Mercier), and indicated more truly the relations of sanity to insanity. In the treatment of insanity little has been done but to complete the non- restraint system which in principle belongs to the earlier part of the century (Pinel, Tuke, Hill, Conolly) (see In- sanity, vols. xiii. and xxix.). An enormous accumulation of lunatics of all sorts and degrees seems to have paralysed public authorities, who, at*~~

~~vast expense in buildings, mass them more or less indiscriminately in barracks, and expect that their sundry and difficult disorders can be properly studied and treated by a medical superintendent at a com- paratively low salary, with but young assistants under him, who may have a couple of thousand patients in his charge, together with the management of a huge institution. The life of these insane patients is as bright, and the treat- ment as humane, as a barrack life can be ; but of science,~~

~~whether in pathology or medicine, there can be little. A step iu advance has been made by the London County Council, which has established a central laboratory for its asylums, and placed an eminent pathologist at the head of it : from this laboratory valuable reports have already been issued. Provision for the reception and treatment of insanity in its earliest and more curable stages can scarcely be said to exist. Sufferers from mental disease are not to be regarded as troublesome persons to be hidden away in humane keeping, but as cases of mani- fold and obscure disease, to be studied and treated by physicians of the highest skill, whose attention to their proper work is imdivided. The care and education of idiots, initiated by Guggen buhl and others, has made good way in England, and if as yet insufficient, is good of its kind.~~

~~By the genius of Laennec diseases of the lungs and heart were laid on a foundation so broad that his successors have been occupied in detail and refinement rather than in reconstruction. In heart disease the chief work of the latter half of the 19th century was, in the first quarter, such clinical work as that of Stokes and Latham; and in the second quarter the fuller comprehension of the vascular system as a whole, with its cycles and variations of blood pressure, venous and arterial. By the greater thoroughness of our know- ledge of the physics of the circulation (Marey, Ludwig) we have attained to a better conception of such events as arterial disease, apoplexy, "shock," and so forth. To the discovery of the parts played in disease by throm- bosis and embolism we have referred above. With this broader and more accurate knowledge of the condi- tions of the health of the circulation a corresponding efficiency has been gained in the manipulation of certain remedies and new methods of treatment of~~

~~heart diseases, as by baths and gymnastics, of which a more particular account will be found in the article on Thbbapbutics.~~

~~As regards pulmonary disease, pneumonia has passed more and more definitely into the category of the infec- tions : the invasion of the lungs andpleura by tuberculosis, now definitely recognized as an infection, has been more and more accurately followed ; and the treatment of these diseases, in the spheres both of prevention and of cure, has undergone a radical change. Instead of the close protection from the outer air, the respirators, and the fancy diets of our fathers, the modern poitrinaire camps out in the open air in all weathers, is fed with solid food, and in his exercise and otherwise is regulated with minute particularity according to the indications of the clinical thermometer and other symptoms. The almost reckless reliance on climate, which, at Davos for instance, marked the transition from the older to the modern methods, has of late been sobered, and supple- mented by more systematic attention to all that con- cerns the mode of life of the invalid. The result is that, both in physicians and in the public, a more hopeful attitude in respect of the cure of phthisis has led to a more earnest grappling with the infection in its earliest stages and in every phase, with a correspondingly large improvement in the methods of treatment. Indeed, in such early stages, and in patients who are enabled to command the means of an expensive method of cure, phthisis is no longer regarded as desperate; while for those who of their own means are unable to obtain these advantages, steps are being taken to provide by the erection of special sanatorium s on a more or less charitable basis. Perhaps no advance in medicine has done so much as the study of tuberculosis to educate the public in the methods and value of research iu medical subjects, for the results, and even the methods, of such labours have been~~

~~brought home not only to patients and their friends, but also to the farmer, the dairyman, the butcher, the pro- prietors of public vehicles,~~

~~*and, indeed, to every home in the land.*~~

~~*It was in the management of pleurisies that the aid of surgical means first became eminent in inner disease. In the treatment of effusions into the pleura, and, though with less success, of pericardial effusions, direct mechani- cal interference was practised by one physician and an- other, till these means of attaining rapid and complete cure took their place as indispensable, and were extended from thoracic diseases to those of the abdominal and other inner parts formerly beyond the reach of direct therapeutics. Lister's discoveries brought these new methods to bear with a certainty and a celerity pre- viously undreamed of; and many visceral maladies, such as stone of the kidney or gall-bladder, perityphlitis, ovarian dropsy, and even cancer of the stomach — which in the earlier part of the 19th century were either fatal or crippling — are now taken promptly and safely in hand, and dealt with successfully. We have said that this advance is often quoted, not very wisely, to signify that in modern progress " medicine " has fallen behind surgery — as if the art of the physician were not one and indivisible. A disease which cannot be got at by one method is reached by another ; the division of the art being, as we have said, an unreal and mischievous survival of old and erroneous customs, perpetuated in England by a merely mechanical severance. That cer- tain Fellows of the College of Physicians have personally taken operative procedures in hand is some good omen that in time this schism may be healed.*~~

~~*In the department of abdominal disease progress has been made, not only in this enormous extension of means of cure by operative methods, but also by similar means for the verification of diagnosis. The first recogni- tion of a disease may be at a necropsy, but then usually by irresponsible pathologists ; it is another matter when the physician himself comes under rebuke for failing to seize a way to cure, which he might have discovered, while the chance remained to him, by section of the abdomen during life. The abdomen is still " full of sur- prises " ; and he who has most experience of this decep- tive region will have least confidence in expressing positive opinions in particular cases of disease without operative investigation. Besides the attainments men- tioned above, in respect of operative progress, many im- portant revisions of older rule-of-*~~

~~thumb knowledge have come about, and not a few other substantial discoveries. Among the revisions may be adduced the new accuracy of our knowledge of dyspepsia, attained by analytic investi- gations into the contents of the stomach at various stages of digestion. By physical signs, and by examining the contents of the viscus recovered, for instance, after "test meals," the defects, whether of this secretion or of that, and again of its motor activity, the state of the pyloric orifice, the volume of the sac, and even its position in the cavity of the abdomen, may be surmised or ascertained, and dealt with as far as may be ; so that the application of remedies after a mere traditional routine is no longer excusable. In our conceptions of the later stages of assi- milation and of excretion, with the generation of poisons (auto-intoxication) in the intestinal tract, there is still much obscurity and much guess-work ; but in some direc- tions positive knowledge has been gained, partly by the physiologist, partly by the physician himself. Of such are the better understanding of the functions of the liver in normal catabolism, in the neutralization of poisons absorbed from the intestines or elsewhere, in the causation of jaundice, and in diabetes (Naunyn, Pavy). Nor must we forget the unfolding of a new chapter of disease, in the~~

~~nosology of the pancreas. In diabetes this organ seems to play a part which is not yet precisely determined ; and one fell disease at least has been traced to a violent access of inflammation of this organ, caused perhaps by entry of foreign matters into its duct. The parts of the pancreas and spleen in digestion also are better understood, and this knowledge is turned to good effect in the interpretation of the motley group of dyspepsias and anaemias.~~

~~The peritoneum is no longer regarded with awe as inviolable; by modern methods, if not as manageable as other lymphatic sacs, it is at any rate accessible enough without substantial risk to life. Not only in its bacteriological relations are the conditions of peritonitis recognized in its various kinds, but also the state known as "shock" turns out to be largely mechanical, and avoidable by measures belonging in considerable part to this category. Thus, by the avoidance both of toxaemia and of shock, peritonitis and other dangers of the abdo- men, such as strangulations or~~

~~*intussusceptions of the bowels, formerly desperate, can in many cases be dealt with hopefully and efficiently.*~~

~~*Our knowledge of diseases of the kidneys has made no great advance since the time of Bright. In the sphere of physiology and in the interpretation of associated arterial diseases much obscurity still remains ; as, for instance, concerning the nature of the toxic substances which produce those bilateral changes in the kidneys which we call Bright's disease, and bring about the "uraemia" which is characteristic of it. Lardaceous disease, how- ever, here and in other regions, now appears to be due to the specific toxins of pyogenetic micro-organisms. In stone of the kidney a great advance has been made in treatment by operative means, and the formation of these stones seems to recent observers to depend less upon con- stitutional bent (gout) than upon unhealthy local condi- tions of the passages, which in their turn again may be due to the action of micro-organisms.*~~

~~*To Addison's descriptions of pernicious anaemia, and of the disease of the suprarenal capsules which bears his name, little has been added : but Hunter's researches may explain the causes of the former ; the latter proves to be tuberculous, and on its fall of blood pressure physiologists have thrown some light.*~~

~~*The secret of the terrible puerperal septicaemia was read by Semmelweiss (q.v.), wherein he proved himself to be the greatest of Lister's forerunners (see Listbe).*~~

~~*The diseases peculiar to women have received attention from early times, but little progress had been made in their interpretation till the 19th century. In the middle part of the century, by a natural exaggeration of the im- portance of newly-discovered local changes in the pelvic organs, much harm was done to women by too narrow an attention to the site, characters, and treatment of these ; that which in the physician was meddlesomeness becom- ing in the temperament of woman a morbid obsession. To Matthews Duncan we chiefly owe a saner and broader comprehension of the relative importance of the local and the general conditions which enter into the causation of uterine and ovarian disorders. For the success of opera- tive means in diseases of the pelvis, in*~~

~~*ovarian dropsy, in cancer of the uterus, and in other grave diseases of the region, a success which may be called stupendous, the reader is referred to the article on Surgebt.*~~

~~*In the subject of diseases of the skin much has been done, in the minuter observation of their forms, in the description of forms previously unrecognized, and in respect of causation and treatment. In the former line of research the comparison of observations in various climates and peoples has had some weight ; while in the better know- ledge of their causes their treatment has found permanent*~~

~~*advantage. Not only is the influence of bacteria in the causation of many of them newly revealed, but it is now recognized also that, even in skin diseases not initi- ated by microbic action, microbes play a considerable and often a determining part in their perpetuation ; and that the rules of modern aseptic surgery are applicable with no little success to skin therapeutics. We have learned that " constitutional " causes play a smaller part in them than was supposed, that a large number of diseases of the skin are local diseases, either initiated by local infection or perpetuated thereby, and that, generally speaking, they are to be cured by local means.*~~

~~*The diseases of children have not lacked the renewed attention, the successful investigation, and the valuable new lights which have been given to other departments of medicine. That infantile palsy is an infection, and that its unhappy sequels are now treated with more hope of restoration, has been indicated already. Infantile diarrhcsa has also been recognized as an infection (Ballard), and the means of its avoidance and cure ascertained ; the conditions of digestion in children are now far better understood, and many of theirmaladies, formerly regarded as organic or in- comprehensible, are referred to errors in diet, and cured or prevented by dietetic rules. Rickets, scurvy, and " tabes " may be instanced as diet diseases in children. Acute in- flammation of the ear, with its alarming extensions to the cerebral cavity, is now often dealt with*~~

~~*successfully by surgical means, and infected sinuses or encephalic ab-scesses are reached and cleansed. The origins, kinds, and processes of meningitis are more clearly distinguished, and referred each to its proper cause — for the most part bacterial.*~~

~~*As by the discovery of stethoscopy by Laennec a new field of medical science and art was opened up, so, more recently, inventions of other new methods of investigation in medicine have opened to us other fields of little less interest and importance. Of such is the ophthalmoscope, invented by Helmholtz in 1851. By the revelations of this instrument not only have the diseases of the eye been illuminated, but much light has been thrown also upon the part of the eye in more general maladies ; as, for instance, in syphilis, in diabetes, in kidney diseases, and in diseases of the brain (Bonders, von Graefe, and others). A remarkable help to the cure of headaches and other nervous disorders has come out of the better appreciation and correction of errors of refrac- tion in the eye. Radiography has done great things for surgery ; for medicine its services are already appreciable, and may prove more and more valuable hereafter. In 1879 the use of the spectroscope in medicine was pointed out by Dr M'Munn. By du Bois-Reymond, Remak, Mat- teucci, Duchenne, the value of electricity in medicine, greater in diagnosis perhaps than in therapeutics, was demonstrated. By the sphygmograph (Marey, 1863) at- tention was drawn to the physical features of the circu- lation, to the signs of degeneration of the arterial tree, and less definitely to the fluctuations of blood pressure ; but the kymographs of Ludwig and his pupils brought out these features far more accurately and completely, as we have said under the consideration of diseases of the heart. By these, and other instruments of precision, such as the thermometer, of which we have already spoken, the eminently scientific discipline of the measurement of functional movements, so diflcult in the complex science of biology, has been cultivated. By the laryngoscope, invented about 1850 by Manuel Garcia, the celebrated singing-master, and perfected by Czermak and others, the diseases of the larynx also have been brought into the general light which has been shed on all fields of dis- ease; and many of them, previously known more or less empirically, were submitted to precise definition and cure.*~~

~~*Of such we may cite tuberculosis of the larynx, formerly as incurable as distressing ; and " adenoids " — a disease revealed by intrascopic methods — which used to thwart and stifle the growth both of mind and body in children, but are now removed early and promptly, to the infinite advantage of the rising generation. To the value of stains in clinical diagnosis, especially in investigation of perver- sions of the blood in leucsemia, and so forth, we have already made some reference. The discovery of the Ront- gen rays has also extended the physician's power of vision, as in aortic aneurysm, and other thoracic diseases.*~~

~~*By photography and diagrammatic records the clinical work of hospital wards has been brought into some better definition, and teaching made more accurate and more im- pressive. The separation of the alkaloids belongs rather to the earlier part of the 19th century, but the adminis- tration of these more accurate medications by means of hypodermic injection (see Thekapeutics) belongs to the latter. The ancient practice of transfusion has been placed on a more intelligible footing, and made more manageable as a means of cure or relief. Finally, calcu- lation by statistics (Farr and others) has been brought into line with other scientific methods : although the method is a difiBcult one, and one full of pitfalls for the unwary, yet when perfected and the sources of its materials puri- fied, its services will appear more and more indispensable.*~~

~~*Among the achievements of the medicine of the 19th century, the growth of the medical press must not be forgotten. In England, by the boldness of the Lancet (founded in 1823) the tyranny of prescription, inveterate custom, and privilege abused was defied and broken down ; freedom of learning was regained, and promotion thrown open to the competent, independently of family and pro- fessional status. For the record and diffusion of rapidly growing knowledge, learned societies, universities, and laboratories, greatly increased in number and activity, issue their transactions in various fields ; and by means of year-books and central news-sheets the accumulation of knowledge is organized and made accessible.*~~

~~*It is interesting to find that, with all this activity in the present, reformed methods of research and verifica- tion are not confined to the work of the*~~

passing day ; in the brilliant achievements of modern research and recon- struction the maxim that " Truth is the daughter of Time " has not been forgotten. In the field of the History of Medicine the work of scholars such as Greenhill and Creighton in England, Daremberg in France, and Haeser and Hirsch in Germany, will prove to our children that tradition was as safe in our hands as progress itself.

(t. c. A.)

M ed i na, a city of Orleans county, New York, U.S.A., in the north- western part of the state, on the Erie canal and the New York Central and Hudson River railroad. Its site is level and its plan regular. It has varied manu- factures, and there are quarries of Medina sandstone in the vicinity. Population (1890), 4492 ; (1900), 4716, of whom 857 were foreign-born and. 30 were negroes.

Medina, Jose Toribio (1852), Chilian bib- liographer, was born at Santiago in 1852, and was edu- cated for the bar. His first publication, when a very young man, was a metrical translation of Longfellow's Evangeline. At the early age of twenty-two he was appointed secretary to the legation at Lima. After his return he published a history of Chilian literature (1878), and a work upon the aboriginal tribes (1884). In this latter year he was appointed secretary of legation in Spain, and availed himself of the opportunity of examining the treasures of the old Spanish libraries. These researches, repeated on occasion of subsequent visits to Spain, and

also to France and England, enriched him with a mass of historical and bibliographical material, which he turned to account in a series of publications evincing almost incredible activity and industry. Among them may be specially mentioned the Biblioteca Hispano- Americaua, a verbatim catalogue of all books and pamphlets relating to Spanish America printed in Spain ; the Biblioteca Hispano-Cliilena, a similar work, com- menced in 1897; the standard and magnificent history of

~~*printing in the La Plata countries (1892) ; compre- hensive works on the Inquisition in Chile, Peru, and the Philippines ; and the standard treatise on South American medals (1899). In addition, Senor Medina produced the fullest bibliographies yet attainable of books printed at Lima, Mexico, and Manila, and a number of memoirs and other minor writings. No other man had rendered anything like the same amount of service to the literary history and bibliography of the Spanish colonies. Most of his later works were printed at his own house.*~~

~~*Medina Sidoniaf a town and railway station of Spain, in the province of Cadiz. The population in 1897 was 10,929. It is the centre of the trade of the sur- rounding district in agricultural products, particularly wheat, olives, and oats, and contains two parish churches, several convents, a large town hall, a fine Gothic church, and the ancestral palace of the dukes of Medina Sidonia, the title conferred by John II. in 1445 on Juan Alonzo de Guzman, count of ISTiebla, a descendant of the famous Alonzo Perez de Guzman el Bueno. Prom this house sprang a long line of statesmen, generals, colonial viceroys, including the Duke Alonzo Perez de Guzman, captain- general of the ocean and commander of the Invincible Armada that came to grief on the shores of Great Britain. The titles and grandeeships passed, in accordance with Castilian law, by marriage of a daughter and heiress in 1777, to the marquess of Villafranca, and have since remained in that noble house.*~~

~~*Medinet-el-Fayum, a city of Middle Egypt, capital of the province of Payum, connected by a branch line 5 miles long with El Wasta, which is a station on the Nile Valley railway, 66 miles from Cairo. It is a great agricultural centre, with a population which increased from 26,000 in 1882 to 40,000 in 1900, and has several large bazaars, mosques, baths, and a much-frequented weekly market. The town stands on one of the two main branches of the Bahr Yusuf, which conduct the flood waters of the Nile to the Fayum, and have here the aspect of natural rivers. The neighbouring mounds mark the site of Arsinoe (Crocodilopolis), that is, the Egyptian city of Shat, where was worshipped the sacred crocodile kept in Lake Moeris.*~~

Mediterranean Sea. — The Mediterranean is all that remains of a great ocean which at an early geological epoch, before the formation of the Atlantic, encircled half the globe along a line of latitude. This ocean, already diminished in area, retreated after Oligocene times from the Iranian plateau, Turkestan, Asia Minor, and the region of the north-west Alps. Next the plains of eastern Europe were lost, then the Aralo-Caspian region, southern Russia, and finally the valley of the Danube. The " Mediterranean region," as a geographical unit, includes all this area ; the Black Sea and the Sea of Marmora are within its submerged portion, and the climate of the whole is controlled by the oceanic influences of the Mediterranean Sea. Prof. Suess, to whom the above description is due, finds that the Mediterranean forms no exception to the rule in affording no evidence of elevation or depression within historic times; but it is

noteworthy that its present basin is remarkable in Europe for its volcanic and seismic activity. Submarine earth- quakes are in some parts sufficiently frequent and violent as to seriously interfere with the working of telegraph cables. Suess divides the Mediterranean basin into four physical regions, which afford probably the best means of description : — (1) The western Mediterranean, from Gibraltar to Malta and Sicily, enclosed by the Apennines, the mountains of northern Africa, and of southern and south-eastern Spain {Cordill&re hkique). (2) The Adriatic, occupying the space between the Apennines and the Dinaric group (Suess compares the Adriatic to the valley of the Brahmaputra). (3) A part surrounded by the fragments of the Dinaro-Taurus arch, especially by Crete and Cyprus. This includes the .^Egean and the Black Sea, and its margin skirts the south coast of Asia Minor. These three parts belong strictly to Eurasia. (4) Part of the coastal region of Indo-Africa, terraced downwards in successive horizontal planes from the Shot, reaching the sea in the Little Syrte, and continuing to the southern depressions of Syria. Malta and Gozo are the only islands of the Mediterranean which can be associated with this section, and, per contra, the mountain chain of north-west Africa belongs to Eurasia. Murray (1888) estimates the total area of the Mediterranean at 813,000 square miles. Karstens (1894) breaks it up into parts as follows : —

Western Mediterranean

~~841,593 sq. km~~

~~Sicilian-Ionian basin .~~

~~. 767,658 „~~

~~Greece and Levant basin .~~

~~. 769,652 „~~

~~Adriatic Sea~~

~~. 130,656 „~~

~~Total~~

~~2,509,559~~

~~Murray estimates the total surface of the Mediterranean drainage area, with which must be included the Black Sea, at 2, 934,500 square miles, of which 1,420,800 are Eurasian and 1,613,700 are African. The principal rivers entering the Mediterranean directly are the Nile from Africa, and the Po, Rhone, and Ebro from Europe.~~

~~The physical divisions of the Mediterranean given above hold good in describing the form of the searbed. The western Mediterranean is cut oif by a bank crossing the narrow strait between Sicily and Cape Bon, usually known as the Adventure Bank, on which the depth is nowhere 200 fathoms. The mean depth of the western basin is estimated at 881 fathoms, and the deepest sounding recorded is 2040 fathoms. In the eastern Mediterranean the mean depth is nearly the same as in the western basin. The Sicilian-Ionian basin has a mean depth of 886 fathoms, and the Levant basin, 793 fathoms. Deep water is found close up to the coast of SicUy, Greece, Crete, and the edge of the African plateau. The steepest slope observed occurs off the island of Sapienza, near Navarino, where 1720 fathoms has been obtained only 10 miles from land. In 1897 the ship Washington obtained depths of 2220 fathoms in the middle of the eastern Mediterranean, and the Austrian expeditions in the~~

~~*Pola discovered in the "Pola Deep" (36° 44' N., 21° 45' E.), south-west of Cape Matapan, a maximum depth of 2406 fathoms. Between these two deep areas a ridge runs in a north- westerly direction 550 fathoms from the surface — possibly a projection from the African plateau. Another bank 1100 fathoms from the surface runs south from the east end of Crete, separating the Pola Deep from the depths of the Levant basin, in which a depth of 1960 fathoms was recorded near Makri on the coast of Asia Minor. The later expedition of the Pola discovered the "Rhodes Deep" (36° 5' N., 28° 36' E.), with a maximum depth of 2110 fathoms : this deep is closed to the south-east by a ridge running south-east, over which the depth is 1050 fathoms. Off the coast of Syria the Pola obtained four soundings of more than 1100 fathoms, and between Cyprus*~~

~~*and the coast of Asia Minor only two over 660 fathoms. Murray gives the following figures for the areas and volumes of the Mediterranean at different depths : —*~~

~~*Depth.*~~

~~*Area.*~~

~~*Volume.*~~

~~*Fathoms.*~~

~~*Sq. Miles.*~~

~~*Cub. Miles*~~

~~*0- 100 .*~~

~~*201,300*~~

~~*80,950*~~

~~*100-500 .*~~

~~*251,650*~~

~~*220,850*~~

~~*500-1000 .*~~

~~*81,300*~~

~~*189,200*~~

~~*1000-2000 .*~~

~~*263,250*~~

~~*217,050*~~

~~*Over 2000 .*~~

~~*15,500*~~

~~*1,750*~~

~~*813,000*~~

~~*709,800*~~

~~*which gives a mean depth over all of 768 fathoms, following table is due to Karstens : —*~~

~~*Western Mediterranean Sicilian-Ionian basin . Levant Adriatic Sea*~~

~~*The*~~

~~*Volume.*~~

~~*Mean Depth*~~

~~*Cub. Km.*~~

~~*Fathoms.*~~

~~*1,356,512*~~

~~*881*~~

~~*1,242,549*~~

~~*885*~~

~~*1,116,599*~~

~~*793*~~

~~*31,844*~~

~~*133*~~

~~*Meteorology. — As already stated, the "Mediterranean region " forms a distinct climatic unit, due to the Mediter- ranean Sea. The prevailing winds in this region, which the sea traverses longitudinally, are westerly, but the sea itself causes the formation of bands of low barometric pressure during the winter season, within which cyclonic disturbances frequently develop, while in summer the region comes under the influence of the polar margin of the tropical high-pressure belt. Hence the Mediterranean region is characteristically one of winter rains, the dis- tinctive feature becoming less sharply defined from south to north, and the amount of total annual fall increasing in the same direction. The climate becomes, on the whole, more continental in type from west to east, but there are great local irregularities — the elevated plateaux of Algeria and Spain cause a rise of pressure in winter and delay the rainy seasons : the rains set in earlier in the west than in the east, and the total fall is greater. Temperature varies greatly, the annual mean varying from 56° E. to 77° P. In the west the Atlantic influence limits the mean annual range to about 10°-12° F., but in the east this increases to 36° and even 40°. Autumn is warmer than spring, especially in the coastal regions, and this is exaggerated in the eastern region by local land winds, which replace the cool sea-breezes of summer : overcoats are ordinarily worn in Spain~~

~~*and Italy till July, and are then put aside till October. Local winds form an important feature in nearly all the coast climates of the Mediterranean, especi- ally in winter, where they are primarily caused by the rapid change of temperature from the sea to the snow-clad hinter- lands. Cold dry winds, often of great violence, occur in the Rhone valley (the Mistral), in Istria, and Dalmatia (the Bora), and in the western Caucasus. In summer a north- west "trade" wind, the Maestro, occurs in the Adriatic. The Sirocco is a cyclonic wind characteristic of the winter rainy season ; in the Adriatic it is usually accompanied by cloud and moisture, often by rain. In Sicily and southern Italy the Sirocco occurs at all seasons ; it is a dry, dusty wind from south-east or south-west. The dust is chiefly of local origin, but partly comes from the Sahara. Similar winds are met with in Spain (the Leveche), but they reach their greatest development in the Simooms of Algeria and Syria, and the Khamsin of Egypt.*~~

~~*Temperature. — The mean surface temperature of the waters of the Mediterranean falls from south-east, where it is over 70°, to north-west, the average at the coast of the Gulf of Lyons being 60°. The isothermal of 65° runs from Gibraltar to the north of Sardinia, and thence by the Strait of Messina to the Gulf of Corinth. A similar dis- tribution is found 100 fathoms from the surface, temperar ture falling from 60° in the Levant to 55° east of Gibral- tar. At 200 fathoms temperature falls in the same way*~~

~~*from 58° to 65°, but below 260 fathoms temperatures are practically uniform to the bottom, 55-5° in the western basin and 66-5° in the eastern. The bottom temperature observed in the Pola Deep was 66-3°.*~~

~~*Salinity. — In the extreme west the salinity of the sur- face water is about 36-3 per mille, and it increases east- wards to 37-6 east of Sardinia and 39-0 and upwards in the Levant. Observations of salinity in the depths of the western Mediterranean are very deficient, but the average is probably between 38-0 and 38-6. In the east- ern basin the Pola expedition observed salinities of 38-7 to 39-0 to the east of a line joining Cape Matapan with Alexandria, and 38-2 to 38-7 to the west of it. The Salter waters apparently tend to make their way west- wards close to the African coast, and at the bottom the highest salinities have been observed south of*~~

~~*Crete. Evnitzki states that the saltest water of the whole basin occurs in the JUgean Sea.*~~

~~*Circulation. — There is little definite circulation of water within the Mediterranean itself. In the straits joining it with the Atlantic and the Black Sea the fresher surface waters of these seas flow inwards to assist in making good the loss by evaporation at the surface of the Medi- terranean, and in both cases dense water makes its way outwards along the bottom of the channels, the outflow- ing currents being less in volume and delivery than the inflowing. Elsewhere local surface currents are devel- oped, either drifts due to the direct action of the winds, or streams produced by wind action heaping water up against the land, but these nowhere rise to the dignity of a distinct current system, although they are often suf5- cient to obliterate the feeble tidal action characteristic of the Mediterranean. Dr batterer, the chemist of the Pola expeditions, has expressed the opinion that the poverty of the pelagic fauna is solely due to the want of circulation in the depths.*~~

~~*Deposits. — A great part of the bottom of the Mediter- ranean is covered with blue mtids, frequently with a yel- low upper layer containing a considerable proportion of carbonate of lime, chiefly shells of pelagic Foraminifera. In many parts a calcareous or silicious crust, from half an inch to three inches in thickness, is met with; and Natterer suggested that the formation of this crust may be due to the production of carbonate of ammonium where deposits containing organic matter are undergoing oxidation, and the consequent precipitation of carbonate of lime and other substances from the waters nearer the surface. This view, however, has not met as yet vnth very general acceptance. (h. n. d.)*~~

~~*Meerane, a town in Germany, 9 miles by rail north of the town and in the circle of Zwickau, kingdom of Saxony; station on the Gossnitz-Glauchau railway. It has real, commercial, and technical schools, and is one of the most important places in Germany for the manufac- ture of woollens and mixed cloths, having, in addition to work done in houses, 9 weaving mills, a worsted-spinning mill, and other factories. Population (1890), 22,446;*~~

~~*(1901), 23,797.*~~

~~*Meerut, a city, district, and division of British India, in the North- West Provinces. The city is half-way be- tween the Ganges and the Jumna, and has two stations on the North- Western railway, 37 miles north-east from Delhi. Population (1881), 99,965; (1891), 119,390; (1901), 118,642; municipal income (1897-98), Rs.2,06,111, mainly derived from octroi ; incidence of taxation, E.l : 2 : 1 per head; registered death-rate (1897), 357 per thousand. It is the headquarters of a military d.ivision, with accom- modation for horse and field artillery, British and native cavalry and infantry. The aided college, opened in 1895, had 63 students in 1896-97. There are 3 high schools,*~~

~~*and 25 printing-presses, most of which issue a vernacular newspaper, besides 3 literary associations. The municipal water-works provides 7 gallons a day of filtered water per head, at a total cost of about 6 annas per thousand gallons.*~~

~~*The district of Meertjt forms part of the upper Doab, or tract between the Ganges and the Jumna, extending from river to river. Area, 2370 square miles; population (1881), 1.313,137; (1891), 1,391,458; (1901), 1,539,917, showing an increase of 6 per cent, between 1881 and 1891, and of 10-7 per cent, between 1891 and 1901 ; average density, 649 persons per square mile. The land revenue and rates were Rs.26,31,762, the incidence of assessment being R. 1 : 7 : 5 per acre ; the cultivated area in 1896-97 was 1,068,375 acres, of which 265,912 were irrigated, including 172,254 from Government canals; number of police, 3009 ; number of vernacular schools, 294, with 8119 pupils; registered death-rate (1897), 27-8 per thousand. The principal crops are wheat, pulse, millet, sugar-cane, cotton, and indigo. There are 63 indigo factories, with an out-turn valued at Rs.4,58,000. The district is watered by the eastern Jumna canal, and also by two branches of the*~~

~~*Ganges canal. It is traversed by the North-Western railway, and also contains Ghaziabad, the terminus of the East Indian system, whence a branch runs to Delhi and another (under construction) to Moradabad.*~~

~~*The division of Meerut comprises the northern portion of the Doab. It consists of the six districts of Dehra Dun, Saharanpur, Muzaffamagar, Meerut, Bulandshahr, and Aligarh. Area, 11,326 square miles; population (1881), 5,141,204; (1891), 5,326,833; (1901), 5,983,302, showing an increase of 12-3 per cent, between 1891 and 1901 ; average density, 628 persons per square mile.*~~

~~*Megalopolis. — The site of Megalopolis was ex- cavated by members of the British School at Athens in the years 1890-92. No early remains were to be expected, since the city was founded by Epaminondas in 370 b.c. to unite the scattered Arcadians as a counterpoise to the power of Sparta ; but on the other hand, the description of Pausanias indicated that the town was laid out on a plan specially adapted to the federal capital, and this descrip- tion is so clear and explicit that it enables Curtius, in his*~~

~~*MEGALOPOLIS.*~~

~~*By permission from plans by R.W.Schultz & W.Loring in "Excavations at Megalopolis." (Socie^ ioz the Fromoticm 0/ Hellenic Studies.)*~~

~~*Walker & Cockerell sc.*~~

~~*Peloponnesos, to give a conjectural plan that was found to tally in most respects with the reality. The town was divided into two approximately equal parts by the river Helisson, which flows through it from east to west. The line of the walls may still be traced, partly by extant remains, partly by the contours it must have followed, and confirms the estimate of Polybius that they had a circuit of 60 stades or about 5|- miles. It is difficult to see how the river bed, now a broad and shingly waste, was dealt with in ancient times; it must have been embanked in some way, but there are no remains to show whether the fortification wall was carried across the river at either end, or along the parallel embankments so as to make two separate enclosures. There must have been, in all probability, a bridge to connect the two halves of the city, but the foundations seen by Leake and others, and commonly supposed to belong to such a bridge, proved to be only the substructures of the precinct of Zeus Soter. The buildings to the north of the river were of a municipal character, and*~~

~~were grouped round the square agora. One, of which the complete plan has been recovered, is the~~

~~portico of Philip, a splendid building, which bounded the agora on the north ; it was 300 feet long, with three rows of columns running its whole length, three in the outer line to each one in the two inner lines ; it had a slightly projecting wing at either end. At the south-west of the agora was found the precinct of Zeus Soter : it consists of a square court surrounded by a double colonnade, and faced on the west side by a small temple ; on the east side was an entrance or propylaeum approached by a ramp. In the midst of the court was a great substructure which has been variously interpreted as an altar or as the base of the great group of Zeus and Megalopolis, which is recorded to have stood here. North of this was the Stoa Myropolis, forming the east boundary of the agora, and, between this and the Stoa of Philip, the Archeia or municipal ofB.ces. These buildings were of various dates, but seem all to fit into a harmonious plan. The buildings on the south and west of the agora have been almost entirely destroyed by the Helisson and a tributary brook. On the south bank of the river were the chief federal buildings, the theatre (noted by Pausanias as the largest in Greece),~~

~~and the Thersilion or parliament hall of the ten thousand Arcadians. These two buildings form part of a common design, the great portico of the Thersilion facing the orchestra of the theatre. As a consequence of this arrangement, the plan of the theatre is abnormal. The auditorium has as its lowest row of seats a set of "thrones " or ornamental benches, which, as well as the gutter in front, were dedicated by a certain Antiochus ; the orchestra is about 100 feet in diameter; and in place of the western parados is a closed room called the Scano- theca. The chief peculiarity, however, lies in the great portico already mentioned, which has its base about 4 feet 6 inches above the level of the orchestra. It was much too lofty to serve as a proscenium ; yet, if a proscenium of the ordinary Greek type were erected in front, it would hide the lower part of the columns. Such a proscenium was actually erected in later times ; and~~

~~*beneath it were the foundations for an earlier wooden proscenium, which was probably erected only when required. In later times steps were added, leading from the base of the portico to the level of the orchestra. The theatre was probably used, like the theatre at Athens, for political assemblies ; but the adjoining Thersilion provided covered accommodation for the Arcadian ten thousand in wet weather. It is a building unique in plan, sloping up from the centre towards all sides like a theatre. The roof was supported by columns that were placed in lines radiating from the centre, so as to obscure as little as possible the view of an orator in the position from all parts of the building ; there were two entrances in each side. It needs but a little imagination to appreciate the public buildings of Megalopolis as a splendid and unique example of federal and municipal architecture on a scale worthy of the principles which they represented.*~~

~~*See Excavations at Megalopolis (E. A. Gardner, W. Loring, G. 0. Kiohards, W. J. Woodhouse ; Architecture, by K. W. Schultz).—Supplementary Paper issued by the Society for the Promotion of HHellenic Studies, 1892 ; Journal of HHellenic Studies, xiii. p. 328, A. G. Bather; p. 319, E. F. Benson ("Thersilion") ; 1898, p. 15, J. B. Bury ("Double City"); Dorpfeld ("Das Griechische Thea^ ter"); Pnchstein, " Griechische Buhne " (Theatre). (b. Gr.)*~~

~~*Meiderich, a commune of Prussia, in the Rhine pro- vince, 2^ miles north-east of Euhrort, whose harbour is in great part within its confines. Large iron and steel works, coal-mines, saw-mills, brick-works, machine-shops, and rope-walks furnish the principal occupations of the in- habitants. Population (1885), 16,105 ; (1900), 33,684.*~~

~~*Meiktila, a division and district in Upper Burma. The division includes the districts of Meiktila, Kyauksfe, Yamfethin, and Myingyan, with a total area of 10,854 square miles, and a population of (1891) 902,370, and (1901) 994,432, showing an increase of 10-2 per cent., and giving a density of 91 inhabitants to the square mile. There were 3573 villages in 1898-99, paying a revenue of Es. 23,23,193. All but a small portion of the division lies in the so-called rainless district or dry zone, and the bulk of the cultivation is dependent on irrigation.*~~

~~*Meiktila District is the most easterly of the districts in the dry zone, and has an area of 2178 square miles. It lies between Kyauksfe, Myingyan, Yamfethin, and on the east touches the Shan States. The general character of the district is that of a slightly undulating plain, the gentle slopes of which are composed of black " cotton " soil and are somewhat arid. The only hills above 300 feet are on the slopes of the Shan hills. The lake is the chief feature of the district. It is artificial, and according to Burmese legend was begun 2400 years ago by the grandfather of the Buddha Gautama. It is 7 miles long, averages half a mile broad, and covers an area of 3^ square*~~

~~*miles. Its depth is considerable, and with the Minhla and other connected lakes it irrigates a large extent of country.*~~

~~*There are small forest reserves, chiefly of cutch, in the dis- trict. Large numbers of cattle are bred. The chief agricultural products are, in their order, rice, sesamum, cotton, peas, maize, millet, and grain. The population of the district was (1891) 206,794; and (1901) 252,702, which gives an average of 116 to the square mile. Famines in 1891, 1895, and 1896 led to con- siderable emigration. Many families have returned, but the population is thought to have decreased. The climate is healthy except in the sub-montane townships. The temperature rises to 100° and over between the months of March and June, and the mean minimum in January is about 61°. The rainfall is very uncertain. The highest recorded has been 36-79 inches in 1893, and the lowest 25-59 in 1891. The district has the name of being the healthiest in Upper Burma. There were 1068 villages in 1898-99, paying Es.4,67,190 revenue. The vast majority of the population are Buddhists. The headquarters town, Meiktila, stands on the banks of the lake. It had a population of 4685 in 1891. A wing of a British regiment is stationed here. A branch railway connects it at Thazi station with the Kangoon-Mandalay line, and continues westward to its terminus on the Irrawaddy at Myingyan.*~~

~~*Meilhac, Henri (1831-1897), French dramatist, was born in Paris in 1831, and while still a young man began writing fanciful articles for the newspapers and vaudevilles for the theatres, in a vivacious boulevardier spirit which brought him to the front. About 1860 he met Ludovic Halevy,*~~

~~*and the two began a system of collaboration in writing for the stage which lasted for twenty years. An account of their work is given under Halevt. Meilhac wrote a few pieces also with lesser collaborators. In 1888 he was elected to the Academy. He died at Paris in 1897.*~~

~~*Meiningen, a town of Germany, capital of the duchy of Saxe-Meiningen, on the right bank of the Werra, embowered in forests, 39 miles south of Eisenach by rail. In the town are the Henneberg House, with the collections of the Henneberg Antiquarian Society ; an arsenal, hall of the diet, and high school (with natural history collection). The Meiningen Company of actors, which won unstinted applause for the general level of excellence it attained and the effective tout ensemble of its staging, was dissolved in 1890 after a career of sixteen years. A new parish church was built in 1888. Busts of Brahms (1899) and Jean Paul (who lived here in 1801-03) adorn the town. Population (1885), 11,448 ; (1900), 14,518.*~~

~~*Meissen, a town of Germany, at the influx of the Triebisch and the Meisse into the Elbe, 14 miles by rail north-west by west of the town and in the circle of Dresden, kingdom of Saxony. It has a progymnasium, a real school and a commercial school, and a monument to Bottger (1892). The royal porcelain manufactory employs from 700 to 800 workmen. Population (1890), 17,875 ; (1900), 20,123. On 1st January 1901 Colin (11,309 in 1900), on the Elbe, was incorporated with INIeissen, giving the latter a total population of 31 ,432.*~~

~~*Meissonier, Jean Louis Ernest (1815-1891), French painter, was born at Lyons on 21st February 1815. From his schooldays he showed a marked taste for painting, to which some early sketches, dated 1823, bear witness. After being placed with a druggist, he obtained leave from his parents to become an artist, and, owing to the recommendation of a painter named Potier, himself a second class Prix de Rome, he was admitted to Leon Cogniet's studio. He paid short visits to Rome and to Switzerland, and exhibited in the Salon of 1831 a picture then called " Les Bourgeois Flamands " (" Dutcli Burghers "), but also known as " The Visit to the Burgo- master," subsequently purchased by Sir Richard Wallace, in whose collection (at Hertford House, London) it is, with fifteen other examples of this painter. It was the first*~~

~~“1814.” By Meissosiei:. (From a FJwtogmph by Biaun, Clement, and Co., Dornach (Alsace), Paris, and New Yorli.)~~

~~“La Rixk.” I’.y Meisso^ieb.~~

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~~ME KONG~~

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~~attempt in France in the particular genre which was destined to make Meissonier famous : microscopic painting — miniature in oils. Working hard for daily bread at illustrations for the publishers — Curmer, Hetzel, and Dubocher — he also exhibited at the Salon of 1836 the ” Chess Player ” and the ” Errand Boy.” After some not very happy attempts at religious painting, he returned, under the influence of Chenavard, to the class of work he was born to excel in, and exhibited with much success the “Game of Chess” (1841), the “Young Man playing the ‘Cello” (1842), “The Painter in his Studio” (1843), “The Guard Koom,” the “Young Man looking at Draw- ings,” the “Game of Piquet” (1845), and the “Game of Bowls ” — works which show the finish and certainty of his technique, and which assured his success. After his ” Soldiers ” (1848) he began ” A Day in June,” which was never finished, and exhibited “A Smoker” (1849) and ” Bravos ” (” Les Bravi,” 1852). In 1855 he touched the highest mark of his achievement with ” The Gamblers ” and ” The Quarrel ” (” La Eixe “), which was presented by Napoleon III. to the English Court (see Plate). His triumph was sustained at the Salon of 1857, when he exhibited nine pictures and drawings ; among them the ” Young Man of the Time of the Regency,” ” The Painter,” ” The Shoeing Smith,” ” The Musician,” and ” A Reading at Diderot’s.” To the Salon of 1861 he sent ” The Em- peror at Solferino,” ” A Shoeing Smith,” ” A Musician,” “A Painter,” and “M. Louis Fould”; to that of 1864 another version of “The Emperor at Solferino,” and “1814" (see Plate). He subsequently exhibited “A Gamblers’ Quarrel” (1865), and “Desaix and the Army of the Rhine ” (1867). Unspoiled by his success, Meis- sonier continued to work with elaborate care and a scrupulous observation of nature. Some of his works, as for instance his ” 1807,” remained ten~~

~~*years in course of execution. To the great Exhibition of 1878 he contributed sixteen pictures : the portrait of Alexandre Dumas which had been seen at the Salon of 1877, " Cuirassiers of 1805," " A Venetian Painter," " Moreau and his Staff before Hohenlinden," a "Portrait of a Lady," the "Road to La Salice," "The Two Friends," "The Outpost of the Grand Guard," "A Scout," and " Dictating his Memoirs." Thenceforward he exhibited less in the Salons, and sent his works to smaller exhibi- tions. Being chosen as president of the Great National Exhibition in 1883, he was represented there by such works as "The Pioneer," "The Army of the Rhine," " The Arrival of the Guests," and " Saint Mark." On 24th ilay 1884 an exhibition was opened at the Petit Gallery of Meissonier's collected works, including 146 examples. As president of the jury on painting at the Exhibition of 1889 he contributed some new pictures. In the following year the New Salon was formed (the National Society of Fine Arts), and Meissonier was the president. He exhibited there in 1890 his picture " 1807 " ; and in 1891, shortly after his death, his " Barricade " was displayed in the same place. A less well-known class of work than his painting is a series of etchings : " The Last Supper," " The Skill of Vuillaume the Lute Player," " The Little Smoker," "The Old Smoker," the "Prepara^ tions for a Duel," " Anglers," " Troopers," " The Reporting Sergeant," and " Polichinelle," in the Hertford House collection. He also tried his hand at lithography, but the prints are now scarcely to be found. Of all the painters of the century, Meissonier was one of the most fortunate in the matter of payments. His " Cuirassiers," now in the late due d'Aumale's collection at Chantilly, was bought from the artist for £10,000, sold at Brussels for £11,000, and finally resold for £16,000. Besides his genre portraits, he painted some others: those of "Doctor Lefevre," of "Chenavard," of " Vanderbilt," of "Doctor Guyon," and*~~

~~*of "Stanford." He also collaborated with the painter Franqais in a picture of " The Park at St Cloud." In 1838 Meissonier married the sister of ^I. Steinheil, a painter. Meissonier was attached by Napoleon III. to the Imperial Staff, and accompanied him during the campaign in Italy and at the beginning of the war in 1870. During the siege of Paris in 1871 he was colonel of a marching regiment. In 1840 he was awarded a third-class medal, a second-class medal in 1841, first-class medals in 1843 and 1844, and Medals of Honour at the great exhibitions. In 1846 he was*~~

appointed Knight of the Legion of Honour and promoted to the higher grades in 1856, 1867 (29th June), and 1880 (12th July), receiving the Grand Cross in 1889 (29th October). He nevertheless cherished certain ambitions which remained unfulfilled. He hoped to become a professor at the !lScole des Beaux Arts, but the appointment he desired was never given to him. On various occasions, too, he aspired to be chosen deputy or made senator, but he was not elected. In 1861 he succeeded Abel de Pujol as member of the Academy of Fine Arts. On the occasion of the centenary festival in honour of Michael Angelo in 1875 he was the delegate of the Institute of France to Florence, and spoke as its representative. Meissonier was in his day an admirable draughtsman upon wood, his illustrations to Les Contes Bimois (engraved by Lavoignat), to Lamartine's Fall of an Angel, to Paul and Virginia, and to 77ie French painted by Tliemselves being among the best known. The leading engravers and etchers of France have been engaged upon plates from the works of Meis- sonier, and many of these plates command the highest esteem of collectors. Meissonier died in Paris on 21st January 1891. His son, Jean Charles Meissonier, also a painter, was his father's pupil, and was admitted to the Legion of Honour in 1889.

See Alexandre. Histoire de la peinture militaire en France. Paris, 1891. — Lacrens. Notice sur Meissonier. Paris, 18'.i2. — Greabd. Meissonier. Paris and London, 1897. — T. G. Du.mas. Maitres moclernes. Paris, 1884. — Ch. Foementin. Meissonier, sa vie — son oeitrre. Paris, 1901. — J. W. Mollett. Illustrated Bio- graphies of Modern Artists : Meissonier. London, 1882. (h. Fe.)

Me Kong, or Me Nam Kong (pronounced Kawng), sometimes known as the Cambodia river, the great river of Indo-China, and one of the most interesting of the remarkable rivers of south-eastern Asia which have their origin in the Tibetan highlands. Rising in about 33° 17' N. and 94° 25' E., it is known as the Gergu river, and flows south-eastwards through Chinese Tibetan territories to Chiamdo, on the great east and west caravan route from China to Lhasa. At this point it is about 10,000 feet above sea-level. From here, under the name Nam Chu or Chiamdo Chu, it flows southwards through little-known mountain wastes. Below Dayul in lat. 29° it is known by the Chinese name of Lantsan Kiang. For the

next 300 miles of its course the Lantsan Kiang, or, as it soon becomes known among the Tai peoples inhabiting its rugged valley, the Me Kong, is very little known to us. 'The river flows beneath bare and rocky walls. A few scattered villages of Lusus and Mossos exist in this region : there is no trade from north to south. In 25° 18' N. the Tali-Bhamo caravan route, which has been so ably described by Colborne Baker, crosses the river by one of those iron suspension bridges which are a feature of Yunnan, at a height of 4700 feet above sea-level. From this point to Chieng or Keng Hung, the head of the old confederacy of the Sibsawng Punna or Twelve States, it is little known ; the fact that it falls some 900 feet for each degree of latitude is sufficient indication of the character of the river. Between the 22nd and 23rd parallels the Burma Yunnan railway, which is being pushed up

through the Shan States, will cross into Chinese territory. Under the provisions of the Anglo-French agreement of January 1896, from the Chinese frontier southwards to the mouth of the ISTam Huok the Me Kong forms the frontier between the British Shan States on the west and the territories acquired from Siam by France in 1893. By the treaty of 1893, from that point southwards to about 13° 30' N. it is also the frontier between French Indo- China and Siam, and a special zone extends 25 kilometres inland from the right bank, within which the Siamese Government agreed not to construct any fortified port or maintain any armed force. Below the Siamese Shan town of Ghieng Sen the river takes its first great easterly bend to Luang Prabang, being joined by some rather important tributaries. This portion of the river is considerably obstructed by rapids. The country is mountainous, and the vegetation at the lower heights begins to assume a thoroughly tropical aspect. From Lu ang Prabang the river cuts its way southwards for two degrees through a lonely jungle country among fast-receding hills of low elevation. From Chieng Kan the river again turns eastwards along the 18tli parallel, forcing its way through one of the most serious rapid-barriers with which

~~*the native navigator has to contend, receiving some important tributaries from the highlands of Tung Chieng Kum and Chieng Kwang, the finest country in Indo-China. In 104° E. the river resumes a southerly course through a country but thinly peopled. At Kemarat (16° N.) the fourth serious rapid- barrier occurs, some 60 miles in length, and the last at Kawng in 14° N. From here to its outfall in the China Sea the great river winds for some 400 miles through the French territories of Cambodia and Cochin China, and to its annual overflow these countries owe the extraordinary fertility of their soil. The uselessness of this great river as a commercial highway has been amply demonstrated, and it is noticeable that, with the exception of Luang Prabang and Pnompenh, there is not a single populous town along the whole 2000 miles of its stormy course.*~~

~~*Authorities. — ^Major Bower. Geogr. Journal, vol. i. No. 5. — WooDviLLE RpcKHiLL. Geogv. Journal, vol. iii. No. 5. — Gaeniek, Fkancis.- Voyage d' Exploration en Indo-Chine. — CoLBORNE Baker. Report of the Grosvenor Mission, in B. G. 8. Suppl. Papers, vol. i. pt. i. — Cooper. Travels of a Pioneer of Commerce. 1871. — L'Aebe Desgodins. Le Thibet. — Henri MouHOT. Travels in Indo-China. — Prince Henri d'Orleans. Geogr. Journal, vol. viii. No. 6 ; and Around Tonkin and Siam, 1894 ; and Tonkin to India, 1898. — Lord Lamington. Proc. B. G. S. vol. xiii. No. 12. — Archer, W. J. Beport on a Journey in the Me Kong Valley. — ^General Woodtholkpe. Geogr. Journal, vol. vii. No. 6.— Beckett, W. K. D. Beport on Korat Plateau and Lower Me Kong. — Lord Curzon. "Journeys in French Indo-China," Geogr. Journal, vol. ii. No. 3. — M'Carthy. Beport on a Survey in Siam. 1894. — Bulletins, Paris Geographical Society. — H. "Warrington Smyth. Five Years in Siam. 1898. (h. W. Sm.)*~~

~~*Melanesia. — In 1880 this insular region was almost a " No Man's Land," but has since been entirely partitioned between the Netherlands, Great Britain, Ger- many, and France, as shown in the subjoined table. A change of nomenclature has also been introduced in the insular section of the German possessions in Melanesia. But protests have been raised against these innova- tions, as contrary to all precedent and international etiquette, while the new names, although now figuring on many maps, have not yet been officially adopted. The chief group affected is the New*~~

~~*Britain archipelago, which thus becomes the Bismarck archipelago ; the several members of the group — New Britain, New Ireland, and Duke of York — also becoming Neu Pommern, Neu Mecklenburg, andNeuLauenburg respectively. It should also be noticed that the section of New Guinea assigned to Germany takes the official designation of Kaiser Wilhelm's Land. Of the*~~

~~*Solomon group, which by previous treaties had been dis- tributed in nearly equal parts between Germany and Great Britain, the former Power retains only the northern island of Bougainville, having ceded to Great Britain the two large islands of Choiseul and Ysabel by the convention of November 1899. Consequently, the parting line between the British and German possessions in the western Pacific, which formerly ran from New Guinea eastwards, and was then deflected in the Solomon group a long way to the south, must now be shifted northwards so as to run nearly due east through Bougainville Strait, and then north-east- wards between the Gilbert and Marshall groups, but so as to leave Ongtong-Java to Germany.*~~

~~*Political Divisions of Melanesia (1900)*~~

~~*Area in sq. miles. Pop. (est.)*~~

~~*152,000 240,000*~~

~~*72,000*~~

~~*110,000*~~

~~*28,000 6,000*~~

~~*180,000*~~

~~*(?) 10,000*~~

~~*90,540*~~

~~*20,000*~~

~~*950*~~

~~*8,000*~~

~~*200,000*~~

~~*9,000*~~

~~*122,000*~~

~~*7,630*~~

~~*51,000*~~

~~*8,000*~~

~~*70,000*~~

~~*393,120*~~

~~*992,000*~~

~~*Dutch Possessions —*~~

~~*West New Guinea .... German Possessions — North-East New Guinea (Kaiser Wil- helm's Land)*~~

~~*New Britain (Bismarck) and Ad- miralty Archipelagos Bougainville ...*~~

~~*British Possessions — South – East New Guinea, with the D'Entrecasteaux and Louisiade*~~

~~*groups*~~

~~*Solomon group (except Bougainville) Santa Cruz and Banks groups Fiji with Eotuma ....*~~

~~*French Possessions —*~~

~~*New Caledonia and Loyalties Anglo-French Dual Control — New Hebrides*~~

~~*Total Melanesia*~~

~~*Dutch New Guinea, which comprises the western half of the island as far as a conventional line coinciding with 1410 E., is dependent on the Residency of Ternate, in the Moluccas. Kaiser Wilhelm's Land was declared a German protectorate in 1884, and since 1896 the territory has been entrusted for administrative and general purposes to the German New Guinea Company, which has also taken charge of the other German possessions in Melan- esia and the Pacific Ocean. Over the New Britain archipelago and neighbouring islands a German protectorate was proclaimed in 1884. (For these and British New Guinea see New Guinea. For the British Solomon Islands see Solomon Islands. For Anglo- French Melanesia see New Hebrides. For Fiji and New Cale- donia see the respective articles.)*~~

~~*Authorities. — Dr R. H. Codrington. The Melanesian Languages. Oxford, 1885 ; and The Melanesians. Oxford, 1891. — Dr F. H. H. Guillemard. Australasia, vol. ii. London, 1894. — Joachim Graf Pfeil. Studien, &c., aus der Sudsee. Brunswick, 1899. — Woodford, Resident Commissioner. Beport on the British Solomon Islands, No. 275, 1897-98. — Sir W. Mac- Geegok. Journey across New Guinea. London, 1897. — H. C. Webster. Through New Guinea, &c. London, 1878.*~~

~~*(a. h. k.)*~~

~~*Melbourne, the capital of the state of Victoria, and the most populous city in Australia, situated at the head of the large bay of Port Phillip, on its northern bend, known as Hobson's Bay, about 50() miles south-west of Sydney by land and 770 by sea, the position of the obser- vatory being 37° 49' 53" S. and 144° 68' 32" E. The entrance to Port Phillip is narrow, and a bar, called " The Rip," occupies the entrance. Within the port there are a number of suburbs on either side, such as Sorrento and Queenscliff, at the Heads, and then Mentone, Carrum, Mordialloc, Frankston, Eedcliff, Picnic Point, Brighton, and St Kilda. Then the busy wharfs of Port Melbourne and Williamstown are reached. Port Melbourne (formerly knovm as Sandridge) is one of the most important of the shipping suburbs of Hobson's Bay, as the northern end of Port Phillip is called. It is connected with the city by railway and by cable tram, and*~~

~~*besides its busy piers, it is a large manufacturing centre. On the opposite side of the bay to Port Melbourne is Williamstown.*~~

~~*MELBOURNE*~~

~~*627*~~

~~*Here the deep-sea mail liners are berthed beside the long piers, upon which a railway runs connecting the wharf with the city. The river Yarra, which runs into*~~

~~*Hobson's Bay, is a winding narrow stream which has, by means of a system of canals and by dredging, been made navigable right into the heart of Melbourne for large*~~

~~*1. ParfJament /fousea*~~

~~*2. Treasury Buildins^*~~

~~*3. Law Courts 4 Mint*~~

~~*5. Town Hall*~~

~~*6. General Post OffloA*~~

~~*7. Custom House*~~

~~*8. Free Publlo Library and Art Gallerg*~~

~~*8. Trades Hall*~~

~~*Reference.*~~

~~*10. Victoria Marltets U. Princess Theatre*~~

~~*12. Theatre Royal*~~

~~*13. St.Patrick's Cathedral*~~

~~*14. Independent Congl. Ch,*~~

~~*15. Scots Church*~~

~~*16. Anglican Cathedral*~~

~~*17. Melbourne Hospital*~~

~~*18. Alfred Hospital*~~

~~*19. Homtaaptxthlo Hospital*~~

~~*Walker & CockereU sc*~~

~~*steamers. Navigation for large vessels ends at the Falls Bridge, but above that bridge the river is devoted to rowing and pleasure boats. The port of Melbourne is under the control of a Harbour Trust, established in 1877, which has borrowed over £2,000,000 for the improvement*~~

~~*of the port, for constructing canals, dredging, and other- wise overcoming the nataral disadvantages in the way of the safe navigation of the river and port.*~~

~~*The city proper is built upon long undulating hUls, rising from a shallow valley, once occupied by a small but*~~

~~*densely-wooded stream running into the river Yarra. This is now the site of Elizabeth Street, one of the principal streets of IMelbourne. The original plan appears to have been to construct alternately wide and narrow streets running parallel with the river, the narrow streets to give access to the big business' houses which would, it was foreseen, be built on the frontages of the main streets. The plan miscarried, for city space grew so valuable that large stores and business establishments have been erected in these lanes. The main streets are 99 feet wide, and the lanes or " little " streets somewhat less than half that width. On the crown of the*~~

~~*eastern hill stand the Parlia- ment Houses, a massive square building, with a pillared faqade to which broad steps lead up. This building is as yet unfinished, lacking the central tower. Within are the two legislative chambers — the assembly and the council. There axe a fine library of reference for members, dining- rooms, billiard-room, committee-room, Speaker's room, and spacious well-kept grounds at the back of the building. Most of the streets are paved with hardwood blocks, and the main streets are traversed by cable trams, which radiate in all directions. The footpaths are broad and well paved, the streets are well lighted, and tree-planting has in many parts been successfully carried on. The public buildings and business houses are generally fine architecturally. At the top of Collins Street are the Treasury Buildings, a splendid block in brown freestone. A little farther on is St Patrick's Roman Catholic Cathedral, built of hard bluestone, the sombre appearance of which detracts somewhat from the architectural beauty of the structure. There are two other churches in Collins Street, viz., the Independent Congregational Church and the Scots Church, on opposite corners of Eussell and Collins Streets. The architecture of both churches is very striking, and their commanding site on the hill makes the spire of the latter and the campanile of the former land- marks from all parts of the environs. St Paul's Cathedral (Anglican) is at the corner of Swanston Street and Plinders Street, near the Princes Bridge. The choice of a site was not a happy one, and this fine structure is hidden away on low-lying ground. The law courts are contained in a square block of buildings of classic design, with a central dome in the style of that of the Capitol at Washington. To these buildings all the courts have been removed, and are thus now under one roof. The Free Public Library and Art Gallery in Swanston Street possesses a splendid collection of volumes — considerably over 100,000 in number. It is open on week-days, and is free. In the Art Gallery the lower storey is devoted to sculpture. To the rear is the picture gallery, containing a fine collection of paintings by modern European and Australian artists. In connexion with the picture gallery there is a travelling scholarship for students, subsidized by the state, which gives a large sum annually to enable the prize-winners to pursue their studies in Paris, London, Pome, or Berlin. There are also in this building a technological museum and a collection of ethnical exhibits in the shape of Australian aboriginal and South Sea Island weapons of war,*~~

~~*domestic utensils, and native manufactures. The Exhibition Building occupies a com- manding position on a hill in Carlton Gardens, its dome being the first object which strikes the visitor approach- ing the city either by land or water. The building, which housed the first International Exhibition held in Victoria, was opened in 1880. It consists of a nave 500 feet long and 160 feet broad, surmounted by the dome, with two annexes 460 feet long. A good deal of the building is now used for the purposes of an aquarium and picture gallery. Government House is situated at Toorak, and is surrounded by a large domain. To the northward are Melbourne University,*~~

~~*Wilson Hall, and Ormond College. The General Post Office is situated at the corner of Bourke and Eliza- beth Streets, a site which may be described as the very centre of the city. The Town Hall is at the corner of Collins and Swanston Streets, and possesses a large concert hall of good acoustic properties and a fine organ. The Trades Hall, Carlton, is a building of some importance, being the central meeting rooms of the trades unionists of Victoria and the focus of much political power. Melbourne University is undenominational, and was established in 1865. It received in 1898 a Govern- ment endowment of £12,750. There are three affiliated colleges, viz.. Trinity (Episcopalian), Ormond (Presby- terian), and Queen's (Wesleyan). Ormond College is called after the late Frances Ormond, who contributed a sum of £82,000 towards its erection and endowment. The University Hall was built by the late Sir Samuel Wilson, after whom it is called Wilson Hall. In 1880 women were admitted to the University, and since then therehave been 139 lady graduates. Behind the University is the Natural History Museum. The Mint is situated between Latrobe and Lonsdale Streets. From the opening in 1869 to the end of 1898, 20,892,650 oz. of gold had been received, valued at £82,873,785, and issued from the Mint as coin or bullion. There were 76,117,421 sovereigns and 884,664 half-sovereigns issued, besides bullion to the value of £6,310,693. Other buildings subserving useful public ends are the Melbourne Hospital, the Victoria Markets, the Custom House, the Alfred Hospital, and the Homoeopathic Hospital on St Kilda Eoad. There are also a deaf, dumb, and blind institution, and a lunatic asylum at Yarra Bend. The most notorious feature in connexion with later developments of the city architecture was the erection of the " sky-scraper*~~

~~" buildings, which were the product of the " boom " period. They soar into the sunshine to a height of thirteen or fourteen storeys, with lifts, electric light, and all modern embellishments ; but so far they have not been a financial success.~~

~~Melbourne is up to date in all respects, and in none more so than in its means of communication. There are in all the import- ant buildings swift and secure elevators ; the telephone service is effective, the streets and many shops are lighted by electricity. But the tramway system is the best evidence of the modernity of the city. From the central area lines of swift-moving cable trams run to all the suburban environs, such as St Kilda, Prahran, Williamstown, Port Melbourne, Richmond, South Melbourne, ritzroy, CoUingwood, Carlton, Hotham, &c. A tramway trust, representing twelve of the metropolitan municipalities, was formed under statutory authority, and was entrusted with powers to construct tramways through the streets of the municipalities concerned. The trust has leased the tramways to a private company on a 32 years' lease, which in 1900 had 17 years to run ; and on the expiration of this period the councils have the power to acquire the system. Melbourne is the chief city of Australia from the point of view of population. In 1901 the population numbered 494,129; in 1891 it was 490,896. The slight advance in the decade was due to the commercial depression and bank failures, and the exodus to West Australia consequent upon the discovery of gold in that colony. The proportion of the population in Melbourne compared with that of the whole colony was, in 1871, 28-27, in 1889, 32-81, and in 1891, 43-06. These figures are noteworthy as an example of the remarkable aggregation of populations in the principal cities which is such a marked feature of Australian life. Melbourne is favoured in the matter of parks, gardens, and open spaces. The extent of the open spaces in the metropolitan area is 5329 acres, including 604 acres under the joint control of the Government and the City Council. Eoyal Park has an area of 600 acres. It contains in the centre a splendid Zoological Gardens, having the finest collection of wild animals and native fauna in Australia. The Botanic Gardens are situated on the banks of the river Yarra. They comprise 83 acres. But the most popular of the open-air resorts around Melbourne is the Flemington racecourse, where the " Cup " is run. This is tlie great Australian horse-racing event of the year, and during Cup~~

week there is a large influx of visitors from the other states. The race takes place on the first Tuesday in November, and the average

attendance on Cup day has, for some years, been 100,000 people. The principal theatre is the Princess, in Spring Street, opposite the Parliament Houses. It is a modern house, fitted with electric light and every convenience. The Theatre Koyal, in Bourke Street, is one of the oldest as it is the largest of Melbourne theatres. The drainage of the city was for many years a subject of frequent denun- ciation, and is still decidedly defective. Broad deep gutters, with footbridges over them, carried ofi the house and surface drainage. But now a comprehensive scheme of sewerage is being worked out throughout the city and suburbs, and in time even in point of drain- age Melbourne will rank as a modem city. The city is supplied with water from the Yan Yean water-works, an artificial lake at the foot of the Plenty Ranges, nearly 19 miles away. From thence the water has been brought into the city and suburbs at a cost of £3,677,000. The Water and Sewerage Board, which manages this scheme, has a revenue of £1,251,000 per annum. Melbourne was constituted a municipality in 1842. The value of rateable property, which grew enormously after the incorporation of the city, has declined since the year 1891. In that year, according to The Seven Colonies of Australasia, the annual value of rateable property was £6,533,717, and the capital value £89,939,287. In 1898 the annual value was only £3,973,357, and the capital value £60,626,915. HOwever, the comparative position of Melbourne is still important. "The annual value of Melbourne," says the authority quoted above, "is only surpassed by London, and to a small extent by Glasgow, in the British dominions." The city is governed muni- cipally by a council consisting of 24 aldermen, presided over by a mayor, and is divided into seven wards. For parliamentary purposes Melbourne is divided into 25 electorates, returning 30 members.

The suburbs are important communities in themselves, and are thickly populated. They have their separate municipal govern- ments, and most of their town halls are fine buildings, which vie with the public buildings

~~*of Melbourne. Amongst these are the town halls of South Melbourne, Prahran, Richmond, CoUingwood, and South Yarra. Amongst the most populous suburbs are CoUing- wood, 32,191 inhabitants ; Richmond, 34,097 ; Prahran, 36,500 ; South Melbourne, 38,000 ; Fitzroy, 29,719 ; Williamstown, 13,449 ; St Kilda, 19,703 ; Brighton, 9534 ; Kew, 8781 ; Hawthorne, 20,000 ; Brunswick, 22,769; Essendon, 15,200; Footscray, 16,880; North Melbourne, 17,886 ; Port Melbourne, 11,039 ; Flemington and Kensington, 10,501. As a port Melbourne takes the first place as regards tonnage — though of course this is discounted by the fact that imports and exports in through liners are registered in Mel- bourne and swell the Melbourne tonnage, though the terminal port is Sydney. The tonnage entered and cleared in various periods was in 1881, 2,144,949 tons ; in 1891, 4,362,138 ; and in 1899, 4,947,118 tons. The yearly movement of tonnage at Melbourne and Sydney far exceeds that of any of the ports of any other Brit- ish possession, Hong-Kong and Singapore excepted. Melbourne is a great manufacturing centre, and both city and suburbs have their distinctive industries. Within the metropolitan district there were, during 1898, 1375 manufactories employing 40,021 hands, 27,694 of whom were males and 12,327 females. Details are only furnished in respect of the following industries : —*~~

~~*Nature of Manufactory. Tanneries, fellmongeries, and wool-washing*~~

~~*establishments*~~

~~*Bacon and ham curing establishments . Butter and cheese factories, and creameries .*~~

~~*Flour-mills*~~

~~*Breweries . . . ...*~~

~~*Tobacco, cigar, and snuff manufactories*~~

~~*Boot factories*~~

~~*Brickyards and potteries*~~

~~*Soap and candle works .*~~

~~*Electric light works*~~

~~*Gas and coke works*~~

~~*Stone quarries*~~

~~**T Average Number of Hands employed.*~~

~~*33*~~

~~*972*~~

~~*7*~~

~~*87*~~

~~*10 ♦*~~

~~*167*~~

~~*10*~~

~~*258*~~

~~*12*~~

~~*680*~~

~~*13*~~

~~*764*~~

~~*78*~~

~~*3618*~~

~~*15*~~

652

10

360

7

137

7

621

19

118

Melbourne cemetery is situated to the north of the city, near Princes Park, and has been used as a burial-ground since 1853. Owing to the growth of the suburban population, which has prevented the extension of this cemetery, a large necropolis has been set apart at Frankston, on the eastern shore of Hobson's Baj', at some distance from the city. Melbourne has some good monu- ments and statues, amongst which may be named the statue of Queen Victoria in the Parliament Houses vestibule ; the statue to Sir Redmond Barry, outside the Public Library ; the statue to Bourke and Wills, explorers, which was formerly at the top of Collins Street, but was removed to Spring Street to make room for the cable tram ; the Gordon statue in Spring Street, which is a replica of the Gordon monument in Trafalgar Square, London ; and a statue to Daniel O'Connell outside St Patrick's Cathedral. The large markets, erected at a cost of £80,000, stand in Bourke Street, and a brick market is situated in Flinders Street. There were

formerly two railway stations — the main station at Spencer Street and the Hobson's Bay Railway station, as it was then called. Since then the Hobson's Bay Company have handed over their lines to the Government, and the whole system is now managed by the railway commissioners. The

~~*Hobson's Bay line is now con- nected with the Spencer Street line. The Spencer Street station is not an ornate structure, being built of wood principally, but an imposing building is in contemplation to take its place. There are in Melbourne, among its numerous state schools, about thirty whose size and proportions entitle them to rank with the archi- tectural ornaments of the city. They have each accommodation for from 200 to 2000 scholars. There are many good private schools besides. The principal defences are placed at Port Phillip Heads, and consist of batteries at Queenscliff, Point Nepean, Swan Island, Point Franklin, and the shoals in mid-channel. There is also an obsolete monitor, the Cerberus, which lies in Hobson's Bay. But as the state of Victoria participates in the subsidy to the Australian Imperial Defence Squadron, less reliance is now placed on the Cerberus, and the fleet pays several visits annually to Port Phillip. There is a large graving-dock at Williamstown, the length of which is 450 feet, and which cost £341,678. The mean tem- perature is 57'3°, corresponding with that of Washington in the United States, and of Madrid, Lisbon, and Messina. The mean temperature is 6° less than that of Sydney and 7° less than that of Adelaide — ^the result of a long series of observations being : spring, 57°; summer, 65-3°; autumn, 58-7° ; winter, 49-2°. The highest recorded temperature in the shade was 117'7", and the lowest 27°. The average rainfall over a long series of years was 25'58 inches.*~~

~~*Melcombe Regis. See Weymouth. '>■■■-'*~~

~~*Meleda, formerly Melita (Slavonic, Mljet), the most southern of the larger Adriatic islands of the Aus- trian province of Dalmatia. It is of volcanic origLa, with numerous chasms and gorges, of which the longest, the Babinopolje, connects the north and south of the island. Porto Palazzo, the principal harbour, on the north, is a port of call for tourist steamers, and contains the ruins of an ancient palace. Population, 1617.*~~

~~*Melegnano, formerly Mabignano, a town of the province of Milan, Lombardy, Italy, 11 miles south-east of Milan by the railway to Piacenza. It has manufactures of linen, silk, clothing, and bricks, and rice-husking. It was a stronghold of Milan in her great struggle against Lodi, and is famous for the victory of Francis I. of France over the Swiss in 1515, and*~~

~~for the battle between the French and Austrians in 1859. Population, about 6000.~~

~~Mel ilia, a Spanish fortified station and penal settle- ment on the north coast of Morocco, to the south of Cape Tres Forcas, with a population of 5432 in 1887 and 10,201 in 1897. The civil population is not important, but there is a strong garrison to protect the place against its turbulent neighbours, the lawless Arab RifP tribes, and to keep in order the large number of convicts. The town is on a peninsula connected with the mainland and outer lines of fortifications by a rocky isthmus. There is a lighthouse on the north of the town. The Vega of Melilla extends to the south and west of the outer de- fences, and is watered by the Oro river, whose course has been altered behind Mount San Lorenzo to prevent this stream from flowing into the little harbour, which is only accessible to very small vessels ; the roadstead outside is safe and has deep water a mile to the east of the fortress. The Moorish custom-house is on the Spanish border be- yond the fort of Santa Isabel, and is the only authorized centre of trade on the Riff coast between Tetuan and the Algerian frontier. Spain has always had much trouble with the Eiff tribes around Melilla, and when they be- sieged the town in 1893, 25,000 men had to be despatched against them.~~

~~Meline, Felix Jules (1838 ^), French states- man, was born at Remiremont, in the department of the Vosges, on 20th May 1838. After studying law in Paris, he practised in the Court of Appeal, and took no part in politics till the fall of the Empire. The moderate~~

~~Republican opinions which he had always held now obtained for him a post in the mayoralty of the 1st arrondissement, which in March 1871 elected him a member of the Commune. IIe declined, however, to sit. IIe had been an unsuccessful candidate for the representa- tion of his native department, the Vosges, in the National Assembly at the general election of February 1871, but was returned at a bye-election in October of the following year. IIe voted consistently in support of Thiers, and in 1876~~

was returned for the arrondissement of Eemiremont. As member of the Conseil General of the Vosges, and founder of the l^pinal journal, Le Memorial des Vosges, he acquired a local influence, which, added to his gift of brilliant and incisive oratory, brought him the appoint- ment of under-secretary for justice in the Jules Simon ministry (December 1876 to May 1877). In the Eepublican Chamber, returned by the elections of 1877, he remained consistently moderate, and was among those who voted against the proposal for a general amnesty. Sitting for an agricultural constituency, he now came forward as the champion of the agricultural interest, and began a cam- paign, conducted with signal skill, knowledge, and per- tinacity, in favour of a strongly protectionist policy. His first opportunity of enunciating these views with effect came with his selection in 1880 to be one of the reporters and subsequently president of the commission on the customs tariff. In February 1883 he became Minister of Agriculture in the second Ferry cabinet, and held this post till the fall of the ministry in April 1885. It was a period of severe distress both in industry and agriculture. He carried a law to protect the French beet- sugar industry from German competition, and introduced a measure raising the duties on the importation of cereals and cattle. He also founded the order of agricultural merit. In April 1888 the presidency of the Chamber became vacant on the acceptance of the premiership by Floquet. The voting for M. M^line and M. Cl^menceau was equal, and by virtue of the rule giving precedence to the senior candidate M. Meline was declared elected. His tenure of the post coincided with the height of the Boulangist agitation. The debates in the Chamber were marked by an unprecedented violence, with which he proved unable to cope. It was felt that he did not wield the authority of his predecessor, Floquet, by whom he was replaced in the new Chamber of 1889. A staunch Eepublican, he was one of the most prominent opponents of Boulanger, and on the fall of the Floquet cabinet in February 1889 was entrusted with the formation of a new ministry, but was forced to abandon the attempt. As president of the commission on the tariff, he succeeded during the session of 1891 in inducing first the com- mission and then the Chamber to replace the existing system of commercial treaties by a uniform tariff of a strongly protective character, especially on articles of agricultural produce. On the fall of the Eibot ministry in March 1893, and again on the fall of the Dupuy ministry in November, he was summoned by the President, but was

~~unable to effect a working combination. In the same year he was elected to succeed Jules Ferry as pre- sident of the Conseil Gdn^ral of the Vosges. In December 1894 he again stood for the presidency of the Chamber, but was defeated by the Eadical candidate, M. Brisson. On the resignation of the Bourgeois cabinet, M. Meline formed a new administration (30th April 1896), in which he himself took the portfolio of agriculture. The most urgent question that confronted him was the conflict between the Cham ber and the Senate, which had caused the downfall of his Eadical predecessor. M. Meline's declara- tion stated that while the Chamber of Deputies, as elected by direct universal suffrage, had a preponderating iniluence on politics, it was impossible to legislate and govern with-~~

~~out the co-operation of the Senate. This declaration, fiercely attacked by the Eadicals, was carried by the help of the Eight, on whom the Meline ministry found itself more and more dependent. Another pressing question was that of financial reform. M. Meline abandoned the unpopular Eadical project of a tax on the French rente, and proposed an income-tax designed to redress the balance of taxation in favour of real property, and thus to foster the greatest of French interests — agriculture. But the opposition prevented the Government from making any substantial progress with its financial measures either in this or in the following session. The Meline ministry, however, derived fresh strength from the success of its foreign policy. The premier played a prominent part in the splendid reception accorded to the Tsar in October 1896, and during the return visit of President Faure in August 1897 reaped the credit of the most brilliant achievement of French diplomacy under the Third Eepublic — the public proclamation of the alliance between France and Eussia. The remainder of his term of office was overshadowed by the Dreyfus case. M. Meline maintained that the verdict of the court-martial could not be revised by the Government ; he prosecuted M. Zola for his attack on that tribunal, and in the debates raised by M. Zola's condemnation declared that the matter was chose jugie, and that there was no longer a Dreyfus case or a Zola case. The Chamber ordered by 471 votes to 40 that this speech should be posted up throughout France. His protectionist policy was severely tried by the high price of wheat in the spring of 1898. He was at last forced to decree a~~

~~*temporary suspension of the duty. Immediately after this the general election took place. Though the balance of parties remained nominally un- changed, the new Chamber at once proved itself hostile to M. Meline's policy of alliance with the Eight. On 14th June, after passing a vote of approval in the declarations of the Government, it demanded that the latter should rely on an exclusively Eepublican majority. M. Meline there- upon resigned. IIe stood as the candidate of the Eight at the Presidential election of Fcbruary 1899, but received only 279 votes, against 483 cast for M. Loubet. IIe was afterwards the most prominent opponent of the Waldeck- Eousseau cabinet, attacking especially the policy of con- ciliating the Socialists by the inclusion of a Socialist, M. Millerand, as minister of commerce.*~~

~~*Melitopol, adistrict town of Russia, government of Taurida, 151 miles by rail north-east of Simpheropol, on the Molochnaya river. Till 1841 it was a small village fNovo-Alexandrovskaya), but has grown owing to its important fairs. It has two gymnasia, for boys and girls. Population (1897), 15,120.*~~

~~*Melrose, a police burgh of Eoxburghshire, Scotland, on the river Tweed, 37^ miles south-east by south of Edin- burgh by rail. There is a market cross of date 1642, a public hall, and an institute containing library and recrea- tion rooms. A hydropathic establishment is adjacent, and two miles west stands Abbotsford, the mansion built by Sir Walter Scott. Population (1881), 1550 ; (1901), 2195. The parish formerly contained part of the burgh of Galashiels, but that part was transferred to the parish of Galashiels in 1891.*~~

~~*Melrose, a city of Middlesex countj^, Massachusetts, U.S.A., on a branch of the Boston and Maine railroad, iu the eastern part of the state, 7 miles north of Boston, of which it is a suburb. Its area of 6 square miles is broken and hilly, and the street plan is irregular. It has exten- sive and varied manufactures, with (ia 1900) a capital of $3,296,048, products valued at $3,945,580, and 1428*~~

~~hands. Population (1890), 8519 ; (1900), 12,962, of whom 2924 were foreign-born and 130 were negroes.~~

~~Melton Mowbray, market town and parish in the Melton parliamentary division of Leicestershire, England, on the river Wreake, 14 miles north-east of Leicester by rail. St. Mary's peal of ten bells is played by a carillon machine. The CoUes Memorial Church Institute was erected in 1890, and a new cemetery of six acres opened in 1893. Three blast furnaces have been erected in the neighbouring parish of Asfordby for the smelting of the abundant supply of iron ore in the district. Population (1891), 6392; (1901), 7454.~~

~~Melville, Herman (1819-1891), American author, was born in New York City on the Ist of August 1819. He shipped as a cabin-boy at the age of eighteen, thus being enabled to make his first visit to England, and at twenty-two sailed for a long whaling cruise in the Pacific. After a year and a half of this experience he deserted his ship at the Marquesas Islands, on account of the cruelty of the captain ; was captured hj cannibals on the island of Nukahiva, and detained, without hard- ship, four months ; was rescued by the crew of an Australian vessel, which he joined, and two years later reached New York. Thereafter, with the exception of a passenger voyage around the world in 1860, Melville remained in the United States, devoting himself to literature — though for a considerable period (1866-85) he held a post in the New York custom-house — and being perhaps Hawthorne's most intimate friend among the literary men of America. His writings are numerous, and of varying merit ; his verse, patriotic and other, is quite forgotten ; and his works of fiction and of travel are of irregular execution. Nevertheless, few authors have been enabled so freely to introduce romantic personal experiences into their books : in his first work, Typee : A Peep at Polynesian Life, or Four Months' Residence in a Valley of the Marquesas (1846), he described his escape from the cannibals; while in Omoo, a Narrative of Adventures in the South Seas (1847), W7iite Jacket, or Tlie World in a Manrof-War (1850), and especially Mohy Dick, or Hie Wliale (1851), he portrayed seafaring life and character with vigour and originality, and from a personal knowledge equal to that of Cooper, Marryat, or Clark Eussell. The experiences of sailor-life in forecastle or~~

~~*on deck, in storm and in sunshine, in pursuit of the whale or in danger of capture by savages, as narrated by Melville in his chief works, have never ceased to interest a limited yet loyal public of readers in America and England. But these stirring records of adventure were ajpcompanied by other tales so turgid, eccentric, opinionative, and loosely written as to seem the work of another author. Melville was the product of a period in American literature when the fiction written by writers below Irving, Poe, and Hawthorne was measured by humble artistic standards. He died in New York on the 28th of September 1891. (c. f. b.)*~~

~~*Memel, a seaport town of Prussia, province of East Prussia, near the northern extremity of the Kurisches Ha£f, 91 miles by rail north by east of Konigsberg vid Tilsit. It is the centre of the timber-exporting trade, and one of the chief seaports for the products of Lithuania. There is an average depth of 22 feet on the bar. The total value of the exports increased from £1,082,160 in 1893 to £1, 484,550 in 1899, about 65 per cent, of this total being for timber. The other exports are chemicals and artificial manure, flax, linseed, and cereals. The imports, principally timber, increased from £1,236,500 in 1893 to £1,712,800 in 1899. The port was cleared in 1898 by*~~

~~*748 vessels of 267,360 tons. Several fresh industries have been started, e.g., cellulose factories, chemical works, iron-foundries, and shipbuilding yards. The town is adorned by a bronze statue of the Emperor William I. (1896). Population (1886), 18,748 ; (1900), 20,174.*~~

~~*Memphis, a city of Tennessee, U.S.A., capital of Shelby county, and the first city in population in the state. It is situated on the east bank of the Mississippi, in the south-western part of the state, at an elevation (at the dep6t of the Louisville and Nashville railroad) of 227 feet. The city is divided into twenty-two wards, and no fewer than ten railways centre in it. These, with the river, which is navigable for large vessels at all stages of water, make it one of the most important centres of internal commerce. It is connected with West Memphis, on the opposite side of the river, by a steel cantilever bridge. Memphis has large and rapidly increasing manufacturing interests. In 1900 it had 658 manufacturing establishments, with a total capital of f 11,179,024. They employed 8428*~~

~~*hands, and the products were valued at $17,848,530. Among these products were lumber and timber, with a value of $3,051,181; cotton-seed oil and cake, $2,271,313; and foundry and machine-shop products, $1,078,713. Among its educational institutions is the Christian Brothers' College, a Bom an Catholic institution, founded in 1871, which in 1898 had 13 instructors and 179 students. The assessed valuation of real and personal property in 1900, on a basis of about 60 per cent, of the full value, was $38,211,544, and the net debt was $3,041,966. The tax rate ranged from $29.70 per $1000 in some of the wards to $36.20 in others. Memphis was rechartered as a city with its limits extended in 1891. The population in 1890, including the population of the area added when the city was rechartered the following year, was 64,495. In 1900 the population was 102,320, of whom 5110 were foreign-born and 49,910 were negroes. The death-rate in 1900 was 25-1, about one-third higher among the coloured than among the white.*~~

~~*Menabrea, Luigi Federico, Mabquis of Yai.- DOBA (1809-1896), Italian general and statesman, was born at Chamb^ry on 4th September 1809. After study- ing at the Turin Military Academy, he was in 1848 sent on a political mission to the duchies of Modena and Parma. Elected deputy, he opposed Cavour's ecclesiastical policy and recommended reconciliation between Church and State. During the war of 1859 he gained the title of marquis by his defence of Valdora, and acquired further distinction during the siege of Peschiera. In 1860 he conducted the siege of Gaeta and was appointed senator. Entering the Eicasoli Cabinet of 1861 as Minister of Public Works, he retained his portfolio until 1864 in the succeeding Parini and Minghetti Cabinets. After the war of 1866 he was chosen as Italian plenipotentiary for the negotiation of the treaty of Prague and for the transfer of Venetia to Italy. In October 1867 he succeeded Eattazzi in the premiership, and was called upon to deal with the difficult situation created by the Garibaldian invasion of the Papal States and by the catastrophe of Mentana. During his term of office the famous grist tax Bill was passed and the tobacco monopoly instituted. After his fall in December 1869 his successor, Lanza, in order to remove him from his influential position as aide-de-camp to the king, sent him to London as am- bassador, where he remained until in 1882 he replaced General Cialdini at the Paris Embassy. Ten years later he definitively*~~

~~*withdrew from public life, and died at Saint Capin on 24th May 1896. (h. w. s.)*~~

~~*Menado. See Celebes.*~~

~~*Me Nam, or Menam (signifying literally the "mother water" or "main river"), the "Nile" of Siam, as Turpin calls it, and the chief highway of the interior, on whose yearly rise and fall depends the whole of the rice crop of Lower Siam. Rising in the Lao, or Siamese Shan, state of Nan in 19° 35' N. and 101° 24' E., at a height of 1400 feet upon the shoulders of the mountain mass of Doi Luang, it is first known as the Nam Ngob after a village of that name. As the Nam Nan, still a mere mountain stream, it flows southwards through the state so named between high forested ranges, and, not- withstanding the frequent rapids along its course, the natives use it in their dug-outs for the transport of hill produce. From Utaradit, where it leaves the hills of the Lao country, it flows southwards through the great plain of Lower Siam, and is navigable for flat-bottomed native craft of considerable capacity. It is here known as the Nam, or Me Nam Pichai. Below Pichai the river flows through lonely tracts of forest and swamp country, the lat- ter providing vast overflow basins for the yearly floods. Thousands of tons of fish are caught and cured here during the fall of the river after the rains. Below Pitsunalok the waters of the Me Nam Yom, the historic river of Siam, upon which two of its ancient capitals, Sawankalok and Sukotai, were situated, meander by more than one tortuous clayey channel to the main river, and combine to form the Nam Po. At Paknam Po the main western tributary comes in, the shallow, capricious Me Ping, the river of Raheng and Chieng Mai, bringing with it the waters of the Me Wang. As the chief duty- station for teak, which is floated in large quantities down all the upper branches of the river (see under Chibstg Mai), and as a place of transhipment for boats, Paknam Po is an important and growing town. Prom this point southwards the river winds by many channels through the richest and most densely-populated portion of Siam. About Chainat the Tachin branches off, forming the main western branch of the Me Nam, and falling into the gulf at a point*~~

~~*about 24 miles west of the bar of the main or Bangkok river. At Ayuthia, another of the ancient capi- tals of Siam, the Nam Sak flows in from the north-east, an important stream affording communication with the rich tobacco district of Pechabun, and draining the west- ern slopes of the Korat escarpment. (See Siam.)*~~

~~*Authorities. — Foreign Office Trade Meports for Bangkok and Chieng Mai Districts. — Crawford. Journal of an Embassy to Siam. — Holt Hallett. A Thousand Miles on an Elephant. — Prince Henri d'Orleans. Around Tonkin and Siam. — Grind- rod, Mrs. Siam. — H. Warrington Smyth. Notes on a Journey on the Upper Me Kong and Five Years in Siam.*~~

~~*Menasha, a city of Winnebago county, Wisconsin, U.S.A., on the Fox river, at the foot of Lake Winnebago, in the eastern part of the state. It is on the Chicago and North-western, the Chicago, Milwaukee and St Paul, and the Wisconsin Central railways. Population (1890), 4581 ; (1900), 5589, of whom 1535 were foreign-born.*~~

~~*Mende, chief town of department Loz^re, France, 252 miles south-south-east of Paris, picturesquely situated on the Lot, at an altitude of 2420 feet, and at the foot of the Mimat cliff, which rises 1000 feet above the town. The cathedral of St Peter was founded in the 14th cen- tury by Urban V., a native of the district, but the two towers, respectively 280 and 210 feet high, were added by Franqois de la Rov^re in the early part of the 16th century. Partly destroyed by the Protestants in 1580, it was rebuilt in the 17th century, and in 1874 a statue of Pope Urban V. was erected in front. A Renaissance tower of the ancient citadel now serves as the belfry of the church of the Penitents, and a 14th-century bridge crosses the Lot. The town is a convenient centre for*~~

~~*visitors to the gorges of the Tarn. Local institutions are a communal college, library of 12,000 volumes, hospital, and consultative chamber of agriculture. An important industry is the manufacture of serges and shalloons, known as Mende stuffs, exported to Spain, Italy, and Germany. Mende grew up around the Hermitage of St Privat, partly excavated in the side of the Mimat cliff, to which the bishop retreated after the destruction of the town of Javols, and where he was subsequently slain by the*~~

~~*Vandals, who had pursued him thither, about 408. In the 14th century the new town became the civil, as it had previously been the ecclesiastical, capital of the Gevandan district. Population (1881), 4994; (1901), 7319.*~~

~~*Mendeleeff, Dmitri Ivanovitch (1834),*~~

~~*Russian chemist, the youngest of a family of seventeen, was born at Tobolsk, Siberia, on 7th February (N.S.) 1834. After attending the gymnasium of his native place, he went to study natural science at St Petersburg, where he graduated in chemistry in 1856, subsequently becoming privat-docent. In 1859 he went to Heidelberg, where he started a laboratory of his own, but returning to St Petersburg in 1861, he became professor of chem- istry in the Technological Institute there, and three years later succeeded to the same chair in the univer- sity. Mendeleeff's original work covers a wide range, from questions in applied chemistry, such as the origin of petroleum deposits and the application of nitro- compounds to the manufacture of smokeless powders, to the most general problems of chemical and physical theory. His name is best known for his work on the Periodic Law. He was not the first to take up this sub- ject, for before him various chemists had traced numeri- cal sequences among the atomic weights of some of the elements and noted connexions between them and the properties of the different substances, but it was left to him to give a full expression to the generalization, and to treat it not merely as a system of classifying the elements according to certain observed facts, but as a " law of nature " which could be relied upon to predict new facts and to disclose errors in what were supposed to be old facts. Thus in 1871 he was led by certain gaps in his tables to assert the existence of three new ele- ments so far unknown to the chemist, and to assign them definite properties. These three he called ekaboron, ekaaluminium, and ekasilicon; and his prophecy was completely vindicated within fifteen years by the dis- covery of gallium by de Boisbaudran in 1871, scandium by Nilson in 1879, and germanium by Winkler in 1886. Again, in several cases he ventured to question the cor- rectness of the " accepted atomic weights," on the ground that they did not correspond with the Periodic Law, and here also he was justified by subsequent investiga- tion. Since his early work the periodic arrangement of the elements has engaged the attention of many*~~

chemi- cal thinkers, and numerous variations in it and in the modes of stating it have been proposed. So far, how- ever, no formulation has been suggested which commands universal acceptance as final, and the task still remains not only of finding a solution of certain anomalies, real or apparent, but of explaining the cause and inner meaning of the periodicities that have already been observed. Another branch of chemical theory to which Mendeleeff attaches great importance and has devoted much study is the question of such " indefinite " compounds as solu- tions, which he looks upon as homogeneous liquid systems of unstable dissociating compounds of the solvent with the substance dissolved, holding the opinion that they are merely an instance of ordinary definite or atomic com- pounds, subject to Dalton's laws. In another department of physical chemistry he has investigated the expansion of

liquids with heat, and devised a formula for its expression similar to Gay-Lussac's law of the uniformity of the expansion of gases, while so far back as 1861 he antici- pated Andrews's conception of the critical temperature of gases by defining the absolute boiling-point of a sub- stance as the temperature at which cohesion and heat of vaporization become equal to zero and the liquid changes to vapour, irrespective of the pressure and volume. Men- del^eif has written largely on chemical topics, his most widely-known book probably being the Principles of CJiemistry, which was written in 1868-70, and has gone through many subsequent editions in various lan- guages. For his work on the Periodic Law he was awarded in 1882, at the same time as L. Meyer, the Davy medal of the Royal Society.

Mendoza, a province in the west of the Argentine Republic, bounded on the N. by San Juan, on the E. by San Luis, on the S. by the territories of Pampa and Neuquen, and on the W. by Chile. The official area at the census of 1895 was 66,502 square miles. The popu- lation in 1869 was 65,413, and in 1895 it was 116,136. Mendoza is divided into sixteen departments. In 1895 there were 7308 farms, and 28,244 acres planted in

~~*cereals. The capital, Mendoza, with a population in 1895 of 28,302, is 636 miles from Buenos Aires by rail, and has a national college, agricultural school, normal school, and other public institutes.*~~

~~*Meneiek II. (Sahala Mabiem), Emperor of*~~

~~*Abyssinia (1844), son of Haeli Melicoth, king of*~~

~~*Shoa, was born in 1844, and claimed to be a direct descendant of Solomon by the Queen of Sheba. On the death of his father in 1856 he was kept a prisoner at Gondar by Kassai, the governor, who had seized the throne under the title of Theodore III. But having succeeded in effecting his escape, he was acknowledged king of Shoa, and at once attacked the usurper. These campaigns were unsuccessful, and he turned his arms to the west, east, and south, and annexed much territory to his kingdom, still, however, maintaining his divine right to the crown of Ethiopia. After the death of Theodore in 1868 he con- tinued to struggle against his successor, the Emperor Johannes. Being again unsuccessful, he resolved to await a more propitious occasion; so, acknowledging the su- premacy of Johannes, he married his daughter to the emperor's son, the Ras Area; he was thereupon declared heir to the empire, and on his side acknowledged the Ras Area as his successor. Shortly afterwards the R§,s Area died, and the Emperor Johannes was killed in a war against the Dervishes at the battle of Matama, 10th March 1889. The succession nowJay between the late emperor's natural son, the R9,s Mangasha, and Meneiek, but the latter was elected by a large majority on 4th November, and consecrated shortly afterwards. His clemency to Mangasha, whom he compelled to submit and then made viceroy of Tigre, was ill repaid by a long series of revolts. In 1889 Meneiek signed the treaty of Uccialli, but finding that its ambiguity placed his empire under Italian domina- tion, he denounced it ; and after defeating the Italians at Amb-Alaghi, he compelled them to capitulate at Adowa in February 1896, and a treaty was signed recognizing the absolute independence of Abyssinia. His French sympathies were shown in a reported official offer of treasure towards payment of the indemnity at the close of the Franco-Prussian war, and in February 1897 he con- cluded a commercial treaty with France in very favourable terms. The British mission under Sir Rennell*~~

~~*Rodd in the following year was, however, cordially received, and Mene-iek agreed to a settlement of the Somali boundaries, to keep open to British commerce the caravan route between*~~

~~*Zeila and Harrar, and to prevent the transit of munitions of war to the Mahdists, whom he proclaimed enemies of Abyssinia. (See also Abyssinia.)*~~

~~*Mengtze, a district city in the south-east of the province of Yunnan, China. It was selected by the French convention of 1886 as the seat of the overland trade be- tween Tongking and Yunnan, and opened two years later. It is situated on an elevated plateau 4580 feet above sea- level. The country round is fertile and well cultivated, and the place must have been one of considerable wealth before the Taiping rebellion, as the ruins of many fine temples attest. Population, about 12,000. A very con- siderable overland trade has sprung up since the opening of Mengtze. In 1898 the value of the trade was £596,748, in 1899, £854,252, and in 1900, £832,860, 54-8 per cent, of this being imports and 45‘2 per cent, exports. Of the import trade Hong Kong supplied 96 per cent, and of the export trade 80 per cent., Tongking claiming the re- mainder. Tin (79-5 per cent.) and opium (17-7 per cent.) are the principal exports, and textiles (67 per cent.), mostly cottons, and tobacco (9-3 per cent.) are the chief of the imports. On the Tongking side this trade follows the Red river route as far as Manhao, which is distant from Mengtze about 40 miles, though the navigation of the river is attended by considerable difficulties. From Man-hao the transit is by land, and is performed by coolies or pack animals. Concessions have been obtained by the French Government to build a line of railway from Tong- king frontier at the town of Laokai vid Mengtze to Yunnanfu.*~~

~~*Menominee, a city of Michigan, U.S.A., capital of Menominee county, on Lake Michigan, at the mouth of Menominee river, in the southern part of the Upper Peninsula, at an altitude of 595 feet. It has three railways, the Chicago and North-western, the Chicago, Milwaukee and St Paul, and the Wisconsin and Michigan. It is an important shipping point for lumber and iron ore, and has many saw and planing mills. Population (1890),*~~

~~10,630; (1900), 12,818, of whom 4186 were foreign-born. The death-rate in 1900 was 14.~~

~~Menomonie, a city of Wisconsin, U.S.A., capital of Dunn county, on the Red Cedar river, in the western part of the state, at an altitude of 807 feet. It is on the Chicago, Milwaukee and St Paul, and the Chicago, St Paul, Minneapolis and Omaha railways. It has lumber and flour mills, and is an important shipping point for grain and lumber. Population (1890), 5491 ; (1900), 5655, of whom 1772 were foreign-born.~~

~~Menorca. See Balearic Islands.~~

~~Mentone (Italian, Mentone), town, arrondissement of Nice, department of Alpes-Maritimes, France, 19 miles east-north-east of Nice by rail. The church of St Michel in the old town has been rebuilt in great part since the earthquake of 1887. A monument was erected in 1895 to commemorate the union of Mentone with France. There is a proposal to convert the Corel Valley into public gardens. In the eastern bay is the harbour, con- structed in 1890. It has a depth of 24 feet, and is shel- tered by a jetty 400 yards long; but although accessible to large vessels, it is frequented chiefly by those engaged in coasting trade. The distillation of various essences is an important industry, to feed which the double violet and a particular species of orange are cultivated. The culture of the vine, for some time abandoned, has been again introduced, and yields a wine of fair quality. About 1-^ miles east of the town the bridge of St Louis crosses the torrent which separates France from Italy. Popula- tion (1881), 6737 ; (1891), 8232; (1901), 14,913.~~

~~Menzel, Adolph Friedrich Erdmann von~~

~~(1815), German artist, was bom at Breslau on 8tli~~

~~*December 1816. HIs father was at the head of a school for girls, and intended to educate his son as a professor ; but he would not thwart his taste for art. Left an orphan in 1832, Menzel found himself called upon to maintain his family. In 1833 Sachse of Berlin published his first work, an album of pen-and-ink drawings reproduced on stone, to illustrate G- oethe' s little poem, " Klinstler's Erden- wallen." HE executed lithographs in the same manner to illustrate Denkwurdigkeiten aus der brandenburgisch- preussischen GescJiicMe, pp. 834-36 ; " The Five Senses " and " The Prayer," as well as diplomas for various cor- porations and societies. From 1839 to 1842 he produced 400 drawings, reviving at the same time the technique of engraving on wood, to illustrate the Geschichte Friedriclis des Grossen (" HIstory of Frederick the Great ") by Franz Kugler. HE subsequently brought out Friedriclis des Grossen Armee in HIrer Uniformirung (" The Uniforms of the Army under Frederick the Great "), Soldaten Fried- richs des Grossen (" The Soldiers of Frederick the Great ") andfinally, by order of the Emperor Frederick William H., he illustrated the works of Frederick the Great, Illustror tionen zu den Werken Friedriclis des Grossen. By these works Menzel has established his claim to be considered one of the first, if not actually the first, of all the illus- trators, of his day in his own line. Meanwhile Menzel had set himself to study unaided the art of painting, and he soon produced a great number and variety of pictures, always showing keen observation and honest workman- ship— subjects dealing with the life and achievements of Frederick the Great (" A Concert," see Plate) and scenes of everyday modern life, such as "In the Tuileries," " The Ball Supper," and " At Confession." Among the most important of these works are "The Forge" and " The Market-place at Verona." Invited to paint " The Coronation of William I. at Koenigsberg," he produced an exact representation of the ceremony without regard to the traditions of official painting. In a curious study of Menzel {Gaz. des Beaux Arts, Paris, 1880) M. Duranty writes, " Though in excellent health, Menzel has a mor- bid love of truth." Menzel's example has been an encouragement to multitudes of his fellow-artists ; and more than one who would have been no more than a pleasing painter of incident has, by his influence, been trans- formed into an attentive observer of the facts of nature. Among these disciples are F. Skarbina, Max Liebermann, and G. Kiihl. Menzel is*~~

~~*one of the most interesting and most genuinely original personalities among the artists of the 19th century.*~~

~~*See LuDwiG Pietsch. A. Menzel. — "A. Menzel," Knackfuss Collection, No. 7.*~~

~~*Menzelinsk, a district town of Eussia, govern- ment of Ufa, 181 miles north-west of the town of Ufa, and 10 miles from the left bank of the Kama. Its fair is one of the most important in the southern Ural region, goods, chiefly cattle, hides, furs, grain, tea, manufactured articles, crockery, &c., being sold to the annual value of £400,000 to £500,000. Population (1897), 7642.*~~

~~*Me ran, a favourite health resort and the capital of a district in South Tirol, Austria. The population in 1890 was 7176, or, with the adjoining communes of Obermais and Untermais, 13,201; and in 1900, 9284, and with adjoining communes, 17,961. It is Catholic, and chiefly German. The public iDuildings now include a Protestant church. The annual number of visitors and patients is about 10,000.*~~

~~*Mercantile, or Commercial, Agencies, in*~~

~~*America, are organizations designed to collect, record, and distribute to regular clients information relative to*~~

~~*the standing of commercial firms. In Great Britain and some European countries trade protective societies, com- posed of merchants and tradesmen, are formed for the promotion of trade, and members exchange information regarding the standing of business houses. These soci- eties had their origin in the associations formed in the middle of the 19th century for the purpose of disseminat- ing information regarding bankruptcies, assignments, and bills of sale. The mercantile agency in the United States is a much more comprehensive organization and covers a wider field. It came into existence after the great financial disaster of 1837, when all commerce was pros- trate. Trade in the United States had become scattered over a wide territory. Communication was slow and the town merchant was without adequate information as to the standing of many business men seeking credit. Such information as could be gathered*~~

was collected individually by correspondence and in other ways. Some large houses, whose business justified the expense, em- ployed travelling agents to report on debtors and collect moneys due. At best the information obtained was very meagre and by no means trustworthy. Undoubtedly the severity of the collapse of 1837 was due in part to the insufficiency of this information. !N"ew York merchants, who had suffered so severely, determined to organize a headquarters where reports regarding the standing of customers could be exchanged. Lewis Tappan, a man well known in business circles at that time, undertook the work. This led to the establishment of the Mercan- tile Agency in New York in 1841, the first organization of its kind. The system has been wonderfully developed and extended since. It now includes the whole North American continent. The territory has been completely divided into districts with more than 160 branch offices. Branches are also established in all the leading capitals of the world. HIundreds of reporters, correspondents, and clerks are employed constantly in gathering and recording information relative to the formation of firms and corporations, of persons identified with such firms and corporations or engaged themselves in mercantile pursuits ; their financial resources ; their past business training and present business relations, and other facts having a direct bearing on their standing and credit. This information is not wholly ex parte; where circum- stances warrant it, reliance is placed on statements made by parties concerned, and the making of such statements is encouraged. Financial responsibility is not the whole question to be determined by the grantor of credit, but the capacity of the grantee to transact business, his opportunities and the competition he is compelled to meet. Credit is an essential to commerce conducted on enormously broad lines, and those lines are constantly extending. The granting of credit is as much a problem in the mercantile world to-day as it was when mercan- tile agencies were first known. Improvement in means of communication by post and with the aid of the electric current, and the perfection of the art of printing, have made possible immense strides in mercantile agency business. Instead of curtailing the usefulness of the system, they have been the means of expanding enor- mously trade possibilities, thereby increasing in greater ratio the necessity for quick and accurate sources of information. Agency records are subject to constant revision, and through the improved methods of com- munication are constantly at the service of

~~clients at distant points. A rating book is issued quarterly, in which the names of a million and a half separate and distinct mercantile firms are given, classified by states, cities, and towns, and arranged alphabetically, with a key showing estimated capital and credit rating, explanatory classification symbols, state maps showing routes, and~~

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~~much information of value to mercantile firms. Weekly correction sheets are issued. There are two large agencies in the United States — the Mercantile Agency, E.. Gr. Dun and Co., established 1841, and the Bradstreet Company. There are a number of small agencies, but in the main they are confined to single trades.~~

~~Mercury. — The world's production of mercury for 1899 was 3775 metric tons, of which Spain produced 1357, the United States 993, Austria 536, Eussia 360, Mexico 324, and Italy 205 metric tons. The American product~~

~~*comes almost entirely from California. Mercury is known to occur in South America, China, Japan, Aus- tralia, New Zealand, the East and West Indies, and Ice- land. Mercury occurs in formations of all ages from the Archaean to the Quaternary, and it has been found in both sedimentary and eruptive rocks of the most varied character, e.g'., conglomerates, sandstones, shales, lime- stones, quartzites, slates, serpentines, crystalline schists, and eruptive rocks from the most acid to the most basic. It appears that nearly all known deposits occur along lines of continental uplift, where active shearing of the formar tions has occurred. Large deposits are seldom found in eruptive rocks, but generally near such formations or near active or extinct hot springs. The deposits are of many types, simple fissure veins being less usual than compound, recticulated, or linked veins. Segregations and impregnations are very common. The form of the deposit seems to depend chiefly on the physical proper- ties and structure of the enclosing rocks and the nature of the fissure systems that result from their disturbance. The principal ore is cinnabar, though metacinnabarite and native mercury are often abundant ; the selenide, chloride, and iodide are rare. Of the associated heavy minerals, pyrite (or marcasite) is almost universal, and chalcopyrite, tetrahedrite, blende, and realgar are frequent. Many deposits contain traces of gold and silver, and some deposits, as the Mercur in Utah, are more valuable for their gold than their mercury content. The usual gangae- forming minerals are quartz, dolomite, calcite, barite, fluorspar, and various zeolites. Some form of bituminous matter is one of the most universal and intimate associates of cinnabar. Formerly quicksilver deposits were sup- posed to be formed by sublimation, but a careful study of the California occurrences convinced the writer as early as 1875 that this was unlikely, and that deposition from hot alkaline sulphide solutions was more probable. By treating the black mercuric sulphide with such solutions, hot and under pressure, he succeeded in producing artifi- cial cinnabar and metacinnabarite. He also showed that the mineral water at the New Almaden mines, when charged with sulphydric acid and heated under pressure, was capable of effecting the same change, and that this method of production agreed better with all the facts than the sublimation theory. (See " Genesis of Cinna- bar Desposits," Am. Jour. Science, vol. xvii. p. 453.) The investigations of Dr G. F. Becker on the " Quick- silver Deposits of the Pacific" {U.S. Geol.*~~

~~*Survey, Mon. xiii. 1888) established the correctness of these views beyond doubt.*~~

~~*With the exception of the massive deposits of Almaden in Spain and a few of those in California and Idria, cinnabar occurs in forms so disseminated as to make its mining very expensive. Eude hand- sorting of the ores is usually practised. Wet concentration has not been successful, because it necessitates ore crushing and extensive slime losses of the brittle cinnabar. As a rule low-grade ores can be roasted directly with less loss and expense. At Almaden in Spain the ores average from 5 to 7 per cent., but in other parts of the world much poorer ores have to be treated. In California, in spite of the high cost of labour, improved furnaces enable ores containing not more than one-half per cent, to be mined and roasted at a profit. Distillation with lime in retorts, being applicable to rich ores only, is no longer used. The first improvement was the roasting of the coarse ores in discontinuous furnaces ; these were*~~

~~*first made continuous at Idria in Austria. The most successful of these continuous furnaces was a modification of Count Rumford's continuous lime-kiln. This furnace was introduced at New Almaden by Mr J. B. Randol, the author of many improvements in the me- tallurgy of mercury. The success of the continuous coarse-ore fur- nace at New Almaden led Mr Randol to attempt the continuous treatment of fine ores also, and the Huettner and Scott continuous fine-ore furnace, which was the result of these experiments, solved the problem completely. It contains several vertical shafts in which the descending ore is retarded at will by inclined shelving, which causes it to be exposed to the flames as long as may be neces- sary to roast it thoroughly. The time of treatment is determined by the rapidity with which the roasted ore is withdravyn at the bot- tom. Several simUar furnaces are in use, as the Knox and Osborne, the Livermore, and the Cormak-Spirek. The fumes from the roasts ing furnaces are received in masonry chambers, usually provided with water-cooled pipes ; from these it passes through earthen- ware pipes, and finally through others of wood and glass. Not all the yield is in liquid mercury ; much of it is entangled in masses of soot that cover the condenser walls, and this is only recovered after much labour. The conditions for effective condensation are : — (1) The furnace gases*~~

~~should be well oxidized, to avoid the produc- tion of an excess of soot. Gas firing would meet this requirement better than the use of wood or coal. (2) The volume of permanent gases passing through the furnace should be reduced to a minimum consistently with complete oxidation. (3) The cross-section of the condensers should be sufficient to reduce the velocity of the escap- ing gases, and the surface large enough for cooling and for the adhesion of condensed mercury. The latter requirement is best provided for by hanging wooden aprons in the path of the cooled gases. (4) The temperature of the escaping gases should not ex- ceed 15° to 20° C, but cooling below this temperature would not give any adequate return for the expense. Cooling by water is quicker, but more expensive than by air. Water sprays, acting directly on the fumes, have not given good results, on account of the difficulty of recovering flowered quicksilver from the water. (5) The use of an artificial inward draught is absolutely necessary to control the operation of the furnaces and condensers and to avoid the salivation of the workmen. (6) The condenser should be easily and quickly cleaned during the operation of the furnace. (7) Both furnaces and condensers should have inclined iron plates in their foundations to prevent the infiltration of mercury. (8) There Is a great need of some substance for the construction of quicksilver condensers which shall be strong enough to be made thin, be a good conductor of heat, and resistant to abrasion and the alternate action of heat and cold. It should also resist the action of mercury and warm dilute sulphuric acid, and be not too expensive. Quicksilver is best removed from the "soot," not by pressure, but by the oppo- site treatment. A machine in use for this purpose at New Alma- den, devised by Col. von Leicht, consists of an iron bowl, perforated at the bottom, in which revolves a vertical shaft carrying a propeller blade which tosses the soot (mixed with wood ashes and a little coal oil) into the air, so that the entangled mercury is free to run out through the bottom of the bowl. The residue from which no more mercury can be extracted mechanically is returned to the roast- ingfurnace. The losses of treatment are : — (1) Furnace loss, which is easily reduced to nothing, and (2) condenser loss, which can never be zero. The latter consists of mercury lost as vapour and as mist, and its minimum amount is determined not by the richness of the ore but by the volume of escaping gases, their velocity and tem- perature. The percentage of loss will be higher with a poor than a rich ore. On a 3 per cent, ore the losses need~~

~~not exceed 3 or 4 per cent, ore content. On a 1 per cent, ore they will run from 5 to 10 per cent. But in poorly arranged plants under bad man-agement they may easily be doubled or even trebled. The Huett- ner and Scott fine-ore furnace costs with condensers in California about $30,000,|and roasts from 30 to 45 tons of ore (from 2^ inches to dust) in 24 hours at a cost of from $1 to $0.62 per ton.~~

~~For details see "Mines and Works of Almaden in Spain," by M. Knss, translated from Ann. des Mines by S. B. Christy. San Francisco, 1879 ; and " Imperial Quicksilver Works, Idria in Krain [Camiola]," translated by S. B. Christy. San Francisco, 1884. Also the following from the Trans. Am. Ins. Min. Eng. : — T. Eg-~~

~~GLESTOK. "Mercury in North California," vol. iii. p. 273. S. B.~~

~~Christy. "Quicksilver Reduction and Condensation at New Almaden," vols. xiii. p. 574, xiv. p. 206. — V. Spikbk. " Quick- silver Industry of Italy," Mineral Industry, vol. vi. p. 568. The geological occurrence of cinnabar is elaborately treated in the work of Dr Becker already cited. (g. b. c.)~~

~~Meredith, George (1828), British novelist~~

~~and poet, of mixed Irish and Welsh descent, was born in Hampshire on the 12th of February 1828. At an early age he was sent to school in Germany, where he remained until he was fifteen. During these impressionable years~~

~~he imbibed a good deal of the German spirit; and Ger- man influence, especially through the media of poetry and music, can often be traced in the cast of his thought and sentiment, as well as in the formation of his literary style. Upon his return to England he started, at his guardian's desire, upon the study of law, for which, however, he felt very little inclination, and he soon abandoned it for the more congenial sphere of~~

~~*literature. At the age of twenty-one he began to con- tribute poetry to the magazines. His early career was not without the difficulties commonly incident to the lit- erary calling. He was engaged for some years in journal- ism, editing an Eastern Counties paper, for which he wrote numerous political notes and articles. During the Austro-Italian war of 1866 he acted as special corre- spondent of the Morning Post, and, although he saw little actual fighting, he enjoyed, particularly at Venice, oppor- tunities for a study of the Italian people which he after- wards turned to account in his novels, and especially in Vittoria. Towards the close of 1867, when his friend Mr John Morley paid a visit to America, Mr Meredith un- dertook in his absence the conduct of the Fortnightly Re- view. For many years he acted as literary adviser to the publishing firm of Chap- man and Hall, in which car pacity he left a reputation for being not only eminently wise in his selection of the books to be published, but both crit- ical and encouraging to au- thors of promise whose works he found himself obliged to reject. Among the writers with whom he came in con- tact in this way were Lord Lytton ("Owen Meredith"), Mr Thomas Hardy, and Mr George Gissing, all of whom have expressed their grateful sense of his wise assistance. He was, indeed, one of the*~~

~~*last of the old school of " readers." Mr Meredith mar- ried twice, his first wife being a daughter of Thomas Love Peacock. She died after twelve years of married life, broken by separation. On his second marriage Mr Meredith settled at Box Hill, Surrey, close to the old inn in which Keats wrote part of Endymion. His second wife died 17th September 1885.*~~

~~*Mr Meredith's first appearance in print was in the character of a poet, and his first published poem may be found in Chambers's Journal for 7th July 1849. Two years later he put forth a small volume of Poems (1851), which, if it did not attract a large public, was at least fortunate in eliciting the praise of two judges whose opinion was of the first importance to a beginner. Tennyson was at once struck by the individual flavour of the verse, and declared of one poem, "Love in the Val- ley," that he could not get the lines out of his head. Charles Kingsley's eulogy was at once more public and more particular. In Fraser's Magazine he subjected the*~~

~~volume to careful consideration, praising it for richness and quaintness of tone that reminded him of Herrick,~~

~~for completeness and coherence in each separate poem, and for the animating sweetness and health of the general atmosphere. At the same time he censured the laxity of rhythm, the occasional lack of polish, and the tendency, always characteristic of Mr Meredith's poetry, to overload the ■ description with objective details to the confusion of the principal effect. No doubt as a result of Kingsley's introduction, two poems by Mr Meredith appeared in Fraser's Magazine shortly afterwards ; but with the ex- ception of these, and a sonnet in the Leader, he did not publish anything for the next five years. In the mean- while he was busy upon a work which was to give him a triumphant introduction to the world of letters. It was early in 1856 that the Shaving of Shagpat made its appear- ance, and, despite the fact that the hourwas particularly rich in literary production, it was at once recognized as a work of singular imagina- tion, richness, and romance. George Eliot was one of the first to acclaim its excellence, and Dante Gabriel Eossetti was among its enthusiastic eulogists. Its success was not, perhaps, popular, but it was at least genuine, and the book remains one of the most fascinating in the lan- guage. Modelled upon the Arabian Nights, it catches with wonderful ardour the magical atmosphere of Orien- talism; through its city of "yellow domes and black cypresses, silver fountains and marble pillars," the reader wanders with all the circumstance of imaginative actuality. Mr Meredith, in casting about for a new field, was less fortunate in inspiration. It occurred to him to turn his familiarity with the life and legendary tradition of the Ehinelander into a sort of imitation of**

the grotesquerie of the Ger- Geoege Meredith. man romanticists, and in the

(From a photogrnphhij Frederifk IluUyer of the painting by G.F.Watix.) following year 1857 he put

forth Farina, a Legend of Cologne, which sought to transfer to English sympathies the spirit of German romance in the same way that Shagpat had handled Oriental fairy-lore. The result was less successful. The' plot of Farina lacks fibre, its motive is insufficient, and the diverse elements of

humour, serious narrative, and romance scarcelj^ stand in proportion to one another. If, however. Farina lost him a little ground, the Ordeal of Richard Feverel, which followed in 1859, transferred Mr Meredith at once to a new sphere and to the altitude of complete success. With this novel Mr Meredith de- serted the realm of fancy for that of the philosophical and psychological study of human nature, and Richard Feverel was the first, as it is perhaps the favourite, of those wonderful studies of motive and action which placed him at the head of contemporary novelists. The theme of this fine study is the question of a boy's education. It depicts the abortive attempt of a proud and opinionated father, hide-bound by theory and precept, to bring up his son to a perfect state of manhood through a "system" which controls all his early circumstances and represses

many of the natural and wholesome instincts and impulses of adolescence. The love scenes in Bichard Feverel are specially fresh and full of vitality, and marked a revolution in the English treatment of clean and manly passion. In the following year Mr Meredith contributed to Once a Week, and in 1861 published as a book the second of his novels of modern life, Evan Harrington, which con- tains a richly humorous — occasionally almost farcical — plot, with some magnificent studies of character. A year later he produced his finest volume of poems, entitled Modei-n Love, and Poems of the English Roadside, with Poems and Ballads. A memorable attack upon the dramatic poem which gives the volume its title appeared in the Spectator, based upon the view that the poet had elected to treat a deep subject — psychical unfaith- fulness — without himself possessing any sufficient con- viction upon its issues. To this Mr Swinburne, with one of his characteristically generous impulses, replied (Spectator, 7th June 1862) in a spirit of fervent eulogy, pointing out that it is the part of poetry not so much to argue a thesis as to state a case, and that the subject had been treated in Modem Love with all the lucidity demanded by poetic convention. Some of the individual " sonnets " (of sixteen lines) into which Modem Love is divided are certainly worthy

~~*of being ranked with the most subtle and most intense poetic work of the 19th century.*~~

~~*Eeturning to fiction, Mr Meredith next published Emilia in England (1864), afterwards renamed Sandra Belloni. HIs powerful story, Rhoda Fleming (1866), followed soon afterwards. Vittoria, published in the Fortnightly Review in 1866, and in book form in 1867, is a sequel to Emilia in England. Four years later appeared The Adventures of Harry Richmond, in the pages of Cornhill (1870-71). Its successor was BeaucJiamp's Career (Fortnightly Review, 1874-75), the novel which Mr Meredith has privately described as his own favourite. Its hero's character is sup- posed to have been founded upon that of the late Admiral Maxse, Mr Meredith's brother-in-law. " The HOuse on the Beach " and " The Case of General Opie and Lady Camper" (Neiv Quarterly Magazine, 1877) were slight but glittering exercises in comedy ; the next important novel was The Egoist (1879). In an interesting series of lectures which Mr Meredith delivered at the London Institution in 1877 his main thesis was that a man without a sense of comedy is dead to the finer issues of the spirit, and the conception of Sir Willoughby Patterne, the central figure of The Egoist, is an embodiment of this idea in the flesh. The Tragic Comedians (1880), the next of Mr Meredith's long novels, combines the spirits of comedy .and tragedy in the story of the life of Ferdinand Lassalle, the, German Socialist. The appearance of Diana of the Crossways (1885) marks an epoch in Mr Meredith's career, since it was the first of his stories to strike the general public. Its heroine was popularly identified with Sheridan's grand- daughter, Mrs Norton, and the use apparently made of the well-known story of that lady's communication to Tlie Times of the Cabinet secret of Peel's conversion to Free Trade had the effect of producing explicit evidence from Lord Dufferin and others that this story was untrue. HOwever that might be, its popular acceptance gave additional interest to the novel.*~~

~~*Meanwhile further instalments of poems — Poems and Lyrics of the Joy of Earth (1883) — had struck anew the full, rich note of natural realism which is Mr Meredith's chief poetic characteristic. " The Woods of Westermain," in particular, has a sense of the mysterious communion of man with nature unapproached by any English poets save Wordsworth*~~

~~*and Shelley. Ballads and Poems of Tragic Life (1887) and A Reading of EaIIh (1888) gave further evidence of the wealth of thought and vigour of*~~

~~*expression which Mr Meredith brought to the making of verse. To " the general," no doubt, Mr Meredith's verse is prohibitive, or nearly so — for, after all, he has written " Martin's Puzzle," " The Old Chartist," and " Juggling Jerry." HIs readers, of the verse even more than of the prose, must be prepared to meet him on a common intellectual footing. But when once that is granted, the music and magic of such poems as " Seed-time," " Hard Weather," "The Thrush in February," "The South-Wester," " The Lark Ascending," " Love in the Valley," " Melampus," "A Faith on Trial," are very real, amid all their occasional obscurities of diction.*~~

~~*Mr Meredith had, however, now completed his sixtieth year, and the angles of his individuality began to grow sharper, while the difficulties of his style, which had never been easy, became accentuated. The increase in mannerism was marked in One of Our Conquerors (1891) and in the poem of " The Empty Purse," (1892). Nor did either Lord Ormont and HIs Aminta (1894) or TJie Amazing Marriage (1896) reach the high level of the earlier novels, though in the latter he seemed to catch an afterglow of genius. But by this time Mr Meredith's fame was assured, and the greatness of the work of his prime fully acknowledged. HIe was chosen to succeed Tennyson as President of the Authors' Society; on his seventieth hirthday (1898) he was presented with a congratulatory address by thirty of the most prominent men of letters of the day ; and in various other ways his position as the greatest living English writer had come to be popularly recognized. The critics discussed him; and new editions of his books (both prose and verse), for which there had long been but scanty demand, were called for. One of the results was that Mr Meredith, with very doubtful wisdom, recast some of his earlier novels; and in the sumptuous "authorized edition" of 1897 (published by Constable) very large alterations are made in some of them. In fact, a reader who compares the first and last editions either of Richard Feverel or Evan Harrington will notice changes little short of revolutionary. It is no doubt competent to an author himself to revise his earlier published work even to the extent to which Mr Meredith in the 1897 edition revised these*~~

~~*novels ; but certainly it is not necessary to accept his judgment when this involves the excision in old age of some of the most virile passages of books that were written in the full glow and vigour of his prime ; and one of the duties of future editors will be to restore Richard Feverel and Evan Harrington to their earliest versions. In 1898 appeared his Odes in Contribution to the Song of French History, consisting of one ode (" France, December 1870 ") reprinted from Ballads and Poems (1871), and three others previously unpublished; a fine example of his lofty thought, and magnificent — if often difficult — and in- dividual diction. In 1901 another volume of verse, A Reading of Life, appeared.*~~

~~*Mr Meredith's literary quality must always be considered in the light of the Celtic side of his temperament and the peculiarities of his mental equipment. His nature is intuitive rather than ratiocinative ; his mental processes are abrupt and far-reaching; and the suppression of connecting associations frequently gives his language, as it gave Browning's, the air of an impenetrably nebulous obscurity. It is this " anfractuosity," to use a word of Dr Johnson's, that leaves much of his poetry, despite the intellect that illumines it and the beauty that lends it colour for readers who will take the trouble to put them- selves at the writer's point of view, with a dimness and a blurred outline beyond even the intricacies of his prose. But, when once his manner has been properly understood, it is seen to be inseparable from his method of intellection, and to add to the narrative of description both vividness*~~

~~*of delineation and intensity of realization. The essential respect in which Mr Meredith's method of describing action and emotion in narrative differs from that of convention is that, while the ordinary method is to relate what happens from the point of view of the onlooker, Mr Meredith describes it from the point of emotion of the actor ; and his influence in this direction has largely modified the art of fiction. Herein lies the secret of the peculiar brilliancy of his style, derived from his combination of the narrator with the creator, or — in its strict sense — the seer. The reader, by the transference of the interest from the audience to the stage, is*~~

~~*transported into the very soul of the character, and made to feel as he feels and act as he acts. Moreover, Mr Meredith's instinct for psychology is so intimate, and his sense of motive and action so true, that the interaction of character and character directly dominates the sequence of events depicted in his imaginary world, and discloses the moral idea or criticism of life, instead of the preconceived " moral " being merely illustrated by the plot. In building up the minds, actions, creeds, and tragedies or comedies of his imaginary per- sonalities amid the selected circumstances, and inspiring them with the identical motives and educational influ- ences of life itself, Mr Meredith has spent an elabora- tion and profundity of thought and an originality and vigour of analysis upon his novels which in explicitness go far beyond what had previously been attempted in fiction, and which give to his works a philosophical value of no ordinary kind. Simplicity can scarcely be expected of his language, for the interplay of ideas is in itself original and complex, and their interpreta- tion is necessarily original and complex too. But when Mr Meredith is at his best, he is only involved with the involution of his subject; the aphorisms that deco- rate his style are simple when the idea they convey is simple, elaborate only in its elaboration. Pregnant, vividly graphic, capable of infinite shades and gradations, his style is a much finer and subtler instrument than at first appears, and must be judged finally by what it con- veys to the mind, and not by its superficial sound upon the conventional ear. It owes something to Jean Paul Eichter ; something, too, to Carlyle, with whose methods of narrative and indebtedness to the apparatus of Ger- man metaphysics it has a good deal in common. To the novelist Richardson, too, a careful reader will find that Meredith, both in manner and matter (notably in Tlie Egoist and in Richard Feverel), owes a good deal ; in " Mrs Grandison " in Richard Feverel he recalls " Sir Charles Grandison " by name ; and nobody can doubt that Sir Willoughby Patterne, both in idea and often in expres- sion, was modelled on Richardson's creation. But what is most characteristic in Mr Meredith remains individual. Like all the great masters, he has his own tone of voice, his own fashion of expressing an idea. Peeling, per- ception, reflection, judgment, have equal shares in deter- mining his architectonic relation to a problem or a situation. HIe rings changes on the changing emotions of humanity, but every chime rings true. It is beyond our scope here to enter into details concerning the phil- osophy*~~

~~*which represents Mr Meredith's "criticism of life." Broadly speaking, it is a belief in the rightness and whole- someness of Nature, when Nature — " Sacred Reality " — is lovingly and faithfully and trustfully sought and known by the pure use of reason. Man must be "obedient to Nature, not her slave." Mystical as this philosophy occasionally becomes, it is in the main inspiring, clean, austere, and practical; and it is always dominated by the categorical imperative of self-knowledge and the striving after honesty of purpose and thought. A strong vein of political Radicalism runs through Mr Meredith's philosophy. It is, however, a Radicalism allied to that*~~

~~*of the Trench sages rather than to the current develop- ments of British party politics. Mr Meredith has always been strongly French in his sympathies, and his appre- ciation of French character at its best and at its worst is finely shown in his Napoleon odes. In the main his politics may be summed up as a striving after liberty for reason and conscience and the constant progress of hu- manity —*~~

~~*The oiy of the conscience of life ; Keep the young generations in hail, And bequeath them no tumbled house.*~~

~~*It is part of Mr Meredith's creed — and this must be remembered in considering his diction — that verbal expres- sion is itself a test of right thought and action. Hence is derived his passion for verbal analysis. Hence also his ■ impulse towards and vindication of poetry — ^meaning still " the best words in the best order " ; and hence his own dictum, otherwise perhaps hard to undiscerning minds, that Song itself is the test by which truth may be tried. The passage occurs in " The Empty Purse " — itself a care- ful though mannered exposition of Mr Meredith's general views on life : —*~~

~~*Ask of thyself : This furious Tea*~~

~~*Of a speech I thump to repeat,*~~

~~*In the case I would have prevail,*~~

~~*For seed of a nourishing wheat,*~~

~~*Is it accepted of Song ?*~~

~~*Does it sound to the miad through the ear,*~~

~~*Right sober, pure sane ? has it disciplined feet ?*~~

~~*Thou wilt find it a test severe ;*~~

~~*Unerring whatever the theme.*~~

~~*Kings it for Reason a melody clear,*~~

~~*We have bidden old Chaos retreat,*~~

~~*"We have called on Creation to hear ;*~~

~~*All forces that make us are one full stream.*~~

~~*Undoubtedly, as a poet, Meredith is generally ranked far less high than as a novelist. But he can only be understood and appreciated properly by those who realize that not prose (in the ordinary sense) but poetry is to him the highest form of expression, and that only in it can he fully deliver his message as a writer who aspires to con- tribute something more to the common stock of ideas than can be embodied dramatically in prose fiction.*~~

~~*A carefully compiled bibliography by John Lane is included in George Meredith : Some Characteristics. By R. Le Galliemje,*~~

~~*1890. (Lane.) (h. ch.; A. Wa.)*~~

~~*Mergui, the southernmost district of Lower Burma, in the Tenasserim division, bounded on the W. by the Bay of Bengal and on the E. by Siam. It had in 1876 a population of 61,846, 73,748 in 1891, and 88,667 in 1901, showing an increase of 20-23 per cent, and giving a den- sity of 9 inhabitants to the square mile. The area is 9789 square miles, and it had in 1898-99, 360 villages paying a revenue of Rs.2,98,671. Of the population in*~~

~~*1891, 63,296 were Buddhist and Jains, 5288 Mahomme- dans, 857 Hindus, 1891 aborigines, mostly Selungs, and 2416 Christians, 2191 of whom were natives. Of the total area of 6,264,960 acres, only 81,785 acres were cultivated in 1898-99 : 3,503,259 were not available for cultivation, and 2,482,299 acres apart from fallow were cultivable. The rainfall in 1898-99 taken at Mergui was 150-71 inches. Mergui to-wn had in 1891 a population of 10,137. There is a considerable coasting trade with other Burmese ports and with the Straits Settlements, but the to-wn does not greatly increase in size. The coal on the Tenasserim river still remains unworked, but a renewed effort is being made to work the Maliwun tin mines by European methods. There were 192,000 acres of forests in the Mergui district in 1889-90.*~~

~~*Merida, a town of Spain, in the pro-vince of Badajoz, 30 miles east of Badajoz by rail. The population was*~~

~~10,886 in 1897. There is an active trade in the agricul- tural products of the surrounding districts, and such local industries as manufactures of leather, linen goods, soap, and hats have developed. Several improvements have, fortunately, not greatly interfered so far with the priceless treasures of Roman and mediaeval antiquities.~~

~~Meriden, a city and town of New Haven county, Connecticut, U.S.A., on the New York, New Haven, and Hartford railroad, south-west of the centre of the state, at an altitude of 133 feet. The plan of the city, which is included within the town, is irregular ; it is divided into five wards, and the waterworks, which supply water by gravity, are owned by the city. In 1900 its manufactur- ing establishments had a capital of f 16,699,004, employed an average number of 7531 wage-earners, and had a product valued at $13,485,640. Of this, plated and Britannia ware had a value of $4,129,896 ; hardware, $1,619,149; and cutlery and edge tools, $408,493. Population of the town (1890), 25,423; (1900), 28,695; of the city (1890), 21,652; (1900), 24,296, of whom 7215 were foreign born and 207 were negroes. The death-rate of the city in 1900 was 14-3.~~

~~Meridian, a city of Mississippi, U.S.A., capital of Lauderdale county, on the Mobile and Ohio, the Queen and Crescent and the Southern railways, in the eastern part of the state, at an altitude of 344 feet. It is in a region in great part devoted to the production of cotton, of which staple Meridian is a collecting and shipping point of much importance. It is the seat of Eastern Mississippi Female College, a Methodist Episcopal institu- tion, founded in 1869. In 1899 it had 28 instructors and 307 students. Population (1890), 10,624; (1900), 14,050, of whom 235 were foreign-born and 5787 were negroes.~~

~~Merioneth, a maritime county of North Wales, is bounded on the N. by Carnarvon and Denbigh, on the E. by Denbigh, on the S.E. by Montgomery, on the S. by Cardigan, and on the W. by Cardigan Bay.~~

~~*Area and Population. — The area of the ancient ooxmty, as given in the census returns of 1901, was 427,810 acres, or 668 square miles, with a population in 1881 of 51,967, in 1891 of 49,212, and in 1901 of 49, 130, the number of persons per square mile being 73, and of acres to a person 8·7. In 1895 the area of the administrative county was diminished by the transference of the part of the parish of Beddgelert in Merioneth to Carnarvon. In 1891 its population was 48,859, and in 1901, 48,774. The area of the registration county is 625,802 acres, with a population in 1891 of 64,726. Be- tween 1881 and 1891 the population decreased 5‘15 per cent., and between 1891 and 1901, 0·2 per cent. The excess of births over deaths between 1881 and 1891 was 7092, but there was a decrease in the resident population of 3511. The following table gives the numbers of marriages, births, and deaths, with the number and percentage of illegitimate births, for 1880, 1890, and 1898 : —*~~

~~*Tear.*~~

~~*Marriages.*~~

~~*Births.*~~

~~*Deaths.*~~

~~*Illegitimate Births. 1*~~

~~*Number.*~~

~~*Per Cent.*~~

~~*1880 1890 1898*~~

~~*407*~~

~~*365 506*~~

~~*2161 1723 1842*~~

~~*1423 1213 1188*~~

~~137 131 139~~

~~6-4 7-6 7-5~~

~~In 1891 there were in the county 102 natives of Scotland, 85 natives of Ireland, and 65 foreigners", while 3621 persons could speak English, 45,856 "Welsh, and 12,023 English and Welsh.~~

~~Constitution and G-overnment. — The county returns one member to Parliament. It has neither parliamentary nor municipal borough, but the following are urban districts: Bala (1544), Barmouth (2213), Dolgelley (2437), Festiniog (11,435), Mallwyd (890), and Towyn (3744). The county is in the North Wales circuit, and assizes are held at Dolgelley. It is partly in the diocese of Bangor and partly in that of St Asaph, and contains 37 ecclesiastical parishes and districts, and parts of 4 others.~~

~~Education. — The total number of elementary schools on 31st August 1899 was 77, of which 50 were board and 27 voluntary schools, the latter including 26 National Church of England schools~~

~~and 1 "British and other." The average attendance at board schools was 5808, and at voluntary schools 1580. the total school board receipts for the year ended 29th September 1899 were over £24,212. The income under the Agricultural Rates Act was over £1234.~~

~~Agriculture. — Rather more than a third of the total area is under cultivation, and of this more than two-thirds is in permanent pasture, while com crops occupy an eleventh and green crops less than a fortieth. Oats are the principal com crop, occupying more than three-fifths of that acreage, while the small acreage under green crops is usually nearly equally divided between potatoes and turnips. There is a specially large proportion of cows among the cattle kept. The following table gives the main divisions of the cultivated area at intervals from 1880 : —~~

~~Year.~~

~~Total Area under Cultiva- tion.~~

~~*Corn Crops.*~~

~~*Green Crops.*~~

~~*Clover.*~~

~~*Permanent Pasture.*~~

~~*Fallow.*~~

~~*1880 1885 1890 1895 1900*~~

~~*152,623 157,098 161,315 154,038 152,929*~~

~~*16,868 17,004 16,317 14,937 13,963*~~

~~*4033 3954 4072 3768 3611*~~

~~*15,067 11,225 12,160 13,897 18,698*~~

~~*116,221 124,879 128,616 121,341 116,559*~~

~~*434 36*~~

~~*150 95 98*~~

~~*The following table gives particulars regarding the prmcipal live stock for the same years : —*~~

~~*Tear.*~~

~~*Total Horses.*~~

~~*Total Cattle.*~~

~~*Cows or Heifers*~~

~~*in Milk or in*~~

~~*Calf.*~~

~~*Sheep.*~~

~~*Pigs.*~~

~~*1880 1885 1890 1895 1900*~~

~~*6137 5453 4998 5266 5219*~~

~~*38,493 39,500 38,281 38,002 39,518*~~

~~*14,827 14,937 14,549 13,998 14,276*~~

~~*413,473 399,743 412,878 376,853 433,727*~~

~~*8,468 9,059 10,049 9,561 8,137*~~

~~*Industries and Trade. — Manufactures are insignificant, only about 800 persons being employed in factories and workshops. The total number of persons employed in connexion witli mines and quarries in 1898 was 6062 ; 35 tons of gold ore valued at £7 were mined in 1885, 13,264 tons valued at £16,584 in 1895, 703^ tons valued at £1158 in 1898 ; 155,634 tons of slate valued at £435,438 were dug in 1885, 135,457 tons valued at £456,865 in 1895, and 151,279 tons valued at over £500,000 in 1899. In 1899 sandstone was raised to the amount of 21,856 tons, igneous rocks of 12,808 tons, and slate of 160,565 tons. Fisheries are unimportant.*~~

~~*Authorities. — Ramsay. The Geological Structure of Merioneth- shire and Carnarvonshire. London, 1858. — ^Breese. Kalendars of Crwynedd. London, 1873. — Kilner. Four Welsh Counties. London, 1891. — Guides to North Wales. (t. f. h.)*~~

~~*Merivale, Charles (1808-1893), English his- torian and dean of Ely, born 8th March 1808, was the second son of John Herman Merivale, a Chancery bar- rister, and Louisa Heath Drury, daughter of Dr Drury, headmaster of Harrow. Another son was Herman Merivale, formerly permanent Under-Secretary of State for the Colonies (1848), and India (1860). Charles Merivale was at Harrow School (1818 to 1824) under Dr Butler. His chief friends were Charles Wordsworth, afterwards bishop of*~~

~~St Andrews, and Eichard Chenevix Trench, afterwards archbishop of Dublin. In 1824 he was offered a writership in the Indian Civil Service, and went for a short time to Haileybury College, where he was distinguished for proficiency in Oriental languages. But he eventually decided against an Indian career, and went up to St John's College, Cambridge, in 1826. Among other distinctions he came out as fourth classic in 1830, and in 1833 was elected fellow of St John's. He was a member of the Apostles' Club, his fellow-members including Tennyson, A. H. Hallam, Monckton Milnes, W. H. Thompson, Trench, and Spedding. He was fond of athletic exercises, had played for Harrow against Eton in 1824, and in 1829 rowed in the first inter-University boat-race, when Oxford won. In 1833 he was ordained, and undertook college and university work successfully, acquiring some fame as a preacher. In 1848 he took the college living of Lawford, near Manningtree, in Essex ; he married, in 1860, Judith Mary Sophia, youngest daughter~~

~~of George Frere. In 1863 he was appointed chaplain to the Speaker of the House of Commons, declined, the professorship of modern history at Cambridge in 1869, but in the same year accepted from Mr Gladstone the deanery of Ely, and until his death on 27th December 1893 devoted himself to the best interests of the cathe- dral. He received many honorary academical d istinctions. His principal work was A History of the Romans under the Empire, in seven volumes, which came out between 1850 and 1862; but he wrote several smaller historical works, chiefly of an educational character, and published sermons, lectures, and Latin verses. His history did much to popularize the study of Roman history during the Empire, and was the first readable book on the subject that covered the ground satisfactorily. Merivale as a his- torian cannot be compared with Gibbon for virility, but he takes an eminently common-sense and appreciative view. The chief defect of the book, inevitable at the time it was composed, is that, drawing the materials from contemporary memoirs rather than from inscriptions, he relies on literary gossip rather than on the evidence of fact that inscriptions alone can supply. His judgment of~~

~~*character is mainly ethical, and not sufficiently rela- tive to circumstances. The style is easy and flowing, but has a rotundity now unfashionable, and adapted to gliding skilfully over difficulties imperfectly appre- hended. The Dean was an elegant scholar, and his ren- dering of the Hyperion of Keats into Latin verse (1862) has received high praise. A typical instance of the mens Sana in corpore sano, his geniality was seasoned by an acute, almost caustic sense of humour, and it may be questioned whether he would have been more severe to fanaticism or listlessness. He had none of the faults or affectations of the pedant, and was eminently a prac- tical man, with an accurate memory and a good head for business. His vigorous enjoyment of life, his shrewd interest in men and affairs, continued unabated to the last. (a. c. Be.)*~~

~~*Merrill, a city of Wisconsin, U.S.A., capital of Lin- coln county, on the Wisconsin river and the Chicago, Milwaukee, and St Paul railway, north of the centre of the state, at an altitude of 1263 feet. In 1900 the city contained 69 manufacturing establishments, with a total capital of $3,520,126, products valued at $4,150,272, and 1694 wage-earners. It is in a heavily-timbered region, and its manufactures consist in great part of lumber. Population (1890), 6809; (1900), 8537, of whom 2399 were foreign-born.*~~

~~*Merrirnac River, a stream of New Hampshire and ^Massachusetts, U.S.A., rising in the White Mountains of New Hampshire and flowing south into Massachusetts, and thence north-east to its mouth at Newburyport. Its length is 110 miles, and it drains an area of 4864 square miles. Its course is through a glaciated region, in con- sequence of which it is interrupted by many rapids and falls, which have been extensively utilized as sources of water power in the manufacture of cotton and woollen goods, notably at Lawrence and Lowell, Massachusetts, and at Nashua and Manchester, New Hampshire. This stream probably drives more spindles than any other river in the world.*~~

~~*Merritt, Wesley (1836-*~~

~~*-), American soldier.*~~

~~was born in New York City on the 16th of June 1836, and after graduating at West Point in 1860, was assigned to dragoon service. During the Civil War he gained renown as a cavalry officer, serving in successive Virginia campaigns, under Stoneman and Sheridan. He was made a major-general of volunteers on 1st April 1866, and was promoted gradually from lieutenant-colonel of regulars to major-general. He served in Indian cam-~~

~~paigns, as superintendent at West Point, and in command of military departments. He was assigned in May 1898 to the command of the United States forces that were sent to the Philippines, after Admiral Dewey's victory, and made first military governor of the islands. He was retired from service, June 1900.~~

~~Merscheid, a town of Prussia, in the Rhine pro- vince, now known as Ohligs.~~

~~Merseburg, a town of Prussia, province of Saxony, on the left bank of the Saale, 9 miles by rail south of Halle. The cathedrq,l was thoroughly restored in 1883- 86. A new meeting-hall of the provincial estates was built in 1895. The cr 'tie, built in 1483-1661, but re- stored in the 17th catury, now serves Government purposes. A bronze statue of the Emperor Frederick III. (1894), and another of the Emperor William I. (1897), adorn the town. Population (1885), 16,828;~~

~~(1900), 19,119.~~

~~Mersina, a town of recent foundation, on the south coast of Asia Minor, in the vilayet of Adana, and the port (an open roadstead) of Tarsus and Adana, with which it is connected by railway and road. The population of 12,500 is half Moslem, half Christian. The average annual exports in 1896-1900 were valued at £639,830 (1900, £821,243), the imports at £332,639 (1900, £269,121). The town is the seat of British and other consuls.~~

~~Merthyr Tydfil, a parliamentary borough and mar- ket town of Glamorganshire, Wales, on the river Taff, 24 miles by the Taff Vale railway north-north-west of Cardiff, with which it is also connected by~~

~~canal. The iron ore here treated is mainly imported from Spain. At Merthyr Vale is one of the largest collieries in South Wales. A theatre has been erected, seating 1800 persons and lighted by electricity. A Roman Catholic church (1894) and a town hall (1898) have been erected ; and the General Hospital, built in 1887, was enlarged in 1897. Population (1891), 59,004; (1901), 69,227.~~

~~Merv, formerly a large and flourishing town in the east of the oasis of the same name, in western Asia, now in ruins. New Meev was founded in the first quarter of the 19th century, more to the west of the oasis, and is now a district town of Russia, in the Transcaspian pro- vince, and on the Transcaspian railway, 510 miles from Uzun-ada station on the Caspian Sea, and 381 miles from Samarkand. It stands on both banks of the Murghab, at an altitude of about 820 feet above the Caspian, the Russian fort being situated on the right bank of the river. It is a well-built town, with (1897) 8729 inhabit- ants, Russians, Armenians, Turkomans, Persians, and Jews. It has a Greek and an Armenian church, and a synagogue, a Russian and two Mussulman schools, a hospital, and a meteorological observatory. Its trade re- turn^ are considerable. Corn, raw cotton (two factories), hides, wool, nuts, and dried fruit are exported. The climate is extremely dry and continental ; there is often no rain from June till October, and the total rainfall is but 5 inches ; the average yearly temperature is 60° Fahr. The Merv oasis was taken possession of by Russia in 1884.~~

~~Meshed, properly Mash-had (the place of martyr- dom), capital of the great Persian province of Khorassan, situated in 36° 17' N. and 59° 36' E., at an elevation of 3180 feet. Its population is about 70,000 fixed and 10,000 floating, the latter consisting of pilgrims to the shrine of Imam Riza. Without the pilgrims, who come to visit it to the number of over 100,000 yearly, INIeshed would be but a poor place; but lying on the eastern confines of Persia, close to Afghanistan, Russian Central Asia, and Transcaspia, at~~

~~*the point where a number of trade routes converge, it is very important politically, and the Russian and British Governments have maintained consulates-general there since 1889. Meshed had formerly a great transit trade to Central Asia: of European manufactures, mostly Man- chester goods, which came by way of Trebizond, Talftiz, and Tehran ; and of Indian good's and produce, mostly muslins, Indian and green teas, which came by way of Bander Abb^si. With the opening of the Russian railway from the Caspian to Merv, Bokhara, and Samarkand in the 'eighties, Russian manufacturers were enabled to com- pete in Central Asia with their western rivals, and the value of European manufactures passing Meshed in transit was much reduced. In 1894 the Russian custom-house en- forced new regulations by which a heavy duty is levied on Anglo-Indian manufactures and produce, excepting pepper, ginger, and drugs, imported into Russian Asia by way of Persia ; and the importation of green teas is altogether prohibited except by way of Batum, Baku, Uzun-ada, and the Transcaspian railway. Since then the transit trade is practically nil. The present trade of Meshed is estimated at : exports, £120,000 ; imports, £210,000. In 1890 General Maclean, the British consul- general, reported that there were 650 silk, 40 carpet, and 320 shawl looms at work ; in 1898 Colonel Temple men- tioned 250 silk and 200 carpet looms. The Imperial Bank of Persia opened a branch at Meshed in 1891. (a. h.-s.)*~~

~~*Mesolonghi. See Missolonghi.*~~

~~*Mesopotamia.—Since 1885 the Porte has been gradually extending its authority over the nomads in Mesopotamia. When Sheikh Faris, the paramount sheikh of the northern Shammar Arabs, made his submission he was appointed Pasha, and maintained order within the limits of his authority. Some of the smaller tribes, on the outskirts of the desert, have been settled in villages ; in several localities the Sultan owns large private estates, upon which there are model farms; small military posts' have been established to protect the agricultural colonies from Arab raids ; and in 1892 a special school was opened at Constantinople for the sons of influential Kurd and Arab sheikhs. There has been a great extension of cultivation in the Euphrates valley : the rich lands south of Jebel Sinjar are cultivated, and villages have been built on them; Rakka has been*~~

occupied by colonists from Aleppo ; and the Circassians of Ras el-"Ain have planted colonies as far south as Jebel Abdul-aziz. In 1892 the most influential chiefs of the Yezidis were treacherously murdered at Mosul by Omar Pasha, and an attempt was made to exterminate the sect. This was checked by an appeal to Constantinople through the European consuls at Mosul. Throughout the country there has been a great increase of German influence, especially since the extension of the Anatolian railway to Diarbekr, Mosul, and Baghdad was projected.

See Sacha0. Beise in Sxjrien und Mesopotamien. Leipzig, 1883 ; Am Euphrat und Tigris. 1899. — Parky. Six Months in a Syrian- Monastery. 1895. — ^Von Oppenheim. Vom Mittelmeer zum Persischen Gulf. Berlin, 1900. (c. W. W.)

Messina, a city of Italy in the north-east corner of the island of Sicily, with an excellent harbour opening upon the strait of the same name. Owing to its excel- lent position, Messina has gradually recovered its import- ance, and now, with a population of 156,552, is the second city of Sicily. Its harbour, strongly fortified, is visited by most of the vessels which pass through the Mediterranean to the Suez Canal eastward bound. In consequence it has become an important trade centre with a large number of wealthy commercial houses. Some industries have been established and show signs of flourishing. Agricul-

ture, however, is the principal occupation of the district, although the province of Messina is one of the poorest of the island. Excellent silk is produced, Messina being in this respect ahead of the rest of Sicily. Except the cathedral, begun by the Normans and enlarged and embellished by Angevins and by the Spaniards,^ Messina has few ancient monuments, earthquakes having time after time ruined the most important edifices. By the Casati Law on higher instruction in Italy, the University of Messina was in 1860 given second-class status and its faculties restricted to law and medicine. It underwent a period of decadence from 1860 to 1885. In the latter year a Consorzio Universitario, in which the municipality, the provincial authorities, and the Chamber of Commerce were represented, provided funds for the extension of the University, and obtained from Parliament a law conferring upon it first-class status, with the addition of

~~*faculties of philosophy and letters, and of natural science and mathematics. In 1899 the University possessed 41 official and 31 free chairs. Its students, who in 1890 numbered only 302, had in 1900 increased to 672, a development due chiefly to the reputation of the various professors. In 1896, 6370 vessels of 3,257,403 tons entered and cleared the port, unloading and loading 379,623 tons of goods; in 1898, 7478 vessels of 3,392,756 tons, unloading and loading 391,201 tons of goods, entered and cleared.*~~

~~*Meta. See Orinoco.*~~

~~*Metabolic Diseases. See PATHOLoaY.*~~

~~*Metallography. — The examination of metals and alloys by the aid of the microscope has assumed much importance in comparatively recent years, and it might at first be considered to be a natural development of the use of the microscope in determining the constitution of rocks, a study to which the name petrography has been given. It would appear, however, that it is an extension of the study of the structure of meteoric irons. There can be no question that in the main it was originated by Dr Sorby, who in 1864 gave the British Association an account of his work. His later papers will be referred to in the bibliography. Following the work of Sorby came that of Professor Martens of Charlottenburg, presenting many features of originality. Although much of his work dealt with the examination of opaque bodies and the application of the method to the various products of the metallurgy of iron, he studied also the general laws of fractures, fissures, blow-holes, and crystallization in metals. M. Osmond, who was one of the earliest to recognize the importance of micrography, has made certain branches of the work peculiarly his own, and has obtained results in connexion with iron and steel which are of the highest interest. A list of the more important papers by these and other workers will be found in the appended bibliography.*~~

~~*Preparation of the Specimen. — Experience alone can enable the operator to determine what portion of a mass of metal or alloy will afford a trustworthy sample of the whole. In studying a series of binary alloys it has been found advantageous in certain cases to obtain one section which will show in a general way the variation in structure from one end of the*~~

series to the other. This has been effected by pouring the lighter constituent carefully on the surface of the heavier constituent, and allowing solidifica tion to take place. A section through the culot so obtained will show a gradation in structure from pure metal on one side to pure metal on the other. A thin slice of metal is usually cut by means of a hack-saw, and for this piirpose saws driven by mechanism are frequently used. The thickness of the piece should not be less than \ inch, and

in order that it may be firmly held between the fingers it should not be less than 1 inch square. The preliminary stages of polishing are effected by emery paper placed on plate glass, or preferably on wooden discs capable of being revolved at a high rate of speed. The finest grade of emery paper that can be obtained is iised towards the end of the operation. Before use the finer papers should be rubbed with a hard steel surface to remove any coarse particles. The completion of the operation of polishing is effected in various ways, according to the nature of the specimen. It is generally effected on wet cloth or parch- ment covered with a small amount of carefully washed jeweller's rouge. Various mechanical aiDpliances are em- ployed to minimize the labour and time required for the polishing. These usually consist of a series of inter- changeable revolving discs, each of which is covered with emery paper, cloth, or parchment, according to the particular stage of polishing for which it is required. In the case of brittle alloys and of alloys having a very soft constituent, which during polishing tends to spread over and obliterate the harder constituents, polishing is in many cases altogether avoided by casting the alloy on the surface of glass or mica. In this way, with a little care, a perfect surface is obtained, and it is only necessary to develop the structure by suitable etching. In adopting this method, however, instances have occurred in which

~~*the removal of the cast surface has shown a structure differing considerably from the original.*~~

~~*Polishing in Bus-Belief. — If the polishing be completed with fine rouge on a sheet of wet parchment, placed upon a comparatively soft base such as a piece of deal, certain soft constituents of an alloy may often be eroded in such a manner as to leave the hardest portions in relief. For the later stages of polishing Le Chatelier recommends the use of alumina obtained by the calcination of ammonium alum ; and for the final polish of soft metals, chromium oxide.*~~

~~*DevelojDment of the Structure hy Reagents. — Usually the constituents of an alloy do not possess a characteristic or distinctive tint, and polishing is supplemented by reagents which serve to reveal the constituents by the varying degree to which they are acted upon. Osmond divides these into three classes — acids, halogens, and salts. As regards acids, water containing from 2 to 10 per cent, of hydrochromic acid is useful. It is made by mixing 10 grams of potassium bichromate with 10 grams of sulphuric acid in 100 grams of water. The use of nitric acid requires much experience. It is frequently employed in the examination of steels, and the writer prefers to use a 1 per cent, solution in alcohol, although many workers use concentrated acid, and effect the etching by allowing a stream of water to dilute the film of acid left on the*~~

~~*Fig. 1. — Micrographic Apparatus.*~~

~~*surface of the specimen after dipping it. Of the halogens, iodine is the most useful. A solution in alcohol is applied, so that a single drop covers half a square inch of surface. The specimen is then washed with alcohol, and dried with a piece of fine linen or chamois leather. Tincture of iodine also affords a means of identifying lead in certain alloys by the formation of a yellow iodide of lead, while the vapour of iodine has in certain cases been used to tint the con- stituents. Thin coloured films may often be produced by the oxidation of the specimen when heated in air. This, as a means of developing the structure, in the case of the copper alloys is specially useful. Tinted crystals may thus be distinguished from the investing layer caused by the presence of a minute quantity of another constituent. The temper colours produced by heating iron or steel in air*~~

~~*are well known. Carbide of iron is less oxidizable than the iron with which it is intimately associated, and it assumes a brown tint, while the iron has reached the blue stage. These coloured films may be fixed by cover- ing with thin films of gelatine.*~~

~~*In some cases the alloy may be attacked electrolytically by exposing it for a few minutes to a weak electric current in a bath of very dilute sulphuric acid. Certain organic bodies give very satisfactory results. The Japanese, for instance, produce very remarkable,effects by simple rear gents of which an infusion of certain forms of grass is a not unimportant constituent. In the case of iron and steel a freshly-prepared infusion of liquorice root has been found to be most useful for colouring certain constituents of steel. M. Osmond, who was the first to use this reagent, insisted that it should be freshly prepared and always used*~~

~~*under identical conditions as regards age and concentration. HIs method of applying it was to rub the specimen on parchment moistened with it, but he has subsequently modified this " polish attack" by substituting a 2 per cent, solution of ammonium nitrate for the liquorice infusion. In each case a small quantity of freshly-precipitated calcium sulphate is used on the parchment to assist the polishing.*~~

~~*Appliances used in Micrography. — The method of using the microscope in connexion with a camera for photograr phic purposes will now be considered. Every micrographer has his own views as to the form of an installation to be adopted, and it will therefore be well to give an illustration of a definite apparatus (Fig. 1) which has been found to give satisfactory results. It consists of a microscope A with a firm base placed in a horizontal position. The microscope can be connected by a tube B with the expanded camera CC, at the end of which is the usual frame to receive the photographic plate. A practised observer can focus on a plate of clear glass by the aid of a subsidiary low-power microscope lens. If a semi-transparent plate is employed it should be as fine as possible. The surface of the table is cut in such a way near H that the observer who is seated may conveniently examine the object on the stage of the microscope, the portion B turning aside for this purpose. The subsequent focussing is effected by a rod, FFF, and gearing attached to the fine*~~

~~*adjustment of the microscope, GA ; flap J when raised forms the support of the lamp used for illumination. As an illuminant an arc light has many advantages, as the exposure of the plate used will seldom exceed 10 seconds. An incandescent lamp or a gas*~~

~~*METALLOGRAPHY.*~~

~~*Fio. 1. — Gold containing 5 per cent, of copper, etched by ritro-liydrochloric acid. Shows crystalline grains Mag 2a dianis.*~~

~~*]?io 2. — Steel containing 1-2 percent, of carbon quenched in iced brine from a temperature of 1000 ‘ C. Mag. 1000 diarns.*~~

~~*Fig. 3. — Steel containing 1‘2 per cent, of carbon slowly cooled :froni 000° C. Shows pearlite and cementite. Mag. 1000 diams.*~~

~~*Fro. 4. — Lead-antimony alloy cast on mica and etched. 75 per cent. Pb, 25 per cent. Sb. Mag. liO diams.*~~

~~*Fig. 5.— Cold-lead alloy li<;Iitly etched wilh 1 per cent, nitric acid. 50 per cent. Pb, 50 per cent. Au. Mag. 140 diams.*~~

~~*Fig. 6.— Sli’fl containing O’S per cent, cavhon quenched in water fi’iim a teniperalurp of lOOU” C. t’liuws the martensitic structure. M;ty. 1000 diams.*~~

~~*METAL WOEK, ART*~~

~~*643*~~

~~*lamp with a mantle will give good results, but with much longer exposure. Actual illumination is best effected by a Beck vertical illuminator or a Zeiss prism. It is neces- sary that the lens used for concentrating the light on the illuminator should be an achromatic one, as colour effects cause trouble in photographing the objects. For lower powers the Lieberkuhn parabolic illuminator is useful. Certain groups of alloys show better under oblique illu- mination, which may be effected by the aid of a good condensing lens, the angle of incidence being limited by the distance of*~~

~~*the object from the objective in the case of high magnification. As regards objectives, the most useful are the Zeiss 2 mm., 4 mm., and 24 mm. ; two other useful objectives for low powers being 35 mm. and 70 mm., both of which are projecting objectives. A projecting eye-piece, preferably of low power, should be employed with all but the two latter objectives. The immersion lens, the Zeiss 2 mm., is used with specially thickened cedar oil, and if the distance from the objective to the plate is 7 feet, magnifi- cations of over 2000 diameters can easily be obtained (see Plate). As regards sensitized plates, excellent results have been obtained with Lumifere plates sensitive to yel- low and green. The various brands of "process" plates are very serviceable where the contrasts on the specimen are not great.*~~

~~*Authorities. — H. C. Sorby. " On Microscopical Photographs of Various Kinds of Iron and Steel," Brit. Assoc. Beport, 1864, Part II. p. 189; "Microscopical Structure of Iron and Steel," Journ. Iron and Steel Inst. 1887, p. 255. — A. Maktens. "Die mikroskopische Untersuchung derMetalle," Glaser' s Annalen, vol. XXX. p. 201, 1892. — H. Wedding. "Das Gefuge der Sohienen- kopfe," Stahl und Eisen, vol. xii. p. 478, 15th May 1892. — F. Osmond. '■ Sur la metallographie microscopique," Eapport presents a la Commission des methodes d'essai des materiaux de construction le 10 fevrier 1S93 ; et vol. ii. pp. 7-17, Paris 1895 ; " Microscopic Metallography," Trans. Amer. Inst. Mining Eng. vol. xxii. p. 243. — J. E. Stead. " Methods of preparing Specimens for Jlicroscopic Examination," Journ. Iron and Steel Inst. 1894, Part I. p. 292. — W. C. Roberts-Adsten and E. Os.mond. "On the Structure of Metals, its Origin and Causes," Phil. Trans. Boy. Soc. vol. clxxxvii. pp. 417-132 ; and Bull, de la Soc. d' encouragement pour Vindustrie nationale, 5= sSrie, vol. i. p. 1136, Aout 1896. — G. Chaepy. " Microscopic Study of Metallic Alloys," Bull, de la Soc. d'en- couragement pour Vindustrie nationale, March 1897. — A. SAUVEnK. " Constitution of Steel," Technology Quarterly, June 1898 ; Metallo- graphisl, vol. i. No. 3. — J. E. Stead. " Crystalline Structure of Iron and Steel," Journ. Iron and Steel Inst. 1898, i. p. 145 ; " Practical Metallography," Proc. Cleveland Inst, of Engineers, 26tU February 1900. — Ewing and Rosenhain. " Crystalline Structure of Metals," Phil. Trans. Boy. Soc. vol. cxciii. p. 353 and vol. cxov. p. 279. — F. Osmond. " Crystallography of Iron," Annales des Mines, January*~~

~~*1900. — Lb Chatelieb. " Technology of Metallography," Metallographist, vol. iv. No. 1. — Contribution a Vetude des alUages. Societe d' encouragement pour Vindustrie nationale, 1901. (w. c. e. a.)*~~

~~*Metal Work, Art. — The term "art metal work" is applied to those works in metal in which beauty of form or decorative effect is the first consideration, irrespective of whether the object is intended for use or is merely ornamental ; and it embraces any article from a Birmingham brass bedstead to works of the highest artistic merit. The term, as definitely distinguishing one branch of metal-working from another, has scarcely been in use for more than half a century, and is objected to by many on the ground that no such prefix was required in the best periods of art, and that allied crafts continue to do without it to the present day. Indeed, as long as metal- working remained a handicraft — in other words, until the introduction of steam machinery — every article, however humble its purpose, seems to have been endowed with some traditional beauty of form. The ceaseless changes in taste and fashion attendant upon progressive civilization, the proclivities of rulers, foreign alliances, facilities for travel, and the opening up of new areas to trade, had led to the evolution of a long series of distinct*~~

~~*styles, developed without apparent effort by successive generations of craftsmen. The robust, florid, and dis- tinctly Eoman rendering of the classic, which followed the refined and attenuated treatment associated with the architecture of the brothers Adam, who died in 1792 and 1794, is the last development in England which can be regarded as a national style. The massively moulded ormolu stair balustrade of Northumberland House, now at 49 Prince's Gate ; the candelabra at Windsor and Buck- ingham Palaces, produced in Birmingham by the firm of Messenger ; the cast-iron raUings with javelin heads and lictors' fasces, the tripods, Corinthian column, standard lamps and candelabra, boat-shaped oil lamps and tent- shaped lustres with classic mountings, are examples of the metal work of a style which, outside the eccentric Brigh- ton Pavilion and excursions into Gothic and Elizabethan, was universally accepted in the United Kingdom from the days of the Regency until after the accession of Victoria. Except perhaps the silversmiths, no one was conscious of being engaged in " art metal-working," yet the average is*~~

~~*neither vulgar nor in bad taste, and the larger works are both dignified and ‘ suited to their architectural surroundings.*~~

~~*The introduction of gas as an illuminant, about 1816, at once induced a large demand and a novel description of metal fitting ; and with this the craft fell under the control of a new commercial class, imbued with ex-pansive notions of free trade, eager to supply the markets of the world, intent on breaking with past traditions, and utilizing steam power, electro-deposition, and every mechanical and scientific invention tending to economize metal or labour. Such were the conditions of metal- working, especially as carried on in the great centres of Birmingham and Sheffield, at this time. But when all artistic perception in Great Britain appeared lost in general admiration of the triumphs of machinery and the expansion of trade, a new influence in art matters, that of the Prince Consort, began to make itself felt. The Great Exhibition, state-aided schools of design, the South Kensington Museum, and the establishment of a Science and Art Department under Government, are among the results of the important art revival which he inaugurated. He is credited with having himself designed candelabra and other objects in metal, and he directly encouraged the production of the sumptuous treatise on metal work by Digby Wyatt, which laid the foundations of the revival. To this work, and that of Owen Jones, can be traced the origin of the eclecticism which has laid all past styles of art under contribution. The Gothic revival, pursued simultaneously but quite independently, also helped in a general way the recognition of art, without very directly affecting the movement. It did, however, lead to a profound study of one of the bygone phases of the art of Great Britain, and was especially valuable in teaching how to work within definite limita- tions, but without slavish copying ; it also emancipated a considerable body of craftsmen from the tyranny of manufacturers whose sole idea was that machine work should supercede handicraft. Its greatest efforts were the metal chancel screens designed by Sir G. G. Scott, that for Hereford Cathedral having been exhibited in 1862. The effect produced by these, though purporting to be strictly Early English in character, could hardly on the -whole have been conceived by the designers and workers of that period. It does not appear that the influence either of Owen Jones or Digby Wyatt on metal-working extended beyond bringing the variety and beauty of past styles to the*~~

~~*direct notice of designers. They did not actu'ally themselves produce designs affecting the development of the metal crafts. Neither can the London silversmiths, though they employed the best talent available, particularly*~~

~~*in the decade folio-wing the Great Exhibition of 1851, be credited with directing or even much influencing the art metal revival, especially of later years. They were rivalled by Elkington of Birmingham, who secured the permanent assistance of at least one fine artist, Morel Ladeuil, the producer of the Elcho Challenge Shield. Perhaps the first actual designer to make a lasting im- pression on the crafts was Thomas Jeckyll, some of whose work, including gates for Sandringham, was exhibited in 1862. Infinitely greater as a designer was Alfred Stevens, whose influence on English craftsmen might be regarded as almost comparable to that of Michelangelo on that of his Italian contemporaries. Stevens's designs certainly directly raised the standard of production in several metal-working firms by whom he was employed ; whilst in the Wellington Memorial in St Paul's Cathedral, and in Dorchester House, his work is seen unfettered by commercial considerations. Omitting many whose occasional designs have had little influence on the develop- ment of the metal crafts, we come to Alfred Gilbert, whose influence for a time has been scarcely less than that of Stevens himself. Monumental works, like his statue of Queen Victoria at Winchester and his work at Windsor, may be handed down as his greatest achievements, but judged as art metal work, his smaller productions, such as the centre-piece presented by the army and navy to Queen Victoria on her Jubilee, have been more important.*~~

~~*The charming bronze statuettes of Onslow Eord, the most representative of which are in the Tate Gallery ; the work of George Frampton, as seen in the Mitchell Memorial; and the beautiful bas-reliefs of W. Stirling Lee, examples of which are illustrated in the bronze gates of the Adelphi Bank at Liverpool (see Plate), have all contributed, especially when applied to architectural decoration, to a high standard of excellence. Painters also*~~

have frequently designed and modelled for metal work, like Lord Leighton, who produced bronze statuettes of most refined character; and Sir L. Alma^Tadema, who designed the grilles for his studio and entrance hall ; but none have devoted themselves so conspicuously to it as Professor von Herkomer, who, whether working in gold and enamel, iron, or his favourite alloy, pewter, infuses a freshness into his designs and novelty into his methods which display an unusual mastery over materials.

The gift of reproducing effects of nature or art by brush or chisel is not, however, accompanied necessarily by power to design, as many have discovered; but a note- worthy exponent of the dual faculty is G. C. Haite, whose designs are widely applied.

It is chiefly to architecture that metal work owes its permanent, steady, and comprehensive artistic improve- ment. Good architecture creates good craftsmen, and together they have ever stood and fallen. The buildings of Norman Shaw and Ernest George demanded quiet and harmonious metal work; and the custom of these architects of superintending and designing every detail, even for interiors, created the supply. Such men educate those they employ, and apt pupils gather round them. The work of every worthy architect raises the standard of the crafts ; but beyond others Messrs Ashbee, Lethaby, and Wilson have taken an active personal interest in schools of metal work. The technical schools, main- tained or subsidized by corporate bodies, have also been of immense service in creating a class of intelligent, capable, and self-respecting craftsmen, whose wages, proportioned to their skill, enable them to regard their work not merely as irksome toil, but as worthy occupation abounding in interest. Home industries, carried on far from the recognized centres, such as the metal work-

ing round Keswick, executed during hours of enforced idleness by field labourers and railway porters, educate the passer-by as well as the worker. This admirable school, founded in 1884 by Canon and Mrs Rawnsley, to provide recreation as well as remunerative work, was in 1901 attended by about fifty men during the winter, in addition to employing a permanent staff of twelve.

~~*Architects and artists who design for the principal decorating firms are to-day as conversant with the Renais- sance and succeeding styles of France and Italy as mediaeval revivalists were familiar with the Gothic styles with which they made us so well acquainted. Metal work more or less based upon every kind of past style, and appropriate to the most varied architectural and decorative surround- ings, is produced in vast quantities, and in some cases so skilful are the workers that modern forgeries and repro- ductions are almost beyond the power of experts to detect. This large class of designers and craftsmen, to whom a thorough knowledge of the history of design is a necessity, may be distinguished as conventional, following and de- veloping traditional lines. The new art school, on the con- trary, breaks wholly with tradition, unless unconsciously influenced by the Japanese, and awards the highest place to originality in design. It is not to be expected that an art revival following on, and in possession of, all the results of a period of unprecedented activity in scientific research should proceed as leisurely or with the same restraint as heretofore ; but unfettered activity, and the general encouragement almost ostentatiously to abandon the tradi- tions of art, have no exact parallel in the past, and may yet prove a danger. It is perhaps the very rapidity of the movement, so characteristic of the age, that is likely to retard its progress and to fail to carry with it the wealthy clients and the decorators they employ, or per- haps even to increase the disposition, already apparent, to cling to the safe ground of reproductions of the styles of the 17th and 18th centuries. The multiplication of art periodicals, lectures, books, photographs, meetings of societies and guilds, museums, schools of arts and crafts, polytechnics, scholarships, facilities for travel, exhibitions, even those of the Eoyal Academy, to which objects of applied art are now admitted, not only encourages many persons to become workers and designers in the applied arts, but exposes everything to the attentions of the plagiarist, who travesties the freshest idea before it has well left the hands of its originator. Thus the inspirations of genius, ap- propriated by those who imperfectly appreciate their subtle beauty and quality, become hackneyed and lose their charm and interest. The keen desire to be unconventional in applied art has spread from Great Britain and the United States to Germany, Austria, and other countries, and is, in fact, everywhere apparent, but without concerted lines, well- defined first principles, or limitations. Individuals may follow Rossetti, or Burne-*~~

~~*Jones, or William Morris, or any other brilliant masters at home or abroad, but neither artists nor public are agreed as to any particular school being best worth development. It seems agreed in a general way that the completed work in metal is to be wholly the conception and, as far as possible, the actual handiwork of the designer : casting by the cire-perdue process, left practically untouched from the mould, and embossing, beingthe two most favoured processes. The female figure is largely made use of in every class of unconventional design, and rich and harmonious colours are sought, the glitter of metal being invariably subdued by deadening its lustre, or by patinas and oxides. Gilding, stains and lacquers, electro-plating, chasing, " matting," frosting, burnish- ing, mechanically produced mouldings and enrichments, and the other processes esteemed in the 19th century, are disused and avoided. New contrasts are formed by the*~~

~~*METAL -WORK.*~~

~~*Cast Beonze Gates, Adelpiii Bank, Liverpool. Designed by 'W. D. Cakoe, the figures by Stirling Lee*~~

~~*executed by Starkie Gardner and Co. '*~~

~~*METAL -WORK.*~~

~~*n'^i^Wj^i*~~

~~*Rain-water Head, in Lead, for the Victoria Law Courts, Birminghaji. Designed by Aston Webb and Ingres Bell,*~~

~~*and executed by Dent and Hellier.*~~

~~*Covered Bridue of Ii*~~

~~*IX, sheathed in Cast Leah, Grand Hotel, London. Designed by William Woodward, and executed by Si'arkie Gardner and Co.*~~

~~*METAL WOEK, AET*~~

~~*juxtaposition of differently toned metals ; or these with an inlay of haliotis shell, introduced by Alfred Gilbert ; or of coloured wax, favoured by Onslow Ford ; or enamelling, perfected by Professor von Herkomer ; or stained ivory, pearls, or semi-precious stones. The quality of the surface left by the skilled artist or artisan is more regarded than symmetry of design, or even than correct modelling. Frequently only the important parts in a design are care- fully finished and the rest merely sketched, the mode of working, whether by modelling tools or hammer, being always left apparent.*~~

~~*The newer kinds of art metal work have, until recently, reached the purchaser direct from the producer's work- shop, but they may now also be seen in the shops of silversmiths, jewellers, and general dealers, who are thus helping to transfer production from large commercial manufactories to smaller ateliers under artistic control. The production of the larger household accessories, such as bedsteads, fenders, gas and electric fittings, clocks, &c., has hardly as yet come under the influence of the art movement. The services rendered by Mr W. A. S. Benson of Chiswick, who by his practical and elegant designs commenced about 1886 to revolutionize the pro- duction of sheet-brass and copper utensils, cannot be passed over in this connexion. The average ecclesiastical metal work has upon the whole rather receded than progressed in merit, except when it is specially designed by architects and executed under their supervision. Though the demand for good domestic wrought-iron work has enormously increased, adaptations from the beautiful work of the 17th and 18th centuries have been found so suited to the architectural surroundings amidst which they are placed, that entirely new departures have hitherto been relatively uncommon. Of such the gates for Sandringham, by Jeckyll ; for Crewe Hall, by Charles Barry; and for the Victoria and Albert Museum, by Gamble, are the earliest and best known. Of the vast number designed upon traditional lines may be cited those for Lambton Castle, Welbeck, Eaton Hall, Twickenham, Clieveden, and the Astor Estate Office on the Victoria Embankment. Cast iron, brought to perfection by the Coalbrookdale Company about 1860, but now little esteemed, owing to the poverty of design which so often counterfeits smith's work, presents great opportuni- ties to founders possessing taste or willing to submit to artistic control. A very large field is also opening*~~

~~*for cast- lead work, whether associated with architecture, as in the leaden covered-way over Northumberland Street, in London (see Plate), and the fine rain-waterheads of the Birmingham Law Courts (see Plate), or with the revival of the use of metal statuary and vases in gardens. The subdued colour and soft contours of pe-Cvter render it once more a favoured material, peculiarly adapted to the methods of the art revival, and perhaps destined to supersede electro-plate for household purposes. In silver work the proportion of new art designs exhibited by dealers and others is still relatively small ; but jewellers, except when setting pure brilliants and pearls, are becoming more inclined to make their jewels of fi.nely modelled gold and enamel enriched with precious and semi-precious stones, than of gems merely held together by wholly subordinate settings.*~~

~~*On the continent of Europe, France was undoubtedly the first to recognize the merits of its bygone designers and craftsmen, and even antecedent to the Exhibition of 1851, when art in Great Britain was practically dormant, it was possible to obtain in Paris reproductions of the finest ormolu work of the 18th century faithfully render- ing the characteristics of the originals. At the same time a most active production of modern designs was proceeding, stimulated by rewards, with the result that the supply of clocks lamps, candelabra, statuettes, and other ornaments*~~

~~*in bronze and zinc to the rest of Eui-ope became practi- cally a monopoly of Paris for nearly half a century. In all connected with their own homes the French adhere to their traditions far more than other nations, and the attempt at originality in the introduction of metal work into the scheme of decoration of a room is almost un- known. In the domain of bronze and imitation bronze statuary the originality of the French is absolutely un- rivalled. And not only in bronze, but in Paris jewellery, enamels, silver, pewter, and iron work an excessively cultured refinement is apparent, beside which other jjro- ductions, even the most finished, appear imperfectly developed and crude. The French artist attains his ideal, and it is difficult to imagine, from his standpoint, that the metal-work of the present can be surpassed. The best English metal-worker, on the contrary, is probably not often quite satisfied with the results he attains, perhaps because in Great Britain the pursuit of art has for centuries been fitful*~~

~~*and individual, while in France art traditions have been continuously developed and maintained, and are hereditary. The British tempera- ment may cause French art to be regarded by many as exotic and over-developed, but the fact remains that their metal-work is approached in power and technique by a very few of the best British artists. The metal-work of Belgium is based at present entirely on that of France, without attaining the same standard, unless designed for ecclesiastical uses. In Holland these crafts have not progressed. Italian metal-workers are now mainly em- ployed in reproduction, but traditions linger, either of the goldsmith or blacksmith, in some remote parts, while the sporadic appearance of craftsmen of a high order is e viden ce that the ancient artistic spirit is not wholly extinct. Simi- larly, the surprising damascening by Messrs Zuluaga of Madrid in the monument to General Prim, and that of Alvarez of Toledo, give hope that the Spanish craftsman only needs to be properly directed. German and Austrian workers had for years shown more energy than originality, but they have recently embraced the newest English de- velopments and carried them to extremes of exaggeration. For really fresh and progressive indigenous art we may perhaps have, in the near future, to turn to America and to Russia, where, having little artistic past to refer to, de- signers and craftsmen display unequalled individuality and force. It is from the Far East, however, that the most 'seri- ous rivalry may be anticipated. The metal-work of China and Japan, so pleasantly naive and inexpensive, though be- coming undesirably modified as to design through contact with European buyers, is losing none of its matchless technique, which indeed in Japan is still being developed. In any history of the art revival the influence of such firms as Barbedienne and Christofle in Paris and Tiffany in New York cannot be ignored. The example and success of the latter probably did much to stimulate workers in England. Their aim, however, has been consistently to surpass exist- ing standards in beauty and originality, without departing from recognized canons of art. The " new art " of Great Britain, so earnestly and actively promulgated, has no doubt a fine future, but its immediate expansion is checked and limited by the pronounced partiality of the wealthy classes for antiques and reproductions. On this account, immense sums are still spent in Paris and elsewhere abroad upon metal work destined for British and American houses, while the money available to be spent on works of art flows*~~

~~mainly into the pockets of the dealers in bric- a-brac. This patronage can be intercepted, and a settled preference for modern British art induced, not by ignoring the beauty and magnificently decorative effects of the works that are preferred, but by careful study of the works of the past, with a view to equalling or surpassing them in the qualities which render them so attractive. (j. s. g.)~~

~~METAPHYSICS.~~

~~§ 1. Metaphysics the Science of Being.~~

~~SIDE by side with psychology, the science of mind, and with logic, the science of reasoning, metaphysics is tending gradually to reassert its ancient Aristotelian position as the science of being in general. Not long ago, in England at all events, metaphysics was merged in psychology. But with the decline of dogmatic belief and the spread of religious doubt about the creation and government of the world ; as the special sciences also grow more general, and the natural sciences become more speculative about matter and force, evolution and teleology ; men begin to wonder again, like the Greeks, about the nature and origin of things, and half uncon- sciously discover that they are metaphysicians. Nor must we expect any great difference between the old and the new methods of dealing with these problems, when the causes have been similar : the decay of polytheism in Greek religion and his own discoveries in natural science were the motives which impelled Aristotle to metaphysical questions. There is, however, a certain difference in the way of approaching things. Aristotle emphasized being as being, without always sufficiently asking whether the things whose existence he asserted are really knowable. We, on the contrary, mainly through the influence of Descartes, rather ask what are the things we know, and therefore, some more and some less, come to connect ontology with epistemology, the science of being with the science of knowing, and in consequence come to treat metaphysics in relation to psychology and logic, from which epistemology is an offshoot. To this pressing ques- tion then — What is the world as we know it ? — three kinds of definite answers are returned : those of materialism, idealism, and realism, according to the emphasis~~

~~*laid by metaphysicians on body, or mind, or on both. Metaphysical materialism is the view that everything known is body or matter ; but while according to ancient materialists soul is only another body, according to modern materialists mind without soul is only an attribute or function of body. Metaphysical idealism is the view that everything known is mind, or some mental state or other, which some idealists suppose to require a substantial soul, others not; while all agree that body has no different being apart from mind. Metaphysical realism is the intermediate view that everything known is either body or soul, neither of which alone exhausts the universe of being. Aristotle, the founder of metaphysics as a distinct science, was also the founder of metaphysical realism, and still remains its main authority. His view was that all things are sub- stances, in the sense of distinct individuals, each of which has a being of its own different from any other, whereas an attribute has only the being of its substance {Met. Z 1-3 ; Post. An. I 4) ; that bodies in nature are obviously natural substances, and as obviously not the only kind of substance ; and that there is supernatural substance, e.g., God, who is an eternal, perfect, living being, thinking, but without matter, and therefore not a body. At the present day realism is despised on the ground that its differentiation of body and soul, natural and supernatural, ignores the unity of being. Indeed, in order to oppose this unity of being to the realistic duality, both material- ists and idealists nowadays arrogate to themselves the title of monists, and call realists dualists by way of disparage- ment. But we cannot classify metaphysics by the antith- esis of monism and dualism without making confusion worse confounded. Not to mention that it has led to*~~

~~*another variety, calling itself pluralism, it confuses materi- alism and idealism. Extremes meet ; and those who believe only in body, and those who believe only in mind, have an equal right to the equivocal term " monist." Moreover, there is no real opposition between monism and dualism, for there can very well be one kind of being, without being all body or all soul ; and as a matter of fact, Aristotelian realism is both a monism of substance and a dualism of body and soul. It is in any case unfair to decide questions by disparaging terms, and to argue as if the whole choice were between materialistic or idealistic monism, leaving realism out of court. In this case it would also hide the truth of things,*~~

~~*which requires two different kinds of substance, body and soul. The strength of materialism consists in recognizing nature without explaining it away, its weakness in its utter inability to explain consciousness either in its nature or in its origin. On the other hand, it is the virtue of idealism to emphasize the fact of consciousness, but its vice to exaggerate it, with the consequence of resorting to every kind of paradox to deny the obvious and get rid of bodies. There are in reality two species of substances, or entirely distinct things, those which are impenetrably resisting, and those which are conscious substances ; and it is impossible to reduce bodies and souls to one another, because resistance is incompatible with the attributes of spirit, and consciousness inexplicable by the attributes of body. So far true metaphysics is a dualism of body and soul. But this very dualism is also monism : both bodies and souls are substances, as Aristotle said ; and we can go farther than Aristotle. Men are apt to dwell too much on the coexistence and too little on the inclusiveness of substances. The fact is that many substances are often in one ; e.g., many bodies in the one body, and both body and soul in the one substance, of man. What is true of the microcosm is true of the macrocosm. There are many bodies in one earth ; and there is no reason for stopping this inclusiveness short of one bodily universe, or for refusing to believe that with the omnipresent spiritual substance of God it forms one substantial universe, like a gorgeous palace containing many rooms and inhabitants, all under one master. So far true metaphysics is a monism of substance, in the sense both that all things are substances and that all substances, however different, are members of one substance, the whole universe of body and spirit. In this case metaphysics generally will have to recognize three monisms, a materialistic monism of body, an idealistic monism of soul, and a realistic monism of substance, which is also a dualism of substances. But a term so equivocal, leading to an antithesis so misleading as that between monism and dualism, can never represent the real difference between metaphysical schools. We shall return, then, to the clearer and more authoritative division, and proceed to discuss materialism, idealism, and realism in their order. Idealism will receive most attention, because it is the dominant philosophy of modern thought, which tries to dethrone Aristotle as Jupiter dethroned Saturn. But perchance redeunt ScUumia regna.*~~

~~§ 2. Recent Materialism.~~

~~(1) Matprialism Proper. — IMaterialism in its modern sense is the view that all we know is body, of which mind is an attribute or function. Several causes, beginning towards the end of the 18th century, gradually led up to the materialism which flourished in the middle of the 19th century in the writings of Moleschott, Yogt, and~~

~~matekialism]~~

~~Buchner. The first cause was the rapid progress of natural science. The chemistry of Lavoisier, and espe- cially his discovery of the nature of combustion, from which followed that of respiration, gave fresh evidence to the old principle of the indestructibility of matter by bodily forces, and to the application of chemical laws to biology. The zoology of Lamarck, although his views were unpopular and condemned by the authority of Cuvier, yet weakened the old hypothesis of the immu- tability of species, and started the theory of evolution in the form of the hereditary transmission of modifica- tions produced in organisms by use and adaptation to the environment. The astronomy of Laplace suggested the hypothesis that the regular motions of the bodies comprising the solar system might be explained by sup- posing that the atmosphere of the sun originally extended beyond the orbits of all the planets and had gradually contracted. The geology of Lyell continued, as it were, the evolution of the solar system by accumulating facts inclining him to believe that the forces now operating are similar to those which worked out geological revolu- tions, or that we may dispense with catastrophes, and regard ancient and present fluctuations of the organic and inorganic world as belonging to one series of events. These advances in natural science, which pointed to a unity and gradual evolution in nature, were accompanied by a growth in commerce, manufactures, and industrial- ism which tended to absorb men's minds in material interests ; and it was the same kind of spirit which showed itself in the revolutionary upheaval of 1848, and in the materialistic publications which immediately followed, while these~~

~~publications have reacted on the industrial socialism of our own time. Meanwhile, philo- sophic forces to counteract materialism were weak. Realism was at a low ebb. Idealism was receding for the moment. Hegelianism, which had for a time been converted into a kind of orthodox basis of State-educa- tion in Germany, had made itself unpopular. Its con- fusion of God, nature, and man had also led to differences within the school itself. Out of the Hegelians of the "left" arose not only David Strauss (1808-1874), but also Ludwig Feuerbach (1804-1872), who became the immediate forerunner of the materialists. Feuerbach's point against Hegel — not God, but man — made him a philosopher of humanity, like Comte, rather than a materialist. But he enunciated propositions which could not but lead to materialism, such as, " The body is part of my being ; nay, the body is its totality, is my Ego," and "Man is what he eats," and "Man by himself is but man ; man with man, the unity of ' I ' and ' thou,' is God." These causes, then, scientific, industrial, and philosophical, led to the domination of materialism in the middle of the 19th century in Germany, or rather to its revival ; for in its main position, that matter and motion are everything and eternal, it was a repetition of the materialism of the 18th century in France. Carl Vogt (1817-1895) was an instance of this revival. When in 1854 the physiologist Eudolf Wagner declared that an individual permanent Seelensubstanz is required, if not by physiology yet by morals, if not by science yet by faith, Vogt replied by turning the saying of the French physician Cabanis, " The brain is determined to thought as the stomach is to digestion, or the liver to the secretion of bile," into the offensive form, " Thought stands in the same relation to the brain as the bile to the liver or the urine to the kidneys." But recent materi- alism was not mere repetition. J. Moleschott (1822-1893) made a diligent use of the science of his day in his Kreis- lauf des Lehens (1852). , Starting from Lavoisier's dis- coveries, he held that life is metabolism, a perpetual circulation of matter from the inorganic to the organic**

~~world, and back again. He urged this metabolism against the hypothesis of vital force as then held by Liebig, but descending from antiquity in various forms. Aristotle had imputed to all living beings a soul, but to plants only in the sense of a vegetative, not a sensitive, activity. Stahl (1666-1734) changed Aristotle's vegetative into a sensi- tive soul, which~~

~~*he imputed to all living beings, and sup- posed that it is an incorporeal substance governing the body and its forces, as well as performing mental opera- tions. Since Stahl's time the psychical side of his views has usually been either abandoned or modified, but in Moleschott's time many scientific men still accepted some sort of vital principle, not exactly soul, yet over and above bodily forces in organisms. Moleschott, like Lotze, had the merit of resisting the whole hypothesis of a vital principle, and in later editions of his work he supported his case by Berthelot's discoveries in artificially produc- ing from the chemical elements organic substances. But he went farther. On the basis of Lavoisier's discovery that respiration is combustion, he argued that the heat so produced is the only force developed in the organism, and that matter therefore rules man. His saying, " Without phosphorus no thought," does not mean much ; but he went on to the conclusion that thought is a movement of the matter of the brain. Finally, he put the whole materialistic view of the world into the following form : Without matter no force, without force no matter. L. Buchner (1824-1899) himself said that he owed to Mole- schott the first impulse to composing his important work Kraft und Stoff (1855), which has run through many editions and become a kind of text of materialism. He borrowed from Moleschott the hypothesis that matter and force are inseparable. At the same time his originality consisted in his use of the theory of evolution. He applied Lyell's evolution of the earth's crust to the evolution of life upon it. In later editions, after the publication of the Origin of Species in 1869, he regarded Darwinism as the chief support of materialism, and asserted that the struggle for life and natural selection have abolished final causes. As in the sequel it became more and more patent that natural selection gives no account of the origin of variations, as proofs of the direct action of the environment on the species became more plentiful, so that Darwin himself in 1876 confessed that he had not attached sufiBcient weight to food, climate, &c., and as in consequence Lamarck's views revived in a neo- Lamarckian school, Bilehner accepted the new theory, that Lamarckian adaptation to the environment heredi- tarily transmitted produces the variations which are the materials of Darwinian natural selection. His general in- ference was that, not God, but evolution of matter, is the cause of the order of the world ; that life is a combination of matter which in favourable circumstances is spontane- ously generated ; that there is no vital principle, because all forces, non-*~~

vital and vital, are movements ; that move- ment and evolution proceed from life to consciousness ; that it is foolish for man to believe that the earth was made for him, in the face of the difficulties he encounters in inhabiting it ; that there is no God, no final cause, no immortality, no freedom, no substance of the soul; and that mind, like light or heat, electricity or magnetism, or any other physical fact, is a movement of matter. Some- times he spoke of mind as an effect of matter ; but, though his expressions may be careless, nothing is to be made of the difference, for he called it movement and effect indif- ferently in the same context. His definitely expressed view was that psychical activity is " nothing but a radi- ation through the cells of the grey substance of the brain of a motion set up by external stimuli."

Belonging to a slightly later time than the materialists hitherto mentioned, E. Haeckel has lately published a

book whicli may be taken to represent materialism as it stands, Die Weltrdthsel, or, as it appears in the translation by J. M'Cabe, Tlie Riddle of the Universe. The point of this book is the identification of substance with body. Starting like his predecessors with the indestructibility of matter, Haeckel makes more than they do of the con- servation of energy, and merges the persistence of matter and energy in one universal law of substance, which, on the ground that body is subject to eternal transformation, is also the universal law of evolution. One of the first to popularize Darwin in Germany, he regards Darwinism, like Btlchner, as a supplement of Lamarckism. His strong point, however, consists not in establishing either selection, or adaptation, or any other process, but in inferring the fact of evolution of some sort from the consideration of three evidences : comparative anatomy, showing the long-known graduated series of organisms ; palaeontology, showing their similar geological succession in a historical series ; and embryology, showing the simi- lar development of the organism from the impregnated ovum,

~~expressed in the biogenetic law, " Ontogenesis is a brief and rapid recapitulation of phylogenesis." On the strength of this concilience of arguments for evolution in the organic world, he carries back the process in the whole world, until he comes to a cosmology, which reminds one of the rash hypotheses of the Presocratics. He supposes that all organisms have developed from the simple cell, and that this has its origin by spontaneous generation, to explain which he propounds the " carbon-theory," that protoplasm comes from inorganic carbonates. He not only agrees with Laplace and Lyell about the evolution of the solar system, but also supposes that the affinities, pointed out by Lothar Meyer and Mendeleeff, between groups of chemical elements prove aa evolution of these elements from a primitive matter (prothyl) con- sisting of homogeneous atoms. These, however, are not ultimate enough for him; he thinks that everything, ponderable and imponderable or ether, is evolved from a primitive substance, which condenses first into centres of condensation (pyknatoms), and then into masses, which when they exceed the mean consistency become ponderables, and when they fall below it become im- ponderables. Here he stops : according to him, substance is eternal and eternally subject to the law of substance ; and God is the eternal force or energy of substance. What then is the origin of mind or soul ? Haeckel answers that it has no origin, because sensation is an inherent property of all substance. He supposes that cesthesis and tropesis, as rudimentary sensation and will, are the very causes of condensation ; that they belong to pyknatoms, to ponderables and imponderables, to chemical atoms and molecules. Hence, when he returns to organ- isms, it does not surprise us that he assigns to ova and spermatozoa cell-souls, to the impregnated ovum germ-soul, to plants tissue-souls, to animals nerve-souls ; or that he regards man's body and soul as born together in the im- pregnated ovum, and gradually evolved from the bodies and souls of lower animals. It appears to his imagination that the affinity of two atoms of hydrogen to one of oxygen, the attraction of the spermatozoon to the ovum, and the elective affinity of a pair of lovers, are all alike due to sensation and will. But has he solved the problems of mind ? When he applies sensation and will to nature, and through plants to the lowest animals, he considers their sensation and will to be rudimentary and unconscious. Consciousness, according to his own admission,is not found even in all animals, although it is present not only~~

~~*in the highest vertebrates — men, mammals, birds — but also in ants, spiders, the higher crabs and molluscs. He holds indeed that, in accordance with the law of substance, con- sciousness must be evolved from unconsciousness with the*~~

~~*development of sense organs and a central nervous organ. At the same time he admits, first, that to mark the barrier between unconscious and conscious is difficult ; secondly, that is it impossible to trace the first beginning of con- sciousness in the lower animals ; and, thirdly, that "however certain we are of the fact of this natural evolution of consciousness, we are, unfortunately, not yet in a position to enter more deeply into the question" (Riddle of the Universe, 191). Thus in presence of the problem which is the crux of materialism, the origin of consciousness, he first propounds a gratuitous hypothesis that everything has mind, and then gives up the origin of conscious mind after all. He is certain, however, that the law of substance somehow proves that conscious soul is a mere function of brain, that soul is a function of all substances, and that God is the force or energy, or soul or spirit, of Nature. He, in fact, returns to ancient hylozoism, which has tended to revive from time to time in the history of thought. As Empedocles confused physical attraction and repulsion of bodily elements with the love and hatred of conscious beings, so Telesio and Campanella believed in the " sense of things," Bruno, an ardent admirer of the Presocratics, believed in animated minima, and Leibnitz after him endowed monads with perception and appetition. Maupertuis converted the percipient monads of Leibnitz into percipient atoms. Haeckel is the inheritor of these animistic views, and especially of the first and the last. He believes that mind and soul are inherent attributes of all bodies. Curi- ously enough,he supposes that by making mindaimiversal attribute of matter he has made his philosophy not materialism, but monism. It is really both: monistic, because it reduces substance to one kind ; materialistic, because it identifies that one kind of substance with body or matter, and reduces mind to an attribute of matter. It makes no difference to attribute mind to all matter, so long as it is attributed as an attribute. It is at least as materialistic to say that unconscious mind is an attribute of Nature as to say that conscious mind, is an attri- bute of brain; and this is the position of Haeckel. Materialists seem to dread the word "materialism." Biichner*~~

~~also entreats us " to abandon the word ' materi- alism,' to which (it is not clear why) a certain scientific odium attaches, and substitute ' monism ' for it " {Last Words on Materialism, 273). His reason, however, is different : it is that a philosophy, not of matter as such, but of the unity of force and matter, is not materialism. But if a philosophy makes force an attribute of matter only, as his does, it will recognize nothing but matter possessing force, and will therefore be materialism as well as monism, and in short materialistic monism. The point is that neither Btlchner nor Haeckel could on their assumptions recognize any force but force of body, or any mind but mind of body, or any distinct thing or substance except body. This is materialism.~~

~~(2) Materialistic Tendencies. — Besides these direct in- stances of materialism, there are philosophers to whom the scientific tendencies of the age have given a materialistic tendency. In Germany, for example, Eugen Dlihring is a realist, whose intention is to prove against Kant a knowledge of the thing in itself by attributing time, space, and categories generally to the. real world. But, under the influence of Trendelenburg's attempt to reconcile thought and being by assigning motion to both, his WirMichkeitsphilosophie, in a similar effort after a unity of being, lands him in the contention that matter is absolute being, the support of all reality underlying all bodily and mental states. So R. Avenarius was no materialist, but only an empiricist anxious to reclaim man's natural view of the world from philosophic in- crustations; yet when his Empiriohriticismus ends in~~

~~materialism]~~

~~nothing but environment, nervous system, and statements dependent on them, without soul, though within ex- perience, he comes near to materialism, as Wundt has remarked. In France, again, positivism is not materialism, but rather the refusal to frame a metaphysical theory. Comte, in his law of the three stages, tells us that man iirst gets over theology, then over metaphysics, and finally rests in positivism. Yet in~~

~~*getting over theology he ceases to believe in God, and in getting over metaphysics he ceases to believe in soul. As Paul Janet truly re- marked, positivism contains an unconscious metaphysics in rejecting final causes and an immaterial soul. So E. Littr^ (1801-1881), Comte's disciple, said that soul signifies " considered anatomically the ensemhle of functions of the brain, and considered physiologically the ensemble of functions of encephalic sensibility." He also took Mill to task for recognizing the possibility of a supernatural principle of the world. Now, when in surrendering theology and metaphysics we have also to surrender God and the soul, we are not free from materialism. Positivism, however, shelters itself behind the vague word "pheno- mena." Lastly, in England we have not only an influence of positivism, but also, what is more important, the syn- thetic philosophy of Herbert Spencer. The point of this philosophy is not materialism, but realism. The author himself says that it is transfigured realism — which is realism in asserting objective existence as separate from subjective existence, but anti-realism in denying that objective existence is to be known. In his Principles of Psychology he twice quotes his point that " what we are conscious of as properties of matter, even down to its weight and resistance, are but subjective affections pro- duced by objective agencies which are unknown and unknowable." This then is his transfigured realism, which, as far as what is known goes, is idealism, but as far as what exists goes, realism — of a sort. His First Principles, that is, his book on metaphysics, is founded on this same point, that what we know is phenomena produced by an unknown noumenal power. He himself identifies phenomenon, appearance, effect, or impression produced on consciousness through any of the senses. He divides phenomena into impressions and ideas, vivid and faint, object and subject, non-ego and ego, outer and inner, physical and psychical, matter and spirit; all of which are expressions of the same antithesis among phenomena. He holds that all the time, space, motion, matter known to us are phenomena ; and that force, the ultimate of ultimates, is, as known to us, a phenomenon, " an affection of consciousness." If so, then all we know is these phenomena, affections of consciousness, subjective affections, but produced by an unknown power. So far as this main point of transfigured realism is steadily main- tained, it is a compound of idealism and realism, but not materialism. But it is*~~

~~*not maintained, on the side either of phenomena or of noumena ; and hence its tendency to materialism.*~~

~~*In the first place, the term " phenomenon " is ambigu- ous, sometimes meaning a conscious affection, and some- times any fact whatever. Spencer sets himself to find the laws of all phenomena. He finds that throughout the universe there is an unceasing redistribution of mat- ter and motion, and that this redistribution constitutes evolution when there is a predominant integration of matter and dissipation of motion, and constitutes dis- solution where there is a predominant absorption of motion and disintegration of matter. He supposes that evolution is primarily integration, from the incoherent to the coherent, exemplified in the solar nebula evolv- ing into the solar system ; secondly differentiation, from the more homogeneous to the more heterogeneous, exem- plified by the solar system evolving into different bodies ;*~~

~~*thirdly determination, from the indefinite to the definite, exemplified by the solar system with different bodies evolving into an order. He supposes that this evolution does not remain cosmic, but becomes organic. In ac- cordance with Lamarck's hypothesis, he supposes an evolution of organisms by hereditary adaptation to the environment (which he considers necessary to natural selection), and even the possibility of an evolution of life, which, according to him, is the continuous adjustment of internal to external relations. Next, he supposes that mind obeys the same law of evolution, and exemplifies integration by generalization, differentiation by the de- velopment of the five senses, and determination by the development of the order of consciousness. He holds that we pass without break from the phenomena of bodily life to the phenomena of mental life ; that consciousness arises in the course of the living being's adaptation to its envi- ronment, and that there is a continuous evolution from reflex action through instinct and memory up to reason, an evolution of social institutions, and an evolution of conscience out of fear. He throws out the brilliant suggestion that the experience of the race is in a sense inherited by the individual ; which is tme in the sense that animal organisms become hereditarily better adapted to perform mental operations, though no proof that any elements of knowledge become a priori. Now, although in his enthusiasm for universal evolution Spencer*~~

~~*does not perceive it, he has clearly changed the meaning of the term "phenomenon" from subjective affection of consciousness to any fact of nature, in regarding all this evolution, cosmic, organic, mental, social, and ethical, as an evolution of phenomena. The greater part of the process is a change in the facts of nature before conscious- ness ; and in all that part, at all events, the phenomena evolved must mean physical facts which are not conscious affections, but, as they develop, are causes which gradually produce life and consciousness. Moreover, evolution is defined universally as an "integration of matter and dissipation of motion," and yet mental, social, and moral developments are also called evolution, so that, in accord- ance with the definition, they are also integrations of matter and dissipations of motion. It is true that the author did not see that he was passing from transfigured realism into materialism. He thinks that he is always speaking of phenomena in the sense of subjective affections ; and in spite of his definition, he half imconsciously changes the meaning of evolution from a change in matter and motion, first into a change in states of consciousness, then to a change in social institutions, and finally into a change in moral motives. He also admits himself that mental evolution exemplifies integration of matter and dissipation of motion only indirectly. But here he becomes hopelessly inconsistent, because he had already said, in defining it, that, " evolution is an integration of matter and concomitant dissipation of motion" (First Principles, § 145). However, with all the author's dis- claimers, the general effect left on the reader's mind is that throughout the universe there is an unceasing change of matter and motion, that evolution is always such a change, that it begins with phenomena in the sense of physical facts, gradually issues in life and consciousness, and ends with phenomena in the sense of subjective affections of consciousness.*~~

~~*In the second place, having declared the noumenal power, which causes phenomena, or conscious affections, to be unknowable, and having left anybody who pleased to make it a god and an object of religion, he proceeds to describe it as if it were known force, and known in two respects as persistent and as resistent force. He supposes that the law of evolution is deducible from the law of persistent force, and includes in force what is now called energy. Then*~~

~~[matbeialism~~

~~having discussed force as sometliiiig thoroughly material, and laving special emphasis on resistance, he tells us that " the force of which we assert persistence is that Absolute Force of which we are indefinitely conscious as the neces- sary correlate of the force we know " {First Principles, § 62). Similarly, both in First Principles and in the Principles of Psychology, he assigns to us, in addition to our definite consciousness of our subjective affections, an indefinite consciousness of something out of conscious- ness, of something which resists, of objective existence. Thus it turns out that the objective agency, the noumenal power, the absolute force, declared unknown and unknow- able, is known after all to exist, persist, resist, and cause our subjective affections or phenomena, yet not to think or to will. Such a noumenon looks very like body or matter. Lastly, when a theory of the world supposes a noumenal power, a resistent and persistent force, which results in an evolution, defined as an integration of matter and a dissipation of motion, which having resulted in inorganic nature and organic nature, further results without break in consciousness, reason, society, and morals, then such a theory will be construed as materialistically as that of Haeckel by the reader, whatever the intention of the author.~~

~~It may be urged in reply that the synthetic philosophy could be made consistent by transferring the knowable resistance and persistence of the unknowable noumenon to knowable phenomena on the one hand, and on the other hand by maintaining that all phenomena from the original nebula to the rise of consciousness are only " impressions produced on consciousness through any of the senses," after all. But in that case what will become of Spencer's theory of evolution ? It will have asserted the evolution of man and his consciousness out of the phenomena of his con- sciousness. The truth is that his theory of evolution can be carried through the whole process from inorganic, through organic, to mental~~

~~*and moral facts, without a break, only by giving the synthetic philosophy a materialistic in- terpretation, and by adhering consistently to Spencer's own materialistic definition of evolution ; otherwise there will be a break at least between life and mind, where there will be something more than matter and motion to be redis- tributed. If everything knowable is an example of evolu- tion, and evolution is by definition a transformation of matter and motion, then everything knowable is an example of a transformation of matter and motion. As an exponent of universal evolutionHaeckelis more consistentthan Spencer. Huxley (1825-1895) developed views very like those of Spencer, and similarly materialistic without being material- ism, because inconsistent. He regarded everything known as evolved from matter, and reduced consciousness to a mere collateral product (or " epiphenomenon") of cerebral operations without any powerof influencing them. Matter, according to him, impresses the afferent nervous system, this the brain, this the efferent nervous system, while consciousness remains a mere spectator. " In man, as in brutes," said he, " there is no proof that any state of consciousness is the cause of change in the nature of the matter of the organism " ; so that " we are conscious automata." But, in spite of these materialistic tendencies, he followed Hume in reducing matter find everythin,!,^ knowable to phenomena of consciousness ; and, supposing that nothing is knowable beyond phenomena, concluded that we can neither affirm nor deny that anything exists beyond, but ought to take up an attitude which the ancient sceptics called Ajjhasia, but he dubbed by the new na.me of Agnosticism. Thus Huxley first reduced con- sciousness to a product of matter, and then matter to a phenomenon of consciousness. By comljining materialism with idealism he made consciousness a product of itself. Tyndall (1820-1893), again, came still nearer to material-*~~

~~*ism, and yet avoided it. In his Belfast address (1874), while admitting that naatter as understood by Democritus is insufficient, because atoms without sensation cannot be imagined to produce sensation, he contended, nevertheless, that matter properly understood is " the promise and potency of all terrestrial life." In thus endowing all matter with sensation likeHaeckelhe was not avoidingmaterialism. But in the very same address, as well as on other occasions, he did not identify mind with matter, but regarded them as concomitant.*~~

~~*All these materialistic tendencies seem to have one explanation. They emanate from scientific writers who rightly try to rise from science to metaphysics, but, as Bacon says, build a universal philosop)hy on a few experi- ments. The study of evolution, without considering how many conditions are required for " the integration of matter and the dissipation of motion " to begin, and the undoubted discoveries which have resulted from the study of inorganic and organic evolution, have led men to expect too much from this one law of nature. This tendency especially prevails in the uncertain science of biology, which is so far off the general principles of natural philosophy that its votaries are often ignorant of the real nature of body as matter and force. The close dependency of all mental operations on brain also tempts them to the conclusion that brain is not only an organ, but the whole organ of conscious mind. We may see traces of this tendency in the writings of H. Maudsley, in his lecture, for example, on Lessons of Materialism (1879). It appears also that Darwin, having extended his theory of evolution as far as the rational and moral nature of man, in the Descent of Man, ended in his Autobiography by declaring his attitude to first and final causes to be that of an agnostic. Not that he was a materialist, and shortly before his death, in a conversation with Btlchner, he maintained his agnosticism against his opponent's atheism. Still, his agnosticism meant that, though he did not assert that there is no God, he did assert that we can- not know whether there is or there is not. To the evolutionary biologist brain is apt to appear to be the crowning object of knowledge. On the other hand, those scientific men, such as Herschel, INfaxwell, and Stokes, who approach nature from mathematics and mechanics, and therefore from the universal laws of motion, have the opposite tendency, because they per- ceive that nature is not its own explanation. In order to exert force, or at all events that force of reciprocal pressure which we best understand, and on which, in impact, the third law of motion was founded, there are always at least two bodies, enduring, triply extended, mobile, each inert, mutually impenetrable or resistent, different yet similar ; and in order to have produced any effect but equilibrium, some bodies must at some time have differed either in mass or in velocity, otherwise forces would only have neutralized one another. "Why do bodies exist, with all these conditions, so similar yet different — that is, in so harmonious an order ? Natural science has no answer : natural theology has an answer. This*~~

~~essence of bodies, this resemblance in difference, this prevailing order of nature, is the deepest proof of God ; and it cannot be the result of evolution, because it is the condition of natural force, and therefore of natural evolu- tion. A second argument for God is the prevailing good- ness or adapta4i(jn of nature to the ends of conscious beings, which might conceivably be explained by Lamarck- ian evolution, but has not yet been so explained, and if it were, would not be inconsistent with a divine design in evolution. Further, the very existence of conscious beings is the best proof of the distinct or substantial being of the soul, existing in man with body, in God as pure spirit. It seems hopeless to expect that natural science, even with~~

~~idealism]~~

~~the aid of evolution, can explain by mere body the origin and nature of this fact of consciousness. If so, materialism is not the whole truth of metaphysics.~~

~~§ 3. The Rise of jMetaphtsical Idealism. (1) Descartes to Leibnitz. — Metaphysical arises from psychological idealism, and always retains more or less of an epistemological character. Psychological idealism assumes without proof that we perceive nothing but mental objects, and metaphysical idealism draws the logical but hypothetical conclusion that all we can know from these mental objects of sense is mental objects of knowledge. But at first this logical conclusion was not drawn. Descartes, the founder of psychological idealism, having proceeded from the conscious fact, cogito ergo sum, to the non-sequitur that I am a soul, and all a soul can perceive is its ideas, nevertheless went on to the further illogical conclusion that from these mental ideas I can (by the grace of God) infer things which are extended substances or bodies, as well as thinking substances or souls. He was a psychological idealist and a metaphy- sical realist. This illogicality could not last. Even the Cartesian school, as it came more and more to feel the difficulty of explaining the interaction of body and mind, and, indeed, any efficient causation~~

~~*whatever, gradually tended to the hypothesis that the real cause is God, who, on the occasion of changes in body, causes corresponding changes in mind, and vice versd. This occasionalism is not idealism, but its emphasis on the will of God gave it an idealistic tendency. Thereupon Spinoza advanced a pantheism which supposed that bodies and souls are not, as Descartes thought, different substances, but merely attributes — the one the extension and the other the thought of one substance, Nature or God. Taking the Aristotelian theory that a substance is a thing in itself, not in Aristotle's sense of any individual existing differently from anything else, but in the novel meaning of something existing alone, he concluded, logically enough from this mere misunderstanding, that there can be only one substance, and that, as no finite body or soul can exist alone, everything finite is merely a mode of one of the attributes of the one infinite substance which alone can exist by itself. Spinozism, however, though it tramples down the barrier between body and soul, is not yet metaphysical idealism, because it does not reduce extension to thought, but only says that the same sub- stance is at once extended and thinking — a position more akin to materialism. At the same time Spinoza maintained a parallelism between extension and think- ing so close as to say that the order of ideas is the same as the order of things, so that any mode of extension and the idea of it are the same thing expressed in two ways, under the attribute of extension and under the attribute of thought. (See H. H. Joachim's Study of the Ethics of Spinoza, 1901, p. 72.) It remained, however, for Schelling to convert this parallelism into identity by identifying motion with the intelligence of God, and so to transform the pantheism of Spinoza into pantheistic idealism. Leibnitz, again, having become equally dis- satisfied with Cartesianism, Spinozism, and the Epicurean realism of Gassendi, whom he had first followed in analysing nature into atoms and vacuum, in the latter part of his life came still nearer than Spinoza to meta- physical idealism in his monadology, or half-Pythagorean, haif-Brunistic analysis of bodies into monads, or units, or simple substances, indivisible and unextended, but en- dowed with perception and appetite. HIe gradually fell under the dominion of two false assumptions. On the one hand, essentially a mathematician, he supposed that unity is indivisibility, whereas everything known to be one is merely undivided or individual, and that there*~~

~~must be simple because there are compound substances, although composition only requires simpler or relatively simple elements. On the other hand, under the influence of the mechanics of his day, which had hai-dly dis- tinguished between inertia, or the inability of a body to change itself, and resistance, or the ability of bodies to oppose one another, he concluded that, as inertia is passive, so is resistance, and refused to recognize that in collision the mutual resistance of moving bodies is a force, or active power, of changing their movements in opposite directions. Erom these two arbitrary hypotheses about corporeal motion, that it requires indi visibly simple elements, and that it offers only passive resistance, he concluded that behind bodies there must be units, or monads, which would be at once substantial, simple, indivisible, and active. He further supposed that the monads are " incorporeal automata," not interacting like bodies, but each perceiving what was passing in the other, and acting in consequence by appetite, or self- acting. Such mentally endowed substances might be called souls ; but, as he distinguished between perception and apperception or consciousness, and considered that perceptions are often unconscious, he preferred to divide monads into unconscious entelechies of inorganic bodies, sentient souls of animals, and rational souls, or spirits, of men ; while he further concluded that all these are derivative monads created by God, the monad of monads. All derivative monads, he allowed, are accompanied by bodies, which, however, are composed of other monads dominated by a central monad. Purther, he explained the old Cartesian difficulty of the relation of body and mind by transforming the Spinozistic parallelism of ex- tension and thought into a parallelism between the motions of bodies and the perceptions of their monads ; motions always proceeding from motions, and perceptions from perceptions; bodies acting according to efficient causes, and souls according to final causes by appetition, and as if one influenced the other without actually doing so. Finally, he explained the concomitance of these two series, as well as that between the perceptions of different monads, by supposing a pre-established har- mony ordained by the primitive monad, God. Up to this point, then, Leibnitz opened one of the chief avenues to metaphysical idealism, the resolution of the material into the immaterial, the analysis of bodies into mental elements. Like the Pythagoreans, he regarded bodies as composed of units ; unlike them, he endowed these units with minds. He followed~~

Bruno's dogma — " Spirto si trova in tutte le cose, e non e minimo corpusculo, che non contegna cotal porzione in se, che non inanimi" (Delia causa). His theory of bodies involved an idealistic analysis neither into bodily atoms, nor into mathematical units, but into mentally endowed simple substances. There remained, however, his theory of the nature of bodies; and here he hesitated between two alterna- tives. According to one alternative, which consistently flowed from the psychological idealism of Descartes, as well as from his own monadism, he suggested that bodies are real phenomena; phenomena, because they are aggregates of monads, which derive their unity only from appearing together to^our perceptions; real phenomena well founded, because they result from real monads. In support of this view, he said that bodies are not substances, though substantiata ; that their apparent motion and resistance are results of the passions of their monads ; that their primary matter is nothing but passive power of their monads ; that the series of efficient causes between them is merely phenomenal. According to this alternative, then, there is nothing but mental monads and mental phenomena ; and Leibnitz is a metaphysical idealist. According to the other alternative, however, he suggested*

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tliat at least organic bodies are compound or corporeal substances, which are not phenomena, but something realizing or rather substantializing phenomena; and not mere aggregates of monads, but something substantial beyond their monads, because an organiobody, though com posed of monads, has a real unity (umo realis). From this point of view he believed that the real unity of a body is a vinculum substantiale, which gives it its real continuity and is the principle of its actions; that its primary matter is its own principle of resistance ; and that it has not only this passive, but also an active, power of its own. He suggested that this theory of the substantial unity of a body might explain transubstantia- tion, by supposing that, while the monads and phenomena of bread remain, the vinculum substantiale of the body of Christ is substituted. He

~~feared also whether we can explain the mystery of the Incarnation, and other things, unless real bonds or unions are added to monads and phenomena. According to this alternative, these organic bodies are compound or corporeal substances, between monads and phenomena ; and Leibnitz is a metaphysical realist. He was held to this belief in the substantiality of bodies by his Christianity, by the influence of Aristotle, of scholasticism, and of Cartesianism, as well as by his own mechanics. But the strange thing is that at the very end of his life and at the very same time, in 1714-16, he was writing the idealistic alternative to Eemond de Montmort and Dangicourt, and the realistic alternative to Father des Bosses. He must have died in doubt. We cannot, therefore, agree with many recent idealists who regard Leibnitz as one of themselves, though it is true that, when stripped of its realism, his metaphysics easily passed into the metaphysical idealisms of Lotze and of Fechner. It is true, also, that on its idealistic side the philosophy of Leibnitz is the source of many current views of panpsychism, of psychophysical parallelism, as well as of the phenomenalism of bodies, and of the analysis of bodies into mental elements.~~

~~(2) Locke to Hume. — Meanwhile in England, Locke, though differing from Descartes about the origin of ideas, followed him in the illogical combination of psychological idealism with metaphysical realism. He thought that we perceive nothing but ideas botB. of primary and of second- ary qualities, and yet that somehow we are able to infer that, while our ideas of secondary qualities are not, those of primary qualities are, like the real qualities of external things. Berkeley saw the inconsistency of this position, and, in asserting that all we perceive and all we know is nothing but ideas in " mind, spirit, soul, or myself," has the merit of having made, as Paulsen remarks, " epistemo- logical idealism the basis of metaphysical idealism." According to him, a body such as the sun is my idea, your idea, ideas of other minds, and always an idea of God's mind ; and when we have sensible ideas of the sun, what causes them to arise in our different minds is no single physical substance, the sun, but the will of God's spirit. Hume saw that in making all the objects of perception ideas Berkeley had given as little reason for inferring substantial souls as substantial bodies. He therefore con- cluded that all we know from the data of psychological idealism is impressions or~~

~~*sensations, ideas, and associa- tions of ideas, making us believe without proof in sub- stances and causes, together with " a certain unknown, inexplicable something as the cause of our perceptions." We have here, in this sceptical idealism, the source of the characteristically English form of idealism, still to be read in the writings of Mill and Spencer, and still the starting-point of more recent works, such as Pearson's Grammar of Science and James's Prlnciph's of Psycholomi.*~~

~~*{■j) Kant atid Fivhte. — Lastly, in Germany, partly influenced by Leibnitz and partly roused by Hume, Kant*~~

~~*elaborated his transcendental or critical idealism, which, if not, as he thought, the prolegomena to all future meta- physics, is still the starting-point of most metaphysical idealists. Kantism consists of four main positions, which it will be well to lay out, as follows : —*~~

~~*(ft) As to the origin of knowledge, Kant's position is that sense, outer and inner, affected by things in them- selves, receives mere sensations or sensible ideas {Vorstel- lungen), as the matter which sense itself places in the A priori forms of space and time ; that thereupon under- standing, by means of the synthetic unity of apperception, " I think " — an act of spontaneity beyond sense, in all consciousness one and the same, and combining all my ideas as mine in one universal consciousness — and under d, priori categories, or fundamental notions, such as sub- stance and attribute, cause and effect, &c.. Unites groups of sensations or sensible ideas into objects and events, e.g., a house, one ball moving another ; and that, accordingly, perception and experience, requiring both sense and under- standing, are partly d, posteriori and partly A priori, and constitute a knowledge of objects which, being sensations combined by synthetic unity under A priori forms, are more than mere sensations, but less than things in them- selves. This first position is psychological idealism in a new form and supported by new reasons ; for, if experience derives its matter from mental sensations and its form from mental synthesis of sensations, it can apprehend nothing but mental objects of sense, which, according to Kant, are sensible ideas having no existence outside our thought, not things in themselves ; or phenomena, not noumena.*~~

~~*(6) As to the known world, Kant's position was the logical deduction that from such phenomena of experience all we can know by logical reason is similar phenomena of actual or possible experience; and therefore that the known world, whether bodily or mental, is not a Cartesian world of bodies and souls, nor a Spinozistic world of one substance, nor a Leibnitzian world of monadic substances created by God, but a world of sensations, such as Hume supposed, only combined, not by association, but by syn- thetic understanding into phenomenal objects of experience, which are phenomenal substances and causes — a world of phenomena, not noumena. This second position is a new form of metaphysical idealism, containing the supposition, which lies at the foundation of later German philosophy, that since understanding shapes the objects out of sensa- tions, and since nature, as we know it, consists of such objects, "understanding, though it does not make, shapes nature," as well as our knowledge. Known nature is a mental construction in part, according to Kant.*~~

~~*(c) As to existence, Kant's position is the wholly illogical one that, though all known things are phenomena, there are things in themselves, or noumena ; things which are said to cause sensations of outer sense and to receive sensations of inner sense, though they are beyond the category of causality which is defined as one of the notions uniting phenomena; and things which are assumed to exist and have these causal attributes, though declared unknowable by any logical use of reason, be- cause logical reason is limited by the mental matter and form of experience to phenomena ; and all this according to Kant himself. This third position is a relic of ancient metaphysical realism ; although it must be re- membered that Kant does not go to the length of Descartes and Locke, who supposed that from mere ideas we could know bodies and souls, but suggests that beneath the phenomena of outer and inner sense the thing in itself may not be heterogeneous {niiglelchartig). In this form we shall find the thing in itself' revived in our day by A. Riehl.*~~

~~*(d) As to the use of reason beyond knowledge, Kant's*~~

~~*idealism]*~~

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~~position is that, in spite of its logical inability to tran- scend phenomena, reason in its pure, or d, priori use, con- tains necessary d, priori " ideals " (Ideen), and practical reason, in order to account for moral responsibility, frames postulates of the existence of things in them- selves, or noumena, corresponding to these " ideals " ; postulates of a real free-will to practise morality, of a real immortality of soul to perfect it, and of a real God to crown it with happiness. This fourth position is the coping-stone of Kant's metaphysics. It is quite incon- sistent with its foundation and structure. Kant first deduced that from the experience of mental phenomena all logical use of reason is limited to mental phenomena, and then maintained that to explain moral responsibility practical reason postulates the existence of real noumena. But what is a postulate of practical reason to explain moral responsibility except a logical use of reason ? Nevertheless, in his own mind Kant's whole speculative and practical philosophy was meant to form one system. In the preface to the second edition of the Kritik he says that it was necessary to limit speculative reason to a knowledge of phenomena, in order to allow practical reason to proceed from morality to the assumption of God, freedom, and immortality, existing beyond phe- nomena : " Ich musste also das Wissen aufheben, um zum Glmiben Platz zu machen." He forgot that he had also limited all logical use of reason, and therefore of practical reason, to phenomena, and thereby undermined the rationality not only of knowledge, but also of faith. Fichte now set himself in the Wissenschaftslehre (1794) to make transcendental idealism into a system of meta- physical idealism without Kant's inconsistencies and relics of realism. His point was that there are no things in themselves different from minds or acting on them ; that man is no product of things ; nor does his thinking arise from passive sensations caused by things ; nor is the end of his existence attainable in a world of things ; but that he is the absolute free activity constructing his own world, which is only his own determination, his self-imposed limit, and means to his duty which allies him with God. In order to prove this novel con- clusion, he started afresh from the Cartesian "I think" in the Kantian form of the synthetic unity of appercep- tion acting by d, priori categories ; but, instead of allow- ing, with all previous metaphysicians, that the Ego passively receives~~

~~sensations from something different, whether bodies, or monads, or God, or an unknown thing in itself, and not contenting himself with Kant's view that the Ego, by synthetically combining the matter of sensations with d priori forms, partially constructs ob- jects, and therefore Nature as we know it, he boldly asserted that the Ego, in its synthetic unity, entirely constructs things ; that its act of spontaneity is not mere synthesis of passive sensations, but construction of sen- sations into an object within itself ; and that therefore understanding makes as well as shapes Nature, as the Ego in thinking constructs both its own knowledge and its own world. This construction, or self-determination, is what Fichte called positing (setzen). According to him, the Ego posits first itself (thesis) ; secondly, the non-Ego, the other, opposite to itself (antithesis) ; and, thirdly, this non-Ego within itself (synthesis), so that all reality is in consciousness. But, he added, as the Ego is not conscious of this self-determining activity, but forgets itself, the non-Ego seems to be something independent, a foreign limit, a thing in itself, or per se. Hence it is the office of the theory of knowledge to show that the Ego posits the thing per se as only existing for itself, a nou- me.Hon in the sense of a product of its own thinking. Further, according to Fichte, on the one hand the Ego posits itself as determined through the non-Ego — no ob-~~

~~ject, no subject ; this is the principal fact about theoreti- cal reason; on the other hand, the Ego posits itself as determining the non-Ego — no subject, no object ; this is the principal fact about practical reason. Hence he united theoretical and practical reason, which Kant had sepa- rated, and both with will, which Kant had distinguished ; for he held that the Ego, in positing the non-Ego, posits both its own limit and its own means to the end, duty, by its activity of thinking which requires will. The con- clusion of his epistemology is that we start with our- selves positing subjective sensations — e.g., sweet, red — and refer them as accidents to matter in space, which, though mental, is objective, because its production is grounded on a law of all reason. The metaphysics re- sulting from this epistemology is that the so-called thing in itself is not a cause of our sensations, but a product of one's own thinking, a determination of the Ego, an object, limit, and means to the end of the Ego, a thing known to the Ego which constructs it. Fichte thus transformed the transcendental idealism of Kant by identifying the thing~~

~~*with the object, and by interpreting noumenon, not in Kant's sense of something which speculative reason conceives and practical reason postulates to exist in ac- cordance with the idea, but in the new meaning of a thought, a product of reason. This change led to another. Kant had said that the synthetic unity " I think " is in all consciousness one and the same, meaning that I am always present to all my ideas. Fichte transformed this unity of the conscious self into a unity of all conscious selves, or a common consciousness ; and this change en- abled him to explain the unity of anything produced by the Ego by contending that it is not the different objects of different thinkers, but the one object of a pure Ego or consciousness common to them all. According to Kant, the objective is valid for all consciousnesses ; according to Fichte, it is valid for one consciousness. Here he was for the first time grappling with a fundamental difficulty in metaphysical idealism which is absent from realism, namely, the difficulty of explaining the identity of a thing, e.g., the sun. As long as even the meagre realism of the Kantian thing in itself is maintained, the account of there being one sun is simply that one thing causes different phenomena in different minds. But as soon as the thing in itself is converted into something mental, metaphysical idealists must either say that there are as many suns as minds, or that there is one mind and therefore one sun. The former was the alternative of Berkeley, the latter of Fichte. In fact, Fichte differed from Berkeley, as from Kant, in two respects. In the first place, while Berkeley said that God, and Kant that an unknown thing, is the cause of our sensations, Fichte said that we posit the sensations and the thing, and falsely regard the thing as the cause of sensations, until the theory of knowledge shows that it is only a mental product and a noumenon in this sense. Secondly, while Berkeley supposed that there might be as many suns as ideas, and Kant that an unknown thing causes many appearances of the sun in many minds, Fichte said that there is one mind positing one sun, a single pure Ego positing a single mental object, one and the same in all human persons. Thus the com- plete metaphysical idealism of Fichte's Wissenschaftslehre, formed out of the incomplete metaphysical idealism of Kant's Kritik, is the theory on its epistemological side that the Ego posits the non-Ego as a thing in itself, and yet as only a thing existing for it as its own noumenon, and on its metaphysical side that in consequence all reality is the Ego and its own determinations, which are objective, or valid for all, as*~~

~~*determinations, not of you or of me, but of the consciousness common to all of us, the pure or absolute Ego. Lastly, Fichte called this system realism, in so far as it posits the thing in itself as another thing ;*~~

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~~*idealism, in so far as it posits it as a noumenon which is a product of its own thinking; and on the whole real idealism or ideal realism.*~~

~~*God does not seem to find much place in the Wissen- schaftslehre, where mankind is the absolute and nature mankind's product, and where God neither could be an absolute Ego which posits objects in the non-Ego to infinity without ever completing the process, nor could be even known to exist apart from the moral order which is man's destination. Hence in his Philosophical Journal in 1798 Eichte prefaced a sceptical essay of Forberg by an essay of his own, in which he used the famous words, " The living moral order is God ; we need no other God, and can comprehend no other." Having, however, in con- sequence, lost his professorship at Jena, he gradually altered his views, until at length he decided that God is not mere moral order, but also reason and will, yet without consciousness and personality ; that not mankind but God is the absolute; that we are only its direct manifestations, free but finite spirits destined by God to posit in ourselves Nature as the material of duty, but blessed when we relapse into the absolute; that Nature, therefore, is the direct manifestation of man, and only the indirect manifestation of God ; and, finally, that being is the divine idea or life, which is the reality behind appearances. In this extension of meta- physical idealism he was influenced by his disciple, Schelling. Nevertheless, he refused to go as far as Schelling, and could not bring himself to identify either man or nature with Absolute God. He wanted to be- lieve in the absolute_without sacrificing personality and freedom. God determines man, and man determines Nature : this is the final outcome of Eichte's pure idealism.*~~

~~*Fichte completed the process from psychological and epistemological to metaphysical idealism, which it has been necessary to recall from its beginnings in France, England, and Germany, in order to understand present idealism, which derives its original inspiration from the past and immediately from Spinoza and Leibnitz, Berkeley and Hume, Kant and Eichte. The assertion of absolute substance by Spinoza incited Schelling and Hegel. The analysis of bodies into immaterial elements by Leibnitz incited Lotze. The Spinozistic parallelism of extension and thought, and the Leibnitzian parallelism of bodily motion and mental action, incited Schelling and Feohner. Berkeley and Hume produced the English idealism of Mill and Spencer, with their successors, and occasioned the German idealism of Kant. Kant's d, priori synthesis of sensations into experience lies at the root of all German idealism. But Fichte was the most fertile of all. He carried metaphysical idealism to its height, by not only resolving the bodily into the mental, but also elevating the action of mind into absolute mental construction ; not inferring things in themselves beyond, but originating things from within, mind itself. By changing the meaning of "noumenon" from the thing apprehended {voovixtvov) to the thought (vor;/ia), and in the hypothesis of a common consciousness, he started the view that a thing is not yours or my thought, but a common thought of all mankind, and led to the wider view of iSchelling and Hegel that the world is an absolute thought of infinite mind. In making the essence of mind activity and construction, in destroy-ing the separation of theoretical and practical reason, in asserting that mind thinks things as means to ends of the will, he prepared the way for Schopenhauer and other voluntarists. In making the essence of the Absolute not mere reason, but will, action, and life, he anticipated Lotze. In reducing the thing in itself to a thought, he projected the neo-Kantism of Lange and Oohen. In the doctrine — no object, no subject — no subject, no object — that is, in*~~

~~*the utter identification of things with objects of subjects, he anticipated not only Schelling and Hegel, but also Schuppe and Wundt with their congeners. In expanding Kant's act of synthesis till it absorbed the inner sense and the innermost soul, he started the modern paradox that soul is not substance, but subject or activity, a paradox which has been gradually handed down from Schelling and Hegel to Fechner, and from Fechner to*~~

~~*Paulsen and Wundt. Meanwhile, through holding with Kant that man is not God, but a free spirit, whose destiny it is to use his intelligence as a means to his duty, he is still the resort of many who vindicate man's independence, free- dom, conscience, and power of using nature for his moral purposes : such, for example, are Eucken and Munster- berg. Kant and Fichte together became the most potent philosophic influences on European thought in the 19th century, because their emphasis was on man. They made man believe in himself and his mission. They fostered liberty and reform, and even radicalism. They almost avenged man on the astronomers, who had shown that the world is not made for earth, and there- fore not for man. Kant half asserted, and Fichte wholly, that nature is man's own construction. The Kritik and the Wissenschaftslehre belonged to the revolutionary epoch of the "Eights of Man," and produced as great a revolution in thought as the French Eevolution did in fact. Instead of the old belief that God made the world for man, philosophers began to fall into the pleasing dream, I am everything, and everything is I — and even I am God.*~~

~~*§ 4. NouMENAL Idealism in Geemant.*~~

~~*Noumenal idealism is the metaphysics of those who suppose that all known things are indeed mental, but not all are phenomenal in the Kantian sense, because a noumenon is knowable so long as by a noumenon we mean some mental being or other which we somehow can discover beyond phenomena. The noumenal idealists of Germany assumed, like all psychological idealists, the unproved hypothesis that there is no sense of body, but there is a sense of sensations ; and they usually accepted Kant's point, that to get from such sensations to knowledge there is a synthesis contributing mental elements beyond the mental data of sense. They saw also the logic of Kant's deduction, that all we can know from such mental data and mental categories must also be mental. This was the starting-point of their metaphysical idealism. But they disagreed with Kant, and agreed with Fichte about things in themselves or noumena, and contended that the mental things we know are not mere phenomena of sense, but noumena, precisely because noumena are as mental as phenomena, and therefore can be known from similar data: this was the central point of their noumenal idealism. They*~~

~~*rightly revolted against the inconsistencies of Kant's third and fourth positions about the existence of unknown but postulated things in themselves, hidden from theoreti- cal, but revealed to practical, reason. In a way they re- turned to the wider o])inions of Aristotle, which had come down to Descartes and Locke, that reason in going beyond sense knows more things" than phenomena; yet they would not hear of external bodies, or of bodies at all. No realists, they came nearer to Spinozistic pantheism and to Leibnitzian monadism, but only on their idealistic side ; for they would not allow that extension and body are different from thinking and mind. In this denial of all bodily substances and all bodily attributes they were anticipated by r>erkeley's view that when we get beyond ourselves we find nothing but other minds and ideas. But their real founder was Fichte, on account of his definite' reduction of the noumenal to a mental world. This was indeed the very point — the knowability of a*~~

~~*idealism]*~~

~~*noumenal mental world. At the same time it soon appeared that they could not agree among themselves when they came to ask what it is, but in attempting to define it seem to have gone through the whole gamut of mind. Schelling and Hegel thought it was infinite reason ; Schopenhauer, unconscious will ; Hartmann, unconscious intelligence and will; Lotze, the activity or life of the divine spirit ; Fechner, who has been followed by Paulsen, a world of spiritual actualities comprised in the one spirit- ual actuality, God, in whom we live and move and have our being.*~~

~~*(1) Schelling and Hegel. — Of these noumenal idealisms the earliest in time and the nearest to Fichte's philosophy was the panlogism, begun by Schelling (1775-1854), completed by his disciple Hegel (1770-1831), and then modified by the master himself. Starting from Fichte's Wissenschaftslehre, Schelling accepted the whole process of mental construction, and the deduction that noumena are knowable products of universal reason, the Absolute Ego. But from the first he was bolder than Fichte, and had no doubt that the Absolute is God. God, as he thought, is universal reason, and Nature a product of universal reason, a direct manifestation, not of man, but of God: Deus mundus implicitus; mundus Deus explidtus. While Fichte emphasized man, Schelling emphasized Nature, and made a NaturpMlosophie, which, extrava- gant as it was, yet had the merit of rising beyond the narrow relation of Nature to mere man up to the uni- versal relation of Nature to God Himself. This depar- ture from Fichte was due to the pantheism of Spinoza, from whom Schelling derived the identification of God and Nature. But he passed Spinozism through the pure idealism of Fichte, and therefore regarded God, not as one substance partly extended and partly thinking, but as one intelligent subject ; and Nature, not as God's ex- tension, but with its extension and all its attributes as nothing but God's intelligence made manifest, beginning unconsciously in the inorganic world, and finally rising to conscious intelligence in man. Hence numerous phrases, such as, " Dead*~~

~~*nature is only unripe intelligence," " Mat- ter is slumbering spirit," "The process of Nature is an unconscious poetry," "Nature is the Odyssey of spirit," in which he strove to express his conversion of Spinoza's realistic into his own idealistic pantheism. Thus also the correspondence supposed by Spinoza between thought and extension, and the pre-established harmony supposed by Leibnitz between the perceptions of monads and the movements of bodies (phenomenal or substantial) were transformed into an identity of ideal and real, subjective and objective, in absolute reason. The hypothesis of parallelism became for the first time a hypothesis of identity. Again, Schelling's attention was soon diverted from Fichte to Kant ; not, however, to the Kritik, but to the Metaphysical Foundations of Natural Science, wherein Kant had perversely tried to show that bodies are not im- penetrable substances exerting repulsion and attraction, but are composed of these very forces. This work of Kant doubly affected Schelling : it suggested to him the idea of a NaturpMlosophie, and of a construction of nature. But he passed Kantism, as well as Spinozism, through the pure idealism of Fichte. In the first place, he divided philosophy into two : (a) Transcendental philosophy pro- ceeding from subject to object, (&) Natural philosophy proceeding from object to subject. IIe thus widened the method of philosophy by adding to Fichte's " trans- cendental" his own "natural" method. Secondly, he extended Fichte's process of construction from man's knowledge to Nature. According to him, not only know- ledge, but also Nature, goes through the triple process of thesis, antithesis, and synthesis; Nature is the self-activ- ity of the subject (natura natiawis), which continually*~~

~~*becomes an object, and issues in a product (natura naturata) in which subject and object are identical ; and this identity in duplicity is the foundation of repulsion and attraction, and repeats itself throughout the whole world, ideal and real. IIence, instead of speaking, with Fichte, of the Absolute Ego positing Nature as the non- Ego, Schelling prefers to say that Absolute Reason becomes Nature, the subject becomes the object, only to return into itself as a unity of opposites ; so that nature as well as knowledge is a system of the rational, and everything is identified in the Absolute Eeason. IIow then is this Absolute known ? According to Schel- ling, by intellectual intuition. Kant had attributed to God, in distinction from man's understanding, an intel- lectual intuition of things. Fichte*~~

~~had attributed to man an intellectual intuition of himself as the Absolute Ego. Schelling attributes to man an intellectual intui- tion of the Absolute God ; and as there is, according to him, but one universal reason, the common intelligence of God and man, this intellectual intuition at once gives man an immediate knowledge of God, and identifies man with God Himself.~~

~~On Schelling's idealistic pantheism, or the hypothesis that there is nothing but one absolute reason identifying the opposites of subjectivity and objectivity, Hegel based his panlogism. But, while he fully recognized his in- debtedness to his master, he differed from him profoundly in one respect, which, being fundamental, could not but have many consequences. He rightly objected that the system was wanting in logical proof. He rightly, there- fore, rejected the supposed intellectual intuition of the Absolute. He rightly contended that, if we are to know anything beyond sense, we must know it by a process of logical reason. But, unfortunately, he meant not the log- ical inferences described in the Organon and the Novum Organum, the analogical, inductive, and deductive pro- cesses, which enable us to infer other things similar to what we perceive in ourselves. He meant a new "specu- lative " method, dialectic, founded on an assumption which he had already learnt from Schelling, namely, that things which are different but similar can have the same attri- bute, and therefore be also the same. With this powerful instrument of dialectic in hand, he attempted to show how the Absolute gradually develops into the world and maintains itself j how being passes into its opposite, not- being, and returns into itself ; how the Idea becomes Nature, and returns into itself in Spirit ; how, in short, absolute reason differentiates itself into subjective and objective, ideal and real, and yet is the identity of both — an identity of opposites, as Schelling had said. By the same dialectic Hegel was able to justify the gradual trans- formation of transcendental into noumenal idealism by Fichte and Schelling. If things different but similar have the same attributes, and are thereby the same, then in the first place the Kantian categories, though thoughts of mental origin and therefore confined to mind, are neverthe- less applicable to things, because things, though different from, are the same as, thoughts, and have the categories of thoughts ; in the second place, the Fichtian Ego of man- kind is not the Absolute Eeason of God, and yet~~

~~*is the same Absolute Reason ; in the third place, the Schellin- gian Nature is the " other " of .Spirit, and yet, being a mere reflex of the Idea of Nature, is identical with Spirit ; and as this Spirit is eveiywhere the same in God and men. Nature is also identical with our Spirit, or rather with the Infinite Spirit, or Absolute Reason, which alone exists. The crux of all metaphysical idealism is the difficulty of reconciling the unity of the object with the plurality of subjects. Hegel's assumption of identity in difference at once enabled him to deal with the whole difficulty by holding that different subjects are yet one subject, and*~~

~~*any one object, e.g., the sun, is at once different from, and identical with, the one subject which is also many. By the rough magic of this modern Prospero, the universe of being is not, and yet is, thought, idea, spirit, reason, God. So elastic a solution established a dominant Hegelian school, which is now practically extinct, in Germany, and from Germany spread Hegelianism to France, Eng- land, America, and, in fact, diffused it over the civilized world to such an extent that it is still a widespread fashion outside Germany to believe that the world of being is a world of thought.*~~

~~*The plain answer is to contest the whole assumption. Different things, however similar, have only similar attributes, and therefore are never the same. God cre- ated man in His own image, and the world in the image of the Divine Idea ; but I am not God, and the transitory sun is not the same as God's eternal idea of it. The creatures, however like, are not the same as the Creator and His thoughts. Each is a distinct thing, as Aristotle said. Reality is not Eeason. It is strange that the underlying assumption of panlogism was not at once contested in this plain way. Nevertheless, objection was soon taken to the unsatisfactoriness of the system reared upon it. Schelling himself, as soon as he saw his own formulae exposed in the logic or rather dialectic of his disciple, began to reconsider his philosophy of identity, and brought some powerful objections against both*~~

~~*the conclusions and the method of Hegel. Schelling per- ceived that Hegel, in reducing everything to infinite mind, absorbed man's free but finite personality in God, and, in declaring that everything real is rational, failed to explain evil and sin : indeed, the English reader of T. H. Green's Prolegomena to Ethics can see how awk- ward is the Hegelian transition from " one spiritual prin- ciple" to different men's individual freedom of choice between good and evil. Again, Schelling urged that besides the rational element there must be something else ; that there is in nature, as natura natiirans, a blind impulse, a will without intelligence, which belongs to the existent ; and that even God Himself as the Absolute cannot be pure thought, because in order to think He must have an existence which cannot be merely His thought of it, and therefore pure being is the prior con- dition of thought and spirit. Hence Schelling objected to the Hegelian dialectic on the ground that, although reason by itself can apprehend notions or essences, and even that of God, it cannot deduce d, priori the existence either of God or of Nature, for the apprehension of which experi- ence is required. He now distinguished two philosophies : negative philosophy starting from notions, and positive philosophy starting from being ; the former a philosophy of conditions, the latter of causes, i.e., of existence. Hegel, he said, had only supplied the logic of negative philosophy ; and it must be confessed that the most which could be extracted from the Hegelian dialectic would be some connexion of thoughts without proving any exist- ence of corresponding things. Schelling was right ; but he had too much affinity with Hegelian assumptions, e.g., the panlogistic confusion of the essences of things with the notions of reason, to construct a positive philosophy without falling into fresh mysticism, which failed to exorcise the effect of his earlier philosophy of identity in the growing materialism of the age.*~~

~~*(2) Schopenhauer. — Meanwhile, by the side of panlog- ism arose the panthelism of Schopenhauer (1788-1860). This new noumenal idealism began, like the preceding, by combining])sychological idealism with the tran- scendentalisiu of Kant and Fichte. In Die Welt als Wille und Vorstelhoig Schopenhauer accepted Kant's position that the world as phenomenal is idea {Vorstellung) ; but he added that the world as noumenal is will (WilU). He*~~

~~*got the hint of a noumenal will from Kant ; but in re- garding the noumenal as knowable, because mental, as well as in the emphasis he l,aid on the activity of will, he resembled Fichte. His theory of the nature of will was his own, and arrived at from a voluntaristic psychology leading to a voluntaristic metaphysics of his own. His psychological starting-point was the unproved assump- tion that the only force of which we are immediately aware is will ; his metaphysical goal was the consistent conclusion that in that case the only force we can know, as the noumenal essence of which all else is phenomenal appearance is will. But by this noumenal will he did not mean a divine will similar to our rational desire, a will in which an inference and desire of a desirable end and means produces our rational action. He meant an unintelligent, unconscious, restless, endless will. In con- sidering the force of instinct in animals, where, without any apprehension of a prospective end, a present feeling of pleasure or pain, such as hunger, produces an impulsive action, he was obliged to divest will of reason. When he found himself confronted with the blind forces of Nature, where bodies insensibly change one another, he was obliged to divest irrational will of feeling. As he resolved one force after another into lower and lower grades of will, he was obliged to divest will of all con- sciousness. In short, his metaphysics was founded on a misnomer, and simply consisted in calling unconscious force by the name of unconscious will (Unbewusster Wille). This abuse of language brought him back to Leibnitz. But, whereas Leibnitz imputed unconscious perception as well as unconscious appetition to monads, Schopenhauer supposed unconscious will to arise without perception, without feeling, without ideas, and to be the cause of ideas only in us. Hence he rejected the infinite intelligence supposed by Fichte, Schelling, and Hegel, against whom he urged that blind will produces intelli- gence, and only becomes conscious in us by using in- telligence as a means to ends. He also rejected the optimism of Leibnitz and Hegel, and placed the most irrational of wills at the base of the worst possible of worlds, holding that the state of will is a state of end- less striving, a state of evil ; that the will to live brings no happiness ; that pain is positive evil and pleasure only its absence ; that misery only increases with the accession of intelligence, and so the world becomes worse, until in- telligence, by supplying will with a knowledge of its evil nature, enables it in the individual man to negate itself by virtue and asceticism, and so to be at*~~

~~peace. This- pessimistic panthelism, though of little account during the Hegelian domination, gradually won its way, and pro- cured exponents such as J. Frauenstadt, J. Bahnsen, and,, more recently, P. Deussen. The accident of its pessimism attracted F. W. Nietzsche, who afterwards, passing from the philosophy of will to the theory of evolution, ended by imagining that the struggle of the will to live produces the survival of the fittest, that is, the right of the strongest and the will to exercise power, which by means of selection may hereafter issue in a new species of superior man — the JJehermenach. Finally, Schopenhauer's voluntarism has had a profound effect on psychology inside and outside- Germany, and to a less degree produced attempts to deduce from voluntaristic psychology new systems of volunta- ristic metaphysics, such as those of Paulsen and Wundt. (3) E. von Hartmann. — But the first to modify the pure voluntarism of Schopenhauer was E. von Hartmann, who,, in Die Philosophie des Unbewussten (1869, 1st ed.), ad- vanced the view that the world as noumenal is both un- conscious intelligence and unconscious will, thus founding- a panpneumatism which forms a sort of reconciliation of the panlogism of Hegel and the panthelism of Schopen- hauer. In his tract entitled Schelling' s positive Philosophie~~

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~~als Einheit von Hegel und Schopenhauer (1869), he further showed that, in his later philosophy, Schelling had already combined reason and will in the Absolute. In- deed, Fichte had previously characterized the life of the Absolute by reason and will without consciousness ; and, before Fichte, Leibnitz had asserted that the elements of Nature are monads with unconscious perception and appetition. Hartmann has an affinity with all these pre- decessors, and with Spinoza, with whom he agrees that there is but one substance unaltered by the plurality of individuals which are.only its modifications. Following, however, in the footsteps of Schelling, he idealizes the one extended and thinking substance into one mental being ; but he thinks that its essence consists in uncon- scious intelligence and will, of which all individual in- telligent wills are only activities. The merit~~

~~*of this fresh noumenal idealism consists in its correction of the one-sidedness of Schopenhauer : intelligence is necessary to will. But Hartmann's criticism does not go far enough. Instead of concluding that will is intelligent desire to act by means to a future end, that instinct is feeling pro- ducing action, that unconscious force is stress of bodies mutually changing one another unconsciously, and that the conscious intelligent will of omnipresent God is the primary cause beneath all secondary causes, unconscious and conscious, he outdoes the paradox of Schopenhauer by concluding that Nature in itself is intelligent will, but unconscious, a sort of immanent unconscious God. As with his master, his reasons for this view are derived, not from a direct proof that unconscious Nature has the mental attributes supposed, but from human psychology and epistemology. Like Leibnitz, he proceeds from the fact that our perceptions are sometimes conscious, some- times unconscious, to the inconsequent conclusion that there are beings with nothing but unconscious perceptions ; and by a similar non sequitur, because there is the idea of an end in will, he argues that there must be an uncon- scious idea of an end in instinctive, in reflex, in all actions. Again, in his Grundproblem der Erkenntnissthe- orie (1889) he uses without proof the hypothesis of psy- chological idealism, that we perceive psychical effects, to infer with merely hypothetical consistency the con- clusion of noumenal metaphysical idealism that all we can thereby know is psychical causes, or something transcendent, beyond phenomena indeed, yet not beyond mind. But, according to him, this transcendent is the unconscious, which is Kraftvolles unbewusst ideales Geschehen. He calls this epistemology "transcendent realism"; it is really "transcendent idealism." On these foundations he builds the details of his idealistic metaphysics. He identifies matter with mind by identi- fying atomic force with the striving of unconscious will after objects conceived by unconscious intelligence, and by defining causality as logical necessity receiving actuality through will. Secondly, he contends that, when matter ascends to the evolution of organic life, the unconscious has a power, over and above its atomic volitions, of introducing a new element, and that in consequence the facts of variation, selection, and inheri- tance, pointed out by Darwin, are merely means which the unconscious uses for its own ends in morphological development. Thirdly, he explains the rise of con- sciousness by supposing that, while it requires brain as a*~~

~~*condition, it consists in the emancipation of intelligence from will at the moment when in sensation the individual mind finds itself with an idea without will. Here follows his pessimism, like to, but differing from, that of his master. In his view consciousness begins with want, and pain preponderates over pleasure in every in- dividual life, with no hope for the future, while the final end is not consciousness, but the painlessness of the un-*~~

~~*conscious, which mankind wiU attain when, convinced of the misery of life, it will work a common resolve not to will, and somehow stop all will. But why exaggerate ? The truth of Nature is force ; the truth of will is rational desire; the truth of life is neither the optimism of Leibnitz and Hegel, nor the pessimism of Schopenhauer and Hartmann, but the moderatism of Aristotle. Life is sweet, and most men have more pleasures than pains in their lives.*~~

~~*(4) Lotze and Zeller. — Lotze (1817-1881) elaborated a very different noumenal idealism, which perhaps we may express by the name " Panteleologism," to express its conclusion that the known world beyond phenomena is neither absolute thought, nor unconscious will, nor the unconscious at all, but the activity of God ; causing in us the system of phenomenal appearances, which we call Nature, or bodies moving in time and space ; but being in itselJE the system of the universal reciprocal actions of God's infinite spirit, animated by the design of the supreme good. The Metaphysik of Lotze in its latest form (1879) begins with a great truth : psychology cannot be the foundation of metaphysics, metaphysics must be the foundation of psychology. He saw that the theories of the origin of knowledge in idealistic epistemology are unsound and lead to no solid result. Like Aristotle, then, he proposed anew the question, What is being ? Nevertheless he was too much a child of his age to keep things known steadily before him, but had no sooner asked the metaphysical question than he proceeded to find a psychological answer in a theory of sensation, which asserted the mere hypothesis that the being which we ascribe to things on the evidence of sensation consists in their being felt. He really accepted, like Kant, the hypothesis of a sense of sensations which led to the Kantian conclusion that the Nature we know in time and space is mere sensible appearances in us. Further, from an*~~

~~early period in his Medicinische Psychologie (1862) he reinforced the transcendental idealism of Kant by a general hypothesis of "local signs," containing the sub- ordinate hypotheses, that we cannot directly perceive ex- tension either within ourselves or without ; that spatial bodies outside could not cause in us spatial images either in sight or in touch ; but that besides the obvious data of sense, e.g., pressure, heat, and colour, there must be other qualitative different excitations of different nerve-fibres, by means of which, as non-local signs of localities, the soul constructs in itself an image of extended space con- taining different places. This hypothesis of an acquired perception of a space mentally constructed by "local signs," brought forward in opposition to the nativistic hypothesis of Joh. Miiller, supplied Lotze and many succeeding idealists, including Wundt, with a new argument for metaphysical idealism. Lotze concluded that we have no more reason for supposing an external space like space constructed out of our perceptions, than we have for supposing an external colour like perceived colour. Agreeing, then, with Kant that primary qualities are as mental as secondary, he agreed also with Kant that all the Nature we know as a system of bodies moving in time and space is sensible phenomena. But while he was in fundamental agreement with the first two posi- tions of Kant, he differed from the third ; he did not believe that the causes of sensible phenomena can be un- known things in themselves. What then are they ? In answering this question Lotze regarded Leibnitz as his guide. IIe accepted the Leibnitzian fallacy that unity is indivisibility, which led to the Leibnitzian analysis of material bodies into immaterial monads, indivisible and therefore unextended, and to the theory of monadic souls and entelechies. Indeed, from the time of Leibnitz such attempts either to analyze or to construct matter had~~

~~become a fashion. Boscovich had supposed repulsive and attractive centres of force, and Kant had constructed matter with extension and impenetrability out of repul- sion and attraction. Schelling had constructed all Nature out of the thesis, antithesis, and synthesis of spirit.~~

~~*Her- bart had analysed it into " reals," or simple substances, each with an unknown quality. Lotze agreed with Leib- nitz that the things which cause phenomena are immar terial elements, but added that they are not simple substances, self-acting, as Leibnitz thought, or preserving themselves against disturbance, as Herbart thought, but are interacting modifications of the one substance of God. In the first place, he resolved the doubt of Leibnitz about bodies by deciding entirely against his realistic alterna- tive that an organic body is a sicbstaiitia realizans pliceno- Tnena, and for his idealistic alternative that every body is a phenomenon and not a substance at all. Secondly, he accepted the Leibnitzian hypothesis of immaterial ele- ments without accepting their self-action. He believed in reciprocal action ; and the very essence of his meta- physics consists in sublimating the interaction of bodies into the interaction of immaterial elements, which pro- duce effects on one another and on the soul as one of them. According to the mechanics of Newton, when two bodies collide and by their mutual resistance make one another move in opposite directions, each impresses on the other an equal change of momentum, so that as much momentum as one causes in one direction, the other causes in the opposite direction. Each body moving makes the other move equally and oppositely ; but it has become a convenient habit to express this concrete fact in abstract language by calling it the conservation of mo- mentum, by speaking as if not the equivalent but the very same momentum lost by one body is gained by the other, and by talking of one body communicating its motion to the other ; as if bodies exchanged motion as men do money. Now Lotze took this abstract language literally, and had no dilficulty in showing that, as an at- tribute is not separated from its substance, this supposed communication of motion does not really take place: nothing passes. But instead of returning to the concrete fact of the equivalence of momentum, by which each body moving makes the other move oppositely, he denied that bodies do reciprocally act on one another, and even that bodies as mutually resisting substances press one another apart in collision. Having thus rejected all bodily mechanism, he had to suppose that reciprocal action somehow takes place between immaterial elements. This brought him to another difference from Leibnitz as well as from Newton. According to Leibnitz, while each im- material element is a monadic substance and self-acting secondary cause, God is the primary cause of all. Accord- ing to Lotze, the*~~

~~*connexion required by reciprocity re- quires also that the whole of every reciprocal action should take place within one substance; the immaterial elements act on one another merely as the modifications of that substance interacting within itself; and that one substance is God, who thus becomes not merely the primary but the sole cause, and in scholastic language is not a cruma trunsien.s, or creator of works beyond, but a causa immanenft, or agent of acts remaining within, the agent's being. At this point, having "rejected both the Newtonian mechanism of bodily substances and the Leibnitzian automatism of monadic substances, he flew to the Spinozistic unity of substance ; except that, according to him, the one substance, God, is not extended at all, and is not merely thinking, but is a thinking, willing, and acting Spirit. Lotze's metaphysics is thus distinguished from the theism of Newton and Leibnitz by its pantheism, and from the pantheism of Sjiinoza by Its idealism. It is an idealistic pantheism, which is a*~~

~~*denial of all bodily mechanism, a reduction of every- thing bodily to phenomena, and an assertion that all real action is the activity of God. At the same time it is a curious attempt to restore mechanism and reconcile it with teleology by using the word " mechanism " in a new meaning, according to which God performs His own reciprocal actions within Himself by uniform laws, which are also means to divine ends. It is also an at- tempt to reconcile this divine mechanism with freedom. In his Metapliysik (1879), as in his earlier Mikrokosmus (1856-64), Lotze vindicated the contingency of freedom by assigning to God a miraculous power of unconditional commencement, whereby not only at the very beginning but in the course of nature there may be new begin- nings, which are not effects of previous causes, though once started they produce effects according to law. Thus his pantheistic is also a teleological idealism, which in its emphasis on free activity and moral order recalls Leibnitz and Fichte, but in its emphasis on the infinity of God has more affinity to Spinoza, Schelling, and Hegel. Indeed, it has been truly said by G. T. Ladd that Lotze tried to correct Hegel by substituting for a movement of absolute thought a movement of absolute life as the sum of reality. Hence his philosophy, like the Hegelian, continually torments one with the diffi- culty that its sacrifice of the distinct being of all indi- vidual substances to the universality of God*~~

entails the sacrifice of the individual personality of men. Our bodies were reduced by Lotze to the general ruck of pheno- menal appearances. Our souls he tried his best to endow with a quasi-existence, arguing that the unity of con- sciousness requires an indivisible subject, which is dis- tinct from the plurality of the body but interacting with it, is in a way a centre of independent activities, and is so far a substance, or rather able to produce the appear- ance of a substance. But at the end of his Metapliysik, from the conclusion that everything beyond phenomena is divine interaction, he drew the consistent corollary that individual souls are simply actions of the one genuine being. His final view was that certain actions of the divine substance are during consciousness gifted with knowledge of themselves as active centres, but during unconsciousness are non-existent. If so, we are not persons with a permanent being of our own distinct from that of God. But in a philosophy which reduces everything to phenomenal appearance except the self- interacting substance of God, there is no room for either the bodies or the souls of finite substances or human persons. Yet the pantheistic teleological ideal- ism of Lotze has had, and still has, a wide influence in and out of Germany. The secret of this influence is the revival of the Leibnitzian analysis of matter into non-material elements. This influence appears in a most interesting way in Zeller's essay " Ueber die Grtinde unseres Glaubens an die Eealitat der Aussen- welt," 1884 (in his Vortniije, iii. 225 seq.). After an able justification of our belief in the reality of the ex- ternal world, Zeller contends that its forces are imma- terial. He advances three arguments : the Leibnitzian argument that simple elements must be unextended, the Lotzian argument that the interactions of body and soul are explained by supposing them to belong to immaterial elements, and his own argument that, if the immaterial is common to the inner and outer worlds, we can at once maintain with Kant that space is d, priori, m\A. infer with- out fallacy that it also belongs to outer things in them- selves made of immaterial elements. He remarks also that this reduction of the material to the immaterial is a point of agreement between Lotze and Fechner ; but, while agreeing in other respects with Lotze, he adds, " I do not hold space, as he does, to be something merely belonging

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~~to our apprehension." In short, his view is that there is an inner and an outer spatial world, composed of immaterial elements, whose forces produce in us the appearance of impenetrable bodies. In a similar way, W. Ostwald, taking advantage of the abstraction of energy from bodies having the power of doing work on one another, concludes that energy is immaterial, and nature consists of immaterial energy. HIe neglects the facts, that the mass included in energy is known to us only as mass of body, that aU we know about any energy has been discovered from bodies, and that all the elements of bodies known to us are more elementary bodies. This last is the fact neglected in the analysis of the material into the immaterial from Leibnitz to the present day. The original cause of error was the Pythagorean fancy that the " one " is the origin of all things. But everything known to us is, as Aristotle said, an individual substance, one as undivided not as indivisible ; and some substances are bodies. We attend for simplicity to the undividedness of a body, or to its position, or to a central position in it, or to its power of doing work ; but we have no evidence that a monad, or a point, or a centre of force, or an energy, has any reality distinct from a body.~~

~~(5) Fechner and Paulsen. — Fechner (1801-1887) afEords a conspicuous instance of the idealistic tendency to myste- rize nature in his Panpsychism, or that form of noumenal idealism which holds that the universe is a vast commun- ion of spirits, souls of men, of animals, of plants, of earth and other planets, of the sun, all embraced as dif- ferent members in the soul of the world, the highest spirit — God, in whom we live and move and have our being ; that the bodily and the spiritual, or the physical and the psychical, are everywhere parallel processes which never meet to interact ; but that the difference between them is only a difference between the outer and inner aspects of one identical psychophysical process ; and yet that both sides are not equally real, because, whUe psychical and physical are identical, the psychical is what a thing really is as seen from within, the physical is what it appears to be to a spectator outside ; or spirit is the self- appearance of matter, matter the appearance of one spirit to another. Fechner's panpsychism has a certain affinity both to Stahl's animism and to the hylozoism of material-~~

~~ists such as Haeckel. But, while it differs from both in denying the reality of body, it differs from the former in extending conscious soul not only to plants, as Stahl did, but to all nature ; and it differs from the latter in the different consequences drawn by materialism and idealism from this universal animism. According to Haeckel, matter is the universal substance, spirit its imiversal attribute. According to Fechner, spirit is the universal reality, matter the universal appearance of spirit to spirit; and they are identical because spirit is the reality which appears. Hence Fechner describes himself as a twig fallen from Schelling's stem. The religious feeling inspired by his clerical parentage and his pursuit of natural science, of which he was at first a professor, inclined him to the theosophical author of the Natur- philosophie. It was Schelling's adherent Oken who by his Leiirbuch der Naturphilosophie conveyed to his mind j the life-long impression that God is the universe and nature God's appearance. At the same time, while accepting the Schellingian parallelistic identity of all things in God, Fechner was restrained by his accurate knowledge of physics from the extravagant construction of Nature, which had failed in the hands of Schelling and Hegel. Besides, he was deeply impressed by the fact of man's personality and by the problem of his personal immortality, which brought him back through Schelling to Leibnitz, whose Monadologie throughout maintains the plurality of monadic souls and the om-~~

~~nipresence of perception, sketches in a few sections (§§ 23, 78-81) a panpsychic parallelism, though without identity, between bodily motions and psychic percep- tions, and, what is most remarkable, already uses the conservation of energy to argue that physical energy pursues its course in bodies without interacting with souls, and that motions produce motions, perceptions produce perceptions. Leibnitz thus influenced Fechner, as in other ways he influenced Lotze. Both, however, ■used this influence freely ; and, whereas Lotze used the Leibnitzian argument from indivisibility to deduce in- divisible elements and souls, Fechner used the Leibnitz- ian hypotheses of universal perception and parallelism of motions and perceptions, in the light of the Schel- lingian identification of physical and psychical, to evolve a world-view (Weltansicht) containing something which was neither Leibnitz nor Schelling. Fechner's first point was his panpsychism. Emphasizing the many real analogies between~~

~~*physical and mental agency, but under- rating the much stronger evidences that all the mental operations of men and animals require a nervous system, he flew to the paradox that soul is not limited to men and animals, but extends to plants, to the earth and other planets, to the sun, to the world itself, of which, accord- ing to him, God is the world-soul. In this doctrine of universal animation he was like Leibnitz, yet very different. Whereas Leibnitz confined a large area of the world to wholly unconscious perceptions, and therefore preferred to call the souls of inorganic beings " Entelechies," Fech- ner extended consciousness to the whole world ; and accordingly, whereas Leibnitz believed in a supramundane Creator, " au dessus du Monde " and " dans le Monde," Fechner, in the spirit of Schelling, identified God with the soul of the world. Fechner's second point was that, throughout the animated universe, physical processes accompany psychical processes without interaction. In this panpsychistic parallelism he was again like Leibnitz, and he developed his predecessor's view, that the conser- vation of energy prevents interaction, into the supposition that alongside the physical there is a parallel psychical conservation of energy. Here, again, he went much fur- ther than Leibnitz, but along with Schelling, in identify- ing the physical and the psychical as outer and inner sides of the same process, in which the inner is the real and the outer the apparent. Fechner's third point carried him beyond all his predecessors, containing as it does the true originality of his " world-view." He advanced the ingen- ious suggestion that, as body is in body and all ultimately in the world-body, so soul is in soul and all ultimately in the world-soul. By this means he explained immor- tality by supposing that in this life every man, accord- ing to his works, fashions himself a higher body which is as much of the common body of the earth as he has developed in this life, and that death is only the con- tinuation of the life of the soul with higher powers in this higher body of the earth, and, if the earth fell into the sun, then in the still higher body of the sun ; while the soul throughout is interwoven with other spirits in the highest spirit of the world, or God. By the same means he vindicated our personality, on the ground that each spirit is a different member of the same great spirit, and that in a future state the new body is a continuation of the old body, and the new soul of the old soul, by an eternal conservation of the energy of both. Fechner's fourth point was connected with this inclusion of personal spirits in higher spirits and in*~~

~~the highest. It is his so-called " synechological view " of the soul. Herbart and Lotze, both deeply affected by the Leibnitzian hypothesis of indivisible monads, supposed that man's suul is seated at a central point in the brain ; and Lotze supposed that this supposition is necessary to explain the unity of~~

~~consciousness. Fechner's supposition was that the unity of consciousness belongs to the unity of the whole body ; that the seat of the soul is the living body ; that the soul changes its place as in different parts a process rises above the "threshold of consciousness"; and that soul is not substance but the single psychical life which has its physical manifestation in the single bodily life. Applying this " synechological view" to the supposed inclusion of soul in soul, he deduced the conclusion that, as here the nature of one's soul- is to unite one's little« body, so hereafter its essence will be to unite a greater body, while God's spirit unites the whole world by His omnipresence ; and he pertinently asked, in opposition to the " punctual " view, whether God's soul is centred in a point. Lastly, the whole of this " world-view " was de- veloped by Fechner in early life, under the influence of his religious training, and out of a pious desire to under- stand.those main truths of Christianity which teach us that we are children of God, that this natural body will become a spiritual body, and that, though we are differ- ent individual members, we live and move and are in God : " in Deo vivilnus, movemus, et sumus." It is im- portant to notice that Fechner maintained this " world- view" in a little book. Das Bilchlein vom Leben nach dem Tode, which he originally published in 1836 under the pseudonym of Dr Mises, but which he afterwards repub- lished in his own name in 1866, and again in 1887, as a sketch of his Weltansicht. Afterwards in Nanna (1848) he discussed the supposed souls of plants, and in Zenda- vesta (1851) the supposed souls of the earth and the rest of the world. Then in 1855 he published his Atomenlehre, partly founded on his physics, but mainly on his meta- physics. Under the influence of Leibnitz, Boscovich, Kant, and Herbart, he supposed that bodies are divisible into punctual atoms, which are not~~

~~*bodies, but centres of forces of attraction and repulsion ; that impenetrability is a result of repulsive force ; and that force itself is only law — taking as an instance that Newtonian force of attraction whose process we do not understand, and neg- lecting that Newtonian force of pressure and impact whose process we do understand from the collision of bodies already extended and resisting. But, in thus adapting to his own purposes the Leibnitzian analysis of material into immaterial, he drew his own conclusions according to his own metaphysics, which required that the supposed centres of force are not Leibnitzian " monads," nor Herbartian "■ reals," nor divine modifications such as Lotze afterwards supposed, but are elements of a system which in outer aspect is bodily and in inner aspect is spiritual, and obeying laws of spirit. At the same time, his synechological view prevented him from saying that every atom has a soul, because according to liiui a soul always corresponds to a unity of a physical manifold. Thus his metaphysics is Leibnitzian like that of Lotze, and yet is opposed to the most characteristic feature of monadology — the percipient indivisible monad.*~~

~~*In 1860 appeared Fechner's Eleynente der Psycliophysik, a work which has deeply affected recent psychology, and almost revolutionized recent metaphysics of body and soul, and of physical and psychical relations generally. It becomes necessary, therefore, to determine how far Fechner derived his psychophysics from experience, how far from fallacies of inference, from his romantic imagi- nation and from his theosophic metaphysics, which indeed coloured his whole book on psychophysics. At the very outset he started with his previous metaphysical hypothesis of parallelistic identity without interaction. He now compared the si)iritual and bodily sides of a man to the concave and convex sides of a circle, as inner and outer sides of the same process, which is psychical- as viewed from within and physical as viewed from without.*~~

~~*He also maintained throughout the book that physical and psychical energy do not interfere, but that the psychical is, like a mathematical quantity, a function of the physical, depending upon it, and vice versd, only in the sense that a constant relation according to law exists, such that we may conclude from one to the other, but without one ever being cause of the other. By his psycophysics he meant the exact doctrine of the*~~

relations of dependency between physical and psychical. _ The name was new, but not the doctrine. From antiquity men had applied themselves to determine the relations between the physical stimuli and the so-called " quality " of sensations ; and especially in acoustics the Pythago- reans showed that the lengths of strings, and the mod- erns that the vibrations of air, vary in a geometrical ratio as the height of audible sounds varies in an arith- metical progression, or that musical intervals are propor- tional to the logarithms of the ratios of the vibrations, or of the lengths of vibrating strings. But what was new in the 19th century was the application of this doctrine to the relations between the stimuli and the so-called " intensity " of sensations. By experiments on touch in 1849 E. H. Weber showed that in lifting weights the increase in weight of stimulus necessary to produce a sensible difference of intensity between two tactile sensa- tions is not a constant quantity, but varies with the pre- vious stimulus so as to be always a constant fraction of the previous stimulus. Thus, if an increase from 40 to 41 grammes produced a sensible difference, it required an increase from 80 to 82, from 400 to 410, from 800 to 820, to produce these higher sensible differences; or always ^ij- of the previous stimulus. Thereupon Fechner, incited by a hypothesis which occurred to him in 1850, discov- ered by a great number of experiments, conducted in most methodical ways, that Weber's law, as he called it after the name of his master, admits of being generalized to all the senses, but that the constant function of the previous stimulus is different for different senses : in sound, in light only y, and so forth. Hence he gen- eralized Weber's law in the form that sensation generally increases in intensity as the stimulus increases by a con- stant function of the previous stimulus ; or increases in an arithmetrical progression as the stimulus increases in a geometrical ratio ; or increases by addition of the same anvount as the stimulus increases by the same multiple; or increases as the logarithm of the stimulus. This law of the measure of sense Fechner called the Jfassformel ; and as Herbart had called the least stimulus necessary to conscious sensation the '• threshold," so Fechner called the least difference of stimulus necessary to conscious difference of sensation the " difference-threshold," which, according to the law, is always a constant fraction of the previous stimulus for any one sense. There are then, at least within the limits of moderate sensations, concomi- tant variations between stimuli and sensations, not only in "quality," as in the

~~intervals of sounds, which were un- derstood long ago, but also in " intensity " ; and the dis- covery of 1 the latter is the importance of Weber's and Fechner's law. By the rules of induction from concomi- tant variations, we are logically bound to infer the realis- tic conclusion that outer physical stimuli cause inner sensations of sensible effects. But, unfortunately for Fechner, the very opposite conclusion followed from the presuppositions of his parallelistic metaphysics, and from the Leibnitzian view of the conservation of energy, which he was the first in our time to use in order to ai'gue that a physical cause cannot produce a psychical effect, on the ground that physical energy must be exactly replaced by physical energy.~~

~~It is certain that a body does work in the mechanical sense on body, and thereby always causes therein changes~~

~~of motion and configuration or relative position ; and it is very probable that, so far as its energy or working power is diminished by its being resisted, it always causes an increase of energy, so that the amount of energy before and after in the whole system is equiva- lent, so long as we count, besides molar, molecular energy of sound, heat, &c., and both kinetic energy, or power of doing work in virtue of actual motion {e.g., in a body being raised), and potential energy, or power of doing work in virtue of configuration with potential motion (e.g., in a body having been raised to a position from which it can fall). But, as Clerk Maxwell remarked, we do not know that all changes are in configuration and motion, or that all energy must be either potential or kinetic. HIence we cannot say that a body does nothing but work in the mechanical sense, or causes no other changes but those in motion and configuration, even in body. Still less can we say that a body causes no other changes in soul, which, not being a resisting substance, would not diminish the energy of a body acting upon it, and therefore would in any case be affected by a body only in a non-mechanical way. It is true that from the conser- vation, or rather equivalence, of energy, whenever a body does work, we can deduce that probably a change pro- duced, e.g., heat, though not apparently, is~~

really a change either in motion or in configuration ; but this evidence becomes less certain in proportion to our ignorance of the changes in question, and in any case does not prove that there are no other changes produced. Now, changes in a nervous organism are conspicuous instances of this un- certainty. What is a nervous process, and how far is it a change in motion and configuration ? What is a sen- sation ? Is it a nervous process or not, or partly so and partly not ? (cf. Case, Physical Realism, chap. v.). In our uncertainty about the nature of these changes it is open to us to believe in the conservation of energy and yet recognize its limits. A stimulus, exerting as it always does some pressure on the nerves, and causing an internal pressure which we feel by touch, does work on the nerves ; it therefore causes changes in motion and configuration, molar and molecular, in them, though these are very imperfectly understood; and, so far as its own energy is thereby diminished, it probably causes in them an equivalent increase of energy, potential or kinetic, though this sum has not been calculated. But it is quite consistent to contend that the stimulus, at the same time that it causes a nervous change in motion and configuration by work, also causes a sensation which is a different kind of change; that thereupon these mechanical and non- mechanical changes cause further mechanical changes in the brain together with the non-mechanical change of thinking, and these again still further mechanical changes together with non-mechanical volition ; and that finally these mechanical and non-mechanical changes produce changes in the motor nerves, and so forth, without any breach of nervous continuity, and without disturbing the equivalence of mechanical energy, and yet so that the non- mechanical changes of body and soul co-operating com- plicate the result. This contention, no doubt, if it were drawn from mere consistency, would not infer truth. But we have other evidences of its truth ; first, from conscious- ness itself, which assures us that operations with which it interferes, as in writing a book, far outstrip unconscious operations in complexity, by which is not meant mere mechanical energy, of effect ; and, secondly, from experi- ment, the very experiments completed by Fechner himself, which make us practically certain that stimulus and sensation vary so concomitantly that the former produces the latter. We are more certain of this induction from concomitant variations than of any deduction from con- servation of energy to organic change. Yet Fechner

~~refused to draw the only logical conclusion from his own evidence, and in spite of it supposed that physical stimulus only causes physical nervous process, and not sensation. Why ? Partly because he did not understand the limits of the conservation of energy, and partly be- cause of his preconceived metaphysics, which had long condemned him to the fallacy of physical and psychical parallelism without mutual interference.~~

~~Having thus satisfied himself in what he called " outer psycophysics " that the stimulus causes only the nervous process and not sensation, he passed to what he called " inner psychophysics," or the theory of the relation between nervous and psychical processes. He rightly argued against the old theory that the continuity of nervous processes in the brain is interrupted by men- tal processes of thought and will : there is a nervous process for every mental process. But two questions then arose. What is the relation between nervous pro- cess and sensation ? What causes sensation ? The first question he answered from his imagination by supposing that, while the external world is stimulus of the nervous process, the nervous process is the imme- diate stimulus of the sensation, and that the sensation increases by a constant fraction of the previous stim- ulus in the nervous system, when Weber's law only proves that it increases by a constant fraction of the previous stimulus in the external world. The second ques- tion he answered from his parallelistic metaphysics by deducing that even within the organism there is only a constant dependency of sensation on nervous process- without causation, because the nervous process is physi- cal but the sensation psychical. This answer supposed that the whole physical process from the action of the external stimulus on the nervous system to the reac- tion of the organism on the external world is one series, while the conscious process beginning with sensation is only parallel and as it were left high and dry. What then is the cause of the sensation ? Huxley, it will be remembered, in similar circumstances, answered this question by degrading consciousness to an epiphenome- non, or bye-product of the physical process. Fechner was saved from this absurdity, but only to fall into the greater absurdity of his own panpsychism. Hav- ing long assumed that the whole world is animated throughout, and that there are always two parallel series, physical and psychical, he concluded that, while a physical stimulus is causing a physical nervous process, a psychical accompaniment of the~~

stimulus is causing the sensation, which, according to him, is the psychical accompaniment of the nervous process ; and that, as the whole physical and the whole psychical series are the same, differing only as outer and inner, this identity holds both of stimulus and its psychical accompaniment and of nervous process and its accompanying sensation. Accordingly, he calls these and all other processes " psychophysical " ; and as he recog- nized two parallel energies, physical and psychical, differ- ing only as outer and inner aspects of the same energy, he called this "psychophysical energy." In such a philosophy all reality is " psychophysical." At the same time Fechner would not have us suppose that the two sides are equal ; according to him, the psychical, being the psychophysical viewed from within, is real, the physical, being the psychophysical as viewed from without, is ap- parent ; so in oneself, though nervous process and psy- chical process are the same, it is the psychical which is the reality of which the nervous is mere appearance ; and so everywhere, spirit is the reality, body the appearance of spirit to spirit. Finally, he supposed that one spirit is in another, and all in the highest spirit, God. By this means also he explained unconsciousness. In point of fact, many stimuli are beneath the " threshold " of a

man's consciousness. Leibnitz, in the Nouveaux JEssais, ii. 11, had also said that we have many " petites perceptions," of which we are unconscious, and had further suggested that a perception of which we axe, is composed of a quantity of " petites perceptions " of which we are not, conscious. Proceeding on this suggestion, and misled by the mathematical expression which he had given to Weber's law, Fechner held that a conscious sensation, like its stimulus, consists of units, or elements, by summation and increments of which conscious sensations and their differences are produced ; so that consciousness, according to this unnecessary assumption, emergesf romanintegration of unconscious shocks or tremors. But by the hypothesis of the inclusion of spirit in spirit, he was further able to hold that what is unconscious in one spirit is conscious in a higher spirit, while everything whatever is in the con-

~~sciousness of the highest spirit of God, who is the whole of reality of which the spirits are parts, while the so-called physical world is merely outer appearance of one spirit to another.~~

~~Fechner first confused physics and metaphysics in psychophysics, and next proceeded to confuse them again in his work on evolution (Einige Ideen zur Schopfungs- und Entwickliings-gescliichte der Organismen, 1873). He perceived that Darwinism attributed too much to accident, and was also powerless to explain the origin of life and of consciousness. But his substitute was his own hy- pothesis of panpsychism, from which he deduced a " cosmorganic " evolution from a " cosmorganic " or origi- nal condition of the world as a living organism into the inorganic, by the principle of tendency to stability. The world, as he thought, on its physical side, always was a living body ; and on its psychical side God always was its conscious spirit ; and, so far from life arising from the lifeless, and consciousness from unconscious- ness, the life and consciousness of the whole world are the origin of the lifeless and the unconscious in parts of it, by a kind of secondary automatism, while we ourselves are developed from our own mother-earth by differenti- atiou. By thus supposing a psychical basis to evolution, Fechner, anticipating Wundt, substituted a psychical development of organs for Darwinian accidental variation. Where Darwin would say that a cock has crest and spurs because individuals happened to vary in this advantageous manner, Fechner would suppose, as the inner aspect of the physical organism, a "psychical impulse" (psychische Streben) to fight, predisposing the germs and therewith the oftspring. The difficulty of such speculations is to prove that things apparently dead and mindless are living souls. Their interest to the metaphysician is their opposition to physics on the one hand and to theism on the other. We have nowadays to ask ourselves whether we are to resign our traditional belief that the greater part of the world is mere body, but that its general adaptability to conscious organisms proves its creation and government by God, and to take to the new hypothesis, which, by a transfer of design from God to Nature, supposes that everything physical is alive, and conducts its life by psychical im- pulses of its own. Fechner himself went even farther, and together with design transferred God HImself to Nature. This is the subject of his last metaphysical work. Die Tagesau.ticht gegeniiber der Nachtaihsicht~~

~~*(1879). The " day-view " is the view that God is the psychophysical all-embracing being, the law and consciousness of the world ; as opposed to the " night-view," according to which the world is not throughout psychical, but consciousness appears only transiently in men and animals, while the rest of the world is dark night. The " day-view," which is Fechner's, resembles the views of Hegel and Lotze in its pantheistic tendency. But it does not,"like theirs, sacrifice*~~

~~*our personality ; because, according to Fechner, there is neither one infinite mind with which our mind is identical, nor one infinite active substance of which we are modifica- tions, but one divine consciousness, which includes us as a larger circle includes smaller circles. By this ingenious suggestion of the membership of one spirit in another, Fechner's "day-view" also puts Nature in a different position; neither with Hegel sublimating it to the thought of God's mind, nor with Lotze degrading it to the pheno- mena of our human minds, but identifying it with the outer appearance of one spirit to another spirit in the highest of spirits.*~~

~~*We have dwelt on this curious metaphysics of Fechner because it contains the master-key to the philosophy of the present moment. While he was developing it during the domination of Hegelianism, and the subsequent re- action to materialism, it attracted little notice. But when the later reaction to Kant arose against both Hegelianism and materialism, the nearly contemporary appearance of Fechner's Psycliopliysics began to attract experi- mental psychologists by its real as well as its apparent exactness, and both psychologists and metaphysicians by its novel way of putting the relations between the physical and the psychical in man and in the world. Fechner enjoyed the felicity of seeing psychology deriving advantage from the methods, as well as the results, of his experiments, and of seeing in 1879 the first psychological laboratory erected by Wundt in his own Leipzig. But he had also to endure countless objections to his mathematical statement of Weber's law, to his unnecessary assumption of units of sensation, and to his unjustifiable transfer of the law from physical to physiological stimuli of sensa- tions, involving in his opinion his parallelistic view of body and mind. Among psychologists Helmholtz, Mach, Brentano, Hering, Delboeuf were all more or less against him.*~~

~~Sigwart in his Logic has also opposed the parallelistic view itself ; and James has criticized it from the point of view that the soul selects out of the possibilities of the brain means to its own ends. Nevertheless, largely under the influence of the exaggera- tion of the conservation of energy, many psychologists — Wundt, Paulsen, B.iehl, Jodl, Ebbinghaus, Milnster- berg, and in England Lewes, Clifford, Romanes, Stout — have accepted Fechner's Leibnitzian hypothesis of non- interacting parallelism between stimirli and sensations, nervous-processes and sensations, body and soul ; as far at least as men and animals are concerned. Most stop here, preferring with Wundt to content themselves with this psychological parallelism. But some go with Fechner to the full length of his metaphysical parallelism of the physical and psychical, as psychophysical, throughout the whole world ; and this influence has extended from Germany to Denmark, where it has been embraced by Hoffding, and to England, where it has been accepted by Romanes, and in a more qualified manner as " a working hypothesis " by Stout. But the most thorough and most eloqiient of Fechner's metaphysical disciples is F. Paulsen, who has spread panpsychism far and wide in his well-known Eiideitimg in die PhilosopJiie, published in 1892, and re- published at least seven times since. Here reappear all the characteristic points of Fechner's " world-view " — the panpsychism, the universal parallelism with the identifica- tion of physical and psychical, the inclusion of spirit in spirit, the synechological view of spirit, and the final " day- view" that all reality is spirit, and body the appearance of spirit to spirit. But this is not all : Paulsen tries to supply something wanting in Fechner. Fechner was a psychophysical metaphysician, and a metaphysical psycho- logist, but he troubled himself little about epistemology, and the question — How do we know all these psycho- physical things ? He thought little of Kant's criticism,~~

~~which ended in admitting without explaining things in themselves. Now, the originality of Paulsen consists in trying to supply an epistemological explanation of the metaphysics of Fechner,by reconciling him with Kant~~

and Schopenhauer. He borrows from Kant's « rationalism " the hypothesis of a spontaneous activity of the subject with the deduction that knowledge begins from sense, but arises from understanding ; and he accepts from Kant's metaphysical idealism the consequence that everything we perceive, experience, and know about physical nature, and the bodies of which it consists, is phenomena, and not bodily things in themselves. But he has a different theory of human nature and soul, and so does not accept the Kantian conclusion that things in themselves, in the sense of things beyond phenomena, are all unknowable. On the contrary, his contention is that of Fechner — that all knowable things are inner psychical realities beneath outer physical appearances — the invisible symbolized by the visible. Kant, however, had no epistemology for such a contention, because according to him both outer and inner senses give mere appearance, from which we could not know either body in itself, or soul in itself. Parting, then, from Kant, Paulsen resorts to a paradox which he shares with Pechner and Wundt. He admits, indeed, Kant's hypothesis that by inner sense we are conscious only of mental states, but he contends that this very consciousness is a knowledge of a thing in itself. He agrees with Pechner and Wundt that there is no substantial soul, and that soul is nothing but the mental states, or rather their unity — thus identifying it with Kant's synthetic unity. On this assumption he deduces that in being conscious of our mental states we are conscious of soul not merely as it appears, but as it is in itself, and therefore can infer similar souls, other psychical unities, which are also things in themselves. But what is the essence of this psychical reality which we thus immediately and mediately know '/ Por an answer to this question he appeals from Pechner to Schopenhauer, believing that, while Pechner excels Schopenhauer in his clear insight that the inner world is no explanation of the physical world, Schopenhauer on his side has the advantage of a voluntaristic psychology. Hence he is one of the now numerous band wh^tell us, after Schopenhauer, that will of some sort is the funda- mental fact of mental life. Taking, then, will to be the essential thing in itself of which we are conscious, he deduces that we can infer that the psychical things in themselves beyond ourselves are also essentially " wills." Then combining the central dogma of Pechner that spirit extends throughout the world of bodily appearance, and the central dogma of Schopenhauer that what in idea appears to xis as body is in

~~*itself "will," he concludes that the realities of the world are "wills," that bodies are mere appearances of " wills," and that there is one universal and all-embracing spirit, which is "will." His ultimate metaphysics, then, is this : — Everything is spirit, and spirit is " will." Lastly, he interprets " will " ac- cording to his premisses. By " will " he does not mean "rational desire," which is its proper meaning, but in- applicable to Nature ; nor unconscious irrational will, which is Schopenhauer's forced meaning ; nor unconscious intelligent will, which isHartmann'smorecorrectmeaning, though inapplicable to Nature. What he does mean by " will " is instinct, impulsive feeling, a " will to live," not indeed unconscious, but often subconscious, with- out idea, without reasoning about ends and means, yet pursuing ends — in short, what he calls, after K. E. von Baer, Zielstrebigkeit. In this sense of appetition he makes out everything, which appears as a body, to be really in inner essence a "will." How persistent is ancient animism ! Empedocles, Plato, and Aristotle ;*~~

~~*Telesio, Bruno, and Campanella ; Leibnitz ; the idealists, Schopenhauer and Hartmann, Pechner and Paulsen; and the materialist, Haeckel — all have agreed in accord- ing some sort of appetition to Nature. So prone are men to exaggerate adaptation into aim ! So prone are they to transfer to Nature the part played by the providence of God ! (see Bacon, Be Aiigmentis, iii. 4, sub Jill.).*~~

~~*It would be a mistake to suppose that noumenal idealism is dead in Germany. It died down for a time in the decline of Hegelianism and the rise of materialism. It has since revived. The pure idealism of Pichte is at the bottom of it all. The panlogism of Schelling and Hegel survives in its influence. So still more does the panthelism of Schopenhauer. The three most vital idealisms of the kind at the moment are the panpneumatism of Hartmann, combining Hegel with Schopenhauer ; the panteleologism of Lotze, reviving Leibnitz; and the panpsychism of Paulsen, continuing Pechner, but with the addition of an epistemology combining Kant with Schopenhauer. All these systems of metaphysics, differ as they may, agree that things are known to exist beyond sensible phenomena, but yet are mental realities of some kind. Meanwhile, the natural substances of Aristotelian realism are regarded with common aversion.*~~

~~§ 5. Phenomenal Idealism in Germany.~~

~~Phenomenal idealism is the metaphysics which deduces that, as we begin by perceiving nothing but mental pheno- mena of sense, so all we know at last from these data is also phenomena of sense, actual or possible. So far it is in general agreement not only with Hume, but also with Kant in his first two positions. But it follows Pichte in his revolt against the unknown thing in itself. On the other hand, as the speculative systems of noumenal idealism, starting from Pichte, succeeded one another, like ghosts who "come like shadows, so depart," without pro- ducing conviction, and often in flagrant opposition to the truths of natural science, and when, in consequence, a wave of materialism threatened to submerge mind altogether by reducing it to a function of matter, many philosophers be- gan to despair of the ambitious attempts which had been made to prove that there is a whole world of mind beyond phenomena, as the noumenalists had supposed. Thus they were thrown back on the limits of human knowledge pre- scribed by Kant, but purged of the unknown thing in itself by Pichte. They contented themselves with the result that the world we know is phenomenal, a world of ex- perience (Erf aiming swelf), with no power of reason to infer things beyond phenomena of sense, actual and possible ; and they endeavoured to show that this world of pheno- mena provides a sufficient field for natural science, a suffi- cient vindication of mind against materialism, a sufficient justification of idealism. Phenomenal idealism, in short, is the Kantian contention that Nature, as known to science, is phenomena of experience. Unfortunately, the word "phenomenon " is equivocal (see Mind, xiv. 309). Some- times it is used for any positive fact, as distinguished from its cause ; in this sense everything is a phenomenon, and indeed in this sense Aristotle spoke of God's intelligence as the divinest of phenomena. But sometimes also it means what appears, or can appear, to the senses, as dis- tinguished from what does not appear, but can be inferred to exist. Now, Kant and his followers start from this second and narrower meaning, and usually narrow it still more by assuming that what appears to the senses is as mental as the sensation, being undistinguishable from it or from the idea of it, and that an appearance is a m ental idea (Vbrstellung) of sense ; and then they conclude that we can know by influence nothing but such~~

mental appearances, actual and possible, and therefore nothing beyond sensory

experience. When, on the other hand, the objects of science are properly described as phenomena, what is meant is not this pittance of sensible appearances, but positive facts of all kinds, whether perceptible or imperceptible, whether capable of being experienced or of being inferred from, but beyond, experience, e.g., the farther side of the moon which, as the moon only rotates once in a revolu- tion, is always turned away from a spectator on the earth, from his senses, from his experience, actual or possible, and yet is known to exist by inference. Hence the doc- trine of Kant, that Xature as known to science is phe- nomena, means one thing in Kantism and another thing in science. In the former it means that Nature is men- tal phenomena, ■ actual and possible, of sensory experi- ence ; in the latter it means that Nature is positive facts, either experienced or inferred. It is most important also to notice that Kantism denies, but science asserts, the logical power of reason to infer actual things beyond experience. But the phenomenal idealists have not, any more than Kant, noticed the ambiguity of the term " phenomenon " ; they fancy that, in saying that all we know is phenomena in the Kantian sense of mental appearances, they are describing all the positive facts that science knows ; and they follow Kant in supposing that there is no logical inference of actual things beyond experience.

(1) The Reaction to Kant. — The reaction to Kant (" Zuriick zu Kant ! ") was begun by 0. Liebmann in Kant und die Epigonen (1865), and expressed in his often-quoted words, "Es muss auf Kant zurilckgegangenwerden." Im- mediately afterwards, in 1866, appeared Lange's Geschichte des Materialismus. In 1870 J. B. Meyer published his Kant's Psydiologie, and in 1871 H. Cohen his more im- portant Kant's Theorie der Erfahrung, which led Lange to modify his interpretation of Kant in the second edition of his own book. Lange (1828-1875) by his History of Materialism has exercised a profound influence, which is due partly to its apparent success in answering materialism by Kantian

~~arguments, and partly to its ingenious attempt to give to Kantism itself a consistency, which, however, has only succeeded in producing a new philosophy of Neo-Kantism, differing from Kantism in modifying the d, priori and rejecting the thing in itself. Lange to some extent modified the transcendentalism of Kant's theory of the origin of knowledge. A priori forms, according to Kant, are contributions of the mental powers of sense, understanding, and reason ; but, according to Lange, they are rooted in " the physico-psychical organization." This modification was the beginning of a gradual lessening of the antithesis of A priori to d posteriori, until at last the h priori forms of Kant have been transmuted into " auxiliary conceptions," or "postulates of experience." But this modification made no difference to the Kantian and Neo-Kantian deduction from the epistemological to the metaphysical. Lange entirely agreed with Kant that d, priori forms can have no validity beyond experience when he says, "Kant is at any rate so far justified as the principle of intuition in space and time A jyriori is in us, and it was a service to all time that he should, in this first great example, show that what we possess d p>riori, just because it arises out of the disposition of our mind, beyond our experience has no longer any claim to validity " {Hist, of 3f~~

~~hands of the idealist — an answer which would be com- plete if it did not turn on the equivocation of the word " phenomenon," which in science means any positive fact, and not a mere appearance, much less a mental appear- ance, to sense and sensory experience. Having, however, made a deduction, which is at all events consistent, that on Kantian assumptions all we know is mental phenomena, Lange proceeded to reduce the rest of Kantism to con- sistency. He saw that if all logical inference is limited to mental phenomena of experience, we can form ideas of things beyond, but not know corresponding realities. Consequently he retracted Kant's admission that the thing in itself is something existing though unknowable. He regarded the thing in itself as a mere idea of limit, a limitative idea, an ideal, which we must conceive as a necessary outcome of our organization — but that is all ; and when Cohen, taking advantage of some passages in which Kant speaks of the thing in itself as the idea of pheno- mena under the conception of an object in general, had, like Fichte before him, contended that this was all Kant had really meant, Lange, in his second edition, adopted this interpretation, and contended~~

~~*that the thing in itself is, and was meant by Kant to be, a mere idea. But his ardent love of consistency led him far away from Kant in the end ; for he proceeded consistently from the as- sumption, that whatever we think beyond mental pheno- mena is ideal, to the logical conclusion that in practical matters our moral responsibility cannot prove the reality of a noumenal freedom, because, as on Kant's assumption we know ourselves from inner sense only as phenomena, we can prove only our phenomenal freedom. Lange thus transmuted inconsistent Kantism into a consistent Neo- Kantism, consisting of these reformed positions : (1) we start with sensations in d priori forms ; (2) all things known from these data are mental phenomena of experi- ence; (3) everything beyond is idea, without any cor- responding reality being knowable. "The intelligible world," he concluded, "is a world of poetry." Our reflection is that there is a great difference between the essence and the consistency of Kant's philosophy. Its essence, as stated by Kant, was to reduce the logical use of reason to mental phenomena of experience in specular tion, in*irder to extend the practical use of reason to the real noumena, or things in themselves, required for morality. Its consistency, as deduced by Lange, was to reduce all use of reason, speculative and practical, to its logical use of proceeding from the assumed mental data of outer and inner sense, arranged d priori, to mental phenomena of experience, beyond which we can conceive ideas but postulate nothing. As H. Vaihinger, himself a profound Kantian of the new school, says, "Critical scepticism is the proper result of the Kantian theory of knowledge."*~~

~~*There is only one Neo-Kantian way out of this dilemma, but it is to alter the original assumptions of Kant's psychological idealism. This is the alternative of A. Riehl, who in Der philosophisclie Kriticismns (1876, &c.) proposes the non-Kantian hypothesis that, though things in themselves are unknowable through reason alone, they are knowable by empirical intuition, and therefore also by empirical thought starting from intuition ; or, in other words, that we have an immediate perception of an exter- nal world. Like all true followers of Kant, Eichl prefers epistemology to metaphysics; and indeed wishes to avoid metaphysics, but really proceeds to found a metaphysics on epistemology, which he calls "critical realism," so far as it asserts a knowledge of things beyond phenomena, and " critical monism," so far as it holds that these things are unlike both*~~

~~physical and psychical phenomena, but are nevertheless the common basis of both. He starts by accepting the Kantian positions that unity of conscious-~~

~~ness combines sensations by d, iwiori synthesis, and that therefore all that natural science knows about matter moving in space is merely phenomena of outer sense ; and he agrees with Kant that from these data we could not infer things in themselves by reason. But his point is that the very sensation of phenomena or appearances implies the things which appear. " Sensory knowledge," he says, "is the knowledge of the relations of things through the relations of the sensations of things." Further, holding that, "like every other perception, the perception of a human body immediately involves tlae existence of that body," and, like Fichte, believing in a "common consciousness," he concludes that the evidence of sense is verified by " common consciousness" of the external world as objective in the Kantian sense of universally valid. He interprets the external world to be the common basis of physical and psychical phenomena, and so far his " critical realism" reminds lis of Trendelenburg's "Liickentheorie" and Dtihring's " Wirklichkeitsphilosophie." But whereas Trendelenburg thought that motion is common to thought and being, and Duhring thinks that matter underlies all bodily and mental states, lliehl's view is different, and is founded on his interpretation of Kant. He rightly relies on the numerous passages, neglected by Lange, in which Kant regards things in themselves as neither phenomena nor ideas, but things existing beyond both. But his main reliance is on the passage in the Kritik, where Kant, speaking of the Cartesian difficulty of communication between body and soul, suggests that, however body and soul appear to be different in the phenomena of outer and inner sense, what lies as thing in itself at the basis of the j)henomena of both may perhaps be not so heterogeneous (ungleichartig) after all. Riehl elaborates this bare sug- gestion into the metaphysical theory that the single basis of physical and psychical phenomena is neither bodily nor mental, nor yet space and motion. In order to establish~~

~~*this paradox of "critical monism," he accepts to a certain extent the psychophysical philosophy of Fechner. He agrees with Fechner that physical process of nerve and psychical process of mind are really the same psychophysical process as appearing on the one hand to an observer and on the other hand to one's own consciousness ; and that physical phenomena only produce physical phenomena, so that those materialists and realists are wrong who say that physical stimuli produce sensa- tions. But whereas Fechner and Paulsen hold that all physical processes are universally accompanied by psy- chical processes which are the real causes of psychical sensations, Eichl rejects this paradox of universal paral- lelism in order to fall into the equally paradoxical ^lypothesis that something or other, which is neither physical nor psychical, causes both the physical phenomena of matter moving in space and the psychical phenomena of mind to arise in us as its common effects. In supposing a direct perception of such a nondescript thing, he shows to what straits idealists are driven in the endeavour to supplement Kant's limitation of knowledge to phenomena by some sort of knowledge of things.*~~

~~*(2) The Reaction to Hume. — When the Neo-Kantians, led by Lange, had modified Kant's hypothesis of d imori forms, and retracted Kant's admission and postulation of things in themselves beyond phenomena and ideas, and that too without proceeding farther in the direction of Fichte and the noumenal idealists, there was not enough left of Kant to distinguish him essentially from Hume. For what does it matter to metaphysics whether by association sensations suggest ideas, and so give rise to ideas of substance and causation d. posteriori, or synthetic unity of consciousness combines sensations by d priori. notions of substance and causation into objects which are merely mental phenomena of experience, when it is at*~~

~~*once allowed by the followers of Hume and Kant alike that reason in any logical use has no power of inferring things beyond the experience of the reasoner ? In either case, the effective power of inference, which makes us rational beings, is gone. Xaturally then the reaction to Kant was followed by a second reaction to Hume, partly under the name of "Positivism," which has attracted a number of adherents, such as C.*~~

~~*Goring and E. Laas, and pai-tly under the name of the "Physical phenomenology" of E. Mach.*~~

~~*G. Goring (1841-1S79), author of an incomplete System der Kritischen Philosophie (1874-1875), recalled Hume's sensationalism by saying that the origin of all knowledge is in sense and no knowledge is possible beyond experience. E. Laas (1837-1885) signalized himself in A'cH/i's yljioiog'ien der Erfahrung (1876) by his keen criticism of Kant's trans-cendentalism, and in his later IdeaUsmus mid Positivismus (1879, &c.) by his clear contrast between Platonism, from which he derived transcendentalism, and Positivism, of which he considered Protagoras to have been the founder. Under the head of Platonism he condemned all belief in mathematical method, in absolute principles, in drpriorism, in freedom, and in the transcendent ; while Protagoreanism seemed to him to contain three great truths — the insepa- rability of subject and object, the concomitant variability of both, and the reduction of all higher processes to sensation. He thought that the mantle of Protagoras had descended to Hume and Mill. Now, it is true that the ancient sophistry of Protagoras has issued in the modern sensationalism of Hume, the positivism of Comte, the relativism of Mill, and the universal relativism or correlativism of Laas. Indeed, all these views are varieties of scepticism. Nevertheless, we must not con- fuse ancient and modern scepticism. Though both asserted a relativity of object and subject, Protagoras thought that there are two different but accompanying streams, the stream of matter and the stream of sense, whereas Hume and Mill positively identified matter with sensations. Now, Laas appealed to Protagoras ; but in reality he was, a disciple of Hume. So again, if we are to call him a positivist because he believed in nothing but phenomena, we must remember the equivo- cation of the term " phenomenon." Laas was not so near to the positivism of Comte, who said that the mind can observe all phenomena but its own, as to the psychological positivism of Mill, who thought that it has no other phenomena to observe.*~~

~~*E. Mach (b. 1838) is a conspicuous instance of a con- fusion of physics and psychology ending in a scepticism like that of Hume. He tells us how from his youth he pursued physical and psychological studies, how at the age of fifteen he read Kant's Prolegomena, and two or three years later*~~

rejected the thing in itself, and came to the conclusion that the world with his ego is one mass of sensations. For a time, under the influence of Fechner's PsycJiophysics, he thought that Nature has two sides, a physical and a psychological, and added that all atoms have feeling. But in the progress of his physical work, which taught him, as he thought, to distinguish between what we see and what we mentally supply, he soon passed from this noumenalism to a "universal physical phenomenology," which still remains his philosophy. It retains some relics of Fechner's influence ; first, the theory of identity, according to which the difference between the physical and psychical is not a dualism, but everything is at once both; and secondly, the substitution of mathematical dependence for physical causality, except that, whereas Fechner only denied causality between physical and psychical, Mach rejects the entire distinction between causality and dependence, on the ground that " the law of causality simply asserts that the phenomena of Nature

are dependent on one another." He comes near to Hume's substitution of succession of phenomena for real causality. He holds, like Hume, that nothing is real except our sensations and complexes of sensory elements ; that the ego is not a deiinite, unalterable, sharply bounded unity, but its coptinuity alone is important; and that we know no real causes at all, much less real causes of our sensations ; or, as he expresses it, bodies do not produce sensations, but complexes of sensations form bodies. If he has auy originality, it consists in substituting for the association of ideas the " economy of thinking," by which he means that all theoretical conceptions of physics, such as atoms, molecules, energy, &c., are mere helps to facilitate our consideration of things. But he limits this power of mind beyond sensa- tions to mere ideas, and like Hume, and also like Lange, holds at last that, though we may form ideas beyond sensations or phenomena, we cannot know things. If we ask how INLach arrived at this scepticism, which is contained in his well-known scientific work on the His- tory of Mechanics (Die Meclianik in Hirer Eiitwkkelung, 1883) as

~~well as in his psychological work on the Analysis of Sensations (Beitrage zur Analyse der Empfin- dungen, 1886), we find two main causes, both psychologi- cal and epistemological ; namely, his views on sense and on inference. In the first place, he displays in its most naked form the common but unproved idealistic paradox of a sense of sensations, according to which touch appre- hends not pressure but a sensation of pressure, sight apprehends not colour but a sensation of colour, and there is no difference between touch and pressure felt, between vision and colour seen, or between the sensory operation and the sensible object apprehended by any sense, even within the sentient organism. Hence, ac- cording to him, sensations are not apprehensions of sensible objects {e.g., pressures felt) from which we infer similar objects beyond sense {e.g., similar pressures of outside things), but are the actual elements out of which everything known is made; as if sensations were like chemical elements. "Within the limits of these supposed sensory elements he accords more than many psycholo- gists do to sense; because, following the nativists, Johannes Mtiller and Hering, he includes sensations of time and space, which, however, are not to be regarded as " pure intuitions " in the style of Kant. But here again he identifies time and space with the sensations of them, which he calls time-sensations (Zeitempjindimgeri) and space-sensations {Rmimempfindungen). On the assump- tion, then, that time and space are not objects, but sys- tems, of sensations, he concludes that a body in time and space is " a relatively constant sum of touch-and-light- sensations, joined to the same time-and-space-sensations," that each man's own body is included in his sensations, and that to explain sensations by motions would only be to explain one set of sensations from another. In short, according to Mach sensations are elements and bodies complexes of these elements. Secondly, his theory of inference contains the admission that we infer beyond sensations : he remarks that the space of the geometer is beyond space-sensations, and the time of the physicist does not coincide with time-sensations, because it uses measurements such as the rotation of the earth and the vibrations of the pendulum. But by inferc^nce beyond sense he does not mean a process of concluding from sen- sible things to similar things, e.g., from tangible pressures to other similar pressures in the external world. Infer- ence, according to him, is merely mental completion of sensations; and this mental completion has two character- istics : it only forms ideas, and~~

~~*it proceeds by an " econ- omy of thought." In the course of his learned studies on the History of Mechanics he became deeply impressed*~~

~~*with Galileo's appeals to simplicity- as a test of truth. Galileo, for instance, recommended his discovery of the law of the uniform acceleration of a falling body as the " simplest and most natural." But unfortunately he had previously said the same thing about his first and false , hypothesis that the uniform acceleration is directly pro- portional to the space ; and, when he resigned the false for the true hypothesis that it is directly proportional to the time, his real evidence was not simplicity, but his carefully conducted experiments of letting bodies fall down inclined planes, and measuring the time by the flow of water. Mach, however, oblivious to these distinctions, converts what is at best only one characteristic of think- ing into its essence. Generalization, for instance, which essentially consists in inferring that all similar things of a kind have the attributes of particular instances, does also abbreviate thought by embracing all instances in a universal ; but Mach supposes that it essentially consists in this mere economy, and that only an economy of con- ception, without arriving at true beliefs about things. According to him, whatever inferences we make, certain or uncertain, are mere economies of thought, adapting ideas to sensations, and filling out the gaps of experience by ideas ; whatever we infer, whether bodies, or mole- cules, or atoms, or space of more than three dimensions, are all without distinction equally provisional concep- tions, things of thought ; and " bodies or things are com- pendious mental symbols for groups of sensations — sym- bols which do not exist outside thought." Moreover, he applies the same scepticism to cause and effect. " In Nature," says he, " there is no cause and no effect." He thinks that repetitions of similar conjunctions occur in Nature, the connexion of cause and effect only in abstrac- tion. He refers to Hume as recognizing no causality but only a customary and habitual succession, but adds that Kant rightly recognizes that mere observation cannot teach the necessity of the conjunction. But in reality his theory is neither Hume's theory of association nor Kant's of an h, priori notion of understanding under which a given case is subsumed. He thinks that there is a notion of understanding (Verstandesbegriff), under which every new experience is subsumed, but that it has been devel- oped by former experience, instinctively, and by the*~~

~~de- velopment of the race, as part of the economy of thinking. "Cause and effect are therefore," he concludes, "thought- things of economical function {Gedankendinge von okono- mischer Function)." HIs philosophy, therefore, is that all known things are sensations and complexes of sensory elements, supplemented by an economy of thinking which cannot carry us beyond ideas to real things, or beyond relations of dependency to real causes.~~

~~It is important to understand that jMach had developed this economical view of thought in 1872, or more than ten years before the ap})earance of his work on the HIstory of Mechanics in 1883, as he tells us in the preface, where he adds that at a later date similar views were expressed by Kirchhoff in his Vorleswigen iiber Mathematische Physik (1874). Kirchhoff asserted that the whole object of me- chanics is "to describe the motions occurring in Nature completely in the simplest manner." This view involves the denial of force as a cause, and the assertion that all we know about force is that the acceleration of one mass de- pends on that of another, as in mathematics a function de- pends on a variable ; and that even Newton's third law of motion is merely a description of the fact that two material points determine in one another, without reciprocally caus- ing, opposite accelerations. It is evident that Kirchhoff's descriptive is the same as Mach's economical view. " When I say," says Mach, " that a body A exerts a force on a body B, I mean that B, on coming into contraposition with A, is immediately affected by a certain acceleration with~~

~~respect to A." In a word, Mach and KirchhofE agree that force is not a cause, convert Newtonian reciprocal action into mere interdependency, and, in old terminology, reduce mechanics from a natural philosophy of causes to a natural history of mere facts. Now, Mach applies these preconceived opinions to " mechanics in its development," with the result that, though he shows much skill in mathematical mechanics, he misrepresents its development precisely at the critical point of the~~

~~*discovery of Newton's third law of motion, "Action! contrariam semper et aequalem esse reactionem."*~~

~~*The order of discovery, recorded in the PldlosopMcal Transactions of the Royal Society, was as follows : —*~~

~~*(a) Sir Christopher Wren made many experiments before the Eoyal Society, which were afterwards re- peated in a corrected form by Sir Isaac Newton in the Principia, experimentally proving that bodies of ascertained comparative weights, when suspended and impelled against one another, forced one another back by impressing on one another opposite changes of velocity inversely as their weights and therefore masses ; that is, by impressing on one another equal and opposite changes of momentum.*~~

~~*(&) Wallis showed that such bodies reduce one another to a joint mass with a common velocity equal to their joint momentum divided by their joint weights or masses. This result is easily deducible also from Wren's discovery. If m and ml are the masses, v and v' their initial velocities, and V the common velocity, then*~~

~~*m(v — V) =m'(V — b') .•. mi) | m'i;'=(m+m')V*~~

~~*mv+m'v' m+m'*~~

~~*=V.*~~

~~*(c) Wren and Huyghens further proved that the law of equal action and reaction, already experimentally established by the former, is deducible from the con- servation of the velocity of the common centre of gravity, which is the same as the common velocity of the bodies ; that is, deducible from the fact that their common centre of gravity does not change its state of motion or rest by the actions of the bodies between themselves ; and they further extended the law to bodies, qua elastic.*~~

~~*(d) Hence, first inductively and then deductively, the third law was originally discovered only as alaw of collision or impact between bodies of ascertained weights and therefore masses, impressing on one another*~~

~~*equa,l and opposite changes of momentum, and always reducing one another to a joint mass with a common velocity to begin with, apart from the subsequent effects of elasticity.*~~

~~*(e) Newton in the Principia, repeating and correcting Wren's experiments on collision, and adding further instances from attractive forces of magnetism and gravity, induced the third law of motion as a general law of all forces.*~~

~~*This order of discovery shows that the third law was generalized from the experiments of Wren on bodies of ascertained comparative weights or masses, which are not material points or mass-points. It shows that the bodies impress on one another opposite changes of velocity in- versely as their weights or masses ; and that in doing so they always begin by reducing one another to a joint mass with a common velocity, whatever they may do afterwards in consequence of their elasticities. The two bodies there- fore do not penetrate one another, but begin by acting on one another with a force precisely sufficient, instead of penetrating one another, to cause them to form a joint mass with a common velocity. Bodies then are triply extended substances, each occupying enough space to prevent mutual penetration, and by this force of mutual impenetrability or inter-resistance cause one another to form a joint mass*~~

~~*with a common velocity whenever they collide. Withdraw this foundation of bodies as inter-resisting forces causing one another in collision to form a joint mass with a common velocity but without penetration, and the evidence of the third law disappears ; for in the case of attractive forces we know nothing of their modus operandi except by the analogy of the collision of inter-resisting bodies, which makes us believe that something similar, we know not what, takes place in gravity, magnetism, electricity, &c. Now, Mach, though he occasionally drops hints that the discovery of the law of collision comes first, yet never explains the process of development from it to the third law of motion. On the contrary, he treats the law of collision with other laws as an application of the third law of motion, because it is now unfortunately so taught in books of mechanics. He has therefore lost sight of the truths that bodies are triply extended, mutually impenetrable substances, and by this force causes which reduce*~~

one another to a joint mass with a common velocity on collision, as for instance in the ballistic pendulum ; that these forces are the ones we best understand; and that they are reciprocal causes of the common velocity of their j oint mass, whatever happens afterwards. In the case of this one force we know far more than the interdependence supposed by Mach and Kirchhoif ; we know bodies with impenetrable force causing one another to keep apart. It might have been expected that scepticism on this subject would not have had much effect. But the idealists are only too glad to get any excuse for denying bodily substances and causes ; and, while Leibnitz supplied them with the fancied analysis of material into immaterial elements, and Hume with the reduction of bodies to assemblages , of sensations, Mach adds the additional argument that bodily forces are not causes at all. In Great Britain, at this moment, Mach's scepticism is welcomed by Karl Pearson to support an idealistic phenomenalism derived from Hume, and by Ward to support a noumenal idealism derived from Lotze. No real advance in metaphysics can take place, and natural science itself is in some danger, until the true history of the evidences of the laws of mechanical force is restored ; and then it will soon appear that in the force of collision what we know is not material points determining one another's opposite accelerations, but bodies by force of impenetrable pressure causing one another to keep apart. Mechanics is a natural philosophy of causes.

(3) Diialism within Experience. — As it comes to be realized that Hume and Kant agreed more than they differed, German philosophers tend to make new philo- sophies out of their common points. Hume thought that knowledge has its origin from experience, and Kant that d. priori elements are contained in this experience ; but, in differing about the origin, they agreed about the limits of knowledge, which, according to both, is a knowledge of mental phenomena of sense, and a knowledge limited to objects of experience, without any power of knowing by logical inference anything existing beyond, anything transcending, experience, actual and possible. Now, besides philosophies which are reactions to Kant or to Hume, there are a number of other philosophies in our day which start with this common hypothesis as a prin- ciple— ^knowledge is experience. The consequence is that whatever is true of experience they transfer to all knowledge. One of the characteristics of actual experi- ence

~~*is that its object is, or has been, present to an experiencing subject ; and of possible experience that it can be present. As a matter of fact, this characteristic differentiates experience from inference. By inference we know that things, such as the farther side of the moon, which neither are, nor have been, nor can be, present to an experiencing subject on the earth, nevertheless exist, and only become objects of inference. But, on the*~~

~~*hypothesis that knowledge contains no inferences beyond experience, it follows that all the objects of knowledge, being objects of experience, are, or have been, or can be, present to an experiencing subject. Hence it is common nowadays to hold that there is indeed a difference between knower and known, ego and non-ego, subject and object, but that they are inseparable ; or that all known things are objects and subjects inseparably connected in experi- ence. This view, however, is held in different forms ; and two opposite forms have lately arisen in Germany, " immanent philosophy " and " empirio-criticism," the former nearer to Kant, the latter to Hume.*~~

~~*" Immanent philosophy " is the hypothesis that the world is not transcendent, but immanent in consciousness. Among the upholders of this view are Anton von Leclair, who expresses it in the formula — "Denken eines Seins= gedachtes Sein," and R. von Schubert-Soldern, who says that every fragment of the pretended transcendent world belongs to the immanent. But the best known repre- sentative of Immanent Philosophy is W. Schuppe, who, in his Erkenntnistheoretische Logik (1878), and in his shorter Grundriss der Erkenntnistheorie und Logik (1894), gives the view a wider scope by the contention that the real world is the common content or object of common consciousness which, according to him, as according to Fichte, is one and the same in all individual men. Different individual consciousnesses plainly differ in having each its own content, in which Schuppe includes each individual's body as well as the rest of the things which come within the consciousness of each ; but they also as plainly agree, e.g., in all admitting one sun.*~~

~~*Now, the point of Schuppe is that, so far as they agree, in- dividual consciousnesses are not merely similar, but the same in essence ; and this supposed one and the same essence of consciousness in different individuals is what he calls consciousness in general (Bewusstsein uberhaupt). While in this identification he follows Pichte, in other respects he is more like Kant. HIe supposes that the conscious content is partly d. posteriori, or consisting of given data of sense, and partly d, priori, or consisting of categories of understanding, which, being valid for all objects, are contributed by the common consciousness. HIe differs, however, from Kant, not only because he will not allow that the given data are received from things in themselves, but also because, like Mach, he agrees with the nativists that the data already contain a spatial determinacy and a temporal determinacy, which he regards as d posteriori elements of the given, not, like Kant, as d, priori forms of sense. HIe allows, in fact, no d priori forms except categories of the under- standing, and these he reduces, considering that the most important are identity with difference and cau- sality, which in his view are necessary to the judg- ments that the various data which make up a total impression (Oe,sammteindruck, Ti>lalei)i.ilriifk) are each different from the others, together identical with the total impression, and causally connected in relations of necessary sequence and coexistence. At the same time, true to the hypothesis of " immanence," he rigidly con- fines these categories to the given data, and altogether avoids the inconsistent tendency of Kant to transfer causality from a necessary relation between phenomena to a necessary relation between phenomena and things in themselves as their causes. HIence he strictly con- fines true judgment and knowledge to the conscious- ness ^ of the identity or difference, and the causal relations of the given content of the common conscious- ness._ From this epistemology he derives the meta- physical conclusion that the things we know are indeed independent of my consciousness and of yours, taken individually, or, to use a new phrase, are "trans-subjec-*~~

~~*tive ' ; but, so far from being independent of the common consciousness, one and the same in all of us, they are simply its contents in the inseparable relation of sub- ject and object. To the objection that there are objects, e.g., atoms, which are never given to any consciousness, he returns the familiar Kantian answer that, though un- perceived, they are*~~

~~*perceptible. The whole known world, then, according to him, is the perceived and the percep- tible content of common consciousness. Schuppe has been compared by Wundt with Berkeley. But Schuppe himself distinguishes himself from Berkeley on the ground that, by supposing an object to be the one con- tent of our common consciousness, he explains the unity of an object, which Berkeley's theory of the different ideas of different minds certainly does not; and further, on the ground that he does not, like Berkeley, suppose the will of God to be the direct cause of sensations, but simply regards them as given. The world, according to Berkeley, is immanent in God's consciousness as well as severally in ours ; according to Schuppe, it is immanent jointly in ours. Again, this hypothesis of one consciousness reminds us of the Hegelian one reason, the same in God and man. But Schuppe only means one common consciousness uniting the finite consciousnesses of us men. He really descends from Fichte ; except that the common consciousness of finite individuals, according to Fichte, by its own activity posits Nature in consciousness itself, but, according to Schuppe, finds Nature given in its own content. From Fichte also comes the supposed inseparability of subject and object. Kant held that the thing in itself can, the thing as object cannot, exist without the synthetic subject. It was Fichte who, identifying thing and object, enunciated the formula — no subject without object and no object without sub- ject, as an exhaustive description not only of knowledge but also of existence. Schuppe reduces the formula from a position of the common ego to a fact of its common ex- perience.*~~

~~*The " empirio-criticism " of R. Avenarius (1843-1896), the former editor of the Vierteljahrsschrift filr wissen- schaftliche Philosophie, is the hypothesis of the insepara- bility of subject and object, or, to use his own phraseology, of ego and environment, in purely empirical, or d, posteriori form. It is like " immanent philosophy," in opposing experience to the transcendent ; but it also opposes ex- perience to the transcendental, or d. jjriori. It opposes " pure experience " to " pure reason," while it agrees with Kant's limitation of knowledge to experience. Avenarius held a view of knowledge very like that of JMach's view of the economy of thinking. In his first philosophical treatise, Philosophie als Denken der ^VeU genidss dein Princip des kleinsten Kraftmaasses, Prolegomena zu einer*~~

Kritik der reinen Erfahning (1876), he based his views on the principle of least action, contending that, as in Nature the force which produces a change is the least that can be, so in mind belief tends in the easiest direction. In illus- tration of this tendency, he pointed out that mind tends to assimilate a new impression to a previous content, and by generalization to bring as many impressions under as few general conceptions as possible, and succeeds so far as it generalizes from pure experience of the given. Nor is there any objection to this economical view of thought, as long as we remember what Avenarius and Mach forget, that the essence of thought is the least action neither more nor less than necessary to the point, which is the reality of things. Afterwards, in his Kritik der reinen Erfidimng (1888-90), Avenarius aimed at giving a de- scription of pure experience, which he identified with the natural view of the world held by all unprejudiced persons. \Miat, then, is this pure ex])erience ? " Every hmnan individual," says he, " originally accepts over against him an environment with manifold parts, other individuals

making manifold statements, and what is stated in some way dependent upon the environment." Statements de- pendent upon the environment are what he means by pure experience. At first this starting-point looks like dualistic realism, but in reality the author only meant dualism within experience. By the environment he meant not a thing existing in itself, but only a counter- part (Gegenglied) of ourselves as central part {Oentral- glied). "We cannot," he adds, "think ourselves as central part away." IIe went so far as to assert that, where one assumes that at some time there was no living being in the world, all one means is that there was besides oneself no other central part to whom one's counterparts might also be counterparts. The consequence is that all the world admitted into his philosophy is what he called the " empirio-critieal essential co-ordination " (empirio- kritische Prinzipialkoordination), an inseparable correlation of central part and counterpart, of ego and environment. Within this essential co-ordination he distinguished three values — R-values of the environment as stimulus, C^alues of the central nervous system, and E-

~~values of human statements ; the latter being characterized by that which at the time of its existence for the individual admits of being named, and including what we call sensations, &c., which depend indirectly on the environment and directly on the central nervous system, but are not, as the materialist supposes, in any way reducible to possessions of the brain or any other part of that system. This division of values brings us to the second point in his philosophy, his theory of what he called " vital series," by which he essayed to explain all life, action, and thought. A vital series he supposed to be always a reaction of C against disturbance by E, consisting in first a vital differ- ence, or diminution by R of the maintenance-value of G, and then the recovery by C of its maintenance-value, in accordance with the principle of least action. He further supposed that, while this independent vital series of C is sometimes of this simple kind, at other times it is com- plicated by the addition of a dependent vital series in E, by which, in his fondness for too general and far-fetched explanations, he endeavoured to explain conscious action and thought. Thus, if a pain is an E-value directly dependent on a disturbance in C, and a pleasure another E-value directly dependent on a recovery of C, it will follow that a transition from pain to pleasure will be a vital series in E directly dependent on an independent vital series in C, recovering from a vital difference to its maintenance-maximum. Similarly, when in consequence of the stimulus of vibrations of ether, I have a percep- tion of blue, the stimulus E is followed by a vital differ- ence and a recovery of its maintenance-value in C, and this vital series is accompanied by another expressed in the statement E, "I have a perception of blue." Lastly, supposing that all human processes can in this way be reduced to vital series in an essential co-ordination of oneself and environment, Avenarius held that^ this empirio-critical supposition, which according to him is also the natural view of pure experiences, contains no opposition of physical and psychical, of an outer physical and an inner psychical world — an opposition which seemed to him to be a division of the inseparable. According to him, we should not say that a sensation is in us, but that an E-value is a sign of an object {e.g., blue) ; and of the relation of object and subject {e.g., per- ception of blue) ; nor should we say that the change in C is the cause of another change, E, in us, but only that, if there is a change in C, there is a change in E. He con- sidered that the whole hypothesis that an outer physical thing causes a~~

~~*change in one's central nervous system, which again causes another change in one's inner psychi- cal system or soul, is a departure from .the natural view*~~

~~*of the universe, and is due to what he called " introjec- tion," or the hypothesis which encloses soul and its faculties in the body, and then, having created a false antithesis between outer and inner, gets into the difficulty of explaining how an outer physical stimulus can impart something into an inner psychical soul. He concluded therefore that, having disposed of this fallacy of introjec- tion, we ought to return to the view of reality as an essen- tial co-ordination of ego and environment, of central part and counterpart, with E-values, C-values, and E-values. It is curious that Avenarius should have brought forward this artificial hypothesis as the natural view of the world, without reflecting that on the one hand the majority of mankind believes that the environment (E) exists, has existed, and will exist, without being a counterpart of any living being as central part (C) ; and- that on the other hand it is so far from being natural to man to be- lieve that sensation and thought (E) are diffei'ent from, and merely dependent on, his body (C), that throughout the Homeric poems, though soul is required for other purposes, all thinking as well as sensation is regarded as a purely bodily operation. It is indeed difllcult to assign any rational place to the empirio-criticism of Avenarius. It is materialistic without being materialism, because, while it regards the supposition of a soul as due to the fallacy of "introjection," it separates thought from the brain. It is realistic without being realism, because, while it distinguishes E-values, C-values, and E-values, it regards the environment, as well as the nervous system, as existing only in relation to the ego, which cannot think itself away. It borrows tenets of different philoso- phers, — self-maintenance against disturbance from the realist Herbart, and interdependence without causality between stimulus and ego from the idealist Eechner ; while it agrees with Mach's views on the economy of thinking, and in opposition to transcendentalism as well as transcendence. Its rejection of the whole relation of physical and psychical makes it almost too indefinite to classify among philosophical systems. But its main point is the essential co-ordination of ego and environment, as central part and counterpart, in experience. It is therefore nearly connected with "immanent philosophy." Schuppe,*~~

~~*indeed, wrote an article in the Vierteljahrsschrift of Avenarius to prove their essential agreement. At the same time Schuppe's hypothesis of one common conscious- ness uniting the given by d, priori categories could hardly be accepted by Avenarius as pure experience, or as a natural view of the world. His "empirio-criticism" is idealistic dualism within experience in an d, posteriori form, but with a tendency towards materialism.*~~

~~*(4) Voluntaristic Phenomenalism of Wiuidt. — Wundt's metaphysics will form an appropriate conclusion of this sketch of German idealism, because his patient industry and eclectic spirit have fitted him to assimilate many of the views of his predecessors. Wundt proves, not exactly as Hegel thought that all philosophies are one philosophy, but that all idealisms are in a way one. He starts as a phenomenalist from the hypothesis, which we have just described, that knowledge is experience containing subject and object in inseparable connexion, and has something in common with the premature attempt of Avenarius to develop the hypothesis of dualism in experience into a scientific philosophy comprehending the universe in the simplest possible manner. Again he agrees with the reaction both to Hume and to Kant in limiting knowledge to mental phenomena, and has affinities with Mach as well as with Lange. His main sympathies are with the Neo- Kantians, and especially with Lange in modifying the d priori, and in extending the power of reason beyond phenomena to an ideal world; and yet the cry of his phenomenalism is not "back to Kant," but "beyond*~~

~~*Kant." Though no noumenalist, in many details he is with noumenalists ; with Fechner in psychophysics, in psychophysical parallelism, in the independence of the physical and the psychical chains of causality, in re- ducing physical and psychical to a difference of aspects, in substituting impulse for accident in organic evolu- tion, and in wishing to recognize a gradation of indi- vidual spiritual beings ; with Schopenhauer and Hart- mann in voluntarism ; and even with Schelling and Hegel in their endeavour, albeit on an artificial method, to bring experience under*~~

~~*notions, and to unite subject and object in one concrete reality. He has a special relation to Fichte in developing the Kantian activity of consciousness into will and substituting activity for substantiality as the essence of soul, as well as in break- ing down the antithesis between phenomena and things in themselves. At the same time, in spite of his sym- pathy with the whole development of idealism since Kant, which leads him to reject the thing in itself, to modify d |3riorjsm, and to stop at transcendent "ideals," without postulates of practical reason, he nevertheless has so much sympathy with Kant's Kritik as on its theories of sense and understanding to build up a system of phenomenalism, according to which know- ledge begins and ends with ideas, and then on its theory of pure reason to build a crown to his edifice by according to reason a power of logically forming an " ideal " of God as ground of the moral " ideal " of humanity — though without any power of logically in- ferring any corresponding reality. He constructs his system on the Kantian order — sense, understanding, reason — and exhibits most clearly the necessary conse- quence from psychological to metaphysical idealism. His philosophy is the best exposition of the method and argument of modern idealism — that we perceive the mental and, therefore, all we know and conceive is the mental. The order of his philosophy is unmistak- ably as follows : —*~~

~~*(a) Psychology, which he says is, in relation to natural science the supplementary, in relation to mental science the fundamental, in relation to philosophy the propoedeutic, empirical science.*~~

~~*(6) Logic and epistemology, whose problem of know- ledge he calls the precondition for the answer to all other questions.*~~

~~*(c) Metaphysics, which deals, according to him, with the fundamental principles of all the natural and spirit- ual sciences, on the foundation of experience, and on a method based on the principle of ground and consequent. Its positive conclusion, drawn from all the previous psy- chological, logical, and epistemological considerations, is that all we know from sense is ideas (Vbrstellungen, so translated by himself), distinguishable, but not separable, into subject and object within unitary experience, and dominated by will ; while reason logically and necessarily transcends this experience by the principle of ground, but only to form transcendent "ideals" (Ideen, to us an untranslatable term), and ultimately the universally valid and necessary " ideal " of God as will of the world (Weltvnlle). Its negative conclusion, is that reason has no power to give us a real knowledge of a reality cor- responding to the " ideal," and no power in any case of logically inferring things beyond experience, actual and possible. The phenomenal metaphysics of Lange and of Wundt are exceedingly alike ; but perhaps we may say that the intelligible world beyond experience is with Lange a world of poetry ; with Wundt a world of logic ; with both a world of " ideals."*~~

~~*Wundt founds his whole philosophy on four psychologi- cal positions — his phenomenalistic theory of unitary ex- perience, his voluntarism, his actualistic theory of soul.*~~

~~*and his psychological theory of parallelism. They are positions also which deeply affect, not only the psycho- logical, but also the metaphysical idealisms of our time, in Germany, and in the whole civilized world. IIis first position is his phenomenalistic theory of unitary experi- ence. According to him, we begin with an experience of ideas, in which object and idea are originally identical (Vorstellungsobject) ; we divide this unitary experience into its subjective and objective factors, and especially in natural science we so far abstract the objects as to believe them at last to be independent things ; but it is the office of psychology to warn us against this popular dualism, and to teach us that there is oidy a duality of psychical and physical, which are divisible, not separable, factors of one and the same content of our immediate experience ; and experience is our whole knowledge. IIis metaphysical deduction from this psychological*~~

view is that all we know is mental phenomena, "the whole outer world exists for us only in our ideas," and all that our reason can logically do beyond these pheno- mena is to frame transcendent " ideals." His second posi- tion is his voluntarism. He agrees with Schopenhauer that not intellect but will is the fundamental form of the spiritual (die Gritndfonn des Geisiigen). He does not mean that will is the only mental operation ; for he recog- nizes idea derived from sensation, and feeling, as well as wUl. Moreover, he contends that we can neither have idea without feeling and will, nor will without idea and feeling ; that idea alone wants activity, and will alone wants content ; and that will is ideating activity (vor- stellende TJidtigkeit), which always includes motives and ends and therefore ideas. He is therefore a follower of Schopenhauer as corrected by Hartmann. Like these predecessors, and like his younger contemporary Paulsen, in calling will fundamental he includes impulse {Trieb). Accordingly he divides will into two species; on the one hand, simple volition, or impulse, which in his view requires as motive a feeling directed to an end, and therefore an idea, e.g., the impulse of a beast arising from hunger and sight of prey ; on the other hand, complex volition issuing in a voluntary act, requiring decision (Entscheidung) or con- scious adoption of a motive, with or without choice. Like other German voluntarists, he imputes "impulsive will " to the whole organic world. He holds that not only reflex action in animals, but also irritability in plants is originally an impulse which becomes secondarily auto- matic ; that the protozoon acts in all its parts by " will- impulses," as well as in its whole organism ; and that the simplest forms of life are impulsive animals from which plants are developed as chlorophyll-producing organisms. He follows Fechner closely in his answer to Darwin. If he is to be believed, at the bottom of all organic evolu- tion, organic impulses becoming habits produce structural changes, which are transmitted by heredity ; and as an impulse thus gradually becomes secondarily automatic, the wiU passes to higher activities, which in their turn become secondarily automatic, and so on. As now he sui)poses feeling even in " impulsive will " to be directed to an end, he deduces the conclusion that in organic evolution the pursuit of final causes precedes and is the origin of mechanism. But at what a cost ! He has endowed all the plants in the world with motives, feelings directed to an end, aud ideas, all of which, according to him, are required for impulse ! He apparently forgets that

~~*mere feelings often produce actions, as when one writhes with pain. But even so, have plants even those lowest impulses from feelings of pain or pleasure ? Wundt, however, having gone so far, there stops. It is not necessary for him to follow Schopenhauer, Hartmann, andFechnerin endowing the material universe with will or any other mental operar tion, because his phenomenalism already reduces inorganic*~~

~~*nature to mere objects of experiencing subjects. Wundt's voluntaxism takes a new departure, in which, however, he was anticipated by the paradox of Descartes that will is required to give assent to anything perceived (Principia Philosophic, i. 34). Wundt supposes not only that all organisms have outer will, the will to act, but also that all thinking is inner will, the will to thiak. Now, there is a will to think, and Aristotle pointed out that think- ing is in our power whenever one pleases, whereas sense depends on an external stimulus (De Anima, ii. 5). There is also an impulse to think, e.g., from toothache. But it does not follow that thought is will, or even that there is no thinking without either impulse or will proper. The real source of thinking is evidence. Wundt, however, having supposed that all thinking consists of ideas, next supposes that all thinking is wUling (jedes Denken ein Wolleny What is the source of this paradox ? It is a confusion of impulse with will, and activity with both. He supposes that all agency, and therefore the agency of thinking, is will. In detail, to express this supposed inner will of thinking, he borrows from Leibnitz and Kant the term "apperception," but in a sense of his own. Leibnitz, by way of distinction from unconscious perception, gave the name " apperception " to conscious- ness, or the reflective knowledge of our inner states which, according to his monadology, is not given to all souls, nor always to the same soul. Kant further insisted that this apperception, " I think," is an act of spontaneity, distinct from sense, necessary to regarding all my ideas as mine, and to combining them in a synthetic unity of apperception ; which act Fichte after- wards developed into an active construction of all knowledge, requiring will directed to the end of duty. Wundt, in consequence, thinking with Kant that apper-*~~

~~ception is a spontaneous activity, and with Fichte that this activity requires will, and indeed that all activity is will, infers that apperception is inner will. Further, on his own accoixnt,he identifies apperception with the process of attention, and regards it as an act necessary to the general formation of compound ideas, to all association of ideas, to all imagination and understanding. According to him, then, attention, ev-en involuntary attention, requires inner will ; and all the functions imputed by Hume to associatiqn, as well as those imputed to understanding by Kant, require apperception, and therefore inner will. At the same time, he does not suppose that they all require the same kind of will. In accordance with his previous division of outer will into impulsive and decisive, he divides the inner will of apperception into (1) passive apperception, or impulsive will necessary to association, passive in receiving the content of sensations, but active so far as this content is a motive rousing it to ideating activity, and (2) active apperception, or decisive will nec- essary to understanding, and giving rise to what he awk-wardly calls "apperceptive combinations," among which come judgments. Apperception in general thus becomes activity of inner will, constituting the process of attention, passive in the form of impulsive will required for associa- tion, and active in the form of decisive will required for understanding and judgment. Now, beneath these con- fusing phrases the point to be regarded is that, in Wundt's opinion, though we can receive sensations, we cannot think at all beyond sense, without some will ; we cannot form any compound idea, or any association of ideas without impulse, and we cannot make any comparison or any judgment without decision, and a decision, not in the intellectual sense of a conclusion from evidence, but on the practical sense of a conscious adoption of a motive. This exaggeration of the real fact of the will to think ignores throughout the position of little man in the great world and at the mercy of things which drive him perforce to sense~~

~~and from sense to thought. (See article on Logic.) It is a substitution of will for evidence as ground of assent, and a neglect of our consciousness that we often believe against our will (e.g., that we must die), often without even an impulse to believe, often without taking any interest, or when taking interest in something else of no import- ance. " The Dean is dead (Pray, what is trumps ?)." Yet many psychologists accept the~~

~~universality of this will to believe, and among them James, who says that " it is far too little recognized how entirely the intellect is built up of practical interests." We should rather say " far too much." Wundt, however, goes still farther. According to him, that which acts in all organisms, that which acts in all thinking, that which divides unitary experience into subject and object, the source of self- consciousness, the unity of our mental life, the most proper being of the individual subject, is will (das eigenste Sein des einzelnen Subjectes das Wollen ist). In short, his whole voluntarism means that, while the inorganic world is mere object, all organization is con- gealed will, and all thinking is apperceptive will. But it must be remembered that these conclusions are arrived at by confusing action, reaction, life, excitability, impulse, and rational desire, all under the one word "will," as well as by omitting the involuntary action of intelli- gence under the pressure of evidence. Nothing is gained by obliterating the distinctions between physical agency of which vegetative excitability and reflex action are instances, instinctive action from feeling, and voluntary action of will from reason and desire of end. It may well be that impulsive feeling is the beginning of mind; but then the order of mind is feeling, sense, inference, will, which instead of first is last, and implies the others. To proceed, however, with voluntarism, Wundt, as we have seen, makes personality turn on will. He does not accept the universal voluntarism of Schopenhauer and Hartmann,but believes in individual wills, and a gradation of wills, in the organic world. The protozoon, he says, has " will-impulses " in its parts, as well as in the whole organism. Similarly, he supposes, our personal individual will is^a collective will containing simpler will-unities, and he thinks that this conclusion is proved by the continuance of actions in animals after parts of the brain have been removed. In a similar way, he supposes, our wills are included in the collective will of society. He does not, however, think with Schuppe that there is one common consciousness, but only that there is a collective con- sciousness and a collective will ; not perceiving that then the sun, in his view a mere object in the experience of every member of the collection, would be only a collective sun. Lastly, he believes that reason forms the " ideal " of God as world-will, though without proof of existence. On the whole, his voluntarism, though like that of Schopen- hauer and Hartmann, is not the same; not Schopen- hauer's, because the ideating will of Wundt's philosophy is not a universal irrational will ; and~~

~~not Hartmann's, because, although ideating will, according to Wundt's phe- nomenalism, is supposed to extend through the world of organisms, the whole inorganic world remains amere object of unitary experience. His third position is his actualistic theory of soul, which need not detain us, as he shares it with Fichte, Hegel, Fechner, and Paulsen. When Fichte had rejected the Kantian soul in itself and developed the Kantian activity of apperception, he considered that soul consists in constructive activity. Fechner added that the soul is the whole unitary spiritual process manifested in the whole unitary bodily process without being a sub- stance. Wundt accepts Fichte' s theory of the actuality, and Fechner's synechological view, of the soul. Taking sub- stance entirely in the sense of substrate, he argues that there is no evidence of a substantial substrate beneath~~

~~mental operations ; that there is nothing except unitary- experience consisting of ideas, feelings, volitions, and their unity of will ; and that soul in short is not snhstantia, but actus. He does not see that this unity is only ap- parent, for men think not always, and will not always. ISTor does he see that a man is conscious not of idea, feel- ing, will, experience, but of something conceiving, feeling, willing, and experiencing, which he gradually learns to call himself, and that he is never conscious of doing all this " minding " without his body. If, then, these mental operations were merely actuality, they would be actuality of a man's bodily substance. In truth, there is no sound answer to Materialism, except that, besides bodily sub- stance, psychical substance is also necessary to explain how man performs mental actualities consciously (see Physical Realism, ch. v.). Wundt, however, has satisfied himself, like Fechner, that there is no real opposition of body and soul, and concludes, in accordance with his own phenomenalism, that his body is only an object abstracted from his unitary experience, which is all that really is of him. Hence his fourth point is his psychological theory of parallelism of physical and psychical reduced to identity in unitary experience. Here his philosophy is Pechnerism phenomenalized. He delivered a well- deserved encomium on~~

~~*Fechner's experimental psychology at his master's grave. He accepts Fechner's extension of Weber's law of the external stimuli of sense, while judiciously remarking that " the physiological interpreta- tion is entirely hypothetical." He accepts psychophysical parallelism in the sense that every psychical process has a physical accompaniment, every physiological function has a psychical meaning, but neither external stimulus nor physiological stimulus is cause of a psychical process, nor vice versa. Precisely like Fechner, he holds that there is a physical causality and energy, and there is a psychical causality and energy, parallels which never meet. He uses this psychical causality to carry out his voluntarism into detail, regarding it as an agency of will directed to ends, causing association and understanding, and further acting on a principle which he calls the heterogony of ends; remarking very truly that each particular will is directed to particular ends, but that be- yond these ends effects follow as unexpected consequences, and that this heterogony produces social effects, which we call custom. But while thus sharply distinguishing the physical and the psychical in appearance, he follows Fechner in identifying them in reality; except that Fechner's identification is noumenal,Wundt's phenomenal. Wundt does not allow that we know beyond experience any souls of earth, or any other inorganic being. He does not, therefore, allow that there is a universal series of physical and psychical parallels. According to his pheno- menalism, the external stimulus and the physiological stimulus are both parallels of the same psychical process ; the external body, as well as my body, is merely an object abstracted from an idea of my experience ; and what is really known in every case is a unitary experience divis- ible, but not separable, into body and soul, physical and psychical factors of one and the same unitary experience. Wundt is confined by his starting-point to his deduction that what we know is mental phenomena, ideas regarded as olijects and subjects of experience.*~~

~~*With these four positions in hand, Wundt's philosophy consecutively follows, beginning with las psychology. I am conscious of having sensations of pressure between the members of my body, and of inferring similar pressures be- tween my body and external bodies, and between external bodies themselves. I am conscious of having other sensa- tions of heat, colour, sound, odour, flavour, and of inferring that the same*~~

~~external body, e.g., an orange, which causes m me sensible pressure, causes in me these other sensibh-~~

~~effects. I am conscious that I never perceive any of these sensible objects except as enduring temporally, or any pressure or colour except as extended spatially; and that I feel triply-extended pressure, as when I suck my tongue or clench my fist. I am conscious that I infer distinct triply-extended bodies, e.g., an orange. I am not conscious of fusing my sensations and ideas into a com- pound object. I am conscious that I have acquired a habit of confusing my sensations, ideas, inferences ; but that I can distinguish them by consciousness. In defiance of these conscious facts Wundt constructs his psychology. He begins with psychical elements, sensa- tions and feelings, but he asserts that these always exist in a psychical compound, from which they can be discov- ered only by analysis and abstraction ; and his paradox that " a pure sensation is an abstraction " is repeated by W. James. Further, Wundt declares that the psychical compound of sensations, with which, according to him, we actually start, is not a complex sensation, but a com- pound idea ; so that I am expected to believe that, when I hear the chord of J), I am not conscious of single sensations of D, F, A, and have only a compound idea of the chord — as if the hearing of music were merely a series of ideas ! Wundt, however, has a reason for substituting compound idea for sensation : he accepts Lotze's hypothe- sis of local signs, and adds a hypothesis of temporal signs. He supposes that we have no sensations of space and time, as the nativists suppose, but that, while local signs give us spatial ideas, feelings of ex- pectation are temporal signs giving us temporal ideas, and that these ideas enter into the psychical compound, which is our actual starting-point. It follows that every psychical compound into which temporal and spatial ideas enter must itself be an idea ; and, as time at any rate accompanies all our sensations, it follows that every psychical compound of sensations, containing, as it does, always temporal, if not also spatial, ideas, must be a compound idea, and not, as nativists suppose, Schuppe for instance, a compound sensation. The next question is, how compounded ? Wundt's answer is that inner impulse wiU, in the form of passive apperception, forms compound ideas by association ; so that all these operar tions are necessary to the starting-point. He prefixes to the ordinary associations, which descend from**

~~Hume, an association which he calls fusion {Verschmelzung), and supposes that it is a fundamental process of fusing sensations with spatial and temporal ideas into a com- pound idea. But he also recognizes association by simi- larity, or assimilation, or " apperception " in Herbart's more confined sense of the word, and association by contiguity, or complication. Eecognizing, then, three kinds of association in aU, he supposes that they are the first processes, by which inner will, in the form of passive apperception, generates ideas from sense. So far his psychology is a further development of Hume's. But he does not agree with Hume that mind is nothing but sensations, ideas, and associations, but with Kant, that there are higher combinations. According to him, inner decisive will, rising to active apperception, proceeds to what he calls " apperceptive combinations " {Apperception vcr- hiiidaiujeit) ; first to simple combinations of relating and comparing, and then to complex combinations of synthesis and analysis in imagination and understanding ;" in con- sequence of v.'hich synthesis issues in an aggregate idea {OesammtvorsteUinuf),^nA then at last analysis, by dividing au aggregate idea into subject and predicate, forms a judgment. For a criticism of this extraordinary theory of judgment we may refer to tlie article on Logic. At present the main point is that, if it were true, we should be for ever confined to a jumble of ideas, Wundt, indeed, is aware of the consequences. If judgment is an analysis~~

~~of an aggregate idea into subject and predicate, it follows, as he says, that " as judgment is an immediate, so is infer- ence a mediate, reference of the members of any aggregate of ideas to one another" {System der PhilosopMe, 66, first ed.). He cannot allow any inference of things beyond ideas. His psychology poisons his logic.~~

~~In his logic, and especially in his epistemology, Wundt appears as a mediator between Hume and Kant, but with more leaning to the latter. While he regards association as lying at the basis of all knowledge, he does not think it sufficient, and objects to Hume that he does not account for necessity, nor for substance and causation as known in the sciences.~~

~~*He accepts on the whole the system of synthetic understanding which Kant superimposed on mere association. He agrees with Kant about the spontaneous activity of apperception, which he develops into inner will to think. Unlike Hume, but like Kant, he distinguishes between an idea and a judgment so far as the latter involves a bifurcation into subject and predicate ; and consequently he regards the processes by which we form judgments as not passive associations of ideas but active synthesis and analysis. Once more, he agrees with Kant that the function of understanding consists in "the interpretation of experience by its arrangement under common notions." He does not think that all these notions are empirical, or contained in the primary ideas of unitary experience, or in the object of idea (Vorstellungsobject) in which idea and object are as yet undistinguished. Yet he will not proceed to the length of Kant's transcendentalism, but says that "an A- priority of forms of intuition and notion in the Kantian sense cannot be rightly maintained " {System, 202). Be- tween Hume's A posteriori and Kant's h priori hypothesis, he proposes a logical theory of the origin of notions beyond experience. He explains that the arrangement of facts requires " general supplementary notions {Uiilfs- begriffe), which are not contained in experience itself, but are gained by a process of logical treatment of this experience." Of these supplementary notions he holds that the most general is that of causality, coming from the necessity of thought that all our experiences shall be arranged according to ground and consequent. That sense only gives to experience coexistences and sequences of appearances, as Hume said and Kant allowed, is also Wundt's starting-point. How then do we arrive at causality? Not, says Wundt, by asso- ciation, as Hume said, but by thinking; not, however, by ct priori thinking, as Kant said, but by logical thinking, by applying the logical principle of ground and consequent (which Leibnitz had called the principle of suflcient reason) as a causal law to empirical appear- ances. .Now, Wundt is aware that this is not always possible, for he holds that the logical principle of ground belongs generally to the connexion of thoughts, the causal law to the combination of empirical appearances. Nevertheless he believes that, when we can apply meas- ures to the combination of empirical appearances, then we can apply the logical principle as causal law to this combination, and say that one appearance is the cause of another, thus adding a notion of causality not contained in the actual*~~

~~observations, but specializing the general notion of causality. He quotes as an instance that Newton in this way added to the planetary appearances contained in Kepler's laws the gravitation of the planets to the sun, as a notion of causality not contained in the appear- ances, and thus discovered that gravitation is the cause of the appearances. But Newton had already discovered beforehand in the mechanics of terrestrial bodies that gravitation constantly causes similar facts on the earth, and did not derive that cause from any logical ground beyond experience, any more than he did the third law of~~

~~motion. Wundt does not realize that, though we can often use a cause or real ground (principium essendi) as a logical ground (principium cognoscendf), for deducing effects, we can do so only when we have previously inferred from experience that that kind of cause does produce that kind of effect (see article on Logic). Otherwise, logical ground remains logical ground, as in any non-causal syllogism, such as the familiar one from " All men are mortal," which causes me to know that I shall die, without telling me the cause of death. Wundt, however, having satisfied himself of the power of mere logical thought beyond experience, goes on to further apply his hypothesis, and supposes that, in dealing with the physical world, logical thinking having added to experience the " supple- mentary notion " of causality as the connexion of appear- ances which vary together, adds also the "supplementary notion" of substance as substratum of the connected appearances. But, using substance as he does always in the Kantian sense of permanent substratum beneath changing phenomena, and never in the Aristotelian sense of any distinct thing, he proceeds to make distinctions between the applications of causality and of substance. Even in the physical, he confines substance to matter, or what Aristotle would call material causes, thus makes its power to be merely passive, and limits substantial causality to potential energy, while he supposes that actual causality is a relation not of substances but of events. On this false abstraction Sigwart has made an excellent criticism in an appendix at the end of his Logic, where he remarks that we cannot isolate events from the substances of which they are attributes. Motions do not cause motions ; one body moving causes another body to move : what we know is causal substances. Secondly, when Wundt comes to the psychical, he naturally infers from his narrow Kantian definition of~~

~~*substance that there is no proof of a substrate over and above all mental operations, and falsely thinks that he has proved that there is no substance mentally operating in the Aristotelian sense. Thirdly, on the grounds that logical thinking adds the notion of substance, as substrate, to experience of the physical, but not of the psychical, and that the most proper being of mind is will, he concludes that wills are not active substances, but substance-generating activities ("nicht thatige Substanzen sondern substanzerzeugende Thatigkeiten," System, 429).*~~

~~*What kind of metaphysics, then, follows from this compound of psychology and epistemology ? As with Kant against Hume, so with Wundt against Mach and Avenarius, the world we know will contain something more than mere complexes of sensations, more than pure experience : with Wundt it will be a world of real causes and some substances, constituted partly by experience and partly by logical thinking, or active inner will. But as with Kant, so with Wundt, this world will be only the richer, not the wider, for these notions of understanding ; because they are only contributed to the original experience, and, being mentally contributed, only the more surely confine knowledge to experience of mentaj. phenomena. Hence, according to Wundt, the world we know is still unitary experience, distinguished, not separated, into subject and object, aggregates of ideas analysed by judgment and combined by inference, an object of idea elaborated into causes and substances by logical thinking, at most a world of our ideas composed out of our sensations, and arranged under our categories of our understanding by our inner wills, or a world of our ideating wills ; but nothing else. It is Wundt's own statement of his solution of the epistemological problem " that on the one hand the whole outer world exists for us only in our ideas, and that on the other hand a consciousness without objects of idea is an empty abstraction which possesses no actuality"*~~

~~{System, 212-213). There remains his theory of reason. His pupil, 0. Killpe, who bases his Grundriss der Psycho- logie on the hypothesis of unitary experience, says in his Einleitimg in die PJulosophie (1895) that Wundt in his System derives the right of metaphysics to transcend ex- perience from similar procedure within the limits of the special sciences. This is Wundt's view, but only in the sense that reason passes from ideas to " ideals," whether in the special sciences or in metaphysics. Reason, as in most modern psychologies and idealisms, is introduced by Wundt, after all sorts of operations, too late; and, when at length introduced, it is described as going beyond ideas and notions to "ideals" (Ideeti), as an ideal con- tinuation of series of thoughts beyond given experience — nothing more. Reason, according to Wundt, is like pure reason according to Kant; except that Wundt, re- ceiving Kantism through ISTeo-Kantism, thinks that rea- son arrives at " ideals " not d, priori, but by the logical process of ground and consequent, and, having abolished the thing in itself, will not follow Kant in his incon- sequent passage from pure to practical reason in order to postulate a reality corresponding to " ideals " beyond experience. Wundt, in fact, agrees with Lange that reason transcends experience of phenomena only to con- ceive "ideals." This being so, he finds in mathematics two kinds of transcendence — real, where the transcendent, though not actual in experience, can become partly so, e.g., the divisibility of magnitudes ; imaginary, where it cannot, e.g., n-dimensions. He supposes in metaphysics the same transcendence in forming cosmological, psycho- logical, and ontological "ideals." He supposes real as well as imaginary transcendence in cosmological " ideals " ; the former as to the forms of space and time, the latter as to content, e.g., atoms. But he limits psychological and ontological " ideals " entirely to im- aginary transcendence (" die psychologischen und ontolo- gischen Ideen dagegen fallen ganz und gar dem Gebiet imaginarer Transcendez zu"). The result is that he confines metaphysical transcendence to " a process into the imaginary" as regards the substantial and causal content of cosmological " ideals," and altogether as re- gards psychological and ontological "ideals." Thus, according to him, in the first place reason forms a cosmo- logical " ideal " of a multitude of simple units related \ secondly, it forms a psychological "ideal" of a multit^ide of wills, or substance-generating activities, which com- municate with one another by ideas so that will causes ideas in will, while together they constitute a~~

~~collective will, and it goes on to form the moral ideal of humanity (das sittliche Menscliheitsideal) ; and thirdly, it forms an ontological " ideal " of God as ground of this moral " ideal," and therewith of all being as means to this end, and an " ideal " of God as world-will, of which the world is development, and in which individual wills participate each in its sphere. " Herein," says Wundt, " consists the imperishable truth of the Kantian proposition that the moral order of the world is the single real proof of the existence of God " (System, 405, cf. 439). " Only," he adds, " the expression proof is here not admissible. Rational ' ideals ' are in general not provable." As the same limit is applied by him to all transcendent rational " ideals," and especially to those which refer to the con- tent of the notion of the world, and, like all psychologi- cal and ontological "ideals," belong to the imaginary transcendent, his conclusion is tliat reason, in transcend- ing experience, logically conceives "ideals," but never logically infers corresponding realities. He contends, indeed, that at least the moral " ideal " of humanity and the ontological "ideal" of God are universally valid, and that therefore reason alone can give an account of them. But what account ? " While in this way philo-~~

~~sophical inquiry exhibits the ground of their universal validity, it indicates at the same time the 'ideals' themselves as necessary. To contribute more it is neither called nor capable. Especially must it completely ab- stain from exhibiting besides that necessity of the ' ideal ' also the necessity of a reality corresponding to the idea. Philosophy can prove the necessity of faith ; to convert it into knowledge is beyond its power." These are the concluding words of the part of his System der Philosophie (1889) which deals with metaphysics.~~

~~The conclusion that reason in transcending experience can show no more than the necessity of " ideals " is the only conclusion which could follow from Wundt's pheno- menalism in psychology, logic, and epistemology. If knowledge is experience of ideas distinguished by inner will of apperception into subject and object in insepa- rable connexion, if the starting-point is ideas, if judgment is analysis of an aggregate idea, if inference is a mediate reference of the members of an aggregate of ideas to one another, then, as Wundt says, all we can know, and all reason can~~

logically infer from such data, is in our ideas, and consciousness without an object of idea is an abstraction ; so that reason, in transcending experience, can show the necessity of ideas and " ideals," but infer no corresponding reality beyond, whether in Nature, or in Man, or in God. Wundt, starting from a psychology of unitary experience, deduces a consistent metaphysics of no inference of things transcending experience throughout, — or rather until he comes to the very last sentence quoted above, when he suddenly passes from a necessity of " ideals " (Ideen), to a necessity of " faith" ((rtow&en), without " knowledge " (TFissen). HIe forgets apparently that faith is a belief in things beyond ideas and ideals, which is impossible on his psychology of judgment and logic of inference. The fact is that his System may easily seem to prove more than it does. HIe describes it as idealism in the form of ideal realism, because it recognizes an ideating will requiring sub- stance as substratum or matter for outer relations of phenomena. But when we look for the evidence of any such will beyond ourselves and our experience, we find Wundt offering nothing but an ontological " ideal " of reason, and a moral " ideal " requiring a religious "ideal," but without any power of inferring a corre- sponding reality. The System then ends with the neces- sity of an " ideal " of God as world-will, but provides no ground for the necessity of any belief whatever in the being of God, or indeed in any being at all beyond our own unitary experience.

Wundt, however, has since written an Einleitung in die Philosoj)hie (1901), in which he speaks of realism in the form of ideal realism as the philosophy of the future. It is not to be idealism which resolves everything into spirit, but realism which gives the spiritual and the ma- terial each its own place in harmony with scientific con- sciousness. It is not to be dualistic but monistic realism, because matter is not separate from spirit. It is not to be materialistic but ideal realism, because the physical and the psychical are inseparable parallels inexplicable by one another. It is to be monistic ideal realism, like that of Fichte and HIegel ; not, however, like theirs idealistic in method, a Phantastisches Begriffsgebaiide, but realistic in method, a Wi.'<.':enschaftliche Philosophie. It is to be ideal realism, as in the Si/.stem. It is not to be a species of idealism, as in the System, — but of realism. HIow are we to understand this change of front? We can only explain it by supposing that Wundt wishes to believe that, beyond the

~~" ideal," there really is proof of a trans- cendent, ideating, substance-generating will of God ; and that he is approaching the noumenal voluntarism of his younger contemporary, Paulsen. But to make such a~~

~~conversion from phenomenalism plausible, it is necessary to be silent about his whole psychology, logic, and epistemology, and the consequent limitation of knowledge to experience, and of reason to ideas and " ideals," with- out any power of inferring corresponding things.~~

~~What a pity it is that Wundt had committed himself by his psychology to phenomenalism, to unitary experience, and to the limitation of judgment and reason to ideas and " ideals " ! For his phenomenalism prevents him from consistently saying the truth inferred by reason, that there is a world beyond experience, a world of Nature, and a will of God, real as well as ideal. To understand Wundt is to discover what a mess modem psychology has made of metaphysics. To understand phenomenal idealism in Germany is to discover what a narrow world is to be known from the transcendental idealism of Kant shorn of Kant's inconsistencies. To understand noumenal idealism in Germany and the rise of meta- physical idealism in modern times is to discover that psychological is the origin of all metaphysical idealism. If we perceive only what is mental, all that we know is only mental. But who has proved that psychological starting-point ? Who has proved that, when I scent an odour in my nostrils, I apprehend not odour but a sensation of odour ; that when I taste a flavour in my mouth, I apprehend not flavour but a sensation of flavour ; that, when I hear a sound in my ears, I apprehend not sound but a sensation of sound ; that, when I see a colour in my eyes, I apprehend not colour but a sensation of colour; that, when I feel a pressure and heat in my body, I apprehend not pressure and heat but a sensation of pressure and of heat ? Sensation, as Aristotle said, is not of itself r it is the apprehension of a sensible object in the organism. I perceive pressure, heat, colour, sound, flavour, odour, in my five senses. Having felt reciprocal pressures in touch, I infer similar pressures between myself and the external world.~~

~~§ 6. Ebcent English Idealism.~~

~~(1) Tlie Followers of Hume's Phenomenalism. — Com- pared with the great systems of the Germans, English idealism in the 19th century shows but little originality. It has been largely borrowed either from previous English or from later German idealism, and what originality it has possessed has been mainly shown in that spirit of eclectic compromise which is so dear to the English mind. The predominant influence, on the whole, has been the pheno- menalism of Hume, with its slender store of sensations, ideas, and associations, and its conclusion that all we know is sensations without any known thinkers or any other known things. This phenomenalism was developed by James Mill (1773-1836) and J. S. Mill (1806-1873), and has since been continued by A. Bain. It also became the basis of the philosophies of Huxley and of Spencer on their phenomenalistic side. It is true that Spencer's " transfigured realism " contains much that was not dreamt of by Hume. Spencer widens the empirical theory of the origin of knowledge by his brilliant hypothesis of in- herited organized tendencies, which has influenced all later psychology and epistemology, and tends to a kind of compromise between Hume and Kant. He describes his belief in an unknowable absolute as " carrying a step farther the doctrine put into shape by Hamilton and Mansel." He develops this belief in an absolute in connexion with his own theory of evolution into some- thing different both from the idealism of Hume and the realism of Hamilton, and rather falling under the head of materialism. Nevertheless, as he believes all the time that everything knowable throughout the whole world of pvolution is phenomena in the sense of subj ective affections~~

~~of consciousness, and as he applies Hume's distinction of impressions and ideas as a distinction of vivid and faint states of consciousness to the distinction of ego and non-ego, spirit and matter, inner and outer pheno- mena, his philosophy of the world as knowable remains within the limits of phenomenalism. Nothing could be more like Hume than his final statement that what we are conscious of is subjective affections produced by objective agencies unknown and unknowable. The "anti- realism," which takes the lion's share in "transfigured realism," is simply a development of the phenomenalism of HLime. Hume was also at the~~

~~bottom of the philo- sophies of G. H. Lewes, who held that there is nothing but feelings, and of W. K. Clifford. Nor is Hume yet dethroned, as we see from the works of Karl Pearson and of William James, who, though an American, is exercis- ing a considerable influence on English thought. The most flourishing time of phenomenalism, however, was during the lifetime of J. S. Mill. It was counteracted to some extent by the study at the universities of the deductive logic of Aristotle and the inductive logic of Bacon, by parts of Mill's own logic, and by the natu- ral realism of Keid, Stewart, and Hamilton, which met Hume's scepticism by asserting a direct perception of the external world. But natural realism, as finally inter- preted by Hamilton, was too dogmatic, too unsystematic, and too confused with elements derived from Kantian idealism to withstand the brilliant criticism of Mill's Examination of Sir William Hamilton's Philosophy (1866), a work which for a time almost persuaded us that Nature as we know it from sensations is nothing but permanent possibilities of sensation, and oneself only a series of states of consciousness.~~

~~(2) The Influence of Kant and Hegel. — Nevertheless, there have never been wanting more soaring spirits who, shocked at the narrowness of the popular phenomenalism of Hume, have tried to find a wider idealism. They have, as a rule, sought it in Germany. Before the beginning of the 19th century, Kant had made his way to England in a translation of some of his works, and in an account of the Elements of the Critical Philosophy by A. E. M. Willich, both published in 1798. After a period of struggle, the influence of Kant gradually extended, and, as we see in the writings of Coleridge and Carlyle, of Hamilton and Mansel, of Green and Caird, of Laurie and Martineau, has secured an authority over English thought almost equal to that of Hume, with whom, indeed, Kant had much in common. Both philosophers appeal to the English love of experience, and Kant had these advantages over Hume, that within the narrow circle of sensible phenomena his theory of understanding gave to experience a fuller content, and that beyond phenomena, however incon- sistently, his theory of reason postulated the reality of God, freedom, and immortality. Other and wider German philosophies gradually followed that of Kant to England. Coleridge (1772-1834) not only called attention to Kant's distinction between understanding and reason, but also introduced his~~

~~*countrymen to the noumenal idealism of Schelling. In the Biographia Literaritt, (1817) he says that in Schelling's Naturphilosophie and System des trans- cendentalen Idealismus he first found a general coin- cidence with much that he had toiled out for himself, and he repeated some of the main tenets of Schelling. Carlyle (1795-1881) laid more emphasis on Eichte. At the height of his career, when between 1840 and 1850 many of Eichte's works were being translated in the Catholic Series, he called attention to Eichte's later view that all earthly things are but as a vesture or appearance under which the Divine idea of the world is the reality. Extravagant as this noumenalism is, it was a healthy antidote to the phenomenalism of the day. Not*~~

~~*long afterwards, J. T. Eerrier (1808-1864) published his Institutes of Metaphysics (1854). Ferrier held a theory that reality is " thing-mecum," or object plus subject, -which reminds us of Fichte and his successors. The key to his metaphysics is that, starting from Hamilton's theory that what we know is always the ego and the non-ego in inseparable connexion, he also imbibed Ham- ilton's love of historical research, and affected by the Germans through Hamilton, gradually deserted his mas- ter. Thus he did not agree with Hamilton, but with Schelling, about the absolute. Schelling asserted that we know the absolute by an intellectual intuition which we have in common with it, Hamilton that by the constitution of our faculties we know only the condi- tioned. Terrier perceived that the victory is with Schelling, if there is a common intelligence, and not only accepted this condition, but also founded his lec- tures on Greek philosophy on the assumption that abso- lute truth is truth for this universal intelligence, and that the object of philosophy is to find this absolute truth. Terrier then ended with the hypothesis of Schel- ling and Hegel that there is one absolute intelligence (see Terrier, Lectures and PhilosophicalMemains, 1866, i. 1-33; ii. 545-68). In 1865 his compatriot J. Hutchison Stir- ling published Tlie Secret of Hegel. While the Scottish philosophers were thus passing from natural realism to the noumenal idealism of Schelling and Hegel, B. Jowett (1817-1893),*~~

~~*then tutor of Balliol College, Oxford, had been studying the philosophy of Hegel, as we learn from his Life by Campbell and Abbott (i. 90-92). Through- out his life he continued to admire the flashes which illuminate the obscurity, and the habit of looking at both sides of the question which palliates the confu- sion, of the Hegelian writings. But, being a man en- dowed with much love of truth but with little belief in first principles, he was too wise to take for a prin- ciple Hegel's assumption that different things are the same. He had, however, sown seeds in the minds of two distinguished pupils, T. H. Green and E. Caird, the present Master of Balliol. Both proceeded to take Hegelianism seriously, and between them spread a kind of Hegelian orthodoxy in metaphysics and in theology throughout Great Britain. Green (1836-1882) in his lectures, delivered as professor of moral philoso- phy at Oxford, and posthumously published under the title of Prolegomena to Ethics (1883), tried to effect a harmony of Kant and Hegel by proceeding from the epistemology of the former to the metaphysics of the latter. Taking for granted the Kantian hypothesis of a sense of sensations requiring synthesis by understanding, and the Kantian conclusion that Nature as known con- sists of phenomena united by categories as objects of experience. Green argued, in accordance with Kant's first position, that knowledge, in order to unite the mani- fold of sensations by relations into related phenomena, requires unifying intelligence, or what Kant called syn- thetic unity of apperception, which cannot itself be sensation, because it arranges sensations ; and he argued, in accordance with Kant's second position, that therefore Nature itself as known requires unifying intelligence to constitute the relations of its phenomena, and to make it a connected world of experience. When Green said that " Nature is the system of related appearances, and related appearances are impossible apart from the action of an intelligence," he was speaking as a pure Kantian, who could be answered only by the Aristotelian position that Nature consists of related bodies beyond appearances, and by the realistic supposition that there is a tactile sense of related bodies, of the inter-resisting members of the organism, from which reason infers similar related bodies beyond sense. But now, whatever opinion we may*~~

~~*have about Nature, at all events, as Green saw, it does not come into existence in the process by which this person or that begins to think.*~~

~~*Nature is not my nature, nor your nature, but one. Everything in it is one ; the sun is not lit up every time a man looks at it, as Hume would make us suppose. Erom this fact of the unity of Nature and of everything in Nature, com- bined with the two previous positions accepted, not from Nature, but from Kant, Green proceeded to argue, altogether beyond Kant, that Nature, being one, and also requiring unifying intelligence, requires one intelli- gence, an eternal intelligence, a single spiritual-principle, prior to, and the condition of, our individual knowledge. According to him, therefore. Nature is one system of phenomena united by relations as objects of experience, one system of related appearances, one system of one eternal intelligence which reproduces itself in us. The " true account " of the world in his own words is " that the concrete whole, which may be described indiffer- ently as an eternal intelligence realized in the related facts of the world, or as a system of related facts rendered possible by such an intelligence, partially and gradually reproduces itself in us, communicating piecemeal, but in inseparable correlation, understanding and the facts understood, experience and the ex- perienced world." Nobody can mistake the Schellin- gian and Hegelian nature of this conclusion, which had already been imported into Great Britain by Eerrier, and which, as it became Green's, so is now in its essence Caird's metaphysics. It is the Hegelian view that the world is a system of absolute reason. But it is not a Kantian view ; and it is necessary to correct two confusions of Kant and Hegel, which have been im- ported with Hegelianism by Green and Caird. Eerrier was aware that in Kant's system "there is no common nature in all intelligence " (Lectures, ii. 568). Green, on the other hand, in deducing his own conclusion that the world is, or is a system of, one eternal intelligence, incautiously put it forward as " what may be called broadly the Kantian view" {Prolegomena, § 36), and added that he follows Kant "in maintaining that a single active conscious principle, by whatever name it be called, is necessary to constitute such a world, as the condition under which alone phenomena, i.e., appearances to consciousness, can be related to each other in a single universe" (§ 38). He admitted, however, that Kant also asserted, beyond this single universe of a single principle, a world of unknowable things in themselves, which is a Kantian not a Hegelian world. But Caird has since en- deavoured to break down even this second barrier between Kant and Hegel. According to Caird, Kant "reduces the inaccessible thing in itself*~~

~~(which he at first speaks of as affecting our sensibility) to a noumenon which is projected by reason itself" (Caird, Essays, ii. 405); and in the Transcendental Dialectic, which forms the last part of Kant's Kritili, the noumenon becomes the object of an intuitive understanding " whose thought," says Caird, "is one with the existence of the objects it knows " (ib. 412, 413). Kant, then, as interpreted by English Hegelians, already believed, before Hegel, that there is one intelli- gence common to all individuals, and that a noumenon is a thought of this common intelligence, " an ideal of reason " ; so that Kant was trying to be a Hegelian, holding that the world has no being beyond the thoughts of one intelligence. But history repeats itself ; and these same two interpretations of Kant had already been made in the lifetime of Kant by Fichte. In 1797 Fichte published two Introductions to the WissenschaftsleJirem his Philosophical Journal. In the first he said, " My system is no other than the Kantian." In the second he admitted that the Kantians, and Kant himself, " assert the contrary," but~~

~~contended tliat really the two systems are the same, and that in two respects. By the pure unity of apperception Kant meant, according to Fichte, " not the consciousness of our individuality," but "the notion of the pure ego exactly as the Science of Knowledge puts it." Secondly, by the thing in itself Kant, according to Fichte, meant a noumenon, and by a noumenon something " which arises only through our thinking." These are the very two views imputed to Kant by G-reen and Caird. Now, the curious fact is, that two years after Fichte had published these two interpretations, Kant himself wrote a most indignant letter, dated 7th August 1799, and published in the Intelligenzblatt der AUgem. Literatur-Zeit. v. J., 1799, No. 109 (Kant's Werke, ed. Hartenstein, viii. 600-601), on purpose to repudiate all connexion with Fichte. Fichte's Wissenchafislehre,he said, is a completely untenable system, and a metaphysics of fruitless apices, in which he disclaimed any participation ; his oWn Kritik he refused to regard as a propoedeutic to be construed by the Fichtian or any other standpoint, declaring that it is to be understood~~

~~*according to the letter ; and he went so far as to assert that his own critical philosophy is so satisfactory to the reason, theoretical and practical, as to be incapable of im- provement, and for all future ages indispensable for the highest ends of humanity. After this letter, it cannot be doubted that Kant not only differed wholly from Fichte, both about the synthetic unity of apperception and about the thing in itself, but also is to be construed literally throughout. When he said that the act of consciousness, " I think," is in allem Bewusstsein ein und dasselbe, he meant, as the whole context shows, not that it is one in all thinkers, but only that it accompanies all my other ideas and is one and the same in all my consciousness, while it is different in different thinkers. Though again in the Transcendental Dialectic he spoke of pure reason conceiving " ideals " of noumena, he did not mean that a noumenon is nothing but a thought arising only through thinking, or projected by reason, but meant that pure reason can only conceive the "ideal," while, over and above the "ideal" of pure reason, a noumenon is a real thing, a thing in itself, which is not indeed known, but whose existence is postulated by practical reason in the three instances of God, freedom, and immortality. Consequently Kant's expla^ nation of the unity of a thing is that there is always one thing in itself causing in us many pheno- mena, "which as understood by us are objectively valid for all our consciousnesses. What Kant never said, and what his whole philosophy prevented his saying, was that a single thing is a single thought of a single conscious- ness ; either of men, as in Fichte's philosophy, or of God and man, as in Hegel's. The passage from Kant to Hegel attempted by Green, and the harmony of Kant and Hegel attempted by Green and Caird, are unhistorical, and have caused much confusion of thought. The success, there- fore, of the works of Green and Caird must stand or fall by their Hegelianism, which has indeed secured many adherents, partly metaphysical and partly theo- logical. Among the former we may mention W. Wallace, the translator of most of Hegel's Encyklopddie, who had previously learnt Hegelianism from Ferrier ; W. H. Fair- brother, who has written a faithful account of Tim Philo- sophy of Thomas Hill Green (1896) ; R. L. Nettleship,*~~

~~*D. G. Ritchie, J. H. Muirhead, J. S. Mackenzie, and J. M.*~~

~~E. M'Taggart, who closes his acute Studies in Hegelian Cosmology (1901) with "the possibility of finding, above all knowledge and volition, one all-embracing unity, which is only not true, only not good, because all truth and all goodness are but distorted shadows of its absolute perfec- tion— 'das Unbegreifliche, well es der Begriff selbst ist.' "~~

~~There are still to be mentioned two English Hegelians,~~

~~who have not confused Kant and Hegel as Green did ; namely, S. S. Laurie, who attempts to discover a new passage from Kant to Hegel, and F. H. Bradley, who builds a more independent system on the Hegelian assumption that contradictions are capable of being re- conciled in a higher unity. Laurie is the author of Metaphysica Nova et Vetusta, a Return to Dualism, by Scotus Novanticus, 1884;' 2nd edition, enlarged, 1889. His attitude to Green is expressed towards the end of his book, where he says, " The more recent argument for God, which resolves itself into the necessity of a self-dis- tinguishing one basis to which Nature as a mere system of relations must be referred, is simply the old argument of the necessity for a First Cause dressed up in new clothes Not by any m.eans an argument to be despised, but stopping short of the truth through an inadequate analytic of knowledge. " His aim is to remedy this defect by psychology, under the conviction that a true metaphysics is at bottom psychology, and a true psychology fundamentally metaphysics. His psy- chology is founded on a proposed distinction between "attuition" and reason. His theory of "attuition," by which he supposes that we become conscious of objects outside ourselves, is his " return to dualism," and is indeed so like natural realism as to suggest that, like Ferrier, he starts from Hamilton to end in Hegel. As, however, he does not suppose that we have a direct perception of something resisting the organism, such as Hamilton maintained, it becomes necessary to explain exactly what he means by "attuition." It is, according to him, something more than sensation, but less than perception ; it is common to us with lower animals such as dogs; its operation consists in co-ordinating sensations into an aggregate which the subject throws back into space, and thereby has a consciousness of a total object outside itself, e.g., a stone or a stick, a man or a moon. He carries its operation before reason still farther, supposing that " attuition " makes particular in- ferences about outside~~

~~*objects, and that a man, or a dog, through association "attuites " sequence and invariableness of succession, and, in fact, gets as far in the direction of causation as Hume thought it possible to go at all. Laurie's view is that " attuition," and a dog who has no higher faculty, can go no farther ; but that a man goes farther by reason. He thinks that " attuition " gives us consciousness of an object, but without knowledge, and that knowledge begins with reason. His theory of reason brings him into contact with the German idealists : he accepts from Kant the hypothesis of synthesis and h priori categories, from Fichte the hypothesis that will is neces- sary to reason, from Schelling and Hegel the hypothesis of universal reason, and of an identity between the cosmic reason and the reason of man, in which he agrees also with Green and Caird. But he has a peculiar view of the powers of reason; that (1) under the law of excluded middle it states alternatives, A or B or C or D ; (2) under the law of contradiction it negates B, C, D ; (3) under the law of sufficient reason it says " therefore " ; and (4) under the law of identity it concludes, A is A. In working out this process, he supposes that reason throws into consciousness Si priori categories, synthetic predicates d, priori, or, as he also calls them, " dialectic percepts." Of these the most important is cause, of which his theory, in short, is that by this d priori category and the process of reason we go on from sequence to consequence ; first stating that an effect may be caused by several alternatives, then negating all but one, next concluding that this one as sufficient reason is cause, and finally attaining the necessity of the causal nexus by converting causality into identity, e.g., instead of " Fire burns wood," putting " Fire is com- burent, wood is combustible." Lastly, while he agrees*~~

~~*•with Kant about d, priori categories, he differs about the knowledge to be got out of them. Kant, applying them only to sensations, concluded that we can know nothing beyond by their means. But Laurie, applying them to " attuitions " of objects outside, considers that, though they are "reason-born," yet they make us know the objects outside to which they are applied. This is the farthest poiut of his dualism, which suggests a*~~

~~*realistic theory of knowledge, different in process from Hamilton's, but with the same result. Not so : Laurie is a Hegelian, using Kant's categories, as Hegel did, to argue that they are true not only of thoughts but of things; and for the same reason, that things and thoughts are the same. At first in his psychology he speaks of the "attuition" and the rational perception of an outside object. But in his metaphysics founded thereon he inter- prets the outside object to mean an object outside you and me, but not self-subsistent ; not outside universal reason, but only " Beent reason." He quotes, with approval, Schelling's phrase, " Nature is visible Intelligence and Intelligence visible Nature." He agrees with Hegel that there are two fundamental identities, the identity of all reason, and the identity of all reason and all being. Hence, he explains, what is a duality for us is only a " quasi-duality " from a universal standpoint. In fact, his dualism is not realism, but merely the distinction of subject and object within idealism. Laurie's metaphysics is an attempt to supply a psychological propoedeutic to Hegelian metaphysics.*~~

~~*Bradley's Appeara7ice and Reality (1893) is a more original performance. It proceeds on the opposite method of making metaphysics independent of psychology. "Metaphysics," says he, "has no direct interest in the origin of ideas " (254), and " we have nothing to do here with the psychological origin of the perception" (35). This metaphysical method, which we have already seen attempted by Lotze, is the true method, for we know more about things than about the beginnings of our knowledge. Bradley is right to go straight to reality, and right also to inquire for the absolute, in order to take care that his metaphysical view is comprehensive enough to be true of the world as a whole. He is unconsciously returning to the metaphysics of Aristotle in spirit ; yet he differs from it toto coe.lo in the letter. Let us see first what Aristotle says. Aristotelian metaphysics is the view that reality consists of natural and supernatural substances, in the sense of distinct individuals, numerically different; and that these substances, though distinct, are variously quantified, qualified, related ; that two substances being related are still different, e.g.', father and son, and qua different each per se, self-subsistent, independent ; that a thing cannot be contradictory in the sense of being and not being something at the same time and in the same respect, e.g., a square circle ; but that without contradiction it can be and not be at different times, or at the*~~

~~*same time in different respects, so that a body can change from one moment to the next in the same time, and any sub- stance can be one as a whole and many either in its attributes or in its parts ; that the same thing is capable of opposites, but is not actually both at once ; that the same thing can appear sweet to one man and bitter to another at the same moment or to the same man at different moments, but not to the same man at the same moment ; that finally everything is either different or the same, but not both at once. This is Aristotelianism in contrast with Bradleianism ih meta])liysics. The moder- ating genius of Aristotle introduced qualifications into metaphysical propositions in order to keep them within the truth and guard them against " sophistical difficulties." By simply omitting these qualifications, Bradley con- structs his metaphysics. HIs starting-point is the view*~~

~~*that things as ordinarily understood, and (we may add) as Aristotle understood them, are self -contradictory, and are therefore not reality, but appearances. If they were really contradictory they would be non-existent. How- ever, he illustrates their supposed contradictoriness by examples, such as one substance with many attributes, and motion from place to place in one time. But he faUs to show that a substance is one and many in the same respect, and that motion requires a body to be in two places at the same moment of one time. There is no contradiction between a man being determined by many attributes, as rational, six-foot-high, white, and a father, and yet being one whole substance distinct from any other including his own son ; nor is there any contradiction between his body being in bed at 8.15 and at breakfast at 8.45 within the same hour. Bradley's supposed con- tradictions are really mere differences. So far he reminds one of HIerbart, who founded his " realistic " metaphysics on similar misunderstandings ; except that, while HIerbart concluded that the world consists of a number of simple " reals," each with a simple quality but unknown, Bradley concludes that reality is one absolute experience which harmonizes the supposed con- tradictions in an unknown manner. If his starting-point recalls HIerbart, his method of arriving at the absolute recalls Spinoza. In his Table of Contents, chapter xiii., on the General Nature of Reality, he says, in true Spinozistic vein, " The Real is one substantially. Plurality of Reals is not possible." In the text he explains that, if there were a plurality of reals, they would have to be beings*~~

~~*independent of each other, and yet, as a plurality, related to each other ; and this again seems to him to be a contradiction. Throughout the rest of the work he often repeats that a thing which is related cannot be an independent thing. Now, if " independent " means " existing alone " and unrelated, the same thing could not be at once related and inde- pendent ; and, taking substance as independent in that sense, Spinoza concluded that there could only be one substance. But this is not the sense in which a plurality of things would have to be independent in order to exist, or to be substances in the Aristotelian sense. " Independent " (xopio-Tov), or " self-subsistent " (xa^' avro) means " exist- ing apart," i.e., existing differently, as I am not you: it does not mean " existing alone," solitary, unrelated. This existing apart is the only sense in which a plurality of things need be independent in order to be real, or in order to be substances ; and it is a sense in which they can all be related to each other, as I am not you, but I am address- ing you. There is no contradiction, then, though Bradley supposes one, between a thing being an individual, in- dependent, self-subsistent substance, existing apart as a distinct thing, and being also related to other things. Accordingly, the many things of this world are not self- discrepant, as Bradley says, but are distinct and relative substances, as Aristotle said. The argument, therefore, for one substance in Spinoza's Ethics, and for one absolute, the Real which is one substantially, in Bradley's Appeai-ances and Realitij, breaks down, so far as it is designed to prove that there is only one substance, or only one Real. Though the universe is one substance, one distinct thing, it includes many substances, many things distinct from, but related to, one another, liradley, however, having satisfied him- self, like Spinoza, by an abuse of the word " independent," that "the finite is self-discrepant," goes on to ask whatthe one Real, the absolute, is ; and, as he passed from Herbart to Spinoza, so now he passes from Spinoza to Kant. Spinoza answered realistically that the one substance is both extended and thinking. Bradley answers idealistic- ally that the one Real is one absolute experience, because all we know is experience. " This absolute," says he, " is*~~

~~*experience, because that is really what we mean when we predicate or speak of anything." But in order to identify the absolute with experience, he is obliged, as he before abused the word" contradictory" and the word " independent," so now to abuse the word " experience," which he takes in a far wider sense than any philo- sopher before him. " Experience," says he, " may mean experience only direct, or indirect also. Direct experi- ence I understand to be confined to the given simply, to the merely felt or presented. But indirect experience includes all fact that is constructed from the basis of the ' this ' and the 'mine.' It is all that is taken to exist beyond the bare moment " (248). This is to substitute " indirect experience " for all inference, and to main- tain that when, starting from any " direct experience," I infer the back of the moon, which is always turned away from me, I nevertheless have experience of it ; nay, that it is experience. Having thus confused con- tradiction and difference, independence and solitariness, experience and inference, Bradley is able to deduce finally that reality is not different substances, expe- rienced and inferred, as Aristotle thought it, but is one absolute super-personal experience, to which the so- called plurality of things, including all bodies, all souls, and even a personal God, is appearance — an appearance, as ordinarily understood, self-contradictory, but, as ap- pearing to one spiritual reality, somehow reconciled. But how ?*~~

~~*(3) Other German Influences. — Meanwhile, but less noticeably, other English idealists, inside and outside the dominant phenomenalism of Hume, have quarried in the rich mines of German idealism. G. H. Lewes (1817- 1878) was a thorough disciple of Hume's phenomenalism in his main position, that all phenomena, objective and subjective, all we perceive, all we know, things in them- selves, the absolute, all are feelings, which are felt or might be felt. He saw, moreover, how Spencer has enriched empiricism " by showing that the constant experiences of the race become organized tendencies which are transmitted as a heritage " ; and also how he has confused empiricism by supposing with Hamilton the existence, apart from all appearances, of an absolute noumenon, which, according to Spencer, is unknowable, but, according to Lewes, " metempirical," or in other words, beyond all sense, inference, and verification, an ideal construction, not of science, but of imagination. So far Lewes was an English philosopher. At the same time a sympathetic*~~

~~*lover of literature of all kinds, he absorbed something from French and more from German sources. Affected by the positivism of Comte in his earlier days, he retained the positivist's convic- tions that there is no metaphysics of a world beyond phenomena, and that psychology is a branch of biology. But he was really nearer to Mill's psychological positivism, based on the method of introspection which Comte had rejected. In his later days, when he gradually elaborated his final system in Problems of Life and Mind (1875-79), Lewes had fallen under the spell of Kant and his suc- cessors, and produced a compromise between Hume and Kant, which reminds us of some of the later German phenomenalisms which we have already described. He agreed with Kant, as with Hume, in limiting knowledge to experience of mental phenomena of sense. He also went beyond Hume, and developed Kant's view of under- standing — according to which understanding forms con- ceptions which must, however, be reduced to sensory intuition in experience — into a theory of inference. In- ference, according to Lewes, is an ideal construction of uni- versal conceptions symbolical of the sensible, and requiring verification by reduction to sense; it is not concluding that there are extrasensible like sensible things. Such a*~~

~~*theory ignores the fact that science infers not only univer- sal but also particulars, e.g., a particular eclipse, and par- ticulars which are not always verifiable, e.g., the back of the moon, a star only inferrible from a photograph, &c. But it is a theory of all the inferences which the phenomenalism of Hume could allow, or the phenomenalism of Kant when reduced to consistency. Lewes, moreover, thought that there was something even in Kant's transcendentalism ; but that Kant was wrong in preferring " selbstgedachte erste Principien dpriori " to " eingepflanzte Anlagen zum Denken," in order to vindicate a knowledge of necessity, and Spencer right in asserting inherited organized ex- periences. He rejected, in fact, everything in Kant's Kritik which savoured of the " metempirical," whether it was Kant's belief in the transcendental power of the mind to generate the d. priori, or his belief in the transcendent existence of a noumenon. With Hegel, however, noume- nalist as he was, the phenomenalist Lewes sympathized in one respect ; namely, in the identification of cause and effect, except that he interpreted the hypothesis phenome- nalistically by sayingthat "cause and effect are two*~~

~~aspects of the same phenomenon." But his main sympathy was with another noumenalist — Eechner. In the second volume of Problems of Life and Mind, Problem VI., on "The Absolute in the Correlations of Peeling and Motion," is simply an adaptation of Pechner's psychophysical paral- lelism. It begins by quoting the now celebrated passage from the Elemente der Psychophysik, i. 2, in which Pechner compares the spiritual and bodily sides of a man to the inner and outer sides of a circle ; and it agrees with Pechner throughout that the two sides are to be identified by first regarding them as the objective and subjective aspects of one process, and then regarding that one pro- cess as only apparently bodily, but really spiritual, or, as Lewes thought in his phenomenalistic way, feeling ; so that the absolute is feeling. In detail, he agreed closely withPechner's"innerpsychophysics,"holding that neural process and feeling are one process viewed objectively and subjectively ; that feeling is a function of the organism quantitatively varying with it ; but that the neural process does not produce the feeling. " If it did," says he, " the law of the conservation of energy would be at fault, since a motion would terminate in what was neither motion nor a mode of motion." He thought that, if we identify feeling and neural process, the old mystery of the mutual action of mind and body is dispelled. He saw the diflB.culty, as Pechner did, that there are neural processes below and above consciousness and sensation ; and he adopted Pech- ner's solution, that sensation is an integration of sensible units parallel to and identical with neural units or tremors, and that there are certain limits between which neural tremors are fused into neural processes and emerge in con- sciousness ; while beyond these limits, on either side, there is no sensation, only sensible units. In fact, he adopted the gist of Pechner's "inner psychophysics," without, however, Pechner's noumenalistic hypothesis that what is uncon- scious in us is conscious in the all-embracing spirit of God. His phenomenalism also compelled him to give a more mod- ified adhesion to Pechner's "outer psychophysics." It will be rememberedthat Pechner regarded every composite body as the appearance of a spirit ; so that when, for example, molecular motion of air is said to cause a sensation of sound in me, it is really a spirit appearing as air wbii h causes the sensation in my spirit. This noumenalism would not do for Lewes, who says that air is a group of qualities, and qualities are feelings, and motion is a mode of feeling.~~

~~What, then, could he make of the external stimulus? He was obliged by his phenomenalism to say that it is only one feeling causing another in me. He ingeniously suggested that the external agent is one feeling regarded objectively, and the internal effect another feeling regarded~~

~~subjectively; "and therefore," to quote his own words, "to say that it is a molecular movement which produces a sensation of sound, is equivalent to saying that a sensa- tion of sight produces a sensation of hearing." Accordingly his final conclusion is that " existence — the absolute — is known to us in feeling," and " the external changes are symbolized as motion, because that is the mode of feeling into which all others are translated when objectively con- sidered : objective consideration being the attitude of looking at the phenomena, whereas subjective considerar tion is the attitude of any other sensible response." He does not say what happens when we use vision alone, and still infer that an external stimulus causes the internal sensation. But his metaphysics is an interesting exam- ple of a phenomenalist, sympathizing with noumenalists so different as Hegel and Fechner, and yet maintain- ing his phenomenalism. In this feature, in reducing Fechner's cosmic to a psychological parallelism of psy- chical and physical, and in supposing that all we know is feelings, in which mind and matter are opposed but not as distinct exi stents, while inference can make ideal con- structions but without knowing anything beyond, the phenomenalism of Lewes is the English parallel to the German phenomenalism of Wundt. At the same time, and under the derivative influence of Wundt, rather than the more original inspiration of Fechner, W. K. Clifford (1845-1879) was working out the hypothesis of psycho- physical parallelism to a conclusion different from that of Lewes, and more allied to that of Leibnitz the prime originator of all these hypotheses. Leibnitz had asserted that all monads have perceptions, that motions and per- ceptions are merely parallel, and that conscious percep- tions are composed of unconscious " petites perceptions." Fechner developed this panpsychistic parallelism into an idealistic and noumenalistic identity, and gave a more mathematical form~~

~~*to the composition of consciousness out of units in his Elements der PsycJiophysik, ii. 45. After the publication of this work in 1860, the hypothesis that conscious states are composed of unconscious units became common not only in Germany, but also in Eng- land and in France. We have traced its influence on Lewes. But before the publication of Lewes's Problems, Spencer, in discussing the Substance of Mind (Principles of Psychology, 2nd edition, 1870, Part H., chap, i.), had already supposed that feelings, e.g., sensations of sound, are resolvable into simpler feelings, or nervous shocks corresponding to the shocks of molecular change, that perhaps all the units of feeling are homogeneous, and that possibly units of external force may be identical with units of feeling; only that we must remember that this phenomenal analysis does not reach to the substance of noumenal matter or noumenal mind, both of which are unknowable things in themselves. Clifford broke down this artificial distinction by advancing the further hypothesis that the supposed unconscious units of feeling, or psychical atoms, are the " mind-stuff " out of which everything physical and psychical is composed, and are also things in themselves, such as Kant supposed when he threw out the hint that after all "the Ding-an-sich might be of the nature of mind" (see Mind, 1878, 67). As a matter of fact, this " mind-stuff" of Clifford is far more like the "petites perceptions" of Leibnitz, from which it is indirectly derived. Clifford first brought out this hypothesis at the Sunday Lecture Society, 1st November 1874. Both then and afterwards he connected it with the hypothesis of psychophysical parallelism. HIe maintained that the physical and the psychical are two orders which are parallel without interference ; that the physical or objective order is merely phenomena, or groups of feelings, or "objects," while the psychical or subjective order is both a stream of feelings of which we are conscious*~~

~~*in ourselves, and similar streams which we infer beyond ourselves, or, as he came to call them, " ejects " ; that, if we accept the doctrine of evolution at all, we must carry these ejective streams of feelings through the whole organic world and beyond it to the inorganic world, as a " quasi- mental fact " ; that at bottom both orders, the physical phenomena and the psychical streams, are reducible to feelings ; and that therefore there is no reason against supposing that they are made out of the same*~~

~~*"mind- stuff," which is the thing-in-itself. The resemblance of this noumenal idealism to that of Fechner is unmistak- able. The difference is that Clifford considers "mind- stuff" to be unconscious, and denies that there is any evidence of consciousness apart from a nervous system. He agrees with du Bois-Eeymond in refusing to regard the universe as a vast brain animated by conscious mind. He disagrees with Fechner's hypothesis of a world-soul, the highest spirit, God, who embraces all psychophysical processes. Curiously enough, his follower G. J. Ro- manes (1848-1894) took the one step needed to bring Cliffordism completely back to Fechnerism. In his Rede Lecture on Mind and Motion (1886), he said that Clif- ford's deductions, that the dissolution of a human brain implies the dissolution of a human mind, and hence also that the universe, although entirely composed of mind- stuff, is itself mindless, did not follow by way of any logical sequence from his premisses. Afterwards, when the Lecture was published in Mind and Motion and Monism (1895), this work also contained a chapter on "The World as an Eject," in which Romanes again con- tended against Clifford that the world does admit of being regarded as an eject, that is, as a mind beyond one's own. At the same time, he refused to regard this " world-eject " as personal, because personality implies limitation. It seems reasonable to conclude, he says, that the integrating principle of the whole — the Spirit, as it were, of the Universe — must be something akin to, but immeasurably superior to, the " psychism " of man. Nothing can be more curious than the way in which a school of English philosophers, which originally stai-ted from Hume, the most sceptical of phenomenalists, thus gradually passed over to Leibnitz and Fechner, the originators of panpsychistic noumenalism. The Spirit of the Universe contemplated by Romanes is identical with the World-soul contemplated by Fechner.*~~

~~*Karl Pearson, in TJie Gh-ammar of Science (1892, 2nd enlarged edition 1900), starting from" Hume's phenomenal idealism, has developed views so like Mach's universal physical phenomenology, that it is hardly necessary to repeat here what we have already said about Mach. What Hume called repeated sequence Pearson calls " routine " of perceptions, and, like his master, holds that cause is an antecedent stage in a routine of perceptions ; while he also acknowledges that his account of matter leads him very near to John Stuart Mill's definition of matter as " a per-*~~

~~manent possibility of sensations." He copies a picture from Mach's Beitriige znr Analyse der Empfindiingen, designed to show that one's bodyj so far as visible, with its environment is part of the world of sense appearing to be outside. His views, in his chapter on the Laws of Motion, that the physicist forms a conceptual model of the universe by aid of corpuscles, that these corpuscles are only symbols for the component parts of perceptual bodies, and that force is a measure of motion, and not its cause, are the views of Mach. At the end of this chapter he says that the views put forward in it were reached when the author was studying the laws of motion for teaching purposes in 1882," and were developed for the purpose of college lectures in 1884, but that the only pub- lished work in which the author has found any indication of similar opinions, or from the perusal of which he has~~

~~received any help, is Mach's Die Mechanik in Hirer EntwicMung (1883). In point of fact, Mach had begun to put them forward in 1872, and Kirchhoff in 1874. But they may very well have been developed independently in Germany and in England from their common source in Hume. Their point is to stretch Hume's phenomenalism so as to embrace all science, by contending that mechanism is not at the bottom of phenomena, but is only the con- ceptual shorthand by aid of which men of science can briefly describe phenomena, and that all science is descrip- tion and not explanation. These are the views of Mach and of Pearson, as we read them in the latter's Preface. Nor can we find any difference, except the minute shade that Pearson takes up a position of agnosticism between Clifford's assertion of " mind-stuff " and Mach's denial of things in themselves. J. Ward, in Naturalism and Agnos- ticism, (1899), starts from the same phenomenalistic views of Mach and Kirchhoff about mechanics ; he proceeds to the hypothesis of duality within experience, which we have traced in the phenomenalisms of Schuppe, Avenarius, and Wundt, and to the hypothesis of one consciousness, which appears variously in the German idealisms, not of Kant, as Ward thinks, but of Fichte, Hegel, and Schuppe ; and somehow he manages to end with the~~

~~*noumenalistic conclusion that Nature is God's Spirit. Though this work evinces a thoroughly English love of compromise, yet it is not merely eclectic, but is animated throughout by the in- spiration of his "old teacher, Lotze," as Ward affec- tionately calls him. Lotze, as we saw, rejected bodily mechanism, reduced known bodies to phenomena, and concluded that reality is the life of God. Ward on the whole follows this triple scheme, but modifies it by new arguments founded on later German phenomenalism. Under the first head, mechanics, according to Ward, can dispense entirely with " real categories." He means, in obedience to the views of Mach and Kirchhoff, that mass and force are not substance and cause ; that, while mass means "mass-points," force only means mass-acceleration which is not a cause but an event; and that mechanics, requiring not causality but only depend- ence, is merely descriptive, or kinematical. He also identifies mass with quantity of inertia, and concludes with Leibnitz that there is passivity but no activity in the physical world. He adds that mechanics, having gradually rid itself of the categories of substance and cause, begins and ends with abstractions ; that it is clear of all induction ; and that the application of abstract mechanics to real bodies is throughout hypothetical, while ether is " non-matter in motion," and ■ inconsistent with realism. " Molecules, atoms, ether, prima materia — one and all," says he without making any distinctions, " are hypothetical." They are even less according to him ; for he holds that whatever is inferred beyond " perceptual realities" in mechanics, or any other natural science, matter and force, " mass-points " and motions, time and space, are conceptions; ideas not facts; thoughts not things ; not " perceptual realities," not " phenomena," but abstract ideal conceptions devised for the description of such ; and conceptions not causes. All this attack on mechanics is pure Machisni, and, if consistently carried out, would have carried Ward no farther than Mach. Under the second head, according to Ward, as according to Wundt, knowledge is experience ; we must start with the duality of subject and object, or per- ceptual reality, phenomenon, in the unity of experience, and not believe, as realists do, that either subject or object is distinct from this unity ; moreover, experience requires " conation," because it is to interesting objects that the subject attends ; conation is required for all synthesis, associative and intellective ; thinking is doing; presentation, feeling, conation are one inseparable whole ;*~~

~~*and the unity of the subject is due to activity and not to a substratum. But, in opposition to Wundt and in common with Schuppe, he believes that experience is (1) experience of the individual, and (2) experience of the race, which is but an extension of individual experience, and is variously called, in the course of the discussion, universal, collective, conceptual, rational experience, con- sciousness in general, absolute consciousness, intelligence, and even, after Caird, "a perfect intelligence." He regards this universal experience as the result entirely of intersubjective intercourse, and concludes that its sub- ject is not numerically distinct from the subject of individual experience, but is one and continuous with it, and that its conceptions depend on the perceptions of individual experience. He infers the corollary that universal experience contains the same duality of sub- jective and objective factors without dualism. He thinks that it is the origin of the categories of causality, which he refers to " conation," and substance, which he attributes to the interaction of active subjects with their environ- ment and to their intercourse with each other. He applies universal experience, as Schuppe does, to explain the unity of the object, and its independence of individ- ual but not of universal experience, holding that the one sun, and the whole world of intersubjective intercourse, or the "trans-subjective" world, though "independent of the individual percipient as such," is "not independent of universal experience, but the object of that experience " (ii. 196-197). He applies universal experience to explain how we come, falsely in his opinion, to believe that the object of experience is an independent thing ; and he uses three arguments, which are respectively those of Schuppe, Avenarius, and Wundt. He supposes first, that we falsely conclude from the sun being independent of each to being independent of all; secondly, that by "introjection" we falsely conclude that another's experience is in him and therefore one's own in oneself, while the sun remains outside ; and thirdly, that by " reification " of abstractions, natural science having abstracted the object andpsychology the subject, eachfalsely believes thatits own abstract,the sun or the subject, is an independent thing. What, then, could we know from this " duality in experience " ? He hardly has a formal theory of inference, but implies throughout that it only transcends perceptions, and perceptual realities or phenomena, in order to conclude with ideas, not facts. When we combine his view of Nature under the first head that whatever is inferred in the natural sciences is ideas, with his*~~

~~*view of knowledge under the second head that knowledge is experience, and experience, individual or universal, is of duality of subject and object in the unity of experience, it follows that all we could know from the data would be one experience of the race, one subject consisting of individual subjects, and in Nature single objects in the unity of this universal experience; and beyond we should be able to form conceptions dependent on the perceptions of individual experience in the unity of universal experience : that is all. There can be no doubt that Mach, Schuppe, and Wundt drew the right pheno- menalistic conclusions from such phenomenalistic data. Not so Ward, who proceeds to a Natural Theology, on the ground that " from a world of spirits to a Supreme Spirit is a possible step." He had definitely confined universal experience to the one experience of the race. But perhaps Caird's phrase " a perfect intelligence " has beguiled him into thinking that the one subject of universal experience is not mere mankind, but God Himself. Under the third head, however, his guide is Lotze. The argument may be shortly put as follows : — As the Nature which is the object of mechanics and all natural sciences, is not natural substances, but phenomena and ideas ; as mass is not substance, and force is not cause ; as activity is not in the*~~

~~*physical but in the psychical world; as the laws of Nature are not facts but teleological conceptions, and Nature is teleological, as well as not mechanical but kinematical ; as the category of causality is to be referred to " conation " ; as, in short, " mind is active and matter inert," what then ? One subject of universal experience, one with the subjects of individual experience, you would suppose, and that Nature as a whole is its one object. Not so, according to Ward ; but " God as the living unity of all," and "no longer things, but the connecting con- serving acts of the one Supreme." What, then, is the relation of God to the one universal experience, the experience of the race, which was under the second head the unity in duality of all knowledge ? He does not say. But instead of any longer identifying the experience of the race and universal experience, he*~~

~~*concludes his book by saying " our reason is confronted and determined by universal reason." This is his way of destroying Natu- ralism and Agnosticism.*~~

~~*(4) Personal Idealism.- — Mechanics does not abstract from the essentials of bodies, but only from their accidents ; for, as we saw in dealing with Mach, the third law of motion was generalized by induction from the collision of bodies, which, as triply extended and mutually impenetrable substances, by their inter-resist- ance reduce one another to a joint mass with a common velocity so as to avoid penetration. The essential ex- tension, inertia, and mutual impenetrability of bodies constitute the negative instance to all idealism : unless these are the attributes of Spirit, Nature is not Spirit. Again, Nature is one, but not one system of one con- sciousness. There is no one consciousness ; the supposi- tion of it is a confusion of same and similar. Men's minds are alike, but different. Not only do men disagree and contradict one another, but also they differ more in their minds than in their bodies. What would I not give for the mind of Aristotle or of Bacon ? Moreover, men know but little of one another's minds, and that indirectly ; only through their bodies, as far as we know. Consciousness is personal. I am conscious of myself, but infer everybody else. Hence it is a healthy sign that, even among the idealists, a protest is beginning to be made against the hypothesis of one mind, in favour of the personality of individuals. That this protest should arise in England against Green, Caird, and Bradley is only what might be expected. The English have long believed in individuality, in private judgment, in freedom, in the individual conscience. English moral philosophy cannot long tolerate a metaphysics which, by merging all minds in one, would destroy personality, personal causation, and moral responsibility, as J. Martineau well said. Moreover, there are signs that Green would have agreed with Martineau ; for, though he resolves the whole world into one eternal intelligence, yet, however inconsistently, he wanted to make out that this absolute reproduces itself in each of us, and even in connexion with an individual animal organism. But the rise of a personal idealism is not directed merely against .the English Hegelians and their master. It is also opposed to the one substance of Spinoza, the pure ego of Fichte, the absolute of Schelling in his first philosophy, and the common consciousness of*~~

~~*Schuppe and of Ward. It is a return to the idealistic theories of personality held by Descartes, Leibnitz, Berkeley, Kant, Schelling in his later philosophy, and Fechner. Indeed, we must not suppose that recent personal idealists form one school, or that they have mastered the nature of personality, or that they have as yet worked out great systems. They are only united by their consciousness of the existence of personality.*~~

~~*Andrew Seth Pringle Pattison is the protagonist of the movement in his books on Scottish Philosophy (1886), and*~~

~~*Hegelianism and Personality (1887). " The radical error," says he, " both of Hegelianism and of the allied English doctrine I take to be the identification of the human and the divine self-consciousness, or to put it more broadly, the unification of consciousness in a single self"; and immediately afterwards, "Each of us is a self " ; and in another passage, " The real self is one and indivisible, and is unique in each individual. This is the unequivocal testimony of consciousness." What makes his vindication of conscious personality all the more interesting is that he has so much in common with the Hegelians ; agreeing as he does with Hegel that self- consciousness is the highest fact, the ultimate category of thought through which alone the universe is intel- ligible, and an adequate account of the great fact of existence. He agrees also that there is no object without subject. It is difficult to see exactly where he begins to differ from Hegel ; but at any rate he believes in different self-conscious persons ; he does not accept the dialectical method, but believes in beginning from the personal experience of one's own self-consciousness ; and, though he is not very clear on the subject, he would have to admit that a thing, sirch as the sun, is a different object in each person's consciousness. "Every Ego," says he, "carries in itself a Non-Ego^ but that does not justify us in sweeping all existence without more ado into the circle of a single self-consciousness, identifying Nature with the Non-Ego of God, and simplifying the problem by extruding our own self-consciousness altogether" (Hegelianism, p. 162). He is not a systematic thinker, but is too much affected by the eclectic notion of recon- ciling all philosophies. Thus, he thinks, on the one hand, that the Berkeleian analysis of Mill and Bain is absolutely true as psychology, but must not pass off as metaphysics, although, if any metaphysics but idealism is true,*~~

~~*the Berkeleian psychology is false ; and he thinks, on the other hand, that Natural Eealists who believe in an intuition of the external world can accept the Hegelian metaphysics that Nature is " the other " of thought, when the former believe that the external world is perceived as body resisting the organism. F. C. S. Schiller, in Piddles of the SjMnx (1891), is a more systematic thinker. He rejects the difference between matter and spirit. He agrees with Leibnitz in the analysis of the material into the immaterial, but with Lotze in holding that the many immaterial elements coexist and interact. At the same time he differs from Lotze's conclusion that their union requires one absolute substance. Again, he thinks that sub- stance is activity ; differing from both Leibnitz and Lotze herein, and still more in not allowing the existence of the many beyond experience. Hence his personal or pluralistic idealism is the view that the world is a plurality of many coexisting and interacting centres of experience, while will is the most fundamental form of experience. In con- nexion with these views, it is a pleasure to welcome the appearance of Personal Idealism, Philosophical Essays by Eir/ht Members of the Ut)i versify of Oxford (1902), edited by H. Sturt, and numbering Schiller, as well as'G. F. Stout, H. Kashdall, and others among its contributors. They do not all agree with one another, or perhaps even with the title. Nevertheless, there is a common tendency in them, and in the University of Oxford, towards the belief that, to use the words of the editor, "We are free moral agents in a sense which cannot apply to what is merely natural." There is indeed much more activity of thought at Oxford than the world suspects. IMansel and Jowett, Green and Caird, Bradley and Bosanquet have arisen in quick succession, and in 1902 are being succeeded by a generation which is the centre of a new movement in metaphysics. We may also notice that the same sort of antithesis between the one and the many has*~~

~~*appeared in the United States. J. Eoyce is a believer in the absolute like Green and Bradley, in " the unity of a single self-consciousness, which includes both our own and all finite conscious meanings in one final eternally present insight," as he says in Tlie World and the Indi- vidual*~~

(1900). G. T. Ladd also believes in " a larger all- inclusive self," and goes so far as the paradox that perfect personality is only reconcilable with one infinite being. While Royce is Hegelian, Ladd prefers Lotze, but both believe in one mind. William James, on the other hand, in his psychological works shows that the tendency of re- cent psychology is to personality, interpreted idealistic- ally ; though without a very clear appreciation of what a person is, and personality means. By a curious coincidence, almost at the tiiue of the appearance of the Essays on Personal Idealism in England, an American writer, G. H. Hewison, published The Limits of Evolution, and other Essays illustrating the Metaphysical Theory of Personal Idealism (1901). But lately there has been an increase of philosophical intercourse between English and Ameri- can universities, which is a hopeful sign of progress in both : they have much to learn from one another.

The advent of personal idealism is a welcome protest against the confusion of God and man in one mind, and against the confusion of one man's mind with another's. But it has not passed as yet from negative to positive philosophy. As it advances, it will carry the new school in different and unexpected directions. It will end in realism. I am conscious only of myself as a person, and of my bodily signs. I know the existence of other human persons and minds only through their giving similar bodily signs. If the personal idealist consistently denies other bodies, then the bodily signs become, according to him, only part of his experience, which can prove only the existence of himself. To infer another mind he must infer another body, and the bodily environment including his and other bodies. Again, in being conscious of myself, I am not conscious of my mind in the abstract without my body. I cannot separate touching from my tactile organs, seeing from my eyes, or hearing from my ears. I cannot think my body away. Moreover, I am not conscious of my whole personal life at all. How do I know that I was born, though I cannot remember it, and that I shall die, though I am not now conscious of death ? How do I know that I am the same person from birth to death ? Not by my consciousness, but by knowing the bodies of others — ^of babies on the one hand, and of old men on the other hand. It is usual to say that the body has not enough unity to be part of the person : the objec- tion is much more true of conscious mind. The truth is that not the unity of

~~consciousness but the fact of its existence is the important point. The existence of my consciousness is my evidence for my soul. But it does not prove that I am nothing but soul. As a human person, I am body and soul ; and the idealistic identifi- cation of the ego with soul or mind, involving the corol- lary that my body belongs to the non-ego and is no part of myself, is the reductio ad absurdum of idealism. Lastly, though the personal idealists are right in rejecting the hypothesis of one mind, they are too hasty in supposing that the hypothesis is useless for idealistic purposes. No idealism can explain how we all know one sun, except by supposing that we all have one mind. The difficulty of personal idealism, on the other hand, is to reconcile the unity of the thing with the plurality of thinkers. The unity of the sun can only be explained either idealistic- ally by supposing it to be one object of one mind, or realistically by supposing it to be one thing distinct from the many minds which think about it. The former alternative is false, the latter true. Personal idealism, therefore, must end in personal realism.~~

~~§ 7. Eealism.~~

~~(1) Metaphysical and Psychological Realism. — Realism is the view that some known things are bodily, and some are mental. At its best, it is the Aristotelian view that both are substances. The modern misunderstanding of " substance " has been a main cause of the confusion of modern thought. Aristotle meant by it any distinct thing ; e.f/., I, you, an animal, a plant, the earth, the moon, the sun, God. IIe calls each of these, as existing apart, a thing per se {Ka.6' airo). It is true that, having divided a natural substance into form and matter, he called each element " substance." But these are not primary mean- ings ; and matter, or supposed substratum, in particular, he s^ys, is not actually substance (Met. Z 3) or is only potentially substance (Met. II 1-2). In modern times, Spinoza, by a mere mistake, changed the meaning of " substance " from " existing apart " to " existing alone," and consistently concluded that there is only one. Locke mistook it to mean " substratum," or support of qualities, and naturally concluded that it is unknown. Kant, taking it in the mistaken meaning of Locke, converted it into the A priori category of tlie permanent substrate beneath the changes of phenomena, and even went so far as to separate it from the thing in itself, as .'substantia pheno-~~

~~*menon from noumenon. When it had thus lost every vestige of its true meaning, Kant's successors naturally began to speak of things as being distinct without being substances. Fichte began this by saying that ego is activity, and being is life. Hegel said that spirit is not substance but subject, which to Aristotle would have meant that it is not a distinct thing, yet is a distinct thing. Eechner, Wundt, and Paulsen have fixed the conclusion in psychology that soul is not substance but unity of mental life ; and Wundt concludes from the modern history of the term that substance or " substrate " is only a secondary conception to that of causality, and that, while there is a physical causality distinct from that of substance, psychical causality requires no sub- stance at all. The result of this confusion is that the moderns, who think themselves a thousand times wiser than Aristotle, have no name at all for a distinct thing, and, being mere slaves of abstract terms, constantly speak of mere attributes, such as activity, life, will, actu- ality, unity of mental operations, as if they were distinct things. Attributes, it may be said, are knowable things, and indeed are often objects of science : thus, arithmetic deals with unity and number ; geometry, with extension and figures; mechanics, with motion, force, and energy ; morals, with happiness, virtue, and conscience ; and politics with government and taxes. But an attribute, though real, is not a distinct reality, but is only a determinant of a substance, and has no being of its own apart from the substance so determined ; whereas a substance, deter- mined by all its attributes, is different from everything else in the world. Though, for simplicity and univer- sality of thought, even in science, we must use the ab- straction of attributes, and, by the necessity and weak- ness of language, must signify what are not substances by nouns substantive, we must guard against the over- abstraction of believing that a thing exists as we abstract it. A thing, as it is known to exist in rerum naturA, is never a single attribute, e.g., unity ; nor a sum of attri- butes, e.g., humanity ; nor a substratum beneath these attributes in the abstract ; but is always a single thing, wholly determined by all its attributes in the concrete, and different from everything else, e.g., a man, a body, God. The point of true realism is Aristotle's point that the world consists of such distinct, though related, things, and therefore of substances, natural and supernatural. Again, the method of true realism is that of Aristotle, and*~~

consists in recognizing the independence of metaphysics. The contrary method is psychological metaphysics, which makes metaphysics dependent on psychology, on the ground that the origin of knowledge determines its limits. This is the method which, as we have seen, has led from psychological to metaphysical idealism, by the argument that what we begin by perceiving is men- tal, and, therefore, what we end by kno'vy'ing . is men- tal. Now, there is no principle of method superior to that of Aristotle — we must begin with what is known to us. If one could begin as a child to register a history of one's own operations, one might proceed from origin to limits. But the psychologist and the meta-physician is always a grown man^too late for this pro- cess from his psychology to his metaphysics. The things best known to him are the things which he now knows as a man. About these known things there is some agreement : about the beginnings of knowledge there is nothing but controversy. We do not know enough about the origin of knowledge to determine its limits. Hence, to proceed from psychology to metaphysics is to proceed from the less to the more known ; and the paradoxes of psychological have caused those of metaphysical idealism. The realist, then, ought to begin with metaphysics with- out psychological prejudices. He must ask what are known things, and especially what has been discovered in the sciences ; in m.echanics, in order to find the essence of bodies which is neglected by idealism ; in mental science, in order to understand consciousness which is neglected by materialism. With the conviction that the only fair way of describing metaphysics has been to avoid putting forward one system, and even to pay most atten- tion to the dominant idealism, we have nevertheless been driven occasionally to test opinions by this independent metaphysical method. The chief results we have found against idealism are that bodies have not been success- fully analysed except into bodies, as real matter ; and that bodies are known to exert reciprocal pressure in reducing one another to a joint mass with a common velocity by being mutually impenetrable, as real forces. The chief results we have found against materialism are that bodies evolving account neither for the origin of themselves, their nature, and their

~~*fundamental order of resem- blance and difference, nor for the nature and origin of consciousness, nor even as yet for their becoming good for conscious beings. Hence we come to the realistic conclusions, that among known substances some are bodies, others are souls ; that man is body and soul ; and that God is a pure soul or spirit. At the same time, while the independence of metaphysics leads us to metaphysical realism, this is not to deny the value of psychology, still less of logic. Besides the duty of determining what we know, there is the duty of deter- mining how we know it. But in order to discharge it, a reform of psychology as well as of metaphysics is re- quired. Two psychological errors, among many others, constantly meet us in the history of idealism — the arbi- trary hypothesis of a sense of sensations, or of ideas, and the intolerable neglect of logical inference. The latter error we have endeavoured to correct in dealing with Logic. Logical inference from sense is a process from sensible to insensible existence. The former error needs something deeper than a Kantian critique of reason, or an Avenarian criticism of experience ; it needs a criticism of the senses. We want an answer to this question — What must we know by the senses in order to enable us to know what we infer by reason in the sciences ? AMth- out here aiming at exhaustiveuess, we may bring forward against the dominant idealism a psychological theory of sense and reason. By touch, I piu-ceive one bodily mem- ber reciprocally pressing another in myself, e.g., lip press-*~~

~~*ing lip ; by touch again, I perceive one bodily member sim- ilarly pressing but not another member in myself, e.g., only one lip pressing ; by inference from touch, I infer that it is reciprocally pressing another body similar to my other bodily member, e.g., another body similar to my other lip. Johannes Milller recognized this sense of resistance be- tween one's own members, and its importance for know- ledge, but confused it with the inference of external resistance (see his Elements of Physiology, translated by Baly, p. 1081). On this theory, then, founded on the conscious facts of double and single pressure in touch, and on the logic of inference, we have at once a reason for our knowledge of external bodies, and an explanation of the early appearance of that knowledge. The child has only to have its mother's nipple in its mouth in order to infer something very like the mutually pressing parts of its own mouth. Having thus begun by touch and tactile inference, we confirm and extend our*~~

~~*inferences of bodies in Nature by using the rest of the senses. This is not to forget that the five senses are not our whole stock, or to confine inference to body. We have also the inner sense of consciousness which is inexplicable by body alone. By combining, moreover, our knowledge of Nature with our consciousness of our own works, we can infer that Nature is a work of God. Next, finding that He gives signs of bodily works, but no signs of bodily organs, we can infer that God is a Spirit. Finally, returning to our- selves, we can conclude that, while the conscious in God is Spirit without Body, in us it is spirit with body. This final distinction between bodily and spiritual sub- stances we owe to Descartes.*~~

~~*(2) T7ie Undercurrent of Modern Realism. — Coming after the long domination of Aristotelian realism, Des- cartes and Locke, though psychological idealists, were metaphysical realists. They were what Hamilton called cosmothetic idealists and hypothetical realists. Their position was so illogical that it was easily turned into metaphysical idealism. But their psj'chological method and idealism produced another mistake — the tendency to a modicum of realism, as much as seemed to this or that author to follow from psychological idealism. Thus we have Spinoza and Leibnitz, and then his disciple Wolff (1679-1754), who emphasized the realistic side of Leib- nitz. In Germany, since the victory of Kant over Wolff, realism has always been in difB.culties, which we can ap- preciate when we reflect that the Germans by preference apply the term " realism " to the paradoxes of Herbart (1776-1841), who, in order to avoid supposed contradic- tions, supposed that bodies are not substances, but show (Schem), while "reals " are simple substances, each with a simple quality, and all preserving themselves against disturbance by one another, whether physically or psycho- logically, but not known to be either material or spiritual because we do not know the simple quality in which the nature of the real consists. There have indeed been other realisms in Germany. Trendelenburg (1802-1872), a formidable opponent of Hegel, tried to surmount Kant's transcendental idealism by supposing that motion, and therefore time, space, and the categories, though d priori, are common to thought and being. Duhring, with a similar object, makes matter a common basis. While these realisms come dangerously near to materialism, that of the Roman Catholic A. Gtinther (178;i-1863),*~~

~~" Cartesius correctus," erected too mystical an edifice on the psycho-logical basis of Descartes to sustain a satisfactory realism. Yet Glintherism has produced a school, of which the most distinguished representative is the Old Catholic Bishop in Bonn, Th. Weber, whose Metaphysik, completed in 1891, starting from the ego and the analysis of consciousness, aims at arriving at the distinction between spirit and nature, and at rising to the spirit of God the Creator.~~

~~Another realism is that of J. H. von Kirchmann (1802- 1884), author, among other works, of Die PMlosopUe des Wissens (1864), and Ueber die Principien des Realismus (1875). His point was that being and knowing are identical in content, and are only different in the form in which the content appears. Hence he deduced, on the one hand, that being can exist without knowing, and on the other hand that the object of perception is an image of being. Further, according to him, perception is the sole way of knowing the content, while thinking does nothing but purify the perceived content from contradictions ; and therefore there are two principles of truth, (1) "Das Wahrgenommene ist," (2) " Das sich Widersprechende ist nicht." When an author thus supposes that perception knows only an image of a thing, that thinking knows no more, and that therefore knowledge is a sort of imaging of being, one cannot wonder that the idealists object that realism is a false transition from ideas to things, and speak of what they call " naive realism " with contempt. Other realisms of our time are those of G. K. Uphues, directed against the scepticism of Shute's Discourse on Truth, and of H. Schwarz, who completes the psychological view of Uphues that we can know objects as they are, by the metaphysical view that they can be as we know them. But German realism lacks critical power, and is little better than a weed overshadowed by the luxuriant forest of German idealism.~~

~~In France, the home of Cartesian realism, after the vicissitudes of sensationalism and materialism, which became connected in the French mind with the Eevo- lution, the spirit of Descartes revived in the 19th century in the spiritualistic realism of Victor Cousin (1792-1867). But~~

~~*Cousin's psychological method of pro- ceeding from consciousness outwards, and the emphasis laid by him on spirit in comparison with body, prevented a real revival of realism. He essayed to answer Locke by Kant, and Kant by Eeid, Maine de Biran, and Schelling. From Reid, whose works had been introduced by Royer-CoUard, he adopted the belief in an external world beyond sensation, from Biran the explanation of personality by will, from Schelling the identification of all reason in what he called " impersonal reason," which he supposed to be identical in God and man, to be subjective and objective, psychological and onto- logical. We start, according to him, from a psycho- logical triplicity in consciousness, consisting of sensation, personal will, and impersonal reason, which by d, priori laws of causality and substance carries us to the onto- logical triplicity of oneself as ego willing, the non-ego as cause of sensation, and God as the absokite cause beneath these relative causes. So far this ontological triplicity is realism. But when we examine his theory of the non-ego, and find that it resolves matter into active force and this into animated activity, identifies law with reason, and calls God absolute substance, we see at once that this spiritual realism is not very far from idealism. About 1840, owing largely to the teaching of E. Saisset in the spiritualistic school, the influence of Descartes began to give way to that of Leibnitz, whose monadism literally taken was consistent with bodies and recognized a supramundane God, but nevertheless,- through its endowing monads with mental perception and appetition, could easily pass into systems of idealism and pantheism, such as we have found in Germany. Leibnitz has been used both realistically and idealistically in France. He was taken literally by spiritual realists ; as, for example, by Paul Janet, whose works on Materialism (1864) and Final Causes (1876) have become well known in England by translations. Their point is that matter and evolution are inexplicable without spirit and final causes, but that, guided by " une*~~

~~*volonte prevoyante," evolution could be the means of rising by acontinuous process from the monad to humanity. Janet accepted the traditional ontological triplicity — God, souls, and bodies — and, in answer to Ravaisson, who called this realism " demi-spiritualisme," rejoined that he was content to accejjt the title. At the same time, like Cousin, his works show a tendency to underrate body, tending as they do*~~

~~*to the Leibnitzian analysis of the material into the immaterial, and to the supposition that the unity of the body is only given by the soul. HIs emphasis is on spirit, and he goes so far as to admit that "no spiritualist is engaged to defend the existence of matter." So E. Thouverez says, "Realisme et rationalisme sont tout un." The strength of Janet's position is his perception that the argument from final causes is in favour of an omnipresent rational will making matter a means to ends, and not in favour of an immanent mind of Nature working out her own ends. "Beau- coups d'esprits aujourd'hui," says he at the end of Le Matirialisme Contemporain, " voudraient se dissimuler a eux-m§mes la pente qui les entraine vers I'atheisme, en prgtant a la nature une vie, un instinct, une §.me, et h, cette fi,me une tendance inconsciente vers le Men." Nevertheless, the psychological metaphysics of Cousin and of Janet was too flimsy a realism to withstand its passage into this very idealism of matter which has become the dominant French metaphysics. E. Vacherot deserted Descartes for HIegel. At first in La Mka- physique et la Science (1858) he said, in opposition to the Cartesian argument from the perfection to the being of God, that the ideal cannot be real. But, when Janet had rejoined that "to be is worth more after all than not to be," Vacherot reconsidered his position in Le Nouveau Spiritualisme (1884). HIe accepted from HIegel " the real is rational " without the HIegelian method, for which he substituted conscious experience as a revela- tion of the divine. Matter he held to be mind at the minimum of its action, and evolution the "expansion de I'activite incessante de la cause finale." God, accord- ing to his latest view, is the absolute being as first cause and final end. " Let us leave," says he in deference to Janet, " the category of the ideal, which applies to nothing real or living." But the most noticeable passage in Le Nouveau Spiritualisme is its contrast between the old and the new ; where he says that the old spiritualism opposed spirit to matter, God to Nature, the new spirit- ualism places matter in spirit, Nature in God (p. 377). F. Ravaisson, by his Rapport (prepared for the Exhibition of 1867) on philosophy in France, gave a fresh impulse to the transition from spiritual realism to idealism, by developing the Aristotelian Ic^eo-is of matter and the Leibnitzian appetition of monads into " I'amour " as the very being of things. J. Lachelier agreed with Ravaisson that beauty is the last word of things, but, under the influence of Kant and his successors, put his idealism*~~

rather in the form that all is thought. A. Fouillee rightly objects that we must not thus impute thought and intention to nature, and yet does not scruple to impute to it life, sensation, and want. Starting from consciousness, he argues that all known things are pheno- mena of consciousness. Then, agreeing with evolutionism,, that things are necessarily determined by forces, but with Leibnitz that body is merely passive, he infers that force, being active, is psychical — a force, which he describes as. " id^e-force," and as " vouloir-vivre." In connexion with the " idees directrices et organisatrices," supposed by the French physiologist Claude Bernard, and the universal will supposed by German voluntarists, Fouillee concludes that the world is a society of wills. Meanwhile, more under the influence of Kant, C. Renouvier has worked out an idealism which he calls " Neo-criticisme," rejecting

the thing-in-itself, while limiting knowledge to pheno- mena constituted by a j>i'iori categories. Phenomena he identifies with " representations representatives et repre- sentees." But he takes the usual advantage of this most ambiguous of terms, when he extends it to embrace God, freedom, and immortality required by the moral law. Latterly, he has published La Noarelle Monadologie (1899), in which he maintains that each monad is a simple substance, endowed with representation, which is consciousness in form, phenomenon in matter as repre- sented. In order to explain free-will, he supposes, con- trarily to Fouillee, that the laws of phenomena are indeterminate, contingent, and liable to exceptions. Here we trace the influence of Leibnitz and Lotze, which is still more marked in La Contingence des Lois de la Nature (1874), by E. Boutroux. Pouillee meets the mechanics of evolution by the argument that will to live determines its necessary laws, Boutroux by denying the necessity. His point is, that the world only appears to be pheno- mena governed by necessary laws, and is really a spon- taneity which makes new beginnings, such as life and consciousness, tending to good. We wish we could have given more space to these French spiritualisms, which, realistic and idealistic alike, spring from a genuine enthu- siasm for the spirit of man

~~*and his liberty. But we have said enough to show that the psychological metaphysics of spiritual realism has not been able to withstand the rise and progress of spiritual idealism in France.*~~

~~*In England, the land of Bacon and Locke, the realistic tendency has been more active than on the Continent, and is exhibited in Bacon's Novum, Organum and De Aug- mentis Scientiarum, as well as to a less degree in the Fourth Book of Locke's Essay. After the metaj)hysical idealism, begun by Berkeley, had eventuated in Hume's reduction of the objects of knowledge to sensations, ideas, and associations, the Scottish School, applying the Baco- nian method to the study of mind, began to inquire once more for the evidences of our knowledge, and produced the natural or intuitive realism of T. Eeid (1710-1796), Dugald Stewart (1753-1828), and Sir William Hamilton (1788-1866), who, having been followed by H. L. Mansel (1820-1871), as well as by J. Veitch, H. Calderwood, and J. M'Cosh, prolonged the existence of the school, in which we may venture to place L. T. Hobhouse, and F. W. Bain, author of Tlie Realization of the Possible (1899), down to our own time. Its main tenet, that we have an immediate perception of the external world, is roughly expressed in the following words of Eeid : "I do per- ceive matter objectively — that is, something which is ex- tended and solid, which may be measured and weighed, is the immediate object of my touch and sight. And this object I take to be matter, and not an idea. And, though I have been taught by philosophers, that what I immediately touch is an idea, and not matter, yet I have never been able to discover this by the most accu- rate attention to my own perceptions." No opposition to idealism could be more distinct. Eeid, however, did not always express himself so distinctly. Moreover, he and his successors mixed uj) so many accidents with the essence of their realism that the whole system broke down under its own weight. Their psychology contained valuable points. It also contained much that was doubt- ful, and much that was ill-adapted to the metaphysics of realism. Yet they thought it the only avenue to metar physics. It is full of appeals to common sense, and of principles of common sense, which Eeid also called intui- tive first principles, and self-evident truths. It is spoilt by Locke's hypothesis that we do not perceive things but qualities implying things. While it asserted a n^alism of individuals, it admitted a*~~

~~*conceptualism of universals. .Stewart also said that our knowledge of matter and mind*~~

~~*is merely relative. Hamilton went still farther than his predecessors ; he tried to combine the oil of Eeid with the water of Kant ; and converting the intuitive into the A priori, he found a further reason for the relativity of knowledge. "Our knowledge is relative," said he, "first, because existence is not cognizable absolutely and in itself, but only in special modes ; second, because these modes thus relative to our faculties are presented to and known by the mind, only under modification, determined by these- faculties themselves." JSTot only so, but in his review of Cousin (" Philosophy of the Unconditioned," in Discussions, pp. 12-15), he made conception the test of knowledge, argued that " the mind can conceive, and consequently can know, only the limited, and the con- ditionally limited," that " to think is to condition," that all we know either of mind or matter is "the pheno- menal," that " we can never in our highest generalizations rise above the finite," and concluded that we cannot con- ceive or know the unconditioned, yet must believe in its existence. Nevertheless, in spite of all this Kantisni, which ought to have driven him to the conclusion that all we know is mental phenomena, he adhered to his natural realism. He vacillated a great deal about our mode of perceiving the external world ; but his final view was contained in his edition of Eeid's works (note D*), and consisted in supposing that (1) sensation is an apprehen- sion of secondary qualities purely as affections of the organism viewed as ego ; (2) perception in general is an apprehension of primary qualities as relations of sensa- tions in the organism viewed as non-ego ; while (3) a special perception of a so-called "secundo-primary " qual- ity Consists in "the consciousness of a resisting something external to our organism." Hamilton's views both on the absolute and on perception affected Mansel and Spencer. They were not, however, received without question even by his followers. H. Calderwood, in his Philosophy of the Infinite (1854), made the pertinent objection that, though thought, conception, and knowledge are finite, the object of thought may be infinite. Hamilton, in fact, made the double mistake of limiting knowledge to what we can con- ceive, and confusing the determinate with the finite or limited. We never know anything except as determined by its attributes ; but that would not prevent us from in-*~~

~~ferring something determined as unconditioned whether infinite or absolute. J. M'Cosh again, in Hie Prevailing Types of Philosopihy : Can they logically reach reality? (1891), rightly protests against Hamilton's combination of Scottish and German schools which will not coalesce, and exhorts the former "to throw away its crutches of im- pressions, instincts, suggestions, and common sense, and give the mind a power of seeing things directly." He has the merit of presenting natural or intuitive realism in its purity. The common tenet of the whole school is that without inference we immediately perceive the external world, at all events as a resisting something external to our organism. But is it true ? There are three reasons against it, and for the view that we perceive a sensible object within, and infer an external object without, the organism. In the first place, there are great differences between the sensible and the external object; they differ in secondary qualities in the case of all the senses; and even in the case of touch, heat felt within is different from the vibrating heat outside. Secondly, there are so-called " subjective sensations," without any external object as stimulus, most commonly in vision, but also in touch, which is liable to formication, or the feeling of creeping in the skin, and to horripilation, or the feeling of bristling in the hair; yet, even in "subjective sensations," we per- ceive something sensible, which, however, must be within, and not outside, the organism. Thirdly, the external world and the senses always act on one another by cause and~~

~~effect, and by pressure, although we only feel pressure by touch. Now, when the thing with which touch is in a state of reciprocal pressure is external, e.g., a table, we feel our organism pressed and pressing; we do not feel the table pressing and pressed, but infer it. The Scottish School never realized that every sensation of the five senses is a perception of a sensible object in the bodily organism ; and that touch is a perception, not only of single sensible pressure, but also of double sensible pressure, a perception of our bodily members sensibly pressing and pressed by one another, from which, on the recurrence of a single sensible pressure, we~~

~~*infer the pressure of an external thing for the first time. Intuitive Realism is to be replaced by Physical Realism.*~~

~~*(3) Reaction to Hypothetical Realism. — The three evi- dences, which are fatal to intuitive realism, do not prove hypothetical realism, or the hypothesis that we perceive something mental, but infer something bodily. This illogical hypothesis, which consists of incautiously pass- ing from the truth that the sensible object perceived is not external but within the organism to the non-sequitur that therefore it is within the mind, derived what little plausibility it ever possessed from three prejudices : the first, the scholastic dogma that the sensible object is a species sensibilis, or immaterial sensible form received from the external thing ; the second, the Cartesian d, priori argument that the soul as thinking thing can perceive nothing but its own ideas ; the third, the common assump- tion of a sense of sensations. But notwithstanding its illogicality, its tendency to underrate Nature as inferred from such idealistic premisses, and its certain transition into a consistent idealism, hypothetical realism has, with little excuse, revived among us in the writings of Shad worth Hodgson, J. Martineau, and A. J. Balfour. The cause of this anachronism has been the failure of in- tuitive realism and the domination of idealism, which makes short-sighted men suppose that at all events they must begin with the psychology and the psychological idealism of the day, in the false hope that on the sands of psychological idealism they may build a house of metaphysical realism.*~~

~~*Shadworth Hodgson, after writing many laborious works, has recently put together his conclusions in The Metaphysic of Experience, in four volumes, 1898. Be- lieving that philosophy is an analysis of the contents of consciousness, or experience, and that this is metaphysics, he begins, like Kant, with an analysis of experience. Like Kant, he supposes that experience is concerned with sensations, distinguishes matter and form in sense, identifies time and space, eternal time and infinite space, with the formal element, and substitutes synthesis of sensations of touch and sight for association and inference, as the origin of our knowing such a solid material object as a bell. Although he does not agree with Kant that either the formal element in sense or the synthesis of sensations is A priori, yet in very Kantian fashion, through not distinguishing between operation*~~

~~*and object, he holds that, in synthetically combining sensations of touch and sight, we not only have a complex perception of a solid body, but also know this "object thought of" as itself the complex of these sensations objectified. Hence he concludes that "matter is the name for the sensation-elements derived from both senses, abstracting in thought, so far as possible, from the extension-elements of both" (i. 296). Here you would expect him to stop, as the German Neo-Kantism of Lange stops, with the consistent conclusion that all we know of Nature from such data is these complexes of sensation-elements, or phenomena in the Kantian meaning. Not so; like Kant himself, Hodgson supposes something beyond; not, however, an unknown thing in itself causing sensations.*~~

~~*but a condition, or sine qua nan, of their existence, with- out being a cause of their nature. In order to make this leap he supposes that we have beyond perceptions a con- ception of condition. His account of the origin of this conception is puzzling. "Although," says he, "it is neither a Kantian A priori concept of the understanding, nor a Scholastic intellectual intuition of causal essences, nor yet, on the other hand, a mere record of de facto ex- perience, it is nevertheless an idea which is thoroughly and completely justified as true by de facto experience, provided that it is frankly acknowledged to be a concep- tion which needs justification; that is to say, a conception framed by conscious reaction on the part of the subject, whereby he interprets facts of perception, &c." (i. 380). Whatever this origin of the conception of condition may be, it could not, any more than a Kantian category of cause, justify us in concluding anything more than a relation of perceptions as conditions of one another, seeing that they were supposed to be the whole data, and matter itself to be "sensation-elements." But what he proceeds to suppose is that, having the conception, and finding that the complex of perceptions needs accounting for, we infer a real condition, e.g., the solid interior of a bell. What we know, however, of this condition, according to him, has two limits : on the one hand, it is the condition only of the existence of our perceptions ; on the other hand, all we know of its nature is our perceptions. Matter thus, which had at first been defined as a complex of perceptions objectified, now turns out to be a con- dition without which perceptions would not exist, but whose nature is known only as a complex of perceptions. Finally, according to him, having inferred matter as the*~~

~~condition of our perceptions, we are entitled to infer that the condition of the existence of matter is Grod, whose nature, however, can be inferred only by practical reason from conscience. IIe avers that this " metaphysic of experience" is not idealism, or the tenet that consciousness is the only reality. It is realism — but inconsequent and inadequate realism, something like that of Spencer ; according, indeed, more knowledge of the distinction between nature as condition of sensations and God as condition of Nature ; but very like in hold- ing that all we know of natural forces is our perceptions. We know more, however, about a body, such as a bell, than either Spencer or IIodgson allows. We know, from the concomitant variations between its vibrations and our perceptions, that its vibrations are not mere con- ditions but real causes of our perceptions; and that those vibrations are not our perceptions, because we cannot perceive them, but are real attributes of the bell. It will be objected that they are merely possible perceptions. But as they really produce onr real perceptions, they are themselves not merely possible, but real or actual. A possible cause could not actually produce an actual effect.~~

~~James Martineau (1805-1900) in A Study of Religion (1888), like Shadworth IIodgson, started from Kant, and tried to found on transcendental idealism " a return to dualism." If there is one thing certain in the Kantian philosophy, it is its author's perception that what is con- tributed by mind must not be extended to things beyond mind. IIegel only extended d, priori forms to things by resolving things into thoughts. Mill also, in answer to those who would assign an d priori origin to the uniform- ity of Nature, says: " I must protest against adducing, as evidence of the truth of a fact in external nature, the disposition, however strong or however general, of the human mind to believe it." Yet Martineau following Tren- delenburg, whose lectures he had attended in Germany forty years before, adopted, as his view of the limits of human intelligence, that Kant was right in making space~~

~~and time h priori forms of sense, but wrong in limiting them to sensations. But in order to make space a form of external things, Martineau had to~~

~~take the external in space, by which Kant meant one sensation out of another, in the very different meaning of the self here and the not-self there. He facilitated this awkward transition by adding to Kant's cl priori forms of space and time an "A priori form of alternative causality," or, as he also called it, " an intuition of causality involved in the elementary exercise of perception," which is the key to his whole philosophy. He supposed that this intuition of causality arises when will is resisted, and, further suppos- ing that causality requires decision between alternatives, concluded that the intuition of will resisted is an intuition of will against will, mine against other (i. 65). To pass over its confusion of 6i priori and intuitive, there are two fatal objections to this view. In the first place, the intuition of causality does not require will at all, because we often perceive one bodily member pressing another involuntarily; a man suffering from lockjaw neither wills nor can avoid feeling the pressure of his upper and lower jaws against one another. Secondly, though causality requires alternatives in the material cause, e.g., wax may or may not be melted, the determina- tion between them is not always a decision of will, but in physical causation depends on the efBcient cause, e.g., the fire : as Aristotle says, when the active and passive powers approach, the one must act and the other suffer, and it is only in rational powers that will decides (Met. © 5). Martineau's philosophy thus falls to the ground, or rather stumbles at the start. We perceive and infer other causes than will. If allowed, however, to pro- ceed, by combining d priori forms of space, time, and caus- ality consisting of will, and holding that they are not only subjective but also objective forms, he arrives at a theory of immediate perception of the external world, involving a knowledge of both phenomena and noumena, and a dualism of ego and non-ego, reciprocally cause and effect, here and there in space, will vis-ci-vis to will. Founded on this theory of the limits of human intelligence is his theism. If, he said, we consider cause and effect as judged by the observer of nature, we find that, while the cause of a phenomenon is always a noumenon, the relation between phenomena is, as Hume said, not a real causality. He concluded that, in order to arrive at causality, one must throw oneself into the field as agent, and then one finds antagonist agents, other wills, and ultimately the will of God. All causality then is, according to him, our will and God's will. " By self," says he, " we mean the will internal ; by ' God ' we mean the will external ; by cause we mean~~

~~either ; and as the two former come into our knowledge as terms of a relation under the category of the latter, it is impossible for either extreme to lapse into the other " (ii. 176). This theory reminds us at once of the Panthelism of Schopenhauer and the Pan- pneumatism of Hartmann. But it is superior to both, because it recognizes intelligence in all will, without confusing either with the unconscious. Martineau also justly claimed to have freed the human will from the Pantheistic absorption which is inherent in the Panlogism of Hegel. But, with all these merits, his own theory that all causality is " will vis-d-vis to will " leads to strange consequences. He spoke of the will to shut a door against a furious wind. But this ou his theory could only mean will to shut the door against God's will, which is fate knocking at the door with a vengeance. In his eagerness to prove the causality of God's will he had to deny all secondary causes except our wills. He said that " however wide the sweep and durable the continuance of the laws of physical change, they are entrusted with no causality of their own, but are only the modes of the

~~Divine action. The whole external universe then (external, I mean, to self-conscious beings), we unreservedly sur- render to the In-dwelling Will, of which it is the organized expression" (ii. 176). What then becomes of Nature? Like Spencer, Martineau used the term " phenomenon " in so many varieties of sense, that we cannot attach any definite meaning to his calling Nature "the assemblage of phenomena, i.e., of what comes and goes." But we can understand what he meant when he said that no pheno- menon causes any change in any other phenomenon ; he meant that no body is a cause, and that God's will and ours are the sole causes. This belittling of Nature, to magnify God and ourselves, deserts truth and defeats its own object. On the one hand, to deny that Nature is a vera causa, and resolve it into a sequence of phenomena, is to desert the truth that bodies are real substances and real causes by their interresistant pressure: when, for example, I try to shut the door against the wind, the wind's pressure counteracts the door's pressure directly and mine indirectly. On the other hand, to set God's will vis-d,-vis to man's will is to make both ridiculous. God is the primary cause of all secondary causes, voluntary and involuntary; and, the greater the involuntary power of Nature, the mightier the voluntary power of the Creator and Governor of the world. Caeli enarrant Dei gloriam.~~

~~*A. J. Balfour in The Foundations of Belief, being Notes Introductory to the Study of Theology (1895), begins by maintaining that the evidence of the senses is not a foundation of belief, and then expects us to believe in Nature and in God. Aristotle said that without sense there is no science, because there is no proceeding from universals without induction nor by induction without sense ; and, again, that perceiving nothing we could learn and understand nothing. Bacon said, "Nos vero non Acatalepsiam sed Eucatalepsiam meditamur et propo- nimus : sensui enim non derogamus sed ministramus ; et intellectum non contemnimus sed regimus." But Balfour has revived that very '.' Acatalepsia " of the New Academy. In Part II., chapter i., he makes three assumptions about the senses, and, without stopping to prove them, or even to make them consistent, deduces from them his thesis that the evidence of the senses is not a foundation of belief in Nature. He first assumes an immediate experi- ence of a body, e.g., a green tree; and then deduces that the evidence of the senses proves now and then to be fallacious, because we may have an experience indistin- guishable from that of a tree but incorrect ; and further, that , our perceptions are habitually mendacious, because all visual experiences are erroneous, as colour is a sensar tion while the thing consists of uncoloured particles. This argument from a pure assumption is a confusion of sense and inference. The sense of vision perceives a sensibly visible picture, e.g., green, which is always really as perceived : inference, usually rightly, though some- times wrongly, infers a tree, and always is wrong when it infers that a tree is green like sensible green, but right when it infers that a tree is green in reflecting correspond- ing vindulations. In no case is the evidence of the senses fallacious or mendacious; the fallacy is in the inference. He next assumes that we have no immediate experience of independent things such as has been gratuitously supposed, and by himself, but that what is immediately experienced is mental facts ; or in other words, that sense perceives sensations, feelings, or ideas ; while all else, e.g., a tree, is a matter of inference. On ■ this quite new assumption of a sense of sensations he deduces that, from a perception of these mental facts, we could not infer material facts, e.g., a tree ; so that again the evidence of the senses does not afford trustworthy knowledge of the material universe. His deduction is logical ; but he has*~~

~~***METAPHYSICS***~~

forgotten to prove the assumption, and now confuses sensory operation with sensible object. Vision does not perceive a sensation of colour ; it perceives a visible picture, e.g., green, which is in the organism, but has never been proved to be a mental fact, or not to be a material fact. So touch perceives not a sensation of pressure, but a pressure which is a material fact in the organism. From a material pressure within we logically infer a material pressure outside. He thirdly assumes an appendix, to the second assumption : he assumes that sense perceives mental sensations with succession but without causality, because no kind of cause is open to observation. On this assumption of a sense of sensations but not of causality he deduces that we could not from such data infer any particular kind of cause, or a bodily cause, e.g., a tree, or indeed any cause at all, or any event beyond perception, without assuming the principle of causation that Nature is uniform in cause and effect over great in- tervals of time and space, assuming it without experience ready-made, and believing it beforehand. But he gives absolutely no proof of the assumption that there is no sense of causality. There is none in the subsidiary senses, because none of them perceives the pressures exerted on them. But the primary sense of touch perceives one bodily member causing pressure on another, reciprocally, within the organism, from which we infer similar par- ticular pressures caused between the organism and the external world; but without needing the supposed stu- pendous belief and assumption of the uniformity of Nature, which is altogether ignored in the inferences of the ordinary man. Finally, as touch perceives reciprocal pressure within, and tactile inference infers it without, touch is the primary evidence of the senses which is the foundation and logical ground of our belief in Nature as a system of pressing bodies. Balfour, however, having from unproved assumptions denied the evidence of the senses, and the rational power of using them to infer things beyond oneself, has to look out for other, and non- rational, foundations of belief. He finds them in the needs of man. According to him, we believe in Nature because it satisfies our material needs, and in God because He satisfies our spiritual needs. But bare need, e.g., a pang of hunger, is no cause of belief beyond itself; and desire, or need, of

something prospective, e.g., a desire of food, is effect, not cause, of a previous belief that there is such a thing, and of a present inference that it may again be realized. Moreover, when the belief or inference is uncertain, need even in the shape of desire is not in itself a foundation of belief in the thing desired : to need a dinner is not to believe in getting it ; and, as Aristotle said, "there is a wish for impossibilities." It is fair, however, to add that Balfour has a further foundation for the belief in Nature, the survival of the fittest, by which those only would survive who possessed and could transmit the belief. But here he fails exactly as Darwin himself failed. Darwin said, given that organisms are fit, they will tend to survive; but he failed to show how they become fit. Balfour says, given that men believe in Nature, they will survive; but he fails to show how they come to believe in it._ Inference from sense is the one condition of all belief in anything beyond oneself, whether it be Nature, or Authority, or God ; and it is the one condition of all needs, which are not mere feelings, but desires of things. The result of undermining this sure foundation emerges in Balfour's attitude to the beliefs themselves. HIe holds that space, time, matter, motion, force, are all full of the insoluble contradictions supposed by Spencer; and that all our beliefs, in Nature and in God, stand on the same footing of approximations. HIence his really valuable arguments from Nature to God sink to the problematic form — there

may be Nature ; if so, there is God. Such is the niodern "Acatalepsia," which arises from denying the evidence of the senses, and from citing the transfigured realism of Spencer instead of the original realism of Aristotle, about whom Balfour speaks as follows : " It would be difficult, perhaps impossible, to sum up our debts to Aristotle. But assuredly they do not include a tenable theory of the universe."

(4) The Past and Future of Metaphysics. — Aristotelian realism is the strong point of Roman Catholic philoso- phy. As interpreted by Thomas Aquinas, it is now in danger of becoming a dogma. In 1879 Pope Leo XIII. • addressed to the bishops the Eneydica ^terni Patris, which contained the words, Sancti Thomoe sapientiam restituatis et quam latissime propiagetis. From the Roman Catholic point of view, this reaction to " Thomism " was a timely protest against modern

~~*metaphysics. It was founded upon a feeling of uneasiness at a growing ten- dency among Roman Catholic writers not only to treat theology freely, but to corrupt it by paradoxes. Thus the French philosophy of Cousin was suspected by the Vatican of pantheism; the German philosophy of Gilnther, " Cartesius correctus," was condemned at Rome in 1867 ; and in 1888 the Italian philosophy of Rosmini, which leant towards German idealism, was condemned by Leo XIII. himself. The Jesuits regarded modern philosophy as the pathology of human reason, and they were at the bottom of the movement. Perhaps they were not altogether mistaken. One cannot but feel regret at seeing the Reformed Churches blown about by every wind of doctrine, and catching at straws now from Kant, now from Hegel, and now from Lotze, or at home from Green, Caird, Martineau, Balfour, and Ward in succession, without ever having considered the basis of their faith; while the Roman Catholics are making every effort to ground a Universal Church on a sane system of metaphysics. However this may be, the power of the movement is visible enough from the spread of Thomism over the civilized world, and in England from the difference between the freer treatment of metaphysics by some of our Roman Catholic writers and that which has arisen under the immediate influence of Thomism. J. H. Newman (1801-1890), maintaining the authority of conscience and the probabilism of the understanding, concluded to the necessity of a higher authority in the primitive Church. W. G. Ward was a philosophical critic of Mill. St George Mivart, in 27ie Ground-worTc of Science (1898), maintained the reality of an active causative power underlying Nature, and the dignity of human reason, from an independent point of view. On the other hand, more under the influence of the Thomist reaction Thomas Harper has published The Metaphysics of the School (1879, &c.), describing scholasticism, as it appears in the works of Aquinas ; and The Manuals of Catholic Philosophy, edited by R. F. Clarke, include Gen- eral Metaphysics (1890), by J. Rickaby, who effectively criticizes Hegel by precise distinctions, which, though scholastic, did not deserve to be forgotten.*~~

~~*The Thomist reaction has had a good effect in the way of encouraging the study of Aristotelian philosophy, in itself and as modified by Aquinas. Nevertheless, the world cannot afford to surrender itself to Aristotle, or to*~~

~~Aquinas ; the master had too many weak points, and the commentator has corrected too few of them. Aristotle could not know enough, physically, about Nature to understand its matter, or its motions, or its forces ; and consequently he fell into the error of supposing a primary matter with four contrary primary qualities, hot and cold, dry and moist, forming by their combinations four simple bodies, earth, water, air, and fire, with natural rectilineal motions to or from the centre of the earth; to~~

~~wMch he added a quintessence of ether composing the stars, with a natural circular motion round the earth. Metaphysically, he did not, indeed, as is often supposed, think the nature of substance to be matter and form, because in his view God is a substance, yet with no matter ; but he did think that every natural substance, or body, is a concrete whole, composed of matter and form diiferent from matter. He thought that besides proximate matter, or one body as matter of another, there is a primary formless matter beneath all bodies, capable of becoming all in turn, but itself potentially, not actually, substance. He thought not only that a form, or essence, is something different from, and at most conjoined with, matter in a concrete body, but also that in all the bodies of one kind, e.g., in all men, there is one undivided form or essence, e.g., rational animal, communicated from one member to another member of the kind, e.g., from father to son, by what we still call, though without any meaning, the propagation of the species. He thought, in consequence, that the princi- piutn iniliinduationi.t, which differentiates two members of the kind, e.g., Socrates and Callias, is their one form or essence only as conjoined with different matters, e.g., different bones and flesh. He thought, moreover, that the one form of a kind is an original essence (6 tC r)v eTvat), which is uncreate ; and, in order to avoid the " separate forms " supposed iyj Plato, he concluded that the world of Nature m.ust be eternal, in order that each original essence may from eternity always be in some individual or another of its kind. On this assumption of the eter nity of the world, God could not be a Creator. Aristotle thought that God is~~

~~only prime mover, and that too only as the good for the sake of which Nature moves ; so that God moves as motive. Psychologically, Aristotle applied his dualism of matter and form to explain the antithesis of body and soul, so that the soul is the form, or entelechy, of an organic body ; and he applied the same dualism to ex- plain sensation, which he supposed to be reception of the sensible form or essence, without the matter, of a body, e.g., of the form of white, without the matter, of a white stone. HIe thought that in the soul {h rrj i/'i'xs) t'^^re is a produc- tive intellect and a passive intellect, and that, when we rise from sense by induction, the productive causes the pas- sive intellect to receive the universal form or essence, e.g., of all white things ; and he thought that this productive intellect is our immortal faculty. Lastly, he thought that, while other operations have, intellect (voiJs) has not, a bodily organ ; and hence he became responsible for the fancy that there is a break in bodily continuity between sense and will, while intellect is working out a purely im- material operation of soul, resulting from the former and tending to the latter. It is evident that a philosophy con- taining so many questionable opinions is not tit to be made into an authoritative orthodoxy in metaphysics.~~

~~Now these, on the whole, are the very opinions of Aquinas (122n-1274), except so far as they were clearly inconsistent with the Christian faith. Aquinas thought, as an article of faith, that the world began, and that God is its Creator. This Christian difference from Aristotle involved a change of detail in the theory of essences and of universals generally. Aquinas thought that before the creation the one eternal essence of any kind was an abstract form, an idea in the intellect of God, like the form of a house in the mind of a builder, ante rem; that after the creation of any kind it is in re, as Aristotle supposed; and that, as we men think of it, it is post rem, as Aristotle also supposed. Of this view the part which was not Aristotle's, the state of " universalia ante rem," was due to the Neo-Platonists, who interpreted the " separate forms " of Plato to be ideas in intellect, and handed down their interpretation through St Augustine to the mediasval~~

~~Realists like Aquinas, who thus combined Neo-Platonism with Aristotelianism. HIence too Aquinas opposed essence to existence much~~

~~*more than Aristotle did. Lastly, as a Christian, he supposed the whole soul to be immortal, and to form for itself a new body after death. But, with these modifications he accepted the general physics of Aristotle, the metaphysical dualism of matter and form, and the psy- chology founded upon it. The Thomism, therefore, of our day is wrong, from a metaphysical point of view, so far as it elevates Aristotelianism, as seriously modified but not fundamentally corrected by Aquinas, into an authorita- tive orthodoxy in metaphysics.*~~

~~*Centuries elapsed after Aquinas before Galileo and his successors reformed natural science, and before Bacon destroyed the metaphysical dualism of matter and form by showing that a form in Nature is only a law of the action of matter, and that, as the action of a body is as individual as the body, the form is eternal only in thought (ratione). The psychology of Aristotle and Aquinas thus became impossible ; for, if the form of a body is only a mode of matter, to call one's soul the form of one's body is to reduce it to only a mode of matter, and fall into materialism. HIence Descartes began the reform of psy- chology not only by the appeal to consciousness, " I think," but also by opposing body and soul, no longer as matter and form, but as different substances. These great improvements, due to the genius of Galileo, of Bacon, of Descartes, are the fresh beginnings of modern thought, from which we dare not turn back without falling into obscurantism. What, then, is the future of metaphysics ? We must return not to the authority but to the studj- of Aristotle. The independence of metaphysics as the science of being, the principles of contradiction and excluded middle with their qualifications, the distinction without separation between substance and attributes, the definition of substance as a distinct individual thing, the discovery that the world consists of substances existing apart but related to one another, the distinction between material and efficient causes or matter and force, the recognition both of the natural and of the supernatural — all these and many other half-forgotten truths are the reasons why we must always begin with the study of Aristotle's j\fpta- physics. But their incompleteness shows that we must go forward from Aristotle to Bacon and modern science, and even pass through the anarchy of modern metaphysics, in the hope that in the future we may discover as complete an answer as possible to these two questions : —*~~

~~*1. What is the world of things we know ?*~~

~~*2. How do we know it ?*~~

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~~*METEOR*~~

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~~*and Motion and Monism, 1895.— F. C. S. Schiller. Biddies of the Sphinx, 1891. — A. Seth. Hegelianism and Personality, 1887. —J. Ward. Naturalism and Agnostieism, 1899. III. French:— E. Boutrohx. De la Gontingence des Lois de la Nature, 1874.— A. Fouillee. Le Mouvement Idealiste, 1896.— Paul Janet. Les Causes Finales, 1877.— C. Renouviek. La Nouvelle Monadologie, 1899.— E. Vaoherot. Le Nouveau Spirit- ualisme, 1884. (,j, ^^ n*~~

~~*Meteor. — Meteors, or shooting stars, as they are familiarly called, are minute bodies which, moving through space, are raised to incandescence by encountering the atmosphere of the earth. Great swarms of these bodies move in streams along common orbits. The outburst of several meteors belonging to the same stream is called a shower, and every shower has a radiant point from which the paths of all its meteors are directed. During the last quarter of the 19th century a large number of radiantpoints of meteoric showers have been made out. The number of such points known in 1876 was 850, whereas in 1899 it had risen to 4400,*~~

~~*but they do not all represent differ- ent systems. The great majority of meteoric streams are very feeble, but the displays arising from a few recur at intervals with brilliant effect. The following is a list of the dates and radiants of some of the principal showers : —*~~

~~*Date*~~

~~*Eadiant E.A. Dec.*~~

~~*Date.*~~

~~*Kadiant li.. V.Dec.*~~

~~*Jan. 2-3*~~

~~*230″ + 53°*~~

~~*Aug. 30-Sept. 2*~~

~~*47° +43″*~~

~~*Feb. 10-15*~~

~~*74 +43*~~

~~*Sept. 10-15*~~

~~*62 +37*~~

~~*March 1*~~

~~*166 + 5*~~

~~*Sept, 21-22*~~

~~*74 +41*~~

~~*March 28*~~

~~*263 +62*~~

~~*Oct. 2*~~

~~*230 +52*~~

~~*April 19-22*~~

~~*270 +33*~~

~~*Oct. 18-20*~~

~~*92 +15*~~

~~*May 2-6*~~

~~*338 — 2*~~

~~*Oct. 29-Nov. 1*~~

~~*43 +22*~~

~~*May 11-18*~~

~~*231 +27*~~

~~*Nov. 2*~~

~~*55 + 9*~~

~~*May 30*~~

~~*333 +27*~~

~~*Nov. 14-16*~~

~~*151 +22*~~

~~*June 3-7*~~

~~*250 -22*~~

~~*Nov. 20-23*~~

~~*63 +22*~~

~~*July 15-19*~~

~~*314 +48*~~

~~*Nov. 23-24*~~

~~*25 +44*~~

~~*July 28-30*~~

~~*339 -12*~~

~~*Nov. 25*~~

~~*154 +40*~~

~~*Aug. 10-1 2*~~

~~*45 +57*~~

~~*Dec. 6*~~

~~*80 +23*~~

~~*Aug. 12-15*~~

~~*292 +53*~~

~~*Dec. 10-12*~~

~~*108 +33*~~

~~*Aug. 21-23*~~

~~291 +60~~

~~Dec. 12~~

~~119 +29~~

~~The August shower of Perseids is annually visible for several weeks (July 11 to August 20), the radiant having a daily motion of 1° to the E.N.E. The October Orionids are to be seen during three weeks from a fixed radiant. Some showers appear to be of short duration, while others continue for several weeks, if not months. Probably more than 100 meteor showers of very feeble character are in action on every night of the year. The Lyrids (April 19-22), Leonids (November 14-16), and Andromedids (November 23-24) are periodical, and sometimes make brilliant displays. The Quadrantids (January 2-3), Per- seids (maximum, August 10-12), Orionids (October 18-20), Geminids (December 10-12), and other systems recur annually without any great variation of strength. Bright returns of the Leonids will probably be witnessed in Nov- ember 1933, 1934, 1966, &c. The Andromedids should reappear in November 1905, in 1912-13, and 1918-19.~~

~~In the spectroscope most bright meteors show the green line of magnesium as a principal constituent. In a large meteor of 26th July 1873, Professor Konkoly remarked the lines of magnesium and sodium. Other lines in the red and green have been seen, and found by comparison identical with the lines of marsh gas. Bright meteors often emit tHe bluish white light suggestive of burning magnesium. In addition to magnesium and sodium, the lines of potassium, lithium, and also the carbon flutings exhibited in cometary spectra have been seen.~~

~~The movements of those meteorites which have actually been seen to fall upon the earth have been investigated by Professor Newton with a view to ascertaining the character of their orbits. In the great majority of cases lie found that they had moved in direct orbits, inclined~~

~~less than 90°, and that their perihelion distances were between 0-5 and 1-0, the earth's distance from the sun being unity. HIs opinion was therefore that the large meteorites moving in our solar system are allied~~

~~*much more closely with the group of short-period comets than with parabolic comets. This is true also of the large, slow-moving fireballs which are consumed in our atmo- sphere and do not reach the ground. The writer, compar- ing a large number of observations of these objects which appeared during the 19th century, finds that the majority travelled slowly from radiant points near the horizon, and from directions in which they must necessarily have over- taken the earth in her orbit. This suggests a community of origin between stony meteorites which have been seen to fall, fireballs which are burnt up and dissipated in the air, and comets of short period.*~~

~~*Meteoric observation has depended upon rough and hurried eye-estimates in past years, but the importance of ensuring greater accuracy by means of photography has recently been recognized. At Yale, Harvard, and North- field observatories and at Vienna, photographic determina- tions were made of the radiant of the inconspicuous Leonid meteor-shower of 1898. They give a mean of R.A. 161° 33', Dec. -1-22° 12'. This is probably much more correct than the average place of 109 various eye-deter- minations of the same radiant, which put it at E.A. 149° 40', Dec. 4-22° 42'. In 1899 elaborate prepara. tions were made in various places to observe the shower and to obtain photographic trails of as many meteors as possible, but the expected display failed to assume a strik- ing character, and the photographic method resulted in practical failure. Calculations indicate that the group of meteors has been disturbed by the powerful attraction of Jupiter and Saturn, and that probably the swarm passed more than a million of miles inside the earth's orbit instead of nearly intersecting it as formerly. But as we do not know the exact width of the stream or the amount of the perturbations it has suffered, the display may yet recur with some of its former brilliancy.*~~

~~*About 1866 the orbit elements of four, well-observed comets were found to present a great affinity to, if not actual identity with, the orbits of four of the best-known and most brilliant meteoric streams. More recent years have added few, if any, well-defined correspondences of similar character, though the orbit of a shower of Aqua- rids, occurring early in May, offers a suggestive resem- blance to the path of Halley's comet. It may be thought surprising, when the large number of cometary and meteoric*~~

~~systems are considered, that so few accordances have been detected, but the explanation is that really very few comets pass near enough to the earth to give rise to showers of meteors. Of eighty comets observed during the twenty years ending 1893, Professor Herschel found that only two, viz., Denning's comet of 1881 and Finlay's of 1886, approached comparatively near to the .earth's path, the former within 3,000,000 miles and the latter to within 4,600,000. (See Comets.)~~

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~~METEOROLOGY.~~

~~PEOPERLY speaking, meteorology is the study of all tlie phenomena of the gaseous atmosphere that surrounds the earth and extends to some unknown outer surface that marks the beginning of the so-called inter-stellar space. These phenomena may be studied either individually or collectively. The collective study has to do with statistics and general average conditions, some- times called normal values, and is known as Climatology. The study of the individual items may be either descrip- tive, explanatory, physical, or theoretical. Physical mete- orology is again subdivided according as we consider either the changes that depend upon the motions of masses of air or those that depend upon the motions of the gaseous molecules ; the former belong to hydrodynamics, and the latter are mostly comprised under thermodynamics, optics, and electrics.~~

~~*The general problems of climatology are best presented In the Lehrbuch of Dr Julius Hann (second edition, Strasburg, 1896). The general distribution of temperature, winds, and pressure over the whole globe was first given by Buchan in charts published by the Royal Society of Edinburgh in 1868, and again greatly revised and improved in the volume of the Challenger reports devoted to meteorology. The most complete atlas of meteorology is Buchan and Herbertson's edition of Bartholomew's Atlas, published in London in 1899. Extensive works of a more general character have been published by the London Meteorological Office, and the Deutsche Seewarte for the Atlantic, Pacific, and Indian Oceans. Daily charts of atmospheric conditions of the whole northern hemisphere were published by the U.S. Weather Bureau from 1875 to 1883 inclusive, with monthly charts for succeeding years. The physical problems of meteorology were discussed in Eerrel's Recent Advances in Meteorology, Washington, 1885. Mathematical papers on this subject will be found in the author's collection known as The Mechanics of the Earth^s Atmosphere, second edition, Washing- ton, 1893 ; the memoirs by Helmholtz and Von Bezold contained in this collection have been made the basis of a most important work by Brillouin, Paris, 1898, entitled Vents Contigus et Nuages. A general summary of our knowledge of the mechanics and physics of the atmosphere is contained in the Report on the International Cloud Work by F. H. Bigelow, Washington, 1900. The extensive treatise on meteorology by Dr Julius Hann (1901) is an authoritative work. The optical phenomena of the atmosphere are well treated by Mascart in his Traite d' Optique, Paris, 1891-98. Of minor treatises especially adapted to popular reading, or to school use, or collegiate courses of study, we may mention those by Sprung, Berlin, 1885 ; Ferrel, New York, 1890 ; Angot, Paris, 1898 ; Davis, Boston, 1893 ; Waldo, New York, 1898 ; Van Bebber, Stuttgart, 1890 ; Moore, London, 1893 ; Russell, New York, 1895.*~~

~~*I. Fundamental Physical Data.*~~

~~*Atmospheric air is a mixture of nitrogen, oxygen, aqueous vapour, carbonic acid gas, ammonia, argon, neon, helium, and possibly traces of free hydrogen and hydro- carbons. The proportions in which these gases are present are quite constant, except that the percentage of aqueous*~~

~~vapour is subject to large variations. In an atmosphere that is saturated at the temperature of 90° F., as may occur in such a climate as that of Calcutta, the water may be 2^ per cent, of the whole weight of any given volume of air. When this aqueous vapour is entirely abstracted, the remaining dry gas is found to have a very uniform constitution in all regions and at all alti- tudes where examination has been carried out. In the so-called dry atmosphere the relative weights are about as follows:— Oxygen, 2.3-16; nitrogen and argon, 76w7 ; carbonic acid, 0'04 ; ammonia and all other gases, less than 0-01 in the lower half of the atmosphere, but probably in larger percentages at great altitudes. The two constituents, argon and neon, were discovered by Eayleigh and Eamsay in January, 1895 ; in 1898 Ramsay and Travers announced the presence of krypton. The density of argon is about 19-9, that of oxygen 16, and that of nitrogen 14, when hydrogen is unity. Dewar has so perfected the process of reaching low tempera- tures that liquid hydrogen has been produced, and by its means all the more easily condensed gases contained in atmospheric air have been removed, so that there is left in the experimental tube a minute quantity of less con- densible gases, such as helium. These exceedingly vola^ tile components of the atmosphere cannot apparently be held down to the earth by the attraction of gravitation, but are continually diffusing through the atmosphere out- wards into interstellar space, and possibly also from that region back into the atmosphere. There are doubtless other volatile gases filling interstellar space and occasion- ally entering into the atmosphere of the various planets as well as of the sun itself; even the hydrogen and hydrocarbons that escape from the earth into the lower atmosphere undoubtedly ascend to regions inaccessible to man and slowly diffuse into the outer space. The laws of diffusion show that for each gas there is an altitude at which as many molecules diffuse inwards as outwards in a unit of time. This condition defines tjie outer limit of each particular gaseous atmosphere, so that we must not imagine the atmosphere of the earth to have any general boundary. The only intimation we have as to the presence of gases far above the surface of the globe comes from the phenomena of the refraction of starlight, the morning and evening twilight, and especially from the shooting stars which suddenly become luminous when they pass into what we call our atmosphere. Such obser-~~

~~vations are supposed to show that there is an appreciable quantity of gas at the height of one hundred miles, where it may have a density of a millionth part of that which prevails at the earth's surface.~~

~~According to Professor E. W. Morley, of Cleveland, Ohio, the relative proportions of oxygen and nitrogen vary slightly at the surface of the earth according as the areas of high pressure and low pressure alternately pass over the point of observation ; his remarkably exact work seems to show a possible variation of a small fraction of 1 per cent., and he suggests that the air descending within the areas of high pressure is probably slightly poorer in oxygen. The proportion of carbonic acid gas varies appreciably with the exposure of the region to the wind, increasing in propor- tion to the amount of the shelter ; it is greater over the land than over the sea, and it also slightly increases by night-time as compared with day, and in the summer and winter as compared with the spring and autumn months. During the year 1896 Professor Arrhenius in the L. E. D. Philosophkal Magazine, and in 1899 Professor Chamberlin in the American Geological Journal, published memoirs in which they argue that a variation of several per cent, in the proportion of carbonic acid gas is quite consistent with the existence of animal and vegetable life, and plausibly explains the cold climate of any glacial period. The question whether free ozone exists in the atmosphere is still debated, but there seems to be no satisfactory evidence of its presence, except possibly for a few minutes in the neighbourhood of, and immediately after, a discharge of lightning. In the case of still air the general- proportions of the principal gases up to considerable altitudes can be calculatedwithcloseapproximationby thelaws of diffusion and elastic pressure ; on the other hand, actual observations show that the rapid convection going on in the atmosphere changes these proportions and brings about a fairly uni- form percentage of oxygen, nitrogen, and carbonic acid gas up to a height of ten miles. The quantity of aqueous vapour is controlled by temperature quite as much as by**

~~*convection, and has very little to do with diffusion ; the law of its distribution in altitude has been well expressed by Hanii by the simple formula: log e = log C„ — 7i/6517 where h is the height expressed in metres and e and e^ are the vapour tensions at the upper station and sear level respectively. Thus, if the vapour tension is 10 millimetres at sea-level corresponding to saturation at a temperature of about 11° C. or 62° F., then the pressure and the dew-point at other altitudes should be about as follows : —*~~

~~*Altitude.*~~

~~*Vapour Pressure.*~~

~~*Dow-Point.*~~

~~*Kll.*~~

~~*Mm.*~~

~~*°0.*~~

~~*θ*~~

~~*10-00*~~

~~*-m-4*~~

~~*5*~~

~~*6-87*~~

~~*1-5-8*~~

~~*10*~~

~~*4-59*~~

~~*1-0-1*~~

~~15~~

~~2-98~~

~~-5-0~~

~~20~~

~~1-86~~

~~-10-6~~

~~30~~

~~0-64~~

~~-22‘0~~

~~40~~

~~0-18~~

~~-34-2~~

~~60~~

~~0-04~~

~~-48-0~~

~~60~~

~~0-00~~

~~?~~

~~*In addition to the gases and vapours in the atmosphere, both meteorology and hygiene have come to consider the motes of dust as very important constituents. The aqueous particles that constitute cloud, fog, and haze*~~

~~*are also important. As all these float in the air, slowly descending, but resisted by the viscosity of the atmosphere, their whole weight is added to the atmosphere and becomes a part of the barometric record. When the air is cooled to the dew-point and condensation of the vapour begins, it takes place first upon the atoms of dust as nuclei ; conse- quently, air that is free from dust is scarcely to be found except within a mass of cloud or fog.*~~

~~*According to a calculation published in the U.S. Monthly Weather Review for February 1899, the total mass of the atmosphere is 1/1,125,000 of the mass of the earth itself, but, according to Professor E. S. Woodward (see Science for January 1900), celestial dynamics shows that there may possibly be a gaseous envelope whose weight is not felt at the earth's surface, since it is held in dynamic equilibrium above the atmosphere ; the mass of this outer atmosphere cannot exceed y^i^-^th of the mass of the earth, and is probably far less, if indeed it be at all appreciable.*~~

~~*There can be no proper study of meteorology without a*~~

~~*consideration of the various physical properties*~~

~~*Physical gf ^jjg atmosphere's gases and vapours, each of*~~

~~*prope es. ^j^j^jj^ plays an independent part, and yet also*~~

~~*reacts upon its neighbours.*~~

~~*Conductivity. — Dry air is a poor conductor of heat, its coefficient of conduction being expressed by the formula : 0-000 0568 (1+0 00190<) where the temperature (t) is expressed in centigrade degrees. This formula states the fact that a plate of air 1 centimetre thick can conduct through its substance for every square centimetre of its area, in one second of time, when the difference of tempera- ture between two faces of the plate is 1° C, enough heat to warm 1 gram of water 0-000 0568° C, or 1 gram of air 0-000 239° C, or a cubic centimetre of air 0.1850° C, if that air is at the standard density for 760 millimetres of pressure and 0 degrees of temperature centigrade.*~~

~~*Diathermancy. — The air is extremely diathermanous or transparent to the general transmission of radiant heat. In general the coefficient of transmission increases as the heat waves become longer, but certain wave-lengths or kinds of heat are specifically absorbed. The general co-efficient of transmission for a zenithal sun is 0·4 at the violet and 0·8 at the red end of the spectrum. By the specific absorption certain long wave-lengths are entirely cut off by aqueous vapour and others by the carbonic acid gas, so that in general the atmosphere appears to be more*~~

~~*transparent to the short wave-lengths. When the zenithal sun's rays fall upon a station whose barometric pressure is 760 millimetres, then only from 50 to 80 per cent, of the total heat reaches the earth's surface, and thus the general coefficient of transmission for the thickness of one atmosphere is usually estimated at about 60 per cent. Of course when the rays are more oblique, or when haze, dust, or cloud interfere, the transmission is still farther diminished. In general one-half of the heat received by the illuminated atmosphere is absorbed by it, leaving the other half to reach the surface of the ground, provided there be no intercepting clouds. The thermal conditions actually observed at the immediate surface of the globe may therefore be of minor importance in the mechanism of the atmosphere.*~~

~~*Specific Heat. — The capacity of the air for heat varies according as the heat increases the volume of the air expanding under constant pressure, or the pressure of the air confined in constant volume. The specific heat under constant pressure is about 1·406 times the specific heat under constant volume. The numerical value of the specific heat under constant pressure is about 0·2377; that is to say, that number of calories, or units of heat, is required to change the temperature of 1 gram of air by 1° C. This coefficient holds good, strictly speaking, between the temperatures minus 30° and plus 10° C, and there is a very slight diminution for higher temperatures up to 200°.*~~

~~*Radiating Power. — The radiating power of dry air is so small that it cannot be measured quantitatively, but the spectroscope and bolometer demonstrate its existence. The coefficient of radiation of the moisture diffused in the atmosphere is undoubtedly much larger than that of the*~~

~~*particles of dust and cloud, and is nearly equal to that of a lamp-black surface, or unity. From the normal diurnal change in temperature at high and low stations, it should be possible to determine the general coefficient of atmospheric radiation for the average condition of the air in so far as this is not obscured by the influence of the winds. This was first done by Maurer in 1885, who obtained a result in calories that may be expressed as follows : — The total radiation in twenty-four hours of a unit mass of average dusty and moist air towards an enclosure whose temperature is 1° lower is sufficient to lower the temperature of the radiating air by 3-31° C. in twenty-four hours. This very small quantity was confirmed by the studies of Trabert, published in 1892. The direct observations of Hutchins on dry dusty air, as published in 1890, gave a much larger value — evidently too large. The in- vestigation of this subject prosecuted by Professor F. W. Very at the Allegheny Observatory, and published as "Bulletin G-" of the U.S. Weather Bureau, shows the character and amount of the radiation of several gases, and especially the details of the process going on under normal conditions in the atmosphere.*~~

~~*Density. — The absolute density or weight of a cubic centimetre of dry air at the standard pressure, 760 millimetres, and temperature 0° C, is 0-001 29305 grams ; that of a cubic metre is 1-29305 kilograms; that of a cubic foot is O-O8O7I pounds avoirdupois.*~~

~~*Expansion. — The air expands with heat, and the ex- pansion of aqueous vapour is so nearly the same as that of dry air that the same coefficient may be used for the complex atmosphere itself as a whole. The change of volume may be expressed in centigrade degrees by the for- mula V=V„ (1-1-0.000 3665f), or in Fahrenheit degrees V=Vo (1 -1-0-000 2370-*~~

~~*Elasticity. — The air is compressed nearly in proportion to the pressure that confines it. The pressure, tempera- ture, and volume of a true gas are connected by the*~~

equation pt;=ET, where T is the absolute temperature or 273° plus the centigrade temperature; p is the barometric pressure in millimetres and v the volume of a unit mass of gas, or the reciprocal of the density of the gas. The constant E, is 29-272 when the centimetre, the gram, the second, and the centigrade degrees are adopted as units of measure, and differs for each gas. The number just given relates to dry atmospheric air. For aqueous vapour in a gaseous state and not near the point of condensation E has the value 47-061. For ordinary air in which x is the mass of the aqueous vapour that is mixed with the unit mass of dry air, the above equation becomes pi) =(29 -272 + a-47-061) T. This equation is sometimes known as the equation of condition peculiar to the gaseous state. It may also be properly called the equation of elasticity or the elastic equation for gases, as expressing the fact that the elastic pressure p depends upon the temperature and the volume. The more exact equation demonstrated by

Van der Waals, i.e., (p + -j](«—&) =ET, is not needed for

the low pressures that occur in meteorology.

Diffusion. — In comparison with the winds, it may be said that it is difficult for aqueous vapour to diffuse in the air. In fact, the distribution of moisture is carried on principally by the horizontal convection due to the wind and the vertical convection due to ascending and descending currents. Diffusion proper, however, comes into play in the first moments of the process of evaporar tion. The coefficient of diffusion for aqueous vapour from a pure water surface into the atmosphere is 0-18 according to Stefan, or 0-1980 according to Winkelmann ; that is to say, for a unit surface of one square centunetre, and a unit gradient of vapour pressure of one atmosphere per centimetre, as we proceed from the water surface into the still dry air, at the standard pressure and tempera- ture, the quantity of moisture diffused is 0-1980 gram per second. This coefficient rises or increases with the temperature, and is 0-2827 at 49-5° C. But this rate of diffusion diminishes very rapidly at a small distance from the free surface of the water, so that the most im- portant condition facilitating evaporation is the action of the wind.

Viscosity. — When the atmosphere is in motion each layer is a drag upon the adjacent one that moves a little faster than it does. This drag is the so-

~~*called molecular or internal friction or viscosity. The coefficient of viscosity in gases increases nearly in proportion to the absolute temperature, and its value is given by an equation like the following: 0-000 248 (1+0-003 6650%, which is the value given by Carl Barus {Ann. Phys. 1889, xxxvi.). This expression implies that for air whose temperature is the absolute zero there is no viscosity, but that at a temperature of 0° C, or 273° on the absolute scale, a force of 0-000 248 gram is required in order to push or pull a layer of air 1 centimetre square past another layer distant from it by 1 centimetre at a uniform rate of 1 centimetre per second. In treating of the general motions of the atmosphere it is quite common to consider the viscosity of the air as a resisting force, but the above figures show that it exerts an exceed- ingly feeble resistance as compared with the obstacles encountered on the earth's surface and the inertia of the rising and falling masses of warm and cold air. The coefficient of friction usually deduced from the observations of the winds results essentially not from viscosity, but from the resistances of all kinds to which the motion of the atmosphere is subjected. The greater part of these resistances consists essentially in a dissipa- tion of the energy of the moving masses by their division into smaller masses which penetrate the quiet air in all*~~

~~*directions. The loss of energy due to this process, if it must be called friction, should perhaps be called convective friction, or, more properly, convective loss of energy.*~~

~~*Gravity. — The weight of the atmosphere depends pri- marily upon the action of gravity, which gives a downward pressure to every particle. Owing to the elastic compres- sibility of the air, this downward pressure is converted at once into an elastic pressure in all directions. The force of gravity varies with the latitude and the altitude, and in any exact work its variations must be taken into account. Its value is well represented by the formula due to Helmert, ^g=980-6 (1-0-0026 cos 2L) x (l-.A), where L represents the latitude of the station and h the altitude. The coefficient / is small and has a different value accord- ing as the station is raised above the earth's surface by a continent, as, for instance, on a mountain top, or by the ocean, as on a ship sailing over the sea, or in the free air, as in a balloon. Its different values are sufficiently well known for meteorological*~~

~~*uses, and are utilized most discreetly in the elaborate discussion of the hypsometric formula published by Angot in 1899 in the memoirs of the Central Meteorological Bureau of France.*~~

~~*The temperature of the air, at the surfaces of both the earth and ocean and throughout the atmosphere, is the fundamental e].emeat of both climatology and dynamic meteorology. As far as it is known Distriba- from direct observation, it is best exhibited by "°" "' means of isotherms or lines of equal temperature tur^"' drawn on charts of the globe. It can also be expressed analytically by harmonic spherical functions, as was first done by Schoch. The normal distribution of temperature for each month of the year over the whole globe has been given by Buchan in his charts of 1868 and of 1888, also by the U.S. Weather Bureau " Bulletin A-' of 1893, and again by Buchan in his new edition of Bartholomew's Physical Atlas, London, 1899. The tem- peratures, as thus charted, first receive a slight correction, called a reduction to sea-level, in order to reduce them to a homogeneous system. The actual temperature near the ground at any altitude on a continent or island may be obtained from these charts by subtracting 0-5° C. for each 100 metres of elevation of the ground above sea-level, or 1° F. for 350 feet. This reduction, however, applies specifically to temperatures observed near the surface of the ground, and cannot be used with any confidence to determine the temperature of points in the free air at any distance above the land or ocean. On all such charts the reader will notice the hi^h temperatures near the ground in the interior of each of the continents in the summer season and the low temperatures in the winter season. In February the average temperatures in the northern hemisphere ai-e not lowest near the Korth Pole, but in the interiors of Siberia and North America ; in the southern hemisphere they are at the same time highest in Australia, and Africa, and South America. In August the average temperatures are unexpectedly high in' the interior of Asia and North America, but low in Australia and Africa. The vertical distribution in the free air must also be studied in detail, in order to understand both the general circulation and tlie si^ecial systems that characterize the earth's atmosphere. jMauy observations on mountains and by aeronauts in balloons were made during the 19th century in order to ascertain the facts with regard to the decrease of temperature as we ascend in the atmosphere, but it is now*~~

~~recognized that both these classes of observations were largely affected by local influences due to the presence ofthe ground and the balloon. Later efforts have been directed to the elimination of these disturbing elements, and the determination of the temperature of the free~~

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~~air by means of delicate thermographs carried up to great heights by small free "sounding balloons," and ,to lesser heights by means of kites. Many interna^ tional balloon ascents have been made since 1890, and a large amount of information has been secured. Keports upon these results have been published by Dr H. Hergesell for Europe in general, and by L. Teisserenc de Bort relative to that done at his private observatory for dynamic meteorology at Trappes, near Paris. Valuable work has also been done with kites, both at Trappes and by Mr A. Lawrence lloteh at his private meteoro- logical observatory on Blue Hill, near Boston ; but the principal work with kites has been that accomplished in 1898 at the seventeen kite stations of the U.S. Weather Bureau. The first results of all this latter work are published in a memoir, " Bulletin F," by Dr H. C. Trankenfield, of which a summary is given in the U.S. Monthly WecUher Review for September 1899. Some of the more general results are given in the following table : —~~

~~.Vltitude.~~

~~Temperature.~~

~~Stations.~~

~~Feet.~~

~~Gradient.~~

~~Reduction.~~

~~*Fall! .*~~

~~*Fahr.*~~

~~*o*~~

~~*θ*~~

~~*Waslmigtou .*~~

~~*210*~~

~~*-3-00*~~

~~*-15-2*~~

~~*Cairo*~~

~~*315*~~

~~*-4-30*~~

~~*-26-6*~~

~~*Cincinnati*~~

~~*940*~~

~~*-5-15*~~

~~*-27-5*~~

~~*Fort Smitli .*~~

~~*527*~~

~~•>~~

~~?~~

~~*Knoxville*~~

~~*9!I0*~~

~~*-5-00*~~

~~*-21-5*~~

~~*Mempliis*~~

~~*319*~~

~~*-3 -.50*~~

~~*-17-3*~~

~~*Springijeld .*~~

~~*684*~~

~~*-3-85*~~

~~*-17-7*~~

~~*Cleveland*~~

~~*705*~~

~~*-4-10*~~

~~*-18-8*~~

~~*Daluth .*~~

~~*1197*~~

~~*-4-30*~~

~~*-17-C*~~

~~*Lansing*~~

~~*869*~~

~~*-3-85*~~

~~*-170*~~

~~*Sault Ste Marie .*~~

~~*722*~~

~~*-3-45*~~

~~*-15-7*~~

~~*Dodge ....*~~

~~*2473*~~

~~*-4-10*~~

~~*-ll-O*~~

~~*Dubuque*~~

~~*894*~~

~~*-3-30*~~

~~*-14-5*~~

~~*North Platte .*~~

~~*2811*~~

~~*-5-40*~~

~~*-13-3*~~

~~*Omaha ....*~~

~~*1241*~~

~~*-3·20*~~

~~*-12·9*~~

~~*Pierre .*~~

~~*1595*~~

~~*-3·90*~~

~~*-14·4*~~

~~*Topeka .*~~

~~*972*~~

~~*-3·83*~~

~~*-16·5*~~

~~*In this table the second column gives the altitude of the ground at the reel on which the kite wire was wound. The third column shows the average gradient in degrees Fahrenheit per 1000 feet above the reel at the respective stations, up to a uniform surface 5280 feet above sea-level. The fourth column shows the total reduction to be applied to the temperature at the reel in order to obtain the temperature at the one-mile level above sea. These gradients and reductions are based upon observations made only during the six warm months from May to October 1898. At the observatory of Trappes free balloons and kites were used during eighteen months, in 1898 and 1899, with sufS.cient frequency to give us some knowledge of the monthly gradients of temperature in a vertical direction and a fair average for a whole year. The following results are taken from the U.S. Monthly Weather Review, September 1899 : — Decrease of Temperature in Free Air.*~~

~~*Altitude*~~

~~*above*~~

~~*Annual.*~~

~~*May-Oot.*~~

~~*Nov.- Apr.*~~

~~*ground.*~~

~~*Cent.*~~

~~*Cent.*~~

~~*Cent.*~~

~~*KU.*~~

~~*o*~~

~~*o*~~

~~*o*~~

~~*10*~~

~~*-60-1*~~

~~*-63-T*~~

~~*-56-5*~~

~~*9*~~

~~*-51-4*~~

~~*-54-5*~~

~~*-48-3*~~

~~*8*~~

~~-44-7~~

~~-47-2~~

~~-42-2~~

~~7~~

~~-37-7~~

~~-39-5~~

~~-35-8~~

~~6~~

~~-30-2~~

~~-31-1~~

~~-29-2~~

~~5~~

~~-24-2~~

~~-25-3~~

~~-23-2~~

~~4~~

~~-18-3~~

~~-19-9~~

~~-16-7~~

~~3~~

~~*-13·2*~~

~~*-15·3*~~

~~*-11·0*~~

~~*2*~~

~~*-8·6*~~

~~*-10·3*~~

~~*-6·8*~~

~~*1*~~

~~*-4·0*~~

~~*-5·7*~~

~~*-2·3*~~

~~*0*~~

~~*0·0*~~

~~*0·0*~~

~~*0·0*~~

~~*It is evident that the annual average vertical gradient of temperature is between 4° and 6° C. per thousand metres of ascent in the free air. In the summer months — May-October — the gradient up to 6000 kilometres agrees closely with the value 5° per thousand metres, which has come into extensive use since the year 1890 on the recommendation and authority of Hann. The winter gradients are apparently less than those for summer, possibly owing to the influence of the condensa- tion into cloud and rain during the winter season in France ; the same value may not result from the kite work in the United States, where the clouds and precipi- tation of*~~

~~*winter do not so greatly exceed those of summer. The work at Trappes is therefore not necessarily repre- sentative of the general average of the northern hemi- sphere, but belongs to a region in which during the summer time, at great heights, the air is cooler than in the winter time, since during the latter season there is an extensive flow of warm air from the ocean over the cold air from the land. The isotherms at 6000 and 10,000 metres altitude over all Europe, on three special days when many ascensions were made, are published by Hergesell in the Met. Zeit. for January 1900, and show unexpectedly great diversities at those altitudes.*~~

~~*The distribution of aqueous vapour is best shown by lines of equal dew-point or vapour tension, though for some purposes lines of equal relative humidity o/stribu- are convenient. The dew-point lines are not tioaot usually shown on charts, partly because the lines aqueous of vapour pressure are approximately parallel to ^^p”’”’- the lines of mean temperature of the air, and partly because the observations are of very unequal accuracy in different portions of the globe. In general we may con- sider any isotherm as agreeing with the dew-point line for dew-points a few degrees lower than the temperature of the air. The distribution of moisture is quite irregular both in a horizontal and in a vertical direction. On charts of the world we may draw lines based on actual observations to represent equal degrees of relative hu- midity, or equal dew-points and vapour pressures ; but as regards the distribution of moisture in a vertical direction we are, in the absence of specific observations, generally forced to assume that the vapour pressure at any altitude h follows the average law first deduced from a limited number of observations by Hann, and expressed by the logarithmic equation, log. e=log. eo— 7i/6ol7, which is quite analogous to the elementary hypsometric formula, log. p=log. pa— h/l%iQlQ). Therefore, in general, the ratio between the pressure of the vapour and the pressure of the atmosphere at any altitude is represented by the ap- proximate formula, log. e/p=log. eo/Po— Vl*^091. Of course these relations can only represent average or normal conditions, which may be departed from very widely at any moment. They have, however, been found to agree remarkably with all observations which have as yet been published. The average results are given in the following table, which is abbreviated from one published by Hann, but with the addition*~~

~~*of the work done by the U.S. Weather Bureau, as reduced by Dr Frankenfield in*~~

~~*1899.*~~

~~*It is therefore evident that the formula first published by Hann in 1874 as the result of observations on fifteen balloon ascents and six mountains, by means of which the last line in the table was computed, is abundantly confii-med by the Weather Bureau work in the United States with kites and balloons. The distribution of vapour it indicates is wholly different from that as- sumed by Dalton and the physicists who followed him. It is not the law of diffusion, but it agrees so closely with actual observations up to altitudes of five miles that we may safely assert that the vapour constituent*~~

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~~*of the atmosphere is not distributed according to the law of gaseous diffusion, but, like temperature and the ratio between oxygen and nitrogen, is controlled by other laws prescribed by the winds and currents, namely — convection.*~~

~~*Diminution of the Relative Vapor Pressure with Altitude.*~~

~~*Authority.*~~

~~*1500*~~

~~*feet.*~~

~~*2000*~~

~~*feet.*~~

~~*8000*~~

~~*feet.*~~

~~*4000*~~

~~*feet.*~~

~~*5000*~~

~~*feet.*~~

~~*6000*~~

~~*feet.*~~

~~*7000*~~

~~*feet.*~~

~~*8000*~~

~~*feet.*~~

~~*No. Obs.*~~

~~*Kites.*~~

~~*0-82*~~

~~*0-78*~~

~~*0-70*~~

~~*0-61*~~

~~*0-52*~~

~~*0-49*~~

~~*0-39*~~

~~*0-44*~~

~~*1123*~~

~~*U.S. W.B. Balloons.*~~

~~*0-97*~~

~~*0-96*~~

~~*0-87*~~

~~*0-68*~~

~~*0-44*~~

~~*0-59*~~

–

~~*4*~~

~~*Hamraon. Balloons.*~~

~~*0-89*~~

~~*0-83*~~

~~*0-80*~~

~~*0-78*~~

~~*0-67*~~

~~*0-46*~~

~~*0-44*~~

–

~~*2*~~

~~*Hazen. Balloons.*~~

~~*0-84*~~

~~*0-80*~~

~~*0-66*~~

~~*0-61*~~

~~*0-60*~~

~~*0-54*~~

~~*0-41*~~

~~*0-37*~~

~~*15*~~

~~*Hann.*~~

~~*Mountains.*~~

~~*0-83*~~

~~*0-81*~~

~~*0-80*~~

~~*0-66*~~

~~*0-61*~~

~~*0-58*~~

~~*0-55*~~

~~*0-47*~~

~~*6*~~

~~*Hann. Computed by Hann.*~~

~~*0-85*~~

~~*0-81*~~

~~*0-72*~~

~~*0-65*~~

~~*0-58*~~

~~*0-52*~~

~~*0-47*~~

~~*0-42*~~

—

~~*Jsfote. — The vapour pressure at any altitude is supposed to be expressed as a fraction of that observed at the ground. When the altitudes are given in feet Hann's formula be- comes log e/eo= — ft/29539.*~~

~~*The total amount of vapour in the atmosphere is between one-fourth and one-fifth of the amount required by Dal ton's hypothesis, as is illustrated by the following table taken from an article by the writer in the Smithsonian Report for 1888, page 410 :—*~~

~~*Total Vapour in a Vertical Column.*~~

~~*Altitude. Feet.*~~

~~*Eelative Tension*~~

~~*Actual Weight Gr. per Cubic Foot.*~~

~~*Total Vapour In the*~~

~~*Columns expressed as*~~

~~*Inches of Kain.*~~

~~*80° F.*~~

~~*TO°F,*~~

~~*60° F.*~~

~~*50° F.*~~

~~*SO°F.*~~

~~*70° F.*~~

~~*60° F.*~~

~~*50° F.*~~

~~*θ*~~

~~*1-000*~~

~~*10-95*~~

~~*7-99*~~

~~*5-76*~~

~~*4-09*~~

~~*0-0*~~

~~*0-0*~~

~~*0–0*~~

~~*0–0*~~

~~*6,000*~~

~~*0–524*~~

~~*6–75*~~

~~*4–19*~~

~~*8–02*~~

~~*2–14*~~

~~*1–3*~~

~~*1–0*~~

~~*0–7*~~

~~*0–5*~~

~~*12,000*~~

~~*0–275*~~

~~*3–01*~~

~~*2–20*~~

~~*1–58*~~

~~*1–12*~~

~~*2–1*~~

~~*1–5*~~

~~*1-1*~~

~~*0-8*~~

~~*18,000*~~

~~*0-144*~~

~~*1-58*~~

~~*1-15*~~

~~*0-83*~~

~~*0-59*~~

~~*2-5*~~

~~*1-8*~~

~~*1-3*~~

~~*0-9*~~

~~*24,000*~~

~~*0-075*~~

~~*0-82*~~

~~*0-62*~~

~~*0-43*~~

~~*0-31*~~

~~*2-7*~~

~~*2-0*~~

~~*1-4*~~

~~*1-0*~~

~~*30,000*~~

~~*0-040*~~

~~*0-43*~~

~~*0-32*~~

~~*0-23*~~

~~*0-16*~~

~~*2-8*~~

~~*2-1*~~

~~*1-5*~~

~~*1-1*~~

~~*We see that a heavy rainfall may result from the precipitation of only a small percentage of tlie water contained in the fresh supplies of air brought by the wind, and that consequently, if all moisture were abstracted from the atmosphere throughout the equatorial regions, it could only affect the barometer by 2-8/13-6 inches, or about two-tenths of an inch, while at the polar regions the diminution would be much less than one-tenth. Evidently, therefore, it is idle to argue that the fall of pressure in an extensive storm is to be considered as the simple result of the condensation of the vapour into rain.*~~

~~*The horizontal distribution of barometric pressure over the earth's surface is shown by the isobars, or lines of equal pressure ; it can also be expressed by a ff™"?""" system of complex spherical harmonics. As the indications oi the mercurial barometer must vary with the variation of gravity, whereas those of the aneroid barometer do not, it has been agreed*~~

by the International Meteorological Conventions that for scientific purposes all atmospheric pressures, when expressed in barometric inches, must be reduced to one standard value of gravity, namely, its force at sea-level and at 45° of latitude. In this locality its value is such as to give an acceleration of 980·8 centimetres, or 32·2 English feet, per second. The effect of the variation of gravity with latitude is therefore to make the mercurial barometer read too high, between 45° and the equator ; and too low, between 45° and the pole. The correction to be applied to any mercurial baro- metric reading at or near sea-level, in order to get the

atmospheric pressure in standard units, should be given on the edge of a meteorological chart, unless the isobars shown thereon already contain this correction. On such ^ charts it will be perceived that the barometric pressure at sea-level is by no means uniform over the earth's surface, and daily weather charts show very great fluctuations in this respect, the lowest pressures being storm centres and the highest ones areas of clear cold weather. But even the normal average charts show high pressures over the continents in the winter and low pressures over the oceans, these conditions being reversed in the summer time. Schouff {Fogg. Ann., 1832) first demonstrated that the average pressure in the neighbourhood of the equator is slightly less than under either tropic, and that there is a still more remarkable diminution of pressure from either tropic towards its pole. The exact statement of these variations of pressure with latitude was subsequently worked out very precisely by Eerrel, and forms the basis of his explanation of the general circulation of the earth's atmosphere and its influence on the barometer. The series of monthly charts for the whole globe, compiled by Buchan and published by the Eoyal Society of Edinburgh in 1868, as well as Buchan's later and more perfect charts in the meteorology of the Challenger Expedition, Edin- burgh, 1889, first revealed clearly the fact that the distinct areas of high and low pressure which are located over the continents and the oceans vary during the year in a fairly regular manner, so that the pressure is higher over the continents in the winter season and lower in the summer season, the amount of the change depending principally upon the size of the continent. A part of this annual variation in pressure is undoubtedly introduced by the methods of reduction to sea-level ; indeed, if the data of the lower stations are reduced up to the level of 10,000 or 16,000 feet, we

~~*sometimes find the barometric conditions quite reversed. These annual changes are intimately connected as cause and effect with the annual changes of temperature, moisture, and wind, but it is quite erroneous to imagine that the observed pressures control the winds ; there is a reaction going on between the wind and the barometric pressure, and the resistance of the earth's surface is such that the true relation between these factors is a complex but fundamental problem of theoretical meteorology.*~~

~~*The vertical distribution of pressure as deduced from observation shows a rate of diminution with increasing altitude very closely but not entirely accordant with the laws of static equilibrium, as first elaborated by Laplace in his hypsometric formula. The departures from the law of static equilibrium are sufficient to show that, if our at- mosphere is really in a state of equilibrium, it must be a matter of dynamics and not of statics. The relation of the density of the air to the altitude and temperature, and the total pressure of the superincumbent atmosphere, are shown in the accompanying diagram (Fig. 1), which is taken from a paper by the late Joseph Cottier, published in the U.S. Monthly Weather lienew for July 1897. The diminution of pressure with altitude, as shown in this diagram for average conditions, but not for the temporary conditions that continually occur, follows a logarithmic law, and can undoubtedly be extended upwards for the normal atmosphere to a height of 20 or 30 miles, but not much farther, owing to our uncertainty as to the actual temperature and pressure in the upper portions of the atmosphere. This diagram is based upon the assumption that the atmosphere is in a state of convective equilibrium ; the ascending and descending masses expand and cool as they ascend, or contract and warm up as they descend, nearly but not quite in accordance with the adiabatic law of the change of temperature in pure gases. The limiting height of the atmosphere must be at some known elevation*~~

~~*above 20 or 30 miles, where the temperature would become absolute zero, according to the adopted law of diminution. But the uncertainty of the various hy- potheses as to the physical properties of the upper atmosphere forbids us to entertain any positive ideas on this subject at the present time. If we define the outer limit as that point at which the diffusion of gases inwards just balances the diffusion outwards, then this limit must be determined not by the hypso- metric formula, but by the properties of gases at low temperatures and pressures under conditions as yet uninvestigated by physicists.*~~

~~*It is evident that the clouds are formed from clear transparent air by the condensation of the invisible mois- ture therein into numerous minute globules of water or crystals of ice and snow. Not- withstanding their transparency, these individual globules and crystals, when collected in large masses, disperse the solar rays by reiiexion to such an extent that direct light from the sun is unable to penetrate them, and partial darkness re- sults. In a general survey of the atmo- sphere the geographical distribution of the amount of cloudy sky is important. When the solar heats falls upon the surface of the cloud it is so absorbed and reflected that, on the one hand, scarcely any penetrates to the ground beneath, while on the other hand the upper surface of the cloud becomes unduly heated. Even if this upper surface is completely evaporated, it may continually be renewed from below, and, moreover, the evaporated moisture mix- ing with the air renders it very much lighter specifi- cally than it would other- wise be. Hence the upper surface of the cloud replaces the sur- face of the ground and of*~~

~~*the ocean; the air in contact with it acquires a higher temperature and greater buoyancy, while the ground and air beneath it remain colder than they would be in sunshine. The average annual cloudiness over the globe is therefore intimately related to the density and circulation of the atmosphere ; it was first charted in general terms by L. Teisserenc de Bort*~~

~~*of Paris about 1886. The manifold modifications of the clouds impress one with the conviction that, when properly understood and interpreted, they will reveal to us the most important features of the processes going on in the atmosphere. If the farmer and sailor can correctly judge*~~

~~*of the weather several hours in advance by a casual glance at the clouds, what may not the professional meteor- ologist hope to do by a more careful study? Acting on this idea, the author in 1868 asked from all of his correspondent observers full details as to the quantity, kind, and direction of motion of each layer of clouds ; these were telegraphed daily for publication in the bulletin of the Cincinnati Observatory, and for use in the weather predictions made at that time. Since January 1872 similar data have been regularly tele- graphed for the use of the U.S. Weather Bureau in preparing forecasts, although the special cloud maps that are compiled have not been published, owing to the expense. These data were also published in full in the Bulletin of the International Simultaneous Meteorological Observations for the whole northern hemisphere during the years 1875-84. The writer's work on the U.S. Eclipse Expedition to the West Coast of Africa in 1889-90 was wholly devoted to the determination of the height and motions of the clouds by the use of a special form of the marine nephoscope, whose use can easily be understood from an examination of Eigs. 2, 3, and 4. It consists simply of a framework and mirror fitting upon the standard compass of the navigator, and removable at a moment's notice if necessary. The use of this instrument is to be strongly recommended, as it gives the navigator a means of determining exactly the bearing of a storm centre at sea by studying the lower clouds better than he can possibly do by the observations of the winds alone. The im- portance of cloud study has been especially emphasized by the International Meteorological Committee, which arranged for a complete year of systematic cloud-work by national weather bureaus and individual observatories throughout the world from May 1896 to June 1897. In this connexion Mr H. C. Clayton of Blue Hill Observa- tory has published a very comprehensive report on cloud forms. The complete report by Professor F. H. Bigelow on the work done by the U.S. Weather Bureau forms a part of the annual report for 1899, and constitutes a remarkable addition to our knowledge of the subject. Some preliminary account of*~~

~~this work was published in the American Journal of Science for December~~

~~1899.~~

~~In order to obtain the greatest benefit from the study of the clouds, we must understand the laws and processes involved in their formation ; but as these constitute a study in mechanics and physics of great complexity, the results already obtained will be stated in a subsequent section of this article as a part of theoretical physical meteorology. Meanwhile the following brief remarks relative to the kinds of clouds will serve as an introduction to the subject. The name stratus implies a horizontal sheet of cloud having no special structure, except that it is a thin layer. It was first applied by Howard specifically to the thin layers that form within a short distance of the earth's surface in quiet places on a still evening, preliminary to the general formation of low fog at night; there- fore it is sometimes called high or lifted fog. It is also applicable to thicker layers that form at con- siderable heights above the ground, and by cutting off radiation effectually prevent the formation of fog at the earth's surface. Again, the term is applied to layers of haze that may form even at the highest altitude. Near the observer's zenith such a layer usually appears as haze, but when seen in the distant horizon it appears as a hori- zontal layer of stratus. Einally the term is applied in various combinations toindicate, for instance, that the main cloud has a broad thin base, like a stratus, attached to its lower part or broad horizontal sheets overflowing at the top.~~

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~~The presence of a stratus cloud indicates that there is no rapid or great vertical motion going on, such as would throw a thin layer of stratus into great rolls or heaps. Cumulus may be described as the direct result of~~

~~rapidly ascending currents that have been started either by the buoyancy of the warm air at the surface of the earth or at the surface of a stratus cloud. But it is also formed by the direct action of moist winds, which, blowing against mountains or other obstacles, are forced to rise rapidly. In either case the ascending air must expand as it corjaes under the low pressure of greater altitudes, and as it does work in expanding, it must cool by an amount that is determined by the laws of thermodyna- mics. This cooling is distinctly not due to any great extent to mixture with cold air, the radiation of heat, or the so-called cold of altitude, but, as Espy first main- tained in 1826, is a simple thermodynamic operation, by which heat is converted into work, or work that is done makes a draft upon the available heat that is contained in the air. At a certain point of its ascent the air thus cools sufficiently to form haze and cloud. Espy showed that the latent heat evolved in the formation of the cloud may become again apparent if the cloudy air is forced to descend, so that, except for a small loss by radiation, the air will return to the same temperature as that with which it started. If, however, rain or snow should fall from the clouds leaving the evolved latent heat behind, then when the cloudy air returns to the ground it is drier and warmer than in its initial condition, and thus gives rise to the hot waves known as chinooks and foehns ; or if the process goes on over a large area of the earth, it causes regions of drought and even deserts. Alto-cumulus is a comparatively thin layer of clouds of the cumulus type, occurring in cases where the ascending currents are not strong enough, or do not continue long enough, to stimulate the formation of very high or thick cumuli. Sometimes these clouds represent the upper portions of a series of waves in the atmosphere. At other times they are formed between two layers of air, of which the upper one has a different velocity and direction of motion from the lower one; consequently, at the boundary surface a series of rolls or horizontal cylindrical vortices are produced, and the cloudiness is due partly to mixture and partly to the expansion of the air in the rising portion of the clouds. Systems of alto-cumulus rolls sometimes extend for several hundred miles in all directions, or in a straight line for a hundred miles to lee- ward of a mountain top. Cirro-cumulus is much smaller than the alto-cumulus, of a more delicate texture, purer white, and almost invariably arranged in rank and file or other very regular patterns. It is formed, like the alto- cumulus, in the mixing regions between two layers~~

~~*of air moving in different directions, but its typical peculiarities apparently arise from the fact that it is formed at such high altitudes and low temperatures that it can only consist of the finest crystals of ice and snow. It is so thin or contains so little water that it scarcely ever presents a dark side having an appreciable contrast to the bright side ; in other words, the sunlight seems to illuminate it through and through. Cirrus clouds appear both singly and in large groups— generally of a pure white — sometimes in belts or bands, which converge by perspective in opposite points of the horizon, and whose actual length is therefore to be measured by several hundred miles. They are the highest and whitest of all the clouds ; they may be formed by mixture, or even sometimes by mere contact and the conduction of their own heat to neighbouring cold air. More frequently they must be due to cooling of moist streaks in the upper atmosphere by expansion and radia- tion. As soon as these clouds are formed in daylight, the heat of the sunshine begins to dissipate them, and they*~~

~~*soon disappear if they are surrounded by very dry air ; but, if the air be moist, the same process that formed the first cirrus will continue until the whole layer of air be- comes filled with a thick haze which indicates the pres- ence of conditions favourable to a storm.*~~

~~*II. Apparatus and Methods.*~~

~~*The observational basis of meteorology is the frequent, and, if possible, continuous record of the temperature, moisture, and barometric pressure in the free atmosphere, the direction and velocity of the wind, the rain and snow fall, and the kind, amount, and motion of the clouds. For Europe these data have been furnished with more or less accuracy and continuity by thousands of observers ever since 1653, when Ferdinand II., grand duke of Tuscany, organized a system of daily observations in Italy under the general supervision of Luigi Antinori. During the 19th century great efforts were made to obtain equally full records from all parts of the land and ocean, and thousands of navigators were added to the great corps of observers. Other matters have also been investigated, the most important being the intensity of radiation from the earth at night-time and from the sun by day-time, the optical phenomena of the sky, the amount of dust in*~~

~~*the air, the electrical condition and the chemical constitution of the atmosphere. Although all the instruments used belong to the category of physical apparatus, yet certain points must be considered as peculiar to their use in connexion with meteorology.*~~

~~*In using the thermometer to determine the temperature of the free air it is necessary to consider not merely its in- trinsic accuracy as compared with the standard gas thermometer of the International Bureau of* ^^”/^ *Weights and Measures at Paris, but especially its sluggishness, the influence of noxious radiations, the gradual change of its zero point with time, and the in- fluence of atmospheric pressure.*~~

~~*Sensitiveness. — The thermometer indicates the temperature of the outside surface of its own bulb only when the whole mass of the instrument has a uniform temperature. Assuming that by’ appropriate convection we can keep the surface of the thermometer at the temperature of the air, we have still to remember that ordinarily this itself is perpetually changing both in rapid oscilla- tions of several degrees and in diurnal periods of many degrees, while the thermometer, on account of its own mass or thermal inertia, always lags behind the changes in the temperature of its own surface. On the other hand, radiant heat passes easily through the air, strikes the thermometer, and raises its temperature quite in- dependently of the influence of the air whose temperature we wish to measure. The internal sluggishness or the sensitiveness of the thermometer is usually different for rising and for falling tempera- ture, and is measured by a coefficient which must be determined experimentally for each instrument by observing the rate at which its indications change when it is plunged into a well-stirred bath of water whose temperature is either higher or lower than its own. This coefBoient indicates the rate per minute at which the readings change when the temperature of the surface of the bulb is one degree warmer or colder than the temperature of the bath. Such coefiioients usually vary between ^th of n degree centigrade for sluggish thermometers, and one or two degrees for very sensitive thermometers. Suppose, for instance, that the coefficient is one- half degree, then when the rate of change in the temperature of the air is one degree per minute it is exactly the same as that which the thermometer itself undergoes when its own temperature is*~~

two degrees different from that of the air ; consequently, the ther-mometer will lag behind the air temperature to that extent and by that amount of time, assuming that the air itself flows fast enough to keep the surface of the bulb at the air temperature. When tlie air temperature ceases to rise or fall, and begins to change at the same rate in the opposite direction, the thermometer will fail to record the true maxinmm or minimum temperature by an appre- ciable error depending upon the rapidity of the change, and will follow the new temperature changes with the same lag. For example, in the case just quoted, if a rising temperature suddenly changes to a falling temperature, the error of the thermometer at the niaximuni temperature will be two degrees, and yet the ther-

mometer may be absolutely correct as compared with the standard when it is allowed five or ten minutes' time to overcome the slug- gishness. It is very difficult to obtain the temperature of the free air at any moment within fj of a degree centigrade, owing to the sluggishness of all ordinary thermometers and the perpetual variations in the temperatures of the atmospheric currents.

Badiation. — When a thermometer bulb is immersed in a bath of liquid all radiant heat is cut off, but when hung in the open air it is subject to a perpetual interchange of radiations between itself and all its surroundings ; consequently its own temperature has only an indirect connexion with that of the air adjacent to it. One of the most difficult problems of meteorology is so to expose a thermometer as to cut off noxious radiations and get the true temperature of the atmosphere at that spot. The following are a few of the many methods that have been adopted to secure this end : — Melloni put the naked glass bulbs within open sheltering caps of perforated silver paper. Elaugergues used a protection consisting of a simple vertical cylinder of two sheets of silver paper enclosing a thin layer of non- conducting substance, like cotton or wool. The influence of radia-tion upon a thermometer depends upon the radiating and absorbing

~~*powers of its own surface ; a roughened surface of lamp-black radiates and absorbs perfectly ; one of chalk powder does nearly as well ; glass much more imperfectly ; while a polished silver surface reflects with ease, but radiates and absorbs with the greatest diffi- culty. Fourier proposed to use two thermometers side by side, one of plain glass and the other of blackened glass ; the difference of these would indicate the effect of radiation at any moment ; but in- stead of plain glass he should have used polished silver. His method was quite Independently devised and used by the writer in 1865 and 1866 at Pulkowa, where the thermometers were placed within a very light shelter of oiled paper. In order to use this method successfully, both the black and the silvered thermometers should be whirled side by side inside the thermometer shelters (see Bulletin of the Philosophical Society of Washington for 1883). Various forms of open lattice work and louvre screens have been devised and used by Glaisher, Kupffer, Stevenson, Stowe, Dove, Renou, Joseph Henry, and others, in all of which the wind is supposed to blow freely through the screens, while the latter cut off the greater part of the direct sunshine and other obnoxious radiations by day, and also prevent obnoxious radiation from the thermometer to the sky by night. The Italian physicist Belli first proposed a special artificial ventilation drawing the fresh air from the outside and making it flow rapidly over the thermometer. Even before his day de Saussure, Espy, Arago, and Bravais whirled the thermometer rapidly either by a small whirling machine, or by attaching it to a string and swivel and whirling it like a sling. When this whirling is done in a shady place excellent results are obtained. Kenou and Craig placed the thermometer in a thin metallic enclosure or shelter, and whirled the latter. Wild established the thermometer in a fixed louvre shelter, but by means of a ventilating apparatus drew currents of fresh air from below into the shelter, where they circulated rapidly and passed out. In Germany, since 1885, Dr Assmann has developed the apparatus known as the ventilated psychrometer, in which the dry-bulb thermometer is placed withiu a double shelter of thin metallic tubing, and the air is drawn in rapidly by means of a small ventilating fan. In the observations made by the writer on the cruise of the Pensacola to the west coast of Africa, the dry- and wet-bulb thermometers were enclosed within bamboo tubes and rapidly whirled. The inside of the wet-bulb tube was kept wet, so that its surface being cooled by evaporation could not radiate injuriously to the*~~

~~*thermometer. In the system of exposure adopted by the U. S. Weather Bureau the dry and wet bulbs are whirled by a special apparatus fixed within the louvred shelter, which is about 3^ feet cube, and is placed far enough above the ground or building to ensure free exposure to the wind. In using the whirling and ventilating 'methods it is customary to take a reading after whirling one minute, and a second reading at the end of the second minute, and so on until no appreciable changes are shown in the thermometer. Of course in perfectly calm weather these methods can only give the temperature of the air for the exact locality of the thermometer. On the other hand, when a strong wind is blowing the indicated temperature is an average that represents the long narrow stream of air that has blown past the thermometer during the few minutes that are necessary in order that the bulb may obtain approximately the temperature of the air.*~~

~~*Change of Zero.— AU thermometers having glass bulbs, especially those of cylindrical shape, are sensitive to changes of atmospheric pressure. The freezing-point, determined under a barometric pressure of 30 inches, or at sea-level, stands higher on the glass tube than if it had been determined under a lower pressure on a mountain top. Therefore delicate thermometers, when transported to great heights, or even during the very low pressure of a storm centre, read too low and need correction. The zero-point also chaa.o-es with time and with the method of treatment that the bulb has received, owing to the slow adjustment of the molecules*~~

~~*of the glass bulb to the state of stable equilibrium. Their relations among themselves are disturbed whenever the bulb is freshly heated. At this time the freezing-point is depressed to an amount nearly proportional to the heating. The normal method of treat- ment consists in first determining the boiling-point of the ther- mometer, and, after a few minutes, the freezing-point. If this method is uniformly followed the two fiducial points will stay in permanent relation to each other. A thermometer that has been used for many years by a faithful meteorological observer has almost inevitably been going through a steady series of changes ; in the course of ten years its freezing-point may have risen by 2° or 3° E., and, moreover, it changes by fully a tenth of a degree between summer and winter. The only way completely to eliminate this source of error from*~~

~~meteorological work is to discard the mercurial thermometer altogether ; but, instead of adopting that course, the use is generally recommended of ther- mometers whose bulbs are made of a special glass, upon which heating and cooling have comparatively very little influence. Any argument as to secular changes in the temperature of the atmosphere is likely to be greatly weakened by the unknown influence of this source of error, as well as by changes in the methods of exposure and in the hours of observation.~~

~~The barometer indicates the elastic pressure prevailing in gas or liquid at the surface of the mercury in the open tube or cistern, provided that the fluid at that point is in a state of quiet relative to the m&te'r. mercury. Any motion of the air will have an in- fluence upon the reading quite independently of the prevail- ing elastic pressure. The pressure within a mass of gas at any point is the summation of the effects due to the motions of the myriad molecules of the gas at that point ; it is the kinetic energy of the molecules striking against each other and the sides of the enclosure, which in this case is the surface of the mercury in the cistern of the instrument. If the barometer moves with respect to the general mass of the gas there is a change in the pressure on the mercurial surface, although there may be none in the general mass of the free gas, and a barometer giving correctly the pressure of the air at rest within a room will give a different indication if the instrument or the air is set in rapid motion so that the air strikes violently against it. If the barometer moves with the air it will indicate the elastic pressure within the air. When the wind blows against an obstacle the air pressure is increased slightly on the windward side and diminished on the leeward side. It is thus obvious that in determining the pressure within the free atmosphere the exposure of the barometer must be carefully considered. The other sources of error that give rise to discrepancies in meteorological work relate to the temperature of the instrument, the sluggishness of the movement of the mercury, and the secular changes in the correction for capillarity, due principally to the changes in the condition of the surfaces of the glass and the mercury, especially those that are exposed to the open air. The international comparisons of barometers show that dis- crepancies exist between the best normals or standards, and that ordinary barometers must always be compared with such standards at the temperatures and~~

~~*pressures for which they are to be used. The influence of a gale of wind is to raise the elastic pressure within a room whose window faces to the windward, but to lower the pressure if the window faces to the leeward. The influence of the draught up chimney, produced by the wind blowing over its summit, is to lower the pressure within the room. The maximum effect of the wind in raising the pressure is given by the formula, P-Po=0-000 038 3 x V^ where the pressure is given in inches and the velocity in miles per hour. This amounts to about one-tenth of an inch in a 60-mile wind, and to nearly four-tenths in a 100-mile wind. The diminution by a leeward window or a draught up chimney is usually less than this amount. This altera- tion in pressure, due to the local effect of wind, does not belong to the free atmosphere but to the method of exposure of the barometer, and can be eliminated only by*~~

~~*[apparatus*~~

~~*Anemo' meter.*~~

~~*methods first described by the author in 1882: it is a very different matter from the general diminution of pressure in the atmosphere produced by the movement of the wind over a rotating earth and by the centrifugal force within a vortex. The latter is an atmospheric phenomenon independent of instruments and locality in hurricanes and tornadoes which may amount to several inches of the mercurial column. It is, however, quite common to find in the continuous records of pressure during a hurricane evidence of the fact that the low pressure due to the hurricane and the special diminution due to the exposure of the barometer are combined together, so that when the calm centre of a hurricane passes over a station the pressure temporarily rises by the amount due to the sudden stoppage of the local exposure effect.*~~

~~*The wind is measured either by means of its pressure against any obstacle or by revolving apparatus that gives some idea of the velocity of its movement. The pressure is supposed to interest the engineer and*~~

navigator, but the velocity is the fundamental meteorological datum; in fact, the pressure varies so much with the nature of the obstacle and method of exposure, and the density of the air, that it has no real importance in the study of the movements of the atmo- sphere. Pressure anemometers date from the pendulous tablet devised by Sir Christopher Wren about 1667, and such pressure plates continue to be used in an improved form by Russian observers. Normal pressure plates are used at a few English and Continental stations. The windmill anemometers devised by Schober and Wolt- mann were modified by Combes and Casella so as to make an exceedingly delicate instrument for laboratory use ; another modification by Richard is extensively used by French observers. In the early part of the 19th century Edge worth devised and Robinson perfected a windmill system in which hemispherical cups revolved around a vertical axis, and these have come into general use in both Europe and America. Many studies have been made of the exact ratio between the velocity of the wind and the rotations of the Robinson anemometer. The factor 3 is usually adopted and incorporated into the mechanism of the apparatus, but in ordinary circum- stances this factor is entirely too large, and the recorded velocities are therefore too large. The whirling cups do not revolve with any simple relation to the velocity of the wind, even when this is perfectly steady. The rela^ tion varies with the dimensions of the cups and arms and the speed of the wind, but especially with the steadiness or gustiness of the wind. The exact ratio must always be determined experimentally for each specific type of instrument; in most instruments in actual use the factor for steady wind varies between 2-4 and 2-6. When the wind is gusty the inertia of the moving parts of the instrument necessitates an appreciable correction ; thus, when the gust is at its height the revolving parts receive an impetus that lasts after the gust has gone down, so that the actual velocity of the cups is too high. Eor this reason, also, comparisons and studies of anemo- meters made in the irregular natural winds of a free air are unsatisfactory. For the average winds at AVash- ington, D.C., and on Mount Washington, N.H., and the standard instruments used in the U.S. Weather Bureau service. Professor C. F. Marvin, however, deduced the following table for reduction from recorded to true velocity. This table involves the moment of inertia of the revolving parts of the instrument and the gustiness of the winds at

~~*Washington, and will there- fore of course not apply strictly to other tvpes of in- struments or winds, for which special studies must be made.*~~

~~*Marvin's Table for the Reduction to Tnie Velocities of the Data given hy Robinson's Anemometer.*~~

~~*Indicated Velocity.*~~

~~*True Velocity.*~~

~~*Miles.*~~

~~*0*~~

~~*1*~~

~~*2*~~

~~*8*~~

~~*4*~~

~~*5*~~

~~*6*~~

~~*7*~~

~~*8*~~

~~*9*~~

~~*0 10 20 80 40 60 60 70 80 90*~~

~~*9-6*~~

~~*ITS*~~

~~*23-7 88-8 40-8*~~

~~*4S-0*~~

~~*65-2 62-2 69-2*~~

~~*10-4 18-6 20-5 34-1 41-.5 48-7 55-9 62-9*~~

~~*li's*~~

~~*19-4 27-5 84-8 42-2 49-4 56-6 68-6*~~

~~*12i*~~

~~*20-22*~~

~~*28-0*~~

~~*35-6*~~

~~*48-0*~~

~~*60-2*~~

~~*57-8*~~

~~*64-3*~~

~~*12-9 21-0 28-8 36-3 48-7 50-9 58-0 66-0*~~

~~*5-1 18-8 21-8 29-6 871 44-4 51-6 58-7 65-8*~~

~~*6-0 14-6 22-6 80 '8 87-8 45-1 52-3 59-4 66-4*~~

~~■■~~

~~*6-9 16-4 28-4 81-1 88-5 45-9 58-0 601 67-1*~~

~~*7-8 16-2 24-2 31-8 89-8 46-6 58'8 60-8 67-8*~~

~~*8-7 17-0 24-9 82-6 40-0 47-8 64-6 61-5 68-5*~~

~~*About 1842 a committee of the American Academy of Arts and Sciences experimentally determined, for a large variety of chimney caps, or cowls, or hoods, the amount of suction that produces the draught up a chimney, and shortly afterwards a similar committee made a similar investigation at Philadelphia (see Proc. Amer. Acad. vol. i. p. 307, and Journal of Franklin Institute, vol. iv. p. 101). These investigations showed that the open end of the chimney, acting as an obstacle in the wind, is covered by a layer of air moving more rapidly than the free air at a little distance, and that therefore between this layer and the aperture of the chimney there is a space within which barometric pressure is less than in the neighbouring free air. The draught up the chimney is due to the pressure*~~

~~*As to the exposure of the anemometer, no uniform rules have as yet been adopted. Since the wind is subject to exceedingly great disturbances by the obstacles near the ground, an observer who estimates the force of the wind*~~

~~*apparatus]*~~

~~*Hygro' meter.*~~

~~*by noticing all that goes on over a large region, or about him, has some advantage over an instrument that can only record the wind prevailing at one spot. The practice of the U.S. Weather Bureau has been to insist upon the per- fectly free exposure of the anemometer as high as can possibly be attained above buildings, trees, and hills ; but of course, in such cases, the instruments give records for an elevated point, and not for the ground. They are there- fore not precisely appropriate for use in hygienic and agricultural studies, but they yield the records needed for general dynamic meteorology and proper for compari- son with the isobars and the movements of the clouds shown on the daily weather map.*~~

~~*Moisture floats in the atmosphere either as invisible vapour or as visible haze, mist, and cloud. The presence of the latter generally assures us that*~~

~~*the air is fully saturated. The total amount of both visible and invisible vapour contained in a unit vokime of cloud or mist is directly determined by the Schwackhofer or Svenson hygrometer, or it may be ascertained by warming a definite portion of the air and fog and measuring the tension of the vapour by Edelmann's apparatus. Both these methods, however, are in practice open to many practical sources of error. If only invisible aqueous vapour is present we may de- termine its amount by several methods — (a) the chemical method, by absorbing and weighing it ; (&) the dew-point method, by cooling the air down to the temperature where coNidensation begins ; (c) Edelmann's method, by absorb- ing the moisture chemically and measuring the change in vapour tension ; (d) by adding vapour until the air is saturated and measuring either the increased tension or the quantity of evaporation ; (e) the psychrometric method, by determining the temperature of evaporation. The wet-bulb thermometer, which is the essential feature of the last method, was used by Baume in 1758 and de Saussure in 1787, but merely as giving an index of the dryness of the air. The correct theory of its action has been elaborated by many investigators — Ivory, 1822 ; August, 1826; Apjohn, 1834; Belli, 1838; Eegnault, 1845. Erom the last date until recent years no import- ant progress was made in our knowledge of the sub- ject, and it was su.pposed that the psychrometer was necessarily crude and unsatisfactory, but in its modern form it has become an instrument of much greater precision, probably quite as trustworthy as the dew-point apparatus or other method of determining atmospheric moisture. In order to attain this accuracy the two bulbs must be of the same size, style, and sensitiveness ; the wet bulb must be covered with thin muslin saturated with pure water ; both thermometers must be whirled or ventilated rapidly, but at the definite prearranged rate for which the tables of reduction have been computed; and, finally, both ther- mometers must be carefully sheltered against obnoxious radiations. In order to attain these conditions European observers tend to adopt Assmaun's ventilated psychro- meter, but American observers adopt Arago's whirled psy- chrometer, set up within an ordinary thermometer shelter. By either method an accuracy of one-tenth degree C. or two-tenths Fahrenheit should be attained. As a crude approximation, we may assume that the temperature of the dew-point is below the temperature of the wet bulb as far as that is below the dry bulb. A greater accuracy can be attained by*~~

~~*the use of Ferrel's or Marvin's psychrometric tables. Glaisher deduced empirically from a large mass of observations certain factors for comput- ing the dew-point, but these do not represent the accuracy that can be attained with the whirled psychrometer, nor are they thoroughly satisfactory when used with Eegnault's tables and the stationary psychrometer. Especially should their use be discarded when the wet*~~

~~*bulb is greatly depressed below the dry bulb and the atmosphere correspondingly dry. Eor occasional use at stations, and especially for daily use by travellers and explorers, nothing can exceed the convenience and accuracy of the sling psychrometer, especially if the bulbs are protected from radiation by a slight covering of non-conducting material or even metal, as was done by Craig in 1866-69 for the stations of the U.S. Army Surgeon-General. The hair hygrometer gives directly the relative humidity or the ratio between the moisture in the air and that which it would contain if saturated. The very best forms perform very well for a time, but in general the instrument is not considered so trustworthy as the ventilated psychrometer.*~~

~~*The simple instrument for catching and measuring the quantity of rain, snow, or hail that falls upon a definite horizontal area consists essentially of a vertical cylinder and the measuring apparatus. The *a/ii- and receiving mouth of the cylinder is usually ^^uge. terminated by a cone or funnel, so that the water running down through the funnel and stored in the cylinder is protected from evaporation or other loss. The cylinder is firmly attached to the ground or building, so that the mouth is held permanently at a definite altitude. The sources of error in its use are the spatter- ing into it from the ground or neighbouring objects, and the loss due to the fact that, when the wind blows against the side of the cylinder, it produces eddies and currents that carry away drops that would otherwise fall into the mouth, and even carries out of the cylinder drops that have fallen into it. As a consequence all the ordinary rain-gauges catch and measure too little rainfall. The deficit increases with the strength of the wind, and the smallness or lightness of the raindrops and snowflakes. If we assume that the correct rainfall is given by a gauge whose mouth is flush with the level of the ground, and is surrounded by a trench wide enough to prevent any spatter, then, on the average of many*~~

years and numerous observations with ordinary rain- gauges in western Europe, and for the average char- acter of the rain in that region and the average strength of the attending winds, the deficit of rain caught by a rain-gauge whose mouth is 1 metre above the ground is 6 per cent, of the proper amount; if its elevation is 1 foot above ground, the deficit will be 3|- per cent. This deficit increases as the gauges are higher above the ground in proportion to the square root of the altitude, provided that they are fully exposed to the increase of wind that prevails at those altitudes. It is evident that even for altitudes of 5 or 10 feet the records become appreciably discrepant from those obtained at the surface of the ground. The following table shows in the last column the observed ratio between the catch of a gauge at any altitude and that of the standard at the level of the ground. Unfortunately, there is no record of the force of the wind to go with these measurements ; but we know that in general, and on the average of many years corresponding with those here tabulated, the velocity of the wind increases very nearly as the square root of the altitude. Although this deficit with increasing altitude has been fully recognized for a century, yet no effort has been made until recent years to make a proper correction, or to eliminate this influence of the wind at the mouth of the gauge. Professor Joseph Henry, about 1850, recom- mended to the observers of the Smithsonian Institution the use of the "pit-gauge." About 1858 he recom- mended a so-called shielded gauge, namely — a simple cylindrical gauge 2 inches in diameter, having a wide horizontal sheet of metal like the rim of an inverted hat soldered to it. This would undoubtedly diminish the

obnoxious currents of air around the mouth of the gauge, but the suggestion seems to have been overlooked by meteorologists. In 1878 Professor jSTipher of St Louis, Missouri, constructed a much more efficient shield, consist- ing of an umbelliform screen of wire-cloth having about sixty-four meshes to the square inch. This shield seems to have completely annulled the splashing, and to have broken up the eddies

~~*and currents of wind. With Nipher's shielded gauges at different altitudes, or in different situations at the same altitude, the rain catch becomes very nearly uniform ; but the shield is not espe- cially good for snow, which piles up on the wire screen. Since 1885 numerous comparative observations have been made in Europe with the Nipher gauge, and with the "protected gauge" devised by Boernstein, who sought to prevent injurious eddies about the mouth of the gauge by erecting around it at a distance of 2 or 3 feet an open board fence with its top a little higher than the mouth of the gauge. The boards or slats are not close together, but apparently afford as good a protection as the shield of Professor Nipher.*~~

~~*Altitude and Relative Catch of Rain.*~~

~~*Situation and Size of Gauge.*~~

~~*Tears of Kecord.*~~

~~*Altitude.*~~

~~*EelatiTO Catcli.*~~

~~*Metres.*~~

~~*Per Cent.*~~

~~*fO*~~

~~*100*~~

~~*Calne, 5-inoli and S-inoli*~~

~~*41*~~

~~*1*~~

~~*90*~~

~~*Castleton, 5-inoh and 8-inch .*~~

~~*3*~~

~~*2*~~

~~*88*~~

~~*Rotherham, 5-incli ....*~~

~~*8 *~~

~~*s 3*~~

~~*86*~~

~~*St Petersburg : Central Physical Ob-*~~

~~*4*~~

~~*85*~~

~~*servatory, 10-inoh*~~

~~*10 J*~~

~~*6*~~

~~*85*~~

~~*6*~~

~~*84*~~

~~*London : Westminster Abbey .*~~

~~*1*~~

~~*9-1*~~

~~*77*~~

~~*Emden ....*~~

~~*2*~~

~~*11*~~

~~*72*~~

~~*St Petersburg : Central Physical Observatory ...*~~

~~*1*~~

~~*13*~~

~~*68*~~

~~*York : Museum ....*~~

~~*3*~~

~~*13*~~

~~*-80*~~

~~*Calcutta : Alipore Observatory*~~

~~*7*~~

~~*15*~~

~~*87*~~

~~*Woodside : Walton-on-Thames*~~

~~*1*~~

~~*15*~~

~~*73*~~

~~*Philadelphia : Frankford Arsenal .*~~

~~*3*~~

~~*16*~~

~~*95*~~

~~*Sheerness : Waterworks .*~~

~~*3*~~

~~*21*~~

~~*52*~~

~~*Whitehaven : St James's Church .*~~

~~*10*~~

~~*24*~~

~~*66*~~

~~*St Petersburg : Central Physical Ob-*~~

~~*servatory*~~

~~*10*~~

~~*25*~~

~~*59*~~

~~*Paris : Astronomical Observatory .*~~

~~*40*~~

~~*27*~~

~~*81*~~

~~*Dublin : Monkstown*~~

~~*6*~~

~~*27*~~

~~*64*~~

~~*Oxfoad: Radcliffe Observatory*~~

~~*8*~~

~~*34*~~

~~*59*~~

~~*Copenhagen : Observatory*~~

~~*4*~~

~~*36*~~

~~*67*~~

~~*London : Westminster Abbey .*~~

~~*1*~~

~~*46*~~

~~52~~

~~Chester : Leadworks~~

~~2~~

~~49~~

~~61~~

~~Wolverhampton : Waterworks~~

~~3~~

~~55~~

~~69~~

~~York Minster ....~~

~~3~~

~~65~~

~~60~~

~~Boston : St Botolph's Church .~~

~~2~~

~~79~~

~~47~~

~~In general it is now conceded by several high autjiorities that the measured rainfall must be corrected for the influence of the wind at the gauge, if the latter is not annulled by Nipher's or Boernstein's methods. A prac- ticable method of measuring and allowing for the in- fluence of the wind was explained by the writer in 1888 (see Siinwn.a's Meteorological~~

~~*Magazine for 1889, or the U.S. Monthbj Weather Review for 1899). This method consists simply in establishing near each other several similar gauges at different heights above the ground, but in otherwise similar circumstances. On the assumption that for small elevations the diminution of the wind, like that of the rainfall, is very nearly in proportion to the square root of the altitude, the difference between the records for two different altitudes may be made the basis of a calculation which gives the correction to be applied to the record of the lower gauge, in order to obtain the rainfall that would have been caught if there were no wind. It is only when the rainfall has been properly corrected for the effect of the wind on the gauge that we*~~

~~*obtain numbers that are proper to serve for the purpose of determining the variation of the rainfall with altitude, locality, or time.*~~

~~*It has been common to consider that the rain-gauge cannot be properly us_ed on ships at sea, owing to the rolling and pitching of the vessel, and the interference of masts and rigging ; but if gauges are mounted on gimbals, so as to be as steady as the ordinary mariner's compass, their records will be of great importance. Experimental work of this sort was done by Mohn, and afterwards in 1882 by Professor Prank Waldo ; but the most extensive inquiry has been that of Mr W. G. Black (see Journal Manchester Oeographical Society, 1898, vol. xiv.), which satisfactorily demonstrates the practicability and import- ance of the marine rain-gauge.*~~

~~*The moisture in the atmosphere comes from the surface of the earth or ocean by evaporation, a process which goes on continually, replacing the moisture that is precipitated as rain, hail, snow, and dew, e"" and maintaining the total quantity of the moisture in the atmosphere at a very uniform figure. The rate of evaporation depends on the temperature, the dryness, and the velocity of the wind. It is not so im- portant to meteorologists to know where the moisture comes from as to know its amount in the atmosphere, and in fact no method has yet been devised for determin- ing how much moisture is given up by any specific portion of the earth, or ocean, or forest. Our evaporo- meters measure the quantity of moisture given off by a specific surface of water, but it is so difficult to*~~

~~maintain this water under the same conditions as obtain in nature that no conclusions can be safely deduced as to the actual evaporation from natural surfaces. The proper use of these evaporometers is as integrating hygrometers, to give the average humidity of the air, the psychrometer giving the conditions prevailing at any moment. Among the many forms of evaporometer the most convenient is that devised by Piche, which may be so constructed as to be exceedingly accurate. Careful comparisons between the Piche and the various forms of absolute evaporo- meters were made by Professor Thomas Eussell, and the results were published in the U.S. Monthly Weather Revieio for September 1888, pp. 235-239. By placing the Piche apparatus upon a large whirling machine he was able to show the effect of the wind upon the amount of evaporation. This important datum enabled him to explain the great differences recorded by the apparatus established at eighteen Weather Bureau stations ; based upon these results, he prepared a table of relative evapora- tion within thermometer shelters at all stations. The actual evaporations from ground and water in the sun- shine may run parallel to these, but cannot be accurately computed. It is probable that Professor Russell's com- putations are smaller than the evaporations from shallow bodies of water in the sunshine, but larger than for deep bodies, like the great lakes and for running rivers. The Piche evaporometer consists essentially of a glass tube, whose upper end is closed hermetically, whereas the lower end is covered by a horizontal disc of bibulous paper, which is kept wet by absorption from the water iir the tube. As the water evaporates its descent in the tube is observed, whence the volume evaporated in a unit of time becomes known. So long as the paper remains clean, and the water is pure, the records of the instrument depend entirely upon the evaporating surface, the dryness of the air, and the velocity of the wind.~~

~~The direction and apparent velocity of the motion of the clouds, or other objects floating above us, are best observed by means of the nephoscope, which has now become a necessary item in the outfit of any first-class~~

~~*meteorological station. Among the various forms of this instrument are the so-called nephodoscope of Fornioni,*~~

~~*the marine nephoscope of Fineman, the simple sXe.' mirror with attachments used by Clayton, the*~~

~~*cloud camera of Vettin, and the alt-azimuths of Mohn and Lettry. The most perfect form for use on*~~

~~*Fig. 2. — Marvin's Nephoscope.*~~

~~*land is that devised by Professor Marvin in 1896 for the U.S. Weather Bureau stations (see Fig. 2) ; while the most convenient for use at sea is that used in 1889 by the author on the cruise of the Pensacola, and first de- scribed in the report of the International Meteorological Congress held at Chicago in August 1893. The construction of this instrument is shown in Figs. 3, 4, 6. In using it the observer looks down upon a horizontal mirror and observes the reflection of the cloud. By moving his eye he brings any cloudy point into coincidence with the reflection of a small fixed spherical knob above the mirror, and keeps the images of the knob and the cloud coincident as they pass from the centre of the mirror to its edge. This line of motion shows the azimuth of the horizontal component of the cloud's motion. The apparent angular velocity of the cloud, as it would be if the cloud started from the zenith, is obtained by counting the seconds that elapse be- tween its passage from the centre to the edge, or to a small circle inscribed within the edge. With this instrument two ob- servers a short distance apart may easily determine the apparent altitude, and azi- muth, and motion of any cloud, whence its true altitude and velocity may be com- puted. When the observer uses the marine nephoscope on a vessel which is itself in motion, he observes the resultant of his own and the cloud's motions. If his vessel is under his own control, so that he may change its velocity or direction at will, he easily determines this resultant for two cases, and obtains data by which he is enabled to calcu- late the real altitude and velocity of the cloud in terms of his own velocity. As the nephoscope can be used on a waggon moving rapidly over a smooth road, or in a small boat on a smooth pond, almost as well as on a larger sea-going vessel, it becomes an instrument of universal application for cloud study. It is also*~~

equally convenient for observing the positions of auroras, halos, meteors, and other special phenomena. For the international work undertaken during the year 1898, the photographic camera established upon an alt-azi- muth mounting, or the so-called photogram-meter, was especially developed. In this apparatus photo- graphs of the clouds are taken simultane- ously at two or more stations, and in each case the centre of the photographic plate has its altitude and azimuth determined. From this centre one can measure on the plate the additional angles required in order to fix the altitude and azimuth of any point that is photographed, and thus the dimensions of the whole visible cloud and its internal or differential motions can be determined, as well as its general motion. During the year 1898 about twenty stations were occupied throughout the world for the purpose of determining accurately the altitudes and motions of every layer of cloud.

The ordinary meteorological record specifies the proportion of sky that appears to be covered with cloud, or the so-called cloudiness, usually expressed in Sunshine tenths. The observer generally con- ”” fines his attention to that portion of the sky within sixty degrees of the zenith, and ignores the lower zone, since the clouds that are found therein are often at so great a distance from him that their record is not supposed to belong to his locality. As the cloudiness — or its reciprocal, the sunshine

HOEIZONTAL PeOJECTION OF NepHIOSCOPE.

s

Fig. 3. — Marvin’s Nephoscope.

— is supposed to be the most important item in agricultural climatology, and is certainly also im- portant for dynamic meteorology, it is usually con- sidered desirable to obtain more complete records than are given by only one or two specified hours of observation. To this end apparatus for record- ing sunshine, or, rather, the effect of cloudiness,

~~*[apparatus*~~

~~*is -widely adopted. At least three forms are worth describing.*~~

~~*The Jordan photographic sunshine recorder consists of a cylinder enclosing a sheet of sensitive paper; the sun's*~~

~~*Horizontal Projection of Compass.*~~

~~*Fig. 4. — Marvin's Nephoscope.*~~

~~*rays penetrate through a small aperture, and describe a path from sunrise to sunset, which appears on this sheet after it has been properly washed with the fixing solution. Any interruption in this path, due to cloudiness or haze, is of course clearly shown, and gives at once the means of estimating what percentage of the day was clear and what cloudy. The form of the instrument constructed by Professor Marvin has been used for many years at about forty Weather Bureau stations, and the original con struction is still employed by other observers throughout the world. The Stokes-Campbell recorder consists of a globe of glass acting as a burning- glass. A sheet of pasteboard or a block of wood at the rear receives the record, and the extent of the charring gives a crude measure of the percentage of full or strong sunshine. Many of these instruments are used at stations in Great Britain and the British col- onies. The Marvin thermometric sun- shine recorder consists of a thermometer tube, having a black bulb at the lower end and a bright bulb at the other. The excess of temperature in the black bulb causes a thread of mercury to move upwards, and for a certain standard difference of temperature of about 5° F., such as would be i)ro(lueed by the sun shining through a very thin cloud or haze, a record is made by an electric current. The record simply shows that during the day sunshine of a certain*~~

~~*intensity prevails, or was prevented by cloudiness. Mr D. T. Maring, in the U.S. Monthly Weather Review for 1897, described an ingenious combination of the thermo- meter and the photographic register of cloudiness, which is worthy of further development. It gives both the quantity of cloudiness and intensity of the sunshine on some arbitrary relative scale.*~~

~~*The intensity of the sunshine, as some- times employed in general agricultural studies, is also shown by Violle's con- jugate bulbs, which are thin copper balls about 3 inches in diameter, one of them being blackened on the outside and the other gilded. When exposed to the sun- shine the difference in temperature of the two bulbs increases with the intensity of the sunshine, but as the difference is dependent to a considerable extent on the wind, the Violle bulbs have not found wide application. The Arago-Davy actinometer, or bright and black bulbs in vacuo, constitutes a decided improve- meait upon the Violle bulbs, in that the vacuous space surrounding the thermo- meters diminishes the effect of the wind. The physical theory involved in the use of this instrument was fully developed by Ferrel, and he was able to determine the coefficient of absorption of the earth's atmosphere and other data, thereby show- ing that this apparatus has consider- able pretensions to accuracy. In using it as contemplated by the inventor and by Professor Ferrel, we read simply the stationary temperature recorded by the bright and black thermometers at any moment, whereas the best method in acti- nometry consists in alternately shading and expos- ing the apparatus so as to determine the total*~~

~~*Section on line ah.*~~

~~*Fm. 5. — Marvin's Noplioscope.*~~

~~*effect of the solar radiation in one minute, or some shorter unit of time. This so-called dynamic, as distinguished from the static, method was first applied by Pouillet in 1838 in his use of his pyrhelio- meter, which was the first apparatus and method that gave*~~

~~*approximate measures of the radiation of heat from the sun. In order to improve upon Pouillet's work more delicate apparatus has been constructed, but the fun- damental methods remain the same. Thus Angstrom has applied both Langley's bolometer and his own still more sensitive thermoelectric couples and balance method, and Violle his*~~

~~*absolute actinometer, consisting of a most delicate thermometer within a polished metal sphere, whose temperature is kept uniform by the flow of water, while Crova, with a thermometer within an enclosure of uniform temperature, claims to have attained an accuracy of one part in a thousand. Chwolson re- viewed the whole subject of actinometry, and has shown the value of his own apparatus, consisting of two thin plates alternately exposed to and shielded from sunshine, whose differences of temperature are measured by electric methods.*~~

~~*As none of the absolute methods for determining the solar radiation in units of heat lend themselves to con- tinuous registration, it is important to call attention to the possibility of accomplishing this by chemical methods. The best of these appears to be that devised by Marchand by the use of a device which he calls the Phot-anti- tupimeter. In this the action of the sunlight upon a solution of ferric-oxalate and chloride of iron liberates carbonic acid gas, the amount of which can be measured either continuously or every hour ; but in its present form the apparatus is affected by several serious sources of error.*~~

~~*The electric compensation pyrheliometer, as invented by Knut Angstrom (Ann. Phys., 1899), offers a simple method of determining accurately the quantity of heat received by radiation. He employs two blackened plati- num surfaces, one of which receives the radiations to be measured, while the other is heated by electric current. The difference of temperature between the two discs is determined by a thermocouple, and they are supposed to receive the same amount of energy when their temperatures are the same. A Hefner lamp is used as an intermediate standard of radiation, and alternate observations on any other two sources of radiant heat give the means of de- termining their own relations to each other. By means of two such instruments observations were made simul- taneously on the intensity of the solar radiation at two points, respectively 360 and 3352 metres above sea-level, to determine the amount of heat absorbed by the inter- laediate atmosphere. An accuracy of 1-1000 appears to be attainable.*~~

~~*The numerous forms of apparatus designed to keep frequent or continuous register of the prevailing pressure, temperature, moisture,*~~

*wind, rainfall, sunshine, '^a*A™" evaporation, and other phenomena are instru- *""■ ' ments that belong peculiarly to meteorology as distinguished from laboratory physics. The apparatus may be broadly divided into several classes according as the records are obtained by the help of photography ,_ or electricity, or by direct mechanical action. The prevailing tendency at present is in favour of apparatus in which the work of the recording pen is done by a falling weight, whose action is timed and limited by the making and breaking of electric currents by the meteorological appar- atus proper. The most serious defect in such instruments, even when kept in good working order, is a want of sensitiveness commensurate with the desired openness of scale. It is very important that a fraction of a minute of time should be recognizable, as also one-tenth of a degree of temperature ; and one-thousandth of an inch of barometric pressure, and velocities of one hundred miles per hour, as well as rapid changes in all these elements, must be measurable. But instruments whose scales are large enough to record all these quantities are usually so sluggish*

Photo- meter.

that the comparison of the records is very unsatisfactory. In order to study the relationships between temporary and fleeting phenomena, it is necessary that all instruments should record upon the same sheet of paper, so that the same time-scale will answer for all. The instruments that respond most nearly to the general needs of meteorology are the various forms of meteorographs devised "by AVild for use at St Petersburg, by Sprung and Puess for use at Hamburg and Berlin, and by Marvin for Washington. The photographic systems for pressure and temperature introduced many years ago at stations in Great Britain and the British colonies are not quite adequate to present needs. The portable apparatus manufactured by Richard Pr^res at Paris is in use at a very large number of land stations and on the ocean, and by giving special care to regular control-observations of time, pressure, a,nd temperature, important results may be obtained ; but in general the time-scales are too small, and the unknown sources of error too uncertain, to warrant implicit reliance upon the records.

~~*The brightness of the sky light, and especially the amount of polarization, have been observed wdth in- creasing interest, as it seems possible from these two elements to ascertain something with regard to the condition and amount of the moisture of the air. With a simple Nicol's prism held in the hand and turned slowly about the axis of vision one can quickly recognize the fact that the sky light is polarized, and that the polarization is largely due to the air or dust lying between us and the clouds in the distant horizon. Arago with a more delicate form of polariscope determined the existence of a so-called neu- tral zone. Babinet located a neutral point or zone about as far from the anti-sun as was Arago's from the sun itself. Brewster discovered a neutral point near the sun and horizon, disappearing when the sun is more than 15° above the horizon. Finally, Brewster explored the sky sufficiently to draw lines of equal polarization, which he published in Johnston's Physical Atlas, and which were confirmed by Zantedeschi in 1849. Since those days far more delicate work has been done- — iirst by Bosanquet of Oxford, afterwards by Professor Pickering of Harvard University and Professor Wright of Yale University. A later contribution to the subject is by Jensen (see Met. Zeit. for Oct.Dec. 1899), who has observed the brightness as well as the polarization, and thus completed the data necessary for testing the various physical theories that have been proposed for the explana tion of this phenomenon. We owe to Tyndall the capital discovery that when a beam of white light penetrates a mass of fine aqueous mist the latter sends off at right angles a delicate blue light, which is almost wholly polarized in a plane at right angles to the plane of reflection. As the particles of mist grow larger, the blue light becomes whiter and the polarization disappears. The original vapour particles are undoubtedly so small as to be comparable in size with a fraction of the wave-length of ordinary light, and Rayleigh was able to show that such minute particles must have a power of selection, and that the diffused sky light comes to us by selective reflection. On this basis we should expect that in the driest air at great heights, where the temperature is low and condensa- tion has but just begun, and the dust particles are rare, there would occur the smallest aqueous particles, the fee- blest intensity, and the largest amount of polarization. In his work on this subject (see Phil. Mag., May 1899) Ray- leigh has shown that it is quite possible that the atoms of oxygen and nitrogen constituting the atmosphere may themselves also exercise a*~~

~~diffuse selective reflection, and contribute to the brightness and polarization that are mainly due to aqueous vapour.~~

~~S. VL — 8q~~

~~[apparatus~~

~~With, these theoretical points in mind, we see the importance of adding photometry and polarimetry to the work of a meteorological observatory. The apparatus to be used in this connexion will vary somewhat with the exact character of the observations to be made. The most extensive researches that have yet been carried out in this line with a meteorological application in view are those of Jensen, Crova, Cornu, Pickering, and especially Eubenson, who in fact recommended that polarimetry and photometry should go hand in hand. In order to measure the position of the plane of polarization the Arago polariscope may be used, but, in order to measure the percentage of polarized light, Mascart's modification of the Savart is better. In order to measure the general brightness of a spot in the sky, Jensen has used a slight modification of the "Weber photometer, and in fact Weber himself has applied the same method to the measurement of the daylight. The complete work of Jensen was pub- lished in the Sclriften of the Scientific Association of Schleswig-Holstein in 1899, and, like the memoir pub- lished by Eubenson in 1863, it gives the meteorological conditions in full as a basis for the investigation of the connexion between sky light and the moisture in the atmosphere.~~

~~The cyanometer devised by Arago to measure the blue- ness of the sky consisted of an arbitrary scale of blues on a strip of porcelain, with which one could compare the blue of the sky. This comparison, however, is open to many subjective errors. A more satisfactory apparatus is ZoUner's photometer or some equivalent, in which a patch of white surface is illuminated by any particular tint or combination that may be desired. In fact. Maxwell's colour-box admits of ready application to the analysis of~~

~~*sky light, and reveals at once the proportions of red, yellow, and blue that may be contained therein.*~~

~~*The importance of observing the dustiness of the atmo- sphere has been especially realized since the invention and use of various forms of apparatus for counting hunter. *^® number of particles of dust in a small volume of air. These inventions are due to Mr John Aitken, of Edinburgh, and a short description of his results was presented by him to the Meteorological Con- gress in 1893 at Chicago. The latest form of his apparatus is very convenient, and is called the pocket dust-counter. In this the air contained in a small receiver is rendered dustless by repeated expansions, in each of which the ' cooling due to expansion forces the vapour to condense upon the dust, which, becoming heavy, falls to the bottom, so that in a short time all is removed. A small stop-cock is now turned, so as to allow a definite small quantity of air to enter and mix with the dustless air in the receiver. The natural and pure airs are now thoroughly mixed, and again the whole quantity within the receiver is expanded, and the dust nuclei fall down by the condensation of vapour upon them. Assuming that every particle of dust is represented by a minute droplet of water, we have but to count the latter ; this is easily done by causing all the drops to fall upon a polished plate of black glass, which is divided into small squares by fine lines ruled with a diamond point. Usually each of these squares represents a small fraction of a cubic centimetre of air ; thus in one case the number of fog particles averaged 2-0 per square millimetre of the glass plate, and, as the multiplying factor was 100, this corresponded to 260 particles of dust in a cubic centimetre of air. The purest air has been found in the West HIghlands of Scotland, where 16])articles per cubic centimetre was once recorded as the minimum, while 7600 was the maximum. On the Rigi Kulm, in Switzer- land, the purest air gave 210, and the dustiest 16,500. On comparing the records of the dust-counter with the record of the apparent state of the air, Mr Aitken found*~~

~~*that 500 particles per cubic centimetre corresponded to clear air, and 1900 to a thick haze in which distant mountain tops were hidden. In the cities the particles of soot and effluvia of all kinds act as dust, and both in*~~

~~*London and Paris the numbers ran as high as 80, 116, 150, and 210 thousand per cubic centimetre.*~~

~~*The electrical phenomena of the atmosphere undoubt- edly belong to meteorology, and yet the methods of obser- vation have been so unsatisfactory and the diffi- culty of interpreting the results has been so fpn^ritus baffling that regular observations in electricity are only carried out at a very few meteorological institu- tions. A general summary of our knowledge of the sub- ject was prepared by J. Elster and H. Geitel for the International Congress held at Chicago in 1893, but the methods and apparatus of observation have not received any remarkable modifications. In general the water- dropping collector of Lord Kelvin, arranged for continu- ous record by Mascart, continues to be the best apparatus for continuous observation at any locality, and a portable form of this same apparatus is used by explorers and in special series of local observations. In order to explore the upper air the kite continues to be used, as was done by McAdie for the Weather Bureau in 1885 and by Weber at Kiel in 1889. The difference of potential between the upper and lower end of a long vertical wire hanging from a balloon has been measured up to consid- erable altitudes by Elster and Tuma. In general it is known that negative electricity must be present in the upper strata just as it is in the earth, while the interven- ing layer of air is positively electrified. The explanation of the origin of this condition of affairs is given in the recent researches of Professor J. J. Thomson {Phil. Mag., December 1899), and his interpretation is almost identical with that now recognized by Elster (see Terres- trial Magnetism, January 1900, vol. iv. p. 213). Accord- ing to these results, if positive and negative ions exist in the upper strata and are carried up with the ascending masses of moist air, then the condensation of the moisture must begin first on the negative ions, which are brought down eventually to the earth's surface ; thus the earth receives its negative charge from the atmosphere, leaving a positive charge or an excess of positive ions in the middle air. The observations of atmospheric electricity consist essentially in determining the amount and character of the difference of potential between two points not very far distant from each other, as, for instance, the end of the pipe from which the water- drops are discharged, and the nearest point of the earth or buildings resting on the earth. The record has only an extremely local value, and*~~

~~*the investigations of Professor Trowbridge, made in conjunc- tion with the U.S. Weather Bureau in 18S2-So, show that the differences vary so much with the winds, the time of day, and the situation of the water-dropper, that the mere comparison of records gives no correct idea of the general electrical relationships. It had been suggested that possibly daily telegrams of electric conditions and daily maps of equipotential curves over the North American continent would be of help in the forecasting of storms, but it was shoAN-n to be useless to attempt any such system until some uniform normal exposure could be devised. (See Atmospheric Electricity and Electricity, Y.)*~~

~~*The exploration of the upper atmosphere is to be regarded as the most important field of research at the present 'time, and the kite and the balloon enable observers and apparatus to be carried to '^""' considerable heights, though by no means so far as is desirable. The kite was first used by Alexander ^^'ilson at or near Glasgow in 1749. and has since then been frequently used by English observers. The later revival of interest in the subject dates principally at least*~~

~~*from the work done in England in 1882 by Archibald, who used the kite to carry up anemometers to very considerable heights, and thereby determined the relative movement of the air in the free atmosphere. In 1883*~~

~~*Fig, 6. — Marvln-Hargrave Kite, witli Meteorograph in position.*~~

~~*Mr Alexander McAdie used the kite in his studies of atmospheric electricity, and the present writer proposed to use it for a complete exploration as to temperature, moisture, and wind ; but Mr W. A. Eddy of New York*~~

~~*Jig. 7. — Marvin Kite Eeel.*~~

~~first forced it upon public attention, and accepted the suggestion of the present writer to employ it for meteoro- logical work. Having flown his kites at Blue Hill, with the permission of Mr Eotch, and having carried up with them the self-registering apparatus devised by Mr Fergu-~~

~~son, he left the further prosecution of this work to Mr Rotch, who has made this a prominent feature of the work at his observatory, having carried up meteorographs to the height of 12,000 feet by means of a series of kites flying in tandem. The oflicials of the U.S. Weather Bureau have developed an admir- able cellular kite, invented by Hargrave of Australia, and Professor Marvin's works on the theory and construction of this form are well known. The general appearance of the Marvin or Weather Bureau kite, the reel and other apparatus that go with it, and the meteorograph it carries up, are shown in Eigs. 6, 7, 8. The size ordinarily used carries about 68 square feet of supporting surface of muslin tightly stretched on a light wooden frame. The line, made of the best steel piano-wire, is wound and unwound from a reel which keeps an automatic re-cord of the intensity and direction of the pull. The reeling in and out may be done either by hand or by a small gas-engine. The observer at the reel makes frequent records of the temperature, pressure, and wind, the apparent angular elevation of the kite, and the length of wire that is pkyed out. At the kite itself the Marvin meteorograph keeps a continuous record of the pressure, temperature, humidity, and velocity of the wind. The meteorograph with its alu- minium case weighs about two pounds, and is so securely lashed behind the front cell of the kite that no accident has ever happened to one, although the kites sometimes break loose and settle to the ground in a broken country many miles away from the reel. On four occasions the line has been completely destroyed by slight discharges of lightning ; but in no case has the kite, the observer, or~~

~~On account of its great interest and importance, we quote the following from Dr Frankenfield's bulletin and the summary in the TJ. S. Monthly Weather Beview for September 1899 : —~~

~~Mean Temperature Gradients in degrees Fahrenheit per 1000 feet from the ground up to the respective altitudes.~~

~~stations.~~

~~1000~~

~~1600~~

~~2000~~

~~3000~~

~~4000~~

~~6000~~

~~6000~~

~~feet.~~

~~feet.~~

~~feet.~~

~~feet.~~

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~~*Washington, D.C. .*~~

~~*5 ‘6*~~

~~*4-4*~~

~~*4-0*~~

~~*3-5*~~

~~*3-2*~~

~~*3-0*~~

~~*3-1*~~

~~*Cairo, 111. ...*~~

~~*9-7*~~

~~*6-6*~~

~~*6-0*~~

~~*4-9*~~

~~*4-7*~~

~~*4-3*~~

~~*Cincinnati, 0. .*~~

~~*13-0*~~

~~*6-3*~~

~~*6-9*~~

~~*5-8*~~

~~*5-6*~~

~~*4-7*~~

~~*4-2*~~

~~*Tort Smith, Ark.*~~

~~*7-2*~~

~~*7-0*~~

~~*6-7*~~

~~*5-8*~~

~~*3-8*~~

~~...~~

~~*Knoxville, Tenn.*~~

~~*8-4*~~

~~*6-2*~~

~~*6-6*~~

~~*5-4*~~

~~*5-0*~~

~~*Memphis, Tenn.*~~

~~*7-8*~~

~~*6-8*~~

~~*5-0*~~

~~*3-8*~~

~~*3-7*~~

~~*3-5*~~

~~...~~

~~*Springfield, 111.*~~

~~*7-6*~~

~~*5-7*~~

~~*6-1*~~

~~*4-4*~~

~~*4-0*~~

~~*3-7*~~

~~*3-6*~~

~~*Cleveland, 0. .*~~

~~*5-7*~~

~~*4-1*~~

~~*3-6*~~

~~*3-5*~~

~~*4-1*~~

~~*4-1*~~

~~*4-3*~~

~~*Duluth, Minn. .*~~

~~*5-2*~~

~~*4-8*~~

~~*4-6*~~

~~*4-6*~~

~~*4-3*~~

~~*3-8*~~

~~*4-6*~~

~~*Lansing, Mich.*~~

~~*7-5*~~

~~*6-0*~~

~~*4-7*~~

~~*4-1*~~

~~*3-9*~~

~~*3-8*~~

~~...~~

~~*Sault Ste Marie, Mich. .*~~

~~*6-6*~~

~~*6-2*~~

~~*5-2*~~

~~*4-5*~~

~~*3-9*~~

~~*3-0*~~

~~**...**~~

~~***Dodge, Kans. .***~~

~~*6-3*~~

~~*5-2*~~

~~*4-8*~~

~~*3-7*~~

~~*3-1*~~

~~*3-2*~~

~~*3-2*~~

~~***Dubuque, Iowa***~~

~~*6-9*~~

~~*5-9*~~

~~*4-6*~~

~~*3-5*~~

~~*3-2*~~

~~*3-3*~~

~~...~~

~~*North Platte, Neb. .*~~

~~*6-8*~~

~~*6-5*~~

~~*5-9*~~

~~*5-2*~~

~~*4-4*~~

~~*4-7*~~

~~*5-4*~~

~~*Omaha, Neb. .*~~

~~*5-4*~~

~~*4-9*~~

~~*3-6*~~

~~*3-2*~~

~~*3-5*~~

~~*3-8*~~

~~*Pierre, S. Dak.*~~

~~*5-9*~~

~~*5-1*~~

~~*4-8*~~

~~*4-3*~~

~~*3-7*~~

~~*4-4*~~

~~*4-0*~~

~~*Topeka, Kans. .*~~

~~*7-4*~~

~~*6-2*~~

~~*4-9*~~

~~*4-0*~~

~~*3-8*~~

~~*3-9*~~

~~*4-5*~~

~~*Average*~~

~~*7-4*~~

~~*5-8*~~

~~*5-2*~~

~~*4-4*~~

~~*40*~~

~~*3-8*~~

~~*4-1*~~

~~the reel been injured thereby. Of course, such flashes are preceded by numerous rapidly-increasing sparks of electricity from the lower end of the wire, which warn the observer of danger. During the six months from May to October 1898, seventeen kite stations were maintained by the U.S. Weather Bureau in the region of the lakes, the Upper Mississippi and the Lower Missouri valleys, in order to obtain data for the more thorough study of atmo- spheric conditions over this particular part of the country. During these months 1217 ascents were made, and as no~~

~~[apparatus~~

~~great height was attempted ;hey were mostly under 7000 or 8000 feet. There was thus obtained a large amount of information relating to the air within a mile of the earth's surface. The general gradients of temperature,~~

~~Ballooas.~~

~~Fig. 8. — Marvin Kite Meteorograph.~~

~~which were promptly deduced and published by H. C. Frankenfield in 1899 in a bulletin of the Weather Bureau, gave for the first time in the history of meteorology trustworthy actual observations of air temperatures in the free atmosphere in numbers sufficient to indicate the nor- mal condition of the air.~~

~~The kite and me- teorograph have al- ready been adopted for use by Euro- pean meteorolo- gists at Trappes, Hambui'g, Brus- sels, Berlin, and Strasburg. Espe- cially successful has been the work of Mr A. L. Rotch, the pro- prietor of the Blue Hill Observa- tory ; and of Mons. Leon Teisserenc de Bort, the pro- prietor of the ob- servatory for dy- namic meteorology at Trappes.~~

~~and Biot at Paris in August and September of 1804. The next important ascent was that of Bixio and Barral in 1860 at Paris. The most~~

~~*remarkable high ascents have been those of James Glaisher, 2nd*~~

~~*September 1862, and Berson at Berlin in 1889 ; on both of these occasions the aeronauts attained altitudes of from 30,000 to 35,000 feet. Similar systematic ascents at many points in Europe simultaneously on pre-arranged dates have been made during the years 1895-99, and promise to be an important feature in the future study of the atmosphere. Owing to the great risk to human life in these high ascents, and especially to the fact that we desire records from still greater heights, efforts have been made to devise self-re- cording apparatus that may be sent up alone to the greatest heights attainable by free hydrogen balloons carrying the least possible amount of ballast. As these ascen- sions are made with great velocity, and therefore as nearly vertical as possible, they are called " soundings," because of their analogy to the mariner's usage at sea, and the balloon is called a " sound- ing balloon." Such balloon soundings have been made not only individually, but by pre-arranged system simultane- ously in combination with the ascent of free-manned balloons above referred to ; and at some places kites have been simultaneously used in order to obtain records for the lower atmosphere. The first experiments in simultaneous work were made in 1896 and in 1897, when ascents were made at eight or more points in France, Germany, and Eussia.*~~

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~~*-40°C.*~~

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~~Fio. 9. — Chart of Isotherms in Free Air above Trappes. This diagram shows the height at which the Isotherms of 0°, -2B°, -40°, -60° C. were encountered on the respective datps. Below the ground-line are given both the dates and the temperatures of the air observed at the ground when the balloon started on each ascent. Thfi isotherms of -40° and -BO°are not given for certain ascents, because in these the balloon did not rise high enough to encounter those temperatures.~~

~~The balloon was used for the scientific exploration of the atmosphere quite freely during the 19th century. The first important voyages were those of Gay-Lussac~~

~~These experiments and the discussions to which they gave rise have emphasized the importance of increasing the sensitiveness of the self-recording apparatus, and~~

~~climatology]~~

~~as far as practicable the rapidity of the ventilation of the thermometers, and of providing more perfect protection against radiation from the sun or to the sky. It is believed that accurate records may be at- tained up to at least 30,000 metres, but as yet 20,000 has not been attained, and the records brought back are still under considerable criticism on account of in- strumental defects. In general the wind that supports the kite also furnishes sufficient ventilation for the thermometer; but in the case of the sounding balloon, which as soon as it attains its summit-level (and its rapid rate of ascent diminishes) floats along horizon- tally in the full sunshine, a strong artificial ventilation must be provided. Moreover, the sluggishness of the best thermometers is such that during the rapid rise the records of temperature that are being made at any moment really belong to some altitude considerably below the balloon, and a most critical interpretation of the records is required.~~

~~The most enthusiastic work both with balloons and kites has been steadily pushed forward by Tiesserenc de Bort at Trappes ; and from the results of about one hundred ascents during 1898-99, published by him in the Comptes Bendus, we quote the accompanying diagram (Fig. 9), showing the height at which the isotherms of 0° C., minus 25° C, minus 40° C, and minus 60° C. were encountered by the kites or bal- loons on the respective dates. As this diagram gives a fair picture of the conditions during the whole year — from April 1898 to July 1899 — the present writer has deduced the average diminution with alti- tude, and the following table of results is quoted from the U.S. Monthly Weather Beview for September 1899, p. 417 :—~~

~~*Average Diminution of Temperature in the Free Air above Trappes during 1898-99.*~~

~~*Altitude (Kilometres).*~~

~~*10*~~

~~*Total Diminution of Temperature.*~~

~~*-60° C. .*~~

~~*Successive*~~

~~*‘ Gradients,*~~

~~*per Kilometre.*~~

~~*9°C.*~~

~~*9*~~

~~*-51*~~

~~*6*~~

~~*8*~~

~~*-45*~~

~~*7*~~

~~*7*~~

~~*-38*~~

~~*8*~~

~~*6*~~

~~*-30*~~

~~*6*~~

~~*5*~~

~~*-24*~~

~~*6*~~

~~*4*~~

~~*-18*~~

~~*5*~~

~~*3*~~

~~*-13*~~

~~*4*~~

~~*2*~~

~~*-9*~~

~~*5*~~

~~*1*~~

~~*-4*~~

~~*4*~~

~~*0*~~

~~*0*~~

~~*III. Climatology. The climate of any locality is generally defined as the average condition in respect of atmospheric phenomena, meaning thereby not merely the general average of all values of the temperature, winds,*~~

~~rainfall, &c., but the extreme values and the averages of the extreme values for long periods of time. If we confined ourselves wholly to meteorology proper, we should necessarily define a climate by numbers and diagrams relating to these meteorological elements ; but from time immemorial it has also been the custom to illustrate and even investigate climatic con- ditions by enumerating the plants and animals that flourish in different localities, and by tabulating the dates of sprouting, budding, leafing, fruiting, ripening, harvest- ing, and the dropping of the leaves. The study of plants from this point of view is called p^enoZogry; and in so far as plants depend upon the meteorological climate, it gives us a comprehensive view of both the present and the past climates of every portion of the earth since the ancient geological periods. But as the relations between plant life and meteorology are complex, 9,nd but little under- stood, we leave this field of study to the botanists and palaeontologists, and confine ourselves to the atmosphere proper. The most remarkable collection of data relative to phenology in its relation to meteorology is to be found in two essays by Dr Karl Linsser, published in 1864 and 1866 by the Imperial Academy of Sciences at St Peters- burg. In these essays he has shown the nature of the dependence of the growth of the plant upon temperature, rainfall, the length and character of the growing season, and the latitude, and has given some important clues as to the natural process of the evolution of various species and varieties.~~

~~As to climatology proper, there are two classes of memoirs — those that confine themselves to numerical data, charts, and diagrams, and those that attempt by general descriptions to give a popular and vivid picture of the conditions that prevail in various localities. Of the latter we find an admirable illustration in HHenry S. Blanford's work, A Practical Guide to tJie Climates and Weather of India, Ceylon, and Burma, and the Storms of Indian Seas, London, 1889. Of the works that combine both numerical tables and descriptive text, with a predilection in favour of the former, there is nothing to compare with the Lehrbuch der KHmatologie of Professor HHann, of which a second edition was pub- lished in 1897 in three volumes. JJut, in general, the climatological elements for any country, and especially for the whole world, can be well presented and compre- hended by means of a few charts, and this is undoubtedly well~~

done in Hann's Atlas of 1887, but most thoroughly in the third volume of Bartholomew's Physical Atlas (Constable and Company, London, 1899). This atlas of meteorology contains over four hundred maps illus- trating the prominent features in the distribution of temperature, pressure, winds, clouds, sunshine, and rainfall, followed by a series illustrating storms and weather, which forms an admirable supplement to any textual presentation of the subject of meteorology. In the present article we shall only attempt some description of the general distribution and peculiarity of rainfall through- out the globe, taking advantage of the important memoir on this subject published by Supan in 1898, as " Supple- mentary volume No. 124 to Petermann's Mitteilungen."

The average condition of the atmosphere as to temperar ture and pressure over the whole globe is the climato- logical feature of fundamental interest for the student of theoretical meteorology. Professor Forbes was the first to attempt to define the relation between the mean tem- perature of any latitudinal zone and the mean ratio between the areas of land and water within that zone. His numerical determination of these ratios has been slightly changed by later authorities ; but on account of the historical interest of the subject the following table is given, showing the temperatures, pressures, and ratios of land to water that served as the basis of important researches. The reader will perceive that the average temperature is decidedly affected by the presence of land; and the column of prevailing winds shows that these, as well as the barometric pressure, depend upon the tem- perature gradient, and therefore upon the presence of the land. In fact, in the study of the climate of a continent, the latter is considered as essentially the centre of a large area of disturbance in the midst of the ocean that covers four-fifths of the earth's surface. As we proceed from the shores of a continent inward we depart from the oceanic and approach the truly continental conditions. Ferrel has expressed these influences of land and water in a general formula, from which may be determined what the temperature and pressure would be if the earth were all land or water.

This subject has also been discussed by Forbes, Sarto- rious von Waltershausen, as well as Hann and Ferrel, and

~~*710*~~

~~*METEOROLOGY*~~

~~*Climatological Table.*~~

~~*[climatology*~~

~~*Mean Annual Insolation.*~~

~~*Annual*~~

~~*Latitude.*~~

~~*Mean Aiuiiuai^*~~

~~*Ratio of*~~

~~*Land to*~~

~~*Water*~~

~~*(Forbes).*~~

~~*Outer Atmosphere.*~~

~~*Earth's*~~

~~*Surface.*~~

~~*Relative Area of Zones.*~~

~~*Rainfall (Loomis- Murray).*~~

~~*Temperature.*~~

~~*Pressure.*~~

~~*Wind.*~~

~~*Cloudiness*~~

~~*0-0.*~~

~~*Cloudiness*~~

~~*0-4.*~~

~~*Degrees.*~~

~~*• Cent.*~~

~~*mm.*~~

~~*Per Cent.*~~

~~*mm.*~~

~~*North 90*~~

~~*-17-0*~~

~~*0-42*~~

~~*0-08*~~

~~*0-03*~~

~~*0-000*~~

~~*„ 85*~~

~~*\ 360*~~

~~*„ 80*~~

~~*-15-8*~~

~~*760-5*~~

~~*E.N.E.*~~

~~*0-43*~~

~~*o’-i’e*~~

~~*0-06*~~

~~*0-174*~~

~~*1 380 1 400*~~

~~*} 590*~~

~~*1 610*~~

~~*j 590 } 730 |l020*~~

~~*-2120*~~

~~*[2030 |l320 ‘ } 710*~~

~~*■ 750 |ll30 }ll20*~~

~~*„ 75*~~

~~*760-0*~~

~~*E.N.E.*~~

~~*„ 70*~~

~~*- io-2*~~

~~*758-6*~~

~~*E.N.E.*~~

~~*48-3*~~

~~o’-47~~

~~0-26~~

~~o’-io~~

~~0-342~~

~~„-65~~

~~758-2~~

~~N.E.~~

~~„-60~~

~~-■2-2~~

~~758-7~~

~~N.E. & S.W.~~

~~66-8~~

~~0-57~~

~~0’-67~~

~~0-15~~

~~0-560~~

~~,-55~~

~~759-7~~

~~W.~~

~~„-50~~

~~+ ‘6-5~~

~~760-7~~

~~W.~~

~~56-3~~

~~o’ -‘68~~

~~0-49~~

~~0-20~~

~~0-643~~

~~45~~

~~761-5~~

~~W.~~

~~„ 40~~

~~14-4~~

~~762-0~~

~~W. &E.~~

~~44-5~~

~~0-79~~

~~0’ -‘55~~

~~0-‘22~~

~~0-766~~

~~*„ 35*~~

~~*762-4*~~

~~*S.W. & S.E.*~~

~~*„ 30*~~

~~*20-4*~~

~~*761-7*~~

~~*E.*~~

~~*43-4*~~

~~*0-88*~~

~~*0’-64*~~

~~*0-26*~~

~~*0-866*~~

~~*„ 25*~~

~~*760-4*~~

~~*E.*~~

~~*„ 20*~~

~~*24-3*~~

~~*759-2*~~

~~*N.E.*~~

~~*30-8*~~

~~*0-94*~~

~~*o’-h*~~

~~*0-28*~~

~~*0-940*~~

~~*„ 15*~~

~~*768-3*~~

~~*N.E.*~~

~~*„ 10*~~

~~*26‘4*~~

~~*757-9*~~

~~*KE. & S.E.*~~

~~*23 -4*~~

~~*o’-99*~~

~~*0-74*~~

~~*0-29*~~

~~*0-985*~~

~~*„ 5*~~

~~*N.E. & S.E.*~~

~~*Equator 0*~~

~~*26-8*~~

~~768-0~~

~~S.E.~~

~~2’l-‘6~~

~~I’-OO~~

~~o’-75~~

~~0-30~~

~~i-‘obo~~

~~South 5~~

~~758-3~~

~~S.E.~~

~~22-6~~

~~„ 10~~

~~25-9~~

~~759-1~~

~~S.E.~~

~~22-6~~

~~0-99~~

~~o’-74~~

~~0’-29~~

~~0-985~~

~~*„ 15*~~

~~*760-2*~~

~~*S.E.*~~

~~*22-6*~~

~~*„ 20*~~

~~*20-5*~~

~~*761-7*~~

~~*E. & S.E.*~~

~~*22-6*~~

~~*0-94*~~

~~*0-71*~~

~~*o’-‘28*~~

~~*0-940*~~

~~*„ 25*~~

~~*763-2*~~

~~*S.E.*~~

~~*22-6*~~

~~*„ 30*~~

~~*19-2*~~

~~*763-5*~~

~~*N”.E. & S.E.*~~

~~*20-5*~~

~~*0-88*~~

~~*o’-64*~~

~~*0-26*~~

~~*0-866*~~

~~*„ 85*~~

~~*15-6*~~

~~*762-4*~~

~~*Var.*~~

~~*9-7*~~

~~*„ 40*~~

~~*12-9*~~

~~*760-5*~~

~~*W.N.W. & W.S.W.*~~

~~*4-1*~~

~~*0’-‘79*~~

~~*0-55*~~

~~*0-22*~~

~~*0-766*~~

~~*„ 45*~~

~~*10-1*~~

~~*757-3*~~

~~*W.N.W.*~~

~~*3-1*~~

~~*„ 50*~~

~~*6-7*~~

~~*753-2*~~

~~*W.N.W.*~~

~~*1-9*~~

~~*0-68*~~

~~*o’-‘49*~~

~~*0-20*~~

~~*0-643*~~

~~*„ 55*~~

~~*3-8*~~

~~*748-2*~~

~~*N.W.*~~

~~*1-3*~~

~~*„ 60*~~

~~+ 0-3~~

~~743-4~~

~~W.N.W.~~

~~0-67~~

~~o’-57~~

~~0-15~~

~~0-500~~

~~„ 65~~

~~739-7~~

~~S.E.~~

~~„ 70~~

~~– ‘4-8~~

~~738-0~~

~~S.E.~~

~~0-47~~

~~0-26~~

~~o’-io~~

~~0-342~~

~~,. 75~~

~~734~~

~~*1070*~~

~~*„ 80*~~

~~*85*~~

~~*- ‘8-2*~~

~~*736*~~

~~*o’-43*~~

~~*0-16*~~

~~*0’-‘06*~~

~~*0-174*~~

~~*„ 90*~~

~~*-9-3*~~

~~...~~

~~*0’-‘42*~~

~~*o’-08*~~

~~*0-03*~~

~~*0-bbo*~~

~~*the latest advance is found in the works of Zenker on “the distribution of heat and the fundamentals of climate.” Formulae representing the numerical relation between latitude and temperature or pressure on the one hand, and the ratio of land to water on the other, have been deduced. In the Met. Zeit. for January 1900 J. Liznar gives a slightly different treatment, somewhat as follows, of the questions discussed by Zenker and those who preceded him : —*~~

~~*The distribution of temperature on a hemisphere which is wholly land and wholly water can be deduced from a knowledge of the relative quantities of heat that fall upon the outer boundary of the atmosphere in different latitudes. Let this latter be indicated by I in arbitrary units ; let the temperature of the surface of a land hemisphere be L, and that of a water hemisphere, W. Liznar gives the following formulae connecting these qualities : L= (1-49) /S395 and W = (1 + 1208) /6365, and the temperatures com- puted by these formulae are as follows : —*~~

~~*Lat.*~~

~~*L*~~

~~*L.*~~

~~*W.*~~

~~*L-W.*~~

~~*θ*~~

~~*3063*~~

~~*+ 33-7°C.*~~

~~*+ 27-7°C.*~~

~~*+ 8-0° 0.*~~

~~*10*~~

~~*3011*~~

~~*32-6*~~

~~*24-9*~~

~~*+ 7-7*~~

~~20~~

~~2886~~

~~29-3~~

~~22-7~~

~~+6-6~~

~~30~~

~~2683~~

~~23-8~~

~~19-0~~

~~+4-8~~

~~40~~

~~2412~~

~~15-8~~

~~13-7~~

~~+2-1~~

~~50~~

~~2088~~

~~+6-4~~

~~+7-1~~

~~-1-7~~

~~60~~

~~1737~~

~~-7.5~~

~~-0.7~~

~~-6.8~~

~~70~~

~~1446~~

~~-19.7~~

~~-7.6~~

~~-12.1~~

~~80~~

~~1310~~

~~-26.1~~

~~-11.1~~

~~-16.0~~

~~90~~

~~1267~~

~~-28.3~~

~~-12.2~~

~~-16.1~~

~~*From these figures for L and W we may compute the tempera- ture of each zone of the earth's surface by taking into account the actual relation between land and water. The amount of land in any zone may be expressed as N, a fraction of the area of the zone,*~~

~~*and the amount of water will therefore be (I — N). Using the value of N, as measured by Dove, we obtain the computed temperatures (C) of the following table, and for comparison we add the observed mean annual temperatures (0), as deduced by Liznar from the measurements previously published by Spitaler and Batchelder, as shown in the following table : —*~~
~~*I*~~

~~*N.*~~

~~*C.*~~

~~*0.*~~

~~*Latitude.*~~

~~*Land*~~

~~*Temperature*~~

~~*Temperature*~~

~~*Area.*~~

~~*computed.*~~

~~*observed.*~~

~~*N. 70*~~

~~*0-543*~~

~~*-14-1°C.*~~

~~*-io-o°c.*~~

~~60~~

~~-609~~

~~-4-8~~

~~-1-0~~

~~50~~

~~•687~~

~~+6-0~~

~~+5-6~~

~~40~~

~~-372~~

~~+14-4~~

~~14-0~~

~~30~~

~~•462~~

~~21-1~~

~~20-3~~

~~20~~

~~■316~~

~~24-8~~

~~25-2~~

~~10~~

~~242~~

~~26 8~~

~~26-7~~

~~θ~~

~~•216~~

~~27-4~~

~~26-2~~

~~-10~~

~~•215~~

~~26-6~~

~~25-3~~

~~-20~~

~~-236~~

~~24-3~~

~~23-0~~

~~-30~~

~~-205~~

~~20-0~~

~~18-4~~

~~-40~~

~~■041~~

~~13-8~~

~~+ 12-0~~

~~-50~~

~~-019~~

~~+ 7-1~~

~~+ 5-6~~

~~*Such studies, however, relate to an ideal earth and atmosphere, and have too little to do with the actual distribution of land and water, Avinds, teinperature, and pressure in longitude, to justify their application to the real earth. Their results belong more properly to a globe whose surface is dotted -with land and water, so uniformly intermixed that there can be no chance for the existence of distinct areas of continental and oceanic climates. We therefore hesitate to apply them to the elucidation of such climatic questions as that of the Glacial epoch and other problems suggested by geology.*~~

~~*CLIMATOLOGYJ*~~

~~*The Distribution of Rain. — From a purely chronological point of view we have to consider the mean annual, seasonal, and monthly distribution of rain, and as a matter of less importance the diurnal distribution ; we have also to consider the liability on the one hand to floods or excessive rains, and, on the other hand, to long periods of drought. From a geogi'aphical point of view we have to consider the rainfall both on the land and on the ocean, the increase or decrease of rainfall with altitude above the ocean, and the average variation of rainfall with the latitude of the place.*~~

~~*It has not been customary for observers on the ocean to keep records of the quantity of rain and snow, owing to the diBiculty of finding a proper situation on the vessel for the rain-gauge, and also because of the supposed uncertainty of the observations themselves in adverse circumstances. Therefore, instead of the quantity of the rainfall, navigators have recorded only the time and duration of its occurrence and*~~

~~*its general character as light or heavy, showery or steady. But even from these records it ia possible to derive a rough approximation to the quantity, which is certainly more important than the mere duration, though both items serve scientific purposes. The depth of snowfall in inches is very important, as indicating the extent to which the soil and the roots of plants are kept warm during the winter season ; but in the present text we consider only the equivalent depth of melted snow expressed in inches or millimetres of rainfall. Although twenty thousand stations are recording rainfall, only the records of perhaps five thousand are available for our study, because of the length of the individual series of observations ; and these would not sufiice as the basis of satisfactory general rainfall charts unless their indications were supplemented by a careful study of the shorter series, and especially of the general statements of explorers, agriculturists, and geographers as to the relation between wind and rainfall, and the results of general experience. The quantity of rain during the respective seasons of the year is very important from an agricultural point of view.*~~

~~*Up to a certain point the terms "wet" and "dry" as applied to a climate are entirely relative, and generally concern the influence of rainfall upon plant life. But the development of plants depends largely upon the character of the soil and its power to retain moisture during drought ; it also depends upon the dryness of the air and the strength of the wind, and the consequent evaporation, and also upon the character of the precipitation, whether rain or snow, and therefore in part upon the temperature. HIowever, we shall not go far wrong if we consider an annual rainfall of 250 millimetres as a dry climate, and one of 1000 millimetres or more, namely, 40 inches, as a wet one.*~~

~~*The isohyetal of 250 millimetres is the boundary of the Arctic basin on the north and the Antarctic on the south. Within these regions the undoubted deficiency in rain, added to the low temperature, forbids almost any form of vegetation. The greater part of Europe between latitudes north 35° and 65° has at least a moderate rainfall, namely, between 250 and 1000 mm. ; the coast of Norway has two rainy regions, but the region east of the Scandinavian mountains shows a great falling-ofif The British islands are more rainy and warmer than Scandinavia, and the con- trast between*~~

~~*the east and west sides of them is strongly marked, the contrast being due to the fact that the south-west winds laden with moisture from the Atlantic necessarily deposit more rain when they first strike the land and are driven upwards by its disturbing action. In the Bay of Biscay we find an increase of rainfall, which is heaviest along the north-western slope of the Serra da Estrellain central Portugal, though almost equally heavy rain falls on the higher mountain slopes in the interior of France. Throughout the region of the Mediterranean the western coasts have more rain than the eastern.*~~

~~*In general the heaviest precipitation occurs when the mountains are so disposed that moist air is rapidly forced up to a great height. The two regions having an average annual rainfall of over 4000 millimetres, or 160 inches, are located on the Dalmatian and Albanian coasts of the Mediterranean and in the north-eastern corner of India, where damp south-west winds are forced up over steep mountain gradients. It is quite possible that an equally heavy rain occurs on the north-east coast near the summits of the moun- tainous islands of the East Indies, as also on the mountain-tops of the lake region of Central Africa. Almost as heavy rains are found in the island of Jamaica, and especially in the upper portions of the valleys of the Orinoco and Amazon. In the interior of Europe, the higher portions of mountain slopes are rainy, although the low land near by may be relatively dry. In mountainous countries like Switzerland the greatest variety exists in the distri- bution of rain, and regions having the most opposite qualities in this respect often lie contiguous to each other. In northern Asia there is great uniformity in the quantity of rain, unless indeed our rainfall records are defective. From the Volga eastwards to the Lena the annual quantity averages between 500 and 750 millimetres, which may be called a moderate rainfall. In Manchuria and northern China the quantity is but little larger, and a decided increase is found ouly as we move south-eastwards along the coast of China, Korea, and*~~

~~*Siam, between latitudes N. 40° and N. 10°. Japan also belongs to this region of moderate rainfall ; but Supan points out the fact that the island stations on the southern coast of China, on which light- houses are stationed, report decidedly less rain than the adjacent coast stations. He thinks that this "is in agreement with the general principle that horizontal currents of air, such as the sea breezes, give no rain until they meet obstacles of considerable extent, such as the precipitous coast, when they begin to rise rapidly and cool, as in the ordinary process of rain-making. But the present writer would say that the study of rain-gauges exposed to severe winds on the east coast of the United States demonstrates that they catch less rain than they should, owing to the action of the wind at the mouth of the gauge. This eff'ect of the wind at the gauge has undoubtedly influenced all records of rainfall in exposed situations, and plausibly explains the deficit just referred to. In the East Indian region British, and especially Dutch, meteoro- logists have made excellent rainfall records. In this region not only do land and water intermingle in fairly equivalent proportions, but the annual movement of the sun northwards and southwards, the annual changes of the monsoon, and the migration of the equatorial belt of calms, all combine to produce most decided seasonal variations in this rainy region. Thus, on the island of Luzon the easterly trade-winds cause an annual rainfall of 3000 millimetres on the eastward slope of the mountains, but the western side has only 1800. On the island of Sumatra, where the rain principally falls during the south-western monsoon, the south- western side has 4160 millimetres, but the north-eastern side 2700 millimetres ; in the northern or peninsular part of the island of Celebes, which trends east and west, the northern slope has an annual rainfall of 2540, but the southern slope 1390 millimetres. In Hindustan the great south-west monsoon of the summer season is the rainy wind ; hence the west or south – west coasts are generally rainier than the east coasts. This summer monsoon, when it reaches the head of the Bay of Bengal, divides into two branches ; the main branch continues on to Burma and Siam, while the other turns to the north-west over the Ganges and along the south face of the Himalaya mountains. The rainiest station on the globe, .Cherrapungi, lies in the midst of the main branch, and is also on the side of a moderate mountain ; it is so situated that it seems to be exactly under the summit of the standing wave in the atmosphere due to the enforced flow of the monsoon over this mountain,*~~

~~*like the waves on the surface of a stream of water flowing over a rocky bed. Doubtless the heavy rainfall at Cherra- pungi is not experienced over a region of more than 10 square miles.*~~

~~*Among the regions that receive but little rain are some that are generally known as deserts, although there may be plenty of water stored away deep down in the soil. Thus on the western side of the Eocky Mountains and iij the so-called plateau region, as also on the eastern slope farther southwards, and among the Andes in South America, are narrow zones containing many regions of small rain- falls. In Europe and Asia there are several such regions. Thus on the northern border of the Tian Shan is a, large area whose annual rainfall is from 400 to 600 millimetres ; but as we pass inwards to the desert of Gobi we come to small regions of less than 200 millimetres, such as we also find when we go far northwards over the Kirghiz Steppes. In general the regions of small rainfall are on the leeward sides of mountain ranges or in valleys and plateaux between such ranges. The great south-western monsoon that brings so much rain to southern India brings dryness to the interior of Asia ; thus, at Leh in the valley of the Upper Indus the annual rainfall is less than 80 millimetres, and the snow-line is at a level of about 19, 000 feet. Similar dry valleys occur in the Rocky Mountain region and the Andes, and several are known in Switzerland.*~~

~~*In both Africa and South America the interesting feature of the rainfall is the great extent and importance of the region of equatorial rains. In Africa this is bounded on the north by the light rain of the Sahara Desert and on the south by the almost equally light rains of the various South African states and colonies. Between these — namely, between latitudes N. 15° and S. 15° — is the region of heavy rain that supports such rivers as the Zambezi, the Congo, the Niger, and the Nile. Over the basins of each of these rivers the general average rainfall is about 1500 millimetres. The heaviest rains of Africa occur on the west coast, especially on the Gulf of Guinea, and from Sierra Leone to the Gold Coast. On the oceanic side of Cameroon mountains there appears to be a remarkable rainfall, but the report of over 9000 millimetres per year at Debundji (latitude N. 4°, longitude E. 9°) has every appear- ance of being a numerical error on the part of the observer. The rainfall at all points on*~~

~~the coast of Africa ia of the monsoon type — that is to say, it has a regular annual period ; but of course the periods vary for the regions within and beyond the equatorial zone. Even the rainfall in the great African lake region has a monsoon character, being largely dependent upon the south-eastern monsoon from the South Indian Ocean, which, after striking the African coast, is during the northern summer deflected northwards, and not only crosses the equator, but becomes the south-western monsoon of India and China.~~

~~[cLIMATOLOG-i~~

~~In Australia the distribution of rain is very sharply marked. The whole interior of this continent lies under the iniluence of the tropical belt of light rain, and is subject to severe droughts. On the south-western coast the south-eastern trade-winds penetrate suffi- ciently to give a considerable region a rainfall of 1000 millimetres annually, mostly in June, July, and August. At the opposite season of the year the north and north-eastern sides of the continent receive rather a large amount coming from the equatorial belt of rains, which then extend south of the equator. The eastern side of Australia receives a moderate amount, but over a larger area, from the south-eastern trades which in the summer season blow with in- creased force against this coast and cause abundant rain on the higher mountains. The western coast and interior of Australia receive on the average less than 250 millimetres, and are classed as desert, although artesian wells frequently bring up a copious supply of water from the reservoirs below.~~

~~In North America certain very dry regions known as the Rio Grande and Colorado deserts in the United States, and in South America the drier portions of Argentina and Peru, probably have about the same annual rainfall, viz., 100 to 200 millimetres. As we depart from these regions, either towards the equator or towards the Atlantic and Pacific Oceans, we come upon others that have more rain, the maximum being over 2000 millimetres on the southern and western coast of Alaska, and the western~~

~~*coast of Chile and Patagonia, and over a large region drained by the Amazon and Madeira rivers in Brazil. In the United States, those states bordering on the Atlantic and the Gulf of Mexico, from Louisiana to Newfoundland, have about the same rainfall as the interior of Siam and southern China.*~~

~~*Seasonal Rainfall. — The distribution of rain according to months and seasons, including periods of drought and flood, is quite as important as the amount of rainfall. In order to express in a few words the seasonal changes at all places on the globe, which have such great variety as to seem purely local in their character, we may perhaps deduce them all from a few general rules which should enable one to anticipate what the character of the rain must be at any place. In general, any cause that makes the air near the ground or ocean ascend rather rapidly will produce rain in proportion to the quantity of air that ascends, the quantity of nioisture in the air, and the quickness with which the moisture condenses into cloud and rain. The last element, quickness, is approximately inverse to the height to which the air must ascend before becoming cloudy, and therefore inverse to the altitude of the lowest cloud surface. In general the north-eastern and south-eastern trade -winds of the northern and southern hemispheres, blowing towards the equator, combine with the intense action of the sun's heat to favour the formation of ascending currents and an equatorial rainy belt on the ocean without the special assistance of mountains or precipitous coasts. These oceanic equatorial rainy belts are very much displaced and distorted by the action of the continents and the larger islands. In this way is brought about the heavy rain over a wide area in Brazil, Central Africa, and the East Indian archipelago. Whatever causes the currents of air to descend retards or prevents the formation of cloud and rain, except in so far as the descent and dryness in one place must be accompanied by a corresponding ascent and rain in some other locality ; thus the great south-western monsoon of India ascends and deposits rain on the southern side of the Himalaya, but, in so far as it descends on*~~

~~*the northern side, it brings extremely dry weather to Tibet, Turkestan, and Mongolia. Similarly, the strong westerly winds that ascend and form*~~

~~rain-'on the Alaskan and Patagonian coasts descend as dry air on the eastern slope of the Hooky Mountains and the Andes respectively.~~

~~Wherever great irregularities are absent from the earth's surface, as over the oceans and the plains, the ascending currents needed to form rain may be produced by the heating of the atmosphere near the soil under th^ influence of direct sunshine ; but in some cases the same result is apparently produced by changes in barometric pressure going on in the upper layers of the atmosphere. These changes have been likened to great waves or billows in the atmosphere extending over large areas, and producing different effects according to the nature of the surface beneath them. When the trough by relieving the pressure over a large region of the lower air allows it to expand and cool, clouds may form and develop into a storm ; the ascending air occurs primarily on the easternsideof the lowest pressure, and the rainfall accompanies it. In great contrast to the south-eastern trades of the southern hemisphere and the north-eastern trades of the northern are the anti-trades that prevail in the atmosphere a short distance above them, and that blow from the north-west and south-west respectively. These anti- trades may possibly have a slight descending tendency, and would therefore not form cloud and rain ; but they are boisterous winds full of eddies, and therefore affect the trade-winds below them in such a way as to give rise to innumerable local rains and gusts. Moreover, when they eventually reach the surface of the ocean they strike the first coast that they meet, such as that of Great Britain or the Scandinavian peninsula, or Alaska, or southern Chile, and with great force are pushed upwards, giving plenty of cloud and rain. In the interior of Russia, Siberia, Australia, and North America the principal sources of local rains are the local eddies caused either by the heating of the ground in the sunshine or by the action of the strong winds overhead.~~

~~Over the ocean the regular migration of the trade winds and equatorial zone northwards and southwards annually with the sun produces a regularity in the seasonal distribution of rain, according to the zones of latitude, which is expressed by Supan in the follow ing table : —~~

~~Zone,~~

~~Limiting Latitudes.~~

~~*I.*~~

~~*Little rain in summer .*~~

~~*. 40° N.*~~

~~*27° N*~~

~~*II.*~~

~~*„ „ at all seasons .*~~

~~*. 27° N.*~~

~~*19° N*~~

~~*III.*~~

~~*„ „ in winter*~~

~~*. 19° N.*~~

~~*7°N*~~

~~*IV.*~~

~~*Abundant rain at all seasons*~~

~~*. 7°N.*~~

~~*1°N*~~

~~*V.*~~

~~*Little rain in winter*~~

~~*. rN.*~~

~~*17° S*~~

~~*VI.*~~

~~*„ „ at all seasons*~~

~~*. 17° S.*~~

~~*30° S*~~

~~*VII.*~~

~~*„ „ m summer .*~~

~~*. 30° S.*~~

~~*35° S*~~

~~*These belts of dryness and rain are strongly marked on the wind- ward coasts of the continents ; they do not extend far inland, and are not clearly defined on the leeward coasts. As the winds are from either the north-east or south-east, the rainy regions must be on the easterly coasts. The changes in these belts depend on the changes of the wind, or what is frequently called the general circulation of the atmosphere ; this latter is associated with the sub -tropical areas of high and low pressure, which shift their positions in summer and winter, about as shown by Supan in the following table : —*~~

~~*Maximum Pressure over*~~

~~*Winter Season.*~~

~~*Summer Season.*~~

~~*Semi-annual Movement, Winter to Summer.*~~

~~*Date.*~~

~~*Latitude.*~~

~~*Longitude.*~~

~~*Date.*~~

~~*Latitude.*~~

~~*Longitude.*~~

~~*Latitude.*~~

~~*Longitude.*~~

~~*North Atlantic . North Pacific South Atlantic . South Indian South Pacific*~~

~~*Jan. 15 Jan. 15 July 15 July 15 July 15*~~

~~*28° N. 30° N. 274° S. 31° S. 34° S.*~~

~~*44° W. 138° W. 16° W. 67° E. 94° W.*~~

~~*July 15 July 15 Jan. 15 Jan. 15 Jan. 15*~~

~~*36° N. 39° N. 30° S. 37° S. 35° S.*~~

~~*34° W.*~~

~~*147° W.*~~

~~*4° W.*~~

~~*91° E. 104° W.*~~

~~*8°N. 9°N. 24° S. 6° S. 1° S.*~~

~~*1° E.*~~

~~*9°W. 12° E. 24° E. 10° W.*~~

~~*The general systematic movement of these areas northwards and southwards with the sun is better marked in the northern hemi- sphere*~~

~~than in the southern, undoubtedly owing to the larger percentage of land in the northern hemisphere, and the resulting contrasts between the temperatures and the resistances to motion over the land and water. In general, during the days and seasons when the barometric pressure is above the average for any region or season little or no rain falls therein.~~

~~The fundamental principle that rain falls only when there is a rapidly ascending moist current usually explains in a simple rnanner all the peculiarities of its geographical and chronological distribution. On the borders of areas of high pressure and within the areas of low pressure the air is ascending, but within the high areas it is des(;endin,r;. Hence the latter are dry and have a clear sky, but the former have cloudy skies and rain. As the sun moves north or south, returning to his first position within a year, so do the systems of winds and the regions of rain. Notwithstanding~~

~~the irregularities of local rainfall, the average of the rain on the land areas in any whole zone around the globe gives fairly homo- geneous results. Such zones were first calculated by Murray (see Scottish Geographical Magazine, 1887, page 65) on the basis of the charts and data published by Loomis in 1882, and such zonal averages are embodied in the last column of the climatological table already given, where they can be compared with the mean_ annual temperature and pressure, but especially with the cloudiness and the ratio of the land and water. The large pre- cipitation hotween 60° S. and 90° S., as compared with that between 60° N. and 90° N., is undoubtedly due to the presence of the Antarctic Ocean, which furnishes the moisture, and especially to the rapid westerly winds, which, by their action on the waves, and ice, and occasional islands, cause a suificient vertical circulation to determine the formation of cloud, and rain, or snow. In general, the excessive precipitation in the equatorial regions both north and south must be ascribed to the abundant moisture in the air. and to~~

~~*the rapid vertical circulation in the daytime, due to the action of the sunshine at the surface of the land and water, and especially to the character of the prevailing winds, which, by blowing from the north — east and south — east, must generally produce ascending currents in that region, except, possibly, in a few districts where they may glide past each other horizontally. In the Indian Ocean during the monsoon season the rainfall on the equator is not particularly large, owing to the absence of islands or opposing currents of air, and to the fact that the air of the south-western monsoon, having come rapidly from cooler regions to the south, has become warmed without being saturated, and has not yet attained the condition to form abundant rain. The hypothesis that any considerable quantity of air from either trade wind region ever crosses tlie equator to the opposite region'was considered untenable until John Eliot, director of the Meteorological Service for India, by means of his monsoon charts of the Indian Ocean, demonstrated that in the northern summer season the heated air over the eastern continent produces such a great disturbance of the ideal symmetrical system of trade winds that the south-easterly trades of the southern Indian Ocean are drawn northwards, becoming southerly winds at the equator and south-westerly winds over the Persian Gulf, Hindu- stan, and the Bay of Bengal, while the feebler south-easterly trades north of Australia become the south-westerly winds of Siam and China. On the western continent, by a similar but feebler action, the north-eastern trades of the Gulf of Mexico become the south-eastern winds of a mild monsoon on the northern coast of the gulf ; but owing to the small extent of the heated and elevated portion of the North American continent, this produces only monsoon rains in the valley of the Rio Grande, and has but slight influence apparently in disturbing the condition of affairs south of the equator in Brazil and Venezuela. In general, in both hemispheres, the amount of rain in the respective summers exceeds that in the winters ; the summer rains are also more uniformly distributed over the general surface of the country, being, in fact, due to a special local action of the solar radiation, and not to the general action that produces the trade-winds and the monsoons. Rapidly ascending currents, and therefore cumulus clouds, may be formed either by the direct action of the solar heat or by the action of the wind upon obstacles at the earth's surface ; the solar action produces the local summer rains, but both solar action and the obstacles to the wind con-*~~

~~tribute to produce the rains that attend the general monsoon winds. Condensation within a cloud, and especially that due to radiation from its upper surface, may be wlioUy counteracted by strong sunshine during the daytime if there be no supply of moist air to maintain the cloud, and, on the other hand, be greatly favoured by the absence of sunshine and by unobstructed radiation during night-time ; in this way are explained the maxima of rain and cloud at 3 or 4 p.m., and about the same time in the early morning. On hot days, and within the tropics, one may see a growing cumulus cloud with its flat lower surface suddenly begin to expand at the top and rise so rapidly as to show that there is not a sufficient supply of moisture from below to maintain the flat base, whereupon the cloud assumes a balloon shape, larger at the top and tapering toward the bottom, and, becoming thinner and whiter, rises until it enters a stratum'of overflow, where it is at once drawn out into a thin horizontal sheet of alto-cumulus or alto- stratus. This process may be again repeated, converting the alto- cumulus into cirrus, so that the same particles of moisture may appear successively as cumulus, alto-cumulus, and cirro-cumulus, and finally attain to the level of the most delicate cirrus cloud within a horizontal distance of one or two hundred miles. "When this process is going on the rain falls from cumulus, if at all, and the cirri floating far in advance announce the presence of the distant storm. The supply of moisture for rain comes ultimately from the oceans ; but the evaporation of this rain after it has fallen to the ground, and the repetition of precipitation and evaporation farther inland, form important steps in the distribution of this oceanic moisture. The wind that blows steadily until it has penetrated to the interior of the continent becomes drier because of its loss of moisture and its increase of temperature. It can only deposit ram when additions are made to its vapour by evaporation from the land or by mixture with moister air, but even then it must be cooled still further by higher ascensions and stronger radiations. In general the winter rains are due to a lower layer of moist air flowing from surfaces of warmer water inwards, sometimes to great distances over the continent, and at the same time rising slowly. The moisture for the summer rains comes from local evaporation and more rapidly rising currents, produced by the heat of the warmer part of the day. Therefore the diminution of rainfall as we pass from the coast to the interior is, relatively speaking, more decided in the winter season than in the~~

~~summer. Supan gives a formula for this relation between the rainfall over the ocean and the land at diflferent seasons and in different zones of latitude. Let L represent the aqueous vapour added to the atmosphere over the land M the aqueous vapour carried by the winds from the ocean to the land, and K the efficiency of the conditions that favour condensation and rain ; then in general we may have the ramfaU~~

~~upon the land represented by the formula (L + M)K. This formula applies, for instance, to the west coasts of Europe and Canada, to the Asiatic and Australian monsoon regions. The various types of rainfall over the globe can be fairly represented by varying the three terms ; for instance, in Egypt, especially in the delta of the Nile, the evaporation during the season of inundation is very large and the ocean breeze is also very strong, so that both L and M are large, but the conditions that favour the production of rain are so slight that K is practically zero, and therefore the rainfall is zero. In the polar zone L is nearly zero. In the temperate zone, as, for instance, over the continent of Europe and Asia, these conditions vary with the seasons. Thus in winter L is zero, but in summer L and M are both appreciable ; in fact, L may be greater than M on the coast and M may be zero in the interior. In the sub-tropical rain zone L is small in winter, but in summer both L and M become large, while K becomes small and the rainfall may become zero. In the tropical zone L is always appreciable, and probably larger in summer than in winter. In the equatorial zone, on account of the light winds, M is inappreciable ; but for coasts on which the trade-winds blow, L, M, and K are all appreciable.~~

~~Among the rainfall types are the following, in which it will he noticed that the distinguishing feature is not the geographical dis- tribution, but the seasonal features or chronological distribution : —~~

~~(a) Permanently rainy regions, where 60 millimetres or 2 '4 inches of rain or more falls during each season of the year. Such regions are found in general on the windward coasts of the continents, on the east coasts within the trade- wind region ; also in the equatorial zone.~~

~~(6) Permanently dry regions, where less tban 60 millimetres falls during each season of the year. Such regions may be found in the Arctic zones, the central portions of the continents of Asia and North America, the sub-~~

~~*tropical region on the west coasts of Africa and South America, the Sahara in northern Africa, and the Mohave Desert in Arizona.*~~

~~*(c) The variable rainy regions, where over 60 millimetres falls in certain special seasons.*~~

~~*(d) The variable dry regions, where less than 60 millimetres falls*~~

~~*Distribution of BainfaZl with Altitude. — In the interior of an island or continent the increasing height of the land usually brings an increasing disturbance of the general currents of air that pro- duce rain in mountainous regions ; and although the wind may be too dry to produce rain over the low lands, yet it falls upon the high lands. "We may thus, as we ascend within a continent, attain an elevation of nearly uniform rainfall throughout winter aiid summer, while the low land receives local summer rain, but little or no winter rain. On the island of Ascension the steady north-easterly trade-winds bring to the summit of Green Mountain uniform temperature, moisture, and rainfall, with an exquisite flora, while ^he lower flat portion of the island is almost rainless, subject to great evaporation, and destitute of plants. In Saxony and the Harz Mountains the general rainfall, according to Schreiber's Klimatogrwphie, 1893, is distributed in altitude as follows : —*~~

~~*Altitude. Metres.*~~

~~*Absolute Rainfalls.*~~

~~*Relative Rainfalls.*~~

~~*Winter.*~~

~~*Summer.*~~

~~*Annual.*~~

~~*Winter.*~~

~~*Summer.*~~

~~*ram.*~~

~~*mm.*~~

~~*mm.*~~

~~*Per cent.*~~

~~*Per cent.*~~

~~*100*~~

~~*221*~~

~~*351*~~

~~*572*~~

~~*38*~~

~~*62*~~

~~*300*~~

~~*280*~~

~~*398*~~

~~*678*~~

~~*41*~~

~~*59*~~

~~*500*~~

~~*337*~~

~~*444*~~

~~781~~

~~43~~

~~57~~

~~700~~

~~396~~

~~490~~

~~886~~

~~45~~

~~55~~

~~900~~

~~454~~

~~536~~

~~990~~

~~46~~

~~54~~

~~1200~~

~~540~~

~~606~~

~~1146~~

~~47~~

~~53~~

~~Evidently, at some slightly higher elevation than 1200 metres, the winter and summer rainfalls would become equal. Above this elevation it is quite possible that the rainy and dry seasons would be reversed. Such inversion is known to occur on the summits of some high mountains and over some lofty plateau regions. The winds change with the seasons, but the rainfall depends upon the windward and leeward aspects of the wind relative to the moun- tains, and also on its dryness and its velocity, so that the altitude of the region of uniform annual distribution of rainfall has not yet been expressed by any simple rule. Not to go into too many details as to the numerous types of rainfall that have been described by Hann, Supan, and other climatologists, we may at least give the following interesting table by Supan, illustrating the features that most affect plant life and animal life, namely, the distribution of rainfall through the year according to three types : — (1) where the mean variability of rainfall is less than 10 per cent., so that the rainfall is uniform throughout the year ; (2) where the mean variability lies between 10 and 19 per cent, inclusive, so that the rainfall may be said to have a very moderate periodicity ; (3) where the rainfall has a mean variability of over 20 per cent, and shows a decided periodicity.~~

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~~714~~

~~METEOROLOGY~~

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~~Distribution of Rainfall during the Year.~~

~~Type I.~~

~~Type II.~~

~~Type III.~~

~~*Philadelpliia.*~~

~~*Copenhagen.*~~

~~*Singapore.*~~

~~*Baku.*~~

~~*Barnaul.*~~

~~*Hong-Kong.*~~

~~*Jerusalem.*~~

~~*:Nercliinsk.*~~

~~*Peking.*~~

~~*Per cent.*~~

~~*Per cent.*~~

~~*Per cent.*~~

~~*Per cent.*~~

~~*Per cent.*~~

~~*Per cent.*~~

~~*Per cent.*~~

~~*Per cent.*~~

~~*Per cent.*~~

~~*January .*~~

~~*77*~~

~~*7-0*~~

~~*8-8*~~

~~*10-2*~~

~~*3-3*~~

~~*1-1*~~

~~*24-8*~~

~~*0-4*~~

~~*0-5*~~

~~*February .*~~

~~*7-0*~~

~~*5-9*~~

~~*8-0*~~

~~*9-0*~~

~~*2-3*~~

~~*1-4*~~

~~*23-1*~~

~~*0-5*~~

~~*0-8*~~

~~*March*~~

~~*8-0*~~

~~*6-1*~~

~~*7-1*~~

~~*6-8*~~

~~*2-7*~~

~~*3-6*~~

~~*14-2*~~

~~*1-3*~~

~~*1-0*~~

~~*April*~~

~~*7-7*~~

~~*6-0*~~

~~*7-4*~~

~~*9-1*~~

~~*3-7*~~

~~*6-0*~~

~~*6-8*~~

~~*3-1*~~

~~*2-6*~~

~~*May.*~~

~~*8-5*~~

~~*7-1*~~

~~*8-3*~~

~~*5-1*~~

~~*9-8*~~

~~*13-8*~~

~~*1-1*~~

~~*6-8*~~

~~*6-3*~~

~~*June.*~~

~~*9-1*~~

~~*9-5*~~

~~*7-6*~~

~~*3-5*~~

~~*13-9*~~

~~*18-0*~~

~~*0-03*~~

~~*15-3*~~

~~*13-7*~~

~~*July .*~~

~~*9-2*~~

~~*10-8*~~

~~*5-6*~~

~~*2-3*~~

~~*17-3*~~

~~*17-6*~~

~~*0-0*~~

~~*26-1*~~

~~*34-1*~~

~~*August*~~

~~*10-3*~~

~~*11-3*~~

~~*8-8*~~

~~*2-2*~~

~~*16-2*~~

~~*16-4*~~

~~*0-0*~~

~~*28-2*~~

~~*26-3*~~

~~*September:*~~

~~*8-0*~~

~~*9-9*~~

~~*7-6*~~

~~*11-0*~~

~~*9-5*~~

~~*13-9*~~

~~*0-1*~~

~~*12-3*~~

~~*10-8*~~

~~*October*~~

~~*8-S*~~

~~*10-6*~~

~~*8-7*~~

~~*13-8*~~

~~*8-5*~~

~~*5-8*~~

~~*1-7*~~

~~*3-4*~~

~~*2-5*~~

~~*November .*~~

~~*7-9*~~

~~*8-6*~~

~~*11-7*~~

~~*15-8*~~

~~*7-2*~~

~~*1-3*~~

~~*7-9*~~

~~*1-7*~~

~~*1-1*~~

~~*December . Year .*~~

~~*8-1*~~

~~*7-2*~~

~~*10-4*~~

~~*11-2*~~

~~*5-5*~~

~~*1-1*~~

~~*20-3*~~

~~*0-9*~~

~~*0-3*~~

~~*100-0*~~

~~*100-0*~~

~~100-0~~

~~100-0~~

~~100-0~~

~~100-0~~

~~100-0~~

~~100-0~~

~~100-0~~

~~*In ge'neral the annual quantity of rainfall increases with the frequency with which rain falls ; and we may also add that the annual quantity is in the inverse ratio to the annual variability, other conditions remaining the same, especially the geographical latitude.*~~

~~*Semlar Change of Climate. — Geological study shows that the present distribution of rain, both geographical and chronological, aid not prevail throughout the past histor}' of the earth, but that the rainfall, snowfall, and fog or cloudiness have varied greatly as to place and time. The preceding tables and the text connected therewith show that these changes may easily have depended solely on corresponding great changes in the elevation of the continents, on the variations in their extent, and the distribution of land in latitude. On the other hand, the changes that have taken place within the past 3000 years — that is to say, since we have any historical or observational data — have been so .small as to elude demonstration. A most careful comparison of the present climate with that prevailing during the earliest times in Greece and Asia Minor was published in 1898 by Eginitis, director of the observatory at Athens, from which we can only infer that there is no apparent difference in the climate, properly so called ; and that if there be any difference in the flora and fauna, it must be due to a change in the latter produced by human interference or natural evolutions, but not by any change in climate.*~~

~~*Artificial Production or Prevention of Bain. — From time immemorial there have been those who believed that in some way or other man can influence the weather so as to avert disaster from droughts or storms. Even now this idea has a strong hold upon some who have not properly studied the advance of our knowledge in regard to the laws of nature. The matter would hardly be worthy of serious mention in this place were it not that there is abundant evidence that many are deceived and much money wasted by the so-called rain-makers and others. It is perfectly safe to maintain the general proposition that man cannot make any important change in the weather by means of noises, explosions, liberation of gases, erection of light- ning rods, or anj' other device that has yet been suggested. We may learn to take advantage of the rain and the wind, or to defend ourselves from the lightning, the flood, and the storm, but we cannot alter them. Even in the case of the destruction of exten- sive forests and equally extensive reafforestations, it has been satis- factorily shown that the measured quantity of rainfall is the same both with and without the forest, and both before and after its destruction ; the numbers of local storms of wind are also the same, but the temperature near the ground and the evaporation from the surface of the ground are changed, so that the so-called climate within a forest is slightly different from that prevailing in an adjacent clearing. This is also true if we cover a piece of land with a house — the climate within the house is different from that outside ; but these are plays upon the word climate and not meteorological changes properly so called. In Italy, Austria, and France a widespread delusion prevails as to the possibility of preventing hail by the bombardment of the clouds, analogous to the short-lived delusion promoted by Dyrenforth in the United States, to the effect that rain could be brought down by bombarding the clouds.*~~

~~*IV. Physical and Theoretical Meteorology.*~~

~~*The ultimate aim of those who are devoted to any branch of science is to penetrate beyond the phenomena observed on the surface to their ultimate t-auses, and to reduce the ■whole complex of observations and empirical rules based upon limited experiences to a simple deductive system in*~~

■which the phenomena observed shall be sho-wn to flo'w naturally from the fe'w simple la'ws that underlie the structure of the universe. A correct " theoria " or physical and logical argumentation deducing from primary la^ws aU the phenomena constitutes the noblest achievement of man in science. It is by such works that Ne^wton and Laplace distinguished themselves in astronomy. The development of the true physical and mechanical theories of atmospheric phenomena has made great progress, but is still inferior in completeness to astronomical ■work, o'wing to the great complexity of the meteorological problems. The optical and the thermal phenomena have been very satis factorily elucidated, but the phenomena of motion or aerodynamics have only been elucidated to a limited extent, ■whUe the electrical phenomena have as yet no firm basis of explanation. We must, ho^wever, introduce the reader to some of the - works that have been published on the subject, in the hope that thereby he ■wOl himself be persuaded to further study and induced to contribute to our kno-wledge.

Between the years 1853 and 1861 Professor "William Ferrel pub- lished in Gould's Astronomical Journal, JRuiiMe's Mathematical Monthly, and the A'merican Journal of Science several treatises on the motions of solids and fluids relative to the earth's surface. HIs work resulted in the elucidation of the problems of the atmosphere, and in ingenious ways, applicable approximately to such complex cases, and analytically equivalent to the arithmetical method of quadratures or the graphic methods of geometry, he deduced im- portant relations between the density of the air, the barometric pressure, and the attending winds. HIs essays seemed to show that it might he possible to treat the complex problems of meteorology logically and deductively by analytical, numerical, and graphic processes, and his memoirs were the first in which observed average meteorological conditions were properly co-ordinated with the fundamental formulae of mechanics. Ferrel's ideas were made the basis of the system of daily weather pre- dictions published by the present writer in 1869 in the Bulletin of the Cincinnati Observatory. This work -was taken up by the Government, and greatly enlarged during 1871-91 by the chief signal officers of the army, and during subsequent years by the chiefs of the U.S. Weather Bureau. HIs works appear to have first attracted the attention of European

~~*mathematicians in con- sequence of reviews published by Hann in the Zeitschrift of the Austrian Meteorological Society in January 1875, but especially after they had been reprinted in a convenient form by the U.S. Signal Oflice as "Bulletin No. VIII." In 1881 Ferrel, after finishing his works on the tides for the U.S. Coast and Geodetic Survey, began a new and extensive series of meteorological contributions, three of which were published by the U.S. Coast Survey and the rest by the Signal Oflice. Stimulated by Ferrel's work, by the urgent needs of the modern weather bureaux throughout the world, and by the beauty of the mathematical problems presented, numerous mathe- maticians liave lately taken up the study of the earth's atmosphere, so that the literature of the subject is now far more extensive than is generally supposed.*~~

~~*In addition to the purely mechanical problems, the numerous physical problems have also been carefully treated, both experi- mentally and mathematically. The problems of radiation have been elucidated by Langley, Hutchins, Angstrom, Pasohen, Yiolle, Maurer, Crova, Ohwolson, and Very. The problems of thermo-*~~

~~*theoey]*~~

~~*dynamica have been especially developed by Kelvin, Hertz, von Bezold, Ferrel, and Brillouin. The physical problems involved in the formation of rain-drops have been studied by an optical method by Carl Bams ; and with brilliant success, from an electrical point of view, by C. T. R. Wilson and J. J. Thomson at the Cavendish Laboratory, Cambridge, England.*~~

~~*In a complete study of the mechanics of the earth's atmosphere we naturally begin by expressing in simple analytic formulae all the various conditions and laws according to which every particle of the air must move. Some of these are local matters, depending upon the resistances at various points of the earth's surface ; others are of the nature of discontinuous functions, as, for instance, when the ascent of moist air above a certain level suddenly gives rise to condensation and clouds, to*~~

~~*the evolution of latent heat, to the precipitation of rain, to the shading of the air and the ground below the clouds, and to the sudden interception of all the solar heat at the upper surface of the cloud. It seems, therefore, incredible that the problems of the atmosphere can ever be resolved by purely analytical methods ; there must be devised combinations of numerical and graphical, and possibly even mechanical, methods to reproduce the problems and give us special solutions adapted to particular cases. But even these special methods can only be perfected in proportion as we attain approxi- mate solutions of the simpler problems, and it is in this preliminary work that a good beginning has already been made, thanks to the homologies between the mathematics of hydrodynamics and of ■ electricity.*~~

~~*The present state of theoretical meteorology, in which, are included both physical and mechanical, cannot be fully presented in non-technical English text. It ia imperatively necessary to employ algebraic formulae, or numerical tables, or graphic diagrams, the former being certainly the least cumbersome and the most generally available. The uniform system of notation devised by Professor F. H. Bigelow, of the U.S. Weather Bureau, is presented in the following lines taken from the U.S. Monthly Weather Beview for May 1897 :—*~~

~~*Professor Bigelow's notation ia : K, radius of earth; r, any distance from the centre of the earth ;, 6, north polar distance ; 0, north*~~

~~*latitude; X, east longitude ; and Y= + — , the potential ; the posi- tive normal is drawn from the surface outwards and the rotation is positive when right-handed, with translation along the positive direction. It is held by Professor Bigelow that terrestrial mag- netism and meteorology must conform to these three last conven- tions, which have been uniformly adopted in modern physics. Developing the angle 0 from the north pole and the angle X towards the east, and the radius r towards the zenith, the system of co-ordinate becomes x positive towards the south, y positive towards the east, and z positive towards zenith. The corresponding velocities are u, v, w ; the corresponding accelerations, du/dt, dv/dt, dw/dt. Further details as to his notation and a very complete summary of the formulae of physical meteorology ex- pressing the results of nearly all*~~

~~*recent students wiU be found in chapters x. and xi. of Professor Bigelow's Report on the Inter- national Cloud Observations, published as vol. ii. of the annual report of the chief of the U.S. "Weather Bureau for 1898-99.*~~

~~*The fundamental laws to which the atmosphere is subject are as follows : —*~~

~~*A. The Equation of Elastic Pressure. — The pressure shown and measured by the barometer is an elastic pressure acting in all directions equally at the point where it is measured. By virtue of this elastic pressure a unit volume of air will expand in all directions if not rigidly enclosed, but will cool in so doing. On the other hand, if forcibly compressed within smaller dimensions, it will become warmer. . For a given temperature and pressure a unit volume of air of a prescribed chemical constitution will have a prescribed definite weight. The general relations between absolute temperature, pressure, and volume are expressed by the*~~

~~*formula , ,*~~

~~*j™=RT .... (1)*~~

~~*where T expresses the absolute temperature, p the elastic pressure, V the volume, and R is a constant which diflfers for each gas, being 29-2713 for ordinary pure dry air and 47-060 for pure aqueous vapour, if we use as fundamental units the kilogram, metre, and centigrade degree. This equation is sometimes called the law of Boyle and Charles ; it is also known as the equation of condition for true gases, meaning thereby that it expresses the fact that a true gas would change its volume directly in proportion to its absolute temperature and inversely in proportion to its elastic pressure. All gases depart from this law in proportion as they*~~

~~*approach the vaporous condition on the one hand, which is brought about by great pressure and low temperature, or the ultra-gaseous condition on the other hand, which obtains under high temperatures and low pressures. The more accurate law of Van der Waals would have no advantage in meteorological work. In place of the absolute temperature T we may substitute the expression 273° C. >^ (l + at), where a is the coefficient of volumetric expansion of the gas for a unit degree of*~~

~~temperature=0-00367 where t is the temperature expressed on the centigrade scale.~~

~~£. Hypsometric Conditions. — The pressure of the atmosphere at any place depends primarily on the weight of the superincumbent mass of air, and therefore diminishes as we ascend to greater heights. If the air is in motion, that and other considerations come in to affect the pressure ; but if the air is quite relative to the earth's surface, then the pressure at any altitude is expressed by the so-called barometric or hypsometric formula~~

~~-/:~~

~~(2)~~

~~where o- is the density and g the gravity for each layer of air whose vertical thickness ia dh. The integral of this formula depends upon the vertical distribution of temperature, and moisture, and gravity ; but under the simplest possible assumptions as to these vertical gradients, the following formula was deduced by Laplace and is generally known as his hypsometric formula :~~

~~h ~ fe„= 18400 (1 -f 0-003670 (1 -f 0-378 1- j (1 < 0-0026 cos 2 0)~~

~~{'Mmy'''''''^'°^f 2^>~~

~~The modifications which this formula needs in order to adapt it to other hypotheses representing more nearly the actual distribution of temperature, moisture, and gravity, have been elaborately investi- gated by Angot in a memoir published in 1899 in Part I. of the Memoirs of the Central Meteorological Bureau of France for the year 1896. Angot, Hergesell, and Rykatcheff have also shown that for hypsometric work of any pretensions to accuracy it is simplest and best to use Laplace's formula for successive thin strata of air, and add together the individual results, rather than attempt a more complex single formula for the whole stratum ; yet the latter seems U) be essential for work in aerodynamics. In this formula t is the average temperature, e the average vapour tension of the layer of air, p the barometric pressure at the top of the layer, p„ the~~

~~*pressure at the bottom, 0 the latitude of the station, h the elevation above sea-level of the lower limit of the stratum, and A„ that of the upper limit.*~~

~~*C. Thermodynamic Relations. — The temperature of the air is due to the quantity of molecular energy that is present in the form of heat, but usually there is also present a quantity of mole- cular energy that is spoken of as latent heat. This latent heat is said to do internal work, such as melting ice or boiling water, while the sensible heat does external work, such as expanding and pushing in all directions. These molecular energies can be trans- formed into each other over and over again without being sensibly diminished, and this power of transformation is expressed in the various equations of mermodynamics, of which the fundamental one for our purpose is*~~

~~*dQ,=C)^t + A.pdv=C^ + k'B.T dvjv . . (3).*~~

~~*This equation expresses the fact that when a quantity of heat measured in calories, dQ, is added to or taken from a volume of dry air, there may result both the change of temperature, dt, corresponding to one portion of the heat, C^i, and a quantity of external work corresponding to the remaining portion of the heat {Apdv). It usually happens that the quantity of heat in a given mass of air does not remain the same for any length of time ; it is diminished by radiation or is increased by absorption, and a certain quantity is lost when rain, snow, or hail drops down from the air, while a quantity is added to the atmosphere when moisture evaporates and mixes with the dry air as invisible vapour. The changes due to increase and diminution of moisture are usually small as compared with the great gain due to absorption and convection of solar heat, and with the loss by radiation. If these losses and gains are to be taken account of, then the quantity dQ in the above equation is finite and important. On the other hand, in some cases atmospheric processes go on so rapidly or in such peculiar circumstances — for instance, in the interior of a cloud — that the change in the quantity of heat may be considered as temporarily negligible. In these cases dQ is zero ; the changes in temperature balance the changes in external work, and the thermal process is said to be adiabatic.*~~

~~*D. The Condition of Continuity. — ^When a mass of liquid or*~~

[theory

changes that go on proceed by gradual continuous processes as to time, the mass of the fluid is subject to the law of continuity as to mass, and the motion of the fluid is continuous as to velocity. The latter condition is implied in the process of integration ; the former is expressed by the equation of continuity

dp ^ d(pu) ^ d(pv) ^ 3(p”’)^p dt dx dy dz

(4)

where p is the density, t is the time, and 3 the ordinary symbol for partial difierentiation.

JS. Cmiditions as to Energy and Motion. — When the total quantity of heat, both latent and sensible, remains constant or changes in a continuous manner, and when the motions are continuous, the mechanical and thermal processes are expressible by ordinary differentials and integrals. Motions of fluids involve both energy and inertia, and are subject to conditions expressed by the following equations of hydrodynamics : —

(a) Equations of energy. Let the kinetic energy be T, the potential energy V, the intrinsic energy W : I, m, n, be cosines of the angle between the pressure^ and the inwardly direct d normal to the boundary surface S. Then will

-^ ^f = I \p(lu + mv + nw)dS . . (5).

(V) Equations of acceleration and inertia. Let P be the potential of the external forces acting on a unit mass of the atmo- sphere ; /x, be the coeificient of viscosity or internal friction. Then will

_3P

~~*ap*~~

~~*3P*~~

~~*dv, &!t*~~

~~*3m*~~

~~*dx’*~~

~~*ot ox oy*~~

~~*du*~~

~~*r32« 3% , 8% l*~~

~~*1 dp_dv 3^ , p dy dt ‘dx*~~

~~*dw*~~

~~*dy r3“i)*~~

~~*8^1) d^v “I + 9^”^3?J*~~

~~*dp_*~~

~~*dw dw dw dw ot ox oy oz*~~

~~*r3^w d^w d^~\ ”’^[W’df’.^A.*~~

~~*(6).*~~

~~*Approximate Assumptions and Solutions. — After introducing into the preceding system of fundamental equations (1-6) the actual conditions as accurately as they are known relative to gravity, solar radiation, the rotation of the earth, the viscosity of the air, its mass or inertia, its absorption and radiation of heat, its variable content of moisture, the precipitation of rain and cloud, the mutual interconversions of latent and sensible heat, a special difiiculty occurs when we attempt to integrate*~~

~~these equations, because we have still to express analytically the initial conditions of the atmosphere as to pressure and temperature, and its boundary conditions as between the rough earth surface on the one hand and the unknown outward surface on the other. As the true earth's surface cannot possibly be represented by any algebraic formula, it is customary to assume simply that it is a uniform sphere, usually neglecting at least partially, if not wholly, the spheroidal shape. We next assume that there is no friction between the earth and the air. Thirdly, we assume that the power of the earth's surface to heat the air and to throw moisture by evaporation into the atmosphere is perfectly uniform. Finally, in many cases we go so far as to assume that the atmosphere is an incompressible rare liquid having a uniform density and a uniform depth of about 8000 metres, corresponding to the average standard density of dry air under a pressure of 760 millimetres and a temperature of 0° C. Even under these simplifica- tions the analytic difficulties have been too great to admit of rigorous solutions, except in a few of the simplest cases. The treatment of atmospheric problems by Ferrel was followed by equally ingenious mathematical treatment by Professors Guldberg and Mohn, of Christiania, in two papers published by them in 1876 and 1880 respectively. These authors, like Ferrel, treat isolated portions of the atmosphere and obtain special solutions, which, however, have not the generality that must eventually be demanded in a rigorous and general discussion of the atmosphere as a whole. A more elegant mathematical sohition of the subject was first given in 1882 by Oberbeck, of the University of Halle, in the Annal. Phy.i. xvii. p. 128. But even Oberbeck's solulions are obtained under various simplifying assumptions that restrict their satisfactory application to the daily weather maps, Ober- beck's first memoir treats of the mechanics of stationary cyclonic movements. Assuming that the isobars are concentric circles, and that in the outer portion of a cyclone the air has only horizontal movements, while in the inner portion it has only vertical move- ments, he solves his system of equations for the inner and outer**

regions of the cyclone separately. He shows that in general the pressure increases on all sides outwards from the centre ; the gradient also increases from the centre outwards to the limit of the inner region, whence it diminishes in the outer region and at a great distance becomes

~~*inappreciable. In both regions the paths of the wind are curved lines, logarithmic spirals, which cut the isobars or the radial gradient everywhere at the same angle ; there- fore, the movement of the air can be considered as a spiral inflow from all sides towards the centre. But the angle between the wind and the gradient follows different laws in the outer and inner regions, depending in the former on the rotation of the earth and the friction, but in the latter also on the intensity of the ascending current of air. In passing from the outer to the inner surface the wind experiences a sudden change of angle, so that the directions of the winds are not continuous, although the movement and the barometric pressures are assumed to be continuous. This latter peculiarity does not occur in nature, and is undoubtedly an analy- tical result peculiar to Oberbeck's method of treating the funda- mental equations.*~~

~~*An improvement in the mathematical analysis was introduced by Dr F. Pockels of Gottingen in a memoir published in the Met. Zeit. for 1893, pp. 9-19. He deduces equations showing continuous changes of temperature, pressure, gradient, wind direction, and velocity from t]»e centre of the cyclone to the outer edge of the anti-cyclone, or, more properly, the peri-cyclone ; these, therefore, may reasonably be supposed to have their counterparts in nature. Such mathematical solutions, however, are based upon the assump- tion that we are dealing with a comparatively small portion of the earth's surface, which may be considered as a plane and as having a uniform diurnal rotation and a uniform coefficient of friction. Moreover, the cyclones and anti – cyclones are assumed to be stationary and permanent by reason of the perfect balance of all the forces involved therein. Of course these conditions are not exactly fulfilled, but in general Pockels shows that his theoretical results agree fairly well with the observed conditions as to wind and pressure. He computes the actual distribution of these elements under the assumption that the centre of the anti-cyclone is at latitude 55 "5, and that the coefficient of friction is 0 •00008.*~~

~~*Notwithstanding the fact that these difficult mathematical investigations still lead us to unsatisfactory results, they are yet eminently instructive as showing the methods of interaction of the various forces involved in the motions of the atmosphere. We must, therefore, mention the interesting*~~

~~attack made by Oberbeck upon the problem of the general circulation of the atmosphere. HIs memoir on this subject was published in the tiitzungsherichte of the Academy of Sciences at Berlin in 1888. The fundamental assumption in this memoir implies that there is a general and simple system of circulation between the equatorial and the polar regions, but the eventual solution of the problem leads Oberbeck to two independent systems of winds, an upper and a lower, with- out any well-defined connexion at the polar and equatorial ends of these two currents, so that after all they are not rigorously re-entrant. Among the hypotheses introduced in the course of liis mathematical work, the most important, and perhaps the one most open to objection, is that the distribution of temperature throughout the atmosphere in both the upper and lower strata can be represented by the equation T = A | B (1-3 cos' 6). Un-doubtedly this equation represents observations in the lower strata near the surface of the earth, but the constants that enter into it, if not the form itself, must be changed for the upper strata. The solution arrived at by Oberbeck gives the following equations representing the movement of the components of the movement of the atmosphere towards the vertical V, towards the north N, and towards the east 0 : —~~

~~V = C(l-3cos2e)/~~

~~N = — 6 C cos 9 sin e 0~~

~~0 = D [sin 9(1-3 cos= 6) g + ^ CDs'" ^7].~~

~~In accordance with these equations he deduces the general Circulation of the atmosphere as follows : — In the lower current the air flows from the polar regions towards the south-east and north-east until it reaches the parallel of 30° or 40° ; it then turns directly towards the equator, and eventually towards the south-west and north-west, until at the equator it becomes a strong easterly wind (or a so-called westerly current). In the upper layer the movemout begins as an easterly wind, turns rapidly to the north at latitude 20° or 30°, and then becomes a south-westerly wind (or north- eastern current) in the northern hemisphere, but a north-westerly wind and south-eastern current in the southern hemisphere. Of course in the highest strata of air the currents must diminish in strength. In a second paper in the same year, 1S8S, Oberbeck determines the~~

~~distribution of pressure over the earth's surface as far as it is consistent with his system of temperatures and winds. HIs general equation shows that as we depart from the equator the pressure must depend upon the square and the fourth power of the cosine of the polar distance or the sine of the latitude, and in this respect harmonizes with Ferrel's work of 1859, although more~~

~~theory]~~

~~general in its bearings. By comparing his forraulte with the observed mean pressure in different latitudes, Oberbeck obtains the general angular velocity of the air relative to the earth, i.e., 0'0292 { ain^ (/> 0'0836 [-, which is (juite small and is a maximum (4-6 metres per second) at latitude S. 56° 27'.~~

~~Contemporary with Overbeck's are the admirable memoirs by Professor Dr Diro Kitao of the University of Toky6, who, as a student of mathematics in Germany, had become an expert in the modern treatment of hydrodynamic problems. In three memoirs published by the Agricultural College of the University of T6ky6 in the German language in the years 1887, 1889, and 1895, he develops with great patience many of the minutiae of the movement of the earth's atmosphere and cyclonic storms. The assumptions under which he conducts his investigations do not depart from nature quite so far as those adopted by other mathematicians. Like f'errel, he adheres as closely as possible to the resnlts of physical and meteorological observations ; and although, like all pure mathe- maticians, he considers Ferrel as having departed too far from rigorous mathematical methods, yet he also unites with them in acknowledging that the results attained by Ferrel harmonize with the meteorology of the earth. The fact is that the solution of the hydrodynamic equations is not single, but mnltiplex. Every system of initial and boundary conditions must give a solution appropriate and peculiar to itself. The actual atmosphere presents us with the solution or solutions peculiar to the conditions that prevail on the earth. Entirely~~

different conditions prevail on Jupiter and Saturn, Venus and Mars, and therefore a wholly new series of problems pertain to the various planets of the solar system. It matters not whether we attempt to resolve our equations by introducing terrestrial conditions expressed by means of analytical algebraic formulae, and integrate the equations that result, or whether we adopt a graphic process for the representation of observed atmospheric conditions and integrate by arithmetical, geometrical, or mechanical processes. In all cases we must come to the same result, namely, our resulting expressions for the distribu- tion of pressure and wind will agree with observations just as closely as our original equations represented the actual tempera- tures, resistances, and other attending conditions. In the last portion of Kitao's third memoir he gives some attention to the interaction of two cyclonic systems upon each other when they are not too far apart in the atmosphere, and shows how the influence of one system can be expressed by the addition of a certain linear function to the equations representing the motions of the other. He even gives the basis for the further study of the extension of cyclonic storms into higher latitudes where conditions are so different from those within the tropics. Finally, he suggests in general terms how the resistances of the earth's surface, in connex- ion with the internal friction or viscosity of the air, are to be taken into consideration, and shows under what conditions the assumptions that underlie his own solutions may, and in fact must, very closely represent the actual atmosphere.

The General Tlieory of the Circulation of the AtmospJiere. — If the meteorologist had a sufficient number of observations of the motions of the winds and clouds to represent both the upper and lower currents, he would long since liave been able to present a satisfac- tory scheme showing the average movement of the atmosphere at every point of its course, and the paths of the particles of air as they flow from the poles to the equator and return. This motion has been called the general circulation of the atmosphere ; it would be a complex matter even if the surface of the earth were homo- geneous and without special elevations, but the actual problem is far different. Something like this general circulation is ordinarily said to be shown by the monthly and annual charts of pressure, winds, and temperature, such as were first prepared and published by Buchan in 1868, and in Bartholomew's Physical Atlas

~~*of 1899. We must not, however, imagine that such charts of averages can possibly give us the true path of any small unit mass of air. The real path is a complex curve, "not re-entrant, which is never described twice over, and would not be even if we had an ideal atmosphere and globe. It is a compound of vertical and undulatory movements in three dimensions of space, variable as to time, which cannot properly be combined into one average. The average temperatures, winds, and pressures presented on these charts suggest hypothetical problems to the student's mind quite different from the real problems in the mechanics of the atmosphere — problems that may, in fact, be impossible of solution, whereas those of the actual atmosphere are certainly solvable. The momentary condition presented on any chart of simultaneous observations belongs to the real, natural, and important questions of meteorology. The efforts of mathematicians and physicists have been devoted to these ideal conditions because of their apparent simplicity, whereas the practical problems offered by the daily weather chart are now so easily accessible that attention must be turned towards them. The most extensive system of homogeneous observations appropriate to the study of the dynamics of the atmo- sphere is that shown in the Daily Bulletin of International Simul- tanems Observations, published by the U.S. Signal Service in*~~

~~*the years 1876-84, jvith monthly and annual summaries, and a general summary in "Bulletin A," published by the U.S. Weather Bureau in 1893. The study of these daily charts for ten years shows how the general circulation of the atmosphere differs from the simple problems presented in the idealized solutions based on monthly and annual averages. The presence of a great and a small continent, and a great and small ocean, and especially of the moisture, with its consequent cloud and rain, has complicated and altered the problem. Nevertheless, it is important for us to follow the historical development of our subject. The most prominent features of the general circulation of the atmosphere are the system of trade winds, north-easterly in the northern tropics, and south- easterly in the southern tropics, the system of westerly winds beyond the trade-wind region, namely, north-westerly in the north tem- perate and south-westerly in the south temperate zone, and again the system of upper winds shown by the higher clouds, namely, south-westerly in the northern hemisphere and north-westerly in the southern.*~~

~~*Halley in 1680, and Hadley in 1735, gave erroneous or imperfect explanations of the mechanical principles that bring about these winds. As some errors in regard to this subject are still current, it is necessary to say that it is erroneous to teach that atmospheric air weighs less on being heated, or by reason of the infusion of more moisture, and that therefore the barometer falls. The addi- tion of more moisture must increase its weight as a whole ; heat, being imponderable, cannot directly affect its weight either way. We are liable to disseminate error by the careless use of the word "lighter," since it means both a diminution in absolute weight and a diminution in relative weight or specific gravity. Hent and moisture may diminish the specific gravity of a given mass of air by increasing its volume, or of a given volume by diminishing its mass, but neither of them can of themselves affect the pressure shown by the barometer so far as that is due to the weight of the atmosphere. It is not proper to say that by warming the air, thereby diminish- ing its specific gravity and causing it to rise, so that colder air flows in to take its place, we thereby diminish the barometric pressure. It is easily seen that in the expression p = RT/i), which, as we have before said, is the law of elasticity, T and v may so vary as to counterbalance each other, and allow the pressure^ to remain the same. Within any given room or other enclosure, as between the equator and the pole, hot air may rise on one side, flow over to the opposite, cool and return, and the circulation be kept up inde- finitely without any necessary change in pressure. The problem of the relation between wind and pressure is more complex than this, and involves the consideration of the inertia of the masses of air that are in motion with the earth around its axis. The air is so extremely mobile that it moves quickly in response to slight differences in pressure that cannot be detected by ordinary baro- metric measurement. The gradients or differences of pressure that are shown on meteorological charts, whether daily, or monthly, or annual, are not directly, but only very indirectly, due to buoyancy, as caused by heat and moisture. The pressure gradients so-called are not merely the prime causes of the winds, but are equally and essentially the resnlts of the winds. They are directly due to the fiict that the atmosphere is rapidly revolving with the surface of the earth around the earth's axis, while at the same time it may be circulating about a storm centre. Inappreciable differences of pressure start the winds in motion, and the air moves towards the region of low pressure, just as in the pneumatic despatch*~~

~~tubes the flow of air towards the low pressure carries the packages along. But in the free air, where there are no important resistances to be overcome, the freedom of motion is greater than in these pneumatic tubes. No sooner is the atmosphere thus set in motion from all sides towards the central low pressure than it rapidly acquires a spiral circulation, and thereby, in addition to the slight diminution of pressure in the direction of the motion of the wind, there is superimposed a much more decided one towards the left hand from the wind, and an equally rapid increase towards the right hand. This gradient of pressure, perpendicular to the direction of the wind, is far greater than that in the direction of the wind, and is that which produces the areas of decided low and high pressures that appear as storm centres and fair-weather centres respectively on the daily weather map. Therefore, in general, the wind cuts across the chartered isobars in directions oblique to these curved lines, and at angles which are nearly 90° for the feeble winds far removed from the centres, but which are almost zero for the most violent winds near the low centre. The winds acquire this spiral circulation for two reasons — (a) all straight line gusts or jets in fluids, subject to any form of resistance, necessarily break up into rotating spirals whenever the velocity exceeds a certain limit because the resistances of the viscosity deprive some particles of the fluid of a little more of their original velocity and energy than the other particles near by them, and thus the whole series is drawn away from linear into curvilinear paths ; (b) in addition to their rectilinear motions the particles of air have a rapid circular motion in common with the whole atmosphere diurnally around the earth's axis. Therefore every particle of moving air comes~~

~~under the influence of a set of forces depending on its own rate of motion, relative to the earth's surface and its position relative thereto. If the particles are moving eastwards, viz., in the same direction as the earth's diurnal rotation, then the result is as though the atmosphere were rotating more rapidly than does the earth at present ; consequently the~~

~~*particles of wind push towards the equator as though the atmosphere were trying to adopt a more flat- tened spheroidal figure corresponding to its greater velocity of rota- tion. If the particles are moving westwards, on the other hand, it is as though the atmosphere were revolving less rapidly than the earth, and as though the flattened spheroid of revolution due to the present rate of rotation were more decidedly flattened than need be ; consequently the particles of air push towards the poles. If the winds blow towards either pole, then their initial moment of inertia about the earth's axis, due to the initial radius and the eastward movement of the air, must be retained ; consequently, as the air advances into higher latitudes and to smaller circles of diurnal rotation its velocity must increase, and must carry the particles to the east of their initial meridians. If the wind blow towards the equator its initial moment of inertia must be applied to a larger radius, and its velocity correspondingly diminished, so that it is left behind or falls away somewhat to the west. " The reasoning, therefore, of those who in attempting to explain the trade winds assume that the atmosphere in moving towards or from the equator has a tendency to retain the same original linear "Velocity is erroneous" (Ferrel's Movoiients of Fluids, 1859). In general the winds tend to retain their moments of inertia, and in the northern hemisphere must necessarily always he deflected continuously towards the right hand. The exact amount of this deflection was first distinctly stated by Poisson, as applied to the movements of projectiles ; it was also announced by Tracy of New Haven in 1843, but was first applied to the atmosphere by Ferrel, who deduced its meteorological consequences. This law is not to be confounded with that of Buys Ballot, who in 1861 deduced from the weather charts of western Europe the rule that the gradient of pressure shown on the weather map for any day would be followed in twenty-four hours by a wind perpendicular to that gradient, and having the lower pressure on the left hand. Buys Ballot's law was in the nature of a rule for prediction, and was modified by Buchan, who enunciated the following : "The wind blows towards the regions of low pressure, but is inclined to the gradient at an angle which is less than 90°." In this form Buchan's law was an improvement upon the laws current among cyclonologists, who had assumed that, in a rough way, the wind blew in circles around the low centre, and was therefore sensibly at right angles to the gradient. It ought, however, to be said that Redfield throughout the*~~

~~*whole course of his studies, from 1831 to 1857, never gave adherence to this view, and in fact determined the average inclina/- tion of the movements of the lower clouds at New York City to be about 7° inwards as compared with the truly circular theory, at least for the severer portions of hurricanes. Now Ferrel's law explains mechanically the reason why the winds do not blow exactly radially or circularly, and gives the means for determining their inclination to the isobar in all portions of the cyclone, and for various degrees of resistance by the earth's surface. The general proposition that the barometric gradients on the weather map are not those that cause the wind, but are, properly speaking, the result of the combined action of the wind, the rotation of the earth, and the friction of the earth's surface, as first explained by Ferrel, seems to have been neglected by meteorologists until brought to their attention repeatedly by the present writer between 1869 and 1875. In 1874 Professor Hann published a review of Ferrel's work that rectified this important oversight. The independent investi- gations of Sprung, Koeppen, Finger, and especially Guldberg and Mohn, confirm in general the correctness of Ferrel's views.*~~

~~*It is quite erroneous to imagine that the low pressures in storm regions and in the polar regions, and especially the belt of low pressure at the equator, are due simply to the diminution of the density and weight of the air by the action of its warmth or its moisture, or to the abundant rainfall as relieving the atmosphere of the weight of water. It has been clearly shown that none of these operations can directly afl'ect the barometric pressure to any appreciable extent, but that high and low pressure areas, as we see them on the weather map, owe their existence entirely to the mechanical interaction of the diurnal rotation of the earth and the motions of the atmosphere. Both Espy and Hann have abundantly shown that the formation and downfall of rain do not produce any low barometric pressure unless they produce a whirling action of the wind — that, in fact, the latent heat evolved by the condensa- tion of vapour into rain may so warm up the cloud as to produce a temporary rise in pressure even at the surface of the ground, due to the downward push produced by the sudden expansion of tlie cloud, analogous to the backward kick of a gun when shot off. The force with which the wind presses to the right or tends to be deflected in that direction is 2re sine 0, while the curvature of*~~

~~*the path of the wind is measured by its radius of curvature, which is vftn sine 0, where v is the velocity of the wind, n is the equatorial*~~

~~*velocity of the earth's rotation, and 0 is the latitude. It will be seen from this that there is no deflection at the equator ; therefore, as Ferrel stated, there is no tendency to the formation of great whirlwinds at the equator, hence hurricanes and typhoons are rarely found within 10° of the equator.*~~

~~*Ferrel frequently speaks of an anti-cyclone, whereby he means the area of high pressure just outside of a strong cyclonic whirl ; the expression peri-cyclone would have been more appropriate and is sometimes substituted. The term aiili-cydmie, as flrst intro- duced by Galton in 1863, is applied to a system of winds blowing out from a central area of high pressure, and this is the common usage of the term in modern meteorology. The term cyclone among meteorologists and throughout English literature, except only a few cases in the United States, is equivalent to the older usage of whirlwind, and it is unfortunate that misunderstandings often arise because local usages in America apply the word cyclone to what has for centuries been called a tornado. The mechanical principles discussed by Ferrel led him to an algebraic relation between the barometric gradient G, the wind velocity v, the radius of curvature of the isobar r, and the inclination i between the wind and the isobar, which is expressed by the following formula for the pressures that prevail at sea-level : —*~~

~~*G =*~~

~~*A popular exposition of this and other results of Ferrel's work is given by Archibald in Nature, 4th May 1882, and still better in Ferrel's Treatise on the Winds, New York, 1897.*~~

~~*The charts of mean annual pressure, temperature, and winds above referred to show certain broad features that embrace the whole system of atmospheric circulation, viz. , the low pressures at the equator and the poles, the high pressures under the tropics, the trade winds below and the anti-trades above, with comparative calms under the belts of equatorial low pressure and tropical high pressure. The first effort of the*~~

~~*mathematician was to explain huw these mean average conditions depend upon each other, and to devise a system of general circulation of the wind consistent with the pressures, resistances, and densities. But, as we have already said, such a system may be very far from that presented by the real atmosphere, and little by little we are being led to a difl'erent view of the question of the general circulation. The earlier students of storms generally accepted one of two views as to the cause of whirlwinds. They were either — (1) formed mechanically between two principal currents of air flowing past each other, the so-called polar and equatorial currents ; or (2) they were due to the ascent of buoyant air while the heavier air flowed in beneath, the whirling motion being communicated by the influence of the rotation of the earth, or by the greater resistances on the one side or the other. In order to explain why hurricanes and typhoons exist continuously for many days, or even weeks, it is necessary that there should be a source of energy which would maintain a continued buoyancy and rising current at the centre, and this was supposed to be fully provided for by Espy's proof of the liberation of latent heat consequent on the formation of cloud and rain. To this latter consideration the present writer has added the even more important influence of the sun's heat intercepted at the upper surface of the cloud. At this stage of the investigation the whirl- wind was but an incident in the general circulation of the atmosphere, but further consideration showed that it ought rather to be regarded as an essential portion of that circulation, and that when temperature gradients and density gradients exceeded a certain limit the formation of gi-eat whirlwinds was inevitable. Therefore, an atmosphere containing several whirlwinds is just as truly a system of general circulation in the one case as an atmo- sphere without a whirlwind is in the other. The formation of rain, the evolution of latent heat, and even the absorption of heat at the upper surface of the cloud really constitute a normal general circulation in this special case.*~~

~~*In 1890 Professor Hann published a careful analysis of the actual temperature conditions prevailing over an extensive area of high pressure in Europe, and showed that the temperatures of the upper strata in both high and low areas, namely, in anti- cyclones and cyclones, are often directly contrary to those supposed to prevail by Espy and Ferrel. This study necessitated a more careful examination into the radiation of heat*~~

~~from the dust and moisture of the atmosphere, and the present writer seems to have shown that in areas of high pressure and clear weather a very slow descending movement throughout each horizontal layer gives time for the radiation of heat that will fully explain the anomalies of temperature. On the other hand, von Helmholtz in several memoirs of 1888-91 showed that waves or billows may be formed in the atmosphere of great extent at the dividing surface between upper and lower strata moving in different directions and with difl'erent velocities. Under specific conditions these billows may become like the breakers and caps of waves of the ocean when driven by the wind. The hypothesis that these aerial breakers correspond to our storms and troughs of low pressure experienced in the lower atmosphere is very plausible. As these billows are~~

~~theory]~~

~~formed between upper and lower air currents of great extent, which themselves represent a large portion of the horizontal circulation between the poles and the equator, it results that if von Helmholtz's suggestion and Hann's hypothesis are correct then our storms must be considered as essentially incidents in the general circula- tion rather than as caused by the vertical circulation over any locality. It must occur to every one to adopt the intermediate view that, on the one hand, the local vertical circulation, with its clouds, rain, hail, and snow, and evolution of latent heat, and, on the other, the waves and whirls in the general circulation, mutually contribute toward our storms and fair weather. It only remains to allot to each its proper importance in any special case.~~

~~Undoubtedly aerial billows, and the clouds that must frequently accompany them, exist everywhere in tlie earth's atmosphere. Perhaps their extent and importance are not properly appreciated. A voyage around the Atlantic Ocean in 1889-90, made by the writer, specifically to study cloud phenomena, revealed many remarkable cases, such as the cumulus rolls that extend in a remarkably symmetrical series from the~~

~~*island of Ascension westwards for a hundred miles in the south-easterly trades, or the delicate fields of cirro-cumuli that extend from the islands of Santa Lucia and Barbados for two hundred miles eastwards under favour- able conditions. The mixtures and vorticose motions going on within aerial billows to form these clouds have been interpreted by Brillouin ; but to a certain extent we must still agree with Ferrel, who could not accept the conclusion that the great storms, in which ascending currents and heavy rains are the most prominent features, depend to any extent on these phenomena of mixture, and therefore on the general circulation of the atmo- sphere.*~~

~~*Mathematicians have, almost without exception, assumed a so-called steady condition in the motion of the atmosphere in order to achieve a successful integration of the general equations of motion. The restrictions within which Helmholtz and others have worked, and the limits within which their results are to be accepted, have been analysed by Dr E. Herrmann in a memoir of which a translation is published in the bulletin of the American Mathematical Society for June 1896. Of course Herrmann's own investigation is also based upon certain simplifying hypotheses, such as the absence of outside disturbing forces and of viscosity and friction, a homogeneous ellipsoidal surface, and a uniform initial temperature and rate of revolution corresponding to an initial state of equilibrium. If now the initial static equilibrium be disturbed by introducing a different distribution of temperature, viz., one that varies with altitude and latitude, hut is uniform in longitude along any circle of latitude, then the first question is whether the atmosphere can settle down to a new state of static equilibrium. Herrmann shows that in general it cannot do so, but that the new state and the future states can only bo one of motion and dynamic equilibrium. If, however, there be no external forces acting on the atmosphere, then in one case static equilibrium relative to the earth can occur, namely, when the new temperatures are so dis- tributed in the atmosphere as to satisfy the equation*~~

~~*÷*~~

~~*pr' w d ■V=M,*~~

in addition to the ordinary equations of elasticity, inertia, and continuity previously given, and to those representing the boundary conditions, M being the total amount of inertia of the atmosphere relative to the axis of rotation. In general, the movements in the atmosphere must consist not only of an inter- change between the poles and the equator, but also of east and west motions, and there must therefore be a different rate of diurnal rotation for each stratum. The second step in this inquiry is, Can these movements become perfectly steady with this unvarying or steady distribution of temperature ? In other words. Can the temperature and the movements be so adjusted to each other that each shall remain invariable within any given zone of latitude ? The reply to this is, that the temperatures and the movements, if they are to become thus adjusted, must satisfy a certain differential equation which itself shows that steady motions and stationary temperatures cannot exist if there is any north or south component. Apart from the fact that Herrmann assumes no friction, it would seem that he has' proved that steady motions and stationary pressures cannot exist in the atmosphere over a homogeneous globe, and presumably the same result would follow for the irregular surface of the actual globe. The motions of the real atmospliere must therefore consist of irregularities and periodic oscillations superimposed upon more uniform, regular progressions, but never repeating themselves. Consequently, the conclusions deduced by those who have assumed that stationary conditions are possible must depart more or less from meteorological observations. There is a general impression that the belt of low pressure at the equator and the low areas at the poles and the high pressures under the tropics are pseudo-stationary, and really represent what would be steady conditions if we had an ideal smooth globe ; but Herrmann's researches show that the unsteadi-

ness observed to attach to these areas under existing conditions would also attach to them under ideal conditions. They really have and must have irregular motions, and we, by taking annual averages, obtain an ideal annual distribution of pressure, tempera- ture, and wind that does not represent any specific dynamic problem. The avera^'es represent what is considered proper in climatology, but are quite improper and misleading from a dynamic point of view, and have no simple logical connexion with each other.

~~*Closely connected with this study of steady motions under a constant supply and steady distribution of solar heat comes the further question as to whether regular seasonal variations in atmo- spheric pressure and wind can be produced by regular seasonal variations in the heat received from the sun ; for instance, a varia- tion in the earth's atmosphere corresponding to the periodic varia- tions of the solar spots. The general current of HIelmholtz's investigations seems to show that no periodic change in the earth's atmosphere can be maintained for any length of time by a given periodic influence outside of the atmosphere. On the other hand, it is barely possible that wave and vortex phenomena on the sun's surface may have the same periodicities as regular phenomena in the earth's atmosphere, so tliat there may be a parallelism without any direct connexion between the two.*~~

~~*An important paper on the application of hydrodynamics to the atmosphere is that by Professor V. Bjerknes, of Stockholm, Sweden, which was read in September 1899 at Munich, and is now published in English translation by the U.S. Weather Bureau. In this memoir Bjerknes applies certain fundamental theorems in fluid motion by HIelmholtz, Kelvin, and Silberstein, and others of his own discovery to the atmospheric circulation. HIe simplifies the hydrodynamic conceptions by dealing with density directly instead of temperature and pressure, and uses charts of "isosteres," or lines of equal density, very much as was proposed by the present writer in 1889 in his Preparatory Studies, where he utilized lines of equal buoyancy or "isostaths." Bjerknes has thus made it practicable to apply hydrodynamic principles in a simple manner without the necessity of integrating the equations, at least for many ordinary cases. HIe also gives a criterion by which we may judge between the physical theory of Espy and Ferrel, according to which cyclones are perpetually renewed, and the mechanical theory according to which the cyclone is simply carried along in the general atmospheric current. Bjerknes's paper is illustrated by another one due to Mr Sandstrom, of Stockholm, who has applied these methods to a storm of Septem- ber 1898 in the United States. Thefurtherdevelopment of Bjerknes's methods promises a decided advance in theoretical and practical meteorology. They are also applicable to the problems of oceanic circulation.*~~

~~*The Diurnal and Semi-diurnal Periodicities in Barometric Pressure. — For a long time attempts were made to explain the periodic variations of the barometer by a consideration of static conditions, but it is now evident that this problem, like that of the circulation of the atm.osphere, is a question of aerodynamics. A most extensive series of researches into the character of the phe- nomena from an observational point of view has been made by Dr Julius Hann, who has also given a summary of the present con- dition of our knowledge of the subject in the Met. Zeit. for 1898, which has been translated by Mr R. H. Scott in the Quarterly Journal of the Royal Meteorological Society for January 1899 (see also an important addition by Hann and Trabert in the Met. Zeit. for November 1899). Professor Hann has shown that at the earth's surface three regular periodic variations are established by observation, viz., the diurnal, semi-diurnal, and ter-diurnal. On the higher mountains these variations change tlieir character with altitude. (1) At the equator the diurnal variation is represented by the formula 0'30 mm. sin (5° + x), where x is the local hour angle of the sun. In higher latitudes either north or south the coefficient Ai = 0'30 mm. diminishes, but the phase angle, 5°, varies greatly, generally growing larger. It is therefore evident that this diurnal oscillation depends directly on the hour angle of the sun, and probably, therefore, principally on the amount of heat and vapour received by the atmosphere from the ocean and the ground at any locality and season of the year. It is apparently but little affected by the wind, but somewhat by altitude above sea ; the amplitude diminishes to zero at a certain elevation, and then re- appears and increases with the opposite sign ; the phase angle does not change. (2) Superimposed upon this diurnal oscillation is a larger semi-diurnal one, which goes through its maximum and minimum phases twice in the course of a civil day. 'The amplitude of this variation is largest in equatorial regions, and is expressed by the formula A2 = (0-988 mm. — 0-573 mm. sin "it>) cos ^ as given by Hann, or A2=(0-92 mm. — 0-495 sin » cos > as revised by Trabert. This amplitude also may be considered as variable along each zone of latitude having a maximum value on certain central local meridians. The times at which the semi-diurnal phases of maxi- mum and minimum occur are subject to laws different from those for the diurnal period. "Within the tropics the phase angle is 160°*~~

and at 50° N. it is 147°, and between these limits it seems to he the same over the whole globe, so that the phase does not depend clearly upon the hour angle of the sun or on the local time. The amplitudes appear to depend on the excess of land in the northern hemisphere as compared with the water and cloud of the southern hemisphere. The amplitude also varies during the year, being greatest at perihelion and least at aphelion. Plann suggests that this is an indirect effect of the sun's heat on the earth, as the northern hemisphere is hotter when the earth is in aphelion than is the southern hemisphere when the earth is in perihelion, owing to the preponderance of land in the north and water in the south. (3) The ter-diurnal oscillation has the approximate value shown by the formula 0-04 mm. sin (355°+ 3a;). The phase angle is sensibly the same .everywhere, and the amplitude varies slightly with the latitude. Both phase and amplitude have a pronounced annual period which is as remarkable as that of the semi-diurnal oscillation ; the maximum amplitude occurs in January in the northern hemispheijfe, and in July in the southern.

The dynamics and physics of the atmosphere have not yet been explored so exhaustively as to explain fully these three systematic barometric variations, but neither have we as yet any necessity for appealing to some unknown cosmic action as a possible cause of their existence. The action of the solar heat upon the illuminated hemisphere, and the many consequences that result therefrom, may be expected to explain the barometric periods. The variations of sunshine and cloud must inevitably produce periodic variations of temperature, moisturfe, pressure, and motion, whose exact laws we have not as yet fathomed. Among the many methods of action that have been studied or suggested in connexion with the barometric variations the most important of all is the so-called tidal wave of pressure due to temperature. Laplace applied his investigations on the tides- to the gravitational tide of the ocean, and when he passed to the corresponding solar and lunar gravitational tides of the atmo- sphere he was able to show that they must be inappreciable, unless, indeed,

~~*certain remarkable relations existed between the circum- ference of the earth and the depth of the atmosphere. As these relations do not exist, it is generally conceded as certain that the gravitational tides, both diurnal and semi-diurnal, cannot exceed a few thousandths of an inch of barometric pressure. On the other hand, the same process of mathematical reasoning enables us to investigate the action of the sun's heat in producing a wave of press- ure that has been called a pressural tide, due to the expansion of the lower layer of air on the illuminated half of the globe. The laws that must govern these pressural tides have been investigated by Kelvin, Eayleigh (Phil. May. February 1890), and especially by Margules (Vienna Sitz. Ber. 1890-93). The two latter have shown the truth of a proposition enunciated by Kelvin in 1882, without demonstration, to the effect that the free oscillation produced by a relatively small amount of tide-producing force will have an ampli- tude that is larger for the half-day term than for the whole-day term. They therefore explain the diurnal and semi-diurnal varia- tions of the barometric pressure as simple pressural tides or waves of expansion, originally produced by solar heat, but magnified by the relation between forced and free waves in an atmosphere on a globe having the specific dimensions of our own. The analytical processes by which Laplace and Kelvin arrived at this special solution of the tidal equation were objected to by Airy and Ferrei, but the matter has been, as we think, most fully cleared up by Dr G. H. Ling, in a memoir published in the Annals of Mathematics in 1896. He seems to have shown that, although a literally correct result was attained by Laplace, his methods were at fault from a rigorous and analytical point of view, at least in so far as they are presented in the Mecanique Celeste. The process by which a diurnal tempera- ture wave produces a semi-diurnal pressure oscillation, as explained by Eayleigh and Margules, may be stated as follows: The diurnal temperature wave having a twenty-four hours period is the gener- ating force of a diurnal pressure tide, which is essentially a forced and small oscillation. The natural period of the free waves in the atmosphere agrees much more nearly with twelve than with twenty- four hours. In so far as the forced and the free waves reinforce each other, the semi-diurnal waves are reinforced far more than the other, so that a very small semi-diurnal term in the temperature oscilla- tions will produce a pressure oscillation two or three times as large as the same term would in the*~~

~~diurnal period. These reinforce- meiits, however, depend upon the elastic pressure within the atmosphere, just as does the velocity of sound. If the prevailing barometric pressures were slightly increased, the adjustment of the twelve-hours free wave of pressure to the forced wave of temperature ?°?2 ^6 so perfect that the barometric wave would increase to an indefinite extent. For the actual temperatures the periodicity of the free wave is about thirteen hours, or somewhat longer than the forced wave of temperature, so that the barometric oscillation does not become excessive. It would seem that we have here a sugges- tion to the effect that if in past geological ages the average tem- perature at any time has been about 268° C. on the absolute scale, then the pressure waves could have been so large as to produce~~

~~remarkable and perhaps disastrous consequences, involving the loss of a portion of the atmosphere.~~

~~The Thermodynamics of a Moist Atmosphere. — The preceding section deals with an incompressible gas, and therefore with simple, pure hydrodynamics. If now we introduce the conception of an atmosphere of compressible gas, whose density increases with altitude, so that rising and falling currents change their tempera- tures by reason of the expansion and compression of the masses of air, we take the first step in the combination of thermodynamic and hydrodynamic conditions. If we next introduce moisture, and take precipitation into consideration, we pass to the difficult prob- lems of cloud and rain that correspond more nearly to those which actually occur in meteorology. This combination has been eluci- dated by the works of Espy and Ferrei in America, Kelvin in England, Hann in Austria, but especially by Hertz, Helmholtz, and von Bezold in Germany, and by Brillouin in France. A most complete study of the subject will be found in Prof. Bigelow's report on the cloud work of the U.S. Weather Bureau.~~

~~The proper treatment of this subject began with the memoir of Kelvin on convective equilibrium (see Trans. Manchester Phil. Soc. 1861). The most convenient method of dealing approximately with the problems is graphic and numerical rather than analytical, and in this field the pioneer work was done by Hertz, who pub- lished his diagram for adiabatic changes in~~

~~*the atmosphere in the Met. Zeit. in 1884. He considers the adiabatic changes of a kilo- gram of mixed air and aqueous vapour, the proportional weights of each being X and /i respectively. In a subsequent elaborate treats ment of the same subject by von Bezold in four memoirs published during 1889 and 1899, the formulse and methods are arranged so as to deal easily with the ordinary cases of nature which are not adiabatic ; he therefore prepares diagrams and tables to illustrate the changes going on in a unit mass of dry air to which has been added a small quantity of aqueous vapour, which, of course, may vary to any extent. Both Hertz and von Bezold consider separately four stages or conditions of atmosphere : — (A) The dry stage, where aqueous vapour to a limited extent only is mixed with the dry air. (B) The rain stage, where both saturated vapour and liquid par- ticles are simultaneously present. (C) The hail stage, where satu- rated aqueous vapour, and water, and ice are all three present. (D) The snow stage, where ice vapour and snow itself, or crystals of ice, are present. The expressions aqueous vapour and ice vapour do not occur in Hertz's article, but are now necessary, since Marvin, Fischer, and Juhlin have been able to show that vapour from water and vapour from ice exert different elastic pressures, and must therefore represent different modifications of liquid water. Accord- ing to Hertz, we may easily follow this mass of moist air as it rises in the atmosphere, if by expansion it cools adiabaticaUy so as to go successively through the four preceduig stages. For a few thou- sand feet it remains dry air. It then becomes cloudy and enters the second stage. Next it rises higher until the cloudy particles begin to freeze into snow, sleet, or hail, which characterizes the third stage. When the hail has fallen and the remainder of the cloud has ascended higher, it contains only ice particles and the vapour of ice, a condition which characterizes the fourth or snow stage. If in this condition we give it plenty of time the precipitated ice or snow may settle down, and the cloudy air, becoming clear, return to the first stage ; but the ordinary process in nature is a circula- tion by which both the cloud and the air descend together slowly, warming up as they descend, so that eventually the mixture returns to the first stage at some level lower than the clouds, though higher than the starting point.*~~

~~*The exact study of the ordinary non-adiabatic process must be carried out by the help of Prof. Bigelow's tables, but the approxi- mate adiabatic*~~

~~*study is so helpful that in Fig. 10 we have traced a few lines from Hertz's diagram sufficient to illustrate its use and con- venience. The reader will perceive a horizontal line at the base representing sea-level; near the middle of this line is zero centigrade ; as we ascend above this line into the upper regions of the air we come under lower pressures, which are shown by the figures on the left-hand side. The scale of pressures is logarithmic, so that the corresponding altitudes would be a scale of equal parts. The temperature and pressure at any height in the atmosphere are shown by this diagram. If the air is saturated at a given tem- perature, then the unit volume can contain only a definite num- ber of grams of water, and this condition is represented by a set of moisture lines, indicated by short dashes, showing the tem- perature and pressure under which 5, 10, or 20 grams of water may be contained in the saturated air. Let us now suppose that we are following the behaviour of a kilogram mass of air rising from near sea-level, where it has a pressure of 750 millimetres, a temperature of 27° C, and a relative humidity of 50 per cent. A pointer pressing down upon the diagram at 750 millimetres and 27° C. will represent this initial condition. A line drawn through that point parallel to the moisture lines will show that if this air were saturated it could contain about 22 grams of water; but inasmuch as the relative humidity is only 50 per cent., therefore it*~~

~~*theory]*~~

~~*actually contains only 11 grams of water, and an auxiliary moisture line may be drawn for this amount. If now the mass rises and cools by expansion, the relation between pressure and temperature will be shown by the line a a. When this line intersects the inclined moisture line for 11 grams of water we know that the rising mass has cooled to saturation, and this occurs when the press- ure is about 640 millimetres and the temperature 13·2° C. By further rise and expansion a steady condensation continues, but by reason of the latent heat evolved the rate of cooling is diminished and follows the line /3 /3. The condensed vapour or cloud particles are here supposed to be carried up with the cooling air,*~~

~~*but the temperature of freezing or zero degrees centigrade is soon attained — as the diagram shows — when the pressure is about 472 milli- metres. At this point the special evolution of latent heat of freez- ing comes into play ; and although the air rises higher and more moisture is condensed, the temperature does not fall because the water already converted into vapour and now becoming ice is giving out latent heat sufficient to counteract the cooling due to expansion. This Illustration from Hertz's diagram therefore shows that the curve for cooling temperature coincides with the vertical line for freezing, and is represented on the diagram by the short piece p y. By this expansion due to ascent the volume is increased while the temperature is not changed ; therefore, the quantity of aqueous*~~

~~*m*~~

~~+~~

~~+ + +~~

~~+ + + "■ ^ ^ -v — ^~~

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~~*Fie. 10.— Diagram for Graphic Method of following AdiabaHc Changes. (^After Hertz.)*~~

~~*vapour has increased. When the ascending mass has reached the level where the pressure is 463 millimetres it has also reached the moisture line that represents this increase in aqueous vapour. As this shows that the aqueous particles havenowall been frozen, and as the air is now*~~

~~*continuously rising, while its temperature is always below freezing-point, therefore at levels above this point the vapour that con- denses from the air is supposed to pass directly over into the condi- tion of solid ice. Therefore from this point onwards the falling temperatures follow along the line y y, and continue along it indefi- nitely. From these considerations it follows that the clouds above the altitude of freezing temperatures are essentially snow crystals, and if the air rises slowly there may be time for the water and ice to settle down towards the ground ; in this case the quantity of snow left within the clouds must be very small, and the cloud has the del- icate appearance peculiar to cirrus. Hertz's original diagram is quite covered by these systems of o, /3, 7, and S lines, and the moisture lines. The lines show the density of the moist air at any stage of the pro- cess. An improved diagram by Neuhoff was published in 1900.*~~

~~*In von Bezold's treatment of this subject only illustrative dia- grams are published, because the accurate figures, drawn to scale, are necessarily too large and detailed. He presents graphically the exact explanation of the cooling by expansion, the loss of both mass and heat by the rainfall and snowfall, and the warmth of the*~~

~~*remaining air when it descends as foehn winds in Switzerland and Chinook winds in Montana. Even in the neighbourhood of a storm, and over low lands and the ocean, the warm moist air in front, after being carried up to the rain or snow stage, descends drier and warmer on the opposite side of the central low pressure. In order to have a convenient term expressive of the fact that two masses of air in different portions of the atmosphere having different pressures, temperatures, and moistures, would, if brought to the same pressure, also necessarily attain the same temperature, von Bezold introduced the expression "potential temperature," and devised a simple dia- gram by which the potential temperature may be determined for any mass of air whose present temperature, pressure, and moisture are known. In an ascendingmass of air, from the beginning of the condensation onwards, the potential temperature steadily increases by reason of the loss of moisture, but in a descending mass of air it remains constant at the maximum value attained by it at the highest point of its previous path. In general the*~~

~~*potential temper- atures of the upper strata of the atmosphere are higher than of the lower. In general the so-called vertical temperature gradient is smaller than would correspond to the adiabatic rate for the dry stage. This latter gradient is 0-993° C. per hundred metres for the dry stage, but the actual atmospheric observations give about 0-6°. Apparently this difference represents primarily the latent heat evolved by the condensation of vapour as it is carried into the upper layers, but it also denotes in part the effect of the radiant heat directly retained in the atmosphere by the action of the dust and the sur- faces of the clouds. Passing from simple changes due to ascent and descent, von Bezold next investigated the results of the mixture of different masses of air, having different temperatures and humidi- ties, or different potential temperatures. The importance of such mixtures was exaggerated by Hutton, while that of thermodynamic processes was maintained by Espy, but the relative significance of the two was first clearly shown by Hann as far as it relates to the formation of rain, and further details have been considered by von Bezold. The practical tables contained in Prof. Bigelow's report on clouds complete our methods of studying this subject.*~~

~~*A most important application of the views of von Bezold, Hertz, and Helmholtz was published by Brillouin in his memoir of 1898. Just as we have learned that the motions of the atmosphere are not due either to the general distribution of heat or to local infiu- enoes exclusively, but in part to each, and just as we have learned that the temperature of the air is not due either to radiation and absorption or to dynamic processes exclusively, but to both com- bined, so in the phenomena of rain and cloud the precipitation is not always due to the cooling by mixture, or to the cooling by ex- pansion, or to radiation, but is in general a complex result of all. The effect of the evaporation of cloudy particles in the production of descending cold currents has always been understood in a general way, but was first brought to prominence by Espy in 1838, and perhaps equally forcibly by Faye in 1875. Helmholtz, in his memoirs on billows in the atmosphere, showed how contiguous currents may interact on each other and mix together at their boundary surface ; but Brillouin explains how these mixtures produce cloud and rain — not heavy rains, of course, but light showers, and spits of snow and possibly hail. He says : " When the layers of clear or cloudy air are contiguous, but moving with*~~

very different velocities, their motion, relative to the earth because of the rotation of our globe, assumes a much more complicated character than that which obtains when the air has no horizontal but only a vertical motion. We know in a general manner what apparent auxiliary forces must be introduced in order to taie into account this rotation, and numerous meteorologists have published important works on the subject since the first memoirs by Ferrel. But their points of view have been very different from mine. The subjects that I desire to study are the surfaces of discontinuity as to velocity, temperature, and cloudiness in one special case only. Analytical methods permit us to resolve complex questions only for limited areas in longitude and for contiguous zones within which the movements are steady, but not necessarily uniform nor parallel. But it is evident that one can learn much as to the con- dition of permanence or destruction of annular zones having uni- form and parallel movements. Thus simplified, the questions can be treated by elementary geometric methods, by means of which we at once rediscover and complete the results given by Helmholtz for zones of clear air and discover a whole series of new results for zones of cloudy air. ‘ ‘ Among Brillouin's results are the following theorems : —

A. If the atmosphere be divided into narrow zonal rings, each extending completely around the globe, thus covering a narrow zone of latitude, and if each is within itself in convective equilibrium so that the surfaces of equal pressure shall be surfaces of revolution around the axis of rotation, then within any such complete ring in convective equilibrium the angular velocity of any particle of the ajr will vary in inverse ratio of the square of its distance from the axis of rotation, or ar^ is constant ; that is to say, the air will not move like a rotating solid, but will have a variable angular velocity, smaller far from the axis and greater near to it.

~~*B. The surfaces of equal pressure are more concave towards the centre than is the surface of the globe Itself, and they are tangent to the latter only along the parallel where calms prevail.*~~

~~*C. A heavy gaseous atmosphere resting upon a rotating friction- less globe divides itself into concentric rings whose angular move- ments increase as we pass from the polar region towards the equato- rial ring ; the central globe rotates more rapidly than the equatorial atmospheric ring.*~~

~~*D. The surface of separation between two contiguous concentric rings must be such that the atmospheric pressure shall have the same value as one approaches this surface from either direction, and the surface of separation is stable if the differences of pressure in diiferent parts of this surface are directed towards the surface of equilibrium. As the distribution of pressure along a line parallel to the axis of rotation is independent of the velocity of rotation, the ordinary condition of stability, viz., that the gas of which the lower ring is composed shall be denser than that above, will hold good for this line. In general, any inclination of the surface of separation to the horizon amounting to 10° must be associated with very small differences of density and large differences of velocity ; in practice the inclinations are far less than 10°.*~~

~~*E. If the surfaces of equal pressure or isobars are nearly horizon- tal, as in ordinary cases, the calculations are comparatively easy to make. Let the inclination of the isobaric surface ascending to- wards the pole be tj> ; let hi be a distance counted along the axis of the earth, and II\ the distance measured in the direction of the attraction of gravity ; then the angle of inclination of the isobaric surface is given by the equation*~~

~~*tang. 0 =* ■~~

~~*Hi — Ai sinX*~~

~~*hi cos X*~~

~~*where X is the complement of the angle between the direction of gravity and the line drawn to the poles, or the axis of rotation of the earth. The*~~

~~*surface of separation is that over which the pres- sure is the same in two contiguous masses or zones, and is identical with a vertical plane only when the densities and velocities in the two layers have certain specific relations to each other. It can never lie between the isobaric surfaces that Brillouin de- signates as 1 and 2. In order that the equilibrium may be stable, it is necessary that when ascending In the atmosphere along a line parallel to the polar axis one should traverse layers of diminishing density. In the midst of any zone there cannot exist another zone of limited altitude ; it must extend upwards indefinitely. Whenever there is any zone of limited altitude it must necessarily have, near its highest or lowest point, an edge by which it is attached to the surface of separation of two other neighbouring zones. In other words, the surfaces of separation of the three zones, of which one is limited and the other two are indefinite, must all run together at a common point or edge, very much as in the problem of the equilibrium of thin films.*~~

~~*F. When the contiguous zones are cloudless the mixtures take place under the following conditions : — Starting from the stable conditions, the cloudless mixture ascends on the polar side when the west wind which prevails on the equatorial side of the surface of separation is warmer, but descends between the pole and the equatorial side of the horizon when the west wind which prevails on the equatorial side of the surface of separation is colder. The mixtures of cloudless air rapidly occupy the whole height of the two layers that are mixing. When they form along a surface that becomes unstable the whirlwind that is thus engendered is sensibly cylindrical at first, but finally becomes extremely conical. This whirlwind may be limited as to height when the two contiguous masses that are mixing are surmounted by a third clear or cloudy layer which Intersects the other two and whose lower surface is stable. (Brillouin suggests that possibly this corresponds to the formation of water-spouts and tornadoes.)*~~

~~*G. When the contiguous zones are cloudy and the mixtures produce decided condensations, and sometimes even precipi- tation, the study of these must follow closely in the train of thought followed out by von Bezold. When the contiguous winds are feeble, but the temperatures are very different and the zones are near the equator, then the position of the*~~

~~*mixture can be inverted by con- densation, since the influence of difference of pressure becomes predominant. At the equator, whatever may be the difference of temperature, a mixture that is accompanied by condensation always rises if the surface of separation is stable. The condeusan tion increases by the expansion, each zone of mixture being an outburst of ascending cumuli. At the equator, whatever may be the difference of temperature, a mixture accompanied by con- densation always descends when the surface of separation is unstable ; moreover, the adiabatic compression rapidly evaporates the mixture.*~~

~~*In the last three chapters of his memoir, Brillouin applies these*~~

~~*principles and other details to almost every observed variety of mixtures due to the pressure of one current of air against another. Fig. 11, prepared for the U.8. Monthly Weather Beview, October 1897, gives five of the cases elucidated by Brillouin. In each of these the left-hand side of the diagram is the polar side, the air being cold above and the wind from the east, while the right-hand side is the equatorial side, the air being warm above and the wind from the west. The reader will see that in each case, depending on the relative temperatures and winds, layers of cloud are formed of marked individuality. As none of these clouds appear in the International Cloud Atlas or the various systems of notation for clouds, one is all the more impressed with the importance of their study and the success with which Brillouin has opened up the way for future investigators. " We have no longer to do with personal and local experience, but with an analytical description of a small number of characteristics easy to comprehend and applicable at every locality throughout the globe."*~~

~~*The Formation of Bain.- — Not only has dynamic meteorology made the progress delineated in the previous sections, but one of the most important questions in molecular physics is in rapid process of being cleared up. The formation of rain, from a physical point of view, is the ultimate step in the formation of cloud. The cloud consists, like fog, of extremely small particles, so light that they float indefinitely in the air ; rain and snow represent those particles that have grown to be too large and heavy to be any longer sus- tained by the air — that is to say, their*~~

~~*rate of fall through the air is greater than the ascending component of the air in which they float. The process by which such larger rain-drops are formed out of the lighter particles that constitute a cloud has not yet been satisfactorily explained. It is probable that either one of several processes contributes to bring about this result, and that in some cases all of these conspire together. The following paragraphs represent the hypotheses that have marked the gradual progress of our knowledge : —*~~

~~*A. Cloud particles may be driven together by the motions im- parted to them by the wind, and may thus mechanically unite*~~

~~*Light Rain. Very Cold*~~

~~*Gusty*~~

~~*Very Warm Wave*~~

~~*Fig. ll.—Diagram illustrating Clouds due to Mixture. (^Affer BriUmiin.)*~~

~~*into larger ones, which, as they descend more rapidly, overtake the smaller ones and grow into rain-drops.*~~

~~*B. The particles on the upper boundary of a cloud may at night- time, or in the shade, cool more decidedly than their neighbours below them, either by radiation or by mixture ; then the air in their immediate vicinity becomes correspondingly cold, the par- ticles and their envelopes of cold air sink more rapidly, overtaking and therefore uniting with other particles until the large rain-drops are formed.*~~

~~*C. Some cloud particles may be supposed to be electrified posi- tively and others negatively, causing them to attract each other and run together into larger ones, or, again, some may be neutral and others charged, which may also bring about attraction and union.*~~

~~*D. When any violent agitation of the air, such as the sound*~~

~~*OKGANIZATIONS]*~~

~~*METEOROLOGY*~~

~~waves due to thunder, or cannonading, or other erplosions, sets the particles in motion, they may be driven together until brought into contact, and united into larger drops.~~

~~E. The air — or, properly speaking, the vapour — ^between cloudy particles, that is to say, within fog or cloud, is generally in a state of supersaturation ; but if it is steadily rising to higher altitudes, thereby expanding and cooling, the supersaturation must increase steadily until it reaches a degree at which the molecular strain gives way, and a sudden violent condensation takes place, in which process both the vapour and the cloud particles within a compara- tively large sphere are instantaneously gathered into a large drop. The electricity that may be developed in this process may give rise to the lightning flash, instead of the reverse process described in the preceding paragraphs (C and D), by which the lightning and the thunder either change the electrical conditions or cause noises and concussions that lead to the formation of rain.~~

~~F. However plausible the preceding five hypotheses have seemed to be, it must be confessed that no one has ever yet observed pre- cipitation actually formed by these processes. The laborious obser- vations of Mr C. T. R. Wilson of Cambridge, England, probably give us our first correct idea as to the molecular processes involved in the formation of rain. After having followed up the methods inaugurated by Aitkeu showing that the particles of dust floating in the air, no matter of what they may be composed, become by pre- ference the nuclei upon which the moisture begins to condense when air is cooled by expansion, Wilson then showed that in absolutely dustless air, having therefore no nuclei to facilitate condensation, the latter could only occur when the air is cooled to a much greater extent than in the case of the presence of dust ; in fact, dustless air requires to be expanded more than dusty air in the ratio of 4 to 3, or 1 J times more. The amount of this larger expansion may vary some- what with the temperature, the moisture, and the gases. More re- markable still, he showed that dustless air, having no visible or probable nuclei, acquired such nuclei when a beam of ultra-violet light, or of the Rontgen rays, or~~

~~*the uranium radiation, or of ordi- nary sunlight (which possibly contains all of these radiations), was allowed to pass through the moist air in his experimental tube. In other words, these rays produce a change In the mixed gas and va- pour similar to the formation of nuclei, and condensation of aqueous vapour takes place upon these invisible nuclei as readily as upon the visible dust nuclei. Further, the presence of certain metals within the experimental tube also produces nuclei ; but the amount of expansion, and therefore of cooling, required to produce conden- sation upon these metallic nuclei is rather larger than in the case of dust nuclei. The nuclei thrown into the experimental tube by the discharge of electricity from a pointed metal wire produced very' dense fogs by means of expansions slightly exceeding those required for ordinary dust. Finally, Wilson has been able to show that when dust particles are electrified negatively their tendency to condense vapour upon themselves as nuclei is much greater than when they are electrified positively, and he suggests that the descent of the rain-drops to the ground, carrying negative electricity from the atmosphere to the earth, may perhaps explain the negative charge of the earth and the positive electricity of the atmosphere.*~~

~~*At this point we come into contact with the views developed by J. J. Thomson as to the nature of electricity and the presence of negative and positive nuclei in the atmosphere. According to him, " The molecules made up of what chemists call atoms must be still further subdivided, and the atoms must be conceived as made up of corpuscles ; the mass of a corpuscle is the same as the mass of the negative ion in a gas at low pressure. In the normal atom this assemblage of corpuscles forms a system which is electrical and neutral. Though the individual corpuscles behave like negative ions, yet when they are assembled in a neutral atom the negative effect is balanced by something which causes the space through which the corpuscles are spread to act as if it had a charge of positive elec- tricity equal in amount to the sum of the negative charges on the corpuscles. I regard electrification of a gas as due to the splitting up of some of the atoms of the gas, resulting in the detachment of a corpuscle from such atoms. The detached corpuscles behave like negative ions, each carrying a constant negative charge which we shall call the unit charge, while the part of the atom left behind behaves like a positive ion with the units positively charged, but with a mass that is large*~~

compared with that of the negative ion. In a case of the ionization of the gas by Rontgen or uranium rays, the evidence seems to be in favour of the view that not more than one corpuscle can be detached from any one atom. Now the ions by virtue of their negative charges act as nuclei around which drops of water condense when moist dust-free gas is suddenly expanded. . . . Mr C. T. R. Wilson has shown that it requires a considerably greater expansion to produce a cloud in dustfree air on positive ions than on negative ones, when the ions are produced by Rontgen rays." It would therefore appear that the moist atmosphere above us may, through the action of sunlight, as well as by other means, become ionized. The negative ions attract moisture to themselves more readily than the positive ; they grow to be larger drops, and

descending to the earth with their negative charges give it negative electricity, while the atmosphere is left essentially either positive or neutral. (See also Atmospheric Electkicity.)

Meteorological Organizations.

During the latter half of the 19th century the prosecu- tion of work in meteorology gradually passed out of the hands of individuals into the control of large national organizations. This was the natural result of the dis- covery that, by the spread of the electric telegraph and ocean cables, it had become possible to compile daily weather maps for large portions of the globe and make predictions of the weather and the storms for a day or two in advance, of sufficient accuracy to be of the greatest importance to the material interests of civilized nations. One by one every civilized nation has established either a weather bureau or a meteorological oflB.ce, or a bureau of hydrography and marine meteorology, according as its special interests demanded. These governmental bureaux usually pursue both climatology and theoretical meteo- rology in addition to their daily practical work of tele- graphy, forecasting, and publication of charts. Although, of course, in most cases, the so-called practical work ab- sorbs the greater part of the labour and the funds, yet everywhere it is recognized that research and the devel- opment of a correct theory of the motions of the atmos- phere are essential to any important progress in the art of forecasting. Among other important works in which the oflScial

~~weather bureaux have united, we may enumerate the International Meteorological Congresses, of which the first was held in 1853 at Brussels, the second in 1873 at Vienna, and others more frequently since that date ; the establishment of an International Committee, to which questions of general interest are referred ; the organization of a systematic exploration of the polar regions in the years 1882 and 1883 ; the general extension of the meteorological service to include terres- trial magnetism as an essential part of the physics of the globe ; the systematic exploration of the upper atmosphere by means of kites and balloons ; and the general co-operation with the U.S. Weather Bureau in the contribution of data for its international bulletin and its daily map of the whole northern hemisphere. The hydrographic oflBces and marine bureaux of the principal commercial nations have united so far as practicable in the daily charting of the weather, but have especially developed the study of the climatology of the ocean, not only along the lines laid down by Maury and the Brus- sels Conference of 1853, but also with special reference to the tracks of storm centres and the laws of storms on the ocean. The present condition of these govern- mental organizations is well presented in the > annual address of the Hon. ~F. Campbell Bayard, delivered before the Eoyal Meteorological Society of London in January 1899, and in the text accompanying Bartholomew's Physical Atlas, vol. iii.~~

~~The development of meteorology, in both its scientific and its practical aspects, is intimately dependent upon the progress of our knowledge of physics, and its study offers innumerable problems that can be solved by proper com- binations of mathematical theory and laboratory experi- mentation. The professors in colleges and universities who have hitherto lectured on this subject have not failed to develop some features of dynamic meteorology, although most of their attention has been given to climatology. In fact, many of them have been engrossed in the study of general problems in molecular physics, and could give meteorology only a small part of their attention. The early text-books on meteorology were frequently mere chapters or sections of general treatises on physics or chemistry. The most prominent early cases of university professorships almost wholly devoted to meteorology are~~

~~*those of the eminent Prof. Quetelet at Brussels and Prof. Kaemtz at Dorpat, Eussia. In modern times we may point to Prof, von Bezold at Berlin, Prof. Hann at Vienna and Gratz, Prof. Pernter at Linz and Vienna, Prof. Woeikof at St Petersburg, Profs. Hildebrandsson at Upsala, Mohn at Christiania, Loomis at New Haven, and Davis and Ward at Cambridge, Mass. W^*^ *^^^^ and a few other exceptions, the great universities of the world have as yet given but little special encouragement to meteorology ; it has even been stated that there is no great demand for higher education on the subject. On the other hand, the existence of thousands of voluntary observers, the profound interest in the weather actually taken by every individual, and the numerous schemes for utilizing our very limited knowledge of the science through the activities of the large weather bureaux of the world demonstrate that there is a demand for knowledge perhaps even higher than the universities can offer. It would be very creditable to a nation or to a wealthy patron of science if there should be established meteorological laboratories in connexion with several important universities, at which not only instruction but especially investigation might be pursued, as is done at the magnificent astronomical observatories that are to be counted by hundreds throughout the world. The great difBculties inherent in meteorology should stimulate the devotion of the highest talent to the progress of this branch of science. The practical value of weather predictions justifies the expenditure of money and labour in order to improve them in every detail. (c. a.)*~~

~~*Method of Differences. See Interpolation.*~~

~~*Methodism. — Since 1882 there have been two Methodist movements of world-wide importance : the "Forward Movement," and Methodist Eeunion. The forward movement originated in the fact that sanctuaries in the crowded centres of modern cities were being gradu- ally abandoned, while the majority of the people were outside all churches. The problem was solved in Man- chester, where an almost abandoned sanctuary was recon- structed and immediately filled. The Manchester example has been followed in London, Leeds, Birmingham, Hull, Glasgow, and Edinburgh,*~~

~~*and will be followed in the principal cities in the United Kingdom. The agencies are adapted to the actual human environment, great*~~

~~*variety of method exists, and marked features of the work are the combination of social enterprises with indi- vidual evangelism, and the organization of sisterhoods. The second notable movement is the growing tendency towards the reunion of the various Methodist churches. The true inwardness of the terrible struggles which so greatly injured British Methodism in the first half of the 19th century had never been clearly stated to the public until 1898, when Dr Benjamin Gregory published Side Lights on the Conflicts of Methodism (Cassell and Co.), which must determine t^he attitude of all future historians of Methodism. The possibility of such conflicts has now passed away. In 1878 laymen were admitted into the Conference, and from that time have taken an equal share in the settlement of all questions of " policy and finance." By the wish of the laymen themselves, doctrinal issues, the appointment of ministers, and all questions of disci- pline are left to the pastoral session. After much further controversy, it was resolved in 1900 that the representa- tive session should henceforth meet before the pastoral session, and also be enlarged to 300 ministers and 300 laymen. This growing liberalism of the parent Confer- ence has brought Methodist reunion, even at home, within the range of possibility. In Canada all branches of Methodism have been united. A similar movement is being consummated throughout Australasia. The British and American Methodist Churches in Germany, Switzer- land, Austria, and Hungary have also been united. The day is evidently not very far distant when Great Britain will follow the example of her colonies. The present ideal of most enlightened Methodists is one Methodist Church in every country, and an oecumenical conference every ten years to bind them all together. Three such conferences have already been held : in London in 1881, in Washing- ton in 1891, and in London in 1901. The quadrennial general conference of the Methodist Episcopal Church in 1900 reached three ecclesiastical decisions of importance — lor the future there will be an equal number of ministerial and lay representatives, the time limit has been abolished, and women as well as men may be elected lay repre- sentatives. The most authentic available statistics of Methodism are those presented to the second oecumeni- cal conference in Washington in 1891.*~~

~~*A special sta- tistical committee collected the facts from all Methodist Churches throughout the world. The following is a summary : —*~~

~~*Summary of Geographical Distribution.*~~

~~*Continents.*~~

~~*Ministers.*~~

~~*Local Preachers.*~~

~~*Churches.*~~

~~*other*~~

~~*Preaching*~~

~~*Places.*~~

~~*Members.*~~

~~*Sunday Schools.*~~

~~*Sunday*~~

~~*School*~~

~~*Teachers.*~~

~~*Sunday*~~

~~*School*~~

~~*Scholars.*~~

~~*Adherents.*~~

~~*4,212,601*~~

~~*118,968*~~

~~*295,376*~~

~~*19,784,293*~~

~~*488,183*~~

~~*Europe*~~

~~*Asia*~~

~~*Africa*~~

~~*America (see also below) Australasia and Polynesia*~~

~~*Total for churches represented at the Conference as far as reported ....*~~

~~*4,488*~~

~~*602*~~

~~*365*~~

~~*39,042*~~

~~*786*~~

~~*39,748 356*~~

~~*2,146 51,578*~~

~~*6,375*~~

~~*16,584 326 671*~~

~~*67,466 3,250*~~

~~*3503*~~

~~*34*~~

~~*1264*~~

~~*2138*~~

~~*916,896*~~

~~*36,314*~~

~~*77,234*~~

~~*5,382,375*~~

~~*93,140*~~

~~*14,405 282 450*~~

~~*62,323*~~

~~*3,828*~~

~~*243,748 1,944*~~

~~*2,669*~~

~~*593,246*~~

~~*19,785*~~

~~*1,781,612 47,430 28,267*~~

~~*4,579,639 197,314*~~

~~*45,283*~~

~~*99,203*~~

~~*77,106*~~

~~*6939*~~

~~6,503,959~~

~~81,288~~

~~861,392~~

~~6,634,162~~

~~24,899,421~~

~~As the advance during the decade 1880 to 1890 amounted to 30 per cent., and as the ratio of growth continually increases, the total number of Methodist adherents throughout the world must in 1900 have ex- ceeded thirty millions. (h. p. h.)~~

~~United States. — The first oecumenical Methodist Con- ference, held in London in 1881, greatlj— broadened the views of its members, and especially increased the spirit of fraternity among American Methodists. This found expression in the centennial Methodist Conference, which in 1884 celebrated the one hundredth anniversary of the~~

~~organization of American Methodism into a church. The second oecumenical Conference, in Washington in 1891, equalled its predecessor in influence and interest. These events materially modified the extent and form of the development of American Methodism. The spirit of fraternity has been illustrated and increased by the estab- lishment of the Epworth League, which was formed in May 1889 by representatives of five of the largest Young People's societies in the Methodist Episcopal Church, and has spread to other Methodist denominations until there are 1,860,000 members. The Woman's Home Missionary Society, which was formed in 1881, has greatly increased~~

~~its membersliip, enlarged its revenue, and expanded its work. In the conduct of a training-school in Chicago the need of a deaconess was felt;~~

~~*the office had been introduced into the Methodist Church in Germany ; and memorials from the Conference, including Chicago and other cities near it, were sent to the general Conference asking for the authorization of deaconesses. These memoiaals were greatly reinforced by a similar memorial from Bengal in India, showing the imperative necessity of deaconesses to the highest success of the mission. Pro- vision was made for their establishment in 1888. The same institution has been established in other Methodist denominations, especially in the Methodist Episcopal Church, South, and with it are connected prosperous hospitals ; and generous bequests and benefactions have been made to that class of institutions which also exist independently. Philanthropic institutions, such as orphan asylums, children's homes, and homes for the aged, have relatively absorbed a large part of the energies and bene- ficence of Methodism, particularly of its women. The first Methodist Episcopal hospital in American Methodism, founded some years before, was opened in 1886 in Brook- lyn, and the next in Philadelphia in 1892. So rapidly has this movement spread that there are more than thirty general hospitals under Methodist auspices.*~~

~~*The Methodist Episcopal Church, South, established equal min- isterial and lay representation in 1866, in the general Conference, and lay representation in the annual Conference, in the proportion of four for each presiding elder's district. The Methodist Episcopal Church in 1872 introduced lay representation, limiting the number of laymen to one for each Conference having but one ministerial delegate, and in all other Conferences to two, whatever the number of ministerial delegates. From time to time efforts have been made to remove this limitation so as to make the representation equal. This involved a change in the constitution, which can be accom- plished only by a vote of three-quarters of the members of the annual Conferences and a two-thirds vote of the general Conference. The first condition having been complied with by the ministers, and the second by the general Conference in May 1900, the restrictive rule was altered, and laymen, selected to be in readiness, were admitted to seats. The Methodist Episcopal Church, South, has largely in- creased its contributions for missions, for Church extension, and for denominational education. Since the overthrow of Spanish rule in Cuba it has established a mission in that island, and in the spring of 1900 had a*~~

~~*number of workers in the field. The contributions for missions of the Methodist Episcopal Church have increased since 1884 from |813,269 per annum to |1,864,325 in 1901, and its missions, in number of societies and members, in proportion. The missionary enterprises of all Methodist denominations in nearly all pagan lands have prospered, prejudices melting away and converts becoming so numerous as to outrun the provisions for their training and organiza- tion. The Woman's Foreign Missionary Societies have contributed in very large measure to these results. In the Methodist Episcopal Church a controversy has prevailed on the eligibility of women to membership in the general Conference. Several in 1888 and 1896 appeared with credentials in due form ; thus far the question is unset- tled, some opposing on principle and expediency, more on the ground that the constitution must first be changed. Two ineffectual efforts have been made to do this. The constitution of the Methodist Epis- copal Church has been entirely revised since 1900, and women are now eligible to seats in the general Conference. The changes made in the polity of the Methodist Episcopal Church, South, in 1866, were so radical that there has been no disposition since, or at most no wide- spread desire, to do more. Occasionally a few, who meet with little support, advocate the abolition of the life tenure of the bishops, or propose radical modifications in the presiding eldership. The Metho- dist Protestant Church, the largest non-episcopal body, is constantly raising the standard of its ministerial qualifications and the grade of its preparatory schools and colleges. It has revised its hymnal and its discipline, restricted its church boards, and has had the satisfac- tion of seeing lay representation (the chief reform advocated by its founders) adopted by those who rejected their propositions. At the general Conference of 1884 the rule limiting a continuous pastorate to five years was abolished, and a rule adopted giving each annual Con- ference authority to decide for itself whether there should be any limit, or, if any, what it shall be. The overture sent down to the Con- ferences authorizing the ordination of women to the ministry, after much discussion and agitation, was rejected. The Wesleyan Metho- dist body, formed in 1843, though small, has a strong denomina- tional spirit, and is true to its fundamental and somewhat exclusive*~~

~~*principles. These were tested in 1895, when the Church refused to modify the rules relating to secret societies, dress, and furniture, though an important Conference threatened disloyalty if it was not done. They declared that on this question as a unit they would survive or perish, and decided that, however few the members that adhered to a Church in case of a rebellion, they should constitute the Church and hold the Church property.*~~

~~*The African Methodist Episcopal Church has extended its mis- sions into British, French, and Dutch Guiana, Trinidad, St Thomas, Hayti, Liberia, and Sierra Leone. This body has devoted itself to education with extraordinary zeal and success, and for this pur- pose it has raised within a few years above $1,000,000. At the Conference of 1884 of the African Methodist Episcopal Zion Church the word "male" was struck out from the Discipline, so that the sexes are equally eligible to all positions, lay and clerical. It has been constantly growing in numbers and in zeal for missions, education, and churchly order.*~~

~~*Statistics of American Methodists (1899).*~~

~~*Methodists.*~~

~~*Ministers.*~~

~~*Churches.*~~

~~*Communi- cants.*~~

~~*1. Methodist Episcopal*~~

~~*16,771*~~

~~*26,424*~~

~~*2,762,691*~~

~~*2. Union American Methodist*~~

~~*Episcopal ....*~~

~~*175*~~

~~*200*~~

~~*16,200*~~

~~*3. African Methodist Episcopal*~~

~~*6,179*~~

~~*5,715*~~

~~*698,354*~~

~~*4. African Union Methodist*~~

~~*Protestant*~~

~~*63*~~

~~*73*~~

~~*2,608*~~

~~*5. African Methodist Episcopal*~~

~~*Zion*~~

~~*3,475*~~

~~*2,955*~~

~~*587,337*~~

~~*6. Methodist Protestant .*~~

~~*1,647*~~

~~*2,401*~~

~~*184,097*~~

~~*7. Wesleyan Methodist .*~~

~~*699*~~

~~*506*~~

~~*16,496*~~

~~*8. Methodist Episcopal, South .*~~

~~*6,166*~~

~~*14,479*~~

~~*1,477,180*~~

~~*9. Congregational Methodist .*~~

~~*345*~~

~~*350*~~

~~*21,000*~~

~~*10. Congregational Methodist*~~

~~*(Coloured)*~~

~~*5*~~

~~*5*~~

~~*319,*~~

~~*11. New Congregational Me-*~~

~~*thodist ....*~~

~~192~~

~~366~~

~~4,000~~

~~12. Zion Union Apostolic .~~

~~30~~

~~32~~

~~2,346~~

~~13. Coloured Methodist Epis-~~

~~copal ....~~

~~2,061~~

~~1,433~~

~~204,972~~

~~14. Primitive ....~~

~~68~~

~~100~~

~~6,834~~

~~15. Free Methodist .~~

~~1,003~~

~~1,034~~

~~27,487~~

~~*16. Independent Methodists*~~

~~*8*~~

~~*15*~~

~~*2,569*~~

~~*17. Evangelist Missionary . Total Methodists .*~~

~~*48*~~

~~*13*~~

~~*2,010*~~

~~*38,935*~~

~~*56,101*~~

~~*5,966,500*~~

~~*(j. M. Bu.)*~~

~~*Metkovic, or Metkovich, a market-place and seat of the administration of the government district of the same name in the Austrian crownland of Dalmatia. It is situated near the frontier of Herzegovina, on the Narenta river, navigable thus far, and has since the Austrian occu- pation been the chief dep6t for imports to Herzegovina. It is a railway and steamship station. Population (1890), 4198 ; (1900), 4878, chiefly Serbo-Croatians.*~~

~~*Metz, a town, first-class fortress, and episcopal see of Germany, in Alsace-Lorraine, capital of (German) Lorraine, on the Moselle, 99 miles north-west of Strasburg by rail, and 10|- miles east of the Erench frontier. The strength of the fortifications now lies chiefly in the ring of detached modern forts, two to three miles distant from the town. Its garrison, a mixed body of Prussians, Saxons, and Bavarians, numbers 22,000 men. The cathedral (Roman Catholic) has been undergoing restoration since 1876. The town hall (1771) contains a small museum (this is in addition*~~

~~*to the library museum). A fine equestrian statue of the Emperor William I. (1892) adorns the esplanade, and a bronze statue of Prince Frederick Charles (1898) the adjacent Boufflers garden ; and there are also statues to Generals Ney (1855) and Eabert. The noteworthy public buildings and institutions include also the law courts, episcopal palace, provincial administrative offices, the arsenal, military school, music school, teachers' semi- naries, theological seminary, deaf and dumb asylum, glass- painting school, &c. Exceptf or tanneries, leather factories, and ironworks, there is relatively little industry. Since*~~

~~*the war of 1870-71 Metz has been visited annually by- great numbers of people desirous of seeing the famous battlefields of the former year — that is, Gravelotte, St Privat, Eezonville, and Vionville, on the west (battles of 16th and 18th August), Colombey and Nouilly on the east (14th and 31st August and 1st September), and Woippy, where Bazaine made his last attempt to break through on 7th October. The capitulation was signed at the chateau of Prescati, about three miles south of Metz. Population (1885), 54,072 ; (1900), 58,424.*~~

~~*Meudon, a town in the arrondissement of Versailles, department of Seine-et-Oise, France, 6 miles east of Ver- sailles by rail. The remains of a castle, burned by the Germans in 1871, have since been adapted for an observar tory of astronomical physics, connected with which is an important magnetic observatory, installed in a modern high tower. The handsome Galliera Institutions, on the hill of Fleury, were founded by the duchess of Galliera for the reception of 100 aged persons and 350 orphans. The buildings were completed in 1885 at a cost of £560,000, and provided with an endowment of £400,000. Meudon is the seat of extensive manufactures of munitions of war for the artillery, and in the neighbouring park of Chablais is the Government establishment of military ballooning. Population (1891), 7258 ; (1901), 9702.*~~

~~*Meurthe-et- Moselle, a department of the east of Prance, bordering on German Lorraine, watered by the two rivers naming it.*~~

~~*Area, 2037 square miles. The population, 419,317 in 1881, had increased to 484,002 in 1901. Births in 1899, 11,044, of which 1054 were illegitimate ; deaths, 9888 ; marriages, 3479. There were in 1896, 1055 schools, with 66,000 pupils, the illiterate forming 2 per cent, of the population. Out of 1,218,272 acres in 1896 of culti- vated land, 635,084 acres were plough-land and 39,530 acres vine- yards. The produce of wheat in 1899 was valued at £814,000 ; oats, £524,000 ; potatoes, £432,000 , mangold-wurzel, £121,000. The natural pastures returned the value of £368,000 ; hops, £51,000. The live stock of 1899 included 51,240 horses, 91,690 cattle, 115,100 sheep, and 88,620 pigs. Meurthe-et-Moselle takes precedence of all the other departments of France for iron-mining, its produc- tion in 1898 amounting to 3,804,000 metric tons, of the value of £445,000, and constituting four-fifths of the total production of France. It further extracted 508,000 metric tons of rook-salt, valued at £202,000. Metallurgy is highly advanced, forming the chief wealth of the department. In 1898 it produced 1,545,000 metric tons of oast-iron, 50,500 tons of iron, and 158,000 tons of steel, totalling altogether the value of £4,410,000. Distilleries manufactured, in 1896, 110,048 gallons of alcohol. Glass-works, peltry, and spinning also occupy many lands. Nancy, the capital, had 102,463 inhabitants in 1901.*~~

~~*Meuse, a department in the north-east of France, watered by the Meuse.*~~

~~*Area, 2409 square mUes. Population, 289,861 in 1881 ; 283,136 in 1901. Births in 1899, 5477, 324 of them illegitimate ; deaths, 5985 ; marriages, 1821. there were in 1896, 900 schools, with 40,000 pupils, the illiterate composing 2 per cent, of the population. Out of 1,457,300 acres of cultivated land in 1896, 810,160 acres were plough-land and 22,230 acres vineyards. The wheat crop of 18'.)i) amounted to the value of £981,000 ; barley, £104,000 ; oats, £640,000 ; vines, £268,000 ; potatoes, £342,000 ; mangold-wurzel, £108,000. The live stock in 1898 included 47,000 horses, 103,480 cattle, 124,680 sheep, and 75,210 pigs. The department is not rich in minerals, yet its industry in metals produced in 1898, 9000 metric tons of iron and 8700 tons of steel, valued at £168,000. Distilling yielded 101,000 gallons of alcohol. There is also a brisk industry in sugar-reflning. Bar-le-Duc, the capital, had 17,093 inhabitants in 1901.*~~

~~*Meuse (Dutch Maas; Flemish, Maes), a river rising in the department of Haute-Marne, France, 16 miles north- east of Laugres, and after pursuing an extraordinary course through France, Belgium, and Holland, falling into the North Sea about 52°. In the department of Vosges the river disappears underground between Bazeilles and Noncourt, a distance of 3^ miles. In Belgium it has been*~~

~~*canalized from Liege to Vise, dose to the German frontier, as has also the lower course of the Ourthe, which joins the Meuse at Liege. In Holland the distance between Maas- tricht and Eindhoven has been reduced from 144^ to 75^ miles by means of the South Willems canal ; and below Mook, where the banks are low, the Meuse is confined by dykes. But, as a means of safety, portions of the river are left undyked, so that at high ilood the water over- flows the low lands of Grave, Bois-le-Duc, and the Langstraat. To obviate the inconveniences of these inun- dations, the mouth of the Maas was diverted in 1883 into a new channel. Starting at Hedikhuizen, the new course runs westwards, follows the line of the Old Maas, and issues into the Amer, and thence into Hollandsch Diep, where the level is lower than that of the confluence of the Waal and the Maas at Loevenstein. By this new regulation the Maas will discharge its waters by mouths nearly identical with those of its earlier history. The new channel thus provided has a breadth of 1640 feet. Total area of river basin, 18,630 square miles ; length, 500 miles ; breadth at Verdun, 213 feet ; at Namur, 426 feet ; at Liege, 656 feet ; at Gorinchem (Gorkum), 1066 feet. (See also Hollai^d : Rivers and Canals, and Rotterdam.)*~~

~~*Mexborough, a town in the Doncaster parliamen- tary division of Yorkshire, England, on the Don, 5-^ miles north-north-east of Rotherham, and on the Great Central railway. It has potteries and ironworks. Popu- lation (1881), 6319 ; (1891), 7734; (1901), 10,417.*~~

~~*Mexico, or the United States of Mexico, lying between the United States of America on the north and Guatemala on the south, extending from 14° 30' 42" to 32° 24']Sr., and from 86° 46' 08" to 117° 07' 31" W. The boundary towards the United States, determined generally by treaties of 1848 and 1853, has in disputed localities been demarcated in accordance with conventions of 29th July 1882 and 18th February 1889, but this*~~

~~*precise delimitation is not yet complete. Towards Guatemala the boundary was fixed by treaties of 27th September 1882*~~

~~*Density*~~

~~*states and Terri-*~~

~~*Area.*~~

~~*Population*~~

~~*Population*~~

~~*per*~~

~~*tories.*~~

~~*Sq. miles.*~~

~~*(1895).*~~

~~*(1900).*~~

~~*sq. mile in 1900.*~~

~~*Federal District*~~

~~*463*~~

~~*476,413*~~

~~*540,478*~~

~~*1167*~~

~~*Tlaxcala .*~~

~~*1,595*~~

~~*166,803*~~

~~172,217~~

~~108~~

~~Guanajuato~~

~~11,370~~

~~1,062,554~~

~~1,065,317~~

~~94~~

~~Mexico~~

~~9,247~~

~~841,618~~

~~924,467~~

~~100~~

~~Puebla~~

~~12,204~~

~~984,413~~

~~1,024,446~~

~~84~~

~~Queretaro .~~

~~3,557~~

~~228,551~~

~~228,489~~

~~64~~

~~Hidalgo~~

~~8,917~~

~~558,769~~

~~603,074~~

~~67~~

~~Morelos~~

~~2,773~~

~~159,355~~

~~161,697~~

~~58~~

~~Michoacan~~

~~22,875~~

~~896,495~~

~~935,849~~

~~40~~

~~Aguascalienles .~~

~~2,950~~

~~104,615~~

~~*101,910*~~

~~*34*~~

~~*Jalisco*~~

~~*31,846*~~

~~*1,107,227*~~

~~*1,137,311*~~

~~*35*~~

~~*“Vera Cruz .*~~

~~*29,202*~~

~~*866,355*~~

~~*960,670*~~

~~*33*~~

~~*Oaxaca*~~

~~*35,382*~~

~~*884,909*~~

~~*947.910*~~

~~*26*~~

~~*Colima*~~

~~*2,272*~~

~~*55,752*~~

~~*65,026*~~

~~*28*~~

~~*San Luis Potosi*~~

~~*25,316*~~

~~*568,449*~~

~~*582,486*~~

~~*23*~~

~~*Zacatecas .*~~

~~*24,757*~~

~~*452.578*~~

~~*462,886*~~

~~*18*~~

~~*Guerrero .*~~

~~*24,996*~~

~~*420,.S39*~~

~~*474,694*~~

~~*19*~~

~~*Tabasco*~~

~~*10,072*~~

~~*134,839*~~

~~158,107~~

~~15~~

~~Tepic (Territory)~~

~~11,275~~

~~148,776~~

~~140.677~~

~~13~~

~~Nuevo Loon~~

~~24,317~~

~~309,252~~

~~326,1140~~

~~13~~

~~Chiapas~~

~~27,222~~

~~319,599~~

~~363,607~~

~~13~~

~~Yucatan .~~

~~.‘15,203~~

~~298,850~~

~~*312,264*~~

~~*9*~~

~~*Sinaloa*~~

~~*33,690*~~

~~*258,865*~~

~~*296,109*~~

~~*9*~~

~~*Durango .*~~

~~*38,009*~~

~~*295,105*~~

~~*371,274*~~

~~*9*~~

~~*Tamaulipas*~~

~~*32,576*~~

~~*206,502*~~

~~*218,948*~~

~~*7*~~

~~*Campeohi^ .*~~

~~*18,086*~~

~~*88,121*~~

~~84,281~~

~~5~~

~~Coahuila .~~

~~62,358~~

~~241,026~~

~~280,809~~

~~4~~

~~Chihuahua~~

~~87,802~~

~~262,771~~

~~327,004~~

~~*4*~~

~~*Sonora*~~

~~*76,900*~~

~~*191,281*~~

~~*220,553*~~

~~*8*~~

~~*Lower California*~~

~~*(Territory) Total*~~

~~*58,328*~~

~~*42,245*~~

~~*47,082*~~

~~*8*~~

~~*765,560*~~

~~*12,632,427*~~

~~*13,645,462*~~

~~*17-7*~~

~~*MEXICO*~~

~~*727*~~

~~*and 1st April 1895. Towards British Honduras the boundary runs in a course defined by treaty of 8th July 1893, from the mouth of the*~~

~~*Bocalarichica, the strait between Yucatan and Ambergris Cay, to the boundary between Mexico and Guatemala.*~~

~~*On an area of about 767,000 square miles Mexico con- tained in 1895 a population of 12,632,427, and in 1900, of 13,545,462. The area and the census population of the Federal District, and of each of the 27 states and 2 territories, are given in the table on the preceding page. (The total area given in the table is exclusive of the coast islands, covering altogether about 1420 square miles.) The population consisted in 1900 of 6,716,007 males and 6,829,455 females. Of the total in 1895, 19 per cent, were of white race, 43 per cent. ladian, and 38 per cent, mixed. The prevailing language is Spanish, but Indian languages were in 1896 spoken by 2,034,712 inhabitants, and foreign languages by 22,972. The number of foreigners resident within the republic in the same year was 49,698, the nations most numerously represented being Guatemala, 12,333 ; Spain, 12,228 ; North America, 10,222; Prance, 3763; Great Britain, 3384; Germany, 2337 ; Italy, 1574 ; China, 987. The population, classified according to occupation, was as follows : —*~~

~~*Professional (teachers, doctors, &c.) Students and school children . Public services Agricultural and pastoral Mining ... Commercial .... Proprietors Industries and arts . Various (household servants, &c.) Without occupation . Children .... Occupation unknown*~~

~~*Total*~~

~~*38,081*~~

~~*635,365*~~

~~*57,488*~~

~~*2,935,070*~~

~~*80,158*~~

~~*205,942*~~

~~38,560~~

~~681,974~~

~~1,562,362~~

~~2,831,363~~

~~3,255,052~~

~~310,143~~

~~12,631,558~~

~~The registration of births, deaths, and marriages was begun in 1893, but the results annually published do not appear to be trustworthy. For 1898 the registered births numbered 489,933; deaths, 452,238; marriages, 61,687. The chief cities and towns of Mexico are the following : — Mexico, 329,774; Puebla, 88,684; Guadalajara, 83,934; San Luis Potosi, 69,050; Leon, 58,426; Monterey, 45,695; Pachuca, 40,487; Zacateeas, 39,912; Guana- juato, 39,404; Merida, 36,935; Queretaro, 34,576; Morelia, 33,890; Oaxaca, 32,437; Orizaba, 31,512; Aguascalientes, 30,872 ; Saltillo, 26,801 ; Durango,~~

~~26,425.~~

~~Constitution and Government. — The constitution in force in Mexico in 1902 was originally promulgated 5th February 1857, and has been frequently amended. It declares that the Mexican Republic, established under the representative, democratic, and federal form of govern- ment, consists of states free and sovereign in everything relating to their internal administration, but united in a federation for common interests. Among the provisions of the constitution may be noted that which restricts military authority in time of peace to the functions connected with discipline, that which declares the Church and the State to be separate, and that which makes marriage a civil contract.~~

~~*Legislative. — The legislative power is vested in a General Congress of two chambers. The Senate consists of two senators (each with an alternate) from each state and the Federal District, elected indirectly by the people for a term of four years. They must be at least thirty years old, in the enjoyment of all their civil rights as Mexican citizens, be residents of the states which they represent, and not be in ecclesiastical orders. Federal office- holders are ineligible. The deputies are elected in the*~~

~~*same manner as the senators, but in the proportion of one deputy for every 40,000 inhabitants or fraction over 20,000. Their term of office is two years, and an alternate is elected for each deputy. Deputies must be at least 25 years of age. In 1897 there were 227 deputies. Members of both houses are paid £300 a year. Electors are all Mexicans possessing honest means of livelihood, and, if married, being over 18 years of age; if unmarried, over 21. The Congress has two ordinary sessions : the first begins on 16th September and ends 15th December ; the second is held from 1st April to 31st May. During the recesses a standing committee of 15 deputies and 14 senators, selected by the respective chambers, is endowed with limited legislative functions.*~~

~~*Executive. — The President of the United Mexican States is elected for four years by electors chosen by the people. His term of ofB.ce commences on the 1st of December after election. He may be re-elected indefinitely (Amend- ment to Constitution, 20th December 1890). In case of his death, or permanent disability, a provisional President is elected by Congress to hold office until an election can be held in the usual manner. Temporary vacancies in the Presidency are filled by the Secretary of State. The President must be a native-born Mexican possessing full civil rights, must be at least 35 years of age, must not belong to any ecclesiastical order, and must be resident in the country at the time of election. He is assisted in the discharge of his duties by a cabinet composed of seven secretaries, who are heads of departments of foreign rela- tions; of finance and public credit; of communications and public works ; of promotion, colonization, and in- dustry; of interior ; of justice and public instruction; of war and navy. Secretaries must be native-born citizens at least 25 years of age.*~~

~~*Judicial Power. — The Supreme Court contains 11 justices and 4 alternate justices, an attorney-general, and a public prosecutor, elected by the people indirectly in the same manner as senators and deputies, and for a term of six years. There are 3 circuit courts and 32 district courts.*~~

~~*Local Government. — The government of the states under the constitution is republican, representative, and popular. Legislative power in most of the states is vested in a congress of one chamber, the members of which are called deputies, and are in most states elected by indirect popular vote for a term of two years. The subject-matter of state legislation includes all that is not expressly given to the Federal authority. It was only in 1883 that an Act was passed for the unification of the mining and commercial legislation within the republic. The executive power is vested in a governor elected for four years, and the states have their own courts of justice. For administrative purposes they are divided usually into districts governed by a prefect. The smaller divisions are municipalities, the local authority being a town council (ayuntamiento).*~~

~~*Beligion. — In 1895 over 99 per cent, of the population belonged to the Roman Catholic faith. The number of Protestants was 42,259; of Mormons, 1560 ; Mahommedans, Buddhists, and others, 804 ; of no professed religion, 62,560 ; and of unknown religion,*~~

~~*6847.*~~

~~*Instruction. — The condition in 1895 with respect to education is indicated by the following figures : —*~~

~~*Able to read and write . Able to read only . Able neither to read nor write Young children (untaught) Unknown ....*~~

~~*Total*~~

~~*1,817,414*~~

~~*328,007*~~

~~*8,094,520*~~

~~2,351,100~~

~~40,517~~

~~12,631,5.58~~

~~Education is gratuitous, obligatory, and lay. Under an Act, passed 14th May 1896, official primary instruction in the Federal~~

~~District and in the territories is under the control of the execu- tive. In the states the schools are maintained either from state funds or municipal funds. The school system comprises primary elementary, primary superior, and preparatory schools, the last being institutions for professional or technical instruction. Besides primary and normal schools, the Federal Government supports schools of jurisprudence, of agriculture and veterinary art, of en- gineering, of fine arts, of trades and arts for men and for women, of commerce and administration, a national conservatory of music, a preparatory school, schools for the blind and for deaf mutes, re- formatory schools, &c. ; also museums, and 17 libraries containing from 400 to 159,000 volumes.~~

~~In 1898 the number of schools was as follows : — Federal and state schools, 6738 ; municipal, 2953 ; private, 2158 ; Church, 346 ; asso- ciation, 163 ; total, 12,358. In 1899 the total number of schools was 11,925 (6876 federal and state schools). At the federal, state, and municipal schools in 1899 there were 15,505 teachers and 684,563 enrolled pupils, the average attendance being 474,622 ; at the other schools the enrolled pupils numbered 134,987, and the average attendance 103,955. The amount spent on federal, state, and municipal schools in 1899 was £680,500.~~

~~Within the republic, in 1899, there were 33 museums, 139 librar ries, with an aggregate of 992,000 volumes, and 39 scientific and literary societies. The number of periodical publications was 702 — 18 being in English, 11~~

~~*in English and Spanish, 3 in French, and 1 in German. The daily papers numbered 55 ; weekly, 242 ; monthly, 85 ; others being published at various other intervals.*~~

~~*Crime. — Criminal statistics for the whole republic are not published ; those for the Federal District showed that, in 1897, 14,512 persons (11,487 males and 3025 females) were tried for crimes or misdemeanours, and 8108 were convicted. The con- victions comprised 5830 oases of assault, 1230 of theft, and 102 of homicide.*~~

~~*Finance. — The federal revenue is derived chiefly from import duties and internal taxation, and the most important branches of expenditure are the public debt, the army and navy, and public works. For each of the years specified the amount of revenue and of expenditure (estimated for 1902-03) has been as follows, the dollar being taken at two shillings : —*~~

~~*Tear.*~~

~~*1896-1897 1899-1900 1902-1903*~~

~~*Eevenue. £5,150,062*~~

~~*6,426,100 6,482,360*~~

~~*Expenditure.*~~

~~*£4,833,050*~~

~~*5,830,990 6,473,880*~~

~~*The foreign debt of the republic consists mainly of the 5 per cent, external consolidated gold loan contracted in 1899 for the conversion of prior loans. The original amount was £22,700,000, of which, in the middle of 1901, £22,479,660 was outstanding. The whole debt is redeemable, not later than the year 1945, by a sinking fund secured on the national import and export duties. The external silver currency bonds of 1890 have been nearly all redeemed ; the outstanding amount in 1900 was about £11,400. The internal debt amounts to $121,824,750, or about £12,182,475 ; and*~~

~~*the floating debt to $1,015,836, or about £101 ,540. The fiscal value of property within the republic in 1899 was — urban, £35,052,370; rural, £42,394,780; total, £77,447,150, the flscal value being taken at one-third less than the actual value. The revenues of the Mexican states vary within narrow limits, while their expenditures on the whole show a considerable decrease. The revenue and expenditure of the municipalities show a considerable increase within the five years ending 1899, when the annual aggregates of these local revenues and expenditures were : —*~~

~~*Eevenue. Expenditure.*~~

~~*States .... £1,995,250 £1,969,590*~~

~~*Municipalities . . . '1,652,250 1,591,970*~~

~~*Army. — The military forces consist of the active army and the reserve, in one or other of which every Mexican capable of bear- ing arms is, from his twentieth to his fiftieth year, liable to serve. The active army in 1900 was composed as follows : —*~~

~~*Infantry Cavalry . Artillery Engineers Other services*~~

~~*Men.*~~

~~*21,291*~~

~~*5,042*~~

~~*1,982 119*~~

~~*1^641*~~

~~*30,075*~~

~~*On war footing the numbers may be increased to 120,000 infantry 20,000 cavalry, and 6000 artillery. The infantry are armed with the Mauser rifie, the cavalry with the Mauser carbine ; the artil- ery are provided with Bange fleld-guus and Gruson mountain batteries.*~~

JVaji;/.— The Mexican navy in 1900 comprised 2 first-class gun- boats (450 tons), 2 second-class gunboats (425 tons), a transport

ship, 2 despatch boats, a corvette, and a training-ship. The per- sonnel of the navy consists of 90 officers and 500 men.

Agriculture. — It is estimated that Mexico contains about 3400 square miles of thick forests, 113,280 of woodland, and 299,280 of uncultivated land. The highlands of the central plateau can pro- duce all known varieties of wheat, maize, beans, and root crops, as well as agave (maguey) and grapes, and they are also adapted to stock-raising. In the hot region rice, sugar-canej tropical fruits, cacao, and rubber can be produced ; and in the temperate region coffee grows abundantly, as do also all the products common to this zone in other countries. Notwithstanding this capability of the soil, agriculture is carried on to a verj' limited extent and by antiquated methods, due to scarcity of labourers and of means of communication, as well as to ignorance of agricultural matters. The Government endeavours to improve the conditions by dissem- inating useful knowledge and distributing seeds and plants, espe- cially vines, olives, fruit trees, cork, oak, fodder plants, and fiax, besides mulberry trees and silk-worms. It has also taken mea's- ures to extend irrigation. The quantities of the principal cereals produced in 1898 and 1900 were as follows : —

Crops. 1898. 1900.

Wheat, tons . . . 235,360 331,500

Rice, „ . . . 20,710 20,360

Barley, bushels . . 12,977,220 10,203,580

Maize, „ . . 107,905,320 89,354,360

The chief wheat^producing states are Chihuahua, Guanajuato, Puebla, and Sonora. A favourite crop in general cultivation in Mexico is beans (frijol), the total yield of which in 1899 amounted to 12,314,400 bushels. Of root crops the most usual is the sweet potato or camote, and, at a long

~~*interval, the common potato. The cultivation of the sugar-cane is carried on throughout the hot region and a great part of the temperate, its yield ranging from about 40 to 60 tons to the acre. Ofiicial returns give as follows the production of sugar and its by-products in 1898 and 1900 : —*~~

~~*Products.*~~

~~*Sugar, tons .*~~

~~*Brown sugar, ,, .*~~

~~*Molasses, ,, .*~~

~~*Rum, gallons .*~~

~~*Coffee is widely cultivated both in hot and temperate regions, but chiefiy in Vera Cruz. Cocoa is grovm in Tabasco, vanilla in Vera Cruz, and tobacco most extensively in Tabasco. The yield of these products in 1900, with the values, was as follows : —*~~

~~*1898.*~~

~~*66,770*~~

~~*1900.*~~

~~*73,554*~~

~~*71,650*~~

~~*65,689*~~

~~*65,210*~~

~~*51,770*~~

~~*13,729,760*~~

~~*11,312,900*~~

~~*Product.*~~

~~*Coffee Cocoa "Vanilla Tobacco*~~

~~*Quantity. ft.*~~

~~*Value.*~~

~~*£.*~~

~~*604,850*~~

~~*170,980*~~

~~*47,267 243,910*~~

~~*46,393,870*~~

~~*4,341,374*~~

~~*32,798*~~

~~*20,555,830*~~

~~*The chief gums collected are chicle and caoutchouc, the former to the amount of 4,690,940 lb, valued at £143,270, and the latter to the amount of 434,630 lb, valued at £24,530 in 1900. Cotton has been cultivated from time immemoriEtl. The staple of the Mexican cotton is longer than that of the United States, but not so soft and lustrous. The chief cotton-growing states are Duraiigo and Coahuila. The total yield in 1898 amounted to 100,156,687 lb, in 1900 to 47,950,970, the value in the latter year being esti- mated at £014,877. One of the most important products is hen- equen (Agave rigida), also called Sisal grass or Sisal hemp. The production of this fibre in 1898 amounted to 66,235 tons, valued at £1,535,120 ; in 1900 to 85,860 tons, valued at £1,826,280. The production of ixtle (Agave ixtle), another fibrous plant, in 1899 amounted to 8305 tons, valued at £80,860. Many fruits are produced, and the official statistics annually state the production of 68 varieties. In the ofiicial list of the flora of the hot lands there are enumerated 233 distinct species of medicinal plants, 14*~~

~~*dyewoods, and 193 varieties of trees, among which are numerous valuable hardwoods.*~~

~~*Lioe (SjocA -! — The raising of cattle has always been one of the most important industries. The states in the northern part are practically vast cattle ranges. The total consumption of meat in the republic in 1899 comprised 817,037 cattle, 807,375 sheep, 680,908 pig-s, and 620,723 goats, the whole being valued at £4,597,365.*~~

~~*Mini III/. — The great mining region runs from the north-west to the south-east, following the direction of the Sierra Madre Cordillera from Sonora to the south of Oaxaca, a distance of 1600 miles. The richest mines have been discovered on the west slope of the Cordillera at an elevation of from 3000 to 8200 feet. The number of mineral districts is 1092. In 1901 the number of existing titles to mining properties amounted to 12,618, covering an area of 209,700 acres ; of these 2666 were for gold and silver claims, 4328 for silver claims, 1922 for silver and lead, 1059 for gold. Besides gold, silver, lead, mercury, copper, iron, antimony.*~~

~~*tin, zinc, sulphur, &c., there are also deposits of precious stones, such as the opal, topaz, emerald, agate, amethyst, and garnet. The production of the principal metals was as follows, in quan- tity and Talue, in 1899; —*~~

~~*Metals.*~~

~~*Quantity.*~~

~~*Yalue.*~~

~~*Gold, oz. .*~~

~~*263,8.30*~~

~~*£670,490*~~

~~*Silver, „ .*~~

~~*. 43,266,900*~~

~~*5,398,950*~~

~~*Copper, tons .*~~

~~*26,962*~~

~~*1,465,930*~~

~~*Lead, „ .*~~

~~*62,550*~~

~~*405,120*~~

~~*Iron, „ .*~~

~~*3,239*~~

~~*28,230*~~

~~*Mercury, lb .*~~

~~*273,090*~~

~~*26,970*~~

~~*The total value of the metallic output for the year was £8,479,774.*~~

~~*Industries and Manufactures. — Mexico has only manufactures of such articles as are required by the mass of the people. The principal article of manufacture is a coarse unbleached cotton cloth called manta, in the production of which over 26 million pounds of cotton are annually used, and more than 50,000 families directly or indirectly employed. In 1898-99 there were 125 mills with 491,443 spindles, 14,759 looms, employing 23,731 hands. The production of roanto reached 10,239,799 pieces, and*~~

~~*of yarn 4,171,290 lb. A considerable quantity of cotton yarn is used in the manufacture of shawls and scarfs (reftozos) , knitted goods, &o. Mexican industry also produces woollen blankets (zarapes) and blankets of mixed cotton and wool. Silk-weaving is in its infancy, but is rapidly progressing. There are a few paper mills. Sugar mills and distilleries are numerous. In 1899-1900 there were 2065 distilleries producing 7,664,732 gallons of spirits from sugar, maguey, and grain. The tobacco industry is extensive, nearly every town having a cigarette factory, the quantity of tobacco manufactured in 1898-99 amounting to 12,202,690 lb. The flour mills cannot supply the local demand. Iron-foundries are nu- merous, but their work is mostly limited to the manufacture of small agricultural implements and ordinary marketable iron. The Government maintains a large arsenal and gun foundry in the city of Mexico. Hammocks and pottery are extensively manu- factured, the former more especially in Yucatan. Cotton-seed oil mills are numerous, as are manufactories of chocolate, felt hats, rubber, &o.*~~

~~*Commerce. — The principal exports are precious metals, henequen, coffee, cattle, &c., while the principal imports are machinery, cotton and woollen textiles, iron and steel, wines and liquors, wood, paper and manufactures thereof, and textile fibres. The value of the imports and exports was as follows for the years named (the Mexican dollar being taken at two shillings and the gold dollar at four shillings) : —*~~

~~*Years.*~~

~~*1895-1896 1898-1899 1900-1901*~~

~~*Imports. £8,450,780*~~

~~*10,173,840 13,094,480*~~

~~*Exports. £10,501,690*~~

~~*13,847,810 14,865,900*~~

~~*In 1900-1 the principal exports were as follows : — Silver, £4,319,400 ; silver coin, £1,638,480 ; silver ore, £1,274,200 ; gold, £859,200 ;*~~

~~*henequen, £1,640,230 ; coffee, £688,980 ; timber, £239,020 ; cattle, £585,760 ; hides, &c., £497,400 ; tobacco, £150,940.*~~

~~*In the year 1900-1 the commerce was distributed as shown in the following table : —*~~

~~*Countrica.*~~

~~*United States Great Britain France . Germany Spain . Other countries*~~

~~*Imports from.*~~

~~*£6,767,100*~~

~~*2,217,100*~~

~~*1,383,900*~~

~~*1,476,600*~~

~~*596,200*~~

~~*653,600*~~

~~*Exports to.*~~

~~*£11,722,900*~~

~~*1,203,310*~~

~~*282,430*~~

~~*501,850*~~

~~*118,770*~~

~~*1,036,640*~~

~~*In 1900 the trade between Mexico and the United States, by rail- way overland, amounted to £2,102,860 imports and £3,938,360 exports ; a total of £6,041,220.*~~

~~*Shipping.— In 1900 Mexico had a merchant marine of 17 steamers of in all 3961 tons net, and 50 sailing vessels aggregating 8445 tons. In the year 1900, including coasting trade, 8905 vessels of 6,670,429 tons entered the ports. The number of British vessels that entered was 803 of 1,241,231. tons, and of American, 1432 of 2,620,456 tons. The ports which have the largest share in the foreign sea-borne trade of Mexico are Vera Cruz and Tampico.*~~

~~*Bailways.— The railways, though their construction began only about 1870, had in 1900 a total length of 9600 miles. In the populous region round the capital they form a complicated net- work extending across the country from the Gulf to the Pacific, while from the long trank lines running from Mexico City to the frontier of the United States branches have been constructed for the development of the mining industries. The first railway con- cession, granted in 1857 and renewed and amended in 1867 and 1868, authorized the construction of a line from the capital to Vera Cruz, and in 1873 this line, called the Mexican railway, was opened for traffic. The main line is 264 miles in length, and there*~~

~~*are two branches, one to Puebla and another to Paohuca, of 29 and 28 miles respectively. The Interoceanic railway connects Vera Cruz, Jalapa, and Puebla with Mexico City, and then runs south- wards to Jojutla and Araaousac (1894), to be ultimately extended to Aoapulco on the Pacific. The main line has a length of 463 miles, while its several branches have a length of 92 miles, the longest being the Matamoros branch of 42 miles. At Amacusac the line joins the Mexico, Cuernavaca, and Pacific railway, which, with a length of about 500 miles, runs from the capital to Mexcala and ultimately reaches the Pacific at Sihuatanejo. Puebla and Oaxaca have been connected since 1892 by the Southern railway, 228 miles in length, which has been extended to Ejutla, about 35 miles to the south. The National Tehuantepec railway, con- structed under a law of 1882, connects Coatzacoalcos on the Bay of Campeche with Salina Cruz on the Pacific, 192 miles distant. This system is connected by rail with Vera Cruz,*~~

~~*and a line is being constructed from Cordoba on the Mexican railway, which will run to Santa Lucretia on the Tehuantepec railway. In Campeche and Yucatan there is a railway system of over 320 miles, connecting the ports of Campeche and Progreso with Merida, Valladolid, and other inland towns. The Mexican Central railway, running from Mexico City to Ciudad Juarez on the northern frontier, a distance of 1224 miles, was opened in 1884, and has now branches with an aggregate length of nearly 1000 miles. The branch from Irapuato to Guadalajara, opened in 1888, has been extended to Ameca and Etzatlan, and from Guadalajara a line runs to Colima, Cayutlan, and Manzanillo on the Pacific coast. From Aguascalientes a branch runs to Tampico on the Gulf of Mexico, where there is a harbour constructed for and owned by the railway company, the Government having gi-anted subsidies. A railway from Tampico to Monterey, opened in 1891 and subsequently extended to Trevifio, with a total length of 388 miles, had been acquired by a Belgium company, but was in 1902 transfeiTed to the Mexican Central Railway Company. The Mexican National' rail- way, completed in 1888, runs from Mexico City to New Laredo on the frontier of Texas, a distance of 839 miles, and is extended into Texas for about 160 miles. The branches in Mexico have a length of 320 miles. One branch runs westwards from Mexico City to Morelia and Uruapan, a distance of 120 miles, and the system includes suburban lines near the capital. The International rail- way from Porfirio Diaz, or Piedras Negras, on the Texan frontier, to Lerdo on the Central railway, 410 miles distant, was opened in 1888. , It has since been extended 130 miles to Durango, whence the line is continued northwards for 130 miles to Cuanacevi. A branch of 71 miles connects Eeata on the main line with Monterey, and thus with the Monterey and Tampico system. The International railway is worked in connexion with the Southern Pacific railway of the United States. The Sonora railway from Guaymas on the Gulf of California to Nogales on the frontier of Arizona, nearly 280 miles in length, has been leased to the Southern Pacific Railway Company, and is worked in connexion with their system. The Mexican Northern railway (for mineral traffic) runs from Bscanlon, on the Central railway, to Sierra Mojada, 81 miles ; the Coahuila and Pacific railway has 100 mOes of line open ; the Chihuahua and Pacific has 125 miles open ; the Rio Grande, Sierra Madre, and Pacific has 156 miles open, and will be continued to Guerrero and the*~~

~~*Pacific coast. In the earlier stages of railway enterprise liberal assistance was granted by Government to companies undertaking the construction and working of new lines, but later the subvention system was more sparingly employed, and in concessions it is usually provided that the lines shall revert to Government at the end of ninety-nine years. The first Mexican railway was, with a Government sub- vention, constructed by a British company, and British capital is still largely invested in Mexican railways, but the rapid develop- ment is mainly due to the enterprise and capital of United States financiers. The following table shows for the year 1899 the number of passengers and the weight of goods carried on the principal Mexican railways, with the gross revenues expressed in sterling, the Mexican dollar being taken at two shillings : —*~~

~~*Kailwa3's.*~~

~~*Passengers.*~~

~~*Tons.*~~

~~*lieveuue.*~~

~~*Mexican*~~

~~*799,575*~~

~~*940,000*~~

~~*£475,490*~~

~~*District (Mexico City) .*~~

~~*25,235,528*~~

~~*192.390*~~

~~*National*~~

~~*909,965*~~

~~*1,019,000*~~

~~*691,660*~~

~~*Interoceanic .*~~

~~*1,184,360*~~

~~*620,000*~~

~~*385,310*~~

~~*Central ....*~~

~~*1,837,299*~~

~~*1,886,000*~~

~~*1,560,210*~~

~~*International .*~~

~~*213,276*~~

~~*741,000*~~

~~*438,000*~~

~~*Monterey to Gulf .*~~

~~*149,604*~~

~~*219,000*~~

~~*129,360*~~

~~*Northern*~~

~~*5,207*~~

194,300

146,990

The development of the railways may be judged from these figures:—In 1890 there were 6037 miles of line; in 1894, 7070; in 1896, 7550 ; in 1898, 9044 ; in 1900, 9798. The Imes in 1900 consisted of 84.54 miles under federal concession, 283 miles of

urban railway, 163 miles of foreign line under state concession, 333 miles for private use, and 565 miles of light railway. In 1899, 36,122,930 passengers and 5,852,000 tons of goods were carried on the railways of federal concession, the gross proceeds amounting to £4,637,740. At the end of 1896 the amount of £12,134,870 had been paid in subsidies.

Post 0#ce.—In the year 1900-1 the Mexican postal system was served by 2082 post ofBces, of which 594 were principal offices and 488 agencies. The correspondence (including letters and post- cards) amounted to 148,086,513 pieces, of which 100,669,465 were in the internal service and 38,417,048 in the international. Postal receipts amounted to £213,560, and expenses to £263,850. In 1899, 23 steamship lines had contracts with the Government for carrying the mails; of these, 11 were Mexican, 5 American, 4 English, 1 Spanish, 1 French, and 1 German.

Telegraph.—The extension of the telegraph system is shown by the following figures:—In 1890, 31,300 miles; in 1894, 38,310; in 1896, 41,040; in 1900, 43,394. The total length in 1900 was made up as follows :—Miles.

Federallines 28,702

State lines 6,305

~~*Private enterprise lines . ... 2,433*~~

~~*Railway lines 6,954*~~

~~*Total 43,394*~~

~~*In 1900-1 the Federal lines were served by 362 telegraph offices ; the number of messages transmitted was 2,604,711. In addition to the telegraph lines there were, at the end of 1900, 22,770 miles of telephone line belonging to the states or to companies. The num- ber of instruments working in the service of the public in 1900 was*~~

~~*8600.*~~

~~*Money and Credit. — There is a gold coinage, but practically no gold is in circulation. Within the republic there are three mints (Jlexico, Zacatecas, and Culiacan); the mint at Guanajuato was closed on 30th June 1900. At these Mexican silver is coined into dollars, which are shipped to China and other Eastern countries. The nominal value of the money coined in the years specified (expressed in Mexican dollars) is given in the following table. In the total of each year the small amount of copper coinage is included.*~~

~~*Tears.*~~

~~*Silver.*~~

~~*Gold.*~~

~~*Total.*~~

~~*1890-91*~~

~~*$24,237,449*~~

~~*$308,083*~~

~~*124,764,402*~~

~~*1891-92*~~

~~*25,520,717*~~

~~*291,940*~~

~~*25,975,351*~~

~~*1892-93*~~

~~*27,169,876*~~

~~*361,672*~~

~~*27,618,604*~~

~~*1893-94*~~

~~*30,185,591*~~

~~*553,978*~~

~~*30,739,569*~~

~~*1894-95*~~

~~*27,628,981*~~

~~*545,237*~~

~~*28,207,175*~~

~~*1895-96*~~

~~*22,634,788*~~

~~*565,786*~~

~~*23,237,099*~~

~~*1896-97*~~

~~*19,296,009*~~

~~*453,474*~~

~~*19,781,733*~~

~~*1897-98*~~

~~*21,427,057*~~

~~*459,219*~~

~~*21,917,876*~~

~~*1898-99*~~

~~*20,184,117*~~

~~*715,882*~~

~~*20,910,693*~~

~~*1899-1900*~~

~~*18,102,630*~~

~~*598,086*~~

~~*18,723,726*~~

~~*There are 24 banks, 19 being banks of issue ; their paper is not a legal tender, but is covered by deposits of coin. The Govern- ment issues no paper money, and as a rule does .not retain any specie in the treasury, the National Bank, which acts as a depository, paying all the warrants, &c. On 31st January 1902 the capital of all the banks amounted to $82,300,000; notes in circulation, $72,890,000; casfi, $55,975,000. The*~~

metric system of weights and measures has heen compulsory since 16th Septem- ber 1896.

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History, 1820-1901.

The history of Mexico from its separation from Spain till the year 1884 exhibits an almost continuous conflict in which the empire of Maximilian is a mere episode. The struggles, which may at first sight seem to be merely between rival generals, are seen upon closer examination to be mainly (1) between the privi- Geaerai leged classes, i.e., the Church and (at times) the /^^y™ army, and the mass of the other civilized popu- lation ; (2) between Centralists and Federalists, the former being on the whole identical with the army, the Church, and the supporters of despotism, while the latter on the whole represent the desire for republicanism and local self-government. Similar conflicts are exhibited, though less continuously, by most of the other Spanish- American states.

~~*On both sides in Mexico there was an element of honest doctrinaires ; but rival military leaders exploited the struggles in their own interest, sometimes taking each side successively ; and the instability was intensified by the extreme poverty of the peasantry, which made the soldiery reluctant to return to civil life, the absence of a regular middle class, and the concentration of wealth in a few hands, so that a revolutionary chief was generally sure both of money and of men. The period of instability ceased soon after the second election of Porfirio Diaz in 1884. Under his rule the Federal system continued in name, but it concealed in fact, with great benefit to the nation, a highly centralized adminis- tration, very intelligent, and on the whole both popular and successful — a modern form of rational despotism.*~~

~~*The war of independence which began in 1810 was largely a movement of native-born Mexicans against Spaniards, and had almost resulted in the extinction of the separated forces, when a new turn was given to the course of events by news of the revolu- tionary movements in Spain. The Spanish king, Ferdinand VII., was seen to be ready to profess Liberal principles in order to secure his throne. The Mexican Clericals and ^^ "^ Conservatives, fearing lest disendowment, toleration, g^^'lgjo and other changes should be forced on them from '*~~

~~*Spain, induced Agustin de Iturbide, who had already been con- spicuous in the revolution, to take the field against Guerrero, the only revolutionary leader still in arms, in order to suppress Repub- licanism and set up an independent and non-Liberal monarchy. Iturbide eventually combined with Guerrero, and proclaimed the "Plan of Iguala," which laid down, as the bases of the new state, the maintenance of the Roman Catholic religion and the privileges of the clergy, the establishujent of a limited monarchy, and equality of rights for Spaniards and native-born Mexicans. Iturbide sought the co-operation of the viceroy Apodaoa, who, however, refused; but he was presently superseded by General O'Donojii, who, being unable to get beyond Vera Cruz, recognized the inde- pendence of Mexico. O'Donoju shortly afterwards died ; the Spanish Government repudiated his act ; and Spanish troops held the fortress of San Juan de Ulda, off Vera Cruz, till 1827. A provisional Junta, nominated by Iturbide, issued a decla- ration of independence (October*~~

~~18‘21), and nominated a regency of five, with Iturbide as its president. The first Mexican Congress met 24th February 1822. A section of it favoured a republic; another, monarchy under Iturbide ; another, which was broken up by the refusal of Spain to recognize Mexican independence, monarchy under a Bourbon prince. A conflict now arose between the Republican majority and Iturbide, which was settled by a military pronunciamiento in his favour, and the Congress was intimidated into electing him emperor. IIe was crowned 21st July 1822. Fresh confiicts, however, soon broke out between him and the Congress, and iVntonio Lopez de Santa Anna, captain-general of Vera Cruz, proclaimed a republic, promising to support the Plan of Iguala. IIe was defeated at Jalapa and driven to Vera Cruz ; but the army deserted Iturbide, who was compelled to abdicate (19th April 1823). The Congress deported him to Italy, and granted him a pension. IIe returned almost immediately, on the pretext that Spain was intriguing against Mexican independence, and on landing was arrested and executed (1st July 1824).~~

~~The Congress bad meanwhile undone much of his work, and had divided into Federalists and Centralists, the latter largely Monarchists and Freemasons. The Federalists were strong enough to secure the adoption of a constitution (4th October 1824)~~

~~General~~

~~Iturbide~~

~~becomes~~

~~emperor,~~

~~1822-23.~~

~~MEXICO~~

~~731~~

~~modelled on the United States, with additional and incongruous clauses, notably one declaring the Catholic religion to be alone recognized. A~~

~~*source of abundant discord was opened by the pro- vision that each state should contribute its quota to the Federal revenues. No proper statistical basis for estimating the quotas existed, and the device gave each state a plausible reason for attempting secession on occasion. Moreover, the capital and some territory round it was severed from the rest of the Republic as a "Federal district" — another grievance intensifying the antagonism of the state to the central power. The Freemasons had been largely instrumental in overthrowing Iturbide ; they now divided into the Escoceses (lodges of the Scottish ritual), who were Monarchist and Centralist, and the Yorkinos, who took their ritual from New York, and their cue, it was alleged, from the American minister, Joel Poinsett. An attempt at revolt, headed by Nicolas Bravo, vice-president, the Grand Master of the Escoceses, was suppressed, but dissensions ensued in the Yorkino party between*~~

~~*the followers of President Guerrero (a man largely of President native blood, and the last of the revolutionary leaders) isis^si"' '‘^ °^ Gomez Pedraza, the war minister. A conflict*~~

~~*broke out, the Guerrerists were victorious, and the pil- lage of foreign shops in Mexico city (1828), among them that of a French baker, gave a basis for the foreign claims which, ten years later, caused the " Pastry War " with France. Meanwhile, attacks on Spanish ships off Cuba by a Mexican squadron, commanded by an American, David Porter, had induced Spain to send an expedi- tion to reconquer Mexico, which, however, was decisively checked at Tampico by Santa Anna. During the invasion Vice-President Antonio Bustamante declared against President Guerrero ; the bulk of the army supported him. Guerrero was deposed, and his partisans in the south, continuing their resistance, were defeated at Chil- pancingo (2nd January 1831) ; and Guerrero, retiring to Acapulco, was enticed on board an Italian merchant-ship, and treacherously seized, tried, and executed (January-February 1831). Next year, however, a revolt broke out against Bustamante, which was joined by Santa Anna, and eventually resulted in a pronunciamiento in favour of Gomez Pedraza. IIe, and his successor, Vice-President Gomez Farias (1833), assailed the exemption of the clergy and of military officers from*~~

~~the jurisdiction of the civil courts, and Santa Anna took advantage of the situation to assume the presidency. He~~

~~eventually became dictator, dissolved Congress (31st Santa jj^y 1834) and the state legislatures, and substituted~~

~~creatures of his own for the governors of the states~~

~~and mayors of towns, then retiring into private life. A~~

~~new Congress, having resolved itself into a constituent assembly, followed up this Centralist policy (30th December 1836) by framing a new constitution, the Siete Leyes or Seven Laws, which converted the states into departments, ruled by governors appointed by the central authority, and considerably reduced popular representation. Antonio Bustamante became the first~~

~~president under it. The French claims set up by the Busta- pillage of foreign shops in Mexico had, however, re-~~

~~""^"f! mained unsatisfied, and in 1838 a French fleet block-~~

~~/«lr 3,ded the coast, bombarded the fortress of San Juan~~

~~de Uliia, off Vera Cruz, and occupied the town. The Mexican Government gave way, threatened by Federalist risings and secessions of states, which culminated in 1841. Santa Anna~~

~~appeared, nominally as a mediator, and put forward a Santa programme, the bases of Tacubaya (28th September~~

~~Annate- 1841), abolishing all the Siete Leyes except the part *'°™'" relating to the judicial system, arranging for a new~~

~~constituent assembly, and reserving for the president (himself) full power of reorganizing the administration. The Centralist Government, after a vain attempt to defeat him by professing a more thorough Federalism, gave way to force, and Bustamante was allowed to leave the country. But the new Congress was too Federalist for Santa Anna, and he retired,~~

~~leaving the reins to Nicolas Bravo, under whose auspices a new Centralist constitution was established (1843). This expressly retained the privileges of the clergy and army, and was m some respects more anti-Liberal than that of 1836. But new complica- tions were now introduced by the question of Texas.~~

~~Texas, a state of the Mexican Union, had been settled largely from the United States in consequence of a land grant given by~~

~~the Spanish viceroy to Moses Austin m 1820, and had The Texas iigen estranged from Mexico partly by the abolition question. ^j slavery under a decree of President Guerrero, and partly by the monstrous Centralist constitution of 1836. It then seceded. Santa Anna attempted to reduce it, but was defeated and captured by Houston at the battle of San Jacmto, and com- pelled to sign a treaty recognizing Texan independence, which he disavowed on returning to Mexico, as extorted by compulsion. A state of war thus continued nominally between Mexico and its seceded member, whose independence was recognized by Eng- land, France, and the United States. The slaveholders m the United States favoured annexation of Texas, and pressed the~~

~~Anna dic- tator,~~

~~1834.~~

~~various claims due from Mexico to American citizens, partly perhaps with the ulterior aim of forcing war. Most of these claims were settled by a mixed commission, with the king of Prussia as umpire, in 1840-41, and a forced loan was raised to pay them in 1843, which greatly increased the internal difficulties of Mexico, and stimulated the revolt of Paredes against Santa Anna, who had returned to power in 1844. It resulted in Santa Anna's downfall, imprisonment at Perote, and eventual exile (December 1844 to January 1845), and the election of General Jose Joaquin Herrera as president. But Herrera was displaced in the last days of the year 1845 by a pronunciamiento in favour of Paredes, who undertook to uphold the national rights against the United States, and who was elected president on 3rd January 1846. Texas had meanwhile applied for admission into the American Union. The annexation, rejected~~

in 1844 by the United States Senate, was sanctioned on 1st March 1845, and carried out on 22nd December 1845. The Mexican minister withdrew from Washington, and both sides made active preparations for war.

The United States forces were ordered by President Polk to advance to the Rio Grande in January 1840. They established a depSt at Point Ysabel (behind the opening of Brazos Santiago), and erected a fort in Texan territory, commanding War with Matamoras, on the Mexican side of the Rio Grande, "f" This provoked the Mexican forces into a defensive in-igdi^ds vasion of Texas, to cut the American communications with Point Ysabel. They were, however, defeated at Palo Alto (8th May) and Resaca de la Palma (9th May) . There was an out- burst of warlike feeling in the United States (accompanied with emphatic opposition to war in the North), and an invasion of Mexico was planned by three routes — from Matamoros towards Monterey in New Leon, from San Antonio de Bexar to Chihuahua, and from Fort Leavenworth to New Mexico. Importance attaches chiefly to the movements of the first force under General Zachary Taylor. During the war preparations President Paredes, suspected of intriguing to overthrow the Republic, had to give place to his vice-president Bravo, who in his turn gave way before the military partisans of Santa Anna, who was hastily recalled from his exile at Havana to assume the presidency and the conduct of the war (August 1846). He was allowed by the American squadron blockading Vera Cruz to pass in without hindrance. Probably it was thought his presence would divide the Mexicans.*

The preparations of the United States took some months. It was not tiU 5th September 1846 that General Zachary Taylor could leave his dep6t at Camargo on the Kio Grande, and March on Monterey. It was taken by assault 23rd September ; Santa Anna was defeated at Buena Vista (near Saltillo) on 27th February 1847, and forced back on San Luis Potosi. New Mexico was occupied without opposition ; Chihuahua was occupied, but not held, owing to the difficulties in maintaining communications ; and Upper California was seized in the autumn of 1846 by John C. Fremont, who had been exploring a route across the continent, and by the United States Pacific squadron, and made secure by the aid of the New Mexico expedition. But as Mexico still con- tinued to fight, it was

determined to reach the capital vidi Vera Cruz. That city was taken by General Scott after a siege (9th to 29th March 1847) ; and after winning the battle of Cerrogordo (18th April), and a long delay at Puebla owing chiefly to illness among his troops and the need of reinforcements, Scott marched on Mexico city, stormed its defences against greatly superior forces, and effected an entrance after severe fighting on 13th September 1847. This virtually ended the war : Santa Anna was deprived of his command, and the treaty of Guadalupe Hidalgo, concluded 2nd February 1848, ceded to the United States Texas, New Mexico, and Upper California, in Treaty ot return for a payment of |1 5,000,000 by the United ™'"- States to Mexico, and the assumption of liability by it for the claims of its subjects which it had hitherto been pressing against Mexico. The object of this payment was doubtless to strengthen the United States' title to the conquered territory. It is generally admitted that Mexico was provoked into aggression in order that additional territory might be available for the extension of slavery.*

The American forces were withdrawn in May and June 1848 after the ratification of the treaty by Mexico. Under the presi- dency of Herrar (1848-51) praiseworthy attempts were made to restore order and the public credit. An Herrera arrangement was effected with English holders of 't^fJ.cl'' Mexican stock, on the basis of a considerable reduction " '*

of the capital (swollen by arrears of interest) and of the annual interest thenceforward, which latter was made a charge on the customs revenue. An attempt was made to carry out a consoli- dation of the internal debt, which failed owing to the total inadequacy of the funds allotted for interest ; the army was reduced and reorganized, new muskets were purchased, and the northern frontier was defended against Indians and raiders by military colonies, formed partly of civilized Seminole Indians from the United States. But the financial situation was desperate ;

the federal revenue, mostly from customs — wliioli were evaded by extensive smuggling — was not half the expenditure; and Indian revolts

~~*in Yucatan (1847-50) and in the Sierra Gorda had added to the strain. Arista succeeded Herrera as president (January 1851), but resigned (January 1853) through Inability to cope with the financial and social disorder.*~~

~~*After asort of interregnum (January-March 1853) Santa Anna was recalled (by a vote of the majority of the states under the Plan of Arroydzarco, 4th February 1853, the result of a pro- Santa nunciamiento), and made dictator in the interests of*~~

~~*Anna la federation. His measures, partly inspired by an able ^SS3-S4 Conservative leader, Lucas Alaman, proved strongly Centralist : one is especially noteworthy, the establish- ment of the ministry of "fomento," or encouragement to public worlis, education, and intellectual and economic development, which is a conspicuous aid to Mexican welfare to-day. He also negotiated (at the end of 1853) the sale of the Mesilla valley (now Arizona) to the United States, but the purchase money was soon dissipated. On 16th December 1853 Santa Anna issued a decree making himself dictator for an indefinite period, with the title of serene highness. A Federalist revolution soon broke out,i and on 1st March 1854, at Ayutla in Guerrero, a section of the army under Colonel Villareal proclaimed the Plan of Ayutla, demanding Santa Anna's deposition and the establishment of a provisional Government to secure a new constitution. Among the leaders in the movement were Generals Alvarez and Comonfort, and it is said that Porfirio Diaz, subsequently president, then a young soldier, made his way to Benito Juarez, then in prison, and arranged with him the preliminaries of the revolt. It spread, and Santa Anna, after severe but futile attempts to quell it, left the country (August 1854).2*~~

~~*The provisional president who succeeded him. General Carrera, proving too Centralist, was replaced by Alvarez (24th September 1855), two of whose ministers are conspicuous in later history — Ignacio Comonfort, minister of war, and Benito Juarez, minister of finance. Juarez (b. 1806), one of the most remarkable men of the 19th century, was of unmixed Indian blood. The son of a Zapotec peasant in a mountain village of Oaxaca, he was employed as a lad by a bookbinder in Oaxaca city, and*~~

aided by him to study for the priesthood. He soon turned to the law, though for a time he was teacher of physios in a small local college ; eventually went into politics, and did excellent work in 1847 as governor of his native state. Juarez almost immediately secured the enactment of a law (Ley Juarez, 23rd November 1855) subjecting the clergy and the army to the jurisdiction of the ordinary courts. "Benefit of clergy" was the curse of Mexico. OfBcers and soldiers could be tried only by courts-martial, the clergy (including numbers of persons in minor orders, who were practically laymen) only by ecclesiastical courts, and both sets of tribunals exercised civil as well as criminal jurisdiction, and were unduly favourable to their own order. 8 The measure roused the Clericals to resistance. Alvarez gave place (8th December 1855) to his war minister Comonfort, who represented the less anti-Clerical Liberals. He had to suppress a Clerical rising in Puebla (March 1856), which was punished by a considerable confiscation of Church property ; sanctioned a law releasing Church land from mortmain, by pro- viding for its sale, for the benefit, however, of the ecclesiastical owners (called after its author Miguel Lerdo de Tejada, brother of the subsequent presidents), and a new draft constitution, largely modelled on that of the United States, and implicitly incom- patible with the maintenance of special ecclesiastical pi'ivileges (5th February 1857). The clergy protested violently, and the Plan of Tacubaya (17th December 1857), which made Comonfort dictator, and provided for the construction of a new constitution under his auspices, was forced on and accepted by him. He was presently displaced by a thorough reactionary, General Zuloaga, and ex- pelled from Mexico early in 1868 ; and for three years Mexico was a prey to civil war between two rival governments — the Republicans' at Vera Cruz under Juarez, who, as Chief Justice of the Supreme Court, succeeded Comonfort under the constitution in the presidential office ; and the reactionaries' at the capital. The latter were at first presided over by Zuloaga, who, proving incompetent, was replaced at the end of 1858 by Pezuela, who early in 1859 gave place to Miguel Miramon, a young, able, and

Benito Juarez.

1 Two filibustering expeditions at this time— one by William Walkci- JBS^'²'''^ "°"""^ '" Nicaragua, in Lower California (December*

~~*1853), the otlier by Count Raoussot de Boulbon and some Freiicli adventurers in Sonora, in Santa Anna's interest (July 1854)— added to the general disorder.*~~

~~*2 Santa Anna tried to get back to politics in Mexico after Maximilian's tall, without suoce.ss. He was amnestied with other exiles in 1S74 and died m obscurity in 187fi.*~~

~~*3 It is even stated that the " housekeopers " of the priests, when in debt tor dress, &c., supplied to them, would claim " benolit (.f clero'v " m order to escape more easily.*~~

~~*unscrupulous soldier, who was shortly afterwards accepted as "constitutional" president by his party. The Juarists were de- feated outside the city of Mexico twice, in October 1858 and on 11th April 1859. On the second occasion the whole body of ju/ramna officers, who had surrendered, were shot with Miramon's authority, if not by his express orders, together with several sur- geons (including one Englishman, Dr Duval) and medical students who were tending the wounded of both armies, some as volunteers (the "martyrs of Tacubaya"). This atrocity caused great indig- nation in Mexico and abroad: the reactionists were divided; their financial straits were extreme, as the Juarists held all the chief ports. Juarez was recognized by the United States, and allowed to draw supplies of arms and volunteers thence ; and on 12th July 1859 he published laws declaring ecclesiastical property confiscated, establishing civil marriage and registration, trans- ferring the cemeteries to civil control, and, in short, disestablish- ing the Church. As opening up a source of revenue other than forced loans, the chief reliance of his opponents, these laws probably contributed largely to his eventual success. But his occupation of all the chief customs ports of the Republic, and the apparent hopelessness of any ending to the conflict, together with the frequent outrages of both parties on foreigners, afforded strong reasons for foreign intervention. Early in 1859 President Buchanan had recommended the step to Congress, which did not respond. On 12th December 1859 the M'Lean-Juarez treaty was concluded, which gave the United States a sort of disguised protectorate over Mexico, with certain rights of way for railroads over the Isthmus of Tehuantepec and between*~~

the Rio Grande and Pacific. The American Senate, however, did not ratify the treaty, and a motion for its reconsideration late in 1860 came to nothing, owing to the approach of the War of Secession.

The question of a joint intervention of Great Britain, France, Spain, and Prussia was mooted between those Powers in 1860. Early in 1859 the outrages on British subjects had caused the British minister to break ofi diplomatic relations. ^/^J^™™"' Forced contributions had been levied by both sides on " "'

of MIra- moa, 1860.

goods or bullion, being European property, in transit to or from the coast, the reactionaries being the worst offenders ; indeed, a seizure of British specie made by a Juarist, General DegoUado, was repudiated by Juarez himself, and restitution was ordered ; and there were numerous shocking cases of murder and robbery of Europeans. At last, on 17th November 1860, Miramon, under the plea of necessity, seized §660,000 in specie which had been left under seal at the British Legation and was intended for the bondholders. On 22nd December 1860 his forces were routed by the Juarist general Ortega at Arroyozarco, and his Government was overthrown.

Juarez entered Mexico city on 11th January 1861. IIe soon found that his Government was held responsible to Europe for the excesses of its rival as well as its own. Miramon's Govern- ment had violated the British Legation ; the Spanish minister, with the Papal legate and two representatives of South American states, were expelled from the country for undue interference on behalf of the reactionaries ; the payments on the British loan were suspended in fact, and afterwards Europeaa formally by Juarez's Congress in July 1861 ; and if,'T|f ,' various outrages had been committed on tlie pei-sons '*

and property of Europeans for which no redress could be obtained. Most serious and unreasonable were the Jecker claims. Jecker, a Swiss banker settled in Mexico, had lent Miramon's Government, when almost at its last extremity (March 1860), §750,000, receiv- ing in payment 6 per cent, bonds for $15,000,000. Juarez's Government declined to recognize the*

~~*whole claim, but seems to have been ready to accept liability for the sum lent, with interest. Jecker, whose firm had meanwhile gone into liquidation, became a French citizen, and his claim furnished Napoleon III. with another reason for interference. A convention between Great Britain, France, and Spain for joint interference in Mexico was signed in London, 31st October 1861. A separate arrangement of the British claims was negotiated by Juarez, but rejected by the Mexican Congress, November 1861 ; and the assistance of the United States with a small loan was declined, Mexican territory being demanded as security. On 14th December A'era Cruz was occupied by Spanish troops under General Prim ; the French fleet and troops arrived soon after, with instructions to seize and hold the Gulf ports and collect the customs for the three Powers till a settlement was effected ; Great Britain sent ships, and landed only 700 marines. In view of the unhealthiness of Vera Cruz, the convention of Soledad was concluded with the Mexican Govern- ment, permitting the foreign troops to advance to Orizaba, and incidentally recognizing Mexican independence. But as the*~~

- ~~*The operation was most ingeniously disguised as a conversion soliemi\ the old and praetieally \alueless 'bonds being exeham;eable at a vast discount, aud along with cash, for the new bonds, wliieli were assured of a sale by being made legal lender lor oue-fifth of any pay- ment of customs duties.*~~

~~*French harboured leaders of the Mexican reactionaries, and showed a disposition to interfere in Mexican domestic politics, which lay beyond the terms of the joint convention, Great Britain and Spain withdrew their forces in March 1862. For the refugees in Paris had been taken up by the Empress Eugenie and the French Clericals, and had revived the old idea of a Mexican monarchy,*~~

~~*which Napoleon adopted in the autumn of 1861. ^""""iiiH ^OTQ troops were sent from France. Their advance '1862 63°"' ^^^ checked by Zaragoza and Porfirio Diaz in the battle*~~

~~*of Cinco de Mayo, 5th May 1862 ; and in September of that year 30,000 more French troops arrived under General Forey. Wintering at Orizaba, they recommenced their advance, 17th February 1863, besieged and reduced Puebla, and entered Mexico city, 17th June. A provisional government of Mexicans was established, nominated directly or indirectly by Dubois de Saligny, the French plenipotentiary. It adopted monarchy, offered the crown to Maximilian of Austria, brother of the Emperor Francis Joseph, and should he refuse, left its disposal to Napoleon III.*~~

~~*Maximilian,, after making some difficulty as to renouncing his right of succession to the throne of Austria, as was required*~~

~~*of him, accepted the crown subject to the approval ’”//)” °* ^^^ Mexican people, and reached Mexico city,*~~

~~*mlllaa ^]2th June 1864. Juarez meanwhile had set up his ‘isii’” ‘ capital, first in San Luis Potosi, then in Chihuahua.*~~

~~*The new empire was unstable from the first. Before Maximilian arrived the provisional government had refused to cancel the sales of confiscated Church lands as the Clericals demanded. When he came, a host of new difficulties arose. A new loan, nominally of about eight millions sterling, but yielding little more than four, owing to discount and commission, was raised in Europe, but no funds were really available for its service. Maxi-milian spent his resources too freely in mere luxury, and carried the elaborate etiquette of the Court of “Vienna to Mexico. Favouring, as he did, toleration of Protestantism, and the supremacy of the Crown over the Church, he was too liberal for the Clericals who had set him up. As a foreigner he was unpopular, and the regi- ments of Austrians and Belgians which were to serve as the nucleus of his own army were more so. As an administrator he was enthu- siastic, but futile : his reforms, excellent on paper, could not be carried out, for the trained bureaucracy necessary — nay, even the material for it — did not exist. For a time he nominally held sway over about two-thirds of the country, — roughly, from lat. 18° to 23°, thus excluding the extreme north and south. Oaxaca city, under Porfirio Diaz,i capitulated to Bazaine — who had superseded the too pro-Clerical Forey in October 1864 — in February 1865, and by the autumn of that year the condition of the Juarists in the north seemed*~~

~~desperate. But the towns asked for permanent French garrisons, which were refused, as weakening their own power of self-defence. Instead, the country was traversed by flying columns, and the guerillas dealt with by a French service of " contre-guerilla, " who fought with much the same savagery as their foes. Directly the French troops had passed. Republican bands sprang up, and the non-combatant Mexicans, to save themselves, could only profess neutrality. Yet on 3rd October 1865, Maximilian, misled by a false report that Juarez had left the country, issued a decree declaring the Juarists guerillas, who whenever captured were to be tried by court-martial and shot. Mexican generals on both sides had done as much. But Maximilian's decree prepared his own fate.~~

~~The American Civil War ended in the spring of 1865, and a strong popular feeling was at once manifested in favour of assert- ing the Monroe doctrine against Maximilian's Government. In the summer there were threatening movements of United States troops towards the Rio Grande; early in 1866 Napoleon III.~~

~~announced to the French Chambers his intention of lAaxl- withdrawing his forces ; in response to a note of~~

~~""""«? Seward, the United States secretary of state, of 12th asserted j- gbruary 1866, he was induced to promise their by trance. ^^^^.^ jy (.j^gg instalments at specific dates (Novem- ber 1866, March and November 1867) . Maximilian now turned for support to the Mexican Clericals; meditated abdication, but was dissuaded by his wife Charlotte ("the better man of the two," as he had once jestingly said), who went to intercede for him with the Emperor of the French. Finding him obdurate, she went on to appeal to the Pope ; on her way, at Botzen, she went mad (end of September 1866). — ^, • , j~~

~~Maximilian had meanwhile drawn nearer to the Clericals, and farther from the French, and, to protect French interests. Napoleon III. had decided to send out General Castelnau to supersede Bazaine, arrange for the withdrawal of the French forces in one body, and restore the Republic under Ortega, who had quarrelled with Juarez, and was therefore, of all Republicans, least unacceptable to the Clericals. But fearing the prospect.~~

1 Diaz refused parole, and was confined at Puebla for some months, but made his escape, and was soon in the field agam.

they induced Maximilian, who had retired to Orizaba for his health, to remain. Father Fischer, a German-American by ex^ traction, was specially influential here. A conference of eighteen representative Mexicans was summoned, and refused his offer to retire by ten votes to eight. He yielded on condition that a congress of all parties should be summoned to decide the fate of the empire. Hereupon he returned to the capital ; the Juarist dominion extended rapidly ; the French troops left (in one body) on 5th February 1867, ignoring and ignored by the Imperial Government, and shortly after Maximilian took command of the army at Queretaro. Here, with Miramon, he was besieged by the Juarists under Escobedo, and the garrison, when about to make a last attempt to break out and seek refuge in the fastnesses of the Sierra Gorda, was betrayed '^ by Colonel Lopez to the besiegers (15th May 1867). Maximilian, with the f"'f" Mexican generals Miramon and Meija, was tried (fairly "Ijutl ' enough) by court-martial, and, refusing (or neglecting) /^g/. ' to avail himself of various opportunities of escape, was convicted on charges which may be summarized as rebellion, murder, and brigandage, on 14th June, and executed, with Mira- mon and Meija, on 19th June 1867.

Meanwhile Porfirio Diaz had captured Puebla (2nd April) and besieged Mexico city, which fell 21st June. The Republican Government behaved with comparative leniency, though Juarez and Diaz were to some extent forced on glffiaeat, by their followers, who rejected a general amnesty. The last anti-Juarist stronghold (Inayarit) submitted on 20th July 1867. A good deal of discontent was caused among the Republican rank and file, partly by the reduction of the army, and partly by a proposal to allow priests to vote, which came to nothing, and in the result Juarez's election in October to the presidency was opposed by Diaz, or rather Diaz's friends, but without success. But so soon as Juarez was elected, insurrections broke out in various states, and brigandage prevailed throughout the following year. There were unsuccessful insurrections also in 1869 (Clerical) and 1870 (Republican), but an amnesty, passed 13th October 1870, helped to restore peace ; trouble again arose, however, at the 1871 election, at which the candidates were Juarez, Sebastian

~~*Lerdo de Tejada, and Diaz. Juarez's continued re-election was regarded as jinconstitutional, and no party obtain- ing a clear majority, the matter was thrown into Congress, which elected him. Diaz's supporters refused to recognize him, and a revolution broke out, which went on sporadically till Juarez's death on 18th July 1872. Sebastian Death of Lerdo de Tejada, as president of the Supreme Court, jg'"^' succeeded him, and amnestied the rebels, but made no further concessions. In the next _ year, however, laws were passed repeating in a stronger form the attacks of 1857 on the supremacy of the Church, and prohibiting the monastic orders or monastic life. The first day of 1873 was marked by the opening of the Vera Cruz and Mexico railway. For the next two years there were only local disturbances, chiefly f"""""" in Yucatan, and an Indian rising in Michoacan. Pro- [trdode testant missions established themselves (with some Tejada. opposition) in the country, and diplomatic relations were renewed with France and Spain (1874). But towards the close of Lerdo de Tejada's term as president he was suspected of aiming at a dictatorship, and Diaz made preparations for a rising, then retiring to Brownsville. At the beginning of 1875 the revolution broke out in Oaxaca with the Plan of Tux- tepec, which was adopted by Diaz, and proclaimed as the Plan of Palo Alto (22nd March). Diaz's attempt to raise the north, how- ever, failed, and, trying to reach Vera Cruz by sea, he was recog- nized on the steamer, recaptured while attempting a four-mile swim ashore, concealed by the purser for some days, generally inside one of the saloon sofas, and helped to get ashore in disguise at Vera Cruz. Lerdo was declared re-elected, but was overthrown and forced into exile (January 1877), and Diaz, who had assumed the provisional presidency, was declared constitutional president on 2nd May 1877. A law forbidding the re-Porfirio election of a president till four years had elapsed from "„g^ag„^ his retirement from office, the outcome of the Republi- /g//, ' can opposition to Juarez and Lerdo, was passed in the autumn of that year (but so modified as to enable Diaz to be re- elected indefinitely in 1887 and 1892).*~~

~~*Diaz's first presidency (1877-80) was marked by some unsuc- cessful attempts at revolution, notably by Escobedo from Texas ; by the resumption of diplomatic relations with Spain, Germany, Italy, and some South American states (1877), and France (1880) ; by some frontier*~~

difficulties with the United States, whose sol- diery had occasionally followed brigands into Mexican territory, and with Guatemala, which revived a claim dropped since 1858 to a portion of the state of Chiapas ; and by considerable internal

2 Lopez said he acted as Maximilian's agent, but his story was generally rejected. Yet see Mrs. Tweedie's Mexico as I Sau) It,]!101.

progress, aided by a too liberal policy of subsidies to railways. The boundary questions were settled under President Gonzalez (1880-84) ; relations with Great Britain were renewed in 1883. The claimsof the railways, however, necessitated retrenchment on official salaries, and the president's plan for conversion of the debt roused unexpected opposition in an ordinarily subservient Congress. It was attacked with great force and eloquence by the youngest mem- ber of the house, Senor Miron ; Seilor Guillermo Prieto, a noted poet and ex-minister, added the weight of his authority to the at- tack ; the students demonstrated against the Bill in the streets ; and finally it was rejected, on the ground that the expenses of con- version were too heavy and the burden on Mexico too great. At the end of 1881 Porfirio Diaz was again elected president, and was continually re-elected, the constitution being twice modified ex- pressly to allow him to continue in office (1887, 1892).

The history of Mexico from 1884 to 1902 is almost void of political strife. President Diaz's policy was to keep down disorder

with a strong hand ; to enforce the law ; to foster rail- Mexlco Yf^j development and economic progress ; to develop under native manufactures by protective tariffs ; to introduce

'"^^' new industries, e.g., the production of silk and wine, of

coca and quinine ; to promote forestry ; to improve elementary and higher education — for all which purposes the Ministerio del Pomento is

~~*a potent engine ; to encourage colonization ; and, above all, to place the national credit on a sound basis. The first step in this process was a settlement of the British debt by direct*~~

~~*arrangement with the bondholders, who were induced Financial jg exchange their outstanding bonds (at a discount of reorgaa- about 85 per cent.) for 6 per cent, bonds secured on Izatlon. one-fifth of the import and export duties and the product of certain direct taxes (1887-88). In 1890 the Spanish bondholders' claims were satisfactorily arranged also. In 1891 the tariff was made more protectionist. In 1893 the depreciation of silver, Mexico's currency and principal article of export, necessitated stringent retrenchment in the diplomatic service and reduction of official salaries ; but the budget balanced for the first time during many years, the floating debt was converted, and a loan raised for the completion of the Tehuantepec railway. After 1896 there were substantial annual surpluses, which were spent in reducing taxation and in the extinction of debt. In*~~

~~*1895 the 6 per cent, external debt was converted into a 5 per cent, debt, the bonds of which were in 1902 at a premium ; in*~~

~~*1896 the alcabalas or interstate customs and municipal octrois were abolished, and replaced in part by direct taxation and in- creased stamp duties.*~~

~~*The institution by Diaz of the guardias rurales, a mounted gendarmerie composed of the class who in former days drifted into revolution and brigandage, was a potent means of PacIIlca- maintaining order, and the extension of railways and ° telegraphs'enabled the Government to cope at once with*~~

~~*coun ry. ^^^ disturbance. The old local revolutions practically disappeared. In 1886-87 there were some disturbances in Coahuila, New Leon, Sinaloa, and Tamaulipas ; subsequently hardly any- thing was heard of such disorders except on the Texan frontier, where in 1890 Francisco Euiz Sandoval and in 1891 Catarino Garza made incursions into Mexico with some support from Mexican ranch-owners in Texas and speculators who expected mining con- cessions in the event of a*~~

~~*revolution. But the raiders, though they seem to have had some sympathizers in the Mexican army, were few, and in fact little more than brigands. Occasionally the Church gave trouble — the presence of foreign priests was complained of ; attempts to evade the law prohibiting conventual life were detected and foiled (1891, 1894); and there were Indian risings, repressed sometimes with great severity, among the Maquis of Yucatan and the Yaquis of Sonora. Now and then the old passions break out : in September 1897 an absurd attempt to assassinate President Diaz was made by a countryman named Arroyo, who was secured, and early next morning lynched in the central police office, partly by members of the force, ten of whom, however, were sentenced to death for the crime. Discontent with Diaz's rule was confined to a small minority. i*~~

~~*In foreign affairs the rule of Diaz was uneventful. There have been transient disputes with the United States (1886, 1888). In 1888-90 and 1894-95 a boundary dispute with ffj" Guatemala became serious, and Mexican wood-cutters were driven out of the disputed territory between the rivers Xicoz and Usumacinto by Guatemalan olHcials, on the ground that an arbitration in progress being suspended, the terri- tory was still Guatemalan. But Guatemala gave way at the threat of war (.lanuary 1895). In the difficulty between England and the United States over the Venezuelan boundary (December 1895) Mexico expressed strong adherence to the Monroe doctrine*~~

~~*1 Don Agustin Iturbide, grandson of the emperor, godson and (per- haps) at one time the destined heir of Maximilian, was turned out of the army and imprisoned in 1890 for abusing President Diaz.*~~

~~*in the abstract, and suggested that its maintenance should not be left wholly to the United States, but should be undertaken by all American Powers.*~~

~~*In brief, under President Diaz's rule the history of Mexico is mainly economic. In the six financial years 1893-94 to 1899-1900 inclusive the yield of the import duties increased by upwards of 80 per cent. ; the revenue from stamps (an Economic excellent index of the volume of business) over 60 per P"">g"ess. cent., though the duties were reduced ;*~~

~~*the postal revenue from 1895-96 to 1899-1900 rose 60 per cent. ; the telegraph revenue over 75 per cent. The great drainage tunnel which is to take the waters of the valley of Mexico, hitherto most inadequately drained, out to the Pacific was completed in 1902 ; the Tehuantepec railway, likely to prove a formidable rival to any interoceanic canal, approached completion. Both titnnel and railway were the work of an English firm of contractors, Messrs S. Pearson and Sons. Great improvements have also been made in the harbours at Tampico and Vera Cruz. In 1891 elementary education was reorganized, and made compulsory, secular, and gratuitous. Great attention has been paid to higher education, and — at least in the hospitals — to modern sanitation and hygiene.*~~

~~*Authorities. — Por English readers the standard work is II. II. BANCKorr, History of the Pacific States, vols, vii.-ix. (Mexico, 1804-67), with vols. x. xi. (Texas), and vol. xii. (New Mexico, &c.). (In Bancroft's collected works the vols, are numbered xi.-xvii.) Also his Popular History of Mexico. For the war with the United States see E. S. Ripley, The War with Mexico (New York, 1849) ; G. D. Mansfield, The Mexican War (New York, 1849) ; and Wintield Scott's Memoirs. Eor Maximilian, the Blue-books on Mexican affairs contained in Accounts and Papers (presented to Parliament), vol. Ixv. 1862, and vol. Ixiv. 186.3, are valuable ; E. de Keratrt, La Creance Jecker ; L" Empereur Maximilien, son Elevation et sa Chute (translated into English by Venables) ; La Contre-Ouerilla Frani^ise au Mexique, are specially noteworthy ; Prince Eelix Salm-Salsi's Diary gives valuable information as to his decline and fall. UncK Ralph Bubke's Life of Benito Jaurez (London, 1894) is of considerable value and interest. Eor the period since 1887 information in English must be sought chiefly in magazine articles : Matias Romero, " The Garza Raid and its Lessons," North American Beview, September 1892 ; Don Agustin Itdr- BiDE, "Mexico under Diaz," ihid. June 1894; Romero, "The Philosophy of Mexican Revolutions," ibid. January 1896 ; and C. P. LuMMis, " The Awakening of a Nation," Harpefs Magazine, 1897, February, March, and April are valuable, as giving informa- tion (especially the last named) and points of view. Van Dtke, "Politics in Mexico," Harper's Magazine, 1885, vol. Ixxi., gives particulars of the opposition to Gonzalez's debt conversion scheme of 1884. President Diaz's*~~

~~message of November 1896, giving an account of his stewardship from 1884 to that year, has been translated into French (^Bapport du General Porfirio Diaz . . . h ses Compatriotes sur les Actes de son Administration, &c.), edited by AuGUSTE Genin, Paris, 1897. The early constitutions of the Republic have been published (in Spanish) in three volumes ; a study of that of 1857 by B. Moses (of the University of California) is in the Annals of the American Academy of Political Science, ii. i. 1891. Many books, chiefly American, have been written on Mexico of late years from a tom-ist's standpoint. Mrs Alec Tweedie's Mexico as I Saio It (London, 1901) contains valuable information personally obtained from good authorities in Mexico, and some interesting experiences of President Diaz. (j. §. ma.)~~

~~Mexico, a state of the Eepublic of JTexico, bounded on the N. by the state of Hidalgo, on the E. by Puebla and Tlaxcala, on the S. and S.K. by jNIorelos, on the S. and S.AV. by Guerrero, and on the W. by IMichoacan, with an area of 9250 square miles. It is one of the most im- portant agricultural and industrial states. The leading manufacturing industries are cotton and woollen goods, bricks, dairy products, wines, glass-ware, flour-mills, sugar, distilleries, potteries, &c. The state is divided into fifteen districts. The capital, Toluca (population, 23,160), 46 miles from Mexico City, is a handsome town, containing fine public buildings; also cotton mills, breweries, oil and flour mills, ice factories, &c. Amongst other towns in the state are Zumpango (9090), Lerma (7167), San Jose de Malacatepec (6561), Tenango del Valle (5465), Metepec (5189).~~

~~Mexico, a city of Missouri, U.S.A., capital of Audrain county, at the intersection of the Chicago and Alton and~~

~~the Wabash railways, north-east of the centre of the state, at an altitude of 831 feet. Its site is uneven and hilly, and the street plan irregular. It is the seat of Hardin College, a Baptist institution for women, founded in 1873, which in 1899 had 23 instructors and 252 students. Population (1890),~~

~~*4789; (1900), 5099, of whom 111 were foreign-born and 948 were negroes.*~~

~~*Mexico City, capital of the Mexican Kepublic, situated in the centre of a high plain, 7460 feet above sea-level, 263 miles west of Vera Cruz by rail. It has undergone considerable improvement, and a very large increase of the suburbs has also taken place. The prin- cipal undertaking has been the great canal scheme for the drainage of the Mexican valley, completed in 1898 at a cost of f 18,000,000. Almost equally important has been the introduction of a complete sewage system on the best scientific principles, a special feature being the flushing of the main drains by fresh water supplied by a pumping engine. The streets are lighted by electricity, and there is an adequate system of tramcars, formerly drawn by mules, but now on many lines propelled by electricity. In 1898 all the various hospitals were merged in one structure, consisting of thirty-five buildings on the scientific plan of pavilions, the whole erected at a cost of f 800,000. A new prison has been erected, and also a fine new HOuse of Congress. The industries have multi- plied as well as increased. There are large cotton, linen, and paper factories, brick works, cork factories, soap works, machine factories, &c. There are many large foreign business houses — German, Trench, English, and Chinese — the Germans having almost a monopoly in the hardware trade. Population (1895), 329,774; (1900),*~~

~~*368,777.*~~

~~*Meyer, Julius Lothar (1830-1896), German chemist, was born on 19th August 1830, at Varel in Oldenburg. Determining to adopt the profession of his father, who was a physician, he went to study medicine first at Zurich University in 1851, and then, two years later, at Wlirzburg, where he had Virchow as his teacher in pathology. Even before he took his doctor's degree (1854), the influence of Ludwig, under whom he studied at Zurich, had decided him to devote his attention to physiological chemistry, and with that end in view he went, after his graduation, to Heidelberg, where Bunsen held the chair of chemistry. There he drifted still farther from medicine, and was so influenced by Kirchhoff's mathematical teaching that he took up the study of mathematical physics at Konigsberg under F. E. Neumann. In 1859 he became Privat-docent in*~~

~~*physics and chemistry at Breslau, where in the preceding year he had graduated as Ph.D. with a thesis on the action of carbon monoxide on the blood. In 1866 he accepted a post in the School of Forestry at ISTeustadt-Eberswalde, but soon moved to Carlsruhe Polytechnic. There he had an opportunity of utilizing his early medical training to great practical advantage, for during the Franco-German campaign the Polytechnic was used as a hospital, and he took an active part in the care of the wounded. Finally, in 1876, he became professor of chemistry at Tubingen, where he died on 11th April 1896. HIs name is best known for the share he had in the periodic classification of the elements. HIe noted, as did Newlands in England, that if they are arranged in the order of their atomic weights they fall into groups in which similar chemical and physical properties are repeated at periodic intervals ; and in particular he showed that if the atomic weights are plotted as ordinates and the atomic volumes as abscissae, the curve obtained presents a series of maxima and minima, the most electro-positive elements appearing at the peaks of the curve in the order of their atomic weights.*~~

~~*HIs book on Die modemen Tlieorien der Chemie, which was first published in Breslau in 1864 and has passed through many editions, contains a discussion of this and other relations between the atomic weights and the pro- perties of the elements. In 1882 he received from the Royal Society, at the same time as Mendeleeff, the Davy medal in recognition of his work on the Periodic Law. A younger brother, 0. E. Meyer, became professor of physics at Breslau in 1864.*~~

~~*Meyer, Victor (1848-1897), German chemist, was born at Berlin on 8th September 1848, and studied at HIeidelberg University under Bunsen, Kopp, Kirchhoff, and HIelmholtz. At the age of twenty he entered Baeyer's laboratory at Berlin, and began original work in organic chemistry, attacking among other problems that of the composition of camphor. In 1871, on Baeyer's recom- mendation, he was engaged by Fehling as his assistant at Stuttgart Polytechnic, but within a year he left to suc- ceed Wislicenus at Zurich. There he remained for thir- teen years, and gained for himself a high place among contemporary chemists. It was during this period that he devised his well-known method for determining vapour densities at high temperatures (seeCnEMiSTEYin these new volumes),*~~

~~*and carried out his experiments on the dissocia- tion of the halogens with great heat, though it is to be noted that he himself never went so far as definitely to assert the decomposition of chlorine. In 1882, on the death of Weith, he undertook to continue the latter's lectures at the University on benzene derivatives, and his preparations for this task led him to the discovery of thiophen. In 1885 he was chosen to succeed Hilbner in Gottingen, where stereo-chemical questions especially engaged his attention ; and in 1889, on the resignation of his old master, Bunsen, he was appointed to the chair of chemistry in Heidelberg. He died on 8th August 1897. In recognition of his brilliant experimental powers, and his numerous contributions to chemical science, he was awarded the Davy medal by the Eoyal Society in 1891.*~~

~~*Mezieres, chief town of department Ardennes, France, 152 miles north-east of Paris, an important junc- tion on railway from Paris to ISTamur. It is now a forti- fied place of the second class. The walls have been demolished, detached forts having been erected outside their circle. There is a monument in memory of those who fell during the war of 1870-71, when the town was captured by the Prussians ; also, a statue of Bayard. The church, which suffered severely in 1870-71, has since been restored. Population (1891), 4675 ; (1901), 7884.*~~

~~*Mezohegyes, a market town of Hungary, in the county of Csanad, 31^ miles by rail north-west of Arad, with 6000 inhabitants. In the district is a great horse- breeding establishment founded in 1785 in connexion with a model farm. The town has a sugar refinery, a steam mill, and seven distilleries.*~~

~~*Mezzotint. See Engraving.*~~

~~*Mhow, town of Central India, with British military cantonment, within the native state of Indore, on the Malwa branch of the Eajputana railway between Khandwa and Rutlam, 13 miles south of Indore. Population (1881), 27,227 ; (1891), 31,773. It is the headquarters of a mili- tary division, with a strong force of all arms. There are two high schools, a Zoroastrian and a Canadian mission, the Dorabji Pestonji dispensary, with an endowment of Rs.28,500, and a gaol. The number of police is 135, and the expenditure on public works in 1897-98 was Rs.61,220.*~~

~~*Miagao, a town on the southern coast of the pro- vince of Iloilo, island of Panay, Philippine Islands. It*~~

~~*h as a cool and healthful climate. The neighbouring country is hilly and sterile, but produces sibucao in considerable quantities. The weaving of fabrics of abaca (Musa textilis) and pine-apple fibre is the most important local industry. The language is Panay-Visayan. Population, 22,000.*~~

~~*Miasskiy Zavod, gold-mining centre and town of Eussia, in the Urals, government of Orenburg, district of Troitsk, 4 miles from Mias railway station. The average annual extraction of gold amounts to 17,280 oz. Popula- tion, 10,580.*~~

~~*Miautze. See Lolos.*~~

~~*Michigan, one of the north central states of the American Union, lying in the valley of the Great Lakes. It is composed of two peninsulas, of which the northern, or as it is commonly called, the upper peninsula, is rich in minerals of various kinds ; the southern, or lower penin- sula, is adapted to agriculture.*~~

~~*Population. — In 1880 the population was 1,636,937; in 1890 it was 2,093,889. In 1880 the density per square mile was 27-80, and in 1900 it had risen to 41-1. In 1900 the total population had increased to 2,420,982. During the last twenty years of the 19th century the natural increase averaged 16-6 per cent, per year. The centre of population has been gradually moving northwards and westwards. In 1900, 541,653 inhabitants (22-4 per cent, of the population) were of foreign birth, and 22,419 (0-9 per cent, of the population were coloured, including 15,816 negroes, 240 Chinese, 9 Japanese, and, 6354 Indians. In 1894, 200,447 were natives of British America ; 96,384 of Great Britain and Ireland ; 143,057 were Germans ; 36,370 were from the Scandinavian peninsula; 32,868 were from Holland. These nationalities constituted 89 per cent, of the foreign population. There are eighty-five organized counties in the*~~

~~state, and seventy-eight incor- porated cities. Ten cities had more than 16,000 inhabit- ants in 1900 : Detroit, 285,704 ; Grand Rapids, 87,565 ; Saginaw, 42,345 ; Bay City, 27,628 ; Jackson, 25,180 ; Kalamazoo, 24,404 ; Muskegon, 20,818 ; Port Huron, 19,158 ; Battle Creek, 18,563 ; Lansing, 16,485. Nine cities had between 10,000 and 15,000 inhabitants : Ann Arbor, 14,509 ; Manistee, 14,260 ; Ishpeming, 13,255 ; West Bay City, 13,119 ; Flint, 13,103 ; Menominee, 12,818 ; Alpena, 11,802 ; Sault Ste Marie, 10,538 ; Marquette, 10,058. The proportion of population of incorporated cities and villages to the total population of the state was 60-1 per cent. The so-called urban population, classing as such all persons in cities of 8000 inhabitants or more, amounted to 747,334, or 30-9 per cent, of the total population, as against 26-1 per cent, in 1890. The death-rate in 1900 was 13-9 for the entire state. Por the rural districts and the cities of less than 8000 inhabitants it was 13-3 ; for the rest of the cities it was 15-3.~~

~~Education. — At an early date Michigan obtained from the general government two townships of land for the support of a univer- sity, and, lilce many other Western states, one section in each town- ship in the state for the support of schools. The funds received from the sale of these lands are held by the state as trust funds on which interest is paid. The annual income accruing to the University of Michigan from this source is $38,500. The school fund held by the state amounts to |4, 694, 025, and the income distributed to the schools from this source amounted to 1319,430 in 1898. There are still over 190,000 acres of school land unsold ; the university lands are almost entirely disposed of. The state holds a sum of $625,790 as a trust fund for the Agri- cultural College, and |66,128 as a normal school fund. In addition to these sums, the public schools received $636,982 from state specific taxes on corporations in 1898. Thes esums, supplemented by district taxation, show an annual expenditure of $7,867,640. In 1898 the ungraded school districts, numbering 6486, enrolled 208,751 pupils, while the graded school districts, 672 in number, enrolled 287,274. The total school attendance in 1898 was~~

~~541,490. In 1900 the number of persons of school age (5 to 20 years inclusive) was 790,275. The higher public institutions of learning are the~~

~~*University, which in 1900 had 3441 students, and 225 persons on the teaching staff ; the State Normal College, with 979 students and 46 teachers ; the Central Normal School, with 314 students and 14 teachers ; the Agricultural College, with 528 students (1899) and 35 teachers ; the Northern State Normal School at Marquette, with 90 students and 6 teachers ; the College of Mines, with 122 students and 17 teachers. In 1894, 5-7 per cent, of all persons of both sexes over five years of age could not read or write. The illiterates twenty-one years of age and over were 2-7 per cent, of the population. In 1900, when the total male population twenty- one years of age and over numbered 719,478, 39,230 (of whom 26,823 were foreign-born) could not write.*~~

~~*Religion. — There were in 1894, 3936 church organizations holding property valued at $20,775,156. The six largest denominations are the Methodists, with 1044 churches and $4,263,835 worth of property; the Baptists, with 370 churches and $1,977,910 worth of property; the Lutherans, with 364 churches and $1,6-33,675 worth of property ; the Roman Catholics, with 362 churches and $4,539,386 worth of property ; the Congregationalists, with 284 churches and $1,701,900 worth of property ; the Presbyterians, with 238 churches and $2,318,850 worth of property.*~~

~~*Charitable and Beformatory Institutions. — The school for the deaf at Flint and the school for the blind at Lansing may be classed as educational as well as charitable institutions. In 1898 the former had 412 pupils and the latter 109. The state public school for dependent and neglected children is situated at Coldwater ; in 1898 the pupils numbered 529. The state has established an industrial home for boys at Lansing, an industrial school for girls at Adrian, a home for the feeble-minded at Lapeer, and the Michigan Soldiers' Home at Grand Rapids. Public institutions for the improvement of criminals are the state prison at Jackson, the state house of correction and reformatory at Ionia, and the house of correction and prison at Marquette. There are asylums for the Insane at Kalamazoo (1308 patients), Pontlac (1057 patients), Traverse City (1011 patients), Newberry (300 patients), and Ionia (245 patients).*~~

~~*Agricultural Products. — Wheat continues to be the most im- portant agricultural product. The acres sown in 1898 were reported as 1,698,453, and the amount produced as 33,006.869 bushels. The yield in bushels of other principal cereals is : Indian corn, 37,259,938 ; oats, 27,529,558 ; clover seed, 86,373. In the same year 1,890,181 tons of hay were raised, and 22,355,520 bushels of potatoes. The number of acres in the apple orchards decreased slightly during the last quarter of the 19th century, but in 1898, 6,024,975 bushels were raised. The acreage of peach orchards has grown with slight fluctuation. In 1881 there were 12,908 acres of peach orchards ; in 1891 there were 20,124 acres ; in 1898 there were 50,148. Of peaches 413,418 bushels were sold in 1880, and in 1898, 1,872,147 bushels were grown. The raising of small fruit has also considerably developed since 1890.*~~

~~*Lumber. — The lumber industry has materially diminished be- cause of the rapid consumption of the standing timber. It has been estimated that Michigan had originally at least 150 billion feet of white pine. In 1897 not more than 10 billion feet were standing, and this was probably a large estimate. The largest cut of lumber ever made in a single year was in 1888, when the production is believed to have exceeded 4,200,000,000 feet. Since that time the decrease has been very marked. The following figures, though not oflBcial, are trustworthy, and include the cut of white pine, hemlock, and hard wood : —*~~

~~*Tear.*~~

~~*Lumber — feet.*~~

~~*Shingles,*~~

~~*1885 . 1890 .*~~

~~*1895 . 1899 .*~~

~~*. 3,578,138,732 . . 4,085,767,849 . . 2,731,029,535 . . 2,328,575,135 .*~~

~~*. 2,674,675,900 . 2,469,878,760 . 1,360,535,500 . 1,444,578,000*~~

The eastern portion of the southern peninsula has been nearly cleared of pine timber ; along the Saginaw river in 1891) there were probably not more than about 225,000,000 feet of timber cut. In Muskegon, where in a single year the cut has reached 750,000,000 feet, there are now only two or three mills, with an output of not far from 70,000,000 feet. The upper peninsula still has a good deal of lumber, but it is rapidly disappearing. In 1888 the Menominee River Boom Company handled 613,703,492 feet; in 1898 only 291,229,121 feet.

Fisheries. — The state through the agency of a commission has done valuable work in propagating fiish and in pi-otecting the natural industry. There are four state hatcheries, from which in two years (1897, 1898) 202,722,360 fish were planted in the waters of the state. The catch of all kinds in 1897 amounted to 32,602,745 pounds, valued at ^709,831.

Minerals. — Michigan produces more iron ore than any other state. The high quality of the ore and the unusual shipping facilities make the iron industry exceedingly important. In 1898

and 1899 the output was very large, amounting in the former year to 7,380,319 tons, in the latter to 9,285,524. Copper-mining has greatly developed. The copper companies have distributed in dividends $96,933,120 since the beginning. Of this sum $6,900,000 was divided or declared for payment in the first half of 1899. For 1899 the production of refined copper was 146,950,338 pounds. The output is 28 per cent, of the total production in the United States. Montana is the only state producing a larger amount. The Calumet and Hecla mine now employs 5000 men, and in 1899 turned out 89,610,963 pounds of copper. Michigan retains its position as first in salt production in the United States. The number of barrels manufactured in 1898 was 4,171,916, valued at about $2,000,000. Large manufactories of soda ash and allied pro- ducts have been established near Detroit, obtaining brine from deep wells. The coal deposits have attracted attention. In addition to those near Jackson, new mines have been opened in the Saginaw valley. The output in 1899 was 624,708 tons, and there are in- dications of a great development. There are many large beds of pure marl fitted to make the finest quality of

~~*Portland cement, for the manufacture of which companies have been organized and factories built. The daily production of cement for 1900 was estimated at 500 barrels.*~~

~~*Manufactures. — In 1900 Michigan ranked tenth among the states of the Union in the value of its manufactured products. The general increase in manufacturing industries during the decade 1890-1900 is shown by the following table : —*~~

~~*1890.*~~

~~*1900.*~~

~~*Per cent, of increase.*~~

~~*Number of establishments Capital .... Salaried officials, clerks, &c. Salaries .... Wage -earners (average*~~

~~*number) 'I'otal wages Miscellaneous expenses Cost of materials used Value of products*~~

~~*12,127*~~

~~*$262,412,240*~~

~~*i:.,207i*~~

~~*$11,364,8921*~~

~~*148,674*~~

~~*•$54,982,906*~~

~~*$18,-348,381*~~

~~*$154,521,918*~~

~~**277, 896,706*~~

~~*16,807*~~

~~*$284,097,133*~~

~~*1.3,858*~~

~~*$12,562,855*~~

~~*162,355*~~

~~*$66,467,867*~~

~~*$25,495,423*~~

~~*$199,5.59,905*~~

~~*$356,944,082*~~

~~*38-6 8-3 9-22*~~

~~*10-5*~~

~~*9-2 20-9 39-0 29-1 28-4*~~

~~*Statistics of twelve of the principal industries are as follows : —*~~

~~*Industry.*~~

~~*Number of Estflb- li.shtnents.*~~

~~*Capital.*~~

~~*Value of Products.*~~

~~*Agricultural implements*~~

~~*59*~~

~~*$8,9.32,.344*~~

~~*$8,339,508*~~

~~*Carriages and waggons*~~

~~*299*~~

~~*7,935,269*~~

~~*11,205,602*~~

~~*Cars, steam railway*~~

~~*4*~~

~~*6,693,209*~~

~~*9,920,780*~~

~~*Chemicals ....*~~

~~*51*~~

~~*7,503,853*~~

~~*5,.364,724*~~

~~*Flouring and grist-mill pro-*~~

~~*ducts ....*~~

~~*765*~~

~~*7,933,587*~~

~~*23,593,991*~~

~~*Foundry and machine-shop*~~

~~*products .*~~

~~364~~

~~19,595,771~~

~~20,615,864~~

~~Furniture~~

~~124~~

~~13,900,789~~

~~14,614,506~~

~~Iron and steel~~

~~10~~

~~3,859,050~~

~~5,902,058~~

~~Leather (tanned, curried, and~~

~~finished) ....~~

~~27~~

~~5,214,042~~

~~6,015,590~~

~~Liquors, malt~~

~~77~~

~~6,2.35,484~~

~~5,296,825~~

~~*Lumber and timber products*~~

~~*1705*~~

~~*67,379,698*~~

~~*54,290,520*~~

~~*Lumber, planing mill pro*~~

~~*ducts ....*~~

~~*235*~~

~~*8,571,453*~~

~~*12,469,532*~~

~~*The making of furniture is one of the greatest industries of the state ; in Grand Rapids alone, which is the centre of the furniture business, $7,494,607 worth of product was manufactured in 1900. One factory in 1899 consumed 2,800,000 feet of veneering and 4,800,000 feet of lumber. Half-yearly fairs are held in Grand Rapids, to which manufacturers in various parts of the country send exhibits, and which are attended by buyers from all over the world. In 1897 the legislature passed a law offering a bounty of one cent for every pound of sugar manufactured for the years 1897 and 1898. In 1900 there were nine large beet sugar factories, with an aggregate invested capital of $4,013,743 and employing 437 persons. In the year ending 31st May 1900 the product of these factories amounted to 33,708,283 lb.*~~

~~*Railways.—Theve are 81 lines of railway, with a single track mileage of 10,497 miles. The capital stock is $441,685,405. Their gross earnings in 1899 amounted to $182,144,820, and the net earnings to $55,827,574. During that year 48,195,594 passengers were carried and 102,456,846 tons of freight handled. The chief lines are the Michigan Central, the Chicago and Grand Trunk, the Lake Shore and Michigan Southern, and*~~

~~*the Pere Marquette. Be- sides these there are many inter-urban electric lines.*~~

~~*Banks.— At the end of 1899 there were 187 state banks, 3 trust companies, and 80 national banks. The state banks and trust companies had as their paid-up capital $12,262,100, with surplus and undivided earnings of $5,090,321. The following table will show the depositors and the sums deposited on Slst December 1899 :—*~~

~~*Banks.*~~

~~*Class of Deposit.*~~

~~*No. of Depositors.*~~

~~*Sums on Deposit.*~~

~~*Average*~~

~~*to eacti*~~

~~*Depositor.*~~

~~*187 State 80 National*~~

~~*f Commercial 1 Savings Commercial*~~

~~*77,857*~~

~~*216,488*~~

~~*87,423*~~

~~*$ 36,772,566 62,660,212 49,920,532*~~

~~*$ 472 290 571*~~

~~*381,768*~~

~~149,353,310~~

~~.391~~

~~1 Includes proprietors and firm members, with their salaries.~~

~~”’ Decrease.~~

~~Thus the total sum on deposit was nearly $60 for every inhabitant in the state.~~

~~Finances. — The financial condition of the state has for many years been peculiarly good. On 30th June 1900 the treasury held a cash balance of $2,501,557, while there was a total bonded indebtedness of only $500,000, most of which was borrowed to defray the war expenses in 1898. There is also a trust-fund debt of $6,273,144, on which interest is paid for the support of various state educational institutions. The aggregate value of property according to tax appraisal in 1896 was $1,105,100,000. A re-etjualization was made in 1901, in accordance with which the appraisal was $1,578,100,000, because a great deal of personal property not before listed had been spread on the rolls. In 1896 the rate of taxation was 1-87 mills on the dollar ; the next year it was 2‘154 mills ; in 1898 it was 1 -95 mills, or a little less than one-fifth on 1 per cent. The proceeds from the direct taxes on real and personal property amounted in 1900 to $3,725,835. In the same year $1,438,946 were received from specific taxes on corporations.~~

~~History. — The Republican party has been successful in every election for governor except in 1882 and 1890, and since the forma- tion of the party in 1854 has controlled the government, with the exception of four years. The constitution of 1850 still remains the fundamental law. The salaries paid under it to a number of the state officers were very small, and various amendments providing for an increase have usually been rejected. The salaries of the governor and the circuit judges have been increased. The Supreme Court is now composed of five justices, one of whom is chosen every two years. The state is divided in thirty-six judicial circuits, on some of which there are several judges.~~

~~*Authorities. — Coolet. Michigan, A History of Governments (American Commonwealths). Boston, 1885. — See also the State Census Reports for 1884 and 1894, published at Lansing two years later in each case, the Legislative Manuals, &c., for 1899-1900 (Lansing, 1899), and the reports of the various state officers for the year 1898 and 1899 (Lansing). (a. c. M.)*~~

~~*Michigan City, a city of Laporte county, Indiana, U.S.A., on Lake Michigan, near its southern end, and on three railways, the Chicago, Indianapolis, and Louisville, the Lake Erie and Western, and the Michigan Central, in the north-western part of the state, at an altitude of 600 feet. The city has a large trade by lake and rail, and varied manufactures. Population (1890), 10,776 ; (1900), 14,850, of whom 3662 were foreign-born and 197 were negroes.*~~

~~*Michigan, University of, the largest and most influential of the state universities of the United States, situated in Ann Arbor, Michigan, a city of 14,500 in- habitants, 40 miles from Detroit. It is the head of the state system of public instruction. Founded in 1837, it opened its doors in 1841, and graduated its first class in 1845. In 1900 its students numbered 3441. The enrol- ment in the different departments, including duplicates, was as follows : Literature, Science and the Arts, 1561 ; Engineering, 280 ; Medicine and Surgery, 600 ; Law, 882 ; School of Pharmacy, 76 ; Homoeopathic Medical College, 70 ; College of Dental Surgery, 247. The teaching staff numbers 230 men. The five libraries, general, law, medical, dental, and homoeopathic, contained, in 1899, 133,206 volumes. The laboratories are numerous and well equipped. The higher degrees (Ph.D. and Sc.D.) are conferred only on examination. The university is co-educational, the ratio of men to women in all departments being about*~~

~~*four to one, but in the literary department 5-6 to 4-4. The institution is supported partly by the income of its endowment fund, partly by fees,*~~

~~*partly by appropriations from the state treasury. The total receipts for the fiscal year ending 30th June 1899 were f 530,000.*~~

~~*Michoacan de Ocampo, a state of Mexico, bounded on the N. by Guanajuato, on the N.E. by the states of Mexico and Queretaro, on the S.E. by the state of Guerrero, on the S.W. by that of Colima, on the W. by Jalisco, and on the S. by the Pacific. Its area is 22,881 square miles. The population in 1879 was 661,534, and in 1900 it was 935,849. It is mountainous, and has a wonderfully rich vegetation, and is also one of the richest mining sections of Mexico, gold, silver, copper, iron, cinnabar, lead, sulphur, coal, marlole, &c., being found in abundance. Foreign trade is carried on through the ports of Vera Cruz and Manzanillo and the frontier towns of Paso del Norte and ISTuevo Laredo. The total trade amounts on an average to about $25,000,000 a year. The Mexican National and the Mexican Central railways traverse the state. The manufacturing industries supply most of the local wants. The capital, Morelia, has 33,890 inhabitants. Amongst other towns are Zamora (10,373), Uruapan (9276), Angangueo (9115), La Piedad (8876), Sahuayo (8443), Puruandiro (7782), Patzcuaro (7082), Zatcuaro (6207), Tacambaro (6369).*~~

~~*Micronesia. — The three insular groups comprised under the expression Micronesia — CaroUnas, Marianas or Ladrones and Pelew or Palao Islands — have been the scene of sweeping political changes, and of archaeological discoveries of exceptional interest. Since their discovery by Spanish navigators in the 16th and 17th centuries all the groups had been recognized as Spanish territory till the year 1885, when the Germans, after proclaiming the New Britain and Admiralty Archipelagos (see Melanesia), took possession of Yap (AVap), one of the largest of the western Carolinas. Before that time Spain never had occupied this or any other member of the group, or even had any relations at all with the Archipelago, except indirectly through the natives of Guam, largest of the Marianas, by whom most of the local trade of the Archipelago is even still carried on. Nevertheless an energetic protest was at once raised, and on the ques- tion being referred for arbitration to the Papal Court, an award was given by Pope Leo XIII. in favour of the Spanish claim to all the Carolinas. Thereupon a treaty (December 1885) was concluded between*~~

Germany and Spain, in which the Spanish sovereignty over the Caro- linas and Pelews was recognized, and the groups defined as lying between the limits of the equator and 11° N. and 133°-1G4° E. A first attempt was now made by Spain to bring about an effective occupation, and the Archipelagos were divided into two administrative dis- tricts— the Eastern f 'arolinas and the AYestern Carolinas with the Pelews. But the new system of government was resented by the natives, and a general revolt in the large island of Ponape had to be suppressed with much bloodshed in September 1S90. This was the last act of sovereign authority exercised by Spain in these waters, and the Spanish flag disappeared from the Pacific insular world in June 1899, when the whole of Micronesia, with the solitary exception of the ishuul of Guam, was sold to Germany. Micronesia comprises altogether about 680 islands and islets, stretching from west to east for over 2000 miles, but with a total population of perhaps less than 50,000. All the islands are of low coralline foi'nui,- tion except the Pelews and Yap in the west, Uuk in the centre, and Ponape and Kusaie in the east, which are of a rugged hilly character, rising from iibout 800 to nearly 3000 feet in altitude. In the central and eastern parts of

Micronesia most of the foreign trade is in the hands of Japanese, American, and German shippers, who forward considerable quantities of copra, Mche-de-mer (sea-cucum- ber), vegetable ivory nuts, turtle-shell, and pearl-shell. In 1898 the copra exported from the Carolinas was stated to exceed 4,000,000 lb weight, of which nearly half ^^•as shipped at Yap.

The inhabitants of Yap on the western fringe of Micronesia are noted for possessing the most extraordinary currency, if it can be so called, in the whole world. Besides the ordinary shell money, there is a sort of stone coinage, consist- " '°° ing of huge calcite or limestone discs or wheels from """"'^y- 6 inches to 12 feet in diameter, and weighing up to nearly five tons. These are all quarried in the Pelew Islands, 200 miles to the south, and are now brought to Yap in European vessels. But some were in the island long before the arrival of the whites, and must consequently have been brought by native canoes or on rafts. The stones, which are rather tokens than money, do not circulate, but are piled up round about the chief's treasure-house, and appear to be regarded as public property,

~~*although it is hard to say what particular use they can serve. Mr Christian concludes that they are " more for show and ornament than for use." In Ponape and Kusaie, towards the eastern verge of the Carolina group, Herr Kubary, Mr F. J. Moss, and later Mr F. 'W. Christian, have made some remarkable discoveries amid the massive stone structures which were long known to exist in those islands, as well as in several other parts of the Pacific Ocean. None of the colossal remains hitherto described appear to have been erected by the present Melanesian or Polynesian peoples, while their wide diffu- sion, extending as far as Easter Island, within 400 miles of the New World, points to the occupation of the Pacific lands by a prehistoric race which had made some advance in general culture. The Funafuti borings (1897) show almost beyond doubt that Polynesia is an area of comparatively recent subsidence. Hence the land connexions must have formerly been much easier and far more continuous than at present. The dolmen-builders of the New Stone Age are now known to have long occupied both Korea and Japan, from which advanced Asiatic lands they may have found little difficulty in spreading over the Polynesian world, just as in the extreme west they were able to range over Scan- dinavia, Great Britain, and Ireland. To Neolithic man, still perhaps represented by some of the more light-coloured and more regular-featured Polynesian groups, may therefore not unreason- ably be attributed these astonishing remains, which assume so many different forms according to the nature of the locality, but seem generally so out of proportion with the present restricted areas on which they stand. With the gi-adual subsidence of these areas their culture would necessarily degenerate, although echoes of sublime theogonies and philosophies are still heard in the oral traditions and folklore of many Polynesian groups. In the islet of Lele, close to Kusaie, at the eastern extremity of Micronesia, the ruins present the appearance of a citadel with cyclopean ram- parts built of large basaltic blocks. There are also numerous canals, and what look like artificial harbours constructed amid the shallow lagoons.*~~

~~*In Ponape the remains are of a somewhat similar character, but on a much larger scale, and with this difference, that while those of Lele all stand on the land, those of Ponape are built in the water. The whole island is strewn with ^^^ natural basaltic prisms, some of great size ; and*~~

of this Poive material, brought by boats or rafts from a distance of mints. 30 miles, and put together without any mortar, but sustained by their own weight, are built all the massive walls and other structures on the east side of the island. Ponape is of circular form, scarcely 16 miles in diameter, and with an area of ;!40 square miles ; yet the walls of the main building near the entrance of Metalanim harbour form a massive quadrangle 200 feet on all sides, with inner courts, vault and raised platform with walls 20 to 40 feet high and from 8 to 18 feet thick. Some of the blocks are 25 feet long and 8 feet in circumference, and many of them weigh from 3 to 4 tons. There are also numerous canals from 30 to 100 feet wide, while a large number of islets, mainly artificial, covering an area of 9 sipare miles, have all been built up out of the shallow waters of the lagoon round about the entrance of the harbour, with high sea-walls composed of the same huge basaltic prisms. In some places the walls of this " Pacific Venice," are now submerged to sonui depth, as it the land had subsided since the construction of these extensive works. Else- wliere huge breakwaters had boon constructed, the fragments of wliich may still be seen stretching away for a distance of from 2 to 3 miles. Most observers, such as Admiral Cyprian Bridge and Mr Le HIunte, agree tliat these structures could not possibly be the work of any of the present Polynesian peoples, and attribute them to a now extinct prehistoi'io" race ; that is, as here

suggested, the men of the New Stone Age from the Asiatic mainland.

Authorities. — J. S. Kueaky. Ethnographische Beitrage zur Kenntniss des Karolinen-Archipel. Leyden, 1889-92. — F. W. Christian. The Caroline Islands. 1900. — Dr E. H. H. Guille- MARD. Australasia, vol. il. London, 1894. — De Adeade. HIs- toria del Conflicto de las Carolinas, &c. Madrid, 1886. — Montero Y ViDAL. El Archipelago Filipino y las Marianas, &c. Madrid, 1886. _ ^ (.^. 11. K.)

Microtomy is the term applied to the preparation of minute sections of organic tissue for the microscope. In 1875 the methods were yet in their

infancy ; their development has enabled observers to achieve the most exact study of minute anatomy, in the case of small objects, which without these methods could only be investigated by the unsatisfactory process of focussing with the microscope through the solid object. It is not necessary here to detail at length the well-known wet method of preparing sections. Briefly, the tissue is soaked in a solution of gum, or of gum and syrup, and after being' frozen by ether spray, or by a mixture of ice and salt, is cut into sections either by the Rutherford, Cathcart, or some similar section-cutter, or by apparatus which can be fitted to the more modern types of micro- tome referred to below. This method, which is to-day used mainly by pathologists, has two main disadvan- tages : the prolonged action of watery fluids on the tissues, and the impossibility of getting ribbons, each sec- tion having to be picked up separately. The general pro- cesses of the dry method employed in zoological and botanical microtomy are, up to a certain point, practically identical with those used for the preservation of animals and their tissues for other branches of microscopic work. In the first place the tissues must be killed; in the sec- ond, they must be fixed, i.e., the protoplasm must be set or coagulated as far as possible in the condition in which it appears in life ; and in the third, they must be hard- ened, i.e., in most cases dehydrated. Killing may be effected by asphyxiation or narcotization (nicotine, co- caine, chloral hydrate, &c.) in special cases, but is generally achieved by fixing reagents, of which corrosive sublimate and other chlorides, picric, acetic, osmic, and chromic acids, alone, or in combination, chromates, and strong alcohol, are the most usual. These serve to a great extent also as hardening agents, but alcohol, used after them, completes this process effectively, and when not too strong (70 per cent.) is the best storage fluid. The second set of processes relates to the staining, with- out which transparent sections are almost invisible. The stains are divisible into general stains, which dye the tissue practically uniformly and indifferently ; and selec- tive stains which have affinity for special tissues or cell elements. Of the latter group- some fasten on nuclei, others only on the chromatin of the nuclei ; some on con- nective tissues, others on muscle fibres, and so on. It is probable that the action of all these selective stains is produced by definite chemical combination with com- pounds originally present in, generated in, or introduced into the tissue selected. The most generally useful stains — for ordinary work belong

either to the cochineal series (borax-carmine, carmalum, &c.), or to the logwood series (haematoxylin, hsemalum,iron hgematoxylin, &c.) ; in both of these great improvements have been introduced of late years by Dr Paul Mayer. The activity of these stains apparently depends upon the presence of alumina or of some similar base. For more special researches, such as cytology, neuro-pathology, neuro-histology, and so forth, greater dependence is placed on the coal-tar colours, the name of which is legion. Some of these, such as saffranin or gentian violet, are regressive stains ; that is to say, the tissues are overstained uniformly, and the superfluous colouring matter washed out either by alcohol or by

weak hydrochloric ■ acid from the unselected parts. Others, such as methyl green, are progressive — that is, the colour is brought up to the pitch required and the reaction promptly stopped. The coal-tar stains can be used singly, or in combinations of two or three. Some of the best, unfortunately, are not permanent. A third group of stains is furnished by such reagents as silver nitrate, gold chloride, and the like (impregnation stains), which can be made not only to stain, but also to deposit a fine metallic precipitate on certain structures. In the case of small and delicate objects, the staining is done in the mass before any further preparation for sections, but with larger animals, or large pieces of resistant tissue, the stain is applied to the sections only. The processes so far mentioned are applicable to many branches of microscopic work.

When preparing tissues for sections, the first step is complete dehydration, generally effected by bringing the object into absolute alcohol. It is then transferred to one of a group of reagents, which are miscible with absolute alcohol, but would form an emulsion with water, and are solvents of the embedding medium. The embedding mass in most general use is paraffin wax, melting at a tempera- ture of 54° to 60° C, according to the character of the object and the thickness of section required. The object is transferred from absolute alcohol to benzol, chloroform, cedar oil, or similar fluid to the melted paraffin ; the fluid diffuses and evaporates, leaving the tissues to be completely permeated by the paraffin. This process can be greatly hastened by the use of a partial vacuum. When impregnation is complete the paraffin is cooled rapidly so as to assume a homogeneous non-crystalline condition, and the tissue

~~thus comes to form part of a block of soft but tenacious material, which protects it from damage by air or damp, and can be readily cut by a razor. The block is then trimmed to the form of a triangle or rect- angle, and fixed by a clamp or by local melting in the holder of the microtome.~~

~~Numerous forms of excellent microtome have been evolved since 1885. Some of these have distinct advan- tages over others, but with microtomes, as with other tools, the success of the results depends very largely on the manipulator, for every one works best with his accus- tomed instrument. In one type of microtome the razor is attached at one end only to a heavy block, sliding back- wards and forwards in a horizontal V-groove ; the paraffin- block is fed to this either up a vertical guide (Schanze, Reichert, &c.), or up an inclined plane (Thoma-Jung). In another type the razor is firmly clamped at both ends to diminish vibration, and the paraffin block advances to it at the end of a long lever on trunnion bearings (Cam- bridge rocker), or up a vertical guide (Minot types).~~

~~In the selection of amicrotome, apart from its steadiness, rigidity, accuracy of workmanship, and so forth, it must be borne in mind that, in general, simplicity of working parts means longer life, and that an elaborate " automatic " mechanism, by which a single movement is translated into several in different directions, not only complicates the machine, but robs the operator of those alterations of pace, rigidity, pressure, &c., which are often necessitated by the varying texture in different parts of the object cut. For general use by less skillful students in a laboratory, price, simplicity, and rapidity of work recommend the rocking microtome of the Cambridge Scientific Instrument Com- pany, but it tends to fail at large or hard objects. For the all-round work of an investigator, its simplicity and finish have made Jung's sliding microtome with the Naples im- provements deservedly popular for many years ; it can be fitted with special apparatus for cutting celloidinand frozen objects, and it can be relied upon to cut any tissue, how- ever difficult ; but it cannot be worked as rapidly as some~~

~~others, nor produce long ribbons of large objects. For tills latter purpose the Minot-Becker, Minot-Zimmermann, and Eeinhold-Gilltay haTC been strongly recommended ; these, however, are all of more complicated construction, with corresponding liability to uneven wear and damage ; they are highly " automatic," leaving nothing but pace under control of the operator, and they are (particularly the last) expensive.~~

~~The sections, when cut by the microtome with the knife straight and the two sides of the rectangular paraffin block parallel to it, in most cases can be got off in a continuous ribbon, each sticking to its predecessor. This very desirable result generally can be insured by a coating of softer paraffin ; but if the object be large, or brittle, or of varying texture, it is safer to cut the sections singly from a triangular block with an oblique knife. The sections or ribbon are often not quite flat, but rolled, creased, or compressed; they must be flattened before being attached to the slide. It is possible to carry out these two processes simultaneously by covering the care- fully-cleaned slide with plenty of a very dilute solution of Mayer's glycerine and albumen, and laying the sections on the fluid and the slide on a hot-plate ; as the water becomes warm the sections flatten out, and as it evapo- rates they settle down on the slide, and are held there by the albumen (many other methods are in use). The slide is then warmed to melt the paraffin, and plunged into benzol, or some similar fluid, which removes the paraffin ; thence into absolute alcohol which dehy- drates and coagulates the albumen. If the tissue has not been stained en bloc, the sections can now be stained on the slide. After staining they are finally dehydrated, rendered transparent by oil of cloves, and mounted in xylol-dammar or Canada balsam.~~

~~For ordinary work the paraffin method excels all others for rapidity, certainty, and cleanliness ; but for large and hard objects, or crumbling tissues (such as ova with a large quantity of yolk), some manipulators prefer to embed in celloidin. By this method, after dehydration, the tissue is soaked in a mixture of absolute alcohol and ether ; thence transferred either to increasingly strong solutions of celloidin in the same mixture or to a thin solution which is then boiled down till strong. The celloidin mass is then hardened, at first, if necessary, by drying, afterwards by a bath of chloroform or its vapour ; it can then be cut in the microtome, either wet,~~

~~*or (if previously cleaned with cedar oil) dry like a paraffin block. The method is more tedious and more messy than the paraffin process ; but amongst its advantages must be reckoned that little or no heat is required, and that the embedding mass is transparent, though it does not allow of such thin sections as paraffin.*~~

~~*The above accounts present an outline of the complex processes employed to-day, by which, on the one hand, sections 30 jj. in thickness may be made through the entire human brain, and, on the other, organisms invisible to the naked eye may be cut into a long ribbon of consecutive sections 1 fj. (one-thousandth of a millimetre) thick, every minutest fragment being retained in its projjer place. The standard book on the subject is BoUes Lee's Mknitonusfs Vude Mecum. (5th edition, 1900), but this should be used only to supplement direct practical training in a laboratory. (<;. h. fo.)*~~

~~*Middelburg, ancient capital of the Dutt-li province of Zeeland, in the middle of the island of Walcheren, 4 miles north by east of Flushing, on the KozencUuil- Flushing railway. There are steam tramway and steam-boat service to Flushing, and canals to Veere and Arnemuiden. Flourishing agricultural markets, flour and margarine factories, and trade in wood indicate partial*~~

~~*revival of trade. In 1876 a large new dock was opened. The Zeeland society has increased its treasures with maps, plans, and drawings relating to Zeeland — Zeelandia Illus- trata — and a complete collection of the fauna and flora of the province. Population (1882), 15,939; (1898),*~~

~~*18,635.*~~

~~*Middelburg (Transvaal). See Transvaal.*~~

~~*M idd leboro, a town of Plymouth county, Massachu- setts, U.S.A., in the south-eastern part of the state, with an area of 73 square miles of rolling surface, interspersed with lakes and ponds. It contains several small villages, the largest of which bears the same name as the town. It is traversed by a branch of the New York, New Haven and Hartford*~~

~~railroad. Population (1890), 6065; (1900), 6886, of whom 920 were foreign-born.~~

~~Middlesbrough — often spelt Middlesbobough, though never locally, the charter having been granted under the first name — a municipal, county (1888), and parliamentary borough, seaport, and market town of Yorkshire, England, on the Tees, 238 miles by rail north of London. Among modern erections are a music hall, co-operative stores, and extensions of the public baths. The high school was enlarged in 1892. The municipal buildings, costing about £130,000, were opened in 1889 ; thither has been removed the free library. There are 2 daily newspapers. In 1888 the artificial channel branching oif from the river, by which the docks are reached, was deepened from 23 to 28 feet and widened from 80 to 200 feet, an extreme width of about 230 feet having been given at the mouth of the channel. The docks have also been enlarged to the extent of about 4 acres, and made accessible at all states of the tide for the. largest vessels up to 8000 tons burden. There is nearly 1300 feet additional length of quay accommoda- tion. Extensive tube works, wire mills, and oil works have become important. In 1891 there were 5460 per- sons employed in the iron and steel trade, and 1437 persons in the making of machinery. The imports of foreign and colonial merchandise in 1898 were valued at £1,081,693, against £773,485 in 1888. The exports of produce of the United Kingdom in 1898 were valued at £4,592,415, against £2,675,795 in 1888. The export of iron of all sorts in 1898 was valued at £2,887,067; of machinery and mill work, at £186,152 ; of cotton yarn, at £397,941 ; of cotton manufactures, at £382,940. In 1900 the total value of the exports was £6,318,282. In 1901 the output of pig-iron at the furnaces within the port amounted to 1,920,000 tons (annual average of 1896-1901, 2,190,250 tons) ; and in the same year 960,785 tons of pig-iron and 353,649 tons of manu- factured iron and steel were exported. 99 vessels of 35,806 tons were registered in 1888, 67 of 39,594 tons in 1900. Vessels entering the port in 1888 numbered 3445 of 1,340,940 tons; clearances, 3619 of 1,380,279 tons. Entrances in 1900 numbered 3495 vessels of 1,843,165 tons ; clearances, o46,'> of 1,836,353 tons. Area of municipal and county borough, 2824 acres. Population (1881), 55,934; (1891), 75,532; (1901),**

~~91,317.~~

Middlesex, an inland cou.nty in the south-east of England.

^Ircd and Popniation. — The area of the ancient comity as given in the census returns is 181,301 acres, or 283 square miles, with a population in 1881 of 2,920,486, in 1891 of 3,251,671, and in 1901 of .3,585,139, the number of persons per square mile being 12,068, and of acres to a person, -05. The area of the administrative county is 149,046 acres, with a population of 792.225 in 1901. 31,484 acres of the ancient county were transferred under

the provision of the Local Government Act, 1888, to the county of London, and 771 acres to Hertfordshire ; and under the London Government Act, 1899, South Hornsey has been transferred to London. The area of the regis- tration county is 178,764 acres, with a population in 1891 of 574,999, and in 1901 of 810,213. Within this area the increase of population between 1881 and 1891 was r>0-93 per cent. The excess of births over deaths between 1881 and 1891 was 76,765.

The following table gives the number of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1899 : —

Year.

Marriages.

Births.

Deaths.

Uloflitimate Births.

Males.

Females.

~~*1880 1800 1899*~~

~~*2104 3149 5309*~~

~~*12,240 16,475 21,963*~~

~~*6,332*~~

~~*9,290*~~

~~*11,8.50*~~

~~*246 251 361*~~

~~*201 246 314*~~

~~*The following table shows the marriage-, birth-, and death- rates per thousand of the population, with the percentage of illegitimate births, for a series of years : —*~~

~~*1870-T9.*~~

~~*1880.*~~

~~*1880-89.*~~

~~*1890.*~~

~~*1889-98.*~~

~~*1899.*~~

~~*Marriage-rate*~~

~~*10-4*~~

~~*11-3*~~

~~*11-1*~~

~~*11-3*~~

~~*11-7*~~

~~*13-2*~~

~~*Birth-rate*~~

~~*32-1*~~

~~*82-9*~~

~~*83-0*~~

~~*29-5*~~

~~*28-4*~~

~~*]27-3*~~

~~*Death-rate .*~~

~~*18-8*~~

~~*17-0*~~

~~*16-5*~~

~~*16-6*~~

~~*14-7*~~

~~*14-7*~~

~~*Percentage of*~~

~~*illegitimate*~~

~~*births*~~

~~*3-6*~~

~~*3-7*~~

~~*3-5*~~

~~*30*~~

~~*3-1*~~

~~*3-1*~~

~~*Both the birth-rate and death-rate are below the average of all England. The number of Soots in the county in 1891 was 6066 ; of Irish, 5834 ; and of foreigners, 4409.*~~

~~*Administration. — The ancient county is divided into seven par-liamentary divisions, and contains no parliamentary boroughs, excepting those now included in the county of London. The administrative county includes the following urban sanitary dis- tricts:— Acton (37,744), Brentford (15,171), Chiswick (29,809), Ealing (33,040), Edmonton (46,899), Enfield (42,738), Finchley (28,591), Friern Barnet (10,101), Greenford (819), Hampton (0812), Hampton Wick (2606), Hanwell (10,437), Harrow (10,220), Hendon (22,450), Heston and Isleworth (30,838), Hornsey (72,056), Kingsbury (757), Southall Norwood (13,200), Southgate (14,993), Staines (6686), Sunbury-on-Thames (4544), Teddington (14,029), Tottenham (102,519), Twickenham (20,991), Uxbridge (8585), Wealdstone (5852), Wembley (4.568), Willesden (114,815), Wood Green (34,188). With the exception of the City of London, which has a separate police force, the county of Middlesex is wholly within the Metropolitan Police District and jurisdiction of the Central Criminal Court. The administrative county has one court of quarter sessions, and is divided into eight petty sessional divi- sions. The ancient county, which is almost entirely in the diocese of London and province of Canterbury, contains 122 ecclesiastical parishes and parts of eleven others, exclusive of those now in the county of London. Part of Stanwell parish is in the diocese of Oxford.*~~

~~*Education. — The number of elementary schools in the county on 31st August 1899 was 245, of which 84 were board and 161 were voluntary schools. The average attendance at board schools was 435,298, and at voluntary schools 177,124. The total school board receipts for the year ended 29th September 1898 were over £287,985. The income under the Agricultural Rates Act was over £1813. At Twickenham there is a training college for school-mistresses, and one at Spring Grove for masters. At Whitton, Kneller Hall is a college for military musicians. In 1899 there were twelve reform- atory and industrial schools in the county.*~~

~~*Agriculture. — Nearly two-thirds of the area of the county is under cultivation, and of this about one-fourteenth is in permanent pasture. In 1899, 4316 acres were devoted to small-fruit cultiva^ tion, and 3656 were under wood. There is no heather land in the county. The following table gives the main divisions of the cultivated area at intervals from 1880 : —*~~

~~*Year.*~~

~~*Total Area under Cultivation.*~~

~~*Corn Crops.*~~

~~*Green Crops.*~~

~~*Clover.*~~

~~*Permanent Pasture.*~~

~~*Fal- low.*~~

~~*1880 1890 1899*~~

~~*117,087 112,847 102,198*~~

~~*17,169 12,811*~~

~~*9,469*~~

~~*14,161*~~

~~*12,755 10,875*~~

~~*3286 2806 2.517*~~

~~*81,470 80,878 73,940*~~

~~*1051*~~

~~*771*~~

~~*1081*~~

~~*The following table gives particulars regarding the principal live stock during the same years : —*~~

~~*1880 1890 1899*~~

~~*Total Horses.*~~

~~*6183 6240 6279*~~

~~*Total Cattle.*~~

~~*25,859 20,878 16,742*~~

~~*Cows or Heifers*~~

~~*in MUk or in*~~

~~*Calf,*~~

~~*16,790*~~

~~*14,100*~~

~~*6,096*~~

~~*Sheep.*~~

~~*32,267 21,358 18,717*~~

~~*Pigs.*~~

~~*10,962 11,667 13,271*~~

~~*Industries and Trade. — According to the annual report for 1898 of the chief inspector of factories (1900), the total number of per- sons employed in factories and workshops in 1897 was 23,922, as compared with 20,744 in 1896. Textile factories only employed 27. In non-textile factories 20,497 persons were employed, as compared with 17,875 in 1896. Of this number 6148 were em- ployed in the manufacture of machines, appliances, conveyances, or tools. Ot the 3398 persons employed in workshops, 1894 were employed in the clothing industries. The chief industries besides these are brick- and tile-making, malting, distilling, and soap- making. The gunpowder mills known as the Houston Mills are extensive establishments.*~~

~~*Authorities. — Lysons. Parishes in the County of Middlesex. London, 1800. — Trimen and Dyer. Flora of Middlesex. London, 1869. — Whitaker. Geology, Memoirs of the Geological Survey. London, 1864. — Harting. Birds of Middlesex. London, 1866. — Transactions of the London and Middlesex Archmological Society. London, from 1860. (h. b. w*.)*~~

~~*Middleton, a municipal borough (1886) and market town in the Middleton parliamentary division of Lan- cashire, England, 6 miles north of Manchester on the Lancashire and Yorkshire railway. There are chemical works and coal mines, but the staple industry is in cotton and silk. Population (1881), 19,750; (1901),*~~

~~*26,178.*~~

~~*Middletown, a city of Connecticut, U.S.A., capital of Middlesex county, on the west bank of the Connecticut river, 30 miles from its mouth, and on the New York, New Haven and Hartford railroad. It is well laid out, with broad, shaded streets, and has a good water- supply brought by gravity. Wesleyan University, which is situated here, had, in 1899, 35 professors and in- structors, and was attended by 331 students, 75 of whom were women. Its property was valued at f 1,983,133, and its income was*~~

~~*$108,669. Population (1890), 9013 ; (1900), 9589, of whom 2316 were foreign-born and 127 were negroes.*~~

~~*Middletown, a city of Orange county. New York, U.S.A., on the Walkill river, in the south-eastern part of the state, at an altitude of 564 feet. It is on three rail- ways, the Erie, the New York, Ontario and Western, and the New York, Susquehanna and Western. Population (1890), 11,977 ; (1900), 14,622, of whom 1700 were foreign- born and 480 were negroes.*~~

~~*Middletown, a city of Butler county, Ohio, U.S.A., on the Miami river, on the Miami and Erie Canal, and on the Cincinnati, Hamilton and Dayton, the Cincinnati Northern, the Cleveland, Cincinnati, Chicago and St Louis, and the Middletown and Cincinnati rail- ways, in the south-western part of the state, at an altitude of 667 feet. It has varied manufactures, among which the making of paper is prominent. Population (1890), 7681 ; (1900), 9215, of whom 769 were foreign-born and 314 were negroes.*~~

~~*Middletown, a borough of Dauphin county, Penn- sylvania, U.S.A., on the east bank of the Susquehanna river, 9 miles below Harrisburg, and on the Pennsylvania and the Philadelphia and Reading railways, towards the south-eastern part of the state, at an altitude of 546 feet. Its manufactures are largely of iron and steel. Popula- tion (1890), 5080; (1900), 6608, of whom 340 were foreign-born and 289 were negroes.*~~

~~*Mid hat Pasha (1822-1884), Turkish statesman, the son of a civil judge, was born at Constantinople in 1822. His father, a declared partisan of reform, trained him for an administrative career, and at the age of twenty-two he was attached as secretary to Faik Effendi, whom he accompanied in Syria for three years. On his return to Constantinople Midhat was appointed Chief Director of Confidential Eeports, and after a new financial mission in Syria was made second secretary of the Grand Council. His enemies, however, succeeded in ousting him from this post, and caused him to be entrusted with the apparently impossible task of*~~

~~*settling the revolt and brigandage rampant in Eumelia. His measures were drastic and their success was startling, and the Government made him an official of the first rank and restored him to his place in the Grand Council. In similar vigorous fashion he restored order in Bulgaria in 1857. In 1860 he was made vizier and pasha, and entrusted with the govern- ment of Nisch, where his reforms were so beneficial that the Sultan charged him, in conjunction with Fuad Pasha and Ali Pasha, to prepare the scheme for adapting them to the empire which was afterwards known as the law of the vilayets. After further administrative work in his province, he was ordered to organize the Council of State in 1866, and was then made governor of Baghdad, where his success was as decisive as at Nisch, but attended with much greater difficulties. In 1871 the anti-reform in- fluence of the Grand Vizier, Mahmoud Nedim, seemed to Midhat a danger to the country, and in a personal interview he boldly stated his views to the Sultan, who was so struck with their force and entire disinterested- ness that he appointed Midhat Grand Vizier in place of Mahmoud. Too independent, however, for the Court, Midhat remained in power only three months, and after a short governorship of Salonica he lived apart from affairs at Constantinople until 1875.*~~

~~*From this time forward, however, Midhat Pasha's career resolved itself into a series of strange and almost romantic adventures. While sympathizing with the ideas and aims of the " Young Turkey " party, he was anxious to restrain its impatience, but the Sultan's obduracy led to a coalition between the Grand Vizier, the War Minister, and Midhat Pasha, which deposed him in May 1876, and he was mur- dered in the following month. His nephew Murad V. was in turn deposed in the following August and replaced by his brother, Abdul Hamid II. Midhat Pasha now became Grand Vizier, reforms were freely promised, and the Otto- man Parliament was inaugurated with a great flourish. In the following February, however, Midhat was dismissed and banished for supposed complicity in the murder of Abdul Aziz. He then visited various European capitals, and remained for some time in London, where he carefully studied the procedure in the House of Commons. Again recalled in 1878, he was appointed governor of Syria, and in August 1888 exchanged offices with the governor of Smyrna. But in the following May the Sultan again ordered him to be arrested, and although he effected' his escape*~~

~~*and appealed to the Powers, he shortly afterwards saw fit to svirrender, claiming a fair hearing. The trial accordingly took place in June, when Midhat and the others were sentenced to death. It was, however, gener- ally regarded as a mockery, and on the intercession of the British Government the sentence was commuted to ban- ishment. The remaining three years of his life were con- sequently spent in exile at Taif in Arabia, where he died, probably by violence, 8th May 1884. To great ability, wide sympathies, and undoubted patriotism he added absolute honesty, that rare quality in a vizier, for he left office as poor as when he entered it. (a. f. b.)*~~

~~*Midlothian. See Edinbukghshiee.*~~

~~*Midnapore, a town and district of British India, in the Burdwan division of Bengal. The town is 68 miles west of Calcutta ; it has a railway station. Population (1881), 31,491 ; (1891), 32,264. It is an important centre of trade, being the terminus of a navigable canal to Cal- cutta, and also the junction for the Sini branch of the Bengal-Nagpur railway. There are manufactures of brass and copper wire. It has an American mission, a municipal college, with 31 students in 1896-97, a colle- giate high school, nine printing-presses, issuing one ver- nacular journal, and a public library, founded in 1852.*~~

~~*The district of Midhapobe has an area of 5186 square miles ; population (1881), 2,515,565; (1891), 2,631,516; and (1901), 2,792,953, showing an increase of 5 per cent, between 1881 and 1891, and of 6-2 between 1891 and 1901 ; average density, 538 persons per square mile. Classified according to religion, Hindus in 1891 numbered 2,321,424 ; Mahommedans, 171,412 ; Christians, 1545, of whom 73 were Europeans ; aborigines, 137,135. The land revenue and rates in 1897-98 were Rs.25,96,556 ; number of police, 861 ; number of boys at school (1896-97), 115,516, being 58-8 per cent, of the male population of school-going age, com- pared with 28 per cent, for the province generally ; registered death-rate (1897), 28-3 per thousand. Both silk and indigo are decaying industries. There are 31 indigo factories, with an out-turn of 700 maunds, valued at Rs.l, 00,000. The navigable canal irrigates 70,000 acres. The*~~

~~*district is traversed by the Bengal-Nagpur railway towards Orissa, with a branch to Chota Nagpur. (j. s. 00.)*~~

~~*Mieres, an industrial and mining centre in the pro- vince of Oviedo, Spain, 12 miles south of Oviedo by rail, on the river Candal or Lena. It has a mining school, a sanctuary of the Virgin del Carmen, a fine parish church, a town hall, and the palaces of three distinguished families. There is an active trade in agricultural pro- ducts and in ores. There are also important iron, coal, and copper mines in the neighbourhood ; and 3 miles to the north some thriving works which employ 2000 hands and turn out 40,000 tons of iron annually. The popula- tion in 1897 was 17,144.*~~

~~*Migration. — Under this title will be considered movements of men with intention of changing their residence or domicile. Such migration may be either external — that is, from one country to another, including emigration from mother country to colony ; or it may be internal — that is, within the limits of a single country. Under external migration is comprised emigration and immigration, denoting simply direction from and to. The emigrants are at the same time the immigrants ; that is, the material of the movement is the same, but the effect upon the country giving up and the country receiving the migrant requires separate treatment. HIence it is proper to separate emigration from immigration. Temporary migration, or travel for purposes of business, enterprise, or pleasure, will be considered only incidentally, and because in some cases it is difficult to distinguish between such movements and permanent migration.*~~

~~*Migration in general may be described as a natural function of social development. It has taken place at all times and in the greatest variety of circumstances. It has been tribal, national, class, and individual. Its causes have been political, economic, religious, or mere love of adventure. Its causes and results are fundamental for the study of ethnology (formation and mixture of races), of political and social history (formation of states and survival of institutions), and of political economy (mobility of labour and utilization of productive forces). Under the form of conquest it makes the grand epochs in history {e.g., the fall of the*~~

~~Koman Empire); under the form of colonization it has transformed the world (e.g., the settlement of America) ; under free initiative it is the most powerful factor in social adjustment (e.g., the~~

~~growth of urban population). It must suffice here to indicate the character of the principal movements in the past, and then describe certain aspects of modern migra- tion. The early movements may be grouped as follows : — (a) Prehistoric migrations. Among savage and nomadic nations the whole tribe often moves into new territory, either occupying it for the first time or exterminating or driving out the indigenous inhabitants. We have only vague knowledge of these early movements, laboriously gleaned from archaeology, anthropology, and philology. The cause has been commonly said to be the pressure of population on the food-supply. A more probable explana- tion is the love of booty and the desire of the stronger to take possession of the lands of the weaker. (6) Greek and Roman colonization. Both of these ancient civiliza- tions extended their influence through migration of indi- vidual families and the planting of colonies. The motive seems to have been primarily commercial — that is, the love of gain. It may have been partly a sort of " swarm- ing " process, caused by pressure of population at home. In some cases it had a political motive, as the planting of military colonies or providing new homes for the pro- letariat. The consequences were of course momentous, (c) The German Conquest. Beginning about the 5th cen- tury, the Roman Empire was overthrown by German tribes from the north of the river Danube and east of the river Rhine. This Volkerwanderung, as it is called by German historians, again transformed the face of Europe, resulting in the establishment of independent kingdoms and a great mixture of races and institutions. It was coin- cident with the building-out of the feudal system. The conquered in many cases could be left as serfs and tillers of the soil, while the conquerors seized the higher posi- tions of administration and power, (d) The later Middle Ages saw many minor migratory movements, such as those accompanying the Crusades, the pushing of German colonization among~~

~~*the Slavs, and the introduction of Flemish weavers into England. The religious reforma- tion caused a considerable amount of expatriation, cul- minating in the expulsion of the Huguenots from France. (e) The Period of Discovery and Colonization. This opened up a new era for migration. The first expeditions were for adventure and booty, especially the discovery of gold and silver. Then came the establishment of com- mercial posts or factories for the purposes of trade. Finally came colonization proper — that is, the settlement of new countries by Europeans intending to remain there permanently, but still retaining their connexion with the mother country. This meant the opening up of the world to commerce and the extension of European civilization to vast areas formerly peopled by savages or half- civilized peoples. It meant a great outlet for the spirit of enterprise and adventure, relief from over- population, an enormous increase in wealth and power, and a strug- gle for supremacy among the nations of Europe. Colo- nization and colonial policy excited immense attention in Europe; and this extended even into the 19th century (e.f/., Wakefield's plans for colonization, and the various colonization societies of modern times). The colonial policy proper was broken down by the revolt of the Xorth American colonies from Great Britain, and later of Mexico and Central and South America from Spain. (/) The movement of population, however, has continued under the form of emigration. This movement is char- acterized firstly by its magnitude ; secondly, by the fact that the emigrant changes his political allegiance, for by far the greater part of modern emigration is to inde- pendent countries, and even where it is to colonies, the colonies are largely self-governing and self-regarding; and thirdly, it is a movement of individuals seeking their own good, without State direction or aid. This is 19th-*~~

~~*century emigration, differing from all preceding forms and having an importance of its own.*~~

~~*Statistics of Emigration. — The direction of the modern movement is from Europe to America, Australia, and South Africa, as shown in the following table : —*~~

~~*Emigration from Certain*~~

~~*States of Europe,*~~

~~1890-~~

~~-99}~~

~~Year,~~

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~~To~~

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~~■s~~

~~1~~

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~~3~~

~~*Cm*~~

~~*&*~~

~~*»*~~

~~*ai*~~

~~*o*~~

~~*1890*~~

~~*115,596*~~

~~*20,560*~~

~~*2976*~~

~~*3626*~~

~~*37,025*~~

~~*28,945*~~

~~*74,002*~~

~~*6698*~~

~~*97,103*~~

~~*1891*~~

~~*189,746*~~

~~*6,217*~~

~~*8456*~~

~~*4076*~~

~~37,721~~

~~38,284~~

~~81,407~~

~~6621~~

~~120,089~~

~~1892~~

~~116,642~~

~~5,528~~

~~5174~~

~~6290~~

~~80,190~~

~~20,772~~

~~74,947~~

~~6689~~

~~116,889~~

~~1893~~

~~142,269~~

~~6,686~~

~~3881~~

~~4820~~

~~88,707~~

~~30,098~~

~~65,664~~

~~6229~~

~~87,677~~

~~1894~~

~~114,566~~

~~1267~~

~~1146~~

~~34,102~~

~~26,666~~

~~25,586~~

~~2863~~

~~40,964~~

~~1895~~

~~187,908~~

~~1318~~

~~1314~~

~~86,220~~

~~44,420~~

~~63,662~~

~~8107~~

~~87,498~~

~~1896~~

~~197,564~~

~~1429~~

~~1387~~

~~45,817~~

~~27,626~~

~~66,547~~

~~2441~~

~~32,162~~

~~189T~~

~~174,845~~

~~760~~

~~792~~

~~39,366~~

~~21,369~~

~~8.5,634~~

~~1778~~

~~23,249~~

~~1898~~

~~189,188~~

~~928~~

~~851~~

~~28,280~~

~~63,947~~

~~1694~~

~~20,9nr.~~

~~1899~~

~~146,440~~

~~1347~~

~~1701~~

~~22,114~~

~~Year.~~

~~e~~

~~X~~

~~3~~

~~Great Britain and Ireland.~~

~~■§.„»~~

~~d~~

~~Total~~

~~p~~

~~S~~

~~•5, = !~~

~~a~~

~~=~~

~~United~~

~~g~~

~~a~~

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~~g~~

~~■3~~

~~Kingdom,~~

~~CO~~

~~13~~

~~"~~

~~B~~

~~w~~

~~1890~~

~~*30,128*~~

~~*10,991*~~

~~*85,548*~~

~~*10,298*~~

~~*189,979*~~

~~*20,653*~~

~~*57,484*~~

~~*218,116*~~

~~*1891*~~

~~*88,818*~~

~~*13,341*~~

~~*109,415*~~

~~*10,882*~~

~~*137,881*~~

~~*22,190*~~

~~*68,446*~~

~~*218,517*~~

~~*1892*~~

~~*41,276*~~

~~*17,049*~~

~~*74,681*~~

~~*10,442*~~

~~*138,816*~~

~~*23,325*~~

~~*52,902*~~

~~*210,042*~~

~~*1893*~~

~~87,504~~

~~18,778~~

~~40,545~~

~~9,160~~

~~134,046~~

~~22,637~~

~~62,132~~

~~208.814~~

~~1894~~

~~9,678~~

~~5,642~~

~~17,792~~

~~4,105~~

~~99,590~~

~~14,432~~

~~42,008~~

~~166,030~~

~~1896~~

~~15,104~~

~~6,207~~

~~36,725~~

~~8,607~~

~~112,638~~

~~18.294~~

~~64,849~~

~~185,181~~

~~1896~~

~~12,919~~

~~6,679~~

~~82,127~~

~~2,876~~

~~102,887~~

~~16,866~~

~~42,222~~

~~161,926~~

~~1897~~

~~8,926~~

~~4,669~~

~~18,107~~

~~2,260~~

~~*94,668*~~

~~*16,124*~~

~~*36,678*~~

~~*146,460*~~

~~*1S9S*~~

~~*7,821*~~

~~*4,869*~~

~~*27,853*~~

~~*2,340*~~

~~*90,679*~~

~~*15,670*~~

~~*34,395*~~

~~*140,644*~~

~~*1899*~~

~~*2,799*~~

~~*87,400*~~

~~*16,072*~~

~~*42,890*~~

~~*146,362*~~

~~*Since 1820 over twenty million persons have emigrated from Europe to countries beyond the sea. The greater part of this emigration has been to*~~

~~*the United States of North America. The history of emigration is well shown in the following table of emigration from Great Britain and Ireland. Down to 1853 the figures include all emi- grants from British ports ; after 1853 emigrants of British and Irish origin only.*~~

~~*Em igration from*~~

~~*Oreat Britain*~~

~~*ind Ireland, 1815-99.*~~

~~*All Emigrants.*~~

~~*To*~~

~~*British*~~

~~*North*~~

~~*America.*~~

~~*To United States,*~~

~~*To Australia.*~~

~~*To other Places. '*~~

~~*Total,*~~

~~*1816-20 (5 years) . 1821-30 10 „ 1831^0 „ „ 1841-50 „ „ 1851-52 2 „*~~

~~*70,438 189,269 .322,465 429,044*~~

~~*75,478*~~

~~*60,859 99,801*~~

~~*808,247 1,094,666*~~

~~611,618~~

~~9,036 67,882~~

~~109,418~~

~~2,781 1,806 4,586 84,168 8,221~~

~~123,1528 249,911 708,150 1,684,892 704,780~~

~~1816-52 (37 years) .~~

~~1,036,714~~

~~2,064,581~~

~~318,465~~

~~61,461~~

~~3.466,211~~

~~Emigrants of British and Irish Origin.~~

~~1863-60 (8 years) 1861-70 10 „ 1871-80 „ „ 1881-90 „ „ 1891-99 9 „ . ,~~

~~128,408 130,310 177,976 301,922 168,538~~

~~806,696 1,182,626 1,087,872 1,718,968 1,042,707~~

~~365,807 267,858 808,367 872,744 112,759~~

~~18,372 41,686 110,204 169,9164 249,666"~~

~~1.312,688 1,571,829 1,678,919 2,668,636 1,678,666~~

~~1863-99 (47 years) .~~

~~902,149~~

~~*6,782,254*~~

~~*1,421,5.36*~~

~~*689,593*~~

~~*8,695,531*~~

~~*The general direction of emigration from Europe is shown in the following table : —*~~

~~*1 Compiled by the Italian Bureau of Statistics, with additions from the Statesman's Year-Book for 1901. The figures relate only to the emigrants of each nationality emigrating from their own country to countries outside of Europe.*~~

~~*2 Exclusive of emigrants to Spanish colonies. 8 Russian emigrants from German ports.*~~

~~*4 Of these, 77,409 went to the Cape of Good Hope and Natal. 5 Of these, 145,380 went to the Cape of Good Hope and Natal.*~~

~~*E'*~~

~~*migraiion from Var*~~

~~*ious Coun*~~

~~*tries of Europe.*~~

~~*Country.*~~

~~*Country of Destination.*~~

~~*Total.*~~

~~*British*~~

~~*States.*~~

~~*Nortli America.*~~

~~*BrazU.*~~

~~*Argentine.*~~

~~*Australasia.*~~

~~*Africa.*~~

~~*All other.*~~

~~*Great Britain and Ireland, 1897*~~

~~*85,324*~~

~~*15,571*~~

~~*12,061*~~

~~*21,109*~~

~~*12,395*~~

~~*146,460*~~

~~*Norway, 1895*~~

~~*6,584*~~

~~*22*~~

~~*10*~~

~~*63*~~

~~*6,679*~~

~~*Sweden, 1894 .*~~

~~*9,529*~~

~~*13*~~

~~*48*~~

~~*88*~~

~~*9,678*~~

~~*Denmark, 1896*~~

~~*2,479*~~

~~*81*~~

~~*47*~~

~~*269*~~

~~*2,876*~~

~~*Germany, 1896*~~

~~*29,007*~~

~~*634*~~

~~*1,001*~~

~~*174*~~

~~*1,346*~~

~~*1,662*~~

~~*33,824*~~

~~*Holland, 1896 .*~~

~~*12,611*~~

~~*...*~~

~~*51*~~

~~*125*~~

~~*12,787*~~

~~*Belgium, 1893 .*~~

~~*2,431 1,326*~~

~~*10*~~

~~*1*~~

~~*113*~~

~~*3,881*~~

~~*France, 1892*~~

~~*2,798*~~

~~*192*~~

~~*2,106*~~

~~*93*~~

~~*339*~~

~~*5,528*~~

~~*Portugal, 1895 .*~~

~~*1,239*~~

~~*43,180*~~

~~*44,419*~~

~~*Spain, 1895*~~

~~*13*~~

~~*10,355*~~

~~*7,732*~~

~~*4*~~

~~*15,727*~~

~~*33,831*~~

~~*Italy, 1895*~~

~~*37,851*~~

~~*783*~~

~~*98,090*~~

~~*41,029*~~

~~*154*~~

~~*3,432*~~

~~*6,569*~~

~~*187,908 -*~~

~~*Switzerland, 1896 .*~~

~~*2,789*~~

~~*• • .*~~

~~*499*~~

~~*9*~~

~~*28*~~

~~*5*~~

~~*3,330*~~

~~*Austria- Hungary, 1896 .*~~

~~*45,754*~~

~~*12,815*~~

~~*1,385*~~

~~*...*~~

~~*6,502*~~

~~*66,456*~~

~~*Statistics of Immigration. — The statistics of the United States are the most important and the most complete. The statistics since 1820 are shown in the following table : —*~~

~~*Annual Average.*~~

~~*14,343 59,912 171,325 259,821 231,482 281,219 524,661 384,442*~~

~~*Immigration into the United*~~

~~*Decade ending*~~

~~*Aggregate*~~

~~*80th June*~~

~~*Arrivals.*~~

~~*1830 .*~~

~~*143,439*~~

~~*1840*~~

~~*599,125*~~

~~*1850*~~

~~*1,713,251*~~

~~*1860*~~

~~*2,598,214*~~

~~*1870*~~

~~*2,314,824*~~

~~*1880*~~

~~*2,812,191*~~

~~*1890*~~

~~*5,246,613*~~

~~*1900 .*~~

~~*3,844,422*~~

~~*Total*~~

~~*19,272,079*~~

~~*Prior to 1820 there was no official record of immigra- tion, but it is estimated that the total number of immi- grants from the close of the Revolutionary War was 260,000. During the decade from 1820 to 1830 the movement was very moderate. From 1830 to 1840 it*~~

~~*, steadily increased, but never reached 100,000 per annum.*~~

~~*• In 1846 came the Irish potato famine, and an enormous emigration began, foil owed by a very large German emigra- tion from similar causes. The Civil War in the United States interrupted the movement, but it was speedily resumed on an enlarged scale owing especially to the*~~

~~*‘ improved means of ocean transportation. It culminated in the decade 1880-90, and declined after the commercial*~~

~~*■crisis of 1893. Later there were signs of another increase (448,572 in 1900).*~~

~~*The relative movement of nationalities is best presented by the statistics of the United States. The nationality (country of origin of immigrants coming to the United States, 1871-95) is shown in the following table : —*~~

~~*Nationality of Immigrants to the United States.*~~

~~*Anglo-Saxons, Celts, and “Welshmen- England and Wales Scotland*~~

~~*Total .*~~

~~*Irish — Ireland*~~

~~*Teutons — Austria Germany Netherlands*~~

~~*Total . Latins — Belgium France Italy . Spain . Portugal*~~

~~*Total .*~~

~~*2.5 Tears*~~

~~*1871-93.*~~

~~*1,334,817 286,807*~~

~~*Per cent.*~~

~~*of Total*~~

~~*Immigration.*~~

~~*12-9 2-8*~~

~~*1,621,624 15-7*~~

~~*1,3.34,635*~~

~~*12-9*~~

~~*374,872*~~

~~*2,607,562*~~

~~*96,035*~~

~~*3-6*~~

~~*25 -.S •9*~~

~~*3,078,469*~~

~~*42,447*~~

~~*148,683*~~

~~*655,104*~~

~~*14,292*~~

~~17,108~~

~~29·8~~

~~•4~~

~~1·4 6·3~~

~~•2~~

~~•2~~

~~877,634~~

~~Scandinavians — Denmark Norway Sweden~~

~~Total~~

~~Czechs, Magyars, Slavs- Bohemia Hungary Poland Rumania Russia~~

~~Total~~

~~Swiss — Switzerland Greeks — Greece Turks — Turkey Europe, not specified~~

~~Total Europe~~

~~North America All other countries~~

~~25 "i ears~~

~~1871-96.~~

~~159,759 331,258 660,193~~

~~Per cent.~~

~~of Total~~

~~Immigration.~~

~~*1-5 3-2 6-4*~~

~~*1,151.210 111*~~

~~*77,247 256,347 141,908*~~

~~*10,377 500,797*~~

~~*986,676*~~

~~*135,736*~~

~~*7,325*~~

~~*3,411*~~

~~*294*~~

~~■*7*~~

~~*2-5 1-4*~~

~~■*1*~~

~~*4-8*~~

~~*9-5*~~

~~*9,197,014 88-9*~~

~~*776,071 360,454*~~

~~*7-5 3-6*~~

~~*Grand Total . . 10,339,539 100-0*~~

~~*A very important transformation has taken place in the proportionate number coming from different countries during the last half of the 19th century. At first the Irish and Germans were most prominent. Of later*~~

~~*years the Italians, Czechs, Hungarians, and Russians were numerously represented.*~~

~~*The following table shows the relative number of different nationalities represented in the immigration to the United States ; —*~~

~~*Country.*~~

~~*lS61-7rt.*~~

~~*lb71 - -0.*~~

~~*lSSl-90.*~~

~~*1891-95.*~~

~~*Per cent.*~~

~~*Per cent.*~~

~~*Great Britain*~~

~~*24-5*~~

~~*16-4*~~

~~*12-5*~~

~~*9-3*~~

~~*Ireland ....*~~

~~*18-8*~~

~~*15-5*~~

~~*12-5*~~

~~*19-6*~~

~~*Germany ....*~~

~~*34-0*~~

~~*25-5*~~

~~*27-7*~~

~~*19-1*~~

~~*Austria- Hungary*~~

~~■*3*~~

~~*2-6*~~

~~*6-7*~~

~~*12-4*~~

~~*Norway and Sweden .*~~

~~*4-7*~~

~~*7-5*~~

~~*10-8*~~

~~*9-3*~~

~~*Russia and Poland*~~

~~•*2*~~

~~*1‘9*~~

~~*5-1*~~

~~*10-4*~~

~~*Italy*~~

~~*•5*~~

~~*2-0*~~

~~*6-9*~~

~~*12-8*~~

~~A~~

~~*Se.v and Age. — Of all the immigrants (1871-95), 61-2o per cent, were males and 38-75 per cent, were females. This proportion differed somewhat among different nation- alities, as shown in the following table :—*~~

~~*Proportion*~~

~~*of Females among Immigmnts,*~~

~~*1871-95.*~~

~~*Per cent.*~~

~~*Per cent*~~

~~*England and Wales*~~

~~*39-0*~~

~~*Denmark .*~~

~~*. 38-0*~~

~~*Scotland .*~~

~~*39-2*~~

~~***Norway***~~

~~***38-3***~~

~~***Ireland***~~

~~**:**~~

~~***49-6***~~

~~***Sweden***~~

~~***. 39-5***~~

~~***Austria- Hungary***~~

~~***35-4***~~

~~***Bohemia .***~~

~~***. 47-3***~~

~~***Germany .***~~

~~***42-4***~~

~~***Hungary .***~~

~~***. 27-7***~~

~~***Netherlands***~~

~~***39-6***~~

~~***Poland***~~

~~***. 33.6***~~

~~***Belgium***~~

~~*34·9*~~

~~*Rumania .*~~

~~*. 45·6*~~

~~*France*~~

~~*36·6*~~

~~*Russia*~~

~~*. 37·8*~~

~~*Italy .*~~

~~*21·9*~~

~~*Switzerland*~~

~~*. 36·3*~~

~~*Portugal .*~~

~~*23·4*~~

~~*British N. Amer*~~

~~*ica . 40·1*~~

~~*MIGRATION*~~

~~*745*~~

~~*The emigrants were in the most vigorous period of life, few children and few old people, as shown in the following table : —*~~

~~*Ages of Immigrants to the United States, 1881-90.*~~

~~*Country of 0i1|ln.*~~

~~*Under 15.*~~

~~*From 15 to 40.*~~

~~*Over 40 years.*~~

~~*Number.*~~

~~*Per*~~

~~*cent.*~~

~~*Number.*~~

~~*Per cent.*~~

~~*Number.*~~

~~*Per cent.*~~

~~*Germany*~~

~~*Ireland*~~

~~*England*~~

~~*Sweden and Norway*~~

~~*Italy*~~

~~*Russia (includ- ing Poland).*~~

~~*Austria ,*~~

~~*Scotland .*~~

~~*Hungary .*~~

~~*386,984 92,808 151,815*~~

~~104,254 47,608~~

~~65,427~~

~~TM.iYll~~

~~80,102~~

~~1II,7S.”)~~

~~26-6 14-1 28-5~~

~~18-8 15-8~~

~~24-7 22-1 24-2 14‘7~~

~~904,002 515,089 420,808~~

~~414,609 212,475~~

~~174,751~~

~~149,909~~

~~97,819~~

~~9.5,085~~

~~62-2 78’-6 65-2~~

~~78-0 69-2~~

~~65-9 66-3 65 2 74-9~~

~~162,084 48,085 73,062~~

~~49,499~~

~~47,771~~

~~*24,907 26,109 15,8,58 18,261*~~

~~*11-2 7-3 11-3*~~

~~*8-7*~~

~~*]5‘5*~~

~~*9-4 116*~~

~~*lO’O*~~

~~*10-4*~~

~~*Occupation. — The immigrants are for the most part*~~

~~*unskilled labourers. The statistics for the United States*~~

~~*‘ show the following figures for the ten years 1881-90 : —*~~

~~*Occupation of Immigrants to the United States.*~~

~~*Males.*~~

~~*Females.*~~

~~*Total.*~~

~~*Professional . Skilled . Miscellaneous Not stated Without occupation*~~

~~*Total*~~

~~*25,257*~~

~~*514,552*~~

~~*1,833,325*~~

~~*73,327 759,450*~~

~~*1,740*~~

~~*25,859*~~

~~*245,810*~~

~~*42,830*~~

~~*1,724,454*~~

~~*27,000 540,411*~~

~~*2,079,135 116,1.57*~~

~~*2,483,904*~~

~~*3,205,911*~~

~~*2,040,702*~~

~~*5,246,613*~~

~~*Those " without occnpation " are mostly women and children. The " miscellaneous " are day labourers. It is probable that about 20 per cent, of the adult males are " skilled."*~~

~~*Immigration to other Countries. — In no other country is immigration so important as in the United States. The statistics are very imperfect. The main figures have already been given in the table of emigration. Australia has an annual immigration of about 250,000, mostly of British origin. This is offset by a very heavy emigration, which sometimes exceeds the immigration in certain of the states. The immigration to Canada for the year 1891 was put down as 82,165, but a portion of this consists of immigrants passing through to the United States. Brazil has had a large immigration (in 1895 equal to 169,524, but in 1898 only 63,822). The Argentine is credited with an immigration in 1899 of 111,083, and Uruguay with an immigration in 1895 of 9185. In all the South American immigration the countries principally represented are those of southern*~~

~~*Europe, especially Italy. The majority of the immigrants are adult males and farm labourers.*~~

~~*Balance of Emigration and Immigration. — Even in the case of emigration from Europe to countries beyond the seas there is some return movement. Emigrants who ‘ have been successful in business return in order to end their days in the old country. Those who have not succeeded return in order to be cared for by friends and relatives, or simply from home-sickness. Thus, for Great Britain and Ireland, while the emigration of persons of British and Irish origin was, in 1899, 146,362, the im-migration of persons of the same category was 100,246, leaving a net emigration of only 46,116. In the United States statistics we cannot distinguish in the outgoing passenger movement emigrants from other persons. But if for a period of ten years we take the total inward passenger movement and subtract from it the total out- ward passenger movement, we ought to have the net immigration. By this method we arrive at the conclusion that while the gross immigration during the ten years 1881-90 was 5,246,613, the net immigration was only*~~

~~*4,417,337, showing an outward movement of 829,276, or about 15-8 per cent, of the total number of immigrants.*~~

~~*Temporary Emigration. — In many European countries there is not only emigration beyond seas, but_ a very considerable movement to neighbouringcountries in search of’ work, and generally with the intention of returning. Thus, in Italy the “permanent” emigration (i.e., to countries beyond seas) numbered, in 1894, lOl,206; the “temporary” emigration to neighbouring countries amounted to 124,139. This temporary emigration is strongest in the spring, and consists principally of adult males (agriculturists, farm and day labourers, bricklayers and masons) in search of work. It resembles somewhat the, movement of Irish labourers into Great Britain at harvest time.*~~

~~*Effects of Emigration. — There are two views with regard to emigration : one unfavourable, viz., that it is a drain on population, reducing its economic strength and dis- turbing social and political relations; the second looking upon it as a relief from over-population and a congested labour market. As a matter of fact, emigration has not succeeded in*~~

~~*diminishing the population of Europe, which, on the contrary, doubled during the 19th century. The one great exception is Ireland, where population has been reduced from 8,175,124 in 1841 to 4,531,051 in 1899. From 1851 to 1899 the total emigration from Ireland was 3,796,131, or 68-6 per cent, of the average population. Emigration, by carrying off the young men and women, has also reduced the Irish marriage- and birth- rates, which are the lowest in Europe. But hitherto the countries of strongest emigration (England, Germany, &c.) have shown practically undiminished birth- and marriage- rates and a steady growth in population.*~~

~~*The intensity of emigration is measured not by the absolute number of emigrants, but by the number of emigrants to the total population. Its effect is shown by comparing the number of emigrants with the excess of births over deaths per 1000 of the population. This is shown in the following table (1892) : —*~~

~~*Excess of Births*~~

~~*Emij^iints*~~

~~*over Deaths per*~~

~~*per 1000*~~

~~*1000 Inhabitants.*~~

~~*Inhabit.nnts*~~

~~*Great Britain and Ireland . 10-54*~~

~~*5-61*~~

~~*England and Wales*~~

~~*11-50*~~

~~*4-56*~~

~~*Scotland*~~

~~*12-17*~~

~~*5-74*~~

~~*Ireland .*~~

~~*3-04*~~

~~*11-3!)*~~

~~*Germany-*~~

~~*11-6*~~

~~*2-2:3*~~

~~*Switzerland .*~~

~~*8-7*~~

~~*2-64*~~

~~*Sweden .*~~

~~*9-1*~~

~~*6-87*~~

~~*Norway .*~~

~~*11-9*~~

~~*8-53*~~

~~*Denmark*~~

~~*10-1*~~

~~*4-76*~~

~~*Italy*~~

~~*101*~~

~~*3-53*~~

~~*Trance .*~~

~~*0-5*~~

~~*0-14*~~

~~*It will be observed that, with the exception of Ireland, wherever there is a heavy emigration, there is at the same time a considerable excess of births over deaths, i.e., natural increase more than makes up for the loss by emi- gration. Even taking Great Britain and Ireland together, the loss by emigration per annum has not been very large, as is shown by the following table : —*~~

~~*Annual Ejnigration per 1000 of the Average Population of Great Britain and Ireland.*~~

~~*. 7-1*~~

~~*. 5-1*~~

~~*-H*~~

~~*ol*~~

~~*Even in particular districts where emigration is heavy, the loss is made up by births. Eor instance, in 1891 the emigration from the provinces of AVest Prussia and Posen was extraordinarily heavy — 10-9 and 10-4 per mille re- spectively — but the excess of births over deaths was 19-6 per mille. Emigration may give temporary relief to con-*~~

~~*1853-55 .*~~

~~*. 8-4*~~

~~*1881-90*~~

~~*1856-60 .*~~

~~*. 4-3*~~

~~*1891-95*~~

~~*1861-70 .*~~

~~*5-2*~~

~~*1896 .*~~

~~*1871-80 .*~~

~~*. 5-1*~~

~~*1897 .*~~

~~*746*~~

~~*MIGRATION*~~

~~*gested districts, but it is not in itself a remedy for so- called over-population.*~~

~~*It is diflBcult to analyse closely the economic effect of emigration, because so much depends upon the character of the emigrants and the condition of the labour market. The following considerations have been urged at different times : — Although emigration does not diminish popula- tion, yet, as the emigrants are in the most productive period of life (IS.to 46), the country of emigration loses adults and replaces them with children. It thereby loses the cost of rearing that number of people to adult age, and is left with a disproportionate number of children and old*~~

~~*people. The age distribution of the population of Ireland lends some support to this view. In the same vein it is urged that voluntary emigration takes away the cream of the working-classes. It is the man of energy, of some means, of ambition, who takes the chances of success in the new country, leaving the poor, the indo- lent, the weak, and crippled at home. It is maintained that such emigration institutes a process of selection which is unfavourable to the home country.*~~

~~*On the other side, it is said that the men who are doing well at home are the ones least likely to emigrate, be- cause they have least to gain. Modern means of trans- portation have made the voyage so' cheap that almost any one is able to go. It is therefore the restless, the unsuccessful, or at least those not fitted for the strenuous competition of the older countries, who are tempted to go. Emigration affords a natural outlet for the super- fluous labour force of a country. The supply of labour is somewhat reduced, but wages are kept up for those who remain. Those who go find means of bettering their own condition beyond the seas, where they become producers of food and raw material for the home coun- try, and at the same time customers for her manufac- tured products. Emigration is therefore an economic gain, both directly and indirectly. It is evident from these arguments that no general answer can be given to the question. In some cases it may be an evil ; in most, when conducted under normal conditions, it would seem to offer little danger.*~~

~~*The same remark would hold true in regard to the social and political effects of emigration. In some cases, by taking away the strong, self- reliant, and energetic, it may result in the deterioration of the home population. In other cases it allows restless spirits who have failed at home to try again elsewhere. Often in cases of political revolution the members of the defeated party have sought refuge elsewhere, as after the revolutionary movements of 1848. In case of conquest the conquered nationality takes to emigration ou an extensive scale, as after the absorption of Alsace-Lorraine by Germany in 1871. The movement may be aided either by the State or by private associations. Of such character have been the State-aided emigration from Ireland, and the assisted emigration of paupers, criminals, and other persons, in the effort to relieve a congested population, or simply from the desire to get rid of*~~

~~undesirable members of the community. Such efforts fail if the new countries are unwilling to admit these persons. Finally, we have the expulsion of the Jews from Russia as an example of the effort of a community to get rid of an element which has made itself obnoxious to the local sentiment.~~

~~Effects of ImmiijnUion. — The effects of emigration are negative in character; those of immigration are positive, (a) On population: Immigration, of course, is a direct addition to the population of new countries, and greatly accelerates the growth by natural increase, especially as the immigrants are in the most productive ages of man- hood and womanhood. In the United States, for instance, out of a population of 76,303,387 (in 1900), there were~~

~~26,147,407 persons who were either foreign-born or who had one or both parents foreign-bo'-n. This does not mean that the population would have been twenty-six millions less if it had not been for immigration ; for the rate of natural increase among the native-born might have maintained itself. Nevertheless, immigration has probably stirbulated the growth of population. QA Eco- nomic effects : The economic gain of immigration fo new countries is evident. It adds directly to their available labour force, that. is, to the number of adults engaged in the work of producing wealth.~~

~~According to the United States census of 1890, out of 22,735,661 persons engaged in gainful occupations, 5,104,767, or 22-5 per cent., were of foreign birth. If we add to these the native whites of foreign parentage (3,542,408) we have 8,647,166 persons of foreign extrac- tion, or 38 per cent, of the total labour force. The foreign whites alone constituted 14-5 per cent, of the total number of persons engaged in agriculture, fisheries, and mining ; 12-1 per cent, of those in professional ser- vices; 31 '6 per cent, in domestic and personal services; 21-4 per cent, in trade and transportation; and 31-4 per cent, of those engaged in manufacturing and mechanical industries. In addition to these, the native whites of foreign parentage constituted, in agriculture, &c., 8-8 per cent. ; in professional service, 16-3 per cent. ; in domestic service, 14-2 per cent. ; in trade and transportation, 22-1 per cent. ; in manufacturing, 24-4 per cent, of all those engaged in those occupations. The labour force of the United States~~

~~*is thus made up very largely of immigrants and the children of immigrants.*~~

~~*Attempts have sometimes been made to put a money value on the economic gain by immigration. The amount of money brought by the immigrants is not large, and is probably more than offset by the money sent back by immigrants for the support of families and friends at home or to aid them in following. The valuable element is the able-bodied immigrant himself as a factor of production. It is said, for instance, that an adult slave used to be valued at from $800 to $1000, so that every adult immi- grant may be looked upon as worth that sum to the country. Or, it has been said that an adult immigrant represents what it would cost to bring up a child from infancy to the age say of 15. This has been estimated by Ernst Engel as amounting to $!550 for a German child. The most scientific procedure, however, is to calculate the probable earnings of the immigrant during the rest of his lifetime, and deduct therefrom his expenses of living. The remainder represents his net earnings which he will contribute to the well-being of the new country. Farr reckoned this to be, in the case of unskilled English emi- grants, about £175. Multiplying the total number of adult immigrants by any one of these figures, we get the annual value of immigration. Such attempts to put a precise money value on immigration are futile. They neglect the question of quality and of opportunity. The immigrant is worth what it has cost to bring him up only if he is able-bodied, honest, and willing to work. If he is diseased, crippled, dishonest, or indolent, he may be a direct loss to the community instead of a gain. So, too, the immigrant is worth his future net earnings to the community only if there ife a demand for his labour.*~~

~~*Social and Political Effects of Immigration. — The influx of millions of persons of different nationality, often of a foreign language and generally of the lower classes, would seem to be a danger to the homogeneity of a community. The United States, for instance, has felt some inconven- ience from the constant addition of foreigners to its electorate and its population. The foreign-born are more numerously represented among the criminal, defective, and dependent classes than their numerical strength would*~~

~~*justify. They also tend to segregate more or less, espe- cially in large cities. Nevertheless, the process of assimi- lation goes on with great rapidity. Intermarriage with the native-born occurs to a considerable extent. The influence of the physical environment leads to the adoption of the same mode of life. The most powerful influences, how- ever, seem to be social. These are common school education and the adoption of one language (English) ; participation in political life, which is granted to all adult males after five years' residence ; and the general influence of social standards embodied in laws, institutions, and customs already established. Doubtless immigration of the last fifty years of the 19th century has had a modi- fying effect on American life;.but on the whole the power of a modern civilized community working through individual freedom to assimilate elements not differing from it too radically has been displayed to a remarkable degree.*~~

~~*Restriction of Immigration. — New countries have sought to escape certain evils of indiscriminate immigration. These evils were as follows: — (a) The immigration of criminals, paupers, persons diseased in mind or body, and persons unable to support themselves. By the Acts of 1882 and 1893 such persons were refused admission to the United States, and, when rejected, the steamship companies that brought them were compelled to take them back. The number rejected in 1899 was 3057. No law of international comity is violated by the refusal to receive these unfortunates. They should be taken care of at home. (b) Immigration sometimes increases the competition in the labour market, and thus lowers wages. One case is particularly aggravating, viz., when employers import foreign labourers in order to take the place of their men who are on strike. In 1885 the United States passed what is called the Contract Labour Law, forbidding the land- ing of any person who is under contract to perform labour in the United States. It is very difficult to discover such cases, and in 1899 only 741 persons were rejected on that account, (c) The immigration of men of alien race who refuse to assimilate with the natives is said sometimes to be a danger to the country. This at least is the*~~

~~*excuse for the entire exclusion of Chinese labourers from the United States since 1882 (provisions made more severe in 1888 and 1892).*~~

~~*Internal Migration. — In modern times there is constant movement of population within national lines, from section to section, and especially from rural districts to the cities. No record is kept of this, and we can trace it only through the census statistics of birthplace. In the United States, for instance, it was shown in 1890 that more than 21-5 per cent, of the native-born inhabitants were living in a state other than that in which they were born. Still further, it appears that about one-half of the native-born inhabitants had moved out of the county in which they were born. In 1890 there were 1,233,629 natives of tlie state of New York living in other states. The movement is principally westwards in direction and along parallels of latitude. For instance. New York has made large contributions to the population of Ohio, Michigan, Illinois, Wisconsin, Iowa, and so on. Virginia has contributed largely to the population of West Virginia, Kentucky, Ohio, Indiana, Illinois, and Missouri. In Europe there is asimilarmovemeut; but it is difficult to make comparisons, because of the differences in the administrative areas. In England in 1891, 71-6 per cent, of the population were residing in their native county; in Prussia, 69-7 per cent, in the Tcreis; in France, 81-7 per cent, in the department ; in Austria, 80-2 per cent, in the 'bezirk; in Switzerland, 82-1 per cent, in the canton where they were born (Weber, Growtli of Cities, p. 249). The most important phase of internal migration is the movement from the rural districts to the cities. The statistical results are shown in the*~~

~~*following table extracted from the admirable work of Weber just quoted: —*~~

~~*Percentage of Population, living in Towns of 10,000 and over at Three Periods.*~~

~~*About 1801)*~~

~~*About IS.'iO*~~

~~*About 1890*~~

~~*or 1801.*~~

~~*or 1S51.*~~

~~*or 1891.*~~

~~*England and Wales .*~~

~~*21-3*~~

~~*39-5*~~

~~*61-7*~~

~~*Scotland*~~

~~*17-0*~~

~~*32-'2*~~

~~*50-0*~~

~~*Australia (7 colonies).*~~

~~*41-4*~~

~~*Belgium*~~

~~*1.3-5*~~

~~*20-8*~~

~~*;34-8*~~

~~*Netherlands*~~

~~*29-5*~~

~~*29-0*~~

~~*31-3*~~

~~*Prussia (1816) .*~~

~~*7-3*~~

~~*10-6*~~

~~*30-0*~~

~~*United States*~~

~~*3-8*~~

~~*12-0*~~

~~*27-6*~~

~~*France*~~

~~*9-5*~~

~~*14-4*~~

~~*25-9*~~

~~*Denmark .*~~

~~*10-9*~~

~~*9-6*~~

~~*23-6*~~

~~*Italy . . . .*~~

~~*20-6*~~

~~*Ireland*~~

~~*7-8*~~

~~*lO-l*~~

~~*18-0*~~

~~*Norway*~~

~~*3-3*~~

~~*6-3*~~

~~*16-7*~~

~~*Switzerland (1822) .*~~

~~*4-3*~~

~~*7-3*~~

~~*16-5*~~

~~*Austria*~~

~~*4-4*~~

~~*5-8*~~

~~*15-8*~~

~~*Hungayy*~~

~~*5-4*~~

~~*91*~~

~~*16-1*~~

~~*Sweden*~~

~~*3-9*~~

~~*4-7*~~

~~*13-7*~~

~~*Portugal*~~

~~*12-7*~~

~~*12-9*~~

~~*12-7*~~

~~*Russia ….*~~

~~*3-7*~~

~~*5-3*~~

~~*9-3*~~

~~*Everywhere the city population is increasing faster than the rural. In the United States the rate of increase per decade was as follows : —*~~

~~*Year.*~~

~~*Unitcfl States.*~~

~~*In Towns of 8000 and over.*~~

~~*Rural Districts.*~~

~~*Per cent.*~~

~~*Per cent.*~~

~~*Per cent.*~~

~~*1790-1800*~~

~~.35-1~~

~~60~~

~~34~~

~~1800-1810~~

~~36-4~~

~~69~~

~~35~~

~~1810-1820~~

~~33-0~~

~~33~~

~~33~~

~~1820-1830~~

~~.33-6~~

~~82~~

~~31~~

~~1830-1840~~

~~32-7~~

~~68~~

~~m~~

~~1840-1850~~

~~35-9~~

~~99~~

~~30~~

~~1850-1860~~

~~35-6~~

~~75~~

~~30~~

~~1860-1870~~

~~22-6~~

~~59~~

~~15~~

~~1870-1880~~

~~.30-1~~

~~40~~

~~27~~

~~1880-1890~~

~~24-!)~~

~~61~~

~~15~~

~~1890-1900~~

~~20-8~~

~~37~~

~~14~~

~~In England and Wales the rural population is actually decreasing, while the urban is increasing, as shown in the following table : —~~

~~Decennial Hate of Increase or Decrease.~~

~~Year. Urban. Eural.~~

~~Per cent.~~

~~18.51-61 1861-71 1871-81 1881-91~~

~~Urban. Per cent.~~

~~-1-21 -9~~

~~-f28-l I 25 -6 -M8-5~~

~~-1 l-~~

~~-5-86 -3-84 -2-76~~

~~In 271 out of 632 registration districts of England and Wales there was an absolute decrease of population from 1881 to 1891. The same phenomenon is seen in France. According to the census of 1891, not less than 55 out of the 87 departments had decreased in population ; and out of the 32 that had increased, 7 showed a decrease in their rural parts when the large towns were deducted. In Germany the towns of 10,000 and over show a much more rapid increase than the rural districts ; and the same fact is generally true of the other countries of Europe. This more rapid increase of population in cities is due only in part to migration from the country. Until the 19th century deaths generally exceeded births in cities, so that if it had not been for constant immigration the cities would not only not have grown, but would have decreased in population. Cities~~

grow more rapidly now than formerly, because the excess of deaths over births has been turned into an excess of births over deaths. Thereby the cities are becoming less dependent upon immigration for increase of population than formerly, but the migration still goes on. The causes of migration from country to city are mainly economic. In early stages

of culture men are scattered over the country, or at most gathered together in hamlets and villages. Each of these is self-sufficing, having its own artisans and handicrafts- men, and producing what it needs. With the beginning of exchange, commercial centres spring up, situated on navigable streams and especially at points where land and water journey are broken. With the growth of manu- factures, industrial centres spring up where the division of labour can be fully provided for. In modern times two factors have accelerated this process, viz. : (1) the building of railways, which have developed commerce to a very great degree and favoured the large towns at the expense of the small ; and (2) the invention of machinery, which has greatly increased the possibility of division of labour and manufactures on a large scale. The old handi- craftsman has been superseded by machine labour and the village artisan by the factory hand. At the same time improvements in agriculture and the opening up of new countries have enabled the modern com- munity to gain its food and raw material with a less expenditure of labour force, and the surplus agri- cultural population has gone to the city. The attractive influences upon individuals have been higher wages, greater scope for the ambitious, and the social advantages of city life.

The general laws of internal migration may be summar- ized (according to Eavenstein) as follows : —

1. The great body of migrants proceed only a short distance.

2. The process of absorption goes on as follows : The inhabitants of the country immediately surrounding a town of rapid growth flock into it ; the gaps thus left in the rural population are filled up by migrants from

~~*more remote districts, until the attractive force of one of the rapidly-growing cities makes its influence felt, step by step, to the most remote corner of the land. Migrants enumerated in a certain centre of absorption will conse- quently grow less with the distance, proportionately to the native population which furnishes them.*~~

~~*3. The process of dispersion is the inverse of that of absorption, and exhibits similar features.*~~

~~*4. Each main current of migration produces a com- pensating countercurrent.*~~

~~*5. Migrants proceeding long distances generally go by preference to one of the great cities of commerce or industry.*~~

~~*6. The natives of towns are less migratory than those of the rural parts of the country.*~~

~~*7. Females are more migratory than males.*~~

~~*Ahthokities. — The statistics of migration are to be found in the oiBcial returns of different countries, especially the statistical tables relating to emigration and immigration published by the British Board of Trade, and the Reports (annual) of the Commissioner- General of Immigration of the United States. For general discussion see Philippovich. Auswanderung und Auswanderungspolttik. Leipzig, 1892. Exhaustive bibliography will be found in article by same author, " Auswanderung," in Handworterhuch der Staats- viissenschaften.—R. Mavo-Smith. Emigration and Immi*~~

~~*_ Mikhailovskaya, a Cossack village of Russia, pro- vince of Don (;ossacks, 4.3 miles from Shakhtnaya rail- way station. It is an important centre for grain export Population, 17,848.*~~

~~*Milan, capital of the province of Milan, Italy, situ- ated in 4.5° 28′ N. and 9° 11′ E., on the river Olona The development of the city, which became noteworthy after the annexation of Lombardy to I'iedniont in 1859, continued duringthe last quarter of thel9th century. The population*~~

which in 1875 numbered 273,079, reached 500,000 in 1900. The customs circle, -which prior to 1898 measured %\ miles, measures now 18 miles. As early as 1880 the increase of the population necessitated the construction of new quarters (Porta Genova, Principe Umberto, Via Solferino, &c.) within the line of bastions erected by the Spaniards towards the middle of the 16th century ; while outside the bastions working-class quarters and industrial es- tablishments grew up. The lack of a general building scheme occasioned confusion, however, and in 1885 the municipal authorities were obliged to lay out the lines of new streets for the whole extra-bastion zone. The scheme, known as the pimio regolatore, was adopted in 1888, together with a regolamento edilizio or building regulation designed to fix the length of the streets and the height of houses, and to secure their solidity and proper drainage. Inside the bastions the piano regolatore pro- vided for the completion of the I'iazza del Duomo (begun in 1865), and for the formation of a new quarter upon the vast areas of Piazza Castello and Piazza d'Armi. The municipality undertook to furnish the military authorities with a new Piazza d'Armi or military exercise ground, to contribute to the cost of the construction of new barracks in compensation for the military quarters in the Castello Sforzesco, which thenceforward became municipal pro- perty. In order to provide for direct couimunication between this quarter and the centre of the city, it was de- cided in 1887 to cut a new street. Via Dante, through a zone of old houses. Subsequently, it wasthought expedient to lay out the whole Piazza d'Armi as a public garden. This variation of the original plan was completed in 1893. It created in the highest zone of Milan a magnificent quarter, with wide streets, spacious gardens, and private villas, in strong contrast to the narrow and irregular thoroughfares of the old part of the city. The growth of municipal expenditure kept pace with the growth of population and with the structural development of the city. The result was increased taxation within the octroi circle, until it became almost intolerable, and large loans had to be efl:ected. In 1898, after several years of party struggle, the octroi circle was enlarged so as to include the Corpi Santi with their large industrial population. As a result of the change, municipal revenue has increasedsoconsiderably as toassure a surplus after meeting ordinary and extraordinary expen- diture out of current income ; octroi on several prime necessaries of life, such as flour, bread, and vegetables, has been abolished, and the collection

simplified proportion- ately. Nevertheless, the agitation connected with this fiscal reform contributed greatly to displace the centre of political gravity in favour of the Anti-monarchical Radicals. Up till 1882 the Moderate or Conservative IMonarchical party ruled supreme, both in the municipality and in the, parliamentary representation of Milan. In that year the extension of the suffrage and the adoption of the scrutin de liste assured to the Radicals four-fifths of the parlia- mentary representation of the city ; and though, after the return to the uninominal ballot, the Conservative party succeeded in regaining four of the six constituencies into which the city was then divided, the Radical, Republican, and Socialist jiarties, particularly the last, have steadily increased until they secured the whole parliamentary representation of Milan in the general election of June 1900. Similarly, in municipal elections the Socialists and Radicals have gained ground ; and though the Moderates continued to hold office, with the help of the Catholic party, until 1809, the municipal elections of December 1899 resulted in a sweeping victory for the Anti-monarchical list, which polled 19,000 votes as compared with 8000 cast for the Conservatives. The success of the popular party was due in part to the defection of the Clericals, but principally to the organization of the

working-class vote and railway vote by the Socialists, to the agitation on the octroi question, and to the discontent occasioned by the imposition of a new municipal house- rate. The growth of political Radicalism in MUan has further been favoured by the decadence of the Conserva^ tive party organization, and by the unsatisfactory con- dition of Italian public affairs during the last decade of the 19th century. Nevertheless, manifestations of public

opinion in connexion with the riots of 1898 (which necessi- tated severe measures of military repression) and with the assassination of King Humbert at Monza (29th July 1900) proved that the bulk of the Milanese population was by no means disaffected towards existing institutions. The municipal elections of 1902 proved that, though still masters of the city,

~~*the Kadical parties had lost ground. Since 1875 great improvements have been effected in the*~~

~~*MILAN*~~

~~*(MILANO).*~~

~~*Scale of Yards ^ 200 ^ 400 ^ 600 ^ 890 ropo*~~

~~*Scale of JWetri zoo 400 _ 690 . 8c?o 1000*~~

~~*2. Duomo S.Lorenzo*~~

~~*4. 8. Maria delle Grazie*~~

~~*5. S.Maria presso S.Celso*~~

~~*6. S.Sepolcro*~~

~~*7. Bibb'oteca Ambrosiana Brera*~~

~~*9. Oapedale Maggiore*~~

~~*10. Padigtione Litta*~~

~~*11. Muaeo Poldl-Pezzofi*~~

~~*12. Museo Archeologico*~~

~~*13. Museo Artistico*~~

~~*14. Museo del Risorgimento*~~

~~*15. Maseo Civico*~~

~~*16. Conseruatori'o di Musioa*~~

~~*17. Palazzo Borromeo*~~

~~*18. Palazzo Reale*~~

~~*19. Palazzo Marino*~~

~~*20. Palazzo Arciuescovile*~~

~~*21. Palazzo Ciustizia*~~

~~*32. Statue Leonardo da Vinci*~~

~~*23. Statue of Napoleon III.*~~

~~*24. Stat.of Vict.EmanuelB II.*~~

~~*25. Statue of Piatti 2". Statue of Rosminl 2'7. Statue of Manara*~~

~~*28. Statue of Sirtori*~~

~~*29. Statue of Manzoni*~~

~~*30. StazueofGen.Giac.Medici*~~

~~*31. La Scala P.O. Post Office T.O. Telegraph Office*~~

~~*Walker & Cockeiell sc.*~~

~~*means of communication. The omnibus service, organized in 1862, was largely supplanted in 1881 by horse tram- ways. In 1893 the first electric tramway was tried, and by degrees electric traction on the overhead system has been applied to the whole service. The transformation, completed in 1898, was carried out on the basis of the lines being laid by the municipality while their work- ing was entrusted to the Edison Company. The muni- cipality, however, reserved for itself a share in the profits, so that it possesses more than ^^ miles of electric tramways, from which it derives an annual revenue of more than 1,000,000 lire. The number of passengers annually carried by the tramway company is 50,000,000.*~~

~~*Simultaneously with the development of the tram service, the network of railways which makes Milan the most active railway centre of Italy notably increased. In 1882 the important St Gothard line was added to*~~

those already converging on the Lombard metropolis from Turin, Venice, Genoa, Piacenza, Gomo, Varese, and Vigevano, The St Gothard tunnel added immensely to the commerce of Milan by placing it in direct communication with the principal cities of central Europe. At the same time the local railway system has been considerably extended. A further increment of traffic will doubtless follow the opening of the Simplon tunnel in 190;*i. although even now Milan outdistances all other Italian

cities, including Eonie, in respect of passenger and goods traffic and of the postal and telegraphic services. Two other public services, namely, the water supply and the sewersystem,have been completely transformed since 1880. The old system of water supply was that of piercing a well for every house built. But with the growth of the city the system was found to be inadequate and dangerous. The municipal technical bureau proposed, as an experiment, to adopt the system of mechanical extraction of water from the deeper strata of the subsoil. This was so successful (1889) that the system has been adopted and extended, so that now deep wells furnish 12,000 litres per minute, with a pressure equal to that of a reservoir at a height of 40 metres. By 1899 the length of water-pipes had increased from 5 miles to 78 miles, and the consumption from 146,000 litres to 4,088,000 litres. Since 1888 the drainage has been greatly improved. Milan has now in all 48 miles of sewers worked on the single- channel principle — that is, a channel which receives all kinds of drainage and rain-water. The chief collectors dis- charge themselves into the Vettabia, which in its turn com- municates with the river Lambro near Melegnano. The Vettabia is an ancient river-bed, adapted centuries ago for irrigation. It irrigates a tract of land nearly 7000 acres in extent, and its surplus waters pass over a further zone of low-lying land 20,000 acres in extent. Thus some 27,000 acres of land are available for the sterilization of Milanese sewage. The growth of population obliged the munici- pality in 1860 to increase burial accommodation by opening a new cemetery, 120,000 metres in extent, known as the Cimitero Monumentale, at first intended to replace the four old cemeteries in the neighbourhood of the bastions. As its insuflBciency

~~*became apparent, the abolition of the old cemeteries was suspended until, in 1888, a much larger burial-ground was laid out in the commune of Musocco, 3 miles from the city. This new cemetery is the general burying-ground, the Cimitero Monumentale being reserved for the erection of monumental tombs. An electric tramway connects the two cemeteries. It cannot be said that the development of Milanese hospitals has kept pace with the growth of the population. The Ospedale Maggiore, built in 1466, is still the most important. On the other hand, several special institutes and ambulances have been created by private philanthropy since 1880. The Institute dei Rachitici, for the cure and education of children suffering from rickets ; the Instituto Oftalmico, for eye diseases ; and the Padiglione Litta, for surgical operations, deserve mention. The institute for the in- struction of the blind, the deaf, and the dumb has been renewed and enlarged. The municipality has further provided a hospital for contagious diseases at Dergano, some distance from the city. Philanthropic institutes such as soup-kitchens, public dormitories, and foundling hospitals have also been established. Two small experi- ments in the construction of workmen's houses have also been carried out, but, either on account of the special conditions of the Milanese working-classes, or of inherent defects, have not been attended with noteworthy success.*~~

~~*The artistic and scientific patrimony has notably increased since 1875. The Gallery of Brera, founded at the end of the 18th century with works of art accumulated during the sup- pression of the religious orders, has become one of the most im- portant Italian galleries. Since 1880 it has been enriched with pictures by Titian, Tintoretto, Paris Bordone, Antonello, Cossa, Borgognone, &c. ; in 1900 the gallery was enlarged, the number of its rooms being doubled. In 1880 an interesting art collec- tion was bequeathed to Milan by a patrician, Poldi Pezzoli, and has since been opened to the public ; it contains many pictures of prime value by painters of the Lombard school, besides bronzes, ceramics, old stuffs, jewellery, glasses, and an important collec- tion of ancient weapon.s. In 1878 the municipality organized an art museum with objects bequeathed to the city ; and in 1809 the collection was placed in the Castello Sforzesco, which has*~~

been restored by the architect Luca Beltrami. In 1896 the Museo del Risorgimento Nazionale was transported thither ; in 1896 the school of art applied to industry was installed there ; in 1900 the municipal art and archaeological museums were added. In regard to science and scientific collections Milan has made considerable progress. The National Library in the Palace of Brera possesses 250,000 volumes, 126,000 pamphlets, and many manuscripts relating to Lombard history and to the territory of Milan. A Manzoni room has been opened for the collection of all the editions and the auto- graphs of the writings of Alessandro Manzoni, who died in 187.3. The Ambrosian Library has continued to receive many important be- quests of MSS. and works of art. The reproduction of the Codice Atlantico of Leonardo da Vinci, preserved in this library, has reached its eighteenth part ; when complete it will constitute a work of more than 1200 plates in heliotype of large form. The civic museum of natural history, founded about 1850 with small resources, has been increased by donations and bequests, notably by that of Count Turati, who presented to the municipality his ornithological collection, one of the richest in Europe. In 1888 the museum was installed in a special edifice in the public gardens, where the miner- alogical and fossil collections are displayed to advantage. The Brera Observatory was furnished in 1882 with a large equatorial refractor, having an objective 18 Paris inches in diameter. The Milanese Polytechnic, founded in 1865 by the mathematician Brioschi, has greatly developed. A considerable number of m onuments have been erected in the gardens and squares. The principal are the equestrian statues of Victor Emmanuel II., Garibaldi, and the monument com- memorative of the insurrection of 1848 against the Austrians. Other statues are those to Alessandro Manzoni, Giuseppe Parini, Antonio Eosmini, G. B. Piatti (inventor of the drills used in boring the Cenis tunnel), Antonio Stoppani, Generals Sirtori and Medici, Luciano Manara, and Francesco Brioschi. The equestrian statue of Napoleon III. is still in the Senate courtyard awaiting its transfer to the posi- tion assigned to it in front of the Arco della Pace, through which the allied French and Italian armies entered Milan after the battle of Magenta. The ancient monuments have, on the whole, been well cared for. Besides the above-mentioned restoration of the Castello Sforzesco, works of restoration have been executed in the churches of Santa Maria delle Grazie (in terra-cotta) , of Santa Maria presso San Celso, and of San

~~*Sepolcro. The belfry of San Gottardo has been repaired, Palazzo Marino (the seat of the munici- pality) completed, and various repairs carried out in the Palazzo dei Giureconsulti and the Loggia dei Notai. Unfortunately, Milanese archaeologists have not succeeded in every case in pre- venting acts of vandalism during the transformation of the city. Thus, in 1900, the ancient Porta dei Fabbri was demolished — one of the last traces of the walls rebuilt by the Milanese after the de- struction of their city by Frederick Barbarossa. Milan has retained its position as musical centre of Italy, and as one of the chief musicial centres of Europe. The Scala Theatre, with a municipal subsidy, maintained its traditions. In 1897 the municipality with- drew its subsidy, and the Scala remained closed during the season 1897-98; but, owing to private initiative, the theatre was reopened for the triennium 1898-1901 with a limited subvention from the commune. The result of this experiment assured the continuance of the traditions of the Scala.*~~

~~*Province of Milan. — The conditions of Lombard agriculture in the Milan district have been somewhat modified by the exten- sion of irrigation and the development of intensive culture. The territory of which Milan forms the centre has been for centuries divided into a dry zone, extending from the Lower Alps to the city, and an irrigated zone, stretching from the city to the Po. In 1860 the Cavour and Villoresi canals extended the irrigated zone towards the north. Milan still remains the centre of the most rationally irrigated districts in Europe. The poten- tiality of the north Italian canals is surpassed only by that of the great Ganges canal constructed by the British in the second half of the 19th century. The oldest canals lead from Lakes Maggiore and Como ; the Muzza canal, leading from the Adda, existed earlier than the year 1000, and has now an average potentiality in the summer season of 90 cubic metres per minute. The Naviglio Grande, begun for purposes of irrigation in 1186, was adapted also for navigation earlier than the 16th century. The Martezana canal was constructed at the end of the 16th century, Leonardo da Vinci taking part in its preparation. These two latter canals, leading respectively from the Ticino and the Adda, discharge them- selves into the Pavia canal, which in its turn flows into the Ticino at a short distance from the Po. Besides these great arteries, irrigation is eflected with water drawn from springs and wells, which, on account of the*~~

natural slope of the Lombard plain, are able to irrigate land at several kilometres' distance. This system is facilitated by the so-called " right of passage " or " right of aqueduct " created in Lombardy, and now included in the civil codes of several nations. The rent of irrigated land varies from 8 to 11 lire per perch (120 to 105 lire per hectare) — scarcely one-half of the rent demanded a few years back. This reduction has led to

the intensification o£ pasturage and grazing products ; but tlie.se, in tlieir turn, have fallen in price on account of the diiiiculty of exportation. The Lombard peasants hold a high place amongst Italian. agriculturists, and have been instrumental in introducing superior systems of agriculture into Lazio, Apulia, and Sardinia. The dry zone has undergone little change either as regards culture or land tenure. Silkworm rearing is still the chief industry of the region, the land being lield on the mezzadria or metayer system, according to which the products of the soil are divided between landlord and tenant. The fall in prices has caused a diminution in rents and incomes, and has stimulated emigration to South America.

Most noteworthy, too, has been the industrial development of Milan, with its suburbs and neighbouring towns, such as Monza, Gallarate, Saronno, Busto Arsizio, and Legnano. Machine-making on a large scale is carried on by firms widely celebrated for the construction of locomotives, railway trucks and carriages, steam boilers and motors, turbines, pumps, metal bridges and roofs. A number of large turbines for the liydraulic works at Niagara Falls •were constructed at Milan in 1900. Minor industries are repre- sented by workshops for the production of surgical, musical, and geodetic instruments ; of telephone and telegraph accessories ; dynamos, sewing machines, bicycles and automobiles. There is also a large carriage industry. In textile industries silk holds the first place. The amount of silk handled and woven in Milan is greater than that dealt with at Lyons. Milan, indeed, supplies 9,000,000 out of the 24,00.1,030 kilogrammes produced in Europe. Spinning and twisting ([taly produces 50,000,000 kilogrammes of cocoons, which supply work for 00,000 basins and 1,600,000 spindles) are as highly developed as the weaving industry.

~~*Cotton-spinning is represented by 1,000,000 spindles in Lombardy alone. At Milan, headquarters of the industries, cotton weaving, dyeing, and print- ing are extensively carried on. Linen, flax, jute, and wool are also spun and woven. The Milanese manufactures of articles in ca)Utchouc and of electric cables have acquired a world-wide repu- tation. In typography Milan is renowned principally for its musi- cal editions and for its heliotype and zincotype establishments. There is besides a, huge production of posters for advertisement. The manufacture of furniture of all kinds is still extensively carried on, Milan being the chief Lombard market and centre of exporta- tion. The towns of Cantu, Meda, Lissone, and Carugo supply Milanese firms with most of their merchandise, the furniture being made by the workmen at their own homes with materials supplied by the Milanese buyers, who also advance the capital necessary for working expenses. House industry is still widely diffused in Milan itself, especially as regards working in gold, silver, vulcanite, bronze, and leather. The motive power for much of the house- industry is supplied by electricity, 7000 kilowatts being thus em- ployed. The electricity is furnished by the hydraulic works at Paderno, 24 miles from Milan. (l. bi.)*~~

~~*Milan Obrenovitch IV. (1854-1901), king of Servia, was born 22nd August 1854, at Jassy. He was the grandnephew of the famous Milosh, whose brother Jefrem (d. 1856) had a son, Milosh (1829-1861), who married Maria Katardzi, a Moldavian. Milan was their son. While still very young, he lost both his parents, and was adopted by his cousin, Michael Obrenovitch, who re- turned to Servia on the expulsion of the Karageorge- vitches in 1858 and became ruling prince on the death of his father, Milosh, in 1860. During the reign of Michael young Milan was educated in Paris, at the Lycee Louis-le- Grand, where he displayed considerable precocity, but he was only fourteen years of age when in 1868 his cousin was assassinated and he succeeded to the throne under a regency. In 1872 he was declared of age, and taking the reins of government into his own hands, soon manifested great intellectual power, coupled with a passionate head- strong character. Eugene Schuyler, who saw him about this time, found him "a very remarkable young man . . . singularly intelligent and well informed." By a careful balancing of the Austrian and Russian parties in Servia, with a judicious leaning towards the former. Prince Milan was enabled in 1878, at the end of the Turkish*~~

~~*war, to induce the Porte to acknowledge his independence, and was proclaimed king in 1882. (The history of his reign is told in detail under Servia.) Acting under Austrian influence, King Milan devoted all his energies to the im- provement of means of communication and the develop- ment of natural resources, but the cost, which was unduly*~~

~~*increased by reckless extravagance, led to proportionately heavy taxation. This, coupled with increased military service, rendered King Milan and the Austrian party most unpopular ; and his political troubles were further increased by the defeat of the Servians in the war against Kulgaria, 1886-86. In 1885 (September) the union of Rumelia and Bulgaria caused widespread agitation in Servia, and Milan precipitately declared war upon his kinsman Prince Alexander on 15th November. After a short but decisive campaign, the Servians were vitterly routed at the battles of Slivinska and Pirot, and Milan's throne was only saved by the direct intervention of Aus- tria. Domestic difficulties now arose which rapidly as- sumed a political significance. In October 1875 King Milan had married Natalie, the sixteen-y ears-old daughter of Peter Ivanovich Ketchko, a Moldavian Boyar, who was a colonel in the Eussian army, and whose wife, Pulcheria, was by birth Princess Sturdza. A son, Alexander, was born in 1876, but the king and queen soon showed signs of friction. Milan was anything but a faithful husband. Queen Natalie was greatly influenced by Eussian sympa- thies ; and the couple, ill-assorted both personally and politically, separated in 1886, when the queen withdrew from the kingdom, taking with her the young prince, Alexander, afterwards king, then ten years of age. While she was residing at Wiesbaden in 1888, King Milan suc- ceeded in recovering the Crown Prince, whom he under- took to educate ; and in reply to the queen's remonstrances, he exerted considerable pressure upon the metropolitan, and procured a divorce, which was afterwards annulled as illegal. King Milan now seemed master of the situa- tion, and on 3rd January 1889 promulgated a new consti- tution much more liberal than the existing one of 1869. Two months later (6th March) he suddenly abdicated in favour of his son, a step for which no satisfactory reason was assigned, and settled as a private individual in Paris. In February 1891 a Eadical ministry was formed, Queen Natalie and the ex-metropolitan Michael returned to Bel- grade, and Austrian influence began to give way to Eus-*~~

~~sian. Fear of a revolution and of King Milan's return led to a compromise, by which in May 1891 the queen was expelled, and Milan was allowed a million francs from the civil list, on condition of not returning to Servia during his son's minority. Milan in March 1892 renounced all his rights, and even his Servian nationality. The situa- tion altered, however, after the young King Alexander in April 1893 had effected his coup d'itat and taken the reins of government into his hands. Servian politics began to grow more complicated, and Eussian intrigue was rife. In January 1894 Milan suddenly appeared at Belgrade, and his son gladly availed himself of his experience and advice. On 29th April a royal decree reinstated Milan and Natalie, who in the meantime had become ostensibly reconciled, in their position as mem- bers of the royal family. On 21st May the constitution of 1869 was restored, and Milan continued to exercise considerable influence over his son. The queen, who had been residing chiefly at Biarritz, returned to Bel- grade in May 1895, after four years' absence, and was greeted by the populace with great enthusiasm. In 1897 Milan was appointed commander-in-chief of the Servian army. In this capacity he did some of the best work of his life, and his success in improving the Servian military system was very marked. HIs relations with the young king also remained good, and for a time it seemed as though all Eussian intrigues were being checked. The good relations between father and son were interrupted, however, by the latter's marriage in July 1900. Milan violently opposed the match, and resigned his post as commander-in-chief ; and the young king banished him from Servia and threw himself into the arms of Eussia.~~

~~Milan retired to Vienua, and there lie died unexpectedly on 11th February 1901. Milan was an able, though head- strong man, but he lived a scandalously irregular life, and was devoid of moral principle. In considering his rela- tions with his young son, it must be remembered that in the dynastic and political condition of Servia natural feeling was inevitably subordinated in Milan to other considerations.~~

~~*Milazzo, a seaport town of the province of Messina, Sicily, Italy, 22 miles west of Messina by rail. There is a good harbour, which can be entered by vessels drawing 20 feet, but the trade is decreasing ; in 1888 the port was entered by 1523 vessels of 147,150 tons, in 1899 by 515 vessels of 82,600 tons. The exports are wine, tunny, oranges, lemons, and other fruit, and olive oil. Popular tion (1881), 9468 ; (1899), 13,000.*~~

~~*Miles, Nelson Appleton (1839), Amer- ican soldier, was born in Westminster, Mass., on 8th August 1839. A civilian, and engaged in mercantile pur- suits when the Civil War began, he entered service in September 1861 as a lieutenant in the 22nd Massachusetts volunteers, won campaign distinction, and was commis- sioned, in September 1862, colonel of the 61st New York volunteers. He was advanced to brigadier-general of volunteers in May 1864, and to major-general in October 1865. He fought in most of the great battles of the army of the Potomac, and at the end of the war was appointed (July 1866) a colonel of regulars. Promoted to U.S. brigadier-general (December 1880), and major-general (April 1890), he succeeded to chief army command in 1895. He was successful (1869-86) in suppressing Indian outbreaks, and commanded in Chicago during the railway riots in July 1894. He was in nominal direction of opera- tions during the war with Spain, 1898, though tardily sent to the front. He was raised to the rank of lieuten- ant-general commanding in June 1900.*~~

~~*Milford, contributory parliamentary borough (Pem- broke district) and seaport of Pembrokeshire, Wales, about 8 miles west-north-west of Pembroke on Milford Haven ; a terminal station of the Great Western railway. New water storage has been constructed, with a capacity of 3,000,000 gallons. Mackerel are brought here from the Irish coast and despatched by rail to London and other centres. In 1890, 1705 vessels of 350,504 tons entered and 1709 of 350,375 tons cleared ; in 1900, 1206 vessels of 272,124 tons entered and 1153 of 265,525 tons cleared. Population (1891), 4070; (1901), 6102.*~~ •

~~*Milford, a town of Worcester county, Massachusetts, U.S.A., in the southern part of the state. Within its area of 16 square miles are a large rural population and a village of the same name as the town. Three*~~

railways traverse the town — the Boston and Albany, the Grafton and Upton, and a branch of the New York, New Haven and Hartford. It manufactures boots and shoes, besides a variety of other goods. Population (1890), 8780 ; (1900), 11,376, of whom 3342 were foreign-born.

Military Law (see also Etunj. Srit. vol. xvi.). — Military law is " the law which governs the soldiers in Definition. ™®° peace and in war, at home and abroad. At all times and in all places the conduct of officers and soldiers as such is regulated by military law." This is the definition given in the opening chapter of the Manual of Military Lam, which is issued under the authority of the War Office, and which is the text-book used by all courts-martial. The definition is, however, somewhat too wide, and places the Hritish soldier on the level of the French soldier, who is amenable to military tribunals at all times and for all breaches of the law, whether of a civil or of a military charaiiter. The British system does not exclude in time of peace the

action of the civil courts. In time of peace all persons who belong to the military class in France and other Continental countries are judged by military law and by military courts. There is also in most Continental coun- tries an intermediate stage between war and peace known as an etat de sidge, which may be declared for a fixed period for a district, or even a city, by reason of domestic insurrection or the presence of an enemy. It requires legislative enactment. Thirdly comes a state of war, when the military authorities are supreme ; and whilst they can call upon the civil power to act in concert with them, the military authority is final. This is a brief summary of the system of military law that prevails in most countries of the Continent. The cardinal point of difference between the British and the Continental systems lies in the fact that in the United Kingdom the soldier is not only a soldier, butacitizenalso ; and although he may be tried for civil offences by a military tribunal, the power is not exercised in all cases. Thus treason, treason-felony, murder, manslaughter, rape, are brought before a civil court in times of peace, if the offence is committed in the United Kingdom, or if it is committed anywhere else in the king's domains, except Gibraltar, within a hundred miles from a place where the offender can be tried by a civil Court. Minor

civil offences, when not committed within military lines, or when the person affected by the offence is a civilian, or when it is a case for a jury, or where intricate questions of law may arise, may also be brought before a civil tribunal. But an offence, of whatever nature, committed on active service would be brought before a military tribunal.

The British army estimates for 1902 provided for a force of 420,000 men, 219,000 being for ordinary army service and 200,300 for wai service, as compared with 180,513 in the year before the South African ^/Z^ato war. Militia, yeomanry, and volunteers have all increased in numbers as well as the regular forces. This increase in all the British military forces has rendered necessary a further development of military law. Martial law has also come into unusual prominence, and it is treated under its own heading.

The courtsi-martial in the year preceding the South African war were over 8000 in number. The number in 1901 exceeded 20,000. The number of field gen- eral courts-martial greatly increased ip. conse- p^ ,^ quence of the war, and a field general court- general martial has become of special importance. It courts- is convened (1) by any officer in command of a ’”^^”- detachment or portion of troops beyond the seas when not on active service, where complaint is made to him that any offence has been committed by any person under his command against the property or person of any inhabitant or resident in that country; or (2) by the commanding officer of an army corps or portion of a corps on active service, or by any offieer in immediate com- mand of a body of forces on active service where it appears to him on complaint or otherwise that a person subject to military law has committed an offence. The officer must be satisfied that it is not practicable, with due regard to the public service, to try the person by an ordinary court-martial. The quorum of the court is three, if consistent with military exigencies, and each member must have held a commission for not less than a year. The quorum may be reduced when the public service requires it. The procedure of ordinary courts-martial is observed as far as possible, and the proceedings always should be in writing when possible. But in the circum- stances in which these courts are assembled, it is not always possible to adhere to the technical

rules which obtain in the ordinary tribunals, althout;h the broad principles are not violated. The evidence on a field

general court-martial is taken on oath. The prisoner may cross-examine the witnesses for the prosecution, and may call any available witnesses for his defence. The prisoner is allowed to address the court in his own defence.

Important changes were made in the system of courts of inquiry by an Army Order of 10th February 1902. A court of inquiry is and has been an assembly of tag^nK?' officers directed by a commanding officer to collect evidence and report with respect to a transaction into which he cannot conveniently himself make inquiry. But now, whenever any inquiry aifects the character or military reputation of an officer or soldier, full opportunity must be given him of being present at the inquiry and of giving any evidence, or making any statement, or cross-examining adverse wit- nesses, or producing witnesses on his own behalf. Evi- dence may now be ordered to be taken on oath if the assembling officer thinks the case requires it. No pro- ceedings of a court of inquiry, no confession, statement, or answer is admissible in a court-martial. But an officer or soldier tried by court-martial in respect of matter which has been the subject of a court of inquiry is entitled to a copy of the proceedings on payment of the cost of the copy. The iinding and sentence are only valid after con- firmation by the proper military authority. A sentence of death or penal servitude can only be confirmed by the general or field officer in command of the forces with which the prisoner is present. The rule which allows the prisoner aad his wife to tender their evidence on oath under the recent Act as regards evidence is applicable to field general courts-martial. It is useful to note that the Army Act, sec. 70, enables His Majesty to make new provisions under tlie hand of a Secretary of State for, amongst other things, the assembly and procedure of courts of inquiry. The power to make changes by Army Order or rule is only limited by the principle that the rules must not be contrary to or inconsistent with the Act.

~~*The Militia Act, 1882 (sec. 12), confined liability to the service of the militia to any part of the United King- dom, but no part of the militia could be ordered ‘”’””^- out of the United Kingdom. The Eeserve Forces and Militia Act of 1898 now enables them by voluntary offer to extend their services to any place out of the United Kingdom. Under the recent Act the volun- teers also can be accepted for service out of the United Kingdom for a period not exceeding one year, whether an order embodying the militia is in force or not at the time. Militia officers are at all times subject to military law, and militiamen during their preliminary training, during their annual training when acting with the regular forces, and during their embodiment. The old system of ballot for militia services (which is generally thought to be the sound basis of a regular army, because it would provide not only a system of home defence, but also reinforce- ments for the regular forces) would require no addition to the Militia Act, as already there is legislative power lo revive the militia ballot.*~~

~~*The yeomanry stand on the same footing as the volun- teers, and may be considered a cavalry branch of the volunteer force ; so these auxiliary forces rank Yeomanry, gq^g^jjy jjj military law. No limit is placed on their number, and they only require the acceptance of their services by the King. They are not held to be effective unless they do a yearly training of five consecu- tive days, or six days in the year. The yeomanry are in- cluded in the Army Act with the militia and volunteers as ” auxiliary forces ” when employed in military service — that is, they become subject to military law.*~~

~~*The Eeserve Forces Act, 1882, established the reserve for the regular forces and the militia. The main object of*~~

~~*The reserve.*~~

~~*the Reserve Forces Act at the date of its enactment was to aid the civil power in the preservation of the public peace. But by the Eeserve Forces and Militia Act, 1898, any man belonging to the first class of the army reserve whose character on transfer to the army reserve is good shall, if he so agrees in writing, be liable for the first twelve months of his service in that reserve to be called out on permanent service without being called*~~

~~*out by proclamation or without the meeting of Parliament ; and in case there is a state of war between HIs Majesty and any foreign power, the service of a re- serve man may be prolonged for a further period not exceeding twelve months, or his services may be dis- pensed with by the competent military authority.*~~

~~*By the Eeserve Forces Act, 1899, if serving out of the United Kingdom, he may at his own request be trans- ferred to the reserve without being required to return to the United Kingdom. Volunteers ygf^nteers are a voluntary service, but in case of actual or apprehended invasion of any part of the United Kingdom they may be called out for actual service (Volunteers Act, 1863). They are subject to military law when on actual military service, when being trained or exercised with any portion of the regulars, or with any portion of the militia when subject to military law. But any volun- teer may (since 1895) offer himself for active military service whenever an order for the embodiment of the militia is in force.*~~

~~*In an authoritative report published by the Norwegian Government, and compiled by a trained Norwegian lawyer, who visited the various countries, the systems _^ of twenty-two states are reviewed. The earliest nentai military law still in vigour is found in Norway military and Denmark, and dates from 1683, while ’”””’• England and Sweden date from 1881. Sweden has a military penal code, and England is ruled by the Army Act. There are two kinds of military courts of first in- stance : (1) those belonging to separate military bodies, such as divisions, brigades, regiments ; (2) those having jurisdiction in a certain territory, and their seat deter- mined. In times of war the courts must follow the mili- tary bodies. In Bavaria and Switzerland a military jury is attached to a court-martial. In several states ” audi- tors,” i.e., judicial guides, are attached to courts-martial. In some a military jurisconsult (lawyer) is attached as judge, always a fixed post. This obtains in Sweden, Finland, Austria-Hungary, Switzerland, and Portugal. In Norway, Denmark, Sweden, Finland, Belgium, Great Britain, Germany, Austria, United States, Spain, Wiir- temberg and Switzerland, the presiding officer is chosen for the single trial. In other states the military judges are appointed for a certain term, usually six months. The quorum of judges required on military courts on the Continent differs. Seven judges sit in Belgium, HIolland,*~~

~~*France, Spain, Portugal, Greece, Turkey, and Wlirtem- berg ; three only, in cases of ordinary offences committed by non-commissioned officers and soldiers in Switzerland, Eussia, the United Kingdom, United States, and Bavaria. In grave cases in the United Kingdom five to nine sit, nine in Eussia, five to thirteen in the United States. In Norway and Denmark the court is of thirteen up to twenty-five, unless replaced by a commission and a mili- tary lawyer.*~~

~~*In Norway, Denmark, Sweden, Finland, and Bavaria and other places in Germany, special summary courts-martial are held when necessary. Certain forms and legal guarantees are then dispensed with. Such Summary are held in Belgium and Holland "in a town or ^arifai. place in state of siege." La Privdti is a special court of a judge assisted by a registrar, for vagabonds, servants, sutlers, and with a very limited competence over*~~

~~*soldiers who have committed a petty offence, held in time of war in France, Kumania, and Greece.*~~

~~*The United Kingdom has a summary court-martial when the regular-court-martial cannot be held without injuring the military service. In the United States there are the " field officers' court-martial " and " military commission," consisting of three officers. The second is for judging spies, and some other matters that escape the jurisdiction of the regular courts-martial. A special military tribunal in Germany judges the officials attached to the army. Courts of Honour exist in Russia, Germany, Bavaria, Wiirtemberg, Austria-Hungary, and Spain. Great Britain and the United States have the system of a " court of inquiry." This was only a commission of inquiry, but it is now public, the accused is present, and the witnesses are sworn.*~~

~~*Soldiers not on active service, says the Swedish report, should be answerable for infractions of common law, „ _ under the jurisdiction of the civil courts. All teaceot infractions of military order or discipline com- mintary mitted by soldiers, whether on active service or courts. ^^^ should be judged by militarj'- courts. In time of war, it is equally admitted, military courts must judge all offences, even offences at common law, committed by soldiers forming part of an army on campaign. The difference lies in regard to offences committed in time of peace. Sweden, Great Britain, Italy, and the United States, as a general rule, place offences against the com- mon law {infractions de droit commun) in time of peace under the jurisdiction of the civil courts. In the United States offences against good order, in Great Britain personal offences (such as drunkenness), are judged by court-martial. In most other states the general rule is that soldiers, even in time of peace, if on actual service, are judged by courts-martial. In the case of complicity between a soldier and a civilian, sometimes one is judged by a military, and the other by a civil court (in Germany, Switzerland, and Spain), sometimes both by amilitary court (Belgium, France, Italy, Servia, Rumania, and Greece) ; sometimes it depends on the nature of the crime — in the United Kingdom, United States, Sweden, Finland, Hol- land, and Portugal. In Norway a mixed tribunal judges them.*~~

~~*The procedure in military courts differs according to the countries. In some systems (a) the examination and Procedure, preparation of evidence are confided to a juge d' instruction; (b) in other systems they are confided to a special commission of inquiry ; (c) again, in other places they are left to the court-martial itself that will judge the case. The United Kingdom and the United States follow the last plan. There is no preparatory examination in these two countries. A commission of inquiry for the preparation of evidence is held in Norway, Denmark, Germany, Wiirtemberg, Austria-Hungary, Servia, Belgium, and Holland. An auditor directs these courts of inquiry. In Russia an officer acts as jvge d'in- struction; in grave cases he must be a military juriscon- sult. In France, Italy, Spain, Rumania, Greece, and Turkey an officer acts as juge. d'instrtirtiou.*~~

The proceedings before a court-martial are usually public, except in the case of matters that offend morality. Publicity, porapromise p\iblic order, or where publicity is considered injurious to the interests of the service (cases of discipline, disclosing plans, &c.). This does not apply (except in Great Britain and the United States) to the proceedings before the courts liharged with preliminary investigation. In several states, i.e., Norway, Denmark, Holland, Austria, Servia, (xermany, and Wurtemberg, the public prosecutor is also the counsel of the accused. The auditor who directs the court of iiKjuiry tills these offices (except in cases of small importance in

Germany and A'urtemberg). In other states there is a special office of public prosecutor. In France he is an officer, and in Spain, Portugal, Rumania, Greece, and Turkey. In Russia, Belgium, Bavaria, Switzerland, and Italy he is a military lawyer. In these countries the accused has the right to choose a counsel, or one is assigned him. In the United Kingdom and the United States, when the matter is grave, the direction of the case is put in the hands of a judge-advocate. In the United States the judge-advocate is the public prosecutor.

There is no superior tribunal to which to appeal in Denmark, Great Britain, and the United States. In Den- mark the cases are sent to the auditor-general, . . who can annul if there is error in form, and wheaai- send back the case to be tried anew. In Great 'ot^erf and Britain and the United States judgment in ^ ”’”’ ordinary cases must be confirmed by the commanding officer by whose order the court was called. He can lighten the sentence. In certain cases of great gravity it must go on to the head of the State, after passing through the revision of the judge-advocate-general, who is the constitutional adviser of the Crown as regards courts-martial from the point of view of legality. There is also in these two countries a special revision of judgments in the judge-advocate-general's office. This revisional power is the safeguard of military justice, as all decisions are reviewed, and if any illegality is pointed out the proceed- ings are consequently quashed. The effect of this disap- proval is not merely to annul the proceedings, but it also prevents the accruing of any disability or forfeiture. The British judge-advocate's office has been much strengthened. It now consists of- — (1) The judge-advocate-general (one

~~of H.M. judges). (2) A deputy judge-advocate-general, who is a trained lawyer. (3) A deputy judge-advocate, also a trained lawyer. (4) A military officer of the rank of colonel who has been called to the Bar. (5) In South Africa (since 1899, and on a five-years appointment from 1902) a colonel who has been called to the Bar. ^~~

~~In Germany there is no appeal except for officials at- tached to the army. In Austria-Hungary the sentence can be lightened by the commanding officer. It can also be returned for trial by a superior court if it appears to him too light. In Spain all judgments have to be confirmed, and if confirmation is refused, it is carried before the supreme court of the navy and army. The condemned has no power of appeal himself, but all cases of death or life sentences go before the supreme court of the navy and army. Russia only requires the confirmation of the commanding officer. In France, Rumania, and Greece all condemned prisoners in time of peace can demand a court of revision, composed of ageneral and four superior officers. In time of war the court may be composed of three.~~

~~Certain forms of punishment, in all countries but the United States, can be given by the superior officer, without judicial intervention, for small purely military „. , offences, where a summary procedure is required. piiaary The offender, if he prefers, may be carried before punish- court-martial. The punishment is immediately '"«"'*• carried into force, but the person punished can complain to higher military authority. In that case, if the com- plaint is not admitted, the punishment is enhanced. The commonest of these disciplinary punishments are depriva- tion of liberty, confined to barracks, arrests and prison. Certain special punishments obtain in certain countries — for instance, imprisonment in Turkey may be accompanied by a bread and water diet; and officers in Finland and Russia may be deprived of advancement.~~

~~AuTiiouiTiES. — 3/r7»?(rt/ of Militart/ Law. — The King"s Begnla- tions. — Clode. — Military Furce.i of the. Crown. — T. Gram. Fonctionnement de la Jn.itice .)Hlila'iye dainf les differents £tals de V Europe. Christiania. — Military Laws of the United States. —~~

~~MILITARY TACTICS — MILITIA~~

~~Commentaire sur le Code de Justice Militiiire (Pradier Foijiri et J'auke). (jno. h.)~~

~~Military Tactics. See Tactics.~~

~~iVIiiitia. — The militia of the United Kingdom, com- monly so called, is the general or regular militia, as distinguished from the local militia, which was estab- lished in the year 1808, and which, though in abeyance, might still legally be raised. It consists of a number of ofiBcers, non-commissioned officers, and men, serving under special ■ enactments and regulations, formed into corps or battalions, and trained as soldiers for the purpose of aug- menting the military stre'ngth of the country in case of national danger or emergency. Although the force is very ancient, being the direct descendant of various levies com- pulsorily raised for national defence from the earliest times, the title militia first appears in the year 1690, and constantly occurs in parliamentary reports in 1640 and 1641, at which time it was referred to as a new word. The actual origin of the militia is lost in antiquity.~~

~~The Roman invasion was stoutly resisted by armed tribes re- sembling a militia, and possessing both organization and military ability. The inhabitants of Britain are described by~~

~~s ory. historians as a military people, well armed, and adopt- ing tactics in which, by means of chariots, they combined great mobility with the steadiness of foot soldiers. With the advent of the Saxons began the county organization, with which the militia is still closely identified, and the development of a military force called " The Fyrd," easily recognizable as identical in principle with the modern militia. This was the force which King Alfred re- organized. Under this reform was established a general liability to military service on the part of every able-bodied male between the ages of 16 and 60. Although the title of "The Fyrd " survived until long after the Norman Conquest, the force established by King Alfred was known as the general levy, which was bound to appear armed when ordered to aid in suppressing domestic riots as well as in defending the realm against invasion by foreign foes. Service~~

~~*was restricted to the (iounties except in case of invasion, when it was extended to the whole kingdom. For centuries these re- mained with little alteration as the principles governing the national forces of the kingdom, and form in effect with certain developments the basis of the modern militia system. The Norman Conquest was immediately followed by the introduction of the feudal levy in ad- dition to the general levy, the distinction between these forces being that while obligation to serve in the latter rested upon every male within certain limits of age, service in the feudal levy depended upon tenure of land under the king as feudal lord. The general levy probably constituted the larger part of the infantry, while the feudal levy consisted of the knights who, with their retainers, mounted and armed, were bound to attend the king at their own expense. Thus early, as in the present day, the question of service abroad as well as at home was raised, with the result that the feudal tenants successfully refused to serve out of the kingdom. Personal service formed the basis of both levies, but service by deputy, or payment in lieu of personal service, and the calling out of a quota only, were allowed from very early times. The feudal levy was dis- continued during the Commonwealth and abolished at the Resto- ration ; but liability to serve in the general levy has never been extinguished, but remains in the statutory and practical form of liability to serve both in the general and local militia. Inspections of arms and the assembly and training of the men raised under this national system were secured from time to time by means of "assizes of arms," " views of armour," " commissions of array," and "com- missions of musters," dating from early in the 12th century down to the 16th century. The machinery employed to carry out the law formed the basis of the existing procedure for the enforcement of the ballot for the militia, which thus bears a strong resemblance to the means adopted from ancient times. These constitutional powers were frequently abused by " electing" or impressing men to serve out of the kingdom, but this was checked in the year 1.327 by an Act of Parliament, which strictly regulated the scope and limits of military service within the kingdom at the charge of the parislies or counties, but provided for service abroad at the charge of the Crown. "Commissions of musters" were a development of preceding measures for raising men and material for military service, under which the commissioners registered and mustered persons liable to serve, sorted them into bands, and trained and exercised them at the charge of the*~~

county. These bands became known as train or trained bands, and were mustered annually. With them were as- sociated lieutenants of counties, first appointed in 1549 by Edward VI., subsequently in Queen Mary's reign called iord-lieutenants, and after the Restoration appointed as statutory oflSoers for the

militia, their commissions at the present day being issued under the Militia Act. There does not appear to have been any clearly de- fined regimental organization in existence until these bands or companies were called into active service, but the Acts of the Com- monwealth supplied this defect, and initiated a permanent regi- mental system. One of the earliest attempts to reform the force since the time of King Alfred was made by Charles I. in 1629, when Orders in Council were issued instructing lord-lieutenants to put the militia on a better footing and to fill up vacancies among the officers. Cromwell subsequently is.sued similar orders couched in strong terms, though under the Commonwealth the duties of lord- lieutenants were not recognized, the militia being raised by com- missioners. At the Restoration an Act was passed declaring that the control of the militia was the prerogative of the king, and in the following year another Act, with subsequent amendments, estab- lished the militia upon the basis on which it rested until 1757, the year of Pitt's great reform. Charles II. transferred the control of the militia to the lord-lieutenants, but lowered the military status of the force by requiring all offences to be punished by the civil magistrate. To this cause is attributed the disrepute into which the militia fell and the inefficiency it displayed, with the exception of the trained bands of London, until it was reorganized in 1757. Under the Act of 1662 all train bands were discontinued in the counties, but those of London, with their auxiliaries, remained until 1794, when they were reorganized as the City of London militia. In 1688 an Act was passed raising the militia for one year, and for some time this Act became an annual one. In 1690, on the occasion of the French invasion, the militia was embodied ; and again in 1715 and 1745 during the troubles caused by the Old and Young Pretenders. In a pamphlet of 1712 the English militia was estimated at 7450 horse and 84,391 foot soldiers. From 1715 until 1734, and again from that year until 1757, with the exception of 1745, no votes were taken in Parliament for the militia.

~~*The foregoing remarks apply only to the English militia and its predecessors. Ireland and Scotland did not furnish any regular militia until 1716 and 1797 respectively, although in Scotland militia existed long before 1797, e.g., in Perthshire in 1684 ; and in addition corps of fencibles were raised and embodied. The Irish militia when first raised in 1715 was restricted to Protestants between the ages of 16 a,\A 60, who were bound to appear or provide substi- tutes. The force was not made subject to military law, but various military offences were punishable by fine or imprisonment. Several amendments and other Acts followed until 1793, when a new Act was passed providing for raising a force of militia by ballot among men between the ages of 18 and 45, to serve for four years. Each county was liable to a fine of £5 for each man deficient, and enlist- ment in the army was prohibited. Other amendments followed from time to time, and notably one in 1797 abolishing religious re- strictions for the supplementary militia, and another in 1802 removing the same restrictions in the case of the general militia. Finally, all the Acts were consolidated in 1809 by an Act which fixed establishments, provided for raising the men by ballot, but gave power to the lord-lieutenant to authorize voluntary enlistment by means of bounties, and also to suspend the raising of any regi- ment. The Scottish militia was at first raised by ballot among men between the ages of 19 and .30. In 1802 former Acts were re- placed by an Act providing for the organization of the militia on a basis similar to that on which the militia of England was organized by the Consolidation Act passed in that year.*~~

~~*The immediate cause of the organic reform carried out in 1757 was the disclosure of the inefficiency of the militia during the rebellion of 1745. The Act of 1662 followed the old law by requir- ing owners of property to furnish men, horses, and arms in propor- tion to the value of their property, and the liability of persons of small property was to be discharged out of a rate levied in the parish. This was entirely altered in 1757, a liability on the part of the county or parish being substituted for a liability on the part of individuals. Each county was required to furnish a quota appor- tioned among the various parishes ; men were to be chosen by lot to serve for three years (this being the first provision of a fixed terra of service) or to provide a substitute, and vacancies were to be filled from time to time by a like process of ballot. The system tlms legalized is*~~

~~*practically the existing though suspended ballot system. The force was to be annually trained and exercised for a limited period, and in case of invasion or danger thereof, or in case of rebellion, the Crown could order it or any portion of it to be embodied ; and during embodiment it was subject to the Mutiny Act. Under this Act 30,000 militiamen were raised hy ballot and embodied from 1759 to 1763. This force was exclusively "Pro- testant," and remained so until 1802. The service of the militia as thus arranged remained nearly in the same state until 1870. Pitt's reform, however, was followed by numerous amendments, new enactments, and other changes, of which the following is a summary in chronological order : —*~~

~~*1758. Volunteers officially recognized as counting towards the quota.*~~

~~*1761. Raising of quota made compulsory on counties under penalty*~~

~~*of fines. Mutiny Act applied to militia when out for training as well*~~

~~*as when embodied. 1775. (American War.) Act passed empowering embodiment of*~~

~~*militia in case of colonial as well as domestic rebellion. 1786. Charge on parishes for storage of arms, &c., transferred to*~~

~~*counties.*~~

~~*1795. Enlistment into regulars encouraged.*~~

~~*1796. Supplementary militia formed, consisting of 63,878 men.*~~

~~*1798. (Irish Rebellion.) English militia volunteered for service*~~

~~*in Ireland.*~~

~~*1799. Irish militia volunteered to serve in Great Britain. 16,000 militiamen volunteered to regular army.*~~

~~*1803. 45,492 men raised for militia by ballot, but of these 40,998 were substitutes.*~~

~~*1805. Militia affiliated to line for purposes of recruiting for*~~

~~*regulars.*~~

~~*1806. Training Act to raise by ballot 200,000 men to be trained*~~

~~*for one whole year, and then to discharge them from train- ing for two years. 1808. Difficulties having arisen under above Act, local militia (which is in effect the old general levy) established in addition to general militia then embodied. 27,000 militiamen volunteered to regular army during pre- ceding twelve months.*~~

~~*1811. English militia, hitherto not liable to serve out of the king-*~~

~~*dom, now made liable to serve in any part of the United Kingdom under certain restrictions, which were subse- quently (in 1859) removed. Method of obtaining men from militia for regulars further systematized.*~~

~~*1812. In this year there were 250 regiments of local militia, with*~~

~~*an establishment of 240,388 men and 214,418 actually enrolled.*~~

~~*1813. During ten years, from 1803 to 1813, nearly 100,000*~~

~~*militiamen joined the regular army. Act passed to enable militia to serve abroad as militia with their own officers. Three strong battalions joined the British army in France.*~~

~~*1815. Militiamen recruited in gi-eat numbers the army which*~~

~~*fought at Waterloo. Local militia ceased to be raised.*~~

~~***1816. Local militia and Ballot Act suspended. General militia disembodied.***~~

~~*1820-21-25. Militia called out for training.*~~

~~*1829. Act passed suspending ballot for the general militia.*~~

~~*1831. Militiamen raised by ballot in accordance with Order in*~~

~~*Council, 27th December 1830. This was the last occasion*~~

~~*on which the ballot was put in force. During the great French war the utility of the militia was most marked, and before passing on to its revival in 1852, after the lapse of nearly forty years, tlie following summary of its position in the early years of the 19th century in relation to the whole army may be stated ; — The tendency of the Government was to use the general militia rather as an offensive force and the local militia as the real defensive force. During the height of the war (in 1812) the relative position of the various branches of the army was as follows : — First line, the standing army ; second line, the general or regular militia, which as the war went on were more and more used abroad ; third line, the local militia, with the survivors of the volunteers, who at that time numbered about 68,000 men. After the peace of 1815 the militia was allowed practically to fall into abeyance, although the permanent staff was maintained. In 1848 the Prime Minister intimated in Parliament his intention to re-establish the militia, but it was not until 1852, after an unsuccessful attempt to resuscitate the local militia, that the general militia of England was reorganized under a system of voluntary enlistment with the ballot in reserve, Scotland and Ireland being included in 1854. The property qualification of officers which had hitherto existed (with exception in favour of ex-oflficers of the army and navy) was reduced, and after a further reduction in 1854, abolished in 1869. Larger powers respecting the militia were conferred upon the Crown, and during the Crimean war the Queen was authorized to embody the militia whenever a state of war existed with any foreign Power. The ac- ceptance of voluntary offers of service in the Channel Islands and Isle of Man was authorized in 1859, and extended to service in Malta and Gibraltar in 1875. Previously service abroad was only tem- porarily authorized under certain restrictions, e.g., in 1813, 1855, and 1858. Later enactments will be referred to in their proper place.*~~

~~*In 1871 the militia was brought more ihto touch with the regular army, and in 1881 became, with the line, battalions of Receai territorial regiments, the artilleiy and engineers being changes. ^'^° closely associated with the regular services. Various amendments and new enactments followed, all in the direction of increasing the usefulness of the militia, render-*~~

~~*ing it more efficient and readier for service, and making it more and more a means for supplying recruits, both officers and men, to the regular army. The present position of the force is as follows : — The officers who are commissioned by the Crown are, with the permanent staff, at all times (since 1877) subject to military law. Non-commi^f ioned officers and men are only so subject when em- bodied or out for training, with extension in the case of men convicted of offences committed during training until the expiration of the punishment. Enlistment is at present voluntary, though compulsory service by ballot is still legal and may be at any time enforced. The minimum age for recruits is 17. Boys from 14 to 16 may be specially enlisted for buglers, drummers, or trumpeters. The period of engagement is for six years. Militiamen up to 45 years of age may re-engage for a further term of four years. Bounties are paid to militiamen at various rates upon enlistment, conclusion of training, re-engagement, enlistment into reserve or special service section, and other special circumstances. Recruit training may be extended to six months, but as a rule will not exceed three months. Recruits are either drilled immediately upon enlistment at any time of the year, which is now the most usual system, or else at preliminary drills (first instituted in 1860), im- mediately preceding the annual training of the corps. The annual training varies with the different branches of the service and certain special circumstances, but must not exceed 56 days. The usual term for infantry is 27 days, but when on manoeuvres this is generally extended to 34 days. Artillery and fortress engineers are trained for 41 days, and submarine mining engineers for 55 days. Trainings now take place for the most part in camp or barracks, and large numbers of militia battalions during recent years have been called upon to take part in field manoeuvres. Each branch of the militia service is now incorporated with the corresponding branch of the regular army, the dep6ts occupy as a rule the same barracks, and officers and men wear (with slight distinctions) the same uniform as the regulars. The militia*~~

~~occupies an important position in the mobilization scheme for national defence. The permanent staff consists of an adjutant, quartermaster, and an establishment of non- commissioned officers, and buglers or drummers, who are all regulars. During the non-training period of the year they are engaged in recruiting, care of arms, clothing, &c., and in drilling recruits. When the militia is embodied or called out for training they are in- corporated with their units for executive as well as administrative duties.~~

~~The militia ordinarily is liable only for service in the United Kingdom, but by legislation in 1899 may voluntarily serve in any part of the world, including India. During 1899-1900, 22,000 militiamen were thus accepted for service abroad, the bulk of them proceeding to the seat of war in South Africa. The militia may be embodied in case of imminent national danger or great emergency. The procedure is by proclamation of the sovereign, the occasion being communicated to Parliament if sitting, but if not in session, Parliament must be called together within ten days. The militia has been constantly embodied since the reorganization in 1757 as follows :— 1756-63, Seven Years' War ; 1778-83, American War ; 1792-1802, threatened invasions and Irish Rebellion ; 1803-16, war with France ; 1854-56, Crimean War, when several battalions served in Mediterranean garrisons ; 1857-59, Indian Mutiny ; 1885, Sudan Campaign ; 1899-1902, South African War, when the whole militia force was embodied, and a large number of units of all branches volunteered for foreign service. The mUitia reserve consists of men selected from the ranks of the militia for special enlistment for service in the regTilar army when called upon in emergencies, in the following proportions to the establishments of the various corps :— Artillery, one-third ; engineers and infantiy, one-fourth ; medical staff corps, one-half. Special regulations are made as to age, physique, and character. The militia reserve was first formed in 1867, and in 1900 numbered 30,000 men. During an emergency in 1878, 20,000 militia reservists joined the regular army. The term " militia " reserve is therefore a complete misnomer, and the force so called is purely an army reserve. The special service section of the militia was formed by royal warrant in 1898, and consists of (1) militia units and (2) individual militiamen. A militia unit may be registered as available for special service if not less than 75 per cent, of~~

~~the officers anil men present at training make a voluntary offer to engage for special sei'vice in any part of the world, and if in the infantry at least 600 and in the artillery at least 250 men are accepted as qualified. Individual militiamen are those who engage to serve either with their militia unit if registered for service, or else for special service with the regular forces. Liability for service will not exceed twelve months. They will not be called out except for service out of the United Kingdom ; age 20 to 34 ; physical reiiuirements as for regular army. Men of the special service section may also belong to the militia reserve, and receive a bounty in addition to that given for the reserve. The result of this special section was not up to 1900 so satisfactory as expected. Very few units could qualify for registration, and the response of in- dividual men was comparatively insignificant.~~

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~~M I L L A I S~~

~~There is no fixed quota for the militia under present enactments ; the numbers vary from year to year, as voted by Parliament. The following figures (showing the state of affairs previous to the Boer war of 1899) relate to the year 1898. The total establishment for the United Kingdom numbered 132,493, divided between England, 87,828 ; Scotland, 15,695 ; Ireland, 28,970. Subdivided among the different branches these numbers represented 18,520 artillery, 2000 engineers, 111,300 infantry, and 613 medical staff. The total number actually enrolled was 113,439, thus showing a deficiency of 19,054, made up of 649 officers, 77 permanent staff, and 18,328 non-commissioned officers and men. England was responsible for 14,169 of this deficiency, Scotland for 2011, and Ireland for 2874. Of the total number enrolled (113,439), England provided 73,659 ; Scotland, 13,684 ; and Ireland, 26,090. Shown by arms, the artillery mustered 16,886 ; the engineers, 2098 ; infantry, 94,114 ; and~~

medical staff, 341. The religious denominations of the non- commissioned officers and men were thus returned : — Church of England, 53,610 ; Roman Catholic, 40,496 ; I'resbyterians, 8668 ; "Wesleyans, 3624; other Protestants, 1309; Jews, 46. 40,127 recruits joined the militia during 1898. Of these approximately one-half were 18 years of age and under. 2905 men re-enlisted or rejoined after desertion. The total increase was shown as 43,013. The total decrease from all causes was 44,897 men, of whom 19,808 were discharged, 383 were reported to have died, and 8743 were struck off for desertion or other causes. 15,167 men were trans-ferred to the regular army, and 796 to the Royal Navy and marines. Militia recruiting for the regulars thus shows a large increase compared with preceding years. The net decrease was 1884 men. ' ' Crime ' ' in the militia was represented by 996 offences of the usual military character, which were dealt with by 846 courts-martial. Of these offences, 489 were for absence without leave. None of the others were of a serious nature. 2726 men were fined for drunken- ness. 8718 men deserted, of whom nearly half had less than one year's service. 98,042 militiamen were present at annual training; 7240 were absent with leave, 8157 without leave. England, pro- duced 63,048 men for training, Scotland 11,520, and Ireland 23,474. These numbers together represented 14,7.S4 artillery, 1864 engineers, 81,161 infantry, and 283 medical staff corps. The ages of the majority^of militiamen range from 17 to 35 years. 782 were under 17, and 14,611 over 35 years of age. The heights of the majority of the men range from 5 feet 4 inches to 6 feet. 8997 men were under 5 feet 4 inches, and 909 were over 6 feet in height. A larger number of men approximated to 5 feet 6 inches than to any other height. In the House of Lords, on Friday the 25th May 1900, the marquis of Lansdowne, Secretary of State for War, stated that the grand total of the militia on the 1st May was 99,000 men. Of these 22,000 were abroad, 11,000 belonged {i.e. , called up for service with regulars) to the militia reserve, leaving 66,000 militia at home. These figures, presumably correct, thus show a further decrease of 14,000 men since the returns of 1898. On the other hand, Lord Lansdowne was able to announce that a deficiency of 649 officers in 1898 had by the war been turned into an excess of 20 officers above the establishment. The militia in recent years had steadily decreased. In 1881, the year when the militia was practically incorporated with the. regular army, there were 127,868 militia of all ranks actually enrolled, and 11,633

~~*wanting to complete. Thus it appears that up to 1898 there had been a loss of 14,429 men, and with the further loss of 14,000 noted above as officially stated in Parlia- ment, the total decrease in the militia in nineteen years was upwards of 28,000 men. This steady depletion of the militia has a most serious bearing upon the military strength of Great Britain.*~~

~~*(a. B. W.)*~~

~~*Millais, Sir John Everett (1829-1896), English painter, was born at Southampton on the 8th June 1829, the son of John William Millais, who belonged to an old Norman family settled in Jersey for many genera- tions, and Emily Mary, nie Evamy, the widow of a Mr Hodgkinson. After his birth the family returned to Jersey, where the boy soon began to sketch. At the age of eight he drew his maternal grandfather. He went to school for a short time, but showed no inclination for study, and was afterwards educated entirely by his mother. In 1835 the family removed to Dinan in Brittany, where he sketched the French officers, to their great amusement, and in 1837, on the family's return to Jersey, he was taught drawing by a Mr Bissel. In 1838 he came to London, and, on the strong recommendation of Sir Martin Archer Shee, P.R.A., his future was decided. He was sent at once to Sass's school, and entered the Academy schools in*~~

~~*1840. He won a silver medal from the Society of Arts in 1839, and carried off all the prizes at the Royal Academy. He was popular amongst the students, and was called " the child," because he wore his boyish costume till long after the usual age. In 1840 and the immediately suc- ceeding years he made the acquaintance of Wordsworth and other interesting and useful people. He was at this time painting small pictures, &c., for a dealer named Thomas, and defraying a great part of the household expenses in Gower Street, where his family lived. In 1846 he exhibited " Pizarro seizing the Inca of Peru " at the Eoyal Academy, and in 1847 " Elgiva seized by the Soldiers of Odo." In the latter year he competed un- successfully at the exhibition of designs for the decoration of the Houses of Parliament, sending a very large picture of " The Widow's Mite," which was afterwards cut up. In the beginning of 1848 he and W. Holman*~~

~~*Hunt, dis- satisfied with the theory and practice of British art, which had sunk to its lowest and most conventional level, initiated what is known as the Pre-Raphaelite movement, and were joined by Dante Gabriel Rossetti, and afterwards by five others, altogether forming the Pre-Raphaelite Brotherhood. Rossetti was then engaged, under the technical guidance of Hunt, upon his picture of " The Girlhood of Mary Virgin," which, with Hunt's "Light of the World " and Millais's " Christ in the House of His Parents," forms what has been called the trilogy of Pre- Raphaelite art. According to Millais, the Pre-Raphaelites., had but one idea — " to present on canvas what they saw in Nature." Millais's first picture on his new principles was a banquet scene from Keats's "Isabella" (1849), and contains all the characteristics of Pre-Raphaelite work, including minute imitation of nature down to the smallest detail, and the study of all persons and objects directly from the originals. The tale was told with dramatic force, and the expression of most of the heads was excellent. His next important picture, " Christ in the House of His Parents," or " The Carpenter's Shop " (1850), represented a supposed incident in the childhood of our Lord treated in a simply realistic manner, and drew down upon him a storm of abuse from nearly all quarters, religious and artistic. The rest of his' more strictly Pre-Raphaelite pictures — "The Return of the Dove to the Ark," "The Woodman's Daughter," and the "Mariana" of 1851, " The Huguenot " and " Ophelia " of 1852, " The Proscribed Royalist " and " The Order of Release " of 1853— met with less opposition, and established his reputation with the public. Indeed, this may be said to have been accomplished by the " Huguenot " and " Ophelia," the refined sentiment and exquisite execution of which appealed to nearly all who were unprejudiced. The public were also greatly in- fluenced by the splendid championship of Ruskin, who, in letters to The Times, and in a pamphlet called " Pre- Raphaelitism," enthusiastically espoused the cause of the Brotherhood. In 1851 Millais, who had refused to read Modern Painters, where the supposed principles of the Brotherhood were first recommended, became acquainted with Ruskin, and in 1853 went to Scotland with him and Mrs Ruskin, the latter of whom sat for the woman in " The Order of Release." He made several designs for Ruskin, and painted his portrait. In 1855 Millais exhibited " The Rescue," a scene from a fire, which drew great attention, from the frantic expression of the mother and the brilliant painting of the glare. In*~~

~~the Paris Ex- hibition of this year he was represented by " The Order of Release," " Ophelia," and " The Return of the Dove." This was also the year of his marriage with Mrs Ruskin (Euphemia Chalmers, daughter of Mr George Gray of Bowerswell, Perth), who had obtained a decree of the nullity of her previous marriage. The newly- wedded couple went to live at Annat Lodge, near Bowers well, where~~

~~"Autumn Leaves," described by Ruskin as "the first instance of a perfect twilight," was painted. This and " Peace Conchided " were singled out for special praise by Ruskin in his notes on the Academy Exhibition of 1856, which contained, with other works by Millais, the picture of " A Blind Girl," with a beautiful background of Ickles- ham and its common. The principal pictures of 1857 were " Sir Isumbras at the Tord," and " The Escape of a Heretic," both of which were violently attacked by Euskin, who was kinder to the "Apple-blossoms" and " Vale of Eest " of 1859, extolling the power of their painting, but still insisting on the degeneracy of the artist. The "Black Brunswicker" of 1860 was in motive very like the " Huguenot," but it was less refined in expres- sion, and a great deal broader in execution, and may be said to mark the end of the period of transition from his minute Pre-Raphaelite man- ner to the masterly freedom of his mature style. Prom 1860 to 1869 the invention of Millais was much employed in illustration, especially of Trollope's novels, beginning with Framley Parsonage in the Cornhill Magazine. He made altogether eighty-seven drawings for Trollope, and was the cleverest and one of the most prolific of the book illustrators of the 'sixties. He contributed to Moxon's illustrated edition of Tenny- son's Poems, and made occa- sional drawings for Once a Week, the Illustrated London News, Good Words, and other periodicals and books. In 1863 he was elected a Royal Academician. The most im- portant pictures of this and the next few years were " The Eve of St Agnes," remarka- ble for the painting of moon- light, " Romans leaving Brit- ain " (1865), "Jephthah" (1867), "Rosalind and Ceha" (1868), "A Plood," and " The Boyhood of Raleigh" (1870). All these were executed in a very broad and masterly~~

~~*manner. In many of his pic- tures of this period, such as " The Boyhood of Raleigh," his children were his models, and formed the subject of many more, like "My First Sermon," "My Second Ser- mon," "Sleeping," "Awake," "Sisters," "The First Minuet," and " The Wolf's Den." He now painted many single figures with more or less sentiment, like " Stella," " Vanessa," and "The Gambler's Wife," with occasionally a more important composition, like "Pilgrims to St Paul's," and "Victory, O Lord" (exhibited 1871), repre- senting Aaron and Hur holding up Moses' hands (Exodus xvii. 12). With it was exhibited the first and most popular of his pure landscapes, called " Chill October," which was followed at intervals by several others re- markable for literal truth to nature and fine execution. They were all from Perthshire, where he generally spent the autumn, and included " Scotch Firs " and " Winter Fuel" (painted in 1874), "Over the Hills and Far Away," and "The Fringe of the Moor" (1875), and "The Sound of Many Waters" (1876). A later series was painted m the neighbourhood of Murthly, a villao-e*~~

~~*(F;*~~

~~*in the parish of Little Dunkeld, Perthshire, where he rented a house and shooting from 1881 to 1891. It was to painting nature and the world around him that he principally devoted himself for the last twenty- five years of his life, abandoning imaginative or didactic themes. To this period belong a number of pictures of children, with fancy titles, like "Cherry Ripe," " Little Miss Muffet," " Bubbles," and others well known by reproductions in black and white and in colour for the illustrated papers ; and also some charming studies of girlhood, like "Sweetest eyes were ever seen," and " Cinderella." Amongst his more serious pictures were " The Princes in the Tower " (1878), " The Princess Elizabeth" (1879), two pictures from Scott — "Effie Deans " and " The Master of Ravenswood " — painted for*~~

~~*Messrs Agnew in 1877 and 1878, and "The North- West Passage," sometimes regarded as his masterpiece, represent- ing an old mariner (painted from Edward John Trelawney, the friend of Byron) listen- ing to some tale of Arctic exploration in a room over- looking the sea anU strewn with charts. " A Yeoman of the Guard" (1877) was per- haps his*~~

most splendid piece of colour, and was greatly admired at the Paris Exhibi- . tion of 1878, where it was sent with "Chill October" and three others of his pic- tures. But perhaps the works of his later years by which he will be most remembered are his portraits — especially his three portraits of Glad- stone (1879, 1885, and 1890), and those of John Bright, of Lord Tennyson, and of Lord Beaconsfield, which was left unfinished at his death. He also painted the mar- quess of Salisbury, Lord Rosebery, the dukes of I)e- onshire and Argyll, Cardinal Newman, Thomas Carlyle, Sir James Paget, Sir Henry Irving, George Grote, Lord C. Hook, R.A., and himself He drew Charles Dickens after his death. Amongst his finer portraits of women were those of]Mrs Bischofisheim, the duchess of West- minster, Lady Campbell, and Mrs Jopling.

No very serious interruption of his usual life as a prosperous English gentleman occurred in these years, except the death of his second son George in 187.S. In 1875 he went to Holland, one of his few visits to the Continent. In 1879 he left Cromwell Place for a house at Palace Gate, Kensington, which he built, and where he died. In 1885 he was created a baronet on the suggestion of Mr Gladstone. In 1892 his health began to break down. After a bad attack of influiMiza he was troubled with a swelling in his throat, which proved to be due to cancer. He suffered much from depression, but worked when he could, and derived much pleasure in painting several pictures, including "St Stephen," "A Disciple," "Speak! Speak!" (which was bought out of the Chantrey Bequest), and " The Forerunner "—his last exhibited

rim Jdll.N EVKUKTT Mll.L^lS.

»i a photograph by Elliott and Fry, London.)

Chief Justice Russell, J. (Uftizi Gallery, Florence).

subject picture. His finely-characterized portraits of Mr John Hare, the actor, and Sir Richard Qnain, belong also to his last years. In 1895, in

~~*consequence of tlie illness of Lord (then Sir Frederick) Leighton, he was called upon to preside at the annual banquet of the Royal Academy, and on the death of Lord Leighton he was elected to the presidential chair. He died on the 13th August 1896, and was buried in St Paul's Cathedral. The Winter Ex- hibition of the Royal Academy in 1898 was devoted to his works. The list of his honours at home and abroad is a long one. Millais was one of the greatest painters of his time, and did more than any other to infuse a new and healthy life into British art. He had not the imagina- tion of an idealist, but he could paint what he saw with a force which has seldom been excelled. As a man he was manly, frank, and genial, devoted to his art and his family, and very fond of sport, especially hunting, fishing, and shooting. He was greatly loved by a very large circle of friends. He was singularly handsome, and had a fine presence. The National Gallery of British Art possesses many of his finest works. He is also represented in the National G-allery, in the National Portrait Gallery, the Victoria and Albert Museum, and in the public galleries at Manchester, Liverpool, and Birmingham.*~~

~~*Authorities. — J. G. Millais. Life and Letters, &c. — Ruskin's Modern Painters, Notes on Boyal Academy Exhibitions, Pre- Saphaelitism, &c. — Catalogues of Grosvenor Gallery, summer of 1886 ; and of Royal Academy, winter of 1898. — M. H. Spielmann. Millais and his Works. London, 1896. — A. L. Baldry. Sir J. E. Millais, his Art and Influence. London, 1899. (c. Mo.)*~~

~~*Millbury, a town of Worcester county, Massachu- setts, U.S.A., a few miles south of the city of Worcester. It is traversed by the Boston and Albany and the New York, New Haven, and Hartford railways. It has an area of 17 square miles, composed of hills and valleys, with many small lakes and ponds. The village of Millbury has an irregular plan, and contains many small manufactur- ing establishments with varied products. The town was separated from Sutton and incorporated in 1813. Popula- tion (1890), 4428; (1900), 4460, of whom 1176 were foreign-born.*~~

~~*Milledgeville, a city of Georgia, U.S.A., capital of Baldwin county, on the west bank of the Oconee river, at the head of navigation, and on the*~~

~~*Georgia and the Central of Georgia railways, a little north-east of the centre of the state, at an altitude of 276 feet. It is the seat of several educational institutions, and of the state lunatic asylum. It was formerly the state capital. Popula- tion (1890), 3322 ; (1900), 4219, of whom 29 were foreign- born and 2663 were negroes.*~~

~~*Miller, Joaquin [Cincinnatus Hinee] (1841- -), American poet, was born in Indiana, 10th November*~~

~~*1841, and was educated for the law. After some experi- ences of mining and journalism in Idaho and Oregon, he settled down in 1866 as judge in Grant county, Oregon, and during his four years' tenure of this post he began to write verse. In 1870 he travelled in Europe, and in 1871 he published his first volume of poetry, full of tropical passion, Songs of the Sierras, on which his reputation mainly rests. His Songs of the Sunlands (1873) followed in the same vein, and after other volumes had appeared, his Collected Poems were published in 1882. He also wrote plays, Tlie Danites having some success as a sensational melodrama. On his return from Europe he became a journalist in Washington, but in 1887 returned to California. His pen-name, "Joaquin Miller," by which he is known, was assumed by him when he published his first book, in consequence of his having written an article in defence of Joaquin Murietta, the Mexican brigand.*~~

~~*Milligan, William (1821-1892), Scottish com- mentator and theologian, was bom 15th March 1821, and commenced his education at the High School, Edinburgh. When his father was appointed to the charge of the parish of Elie, in Fifeshire, he went to a parish school in the neighbourhood, and proceeded to the University of St Andrews at the age of fourteen. His college career was distinguished, and he graduated in 1839. His divinity studies were carried on partly at St Andrews and partly in Edinburgh. In 1844, a year after the Disruption, he became minister of Cameron in Fifeshire. In 1845, his health having given way, he went to Germany, and studied at the university of Halle. There ■ he became acquainted with the German language and German theology, a fact which greatly influenced his later career. He began, after his return to Scotland and his resumption of his clerical duties, to write articles on*~~

~~*Biblical and critical subjects for various reviews. This led to his appointment in 18C0 to the professorship of Biblical criticism in the University of Aberdeen. In 1865 he acquired the Syriac tongue. In 1870 he was appointed one of the committee for the revision of the translation of the New Testament. HIs fervent piety, and his wide interest in educational and social questions, extended his influence far beyond the circle of theologians. HIs con- tributions to periodical literature for many years were numerous and valuable ; but his celebrity will chiefly rest on his works on the Resurrection (1890) and Ascension of otir Lord (1892), his Baird Lectures (1886), on the Revelation of St John, and his Discussions (1893) on that book. All these volumes are distinguished by great learning and acuteness, as well as by breadth and originality of view. HIe died on 11th December 1892. (j. J. L*.)*~~

~~*Millom, a market town in the Egremont parlia^ mentary division of Cumberland, England, 9 miles north by west of Barrow, on the Furness railway. There are blast furnaces and highly productive mines of red haematite ore. The deposit lies partly under the foreshore of the river Duddon, and a company has expended upwards of £120,000 upon a sea-wall and embankment to protect the mine from the sea. St Luke's Church (1891), a Baptist chapel and Salvation Army station, are new. Population (1891), 8895; (1901), 10,426.*~~

~~*Millville, a city of Cumberland county. New Jersey, U.S.A., on the Maurice river and on the West Jersey and Seashore railroad, in the southern part of the state, at an altitude of 36 feet. Its site is level and its street plan is regular. It has manufactures of glass, iron, and cotton. Population (1890), 10,002; (1900), 10,583, of whom 598 were foreign-born and 139 were negroes.*~~

~~*Milne- Edwards, HIenry (1800-1885), French zoologist, the son of an Englishman, was born in Bruges on 23rd October 1800, but spent most of his life in France. At first he turned his attention to medicine, in which he graduated at Paris in 1823 ; but his passion for natural history soon prevailed, and he gave himself up to the study of the lower forms of animal life. One of his earliest papers (Recherches anatomiques sur les Crustach), which was presented to the Academy of Sciences in 1829,*~~

~~*formed the theme of an elaborate and eulogistic report by Cuvier in the following year. It embodied the results of two dredging expeditions undertaken by him and his friend Audouin during 1826 and 1828, in the neighbourhood of Granville, and was remarkable for clearly distinguishing the marine fauna of that portion of the French coast into four zones. Much of his original work was published in the Annales des Sciences Naturelles, with the editorship of*~~

~~*whicli he was associated from 1834. Of his books may be mentioned the Histoire naturelle de Crnstacis (3 vols., Ig37_41)j which long remained a standard work ; His- toire naturelle des Coralliaires, published in 1858-60, but begun many years before ; Lemons sur la physiologie et Vanatomie compuree de I' Homme et des Animaux (1857- 1881), in 14 volumes ; and a little work on the elements of zoology, originally published in 1834, but subsequently remodelled, which enjoyed an enormous circulation. He was appointed professor of natural history at the Faculte des Sciences in 1841, and twenty-one years later became professor of zoology at the Museum, where in 1876 he was succeeded by his son Alphonse (b. 1835). The Royal Society in 1856 awarded him the Copley medal in recognition of his zoological investigations. He died in Paris on 29th July 1885.*~~

~~*Milngavie, a police burgh of Dumbartonshire, Scotland, transferred from Stirlingshire in 1891, lies 9i- miles north-north-west of Glasgow by rail. There are bleach-fields, dyeworks, and a paper mill ; but the town is rapidly becoming residential for Glasgow business men. Adjacent are two water reservoirs, 60 and 90 acres in extent, belonging to the corporation of Glasgow. There is a burgh hall. Population (1881), 2636 ; (1901), 3481.*~~

~~*Milton, a town of ISTorfolk county, Massachusetts, U.S.A., a few miles south of Boston, of which it is practi- cally a suburb, on a branch of the New York, New Haven, and Hartford railroad, in the eastern part of the state. It contains an area of 18 square miles of rolling and hilly country,*~~

~~in which are the villages of Milton, Milton Lower Mills, East Milton, and Milton Upper Mills. It contains the Blue Hills, now a part of the Boston park system, on one of which is situated a meteorological observatory. The town was settled in 1640 and incorporated in 1662. Population (1890), 4278; (1900), 6578, of whom 1840 were foreign-born.~~

~~Milton, a borough of Northumberland county, Pennsylvania, U.S.A., on the Susquehanna river, on the Pennsylvania canal, and on the Pennsylvania and the Philadelphia and Reading railways, a little east of the central part of the state, at an altitude of 472 feet. It contains car works, rolling mills, and other iron and steel works. It was founded in 1797, and chartered twenty years later. In 1882 it was in great part destroyed by fire. Population (1890), 5317 ; (1900), 6175, of whom 168 were foreign-born and 97 were negroes.~~

~~Milwaulcee, the largest and most important city of Wisconsin, U.S.A., capital of Milwaukee county, on the western shore of Lake Michigan, at the mouth of the Milwaukee river, in the south-eastern part of the state. It is regularly laid out, with broad streets, paved mainly with wooden blocks. Its water-supply is derived from Lake Michigan, and it has an excellent sewer system. Among its newer buildings of note are the Federal Building (housing the Post OfBce, Custom HOuse, &c.). Court HOuse, City Hall, the Chamber of Commerce, and the Public Library (containing 100,000 volumes). Milwaukee is a lake port of the first importance, having an excellent harbour, improved by breakwaters. Most of its commerce IS domestic, and consists mainly of grain and lumber. It is also a large railway centre, being entered by four railways — the Chicago and North- Western, the Chicago, Milwaukee and St Paul, the Pere Marquette, and the AVisconsin Central, giving it a large inland traffic. As a manu- tacturing city Milwaukee is of great importance. In 1900 It contained 3342 manufacturing establishments, J'foo i*"*"*"! "^^'" °^ 1110,363,854. They employed 48,328 hands (exclusive of 4352 salaried officials, clerks~~

~~&c.), to whom was paid in wages $20,240,666. The value of materials used was $65,118,719, and that of the products was $123,786,449. The principal of these products, with their values, were as follows : —~~

~~flouring and grist-mill products, $6,357,983 ; foundry and machine- shop products, $14,495,362 ; iron and steel, $7,410,213 ; leather (tanned, curried, and finished), $10,267,835 ; malt liquors, $13,899,390 ; slaughtering and meat-packing (wholesale), $5,980,340. The city is noted for its ex- tensive breweries, the products of which are distributed to all parts of the country. The assessed valuation of real and personal property in 1900, on a basis of about 60 per cent, of the full value, was $158,174,873 ; the net debt was $6,576,586, and the average rate of taxation was $23.14 per $1000. The actual income of the city for the fiscal year,' exclusive of loans, was $4,349,065, and the expenditures, exclusive of loans repaid, were $4,313,889. Population (1880), 115,587 ; (1890), 204,468 ; (1900), 285,315, showing a very rapid growth. Of the total population in 1900, 98,991 were foreign-born (principally Germans) and 862 were negroes. There were 98,802 persons of school age (6 to 20 years inclusive). Out of a total of 75,020 adult males, 34,535 were native-born (of whom only 163 were illiterate, i.e., could not write), and 40,485 were foreign-born (of whom 2896 were illiterate). The death-rate in 1900 was 15 9 ; in 1890 it was 18-8.~~

~~Minas Ceraes, a state of Brazil, situated between 13° 56' and 23° S. and 39° 37' and 50° 58' W., bounded on the N. by the state of Bahia, on the W. by Goyaz, Matto Grosso, and Sao Paulo, on the S. by Sao Paulo and Rio de Janeiro, and on the E. by Espirito Santo and Rio de Janeiro. Its area is 222,160 square miles, and it has the largest population, about 3\ millions, of any state in Brazil. The capital, Ouro Preto, has a population of over 20,000. Amongst other towns are Diamantina (13,000), Entre Rios (8600), Marianna, Earbaeena, Abaete, Bani- buhy, Curvello, &c. The state is well provided with railways, and its mines and agricultural products are rich and varied.~~

~~Minbu, a division and district in Upper Burma. The division includes the districts of Thayetmyo,Pakokku, Minbu, and Magwe. It has a total area of 17,170 square miles, and a population (1891) of 996,873, and (1901) 1,077,978, showing an increa,se of 8 per cent., and giving a density of 63 inhabitants to the square mile, with 4095 villages paying in 1898-99 a revenue of Rs.23,28,599. It bestrides the Irrawaddy. The district of jMinbu has an area of 3297 square miles, and population (1891) of~~

~~215,663, and (1901) 236,262, showing an increase of 9-6 per cent, and a density of 71 inhabitants to the square mile, with 1043 villages paying a revenue of Rs.5,99,866. As a whole the district may be said to consist of low plain land towards the Irrawaddy, and of undulating country inland rising higher and higher westwards towards the Arakan hills. Between the plain and the Yoma is a distinct range of hills running north and south, and usually called the Nwa-Madaung hills. The submontane valleys are largely cultivated, but are deadly except to those born in them. The chief streams besides the Irrawaddy are the Mon, the]\[an, and the Salin, which are largely used for irrigation purposes. At Minbu town the Irrawaddy is 3 miles wide, with numerous islands and sandbanks. There are considerable fisheries along the Irrawaddy and on the Paunglin lake, which is a lagoon fed from the Irrawaddy. The rights are sold yearly by public auction, and realize an average of Rs.l-"'>,0()0. Oil has been discovered near the mud volcanoes of Minbu, but it seems to lie at too great a depth to be profitably worked.~~

~~There are 185 square miles of reserved forest in the district. The great bulk of the population is agricultural, and the chief crops raised are paddy, gram, millet, beans, peas, sesamum, and tobacco. The betel-vine is largely cultivated along the M6n river. The district, which was in a chronically disturbed state before the annexation, was not reduced till two years afterwards, many oiBcers losing their lives, among them Phayre, the first deputy-commis- sioner. The population of the district in 1891 was made up of 206,914 Buddhists, 6867 Chins, 956 Hindus, 691 Mahommedans, and 135 Christians. 173,408 acres were cultivated in 1898-99, and 463,000 acres were available for cultivation ; 362,827 acres of current fallow existed, and there were 229,120 acres of forest land, besides 881,771 not cultivable. The annual rainfall varies greatly over the district. It is very considerable on and under the Arakan Yoma, and very slight towards the Irrawaddy. The total in 1898-99 at Minbu was 25-66 inches. The thermometer rises to over 100° in the hot months, and the mean of minimum readings in December is usually about 49°. Minbu, the~~

~~district head- quarters, stands on the IiTawaddy. It had a population of 7270 in 1891. A bank has formed in front of the town, so that the river steamers in the dry season can come no nearer than two miles to the south of the town. (j. q_ ^q\~~

~~M i nd e n , a town and episcopal see of Prussia, province of AV^estphalia, on the river Weser, 40 miles ■west-south- west of Hanover by railway. The churches of St Mary and St Simeon, the synagogue (1864), the post office (1895), the war memorials of 1864-66 and 1870-71, and the classical school (with two large paintings by Thumann) should be mentioned. Population (1885), 18,592 ; (1900), 24,327.~~

~~Minehcad, a market town and seaside watering- place of Somersetshire, England, on the Bristol Channel, with a station (branch terminus) on the Great Western railway. It has a tidal harbour and a quay. Minehead is the point of departure for the coaches to Porlock and Lynton. Population, about 3000.~~

~~Mineo, a town of the province of Catania, Sicily, Italy, with a station (4 miles distant) on the branch line from Catania (35 miles) to Caltagirone. The ancient Mence, laid out by the Sikelian chief Ducetius, a native of the town, in the middle of the 6th century B.C., it was captured by the Saracens in 840. Pour miles to the north is Lake Palici, with strong outflow of carbonic acid, a place of great sanctity and veneration to the ancients, who had there a widely famous temple to the " Palician gods." Population, about 9000.~~

~~Minghetti, Marco (1818-1886), Italian patriot and statesman, was born at Bologna on 18th November 1818. In 1846 he signed the petition to the Conclave for • the election of a Liberal pope, and was appointed member of the State Council summoned to prepare the constitution for the papal states. In the first constitutional cabinet, presided over by Cardinal Antonelli, Minghetti held the portfolio of public works, but after the allocution pro- nounced by Pius IX. against the Italian war of independ- ence he resigned office and joined the Piedmontese army with the rank of major. Keturning to Eome in September 1848, he refused to form a cabinet after the assassination of Pellegrino Rossi, and, withdrawing from political life, spent the next eight years in study and travel. Summoned to~~

~~*Paris by Cavour in 1866 to prepare the memorandum on the Eomagna provinces for the Paris congress, he resumed his public labours for the cause of unity, and was in 1859 appointed by Cavour secretary-general of the Italian Poreign Office. In the same year he was elected president of the assembly of the Eomagna after the rejection of pontifical rule by those provinces, and pre- pared their annexation to Piedmont. Appointed Pied-montese minister of the interior, he resigned office shortly after Cavour's death, but was subsequently chosen to be minister of finance by Farini, whom he succeeded as premier in 1863. With the help of Viscouti Venosta he concluded (15th September 1864) a convention with*~~

~~*France known as the " September Convention," whereby Napoleon agreed to evacuate Rome and Italy to transfer her capital from Turin to Florence. The convention excited violent opposition and sanguinary disorders at Turin, in consequence of which Minghetti was obliged to resign office. An object of hatred and unjust accusations, he took little part in j)ublic life until 1869, when he ac- cepted the portfolio of agriculture in the Menabrea Cabinet. Both in and out of office he exercised his influence against the scheme of an Italo-French alliance and in favour of an immediate advance upon Rome, and in 1870 was sent to London and Vienna by the Lanza-Sella Cabinet to organize a league of neutral powers in consequence of the outbreak of the Franco-Prussian war. In 1873 he overthrew the Lanza-Sella Cabinet and regained the premiership, which, with the portfolio of finance, he held until the fall of the Right from power on 18th March 1876. During his premiership he inaugurated the rapprochement between Italy, Austria, and Germany, and before his fall was able, as finance minister, to announce the restoration of equi- librium between expenditure and revenue for the first time since 1860. After the advent of the Left, Minghetti remained for some years in Opposition, but, towards 1884, joined Depretis in creating the parliamentary phenomenon known as " Transformism," which consisted in bringing Conservative support to Liberal cabinets. Minghetti, however, drew from it no j)ersonal advantage, and died at Rome on 10th December 1886 without having returned to power. (h. w. s.)*~~

~~*Miniatures. — The word miniature is derived from minium, signifying red lead, in consequence of the capital letters, borders around pages, and*~~

headings to chapters in ancient manuscripts having been drawn in this mate- rial ; it was applied originally to the decorations on the pages of such manuscripts. These illuminations were at first executed in red alone, and afterwards in various colours, when later on they took the form of elaborate designs, embracing pictures of saints, portraits of persons, and illustrations of stories and legends, with religious emblems and medallions. By a further development the word came to be applied to such pictures or portraits as were similar in size to these small illuminations on MSS. It is believed that this use of the word came into vogue in the early part of the 18th century, and was applied to such paintings as before then had commonly been called either " limnings " (see the catalogue of the pictures belonging to Charles I.) or else " paintings in little " (see Pepys' Diary, 30th March 1668, &c.). The word is now used mainly in this sense, and by a miniature is meant a painting on a very small scale, usually a portrait, painted on ivory, card, or metal, of such a size as can be carried in the pocket.

In Europe the art of painting in miniature is to a great degree distinctively English, and the greater number of the chief masters in the art have been Englishmen or at least have lived in England. Several of the great portrait painters are said to have worked occasionally in miniature, and there are paintings, small in size, which are attributed with reason to Holbein, Antonio More, " Shootes and Betts " (see Lomazzo's Trattato dell' Arte della Pittura, Oxford, 1698), Cleef, Stretes, Teerlinck, Zucchero, John and T. Betts, and with less probability even to Van Dyck. The first true miniaturist, however, was Nicholas Hilliard {circa 1647-1619), whose work partakes of the character of that seen in illuminated manuscripts. The colours are opaque, gold is used to heighten the brilliant effect, and the paintings are on card. They are often signed, and have frequently also a Latin motto upon them.

Isaac and Peter Oliver (father and son) succeeded Hilliard. Isaac {circa 1651-1617) is said to have been

~~*the pupil of Hilliard and of Zucchero. Peter (died 1647) was the pupil of Isaac. The two men were the earliest to give roundness and form to the faces they painted, leaving for ever the flat method of the illuminators. They signed their best works by a monogram, and painted not only very small miniatures, but larger ones measuring as much as 10 inches by 9. They copied for Charles I. on a minute scale many of his famous pictures by the old masters. Several of these copies are at Windsor and Montagu House. At about the same date Gerbier, Poel- emberg, Jamesone, Penelope Cleyn, and her brothers, were workers in the art. John Hoskins (died 1664) was a far better artist in miniature than those just named, but his greatest claim to recollection consists in his having been the master of Samuel Cooper, the greatest English miniaturist. The work of Hoskins can be specially well studied in the collection at Ham House.*~~

~~*Samuel Cooper (1609-1672) was a nephew of Hoskins. He spent much of his time in Paris and Holland, and very little is known of his career. His work has a superb breadth and dignity. It has been well if paradoxically called " life-size work in little " ; and the portraits which he painted of the men of the Puritan epoch are remarkable for their extraordinary merit, for truth to life, and for strength of handling and presentment. He painted upon card, chicken-skin (pecorella), or vellum, and on rare occasions upon rough bone. The use of ivory was not in- troduced until after his time. His work is frequently signed with his initials, generally in gold, and often in the hair of the person depicted. Flatman (died 1688), Alexander Cooper, brother of Samuel Cooper, David Loggan, White, Sadler, Digby, and Faber deserve notice at this period ; and they were followed by such artists as Lawrence Crosse (died 1724), Gervase Spencer (died 1763), Lens, Hone, and Meyer, the latter two of whom were notable in connexion with the foundation of the Royal Academy.*~~

~~*The 18th century produced a great number of miniature painters, of whom Richard Cosway (circa 1742-1821) is the most famous. His works are of great beauty, and are done with a dash and brilliance which no other artist excelled. The leading miniaturist of his time, Cosway was especially popular in the circle of the Prince Regent. His best work was*~~

done about 1799. It is always on ivory, although he also did what were called " stayned drawings." These were drawn in pencil on paper, with the faces coloured. Cosway's finest paintings are signed on the back with a specially pompous signature ; there is known but one genuine Cosway miniature which is signed on its face ; very few bear even his initials on the front. George Engleheart (1750-1829) was his great rival, and was attached to the court of the king. He painted 4900 miniatures, and his work is stronger and more impressive than that of Cosway ; it is often signed " E." or " G. E." Andrew Plimer (176.3-1837) was a pupil of Cosway, and both he and his brother Nathaniel, who worked in the same studio, produced some lovely portraits. The bright- ness of the eyes, wiriness of the hair, and exuberance of colour, combined, however, with drawing which is often very inaccurate, are characteristics of Andrew Plimer's work.

John Smart (1741-1811) was the greatest of Cosway's piipils. His work surpassed that of his master in refine- ment, power, and delicacy ; its silky texture and elaborate finish, and the. artist's love for a brown background, dis- tinguish it. Other notable painters were Ozias Humphrey (1742-1810); Nixon (1741-1812); Shelley (cimi, 1750- 1808), whose best pictures are groups oi' two or more persons; William Wood, a Suffolk artist (1768-1808); Edridge (1769-1821) ; Sullivan, Sheriff, Crosse, Boyle, and Finney. In the 19th century J. C. D. Engleheart (1784-1862; nephew of George), Andrew Robertson (1777-1845),

Beaumont, Behnes, Harlow, Heaphy, and Mrs Mee must be mentioned. Sir Thomas Lawrence painted miniatures, but the art may be said to have died out with Sir William Ross, the Chalons, and Newton (although some works by Landseer in this form are in existence). Towards the end of the 19th century there was an attempted revival ; but although there have been many miniatures, there have hitherto been no masters. Of modern miniature painters, Alyn Williams best deserves mention.

Many fine miniatures were executed in enamel. Petitot (1607-1691) was the greatest worker in this material, and did his finest portraits in Paris for Louis XIV. His son succeeded him in the same profession. Other artists in enamel were Boit (died 1727), Zincke (died 1767), Hurter (1734-

~~*1790), Spicer, Thouron (1737-1789), Prieur, Ding- linger, and Thienpondt. Many of these artists were Swiss, but most of them visited England and worked for a while there. The greatest English enamel portrait painter was Henry Bone (1766-1834), the finest of whose productions are now at Kingston Lacy. A great collection of his small enamel reproductions of celebrated paintings is in Buckingham Palace.*~~

~~*Perhaps the earliest French miniature painter was Jean Clouet (died circa 1490), while of a much later date Blarenberghe (born 1719) and Drouais (1699-1767) should also be mentioned ; but the most popular artists were Augustin (d. 1832) and Isabey (d. 1855). Their portraits of Napoleon and his court are exceedingly fine.*~~

~~*Hall the Swede and Filger the Austrian were also great miniature painters; and others whose names might be mentioned were Werner (1637-1710), Rosalba Carriera (1675-1757), Chatillon, Pasquier, and Festa.*~~

~~*Miniatures are painted both in oil and in water colour, but by far the greater number are in water colour. A few of Cooper's works are in oil, and these are generally painted on copper. The work of the 18th century is exclusively in water colour. The use of ivory came into general adoption in the early part of the reign of William III., although there are extant miniatures even by Cooper which are painted on a sort of rough bone closely re- sembling ivory. The work of Snelling, David Loggan, and others was in pencil, used with great effect on vellum. The earliest miniatures are upon card, copper, vellum, or chicken-skin.*~~

~~*The greatest collections of miniatures in England are now (1902) those in the possession of the King, the duke of Buccleuch, the earls of Ilchester, Dysart, Dartrey (notable for enamel work, some examples of which are of the greatest rarity), and Ancaster (especially notable for works by fosway) ; of Earl Beauchamp, the Baroness Burdett-Coutts, Sir Gardner Engleheart (notable for works by the Englehearts), Countess Tolstoy, and IWessrs. Drake, Digby, J. Pierpont Morgan (noteworthy for the superb series of 18th century portraits and works by Cooper), Senior, E. AV. Williams, Whitehead, and Usher of Lincoln. There are also very fine works by Cooper at South Kensington, and in the same gallery, in the*~~

~~*Jones collection, some splendid works by Petitot ; and there are some famous foreign portraits and picture-miniatures in the Wallace collection, Hertford House, London. The collection at the Louvre, especially as regards the works of Petitot, is of supreme merit ; and there are also fine collections at Vienna, Berlin, and Florence.*~~

~~*See also J. J. Fosteis. Briti.^Ji 3Iiniatnre Portraits. London. IIIDM. — J. L. Pdopkkt. Hialiiry of Jliniatnrc Art. London, 1887.— G. C. Williamson, rorlrait' Jliniatnrcs. London, 1897; Jiidiard Cosway. London, 1897 ; Gi>iir*~~

~~*(g. C. W.)*~~

~~*Mingrelia. See Caucasus and Kutais.*~~

~~*MINING*~~

~~*763*~~

~~*Mining (see also Ency. Brit., ninth edition, vol. xvi.).*~~

~~*1. Occurrence. — In the case of the precious metals several new and interesting discoveries may be men- tioned. The three principal are the gold deposits of the Witwatersrand, Cripple Creek, and West Australia. In the year 1885, when first the news came that gold was being found to the south of Pretoria, no one dreamt of the vast importance of the discovery. The metal is there found in several beds of conglomerate, which are interstratified with sandstone and quartzite. The con- glomerate consists of quartz pebbles, often the size of a walnut or larger, cemented together in the main by silicious matter and iron pyrites. The gold is contained almost entirely in this cementing material, the quartz pebbles themselves being usually barren. As in the case of other pyritiferous deposits, the parts near the surface are decomposed into oxides, with liberation of the gold, and the easily-worked rusty conglomerate was the source of riches in the earlier days of Johannesburg. The fears that the passage of the oxidized ores into pyrites meant disappearance of the gold are now allayed, and mining engineers do not hesitate to propose to work the pyritiferous beds at a depth of 5000 feet or more. Cripple Creek is a small*~~

~~but rich gold-bearing district in Colorado, where the precious metal occurs largely in combination with tellurium. The tellurides are found in sheets of fissured volcanic or granitic rock altered by mineral solutions. The principal tellurides appear to be calaverite. The state of West Australia attracted little attention until the wonderful discoveries at Coolgardie proclaimed it to be a rich gold-bearing country. The gold occurs native in quartz veins, and also more particu- larly as a telluride. The so-called " lode formations " of Kalgoorlie are zones of shattered igneous rock, so crushed as to be often schistose in texture, in which tellurides have been deposited. There is no marked sharp plane of division (" wall ") separating the auriferous deposits from the surrounding rocks. Here, as at Cripple Creek, we have examples of the doctrine of " selective porosity " — ^that is to say, certain zones of rock are rich, because the metal-bearing solutions found the fissured portions to be the easiest channels for their passage, and coursed with greater abundance through them. In other words, where the path was easy and the flow abundant, the deposition was copious ; impermeable belts of rock received no nourishing currents, and remained barren. This theory may further be advanced as an explanation of the fact that the conglomerates, i.e., coarse or more permeable sediments, in the Transvaal contain payable quantities of gold, whilst the fine sediment, the sandstone, is barren or poor. The Cripple Creek and Kalgoorlie gold deposits are remarkable instances of veins or lodes which are tabular masses of altered rocks, aaid not merely filled-up fissures.~~

~~2. Prospecting. — The searcher is now often better equipped for his work by having acquired an elementary knowledge of mineralogy and blowpipe analysis. In some cases a knowledge of geology has had far-reaching effects ; the most brilliant example of the result of geo- logical reasoning is the discovery of coal in Kent. Care- fully conducted magnetic observations with the Thalen and Tiberg instruments have proved valuable in prospect- ing for magnetic iron ore. Professor H. Louis has im- proved the American dipping needle, and finds that it may be usefully applied in searching for deposits of pyrrhotite, which may be rendered valuable by the accompanying nickel or copper ore.~~

~~*3. Boring. — No one process of percussive boring can claim universal adoption. The old Chinese system of boring with the rope has been brought to a high pitch of perfection in the United States, where it has been and is*~~

~~*still largely used for drilling oil wells. In Europe rods, either of iron or wood, seem to be preferred, though rope boring is by no means unknown. Fauck of Vienna has introduced an improvement by substituting a quick short stroke for the old-fashioned slow and long stroke ; and by combining this method with the water-flush- ing system he has attained great rapidity and economy in boring. The rods are hollow, and a stream of water is constantly being forced down through them to the very bottom of the hole, as in the case of the diamond drill. The debris are therefore removed as fast as they are pro- duced, and there is no necessity for stoppage for clearing out the hole. If cores are required, Fauck employs a special chisel with a large central hole, and instead of forcing down water through the rods, pumps it up. The cores are sucked up in this manner, and are delivered piece after piece into a receiving box at the surface. Years of experience with the diamond drill have led to the introduction of sundry improvements. Instead of fixing the black diamonds in the crown itself, each separate stone is often set in a piece of steel, which can be let into a suitable recess in the crown. The advantages of this method are, firstly, firmer setting and consequently less danger of loss of the stone; and secondly, the possibility of shifting stones from one crown to another without resetting. A crown with steel teeth, exchangeable with the diamond crown, has been successfully used for the softer strata, as in the Davis calyx system. It has been abundantly proved that bore-holes frequently deviate very considerably from the straight path they were in- tended or supposed to take, and in some cases it becomes very important to determine the amount and direction of the deviation. McGeorge's clinograph is one of several ingenious appliances which have been used.*~~

~~*4. Excavation. — Everywhere there is a growing tend- ency to substitute power-driven machines for hand tools. The power may be generated on the spot, but in the case of underground excavations it is usually transmitted by water, compressed air, or electricity. The air-compressors most commonly used work dry — that is to say, there is no injection of*~~

~~*water. The cooling of the air in the cylinder is affected by an outer jacket with a constant flow of water. Two-stage compressors with an inter-mediate cooler enable a pressure of 90ft per square inch to be reached without difficulty. The machines used in excavating may be classified as follows : — A. Diggers and dredgers ; B. Machines for boring holes for blasting ; C. Groove-cutters ; D. Tunnelling machines and shaft- sinking machines.*~~

~~*A. The principal types of mechanical excavators are the steam navvy, or steam shovel, as it is commonly called in the United States, the grab dredge, and the bucket or ladder dredge. The steam shovel is a huge scoop worked by a small steam engine standing on a truck, which also carries the steam boiler. The whole machine runs upon rails which are laid down as the excava- tion proceeds. The amount of work done by these machines is enormous. A 90-ton "Vulcan" steam shovel dug up and loaded into railway cars no less than 170,000 gross tons of iron ore in twenty-six days at the Mountain Iron Mine, Minnesota. This type of excavator is employed very largely for stripping off over- burden and for quarrying iron ore. It is also seen in some of the open workings for anthracite in Pennsylvania ; it is used for loading iron ore from stock piles into railway waggons, and when mounted on a barge it will scoop up auriferous gravel and sand from the bed of a river. Grab dredges are semi-cylindrical or semi-spherical buckets, raised and lowered by cranes, and so constructed that they open on being lowered, fill themselves, and then close on being raised. The bucket is then swung round by the crane and made to drop its contents into a railway waggon or other receptacle. The grab, or "clam-shell" dredge, as it is usually called in the United States, is principally used for excavating under water. Bucket or ladder dredges resemble the well-known machines in common use for deepening river channels and harbours. They find their most important sphere of action in raising gold-bearing sand and gravel from the beds of existing rivers, or from adjacent alluvial flats. New*~~

~~*Zealand has profited greatly by this method of working, and fully one-seventh of the gold produced by this colony is extracted in this manner, which is exceedingly economical. According to an official report published in 1899, the cost of dredging the gravel, washing out the gold, and getting rid of the waste is only from Id. to 3d. per cubic yard. The addition of the tailings elevator is an im- portant improvement.*~~

~~*B. Of machine drills there are two main types, viz., rotary and percussive. Rotary drills worked by water, compressed air, or electricity are in common use. Brandt's hydraulic drill, with a toothed steel crown, has increased its reputation by enabling two of the "ends " of the Simplon tunnel to be driven at the enormous speed of 22 feet per day through hard rook. Motors driven by com- pressed air or electricity can easily be made to communicate rotary motion to a twist drill, and machines of this description are to be found in various mines in which comparatively soft materials, such as coal and ironstone, are being excavated. Percussive drills are worked by compressed air or by electricity • of the former kind two principal varieties may be distinguished, according as the cutting chisel is attached to the moving piston-rod or receives blows from a mechanical hammer in imitation of the hand tool. The former type is by far the more common, and in fact at the present time is the one almost universally adopted. The machines, though called by various names, have often very much in common, and are dis- tinguished merely by some slight difference in the valve. The hammer-action machines more or less resemble the caulking, chipping, and riveting tools of the ship-yard, and are mechanical hammers which strike several thoiisand blows per minute upon the head of the chisel. There appears to be a great future for appliances of this kind, in which the extreme rapidity of the stroke makes up for the want of power of each particular blow. A most important point in their favour is their lightness. The Franke drill of the Mansfeld mines, which is held in the hand, weighs only 16 lb ; the small Schmucker drill weighs 35 lb , and the large one 80 lb . The Schmucker drills require stands, but they are far lighter and more easily handled than the percussive drills in common use. The new Leyner drill, a heavier machine with a less rapid stroke, is distinguished by its good water-flushing arrangement. Electrically-driven percussive drills are not yet largely employed, in spite of the urgent need which exists of a suitable machine.*~~

~~*The problem of obtaining a reciprocating motion by means of an electrical current is solved in two ways. The Marvin drill, already used in a few workings, is based upon the principle of the solenoid. The electric current passes alternately through two coils of copper wire, and converts them into magnets sufficiently strong to suck the tool-holder backwards and forwards ; the backward stroke compresses a spring, the recoil of which aids the forward blow. The second method consists in employing rotary motors, from which a back-and-forward action is easily obtained by the aid of a crank. Siemens and Halske, who have already supplied several hundred percussive electric drills, keep the motor entirely separate from the striking part. It is placed in a box on the floor of the working place, and its rapidly rotating axle is connected to the drill proper by the aid of flexible shafting. The drill proper is thus rendered much lighter and more easily handled. The same method is followed in the Gardner electric drill.*~~

~~*C. Groove-cutters. — Mechanical groove-cutters serve in quarrying stone, and for undercutting beds of coal or other minerals. There are many varieties : mechanical chisels, boring machines mounted on bars along which they can be shifted, travelling jumpers running upon rails, circular saws, endless chain armed with cutting teeth, wire saw, revolving toothed bar, blade with scythe motion. Mechanical chisels are largely employed in coal mines in the United States for the purpose of undercutting (holing). The best-known machines are the Harrison, the IngersoU, and the Sullivan. This type of coal-cutter consists of a strong cylinder, with an air-driven piston, mounted on a couple of wheels, and having handles at the back to enable the operator to turn it in the desired direction. Into the end of the piston-rod is fitted a strong chisel, the blows of which are directed against the bottom of the bed of coal, the underlying shale, or some parting of waste, so as to chip out a groove corresponding to the "holing " of a hand-wielded pick. According to Mellin (Cfliickauf, vol. xxxvi. p. 1057), one- quarter of the bituminous coal raised in the United States in 1900 was undercut mechanically, and 1997 out of a total of 3125 machines in use belonged to the type just described. There is every reason to believe that the rapidity of the rise in the produc- tion of coal in the United States is largely due to the introduction of coal-cutting machinery. Franke's small groove-cutter, used at the Mansfeld copper mines, is a*~~

~~*chisel which is struck several thousand blowsaminuteby apneumatichammer. Thereisnoreason why tools of this description should not be used for "holing " coal. If a series of holes are bored in a line anil almost touching each other, it is easy to make a groove by breaking down the inter- vening partitions. Several of the well-known manufacturers supply quarry-bars upon which their boring machines can be mounted, so as to bore the necessary set of boles in a vertical or inclined*~~

~~*position and produce a severance along any desired plane. In the third type, of which the Wardwell channeller is a good example, compressed air or steam is made to communicate a reciprocating motion to a set of chisels clamped together; the machinery is mounted upon a carriage running upon horizontal rails which are laid upon the surface of the bed of stone to be cut. The chisels cut a vertical groove, which can be prolonged indefinitely as the machine travels. Other machines will cut an inclined groove if necessary. The so-called "disc-cutters" are circular saws mounted upon carriages which travel upon rails laid along the working face. The saw is driven by an electric motor or a compressed-air engine, and as the carriage is drawn along automatically, the saw makes a long undercut in the seam of coal or other mineral which has to be worked. The armed endless chain likewise does its work by a sawing action. Upon a frame shaped liked like an isosceles triangle are fixed three pulleys, a driving pulley at the apex and a guiding pulley at each of the other two angles. A chain is kept continually in motion around the frame by means of a compressed-air or electric motor working the driving pulley. The chain is armed with steel teeth at suitable intervals. The short side of the frame opposite its apex is brought against the face of the coal, and when the chain is set in motion its teeth cut a groove parallel to this side ; all the time the chain is cutting, its frame is being mechanically fed forwards at right angles to the line of the groove, so that eventually the coal is undercut over a space equal to the width of the frame multiplied by the amount of the forward feed, say 5 feet by 6 feet. The frame is then withdrawn, and the machine shifted sideways so as to begin a new cut. This kind of machine requires a considerable amount of open space at the working face, and therefore it cannot be used unless the roof is strong enough to remain without supporting timber for some distance. It is chiefly used for "pillar and stall" workings. The wire-saw may be*~~

regarded as a kind of band saw. It is an endless strand composed of three steel wires, which is kept moving upon the rock while sand and water are fed to it. The grains of hard sand are caught in the spaces between the wires, dragged along, and so made to abrade the stone and cut a groove. The wire is kept constantly pressed against the bottom of the groove by the aid of two pulleys, one at each end of the cut. In the case of a vertical cut these pulleys are placed upon suitable frames in small pits, and are so arranged that they can be fed downwards by the aid of screws. The wire-saw is employed in various open marble quarries for making long cuts in the live rock and for subdivid- ing the blocks afterwards, and it has also been apphed to the "getting" of slate in underground slate quarries. It is made to cut a horizontal groove over a space 170 feet long by 39 feet wide, and the work is done at a cost of only 16d. per square yard. This application of the wire-saw to horizontal cutting may have very far-reaching effects. Monticolo has introduced what he calls a "penetrating pulley," which enables the terminal pits to be dis- pensed with, or rather to be replaced by two inexpensive bore-holes. The mode of action of the revolving toothed bar wiU be under- stood by looking upon the cutting tool as a gigantic round rasp standing at right angles to the working face, and revolving rapidly, while the frame, which carries it and its driving machinery, is made to travel upon temporary rails laid parallel to the working face. Fayol's coal-cutter is a toothed blade to which a scythe-like motion is imparted by a compressed-air motor. Like the disc-cutters, these two last machines require a small amount of free space, and may be made to travel for an unlimited distance along an uninterrupted face of long-wall workings, cutting a continuous groove.

D. Tunnellers are machines which cut out a drift in one opera- tion, or, at all events, an annular groove which will render the completion of the drift a very easy matter. Stanley's "heading " machine consists of a strong axle standing in the centre line of the drift and made to revolve by the aid of compressed-air engines. It carries a cross-head with large teeth at each end ; these cut an annular groove as they revolve, and in soft rocks, such as coal, the work of complete excavation is speedily accomplished with the pick. The machine cuts a circular tunnel 6 feet in diameter. It has been proposed to apply this principle of mechanically cutting an annular groove to the case of sinking shafts through fairly hard ground, but no

large undertaking of this kind has been carried out at present. On the other hand, shafts are being sunk on the Continent by several ingenious rotary boring processes in soft ground or through quicksands.

5. Explosives. — In no branch of mining has more progress been made than in the manufacture of mining explosives, particularly with the object of supplying materials which can be used with safety in collieries. A conviction has gradually come over the mining world that many of the worst explosions in collieries have been due to the ignition of gas, or of a fine coal dust floating in the atmosphere, by the flame of the explosive used in blasting, especially when the shot, instead of rending the coal, blows out the tamping like a ball from a cannon. It is to the French Firedamp Commission that we are specially indebted for early scientific inves- tigations upon the subject. They ascertained that if the gases given

off by an explosion have a temperature exceeding 2200° C, they are liable to ignite firedamp, and a law was made prohibiting the use of gunpowder altogether and permitting only such explosives as have a temperature of detonation considerably below the limit just named. Austria, Belgium, Germany, and Great Britain have followed the example of France in endeavouring to supply the miner with explosives possessing a reasonable amount of safety, and a special statute (59 and 60 Vict. c. 43) was passed in Great Britain in 1896 to give the Secretary of State full statutory powers for dealing with the question. An official testing station has been erected at Woolwich ; the explosives which pass the teat are placed upon what is known as the "Permitted List," and their use is then sanctioned. In order to enable mine- owners to ascertain which are the safer of the explosives in this list, which includes some that barely succeed in satisfying its conditions, the British Government has instituted a "Special Test," which is far more severe than the first. Not only in explosives themselves, but also iu the means of firing them, much progress has been made. Cheap and trustworthy electric fuzes are now manufactured on a very large scale, both on the high- and the low-tension systems, and are used with advantage instead of the ordinary safety fuze. Where it is

~~*necessary to delay the ignition of certain shots until others have been exploded, electric time fuzes are available. In Austria several other methods of ignition have received the approval of the authorities, such as Tirmanu's percussion fuze, Lauer's friction fuze, and Jarolimek's lime fuze. Though the old process of fire-setting is extinct save on a small scale vin very out-of-the-way districts, the agency of heat is invoked by the miner for the purpose of thawing ice-bound auriferous alluvium and so facilitating the process of excavation. Prospectors in Siberia have long been accustomed to sink their shafts by the aid of heat generated by burning billets of wood. In the Klondike district this process of thawing has been largely replaced by the use of steam. A boiler is erected at the surface and steam is taken down the shaft in a pipe, a hose from which conducts it to the working place. At the end of the hose is a piece of iron pipe terminating in a small hole. Steam is turned on, and the pipe is passed into the frozen gravel and left there. After the lapse of three or four hours a large mass of gravel has been thawed, and can easily be worked away with the pick.*~~

~~*6. Principles of employment of mining labour. —Persons employed at mines are still paid by time, by work accom- plished or calculated by measuring or weighing, or by some settled proportion of the value of the mineral excavated, as described in the ninth edition of this work (vol. xvi. p. 449).*~~

~~*7. Support. —-Three kinds of supporting materials are still in use, viz., timber, metal, and masonry, the last heading including both brickwork and concrete.*~~

~~*In order to reduce the expense of cutting the somewhat compli- cated joints required for "square sets," mines now use special machines consisting of circular saws so arranged as to make the necessary outs. Machines like huge pencil-sharpeners are employed for tapering the ends of props when Hepple white's system is adopted. Preservatives against dry rot are not commonly used, in spite of the advantage of prolonging the life of the timber and rendering it less inflammable. Aitken's process of impregnating the timber with a solution of the chlorides of sodium and magnesium has been found very effective at certain collieries in Scotland.*~~

~~*Steel is becoming a favourite supporting material in many countries, and especially for permanent levels and shafts. It possessesmanyad vantages, especially durability, small size compared with timber and consequent increase of ventilating area, and is free from danger from fire. The II-section is usually adopted, and two bars suitably bent into an arched form at the top, which can be quickly and firmly united by fish-plates, form an admirable lining for a level. The ground between two adjacent frames may be further supported by small rods of square section. This kind of support is common in many French collieries. Where the bottom of a level is liable to rise, from the pressure upon it, the steel lining is sometimes made of two semicircles suitably joined by sleeves. Shafts are lined with circular frames of channel steel, each frame consisting of two or more segments united by suitable fish-plates and bolts ; the space between two successive frames is lined with planks or with bars of steel. The commonest permanent lining for round shafts in Great Britain is brickwork ; but concrete is gradually coming to the front, on account of its two great advantages, viz., speed of execution and economy in price. In northern France, where oast-iron lining (tubbing) is common, it is usual to employ segments with internal flanges which are bolted together. The stanchness of the joint is secured by interposing thin sheet lead. The Poetsch method of sinking in water-bearing strata by artificially freezing the ground (see Coal) was successfully applied in many in- stances at the end of the 19th century, and the boring processes*~~

~~*associated with the names of Kind and Chaudron, which afford another solution of the problem of putting down a shaft through water-bearing rocks, have been considerably simplified in some of their later applications. The moss-box and equilibrium pipe have been dispensed with, and the engineers have relied upon very care- fully placed concrete for making a stanch joint at the base of the tubbing.*~~

~~*8. Exploitation. — The methods of working away min- erals have been arranged by Haton de la Goupilliere in three great classes, according as the original excavation is left open permanently, is allowed to "cave" in of itself, or is artificially filled up with rubbish. On the whole, it may be said that the third method is gaining ground, and is being largely employed, not only in collieries, but also in working beds of slate and wide mineral*~~

~~*veins. Though hydraulic mining in principle remains as it was, attention may be drawn to some successful applications in Australia, where alluvial flats are being worked with great success under conditions which would make the process impossible if carried out in the typical Californian manner. The necessary pressure for the powerful jet of water is obtained not by its natviral fall, but by a steam pump ; the stream of mud, sand, and gravel coming away from the working face is raised by a centrifugal pump, passed along gold-catching sluices, and, when deprived of its gold, is run into a part of the excavation whence the gold has already been extracted, and gradually fills it up. The steam boiler, the pump which generates the pressure, and the centrifugal pump are all carried upon a barge of very shallow draught, so that when work is finished at a given spot it is easy to float the plant to a short distance and repeat the operation until the whole flat has been treated.*~~

~~*9. Haulage. — More and more attention is being paid to the substitution of mechanical power for animal power in mines. In addition to the older process of haulage by wire rope or chain, the mine-owner now has at his disposal successful methods of doing the work by electricity and compressed air. Electric locomotives are usually operated by overhead wires with trolleys connecting them with the motor. Accumulators have been little used, though they have been adopted at the Vicoigne and Nceux collieries in the Pas de Calais. The comjsressed-air locomotive is adopted in fiery mines in order to secure freedom from sparks. The Porter locomotive is supplied from a large reservoir which is charged with air at a pressure of 600 lb per square inch.*~~

~~*10. Windi7ig. — Flat ropes made of the so-called aloe fibre are still largely employed in France and Belgium, but hoisting is generally performed by round ropes of steel wire of a liigh tensile strain, often capable of supporting no less than 180 kilos per square millimetre, or, speaking roughly, 120 tons per square inch. Eopes with the so- called Lang's lay, in which the spirals of the strands are turned in the .same direction as the spirals of the individual wires, have proved by long practice to last longer than ropes made upon the old principle. In order to make the surface of the rope more nearly approach that of a cylinder, and so to throw the wear upon a large number of wires, the strands are*~~

~~sometimes made oval by employing flat wire for the core. These " flattened strand ropes " have given good results. Casting aside entirely the principle of making wire ropes of separate strands, we come to the so-called locked coil ropes. Specially-shaped wires — V-shaped or S-shaped, for instance — are used, and in section the rope is seen to consist of several successive concentric sheaths, each composed of interlocking wires. The outer surface of the rope is cylindrical ; no space is wasted, and a rope of given diameter is able to support a greater weight than one made in the old way. The carefully kept statistics concerning the life and wear of winding ropes in Westphalia are not, however, favourable~~

~~to the locked coil variety for hoisting purposes. The clumsy kibble hanging loose in the pit, or sliding along a bed of planks or poles in an inclined shaft, is fast disappearing, and in mines worked on a large scale the material is hoisted either in a cage, which carries the waggon, or in a steel box called a skip. Both cage and skip are properly guided. Efforts are constantly being made to increase the rapidity of hoisting. Machinery is employed to push the waggons from the cage, or the cage is so arranged that its floor is tilted automatically on reaching the surface, and causes the waggons to empty themselves without leaving the cage. The skips, whether hoisted up inclined or vertical shafts, are made to turn over automatically on reaching the surface, discharge their contents, and return to their original position with- out the aid of a workman (see Coal). For the preven- tion of accidents in winding, speed indicators and auto-matic speed-checking appliances have been introduced in various mines. Less reliance than formerly is placed upon safety catches, and especially in Great Britain, where, on the whole, they are regarded with little favour. No progress has been made in pneumatic hoisting, for the colliery where Blanchet's apparatus was in use had to be abandoned for lack of coal, and the system has not been tried elsewhere.~~

~~11. Drainage. — The most important drainage tunnel in course of construction at the present time is that which is being driven from Marseilles to unwater the Gardanne lignite mines, situated at a distance~~

~~of more than 9 miles (16 kilometres) from the sea. The importance of this gigantic undertaking may be measured by the fact that the total cost is estimated at about a quarter of a million sterling. The work was to be finished by the end of 1902. It is calculated that the great adit will unwater 40,000,000 tons of lignite, besides enabling more than 100,000,000 tons to be worked from depths not exceeding 300 metres below it. When pumps have to be em- ployed, the tendency is to abandon the old Cornish method of raising water, which consists in employing a slow-working single-acting beam-engine with a ponderous main-rod to transmit power from the surface to a series of force pumps in the shaft, which step by step raise the water to the top. Nowadays the main pump is frequently placed in a chamber near the bottom of the shaft, and is made to force the water to the surface in one continuous column. The force-pumps are driven (a) by steam engines, the steam for which is usually gener- ated at the surface and piped down the shaft ; (&) by hydraulic engines driven by water under pressure brought down in pipes from the surface; (c) by compressed-air engines ; (d) by electric motors connected by wires with dynamos on the surface. A type of electric pump in common use consists of three plungers actuated by a three-throw crank, driven by a quick-running motor, with suitable intermediate gearing or a belt for reducing the speed. Now engineers have gone further, and by diminishing the length of stroke of the plungers they have found it possible to run them at such a speed that the intermediate gearing is dispensed with entirely and the crank shaft coupled direct to that of the motor. Riedler and Stumpf 's " Express " pumps are driven di i-('ctly from electric motors or other high-speed])rime movers making 200 to 300 revolutions a minute, and are employed for forcing considerable quantities of water to a maximum height of 1886 feet (575 m.). Ehrhardt and Sc.hmer like-wise make mine pumps with the crank coupled directly to the shaft of an electric motor running at 200 to 300 revolutions a minute, and forcing 200 to 300 gallons (1 to 1^ cb.m.) of water per minute to heights of 800 to 1000 feet (250 to 300 m.), the cranks running in oil. They contend that mechanically controlled valves, a special**

feature of Eiedler's pumps, can be dispensed with. It is manifestly unfair that one mine should be saddled with the expense of pumping more than its share of water because it happens to be deeper than its neighbours,

~~*and the difficulty is sometimes met by establishing a drainage board — i.e., a corporate body whose sole business it is to drain the water from a definite area and make each mine pay a share of the expense. The scheme has worked well in South Staffordshire, where, in addition to maintaining large pumping engines, the Drainage Commissioners have done excellent work by preventing surface water from finding its way into the mines. At Mansfield also measures have been taken to prevent surface percolation.*~~

~~*12. Ventilation. — Though many mines, and especially workings on mineral veins, are dependent for their supply of air solely upon natural currents, the standard method of ventilation is by centrifugal fans, which have to a large extent entirely replaced the old furnaces, with great advantages of economy and safety. The main fan is placed at the surface, and acts almost invariably by exhausting the foul air from the mine. Sometimes certain working places in the mine are specially venti- lated by small fans driven by electric motors or com- pressed-air engines. The fans most in use are those of Capell, Geissler, Guibal, Mortier, Bateau, Schiele, Ser, and Waddle. Murgue has devised an ingenious appli- ance, which shows the volume of air passing through a mine at any given moment, and registers it upon a scroll of paper placed around a cylinder, which revolves by clockwork. The curve which is traced resembles that of a self-registering aneroid barometer, and affords a use- ful check upon the mine officials, besides forming au im- portant record in case of any disputes. Murgue has also done good work by j)ointing out the large amount of power expended in overcoming the friction of the air currents against the sides of mine passages, especially those which are timbered, and by explaining the manner in which such friction can be reduced. The means of testing the air of mines have been improved. Instead of depending upon the indications of an oil lamp, the searcher for fire-damp may now avail himself of the far more delicate alcohol fiame. Chesneau's lamp, largely used in French collieries, burns alcohol containing chloride of copper, and the flame tinged by the metallic salt gives an indication of fire-damp when the amount of gas exceeds 0·1 per cent. Stokes has brought out a lamp with a detachable alcohol reservoir, which enables the oil flame or an alcohol flame to be used at pleasure. Le (_^hatelier's laboratory method of determining the amount of fire-damp in a sample by the limit of inflammability of a mixture of the gas and air,*~~

~~*is regularly employed in some collieries. Shaw's more cumbrous apparatus depends upon the same principle. (Also see Coal.)*~~

~~*13. LightiiKj. — The safety lamp most largely used at the present day is that of Marsaut, though the name of the eminent French engineer is often ignored by manufacturers. It is a safety lamp with two or more gauzes and an outer shield capable of resisting strong air-currents with safety. The use of mineral oil in place of vegetable oil is spreading. Many safety lamps are now lighted electrically, with agreat economy of time aud trouble. An appliance for relighting a safety lamp which has t;()ne out accidentally is largely used at some collieries on the Continent, and is considered by many engineers to bo a valuable addition. A roll of paper, with little spots of a material ignitible by friction or a blow, is fitted close to the top of the wick aud is rubbed or struck without opening the lamp, the flame so jjroduced igniting the wick. The commonest method of preventing the illegal opening of safety lamps underground is by the load plug ; the magnetic lock finds favour in*~~

~~*some collieries; and the ingenious cuvelier, or water- pressure lock, is not without adherents. Much labour has been expended in endeavouring to devise a portable electric lamp for use in mines, but, so far, the Sussmann lamp is the only one which can claim to have been introduced on a large scale. Several thousands of these lamps are employed at collieries in England and Belgium.*~~

~~*14. Ascent and Descent. — The standard method of de- scent into mines and ascent therefrom is by the cage or the skip; even in the most conservative ore-mining districts managers are recognizing the absurdity of making a miner waste his strength and endanger his health by excessive ladder-climbing, and this mode of reaching and bavin g the workings is disappearing. The man-engine, which has done good work in its day, is likewise doomed to extinction, now that strong steel ropes enable cages to be raised and lowered with so much rapidity and safety. (See Oee-dkkssing.)*~~

~~*15. Legislation. — ^Laws for rendering the miner's calling leiss dangerous are found in most civilized countries, and the amount of legislation in recent years has been great. The Acts of Parliament in the United Kingdom, and the mining law of the late South African Republic, may be taken as typical examples of laws for regulating the working of coal and ore mines respectively. The mines of coal, fire-clay, shale, and stratified ironstone in Great Britain are governed in the main bv the Coal Mines Regulation Act of 1887 (50 and 51 Vict. o. 58). the Coal Mines Regulation Act of 1896 (59 and 60 Vict. c. 43) was passed with the prime object of giving the Secretary of State power to regulate the use of ex-plosives in mines where blasting might cause dangerous explosions by igniting fire-damp or an atmosphere charged with coal dust. All the mines in the United Kingdom not covered by the Coal Mines Act are governed by the Metalliferous Mines Regulation Act, 1872 (35 and 36 Vict. o. 77). Its title is bad, as it regulates not only ore mines, but all underground workings for salt, slate, stone, &c. The Transvaal Law (Law No. 12, 1896) was a general mining statute dealing with many questions besides the safety of the workman. It was far ahead of the British Metalliferous Mines Act. Mine managers were required to give proof of their competency by passing an examination, plans had to be kept up by competent surveyors, and far more complete statistics of output had to be furnished than was the case in Great Britain.*~~

~~*16. Accidents. — It is a matter of great congratulation that mining is every year becoming a less dangerous occupation, and this as- sertion can be proved by reference to official statistics which are so abundantly furnished by many countries. One point in preparing these statistics is sometimes forgotten, viz., the necessity of calcu- lating the death-rates of the underground workers separately. If the death-rate of the true miner is watered down by mixing it up with that of surface workers, who have a comparatively small risk, conclusions will be erroneous.*~~

~~*Table I. — Death-rate from Accidents in and about the Mines of the United Kingdom per 1000 Persons employed, in 1S91 and 1900.*~~

~~*Death-rate from Accidents*~~

~~*per 1000 Persons.*~~

~~*Underground Workers take*~~

~~*n*~~

~~*separately.*~~

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~~*1900 .*~~

~~*Average for*~~

~~*•070*~~

~~*■790*~~

~~*•133*~~

~~*•452*~~

~~*1-445*~~

~~*•699*~~

~~*1-289*~~

~~*10 years .*~~

~~*•175*~~

~~*•791*~~

~~*■158*~~

~~*■463*~~

~~*r586*~~

~~*•800*~~

~~*1^423*~~

~~*In the early 'fifties the underground death-rate was more than 5 per 1000, whilst, taking all the mines together, both under the Coal Mines Acts and Metalliferous Mines Acts, the average death-rate of the underground workers in 1900 was only 1^445 ; this is slightly higher than the corresponding figures for the two previous years.*~~

~~*though lower than the average for the previous decade, which was 1-586. The general decline in the death-rate from accidents in Great Britain is shown graphically for the years 1873-1900 by Figs. 1 and 2, and numerically for 1891 and 1900 by Table I. Fig. 3 shows the proportions in which each class of accident swelled the total during the last half of the 19th century. The small impor- tance of explosiOQS, compared with falls of ground, is very striking. What can be done to combat falls has been shown by the Courriferes Colliery Company in France. By systematic timbering, increased supervision, and the employment of iron bars as temporary supports to the roof in advance of the last row of props, the death-rate from falls at Courriferes has been reduced to 0^15 per 1000, or J of what it used to be, and J of the British death- rate from falls in 1900. Without indulging in optimistic hopes, it may fairly be assumed that the general death-rate of miners from accidents can be brought down below 1 per 1000 per annum, a figure which may be conveniently taken to denote the border- land between hazardous and non-hazardous occupations. British statistics point to the attainment of this desirable goal in the early years of the 20th century. In some other countries such a result will be delayed on account of the employment of unskilled labourers, fearless to a fault, and imperfectly acquainted with the language of their masters and some of their companions. Thus the death-rate from accidents at the diamond mines of Kimberley, and the gold mines of the Transvaal and Mysore, far exceeds that in Great Britain.*~~

~~*17. Mineral Statistics. — The output of mines and quarries of the United Kingdom in 1900 was as follows : —*~~

~~*Table III — General Summary of Mineral Produce.*~~

~~*Deecription of Mineral.*~~

~~*Alum Shale*~~

~~*Arsenical Pyrites*~~

~~*Arsenic*~~

~~*Barytes*~~

~~*Bauxite*~~

~~*Bog Ore*~~

~~*Chalk .*~~

~~*Chert and Flint .*~~

~~*Clay .*~~

~~*Coal .*~~

~~*Copper Ore .*~~

~~*Copper Precipitate*~~

~~*Fluor Spar .*~~

~~*Gold Ore .*~~

~~*Gravel and Sand*~~

~~*Gypsum*~~

~~*Igneous Rocks .*~~

~~*Iron Ore*~~

~~*Iron Pyrites*~~

~~*Lead Qre .*~~

~~*Limestone (other than*~~

~~*Manganese Ore .*~~

~~*Mica .*~~

~~*Ochre, Umber, &c.*~~

~~*Oil Shale .*~~

~~*Petroleum .*~~

~~*Phosphate of Lime*~~

~~*Salt .*~~

~~*Sandstone .*~~

~~*Slate .*~~

~~*Strontium Sulphate*~~

~~*Tin Ore (Dressed)*~~

~~*Uranium Ore*~~

~~*Wolfram*~~

~~*Zinc Ore*~~

~~*Chalk)*~~

~~*Totals*~~

~~*Quantity.*~~

~~*Tons.*~~

~~*1,308*~~

~~*9,573*~~

~~*4,081*~~

~~*29,456*~~

~~*5,779*~~

~~*4,153*~~

~~*4,373,331*~~

~~*77,693*~~

~~*14,049,694*~~

~~*225,181,300*~~

~~*9,108*~~

~~*380*~~

~~*1,448*~~

~~*20,802*~~

~~*1,837,202*~~

~~*208,038*~~

~~*4,634,.301*~~

~~*14,028,208*~~

~~*12,279*~~

~~*32,010*~~

~~*11,905,477*~~

~~*1,362*~~

~~*15,200*~~

~~*2,282,221*~~

~~*”” 620*~~

~~*1,861,347*~~

~~*5,019,874*~~

~~*585,859*~~

~~*9,121*~~

~~*6,800*~~

~~*41*~~

~~*9*~~

~~*24,675*~~

~~*286,232,750*~~

~~*Value at the Mines and Quarries, £*~~

~~*164*~~

~~*8,710*~~

~~*67,028*~~

~~*29,244*~~

~~*1,350*~~

~~*1,038*~~

~~*208,032*~~

~~*13,900*~~

~~*1,571,043*~~

~~*121,652,596*~~

~~34,.503~~

~~2,450~~

~~1,604~~

~~42,925~~

~~138,163~~

~~69,642~~

~~1,238,747~~

~~4,224,400~~

~~5,788~~

~~349,094~~

~~1,300,314~~

~~675~~

~~13,398 627,844~~

~~“i,085~~

~~611,920~~

~~1,586,045~~

~~1,528,.336~~

~~4,560~~

~~523,604~~

~~1,517~~

~~*351*~~

~~*97,606*~~

~~*£135,957,676*~~

~~*Table III. — Summary of the Metals obtainable by Smelting from the Ores in Table II.*~~

~~*Description of Metal.*~~

~~*Aluminium Copper Gold . Iron . Lead . Silver . Sodium Tin . Zinc .*~~

~~*Quantity.*~~

~~*560 tons 765 „ 14,004 oz. 4,666,942 tons 24,.S64 „ 190,850 oz. 250 tons 4,268 „*~~

~~*9,066 „*~~

~~*Value at the Average Market Price,*~~

~~*£72,800*~~

~~*59,995*~~

~~*52,147*~~

~~*19,596,910*~~

~~*418,960 22,465 31,000*~~

~~*587,869*~~

~~*188,573*~~

~~*Total value £21,030,719*~~

~~*768*~~

~~*MINING*~~

~~*DEATHS PER 1000 PERSONS EMPLOYED*~~

~~*YEARS*~~

~~*PERSONS EMPLOYED*~~

~~*1873 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 1900*~~

~~*35*~~

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~~*A*~~

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~~*3-5*~~

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~~»»•-•>-» MINES UNDER THE COAL MINES REGULATION ACTS.~~

~~MINES UNDER THE METALLIFEROUS MINES REGULATION ACT5.~~

~~Fig. 1. — Death-rate from accidents imder.cround per 1000 persons employed in mines in the United Kingdom, under the Coal and~~

~~Metalliferous Mines liegulation Acts, from 1873 to 1900.~~

~~ALL ACCIDENTS IN AND ABOUT MINES.~~

~~*Fio. 2.— Death-rate from various classes of accidents in and about all mines in the United Kingdom from 1873 to 1900,*~~

~~*I05I-I86O 1861-1870 (871-1880 1881-1890 1891-1900 iss^-igoo*~~

~~*SOU*~~

~~*n-85&*~~

~~*21-2%*~~

~~*376%*~~

~~*2+4%*~~

~~*73*~~

~~*18 0%*~~

~~*142%*~~

~~*39-Z^*~~

~~*213%*~~

~~*8 3% 17 2%*~~

~~*12 8%*~~

~~*39.4«/.*~~

~~*22-3%*~~

~~^~~

~~*98% 1-8% 91571.*~~

~~*439?4*~~

~~*15-0%*~~

~~*ll-65»*~~

~~*25-8% 8-8%*~~

~~*441 5«*~~

~~*19-7% 1*~~

~~■~~

~~*8-4J>* I9>0%*~~

~~*13-2%*~~

~~*408K'I ISeVo*~~

~~*?5- SURFACE*~~

~~*> MISCtLLANEOUS UNDERGROUIID. = SIIAFTS. ■ FALLS OF GROUND. I"^ EXPLOSIONSOF FIREOAMPorCQALOUST.*~~

~~*FIO. 3.-Proportion of deaths from different classes of accidents in and about mines in the United Kingdom, 1881-1900.*~~

~~*MINING*~~

~~*769*~~

~~*Taule Yl.— Summary of Output of Certain Mirwrals and Metals in the British Empire and in Foreign Countries during the Year 1900.*~~

~~*Country.*~~

~~*Great Britain and Ireland British Colonies, Dependencies, and Possessions ; — Aden , , . . Bahamas . '.*~~

~~*Barbados ....*~~

~~*Bechuanaland Protectorate*~~

~~*British Borneo*~~

~~*British Central Africa Protectorate*~~

~~*British Guiana .*~~

~~*British New Guinea*~~

~~*British Solomon Islands .*~~

~~*Canada*~~

~~*Cape Colony- Ceylon 2 .*~~

~~*Channel Islands*~~

~~*Cyprus 2 ....*~~

~~*Federated Malay States .*~~

~~*Gold Coast*~~

~~*India*~~

~~*Malta ....*~~

~~*Natal (including Zululand)*~~

~~*Newfoundland .*~~

~~*New South Wales .*~~

~~*New Zealand .*~~

~~*Nigeria ....*~~

~~*Orange River .*~~

~~*Queensland*~~

~~*Redonda ....*~~

~~*Rhodesia ....*~~

~~*Somali Coast Protectorate*~~

~~*South Australia*~~

~~*Tasmania 3*~~

~~*Transvaal .*~~

~~*Trinidad ....*~~

~~*Turks and Caicos Islands*~~

~~*Victoria .*~~

~~*West Australia*~~

~~*Total for British Empire*~~

~~*Foreign Countries : —*~~

~~*Abyssinia*~~

~~*Argentine Republic . Austria-Hungary*~~

~~*Bosnia and Herzegovina Belgium . Bolivia*~~

~~*Brazil*~~

~~*Bulgaria 2 . ...*~~

~~*Chile*~~

~~*China*~~

~~*Colombia*~~

~~*Corea*~~

~~*Costa Rica .... Cuba ....*~~

~~*Ecuador*~~

~~*France . ...*~~

~~*Algeria*~~

~~*French Guiana*~~

~~*French Sudan 2*~~

~~*Indo-China*~~

~~*Madagascar ....*~~

~~*New Caledonia . , ,*~~

~~*Senegal 10 ....*~~

~~*Tunis*~~

~~*German Empire*~~

~~*Greece 2*~~

~~*Holland*~~

~~*Dutch East Indies u .*~~

~~*Dutch Guiana*~~

~~*Dutch West Indies Honduras 2 ....*~~

~~*Italy*~~

~~*Japan*~~

~~*Luxemburg .... Mexico . ...*~~

~~*Nicaragua*~~

~~*Norway 2*~~

~~*Peru*~~

~~*Portugal 2*~~

~~*Portuguese Bast Africa .*~~

~~*Rumania*~~

~~*Russia*~~

~~*Servia2*~~

~~*Siam*~~

~~*Spain*~~

~~*Sweden*~~

~~*Switzerland 12*~~

~~*Turkey . ...*~~

~~*United States ....*~~

~~*Uruguay*~~

~~*Venezuela*~~

~~*Coal.*~~

~~*Total for Foreign Countries Total for the World*~~

~~*Metric*~~

~~*Tons.*~~

~~*228,794,919*~~

~~*61,267*~~

~~*4,837,291 201,686*~~

~~*6,216,882 246,203*~~

~~*5,6(15,879 1,111,546*~~

~~*Copper.*~~

~~*Metric*~~

~~*Tons.*~~

~~*777*~~

~~*605,110*~~

~~*214,992 120,310*~~

~~*247,938,725*~~

~~*39,029,729*~~

~~*394,515*~~

~~*23,402,817*~~

~~*102,000 326,042*~~

~~*33,403,736*~~

~~*4oO*~~

~~*149,788,256*~~

~~*11,363*~~

~~*320,225*~~

~~*196,206*~~

~~*480,859 7,429,467*~~

~~*38,676*~~

~~*47,500 22,199*~~

~~*86,000*~~

~~*16,151,657*~~

~~*112,237*~~

~~*2,674,105*~~

~~*252,320*~~

~~*2,000*~~

~~*270,000*~~

~~*244,901,839*~~

~~*Fine*~~

~~*G.iia*~~

~~*Kilos.*~~

~~*415*~~

~~*8,582 6,7001*~~

~~*201*~~

~~*2,928*~~

~~*6,3101*~~

~~*11*~~

~~*6,4001 9,7661*~~

~~*6301*~~

~~*Iron.*~~

~~*Metric*~~

~~*Tons.*~~

~~*4,741,835*~~

~~*1,062 600*~~

~~*2011*~~

~~*4781 3741 13,862*~~

~~*75 8,7461 10,641*~~

~~*21,027 2,860*~~

~~*603*~~

~~*2,244 14,704 4*~~

~~*23,647 43,297*~~

~~*Lead.*~~

~~*Metric Tons.*~~

~~*24,766*~~

~~26,600 1 180,434~~

~~1,6491~~

~~4,182 25,304~~

~~4,4061 8,5001 9,9331~~

~~6,941 270~~

~~74,7391 8271~~

~~2,400 275,008~~

~~969~~

~~66~~

~~3,343~~

~~3,6291~~

~~1,6921 8,387 2~~

~~2,Y23 2~~

~~2,660 1 284~~

~~“722 11~~

~~2,089~~

~~84~~

~~1,850 113~~

~~7321~~

~~“171 88 2,130~~

~~12,‘2‘01 1,045 1~~

~~4 1,815 1 411~~

~~38,86810 “‘191~~

~~119,913 49 468~~

~~1,445,703 70,063 1 90,480 1~~

~~224,9452~~

~~1,77‘2’,0001 380,9881~~

~~4,605,600 1~~

~~147,1861~~

~~21,299~~

~~2,221,6431~~

~~2,448 7,841 1~~

~~2,907,299~~

~~6,626,4101~~

~~1,617,8901~~

~~3,600 1~~

~~14,014,475~~

~~Metric Tons.~~

~~1,8001 13,3471~~

~~1701 2,8841~~

~~619,697,479 1 493,279 !204,705 — 36,439,794~~

~~767,636,204 I 534,735 393,196 40,427,435~~

~~16,9931~~

~~4,1181~~

~~121,513~~

~~6,4271~~

~~18,264 1,877~~

~~75,413~~

~~1801 2,1671~~

~~208,7441 1,8661~~

~~245,757~~

~~714,638~~

~~787,841~~

~~89,798 1~~

~~151,6461~~

~~60,375 127,610 1~~

~~1,6! 86,2001~~

~~36,640 1~~

~~385,000 9,827,822~~

~~7,485,679~~

~~*Salt.*~~

~~*Metric Tons.*~~

~~*1,891,217*~~

~~*50,562 1,769*~~

~~*56,296 11,833 6,063*~~

~~*‘3,176*~~

~~*1,021,426*~~

~~*Fine Silver.*~~

~~*Kilos.*~~

~~*5,93(*~~

~~*188,802*~~

~~*55,616 ‘ 183*~~

~~*815,261 10,164*~~

~~*3111 108,660 1*~~

~~*Tin.*~~

~~*Metric Tons.*~~

~~*4,836*~~

~~*14,0001*~~

~~*619,639 16,790*~~

~~*10,00Q*~~

~~088,034 18,326~~

~~9,160~~

~~1,614,027~~

~~20,000~~

~~11,968 5011 867,255 659,118~~

~~i,518~~

~~16,000~~

~~92,000 1,606,88610~~

~~450,059~~

~~49,284 208,12813 2,650,076~~

~~224,74010~~

~~18,568,960~~

~~9,441,047~~

~~12,572,076~~

~~43,123 “451~~

~~7421~~

~~1,882 1~~

~~461 6681~~

~~Metric~~

~~Tons.~~

~~9,211~~

~~18,417~~

~~84 11,980 6 69,765~~

~~496,480 8~~

~~69,7008 109,565 2~~

~~240 2~~

~~16,1001~~

~~2601~~

~~168,349 82,1871~~

~~16,6701~~

~~13,156~~

~~68,953~~

~~1,923,831~~

~~4,598 265,700~~

~~176,800 1 2,2001~~

~~1,862,829 22~~

~~7201~~

~~5,291,362~~

~~6,874,284~~

~~6,741 8,2251~~

~~161~~

~~4,000 1 101~~

~~31,6001 10,600~~

~~5,8001 168,860~~

~~1801 1371 ‘151~~

~~,‘907~~

~~20,6781 24,4181~~

~~112,419~~

~~29,019 432,956~~

~~),643 1 446,373~~

~~1 Estimated. 2 Figures for 1899.~~

~~3 Figures for year ending June 1901.~~

~~4 Output of Witwatersraand district from~~

~~November 1899 to May 1900.~~

~~5 Figures for 1897.~~

~~6 Figures for Austria^for 1899.~~

~~7 Included with Chile.~~

~~8 Converted into fine silver, on the total value of~~

~~ingots, matte, ore, and sulphide exported.~~

~~9 Including Bolivia. 10 Figures for 1898.~~

~~*11 Output of coal for Sumatra only, and of*~~

~~*petroleum for Java for the year 1900 and for Sumatra for the year 1899.*~~

~~*12 Figures (except those for salt) for 1896.*~~

~~*13 Figures for 1894.*~~

~~*S. VI. — 97*~~

~~*770*~~

~~*MINNEAPOLIS*~~

~~*Table IV. — Summary of the Output of Iron Ore from Mines and Quarries in the United Kingdom, and the Quantity and Value of Fig Iron obtainable therefrom, in 1900,*~~

~~*Iron Ore*~~

~~*Pig Iron obtainable.*~~

~~*Quantity.*~~

~~*Comparison with Pre- ceding Year.*~~

~~*Value.*~~

~~*Quantity.*~~

~~*Value.*~~

~~*From Mines . From Quarries*~~

~~*Totals .*~~

~~*Tons.*~~

~~*9,631,292 4,496,916*~~

~~*Tons.*~~

~~*-200,372 , -232,760*~~

~~*£*~~

~~*3,704,161*~~

~~*620,239*~~

~~*Tons.*~~

~~*3,235,791 1,481,151*~~

~~*£*~~

~~*1 19,696,910*~~

~~*14,028,208*~~

~~*-433,122*~~

~~*4,224,400*~~

~~*4,666,942*~~

~~*19,596,910*~~

~~*Tables V. and VI. give a general idea of the number of persons em- ployed at mines and quarries and of the output of certain minerals and metals in the British Empire and foreign countries during the year 1900*~~

~~*Table V. — Summary of the Number of Persons employed at Mines, Quarries, and other Mineral Workings in tlie British Empire and in Foreign Countries during the year 1900.*~~

~~*Great Bkitain and Ikeland*~~

~~*. 908,412*~~

~~*Bbitish Colonies, Dependencies, and*~~

~~*Possessions : —*~~

~~*Aden*~~

~~*1*~~

~~*Bahamas*~~

~~*! — “ioo*~~

~~*Barbados*~~

~~*100 «*~~

~~*Bechuanaland Protectorate*~~

~~*—1*~~

~~*British Borneo ….*~~

~~*‘. ‘.’.’}■*~~

~~*British Central Africa Protectorate*~~

~~*‘. ‘.’.’.^*~~

~~*British Guiana*~~

~~*5,616*~~

~~*British New Guinea .*~~

~~*3253*~~

~~*British Solomon Islands .*~~

~~*1*~~

~~*Canada^*~~

~~*29, 864 s*~~

~~*Cape Colony ....*~~

~~*14,645*~~

~~*Ceylon*~~

~~*189,930 8*~~

~~*Channel Islands*~~

~~*1,200*~~

~~*Cyprus*~~

~~*...1*~~

~~*Federated Malay States .*~~

~~*168,000*~~

~~*Gold Coast ....*~~

~~*2,913 2*~~

~~*India .....*~~

~~*133,951'*~~

~~*Malta*~~

~~*_ 1*~~

~~*Natal (including Zululand)*~~

~~*l', '602*~~

~~*Newfoundland*~~

~~*1,3.52*~~

~~*New South Wales .*~~

~~*43,745*~~

~~*New Zealand ....*~~

~~*15,962*~~

~~*Nigeria*~~

~~*1*~~

~~*Orange River ....*~~

~~*1*~~

~~*Queensland ....*~~

~~*13','672*~~

~~*Redonda*~~

~~*146*~~

~~*Rhodesia*~~

~~*1*~~

~~*Somali Coast Protectorate*~~

~~*1*~~

~~*South Australia*~~

~~*'. 5,986 «*~~

~~*Tasmania ....*~~

~~*6,834*~~

~~*Transvaal ....*~~

~~*.:}*~~

~~*Trinidad*~~

~~*1 1*~~

~~*Turks and Caicos Islands .*~~

~~*“]i*~~

~~*Victoria*~~

~~*29”,865*~~

~~*Western Australia .*~~

~~*17,735*~~

~~*Total for the British Empire*~~

~~*1,692,155*~~

~~*Foreign Countries : —*~~

~~*Austria-Hungary*~~

~~*Bosnia and Herzegovina*~~

~~*226,330 6*~~

~~*2,029*~~

~~*Belgium ....*~~

~~*171,467*~~

~~*Chile*~~

~~*19,672^*~~

~~*Corea*~~

~~*1,286*~~

~~*Denmark*~~

~~*Greenland .*~~

~~*75*~~

~~*France*~~

~~*309,815*~~

~~*Algeria*~~

~~*5,919*~~

~~*New Caledonia*~~

~~*6,090 =*~~

~~*German Empire*~~

~~*733,683*~~

~~*Greece*~~

~~*9,346"*~~

~~*Holland .*~~

~~*3,806*~~

~~*Dutch East Indies*~~

~~*25,383"*~~

~~*Italy*~~

~~*102,728*~~

~~*Japan*~~

~~*119,667"*~~

~~*Luxemburg*~~

~~*6,207*~~

~~*Mexico . Norway .*~~

~~*106,536" 2,457"*~~

~~*Peru*~~

~~*Portugal . . ,*~~

~~*Rumania .*~~

~~*105,000 9,421" 1*~~

~~*Foreign Countries, continued: —*~~

~~*Russia 286,983 =*~~

~~*2,070"*~~

~~*22,000"*~~

~~*83,662*~~

~~*13,861*~~

~~*1,877"*~~

~~*506,830=’*~~

~~*2,883,200*~~

~~*4,476,365*~~

~~*Servia*~~

~~*Siam ..... Spain ..... Sweden .....*~~

~~*Switzerland .... United States ....*~~

~~*Total for Foreign Countries*~~

~~*Total for the World .*~~

~~*1 Information not available. 2 Figures for 1898. 3 Figures for 1897,*~~

~~*4 For British Columbia, Nova Scotia, Ontario, an4 Quebec only.*~~

~~*5 Including some figures for 1899. 6 Figures for 1899. 7 Returns incomplete. 8 Persons employed in saltpetre works only. 9 Coal miners*~~

~~*only, and ore miners of Colorado, Montana, and Tennessee.*~~

~~*Authorities. — The following works may be consulted : — Books. — Bertolio. CoUivazione delle Minere. Milan, 1902. — Bilharz. Die mschanische Aufbereitung von Erzen und mineralischen Kohlen. Leipzig, 1896. — Brown. The Organization of Gold Mining Business. Glasgow, 1897. — Brough. Mine Surveying. 7th edition. London, 1899. — Bulman and Redmayne. Colliery Working amd Managem^ni. London, 1896. — Colomer. Exploita- tion des Mines. Paris, 1899. — Demanet. Traiti d' exploitation des mines de houille. 2nd edition. Brussels, vols. i. and ii. 1898, vol. iii. 1899. — Foster. Ore and Stone Mining. 4th edition. London, 1900. — Galloway. Lectures on Mining. Cardiff, 1900. — Hatch and Chalmers. The Gold Mines of the Rand. London, 1895. — Haton db la Goupinii:EE. Cours d' exploitation des Mines. 2nd edition. Paris, vol. i. 1896, vol. ii. 1897. — Hoefer. Taschenbuch fur Bergmdnner. Leoben, 1897. — Hughes. Coal Mining. 4th edition. London, 1900. — Ihlseng. A Manual of Mining. 3rd edition. New York, 1899. — Kirschner. Grundriss der Erzaufbereitung. Leipzig and Vienna, vol. i. 1898, vol. ii. 1899. — KoHLER. Bergbaukunde. 5th edition. Leipzig, 1900. — Lawn. Mine Accounts and Mining Book-keeping. London, 1897. — Louis. Handbook of Gold Milling. 2nd edition. London, 1899. — Lupton. Mining. London, 1893. — Rickard. The Stamp Milliyig of Gold Ores. New York and London, 1897. — Trusoott. The Witwatersrand GoldfUlds — Banket and Mining Practice. , London, 1898. — Periodical Publications. — Annates des Mines de Belgique. Brussels, quarterly. — Australian Mining Standard. Melbourne, Sydney, and Brisbane, weekly. — Gliickauf. Essen, weekly. — Mines and Quarries: General Report and Statistics. Edited by C. Le Neve Foster. London, annually ; with details from official reports of colonial and foreign Mining Depart- ments. — The Mineral Industry. New York, annually. — Trans- actions of the Institute of Mining and Metallurgy. London. — Transactions of the Institution of Mining Engiiieers. Newoastle- oii-Tyne. (c. L. N. F.)*~~

~~*Minneapolis, the capital and leading city of Minnesota, U.S.A., situated on both banks of the Mississippi river at the Falls of St Anthony. "With the " twin " city of St Paul it constitutes the centre of the commercial life of the north-west, sharing the termini of the Northern Pacific, Great*~~

~~*Northern, Canadian Pacific ("Soo"Line), St Paul and Duluth, Chicago and North- Western, Chicago and Great Western, Mmneapohs and St Louis; Chicago, Burlington, and Quincy; Chicago, Milwaukee, and St Paul; and the Wisconsin Central Hallways. Dams are being constructed by the Federal Government below the city, which will make Minneapohs the head of navigation on the Mississippi. Communica- tion with St Paul is secured, besides the steam railways, by an electric HIne. Minneapolis possesses a street-car system of some 120 miles of tracks. Its population in 1895 wa.s 192,833, and in 1900, 202,718, of whom 61,021 were foreign-born (largely Scandinavian) and 1548 were negroes. The birth-rate is 13-54 per 1000, and the death-rate (1900) only 10-8. The public school system has 59 buildings, 4 of which are high schools, and there axe 782 teachers. The school attendance in 1899 was 34,863. In 1900 the United States census reported 60,377 persons of school age (5 to 20 years inclusive). Out of 63,711 males of voting age, 1205 were iUiterate (unable to write), of whom 1065 were foreign-born. In addition to the public schools, there are three preparatory schools, a medical college, an art school, and a conservatoire*~~

~~*of music. The higher institutions of learning are the Augsburg , theological seminary and the University of Minnesota. The public life of the city is indicated in its library of 106,000 volumes, art gallery, park system, 18 miles of boulevards, 170 churches, 3 theatres, 4 daily newspapers, 43 weekly, 6 semi-monthly, 27 monthly, and 2 quarterly periodicals. In finance and manufacturing Minneapolis has made rapid progress. There are 6 national banks, 6 state and savings banks, and 4 trust companies with a combined capital of $8,536,000. In 1899 the bank clearings reached the sum of $539,400,176. The deposits in these banks in the same year amounted to $34,604,720. During 1899 buildings to the value of $3,052,500 were erected. In 1900 there were 2368 manu facturing establishments, with a capital of $57,708,204, and products valued at $1 10,943,043. There were 26,608 wage-earners employed (exclusive of 2606 salaried officials, clerks, &c.), who received in wages*~~

~~$12,708,523. The principal output consisted of lumber and timber products, valued at $12,285,305, and flouring and grist-mill products, valued at $49,673,568. In 1899 the jobbing or wholesale business amounted to $100,000,000. The assessed valua- tion of real and personal property in 1900, on a basis of about 60 per cent, of the full value, was $99,492,054, and the rate of taxation $27.40 per $1000. The bonded indebtedness was $8,550,000, but there was a sinking fund of $1,872,115. The cost of the city government was $2,882,719. (f.l. mcv.)~~

~~MinneSOtcl, one of the north-central states of the United States, situated between 43° 30' and 49° 25' N. and 89° 29' and 97° 5' W. In 1885 the population was 1,117,896, an addition in five years of 43 per cent.; in 1890 it was 1,301,826, or 16‘4 persons to the square mile; and in 1900 it was 1,751,394, and the density 22‘1 per square mile. In 1895 the population comprised 1,057,084 native-born persons and 517,535 foreign-born. Of these 119,554 were born in Sweden, 107,319 in Norway, 133,768 in Germany, 49,831 in Canada, 26,106 in Ireland, and 70,957 in other countries. Of the total population in 1900, 932,490 (53-2 per cent.) were males and 818,904 (46‘8 per cent.) females; 1,246,076 native-born and 505,318 (28-9 per cent.) foreign – born ; 1,737,036 were white and 14,358 (0‘8 per cent.) coloured, of whom 4959 were negroes, 166 Chinese, 51 Japanese, and 9182 Indians. The death-rate in 1900 was about 9 ‘7 percent. The urban population, classing as such all persons in cities of 8000 inhabitants or over, was 470,046, or 26‘8 per cent, of the total population, as against 28 ‘2 per cent, in 1890. In 1890 the population of the forty cities and villages with over 2000 inhabitants was 456,214 ; but in 1900 it had increased to 52 with a combined population of 629,398. Since 1880 the three largest cities have had a rapid growth. In 1880 Minneapolis had a population of 46,887, St Paul 41,473, and Duluth 838. In 1890 the respective figures were 164,738, 133,156, and 33,115. In 1 900 the populations were as follows : Minneapolis 202,718, St Paul 163,065, and Duluth 52,969.~~

~~Religion. — In 1890 there were thirteen denominations with over SOOOmembers. Of thesethe Roman Catholics had 271,319members; the Lutherans (of all denominations), 136,914 ; the Methodists, 30,387 ; the~~

~~Baptists, 14,698 ; the Presbyterians, 13,734 ; theCon- gregationalists, 13,624 ; and the Episcopalians, 11,142.~~

~~Charities and Corrections. — In 1860 there were in the state in- stitutions 23 inmates, or one to every 8826 of the population. In 1898 the number had increased to 5671, or one for every 306. The expense of maintaining these was $2,829,723. The insane asylums are at St Peter, Rochester, Fergus Palls, Anoka, and Hastings, and the schools for the deaf, dumb, blind, and imbecile at Paribault. The soldiers' home is at Minnehaha Falls, and the school for neglected and dependent children at Owatonna. Young boys and girls under sixteen are sent for certain offences to tho training school at Red Wing. Young men between sixteen and~~

~~thirty are committed to the state reformatory at St Cloud for the firSi, offences. Criminals are sent to the state prison at Stillwater. Under the Act of 2nd March 1883 the Legislature created a boa,rd of six persons to supervise the entire system of public charities and correctional institutions, which was appointed by the gover- nor, and served without recompense. By Act of the Legislature in 1901, however, its work and powers were placed in the liands of three persons known as the Board of Control. The members are appointed by the governor, and hold office for six years.~~

~~^dijcatto?!. — Illiteracy had fallen to 5-9 per cent, in 1890. This was due to the public school system, which includes a series of closely associated institutions from the primary school to the university. The schools proper are under the general super- vision of a high school board consisting of a principal of an independent state high school appointed by the governor, the president of the university, and the superintendent of public instruction. The Legislature in 1899 made an appropriation for the aid of the schools of the state, which has been apportioned by the high school board. Rural schools receive §75 per year ; semi – graded schools, flOO ; graded schools, $200 ; and high schools, 1800. The number of pupUs enrolled in 1898 nas 364,063. At that time there were 6415 common schools, 151 independent schools, 25 special, 97 state high, and 110 state graded schools. The value jjf the school houses and apparatus was $15,277,500. The support of the public schools comes from two sources,~~

~~*taxation and the interest from a, permanent school fund now amounting to $12,087,627. There are five normal schools at Winona, Mankato, St Cloud, Moorhead, and Duluth, with an attendance in 1898 of 3052. Regular appropriations are made for their support by the state legislature. The State University in Minneapolis has faculties of literature, science, and art ; of agriculture, of law, of medicine, and of engineer- ing, and the schools of chemistry and mines. The attendance is 3400 ; the income — derived from a ^W ™ill tax, from students' fees, from United States appropriations, and from interest on endowment — is about $380,000 per annum. The Legislature has supplemented the public school work by creating a system of travelling libraries, farmers' institutes, and local option free text-books. In 1900 the number of persons of school age (5 to 20 years inclusive) was 612,990. Out of 506,794 males of voting age, 20,785 were illiterate (unable to write), of whom 16,780 were foreign-born and 1378 Indians.*~~

~~*Banks. — The banks on the 1st of February 1899 were divided as follows : — National 72, capital $13,750,000 ; state banks 149, capital $6,600,000 ; savings banks 14, with deposits of $11,000,000, and 47,328 depositors ; trust companies 8, capital f3, 664, 226 ; and 206 private banks with a capital of $3,975,500. With the excep- tion of the private banks, all are under the supervision of the state examiner.*~~

~~*Finances. — The income is derived from twenty different sources, and in the year ending 31st July 1898 amounted to $5,429,240, while the expenditure was $5,298,942. There was a balance in the treasury of $2,184,612. The expenditure for 1899 and 1900 was estimated at $3,086,660 and $2,607,812. The state debt is $1,475,647. In 1899 the total valuation of all classes of property was $585,083,328. On this amount taxes were levied to the amount of $14,539,285, the state receiving $2,026,774. The principal source of income, outside the personal and property taxes, is a 4 per cent, tax on the gross earnings of railway, express, telephone, telegraph, fast freight and sleeping-car com- panies. The total tax levied for all purposes averaged for the whole state 24 '85 mills.*~~

~~*Agriculture. — In 1900 there were in the state 154,659 farms, containing 26,248,498 acres, of which 70‘3 per cent, were improved land. The total value of farm property was $788,684,642, made up as follows : — Land, improvements and buildings, $669,522,315 ; implements and machinery, $30,099,230 ; live stock, $89,063,097. The increase in the total value of farm property during the decade 1890-1900 was $373,983,016, or over 90 per cent. Of the total number of farms, 827 per cent, were worked by owners, a ‘3 per cent, by cash tenants, and 14 per cent, by share tenants. The total value of farm products for the year 1899 was $161,217,304. Statistics of the principal crops are given in the following table : —*~~

~~*Crops.*~~

~~*Acres*~~

~~*Quantity.*~~

~~*Value.*~~

~~*Indian corn*~~

~~*1,441,580*~~

~~*47,256,920 bushels*~~

~~*$11,337,105*~~

~~*Wheat .*~~

~~*6,560,707*~~

~~*95,278,660 „*~~

~~*50,601,948*~~

~~*Oats*~~

~~*2,201,325*~~

~~*74,054,150 „*~~

~~*15,829,804*~~

~~*Barley*~~

~~*877,845*~~

~~*24,314,240 „*~~

~~*7,220,739*~~

~~*Flax seed*~~

~~*566,801*~~

~~*5,895,479 „*~~

~~*5,898,556*~~

~~*Hay and forage*~~

~~*3,157,690*~~

~~*4,411,667 tons*~~

~~*14,585,281*~~

~~*Potatoes .*~~

~~*146,659*~~

~~*14,643,327 bushels*~~

~~*3,408,997*~~

~~*Miscellaneous*~~

~~*vegetables .*~~

~~27,438~~

~~1,372,907~~

~~Forest products~~

~~2,602,335~~

~~772~~

~~M I N 0 R C A — M I N S T E R~~

~~The number and value of the most important domestic animals were as follows :— 753,632 dairy cows, $21,513,337; 1,117,693 other neat cattle, |14,785,621 ; 696,469 horses, $42,255,044 ; 8500 mules and asses, $498,055; 359,328 sheep (not including lambs), |l,32i»,5.Sl ; 1,440,806 swine, $5,865,590.~~

~~Jlininy.— In 1884 the great iron ranges were little known ; only 62,124 tons had been taken out of the Vermilion range. The Mesabi range mines were opened in 1892, and in 1898 the two ranges produced 5,878,908 tons of ore. The total tonnage since 1884 is 28,492,256. Several valuable mines have been leased to private companies on terms that require payment in advance and a second payment on the execution of the contract. Up to 31st July 1898 the state had made 2520 prospecting leases, twenty-six of which are in force. There are also eighty-six mining contracts in force. The royalties paid into the state treasury from such contracts in 1897 and 1898 amounted to nearly $51,447. The private mines are largely controlled by eastern syndicates. The ore is shipped to Ashtabula, Cleveland, Buffalo, and Erie from Two Harbors, Duluth, and West Superior by way of the great lakes.~~

~~Manufactures.— The general statistics of manufactures in 1890 and 1900 are shown in the following table :—~~

~~1S90.~~

~~1900.~~

~~*Per cent, of Increase.*~~

~~*Number of establish-*~~

~~*ments .*~~

~~*7,505*~~

~~*11,114*~~

~~*48-1*~~

~~*Capital*~~

~~*$127,686,618*~~

~~*8165,832,246*~~

~~*29-9*~~

~~*Salaried officials,*~~

~~*clerks, &c.*~~

~~*9,839 1*~~

~~*7,319*~~

~~*, 25-6 2*~~

~~*Salaries*~~

~~*$7,818,1161*~~

~~*$6,554,424*~~

~~*16-2 2*~~

~~*Wage-earners (aver-*~~

~~*age number)*~~

~~*69,790*~~

~~*77,234*~~

~~*10-7*~~

~~*Total wages*~~

~~*$.30,371,123*~~

~~*$35,484,825*~~

~~*16-8*~~

~~*Miscellaneous ex-*~~

~~*penses .*~~

~~*$12,1.36,612*~~

~~*.$13,273,648*~~

~~*9-4*~~

~~*Cost of material used*~~

~~*$118,481,941*~~

~~*$173,425,615*~~

~~*46-4*~~

~~*Value of products*~~

~~*$192,033,478*~~

~~*$262,655,881*~~

~~The principal industry is milling. In 1900 the manufacturing establishments for flouring and grist-mill products numbered 512, and employed an average number of 4086 wage-earners. The capital invested in this industry amounted to $24,125,781. The products were valued at .$83,877,709, or 15 per cent, of the total value of the flouring and grist-mill products of the United States. Not only did Minnesota lead in this industry among the states of the Union, but the like products in the state next in rank (New York) amounted in value to only a little more than half as much. A very large export trade in flour lias been built up, amounting in 1898 to 4,000,000 barj-els. I/umber and timber products rank next in importance, being valued in 1900 at $43,585,161. In this industry there were 438 establishments, with a total capital of $52,095,923, and employing 15,140 wage-earners. The lumber pro- duct in 1898 was 1,687,762,000 feet of board lumber, 440,511,000 shingles, and 315,869,000 lath. It is estimated that there is still standing in the state 13,000,000,000 feet of pine. At the present rate of cutting this would disappear within a few years, but un- doubtedly the cut will decline each year. The products of slaugh- tering and meat-packing (wholesale) amounted in 1900 to $6,803,112, and the value of cheese, butter, and condensed milk produced at factories amounted to $8,479,896. The leading manufacturing centre in the state is Minneapolis.~~

~~Commerce. — The jobbing or wholesale trade is estimated at $600,000,000. The two customs districts with ports of entry at Duluth and Minnesota City, recorded $4,410,303 worth of exports, and $1,743,204 of imports in 1899.~~

~~Bailways. — The facilities for transportation are exceptionally good. The railway mileage in 1899 was (i:!38. Three trunk lines cross the state to the Pacific coast, six lines extend from the twin cities to Chicago, and a number run from north to south. In 1898 the capital stock and bonds of these railways were .$1,157,061,160. Minnesota's proportion on a mileage basis was $264,320,770. The gross earnings of the railways for that year, inside the state, amounted to $43,903,818. The Federal Government has given these railways 17,621,952 acres, and the state 3,648,71!) acres— a~~

total of 21,170,071 acres. Of this 10,23i,598 acres have been patented by the state to the railways.

liistory and Politics. — The state has been undisturbed by strife, with the exception of the rise of the Pilla

1 Includes proprietors and firm iiu.mbers, with their salaries. 2 Di.'uroiise.

disturbance. But the resistance was intensified by injustice done to the Indians in connexion with the sale of their lands, and made the incident from their point of view an effort towards vindication. In politics the Republican party controlled state elections for forty years after the admission of the state into the Union. In 1898 this long history was broken by the fusion of the forces of the Democrats and Populists, which elected their candidate for governor. The Democratic-Populist candidate received 131,980 votes, while the Republican received only 111,706. In the presidential election of 1900, out of a total vote of 313,087, McKinley (Republican) received 190,461 votes, and Bryan (Democratic) 112,901.

Constitutional Changes. — Important changes have been made in the constitution since 1880. The requirements of citizenship are more rigorous ; only full citizens of the United States are permitted to exercise the franchise, and these only after a resi- dence of six months in the state and thirty days in the district. Special legislation was restricted by constitutional amendment in 1891, as a result of which it was impossible for cities to obtain any revision of their charters except by general Act. It was therefore necessary to' amend the constitution so as to permit citizens to frame charters for their respective municipalities. This was done in 1896. Any city of over 1000 inhabitants may secure a new charter by appointing a charter commission to draw s.uch an instrument. The charter must be submitted to the people within six months after the appointment. A four-sevenths vote m^kes it the basis of the city organization. The session of the Legislature has been increased to ninety days. In civil actions a jury after six hours' deliberation may render a verdict by a five-sixths vote. Combinations against trade are prohibited by the constitution. The governor may veto a part of a money Bill without invalidating the remainder.

~~Authorities. — Legislative Manual, 1899 ; Executive Documents of the State. — Neill. Concise History of Minnesota. St Paul, 1887, — McVet. The Government of Minnesota. New York, 1901. — Collections of the Minnesota Historical Society, vol. viii. (this volume contains a bibliography of the state). — Reports of the State, Labour Commissioner. — Publications of the Natural Histoi-y and Geological Survey, 1898. — General Statutes,l?)9i. (f. l. McV.)~~

~~Minorca or Menoeca. See Balearic Islands,~~

~~Minsk, a government of western Eussia, bounded on the N. and E, by Vilna, Vitebsk, and Moghilev; on the S, and ^V. by Chernigov, Kieff, Volhynia, and Grodno. Area, 35,29.3 square miles. Its population in 1897 was 2,166,123, of whom 1,078,466 were women, and 228,822 lived in towns. They were distributed as follows, according to religion : — Greek Orthodox, 71-3 per cent. ; Jews, 17-3 ; Catholics, 10-1 ; Greek Nonconformists, 0-8 ; Mussulmans, 0-3 ; Protestants, 0-2 per cent. The peasants constitute 65 per cent, of the population. The average yearly crops of 1893-98 were: rye 6,720,000 cwt., wheat 1,607,000 cwt, oats 3,314,300 cwt. ; all cereals 13,067,000 cwt. Gardening is carried on in some districts. There were in 1896, 269,000 horses, 690,000 horned cattle, and 560,000 sheep. The chief industrial establishments are distilleries, breweries, steam flour mills, tobacco, and various factories for dealing with forestry produce. Their aggregate returns amounted in 1897 to £1,742,700. Archaeological finds of great value, dating from the Neo lithic and subsequent ages, have lately been made. Of schools there were, in 1897, 1827 and 726 Jewish hedeis, with an aggregate of 67,130 jiupils (8580 girls). The government is divided into nine districts, of which the chief towns and populations are : Minsk, capital of the government, 91,494 inhabitants in 1897; Bobruisk (35,177), Isumeil (4579), jMozyr (10,762), Novogrudek (7700), Pinsk (27,938), Eyechitsa (9322), and Slutsk~~

~~(14,180).~~

~~Minster, or IMinsteh. in Sheppey, a parish and village in the Isle of Sheppey, Kent, England, 3 miles south-east of Sheerness. The church of SS. Mary and Sexburga was formerly part of an ancient convent church.~~

~~In 1894 the parish was reduced by the formation out of it of the civil parish of Sheerness. It is connected with Queenborough by a light railway, opened in 1901. Popu- lation (1891), 1307 ; (1901), 1292.~~

~~Minto, William (1845-1893), Scottish man of letters, was born at Auchintoul, Aberdeenshire, in 1845, and educated at Aberdeen University and Merton College, Oxford, winning high honours in classics, mathematics, and philosophy. HIe was assistant professor under Alexander Bain at Aberdeen for some years, and between 1874 and 1878 was editor of the Examiner; he subsequently wrote for various newspapers, and in 1880 was made full pro- fessor of logic and English at Aberdeen. In 1872 he published a Manual of English Prose Literature, which was very successful, and was distinguished by sound judg- ment and sympathetic appreciation ; and his Character- istics of English Poets (1874) showed the same high qualities. HIe contributed Daiiiel Defoe (1879) to the " English Men of Letters " series, and was also the author of two novels, The Crack o/ Doom (1886) and TJie Media- tion of Ralph Rardelot (1888). HIe died in 1893.~~

~~Minusinsk, a district town of Russia, East Siberia, government of Yeniseisk, 220 miles south of Achinsk railway station, 5 miles from the right bank of the Yenisei, situated in a fertile prairie region. It is a centre for trade (annual vahie, £100,000) with the native popu- lations of the Sayans and north-western Mongolia. It has one gymnasium for girls, and an excellent natural history, ethnographical, and archaeological museum (1877), with a library and a meteorological station. The industry is chiefly agricultural ; large herds of cattle are kept, but there is a variety of small trades. Population (1897),~~

~~10,255.~~

~~Miquel, Johann von (1829-1901), German states- man, was born at Neuenhaus, Hanover, on 21st February 1829. HIe sprang from a French family which had emigrated during the Kevolution. HIe learnt law at the~~

~~*universities of Heidelberg and Gottingen, and at an early age studied the writings of Karl Marx. For a time he became a convert to the extreme revolutionary, socialistic, and atheistic creed; but though he entered into correspondence with Marx, with the object of start- ing a revolutionary movement, he does not appear to have taken any overt part in the events of 1848-49. Further study of political economy soon enabled him to pass out of this phase, and in 1850 he settled down to practise as an advocate at Gottingen. He acquired repute as an able lawyer and a rising politician, was one of the founders of the National- Verein, and in 1864 was elected member of the Hanoverian Parliament as a Liberal and opponent of the Government. He a.ccepted the annexation of Hanover by Prussia without that regret felt even by many Liberals who belonged to older Hanoverian families, and was one of the three Hanoverians whose brilliant parliamentary abilities at once won a commanding position in the Prussian and German Parliaments. For some reason, perhaps because Bismarck did not entirely trust him, he did not at this time attain quite so influential a position as niight have been antici- pated ; he was chairman of the parliamentary committee by which in 1876 the new rules of legal procedure were drafted, but he found scope for his great administrative abilities in the post of burgomaster of Osnabriick (1865-1870 and 1876-80), and was also from 1870 to 1873 a director of the Discontogesellschaf t, the most important of German banks. In 1880 he was elected burgomaster of Frankfort-on-Main, where he gained great reputation for the energy with which he dealt with social questions, especially that of the housing of the poor. Probably owing to his early study of Socialism, he had never adopted the economic as well as the political doctrines of Liberalism, and he was very ready to support the new State Socialism of Bismarck. He was the chief agent in the reorganization*~~

~~*of the National Liberal party in 1887. After Bismarck's fall he was chosen as Prussian minister of finance, and held this post for ten years. He distinguished himself by his reform of the Prussian system of taxation, an important series of measures to which the financial prosperity of Prussia is largely attributed, and the one really successful measure of the new reign in internal affairs. An attempt to reform the system of imperial finance in 1893-94 failed, and much injured his reputation. In all the*~~

~~*political con- troversies and intrigues of the time he took a leading part, but it is impossible to explain here the course of his policy, which was not always clear. He had entirely given up his Liberalism, and aimed at practical measures for im- proving the condition of the people irrespective of the party programmes ; some of his measures, such as that for taxing " Waarenhauser," i.e., stores, were of a very injudicious nature. He professed to aim at a union of parties on the basis of the satisfaction of material interests, a policy to which the name of Sammlung was given ; but his enemies accused him of constantly intriguing against the three Chancellors under whom he served, and of him- self attempting to secure the first place in the State. The sympathy which he expressed for the Agrarians increased his unpopularity among Liberals and industrials, and added to the difficulties of the Administration to which he be- longed ; but he pointed out that the State, which for half a century had done everything to help manufactures, might now attempt to support the failing industry of agriculture. In June 1901 the rejection of the canal Bill led to a crisis which probably took the form of a trial of strength between him and Billow, and he was obliged to send in his resigna- tion. His health was already failing, and he died on 8th September of the same year at his house in Frankfort. He left the reputation of a statesman in ability second to none of those who had risen to power under the Empire, who only failed to reach the highest rank because of a rest- less ambition and an uncertainty in action which prevented men from depending onhim whether as leader or colleague.*~~

~~*M i raj , a native state of India, in the Deccan division of Bombay, forming part of the southern Mahratta Jagirs. Since 1820 it has been subdivided between a senior and a junior branch. The territory of both is widely scattered among other native states and British districts. Area of the senior branch, 339 square miles ; population (1891), 88,343 ; average density, 260 persons per square mile ; gross revenue (1897-98), Rs.2,81,883, of which Es.86,605 was expended on public works and E.s.32,808 on famine relief ; tribute, Iis.l2,56_8 ; number of police, 335 ; 29 schools, with 2691 pupils. Area of the junior branch, 225 square miles ; population (1891), 35,487 ; gross revenue, Rs.3,47,657, of which Rs.46,431 was expended on public works ; tribute, Es.6412 ; number of police, 137 ; 31 schools, with 1362 pupils. The chiefs are Brahmans by*~~

caste, of the Patwardhan family. The town of Miceaj, at which both chiefs hav£ their residence, is situated in 16° 49' N". and 74° 41' E., near the river Kistna ; it is a junction on the Southern Mahratta railway for the branch to Kolhapur. It has a high school, with 244 pupils in 1897-98, and two state printing-presses. Population

(1881), 20,616 ; (1891), 26,060.

Mirgorod, a district town of Little Russia, govern- ment of Poltava, 90 miles north-west of the town of Poltava, 14 miles from the KharkofE-Nikolaeff railway. It is an old town, which played an inlportant part in the wars between Little Russia and Poland. Population,

(1897), 10,023.

Mirzapur, a city and district of British India, in the Benares division of the North- West Provinces. The

city is on the right bank of the Ganges ; a station on the East Indian railway, about half-way between Allahabad and Benares, 509 miles north-west from Calcutta. Population (1881), 85,362 ; (1891), 84,130; and (1901), 79,787 ; municipal income (1897-98), Es.60,360, almost entirely from octroi; incidence of taxation, nearly 10 annas per head ; registered death-rate (1897), 60-86 per thousand, formerly it was the emporium of trade between northern and central India, which has now been diverted to the railways. It has two European and 39 native lac factories, the latter employing 2400 hands, with an out-turn valued at Rs.9,72,000. The London Mission manages a high school. There are three printing-presses, one of which issues a newspaper in vernacular and English.

The district of Mibzapub extends into tlie Sone valley. Area, 5223 square miles ; population (1881), 1,136,796 ; (1891), 1,161,508 ; (1901), 1,082,706 ; showing an increase of 2 percent, between 1881 and 1891, but a decrease of 6-8 between 1891 and 1901 ; average density, 207 persons

~~*per square mile. The land revenue and rates are Rs.9,71,735, the Incidence of assessment being less than8 annas per acre ; cultivated area (1897-98), 385,808 acres, of which 45,495 were irrigated from wells, &c. ; number of police, 2156 ; number of vernacular schools, 103, with 4856 pupils ; registered death-rate (1897), 51-7 per thousand. The district is permanently settled, and comprises a large part of the hereditary domains of the Raja of Benares, which are revenue-free. It is traversed, near the Ganges, by the main line of the East Indian railway for 53 miles. The Great Southern road used to start from Mirzapur city. There are no Government canals.*~~

~~*Mishawaka, a city of St Joseph county,' Indiana, U.S.A., on the St Joseph river, at the intersection of the Grand Trunk and Michigan Southern railways, in the northern part of the state. Its manufactures consist largely of agricultural tools and machines. Population (1890), 3371 ; (1900), 6560, of whom 821 were foreign- born and 21 were negroes.*~~

~~*Misiones, a territory of the Argentine Eepublic, bounded on the E. by Brazil, from which it is sepa- rated by the rivers Pepiri (also called Pepiri-Guazu) and San Antonio, on the S. by Brazil, on the N. by Brazil, and on the W. by Paraguay and the Argentine province of Corrientes. The official area at the census of 1895 was 11,282 square miles ; and in 1895 the population was 33,163. The capital, Posadas, was founded in 1865. The territory is divided into fourteen administrative divisions. In 1895 there were 2519 farms in the terri- tory, and 15,630 acres planted in cereals ; 70,259 head of cattle, and 25,002 horses.*~~

~~*Miskoicz, a corporate town of HIungary, capital of the county of Borsod, with 32,288 inhabitants in 1891, and 43,096 in 1900. It has two gymnasia, a commercial school, an orphanage, a hospital, and is an important centre of trade and trafiic.*~~

~~*Missions. — This article is mainly devoted to the extension of missionary work since 1881, with some reference to previous events not fully dealt with in the article on the subject in the earlier volumes of this work. It is generally agrei^d that the years since 1885 have wit- nessed a very marked increase of missionary zeal and interest in Great Britain, both in the Church of England and among the Nonconformists. The*~~

~~*improvement, indeed, dates back somewhat earlier. So far as the Church of England is concerned, it may fairly be said to have started afresh in the year following the first observance of the Day of Intercession for Missions, 20th December 1872. Both the Society for the Propagation of the Gospel and the Church Missionary Society were atthat time sufferingfrom a general coldness whirh, in the case of the latter society, had led in that very year to the committee reporting " a*~~

~~*failing treasury and a scanty supply of men." The observ- ance of that first Day of Intercession was followed by an immediate change, and unquestionably there has been progress ever since. Then, less than five months after- wards, David Livingstone died at Ilala ; and no event of the whole century did so much to wake up Protestant Christendom. Most of the Missions in Central Africa owe their origin to the spirit it aroused. But the year 1884, from which the present survey mainly starts, was also an epoch to be marked. In that year Bishop Han- nington went to Africa; and his murder in 1886 (first reported in England on New Year's Day, 1886) deeply- touched the Christian conscience. The speedy publi- cation of Mr Dawson's biography of him worked a revolution in the circulation of missionary literature. Not only was the sale of the book itself large, but it encouraged publishers to bring out other works on Missions. Another event of 1884-86 was the going forth to China of the men known as the Cambridge Seven, in connexion with the China Inland Mission. AH were men of good family; some of them went at their own charges ; and among them were the stroke-oar of the University Eight (Mr Stanley Smith) and the captain of the University Eleven (Mr C. T. Studd). Probably no event of recent years has exercised a wider influence in the cause of Missions. In particular, univer- sity graduates have since then gone out as missionaries in much larger numbers than before. There are now five Missions definitely linked with the iniversities. The Central African Mission (1858), indeed, is not for the most part manned by graduates, though it is led by them ; but the Cambridge Mission at Delhi (1878), the Oxford Mission at Calcutta (1880), and the Dublin Missions in Chota Nagpore (Society for the Propagation of the Gospel, 1891) and the Puh-Kien Province of China (Church Mis- sionary Society, 1887) consist of*~~

~~*university men. jNIore- over, the older and larger societies have much increased the proportion of graduates on their staffs, the Society for the Propagation of the Gospel and Church Missionary Society having between them about 300 engaged in actual missionary work among the heathen (besides the S.P.G. colonial clergy).*~~

~~*The cause of Missions in the universities has been fostered in the last few years by the Student Volunteer Missionary Movement, initiated in America in 1886, and organized in England in 1892. Between 1892 and 1902 no less than 1880 students in colleges in the United Kingdom (including theological colleges and medical schools) signed a declaration expressing their purpose, " if God permit," to be foreign missionaries ; and of these, 733 had sailed by Eebruary 1902 in connexion vnth various societies, Anglican and Nonconformist. The Student Volunteer Missionary Union has adopted as its watchword, "The Evangelization of the World in this Generation"; and this motto has been approved by several bishops and other Christian leaders. Another influence upon university men and others who have taken holy orders is that of the Younger Clergy Union of the Church Missionary Society (1886), and the Junior Clergy Association of the Society for the Propagation of the Gospel (1891). Some 4000 clergymen have joined one or other of these organizations, and while more than 100 have gone out as missionaries, the members generally have been incited to the study of Missions and to elforts for their support. At the same time there has been a great accession of men to the missionary ranks from among other classes of society. The Anglican societies and the regular and older Non- conformist societies (INIethodist, Baptist, Presbyterian, and the London Missionary Society, which is virtually (Jongregationalist) have shared in these humbler recruits; but a large proportion of them have joined several younger "non-denominational" or "inter-denominational" Missions.*~~

~~*Of these the China Inland Mission is the largest and most influential ; and while it has sent forth many of this class, it has also enrolled not a few men and women of considerable wealth, education, and social status.*~~

~~The South Africa General]\Iission, the North Africa Mission, and the Congo Balolo Mission come next in importance ; but there are several smaller bodies working in different countries. The Salvation Army also has missions in India, Ceylon, and Japan ; but these cannot be called "non-denominational," because the Army has gradually become a very strict denomination itself. There is one Anglican society working, like some of those just men- tioned, in one particular field, viz., the Soutli American Missionary Society, founded in 1844. Many foreign dioceses also have associations in England for their help and support. Medical men have come forward in increasing numbers for missionary service, and Medical Missions are now regarded as a very important branch of the work of evangelization. They are especially valuable in INIahommedan countries, where open preaching is difl&cult and sometimes impossible,, and also in works of mercy among barbarous tribes ;, while in China, which comes nnder neither of these two categories, they have been largely developed. About 500 fully qualified doctors are labouring in British and American Missions ; and in 1898 it was calculated that the in-patients in British Mission . hospitals exceeded 30,000, while the visits of out-patients in a year were nearly a million and a half. In several of the great London hospitals there are missionary associations, the members of which are medical students ; but a chief source of supply in the past has been the Edinburgh Medical Mission, founded in 1841, which, while working among the poor in that city, has trained many young doctors for missionary service. Of course the total number is only a small fraction of the whole body of medical men; but the same remark applies to other classes of missionaries, clerical and lay.~~

~~The most remarkable development of missionary enter- prise has been the employment of women. From an early date many of the wives of missionaries have done good service;- but the going forth of single women in any appreciable number has only been 'encouraged by the societies in the last quarter of the 19th century. The Society for Promoting Eemale Education in the East (now absorbed by others, chiefly by the Church Mis- sionary Society) was founded in 1834 ; the Scottish Ladies' Association for the Advancement of Female Education in India (which subsequently became two associations, for more general work, in connexion with the Established and Free Churches of Scotland~~

~~*respectively) in 1837; the Indian Female Normal School Society (now the Zenana Bible and Medical Mission) in 1861 (taking over an association dating from 1852) ; the Wesleyan Ladies' Auxiliary in 1859 ; the Women's Association of the Society for the Propaga^ tion of the Gospel, and the Baptist Zenana Mission, in 1867; the London Society's Female Branch, in 1875; the Church of England Zenana Society (an offshoot from the Indian Female Society) in 1880. But the earlier of these organizations only contemplated employing women for educational work, on a very small scale. Out of it grew the visitation of Indian zenanas. The employment of women in general evangelistic work, such as village itineration, house-to-house visiting in towns, classes for female inquirers, training of native female workers, &c., although recent, has rapidly extended. The Church Missionary Society, besides relying on the above-named Zenana Bible and Medical Mission and Church of England Zenana Missionary Society for women's work at several of its stations in India and China, sent out 500 single women in the fifteen years*~~

~~*ending 1900 ; and the non-denominational Missions above referred to have (including wives) more women than men engaged in their work, — especially the China Inland Mission, which has sent out several hundreds to China, and in 1900 had just 300 (unmarried) on the roll. M'omen's work and medical work are combined in the persons of about eighty fully-qualified lady doctors in various Missions. Although nearly half the male missionaries (Protestant) are immarried, these are exceeded in number by the unmarried women ; and consequently, the husbands and wives being equal, the aggregate of women in the Missions is greater than the aggregate of men. If the total number of British missionaries, including wives, is taken at 7000, the married men would stand at about 1900, and their wives at 1900, the single men at 1400, and the single women at 1800 ; but this is an estimate in round figures.*~~

~~*The home organization of Missions is a subject that has been much considered. The bulk of the work has been done by voluntary societies, membership in which depends upon a pecuniary subscription, and the adminis- tration of which is entrusted to elected committees. These committees comprise not only real experts, such as retired vetei-an missionaries, and retired civil and military officers who have been active*~~

~~*friends of Missions while on foreign service, but also leading clergymen and laymen who, though not personally acquainted with the mission fields, become almost equal experts by continuous attendance and careful study. In the case of the two leading Church of England societies, the bishops (being members) are ex officio on all execu- tive committees; but their labours in other directions prevent their ordinarily attending. The numerous non- denominational Missions previously referred to are differently worked. There is no membership by sub- scription, nor any elected committee. The " Mission " consists of the missionaries themselves, and they are governed by a " Director," with possibly small advisory councils^ in the field and at home, the latter under- taking the duty of engaging missionaries and raising funds.*~~

~~*On the other hand, there is a growing sense that Missions should be the work of the Church in its corporate capacity, and not of voluntary associations. This is the system of the Presbyterian Churches, the Missions of which are entirely controlled by the General Assemblies in Edin- burgh, Belfast, and London respectively. The Wesleyan Society also is under the authority of the Conference. In the Church of England the question was broached in Convocation, shortly after the revival of that body, in 1859; and during the next few years many suggestions were put forth for the establishment of a Board of Missions which should absorb the societies, or at least direct their work. It soon appeared, however, that neither the Society for the Propagation of the Gospel nor the Church Mission- ary Society was willing to be absorbed ; and it was urged by some that in a great comprehensive national Church, com- prising persons of widely diflierent views, more zeal was likely to be thrown into voluntary than into ofBcial enter- prises. Eventually, in 1887, the Canterbury Convocation and Archbishop Benson formed a Board of Missions ; and York followed shortly afterwards. These Boards, however, were not to supersede the societies, but to supplement their work, by collecting information, fostering interest, register- ing results, and acting as referees when required. They have already done some useful work, and will probably do more. Their most active members are men who are also leaders in their respective societies, and have thus gained experience in missionary administration. But the Church of England has not yet put*~~

~~*Missions in the prominent place they occupy in the Nonconformist denominations.*~~

~~*776*~~

~~*MISSIONS*~~

~~*AVhen the Baptist Union holds its annual session, the first day is devoted to a review of the Baptist Mis- sions. Convocation has not yet adopted a similar pro- cedure.*~~

~~*The closing years of the 19th century were remarkable for the centenary commemorations of the older missionary societies. The Baptist Society celebrated its centenary in 1892 ; the London Missionary Society (Congregationalist) did the same in 1895 ; the Society for Promoting Christian Knowledge tept its bi-centenary in 1898; the Church Missionary Society its centenary in 1899 ; the Society for the Propagation of the Gospel its bi-centenary in 1900-01 ; and the British and Foreign Bible Society was founded in 1804. Considerable special funds have been raised in connexion with these commemorations.*~~

~~*Colonial Missions next claim attention. By " colonial " is meant not missions to the British colonial population, but Missions from the colonial population to the heathen. The former have been very largely the work n/a?"" °^ ^^® Society for the Propagation of the Gospel, and, in a smaller degree, of the Colonial Church Society (Church of England) and the Colonial Missionary Society (Nonconformist). Those Missions, however, are more properly an outlying branch of home Missions, being to the professing Christian settlers or their descendants. But these Christian settlers have their own Missions to the heathen — both to the heathen at their doors and to the great heathen lands beyond.*~~

~~*In Canada and Australia, the Anglican, Presbyterian, Methodist, Baptist, and other communities have regular organizations for foreign Missions. The non-Episcopal Missions thus formed and supported are worked quite independently of the home societies of the denominations respectively. The Australian Presbyterians have import- ant agencies in the South Seas and in Korea, the Austra- lian Baptists in Bengal, the Canadians of*~~

~~*various denom- inations in the Ear North-West of the Dominion, and in India and China. The Anglican Church in Canada has its Domestic and Foreign Missionary Society, working in the North- West and in Japan ; and in Australia it has a Board of Missions, working amongst the Australian aborigines and in New Guinea. The Melanesian Mission, associated with the names of Selwyn and Patteson, is officially con- nected with the Church of New Zealand, but is also largely supported in Australia. In New South Wales, Victoria, New Zealand, and Canada there are also Church Missionary Associations which supply missionaries, and support them, for the mission fields of the Church Mis- sionary Society.*~~

~~*The Oerman societies are numerous and important, and have increased in number and in vigorous work. The Moravian Church, whose Missions are the old- est (1732), is itself a missionary organization in a sense in which no other Christian com- munity rivals it. Its total membership is under 100,000, and it has some 350 missionaries, labouring in the most unpromising fields, Greenland, Labrador, Alaska, Central America, Tibet, and among the Hottentots. The Basel Society, with its famous seminary at Basel, which formerly supplied many able German missionaries to the Church Missionary Society, has extensive work in India, West Africa, and South China. The Berlin Society and the Rhenish Society labour in South Africa and China, the Hermannsburg Mission (Hanover) in South Africa and India; Oossner's Mission (Berlin) and the Leipzig Lu- therans in India. At least two of these societies, and other new associations formed for the purpose, and the Moravians, have taken up work in German East Africa. In 1900 German missionaries numbered 986, and their converts were estimated at 370,000. The principal or- ganization in Holland is the Netherlands Missionary*~~

~~*3. Cott- tlneatal.*~~

~~*Society, working in the Dutch East Indies. A Danish Society has a mission in South India. The old Swedish and Norwegian Missionary Societies work in South Africa, Madagascar, and India; but large numbers of Scandi- navians have been stirred up in missionary zeal, and have gone out to China in connexion with the China Inland Mission ; several were massacred in the Boxer outbreaks. The French Protestants*~~

~~support the SociAte des Missions. Evangeliques, founded in 1822. Its chief mission has been in Basutoland, since extended to the Zambezi ; but it has also followed Erench colonial extension, establishing missions in Senegambia, the Erench Congo, Madagascar, and Tahiti.~~

~~The newer American organizations are, as in England, non-denominational and " free-lance," especially the Christian Alliance under the direction of a popular minister at New York, the Eev. A. B. *^°"""" Simpson, which has sent many missionaries to India and China. The older societies attribute to these- new agencies more zeal than discretion, while the newer credit the older with a discretion that cripples zeal. The Student Volunteer Movement, already referred to, has had large influence in the United States, where it arose ; and its leaders have proved themselves men of rare intel- lectual and practical capacity. In a journey round the world in 1895-97, Mr J. R. Mott succeeded in forming students' associations in universities and colleges in several European countries, as well as in Turkey in Asia, Syria, India, Ceylon, China, Japan, and Australia; and all these associations, nearly 100 in number, are now linked together in a great International Student Eederation, of which a Swede is chairman and a Japanese vice-chair- man. The older American societies, especially the American Board (Congregationalist), the Presbyterian Boards, the Methodist Episcopal Church Society, the Baptist Missionary Union, and the Missionary Society of the Protestant Episcopal Church, have much ex- tended their work. The "Ecumenical Missionary Con- ference" held at New York in April 1900 was an astonishing revelation to the American public of the- greatness of Missions generally, and of the Missions of their own Churches in particular. American missionaries- number about 4800.~~

~~Missions to the Jews are distinct from Missions to- heathen and Mahommedans, and are worked by distinct organizations. There are several societies in England, Scotland, Germany, and America. No ■*• '^'*" special development has to be reported, except the Jews. the great extension of Mr John Wilkinson's Mildmay Mission to the Jews, and its energy in the free distribution of Hebrew New Testaments. Converted Jews are commonly supposed to be very few, and in numbers they do not compare with converted heathen ; but they are more numerous than is~~

usually imagined, especially if the second and third generations of Christians of He- brew race are included. It is estimated, for example, that 250 Anglican clergymen are converted Jews or the sons of converted Jews. The London Society for Pro- moting Christianity among the Jews includes among its missionaries about 80 who are converts. Professor De- litzsch estimated that 100,000 Jews had embraced Chris- tianity in the first three quarters of the 19th century ; and Dr Dalman of Leipzig says that " if all those who- have entered the Church and their descendants had re- mained together, instead of losing themselves among the other peoples, there would now be a believing Israel to- be counted by millions, and no one would have ventured to speak of the uselessness of preaching the Gospel to the Jews."

At the beginning of the 19th century the Eoman Com- munion seems to have shared to some extent in the torpor

and stagnation as regards Missions that characterized the Protestant Churches. There was little of the zeal which

had carried the Franciscans all over Asia in camoTic" *^® ?^ century, and the Jesuits to South Missions. America, India, and Japan in the 16th. But

the 19th century has witnessed a great change, and Eoman Catholic Missions have been extended pari passu with Protestant. The revival was not a little due to the foundation in 1822, by a few earnest but (as they called themselves) " humble and obscure " Catholics at Lyons, of a new voluntary society called the Institu- tion for the Propagation of the Faith. It collected in its first year about £2000 from the shopkeepers and artisans of Lyons. Thirty years later its income was £200,000 a year ; and now it is £300,000. It has sent out no mis- sionaries of its own. It merely makes grants to the various missionary parties sent forth, and it has done much in this direction. Roman Missions are carried on both by missionary societies and by religious orders, all under the supreme direction of the

Pope, and also more or less under the general supervision of the Congregation ■de Propaganda Fide at Eome since its foundation in 1622. The Congregation of Lazarists was founded at Paris by St Vincent de Paul in 1632, and the Socidt^ des Missions ifitrang^res, also at Paris, in 1663. This last- named society is the largest Roman Catholic missionary organization, labouring all over eastern Asia and parts of India. It had, in 1899, 34 bishops, 1100 missionaries, 680 native priests, and 1,227,000 native Christians. In that year it baptized 46,000 adult pagans, 41,000 children of Christians, and 155,000 " children of pagans in articulo mortis." Several other smaller societies have their head- quarters in Belgium, Italy, and Ireland. For the pur- pose of Missions in Africa several modern congregations have been formed, particularly the Congregation of the Holy Ghost and Heart of Mary, the Lyons So- ciety of African Missions, the Institute of Verona, and the Algerine Congregation for the conversion of Central Africa (White Fathers). An English organi- zation, St Joseph's Foreign Missionary Society, was founded by Cardinal Vaughan at Mill Hill, near Lon- don, about 1870. It had in 1900 two bishops and 86 priests in the mission field, and works in Uganda, north and south India, Borneo, and New Zealand. The religious orders are also largely represented in the foreign field. The English Benedictines work in British colonies; the Capuchins in the Levant, Western Asia, North Africa, and South America; the Carmelites in India ; the Dominicans in Turkey, Indo-China, North and South America ; the Lazarists in China, the Levant, Persia, Abyssinia, Madagascar, and South America ; the Franciscans, who have been zealous missionaries since the days of their great founder, in China, in the Philippines and Pacific islands, in North and South America, in Egypt and North Africa, in Palestine (where they are the appointed guardians of the Holy Places), and in many European countries ; the Priests of the Sacred Heart in South America and the Pacific Ocean ; the Oblates of St Mary in the polar regions of North America; and, lastly, the Jesuits in all quarters of the world, who in 1899 had 116 missionaries in Europe, 233 in Africa, 988 in Asia, 550 in Oceania, 1246 in North America, and 856 in South America ; total Jesuit missionaries, 3989. In 1895 the Propaganda returned the number of Catholics in heathendom as 3,606,000. But this did not include North and South America, so that the total would be quite four millions. By far the greater part of the Eoman missionary work is

done by France. The majority of the missionaries are French (over 7000) ; the bulk of the money — so far as it is voluntary contribution (but the Propaganda at Eome has large endowments) — is raised in France. The French

Government, anti-clerical as it is at home, is the watchful and strenuous protector of the Missions abroad; and it is evident that not a little political influence in foreign countries is gained thereby. L'Ann^e de VEglise, in re- porting on the Missions in all parts of the world, dwells continually on this with satisfaction. Protestant mission- aries are opposed, not merely because they are heretical, but because they are English or (if American) English-speaking ; and the Greek Church missionaries in Persia and Japan, not only because they are schismatic, but because they are Eussian — the Franco-Eussian alliance notwithstanding. This is a feature in French Catholic Missions which cannot be overlooked in the briefest account of them.

Africa. — The old Missions on the West Coast, of the Church Missionary Society, the Wesleyans, and others, including several American agencies in Liberia, have continued to de- velop and extend. The native church organizations ^* at Sierra Leone, Lagos, the Niger Delta, &c., are self-pleUs" supporting, and the Missions proper have advanced into the interior. The professing Christians (Protestant) on the coast probably number not less than 100,000. More than 120 negroes have been ordained to the ministry of the Church of England. There are now four negro bishops, one of them (in Liberia) connected with the American Episcopal Church. Attempts have been made to reach the Mahoramedan populations of the Western and Central Sudan, particularly Hausaland, but so far they have been unsuccessful. In the southern half of West Africa, i.e., the Congo Megion, there are extensive Missions of the English and American Baptist Societies, the Congo Balolo Mission, and others, all founded since 1875. Although still in their early stages, some hundreds of converts have been received. In all these regions there are extensive Roman Catholic Missions, chiefly Erench, of the Congregation of the Holy Ghost and the Lyons African Mission.

~~*The South African Colonies, being the borderlands of native barbarism and European civilization, are among the hardest of mission fields. The Society for the Propagation of the Gospel, the London Missionaiy Society, the Wesleyans, the United Free Church of Scotland, the South Africa General Mission, the Mbra^ vians, the French Protestants, and some German societies, are at work among Kaffirs, Zulus, Pondos, Basutos, Beohuanas, Hotten- tots, &c., with considerable results, there being probably 150,000 native Christians (Protestants) ; and several missions now extend northwards to the Zambezi. The Church of England has nine dio- ceses, in all of which the work is among both colonists and heathen. The American Board (Congregationalist) has begun work on both sides of Africa, a little north of South Africa proper. There are several vioariats and prefectures of the Roman Church, the princi- pal Missions being French, those of the Congregation of the Holy Ghost, and the Oblates of Mary.*~~

~~*East and Central Africa have witnessed great missionary develop- ment since 1884. The Scottish Missions in Nyasaland have gained great influence and won many converts. The church at Blantyre, connected with the Mission of the Established Presbyterian Church of Scotland, and built by the natives themselves, is a large and imposing one. The Universities' Mission, with its two bishops, and its cathedral at Zanzibar, also works on Lake Nyasa, and in several other East African districts, with increasing success. In Bishops Steere, Smythies, and Maples it added distinguished names to the roll of Anglican heroes. The London Missionary Society's enter- prise on Lake Tanganyika has been disappointing, despite much patient and zealous labour. The German Missions in German East Africa are still in their infancy. Of the several Church Missionary Society Missions, Uganda has proved the most successful. In 1884 the first handful of converts had recently been baptized. There are now 30,000 baptized Christians, 2000 native teachers, 27 native clergymen, 800 churches, all sup- ported by the converts themselves ; and under Bishop Tucker's direction the Mission is branching out into the surrounding countries. The Eoman Mission in Uganda, begun about two years after the Anglican one, in 1901 reckoned 8000 baptized Christians and about 16,000 catechumens. It was for some years a French Mission only, the White Fathers of Algeria, but there is*~~

now an English bishop with English priests from St Joseph's Society at Mill Hill. The Jesuits work on the Zambezi, the White Fathers in the Great Lake region, and the French Con- gregation of the Holy Ghost and German Benedictines on the Zanzibar coast. The French Mission at Bagamoyo has long been famous for its excellent work.

Moslem States. — North Africa a,ni Egypt are among the hard Mahommedan fields, and so are the Turkish Empire, Arabia, and Persia. The American Presbyterians and Congregationalists have

the largest Protestant Missions in these lands, working, however, mainly for the enlightenment and education of the Oriental Christians. W^th the same object, though on different lines, the archbishop of Canterbury's Assyrian Mission seeks to influence the Nestorians. The Roman Catholics have extensive Missions in these countries, directed at winning adherents to the unity of the Holy See from the Oriental Churches, which are regarded as schismatic and heretical. In this enterprise there has been great advance in Egypt among the Copts, and in 1899 the Pope signalized ' ' the resurrection oE the Church of Alexandria " by appointing a Patriarch for Egypt, Libya, arid Nubia. Farther east, on the borders of Turkey and Persia, the Roman and Russo-Greek Churches compete for the ad- hesion of the Nestorians, Chaldeans, and Armenians. The Francis- cans, Dominicans, Lazarists, and Jesuits are engaged in all these works. Direct work among Mahommedans is done, though with small result, by the North African Mission (non-denominational) and the Church Missionary Society. The Egypt, Palestine, and Persia Missions of the latter society have been largely reinforced and extended since 1884, medical work and women's work being especially prominent. Four cities in southern Persia are now oc- cupied. Three Missions just touch the borders of Arabia, viz., the United Free Church of Scotland at Aden, founded by the late Hon. Ion Keith-Falconer, Arabic professor at

~~*Cambridge ; an American Presbyterian Mission on the Persian Gulf; and the Church Missionary Society's Mission at Baghdad.*~~

~~*India. — The India Missions illustrate, as no others do, the diversi- ties of missionary operations — bazaar preaching, village itineration, lectures and conversations, zenana visiting, vernacular schools, high schools and colleges, orphanages and boarding schools, mission hos- pitals and dispensaries, native church councils, and the quiet labour of linguistic translation. Almost all the great Protestant societies have their India Missions, and these have been largely reinforced. Perhaps the most notable feature is the extensive, development of the American agencies, particularly those of the Episcopal Metho- dists, who are rapidly spreading their organization over many parts of India ; but also those Of the Presbyterians, Congregationalists, and Baptists. In 1890 the total number of Protestant missionaries was 975. It is probably at least 1300 now, possibly 1-500. In the decade 1881-90 the Indian Protestant Christians increased from 417,000 to 569,000. The census of 1891 reported. 2,036,000 native Christians, 70 per cent, of whom belonged to the Roman and Syrian Churches. The Church of England claimed 10 per cent., and the other Protestant denominations 18 per cent. The Government figures fortheProtestantChristians were higher by 20,000 than those com- piled by the missionary societies, showing that the latter had not over-estimated their results. The census of 1901 gives the native Christians as 2,664,359, showing an increase in the decade since 1891 of 628,859. The total is thus made up : — Roman Catholics, 1,122,378; Syro-Romans, 322,583; Jacobite Syrians, 248,737; Angli- cans, 305,907 ; other Protestants, 561,078 ; miscellaneous and unspe- cified, 103,676. The Anglicans and other Protestants show a larger relative increase than the Roman Catholics. In 1891 the latter (including Syro-Romans) were 61 per cent, of the whole ; now they are 54 per cent. There is no better gauge of real missionary success than ordinations, as they indicate the highest result of Christian training. About 400 natives of India have received Anglican orders, almost all of them since 1850 ; and very many of those in Presbyterian and other orders have been at least their equals in education and capacity. The large majority of baptisms in India continue to be among the non-caste or " depressed " classes of the population, comprising both the non-Aryan tribes and the lower grades of Hindus ; but year by year there are numerous baptisms of Brahmans and other high-caste men, and even of the higher classes of Mahommedans. The missionary colleges and high schools have much increased in efficiency under the spur of Government examina- tions, and the moral results of the education they impart — even apart from conversions — are acknowledged on all hands. The great United Free Church College at Madras, under Dr W. Miller, confessedly stands in the front rank of all*~~

~~educational institutions. Female education is spreading, though still slowly, and chiefly among the native Christian population. The total number of women who had matriculated at the Indian Universities to 1899 was 1306. The majority were Europeans or Eurasians, but 395 were Indian women, and of these 367 were Christians, 27 Hindus, and one a Mahom- medan. Roman Catholicism has made considerable progress in India, particularly in the south, and since the famine of 1877-78 ; but a large proportion of its adherents are descendants of the converts of the 16th and 17th centuries. The Missiones Catholicae in]8'.»5 gave the total as 1,391,000, including Burma and Ceylon. The Illustrated Catholic Minsinns gives it as justover 2,000,000 in 1900. The ecclesiastical organization comprises a Papal delegate at Kandy, 7 archbishops, 21 bishops, and 7 vicars or prefects apostolic ; under whom are 800 European missionaries (French, English, German, Italian), 800 Goanese priests, and 700 Indian priests. The various societies and orders do not seem to be more united than the different Protestant denominations. The French Jesuits of Madura and~~

~~Tinnevelly complain bitterly (in L"Annee de Vllglise) of the oppo- sition of the Goanese as worse even than that of the pagans and Protestants. Prior to 1884 the archbishop of Goa's jurisdiction extended over the whole Roman Church in India, but in that year the Pope confined it to the Portuguese section, abolishing it in British and French territory. VAnnee de vMglise attributes the progress of the Protestant Missions to their extensive educational work, and urges the Roman missionaries to do likewise, pointing to the success of the Catholic colleges already established.~~

~~Indian Ocean. — Ceylon is ,a flourishing mission field. The Anglican Church there is now properly organized, with a constitu- tion of its own. Roman Catholics and Wesleyans are also strong. Mauritius is an outpost of India, the work being mainly among Indian coolies. In Madagascar the work of the London Missionary Society, which had been among the most successful in the world, and also the work of the Society for the Propagation of the Gospel, and of the Friends' and the Norwegian Missions, have suffered much since the French conquest of the island. Gradually, however, by accept- ing the situation, and adopting the French~~

~~*language in the schools, the missionaries have conciliated the new rulers, and many difficulties have been removed, while good has resulted from the advent of the French Protestant missionaries. The French Catholic Missions are on an extensive scale, reckoning 94,000 baptized and 267,000 cate- chumens. VAnnee de rjSglise complains of the favour shown to the Protestant Missions by the French officials, without which, it says, those missions would have disappeared in twenty years ; before the war the Protestants had two-thirds of the Christian adherents and the Catholics one-third, but the proportions have since the war been exactly reversed. In the Malay Archipelago the principal Missions are Dutch, and the external results are considerable. The Rhenish Society also works in the islands, especially in Sumatra. There is an Anglican bishop for the Straits Settlements and Borneo.*~~

~~*China. — The years since 1880 have been a period of extraordinary extension in the Protestant Missions in China. It was not until after the Chefoo Convention of 1876 that the great pioneer journeys of the China Inland Mission men carried them into almost all the eighteen provinces. In 1878 there were 473 Protestant missionaries in China ; in 1890 there were 1300 ; in 1900 there were 2800 (includ- ing wives) . Of these, 784 belonged to the China Inland Mission ; about the same number to other British societies (Church Mission- ary Society 189, London Missionary Society 120); about 930 to American societies ; and the rest to Continental and colonial asso- ciations, or unconnected. There are four English bishops and two American. Women missionaries are especially numerous, and they have travelled with propriety and with safety (all assertions to the contrary notwithstanding) into the remotest provinces. The converts who were communicants numbered 13,000 in 1878 ; in 1900 they were estimated to be 100,000. The excellence of the converts, upon the whole, is testified to by travellers who really know the case ; particularly by Mrs Bishop, who speaks of the "raw material" out of which they are fashioned as "the best stuff in Asia." China has been regarded as the most promising of all mission fields. The whole country has been open, even the long-closed and hostile province of HIunan ; the people generally friendly, notwithstanding occasional local riots and outrages, such as the massacre of a clergyman, eight ladies and two children, in Fuh-Kieu in 1 895 ; the mandarins often displaying singular*~~

fair- ness in dealing with inevitable difficulties, the Government of Peking becoming more and more liberal under the young Emperor, and English education beginning to attract the upper classes, awakened from their torpor by the issue of the war with Japan. But all this was changed in 1900 by the high-handed proceedings of the Dowager-Empress, the rise of the Boxer fanatics, the struggle at the Peking embassies, the terrible massacres of 133 Protestant and 49 Roman missionaries in the northern provinces, and the with- drawal of some hundreds more fro»4i the interior by the peremptory orders of the consuls. Much of the work in the south, however, went on without interruption, and even ^'■here the missionaries had withdrawn the Chinese mmisters and teachers continued their labours amongst their own countrymen. Since then the viceroys of the northern provinces have themselves invited the missionaries back. Roman Catholic Missions in China have a remarkable history from the 16th century downwards. The scientific and literary attainments of the Jesuit missionaries rendered them famous. The work is now carried on by ten societies or religion orders. There are 39 bishops and 71>0 European priests (600 of them French). There were 370 nntive priests in 1895. The Chinese Christians nunibevi'd 582,000 in that year, and are now reckoned as 661,000. VAiince de VEglixe says that the most prominent feature of the work is the large number of baptisms of tlie children of pagans. In the province of Szechuen alone 85,643 children of heatlien parents were baptized in 1899, a large proportion of them being baby girls thrown away by their mothers. In 1898 the Jesuits of the Shanghai mission baptized 41,400 pagan children " at the point of death." An important concession was obtained in 1899 by the French Minister at Peking, with a view to the more effective

protection of the Roman Missions. The bishops were declared "equal in rank to the viceroys and governors," and the priests "to the prefects of the first and second class" ; and their influence and authority were to correspond. The Anglican bishops agreed to decline these secular powers, as also did the heads of other Pro- testant Missions. It is alleged by some that the exercise of the powers gained by the lloman hierarchy was one

~~*cause of the Boxer outbreaks. Certainly their native adherents had their full share of persecution and massacre.*~~

~~*Japan. — Although effective missionary work on any scale was little more than ten years old in 1884, that was a period of high hopes for the early triumph of Christianity. The Japanese news- papers openly anticipated it, and some of them welcomed the prospect. When the first Parliament, or Diet, of Japan was elected in 1890, out of 300 representatives, all leading men, 14 were Christians ; and the president chosen for the Lower HOuse was a member of the Presbyterian Church. But the following decade witnessed a change. A strong tide of national pride and indepen- dence set in, and there was less readiness to adopt anything Western. Progress therefore became slower, and there were many apostasies, chiefly from some American Missions regarded as lacking in ortho- doxy. The bulk of the Protestant work all along has been Ameri- can and non-Episcopal, and of the 40,000 I'rotestant converts three-fourths belong to churches founded by American missionaries. These are rapidly assuming a more or less national character ; and similarly, the Anglican Missions have combined with the American Episcopal Church to form the Nippon Sei-Kokwai, or Japan Church, with a constitution and synod of its own, and 10,000 members ; though for the present it has foreign bishops, four Eng- lish and two American. The Russo-Greek Church has an import- ant Mission in Japan, under an able bishop. It has enrolled some 25,000 converts. The Roman Church, which achieved such extraor- dinary success in the 16th century, is again to the front, having 54,000 Christians, about half of whom are the descendants of the small remnant left after the dreadful persecutions of that period. It has an arch-bishop and three bishops, and it works largely through orphanages, hospitals, &o., which methods have not been adopted by Protestant Missions in Japan, as they have been in India. A remarkable article in the Illustrated Catholic Missions for October aad November 1900 states that while the Protestant Missions have gained many converts from among the educated classes, the Catholic Missions are most successful among the poor. The writer cites an intelligent Japanese as attributing this to the similarity of Roman and Buddhist ritual : educated men, despising the latter, are led to despise the former ; but he himself attributes it rather to the fact that Protestantism is the religion of the*~~

~~*nations which Japan regards as most progressive. Great Britain, Germany, and the United States. IIe considers, liowever, that the Catholic religion will eventually prevail, because it is embraced from " supernatural motives," while the Protestants, being swayed by private judgment, are more likely to become freethinkers.*~~

~~*The Rest of Eastern Asia. — Burma is part of British India, although very different in many ways, and Buddhist in religion. The Society for the Propagation of the Gospel, the American Baptists, and the Roman Catholics have large and fruitful Missions there. Slam is a field of the American Presbyterians, also with promising fruit. In French Indo-China the Roman Missions are very extensive, and have 700,000 converts, notwithstanding violent persecution prior to the French occupation, with terrible massacres of priests and native Christians. The Pope in 1900 "beatified" many of the martyrs. Mongolia has been the scene of pioneer efforts by the London Society. In Manchuria the Scottish and Irish Presbyterians have had remarkable success, while the Roman year- book says that, despite Russian influence, the people " are throwing themselves en masse into the Catholic Church." This field has been called the Uganda of Asia. Korea -, opened by Sir II. Parkes's treaty in 1883, has been occupied by American, Canadian, and Australian Presbyterians, and, since 1889, by the Society for the Propagation iif the Gospel. The Roman Catholics had Missions there before the opening, and nine missionaries were martyred in 1866, while now there are 36,000 adherents. The Philippine Islands have already attracted missionaries from the United States.*~~

~~*The South Seas. — The great archipelagos of the Pacific are old and very fruitful fields of the English Congregationalists and Wesleyans and the Scottish Presbyterians. The Anglican Mission in Melanesia has been already mentioned. The Sandwich Islands and Micronesia are American fields. In the whole Pacific the Roman Missions count 85,000 converts. A more modern field is jVew) Guinea. In the British part of that great island there are Missions of the London Society (1871), the Anglican Church of Australia (1892), and the Australian Methodists (1892) — all in the early stages of work.*~~

~~*North America. — Missions among the Red Indian tribes in the North-West Territories of both the United States and Canada have long been carried on by several societies. Bishop Whipple of Minnesota was justly called the Apostle of the Indians, so far as the*~~

~~*work of the American Episcopal Church was concerned. In the Canadian North-West the Church Missionary Society's Missions have reached many tribes, up to the shores of the Polar Sea, and made some thousands of oonveits. Even the wandering Eskinio have supplied a few hundred members to the Christian Church. The one bishopric of those territories in 1872 has since become eleven. The Roman Catholic missionaries also are scattered over these iuimense territories, and have a large number of Indian ad- herents. Besides the Oblates before mentioned, many are Jesuits from French Canada. The Russo-Greek Church has a-mission m Alaska, dating from the time when it was Russian territory. The total number of Indians in British North America is 99,000, of whom about 27,000 are still pagan, and the rest are about equally divided between the Protestant and Roman Catholic Missions.*~~

~~*Central America and West Indies. — American Missions are at work in Mexico and adjacent countries. In the islands the negro population has been reached by most of the larger British societies.*~~

~~*South America. — The South American Missionary Society, founded by the ill-fated Captain Allen Gardiner, has much ex- tended its work among the Indians of the interior of what has been well called " the Neglected Continent " ; and several American Missions are also at work. The Society for the Propagation of the Gospel has an important Mission in British Guiana. But there are numerous heathen tribes never yet reached. The Roman Church, which is dominant throughout the continent, has been engaged in serious struggles with the anti-religious tendencies of •the Republican governments, and L^Annee de VlSglise makes no mention of Missions among the Indians. In fact, the Pope in 1897 was obliged to send a severe rebuke to the clergy for then- lack of consistency and zeal.*~~

~~*The Christian Church bases its missionary enterprise upon the command of its Founder, and regards the duty as just the same whether the results*~~

be large or small. It appeals to common sense, saying in ^^",q° effect, "If it be a fact that a Divine Person came into the world to bless mankind, all men ought to know it, and have a right to know it. However much or (if you will) little a Buddhist or a Moslem may need to know of Christ, he certainly has a claim to be told of Him. The responsibility, if there be any, of believing, rests with the individual told ; the responsibility of tell- ing him rests with the Christian Church." On this view of the matter, results, however desirable, are no certain test of a Mission doing its work. A Mission in Persia, with its handful of converts, has, on this view, as much right to support and appreciation as a Mission in southern India with its tens of thousands. Again, on the hypothe- sis that Christianity is true, the statistics at a particular period are no test of success at all. Por in them the dead are not counted ; and the converts who are already dead are — at least in respect of individual salvation — ^the surest of results. If, however, we are to take statistical returns for what they are worth, it is estimated that the Christians in heathen lands gathered by Protestant Missions probably amount to four millions, and, as above stated, a similar total may be ascribed to Roman Catholic Missions, making eight millions in all. This, however, includes adherents still under instruction for baptism, and their children. The inner circle of communicant members is not more than one-third of the total.

But it has to be carefully borne in mind that Missions are still — to the reproach of the Christian Church on the above hypothesis — in their infancy. In most of the South Sea Islands, and among the Red Indians of North America, the work of evangelization, i.e., of proclaiming the Gospel, may be said to have been fairly completed, but in the great continents of Africa and Asia it is as yet in an early stage. Meanwhile, it is generally acknow- ledged that a vast preparatory influence is being exercised. In effecting the mighty social changes in India since 1850, Lord Lawrence said that Christian Missions had done more than all other agencies combined. The forward move- ments in China (prior to the Boxer outbreaks) were largely the direct result of missionary influence. In Japan, lead- ing men fully recognize the importance of that influence.

~~*MISSISSIPPI*~~

~~*In Africa, geographical exploration, commercial enterprise, and the extension of European power, have followed in the wake of missionary pioneers. While it is true that very diverse opinions are held concerning Missions, it is indis- putable that the most favourable testimonies come from those who have really taken the most pains to examine and understand their work. The one discouraging feature, from the Christian point of view, is the backwardness of Christendom in its great enterprise. If the Churches did their foreign work with the same energy which they throw into their home work, the results would be very different.*~~

~~*Statistics of Protestant Missions. — A very elaborate volume of Protestant missionary statistics at tiie end of the 19tti century has been compiled by Dr Dennis of America, and published in Great Britain by Messrs Oliphant, Anderson, and Ferrier. We take the following condensed figures from its tables : —*~~

~~*There are 558 missionary societies, viz : — Engaged in direct evangelization Indirectly aiding the worlc Devoted to specific branches of the worls: .*~~

~~*294 127 137*~~

~~*558*~~

~~*These societies have their headquarters in the following parts of the world :—*~~

~~*Great Britain and Ireland*~~

~~*European Continent*~~

~~*American Continents*~~

~~*Asia*~~

~~*Africa*~~

~~*Australasia and Oceania*~~

~~*154*~~

~~*82*~~

~~*128*~~

~~*117*~~

~~*42*~~

~~*35*~~

~~*558*~~

~~*The total number of missionaries is stated to be 17,974, but the figure needs considerable reduction, and a more careful analysis gives the following approximate results : —*~~

~~*Ordained 4,800*~~

~~*Physicians : Men . . ... 480*~~

~~*,, Women . . . 220*~~

~~*Laymen not physicians 2,000*~~

~~*Unmarried women not physicians . . 3,600*~~

~~*Married women not physicians . . . 4,400*~~

~~*15,500*~~

~~*The results of Missions, as represented by living native Christians, are thus given : —*~~

~~*Christian community — including communicants*~~

~~*and non-communicants of all ages*~~

~~*. 4,514,592*~~

~~*Of whom are communicants*~~

~~*1,531,889*~~

~~*Increase of communicants in one year*~~

~~*. 112,152*~~

~~*The following educational statistics are given :—*~~

~~*Missionary universities and colleges .*~~

~~*94*~~

~~*Theological and training schools*~~

~~*375*~~

~~*Boarding and high schools, &c.*~~

~~*879*~~

~~*Industrial training institutions*~~

~~*179*~~

~~*Medical schools ...*~~

~~*67*~~

~~*Elementary day schools ....*~~

~~*18,742*~~

~~*Pupils in the higher institutions-*~~

~~*Males*~~

~~*97,667*~~

~~*Females ....*~~

~~*42,908*~~

~~*Total pupils — Males . ...*~~

~~*. 716,741*~~

~~*Females*~~

~~*. 332,980*~~

~~*Philanthropic institutions : —*~~

~~*Orphanages*~~

~~*247*~~

~~*Leper homes, &c. . . .*~~

~~*100*~~

~~*Homes for blind or deaf mutes*~~

~~*30*~~

~~*Miscellaneous ....*~~

~~*l.”>6*~~

~~*Guilds and associations*~~

~~*118*~~

~~*Medical statistics : —*~~

~~*Mission hospitals*~~

~~*379*~~

~~*,, dispensaries ....*~~

~~*783*~~

~~*Hospital in-patients, in year*~~

~~*85,169*~~

~~*Individual patients, in year*~~

~~*. 2,347,780*~~

~~*Total treatments, in year ....*~~

~~*. 6,442,427*~~

~~*Literary statistics : —*~~

~~*Missionary Bible translations^*~~

~~*Of the whole Bible ....*~~

~~*99*~~

~~*Of the New Testament . . . '.*~~

~~*121*~~

~~*Of portions*~~

~~*2;i(j*~~

~~*Carried forward*~~

~~*450*~~

~~*Brought forward Add transliteral versions*~~

~~*Deduct obsolete versions .... Versions in use .....*~~

~~*Mission publishing houses and printing-presses Periodicals issued by missionaries*~~

~~*456 20*~~

~~*476 40*~~

~~*436*~~

~~*159 379*~~

~~*Authorities. — The following are a few of the books recom- mended : J. S. Dennis. Centennial Survey of Foreign Missions. Edinburgh, 1902. — A. T. Pierson. New Acts of the Apostles. New York, 1894. — George Smith. Short History of Christian Missions. Edinburgh, 1897. — J. Liggins. Great Value and Success of Foreign Missions. New York, 1894. — Gestav War neck. Modern Missions and Culture. New Edition translated from the German by T. Smith. Edinburgh, 1882.— J. S. Dennis. Christian Missions and Social Progress. Edinburgh, 1897. — A. C. TiiojipsoN. Protestant Missions : their Pise and Early Progress. New York, 1894. — Gustav Warneck. Outline of a History of Protestant Missions. Translated by G. Eobson. Edinburgh, 1901. — Edward Storrow. Protestant Missions in Pagan Lands. London, 1888. — J. A. Graham. Missionary Expansion of the Eeformed Church. London, 1898. — Bishop A. Barry. Ecclesi- astical Expansion of England in the Growth of the Anglican Com- munion. Hulsean Lectures 1894—95. London, 1895. — A Hundred Years of Missions ; or, the Story of Progress since Carey" s Begin- ning. New York and London, 1895. — K. Waedlaw Thompson- and A. N. Johnson. British Foreign Missions, 18S7-97. London, 1899. — F. P. Noble. Bedemption of Africa: A Story of Civilization, 2 vols. New York and Chicago, 1899. — R. N. Cust. Africa Bediviva. London, 1891. — D. M. Thornton. Africa Waiting: or, the Problem of Africans Evangelization. London, 1898. — George Smith. Conversion of India from Pantaenus to the Present Time. London, 1893.*~~

— E. M. Bliss (Ed.). Encyclopoedia of Missions. New York, 1891. — E. Hodder. Conquests of the Cross, 3 vols. London, 1893. — Missionary Year-Book for 1889. London, E.T.S. — James John- ston (Ed.). Beport of Centenary Conference on the Protestant Missions of the World, 1888. London, 1888.— G. A. Spottis- woode (Ed.). Official Beport of the Missionary Conference of the Anglican Communion, 1894. London, 1894. — " Make Jesus King." Report of the Student Volunteer Missionary Union Conference at Liverpool, 1897. London. — Students and the Missionary Problem. London, 1899. — Eugene Stock. History of the Church Missionary Society, 3 vols. London, 1899. — The Church Missionary Atlas. Eighth edition. London, 1896.— C. F. Pasooe. Two Hundred Years of the S.P.G., 1701-1900. London, 1901.— H. W. Tucker. English Church in other Lands. London, 1886. — Bishop Montgomery. Foreign Missions. London, 1902.— A. E. M. Anderson Morshead. History of the Universities" Mission to Central Africa, 1869-96. London, 1897. — J. B. Myers (Ed.). Centenary Volume of the Baptist Missionai-y Society, 179S-189S. London, 1892.— R. Lovett. History of the London Missionary Society. 2 vols. London, 1899.— J. M. Reid, &c. Missions and Missionary Society of the Methodist Episcopal Church. New York, 1896. — Ch. Egremont. LWnnee de Vhglise [Roman Catholic] 28 ann^e, 1899. Paris and London. — Missiones Catholicae Cura S. Congregationis de Propaganda Fide descriptae. [Roman Catholic] Rome (biennial). — Societe iiEs Missions Etrang{:i!es [Roman Catholic]. Compte Bendu des 2'ravaux de 1899. Paris, 1900. Ce. st.')

Mississippi, one of the southern states of the American Union, situated south of the state of Tennessee, and immediately east of the Mississippi river. It is separ- ated from Tennessee by 35° N. approximately. The 31st parallel forms its southern boundary from the Mississippi river to the I'earl, and the Gulf of Mexico marks its limits from the mouth of thia river to the arbitrary line which separates Mississippi from the state of Alabama on the east. The islands within 6 leagues of the coast are included, and the total land area of the state is 46,383 square miles. The state was organized in 1817. Popnlalion.—XXie census figures have been as follows :—

Toul.

~~*White.*~~

~~*Coloured.*~~

~~*Density per square mile.*~~

~~*1880 1890 1900*~~

~~*1,131,592 1,289,000 1,551,270*~~

~~*479,,371 544,851 642,900*~~

~~*652,221 744,749 908,3701*~~

~~*24-42*~~

~~*27-57 3;! -48*~~

~~*1 Including a small number of Chinese and Indians.*~~

~~*MISSISSIPPI*~~

~~*781*~~

~~*The rate of increase from 1890 to 1900 was 20-3 per cent., as com- pared with 14-0 per cent, for the preceding decade. The census of 1900 showed 781,451 males and 769,819 females, 1,543,289 native-born and 7981 foreign-bom inhabitants. The proportion of whites to the total in 18,80 was -423, in 1890 -424, and in 1900 ■415. There are about 2200 Indians of the Choctaw tribe still remaining scattered through the central parts of the state. In 1900 there were seven cities and towns having a population of more than 5000 inhabitants each, and an aggregate population of 68,503, and of these only three had a population of over 8000. The urban population was therefore 2-6 per cent, of the total number of inhabitants. The population of the chief cities was, in 1900, Vioksburg, 14,834, Meridian, 14,060, Natchez, 12,210. The population has grown in the last decade of the 19th century chiefly by natural increase.*~~

~~*Education. — Interest in education has been greatly increased, and the public schools have made decided advances. The total number of persons of school age, including all between the ages of 5 and 21 years, in 1900 was 588,275. Of these 167,178 were white and 192,368 coloured. In 1900-01, 387,488 pupils were enrolled in the public schools; The total number of teachers employed was 8515, 5147 white and 3368 coloured. The cost of maintaining these schools, not including the higher Institutions, was $1,472,432. The length of the public school term averages 4^ months. Separate schools of all grades are maintained for the two races, affording equal facilities. The State University, near Oxford, has an academic department, and schools of law, engineering, &o. There are 20 instructors and 300 students. Its endowment amounts to $750,000, besides equipment worth $300,000. Its annual income is $50,000. Its endowment comes from the sale of lands given by Congress in trust to the legislature of the state for this use. The State Agricultural College has revenues amounting to $55,000, about 20 instructors, and 300 students. The Industrial Institute and College for Girls has an income of $30,000, and 400 students. These institutions are for white youth. There are corresponding institutions for coloured youth maintained by the state. In all slate institutions tuition is free. The number of private schools and endowed colleges, other than state, is small.*~~ •

~~*Charitable and Penal Institutions. — The state supports two hospitals for the insane, one at Jackson, with 900 patients, and one at Meridian, with 312. It maintains two hospitals, one at Vioksburg and one at Natchez, and schools for the blind and for deaf mutes at Jackson. All of these have liberal provision for support. The state has adopted the policy of keeping the convicts condemned to the state prison at work on farms leased or owned by the state. Under this system abuses have been avoided, eminently humane treatment has been secured, and convict labour in agriculture, chiefly in the raising of cotton, has been quite profitable. The inanagement is under a board of control, consist- ing of the governor of the state, the attorney-general, and the three railroad commissioners.*~~

~~*Eeligion. — -The chief religious denominations are branches of the Methodists, Baptists, and Presbyterians, having numerical strength in the order named. The population is largely religious.*~~

~~*Agriculture. — Agriculture is the occupation of a very large pro- portion of the people. Cotton is the chief market crop. The production amounts to about 1,000,000 bales of 500 lb each, the value of which is from $40,000,000 to $50,000,000. The state grows enough grain and hay for domestic use. Stock-raising, particularly the raising of cattle, is an important and growing industry. The southern third part of the state is covered with a heavy growth of yellow pine, representing a value of $250,000,000. The useful timber of other varieties aggregates in value more than this amount. Clays and marls are mined to a small extent. Borings to a depth of from 200 to 500 feet in nearly every county yield an abundance of pure water.*~~

~~*Manufactures. — The following table shows the manufacturing and mechanical industries in 1890 and 1900, with the percentage of increase for the decade : —*~~

~~*1890.*~~

~~*1900.*~~

~~*Percentage of Increase.*~~

~~*Number of establish- ments*~~

~~*riflTiital*~~

~~*1,698 $14,896,884*~~

~~*4,772 $35,807,419*~~

~~*26,418*~~

~~*$7,471,886*~~

~~*$21,692,092*~~

~~*$40,431,386*~~

~~*181-0 140-4*~~

~~82-6~~

~~78-3~~

~~115-5~~

~~116-1~~

~~Wage-earners, average number .... Total wages .... Cost of material used Value of products . .~~

~~14,465~~

~~$4,191,754 $10,064,897 $18,705,834~~

~~The manufacture of lumber, of cotton goods, and of cotton-seed products are the chief industries, and are profitable.~~

~~Railways. — The chief railway lines are the Illinois Central and its branches, the Mobile and Ohio, the Southern, and the Louis- ville and Nashville. The total mileage is 2681. These lines repre-~~

~~sent a value of about $10,000 per mile. The maritime interests are confined to fishing boats on the coast, where oysters are taken in great quantity for packing. The commercial business is trans- acted largely through cities in adjoining states, chiefly New Orleans, Mobile, and Memphis.~~

~~Internal Improvements. — Under state management a complete system of embankments, or levees, has been completed along the east bank of the Mississippi river from the northern boundary of the state southwards to the vicinity of Vioksburg. These have in the main been efficient in preventing the river from overflowing the rich delta lands situated between the Mississippi and the Yazoo, thus rendering available for agriculture thousands of acres of the most fertile soil. The new capitol building at Jackson will cost at least $1,000,000.~~

~~Finances.' — The total valuation of property, from assessment rolls, was in 1899 : Realty, $113,210,931 ; personal property, $74,606,004. The state~~

~~debt was .$2,666,048, of which .?l,03q,946 is payable, and the balance, $1,635,102, represents trust funds for educational purposes, derived from the sale of lands granted by Congress for these purposes.~~

~~Banks. — There are 12 national banks ; aggregate capital, $780,000; deposits, $2,725,391. There are 107 private banks, with capital amounting to $646,584 and deposits amounting to $11,349,618. There are nine building and loan associations.~~

~~History. — Since 1880, and especially during the last de(jade of the 19th century, the attention of the people has been given to the intellectual, moral, and material advancement of the state. The white race has been dominant in politics since 1875. The legislation passed since that time marks a distinct advance and betterment for all classes. High licence and prohibitory legislation make the sale of intoxicants illegal in all counties except fourteen. The law regulating distribution of school funds gives decided advantages to the counties where blacks largely predominate, and allows in those counties a term of from seven to nine months. The white population pays nine-tenths of the school tax. Railways are required to furnish separate and equally good accommodation for white and coloured passengers. Legislation amply protects the labouring classes in their rights. Liberal inducements in the way of exemption from taxation are offered to investments in manufactures, and full protection is afforded to vested capital. The Constitutional Convention of 1890 changed the organic law in several important particulars. Elections are by secret ballot, each voter marking without assistance the names of the persons voted for. "Every male inhabitant of this state, except idiots, insane persons, and Indians not taxed, who is a citizen of the United States, twenty-one years old and upwards, who has resided in this state two years, and one year in the election district, or in the incorporated city or town in which he offers to vote, and who is duly registered as provided in this article, and who has never been convicted of bribery, burglary, theft, arson, obtaining money or goods under false pretences, perjury, forgery, embezzlement, or bigamy, and who has paid, on or before the 1st day of February of the year in which he shall offer to vote, all taxes which may have been legally required of him, and which he has had an opportunity of paying according to law, for the two preceding years, and who shall~~

~~*produce to the officers holding the election satisfactory evidence that he has paid said taxes, is declared to be a qualified elector ; but any minister of the Gospel in charge of an organized church shall be entitled to vote after six months' residence in the election district, if otherwise qualified." (Constitution of 1890, sec. 241.) It is also provided that a uniform poll tax of two dollars, to be used solely in aid of the common schools, shall be imposed on every male inhabitant between the ages of twenty- one and sixty years. Electors must be duly registered at least four months before any election in which they may offer to vote, and "every elector shall, in addition to the foregoing qualifications, be able to read any section of the Constitution of this state ; or he shall be able to understand the same when read to him, or give a reasonable interpretation thereof. ' ' Elections for state and county officers occur every four years. The governor, state treasurer, state auditor, county sheriffs and treasurers, and certain other ofiicers are not eligible for immediate re-election. Corporations can be formed under general laws only. Property rights of married women are fully protected. While the new qualifications for voting have barred from the polls many illiterates of both races, the state has since 1880 been offering equal^ school facilities to all, and ample oppor- tunity for becoming qualified. The careful restrictions placed upon the use of the ballot have excluded chiefly unworthy and inconsiderate voters. These laws have evidently allayed political excitement, and promoted, among the labouring classes attention to private business and the means afforded for education. The accumulation of property by these classes has been greater during the last decade of the 19th century than during any equal preceding period. This legislation has gone far towards solving the problem of the satisfactory co-existence of the white and black races in the state. (ii_ 3_ J, –*~~

~~*782*~~

~~*MISSISSIPPI RIVER*~~

~~*Mississippi River. — A general account of the Mississippi river and of its valley is given in the earlier volumes (ninth edition) of this work (vol. xvi. pp. 518-521). We are here concerned with the history of the improve- ment works which have been carried out in it since 1880.*~~

The distance from St Paul to St Louis, by the river, is 698 miles. On this portion an attempt is being made to obtain at least i} feet of water at all stages, from St Paul to the Missouri river, and 6 feet thence to St Louis. Below St Paul the low-water depths were sometimes not more than 2 feet. The usual methods for regulating rivers are followed: lateral channels are closed, excessive widths are reduced by spurs and closing side channels, caving banks are protected, and dredging is used. At Des Moines a ship canal, with locks, has been built to avoid the rapids, and at Eock Island a channel has been cut in the rock. From St Louis to Cairo, at the mouth of the Ohio, the Mississippi carries all the sediment from the Missouri, at the mouth of which it changes from a clear to a muddy stream. In contraction works here, accord- ingly, hurdles of piles and brush are used instead of the solid spurs of the upper river. They have had surprising results in building up new banks. Caving banks have been protected by mattresses similar to those used on the lower river, but, partly on account of lesser depths of water, much lighter mattresses can be used. Two pump- ing dredges with a capacity of 1000 cubic yards of sand per hour have been built, with which it is hoped to main- tain low- water depths ^f 6 feet instead of 3|- or 4 feet. The depth ultimately desired is 8 feet. Above Cairo there had been expended, under the present projects for improving the river, about $17,000,00b up to 1898.

Of the tributaries to the Mississippi, the Ohio is commercially the most important, as it carries coal from Pittsburg to all points _ ^.. below. Works for its improvement, on the same ’”■ general principles as those for the Upper Mississippi, have been going on for many years, the aim being to get 6 feet of water at low stages. This is impracticable immediately below Pittsburg (1000 miles above the mouth of the Ohio), on account of the small low-water flow. Accordingly locks and movable dams are being constructed to give navigable pools during low water. Six have been completed or are in course of construction, and Congress has required an estimate for twelve more, carrying the system down to Marietta. Each lock and dam costs about $800,000. The Lower Missouri river has a slope nearly double Mitsoarl ^^^^ °^ ^^^ Mississippi below Cairo ; its low-water flow may sink to j- part of its high-water flow, or to 15,000 cubic feet per second : its average sediment for one year was j part by weight of the water, rising to a maximum of ^^ part. A good deal of money has been spent in attempting

to im- prove it by works of regulation, but, as might be expected in a river of such characteristics, with limited success.

The principal expenditure for the improvement of the Mississippi river below Cairo has been since 1879 under the control of the Mississippi River Commission, the jurisdiction of which extends from Cairo to the head of the passes, a distance of 1060 miles by the river. The plan adopted by the commission was that usually followed on such rivers, namely, to protect the banks when caving existed or was to be feared, and to build contracting works when the widths exceeded about 3500 feet and the low-water navigation was difficult. The low-water depths were sometimes 4^- or 5 feet ; it was proposed to obtain 10. In addition the use of levees was adopted as an important part of " any general and systematic plan for the improve- ment of the river and the prevention of destructive floods."

In protecting the banks, mattresses of brush or small trees, woven like basket-work, were sunk on the portion of the bank at the time Mattresses ^^'^^^ water, by throwing rubble stone upon them, an ■ excess of stone being used. A common size of mattress was 800 feet long, counted along the bank, by 260 feet wide. Sometimes a width of 300 feet was used, and lengths have reached 2000 feet. The depth of water was often from 00 to 100 teet. At first these mats were light structures, but the loss of

large quantities of bank protection by the caving of the bank behind them, or by scour at their channel edges, forced the com- mission steadily to increase the thickness and strength of the mattress, so that the cost of the linear foot of bank protection, measured along the bank, rose from .$8 or $10 to $30 in the later work. The structure of the mattress was also changed, so that its longitudinal strength became that of the strands of wires which replaced the binding poles formerly used, and its thickness that of the fascines which replaced the brush. Even in the stronger types of bank protection there have been failures, and ther per- manence of the present type is not fully assured. At first the portion of bank out of water was graded to a gentle slope and then covered by a mattress built in place ; later, rubble stone was used instead, and was much more satisfactory. When stone is costly, as on the lower river, concrete slabs have been experi- mented with, both for the upper bank and for sinking mattresses.

~~*The contraction works adopted were systems of spurs or pile dykes, running out from the shore nearly to the line of the pro- posed channel. Kach dyke consisted of from one to f ^, four parallel rows of piles, the interval between rows “”” “‘O”- being about 20 feet, and between piles in a row 8 or 10 feet. The piles and rows were strongly braced and tied together, and in many cases brush was woven into the upper row, forming a hurdle, in order further to diminish the velocity of the water below the spur. At Baleshed, 540 miles below Cairo, an area of 700 acres was built up 20 feet in a, few years by such spurs. Similar dykes were used to close waterways behind islands. This system of contraction works and bank protection was applied to two stretches of the river. The first, at Plum Point, 165 miles below Cairo, was 18 miles long, and was carried well towards com- pletion, the navigable depths being increased from a minimum of 5 feet to 9 or 10 feet in ordinary seasons. The second, at Lake Providence, 542 miles below Cairo, was 19 miles long, and was not nearly completed. At one time a prohibition by Congress of the use of bank revetment, followed by a lack of funds, led to a large loss of work caused by changes in the river. By 1893 there had been expended at Plum Point $3,600,000, and at Lake Providence $3,200,000. It was evident that the cost of the proposed improve- ment, which had been estimated at $33,000,000 by a majority of the commission in 1881, would really te several times that amount, and that the works would require heavy expense for their maintenance and many years for their execution. Naviga- tion interests demanded more speedy relief.*~~

~~*The commission then began building powerful pumping dredges, and in 1900 had nine in operation. Centrifugal pumps are used, the suction pipes being at the tow and the discharge at „^ the stern through a line of pipes about 1000 feet long, ^**’*~~

~~*supported on pontoons. Water jets or cutters stir up the material to be dredged before it enters the suction pipes. The largest of the dredges had two entirely independent pumps, each having discharge pipes 33 inches in diameter. Its engines had 2000 horse-powtr. During test trials its average delivery of sand was 4920 cubic yards per hour. It cost $217,000. The later dredges, of a more conven- ient size, have a capacity of about 1000 cubic yards of sand per hour, the velocity in the 32- to 34-inch discharge*~~

pipes being from 10 to 15 feet per second. They cost from $86,000 to $120,000, and their working during a low-water season costs about $20,000. These dredges begin work on a bar where trouble is feared before the river reaches its lowest stage, and make a cut through it. A common cut is 2000 feet long by 250 feet wide, and 3 or 4 feet deep. They have rendered much service to navigation, and the aim now is to maintain with them low-water navigable depths of 9 feet.

In 1882 occurred one of the greatest floods known on the Mississippi, and extensive measurements of it were made. A maximum flood of 1,900,000 cubic feet per second crossed the latitude of Cairo. Much of it escaped into Levees. the bottom lands, which are below the level of great floods, and flowed through them to rejoin the river below. The flovf m the river proper at Lake Providence, 642 miles below Cairo, was thus reduced to about 1,000,000 feet per second, while if the river liad been confined by levees, the flow between tliein would have been double, or about 2,000,000 cubic feet per second. The volume of the levees in 1882 was about 33,000,000 cubic yards, and by 30th June 1899 had been increased to about 137,000",000 cubic yards, of which the United States has built about one-half, and has ex- pended on them about $14,000,000. The length of levees is about 1100 miles, and, with the exception of a .anp of about 50 miles of broken le\ees on the west bank below Memphis, is continuous, save where interrupted by tributaries or by high lands, from New Madrid, or 80 miles below Cairo, to Fort Jaoks'on, 1039 miles below Cairo. The width of the interval between levees on the opposite banks of the river varies greatly ; in many places the levees are built much nearer the normal margin of the river than is consist- ent with keeping the flood heights'as low as possible. This has arisen from two causes : firstly," to give protection to lands already cultivated, which lie usually near the bank of the river ; secondly,

to avoid the lower ground, -which, owing to the peculiar formation, is found as one goes back from the river. Another ill result of this nearness of the levees to the bank of the river is the loss of levees by caving, which

was over 4,000,000 cubic yards in 1898-99, and can only be prevented by bank protection costing $150,000 per mile, to protect a levee perhaps 16 feet high costing about $30,000 per mile. The levees have top widths of 8 feet, side slopes of ^, and banquettes when their heights exceed about 10 feet. The grades of the levees are usually 3 feet above the highest water, and have to be raised from year to year as greater confinement of water gives greater flood heights. When this system is completed, there will probably be hundreds of miles of levee with heights exceeding 14 feet. In 1883 a majority of the Mississippi River Commission estimated the cost of a system of levees from Com- merce, Missouri, 38 miles above Cairo, to Fort Jackson, 1039 miles below Cairo, at $11,443,000. In 1890, after about $28,000,000 had been spent on levees by the United States and by the local authorities, the commission submitted an estimate for additional work on levees, amounting to 124,000,000 cubic yards and costing $22,000,000. The effect of the levees has been to increase flood heights. A conspicuous example is that on Lake Providence, where the maximum gauge heights since 1879 have risen from 38-3 feet in 1882 to 44-5 in 1897, or by 6-2 feet. Captain Newcomer, the local engineer, estimates that perfect confinement of the water will increase this maximum gauge read- ing to 49- 5, a total increase of 11-2 feet. Though the Mississippi River Commission was forbidden by Congress to build levees to protect lands from overflow, a majority of its members believed them useful for the purpose of navigation improvement. Since 1882 no less than .$28,000,000 has been expended on levees. This enormous expenditure has effected no sensible improvement in the navigation of the river at low stages, and at other stages no im- provement was needed for the purposes of navigation. About $37,000,000 has been appropriated for the commission work below Cairo since 1879.

In 1879 Mr J. B. Eads, the contractor for the South Pass jetties, obtained a channel through the pass having a depth of „ . p 30 feet, the original depth on the bar having been 9 ou ass. jggj.^ ^^^ ^.j^j^g earned his final payment for the jetties. HIe used essentially the plan of a Government board of engineers, on which Congress gave him the contract, without competition. HIs original contract was for a channel 30 feet deep and 350 feet wide, but Congress subsequently removed this restriction on the width without making a corresponding reduction in the price. The works were

~~required to be " permanent works by which said channel maybe maintained for all time after their completion." He was entitled by law to $100,000 per annum for maintenance of a channel 26 feet deep and 200 feet wide through the jetties, and a central depth of 30 feet, and of 26 feet deep through the pass, until 1901. By the aid of dredging, this channel has thus far, with interruptions, been maintained ; but these interruptions were for 174 days In 1897, and 63 days in 1898. In 1891 a crevasse occurred about 2 miles from tlie head of South Pass, from Pass k 1' Outre to the gulf, and gradually increased until it was 2000 feet wide in 1894. The contractor's heirs made re- peated efforts to close it, but in vain, and now the United States has undertaken the work. This crevasse, by lowering the water surface at the head of South Pass, diminished the flow through the pass, which has decreased somewhat in size. At the sea end of the jetties delta-building has gone on, so that dredging has been needed there. Of the curves of depth at the sea end of the jetties, the 60, 70, 80, 90, and 100 feet curves each advanced, between 1877 and 1897, from 92 to 108 feet annually, and the 40 and 50 feet curves advanced respectively about 52 and 62 feet. The difficulties in the South Pass have led Congress to require a plan to be made for improving the South-West Pass, which is much longer, and where the delta-advance at the sea end is much more rapid.~~

~~See the Annual Reports of the Chief of Engineers, U.S.A., since 1879. (c. B. C.)~~

~~Missolonghi or Mesolonghi, a city of Greece, on the north side of the Gulf of Patras, about 7 miles from the coast. It is the chief town of the province of Acarnania and iEtolia. Population about 10,000.~~

~~Missoula, a city of Montana, U.S.A., capital of Missoula county, on Clark fork of the Columbia river, at the mouth of the Bitter Eoot, in the western part of the state, at an altitude of 3197 feet. It is on the main line of the Northern Pacific railway, at the junction of a branch from the Bitter Eoot valley, and is situated in the level valley, on which the town is regularly laid out. It is the seat of the University of Montana, a~~

~~non-sectarian institution, founded in 1895. In 1899 this had 12 instructors and was attended by 208 students, of whom 108 were women.~~

~~*Near it is the United States military post of Fort Missoula. Population (1890), 3426 ; (1900), 4366, of whom 1020 were foreign-born and o4 were negroes.*~~

~~*Missouri, a central state of the American Union, lying between about 36° and 40° 30' N. and 89° 2' and 95° 44' W. Its population in 1890 was 2,679,184, or 39 persons to the square mile. The native-born population in 1890 was 2,444,315 ; the foreign-born, 234,869. 51-7 per cent, of the population were males. The white pop- ulation by the same census was 2,528,458, and the coloured, 150,726. There were, in 1890, 705,718 persons entitled to the privilege of voting. The population of the state in 1900 was 3,106,665, giving a density of 45-2 to the square mile, and was made up as follows : — 1,595,710 (51-4 per cent.) were males and 1,510,955 (48-6 per cent.) females ; 2,890,286 native-born and 216,379 (7-0 per cent.) foreign-born ; 2,944,843 were white and 161,822 (5-2 per cent.) coloured, of whom 161,234 were negroes, 449 ('hinese, 9 Japanese, and 130 Indians. The death-rate in 1900 was about 12-25 per cent. The urban population, classing as such all persons in cities of 8000 inhab- itants or over, was 955,563, or 30-8 per cent, of the total population, as against 26-3 per cent, in 1890. St Louis, the chief city, had in 1880 a population of 350,518 ; in 1890, 451,770 ; and in 1900, 675,238. Kansas City, on the western border, next in importance, had in 1880 a population of 55,785 ; in 1890, 132,716 ; in 1900, 163,752. St Joseph, in the north-west, had in 1880, 32,431 ; in 1890, 62,324 ; in 1900, 102,979. Hannibal, in the north- east, had in 1880, 11,074 ; in 1890, 12,857 ; in 1900, 12,780. Springfield, a thriving railway centre in the south-west, had in 1880, 6522; in 1890, 21,860; in 1900, 23,267. Joplin, in the extreme south-west, in the centre of a lead and zinc mining district, had in 1880, 7038 ; in 1890, 9943 ; and in 1900, 26,023.*~~

~~*AgrictUure. — All the chief cereals, all varieties of fruits, and all varieties of grass are found in almndance. Horses and mnles are raised, and the mule market of St Louis is visited by purchasers from every part of the world. Por 1899 the cereal products were reported to be as follows : corn, 162,915,064 bushels ; wheat, 11,398,702 bushels ; and oats, 20,709,000 bushels. A large crop of tobacco is also raised, that for 1899 being estimated at 7,580,000 lb. The fruit crop for 1899 was valued at*~~

~~$19,500,000. The total num- ber of farms in the state in 1890 was 2.38,043, with an aggregate acreage of 30,780,290, and a valuation of $109,751,024.~~

~~Minerals. — Coal and iron are found in large quantities, as also are clays for fire-brick, marbles, limestone, and sandstone. The most important minerals of late years have been the immense deposits of lead and zinc in the southern and south-eastern sections, the richest of which lie in the counties of Jasper and St Frangois. The output for the year ending 30th June 1899 was 70,829 tons of lead ore, and 181,430 tons of zinc ore, the total valuation of both being $9,120,861. A large increase is made yearly in the lead and zinc product, especially from the south-western part of the state, and the area of mining lands is being greatly extended.~~

~~Commerce.- — The commerce centres at St Louis in the east and Kansas City in the west. Trade with the south-west and with Mexico has made great strides since 1880. Foreign shipments of flour and grain by railways and river during 1899 were : flour, 743,373 barrels ; wheat, 1,006,840 bushels ; corn, 12,285,515 bushels ; oats, 860,697 bushels. The total amount of freight re- ceived at St Louis by rail and river in 1899 was 15,272,482 tons, and the total amount shipped was 8,469,598 tons. The shipments of cotton for 1899 showed 377,513 bales exported, while 612,446 bales went to various parts of the United States. The total value of the gross receipts of cotton for the year was about $15,000,000. Among other receipts at the St Louis market for 1899 were : lumber and logs, 1,148,124,000 feet ; wool, 28,491,625 ft ; sugar, 204,322,225 R) ; coal, 109,067,875 bushels ; butter, 13,729,188 lb.~~

~~Banks. — There were, in 1898, 494 banks incorporated under the state law. There were also 85 private banks and 70 national banks. The total resources of the banks in the state amounted to $117,009,314, distributed as follows : loans and discounts, $76,161,897; overdrafts by solvent customers, §771,803 ; U.S. bonds and other bonds and stocks, $6,292,472 ; real~~

~~*estate, including banking-house, $3,408,262 ; furniture and fixtures, 1578,388 ; due from other banks, $17,872,944 ; cheques and other cash items, $1,816,523 ; U.S. notes of various kinds, $6,092,722 god coi^ $3,201,406 ; 'silver and other small coin, $669,421 ; all Sther resources, $143,476. The St Louis bank clearings for 1899 reached a total of $1,638,348,203, a gain of more than 65 per cent.*~~

~~*in ten years. . „ . , . i onn*~~

~~*Manufactures.— The general statistics of manufactures in 1890 and 1900, with the percentages of increase during the interven- ing decade, are given in the following table :—*~~

~~*1890.*~~

~~*1900.*~~

~~*Per cent. Increase.*~~

~~*Number of establishments Capital .... Salaried officials, clerks,*~~

~~*&c*~~

~~*Salaries .... Wage-earners, average*~~

~~*number Total wages . Miscellaneous expenses . Cost of materials used . Value of products .*~~

~~*14,052 $189,558,546*~~

~~*18,9361 $16,77.3,9351*~~

~~*124,203*~~

~~*$59,643,429*~~

~~*$22,885,565*~~

~~*$177,582,382*~~

~~*$324,561,993*~~

~~*18,754 $249,888,581*~~

~~*13,900 $14,569,606*~~

~~134,975~~

~~$60,719,429~~

~~$41,396,905~~

~~$214,988,018~~

~~$385,492,784~~

~~33·5 31·8~~

~~26·62 13·12~~

~~8·7~~

~~1·8~~

~~80·9~~

~~21·1~~

~~18·8~~

~~A brief summary of the statistics of follows : —~~

~~thirteen leading industries~~

~~Number of~~

~~Value of~~

~~Industry.~~

~~Establish- ments.~~

~~Capital.~~

~~Products.~~

~~*Boots and shoes*~~

~~*50*~~

~~*$4,183,979*~~

~~*$11,253,202*~~

~~*Carriages and waggons .*~~

~~*377*~~

~~*4,019,087*~~

~~*5,583,364*~~

~~*Cars (steam railway) and*~~

~~*general shop construc-*~~

~~*tion and repairs by*~~

~~*steam railway companies*~~

~~*47*~~

~~*8,176,242*~~

~~*14,246,889*~~

~~*Clothing, men's, factory*~~

~~*product*~~

~~*148*~~

~~*4,651,882*~~

~~*8,925,088*~~

~~*Coffee and spice, roasting*~~

~~*and grinding*~~

~~*27*~~

~~*2,517,482*~~

~~*5,266,264*~~

~~*Confectionery .*~~

~~*99*~~

~~*2,842,164*~~

~~*5,554,384*~~

~~*Flouring and grist — mill*~~

~~*products*~~

~~*, 1145*~~

~~*11,402,827*~~

~~*26,393,928*~~

~~*Foundry and machine —*~~

~~*shop products*~~

~~*261*~~

~~*11,606,445*~~

~~*15,073,005*~~

~~*Lumber and timber pro-*~~

~~*ducts*~~

~~*1197*~~

~~*11,089,799*~~

~~*11,177,529*~~

~~*Malt liquors*~~

~~*49*~~

~~*25,731,930*~~

~~*13,776,905*~~

~~*Printing and publishing*~~

~~*(including newspapers*~~

~~*and periodicals) .*~~

~~*1100*~~

~~*11,149,288*~~

~~*15,355,949*~~

~~*Slaughtering and meat*~~

~~*packing (wholesale)*~~

~~*31*~~

~~*7,844,054*~~

~~*42,229,127*~~

~~*Tobacco and snuff .*~~

8,011,237

27,847,432

The three most important manufacturing centres are St Louis, Kansas City, and St Joseph, in the order named. The products of the first named amounted in value to more than 60 per cent, of the total products of the state. As the foregoing table shows, the most important industry in the state is slaughtering and meat packing ; during the decade 1890-1900 the value of its products increased nearly 135 per cent. St Joseph is the principal centre of manufacture for this industry, and St Louis ranks next.

Bailways. — Several Important trunk lines of railway afford ample accommodation for passenger and freight traffic. Chief among these are the Missouri Pacific ; the Iron Mountain ; the St Louis and San Francisco ; the Wabash ; the Chicago, Bur- lington, and Quincy ; the Atchison, Topeka, and Sante F6 ; the St Louis South-Western ; the Missouri, Kansas, and Texas ; and the Kansas City, Fort Scott, and Memphis. The total mileage of rail- ways in Missouri in June 1898 was 6762-56.

Finance. — The financial condition of the state, as shown in a statement prepared by the state auditor, 4th January 1900, is as follows : —

Total valuation of real estate and personal pro- perty, as fixed by the State Board of Equalization for 1899 taxes .... $987,456,906 Railway, bridge, and telegraph property, includ- ing street railway property for 1899 taxes . 102,946,600 Merchants and manufacturers, valuation for

1899 taxes (estimated) . . . 55 125 824

Total $l,145,5297:i:!0

Balance in treasury, 31st December 1898 . . $897,109 Receipts into the state treasury from all sources,

~~*for all purposes, for the year ending 30th*~~

~~*December 1899 4,370,249*~~

~~*Expenditure during 1899, for all purposes . . 4,690,351*~~

~~*Balance in treasury, 30th December 1899 . . 577,007*~~

~~*State Bonded Debt, 1st January 1900. 5 3| per cent. 5-20 refunding bonds, due 1st*~~

~~*July 1907 $5,000*~~

~~*5 3i per cent. 5-20 refunding bonds, due 1st*~~

~~*October 1907 5,000*~~

~~*2837 31 per cent. 5-20 refunding bonds, due 1st*~~

~~*January 1908 2,837,000*~~

~~*Total bonded debt .... $2,847,000*~~

~~*School and Seminary Certificates of Indebtedness.*~~

~~*School certificates, 6 per cent $2,909,000*~~

~~*School certificates, 5 per cent 249,000*~~

~~*$3,158,000*~~

~~*Seminary certificates, 6 per cent. Seminary certificates, 5 per cent.*~~

~~*$122,000 1,113,839*~~

~~*$1,235,839*~~

~~*1 Includes proprietors and firm members, with their salaries*~~

~~*2 Decrease.*~~

~~*The rate of taxation in 1898 was 25 cents on every $100 of the valuation.*~~

~~*Education.— Since 1880 the state university at Columbia, hav- ing lost its old buildings by fire, has erected new and commodious structures. Its endowment has been increased, its faculty en- larged, and its standard of scholarship raised. The high schools have felt the Impulse of the new life of the university, and about 100 of these schools are now able to prepare their pupils for admission to its classes. The number of students enrolled at the university in January 1900 was 1000 ; the number of in- structors 65. Washington University, a non-sectarian endowed institution in St Louis, has increased its endowment funds by nearly $4,000,000, has purchased a tract of 150 acres for a new site, and is erecting new buildings at an immediate cost of $800,000. The number of students during 1899-1900 was 645, of instructors 99. The St Louis University is the oldest and most influential of the Roman Catholic institutions. It was established in 1829, and is controlled by the Order of Jesuits. It occupies a group of commanding buildings, erected at a cost of about $1,000,000. The faculty of government and instruction numbers 25. Other colleges and schools, founded in the interests of various religious bodies, are increasing in strength and influence. The net amount of state school moneys apportioned to the use of the public schools in 1898 was $915,866, and the state school enumeration was 980,422, with 15,259 teachers. The percentage of illiterates is 9-5. In 1900 the number of persons of school age (5 to 20 years inclusive) was 1,105,258. Out of 856,684 males of voting age, of whom 46,418 were negroes, 60,327 were illiterate (unable to write), of whom 14,829 were negroes.*~~

~~*Penal and Charitable Instittitions.— The state penitentiary is situated at JeHerson City, the capital. On 1st January 1901 it contained 2116 convicts. Other state institutions are an insane hospital at Fulton, with 566 patients in 1896 ; one at St Joseph, with 714 inmates ; and another at Nevada with 466. There are also the following schools : (1) the Missouri school for the blind, at St Louis, with 116 scholars ; a school for the deaf and dumb at Fulton, with 392 scholars ; a reform school for boys at Boonville, with 160 boys ; a reform school for girls at Chillicothe, with 63 girls.*~~

~~*Bclif/ion. — The Roman Catholic Church was, for many years after the early settlement of the state, the only religious organiza- tion. Many Protestant bodies, however, now share with that Church in the religious work of the state. In 1896 the number of communicants in the leading denominations was reported as follows : Roman Catholics, 160,000 ; Methodists, 160,000 ; Baptists, 160,000 ; Disciiiles of Christ, 05,000 ; Presbyterians, 50,000 ; Lutherans, 25,000 ; Episcopalians, 6406. Denominational col- leges are supported by most of these sects.*~~

~~*Politics. — Missouri has given a large plurality to the Democratic candidate at every Presidential election since 1872. The vote for President for the elections specified was given as follows : —*~~

~~*1888, Democratic, 261,974 Republican, 236,257*~~

~~*1892 „ 268,398 „ 226,918*~~

~~*1896 „ 303,667 „ 804,940*~~

~~*1900 „ 351,912 „ 314,091*~~

~~*The vote of St Ltiuis in 1896 was : for Bryan (Democrat), 60,091,*~~

~~*and for McKinley (Republican), 65,708 ; in 1900, for the same*~~

~~*candidates, 59,931 and (50,697 respectively. No important changes*~~

~~*have been made in the state constitution since 1875, when the*~~

~~*present constitution was drawn up by a convention called for that purpose, and was ratified by the people. (m. s. 8.)*~~

~~*Missouri River, the main western branch of the Mississippi river, U.S.A. It rises in three streams in the Rocky Mountains of south-western Montana, the Jefferson, Madison, and Gallatin rivers, which unite at the foot of*~~

~~Gallatin Valley ; thence the ^iver flows north, out of the mountain region into the plains, which it traverses in a course at first north-east, then east, flowing down the general slope. Entering North Dakota the river turns gradually to the south-east, then south, and again south- east, traversing both North and South Dakota. It forms the eastern boundary of Nebraska and part of Kansas, and crosses Missouri in an easterly course to its junction with the Mississippi a few miles above St Louis. Its entire length is 3475 miles, and ' it drains an area of 527,155 square miles, or more than one-sixth of the area of the United States, excluding Alaska. As its longest and largest afiluent, it is properly the main source of the Mississippi. Of the three sources of the Missouri, the middle stream, Madison river, rises in Yellowstone National Park, and is fed by geysers and hot springs. Yellow- stone river, a right-hand tributary, rises just south of Yellowstone National Park, flows through it, and joins the Missouri at the eastern boundary of Montana. On this stream, within the park, are Yellowstone Lake, the Great Palls (300 feet high), and the canon, features which constitute some of the finest scenery of the United States. In the Dakotas many small but long streams join it, among them the Little Missouri from the Bad Lands, and the Cheyenne from the Black Hills. In Nebraska come the muddy waters of the Platte, which rises in two large branches in Colorado. At Kansas City the Missouri is joined by Kansas river, a stream of the plains. On the left the Missouri is fed by Sun, Marias, and Milk rivers, which rise in Mission Range in western Montana, and farther down by the James, the Big Sioux, and many smaller streams. Owing to the vast amount of detritus which its waters collect in its long course over the plains, the Missouri is at all times thick with mud, and well deserves its familiar cognomen of " Big Muddy." The Missouri is navigable at high water to the Great Falls, near the city of that name in Montana ; and even now, in spite of the competition of the rail- ways, carries a large amount of freight. Upon it are situated many cities, the principal of which are Kansas City, Mo., St Joseph, Mo., and Omaha, Neb. (h. g*.)~~

~~-), Provenqal poet.~~

~~Mistral, Frederic (1830- was born at Maillane (Bouches-du-Rli6ne) on 8th Sep- tember 1830. In the autobiographical sketch prefixed to the Isdo~~

~~d'Or (1876") he tells us, with great simplicity and charm, all that is worth knowing of his early life. HIs father was a prosperous farmer, and his mother a simple and religious woman of the people, who first taught him to love all the songs and legends of the country. In these early days on the farm he received those first impressions which were destined to constitute one of the chief beauties of MirMo. " Mon enfance pre- miere se passa done a la f erme, en compagnie des laboureurs, des faucheurs et des patres. Je me souviens toujours de cette ^poque avec delices. . . ." In his ninth year Mistral was sent to a small school at Avignon, where he was very wretched at first, regretting the free outdoor life of the country. Gradually, however, his studies attracted him, above all the poetry of Homer and Virgil ; and he trans- lated the latter's first eclogue, showing his efforts to a young schoolfellow, A. Mathieu, who was destined to play a part in the foundation of the Pelibrige. When Roumanille (see Provencal Litekatuke, Modekn) be-~~

~~came an usher at Mistral's school, the two, fired by the same love of poetry and of their native Provence, soon became close friends. " Voila I'aube que mon §,me attendait pour s'dveiller a la lumifere," he exclaimed, on reading Roumanille's first dialect poems ; and he goes on to say : " Embrases tons les deux du ddsir de relever le parler de nos m^res, nous etudi§,mes ensemble les vieux livres Provengaux, et nous nous propos&mes de restaurer la langue selon ses traditions et caractferes natio- naux." On leaving school (1847) he returned to Maillane, where he sketched a pastoral poem in four cantos (Li Meissoun). With all his love for the country, he soon realized that life on a farm did not satisfy his ambition. So he went to study law at Aix, where he contributed his first published poems to Roumanille's Li Prouvengalo (1852). HIe had become licencU en droit the year before, but now decided on a literary career. The Felibrige was founded in 1854, and five years later appeared Miriio, the masterpiece not only of Mistral, but so far of the entire school. It was everywhere hailed with enthusi- asm : Lamartine wrote a panegyric on it, Gounod set its theme to music, and several translations appeared. The tale itself was nothing — the old story of a rich girl and her poor lover, kept apart by the girl's parents. Mireille, in despair, wanders along a wide tract of country to the church of the Trois-Maries, in the hope that these may aid her. But the effort was too great :~~

she sinks ex- hausted, and dies in the presence of her stricken parents and her frenzied lover. Into this simple web Mistral has woven descriptions of Provencal life, scenery, char- acter, customs, and legends that raise the poem to the dignity of a rustic epic, unique in literature. Nothing is forced : every detail is filled into the framework of the whole with a cunning which the poet was never again to attain. In the first lines he invokes Homer; and the Greek nature of his epic has been dwelt on by all its critics, from Lamartine to Gaston Paris. It is indeed Greek in its truth to nature, in the simplicity of its presentment, and in the perfection of its manner. There is no deep psychology in the characters, but then the people depicted are simple rustic folk, who wear their hearts on their sleeve, and whose inner lives and motives do not require, nay, would not bear, the dissecting- knife of a Bourget. Calendau (1867), the story of a princess held in bondage by a ruthless brigand, and eventually rescued by a youthful hero, is a comparative failure. There are many purple patches, but an epic must be judged as a whole, not piecemeal. The descrip- tion of scenery is again masterly ; but the old lore, which had charmed all readers in Mirhio, here becomes wearisome, its introduction being forced, not inevitable. The characters are mere symbols — indeed, the whole poem is obviously an allegory, the princess standingfor Provence, the brigand for France, and the young lover for the Felibrige. Mistral lavished enormous labour on this work, which probably accounts for its lack of spontaneity, as also for the love he bears it (" Malgre la bienveillance de tons les journaux, le public en general se montra moins empresse pour Calendal que pour Mireille; non pas que le premier contienne moins de poesie, mais parce que dans Mireille la nature pr^domine, et dans I'autre, a mon sens, c'est imagination. J'ai croyance pourtant que, si un jour ce pays n'est plus emascule par une education fausse, beaucoup prendront plaisir a lire Calendal"). In 1876 (the same year in which he married Mile Mane Riviere, of Dijon) was published the volume Lis Isdo d'Or — a collection of the shorter poems Mistral had composed from the year 1848 onwards. Here he is again at his very best. Old legends, sirventes (mostly, as in mediaeval times, poems with a tendency), and lyrics — all are admir- able. Even the pieces d'occasion may be reckoned with

the best of their kind. Two pieces, the Coupe and the PriMcesse, aroused violent controversy on their first appear- ance. They reproduce, in effect, the theme of Calendau, and Mistral was accused of trying to sow discord between the north and south of Prance. Needless to say, he was altogether innocent of such a design. HIs earnest desire to awaken in the Provencals a sense of their past achieve- ment was not only compatible with a love of the whole of France, but inseparable from it. Nerto (1884) is a charming tale of Avignon in the olden days, in which a girl's purity triumphs over her lover's base designs and leads him to nobler thoughts. There is little individuality in the characters, which should rather be regarded as types ; and we feel no terror or pity at the tragic close. But we are carried along by Mistral's art and by the brilliancy of his episodes ; and though comparisons with Ariosto, that have so often been instituted, are altogether beside the mark, our poet has here achieved the object he had in view : he has told a pretty tale — it is almost a fairy tale — and he has imbued it with the proper touch of local colour and with the true spirit of romance. The play La Riino Jano (1890) is a complete failure, if judged from the dramatic standpoint : it is rather a brilliant panorama, a series of stage pictures, and the characters neither live nor arouse our sympathy. In the great epic on the Rhone {Lou Ponhno ddu HIouse, 1 897), the poet depicts the former barge-life of that river, and intertwines his narrative with the legends clustering round its banks, and with a graceful love episode. For the first time he employs blank verse, and uses it with great mastery ; the lines roll on with a fine volume of sound. But his chief failing reappears in an accentuated form : the ancient lore is overdone, and produces a sense of weari- ness. A splendid piece of work is Lou Tresor ddu FMi- brige (1886), which is fit to rank with Littre's great French dictionary. In these two volumes Mistral has deposited with loving care every word and phrase, every proverb, every scrap of legend that he had gathered during his many years' journeyiugs in the south of France.

An excellent literary appreciation o{ the poet is that by Gaston Paris, Frederic Mistral (originally in the Bevue de Paris, October and November

~~*1894; then in Penseurs et Poetes, Paris, 1896). More elaborate accounts are Welter, Frederic Mistral, Marburg (1899); and Downer, Frederic Mistral, New York, 1901 (with a full bibliography).*~~

~~*Mitcham (the Michelham, "great village," of Domesday Book), a suburb of London, in the Wimbledon parliamentary division of Surrey, 10 miles south of London Bridge by rail. Mitcham Common covers an area of 480 acres, and affords one of the best golf-courses near London. The neighbourhood abounds in market gardens and plantations of aromatic herbs for the manufacture of scents and essences. Population (1901), 14,904.*~~

~~*-), American*~~

~~*Mitchell, Donald Grant (1822-*~~

~~*author, was born in Norwich, (Connecticut, on the 12th of April, 1822. IIe graduated at Yale College in 1841 ; studied law, but soon took up literature as his profes- sion. Throughout his life he showed a particular interest in agricultural and horticultural pursuits, which he fol- lowed at first in pursuit of health. IIe has produced books of travel ; volumes of essays on rural themes, of which My Farm of Edgeivood (ISO.'l) is the best; sketchy studies of English monarchs and of English and American literature; and a character-novel entitled Doctor Johns (1866), &c. ; but is best known as the author, under the pseudonym of "Ik Marvel," of the gently senti- mental essays contained in the volumes Reveries of a Bachelor, or a Book of the IIeart (1850), and Dmnn Life, a Fable of the Sentioiis (18.51), long popular in the United States, especially during the latter years of the*~~

~~*first literary period in that country, in which reminiscential egotism of the school of Irving had affected many writers and readers.*~~

~~*Mitchell, Silas Weir (1829-*~~

~~*-), American*~~

~~*physician and author, was born in Philadelphia on the 15th of February 1829. HIe studied at the University of Pennsylvania in that city, and received the degree of M.D. at Jefferson Medical College in 1860. During the Civil War he had charge of the governmental wards for nervous injuries and maladies at Turner's Lane HIospital, Philadelphia, and at the close of the war became a specialist in nervous diseases, contributing numerous articles to medical and other scientific journals, and attaining a high place in his profession and in various academies and societies. While working in his chosen field as a physician, in 1863, he wrote a clever short story, combining physiological and psychological problems, entitled The Case of George Dedlow, which appeared in the Atlantic Moiithly. Thenceforward Dr Mitchell, as a writer, divided his attention between professional and literary pursuits. In the former field he produced monographs on rattlesnake poison, on intellectual hygiene, on injuries to the nerves, on neurasthenia, on nervous diseases of women, on the effects of gunshot wounds upon the nervous system, and on the relations between nurse, physician, and patient; while on the latter he wrote juvenile stories, several volumes of respectable verse, and prose fiction of varying merit, which, however, gave him a leading place among the American authors of the close of the i9th century. HIs short stories, with the exception of the strong tale already named, are sketches rather than finished results ; but his historical novels HIugh Wi/nne, Free Quaker (1897) and TJie Adventures of Francois (1898) take high rank amongst the best efforts in this branch of fiction.*~~

~~*Mitford, William (1744-1827), English historian, was the elder of the two sons of John Mitford, a bar- rister, who lived near Beaulieu, at the edge of the Xew Forest. HIere, at Exbury HIouse, his father's property, Mitford was born on the 10th of February 1744. HIe was educated at Cheam School, under the picturesque writer William Gilpin, but at the age of fifteen a severe illness led to his being removed, and after two years of idleness Mitford was sent, in July 1761, as a gentleman commoner to Queen's College, Oxford. In this year his father died, and left him the Exbury property and a considerable fortune. Mitford, therefore, being "" very much his own master, was easily led to prefer amusement to study." HIe left Oxford (where the only sign of assiduity he had shown was to attend the lectures of Blackstone) without a degree, in 1763, and*~~

proceeded to the Middle Temple. But gradually he began to feel a curiosity "to become acquainted with the celebrated writings of the Greeks in their own language," and when he married Miss Fanny Molloy in 1766, and retired to Exbury for the rest of his life, he made the study of the Greek language and litera- ture "without the assistance of any instructor" his constant hobby and occupation. After ten years passed in this ^^■ay, his wife died, and in October 1776 Mitford went abroad. IIe was encouraged by French scholars whom he met in Paris, Avignon, and Nice to give himself systematically to the study of Greek history. But it was Gibbon, witli whom he was closely associated ^\•hen they both were officers in the South Hampshire Militia, who definitely suggested to Mitford the form which his work should take. In 1784 the first of the volumes of his Hv

a loss of memory, forbade his continuation of the enter- prise, although he painfully revised successive new editions. While his great book was slowly progressing, Mitford was engaged in a certain amount of public activity. IIe was a member of the House of Commons, with intervals, from 1785 to 1818, and he was for many years verderer of the New Forest and a county magistrate. It does not appear that at any time in his life William Mitford visited Greece. After a long and enfeebling illness he died at Exbury on his eighty-third birthday, 10th February 1827. In addition to his famous History of Oreece, he published a few smaller works, most of them of a subsidiary character. Of these the most im- portant was an Essay on the Harmony of Language, 1774. The style of Mitford is natural and lucid, \>\xt without any of the rich colour of Gibbon. IIe affected some oddities both of language and of orthography, for which he was censured and which he endeavoured to revise. But his political opinions, applied to the constitutions of the Greek republics, were still more severely treated, since Mitford was an impassioned anti-Jacobin, and thought that a king could do no wrong. IIis partiality for a monarchical form of government led him to be unjust to the Athenians. IIence his History of Greece, after having had no peer in European literature for

~~*half a century, faded in interest on the appearance of the more democratic work of Grote. Clinton, too, in his Fasti Hellenici, charged Mitford with '■' a general negligence of dates," though admitting that in his philosophical range " he is far superior to any former writer " on Greek history. Byron, who dilated on Mitford's shortcomings, neverthe-less declared that he was " perhaps the best of all modern historians altogether." This Mitford certainly is not, but his pre-eminence in the little school of English historians who succeeded Hume and Gibbon it would be easier to maintain. (e. g.)*~~

~~*Mithras. — The cult of Mithras is one of the most important Eastern cults which were introduced at Kome. The god was worshipped before the separation of the Iranian from the Indian Aryans. Among the early Persians he held a foremost place with Ahura-lMazda and Anahita. In the Avesta he has become less potent, and is one of the gods who serve Ahura-Mazda in his struggle against evil. He is the embodiment of created light, and is the god ^ of truth. Erom Iran his worship spread to Babylonia, where it absorbed Chaldean elements. Old Persian gods became identified with the stars adored by the Babylonians, and were connected with the theory that the soul after death wanders through the region of the stars. From Babylon Mithras travelled to Pontus and Cappadocia, and while little known to the Greeks, was brought to Rome by soldiers and slaves. He is first mentioned by Statius in the Tliebais, a.d. 90. The oldest known Roman Mithras inscriptions date from Trajan and Hadrian. First favoured by the lower classes, the cult spread upwards. Sculptures represent Mithras as (1) a boy with Phrygian cap, emerging from a rock and holding a torch, probably signifying Mithras as god of light, gilding the mountains ; (2) shooting a rock whence comes a stream from which a man takes water : here he is the mythical bowman who causes rain to come upon the earth ; (3) stabbing a bull : a serpent and a dog lick the blood, a scorpion grips the bull, a raven stands by, and boys hold torches : here the bull is the first creature made by AhurarMazda, the death of which is necessary for the creation of plants and animals ; the scorpion is the animal of Aiigra-Manyu (Ahriman), who tries to hinder the work of Ahura-Mazda; the serpent is the symbol of the earth enriched by the bull's blood ; the dog catches the soul of the bull for new uses ; the raven is probably*~~

~~an emblem of the sun-god, signifying that the sacrifice is performed at his command.~~

~~The devotees of Mithras formed a community which consisted of seven divisions, Coraces, Gryphi, Milites, Leones, Persce, Heliodromi, Patres. At the head of the Patres was the Pater Patrum. The Patres do not seem to have been necessarily sacerdotes, a class which offered the sacrifices and was presided over by a summus pontifex. Worship was not conducted in temples. Each Mithraeum was a grotto, real or artificial. Existing examples are at Rome under the church of S. Clemente, and under the Capitol, and at Spoleto. That at Spoleto had three niches at the end for statues of Mithras and the two torch-bearers. Before them was a small altar inscribed " Soli invicto Mitrae Sacrum." Near it stood two large stones, one triangular and the other conical and per- forated. The latter may have been an emblem of the rock from which Mithras was born. Some caves have two altars and a hole for the blood of the bull sacrificed. The Christians regarded Mithraism as a dangerous rival of Christianity. Its belief in a mediator, in the resurrec- tion, the lustrations and the common meal of bread and water were points of contact. Apparently the Mithraists made the most of these resemblances, as is done in parts of India by Hindus who exalt Krishna against Christ. Investigation of early Christian worship has proved that it owes nothing to Mithraism. The only point still dubious is the origin of observing 26th Decem- ber as Christmas. But the heathen Roman observance of 26th December seems to date from the Syrian sun worship introduced by Aurelian a.d. 270, while belief that Christ was born on 'Joth. December can be traced back at Rome to Hippolytus c. 220. It is i^ossible that 26th December was attained as the result of the strong belief that Christ died on 25th March. It was thought that He spent an exact number of years on earth, and thus 26th March was chosen for the Annunciation and 25th December reckoned from it.~~

~~For bibliography see article " Mithras " in "W. H. Eosoher's Lexicon der Griechisr.hen und Momischen MythologieCB. G. Teubner, Leipzig, 1894-97). (l. p.)~~

~~*Mitrovicza, a town of Hungary, in the county of Szerem, in the province of Croatia-Slavonia, on the Save, with 19,796 inhabitants in 1891, and 11,618 in 1901. It has an under realschule, many administrative and other offices, and a thriving trade. On its site once stood the Roman city of Syrmium, the capital of Pannonia, and later of lUyricum, where was born and buried the Emperor Probiis, and where dwelt other Roman emperors. Its ancient buildings were destroyed by the Turks in 1396 and 1621.*~~

~~*Mittweida, a town of Germany, on the Zschopau, 12 miles by rail north of Chemnitz, in the circle of Leipzig, kingdom of Saxony. There are an engineering and electrotechnical institute, cotton and spinning mills, machinery, dye, earthenware, and furniture works. Popu- lation (1890), 11,298; .(1900), 16,117.*~~

~~*Mivart, St George (1827-1900), English biologist, was born in London on 30th November 1827, and educated at Clapham Grammar School, Harrow and King's College, London, and afterwards at St Mary's, Oscott, since his conversion to Catholicism prevented him from going to Oxford. In 1851 he was called to the bar, but his interests were chiefly scientific, and he devoted himself to medical and biological studies. In 1862 he was appointed lecturer at St Mary's Hospital medical school, in 1869 he became a fellow of the Zoological Society, and in 1874 he was appointed pro- fessor of biology at University College, London. In 1873 he had published Lessons in Elementary Anatomy, and*~~

~~*a separate essay on Man and Apes. HIs monograph on Apes written for the Encyclopcedia Britannica was incorporated in the Study of Mammals by Plower and Lydekker, for which he also wrote Skeleton and Reptiles. In 1881 appeared The Cat, an Introduction to the Study of Back-honed Animals, in which the detailed study of one particular animal is made the starting-point of a general survey of its kindred. The careful and detailed work he bestowed on Insectivora and Carnivora has largely increased our knowledge of the anatomy of these groups. In 1871 his Genesis of Species*~~

~~had brought him into the controversy then raging round the question of evolution. While fully asserting evolution generally, Mivart denied its applicability to the human intellect. He represented the formation of new species as mainly due to one mode of action of that plastic innate power manifest on all hands in nature, as evidenced by many instances quoted by him. His views as to the relation- ship existing between human nature and intellect and animal nature in general were given in Nature and Thought (1882) ; and in the Origin of Human Reason (1899) he stated what he considered the fundamental difference between men and animals, pointing out where the human intellect differed from the highest psychical actions of brutes. In 1884, at the invitation of the Bel- gian episcopate, he became professor of the philosophy of natural history at Louvain. This university also conferred on him the degree of M.D. Some articles in the Nineteenth Century, in which Mivart advocated the claims of science even where they seemed to conflict with religion, were placed on the Index Expurgatorius, and a curious correspondence ensued between him and Cardinal Vaughan, in which Mivart vindicated his claim to hold liberal opinions while remaining in the Catholic Church ; but the result was that, as he refused to recant, he was excommunicated. The episode was interesting as throwing light on the state of Roman Catholic senti- ment in England ; but Mivart died almost immediately afterwards (on 1st April 1900), and the discussion dropped. (a. z.)~~

~~Mtawa, a district town of Russian Poland, govern- ment of Fiock, 7 miles from the Prussian frontier, and 78 miles by rail north-west of Warsaw, near the Prussian frontier. It has a realschule, agricultural machinery works, steam flour-mill, tanneries, and soap-works. It is an important railway junction, and has considerable trade in grain. Population (1897), 13,449.~~

~~Moberly, a city of Randolph county, Missouri, U.S.A., on the Missouri, Kansas and Texas and the Wabash railways, north of the centre of the state, at an altitude of 858 feet. It has a level prairie site and a regular plan, divided into four wards. It contains the machine shops of the Wabash rai,lroad, in addition to varied manufactures. Population (1880), 6070 ; (1890), 8215 ; (1900), 8012, of whom 450 were foreign-born and 923 were negroes.~~

~~*Mobile, a city and seaport of Alabama, U.S.A., capital of Mobile county, on the west side of the Mobile river near its mouth. Its site is level and its plan fairly regular; it has a good water-supply, and its business streets are paved with brick and wood. Four railways centre in the city, the Louisville and Nashville, the Mobile and Ohio, the Mobile, Jacksonville and Kansas City, and the Southern. Mobile is the only seaport of the state, and it has considerable export trade, consisting almost entirely of cotton. Its importance in this regard has, however, diminished greatly. In 1900 its manufac- turing establishments had a total capital of $3,294,238 and employed an average number of 2827 wage-earners!*~~

~~*The total products were valued at $4,451,062, of which the most important were lumber and timber products (f 566,800) and flouring and grist-mill products ($454,134). The city was rechartered in 1887, the state assuming most of the debt which had made it bankrupt. The assessed valuation of real and personal property in 1900, on a basis of about one-half of the full value, was $15,986,201, the net debt was $822,000, and the rate of taxation was $26-50 per $1000. Population (1890), 31,076 ; (1900), 38,469, of whom 2111 were foreign-born and 17,046 were negroes. The death-rate in 1900 was 26-9 ; the death-rate of the coloured population was about one-half greater than that of the white.*~~

~~*Models. — The term model denotes a tangible repre- sentation, whether the size be equal, or greater, or smaller, of an object which is either in actual existence, or has to be constructed in fact or in thought. More generally it denotes a thing, whether actually existing or only men- tally conceived of, whose properties are to be copied. In foundries, the object of which a cast is to be taken, whether it be for engineering or artistic purposes, is usu- ally first formed of some easily workable material, gen- erally wood. The form of this model is then reproduced in clay or plaster, and into the mould thus obtained the molten metal is poured. The animate figures which serve the painter as types are described as models. The sculptor first makes a model of the object he wishes to chisel in some plastic material such as wax, ingenious and complicated contrivances being employed to transfer this wax model, true to nature, to the stone in which the final work is to be executed. In anatomy and physiology, models are specially employed as aids in teaching and study, and the*~~

method of motdage or chromoplastic yields excellent impressions of living organisms, and enables anatomical and medical preparations to be copied both in form and colour. A special method is also in use for making plastic models of microscopic and minute micro- scopic objects. That their internal nature and structure may be more readily studied, these are divided by numer- ous parallel transverse cuts, by means of a microtome, into exceedingly thin sections (see Mickotomt). Each of these shavings is then modelled on an enlarged scale in wax or pulp plates, which are fixed together to form a. reproduction of the object.

*Models in the mathematical, physical, and mechanical sciences are of the greatest importance. Long ago philo- sophy perceived the essence of our process of thought to lie in the fact that we attach to the various real objects around us particular physical attributes — our concepts — and by means of these try to represent the objects to our minds. Such views were formerly regarded by mathe- maticians and physicists as nothing more than unfertile speculations, but in more recent times they have been brought by Maxwell, Helmholtz, Mach, Hertz, and many others into intimate relation with the whole body of mathematical and physical theory. On this view our thoughts stand to things in the same *”’”*■ relation as models to the objects they represent. /a”*

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two — the musical scale, for example, being imitated by placing the notes higher or lower. When, therefore, we endeavour to assist our conceptions of space by figures, by the methods of descriptive geometry, and by various thread and object models ; our topography by plans, charts, and globes; and our mechanical and physical ideas by kinematic models — we are simply extending and continu- ing the principle by means of which we comprehend objects in thought and represent them in language or writing. In precisely the same way the microscope or telescope forms a continiiation and multiplication of the lenses of the eye ; and the notebook represents an exter- nal expansion of the same process which the memory brings about by purely internal means. There is also an obvious parallelism with representation by means of models when we

~~express longitude, mileage, temperature, &c., by numbers, which should be looked upon as arith- metical analogies. Of a kindred character is the repre- sentation of distances by straight lines, of the course of events in time by curves, &c. Still, neither in this case nor in that of maps, charts, musical notes, figures, &c., can we legitimately speak of models, for these always involve a concrete spatial analogy in three dimensions.~~

~~So long as the volume of matter to be dealt with in science was insignificant, the need for the employment of models was naturally less imperative ; indeed, there are self-evident advantages in comprehending things without resort to complicated models, which are difi&cult to make, and cannot be altered and adapted to extremely varied conditions so readily as can the easily adjusted symbols of thought, conception, and calculation. Yet, as the facts of science increased in number, the greatest econ- omy of effort had to be observed in comprehending them and in conveying them to others ; and the firm estab- lishment of ocular demonstration was inevitable in view of its enormous superiority over purely abstract symbol- ism for the rapid and complete exhibition of compli- cated relations. At the present time it is desirable, on the one hand, that the power of deducing results from purely abstract premisses, without recourse to the aid of tangible models, should be more and more per- fected, and on the other that purely abstract concep- tions should be helped by objective and comprehensive models in cases where the mass of matter cannot be adequately dealt with directly.~~

~~As regards their use, models may be divided into those which only subserve educabional purposes and those which Models la ^ssist scientific investigation. In pure mathe- mathe- matics, especially geometry, models constructed matics and oi papier-mdcM and plaster are chiefly employed physics. ^^ present to the senses the precise form of geo- metrical figures, surfaces, and curves. Surfaces of the second order, represented by equations of the second degree between the rectangular co-ordinates of a point, are very simple to classify, and accordingly all their possible forms can easily be shown by a few models, which, however, become somewhat more intricate when lines of curvature, loxodromics, and geodesic lines have to appear on their surfaces. On the other hand, the multiplicity of surfaces of the third order is enormous, and to convey~~

~~their funda- mental types it is necessary to employ numerous models of complicated, not to say hazardous, construction. In the case of more intricate surfaces it is sufficient to present those singularities which exhibit variation from the usual type of surface with synclastic or anticlastic curvatures, such as, for example, a sharp edge or point, or an inter- section of the surface with itself ; the elucidation of such singularities is of fundamental importance in modern mathematics.~~

~~In physical science, again, models that are of unchange- able form are largely employed. For example, the opera-~~

~~tion of the refraction of light in crystals can be pictured if we imagine a point in the centre of the crystal whence light is dispersed in all directions. The aggregate of the places at which the light arrives at any instant after it has started is called the wave-front. This surface consists of two cups or sheets fitting closely and exactly one inside the other. The two rays into which a single ray is broken are always determined by the points of contact of certain tangent planes drawn to those sheets. With crystals possessing two axes these wave-surfaces display peculiar singularities in the above sense of the term, in that the inner sheet has four protuberances, while the outer has four funnel-like depressions, the lowest point of each depression meeting the highest point of each protuberance. At each of these funnels there is a tangent- plane that touches, not in a single point, but in a circle bounding the depression, so that the corresponding ray of light is refracted, not into two rays, but into a whole cone of light — the so-called conical refraction theoreti- cally predicted by Hamilton and experimentally detected by Lloyd. These conditions, which it is difficult ade- quately to express in language, are self-evident so soon as the wave-surface formed in plaster lies before our eyes. In thermodynamics, again, similar models serve, among other purposes, for the representation of the sur- faces which exhibits the relation between the three thermodynamic variables of a body, e.g., between its temperature, pressure, and volume. A glance at the model of such a thermodynamic surface enables the behaviour of a particular substance under the most varied conditions to be immediately realized. When the ordinate intersects the surface but once a single phase only of the body is conceivable, but where there is a multiple inter- section~~

~~*various phases are possible, which may be liquid or gaseous. On the boundaries between these regions lie the critical phases, where transition occurs from one type of phase into the other. If for one of the elements a quan- tity which occurs in calorimetry be chosen — for example, entropy — information is also gained about the behaviour of the body when heat is taken in or abstracted.*~~

~~*After the stationary models hitherto considered come the manifold forms of moving models, such as are used in geometry, to show the origin of geometrical figures from the motion of others ; e.g., the origin of surfaces from the motion of lines. These include the thread models, in which threads are drawn tightly between movable bars, cords, wheels, rollers, &c. In mechanics and engineering an endless variety of working models are employed to con- vey to the eye the working either of machines as a whole, or of their component and subordinate parts. In theoretical mechanics models are often used to exhibit the physical laws of motion in interesting or special cases ; e.g., the motion of a falling body or of a spinning-top, the move- ment of a pendulum on the rotating earth, the vortical motions of fluids, &c. Akin to these are the models which execute more or less exactly the hypothetical motions by which it is sought to explain various physical phenomena, as for instance the complicated wave-machines which pre- sent the motion of the particles in waves of sound (now ascertained with fair accuracy), or the more hypothetical motion of the atoms of the ether in waves of light.*~~

~~*The varying importance which in recent times has been attached to njodels of this kind is intimately connected with the changes which have taken place in our conceptions of Nature. The first method by which an attempt was made to solve the problem of the universe was entirely under the influence of Newton's laws. In analogy to his laws of celestial gravitation, all bodies were sature^^"' conceived of as consisting of points of matter — atoms or molecules — to which was attributed a direct action at a distance. The circumstances of this action at*~~

~~*a distance, however, were conceived as differing from those of tlie Newtonian law of attraction, in that they could explain the properties not only of solid elastic bodies, but also those of fluids, both liquids and gases. The phenomena of heat were explained by the motion of minute particles absolutely invisible to the eye, while to explain those of light it was assumed that an impalpable medium, called luminiferous ether, permeated the whole universe ; to this were attributed the same properties as were possessed by solid bodies, and it was also supposed to consist of atoms, although of a much finer composition. To explain electric and magnetic phenomena the assump- tion was made of a third species of matter — electric fluids which were conceived of as being more of the nature of fluids, but still consisting of infinitesimal particles, also acting directly upon one another at a distance. This first phase of theoretical physics may be called the direct one, in that it took as its principal object the investigation of the internal structure of matter as it actually exists. It is also known as the mechanical th'eory of nature, in that it seeks to trace back all natural phenomena to motions of infinitesimal particles, i.e., to purely mechan- ical phenomena. In explaining magnetic and electrical phenomena it inevitably fell into somewhat artificial and improbable hypotheses, and this induced Maxwell, adopt- ing the ideas of Faraday, to propound a theory of electric and magnetic phenomena which was not only new in sub- stance, but also essentially different in form. If the molecules and atoms of the old theory were not to be conceived of as exact mathematical points in the abstract sense, then their true nature and form must be regarded as absolutely unknown, and their groupings and motions, required by theory, looked upon as simply a process having more or less resemblance to the workings of Nature, and representing more or less exactly certain aspects incidental to them. With this in mind, Maxwell propounded certain physical theories which were purely mechanical so far as they proceeded from a conception of purely mechanical processes. But he explicitly stated that he did not believe in the existence in Nature of me- chanical agents so constituted, and that he regarded them merely as means by which phenomena could be re- produced, bearing a certain similarity to those actually existing, and which also served to include larger groups of phenomena in a uniform manner and to determine the relations that held in their case. The question no longer being one of ascertaining the actual internal structure*~~

~~*of matter, many mechanical analogies or dynamical illustrations became available, possessing dif- ferent advantages ; and as a matter of fact Maxwell at first employed special and intricate mechanical arrange- ments, though later these became more general and in- definite. This theory, which is called that of mechanical analogies, leads to the construction of numerous mechan- ical models. Maxwell himself and his followers devised many kinematic models, designed to afford a representation of the mechanical construction of tlie ether as a whole as well as of the separate mechanisms at work in it: these resemble the old wave-machines, so far as they represent the movements of a purely hypothetical mechanism. But while it was formerly believed that it was allowable to assume with a threat show of probability the actual existence of such mechanisms in Nature, yet nowadays philosophers postulate no more than a partial resemblance between the phenomena visible in such mechanisms and those which ajjpear in Nature. Here again it is perfectly clear that these models of wood, metal, and cardboard are really a continuation and integration of our process of thought ; for, according to the view in question, physical theory is merely a mental construction of mechanical models, the working of which*~~

~~*we make plain to ourselves by the analogy of mechanisms we hold in our hands, and which have so much in common with natural phenomena as to help oar comprehension of the latter.*~~

~~*Although Maxwell gave up the idea of making a precise investigation into the final structure of matter as it actually is, yet in Germany his work, under Kirchhoff's lead, was carried still farther. Kirchhoff defined his own aim as being to describe, not to ex- plain, the world of phenomena; but as he leaves the means of description open his theory differs little from Maxwell's, so soon as recourse is had to description by means of mechanical models and analogies. Now the resources of pure mathematics being particularly suited for the exact description of relations of quantity, Kirchhoff's school laid great stress on description by mathematical expressions and formulae, and the aim of physical theory came to be regarded as mainly the construction of formulae by which phenomena in the various branches of physics should be determined with the greatest approximation to the reality. This view of the nature of*~~

~~*physical theory is known as mathe- matical phenomenology; it is a presentation of phe- nomena by analogies, though only by such as may be called mathematical.*~~

~~*Another phenomenology in the widest sense of the term, maintained especially by Mach, gives less prominence to mathematics, but considers the view that the phenomena of motion are essentially more fundamental than all the others to have been too hastily taken. It rather emphasizes the prime importance of description in the most general terms of the various spheres of phenomena, and holds that in each sphere its own fundamental law and the notions derived from this must be employed. Analogies and elucidations of one sphere by another, e.g., heat, electricity, &c., by mechanical conceptions, this theory regards as mere ephemeral aids to perception, which are necessitated by historical development, but which in course of time either give place to others or entirely vanish from the domain of science.*~~

~~*All these theories are opposed by one, called in Germany Energetics (in the narrower sense), which looks upon the conception of energy, not that of matter, as the funda- mental notion of all scientific investigation. It is in the main based on the similarities energy displays in its various spheres of action, but at the same time it takes its stand upon an interpretation or explanation of natural phenomena by analogies which, however, are not mechanical, but deal with the behaviour of energy in its various modes of manifestation.*~~

~~*A distinction must be observed between the models which have been described and those experimental models which present on a small scale a machine that is subsequently to be completed on a larger, so Expert- as to afford a trial of its capabilities. Here it must be noted that a mere alteration in d.imensions is often sufficient to cause a material altera- tion in the action, since the various capabilities depend in various ways on the linear dimensions. Thus the weight varies as the cube of the linear- dimensions, the surface of any single part and the phenomena that depend on such surfaces are proportionate to the square, while other effects, such as friction, expansion, and conduction of heat, &c., vary according to other laws. Hence a flying machine, which when made on a*~~

small scale is able to support its own weight, loses its power when its dimensions are increased. The theory, initiated by Newton, of the dependence of various effects on the linear dimensions, is treated at length in the text-books of mechanics. Under simple conditions it may often be affirmed that in com- parison with a large machine a small one has the same

mental models.

capacity, with reference to a standard of time which must be diminished in a certain ratio.

Of course experimental models are not only those in which purely mechanical forces are employed, but also include models of thermal, electro-magnetic, and other engines ; e.g., dynamos and telegraphic machines. The largest collection of such models is to be found in the museum of the New York Patent Office, in which a model of every patented invention must be deposited. Sometimes, again, other than purely mechanical forces are at work in models for purposes of investigation and instruction. It often happens that a series of natural processes, such as motion in liquids, internal friction of gases, and the conduction of heat and electricity in metals, may be expressed by the same differential equations ; and it is frequently possible to follow by means of measurements one of the processes in question — e.g., the conduction of electricity just mentioned. If then there be shown in a model a particular case of elec- trical conduction in which the same conditions at the boundary hold as in a problem of the internal friction of gases, we are able by measuring the electrical conduction in the model to determine at once the numerical data which obtain for the analogous case of internal friction, and which could only be ascertained otherwise by in- tricate calculations. Intricate calculations, moreover, can very often be dispensed with by the aid of mechani- cal devices, such as the ingenious calculating machines which perform additions and subtractions and very elaborate multiplications and divisions with surprising speed and accuracy, or

~~apparatus for solving the higher equations, for determining the volume or area of geo- metrical figures, for carrying out integrations, and for developing a function in a Fourier's series by mechanical means. (l. bo.)~~

~~Modena, a town, archiepiscopal see, and capital of the province of Modena, Emilia, Italy, 23 miles north- west of Bologna by rail. The ducal palace now shelters the military school and the astronomical observatory, while the art galleries and the libraries are housed in the Albergo Arti, built by Duke Francesco III. in 1764. In 1898 the university was attended by 435 students, with 46 professors. Amongst the public statues is a par- ticularly fine one of Victor Emmanuel (1890), by Gibel- lini; others are of the poet Tassoni (1860), Menotti (1879), and Muratori (1853). There is a noteworthy town hall, with arcades, dating from 1194, but in part rebuilt in 1826. Population (1881), 31,053 ; of commune~~

~~(1901), 64,941.~~

~~Modica, a town of the province of Syracuse, Sicily, Italy, 63 miles south- west of Syracuse by rail. It has a technical school and an industrial institute ; also factories for macaroni, sweetmeats made from oranges, lemons, &c., olive oil presses, limestone quarries, and cheese factories. Population (1881), 38,390; (1899), about 42,000.~~

~~Modjeska, Helena (1844), Polish actress,~~

~~was born at Cracow, 12th October 1844. Her father, Michael Opido, was something of a musician, and her tastes soon declared themselves strongly in favour of a dramatic career; but it was not until after her marriage in 1861 that she first attempted to act, and then it was with a company of strolling players. Her husband (whose name, Modrzejewski, she afterwards adopted in a simplified form for stage purposes) died in 1865. Three years later she married Count Bozenta Chlapowski, a Polish politician and critic, and almost immediately after that event received an invitation to act at Warsaw. There she remained for seven or eight years, and won a high position in her art. In 1876 she went with her~~

~~husband to California, where they settled on a ranch. This new career, however, proved a failure, and Madame Modjeska returned to the stage.~~

~~*She appeared in San Francisco in 1877, in an English version of Adrienne Lecouvreur, and, in spite of her imperfect command of the language, achieved a remarkable success. She con- tinued to act principally in America, but was also seen from time to time in London and other towns in the United Kingdom, her repertory including several Shake- spearian rdles and a variety of emotional parts in modern drama.*~~

~~*Mod ling, an old town in the government district of the same name iu Lower Austria, about 10 miles south of Vienna, at the entrance of the Brtlhl valley. It has iron and sulphur baths, and is a popular local summer resort, being connected with Vienna by rail and tramway. There is a park, a " cur-salon," and an open-air theatre ; and it possesses a Gothic church, with a crypt dating from the 15th century, and a still older Romanesque burial chapel. It has a considerable iron and metal in- dustry, including railway material, and manufactures shoes, varnish, &c. Population (1890), 11,120; (1900), 15,304, mostly German and Catholic.*~~

~~*Moe, Jorgen Engebretsen. See Asbjoknsen.*~~

~~*Moffat, a burgh of barony, police burgh, and health resort of Upper Annandale, Dumfriesshire, Scotland, 52 miles south-south-west of Edinburgh by road. Its spa was purchased by the Burgh Commissioners from a com- pany in 1898. There are a hydropathic establishment and an endowed workmen's institute, containing a library and baths. Episcopal, Established, and United Free churches have been erected. The academy is a secondary school, and the town contains several well-known private board- ing schools. Population (1891), 2291 ; (1901), 2153.*~~

~~*Mogador (Es-S&etra), seaport on the west coast of Morocco, Africa, 128 miles west by south of Morocco. It is the best-built port of the sultanate, and second in point of trade.- Although formerly much more important, it still includes the largest variety of exports. The climate, although damp, is healthy, and is strongly recommended for chest complaints. The rainfall varies between 13 and 20 inches annually. Exports: 1896, £226,963; 1900, £407,592, the principal items being almonds (51 per cent.), goat-skins, olive oil, beeswax, gums, and eggs. Imports : 1896, £225,430 ; 1900, £246,231. In the same year the port was entered and cleared by 143*~~

vessels of 132,326 tons, an increase of 6638 tons since 1896. Popu- lation, about 20,000.

Moghllev, a government of western Eussia, having Minsk on the W., Smolensk on the IST.E., and Chernigov on the E. and S. Its area occupies 18,551 square miles. It is built up of Devonian deposits in the north, of Cretaceous in the east, and of Tertiary elsewhere, but generally is covered with a thick layer of Glacial and later alluvial deposits. Interesting finds from the Stone Age, as well as remains of the mammoth, have been made. The population in 1898 was 1,717,291, of whom 861,533 were women, and 146,752 lived in towns (census of 1897). Both birth-rate (77,790 in 1897) and death-rate (47,158) are high. The population is mostly White Russian, and was distributed as follows according to re- ligion : Greek Orthodox, 1,426,347 ; Raskolniks, 26,286 ; Roman Catholics, 50,344 ; Protestants, 5651 ; Jews, 208,560 ; Mussulmans, 103.

In 1899, out of a total of 11,309,200 acres, 4,622,000 acres were held in communal ownership by the peasants, 5,776,300 acres were owned by landlords owning more than 270 acres each, and 399,000 acres by small owners. Most of the private owners belong to the nobility. At the same time 3,185,600 acres were under crops, and the produce

of the crops in 1899 was: wheat, 219,000 cwt.; rye, 5,353,700; oats, 2,893,600 ; of all cereals, 10,200,000 cwt. Flax, hemp, and tobacco are also grown. In 1897 there were 401, 960 horses, 470,770 horned cattle, 427,000 sheep, and 439,150 swine. In the same year 820 factories employed 6885 hands, but showed an aggregate return of only £528,400. Paper, spirits, wire and nails, leather, and tiles were the chief products. Nearly 60,000 children were in receipt of education. The province is divided into 11 districts, of which the chief towns, with their population in 1897, were : Moghilev-on-Dnieper, or Moghilev Gubernskiy (43,106 in 1897), Chausy (5550), Cherikoff (5250), Gomel (35,846), Gorki (6730), Klimovichi (4706), Mstislavl (8467), Orsha (13,161), Rogacheff (9103),

~~*Staryi Bykhov (6354), and Syenno (4061). Shklov, another town, has 10,630 inhabitants. (p. A. K.)*~~

~~*Moguer, a town of Spain, in the province of Huelva, on the Eio Tinto, not far from the sea. The population, 8750 in 1887, was only 7689 in 1897. The streets are regular, and contain many modern houses. There are distilleries and flour mills, and vessels of light draught can come up to the town. There is an active export of wine and oil.*~~

~~*Mohl, Hugo von (1805-1872), German botanist, was born at Stuttgart on 8th April 1805. He came of a family connected on both sides with the higher class of state officials of Wiirtemberg, and he and his three brothers justified by their distinguished careers their excellent early education at home. While a pupil at the gymnasium he pursued botany and mineralogy in his leisure time, till in 1823 he entered the University of Tubingen. After graduating with distinction in medicine he went to Munich, where he met a distinguished circle of botanists, and found ample material for research. This seems to have determined his career as a botanist, and he started in 1828 those anatomical investigations which he continued till his death. In 1832 he was appointed professor of botany in Tubingen, a post which he never left. Unmarried, his pleasures were in his laboratory and library, and in perfecting optical apparatus and microscopic preparations, for which he showed extraordinary manual skill. He was largely a self-taught botanist from boyhood, and, little influenced in his opinions even by his teachers, preserved always his independence of view on scientific questions. He received many honours during his lifetime, and was elected Foreign Fellow of the Eoyal Society in 1868. Von Mohl's writings cover a period of forty-four years ; the most notable of them were republished in 1845 in a volume entitled Vermischte Schriften. (For lists of his works see Botanische Zeitung, 1872, p. 576, and Boyal Soc. Catalogue, 1870, vol. iv.) They dealt with a variety of subjects, but chiefly with the structure of the higher forms, including both rough anatomy and minute histology. The word " protoplasm " was his suggestion ; the nucleus had already been recognized by Brown and others, but von Mohl showed in 1844 that the protoplasm is the source of those movements which at that time excited so much attention. He recognized under the name of " primordial utricle " the protoplasmic*~~

~~*lining of the vacuolated cell, and first described the behaviour of the protoplasm in cell- division. These and other observations led to the overthrow of Schleiden's theory of origin of cells by free- cell-formation. His contributions to knowledge of the cell-wall were no less remarkable ; he held the view now generally adopted of growth of cell-wall by apposition. He first explained the true nature of pits, and showed the cellular origin of vessels and of fibrous cells ; he was, in fact, the true founder of the cell theory. Clearly the author of such researches was the man to collect into one volume the theory of cell-formation — this he did in his treatise Die Vegetabilische Zelle (1851), a short work translated into English (Ray Society, 18513). Von Mohl's early investigations on the structure of palms, of cycads, .and of tree-ferns permanently laid the foundation of all*~~

~~*later knowledge of this subject : so also his work on Isoetes (1840). His later anatomical work was chiefly on the stems of dicotyledons and gymnosperms ; in his observar tions on cork and bark he first explained the formation, and the origin of different types of bark, and corrected errors relating to lenticels. Following on his early demonstra- tion of the origin of stomata (1838), he wrote a classical paper on their opening and closing (1850). In 1843 he started in conjunction with Schlechtendal the weekly Botanische Zeitung, which he jointly edited till his death. He was never a great writer of comprehensive works ; no text-book exists in his name, and it would indeed appear from his withdrawal from co-operation in Hofmeister's Handbuch that he had a distaste for such efforts. In his latter years his productive activity fell off, doubtless through failing health, and he died suddenly at Tubingen on 1st April 1872.*~~

~~*iSee Sachs, History of Botany, p. 292, &c. — De Bart, Botanische Zeitung, 1872, p. 561. — Boy. Soc.Froc. vol. xxiii. p. 1. — AUgemeine Deutsche Biographic, vol. xxii. p. 55. (j . o. B.)*~~

~~*Mohmand Campaign, The. — The year 1897 witnessed an almost general outbreak among the tribes on the north-west frontier of India. The tribes involved were practically independent, but the new frontier arranged with the Amir of Afghanistan, and demarcated by Sir Mortimer Durand's commission of 1893-94, brought them within the British sphere of*~~

~~influence. The great dread of these high-spirited mountaineers was annexation, and the hostility shown during the demarcation led to the Waziri expedition of 1894. Other causes, however, con- tributed to bring about the outbreak of 1897. The easy victory of the Turks over the Greeks gave rise to excite- ment throughout the Mahommedan world, and the publica- tion by the Amir of Afghanistan, in his assumed capacity of king of Islam, of a religious work, in portions of which fanatical antipathy to Christians was thinly veiled, aroused a warlike spirit among the border Mahommedans. The growing unrest was not recognized, and all appeared quiet, when, on 10th June 1897, a detachment of Indian troops escorting a British frontier oflBcer was- suddenly attacked during the mid-day halt in the Tochi valley, where, since the Waziri expedition of 1894-95, certain armed posts had been retained by the Government of India. On the 29th July, with equal suddenness, the fortified posts at Chakdara and Malakand, in the Swat valley, which had been held since the Chitral expedition of 1895, were for several days fiercely assailed by the usually peaceful Swatis under the leadership of the Mad IMullah. On 8th August the village of Shankaghar, within a few miles of Pesha- wur, and in British territory, was raided by the Moh- mands, while the Afridis besieged the fortified posts on the Sam ana ridge, which had been maintained since the expeditions of 1888 and 1891. Finally, the Afridis, within a few days, captured all the . British posts in the Khyber Pass. A division commanded by Major-General Sir Bindon Blood was assembled at ISTowshera. The post at Malakand was reached on 1st August, and on the following day Chakdara was relieved. The punishment of the Afridis was deferred till the preparations for the Tirah campaign (see Tirah) could be completed. The Mohmands, however, could be immediately dealt with, and against them the two brigades of Sir Biudon Blood's division advanced from Malakand simultaneously with the movement of another division under Major-General (afterwards Sir Edmund) R. Elles from Peshawur ; it was intended that the two columns should effect a junction in Bajaor. About the 6th September the two forces advanced, and Major-General Blood reached Nawagai on 14th September, having detached a brigade to cross the Eambat Pass. This brigade being sharply attacked in eauip at Markhanai at the foot of the pass~~

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on the night of the 14th, was ordered to turn north- wards and punish the tribesmen of the Mamund valley. On the 16th Brigadier- (afterwards Major-) General Jeffreys camped at Inayat Killa, and on the following day he moved up the Mamund valley in three columns, which met with strong resistance. A retirement was ordered, the tribesmen following, and when darkness fell the general, with a battery and a small escort, was cut off, and with difficulty defended some buildings until relieved. The casualties in this action numbered 149. This partial reverse placed Major-General Blood in a position of some dif&culty. HIe determined, however, to remain at Nawagai, awaiting the arrival of Major-General Elles, and sent orders to Brigadier-General Jeffreys to prosecute the operations in the Mamund valley. From the 18th to the 23rd these operations were carried on suc- cessfully, several villages being burned, and the Mamunds ■ were disheartened. Meanwhile, the camp at Nawagai was heavily attacked on the night of the 20th by about 4000 men belonging to the Hadda Mullah's following. The attack was repulsed with loss, and on the 21st Generals Blood and Elles met at Lakarai. The junction having been effected, the latter, in accordance with the scheme, advanced to deal with the Upper Mohmands in the Jarobi and Koda Khel valleys, and they were soon brought to reason by his successful and well-conducted operations. The work of the Peshawur division was now accomplished, and it returned to take part in the Tirah campaign. Its total casualties were about 30 killed and wounded. On the 22nd Major-General Blood joined Brigadier-General Jeffreys, and on the 24th he started with his staff for Panjkora. Onthe27th Brigadier-General Jeffreys resumed punitive operations in the Mohmand valley, destroying numerous villages. On the 30th he encountered strong opposition at Agrah, and had 61 casualties. On 2nd October Sir Bindon Blood arrived at^ Inayat Killa with reinforcements, and on the 11th the Mohmands tendered their submission. The total British loss in the Mohmand valley was 282 out of a force which never exceeded 1200 men. After marching into Bunar, and revisiting the scenes of the Ambeyla expedition of 1863, the Malakand field-force was broken up on 21st January. The objects of the Mohmand expedition were completely attained, in spite of the great natural difficulties of the country. The employment of imperial service troops with

~~*the Peshawur column marked a new departure in frontier campaigns. (c. J. b.)*~~

~~*Moji^ a Japanese town on the Kiushiu side of the Shimonoseki strait. The strait being only oiie mile in width, Moji and Shimonoseki would be practically the same port did not the swiftness of the current along the latter shore make it convenient for vessels to anchor on the Moji side. Moji is one of the places voluntarily opened by the Japanese for purposes of direct export. It is the starting point of the Kiushiu railway, and as there is abundance of coal in its neighbourhood, it promises to become a town of great importance. In 1890 it was little more than a hamlet, but it had in 1901 a popula- tion of 26,274, and its foreign trade aggregates nearly £700,000.*~~

~~*Mokha. See Arabia.*~~

~~*Mola di Bari, a seaport town of the province of Bari, Apulia, Italy, on the Adriatic coast, 12 miles east- south-east o'f Bari by the railway to Brindisi. Popula- tion (1881), 12,070 ; (1899), 13,000.*~~

~~*Mold, contributory parliamentary borough, market town, and railway station of Flintshire, Wales, 11 miles west by south of Chester. There are extensive collieries.*~~

~~*potteries, limestone quarries, and lead mines in the neigh- bourhood. Population (1891), 4457 ; (1901), 4263.*~~

~~*Molenbeek-Saint-Jean, a town of Belgium, in the province of Brabant, north-west of Brussels, one of the eight communes constituting the capital, with a station on the suburban railway running round the city. It has been called the Manchester of Belgium, on account of its great manufacturing establishments. The popula- tion (communal) (1880), 41,737 ; (1900), 68,445.*~~

~~*), Seot*~~

~~*Molesworth, Mary Louisa (1839- tish writer, daughter of Major-General Stewart, of Strath, N.B., was born in Rotterdam, 29th May 1839, and was*~~

~~*educated partly in Great Britain and partly abroad. In 1861 Miss Stewart married Major E. Molesworth. She began writing stories while quite young, and her first novels (Lovet and Husband, 1869, to Cicely, 1874) ap- peared under the pseudonym of " Ennis Graham." Mrs Molesworth is best known, however, as a writer of books for the young. Her Tell Me a Story (1876), Carrots (1876), and The Cuckoo Clock (1877) at once established her reputation in that line, and were succeeded by many others.*~~

~~*Molfetta, a seaport town and episcopal see of the province of Bari, Apulia, Italy, on the Adriatic coast, 16 miles north-west of Bari by rail. It has manufactures of macaroni and olive oil, shipbuilding, brickworks, fish- ing, and an active coasting trade, the port being cleared by approximately 250,000 tons annually. Population (1881), 29,697 ; (1899), about 30,000.*~~

~~*Moline, a city of Eock Island county, Illinois, U.S.A., on the east bank of the Mississippi river, adjoin- ing Eock Island, and opposite the upper end of the island, in the north-western part of the state, at an altitude of 674 feet. It has four railways, the Chicago, Burling- ton and Quincy, the Chicago, Milwaukee and St Paul, the Chicago, Eock Island and Pacific, and the Davenport, Eock Island and North-western. In 1900 the city con- tained 157 manufacturing establishments, with a total capital of f 11,165,701, an average number of 4438 wage- earners, and products valued at $10,000,282. Moline is noted for its manufacture of agricultural implements, and especially for its farm waggons. Population (1890), 12,000 ; (1900), 17,248, of whom 6699 were foreign-born and 268 were negroes.*~~

~~*Molique, Wilhelm Bernhardt (1802-1869), German violinist and composer, was born at Nuremberg, 7th October 1802, and learnt the violin at Munich under Pietro Eovelli. In 1826 he became music-director at Stuttgart. As a composer for the violin Molique was commonly compared with Spohr. Some of his songs, too, were charming, and have survived. He died at Cannstadt in 1869.*~~

~~*MoMusca. — Until comparatively recently, the num- ber of types of Mollusca which had been studied from the morphological standpoint was relatively inconsiderable. The different subdivisions of the group thus*~~

~~seemed quite distinct and easily characterized ; and the really intimate relations between them were not apparent. The first, but fruitless, attempt at a phylogeny of Mollusca was made by von Jhering (1) in 1877 — that is to say, at a time when our knowledge of the organization and development of these organisms was still inadequate. But, a decade later, numerous studies were begun with the aim of investigating the more primitive forms in each group, and thus of throwing light on morphology by means of phylogeny. The article by Eay Lankester in an earlier volume of this work (ninth ed., vol. xvi.) contributed not a little to the genesis of this movement ; hence the~~

~~fact that since its publication our knowledge of Molluscs has made such great strides, the cause being, not so much the large number of memoirs as the phylogenetic tendency of many of them. (See list at the end of this article.)~~

~~Classification. — It has not been necessary to alter the boundaries of the group, but the genus Ehodope has been definitely removed as a Platylielminth (Buhmig, li). The affinity of the Aplacophora and Chitonidae to one another has been completely confirmed, and the molluscan nature of these two subdivisions is now hardly questioned. The only three modifications in the general classification which have been introduced since the ninth edition of this Encyclopaedia are as follows : — (a) the class Cephalopoda contains only the Siphonopoda of Lankester, the Pteropoda being excluded ; (b) the class Gastropoda comprises only the Anisopleura of Lankester plus the Pteropoda (Boas, 4, and Pelseneer, 5), a more complete knowledge of the Aplacophora and Polyplacophora having shown that the Isopleura of Lankester form a distinct class = the Araphi- neura of von Jhering ; (c) on the other hand the class Lamellibranchia no longer constitutes a distinct " branch," in contrast to the remaining MoUusca ; as a result of the work of Pelseneer (6), it is recognized as having great special affinity to the Gastropoda and~~

~~*Scaphopoda, these three groups being capable of union into one branch, the Pro- rhipidoglossoniorpha (Grobben) ; the name being taken from their common ancestor Prorhipidoglossum (Pelseneer). The following table summarizes the division into classes ■which is generally adopted at the present day : —*~~

~~*Phylum Mollusca. Class I. Amphiueura „ II. Gastropoda] g j^*~~

~~*„ III. Scaphopoda !•„,..., „ IV. LamembranchiaJ^o^'^iP"^°SlosBomorpha*~~

~~*„ V. Cephalopoda*~~

~~*Morphology. — The general morphological characters are obviously those of the more primitive forms of the different classes, for in each class the same specializations may be observed — the loss of shell, foot, ctenidia, and radula. This is the case not only in Lamellibranchia, but also in numerous Gastropoda (EulimidcB, Pyrami- dellidae, Coralliophilidas, Phyllidiidae, Thetyidse, &c.), in several Aplacophora, and even in Cephalo- poda (CirroteuthidLe). The nervou^ system consists of two pedal cords and two pallial cords, united by a supra-oesophageal (cerebral) commissure which innervates the principal sense-organs, and also by an infraoesophageal (labial) commissure, from which arise the stomato- gastric nerves. The alimentary canal exhibits a radula-sac on its anterior portion. The circu- latory system is closed, allowing no water to enter the blood ■ respiration is efiected by a pair of ctenidia. The ccelom is represented only by the gonad and the pericardium ; and is not an^ enterocoel, for its wall is derived from endo- dermal elements in the neighbourhood of the blastopore • these sink down between the adjacent cells, or divide giving rise to other elements which interpose themselves between ectoderm and endoderm. The dorsal invagination for the shell-gland, often present as early as a gastrula- stage, is notable as forming the mantle and secreting the embryonic shell. The Schenmlio Mollusc (the Archimollvsc of Lankester) is a generalized hypothetical type which summarizes the principal features which we believe to have been possessed by those ancestral organisms from which have descended all the classes of Molluscs existing at the present day. In addition to many of the general mor^ phological characters just enumerated, it may be*~~

~~conceived to have possessed a symmetrical organization, with the anal orifice at the posterior extremity, and on the dorsal surface a shell which was not covered by mantle-folds. 1~~

~~The two portions of the primitive coelom were continuous, namely, the anterior or gonadial and the posterior or pericardial ; each of these possessed its pair of nephridia (retained in some Cephalopoda and Polyplacophora), an anterior or genital pair, a posterior or renal pair.~~

~~Class I. Amphineura { = Isopleura). — Without torsion, possess- ing an elongate body, a, heart, posterior anal and renal openings, and spicules in the integument ; no visceral commissure. Subclass A. PoLYPLACOPHoaA. — Mantle with a shell of eight articulated valves ; foot for crawling ; ctenidia metamericaJlv segmented ; one pair of genital nephridia. Families: Lepido- pleiiridse, Ischnochitonidae, Acanthochitonidffi, Cryptoplacidae, Chitonidae. Subclass B. Aplacophora. — Foot vestigial ; mantle occupying the whole surface of the body, and devoid of shell ; gonads opening into the pericardium. Order 1. Ncomenioidea. — A longitudinal ventral groove ; the foot represented by a ciliated ridge; gonads paired, hermaphrodite. About forty species, distributed not only in the northern hemi- sphere, but also in the Malayan, Australian, and Antarctic regions. Principal genera : Keomenia, Tullberg ; Paramenia, Pruv. ; Proneonienia, Hubr. ; Ismenia, Pruv. ; Lepidomenia, Kowal. Mar. ; Uondersia, Hubr. Order 2. Ghcetodermoidea. — No pedal ridge ; two ctenidia, posterior, symmetrical, and bipectiuate ; sexes separate. Genus : Chaeto- derma, Loven. The shell of the Polyplacophora is foimed of two layers — the one deep and compact (articulamentum) ; the other (tegmentum) is alone to be seen externally, and is pierced by numerous vertical canals~~

~~Fig. 1. — Pallial Eye and ^Esthetes ot Amntliopleura apiniger (iloseley).~~

~~througli which pass sense-organs. The tegmentum is a secondary structure derived from the edges of the mantle which overlap the border ot the articulamentum. The pallial sense-organs which per orate the tegmentum are epithelial papilte, innervated by the paUial cords containing nerve-end bulbs, and covered by a dome 01 cuticle ; they are termed, according to size, micrsesthetes and megatesthetes lu some cases~~

(Touicia, Choetopleura) megala;s- thetes are modified into eyes, formed by a deep retina, a fens, a calcareous cornea and an envelope of pigment (15). The ctenidia 01 the 1 olyplacophora are metainericaliy segmented, and form from lour to eighty pairs. They are arranged on both sides of the body in rows between mantle and foot, as holobranchs or merobranchs. I lie largest pair of branchia. is placed immediately behind the renal openings, and corresponds to the two ctenidia of other Molluscs the orignial ctenidia being repeated anteriorly and posteriorly in the Jlesomacrobranchs, anteriorly only in the Motnmacrobranohs. In adults of various species, the number of m-ancliia; is greater than in young specimens ; and there is often a numerical asymmetry on the two sides.

*In all Amphiueura (including Neomeniidfe.) there is a true heart ve, el 'Z ”² ^^tr^^l^ f”™ied of the hinder part of the dorsal oZfL , “‘f *”“‘f ’” Po yplacophora has two lateral auricles, continuous posteriorly, with which it communicates bv one o[- more oveiiings, which occasionally are asvumietri.'al. The exten-*

ofTl,:”, ,1? /. °’ “;’ ‘“‘P’;?’^” ‘•’^””«™“y proportionate to that atelv in fro? f ^'t'\f'%- The external opening is placed immedi- >f ,H„ :Vf °“1? ^“5”’ branchia. The gonad is paired iu Nuttalochiton and the Neomeuiidre ; in other cases it is sin-le*

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It always occupies tlie whole dorsal and anterior region of the bodj' in front of the pericardium. The genital ducts of the Polyplacophora have the same arrangement as the renal nephridia, bent slightly forward. They are not directly continuous with the wall of the gonadial cavity, which they place in co)uinunication with the exterior ; but each commences by a large ciliated funnel ; they are, in fact, an anterior pair of nephridia, like the genital ducts of the Cephalopoda. The Chitons are therefore no less jirimitive in this respect than Molluscs the gonads of which open to the interior of the renal nephridia ; on the contrary they are more primitive than most MoUusca, as having retained two pairs of nephridia, the

anterior serving as gonaducts. fhe genital opening is slightly in front of the renal ; between the two are one or more pairs of branchife (at most, nine, in Cryptoplax larvseformis). In the Aplacophora the generative organs open into the pericardium ; the nephridia thus serve as genital ducts, and exhibit accessory glands in their course ; they often unite into a single median aperture in the cloacae (Neomeniidae). Witli regard to the nervous system, in addition to anastomoses between the pedal cords, there are in the majority of species pallio-pedal anastomoses between the pedal and pallial cords of the same side. Further, in certain Aplacophora (Chsetoderma and Paramenia) the pallial and pedal cords of the same side unite posteriorly into a single cord. The two lateral cords always unite posteriorly above the rectum, often prodncing a ganglionic swelling. There is no visceral commissure ; the generative and renal glands and heart are innervated from the jiallial cords. The labial or infra-cesophageal commissure of Polyplacophora gives rise to a stomato-gastrio commissure, the two branches of which unite above and below the alimentary canal ; and also to a second infra- cesophageal or subradular commissure with ganglia and sense- organs, which lies in front of the radula. This labial commissure, with subradular commissure and organs, corresponds to the parts of the same name in Soaphopoda and Cephalopoda. In addition to the subradular organ, adult Chitonids sometimes have pallial eyes (see above), and generally an osphradium on each side, not one at the base of each otenidium. This organ is a sensitive spot on the inner face of the mantle outside the branchial region, near the largest branehia, and innervated from the pallial cord.

In the Polyplacophora (16, 17) the embryo becomes a trocho- phore with apical ciliary tuft in the centre of the velar ring ; its large and long foot gland [byssus gland] atrophies in the adult. The dorsal cuticle calcifies to form the shell- plates, of which often only the anterior seven are found at first. In each lateral groove, immediately behind the velum, is a larval eye corresponding to the cephalic eye of Lamellibranohia (18). In the Neomenioidea (19) the ova develop into an invaginate gastrula which becomes a trochophore with posterior blastopore, anterior ciliated ring on the velum, and central apical flagellum. The external surface of the trochophore is formed of ciliated "test cells," which ultimately disappear, as in Yoldia (Fig. 2) ; beneath them is formed the future mantle. On the

trochophore becoming a larva, spicules appear under the mantle, and the dorsal face is covered by seven imbricated calcareous plates, formed by apposed flattened spicules (Ficr. 3, C).

The Polyplacophora present the most archaic characters among the Amphi- neura ; the Aplacophora, on the contrary, „ „ „ ,. . „ Tj,. are the more specialized in the following

‘\J;;;^TiXt“70 hot: Points-a) the reduction of the foot; old (Drew). (2) the disappearance of the shell (one of

the Polyplacophora shows how these two reductions result simnltaneously) ; (3) the loss of the anterior nephridia ; (4) the absence of the radula in several forms.

Branch FrorhipidoglossomOTpha. — These organisms are char- acterized by the presence of a visceral commissure in the nervous system, and by the absence of genital nephridio-duots ; the gonads open either into the kidneys, or more or less close to their external apertures, by means of ducts formed at the expense of part of the renal nephridia.

Class II. Gastropoda. — Their essential character is a loss of symmetry, produced by torsion of the visceral sac. This torsion may be resolved into two successive movements — the first is a ventral flexure in the antero- posterior or sagittal plane ; the result of this is to approximate the two ends of the alimentary canal. In development, the openings of the mantle- cavity and the anus are always originally posterior ; later they are brought forward ventrally. During this first movement flexure is also produced by the coiling of the visceral sac and shell ; primitively the

latter was bowl-shaped; but the ventral flexure, which brings together the two extremities of the digestive tube, gives the visceral sac the outline of a more or less acute cone. The shell necessarily takes this form also ; and then becomes coiled in a dorsal or anterior plane— that is to say, it becomes exogastrio. This con- dition may be seen in embryonic Patellidae, Fissurellidse, and

~~*Fig. 3. — D(mderHa banifidensis (Pruvot). A, larva of 36 hours ; B, larva of 100 hours ; C, young animal of 7 days.*~~

~~*Trochidae, and agrees with the method of coiling of a Mollusc with- out lateral tor.sion, such as Nautilus. But ultimately the coil becomes ventral or endogastric, in consequence of the second torsion movement then apparent, the first being inadequate to approximate the two extremities of the digestive tract. The elongation for crawUug of the ventral surface, which primitively was very short, not only prevents the approximation of these two extremities, but actually tends to separate them. The second movement is therefore a lateral torsion of the visceral mass, which forcibly effects this approximation ; the foot remaining a fixed point, this torsion occurs in a plane approximately at right angles to that of the first movement, and carries the pallial aperture and the anus from behind forwards. If, at this moment, the animal were placed with mouth and ventral surface turned towards the observer, this torsion carries the circumanal complex in a clock- wise direction (along the right side in dextral forms) through 1 80° as compared with its primitive condition. The (primitively) right- hand organs of the complex thus become left-hand, and vice versd. The visceral commissure, while still surrounding the digestive tract, becomes looped ; its right half, with its proper ganglion, passes to the left side over the dorsal face of the alimentary canal (whence the name supra-intestinal), while the left half passes below towards the right side, thus originating the name infra-intestinal given to this half and to its ganglion. Next, the shell, the coil of which was at first exogastrio, being also entangled in this rotation through 180°, exhibits an endogastric coiling. This, however, is not generally retained in one plane, and the spire projects, little by little, on tlie side which was originally left but finally becomes right (in dextral forms, with a clockwise direction, if viewed from the side of the spire ; but counter-clockwise in sinistral forms). The direction of involution of the shell thus corresponds to that of the lateral torsion. Finally, the original symmetry of the circum- anal complex vanishes ; the anus leaves the centre of the pallial cavity and passes towards the right side (left side in sinistral forms) ; the organs of this side become atrophied and disappear. The essential feature of the asymmetry of Gastropoda is the atroply or disappearance of the primitively left half of the circumanal complex (the right half in sinistral*~~

forms), because the direction of coiling is in relation both to that of the asymmetry and to that of the torsion ; the sinistral involution corresponds exactly to a situs inversus viscerutn of a Gastropod with dextral coil (Physa, Clausilia, Triforis, &c.) But there are forms in which the in-volution is "hyperstrophio," that is to say, the turns of the spire projecting but slightly, the spire, after flattening out gradually, finally becomes re-entrant and transformed into a false umbilicus ; at the same time that part which corresponds to the umbilicus of forms with a normal coil, projects and constitutes a false spire ; the coil thus appears to be sinistral, although the asymmetry remains dextral, and the coil of the operculum (always the opposite to that of the shell) sinistral (Lanistes among Streptoneura, Limacinidae among Opisthobranohia). The same, mutatis mutandis, may occur in sinistral shells.

The characteristic torsion attains its maximum effect among the majority of Streptoneura. It is followed in some specialized " Heteropoda " and in the Euthyneura by a torsion in the opposite direction or detorsion, which brings the anus farther back, and untwists the visceral commissure (see Euthyneura, below). This conclusion has shown that the Euthyneura do not represent an archaic form of Gastropoda, but are themselves derived from streptoneurous forms. The difference between the two subclasses has been shown to be slight ; certain of the more archaic Tecti- branchia (Actaeon) and Pulmonata (Chilina) still have the visceral commissure long and not untwisted. The fact that all the Euthyneura are hermaphrodite is not a fundamental difference ;

several Streptoneura are so likewise (Valvata, Onchidiopsis, Mar- senina, Odostomia, Bathysciadium, Entoconcha).

Subclass A. Streptoneuka. — The old division into Zygo- branohia and Azygobranchia must be abandoned, for the Azygo- branchiate RhipiUoglossa h.ive much greater affinity to the Zygobranchiate Haliotidae and FissurelliJse than to the Azygo- branchia in general, properly so called. This is shown by the labial commissure and pedal

~~*cords of the nervous system, by the opening of the gonad into the right kidney, and by other points. Further, the Pleurotomariidse have been discovered to possess two branchife.*~~

~~*Order I. Scutibranchia. — A general symmetry of the nepbridia and auricles ; pedal cords with multiple anastomoses ; bipectinate ctenidia ; the genital products escape to the exterior by the right nephridium (except Helicinidae). SsyxhorAer A. llocoglossa. Radula with the lateral teeth few in number, generally beam — shaped ; the heart is not traversed by tlie rectum, and has but one auricle. Families : Acmeeidas, Patellidfe, Lepetidie, Bathyseiadiidas. Sub- order B. Ehipidoglossa. Radula with numerous lateral teeth, disposed in a fan ; heart traversed by the rectum, and provided with two auricles. Families : Pleurotomariidse, Fissurellidee, Haliotidae, Trochidae, Stomatellidae, Delphinulidae, Turbinidffi, Neritidse, Titiseaniidse, Helicinidae.*~~

~~*The bipectinate bianchise are only paired in Pleurotomaria, Fissurellidfe, and Haliotidte. In Scissurella the right branchia is only monopectinate ; in other cases it is absent (Acmsea, Trochus, Nerita, &c.) ; but the left is always bipectinate in them. In the Helicinidae, which are terrestrial and physiologically Pneumo- chlamydate although morphologically Rhipidoglossate, there is neither branchia nor osphradium, but the pallial chamber with a large opening serves as a lung. The shell wliich at times is largely overspread by the mantle in certain Fissurellidae, is entirely internal in Pupilia, and absent from Titiscauiidae. Each pleural ganglion anastomoses with the opposite half of the visceral commissure by its pallial nerve (dialyneury) in the Ehipidoglossa, but not in the Docoglossa. The gonad opens into the right kidney, connexion being made through a permanent opening or a papilla, at any rate in various Rhipidoglossa ; but the Neritidae have lost tlie right kidney, and consequently have an external generative opening. The trochosphere has a shell which is at first exogastrically coiled, and has a posterior pallial chamber ; torsion commences late.*~~

~~*Order II. Pectinibranchia. — One branchia only present ; mono- pectinate (except in Valvata) ; gonad opening to the exterior by its own duct. The former classification into Holochlamyda, Pneumo- chlamyda,*~~

~~*and Siphonoehlamyda must be abandoned, as the Pneumochlamyda and Siphonoehlamyda are polyphyletic ; the Helicinidse in particular can no longer be retained in the former, as being Scutibranchia Ehipidoglossa, with close affinity to the Neritidae. Suborder A, Tcenioglossa, Radula with three rows of teeth on each side of the median. This suborder includes two groups : — 1. Platypoda (Eeptantia), comprisingthegreat majority of the families of Streptoneura ; 2. Heteropoda (Natantia), containing the families Atlantidae, Carinariidae, Pterotracheidae. Suborder B. Stenoglossa. The radula narrow, with only one lateral tooth on each side, in each transverse row ; all are siphonate. Group 1. Ehachiglossa. With a median tooth. Families : Fasciolariidoe, Turbinellidse, Mitridae, Buccinidae, Haliidae, Muricidae, Corallio- philidae, Cancellariidas, Volutidae, Olividie, Harpidae, Marginellidas. Group 2. Toxiglossa. No median tooth. Families : Conidae, Terebridie, Pleurotomatidiie.*~~

~~*Throughout, the pleural ganglia anastomose with the opposite half of the visceral commissure, or even with the corresponding ganglion, by a longer or shorter connective. In the more primi- tive Taenioglossa the osphradium is only a filiform prominence of epithelium (Littorina, Fig. 4) ; by further specialization it may develop pectinations on both sides, which may even be arborescent (Pteroceras, Gyprfea). It is absent from the Pulmonate forms ; in one of these (Gerithidea) it is replaced by a pallial eye, of structure analogous to those of Onohidium and the PeotinidiE. There are two larval nephridia — closed sacs in marine Pectinibranchia, tubes with an external opening in Paludina and Bithynia. The adult kidney develops at the expense of the ccelomic (pericardial) epi- thelium. In Paludina traces of the left kidney are recognizable, but atrophy, the ducts becoming the genital duct. The genital gland is formed in mesoderm as a cojlomio -region separate from the pericardium (Paludina). The branchia is formed by folds on the internal surface of the mantle. In pelagic Streptoneura (Heteropoda) we may observe a detorsion and return to an external symmetry concurrently with a retrogressive evolution of the shell, which is paralleled by Opisthobranchia : the Atlantidae have a coiled and well-developed shell, an operculum, ami prosobranchial- ism ; the GarinariidfE, an uncoiled and diminished shell, and no operculum ; the Ptcrotracbeidie, no shell and opisthobranchialism, or even abranchialism in Firoloida. The foot is*~~

~~*laterally com- pressed, and carries a sucker in the middle line (in the male only, among Pterotracheidae). In the nervous system the pleural ganglia are coupled to the cerebral and not to the pedal centres ; there is no dialyneury, but viscero-pedal anastomoses connect the ri^ht*~~

~~*pedal ganglion with the infra-intestinal, and the left with the supra-intestinal. In Garinariidae and Pterotracheidae the eyes are very voluminous, the retina of small extent, with rods arranged in grooves perpendicular to the optic axis.*~~

~~*Subclass B. Euthyxeura. — Among the essential characters which discriminate these from the Streptoneura, is notable not an absence of torsion, but an actual detorsion of the visceral com- missure. In several of the more primitive forms (Actaeonidae and*~~

~~*Fig. 4. — Littorina, dorsal view of nervous system (Bouvier) ; pi, p~, accessory pedal ganglia ; P, pedal ganglia ; Cq, left pleural ganglion ; Cd, right pleural -ganglion; c, cerebral ganglia; Sj), supra-intestinal ganglion; Sb, sub- intestinal ganglion ; F, abdominal ganglion ; Z^ dialyneuric anatomosis.*~~

~~*Limacinidae among Opisthobranchia, Chilinidae among Pulmonata) the same torsion occurs as in Streptoneura : prosobranchialism (Actaeon), a looped visceral commissure (Act8eon = ToTnatella, Chilina, and even slightly still in Bulla and Scaphander), the os- phradium to the left, innervated from the .supra-inteStinal ganglion (Actaeon, Limacina). This untwisting of the visceral commissure is the result of a general untwisting which gradually restores the anus and circumanal complex from the anterior region to the right side (Bulla, Aplysia), or even to a posterior position (Onchidium, Philine, straight Pteropoda, Thecosomata, Cavolinia, Clio, ka.).*~~

~~*In the latter the detorsion is complete, and consists in a rotation of 180° in a direction counter to the original Gastropod torsion ; it carries the pallial cavity on to the ventral surface by way of the right-hand side, and from this results in "straight Pteropods" the loop of the genital duct round the alimentary tract. An oper- culum is retained by the adult not*~~

~~only of Actaeon, but also in Limacinidae, Eingiculida;, and Amphibolidae (Pulmonata). The subclass contains two orders.~~

~~Order I. OpisthohrancMa. — The order contains two sections only, Tectibranchia and Nudibranchia ; the old Phyllidiobranchia being united with the latter ; indeed, the Phyllidia are Dorids, and the Pleurophyllidia are Eolids.~~

~~Section 1. Tectibranchia. — Characterized by the presence of a ctenidium and the asymmetry of their external form. Suborder A. Bulloida (including Pteropoda Thecosomata). Pallial cavity well developed. Families : Acta-onidae, Ringiculidss, Tornatinidae, Scaphandridae, Philinidte, Peltidfe, Lophocercido;, Limacinidae, Cymbuliida;, Cavoliniidfe (the three last forming the old Ptero- poda Thecosomata). Suborder B. Aplysioida. Pallial cavity greatly reduced or absent ; parapodia not continuous with the sole of the foot. Families : Aplysiida?, and the four families of Ptero- poda Gymnosomata — Pncumonodermatidte, Notobranchaeidse. Clionidii?, Halopsychidic. Suborder C. PUurobranchoUla. Pallial cavity absent; no parapodia. Families: Umbrellidte, Pleuro- branchidic.~~

~~Section 2. Niidibrmichia. — Characterized by the absence of ctenidia, and their external symmetry. Suborder A. Tritonioida. Holohepatic, with anus on the right side. Families : Tritoniidae, Seyllfeidffi, PhyllirhoidtE, Thetj-idfe. Suborder B. Doridoida. Holohepatic, with anus, median, and posterior. Families : Poly- ceratidae, Doridldae, Doridopsidae, Corambidce, PhyllidiidtE. Sub- order 0. Eolidoida. Cladohepatic, with simple oviduct. Families : Eolididfe, Glaucidae, Pleurophyllidiidae, Dotonids, Proctonotidip, Fiouidrc. Suborder D. Ehixioida. Cladohepatic, with bi^ircated oviduct. Families: Hermaeida?, Elysiidae, Limipontiida? (Fi". ,'i).~~

~~The borders of the solar face of the foot are often produced into fins or "parapodia," to be distinguished from the epipodia of the Aspidobranchia~~

~~*which are outgrowths of the sides of the foot and not of its ventral surface. These parapodia, wliioh*~~

~~*are greatly developed in Accra and Gastroptoron among Bul- loida, may even form a con- tractile sac right round the body (Notarchus) and constitute the fins of many Pteropods. The ctenidium is generally a lamina plicated in two directions alter- nately, and not a bipectinate appendage as in Streptoneura Aspidobranchia. It is absent from Nudibranchs, even from Dorids, the peri-anal leaf- like gills of which are homodyna- mous with the dorsal appendages of Tritonioida. Prosobranohial- ism occurs in Actseon, Limacina, &c., as in the Streptoneura. The hepatic caeca in the dorsal papillae of Eolidoida actually communicate with the cnido- genous sacs at their extremity ; cnidocysts are absent from Eolis glaucoides. The nervous system is concentrated dorsally in Pleurobranchoida and Nudi- branchia, but ventrally in Pteropoda Thecosoniata. The opening ; m, prostate ; n, vaginal osphradium is absent from opening ; q, reoeptaculum seminia. Nudibranchia, in which there*~~

~~*is an increase o[_ the tentacular olfactory organ (rbinophore) ; it is, however, retained by all Ptero- poda Gymnosomata, although they generally lack a ctenidium.*~~

~~*The free veliger of Nudibranchs is' followed by a creopin— planari- form stage which shortly loses its shell, and ultimately acquires dorsal papillae, beginning with the anterior. In Oenia (Elysioida) the young leave the egg in the adult shape ; there exists in this case, as in Pelta = Runcina among Tectibranchs, neither free veliger nor embryonic shell, these being the sole examples known among Opisthobranchia ; all the others have a larval shell, even the Pteropoda Gymnosomata, with the possible exception of Theceurybia = Halopsy ohe.*~~

~~*Tlie phylogenetio relations between Nudibranchia and Tecti- branohia become clear through the organization of the Pleuro- brancliioida ; in these there is neither pallial chamber nor osphradium, and respiration is largely pallial ; the shell may be entirely absent (Pleurobranchia) ; the nervous system is concen- trated dorsally ; spicules and cnidocysts exist in the dorsal integuments. The mantle of Doridoida is quite homologous*~~

with that of Pleurobranchoida, and in no case with an epipodium re-flected dorsally over the surface of the body.

Order II. Fulmonata. — (For the definition the article in vol. xvi.

Fio. 5. — Limajpontia nigra^ generative organs (Hancoclc) : a, penis ; d, albuminiparous gland ; h, herma- phrodite follicles ; j, oviduct ; k, mucous oviducal gland ; I, ovidxical

of this work should be consulted.) Suborder I. JBasommatophora. Families : Auriculidie, Amphibolidie, Siphonariadse, Chilinidae, Lininajidse, P^ano^bida;, Physidae. Suborder II. Stylo mTnalophora. The various slugs do not form a homogeneous gi'oup, but are poly-phyletic. Families:. Succineidae, Athoracophoridae, Pupidae, Helicidae, Philomycidae, Arionidae, Limacidae, Teatacellidse, Vaginu- lidae, Onchidiidae.

The Pulmonate ventricle is generally at the back of the heart ; this is explicable by the descent of Pulmonata from very primitive Tectibranohia, highly twisted forms alone carrying the ventricle behind (Testacella, Onchidium). The lung, which in the majority of cases is vascular, is tracheal in the Athoracophoridae. Among Stylommatophora, this organ is reduced in Onchidiidae (the marine forms of which acquire branchial mantle-tufts dorsally) and absent in Vaginulidae. Among Basommatophora, in addition to Limnaea of deep lakes the following admit water to the lung : — of marine forms, Amphibola, Gadinia, Siphonaria (this acquires a new pallial intrapulmonary gill) ; and of fresh-water forms, Ohilina and Plan- orbis nautileus. . Other fresh-waterBasommatophoradevelop a pallial extrapulmonary gill (Planorbis corneus, Pulmo- branchia (Fig. 6), Ancylus, the latter having lost all trace of a lung-cavity). The kidney almost invariably, notably among Stylommatophora, has a distinct ureter, opening more or less closely to the lung -aperture, sometimes at the extremity of the rectum. In Pythia of the Auriculidae,

the sperm duct is an open Fio. 6— Fidmdbranchla lamellata, with furrow from the hermaphro mantle partially cut out above the pul- dite opening to the penis ; in ”’™‘“7 opening and the gilL other members of the same

~~family it is tubular, and the bifurcation of the hermaphrodite duct occurs at some distance from the female opening, representing the primitive hermaphrodite opening. The penis is apparently inner- vated from the cerebral centre, but in fact from the pedal ganglion. In some less specialized Basoramatopliora the nervous system still exhibits a long commissure ; it is even slightly looped in Chilina. An osphradium occurs in development, even among Stylommatophora (Helix, Limax) ; among these, however, it is always on the right in dextral species, as is the vestigial osphradial ganglion of Auri- cula. The velum is vestigial, except in Auriculidae, Siphonariidae, Amphibolidffl, and Onchidiidae, where it is well developed. These families possess a larval operculum, retained till the adult stage by Amphibola. The eyes and part of the cerebral centres develop as ectodermal invaginations ; these cerebral cavities are preserved in adult Limnaea and Planorbis. In Clausilia and Succinea the shell arises in a sac which at first is entirely closed. The embryonic nephridia are bent tubes, which open to the exterior and terminate internally by a funnel with flame-cell. In the Basommatophora three perforated cells constitute the canal, a fourth forms the funnel.~~

~~Tabular View of t Toxiglossa-<-Rach iglossa~~

~~T I~~

~~Classification of the Class Gastropoda.•~~

~~Basommatophora->-Stylommatophora~~

~~Reptantia-^Natantia I I~~

~~Stenoglossa-<— Taenioglossa I I~~

~~Nudibranchia^Tectibranchia~~

~~Opisthobranchia~~

~~Pulmonata~~

~~Docoglossa-^Rhipidoglossa^~~

Peotinibranchia Aspidobranchia

I Streptoneura

Suthjmeura

Gastropoda

Class III. Scaphopoda. — The Scaphopoda hi-ve no ctenidia. "The cephalic filaments or captaoula are outgrowths of the paired dorsal cephalic lobes. The circulatory system has neither vessels nor well-developed muscular walls to the ventricle. The kidneys have no pericardial orifices ; the genital gland opens into the right kidney. The nervous system exhibits two pleural ganglia, ■each with oerebro-pleural and pleuro-pedal connectives, the latter

fusing immediately with the cerebro- pedal, ts in Nucula. An infracesophageal labial commissure gives origin to a stomatogastrio commissure (as in Aspidobranchia and Polyplacophora), and in- nervates a sensory subradial organ. The ova are laid singly, and segmentation is irregular ; invagination produces a gastrula with large blastopore original y at the posterior end of the embryo. The latter elongates, and acquires anteriorly ~· tuft of cilia, sur-

rounded by four circles of cilia, to form the velum. The blasto- pore remains open, and draws gradually towards the anterior end along the ventral surface. On the dorsal aspect spring two lateral pallial ridges, parallel and symmetrical ; these stretch towards the ventral surface, where they finally fuse to form a tubular mantle round the body. The shell which this mantle secretes, at first cup-shaped, little by little assumes the form of a tube, like the mantle, by union of its margins. On the ventral surface the^ foot appears as a prominence ; this becomes elongated anteriorly, and by its aid the animal can crawl after the disappearance of the velum. The cerebral ganglia arise as two ectodermal invagina- tions

~~*in the velar area ; the otocysts by invagination at the surface of the foot ; and the pedal ganglia, after the otocysts, by ecto- dermal thickenings. Ihe anus is perforated very late. After five or six days the velum atrophies, and the embryo begins to crawl. Families ; Dentaliidae, Siphouodentaliidse.*~~

~~*Class IV. LamellibranoMa. — The old classification, founded on the number of adductor muscles, can no longer be retained, the " Monomya " being polyphyletic. The degree of specializa- tion attained by different forms is well shown by the structure of the branchiae (ctenidia) ; using these, five orders may be distinguished.*~~

~~*Order 1. Frotobranchia. — Branchial filaments short, not flexed, not united by junctions, arranged in two series in opposite direc- tions. Families : Nuculids, Solenomyidse.*~~

~~*Order 2. Filibranchia. — Branchial filaments elongated, parallel, flexed, and united together by ciliary junctions. Families : AnomiidiE, Arcidee, Trigoniidje, Mytilidte.*~~

~~*Order 3. PseudolameUibranchia. — Branchial filaments with interfoliate junctions (vascular or connective) ; branchiae plicated ; posterior adductor muscle reduced or wanting ; foot slightly developed. Families : Ayieulidae, Ostraeidae, Pectinidae, Dimyidae.*~~

~~*Order 4. Eulavullibranchia. — P>ranchiae with interfilamentar and interfoliar unions, all of which are vascular ; mantle lobes united posteriorly at one or two points. This order includes the great majority of families, which are distributed among seven sub- orders ; Snbmytilacea, Tellinacea, Veneracea Cardiacea, Myaeea, Pholadaoea, and Anatinacea.*~~

~~*Order 5. Septibranchia. — Branchiae transformed into a muscular septum, which stretches from the anterior adductor to the separation of the two siphons, and surrounds the foot. Families : Poromyidae, Cuspidariidae.*~~

~~*As in other MoUusca, the edges of the mantle can be reflected over (Galeomma, Entovalva), or can even entirely conceal the shell, which is*~~

~~*absolutely internal in three genera, Chlamydoconcha, Ephippodonta, and Scioberetia. In the last the adductor muscles are absent, as in Aspergilluni. Both adductors are embryonically developed in all Lamellibranch';, the anterior ap- pearing always first, even in cases where it ultimately disappears. The retractor muscles of the foot correspond to the columellar muscle of Gastropoda. The foot has a ventral disc only in Frotobranchia and Pectunculus ; in other forms it exhibits very generally a cavity, the cells of which secrete a byssus for fixation of the animal. The liver occasionally presents an asymmetry, the left lobe being in such oases the larger (Nucnlidae). The epithelial covering of the auricles often constitutes pericardial glands ; other portions of the wall of the pericardium may penetrate into the mantle. In the Septibranchia, by abnormal development of their muscular elements, the branchiae form a muscular septum with symmetrical orifices ; respiration is effected by the internal surface of the mantle, over which the contractions of the septum force a powerful current of water. The two nephridia communicate with one another ; they extend sometimes into the mantle. The genital glands also communicate with one another in many forms ; and in some cases open into the kidneys. Many species are hermaphrodite, but while in some (e.g., Ostraea, Oardium) ova and spermatozoa arise side by side throughout the extent of the gland, in others (e.g., Pecten) male and female portions are distinct ; and in Poromya and Anatinacea there exist a pair of ovaries and a pair of testes entirely distinct, each with its proper orifice.*~~

~~*In the more archaic forms (Frotobranchia) the pleural ganglia are distinct, as in Gastropoda and Scaphopoda ; they are coupled to the cerebral, each giving rise to a pallial nerve, and a pleuro- pedal connective more or less promptly united to a oerebro-pedal connective. The existence of the pleural ganglia shows that no other visceral centre is fused with the cerebral, and that these are the posterior centres which correspond to the visceral ganglia of other Mollusca. The otocysts remain open to the exterior in some adult NuculidiE. The cephalic eyes observable in various larvse are retained in some adults on the anterior region of the branchial axis (Mytilus, Avioula, Fig. 7). A unique structure characterizes the pallial eyes of PectinidEe and of some species of Cardium.*~~

~~*The ova are laid separately (except in Nucula delphinodonta). A large number of Laraellibranohia retain the developing eggs in the branchial lamellae (Submytilacea, and fresh-water forms, except Dreissensi). Larval nephridia have been detected in several*~~

~~&•*~~

~~*Fig. 7. — Avicula, left view of anterior part of the body : pa, anterior palp ; pe, foot ; pp, posterior palp ; hy, byssus ; 6r, internal gill-plate ; &r2, external gill-plate ; m, reflected left mantle lobe ; o, eye (on the first internal gill filament).*~~

~~*Sepiolidae, Idiosepiidae, Sepiida-*~~

~~*Cirrbotenthidae, Octopodidae,*~~

~~*sub-groups, consisting of a deep canalicular portion, and a super- ficial portion which opens to the exterior postero-ventrally of the head ; the lumen is intracellular, with a flame cell.*~~

~~*In the Unionidae the larva ((jlochidium) is temporarily parasitic, and encysts in the skin of a fish, deriving sustenance by means of the ectodermal cells of the mantle from the epidermis of the host. Parasitic life lasts from two to five weeks.*~~

~~*Class V. Cephalopoda. — For definitions of the divisions, the article in vol. xvi. of this work should be consulted.*~~

~~*Subclass A. Tetrabkanohia. — This contains a single living genus. Nautilus, and numerous fossil genera (see article Cepha- lopoda).*~~

~~*Subclass B. Dibkanchia. Order 1. Decapoda. — Suborder (a) Qigopsida, with seven living f.imilies: Spirulidae, Ommato- strephidse, Physanoteuthidse, Onychoteuthidae, Gonatidae,*~~

~~*Chiroteuthidae, Cranchiidae.*~~

~~*Suborder (b) Myopsida. Families : riidae, Loliginidae, Sepiidae*~~

~~*Order 2. Octopoda. — Families ; Argonautidae, Philonexidae. The internal shell is greatly reduced ; it is purely chitinous in all Octopoda, forming an unpaired piece in Cirrhoteuthis, a pair of stylets in Octopus. In Argonauta alone the shell gland shallows out, without closing. In the Decapoda some allies of Sepiola are also shell-less. The tentacular arms atrophy in various (Egopsida. The hectocotylized arm belongs generally to the fourth pair in Decapoda, that of the left side only (Ommato-strephidiB, Onychoteuthidfe, and most Myopsida), or on both sides (Idiosepius, Spirula, Fig. 8). In Nautilus the spadix may be right or left. Some deep-water (Egopsida possess luminous organs. * The radula is absent from Cirrhoteuthis ; the ink-sao is also want- ing in this genus and in some species of Octopus. In Octopoda the pericardial part of the coelom is wanting. The ccelom includes only the genital capsule, which communicates with the capsules of the branchial hearts by long canals (absent in two families). The appendices of the branchial hearts are the morphological equivalent of the "pericardial glands" of other Mollusca ; their glandular wall is excretory. The nervous system presents the same labial commissure as do Amphi- nenra and Prorhipidoglossomorpha. 'ITie osphradium of Nautilus is placed against and protected by the interbranchial papilla. Certain pigmented organs of Cirrhoteuthis are supposed to be thermo- scopic. In those Octopoda in which the hectocotylus is not autotomous, it is intruded into the pallial cavity of the female so as to introduce spermatophores into the distal portion of the oviduct (Octopus) ; both arms of the dorsal pnir in Sepiolidae place the sperm.itophores in the neighbourhood of the female open- ing.*~~

~~*In Nautilus the ova, which are four or five millimetres long, are laid separately in two shells, the outer of which is partially opened. In the Dibranchia, the nerve-centres arise from ectodermal thickenings ; the brachial ganglia are formed by subdivision of the primitive*~~

~~*TlkuLTtnT PelseCer): P._^"! g?"S'"' thus showing the pedal F, Jfi, fins; Pd, dorsal °'"g" _o, the arms. Ihe external portion anterior mantle-lobe; T, of the orvstalline lens has a separate V.B^^.,. 5l'.="='?'^.'" ™" ; origin from the internal portion. The blastoderm of the egg forms the ecto- derm ; the primitive endoderm takes origin at the periphery of the ectoderm, spreading under and away from it, enclosing the yolk with a layer of large nuclei at its*~~

surface to form the perivitelline membrane. The remainder of the endoderm is in groat measure transformed into the mesoderm. The primitive endoderm being unable to surround itself with ectoderm to form a gastrula, the definitive endoderm appears rather lato in development ; a furrow of cells below the hinder part of the mantle in the middle line, derived, like the perivitelline membrane, from the primitive endoderm, gives rise to stomach, liver, and intestine. AurHORiTiEs.— 1. Von Jherino. Fergleicliendc Anatmnnic dcs

-2.

classifica-

tentacnlar arm ; r; II', IIV, left arms; 1, 11, III, ir, right arms.

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Molsheim, an ancient town of Germany, in tlie province of Alsace-Lorraine, knovTn in the 9th century as Molleshem, and formerly the seat of a famous Jesuit college, which in 1701 was removed to and united with the University of Strassburg. It has now manufactures of bayonets, swords, and hardware. Population, 4000.

Moltke, Helmuth Carl Bernhard,

Count von (1800-1891), Prussian field-marshal, for thirty years chief of the staff of the Prussian army, the greatest strategist of the latter half of the 19th century, and the creator of the modern method of directing armies in the field, was born 26th October 1800, at Parchim in Mecklenburg, of a German family of ancient nobility. His father in 1805 settled in Holstein and became a Danish subject, but about the same time was impoverished by the burning of his country house and the plunder by the French of his town house in Liibeck, where his wife and children were. Young Moltke therefore grew up in straitened circumstances. At the age of nine he was sent as a boarder to Hohenfelde in Holstein, and at the age of eleven to the cadet school at Copenhagen, being destined for the Danish army and court. In 1818 he became a page to the king of Denmark and second lieutenant in a Danish infantry regiment. But at

~~twenty-one he resolved to enter the Prussian service, in spite of the loss of seniority. HIe passed the necessary examination with credit, and became second lieutenant in the 8th Infantry Kegiment stationed at Frankfort-on-the-Oder. At twenty- three, after much less than the regulation term of service, he was allowed to enter the general war school, now the war academy, where he studied the full three years and passed in 1826 a brilliant final examination. HIe then for a year had charge of a cadet school at Frankfort-on-the- Oder, after which he was for three years employed on the military survey in Silesia and Posen. In 1832 he was seconded for service on the general staff at Berlin, to which in 1833 on promotion to first lieutenant he was transferred. HIe was at this time regarded as a brilliant officer by his superiors, and among them by Prince William, then a lieutenant-general, r.fterwards king and emperor. HIe~~

~~was well received at court, and in the best society of Berlin. HIs tastes inclined him to literature, to historical study and to travel. In 1827 he had published a short romance. The Two Friends. In 1831 it was followed by an essay entitled HIolland and Belgivm, in their Mutual Relations, from their Separation under Philip II. to their Reunion under William I., in which were displayed the author's interest in the political issues of the day, and his extensive historical reading. In 1832 appeared An Account of the Internal Circvmistances and Social Conditions of Poland, a second study of a burning question based both on reading and on personal observation of Polish life and character. In 1832 he contracted to translate Gibbon's Decline and Fall into German, for which he was to receive £75, his object being to earn the money to buy a horse. In eighteen months he had finished nine volumes out of twelve, but the publisher failed to produce the book and Moltke never received more than £25, so that the chief reward of his labour was the historical knowledge which he acquired. HIe had already found opj)ortunities to travel in South Germany and Northern Italy, and in 1835 on his promotion as captain he obtained six months' leave to travel in South-Eastern Europe. After a short stay in Constantinople he was requested by the Sultan to enter the Turkish service, and being duly authorized from Berlin he accepted the offer. HIe remained two years at Constantinople, learned Turkish and surveyed for the Sultan the city of Constantinople, the Bosphorus, and the Dardanelles. HIe travelled in the Sultan's retinue through Bulgaria and~~

~~*Eumelia, and made many other journeys on both sides of the Strait. In 1838 he was sent as adviser to the Turkish general commanding the troops in Armenia, who was to carry on a campaign against Mehemet Ali of Egypt. During the summer he made extensive reconnaissances and surveys, riding several thousand miles in the course of his journeys, navigating the dangerous rapids of the Euphrates, and visiting and mapping many districts where no European traveller had preceded him since Xenophon. In 1839 the army moved south to meet the Egyptians, but upon the approach of the enemy the general became more attentive to the prophecies of the moUahs than to the advice of the Prussian captain. Moltke resigned his post of staff officer and took charge of the artillery, which therefore, in the ensuing battle of Nisib, was the last portion of the Turkish army to run away. The Turks were well beaten and their army dispersed to the four winds. Moltke with infinite hardship made his way back to the Black Sea, and thence to Constantinople. HIs patron Sultan Mahmoud was dead, so he returned to Berlin, where he arrived, broken in health, in December 1839. When he left Berlin in 1834 he had already "the courtier's, soldier's, scholar's eye, tongue, sword." When he returned it was with a mind expanded by a rare experience, and with a character doubly tempered and annealed. While away, he had been a constant letter- writer to his mother and sisters, and he now revised and published his letters as Letters on Conditions and Events in Turleey in the Years 18S5 to 18S9. No other book gives so deep an insight into the character of the Turkish Empire, and no other book of travels better deserves to be regarded as a German classic. One of his sisters had married an English widower named Buit, who had settled in HIolstein. Her step-daughter, Mary Burt, had read the traveller's letters, and when he came home as a wooer was quickly won. The marriage took place in 1841, when Mary was just turned sixteen. It was a very happy union, though there were no children, and Moltke's love- letters and letters to his wife are among the most valuable materials for his biography. On his return in 1840 Moltke had been appointed to the staff of the 4th army corps, stationed at Berlin ; he was promoted major on his*~~

wedding day. The fruits of his Eastern travels were by no means exhausted. HIe published his maps of Con- stantinople, of the Bosphorus, and of the Dardanelles, and, jointly with other German travellers, a new map of Asia Minor and a memoir on the geography of that coun- try, as well as a number of periodical essays on various factors in the Eastern Question. In 1845 appeared The Russo-Turkisli Campaign in Europe, 1828-29, described in 18Ji5 hy Baron von Moltke, Major in the Prussiayi Staff, a volume which was recognized by competent judges as a masterpiece of military history and criticism. Moltke at this period was much occupied with the development of railways. HIe was one pf the first directors of the HIamburg-Berlin railway, and in 1843 publ ished a re- view article entitled What Considerations should deter- mine the Choice of the Course of Railways 1 which reveals a mastery of the technical ques- tions involved in the con- struction and working of railway lines.

In 1845 Moltke was ap- pointed personal adjutant to Prince HIenry of Prussia, a Roman Catholic who lived at Eome. HIe thus had the opportunity of a long stay in the Eternal City, with no more than nominal duties to perform. It was a life which he and his wife much en- joyed, and he spent much of his leisure in a survey, of which the result was a splendid map of Borne, pub- lished at Berlin in 1852. In 1846 Prince HIenry died, and Moltke was then appointed to the staff of the 8th army corps at Coblenz. In 1848, after a brief return to the great general staff at Berlin, he became chief of the staff of the 4th army corps, of which the headquarters were then at Magdeburg, where he re- mained seven years, during which he rose to lieutenant- colonel (1850), and colonel (1851). In 1855 he was ap- pointed first adjutant to Prince Frederick William (after- wards crown prince and emperor), whom he accompanied to England on his betrothal and marriage, as well as to Paris and to St Petersburg to the coronation of Alexander II. of Russia. Prince Frederick William was in com- mand of a regiment stationed at Breslau, and there as his adjutant Moltke remained for a year, becoming major- general in 1856. On the 23rd of October 1857, owing to the serious illness of King Frederick William IV., Prince William became prince regent. Six days later the regent selected Moltke for the then vacant post of chief of tlie general staff of the army. The appointment was made definitive in January 1858. Moltke's posthumously pub- lished military works disclose a remarkable

activity, be- ginning in 1857, devoted to the adaptation of strategical and tactical methods to changes in armament and in means of communication, to the training of staff officers in accordance with the methods thus worked out, to the perfection of the arrangements for the mobilization of the army, and to the study of European polities in connexion with the plans for campaigns which might become neces-

Field-Marshal von Moltke. {From a photograph hy Loescher and Petsch

sary. In 1859 came the war in Italy, which occasioned the mobilization of the Prussian army, and as a conse- quence the reorganization of that army, by which its numerical strength was nearly doubled. The reorganiza- tion was the work not of Moltke but of the king, and of Roon, minister of war ; but Moltke watched the Italian campaign closely, and wrote a history of it, published in 1862, and attributed on the title-page to the historical division of the Prussian staff, which is the clearest ac- count of the campaign and contains the best criticism upon it. In December 1862 Moltke was asked for an opinion upon, the military aspect of the quarrel with Denmark then becoming acute. He thought the diffi- culty would be to bring the war to an end, as the Danish army would if possible retire to the islands, where, as the

Danes had the command of the sea, it could not be at- tacked. He sketched a plan for turning the flank of the Danish army before the at- tack upon its position in front of Schleswig, and hoped that by this means its retreat might be intercepted. When the war began in February 1864, Moltke was not sent with the Prussian forces, but kept at Berlin. The plan was mismanaged in the execution, and the Danish army escaped to the fortresses of Dtippel and Fredericia, each of which com- manded a retreat across a strait on to an island. The allies were now checked ; Dtip- pel and Fredericia were be- sieged by them, Dtippel taken by storm, and Fredericia aban- doned by the Danes without assault ; but the war showed no signs of ending, as the Danish army was safe in the islands of Alsen and Funen. On the 30th of April Moltke was sent to be chief of the staff to the commander-in-chief of the allied forces, and, so soon as the armistice of May and June was over, persuaded Prince Frederick Charles to attempt to force the passage pf the Sundewitt and attack the Danes in

~~*the island of Alsen. The landing was effected on the 29th of June, and the Danes then evacu- ated Alsen. Moltke next proposed a landing in Funen, but it was unnecessary. The Danes no longer felt safe in their islands, and agreed to the German terms. Moitke's appearance on the scene had quickly transformed the aspect of the war, and his influence with the king had thus acquired a firm basis. Accordingly, when in 1866 the quarrel with Austria came to a head, Moltke's plans were adopted and he was almost invariably supported in their execution. A disciple rather of Clausewitz, whose theory of war was an effort to grasp its conditions, than of Jomini, who expounded a system of rules, Moltke re- garded strategy as a practical art of adapting means to ends, and had developed the methods of Napoleon in accordance with the altered conditions. He had been the first to realize the great defensive power of modern fire-arms, and had inferred from it that an enveloping attack had become more formidable than the attempt to pierce an enemy's front. He had pondered the tactics of Napoleon*~~

~~*'i, BerUn.)*~~

~~*M 0 L T K E*~~

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~~*at Bautzen, when the emperor preferred to bring up Ney's corps, coming from a distance, against the flank of the allies, rather than to unite it with his own force before the battle ; he had also drawn a moral from the combined action of the allies at Waterloo. At the same time he had worked out the conditions of the march and supply of an army. Only one army corps could be moved along one road in the same day ; to put two or three corps on the same road meant that the rear corps could not be made use of in a battle at the front. Several corps stationed, close together in a small area could not be fed for more than a day or two. Accordingly he inferred that the essence of strategy lay in arrangements for the separation of the corps for marching and their concentration in time for battle. In order to make a large army manageable, it must be broken up into separate armies or groups of corps, each group under a commander authorized to regu- late its movements and action subject to the instructions of the commander-in-chief as regards the direction and*~~

~~purpose of its operations. In the strategy of 1866 the conspicuous points are : (1) The concentration of effort. There were two groups of enemies, the Austro-Saxon armies, 270,000; and the North and South German armies, 120,000. The Prussian forces were 64,000 short of the adverse total, but Moltke determined to be superior at the decisive point against the Austro-Saxons ; he there- fore told off 278,000 men for that portion of the struggle, and employed only 48,000 men in Germany proper. His brilliant direction enabled the 48,000 to capture the Hanoverian army in less than a fortnight, and then to attack and drive asunder the South German forces.~~

~~(2) In dealing with Austro-Saxony the difiBculty was to have the Prussian army first ready — no easy matter, as the king would not mobilize until after the Austrians. Moltke's railway knowledge helped him to save time. Five lines of railway led from the various Prussian provinces to a series of points on the southern frontier on the curved line Zeitz-Halle-Gorlitz-Schweidnitz. By employing all these railways at once, Moltke had the several army corps moved simultaneously from their peace quarters to points on this curved line. When this first move was finished the corps then marched along the curve to collect into three groups, one near Torgau (Elbe army), another at the west end of Silesia (first army. Prince Frederick Charles), the third between Landshut and Waldenburg (second army. Crown Prince). The first army when formed marched eastwards towards Gorlitz. The small Saxon army at Dresden now had the Elbe army in its front and the first army on its right flank, and as it was outnumbered by either of them, its position was untenable, and so soon as hostilities began fell back into Bohemia, where it was joined by a-n Austrian corps, with which it formed an advance guard far in front of the Austrian main army concentrated near Olmiitz. The Elbe army advanced to Dresden, left a garrison there, and moved to the right of Pflnce Frederick Charles, under whose command it now came.~~

~~(3) Moltke now had two armies about 100 miles apart. The problem was how to bring them together so as to catch the Austrian army between them like the French at Waterloo between Wellington and Bliicher. If, as was thought likely, the Austrians moved upon Breslau, the first and Elbe armies could continue their eastward march to co-operate with the~~

~~*second. But on 16th June Moltke learned that on the 11th of June the Austrian army had been spread out over the country between Wildenschwerdt, Olmiitz, and Brtinn. He inferred that it could not be concentrated at Josefstadt in less than thirteen days. Accordingly he determined to bring his own two armies together by directing each of them to advance towards Gitschin. He foresaw that the march*~~

~~*of the Crown Prince would probably bring him into collision with a portion of the Austrian army ; but the Crown Prince had 100,000 men, and it was not likely that the Austrians could have a stronger force than that within reach of him. The order to advance upon Git- schin was issued on the 22nd of June, and led to one of the greatest victories on record. The Austrians marched faster than Moltke expected, and might have opposed the Crown Prince with four or five corps ; but Benedek's attention was centred ou Prince Frederick Charles, and he interposed against the Crown Prince's advance four corps not under a common command, so that they were beaten in detail, as were also the Saxons and the Aus- trian corps with them, by Prince Frederick Charles. On the 1st of July Benedek collected his already shaken forces in a defensive position in front of Koniggratz. Moltke's two armies were now within a march of one another and of the enemy. On the 3rd of July they were brought into action, the first against the Austrian front and the second against the Austrian right flank. The Austrian army was completely defeated and the cam- paign decided, though an advance towards Vienna was needed to bring about the peace upon Prussia's terms. Moltke was not quite satisfied with the battle of Konig- gratz. He had tried to have the Elbe army brought up to the Elbe above Koniggratz so as to prevent the Aus- trian retreat, but its general failed to accomplish this. He also tried to prevent the first army from pushing its attack, hoping in that way to keep the Austrians in their position until retreat should be cut off by the Crown Prince, but he could not restrain the impetuosity of Prince Frederick Charles and of the king. During the negotiations Bismarck, who dared not risk the active in- tervention of France, opposed the king's wish to annex Saxony and perhaps other territory beyond what was actually taken. Moltke would not have hesitated ; he was confident of beating both French and Austrians if the French should intervene, and he submitted to*~~

~~*Bis- marck his plans in case of need for the opening moves against both French and Austrians.*~~

~~*After the peace, the Prussian Diet voted Moltke the sum of £30,000, with which he bought the estate of Creisau, near Schweidnitz, in Silesia. In 1867 was pub- lished The Campaign of 1866 in Germany, a history pro- duced under Moltke's personal supervision, and remarkable for its combination of accuracy with reticence. > On the 24th of December 1868 Moltke's wife died at Berlin. Her remains were buried in a small chapel erected by Moltke as a mausoleum in the park at Creisau.*~~

~~*In 1870 suddenly came the war with France. The probability of such a war had occupied Moltke's attention almost continuously since 1857, and a series of memoirs is preserved in which from time to time he worked out and recorded his ideas as to the best arrangement of the Prussian or German forces for the opening of the cam- paign. The arrangements for the transport of the army by railway were annually revised in order to suit the changes in his plans brought about by political conditions and by the growth of the army, as well as by the improve- ment of the Prussian system of railways. The great suc- cesses of 1866 had strengthened Moltke's posiiion, so that when on the 15th of July 1870 the order for the mobili- zation of the Prussian and South German forces was is- sued, his plans were adopted without dispute, and five days later he was appointed " Chief of the general staff of the army at the headquarters of his Majesty the King" for the duration of the war. This gave Moltke the right to issue in the king's name, though of course not without his approval, orders which were equivalent to royal commands. Moltke's plan was to assemble the whole army to the south of Mainz, this being the one district in*~~

~~*•whicli an army could best secure the defence of the whole frontier. If the French should disregard the neutrality of Belgium and Luxemburg, and advance on the line from Paris to Cologne or any other point on the*~~

~~*Lower Ehine, the German army would be able to strike at their flank, while the Ehine itself, with the fortresses of Cobleuz, Cologne, and Wesel, would be a serious obstacle in their front. If the French should attempt to invade South Germany, an advance of the Germans up either bank of the Ilhine would threaten their communications. Moltke expected that the French would be compelled by the direction of their railways to collect the greater part of their army near Metz, and a smaller portion near Strasburg. The German forces were grouped into three armies : the first of 60,000 men, under Steinmetz, on the Moselle below Treves ; the second of 131,000 men, under Prince Frederick Charles, round Homburg, with a re- serve of 60,000 men behind it; the third under the Crown Prince, of 130,000 men, at Landau. Three army corps amounting to 100,000 men were not reckoned upon in the first instance, as it was desirable to keep a con- siderable force in north-eastern Germany, in case Austria should make common cause with France. If, as seemed probable, the French should take the initiative before the German armies were ready, and for that purpose should advance from Metz in the direction of Mainz, Moltke would merely put back a few miles nearer to Mainz the points of debarcation from the railway of the troops of the second army. This measure was actually adopted, though the anticipated French invasion did not take place. Moltke's plan of operations was that the three armies while advancing should make a right wheel, so that the first army on the right would reach the bank of the Moselle opposite Metz, while the second and third armies should push forward, the third army to defeat the French force near Strasburg, and the second to strike the Moselle near Pont-arMousson. If the French army should be found during this advance in front of the second army, it would be attacked in front by the second army and in flank by the first or the third or both. If it should be found on or north of the line from Saarburg to Luneville, it could still be attacked from two sides by the second and third armies in co-operation. The inten- tion of the great right wheel was to attack the principal French army in such a direction as to drive it north ai\d cut its > communications' with Paris. The fortress of Metz was to be observed, and the main German forces, after defeating the chief French army, to march upon Paris. This plan was carried out in its broad outlines. The battle of Worth was brought on prematurely, and therefore led, not to the capture of MacMahon's army, which was intended, but only to its total defeat and*~~

~~*hasty retreat as far as Chalons. The battle of Spicheren was not intended by Moltke, who wished to keep ISazaine's army on the Saar till he could attack it with the second army in front and the first army on its left flank, wlrile the third army was closing towards its rear. But these unintended or unexpected victories did not disconcert Moltke, who carried out his intended advance to Pont-^-Mousson, there crossed the Moselle with the first and second armies, then faced north and wheeled round, so that the effect of the battle of Gravelotte was to drive Bazaine into the fortress of Metz and cut him off from Paris. Nothing shows Moltke's ilisight and strength of purpose in a clearer light than his determina- tion to attack on the 18th of August, when many strate- gists would have thought that, the strategical victory having been gained, a tactical victory was unnecessary. He has been blamed for the last local attack at Grave- lotte, in which there was a fruitless heavy loss ; but it is now known that this attack was ordered by the king, and*~~

~~*Moltke blamed himself for not having used his influence to prevent it. During the night following the battle Moltke made his next decision. He left one army to in- vest Bazaine and Metz, and set out with the two others to march towards Paris, the more southerly one leading, so that when MacMahon's army should be found the main blow might be delivered from the south and MacMahon driven to the north. On the 25th of August it was found that MacMahon was moving north-east for the relief of Bazaine. The moment Moltke was satisfied of the ac- curacy of his information, he ordered the German columns to turn their faces north instead of west. MacMahon's right wing was attacked at Beaumont while attempting to cross the Meuse, his advance necessarily abandoned, and his army with difficulty collected at Sedan. Here the two German armies were so brought up as completely to surround the French army, which on the 1st of Sep- tember was attacked and compelled to raise the white flag. After the capitulation of Sedan, Moltke resumed the advance on Paris, which was surrounded and invested. From this time his strategy is remarkable for its judicious economy of force, for he was wise enough never to at- tempt more than was practicable with the means at his disposal. The surrender of Metz and of Paris was a question of time, and the problem was, while maintaining the investment, to be able to ward off the attacks of the new French armies levied for the purpose of raising the*~~

~~*siege of Paris. Metz surrendered on the 27th of October, and on the 28th of January 1871 an armistice was con- cluded at Paris by which the garrison became virtually prisoners and the war was ended.*~~

~~*On the 29th of October 1870 Moltke was created Graf (count or earl), and on the 16th of June 1871, field-mar- shal. After the war he superintended the preparation of its history, which was published between 1874 and 1881 by the great general staff. In 1888 he resigned his post as chief of the staff. In 1867 Moltke was elected to the North German Diet, and in 1871 to the Reichstag. HIs speeches, dealing mostly with military questions, were regarded as models of conciseness and relevancy. HIe died suddenly on the 24ih of April 1891, and after a magnificent funeral ceremony at Berlin his remains were laid beside those of his wife in the chapel which he had erected as her tomb at Creisau.*~~

~~*As a strategist Moltke cannot be estimated by compari- son with Frederick or Napoleon, because he had not the authority either of a king or of a commander-in-chief. While it is doubtful whether he can be convicted of any strategical errors, it seems beyond doubt that he never had to face a situation which placed any strain on his powers, for in the campaigns of 1S66 and 1S70 his de- cisions seemed to be made without the slightest effort, and he was never at a loss.*~~

~~*HIe had a tall spare figure, and in his latter years his tanned features had received a set expression which was at o?ice hard and grand. HIe was habitually taciturn and reserved, though a most accomplished linguist, so that it was said of him that he was " silent in seven languages." The stem school of his early life had given him a rare self-control, so that no indiscreet or unkind expression is known to have ever fallen from him. Long before his name was on the lips of the public he was known in the army and in the staff as the " man of gold," the ideal character whom every one admired and who had no enemies.*~~

~~*AvTnoKmKs.—Gesammelte Schriften tind Denl-ieiirdiiikeiten des General Fehhnarschalls (h-afen jidmuth von Jloltke. 8 vols. Berlin, 1892-93.—J/oZ«A:e's militarisclie Werke. Berlin. (ISine volumes appeared between 18!1'2 and 1900.)—Feldmarschall Moltke. By Max Jahns. 3 vols. Berlin, 1S<.II-1900.—Feldmarschall Graf Moltke: Eiii miliUii-*~~

*isdies Lebensbild. By W. Bigge, Obeest, &o. 2 vols. Munich, 1901. r^ g_ ti^*

M 0 L T 0 N — M 0 M M S E N

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Molton, South, municipal borougli, and ancient market-town in the South Molton parliamentary division of Devonshire, England, 12 miles east-south-east of Barn- staple by rail, on the river Mole. There are a shirt and collar factory, and numerous corn mills, all worked by the river. The gasworks belong to the corporation. Popula- tion (1881), 3340; (1901), 2848, the area having been altered between 1891 and 1901.

Moluccas, groups of islands .lying between Celebes on the west and New Guinea on the east, in the Malay Archipelago (q.v.), between 2° 43' N. and 8° 23' S. and 124° 22' and 135° E., with an area, inclusive of Dutch or Western New Guinea, of about 160,000 square miles. Since 1867, when the political unity, under a governor, was dissolved, the Moluccas are often named by the Dutch the "Great East" (Groote Oost). Politically they now belong to the residencies of Amboyna and Ternate. Most of the islands are mountainous, with still active volcanoes. As they lie near or under the equator, the monsoons blow- ing over them are less regular, and the rainfall, of large volume throughout the year, is dependent on the height and direction of the chains. The vegetation of the small and narrow islands, all encompassed by the sea, is very luxuriant, and the products, principally nutinegs, mace, and other spices, include also rice and sago. ' The original inhabitants, Alfuros, have become mixed with the traders and colonists of later times — the Makassars, Buginese, Javanese, and Europeans. See Celebes, Seeang, Tek-

NATE, TiDOR, TiMOK, NeW GuINBA (DuTCH).

Mombasa, a seaport town and the administrative capital of British East Africa (East African Protectorate), on the east side of a small island of the same name, close to the coast, in 4° S. It has two good harbours ; one, Kilindini, is a naval depot. Its ' total trade in 1901 amounted to £423,000, of which £348,600 were imports and £74,400 exports. These last consist

~~principally of ivory, copra, hides, and rubber. Population, about 27,000. See East Africa, British.~~

~~Momein, the Burmese name of the Chinese city Teng Yueh-chow, a town in the south-west of the province of Yunnan, China. It was opened to foreign trade by the Burmese convention of 1897, but so far no advantage has been taken of the permission. It lies close to the Burmese frontier, and on the old trade route from Bhamo to Yunnan, but its importance as an outpost of the British empire is political rather than commercial. Near Momein and within its jurisdiction is the frontier town of Man- wyne, where Mr A. E. Margary, a member of H.B.M. consular service, was assassinated in January 1875 (vide China).~~

~~Mommsen, Theodor (1817), German histo- rian, was born on 30th November 1817, at Garding, in Schleswig, where his father was the pastor ; he was the eldest of three brothers (the others being August and Tycho), who earned distinction in scholarship. After being educated in the gymnasium at Altona and the University of Kiel, he devoted himself to the study of Eoman law and antiquities. In 1839 he published, with his brother Tycho and another friend, a short collection of poems of no great merit. In 1843 a grant from the Danish Government enabled him to undertake a journey to Italy, which was to be as decisive for his future career as was the Italian journey of Goethe or of Eanke. There he began the study of Roman inscriptions, in association with other Italian and German scholars, especially Borghesi, de Rossi, and Henzen. His first work was directed to the restoration of the old Italian dialects. It was a time when the necessity for compiling a complete*

~~collection of all extant Eoman inscriptions was becoming pressing. Mommsen's work attracted attention, and the French Government, which at one time proposed to under- take the task, asked for his co-operation. When they gave up the project it was taken up by the Berlin Academy, which had recently completed the collection of Greek inscriptions edited by Boeckh. They had already made a grant to Mommsen, and in 1844 Savigny proposed that he should be appointed to carry out the great work. The Academy, however, feared the expense, and there were rival claimants, especially Zumpt ; many years accord- ingly passed before the~~

~~*plan was finally approved. Mean- while Mommsen continued his work in Italy: he drew up a full memorandum explaining the principles on which a Corpus Inscrix)tionum should be compiled, and on which alone he could undertake the editorship; he insisted that it should be based on a fresh examination of every stone, and not a mere compilation from existing collections. As a specimen he collected the inscriptions of Samnium, and in 1852 published the inscriptions of the kingdom of Naples. These works caused him to be recognized as the first authority in this field of learning. In 1847, however, he was obliged to return to Germany : he first went to Schleswig, where during the Revolution he edited a paper in which he supported the claims of the Elbe Duchies ; at the end of 1848 he was appointed professor of civil law at Leipzig. HIs work there was interrupted by his political opinions. During 1848, when the extreme party was in the ascendant, Mommsen supported the monarchy against the Eepublicans. With characteristic courage and independence, next year, when the Eevolution had spent its force and Beust executed his coup d'&at, he protested, with many of his colleagues, against this act, but was summoned before a disciplinary court, and, together with Haupt and Jahn, two of the other most distinguished scholars of that generation, to whom his Roman History was afterwards dedicated, he was dismissed from his pro fessorship.*~~

~~*Like many other Germans, Mommsen found an asylum in Switzerland, and became professor at Zurich : he re- paid the hospitality of the Eepublic by writing ex- haustive monographs on Eoman Switzerland. HIs spare time was occupied with the Roman HIstory, imdertaken at the suggestion of a publisher, whose daughter he married. 'The three volumes appeared between 1854 and 1856. HIs name at once became known throughout Europe. It was a new thing in Germany for a great scholar to write a book which men who were not scholars would read. The fruits of prof oundest learning were given without display of erudition. With a true insight into the relative importance of things, he passed over with a few strong broad touches the antiquarian discussions on the origins of the city, on which previous historians had laboured so long ; but in place of this he painted with astonishing vigour the great political struggle that accom- panied the fall of the Eepublic. It was, above all, his new reading of old characters which demanded attention, if*~~

not always approval : Cicero, the favourite of men of letters, was for him " a journalist in the worst sense of the word " ; Pompey, the hero of Plutarch and the Moralists, was brushed aside as a mere drill-sergeant ; and the book culminated in the picture of Caesar, who established absolute rule in the name of democracy, "the complete and perfect man." The work had more than a mere literary interest; it was one of the numerous influences which awoke in the rising generation the feeling that what Germany wanted was not theories and principles of govern- ment, but power and efficiency. But he always disclaimed the belief that in his panegyric of Caesar he was thinking of and recommending the new Csesarism of Napoleon III.

The three volumes ended with the dictatorship of Caesar. The book has never been continued, for the volume on the Roman Provinces under the Empire, which appeared in 1884, though nominally the fourth volume of the history, is in reality a separate work. Mommsen was hence- forward fully occupied with work of a more technical nature. In 1854 the definite offer was made to him by the Academy that he should be chief editor of a Corpus Inscriptionum, with full control. In order that he niight carry on the work, he was appointed to a professorship at Berlin (for two years he had already been at Breslau), and for over forty years he was occupied in producing this great work. The first volume appeared in 1861, followed by sixteen others ; and Mommsen lived to see his task completed so far as work of this kind ever can be com- plete. Five of the volumes he edited himself, and the whole was executed according to his instructions, under his immediate supervision and co-operation to a great extent, by scholars whom he had himself trained. It is the finest example of that association in learning" which he made the text of one of his addresses to the Academy.

Enormous as was the labour, this task occupied only a small part of his extraordinary intellectual energy. During these forty years he found time to write two larger works, the History of the Roman Coinage and the Romisches Staatsrecht, a profound analysis of Koman con- stitutional

law. His Roman Provinces already mentioned gives a singularly interesting picture of certain aspects of social life under the Empire. His smaller papers amount to many hundreds in number, and there is no department of Roman life and learning, from the earliest records of the Eoman law to the time of Jornandes, which he has not illuminated. Nor did this exhaust his activity. He has himself realized the ideal of a scholar which was in his mind when he said, "Each one must specialize in one branch of learning, but not shut himself up in it. How miserable and small is the world in the eyes of the man who sees in it only Greek and Latin authors or mathematical problems ! " As secretary to the Berlin Academy for over twenty years he took a leading part in their deliberations, and was their spokesman on great occa^ sions. His interest in political problems of the present was as keen as in those of the past. He was one of the founders of the Preussische Jahrbiicher, the most influen- tial of German political periodicals. Eor many years he was a member of the Prussian Parliament. His political opinions were strong but ill- regulated. Intensely nation- alist, he acquiesced in the annexation of his native land to Prussia, and in a public letter to the Italian nation in 1870 defended the German cause before the nation which had become to him a second fatherland ; but he was of too independent a character ever to be quite at ease under Prussian government. Loving liberty, he hated its con- sequences ; a democrat, he had and always expressed a profound contempt for the mob. Like many idealists, he was a severe critic of the faults of his own and other countries, and he added something to the increasing Chauvinism in Germany. He was one of the few men in high position who always refused to bow the knee to Bismarck. A member of the Freisinnige party, he was even brought to trial in 1880 because in an election ad- dress he had used the expression " Politik von Schwindel " of the Government. He defended himself, and was acquitted.

It was, however, above all, German scholarship which remained his first interest. There is probably no other instance in the history of scholarship in which one man has established so complete an ascendancy in a great department' of learning. Equally great as antiquary, jurist, political and social historian, he lived to see the time when among students of Roman history he had

~~*pupils, followers, critics, but no rivals. He combined the power of patient and minute investigation with a singular faculty for bold generalization and the capacity for tracing out the effects of thoughts and ideas on political and social life. Partly, perhaps, owing to a philosophical and legal training, he had not the gift of clear and simple narrative, and he is more successful in discussing the connexion between events than in describ- ing the events themselves. Though his History ends with the fall of the Republic, his most enduring work has been that on the Empire ; and if he has not written the history of the Empire, he has made it possible for others to do so.*~~

~~*The History of Borne (including the volumes on the Provinces) has been translated into English ; there is a, French edition of his work on Boman Coinage. Many of his pamphlets and articles have been collected under the title Bomische Forschungen. Of his other works, the more important are the Boman Chronology to the Time of CcBsar (1858), a work written in conjunction with his brother August ; his editions of the Monumentum Ancyranum and of the Digest in the Corpus Juris Civilis. A great part of his work is to be found in the German learned publications such as Hermes, Bheinisches Museum, &c. A full list of his works is given by Zangemeister, Mommsen als Schriftsteller (1887).*~~

~~*Monaco, the smallest sovereign principality of Europe, on the Mediterranean, 9 miles east of Nice, and surrounded by the French Alpes Maritimes, with an area of about 3 square miles and a population of (1890) 13,304. It includes the towns of Monaco (3292), Condamine (6218), and Monte Carlo (3794). The principality at one time included Mentone and Roccabruna, now known as Roquebrune, which towns, however, were ceded to France in 1861 for a sum of four million francs. The ruler of the principality. Prince Albert, born 1848, succeeded his father. Prince Charles III., in 1889. He married in 1869 Lady Mary Douglas Hamilton, by whom in 1870 he had a son. Prince Louis : that marriage was, however, annulled in 1880, and subsequently Prince Albert married Alice, dowager-duchess of Richelieu.*~~

~~*The interest of the principality centres in the Casino of Monte Caelo, which is visited by thousands of people from every part of the world ; but*~~

the natural attractions of the place are sufficiently great, ^"o apart from its connexion with gambling. It is a common experience for travellers to Monte Carlo to leave England shrouded in snow, and in well under twenty-four hours to find themselves beneath a cloud- less blue sky, in a climate which makes the shade welcome, surrounded by summer foliage and flowers. The journey, or at least the latter part of it, has also charms of its own. It is customary to leave Paris in the evening, the trains being provided with ivarjon- lits and lit-salons, which aiford as comfortable sleeping accommodation as can be procured on the ill-laid Paris, Lyons and Mediterranean line. Marseilles is reached in the morning, and the first glimpse of the Mediterranean obtained, thence nearly to St Raphael the line is mostly inland, but afterwards it runs by the sea, past singularly beautiful coast scenery. Numberless tiny bays indent the shore; into them the blue waters of the tideless sea ripple gently, or if there be any wind the waves break in snowy showers against the jagged rocks. From the left-hand vpindow of the carriage endless acres of olive-trees covering the valleys at the foot of the hills are to he seen; the yellow flower of the mimosa brightens the pic- ture, as do the orange-trees, the rich fruit of which peeps through the dark green leaves ; palms, aloes, cacti, and other tropical plants are frequent. On some of the hill- tops are forts which suggest watchfulness and vigour in restraint. Cannes and Antibes are passed, Nice at length is reached, and i)assing through a number of tunnels.*

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which make the glimpses of the shore all the brighter, the train runs through Monaco to Monte Carlo.

There appear to have been some gambling-tables here in the year 1856, but it was in 1861 that M. Blanc, seeing his tenancy at Homburg coming to an end with no hope of renewal, obtained a concession for fifty years from Charles III. This concession passed into the hands of a joint-stock company, which in 1898 obtained com^ss'ioa ^^ extension to 1947, in return for a payment ■ to the prince of £400,000 in 1899 and of £600,000

~~*in 1913, together with an increase of the annual tribute of £50,000 to £70,000 in 1907, £80,000 in 1917, £90,000 in 1927, and £100,000 in 1937.*~~

~~*M. Blanc was a man who did nothing by halves. He set to work to build the Salons des Jeux, the famous — or infamous — Casino, and began to devise means to attract wealthy pleasure-seekers from all countries to the little principality. He erected the Hotel de Paris, a notably fine structure in comparison with the hotels of the period ; the best available chefs were employed, a dinner at least equal to that obtainable at the leading Paris restaurants was here to be had for a tenth of the amount Casiao. ^* would there have cost; wines of the best vintages were to be procured at cost price or under ; beautiful gardens were laid out and assiduously tended ; attached to the Casino was a concert-room, where an admirable orchestra of carefully-selected musicians could be heard without payment by those who cared to stroll in and take a seat. The comfort and convenience of visitors were considered in every possible way, the shrewd administrator knowing that his outlay would come back to him with interest from the tables. Other hotels rapidly sprang up, handsomely served and ap- pointed ; sumptuous villas were built ; in the Salons des Jeux tables were added, and now the twelve devoted to roulette and the four to trente-et-quarante are found insufficient, for at the busiest hours of the afternoon — play begins at mid-day, and continues till eleven o'clock in the evening — a crowd four or five deep prevents many who are anxious to tempt fortune from approaching near enough to stake. The pressure has been somewhat relieved latterly by the establishment upstairs of a cerde privie, where the games are continued till long past midnight under the same conditions as downstairs, ex- cept that visitors are here allowed to smoke, tobacco and the wearing of hats being interdicted in the lower room.*~~

~~*Admission to the salon is obtained by ticket. Turning to the left on entering the Casino, the would-be player finds a number of clerks seated in a small room. He presents his visiting card, and is furnished with a carte d' admission, making him free of the Cercle des Etrangers de Monaco for one day ; but if he desires an extension it is afterwards readily obtainable. On the back of the carte it is stated that " line tenue de ville convenable est indispensable pour obtenir I'entree dans les salons,"*~~

~~*and the applicant is warned that " Cette carte ne peut gtre delivree que sur la production de pieces d'identite serieuses," as also that "Cette carte doit 8tre presentee pour I'entree dans les salons et peut gtre retiree." The holder's signature and that of le commissaire spdciale complete the business. Entering the rooms at any hour, play is sure to be found in progress. Early in the day not all the tables are occu- pied, though on the other hand many persons who have been keen to begin have waited in the capacious atrium for the opening of the doors, in order that they might rush to secure their favourite places. Liveried attendants stand about, furnished with ruled cards, on which some players like to keep records of the numbers which have turned up; and these servants will also supply large pins, for at trente-et-quarante it is a favourite custom to*~~

~~*score by means of pricks. At the newspaper kiosks in the gardens round the Casino, and at shops in the town, all sorts of brochures giving details of various systems of play can be procured, together with diagrams of the tables and all sorts of information about the methods in vogue.*~~

~~*Under the heads of Roulette and Trente-et-Quar- ANTE these games are elsewhere described ; it will suffice here to remark that by no system can success by any possibility be assured, for the simple reason that at both games, but much more especially at roulette, there is a steady percentage in favour of the bank which must in- evitably tell in its favour in the long run. There are thirty-seven numbers on the roulette ^/^layf board, including zero; the table pays only thirty-five times the player's stake on the winning number, so that practically from every coin won some- thing is deducted. As a rule, however, players are not satisfied with one stake. The ways in which the mise can be placed are almost innumerable, and if players stake on different numbers and combinations, so much more does the bank secure. There are various systems which frequently bring profit for a time, though on the other hand they may be defeated at the first attempt, and subsequently day after day; but if the player were to stake blindfold he would have just as good a chance of winning as he can have by any method of calculation. Sometimes when rouge, pair, or manqtie has turned up several times players will stake on them again because of the "run"; sometimes, on the contrary, they will stake on the opposites, noir, impair, and passe, because it seems the turn of those to come up. In*~~

~~*truth there are no turns, and one way is just as sensible or as foolish as the other. In these days of multi-millionaires it might seem to the uninitiated that force of money, if some system of gradual increase were adopted, would in time defeat the bank; but here the bank protects itself by limit- ing the stakes to various maximums, beyond which it is not permissible to wager. On this subject an instructive little anecdote may perhaps be related. One morning on the terrace by the Casino overlooking the sea a visitor was iu conversation with an old croupier, and made mention of a system that had been recommended. The old man shook his head. " There are more than 150 of us croupiers employed in that building, sir," he said; " we sit there and watch the game hour after hour, week after week, year after year. Some of us are not fools. Do you not think that if any successful system existed, one of us would have found it out before now ? " At trente-et-quarante many players are accustomed to follow " the run of the table," as it is termed — that is to say, to wager on the colour which last won; but there is of course no foundation for the idea that runs of colour are more likely to happen than intermittences. Very often nearly all the coins and banknotes will be on one side, either on red or black, and very often therefore the bank makes a rich haul with little or nothing to pay. The morality of gambling is not here in question ; the folly of it is surely evident. The only point is whether the gambler derives from playing what he con- siders sufficient amusement to recompense him for the money he loses.*~~

~~*The natural beauties of Monte Carlo, and the warm dim ate so comparatively near to places where more rigorous temperatures are the rule, might well tempt visitors to the principality. A very special temptation, however, is the toury which prevails, apart from those beauties which nature has provided. The whole district for miles round has benefited by the influx of wealth, and travellers on the roads beyond Bordighera cannot fail to be struck by the comparative squalor of the surroundings in contrast*~~

~~*with the charming villas, superb gardens, well-provided shops, and perfect roads which distinguish Monte Carlo and the neighbourhood. Concerts are no longer free in the Casino. The room has been turned into a theatre, where operatic performances, supported by the best singers, are given during the season. A Salon des Beaux Arts has been built, and pictures of more or less merit are always on exhibition. Here, too, theatrical representations sometimes take place in the afternoons. Indoor entertainments are not likely to receive much patronage when the days are fine; but those who have visited Monte Carlo on only a few occasions, and have been fortunate in their weather, would be surprised to find how bleak and wet the sunny south can sometimes be. Deep snow on the racecourse at Nice once actually led to the abandonment of the steeplechases that annually take place there and are a feature of the season, and more than once they have been interfered with by frost ; though whenever this happens the residents, }ealous for the reputation of their town, will declare that such a thing was never known before in the memory of the oldest inhabitant. Rainy weather causes grave dismay at Monte Carlo, and with regard to climate it may be noted that genial as is the sun during the day, the evenings are often treacherous and chilly. A favourite pastime is a drive to Nice, which enables one to enjoy the beautiful coast scenery in more leisurely fashion than when viewing it during the more rapid railway journey. Off Beaulieu, and in the picturesque harbour of Ville- franche, yachts are often anchored, and in the latter not seldom French men-of-war. Long since the district appealed to Lord Salisbury, whose villa on the hillside above Beaulieu became one of the landmarks of the district. On the east of Monte Carlo lies Mentone, some five miles away along a road which winds round the bays, and within a long drive farther on, past Ventimiglia and Bordighera, are the frontiers of Italy, with the picturesque old town of San Remo accessible for well-horsed carriages or motors. Travellers who propose to make the journey thitherwards by rail from Monte Carlo will do Avell to remember the great difference between French and Italian time, for French time is adopted in the principality, though in some respects the prince maintains the integrity of his own little land. Thus Monte Carlo issues its own postage stamps ; and one coin, a handsome five-louis gold piece, bears the prince's efBgy, and may perhaps be described as only current in his*~~

~~*abbreviated dominion, for even at Nice not a few of the shopkeepers look at it with curiosity and doubt.*~~

~~*A particularly agreeable walk from Monte Carlo is down the hill by the Condamine, and round the rock of Monaco, upon which the prince's palace, part of which dates from 1572, and the administrative buildings, are erected. The rock was fortified by Louis XIV., and some quaint old cannon, with piles of round iron cannon- balls, are supposed to guard the fortress. A portion of the wealth which flows into the little country has been devoted to the building of a beautiful church here. The path winds down, high up above the Mediterranean, through well-kept gardens, until turning the corner Monte Carlo is seen across the bay, with the Casino prominent, and near to it the little semicircular patch of green upon which pigeon-shooting is practised during several weeks of the season. Looking to the right Corsica may usually be discerned. The bay has been descrilicd as a favourite anchorage for English and other yachts, but this state- ment must be accepted with reservations, as when certain winds prevail an ugly sea is frequently raised, rendering the harbour dangerous. Plans for the construction of a breakwater have been mooted. Beyond and behind Monte*~~

~~*Carlo rises the mountain, with its olive-clad slopes and carefully cultivated terraces, at the top of which, on the old Cornice road, is situated the village of La Turbie, and this may now be reached by a cog-wheeled. mountain railway. Trains run at frequent intervals during the day. (a. e. t. w.)*~~

~~*Monaghan, an inland county of Ireland, province of Ulster. The area of the administrative county in 1900 was 318,806 acres, of which 113,311 were tillage, 169,112 pasture, 450 fallow, 4291 plantation, 5646 turf bog, 1184 marsh, 1514 barren mountain, and 23,298 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, is identical with the old judicial county.*~~

~~*The population in 1881 was 102,748 ; in 1891, 86,206 ; and in 1901, 74,505, of whom 37,034 were males and 37,471 females, divided as follows among the different religions : Roman Catholics, 54,708 ; Protestant Episco- palians 9532 ; Presbyterians, 9515 ; Methodists, 407 ;*~~

~~*and other denominations, 343. The decrease of popular- tion between 1881 and 1891 was 16-1 per cent., and between 1891 and 1901, 13-6, the largest decrease in both decades of any county in Ireland. The average number of persons to an acre in 1891 was 27, and of the total population, 81,236 persons inhabited the rural dis tricts, being an average of 183 persons to each square mile under crops and pasture.*~~

~~*The following table gives the degree of education in 1891 :—*~~

~~*Males.*~~

~~*Females.*~~

~~*Total.*~~

~~*Percentage.*~~

~~*E. C.*~~

~~*Pr.Ep.*~~

~~*Presb.*~~

~~*.MetL.*~~

~~*Read and write Read only Illiterate .*~~

~~*27,011 4,955 6,927*~~

~~*25,586 7,107 7,092*~~

~~*52,597 12,062 14,019*~~

~~*60-9*~~

~~*17-2 21-9*~~

~~*79-4*~~

~~*12-1*~~

~~*8-5*~~

~~*86-4 8-7 4-9*~~

~~*91-7 4-6 .3-7*~~

~~*The percentage of illiterates among Roman Catholics in 1881 was 28-1. In 1891 there were 7 superior schools with 178 pupils (Roman Catholics, 111, and Protestants, 67), and 188 primary schools with 12,236 pupils (Roman Catholics, 8633, and Protestants, 3603). The number of pupils on the rolls of the national schools on 31st Decem- ber 1900 was 12,460, of whom 8959 were Roman Catholics and 3501 Protestants. The following table gives the number of births, deaths, and marriages in the years specified : —*~~

~~*Year.*~~

~~*Births.*~~

~~*Deaths.*~~

~~*Marriages.*~~

~~*1881 1891 1900*~~

~~*2379 1598 1410*~~

~~*1779 1486 1567*~~

~~*391 349*~~

~~*334*~~

~~*In 1900 the birth-rate per thousand was 18-9, and the death-rate 21-0 ; the rate of illegitimacy was 2-5 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 7.'^, 825, of whom 38,404 were males and 35,421 females. The chief to\vns in the county, •^ith their populations in 1901, are : Monaghan, 2938 ; Clones, 2065 ; Carrickmacross, 1880.*~~

~~*Administration. — The county is divided into two parliamentary divisions, Nortli and South, tlie number of registered electoi'S in 1901 being respectively 6863 and («705. The rateable value In 1900 was 4:274,904. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were ti'ans- ferred to a county council, urban and rural district councils were established, and under that Act the county now comprises 4 urban and 7 rural sanitary districts.*~~

~~*Agriculture. — The following tables show the acreage under*~~

~~*M U W A S T I R — M 0 N G II Y E*~~

~~*807*~~

~~*?"°JS,™?L'i'J^'ig meadow and clover, and the amount of live stock m 1881, 1891, 1895, and 1900 :—*~~

~~*Year.*~~

~~*i*~~

~~*Oats.*~~

~~*5^.M*~~

~~*1*~~

~~*i*~~

~~*s*~~

~~*III COO*~~

~~*Flax.*~~

~~*Total.*~~

~~*ISSl*~~

~~*isul Hoa woo*~~

~~*1049 985 440 506*~~

~~*55,964 46,046*~~

~~*43,r)04*~~

~~*42,481*~~

~~*2298 1286 712*~~

~~*S95*~~

~~*21,828 21,960*~~

~~*21,4«T*~~

~~19,005~~

~~7877 7422 7849 7086~~

~~1865 2270 2112 2142~~

~~16,088 6,913 9,214 2,085~~

~~32.164 88,260 42,215 39,112~~

~~138,228 125,042 129,479 113,321~~

~~In 1900 the total value of the cereal and other crops was esti- mated at £632,197. The number of acres under pasture in 1881 was 140,532 ; in 1891, 158,840, and in 1900, 169,112.~~

~~Year.~~

~~Horses~~

~~and Mules.~~

~~Asses.~~

~~Cattle.~~

~~^heep.~~

~~Rgs.~~

~~Goats.~~

~~Poultry.~~

~~1881 1891 1895 1900~~

~~11,071 12,721 14,139 12,466~~

~~8571 4210~~

~~4S.jO~~

~~4568~~

~~70,282 86,184 86,294 90,887~~

~~11,313 21,878 16,220 17,768~~

~~19,965 80,225 84,795 84,001~~

~~12,805 14,889 18,086 18,128~~

~~440,308 517,618 561,411 700,152~~

~~The number of milch cows in 1891 was 30,940, and in 1900, 31,161. The total value of cattle, sheep, and pigs for 1900 was £1,203,382. In 1900 the number of holdings not exceeding 1 acre was 855 ; between 1 and 5, 1888 ; between 5 and 15, 7366 ; between 15 and 30, 4941 ; between 30 and 50, 1560; between 50 and 100, 530 ; between 100 and 200, 114 ; between 200 and 600, 22, and above 500, 4—total, 17,280. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts 1885, 1891, and 1896, up to 31st March 1901, was 2642, amounting to £613,016. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, between 1882 and 1901 was 113, and the amount issued, £6317. The total amount Lssued on loan for all classes of works under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1901, was £46,750. (W. H. Po.)~~

~~Monastir, the second city of Macedonia, and the capital of the vilayet of Monastir in European Turkey, situated in a valley watered by the Kara Su, an affluent of the Vardar, and on the Salonica-Monastir railway, 400 miles west of Constantinople. The chief exports are cereals, flour, hides, woollen stuffs, and bones. The total value of the exports in 1899 was £71,000 and of the imports £299,500. The city is the headquarters of the third army corps, and possesses nine mosques, a military hospital, a school of art and science, &c. Population,~~

~~*60,000.*~~

~~*Monchique, a town of Portugal, in the district of Faro, 40 miles north-west from Faro, on the Serra de Monchique. Three miles south of the town there are hot sulphur springs, with baths and a sanatorium. Wheat, millet, rye, beans, vegetables, wine, olive oil, and chestnuts are the chief products, and there is a woollen factory. Population, about 7000.*~~

~~*Moncton, a city and port of entry in Westmoreland county. New Brunswick, the centre of the Intercolonial railway. It has a good harbour, good municipal buildings and schools, nine churches, three banks, and two daily newspapers'; an iron foundry, cotton, woollen, and flour mills, and other industries. In 1901 the value of the exports was $591,523; imports, $496,688. Population*~~

~~*(1891), 8762 ; (1901), 9026.*~~

~~*Mondovi, a town and episcopal see of the province of Guneo, Piedmont, Italy, 14 miles by rail east of Cuneo. It has a school of the industrial arts and handicrafts, manufactures majolica and paper, and raises cocoons. Population (1881), 10,302; (1899), 9000. About 2 miles to the east the sanctuary of Vico, a church designed by Ascanio Vittozzi in 1590, and crowned by a famous dome (1730-48), ha.=: been declared a national monument. In the square before it is a monument (1891) to Charles Emmanuel I. of Savoy.*~~

~~*Monet, Claude (1840), French painter,*~~

~~*was born in Paris 14th November 1840. HIs youth was passed at Havre, where his father had settled in 1845. Until he was fifteen years old he led a somewhat irregular life, learning little at school, and spending all his time in decorating his books with drawings and caricatures which gave him notoriety in HS-vre. At the same time he became acquainted with Boudin, a clever sea-painter, under whose guidance he learned to love and to understand nature. At the age of twenty he became a soldier, and spent two years of his military time with the regiment of the Chasseurs d'Afrique in the desert. Falling ill with fever, he was sent home, and entered the studio of Gleyre. This classical painter tried in vain to keep*~~

~~*him to conventional art and away from truth and nature, and Monet left his studio, where he had become acquainted with two other " impressionistic " painters, Sisley and Eenoir. At that time he also knew Manet (q.v.) and in 1869 he joined the group of Cezanne, Degas, Duranty, Sisley, and became a plein air (open-air) painter. During the war of 1870' he withdrew to England, and on his return was introduced by Daubigny to a dealer, M. Durand-Euel, in whose galleries almost all his works have been exhibited. In 1872 he exhibited views of Argenteuil, near Paris ; in 1874 a series entitled " Cathedrals," showing the Cathedral of Rouen under different lights. IIe afterwards painted views of Vetheuil (1875, see Plate), Pourville and cliffs of :fitretat (1881), of Bordighera (1886), of the Creuse (1889), Le Meules (1891), and some further views of cathedrals (1894). In December 1900 he exhibited some pictures called " Le Bassin des Nympheas," and was engaged at the beginning of 1901 in painting views of London. Several of Monet's paintings, bequeathed by M. Caillebotte, are in the Luxembourg Museum, Paris. (See also Impees-*~~

~~*SIONISM.)*~~

~~*See GusTAVE Gefproy. La Vie Artistique (passim). — J. Van Dyke (Ed.). Modern French Masters. London, 1896.*~~

~~*Monforte, a township of Spain, in the province of Lugo, on the railway from Palencia to Corunna. The population in 1897 was 12,664. In the old part of the town there are a tower, belonging to the Counts of Leon ; a hospital, in an old convent ; the church of San Vicente, a handsome Renaissance structure ; and a palace of the Counts of Leon. The new part of the town contains a fine Jesuit college. Monforte has several convents and an ancient synagogue. The local industries are the manu- factures of linen and soap, saw-milling, and live stock rearing.*~~

~~*Monghyr, a town and district of British India, in the Bhagalpur division of Bengal. The town is on the right bank of the Ganges, and has a railway station, with steam ferry to the railway on the opposite bank of the river. Population (1881), 65,372 ; (1891), 57,077 ; (1901), 35,883, a decrease of 37-1 per cent, between 1891 and 1901. Cheap firearms, swords, and other iron articles are still manufactured. The high school had 302 pupils in*~~

~~*1896-97- There are two printing-presses, and Mahommedan, Hindu, and bar associations.*~~

~~*The district of Monghyr has an area of 8921 square miles ; population (1881), 1,969,950 ; (1891), 2,036,021 ; (1901), 2,064,077, showing an increase of 3 per cent, between 1881 and 1891, and of 1-4 per cent, between 1891 and 1901 ; average density, 526 persons per square mile. Classified according to religion, Hindus in 1891 numbered 1,839,159 ; Mahommedans, 191,770 ; Christians, 1324, of whom 692 were Europeans ; aborigines, 3708. The land revenue and rates in 1897-98 were Rs. 10,36,442 ; number of police, 487 ; number of boys at school (1896-97), 28,308, being 19 per cent, of the male population of school-going age ; registered death-rate (1897), 32-65 per thousand. The principal industry is indigo. There are eleven factories, employing 12,000 persons, with an out-turn of 3000 maunds valued at Rs.3,61,000. The southern portion of the district is well provided with railways. At*~~

~~*Lakhisarai junction the arc and chord lines of the Bast Indian railway divide, and here also starts the branch to Gaya. At Jamalpur, which is the junction for Monghyr, are the engineering workshops of the company.*~~

~~*Mong Nai (called by tlie Burmese and on most old maps Moni), one of the largest and most Important of the states in the eastern subdivision of the southern Shan States of Burma. The state of Keng Tawng (Burmese Kyaing Taung) is a dependency of Mong Nai. It lies approximately between 20° 10' and 21° N. and between 97° 30' and 98° 45' E., and occupies an area of 2716 square miles. The Salween river bounds it on the east. The main state and the sub-state of Keng Tawng consist of two plains with a ridge between them. There is much flat paddy bottom, but a considerable por- tion consists of gently undulating plainland. In 1891 the population was estimated at 18,600 persons, and with Keng Tawng 21,170 ; in 1897, 23,673. In the central plain rice is the only crop. Outside this considerable quantities of sugar are produced. Tobacco of a quality highly esteemed by the Shans is grown in the Nawng Wawp circle at an*~~

~~*altitude of 3100 feet above sea level ; gram, thanatpet (a leaf used for cigar wrappers), and gar- den crops are the chief produce otherwise. In the outly- ing districts quantities of coarse native paper are manu- factured from the bark of a species of mulberry, and much is exported to other parts of the Shan States. This is almost the only thing the state has to export, and the bullock caravans, which are fairly numerous, are chiefly engaged in a carrying trade with the produce of other states, bringing cotton and silk piece goods, salt, kerosene oil, anci the like np from Mandalay or Toungoo.*~~

~~*Under King Thibaw the Mong Nai state was reduced to a terrible state of desolation, from which it is only slowly recover- ing. Mong Nai, the capital, was the seat of the chief Burmese official in the Shan States, and the remains of pagodas and monas- teries point to past wealth. There were not fifty houses when the Sawbwa made his submission to the British Government in 1887. The number had grown to 800 in 1898, when a fire destroyed the whole town, but the bamboo and thatch houses were rebuilt within a few months. There is an American Baptist Mission school and dispensary in the town. The political ofiicer in charge of the eastern division now has his headquarters at Bamp6n, a village ten miles west of Mong Nai town, with a post of 75 rifles. Mono Nai town stands on the western edge of a valley about 12 miles long with an average width of 3 miles, 5 at the town, where there are two lakes. The annual tribute paid by the state is Rs. 18,000. The Sawbwa has visited Rangoon, Gaya in India, and Ceylon on pious pilgrimages. (j. q, so.)*~~

~~*Mongolia, a vast territory belonging to the Chinese Empire, the administrative limits of which cannot be determined with precision. On the north it is bounded by the frontier of Russia, beginning at Mount Kalas or Kanas (49° 5' N. and 87° 40' E.) in the Altai, and running to the south-east corner of Transbaikalia in the vicinity of Dalai-nor, thus having on the north the Siberian provinces of Tomsk, Yeniseisk, Irkutsk, and Transbaikalia. In the east the boundary line which separates Mongolia from Manchuria runs past Dalai-nor and Lake Buir, crossing the Great Khingan in 47° 30' N. towards Tsitsihar in Manchuria ; then, crossing the Nonni river, it strikes the Sungari at Khulan-chen, where it turns westwards up this river, reaching the Lao-ho or Shara-muren river*~~

in 123° 30′ E. From China proper on the south Mongolia is sep- arated by a line running in a south-westward direction up the Shara-muren and across the Mongolian plateau to the bending of the Hoang-ho or Yellow river in about 40° N. and 110° 30′ E. Thence the boundary describes a sinuous line, following the Great Wall, and thus includes the Ordos (Ho-tao) and Alashan (Si-tao), and reaches its most south- ern point in 36° 40′ N. and 104° 20′ E. Thence it turns north-west, following the Great Wall for over 300 miles ; it then crosses the plateau so as to separate Mongolia

from the Chinese province of Han-su-sin-tsian (which in- cludes the ISTan-shan highlands and eastern 'Turkestan) and from Dzungaria, reaching the Chinese or Ektag Altai in 46° 30′ N. and 92° 60′ E. From that point the bound- ary coincides with the main water-parting of the Altai mountains till it reaches Mount Kalas.

Geographically, Mongolia may thus be said to occupy both terraces of the great plateau of east Asia, which stretches in the south of Siberia, between the Sailughem range of the Great Altai and the Great Khingan — with the excep- tion of the Dzungarian depression. From Manchuria and China it is separated by the border ridge of the plateau — the Great Khingan, while in the south-west it runs up to the foot of the high northern border-ridges of the Tibetan plateau — an artificial frontier separating it from east Turkestan and Dzungaria. Broadly speaking, Mongolia may be divided naturally into three parts : (1) north-western Mongolia, which occupies the high terrace of the plateau ; (2) the Gobi, in its wide sense, covering the lower terrace of the plateau, together with a slightly more elevated and better-watered zone along the western slope of the Great Khingan and its south-western continuation ; and (3) south-eastern Mongolia, on the eastern slope of the Khingan.

I. North-Western Mongolia.

This was formerly represented as a region intersected by lofty mountain chains. It appears, however, from Russian explora- tions during the last third of the 19th century that it has all the characteristics of an elevated plateau, of a rhomboid shape (like Bohemia), bounded by four mountain ranges ; namely, the Russian Altai on the N. W., the western Sayans on the N.E., the Kentei range on the S.E., and the Ektag Altai on the S.W.

~~*The border- ridge character of the west Sayans (Ergik-targak-taiga) is well established, and the same orographic character is confirmed by recent explorers with regard to the Sailughem range of the Altai. The only point still remaining undecided is whether the valleys of the Bom-kemchik (a tributary of the Yenisei) and its left-hand tributaries do not belong geographically to the Altai region. At any rate, throughout the whole of north-west Mongolia, which covers an area of nearly .370,000 square miles, the altitude nowhere falls below 2370 feet (Ubsa-nor) ; and the area round this lake which has less than 8000 feet of altitude covers only 6600 square miles. The remainder of this extensive territory ranges at altitudes of from 3000 to 4500 feet, even in the bottoms of the river valleys and in the lower plains ; while the ridges which constitute the water-partings rise a couple of thousand feet above the general level of the plateau. Along the south-western border of this division of Mongolia a gigantic border -ridge, the Ektag (or Mongolian) Altai, runs in an east-south-eastern direction from the Russian Altai to 99° E. long., and is probably continued even farther by the Artsa-bogdo, the Saikhat, and other ranges as far as the northern loop of the Yellow river. The passes across the Ektag Altai lie at altitudes of 10,000 feet in the north-west and 9250 feet in 93° 20′ E. ; farther east they become much lower. But while its southern foot stands in the Dzungarian trench, i.e., at altitudes of 1550 feet only near Lake Ulungur, and at 3000 feet in 94° E., its north-eastern foot rests on the high plateau, i.e., at 4260 feet at Kobdo, 6410 at Oshku, 4070 at Orok-nor on the route from Kiakhtah to 8u-chow, and so on. Thus the Ektag Altai is a true border-range— that is, a lofty and steep escarpment facing the Dzungarian depression, with a gentle and relatively short slope towards the plateau.*~~

~~*In the same way the Kentei (or Gentei) mountains, as they are called, to the south of Urga, and the Yablonovoi Khrebet of Transbaikalia, separate the higher terrace of north-west Mongolia (drained by the tributaries of the Selenga) from the lower terrace of the Gobi, which is drained by the upper tributaries of the Onon and the Kerulen, both belonging to the basin of the Amur. It is also very probable that the Tannu-ola mountains to the north-east of Ubsa-nor, and the Khangai mountains between Ulyasutai and the upper Orkhon', both running west-north-west to east-south-east, border another slightly higher terrace of the same great*~~

~~*plateau of north-west Mongolia, upon which Lake Kosogol lies, at an altitude of 5320 feet. On this vast upper terrace even the bottoms of the river valleys are at altitudes of 4200 to 5500 feet, with one single exception — the narrow gorge of the Khua (Khi)-khem, or upper 'i'enisei ; while the highest pass across the Tannu-ola moun- tains is 7090 feet, though the others are Hiuch lower. The con- ception of north-west Mongolia as a region filled with mountain ranges radiating from the Altai must thus be. abandoned. It is a massive swelling of the earth's crust, represei.'ting the northera*~~

~~*counterpart of the plateau of Tibet. This massive swelling is cut into, between the Elttag Altai and the eastern Tian-shan, by the relative depression of Tarbagatai and Dzungaria, 1500 to 3000 feet in altitude ; while to the south of the eastern Tian-shan comes the Tarim depression, from 2200 to 3000 feet high, and occupying an area of about 88,000 square miles. Neither of these " depressions," however, penetrates beyond 94° E., and (see Skassi's map) on the route from Kiakhta to Su-chow, in 100° E., there is only one single place (42° N.) in which the altitude drops as low as 3300 feet ; everywhere else it varies between 4000 and 5000 feet.*~~

~~*Lakes and Bivers. — North-western Mongolia is well watered, and has in its western part a group of lakes which possess no outlet to the ocean, being in reality the rapidly desiccating remains of what were formerly much larger basins. The chief of them is Ubsanor (2370 feet), which receives the large river Tes. It lies in the middle of a large plain, and has to the west of it a smaller but much higher lake, Urga-nor, besides several smaller ones. Farther south on the same wide plain lie the sister lakes Kirghiz-nor and Airyk-nor, which receive another large river, the Dzap'hyn, and the Kungui. Many small lakes are scattered over the plain to the east of them. A third group of lakes occurs in the neighbourhood of Kobdo. The Kobdo river, which rises in the Dain-gol (7060 feet) in the Ektag Altai, winds in great curves across the plateau, and enters Lake Kara-usu (3840 feet), which also receives the Buy- antu, an outflow from Lake Kobdo, and is connected by a small river with another large lake,*~~

~~*Durga-nor, situated a score of miles to the east. There are also many smaller lakes fed by the glaciers of the Sailughem (Achit-nor, 4650 feet, and TJryu-nor), and others scattered through the Ektag Altai. The largest lake of this region is, however, Kosogol (Khubsu-gul), which lies at an altitude of 5320 feet, close to the Russian frontier, at the foot of the snowclad Muuku-sardyk. Besides the rivers just mentioned, there are others belonging to the basin of the Yenisei (Khua-or Khi-khem, Bei-khem, and Bom-kemchik) ; while yet others belong to the Selenga, a river formed by the junction of the Eder with the Tel- ghir. The Selenga receives the Tola, at the head of which, the Orkhon, remarkable inscriptions were discovered in the end of the 19th century, and cleverly deciphered by Professor V. Thomsen of Copenhagen.! The rivers which flow down the outer slopes of the border-ridges become lost in the Gobi shortly after entering it.*~~

~~*A very large portion of north-west Mongolia constitutes a high plain, 3000 to 4200 feet in altitude, which penetrates from the south-east in a north-western direction between the Ektag Altai and the Khangai mountains. It has a true Mongolian character, i.e., it is covered with gravel, and presents the appearance of a dry prairie devoid of forests. This same character is also exhibited by the bottoms of the broad valleys, while the more elevated and hilly portions of the territory, especially on their northern slopes, are covered with larch, cedar, pine, and deciduous trees belonging to the Siberian flora ; where the forests fail they are marshy or as- sume the character of Alpine meadows — e.g., in the Khangai, the Tannu-ola, and on the slopes of the border-ridges. The whole of this region is covered with excellent pasture. The forests decrease as one travels southwards. For instance, while both slopes of the Sayans are covered with forests, the Tannu-ola and the Khangai mountains have woods on their northern faces only, and the Ektag Altai is quite devoid of woods, even on its northern slope.*~~

~~*Climate. — Owing to its high altitude, north-western Mongolia is very cold, and the severity of the winter is intensified by the preva- lence of cold but dry north-western winds. The north-east wind brings more moisture. In summer the warm winds come from the south and south-east, but having first to cross the Gobi, they are dried before they reach*~~

~~north-western Mongolia. The yearly amount of rain at Urga (altitude 4350 feet, at the northern foot of the Kentei mountains is only 9J inches, and the average tempera- tures are: year 27° P., January —18°, July 64°; a minimum of —35° F. has been observed. The climate of Ulasutai (5400 feet) may be taken as typical, its average temperatures being : year 31-6°, January -12°, July 66°.~~

~~The geology is still very imperfectly known. The plateau is built up of granites, gneisses, and crystalline schists of Archaean and probably Primary age. Coal is known to exist to the south- east of Kobdo, in the Tannu-ola, and in the basin of the Yenisei, but its age is unknown (fresh-water Jurassic?). Graphite and some silver ores have also been found.~~

~~The fauna is a mixture of the Siberian and the Daurian — the latter penetrating up the valleys of the Selenga basin.~~

~~The population of north-west Mongolia is mixed, and contains, besides Mongols and Kalmuks, also Turkish tribes ; namely, Kirghiz, on the slopes of the Ektag Altai ; Uryankhs, about Kosogol as well as on the middle course of the Kobdo river (Kokchulutuns); and Kotons, who dwell on the lands of the Durbet (Dorbod) Kalmuks about Ubsa-nor. In the vicinity of this there are also Mussulman immigrants from east Turkestan ; and Chinese are found in all the~~

~~‘ See V. Thomsen, Inscriptions de I’Orkhon (Helsingfors, ISKX)).~~

~~towns. Cattle-breeding is the chief occupation, agriculture being carried on, and then to no great extent, only about Ubsa-nor, occa^ sionally beside the Selenga, and in the southern parts of the Ektag Altai. Hunting is a favourite occupation, and furs (especially of marmots) and stags’ horns (sayans) are exported in considerable quantities. The transport of goods to and from China is also a large source of income. The chief towns of this division of Mon- golia are Urga, Ulasutai, Kobdo, and Ulanbom.~~

~~H. The Gobi.~~

~~*Geographically speaking, the Gobi comprises the lower terrace of the great plateau of east Asia, bounded on the N.W. by the slopes of the Kentei mountains, and on the E. and S.E. by the Great Khingan mountains, from which it is, however, separated by a bor- derland, about 100 miles wide, belonging to the foot-hills of the latter range. Its southern limits cannot yet be definitely deter- mined, as the Gobi cannot very well be separated from Alashail. In the west, as appears from the journeys of the brothers Grum- Grzimailo, its natural limits are the hilly tracts of the Bei-shan, which occupy the space between the 94th and 100th degrees of longitude (route from Hami or Khami to Su-chow), rising to alti- tudes of 4000 to 7500 feet. In view of this the Hashufl Gobi, or Ilhuma, with the Kum-tagh Sands (40° N. and 92° E.), might be advantageously considered as part of the Tarim region. The 95th meridian may be taken as separating the Gobi from Dzungaria. The Mongolian word Gobi, as well as the Chinese Sha-nio, means a desert, stony or sandy, devoid of water and pasturage ; but the resulting current conception of the Gobi as a sand desert is abso- lutely incorrect. Nowhere does it contain such sand deserts as are found in the Transcaspian territory, but everywhere presents the characteristics of an open, flat, or undulating plain, covered with a hard coating of gravel, from which the wind has swept the lighter and minuter particles of mud or sand, and from beneath which the hills and mountains protrude littered with fragments of rook, much as islands emerge from the sea. As to the name of Han-hai, pro- posed by Richthofen, it has the disadvantage of presupposing that all the Gobi-like portions of the plateau have been covered by a Central Asian Mediterranean, which is supposed to have levelled the mountains. However, the very origin of the plateau-forms on our globe, as well as the origin of the gravel with which the Gobi is covered, is very far from being known. Everywhere throughout the Gobi a formation of red and brown conglomerates, sandstones, and clays is very common ; this most travellers, following Kichtho- f en's hypothesis, have described as deposits of a Tertiary "Han- hai sea." But after traversing some 20,000 miles of the Mongolian plateau, the professional geologists Bogdanovitch and Obrucheff, who have both devoted considerable attention to the red " Gobi or Han-hai deposits," have discovered but one fossil (Obrucheff), namely, the enamel of the teeth of a rhinoceros — a testimony which points to a fresh-water origin of these deposits rather than to a*~~

~~*hypothetical Han-hai sea, which consequently remains a mere speculation. On the other hand, Jurassic coal-bearing deposits are known to exist in several places in the Gobi, but all of them, as is proved by their well-explored fossil flora and insects, were deposited in separate fresh-water basins. Since Bogdanovitch has shown that the fossils which Stoliczka picked up in the Sanju Pass at its issue into Kashgaria are Upper Devonian (see Kuen-lun) and not Triassic, the total absence of marine formations of the Secondary and Tertiary ages on the Mongolian plateau — and dur- ing 1885-1900 it was crossed and explored in all directions by a number of scientific explorers — is the more striking from the fact that deposits of these two epochs have been found everywhere on the outer slopes of the plateau — on the Amur, the Sungari, in the Peking plain, and even in the Kalgan gorge, leading down the plateau towards Peking, as well as on the south-eastern slopes of the In-shan border ridge of the "plateau.*~~

~~*The Kentei range which limits the Gobi in the north-west, from the Transbaikalian frontier (109° 30' E.) to the point where it appears to join the Ektag Altai (in about 45° N. and 102° E.) , is apparently an escarpment, or border-ridge, of the higher terrace of the plateau occupied by north-west Mongolia, which is fringed (at least to the south-west of Urga) by a second parallel ridge.i Farther to the south-west comes the Bei-shan swelling, about 150 miles wide, the border of which runs, broadly speaking, in a north-western direction from the Nan-shan highlands to the extremity of the eastern Tian Shan. It consists of high dry plains, rapidly rising from 2300 feet in the south-east of Hami to 4000 feet in 42° N., and to 5000 and 6000 feet farther south-*~~

~~*1 The sources of the Onghin-gol, penetrating into the upper terrace, may mask the connexion. It remains also an open question whether traces of the Kentei escarpment may not be found in a south-west direction as far as 42° N., where they possibly join the Beishan, in which case they would separate the higher plams of Jasaktu-khan (4650 to 5920 feet) from the lower plains (3300 to 4000 feet) to the south-east of it.*~~

~~*east, and is intersected ty a series of parallel ridges, running west-south-west to east>-north-east, and reaching about 1000 feet above the plains (7000 to 7420 feet in the maximum). The Hashufi Gobi to the west of this swelling is still but little known. This, however, is known, that along its northern border a relatively narrow depression (2000 to 3000 feet) extends west and east at the southern foot of the eastern Tian Shan from Lake Bagrach-kul (42° N. and 87° E.) to 94° 30′ E. ; and another similar depression fringes it on the south, along the northern foot of the Altyn-tagh, from Lob-nor (2600 feet) to the small lake of Halachi (3500 feet), situated west-north-west of Su-chow. In the south-west the Gobi may be considered as limited by the Nan-shan highlands (see Kuen-lun)— that is to say, by the Great Wall between Su-ohow and Lan-chow on the Yellow river, or rather by the Sin-tang, the Vei- tsi-shang, and the Lu-huang-lin mountains. In reality, however, the Alashaii and the Ordos represent a slightly higher terrace of the Mongolian plateau. In the east the natural limits of the Gobi are the Great Khingan border-ridge, which runs from the Amur at Kumara to Kalgan near Peking, and is further continued by the In-shan mountains and the mountains which are pierced by the Yellow river in the south of Kia (88° 10′ N. and 110° 20′ E.). The Khingan, which is well known from 50° N. to the In-shan moun- tains, appears throughout this length, not as a single escarpment, but as a series of two or three parallel ridges, thus constituting a zone 80 to 100 miles wide, by which the Mongolian plateau drops south-eastwards to the deeper-lying plains (see Khingan). On the north-western slope of this border-ridge there is a zone, about 100 miles wide, which does not possess the exact characteristic features of the Gobi, but the features of an undulating high tableland, ridged with flat hills and low ranges, well wooded, well watered, and in places marshy. The Gobi proper is thus the deeper part of the trough extending over the lower terrace of the Mongolian plateau for over 1000 miles from south-west to north-east, with a width of from 450 to 550 or 600 miles in its south-western portion. The plateau itself is built up of granites, gneisses, and a variety of crystalline schists and slates, with limestones on its periphery, the youngest of which belong to the Carboniferous formation. Con- siderable layers of basalt and other volcanic formations occur in the border-ridges.*~~

~~*As regards the causes which have produced the abrasion of the surface of the plateau, they are no better known in the case of the Gobi than they are in the case of all other plateaus of the world. Wind and frost are certainly powerful agents in the destruction of denuded rocks, and their force must not be under- valued. Anyway, it is indisputable that the wind has been active in destroying the softer "red Gobi deposits," and in sweeping the finer particles of mud and sand clean off the superficial gravels. Viewed from the Peking lowlands, clouds of dust are seen to envelop the slopes of the Great Khingan, and aerial agencies have unquestionably been at work in the deposition of the thick loess deposits which, line the foot of the plateau and fill the valleys of Turkestan. But water must also have played a part in the laying down of these deposits, for usually they contain strata of pebbles in their lower parts. How far an ice-sheet, similar to that of Greenland, which covered the whole of the plateaus of Asia, may have contributed to the levelling of the mountains, is a question for future investigation to decide. The surface of the Gobi lies at altitudes of 2700 to 3000 feet, slightly increasing towards the Khingan mountains. The lowest elevation hitherto determined on this plateau is 2766 feet (907 metres, not 607 metres, as suggested by Obrucheff). But its surface is by no means level : it is diversi- fied by ranges of hills, from 300 to 1000 feet above the general level of the plateau, and occasionally more (Khan-ula, 6400 feet). Perfectly fiat plains are of limited extent ; as are also sandy plains — the surface being undulating as a rule and intersected by small ravines and protruding rocky areas. Even the western Gobi, especially in its northern parts, as appears from the KozloS expedition, is covered with numbers of parallel low ranges, which are pretty well watered and have an interesting fauna.*~~

~~*liivers. — In the central parts of the Gobi there are no rivers. They only flow on its outer margin. Such are the Onon, a tributary of the Shilka ; the Kerulen, which rises in the Kentei mountahis and flows north-east into Dolon-nor or Khulun, from which it only occasionally overflows into the Arguii ; the Khala- gol, a tributary of Buir-nor, connected by the Urgon with the former lake, on the north-east frontier of Mongolia ; a number of small rivers, which flow from the Khingan mountains but dry up as soon as they reacli the Gobi ; the Hoang-ho or Yellow river which describes a great loop round the Ordos ; several rivers which flow from*~~

~~*the Nan-shan but end in small lakes shortly after they enter the Gobi (e.g., Shao-hai and lakes Sohok and Sobo) ; and the Onghin-gol, which rises in the Kentei mountains. In the interior of the Gobi, water is only obtainable from wells.*~~

~~*The climate of the Gobi is characterized by a great dryness of the air and rapid changes of temperature all the year round and even within twenty-four hours. Dr Woeikoff has ascertained that the Gobi lies within the influence of the south-eastern monsoons.*~~

~~*In the winter the prevailing winds blow from the interior of the Asiatic continent towards the ocean, and are very dry, while in summer they blow in the opposite direction, and bring rain. At Si-van-tse the annual rainfall is 18 inches, and the absence of moisture is such that only 1 per cent, of saturation is observed. The cold in winter is truly Siberian— 27° Eahr. has been observed in November in South Mongolia, while in the Alashaii the average daily temperature in July is truly Indian, i.e., 99° Fahr., and temperatures of even 150° and 167° Eahr. in the shade have been observed. The average temperature at Si-van-tse is : year, 37° ; January, 2° ; July, 67° ; maximum, 98° ; minimum, —53°.*~~

~~*Flora and Fauna. — The vegetation is extremely poor ; the deresu, the steppe acacia (Caragana), and Festucas are the commonest plants, together with a number of Salsvlacem {Nitraria, Ephedra') and poplars along the rivers. It is only upon approaching the slopes of the mountains which encircle the region that other vege- tation— e.g., wild peaches, elm-trees, and so on — begins to appear. A little agriculture is carried on in the southern districts of the Gobi. The fauna has been well studied by Prjevalsky, and while it is generally similar to that of the Tian-shan region and Siberia, it has its own peculiar forms.*~~

~~*The Ordos or Ho-tao, in southern Mongolia, forms a sufficiently distinct region to be treated by itself. It is enclosed on the north by the great loop of the Hoang-ho, and in the south it is bounded by the mountains of Lu-huang-lin or the escarpment of the plateau towards the south. The Ordos is a gently sloping tableland, rising from 3300 feet in the north and in the vicinity of the Yellow river to 4400 in the middle, and reaching 5200 feet In the Lu-huang-lin. It is to a great extent covered with sand, especially in*~~

~~*the north and west, and with wide depressions {chaidam or tsaidam in Mongolian), the basins of desiccated lakes ; many smaller lakes are scattered over its surface. Minor tributaries of the Hoang-ho drain it in the east. The Arbus or Arbiso mountains, and the Khantagheri, about 3000 feet above the surface of the plateau, appear on the right bank of the Hoang-ho, stretching in a north- north-east direction as a continuation of the Alashan range. Several caravan routes intersect the Ordos, the principal one being that from Gui-hua-chen or Kuku-klioto, viS. Djungar, to Boro- bolghysun — the chief town of the province. There are also several towns in the eastern part of the province, on or near the Hoang-ho, namely, Fu-gu, Shan-mu, Yui-lin, and Kia, as well as in the south — Huai-shang, Tsin-kiang, Din-kiang, and Lin-chow.*~~

~~*The Alashaii range, to the west of the upper Hoang-ho, separates the Ordos from the Alashan. It runs south-south-west to north-north-east for about 160 miles, with a width of about 16 miles, and lifts its crest 5000 to 7000 feet above the surrounding plateau (which is itself 3400 to 4800 feet high), and reaches 10,000 and 11,600 feet in the only two passes which cross it. This range does not reach the limit of perpetual snow, but is extremely stony and wild. The Alashan is another vast territory of southern Mongolia ; its northern frontier corresponds, broadly speaking, with 42° N., and its southern frontier lies on the Nan-shan high- lands, while on the west it has the Bei-shan and on the east the Ordos. It also is a plateau covered by a network of hills, its lowest parts, in the lower valley of the Edzin-gol, being at alti- tudes of 4000 to 3500 feet (3290 in Sohok-nor), while the re- mainder of the region has an altitude of 4000 to 5000 feet, with ridges running up to another thousand feet. Its chief river is the Edzin-gol, which flows to the north-west along the foot of the Nan-shan, receiving several tributaries on the way. In 100° E. it turns towards the north, and finally dwindles away in the smaU lakes Sonok and Sobo. Two other rivers emerge from the Nan- shan, but are lost before they reach the Chukhun-shan hills.*~~

~~*Several towns of some importance, of which Liang-chow, Hang- chow, and Su-chow are the chief, have grown up along the foot of the Nan-shan, amidst a series of well-irrigated and well-cultivated oases, separated from each other by tracts of sand.*~~

ni. South-Eastekn Mongolia. This is the part of Mongolia which lies on the eastern slope of the Great Khingan mountains, entering like a wedge between the lower course of the Nonni river and the middle Sungari. Chiefly owing to the dryness of climate, its physical characteristics are 'similar to those of Mongolia proper, except that the altitude of the plains is much lower. This portion of Mongolia is also much better watered, namely, by the Khatsyr, the Lao-ho, and the Shara-muren, all fiowiug from the Khingan mountains eastwards, anil the last making the frontier between Mongolia and the Chinese province of Chihli.

PopiiJittion. — The population of the whole of Mongolia is estimated at about 6,000,000. It consists of Mongols — Eastern INlongols and Kalmuks in the west — various Turkish tribes, Chinese, and Tungus. The Mongols proper, with the exception of those who inhabit north- west Mongolia, may be divided into northern and southern

(more properly north-westem and south-eastern) Mongols. The former, belonging to the Khalkhas, occupy the Gobi and the regions of the Kentei mountains and Khingan mountains, while the second, divided into numerous minor branches, roam over south-eastern and southern Mongolia. The principal occupation of the Mongols is cattle-breed- ing, and Russian writers estimate that on an average each yurta, or family, has about 50 sheep, 25 horses, 15 horned cattle, and 10 camels. The transport of goods is their next most important occupation. It is calculated that 100,000 camels are used for the transport of tea only from Kalgan to Siberia, and that no less than 1,200,000 camels and 300,000 ox-carts are employed in the internal caravan trade. Agriculture is only carried on sporadically, chiefly in the south, where the Mongols have been taught by the Chinese. Various domestic industries are also carried on. The trade is chiefly concentrated at Urga, Ulasutai, and Kobdo, in north-west Mongolia ; Kalgan, Kuku-khoto, Kuku-erghi, Dolon-nur, and Biru-khoto, in southern and south-eastern Mongolia; and at Kerulen in the north-east. There is a very considerable trade between Mongolia and China, estimated at £900,000 a year for Urga alone. Some 25,000 horses, 10,000

~~horned cattle, and 250,000 sheep, as well as 330,000 hides and £30,000 worth of furs, are exported annually from eastern Mongolia; and about 70,000 horses, 30,000 camels, 1,500,000 to 2,000,000 sheep, and £40,000 worth of furs from western Mongolia. Salt, timber, sarsapa- rilla, stags' horns, rhubarb (drug), mushrooms, &c., must be added; while tea, cottons (Chinese, European, and American), crockery-ware, cutlery, flour, tobacco, paper, &c., are imported from China. The imports from Russia increase every year, but are still a long way behind those from China, hardly reaching £200,000 yearly in value.~~

~~Administration. — Before the Manchurian conquest the Mongols were governed by their own feudal princes, who regarded themselves as being descended from seven different ancestors, all, however, of the same kin. Each group of principalities constituted a separate aimalc, and each principality a separate lioshun. Under Manchu rule the aimaks became converted into the same number of military corps, each composed of so many hoshuns as military units. Each of these again was divided into sumuns or squadrons, each containing 150 families. In case a hoshun contained more than 6 sumuns, every 6 of the latter were organized into a regiment — tsalan. Eour Manchu tsiaiv-tsuns, or governor-generals, acted as chiefs of the troops, and the prince of each aimak, nominated from Peking, was considered as the lieutenant or assistant of his respective Manchu chief. The hoshuns were subject to their own princes, each of whom had a military adviser, generally a Manchu. Their internal or tribal affairs were in the hands of the princes, those which concerned a whole aimak being settled at gatherings of the princes under the eldest of them, named khan. This organization was maintained by the Manchu rulers, the khan being elected from among the princes, and the latter having each an adviser, tusalakchi, nominated from Peking.~~

~~Mongolia is now divided into 27 aimaks, which are bound to furnish 1325 squadrons, of 198,750 armed men, one-third of whom must carry rifles ; but as a matter of fact the Mongols are not provided with arms for even one-tenth of that number (Pozdn^eff, in Russian Encydo- piedical Dictionary).~~

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~~(p. A. K.)~~

~~Mong Pai (called Mobyi by the Burmese), the most south-westerly of the British Shan States of Burma. It has an approximate area of 1000 square miles. The general character of the country is hilly, rising westwards in a gentle slope from the chief stream, the Nam Pilu or Balu. This is navigable for native boats throughout the year to the point where it sinks underground in Karen-ni. The chief cultivation is rice, with about two acres of dry or hill rice to one of wet bottom. The hill fields are left fallow for ten years after two years' cultivation. Population estimated in 1898 at 16,772, of whom 2520 were Shans, 2048 Taungthus, 617 Taungyos and Inthas (from the Nyaungywe Lake), and the remainder various tribes of Karens, of whom the Padaungs (7792) were the most numerous. The chief, the Sawbwa Hkun Yon, held charge through the reigns of four Burmese kings, and submitted early in 1887 on the first arrival of British~~

~~*troops. He abdicated in favour of his son in 1890. The state pays Rs.2000 tribute.*~~

~~*Mong Pan (the Burmese Maingpan), a state in the eastern division of the Southern Shan States, lying approximately between 19° 45′ and 20° 25′ N. and between 98° and 99° E., with an area of 2299 square miles. The main state lies, except for a few insignificant circles, entirely west of the Salween, but beyond that river are the four sub-feudatory states of Mong Ton, Mong Hang, Mong Kyawt, and Mong Hta. The only considerable area of flat land is round the capital, which lies in a large and fertile plain, marking roughly the centre of the state. Erom this plain rise on all sides low hills covered with scrub jungle, sloping up to ranges of about 6000 feet on nearly every side. Rice is the only crop, irrigated where possible; elsewhere dry cultivation prevails. The state has valuable teak forests on both sides of the Salween, which cover a considerable but undetermined area. The general altitude of the valleys is about 2000 feet. The state pays an annual tribute of Rs.2000. The capital is small, and has only about 200 houses. The chief is of Sawbwa rank. Population (1891), 3099 ; of the trans- Salween sub-states, 4000 ; (1898), about 9000.*~~

~~*Monier-Williams, Sir Monier (1819-1899), Sanskrit scholar, born at Bombay on 12th November 1819, was a son of Colonel Monier-Williams, surveyor-general, Bombay presidency. He matriculated at Oxford in 1837, but left the University on receiving in 1839 a nomination for the East India Company's civil service, and was complet- ing his course of training at Haileybury when the entrea^ ties of his mother, who had lost a son in India, prevailed upon him to relinquish his nomination and return to Oxford. He there devoted himself to the study of Sanskrit, and gained the Boden scholarship in 1843. After taking his degree he was appointed professor of Sanskrit, Persian, and Hindustani at Haileybury, where he remained until the abolition of the college upon the transfer of the gov- ernment of India from the Company to the Crown. He taught Oriental languages at Cheltenham for ten years, and in 1860 was elected Boden professor of Sanskrit at Oxford*~~

after a severe contest with Professor Max Miiller (q.v.), -which attracted great public interest and severe criticism, the motive of the non-resident voters whose suifrages turned the scale being notoriously not so much to put Monier^ Williams in as to keep Max Muller out. Although, however, far inferior to his rival in versatility and literary talent, Monier-Williams was no way inferior in the special field of Sanskrit, and did himself and his professorship much honour by a succession of excellent works, among which may especially be named his Sanskrit-English and English-Sanskrit Dictionaries; his Indian Wisdom, an anthology from Sanskrit literature ; and his translation of Sakimtala. In his later years he was especially attracted by the subject of the native religions of India, and wrote popular works on Brahmanism, Buddhism, and Hinduism. His principal undertaking, however, was the foundation of the Indian Institute at Oxford, which owes its existence entirely to him. He brought the project before the University in May 1875, and in that year and the following, and again in 1883, visited India to solicit the moral and financial support of the native princes and other leading men. Lord Brassey came to his aid with a donation of £9,000, and in ISTovember 1880 the Institute was adopted by the Univer- sity, but the purchase of a site and the erection of a building were left to the professor. Upwards of £30,000 was eventually collected ; the Prince of Wales, in mem- ory of his visit to India, laid the foundation stone in May 1883 ; and the edifice, erected in three instalments, was finally completed in 1896. Ere this, failing health had compelled Monier-Williams to withdraw from the active duties of his professorship, which were discharged by the deputy-professor, Dr Macdonell, who afterwards succeeded him. He continued, nevertheless, to work upon Sanskrit philology until his death at Cannes on 11th April 1899. He had been made K.C.I.E. in 1889, when he adopted his Christian name of Monier as an addi- tional surname. (r. g.)

Monkhouse, William Cosmo (1840-1901), English poet and critic, was born in London on 18th March 1840. His father, Cyril John Monkhouse, was a solicitor ; his mother's maidennamewasDelafosse. He waseducated at St Paul's School, quitting it at seventeen to enter the Board of Trade as a junior supplementary clerk, from which grade he rose eventually to be the assistant-secretary to the finance department of the office. In 1870-71 he visited South America in connexion with the hospital accommodation

~~*for seamen at Valparaiso and other ports ; and he served on different departmental committees, notably that of 1894-96 on the Mercantile Marine Fund. He was twice married : first to Laura, daughter of James Keymer of Dartford ; and secondly, to Lenora Eliza, daughter of Commander Blount, R.N. He died in London, 20th July 1901, and was buried in Finchley Cemetery. Cosmo Monkhouse was one of those who have not only a vocation, but an avocation. His first bias was to poetry, and in 1865 he issued A Dream of Idleness and other Poems, a collection strongly coloured by his admiration for Wordsworth and Tennyson. It was marked by excep- tional maturity, and scarcely received the recognition it deserved. Owing perhaps to this circumstance, it was not till 1890 that he put forth Com and Puppies, a col- lection which contains at least one memorable effort in the well-known " Dead March." Five years later appeared a limitpxl edition of the striking ballad of The Christ u^mn the iIt7Z, illustrated with etchings by Mr William Strang. After his death his poetical output was com]]leted by Pasiteles the Elder awl other Poems (including The Christ upon the Hill). In 1868 Monkhouse essayed a novel, A Question of Honour. Then, after preluding with a ^1 Life*~~

~~*of Turner in the " Great Artists Series " (1879), he devoted himself almost exclusively to art criticism. Besides many contributions to the Academy, the Saturday Review, the Magazine of Art, and other periodicals, he published volumes on TJie Italian Pre-Raphaelites (1887), The Earlier English Water-Colour Painters (1890 and 1897), In the National Gallery (1895), and British Contemporary Artists (1899). He also edited the Life and Works of Joseph Wright (1885), and his sister-in-law Mrs. Heaton's Concise History of Painting (1888). He prefaced many of the publications of the Burlington Fine Arts Club, of which he was a member, and he was a contributor to the Dictionary of National Biography from the beginning. Monkhouse also wrote an excellent Memoir of Leigh Hunt in the " Great Writers Series " (1887), and for civil service purposes compiled, in 1877, a little manual of pricis writing. As an art critic Monkhouse's judgments were highly valued ; and he had the rare gift of differing without offending, while he invariably secured respect for his honesty and ability. As a poet, his ambition was so wide and his devotion to the art so thorough, that it is diflBcult not to regret the slender bulk of*~~

~~*his legacy to posterity. Some of the best of his pieces are to be found in Mr Miles's Poets and Poetry of the Century. (a. d.)*~~

~~*Monkswell, Robert Porrett Collier, 1st*~~

~~*Baron, English judge (1817-1886), was born at Plymouth, 21st June 1817, and was the son of a prominent merchant of Quaker extraction. He was educated at Oxford, was called to the bar in 1843, and went the western circuit. He obtained a high reputation by his successful defence of Brazilian pirates in 1845 : they were, indeed, convicted at the assizes, but Collier ultimately procured their escape upon a point of law which the judge had refused to reserve. He was elected member of Parliament for Plymouth in the Liberal interest in 1852, and in 1859 was appointed counsel to the Admiralty and judge- advocate to the Fleet. In this capacity he gave in 1862 an opinion in favour of detaining the Confederate rams building in the Mersey, which would have saved his country much money and much credit if it had been acted upon. In 1863 he became Solicitor-General, and in 1868 Attorney-General, and in 1869 successfully passed a Bankruptcy Bill. In 1871 he was appointed by Mr Glad- stone one of four new judges upon the judicial committee of Privy Council, although it was expressly provided by the Act creating these offices that none of them should be filled by a law officer of the Crown. This prohibition was evaded by making Collier a judge of Common Pleas, and transferring him after a few days to the Privy Council. It is singular that neither Mr Gladstone, Lord Hatherley, nor Lord Selborne should have seen anything reprehen- sible in this arrangement, which was unanimously con- demned by public opinion, and gave the Gladstone Cabinet a serious blow. Collier's qualifications were undoubted, but that was not the question. He officiated, neverthe- less, with distinction until his death on 3rd November 1886, and was raised to the peerage as Baron Monkswell in 1885. He was a man of many accomplishments, and especially distinguished as an amateur painter, frequently exhibiting landscapes at the Royal Academy and else- where. In his younger days he had been noted as a clever caricaturist. He was succeeded in the peerage by his eldest son, Robert (b. 1845), who, after taking a first class in law at Cambridge, went to the bar, and became (1871) conveyancing- counsel to the Treasury, and (1885-86) an official examiner of the High Court. As a*~~

~~*Gladstonian Liberal he unsuccessfully sought a seat in the HIouse of Commons, but for 1892-94 was a lord-in-waiting, and in 1895 Under Secretary of State for War in Lord Eosebery's*~~

~~*MONMOUTH*~~

~~*813*~~

~~*Government. Besides serving on parliamentary com- mittees on the sweating system, the London hospitals, and the law of copyhold, he took a leading part in attempting to pass the Bills (1891, 1897) for amending the Copyright Acts. (k. g.)*~~

~~*Monmouth, a maritime county of England, on the Welsh border, bounded on the E. by Gloucester, on the N.E. and N. by HIereford, on the N.W. by Brecknock, on the W. by Glamorgan, and on the S. by the estuary of the Severn.*~~

~~*Area and Population. — The area of the ancient county is 341,688 acres, or 534 square miles, with a population in 1881 of 211,172, in 1891 of 252,416, and in 1901 of 292,327, the number of persons per square mile being 547, and of acres to a person 1-16. The area of the administrative county, as given in the census returns of 1891, was (including the county borough of Newport) 324,701 acres, with a population of 258,054 ; but since 1891 certain changes have been made in the area, and in 1901 the population was 230,800. In 1894 this county received a small addition from HIereford, and in 1895 the contributory place of Roath in the rural district of Llandaff and Dinas Fowls was transferred from Mon- mouth to the county borough of Cardiff in Glamorganshire, while the area which, prior to the passing of the Local Government Act of 1894, constituted the part of the parish of Rumney in the county borough of Cardiff, was transferred to Monmouth. The area of the registration county is 394,424 acres, with a population in 1891 of 275,242 (of which 208,368 wero urban and 68,874 rural), and in 1901 of 316,875. Within the registration area the increase of popu- lation between 1881 and 1891 was 7-47 per cent., between 1881 and 1891 the increase was no less than 40,938, and between 1891 and 1901 it was 41,263, or 14-1 per cent. The population in 1901 numbered 316,875. The following table gives the numbers of marriages,*~~

~~*births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 :—*~~

~~*Tear.*~~

~~*Mamages.*~~

~~*Births.*~~

~~*Deaths.*~~

~~*Illegitimate Births. 1*~~

~~*Males.*~~

~~*Females.*~~

~~*1880 1890 1898*~~

~~*1676 2466 2085*~~

~~*7,900*~~

~~*9,245*~~

~~*10,299*~~

~~*4520 5433 4984*~~

~~*170 136 181*~~

~~*166*~~

~~*163 172*~~

~~*The number of marriages in 1899 was 2504 ; of births, 9924 ; and of deaths, 5872.*~~

~~*The following table gives the marriage-, birth-, and death-rates per thousand of the population, with the percentage of illegitimate births, for a series of years : —*~~

~~*1870-79.*~~

~~*1880.*~~

~~*1880-S9.*~~

~~*1890.*~~

~~*1888-97.*~~

~~*1898.*~~

~~*Marriage-rate*~~

~~*16-5*~~

~~*14-3*~~

~~*15 ‘6*~~

~~*18-1*~~

~~*16-0*~~

~~*13-5*~~

~~*Birth-rate*~~

~~*38-1*~~

~~*33-8*~~

~~*34-5*~~

~~*34-0*~~

~~*34·6*~~

~~*33·4*~~

~~*Death-rate*~~

~~*22·1*~~

~~*19‘3*~~

~~*19·8*~~

~~*20·0*~~

~~*19·0*~~

~~*16·2*~~

~~*Percentage of ille-*~~

~~*gitimacy*~~

~~*4·3*~~

~~*4·3*~~

~~*4·1*~~

~~*3·2*~~

~~*3·3*~~

~~*3·4*~~

~~*The birth-rate is above the average, but the percentage of illegiti- mate births is small. In 1891 there were in the county 944 natives of Scotland, 3807 natives of Ireland, and 1159 foreigners.*~~

~~*Constitution and Government. — The county is divided into three parliamentary divisions, and it also includes the Monmouth district of parliamentary boroughs, consisting of Monmouth, Newport, and Usk. The administrative county contains three municipal boroughs: Abergavenny (7795), Monmouth (5095), and Newport, also a county borough (67,290). The following are urban districts: Abercarn (12,607), Abersychan (17,768), Abertillery (21,955), Bedwellty (9919), Blaenavon a0,869), Caerleon (1367), Chepstow (3067), Ebbw Vale (20,993), Upper Llanfrechfa (2979), Llantar- nam (5287), Nantyglo and Blaina (13,491), Pan teg (7482), Ponty- pool (6126), Rhymney (7914), Risoa (9661), Tredegar (18,574), and Usk (1476). Monmouthshire is in the Oxford circuit, and assizes are held at Monmouth. The boroughs of Monmouth and Newport have commissions of the peace, but no separate court of quarter sessions. The ancient county — which is partly in the diocese of Llandaff and partly in that of Hereford— contains 120 ecclesiastical parishes and districts, and parts of others.*~~

~~*Education. — There is a board school for the blind at Newport. On 31st August 1899 there were in the county (including Newport) 200 elementary schools, of which 105 were board and 95 voluntary- schools, the latter including 74 National Church of England schools, 1 Wesleyan, 13 Roman Catholic, and 7 "British and other." The average attendance at voluntary schools was 12,643, and at board schools 32,104. The total school board receipts for the year ended 29th September 1899 were over £140,127. The income under the Agricultural Rates Act was over £1411.*~~

~~*Agriculture. — Only about two-thirds of the total area of the comity is under cultivation, and over three-fourths of this is in permanent pasture. There are also about 35,000 acres in hill pasture, 4000 under orchards, and 32,000 under woods. Wheat and oats are the principal corn crops, and turnips the principal green crop. Since 1880 the acreage under corn crops has dimin- ished by considerably more than a third, and that under wheat by about a half. The following table gives the larger main divisions of the cultivated area at intervals from 1885 : —*~~

~~*Tear.*~~

~~*Total Area under Cultiva- tion.*~~

~~*Corn Crops.*~~

~~*Green Crops.*~~

~~*Clover.*~~

~~*Permanent Pasture.*~~

~~*Fallow.*~~

~~*1885 1890 1895 1900*~~

~~*243,832 245,643 242,942 242,525*~~

~~*28,721 26,429 21,455 21,373*~~

~~*11,713*~~

~~*11.264*~~

~~*9,943*~~

~~*9,129*~~

~~*19,561 15,684 15,215 14,368*~~

~~*180,438 189,572 194,415 196,545*~~

~~*3348 2616 1715 1008*~~

~~*The following table gives the numbers of the principal live stock during the same years : —*~~

~~*Tear.*~~

~~*Total Horses.*~~

~~*Total Cattle.*~~

~~*Cows or Heifers*~~

~~*in Milk or in*~~

~~*Calf.*~~

~~*Sheep.*~~

~~*Pigs.*~~

~~*1885 1890 1895 1900*~~

~~*11,881 11,999 13,946 13,209*~~

~~*50,554 46,893 45,542 49,799*~~

~~*18,572 18,609 17,763 18,008*~~

~~*184,955 200,311 201,274 227,142*~~

~~*17,126 17,590 18,877 16,426*~~

~~*Industries and Trade. — According to the report for 1898 of the chief inspector of factories (1900), the total number of persons em- ployed in factories and workshops in 1897 was 16,945, as compared with 16,799 in 1896. Non-textile factories employed 15,200, of whom 8040 were employed in the founding and conversion, extraction and finishing of metals, and 3157 in the manufacture of machines ; and there is some manufacture of paper. Of the 1704 employed in workshops, 1114 were employed in clothing industries. The prosperity of the county depends chiefly on its minerals. The total number of persons employed in mines and quarries in 1899 was 33,233. The same year 169,135 tons of clay were raised, much of it valuable fireclay, 79,323 tons of limestone, and 51,036 of sandstone. Some iron is obtained from the coal mines, but coal is by far the more important mineral, and on this account much iron is imported for smelting and other purposes. There are large smelting furnaces at Newport, Cwmbran, Ebbw Vale, Blaina, and Tredegar. . The pig iron made in 1885 amounted to 438,092 tons, in 1890 to 399,538 tons, and in 1899 to 350,764 tons. The follow- ing table gives the tonnage and value of the principal minerals for 1890 and 1899 :—*~~

~~*Tear.*~~

~~*Fireclay.*~~

~~*Coal.*~~

~~*Iron Ore. 1*~~

~~*Tons.*~~

~~*Value.*~~

~~*Tons.*~~

~~*Value.*~~

~~*Tons.*~~

~~*Value.*~~

~~*1890 1899*~~

~~*97,745*~~

~~*79,481*~~

~~*£17,105*~~

~~*19,870*~~

~~*1,5.36,574 10,103,067*~~

~~*£437,070*~~

~~*6,061,840*~~

~~*17,435 12,794*~~

~~*£10,026*~~

~~6,397~~

~~Authorities. — Roger. Memoirs of Monmouthshire. London, 1708. — WiLLiAais. Histoi-y of Monmouthshire. London, 1796. — Cone. Historical Tour in Monmouthshire. London, 1801. — Ormerod. Strigulensia : Archceological Memoirs relating to the District adjacent to the Confluence of the Severn and the Wye. London, 1861. — Bagnall-Oaklby. Account of the Bude Monu- ments in Monmouthshire. Nevfport, 1889 ; and Proceedings of the Monmouth Antiquarian Association. (i. f. h.)~~

~~Monmouth, a municipal and contributory parliar mentary borough (forming, with Newport and Usk, the Monmouth district of boroughs, returning one member) of Monmouthshire, England, 18 miles south of Hereford, at the confluence of the Wye and the Monnow, on the Great Western railway. The Rolls Hall was presented to the town in 1888. Population (1881), 6111; (1891),~~

~~6470 ; (1901), 5095.~~

~~Monmouth, a city of Hlinois, U.S.A., capital of Wa:rren county, at the intersection of the Chicago, Bur- lington, and Quincy and the Iowa Central railways, in the western part of the state, at an altitude of 774 feet. It is in a coal region and has some manufactures, largely of agricultural implements. It is the seat of Monmouth College. Population (1890), 5936 ; (1900), 7460, of whom 594 were foreign-born and 321 were negroes.~~

~~Monmouth, a village in Monmouth county, New Jersey, U.S.A., about 28 miles east of Trenton. It was the scene of a sharp battle in the war of the American Eevolution, in which neither side was victorious. In June 1778 the British troops, under Sir Henry Clinton, evacuated Philadelphia in order to concentrate all avail- able forces in New York. General Washington followed in pursuit, and a battle took place at Monmouth~~

~~*Court House, about two miles from Freehold, the county seat. The losses of the two armies were about equal, approxi- mately 400 on each side.*~~

~~*Monongahela, a city of Washington county, Pennsylvania, U.S.A., on the west bank of the Monon- gahela river and on the Pennsylvania and the Pittsburg and Lake Erie railways, in the south-western part of the state, at an altitude of 753 feet. It is in a mining region, producing coal, petroleum, and natural gas, with which its industries are connected. Population (1890), 4096; (1900), 6173, of whom 711 were foreign-born and 345 were negroes.*~~

~~*Monopoli, a seaport town and archiepiscopal see of the province of Bari, Apulia, Italy, on the Adriatic coast, 26 miles south-east of Bari by rail. Its trade has declined owing to the successful rivalry of Tarentum (Taranto), Brindisi, and Bari; but it still exports olive oil, wine, flour, fruits, soap, and lime, and imports a little timber, cattle, coal, and cotton. The port is cleared by some 180 vessels of about 100,000 tons annually. Population (1881),*~~

~~*13,151 ; (1899), 12,000.*~~

~~*Monroe, a city of Louisiana, U.S.A., capital of Ouachita parish, on the east bank of the Ouachita river, on the Queen and Crescent and the St Louis, Iron Mountain, and Southern railways, in the northern part of the state, at an altitude of 80 feet. It is situated in the fertile bottom-lands, and surrounded by cotton planta- tions and uplands covered with forests of yellow pine. The industries consist mainly of the manufacture of lumber, compressing and shipping cotton, and the ex- traction of cotton-seed oil. Population (1890), 3256 ; (1900), 6428, of whom 232 were foreign-born and 2834 were negroes.*~~

~~*Monroe, a city of Michigan, U.S.A., capital of Monroe county, in the south-eastern part of the Lower Peninsula, on the Eaisin river, near its mouth in Lake Erie, at an altitude of 683 feet. Three railways, the Pere Marquette, the Lake Shore and Michigan Southern, and the Michigan Central, pass through it. It has extensive and varied manufactures, largely of agricultural implements, flour, paper, &c. Population (1890), 5258 ; (1900), 5043, of whom 692 were foreign-born and 27 were negroes.*~~

~~*Monroe Doctrine.— That the United States should avoid entangUng itself in the politics of Europe was a policy recommended by Washington. The counter- part of this, that European Powers should be prevented from taking a controlling share in the politics of the American continent, grew gradually as the importance and influence of the United States increased. It was announced in a concrete form, though not originated, by President Monroe. The threatened action of certain Continental Powers leagued together under the name of the Holy Alliance called out his declaration. Several of the South American colonies of Spain had asserted their independence. The Holy Alliance having helped into power a royalist insurrection in Spain, seemed about to use force to restore its revolted colonies also. To meet and check this movement, in his message to Congress in 1823 Monroe made the following pronouncement, which has ever since been styled the Monroe Doctrine :—*~~

~~*In. the wars of the European Powers in matters relating to them- selves we have never taken any part, nor does it comport with our policy so to do. It is only when our rights are invaded or seriously menaced that we resent injuries or make preparations for our defence. With the movements in this hemisphere we are of neces- sity more immediately connected, and by causes which must be obvious to all enlightened^and impartial observers. The political system of the allied Powers is essentially different in this respect from that of America. . . . "We owe it, therefore, to candour, and to the amicable relations existing between the United States and those Powers, to declare that we should consider any attempt on their part to extend their system to any portion of this hemisphere as dangerous to our peace and safety. With the existing colonies or dependencies of any European Power we have not interfered and shall not interfere. But with the Governments who have declared their independence and maintained it, and whose independence we have on great consideration and on just prmciples acknowledged, we could not view any interposition for the purpose of oppressing them or controlling in any other manner their destiny by any European Power in any other light than as the manifestation of an unfriendly disposition towards the United States. ... It is impos- sible that the allied Powers should extend their political system to any portion of either continent without endangering our peace and happiness ; nor can any one believe that our Southern brethren, if left to*~~

~~*themselves, vvould adopt it of their own accord. It is equally impossible, therefore, that we should behold such interposition in any form with indifference.*~~

~~*Earlier in the same message, while discussing negotia- tions for the settlement of the respective claims of Eussia, Great Britain, and the United States in the north-west, Monroe also said : —*~~

~~*In the discussion to which this interest has given rise and the arrangements by which they may terminate, the occasion has been judged proper for asserting as a principle in which the rights and interests of the United States are involved, that the American continents, by the free and independent condition which they have assumed and maintain, are henceforth not to be considered as sub- jects for future colonization by any European Powers.*~~

~~*With the first-quoted part of this message Great Britain was in hearty agreement.*~~

~~*This announcement of policy, it will be noticed, involved, firstly, a declaration aimed at foreign intervention in the political affairs of independent American states ; secondly, a warning against future European colonization on the American continents. The first was avowedly based on the right of self-defence ; it was a policy, not a law ; it was not to constrain the minor republics, but to protect them. The second, as explained by John Quincy Adams, was intended to state the fact that the American continent was occupied by contiguous states, leaving no room for further colonization and introduction of foreign sover- eignty. No legislative sanction was given to Monroe's statement of policy at the time, and in fact none was needed, for the mere announcement served to prevent foreign action in South America. Eepeatedly, since 1823, efforts have been made, and have failed, to enact the principles of the Doctrine in statutory form, and repeatedly high officials of the United States have re-announced the policy. It has thus remained a policy, not a law binding to certain action. It has never formed part of the body of International Law, being unilateral. Nor has the United States bound itself by compact with the other republics on the American continent to protect them from European aggression. Thus it hesitated to send delegates to the Panama*~~

~~*Congress in 1826, and took no part in any con- gress with the Latin American states until 1889.*~~

~~*Nevertheless, on several occasions since its conception the Monroe Doctrine has been enforced. Its spirit per- meated the Clayton-Bulwer Treaty, in which Great Britain and the United States, in 1860, mutually renounced the right of colonizing, fortifying, or occupying any portion of Central America. It was enforced against Maximilian, who, by Erench intervention in Mexico, had been made emperor, and until the close of the American Civil War had perforce been left undisturbed. Its applicability was urged when de Lesseps's Panama Canal was thought*~~

~~*possible of completion. Both Cuba and the Hawaiian Islands at various periods have felt its influence, the general, though not consistent policy of the United States being, while disclaiming the desire of annexation itself, to deny the right of any European Power (except Spain in Cuba's case, until 1898) to control them. And, finally, it was applied to the claims of British Guiana to Venezuelan territory by President Cleveland's message in 1895, which proposed a commission to settle the boundary and threat- ened war if its line were not accepted. This commission never reported, but the disputants finally agreed to arbitrate, and the British claim was in the main upheld. Between 1823 and 1895 the development and enlarge- ment of this policy on the part of the United States has been very striking. To prevent the overthrow of an independent republic is one thing; to interfere in the settlement of a boundary dispute between two states, also on the ground of self-defence, is quite another. Yet Cleveland's doctrine met with general acceptance, and in fact it had been in a sense anticipated by President Grant, who, in urging the annexation of San Domingo upon the United States Senate in 1870, used this language :—*~~

~~*The Doctrine promulgated by President Monroe lias been adliered to by all political parties, and I now deem it proper to assert the equally important principle that hereafter no territory on this continent shall be regarded as subject of transfer to a European Power.*~~

~~*Never having been formulated as law or in exact language, the Monroe Doctrine has meant different things to different persons at different times. It has grown with the consciousness of growth in power — a curious fact, since it is founded on the right of defending interests which must be less endangered as the United States becomes greater. It has become deeply rooted in the American heart, and a permanent part of the foreign policy of the United States. It tends to change into the principle that every portion of the American continent must be free from Eurispean control. It is still coupled, however, with the converse principle that America takes,no part in European politics, as the disclaimer of the American delegates to the Peace Conference at The Hague proved.*~~

~~*See Tucker's Monroe Doctrine. — Oilman's Life of Monroe. — 'WHARTO^f's International Law Digest (title, Monroe Doctrine). — Snow's American Diplomacy. — Also an article by Sir Frederick Pollock in the Nineteenth Century and After, 1902.*~~

~~*(t. S. W.)*~~

~~*Mons, a town of Belgium, capital of the province of Hainault, 38 miles south of Brussels. It has communi- cation by rail with Ghent, Brussels, Charleroi, and other towns of importance. It is the centre of a rich coal dis- trict, and there are numerous sugar refineries in its vicinity. Population (communal) (1880), 24,049; (1890), 25,237;*~~

~~*(1900), 27,015.*~~

~~*Montana, a north-western state of the American Union, bounded on the N. by Canada, on the E. by jSTorth and South Dakota, on the S. by Wyoming and Idaho, and on the W. by Washington, with an area of 145,310 square miles. About one-third of the state is mountainous, the remainder consisting of agricultural or grazing lands. It is no longer on the frontier, as the term was once used. Fears of Indian uprisings are gone ; the Government has so systematized its management of the various tribes, by its reservations and encouragements for farming and stock-raising, that the Indians, as a rule, ai-e content to remain within their reserves. Society has assumed a stability and permanency like that of the older states. The valleys throughout the state have been ploughed and*~~

~~*cultivated. In manufactures, apart from the mining industry, the state has not advanced as fast as it otherwise might have done, because of the lack of*~~

~~*skilled labour and the inability to compete with older communities.*~~

~~*Population.— The population in 1890 was 132,159, of whom 87,882 were males and 44,277 females. There were 89,063 native- born and 4.3,096 foreign-born. There were also 10,346 Indians, not included in the foregoing figures. In 1900 the population was 243,329, showing an increase during the decade of over 84 per cent. The males numbered 149,842, the females 93,487 ; the native-born, 176,202 ; the foreign-bom, 67,067 ; the negroes, 1523 ; the Chinese, 1739 ; the Japanese, 2441 ; and the Indians, 11,343. There were 26 incorporated cities, towns, and villages, of which 11 had more than 2000 inhabitants, but only 4 over 5000, namely, Butte, with 30,470; Great Falls, with 14,930; Helena, the capital, with 10,770 ; and Anaconda, with 9453. The average number of persons to the square mile was 1-7, as compared with 0-9 in 1890, and the urban population was 28-8 per cent, of the total.*~~

~~*Education. — The public schools are supported by a direct tax, which may not exceed 10 mills on the dollar of the assessment of the district. There were 678 school districts in 1890 ; the enrolment was 37,117, and the number of teachers was 97 male and 929 female. The sum of $606,990 was apportioned to the 678 districts. The amount paid in 1899 for salaries was $511,829; the value of schoolhouses was $2,426,592. The state university at Missoula had, in 1890, 209 students and 20 instructors, the annual expenses being $58,284. A school of mines is under organization at Butte ; the state agricultural college at Bozeman, in 1899, had 173 students and 14 instructors, the annual expenses being $23,500. The state normal school at Dillon had 45 students and 8 teachers, the annual expenses being $16,337.*~~

~~*Charities, &c. — The total number of prisoners in 1899 in the state prison at Deer Lodge was 328. In the insane hospital at Warm Springs the number of patients in 1899 was 477 — male, 375 ; female, 102. The number of inmates in the state reform school at Miles City in 1899 was 72 (60 boys, 12 girls). In 1899 the school for deaf and dumb at Boulder had*~~

~~*21 pupils. On Ist December 1899 there were 51 inmates in the soldiers' home at Columbia Falls. The state orphans' home at Twin Bridges cared for 106 children in 1899. The agricultural college has issued bonds to the amount of $100,000 ; the normal school to the amount of $50,000 ; the university to the amount of $100,000 ; the deaf and dumb asylum to the amount of $40,000. The principal and interest on these bonds are secured by the several land grants made to the state by the U. S. Government.*~~

~~*Libraries. — The report of the United States Commissioner of Education for 1896 shows that in Jive years there was an increase of 227 per cent, in the number of volumes in Montana libraries, the total number of volumes being 86,093, exclusive of pamphlets. The largest free libraries are found at Helena, 29,966 volumes ; Butte, 26,984 ; Anaconda, 5562 ; Bozeman, 8000 ; Missoula, 4828 ; Billings, 3500 ; Great Falls, 5148 ; and Dillon, 2105.*~~

~~*Minerals. — The principal mineral products are gold, silver, copper, and lead. The following statistics give the value of the mining industry for 1889 and 1899, the figures for the latter year being subject to slight revision : —*~~

~~*Gold.*~~

~~*Silver.*~~

~~*Copper.*~~

~~*Lead.*~~

~~*Total.*~~

~~*Per cent. Increase*~~

~~*over*~~

~~*Preceding*~~

~~*Year,*~~

~~*1889 1899*~~

~~*$ 3,500,000 4,919,896*~~

~~*$ 19,393,939 20,040,404*~~

~~*% 18.334,970 89,471,000*~~

~~*$ 456,975 979,000*~~

~~*$*~~

~~*36,6S5,8&1*~~

~~*65,410,800*~~

~~*3*~~

~~*21i*~~

~~*Coal-mining is also a valuable industry. The total value of the coal output at the mines for 1898 amounted to $2,130,094.*~~

~~*Agriculture. — The agricultural products are much the same as those of the middle states, the yield, however, especially in cereals, being more abundant. The following figures show the acreage under cultivation and the yield for 1896: —*~~

~~*Crop. Acreage. Yield.*~~

~~*Oats . . . 64,911 acres 3,050,770 bushels*~~

~~*"Wheat . . 45,443 „ 1,204,240 „*~~

~~*Bariey . . 5,701 „ 142,525*~~

~~*Potatoes . . 4,952 „ 841,840 „*~~

~~All grasses grow luxuriantly, and the harvest of hay from the irrigated lands is exceedingly large. In the southern valleys, on both sides of the main mountain range, both large and small fruits are grown in the greatest abundance. Fruit-growing has become a most important industry in several counties in the western part of the state. On 18th August 1894, as an induce- ment to the reclamation and settlement of arid lands, Congress passed the Carey Desert Land Act, which gave to the state the title to one million acres of arid lands, the title to be passed when the state should reclaim the lands. The state Legislature, by Act of 18th March 1895, formally accepted the eSer, and~~

~~passed an Arid Land Act, under which an irrigation commission was appointed, and provision made for securing funds for the reclamation of all the land offered. Surveys have been made for three canals in the eastern part of the state. These canals will render arable about 75,000 acres.~~

~~Stock-raising. — TluTiog 1898, owing to high prices prevailing for young stock, a smaller number of stock cattle came into the state than formerly, the total hardly exceeding 60,000 head, a falling off of more than 75 per cent, from the preceding year. During 1899, 50,000 head of young stock were shipped into the state, a considerable increase over the previous year, but still not as many as usual. In 1890, 124,035 cattle were shipped out of the state ; estimating that 50,000 were consumed within Montana, the total amounted to 174,035. In 1898, 172,225 head of cattle were shipped to various markets. Estimating the home consumption at 60,000, the total was 232,225 head. The average price was estimated at ^39 per head, an increase of about 5 per cent, over any previous year. In 1899, 143,498 head were shipped out of Montana, making a total of 203,498. The total assessed value of cattle in 1899 was $12,057,087. On the 1st of March 1898 there were 2,967,901 sheep assessed in the state, the valuation per head being placed at $2.52, making the total valuation 17,450,848. The number of sheep at this time was 3,146,868. The number of sheep brought in from other states from March to December 1898 was~~

~~79,277 ; the number of lambs, 1,217,057. The number of sheep and lambs slaughtered, sold, and shipped from March to December 1898 was 583,320. The number of pelts sold was 450,296, the price ranging from 6 cents to 9| cents per pound. The number of pounds of wool for the season's clip was 22,916,603, and the lowest and highest prices received by the producer were 7 J and 20 cents. In 1899 wool went as high as 22 cents. The total assessed value of sheep in 1899 was $8,302,944. Great num- bers of horses — many of the very best type of driving and draught animals — are reared. The number shipped during 1899 was 35,000, and the total assessed value of horses was $3,289,726.~~

~~Railways. — The mileage of the chief lines of railways was as follows : — Northern Pacific railway, 1371 miles ; Great Northern railway, 1066 miles ; Great Ealls and Canada railway, 133 miles ; Oregon Short Line, 126 miles ; Big Horn Southern, 101 miles ; and Butte, Anaconda, and Pacific, 51 miles.~~

~~5a lifts. — There were at the end of 1899, 21 national banks, 13 private banks, and 14 state banks ; their total capitalization and surplus was then $5,849,393 ; and the total deposits amounted to $28,732,447.~~

~~Finances. — In 1899 the assessed valuation of real property was $72,514,960; of personal, $54,610,006; and of railways, $14,992,689, giving a total of $142,117,655. On 30th November 1899 the outstanding registered general fund warrants amounted to $349,360 ; accrued interest (estimated), $5300 ; total debt, $354,660. The estimated taxes and licences due and unpaid were $357,000 ; cash on hand in general fund was $7957 ; total, $364,957 ; the estimated credit balance was $10,297. There was no bonded indebtedness. The rate of taxation differs in each county ; the average was 24| mills in 1899 for state and county purposes ; the tax for state purposes is limited to 2^ mills. The income is derived from this tax of 2| mills, from licences, escheated estates, fees paid to state officers, inheritance tax, fines, &c. The income from all these sources (for general purposes, not for schools) for the fiscal year ending 30th November 1899 was $571,450 ; the expenses amounted to~~

~~$588,727.~~

~~*Manufactures.— — The following table shows the manufacturing and mechanical industries as returned at the censuses of 1890 and 1900, and the percentage of increases : —*~~

~~*1890.*~~

~~*1900.*~~

~~*Per cent, of Increase.*~~

~~*Number of establish-*~~

~~*ments*~~

~~*289*~~

~~*1,080*~~

~~*273-7*~~

~~*Capital*~~

~~*$4,293,794*~~

~~*$40,945,846*~~

~~*$853-0*~~

~~*Wage-earners, aver-*~~

~~*age number .*~~

~~*2,386*~~

~~*10,117*~~

~~*324-0*~~

~~*Total wages*~~

~~*$1,652,413*~~

~~*$7,969,886*~~

~~*$ 382-3*~~

~~*Cost of material used*~~

~~*$2,375,093*~~

~~*$32,702,650*~~

~~*$1276-9*~~

~~*Value of products*~~

~~*$5,507,573*~~

~~*.$57,075,824*~~

~~*$ 930-3*~~

~~*The chief industry is the smelting and refining of copper ; the total value of its products in 1900 was ti:!", 387, 063, or over half of that of the whole state. The smelting and refining of lead and lumber and timber products rank next in importance.*~~

~~*Beliijion. — The number of members or communicants in the chief denominations was in 1890 as follows :— Roman Catholic, 25,149; Methodist, 2425; Presbyterian, 1232; Protestant Epis- copal, 1 104 ; Disciples of Christ, 785 ; Baptist, 683 ; Congre- gational, 345 ; and Lutheran, 394.*~~

~~*Political Changes. — Politically' Montana has been irregular since its admission as a state (8th November 1889). The Re- publican party was slightly in the lead in 1892, Harrison having secured the electoral vote by a plurality of 1270 votes over Cleveland, out of a total vote of 44,315. In 1896 interest in silver coinage was intense, and Bryan received 42,537 votes out of 53,217 cast. In 1900 Bryan received 37,146 votes and*~~

~~*McKinley 25,373 votes out of a total of 63,641. The Populist party polled 15,240 votes in 1894, and 11,607 votes in 1898. The state officials elected in 1896 and 1899 were principally Democratic ; in 1900 the entire Fusion (Democrat-Populist) state ticket was elected. The state has not experimented much in novel legis- lation. There are 24 counties in Montana. The Australian ballot system prevails.*~~

~~*Authorities. — Bancroft, H. H. History of Washington, Idaho, and Montana, 1890.— Coues, E. ed. History of the Ex- pedition under the Command of Lewis and Clarice, 1893. — Da vies, J. T. and J. F. Civics of Montana, 1896 ; History of Montana, 1885. — Miller, Joaquin. Illustrated History of the State of Montana, 1894 ; Montana Historical Society Contribu- tions, 1898. — Pallidin'o, L. B. Indian and White in the North-West, or a History of Catholicity in Montana, 1895 ; U.S. Government Beports ; General Scientific Information.*~~

~~*(w. H. H*.)*~~

~~*Montargis, chief town of arrondissement and an important rail vsray junction, department of Loiret, 45 miles east by north of Orleans. A handsome modern building contains the town hall, public library, and museum. In the courtyard is a fine bronze group, " The Dog of Montargis," and in the town is a statue of Mirabeau erected 1888. The total port traffic in 1898 amounted to 162,579 tons. Population (1891), 9789 ; (1901), 10,517.*~~

~~*Montauban, chief town of department Tarn-et- Garonne, Prance, 411 miles south-south-west of Paris by rail. A monument to Leon Cladel was erected in 1895. Silk-mills give employment to a large number of work-people, and the final dressing of textiles manufactured elsewhere constitutes a special industry. Population (1891), 16,732 ; (1901), 30,506 (comm.).*~~

~~*Montauban, Charles Cuillaume Marie Appollinaire Antoine Cousin de, Count DE Palikao (1796-1878), French general and states- man, was born in Paris on 24th June 1796. He entered the army as a cavalry officer, and saw much service in Algeria. His promotion was by no means rapid, and he was still but a colonel of spahis when, in 1847, he effected*~~

~~the long-sought capture of the famous guerilla leader, Abd-el-Kader. After rising to the rank of general of division, commanding the province of Constantine, he was appointed in 1868 to a command at home, and at the close of 1859 was selected to lead the French troops in the joint French and British expedition to China. Montauban's strategy left much to be desired, and more than once — notably at the landing near the Taku forts — the success of the allies was secured only by his yielding to the counsels of his colleague, Sir Hope Grant. After the capture of the forts the allies advanced upon Peking, scattered the huge but ill-trained Chinese army at Changkiawan and Palikao (" the Eight-Mile Bridge"), and dictated terms of peace in the capital. Montauban was made a senator by Napoleon III., and in 1862 received the title of Count de Palikao. But an indelible stain was cast upon the expedition by the plunder of the Summer Palace. Montauban himself was loelieved — though, as it seems, without foundation — to have acquired a vast fortune from the spoils, and on this ground the French Chamber rejected the Emperor's proposal for bestowing a large grant upon him. He remained unemployed till 1865, when he was appointed to the command of the 4th Army Corps at Lyons, in the training of which he disjilayed exceptional energy and administrative capacity. On the outbreak of the Franco- German war in 1870 he was not given a command in the~~

~~field, but after the opening disasters of the war had shaken the Ollivier ministry he was entrusted by the Empress-Regent with the portfolio of war, and became president of the council in a new Liberal cabinet (10th August). He at once set to work with great success to reorganize the military resources of the nation. He claimed to have raised MacMahon's force at Chalons to 140,000 men, to have created three new army corps with their equipment, 33 new regiments and 100,000 gardes mobiles, and to have brought the neglected defences of the capital to a state of efficiency — and all this in twenty- four days. It was he who conceived the idea of sending MacMahon's army to raise the blockade of Metz. The scheme depended for its successful execution on a pre- cision and rapidity~~

~~*of movement of which the army of Chalons was no longer capable. Political reasons caused the rejection of the only sound plan, to concentrate on Paris. Upon the news of the capitulation of Sedan, the majority of the deputies offered the dictatorship to Palikao ; but he refused to desert the empire. IIe laid before the Corps Ldgislatif a proposal to establish a council of national defence, consisting of five members elected by the deputies, with himself as "lieutenant- general of government " ; but before a decision was made, the Chamber was invaded by the mob. Palikao fled to Belgium, and subsequently offered his sword to the Government of National Defence, which declined his services. On 20th July 1871 he appeared before the parliamentary commission of inquiry, and later in the same year published a defence of his administration under the title of Un Ministire de la Guerre de vingt-quatre jours. IIe again appeared in public as a witness in the action for libel brought by General Trochu against the Fk/aro in 1872. IIe died at Versailles on 8th January 1878. (h. ST.)*~~

~~*Montbeliard, chief town of arrondissement, depart- ment of Doubs, 46 miles east-north-east of BesanQon by rail. It occupies a strategic position in the Gap of Belfort, and besides its ancient castle, now used for barracks, and a battery, is defended by outlying forts. A statue has been erected in memory of Colonel Denfer1>Rochereau (d. 1878), leader of the defence at Belfort. Clocks and watches are made to the annual value of about £40,000. Population (1891), 8417 ; (1901), 9154.*~~

~~*See Tenot, Eug^^ne. Les nouvelles defenses de la France ; La Frontiere, 2nd ed. Bordeaux, 1893.*~~

~~*Montbrison, chief town of arrondissement, depart- ment of Loire, Prance, 22 miles north-west of St ^fitienne, on the railway from Clermont to St fitienne. It is situated on a volcanic hill overlooking the Vizezy, a right-bank affluent of the Lignon. The principal buildings are the church of Notre Dame (founded about 1220) and the 14th-century edifice known as Diana (Decana), restored in 1886, which serves as the meeting-place of an important archaeological society. The town has also two hospitals and a statue of the poet de Laprade (died 1883), a native of the town. Cretonnes and other cotton fabrics and silk ribbons are manufactured,*~~

~~*and there is considerable com- merce in grain. Population (1881), 6803 ; (1901), 7620.*~~

~~*Montceau- les -Mines, town and railway station, arrondissement of Chalon-sur-Sa8ne, department of Saone- ct-Loire, France, 28 miles in direct line north-west of Macon. Its importance is chiefly due to its position as the centre of the Blanzy coal basin, in which about 10,000 persons are employed. Situated on the Canal du Centre, which is connected with the coalfield by numerous lines of railway, the total traffic in 1900 amounted to 436,487 tons. Various manufacturing establishments are in operation, including weaving and spinning factories, iron*~~

~~*and copper foundries, and engineering workshops. Pop- ulation (1901), 24,690.*~~

~~*Montclair, a township of Essex county, New Jersey, U.S.A. It is situated in 40° 49' N., 74° 13' W., on the east incline of Watchung Mountain, in the north-eastern part of the state. Owing to its sloping site, the altitude of the town varies from 217 to more than 600 feet. The street plan is irregular. The Delaware, Lackawanna and Western, and the Erie railways give direct and frequent communication with New York, of which it is a residential suburb. Population (1890), 8666; (1900), 13,9(32, of whom 3071 were foreign-born and 1344 were negroes.*~~

~~*Mont-de-Marsan, chief town of department Landes, France, 428 miles south-west of Paris, on the railway from Bordeaux to Tarbes, and at the confluence of the Midou and the Douze (=the Midouze). The local institutions comprise a lycee, female normal school, library, and hospital. The industries include distilla- tion of resins, forges, and manufactures of drugget and of plaster. There is trade in resin, wine, brandy, oil- seeds, haricots, young pigs, mules, and horses. Popula- tion (1881), 8178; (1901), 11,604.*~~

~~*The town dates from the 12th century, when it was founded by Pierre, vicomte de Marsan, a.s the capital of his territory, though unsubstantial claims for an earlier foundation have been advanced. In the 13th century it passed to the viscounts of Bfiarn, but the harsh rule of Gaston Phoebus (of whose large prison some remains exist) and some of his successors*~~

~~*alienated the loyalty of the people and induced them to favour the English. The territory was united to the French Crown on the accession of Henry IV.*~~

~~*Monte Carlo. See Monaco.*~~

~~*Montecatini, two much-frequented mineral baths of Tuscany, Italy. (1) In the province of Pisa, 5 miles west of Volterra. The water is saline, with a temperature of 78-8° F. There are also copper mines, which have been worked since the 15th century. Population, about 5000. (2) In the province of Lucca, 7 miles west by south of Pistoja, in the valley of the Nievole (see Kuskin's description in Fors Clavigera, vol. ii.). 'The springs, which number ten in all, are saline, and range in tempera- ture from 82-4=' to 86° F. The water is both drunk and used for bathing by some 40,000 visitors annually, and is exported in bottles to a great quantity. There is also a large natural vapour bath (80°-95° F.) in a grotto near by, discovered in 1849. Another attraction of the place is the gardens of Collodi, a model of Italian land- scape gardening. Here the Florentines were defeated by Uguccione della Faggiuola of Pisa in 1316. Population, about 7000.*~~

~~*Montefiascone, a town, and episcopal see of the province of Rome, Italy, built on a hill (1326 feet) at the south-east of Lake Bolseno, 47 miles by rail north-west of Rome. The cathedral (1519) is one of the earliest structures by Sammicheli. The town has in San Flaviano, built in 1030, rebuilt in the Gothic style in 1262, a curious double church ; in its interior some 14th-century frescoes were discovered in 1896. In the crypt is the reputed grave of the German Bishop Fugger of Augsburg, who succumbed to over-copious libations of the local wine, known as Est, est, est. Population, about 6000.*~~

~~*MontefTore, Sir Moses Haim (1784-1885), Jewish philanthropist, eldest son of Joseph Elias Mon- tefiore, a London merchant, and of Rachel, daughter of Abraham Lumbroso de Mattos Mocatta, was born at Leg- horn, 24th October 1784. His paternal ancestors were Jewish merchants who settled at Ancona and Leghorn in the 17th century, whilst his grandfather. INIoses Haim*~~

~~Montefiore, emigrated from the latter town to London in 1758. Montefiore was educated privately, and after being articled for some time to a wholesale tea merchant he entered the Stock Exchange, his nncle purchasing for him at a cost of £12,000 the right to practise as one of the twelve Jewish brokers licensed by the City of London. Althongh belonging to the Sephardic or " Spanish" con- gregation of Jews, he married in 1812 Judith, a daughter of Levy Barent Cohen, of the " German " Jews, another of whose daughters was the wife of Nathan Mayer Roths- child, the head of the great banking firm ; this relation- ship led to a close connexion in business between Monte- fiore and that house, whilst, further to cement the bond existing between the two families, his brother Abraham married Henrietta Rothschild, a sister of the financier. In 1824 Montefiore, having amassed a fortune, retired from the Stock Exchange, and during the next few years assisted in founding the Alliance Fire, Life and Marine Insurance Office, the Imperial Continental Gas Associa- tion, and the Provincial Bank of Ireland. From his forty- third year to the end of his exceptionally long and active life Montefiore devoted all his energies to ameliorating the lot of his co-religionists both in the United Kingdom and in other countries. His first pilgrimage to Palestine was undertaken in 1827, and resulted in a friendship with Me- hemet Ali which was to lead to much practical good, though for the moment the visit was confined to the prosecution of fruitful inquiries and the bestowal of princely alms. Im- mediately on his return, Montefiore began to take an active part in the struggle which British Jews were then carrying on to obtain full political and civic rights. In 1837 he be- came the City of London's second Jewish sheriff, and was knighted. In 1838, accomj>anied by Lady Montefiore, he started on a second voyage to Palestine, in order to submit to Mehemet Alia scheme for Jewish colonization in Syria. Though political disturbances rendered his efforts again unsuccessful, the year 1840 brought Montefiore once more before Mehemet, this time to plead the cause of some Jews imprisoned at~~

~~*Damascus on a charge of ritual murder. He obtained their release, and on his way back wrung from the Porte a decree giving Jews throughout Turkey the utmost privileges accorded to aliens. In 1846 the threatened reissue in Russia of an Imperial ukase (first promulgated in 1844) ordering the withdrawal of all Jews from within 60 versts of the German and Austrian frontiers, caused Montefiore to proceed to St Petersburg, where in an interview with the Tsar he succeeded in getting the ukase rescinded. On his return. Queen Victoria, on the recommendation of Sir Robert Peel, made him a baronet, to mark her appreciation of his efforts in the cause of human- ity and civilization. In 1859 a case of injustice which*~~

~~*attracted the attention of all Europe brought Sir Moses to the gates of the Vatican. A Jewish child named Mortara had been secretly baptized by its nurse and stolen from its mother, who died of grief. Cardinal Antonelli, in the name of the Pope, refused to give up the boy, who became a priest. In 1863 we find Montefiore on a mission in Constantinople to obtain from the Sultan, Abdul Aziz, the confirmation of his predecessor's decrees in favour of the Jews ; in 1864 in Morocco to combat an outbreak of anti-Semitism ; in 1866 in Syria, relieving the distress resulting from a plague of locusts and an epidemic of cholera; and in 1867 in Rumania, once more pleading the cause of the oppressed Jews with Prince Charles. In 1872 Montefiore was deputed by the British Jews to present to Alexander II. their congratulations on the bicentenary of the birth of Peter the Great, and was received by the Tsar with great honour at the Winter Palace. His seventh and last pilgrimage to the Holy Land was made in 1875, of which he wrote an account in his Narratire of a Forty Days' Sojourn in the Holy Land, published in that year. The last decade of his life was passed in comparative quiet upon his estate near Rams- gate in Kent ; and there, after having received general congratulations on the completion of his hundredth year, he passed peacefully away on 28th July 1885. Sir Moses Montefiore was a strictly orthodox Jew, scrupulously observant of both the spirit and the letter of the Scrip- tures ; in his grounds he had a synagogue built where services are still held twice a daj', a college where ten rabbis live and expound the Jewish law, and a mauso- leum that contains the remains of himself and of Lady Montefiore, who died in 1862. (j. a. j. de v.)*~~

~~*Montefrio, a town of Spain, in the province of Granada, not far from the border of the province of Cor- doba. The industries include manufactures of cotton stuffs, alcohol, and soap. The town is irregularly built, and has a modern parish church. It was an important fortress in the days of the Moorish rule, and there is a strong castle which commands the town. The population in 1897 was 10,404.*~~

~~*Montelimar, chief town of arrondissement, depart- ment of Drome, France, 27 miles south of Valence, on the railway from Lyons to Marseilles. It has a com- munal college, library (12,000 volumes), and consultative chamber of agriculture. The industries include the manu- facture of tiles and bricks, and alimentary conserves, and important saw- mills for dressed wood and parquetry. At Bondonneau, 2^ miles south- south-east, is acold carbonated spring, utilized in a local thermal establishment. Popu- lation (1881), 8963; (1901), 13,351.*~~

~~*MOI^TENEGRO.*~~

~~*MONTENEGRO, or the Black Mountain (Servian Tzmdgora; Albanian 3Ial Esiya; the form Mon- tenegro the Venetian variant of Montenero), though prac- Baiarge. ^^^^^^^J ire and self-governed state for more than meat of five Centuries, was for the first time formally rec- bouad- ognized as an independent principality by the '■**' Great Powers and Turkey under the Berlin Treaty, 13th July 1878. The considerable increuso of ter- ritory then accorded to the primitive little community, and the acquisition of two ports on the coast of the Adriatic, seem destined eventually to effect an important chans^e in the characterof the Montenegrins, and to modify the patri- archal customs and institutions to which they are still at- tached. Formerly confined to a barren tract of mountain land, and addicted exclusively to warlike pursuits, they are*~~

~~*now in possession of rich well-watered plains, extensive pastures, and vast forests : the development of these new sources of wealth, as well as increased contact with the world of commerce, must sooner or later alter the conditions of life \'hich have jnevailed amongst them for so many centu- ries. The present frontier, which was not finally delimited till ISSl, ascends the lioyana river from its mouth as far as Lake Shas, then follows the river Megured to the summit of Mount T'ratovitza, reaching Lake*~~

~~*Scutari at aspotoppo- site the island of Goritza Topal. Crossing the lake north- east to a point a little south-east of Plavnitza, and leaving the territory of the Hot and K lenient tribes to the south, and the districts of Kutchka Kraina to the north, it liassi's north of the districts of Plava and Gusinye and reaches the western end of the IMokra Planina, where it*~~

~~*turns to tlie north-west. After crossing the Lim at its junction with the Skula, it coincides with the old frontier for some distance ; then reaching the Tara at Maikovatz, it follows the course of that riyer to near its junction with the Piva : turning southwards, it reaches the old frontier once more at Klobuk, and, passing between the district of Grahovo and the Krivoshian mountains, approaches to within a few kilometres of the Bocche di Cattaro : then, following the maritime mountain ridges for a considerable distance, it rejoins the coast a little south of Spizza. The district of Spizza was occupied by Austria subse- quently to the Berlin Treaty, and the political and com- mercial barrier interposed between the Montenegrin hinterland and the sea was thus,'unfortunately, extended. The possession of Antivari and Dulcigno will, however, considerably facilitate the future economic developmenb of the principality, notwithstanding the inconvenient situation of these ports and their present commercial insignificance. Another probable consequence of the enlargement of boundaries will be the transference of the seat of government from the mountain village of Tzetinye (usually written Cettigne) to one of the towns in the newly-acquired territory, such as Nikshitch or Podgoritza, possessing greater advantages as a commercial and ad- ministrative centre.*~~

~~*In recent years the less known districts of the newly- acquired territory have been visited by several travellers,*~~

~~*especially the finely-wooded tracts extending teMurTs'. north of Nikshitch to the Dormitor mountain*~~

~~*group ; the remote region of the Vasoyevitchi, lying to the extreme east on either side of the upper Lim, has also been explored. The Dormitor district contains rich grassy uplands dotted with numerous small lakes, from which it derives its name of Yezera (the lakes) ; the rivers Tara and Piva flow through magnificent gorges clothed with rich forests, and unite near the extreme northern point of the frontier. In the district of the Vasoyevitchi, which surrounds the little town of Andriye- vitza, is the fine double peak of Kom, and, a little to the south-west, the summit of Maglitch, commanding a mag- nificent view over the wooded valley of Gusinye to the great Prokletia range in Albania.^ The contrast between the rich undulating landscape of the northern regions and the sterile calcined rooks of Montenegro proper is very remarkable. Themountains of the former districts together with those of the Brda are divided into four masses : (1) the group enclosed by the Tara and Piva rivers with Dormitor, one of the highest mountains in the Peninsula (2483 metres), Yablonov Vrkh (2168 metres), and the Vrkhove Pochoratz (2012 metres) ; (2) the group between the Zeta and the Moratcha with Ostri-Kuk (2300 metres), Vlasulya (2296 metres), Brnik (2091 metres), and Maganik (2018 metres) ; (3) the ranges between the Moratcha and Tara with Sto (2232 metres), and Gradishte (2181 metres) ; and (4) those between the upper Tara and the upper Lim with Kom, the second highest mountain in the country (Kom Kutchki (2448 metres), Kom Vasoyevitchki (2422 metres)), separating the districts of the Vasoyevitchi on the north-east from that of the Kutchi on the south-west, and Visitor (2114 metres), on the frontier. In Montene- gro proper the only prominent summit is Lovchen (1723 metres), between Cettigne and the western frontier ; its dark appearance, partly due to the shadow resting on its northern and eastern declivities during the greater part of the day, and partly to the dusky pine-woods on its upper slopes, has given a name to the whole country. In the maritime districts is the Sutorman range, with the fine pyramidal summit of Eumiya (1569 metres), overhanging*~~

~~*1 This mountain must be distinguished from the higher Maglitch (2347 metres) on the northern frontier near the junction of the rivers Fiva and Tara. **~~

~~*Antivari. Beyond the Lim, at the extremity of the east- ern frontier, is the Mokra Planina. The only extensive plains are those of Nikshitch and Podgoritza and the lowland tract between Dulcigno and the Boyana. Mon- tenegro proper is almost absolutely waterless, the only stream being the Eieka, which probably drains the Cet- tigne valley by an underground outlet : its lower course is practically an inlet from Lake Scutari, and is navigable up to the town of Eieka. The scarcity of water has largely contributed to the successful defence of the coun- try against Turkish invasion : the few springs are hidden in deep crannies among the rocks, and the inhabitants are accustomed to preserve melted snow for use during the summer. On the other hand, the Brda and porth- eastern districts are abundantly watered. Lake Scutari (350 square kilometres) is among the most beautiful in Europe ; its scenery may be compared with that of Lake Garda. The water is of a light green colour, and the bed shallow (average depth 2 to 3 fathoms).*~~

~~*The climate generally resembles that of northern Albania ; it is severe in the higher regions, and compara- tively mild in the valleys, while in the maritime _„ ;*~~

~~*T- ft,' -TT^i' -J 1 Climate*~~

~~*districts of Antivari and Dulcigno it may be and compared with that of central Italy. The natural average temperature is about 15° (Celsius), p™**""'*. The high basin of Cettigne (638 metres) is deeply covered with snow during the winter months, and the village capital is sometimes almost inaccessible ; in summer the days are hot, but the nights are cool andf requently chilly. The alpine vegetation of the summits gives way to pine forests in the sub-alpine zone (1200 to 1800 metres) : below these the beech, and then the oak, the walnut, the wild pear, and wild plum make their appearance ; the fig-tree, the mul- berry, and the vine grow in the middle Zeta and Moratcha valleys ; the myrtle, orange, laurel, and olive in the lower Moratcha region, and more abundantly in the Tzrmnitza and maritime districts. The small patches of potato- culture among the boulders, together with the stone-built huts of the inhabitants, often roofed with shingle or straw, remind the traveller of western Ireland. The vineyards produce excellent grapes, but wine production, which might*~~

become an important industry, is at present limited to home consumption. Tobacco is now largely cultivated, especially in the neighbourhood of Podgoritza ; the annual produce amounts to 250,000 kilogrammes. The leaves of the sumach (Rhus cotinus), which flourishes in the warmer districts, are exported for use in dye-works ; the Pyrethrum cinerariaefolium supplies material for the manufacture of insect-powder ; the fruit of the Cornus mascida, as well as the grape, is employed for the produc- tion of raki, a favourite beverage with the people. The grassy uplands of the northern and eastern districts afford magnificent pasturage ; the native breed of cattle is small, but efforts are being made to improve it, and a stock-farm has been established by Prince Nicholas near Nikshitch. The horses, as elsewhere in the Balkan Peninsula, are dim in- utive, wiry, and intelligent. The arid rocks of Montenegro proper are infested with numerous reptiles, among them the scorpion and the dangerous Vipera ammodytes. Immense flocks of water-fowl haunt the upper reaches of Lake Scutari. The rivers abound with trout, tench, carp, and eels ; the trout of the Moratcha are especially fine. More important from an economic point of view is the scoranze (Leuciscus alburnus : Servian oklievi), a kind of sardine, which supplies an article of food and merchandise to a considerable portion of the population. The fish, which enter the Eicka inlet of Lake Scutari during the winter, are taken with nets during a few weeks in the spring, when the fishing season is inaugurated with a religious service ; they are salted and exported in large quantities to Trieste and the Dalmatian coast. The annual

take is valued at 50,000 florins. The mineral resources of the country have not yet been investigated. Traces of iron, copper, and coal are said to exist, and a petroleum spring has been discovered.

The exports, valued at 1,179,960 florins in 1898, include cattle (large and small), smoked and salted meat known

as castradina, cheese, undressed hides, scoranze, and”” ‘”’ sumach, pyretlirum, tobacco, and wool. The Industries, imports, valued in the

same year at 1,405,680 Communi- florins, consist mainly of manufactured articles, ”’ ‘”’■ such as iron utensils and weapons, soap, candles, &c., and colonial products. An 8 per cent, ad valorem duty is levied on imports, and a further consumption tax of 2 per cent. The principal occupation of the people is cattle-rearing. The exportation of the animals is greatly hindered by the high tariff imposed on the Austrian frontier, which is productive of ‘much illicit trading. Agriculture is still in its infancy, and the implements employed are of the most primitive kind. Bee-keeping is practised in the Kutchi district. There are practically no manufactures : the men disdain industrial employment, while the women are occupied by household duties or work in the fields. A brewery and a cloth factory, however, have been established at Nikshitch, a soda-water factory at Cettigne, and an olive-oil refinery at Antivari. The coarser cloth worn by the peasants is home-made; the finer kind worn by the wealthier class is imported. The progress of trade and the development of the natural resources of the country must largely depend on improved means of communication. In this direction considerable progress has already been achieved. Montenegro now possesses 180 kilometres of excellent carriage roads, admirably engineered and maintained. The remarkable zig-zag road from Cattaroto Niegush and Cettigne was completed in 1881 ; it has been prolonged to Eieka, Podgoritza, Danilovgrad (where a fine bridge across the Zeta was erected in 1870), and Nikshitch. Another road connects Podgoritza with its port, Plavnitza, on Lake Scutari ; a third runs from Antivari to Vir-Bazar ; when completed to Kieka, it will unite the sea-coast with the richest districts of the interior. The ports of Antivari and Dulcigno are insufiiciently sheltered, but are capable of considerable improvement ; both are places of call for the Austrian Lloyd steamers, and a regular service between the former and Bari on the Italian coast is maintained by the “Pnglia” Steamship Company. The Boyana is navigable to sea-going vessels as far as Oboti (20 kilometres from its mouth), where cargoes for Scutari must be transferred to small river craft. The Anglo-Montenegrin Trading Company possesses two steamers on Lake Scutari. Postal and telegraphic com- munication is being rapidly extended. There are 18 post offices, and 20 telegraph stations, with 678 kilometres of wire. The telegraph, which is much used by the people (68,606 messages in 1898), will greatly facilitate the mo- bilization of the*

~~***army. Hitherto the warriors have been summoned by stentorian couriers, who shouted from the tops of the mountains.***~~

~~***The population is usually estimated at about 230,000, or 25 to the square kilometre, the area being approximately***~~

*9000 square kilometres. According, however, ‘^afau *° information oflicially furnished to the writer t’owds. “”’ at Cettigne, the total number of inhabitants*

is 311,564, of whom 293,527 belong to the Orthodox Church, 12,493 are Moslems, and 5.1-14 are Eoman Catholics ; 71,528, or 23 per cent., are literate, and 240,036, or 77 per cent., are illiterate. The official estimate of the area is 8433 square kilometres. The population was estimated as low as 1 (;o,000 by Schwartz in 1882. It is densest in the fertile eastern districts ; Montenegro proper is sparsely inhabited. The Moslems

have greatly decreased owing to emigration. The great majority of the people is of the Serb race ; there are about 5000 Albanians, and 1000 gipsies. The principal towns are Podgoritza, the chief aommercial centre (population about 5500); Dulcigno (5000); Nikshitch (3500); Cettigne (3200); Antivari (2500); Niegush (1800); Eieka (1500) ; Danilovgrad, founded by Prince Nicholas (1300) ; Kolashin, Vir-Bazar, Grahovo, and Andriyevitza. Cettigne, the seat of government, is a capital in miniature, possessing a palace, a theatre, foreign legations, public offices, a park, a hospital, a museum, a library, and a gaol. The little town, which a few years ago numbered only 1000 inhabitants, is rapidly increasing ; the streets are regularly laid out and admirably kept. The palace, built in 1863, is an unpretending structure, but a new palace has been erected for the heir-apparent. Close by is the celebrated plane-tree, beneath which the prince gives audiences to his subjects, accepts their petitions, and settles their disputes. The adjacent Government buildings, and the monastery, which contains the tomb of the great vladika, Petar I., are fortified with towers. The prince possesses other residences at Niegush, Orialuka, Rieka, and Antivari.

The Montenegrins present all the characteristics of a primitive race as yet but little affected by modern civilization. Society is still in that early stage of its development at which personal valour is Natioaai regarded as the highest virtue, and warlike Istic^’^’ prowess constitutes the principal, if not the only, claim to pre-eminence. The chiefs are distinguished by the splendour of their arms and the richness of their costume; women occupy a subject position ; the physically infirm adopt the profession of minstrels,

and sing the exploits of their countrymen like the rhapsodists of the Homeric Age. A race of warriors, the Montenegrins are brave, proud, chivalrous, and patriotic ; on the other hand, they are vain, lazy, cruel, and revengeful. They possess the domestic virtues of sobriety, chastity, and frugality, and are well-mannered, affable, and hospitable, though some- what contemptuous of strangers. They are endowed in no small degree with the high-flown poetic temperament of the Serb race, and delight in interminable recitations of their martial deeds, which are sung to the strains of the gUsla, a rudimentary one-stringedfiddle. Likemost imagi- native peoples, they are extremely superstitious, and belief in the vampire, demons, and fairies is almost universal. The physical type contrasts with that of the northern Serbs: the features are more pronounced, the hair is darker, and the stature is greater. The men are tall, muscular, and wonder- fully active, displaying a cat-li'ke elasticity of movement when scaling their native rocks ; their bearing is soldier- like and manly, though somewhat theatrical. The women, on the other hand, are short and stunted, though strong, owing to the drudgery imposed on them from childhood : they work in the fields, carry heavy burdens, and are generally treated as inferior beings. In public, and even in her own house, the wife does not dare to address her husband by his name ; the husband begs to be excused should he inadvertently mention his wife in conversation. In time of war the women provide the commissariat, and carry tlie ammunition for their male relatives. Like the Albanians, the i^lontenegrins take great pride in personal adornment. The men wear a red embroidered waistcoat, over which a long plaid is sometimes thrown in cold weather ; a red girdle, in the folds of which pistols and yataghans are placed ; loose dark-blue breeches and white stockings, which are generally covered with gaiters ; the opanlai or opiiika, a kind of sandal, is worn instead of boots. The head-dress is a small scarlet cap (kajia), edged with black, in token of mourning for the disastrous battle of Kossoiro, and adorned with semicircular lines of gold braid

~~enclosing the prince's monogram. A pale blue or green mantle is sometimes worn in addition by the chiefs. The poorer mountaineers are often dressed in coarse sacking, but all, without exception, carry arms. The women, as befits their servile condition, are generally clothed in black, and wear a black head-dress or veil ; unmarried girls, however, are allowed to wear the scarlet Itapa. The Vasoyevitch tribe retain the Albanian costume. The dwelling-houses are invariably of stone, except in the east- ern districts, where wooden huts are found. As a rule, only the mansions of cattle-owners have a second storey : the ground floor, which is dark and unventilated, is occupied by the animals ; the upper chambers, in which the family reside, are reached by a ladder or stone stair- case. Chimneys are rare, and the smoke of the fireplace escapes through the windows (if any exist) or the open doorway. The principal food of the people is rye or maize cake, cheese, potatoes, and salted scoranze; their drink is water or sour milk ; meat is seldom tasted, except , on festive occasions, when raki and red wine are also enjoyed. The Montenegrins are great smokers : the men, whose dignity never permits them to carry burdens, may be seen going to market with the chihiih, or long pipe, slung across their backs. Family life pre- sents few attractive features, owing to the degraded condition of the women : the mother possesses little in- fluence over her sons, who are trained from their earliest infancy to cultivate warlike pursuits and to despise the weaker sex. Young men who are attached to each other are accustomed to swear eternal brotherhood (j)obra- timstvo) ; the bond, which receives the sanction of the Church, is never dissolved. The zadruga, or house-community, under the rule of a stareshina, or house-father, is found in Montenegro as in other Slavonic lands. The tribal system still exists, but possesses less significance than in Albania, owing to the centralization of authority at Cettigne. The tribe (pleme, pi. plemena) is subdivided into clans (bratstva).~~

~~Notwithstanding the creation of an elective Senate in 1831, the grant of a so-called constitution in 1868, and the establishment of a responsible ministry in 1874, Admiais- ^}^q government is practically autocratic, the u^sUix. "" ■whole power being centred in the hands of the prince. The Senate, instituted by Petar II. with the object of limiting the power of the tribal chieftains, has now become merged in a Council of State, the~~

~~*members of which are nominated by the prince. The ministry com- prises six departments : (1) The Interior, with separate sections for public works, posts and telegraphs, commerce and industry, shipping, sanitary service, and agriculture ; (2) Foreign Affairs ; (3) War; (4) Finance; (6) Justice; and (6) Education. The ministers have seats in the Council of State, of which the Minister of the Interior is ex officio president ; they are nominated by the prince, and are responsible to him alone. A SkupsJitina, or popular assembly, is summoned on rare occasions of national im- portance. Forpurposes of local administration the country is divided into ten naliie or departments, each governed by a " captain " or prefect (okr&zJuii kapetan), who exercises judicial as well as administrative authority. The tribes, or plemena, eighty in number, are distributed among the nahie. Each is under an official, also styled kapetan, who holds a court of first instance. The kapetans of both categories are nominated by the prince. Eural communes, each under an elected kmet or mayor, exist in Montenegro as in all Slavonic countries. The kmet acts as justice of the peace, and there is an appeal from his decisions to the court of first instance. The commune comprises one or more of the bratstva. There is a HIgh Court of Justice at Cettigne, from which there is an ultimate appeal to the prince. The local gendarmerie is under the control of the*~~

~~*kapetan. The codification of the law, which had hitherto been administered according to unwritten custom, was first undertaken by Petar I. in 1796. An improved code, issued by Danilo II. in 1855, still contained many quaint enactments. The excellent code, drawn up by Professor Bogishitch, a native of Eagusa, in 1888, was revised and enlarged in 1899. It contains elements from various foreign systems scientifically adapted to national usages and requirements. Prince Nicholas and his predecessors have made great efforts to exterminate the vendetta, or blood-feud, and to put down robbery, which, if practised by means of raids across the frontier, is not condemned by public sentiment. The death penalty was first introduced by Petar I. Executions are carried out by a firing party selected from the various tribes, in order to prevent the relatives of the criminal from exacting vengeance.*~~

~~*Financial statistics are not published. The total receipts are stated to amount to 1,500,000 francs — the principal sources of income being the taxes on land, houses, and cattle, the monopolies of salt and alcohol, and the customs dues. The public debt is estimated at 2,500,000 francs. The contribution of Montenegro to the Ottoman Debt has not been fixed. The prince, who under the " constitution " of 1868 relinquished the control of the state revenue, enjoys a civil list of about 200,000 francs. From time to time considerable subventions have been received from Eussia and Austria.*~~

~~*The Montenegrin is a born warrior ; his weapons, which he never lays aside, are his most precious possession, and distinction in battle is the sole object of his ambition. Brave to a fault, an unerring marks- e ence. man, hardy, agile, crafty, and enduring, he has few rivals in the practice of guerilla warfare. The traditional method of fighting is by ambuscade : the enemy is en- ticed irufco some intricate defile, surrounded, and harassed by rifle-fire ; then the mountaineers, throwing aside their firearms, deliver a swift attack with the hanjar, or yatar ghan, which they wield with terrific effect. Quarter is neither given nor expected ; the wounded and the prisoners taken in battle are decapitated and their heads brought home in triumph ; a number of these ghastly trophies adorned the parapet of a small tower near Cettigne as late as 1850. When reduced to extremity the Montenegrins often commit suicide rather than fall into the hands of the enemy, the last cartridge being reserved for this purpose ; disabled comrades who cannot be removed are beheaded ; in 1876 a Montenegrin offered to perform this friendly service for a Eussian officer who was wounded at Klobuk. Savage methods of warfare, however, have been strongly discountenanced by Prince Nicholas and his predecessor. Till the middle of the 19th century the forces of the principality consisted of undisciplined bands of tribesmen under local chiefs, whose rivalries often proved injurious to the national cause. The nucleus of a permanent corps was created by Petar II., who formed a bodyguard of picked men known as perianitzi, from the feathers (pera) which adorned their caps. In 1863 Danilo II. ordered the enrolment of all persons capable of bearing arms, and instituted a military hierarchy of voievodes (generals), sirdars (colonels), and kapetans; the organization, which was based on the tribal system, was remodelled by Servian oflEicers in 1870, when the chiefs*~~

~~were brought to Cettigne to receive military instruction. In the same year arms of pre- cision were introduced : the cost and complex structure of the new weapons threatened to cause serious difficulty, but Eussian aid was soon forthcoming. Since 1870 almost the whole supply of arms and ammunition has been provided by Eussia. The military organization has un- dergone a gradual transformation under Prince Nicholas,~~

~~in conformity with the changed circumstances of the country and the requirements of modern warfare. The militia organization on the tribal basis is maintained, but since 1896 a permanent battalion of 600 men has been established at Cettigne, Nikshitch, and Podgoritza, under a komandir, or major, 4 captains, and 15 lieutenants. It is composed of young men below the age of twenty- seven, who are drawn by lot and serve for four months ; in this way a regular training is annually given to 1500 men. A permanent battery of artillery was formed in 1897, under a major, a captain, 2 lieutenants, and 18 sub-lieutenants. In time of war Montenegro can put into the field 42,000 men — the infantry is composed of 32,000 men of the iirst ban and 8000 of the second, or reserve; the artillery of 2000. The infantry is divided into 8 brigades, each containing from 6 to 8 battalions ; the battalion is composed of a varying number of tcJiete, or companies, each of which belongs to a separate clan and has its own haridktar, or standard-bearer. The younger men of the first ban are exercised in the neigh- bourhood of their homes on Sundays and holidays. They are armed either with the Berdan or the Moskovska (repeating) rifle. The artillery forms a brigade with 3 siege, 2 field, and 6 mountain batteries ; its head- quarters are at Spuzh, where the principal arsenal is situated. The perianitzi, whose numbers were increased by Prince Danilo, were disbanded in 1898, when a body- guard of 3000 picked men was formed and placed under the command of Prince Mirko, Prince Nicholas's second son.~~

~~The Montenegrin Church is an autocephalous branch of the Orthodox Greek communion. The vladikas, or prince- bishops, formerly depended on the Patriarchate Religion Qf ipek. The theocratic system of~~

government education, "vvhich existed from 1516 to 1851 tended to unite the patriotic and the religious instincts of the people. Since the separation of the spiritual and temporal powers in the latter year, the see of Cettigne has been occupied by a metropolitan, styled vladika, who possesses a nominal jurisdiction over Scutari and the Primore, or South Dalmatian coast. There is a Roman Catholic archbishop at Antivari. The churches are small, unpretending structures, almost all exactly alike ; a handsome cathedral, however, has , been erected at ISTikshitch. The monastic order is almost extinct; the parochial clergy, who number about 400, are only dis- tinguishable from the laity by their beards ; they wear the national costume, carry weapons, take part in war- fare, and follow the ordinary avocations of the peasantry. Even the old vladikas discarded the episcopal robe, except when engaged in sacerdotal duties. The clergy are still for the most part extremely ignorant. The Bogoslavia, a seminary for the instruction of young priests and schoolmasters, was established at Cettigne in 1869. It is maintained hy a subvention from the emperor of Russia, while the empress supports the Zhenski Tzrno- gorski Institut, an excellently managed school for girls. In 1900 the number of pupils in the former was 45 ; in the latter, 70. In addition to these institutions there is a gymnasium, or high school, at Cettigne, with 4 classes (150 pupils in 1900). The revenues of the monasteries are now assigned to educational purposes, and primary in- struction has been made obligatory for children over seven years of age. In 1900 there were 168 primary schools in the principality, with 180 teachers and 9756 pupils • of these 140 were maintained by the State and 28 by various communities; the Moslems and Roman Catholics have separate schools. The progress of educa- tion under Prince Nicholas has been very remarkable. In the time of his predecessor, Danilo II., who taught the sons of his chieftains in the palace, there were only

3 schools in the principality. In 1876, at the beginning of the war, there were 62 schools, with 62 teachers and 3159 pupils. The schools were closed during the war, and at its conclusion only 22 could be reopened, owing to want of funds. Elementary education was reor- ganized in 1878. An agricultural college has been founded at Podgoritza. Lecturers are appointed to explain to the peasants the advantages of learning. HIgher

~~education is still unobtainable, and the youth of the wealthier class complete their studies abroad.~~

~~The Montenegrin language is practically identical with the Serbo-Croatian ; it exhibits certain dialectical varia- tions, and has borrowed to some extent from the Turkish and Italian. Existing manuscripts ^"™"'«' and printed books, chiefly psalters and gospels, bear witness to a period of literary culture among the clergy contemporaneous with the activity of the printing-press at Obod (1493-1566). The folk-songs, ho-n-ever, of which the first collection was made in the reign of Petar II., constitute the bulk of the national literature. The poems of that ruler are accounted among the classics of the Servian language, especially his Gorski Vienatz, a drama describing the massacre of the Montenegrin Moslems by their Christian kinsmen in 1702. The reigning family has produced a succession of poets ; the songs of Mirko Petrovitch, the father of Prince Nicholas, and the lyrics and dramas of Prince Nicholas himself enjoy great celebrity. The Orlitze, or " Turtle-doves," a kind of almanac published at Cettigne by Milakovitch between 1835 and 1839, contained poems, tales, statistics, and an abridgment of the Montenegrin annals down to 1830; it was succeeded in the time of Danilo II. by the Orlitch, or "Eaglet." The first Montenegrin newspaper, the Tzrnogoratz, or " Montenegrin," founded in 1870, was prohibited on the Austrian frontier, and soon disappeared; it was replaced by the Glas Tzrnogortza, or "Voice of the Montenegrin," a semi- official publication, and at present the only journal in the principality.~~

~~In Montenegro, as in Albania, the monuments of early civilization bear witness to Roman rather than to Greek influence. Roman remains occur in various parts of the country east of the Zeta, and eai-ly Latin ^Q"'- churches exist at Dulcigno {Ulcinium) and other places. "The organization and forms of the churches, the architecture and ornamentation, point to the "West and not to the East." It is evident that Latin civibza- tion was firmly planted in Illyria before the barbarian incursions of the 6th century. Latin sepulchral in- scriptions and some finely-cut maible blocks have been found at Berane, a little beyond the eastern frontier, and at Budimlye, in its neighbourhood. Especially interesting and important are the extensive ruins of Dodea, now known as~~

~~*Dukle, the birthplace of the Emperor Diocletian. The city, which received the fran- chise under the Flavian emperors, occupied a remark- able site at the junction of the rivers Zeta and Moratcha. The outer walls are standing in many places, and exca- vations carried out in 1893 by J\[. Rovinski and Mr J. A. R. Munro,]\[r jNIilne, and ilr Anderson revealed a considerable portion of the ground-plan, including several streets and a forum. Among the buildings are a fine civil basilica, with a great inscription on the architrave, two small temples, an early Christian basilica, and a later church ; several inscriptions, columns, richly-worked capitals and tracery, and mosaic pavements have been brought to light. At :Medun there are remnants of polygonal masonry. Illyrian forts are found in many parts of the country. The ravages of the Turks have obliterated almost every trace of culture of the IMiddle Ages. A few ruins mark the site of the fortress of Obod,*~~

~~*Recent history.*~~

~~*near Eieka, where the celebrated printing-press, which sent out the Gospel to all Slavonic lands, was founded in 1493 : a fragment of one of the first gospels printed here is shown at Cettigne ; it bears the date 1494. Other editions are preserved at Moscow and in the monastery of Tzainitza, on the Bosnian side of the frontier.*~~

~~*Shortly after the accession of Nicholas (13th August 1860), an insurrection broke out in Herzegovina, and the sympathy which the mountaineers displayed with their Christian kinsmen led to a rupture with Turkey (1862). Notwithstanding the heroic defence of Ostrogby the prince's father, Mirko Petrovitch, " the Sword of Montenegro," the war proved disastrous, owing to the superior armament and discipline of the Turkish troops, and severe terms were imposed on the principality by the convention of Scutari (31st August). During the fourteen years of peace which followed, the country suffered greatly from pestilence and famine. Within this period a series of reforms were carried out by the prince : the army was rearmed and reorganized, an educational system was initiated,*~~

~~*and a constitution under which the prince surrendered various prerogatives to the Senate was granted. In 1869 the Krivoshians, or Serb inhabitants of the northern shores of the Bocche di Cattaro, rose against the Austrian Government : the excitement in Montenegro was intense, but the prince succeeded in checking the warlike ardour of his subjects. The revolt in Bosnia and Herzegovina in 1875 had more important consequences for the principality. On the 2nd July 1876, Prince Nicholas, in alliance with Prince Milan of Servia, declared war against Turkey and invaded Herzegovina. A victory was gained at Vuchidol (28th July) and Medun was captured; but the Servian army suffered reverses, and an armistice was arranged in November. In the following spring the determination of Russia to take the field against Turkey encouraged the Montenegrins to renew the war. The Turks suc- ceeded in occupying Ostrog, but were subsequently repulsed ; the greater part of their forces was soon with- drawn to Bulgaria, and Prince Nicholas captured suc- cessively Nikshitch, Antivari, and Dulcigno. The recovery of the seaboard, which had belonged to Montenegro in the Middle Ages, was perhaps the principal achievement of the war. The enlargement of territory stipulated for by Russia under the treaty of San Stefano (3rd March 1878) would have brought Montenegro into close con- tiguity with Servia, thus facilitating the eventual union of the Serb race and closing the path of Austria towards the iEgean. The Berlin Treaty (article xxviii.) gave to Montenegro Nikshitch, Spuzh, Pod- goritza, Plava, Gusinye, and Antivari, but restored Dulcigno to Turkey. The resistance of the Moslem inhabitants of Plava and Gusinye to annexation led to long negotiations, and eventually the " Corti Com- promise " was agreed to by a conference of the Powers at Constantinople (18th April 1880). Plava and Gusinye were to be restored to Turkey, while the Montenegrin frontier was extended so as to include the Hot and the greater part of the Klement tribes. This arrangement, which could hardly have proved successful, was not carried out by Turkey, and the Powers subsequently decided to annex Dulcigno to Montenegro in exchange for Plava and Gusinye. The Porte interposed delays, though consenting in principle, and the Albanian League (see Albania) assumed a menacing attitude. On the 28th September the fleets of the Powers under Admiral Seymour appeared off Dulcigno, and the British Government shortly after- wards proposed to occupy Smyrna. On the 11th November the Porte yielded ; on the 22nd*~~

~~*the Turkish troops defeated the Albanians, and on the 25th Montenegro obtained possession of Dulcigno. The present frontier, as already*~~

~~*described, was shortly afterwards delimited by an inter- national commission. With the exception of some frontier troubles, the years since 1880 have been spent in peace, and the country has advanced in prosperity under the autocratic biit enlightened rule of Prince Nicholas. The relations with Turkey, the traditional foe, have improved, while those with Austria have become less friendly. In July 1893 the four-hundredth anniversary of the foundation of the printing-press at Obod was celebrated at Cettigne, several foreign universities and learned bodies being rep- resented at the festivities. In September 1896 the bi- centenary of the Petrovitch dynasty was commemorated.*~~

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~~*Montepulciano, a town and episcopal see of the province of Siena, Tuscany, Italy, 44 miles south-east of Siena by rail. It crowns the summit of a hill (2074 feet), and is still surrounded by mediaeval walls. Amongst its noteworthy buildings are several interesting private mansions of the 16th and later centuries, the church of the Madonna, built by Antonio da Sangallo, senior, in 1618-37, the cathedral (restored in 1888), a fountain (1520), and a 14th-century town hall, with a small picture-gallery. Montepulciano is famous for its wine, and was .the birth- place of Cardinal Bellarmino (1642-1621). Population*~~

~~*(1881), 5142; (1899), 3000.*~~

~~*Montereau, to\sii and railway station, arrondisse- ment of Fontainebleau, department of Seine-et-Marne, France, 17 miles in direct line south-east of Melun, at the confluence of the Yonne with the Seine. The church is a handsome edifice dating from the 13th century, with later additions, including the faqade of the Renaissance period. The Asylum Napoleon is an institution for wounded and infirm soldiers. On the right bank of the river is the Chateau de Surville. The industries include a large porcelain factory, the manufacture of refractive and decorative bricks, whiting, and biscuits, and carriage- building. Population (1881), 7031 ; (1901), 7898.*~~

~~*Montereau, partly of monastic and partly of feudal origin, was in the beginning of the 16th century a place of some importance. Here, on the bridge over the Yonne, the duke of Burgundy was assassinated in the presence of the Dauphin, afterwards Charles VII., in 1419. In 1438 the town was captured by Charles VII., and during the wars of religion it was several times taken and retaken. In 1814 Napoleon gained a victory at Montereau over the Wurtemberg troops under Schwarzenberg, and in memory of this his statue has been erected between the two bridges.*~~

~~*Monterey, a city and township in Monterey county, California, U.S.A., on the southern end of the Bay of Monterey. It is about 90 miles south-south-east of San Francisco in a direct line, and 125 miles' by the railway (on the coast division of the Southern Pacific railway).*~~

~~The Bay of Monterey was discovered by Vizcaino in 1602, and in 1770 a mission was established here, upon the site of which is built the present Eoman Catholic church. It was at Monterey, which was the capital of California prior to the Mexican war, that the commander of a U.S. frigate hoisted the American flag and proclaimed Califor- nia a part of the United States (7th July 1846). Monterey has become a popular watering-place and winter resort, on account of its mild and agreeable climate and its attractive environs. Population of the town (1890), 4677; (1900), 3420 (Pacific Grove township, with a population of 1439 in 1900, having been organized from a part of Monterey township since 1890). The population of the city in 1890 was 1662, and in 1900 it was 1748.~~

~~Monterey, a city of Mexico, and capital of the state of Nuevo Leon, situated 675 miles from the city of Mexico by railway. It is a handsome and progressive city, and the commercial centre of northern Mexico. It has im- portant manufactories, foundries, saw mills and flour mills, and 9 miles of tramways. It possesses fine public buildings and all the conveniences of modern civilization. Population, 45,695.~~

~~Montevideo, the principal city and port of Uruguay, South America, on the north side of the La Plata, 120 miles east by south of Buenos Aires. It is the capital of the department of the same name, and had in 1892 a population of 238,080, which at the end of 1899 was estimated to have become about 250,000. The percentage of the port of Montevideo in the general foreign trade of Uruguay between 1894 and 1898 was as follows : —~~

~~1894.~~

~~1895.~~

~~1896.~~

~~1897.~~

~~1898.~~

~~*Imports Exports*~~

~~*90-74 63-48*~~

~~*87-40 61-68*~~

~~*86-46 62-78*~~

~~*87-27 68-78*~~

~~*85-28 63-66*~~

~~*The value of the imports and exports through the same port during the same period was : —*~~

~~*1894.*~~

~~*1896.*~~

~~*1890. 1S97.*~~

~~*1898.*~~

~~*Imports Exports .*~~

~~*"$21,696,203 21,260,896*~~

~~*$22,187,198 20,070,577*~~

~~*$22,072,972 $17,028,783 19,086,956 20,163,047*~~

~~*$21,135,967 19,272,654*~~

~~*" $=1-034 U.S. gold currency.*~~

~~*In 1899, 3974 vessels of 4,105,102 tons entered the port in all— foreign, coasting, and river trade. Of the entrances in 1898, 969 steamers (1,945,884 tons) were from abroad, 35 (54,694 tons) being in ballast. Extensive port im- provements in the harbour, calling for an expenditure*~~

~~of not less than £2,100,000, have been sanctioned, including the deepening of the channel into the harbour so as to leave 24^ feet at low water, and the constructing of a careening dock over 600 feet long and of corresponding width, with 26 feet of water on the lowest beams.~~

~~Montgomery, a town and district of British India, in the Lahore division of the Punjab. The town has a railway station, about half-way between Lahore and Mooltan. Population (1881), .3178 ; (1891), 5159 ; municipal income (1897-98), Rs.15,403. It was founded in 1864, on the opening of the railway, and called after Sir II. Montgomery, then lieutenant-governor. It has a municipal high school, with boarding-house, and two literary institutions.~~

~~The district of Montgomery lies in tlie Bari Boab, o'r tract Ijetween the Sutlej and the Ravi, extending also across the latter river. Area, 5754 square miles; population (1881), 426 529- (1891), 499,521; (1901), 403,585, showing an increase of 17 per cent., due to the extension of irrigation, between 1881 and 1891 but an apparent decrease of 7-2 per cent, between 1891 and 1901; average density, 80 persons per square mile. The land revenue and rates in 1897-98 were Rs.(!,35,298, the incidence of assessment being Rs.0:3:8 per acre; cultivated area, iViT , {f2'.\ acres, of which 318,225 were irrigated, including 136,024 from Government canals –~~

~~number of police, 465; number of schools (1896-97), 168, attended by 3572 boys, being 6-8 per cent, of the boys of school-going age; death-rate (1897), 23 per thousand. The principal crops are wheat', pulse, cotton, and fodder. Camels are bred for export. The lead- ing manufactures are of cotton and silk, and lacquered woodwork, and there are four factories for ginning and pressing cotton. The district is traversed for 82 miles by the main line of the North- Western railway, from Lahore to Mooltan ; and there are 243 miles of navigable rivers. It is irrigated by the Upper Sutlej inundation canal system, and also from the Ravi.~~

~~Montgomery, a city of Alabama, U.S.A., capital of Montgomery county and of the state, on the left bank of the Alabama river, which is here navigable, in the south-east of the centre of the state, at an altitude of 162 feet. The city has a regular plan, is supplied with water by pumping by a~~

~~*private corporation, and is divided into six wards. It is entered by six railways, and these, with the river, give it a large commerce, principally in cotton and lumber. Its manufactures, which are of great variety, had in 1900 a total capital of f 2,930,782, and employed an average number of 2359 wage-earners. The total products were valued at $5,035,190. The assessed valuation of the real and personal property of the city in 1900, on a basis of about three-quarters of the full value, was $12,555,770 ; the net debt was $2,050,551, and the tax-rate $22.'76 per $1000. Population (1890), 21,883;*~~

~~*(1900), 30,346.*~~

~~*Montgomeryshire, an inland county of North Wales, bounded on the N.W. by Merioneth, on the N. by Denbigh, on the E. and S.E. by Shropshire, on the S. by Eadnor, and on the S.W. by Cardigan.*~~

~~*Area and Population. — The area of the ancient and administra- tive county, as given in the census returns, is 510,111 acres, or 797 square miles, -with a population in 1881 of 65,710, in 1891 of 58,003 (of whom 28,222 were males and 29,781 females), and in 1901 of 54,892, the number of persons per square mile being 68-8, and of acres to a person 9-3. The area of the registration county is 589,846 acres, with a population in 1891 of 67,297. Between 1881 and 1891 the decrease of population was 11-68 per cent., and between 1891 and 1901, 5-3 per cent. The excess of births over deaths between 1871 and 1881 was 6886, but the decrease in the resident population was 8900. The following table gives the num- bers of marriages, births, and deaths, with the number and per- centage of illegitimate births, for 1880, 1890, and 1898 : —*~~

~~*Year.*~~

~~*Marriages.*~~

~~*Births.*~~

~~*Deatlis.*~~

~~*Illegitimate Births. 1*~~

~~*No.*~~

~~*Per cent.*~~

~~*1880 1890 1898*~~

~~*404 426*~~

~~*425*~~

~~*2200 1694 1677*~~

~~*1402 1244 1121*~~

~~*195 137 131*~~

~~*8-9 8-3 7-8*~~

~~*In 1891 there were in the county 179 natives of Scotland, 130 natives of Ireland, and 42 foreigners, while 31,770 persons could speak English, 16,414 Welsh, and 15,846 English and Welsh.*~~

~~*Constitution and Government. — The county returns one member to Parliament, and it also includes the Montgomery district of parliamentary boroughs (consisting of Llanfyllin, Llanidloes, Machynlleth, Montgomery, Newtown, and Welshpool), which returns one member. There are four municipal boroughs .- Llan- fyllin (1632), Llanidloes (2769), Montgomery (10.34), and Welsh- pool (6121). The urban districts are JIachynlleth (2038) and Newtown and Llanllwchaiarn (6500). Montgomeryshire is in the North Wales and Chester circuit, and assizes are held at AVelsh- pool and Newtown alternately. The borough of Welshpool has a separate commission of the peace, but no separate court of quarter sessions. The ancient county, which is in the dioceses of Bangor, Hereford, and St Asaph, contains 59 ecclesiastical parishes or districts, and parts of 1 1 others.*~~

~~*Education. — The total number of elementary schools on 31st August 1899 was 94, of which 28 were board "and 66 voluntary schools, the latter including 59 National Church of England schools, and 7 "British and*~~

~~other." The average attendance at board schools was 2474, and at voluntary schools 4970. The total school board receipts for the year ended 29th September 1899 were over £8412. The income under the Agricultural Rates Act was over :t775.~~

~~Agriculture. — Considerably more than one-half of the total area is under cultivation, and of this about two-thirds is in permanent~~

~~pasture, in addition to whicii nearly 150,000 acres are in hill pasturage, while about 650 acres are under orchards and 25,000 acres under woods. Of the acreage under corn crops, which since 1880 has decreased by about a sixth, more than half is under oats, about two-sevenths under wheat, and about one- fifth under barley. The acreage under green crops is very incon- siderable, pasturage being mainly depended on for the winter forage of sheep. Nearly seven-ninths of the green crop acreage is under potatoes, and a little more than one-fifth is under turnips. Cattle are largely kept, specially for dairy purposes, and as a sheep- pasturing county it ranks after Brecon and Merioneth. The following table gives the larger main divisions of the cultivated area at intervals of five years from 1880 : —~~

~~Year.~~

~~Total Area~~

~~under Cultivation.~~

~~Corn Crops.~~

~~Green Crops.~~

~~Clover.~~

~~Perma- nent Pasture.~~

~~*Fallow.*~~

~~*1880 1885 1890 1895 1900*~~

~~*252,961 257,061 266,363 270,783 278,889*~~

~~*50,743 49,411 46,682 43,100 40,274*~~

~~*11,061 11,187 11,097 10,551 9,518*~~

~~*24,966 27,422 30,280 29,706 30,941*~~

~~*161,866 166,404 175,482 185,787 192,099*~~

~~*4322*~~

~~*2687 2759 1507 1004*~~

~~*The following table gives particulars regarding the principal live- stock for the same years : —*~~

~~*Tear.*~~

~~*Total Horses.*~~

~~*Total Cattle.*~~

~~*Cows or Heifers*~~

~~*in Milk or*~~

~~*in Calf.*~~

~~*Sheep.*~~

~~*Pigs.*~~

~~*1880 1885 1890 1895 1900*~~

~~*13,835 14,827 14,891 15,793 15,695*~~

~~62,906 68,902 67,519 69,950 73,273~~

~~21,965 23,692 23,673 22,562 23,760~~

~~325,980 339,997 376,673 367,856 433,145~~

~~19,417 22,575 25,614 27,141 22,521~~

~~Industries and Trade. — According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 2142, as compared with 2063 In 1896. In 1899, 9371 tons of limestone were raised. Zinc has almost ceased to be raised, but barytes is mined in some quantities. The following table gives particulars of the production of lead and slate in 1895 and 1899 : —~~

~~Tear.~~

~~Lead.~~

~~Blate. 1~~

~~Tons.~~

~~Value.~~

~~Tons.~~

~~Value.~~

~~1890 1899~~

~~617 616~~

~~£5775~~

~~6476~~

~~1412 2191~~

~~*£3222*~~

~~*5993*~~

~~*Authorities. — Collections, HIstorical and ArchcBological, relat- ing to Montgomeryshire (issued by the Powysland Club). London, 1868. — Pedigrees of Montgomeryshire Families (published by the same club). London, 1888.— Williams. Montgomeryshire Wor- thies. Newtown, 1894. — Guide-books to North Wales, (t. F. h.)*~~

~~*Montignies-sur-Sambre, a town of Bel- gium, in the province of HIainaut, 25 miles east of Mons, with a station on a branch of the line from Charleroi to Namur. There are coal-mines in its vicinity, and the town has blast-furnaces, rolling-mills, and machine and nail factories. Population (1880), 13,326; (1900),*~~

~~*18,440.*~~

~~*Monti 119011, a town of France, capital of an arron- dissement of the same name in the department of AUier. It lies on both banks of the Cher, and is an important railway junction of the lines Bourges-Moulins and Mont St Sulpice-Tours-Auzances of the Orleans railway. Its close proximity to the coalfields of Commentry has greatly favoured its industrial development, which in the last few years has made rapid advances. The chief articles of manufacture are cutlery, bronze goods, and linen; in addition there are tanneries and iron forges. Population*~~

~~*(1891), 24,911 ; (1901), 35,062.*~~

~~*Montoro, a town of Spain, in the province of Cordoba, on the river Guadalquivir. The population in 1897 had increased to 12,734. The progressive spirit of the inhabitants is shown by the well-kept streets, electric light, water conveyed by an aqueduct from mountains several miles away, public fountains, schools for both sexes.*~~

~~*an institute, 184 oil mills, and markets and fairs where many agricultural products and much live stock are brought from the fertile country around. Much timber is also brought from the woods in the hills. The churches of*~~

~~St Bartholomew, with a fine spire, San Juan de la Cruz, and San Sebastian are good specimens of Spanish church architecture of the Kenaissance.~~

~~Montpelier, a city of Vermont, U.S.A., capital of Washington county and of the state, on the Winooski river, and the Central Vermont and the Montpelier and Wells River railways, in the northern half of the state, at an altitude of 484 feet. It is prettily laid out on a hilly picturesque site, and is well built. Its principal industry is the quarrying of granite in the neighbourhood. Its manufacturing establishments in 1900 employed an average number of 1019 wage-earners, and had products valued at $1,591,968. Population (1890), 4160; (1900),~~

~~6266.~~

~~Montpellier, chief town of department Hdrault, France, 490 miles south-south-east of Paris, on the railway from Bordeaux to Cette. The modern church of St Eoch contains a statue of its patron, and a monument has been erectedtoPlanchon, who did much to improvethe vineyards of the surrounding district. The Palais des Facultes was opened in 1890, and the theatre rebuilt in 1883. Some 1500 students attend the university. There is a municipal library, containing 120,000 volumes and 10,000 prints and engravings. Population (1881), 45,397 ; (1891), 58,380 ;~~

~~(1901), 75,950.~~

~~Montreal, a city of Hochelaga county, Quebec, and the largest city in the Dominion of Canada, situated on an island of the same name at the confluence of the Ottawa and St Lawrence rivers. The observatory in the grounds of M'Gill University stands at a height of 187 feet above the level of the sea in 45° 30' 17" N. and 73° 34' 40-05" W.— the most accurately determined position in America. The city is advantageously situated at the head of ocean navigation — the channel below the city permitting the passage of vessels drawing 27-^ feet at low water — and at the eastern terminus of inland naviga- tion, the enlarged St Lawrence canals furnishing a 14-feet waterway io the head of the Great Lakes. It is on the Grand Trunk, Canadian Pacific, Intercolonial, Canada Atlantic, New York Central, Central Vermont, and Dela- ware and Hudson railways, and~~

during the season of navigation several lines of well-appointed steamers main- tain communication with Liverpool, Glasgow, Bristol, Manchester, and the principal ports on the gulf and river St Lawrence and the Great Lakes. The Montreal Street (110 miles). Park and Island (36 miles), and Belt Line (12 miles) electric railways afford rapid and easy communica^ tion with all parts of the city, suburbs, and neighbouring towns. The famous Victoria bridge having proved in- adequate to the traffic, and having been designed for maximum loads of less than one-half the present require- ments, was replaced by the Victoria Jubilee bridge, opened in December 1898. The new structure consists of 24 spans of pin-connected " through " steel trusses, each 254 feet long, and one of 348 feet over the steamboat channel, carrying two tracks for steam railway trains and electric cars, with roadways on each side for vehicular traffic and foot passengers. The Canadian Pacific railway crosses the St Lawrence at the foot of Lake St Louis, about 6 miles above the city. The charities are numerous, and include 8 hospitals— -5 Protestant and 3 Roman Catholic — orphanages, houses of refuge, deaf and dumb asylums, &c. There are 65 Protestant churches and chapels, 27 Roman Catholic, 2 synagogues, and 26 convents and monasteries. In 1898 the Roman Catholic committee controlled 17

elementary and 4 model schools, 12 academies and 3 col- leges, with 871 teachers and 18,398 pupils ; the Protes- tant committee controlled 12 elementary schools and 3 academies, with 251 teachers and 9103 pupils. McGill University, the foremost educational institution in the province, embraces the faculties of arts, law, medicine, .applied science and comparative medicine, and veterinary science. In addition to the four affiliated theological colleges — Presbyterian, Diocesan, Wesleyan, and Congre- gational— three others, Morrin, Stanstead, and Vancouver, are affiliated in arts. Later additions to the university are the chemistry and mining, the physics and the engi- neering buildings, and the Eoyal Victoria College for women, all built and equipped on a scale of great

~~com- pleteness by wealthy citizens. Laval, the Roman Catho- lic university, includes the faculties of theology, law, medicine, and arts. There are two normal schools, a high school, two affiliated medical colleges — one with Laval and the other with Bishops College, Lennoxville, — the Jesuit college, and the seminary of St Sulpice. The city is the seat of the head offices of the Grand Trunk and Canadian Pacific railways, and of six banks — Montreal, Merchants', British North America (in Canada), Molsons, Jacques Cartier, and Hochelaga — with a total paid-up capital of $27,000,000. It contains many flourishing industries, including manufactories of steam engines, boilers, printing-presses, musical instruments, boots and shoes, tobacco, rubber, paper, rope, glass, carriages, wooden ware, paints and drugs ; also iron and brass foundries, rolling-mills, flour mills, distilleries, and breweries. The harbour is spacious ; there are fine stone docks, and extensive enlargements and improvements are in progress, including an elevator with a capacity of 3,000,000 bushels and three high-level piers, each 825 feet long and 300 feet wide. In the year ending 30th June 1890 the exports from the port were $31,660,216 ; in 1900-01, $59,708,154 ; in 1889-90 the imports were $45,934,406 ; in 1900-01, $64,372,300, and duty collected $9,018,660. In the year 1901, 742 sea-going vessels of 1,453,048 tons cleared for sea, and 8450 coasting vessels of 1,683,186 tons departed ; total tonnage, 3,136,234 tons. In 1899 the exports of wheat totalled 13,588,098 bushels ; homed cattle, 71,488; sheep, 48,073; horses, 6462; cheese, 146,285,909 ft; and butter, 28,068,280 lb. The clearances at the clearing-house amounted in 1897 to $601,185,000, and in 1901 to $889,479,000. The total assessment in 1885 was $72,877,834; in 1890, $123,891,140; and in 1902, $188,000,000; exemptions increased from $14,675,316 in 1885 to $38,000,000 in 1899 ; total expenditure in 1901, $3,131,920 ; and total receipts, $3,570,880. In 1883 Hochelaga (population, 6000), in 1884 St Jean Baptiste (8700), in 1887 St Gabriel (7800), and in 1893 St Denis ward were an- nexed. Population (1881), 140,747; (1891), 216,644; (1901), 267,730; or, if the adjoining suburbs of St Henri, St Cunegonde, Westmount, &c., are included, about 335,000. (j. ^h*.)~~

~~Montreuil-SOUS-Bois, town, arrondissement of Sceaux, department of Seine, France, 4 miles east of Paris, on the slope and summit of a hill,~~

~~*about 1 mile north of Vincennes. Montreuil is now specially noted for its extensive peach orchards, covering about 590 acres and yielding annually from 12 to 15 millions of peaches. The manufactures include paint and varnish, oils, glue, soap, patent leather, and chemicals. Gypsum is quarried' Population (1891), 23,891 ; (1901), 31,773 (comm.).*~~

~~*Montrose, a royal and parliamentary burgh (Mon- trose group) and seaport of Forfarshire, Scotland, at the mouth of the South Esk, 30f miles north-east of Dundee by rail. Ropeworks and chemical works are amongst the*~~

~~*minor industrial features. 551 vessels of 94,462 tons entered in 1888; in 1900, 440 vessels of 51,521 tons. Imports were valued at £220,401 in 1888, and £173,221 in 1900; exports, £102,443 in 1888, and £19,106 in 1900. A new park was laid out in 1890. A museum the infirmary, and a memorial hall have been enlarged • the new market has been converted into a public hall and a railway viaduct built over the Esk. A Roman Catholic chapel and an additional public school have been erected. Population (1891), 12,428 ; (1901), 12,401. (See FoEFAESHiEE for fishing statistics.*~~

~~*Montserrat, one of the presidencies of the Lee- ward Islands, British West Indies. The population in 1881 was 10,083, in 1891 it was 11,762, and in 1901 it was 12,215. The death-rate is 25-77 per thousand. The mean shade temperature at an elevation of 400 feet is 78° to 79° F. The rainfall varies from 40 to 80 inches per annum according to situation. In 1900 the average rainfall at seven stations was 42-68 inches. Montserrat is considered one of the most healthy islands in the West Indies, being remarkably free from epidemics. The chief products are sugar and molasses, lime-juice and essential oils produced from limes. Arrowroot, coffee, and cocoa, are also exported. The island offers special facilities for growing citrus fruits. It is well watered, and possesses good roads. Nearly all the lime- trees, covering about 1000 acres, principally in the north- ern part of the island, were uprooted by a violent hurricane on 7th August 1899. The value of the imports for the three years ending 1880 averaged £26,390 ; those of 1899 were valued at £14,265. The exports for the same periods were £32,963 and £12,893. The revenue in 1900 was £6664, and*~~

~~the expenditure £9597, the defi- ciency being covered by grants from the British ex- chequer. The public debt was £11,400. The total tonnage of vessels entered and cleared during 1900 was 198,730 (185,350 steam, 13,380 sailing). Education is nominally compulsory. In 1899 there were 7 Anglican schools -with 4681 scholars, 3 Wesleyan with 672, 1 Roman Catholic with 113, and 2 undenominational with 511. Montserrat has a legislative council consisting of the governor and 6 nominated members, 3 official and 3 unofficial.~~

~~Monza, a to^n of the province of Milan, Lombardy, Italy, 11 miles north-east of Milan by rail. It has a polytechnic school (1889), and is the seat of a commercial court of arbitration. Population (1881), 17,000 ; (1899), 12,000. \ ^' ' > \/'~~

~~Moody, Dwight Lyman (1837-1899), American evangelist, was born at East Northfield, Massachusetts, 5th February 1837. In 1855, while a salesman in the shoe trade in Boston, he was " converted," and at once became active in religious work. He continued this religious activity on his removal to Chicago in 1856, and in 1860 gave up business to devote himself to evangeliz- ing. In 1865 he became president of the Chicago Young Men's Christian Association, and wielded a large influ- ence also in other cities. He first became widely famous through a series of evangelistic meetings in Great Britain, held jointly with Ira D. Sankey, in 1873. After that he held similar meetings from time to time in all the im- portant cities of the United States, visiting Great Britain again in 1881, 1883, and 1899. It is estimated that he addressed over 50,000,000 persons during his life. Beginning with a small school for girls in 1879, he developed at his home in Northfield, Mass., the Mount Harmon School for boys, the Northfield Seminary for boys, and the school for Christian workers, while, in addition, great religious conferences were held at North- field during the summer months. During the twenty~~

~~years preceding his death, which took place at Northfield on 22nd December 1899, Moody devoted his summers to this work of religious~~

~~*education. Moody was a man of strong physical constitution and even tempera^ ment. He had no academic training, and his theology was that of the orthodox Church of the early middle century; but there was no sectarianism in his work, and he co-operated with men whose theological opinions he could not accept, such as Henry Drummond, George Adam Smith, and Henry Ward Beecher. The elements that constituted his strength were a rugged simplicity and absolute sincerity.*~~

~~*Moon. — Since the publication of the earlier volumes (ninth edition) of this Encyclopaedia, a new method of working out the inequalities in the motion of the moon produced by the disturbing action of the sun has been developed and is being prosecuted to a success- ful conclusion. The establishment of the principle on which the method is based is due to George W. Hill. We recall that when the co-ordinates of the moon are expressed algebraically in terms of the elements of the moon's motion, they appear as an infinite series, pro- ceeding according to the powers of four quantities, namely : e, the moon's eccentricity ; i, the inclination of its orbit ; 4 the eccentricity of the earth's orbit ; and m, the ratio of the moon's mean motion to that of the earth. Of these four quantities, the first three belong to the class of elements, while the fourth may be considered as a measure of the disturbing action of the sun, as this would vanish only when the ratio m was zero. In the usual methods of treating the problem of perturbations, the investigator starts from an approximate solution in which the disturbingf orce vanishes, while the elements have arbitrary values. This method is justified by the general rule that, in all the ordinary cases of perturbations, the disturbing force is very small compared with the elements, and therefore a series developed in powers of that force converges very rapidly. But it happens that, in the case of the motion of the moon disturbed by the sun, the action of the sun is so considerable that the terms of the series depending on powers of m converge less rapidly than those depending on the elements. This fact suggested to Hill the idea of not starting with the elliptic orbit of the moon round the earth, but with an orbit of infinitesimal eccentricity, lying in the plane of the ecliptic, combined with a circular orbit of the earth round the sun. Supposing all the three elements we have mentioned to vanish, the only variable quantity on which the motion would depend would be the difference between the longitudes of the sun and moon. The co-ordinates*~~

~~*of the moon relative to the earth can then be developed in a series, proceeding according to the sines and cosines of multiples of this angle. This series converges so rapidly that a few terms will suffice for a solution. Hill then assumes the orbit of the moon to have an infinitesimal eccentricity, and by an extremely in- genious process, involving the computation of a determin- ant with an infinite number of elements, he determines the motion of the moon's perigee numerically. His celebrated papers on this subject may be found in the Stockholm Acta Mathetnatica and the America7i Journal of Mathematics. A similar method can be applied to the motion of the moon's node, assuming the inclination of the orbit to be infinitesimal. This has been successfully done by P. H. Cowell in a paper in the American Journal of Mathematics, vol. xviii.*~~

~~*The further development and application of the method requires the terms depending on the eccentricity of the sun to be taken into account, and the terms depending on the powers and products of the moon's eccentricity and inclination to be determined. This most laborious part*~~

~~*of the work is being carried on by Professor Ernest W. Brown, F.E.S., an Englishman resident at Haver- ford College, Pennsylvania. The results of Professor Brown's work, so far as yet reached, lead to grave doubts of the numerical precision of the previous theories of the action of the sun on the moon. In the case of Delaunay's theory, this lack of precision was a necessary result of the slowness with which his series in powers of m converge. It has generally been supposed that Hansen's numerical theory — so called because purely numerical values of the four elements in question are introduced from the beginning — was free from the error arising through the slow convergence of the series used by Delaunay. But this may now be doubted. In the important case of the parallactic equation of the moon — an inequality by which the solar parallax can be deter- mined — it seems very probable that Hansen's result is seriously in error, and that the value of the solar parallax to be deduced in this way will be appreciably smaller than that which has been derived from Hansen's num- bers. Most remarkable has been Professor Brown's success in determining from pure theory the motion of the moon's perigee and node. The results he has worked out and published in the Memoirs of the Royal Astro- nomical Society accord with observations to a degree*~~

~~*that was never before possible. HIs results^are not, however, as yet quite definitive.*~~

~~*In the article in vol. xvi. of this work (p. 801) men- tion was made of Airy's numerical theory, which un- fortunately was not brought to a conclusion by its author. The present writer inclines to the opinion that Airy's method is, so far as its general idea is concerned, a practical one, at least for the inequalities of short period, and that its execution — perhaps in a more rigorous way than its author worked it out — is one of the desiderata of lunar theory.*~~

~~*At the present time the most important problem con- nected with the moon's motion is that of the possible inequalities produced by the action of the planets, or by other causes than the action of the sun. The most com- plete works on this subject are those of HUl and Eadau. The former published a very exhaustive determination of the inequalities due to the deviation of the earth from a spherical form {Astronomical Papers of the American Ephemeris, vol. iii.). Eadau has essayed a complete and exhaustive redetermination of the inequalities produced by the action of the planets. It is suggestive and remark- able that neither he nor HIll has discovered any new inequality of such magnitude and period as to account for the observed deviations of the moon from its theoretical place, as they are indicated in the article in vol. xxv. on AsTKONOMY {C[.v.). Their results accord in the main with those of previous investigators, and np to the year 1902 the cause of the observed changes of long period in the moon's mean motion remains the greatest enigma in gravitational astronomy. (s. u".)*~~

~~*Moon, Sir Richard, 1st Baronet (1814-1899), English railway administrator, was the son of a Liverpool merchant, and was born on 23rd September 1814. The history of his life is practically the history of the London and North- Western railway for the period in which he lived. When he first became a member of the board in 1847, the company had just come into existence by the amalgama- tion of the London and Birmingham, the Manchester and Birmingham, and the Grand Junction lines, and it was during his long connexion with it — first as director and then (from 1862 to 1891) as chairman — that its system was developed*~~

~~substantially into what it is now. The Chester and Holyhead, the Lancaster and Carlisle, and many smaller lines were gradually added to it, either by~~

~~leasing or by complete absorption, and finally in 1877 an Act was obtained consolidating all into one homogeneous whole. Throughout his career, Sir Eichard Moon's powers of organization and his genius for what may be called railway diplomacy were of the greatest advantage to the company, and to him it owes in very large measure the commanding position it now enjoys. A striking feature about it is the extent to which its engines and trains are to be seen even in what might be expected to be the most private portions of other companies' lines; it was in great part Moon's prescience that secured for it the numerous running powers which it now exercises (not to mention many that are not exer- cised at present, though they would be if occasion required), and which contribute so much to the strength of its strategic position. An extremely hard worker himself, he expected equal diligence of his subordinates ; but energy and capacity did not go unrewarded, for he made promotions, not by standing or seniority, but by merit. It thus came about that under him the North-Western was looked up to as affording a model of railway management, and the staff he trained has supplied many successful administrators to railways in all parts of the world. Sir Richard Moon, who was created a baronet in 1887, died on 17th November 1899. (h. m. e.)~~

~~Moore, Albert Joseph (1841-1893), English decorative painter, was born at York on 4th September 1841. He was the youngest of the fourteen children of the artist, William Moore, of York, who in the first half of the 19th century enjoyed a considerable reputation in the North of England as a painter of portraits and landscape. In his childhood Albert Moore showed an extraordinary love of art, and as he was encouraged in his tastes by his father and brothers, two of whom afterwards became famous as artists — John Collingham Moore, and Henry Moore, K.A. — he was able to begin the active exercise of his profession at an unusually early age. His first exhibited works were two drawings which he sent to the~~

~~*Royal Academy in 1857. A year later he became a student in the Royal Academy Schools ; but after working in them for a few months only, he decided that he would be more profitably occupied in independent practice. During the period that extended from 1858 to 1870, though he produced and exhibited many pictures and drawings, he gave up much of his time to decorative work of various kinds, and painted, in 1863, a series of wall decorations at Coombe Abbey, the seat of the earl of Craven; in 1865 and 1866 some elaborate compositions, "The Last Supper," and "The Feeding of the Five Thousand," on the chancel walls of the church of St Alban's, Rochdale; and in 1868, "A Greek Play," an important panel in tempera for the pro- scenium of the Queen's Theatre in Long Acre. HIs first large canvas, " Elijah's Sacrifice," was completed during a stay of some five months in Rome at the beginning of 1863, and appeared at the Academy in 1865. A still larger picture, "The Shunamite relating the Glories of King Solomon to her Maidens," was exhibited in 1866, and with it two smaller works, " Apricots " and " Pomegranates." In these Albert Moore asserted plainly the particular technical conviction which for the rest of his life governed the whole of his practice, and with them he first took his place definitely among the most original of British painters. Of his subsequent works the most notable are "The Quartette" (1869), "Sea Gulls" (1871), "Follow- my-Leader" (1873), "Shells" (1874), "Topaz" (1879), "Rose Leaves" QSSOV "Yellow Mnro-norifoo " ? iqqi<*~~

~~*"Lightning and Light" (1892), "An Idyll" (1893), and " The Loves of the Winds and the Seasons," a large picture which was finished only a few day s before his death. HIe exhibited, as well, many smaller pictures and drawings in pastel and water colours at the Royal Academy, the Grosvenor Gallery, the New Gallery, and in the galleries of the Royal Society of Painters in Water Colours, of which he was elected an associate in 1884. It has been matter for frequent remark and surprise that Albert Moore was never elected into the Royal Academy ; there was certainly no lack of ability on the part of the artist to account for the neglect. HIe died on 25th September 1893, at his studio in Spenser Street, Westminster. Several of his pictures are now in public collections ; among the chief are "Blossoms," in the National Gallery of British Art; "A Summer Night" in the Liverpool Corporation Gallery (see Plate) ; " Dreamers," in the*~~

~~*Birmingham Corporation Gallery; and a water-colour, "The Open Book," in the Victoria and Albert Museum, South Ken- sington.*~~

~~*The main idea that governed Albert Moore's practice was a deliberate and intentional disregard of dramatic subject. In all his pictures, save two or three produced in his later boyhood, he avoided any approach to story-telling, and occupied himself exclusively with decorative arrangements of lines and colour masses. The spirit of his art is essentially classic, and his work shows plainly that he was deeply influenced by study of antique sculpture ; but he was not in any sense an archeeologieal painter, nor did he attempt reconstructions of the life of past centuries. Artistically he lived in a world of his own creation, a place peopled with robust types of humanity of Greek mould, and gay with bright- coloured draperies and brilliant-hued flowers. As an executant he was careful and certain; he drew finely, and his colour-sense was remarkable for its refinement and subtle appreciation. Few men have equalled him as a painter of draperies, and still fewer have approached his ability in the application of decorative principles to pictorial art. (a. l. b.)*~~

~~*Moore, Henry (1831-1895), English painter, was the ninth son of William Moore, of York, and was born in that city on 7th March 1831. His artistic education was chiefly supervised by his father, but he also attended the York School of Design, and worked for a short time in the Royal Academy Schools. He first exhibited at the Academy in 1853, and was a constant contributor to its exhibitions till his death. At the outset of his career he occupied himself mostly with landscapes and paintings of animals, executed with extraordinary detail in imitation of the prevailing taste of the Pre- Raphaelite Brotherhood ; but in 1857, while on a visit to the West of England, he made his first attempts as a sear painter. His success in this brairch of practice was immediate, and it had the effect, as years went on, of diverting him almost entirely from landscapes to marine subjects. Among his most important canvases must be reckoned "The Pilot Cutter" in 1866, "The Salmon Poachers" in 1869, "The Lifeboat" in 1876, "Highland Pastures " in 1878, " The Beached Margent of the Sea" in 1880, " The Newhaven Packet " (bought by the Birming- ham Corporation), and " Catspaws off the Land " (bought by the Chantrey Fund Trustees; see Plate) in 1886, " Mount's Bay " (bought by the*~~

Manchester Corporation) in 1886, "Nearing the Needles" in 1888, "Machri- hanish Bay, Cantyre," in 1892, " Hove-to for a Pilot " in 1893, and "Glen Orcliy," a landscape, in 1895. He was elected an associate of the Royal Society of Painters in Water Colours in 1876, and a full member in 1880 ; an associate of the Royal Academy in 18So,

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and an academician in 1893 ; and at Paris, in 1887, where he exhibited " The Newhaven Packet " and " The Clearness after Eain," he received a grand prix and was made a knight of the Legion of Honour. He died at Margate on 22nd June 1895. His works are marked by admirable appreciation of nature, and by a rare under- standing of wave-form and colour and of the subtleties of atmospheric effect ; and as a sea-painter he may fairly be regarded as almost without a rival. (a. l. b.)

Moquegua, a coast department in the extreme south of Peru, divided into three provinces, Moquegua, Tacna, and Arica, of which the principal towns bear the same names. It has an area of 22,516 square miles, with a population in 1896 of 42,694. The port of Arica is in the hands of the Chilians, in accordance with the terms of the treaty of peace of 1884.

~~*Moradabad, a city anddistrict of British India, in the Rohilkhand division of the North- West Provinces. The city is on the right bank of the river Eamganga (655 feet above the sea), and has a station on the Oudh and Eohilkhand railway. Population (1881), 67,387 ; (1891), 72,921; (1901), 75,176; municipal income (1897-98), Es.68,476, mostly derived from octroi ; incidence of tax- ation, nearly 12 annas per head ; registered death-rate (1897), 57 -2 per thousand. It makes a specialty of inlaid metal-work in brass and tin, and of the weaving of chintz. There is a large trade in country produce. It is a cantonment for a native regiment. The municipality consists of twenty-three members, of whom eighteen are elected, with the magistrate as ex officio chairman. There are two high schools, twenty printing-presses, most of which issue vernacular newspapers, and two cotton and hemp-pressing factories.*~~

~~*The district of Moradabad lies east of the Ganges and west of the native state of Rampur. Area, 2282 square miles ; population (1881), 1,155,173 ; (1891), 1,179,398 ; and (1901), 1,192,348, show- ing an increase of 2 per cent, between 1881 and 1891, continuous since 1872, and of 1.1 between 1891 and 1901 ; average density, 522 persons per square mile. Mahommedans are more numerous than in any other district of the province, forming more than one- third of the total. The land revenue and rates are Rs.17,50,496, the incidence of assessment being R.l : 2 : 7 per acre ; cultivated area (1896-97), 740,735 acres, of which 107,147 were irrigated from wells, &c. ; number of police, 3150; number of vernacu- lar schools, 120, with 4820 pupils; registered death-rate (1897), 42-2 per thousand. The principal crops are wheat, rice, millet, pulse, sugar-cane, and cotton. There are no Government canals. The main line of the Oudh and Rohilkhand railway traverses the district from south to north, with branches towards Aligarh and Rampur. A third branch from Moradabad city towards Delhi was commenced in 1898, which will cross the Ganges at Gurmukhteswar by a bridge of eleven spans of 200 feet each.*~~

~~*Morar, town of Central India, in the native state of Gwalior, 3 miles east of Gwalior city. Population (1881), 24,022 ; (1891), 24,518. It was formerly a British mili- tary cantonment and residence of a political agent, but in 1886, when the fortress of Gwalior was restored to Sindhia,*~~

~~the troops at Morar were withdrawn to Jhansi, and the extensive barracks were likewise made over to Sindhia. It has a high school and dispensary.~~

~~Moratalla, a town of Spain, in the province of Mur- cia, in a mountainous district 40 miles north-west of Mur- cia. The streets are narrow and very irregular, but the town contains a good hospital, a theatre, and a large 17th-century parish church. There are manufactures of rough cloth, alcohol, and soap. Population (1897),~~

~~11,848.~~

~~Moravia (German Mdhren; Bohemian or Czech, Morava), a margraviate and crownland in the Cisleithan part of the Austro-Hungarian Monarchy. In 1880 the population was 2,153,407, and in 1890 it was 2,276,870,~~

~~or 266 per square mile. Of these 70-03 per cent, were Slavs of the various subdivisions of the Czech race, 29-4 per cent. Germans, and the balance Slavs of other races; 96-3 per cent.. were Eoman Catholics, 2-7 percent. Protestants, and 2 per cent. Jews. The proportion of females to males was 1094 to 1000. The population in 1900 was 2,435,081. In 1896 the marriage-rate was 7-92, the birth-rate 37-40, or, excluding still-births, 36-32, and the death-rate 25-24 per thousand. Of the births, 10-86 per cent, were illegitimate. Moravia is represented in the Eeichsrath by 43 members, of whom 7 are re- turned by the universal suffrage curia; the Germans have a small majority. In the Diet the Germans are also in the majority with 65 membjers, the Czechs being represented by 45. The educational institutions are a polytechnic (at Brllnn, with about 350 students), two theological seminaries, 48 gymnasia and reaZ-gymnasia, 2556 elementary schools, and 146 continuation schools . and establishments for technical education, &c. There has been a great reduction in the number of illiterates, who amounted to 54 per cent, of the Moravian recruits of. 1870. They had fallen to 10-4 per cent, of the whole population in 1880, and to 6-9 in 1890. In 1898, 221 periodicals and newspapers were published (128 Czech, 88 German, and 5 polyglot). Half of the population is engaged in agi-iculture and forestry, a third in mining and industry, and 6-84 per cent, in trade and transport. Agriculture is prospering, par- ticularly in those branches connected with the indus- tries of the crownland, such as the cultivation of the beetroot~~

~~(30 per cent, of the entire Austrian crop) and barley. Large quantities of wheat, rye, oats, potatoes, turnips, clover, legumes, flax and hemp, &c., are also grown. There is a considerable export of vegetables to Vienna. In the period 1880-90 pigs show the largest increase (from 205,970 to 322,239), while the number of sheep (80,706) shows a reduction of nearly half. Horned cattle numbered 677,807 (+32,600), and horses, 126,131 (3273). The production of coal (15 million metric centals in 1898) has more than trebled, while that of lignite (1 million metric centals) is over two and a half times as much as in 1881. The only other minerals are iron ore (109,150 metric cen tals), lead (360), and graphite (72,850). There were in 1898, 136 breweries and 495 distilleries, 54 sugar refin- eries (199,440 tons of sugar), and 6 state tobacco factories. The manufacture of woollens, silks, cptton goods, and linen is carried on in about 2000 factories, employing over 150,000 hands. According to the cen- sus of 1890, Moravia had 18 per cent, of the factories, 17 per cent, of the hands, and 16 per cent, of the motive power in Austria, thus taking the second place, after Bohemia, for industrial enterprises on the largest scale. It possessed in 1898, 1220 miles of railway, 9·9 per cent, of the total length in Austria, 7083 miles of roads, and 164 miles of waterway, of which, however, only 20 miles are navigable by boats. In the same year there were 646 post and 260 telegraph offices, with 2478 miles of line and 8410 miles of wire. Politically, the current history of Moravia is subordinate to that of the adjoining crownland of Bohemia (q.v.), inhabited by the same race. The Moravians, whose slight local peculiarities have almost disappeared, are on somewhat better terms with their German neighbours than their compatriots in Bohemia. In the mining districts strikes of exceptional violence have occurred.~~

~~Authorities.— Trampler. Heimatskunde der Markgrafschaft Mdhren. 1877.— Smolle. Die MarJcgrafschaft Mdhren. 1881.— W. MbLLEK. Beitrdge zur Volkskunde der Deutschen in Mdhren. 1893.— Bretholz. Geschichte Mdhrens. Brunn, 1893.~~

~~(m. o'n.)~~

~~*MOEAVIAN BRETHEEN — MOEELLI*~~

~~*Communi-*~~

~~*Total.*~~

~~*Congre-*~~

~~*cants.*~~

~~*gations*~~

~~*3,371*~~

~~*6,095*~~

~~*42*~~

~~*6,294*~~

~~*8,159*~~

~~*25*~~

~~*11,776*~~

~~*17,857*~~

~~*89*~~

~~*3,041*~~

~~*5,092*~~

~~*15*~~

~~*394*~~

~~*627*~~

~~32,446~~

~~95,424~~

~~131~~

~~Moravian Brethren ("The Church of the United Brethren"). — This community progresses steadily, its chief characteristics being well maintained : close atten- tion to education, strict discipline of life, and an extra- ordinary missionary zeal. Recently there has been a still stronger tendency towards decentralization. The three Home Provinces have now a greater independence, as the "Directing Board of the Unity," which has its seat at Berthelsdorf , near Herrnhut, only interferes in local affairs when principles are at stake. The Home Provinces now elect their own bishops. Statistics for 1899:—~~

~~1. British Province~~

~~2. German „ . .~~

~~3. American „ (Northern)~~

~~4. „ „ (Southern)~~

~~5. Bohemian Mission .~~

~~6. Foreign Missions~~

~~7. Leper Home at Jerusalem, 48 Inmates.~~

~~8. Sunday Schools (half in Mission field), 36,000 scholars, 3200~~

~~teachers.~~

~~9. Bishops (Home Provinces) . 20 Missions . 5~~

~~10. Presbyters „ . 141 „ . 40~~

~~11. Deacons ,, .104 ,, .144 See HuTTOs. Short History of the Moravian Church. London.~~

~~— Bishop ScHWEiNiTz. History of the Ancient Church of the United Brethren. (a. e. n.)~~

~~Morbihan, a department on the west coast of France, washed by the Atlantic Ocean.~~

~~Area, 2739 square miles. The population increased from 521,614 in 1881 to 557,934 m 1901. Births in 1899, 14,974, of which 704 were illegitimate ; deaths, 10,791 ; marriages, 3934. There were in 1896, 754 schools, vfith 76,000 pupils, and the illiterate con- stituted 20 per cent, of the population. Out of 1,012,700 acres in 1896 of cultivated land, 671,840 acres were plough-land, and the rest divided between meadow and woodland. The wheat crop of 1899 was valued at £344,000; rye, £437,000; buckwheat, £263,000 ; oats, £216,000 ; potatoes, £201,000 ; natural pastures, £200,000 ; hemp. In harl and in seed, £32,000 ; cider-apples, £212,000. The hve stock included 37,820 horses, 257,980 cattle, 58,700 sheep, and 51,240 pigs. The industi-y in metals in 1898 produced 15,200 metric tons of steel, valued at £176,000. Sardine fishing employs many hands, and is one of the sources of wealth to the department. Vannes, the capital, had 23,375 inhabitants in~~

~~1901.~~

~~Moreau, Custave (1826-1898), French painter, was born in Paris, 6th April 1826. HIs father was an architect, who, discerning the lad's promise, sent him to study under Picot, a second-rate artist but clever teacher. The only influence which really affected Moreau's develop- ment was that of the painter Chasseriau (1819-1867), with whom he was intimate when they both lived in the Eiie Prochot, and of whom we find reminiscences even in his later works. Moreau's first picture was a " Pieta " (1852), now in the cathedral at Angoulgme. In the Salon of 1853 he exhibited a " Scene from the Song of Songs " (now in the Dijon Museum) and the " Death of Darius " (in the Moreau Gallery, Paris), both conspicuously under the influence of Chasseriau. To the Great Exhibition of 1855 he sent the " Athenians with the Minotaur " (in the Museum at~~

~~Bourg-en-Bresse) and " Moses putting off his Sandals within sight of the Promised Land." From October 1857 till September 1859 he travelled in Italy, and has left a record of the journey in a few water- colour sketches. On his return he painted " Tyrtasus " (18G0), and undertook to decorate the church at Decaze- yiUe in the Aveyron. " CEdipus and the Sphinx," be~~

~~and " The Saiat and the Poet," in 1869. After working in obscurity for seven years, he reappeared at the Salon in 1876 with " Hercules and the Hydra," " Saint Sebastian," " Salome Dancing " (presented to the Luxembourg by M. Hayem) ; and in 1878 with " The Sphinx's Riddle solved," " Jacob," and " Moses on the Nile." Moreau exhibited for the last time at the Salon of 1880, when he contributed "Helen" and "Galatea"; to the Great Exhibition of 1889 he again sent the " Galatea " and " The Young Man and Death." He took prize medals at the Salon in 1864 1865, 1869, and 1878. He was made knight of the Legion of Honour in 1875, and oflOicer in 1883. He suc- ceeded Delaunay as professor at the ificole des Beaux Arts and his teaching was highly popular. When he died, 18th April 1898, he bequeathed to the State his house, contain- ing about 8000 pictures, water-colours, cartoons, and draw- ings, which form the Moreau Gallery, one of the best organ- ized collections in Paris, arranged by M. Rupp, his executor and, with Delaunay and Fromentin, his closest friend.~~

~~See Akt Rena. Moreau. Paris, 1900. — Paul Flat. Le Musee Gustave Moreati. Paris, 1900. (-^^ yr)~~

~~Morecambe, or Podlton"-le-Sands, a watering- place of Lancashire, England, on Morecambe Bay, 4 miles west-north-west of Lancaster by rail. A new west pier with pavilion has been constructed at a cost of £50,000. A lofty pyramidal tower with summit platform was built in 1890. It is surrounded by ornamental grounds and con- tains an entertainment hall. Amongst other recent build- ings are a Roman'^Catholie church (1895) and a Wesleyan chapel (1897). The Winter Garden with its connected buildings was reconstructed in 1897 at a cost of £100,000. There is regular steam communication with Dublin and the north of~~

~~*Ireland. Population of urban district (Poulton Bare, and Torrisholme) (1881), 3931 ; (1901), 11,798.*~~

~~*Morelia, a city of Mexico and capital of the state of Michoacan de Ocampo. A tramway line connects it with the station of the Central railway; 234 miles west of Mexico city. Population (1895), 33,890.*~~

~~*Morelli, Giovanni [Ivax Lermoliepf] (1816- 1891), Italian patriot and critic, was born at Verona on 16th February 1816. IIe was educated first at Bergamo, the home of his mother, who had removed thither on the death of her husband ; and then at Aarau in Switzerland. At the age of eighteen he commenced his university career at Munich, being debarred as a Protestant from entering any Italian college, and became the pupil of Ignatius Dollinger, the celebrated professor of anatomy and physiology. Natural philosophy and medicine were the studies to which he specially devoted himself, but he was also keenly interested in all scientific and literary pursuits. At Munich, and later at Erlangen, Berlin, and Pans, his brilliant gifts and independence of thought and judgment attracted the attention of the most distinguished men of the day. In Paris he became intimate with Otto IMtindler, and his intercourse with that eminent art critic was not without its effect in determining the direction of his future studies ; and, during a summer spent in Switz- erland, he formed a friendship with Louis Agassiz, whose teaching made a deep and lasting impression upon him. On his return to Italy in 1840 he became associated in Florence with that band of patriots who were strenu- ously labouring for the deliverance of their country from the oppressive Austrian rule. IIe took an active part in the war of 1848, and was subsequentlv chosen by the provisional Lombard Government to plead the cause of Italian unity before the German Pa.rliament assembled at Frankfort. In 1860, in recognition of the great services rendered to his country by Aloi-elli, Victor Emmanuel named hiin a citizen of the Sardinian kingdom, and in the*~~

~~*following year he was elected deputy for Bergamo to the first free Italian Parliament. He was a staunch supporter of Cavour, and, though never a leading politician, exercised a considerable influence over the most prominent statesmen of the Right, who valued his sound judgment, integrity, moderation, and foresight. One of his first acts after his election was to draw the attention of Parliament to the urgent need of reform in the administration of matters relating to the fine arts. In consequence of his represen- tations, a commission was appointed with the object of bringing under Government control all works of art which could be considered public property. The commission, of which Morelli was named president, began its work in Umbria and the Marches, and he appointed as his secretary G. B. Cavalcaselle, who was then engaged in collecting materials for a work on Italian art. According to one who knew Morelli well, much that Cavalcaselle then learned from his chief was embodied in the well-known History of Painting, which was published in 1864 in conjunction with Sir Joseph Crowe.*~~

~~*The immediate result of Morelli's first labours in the Marches was the passing of the law, which bears his name, strictly prohibiting the sale of works of art from public and religious institutions. He also endeavoured to bring about reforms in the management and organization of public galleries ; but though he was repeatedly urged to accept the post of director of all these institutions, he declined any such appointment, confident that in an un- official capacity he could better serve the cause of art. In*~~

~~*1873 he was named a senator of the kingdom of Italy, hav- ing voluntarily resigned his seat in the Lower House owing to the increasingly democratic tendencies of the Chamber. In Rome, the seat of the Government since 1870, he spent several months of each year ; but his settled home was Milan, whither he had removed from Bergamo in 1874. Here he published some of his researches into the history of Italian art. In order to be free to speak his mind unreservedly, he determined to adopt a pseudonym and to write in German. His first contributions, a series of articles on the Borghese Gallery, were published in Ltltzow's Zeitschrift fiir bildende Kunst between the years*~~

~~*1874 and 1876. Posing as an art-loving Russian, who puts ‘ forth his opinions with the utmost diffidence, he adopted*~~

~~*the pseudonym of Ivan Lermolieif — an anagram of his own name with a Russian termination — and described his essays as Ein kritischer Versuch, translated from the Russian by Johannes Schwarze, this time a Germanized form of Morelli. The originality of the method recommended by the author for studying art, the general soundness of his critical opinions, and the many new (and apparently correct) attributions suggested for pictures in the Borghese Gallery and elsewhere, attracted the attention of all students of art ; but failure attended every attempt to discover the identity of the Russian critic. In 1880 Morelli published a small book under the samepseudonym, entitled. Die Werke italienisclier Meister in den Galerien von Miinchen, Dresden, und Berlin. The appearance of this volume, which was cast in so original a form that it was altogether unlike anything which had preceded it in the realm of art scholarship, created an extraordinary sensation. The daring opinions expressed by the author struck at the roots of all existing art criticism, and were often diametrically opposed to the views of the most renowned art historians of the day. The importance of the work could not be denied, and in spite of determined opposition and searching and bitter attacks, it gained general recognition as a standard work which no serious student of art could ignore. It inaugurated a new and more scientific method of criticism, and marks an epoch in the art studies of the 19th century. The book was translated into English in 1883, with Morelli’s own name*~~

~~*upon the title-page, and a few years later into Italian. In the decade between 1880 and 1890 he contributed three articles to German periodicals : Perugino oder Baffael, Baffaels Jugendentwickelung, Noch einmal das Venezianische Skizzenbuch. Being addressed to critics who had challenged his opinions, they are somewhat polemical in character, but contain a mass of information, more especially about drawings. He also wrote a skit on art connoisseurship in Europe, intending to publish it in English as the reflexions of an American on the follies of art critics in the Old World; but he never carried out his intention, though some portion of the MS. was embodied in the first part of his Critical Studies. This volume, the first of a series of three which, under the title of Kunst*~~

~~*kritische Studien, was to contain all Morelli's contributions to art literature, was published in*~~

~~*1890. The first part, cast in dialogue form, contains a detailed exposition of his method. Then follow the Borghese Gallery, a reissue of his former articles with many important additions, and The Doria Gallery, an entirely new contribution. The second volume deals with the galleries of Munich and Dresden, and is a revised edition of the first two parts of the original book of 1880 ; but here again copious additions rendered it practically a new book. The third volume was to treat of the Berlin Gallery, and was also to contain an exhaustive account of the drawings of Italian masters, but it was destined never to be carried out. Morelli was taken seriously ill towards the middle of February*~~

~~*1891, and was found to be suffering from heart disease and other complications ; a fortnight later he died at Milan, on 28th February. His collection of drawings by the old masters he bequeathed to his pupil, Dr Friz- zoni, and his pictures, over one hundred in number, to the city of Bergamo, where they are now exhibited as the Galleria Morelli in two rooms of the Accademia Carrara. A striking half-length portrait by Lenbach, who presented it to his friend in 1886, forms part of the collection. In memory of Morelli a bronze bust of him by a Milanese artist has been placed in the Brera ; but his features are more worthily presented in a second portrait by Lenbach and in a lifelike pastel sketch exe- cuted by the Empress Frederick in 1884, when he was her guest at Baveno. After the death of Morelli the first two volumes of his Critical Studies were published in English, Sir Henry Layard, one of his most intimate friends, contributing to the first a biographical sketch of the author ; and the fragmentary MS. of the third volume was published in German by Dr Frizzoni, under whose editorship an Italian translation of the first volume has also been issued.*~~

~~*Morelli found art criticism uninspired, unscientific, and practically worthless. To be of any real value he held that historical, documentary, and traditional knowledge respecting works of art was only of second- ary importance as compared with the evidence to be derived from the study of the pictures themselves. He contended that art criticism must be*~~

conducted on scientific principles and follow a strict course of induc- tive reasoning. A painting should be subjected to a searching analysis, and its component parts and minut- est details submitted to methodical and exact investiga- tion. ^Esthetic considerations had their value, but they had been given an undue weight, to the neglect of other factors of equal or even greater force. Before his day critics had been mainly guided by the subjective im- pression produced upon them by the work of art as a whole, while the form — that is, the individual and com- ponent parts which contribute to the unity of the whole, and through which the spirit of the master finds expres- sion — was entirely ignored.

The study of the individual parts and forms was, in his estimation, of the highest importance, for they were not mere incidents, but the outward and visible seal of an artist's character stamped upon his work, and obvious to all who had eyes to see. By diligent observation of the forms the rudiments of the language of art might be mastered, and the first step taken towards initiating a methodized system of study. The education of a critic consists chiefly in learning to compare, and Morelli soon recognized the value of systematic comparison in the study of art. By the combined methods of critical analysis and comparative observation, he found the clue he had so long been seeking. Studying one day in the Uflfizi, it suddenly struck him that in a picture by Botticelli containing several figures the drawing of the hands was remarkably similar in all; that the same characteristic but plebeian type, with bony fingers, broad square nails, and dark outlines, was repeated in every figure. Turning to the ears, he observed that they also were drawn in an individual manner, and that in the numerous figures in which the ear was visible the same typical form recurred. Having noted these fundamental forms, he proceeded to an examination of other works by this painter, and found that the same forms were exactly repeated, together with other individual traits which seemed distinctive of the master ; the characteristic type of head and ex- pression, the drawing of the nostrils, the vitality of movement, the disposition of drapery, harmony of colour (where it had not been

~~tampered with by the restorer), and quality of landscape. In all Botticelli's true works the presence of these and other characteristics proclaimed their genuineness. In paintings where the forms and types were those of the painter, but where vitality, movement, and all deeper qualities were absent, Morelli recognized works executed from the master's cartoons ; while in pictures where neither types nor forms responded to the test, and where only a general family likeness connected them with Botticelli, he discerned the productions of pupils and imitators. After applying his method to the works of Botticelli, he proceeded to examine those of other Florentine masters, and afterwards of painters of other Italian schools, everywhere meeting with results to him not less convincing. If the drawing of the hand and ear were not always conspicuous, there were other peculiarities of this language of form to aid in the identification of a master : the treatment of the hair, as in Piero dei Franeeschi; the indication of the sinews, as in Foppa; the drawing of the eye, as in Liberale da Verona ; the modelling of the eyelid and upper lip, as in Ambrogio de Predis ; the form of the feet, as in Luini. In short, all apparently insignificant details were of importance in his plan of study, for to him they were like the signature of the master. He held them to be of far greater value for purposes of identification than the general external aspect of a picture and its supposed technical qualities and colouring; for, after having been exposed for centuries to countless processes of cleaning, repainting, and varnish- ing, pictures, as a rule, retain but little of their original aspect, and it is only in the forms that the master's personality may still be recognized.~~

~~This is a brief outline of Morelli's method from its purely practical and mechanical side, but he did not over- look those deeper qualities to which the vague designation of " spirit " in a work of art is given. Only he maintained that side by side with the psychological study of it must ever be practised a close and systematic study of the form ; for, to quote his own words, " it is only through unremitting study of the form that we may gradually attain to understanding and recognizing the spirit which gives it- life." (c. j. -p*.)~~

~~Morelos, a state of Mexico, bounded by the Federal district on the N., by the state of Mexico on the W., N.W., and IST.E., by Puebla on the E. and~~

~~*S.E., and by Guerrero on the S. and S.E., with an area of 2774 square miles. The population in 1879 was 159,160 and in 1900 it was 161,697. Though small it is progressive' and one of the richest agricultural states in the Republic. The principal products are sugar-cane, rice, maize, coffee and wheat. The sugar-cane products in 1897 were valued at $5,800,000. Its fruit exports are also very large. The Interoceanic railway traverses the state from north- east to south-west. The state is divided into six dis-tricts. The capital, Cuernavaca, had 8747 inhabitants in 1895. Amongst other towns are Yautepec (6766) Morelos (or Cuautla) (6538), Jonacatepec de Leandro Jojutla de Juarez, and Tetecala de la Eeforma.*~~

~~*Morgan, John Pierpont (1837), American*~~

~~*banker and capitalist, was born 17th April 1837 at Hartford, Conn. He was the son of Junius Spencer Morgan, a partner of the London banker and philan- thropist, George Peabody. He received his education at the English High School, Boston, and the University of Gottingen, engaged in banking in New York, and in 1864 organized the firm of Dabney, Morgan and Co. In 1871 he united with Anthony Drexel of Philadelphia to form the firm of Drexel, Morgan and Co., of which he became in 1893 the senior partner. In 1895 the name of the firm was changed to J. P. Morgan and Co. In 1860 he was made American representative of George Peabody and Co. of London, and ultimately became the head of J. S. Morgan and Co., its successor, as also of Morgan, Harjes and Co. of Paris, and Drexel and Co. of Philadelphia. He has been especially successful in the reorganization of a number of bankrupt American railways, among them the Erie, Philadelphia, and Eeading ; New York and New England ; Southern ; Northern Pacific ; and Baltimore and Ohio. In 1895 a large part of the $65,000,000 United States Government bond issue was taken by his firm. Being in command of huge financial resources, Mr Pierpont Morgan became the prime mover in the organization of the principal great Anglo-American and American commercial combinations which came into existence at or about the opening of the 20th century. His enterprise was notably employed in connexion with the formation of the United States Steel Corporation (which took over Mr Andrew Carnegie's business and others), the harmonization of coal and railway interests in Pennsylvania, and the*~~

purchase first of the Leyland line of Atlantic steamers, and then (1902) of other British companies (including the "White Star'^), and the formation of a huge Atlantic shipping combination ; and his name became a household word in connexion with similar schemes of gigantic commercial amalgamation. Among his benefactions were $1,000,000 to the lying-in hospital of New York, $500,000 to the New York trade schools, and $1,000,000 to Hai'vard University. He also bought works of art on a princely scale, his picture purchases including the famous (re- covered) " Duchess of Devonshire " by Gainsborough, and the Colonua Raphael. He married in 1865 Frances Louise Tracy of New York City.

Morier, Sir Robert Burnett David (1826- 1893), British diplomatist, was born at Paris on 31st l\Iarch 1826. He was descended from a family of diploma,tists of Huguenot origin, tlie best known of whom were his father David, consul-general for France and minister at Bern, and his Uncle James, the author of The Adveiitin-es of Hajji Baba. After a somewhat defective private education, he came up to Balliol College, Oxford. Here he attracted the notice of Jowett, under whose

influence his brilliant but wayward mind obtained the discipline of which it stood in need. The relation of tutor and pupil developed into a friendship of rare wannth. Writing towards the close of his life, Jowett, who inspired more devoted friendships than any other man of his time, spoke of Morier as his kindest and best friend for forty-five years, and his correspondence teems with discussions between the two friends on every topic of the day. On leaving Oxford, Morier at first obtained an appointment in the Education Department, but resigned in 1852, and in the following year became attache at Vienna. In the succeeding years he was attached in turn to almost every court in Germany. Eestless in tempera- ment and unconventional in method, he plunged into the vortex of German politics to a degree that did not always accord with the traditions of diplomacy. The most im- portant years of his career in Germany were from 1866 to 1871, when he was secretary of legation at Darmstadt. Here he became a trusted adviser of the crown princess, and

~~through her acquired an intimate friendship with the crown prince (afterwards the Emperor Erederick III.), whose antagonism to Bismarck's reactionary policy met with cordial support from Morier's sturdy Liberalism. Bismarck, already jealous of British influence at court, honoured Morier with a hatred not lessened by the fact that Morier's knowledge of German politics was unri- valled outside Germany. On leaving Darmstadt, Morier became charge d'affaires, first at Stuttgart and then at Munich, and in 1876 was appointed minister at Lisbon. Erom 1881 to 1884 he was minister at Madrid, and dis- tinguished his term of office by the negotiation of an important commercial treaty. In December 1884 he became ambassador at St Petersburg, and almost imme- diately had to face the alarming situation created by the Russian advance to Penjdeh. Thanks to his efforts, a war that at one moment seemed inevitable was averted. His great popularity at the Russian court contributed towards a marked improvement in the relations between the two countries. Bismarck took alarm at the lessen- ing influence of Germany over Russia, and, always relent- less in his hatreds, tried to procure Morier's downfall. The Kolnische Zeitung declared in December 1888 that Morier had made use of his position at Darmstadt dur- ing the Eranco-German war to betray the movements of the German troops to Marshal Bazaine. The authority for this charge was an alleged declaration made by Bazaine to the German military attache at Madrid. Bazaine had died in September, but Morier had heard rumours in July of the charge brought against him, and had procured from Bazaine a written denial, which he now published in The Times. Apart from this, it was clearly shown that Morier could not have transmitted the infor- mation by the alleged date, and that Bazaine, according to the testimony of his own books and of other officers, received the information in question by reports from the front. As a matter of fact, Morier was an ardent cham- pion of the German cause. His correspondence with Jowett shows the latter vainly endeavouring to convince his friend that the Erench were in the right. Public opinion everywhere, except in the German Conservative press, attributed the charge to political motives. This was confirmed by Bismarck's subsequent attempt to implicate Morier in the Geffcken case — a fresh instance of the Chancellor's bitterness against the Emperor Ered- erick and all his friends. The international importance of the affair was shown in the following Eebruary, when a~~

~~*grand ball given by Morier was attended by the Tsar and the whole Imperial family. Morier's failing health caused him, at his own request, to be appointed Lord Dufferin's successor at Rome in 1891 ; but it was felt that he could not be spared from St Petersburg, and there*~~

~~*he remained tiU forced to find a milder climate. It was then too late, and he died at Montreux in Switzerland on 16th November 1893. (h. st.)*~~

~~*Morison, James Augustus Cotter (1832- 1888), British author, was born in London on 20th April 1832. HIs father, who had made a large fortune as the inventor and proprietor of " Morison's Pills," settled in Paris till his death in 1840, and Cotter Morison thus acquired not only an acquaintance with the Erench lan- guage, but a profound sympathy with Erance and Erench institutions. In later life he resided for some years in Paris, where his house was a meeting-place for eminent men of all shades of opinion. HIe was educated at HIgh- gate Grammar School and Lincoln College, Oxford. HIere he fell under the influence of Mark Pattison, to whom his impressionable nature perhaps owed a certain over-fastidiousness that characterized his whole career. HIe also made the acquaintance of the leading English Positivists, to whose opinions he became an ardent con- vert. Yet he retained a strong sympathy with the Roman Catholic religion, and at one time spent several weeks in a Catholic monastery. One other great influ- ence appears in the admirable Life of St Bernard which he published in 1863 — that of his friend Carlyle, to whom the work is dedicated, and with whose style it is strongly coloured. Meanwhile he had been a regular contributor, first to the Literary Gazette, edited by his friend John Morley, and then to the Saturday Review at its most brilliant epoch. In 1868 he published a pam- phlet entitled Irish Grievances shortly stated. In 1878 he published a volume on Oibbon in the "Men of Letters" series, marked by sound judgment and wide reading. This he followed up in 1882 with his Macanlay in the same series. It exhibits, more clearly perhaps than any other of Morison's worlss, both his merits and his defects. Macaulay's bluff and strenuous character, his rhetorical style, his unphilosophical conception of his- tory, were entirely out of harmony with Morison's pre-possessions. Yet in his anxiety to do justice to his subject, he steeped himself in Macanlay till his style often recalls that which he is censuring.*~~

~~*Against this power of sympathy, which Mr Erederic Harrison calls the greatest of Morison's gifts, must be put a want of robustness, sometimes amounting to hypercriticism, as in his remarks on Macaulay's poetry. It was this over- refinement, coupled with delicate health, that kept him from committing to paper his researches on the history of Erench institutions. These researches formed the chief occupation of his life, and would, as his friends believed, have obtained from the world a recognition of powers which his published works did not adequately reveal. His brief sketch, Mme. de Maintenon : une Mude (1885), and some magazine articles, were the only fruits of his labours in Erench history. Towards the closeof his life he meditated a work showing the application of Positivist principles to conduct. Unfortunately, failing health com- pelled him to abandon the second or constructive part : the first, which attempts to show the ethical inadequacy of revealed religion, was published in 1887 under the title of TVte Service of Man. Though containing many im- pressive passages, and animated by a lofty spirit, it can only be regarded as a restatement of familiar arguments, and bears marks, in a certain want of proportion, of the haste with which it was completed; but it was widely read, and made his name known to a larger public. He died in London on 26th Eebruary 1888. (h. st.)*~~

~~*Morlaix, chief town of arrondissement, department of Einistfere, Erance, 62 miles north by east of Quimper, on the railway from Paris to Brest. The tobacco factory employs about 100 men and 700 to 800 women, and the*~~

~~*output of tobacco amounts annually to over 5,000,000 lb. The total port traffic in 1899 amounted to 53,289 tons. Population (1891), 13,259; (1901), 16,086.*~~

~~*Morlanwelz, a town of Belgium, in the province of Hainaut, 15 miles east of Mons by rail. There are foundries, forges, and other iron industries in*~~

~~*the town, and coal-mines in the vicinity. Population (1890), 7307;*~~

~~*(1900), 7895.*~~

~~*Morley, a municipal borough (1885) in the Morley parliamentary division of Yorkshire, England, 4 miles south-south-west of Leeds, on the Great Northern and London and North- Western railways. The gas works were taken over by the corporation in 1898, and extensive waterworks were completed in 1894. A new town hall was opened in 1895 ; a park, for which the ground was presented by Lord Dartmouth, has been laid out; public baths have been erected, and other important improve- ments effected. The chief industries are connected with woollen cloth, machinery for the treatment of wool, coal and stone. The town figures in Domesday Book. Popu- lation (1891), 21,068 ; (1901), 23,636.*~~

~~*Morley, Henry (1822-1894), British man of letters, was born in London on 16th September 1822. After unhappy experiences at English schools, he was sent to the Moravian school at Neuwied, whose system strongly influenced his subsequent theories of education. It was intended that he should follow his father's ^pro- fession of medicine, and in 1844 he bought a share in a practice at Madeley, Shropshire. Plunged into debt by his partner's dishonesty, he set up a small school for young children at Liscard, near Liverpool. His principle was to abolish all punishment, to make his pupils regard their work as interesting instead of repellent, and to form their character by appealing exclusively to higher motives. This scheme, carried out with much ingenuity, proved a complete success. Meanwhile he had devoted his spare time to writing. He long cherished the ambi- tion of making his mark as a poet, and in 1845 published Tlie Dream of the Lilyhell, followed in 1848 by Sunrise in Italy. His muse was fluent, but wanting in distinc- tion, and it was fortunate for his reputation that neces- sity compelled him to turn to other pursuits. His contributions to magazines on sanitation and other sub- jects attracted the notice of Charles Dickens, on whose invitation in 1851 he settled in London as a regular contributor to Household Words. He was also on the staff of the Examiner, which he edited from 1861 to 1867. Meanwhile he had devoted much research to a life of Palissy the Potter (1852), which was at the same time a picture of life in mediaeval France. Encouraged by its*~~

~~*favourable reception, he followed it up with lives of Jerome Cardan (1854) and Cornelius Agrippa (1856), and subsequently of Clement Marat (1870). His dramatic criticisms were reprinted in 1866 under the title of Tlie Journal of a London Playgoer, 1861-1866. In 1857 he was appointed evening lecturer in English literature at King's College, and in 1865 became, in succession to David Masson, professor of English literature at Uni- versity College, London. Deciding to devote his life- work to this subject, he published in 1864 the first volume of a monumental history of English literature entitled English Writers, which he eventually carried in eleven volumes down to the death of Shakespeare. He was indefatigable as a popularizer of good literature. After editing a standard text of Addison's Spectator, he brought out a vast number of classics at low prices in Morley's Universal Library, Cassell's National Library, and the Carisbrooke Library. His introductions to these display his characteristic tendency to dwell on the*~~

~~*ethical rather than the literary merits of his authors. His ready speech, retentive memory, earnest purpose, and bright style made him perhaps the most popular lecturer of his day, and the influence exerted by his countless lectures all over the country was second only to that of his cheap reprints. His teaching work at University College was marked by equally extraordinary success. In 1882 he accepted a post that made great calls on his time and energy — the principalship of University Hall. This institution was partly a place of residence for students of University College, and partly the home of Manchester New College. During this time he rendered further services to the cause of education in London not only by his work on the council of University College, but by his advocacy of a teaching university for London. In 1889 he resigned the principalship of University Hall and his professorship at University College, and retired to Caris- brooke, Isle of Wight, intending to devote his leisure to the completion of the great task of his life, English Writers. But with his work only half achieved he died on 14th May 1894. (h. st.)*~~

~~*Morley, John (1838), English statesman*~~

~~*and author, was born at Blackburn, 24th December 1838, being the son of Jonathan Morley, surgeon. He matri- culated at Lincoln College, Oxford,*~~

~~*in 1856, and after taking his degree in 1859 came up to London with the determination of seeking distinction by literature. He almost immediately became editor of the moribund Literary Gazette, which not all his ability could preserve from extinction. Gradually, however, he became known as a philosopher and a Eadical, and as one of the ablest and most incisive contributors to the literary and political press of the day. His sympathies as a thinker seem to have been at this time chiefly with Positivism, though he never embraced Comte's doctrine in its hierarchical aspects; but he acquired a reputation as an agnostic, which became confirmed in the popular mind when he somewhat aggres- sively spelt God in one of his essays with a small " g." In 1868 he was editor for a short time of the daily. Iforning Star, which came to an end in 1870. In 1867 he succeeded Lewes in the editorship of the Fortnightly Revieiv, which he conducted with brilliant success until 1883, when he was elected to Parliament ; he then assumed in exchange, but not for long, the lighter duties of the editorship of Macmillan's Magazine. He had been con- nected with Messrs Macmillan since the commencement under his editorship, in 1878, of the " English Men of Letters " series, a collection of biographies of various merit, in which nothing is better than the editor's own contribu- tion in his Life of Edmund Burke. Since 1880 he had been the editor of the Pall Jlall Gazette, which was then turned into a Liberal paper (see Newspapers) ; and he succeeded in ably maintaining the high character with which it had started under Mr Greenwood. In 1883 Mr Morley, who had twice unsuccessfully attempted to enter Parliament, was returned for Newcastle-upon-Tyne at a bye-election. The prestige thus acquired led to his pre- siding over a great Liberal congress at Leeds in the same year ; and, although the platform never seemed his natural element, the literary finish of his style and the transparent honesty of his reasoning rapidly gained him a prominent position in the House of Commons. When, in February 1886, Mr Gladstone returned to office as a Home Euler, Mr Morley, who had never before held any public appoint- ment, filled one of the most important posts in the Cabinet as Secretary for Ireland. He had always expressed his sympathy with the Irish Nationalist movement. He had no opinions to recant, no pledges to explain awav. He is credited with an especial influence over Mr Gladstone in the matter of Home Eule, and in particular with having*~~

kept Mm steady in the Bill of 1886 to his original purpose of entirely separating the Irish from the British legislar ture, a provision which pressure from their own party afterwards compelled both MrMorley and Mr Gladstone to abandon. After the severe defeat of the Gladstonian party at the general election of 1886, Mr Morley led a life divided between politics and letters until Mr Glad- stone's return to power in 1892, when he resumed his former office. He had been re-elected for Newcastle in circumstances entirely honourable to himself, a deter- mined attempt having been made to exclude him in consequence of his resistance to an Eight Hours' Labour Bill, of which he disapproved as an undue interference in principle with the rights of adult labour. His constit- uents showed their appreciation of his integrity by returning him with a majority of 1739 ; but the resistance to his views on the labour question went on in his constit- uency, and was assisted by Mr Cowen's persistent cam-

JOHN Morley. ilYom a photograph l>y Elliott and Fry.)

paign in the principal Newcastle newspaper against the general lines of Mr Morley's somewhat doctrinaire and anti-imperialistic views on politics. The result was that, at the election of 1895, he lost his seat, but soon found another in Scotland, for the Montrose Burghs. He had during the interval taken a leading part in Parliament, but his tenure of the chief secretaryship of Ireland was not a success. The Irish gentry, of course, made things as difficult for him as possible, and the path of an avowed Home Ruler installed in office at Dublin Castle was beset with pitfalls. In the intestine disputes which agitated the Liberal party during Lord Rosebery's administration, and afterwards, Mr Morley sided with Sir William Harcourt, and was the recipient and practically co-signatory of his letter resigning the Liberal leadership in December 1898. Mr Morley's activities were again turned to literature, the political views most characteristic of him, on the Boer war in particular, being practically swamped by the over- whelming predominance of Unionism and Imperialism. His occasional speeches, however, denouncing the Govern-

~~*ment policy towards the Boers and towards the war, though not representing the popular side, always elicited a respectful hearing, if only for the eloquence of their language and the undoubted sincerity of the speaker.*~~

~~*As a man of letters Mr Morley's place will be deter- mined by his monographs on Voltaire (1872), Bousseau (1873), Diderot and the Encyclopoedists (1878), Burke (1879), and Walpole (1889). Burke as the champion of sound policy in America and (as Mr Morley deems) of justice in India, Walpole as the pacific minister under- standing the true interests of his country, fired Mr Morley's imagination. HIs Life of Oliver Cromwell (1900) revises Gardiner as Gardiner revised Carlyle. The Life of Cobden (1881) is an able defence of that statesman's views rather than a critical biography or a real picture of the period. Mr Morley's contributions to political journalism and to literary, ethical, and philoso- phical criticism are numerous and valuable. They rarely evince any striking originality of thought, but possess great individuality of character. As in letters, so in politics. A philosophical Radical of a somewhat mid- 19th-century type, and highly suspicious of the later opportunistic reaction (in all its forms) against Cobdenite principles, he yet retained the respect of the majority whom it was his usual fate to find against him in English politics by the indomitable consistency of his principles and by sheer force of character and honesty of conviction and utterance. After the death oj Mr Gladstone Mr Morley was engaged till 1902 upon his biography. Among the Coronation honours of 1902, he was nominated an original member of the new Order of Merit ; and in July 1902 he was presented by Mr Carnegie with the late Lord Acton's valuable library.*~~

~~*Morley, Thomas (1567-1603), English musical composer, was born in 1557, as may be gathered from the date of his motet, " Domine non est," composed " aetatis suae 19 anno domini 1576," and preserved in Sadler's Part-Books (Bodleian Library). HIe was a pupil of William Byrd, but nothing is known as to his origin and very little as to the incidents of his career. In the account of the entertainments given at Elvetham by the earl of Hertford in 1591 in honour of Queen Elizabeth, it is stated that there was "a notable consort of six Musitions," whose music so pleased the*~~

queen " that in grace and favour thereof, she gave a newe name unto one of their Pavans, made long since by Master TJiomas Morley, then Organist of Paules Church." This statement, however, lacks corroboration, and if Morley ever held the post, he must have done so for a very short time. On 5th July 1588 he was admitted Mus. Bac. at Oxford. Pour years later (24th Julyl592) he entered the Chapel Royal, where he successively filled, the offices of epistler and gospeller. From the dedication to his first book of canzonets it seems that in 1595 Morley was married. His wife's Christian name was Margaret, and before her marriage she apparently held some post in the household of Lady Periam, wife of the Lord Chief Baron of the Exchequer. On 11th September 1598 Morley received a licence for twenty-one years to print ruled music-paper and song-books in English, Latin, French, or Italian. His rights under this grant were assigned by him to various publishers. In Burgon's Life of Qresham it is stated (ii. 465) that the registers of St Helen's, Bishopsgate, show that Morley lived in that parish. This is inaccurate, and there is no proof that the family of the same name residing in St Helen's between 1594 and 1600 was related to the com- poser. In the preface to his Plaine and Easie Introduction to Practicall Musicke (1697), Morley gives as one of his reasons for undertaking that work that he led a solitary life, "being compelled to keepe at home," presumably

owing to ill-heal fch. On 7tli October 1602 his place in the Chapel Eoyal was filled up, and on 26th October 1603 administration of his goods was granted to his widow. This document (Act Book, 1603, fol. 171) describes him as " late parishioner of St Botolph's near Billingsgate," but the registers of that parish contain no entries relating to him. Morley was incontestably one of the greatest of the Elizabethan composers. His madrigals, canzonets, and ballets are as remarkable for their beauty as they are for their admirable workmanship, and his Introduc- tion to Practicall Musicke, in spite of its frequent obscurity, is an invaluable source of information as to the state of musical science in England at the end of the 16th cen- tury. His works are : (1) Canzonets to TJiree Voices

~~*(1593, 2nd edition, 1606; 3rd edition, 1631; German Translations : Cassel, 1612, and Rostock, 1624) ; (2) Mad- rigals to Four Voices (1594, 2nd edition, 1600) ; (3) First Book of Ballets to Five Voices (1695. An Italian edition appeared in London in the same year, 2nd edition, 1600 ; German edition, Nuremberg, 1609) ; (4) First Book of Canzonets to Two Voices (1596 ; 2nd edition, 1619) ; (5) Canzonets or Short Little Songs to Four Voices, selected out of Italian Authors (1597) ; (6) Canzonets to Five and Six Voices (1697) ; (7) A Plaine and Easie Introduction to Practicall Musicke (1597 ; 2nd edition, 1608 ; 3rd edi- tion, 1771) ; (7) Madrigals to Five Voices, selected out of Italian Authors (1598) ; (8) Tlie First Book of Consort Lessons, made by divers authors, &c. (1699 ; 2nd edition, 1611) ; (9) Tlie First Book of Airs to Sing and Play to the Lute with the Base Viol (1600) ; (10) The Triumphs of Oriana to Five and Six Voices, com^iosed by divers several authors (1601). Besides the above, services, anthems, motets, and virginal pieces by Morley are to be found in various collections, both printed and manuscript.*~~

~~*(w. B. s*.)*~~

~~*Mormon Church. — The most conspicuous events in the history of the Church of Jesus Christ of Latter- day Saints (i.e., the "Mormon" Church) since 1880 concern polygamy. The Morrill Act of 1862 for the suppression of polygamy in the territories was inopera^ tive owing to certain defects in the law, which made conviction uncertain, and to lack of strong public demand for its enforcement. From time to time other laws of increasing stringency were enacted to the same end. These measures were finally amended and supplemented by the Edmunds-Tucker Act of March 1887, which be- came a law without the President's signature. By it polygamy and cohabitation with more than one woman as wife were prohibited ; persons were disfranchised who could not, or would not, swear that they were guiltless of these offences ; woman suffrage, permitted in Utah by Act of Legislature in 1870, was forbidden ; the Mormon Church and the Perpetual Emigration Fund Company were disincorporated ; the property of these organizations was declared forfeited to the Federal Government, the proceeds to be devoted to the public schools — property actually in use for worship and similar purposes being exempt. Vigorous prosecutions of offenders were at once*~~

~~*instituted. The Mormons were at great expense in attack- ing the validity of the Act, but its constitutionality was sustained by both state and federal supreme courts. Many of the most notable polygamists and eminent authorities of the Church escaped prosecution by hiding — in local slang, by " going on the underground." The property confiscated in the territory of Utah amounted in value to about $1,000,000. The legislature of the territory of Idaho also struck at polygamy in 1885 by the "Test Oath Act," which disfranchised all persons belonging to any organization that should teach or encourage polygamy or unlawful cohabitation. A similar law was for a short*~~

~~*time in force in Arizona. In July 1887, John Taylor, president of the Mormon Church, died while in concealment in a small town near Salt Lake City, Utah. The apostles administered the affairs of the Church until April 1889, when Wilford Woodruff, the senior apostle, succeeded to the presidency. The rigid enforcement of the law did at last what the Acts designed to accomplish. On 24th September 1890 President Woodruff issued the famous manifesto in which he said : " Inasmuch as laws have been enacted by Congress forbidding plural marriages . . . I hereby declare my intention to submit to those laws, and to use my influence with the members of the Church over which I preside to have them do likewise . . . and I now publicly declare that my advice to Latter-day Saints is to refrain from contracting any marriage forbidden by the law of the land." On the 6th of October following, the general conference of the Church approved the manifesto, and by resolution asserted that " we accept his declaration concerning plural marriage as authoritative and binding." These utterances were accepted as made in good faith, and prosecutions at once ceased. Most of the polygamists desisted from cohabiting with their plural wives, and, excepting a few cases, apparently not sanctioned by the Church authorities, no further polygamous marriages have since then taken place. Between 1852, when the doctrine of polygamy was first openly promulgated, and 1890, about 10 per cent, of the adult male members of the Mormon Church took plural wives, practically every man occupying a position of eminence or authority being a polygamist. In all, about 1200 persons were convicted of polygamy or unlawful cohabitation in the territories of Utah, Idaho, and Arizona. The usual penalty was a fine of $300 and confinement in the penitentiary for six months. Under*~~

~~the " test oaths " nearly 12,000 were disfranchised. On the 4th of January 1893, in response to a petition from the officials of the Church, pledging the membership thereof to faithful obedience to the laws against polygamy, &c., and begging amnesty, the President of the United States, Benjamin Harrison, issued a general pardon to all liable to the penalties of the Edmunds-Tucker Act, who had abstained from offending since the 1st of November 1890. On the 25th of September 1894 President Cleveland also granted full amnesty to all who were under political dis- ability for violating the anti-polygamy laws, and who had been law- abiding since the 1st of November 1890. One of the conditions on which Utah was admitted to state- hood in 1896 was that polygamy should be prohibited by an article in the state constitution, repealable only with the consent of the United States and of the people of the state. Although the practice of polygamy has been sus- pended by the Mormon Church, the doctrine is still a valid one. That polygamous relations were not entirely aban- doned by individual Mormons is shown by a few convic- tions since 1890, and in the passing of an Act by the first state legislature in 1896 legitimizing all children born of plural wives previous to the 1st of January 1896. In March 1896 the escheated property of the Church still in possession of the United States Government, amounting to 1286,000, was restored. About $460,000 in the aggre- gate had been previously restored in instalments. The remainder had been consumed in fees and other expenses of managing. The Emigration Fund Company was never reorganized. The Church as a whole was not again incor- porated, its legal business being transacted by its presi- dent as " Trustee-in-trust for the body of religious worship- pers known as the Church of Jesus Christ of Latter-day Saints." Each " ward," or administrative unit, has been incorporated, its executive head being known as " bishop." On the 6th of April 1893 the Mormon temple in Salt Lake City was completed and dedicated. Work on this building had been in almost continuous progress for forty~~

years. The cost was approximately $3,000,000. There are three other temples in Utah, in Logan, Manti, and St George respectively, which though costly are smaller and less elaborate. These edifices are not used for public assemblies of any kind, but are arranged for the secret performance of the sacred rites of baptism, of mar- riage, of baptism in behalf of dead ancestors and friends, and of " endowment," or the higher ordinances of the Church.

President Woodruff died in 1898, and was succeeded in office by Lorenzo Snow. President Snow died in October 1901, and was succeeded by Joseph P. Smith, nephew of Joseph Smith, the founder of the Church. Missionary activity has always been one of the most important poli- cies of the Church. Most of the male members are ex- pected to spend a season away from home preaching the tenets of the Mormon faith. Two years is the usual term. Missionaries to foreign countries, who must learn a new language, often remain three years or even longer. Zealous and efl&cient men frequently serve more than one term. These missionaries are usually young men, who pay their Qwn expenses, even buying the tracts, pamphlets, and books they distribute. In 1901 nearly 2000 Mormons were in the mission field, a few of whom were women. Formerly a person when "called" must go, regardless of financial or family considerations. The system is maintained partly to gain converts and partly as a discipline to the missionaries. At the beginning of the 20th centuryIIhe growth of the Church through con- verts did not seem so great, proportionally, as at some previous times. The missionary work is thoroughly systematized. There are fourteen organized " missions," viz., the Eastern States (United States), the Northern States, the Southern States, the South-western States, California, Great Britain, Switzerland, Germany, the Scandinavian countries, Hawaii, Australia, New Zealand, and Samoa. In 1901 Japan was added. Until about 1892 most converts from nearly all parts of the world, the Pacific Islands being the chief exception, emigrated to Utah or adjacent states and territories, where work and an opportunity to make comfortable homes were provided. Since then the policy, in general, has been to encourage converts to remain at home and so form centres for spreading the influence of Mormonism and for lessening the difficulties of missionaries in their travelling work. Emigration has been greatly assisted by the Perpetual

~~*Emigration Fund Company. This society, organized in 1849, incorporated in 1851, and dissolved in 1887, pro- vided means, in whole or in part, to indigent converts for transportation to Utah, the aid being regarded as a loan to be repaid whenever the assisted immigrant should becom e financially able. Over 50,000 persons have received benefits from the company.*~~

~~*The looked-for Zion of the Mormons, where the final " gathering " shall be, is not Utah but western Missouri, the city of Independence being regarded as the centre. The principal administrative divisions of Mormondom, where the Church is fully organized, are known as " Stakes of Zion," the figurative name being suggested by the stakes that hold a tent firm. There are about fifty of these " stakes " in the western part of the United States, in Alberta, Canada, and in Mexico. In 1901 the Church had about 300,000 members, of whom 200,000 lived in Utah, where they constituted about three-fourths of the entire population of the state; 60,000 were found in neighbouring states, and 40,000 were distributed in other parts of America, and in Europe and the Pacific Islands. Public schools, although early established in the Mormon settlements of Utah, were slow of development. In 1888 President Woodruff began active measures to institute Church schools'. In a few years a well-organized system*~~

~~*was in operation, under control of the general Church board of education. Many of the " stakes " support academies, which when completely developed will conduct full high school courses. Three institutions, the Brigham Young Academy at Provo, the Brigham Young College at Logan, and the Latter-day Saints' University at Salt Lake City (until 1901 known as the L. D. S. College), attempt college work and offer degrees. These were founded prior to 1888, but were put under the control of the general board. In some communities where the Mormons are in consider- able majority these Church academies supply the place of public high schools.*~~

~~*The industrial policy of Mormons is summed up in the word " co-operation." It was the aim of the early leaders in Utah to make their people self-reliant and independent of non-Mormons. The virtue of*~~

~~*mutual helpfulness was therefore inculcated. Companies of settlers were sent to the richest valleys of the inter-mountain region wherever the soil could be most easily irrigated. Each company was selected with care to include artisans of all the indis- pensable crafts, and the people, closely bound by common ties, lived like members of a family. They enclosed great tracts of land for the use of the community, appro- priated the water of convenient streams, and exchanged products and labour. President Young tried to provide that each family in towns should own at least an acre, and each family in farming districts fifteen or twenty acres. He believed that a comparatively small estate well cultivated was better than a large farm badly cared for. People were taught to shun debt, and mortgages were almost unknown. The result of this was shown in 1900, when 60 per cent, of the families in towns and cities lived in their own homes, and 91 per cent, of the farmers tilled their own soil. On their arrival. Mor- mon immigrants were made up into new companies for settlement, or were distributed among the older places according to the needs of the several communities. Men of almost every skilled trade were found among the early inhabitants of Utah. In caring for the poor the Church was a vast labour exchange, and kept in touch with the industrial necessities of every locality, and wherever men needed work or work needed men, the want was supplied. Home production of everything requisite was encouraged by President Young, and under his influence a great variety of industries was fostered. The building of a railway through Utah in 1869 made possible the competi- tion of cheaper and better goods from the East, and many promising enterprises perished. For twenty years after the settlement of Utah, barter was the chief means of exchange, and, as it permitted readier local transactions and compelled the Mormons to be less dependent on Gentiles (i.e., non-Mormons), the system was encouraged long after it might have been supplanted by a more extensive use of money. The existence of precious metals was early dis- covered in Utah. But fearful that a mining mania would result in utter neglect of farming, with consequent dis- tress, if not famine and starvation. Mormons were practi- cally forbidden to open mines. Mining was therefore developed almost wholly by Gentiles, and for many years was carried on by them.*~~

~~*Until three years after the Mormons reached Utah there were no shops in the territory. The most flourish- ing stores were first conducted in Salt Lake City by Gentiles, who, possessing capital and credit, had a mono- poly and practised extortion. These merchants did noth- ing for the improvement of the town, and spent their money elsewhere. This eventually led to the establishing of co-operative companies in nearly every settlement, the shares of which were widely distributed in small lots among great numbers of holders in the different communities. The prices of goods were made reasonable, and all profits*~~

~~*beyond a certain percentage were devoted to the erec tion of new and substantial store buildings and to other enterprises, which gave work to the people and tended to improve the towns. The Church authorities used their utmost power to further these concerns. At one time there existed no fewer than 200 of them, but they gradually grew less popular, and individual firms and merchants, not always .Mormon, opened businesses, and by 1880 controlled the bulk of the trade. Some of the co-operative shops closed. Others consolidated, until in 1900 they did not exceed 60. The shares, too, generally gravitated into the hands of comparatively few, and were even sold to Gentiles. The co-operative establishments conducted business on such conservative lines and with such punctilioirs regard for all obligations that no concerns in the country enjoyed higher credit in the commercial world. The most successful of these establishments is the Zion's Go-operative Mercantile Institution in Salt Lake Gity, organized in 1868, incor- porated in 1870 for twenty-five years, and reincorporated in 1895 for fifty years. The original capital was f 220,000, which has been increased to $1,077,000, partly by stock dividends representing cash accumulations. From the date of its founding to June 1901 it has paid over $2,550,000 in dividends. The net transactions amount to $4,000,000 per year. Besides maintaining mercantile departments in which nearly every commodity is sold, the company engages in the manufacture of shoes and of clothing. It has*~~

~~*branches in Provo and Ogden, Utah, and Idaho Falls, Idaho. Its stockholders number*~~

~~*600.*~~

~~*With the opening of many rich mines and the building of railways, isolation has become no longer possible. Population has rapidly increased, and life has grown more complex, and whatever was socially or economically distinctive among Mormons has slowly disappeared.*~~

~~*(a. M. M.)*~~

~~*Morocco (El Maghrib bl Aksa, "The Farthest West," i.e., of the Mahommedan world), bounded on the N. by the Mediterranean, on the E. by Algeria, on the S. (indefinitely) by the Sahara, and on the W. by the Atlantic as far south as Wad Draa. It is the only North African state retaining its independence, and therefore presents peculiarly interesting features. The climate is good, and produces a hardy race. Shielded by the Atlas from the hot winds of the Sahara, the coast of the Atlantic offers great attractions to those suffering from chest com- plaints. Tangier is already a recognized health-resort, and Mogador and Kabat await development as such, llain falls only between September and April ; on the Atlantic coast it is brought by the south-west wind, and on the Mediterranean sometimes also by the east wind, or sharki, otherwise dry and somewhat trying to invalids. The wonderfully temperate climate of Mogador is due in a great measure to trustworthy trade-winds. In Tangier and Mogador the summer heat is rarely oppressive, never injurious, as the thermometer seldom rises over 80° F. or sinks below 40°, although inland the extremes are much greater; and while on the plains or in low-lying cities the heat grows intense, snow gleams on the Atlas all the year round.*~~

~~*Three races inhabit Morocco, and members of two others are continually introduced. The aboriginal Berbers occupy the mountainous districts, where they still maintain a degree of independence. The plains are for the most part occupied by Arabs, introduced in the 11th and 12th centuries, or by the mixed race to which the majority of the dwellers in towns belong, called by foreigners " Moors " from the old Latin " Mauri." The*~~

~~*third race is the Jewish, of which the original stock dwells inland, speaking Arabic and Berber, the majority of the more*~~

~~*modern arrivals, expelled from Europe, having remained in the ports, where they still speak Spanish. The slave trade with the western Sudan maintains a small proportion of negroes, intermarriage with whom has produced bronzed types, for both Berbers and Arabs are white-skinned. On the coast there are small colonies of Europeans, chiefly engaged in trade. The largest of these colonies, princi- pally Spanish, is found in Tangier. The most widely spoken language is Berber, varying in dialect, but the language of the Government and creed is Arabic, for the religion of the empire is Islam, the Moors being among the strictest followers of Mahommed. The divisions of the East are unknown, and their tenets include the principal teachings of both Shias and Sunnis, but, as employing the Maleki ritual, they must be classed with the latter. Recognizing their own Sultan as Amir el Mu'minin (Gommander of the Faithful) and Khalifa of God on earth, they acknowledge no other claimant, and have few dealings with the Turks, whom they consider corrupt. They have not yet given way extensively to strong drink, and the use of tobacco is also frowned upon and forbidden by law. The Moors are bigoted even when friendly.*~~

~~*Population. — The number of the population has never been known, and while so large a portion of the empire remains unexplored, statistics must be represented by conjecture. Estimates in this case vary from five to ten millions, the majority of whom are pastoral and agricul- tural. There are only three great inla'nd cities, each of which in turn serves as metropolis — Fez, Mequinez, and Marrakesh. The towns next in importance are the sea- ports of Tangier, Mogador, Gasablanca (Dar el Baida), Azammur, Mazagan, SafB, Salli-Eabat, Laraiche, and Tetuan. On the Mediterranean shore, along the coast of Er-Rif, the Spaniards have for centuries possessed Ceuta, Peiion de Velez, Alhucemas, and Melilla ; in 1848 they appropriated the Zaffarine Islands. Inland the only other important cities are the sacred towns of Zarhon, Sheshawan, and Wazzan (the last-named of which alone is open to Europeans), and the minor towns of El Kasar, Sifru, Taza, Dibdu, and Oojda in northern Morocco (once the kingdom of Fez) ; Damnat, El KM, Sidi Eahal, Zettat, and*~~

~~*Amzmiz in central Morocco (once the king- dom of Marrakesh) ; Tarudant, Agadir Ighir, HIgh, Tiznit, and Glimin in southern Morocco (once the king- dom of Sus), and the districts of Tafilalt and other Saharan oases beyond the Atlas.*~~

~~*History. — The history of the Moorish empire com- mences with the settlement near the Roman ruins of Volubilis in a.d. 788 of Idrees the elder, one of the fugitive descendants of Mahommed, during the struggles between rival claimants of the khalifate. Islam had then been established in these parts for eighty years, but Idrees and his son, Idrees II., the builder of Fez, extended its influence, uniting the Berbers into a kingdom. Their line controlled a limited portion of northern Morocco for nearly two centuries, in part sup- planted by the- Miknasa in 917, until displaced by the Magh^wa in 988. These two dynasties were exterminated in 1067 by Yusef I. (bin Tashfin), founder of the Murabti ("Almoravide") dynasty of Berbers, who added the remainder of Morocco, most of Spain and Portugal, and Tlemqen. In 1147 their power was overthrown by a religious leader, 'Abd el Mu'min, at the head of the Muwahhadi — i.e., Unitarian — horde (" Almohades "), under whom the Moorish empire reached its zenith at the close of the 12th century. It then included, in addition to the Murabti realm, what now are Algeria, Tunisia, and Tripoli, extending to the frontier of Egypt, which they were prevented from occupying by the rise of Saladin. Before the middle of*~~

~~*the 13th century they had been driven out of Spain, and had lost all but what is now known as Morocco, whence, "between 1217 and 1269, they were ousted by the Beni Marin (" Mai-inides "). These retained nominal power for three hundred years, but during their third century they became so enfeebled that all continuous record is lost. A branch of the same family, known as the Watasi, reigned in northern Morocco (kingdom of Fez) from 1471 to 1548, when the whole country passed into the hands of the Sa'adi Shereefs, who had occupied southern Morocco (kingdom of Marrakesh) since 1521. Their rule lasted but a century, for between 1630 and 1668 they were gradually replaced by another family of Shereefs, the*~~

FiMli, which is the ninth and reigning dynasty. Of this line the Sultan reigning in 1902 — Mulai ("my lord") 'Abdul 'Aziz IV. — was the fourteenth. He succeeded his father, El Hasan III., in 1894, at the age of fourteen, the empire being governed for the first seven years by a regent. His Shereefian Majesty, or The Lofty Portal (" Sublime Porte "), as he is officially styled b,y Europeans and natives respectively, is married and has sons.

An excellent sketch of the Sultan Mulai "Abdul 'Aziz and of his court was given in Tlie Times of 10th June

1901, by a correspondent who wrote from andhf^ Tangier on 12th May, d, propos of the special court. embassy which was being sent to congratulate

King Edward VII. on his accession to the throne. We give the following extract from that article : —

" Mulai Abdul Aziz succeeded to the throne on the death of his father, the late Sultan Mulai Hasan, in 1894. At the time of his fether's death young Abdul Aziz was in Eabat with his mother, a Circassian lady, and it was there that he was proclaimed. Mulai Hasan died during a punitive expedition in the central provinces -of his country ; but, owing to the extraordinary capability of Si Ahmed Ben Musa, the chamberlain, his Shereefian Majesty's death was concealed from the world, and for two days even the palanquin-bearers imagined that they were carrying a living, though ill. Sultan, and never suspected that their burden was a •corpse. Two days were sufficient for the wily chamberlain. It gave him time to proclaim young Abdul Aziz in Rabat, and to lay the foundations of his plans by which he afterwards became Vizier and practically Sultan, while the real holder of the title was kept hidden away in the palace. But Mulai Abdul Aziz had .an elder brother, Mulai Mohammed, who had been Viceroy of the South, and who by his generosity — with other people's money — and by his libertine ways was extremely popular with the general public. A rising in his favour occurred, but the iron will of the "'izier Si Ahmed crushed it, and even to-day (1901) the prisons ;are full of the tribesmen who rose, wliile Mulai Mohammed him- self lives in confinement in Mekinez. The Vizier died in 1900, still in possession of his great influence, and leaving to be con- Hscated by his royal master a

~~*huge fortune, amounting, it is said, to some millions sterling, every penny of which had been squeezed and extorted from the wretched population of the country. His ■death gave Mulai Abdul Aziz, then some nineteen years of age, an opportunity of emerging from his almost enforced seclusion and of exercising his authority, for up till this period his identity had been entirely overshadowed by that of his powerful and cruel Vizier. Since the death of Si Ahmed he has certainly come forward, and the northern blood inherited from his Circassian mother has rendered him not a little susceptible to European influence, though possibly not to bis own advantage. The Moorish Sultanate is so essentially a religious one, depending upon that descent from the Prophet which confers the title of Amir el- Jlumenin — Commander of the Faithful — that any change in the regime of the court would at once raise the antagonism of the large and fanatical religious faction. At present these progres- sive tendencies have done little more than interest his Shereefian Majesty in European inventions. He rides a bicycle, photo- graphs, and enjoys the cinematograph. So lavish has he been in obtaining all the newest inventions and toys of Europe that one trading Jew alone, who brought him a real circus to the capital, has received some £20,000 of the country's revenue, drawn from the custom-house of Mazagan. It is the custom, unfortunately, for Oriental monarchs to hoard their private fortunes and to draw upon the resources of their country for their private amusements. In appearance Mulai Abdul Aziz is tall and well-built. In bear- ing he is very dignified. On public occasions, in his loose white*~~

~~*robes, he looks, and is, a Sultan. His life is one of great sim- plicity. He rises at dawn and prays at the regular stated intervals throughout the day. His food is simple, and eaten, according to the custom of his country, without knife and fork.*~~

~~*" The position of a Sultan of Morocco never allows him to come into actual touch with his subjects, and the principal power therefore rests with the Grand Vizier. The present (1901) holder of this important office, though he prefers to call himself the Minister of War, is a young and energetic man, Kaid Mehedi el Menebhi, who was in former days an imderstudy of Si Ahmed. His influence is all-powerful, and it was through his agency that, in April 1901, the elderly Haj Mukhtar, the nominal*~~

~~*Grand Vizier, a refined and honest old man, who had done all in his power not to be appointed, was sent a prisoner to Fez, while all his property was confiscated. He knew a year before, when he received his appointment, what his fate would be. Such falls from power are of everyday occurrence in Morocco. No man knows his fate until the fatal day arrives, and the writer has been the guest of a great local governor, whose stables were full of splendid horses, and who was served by a horde of attendants and servants — and within a month he has given in charity a loaf of bread to the same governor's son, begging in the streets, while the father lay dying in prison. The son of another great official, whose wedding attracted thousands of tribesmen, and whose generosity was unsurpassed, was met by the writer within a year loading the baggage mules of a European envoy amongst the muleteers of the Sultan's army. No complaint, no despondency — merely the recog- nition that the wheel of fortune had turned !*~~

~~*" It is a picture-sque court, that of the Sultan of Jlorocco. The great palace squares and courtyards, topped with the iridescent green-tiled roofs, the miles of fortified gardens, the high window- less walls, all present an appearance of unfathomable mystery. Seldom, indeed, do men penetrate within, for the precincts are sacred to the rule of women. Even the ministers of the Great Powers, on their periodical embassies to the Moorish court, see little more than the outside walls and the great green gates. At private audiences with the Sultan the visitor is led through tangled vine-clad gardens to some little smnmer-house, rich in exquisite plaster-work and tiles, half-ruined, perhaps, and yet a gem, where, under a ceiling gorgeous in colours and gilding, sits the almost pathetic figure of the Sultan. The Grand Vizier stands by his master's side, and without the doorway, out of sight of their sovereign, are seated half a dozen soldiers awaiting orders. And all around the tall dark cypresses shoot up their pillar-like forms. Very different is the public reception of the accredited ministers of Europe — very different and more humiliating. The Sultan is mounted, seated on horseback under his umbrella of state, sur- rounded by his courtiers and preceded by his officers of state. His led horses champ their bits and wave their marvellous manes and taUs, and the sun glitters on the lances of the spear-bearers and the gold-embroidered saddles. The empty green-and-gold brougham, part of all*~~

~~processions, creaks and groans as it is brought into position, and in front of it all, bare-headed in the bright sunshine, and on foot, stand the envoys of the emperors and kings of Europe. A blare of trumpets, a banging of salutes, and the Sultan and his procession disappear through the great palace gates, and the reception, as picturesque as it is humiliating, is over.~~

~~" The Sultans of Morocco usually divide their time between their southern and northern capitals, Marrakesh and Fez respectively. They are great undertakings, these fllttings of Sultans, for, with their army, their court, and their hangers-on, the imperial party often numbers some 30,000 or 40,000 persons. HIs Shereefian Majesty's progresses through the country leave poverty, destitu- tion, and famine behind them, for, like locusts, they eat up everything. The one hope for Morocco lies in its young Sultan. HIe has already shown signs of a desire for the improvement of his country."~~

~~Government. — The Moorish government is a limited autocracy, the theoretical power of the sidtan or emperor being greatly circumscribed by the religious influeT/ces which in a measure support him, and by the i^npaid official proletariat with which he is surrounded, whose intrigues, in conjunction with those of European Powers, effectually check all progress. There is no regular assess- ment for taxation, but such organized Sipoliation as may be required for public or private ends. Centring in a group of wazeers, the administration radiates through despotic local governors to sheikhs and an unpaid police.~~

~~Army. — A half-organized army, service in which is partly hereditary, partly forced, is periodically employed in collecting taxes at sword-poiut, and in " eating up" the provinces ; with it the Sultan goes forth to war each summer, spending the winter~~

~~in one of his capitals. HIe has no army adequately trained for effeotive defence, and the "Armstrongs" at Tangier and "Krupps" at Rabat are useless by themselves. The only approach to a regular army consists of~~

~~*certain hereditary troops, the Bokhara (black), the Udaia (mulatto), the Ashragah and Ashrirdah (white), and the Gaish, who form a body of police, Makhhdznla (mixed), all of whom are horsemen. The infantry (^Vskaria) are mostly rough, .ill-trained levies, summoned each year for military expeditions against recalcitrant tribes ; they are of varying numbers, only a small portion being well trained under an Knglish instructor and French and Italian military missions. No accurate estimate can be formed of the total available forces, and the arms are of every pattern. There is no navy.*~~

~~*In these circumstances it is surprising to find that foreigners enjoy protection and liberty wherever the Sultan's writs run, that is to say, on the plains, but it is still more surprising to find that by treaties of long standing they are enabled to secure protection for natives having charge of their interests, without which trade would be impossible. The desire for this protection from rapacity induces the natives to offer premiums for such employment, and this in its turn leads to abuses unavoidable without further regulation, although much has been done towards this end since the Madrid Convention which met in 1881 for the purpose of discussing this question. Foreigners leaving the beaten tracks (there are no roads) are required to employ a policeman (makhdzni) to guard their persons and to prevent their attempting exploration. All the Powers are represented in Tangier by diplomatic and consular officials, who exercise independent jurisdiction over their respective fellow-subjects, to the frequent confusion of justice. The evidence of non-Mahommedans is not accepted in Moorish courts, where venality reigns, and unprotected Jews suffer constant injustice, besides daily indignities, for which they repay themselves by superior astuteness.*~~

~~*Education. — The level of education could hardly be lower, although most males have an opportunity of learning at least to recite or read the Koran, if not to write. Only traders trouble about arithmetic. Youths who desire to pursue their studies attend colleges in Fez or elsewhere to acquire some knowledge of Mahommedan theology, logic, composition, and jurisprudence, beyond which information is considered superfluous. The intel- lectual accomplishments of the Moors of the Middle Ages have been greatly over-estimated. The stars of their brightest period in Spain*~~

~~were Jews or Spaniards, who were sometimes persecuted for attainments which have, by strange perversion, shed a lustre on their persecutors, to whose creed they only adhered by compul- sion. The social condition of Morocco is that of all Mahommedan countries unaffected by the influences of Christendom, such as Upper Egypt, Central Asia, and Arabia, but even in Morocco it is becoming corrupted rather than improved by intercourse with Europeans on the coast.~~

~~Produce. — The natural products remain almost entirely unde- veloped. Numerous attempts have been made of late years to obtain concessions for mining and other exploitation, but in all the Government sees further complications with Europe : if, by whole- sale bribery, any grant is obtained, a nullifying clause is inserted, or the first occasion is seized to raise anew insuperable obstacles. Agriculture, being in native hands, is less restricted, but so many difficulties are placed in the way of exportation, that the most pro- lific cereals are raised in quantities hardly exceeding the local de- mand, and falling short of it in years of drought. Periodical famines are the result. The breeding of horses or cattle, and the rearing of birds for European markets, suffer in the same way, but increase in spite of restriction and heavy dues. One of the most promising developments of recent years has been the growing supply of chickens, eggs, and fruit to Europe, even to England. The fisheries also are capable of great expansion, and are at pres- ent almost entirely in the hands of Portuguese and Spaniards.~~

~~Manufactures. — The manufactures are few, and the most famous — leather — is now either exported undressed to Marseilles or Philadelphia, or is counterfeited by machinery in London or Paris. With the exception of a few slippers and shawls supplied to Moors established in the Levant, its manufactured exports con- sist principally of carpets, rugs, trays, arms, and "curios" for decorative purposes. For home use the Moors do much spinning, weaving, and dyeing, chiefly of wool ; but although it is possible to dress superbly in native-made articles, every year sees an increasing importation of Manchester and Yorkshire goods, rivalled by the cheaper products of Barcelona and Austria, in the last case with great success. Next to " cottons," the import upon which most duty is paid is green tea, transhipped in London ; then come sugar of French, Belgian,~~

~~*or English manufacture, and candles from the same sources. Hardware follows, but machinery holds a very low place.*~~

~~*Commerce. — The commerce is almost entirely shared thus : Great Britain, one-half; France, one-quarter; Germany and Austria, one-tenth ; and Spain, one-twentieth. The fluctuation in its*~~

~~*volume is so slight that it may almost be regarded as stationary. Everything depends upon the state of the crops, and this in turn depends upon the rainfall, but even a good year is sometimes to a great extent wasted by internal dissensions. The average annual export trade of the empire may be reckoned at rather under £1,000,000 sterling, and the average import trade as rather over that sum, the figures having stood in 1873, with phenomenal crops, at £1,563,446 and £934,478 respectively, and at an average during succeeding years of about £900,000 and £1,000,000 re- spectively. At the same time, in the absence of adequate banking facilities, the amount of specie exported and imported ranges out of all proportion to the difference between these figures, and the constant variations in exchange and currency are serious impedi- ments. But none of the figures supplied can be regarded as more than approximate, by reason of the meagreness and imperfection of the records available, and the constant evasion of customs dues by bribery and false invoices — not to mention ordinary smuggling — -so that the actual bulk of the trade is greater than it here appears. The following are the ofiioial returns of exports and imports for the year 1900 : —*~~

~~*Ports*~~

~~*Exports.*~~

~~*Imports.*~~

~~*Totals.*~~

~~*Tangier . Tetuan . Laraiche . Rabat . .*~~

~~*£386,274*~~

~~*4,360*~~

~~*47,033*~~

~~*20,071*~~

~~*307,730*~~

~~*360,577*~~

~~*143,438*~~

~~*407,592*~~

~~*£481,356*~~

~~*33,586*~~

~~*114,693 95,440*~~

~~*291,289*~~

~~*281,690 83,073*~~

~~*246,231*~~

~~*£867,630*~~

~~*37,946 161,726 115,511 689,019 642,267 226,511 653,823*~~

~~*Dar el Baida Mazagan . Saffi . .*~~

~~*Total*~~

~~*£1,767,075*~~

~~*£1,627,358*~~

~~*£3,394,433*~~

~~*Share of Great Britain*~~

~~*£534,478*~~

~~*£888,251*~~

~~*£1,422,729*~~

~~*Communication. — The facilities for communication with the outside world have become greatly extended. Regular and more frequent steamship services now link Morocco with London, Antwerp, Hamburg, Lisbon, Cadiz, Gibraltar, Malaga, Barcelona, Marseilles, Genoa, Oran, Malta, Alexandria, the Canaries and Madeira, Rio Janeiro and Montevideo, and, by transhipment at Gibraltar — only three hours from Tangier — with all great ports, East and West. The tourist traffic in particular has grown exceed ingly, but shows itself still in its infancy. Great Britain, Spain, France, and Germany have postal agencies, and run competing courier mails along the coast, while Great Britain and Spain have laid telegraphic cables from Gibraltar and Tarifa respectively to Tangier ; but the extension of wires inland, save for telephones and electric light, is still prohibited. At the same time the means of internal communication remain unimproved. Travelling in the interior is what it was a thousand years ago. Several courier ser- vices have indeed been established to inland towns, but rather as a speculation in postage stamp Issues than for public benefit, though some have now been taken over by foreign postal authorities.*~~

~~*Finance. — Banking is rarely resorted to, except in underground hoards, though a few enlightened natives know the value of British Consols, and the local Jews continue to transact financial operations with convenience to their clients and considerable satisfaction to themselves, in the manipulation of the exchange and the calling in or pouring out of debased Spanish coinage. One innovation has been the repeated issue of a Moorish coinage of corresponding denominations, minted in France and Germany, and the introduction on the coast of Spanish copper. Moorish weights and measures continue to vary from town to town, but in the foreign trade the decimal system has almost entirely super- seded the native chaos. Credit is allowed by European houses at their peril, and in*~~

~~some lines profits are cut ruinously fine or done away with altogether by dishonest practices, many arising out of the long credit in vogue.~~

~~Missions. — The most striking sign of the times in Morocco has been the almost concurrent though independent introduction of the press and evangelical missions. The Franciscans had for six and a half centuries done brave work in the country, since the founder of their order offered himself for that task in 1214, and many of them, including several British and Irish missionaries, had suffered martyrdom, but they have long abandoned attempts to convert the Moors. The London Jewish Society was estab- lished in Mogador in 1875, and since 1883 various Protestant agencies have commenced operations, and now support between them some ninety missionaries, male and female, including doctors and nurses.~~

~~The Press. — Journalism is entirely foreign, and was introduced in 1883, at the same time as the printing-press, Spanish, French, and English newspapers being established in quick succession. These have done much to make the true state of Morocco known.~~

~~Attempts to establish Hebrew and Arabic papers have hitherto failed. The late Sultan even went so far as to set up a lithographic establishment in Pez, from which a valuable series of Arabic theo- logical, legal, and historical works have been issued, but most noteworthy of all is the publication in Cairo in 1895 of an Arabic history of Morocco, in four volumes, by a native of Salli, Ahmad bin Khalld en-N4siri. Other forward steps have been taken in the production of several important volumes on the country, and in serious attempts to explore the Atlas. The vicomte de Fouoauld has attained the first place by his intrepid journeys as a Jew through the forbidden regions, and by his workmanlike geogi'aphi- cal records ; the late Joseph Thomson did good work m the Great Atlas, though within a limited area ; the vicomte de la Martinifere has excavated some of the Eoman remains ; and Mr Walter B. Harris made a bold journey to TaflUlt. An equally important service was rendered by the~~

~~compilation by Sir R. Lambert Playf air and Dr Robert Brown of an invaluable Bibliography of Morocco containing over 2000 entries.~~

~~Authorities. — Besides the works named in the ninth edition, the principal contributions to the history are : — Native : — Ibn 'Abd EL Hakim, embracing the period from a.d. 690 to 750 (tr. Jones). Gottingen, 1858. — 'Abd el WXhid el MAEKiKESHi (1149- 1224), tr. E. Tagnan in the Bevue Africaine, 202-7. 1891. — Madd ^el Kart&s (788-1326), tr. Baumier. Paris, I860. — El Makkari (710-1500), tr. Gatangos. London, 1840. — El UfeAni (1631-1812), tr. HoDDAS. Paris, 1889 ; and En-Nasiei, not yet translated (710-1894). Cairo, 1895. — Foreign : — MouisTTE. His- toire des Oonquestes de Mouley Archy, &c. Paris, 1683. — De el Puerto. Mission Historial de Marrueeos. Seville, 1708. — Busnot. Histoire du Begne de Mtiley Ismail. Rouen, 1714. — Mas Latrie. Traites de Paix, &o., 3 vols. Paris, 1866-72 ; and Belations et Commerce de VAfrique Septentrionale. Paris, 1886. — Mercier. Histoire de VAfrique Septentrionale, 3 vols. Paris, 1888-91. — Meakik, Budgett. 27ie Moorish Empire, a Historical Epitome, London, 1899, which contains critical notices of all important books on Morocco. Geography: — Leo Afkioanus. Delia Descrizione delV Affrica. Venice, 1526 ; tr. John Poet, London, 1600 ; ed. Dr Robert Beown for the Hakluyt Society, 1896. — Maemol Caevajal. Descripcion General de Affrica. Granada, 1573. — XJeeestazu, F. de A. de. Viajes por Marrueeos. Madrid, 1877. — Bonelli, Captain E. El Imperio de Marrueeos. Madrid, 1882. — De Cuevas, Th. Estudio . . . de Laraiche. Madrid, 1884. — Eeckmann, Captain. Le Maroe Moderne. Paris, 1885. — ^]?Ezzi, Rafael. Los Presidios Menores de Africa. Madrid. 1893. — Meakin, Budgett. The Land of the Moors. London, 1901. Travel: — Lenz, Oscar. Timbuktu, &c., 2 vols. Leipzig, 1884 (Fr. tr. also). — De Foucauld. Beconnaissance au Maroc. Paris, 1888. — Thomson, Joseph. Travels in the Atlas, &c. London, 1889. — MartiniEre, H. de la. Journeys in the Kingdom of Fez. Paris, 1889. — Harris, W. B. Tafilet. London, 1895. Ethnology: — Pellow, Thos. Gaptimty and Adventures. London, 1736 ; ed. Dr Robert Brown, London, 1890. — Host, G. Efteret- ninger om MaroTcos og Fes. Copenhagen, 1779. — Jackson, James G. An Account of the Empire of Morocco. London, 1809. — Meakin, Budgett. T%e Moors. London, 1902. Language : — ^Lerchundi, Rev. Jose. Budimentos del drabe . . . de Mar-~~

~~*rueeos. Madrid, 1878 ; Tangier, 1891 ; and Vocabulario Espanol-Ardbigo. Tangier, 1892. English translation of the former by J. MacIvee MacLeod. Tangier, 1900. — Meakin, Budgett. An Introduction to the Arabic of Morocco (Vocabulary, &c.). Tangier, 1890. — Baldwin, Miss C. W. Morocco-Arabic Dia- logues. Tangier, 1892. ‘ (b. m*.)*~~

~~*Morocco City, the name sometimes erroneously applied to Maeeakesh (q.v.).*~~

~~*Moron, a village in the province of Puerto Principe, Cuba, near the north coast, 250 miles east-south-east of Havana. It was noted as the terminus of one of the defensive trochas of the Spanish generals. Population*~~

~~*(1899), 2084.*~~

~~*Morphy, Paul Charles (1837-1884), American chess champion, was born at ISTew Orleans in 1837, and his skill in chess attracted attention while he was still a boy. In 1857 at the New York Chess Congress he defeated the leading amateurs, and in 1858 gave an exhibition of blindfold playing. He showed his skill in London, Birmingham, and Paris, and defeated the greatest masters of the day, remaining abroad for this purpose till 1859. He then returned to the United States and took up the legal profession ; but he had put too great a strain upon himself, and besides having to give up*~~

~~*chess, his mental condition was permanently impaired, and he died without fulfilling his early promise in 1884. Morphy’s name, however, became a household word as the first, and perhaps greatest, of the modern feat-perform- ing chess champions.*~~

~~*Morrill, Justin Smith (1810-1898), American financier, was born at Strafford, Vt., on the 14th of April 1810. After a common school education and a business career, he was elected to Congress as an anti-slavery Whig in 1856. Becoming a Republican, he remained in the House of Eepresentatives till 1867, and was then elected to the Senate, where he represented Vermont tUl his death on 28th December 1898, thus fulfilling the longest continuous service in Congress since the founda- tion of the government. His career was that of a hard- working and useful, rather*~~

~~*than a brilliant member. His special interest lay in the field of industry and finance. The tariff of 1861 was largely his work and took his name, and all subsequent tariff and fiscal legislation was impressed with the influence he exerted as a member, in the House, of the Committee on Ways and Means, and in the Senate, as member and for a time chairman of the Committee on Pinance.*~~

~~*Morris, a city of Illinois, U.S.A., capital of Grundy county, on the north bank of the Illinois river, and on the Chicago, Rock Island, and Pacific railway, in the north-eastern part of the state, at an altitude of 518 feet. It is in a coal-mining region, has varied manufactures, and is a shipping point for grain. Population (1890),*~~

~~*3653; (1900), 4273.*~~

~~*Morris, Sir Lewis (1833-*~~

~~*-), British poet,*~~

~~*eldest son of Lewis Edward William Morris and Sophia, daughter of John Hughes of Carmarthen, was born at his father's house, Penbryn, in 1833. He was educated at Sherborne School and Jesus College, Oxford, 'where he took a first class in Moderations in 1853, and a first in IJtercB Humaniores in 1856. He won the Chancellor's prize for an English essay in 1858, was called to the bar in 1861, and elected hon. fellow of his old college in 1877. He practised for twenty years as a conveyancing counsel, retiring from active legal work in 1881. He was ener- getic on behalf of educational movements in Wales, and contested Welsh constituencies in the Liberal interest, but without success. Sir Lewis Morris was knighted in 1896, and became also a Jubilee-medallist and Knight of the Redeemer of Greece. Comparatively late in life. Sir Lewis Morris made his appearance as a writer of verse with three series of miscellaneous poems, called Songs of Two Worlds, published respectively in 1872, 1874, and 1875. These little volumes proved him to have a refined taste and a gentle metrical fluidity, which soon won for his work considerable popularity. In 1876 and 1877 he made an important venture with The Epic of Hades, an attempt to re-tell the stories of Hellenic mythology with a certain modern and allegorical setting. This work, though it is not without false sentiment*~~

~~*and artistic in- felicities, contains his best verse and has passages of force and effect. His later work follows much too closely upon the influence of Tennyson, from which he is never altogether free; but his earnest didacticism, genial optimism, and evident sincerity have given his work a thoroughly wholesome influence.*~~

~~*Morris, William (1834-1896), English poet and artist, third child and eldest son of William Morris and Emma Shelton, was born at Elm House, Walthamstow, 24th March 1834. His grandfather was a respected tradesman in Worcester, and his father, who was born in that town in 1797, came up to London in 1820, and*~~

~~*entered the office of a firm of discount brokers, in which he afterwards assumed a partnership, and married Emma Shelton, of a well-reputed Worcester family. They moved to Walthamstow shortly before the birth of the subject of this memoir. As a child William Morris, the poet, was delicate but studious. He learnt to read very early, and by the time he was four years old was familiar with most of the Waverley novels. When he was six the family moved to Woodford Hall, where new opportunities for an out-of- door life brought the boy health and vigour. He rode about Epping Forest, sometimes in a toy suit of armour, became a close observer of animal nature, and was able to recog- nize any bird upon the wing. At the same time he continued to read whatever came in his way, and was particularly attracted by the stories in the Arabian Nights and by the designs in Gerard's Herbal. It is not unlikely that the first seeds of later tastes were sown in these associations. He studied with his sisters' governess until he was nine, when he was sent to a school at Walthamstow. In his thirteenth year his father died, leaving the family well-to-do ; the home at Wood- ford was broken up, as being unnecessarily large; and in 1848 William Morris went to Marlborough, where his father had bought him a nomination. Marlborough College was at that time in a state of consider- able confusion, following upon an*~~

~~unmethodical start with numbers rapidly oiitgrowing accommodation. Discipline was relaxed, and games were disorganized. Morris was at the school three years, but got very little good from it, beyond a taste for architecture, fostered by the school library, and an attraction towards the Anglo- Catholic movement. He made but slow progress in school work, and at Christmas 1851 was removed and sent to a private tutor for a year. In June 1852 he matriculated at Exeter College, Oxford, but, owing to the college being full, did not go into residence till January 1853. Morris found Oxford in a state of mental and spiritual lethargy, and never acknowledged much advantage from its educational side. The typical "don" was always an object of dislike with him, and he thought the Oxford curriculum forced and lacking in expansiveness. But he at once made friends who stood him in good stead all his life, foremost among whom were Edward Burne-Jones, who was a fresh- man of his year, and a little Birmingham group at Pembroke. They read together theology, ecclesiastical history, mediaeval poetry, and, among moderns, Tenny- son and Ruskin. They studied art, and fostered the study in the long vacations by tours among the English churches and the Continental cathedrals. Moreover, Morris began at this time to write poetry, and many of his first pieces, afterwards destroyed, were held by sound judges to be equal to anything he ever did. Both Morris and Burne-Jones had come to Oxford with the intention of taking holy orders, but as they felt their way they both came to the conclusion that there was more to be done in**

~~William Morris. (^Frmn a photograph l>y ElUott and Fr~~

~~the direction of social reform than of ecclesiastical work, and that their energies would be best employed outside the priesthood. So Morris decided to become an architect, and for the better propagation of the views of the new brotherhood a magazine was at the same time projected, which was to make a speciality of social articles, besides poems and short stories. At the beginning of 1856 the two schemes came to a head together. Morris, having passed his finals in the preceding term, was entered as a pupil at the office of George Edmund Street, the well- known architect ; and on New Year's Day the first number of Tlie Oxford and Cambridge Magazine appeared. The expenses of this very interesting venture were borne entirely by Morris, but after the issue of No. 1 he~~

resigned the formal editorship to his friend Eulford. Many dis- tinguished compositions ap- peared in its pages, but it gradually languished, and was given up after a year's experi- ment. The chief immediate result was the friendship be- tween Eossetti and Morris which sprang up from a successful attempt to secure the former as a contributor. In the summer of 1866 Street removed to London, and Morris accompanied him, working very hard both in and out of office hours at architecture and painting. But Eossetti persuaded him that he was better suited for a painter, and after a while he devoted himself exclusively to that branch of art. It was in the summer that the two friends visited Oxford, and finding the new Union debating- hall in course of construction, offered to paint the bays. Seven artists volunteered help, and the work was hastily be- gun. Morris worked with feverish energy, and, on finish- ing the portion assigned to him, proceeded to decorate the roof. The work was done too soon and too fast, the colours began to fade at once, and are now barely decipher- able ; but the broken designs, so long as any vestige remains, will always be interesting as a relic of an im- portant aesthetic movement, and as the first attempt on Morris's part towards decorative art. Early in 1868 Morris published Tlie Defence of Guenevere, which was almost unnoticed by contemporary criticism, but is now recognized as one of the pearls of Victorian poetry. Its medieevalism, picturesque and haunting, its unfailing artistic intuition, and its dim, harmonious colouring, as of some exquisite tapestry, are features peculiar to Morris's best work.

On 26th April 1869 Morris married Jane Burden, a beautiful Oxford girl, who had sat to him as a model, and settled temporarily at 41 Great Ormond Street, London. Meanwhile he set about building for himself at Uptou a house which was to be the embodiment of all his principles of decorative art. Furniture, decorations, household uten- sils, and every article of daily use were specially designed, and in the summer of 1860 the house was ready for occupa- tion. The furnishing of it had suggested a fresh activity ; Morris now determined to embark upon decoration as

, London.)

~~*a career. A small company was formed, consisting of Rossetti, Webb, Burne-Jones, Madox Brown, Faulkner, and Marshall, and in January 1862 started business under the title of Morris, Marshall, Faulkner and Co., with oflB.ces at 8 Red Lion Square. The prospectus set forth that the iirm would undertake church decoration, carving, stained glass, metal work, paper hangings, chintzes, and carpets. The business, after inevitable vicissitudes, flourished, but the " house beautiful " at Upton proved to be unhealthily situated. Serious illness obliged the family to remove to town, and in November 1865 they resettled at 26 Queen Square, Bloomsbury. Morris was now unceasingly busy, but he found time also for literature. In June 1867 he published Tlie Life and Death of Jason, which was at once successful ; and in April 1868 the first two parts of The Earthly Paradise. The rest of this wonderful storehouse of poetic romance appeared in two volumes in 1869 and 1870. In the fol- lowing year he was again looking for a country house, and lighted upon Kelmscott manor house, in the Upper Thames valley, which he took at first in joint-tenancy with Rossetti, and used principally as a holiday home. Hither he would retire from the cares of business, and take up the country life which was always his particular delight. In 1872 appeared Love is Enough, structurally the most elaborate of his poems for its com- bination of the epic and dramatic spirits ; and in the autumn he began to translate the shorter Icelandic sagas, to which his enthusiasm had been directed by two inspir- ing journeys to Iceland. Business worries, however, inter- rupted him; it was found necessary to reconstruct the company owing to its having grown out of proportion with the existing division of profit and labour. Long negotia- tions ensued, and in March 1875 the old firm was dis- solved. Morris now became sole manager and proprietor, although the other members of the old firm continued, in varying degrees, to give him the advantage of their assist- ance and advice.*~~

~~*Meanwhile the epic mood had possessed Morris very strongly, and, in addition to his work upon the sagas, he had actually finished and (in 1875) published a verse translation of the ^neid, which is interesting rather for its individuality than for any fidelity to the spirit of the original. Morris's cast of thought was too essentially mediaeval to accord well with classicism. In the following year appeared Sigurd the Volsung, a version full of heroic vigour, movement, and vitality, but somewhat too lengthy*~~

~~*and incoherent in design to preserve the epic interest in- tact to the British taste. This splendid burst of poetic activity, however, had raised him to a place among the first poets of his time ; and in 1877 an attempt was made to in- duce him to accept the professorship of poetry at Oxford. But he felt himself lacking in the academic spirit, and wisely declined. Mention should be made at this time of a fresh outlet for his energy, furnished by his foundation in 1877 of the Society for the Protection of Ancient Buildings, which sprang into being as a practical pro- test against a scheme for restoring and reviving Tewkes- bury Abbey. He began, too, to take an active interest in politics over the Eastern Question, but his enthu- siasm was at the moment a flash in the pan. Finding that events were going against his judgment, Morris, as was so often the case with him, shrugged his shoul- ders and broke free from the movement. It was never a part of his character to adapt himself to development; if things went awry, he was always apt to lose interest.*~~

~~*Still, although he found it hard to sit close to a definite party, Morris continued to be spasmodically interested in political movements. During the next few years, indeed, the interest gained ground with him steadily. After the general election of 1880 he finally abandoned the Liberal*~~

~~*party, and drifted farther and farther into Socialism. For ten or twelve years the movement had been gaining ground in England, and the Social Democratic Federation was formed in 1881. In January 1883, within a week of his election to an honorary fellowship at Exeter, Morris was enrolled among its members. Thenceforward for two years the cause of Socialism enjoyed not only the advo- cacy of his spare time, but the thought and energy of all his working hours. For it he even neglected literature and art. In March 1883 he gave an address at Man- chester on " Art, Wealth, and Riches " ; in May he was elected upon the executive of the Federation. In Sep- tember he wrote the first of his Chants for Socialists, designed to proclaim that " the lower classes must demand a higher standard of life for themselves, for the good of the whole world, and for the regeneration of the conscience of man." About the same time he shocked the authorities by pleading in University Hall for the wholesale support of Socialism among the undergraduates at Oxford. He was now heart and soul in the movement ; he had sold some of the*~~

~~*treasures of his library to enrich its funds, and was giving it his brain and heart. Nevertheless, the Federation began to weaken. Internal dissensions harassed it. At the franchise meeting in Hyde Park in 1884 it was unable to get a hearing. Morris, however, had not yet lost heart. At the very end of 1884 the Socialist League was founded, and in February 1885 a new organ, Commonweal, began to print Morris's splendid rallying-songs. Still, differences of opinion and degree prevented concerted action ; and when after the Trafalgar Square riots in February 1886 Morris remonstrated with the anarchic section, he was denounced by the advanced party, and ever afterwards was regarded with suspicion. In 1889 he was deposed from the management of Com- monweal, and gradually lost all confidence in the move- ment as an active force. In November 1890 he left the League. The paper went from bad to worse, grew eventually treasonable, and saw its publisher condemned to eighteen months' imprisonment. This was the end of Commonweal, and with it the League also fell to pieces.*~~

~~*Long before that time, however, Morris had returned to the paramount interests of his life — to art and literature. When his business was enlarged in 1881 by the establish- ment of a tapestry industry at Merton, in Surrey, Morris found yet another means for expressing the mediaevalism that inspired all his work, whether on paper or the loom. In 1887 he published his translation of the Odyssey, which had many of the qualities and defects of his ^neid, and. is much more interesting as an experiment than valuable as a " Homeric echo." He then added another to his many activities ; he assumed a direct interest in typography. The House of the Wolfings in 1889 was the first book in which, aided by the Chiswick Press, he tried to beautify the art of modern printing; and in the same year, in The Boots of the Mountains, he carried his theory a step farther towards perfection. Some fifteen months later he added a private printing-press to his multifarious occupations, and started upon the first volume issued from the Kelmscott Press, his own Glittering Plain. For the last few years of his life this new interest remained the absorbing one. A series of exquisite books, which gain in value every year, witnesses to the thorough and whole- hearted fashion in which he invariably threw himself into the exigencies of his life-work.*~~

~~*The last years of his life were peacefully occupied. He was sounded as to whether he would accept the Laureate- ship upon the death of Tennyson, but declined, feeling that his tastes and his record were too remote from the requirements of a Court appointment. His last piece of work, the crowning glory of his printing-press, was the*~~

~~*Kelmscott Cliaucer, which had taken nearly two years to print, and fully five to plan and mature (see Book-Pbint- iN(i for a facsimile of a page). It was finished in June 189G, and before it was in his hands he already knew that his working day was over. His vigour had been slowly declining for some time, and he sank gradually during the autumn, dying on the 3rd October 1896. He was buried in Kelmscott churchyard, followed to the grave by the workmen whom he had inspired, the members of the league which he had supported, the students of the art guild he had founded, and jfche villagers who had learnt to love him.*~~

~~*Essentially the child of the Gothic revival, he had put an ineffaceable stamp on Victorian ornament and design, his place being that of a follower of Euskin and Pugin, but with a greater practical influence than either. In house decoration of all kinds — furniture, wall-papers and hangings (which he preferred to paper), carpet-weaving, and the painting of glass and tiles, needlework, tapestry — he formed a school which was dominated by his protest against commercialism and his assertion of the necessity for natural decoration and pure colour, produced by hand work and inspired by a passion for beauty irrespective of cheapness or quickness of manufacture.*~~

~~*The truest criticism of William Morris is that attributed to his friend, Mr Swinburne, who said that he was always more truly inspired by literature than by life. His own modest claim to be " the idle singer of an empty day " is often quoted in criticism of him, but it is entirely inade- quate. Morris was never idle, nor was his day, either in literature or in art, in any sense empty. But what he clearly lacked, in life no less than in art, was a direct and sincere sympathy with ordinary humanity. His Socialism, though it*~~

~~*made a brave show at times, was at heart a pas- sionate enthusiasm for an inaccessible artistic ideal. Morris, indeed, was not primarily interested in men at all, but in objects. HIs poetry deals, it is true, with the human passions, but the emotion is always seen as in a picture ; he is more concerned with the attitude of the group than with the realization of a character. IIe had very little adaptability in dealing with his fellows ; the crowd, as a crowd, carried his enthusiasm, but lie was unable to cope with the individuals that composed it. Many of his col- leagues bear witness to his generosity and magnanimity, but as a general principle he certainly lacked the wider humanity. This is the one failing of his art : it is also the shortcoming of his poetry. Granted this, there is left an immense amount that will always make demands upon an undivided admiration. The spirit of beauty breathes in every line ; a sense of music and of colour is everywhere abundant ; the reader moves, as it were, under a canopy of apple-blossom, over a flower-starred turf, to the faint harmony of virginals. Nor does the poet lack power and vigour when an adventurous story is to be told. The clash of arms breaks upon his pagan paradise with no uncertain sound ; he is swift in narrative, breathless in escapade. And over all hangs the faint atmosphere of mediaevalism, of an England of green gardens and grey towers, of a London " small and white and clean," of chivalry and adventure in every brake. The critic has also to remember the historical value of Morris's literary influ- ence, following upon the prim domesticities of early Vic- torian verse, and breaking in upon Tennyson's least happy phase of natural homeliness. The period of Enoch Arden was one of the least inspiring in modern literature, and it was due not a little to Morris's fine sense of romantic beauty and glamour that the later years of the Victorian age were rescued from commonplace utilitarianism, and dominated by higher issues of art and higher forms of artistic impulse.*~~

~~*See the Life and Letters, in 2 vols. (Longmans), by J. W. Mackail. (a. Wa.)*~~

~~*Morristown, a town of New Jersey, U.S.A., capi- tal of- j\Iorris county, in the northern part of the state, at an altitude of 328 feet, at the intersection of the Delaware, Lackawanna and Western, the Kockaway Valley, and the Whippany River railways. The Ameri- can army, under Washington, had its headquarters here in the winters of 1776-77 and 1779-80. Population*~~

(1890), 8156; (1900), 11,267.

Mortara, a town of the province of Pa via, Lom- bardy, Italy, an important railway junction in the angle between the Ticino and the Po, 32 miles by rail south- west of Milan. It has fine churches, with pictures by Gaudenzio Eerrari and other artists, and also a technical school. It stands in the midst of a rice-growing region, and has iron-works and manufacture of hats and cheese. Here the Austrians defeated the Piedmontese in 1849. Population, 5100.

Mortlake, a village in the Kingston parliamentary division of Surrey, England, on the Thames, about 6^ miles west of London by rail. It has been associated with the Oxford and Cambridge yearly boat-race since 1845. Population of parish (which includes East Sheen)

(1881), 6330 ; (1891), 7714 ; (1901), 7774.

Morton, John Maddison (1811-1891), English playwright, was born at Pangbourne, 3rd Januar}^ 1811, his father, Thomas Morton (1764-1838), being also a well- known dramatist. His name lives as the author of Box and Cox (1847), but he also wrote a number of other farces. In later life, however, he failed to maintain his success, and eventually he became a Charterhouse pen- sioner, and died 19th December 1891.

Morton, Levi Parsons (1824-

-), Vice-Presi- dent of the United States 1889-93, was born at Shore- ham, Vt., on the 16th of May 1824. After an academic education he went into business. He was uniformly successful as a merchant in Hanover, N.H., and at Bos- ton ; and in 1863 he founded a banking house in New York, which has become one of the strongest in the coun- try, and of which, till his retirement, he was the head. With little previous activity in politics, he was elected to Congress as a Republican in 1878, and again in 1880. In 1881 he was appointed minister to Erance, where he served till 1885. Three years later he was nominated for the Vice-Presidency on the ticket with Benjamin Harrison, and was elected. In 1894 he was elected gov- ernor of New York by a majority of more than 150,000 over his

~~*Democratic competitor, Mr Hill. His two years' service as governor terminated his political activity. Since 1896 he has lived in retirement.*~~

~~*Morton, Oliver Perry (1823-1877), American politician, was born in Wayne county, Indiana, on the 4th of August 1823. He received a college education, and began the practice of law in 1847. In early life a Democrat, he joined the Republican party at its forma- tion, and was elected lieutenant-governor of Indiana in 1860. The governor-elect having resigned, Morton took his place in January 1861, and displayed in connexion with the demands of the Civil War a remarkable degree of vigour and resourcefulness. After a second term as governor, he was sent to the United States Senate, in which he served from 1867 till his death. Prior to the Presidential election of 1876, he laboured strenuously but in vain for the enactment of a law regulating the elec- toral count. When for lack of such a law the dispute arose as to the method of counting the votes, he took a leadiiig part in the controversy ; and though he opposed the Bill creating the Electoral Commission, he served as a member of that body. He died at Indianapolis on 1st November 1877.*~~

~~*M 0 R y I*~~

~~*Morvi, a native state of India, in Kathiawar, within the Gujarat division of Bombay, situated south of the Gulf of Cutch and the Little Eann. Area, 821 square miles ; population (1881), 89,964; (1891), 105,335. The esti- mated gross revenue is Ks.11,26,390 a year, of vehich Rs.3,36,530 was expended on public works in 1897-98 ; tribute, Rs.61,559. The chief, whose title is Thakor Saheb, is a Jareja Rajput, of the same clan as the Rao of Cutch. A steam tramway, constructed at the cost of the state, runs from Rajkot through Morvi town to the*~~

~~*seaport of Wawania, and also to Wadhwan (94 miles). Owing to long- standing disputes with the state of Cutch, the collection of customs duties at Wawania is under British management.*~~

~~*The town of Moevi is situated in 22° 49' N. and 70° 5.3' E., on the river Machhu, 22 miles from the sea and 35 from Kajkot. Population (1881), 15,35.3; (1891), 16,325. Its high school had 364 pupils in 1896-97. There*~~

~~*is a cotton mill, with 36 looms and 1664 spindles. The state printing-press issues a gazette.*~~

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VOLUME XXXL (MOSAICâ€” PEEVESA.)

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PREFATORY ESSAY.

THE INFLUENCE OF COMMERCE ON INTEENATIONAL

CONFLICT.

By Frederick Greenwood.

TRADE is almost as old as the beginnings of human speech, and may be counted among the first and best uses to which speech was turned. When we think of the conditions amid which it arose in the still most fascinating guise of barter, what a pity it seems that there was no mind wise enough to understand what had happened, no fancy bright enough to catch and reflect the beauty of its promise ! The practice began, we may suppose, in the village communities of the time as a neighbourly convenience, since every exchange of what was needed less for what was wanted more struck out the spark of pleased surprise which to this day makes the happiest bargains. A far greater pleasure was missed by those first bargainers for want of wit to comprehend it. Men were already men and far ^^ earliest

â€¢’ Â° . , . . conditions

advanced from all other creatvrres, but yet were incapable of knowing what an immensity of of trade. change began with acquisition by barter, and too insensitive to feel or to care for the distance at which it placed them from the brutes, though by one remove alone. Its infancy being so purely innocent, in a world all rapine for both man and beast, the goodness that came in the train of its material advantage must have seemed to any high human intelligence the promise of a heaven-for-earth transformation. But no such intelligence existed to mark the change, dwell upon its meanings, mark its potentialities, and blame- lessly commit the mistake that was made hundreds of thousands of years afterwards with no excuse whatever.

For, take any great intellect that we know of, suppose it at work at the time when acquisition by barter crept in upon acquisition by capture and robbery, and we see that such a mind ^ might be pardoned for prophesying complete regeneration for mankind. If he saw in this simple innovation something that we might compare with another Speaking of the Word as in the Book of Genesis, still he might be pardoned. For he himself would have known no other dispensation on earth than that which included man in one order of life with the beasts, if not in one law of being, and he can have seen no such means of departure from that state as he discovered when mine became thine and thine became mine to the profit and pleasure of both. This was indeed to go upon new paths altogether, and thence toward others yet more remote from the dread domain of tooth and claw. Following upon the invention of barter, many undreamt-of kinds of good, as great as or far greater than itself, would have been apparent at once to a divining intelligence ; and as the moral good which accompanies material advantage may be counted upon more surely than any other, and since barter was all innocence at the beginning and seemingly incapable of vice, prediction that mankind would be led to its utmost perfection by trade might have been uttered by the wisest in those days.

The truth, then, seems to be that wisdom was saved from disappointment in this momentous particular by having no existence. Trade prospered and no doubt did great things in ages impenetrably

dark ; but we must believe that before there was brain enough in any head to breed reasoned dreams of the future of mankind, trade had revealed its demerits and insufficiency. That, however, is to speak in the ordinary loose way. Like many other things that we accuse of degrading or otherwise damaging the mind of man, trade is in no way harmful of itself, but only as offering employment and satisfaction for some of the worst as well as the most wholesome cravings of human nature. Morally, it was at its best at first, or so it is reasonable to think ; for we have actual observation to go by besides well- grounded conjecture. The earliest or almost the earliest conditions of trade have lasted here and there to our own time. The trappers of the Hudson's Bay Company found them in North America ; they were little changed in the South Sea Islands when our traffic began there ; so they remain in Africa among peoples and tribes in various stages of advancement from the man-brute borderland. And when we mark what barter is among such peoples, we must conclude that it has least guile where intelligence is most rudimentary. There we see where the fault lies if barter has achieved no such mission as, at its beginning, might have seemed worthy of Providential design, and was even thought capable of after ages of failure from its high possibilities as a civilizing agency. Yet its achievements for good (the acknowledgment is unnecessary, and yet must not be withheld) have been immensely great in every kind. Much as they have been exalted, they might still be praised without stint or antiphone if we could be sure that the set-off which must be placed against them in the sharpening of unbeneficent faculties, the stimulation of the lower passions and ambitions, is a dwindling and not a rising quantity. That, however, is much in doubt at present ; and since at the same time all the political and social forces of the world are moving in unexampled volume and rapidity, the difference involved in the doubt is. of such importance that it can hardly be exceeded.

Whoso looks forward to the influence of trade, now that it has become the one grand object of contention with Governments and peoples, naturally looks back also for what light the past may afford. The whole history can never be known. It would be a comparatively easy study if it began with Greece and Rome, or perhaps beyond them with Egypt and the great

Semitic empires whose history enlarges at such a rate under the discovery of to-day. But the same inquiry makes out that this which was “the ancient world” of our grandfathers had other ancient worlds â€” -empires and civilizations not unworthy of those high-sounding names, though now without intelligible record. How they were established, or, what is more to our purpose, how they were maintained, is unlikely to be ever known in particulars ; but though their ^successors flourished more by trade than was lately believed, we must suppose that tribute and not trade was the main support of them all. As it was with the later civiliza- tions of old, so no doubt it was with the earlier. All were built up, under the simple dispensation of the prime, by conquest, plunder, subjugation, and attained to increasing degrees of magnificence by tribute ; though not without help from trade, nor, of course, from the arts that were fed from both. In substance this is the history of the ancient empires that we know most about (its reversal, the story of their fall), and the unended tale may be read, with certain differences for the better and some disguises not so much so, in the chronicles of the kingdoms of the modern world. Spain, Portugal, Holland, England herself but a century or two ago, became rich by exploitation which might almost as well be called tribute as trade in some cases, more than as well in others ; yet trade was the common name for it, as now it is for ruthless and unashamed extortions of conquest in West Africa.

Looking back, then, it seems that trade, to speak of it in the larger, newer meaning of the word, has never been dissociated from aggression, for we can scarcely except such periods in the history of nations when they rested from conquest in the enjoyment of its gains. The tradition is unbroken, though it starts from before the Flood. It goes on from utter barbarism through one civilization to another, and through the darkness of the intervals between one and another. With but little chano-e of circum- stance, small softening of conditions, what it was at the beginning may be seen to-day in the Congo country. That, however, may be regarded as a strange and unexpected “survival” â€” an illustrative particular. The general statement is broad enough that arms and adventure were at the makino- of all the trade of the modern world ; but still with this advantage to the spirit of conquest, that it took to

itself a benign and profitable purpose, and this advantage to commerce, that it shared in the romance of outland enterprise and the glory of war by sea and land.

No people should be more sensibly aware of this ancient association than the English, one of whose most cherished recollections is the adventure of their great sea captains in ” the Spanish main ” ; adventure which, though understood to be piratical, is not remembered for that, but for its splendid belligerency combined with its high commercial character. After that time the association of war and trade became more familiar ; and yet it was in England, in the latest and most enlightened century of the Christian era, that trade was discovered to be the natural foe and destined subverter of war. And so recently as the fifth month of the second year of the present century there arose (was it from the New World ?) the phantom of a reason for thinking that this strange thing might be true. But at the time of Dreams of

the exiinc’

which we speak â€” the thirty years from 1840, or thereabout â€” trade had not yet produced its tioaotwar. brood of monster millionaires, nor was there a dream of such a progeny to be proved absurd by the economic science of the day. Even as a fancy of that commerce-worshipping time, there was no con- ception of Finance as an organism great enough to supersede war, or to do so inasmuch as the old barbaric methods of conquest applied to the subversion of rival States, the wounding of their prestige, the reduction of their security, the transfer of their honours and their means of prospering. We to whom the phantom made its entirely unexpected first appearance are at liberty to interpret by it, if we please, the prophecy that commerce would banish war ; but we may not do so as if any such fulfilment had been looked for. All that the phantom portends (if it is to be considered a portent) is the supersession of the tiger by the stoat, which is far below the meaning of our prophets â€” far below it and very different. The commercial enthusiasm of fifty years since predicted an internationalism of the peoples, brought about b}’ a great extension of trade, the consequent discovery in practice of its true principles as they apply between nation and nation â€” above all, discovery of the fatal hostility of militarism to industrial progress, the sole means of advancement for the masses of mankind. Militarism retains them

under the old dispensation with its universal ” law of the beasts,” Industrialism opens the only broad path of emergence from it ; and the road had never stood so clear as at the time we speak of. Till then commerce had moved in slow and narrow ways, often obstructed and not seldom destroyed. Now, equipped to a wonder by Science, Invention, Discovery, all working together as if from a reserve of forces held back for thousands of years for its timely use, commerce made such play to such beneficent effect that it might well be supposed capable of more than its own advancement. The abolition of war, the institution of a reign of peace throughout the civilized world, was very much more ; but it was accepted as probable by most thoughtful minds â€” of course we mean in England. Moderately stated, the expectation was that commerce, spreading rapidly from this the grand centre of its enterprise over all the civilized nations, would draw their peoples into a common interest. Better acquaintance with each other, which trade intercourse would procure and its amenities improve, must break down the absurd old race hatreds ; they would disappear. That accomplished, it would be no longer easy for monarchs and their ministers to attempt their gambling ambitions, or to indulge or avenge their mere personal pride, by plunging their people into war. It would be the less easy to do so because the spread of commerce was the diffusion of enlightenment as to the truest interests of the nations ; and while no people would henceforth be willing to cut the throats of another merely because they were foreigners, neither would it permit interruption of its new-found blessings by quarrels that ought to be settled in the wise merchant way : by arbitration.

This was the argument of sobriety and the philosophical. Enthusiasm, of course, was far more eloquently and confidently prophetic, yet not as departing from the approved common sense of the day, or from the postulate on which in one shape or another its social philosophy rested almost entirely : to wit, that the most constant factor in human and therefore in national affairs is an intelligent appreciation of private interests. Grounded upon a dogma so safe and respectable as this, enthusiasm could ply the lyre without ever seeming to be visionary or romantic ; and how much there was of it, how much of this enthusiasm even in unemotional and uncommercial persons, would seem exaggerated if told to men who were born in a later day.

No romance, only rejoicing perception of a thing assured ; and yet what did these anticipations

amount to ? In effect, they were the anticipations which, according to our supposition, a keenly imaginative intelligence would have drawn from the first use of barter in a world where appetite and force were all the law ; yet they never found common acceptance till fifty years ago. All the promise that barter brought into the world was visible from before the time when there was mind enough to comprehend it ; the saving practice continued and spread for thousands of generations ; and not till these generations of thinking men had passed away did the belief arise that commerce, the born antagonist of war, would overcome it forthwith. It can hardly be that so much confidence against so much experience was ever shown before ; and we may also say, considering what the abolition of war signifies, and how much else would go with it, that never was so tremendous a revolution of the moral order contemplated with such matter-of-fact composure. The abolition of war was of course understood by the enthusiasts of commerce as an immense achievement ; but it evidently figured in their minds as a vaster abolition of the corn-laws might, rather than as the victory it would be over passions, instincts, impulses continued through ages of inheritance from primeval man. That it would mark a great moral departure in every way was of course recognized and joyfully proclaimed ; but the reward of the great achievement reserved for trade which occupied the foremost place in expectation was the unchecked advance of trade itself.

The domestic history of that time is so poorly recorded that the new generation hardly knows how much of explanation there is for hopes and forecasts so absurdly optimistic. It has been said above that sixty years ago it seemed as if Science, Invention, Discovery, were all working for commerce as if from a reserve of equipment held back for thousands of years for its use when the right hour had come. To most readers of the new volumes of the Enoyclopcedia Britannica this will seem a more or less accept- able flower of speech, meant to adorn and with no other meaning. But in the known history of the world there have been strange

concatenations of change from unknown causes, sudden rushes to development as if by the operation of prepared forces biding their time and strangely hiding in concealment: it is hard to understand how they should have been concealed. Such occurrences, when they happen, naturally take the imagination of men, to their exaltation if fortunate ; and our little flower of speech describes one of them without much aid from fancy. The reality is that though the human mind, and the practice of inquiry, and the direction of it by the more importunate needs and aspirations of mankind, have been the same and ever active from time immemorial, there never was such a display of invention and discovery of a certain order as that which suddenly began in the earlier half of the 19th century. It does seem as if these intellectual agencies, theretofore quiescent though not for want of instigation, had found their appointed time and hastened to heap their hoarded services on industry and trade. The present generation is so familiar with the achievements of science in mastering the secrets and harnessing the forces of Nature as to be almost hlasi Avith them. But in their first days these achievements were veritable wonders â€” wonders in themselves, their novelty, their voluminous advance ; and since by some new mystery all seemed addressed to the aggrandisement of trade, it is not very surprising that there should be an enthusiasm of commerce in which it was regarded as an instrument of Destiny. The beneficence of its aggrandisement â€” that could be seen far better then than now. Not long before the rise of Modern Invention, England had laboured year after year in the worst impoverishment of a most glorious but most exhausting war. There is a sense in which working men were right when they used to say that “war makes good for trade.” But the time in which it seems to do so is short, as the wars that England was engaged in at the begiining of the last and the close of the preceding century were not ; they were followed by many years of industrial lassitude ; and this the people had to endure under a weight and a variety of taxation which the financier of to-day stares at incredulously. Even when trade had begun to revive, the general distress was great enough to break out from time to time in violent disturbance, which even after 1840 was sufficiently serious to alarm the Government. Such were the conditions in which the country stood when the released spirits of Invention and Discovery supplied commerce with their magic, easing its processes, enlarging it forces, multiplying its chances, shortening and smoothing every path that it came and went upon. Nor was there any

tarrying of results. To other wonders was added the rapidity with which (the enormous first-

advantages of free trade assisting) the whole country was filled with material prosperity and the knowledge of the way to more. In twenty years the world was so transformed that no saying was so common as that if one came from the dead he would not know it for the world he had left. No one who is able to cast back his mind from these times to those will lack excuse for the prodigious pride in itself which commerce then displayed, or wonder much at the extravagant elation of its dreams.

Unless some individual participants in the United States must be taken into account, the extravagance was entirely English; but for that there is the further excuse that England was the birth- place of the New Day, the first recipient and distributor of its bounties. Nowhere else in the world (it has been said before) could the gifts of Science, of Invention, have been put to such use and inci-ease. The boast holds no longer, but in that day England had a population of artificers that could be .equalled nowhere. A very pretty breed has been produced in the United States since that time, ^'^JL but in the "'thirties" and " 'forties" of the last century there was a larger and readier supply of ^^ '" mechanical aptitude in the British islands than any other nation could furnish. The indis- pensable material to begin upon, coal and iron, lay ready to hand in matchless abundance, and the advan- tage of its possession was greatly increased by the coal and iron being found close together. Beyond the seas which bounded all this good fortune were many growing colonies, and one vast dependency with a swarming population all ready for the new traffic. Elsewhere the enterprise of the country and the excellence of its goods had founded markets half over the world, and the road to those markets was familiar to the largest and best protected mercantile marine that the world had ever known. From its geographical position (which one great canal has strengthened and another may impair) London remained the most convenient port of distribution then open to trade; and, lastly, there was no lack of capital. Though a comparatively poor country as measured by the standard of .riches in these days, there was money enough in England for all the needs of enterprise, with a stronger

backing of credit than any other could command. The possession of so complete and unique a series of advantages was of course fortuitous, but (we know the universal superstition of mankind) in relation with the other wonders of the time it had a look of destiny. It is the foible of every great nation to conceive itself, at one period or another, chosen to work out some â– mighty change for good, and if the dream was that commerce was to bring about a saving order of things, and to do so in the end by banishing war, it was a dream that England had more excuse for giving way to than her commercial power, potentiality, opportunity, supplied. This is true because the ascendancy of the England of that day was not commercial only. When the moral influences which she was to enlist for the extinction of war had yet to operate, England could all but ordain peace as the most commanding belligerent power in Europe. That was her position at the time of which we speak ; and it completes the explanation and excuse of illusions that were to be destroyed as completely as was the unhappy town of St. Pierre, by similar forces though not of the physical world, and with the accompaniment of similar reflections.

There was also some egotism to pardon in this dream of the commercial redemption of man, for at every view of it Britain figui-ed as prophet, priest, pioneer, and the greatest gainer of all whether in goods or glory. But it would be a far blacker fault to suppose the forecast a romance of selfishness, and thoughtless to deny it a superficial plausibility. As we have said, the expectation that science-taught commerce would work miracles was not formed till marvels had been wrought. To the eyes of the generation that saw its rise its boundaries were prodigies ; and though we should wonder now if it did not spread widely and rapidly through the land, it was a new thing then that it did. And we have always to remember the times which that generation looked back upon. Of wars there had been enough, whether for the good they secure or the ill they bequeath. Poverty was universal. Material prosperity, though not the noblest thing on earth, had become the first thing needful for all the populations of Europe, for the people of Great Britain almost as much as any. When in such conditions the means of material prosperity were suddenly enlarged, as if by a providential awakening of faculties half â– dormant in the human mind, and when the new dispensation had shown the substantiality of its benefactions and their fruitfulness, the thought that the people would never let those benefactions

go was bred in the air. That commerce would banish war was only another expression of the same thought.

or rather the expression of its specific meaning ; and, in the mood then prevalent, we can feel how captivating was the persuasion that influences making strongly for peace and good-will would extend and still extend with the expansion of international trafBc. Nor was there any mistake as to the . reality or the character of those influences. The mistake was in assuming their future predominance, in discarding the consideration that trade has other incitements than those which bring individuals or nations under the rule of interdependence. To be sure, rivalry with England for commercial supremacy was only thought of then by Englishmen as a pleasing impossibility, unless, indeed, for the United States in a hundred years or so. But the calculation that commerce would abolish war, what ground did it stand upon ? It was that, convinced of the more substantial glories of peace, freed by trade intercourse from the barbaric prejudice of race, the European peoples would no longer allow the old wars for the lust of conquest and the pride of aggrandisement by subjugation. But that should have suggested two questions at least: firstly, whether in so doing the European peoples would contentedly resign all ambition to excel, whether, they would not begin to think of striving with England for equality in the larger fields of the greatest good ; and, secondly, what the difference is, in practice, between the con- tention of individuals for trade and the strife of nations. The usual resort in the one case is to ” cut rates,” in the other ?

There were many men in England, of course, who doubted that the victories of trade could include extinction of the Old Adam in Governments and peoples in the summary way that was looked for, if ever at all ; but a certain association of the new cult with religion strengthened the natural inclination to silence in face of a joyfully confident and very large majority. Many of the best minds in the country, too, indulged the hope or permitted,the belief, which soon found a creeping admittance into the sequent regulation of public affairs. Confidence in immunity from attack, acting congenially upon the of’iater- official negligence which may hope to figure largely in

England’s epitaph, had impoverished aatioaai the Services ; the Manchester idea covered the impoverishment with a spurious but hard-

relatloas.

wearing moral sanction. Mr Gladstone’s first budget was a product of the time in its heyday. It was framed in 1853, â€” ” a large plan which,” said his colleague Lord John Russell, ” it rejoices me to be a party to “; and a boldly meritorious budget it was, with this peculiarity: it included a scheme for the extinction of income tax, â€” a scheme, however, which was to be carried out by a comprehensive rearrange- ment of the national finances extending over seven years ! Seven years of unbroken peace were needed for working out the scheme ; continued peace thereafter was necessary for its enjoyment ; and therefore, to the foreknowledge of its author, the success of his plan would have been but a succes pour rire if it ran but for a year or two after completion. Confidence in the remoteness of war could hardly be more clearly shown than by the proposal of such a scheme on such conditions ; but the whole significance of this illustration of the persuasions of the time is not seen till we remember that Mr Gladstone’s confidence in his plan included confidence that the House of Commons and the public would make no difficulty of its essential premisses â€” as in fact they did not. That was done by war itself (the war in 1854) which even while the seven-year scheme was yet untried, had stalked across the horizon.

From the fact that Mr Gladstone’s prepossessions on this great matter remained unshaken, since, indeed, they seem to have been little changed from first to last by the changing portents of his many years of life, he might be put out of court reasonably enough as a too exceptional witness. His views of the subject would have to be regarded as a biographical detail (though far from unimportant in the case of so great a political personage), and not as a strangely common error of mind strongly exempli- fied.i That, however, is what it was. If Mr Gladstone’s policy and the conduct of it were largely determined by a conception of war as fast dying out under the influences of Industrialism and the “enlightenment of the age,” he was supported in that idea by a widely diffused body of feeling which could not be turned from the logic of the Manchester revelation. Experience had no effect,

1 On this point Mr Sydney Buxton, his friendly historian as Finance Minister, says: “He was, perhaps, too much Inclined to believe that, as he said in 1862, ‘we have sown our wild oats long ago,’ and that the national debt would be never again appreciably increased.”

observation went for nothing. The wars that began in the middle of the last century, as if provoked by the prophecy that there would be no more of them, were not only numerous enough to be convincing on that score, but offered strong evidence of little-changed and undiminished impulses to war. In the Crimean war the old-world motives were at work on all sides, and, when needed, in the old disguises : the Russian motives, territorial aggrandisement and the half-mysterious, often invincible stimulus of race ; in Turkey, forces once the same, but now called to the defence and not the seizure of spoil ; the Principalities, revolt against subjugation ; France, dynastic considerations, very personal ; England, pro- tection of threatened interests and a menaced “position in the world.” Half the battles in the “frankly pagan ” days of antiquity, we might say nearly all, would come into one or other of these descriptions. The Austro-German war, a large-scale repetition of tribal conflict for ascendancy. The Italian war of Liberation names its own character â€” again the rebellion of a conquered people, marked by all the good and the bad characteristics of its predecessors “in the dark backward and abysm of time.” Or then the Franco-German war ; which in all that relates to motive, intention, machination, assembled so many precedents from barbarism as to prove an unweakened heredity. Had these wars been arranged to teach the lesson it could hardly have been better done. Apart from the miscalculated influences of commercial intercourse, the wars of the latter half of the l-9th century might well have revealed a growing unwilling- ness, a restraint, fathered by wisdom and mothered by kindness ; but if any change to that effect had been going on, it was little more appreciable by the senses, when the hour came for discovering it, than the meantime weather-wearing of the hills. Yet, despite all this positive evidence, belief in the antiquation of war as a working fact of the day maintained its existence.

It would have done so less vigorously, no doubt, but for certain principles of political economy from which false pictures of the future were drawn. In making these pictures you took the world as it was, saw it imbibe from ever-multipl3dng sources of information the true principles of international trade, and enjoyed the pleasure of each in finding out that the broadest principle of all is the easiest to follow. It is, of course, that every people should devote itself to the supply of such commodities as the natural resources and aptitudes of the country enable it to produce most cheaply â€” the surplus of these being exchanged for other commodities produced elsewhere under similar conditions. You saw that obedience as by compulsion followed the understanding of this first principle ; it fulfilled itself by becoming known. At once, therefore, the nations were brought into a combination in which each secured its utmost profit to the advantage of the rest. At the same time, the comfort of each being dependent on the harmony of a now organic whole, a universal interest in the maintenance of peace is established. Viewed, then, under these conditions, what a picture did the working world present to the fancy of our island philosophers fifty years ago ! Here stood England, incomparably rich in the means and appliances of factory work, machine work, engineering, mining. Busy and apt in all industrial arts, especially in those which the newly-employed agency of steam quickened and cheapened, her cities were fast becoming factories, while fleets of carrier ships were at hand to convey their products wheresoever on earth they were a want. England’s part in the universal harmony was plainly appointed therefore ; she could but call her labourers in from the fields and become manufacturer-in-chief for the rest of the world. Looking abroad upon this unadvanced remainder, there was France, confectioner of many articles of taste and luxury â€” wine-grower, too, for those who did not drink beer ; France had always understood her r6le, and would go on with the production of her incomparably elegant superfluities. Elsewhere were broad cornlands, abundant and cheap grazing lands ; here the people would address themselves with contented assiduity to their old-world employments, raising a commercial surplus of wheat, hides, tallow, bristles, for distribution from British ports. And so with many another scene of tranquil industry. An uncommer- cial Russia, a peasant Germany, numbers of what may be called country States, would become emulous in the production of food-stuffs and raw material, their rural lowliness being enriched and adorned by good things in exchange.

It may be that this bright vision of promise has not the embodiment of print in any of the political economy books. But its warrant is there ; and since it was not the work of imagination so far as any one knew at the time, but a forecast from the teaching of a science impregnably logical,

we can see how it may have served to counter the lessons of those 19th-century wars. The truth is, however, that while the logic of the political economists remains all that it was, the forecasts drawn from it ever go wrong, and none so completely as the more important and impressive of them. We have hitherto spoken of those that related to commerce and war as failures, as unconfirmed; in truth, they have been destroyed by violent disproof. The co-ordination, the interdependence of commercial exchange (what you can best supply for what we can best supply) has an almost aesthetic beauty as a principle; it was thought so obviously sound, and its advantages so equitable as well as great, that it must prevail wherever it was known ; and no doubt its adoption in the spirit and meaning of its propounders would have been a powerful means to the extinction of war. But it was adopted nowhere. The nations are many, and in different conditions of existence; but none of them would consent to a system of international trade' the first recommendations of which were the utmost economy of advantage and the promise of abating the most dreaded cause of misery and waste. Why ? The explanation is suggested (not, of course, for the first time) in the foregoing paragraph. An uncommercial Eussia had no idea of remaining so. A peasant Germany could not definitely resign itself to that order of existence, however much it might be solaced and dignified by music and books. If Industrialism is the only real hope of human advancement, as Mr. Spencer preaches and as many governing men have believed without reasoning about it much, it is a social duty to open and keep open the means of employing all the industrial gifts, inclinations, aptitudes that exist in the community. If a great commerce gives strength to a nation and substantiality to its enterprise, then it is a national duty to strive for the possession of a great trade. There are no circumstances in which either duty can be properly neglected ; and since their performance comes under the wholesome ordinance of competition, since also they may be carried far without trespass and farther yet without unfair aggression, it

would even be absurd to subdue such duties to the eternally limiting scheme “of the professors. But there is more in the facts than this. Were there no more, if, that is to say, these national duties not only could be but habitually were carried out within the bounds of contention proper to trade, every nation might make its own fair growth, the professional ideal might be left to its unfructuous loveliness, and yet there would be a happier likelihood of the decline of war. But in all such matters we have to reckon with the inveterate fact that the relation of nations to each other is not the relation of individuals in the same community. Probably there ought not to be any difference, but there is, and it is immensely great. As a consequence ” the bounds of contention proper to trade ” in the citizen’s case widen into license when the contention for trade is international. And thereupon comes the fact that a great commerce is envied not only for such uses as capital stands for within the community, but as a mark of ascendancy and a means of success in other fields of contention far older and more honoured than the struggle for new markets. The pride of command, the glory of conquest â€” the strongest collective passion of tribes and nations from their beginning, if not the only one â€” must be served. A great trade affords the most effective service in the unending conflict of national ambition, and trade itself is in our day as closely associated with international conquest as tribute was in times of old. Extension of trade and expansion of empire mean the same thing in most European tongues. The)’ cannot be uttered -n-ithout calling up visions of the fleets and armies necessary for acquirement or protection; fleets and armies which become more numerous and powerful as the rivalry increases which is little else than war in abeyance.

These conditions, which apply equally to the European States inasmuch as they aspire to greater domination or fear to be dispossessed, must change entirely before it can be said that commerce and war are at variance. Change there has been of late, increasing at an accelerated pace year by year ; but not in the expected direction. The rivalry intensifies among the European States as they rise to a nearer equality in power ; the number of aspirants for empire has increased, making their claims good in the old way by building fleets and adding army corps to army corps. Yet more unexpectedly, a vigorous Eastern State has come into the ” world-conflict ” for trade and territory, with a retinue of ships and soldiery magnificently armed. Now, this is a nation which did maintain within itself, for hundreds

of years till the other day, all the functions of a full and busy social life, even to the finish of the arts.

PREFATORY ESSAY XV

Immediately upon that surprise another and far greater nation drew out from its own little universe of self-content, to enter the field of Imperialism. Very much because the Americans are not Orientals, but Europeans even as Britons are, this is the more instructive case of the two. For though the conscious motive of the United States in entering upon the Spanish-American war was to stop a useless waste of life under relentless misrule, one result of that war was increase and acknowledgment of the desire, irrepressible though long-pent, to give America a place among the conquering peoples. It is idle to talk of it, impossible for all but a very few minds to think of it, as a vain desire. But, however it may be considered from the moral, prudential, psychological points of view, that the desire exists and prevails is much to the purpose of this discussion. Acknowledged by the world as a great because vastly capable country, America possessed all that could be won by industry untaxed and unchecked by militarism (as Mr Spencer would have it), and by the undistracted use of the highest commercial faculty. It did not suffice. Long before the war, there were many signs in America of a coming change. The conditions which made obedience to the curbing of national ambition more inviting than obedience to that ambition had passed away; and, as was said at the time, it was not in the unregenerate nature of things that a strong, numerous, capable, proud, and stirring people should be content for ever to confine themselves and their influence within the bounds of home government. But it would be superfluous here to go into motive ; enough to state it. The question being whether the tendencies of civilization run toward the extinction of militarism by industrialism, two powerful nations which have hitherto held aloof from the struggle for empire march into the arena with horse, foot, and artillery, and thus make contribution to the answer. One is of the outer East, and not unlikely to bring another Eastern people after it, or even the whole race to which it belongs. The other is of the West; a nation which, having come to full growth upon a religion proscriptive of “world-policies,” and having prospered beyond all dreaming as a self-contained industrial republic, decides that as a career it does not satisfy. To be

complete, it must be a career of conflict and dominion ; with enlargement of trade for business justification, but more looked to for a becoming share of ” the glory that was Greece and the grandeur that was Rome.” And so, with a right-about face, the American people turn from their entirely successful experiment in industrial monasticism, hasten to build fleets of warships, and launch forth upon the ancient ways of national emulation.

It must be agreed that if more impressive evidence of the tendency of change than this can be found, it must be very convincing ; and there is such evidence. We come back to the old countries of Europe, and looking to the agencies of civilization which were to have worked with the amenities of trade to abolish militarism (a “disagreeable word, but inclusive of intended meanings which ” war ” does not express), we find these agencies employed in bringing about an entirely different result. Nor is their working partial, unless in one particular the most unexpected where every expectation has been falsified. The civilizing influences of the time force militarism upon people and princes alike, war as a but most upon the peoples. The pressure is felt, though unequally as yet, where empire is weapon, a possession and where it is an aspiration ; and commerce and labour call eagerly upon mili- “tarism in the one case for the protection of trade acquired, in the other for the acquisition of trade desired.

The effect of these crowding civilizing agencies as they tell upon the ” dim populations ” of Europe is readily traced out. One of them is the closer intercourse of men by the “abolition of distance ” between village and town, but more especially by ” the effacement of the physical barriers between nation and nation” â€” these beneficent changes being the work of our railways, steamships, telegraphs. Another is the diffusion of education, and a printing press that cheapens the means of enlightenment so bountifully that every man may partake. For the dim populations these are the most effective civilizing influences, though no doubt there are others. And now what are their main results for the masses personally, practically, as citizens and industrials? The answer is that the extension of civilization means extension of the demand for the appliances, comforts, and luxuries of civilized life. The effacement of the physical barriers between nation and nation is more famous for enlarging acquaintance with these things, at least by sight and hearing, than for softening the hostilities of race by personal

converse. The abolition of distance between village and town has the same effect,

besides affording to villagers a readier means of seeing what it is to be a town artisan and not a peasant. And so the first employment of the commonest and most powerful agencies of civilization is to bring close to the eyes of poor men what others enjoy, to give them a taste for it as well as a sight of it, and to inform them at large on the subject by every print that finds its way into the hands of poverty. But the higher living so naturally coveted, and that certainly represents civilization however much else that better state may mean, is not obtainable by the wages of rural labour ; and it is not labour alone that seeks the higher living which civilization commends and demands. Hence proceeds the enormously increased and increasing eagerness for trade, for factory profits, which has seized upon the European nations ; although, as we remember, they were to have played a more philosophic and harmonious part m the commercial economy of the world. Hence, but with added cause, the raging desire for colonies which broke ou;t not long since, the competition for an exclusive hold upon distant fields of enterprise, which is business beyond all doubt, and necessary business, but not of the kind that turns spears to pruning-hooks. We have said “with added cause,” for where the wants of the people move them to discontent (civilization being a prolific creator of needs and appetites) Governments are taken with anxiety. They become eager for commercial empire as a provision of wealth and comfort on the one hand, as the prevention of social disorder on the other. Seeing how rapidly and adventurously the still exploitable portions of the earth are staked out for occupation. Governments and people are agreed that their purpose cannot be achieved by waving palm-branches from the doors of empty warehouses. No, but (in short) by the waving of the sword ; by the use of it on occasion ; by the maintenance of large armies to have and to hold ; but especially by adding ship to ship, rediscovery being made that sea- power is the secret of empire, very much by the control of trade.

So far we have viewed the matter from the side of the nations which strive to acquire ; the difference when we look to them that possess is only that

between the offensive and defensive in warfare. Be his condition what it may, every intelligent Briton knows whether the wider, diffusion of commerce and the more general interest in it abroad do or do not reduce England's obligations to stand well armed. He may doubt whether the great "world-movement" continued from the 19th century into the 20th is for trade for the sake of empire, or empire for the sake of trade ; but he sees that in either case the upshot is that British commerce needs the sword of defencp more and more. No doubt it needs other defence, such as firmer energies and a keener outlook upon business would supply ; but this also is understood, though by no means as a substitute for the protection which the greatest navy ever seen is not too great to secure. This is for defence against a sudden blow, and is so vast a navy because the captivation â€" no, the necessity of commerce for other nations brings a sudden blow within probability. Nevertheless, up to the time when these pages are written, this which is a clear is not an animated conviction in the public mind. And yet, when the consequences are considered, failure in defence of a great and long-established commerce is far more serious than defeated endeavour to set up an empire of trade, or militarism, or any other. The difference is provided by the law under which the luxuries of to-day are the wants of to-morrow. A solace for poor communities (as for all poor folk), this unfailing compensatory law imposes on the rulers of England a far sharper* responsibility than they have ever yet revealed a consciousness of. There is poverty enough in the country. Heaven knows ; but take the mass of the population, excluding those who would be called rich by working men, and we shall see that many things which were the luxuries of a well-remembered generation have now become absolute needs. The trade of the country has been good so long, that a share of its benefits not at all too large, but larger than is commonly reckoned, has spread down through the multitudes of a newly-created " lower middle class " to the working population. And there we find many who not only know by sight, and hearing, and sensibility the sweetnesses and decencies which civilization requires, but, thanks to the wages supplied by an abundant commerce on the one hand, thanks to the cheapening of. all manner of civilizing refinements on the other, have made imperative wants of them by habituation. If this is to be regretted we must be sorry for the better good which a nation draws from the enrichment of industry ; for that better good is a common people

in which the lower refinements and the higher decencies of life become sheer necessities. That, however, is by the

way. Now, even a gradual attainment to such advantages is preferable to rapid acquisition ; but being acquired, and having become constituent in the life and character of the people, what would it be to be stripped of them suddenly ? We should listen to the truth that speaks in us when questions so momentous arise, and not be afraid to do so. Were the blow to fall which is a reasonable con- tingency if great fleets are not a foolish waste, it would be virtually (war is quick work at sea) a matter of a few weeks; the trade that feeds numberless factories would in that brief time depart; ransom under the name of indemnity would impose its intentional burden ; and then the law of which we have spoken would fulfil its round. The needs that once were luxuries, and then became both the signs and the substantialites of social advancement, would be so many privations bitterly felt but not of the rousing kind. In other and perhaps more' obvious ways they would be demoralizing privations, and of course an added quantity to those which were the common lot of the common people in the bad times at the beginning of the last century.

Drawn from the most grateful benefactions of trade, these are reasons for a vigorous alliance of commerce with armed Force; and the fuUer the benefit the better the argument. There have been times, as we have said, when this combination under the British flag was little else than piratical; it had been so under other ensigns a hundred times before, is so now, and will be found at the same game as long as this world is made up of various races and nations at different removes from barbarism or at different stages of decadence. So long, therefore, it must also be a defensive combination, in which state it may not only play a natural but a humane and a righteous part. We have given some reasons for thinking so in England's case. Were there a better case, an empire more amply endowed with wealth and power more nobly employed and widely shared, it would make a better argument. Such an empire would perish under readier attack unless more formidably armed.

The benefactions of commerce have never been more loudly celebrated than in these days : they are as the beauty of Helen, with (perhaps) a more interested call to strife. But commerce has its vices, and they should have a greater share of attention. Domestic vices, as seen in the crowding of cities, the mass- ing of misery, the physical degradation of the people, and in some other things that make for meanness, we do not concern ourselves with. The relation of commerce and war is our theme, and there are ways in which commerce works in that relation to extremely bad effect. One of them is by keeping up an incessantly reckless cry for new markets. It is a cry that naturally commends itself as a The cry proof of energy and a sign of ever-conquering advance; there is too much evidence, consular marked. and other, of a different explanation. Are the old markets filled before the cry for new ones is raised ? That they are is assumed from the repetition of the demand ; that they are not is proved by the one fact that within the last thirty years a newly-risen nation of traders has grown rich by gleaning in fields of enterprise where, it appears, British merchants were disappointed with the main crop. Eng- land's markets ? England's markets abroad have been so numerous, so various, and so firmly held by virtue of first occupation, that they should have sufficed to this day by close thought and assiduity. jMost of them wanted and would have repaid, as they have repaid later incursionists, the cultivation that a town shop- keeper spends on his town customers. Our commerce could not descend from the dignity of wholesale export to the petits soins which its rivals have introduced into the trade ; would rather sweep up the first gains of an " unspoilt " market and pass on to others entirelj' new. " By disdain of small business, by contempt for the little cares that win small business, by a preposterous philistine habit of treating foreign tastes and preferences as whims that ought not to be humoured, British commerce shortens the harvest of its opportunities while ever reaching forth for more." Now this was well enough, no doubt, when many populous lands had been little visited, and when England's competitors for trade to far-off places were few and of small consideration. But all that was changed years ago; we have just been recounting the portentous how and why. All the greater nations are fighting together for new markets, oftener than not by their Governments sword in hand ; and nearly all are animated by a fiery opinion that England has more than her share, to their injury. Notwithstanding this opinion England must hold her

own and keep her high place. But it cannot be done with ease ; and the ” commercial interests ” of the

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country should know that when in such conditions they clamour for new markets, the old ones being lazily or ineptly used, they do a grievously unpatriotic thing. The armed forces of the country may of course be called upon most properly to protect the commerce of the country, and perhaps to extend it ; but not to extend it on such terms as these.

More serious in itself, and yet more serious because quite unchecked, is another vice : the reckless- ness of commerce in educating barbarism in the methods of war, and supplying the weapons it is taught the use of. The teaching is not always systematic or direct, but yet it goes as far where the taught are not savages or just emerging from savagery, but advanced from that state by many steps, and therefore more adept, and again on that account more dangerous pupils. The Abyssinians may be mentioned as in this category; much pains have been taken to bring the Abyssinians within the European â„¢Â« system as a properly-equipped military people. And direct teaching goes farther yet in the case

conscience, of the Chinese, who are not at all barbaric in the seuse of being unformed and unpolished, but in the first place eminently capable, and in the next fixed in a civilization which is antagonistic ia the highest degree to that of their instructors in warfare. Most of the commercial nations of Europe have competed for the privilege of imparting this instruction, which if ever it becomes effectual (as there is increasing reason to believe it will under the stimuhis of hatred for its original teachers), wiU probably add to the armies of the world one of the most disturbing ever known. Yet it was but for the sake of a little trade (supply of war-material chiefly we may suppose, or the opening of doors to ” con- cessions”) that English, Germans, and others beside Russians, have played the part of drill-masters and gunnery instructors in China. No doubt this was done in belief that the Chinese were too inept and spiritless to turn their instruction to account. Europe had that excuse, such as it was â€” the excuse of a hazardous,

unnatural calculation. But the error of politics and trade â€” yet of politics far less than trade, with its compelling cry for new markets â€” remained unabated when there was plentiful reason for_ suspecting it. As the commercial eagerness of Europe increased, it was accompanied by yet more heedless provocation of the spirit that detested it, and by ^further lessons to the Chinese in the feasibility of expelling their invaders. However, this is not a chapter on the “awakening” of China. The intention is only to recall the reckless induction of war in that much misunderstood country, and the culmination of the error when the European Powers felt themselves driven to the necessity of settling government at home on commercial empire abroad. In truly barbaric countries, as in nearly all parts of Africa, trade carries on with a like carelessness of the fact that its most positive civilizing process is the one that a Zulu or a Basuto, for example, is by nature, education, situation, most ready to profit by. No doubt he also acquires some of the amenities of civilization â€” those that fall away with such astonishing readiness from its white pioneers when their business lies in an india-rubber country. Much more lightly, however, do such graces sit upon the tribes of fighting-men who are being taught the Chinaman’s lesson in more indirect ways. No doubt this cannot be avoided, but it might be hindered or delayed, whereas trade (which must be considered as an entity without regard to its eccentric members) seems to be quite indifferent on that point. Anything which, by observation, or experience, or provocation, or all three, may train these half-savage millions the sooner into formidable fighting -men is tolerable to trade, if in the meantime business is well served by it. This is no mere peccadillo, but a vice which, considering how rapidly the world narrows, and how much more speedily consequence follows upon cause, becomes signally unpatriotic.

To these unpleasant portents others have been added so lately that their scope can hardly be measured. Tariff -wars are new, as intended by the Government of one state to defend its trade from subversion by another, or to force from another trade advantages. Commerce having risen to such importance in international rivalry, at the same time standing for so much between Governments and peoples, it may be that tariff -wars have been invented to stave off more dread ” complications,” upon which, indeed, tariff-wars seem to merge sometimes. In any case they witness to the command of trade in the world’s affairs, and to its fertility in matter of

direct quarrel. A sudden development of the American system of ” combines ” offers an entirely new view of a possible future, in which the financial machinery which obtains command of the whole stock of some indispensable commodity may

find employment more august. State employment is intended : state employment in a scheme of war without bloodshed. A Government about to declare war arranges with an expert syndicate to obtain control of the whole supply of certain food-stuffs for a certain time, and pays in millionsâ€” as a Govern- ment about to declare war against a strong Power could well afford to do for such a purpose to keep

this food from the lips of the people to be attacked. Anticipated result, famine from the earliest possible moment without the usual preliminaries of slaughter and blockade; or a demonstrable certainty of famine, which, presented at the right moment, would compel submission on the one side, and confer triumph by mere cash transaction on the other. The plan is simple, almost certainly workable, and sure of commendation on grounds of humanity. And it has a particular interest for England, because it would fail against any but an island state, as England is, and one that is open to starvation in a similar degree.

Such being its limitations, there is almost as little likelihood that Finance will abolish war as that Commerce should ; unless we admit the conjecture that a time will come when the great twin brethren will build for themselves a throne of dominion so mighty that to command its own peace will be the banishment of war. Meantime all previous conjecture has perished in disappointment and worse. For the influence of commerce was not the only trust of those who looked for the decline of war. Their expectation was that the characteristic intellectual agencies of the last century, the invention, ‘?*, . the discovery, the high mechanical science which equipped trade so magnificently, would abet Â»”*Â« the suppression of war by direct operation. But that they stood for enlightenment, demon- strated the superiority of the arts of peace, added to the number of good things which war should take shame in destroying â€” such vague considerations as these seem to have been the only foundation of what was hoped from them. Yet

there was some specific argument, as we have seen ; and this too has given way. Nothing was reckoned upon more confidently for a great mixed crop of moral and material good than the bringing of the world together by the shortening of distances and the multiplying of means of communication. One unexpected consequence of these real blessings â€” the driving of Governments yet farther into militarism for the sake of trade â€” has been already noted. But there have been other results which, instead of reducing the need for armies and diminishing their cost, increase both. The bringing together of the various families of mankind has been accomplished with great success as to the material part. But as to the moral effect, it must be reckoned as much worse than nothing, according to evidence brought down to the second year of the new century. There were occasional bursts of fury between nation and natit)n in the less neighbourly days of old. In these times there are occasional bursts of fury as before; but, more remarkably, the intervals are filled with incessant bickerings among the peoples. The relations of the Governments remain what they were, with only one substantial difference : they are sometimes gravely embarrassed by these bickerings, which do not make for peace.

But as the world is brought into an ever-narrowing compass, other consequences ensue which bear more directly upon militarism. Frontiers close in ; and as distances diminish, as time contracts and movement becomes more rapid, larger armies must be kept in readiness to meet or forestall a foe. The facilities and appliances of war being what they are â€” thanks to the abounding mercies of science and invention â€” sudden conquest must be provided against; and since fifty thousand men may be rendered useless within a fortnight of the proclamation of hostilities, large reserves must be kept on a footing of instant readiness. Armies thus attain to more importance than they ever had before, do in fact become a more immediate and more costly necessity ; and this they would be, it seems, if only because of the contrac- tion of time, the closing of -distances, the acceleration of movement. But modern armies must be large for another reason : the tremendous forces of destruction to which they are exposed compel provision of a corresponding ” margin ” for repair. These immensely destructive forces are among the most prodigal gifts of invention and science. If armies are so’ costly a necessity nowadays, it is not only because they must be more numerous, but because science and

invention are tireless in providing ever more terrible and still more expensive engines of war. Hence the need of additional taxation, and therefore of additional trade, and therefore of increased competition for trade. The good genii of the 19th century have done great things for the material welfare of mankind, but what have they done for peace ?

Peace has been little favoured by their labours indirectly â€” their direct labours have been assiduously addressed (no doubt with the best intentions) to enhancing the devastation and the waste of war. And their works continue.

When this unexpected outcome forced itself on attention, second thoughts discovered in it the very thing that would extinguish war most certainly and speedily. War would become so costly, above all it would become so dreadful, that it would not be endured. This remained a hopeful belief for some years, and it was not without reason. It was not without reason then. Since then war has been provided with far greater terrors, and once or twice it has made such havoc, in a space of time terrible in its brevity, as was never seen before under the sun. Yet humanity does endure the excess. There is no sign of its being shocked in the least. Invention is still at work upon improved means of ravage, and the State spends more and more on its productions amidst little complaint. For commerce prospers in reliance on war ; war is everywhere pledged to commerce ; and the old order reigneth still.

There is no more demonstrable truth in mundane affairs than this, and none, of course, that com- pares with it for importance. Should we not acknowledge it, then ? To deny would be as reasonable in these days as to doubt that the original forces of Nature still operate by contention ; and therefore it is not denied. But it is a truth that we conspire to cloak from ourselves and each other, not only fobl’sb^” because there is so much in it that disappoints and even appals, but also because it awakes in us a feeling of shame. And these are not bad reasons for silence, which would be blameless enough were it never allowed to obscure the facts, and if it were not accompanied by certain hypocrisies of a distinct, demoralizing character. But then it has those disadvantages, and to get rid of them would

be a great reform. Now that would be done with sufficient completeness by quiet recognition that the intej”- national relations of mankind are what they are : that is to say, barely redeemed from barbarism, however well-gloved they may be in our day. Sincere endeavour has been made to bring them under the rules that govern civic communities, and not quite without success. In peace time, indeed, the success appears considerable; nevertheless, it is but superficial. Those relations are still rooted in the primal order of things, and at every disturbance show that they are. Now this is a time of great disturbance, and likely to last. Why, then, should we not acknowledge to ourselves the unregenerate character of international relations, and act not as if it were a merit to misunderstand them ? To do this would be to clear away the doubts that hang upon the obligations of defence ; or in case the offensive-defensive should be forced on us, we might then undertake it without resort to false and unworthy affectations of sacrifice to moral

ENCYCLOPEDIA BRITANNICA.

(NEW VOLUMES.)

MOSAIC.

Mosaic. â€” The art o mosaic has never been deeply implanted in the artistic sensibilities of the north of Europe, nor has it been employed much either in France, or Germany, or England. It ceased to be generally adopted in Italy when fresco, oil, and tempera painting came into vogue. Gothic architecture is ill suited to its robust claims as a decorative art ; and the incoming of fashion for the latest and least interesting development of classical architecture, ” Palladian,” divorced not only it, but mural painting also, from all architectural schemes. To be pro- perly consequent and effective, buildings, ecclesiastical or public, should be constructed with the intention of being covered almost entirely by mosaics, which demand rich environment, marble or other colour; mosaic is essentially a colour medium. It is therefore scarcely surprising that when mural decoration became pre-eminently pictorial, and gestures and expression grew complicated, elaborate, and naturalistic, an art limited in its powers of presenting such manifestation of realistic design was relegated into the limbo of obscurity.

There are no instances of the use of mosaic in England after the Roman occupation. The Normans, who derived it from the Greeks and Saracens, and adopted it in Sicily, did not import it either to France or England. Although Eaglish churches, and French also, were highly decorated with polychromy from early times up to the 16th century, there is no evidence of mosaic ever having been used. The revival of a school of mosaicists in Eome during the 17th century, employed in the decoration of St Peter's, and here and there sparsely engaged in other churches, led to the idea which Wren would have carried into effect, namely, making use of mosaic for the cathedral of St Paul's in London; but his scheme, if it was ever really entertained, was not carried out, as we all know ; and the art, which might have become the fashion inEngland, remained an exotic. Even late into the years of the 19th century mosaic decoration was regarded by classical purists as a barbarous art, and the glorious decorations in that material to be seen in Sicily, Italy, Greece, Asia Minor, and Eussia

were disregarded as works of high art. They were in many cases cut out to provide room for extravagant and vulgar designs in fresco or tempera, immeaning, undeeorative, and wholly abominable as decoration. Those Roman mosaics over the altars in St Peter's, being copies of celebrated oil pictures, while they cannot be denied excellence as such and marvellous dexterity, reveal the worst possible taste, for they attempt to represent adequately, in cubes, touches of the brush which were spontaneous, fluid, thick and thin, and as sensitive and spontaneous as the finger pressure on the violin string, so accurate that the least deviation from absolute position produces discord. The only service which such a misplacement of labour and of material can be said to have rendered, is, that when the original oil pictures have been destroyed by time, these inadequate copies of them will remain. In St Mark's in Venice Titian, Tintoretto, Veronese, and other oil painters of renown failed when they put into mosaics designs fitted only for easel pictures. Deeply indeed it is to be regretted that the mosaics (of whibh there stiU remain a few un- restored in St Mark's and in various churches in Italy and' Sicily), designed and executed by Greeks, were cut out in the 16th century and later, to be supplanted by designs which, however good in themselves, are entirely ill adapted to the restricted conditions which ai'e the strength and not the weakness of mosaic treatment when used in perfect justification of its capabilities.

These restrictions are many, and some are obvious. In the first place, mosaic is not suited for a small scale of design. It is true that in the Opera del Duomo in Florence there is a miniature mosaic (executed in the 12th century) of extraordinary beauty, which must have taken a lifetime to execute; but still this remains a curiosity, a bit of craftsmanship, rather than a great work of art. There is also a copy of Mr Holman Hunt's " Finding the Saviour in the Temple," executed for Clifton College by assistants iuMessrs Powell's establishment in Whitefriars, London ; it is admirably done, no doubt, but it is a long way behind the original, which is a design wholly ill

adapted to mosaic. There are several other instances, notably one by Mr H. Holiday of " The Last Supper," where mosaic has been employed to translate a beautiful design, which would have been more satisfactorily executed either in oil or water colours. There are also several isolated figures in mosaic in cathedrals and churches of England, small iu scale, of good workmanship, but failing qud mosaic, because had they been done in oil or tempera colour their design would have been better justified. The primal and most obvious limitation is in matters of detail ~~> â€" detail as regards a multiplicity of forms, many grada~~ tions either of colour or tone and naturalistic accidents. In this respect good mosaic is like good basso relievo; it is accomplished by firmly pronounced outlines, unconf used masses, large planes unbroken up by small adjuncts, and generalized and conventionalized forms and simple colour. So all small curves, as well as small tints, should be eliminated, because it is not in the nature of the material to do them justice. One can scarcely conceive a choice less happy for mosaic than the centre group taken out of the upper portion of the Disputa fresco in the Vatican by Raphael, yet this florid piece of work, so facile in creation, was chosen to be executed on the eastern wall of the morning chapel in St Paul's. It is admirably copied as far as it goes, or rather as far as the material permitted, but hopelessly wanting in the spontaneity and charm of Eaphael's delicate and sketchy work.

It is useless to illustrate the many similar mistakes that have been made. They were made in some of the earlier work in the choir of St Paul's. The

best example of mosaic on a small scale is in Ravenna, the tomb of GallaPlacidia ; the best upon a large scale is the great Christ at the east end of the cathedral at Monreale. These two works ab- solutely justify the means to the end. Interesting are the designs made by Sir Edward Burne-Jones for the mosaics for the American church in Eome, but the execution and colour are alike monotonous. The cathe- dral of Chester contains a series of mosaic pictures designed by Mr Clayton. The Guards' chapel in St James's is adorned likewise by the same artist, under the direction of the late Sir Arthur Blomfield. In the chapel for the school at Giggleswick are mosaics designed by Mr Jackson, E..A., admirably and broadly treated in true mosaic character; these were executed in situ and not, according to the modern habit, upon paper, away from their environment and by a foreign firm. Those mosaic pictures which are placed in niches in the great gallery of South Kensington Museum are failures qud mosaic, though the designs in many instances are fine, notably those by Lord Leighton and Mr Val Prinsep ;* but their execution is uninteresting, because the cubes are laid so flatly and so evenly that they suggest an oil picture appliqui upon a flat ground.

Messrs Powell have been employed on several occasions to decorate churches with mosaic. This firm has adopted the old style, and rejected the new one initiated by Dr Salviati of Venice. If we observe the surface of a fine Greek mosaic, such as that of Andrea Tafiinthe Baptistery of Florence, or the few remains of unrestored mosaic in St Mark's, Venice, or indeed other works scattered over Italy, we shall see that it is rough, not smooth ; that the cubes are irregular in shape ; that there is always a space of the groundcolour left, red or white, and visible between each cube. In modern mosaic, with rare exceptions, res- toration or other, the cubes have been jammed up closely together, and the surface is as smooth as a piece of paper ; thereby is engendered a mechanical and uninteresting surface, over which light plays with monotony, and hence that brilliant and scintillating effect so essentially the character of true mosaic is absent. The tendency in modern times has been to rival the smoothness and

general appearance of an oil picture, which is the very antipodes of the nature and demands belonging to a, material eminently structural and therefore eminently in harmony with building construction. This defect, and

it is a grave one, is evident in the works in mosaic more or less recently set up in Paris, notably in the apse of the Pantheon, the east end of the Madeleine, and the vault- ing of the great staircase of the Louvre. Those in the apse ^re finely designed, but scarcely look like mosaic, those in the Madeleine still less so, and the last not ^ all. These several mosaics were executed by the Ecole Mosaique, long established in Paris, but they are far from interesting or satisfactory.

The artist who designs for this material must set aside all the principles he has learned to estimate in paint, either of oil or tempera. As an instance of a painter, pre-eminently delicate in his colour and tone, failing as a mosaic de- signer, we may quote Cimabue, whose beautiful designs in the cathedral at Pisa would have been far more effective had the artist painted them upon the wall with the medium in the requirements of which he was so great a master. The same criticism may apply to the mosaics in recent years set up on the west front of Santa Maria del Piore in Florence. These look lilie oil pictures. One would never imagine, looking at the cartoons for them in the Opera del Duomo, that the artist had intended his designs for any other material than that in which they are executed â€” oil colour; so, when translated into another material, they retain their special elements of character, and look to be what indeed they are â€” copies in glass cubes of pictures. The very first principles which go to make a fine picture are just those which should be avoided in mosaic â€” elaborate modelling, delicate transitions of light and shade and picturesque effects of dark and light, materialistic resemblance indeed. The designer for mosaic should ever bear in mind his material, and in his designs for it he should accentuate those characteristics which belong essentially and specifically to mosaic and to no other technique. If he is a painter he must forget his lessons in that art and take up with new ones â€” those which teach broad masses of colour obtained in lines. He will find that effects gained by a technique employed in oil colour look bald and ridiculous when translated into mosaic. Water-colour and pastel are by far the best media for cartoons to be copied in mosaic. We do not know how these were executed in ancient days ; probably the design was drawn on the wall, and there were no cartoons. The master not only invented, but he was the master-workman also, and that is how it should be. The probabilty is that the custom of drawing the design upon the wall practised by the early Frescauti was the survival of a method

adopted by the mosaicists, just as their method repeated that of Roman and Greek wall painters. Of course this direct method leads to a large style, a style harmonizing with environment, scale, &c. ; the tendency is to draw large in a large building, to draw small in a small one. Anyhow, this is quite certain, that all the fine Byzantine and 13th-century mosaics, as well as wall paintings, were executed in situ and not away, as was the usual custom in England and elsewhere until recently. What foolishness it seems, when looked at directly and from a common-sense point of view, to design a wall decoration away from the building it is to adorn, then to send it to a foreign country to be set up in another material, unseen during its progress by its creator, and then, still invisible to him, to be applied to a Avail ! Who can wonder that such piecemeal work must, ninety-nine times out of a hundred, issue in failure ?

Mr Harry Powell has permitted the writer to make use of some of his reflections upon the mosaicist's art in the following notes. The mosaicist should not separate the

artistic from the technical details of his craft. He must study not only the decorative effect, form, colour, and spacing of his design, but the surface to be covered as â– well as the materials with which he builds.

Surface. â€" Good brick-work, the mortar joints slightly cut back, affords the best foundation for mosaic. The hollow and sharp- edged joints provide a key for the cement into which the cubes will be set, and they diminish the risk of sagging, a not uncommon event if the cement is not welded to the wall by being well pressed into the joints. If the mosaic is to be applied on stone, the stone must be notched and well roughened to provide support. Whether the surface is brick or stone, it must be well satixrated with boiled oil to prevent suction, because if too much suction takes place the powder only of the cement will remain and the cubes will drop out.

Cement. â€" A cement suitable for mosaic is one which retains its tenacity, which can be applied in layers, which sets slowly, and which is not liable to change colour after long exposure. These conditions are best met by an oil cement. One consisting of equal weights of white oxide of zinc and

carbonate of zinc, mixed with double boiled oil and containing small proportions of wax, gold size, and slaked lime gives good results. This cement can either be white or red, white where greyness of tone is desirable, red where a richer effect is desirable. It is generally mixed with a small portion of oxide of iron or oxide of manganese, whiifh prevents the whiteness of the joints from rendering adjacent tints grey from a distance.

Atmospheric Corrosion. â€” As the atmosphere of modern towns is more corrosive than that of medieeval Venice or mediaeval Rome, it is important that, in choosing the cement and the materials to be embedded in it, the mosaicist should be certain that they are impervious to atmospheric impurities.

Glass. â€” Although marble, mother-of-pearl, and other substances have been, and are still constantly used, the predominant material in ancient as well as modern mosaics is glass. When prepared with due regard to the continuing proportions of its ingredients, glass is impervious to the action of ordinary acids, and is practicaUy indestructible. It can be made to assume almost every shade and tint of colour (see Glass). There are many kinds of glass, but for mosaic work either a potash-lead or a soda- lime glass is usually employed. Both of these glasses can be rendered opaque by mixing with the ingredients either oxide of tin or a mixture of felspar and fluorspar. The texture of a glass which owes its opacity to oxide of tin is dull and granular, and when the colouring agents are added the resulting colours are subdued in tone. Glass rendered opaque by the admixture of felspar and fluorspar has a bright, vitreous, easily cleaned surface, and readily develops brilliant colours.

Production of Colours. â€” Colours are obtained by mixing and melting with the ingredients of the opaque glass small proportions of certain metallic oxides. Oxide of chalk gives a purple blue ; oxidQ of copper gives a peacock blue ; oxide of copper with oxide of iron gives a green ; oxide of copper mixed with oxide of iron and a strong reducing agent gives a red ; oxide of chromium a green ; oxide of nickel a purple ; oxide of uranium a yellow ; and oxide of manganese a violet, or a black, iÂ£ a larger quantity of oxide is used. By continuing the oxides a praoticaEy unlimited palette may be readily obtained.

Manufacture of Glass Slabs. â€” The mixtures, in a state of powder, are shovelled into crucibles standing round the grate of a furnace, and when fusion is complete the viscous glass can be coiled upon the heated end of an iron rod and removed for use, very much in the way that thick treacle may be coiled round the bowl of a spoon. A mass of molten glass, thus collected, is allowed to fall upon a flat iron table, and is pressed into a slab about six inches square and half an inch thick. The slabs are removed to an oven, where they are allowed to cool slowly, and when cool are removed and broken by a hammer or a miniature guiUotine into tesserae or cubes. The fractured edge of the tesserse is used for the surface of the mosaic.

Gold and Silver Slabs. â€” ^The tesserse containing gold or silver leaf are as impervious to surface corrosions from the effects of atmosphere as the solid colours. The process of manufacturing a gold or silver slab for mosaic work is to spread the metallic leaf on a very thiu tray of transparent glass, about five inches in diameter, and after it has been heated to press upon the surface of the leaf a mass of molten glass, so as to create cohesion between the molten glass and the glass tray through the pores of the metallic leaf. The slabs thus formed contain gold, silver, or platinum leaf hermetically imprisoned between two layers of glass. The slabs are cut up into tesserse or cubes by means of a diamond or glasscutter's wheel. Only one surface can be used for mosaic work.

Tinted Metals. â€” By using coloured glass for the thin glass trays which form the surface of the metallic slabs a variety of tinted metallic effects are obtained. Moreover, if the glass which is to form the background is coloured, and it the slab after it has been cooled is strongly reheated, the leaf becomes sufficiently disin-

tegrated to allow the colour of the background to show through, with the result that the colour effect of the metallic leaf is modified.

Palette and Tools. â€” The palette of the mosaic worker is a shallow box with many partitions, each division containing different- coloured tesserse. The only tools reqiured are clippers, for shaping the tesserse, and a pointed awl for pricking through the cartoon into the cement the outlines of the design. Although the process and tools are simple, it requires prolonged training of mind, hand, eye, and fingers to enable a workman to create in

mosaic a living representation as distinguished from a lifeless copy of the master craftsman’s design.

Drawing Directly on the Wall.

Curved Surfaces. â€” If the mosaicist desires to draw his cartoon directly upon the wall, a necessary procedure where curved surfaces are presented, he goes to work in the following manner. He causes a model to be made to scale, of a dome, semi-dome, or spandrel, and upon it he draws his design with a brush in strong red pigment, having previously squared up the whole surface to scale. This done, he causes the dome, semi-dome, or spandrel to be covered over with thick brown paper. This being attached to the wall with white lead suflB.cient only to give temporary adhesion, the brown paper is squared up to the scale of the small sketch ; each square being relatively numbered. The master then sets his pupils to work to draw mechanically and copy accurately from the small design on to the full-sized dome, semi-dome, or spandrel. This done, the master follows on, correcting with charcoal or brush until the whole design is developed in strong outline. Having made a slightly-coloured sketch, the master with the aid of his pupils proceeds to mix all the tints in water colour, adding coUa di pesce or fish glue and a little honey to prevent cracking. He then applies every tint separately, keeping each distract, and above all minding that the local colours of all half tints are different from the colour of all shadows. This done, he dips his brush in black and draws all the outlines, the thickness of which depends upon the distance which wiU intervene between his work and the spectator ; in order that the black may not appear cold from a distance, he will add to one side of the line a red line, thicker or thinner than the black according to the effect he wishes to produce. It is sometimes effective to add upon the other side of the black line a green line, so that the purple effect of the black and red shall be modified.

Colour. â€” ^We now come to the great question of colour and how to obtain it simply, and so that from a distance a blurred and woolly effect is not obtained. There should be a marked and sharp definition between all tints; they should not \>q fused; they should look sharply defined as the squares upon a chessboard, and appear crude and brutal. The work which looks least refined near at hand looks most finished at a distance. Eed and

blue lines alternately laid, either more red or more blue as the pur- ple is intended to tend towards red or blue, make the best purple. Green is best made with yellow and blue lines, the masses being separated by red lines, and the shadows of green should be red or blue: if red, they should be outlined with blue; if blue, with red. Red should be treated flatly, shaded with a deeper red, which should be of a warmer tone than the lights. Blue should be shaded with blue or red; and it is well to mix green tesserae with the blue in the lights, and again green tesserse with the blue or red shades to modify crudity. Pure white should be very sparingly used : it expands greatly at a distance. The best white is that which is of the tone of Naples yellow. Pure white in an atmosphere such as that of England comes to look blue and cold at a distance. Whenever it is necessary, however, to use pure white, either a yellow or pink line should be set on one side of it.

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It is impossible to keep the jlesli too simple. The local colour, i.e., a red orange, is the staple colour. Features should be drawn in strong red or burnt sienna, or a rich brown. The outlines of limbs or the contours of faces should be made first with a green line, a little darker than the local tints, then a red line darker still, then a black or brown line. White draperies are capable of being treated with endless variety. Their shadows may be green, red, blue, grey, or yellow. If the white drapery is to take a neutral tone when seen from a distance, all of these tints should be employed, because when mixed those positive colours appear neutral when seen from afar.

Gold drapery has a fine effect. Bright gold expands to four times the width of the line, so that the lines of gold should be thin. It may be that the gold drapery is to appear greenish ; when that is desirable the folds should be drawn in green outlined with red. All deep shades should be treated with red and hot browns. As gold ex- pands so considerably, a larger interval should be left between the tesserse than between any other colour, even white. Each tessera should have a thin space of the ground colour round it. The tesserse should never be jammed : it is that which causes so many modern mosaics to look like oil-cloth or chromo-lithographs.

The Finished Cartoon.

The finished cartoon, having been coloured in lines, should look exactly like the finished mosaic as regards effect; and the master, in making his cartoon, should always bear in mind that he is designing for mosaic, and not making a finished picture. The cartoon, when complete, is taken off the wall and cut up in pieces. Each piece is then carefully traced. The space upon the wall corresponding to each section is then covered with cement, but only upon that portion of the space which can be worked in mosaic in a day. The mosaic worker then applies the portion of the tracing upon the wet cement, and with a sharp point he pricks through the paper upon the lines thereon drawn; on removing the tracing he will find indents within the surface of the cement, which give him his cue to all the forms. Set- ting up the coloured design by his side, he takes the tesserae, which exactly correspond in colour and tone with those on the drawing, and begins his work, com- mencing from the outline and working inwards towards the centre, the lightest portion being left to the last. Here comes in the real test whether the craftsman is ca- pable or the reverse. This is soon judged by the master, who will put the work in and out until he is satisfied with the result. Unless the master has himself gone through the drudgery of laying the cubes, he can be no teacher. He must be a craftsman as well as a designer, and must know by experience and practice in a very diflRcult craft what the material can do with ease and what it is not called upon to do by reason of its inherent limita- tions. If he has not so trained himself he is certain to pictorialize what he should conventionalize, and moreover he will set technical difiiculties in the way which are im- possible to overcome. He must aim at the greatest sim- plicity without dulness, at producing the greatest effect by the simplest means, and to do that he must Tcnow his material or fail.

From what has been said it is evident that all mosaic work should be executed under the eye of the master, and therefore it is ridiculous to send cartoons to Italy to be executed there, transported to England, placed in situ, under different conditions of light, under different environ- ment, and under conditions possibly reversed. Mosaic will never take its place as a master craft in England or elsewhere until the master designer is also a craftsman. All mosaics should be executed upon the wall, and not

elsewhere ; and to be successful the master must give up almost the whole of his time, when he is not designing, to overlooking the work of his pupils, however capable they may be. n j â–

These are the principles which the author followed in the work at St Paul's; It is not for him to say anything for or against his own work. But of this he is certain, it was conducted upon a right basis, and not on the wrong and futile method previously employed in England. Eng- land can produce as good craftsmen as any other country can do; and if those who have the power would be patient with them, instruct them, encourage them, and work with them, English artists would produce as good work and be as good craftsmen as ever were seen in the best periods of Byzantine or mediaeval mosaic designers and craftsmen. (w- b. ki.)

Moscow, a government of Central Russia, bounded by Tver on the N.W., Vladimir and Ryazan on the E., Tula and Kaluga on the S., and Smolensk on the W. Area, 12,859 square miles.

Its geology has been carefully studied, and it appears that in the Tertiary period the surface of this province was already continental ; but during the Cretaceous period it was covered to some extent with the sea, which has left its traces in sands, clays, and shales, the organic remains of which testify to the littoral character of these deposits. Jurassic deposits are represented by their upper divisions only ; the lower ones, as well as Triassic and Permian deposits, are wanting. The Carboniferous deposits are of a deep- sea origin, and are only represented by the upper division which lies upon Devonian deposits, discovered in an artesian well at Moscow at a depth of 1508 feet. The pendulum anomaly, men- tioned already by Schweitzer, has been investigated. It appears in a zone 10 miles wide and about 95 miles long from west to east, and is positive (-Fl0”~~6) to the north of Moscow and negative (~~ 2”~~7) to the south. The prehistoric archaeology of Moscow has been carefully studied. The site of the district has been inhabited since the Stone Age. Bronze implements are rare, and there are places where instruments of stone, bone, and iron are found to~~ gether. The inhabitants who left the burial mounds in the 10th to 12th centuries seem to have been of Finnish origin, and were poorer, as a rule, than their contemporaries on the Volga.

At the census of 1897 the population was 2,433,356, out of whom 1,208,783 were women, and 1,099,604 lived in towns. In 1899 there were 1,072,600 acres under crops, and the total average annual crop of the period 1895-99 was 5,813,000 owts. of all grain (rye 3,433,000 cwts., oats 1,985,000 cwts.). The importance of the Moscow government as a manufacturing centre is steadily increasing, and it now stands first in Russia with its aggregate annual produc- tion valued at Â£40,300,000 (in 1896), the next three provinces being St Petersburg (Â£31,700,000), Piotrkdw in Poland (Â£21,600,000), and Vladimir (Â£17,800,000). The chief factories are for cottons Â£13,075,300 ;81,936 workers in299 factories), wooUens (Â£5,607,600), silks (Â£244,300), clothing (Â£659,800), sugar refineries (Â£1,050,400), distilleries (Â£1,700,000), iron works (Â£540,000). There is besides a very great variety of smaller industries, such as those concerned in gold thread and gold brocades, gold and sOver jewellery, bronze, perfumery, sweets, tobacco, tanneries, gutta-percha, furniture, carriages, wall-paper, c&o. In 1894 there were in the secondary schools (excluding Moscow) 61,300 pupils. For primary education there were 913 schools, out of which 13 were of the ministry of education, 591 of the zemstvo, 213 of the clergy, and 96 private. The government is divided into 13 districts, the chief towns of which are â€” Moscow (q.v.), Bogorodsk (11,210 inhabitants), Bronnitsy (3837), Dmitroff (4560), Klin (5057), Kolomna (20,970), Mozhaisk (4839), Podolsk (3808), Ruza (2505), Serpukhoff (24,456), Vereya (3704), Volokolamsk (2899), and Zvenigorod (2110). (p. a. k.)

Moscow, the second capital of the Russian Empire and chief town of the government of same name, situated in 55Â° 45′ N., 37Â° 37′ E., on both banks of the river Moskva. Its population has been growing since 1870 at the rate of about 2-i- per cent, per annum, and was in 1872, 601,969 ; (1S8L’), 753,469 ; (1897), 988,614 (1,035,664 with the suburbs). The housing problem is of great importance, as it appears that no less than 7258 lodgings, i.e., over 10 per cent, of the total (occupied by 59,000 persons), are underground. Thus while the average for the city is two occupants to each room, there were

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more than 10,000 lodgings which had more than four occupants to each room, representing one-fourth of the population. The average mortality is consequently high, napiely 28 per 1000 (33 per 1000 if the children inmates of the Foundling House be included). In 1890 there were 9818 industrial establishments giving occupation to 122,445 workers, of whom 14 per cent, were children, 11 per cent, girls above fifteen years of age and women, and 75 per cent, were men and boys above fifteen years. There were besides 16,481 trade establishments, with 10,893 employes.

Moscow still continues the chief industrial centre of Russia, and it is estimated that the yearly returns of the Industries alone exceeded, in 1895, Â£20,000,000. Their character is best seen from the following figures : â€”

Textiles .... Clothing, shedding, laundries Metals . Building

umber

Number

iblishraents.

of Workers

753

35,692

3815

22,.391

1076

10,915

814

10,760

664

9911

881

8261

577

7756

609

7522

181

2497

Articles of food . Wooden goods Machinery Paper and tanneries Polygraphic trades

The importance of Moscow as a centre for trade is steadily grow- ing, and it is estimated that the yearly returns of 15,500 trside establishments amount to Â£200,000,000 ; while as a centre for railways the city plays so predominant a part in the traflBo, that from one-sixth to one-seventh of all the goods shipped by the railways of European Russia (about 322,000,000 tons) loaded or unloaded at Moscow. No less than 501,000 tons of grain and flour, 26,000 tons of meat, 27,000 tons of fish, 226,000 tons of naphtha and its products, 100,000 tons of coal, and 870,000 tons of fuel wood are imported every year. As to the passenger traffic, it attains every year 6,300,000 passengers entering or leaving. The foreign imports are about 230,000 cwts. of tea, 90,000 cwts. of iron and steel goods, about 200,000 bottles and 330,000 gallons of wine, 55,000 cwts. of drugs, as well as raw cotton, raw wool, and silk. The exports are chiefly manufactured goods, sugar, drugs, &c. Tramways are rapidly developing, the tendency being to munici- palize them. There were in 1893, 58 miles of tramways (over 43,000,000 passengei;s), but there has been considerable develop- ment

since. The banks, including the mortgage banks, are the most important in Russia. The water-supply has been largely in- creased, a new supply having been brought from Mytishchi, calcu- lated to yield every day 4,200,000 gallons, but this can be extended so as to provide in the future 9,500,000 gallons. A number of excellent free libraries (Turgufeeff's, Ostrovsky's, Tchertkoff's, Galitzyn's) have been opened, the two latter containing valuable collections of books and MSS. The remarkable Tretiakoff gallery of pictures, chiefly of the Russian school (1278), has been given by its owner to the city. A polytechnic containing a museum, a large school of technical drawing, and various museums â€" technical, decorative art, domestic trades, educational, zoological, antique art, hygienic, municipal economy, and so on â€" have been opened, and the numijer of societies for scientific and various other purposes has greatly increased. Of philanthropic institutions, free' hospitals, cheap lodgings, and the like, there is a great number ; they own property valued at Â£3,000,000, possess an aggregate capital of Â£4,566,860, and in 1897 gave aid to 437,500 persons. Besides, the municipal relief of the poor was entirely reorganized in 1894, partly on the Elberfeld system and partly on quite new and original lines. The movement for the maintenance and scientific restoration of old church architecture has been of value to some of the antiquities as well as to the revival of the 16th-century Moscow style of building (partly Florentine, or Italian altogether). Several buildings, such as a very handsome new Gostinoi Dvor, in lieu of the old one, have been built in that style, which fully corresponds to the style of the best parts of the Kremlin. A gorgeous monument in memory of Alexander II. has been erected. Moscow has always been a centre for the publication of very cheap books for the peasant class, which are carried about the villages by pedlars. Owing to the efforts of Count Tolstoy and others, a great improvement has been introduced into these publications, books and pictures of a high standard being now circulated at a trifling cost. The importance of the book trade is evident from the fact that during a single year eleven firms issued 3,945,000 copies of 396 of such books, to which about 1,500,000 copies of the Posrednik firm must be added. As to the pictures, about 1,700,000 copies of the best kinds and 4,000,000 of the plain- est ones (sold in the villages at half a farthing apiece) are printed at Moscow, and coloured by peasant children in the neighbouring villages. Owing to special conditions of censorship, the periodical

press is not so much developed as it is in St Petersburg. There are only 6 daily and 2 illustrated papers, 3 reviews, and 16 periodicals of a general character, while the number of official publications is 9. There are, moreover, 72 scientific and technical periodicals weekly, making a total of 108 periodical publications, as against 304 published in St Petersburg and 1561 in the provinces. (p. a. K.)

Mosquitoes. â€” The term “mosquito” is derived from the Spanish diminutive mosca â€” alittle fly. A variety of insects comes under the name, the majority belonging to the dipterous famUy Culicidw. Other insects called mosquitoes are the sand-flies (Simulidce), certain midges belonging to the Chironomidm of the genus Ceratopogon, and a few other blood-sucking diptera, such as Plilebo- tomus. True mosquitoes are Culicidce. In that family the wing veins are covered with scales of varied form, and there are also scales on the head, body, and legs ; another essential character is that the costal vein is carried right round the border of the wing. In all the genera, except Corethra and Mochlonyx, the mouth is in the form of a long piercing proboscis. The mouth parts consist of a long lower lip ending in two jointed pro- cesses, the labial palpi, the lip forming a kind of gutter in which lie five lancet-like pieces â€” two needle-like man- dibles, two pointed maxillse, and the hypopharynx, which is a tubular prolongation perforated by the salivary duct, which opens at its end. All these parts are covered above by the narrow upper lip. The whole proboscis except the lower lip is pierced into the skin previous to the blood being extracted, and at the time the puncture is made saliva is injected into the wound. The veins of the wing of a mosquito are scaled, and are also charac- teristic. The second and fourth longitudinal veins are forked, the relative lengths of these fork-cells and the position of the cross-veins being of specific importance.

The larvsB of mosquitoes are all aquatic, the majority living in still or slightly running fresh water, though some occur in brackish and a few in salt water. The pupae are also aquatic, and are more or less active. In Europe and North America mosquitoes generally pass the winter as hibernating pregnant females ; in tropical climates they go into a semi-hibernating condition dur- ing the dry season, when there is little water in which to deposit their eggs. There may be many broods in the year ; Professor Howard has counted as many as twelve. Their reproductive

powers are strongly developed; ac- cording to Mcalbi, one mother may be accountable for a progeny of 50 milliards in the fifth generation. Alti- tude has no effect upon the Culicidce; some have been found in the Himalaya at 13,000 feet. Distribution takes place mainly by ships and trains, on which these pests are often abundant. The natural agencies of dis- persal Sre very limited, as mosquitoes at once seek shelter from the wind, and the larvae are seldom plentiful in running water.

In England mosquitoes are called gnats, and in parts of America gallinippers. Many species are undoubte&ly normally phytophagous, but the majority of the females, and even a few of ttie males, are very sanguinary. These sanguinary Culicidce. form the true mosquitoes which cause such annoyance by their bites, as well as being carriers of disease. It has been said that blood is necessary for them to produce fertile eggs, but this is evidently erroneous. Culicidce are found in all climates, and although in the tropics they are more troublesome than elsewhere, yet even within the Arctic circle they are often so abundant that they may completely cover the exposed parts of the body until, as described by Nansen whilst in Greenland, the hands look as if covered with rough woollen gloves. One genus at least. Anopheles, forms the intermediate host of th.Q Hoemamoehidce, the blood parasites that cause malaria, the gnats acting also as distributors of these germs from

person to person. Another disease traced to them by Dr Patrick Manson, Dr Bancroft, and others is filariasis, in which Cvlex panoplites and Anopheles are employed (see Nematoda). Other complaints, such as yellow fever and elephantiasis, are also connected with these insects.

The family CmKci’iJcb embraces the following genera: â€” Megarrhinus (Desv), Anopheles (Meig), Cycloleppteron (Theo), Psorophora (Desv), Mucidus (Theo), Stegomyia (Theo), Culex (L.), Eretmapo- dites, Panoplites, and Deinokerites (Theo), Tceniorhynchus (Arri), ^des (Meig),Hcemagogus{Will),^deomyiaa.ndWyeomyia(Theo), Uranotcemia

{Atri), Trichoprosopon (Theo), Sabethes (Desv), and the two non-piercing-mouthed genera, Corethra and Mochlonyx.

Those genera which cause most annoyance are Anopheles, Stego- myia, Culex, and Panoplites (see Fig.). Anopheles are nearly all blood-suckers in the female sex, both sexes having long palpi. Most of them have, spotted wings, and when stationary remain with their proboscis and their body in a straight line ; they can thus be distinguished from Culex, which, when settled, carry the proboscis bent at an angle to the rest of the body and the thorax humped. The male palpi are swollen at the ends, which is not

A, Larva of AiwpheUs ; B, pupa of Anopheles ; C, larva of Stegomyia ; D, pupa of Gulex; E, e^g-float and further enlarged detached egg of Oulex; F, female Anopheles costaHs, Loew ; G, head of $ Culex; H, head of J* Anopheles ; J, head of c? Cul&3i ; K, eggs of Anoplieles.

usually the case in Culex or Stegomyia. The larvse live in all kinds of places, but show adecided preference for small surfaces of water, such as temporary roadside puddles ; they cannot live in rapidly- running water, but a few exist in salt waters. They lie almost horizontally in the water, and are grey, green, or brown in colour ; there is no respiratory siphon, and on the anal segment are four leaf-like plates. Head, thorax, and abdomen have tufts of many- branched hairs. Their food consists mainly of green algse and other small water animals, including their own species, and plants. The pupae have two truncated air-tubes on the thorax, and move about freely in the water. Fifty -five species of Anopheles are known, of which nine come from Africa, twenty-three from Asia, five from both North and South America, six from Europe, four from Australia, and four from the West Indies. They seem to be most abundant in India, the Malay Peninsula, West and Central Africa. It is in Anopheles alone that Patrick Manson, Ross, Grassi, and others have shown that the malarial parasite can develop. Only certain species {A. funestus, costalis, maculipennis, &o.) seem to act as intermediate hosts, and the probability is that all Anopheles do not do so. The malarial parasites are injected into the blood with the mosquito saliva.

Culex is the largest genus of the family, and contains probably more than 200 species ; at present some 140 only are known in the restricted genus. The palpi are short in the female, long in the male ; the head is covered with

narrow-curved and forked-upright scales, the soutellum with narrow-curved scales only. The larvsB live in a variety of places, those of the household mosquitoes usually in water-butts and cisterns, and small receptacles of rain-water ; some even in cesspools. A few live in the sea (C. marinus, Theo, &c.), others in salt marshes (C nemorosus, variety salinus. Fie). Culex larvee differ from Anopheles in having a long respiratory siphon, and in the head being much broader than the rest of the body. When at the surface they hang head downwards, the siphon resting against the water-film ; they are very active, and move by a series of jerks. The pupse have two siphons on the thorax, but they are more cylindrical, and not truncated as in Anopheles. Some mosquitoes of this genus have a wide distribu- tion ; Culex fatigans (Wied) occurs all over tropical, sub-tropioal, and warm temperateoountries. Members of this genus act as the intermediate hosts of Filaria Bancroftii, and also of the Proteosoma or blood-parasites of birds (Ross), but so far all experiments with

human malaria have failed with them. Some of the naost vicious mosquitoes are contained in the genus Stegomyia, which is separated from Culex on account of the flat head, scales, and scutellar scales. The larvse apparently have a much shorter and thicker siphon than in Culex. One species, S.fasciata (Fabr), is almost cosmopolitan, this little black-and-white mosquito being one of the commonest- species of the family. Members of other genera also bite, and, as we have said, are connected with certain diseases in man. Those of the genus Panoplites, characterized by their broad wing-scales, cause severe irritation, the saliva being distinctly acid ; most of these are riverside pests. In the genus JSJdes both male and female have short palpi. The allied genera are JEdeomyia, with broad wing-scales ; Hcemagogus, with five-jointed palpi ; Sabethes, with the feet provided with paddle-like tufts in the male sex ; and Uranotcenia, small mosquitoes with very small fork-cells and usually some briUiant scales. The genera Trichoprosopon and Limatus (Theo) are distinguished by the presence of scales and chsts on the metanotum, seen in no other Culicidse. They thus differ from Wysomyia, which has only chaetss. (f. v. t.)

M OSS , a seaport town of Norway,county of Smaalenene, on the east shore of Christiania Fjord, 37 miles by rail south of Christiania. Here was signed, on 14th August 1814, the convention which united Norway to Sweden. The

town was almost destroyed by a fire in 1858, but was promptly rebuilt. The little river Mosse affords motive power for saw-mills, flour-mills, iron-works, and factories for wood-pulp, rice-busking, bottles and glass, preserves, a distillery, &c. The trade, of the annual value of Â£300,000 to Â£400,000, consists chiefly in the export of timber, ice, wood-pulp, grain and flour, and spirits, and in the import of grain and flour (mostly rye from the Black Sea ports), limestone and coal. The port, which affords 13 to 22 feet of water beside the quays, was cleared by 220 vessels of 77,200 tons burden in 1899. Population

(1875), 5117 ; (1891), 8051 ; (1900), 8941.

Mossamedes, a town of Portuguese West Africa, capital of the district of Mossamedes, on the south side of Little Pish Bay (Bay of Mossamedes or Angra do Negro). It is regularly built, and defended by the fort of Sao Fernando. It serves as a sanatorium for the province of Angola. Population, 5000. The district of Mossa- medes is watered by the rivers Kubango, Kunene, and Kwando, and exports spirits, cotton, india-rubber, coffee, wax, hides, gums, ivory, fish, orchil, and cattle. In 1901 the district was divided â€” the coast district or Mossamedes, and the inland district or Huilla. The trade increased from Â£57,000 in 1886 to Â£146,667 in 1899. Pish is the principal export.

Mossley, municipal borough (1885) and market town in the Prestwich parliamentary division of Lanca- shire, England, 10 miles east-north-east of Manchester, on the river Tame and the London and North- Western rail-way. The new church of St George’s has been completed. A mansion which cost Â£80,000 has been sold to the corpo- ration for the nominal sum of Â£4000, and is used as the town hall. There are foundries, mill-works, woollen factories, and large cotton-spinning mills. Population

(1881), 13,860; (1891), 14,162; (1901), 13,452.

Mostaganem, a town of Algeria, in the depart- ment of Oran, chief town-of the arrondissement, 44 miles east-north-east of Oran, on a plateau 278 feet high, half a mile from the Mediterranean coast. It has been made the head of arailway line connecting the coast with Tiaret. The surrounding country, laid out in vineyards and orchai-ds, is one of the healthiest and most fertile

of the colony. There are seventeen European villages in the district, and in the town are tanneries and peltries. An active trade is carried on in wool, skins, figs, and raisins. Noted Mussulman schools attract numerous students. ‘"holly an artificial creation, begun in 1888 and not yet finished, the port, notwithstanding the heavy outlay it has cost, promises but mediocre results. The tonnage averages about 70,000

a year. Population (1881), 13,420 ; (1891), 14,975 ; (1900),

17,353.

Mostar, the chief town of Herzegovina, Austria- Hungary, and. the seat of a Eoman Catholic and a Greek bishopric, situated on the Narenta river, and on the railway from Sarajevo to Metkovic, 81 miles south-west of Sarajevo and 27 north of Metkovic. A Government tobacco factory has been established. The Narenta is crossed by an iron bridge, built in 1881, the remarkable old bridge (built by the Turks in 1566, probably on the site of an old Roman bridge) being now used only by foot-passengers. Population (including the garrison), about 14,500.

Mosul. â€” 1. A vilayet of Asiatic Turkey, of which the greater part lies to the east of the Tigris. It is divided into three sanjaks, Mosul, Shehrizor, and Suleimanieh, and has an area of 29,000 square miles. Population 295,000 (Moslems 245,000, Yezidis 15,000, Christians 30,000, and Jews 5000). The climate is very hot, but healthy. The soil, naturally fertile, is little cultivated. 2. The capital of a vilayet and sanjak of the same name, situated on the right bank of the Tigris. It is now of little industrial or commercial importance, but remains the collecting and distributing centre for the north Mesopotamian desert and Kurdis- tan. The exports and most of the imports pass through Baghdad. Mosul is the meeting point of roads from Aleppo, Diarbekr, Bitlis, north and west Persia, and Baghdad, and it is on the projected line of railway from Constantinople to the Persian Gulf. The population amounts to 40,000 (Moslems 31,500, Christians 7000, Jews 1500). The town is the seat of British, French, and Russian consulates.

Parry. Six Months in a Syrian Monastery. 1895. â€” Saohau. Am Euphrat und Tigris. Berlin, 1899. â€” Von Oppbnhbim. Vom Mittelmeer zum Persischen Golf. Berlin, 1900. (c. w. W.)

Motala, a modern town of Sweden, county of Oster- gotland, on the east side of Lake Wetter, on the Gota canal and the river Motala, at its exit from the lake, 42 miles west from Norrkoping. It was only founded In 1880. Two miles east of the town are the Motala iron- works (1822), the largest in Sweden, with branches in Norrkoping, Gothenburg, and other towns, in which iron war-ships, railway locomotives, iron bridges, machinery, &c., are built. Population (1900), 3047.

Motherwell, a police burgh and important railway junction of Lanarkshire, Scotland, near the Clyde, 12|^ miles south-east by east of Glasgow by rail. A distinctive modern industry is bridge-building, which is carried on in three large establishments. Among modem erections are a town hall, a new post office, and a hospital. A theatre is about to be built. Electric lighting has been introduced, and it is proposed to spend Â£120,000 on an additional gravitation water scheme. A park was presented to the town in commemoration of Queen Victoria's jubilee. United Free, Baptist, and Episcopal churches have been erected, also a secondary and technical school. There is, too, a Eoman Catholic secondary and technical school. Motherwell has been subject for many years to consider- able damage to buildings from the working of the min- eral iield on which the town is built. Population (1881),

12,904; (1891), 18,736; (1901), 30,243.

Motion, Laws of.â€” Before the time of Galileo (1564-1642) hardly any attention had been paid to a scientific study of the motions of terrestrial bodies. With regard to celestial bodies, however, the case was different. The regularity of their diurnal revolutions could not escape notice, and a good deal was known more than 2000 years ago about the motions of the sun and moon and planets

among the stars. For the statement of the motions of these bodies uniform motion in a circle was employed as a fundamental type, combinations of motions of this type being constructed to fit the observations. This

procedure did not afford any law connecting the motions of differ- ent bodies. Copernicus (1473-1543) employed the same system, and greatly simplified the application of it, espe- cially by regarding the earth as rotating and the sun as the centre of the solar system. Kepler (1571-1630) was led by his study of the planetary motions to reject this method of statement as inadequate, and it is in fact in- capable of giving a complete representation of the motions in question. In 1609 and 1619 Kepler published his new laws of planetary motion, which was subsequently shown by Newton to agree with the results obtained by experi- ment for the motion of terrestrial bodies.

The earliest recorded systematic experiments as to the motion of falling bodies were made by Galileo at Pisa in the latter years of the 16th century. Bodies of different substances were employed, and slight Acceiera- differences in their behaviour accounted for by ““avlty. the resistance of the air. The result obtained was that any body allowed to fall from rest would, in a vacuum, move relatively to the earth with constant acceleration ; that is to say, would move in a straight line, in such a manner that its velocity would increase by equal amounts in any two equal times. This result is very nearly correct, the deviations being so small as to be almost beyond the reach of direct measurement. It has since been discovered, however, that the magnitude of the acceleration in question is not exactly the same at different places on the earth, the range of variation amounting to about |- per cent. Galileo proceeded to measure the motion of a body on a smooth, fixed, in- clined plane, and found that the law of constant accelera- tion along the line of slope of the plane still held, the acceleration decreasing in magnitude as the angle of in- clination was reduced; and he inferred that a body, moving on a smooth horizontal plane, would move with uniform velocity in a straight line if the resistance of the air, and friction due to contact with the plane, could be eliminated. He went on to deal with the case of pro- jectiles, and was led to the conclusion that the motion in this ease could be regarded as the result of superposing a horizontal motion with uniform velocity and a vertical motion with constant acceleration, identical with that of a merely falling body ; the inference being that the path of a projectile would be a parabola except for deviations attributed to contact with the air, and that in a vacuum this path would be accurately followed. The method of superposition of two motions may be illustrated by such examples as that of

a body dropped from the mast of a ship moving at uniform speed; and in this case it is found that the body falls relatively to the ship as if the latter were at rest, and alights at the foot of the mast, having consequently pursued a parabolic path relatively to the earth.

The importance of these results, limited though their scope was, can hardly be overrated. They had practically the effect of suggesting an entirely new view of the sub- ject, namely, that a body uninfluenced by other matter might be expected to move, relatively to some base or other, with uniform velocity in a straight line ; and that, when it does not move in this way, its acceleration is the feature of its motibn which the surrounding conditions determine. The acceleration of a falling body is naturally attributed to the presence of the earth ; and, though the body approaches the earth in the com-se of its fall, it is easily recognized that the conditions under which it moves are only very slightly affected by this approach. More- over, Galileo recognized, to some extent at any rate, the

principle of simple superposition of Yelocities and accel- erations, due to different sets of circumstances, when these are superposed (see Mechanics, Ency. Brit. vol. XV.). The results thus obtained apply to the motion of a small body, the rotation of which is disregarded ; and, our first notions being derived from this case, the motion of any system is dealt with by regarding it as built up of small portions. Such portions, small enough for the position and motion of each to be sufQciontly specified by those of a point, are called “particles.” Other forms of experiment can readily be arranged to test, with regard to terrestrial motions, the correspond- ence of constant acceleration to constant conditions, and the principle of superposition.

The’ period immediately succeeding that of Galileo’s work and teaching was not very fruitful in results. Descartes helped to generalize and establish the foros.’””’ iiotion of the fundamental character of uniform motion in a straight line, but otherwise his specu- lations did not point in the direction of sound progress in dynamics ; and the next substantial advance that was

made in the principles of the subject was due to Huygens (1629-95). He attained correct views as to the character of centrifugal force in connexion with Galileo's theory ; and, when the fact of the variation of gravity (Galileo's acceleration) indifferent latitudes first became known from the results of pendulum experiments, he at once perceived the possibility of connecting such a variation with the fact of the earth's diurnal rotation relatively to the stars. He made experiments, simultaneously with Wallis and Wren, on the collision of hard spherical bodies, and his statement of the results (1669) included a clear enunciation of the conservation of linear momentum, as demonstrated for these cases of collision, and apparently correct in certain other cases, mass being estimated by weight. But Huy- gens's most important contribution to the subject was his investigation, piiblished in 1673, of the motion of a rigid pendulum of any form. This is the earliest example of a theoretical investigation of the rotation of rigid bodies. It involved the adoption of a point of view as to the rela- tion between the motions of bodies of different forms, which practically amounted to a perception of the princi- ple of energy as applied to the case in question.

We owe to ISTewton (1642-1727) the consolidation of the views which were current in his time into one co- herent and universal system, sometimes called Oaiiieo- tij^e Galileo-lSTewton theory, but commonly known theon'' as the "laws of motion" ; and the demonstration of the fact that the motions of the celestial bodies could be included in this theory by ineans of the law of universal gravitation. A full account of his results was first published in the Principia in 1687. (For Newton's formal statement of laws of motion see Ency. Brit. vol. XV. p. 676; this should be read in conjunction with the introduction and explanations given in the Principia.)

Such statements as that a body moves in a straight line, and that it has a certain velocity, have no meaning unless the base, relative to which the motion is to be reckoned, is defined. Accordingly, in the extension of Galileo's results for the purpose of a universal theory the establishment of a suitable base of reference is the first step to be taken. ISTewton assumed the possibility of choosing a base such that relatively to it the motion of any particle would have only such divergence from uniform velocity in a straight line as could be expressed by laws of acceleration de- pendent on

its relation to other bodies. He used the term “absolute motion” for motion relative to such a base. . Many writers on the subject distinguish such a base as ” fixed.” It is sometimes convenient to apply to the base in question a name of a more specific character. The name

” Newtonian base ” will serve this purpose. Assuming such a base to exist, Newton admitted at the outset the difficulty of identifying it, but pointed out that the key to the situation might be found in the identification of forces ; that is to say; in the mutual character of laws of acceleration. In this connexion he took an important step by. distinguishing clearly the character of “mass” as a universal property of bodies distinct from weight.

There can be no doubt that the development of correct views as to mass was closely connected with the results of experiments with regard to the collision of hard bodies. Suppose two small spherical bodies which can be regarded as particles to be brought into collision, so that the velocity of each, relative to any base which is unaffected by the collision, is suddenly changed. The additions of velocity which the two bodies receive respectively, rela- tive to such a base, are in opposite directions, and if the bodies are alike their magnitudes are equal. If the bodies though of the same substance are of different sizes, the magnitudes of the additions of velocity are found to be inversely proportional to the volumes of the two bodies. But if the bodies are of different substances, say one of iron and the other of gold, the ratio of these magnitudes is found to depend upon something else besides bulk. A given volume of gold is found to count for this purpose for about two and a half times as much as the same volunle of iron. This is expressed by saying that the density of gold is about two and a half times that of iron. In fact, experiments upon the changes of velocity of bodies, due to a mutual infiuence between them, bring to light a property of bodies which may be specified by a quantity propor- tional to their volumes in the case of bodies which are perceived by other tests to be of one homogeneous sub- stance, but otherwise involving also another factor.

The product of the volume and density of a body measures what is called its ” mass.” The mass of a body is often loosely defined as the measure of the quantity of matter in it. This definition correctly indicates that the mass of any portion of matter is equal to the sum of the masses of its parts, and that

the masses of bodies alike in other respects are equal, but gives no test for comparison of the masses of bodies of different substances ; this test is supplied only by comparison of motions. When, as in the case of contact, a mutual relation is perceived between the motions of two particles, the changes of velocity, or when gradual changes of velocity are in question, the accelerations, are in opposite directions, and the ratio of their magnitudes determines the ratio of the masses of the particles, the motion being reckoned relative to any base which is unaffected by the change. It is found that this gives a consistent result ; that is to say, if by an experi- ment with two particles A and B we get the ratio of their masses, and by an experiment with B and a third particle C we get the ratio of the masses of B and C, and thus the ratio of the masses of A and C, we should get the same ratio by a direct experiment with A and C. For the numerical measure of mass that of some standard body is chosen as a unit, and the masses of other bodies are ob- tained by comparison with this. Masses of terrestrial bodies are generally compared by weighing ; this is found by experiment to give a correct result, but it is applicable only in the neighbourhood of the earth. Familiar cases can readily be found of the perception of the mass of bodies, independently of their tendency to fall towards the earth. The mass of any portion of matter is found to be permanent under chemical and other changes, and this fact adds to its importance as a physical quantity. Minute variations may possibly occur, but none has been estab- lished.

The Galileo-Newton theory of motion is that, relative

tlon of the theory.

to a suitably chosen base, and with suitable assignments of mass, all accelerations of particles are made up of mutual, so called, actions between pairs of particles, whereby the two particles forming the pair have accelera- tions in opposite directions in the line joining them, of magnitudes inversely proportional to their masses. Thus the product of mass and magnitude of acceleration is the same for each. The mutual action between two particles is otherwise expressed by saying that a force acts upon each of them, in the

line joining it to the other^ each force being measured by the product of mass and acceleration ; so that pairs of forces are equal and opposite. Thus the total acceleration of any par- ticle is that given by the superposition of the accelera^ tions due to the several forces which act upon it. An equivalent operation is to compound the several forces acting on a particle by the parallelogram law (see Mechanics) into what may be called the resultant force, the total acceleration of the particle being the same as if this alone acted.

To apply and verify the theory, we depend on being able to identify and classify forces. They are recognized

by their reciprocal character, and it is found Applies- possible to establish permanent laws connecting

the forces in any system with its configuration

and other recognizable characteristics. A gener- alization of Galileo's results takes the form that under constant conditions of this character force is constant, and that the superposition of two sets of conditions, if their independence can be secured, results in superposi- tion of the forces associated v^ith them separately. The association of forces with the conditions of their occur- rence causes some confusion of nomenclature. It is pos- sible to regard specified physical conditions or a certain configuration, such as strain in a case of contact, as provid- ing a definition of force of a certain type ; to deduce other types by reference to their neutralizing effect; and to regard the expression in terms of acceleration as an ex- perimental resalt. Such a course is sometimes followed, and within a limited range of application to terrestrial mechanics it is a natural procedure ; but for the purpose of a universal theory it is difficult to maintain this point of view consistently, and the definition of force in terms of motion is usually adopted by modern writers as being logically the more convenient. Particular laws of force may be suggested by a study of the simplest cases in which they are manifested, and from them results may be obtained by calculation as to the motions of systems of any given structure. Such results may be tested 'by direct observation. For the calculation of the motion of any body which is known to be perfectly rigid, no know- ledge of the forces

between particles composing the body is needed, beyond the fact that they neutralize any ten- dency to change of shape.

Newton’s law of gravitation affords the most notable example of the process of verification of a law of force,

and incidentally of the G-alUeo-Newton theory. oravita- j^^ ^ -^^^ ^^ acceleration of the planets relatively

to the sun, its approximate agreement with Kepler’s third law of planetary motion follows readily from a consideration of the character of the acceleration of a point moving uniformly in a circle. Newton tells us that this agreement led him to adopt the law of the inverse square of the distance about 1665-66, before Huygens’s results as to circular motion had been pub- lished. At the same time he thought of the possibility of terrestrial gravity extending to the moon, and made a calculation with regard to it. Some years later he suc- ceeded in showing that Kepler’s elliptic orb for planetary motion agreed with the assumed law of attraction; he also completed the co-ordination with terrestrial gravity

by his investigation of the attractions of homogeneous spherical bodies. Finally, he made substantial progress with more exact calculations of the motions of the solar system, especially for the case of the moon. The work of translating the law of gravitation into the form of astronomical tables, and the comparison of these with observations, has been in progress ever since. It has involved great labour and refinement of calculation, and is not yet completed. The verification is sufficiently exact to establish the law of gravitation, as providing a statement of the motions of the bodies in question which is correct to a high degree of accuracy. In the meantime some confirmation of the law has been ob- tained from terrestrial experiments, and observations of double stars tend to indicate for it a wider if not uni- versal range. It shotdd be noticed that the verification was begun without any data as to the masses of the celes- tial bodies, these being selected and adjusted to fit the observations. It may be mentioned that another factor has been introduced into the problem of the jnotions of these bodies by the recognition of the effects of their imperfect rigidity.

The case of electromagnetic forces between two con- ductors carrying electric currents affords an example of a statement of motion in terms of force of a highly artificial kind. It can only be contrived by means of complicated mathematical analysis, and the question of its correspond- ence with any actual division of the conductors into par- ticles is a difficult one. In this connexion a statement in terms of force is apt to be displaced by more direct and more comprehensive methods, and the attention of physicists is chiefly directed to the intervention of the ether. In fact, the study of this part of the subject leads us to look upon the universal statement of ruotion in terms of force as really only a provisional one, to be employed in default of more intimate knowledge of the connexions between material systenjs. It is worth noting that there are indications of this having been Newton's own opinion.

The Newtonian base deserves some further considera- tion. It is defined by the property that relative to it all accelerations of particles correspond to forces. This test involves only changes of velocity, and J^^"'â„¢ so does not distinguish between two bases, each of which moves relatively to theother with uniform velocity without rotation. The establishment of a true Newtonian base presumes knowledge of the motions of all bodies. But practically we are always dealing with limited systems, so any actual determination must always be re- garded as to some extent provisional. In the treatment of the relative motions of a limited system, we may use a confessedly provisional base, though it may be necessary to introduce corrections, either exact or approximate, to take account either of the existence of bodies outside the system, or of the rotation of the base employed relative to a more correct one. Such corrections may be made by the device of applying additional unpaired, or what we may call external, forces to particles of the system. These have only to take account of differences of accelerations of the several particles. The earth, which is commonly em ployed as a base for terrestrial motions, is not a very close approximation to being a Newtonian base. Differences of acceleration due to the sun and moon are not important for terrestrial systems on a small scale, and can usually be ignored, but their effect (in combination with the rota- tion of the earth) is very apparent in the case of the ocean tides. A much more sensible defect is due to the earth having a diurnal rotation relative to a Newtonian base, and this is never wholly ignored. Take a base

attached to the centre of the earth, but without this diurnal rotation. A small body hanging by a string, at rest relatively to the earth, moves relatively to this base

uniformly in a circle ; that is to say, with constant accel- eration directed towards the earth's axis. What is done is to divide gravitation into two components ; one of these then corresponds to this acceleration, and the other one is what is called the " weight " of the body. Weight is in fact the force which corresponds to the Galileo accelera^ tion vnth which the body would begin to move relatively to the earth if the string were cut. Another way of stat- ing the same thing is to say that we introduce, as a cor- rection for the earth's rotation, a force called " centrifugal force " which, combined with gravitation, gives the weight of the body. It is not, however, a true force in the sense of corresponding to any mutual relation between two portions of matter. The effect of centrifugal force is to make the weight of a body at the equator about ~~35 per cent, less than the value it would have if due to gravita~~ tion alone. This represents about two-thirds of the total variation of Galileo's acceleration between the equator and the poles, the balance being due to the ellipticity of the figure of the earth. In the case of a body moving relatively to the earth, the introduction of centrifugal force only partially corrects the effect of the earth's rota- tion. Newton called attention to the fact that a falling body moves in a curve, diverging slightly from the plumb- line vertical. The divergence in a fall of 100 feet in the latitude of Greenwich is about one-eleventh of an inch. Foucault's pendulum is another example of motion rela- tive to the earth which exhibits the fact that the earth is not a Newtonian base.

For the study of the relative motions of the solar system, a provisional base established for that system by itself, bodies outside it being disregarded, is a very good one. No correction for any defect in it has been found necessary ; moreover, no rotation of the base relative to the directions of the stars without proper motion has been detected. This is not inconsistent with the

law of gravi- tation, for such estimates as have been made of planetary perturbations due to stars give results which are insignifi- cant in comparison with quantities at present measurable. Our knowledge of motions of the stars and of the solar system relative to them is rather scanty, but is not incon- sistent with the view that the theory may be applicable throughout the whole extent of the known universe. It is natural to suppose that the Newtonian base has a rela- tion to the ether, which is the vehicle of electrical and optical phenomena, but this is a question which has not yet emerged from the region of speculation.

For the measurement of motion it must be presumed that we have a method of measuring time. The question of the standard to be employed for the scientific Measure- measurement of time accordingly demands atten- 7ime. ” tiaTL- Galileo measured time for the purpose of his experiments by the flow of water through a small hole under approximately constant conditions, which was of course a very old method. He had, however, some years before, when he was a medical student, noticed the apparent regularity of successive swings of a pendulum, and devised an instrument for measuring, by means of a pendulum, such short periods of time as sufficed for test- ing the pulse of a patient. The use of the pendulum clock in its present form appears to date from the con- struction of such a clock by Huygens in 1657. Newton dealt with the question at the beginning of the Principia, distinguishing what he called ” absolute time ” from such measures of time as would be afforded by any particular examples of motion ; but he did not give any clear defini- tion. The selection of a standard may be regarded as a matter of arbitrary choice ; that is to say, it woTild be possible to use any continuous time-measurer, and to adapt all scientific results to it. It is of the utmost im- portance, however, to make, if possible, such a choice of

a standard as shall render it unnecessary to date all results which have any relation to time. Such a choice is practically made. It can be put into the form of a definition by saying that two periods of time are equal in which two physical operations, of whatever character, take place, which are identical in all respects except as regards lapse of time. The validity of this definition depends on the assumption that operations of different kinds all agree in giving the same measure of time, such allowances as experience

dictates being made for chang- ing conditions. This assumption has successfully stood all tests to which it has been subjected. All clocks are constructed on the basis of this method of measurement ; that is to say, on the plan of counting the repetitions of some operation, adopted solely on the ground of its being capable of continual repetition with a certain degree of accuracy, and possibly also of automatic com- pensation for changing conditions. Practically docks are regulated by reference to the diurnal rotation of the earth relatively to the stars, which affords a measure- ment on the repetition principle, agreeing with other methods, but more accurate than that given by any existing clock. We have, however, good reasons for regarding it as not absolutely perfect, and there are some astronomical data the tendency of which is to confii-m this view.

The most important extension of the principles of the subject since Newton's time is to be found in the develop- ment of the theory of energy, the chief value of which lies in the fact that it has supplied a ª^^Â°' measurable link connecting the motions of systems, the structure of which can be directly observed, with physical and chemical phenomena having to do with motions which cannot be traced in detail. The import- ance of a study of the changes of the vis viva depending on squares of velocities, or what is now called the " kinetic energy " of a system, was recognized in Newton's time, especially by Leibnitz ; and it was perceived (at any rate for special cases) that an increase in this quantity in the course of any motion of the system was otherwise expres- sible by what we now call the " work " done by the forces. The mathematical treatment of the subject from this point of view by Lagrange (1736-1813) and others has afforded the most important statements of the theory of the motion of a system that are available for practical use. But it is to the physicists of the 19th century, and especially to Joule, whose experimental results were punished in 1843-49, that we practically owe the most notable advance that has been made in the development of the subject, namely, the establishment of the principle of the conservation of energy (see Energetics, Eney. Brit. vol. xxviii. ; also Energy, vol. viii.). The energy of a system is the measure of its capacity for doing work, on the assumption of suitable connexions with other sys- tems. When the motion of a body is checked by a spring, its kinetic energy being destroyed, the spring, if perfectly elastic, is capable of restoring the motion ; but if it is checked by friction no such restoration can be immedi- ately

effected. It has, however, been shown that, just as the compressed spring has a capacity for doing work by virtue of its configuration, so in the case of the friction there is a physical effect produced, namely the raising of the temperature of the bodies in contact, which is the mark of a capacity (in the sense in which the word is used) for doing the same amount of work. Electrical and chemical effects afford similar examples. Here we get the link with physics and chemistry alluded to above, which is obtained by the recognition of new forms of energy, interchangeable with what may be called me- chanical energy or that associated with' sensible motions and changes of configuration.

MOTOR VEHICLES

11

Having identified forms of energy other than mechani- cal, we can attempt to apply to physics and chemistry, or, as we may say, to molecular systems and the ether, not only the principle of conservation of energy, but also other relations connecting changes of energy of various types with the characteristics of a system. In this way the 19th century saw the first steps taken towards the carrying out of work which Newton bequeathed to his successors in the concluding sentences of the Principia.

Authorities. â€" Galileo. Dialogues (translations : " The Sys- tems of the World" and "Mechanics and Local Motion," in T.

^k-Lv&^v^Vs Mathematical Collections and Translations, 1661-65; Mechanics and Local Motion, by T. Weston, 1730).â€" Hutgens. Horologium Oscillatorium, 1673. â€" Newton. Principia, 1687 ; reprint of 3rd edition, 1871 (translation by A. Motte, 1729, New York, 1850).â€" W. W. Rocse Ball. An Essay on Newton's Prin- cipia, 1893. â€" Whewell. History of the Inductive Sciences, 1837; 3rd edition, 1857.â€" J. Clekk Maxwell. Matter and Motion, 1882. â€" H. Streintz. Die physikalischen Cfrundlagen der Mechanik, 1883. â€" E. Maoh. Die Mechanik in ihrer Entwickelung historisch- kritisch dargestellt, 1883 ; 2nd edition, 1889 (translation by T. J. McCoRMACK, 1893).â€" K. Pearson. The Grammar of Science, 1892 ; 2nd edition, 1900.â€" A. E. H. Love. Theoretical Mechanics, 1897. (^. H. M.)

MOTOR VEHICLES.

I. Light Vehicles.

MOTOR-CAE is a term primarily employed in America to denote the car or carriage containing the electro-motor used for propelling an electric tramcar or train of carriages on rails, but of late years more usually applied in Great Britain to light automobile or mechanically-propelled carriages running on common roads. On the Continent of Europe and in the United States the usual expression for these vehicles is ” auto- mobile ” ; the term ” autocar ” has also been employed.

The first practical steam carriage was made by Richard Treve- thick in 1802 (Mg. 1), though Cugnot had produced a rudimentary

Fig. 1. â€” Trevethick’s Steam Carriage : Side View and Plan.

one in Prance in 1769 ; but very little was done in this direction until 1824, from which date a number of these vehicles were con- structed and used with considerable success, taking the form of stage coaches propelled by steam, and weighing some 3 or 4 tons unloaded. Among the most successful of steam-carriage designers at this time were James, Gurney, Dance, Hancock, Maceroni and Squire, Somers and Ogle, Church, Hill, and Scott- Russell, all of whose vehicles proved practicable to some extent. Some of these ran regular passenger services, notably between Cheltenham and Gloucester, attaining average speeds of 10 to 14 miles per hour; but great opposition was met with owing to the narrow prejudice of those whose interests related to horse- haulage, and every obstruction was oHered in the shape of pro- hibitive tolls and legislative enactments. The result was that steam carriages were driven ofl the roads in favour of railways, although the select committee of the House of Commons appointed

in 1831 to inquire into the subject reported completely in favour of their adoption (as did also that of 1873). In 1861 the first Locomotives on Highways Act was passed, but the crushing blow came in 1865, when the Legislature prescribed (1) that the number of persons required to drive the locomotive should be increased to three ; (2) that a man should precede with a red flag ; (3) that the maximum limit of speed should be reduced to 4

miles per hour ; and (4) that they should be forbidden ever to blow off steam, &c. These restrictions were confirmed rather than relieved by the 1878 Act. Although these Acts were created to deal with heavy traction, the famous 1881 appeal in the Court of Queen's Bench placed every type of self-propelled vehicle, from a traction engine down to Bateman's steam tricycle, under their narrow limitations.

Fie. 2.â€" Butler's Motor Tricyde.

This resulted in the development of the heavy traction engine, and light motor vehicles were little more heard of in Great Britain. There were a few exceptions, however, notably the steam vehicles of Rickett (1860), Carrett (1861), Tangye (1862), Yarrow (1862), Holt (1866), Todd (1870), Perkins (1870), Mackenzie (1875), and Blackburn (1878), and some electrical carriages made by Elwell (1884), Ward (1886), and Volk (1888). An important departure was that of Butler, who constructed in 1885 what is believed to be the first vehicle (a tricycle) propelled by an internal combustion engine In England (Eig. 2) ; he used the vapour of benzoline exploded electrically. Later, Roots successfully employed heavy oil, as did Knight. The chief prohibitory clauses of the Acts were

Fib. S.â€" Early Daimler Motor Bicycle.

repealed in 1896, when public interest revived, and Great Britain, in spite of its early exploits in mechanical traction, found that it was completely left behind by other countries, such as Prance, Germany, and America, whose engineers had been handicapped by no such restrictions.

France has undoubtedly led in the development of the light automobile vehicle, though it is right to mention

that the most suc- cessful vehicles used there derive their power from a petroleum spirit motor invented by a German, Herr Gottlieb Daimler, who made numer- ous vehicles, com- mencing with a bicycle fitted with this motor (Fig. 3) in 1885. He dis- posed of his French patents to the firm of MM. Panhard and Levassor, who were well-known makers of wood-working machinery, and it may here be mentioned that to the ingenious application of the Daimler motor by M. Levassor, who was then the moving spirit of the firm, is largely due the successful development of the modern motor industry.

The general arrangement of mechanism that has been adopted by this firm is shown in Fig. 4. The motor, a two- or four-cylinder “equipoise,” is a modified Daimler, known as the Phoe- nix, using petroleum spirit or “petrol” of sp.g. 0-7 vapor- ized in a spray carburalor and ignited electrically, or by means of incandescent plat- inum tubes. It is virtually a gas engine working on the Otto cycle and making its own gas from petrol. It is situated in front, and trans- mits its power by means of a friction cone A, working into the fly-wheel, to one of the changeable spur wheels B1B2B3B* on the square shaft C, thence to one of the fixed spur wheels D^ D^ D3 D* on the second-motion shaft E. This shaft E in turn drives a transverse coun- ter-shaft I through a pair of bevel wheels F and H as shown, and counter-shaft I carries two sprocket pinions at its extremities, from which the back wheels of the car are driven by chains K. This shaft also carries the differ- ential gear G, which enables its ends to revolve at different speeds for going round corners. In order to be able to propel the carriage backwards, a re- versing motion is introduced consisting of two intermediate spur wheels RRi carried on a separate shaft L. When it is desired to go astern the sleeve carrying the spur wheels B^ B^ B^ B* is moved along the shaft C into a position such that the wheel B’ engages with R, and R^ with the spur wheel D^ ; this causes the shaft Eâ€” and consequently the back wheels of the car â€” to rotate in the opposite direction. The four pairs of spur wheels (which run in oil) allow of four ratios of gearing which are inter- changeable whilst running, according to

the power required, the friction clutch being relieved by the foot at each change of gear.

There is also a pedal for regulating the speed of the motor, and a powerful foot-brake, acting on the counter-shaft, besides two band brakes on the back wheels actuated by a lever. The steering is effected by a wheel with worm gear, and the carriage can be steered at high speed with one hand. These vehicles are nearly always fitted with pneumatic tyres, and may have ball or roller bearings, and electrical as well as tube ignition.

A great impulse was given to the French industry by the organization by the Petit Journal of a trial run of automobile vehicles from Ps,ris to Rouen in 1894. , This was followed next year by a race from Paris to Bordeaux and back, in which Â£2500 in prizes was awarded, mostly to MM. Panhard and Levassor, and MM. Peugeot Freres. The first carriage was driven by M. Levassor, and per- formed the journey of 744 miles in one trip, without a break-down, and at a mean velocity of 15 miles per hour. A still more important race was held in 1896, the course being from Paris to Marseilles and back. It was organ- ized by the Automobile Club of France, a society founded in that year upon the initiative of the count de Dion and baron de Zuylen, for the furtherance and encouragement of automobile locomotion : its membership grew in three and a half years to some 2000, and it is now one of the leading institutions in France. The race was 1060 miles in length, and was run under most adverse con- ditions of weather ; the winning carriage by Panhard and Levassor nevertheless made an average speed of 15-85 miles per hour, and was followed by two others of the same house, while the Delahaye and Peugeot carriages did good work. A prominent feature of this race was the remarkable and unexpected performances of the new petrol tricycles (Fig. 6) constructed by de Dion and Bouton, some thousands of which are now in use in France and other countries. This firm were also the

Fig. 4.â€” Mechanism of Panhard and Levassor Motor Cars.

builders of three steam vehicles which attempted the race, but did not get through. This and the Paris-Bordeaux race m fact established the triumph of petrol (i.e., petroleum spirit) for long distances over steam, which only seems to have gained first place on two occasions, VIZ., the Concours du

Petit Journal in 1894, and the Marseilles-Nice-Turbie race in January 1897, when a

de Dion brake covered the rough and hilly route of 145 miles in 7| hours. This vehicle, however, was very- heavy, and no successful attempt seems to have been made in France to construct a light steam vehicle except

Fig. 6. â€” De Dion and Bouton Petrol Tricycle.

by M. SerpoUet, whose “flash” generators are extensively used on tramways.

The speeds attained continued to increase. In 1897 the Paris-Dieppe and Paris-Trouville races showed an average of 26 miles per hour. In the Paris-Amsterdam race (1898), Charron, on an 8-h.p. Panhard carriage, kept up a mean speed of 28 miles an hour, and in 1899 he won the Paris to Bordeaux race on a 12-h.p. vehicle of the same make, covering the 350 miles in 11 hours 43 minutes without a stop. In the same year was held the longest motor race up to the present time (August 1902)â€” viz., the ” Tour de France,” 1440 miles in length, the distance being covered by Chevalier de Knyff (16-h.p. Panhard) in 42 hours 33 minutes running time. Other races of that year were the Paris-St Malo (200 miles), won by Antony’s 16-h.p. Mors in 7 hours 32 minutes; the Paris-Ostend (204 miles), the winning cars being Girar- dot’s Panhard and Levegh’s Mors (tie) ; Paris-Boulogne (143 miles), won by Girar- dot’s Panhard; and the Bordeaux-Biarritz, won by Levegh’s 16-h.p. Mors. In 1900 de Knyff in the Pau-Bayonne race attained a mean speed of 43‘4 miles per hour, the distance being 208 miles. He used a Pan- hard machine of 20 h.p. similar to Fig. 6, but fitted with a “racing” body; and during one part of the race he is said to have done 34|- miles in 33|^ minutes. The most im- portant race of this year, however, was that from Paris to Toulouse and back, which was won by Levegh’s 24-h.p. Mors, the distance of 836 miles being traversed at an average rate of 42-7 miles per hour. Levegh in the same year was also credited with an average

of 51 miles an hour from Bordeaux to Perigueux ; the distance, however, was short, viz., 72 miles.

In 1901 the racing season in France was characterized by two important events, namely, the Paris-Bordeaux and the international race from Paris to Berlin, for which prizes were offered by the German emperor, President Loubet, and the king of the Belgians. The first of these races was won by Fournier on a Mors vehicle of about 60 horse-power. Fournier made an average speed of 53 miles an hour to Bordeaux â€” a distance (after deducting the neutralized sections), of 328 miles, his fastest-timed piece being 17|- miles in 15 minutes ; and from Paris to Berlin he covered a distance of 686 miles at a mean

velocity of over 44 miles per hour, excluding 63 miles of ” controls,” or towns and villages through which each com- petitor has to follow a cyclist at 6 or 8 miles an hour in order to ensure the safety of the public and effectually prevent any attempt at racing through crowded places. The latter event was one which put the vehicles to an extremely severe test, owing to the roughness of the rqad throughout the greater portion of the journey. In 1902 the French Government commenced making strenuous efforts to encourage amongst agriculturists the manufac- ture of denaturalized alcohol as a substitute for petroleum spirit, and to this end a race â€” known as the ” Circuit du Nord” â€” was organized by the Minister of Agriculture, in which the fuel used had to contain at least 50 per cent, of common vegetable alcohol. The course was 571^ miles in length, and was covered by Farman, the winner, on a Panhard machine in about 12 hours. The big event of the year, however, was the race from Paris to Vienna, which was won by Renault’s 16-h.p. ” voiturette.” De- ducting the Swiss portion of the route (which was neutralized), the distance was 615 miles, which was accom- plished in 15 hours 48 minutes â€” running time. Seventy- seven per cent, of the starters arrived at Vienna; and, considering the dangerous character of the route â€” its many steep and tortuous descents â€” this and the race from Paris to Berlin afford striking illustrations of the advance that has been made in the perfecting of the mechanical road carriage since the commencement of this new industry.

Although most of the big races have been won by the cars of Panhard and Levassor, or Mors, there are other makers whose vehicles are widely used, notably Peugeot, Dietrich, Richard, Delahaye, Renault, de Dion, Darracq, and others. The transmission system of the Peugeot and Mors is virtually the same as that of Panhard and Levassor, while Dietrich, Richard, and Delahaye have mostly employed belt-fl.riving and horizontal engines, and

Tig. 6.â€” Panhard Car.

the three firms last named are makers of light cars of the “voiturette” type.

The success of motor vehicles in France may be attrib- uted in a large measure to the demonstration of their capabilities by the organization of frequent races, and to the support given to these by the various authorities and the public, who at once saw. the advantages of the new means of locomotion. Whatever may be said to the contrary, these races and the experience thereby gained have undoubtedly brought out the weak points, have in- duced makers to construct machines of the very best mate- rial and workmanship, and have enabled them to produce a wonderful combination of speed, durability, lightness, and strength â€” a state of perfection that would otherwise scarcely be existent. Hence the importance attached to these periodical contests in the preceding remarks.

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In America the first important developments in auto- mobiles were inaugurated by the Times-Herald con- test in November 1895, in which the tractive power and consumption of fuel were considered. There was deep snow on the ground, and the results achieved were hardly successful, though the Mueller and Duryea cars figured prominently. The latter, together with the Winton (which represented America in the Gordon Bennett Cup race of 1900), are amongst the best-known vehicles pro- pelled by gasolene in the United States. Duryea em- ploys a well-balanced engine,

and the speed changing is effected by clutches, the spur wheels remaining always

Fig. 7.â€”” Locomobile ” Steam Carriage.

engaged. To America is due the first place in regard to electrical carriages, the Colum^a of the Pope Manu- facturing Company, the Eiker, the Woods, and similar vehicles being extensively used by private persons, medical men, and others for town use. These firms construct most elegant vehicles with good workmanship, noiseless transmission, and batteries for 30 to 60 miles. The United States also leads in light steam vehicles, the manufacture of which is now being carried out on a very large scale ; a type of such vehicle, shown in Fig. 7, and once known as the Stanley, is built by the Locomobile Company. This figure also serves to illustrate the type of carriage work most generally adopted for the lighter classes of motor vehicles in the United States. The frame is built on cycle lines, and the boiler and engine are wonderfully small for their capacity. The fuel is light oil vaporized and burned in a large number of jets which are automatically controlled by the steam pressure ; up to the time of writing, sufficient water can only be carried for a run of about 30 miles with the standard vehicles, which, however, have found much favour owing to their low price and quiet running.

As regards other countries, Germany holds an important position, having produced the two great exponents of petrol motors â€” Gottlieb Daimler and Carl Benz. It is believed that M. Lenoir, a Frenchman, constructed in 1862 the first vehicle propelled by an internal combustion engine, but he apparently did not follow up his invention as did Ilerr Benz, who constructed his first carriage in 1885, since when some 2500 of these cars â€” a type of which is shown in Fig. 8 â€” -have been turned out at the Eheinische Gasmotoren-Fabrik of Mannheim. This firm uses horizontal cylinders, electric ignition, and principally belt-driving. The late Herr Daimler, whose work has already been alluded to, was the founder of the Daimler Motoren Gesellschaft of Cannstadt, which constructed vehicles under his patents with the transmission formerly by belts, but now on the lines adopted by Panhard and

Levassor. Their latest production is a racing machine of 35 h.p. known as the Mercedes, which won laurels at the Nice races of 1901 and 1902. It is fitted with magneto- electric ignition, and a 4-cylinder motor cooled by an air- fan in addition to the water circulation. Germany, as also America, Switzerland, Belgium, Italy, and indeed nearly every civilized country, now has its Automobile Club, whose interests are the protection and encourage- ment of the industry.

To return to England, considerable progress has been made since the “Emancipation of the Motor” on 14th November 1896, when the inauguration run from London to Brighton was held, under the new Act of Parliament which raised the limit of speed to that pre- scribed by the Local Government Board, i.e., 12 miles an hour. The pure growth of the industry has been some- what impeded by unscrupulous company promotion, but is now proceeding apace. Of the British constructors, the Daimler Company has probably done most work; its vehicles, as lately improved, resemble considerably the French Panhard, and in fact were originally copied from it. Sectional views of the Daimler motor (12 h.p. 1902 type) are shown in Figs. 9 and 10. The Motor Manu- facturing Company builds similar vehicles, using the Daimler and Iden motors, whilst Napier was the first in England to construct powerful machines for the Continental races, and one of his vehicles won for Great Britain in 1902 the international automobile race held annually for the Gordon Bennett Cup. The Napier car is also of the Panhard type, but with a modified motor, heavier gear, and other improvements. The Wolseley Tool and Motor Car Company have a type of their own, and their carriages are of substantial design and workmanship and are low in price. In addition to the constructors named above, there are numerous smaller

Fig. 8.â€” Benz Car.

firms engaged on motor cycles of the de Dion system and on light cars of the ” voiturette ” class. The Auto- mobile Club of Great Britain and Ireland, amongst whose members are many leading sportsmen and scientific men, has its headquarters in London, with numerous branches at other important centres. It has done much to protect the interests of automobilism in Great Britain; and its frequent tours and competitions have helped to popularize

the motor vehicle and to educate the public as to its capabilities. The most important of these events was probably the thousand miles trial of 1900, which was the first serious test of motor cars in the United Kingdom ; the gold medal for this event was awarded to a French carâ€” that of the Hon. C. S. Rolls, built by Panhard and Levassor of Paris. Similar tests have been repeated annually. It is probable that the revived industry in Great Britain will assume before

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long as large proportions as it has taken in France, where it developed with an unprecedented rapidity, Â£2,400,000 worth of motor vehicles having, it is estimated, been turned out there during 1897, 1898, and 1899. The big makers are so full of work that some require a year for the execution of orders, and premiums of 50 to 100 per cent, have been paid for immediate delivery, whilst up- wards of Â£2000 has several times been realized for high- powered vehicles that have won important races. The French nation, however, has taken the matter up purely from a sporting standpoint, and has rushed into it with an impetuosity hardly characteristic of the Briton, with whom the new means of locomotion is likely to come into favour slowly but steadily.

The three commonest methods of propulsion that have been employed up to the present are steam, oil, and electricity. Of these steam appears to be the most suitable for heavy loads, having a great range and elasti- city of power ; oil or spirit for light carriages, enabling long distances at high speed to be conveniently covered without stoppages ; whilst electricity â€” the ” ideal ” mo- tive power*â€” is at present a luxury to be employed only for towns and short distances, until a light battery is dis- covered having a far greater capacity than is at present

possible. The mechanical difficulties that have been en- countered in the development of the light motor vehicle are very many, and the chief disadvantages hitherto promi- nent have been noise. Vibration, and

uncertainty of ac- tion, all of which, as one may notice in the modern vehicles, have now been greatly reduced, although it is still essential for an owner to have a mechanical instinct â€” or to employ a competent man â€” for the efficient working of his car. For their advantages, apart from heavy transport (dealt with below), much may be said. The capabilities ot the modern automobile, the extraordinary control, freedom from vibration when in motion, and the exhilarating efEect of gliding swiftly and smoothly through the air, are points of which the ordinary individual is totally ignorant ; hence the reason why a first ride in a good vehicle usually converts the most prejudiced person. A good motor car has a large field of use and enjoyment, though the public should be cautioned against the purchase of cheap and inferior productions, many of which are on the market and which cause much disappointment. A motor carriage has a scope of work far beyond the capa- bilities of a horsed vehicle. It can cover long distances, is under absolute control, and can therefore travel at very high speeds with perfect safety. It greatly ecouo-

Induction valve Water inlet

Water outlet

Vapour pipe Throttle valve

Connecting rod Carburettor

Governor gear, Half speed wheel

Crank shaft

Base chamber

^Water jacket

Fios. 9 and 10.

mizes space when among street traffic, and would, if generally employed, render the streets far more sanitary, as well as reduce the wear on the roads ;

it costs nothing for fuel when not in use, and but a penny a mile on an average when running.

A word of warning to the novice may not be out of place. The possessor of an autocar should not let en- thusiasm and the ever-increasing thirst for speed get the better of prudence, and should show due considera- tion for nervous horses, and users of the road generally, remembering that in England a pedestrian has as much legal right to the road as any vehicle. In this way each automobilist will do his part in the popularization of the mechanical road carriage, which has been brought to its present state of perfection by an amount of in- genuity and art realized by few, and which is destined in the near future to play an important part in the civiliza- tion of the world.

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II. Heavy Vehicles. Until the close of the 18th century, the common road constituted the only means by which goods could be trans- ported upon land from one part of the country to another. The marvellous development in the carriage of goods by land since about 1830 is due to the introduction and gradual perfection of the railway system, the essential features of vrhich are a hard steel wheel rolling upon a

hard smooth track, and the substitution of mechanical for animal traction. Railways now constitute the great arterial systems of communication by land all over tne world, and it is no wonder that their rapid development which has absorbed in the United Kingdom alone a capital of over one thousand million pounds, has led to the com- parative neglect of the application of mechanical power upon roads. It is true that traction engines have now been brought to a high ‘state of efficiency, and are being increasingly employed both at home and abroad, but when it is remembered that the vast and ever-growing tonnage carried upon railways must fall very far short of that carried upon roads, it will be seen how limited is the held

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Fig. 1. â€” Ooulthard-Leyland.

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Fig. 3. â€” Clarkson-Capel.

Fig. 4.â€” Thornycroft.

Fig. 5.â€” Simpson-Bibby. Types of Heatt Motor Vehicles.

Fig. 6.â€” Mnsker.

A, Air- fan ; B, boiler ; C, condenser ; D, differential gear ; E, engine ; G, gearing ; H, hot-water tank ; O, oil tank ; S, steering ;

W, water-tank ; X, auxiliary engine.

which is covered by this type of engine. With the exception of the traction engine itself, it cannot be said that there has ever been the same serious attempt to introduce mechanical propulsion for the conveyance of goods that has been shown in the previous section of this article to have taken place since about 1840 in connexion with passenger and pleasure vehicles. But it was to be expected that sooner or later the natural course of events would lead to the introduction of improved and more speedy means of conveyance of goods upon roads, and there is every reason for thinking that during the present century there will be a development in this direction bearing at any rate some proportion to the development of railways during the century that is past.

In the first place, it may be remarlsed that railways themselves are dependent upon the use of roads for the distribution of goods, railway

companies being, in many of the great cities, the largest owners of horses and waggons ; all the railway system would, therefore, derive

much benefit from improved means of road transit. But further, there is a vast field for development in the conveyance of goods which could not be dealt with at all by railways, and in the opinion of those best fitted to judge, country and agricultural districts might be largely opened up if a more rapid and efficient mode of eonVev- ance upon roads became established, while it is almost certain that up to distances of 40 or 50 miles motor vehicles can even now compete successfully with the railways for the carriage of goods in the great industrial centres._ The general feeling that the progress in mechanically propelled vehicles which might be so advantat^eous to the country at large was made absolutely impossible by legislative restrictions led to the passing of the Locomotives on Highways Act in 1896, which has doubtless been the direct cause of the production and successful introduction in Great Britain of a number of heavy motor vehicles, capable of carrying loads up to 6 and 8 tons.

heavy]

MOTOR VEHICLES

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Before proceeding to describe these vehicles, it may be noted that the regulations of the Local Government Board respecting motor vehicles issued in accordance with the foregoing Act, as far as heavy motor vehicles are con- cerned, deal chiefly with restrictions of weight and speed. If the weight of the vehicle is between 1^ and 2 tons, the limit of speed is 8 miles an hour, whereas when the weight exceeds 2 tons, the limit of speed is placed at 5 miles an hour. It is in the direction of the tare limit, or weight when unladen, that the greatest diflBculties have been found by manufacturers. The extreme tare limit is placed at 3 tons â€” with a trailer weighing 1 ton â€” and the construction of a vehicle for heavy traffic which will carry a paying load, and which when unladen shall, with its motive power and accessories, weigh only 3 tons, has not only involved the application of the greatest ingenuity and skill, but has necessitated the use

in many cases of an expensive metal like aluminium for casings and other parts of the motor. Even with the

greatest mechanical skill in construction and design, it is questionable if the full benefits of the self-propelled vehicle can be realized with the 3-ton tare limit in connexion with the hauling of goods to and from docks, and in the great manufacturing centres. Energetic steps are being taken to obtain a modification of this limit, which will probably be successful if the proper protection of the road surface can be secured with the heavy loads which could then be carried.

Concerning the actual results which have been obtained, a summary is given on p. 21 of the trials of heavy motor vehicles held in the years 1898, 1899, and 1901, under the auspices of the Liverpool Self-Propelled Trafiic Associ- ation, although it must be remembered that their practical success must really depend upon a lengthened experience of working, so as to enable a comparison to be made with horse traction. Such facts as are already available from the experience of the engineers of the city of Liverpool, of the Mersey Docks and Harbour Board, of the Lancashire

Fig. 7.â€” Bimpson-Bibby.

Fio. 8.â€” Thornyoroft.

Fig. 9.â€” Coulthard. I

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Fig. 10.â€” Leyland.

Fig. 11.â€” Bayley. Dkiving Wheels for Heavy Motor Vehicles.

Fig. 12.â€” Simpson-Blbby.

and Yorkshire railway, and of private firms, were col- lected in a paper on ” Eoad Locomotion,” read before the Institution of Mechanical Engineers on 26th April 1900, which paper has been freely drawn upon in the prep- aration of this article.

In the United Kingdom it may be said that steam is the only power which has been introduced up to the present time for the mechanical propulsion of vehicles for heavy traflB.c. It does not by any means follow, however, that this will permanently be the case, and both oil engines and electricity have been used with a certain amount of success, while in America compressed air for such purposes is being given a trial. The following descriptive account is limited, however, to steam motor vehicles, which in the first place will be briefly dealt with from the point of view of their general arrangement and construction.

Figs. 1 to 6 represent by skeleton diagrams tlie plan and eleva- tion of these vehicles, a uniform system of lettering being adopted.

A glance at these will show the very varied methods aeaeral jq which makers have distributed the essential construe- features. All the boilers are placed in the front and

above the oar, except in the Musker system (Fig. 6), in which a horizontal boiler with a special fan or draught for the burner is employed, and is placed transversely under the middle- of the car, no funnel being required (see also Fig. 26). The next important feature of difference between the systems is

in the position of the engines. In the Thomycroft and Lifu systems (Fig. 4, see also Figs. 22 and 23) they are placed horizon- tally in the middle of the waggon, and the main driving wheel is driven by means of toothed gearing. This is also the case in the Musker system. The Coulthard-Leyland (Fig. 1 ; see also Figs. 24 and 25) and Clarkson-Capel systems (Fig. 3) all have vertical engines from which the motion is transmitted to the main driving wheel by means of chain gearing operating through a counter-shaft. In the Bayley system (Fig. 2) the engine is also vertical, but transmits the motion by means of a horizontal shaft placed longitudinally with the waggon ; by bevelled gearing this drives a counter-shaft which in. turn drives the main driving wheel by a pinion and spur wheel. In the Simpson-Bibby system (Fig. 5 ; also Fig. 27) the arrangement is neat and ingenious. A pair of small three-cylinder engines work separately and independently the two main driving wheels, the use of separate engines obviating the necessity for a jack-in-the-box or difierential gearing. Another important feature of

difierence between the various systems is to be found in the fact that the Musker, Leyland, Coulthard, and Clarkson-Capel all use condensers, the location of which can be seen by an inspection of the various diagrams, whereas in the others the effect of superheating the steam is relied on in order to avoid the emission of visible vapour. This latter device acts very well in hot dry weather, but when the atmosphere is cold and moist a cloud of steam is undoubtedly formed, the machine thus failing to comply with the provision of the Act which requires that no visible vapour be emitted by light locomotives except from temporary or accidental causes.

When it is remembered that the load has to be concentrated upon the point of contact of the periphery of four wheels, which have also to transmit tractive force from the motor, it is no wonder that they have hitherto been almost

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Wheels

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MOTOE VEHICLES

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entirely made with iron tyres. At the first Livei-pool trials of heavy motor vehicles great trouble was experienced with most of the wheels, which had heen made in the best possible manner for ordinary vehicular traffic, and in almost all cases they showed signs of the severe stresses and shocks to which they had

been subjected, so much so that some of them utterly broke down in consequence. Figs. 7 to 12 illustrate some of the wheels which have been specially designed by the makers of motor vehicles, and show in each case the arrangements for driving, which form a vital part of the design. Messrs Coulthard used a wheel entirely of iron (Fig. 9), which seemed to give very

satisfactory results at the Liverpool trials, where it must be noted that part of the 40 miles run was over a road paved with cobbles of the sort well known in certain parts of Lan- cashire, affording a test scarcely to be surpassed in severity. Messrs Bayley's wheel (Fig. 11) differs from the others in the important detail of being coned or dished, and it has the further important peculiarity that the spur wheel attached to the driving wheel is annular, and is driven by an internal pinion. This affords considerable protection from dust and dirt, and enables the outside of the annular wheel to be used very effectively as a brake wheel encircled by a band brake. The spokes are of oak with ash felloes, the iron tyre being 5 inches wide. In consequence of the new design and special construction of the wheels adopted by most of the makers, they were enabled to stand much better at the second Liverpool trials, but even in the second report the judges wrote in their special conclusions as follows: "The wheels and tyres were generally efficient, but con- centration of heavy loads upon the present small area of wheel- contact is a serious difficulty in the problem of goods transport by motor vehicles, and constitutes the chief mechanical cause of the slow progress made." Quite recently one or two makers have been appreciating the great difficulties of this question, and have tried to adopt solid rubber for tyres. Fig. 12 represents Messrs Simpson and Bibby's wheel, in which india-rubber is shown cross- hatched in section, and from which satisfactory results appear to have been obtained.

It is important to notice that while high speeds up to 70 miles an hour and above have been obtained by means of pneumatic tyres

with motor vehicles Â° fl ^ jf-O weighing in some

*'= â€" = â€" cases more than a ton,

the limit of speed at which a heavy motor

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Tig. 18.â€” Thornycroft Water-tube Boiler.

Fia. 14.â€” De Dion Water-tube Boiler.

vehicle on iron tyres can run with any great load without rapidly destroying the vehicle must apparently be placed at someting like 5 miles an hour. The development of heavy motor traffic is greatly retarded by the difficulties which are encountered in the matter of speed upon bad roads, and even upon good roads during the winter time, while upon the best of roads in dry weather it is scarcely possible to cari-y more than a total possible load of 15 tons upon four

wheels of a motor waggon. Inasmuch as a motor waggon carries its own power and is a very expensive machine, it is necessary for its commercial success that it should carry the greatest possible load at the highest possible speed consistent with the safety of the public and the efficiency of the motor ; for these reasons attention has been turned to some contrivance or other that will replace the ordinary wheel. This is a time-honoured problem which all attempts have hitherto failed to solve, but the recent trials of the Diplock walking machineâ€” called by th4 inventor the “Pedrail â€” give promise of a successful result. In this invention supports carrying rollers are placed on the ground, and the motor or traction engine may be said to be rolled over them, so that a rail fixed to the waggon moves along while the wheels themselves are temporarily

Fig. 15.â€” Simpson-Bibby Flash Boiler.

supported on the ground and picked up when the load, has passed over them. The results seem to point to a great future develop- ment in this direction, especially where bad roads have to be negotiated, or heavy loads carried where no roads at all exist.

The two most important considerations in connexion with the design of a steam boiler for motor vehicles are, first, it must be as light as possible consistent with high pressure, and iiers.

secondly, it must be capable of being forced so as to , meet a sudden demand, such as is caused by climbing a hill, for an increased quantity of steam at a higher pressure. The latter point really constitutes one of the great advantages of steam for a motor vehicle, and in many designs has enabled change of speed-gearing to be dispensed with, since in engines working under the com- pound system arrangemeilts are made to use high-pressure steam in both cylinders in order to surmount a hill or to transport a heavy load over a piece of bad road. One of the most successful boilers is that ,of the Thornycroft Steam Waggon Company, Chiswick, represented in section in Fig. 13. This consists of two separate annular portions, A and B, almost rectangular in section, connected by a number of cylindrical straight water tubes which form the walls of a slightly tapered hollow cone CC. The furnace D is contained in the hollow of the lower annulus B, being fed through the opening in the upper annulus A, through the cover E, which can

be removed for the purpose. The flame has to find its way on all sides through the narrow spaces left between the water tubes, the products of combustion escaping by means of the funnel F. The de Dion boiler, shown in Fig. 14, is better known in France than in the United Kingdom, but at the Liver- pool trials on the Bayley waggon it proved itself a very efficient

Fig. 16.â€” Musker Boiler ajid Burner.

steam generator. It consists, like the Thornycroft, of a double annulus of rectangular section, connected by water tubes, the essential difference between the two boilers being that one annulus M is much smaller than the other, and is parUy contained in it â€¢ the water tubes connected with them, instead of being vertical ai in the Thornycroft, are slightly inclined from the horizontal. The furnace N, as in the case of tha Thornycroft, is fed through a

heavy]

cover P. It is obvious that the heating surface is disposed to the best advantage, as is shown by the results obtained.

The two foregoing boilers are of the water-tube type, but some motor waggons employ flash boilers. In this tyi)e of boiler a small

Iffiute,

quantity of water is injected at each stroke of the engine into a heated coil of metal, or series of tubes, to be flashed into steam and superheated. M. SerpoUet has for some years been engaged in perfecting such a boiler, while in Great Britain Messrs Simpson

Fl6. 17. â€” Lifa Burner.

and Bibby have a very strong and effective flash boiler, shown in Fig. 15. This consists of a series of indented heavy steel tubes C, connected outside the furnace by a Haythom joint. The

Fig. 18. â€” Clarkson-Cftpel Bnmer.

indentations alternate about 168 times in the generator, and any fluid passing round them must encounter an amount of baffling that exposes it in the most effective way to the action of the heating surface. The steam is made to pass through a drum D, which is found necessary to prevent the superheated steam having too high a temperature. The boiler is heated by a coal furnace FF, and in about 40 minutes from lighting the fire steam is generated.

Fig. 25. â€” Conlthard S-ton Lony.

One of the newest forms of combined boiler and burner is that of Messrs C. and A. Musker of Liverpool (Fig. 16). It consists of three cylindrical coils, HH, of strong steel tubes, and the flame is made to circulate in the annular space between them. The point at which the water enters is shown in the diagram, and likewise that at which the steam is supplied to the engine. The weight of this boiler and contents, independently of the burner, is only 4 cwts., and it is capable of developing 30 h.p., representing a weight of 15 lb per h.p. This indicates the great steaming capacity of this type of boiler, and its suitability for motor vehicles.

It will be noted that in some of the foregoing boilers solid fuel is used, while for the Musker boiler liquid fuel is employed, as it is also in the Lifu, SerpoUett, and other steam systems. It cannot be said that at present it is more economical, â€ž‘2!^ but with an ef&cient burner it is certainly more con- venient. Some at least of the difficulties in the way of the construction of a burner using heavy petroleum seem to have been successfully overcome in the systems above mentioned. The essential feature of all these burners is a heated surface over which the liquid fuel is allowed to pass, so as to become heated and vaporized ; the vapour then issues from a suitable jet burning in air under the boiler. The number of burners for liquid fuel which have been invented in recent years is very great, and the figures given merely represent types of those in operation with motor vehicles. An important distinction must

Fig. 19. â€” Leyland Bonier,

be made between burners for light and heavy oil, for with a light spirit vaporization, although necessarily effected on the same principle, is a far less difficult matter, and probably does not involve the same risk of carbonizing the petroleum.

Fig. 27. â€” Simpson-Bibby 5-ton Lorry.

The Llfn burner (Fig. 17) consists of a casting T>, in the tortuous passages of which the petroleum is made to circulate ; it thus becomes thoroughly vaporized, since the casting -is placed in the body of the fiame which issues at E. F is an air cone which

[heavy

allows the proper proportion of air to mix with the vapour issuing from the needle-valve, which is shown in section and is self- regulating. A peculiar feature of the contrivance is an igniter G, filled with fire-brick which is maintained in a red-hot condition by the flame, so that in the event of the flame being extinguished suddenly, it is immediately relighted from the hot fire-clay. In

order to ensure perfect combustion, arrangements are made foi regulating the supply of air in both the Clarkson-Capel and Musker burners. In the former, which is shown m Fig. 1Â«, this is in a sense done automatically. The air can be regulated m quantity by altering the amount of opening of the diaphragm at LL. It mixes there thoroughly with the vapour which has been

Fia. 20. â€” LoD^uemare Burner,

Fia. 21. â€” Tan^e Burner.

generated in the coil H, round which the flame circulates. This vapour enters the mixing chamber J through a small needle- valve M, at the orifice

K. The needle-valve is opened and closed by a lever P, which at the same time raises and lowers the larger valve N, so as to regulate the outflow of combined mixture of oil and air underneath at QQ, the flame being baffled on the inside of a hollow nickel cone. The whole arrangement worked very satis- factorily in the Liverpool heavy motor trials. For the burner of Messrs Musker, which is shown attached to the boiler in Fig. 16, the air is supplied by a fan driven by the same auxiliary engine which supplies both the water for the boiler and the oil for the

Fig. 24.â€” Leyland 6-ton Lorry.

burner, the right proportion being thus automatically regulated. The air passes inwards as shown, through the passage JJ, which is kept at a high temperature by means of cylindrical projecting ribs which form part of the ignition chamber K. The oil, which is admitted by drops at the point L, falling upon the heated iron sur- face, IS vaporized and immediately mixed with the heated air, tlie mixing being further ensured by causing the vapour and the air to pass through a number of holes in a perforated block M. Ignition takes place in the ignition chamber K. The Leyland burner is shown in section in Fig. 19. The Longuemare burner, shown in plan and elevation, Fig. 20, is largely used in France ; it consists

heavy]

MOTOR VEHICLES

21

of a row of coils through ~~which the spirit is brought and after~~ wards passed down a pipe B, through a needle-valve regulated by a wheel C, which can be operated by the driver. The Tangye burner (Fig. 21) will be easily understood from a reference to the sectional plan, while the elevation shows the way in which the flame vaporizes the liquid fuel. The coil, boiler, and casing are also shown.

In general appearance motor waggons at first differed very much from each other, each maker starting at the problem as it were ab initio, and there were no traditions to go upon or to fetter design in any- way. Hence it was that

the questions whether protection for the driver should be employed, whether an air-cooled condenser should be adopted,

Qeneral view of different types.

driving wheels. These general features are well shown in the Thornycroft waggon (Fig. 22), and there is no waggon better kno\/^‘n or which stands higher in the matter either of design or workmanship. Fig. 22 shows the Thornycroft 7-ton lorry, and Fig. 23 shows the Thornycroft system adapted to a steam omnibus. The present form of Leyland waggon (Fig. 24) is practically of the same general external appearance, and a large number of these waggons are now employed in Lancashire and elsewhere ; and, as in the case of the Thornycroft, the workmanship and design are such as to enable them to carry at the highest legal limits of speed a full load without any very rapid deterioration, over some of the roughest Lancashire roads. The same

Fio. 28.â€” Mann 5-ton Lorry.

whether the boiler should be in front of or

behind the driver, or even underneath the

body of the car, were all matters upon

which different makers held different

opinions, and this led to great differences in

the general external appearance of the first

waggons designed by the various makers.

But very quickly a remarkable tendency

became visible to conform to one particular

type, viz., that which was first adopted in

the Lifu system, and which is illustrated

by Figs. 22, 24, and 27. In these waggons

there is a workmanlike funnel and casing

for the boiler, behind which the driver sits

without any attempt at weather protection,

a precaution which may be said to have been

found practically futile on a motor waggon; the engines

and boiler are carried underneath the frame, as in the

original Lifu waggon, thus leaving as large as possible a

space for carrying the load, which comes directly over the

Abstract of Results of Trials of Motor Vehicles for Heavy Traffic
[Liverpool Self-propelled Traffic Association) .

Musker Oil-fii’ed Lorry.

Tear.

Vehicle.

Tare.

rreight.

Mean

total

moving

Weight.

Ratio

of mean

Dead -Weight

to Freight.

Proportion

of mean total moving

Weight on Driving Wheels.

Boiler.

Average of

observed

Pressures.

Heating Surface.

1898 1899 1901

Thornycroft (4-wheeler) do. do. do. do.

Tons.

2-83 3-00 3-80

Tons.

2-53 3-73 4-42

Tons.

5-91 7-24 9-18

1-29 0-96 1-06

0-77 0-68

Tb per sq. in.

152 147 175

Square feet.

65 88 83

1898 1899 1901

Thornycroft (6-wheeler) do. (8-wheeler) do. (4-wheeler)

3-85 3-90 6-40

4-73 6-65 6-33

9-25 11-28 14-03

0-93 0-71 1-21

0-46 0-54

125 176 210

65 83 132

1898 1899 1901

Leyland (liquid fuel) . do. do. do. (coke)

2-86 2-85 2-98

4-06 4-44 4-81

7.29

7-64 8-63

0-78 0-71 0-78

0-62

178 167 212

110 110 76

1898 1899

Lifu .... Clarkson

2-39 3-00

2-20 3-35

4-94 6-68

1-21 1-00

0-77 0-51

207 193

80 80

1898 1899

De Dion (French Trials) Bayley .

4-72 2-97

3-25 3-67

8-60 7-13

1-65 0-95

0-60 0-67

(?)

174

56 70

may be said of the Coulthard, which is sho-wn in Fig. 25, although in the illustration the waggon is shown which, although perfectly successful in operation, has been modified quite recently in its general appearance, so that

it now almost exactly resembles the waggons previously mentioned. Fig. 26 shows the oil- fired Musker waggon, the general details of which have been pre- viously given. Fig. 27 is the Simpson and Bibby lorry. Fig. 28 shows the Mann 5- ton lorry, which is interesting from the fact that, like the Foden motor waggon, it employs a horizontal type of boiler. Both the Foden and the Mann lorry have given excellent results in practice, the former

behaving remarkably well at the War OflBce trials in 1901, under the severe tests to which it was subjected by the military experts.

The table on the previous page gives the chief data of the heavy motors which competed in the various trials conducted by the Self-Propelled Traffic Association at Liverpool. Full information and details of the motors, also their respective consumption of fuel, water, &o., will be found in the three volumes of Reports.

(h. S. h.-s.)

Motril, a town of Spain, in the province of Grenada, one mile from the coast. Its population was 17,108 in 1897. The sugar-cane and beetroot grown in the district both contribute to the increasing prosperity of the sugar factories. Alcohol, flour, soap, iron, and cotton stuffs are among the

other industrial products. Motril itself is considered a port of the second class, but the anchorage at Calahonda, 41 miles to the south-east, is much better. Grapes, esparto grass, dry figs, and almonds were exported to Great Britain in 1898 ; and to France zinc ores, barley, and fruit. The imports in that year included 12,299 tons of coal from Great Britain and 2518 tons of timber from Russia.

Mouchez, Amedee Ernest Barthelemy

(1821-1892), French savant, was born at Madrid of French parents on 24th August 1821. He entered the Naval School at the age of sixteen, and after serving with dis- tinction on various ships was appointed to the command of the Bisson in 1856. Being struck with the inaccuracy of the then existing charts of South America, he con- ceived the design of surveying the whole coast of Brazil. Some idea of the energy and activity he displayed in this task and the enthusiasm with which he inspired his officers may be gathered from the fact that the survey of these coasts, extending for a length of some 3000 miles, was finished in two years and a half. In recognition of this service he was appointed a member of the Bureau des Longitudes. He displayed the same qualities in organizing the French expedition to the island of St Paul to observe the transit of Venus in 1874, and the following year was appointed rear-admiral, and elected a member of the Academy of Sciences. In 1878 he accepted the post of director of the National Observatory at Paris, in suc- cession to Le Verrier. He was perhaps not a great astronomer in the sense that the term is applied to his predecessor, but he found here ample scope for the exer- cise of his great administrative abilities. During the four- teen years of his directorship the usefulness of this famous institution was largely extended. The grounds of the Observatory were enlarged, and two powerful instru- ments of a novel kind were installed ; a new spectroscopic department was established, and the gigantic task of re- observing all Lalande’s stars was completed. Under his direction twenty-one volumes of the Annates were pub- lished, as well as the first two volumes of the great cata- logue, in which he rendered accessible to astronomers the observations which had been accumulating at the Paris Observatory for more than half a century. He founded the Bulletin Astronomique, the School of Astronomy at the Paris Observatory, and the observatory of Montsouris, where naval and military officers, explorers, and

others are instructed in such astronomical observations as are necessary in their various callings. It is, however, as author of the great scheme for an international photo- graphic survey of the heavens that Mouchez will be chiefly remembered. The advances which had been made at the Paris Observatory and elsewhere in stellar pho- tography suggested to him the magnificent idea of con- structing, by the international co-operation of astronomers, a complete photographic chart of the celestial vault, which, containing more than fifty million stars, would

hand down to future ages a faithful picture of the state of the heavens at the end of the 19th century. At three great congresses presided over by Mouchez, and attended by representative astronomers from all the leading ob- servatories of the world, the initial difficulties inseparable from such a vast scheme were overcome ; and although he did not live to see the completion of his splendid project, he had the satisfaction before his death of knowing that its ultimate success was assured. His death occurred very suddenly at his country seat at Wissous, near An- tony, on 26th June 1892. (^- a. e*.)

Moulmein (or Maulme’n), the headquarters of the Amherst district and Tenasserim division of Lower Burma. The populationâ€” 63,107 in 1881â€” was only 66,786 in 1898-99. The shipbuilding, which formerly was an important industry, has now been given up, but there is still a considerable export of teak and rice, and there are several steam rice and saw mills. The number of vessels that entered the port in 1898-99 was 674, with a tonnage of 263,089, and the vessels clearing numbered 712, with a burden of 270,413. The garrison of Madras native infantry, , formerly stationed in the town, wils withdrawn in 1898, and Moulmein was then defended by police only. Germany and Siam are represented by consuls ; Persia, Denmark, and Norway and Sweden by vice-consuls ; and Italy and the United States of America by consular agents. In Moulmein town the chief criminal and civil jurisdiction is exercised by the judge of JMoul- mein, who is sessions judge and district judge. There is an amalgamated high, normal, and practising school, as well as a high school.

Moundsville, a city of West Virginia, U.S.A., capital of Marshall county, on the Ohio river, and on the Baltimore and Ohio and Ohio Eiver railways, in

the “Panhandle” of the state. It contains the state peni- tentiary, and has varied manufactures. It derives its name from an interesting Indian mound in the vicinity. Population (1890), 2688 ; (1900), 5362, of whom 130 were foreign-born and 468 were negroes.

Mounet-Sully, Jean (1841), French actor,

was born at Bergerac, 27th February 1841. His name was Jean Sully Mounet, but he adopted the above form early in life and has been always known by it. After a strug- gle against the prejudices of his parents, he entered the Conservatoire at the age of twenty-one, and a few years later took the first prize for tragedy. In 1868 he made his dibiit at the Odeon, without attracting much atten- tion. His career was interrupted by the Franco-Prussian war, and the liking he developed for soldiering had almost decided him to give up the stage when he was offered the opportunity of playing the part of Oreste in Andromaque at the Comedie Franqaise in July 1872. His striking presence and voice and the passionate vigour of his acting made an immediate impressioa, and the eventual result was his election as ” societaire ” in January 1874. He became one of the mainstays of the Comedie Franqaise, and distinguished himself in a large variety of tragic and romantic parts. Perhaps his most famous impersonation was that of (Edipus in a version of Sophocles’ drama. This was first performed in the ruined amphitheatre at Orange on the occasion of a fÂ§te in 1888. Other prominent parts in his repertory were those of Achille in Iphiginie, Hippolyte in PhMre, Hernani, Ruy Bias, Hamlet, Francis I. in Le Roi s’ Amuse, Didier in Marion Delorme, &c. He was created Chevalier of the Legion d’Honneur in 1889, and is the author of a play entitled La Buveiise de Larmes.

Mountaineering.â€” Mountaineering is the art of

moving about safely in mountain regions, avoiding the

dangers incidental to them, and attaining high, points difBcult of access. It consists of two maia divisions, rock- craft and snow-craft. Eock-craf t consists in the intelligent selection of a line of route and in gymnastic skill to follow the line chosen. In snow-craft the choice of route is the result of a full understanding of the behaviour of snow under a multitude of varying conditions ; it depends largely upon experience, and much less upon gymnastic skill. The dangers which the craft of climbing has been developed to avoid are of two main kinds, the danger of things falling on the traveller and the danger of his falling himself. The things that may fall are rocks, ice, and snow ; the traveller may fall from rocks, ice, or snow, or into crevasses in ice or snow. There are also dangers from weather. Thus in all there are eight chief dangers : falling rocks, falling ice, snow-avalanches, falls from dif- ficult rocks, falls from ice slopes, falls down snow slopes, falls into crevasses, dangers from weather. To select and follow a route avoiding these dangers is to exercise the climber’s craft.

Falling Bocks. â€” Every rock mountain is falling to pieces, the process being specially rapid above the snow-line. Eock-faces are constantly swept by falling stones, which it is generally possible to dodge. Few accidents have occurred in such places. Palling rocks tend to form furrows ia a mountain face, and these furrows (couloirs) have to be ascended with caution, their sides being often safe when the middle is stone- swept. Stones fall more frequently on some days than on others, according to the recent weather. Local ex- perience is a valuable help on such a question. The direction of the dip of rock strata often determines whether a particular face is safe or dangerous ; the char- acter of the rock must also be considered. Where stones fall frequently debris wiU be found below, whilst on snow slopes falling stones cut furrows visible from a great distance. In planning an ascent of a new peak such traces must be looked for. In some mountain ranges (Himalaya, Alps of New Zealand) falling stones are more frequent than in the Swiss Alps. When falling stones get mixed in considerable quantity with slushy snow or water a mud avalanche is formed (common in the Hima- laya). Mud avalanches keep to recognized tracks and move slowly, but advance to great distances and over- whelm large areas of land. It is necessary to avoid camp- ing in their possible line of fall.

Falling Ice. â€” The places where ice may fall can always be determined beforehand. It falls in the broken parts of glaciers (seracs) and from overhanging cornices formed on the crests of narrow ridges. Large icicles are often formed on steep rock-faces, and these fall frequently in fine weather following cold and stormy days. They have to be avoided like falling stones. Seracs are slow in formation, and slow in arriving (by glacier motion) at a condition of unstable equilibrium. They generally fall in or just after the hottest part of the day, and their debris seldom goes far. It is generally possible to esti- mate the stability of a serac within reasonable limits. A skilful and experienced ice-man will usually devise a safe route through a most intricate ice-fall, but such places should be avoided in the afternoon of a hot day. Hang- ing glaciers (i.e., glaciers perched on steep slopes) often discharge themselves over steep rock-faces, the snout breaking off at intervals. They can always be detected by their debris below. Their track should be avoided. In the early summer falls of ice are less common than in the autumn, when the winter snow ‘has melted away and deprived seracs of its support.

Snoio Avalanches. â€” These mainly occur on steep slopes when the snow is in bad condition, early in the year, or after a recent fresh fall. Days when snow is in bad con-

dition are easily recognized; on such days it may be inadvisable to traverse snow-slopes which at another time may be as safe as a high-road. Beds of snow collected on rock ledges in bad weather fall off when a thaw comes, and are dangerous to rock-climbers. Snow that has recently fallen upon ice-slopes is always liable to slip off bodily. Such falling masses generally make the lower part of their descent by couloirs. Snow avalanches never fall in unexpected places, but have their easily recognizable routes, which can be avoided in times of danger by experienced mountaineers.

Falls from Bocks. â€” The skill of a rock-climber is shown by his choice of hand-hold and foot-hold, and his adhesion to those he has chosen. A man who knows the limit of his powers and selects his grip accordingly may be stopped by a difficulty, but will not fall, iluch depends on a correct estimate of the firmness of the rock where weight is to be thrown upon it. Mai^y loose rocks are quite firm enough to bear a man’s weight, but experience is

needed to know which can be trusted, and skill is required in transferring the weight to them without jerking. On all difiicult rocks the rope is the greatest safeguard for all except the first man in the ascent, the last in the descent. In such places a party of three or four men roped together, with a distance of 15 or 20 feet between one and another, will be able to hold up one of their number (except the top man) if one only moves at a time and the others are firmly placed and keep the rope tight between them, so that a falling individual may be arrested before his velocity has been accelerated. In very difficult places help may be obtained by throwing a loose rope round a projection above, and pulling on it ; this method is specially valuable in a difficult descent. The rope usually employed is a strong Manila cord called Alpine Club rope, but some prefer a thinner rope used double. On rotten rocks the rope must be handled with special care, lest it should start loose stones on to the heads of those below. Similar care must be given to hand-holds and foot-holds, for the same reason. When a horizontal traverse has to be made across very difficult rocks, a dangerous situation may arise unless at both ends of the traverse there be firm positions. Even then the end men gain little from the ropef.]\Iutual assistance on hard rocks takes all manner of forms : two or even three men climbing on one another’s shoulders, or using for foot-hold an ice-axe propped up by others. The great principle is that of co-operation, all the members of the party climbing with reference to the others, and not as independent units ; each when moving must know what the man in front and the man behind are doing. Help may sometimes be obtained by fastening iron or wooden pegs into cracks, and hitching a rope over. The greatest danger on difficult rocks is to be roped to a careless companion. After bad weather steep rocks are often found covered with a veneer of ice (verglas), which may even render them inaccessible. Climbing-irons (crampons, steigeisen) are useful on such occasions.

Ice Slopes. â€” Climbing-irons are also most useful on ice or hard snow, as by them step-cutting can sometimes be avoided, and the footing at all times rendered more secure. True ice slopes are rare in Europe, though common in tropical mountains, where newly-fallen snow quickly thaws on the surface and becomes sodden below, so that the next night’s frost turns the whole into a mass of solid ice. An ice slope can only be surmounted by step-cutting. Eor this an ice-axe is needed, the common form being a small

pick- axe on the end of a pole as long as from the elbow of a man to the ground. This pole is used also as a walking- stick, and is furnished with a spike at the foot. A great deal has been written about how to cut stjeps, which need not be repeated here. There is much to be learned in practice, and a wide difference between a quick and a slow

step-cutter. One of the cMef uses of a guide is to save his employer this labour. Special care must be takeu not to slip on an ice slope, and to use the rope carefully, as the best ice-step remains slippery.

Snoiv slopes are very common, and usually easy to ascend. At the foot of a snow or ice slope is generally a big crevasse, called a bergscJirund, where the final slope of the mountain rises from a snow-field or glacier. Such bergschrunds are generally too wide to be strided, and must be crossed by a snow-bridge, which needs care- ful testing and a painstaking use of the rope. A steep snow slope in bad condition may be dangerous, as the whole body of snow may start as an avalanche. Such slopes are less dangerous if ascended directly than obliquely, for an oblique or horizontal track cuts them across and facilitates movement of the mass. New snow lying on ice is specially dangerous. Experience is need- ful for deciding on the advisability of advancing over snow in doubtful condition. Snow on rocks is usually rotten unless it be thick ; snow on snow is likely to be sound. A day or two of fine weather will usually bring new snow into sound condition. Snow cannot lie at a very steep angle, though it often deceives the eye as to its slope. Snow slopes seldom exceed 40Â°. Ice slopes may be much steeper. Snow slopes in early morning are usually hard and safe, but the same in the afternoon are quite soft and possibly dangerous ; hence the advantage of an early start.

Crevasses. â€” -These are the slits or deep chasms formed in the substance of a glacier as it passes over an uneven bed. They may be open or hidden. In the lower part of a glacier the crevasses are open. Above the snow-line they are frequently hidden by arched-over accumulations of winter snow. The detection of hidden crevasses requires care and experience. After a

fresh fall of snow they can only be detected by sounding with the pole of the ice-axe, or by looking to right and left where the open extension of a partially hidden crevasse may be obvious. A master of snow-craft hardly ever falls into a crevasse, a novice is liable to frequent falls. The safeguard against accident is the rope, and no one should ever cross a snow-covered glacier unless roped to one, or better to two, companions. Weather. â€” Many of the dangers resulting from bad weather have been referred to above. Storms seldom destroy mountaineers by mere cold or exposure, unless they sit down and lose vitality by inaction, but there have been eases of men blown from exposed positions to de- struction. Many climbers have been struck by lightning, but few, if any, killed at high elevations. The main group of dangers caused by bad weather centre round the change it effects in the condition of snow and rock, making ascents suddenly perilous which before were easy, and so altering the aspect of things as to make it hard to find the way or retrace a route. The two extremes to be avoided are sitting still and making frantic haste. The worst of all remedies is alcohol ; the best, food, patience, and a dogged will. In storm the man who is wont to rely on a compass has great advantage over a merely em- pirical follower of his eyes. In large snow-fields it is, of course, easier to go wrong than on rocks, but a trained intelligence is the best companion and surest guide.

History. â€” The craft of climbing is essentially a modern invention. Devised for sport, it has become an important adjunct to geographical exploration, for it bears to moun- tain travel the relation that navigation bears to sea-travel. Till relatively recent times a mysterious dread of moun- tains lingered in the minds even of educated people ; horror was the impression derived from mountain scenery by 18th-century travellers The substitution of admiration for horror was the work of the 19th century. The chief Alpine passes were crossed in Koman and even prehistoric

times. The first recorded mountain ascent after Old Testament times is Trajan’s ascent of Etna to see the sun rise. The Roche Melon (11,600 feet) was climbed m 1358. Peter III. of Aragon climbed Canigou in the Pyrenees in the last quarter of the 13th century. In 1339 Petrarch climbed Mount Ventoux near Vaucluse. In 1492 Charles VIII. of France reached the top of Mount Aiguille. The Humanists of the 16th century adopted a new attitude towards mountains, but the disturbed state of Europe nipped in the bud the

nascent mountaineering of the Zurich school. Leonardo da Vinci climbed to a snow-field in the neighbourhood of the Val Sesia and made scientific observations. Conrad Gesner and Josias Simler of Zurich visited and described mountains, and made regular ascents. The use of axe and rope were locally invented at this time. No mountain expeditions of note are recorded in the 17th century. In 1739 the Titlis was climbedâ€” the first true snow-mountain. Pococke and Windham's historic visit to Chamounix was made in 1741, and set the fashion of visit- ing the glaciers. The first attempt to ascend Mont Blanc was made in 1775 by a party of natives. In 1786 Dr Michel Paccard and Jacques Balmat gained the summit for the first time. De Saussure followed next year. The Jungfrau was climbed in 1811, the Einsteraarhorn in 1812, and the Zermatt Breithorn in 1813. Thenceforward tourists showed a tendency to climb, and the body of Alpine guides began to come into existence in conse- quence. Systematic mountaineering, as a sport, is usually dated from Mr Justice Wills's ascent of the Wetterhorn in 1854. The first ascent of Monte Eosa was made in 1855. The Alpine Club was founded in London in 1857, and soon imitated in most European countries. Mr Whymper's ascent of the Matterhorn in 1865 marks the close of the main period of Alpine conquest, during which the craft of climbing was invented and perfected, the body of professional guides formed, and their traditions fixed. Passing to other ranges, the exploration of the Pyrenees was concurrent with that of the Alps. The Caucasus followed, mainly owing to the initiative of Mr D. W. Freshfield ; it was first visited by exploring climbers in 1868, and most of its great peaks were climbed by 1888. Trained climbers turned their atten- tion'to the mountains of North America in 1888, when the Eev. W. S. Green made an expedition to the Selkirks. From that time exploration has gone on apace, and many English and American climbing parties have surveyed most of the highest groups of snow-peaks. The explorer tion of the highest Andes was begun in 1879-80, when Mr Whymper climbed Chimborazo and explored the mountains of Ecuador. The Cordillera between Chile and Argentina was attacked by Dr Gussfeldt in 1883, who ascended Maipo (17,752 feet) and attempted Aconcagua (23,080). That peak was first climbed by the Fitzgerald expedition in 1897. The Andes of Bolivia were explored by Sir Martin Conway in 1898. Chilian and Argentine expeditions revealed the structure of the southern Cor- dillera in the years 188.-98. Sir JNIartin Conway visited the mountains of Terra del Fuego in 1898. The Alps of New Zealand were first attacked in 18S2 by the

Eev. W. S. Green, and shortly afterwards a New Zealand Alpine Club was founded, and by their activities the exploration of the range was pushed forward. In 1896 Mr E. A. Fitzgerald made an important journey in this rain-e. Of the high African peaks, Kilimaniaro AA-as climbed “in 1889 by Dr Meyer, Mount Kenia in 1899 by INlr :Mac- kinder, and a peak of Euwenzori by Mr]\Ioore in 1900. The Asiatic mountains have as -yet been little climbed, though those that lie within the British Empire have been surveyed. In 1892 Sir JNIartin Conwav exi)lored the Karakoram Himalayas, and climbed a peak of 2.3,000 feet. In 1895 Mr A. F. Mummery made a fatal attempt to

ascend Nanga Parbat, whilst in 1899 Mr D. W. Freshfield took an expedition to the snowy regions of Sikkim. A body of Gurkha sepoys has now been trained as expert mountaineers by Major the Hon. C. G. Bruce, and a good deal of exploration has been accomplished by them. The only mountains of the northern polar region that have been explored are those of Spitsbergen by Sir Martin Conway’s expeditions in 1896 and 1897, and the peaks in the north of Norway and the Lof otens by various Alpine Club and Norwegian parties. The greatest mountains of the south polar region have not yet been attempted.

(w. M. c.)

Mount Carmel, a borough of Northumberland county, Pennsylvania, U.S.A. It is at the head of Sha- mokin creek, in the anthracite coal region, in the eastern part of the state, at an altitude of 1064 feet. It is on the Lehigh Valley, the Northern Central, and the Phila- delphia and Reading railways. Its chief business con- sists of mining, handling, and shipping anthracite coal. Population (1880), 2378 ; (1890), 8254 ; (1900), 13,179, of whom 3772 were foreign-born.

Mount Clemens, a city of Michigan, U.S.A., capi- tal of Macomb county, on the Clinton river near its mouth, and on the Grand Trunk railway, in the south- eastern part of the state, at an altitude of 603 feet. It is noted for its mineral springs, which are said to possess remarkable curative properties,

and which draw to it a â€¢ large transient population. Population (1880), 3057 ; (1900), 6576 â€” 1194 foreign-born and 18 negroes.

Mount Desert, an island off the coast of Maine, U.S.A., a part of Hancock county of that state. It has an area of about 100 square miles, and is mountainous, rising to an extreme altitude, in Green Mountain, of 1527 feet. It contains many lakes and ponds, and is deeply penetrated by arms of the sea, affording a great variety of picturesque scenery. It is a popular seaside resort in summer, being reached by a line of the Maine Central railroad and ferry, ‘or by steamers from Portland and Boston. The chief points on the island frequented by visitors are Bar Har- bor (far the most important), Seal Harbor, North-East Harbor, South-West Harbor, and Somesville, at the head of Somes Sound. Population (1890), 5337 ; (1900), 7989, increased in the season by 10,000 to 20,000 visitors.

Mount Morgan, gold-mining town and muni- cipality (1890), Queensland, Australia, in the county of Eaglan, 28 miles south-south-west of Kockhampton, to which a railway was opened in 1898, and believed to be on the richest gold site in Australia. The output m 1900 amounted to nearly Â£790,000, and during that year about 2000 persons were employed. Machinery is re- placing manual labour to a considerable extent. Popular â– tion (1891), 3514 ; (1901), 9609.

Mount Vernon, a city of Illinois, U.S.A., capital of Jefferson county, towards the southern part of the state, at the intersection of four railways, and at an alti- tude of 472 feet. The surrounding country is a rich farming region, for which it acts as a collecting and dis- tributing point. Population (1890), 3233 ; (1900), 5216, of whom 111 were foreign-born and 190 negroes.

Mount Vernon, a city of Indiana, U.S.A., capital of Posey county, on the Ohio river, at the intersection of the Louisville and Nashville and the Evansville and Terre Haute railways, in the south-western part of the state. Population (1890), 4705 ; (1900), 5132, of whom 262 were foreign-born and 892 negroes.

Mount Vernon, a city of Westchester county. New York, U.S.A., on the Bronx river, and the New York Central and Hudson River, and the New

York, New

Haven and Hartford railways, in the south-eastern part of the state. It is a suburb of New York City, being distant but 13 miles. It was incorporated as a village in 1853, and chartered as a city in 1892. Population (1890), 10,830; (1900), 20,346, of whom 5265 were foreign-born and 516 negroes. The death-rate in 1900 was 19-4.

Mount Vernon, a city of Ohio, U.S.A., capital of Kuox county, on the Kokosing river, and the Baltimore and Ohio and the Cleveland, Akron and Columbus rail- ways, north-east of the centre of the state, at an altitude of 991 feet. It has manufactures of furniture, carriages and waggons, and locomotives, besides floirr-mills and machine-shops. Population (1890), 6027; (1900), 6633, of whom 359 were foreign-born and 239 negroes.

Mouscron, a town of Belgium, in the province of West Planders, 35 miles south of Bruges, with a station at the junction of the lines from Courtrai and Tournai to Lille (Prance). Its numerous industries include cotton and wool weaving, dyeing, and oil-refining. Population

(1890), 13,764 ; (1900), 18,909.

Mozambique. See East Africa, Poetuguese.

Mozyr, a district town of Russia, government and 241 miles south-east of Minfek, on the railway from Brest to Bryansk, and on the Pripet river. Coal has been found near the town, which is an entrepdt for goods shipped on .the Pripet. Population (1897), 12,251.

Much We n I oc k . See Wbnlock.

Mundania, the ancient Myrlea, a town of Asia Minor, on the south coast of the Sea of Marmora, and the port of Brusa. It is connected with Briisa by a rail- way and a carriage road, and with Constantinople by a line of steamers. Olive oil is produced in large quantities. The population numbers 4800, almost wholly Greek.

Muhamrah (Mohammeeah), a town of Persia, in the province of Arabistan, 30Â° 26′ N., 48Â° 11′ E., on the HaMr canal, which joins the Karun with the Shatt el Arab, and flows into the latter 40 miles above its mouth at Eao and about 20 miles below Basrah. It has post and telegraph ofiices, and a population of about 5000. With the opening of the Karun river, as far as Ahvaz, to international navigation in 1889, Muhamrah acquired greater importance, and its customs, which until then were leased to the governor for Â£1500 per annum, rose considerably, and now pay Â£8000. A British vice-consul was appointed in 1890. The following table shows the value of the exports and imports and the amount of shipping at intervals since 1890 : â€”

Tear.

Exports.

Imports.

Shipping.

Total.

British.

1890 1895 1899 1900

Â£

58,096

98,193

131,706

164,078

&

146,141 138,006 207,892 281,854

Entered, tons.

111,623 105,480 121,427

Cleared, tons.

89,432 86,252 91,909

Entered, tons.

103,805

97,765

112,946

Cleared, tons.

86,202

Nearly one-half of the exports was specie.

Until 1847, when it definitely became Persian territory in ac- cordance with Art. II. of the treaty of Erzenim, Muhamrah was alternately claimed and occupied by Persia and Turkey, its ruler, an Arab sheikh, helping either Power as he found it convenient. Since then the governor of the town and adjoining district has been a sheikh of the K'ab, or Chaab, Arabs of the powerful tribe of the Shi'ah branch of Islam. At the close of the Anglo-Persian cam- paign in 1857 Muhamrah was taken by a British force.

Muir, Sir William (1819), Arabic scholar,

was born at Glasgow, and educated at Kilmarnock Academy and at Glasgow and Edinburgh Universities.

MUIRKIRKâ€” MULLINGAU

In 1837 he entered the Bengal Civil Service, and there held several important appointments. He served as secretary to the Governor of the ^North-West Provinces, and as a member of the Agra revenue board, and during the Mutiny he was in charge of the Intelligence Depart- ment there. In 1868 he became Lieutenant-Governor of the North- West Provinces. In 1874 he was appointed iinancial member of the Council of the Governor-General of India, and retired in 1876, when he became a member of the Council of India. In 1867 the Order of the Star of India had been conferred on him in recognition of his public services. He had always taken an interest in edu- cational matters, and it was chiefly through his exertions that the large central college at Allahabad, known as Muir's College, was built and endowed. In 1885 he was elected Principal of Edinburgh University in succession to Sir Alexander Grant. Sir William Muir is a good Arabic scholar, and has made a careful study of the history of the time of Mahomet and the following period. His chief books are a Life of Mahomet and History of Islam to the Era of the Hegira, a work of great historic value ; Annals of the Early Caliphate, an admirable account of the period of early Saracenic conquests ; Tlie Caliphate, an abridgment and continuation of the Annals, which brings the record down to the fall of the Caliphate on the onset of the Mongols ; The Goran : its Composition and Teaching ; and The Mohammedan Controversy, a reprint of five essays published at intervals between 1885 and 1887. In 1881 he delivered the Rede lecture at Cambridge on The Early Caliphate and Rise of Islam. His interests are chiefly with the Arabs, and he has less sympathy with the other developments of Islam.

Muirkirk, a mining and manufacturing town of Ayrshire, Scotland, near the river Ayr, 25|- miles east by north of Ayr by rail. It is one of the chief seats of the iron industry, and there are coal-mines and lime-kilns. There are parish council chambers and an institute, with library and recreation rooms. In the neighbourhood are four monuments to Covenanting martyrs, including Cameron of Aird's Moss and Brown of Priesthill ; also Druidical remains and a Roman camp. Population (1891),

3329; (1901), 5670.

Mukden (Chinese, Shing’king),ca,YAsl of Manchuria, . on the Hun-ho, 110 miles north-east of Newchwang, with a [population of 250,000. It is a centre for trade and also for missionary enterprise, and has become of greater importance in consequence of the Russian encroachments and of the projection of new railways. It was formerly the headquarters of the Manchu dynasty, and their tombs lie within its confines.

Miilhausen, a town of Germany, in Alsace- Lorraine, district of Upper Alsace, 21 miles by rail north- west of Basel. It is the centre of the cotton industries of Alsace, though it also has numerous other industries. The museum of the Industrial Society (1882) contains a collection of Romano-Celtic antiquities and a historical museum and picture gallery. Of recent years the opera- tives have gradually moved farther out into the suburbs, leaving the model houses of the ” artisans’ town ” to be occupied by small tradesmen. In addition to a zoological garden, the town has a new chemical school. Population

(1885), 69,759 ; (1900), 89,012.

M ill helm, two towns of Prussia, in the Rhine province. 1. On the Rhine, 3 miles north-nortli-east of Cologne, with numerous manufactures. Population (1885), 24,975 ; (1900), 45,085. 2. On the Ruhr, 5 miles east of Duisburg. It also is a jilace of industrial activity, and has a large trade in coal. On the opposite bank of the

river is the old castle of Broich. The ” small” Evangelical church dates from 1879-81. Population (1885), 24,466;

(1900), 38,292.

Mull, an island of Argyllshire, Scotland, the third of the Hebrides in size, separated from the mainland on the south-east by the Firth of Lorn and on the north-east by the Sound of Mull. A large stretch of grazing ground about Ben More was converted by the late duke of Argyll into a deer forest. Tobermory, which is a police burgh (population, 1019 in 1901) and the only town, has regular steamer communication with Glasgow and Stornoway. Granite and freestone are quarried in the island. Popula- tion (1891), 4691 ; (1901), 4711.

MiJIIer, Ferdinand von, Baeon (1825-1896), botanist and explorer, was born at Rostock on the 30th of June 1825, and was educated, after the early death of his parents, in Schleswig. He studied the flora of Schleswig and Holstein from 1840 to 1847, when he emigrated to South Australia and travelled through the colony from 1848 to 1852, discovering and describing a large number of plants previously unknown. In 1852 he was appointed Government botanist for Victoria, and examined its flora, and especially the Alpine vegetation of Australia, which was previously unknown. Then, as phyto- graphic naturalist, he joined the expedition sent out under Augustus Gregory by the duke of Newcastle, Secretary of State for the Colonies. He explored the river Victoria and other portions of North Australia, was one of the four who reached Termination Lake in 1856, and accom- panied Gregory's expedition overland to Moreton Bay. From 1857 to 1873 he held the ofiice of director of the Botanical Gardens, Melbourne, and not only intro- duced many plants into Victoria, but made the excellent qualities of the blue gum {Eucalyptus globulus) known all over the world, and succeeded in introducing it into the south of Europe, North and South Africa, California, and the extra-tropical portions of South America. For these services' he was decorated by many foreign countries, including France, Spain, Denmark, and Portugal ; was created K.C.M.G. in 1879, baron of the Kingdom of Wtirtemberg in 1871, and F.R.S. in 1861. He published eleven volumes of his Fragmenta Phytographica Australia, two volumes of the Plants of Victoria, and other books on the Eucalyptus, Myoporacese, Acacias, and Salsolaceae, all profusely illustrated. He also co-operated in the produc- tion of Benthen's Flora Australiensis. In 1880 hp was the recipient of one of the medals of the Royal Society of London. Baron von Mliller took a leading part in promoting Australian exploration, especially the Burke and Wills Expedition, which was the first to cross the continent, and in the various attempts to unravel the mystery which attended the fate of his fellow-country- man Leichhardt. He was a commissioner for all the industrial exhibitions held in Melbourne, and a member of the organizations for the representation of Victoria at the interuational exhibitions of London, Paris, Vienna, and Philadelphia. Baron von Muller was one of the greatest descriptive botanists of the 19th century, but his greatest feat was in the dissemination of the Eucalyptus globulus, which has supplied many treeless districts -nitli excellent and fast-growing timber, and has enabled the resources of many districts to be developed

which were previously rendered uninhabitable by malaria. He died at Melbourne on the 9th of October 1896.

Muller, Frederich Max. See Max Mijllee.

Mullingar, the county town of Westmeath, Ireland, on the Royal Canal, 44 miles north-west of Dublin, in direct communication by. rail with every part of Ireland.

It is the centre of the trade of the district, with regular markets and fairs. A post-office has been erected. Popu- lation (1881), 4787 ; (1901), 4504.

Multan, or Mooltan, a city and district of British India, in the Lahore division of the Punjab. The city is 4 miles from the left bank of the Chenab, near the ancient confluence of the Ravi with that river ; it has a railway station. Population (1881), 68,674 ; (1891), 74,562 ; muni- cipal income (1897-98), Es. 1,62,275; death-rate (1897), 30 per thousand. The cantonments can accommodate a battery of artillery and four regiments of infantry. It has manu- factures of carpets, silk and cotton goods, shoes, glazed pottery and enamel work, and an annual horse fair. It is a station of the Church Mission. There are three high schools (municipal, mission, and Anglo-Sanskrit), a normal school, six printing-presses, and Hindu and Mahommedan associations.

The district of Mooltan occupies the lower angle of the Bari Doab, or tract between the Sutlej and the Chenab, with an ex- tension across the Ravi. Area, 6079 square miles ; population (1881), 551,964 ; (1891), 631,434 ; and (1901), 710,548, showing an increase of 14 percent., due to the extension of irrigation, between 1881 and 1891, and of 12-5 per cent, between 1891 and 1901; average density, 117 persons per square mile. The land revenue and rates in 1897-98 were Rs. 10,67,337, the incidence of assessment being Rs.0 : 4 : 5 per acre ; cultivated area, 679,412 acres, of which 582,500 were irrigated, including 427,059 from Government canals ; number of police, 762 ; number of schools (1896-97), 263, attended by

7338 boys, being 11-9 per cent, of the boys of school-going age ; death-rate (1897), 33 ‘5 per thousand. The principal crops are wheat, millet, pulse, oil-seeds, cotton, and indigo. There are twenty factories for ginning and pressing cotton. Indigo is made only by native processes. Irrigation is largely conducted by inundation channels from the boundary rivers, but the centre of the district is absolutely barren. The district is traversed by the main line of the North- Western railway from Lahore, which crosses the Sutlej by the Empress bridge opposite Bahawalpur, 130 miles. It is also entered by the branch from LyaUpur to Khanewal junction, crossing the Ravi. The boundary rivers are navigable for a total length of 344 miles.

Mun, Adrien Albert Marie de, Count (1841- -), French politician, was born at Lumigny, in the

department of Seiue-et-Marne, on 28th February 1841. He entered the army as an officer in the Chasseurs, saw much service in Algeria, and took part in the fighting around Metz in 1870. On the surrender of Metz, he was sent as a prisoner of war to Aix-la-Chapelle, whence he returned in time to assist at the capture of Paris from the Commune. Deeply attached to the Roman Catholic Church, and moved with pity by the condition of the working classes, he re- solved to devote his life to forwarding these two interests in common. His impassioned and stately eloquence made himthemostprominent member of the Cercles Catholiques d’Ouvriers, and his attacks on the Republican social policy evoked a prohibition from the Minister of War. He there- upon resigned his commission (November 1875), and in the following February stood as Royalist and Catholic candidate for Pontivy. The whole influence of the Church was exerted to secure his election, and the Pope himself, during its progress, sent him the Order of St G-regory. He was returned, but the election was declared invalid. He was re-elected, however, in the following August, and continued to sit, with a short interval, for the same con- stituency till 1893. The system that he advocated in and out of Parliament was a reversion to the guilds of the Middle Ages. His Christian Socialism differed from the Socialism that relies mainly on State intervention in desiring the regulation of labour by a patriarchal organiza- tion, in which employer and employed should live and work ” side by side, like the members of a single family.” But, pending the realization of these principles, he urged on the State the adoption of

remedial measures, such as the prohibition of female labour in factories, compulsory

insurance against accidents, and the fixing of a minimum wage. The proposals of successive Republican govern- ments on secondary education and on the increase of the army found in him a warm opponent. He was, indeed, for many years the most conspicuous leader of the anti- Republican party. As far back as 1878 he had declared himself opposed to universal suffrage, a declaration that lost him his seat from 1879 to 1881. He spoke strongly against the' expulsion of the princes, and it was chiefly through his influence that the support of the Royalist party was given to General Boulanger. But as a faithful son of the Church, he obeyed the encyclical of 1892, and declared his readiness to support a Republican govem- m ent, provided that it respected religion. In the following January he received from the Pope a letter commending his action, and encouraging him in his social reforms. He was defeated at the general election of that year, but in 1894 was returned for Morlaix, for which he has since continued to sit. In 1897 he succeeded Jules Simon as a member of the French Academy. This honour he owed to the purity of style and remarkable eloquence of his speeches, which, except a few pamphlets, form his only published work. He took a conspicuous part in the debates on the Dreyfus question, and fought with rare pertinacity and skill against the Associations Bill of 1901, in which, however, he failed to effect any considerable modification.

Muncie, a city of Indiana, U.S.A., capital of Dela- ware county, on the West Fork of White river, and the Lake Erie and Western, the Cleveland, Cincinnati, Chicago and St Louis, and the Fort Wayne, Cincinnati and Louis- ville railways, in the eastern part of the state, at an altitude of 950 feet. It is within the natural gas belt, and has extensive manufactures of iron and steel, glass and paper. In 1900 there were altogether 347 manufactur- ing establishments, with a total capital of $7,793,832, an average number of 6294 wage-earners, and products valued at $12,106,648. Population (1890), 11,345; (1900), 20,942, of whom 1235 were foreign-born and 739 negroes.

Mundella, Right Hon. Anthony John

(1825-1897), educational and industrial reformer, was of Italian extraction, and was born at Leicester in 1825. After a few years spent at an elementary

school, he was apprenticed to a hosier at the age of eleven. He after- wards became successful in business in Nottingham, filled several civic offices, and was known for his philanthropy. He was sheriff of Nottingham in 1853, and in 1859 organized the first courts of arbitration for the settlement of disputes between masters and men. In November 1868 he was returned to Parliament for Sheffield as an advanced Liberal. He represented that constituency until November 1886, when he was returned for the Brightside division of Sheffield, which he continued to represent until his death. In the Gladstone Ministry of 1880 Mundella was Vice-President of the Council, and shortly afterwards was nominated fourth Charity Commissioner for England and Wales. In February 1886 he was appointed President of the Board of Trade, with a seat in the Cabinet, and was sworn a member of the Privy Council. In August 1892, when the Liberals again came into power, Mundella was again appointed President of the Board of Trade, and he continued in this position until 1894, when he resigned office. His resignation was brought about by his connexion with a financial company which went into liquidation in circumstances calling for the official intervention of the Board of Trade. How- ever innocent his own connexion with the company was, it involved him in a good deal of unpleasant public

discussion, and his position became untenable. Having made a close study of the educational systems of Germany and Switzerland, Mundella was an early ad- vocate of compulsory education in England. He ren- dered valuable service in connexion with the Elementary Education Act of 1870, and when he became head of the Education Department, he made compulsion univer- sal by the passing of the Universal Bye-Laws Act. The Educational Code of 1882, which was specially dis- tinguished in educational circles as the “Mundella Code,” marked an entirely new departure in the regu- lation of public elementary schools and the conditions of the Government grants. It inaugurated a system by which greater recognition was given to intelligent teaching and good management, and, by encouraging the cleverest and most industrious teachers, tendered to secure for the children and for the State the best possible results. The

seventh standard was a creation of the Mundella Code, and increased help was given to evening schools. Mundella also took an active interest in higher and technical education, as well as in the multiplication of art schools. He was likewise a firm supporter of trade unions, and did much towards se- curing from Parliament the emancipation of these, bodies. To his initiative was chiefly du’e the Factory Act of 1875, which established a ten-hours day for women and children in textile factories; and the Conspiracy Act, which removed certain restrictions on trade unions. It was he also who established the Labour Department of the Board of Trade, and founded the Labour Oazette. He introduced and passed Bills for the better protec- tion of women and children in brick-yards, and for the limitation of their labours in factories ; and he effected substantial improvements in the Mines Eegulation Bill, and was the author of much other useful legislation. In recognition of his efforts, a marble bust of himself, by Boehm, subscribed for by 80,000 factory workers, chiefly women and children, was presented to Mrs Mundella. He died in London, 21st July 1897.

Munden, a town of Prussia, province of Hanover, picturesquely situated at the confluence of the Pulda and the Werra, 21 miles north-east of Cassel by rail. It i? an ancient place, municipal rights having been granted in 1247. A few ruins of its former walls still survive. The large Lutheran church of St Blasius (14th-16th centuries) contains the sarcophagus of Duke Erik I. of Brunswick- Kalenberg (died 1540) and his wife. The 13th-century church of St jSIgidius was injured in the siege (by Tilly) of \^25, but subsequently restored. There is anew Roman Catholic church (1895V The town hall (1619), and the ducal castle, built by Duke Erik II. in 1571, and rebuilt in 1898, are the principal secular buildings. In the latter are the municipal museum and the collection of the forestry academy (1869). There are various small indus- tries, and a trade in timber. Population (1885), 7053 ;

(1900), 10,646.

Muni River Settiement (Spanish). See Eee-

NANDO Po.

iVIunich, the capital of Bavaria, and the third (1900) largest town in the German empire, near the middle of southern Bavaria, about half-way

between Strasburg and Vienna, in 48Â° 8′ 45″ N. and 11Â° 36′ 24″ E. (observatory), on the river Isar, in the district of Upper Bavaria, and 25 miles north of the foot-hills of the Alps. The process of converting Munich from a provincial capital into a great continental capital, which was begun shortly before the middle of the 19th century, is still being pursued. As opportunity offers, the narrow streets of the older city are being converted into broad, straight boulevards, lined with

palatial mansions and public buildings of architectural pre- tensions, whilst at the same time building is going on apace in the suburbsâ€” e.g-., Giesing, Schwabing, Nymphen- burg, and in the quarter south of the English Garden. The hygienic improvement effected by these changes is shown by the mortality averages â€” 40-4 per thousand in 1871-75, 30-4 per thousand in 1881-85, and 24-1 per thousand in 1896-98. The architectural style which has been principally followed in the later public buildings (e.g., the law courts, finished in 1897, the artists' club, the German Bank, St Martin's hospital), as well as in numerous private dwellings, is the Italian and French Rococo or Renais- sance, adapted to the traditions of Munich architecture in the 17th and 18th centuries. The new Bavarian National Museum (1899), at the south-east corner of the English Garden, is, however, a free adaptation of the native Renais- sance style of the end of the 15th century. Amongst half a dozen new churches, the most noteworthy are St Luke's (Evangelical), a Transitional building, with an imposing dome, finished in 1896 ; the church of the Giesing suburb, Gothic, with a tower 312 feet high and rich interior deco- rations (1866-84) ; and the synagogue (1884-87), in the Romanesque style. Amongst other structures and institu- tions are the new building of the art association, the museum of plaster casts, and the ethnographical museum, all three in the arcades of the royal garden behind the palace ; the academy of the plastic arts (1874-85), in the Renaissance style, situated just outside the gate of victory ; the antiquarium, a collection of Egyptian, Greek, and Roman antiquities, under the roof of the new Pina- kothek ; the Bavarian army museum, in the arsenal ; the Sehack gallery, bequeathed to the German emperor by Count Sehack in 1894, and rich in works by modern Ger- man artists ; the historical museum and the Maillinger collections of art and civilization, both belonging to the town ; the Lotzbeck private collection of sculptures and paintings ; and the Ludwig Bridge across the Isar (1890- 1891). Further, handsome additions have been

made to the public monuments which adorn the streets and squares, in- cluding theWittelsbach Fountain (1896), the monument to the Bavarian army (1892), the monument commemorative of the peace of 1871 (1900), and the marble statue of Liebig (1805-73), the chemist, set up in 1883. Munich in recent years has become one of the principal, if not the principal, art centre of Germany ; and in music it is supreme. Among the educational and charitable institu- tions may be mentioned the technical high school (1865- 1868), which in 1899 acquired the privilege of conferring the degree of doctor of technical science ; the new military school, military academy, and cadet corps' establishment ; the university agricultural college, the Max Joseph educa- tional institute, the Roman Catholic theological seminary, the new deaf and dumb asylum, the St Martin's hospital, the medical and other scientific institutes of the university, the school of the building arts, the hydrographic school, art school, music school, teachers'seminary, industrial and com- mercial schools, and technical schools. The royal library now contains some 1,300,000 volumes and about 30,000 MSS., several of the latter of unique value ; and the uni- versity library contains about 300,000 volumes. In 1900 the university, which had 194 professors and teachers, was attended by 4391 students. On the east side of the Isar is the new Maximilian park. During the last six months of 1897 and the first six months of 1898, 71,095,400 gallons of beer were made, of which about 25 millions were exported to foreign countries and other parts of Germany, the rest being consumed in Munich. (See further under Bavaria.) The restaurants and gardens attached to the breweries play a most important part in the social life of the people, and some of the former, e.g., the Hofbrauhaus, are edifices of truly palatial pretensions. Indeed, the remarkable

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number of nearly 12,000 persons depend for a livelihood upon inn and restaurant keeping, and of this number no fewer than 8500 are women. The building and equip- ment of powerful electric supply works at Hollriegels-gereut on the Isar, a few miles above Munich, has led many industrial establishments to remove out of the city to Sendling and over a score of villages in the neighbour- hood. At Planegg near by and at Harlaching, to the south of the city, sanatoria were opened in 1898 and 1900 respectively. Population (1885), 280,373 ; (1890), 349,024 ; (1900), 499,959. In 1890 the suburbs of Schwabing and Neuhausen were incorporated in the city.

See Munchener bilrgerliche Baukunst der Gegenwart, a series of sixty plates, Munich, 1898-99.

MunkÂ£ics, a corporate town of north-eastern Hun- gary, in the county of Bereg, with 11,142 inhabitants in 1891, and 14,416 in 1901, situated near the Latorcza, where the hills touch the plains. Its most noteworthy buildings are the upper gymnasium, barracks for ” honvdds,” the Greek Catholic cathedral, the theatre, and the beautiful castle of Count Schonborn. In the vicinity of the town stands, on a steep hill 580 feet high, the old fort of Munk^s, which played an important part in Hungarian history, and was famous especially for its heroic defence by Helene Zrinyi, wife of Emeric Tokoli and mother of Francis Eikdczy II., for three years against the Austrians. It was afterwards used as a prison. Ypsilanti, the hero of Greek liberty, and Kazinczy, the regenerator of Hungarian letters, were confined in it. According to tradition, it was near Munk^cs that the Hungarians, towards the end of the 9th century, entered the country. To commemorate this, it was proposed to erect a statue of Arp^d ; in 1896 in the fort was built one of the ” millennial monuments ” established at seven different points of the kingdom.

Munkacsy, Michael von (1844-1900), a painter, whose real name was Miohajel [Miska] Leo Lieb, was the third son of Michael Lieb, a collector of salt-tax in Munk^s, Hungary, and of Cacilia Kock. He was born in that town on the 20th of February 1844. In 1848 his father was arrested at

Miskolcz for complicity in the Hungarian revolution, and died shortly after his release ; a little earlier he had also lost his mother, and became dependent upon the charity of relations, of whom, an uncle, Rock, became mainly responsible for his main- tenance and education. He was apprenticed to a carpenter, Langi, in 1855, but shortly afterwards made the acquaint- ance of the painters Fischer and Szamossy, whom he accompanied to Arad in 1858. From them he received his fijst real instruction in art. He worked mainly at Budapest during 1863-65, and at this time first adopted, from patriotic motives, the name by which he is always known. In 1865 he visited Vienna, returning to Bud- apest in the following year, and went thence to Munich, where he contributed a few drawings to the Fliegende Blatter. About the end of 1867 he was working at Diis- seldorf, where he was much influenced by Ludwig Knaus, and painted (1868-69) his first picture of import- ance, ” The Last Day of a Condemned Prisoner,” which was exhibited in the Paris Salon in 1870, and obtained for him a mMaille unique and a very considerable reputa- tion (see Plate). He had already paid a short visit to Paris in 1867, but on the 25th of January 1872 he took up his permanent abode in that city, and remained there during the rest of his working life. Munkacsy’s other chief pictures are “Milton dictating Paradise Lost to his Daughters” (Paris Exhibition 1878), “Christ before Pilate” (1881), “Golgotha” (1883), “The Death of Mozart” (1884), “Arpad, Chief of the Magyars, taking possession of Hungary,” painted for the new House of Parliament in Budapest, and exhibited at . the Salon in

1893, and “Ecce Homo.” He had hardly completed the latter work when a malady of the brain overtook him, and ultimately proved fatal. He died on the 30th April 1900, at Endenich near Bonn. Just before his last illness he had been offered the directorship of the Hungarian State Gallery at Budapest. Munkacsy’s masterly characterization, force, and power of dramatic composition secured a great vogue for his works, but it is very doubtful if his reputation Vill be maintained at the level it reached during his lifetime. ” Christ before Pilate” and “Grolgotha” are said to have been sold for Â£32,000 and Â£35,000 respectively to an Ameri- can buyer. Munkacsy received the following awards for his work exhibited at Paris : Medal, 1870 ; Medal, 2nd class ; Legion of Honour, 1877 ; Medal of Honour, 1878 ; Ofacer of the Legion, 1878 ; Grand Prix, Exhibi- tion of 1889 ; Commander of the Legion, 1889.

See F. ‘Walther Ilges. “M. von Munkacsy.” Kiinstler Mono- graphien, 1899. â€” Ch. Sedelmeyee. Christ before Pilate. Paris, 1886. â€” J. Beavington Atkinson. “Michael Munkacsy,” Maga- zine of Art, 1881. (j;. p s ^

Munro, Hugh Andrew Johnstone

(1819-1885), British scholar, was born at Elgin on 19th October 1819. He was educated at Shrewsbury School, where he was one of Kennedy’s first pupils, and proceeded to Trinity CoUege, Cambridge, in 1838. He became scholar of his college in 1840, second classic and first chancellor’s medallist in 1842, and fellow of his college in 1843. He became classical lecturer at Trinity College, and in 1869 was elected to the newly- founded chair of Latin at Cambridge, but resigned it in 1872. The great work on which his reputation is mainly based is his edition of Lucretius, the feuit of the labour of many years (1860, 1864). A scholar of wide sympathies, he had yet made Latin poetry his special subject. His extensive knowledge of and enthusiasm for modern poetry found scope in the interpretation of the magnificent outbursts that relieve the exposition of Lucretius’s theories, and enabled him to correct the frigid pedantries of his predecessor, Lachmann. His travels in Italy often guided him to a correct inter- pretation of the landscapes of Lucretius. As a textual critic his knowledge was profound and his judgment unrivalled. But beyond the bounds of pure scholar- ship, the editing of Lucretius demands an intimate knowledge of ancient philosophy. Munro’s ~~commen~~ tary bears ample testimony to the extent of his philo- sophical reading. He had indeed, as early as 1855, marked an epoch in the study of Aristotle’s Ethics by his theory that books v. to vii. are the work of Eudemus. In yet another branch of classical antiquity, the study of archaeology, he had made himself a master by frequent travels in Italy and Greece. Unfortunately, he gave to the world but few specimens of his powers. In 1867 he published a greatly improved text of Aetna with com- mentary, and in the following year a text of Horace with critical introduction, illustrated by specimens of ancient gems selected by C. W. King. His ripe knowledge and fine taste are nowhere better shown than in his Criticisms and Elucidations of CatvMus (1878). He was a master of the art of Greek and Latin verse composition. His contributions to the famous volume of Shrewsbury verse, Sabrime Corolla, are among the most remarkable of a remarkable collection. His Translations into Latin and

Greek Verse were privately printed in 1884. Like his translations into English, they are characterized by minute fidelity to the original, but never cease to be idiomatic. The combination of all these gifts secured him, by general consent, the first place among the Latin scholars of his age. He died at Rome on 30th March 1885. (h. sy.)

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M tj N S T E E â€” M URAL DECORATION

M a nster, a town and episcopal see of Prussia, capital of the province of Westphalia, on the Dortmund-Ems canal, and at the junction of several railways, 107 miles south-west of Bremen. The tower of the Lambert church was rebuilt, to the height of 312 feet, in 1887-98, and the three iron cages were restored to their original places. A new Evangelical church was built in 1898. In 1889 a new building was erected for the municipal archives. Other edifices of mddern date are the Government offices (1886-89), the post office (1878-80), the academy build- ing (1878-80), and a synagogue (1880). The castle (begun in 1767) is the headquarters of the 7th German Army Corps. Amongst the public institutions may be mentioned the .provincial assembly house, a gaol, the museum of Christian art (1866), the provincial museum of natural science, a theological seminary, teachers' semi- naries, and colleges for theological candidates. A bronze equestrian statue of the Emperor William â€¢ I. (1897) by Eeusch, a war monument (1872), and the bronze figure of a Westphalian peasant (the Kiepenkarl, 1896) lend embellishment to the town. The academy was attended by 691 students (Roman Catholic) in 1900, the number of professors being 48. In the Eoyal Pauline Library there are about 120,000 volumes. There is an agricultural experimental station. Population (1885), 44,060;

(1900), 63,776.

Mii nster, a town of Germany, in Alsace-Lorraine, district of Upper Alsace, at the east foot of the Vosges Mountains, 16 miles west by south of Colmar by rail. It is a flourishing place, with good houses and a new Evan- gelical church, and considerable manufacture of calico, cotton, and cloth. Population (1900), 6083.

Miinster am Stein, a watering-place of Prussia, in the Rhine province, on the N”ahe, 2\ miles south of Kreuznach, with brine springs (87Â° Eahr.). Above the village are the ruins of the castle of Rheingrafenstein (12th century), the seat of the counts of the Rhine, destroyed by the French in 1689, and those of the castle of Bbernburg, the ancestral seat of the lords of Sickingen, and birthplace of Eranz von Sickingen (1481-1523), the famous lansknecht captain and protector of TJlricn von Hutten, to whom a monument was erected on the slope leading up to the ruins in 1889. Population (1900), 826.

Mlinsterberg, a town of Prussia, province of Silesia, on the Ohlau, 36 miles by rail south of Breslau. It was the former capital of the principality of Mlinster- berg, which existed from the 14th. century down to 1791, when it was purchased by the Prussian crown. It has manufactures of drain-pipes and fireproof bricks ; there are also sulphur springs. Population (1900), 8159.

Mural Decoration. â€” Mural decoration, it might be said, is the first and the last word of art, at least with the races of mankind who have acquired the habit of living in erected dwellings, with the craft of building walls. Primitive and prehistoric drawings and scratched outlines have been found upon the walls of caves, but it has only been with those races and in those countries where the craft of building has been practised that mural decoration has developed. The tendency to scribble and draw rude designs upon any blank waU-surface is observable anywhere and everywhere in our towns and villages, and our children only repeat in so doing the efforts of our primitive ancestors. At first, no doubt, with them, as with our children, the desire is to repre- sent, or to record, some observed fact, or to symbolize something which has impressed their imagination, and this with gradually acquired skill becomes picture-writing, and finally a conscious aim at decorative mural effect. The ancient Egyptians realized to the full the value as mural

surfaces of the white plastered walls of their temples and tombs as fields for simple mural painting in tempera in bright primary colours, in which the figures, as in all ancient mural art, are represented as on one plane and in profile, outlined and filled in flat local colours without shadow. This system

of treatment, unconsciously perhaps, illustrates, in their simplest form, what may be termed the chief decorative principles of mural decora- tion, which, however varied, added to, or enriched by succeeding ages and stages of more complex and more conscious art, continually reassert themselves to correct excesses and that tendency to escape from real limitations which so frequently characterizes the evolution of the arts. Upon the external walls of their stone temples, at a later date, to give greater emphasis, the outlines of the figures and shapes of the hieroglyphics were chiselled. This probably led in course of time to the complete bas- relief so largely used by the Assyrians and the Persians in the decoration of the large mural surfaces of their palaces. With the Persians, indeed, as we may see in the coloured and glazed brick frieze of archers from the palace of Darius, or fortress of Susa, construction and decoration are one, since the figures â€” a repetition of two patterns used alternately, with repeating borders â€” are built up of separate bricks. Presumably, however, the figures were first modelled upon a slab of clay and after- wards cut up into separate bricks.

We see low-relief sculpture, as a mural decoration intended for colour, carried to its perfection in the pan- athenaic frieze of the Parthenon at Athens, where, however, the Asiatic tradition in the simplicity of the processional and profile arrangement survives, and the single figures are shown on the same plane, and though the horsemen are represented one behind the other, or overlapping, there is but slight acknowledgment of distance. All the subtlety and exquisite refinement of an accomplished sculp- ture of the Phidian period seem concentrated in the work, which even without colour, as we see the frieze now, is yet full of the decorative effect of rhythmic recurring line and carefully planned balance of masses. The frieze as a whole, although full of life, variety, and movement, illustrates at once the acme of slab-sc)ulpture and the gravity and restraint of true mural decoration.

The principles of mural decoration which dominated Roman civilization may be learnt from the painted waUs of the Palatine, and the plaster and stucco reliefs of the tombs of the Latin Way, and the paintings of Pompeii. In these a different feeling comes in. We seem to see some aim at the expression of space and distances, though the main fields of colour upon the wall are still flat. We have fanciful arcades and pilasters, and hanging

wreaths and garlands, subjects in separate panels, both figures and land-scapes as well as still life, and the use of shadow and modelling in the representation of form ; red, black, yellow, and turquoise being-the prevailing colours of the grounds and panelled spaces of the wall. On the whole it is a type of mural decoration which seems to have been influenced by the modeller and relief sculptor and architect, and though graceful and often fanciful and even grotesque, has not the dignity and gravity of the Greek or the Asiatic. Raphael and his pupils in his Loggia revived it, and it has survived, more or less, in the mural decoration of Renascence buildings from that time onwards.

A more solemn and splendid type of mural decoration comes to us from the Christianized Greeks in the mosaics of St Sophia, of the churches of Ravenna of the 5th and 6th centuries, and of St Mark's at Venice. Strictly mural alike in structure, method, and effect, no decoration, per- haps, at its best is so impressive or so magnificent, and none seems so perfectly united with the architectural style and construction with which it is associated as mosaic.

As a consequence, perhaps it is the most difficult method to use with success in a building not originally intended for such decoration, or where carved architectural ornament competes with it, especially where the difficulty exists (which is always present) when it is sought by moderns to decorate a building of another age.

Upon the Byzantine traditions brought by Greek artists to Italy were founded her great schools of mural painting. Giotto showed much of the simplicity,, directness, and decorative quality of the Byzantine, united with a new infusion of life and nature in the greater ease and freedom natural to the fresco painter. Fresco painting became the mural decoration and the distinctive language of artistic expression in Italy from the 13th to the 16th century, and the Latin race has set the type for mural decoration by painting ever since. Between the Arena chapel at Padua and the Sistine chapel at

Eome we may find the whole story of its development, and very splendid the record is.

Such is a very brief and rough sketch of the historic background of mural painting before, in changing condi- tions, oil-painting and the portable easel picture displaced it â€” not, however, until mural painting in fresco and tempera had itself declined. Modern efforts at revival of mural painting have looked back to Italy for instruction in method and use of material, but all countries sooner or later, despite the effect of the interchange of ideas and knowledge of other countries and their arts, must be driven to adopt or to invent their own proper forms of mural decoration. Many efforts have been made in England to revive fresco painting. The Houses of Parliament bear witness to this, the principal works there being those of William Dyce and Daniel Maclise. That of G. F. Watts, whose easel work also is generally distinguished by its mural feeling, is full of serious purpose and dignity of conception too rarely employed. ” Buono fresco ” (the painting in tempera upon a freshly laid ground of plaster while wet), ” spirit fresco ” or Gambier-Parry method (the painting with a spirit medium ujjon a specially prepared plaster or canvas ground^), and “water-glass” painting (wherein the method is similar to water-colour painting on a prepared plastered wall, the painting when finished being covered with a chemical solution which hardens and protects the surface), have all been tried. Other processes are also in the ex- perimental stage, such as that known as Keim’s, which has been successfully tried by Mrs Merritt in a series of mural paintings in a church at Chilworth. Unless, however, some means can be found of enabling the actual painted wall to resist the natural dampness of the English climate, it does not seem likely that true fresco painting can ever be really naturalized in Great Britain. Of two of the few modern artists entrusted with important mural work in England, Ford Madox Brown and Frederick J. Shields, the former, distinguished especially for his fine series of mural paintings in the Manchester Town Hall, in the later paintings there adopted the modern method of painting the design upon canvas in flat oil colour, using a wax medium, and afterwards affixing the canvas to the wall by means of white lead. This is a usual method with modern decorators. Mr Shields has painted the panels of his scheme of mural decoration in the chapel of the Ascension at Bayswater, London, also upon canvas in oils, and has adopted the method of fixing them to slabs of slate facing the wall

so as to avoid the risk of damp from the wall itself. Friezes and frieze panels or ceilings in private houses are usually painted upon canvas in oil and affixed to the wall or inserted upon their strainers, like pictures in a frame. (The present writer has used fibrous plaster

1 It was in this method that the lunettes hy Lord Leighton at the Victoria and Albert Museum were painted on the plaster wall. The same painter produced a fresco at Lyndhurst Church, Hants.

panels, painting in ordinary oil colours with turpentine as a medium, as in Eedcross Hall.) Recently there has been a revival of tempera painting, and a group of painters are producing works on panel and canvas painted in tempera or fresco secco, with yolk of egg as a medium, according to the practice of the early Italian painters and the directions of Cennino Cennini. A remarkably pure and luminous quality of colour is produced by this method, very valuable in mural decoration and also very durable, especially under varnish. There seems no reason why tempera painting should not be used for mural work on fibrous plaster panels, which, being hollow at the back, preserve their dryness. Tempera work can be readily cleaned with bread.

For the decoration and covering of the lower walls of churches, public buildings, and private dwellings, wood- panelling, with or without intarsia, silk hangings, or arras tapestry, have been the principal means from the later Middle Ages to our times, and they still obtain, at least in the houses of the rich. For interior walls, churches, and also in exterior mural decoration on secular buildings, sgraffito might be named as another method recently revived. It consists in cutting or scratching a design through a thinnish surface coat of plaster on to black or various colours previously laid beneath upon the wall. A series of experiments in this method (by the late Mr Moody and his pupils) may be seen on the east wall of the Eoyal College of Science, Exhibition Road, London. Mr Heywood Sumner has also decorated churches in this method, which is very durable, and being composed of coats of plaster, becomes essentially a part of the wall.

Wall-papers. â€” ^For tha mural decoration of the house of the ordinary citizen, however, the above-mentioned’ methods are usually out of reach. The kind of mural decoration in most general use is waU-paper. This was

no doubt at first a substitute for textile hangings, and we may still notice how, in type of pattern, wall-paper design is largely influenced by textile hang- ings. The earliest known example of wall-paper probably dates from the 16th century, but it does not appear to have come into general use until the 18th century. In the 19th century, in design wall-paper closely reflects prevailing taste and modes in decoration and furniture, changing as these have changed. Many eminent designers have given their attention to this sort of design, which demands much ingenuity and taste ; among these may be named B. J. Talbot, J. D. Sedding, Lewis F. Day, C. F. A. Voysey, Heywood Sumner, Henry Wilson, &c. William Morris was very successful in changing the public taste and lifting it to higher standards in this direction, causing a strong revulsion of feeling for patterns of much more strictly mural type and mediaeval in treatment. He adopted patterns from Venetian, Indian, and old English sources, while his own designs were emphatically mediaeval in inspiration. Consisting at first of the repetition of a few simple floral units (like “the Daisy”), they became in his later time very rich and complex ; but all, whether gay or quiet in colour, possessed the distinctive mural quality, forming good backgrounds, never in any way imitative ; and though showing, as might be expected, a certain textile influence in their forms and spacing, they were always essentially patterns entirely adapted to their method â€” block-printing. The best wall-papers are printed from wood blocks upon which the pattern is cut, requiring a different block for each colour used, the out- lines being formed of brass or copper strips set edgeways in the wood block, forming a kind of cloisonnfi. The flat colours form the surfaces of the block left by the cutter of the pattern. The colours are printed in succession as each printing dries, and by hand. Thus the size of the block which governs the width and depth of the repeat is necessarily limited â€” a square of 21 inches being usual ; though greater depth is sometimes allowed, the 21-inch width is never exceeded, except in the case of friezes, which have occasionally run to 42 or more inches wide, though they are never deeper than 21 inches. Wall-papers are also stamped with raised patterns, in emulation of stamped leather, and gilded and lacquered. The cheapest kind of wall-paper is that produced by machine, and is printed from rollers, the outlines of the design being formed of brass or copper wire let into the wood of tie rollers, the repeat, of course, corresponding to the circumference of the roller, each colour being printed

in succession from a corresponding roller. Papers printed by this method never attain the precision, quality of tint, or finish of the block-printed

papers. Another kind, Toy which a certain quality of surface and depth of colour are given, is called flock. This might have originated in the attempt to imitate or to vie with cut velvet hangings and brocade. The ground colours are printed as before from filocks, the parts of the pattern intended to be raised in flock are printed in size, and the paper is then passed through a kind of well or trough of dry finely-powdered fibre, like dust, stained to the desired tint. The bottom of this well or trough of coloured fibre is flexible and is beaten up with sticks to keep the powdered fibrous colour flying, and enable it to settle evenly to the thickly-sized parts of the pattern, which when finished stand up in relief like the pile of velvet or carpet, though closer and harder. Bold patterns suitable for stencils or for stamped or cut velvets are the most effective in this process, but it is questionable whether paper-staining is not attempting to pass beyond its natural limitations in thus emulating effects which can only be satisfactorily obtained in textiles.

Stencilling. â€” Another and, in its simpler forms, cheaper and readier method of decorating walls in stencilling. There has been a considerable revival of this method, and the designs shown by various schools of the United Kingdom in the national competition at South Kensington often display remarkable ability in design and dexterity in the cutting and use of stencils. In some cases, indeed, there has been a tendency to over-elaborate, and by the use of blended tints to obtain effects from the method which its mechanical conditions hardly justify. The pattern is cut out of Bristol board or thin sheets of zinc, and so contrived that its parts are held together by what are called ties. In a stencil pattern the forms are blocked out in masses isolated from each other by lines. In the stencil the parts to appear in colour on the wall are holes, the separating lines and ties are solid and stop out the colour, and so when the stencil plate is applied to the wall and the colour painted through, by dabbing a stiff brush on the open parts, the dividing lines and ties appear white, or in the ground tint of the wall or hanging upon

which the plate is laid. It may be made a tasteful and effective method of covering large wall surfaces, and is sometimes applied to hangings of various kinds. House painters and decorators do not use stencils much except for small borderings and corners, where they usually have a mean and cheap effect ; but used as a means of covering a wall with a bold field of fioral repeating pattern of an abstract kind, they may be quite sufficient and agreeable.

As to mural painting and decoration generally, it is to be re- gretted that more opportunities are not afforded to artists to exer- cise themselves in this highest field of design. Indeed, it would appear that the real modern equivalent for mural decoration as a popular art is only to be found in the coloured poster which covers the dead walls and temporary hoardings of our towns and cities, among which many clever designs have appeared ; but while this class of work certainly frequently demands figure design upon a large scale and bold and simple colouring, the commercial exigen- cies and necessities of its very existence have a hopelessly vulgariz- ing effect, so that a serious school of design cannot be expected to arise out of such conditions. Ow. Cr.)

Muravieff, Michael Nikolaievitch, Count (1845-1900), Russian statesman, born 19tli April 1845, was the son of General count Nicliolas Muravieff (gov- ernor of Grodno), and grandson of the Count Michael Muravieff: who became notorious for the drastic measures he employed in stamping out the Polish insurrection of 1863 in the Lithuanian provinces. H,e was educated at a secondary school at Poltava, and was for a short time at Heidelberg University. In 1864 he entered the chan- cellery of the Minister for Foreign Affairs at St Peters- burg, and was soon , afterwards attached to the Russian legation at Stuttgart, where he attracted the notice of Queen Olga of Wtlrtemberg. He was transferred to Berlin, then to Stockholm, and back again to Berlin. In 1877 he was second secretary at The Hague. During the Russo-Turkish war of 1878 he was a delegate of the Red Cross Society in charge of an ambulance train pro- vided by Queen Olga of Wtlrtemberg. After the war he was successively first secretary at Paris, chancellor of the embassy at Berlin, and then minister at Copenhagen. In Denmark he was brought much into contact with the Imperial family, and on the death of Prince Lobanof in 18‘97 he was appointed by the Tsar Nicholas II. to be his

Minister of Foreign Affairs. The next three and a half years were a critical time for European diplomacy. The Chinese and Cretan questions were disturbing factors.

As regards Crete, Count Muravieff ‘s policy was vacillat- ing; in China his hands were forced by Germany s action at Kiaochow. But he a^ted with singular Ug^rete with regard at all events to his assurances to Great Britain respecting the leases of Port Arthur and Talien- wan from China; he told the British ambassador that these would be “open ports,” and afterwards essentially modified this pledge. When the Tsar K’icholas inaugu- rated the Peace Conference at The Hague, Count Mura- vieff dexterously extricated his country from a situpt’on of some embarrassment; but when, subsequently, tas- sian agents in Manchuria and at Peking connived at the agitation which culminated in the Boxer rising of ‘ 10, the relations of the responsible Foreign Minister with the Tsar became strained. Muravieff died suddenly on 21st June 1900, of apoplexy, brought on, it was said, by a stormy interview with the Tsar. He was a man of imperturbable self-confidence, but a political opportunist.

Murcia, a maritime province in the south-east of Spain ; area, 4478 square miles. It is divided into ten administrative districts and parishes. Population (1*^87), 491,436; (1897), 518,263. The birth-rate is 3-72 per cent., the death-rate 314 per cent., the illegitimate births 5-03 per cent. New railway lines have been established.

In 1898 wheat was grown on 367,742 acres ; rye, oats, barley, and maize on 547,150 acres ; pod fruit on 14,600 acres; vines on 58,309 acres; olives on 66,112 acres. The live stock in that year included 11,054 horses, 34,718 mules, 46,620 asses, 8828 cattle, 225,7.30 sheep, 89,757 goats, and 44,275 pigs. The mines are very important, and many beds remain unworked for lack of means of communication. The mines actually worked in 1898 w=Te ii sulphur, 1 zinc, 14 iron, and 295 argentiferous lead mines employed 2844 hands, and smelting works 960 more. The output included 10,000 tons of sulphurous ore, 46,716 j ,

371,391 of iron ore, 149,652 of argentiferous lead ore, ^nd 12,700 of common salt. The smelting gave 1500 tons of sulphur, 80,018 of argentiferous lead, 8431 of poor grade lead, and 500,000 ^jains troy of silver. These figures show a considerable increase as regards lead and zinq,

but a considerable decrease as regatds iron. Manufacturing industries, though of minor importance, are numer- ous, and commerce is active thro’ugh the ports.

Murcia, the capital of the province, well served by r’ â€” -=, lies 280 miles south-east of Madrid. Population (1887), ;

(1897), 108,408. In outward aspect it has greatly improved: promenades have been extended and laid out anew, churches and monuments have been restored, and the schools for primary and higher education, the hospitals, the provincial museums, the theatres and bull-ring, and the various economic societies have all developed. In addition to the silk industry, manufactures of woollen, linen, and cotton goods, saltpetre, flour, leather, and hats are all deserving of notice.

Murfreesboro, a city of Tennessee, U.S.A., capital of Rutherford county, near Stone river, and on the “Vnsh- ville, Chattanooga and St Louis railway, near the .^. of the state, at an altitude of 583 feet. It was io^frs about 1800, and from 1817 to 1827 was the capital ^^ state. It was the scene of one of the battles Civil War known as Stone river or jMurfreesboro. occurred on the 31st of December 1862 to the 2 January 1863, between the Union forces under Gt,. Rosecrans and the Confederate under General Bragg. Although the action was indecisive, it resulted in the retreat of the Confederates. The Union army lost, out of 43,400 men engaged, 1730 killed, 7802 wounded, and 3717 captured. The Confederates, out of 37,800 men engaged, lost 1294 killed, 7!145 wounded, 1027 captured. Population (1890), 3739 ; (1900), 3999, of whom 31 were foreign-born and 2248 negroes.

Murphysboro, a. city of Illinois, U.S.A., capital of Jackson county, on the Big Muddy river, on the Illinois Central and the Mobile and Ohio railways, in the southern part of the state. Population (1890), 3880 ; (1900), 6463, of whom 557 were foreign-born and 456 were negroes.

Murray, Alexander Stuart (1841), British

archaeologist, the eldest son of George Murray of Ar- broath, was born 8th January 1841, and educated at Ar- broath and Edinburgh High Schools, and at Edinburgh and Berlin Universities. In 1867 he entered the British Museum as an assistant in the Department of Greek and Eoman Antiquities under Sir Charles Newton, whom he succeeded in 1886. His younger brother, George Robert]\f ilne Murray, F.R.S., was made keeper of the Botanical â– f’ ;i*iartment in 1896, the only instance of two brothers bfetoming heads of departments at the Museum. In 1873 r^‘Murray published a Manual of Mythology, and in the i&^owing year contributed to the Contemporary Review two articles, one on the Homeric question, which led to a friendship with Mr Gladstone, the other on Greek painters. He has also written for the Nineteenth Century, the Quarterly Revieiv, the Hellenic Journal, the Mhnoires et Monuments Plot, the Revue ArcMologique, and similar periodicals. In 1880-83 he brought out the History of Greek Sculpture, which at once became a standard auljhority, and a second edition was called for in 1890. As keeper of his department, Dr Murray is acknowledged to have shown remarkably good taste in the arrangement of the collection in the exhibition galleries. In the Mausoleum andEphesus Rooms he took especial interest, and in the latter are to be seen drawings by him repre- senting a restoration of the Temple of Artemis. In 1886 he was selected by the Society of Antiquaries of Scotland to deliver the Rhind Lectures on archaeology, out of which grew his Handbook of Greek Archaeology, published in ‘ tSOP, which also has become a standard work. In

'â€” 96 Dr Murray directed some excavations in

yj;us undertaken by means of a bequest of Â£2000 irum Miss Emma Tournour Turner. These were com- menced in 1894 by Mr Arthur H. Smith, and continued itf’the following year by Mr H. B. Walters, assistants in Dr Murray’s department, and in 1896 by Dr Murray in person on a new site near Salamis. The numerous obj>cts obtained, which greatly enriched the national â– ‘Â»’~V;Â«tion, are described and illustrated in a handsome . . . ‘ volume, Excavations in Cyprus, published by the Trustees of the Museum in 1900. Among Dr Murray’s other official publications are three folio volumes on Terra-cotta Sarcophagi, Wliite Athenian Vases, and De- signs from Greek Yases. In 1898 he wrote for the Port- folio a monograph on

Greek bronzes, founded on lectures delivered at the Royal Academy in that year, and he has contributed many articles on archaeology to the ‘standard publications of the day. In recognition of his services t/3,ii txihaeology, he was made LL.D. of Glasgow University

tii87, and elected a corresponding member of the Berlin .jii demy of Sciences in 1900. ‘ li

:Â«/lurray, James Augustus Henry (1837),

‘ icographer, was born at Denholm, near Hawick, Rox-

..‘ghshire, in 1837, and after a local elementary educa- A,n proceeded to Edinburgh, and thence to the Univer- .sity of London, where he grg.duated B.A. in 1873. Dr Murray, who holds that honorary degree from several universities, British and foreign, was engaged in scholas- tic work for thirty years, from 1856 to 1885, chiefly at Hawick and Mill Hill. During this time his reputation as a philologist was steadily increasing, and he was as- sistant examiner in English at the University of London from 1876 to 1879 and president of the Philological Society of London from 1878 to 1880, and again from 1882 to 1884. It was in connexion with this society that Dr Murray undertook the chief work of his life, the Â«diting of the New English Dictionary based on materials collected by the society. These materials, which had accumulated since 1867, when the society first projected

the publication of a dictionary on philological principles, amounted to an enormous quantity, of which an idea may be formed from the fact that Dr Eurnivall sent in ” some ton and three-quarters of materials which had accu- mulated under his roof.” After negotiations extending over a considerable period, the contracts between the society, the Delegates of the Clarendon Press, and the editor were signed on 1st March 1879, and Dr Murray commenced the examination and arrangement of the raw material, and the still more troublesome work of re-ani- mating and maintaining the enthusiasm of ” readers.” In 1885 Dr Murray removed from Mill Hill to Oxford, where his Scriptorium has since ranked among the insti- tutions of the University city. A full account of the commencement of the dictionary and the manner of working up the niaterials will be found in Dr Murray’s

presidential address to the Philological Society in 1879, while reports of its progress are given in the addresses by himself and other presidents in subsequent years. In addition to his work as a philologist, Dr Murray has been a frequent contributor to the transactions of the various antiquarian and archaeological societies of which he is a member. In 1885 Dr Murray received the honorary de- gree of M.A. from Balliol College.

Murray, Sir John (1841), British geo- grapher and naturalist, was born at Coburg, Ontario, Canada, 3rd March 1841, and after some years' local schooling studied in Scotland and on the Continent of Europe. He was then engaged for some years in natural history work at Bridge of Allan. In 1868 he began his career as an explorer by a visit to Spitsbergen on a whaler, and in 1872, when the voyage of the Challenger was projected, he was appointed one of the naturalists to the expedition. At the conclusion of the voyage he was made principal assistant in drawing up the scientific re- sults, and in 1882 he became editor of the Reports, which were completed in 1896. He himself compiled a sum- mary of the results, and was part-author of the Narrative of the Cruise and of the Report on Deep-sea Deposits. He also published numerous important papers on oceano- graphy and maritie biology. In 1898 he was made K.C.B., and from time to time he was the recipient of many dis- tinctions from the chief scientific societies of the world. Apart from his principal work in connexion with the Challenger Reports, he went in 1880 and 1882 on expedi- tions to explore the Earoe Channel, and between 1882 and 1894 was the prime mover in various biological investi- gations in Scottish waters. References to the important work done by Sir John Murray will be found under the articles treating of geography, oceanography, &c.

Murray, John, publisher. See Publishing.

Murree, a town and sanatorium of British India, in the Rawalpindi district of the Punjab, 7453 feet above the sea, about five hours by cart-road from Rawalpindi town, and the starting-point for Kashmir. Population (1881), 2489 ; (1891), 1459 ; but these figures omit the summer visitors and also the British troops ; municipal income (1897-98), Rs.44,620. During 1897 the maxi- mum temperature was 89-7Â° P. in July, and the minimum was 30Â° F. in December ; the total rainfall was 61 inches. Since 1877 the summer offices of the provincial govern- ment have been transferred to Simla. It has hotels, banks, and churches, and the largest brewery in India, established in 1880, with an annual out-turn of more than 1,000,000 gallons. The Lawrence Memorial Asy- lum for the children of European soldiers had 103 boys and 82 girls in 1896-97, and there are four other schools for Europeans. A water-supply has been provided by the

municipality out of a loan of Rs. 1,00,000 ; and a water- rate is charged, yielding Rs.9000.

S.VIL-5

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MURSHIDABADâ€” MUSCOGEE

Murshidabad, or Mookshbedabad (formerly Muxadabad), a town and district of British India, in the Presidency division of Bengal, the administrative head- quarters of which are at Berhampur. The town is on the left bank of the Bhagirathi or old sacred channel of the Ganges. Population (1872), 46,182; (1881), 39,231; (1891), 35,676, showing a continuous decrease. It is still the residence of the Nawab, who now ranks only as the first nobleman of the province, with the style of Nawab Bahadur of Murshidabad, instead of Nawab Nazim of Bengal. The city is crowded with palaces, mosques, tombs, and gardens, and retains some of the manufactures of luxury, such as carving in ivory, gold and silver embroidery, and silk-weaving. A college is maintained for the education of the Nawab's family, with 60 pupils in 1896-97, and there is a high school, with 347 pupils. There are eleven printing-presses, issuing three vernacular newspapers.

The district of MnESHiDABAD has an area of 2144 square miles. Population (1881), 1,226,790; (1891), 1,250,946; and (1901), 1,335,374, showing an increase of 2 per cent, between 1881 and 1891, and 6-7 per cent, between 1891 and 1901 ; average density, 623 persons^per square mile. 'Classified according to religion, Hindus in 1891 numbered 620,163; Mahommedans, 618,653; Christians, 540, of whom 68 were Europeans ; aborigines, 9333 ; Jains, 2257. The land revenue and rates in 1896-97 were Ks.11,51,179; number of police, 768; boys at school (1896-97), 25,631, being 28-2 per cent, of the male population of school-going age ; registered death-rate (1897), 28-46 per thousand. The prin- cipal industries are siik and indigo, though neither is flourishing. There are nearly 50 silk filatures, employing 12,000 persons, with an outturn of 538,000 lb, valued at Rs.30, 00,000 ; and 21 indigo factories, employing 4000 hands, with an out-turn of 2000 maunds, valued at Es.3, 35,000. A narrow-gauge railway crosses the

district for 14 miles, from the East Indian line at Nalhati to Azimganj on the Bhagirathi, the home of many rich Jain merchants. The district suffered from drought in 1896-98.

Murtoza, a town of Portugal, district of Aveiro, 6 miles north of Aveiro and on the east side of the lagoon. It is an important fishing centre. In 1900 the popula- tion numbered 9881.

Murzuk. See Tripoli.

Muscat, MusKAT, or Maskat, a town on the south- east coast of Arabia, capital of the province of Oman. Its value as a naval base is derived solely from its position, wjiich gives it the command of the entrance to the Persian Gulf and of the Arabian Sea coast. The little district of Gwadur, wherein lies the chief port of Makran, belongs to Muscat, and it is by political arrangement with the sultan that the British occupy that port with a telegraph station of the Indo-Persian telegraph service. Muscat is under British political influence, and an Indian political residency is established there. The most remarkable feature in its geographical position is its isolation from the interior of the continent. The mountains rise behind it in a rugged wall, across which no road exists. It is only from Matrah, which may be regarded as a northern suburb shut off by an intervening spur which reaches outwards to the sea, that land communication with the rest of Arabia can be maintained. Both Muscat and Matrah are defended from incursions on the landward side by a wall with towers at intervals. Muscat rose to importance with the Portuguese occupation of the Persian Gulf, and it is still noted for the extent of Portuguese ruins about it. Two lofty forts, of which the most easterly is called JaMli and the western Merani, occupy the summits of hills on either side the cove overlooking the town ; and beyond them on the seaward side are two smaller defensive works called Sirat. All these old Portuguese constructions are in a ruinous condition. A low sandy isthmus connects the rock and fortress of JaMli with the mainland, and upon this isthmus stands the British residency. The sultan’s palace is a large, three-storeyed building near the centre of the town,

a relic of Portuguese occupation, called by the Arabs El Jereza, a corruption of Igrezia (church). This term is probably derived from the chapel which was once attached to the block of buildings which formed the Portuguese

governor’s residence and factory. The bazaar is insigni- ficant, and its most considerable trade appears to be m a sweetmeat prepared from the gluten of maize. Large quantities of dates are also exported. The early history of Muscat is the history of Portuguese ascendancy m the Persian Gulf. When Albuquerque first burnt the place after destroying Kary^t in 1508, Kalhat was the chief port of the coast and Muscat was comparatively unim- portant. Kalhat was subsequently sacked and burnt, the great Arab mosque being absolutely destroyed, before Albuquerque returned to his ships, ” giving many thanks to our Lord.” Prom that date, through 114 years of Portuguese ascendancy, Muscat was held as a naval station and factory during a stormy period of local revolts, Arab incursions, and Turkish invasions by sea ; but it was not till 1622, when the Portuguese lost Hormuz, that Muscat became the headquarters of their fleet and the most im- portant place held by them on the Arabian coast. In 1650 the Portuguese were finally expelled from Oman. Muscat had teen much reduced in strength previously by the humiliating terms imposed upon the garrison by the Imam of Oman after a successful siege in 1648. Por the short period of five years the Persians occupied Oman, but they disappeared in 1741. Under the great ruler of Oman, Saiad Said din Sultan (1804-^6), the fortunes of Muscat attained their zenith ; but on his death, when his kingdom was divided and the African possessions were parted from w^estern Arabia, Muscat declined to that second-rate position which it still retains. Its recent history is unimportant. In 1883-84, when Turki was sultan, the town was unsuccessfully besieged by the Inda- bayin and Eehbayin tribes, led by Abdul Aziz, the brother of Turki. In 1885 Colonel Miles, then resident at Muscat, made a tour through Omq,n, following the footsteps of Wellsted in 1835, and confirmed that previous traveller’s report of the fertility and wealth of the province. In 1898 the French acquired the right to make use of Muscat as a coaling station.

Stiffe (“Trading Ports of Persian Gulf,” vol. ix. Geog. Journal) gives the most comprehensive account of the port of Muscat which has been published during recent years, if we except the political reports of the Indian Government from the Persian Gulf. Colonel Miles’s explorations in Oman will be found in vol. vii. Journal J?.G.;S. 1896. (t. H. H*.)

Muscatine, a city of Iowa, U.S.A., capital of Muscatine county, on the west bank of the jSIississippi river, and on the Burlington, Cedar Rapids and Northern and the Chicago, Pock Island and Pacific railways, in the eastern part of the state, at an altitude of 554 feet. The city has extensive manufactures of lumber, iron, brick, tiles, and pottery. In 1900 there were altogether in the city 247 manufacturing establishments, with a total capital of $3,725,971 and products valued at $5,791,110. Popu- lation (1890), 11,454; (1900), 14,073, of whom 2352 were foreign-born and 125 negroes.

Muscogee, a town in the Creek Nation, Indian Territory, U.S.A., north of the centre of the territory, on a level plain near the Arkansas river, on the IMiss'ouri, Kansas, and Texas railway, at an altitude of 600 feet. It is the United States headquarters of the territory, the official home of the agent for the Indians, and the" head- quarters of the United States courts. Its inhabitants consist almost entirely of whites and negroes, as the Indians remain away from the railways. Population (1890), 1200; (1900), 4254, of whom 100 were foreign- born and 1120 negroes.

Muscle. See Physiology.

Museums. â€" Not the least striking aspect of artistic hid educational progress during the last quarter of the 19th century has been the growth and development of museums, both in Great Britain and abroad. This growth, as Prof. Stanley Jevons predicted would be the case, synchronizes with the advancement of education. Public museums are now universally required ; old insti- tutions have been greatly improved, and many new ones have been founded. The British Parliament has passed statutes conferring upon local authorities the power to levy rates for library and museum purposes, while on the Continent the collection and exhibition of objects of antiquity and art has become a recognized duty of the state and municipality alike. The modern museum differs essentially from the museum formed a century ago. The aimless collection of curiosities and bric-a- brac, brought together without method or system, was the feature of certain famous collections in bygone days, of which the Tradescant Museum, formed in the 17th century,

was a good example. This museum was a miscellany, without didatic value ; it contributed nothing to the advancement of art ; its arrangement was un- scientific, and the public gained little or no advantage from its existence. The modern museum, on the other hand, shoidd be organized for the public good, and should be a fruitful source of amusement and instruction to the whole community â€” to whom most museums now belong. History records few museums as having belonged to the public, the famous museum of Ptolemy at Alexandria (300 e.g.) being for the learned rather than the community at large. In Athens also the col- lections of sculpture were doubtless accessible to the public, though not directly founded for their benefit. In mediaeval times the Church and cloister afforded the only museum and picture gallery to which the public were in- vited. Great collections were formed by princes and nobles, collections which in many instances have now be- come public property. And even when Dr Waagen de- scribed the collections of England' about 1840, private individuals figured chiefly among the owners of art treasures. Nowadays in making a record of this nature the collections belonging to the public would attract most attention. This fact is becoming more obvious every j'ear. Not only are acquisitions of great value constantly made, but the principles of museum administi'ation and development are being more closely defined. What Sir William Plower, an eminent authority, called the "new museum idea " (Essays on Museums, p. 37) is pervading the treatment of all the chief museums of the world. Briefly stated, the new principle of museum development, first enunciated in 1870, but now beginning to receive general support, is that the first aim of public collections shall be education, and their second recreation. To be of teaching value, museum arrangement and classifica- tion must be carefully studied. Acquisitions must be added to their proper sections ; random purchase of " curios " must be avoided. Attention must be given to the proper display and cataloguing of the exhibits, to their housing and preservation, to the lighting, comfort, and ventilation of the galleries. Furthermore, facilities must be allowed to those who wish to make special study of the objects on view. " A museum is like a living organism ; it requires continual and tender caie ; it must grow, or it will perish " (Flower, p. 13). I^erhaps the best illustration of the new museum idea is a negative example â€" the Soane Museum in London, where the col- lection of Sir John Soane (d. 1837) is exhibited. Like the

Tradescant Museum, it has all the faults condemned by the modern rules of organization, being without

method or science either in the objects exliibited or in the manner of their display. At the same time it possesses objects of great merit, though their charm and value ai-e minimized by their juxtaposition to other things ; but the little museum, being a source of much enjoyment to the public, can at least claim to have attained one objective of the new idea.

Great progress is being made in the classification of objects, a highly important branch of museum work. There are three possible systems, namely by date, by material, and by nationality. It has ‘j^^”’’^’ been found possible to combine the systems to some extent ; for instance, in the i'ory department of the Victoria and Albert Museum, South Kensington, London, where the broad classification is by material, the objects being further subdivided according to their age, and in a minor degree according to their nationality. But as yet there is no general preference of one system to another. Moreover, the principles of classification are not easily laid down; e.g., musical instruments: should they be included in art exhibits, or in the ethnographical section to which they also pertain ? Broadly speaking, objects must be classified according to the quality (apart from their nature) for which they are most remarkable. Thus a musket or bass viol of tlie 16th century, inlaid with ivory and highly decorated, would be properly in- cluded in the art section, whereas a common flute or weapon, noteworthy for nothing but its interest as an instrument of music or destruction, woidd be suitably classified as ethnographic. In England at any rate there is no uniformity of practice in this respect, and though it is to be hoped that the ruling desire to classify ac- cording to strict scientific rules may not become too prevalent, it would nevertheless be a distinct advantage if, in one or more of the British museujns, some attempt were made to illustrate the growth of domestic arts and crafts according to classification by date. Examples of this classification in ^Munich, Amsterdam, Basel, Zurich, and elsewhere afford excellent lessons of history and art â€” a series of rooms being fitted up to show, in chrono- logical order, the home life of our ancestors. In the National Museum of Bavaria (Munich) there is a superb suite of rooms illustrating the progress of art from ilerovingian times down to the 19th century. Thus classification, though studied, must not check the

elasticity of art museums ; it should not be allowed to interfere with the mobility of the exhibits â€” that is to say, it should always be possible to withdraw specimens for the closer inspection of students, and also to send examples on loan to other museums and schools of art â€” an invaluable sys- tem long in vogue at the South Kensington Museum, and one which should be still more widely adopted. An axiom of museum law is that the exhibits shall be properly shown. ” The value of a museum is to be tested by the treatment of its contents ” (Flower,* p. 2-1). But in many museums the chief hindrance to study and enjoy- ment is overcrowding of exhibits. Although a truism, it is necessary to state that each object should be properly seen, cleaned, and safeguarded; but all over the world this rule is forgotten. The rapid acquisition of objects is one cause of overcrow^ding, but a faulty appreciation of the didatic purpose of the collection is more fre- quently responsible.

In Great Britain, museum progress is satisfactory. Visitors are numbered by millions, access is now permitted on Sundays and week-days ‘‘â„¢Â»^ ^^ alike, and entrance fees are being consistently ’’^”**” reduced ; in this the contrast between Great Britain and some foreign countries is singular. A generation ago the national collections of Italy used to be always open to the public. Pay days, however, were gradually established,

â– with, the result that the chief collections are now only visible on Sundays without payment. In Dresden pay- ment is obligatory five days a week. The British Museum never charges for admission. On the other hand, the increase in Continental collections is more rapid than in Great Britain, where acquisitions are Only made by gift, purchase, or bequest. In other European countries enormous collections have been obtained by revolutions and conquest, by dynastic changes, and by secularizing religious foundations. Some of the chief treasures of pro- vincial museums in France were spoils of the Napoleonic armies, though the great bulk of this loot was returned in 1815 to the original owners. In Italy the conversion of a monastery into a museum is a simple process, the Dominican house of San M^rco in Florence oifering a typical example. A further stimulus to the

foundation of museums on the Continent is the comparative ease with which old buildings are obtained and adapted for the collections. Thus the Germanisches Museum of Nuremberg is a secularized church and convent ; the enormous collections belonging to the town of Ravenna are housed in an old Camaldulensian monastery. At Louvain and Florence municipal palaces of great beauty are used ; at Nimes a famous Roman temple ; at Urbino the grand ducal palace, and so on. There are, however, certain disadvantages in securing both building and col- lection ready-made, and the special care devoted to mu- seums in Great Britain can be traced to the fact that their cost to the community is considerable. Immense sums have been spent on the buildings alone. The new build- ings of the Victoria and Albert Museum are to cost Â£800,000. Had it been possible to secure them without such an outlay, the collections themselves would have been much increased, though in this increase itself there would have been a danger, prevalent but not yet fully realized in other countries, of crowding the vacant space with spec- imens of inferior quality. The result is that fine things are badly seen owing to the masses of second-rate exam- ples ; moreover, the ample space available induces the authorities to remove works of art from their original places, in order to add them to the museums. Thus the statue of St George by Donatello has been taken from the church of Or San Michele at Florence (on the plea of danger from exposure), and is now placed in a museum where, being dwarfed and under cover, its chief artistic value is lost. The desire to make financial profit from works of art is a direct cause of the modern museum movement in Italy. One result is to displace and thus depreciate many works of art, beautiful in their original places, but quite insignificant when put into a museum. Another result is that, owing to high entrance fees, the humbler class of Italians can rarely see the art treasures of their own country. There are other collections, akin to art museums, which would best be called biographical museums. They illustrate the life and work of great artists or authors. Of these the most notable are the museums commemorating DUrer at Nuremberg, Beethoven at Bonn, Thorwaldsen at Copenhagen, Shakespeare at Stratford, and Michael Angelo at Florence. The sacristies of cathedrals often contain ecclesiastical objects of great value, and are shown to the public as museums. Cologne, Aachen, Milan, Monza, and Reims have famous treasuries. Many Italian cathedrals have small museums attached to them, usually known as ” Opera del Duomo.”

United Kingdom. â€” The influence and reputation of the British Museum are so great that its original purpose, . as stated in the preamble of the Act by which Museum, it was founded (1753, c. 22), may be quoted : ” Whereas all arts and sciences have a connexion with each other, and discoveries in natural philosophy and other branches of speculative knowledge, for the

advancement and improvement whereof the said museum or collection was intended, do, or may in many instances give help and success to the most useful experiments and undertakings . . .” The ” said museum above mentioned referred to the collection of Sir Hans Sloane, to be purchased under the Act just quoted. Sir Hans Sloane is therein stated “through the course of many years, with great labour and expense, to have gathered together whatever could be procured, either m our own or foreign countries, that was rare and curious. ” In order to buy his collections and found the museum, a lottery of Â£300,000 was authorized, divided into 50,000 tickets, the prizes varying from Â£10 to Â£10,000. Provision was made for the adequate housing of Sir Robert Cotton’s books, already bought in 1700 (12 and 13 Will. III. c. 7). This Act secured for the nation the famous Cottonian manuscripts, ” of great use and service for the knowledge and preservation of our constitution, both in church and state.” Sir Robert’s grandson had preserved the collec- tion with great care, and was willing that it should not be “disposed of or embeziled,” and that it should be pre- served for public use and advantage. This Act also sets forth the oath to be sworn by the keeper, and deals with the appointment of trustees. This is still the method of internal government at the British Museum, and additions to the Board of Trustees are made by statute, as in 1824, in acknowledgment of a bequest. The trustees are of three classes : (a) three principal trustees, namely the Primate, the Lord Chancellor, and the Speaker; (6) general trustees, entitled ex officio to the position in virtue of ministerial office; (c) family, bequest, and nominated trustees. A standing committee of the trustees meets regularly at the museum for the transaction of business. The great departments of the museum (apart from the scientific and zoological collections, now placed in the museum in Cromwell Road, South Kensington) are of printed books, MSS., Oriental books, prints and drawings, Egyptian and Assyrian antiquities, British and mediaeval antiquities, coins and medals. Each of these eight depart- ments is under a

keeper, with an expert staif of subordi- nates, the head executive officer of the whole museum being styled director and chief librarian. Among the higher oflEicials there are also assistant keepers of depart- ments, and fifty-eight first and second class assistants, the annual expenditure on the British Museum (exclud- ing science) amounts to Â£145,000, of which Â£60,000 is for salaries and wages, Â£10,000 for furniture and fittings, and Â£22,000 for purchases. During 1899 the number of visitors amounted to 663,000, the number of students being 237,000. A special feature of the museum work, namely the catalogues and reproductions of acquisitions, realizes an income of Â£1800 a year. The museum has been enriched by bequests of great importance, especially in the- library. Recent legacies have included the porcelain bequeathed by Sir Wollaston Franks, and the valuable collection of works of art (chiefly enamels and goldsmithery) known as the Waddesdon bequest â€” a legacy of Baron F. de Rothschild. The most important group of acquisition by purchase in the history of the museum is the series of Greek sculptures known as the Elgin Marbles, bought by Act of Parliament (56 Geo. III. c. 99).

There are four national museums controlled by the Board of Education, until recently styled the Department of Science and Art. The chief of these is the Victoria and Albert Museum at South Ken- ^/X”” sington. This museum has a dependency at Board of Bethnal Green, the Dublin and Edinburgh BdacaUon. museums having been now remoted from its direct charge. There is also a museum of practical geology in Jermyn Street, containing valuable specimens of pottery

and majolica. The Victoria and Albert Museum owed its inception to the Exhibition of 1851, from the surplus funds of which 12 acres of land were bought in South Kensington. First known as the Department of Practical Art, the museum rapidly established itself on a broad basis. Acquisitions of whole collections and unique specimens were accumulated. In 1857 the Sheepshanks gallery of pictures was presented ; in 1879 the India OfBce transferred to the department the collection of Oriental art formerly belonging to the East India Company ; in 1882 the Jones bequest of French

furni- ture and decorative art (1740-1810) was received ; in 1884 the Patent Museum was handed over to the department. Books, prints, MSS., and drawings were bequeathed by the Eev. A. Dyce and Mr John Eors- ter. Meanwhile, gifts and purchases had combined to make the collection one of the most important in Europe. The museum is not yet regularly divided into departments under expert keepers, as at the British Museum, but the chief features may be summarized as consisting of pictures, including the Raphael car- toons lent by His Majesty ; textiles, silks, and tapestry ; ceramics and enamels ; ivory and plastic art, metal, furniture, and Oriental collections. (There are also large scientific collections.) The guiding principle of the museum is the illustration of art applied to industry. Beauty and decorative attraction is perhaps the chief characteristic of the exhibits here, whereas the British Museum is largely archaiological. With this object in view, the museum possesses numerous re- productions of famous art treasures : casts, facsimiles, and electrotypes, some of them so well contrived as to be almost indistinguishable from the originals. An art library with 75,000 volumes and 250,000 prints and photographs is at the disposal of students, and an art school is also attached to the museum. It is estimated that since its foundation nearly forty million people have visited the museum. As regards the cost, it is impossible to state the exact amount, since the annual estimate deals with the department in general as well as the museum proper. The museum has a staff of 67 members, whose salaries amount to Â£28,000 annually, apart from a large staff in the secretarial department. The purchase grant for 1900-01 amounted to Â£11,260. The museum does con- siderable work among provincial schools of art and museums, ” circulation ” being its function in this con- nexion. Works of art are sent on temporary loan to local museums, where they are exhibited for certain periods, and on being withdrawn are replaced by fresh examples. During recent years there has been a satis- factory progress in this branch of work, and in the future it will have to be still further developed, being the only means of repaying the provinces for their share in creating the central museum. The subordinate museum of the Board of Education at Bethnal Green and that at Edinburgh call for no comment, their contents being of slender value. The Dublin Museum, though now con- trolled by the Irish Department, may be mentioned here as having been founded and worked by the Board of Edu- cation. Apart from the fact that it is one of the most suitably housed and organized museums in the British Isles, it is remarkable

for its priceless collection of Celtic antiquities, belonging to the Eoyal Irish Academy, and transferred to the Kildare Street Museum in 1890. Among its most famous specimens of early Irish art may be mentioned the shrine and bell of St Patrick, the Tara brooch, the cross of Cong, and the Ardagh chalice. The series of bronze and stone implements is most perfect, while the jewels, gold ornaments, torques, fibulae, diadems, and so forth, are such that, were it possible again to extend

the galleries (thus allowing further classification and ex- hibition space), the collection would surpass the Danish National Museum at Copenhagen, its chief rival in Europe. The Dublin Museum is visited by 420,000 people yearly. The Edinburgh Museum (costing about Â£13,000 a year) has about 330,000 visitors yearly.

The famous collections' of Sir Eichard Wallace (d. 1890) having been bequeathed to the British nation by his widow, the public has acquired a magnificent ^^^ gallery of pictures, together with a quantity of national works of art, so important as to make it neces- and quasi- sary to include Hertford House among national ^'Â°ffj,g museums. French art predominates, and the examples of bronze, furniture, and porcelain are as fine as those to be seen in the Louvre. Hertford House, however, also contains a most remarkable collection of armour, and the examples of Italian faience, enamels, bijouterie, &c., are of first-rate interest. The maintenance of this collec- tion (which is governed by trustees), when initial outlay upon furnishing and structural work is completed, will cost about Â£5000 a year. The museum of Sir John Soane, preserved in his house in Lincoln's Inn Fields, to which reference has already been made, was acquired under statute (3 Will. IV. c. 4), and is governed by trustees. The universities of Cambridge and Oxford have museums, the latter including the Ashmolean collec- tions, a valuable bequest of majolica from D. Fortnum, and some important classical statuary, now in the Taylorian Gallery. Christ Church has a small museum and picture gallery. Trinity College, Dublin, has a miniature archaeological collection, containing some fine examples of early Irish art. The National Museum of Antiquities of Scotland, now controlled by the Board of Manufactures, was formed by the Scottish Society of Antiquaries, and has a comprehensive collection of Scot- tish objects, lay and religious. The Tower of London contains armour

of historic and artistic interest, and the Eoyal College of Music has an invaluable collection of musical instruments, presented by Mr George Donaldson. Art museums are also to be found in several public schools in the United Kingdom.

The Museums Act of 1845 enabled town councils to found and maintain museums. This Act was superseded by another passed in 1850, by Mr William Ewart, which in its turn has been replaced by ^”“‘fJ^J amending statutes passed in 1855, 1866, 1868, and 1885. The Museums and Gymnasiums Act of 1891 sanctioned the provision and maintenance of museums for the reception of local antiquities and other objects of interest, and allows a ^d. rate, irrespective of other Acts. Boroughs have also the right to levy special rates under private municipal Acts, Oldham affording a case in point. Civic museums must still be considered to be in their infancy. Although the movement is now firmly established in municipal enterprise, the collections, taken as a whole, are still somewhat nondescript. In many cases collections have been handed over by local societies, particularly in geology, zoology, and other scientific departments. There are now ~~about 250 museums, and it was estimated in 1887, after a most diligent inquiry (British Association Report, 1887, p. 97), that of these there were about 16 in which fine art, and 23 in which archaeology, pre~~ dominated. At that time there were some 36,000 speci- mens of fine art and 350,000 of archaeology. There are about 12 museums in which Eoman antiquities are noticeable, among them being Leicester, and the Civic Museum of London, at the Guildhall. British and Anglo-Saxon relics are important features at Shefiield and Liverpool ; in the former cjise owing to the Bateman collection acquired in 1876 ; while the Mayer collection presented to the latter city contains a highly important

series of carved ivories. At Salford, Glasgow, and Manchester industrial art is the chief feature of the collections. Birmingham, with perhaps the finest pro- vincial collection of industrial art, is supported by the rates to the extent of Â£4200 a year. Its collections (including here, as in the majority of great towns, an important gallery of paintings) are entirely derived from

gifts and bequests. They are valued at Â£60,000, and have been visited by as many as 1,100,000 persons in a single year. Birmingham has made a reputation for special exhibitions of works of art lent for a time to the corporation. These loan exhibitions, about which occa- sional lectures are given, and of which cheap illustrated catalogues are issued, have largely contributed to the great popularity and efficiency of the museum. Liverpool, Preston, Derby, and Sheffield owe their fine museum buildings to private generosity. Other towns have museums which are chiefly supported by subscriptions, e.g., Chester and Newcastle, where there is a fine collec- tion of work by Bewick the engraver. At Exeter the library, museum, and art gallery, together with schools of science and art, are combined in one building. Other towns may be noted as having art museums : Stock- port, Nottingham (Wedgwood collection), Leeds, Bootle, Swansea, Bradford, Northampton (British archaeology), and Windsor. There are museums at Belfast, Lame, Kilkenny, and Armagh. The cost of the civic museum, being generally computed with the maintenance of the free library, is not easily obtained. In many cases the librarian is also curator of the museum ; elsewhere no curator at all is appointed, his work being done by a caretaker. lu some museums there is no classification or cataloguing, and the value of existing collections is impaired both by careless treatment and by the too ready acceptance of worthless gifts ; often enough the museums are governed by committees of the corporation whose interest and experience are not great. However, municipal museums in the United Kingdom have a great future. With sympathetic encouragement from the public they will develop in a rapid and satisfactory manner. Where municipalities have been assured of public support in their efforts, they have invariably done their utmost to promote the interest of their civic collections.

Foreign Museums. â€” Art museums are far more numer- ous on the Continent than in England. In Germany progress has been very striking, their educational aspect being closely studied. In Italy public collections, which are ten times more numerous than in England, are chiefly regarded as financial assets. The best examples of classi- fication are to be found abroad, at Vienna, Amsterdam, Zurich, Munich, and Gizeh in Egypt. The Musde Car- navalet, the historical collection of the city of Paris, is the most perfect civic museum in the world. The build- ings in which the objects can be most easily studied are those of Naples, Berlin, and Vienna. The value of

the aggregate collections in any single country of the Great Powers, Russia excepted, probably exceeds the value of British collections. At the same time, it must be re- membered that masses of foreign collections represent expropriations by the city and the state, together with the inheritance of royal and semi-royal collectors. In Ger- many and Italy, for instance, there are at least a dozen towns which at one time were capitals of principalities. In some countries the public holds over works of art the pre-emptive right of purchase. In Italy, under the law known as the Editto Pacca, it is illegal to export the more famous works of art. Speaking generally, the cost of maintaining municipal^museums abroad is very small, many being without expert or highly-paid officials, while admission fees are often considerable. Nowhere in the

United Kingdom are the collections neglected in a man- ner through which certain towns in Italy and Spain have gained an unenviable name.

Berlin and Vienna have collections of untold richness, and the public are freely admitted. Berlin, besides its picture gallery and architectural museum, has a aermaay collection of Christian antiquities in the uni- and versity. The old museum, a royal foundation, Austria. is renowned for its classical sculpture and a remarkable collection of mediasval statuary, in which Italian art is well represented. The new museum is also noteworthy for Greek marbles, and contains bronzes and engravings, together with one of the most typical collections of Egyptian art. Schliemanu’s discoveries are housed in the Ethnographic Museum. The Museum of Art and Industry, closely similar in object and arrangement to the Victoria and Albert Museum in London, contains collections of the same character â€” enamels, furniture, ceramics, &c. Vienna also has one of these museums (Kunstgewerbe), in which the great value of the ex- amples is enhanced by their judicious arrangement. The Historical Museum of this city is interesting, and the Imperial Museum (of which the structure corresponds almost exactly with a plan of an ideal museum designed by Sir William Flower) is one of the most comprehensive extant, containing armour of world-wide fame and the choicest specimens of industrial art. Prague, Innsbruck, and Budapest are respectively the homes of the national museums of Bohemia, Tirol, and Hungary. The National Museum of Bavaria (Munich) has been completed, and its exhibition rooms, 100 in

number, show the most recent methods of classification, Nuremberg, with up- wards of 80 rooms, being its only rival in southern Germany. Mainz and Trier have Roman antiquities. Hamburg, Leipzig, and Breslau have good “Kunstge- werbe ” collections. In Dresden there are four great museums â€” the Johanneum, the Albertinum, the Zwinger, and the Griine Gewolbe â€” in which opulent art can best be appreciated; the porcelain of the Dresden galleries is superb, and few branches of art are unrepresented. Gotha is remarkable for its ceramics, Brunswick for enamels (in the grand ducal cabinet). Museums of minor importance exist at Hanover, Ulm, Wilrzburg, Danzig, and Liibeck.

The central museum of Erance, the Louvre, was founded as a public institution during the Revolutionary period. It contains the collections of FranQois I., Louis XIV., and the Napoleons. Many works of ai-t ^n””- have been added to it from royal palaces, and collec- tions formed by distinguished connoisseurs (Campana, Sauvageot, La Caze) have been incorporated in it. The Greek sculpture, including the Venus of ilelos and the Nike of Samothrace, is of pre-eminent fame. Other depart- nients are well furnished, and from a technical point of view the manner in which the officials have overcome structural difficulties in adapting the palace to the needs of an art museum is most instructive. The Cluny Museum, bought by the city in 1842, and subsequently transferred to the State, suppleiflents the mediaeval col- lections of the Louvre, being a storehouse of select works of art. It suffers, however, from being overcrowded, while for purposes of study it is badly lighted. At the same time the Maison Cluny is a well-furnished house, decorated with admirable things, and as such has a special didactic value of its own, corresponding in this respect with Hertford House and the Poldi-Pezzoli Gallery at Milan â€” collections which are more than museums, since they show in the best manner the adaptation of artistic taste to domestic life. The French provincial museums are numerous and important. Twenty-two were estab- lished early in the 19th century, and received 1000

pictiirftH an ^ftB from the, Htatc, numbers of which were iKit r<:tunie(l in IHt'i to the countries whence they were taken. 'J'he Jjest of tlicwe rmxseuing are at Lyons; at J>ijo;i, where the l.ojnbs of Jean sans Peiii- and l^hilipthe J/old are preÂ«<;rved ; at Ainicr)Â«, where the capital Mtw^ de I'icardic was built in 1850; at MarÂ«ciJ]es and at Bayeux, win i'- the " 'J'apestry " is well exhibited, Tlie collcctionH of Lille, iJorfleaux, Toulouse, and Avignon are alHo important, 'I'he objects shown in thcHo rfiusciiinsarc chiefly local gleanings, consisting larfjcly of church plate, fumitu/c, together with scuh/ture, carved wood, and [)Ott,(!ry, nearly everything being French in origin. In many towns lloraan antiquities and early ChriHtian relics are picHcrve.d (e.g., Autun, Nimes, Aries, and Luxeuil;. Other eolle(;ti,onH controlle'l by municipalities are kept at Itouen, l^ouai, Montpellier, Ohartres ("lith-century Â»cu I ptu ruH), (j I en obi <;, Toulon, A j acci o, iiipinal (Carol ingian olijeclH), iJeHan'jon, Lourges, Li> Mans (with the remaik- able enamel of fleoffrey of Anjou;, iia.ncy, Aix, and in many other towns. As a rule, tlie public is a/lmitted free of charge, Hj)eeial courtesy being shown to foreigners. In many cases the wjllections are ill cared for arid uncata- loguffd, and little njfHiey is provided for ac’piisitions in the, fiivic Ti/NHciinis; indee

‘J’he /lational, civic, and papal museums of Italy are so numerous that a few only can he mcntiwied. The best . arranged and best classilied collection is the

â– ’’’ MjiHco N at NaplcH, containing many

thousand exam jdes of K,orn an art, chiefly obtained from the immediate neighbonrhotjd. For historical imyior- tanee it ranks as primuH Inter ‘/Ki/rim with the collections of Home and the Vatican. It is, however, the only great it,ali;i,n niiiiieiim where scientific treatment is consistently adopti’.d. Other museums of purely classical art are foiinrl at HyracuHc, Cagliari, and I’alenno. J’Jfcruscan art is best displayed at Ai’czzo, I’crngia (in the university), C’oiiona, l‘‘l(jrene,e (Mukco Archeologico), Volterra, and the Vatican. The Moientine miineunis are of great imjjortan ‘â– (â– ,, consisting of the aichseological museum of aid,ifjN(! bronzes, I’.gyptian ai- t, and a great number of tajteHlricH. The MiiHco Nazionale, housed in the Bargello (a. J). 1200), is the central depository of Tuscan art. Nnmerr)iis

examples of Delia itobbia ware have been gathered together, and are fixed to tlie walls in a man- ner and poHition which reduce their value to a njinimum. The plastic arts of Tus(^ariy are rei^rehiented by Dona- iello, Vcrroce,hio, Ohiberti, and f’ellirii, while the Oarrand colleeUon of ivories, pictures, and varied mediaeval fipeeinjciis aic of much interest. This museum, like so iiiatiy otherij, is becoming seriously overcrowded, to the liiHtingdiilriment of cljurches, market-placciB, and streets, wlience these works of art are being ruthle.sHly removed, ‘I’ho j)ubli(! is adiiiitted free one day a week, and the recei|)tfl arc drjvoted to art and antiquarian purjjoscs (“taHMc . . . dcHtinate . . . allaconwcrvazione dei moriu-]iieriti, ;i,ll’ amplianiento d(!gli scavi, ed’ a.ll’ ineremcnto dISZ.‘J, Â§ .^j. The iiiuiieumH of Rome are tiiiiiricrons, thi; Vatican alone con- taining M,t JciiHl, hIx â€” Musco (Jlruneniiuo, of classical art, wilJi the,]ja,or,oon, the Ajiolio I’.elvcdcre, and other mas- ierpieci::! ; l.iie Ohi;i,ra,mont,i, a,lno of clunnii’,al Sfjuljiture; i\(i (Jallery of Ir]Scri|il,ioTiH; the i’;gy|)tian, the i’ltruHcan, and the (JhriHtian niuHOums. The la,Ht is an extcn.sive colleel.ion eori’cspondirig wiLh anothei’ pafiid jfiiiK(!um in tlio i,/a,l,eran I’alaci-, also known as the, (!hristian JuuHc-nm d’oinidrid IH’l.‘ij, anil remarkable for its sarcophagi and relics from the catacondw. ‘J’he Ivaie.ranhaH also a He,cond museum known as the Musoo I’rofano. Museums be-

longifig to the State are equally remarkable. The Kircher Museum deals with prehistoric art, and con- tains the “Prcueste Hoard.” The Museo Nazionale (by the Baths of Diocletian), the Museo Capitolino, and the J’alazzo dei Coriservatori contain innumerable speci- mens of the finest classical art, vases, bronzes, mosaics, and statuary, Oieek as well as Jtornan. Among jfrovincial museums there are few which do not possess at least one or two objects of signal merit. Thus Brescia, beside:-! a mediaval collection, has a famous bronze Victory. Pesaro, Urbirjo, and the Museo Correr at Venice have admirable examples of majolica ;]Milan, Bi.sa, and OcTJoa liave general archaeology combined with a good proportion of mediocrity. The civic museum of Bologna is comprehensive and well arranged, having Egyptian, classical, and Etruscan collections, besides many things dating from the “Bella Epoca” of Italian art. At liavenna alone can the Byzantine art of Italy be projierly UTiderstood, and it is most deplorable that the sufÂ»erb collections in its fine galleries should remain

uncatalogued and neglected. Turin, Biena, Padua, and other towns have civic museums.

The Ityks Museum at Amsterdam, containing the national collections of Holland, is a modern building in which a series of historical rooms are furnished to show at a glance the artistic progress of the Belgium Dutch at any given period. >i'inc rooms are Holland. also devoted to the chronological display of ecclesiastical art. Besides the famous paintings, this museum (the sole drawback of which is the number of rooms which have no top-light) contains a library, many engravings, a comprehensive exhibit of armour, costume, metal work, an da department of maritime craftsmanship. Amhem and Haarlem have municipal collections. At Leyden the University maintains a scholarly collection of antiquities. The Hague and Rotterdam have also museums, but everything in Holland is subordinated to the development of the great central depository at Amsterdam, to which examples are sent from all jjarts of the country. In I5elgium the chief museum, that of ancient induKtiial art, is at Brussels. It contains many pieces of mediaeval church furniture and decoration, but in this respect differs only in size from the civic museums of Ghent and Luxemburg and the Archbishojj's museum at Utrecht. In Brussels, however, there is a good show of Frankish and Carolingian objects. The city of Antwerp maintains the Mus^e Plantin, a printing establishment which has survived almost intact, and presents one of the most charming and most instructive museums in the world. As a whole, the museums of Belgium are disappointing, though, per contra, the churches are of enhanced interest, not having Ijeen jnllaged for the benefit of museums.

New museums are being founded in Russia every year. Kharkoff and Odessa (the university) have already large collections, and in the most remote parts of â€ž Siberia it is curious to find carefully chosen collections. Krasnoyarsk has 12,000 specimens, a store- house of Buriat art. Irkutsk, the capital, 'Tobolsk, Tomsk (university), K habarovsk, and Yakutsk have now museums. In these Russian art naturally predominates. It is only at Moscow and St Petersburg that Western art is found, 'flie Ilei'mitage Palace in the latter city contains a selec- tion of mediieval objects of fabulous value, there being no less than 40 early ivories. But from a national point of view these colhsetions are insignificant when comitared with tliegohl and silver objects

illustrating the primitive arts and ornament of Scythia, Crimea, and Caucasia, the high standard attained j)roving an advanced stage of ma,nual skill. At Moscow (historical museum) the stone and metal relics are scarcely less interesting. There is also a museum of industrial art, the specimens of which

are not of unusual value, but being analogous to the Kunstgewerbe movement in Germany, it exercises a whole- some influe^ttce upon the designers who study in its schools. Much may be expected of American museums, which are not committed to traditional systems, and where scientific treatment is allowed its fullest scope.. They exist in great numbers, and though in most cases their exhibits are chiefly ethnographic, a far wider range of art objects will undoubtedly be secured during the next generation. The National Museum at Washington is chiefly notable for its historical relics of America. The Smithsonian Institute in the same city has similar collections. On the other hand, the Metropolitan Museum of Art (held by trustees for the benefit of the city of New York) has in the Cesuola collection the most complete series of Cypriot art objects. It has also depart- ments of coins, G-reek sculpture, and general examples of European and American art. The Museum of Fine Arts at Boston is very comprehensive, and has a remarkable collection of ceramics, together with good reproductions of antique art. The public is admitted free on certain days of the week. There are other museums at St Louis, Chicago, and Washington, as well as Montreal in Canada ; and the universities of Harvard, Chicago, and Yale have collections.

The Swiss National Museum is situated at Zurich, and though of medium size (50 rooms), it is a model of arrangement and organization. Besides the special feature of rooms illustrating the his- torical progress of art, its collection of stained glass is important. Basel also (historical museum) is but little inferior in contents or system to the Zurich establish- ment. Geneva has three collections. Lausanne holds the museumof the canton, and

Bern has a municipal collection. All these institutions are well supported financially, and are much appreciated by the Swiss public. The art museum s of Stockholm, Christiania, and Copenhagen rank high for their intrinsic excellence, but still more for their scientific and didactic value. Stockholm has three museums: that of the Royal Palace, a collection of costume and armour ; the Northern Museum, a large collection of domestic art; the National Museum, containing the prehistoric collections, gold ornaments, &c., classified in a brilliant manner. The National Museum of Denmark at Copenhagen is in this re- spect evenmorefamous,beingprobably the second national collection in the world. The arrangement of this collection leaves little to be desired, and it is to be regretted that some British collections, in themselves of immense value, cannot be shown, as at Copenhagen, in a manner which would display their great merits to the fullest degree. There is also at Copenhagen a remarkable collection of antique busts (Gamle Glyptotek), and the Thorwaldsen Museum connected with the sculptor of that name. Norse antiqui- ties are at Christiania (the university) and Bergen. Athens has three museums, all devoted to Greek art : that of the Acropolis, that of the Archaeological Society (vases and terra-cotta), and the National Museum of Antiquities. The “State owns all discoveries, and these are accumulated at the capital, so that local museums scarcely exist. The

collections, which rapidly increase, are of great import- ance, though as yet they cannot vie with the aggregate in other European countries. The Gizeh Museum of Egyptian antiquities (Cairo), founded by Marietta Bey, and developed by Maspero, is the best national museum in the world, well housed in a large building erected in 1890, well classified, and liberally supported with money and fresh acquisitions. Minor museums exist at Carthage and Tunis. At Constantinople the Turkish Museum contains some good classical sculpture and a great deal of rubbish. The Museo del Prado and the Archaeological Museum at Madrid are the chief Spanish collections, containing numerous classical objects and many speci- mens of Moorish and early Spanish art. In Spain museums are badly kept, and their contents are of in- different value. The museums of the chief provinces are situated at Barcelona, Valencia, Granada, and Seville. Cadiz and Cordova have also sadly neglected civic collec- tions. The National Museum of Portugal at Lisbon requires no special comment. The progress of Japan is noticeable in its museums as in its industrial enterprise. The National

Museum (Weno Park, Tokyo) is large and well arranged in a new building of Western architecture. Kiot5 and Nara have excellent museums, exclusively of Oriental art, and two or three other towns have smaller establishments, including commercial museums. There are several museums in India, the chief one being at Calcutta, devoted to Indian antiquities. In Australia the museum movement is just beginning to thrive, the desire for national collections having been hitherto limited to pictures.

The best history of museums can be found in the prefaces and introductions to their official catalogues, but the following works will be useful for reference : â€” Annual Reports presented to Parlia- ment (official) of British Museum and Board of Education ; Civil Service Estimates, Class IV. , annually presented to Parliament ; Second Report of Select Committee of House of Commons on Museums of Science and Art Department (official), 1 vol., 1898 ; Annual Reports of the Museum Association, London.- â€” Edward Edwards.” The Fine Arts in England. London, 1840. â€” Prof. Stanley Jevons. “Use and Abuse of Museums,” printed in Methods of Social Beform. London, 1882. â€” Report of Com- mittee on Provincial Museums. Report of British Association. London, 1887. â€” Thos. Greenwood. Museums and Art Galleries. London, 1888. â€” Prof. Brown Goode. Museums of the Future. Report on National Museums, Washington, 1888-89 ; Principles of Museum Administration. Report of Museum Association, London, 1895. â€” Mariotti. La Legislazione delle Belle Arti. Rome, 1892. â€” L. Benedite. Bapport sur V organisation . . . dans les musees de la Grande Bretagne (official). Paris, 1895. â€” Sir William Flower. Essays on Museums. London, 1898. â€” Le Gallerie Nazionali Italiane, 3 vols. Rome, 1894. (g.)

Mush, the chief town of a sanjak of the same name in the Bitlis vilayet of Asiatic Turkey, altitude 4800 feet, situated on the south side of a fertile plain dptted with villages, through which the Kara Su runs. The climate is healthy, but very cold in winter. The popula- tion numbers 15,000, of whom one-half is Armenian. The massacre of Armenians at Sasiin, in the mountains to the south, in 1894 aroused general indignation in Europe. (See Armenia.)

MUSIC.

SINCE the publication of the article on Music in the earlier volumes (ninth edition) of the Encydopmdia Britannica, the conditions of the art have undergone so striking a change, alike in the United Kingdom and in other countries, that it is necessary to give an account, more or less summary, of modern tendencies, and to pass in rapid

review the later state of music in the countries where it has been most generally encouraged.

To begin with the country which for over two centuries was universally recognized as the chief centre of the musical art. Ever since the time of "^""'"y- Bach and Handel, Germany has been supreme in music,

whether we regard the excellence and thoroughness of her institutions, the superlative eminence of her great masters, or the wide diffusion of a love of music throughout the nation at large. As the 19th century came near to its close, it became increasingly apparent that the legiti- mate successors to such men as Wagner and Brahms had not yet appeared ; the death of the former in 1 883 made it clear that there was no great or even very meri- torious operatic composer ready to take his place, while on the death of Brahms in 1897 much the same discovery was made in the domain of what is known as " absolute " music. Such merely epigonal figures as Bungert (b. 1846) and Cyrill Kistler could not, even by the most eager set of admirers, be credited with powers in any way comparable to the genius whom they imitated ; and Humperdinck's (b. 1854) striking success with Hansel und Gretel (1893) is the result of his application of the Wagnerian principles of " music-drama " to a childish subject and to themes closely analogous to the folk-song, rather than of any gi'eat originality of his own. On the other hand, neither the eccentricities of Richard Strauss (q.v.), who has tried to out-Liszt Liszt himself, nor the academic productions of a host of younger men, showed anything that could be interpreted as giving promise of the advent of a successor to Brahms, in whom the long line of great German masters appears to have come to an end.

From the earliest days of their music, the French have had the enviable power of assimilating the great innovations which were originated in other countries, without losing their habit of warmly appreciating that which their own countrymen produce. That which happened with the Netherlandish composers of the 16th century, and with Lully in the 17th, has been repeated, more or less exactly, with Rossini in the early part of the 19th century and with Wagner at its close. In one generation after another, the young French com- posers have succeeded in applying the principles of the great foreigners without forfeiting their own hold on the nation's respect. During the last quarter of the 19th century all that is represented by the once-adored name of Gounod has been discarded in favour of a style as different as possible from his. The change was mainly due to a Belgian musician of masterly cleverness, Cesar Auguste Franck (1822-1890), who established a kind of informal school of symphonic and orchestral composition, as opposed to the conventional methods pursued at the Paris Conser- vatoire, where attention was chiefly given to the operatic and sentimental styles. Beyond the immediate circle of Franck's actual pupils, what may be called the revolt against sentimentality was widely supported, and its influence can hardly be exaggerated. Massenet was left as almost the only representative of the older school, and from Edouard Lalo (1823-1892) to Charpentier (b. 1860), all the younger composers of France adopted the newer style. With many of them, their newly-found freedom in such matters as harmonic relations, modula- tions, &c., has been somewhat abused, and with Alfred Bruneau (b. 1857), in spite of the intense power of dra- matic realization that is revealed in Le Rive and L'Attaque du Moulin, there are many passages in his Requiem and in Messidor that are undeniably lacking in beauty ; with him the dramatic propriety of the truth of his music ex- cuses much that would otherwise be repellent, but in the case of Gabriel Faure (b. 1845) his application of these strange methods to " absolute " music is seldom success- ful except with the few amateurs who profess to prefer ugly music to beautiful. Camille Saint-Saens (b. 1835) is beyond question the soundest representative of modern French music, if only by reason of his greater command of resources of every kind and his success in

all forms of music. A few other names must be mentioned as making up the modern French school, a body of undoubted distinction and influence : Ernest Reyer (b. 1823) is the author of some ambitious and sterling operas ;

F. L. V. de Joncieres (b. 1839), an enthusiastic follower of Wagner, and a composer of merit; Emanuel Chabrier (1842-1894), a man of extraordinary gift, wrote one of the finest operas comiqv.es of modern times, Le Rot ma,lgr6 Lui (1887), and a grand opera, Gu-e adoline, of no small value; Charles llarie Widor (b. 1845) is an earnest musician of great accomplishment ; and Tincent d' Indy (b. 1851), a strongly original writer, alike in dramatic, orchestral, and chamber com- positions. In the class of lighter music, which yet lies above the level of opera bouffe, mention must be made of Leo Delibes (1836-1891) and Andre ilessager (b. 1855). In describing the state of music in France, it would be wrong to pass over the work done by the great conductors of various popular orchestral concerts, such as Pasdeloup (b. 1819), Lamoureux (1834-1899), and Colonne (b. 1838).

In Italy during the last quarter of the 19th century many important changes took place ; three aspects of modern Italian music must claim our notice. First, the later development in the style of Verdi (1813- "'â–

1901) was only completed in Otello (1887) and Folstaff (1893), while his last composition, the four beautiful sacred vocal works, show how very far he had advanced in reverence, solidity of style, and impressiveness, from the time when he wrote his earlier operas. By his side during the last years of his life stood Arrigo Boito (g.r.), the accomplished writer of his two last libretti, and the composer of Mefistofde, a work which had an immense influence on modern Italian music, and not impossibly on Terdi himself. Among the writers of " absolute "' music the most illustrious are Sgambati (b. 1843) and Martucci (b- 1856) ; the latter's great symphony in D minor is a work the like of which has not been heard in Italy for many years, and the composer's high standard and splendid accomplishment can hardly fail to procure him lasting fame. The third and least estimable aspect of modern Italian music is that of the young operatic school, of which the first production was the Flora Mirabilis of Spiro Samara (b. 1861), given in 1886. There were a good many operas, many of them in one act, and most of them dealing by preference with tragedies of low life, but the most celebrated of all was Cavalleria Rusticana by Pietro Mascagni (b. 1863), upon which a prize was bestowed, and which was brought out in 1890. No work by the same composer has made a similar success, and among the

many who have cast in their lot with this squalid school very few have attained more than an ephemeral reputation. The most familiar to English opera-goers is Leoncavallo (b. 1858), whose Pagliacd has kept the stage for some years since its production in 1892. In contrast to these composers is the work of Giacomo Puccini (b. 1858), who may be called the legitimate successor of Verdi. His operas are Le Villi (1884), Manon Lescaut (1893), La BoMme (1896), and Tosca (1900). So far as concerns the works themselves, the oratorios of Don Lorenzo Perosi (b. 1872) are not of much account, but as an influence on the church music of Italy they must be highly esteemed.

The new Russian school of music has been so popular in England for the last few years that its rapid rise into recognition could not be ignored. As a definite school it had its origin with Balakirev (b. 1836), who was instrumental in founding the Free School of Music at Moscow, and who introduced the music of Berlioz and Liszt into Russia ; he instilled the principles of “advanced” music into Borodin (1834-1887), Cui (b. 1835), Moussorgsky (b. 1839), and Rimskv-Korsakow

Scandl’ navla.

(b. 1844), all of â– whom, as usual with Eussian composers, â€¢were, strictly speaking, amateurs in music, having some other profession in the absence of any possible oppor- tunity for making money out of music in Russia. The most remarkable man among their contemporaries “was undoubtedly Tschaikowsky (1840-1893), whose works, culminating in the ” Pathetic Symphony,” have enjoyed a wonderful vogue in Great Britain and elsewhere ; Liadow (b. 1856) excels as a writer for the pianoforte, but Glazou- now (b. 1865) has already accomplished so much, in so many forms and of such wonderfully high quality, that it seems almost safe to predict that he will be regarded as the chief product of the school.

Of late years the music of Norway and Sweden has been so closely allied with the name of Grieg, and so very few other composers have made any mark, ex- cept sundry imitators of his style, that a refer- ence to the article Grieg is all that is necessary. A distinctively American school of composers can hardly be said to have come into existence as yet, but some of the musicians of the United States have stat^. reached so high a level of attainment that it would be impossible to ignore them in a general survey of music. It is the fault of European musicians, not their own, that their works have not become as widely recognized outside the United States as many of them deserve to be ; and those compositions which have been heard in the United Kingdom have for the most part made a great impression. Of the older Amer- ican composers, only John Knowles Paine and Dudley Buck, both born in 1839, need be mentioned. The former has written oratorios, choral, orchestral, and other music ; is professor of music at Harvard University, and now ranks with the advanced school of romantic composers. The latter was one of the first American composers whose names were known in Europe ; and if his nu- merous cantatas and church music do not reach a very high standard according to modern ideas, he did much to conquer the general apathy with regard to the exist- ence of original music in the States. George Whitfield Chadwick has produced many orchestral and vocal works of original merit. Born in 1854, he may be taken as the typical musician of Boston. Though the works of Clayton Johns (b. 1857) are less ambitious, they have won more popularity in Europe, and his songs, like those of Arthur Foote (b. 1853) and Ethelbert Nevin (b. 1862) are widely known. Edward Alexander MacDowell (b. 1861) has written not only a very large number of artistic songs, piano pieces, and choruses, but symphonic poems, overtures, and suites for orchestra, many of which are better known to German than to English musical audiences. Walter Johannis Damrosch (b. 1862), the eminent conductor of the New York Symphony Orchestra, and of various operatic undertakings, has established his position as an original and poetic composer, not only by his opera, Tlie Scarlet Letter, but by such songs as the intensely dramatic “Danny Deever.” Within the last few years the name of Horatio William Parker has come into prominence in England, and his oratorio settings of the hymn “Hora novissima” and of “The Wanderer’s Psalm ” are deservedly popular. Their masterly workman- ship and his power of expression in sacred music mark him as a distinct personality, and one from whom much

may be expected. Numerous orchestral as well as vocal works have not been heard out of America, but a group of songs, newly set to the words of familiar old English ditties, have obtained great success. Finally, Mrs H. H. A. Beach, the youngest of the prominent composers of the United States, has attained a high reputation as a writer in all the more ambitious forms of music, in which her success is all the more remarkable since she is entirely

self-taught in the more advanced kinds of composition as well as in orchestration. Numerous of her songs and anthems have obtained wide popularity in America, and she is a highly accomplished pianist. If the American composers' names are hardly known to the generality of amateurs in Great Britain, it is worthy of note that no country has produced a greater number of the most eminent singers in the present day. Mesdames Fames, Nordica, Susan Strong, Suzanne Adams, Sybil Sander- son, Esther Palliser, Evangeline Florence, and very many more among leading sopranos, with Messrs Oudin and Bispham, to name but two out of the host of excel- lent male artists, have proved the natural ability of the Americans in vocal music ; and it might also be said that the more notable pupils of the various excellent French schools of voice-production are American with hardly an exception.

Before attempting to describe the great renaissance of English music which accomplished itself in the last quarter of the 19th century, it will be well to glance at the general conditions of music and Kiagdom. the causes of the change. Only the most bigoted admirers of foreign music could deny that there has been a great change in the national feeling with regard to music. The nation had been accustomed for so long to consider music as an exotic, that, notwithstanding the glories of the older schools of English music, the amount of attention paid to everything that came from abroad, and the rich treasures of traditional and distinctively English music scattered through the country, the majority of educated people adhered to the common belief that England was not a musical country. The beauty and the enormous quantity of traditional Irish music, the enthu- siasm created in Scotland by trumpery songs written in what was supposed to be an imitation of the Scottish style, the existence of the Welsh Eisteddfodau, were admitted facts, but England was supposed to have had no share in these gifts of nature or art, and the vogue of foreign music, from Italian opera to classical symphonies, was

held as evidence of her poverty, instead of being partly the reason of the national sterility. In the succes- sive periods during which the music of Handel and Mendelssohn respectively had been held as all-sufficient for right-thinking musicians, success could only be attained, if at all, by those English musicians who deliberately set themselves to copy the style of these great masters ; the few men who had the determination to resist the popular movement were either confined, like the Wesleys, to one branch of music in which some originality of thought was still allowed, that of the Church, or, like Henry Hugo Pierson in the days of the Mendelssohn worship, were driven to seek abroad the recognition they could not obtain at home. For a time it seemed as if the great vogue of Gounod would exalt him into a third artistic despot; but his influence was at first only felt harmfully on the Church music of his time, the introduction of his masses into England being synchronous wath the popu- larity of the Tractarian movement : English opera had fallen on such evil days that no native composer had even the energy to imitate his Faust, the only one of his operas that was then popular; and, by the date of the two sentimental oratorios that were written for Birmingham, Tlie RvdemptUm. (1882) and Mors et Vita (1886), the renaissance of English music had already begun, and ultimately English composers had strength enough to resist the effects of their wide though somewhat transient popularity. It should be explained at this point that the phrase ” harmful influence” is used quite without reference to the merits or demerits of the music in itself ; it refers simply to the kind of influence exerted, which is only to be regretted when the composers are brought face to

face with the necessity of consciously and deliberately imitating a popular model, because they know that there is no chance of success in any other way. All the great masters, from Bach, Mozart, and Beethoven, down to Brahmsand Wagner, havehadinfluence upon the musicians of their time and upon subsequent generations ; but only a very few, and none of those just mentioned, have so dominated a whole nation’s music that their influence could fitly be described as harmful. The Sacred liarmonic Society was the

chief temple of the culte of Handel, as the Ancient Concerts had formerly been ; and the Philharmonic Society was almost given over to the adoration of Mendels- sohn and his servile imitators.

Until about the ‘eighties, the affairs of foreign opera in England were most depressing ; entirely without artistic in- _. fluence of any kind, the rival houses presided over

by the impresarios Frederick Gye (1810-1878) and Colonel J. H. Mapleson (1828-1901) had been going from bad to worse ; the traditions of what were called “the palmy days” had been forgotten, and with the retirement of Christine Nilsson in 1881, and the death of Tietjens in 1877, the race of the great queens of song seemed to have come to an end. It is true that Mme. Patti was in the full plentitude of her fame and powers, but the number of her impersonations, perfect as they were, was so small that she alone could not support the weight of an opera season, and her terms made it impossible for any manager to make both ends meet unless the rest of the company were chosen on the principle enunciated by the husband of Mme. Catalani, ” Ma femme et quatre ou cinq poup^es.” Mme. Albaui (b. 1851) had made her name famous, but the most important part of her artistic career was yet to come. She had already brought Tannhduser and Lohengrin into notice, but in Italian versions, as was then usual ; and the great vogue of Wagner’s operas did not begin until the series of Wagner concerts given at the Eoyal Albert Hall in 1877 with the object of collect- ing funds for the preservation of the Bayreuth scheme, which after the production of the Nibelungen trilogy in 1876 had become involved in serious financial difficulties. The two seasons of German opera at Drury Lane under Dr Hans Eichter (b. 1843) in 1882 and 1884, and the production of the trilogy at Her Majesty’s in 1882, under Angelo Neumann’s managership, first taught stay-at-home Englishmen what Wagner really was, and Italian opera as such (i. e., with Italian as the exclusive language em- ployed and the old ” star ” system in full swing) ceased to exist as a regular institution a few years after that. The revival of public interest in the opera only took place after Mr (afterwards Sir Augustus) Harris (1852-1896) had started his series of operas at Drury Lane in 1887. In the following season Harris took Covent Garden, and since that time the opera has been restored to greater public favour than it ever enjoyed, at all events since the days of Jenny Lind. The clever manager saw

that the public was tired of operas arranged to suit the views of the prima donna and no one else, and he cast the works he produced, among which were Un Bcdlo in Maschera and Les Huguenots, with due attention to every part. The brothers Jean and Edouard de Reszke, both of whom had appeared m London before, the former as a baritone, and the latter during the seasons 1880-84, were even stronger attractions to the musical public of the time than the various leading sopranos, among whom were Mme. Albani, Miss Macintyre, Mme. Melba, Erau Sucher, and Mme. ISTordica, during the earlier seasons, and Mme. Eames, Mile. Ravogli, MM. Lassalle.and PlanQon, and many other Parisian, favourites later. As time went on, the excellent custom obtained of giving each work in the language in which it was written, and among

the distinguished German artists who were added to the company were Erau Temina, Erau Schumann-Heink, Frau Lilli Lehmann, and many more. Since Harris's death in 1896 the traditions started by him have been on the whole well maintained, and as a sign of the difference between the present and the former position of English composers, it may be mentioned that two operas by Cowen, Signa and Harold, and two by Stanford, TJie Veiled Prophet and Mu(fh Ado about Nothing, have been produced. To Signer Lago, a manager of more enterprise than good fortune, belongs the credit of reviving Gluck's Orfeo (with the masterly impersonation of the principal character by Mile. Giulia Kavogli), and of bringing out Cavalleria Husticana, Tschaikowsky's Eugen Onegin, and other works. The fortunes of English opera must be pursued in connexion with the renaissance of music.

Without a congenial atmosphere no germ can be developed, and if it be just to name one institution and one man as the creator of such an atmosphere as allowed the genius of English composers to flourish, ^^j^*^ then that honour must be paid to the Crystal Palace and Mr August Manns (b. 1825), the conductor of its Saturday Concerts. At first engaged as sub-conductor, under a certain Schallehn, at the building which was the lasting result of the great Exhibition of 1851, he became director of the music in 1853, so for the better part of half a century his influence was exerted on behalf of the best music of aU schools, and especially in favour of anything of English growth. Through evil report and good report he supported his convictions, and for many years he introduced one English composer after another to a

fame which they would have found it hard to gain without his help and that of Sir George Grove, his loyal supporter. In 1862, when Arthur Sullivan had just returned from his studies in Leipzig, his Tempest music was produced at the Crystal Palace, and, whatever views may be taken as to the composer's music as a whole, it is beyond question that it was this success and that of the succeeding works from the same hand which first showed Englishmen that music worth listening to might be produced by an English hand. The hold of Sullivan's music upon the English public was at its strongest in the series of " Savoy Operas," from Tlie Sorcerer to Utopia, Limited ; and though these works owe their success at least as much to Gilbert's admirable librettos as to Sullivan's mnsic, they convinced the average English theatre-goer that English comic opera could be as bright as French. Sullivan reached the highest point of his achievement in 2746 Golden Legend (1886), his most important contribution to the music of the renaissance. An important part of the Crystal Palace music was that the concerts did not follow, but led, popular taste ; the works of Schubert, Schumann, and many other great masters were given constantly, and the whole repertory of classical mu^ic was gone through, so that a constant attendant at these concerts would have become acquainted with the whole range of the best class of music. From 1859 onwards the classical chamber-music could be heard at the Popular Concerts started by Mr Arthur Chappell, and for many years their repertory was not less catholic than that of the Crj^stal Palace undertaking ; that ia later times the habit increased to a lamentable extent of choosing only the "favourite" (i.e., hackneyed) works of the great masters does not lessen the educational value of the older concerts. The lovers of the newer developments of music were always more fully satisfied at the concerts of the Musical Union, a body founded by Mr John Ella in 1844, which lasted until 1880. From 1879 onwards the visits of Hans Eichter, the conductor, were a feature of the musical season, and the importance of his work, not only in spreading a love of Wagner's music, but

in regard to every other branch of the best orchestral music, cannot be exaggerated. Like the Popular Con- certs, the Richter Concerts somewhat

fell away in later years from their original purpose, and their managers "were led by the popularity of certain pieces to give too little variety. The importance of Richter's .work was in bringing forward the finest English music in the years when the masters of the renaissance were young and untried. Here were to be heard the orchestral works of Parry, Stanford, Mackenzie, and Cowen ; and the fact that the audience from the first contained a large! propor- tion of the cultivated aristocracy of London brought the names of these composers into notice much more effectually than could have been the case in other surroundings. Meanwhile outside London the work of the renaissance was being carried on, notably at Cambridge, where by the amalgamation of various smaller societies with the University ilusical Society, Stan- ford created in 1876 a splendid institution which did much to foster a love of the best music for many years ; and at Oxford, where private meetings in the rooms of Hubert Parry brought about the insti- tution of the Musical Club, which has borne fruit in many ways, though only in the direction of chamber- music. The Bach Choir, founded by Mr Arthur Duke Coleridge in 1875, and conducted for the first ten years of its existence by Mr Otto Goldschmidt and subsequently by Professor Stanford, worked on purely uncommercial lines ever since its foundation, and besides many import- ant works of Bach, it brought forward most important compositions by Englishmen, , and had a prominent share in the work of the renaissance. The careers of the five composers who must be called the masters of the renaissance â€" Parry, Stanford, Mackenzie, Goring Thomas, and Gowen â€" are dealt with separately under their own headings ; but taking them as a group or school of composers, it will be realized by every thoughtful student of music that their works show a spontaneity, a warmth of imagination, a degree of power and technical skill, which are scarcely to be found in the perfunctory, conventional music of the older generation of English writers, the purveyors of what Wagner called " Kapell- meistermusik." Parry's earlier compositions had a certain austerity in them which, while it commanded the homage of the cultivated few, prevented their obtaining wide popularity ; and it was not until the date of his choral setting of Milton's Ode at a Solemn Musick that he found his true vein. In this and its many successors, produced at the autumn festivals, though very rarely given in London, there are a nobility of utterance, a sublimity of conception, a mastery of resource, that far surpass any- thing accomplished in England since the days of Purcell ; while his " Symphonic

Variations ” for orchestra, and at least two of his symphonies, exhibit his command of the modern modifications of classical forms in great per- fection. Like Parry, Stanford first caught the ear of the public at large with a choral work, the stirring ballad- setting of Tennyson’s Revenge ; and in all his earlier and later works alike, which include compositions in every form, he shows himself a supreme master of effect ; in dramatic or lyrical handling of voices, in orchestral and chamber-music, his sense of beauty is unfailing, and while his ideas have real distinction, his treatment of them is nearly always the chief interest of his works. The work of the musical renaissance has been more bene- ficially fostered by these two masters than by any other individuals, through the medium of the Koyal College of Music. In 1876 the National Training School of .Music was opened with Sullivan as principal ; he was succeeded by Sir John Stainer in 1881, and the circumstance that such artists as Mr Eugen d’ Albert and Mr Frederic Cliffe

received there the foundation of their musical education is the only important fact connected with the institution, which in 1882 was succeeded by the Royal College of Music, under the directorship of Sir George Grove, and with Parry and Stanford as professors of composi- tion In 1894 Parry succeeded to the directorship, and before and after this date work of the best educational kind was done in all branches of the art, but most of all in the important branch of composition. Mackenzie s place among the masters of the renaissance is assured by his romantic compositions for orchestra, such as La Belle Dame sans Merci and the two “Scottish Rhapsodies”; some of his choral works, such as the oratorios, show, some tendency to fall back into the conventionalities from which the renaissance movement was an effort to escape; but in OTJie Cottar’s Saturday Night ; TJie Story of Sayid; Veni, Creator Sioiritus, and many other things, not excepting the opera Colomba, or the witty ” Britan- nia” overture, he shows no lack of spontaneity or power. As principal of the Royal Academy of Music (he suc- ceeded Macfarren in 1888) he revived the former glories of the school, and the excellent plan by which it and the Royal College unite their forces in the exaniinations of the Associated Board is largely due to his initiative. The opera just mentioned was the first of the modern series of English operas brought out from 1883 onwards by the Carl Rosa company during its tenure of Drury Lane Theatre : at the time it seemed as though English opera had a

chance of getting permanently established, but the enterprise, being a purely private and individual one, failed to have a lasting effect upon the art of the country, and after the production of two operas by Mackenzie, two by Arthur Goring Thomas, one by E. Corder, two by Cowen, and one by Stanford, the artistic work of the company grew gradually less and less important. In spite of the strong influence of French ideals and methods, the music of Arthur Goring Thomas was remarkable for individuality and charm ; in any other country his beautiful opera Esmeralda would have formed part of the regular repertory, even if the same favour had not been accorded to its successor, Nadeshda; and his orchestral suites, cantatas, and a multitude of graceful and original songs remain as evidence that if his career had been prolonged, the art of England might have been en- riched by some masterpiece it would not willingly have let die. After a youth of extraordinary precocity, and a number of variously successful attempts in the more ambitious and more serious branches of the art, Cowen found his chief success in the treatment of fanciful or fairy subjects, whether in cantatas or orchestral works ; here he is without a rival, and his ideas are uniformly graceful, excellently treated, and wonderfully effective. His second tenure of the post of conductor of the Phil- harmonic Society showed him to be a highly accomplished conductor.

In regard to English opera two more undertakings deserve to be recorded, although the hope that London will be placed on an equality with the other European capitals in the possession of a permanent operatic insti- tution seems as far off as ever. In 1891 the “Royal English OperarHouse ” was opened with Sullivan’s Ivanhoe, a work written specially for the occasion : the absence of anything like a repertory, and the retention of this one work in the bills for a period far longer than its attractions could warrant, brought the inevitable result, and shortly after the production of a charming French comic opera the theatre was turned into the Palace music hall. The charming and thoroughly characteristic Shamus O’Brien of Stanford was produced in 1896 at the Opera Comique Theatre, and ran with great success. This work brought into public prominence the young conductor Mr

Henry J. Wood (b. 1870), who exercised a powerful influ- ence on the art of the country by means of his orchestra, which was constantly to be heard at the Queen's Hall, and which attained, by continual performance together, a degree of perfection before unknown in England. If the organization did a good deal more for Kussian than for English music, it at least achieved an important work in bringing music within the reach of all classes at the Promenade Concerts given through each summer, as well as by means of the Symphony Concerts at other seasons. The new school of English writers contains many names of skilled composers whose attainment of a high place upon the roll of fame is only doubtful because the British public at large is still slow to realize that any good can come out of England in the way of musical creations. Some of these have already attained conspicuous success, and a few of them have been heard of in Continental centres of music. Dr Edward Elgar has made his repu- tation within the last few years by his vigorous Caracta- cus and the grandiose imaginings of his Dream of Qerontius, as well ais by orchestral and chamber com- positions of decided merit and individuality. Mr Edward German (b. 1862) has won great success as a writer of incidental music for plays, and in various lighter forms of music, for which his great skill in orchestration and his knowledge of effect stand him in good stead. Mr Frederic Cliffe's orchestral works are too few in number, but their quality is extremely high. Mr Arthur Somer- vell (b. 1863) has won the public ear by his charming songs, and notably by a iine song-cycle from Tennyson's Maud, though his Mass and various orchestral works and cantatas and pianoforte pieces show his conspicuous ability in other forms. Various compositions written by Mr Hamish MacCuun (b. 1868), while still a student at the E/Oyal College of Music, were received with acclamar tion ; but his later work up to 1902 was not of equal value, though his operas Jeanie Deans and Diarmid were successful. Mr Granville Bantock, an ardent supporter of the most advanced music, has written many fine things for orchestra, and Mr William Wallace, in various orchestral pieces played at the Crystal Palace and else- where, and in such things as his "Freebooter songs," has shown strong individuality and imagination ; con- siderable power was exhibited by the late Erskine Allon, and Mr Arthur Hinton has produced things of fanciful beauty and quaint originality. Miss Ethel M. Smyth, whose Mass was given at the Boykl Albert Hall some years ago in most favourable conditions, has had her opera Fantasia produced at Weimar and Carlsruhe and Der Wald at Covent

Garden ; her strength lies in orches- tral writing, and her ideas are remarkable for power. Miss Maude Valerie White's graceful and expressive songs must not pass without a word of recognition, nor the cleverly devised cycles of songs or quartets by which Mme Liza Lehmann made a new reputation after her retirement from the profession of a singer. The first part of Mr S. Coleridge Taylor's Hiawatha scenes was performed while he was still a student at the Eoyal College, and so great was its popularity that the third part of the trilogy was commissioned for performance by the Royal Choral Society : his name is known by this work throughout England, and musicians have long realized that he possesses a style quite his own, in which the subtle art of emphasis by reiteration is thoroughly understood. His feeling for orchestral colouring is very strong, and his permanent success a matter of cer- tainty. Dr H. Walford Davies and Mr W. Y. Hurlstone excel in the serious kind of chamber-music, and use the classic forms with notable skill ; and if Mr S. P. Wad- dington's John Gilpin and Mr E. H. Walthew's Jackdaw of Mheims seem to convey the idea that their leanings

are towards what is trivial, the power and humour with which both composers have done their work and their other compositions ,show them to be worthy to be num- bered among the best of the younger writers.

English executive musicians have never suffered from foreign competition in the same degree as English com- posers, and the success of such singers as Miss Anna Williams, Miss Macintyre, Miss Marie Brema, Miss Clara Butt, Messrs Ben Davies, Edward Lloyd, Santley, Ffrangcon Davies, Plunket Greene, Andrew Black, and Watkin Mills, or of such pianists as Miss Fanny Davies and Mr Berwick, is but a continuance of the tradition of British excellence. If no English violinists have been able to command the success of Sarasate, Ysaye, or Kubelik, Messrs Kreuz and Hobday as viola players and Messrs Squire and Ludwig as violoncellists established a firm hold upon the public ; and the fame of the best English artists cannot be shaken by such phenomena as the extraordinary rage for M. Paderewski, or the fashion, commoner a few years ago than at the present day, of attaching great importance to the performances of infant prodigies.

The election of Sir Frederick Bridge (b. 1844) to the Gresham professorship on the death of Dr Wylde in 1890 put a new value on the lectures, for as organist of Westminster Abbey he had the faculty of attracting the attention of the public at large, and his lectures were not only instructive, but very amusing also. His appoint- ment as conductor of the Royal Choral Society, in suc- cession to Sir Joseph Barnby, was a popular success. Of the societies formed for the purpose of bringing the best music into the lives of the poor, the People's Concert Society, founded in 1878, is the oldest and the most widely useful; the musical organizations in connexion with such philanthropic undertakings as the Passmore Edwards settlement and the Oxford House at Bethnal Green are doing a valuable work in a thoroughly artistic if unobtrusive way.

The scientific study of the music of the past has more and more decidedly taken its place as a branch of musical education; the learned writings of W. S. Rockstro (1823- 1895), many of them made public first in Grove's Diction- ary of Music, made the subject clear to many who had been groping in the dark before ; and the actual perform- ance of old music has been undertaken not only by the Bach Choir, but by the Magpie Madrigal Society under Mr Lionel Benson's able direction. In vocal and instru- mental music alike the musical side of the International Exhibition of 1886 did excellent work in its historical concerts ; and in that branch of archaeology which is con- cerned in the structure and restoration of old musical instruments important work has been done by Mr A. J. Hipkins, the Rev. F. W. Galpin, and others. The forma- tion of the Folk-Song Society in 1899 drew attention to the importance and extent of English traditional music, and did much to popularize it with singers of the present day. (j. A. F. M.)

Music Halls. â€" If the Thespian cart or chariot, with all the dramatic sock and buskin actions represented on that movable platform, and the miracle plays performed by the monks in religious sanctuaries, in which the prin- cipal characters often represented the ruling powers of heaven, hell, and earth, were the origin of the theatre, the British theatre, protected by monopolist laws and patent rights, was undoubtedly the creator of that sturdy, comparatively modern, and very flourishing institu- tion known generally as the music hall. The " saloon theatres " of the 'thirties were the

music halls of to-day, and they owed their form and existence to the restrictive action of the patent theatres. These theatres had the

exclusive right of representing what was broadly called the ” legitimate drama,” which ranged from Shakespeare to Monk Lewis, and from Sheridan and Goldsmith to Kotzebue and Alderman Birch of Cornhill, citizen and poet, and the founder of the turtle-soup trade. The patent houses defended their rights when they were attacked by the “minor” and “saloon” theatres, but they often acted in the spirit of the dog in the manger. While they pursued up to fine and even imprisonment the poachers on their dramatic preserves, they too often neglected the ” legitimate drama ” for the supposed mere- tricious attractions offered by their illegitimate competitors. The British theatre gravitated naturally to the inn or tavern. The tavern was the source of life and heat, and warmed all social gatherings. The inn galleries offered rather rough stages, before the Shakespeare and Alleyn playhouses were built. The inn yards were often made as comfortable as possible for the ” groundlings ” by layers of straw, but the tavern character of the auditorium was never concealed. Excisable liquor was always obtainable, and the superior members of the audience who chose to pay for seats at the side of the stage or platform (like the ” avant-scene ” boxes at a Parisian theatre), were allowed to smoke Kaleigh’s Virginian weed, then a novel luxury. This was, of course, the first germ of a ” smoking theatre.”

While the drama progressed as a recognized public entertainment in England, and was provided with its own buildings in the town, or certain booths at the fairs, the Crown exercised its patronage in favour of certain individuals, giving them power to set up playhouses at any time in any parts of London and Westminster. The first and most important grant was made by Charles II. to his ” trusty and well-beloved ” Thomas Killigrew ” and Sir William Davenant.” This was a personal grant, not connected with any particular sites or buildings, and is known in theatrical history as the ” Killigrew and Davenant patent.” Killigrew was the author of several unsuccessful plays, dnd Sir William Davenant, said to be an illegitimate child of William Shakespeare, was a stage manager of great daring and

genius. Charles II. had strong theatrical leanings, and had helped to arrange the court ballets at Versailles for Louis XIV. The Killigrew and Davenant patent in course of time descended, after a fashion, to the Theatres Eoyal, Covent Garden and Drury Lane, and was and still is the chief legal authority governing these theatres. The ” minor ” and outlying playhouses were carried on under the Music and Dancing Act of George II., and the annual licences were granted by the local magistrates.

The theatre proper having emancipated itself from the inn or tavern, it was now the turn of the inn or tavern to develop into an independent place of amusement, and to lay the foundation of that enormous middle-class and lower middle-class institution or interest which we agree to term the music hall. It rose from the most modest, humble, and obscure beginning â€” from the public-house bar-parlour, and its weekly ” sing-songs,” chiefly supported by voluntary talent from the ” harmonic meetings ” of the ” long-room ” upstairs, generally used as a Foresters’ or Masonic club-room, where one or two professional singers were engaged and a regular chairman was appointed, to the ” assembly-room ” entertaininonts at certain hotels, where private balls and school festivals formed part of an irregular series. The district “tea-garden,” which was then an agreeable feature of suburban life â€” the suburbs being next door to the city and the country next door to the suburbs â€” was the first to show dramatic ambition, and to erect in some portion of its limited but leafy grounds a lath-and-plaster stage large enough for about eight people to move upon without incurring the danger of

falling off into the adjoining fish-pond and fountain. A few classical statues in plaster, always slightly mutiiatea, gave an educational tone to the place, and with a lew coloured oil-lamps hung amongst the bushes the proprietor felt he had gone as near the “Eoyal Vauxhall Gai;dens . as possible for the small charge of a sixpenny refreshment ticket. There were degrees of quality, of course, amongst these places, which answered to the German beer-gardens, though with inferior music. The Beulah Spa at Norwood, the White Conduit House at Pentonville, the Yorkshire Stingo in the Marylebone Koad, the Monster at Pimlico, the St Helena at Eotherhithe, the Globe at Mile End, the Eed Cow at Dalston, the Highbury Barn at High-bury, the Manor-House at Mare Street, Hackney, the Eosemary Branch at

Hoxton, and other riis-in-urbe retreats, were up to the level of their time, if rarely beyond it.

The suspended animation of the law â€” the one Georgian Act, which was mainly passed to cheek the singing of Jacobite songs in the tap-rooms and tea-gardens of the little London of 1730, when the whole population of the United Kingdom was only about six millions â€” encouraged the growth eventually of a number of “saloon theatres” in various London districts, which were allowed under the head of ” Music and Dancing ” to go as far on the light dramatic road as the patent theatres thought proper to permit. The 25th of George II., cap. 36, which in 1902 was still the only Act under which the music halls of forty millions and more of people were licensed, was always liberally interpreted, as long as it kept clear of politics.

The ” saloon theatres,” always being taverns or attached to taverns, created a public who liked to mix its dramatic amusements with smoking and light refreshments. The principal ” saloons ” were the ” Effingham ” in the White- chapel Eoad, the ” Bower ” in the Lower Marsh, Lam- beth, the “Albert” at Islington, the “Britannia” at Hoxton, the ” Grecian” in the City Eoad, the ” Union ” in Shoreditch, the ” Stingo ” at Paddington, and several others of less importance. All these places had good companies, especially in the winter, and many of them, nourished leading actors of exceptional merit. The dramas were chiefly rough adaptations from the con- temporary French stage, occasionally flying as high as Alexandre Dumas the elder and Victor Hugo. Actors of real tragic power lived, worked, and died in this con- fined area. Some went to America, and acquired fame and fortune ; and among others, Frederick Eobson, who was trained at the ” Grecian,” first when it was the leading saloon theatre and afterwards when it became the leading music hall (a distinction with little difference), fought his way to the front after the abolition of the ” patent rights ” and was accepted as the greatest tragi- comic actor of his time. The ” Grecian ” saloon theatre, better known perhaps, with its pleasure garden or yard, as the “Eagle Tavern,” City Road, which formed the material of one of Charles Dickens’s Sketches by Boz, was a place managed with much taste, enterprise, and discretion by its proprietor, Mr Eouse. Itwas the “saloon” where the one and only attempt, with limited means, was ever made to import almost all the original repertory of the Opera Comiquq in Paris, with the result that many musical

works were presented to a sixpenny audience that had never been heard before nor since in England. Auber, Herold, Adolphe Adam, Boieldieu, Gretry, Doni- zetti, Bellini, Rossini, and a host of others gave some sort of advanced musical education, through the ” Grecian,” to a rather depressing part of London, long before board schools were established. The saloon theatres rarely offended the patent houses, and when they did the law- was soon put in motion to show that Shakespeare could

not 136 represented with impximty. The ” Union Saloon ” in Shore^itch, then under the direction of Mr Samuel Lane, ~~who afterwards, with his wife, Mrs Sara Lane, at the ” Britannia Saloon,” became the leading local theatri~~ cal manager of his day, was tempted in 1834 to give a performance of Othello. It was “raided” by the then rather “new police,” and all the actors, servants, audi- ence, directors, and musicians were taken into custody and marched off to Worship Street police station, confined for the remainder of the night, and fined and warned in the morning. The same and only law still exists for those who are helping to keep a ” disorderly house,” but there are no holders of exclusive dramatic patent rights to set it in motion.- The abolition of this privileged monopoly was effected about this time by a combination of distinguished literary men and dramatists, who were convinced, from observation and experience, that the patent theatres had failed to nurse the higher drama, while interfering with the beneficial freedom of public amusements.

The effect of Covent Garden and Drury Lane on the art of acting had resulted chiefly in limiting the market for theatrical employment, with a consequent all-round reduction of salaries. They kept the Lyceum Theatre (or ” English Opera House “) for years in the position of a music hall, giving sometimes two performances a night, like a “gaff” in the New Cut or Whitechapel. They had not destroyed the ” star ” system, and Edmund Kean and the boy Betty â€” the “Infant Soscius” â€” ^were able to command sensational rewards. In the end Charks Dickens, Sir Edward Bulwer-Lytton, Sir Thomas ISToon Talfourd, and others got the patents abolished, and the first step towards free trade in the drama was secured.

The effect of this change was to draw attention to the “saloon theaAi-es,” where during the performances smoking, drinking, and even eating were allowed in the auditorium. An act was soon passed, known as the Stage-Play Act â€” the 6 and 7 Viet. c. 68 â€” appointing a censor of stage-plays, and placing the London theatres under the control of a Crown ofBeer, changing -with ministries. This was the Lord Chamberlain for the time being. The Lord Chamberlain of this period drew a hard-and-fast line between theatres under his control, where no smoking and drinking were allowed ” in front,” and theatres or kails where the old habits and customs of the audience were not to be interfered with. These latter were to go under the jurisdiction of the local magistrates, or other licensing authorities, under the 25 Geo. II. cap. 36 â€” the Music and Dancing Act â€” and so far a divorce was decreed between the taverns and the playhouses. The Lord Chamberlain eventually made certain concessions. Eefreshmemt bars were allowed at the Lord Chamberlain’s theatres in unobtrusive positions, victualled under a special Act of William IV., and private smoking-rooms were allowed ,at most theatres on application. All this implied that stage plays were to be kept free from opem smoking .and driiking, and miscellaneous entertainments were to enjoy their old social freedom. The position was accepted by those ” saloon theatres ” which “were not tempted to become Lord Chamberlain houses, and the others, with many additions, started the first music halls.

Amongst the first of these halls, and certainly the very first as far as intelligent management was concerned, was the ” Canterbury ” in the Lower Marsh, Lambeth, which was next door to the old Bower Saloon, then transformed into a ” minor theatre.” The ” Canterbury ” sprang from the usual tavern germ, its creator being Mr Charles Morton, who honourably earned the name of the ” doyen of the music halls.” It justified its title by cultivating the best class of music, and exposed the prejudice and un-

fairness of Blanche’s sarcasm in a Haymarket burlesque â€” “most music hall â€” most melancholy.” Mr Charles Morton added pictorial art to his other attractions, and obtained the support of Punch, which stamped the ” Canterbury ” as the ” Royal Academy over the water.” At this time by a mere accident Gounod’s great opera of Faust, through defective international registration, fell into the public domain in England and

became common property. The “Canterbury,” not daring to present it with scenery, costumes, and action, for fear of the Stage- Play Act, gave what was called “An Operatic Selection,” the singers standing in plain dresses in a row, like pupils at a school examination or a chorus in an oratorio at Exeter Hall. The music was well rendered by a thoroughly competent company, night after night, for a long period, so that by the time the opera attracted the tardy attention of the two principal opera managers at Her Majesty’s Theatre in the Haymarket and Covent Garden Theatre, the tunes most popular were being whistled by the “man in the street,” the “boy in the gutter,” and the tradesman waiting at the door for orders.

With the “Canterbury Hall,” and its brother the ” Oxford ” in Oxford Street â€” a converted inn and coach- ing yardâ€” built and managed on the same lines by Mr Charles Morton, the music halls were well started. They had imitators in every directionâ€” some large, some small, and some with architectural pretensions, but all anxious to attract the public by cheap prices and physical com- forts not attainable at any of the regular theatres.

AVith the growth and improvement of these ” Halls,” the few old cellar ” singing-rooms ” gradually disap- peared. “Evans’s” in Covent Garden was the last to go. ” Rhodes’s,” or the ” Cyder Cellars ” in Maiden Lane, at the back of the Adelphi Theatre ; the ” Coal Hole,” in the Strand, which now forms the site of Terry’s Theatre ; the “Doctor Johnson,” in Elect Street (oddly enough, within the precincts of the City of London), disappeared one by one, and with them the compound material for Thackeray’s picture of ” The Cave of Harmony.” This ” Cave,” like Dickens’s ” Old Curiosity Shop,” was drawn from the features of many places. To do the ” cellars ” a little justice, they represented the manners of a past time â€” heavy suppers and heavy drinks, and the freedom of their songs and recitations was partly due to the fact that the audience and the actors were always composed of men. Thackeray clung to “Evans’s” to the last. It was his nightly “chapel of ease” to the adjoining Garrick Club. In its old age it became decent, and ladies were admitted to a private gallery, behind screens and a convent grille. Before its death, and its revival in another form as a sporting club, it admitted ladies both on and off the stage, and became an ordinary music hall.

In its most prosperous days (or nights) “Evans’s ” never appUed for a music licence, and the other ” cellars ” fol- lowed its example. The music, as in circuses, was held to be ancillary, not what the public paid for. They were kept in countenance by places like ” Willis’s Rooms ” in King Street, St James’s, where the fashionable and exclu- sive assemblies known as “Almack’s” were held without any formal legal sanction. The Georgian Act was pro- bably considered too common and vulgar to touch ; and until the licensing authority was taken from the local magistrates and handed over to the London County Council, the Act 25 Geo. II. c. 36 was often neglected on both sides. The L.C.C. examine and enforce their powers. They have been advised that they can separate a music from a dancing licence if they like, and that when they grant the united licence the dancing means the danc- ing of paid performers on a stage, and not the dancing of the audience on a platform or floor, as at the short-lived but

elegant Cremorne Gardens, or an old-time ” Casino.” They are also advised that they can withhold licences, unless the applicants agree not to apply for a drink licence to the local magistrates sitting in Brewster ses- sions, who still retain their control over the liquor trade. Theatre licences are often withheld unless a similar pro- mise is made â€” the drink authority in this case being the Excise, empowered by the Act of William IV. (5 and 6 Will. IV. c. 39, s. 7).

The rise and progress of the London music halls natu- rally excited a good deal of attention and jealousy on the part of the regular theatres, and this was increased when the first ” Great Variety Theatre ” was opened in Leicester Square. The building was the finest example of Moorish architecture on a large scale ever erected in England. It was burnt down in the ‘eighties, and the present theatre was built in its place. Originally it was ” The Pan- opticon,” a palace of ” recreative science,” started under the most distinguished direction on the old polytechnic institution lines, and with ample capital. It was a com- mercial failure, and after being tried as an ” American Circus, ” it was turned into a great variety theatre, the greatest of its kind in Europe, under the name of the Alhamtra Palace. Its founder

was Mr E. T. Smith, the energetic theatrical manager, and its developer was Mr Erederick Strange, who came full of spirit and money from the Crystal Palace. He produced in 1865 an am- bitious ballet â€” the Dagger Ballet from Auber's Enfant Prodigue, which had been seen at Drury Lane Theatre in 1861, translated as " Azael." â€¢

The Alhambra was prosecuted in the superior courts for infringing the Stage-Play Act â€" the 6 and 7 Vict. c. 68. The case is in the law reports â€" Wigan v. Strange â€" the ostensible plaintiffs being Mr Horace Wigan, the actor and manager, and Mr Benjamin Webster, the celebrated actor and manager. They were supported by Mr J. B. Buck- stone and many other managers. A long trial before eminent judges, with eminent counsel on both sides, pro- duced a decision which was not very satisfactory, and far from final. It held that, as far as the entertainment went, according to the evidence tendered, it was not a ballet representing any distinct story or coherent action, but it might have been a " divertissement " â€" a term suggested in the course of the trial. A short time after this a pantomime scene was produced at the same theatre, called " Where's the Police ? " which had a clown, a pantaloon, a columbine, and a harlequin, with other familiar characters, a mob, a street, and eVen the traditional red-hot poker. This inspired proceedings by the same plaintiffs before a police magistrate at Marlborough Street, who inflicted the full penalties â€" Â£20 a performance for 12 performances, and costs. An appeal was made to the Westminster quarter sessions, supported by Serjeant Ballantine and opposed by Mr Hardinge Giffard (afterwards Lord Chan- cellor Halsbury), and the conviction was confirmed. Being heard at quarter sessions, there is no record in the law reports.

About this time " Pepper's Ghost " was a great public attraction at the theatres and music halls in London and the country. The music halls were prosecuted for in- fringing stage law in this case, although the actors and actresses never appeared on the stage in a solid form, but were thrown up as reflections by an underground arrange- ment of mirrors. The chief offenders in the provinces were Messrs Day and Son, music hall proprietors, of Bir- mingham, and in London Mr Charles Morton at the " Canterbury." Convictions were obtained in all cases. There were other prosecutions for other offences under the Act, one being against the " Eoyal " Music Hall

(formerly known as ” Weston’s “) in Holborn. This per- forniiance openly broke two laws at the same time

â€”the Copyright Act and the Stage-Play Act. It was a condensed version of Barnett’s charming opera of 27*6 Mountain Sylph, originally produced at the ” Gre- cian,” and the chief magistrate at Bow Street had no option but to fine the defendants, Messrs Sweasey and Holland. The fines were light, the prosecution in this case acting on principle.

These prosecutions, and threats of more, suggested the institution of a parliamentary inquiry, and a House of Commons Select Committee was appointed in 1866, at the instigation of the music halls and variety theatres. The committee devoted much time to the inquiry, and examined many witnesses â€” amongst the rest Lord Syd- ney, the Lord Chamberlain, who had no personal objec- tion to undertake the control of these comparatively young places of amusement and recreation. Much of the evidence was directed against the Stage-Play Act, as the difficulty appeared to be to define what was not a stage play. Lord Denman, Mr Justice Byles, and other eminent judges seemed to think that any song, action, or recitation that excited the emotions might be pinned as a stage play, and that the old definition â€” ” the re- presentation of any action by a person (or persons) acting, and not in the form of narration ” â€” could be supported in the then state of the law in any of the higher courts. The variety theatres on this occasion were encouraged by what had just occurred at the time in Erance. Napoleon III., acting under the advice of M. Michel Chevalier, passed a decree known as ” La Liberte des TheS-tres,” which fixed the status of the Parisian and other music halls. Operettas, ballets of action, ballets, vaudevilles-, pantomimes, and all light pieces were allowed, and the managers were no longer legally confined to songs and acrobatic performances. The report of the Select Committee of 1866, signed by the chairman, Mr (afterwards Viscount) Goschen, was in favour of granting the variety theatres and music halls the privileges they asked for, which were those enjoyed in Erance and other countries.

Parliamentary interference and the introduction of several private Bills in the House of Commons, which came to nothing, checked, if they did not altogether stop, the prosecutions. The variety theatres advanced in every

direction in number and importance. Ballets grew in splendour and coherency. The lighting and ventilation, the comfort and decoration of the various “palaces” (as many of them were now called) improved, and the public, as usual, were the gainers. Population increased, and the six millions of 1730 had become forty millions (and more) in 1902. The same and only Act (25 Geo. II. c. 36), adequate or inadequate, still remained. London is defined as the ” administrative county of London,” and its area â€” the 20-mile radiusâ€” is mapped out. The Metropolitan Board of Works retired or was discharged, and the London County Council was created and has taken its place. The London County Council, with extended power over structures and structural alterations, acquired the licensing of variety theatres and music halls from the local magis- trates (the Middlesex, Surrey, Tower Hamlets, and other magistrates) within the administrative county of London. The spread of so-called ” sketches “â€”a kind of condensed drama or farceâ€” in the variety theatres, and the action of the London County Council in trying to check the ex- tension of refreshment licences to these establishments, w-ith other grounds of discontent on the part of managers (individuals or ” limited companies “), led to the appoint- ment of a second Select Committee of the House of Commons in 1892 and the production of another Blue- book. The same ground was gone over, and the same objections were raised against a licensing authority which is elected by public votes, only exists for three years

before another election is due, and can give no guarantee for the continuity of its judgments. The consensus of opinion (as in 1866) was in favour of a State official, responsible to Parliament â€” like the Home Of&ce or the Board of Trade â€” the preference being given to the Lord Chamberlain and his staff, who know much about theatres and theatrical business. The chairman of the committee was the Hon. David Plunkett (afterwards Lord Eathmore), and the report in spirit was the same as the one of 1866. Three forms of licence were suggested : one for theatres proper, one for music halls, and one for concert rooms.

Though the rise and progress of the music hall and variety theatre interest is one of the most extraordinary facts of the last half of the 19th century, the business has little or no corporate organization, and there is nothing like a complete registration of the various pro- perties throughout the United Kingdom. In London the ” London Entertainments Protection Association,” which has the command of a weekly paper called the Music Hall and Tlieatre Review, looks after its interests. The general figures placed in the hands of the chairman at a late meeting were sufficiently startling, but they are more likely to be under- than over-stated. In London alone five millions sterling of capital is said to be invested in these enterprises, employing 80,000 persons of all grades, and entertaining during the year about twenty-five millions of people. The annual applications for music licences in London alone are over 300.

Besides the ” Canterbury ” and the ” Alhambra,” London in 1902 had the ” Palace ” in Charing Cross Eoad, the ” Empire ” in Leicester Square, the ” Pavilion ” in Piccadilly Circus (occupying the finest site in western London), the ” Hippodrome ” in Cranbourn Street, the ” Oxford ” in Oxford Street, the ” Eoyal ” in Holborn, the ” South London ” in London Eoad, the ” Paragon ” at Mile End, the ” Cambridge ” at Shoreditch, the ” Empire ” at Bow, the ” Bedford ” at Camden Town, the ” Metropolitan ” in the Edgware Eoad, the ” Granville ” at Walham Green, the “London” at Shoreditch, the ” Foresters’ ” at Bethnal Green, the ” Tivoli ” in the Strand, and other theatres of variety in every quarter, including the suburbs. The “provinces,” as they are called, are not inclined to lag behind the metropolis, and in the North of England, at Blackpool, a coast town much frequented by ” trippers,” there are five amusement en- terprises outside the regular theatres, concert halls, and gardens, that represent one million sterling. Some of these places may be over-capitalized, but after every allowance is made, enough remains to show that there the theatres proper have now to face a formidable and growing competition. Professional variety ” artistes,” with their own companies, go ” on tour ” from one place to another throughout the year. These ” tours ” are not always confined to the United Kingdom. They often ex- tend to America and Australia, and to various parts of South Africa. Some few get to India and Ceylon, and many go to Prance, Hungary, Russia, Sweden, and Norway, and particularly to Germany and Holland.

(j. hd.)

Muskegon, a city of Michigan, U.S.A., capital of Muskegon county, on the southern shore of Muskegon Lake, 5 miles from Lake Michigan, in the western part of the state, at an altitude of 689 feet. Muskegon Lake forms an excellent harbour, one of the best on the Great Lakes, with a depth at the entrance of 14 feet. The city has regular steamboat communication with Chicago, Mil- waukee, and other lake ports, and a large commerce by water. Three railways enter the city, the Pere Marquette, the Grand Eapids and Indiana, and the Grand Tnmk. It derives its water supply by pumping from Lake Michigan.

Muskegon is a manufacturing city of much importance. In 1900 its manufacturing establishments numbered 200, with a total capital of f 4,602,390, and 3235 hands. The products were valued at $5,097,069 ; of this sum 11,223,918 represented the value of the lumber and timber products. Population (1890), 22,702 ; (1900), 20,818, of whom 6236 were foreign-born and 23 negroes. The death- rate in 1900 was 12-2.

Musselburgh, a municipal and parliamentary burgh, at the eastern extremity of the coast-line of Mid- lothian, 5\ miles from Edinburgh, bisected by the river Esk, which divides Musselburgh proper from the more populous district of Fisherrow. “While still retaining most of the venerable features of its High Street, the town has tended more and more to become a seaside suburb of Edinburgh, and has thus lost something of its old individu- ality. New streets and buildings are springing up, and water, drainage, and other improvements have been carried out. The golf-links, though injured by over-playing, are still a great attraction. Musselburgh joins with Leith in sending a member to Parliament. Population (1891),

8888 ; (1901), 11,704.

Mussoorie, or Masuei, a town and sanatorium of British India, in the Dehra Dun district of the North- West Provinces, 6600 feet above the sea. Population (1891), 10,086 ; municipal income (1897-98), Es.70,890, the incidence of taxation being Es.5 : 8 per head. It stands on a peak of one of the lower Himalayan ranges, amidst beautiful mountain scenery. It practically forms one station with Landaur, the convalescent depot for

European troops, 7362 feet above the sea. Some distai^e off, on the road to Simla, is the cantonment of Chakrata, 7300 feet. Hitherto it has been approached by road from Saharanpur in the plains, but in 1900 the railway was opened to Dehra. There are numerous schools for Europeans, in- cluding St George's College, the Philander-Smith Institute, the Oak Grove School of the East Indian railway, and several Church of England and Eoman Catholic institu- tions. It has two English newspapers. The first brewery in India was established here in 1850. There are now two breweries, with an annual out-turn of 400,000 gallons ; and a third, at Chakrata, with an out-turn of 73,000 gallons. It has botanical gardens, and is the summer headquarters of the Trigonometrical Survey.

Muthuswamy Aiyar, Sir T. (1832-1895), native Indian judge of the High Court of Madras, was born of poor parents in the village of Vuchuwadi, near Tanjore, on the 28th of January 1832. His widowed mother was forced by poverty to remove with Muthu- swamy and his "brother to Tiruvarar, where the former learnt Tamil, and soon set to work under the village accountant at a monthly salary of one rupee. About this time he lost his mother, whose memory he cherished with reverence and affection to the last. His duty took him to the court-house of the Tahasildar, Mr Naiken, who soon remarked his extraordinary intelligence and industry. There was an English school at Tiruvarar, where Muthu- swamy managed to pick up an elementary knowledge of the English language. Mr Naiken then sent him to Sir Henry Montgomery's school at Madras, as a com- panion to his nephew, and there he won prizes and scholarships year after year. In 1854 he won a prize of 600 rupees offered to the students of the Madras Presidency by the Council of Education for the best English essay. This success brought him to the notice of Sir Alexander Arbuthnot and Mr Justice Holloway. He was offered help to proceed to England and compete for the civil service, but being a Brahmin and married, he declined to cross the ocean. Instead he entered the subordinate

Grovernment service, and was employed in sneh various posts as school teacher, record keeper in Tanjore, and in 1856 deputy inspector of schools. At this time the Madras aiithorities instituted the examination for the olfice of pleaders, and Muthuswamy oame out first in the first examination, even beating Sir T. Madhowrao, his senior by many years. Muthuswamy was then appointed in succession district mnusiff at Tranquebar, deputy collector in Tanjore in 1869, sub-judge of south Canara in 1865, and a magistrate of police at Madras in 1868. While serving in the last post he passed the examination for the degree of bachelor of laws of the local university. He was next employed as a judge of the Madras Small Causes Court, until in 1878 he was raised to the bench of the High Court, which office he occupied with ability and distinction for over fifteen years, sometimes acting as the Chief Justice. He attended by invitation of the Viceroy the Imperial Assemblage at Delhi in 1877. In 1878 he received the honour of CLE. and in 1893 the K.C.I.E. was conferred on him. But he did not live long to enjoy this dignity, dying suddenly in 1895. Muthuswamy was too devoted to his official work to give much time to other pursuits. Still he took his full share in the affairs of the Madras University, of which he was nominated a fellow in 1872 and a syndic in 1877, and was well acquainted with English law, literature, and philosophy. He was through life a staunch Brahmin, devout and amiable in character, with a taste for the ancient music of India and the study of the Vedas and other departments of Sanskrit literature.

Mutsu Hi to, Mikado or Emperor of Japan

(1852 J, succeeded his father, Osahito, the former

emperor, in 1867, and was crowned at Osaka in 1868. The country was then in a ferment owing to the concessions which had been granted to foreigners by the preceding shogun, lemochi, who in 1854 concluded a treaty with Commodore Perry by which it was agreed that certain ports should be open to foreign trade. This convention gave great offence to the more conservative daimios, and on their initiative the mikado suddenly decided to abolish the shogunate. This resolution was not carried out without strong opposition. The reigning shogun, Hitot- subashi, yielded to the decree, but many of his followers were not so complaisant, and it was only by force of

arms that the new order of things was imposed on the country. The main object of those who had advocated the change was to lead to a reversion to the primitive condition of affairs, when the will of the mikado was absolute and when the presence in Japan of the hated foreigner was unknown. But the reactionary party was not to be allowed to monopolize revolutions. To their surprise and discomfiture, the powerful daimios of Sat- suma and Choshu suddenly declared themselves to be in favour of opening the country to foreign intercourse, and of adopting many far-reaching reforms. With this movement Mutsu Hito was cordially in agreement, and of his own motion he invited the foreign representatives to an audience on 23rd March 1868. As Sir Harry Parkes, the British minister, was on his way to this as- sembly, he was attacked by a number of two-sworded samurai, who, but for his guard, would doubtless have succeeded in assassinating him. The outrage was re- garded by the emjjeror and his ministers as a reflection on their honour, and they readily made all reparation within their power. While these agitations were afoot, the emperor, with his advisers, was maturing a political constitution which was to pave the way to the assump- tion by the emperor of direct personal rule. As a step in this direction, Mutsu Hito transferred his capital from Kyoto to Yedo, the former seat of the shoguns'

government, and marked the event by renaming the city Tokyo, or Eastern Capital. In 1869 the emperor paid a visit to his old capital, and there took as his imperial consort a princess of the house of Ichijo. In the same year Mutsu Hito bound himself by oath to institute certain reforms, the first of which was the establish- ment of a deliberative assembly. In this onward move- ment he was supported by the majority of the daimios, who in a supreme moment of patriotism surrendered their estates and privileges to their sovereign. This was the death-knell of the feudalism which had existed for so many centuries in Japan, and gave Mutsu Hito the free hand which he desired. A centralized bureau- cracy took the place of the old system, and the nation moved rapidly along the road of progress. Every- thing European was eagerly adopted, even dovm^ to frock-coats and patent-leather boots for the officials. Torture was abolished (1873), and a judicial code, adapted from the Code Napoleon, was authorized. The first railwayâ€" that from Yokohama to Tokyoâ€" was opened in 1872 ; the European calendar was adopted, and English was introduced into the curriculum of the common schools. In all these reforms jMutsu Hito took a leading part. But it was not

to be expected that such sweeping changes could be effected without opposition, and thrice during the period between 1876 and 1884 the emperor had to face serious rebellious movements in the provinces. These he succeeded in suppressing ; and even amid these preoccupations he managed to inflict a check on his huge neighbour the empire of China. As the Government of this state declared that it was incapable of punishing certain Eormosan pii-ates for outrages committed on Japanese ships (1874), Mutsu Hito landed a force on the island, and, having inflicted chastisement on the bandits, remained in possession of certain districts until the com- pensation demanded from Peking was paid. The un- paralleled advances which had been made by the Govern- ment were now held by the emperor and his advisers to justify a demand for the revision of the foreign treaties, and negotiations were opened with this object. They failed, however, and the consequent disappointment gave rise to a strong reaction against everything foreign throughout the country. Foreigners were assaulted on the roads, and even the Russian Cesarevitch, afterwards the Tsar Nicholas II., was attacked by would-be assassins in the streets of Tokyo. A renewed attempt to revise the treaties in 1894 was more successful, and in that year Great Britain led the way by concluding a revised treaty with Japan. Other nations followed, and by 1901 all those obnoxious clauses suggestive of political in- feriority had finally disappeared from the treaties. In the same year (1894) war broke out with China, and Mutsu Hito, in common with his subjects, showed the greatest zeal for the campaign. He reviewed the troops as they left the shores of Japan for Korea and Man- churia, and personally distributed rewards to those who had won distinction. In this, as in all matters, Mutsu Hito always placed himself in the van of his countrymen. He led them out of tlie trammels of feudalism ; by his wise and progressive rule he lived to see his country advanced to the first rank of nations ; and he was the first Oriental sovereign to form a defensive alliance with a first-rate European Power. He had several sons and daughters, his heir-apparent being Yoshi Hito (b. 31st August 1879), and he adopted the epithet of Meiji, or ” Enlightened Peace,” as the Nengo or title of his reign. The year 1902, according to the Japanese calendar, was the 36th year of Meiji.

Muttra, or Mathura, a city and district of British India, in the Agra division of the North- West Provinces.

The city is on tlie right bank of the J,umiia, 30 miles above Agra ; it has a railway station. Population (1881), 57,724; (1891), 61,195; (1901), 59,574; municipal income (1897-98), E.s.61,225, mostly from octroi; incidence of taxation, 14 annas per head ; registered death-rate (1897), 53 per thousand. The special cult of Krishna with which the neighbourhood is associated seems to be of com- paratively late date. Much of its prosperity is due to the residence of a great family of Seths or native bankers, who were conspicuously loyal during the Mutiny. Tem- ples and bathing stairs line the river bank. Most of the public buildings are of white stone, handsomely carved. There are an American mission, a Eoman Catholic church, a museum of antiquities, a high school, thirteen printing- presses, and it is a cantonment for a native infantry regiment.

The district of Muttra has an area of 1441 square miles ; popu- lation (1881), 671,690 ; (1891), 713,421 ; (1901), 763,221, showing an increase of 6 per cent, between 1881 and 1891, and of 7 per cent, between 1891 and 1901 ; average density, 529 persons per square mile. The land revenue and rates are Rs. 17,38,808, the incidence of assessment being B.l : 8 : 6 per acre ; cultivated area (1896-97), 677,224 acres, of which 283,606 were irrigated from wells, &c., including 100,640 from Government canals ; number of police, 246.3 ; vernacular schools, 96, with 4880 pupils ; registered death- rate (1897), 38 ‘6 per thousand. The principal crops are millet, pulse, cotton, wheat, and indigo. There are 41 indigo factories, with an out-turn valued at Rs. 2,52, 000. The famine of 1878 was severely felt. The eastern half of the district is watered by the Agra canal, which is navigable, and the western half by branches of the Ganges canal. A branch of the Rajputana railway, from Achnera to Hathras, crosses the district, and the proposed chord line of the East India, from Agra to Delhi, will traverse it from north to south. Besides Muttra city, the district also contains the holy places of Brindaban, Gobardhan, Gokul, and Mahaban, all associated with the cult of Krishna as a herdsman.

Muzaffar-ed-Dm, Shah op’ Persia (1853—

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the second son of Shah Nasr-ed-Din, was born 25th March 1853. He was in due course declared vail aJid, or heir-apparent, and invested with the governorship of Azarbaijan, but on the assassination of his father in 1896 it was feared that his elder brother, the governor of Ispahan, might prove a dangerous rival, especially when it was remembered that Muzaffar-ed-Din had been recalled to Tehran by his father upon his failure to suppress a Kurd rising in his province. In fact, in early youth he had been a fanatical supporter of orthodox Islam, but his views had undergone a complete change under French iniluence at Tehran. All opposition, however, was satisfactorily obviated, and Muzaffar-ed-Din was duly enthroned 8th June 1896. On this occasion he announced the suppression of all purchase of civil and military posts, and then proceeded to remit in perpetuity all taxes on bread and meat, thus lightening the taxation on food, which had caused the only disturbances in the last reign. That his character had become stronger with maturity was shown by his firmness in repressing the fanatical outbreak against Christian Armenians at Kazoni in September 1899. In accordance with his long-expressed intention of visiting the Paris Exhibition of 1900, the Shah arrived 23rd July, and was conducted by President Loubet to the Palais des Souverains in the Bois de Boulogne. While residing there a dastardly attempt was made to assassinate him by an anarchist named Franqois Salson, but he escaped without injury. (See also Peesia.)

Muzaffargarh, a town and district of British India, in the Derajat division of the Punjab. The town is near the right bank of the river Chenab, and has a railway station. Population (1881), 2720; (1891), 3058; municipal income (1897-98), Rs.11,728.

The district of Mtjzaffargaeh occupies the lower end of the Sind-Sagar Doab. Area, 3422 square miles ; population (1881), 338,605; (1891), 381,095; (1901), 405,743, showing an increase of

12 per cent., due to the extension of irrigation, between 1881 and 18H1, and of 6-5 per cent, between 1891 and 1901 ; average density, 119 persons per square mile. The land revenue and rates in 1897-98 were Rs.7,07,892, the incidence of assessment being Rs.O : 6 : 8 per head ; cultivated area,

472,358 acres, of which 309,025 were irri- gated, including 294,194 from Government canals; number of police, 389 ; number of schools (1896-97), 174, attended by 3721 boys, being 9 per cent, of the boys of school-going age ; death-rate (1897), 44 per thousand. The principal crops are wheat, pulse, rice, and indigo. The most important domestic animal is the camel. .The district is crossed for 64 miles by the North-Western railway, and the boundary rivers are navigable for 277 railfs. These rivers also furnish numerous irrigation channels, originally constructed under native rule.

Muzaffarnagar, a town and district of British India, in the ^Nleerut division of the jS'orth-West Pro- vinces. The town is 790 feet above the sea, and has a station on the]Srorth-"\Vestern railway. Population (1881), 15,080; (1891), 18,166; municipal income (1896-97), lis. 19,488, mostly derived from octroi; incidence of taxation, nearly 14 annas per head ; registered death-rate (1897), 46-95 per thousand. There are a high school and one printing-press.

The district of Muzaffaenagar has an area of 1658 square miles ; population (1881), 758,444; (1891), 772,874; (1901), 877,984, showing an increase of only 2 per cent, between 1881 and 1891, and of 13 -6 per cent, between 1891 and 1901 ; average density, 529 persons per square mile. The land revenue and rates are Es.l8,41,.S22, the incidence of assessment being R. 1.8.7 per acre ; cultivated area (1896-97), 627,348 acres, of which 310,522 were irrigated, including 202,026 from Government canals ; number of police, 1860 ; ver- nacular schools, 133, with 4577 pupils ; registered death-rate (1897), 31-8 per thousand. The principal crops are wheat, pulse, cotton, and sugar-cane. The district is watered by the Ganges and Eastern Jumna canals, and crossed by the North-Western railway for 26 miles.

Muzaffarpur, a town and district of British India, in the Patna division of Bengal. The town is on the right bank of the Little Gandak river, and has a rail- way station. Population (1881), 42,460; (1891), 49,192 ; (1901), 45,499. It is a well-laid-out town, and is an important centre of trade, being on the direct route from Patna to Nepal. The high school had 448 pupils in 1896-97. It has a German mission, six printing-presses, and a club for Indians.

The district of Muzaffarpur has an area of 3003 square miles ; population (1881), 2,582,060 ; (1891), 2,711,445 ; (1901), 2,746,009, showuig an increase of 5 per cent, between 1881 and 1891, and of 1-2 per cent, between 1891 and 1901 ; average density, 914 per square mile, being exceeded In all India only by the neighbouring district of Saran. Classified according to religion, Hindus in 1891 numbered 2,378,168; Mahommedans, 3-32,906; Christians, 371, of whom 123 were Europeans. The land revenue and rates in 1897-98 were Rs.14,99,312 ; number of police, 509; number of boys at school (1896-97), 30,058, being 15-3 per cent, of the male population of school-going age, compared with 28 per cent, for the province generally ; registered death-rate (1897), 32 per thousand. Indigo and opium are largely grown. There are 30 indigo factories, employing 40,000 persons, with an out-turn of 9000 maunds, valued at Rs. 14,68,000. The district is traversed in several directions by the Tirhut system of the Bengal and North-Western railway. It suffered from drought in 1873-74, and again in 1897-98.

Muztagh. See Pamirs.

Mweru., a large lake of Eastern Central Africa, traversed by the Luapula or Upper Congo. It measures about 76. miles in length by some 25 in breadth, and is roughly rectangular, the axis running from south-south-west to north-north-east. At the south end a shallow b9,y extends to 9Â° 31′ S. .East of this, and some miles farther north, the Luapula enters from a vast marsh inundated at high water. The southern portion of the lake is bordered by flat country, that to the east being forest-clad and abound- ing in rubber trees. In the northern half both shores form low cliffs, 100 to 200 feet high, while farther from the lake the country rises on the west to an extensive plateau, and on the east to a range of broken hills some

800 feet above the water-level. The Luapula leaves the lake at its north-west corner, making a sharp bend to the west before assuming a northerly direction. The northern shore was found by Mr Weatherley, by careful rope measurement, to be almost 19 miles in length. Besides the Luapula, the principal influent is the Kalungwizi, from the east. North-west of the Luapula mouth lies the island of Kilwa, about 8 miles in length, rising into plateaux 600 feet above the lake. Here the air is cool and balmy, the soil

dry, with short turf and clumps of shady trees, affording every requirement for a sanatorium. The lake was reported by the Belgian Lieutenant Brasseur, in 1897, to be diminishing in size, biit this pro- bably referred to periodic fluctuations. Mweru was reached by Livingstone in 1867, but its western shore was first explored in 1890 by Mr Alfred Sharpe, who two years later effected its circumnavigation. The whole eastern shores from the Luapula entrance to its exit, together with Kilwa island, belong to British Central Africa ; the western to the Congo Free State.

See Sharpe in Froc. B.Gf.S., 1892, and Geographical Journal, vol. i., 1893. (b. HE.)

Myaungmya, a district in the Irrawaddy division of Lower Burma, formed in 1896 out of a portion of the Bassein district. It has an area of 3006 square miles, and a population (1891) of 217,878, and (1901), 303,308, showing an' increase of 39-2 per cent, and a density of 101 inhabitants to the square mile. In 1898-99 there were 844 villages, paying Es.16,41,719 revenue. Of the population, 203,319 were Buddhists and Jains, 1787 Mahommedans, 669 Hindus, and 12,203 Christians, of whom 12,111 were natives, mostly Karens. There were also 271 non-Christian Karens. Of the total area of 1,923,200 acres, 432,682 were cultivated in 1898-99, 472,494 acres were not available for cultivation, and the cultivable area available, apart from fallow, was 898,968 acres. The total rainfall in 1898-99 was 118-82 inches. The chief town is Pantanaw, which had in 1891 a popula- tion of 6030. Myaungmya, which is a municipal town, had 2162 inhabitants in 1891.

Mycenaean Civilization. â€" "Mycenaean" is a convenient epithet for a certain phase of a prehistoric civilization, which as a whole is often called "Aegean." It owes its vogue to the fame of Henry Schliemann's discovery at Mycenae in 1876, but is not intended to beg the open question as to the origin or principal seat of the Bronze Age culture of the Greek lands.

The site of Mycenae itself was notorious for the singu- lar and massive character of its ruins, long before Schlie- mann's time. The great curtain wall and towers of the citadel, of mixed Cyclopean, polygonal, and ashlar construction, and unbroken except on the south cliff, and the main gate, crowned with a heraldic relief of lionesses, have never been hidden; and though jnuch blocked with their own ruin, the larger dome-tombs outside

the citadel have always been visible, and remarked by travellers. But since these remains were always referred vaguely to a “Heroic” or ” proto-Hellenic ” period, even Schliemann’s preliminary clearing of the gateway and two dome-tombs in 1876, which exposed the engaged columns of the faqades, and suggested cer- tain inferences as to external revetment and internal decoration, would not by itself have led any one to asso- ciate Mycenae with an individual civilization. It was his simultaneous attack on the unsearched area which was enclosed by the citadel walls, and in 1876 showed no remains above ground, that led to the recognition of a ” Mycenaean civilization.” Schliemann had published in 1868 his belief that the Heroic graves mentioned by Pausanias (ii. 16) lay within the citadel of Mycenae,

and now he chose the deeply-silted space just within the gate for his first sounding. About 10 feet below the surface his diggers exposed a double ring of ^ipi’igM slabs, once capped with cross slabs, and nearly 90 feet in diameter. Continuing downwards through earth full of sherds and other debris, whose singularity was not then recognized, the men found several sculptured limestone slabs, showing subjects of war or the chase, and scroll and spiral ornament rudely treated m relief. When, after some delay, the work’ was resumed, some skeletons were uncovered lying loose, and at last, 30 feet from the original surface, an oblong pit-grave was found, paved with pebbles, and once roofed, which con- tained three female skeletons, according to Schliemann, “smothered in jewels.” A few feet to the west were presently revealed a circular altar, and beneath it another grave with five corpses, two probably female, and an even richer treasure of gold. Three more pits came to light to the northward, each adding its quota to the hoard; and then Schliemann, proclaiming that he had found Atreus and all his house, departed for Athens. But his Greek ephor, clearing out the rest of the pre- cinct, came on yet another grave and some gold objects lying loose. Altogether there were nineteen corpses in six pits, buried, as the grave furniture showed, at different times, but all eventually included in a holy ring.

These sepulchres were richer in gold than any found elsewhere in the world, a fact which led to an absurd attempt to establish their kinship with the later and only less golden burials of Scyths or Kelts. The metal was worked up

into heavy death-masks and lighter breastplates, diadems, baldrics, pendants, and armlets, often made of mere foil, and also into goblets, hair-pins, rings engraved with combats of men and beasts, miniature balances, and an immense number of thin circular plaques and buttons with bone, clay, or wooden cores. Special mention is due to the inlays of gold and niello on bronze dagger-blades, showing spiral ornament or scenes of the chase, Egyptian in motive, but non-Egyptian in style ; and to little flat models of shrine-faQades analogous to those devoted to Semitic pillar-worship. The ornament on these objects displayed a highly developed spiraliform system, and advanced adaptation of organic forms, especially octopods and butterflies, to decorative uses. The shrines, certain silhouette figurines, and one cup bear moulded doves, and plant forms appear inlaid in a silver vessel. The last-named metal was much rarer than gold, and used only in a few conspicuous objects, notably a great hollow ox-head with gilded horns and frontal rosette, a roughly modelled stag, and a cup, of which only small part re- mains, chased with a scene of nude warriors attacking a . fort. Bronze swords and daggers and many great caldrons were found, with arrow-heads of obsidian, and also a few stone vases, beads of amber, intaglio gems, sceptre heads of crystal, certain fittings and other fragments made of por- celain and paste, and remains of carved wood. Along with this went much pottery, mostly broken by the collapse of the roofs. It begins in grave 4 (Eig. 1), with a dull painted ware, which we now know as late “proto-Mycenaean,” and it develops into a highly-glazed fabric,’ decorated with spiraliform and marine schemes in lustrous paint, and showing the typical forms, false-mouthed amphorae and long-footed vases, now known, as distinctively Mycenaean. The loose objects found outside the circle include the best intaglio ring from this site, admirably engraved with a cult scene, in which women clad in flounced skirts are chiefly concerned, and the worship seems to be of a sacred tree. In houses south of the circle occurred some goldsmiths’ moulds, which supply indubitable evidence of native productivity, many rude

painted idols in terra-cotta, and (it is said) the fragments of a most notable vase, decorated with armed warriors in a debased style approaching the later ” Dipylon ” manner. This treasure as a whole was admitted at once to be far too highly developed in technique and ornament, and too individual in character, to belong, as the lionesses over the gate used to be said to belong, merely to a first stage in Hellenic art. It preceded in time the classical culture of the same area ; but, whether foreign or native, it was allowed to represent a civilization that was at its acme and practically incapable of further development. So the bare fact of a great prehistoric art-production, not strictly Greek, in Greece came to be accepted without much difl&culty. But before describing how its true relations were unfolded thereafter, it may be mentioned that the site of Mycenae had yet much to reveal after

Schliemann left it. Ten years later the Greek Archaeo- logical Society resumed exploration there, and M. Tsountas, probing the summit of the citadel, hit upon and opened out a fragment of a palace with hearth of stucco, painted with geometric design, and walls adorned with frescoes of figure subjects, armed men and horses. An early Doric temple was found to have been built over this palace, a circumstance which disposed for ever of the later dates proposed for Mycenaean objects. Sub- sequently many lesser structures were cleared in the east and south-west of the citadel area, which yielded commoner vessels of domestic use, in pottery, storie, and bronze, and some more painted objects, including a re- markable fragment of stucco, which shows human ass- headed figures in procession, a tattooed head, and a plaque apparently showing the worship of an aniconic deity.

Fig. 1. â€” Plan of the Citadel of Mycenae. {Baaed on a plan in SchuckhardV s ‘* Schliemann^s Excavations.^^)

From the immense variety of these domestic objects more perhaps has been learned as to the affinities of Mycenaean civilization than from the citadel graves. Lastly, a most important discovery was made of a cemetery west of the citadel. Its tombs are mostly rock-cut chambers, approached by sloping dromoi; but there are also pits, from one of which came a re- markable ivory mirror handle of Oriental design. The chamber graves were found to be rich in trinkets of gold, engraved stones, usually opaque, vases in pottery

and stone, bronze mirrors and weapons, terra-cottas and carved ivory ; but neither they nor the houses have yielded iron except in very small quantity, and that not fashioned into articles of utility. The presence of fibulae and razors supplied fresh evidence as to My- cenaean fashions of dress and wearing of the hair, and a silver bowl, with male profiles inlaid in gold, proved that the upper lip was sometimes shaved. All the great dome- tombs known have been cleared, but the process has added

only to our architectural knowledge. The tomb furniture had been rifled long ago. Part of the circuit of a lower town has been traced, and narrow embanked roadways conducted over streams on Cyclopean bridges lead to it from various quarters.

The abundance and magnificence of the circle treasure had been needed to rivet the attention and convince the judgment of scholars, slow to reconstruct expede Herculem. But there had been a good deal of evidence available previous to 1876, which, had it been collated and seriously studied, might have greatly discounted the sensation that the citadel graves eventually made. Although it was recognized that certain tributaries, represented, e.g., in the 18th Dynasty tomb of Eekhmara at Egyptian Thebes, as bearing vases of peculiar form, were of Mediterranean race, neither their precise habitat nor the degree of their civilization could be determined while so few actual prehistoric remains were known in the Mediterranean lands (Fig. 2). Nor did the Mycenaean objects which

were lying obscurely in miasenms in 1870 or thereabouts provide a sufficient test of the real basis underlying the Hellenic myths of the Argolid, the Troad, and Crete, to cause these to be taken seriously. Both at Sevres and at ISTeuchatel Aegean vases have been exhibited since the ‘thirties, the provenience in the one case being Phyla- kopi in Melos, in the other ease Cephalonia. Boss, by his explorations in the Greek islands from 1836 onwards, called attention to the early intaglios, now known as inselsteine; but it was not till 1878 that Newton demonstrated these to be no strayed Phoenician pro- ducts. In 1866 primitive structures were discovered in the

island of Therasia by quarrymen extracting poz- zolana for the Suez Canal breakwaters ; and when this discovery was followed up in 1870 on the neighbouring Santorin by representatives of the French School at Athens, much pottery of a class now known immediately to precede the typical Mycenaean ware, and many stone and metal objects, were found and dated by the geologist

Fouque, somewhat arbitrarily, to 2000 B.C., by con- sideration of the superincumbent eruptive stratum Meanwhile, in 1868, tombs at lalysos m Rhodes had yielded to M. Biliotti many Si^e.Pf Â°*f'^ ,^^'f Â°! styles which came later to be called the third and fourth Mycenaean; but these, bought by Mr Euskm, and presented to the British museum, excited less attention than they deserved, being supposed to be of some local Asiatic fabric of uncerta,in date. .Nor was a connexion immediately detected between them and the objects found four years later m a dome-tomb at Menidi in Attica and a rock-cut "bee-hive" grave near the Argive Heraeum.
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Even Schliemann's first excavations at Hissarlik m the Troad did not surprise those familiar equally with Neolithic settlements and Hellenistic remains. But the " Burnt City " of the second stratum, revealed in 187d, with its fortifications and vases, and the hoard of gold, silver, and bronze objects, which the discoverer con-

1. Malta.

2. Gozo.

3. Eagusa.

4. Noto.

5. Palazzolo.

6. Leutini.

7. Licodia.

8. Maskarata.

9. Larisaa.

10. Dimini.

11. Delphi.

12. Daulis.

13. Orchomenos.

14. Thebes.

43. Mart.

15. Eleusis.

16. Menidi. IT. Athens.

18. Spata.

19. Thoricos.

20. Aegina.

21. Argos.

44. Nicosia.

22. Mycenae.

23. Heraeum.

24. Tivyns.

25. Kampos.

26. Vaphio.

27. Siphnos.

28. Phylakopi.

29. Syros.

80. Thera.

81. Phaestos.

82. Knossos.

83. Psychro. 34. Goalas. 85. Praesos.

45. Salamis.

86. lalysos.

87. Pitane.

88. Hissarlik.

89. Midas City.

40. Pteria.

41. Naxos.

42. Paphos.

Fig. 2. â€” Map Showing the DiSTRiBniiON or Mycenaean Civilization.

nected with it (though its relation to the stratification is doubtful still), made a stir, which was destined to spread far outside the narrow circle of scholars when in 1876 Schliemann lighted on the Mycenae graves. Like the ” letting in of water,” light at once poured in from all sides on the prehistoric period of Greece. It was estab- lished that the character of both the fabric and the decoration of the Mycenaean objects was not that of any well-known art. A wide range in space was proved by the identification of the inselsteine and the lalysos vases with the new style, and a wide range in time by collation of the earlier Theraean and Hissarlik discoveries. A relation between objects of art described by Homer and the jNIycenaean treasure was generally recognized, and a correct opinion prevailed that, while certainly posterior, the civilization of the Iliad was reminiscent of the great Mycenaean period. Schliemann got to work again at Hissarlik in 1878, and greatly increased knowledge of the lower strata, but did not recognize the Mycenaean remains in his ” Lydian ” city of the sixth stratum ; but by laying bare in 1884 the upper remains on the rock of Tiryns, he made a contribution to the science of

domestic life in the Mycenaean period, which was ampli- fied two years later by Tsountas’s discover^’ of the Mycenae palace. From 1886 dates the finding of Mycenaean sepulchres outside the Argolid, from which, and from the continuation of Tsountas’s exploration of the buildings and lesser graves at ^Mycenae, a large treasure, independent of Schliemann’s princely gift, has been gathered into the National jMuseum at Athens. In that year were excavated dome-tombs, most already rifled, at Arkiiia and Eleusis iu Attica,

at Dimini near Volo in Thessaly, at Campos on the west of Mount Taygetus, and at Maskarata in Cephalonia. The richest grave of all was explored at Vaphio in Laconia in 1889, and yielded, besides man3′ gems and miscellaneous gold- smiths’ work, two golden goblets chased with scenes of bull-hunting. In 1890 and 1893 Staes cleared out more homely dome-tombs at Thoricus in Attica ; and other graves, either rock-cut ” bee-hives ” or chambers, were found at Spata and Aphidna in Attica, in Aegina and Salamis, at the Heraeum and Nauplia in the Argolid, near Thebes and Delphi, and lastly not far from the Thessalian Larissa.

But discovery was far from being confined to the Greek mainland and its immediate dependencies. The limits of the prehistoric area were pushed out to the cen- tral Aegean islands, to Antiparos, to los, to Amorgos, to Syros and Siphnos, all of which are singularly rich in evidence of the pre-Mycenaean period. The series of Syran built graves, containing crouching corpses, is the best and most representative that is known in the Aegean. Melos, long marked as containing early objects, but not systematically excavated until taken in hand by the British School at Athens in 1896, shows at Phylakopi remains of all the Aegean periods. Crete has been proved by the tombs of Anoja and Erganos, by the ex- cavations on the site of Knossos begun in 1878 by M. Minos Kalokairinos and resumed with startling success in 1900 by Messrs Evans and Hogarth, and by those in the Dictaean Cave and at Phaestos, Goumia, Zakro, and Palaeokastro, to be prolific in remains of the prehistoric periods out of all proportion to remains of classical Hellenic culture. A map of Cyprus- in the later Bronze Age now shows more than five-and-twenty settlements in and about the Mesaorea district alone, of which one, that at Enkomi, near the site of later Salamis, has yielded the richest gold treasure found outside Mycenae. Half round the outermost circle to which Greek influence attained in the classical period remains of the same pre- historic civilization have been happened on. M. Chantre in 1894 picked up lustreless ware, like that of Hissarlik, in central Phrygia, and the English archaeological expe- ditions sent subsequently into north-western Anatolia have never failed to bring back ” Aegean ”

specimens from the valleys of the Ehyndacus and Sangarius, and even of the Halys. In Egypt Mr Petrie found painted sherds of Cretan style at Kahun in the Eayum in 1887, and farther up the Nile, at Tell el-Amarna, chanced on bits of not less than 800 Aegean vases in 1889. There have now been recognized in the collections at Gizeh, Florence, London, Paris, and Bologna several Egyptian or Phoenician imitations of the Mycenaean style to set off against the many debts which the centres of Mycenaean culture owed to Egypt. Two Mycenaean vases were found at Sidon in 1885, and many fragments of Aegean, and especially Cypriote, pottery have been turned up during the recent excavation of sites in Philistia by the Palestine Eund. South-eastern Sicily has proved, ever since Orsi excavated the Sikel cemetery near Lentini in 1877, a mine of early remains, among which appear in regular succes- sion Aegean fabrics and motives of decoration from the period of the second stratum at Hissarlik down to the latest Mycenaean. Sardinia has Mycenaean sites, e.g., at Abini near Teti; and Spain has yielded objects recog- nized as Mycenaean from tombs near Cadiz, and from Saragossa.

The results of three excavations will especially serve as rallying points and supply a standard of comparison. After Schliemann's death, Dorpfeld returned to Hissar- lik, and recognized in the huge remains of the sixth stratum, on the southern skirts of the citadel mound, a city of the same period as Mycenae at its acme. Thus we can study there remains of a later stage in one process of development superposed on earlier remains, after an inter- vening period. The links there missing are, however, apparent at Phylakopi in Melos, excavated systematically from 1896 to 1899. Here buildings of three main periods appear one on another. The earliest overlie in one spot a deposit of sherds of the most primitive type known in the Aegean and found in the earliest cist-graves. The second and third cities rise one out of the other without evidence of long interval. A third and more important site than either, Knossos in Crete, awaits fuller publication. Here are ruins of a great palace.

mainly of two periods. Originally constructed about 2000 B.C., it was almost entirely rebuilt at the acme of the Mycenaean Age, but substructures and other remains of the earlier palace underlie the later. The latter was built round a great central court, and was more than one storey high.

Stairways and galleries and fragments of the upper storeys remain, chiefly on the east side. The palace was not fortified. Numerous store galleries, sunken baths, and a room with stone throne and seats are the main architectural features. Much has been recovered of internal decoration in fresco, painted plaster relief- work, and carved stone ; and great variety of furni- ture in all materials, including objects which supply links with Egypt.

Since recent researches, some of whose results are not yet published, have demonstrated that in certain localities, for instance, Cyprus, Crete, and most of the Aegean islands, where Mycenaean remains were not long ago supposed to be merely sporadic, they form in fact a stratum to be expected on the site of almost every ancient' Aegean settlement, we may safely assume that Mycenaean civilization was a phase in the history of all the insular and peninsular territories of the east Mediter- ranean basin. Into the continents on the east and south we have no reason to suppose that its influence penetrated either very widely or very strongly. There has been much excavation in Egypt, but not half-a-dozen sites have yielded the characteristic pottery, not even sites near the Levant sea as thoroughly explored as Naucratis and Daphnae. About Syria and inland Asia Minor we must speak with more reserve ; but all research made hitherto suggests that there, as in Sicily, the peculiar products of the Mycenaean culture were sporadic im- portations. As to Thrace and Macedonia, as well as the Cyrenaic coast of Africa, there is no good evidence as yet available.

The remains that especially concern us here belong to the later period illustrated by these discoveries, and have everywhere a certain uniformity. Some common influence spread at a certain era over the Aegean area and reduced almost to identity a number of local civilizations of similar origin but diverse development. Surviving influences of these, however, combined with the constant geographical conditions to reintroduce some local differentiation into the Mycenaean products.

The Neolithic Age in the Aegean has now been abun- dantly illustrated from the yellow bottom clay at Knossos, and its products do not differ materially from those implements and vessels with which man has everywhere sought to satisfy his first needs. The mass of the stone tools and weapons, and the coarse hand-made and bur- nished pottery, might well

proceed from the spontaneous invention of each locality that possessed suitable stone and clay, but the common presence of flaked blades, arrow-heads, and blunt choppers of an obsidian native, so far as is known, to Melos only, speaks of inter-communica^ tion even at this early period between many distant local- ities and the city whose remains have been unearthed at Phylakopi. The wide range of the peculiar cist-grave strengthens the belief that late Stone Age culture ia the Aegean was not of sporadic development, and prepares us for a striking similarity in the succeeding ware with incised non-spiraliform geometric ornament which prevails oyer an area extending from Hissarlik to Sicily, and for the universality of a certain fiddle-shaped type of stone idol. Local divergence is, however, already apparent in the relative prevalence of certain forms; for example, a shallow bowl is common in Crete, but not in the Cyclades, while the pyxis, so common in the graves of Ajnorgos and Melos, has left little sign of itself in Crete ; and from this point the further development of civilization

in the Aegean area results in increasing differentiation. The Greek mainland has produced as yet very little of the earlier periods (the excavators of the Heraeum promise additions), but the primitive remains in the rest of the area may be divided into four classes of strong family likeness but distinct development.

The pottery supplies the best criterion, and will suflBce for our end. We have no such comprehensive and certain evidence from other classes of remains. Except for the Great Treasure of Hissarlik, and the vsreapons in Cycladic graves, there have been found as yet hardly any metal products of the period. Of the few stone products, one class, the ” island idols ” already referred to, was obviously exported widely, and supplies an ill test either of place or date. There have not been dis- covered sufiiciently numerous structures or graves to afford a basis of classification. Fortified towns have been explored in Melos, Siphnos, and the Troad, and a few houses in Aegina and Thera ; but neither unaltered houses nor tombs of undoubted

primitive character have appeared in Crete as yet, nor elsewhere than “in the Gyclad isles.

(1) Crete follows up the geometric incised ware with a painted geometric fabric developed out of it. This is made on the wheel, and covered with ‘dull glaze, mostly fired black to dull red, on which colour is applied. In fabric, form, and decoration it quickly develops so marked an individuality that, but for the predominance of certain peculiar vase-shapes found also in the Cyclades, it would not readily be known for an Aegean product at all. The walls of the vessels are often reduced to a metallic egg-shell consistency, and both the forms and the treat- ment of the clay surface are imitated with extraordinary fidelity from metallic, probably gold, fabrics, and the decoration, whether in sharply-moulded rings and protu- berances, incrustation, white spotting, or hard geometric painted lines and conventional plant forms, owes its origin to the metallurgist. This ware, known as “Kamares,” from a cave near a village on the south-east of Mount Ida, where it was first observed, but apparently to be found always between the primitive and the Mycenaean strata in Crete, is singular in the field of ceramics, and must owe its fully developed character to some peculiar influence, perhaps to the impression made on a people which did not possess the precious metals by some imported gold or silver fabrics.

(2) If the ware of Crete shows the paramount influence of metal, that of the central Cyclades shows the influence of hard stone. There the geometric incised linear orna- ment is developed into incised curvilinear of an elaborate kind â€” an advance which potters elsewhere, not accustomed to an intractable material, could achieve only by paint. At present Syra has yielded the best examples, but early sites exist in the marble islands, Naxos and Pares, and also in Siphnos, and the origin of the Syran forms and decoration will probably be found elsewhere.

(3) The volcanic isles of the southrwest, Thera and Melos, display the most orderly development of the art of working clay, unaffected by other materials, probably because good clay was readily procurable. Paint ap- pears on the grey body clay of vessels found at very low levels, and curvilinear colour schemes slowly replace rectilinear. Not hampered by the traditions of workers in stone or metal, the Melian and Theraean potters are

those that evolve the most suitable fabrics and shapes in earthenware, and earliest begin to adopt natural forms as motives of decoration. All kinds of vegetable schemes, most naturalistically treated, become characteristic of their school, and from those they pass to marine motives, fish, seaweeds, and the like, and finally to birds and even the human form.

(4) There remains the eastern Aegean, where vessels found in the Burnt City at Hissarlik, at one end, show strong affinity to those from early graves m Cyprus at the other. Here is a certain unmistakable Asiatic element. The use of the wheel and of slip and colour come in early, but the shapes develop towards the fantastic and grotesque, and the decoration makes no approach to nature. One would say that a race whose natural artistic capacity was free to develop m the western isles was either not itself present m the east- ernmost part of the area, or was quickly contaminated there by some strong alien influence. But such con- jectures as to history are very hazardous, while not only has very little of the Anatolian coast been explored, but the earlier sites in the great Sporades islands are unknown.

Here are indubitably distinct lines of local developinent, but there persists, nevertheless, an equally indubitable common character, which both binds all together into one family of civilization and distinguishes all from other con- temporary civilizations, for example, from those of the Nile or Mesopotamian valleys. To take one piece of evidence only. A certain form of beaked jug, called by German archseologists schnabelkanne (Fig. 3), is charac- teristic of the whole area from before the first introduction of the potter’s wheel to the end of the period. The shape is so peculiar that reason revolts against the suggestion of spon- taneous invention in divers places. It is found with the same inevitable certainty on Cretan sites as at Hissarlik.

Above the strata, however, which con- tain these remains of local divergent develop- ment, there lies in all districts of the Aegean area a rich layer of deposit, whose contents show a rapid and marked advance in civilization, are essentially uniform, and have only subsidiary characteristics due to local influence or tradition. The civilization there represented is not of an origin foreign to the area: The germs of all its charac- teristic fabrics, forms, and motives of decoration exist in the underlying strata, though not equally in all districts, and the change which Mycenaean art occasions is not always

equally abrupt. It is most reasonable to see in these remains the result of the action of some accidental influence which greatly increased the wealth and capacity of one locality in the area, and caused it to impose its rapidly developing culture on all the rest. The measure of the reaction that took place in divers localities there- after depended naturally on the point to which local civil- izations had respectively advanced in the pre-Mycenaean period.

The pottery, which supplies a voluminous com- mentary on the new period, is distinguished not only by the regularity of its forms, the purity of its clay, the smoothness of its slip, and the quality of its glaze, but especially by the general use of a peculiar paint, lustrous on properly prepared surfaces. Traces, however, of an earlier knowledge of that pigment have been found in Melos. Along with this ware, however, continued to exist ruder fabrics in common use. In the ware, found up to 1885 mainly at Mycenae, Furtwangler and Loschke distinguished four stages of development. At first greyish ware with dull white and red decoration

Fig. 3. â€” Schnabelkanne.

in a paint only slightly lustrous, because applied on the body clay. To this early class belong, for example, the vases found by Schliemann in the fourth and fifth graves of the Mycenae circle. Next a class with black-brown decoration on a white slip, found in Thera and the Heraeum and Spata graves. Thirdly, the acme of the style, a thin yellow ware of very pure clay with hard slip and decorated with paint highly lustrous. This pre-dominates at Mycenae, and prevails all over the area from Sicily to Cyprus. The decoration varies from brown through yellow to red, detail being often applied in white on a Surface polished by hand ; and it differs from the fourth and last class only in that its paint is more lustrous, its ground deeper in tint, and its glaze more brilliant. Of this fourth class lalysos in Rhodes has supplied good examples.

As to the decorative motives in vogue there is less uni- formity. The earlier Mycenaean vessels have curvilinear and generally spiraliform geometric schemes. These pass into naturalistic vegetable forms, and finally become in the finest typical vases almost exclusively marine â€” algse, octopods, molluscs, shells, in many combinations. Of the last kind is the most of the Ehodian ware, and

Fig. 4. â€” Bugelkanne.

that which lay thickly just below the surface at Phylakopi, and is not of Melian manufacture. On the native Cretan products with Mycenaean paint and slip vegetable schemes of strongly naturalistic character predominate, but marine motives are not absent. Everywhere animal, bird, and human forms are but seldom found. Man certainly appears very late, and in company with the Oriental motives which characterize the Spata objects. Insects, especially butterflies, become common, and when their antennae terminate in exquisite spirals decorative art is at the end of its progress.

The vase-forms become so numerous and various that only a reference to Furtwangler and Loschke's Formentafel will give any idea of them. All the later Greek shapes find their prototypes. One type alone must have special mention, since it is as characteristic of this period as the schnabelJcanne of the earlier. This is the pseudamphora or bugelkanne (Fig. 4), with false neck and a small spout projecting from the body of the vase. Originally the neck was open, and the subsidiary spout was introduced for convenience of drinking ; and the later evolution is so singular that it amounts to proof, if not of the common origin, at least of the common character of Mycenaean civilization. It is found everywhere in the area, made of various local clays, and it long survived into the " Geometric " or sub-Mycenaean period.

Not only in the continuous and universal com- mentary of painted earthenware, but in many other

media, we have evidence of " Mycenaean " art, but vary- ing in character according to the local abundance or variety of particular materials. We have reached an age when the artist had at his disposal not only terrarcotta, hard and soft stone, and wood, but much metal â€” gold, silver, lead, copper, bronze containing about 12 per cent, of tin alloy â€” as well as bone and

ivory, and various com- positions from soft lime plaster up to opaque glass. If it were not for the magnificent stone utensils, in the guise of lioness heads, triton shells, palm and lotus capitals, with spirals in relief and miniature shields for handles, which have come to light at Knossos, we should have supposed stone to have been a material used (except architecturally) only for such rude metallic- seeming reliefs as stood over the Mycenae gate and circle graves, or for heavy commonplace vases and lamps. We have discovered no large free statuary in the round in any material as yet, though part of a hand at Knossos speaks to its existence ; but figurines in metal, painted terrarcotta, and ivory, replacing the earlier stone idols, are fairly abundant. For these bronze is by far the commonest medium, and two types prevail; a female ,with bell-like or flounced divided skirt, and hair -coiled or hanging in tails, and a male, nude but for a loin-cloth. The position of the hands and legs varies with the skill of the artist, as in all archaic statuary. Knossos has revealed for the first time the Mycenaean artist's skill in painted plaster-relief (gesso durd). The life-size bull's head from the northern entrance of the palace and frag- ments of human busts challenge comparison triumphantly with the finest Egyptian work. And from the same site comes the fullest assurance of a high development of fresco-painting. Tiryns had already shown us a galloping bull on its palace wall, Mycenae smaller figures and pat- terns, and Phylakopi its panel of flying-fish ; but Knossos is in advance of all with its processions of richly-dressed vase-carriers, stiff in general pose and incorrect in outline, but admirably painted in detail and noble in type; and its yet more novel scenes of small figures, in animated act of dance or ritual or war, irresistibly suggestive of early Attic vase-painting. Precious fragments of painted trans- parencies in rock-crystal have also survived, and both Mycenae and Knossos have yielded stone with traces of painted design. Moulded glass of a cloudy blue-green texture seems to belong to the later period, at which carved ivory, previously rare, though found even in pre-Mycenaean strata, becomes common. The Spata tomb in Attica alone yielded 730 pieces of the latter material, helmeted heads in profile, mirror-handles and sides of coffers of Oriental- izing design, plaques with outlines of heraldic animals, and so forth. Articles in paste and porcelain of native manufacture, though often of exotic design, have been found most commonly where Eastern influence is to be expected ; for instance, at Enkomi in Cyprus. But the glassy blue composition, known to Homer as

kwi/os, an imitation of lapis-lazuli, was used in architectural orna- ment at Tiryns.

But it is in precious metals, and in the kindred tech- nique of gem-cutting, that Mycenaean art effects its most distinctive achievements. This is, as we have said, an age of metal. That stone implements had not entirely passed out of use is attested by the obsidian arrow-heads found in the circle graves, and the flint knives and basalt axes which lay beside vases of the full “Mycenaean” style at Cozzo del Pantano in Sicily. But they are survivals, unimportant beside the objects in copper, bronze, and precious metals. Iron has been found with remains of the period only as a great i;{irity. Some five rings, a shield boss, and formless lumps alone represent it at Mycenae. In the fourth circle grave occurred thirty-four vessels of nearly pure copper. SUver makes its appearance

before gold, and is found moulded into bracelets and bowls, and very rarely into figurines. Gold is more plentiful. Beaten, it makes face-masks, armlets, pen- dants, diadems, and all kinds of small votive objects; drawn, it makes rings whose bezels are engraved with the burin; riveted, it makes cups; and overlaid as leaf on bone, clay, wood, or bronze cores, it adorns hun- dreds of discs, buttons, and blades. Next to Mycenae in wealth of this metal ranks Enkomi in Cyprus, and pretty nearly all the tombs of the later period have yielded gold, conspicuously that of Vaphio. From the town sites, e.g., Phylakopi in Melos, and Knossos, it has disappeared almost entirely. Detached from the mass of golden objects which show primitive or tentative technique are a few of such elaborate finish and fineness of handiwork that it is hard to credit them to the same period and the same craftsmen. The Mycenae inlaid dagger-blades are famous examples, and the tech- nical skill which beat out each of the Vaphio goblets in a single unriveted plate has never been excelled. The goldsmiths seem not to have used acids. They imitate the doisonnie work of Egypt in pastes only, but repro- duce very beautifully the soldered bead patterns of the same land. In

general schemes of decoration metal fol- lows pottery. Linear ornament passes through vegetable to organic forms, mainly marine, which are finally stylized into heraldic conventions.

The intaglios in stone, work of the same class of artist as the ring bezels, are fashioned oftenest out of agates, among semi-transparent materials, and jaspers, among opaque. But finer stones, such as amethyst, are not in-frequent, and soft stones, like hasmatite and steatite, are also used. Rock-crystal seems to have been the most esteemed material. In shape the intaglios are lentoid, oval, or round. The subjects engraved are animals in various attitudes, single, combative, heraldically opposed, or held in human hands by the leg or neck. The lion, the bull, and various kinds of goat appear most often. Less commonly are seen human figures, men semi-nude, women in flounced skirts, sometimes seemingly in act of adoration before altars or aniconic divinities, sometimes engaged in combat. Rarer still are birds and fish and fantastic combinations like the griffon. On the commoner sort of stones we see geometric schemes, but very rarely vegetable. Impressions of gems bearing human portrait heads were found at Knossos, and the vast number of other clay impressions unearthed there and at Zakro confirms the theory that the use of these intaglios was primarily for sealing. They appear, from a Knossian fresco, to have been worn, among other places, on the wrist.

We are fortunate in possessing very considerable remains of all kinds of construction and structural ornament of the Mycenaean period. The great walls of Mycenae, of Tiryns (though perhaps due to an earlier epoch), and of the sixth layer at Hissarlik, show us the simple scheme of fortification â€” massive walls with short returns and corner towers, but no flank defences, approached by ramps or stairs from within and furnished with one great gate and a few small sally-ports. Chambers in the thickness of the wall seem to have served for the protection of stores rather than of men. The style of building is faced Cyclopean, tending towards polygonal, with ashlar coigns. The great central residences on the citadels are usually of what is known as the Megaron type ; that is to say, they consist of an outer court, from which a vestibule is entered across a massive threshold placed between antae, and a second and smaller threshold admits to a paved and columned hall with central hearth. Besides this, both at Tiryns and

Phylakopi, is found a second block of chambers enclosed by a distinct wall and

entered from a common passage, which is conjectured to have been the residence of the harem. The Cretan palaces at Knossos and Phaestos, however, are of much more complicated plan. Remains of much architectural decoration have been found in these palacesâ€” at My- cenae, frescoes of men and animals ; at Knossos, frescoes of men, fish, and sphinxes, vegetable designs, painted reliefs, and rich conventional ornament, such as an admirably carved frieze in hard limestone ; at Tiryns, traces of a frieze inlaid with lapis-lazuli glass, and also frescoes. The rough inner walls that appear now on these sites must once have looked very different. The smaller houses at Mycenae and Phylakopi consist of two or three rooms opening off a common passage, but at Zakro and Knossos more elaborate structures have been found containing ten or more rooms opening one from the other and from a central hall. Certain cham- bers at Knossos, paved and lined with gypsum, and two in Melos, have square central piers. These seem to have had a religious significance, and are possibly shrines devoted to pillar-worship. The houses of the great dead were hardly less elaborate. The ” Treasury of Atreus ” had a moulded faqade with engaged columns in a sort of proto-Doric order and marble facing ; and there is good reason to suppose that its magnificent vault was lined within with metal ornament or hanging draper- ies. The construction itself of this and the other ma- sonry domes bespeaks skill of a high order. Por lesser folk bee-hive excavations were made in the rock, and at the latest period a return was made apparently to the tetragonal chamber; but now it has a pitched or vaulted roof, and generally a short passage of approach whose walls converge overhead towards a pointed arch but do not actually meet. The corpses are laid on the floor, neither mummified nor cremated ; but in certain cases they were possibly mutilated and “scarified,” and the limbs were then enclosed in chest urns. There is evi- dence for this both in Crete and Sicily. But the order of burial which first made Mycenaean civilization known to the modern world continues singular. Similar shaft graves, whether contained within a circle of slabs or not, have never been found again.

The latest excavation has at last established beyond all cavil that the civilization which was capable of such splen- did artistic achievement was not without a system of writ- ten communication. Thousands of clay tablets (many being evidently labels) and a few inscriptions on pottery from the palace at Knossos have confirmed Mr A. J. Evans's previous deduction, based on gems, masons' and potters' marks, and one short inscription on stone found in the Dictaean Cave, that more than one script was in use in the period. Most of the Knossos tablets are written in an upright linear alphabetic or syllabic character, often with the addition of ideographs, and showing an intelligible system of decimal numeration. Since many of the same characters have been found in use as potters' marks on sherds in Melos, which are of earlier date than the Mycenaean period, the later civilization cannot be credited with their invention. Other clay objects found at Knossos, as well as gems from the east of Crete, show a different system more strictly pictographic. This seems native to the island, and to have survived almost to historic times ; but the origin of the linear system is more doubtful. No such tablets or sealings have yet been found outside Crete, and their writing remains undeciphered. The affinities of the linear script seem to be with the Asianic systems, Cypriote and Hittite, and perhaps with later Greek. The characters are obviously not derived from the Phoenician.

This Mycenaean civilization, as we know it from its remains, belongs to the Aegean area (i.e., roughly the Greek), and to no other area with which we are at

present acquainted. It is apparently not the product of any of the elder races which developed culture in the civilized areas to the east or south-east, much as it owed to those races. It would be easy to add to the singular vase-forms, script, lustrous paint, idols, gems, types of house and tomb, and so forth, already mentioned, a long list of Mycenaean decorative schemes which, even if their remote source lies in Egypt, Baby- lonia, or inner Anatolia, are absolutely peculiar in their treatment. But style is conclusive. From first to last the persistent influence of a true artistic ideal differen-

tiates Mycenaean objects from the hieratic or stylized products of Egypt or Phoenicia. A constant effort to attain symmetry and decorative effect for its own sake inspires the geometric designs. Those taken from organic life show continual reference to the model and a ” natu- ralistic grasp of the whole situation,” which resists con- vention and often ignores decorative propriety. The human form is fearlessly subjected to experiment, the better to attain lightness, life, and movement in its por- trayal. A foreign motive is handled with a breadth and vitality which renders its new expression practically independent. The conventional bull of an Assyrian relief was referred to the image of a living bull by the Elnossian artist, and made to express his emotions of fear or wrath by the Vaphio goldsmith, the Cypriote worker in ivory mirror handles, or the ” island-gem ” cutter.

Since we have a continuous series of links by which the development of the characteristic Mycenaean products can be traced within the area back to very primitive forms, we can fearlessly assert that not only did the full flower of the Mycenaean civilization proper belong to the Aegean area, but also its essential origin. That it came to have intimate relations with other contemporary civilizations, Egyptian, Mesopotamian, perhaps ” Hittite,” and early be- gan to contract a huge debt, especially to Egypt, is equally certain. Not to mention the certainly imported Nilotic objects found on Mycenaean sites, vases in grey granite and diorite, statuettes and fragments of porcelain and paste bearing hieroglyphic inscriptions and cartouches of Pharaonic personages, the later Aegean culture is deeply indebted to the Nile for forms and decorative motives. For example, the Cretan funerary uins are as Egyptian in shape as in their ornamental schemes of ducks chasing insects among the lotus plants. The same must be said of the Knossian frescoes of scenery. Only the treatment of the subjects on the Mycenaean dagger-blades is native; technique, and subject are alike borrowed. The beau- tiful spiral and lotus pattern, of which the Orchomenos ceiling gives the finest presentation, finds its prototype in Egyptian, not Boeotian Thebes. And so forth, through a long list of Mycenaean products, none the less of home manufacture and, in virtue of treatment, distinct in their kind.

At what epoch did Aegean civilization reach its full development ? It is little use to ask when it arose. A terminits a quo in the Neolithic Age can be

dated only less vaguely than a geological stratum. But it is known within fairly definite limits when it ceased to be a dominant civilization. Nothing but derived products of sub-Mycenaean style falls within the full Iron Age in the Aegean. Bronze, among useful metals, accompanies almost alone the genuine Mycenaean objects, atEnkomiin Cyprus, as at Mycenae. This fact supplies a terminus ad quern, to which a date may be assigned at least as precise as scholars assign to the Homeric lays. For these represent a civilization spread over the same area and in process of transition from bronze to iron, and if they fall in the 9th century e.g., then the Mycenaean period proper ends a little earlier, at any rate in the west. It is possible, indeed

probable, that in Asia Minor and Cyprus, where the de- scent of northern tribes about 1000 b.c, remembered by the Greeks as the ” Dorian invasion,” did not have any direct effect, the Mycenaean culture survived longer in something like purity, and passed by an uninterrupted process of development into the Hellenic; and even in Crete, where there was certainly a cataclysm, and in the Argolid, where art was temporarily eclipsed about the 10th century, earlier influence survived and came once more to the surface when peace was restored. Persistence of artistic influence under a new order, and differences in the artistic history of different districts widely sundered, have to be taken into account. The appearance, e.gr., of late Myce- naean objects in Cyprus, does not necessarily falsify the received Mycenaean dates in mainland Greece. For the main fact however, viz., the a^e of greatest florescence all over the area, a singular coincidence of testimony points to the period of the 18th Pharaonic Dynasty in Egypt, usually dated from the middle of the 18th to the end of the 16th century e.g. To this dynasty refer all the scarabs or other objects inscribed with royal cartouches (except an alabaster lid from Knossos, bearing the name of the earlier “Shepherd King,” Khyan), as yet actually found with true Mycenaean objects, even in Cyprus. In a tomb of this period at Thebes was found a bronze patera of fine Mycenaean style. At Tell el-Amarna, the site of a capital city which existed only in the reign of Amenhotep IV., have been unearthed by far the most numerous fragments of true “Aegean” pottery found in Egypt; and of that singular style, which characterizes Tell el-Amarna art, the art of the Elnossian frescoes is irresistibly suggestive. To the 18th and two suc- ceeding dynasties belong the tomb-paintings which

rep- resent vases of Aegean form; and to these same dynasties Mr Petrie's latest comparisons between the fabrics, forms, and decorative motives of Egypt and Mycenae have led him. The lapse of time between the 18th and the 10th centuries is by no means too long, in the opinion of most competent authorities, to account for the changes which take place in Mycenaean art.

The question of race, which derives a special interest from the possibility of a family relation between the Mycenaean and the subsequent Hellenic stocks, is a controversial matter as yet. The light recently thrown on Mycenaean cult does not go far to settle the racial problem. The aniconic ritual, involving tree and pillar symbols of divinity, which prevailed at one period, also prevaOed widely elsewhere than in the Aegean, and we are not sure of the divinity symbolized. Even if sure that itiwas the Father God, whose symbol alike in Crete and Caria is the lahrys or double axe, we could not say if Caria or Crete were prior, and whether the Father be Aryan or Semitic or neither. When it is remembered that, firstly, knowing not a word of the Mycenaean language, we are quite ignorant of its affinities ; secondly, not enough. Mycenaean skulls have yet been recovered to establish more than the bare fact that the race was mixed and not wholly Asiatic ; and thirdly, since identity of civilization in no sense necessarily entails identity of race, we may have to do not with one or two, but with many races â€" ^it will be conceded that it is more useful at present to attempt to narrow the issue by excluding cer- tain claimants than to pronounce in favour of any one. The facial types represented not only on the Knossian frescoes, but by statuettes and gems, are distinctly non-Asiatic, and recall strongly the high-crowned brachy- cephalic type of the modern northern Albanians and Cretan hi 11 men. Of the elder civilized races about the Levantine area, the Egyptians, Assyrians, and Babylonians may be dismissed at once. We know their art from beginning to

end, and its character is not at any period the same as that of Aegean art. As for the Phoenicians, for whom on the strength of Homeric tradition a strong claim has been put forward, it cannot be said to be impossible that some

objects thought to be Mycenaean are of Sidonian origin, since we know little or nothing of Sidonian art. But the presumption against tliis Semitic people having had any serious share in Mycenaean development is strong, since, facial types apart, the only scripts known to have been used in the Mycenaean area and period are in ho way affiliated to the Phoenician alphabet, and neither the characteristic forms nor the characteristic style of Phoe- nician art, as we know it, appear in Mycenaean products. The one thing of which recent research has assured us in this matter is this, that the Keftiu, represented in 18th Dynasty tombs at Thebes, were a ” Mycenaean ” folk, an island people of the northern sea. They came into intimate contact, both peaceful and warlike, with Egypt, and to them no doubt are owed the Aegean styles and products found on ISTile sites. Exact parallels to their dress and products, as represented by Egyptian artists, appear in the work of Cretan artists ; and it is now generally accepted that the Keftiu were ” Mycenaeans ” of Crete at any rate, whatever other habitat they may have possessed.

As to place of origin, central Europe or any western or northern part of the continent is out of the question. Mycenaean art is shown by various remains to have moved westwards and northwards, not vice versd. It arose within the Aegean area, in the Argolid as some, e.g., the Heraeum excavators, propose, or Crete, the Cyclades, or Ehodes ; or, if outside, then the issue is narrowed for practical purposes to a region about which we know next to nothing as yet, northern Libya, and to Asia Minor. So far as the Mycenaean objects themselves testify, they point to a progress not from south or west, but from east. In the western localities, notably Crete and Mycenae, we have more remains of highly developed Mycenaean civilization, but less of its early stages than elsewhere. Nothing in the Argolid, but much in the Troad, prepares us for the Mycenaean metallurgy. The appearance of Mycenaean forms and patterns is abrupt in Crete, but graduated in other islands, especially Thera and Melos. The Cretan linear script seems to be of ” Asianic ” family, and to be inscribed in Melos on sherds of earlier date than its appearance at Knossos. Following Mycenaean development backwards in this manner, we seem to tend towards the Anatolian coasts of the Aegean, and especially the rich and little-known areas of Ehodes and Caria.

It does not advance seriously the solution of the racial problem to turn to Greek literary tradition. Now that we are assured of the wide range and the long continuance of the influence of Mycenaean civilization, overlapping the rise of Hellenic art, we can hardly question that the early peoples whom the Greeks knew as Pelasgi, Minyae, Leleges, Dauai, Carians, and so forth, shared in it. But were they its authors ? and who, after all, were they themselves ? The Greeks believed them their own kin, but what value are we to attach to the belief of an age to which scientific ethnology and archaeology were unknown? Nor is it useful to select traditions, e.g., to accept those about the Pelasgi, and to override those which connect the Achaeans equally closely with Mycenaean centres. We are gradually learning that the classical Hellene was of no pure race, but the result of a blend of several racial stocks, into which those pre-existing in his land can hardly fail to have entered ; and if we have been able to determine that Mycenaean art was distinguished by just that singular quality of idealism which is of the essence of the art which succeeded it in the same area

(whatever be the racial connexion), it can scarcely be doubted in reason that Mycenaean civilization was m some sense the parent of the later civilization of Hellas. In fact, now that the Mycenaean remains are no longer to be regarded as isolated phenomena on Greek soil, but are seen to be intimately connected on the one hand with a large class of objects which carry the evolution of civiliza- tion in the Aegean area itself back to the Stone Age, and on the other with the earlier products of Hellenic development, the problem is no longer purely one ot antiquarian ethnology. We ask less what race was so greatly gifted, than what geographical or other circum- stances will account for the’ persistence of a certain peculiar quality of civilization in the Aegean area.

Authorities.â€” Sohliemann’s successive books (see Schlie- mann), summarized and reduced to order by C. Schuchhardt, Eng tr. Sohliemann’s Excavations, by E. Sellers. 1Â«91.â€” TsouNTAs and Manatt. The Mycenaean Age. 1897. An expan- sion of the first author’s Muk^i-oi.â€” Perrot and Chipiez. Mist, de VArt, vi. “La Grfece Primitive.“â€” W. Dorpfeld. Troja, 1893, about to be superseded by a comprehensive work by the same.â€” Dcmont and Chaplain. Les Ceramiques de la Grece Propre.â€” FuRTWANGLER and LbscHKE. Mykenische Vasen, with atlas.â€” British

Museum Excavations in Cyprus (for Enkomi).â€” .BrrtJs^ School Annual, iii.~~vii. (for Melos and Crete) . â€”Volume on Fhyla~~ kopi, published by Society for Promotion of Hellenic Studies. â€”J. L. Myres in Science Progress, vii.â€” W. Ridgewat. Early Age of Greece.â€” H. E. Hall. The Oldest Civilization of Greece.â€” C. Waldstein, &c. Volume on the Argive Heraevm.â€” W. Hel- BiG. La Question Mychiienne.â€” Articles by Tsountas and Evans in the Ephemeris Archaeologica and Journal of Hellenic Studies respectively since 1896. (p. G. H.)

Myelat, a division of the southern Shan States_ of Burma, including sixteen states, none of any great size, with a total area of 3723 square miles. The name pro- perly means “the unoccupied country,” but it has been occupied for many centuries. All central Myelat and great parts of the northern and southern portions consist of rolling grassy downs quite denuded of jungle. It has a great variety of different races, Taungthus and Danus being perhaps the most numerous. They are all more or less hybrid races. The chiefs of the Myelat are known by the Burmese title of Ngwekunhmu, i.e., chiefs paying their revenue in silver. The amount paid by the chiefs to the British Government is E,s.99,567. The largest state, Loi LSng, has an area of 1600 square miles, a great part of which is barren hills. The smallest, Nam Hkon, has no more than 4 square miles. The majority of the states have less than 100 square miles. Under British administration the chiefs have powers of a magistrate of the second class. The chief cultivation besides rice is sugar-cane, and considerable quantities of crude sugar are made and exported.

Myers, Frederic William Henry (1843- 1901), English poet and essayist, son of Frederic Myers of Keswick â€” author of Lectures on Great Men (1856) and Catholic TJiougJits (first collected 1873), a book marked by a most admirable prose style â€” was born at Keswick, Cumberland, on the 6th of February 1843, and educated at Cheltenham and Trinity College, Cam- bridge, where he won numerous honours, and in 1865 was appointed classical lecturer. He had no love for teaching, which he soon discontinued, but he took up his permanent abode at Cambridge in 1872, when he became a school inspector under the Education Department. Mean- while he published, in 1867, an unsuccessful essay for the Seatonian prize, a poem entitled St Paul, which met at the hands of the general public with a success that would be difficult to explain, for it lacks sincerity, and represents views

which the writer rapidly outgrew. It was followed by small volumes of collected verses in 1870 and 1882 : both are marked by a flow of

rhetorical ardour which culminates in a poem of real beauty, Â« The Eenewal of Youth," in the 1882 collection. His best verse is in heroic couplets. Myers is more

â– â– likely to be remembered by his two volumes of Essays, Classical and Modern (1883). The essay on Virgil, by far the best thing he ever wrote, represents the matured

. enthusiasm of a student and a disciple to whom the ex- quisite artificiality and refined culture of Virgil's method were profoundly congenial. Next to this in value is the carefully wrought essay on Ancient Gfreek Oracles (this had first appeared in Ilellenica). Scarcely less delicate in phrasing and perception, if less penetrating in insight, is the monograph on Wordsworth (1881) for Mr John Morley's "English Men of Letters." In 1882, after several years of inquiry and discussion, Myers took the lead among a small band of explorers (including the Sidgwicks and Mr Hodgson, Mr Gurney, and Mr Â¥. Pod- more), who founded the Society for Psychical Kesearch. He continued for many years to be the mouthpiece of the society, a position for which his perfervidum ingenium, still more his abnormal fluency and alertness, admirably fitted him. His proficiency in the neo-hermeneutic jargon evolved by the society excited the admiration of all who frequented the psychical meetings in Westminster town hall. He contributed greatly to the coherence of the society by steering a mid-course between extremes (the extreme sceptics on the one hand, and the enthusiastic spiritualists on the other), and by sifting and revising the cumbrous mass of Proceedings, the chief concrete re- sults being the two volumes of Phantasms of the Living (1886). Like many theorists, he had a faculty for ignor- ing hard facts, and in his anxiety to generalize plausibly upon the alleged data, and to hammer out striking formulae, his insight into the real character of the evi- dence may have left something to be desired. His long series of papers on Subliminal Consciousness, the results of which were embodied in a

posthumous work called Human Personality and its Survival of Bodily Death, con- stitute his own chief contribution to psychical theory, and this, as he himself would have been the first to admit, was little more than provisional. The last work published in his lifetime was a small collection of essays, Science cind a Future Life (1893) . He died at Rome on 17th January 1901, but was buried in his native soil, at Keswick. (t. se.)

Myingyan, a district in the Meiktila division of Upper Burma. It lies in the valley of the Irrawaddy, to the south of Mandalay, on the east bank of the river. Area, 3139 square miles. Population (1891), 361,861 ; (1901), 357,117, showing an increase of 1-49 per cent, and a density of 113 inhabitants to the square mile. There were 868 villages in 1898-99, paying Rs. 6,62,057 revenue. The greater part of the district is flat, especially to the north and along the banks of the Irrawaddy. Inland the country rises in gently undulating slopes. The most noticeable feature is Popa hill, an extinct volcano, in the south-eastern corner of the district. The highest peak is 4962 feet above sea-level. The climate is dry and healthy, with high south winds from March till Septem- ber. The total rainfall in 1898-99 was 35-28 inches, which was slightly above the average. The highest shade reading was 106Â° F. in May, and the lowest reading in the cold weather a little over 70Â°. The ordinary crops are millet, sesamum, cotton, maize, paddy, gram, and a great variety of peas and beans. The district as a whole is not well watered, and most of the old irrigation tanks had fallen into disrepair before the annexation. There are no forests, but a great deal of low scrub in the dis- trict. The lacquer ware of Kyaung-u and other villages near Pagan is noted throughout Burma.

The population was classified as follows in 1891 :â€” Buddhists and Jains, 348,667 ; Hindus, 1386 ; Mahommedans, 1213 ; Christians, 595. A considerable number of Chinese inhabit Myingyan and others of the larger villages. The net area cropped during 1898-99 was 251,190 acres, and 831,134 acres remained available for cultivation, while there were 276,473 acres of fallow. 650,000 acres are uncultivable out of the total acreage of 2,008,797. The headquarters town, Myingyan, stands on the Irravvaddy, and had a population in 1891 of 19,790. It is the terminus of the branch railway through Meiktila to the main line from Mandalay to Rangoon. The steamers of the Irrawaddy Flotilla Company also call here.

Myitkyina, the most northerly of the districts of Upper Burma in the Mandalay division. It was separated from the Bhamo district in 1895. The district is cut up into strips by comparatively low parallel ranges of hills running in a general way north and south. The chief plain is that of Myitkyina, covering some 600 square miles. To the east of the Irrawaddy, which bisects the district, it is low-lying and marshy. To the west it rises to a higher level, and is mostly dry. Except in the hills inhabited by the Kachin tribes, there are practically no villages off the line of the Irrawaddy. The Indawgyi lake, a fine stretch of water measuring 16 miles by 6, lies in the south-west of the district. A very small amoimt of cultivation is carried on, mostly dry cultiva- tion. The area under forest during ,1898-99 was 82,560 acres. Area, 10,640 square miles. Population (1891), 61,021 ; (1901), 67,149, showing an increase of 31-6 per cent, and a density of 6 inhabitants to the square mile. The people live in 139 villages, and pay Rs.67,767. The numbers of the Kachins in the hills were, however, very imperfectly known. The rainfall in 1898-99 was 74-07 inches. The headquarters town, Myitkyina, had in 1898 a population of 1623, including the garrison of 400 military police. It is the limit of navigation on the Irrawaddy, and is also the terminus of the railway from Rangoon and Sagaing.

Mymensirijgh, or Maimansingh, a district of British India, in the Dacca division of Bengal. It occupies a portion of the alluvial valley of the Brahma- putra, east of the main channel (called the Jamuna) and north of Dacca. The administrative headquarters are at Nasirabad, sometimes called Mymensingh town. Area, 6332 square miles. Population (1881), 3,055,237 ; (1891), 3,472,186 ; (1901), 3,917,460, showing an increase of 14 per cent, between 1881 and 1891, and of 12-8 per cent, between 1891 and 1901 ; average density, 619 persons per square mile. Classified according to religion, Ma- hommedans in 1891 numbered 2,396,800 ; Hindus, 1,045,566 ; Christians, 211, of whom 18 were Europeans ; aborigines, 29,609. The land revenue and rates in 1897-98 were Es.10,69,960 ; number of police, 695; number of boys at school (1896-1897), 62,534, being 22-4 per cent, of the male population of school-going age; registered death-rate (1897), 27-8 per thousand. The two staple crops are rice and jute. There are 20 jute presses, employing 1000 persons, with an out-turn of 680,000 bales, valued at Rs.25,00,000. A branch line of the Eastern Bengal railway, running north from Dacca to jSTasirabad, will ultimately connect, through Jamalpur, with

Jagannathganj on the jnain stream of 4he Brahmaputra. The district was severely affected by the earthquake of 12th June 1897, which destroyed the church and high school at Nasirabad, and damaged even the solid buildings.

Myriapoda. â€” In Professor Moseley's article on the Myriapoda, in vol. xvii. of this work, the relationship was mentioned which the class bears to the Insecta. Much work has since been done, especially in the department of embryology, and several eminent naturalists have ex- pressed the opinion that the class Myriapoda, which has

Mtlierto been considered a homogeneous group, should the exterior of the yolk ; while the hypoblast is represented be broken up; and that of its two larger sub-classes, by the cells still remaining in the yolk at the close of seg- the Chilopoda should be joined with the Hexapoda, the Diplopoda being left by themselves under the original class- name. Mr Pocock proposes to give to the Diplopoda, Scolopendrellidse, and Pau- ropoda the name of Progoneata, and to the Chilopoda and Hexapoda the name of Opisthogoneata. A few of the princi- pal differences between Chilopoda and Diplopoda which have led to this view may be mentioned : â€”

proctoSisinjt â€¢ â€” 'â€¢â€¢ veniraLJTBoatm-

stamodjjtvm â€¢

'siqinijcesaphiigetiL- qnjwljLcm.

(1) The mouth parts cannot satisfactorily he homologized in these two sub-classes ; (2) the form of the somites is different, the sternum in Chilopods being wide and in Biplopods compressed, while the sectional form of Diplopoda is cylindrical and that of Chilopoda flattened dorsoventrally ; (3) the stigmata and trachea are simpler in Diplopods than in Chilopods ; (4) there are no foramina re- pugnatoriain Chilopods (except in very rare cases) ; (5) tlie reproductive organs open in Chilopoda in the posterior region of the body, and in Diplopoda in the anterior. In Chilopods the generative

organs are dorsal, in Diplopods ventral. In Diplopods the gonad is unpaired and opens hy two ducts, iu Chilopods it is paired and opens hy a single duct ; (6) the nerve-cord in Chilo- poda is double (Fig. 2), and is only united at the ganglia, and in Diplopoda the two cords are fused together.

Of these differences some tend to show a closer relationship to the Hexapoda ; â€” (1) the mouth parts of the Chilopods can be homologized with those of Hexapods ; (2) the stigmata and the traohefe in their complexity show a likeness to those of Hexapods ; (3) the terminal opening of the generative tube and the junction of two ducts to form a single tube furnish a resemblance to Hexapods. On the other hand, it may be urged that the different number of legs to each segment cannot be reckoned as a real difference, as both embryology and palaeontology show that the so-called double segments of Diplopoda are not double in reality, but are double segments imperfectly fused. Further, the differences in the width of the sternal region, and in the separation of the nerve cords, are bridged over by the embryonic form of the Diplopoda and by the adult Polyxenus. The form of the young Chilopod is cylindrical in section. The junction of the two generative ducts to form a single tube is not without exception in Hexapoda.

Thus the position of the generative tube and its open- ing is left as the chief character on which to found the new arrangement, and more evidence appears to be re- quired before the groups should be described as proposed. As regards the claims of Scolopendrella to form a link between the Chilopoda and Insecta, the opinions as to its position are very conflicting. A Chilopod has been de- scribed by Pocock, the structural peculiarities of which link together the Scolopendroid and Lithobioid forms. He has named it Craterostigmus. It resembles the Litho- biomorpha and differs from the Scolopendromorpha in the form of the poison claws, in the coxa of the 15th pair, in the presence of 6 pairs of stigmata on the 3rd, 5th, 8th, 12th and 14th segments, and in the possession of a single eye. Germatohms, another Chilopod discovered since Professor Moseley wrote, has its stigmata in a more dorsal position than Lithobius, and forms a link between Lithobius and Scutigeridae.

We will now consider the chief points which have been worked out by later investigators in the embryology of the class.

In the Diplopoda the segmentation of the ovum is partial. In Julus moreletti the surface is marked by furrows corresponding with the segments, but in Jnlas terrestris this is not the case. The mesoblast is formed from a keel-like thickening of the ventral surface of the blastoderm, the epiblast by the layer of cells surrounding

^mesdbVist ceS

^Tierve gangtum.

Fig. 1. â€” Section through twelfth-day Julas.

mentation. In the first formatio7i of the embryo, the soroites are formed in order from before backwards. The ventral flexure takes place in Julus when the antennae, the mouth parts, and three pairs of legs are formed. In Strongylosom a the ventral flexure is formed much earlier, before the ap- pearance of the antennae, and the furrow is not so deep as in Julus. In Polyxenus it is somewhat deeper. In the nervous system (Fig. 1) the cerebral ganglion arises as a thickening of the cephalic lobes, and is split off from the epiblast. In Jti lus two pits are formed in the cephalic lobes, a process which is probably connected with the formation of the optic ganglion. The ventral chain arises as two thickenings in the middle ventral line of the epiblast, partially divided by a furrow. The ganglia are formed as thickenings on the cord. The ganglia in the young Diplopoda are more widely separated than in the adult. The generative oi-gans are formed from the somatic part of the primitive segments. The coelom-sacs fuse in the middle line, and each coelom-sac fuses with the one behind, so as to form the long generative tube. In the digestive system (Fig. 2) the formation of the proctodteum and stomodseum takes place much earlier than that of the mid-gut. The former structures are epiblastic and are formed by invagination, while the latter arises as an accum- ulation of the cells remaining in the yolk. The Malpighian tubes are formed as evaginations of the proctodaeum. The heaH is formed by the cells remaining in the yolk. These arrange themselves in the pseudo-coele so as to form a tube, which is at first imperfectly closed, but gradually becomes firmer and more perfect, leaving, however, unclosed spaces which afterwards become the ostia. A pericardial sinus beneath the heart is formed by the same cells. The trachea appear late in the development. In Julus they begin as pit- like invaginations

of the epidermis as soon as the animal is hatched. The eye in Juhis begins as a thickening of the epidermis in which pigment is deposited. Then a cav'ity is formed in the thickened part, so that the whole appears as an optic vesicle. As the cavity increases the internal wall becomes thin and the external thick. The internal repre- sents the retina and the external the lens. A further dis- covery in the development of the Diplopoda, made by Verhoeff, is of the greatest interest. Professor Moseley

drew attention to the peculiar shape of the first pair of legs in the male JiUus. Dr C. Yerhoeff discovered that

artery

heart

overlof^rijw symsnt

<—Jal body

urutyestedfoodin^^ 'tz^tv^ cord

Fig. 2. â€" Section through jQst-faatched Lithoblus.

there is a stage of development in which the immature animal has a complete pair of legs in place of the hook- like legs of the mature animal. This immature or larval stage differs from the mature stage in three points : in the shape of the cheeks, in the form of the first pair of legs, and in the shape of the copulatory organ. He calls the immature or larval stage the "-status medius," and the animal the larva {schali-milnnchen). He compares this stage in Jlyriapoda to the subimaginal stage in Insecta. In the Chilopoda the structure of the ovum and the segmentation have been worked out in Geophilus ferrvgi- neus, and resemble those in the Diplopoda except that tlie process of segmentation is extended in a greater degree to the yolk, the latter as well as the surface be- ing divided into yolk-pyramids, which,

however, are con- nected at the centre. A ventral keel is formed as in the Diplopoda. The smaller cells of the ventral surface mark out the germinal streak at the end of which the cephalic lobes are formed. The somites are marked off by constrictions from before backwards. The anus is formed very early in the development of Geophilus, the mouth much later. The ventral flexure is formed when a considerable number of somites are present. The de- velopment of Scolopendra cingiilata and Sc. Dalmatka has been worked out very carefully by Heymons. The segmentation is a modified form of epibole, the yolk-free mieromeres surrounding the yolk-laden macromeres. The coelom arises by splitting of the mesoderm, and the eoelom sacs are not enterocoelic. The brain consists of a prae-oral syncerebrum and three pairs of post-oral gang- lia. The head in Diplopoda, Chilopodaj and Insecta consists of the acron united to six posterior metameres. The lymphatic bands of the adult are the representatives of the nephridia of Annelids, and the cephalic lymph bodies are equivalent to the green glands of Crustacea. The coelom extends into the dorso-lateral regions, and sends a diverticulum to the upper part of the legs. The generative organs are formed from the upper part of the dorso-lateral coelom on either side, which unite in the middle line. The heart and vascular system are derived from the schizocoele. For a long time there is a zone of undifferentiated tissue between the 30th metamere and the telson, which zone is homologous with the zone of budding in other forms. There are a series of invagina- tions connected with the formation of the nervous system which resemble the ventral organs of PeripoUus.

Fossil Myriapods have been divided into four orders : (1) Pkotostxgxatha, (2) Abchipolypoda, (3) Chilo- poda, (4) Diplopoda. The first two of these orders differ considerably from those of the present day. The Protosyngnatha have ten somites ; the body is cylindrical in section ; the head, bearing antennae and mouth parts, shows no signs of segmentation ; bundles of bristles are arranged in longitudinal rows along the back. There is a single dorsal and a single ventral plate to each segment, the dorsal and ventral plates being of equal breadth. There is a wide space between the base of the leg on one side and the base of the leg on the opposite side. The Archipolypoda have legs on every somite, no somite be-

Fio. 3.â€”Palâ,¬eocampa anthrax. (From the Cambrid{fe Xatural History, by permission of Messrs Macmillan.)

ing apodous. The dorsal plates are more or less per- fectly divided, the divisions corresponding with the pairs

Fig. 4. â€” Acantherpeistes major. A, Whole animal ; B, Branchiaa on ventral sur- face. (From the Cambridge Natural SUtory, by permission of Messrs Mac- millan.)

of legs. The ChHopoda and Diplopoda bear a great resemblance to those of the present day.

1. Protosyngnatha. Falasocampa anthrax (Coal) (Fig. 3).

2. Akchipoltpoda. Fams.: â€” (1) Archidesmidae (Old Red Sand- stone) ; (2) Euphoberidse (Coal), Acantherpestes major (Fig. 4), and A. inmqualis, Euphoberia (with nine species) ; (.3) Archijulidae (Coal), Archijulus, Xyloiius., Mazorms.

.3. Chilopoda. Fains.: â€” (1) Gerascutigeridse (Coal), resembling Soutigeridse ; (2) Eoscolopendridse (Coal), Eileticus, Anthracimis, Aegualis, Ilyodes, Palanarthrus ; (3) Lithobiidae ; (4) Scolo- pendridae; (5) Schizotarsia; (6) Geophilidae. The last four are mostly from amber.

4. Diplopoda. Fams. : â€” (1) Glomeridae (Amylispes may belong here) ; (2) Polydesmidae ; (3) Lysiopetalidse ; (4) Craspedosomidae ; (-5) Julidae; (6) Polyxenidse. These are mostly from amber; Julopsis cretacea, from the chalk of Greenland.

The Carboniferous fossils discovered by Scudder have completely altered our ideas as to the age of the Chilo- poda. Before his discovery the earliest Chilopoda had been found in amber ; now we know that they extended back into the Carboniferous times. The fossil forms show a certain approximation between the Chilopodous and Diplopodous forms of the present day in the following particulars : (1) the number of legs to each somite, the Archipolypoda having the dorsal segment more or less perfectly divided, thus agreeing with the facts of embry- ology; (2) the cylindrical

shape of the body, a feature that is also paralleled in the embryological history of the two stocks ; (3) the wide sternal region which, as has been said before, is reproduced in the embryology of Juhis.

MYSORE

Good bibliographies of the subject may be found in Latzel. Die Myriapoden der Oesterzeich-XJngarischen Monarchies 1884. â€” ZiTTEL. Handbuch der Palaeontologie. Munich, 1885. â€” KoRscHELT and Heidek. Lehrbuch der Vergleichenden Entwick- lungsgeschichte. Jena, 1890. (f. g. s*.)

Mysore, a native state of Southern India, in political relations with the Governor-General. Owing to the mis- government of the chief, the British assumed the admin- istration in 1831. On his death in 1868, his adopted heir was recognized ; and in 1881, when he had reached the age of eighteen, full powers of government were granted to him, subject to conditions specified in the ” instrument of transfer.” One of these conditions was that the civil and military station of Bangalore should remain under British administration. The new raja, who proved alto- gether worthy of the confidence placed in him (see be- low), died in 1894, and was succeeded by his son, then aged ten years. During his minority the maharani acted as regent, while the administration was conducted by the Diwan, assisted by a council.

The total area of the state is 27,936 square miles, subdivided into 9 districts. Population (1881), 4,186,188 ; (1891), 4,943,604 ; (1901), 5,538,482, showing an increase of 18 per cent, between 1881 and 1891, and of 12 per cent, between 1891 and 1901 ; average density, 198 persons per square mile, ranging from 343 in Bangalore district to 124 in Chitaldrug. Classified according to religion, Hindus in 1891 numbered 4,639,127 ; Mahommedans, 252,973; Christians, 38,135; Jains, 13,278; “others,” 91. The proportion of Hindus (93-8 per cent.) is larger than in any province of India, showing how ineffectual was the compulsory persecution of Haidar and Tippu. The Christians largely consist of the garrison at Bangalore, the families of military pensioners at the same town, coffee-planters and gold-miners. The finances of the state have been very successfully managed

under native rule, assisted by large profits from railways and gold-mines. The income and expenditure (in tens of rupees) for 1897-98 were : â€” income, Rx.1,915,972 ; expenditure, Rx.1,855,090. In accord- ance with the “instrument of transfer,” Mysore pays to the British Government an annual tribute of Rs.35,00,000, as a contribution to military defence ; but the full amount was not exacted until 1896. The state maintains a military force, consist- ing of two regiments of silladar cavalry and three battalions of infantry ; total, about 4000 men ; and also an imperial service transport corps. An interesting political experiment has been made, in the constitution of a representative assembly, which meets annually for the purposes of discussion, without any legis- lative power. Since 1891 this representative assembly has been elected by local boards and other public bodies. In 1897 the session lasted for five days. The number of members present was 275, of whom 252 were Hindus. The Diwan, as usual, presented a formal report on the administration of the year ; and no less than 500 subjects are said to have been discussed. The industry of coffee-planting is not in a flourishing condition, the area under coffee showing no increase during the last ten years of the 19th century. In 1897 the total number of acres was 126,876, com- pared with 141,528 in the preceding year. Of this total, about one-third belongs to European planters. The annual out-turn of gold from the Kolar mines is about 500,000 oz. (j. s. Co.)

Chamarajendka Wadiab Bahadur, Maharaja of Mysore (1862-1894), was the adopted son and successor of Maharaja Krishnaraj, into whose hands as a child the British Company had, after the final defeat of Tipu Sultan, restored the greater part of the territories of Mysore. When Krishnaraj eventually took over the management of his state from his minister Purnaiya in 1812, he received an orderly and contented principality with a surplus of two crores of rupees. Within twenty years he had driven his subjects into rebellion and in- , volved himself and his state in heavy debt. The British Government therefore assumed the government in 1831, and placed it in the hands of commissioners. The reve- nues in 1832-33 amounted to 55 lakhs ; in 1862 they had reached 100 lakhs, in 1881 they grew to 107 lakhs, and in 1894 to 179 lakhs. In 1862 no less than 88 lakhs of state debts and of the Maharaja’s own liabilities had been liquidated. The entire administration had been

reformed, a revised system of land revenue introduced, and many public works executed. The maharaja there- fore pressed his claims to a restoration of his powers, but Lord Canning and the British Government refused the application as incompatible with the true interests of the people of Mysore, and as not justified by any treaty obligation. In the same year Chamarajendra was born of the Bettada Kote branch of the ruling house, and m June 1865 Maharaja Krishnaraj adopted him as his son and successor, although he had been informed, m March 1864, that no adoption could be recognized except to his own private property, already once more heavily weighted with private debts. The maharaja then renewed his request for the recognition of his adopted son, but it was again declined in 1865. In 1867 the policy of Govern- ment underwent a change, and it was determined to secure the continuance of native rule in Mysore by acknowledging the adoption upon certain conditions which would secure to the people the continued benefits of good administration enjoyed by them under British control. The old maharaja died on 27th March 1868, and Chamarajendra Wadiar was publicly installed as the future ruler of Mysore on 23rd September 1868. His education was taken in hand, abuses which had grown up in the palace establishment were reformed, the late maharaja's debts were again paid off, and the whole internal administration perfected in every branch during the minority. Oh the 25th March 1881 Maharaja Char marajendra, having attained the age of 18 years, was publicly entrusted with the administration of the state. He made over to the British Government, with full juris- diction, a small tract of land at Bangalore, forming the "civil and military station," and received in return the island of Seringapatam. But the most important incident of the change was the signing of the "instrument of transfer," by which the young maharaja, for himself and his successors, undertook to perform the conditions imposed upon him. To that agreement the maharaja steadfastly adhered during his reign, and the instru- ment is a landmark in the history of British relations with the protected states of India. The maharaja's first minister was Ranga Charlu, who had been trained in the British administration of Mysore. He signalized the restoration of native rule by creating a " Representative Assembly," composed of 350 representatives of all classes of the community, who, in the absence of special cause, such as plague, meet annually to hear an account of the state administration for the previous year. The assembly has no power to enact laws, to vote supplies,

or to pass any resolution binding upon the executive. But it gives to the leading men of the districts a pleasant opportunity of visiting the capital, and to a limited extent brings the force of public opinion to bear upon the minister. In 1883 Sheshadri Aiyar succeeded Ranga Charlu, and to him Mysore is indebted for the extension of railways and schemes of irrigation, the development of the Kolar gold- fields, and the maintenance of the high standard of its ad- ministration. The maharaja showed his loyalty by placing two regiments of cavalry at the disposal of the Government of India for imperial service. He died at Calcutta, 28th December 1894, universally regretted and beloved by his subjects. His eldest son, Krishnaraj \Vadiar, born in 1884, succeeded him, and his widow, Maharani Vanivilas, was appointed regent. Chamarajendra set the first ex- ample to India of a constitutional ruler. He was faith- ful to the terms of the instrument of transfer, contributing a subsidy in lieu of military service, granting facilities for British railways and cantonments, accepting the British coinage and postal system, readily conceding to the para- mount Power extradition and foreign jurisdiction-, main- taining the laws, regulations, and settlements introduced

by the British administration, and leaving his foreign relations and any serious internal difficulties to the arbit- rament of the British Government. The restoration of native rule to him marked the final abandonment of the annexation policy, and the instrument of transfer sum- marizes the obligations of a protected state to the British protecting power. (w. L.-vf.)

Mytilene, or Mitilini (classical Lesbos), an island of the Aegean, forming the main part of a sanjak in the Archipelago vilayet of European Turkey. It is divided into the three districts of Mytilene or Kastro, Molyvo, and Kalloni ; and the chief towns are Mytilene (15,000) in the east, Molyvo (3000) in the north, Sigri in the west, and Kalloni on the Gulf of Kalloni. The ports are Sigri, Longone in the south, and Olivier near Mytilene. Vessels of large draught cannot enter any of the ports, but there is good anchorage outside. The valleys are fertile, and on the higher grounds there is pasturage for numerous sheep. Oxen are kept mainly for draught, and

about 7000 cattle are annually imported from the Ana^ tolian coast for food supply. The native horses are small, and transport is effected mainly by mules, of which large numbers are bred for sale. The fisheries are of consider- able importance, especially sardines. The main industry, however, is the pressing of olives in the production of olive oil, there being 45 steam-pressing establishments, and about 100 oil mills worked by hand. The annual value varies greatly according to the season, sometimes

amounting to nearly Â£200,000, and sometimes falling below Â£100,000; in 1900 it was Â£400,000. The industry of next importance is the manufacture of soap. Valonea is obtained in the northern part of the island, but only of second-rate quality. Figs and grapes are grown, but hardly in greater quantities than suffice for home consump- tion. The roads throughout the island were re-made in 1889. There is telegraphic communication on the island, and communication with the mainland by cable to Aivati on the Anatolian coast. In 1900 the number of steam- ships that entered and cleared was 1182 of 536,326 tons, as compared with 1324 of 696,106 tons in 1898 ; the number of sailing vessels in 1900 was 3299 of 30,345 tons, as compared with 3042 of 38,148 tons in 1898. The chief exports are olive oil (Â£119,000 in 1900), soap, valonea, skins, dried figs, and fish (principally sardines). Average rainfall for ten years ending 1899, 24-57 inches. The town of Mytilene is built in amphitheatre shape round a small hill crowned by remains of an ancient fortress, and contains 14 mosques and 7 Christian churches, one of which is the cathedral. It possesses flour-mills, oil- works, soap-works, potteries, tanneries, and cement-works, and has a large shipping-trade. Population of the sanjak (1890), 107,283, of whom 92,700 were Greek Orthodox, 13,712 Mussulmans, and the remainder Catholics, Jews, and Armenians ; (1901), 130,000.

Myxoedema. See Pathology (Metabolic Dis- eases).

Nabha, a native state of India, within the Punjab. Area, 936 square miles. Population (1881), 261,824 ; (1891), 282,756 ; (1901), 297,949, showing an increase of 8 per cent, between 1881 and 1891, and oi 5-4 per cent, between 1891 and 1901 ; average density, 318 persons per square mile. Estimated gross revenue, E.s.7,00,000 ; military force (including police), 1818 men ;

no tribute. The raja's imperial service troops did good service during the Tirah campaign of 1897-98. The territory is crossed by the Eajpura-Bhatinda railway, and irrigated by the Sirhind canal ; and the state revenues contributed to the construction of both these worts. In 1896-97 the number of schools was 24, with 958 pupils ; the pro- portion of boys at school was 1 out of 162 of the male population.

The town of Nabha has a station on the Eajpura-Bhatinda railway. Population (1881), 17,116.

Nabua, a town in the extreme southern portion of the province of Ambos Camarines, Luzon, Philippine Islands. It is situated in the district known as La Ein- conada, on account of its inaccessibility, and is the centre of a large, level, and fertile agricultural region, which produces rice, Indian corn, sugar, and pepper in abund- ance. The marketing of agricultural products is, however, interfered with by the difficulties of communication. The language is Bicol. Population, 17,000.

Nachod, a town in Bohemia, Austria, on the Mettau river, at the entrance of the Lewin-Nachod pass, about three miles from the Prussian frontier. The old castle contains a collection of historical paintings and archives, and in the town hall there is a small museum. The castle, which has been the property of the Prince of Schaumburg-Lippe since 1864, was presented to Ostavian Piccolomini in 1634. The important engagements fought near the town on the 27th and 28th of June 1866 opened Bohemia to the victorious Prussians. There are coal- mines in the neighbourhood ; and the industry comprises

cotton-spinning, dyeing, and bleaching. Population (1890), 6364 ; (1900), 9899, chiefly Czech and Catholic.

Nachtigal, Custav (1834-1885), German explorer, son of a Lutheran pastor, was born at Eichstedt in the Mark of Brandenburg, on 23rd February 1834. After a course of medical study at the universities of Halle, Wtirzburg, and Greifswald, he practised for a few years as a military surgeon. Being of a weakly constitution, and finding the climate of his native country injurious to health, he repaired to Algiers and Tunis, and took part, in the capacity of surgeon, in several expeditions into the interior of Africa. Commissioned by

the king of Prussia to carry conciliatory gifts to the sultan of Bornu, he set out in 1869 from Tripoli, and succeeded after two years' journeyings in accomplishing his mission. From Bornu he extended his travels to Baghermi, and proceed- ing by way of Wadai and Kordofan, emerged from darkest Africa, after having been given up for lost, at Khartum in the winter of 1874. His journey, graphically described in his Sahara and Sudan (1879-89), was eminently valuable in its fruits, and placed the intrepid explorer in the front rank of discoverers. On the annexation of Tunis by France, Nachtigal was sent there as consul-general for the German empire, and remained there until 1884, when he was despatched by Prince Bismarck to West Africa as special commissioner, ostensibly to inquire into the condition of German commerce, but really to annex territories to the German flag. On his return voyage he died at sea off Cape Palmas on 20th April 1885, and was buried at Grand Bassa. His remains were later exhumedandconveyedforintermentto German Cameroon. In spite of his weak physique, Nachtigal was a daring, resourceful, and strong-willed man, while his amiability, straightforwardness, and modesty made him universally beloved and respected.

Naden, Constance Caroline Woodhill

(1858-1889), English author, was born at Edgbaston, 28th

January 1858, her father being an architect. Her mother died just after the child's birth, and Constance was brought up in the home of her grandfather, Mr Woodhill, a retired jeweller. She was a clever girl and quick at learning, and was interested in modern culture in all its forms, artistic, scientific, and philosophical. In 1881 she published Sotigs and Sonnets of Springtime; in 1887 A Modern Apostle, and other Poems. Her poems made such an impression on Mr Gladstone that he included her, in an article in the Speaker, as one of the foremost English poetesses of the day. After her grandfather's death Miss Naden found herself a rich woman, and she

travelled in the East and then (1888) settled in London. But on 23rd December 1889 she died, as the result of an operation. Since 1876 she had paid increasing atten- tion to the study of philosophy, with her friend Dr Lewitis, and the two had formulated a system of their own, which they called ” Hylo-Idealism,” and which after Miss Naden’s death aroused some little discussion. Her main ideas on the subject are contained in a post-humous volume of her essays {Induction and Deduction, 1890), edited by Dr Lewins.

Nadia, or Nitddea, a district of British India, in the Presidency division of Bengal. The administrative headquarters are at Krishnagar. Area, 2982 square miles. Population (1881), 1,662,795 ; (1891), 1,644,108 ; (1901), 1,667,990 ; average density, 559 persons per square mile. Classified according to religion, Hindus in 1891 numbered 689,224 ; Mahommedans, 947,390 ; Chris- tians, 7297, of whom 106 were Europeans ; ” others,” 197. The land revenue and rates in 1897-98 were Rs.9,62,339 ; number of police, 721 ; number of boys at school (1897), 30,708, being 25-5 per cent, of the male population of school-going age ; registered death-rate (1897), 26 per thousand. The chief industry is indigo. There are 47 factories, employing 7000 persons, with an out-turn of 2400 mauuds, valued at lv.s.4,30,000. The district is traversed for about 100 miles by the main line of the Eastern Bengal railway, leading to the river port of Kushtia, and onward to Darjeeling; and a branch to Krishnagar has been opened. The three so-called “ISTadia rivers” â– â€” the Bhagirathi, the Jalangi, and the Matabhanga â€” carried in 1897-98 a total traffic in country boats valued at Es.1,50,78,428.

Naegeli, Karl Wilhelm von, Swiss botanist (1817-1891), was born on 27th March 1817, near Zurich. He early devoted himself to the study of botany, which he pursued for a time under A. P. de Candolle at Geneva, and graduated with a botanical thesis at Ztirich in 1840. His attention having been directed by Schleiden, then professor of botany at Jena, to the microscopical study of plants, he engaged more particularly in that branch of research. Soon after graduation he became privat-docent, and subsequently professor extraordinariiis, in the Uni- versity of Zurich : in 1852 he was called to fill the chair of botany in the University of Ereiburg-in-Breisgau; and in 1857 he was promoted to Munich, where he remained

as professor until his death on 11th IMay 1891. Among his more important contributions to science were a series of papers in the Zeitschrift filr ivissenschqffliche BotaniJc (1844-46) ; Die neuern Algensysteme (1847) ; and his Gattuitgen einzelliger Algen (1849) ; his Pflanzen- physiologische UntersuchHiir/en (1855-58), with Cramer; his Beitrdge zur wissenscluiftUdieu Botanih (1858-68) ; a number of papers contributed to the Royal Bavarian Academy of Sciences, forming three volumes of Botan-isclie Mitteilungen (1861-81) ; and, finally, his volume, Mechanisch-pliysiologische Tlieorie der Abstammungslehre, published ia 1884.

The more striking of his many and varied discoveries are embodied in the ZeitscJi. fiir wiss. Bat. In this we begin with Naegeli's extension of Robert Brown s dis- covery of the nucleus to the principal families of Crypto-gams, and the assertion of its universal occurrence in plants, together with the recognition of its vesicular struc- ture. There is further his investigation of the "mucous layer " (ScJileimschicht) lining the wall of all normal cells, where he shows that it consists of granular "mucus," which, at an earlier stage, filled the cell-cavity, and which differs chemically from the cell-wall in that it is nitro- genous. This layer he proved to be never absent from living cellsâ€" to be, in fact, itself the living part of the cell, a discovery which was simultaneously made by von Mohl (1846), who gave to the living matter of the plant- body the name " protoplasm." In connexion with these discoveries, Naegeli controverted Schleiden's view of the universality of free-cell-formation as themodeof cell-multi- plication, and showed that in the vegetative organs, at least, new cells are formed by division. In the Zeitschrift, too, is Naegeli's most important algological work ; such as the paper on Caulerpa, which brought to light the remark- able unseptate structure of the Siphonese, and his research on Delesseria, which resulted in the discovery of growth by a single apical cell. This discovery led Naegeli on to the study of the growing-point in other plants. He con- sequently gave the first accurate account of the apical cell, and of the mode of growth of the stem in various Mosses and Liverworts. Subsequently he observed that in Lycopodimn and in Angiosperms the growing-point has no apical cell, but consists of a small-celled meristem, in which the first differentiation of the permanent tissues can be traced. One of the most remarkable discoveries recorded in the Zeitschrift is that of the antheridia and spermatozoids of Eerns and of Pilularia. The Beitrage zur wiss. Botanik

consists almost entirely of researches into the anatomy of vascular plants, while the main feature of the Pjlanzenphysiologische Untersuchungen is the ex- haustive work on the structure, development, and various forms of starch-grains. The Botanische Mitteilungen include a number of papers in all departments of botany, many of them being continuations and extensions of his earlier work. In his Theorie der Abstammungslehre Naegeli introduced the idea of a definite material basis for heredity ; the substance he termed ” idioplasm.” His theory of evolution is that the idioplasm of any one genera- tion is not identical with that of either its progenitors or its progeny: it is always increasing in complexity, with the result that each successive generation marks an advance upon its predecessor. Hence variation takes place deter- minately, and in the higher direction only; while varia- bility is the result of internal causes, and natural selection plays but a small part in evolution. Whereas, on the Darwinian theory, all organization is adaptive, according to Naegeli the development of higher organization is the outcome of the spontaneous evolution of the idioplasm.

More detailed accounts of Naeg;eli’s life and work are to be found in yature, 16th October 1891, and in Proc. Soyal Soc

vol. li. (g_ jj_ ^.*_-)

Naestved, a market town of Denmark, county Praesto, on the east coast of Sealand, 58 miles by rail south-west of Copenhagen. From 1140 to the Reforma- tion it was one of the most important towns of the king- dom, though dependent upon the monastery of St Peter^s (founded hei-e in 1135); its church was restored in 1883-85. The medijeval town hall was restored in 1894. North of the town (1+ miles) lies Herlufsholm, where Admiral Herluf Trolle founded a Latin school in 1667, which still survives. Population (1880), 4792: a890), 5602; (1901), 7162. . V ;> > ^ ;.

N A G A HILL S â€” N A G P U E

67

Naga Hills, The, a district of British India, in the hills division of 4-Ssam. Its inner boundaries were laid down in 1882 ; but some measure of political control is exercised by the deputy commissioner in charge over a tract of

country, also occupied by Naga tribes, extending north-eastwards to the frontier of Burma. The adminis- trative headquarters are at Kohima â€” population (1891), 1781 â€” which is garrisoned by a Gurkha regiment and also by a strong force of military police. Area, 6710 square miles. Population (1891), 122,867; (1901), 102,409; average density, 18 persons per square mile. Land revenue, Es.51,660, the incidence of assessment being 10 annas per acre ; number of police, 741 ; number of boys at school (1896-97), 275, being 2-94 per cent, of the male population of school-going age. A cart-road is maintained from Nichuguard to Manipur, and a bridle-road from Wokha to Golaghat, in the Brahmaputra valley. The main line of the Assam-Bengal railway is being extended through the district along the Dhansiri river to Golaghat ; and a branch to the Gauhati section will turn off at Lumding. Deep cuttings and tunnels, together with the sparse population and unhealthiness of the country, combine to make this a work of great difB.culty. Only slight damage was done by the earth- quake of 12th June 1897.

Nagasaki, a town on the south-west of the island of Kiushiu, Japan, situated in 32Â° 44′ N. and 129Â° 62′ E., with 107,433 inhabitants, and a foreign settlement contaiiiing a population of 1000. This place owed its earliest importance to foreign intercourse. Originally called Fukae-no-ura (Fukae Bay), it was included in the fief of Nagasaki Kotaro in the 12th century, and from him it took its name. But it remained an insignificant village until the 16th century, when, becoming the head- quarters of Japanese Christianity, and subsequently the sole emporium of foreign trade in the hands of the Dutch and the Chinese, it developed considerable prosperity. The first port of entry for ships coming from the south or the west to Japan, it lies at the head of an inlet some three miles long, with shores indented by bays and sloping up to thickly-wooded hills. This fjord forms a splendid anchorage, and is largely used by ships coming to coal and by men-of-war of various nationalities. But the opening of Moji for export purposes has deprived Nagasaki of its monopoly as a coaling station, and the visits of war vessels have been reduced owing to the acquisition of Port Arthur by Russia, of Wei-hai-wei by Great Britain, and of Kiao- chow by Germany. It seems probable, indeed, that un- less advantage be ultimately taken of its manufacturing facilities, Nagasaki willlose much of its former importance. Up to the present, however, its population and its commerce have shown a

substantial growth, especially its population, which was only 56,063 in 1889, and had increased to 107,433 in 1899. The following table exhibits the condi- tion of its foreign commerce during the years specified : â€”

Exports.

Imports.

Total.

1884 1889 1894 1899

Â£

718,310

1,005,367

444,839

620,777

Â£

197,438

472,839

676,718

1,114,751

Â£

915,748

1,478,206

1,121,557

1,7.35,528

Marine products, coal, and cotton goods are the chief exports, and raw cotton, iron, as well as other metals and materials used for shipbuilding, constitute the principal imports. There is nothing in the present condition of Nagasaki's foreign commerce to suggest appreciable expansion. Its most important enterprises are represented by the engine works of Aka-no-ura, two large docks and a patent slip, the property of the Mitsu Bishi Company. Steamers of over 6000 tons have been constructed at these docks, which, as well as the engine works, are situated on the western

shore of the fjord. The brisk atmosphere of business that per- vades them does not reach the town on the eastern side, where, under the shadow of forests of tombstones that cover the over- looking hills, the citizens seem to live in the company of their dead and in the memory of their past. Nagasaki is celebrated for two very incongruous things : the tranquil loveliness of its scenery and the coaling operations that take place in the harbour, where thousands of men, women, and children, trained to mechanical regularity of action, transfer the fuel from lighters to the ship's bunkers with such rapidity that they have been known to put 1360 tons of coal on board a steamer in four hours, being at the rate of 5-7 tons per minute. The coal is obtained chiefly from Takashima, an Islet eight miles south-east of the entrance to the harbour, and in lesser quantities from two other islets, Naka^no- shlma and Ha-shima, which lie about a mile farther out. These sources of supply do not appear likely to last many years longer. On the north side of the channel, by which the harbour is entered, there stands a olifi called Takaboko, which, under the name of Pappenberg, has long been rendered notorious by a tradition that thousands of Christians were precipitated from it in the 17th century because they refused to trample on the Cross. It has been conclusively proved that the legend is untrue. (jr. by.)

Nagina, a town of British India, in the Bijnor district of the North-Western Provinces ; station on the Oudh and Eohilkhand railway, 48 miles north-west of jMoradabad. Population (1891), 22,150; municipal in- come (1897-98), Es. 10,609. There is considerable trade in sugar, besides manufactures of guns, glass-ware, ebony, carving, hemp-sacking, and cotton cloth. It was formerly the headquarters of the district.

Nagode, a native state of Central India, in the Bag- helkhand agency. Area, 460 square miles. Population (1881), 79,629; (1891), 84,097; showing an increase of 6 per cent. ; average density, 187 persons per square mile. The revenue in 1897-98 was Es.1,60,626, of which Es.99,198 was derived from land. The number of schools is 5, attended by 171 pupils. The chief, whose title is raja, is a Eajput of the Purihar clan. The present ” raja resides at Benares, while the minister has conducted the administration under British supervision. The state suffered severely from the famine of 1896-97.

The town of Nagode is 17 miles west of the British station of Sutna. Population (1881), 4828. It was formerly a military cantonment, and has an Anglo-vernacular school and dispensary. The present capital is Unchehra ; population (1891), 5442.

Nagoya, capital town of the province of Owari, Japan, on the great trunk railway of Japan, 236 miles from Tokyo and 94 miles from Kyoto. Population (1889), 162,767 ; (1899), 244,145. It is the fourth of the chief cities of Japan. In its vicinity (13^ miles distant) are the celebrated potteries of Seto, where the first glazed pottery made in Japan was produced by Kato Shirozaemon, after a visit to China in 1229. Prom Kato’s time Seto continued, during several centuries, to be the chief centre of keramic production in Japan, the manufacture of porcelain being added to that of pottery in the 19th century. All the products of the flourishing industry now carried on there and at other places in the province are transported to Nagoya, either for sale there or for export to other centres of consumption. Cotton mills have been established, and an extensive business is carried on in the embroidery of handkerchiefs. Another of its celebrated manufactures is arimatsii-sMhori, or textile fabrics (silk or cotton), dyed so as to show spots in relief from which the colour radiates. It is further dis- tinguished - as the birthplace of cloisonne enamelling in Japan, all work of that nature prior to 1838 â€” when a new departure was -made by Kaji Tsunekichi â€” having been for purposes of subordinate decoration. Quantities of cloisonni enamels are now produced in the town.

Nagpur, a city, district, and division of British India, Central Provinces. The city is 1125 feet above the sea ; railway station, 620 miles east of Bombay. Popula-

tion (1881), 98,299; (1891), 117,014; (1901), 124,599, showing an increase of 6-6 per cent, since 1891. The town is well laid out, with several parks and artificial lakes, and has numerous temples, with fine carving. The suburb of Sitabaldi contains the chief Government build- ings, the houses of Europeans, the railway station, and the cantonments, with fort and arsenal. The garrison consists of detachments of European and native infantry from Kamptee. It is the headquarters of two corps of rifle volunteers. Nagpur is the junction of two important railway systems â€” the Great Indian Peninsula to Bombay, and the Bengal-Nagpur, now opened throughout to Cal- cutta. The large weaving population still maintain their reputation for producing fine fabrics. Two steam cotton mills, with 1398 looms and 60,000 spindles, employ 4000 hands, and work up 126,000 cwts. of raw cotton in the year ; there is also machinery for ginning and pressing cotton. Education is provided by two aided colleges â€” the Hislop and the Morris, called after a missionary and a former chief commissioner â€” with 198 students in 1896- 97 ; four high schools, with 1705 pupils ; a law school ; an agricultural school, with a class for the scientific train- ing of teachers ; a normal school ; a zenana mission for the management of girls' schools ; an Anglican and two Catholic schools for Europeans, with 336 boys and 171 girls. Good boarding-houses and common playgrounds have been established, and inter-school tournaments are encouraged by a field-games association. There are several libraries and reading rooms, and an active Anjuman or Mahommedan society, besides eight printing-presses, issu- ing one English newspaper and three in Marathi and Hindi.

The district of Naspur has an area of 3843 square miles ; popu- lation (1881), 697,356; (1891), 757,862; (1901), 751,584, showing an increase of 9 per cent, between 1881 and 1891, but a decrease of nearly 1 per cent, between 1891 and 1901 ; average density, 195 persons per square mile, being the highest rate in the province. The land revenue and rates in 1897-98 were Es.ll, 20,876, the incidence of assessment being just over 8 annas per acre; cultivated area (1897-98), 1,247,042 acres, of which 24,388 acres were irrigated from tanks and wells; number of police, 1008; boys at school

(1896-97), 15,405, being 31-8 per cent, of the male population of school-going age, the highest proportion in the province; girls at school, 1139, being 2 per cent. ; registered death-rate (1897), 50 per thousand. The principal crops are millet, wheat, oil-seeds, and cotton. There are two steam factories for ginning and pressing cotton at Kamptee, which is the chief centre of trade. The district is traversed by the two lines of railway which meet at Nagpur city ; total length, 50 miles. It is also well provided with roads.

The division of Nagpuk comprises the five following districts: Nagpur, Bhandara, Chanda, Wardha, and Balaghat. Area, 24,127 square miles; population (1881), 2,758,056; (1891), 2,982,507; (1901), 2,716,748, showing an increase of 8 per cent, between 1881 and 1891, but a decrease of 9 per cent, between 1891 and 1901 ; average density, 112 persons per square mile, ranging from 197 in Nagpur district to 65 in Chanda.

Nagybanya, a corporate mining town, picturesquely situated in north-eastern Hungary, in the county of Szat- mar, with 9842 inhabitants in 1891 and 11,183 in 1901. There are a gymnasium, a Minorite convent, a directory of mines, hospitals, and several other offices and public institutions. Its mines â€” gold, silver, lead â€” are useful, and managed by the state. In the beautiful park are many ateliers, frequented in summer by pupils of the painting academy of Munich.

Nagybecskerek, a corporate town of Hungary, capital of the county of Toront^l, with 22,370 inhabitants in 1891 and 26,407 in 1901. It has an asylum, sup- ported by the Piarists, an upper gymnasium, a school for apprentices, a theatre, a carpet factory, and several financial institutions. Besides the administrative offices, there are a royal tribunal, a royal district court of justice’ and a public prosecutor’s office.

Nagyenyed, a corporate town of Hungary, capital

of the county of Alsd-Eeher, with 6048 inhabitants m 1891 and 7494 in 1901. Its famous educational institution, the Bethlen College, founded in 1622 at Gyulafehervar by Gabriel Bethlen, prince of Transylvania, but transferred in 1662 to Nagyenyed, contains a theological academy, an upper gymnasium, a normal school, and an elementary school, with a rich library

and interesting collections. There are manufactures of carved-wood furniture and textiles. The town has played an important part in Hun- garian history. In the Middle Ages it carried on a flourishing trade, and its celebrated wine cellars still exist.

Nagykaroly, a corporate town in the north-eastern part of Hungary, capital of the county of Szatmar, with 13,593 inhabitants in 1891 and 15,382 in 1901. Besides the Government departments and a few educational insti- tutions of higher rank, there is the beautiful castle of the Counts Karolyi, with a large park, and the statue of the celebrated Hungarian poet Francis Rolcsey.

Nagykikinda, a corporate town of Hungary, in the county of Torontal, with 22,923 inhabitants in 1891 and 24,843 in 1901. Being one of the centres of the produce of the famous wheat of the Banat, its traffic is brisk and flour industry important. Besides wheat, it produces also many kinds of fine fruit. It was once the seat of a privileged Servian district of South Hungary, and the moiety of its population is Servian.

Nagyszeben (German, Hermannstadt), a corporate town of Hungary, capital of the county of SzebÂ§n, with 24,766 inhabitants in 1891 and 29,677 in 1901. Besides several public institutions, there are interesting museums of the Lutheran Church and of the Carpathian Associar tion of Transylvania. It is the seat of an army corps.

Nagyszombat (perman, Tymau), a corporate town of Hungary, in thfe county of Pozsony, with 12,342 inhabitants in 1891 and 13,181 in 1901. Among its institutions are a Eoman Catholic seminary for priests, a gymnasium, an orphanage, and many convents and churches ; hence the town is sometimes called Little Eome. It was in this town that the famous archbishop and cardinal Peter Pazmany founded in 1636 the univer- sity, which at the end of the ISth century was transferred to Budapest. Among its industrial establishments the most important are a sugar refinery and manufactories of matches and malt.

Nagyvarad (German, Grosswardein), chief town of the county of Bihar, Hungary. It is a centre of com- merce, industry, and traffic. In its ancient fort several Hunsjarian kings are entombed. Population (1891),

38,567 ; (1900), 60,177.

Naini Tal, a town and district of British India, in the Kumaon division of the North-Western Provinces. The town is situated in 29Â° 22′ N. and 79Â° 29′ E., 6400 feet above sea-level. Population (1881), 6576; (1891), 12,408; municipal income (1897-98), Es.2,21,670; in-, cidence of taxation, Es.5.11.9 per head. Xaini Tal is a popular sanitarium, and the summer headquarters of the government of the province. It is situated on a lake, surrounded by high mountains. In 1897 the municipality raised a loan of lis. 1,35,000 for an improved water-supply. The approach from the plains is by the Eohilkhand and Kumaon railway from Bareilly, which has its terminus at Kathgodam, 22 miles by cart road. There are several European schools, three printing-presses (each issuing au English newspaper), besides barracks and convalescent depot for European soldiers, and a brewery.

The district of Nainj Tal comprises the lower hills of Kumaon and the adjoining Tarai, or submontane strip. Area, 2658 square miles; population (1891), 350,881; (1901), 806,362, showing a

decrease of 15‘4 per cent. ; average density, 115 persons per square mile. Land revenue and rates, Ks.2,69,807, the incidence of assess- ment being Rs.0.6.9 per acre; cultivated area (1896-97), 262,484 acres, of which 355 were under tea ; number of police, 641 ; ver- nacular schools, 40, with 1054 pupils ; registered death-rate (1897), 37 per thousand.

Nairn, a royal and parliamentary burgh (Inverness group) and the county town of Nairnshire, on the Moray Pirth, 16^ miles east-north-east of Inverness by rail. Its dry climate, good beach, and golf-course draw increasing numbers of visitors yearly. New hotels and a large number of new houses have been built, and the burgh boundary has been enlarged; the water-supply is about to be increased, the drainage system extended, and the harbour improved. The public hall contains a museum, reading-room, and library in connexion with an endowed literary institute; there is also a seamen’s hall and library, and a convalescent home. New United Free and

Established churches have been built. There is a sec- ondary school. Population (1881), 4645; (1891), 4640;

(1901), 5106.

Nairnshire, a small maritime county in the north- east of Scotland, bounded on the W. and S. by Inverness- shire, on the E. by Elgin, and on the N. by the Moray Firth.

Ana and Population. â€” ^In 1891 the barony of Ferintosh, form- ing part of the parish of Urquhart and Logie-Wester, was trans- ferred to Ross-shire from Nairnshire ; of parishes partly in Elgin and partly in Nairn, the parish of Dyke and Moy and part of the parish of Ardclach were given to Elgin ; while of parishes divided between Nairn and Inverness, Cawdor was placed wholly in Nairn, Daviot and Dumlichity wholly in Inverness, part of Moy and Dalarossie was added to the parish of Cawdor, and Croy and Dalcross was re-divided. The area of the county (foreshore excluded) is 104,245 acres, or about 163 square miles. The popu- lation was, in 1881, 10,455; in 1891, 10,019; in 1901, 9291. On the old area, taking land only (124,968 acres, or 195-3 square miles), the number of persons to the square mile in 1891 was 51, and the number of acres to the person 12-5. In the registration county the population decreased between 1881 and 1891 by 3-4 per cent. Between 1881 and 1891 the excess of births over deaths was 881, and the decrease of the resident population 308. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 :â€”

Tear.

Deaths.

Marriages.

Births.

Per cent, of Illegitimate.

1880 1890 1899

180 142 149

87 42

57

262 205 235

10-6

10-24

8-9

breed of horses. The following table gives the principal acreages at intervals of five years from 1880 :â€”

The birth-rate, marriage-rate, and death-rate are all below those for Scotland. The following table gives the birth-rate, death-rate, and marriage-rate per thousand of the population for a series of years : â€”

1880.

1881-90.

1890.

1891-98.

1899.

Birth-rate . Death-rate Marriage-rate .

27-26

13-53

3-85

25-66

16-32

4-83

28-90

16-56

4-89

23-48

17-89

4-70

28-51

18-07

6-91

In 1891 there were 1894 Gaelic-speaking persons in the county, and one foreigner. Valuation in 1889-90, Â£.36,192 ; 1899-1900, Â£37,865.

Administration. â€” The county unites with Elgin to return a member to Parliament, and Nairn (5105), the county town and only royal burgh in the county, is one of the Inverness group of parliamentary burghs. There are four civil parishes and part of a fifth (Croy and Dalcross), all forming the Nairn combination. The number of paupers and dependents In September 1899 was 304. Nairn forms a sheriffdom with Inverness and Elgin, and a sheriff- substitute sits alternately at Nairn and Elgin.

Education. â€” Five school boards manage 13 schools, which had an average attendance of 1236 in 1898-99, and two voluntary schools (one Roman Catholic) had 52. There Is one secondary school in the burgh of Nairn, and the whole of the county and burgh “residue” grant is spent in subsidizing science and art classes in that school, and cookery classes in the county schools.

Agriculture. â€” In 1898 the percentage of cultivated area was 24-6. Barley and oats are the principal corn crops, covering about equal areas. A great

improvement has been notable in the

Tear.

Area under Crops.

Com Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1880 1885 1890 1895 1899

26,359 26,152 25,283 25,709 25,748

9183 9338 9052 9054 9022

4900 4695 4648 4630 4601

10,010 9,914 9,487 8,626

10,014

2188 2191 2054 3337 2087

78 14 38 59 22

The following table shows the live stock during the same years : â€”

Tear.

Total Horses.

Total Cattle.

Cows or

Heifers in

Milk or Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1899

1328 1188 1179 1433 1529

5955 5837 5926 6199 6246

1794 1891 1842 1773 1991

20,108 16,438 18,441 18,335 19,360

720 753 788 681 690

Of the 352 holdings in the county in 1895, the average size was 73 acres ; 10-23 per cent, were under 5 acres, 44-32 between 5 and 50 acres, and 45-45 over 50 acres. The number between 50 and 100 acres was 78 ; between 100 and 300, 75 ; between 300 and 500, 5 ; one between 500 and 1000, and one over 1000. There were 12,767 acres under wood in 1895. At the ‘census of 1891, 1130 men and 159 women were engaged in agriculture.

Industries and Trade. â€” Apart from three distilleries and some sandstone and granite quarries, there is no industry except fishing. In the district of the river Nairn 4600 salmon were caught by fixed nets in 1898.

Authorities. â€” C. Rampini. Sistory of Moray and Nairn. Edinburgh, 1897.â€” G. Bais. History of Nairnshire. Nairn, 1893 ; History of the Parish of Auldearn. Nairn, 1898 ; The Culbin Sands. Nairn, 1899 ; Guide to Nairn. Nairn, 1899. â€” Book of the Thains of Cawdor (Spalding Club). Edinburgh, 1859.â€” J. G. Macneill. History of Cawdor. Glasgow, 1893. â€” W. Leslie. General View of the Agriculture of the Counties of Nairn and

Moray. London, 1813.’ â€” ^Brodie Cruickshank. Place Names of Nairnshire, 1897. â€” W. Laing. xincient Customs, Social and Local. Nairn, 1899. â€” M. Macdonald. The Covenanters of Moray and Boss. Nairn, 1892. â€” G. Bain. The Clova Cairns and Circles. Nairn, 1899. (yf. WA.)

Najibabad, a town of British India, in the Bijnor district of the North-Western Provinces, 31 miles south- east of Hardwar. Population (1891), 19,410 ; municipal income (1897-98), Es.13,161. It was founded in the middle of the 18th century by a Eohilla chief, and still contains several architectural monuments of Rohilla mag- nificence. It has a station on the Oudh and Rohilkhand railway, vrith a junction for the branch to Kotdwara. There is considerable trade in timber, sugar, and grain, and it possesses manufactures of metal -ware, shoes, blankets, and cotton cloth. The nawab of Najibabad was a ringleader during the Mutiny.

Nakskov, a seaport town of Denmark, county Maribo, at the head of a wide bay at the west end of the island of Laaland, 31 miles by rail west of Nykjobing, with a large sugar factory. The church dates from the begin- ning of tJie 15th century ; restored in 1859 and 1897. The port was entered by 1()16 vessels of 58,385 tons, and cleared by 948 of 57,398 tons in 1899. Population

(1880), 5278; (1890), 6722; (1901), 8310.

Namur, a province of Belgium, bordering on the Belgian provinces of Hainaut, Brabant, Liege, and Lux- emburg, and on Prance. It possesses coal mines, employ- ing 2600 workers ; iron mines (550 workers) ; marble, building-stone, and paving-stone quarries, and limestone pits, employing 3400 workers ; plastic clays and slates. In general of little fertility, except to the north of the Meuse, the soil produces especially oats, potatoes, rye, beetroot, and fruits (apples and plums). Woods, occupy- ing 27 per cent, of the surface, give cover to the fox, the deer, and the boar. The most noticeable industries

are glass, cutlery, and the manufacture of chemical products and of beetroot sugar. The province is divided into three administrative arrondissements, the capitals of which are Namur (32,223 inhabitants in 1900), Dinant (7512), notable for its picturesque situation on the Meuse, and Philippeville (1217). IsTamur, with an area of 1414 square miles, is one of the least populous of the provinces of Belgium, having (1900) only 346,512 inhabitants, or 245 per square mile. The population, 315,796 in 1876, has thus undergone an increase of 12 per cent., against 27-7 per cent, in the same period for the whole of the kingdom.

Namur, a town of Belgium, capital of the province of the same name, 37 miles south-east of Brussels by rail. Eailways connect it with the chief Belgian towns and with France, the duchy of Luxemburg, and Prussia. Population (1880), 25,354; (1900), 32,223.

Nanaimo, a town on Vancouver Island, British Columbia, with, valuable coal mines in the immediate vicinity. It is connected with Victoria by the Esquimalt and Nanaimo railway, and has a daily steamer service to Vancouver. Population about 5000.

Nancy, the old capital of Lorraine and chief town of the French department of Meurthe-et-Moselle, 218 miles from Paris by rail. The population in 1886 was 69,463; in 1896, 83,668 (96,306 in the commune); 102,463 in 1901. It has doubled since 1870 by reason of the large number of Alsatians and of people from Metz (and its district) who transported their families and in- dustries here in order to preserve their French nationality. The town has been made the headquarters of the general command of the 20th corps d’armie, owing to the sub- division of the old 6th corps d’armee of ChÂ§.lons-sur-Marne. To facilitate the traflB.c of the Eastern railway (the line from Paris to Avricourt and Strasbourg), a circular rail- way has been constructed skirting the town on the north- east. At the port on the Marne-Khine canal the shipping totals a tonnage of about 237,400 each year, the goods carried consisting of building materials, iron ore, coal, wood, &c. In 1892 a statue of Claude Gelee, called Lorrain, the celebrated French artist of the 17th century, was erected; in 1896 a monumental obelisk to com- memorate the interview between President Carnot and the Grand Duke Constantine of Russia in 1893 ; in 1885 a pyramid in honour of Dr Crevaux,

the explorer of the Amazon ; and a statue of Jeanne d'Arc, a reproduction of that erected in Paris, with busts of the caricaturist Grand- ville and of the satirical poet Gringoire. Nancy has been associated in recent years with the new school of hypnotism, for a discussion of which see Hypnotism.

Nandgaon, a feudatory state of India, in the Chhattisgarh division of the Central Provinces. Area, 905 square miles. Population (1881), 164,339 ; (1891), 183,866 ; (1901), 126,444 ; average density, 139 persons per square mile ; estimated revenue, Rs.2,61,000 ; tribute, Rs.70,000. The state owes its origin to a grant from a raja of Nagpur to his family priest in the 18th century. The present chief is a minor, and the administration is under British control. The state has long been well governed, and has derived additional prosperity from the construction of the Bengal-Nagpur railway, which has a station at Eaj-nandgaon, the capital. Here there is a steam cotton mill, with 156 looms and 14,868 spindles, employing 800 hands, and using up 15,528 cwts. of cotton annually.

Nanking, the capital of the provinces of Kiangsu and Anhwei, China. Since 1880 Nanking has been slowly recovering from the state of ruin caused by the Taiping rebellion. Barely one-fourth of the area

within the walls has been reoceupied, and though its ancient industriesâ€" chief of which was silk- weavingâ€" are reviving, no great progress has so far been made. As the seat of the provincial government, however, which embraces the three provinces of Kiangsu, Kiangsi, and Anhwei, Nanking is a city of first-class importance. The viceroy is the most powerful of all the provincial satraps, inasmuch as he controls a larger revenue than any other, and has the command of larger forces both naval and military. His importance is further enhanced by the fact that, in addition to his other functions, he is super- intendent of foreign trade for the southern ports, includ- ing Shanghai, a position which gives him great weight in all political questions. Nanking was made a treaty port by the French treaty of 1858, but it was never formally opened. Its proximity to Chinkiang, where trade had established itself while Nanking was still in the hands of the rebels, made its opening of little advantage, and the point was not pressed. It was made a place of call for the landing of passengers by steamer in 1878, and in 1899 it was voluntarily thrown open to foreign trade by the

Chinese Government. It contains an arsenal for the manufacture of munitions of war, as also powder mills. A naval college was opened in 1890, and an imperial military college a few years later under foreign instructors. Want of system and of continuity in the method of instruction appears to be nullifying these projects. The population is estimated at 140,000. The only foreign residents are missionaries (mostly American) and employes of the Chinese Government. The only public feature of interest in Nanking is the so-called Jling Tombs, being the mauso- leum of Hung Wu, the founder of thelling dynasty, and one or two of his successors. They lie outside the eastern wall of the city, but they are ill cared for and rapidly going to decay.

Nanning, a treaty port in the province of Kwangsi, China, situated on the West river, 250 miles above Wuchow and 470 miles from Canton. It is the highest point on the West river which is accessible for steam traffic. From Canton, as far as Wuchow, the river has a minimum depth of 8 feet, but on the section from Wuchow to Nanning not more than 3 or 4 feet are found during winter. The town is of considerable size, with a population of 40,000, and constitutes the chief market on the south- ern frontier. Its opening was long opposed by the French Government, who had acquired the right to build a rail- way to it from Tongking, by which the}- hoped to divert the trade through their own possessions. The port has only been lately declared open, but trade is expected to be considerable. Navigation by small native boats is open westwards into Yunnan as far as PosÂ§.

Nansen, Fridtjof (1861), Norwegian ex- plorer. See Polar Regions and Geogbaphy.

N anterre, town and port on the Seine, arrondissement of 8t Denis, department of Seine, France, 6 miles west- north-west of the Invalides, Paris, on the railway to St Germain and at the foot of Mount Valerien. The prin- cipal manufactm-e is that of aluminium ; it is also noted for cakes, and stone is quarried in the vicinity. Port traffic, 1900, 153,850 tons. The crowning of the Rose Queen, a custom handed dovrn from mediaeval times, is annually observed with considerable ceremony. Nan- terre (the ancient Xemptod’irum or Xemetodurum) owes its origin to the shrine of Ste Genevieve (420-512), whose name is still associated with various places in

the town and district. The combined prison and mendicity depot for the department is a very large institution, about two miles from the town. The prison is capable of containing 1500 persons, and the mendicity institution 2900. About

7000 men and 2000 women pass annually through the latter establishment. Population (1891), 5056; (1901),

14,140.

Nantes, capital of the department of Loire-Infdrieure and the most populous town of Brittany, situated, 247 miles from Paris by rail, on the right bank of the Loire, which here divides into several branches. The maritime port of Nantes, reached by the ship canal from the road- stead of St Nazaire, has been much improved. Booms have been built, and a slipway facilitates the repairing of ships. The port extends over a length of about a mile and a half. The outer port as far as Chantenay has a length of over half a mile. The principal quays extend along the right bank of the branch which flows past the town, and on the western shore of the island of Gloriette. The depth of water alongside these quays varies from 10 to 20 feet ; their total length used for trading purposes is 5 miles, and warehouses cover an area of 17 acres. The river port occupies the St Pelix and Madeleine branches, and has quays extending 2625 feet, with an average breadth of 130 feet. Finally, on the Erdre is a third port for inland navigation, with a length of 4100 feet and an average breadth of 80 feet. All these quays are bounded by railway lines along the right bank of the river, which the railway to St Nazaire follows. On 31st December 1899 there were 240 ships of 77,474 tons attached to the port, all but 64 being coasting vessels. In 1899, 2814 vessels of 551,701 tons entered and 3029 of 667,355 tons cleared ; the foreign trade was represented by 482 entrances of 278,042 tons and by 560 clearances of 309,208 tons, the number of French vessels engaged therein being 188 of 84,058 tons. The value of exports reached Â£794,796, and that of imports Â£2,546,000. The chief imports are fine sugar (raw) â€” Nantes imports more of this commodity than any other port in Prance â€” cereals, cocoa,

wood for building purposes, coffee, hemp, olive-oil, cellulose pulp, wine, copper, and manure. The exports are grain, flour, and refined sugar. The French colonies, England, Sweden, and Norway furnish the imports â€” the exports being despatched to England, the French colonies, and Belgium. The chief industries are sugar-refining (30,000 to 35,000 tons are imported, mainly from French colonies), the manufacture of soap (producing 15,000 tons), the husking of rice (9000 tons), and the manufacture of woollen and cotton fabrics, 1507 tons of which are exported. Thirty-three firms manufacture alimentary preserves of fish, especially sardines (4000 to 5000 tons are exported), and of vegetables in tins. The firms engaged in salting lard, beef, and fish export 1000 tons. In 1899, 4,236,000 cubic feet of pine wood imported from Norway and Finland were used in the manufacture of wood pulp, which pro- duced 8800 tons of paper. Several firms manufacture blocks of compressed coal dust, and it is a curious fact that 12,000 tons of coal thus prepared are exported to England. The manufacture of biscuits is important â€” one firm making 80 tons daily. The miller's trade is of modern establishment. One mill alone treats 400 to 500 tons of wheat daily. One factory sends out annually, amongst other chemical productions, 7000 tons of an acid extracted from the chestnut. Nantes has workshops turning out machinery, boilers, and iron frame-work, and has also shipbuilding yards, foundries, forges, bell- foundries, and tanneries. There are 60 nursery gardens and manufacturers of bottles, stained glass, and tobacco (1800 workmen). Population (1886), 110,638; (1901),

128,349.

Nanticoke, a borough of Luzerne county, Penn- sylvania, U.S.A., on the North Branch of Susquehanna river, and on the Central of New Jersey, the Penn- sylvania, and the Delaware, Lackawanna, and West-

em railways, in the eastern part of the state, at an altitude of 540 feet. Its site is level, and its plan fairly regular. It is in the anthracite coal region, is surrounded by mines, and its industries consist chiefly in mining and shipping coal. Population (1880), 3884; (1890), 10,044; (1900), 12,116, of whom 6065 were foreign-born.

Nantwich, a market-town in the Crewe parlia- mentary division of Cheshu'e, England, on the river Weaver and the North-Westem and Great

Western rail- ways. Shrewbridge Hall, formerly a private mansion, was converted into the brine baths hotel for cases of rheumatism, gout, and general debility. Besides its manu- factories, the town possesses tanneries and an iron foundry. It is one of the finest fox-hunting centres in the country, being within easy distance of several meets. Population

(1881), 7495 ; (1901), 7722.

Napier, town in Hawkes Bay county, New Zealand, 165 miles east by south of New Plymouth. It has railway communication with Wellington, New Plymouth, and the Wairarapa, Wanganui, and Manawatu districts. Tree-planting, the sinking of artesian wells, and a fine esplanade by the bay have much improved its appearance and com- fort. The large breakwater, which will supersede the imperfectly-sheltered Port Ahuriri, is nearly completed. The imports in 1898 were only Â£181,486, while the exports reached Â£1,113,242. In 1900 the imports were Â£219,000, but exports had fallen to Â£770,000. Popula- tion, 9016.

Napier and Ettrick, Francis Napier, Baboi? [9th Baron Napier of Merchistoun, and 1st Baron Ettrick of Ettrick] (1819-1898), British diplomatist, was bom in 1819, and succeeded his father in the peerage in 1834. He entered the diplomatic service in 1840, and was em- ployed in successive posts at Vienna, Constantinople, Naples, Washington, and The Hague. During this time he earned the highest opinions both at home and abroad. In 1860 he became ambassador at St Petersburg, and in 1864 at Berlin. In 1866 he was appointed governor of Madras, and was at once confronted with a serious famine in the northern districts. In dealing with this and other problems he showed great activity and practical sense, and he encouraged public works, particularly irrigation. In 1872 he acted for a few months as Viceroy, after Lord Mayo’s assassination ; and on Lord North brook’s appoint- ment to the office he returned to England, being created a baron of the United Kingdom (Baron Ettrick of Ettrick) for his services. He continued, both in England and in Scotland, to take great interest in social questions. He was for a time a member of the London School Board, and he was chairman of the Crofters’ Commission in 1883, the result of which was the appointment of a permanent body to deal with questions affecting the

Scottish crofters and cottars. He died at Florence, 19th December 1898, leaving a widow and three sons.

Napier of Magdata, Robert Cornelis Na- pier, 1st BAEOif (1810-1890), British field-marshal, son of Major Charles Frederick Napier, Royal Artillery, was born at Colombo, Ceylon, on 6th December 1810. He entered the Bengal Engineers from Addiscombe College on the 15th December 1826, ajid after the usual course of instruction at Chatham, arrived in India in November 1828. For some years he was employed in the irrigation branch of the Public Works Department, and in 1838 he laid out the new hill station at Darjeeling. Pro- moted captain in January 1841, he was appointed to Sirhind, wherehe laid out cantonments on a new principle â€” known as the Napier system â€” ^f or the troops returning from.

Afghanistan. In December 1845 he joined the army of the Sutlej, and commanded the Engineers at the battle of Mudki, where he had a horse shot under him. At the battle of Firozshah on the 31st December he again had his horse shot under him, and, joining the 31st Eegi- ment on foot, was severely wounded in storming the entrenched Sikh camp. He was present at the battle of Sobraon on 10th February 1846, and in the advance to Lahore ; was mentioned in despatches for his services in the campaign, and received the medal with two clasps and a brevet majority. He was chief engineer at the reduction of Kote-Kangra by Brigadier-General Wheeler in May 1846, and received the thanks of Government. â€¢ He was then appointed consulting engineer to the Punjab Resident and Council of Regency, but was again called to the field to direct the siege of Multan. He was wounded in the attack on the entrenched position in September 1848, but was present at the action of Surjkhand, the capture of the suburbs, the successful storm of Multan on 23rd January 1849, and the surrender of the fort of Cheniote. He then joined Lord Gough, ‘took part, as commanding engineer of the right wing, in the battle of Gujrat in February 1849, accompanied Sir W. R. Gilbert in his pursuit of the Sikhs and Afghans, and was present at the passage of the Jhelum, the surrender of the Sikh army, and the surprise of Attock. For his services he was mentioned in despatches and received the

medal with two clasps and a brevet lieutenant-colonelcy. At the close of the war Napier was appointed civil engineer to the board of administration of the annexed Punjab province, and carried out many important public works during his tenure of office. In December 1852 he commanded a column in the first Hazara expedition, and in the following year against the Boris ; and for his ser- vices in these campaigns was mentioned in despatches, received the special thanks of Government, the medal and clasp, and a brevet colonelcy. He was appointed mili- tary secretary and adjutant-general to Sir James Outram's force for the relief of Lucknow in the Indian Mutiny in 1857, was engaged in the actions of Mangalwar, Alam- bagh, and Charbagh, and the first relief of Lucknow. He directed the defence of Lucknow until the second relief, when he was severely wounded in crossing a very ex- posed space with Outram and Havelock to meet Sir Colin Campbell. He was chief of the staff to Outram in the defence of the Alambagh position, and drew up the plan of operations for the attack of Lucknow, which was approved by Sir Colin Campbell and carried out by Napier as brigadier-general commanding the Engineers, in March 1858. On the fall of Lucknow Napier was most favourably mentioned in despatches, and made C.B. He joined Sir Hugh Rose as second-in-command in his march on Gwalior, and commanded the 2nd brigade at the action of Morar on the 16th June. On the fall of Gwalior he was entrusted with the task of pursuing the enemy. With only 700 men he came up with Tantia Topi and 12,000 men on the plains of Jaora Alipur, and completely defeated him, capturing all his guns (25), ammunition, and baggage. On Sir Hugh Rose's de- parture he took command of the Gwalior division, cap- tured Paori in August, routed Firozshah, a prince of the house of Delhi, at Ranode in December, and, in January 1869, succeeded in securing the surrender of Man Singh and Tantia Topi, which ended the war. For his services Napier received the medal with three clasps, the thanks of Parliament and of the Indian Government, and was made K.C.B.

In January 1860 Napier was appointed to the command of the 2nd division of the expedition to China under Sir Hope Grant, and took part in the action of Sinho, the

storm of the Peiho forts, and the entry to Peking. For his services he received the thanks of Parliament, the medal with two clasps, and was

promoted major-general for distinguished service in the field. For the next four years Napier was military member of the Council of the Governor-General of India and, on the sudden death of Lord Elgin, for a short time acted as Governor-General, until the arrival of Sir W. T. Denison from Madras. In January 1865 he was given the command of the Bombay army, in March 1867 he was promoted lieutenant- general, and, later in that year, appointed to command the expedition to Abyssinia, selecting his own troops and making all the preparations for the campaign. He arrived at Annesley Bay in the Red Sea early in January 1868, reached Magdala, 420 miles from the coast, in April; stormed the stronghold, freed the captives, razed the place to the ground, returned to the coast, and on the 18th June the last man of the expedition had left Africa. He received for his services the thanks of Parliament, the war medal, and a pension. He was raised to the peerage, and made G.C.B. and G.C.S.I. The freedom of the cities of London and Edinburgh was conferred upon him, with presentation swords, and the universities bestowed upon him honorary degrees. In 1869 he was elected a fellow of the Royal Society. He held the command-in- chief in India for six years from 1870, during which he did much to benefit the army and to encourage good shooting. He was promoted general in 1874, and appointed a colonel-commandant of the Royal Engineers. In 1876 he was the guest of the German Crown Prince at the military manoeuvres, and from that year until 1883 held the government and command of Gibraltar. In the Critical state of affairs in 1877 he was nominated com- mander-in-chief of the force which it was proposed to send to Constantinople. In 1879 he was a member of the Royal Commission on Army Organization, and in November of that year he represented Queen Victoria at Madrid as ambassador extraordinary on the occasion of the sec- ond marriage of the king of Spain. On the 1st January 1883 he was promoted to be field marshal, and in December 1886 appointed Constable of the Tower of London. He died in London on the 14th January 1890. His remains received a state funeral, and were buried in St Paul’s Cathedral on the 21st January. He was twice married, and left a large family by each wife. A statue of him on horseback by Boehm was erected at Calcutta when he left India, and a replica of it was afterwards set up to his memory in Waterloo Place, London. (r. h. v.)

Naples, a city and the chief town of a province, Italy, situated on the north shore of the Bay of Naples, 161 miles by rail east-south-east of Rome. It is

the seat of a pre- fecture comprising the sub-prefectures of Casoria, Pozzu- oli, Castellammare, and sixty-eight communes. According to the census of 1881, the population of the province was 1,001,245, and the city 493,115 ; and in 1901, 1,135,906 and 563,731 respectively. In the later years of this period there was a constant increase of births and a low death-rate (see below). The city proper is about 12 miles in circumference. On the north-east shore of the bay, op- posite the ancient site of Pompeii, stands Nuova Pompeii, where is situated the famous sanctuary of the Madonna di Pompeii._ On the north-west shore the grotto of Pozzuoli (or Posilippo) has been strengthened by supporting arches, without which it threatened to collapse. Another example of Roman tunnelling is the neighbouring gallery, now dry, bored to convey water to Cumse from the Lake of Avernus. A tunnel for the railway and steam tramway also runs through the promontory of Posilippo. It is 826 yards long, 13 yards high, 11 yards broad, with pavements for

foot passengers 8 feet iDroad, and with a lift in the centre giving access to the new Parco Savoja. A penal settle- ment is situated on the island of Nisida, and the Eoyal Park of Astroni should be mentioned. The Lake of Agnano, as it formerly existed, was also an extinct crater more than two miles in circumference. In 1870, how- ever, it was drained and cultivated, to the great improve- ment of the air In 1883 the island of Ischia (famous for its thermal waters) was visited by an earthquake, during which some 4000 inhabitants and visitors were killed. The Via Caracciolo was finally completed in 1891.

The Bisanamento. â€” The curve of the bay is continually being modified by the filling up of the gulf, but indeed, since the cholera epidemic of 1884 the whole city has been rapidly modified by the Bisanamento, an undertaking designed to purify the city by de- stroying old houses and fondaci, and by constructing large new thoroughfares flanked by hygienic dwellings. Some two-thirds of the work originally planned has been executed, and the remaining third is to be completed at an approximate cost of Â£1,600,000. The funds for the undertaking were furnished partly by the

state, which provided 76,000,000 lire (Â£3,000,000), and partly by the Bisanamento Company, which has a capital of Â£1,200,000 The work of Kisanamento provides labour for a large number of men, but otherwise it confers little benefit upon this class of the popular tion, to whose means the new houses are not adapted. Working- class houses, properly so called, have not been constructed. The old area of 1950 acres has been increased by the districts of Vomero Nuovo, near San Martino. New Quarters. â€” Santa Lucia, near the Castel dell' Ovo ; the Sant' Efremo quarter, behind the Albergo dei Poveri ; and the districts of Vasto alia Ferrovia ; Sirignano alia Riviera ; Margherita ; the Amedeo Extension ; the Avenue Prinoipessa Elena at Mergellina, and the Parco Savoja upon the Posilippo Hill. By degrees the narrow streets and alleys of Porto Mercato, Pendino, and San Lorenzo disappear and are replaced by large thoroughfares, and the famous lanes (Vicoli) of Santa Lucia, with their horrible filth, have also followed suit.

Communications a7id Lighting. â€" A more rapid system of city communication corresponds to the growth of the network of streets. The tramway service is exceedingly complete, and on some lines electric traction is employed. "Within a short time electricity wBl be employed throughout the city. The use of electric light is also rapidly extending, and it is already used for the illumination of the theatres, the railway, the hotels, factories, arcades, and the principal streets.

Water-supply. â€" The cholera epidemic of 1884 led also to the re-organization of the water-supply. Previous to that date concessions had been granted for this purpose. First under the management of an English, and then of a French company, the works which bring the water from the sources of the Serine, on the Avellino Hills, have been completed. The exact spot is the lower source at Urciuoli, 1050 feet above sea-level, which gives a minimum supply of 30,800,000 gallons daily. The higher source at Acquaro has not yet been tapped. The aqueduct, which measures from 5 to 6 feet in diameter, runs for a distance of about 40 miles to Cancello, passing through 49 tunnels of an aggregate length of 10 miles. Thence the water is forced through metal syphons for another 16 miles to the reservoirs of Capodimonte and Scudillo. The gradient is one- half per thousand. Some thirty communes near the line of the aqueduct draw from it their water-

supply. The work cost Â£1,400,000, and the water, which is of excellent quality, is supplied at about Is. 2d. per 1000 gallons. As a result of the improved water-supply, Naples has been exempt from epidemics, and the average mortality from infectious diseases has fallen to 7-26 per cent., a figure lower than that of any European capital except Brussels, where the average is 6-49 per cent. The reformed sewer system has also con- tributed to this result. The outfall of sewage is beyond Cape Misenum in the Licola marshes, whither the sewage is carried by two large urban collectors through Cuma and Coroglio.

Castles, Churches, &c. â€" Castel Capuano, formerly residence of the princes of Anjou, but chosen in 1540 as the Law Courts, is being restored on account of its insecure condition. The Law Courts have therefore been transferred to the Institute of Fine Arts. Castel Nuovo will become the municipal palace as soon as it is freed from the old buildings which surround it. Within niches in the front of the royal palace have been placed, by commission from King Humbert, the statues of Roger the Norman, Frederic II., Charles of Anjou, Alphonso of Aragon, Charles V., Charles III., Joachim Murat, and Victor Emmanuel The royal palace of Capodimonte was, until the summer of 1900, chiefly used as a modern picture gallery and armoury, but was rarely used as a royal residence, except by Queen Margherita, who retained a small suite of four rooms. Victor Emmanuel III. has, however, made Capodimonte his principal summer palace. He has enlarged

the grounds, removed the picture gallery to Caserta, and refurnished the royal apartments. The archbishop of Naples need not neces- sarily be a cardinal, but is usually of noble birth. The religious houses suppressed in 1868 have been in great part reconstituted, but they no longer figure as recognized corporations. Among the more noteworthy Neapolitan churches should now be mentioned Sant Anna dei Lombardi, with the picture of Christ by Modanino (Guido Paganini); the sacristy of San Domenico Maggiore, with the remains of ten princes of Aragon ; and San Severe, containing valuable sculptures by Sammartino Queiroli, Corradini, and Cele- brano. There are six non-Catholic churches : English, Scottish, Galilean, German, Greek, and a Jewish synagogue. One of the most noteworthy constructions of modern Naples is the Galleria Umberto I , an

extensive arcade inaugurated in 1890 on the site of the squalid Vicolo Campane. The arcade is slightly larger than that of Milan. It has four entrances, a central cupola, and is richly ornamented with gilding and bas-reliefs. Eighty-six shops are in the interior, and ninety on the exterior. A theatre called the Salone Margherita is situated underground.

Libraries and Education. â€” The libraries number eight. Of these the Nazionale has 600,000 volumes, and that of the Society of Italian History more than 70,000 volumes, dealing with the history, geography, and administration of the Two Sicilies. The foundation-stone of a new university was laid in 1898, but the work of building has not yet begun, as the site is now considered too small for the needs of the city. In 1899-1900, 6000 students were registered, and a similar number were on the books for 1900-1901. Education in general may be said to be steadily pro- gressing, and the number of persons unable to read ‘and write is gradually diminishing. The municipality spends Â£50,000 for the education of some 25,000 children. The commune of Naples sup- ports 43 day schools and 4 evening schools for boys, 11 evening schools of design, and 40 day schools for girls. Important educa^- tional institutions are â€” (1) The Industrial Museum, supported by the state, the province, and the commune â€” an institution which comprises several technical schools and schools of art applied to industry ; (2) The Vittorio Emanuele Reformatory, founded by the provincial administration ; and (3) The Opera Ravaschieri, supported by public subscription, for the education of abandoned children. The Marine Station, of which an account is given under Aquakia, should also be mentioned.

Charitable Institutions. â€” The charitable institutions (opere pie) have been partially reorganized by grouping together cognate institutions, decreasing the number of employfe, and increasing the benefits to the indigent. To the number of those previously existing must be added the new asylum, and the sanatorium for consumptive patients, at San Gennaro di Pozzuoli, generously given to the city by the Duchess Ravaschieri.

New Theatres. â€” Few changes have taken place in Neapolitan theatres. The Mercadante has been renovated and an amphi- theatre added ; a variety theatre opened at Chiatamone, while the popular San Carlino has been

demolished in the’ course of the Risanamento. The Pulcinella, also, has disappeared, and has been replaced by small and sparsely-attended music halls.

Shipping. â€” The improvements in the port and the warehouses have brought Naples up to the level of the principal maritime cities. The minimum depth of water in the harbour Is now 19 feet, the average 26 to over 50 feet, though in the small commercial port the depth is only 10 to 13 feet. The old landing-stage of the Immacolatella, near the Custom House, now serves only for smaU boats, while the new landing-stage, opposite Via Duomo, meets all the requirements of large sea^going steamers. The imports are valued at from Z\ to nearly 5 millions sterling annually, the principal items being cereals, metals, animals and animal foods, stoneware and glass, cottons, and leather wares ; and the exports at approximately 2J millions sterling, live animals and animal produce, cereals, manufactured hemp and flax being the principal. The traffic of the port was in 1900 6,657,185 tons. Italy holds the first place with 2,807,490 tons ; Germany comes second with 1,468,290 tons ; Great Britain third with 1,298,708 ; and France fourth with 497,650 tons. Naples is one of the principal Italian ports for the embarkation of emigrants.

Finance. â€” The financial condition of the municipality of Naples scarcely appears satisfactory. Income amounts to about Â£950,000 per annum, drawn chiefly from the octrois and from taxes upon comestibles. The octroi is collected by the state, which pays Â£460,000 per annum to the commune, in addition to which the commune is authorized to collect further indirect taxes to the amount of some Â£70,000 per annum. The other sources of income, principally direct taxes, yield rather more than Â£400,000. The total municipal debt, which bears interest at rates varying from 5 to 2 per cent., amounts to Â£5,500,000, for the service of which Â£347,612, or rather more than a third of the total municipal revenue, is required. The other items of expenditure are for police, street cleaning, lighting, schools, and the sanitary service.

Industries. â€” The trade of Naples has undergone some modifica-

tions. There are large foundries, iron-works, iron shipbuilding yards at Torre dell' Annunziata, Pozzuoli, andothertownsalongtbeshores of the bay. In Naples itself the glove and coral industries have fal- len off, but the production of carved wood, bronze and iron bedsteads, goldsmiths' work, lithography, and artificial flowers has, under the influence of the above-mentioned Industrial Museum, considerably increased. This institution , by stimulating work, helps to educate the lower classes by raising their moral ^nd economical condition, and frequently changes the so-called camorrista into an honest artisan.

The Camorra. â€" At the time when the camorra existed as an organization young membei-s were known as garzoni di malavita, and became later picciotti di sgarroe, rising finally to the dignity of camorrista. Every quarter of the city had its own special camorra jurisdiction, called a,paranza, with its pui-seror treasurer, known as the contatore. The camorra never assumed the form of brigandage, like the Sicilian maffla, and very rarely assassinated by order. If weapons were used, they were used in duelling, or dichiaramenti, one of the last of which took place in 1892. The camorra, indeed, no longer exists in the form of an organized association, but is rather a manifestation of individual bullying, a kind of tax collected by the strong drone from the weak pro- ducer. Sometimes, however, it takes the form of obtaining by private initiative redress for injury in cases where ofiicial justice is impotent. The word camoi-ra is now replaced by the expression malavita., the members of which, always armed, or "clothed," according to their slang term, constantly use the revolver and the razor. The revolver is employed between men in a duel ; the razor is used to disfigure women in cases of jealousy, or vendetta. The authorities have made some efforts to crush out the evil, especially by exiling the worst characters to places of compulsory residence, but they are weak in dealing with the abuse. Of course, as in every large city, thieves and swindlers are plentiful ; but they are not necessarily members of the camorra, or malavita, which is now little more than a legend. It may he said in another sense, however, that the camorra has grown upwards, and that highly-placed and well-known

camoi”risti infest municipal adminis- tration and political life. During elections, both local and general, violence and corruption openly find free play. In the autumn of 1900 revelations made with regard to the power of the camorra, in the course of a libel suit, led to the dissolution of the Naples municipality and to the appointment of a royal commissioner. A Government commission of inquiry into the municipal corruption exercised by the camorra was also appointed.

The Police Service. â€” The police service is carried out by 830 policemen (agenti qtiesturini) , 547 municipal guards, 567 cara- bineers, and 1195 customs officials. It may be said that the police- men and carabineers alone perform useful service. The absence of respect for authority is noteworthy, and the crowd often takes the part of a criminal in opposition to the police. Criminality, however, shows considerable diminution. In 1899, 4420 thefts (or 1247 less than in 1898), 717 murders (or 53 less than in 1898), and 16,448 cases of wounding (or 2938 less than in 1898) were reported, an improvement which, in the opinion of magis- trates, is not to be attributed only to the severity of penalties, but also to a real improvement in the habits of the population. One of the greatest scourges of Neapolitan life is the apparently ineradicable mendicancy of a whole class of paupers, who expose to the public their real or simulated physical woes. The authori- ties appear impotent to deal effectively with this plague, and the charitable institutions are powerless, because they cannot harbour fictitious paupers who, for their part, have no desire to become inmates of institutions which would prevent them from plying a lucrative and unworthy trade.

The union of Naples with the rest of Italy, while commercially and industrially disadvantageous, has helped to improve the habits, the civilization, and the activity of the Neapolitans. In Naples the upper and middle classes are partisans of unity. The common people are indifferent. The frequency of contact with other provinces is gradually modifying customs and creating a beneficent rivalry. The consciousness of the Neapolitan that he is regarded as an inferior by his countrymen of the North and Centre, while not creating a regionalism proper, doubtless retards the moral and truly national unification of the country.

Authorities.â€” Ma liCELLiN Pellet. Naples Contemporaine. Paris, 1890. â€” .John Peter. litndes Napalitaines. Lausanne, 1882; Non.iielles iStndes Napolitaines. Lausanne,. 1887. â€” Clara EiiSKiNE Clement. Naples, the City of Parthenope, ami its Eiii'iroihi. London, Gay & Bird, 1894. â€” Charles Grant. Hlories of Niiplefi and the Camorra. London, Macmillan & Co., 1897. â€” Eustace Neville Rolfe, Naples in the 'Eighties, and Naples in the ' Nineties. Naples, E. Prass, 1899. â€” UAequedntto di Napuli ; pubblicazione della Society, Veneta. Padua, 188;'). â€" (^uida di Napoli. Morano, 1896. â€" Idem. Pellerano, 1899. â€" Bilanrio Municipalednapoli, 1900. â€" ISollettinidelV Ufficio Statistico Mnaicipnle, up to December 1899. â€" Gloria della carita Napoletana, della Duchessa Ravaschieri. Naples, 1881. (f. v.)

Napo. See Amazon.

Napoleon, Victor Jerome Frederic

(18C>'^), eldest son of Prince Xapoleon (see Boxa-

parte) and of Princess Clotilde, was born at tlie Palais Eoyal, Paris, on 18th July 1862. Upon the overthrow of the Imperial Government he went into exile with his parents, but was brought back by his father as soon as circumstances permitted, aud, notwithstanding his princely quality, received the ordinary public school education of a young Frenchman. P-v the death of his cousin the Prince Imperial (see Boxapakte) in 1879 his father became head of the Bonaparte family and the Imperialist pai-ty, a considerable section of which, notwithstanding, alarmed at Prince Napoleon's democratic and anti-clerical opinions, wished to depose him in favour of Prince Victor. The latter resisted all attempts to estrange him from his father until 1884, when he consented to place himself at the head of the more conservative, who were probably the more numerous, section of the Bonapartists. Both princes were expelled from France in 1886; the son withdrew to Brussels, the father to Switzerland, and no reconciliation ever took place. By the death of his father in 1891 Prince Victor Napoleon became undisputed head of the Imperialists, though there were some who looked hope- fully towards his younger brother Louis, a military officer in the Russian service.

Nara, the first permanent capitol of Japan, situ- ated in the province of Yamato, 25^ miles from Osaka (by rail), with a population of 30,539. Up to the beginning of the 8th century the Imperial Court changed its location at the accession of each sovereign, and the court's place of residence naturally became the official metropolis. But Nara remained the metropolis during seven consecutive reigns (709 to TSi), and its seventy- Hive years of favoured existence sufficed for the building and furnishing of several imposing shrines and -temples, for the laying out of a noble park, for the easting of a colossal image of Buddha, and for the execution of many other beautiful specimens of applied art. Xot much is known of the Nara palace in its original form, but many of the articles and ornaments used by its inmates survive in a celebrated collection which, during nearly twelve hundred years, had been preserved in a store-house con- nected with the Shoso-in. This collection cannot be visited by strangers more than once a year, and even then only by special permission. But some of the massive and beautiful temples erected in the days of the city's great- ness stand still intact, and their graceful proportions, together with the sculptures and paintings they contain, speak eloquently of a refined and even luxurious civiliza- tion.

Not less remarkable was tlie vigorous growth of the Buddhist creed throughout the Nara epoch. This faith in the 8th century assumed the dimensions almost of a mania, and found outward expression in many striking .orchitectui-al and artistic works. The best of these, namely, those dating from the first half of the cen- tury, show Indo-Grecian affinities, which gradually grow fainter as the end of the epoch approaches. The huge bronze image of Loeh.'ina Buddha in the temple called Todai-ji is often spoken of as the most remai'kable of the Nara relics ; but however beauti- fully proportioned the great idol may have been originally, clumsy restorations in consequence of fires and otlier accidents have so marred it that it can no longer be compared with many smaller examples of contemporaneous and subsequent sculpture. M(ire worthy of close attention are two effigies of Bralima and Indra preserved among the relics of Kobuku-ji, which, with Kasuga-no-Miya, Ni-g\vatsu-d6, and TOdai-ji, constitute the chief religious edifices. These figures, sculptured in wood, have suffered much from the ravages of time, but nothing could destroy the grandeur of their proportions or the majesty and dignity oftheir pose.

Several other works of scarcely inferior excellence may be seen among the relics, and at the shrine of Kasuga is performed a religious dance called Kagura, in which the costumes and ges- tures of the dancers are doubtless the same as those of twelve

centuries back. Although a railway now gives access to the town, Nara has not suffered at the hands of the iconoclast. Every effort is made to preserve all the ancient features in their entirety. A museum has been formed, where many antique objects of great interest are displayed, as well as works from the hands of comparatively modern artists. Nara in the days of its prosperity is said to have had a population of a quarter of a million. (f. by.)

Narbonne, chief town of arrondissement, depart- ment of Aude, France, 37 miles east of Carcassonne by- rail. The remains of the ancient fortifications in the vicinity of the railway station have been removed and the site occupied by a new and well-built quarter. An cenological station was formed in 1894. Population

(1881), 25,076; (1891), 24,640 ; (1901), 28,892.

Nares, Sir George Strong (1831-

-‘), British

vice-admiral and Arctic explorer, son of Captain W. H. Nares, K.N., of Aberdeen, was born in 1831, and after passing through the Eoyal Naval College at New Cross, entered the Navy in 1846. His first experience of the Arctic regions was in the Resolute (1852-64), with Mecham ; and he subsequently served in the Crimea, and was employed in surveying work in different parts of the world. Between 1872 and 1874 he commanded the Challenger in the famous voyage of deep-sea exploration. In 1876 Captain Nares was appointed to command the Alert in the Arctic expedition of that year, in company with the Discovery (Captain Stephenson). In the face of unparalleled difiiculties ‘he took the ships farther north than had been

reached before (82Â° 27′ N.), and after en- countering the greatest difficulties and hardships, he brought the ships both safely home in October 1876. It was on this expedition that Lieutenant (afterwards Ad- miral) A. H. MarlAam, with sledges, reached 83Â° 10′ 26″ N. On their return Nares was made K.C.B. ; and in. 1878 he was sent in command of the Alert to survey Magellan Strait, South America. From 1879 to 1896 he was attached to the Harbour Department of the Board of Trade. He became a vice-admiral in 1892. Sir- George Nares published various accounts of his explorations, and a Naval Gadets' Guide, which went through several editions. (See also Polae Kegions, Geogeapht.)

Narni, a town and bishop's see in the province of Perugia, Umbria, Italy, on a height (1191 feet) above the Nera, 8 miles by rail south-west of Terni. The cathedral dates from the 13th century. There are remains of the bridge of Augustus, and of an ancient aqueduct. The town has mineral springs. , Narni was the birthplace of the Emperor Nerva, of Pope John XIII. (965-972), and of the 16th-century condottiere, Erasmus of Narni, known as Gattamelata. There have been bishops since the year 369. Population about 3000.

Narsinghgarh, a native state of Central India, in the Bhopal agency. Area, 623 square miles. Population (1881), 112,427; (1891), 116,280; average density, 186 persons per square mile. Estimated revenue, Es. 6,00 ,000 ; tribute to Holkar, Es. 86,000. The chief, whose title is raja, is a Eajput of the Omat clan. The state vas founded about 1681 by a minister of Eajgarh, who com- pelled the ruler of that state to transfer to him half his territory. The present raja is a minor, and is being educated at the Daly College at Indore, while the admin- istration is being conducted uijder British supervision. The town of Narsinghgarh is situated in 23Â° 42′ N. and 77Â° 5′ E. Population (1881), 11,400 ; (1891), 8661.

Narsinghpur, a town and district of British India, in the Nerbudda division of the Central Provinces. The town is on the river Singri, a railway station 52 miles east of Jubbulpore. Population (1881), 10,222 ; (1891),

10,220.

The district of Narsinghpuk has an area of 1916 square miles population (1881), 365,173; (1891), 367,026; (1901), 313,829 showing a decrease of 14-5 per cent, between 1891 and 1901 average density, 164 persons per square mile, being the highest for any rural district in the province. The land revenue in 1897-98 was Rs.6,28,325, the incidence of assessment being K.0.9.5, the highest rate in the province; cultivated area (1897-98), 545,278 acres, of which 3141 were irrigated ; number of police, 355 ; boys at school (1896-97), 6307, being 22-8 per cent, of the male popu- lation of school-going age; registered death-rate (1897), 73-65 per thousand. The principal crops are wheat, rice, millet, pulse, oil- seeds, and cotton. There are manufactures of cotton, silk, brass, and iron-ware. At Mohpajai is a coal-mine, which employs about 276 persons and has an output of 22,472 tons. The Great Indian Peninsula railway runs through the district for 70 miles, with seven stations, besides a branch to Mohpani.

Narva {Rugodiv of Eussian annals, also Ivan-Oorod), a seaport and fortress of Eussia, government and 100 miles west of St Petersburg, on Narova river, which flows from Lake Peipus or Chudskoye, and enters the Gulf of Finland in Narva Bay (100 miles long and 55 miles wide), 8 miles below this town. Only ships of 7 feet draught can enter the river. The town was founded in 1223 by Danes, and changed hands between Teutonic knights, Danes, Swedes, and Eussians until it was taken by Peter I. in 1704, after the Eussians had suffered a terrible defeat four years before. Its fortress, built on the right bank of the river, and known as Ivan-Gorod, has lost its importance, and is abandoned. The cathedral and the town hall (1683) contain many interesting antiquities. The population in 1897 was 16,577. There are two gymnasia for boys and for girls, a navigation school, and an Esthonian school. It has several important manu- factories on the waterfalls of the Narova â€” cotton-mills (388,812 spindles, Â£971,500 yearly returns), woollen cloth mills (12,300 pieces of cloth), flax and jute mills, saw mills, and steam flour mills. The port is visited every year by about a hundred vessels. A wealthy watering- place has grown up at Ust-Narova, or Hungezburg, at the mouth of the Narova.

Narvacan, a town near the centre of the province of South Ilocos, Luzon, Philippine Islands, and a mile from its Pacific coast. It lies in a level valley surrounded by mountains, and has a cool and healthful climate. The soil,

not only in the valley, but also on the neighbouring mountain-sides, is very fertile, and produces rice, Indian corn, cotton, tobacco, and sugar-cane. Many of the in- habitants manufacture salt from sea-water, and others cut and market the hard-wood trees of the adjoining forests. Cotton fabrics are woven by the women and sold to the pagan mountain tribes. The language is Ilocano. Popu- lation, 16,000.

Nashua, a city of New Hampshire, U.S.A., capital of Hillsboro county, on the Nashua river, at its junction with the Merrimac, and on the Boston and Maine railroad, in the southern part of the state, at an altitude of 120 feet. The city has an irregular plan, is divided into nine wards, and derives its water, supply from Pennichuck creek by pumping. Its prominence as a manufacturing city is due to the fine water-power derived from the rivers. Its manufactures are varied, consisting largely of cotton, iron and steel goods, and paper. Population (1890), 19,811; (1900), ‘23,898, of whom 8093 were foreign-born and 62 negroes.

Nashville, the second largest city of Tennessee, U.S.A., capital of Davidson county and of the state, on both banks of the Cumberland river, which, is here navigable, near the centre of the state, and at an altitude, at the Union depot, of 435 feet. The city is irregularly laid out, on a hilly picturesque site, is divided into 20 wards, has an excellent water supply, owned by the city, and is paved in the business parts with.

brick and granite blocks, while the residential streets are macadamized. Several lines of the Louisville and Nash- ville, and the Nashville, Chattanooga, and St Louis railways furnish communication in all directions. Besides the state buildings and institutions, Nashville contains several institutions for higher education. Among them are Vanderbilt University, with, in 1899, 93 instructors and 766 students ; the University of Nashville, with 70 instructors and 1.306 students ; Roger Williams University, with 9 instructors and 130 students ; Fisk University (for coloured), with 31 instructors and 249 students ; and Central Tennessee College (also for coloured), with 36 in- structors and 327 students. All these institutions are

co-educational. There are also two colleges for women. In 1890 the manufacturing establishments numbered 420, with a capital of $9,904,295. They employed 8122 hands, and the products had a value of $14,590,823. These products were varied, the only item of import- ance being lumber. Near Nashville are the Hermitage, the home of General Andrew Jackson; Belle Mead, a famous stock farm; and a national cemetery. The assessed valuation of property, real and personal, was in 1899, $36,429,396, the net debt of the city was $3,413,500, and the rate of taxation $24.60 per $1000. Population (1890), 76,168, of which only 3794 were of foreign birth and 29,395 were coloured; in 1900, 80,865, of whom 3037 were foreign-born and 30,044 negroes.

Nasik, a town and district of British India, in the Deccan division of Bombay. The town is on the G-odaveri Eiver, 4 miles from a railway station, 117 miles north-east of Bombay. Population (1881), 21,660 ; (1891), 24,429. Nasik is a very holy place of Hindu pilgrimage, being 30 miles from the source of the Godaveri. It has manu- factures of cotton goods, brass-ware, and mineral waters, besides a high school, with 375 pupils in 1896-97, and four printing-presses, each issuing a vernacular news- paper.

The district of Nasik has an area of 5940 square miles ; popular tion (1881), 781,206; (1891), 843,582; (1901), 819,575, showing an increase of 8 per cent, between 1881 and 1891, but a decrease of 2-8 per cent, between 1891 and 1901 ; average density, 138 persons per square mile. The land revenue and rates in 1897-98 wqre Rp.19,80,547, the incidence of as.sessment being R.0.11.2 per acre ; cultivated area (1897-98), 1,830,000 acres, of which 92,309 were irrigated from wells, &c., including 23,312 acres from Government canals ; number of police, 947 ; children at school (1897-98), 16,479, being 1-9 per cent, of the total population; registered death-rate (1897), 54-77 per thousand, being the highest in the province. The principal crops are millet, pulse, wheat, and oil-seeds. Yeola is an important centre for weaving silk .and cotton goods ; there are flour-mills at Malegaon, and the railway workshops at Igatpuri employ 400 hands. There are cantonments at Deolali and Malegaon. The district is crossed by the main line and also by the chord line of the Great Indian Peninsula railway.

Nasirabad, or Mymensingh, a town of British India, headquarters of Mymensingh district in Bengal, situated on the left bank of the old channel of the Brahana- putra, which is- only navigable during the rainy season. It is the terminus of a branch of the Eastern Bengal railway from Dacca (76 miles), which has been extended to Jagannathganj, on the Jamuna or main stream of the Brahmaputra (56 miles). Population (1881), 10,561; (1891), 11,555. The high school had 290 pupils in 1896-97. The earthquake of 12th June 1897 destroyed the church and the high school, and seriously damaged other public buildings.

Nasmyth, James (1808-1890), Scottish engi- neer, was born in Edinburgh on 19th August 1808, and was the youngest son of Alexander Nasmyth, the ” father of Scottish landscape art.” He was sent to school in his native city, and then attended clashes in chemistry, mathe- matics, and natural philosophy at the University. From an early age he showed great fondness for mechanical

pursuits, and the skill he attained in the practical use of tools enabled him to make models of engines, &c., which found a ready sale. In 1829 he obtained a position m Maudslay’s works, where he stayed two years, and then, in 1834, started business on his own accoiint in Manchester. The beginnings were small, but they quickly developed, and in a few years he was at the head of the prosperous Bridgewater foundry at Patricroft, from which he was able to retire in 1856 with a fortune. The invention of the steam-hammer, with which his name is associated, was actually made in 1839, a drawing of the device appearing in his note-book, or ” scheme-book,” as he called it, with the date 24th November of that year. It was designed to meet the difficulty experienced by the builders of the Oreat Britain steamship in finding a firm that would under- take to forge the large paddle-wheel shaft required for that vessel, but no machine of the kind was constructed till 1842. In that year Nasmyth discovered one in Schneiders’ Creuzot works, and he found that the design was his own and had been copied from his ” scheme-book.” His title, therefore, to be called the inventor of the steam-hammer holds good against the claims sometimes advanced in favour of the Schneiders, though apparently he was anticipated in the idea by Watt. Nasmyth did much for the im- provement of machine-tools, and his inventive genius devised many new appliances â€” a planing-

machine (” Nasmyth steam-arm “), a nut-shaping machine, steam pile-driver, hydraulic machinery for various purposes, &c. In his retirement he lived at Penshurst in Kent, and amused himself with the study of astronomy, even publishing a book on the moon in conjunction with Carpenter. He died in London on 7th May 1890. His Autobiography, edited by Dr Samuel Smiles, was published in 1883.

Nasr-ed-Din (1829-1896), Shah of Persia, was born 4th April 1829. His mother, a capable princess of the Kajar family, persuaded Shah Mohammed, his father, to appoint him heir apparent, in preference to his elder brothers ; and he was accordingly made governor of Azer- baijan. His succession to the throne, 13th October 1848, was vigorously disputed, especially by the followers of the reformer El Bab, upon whom he wreaked terrible vengeance. In 1855 he re-established friendly relations with Prance, and coming under the influence of Russia, signed a treaty of amity, 17th December 1855, with that Power, but remained neutral during the Crimean war. In 1856 he seized Herat, but a British army under Outram landed in the Persian Gulf, defeated his forces, and com- pelled him to evacuate the territory. The treaty of peace was signed at Paris, 4th March 1857, and to the end of his reign he treated Great Britain and Russia with equal friendship. In 1866 the Shah authorized the passage of the telegraph to India through his dominions and reminted his currency in the European fashion. In 1873, and again in 1889, he visited England in the course of his three sumptuous journeys to Europe, 1873, 1878, 1889. The only results of his contact with Western civilization appear to have been the proclamation of religious toleration, the institution of a postal service, accession to the postal union, and the establishment of a bank. He gave the monopoly of tobacco to a private company, but was soon compelled to withdraw it in deference to the resistance of his subjects. Abstemious in habits, and devoted to music and poetry, he was a cultured, able, and well-meaning ruler, and his reign, already unusually long for an Eastern potentate, might have lasted still longer had it not been for the un- popular sale of the tobacco monopoly, which was probably a factor in his assassination at Tehran on 1st May 1896, by a member of the Babi faction. He was succeeded by his son Muzaffer-ed-din.

NATAL.

I. Geogbapht and Statistics.

THE area of Natal was increased at the latter end of 1897 by the annexation of Zululand, including the British AmatongalandProtectorate. The colony comprised in 1901 an area of 31,307 square miles, with a seaboard of 376 miles. Lying between the 26th and 32nd parallels of S. latitude, it was bounded on the N. and N.W. by the Portuguese possessions and the Transvaal Colony (late South African Republic), on the W. by the Orange River Colony (late Free State) and Basutoland, and on the S. by the Cape Colony and IJmtamvuna river. The area of the province of Zululand is estimated at 10,456 square miles, in- cluding the lake of St Lucia, which is about 680 square miles in extent. Nearly one- third of the province is comprised of a low- lying belt along the sea coast, from 20 to 30 miles in width, extending from the Umhlatuze river to the Portuguese posses- sions, which form its northernmost boundary. This belt is, for the most part, marshy, sparsely populated, and unhealthy for Euro- peans, especially during the midsummer months. The remainder of the country consists chiefly of an elevated plateau vary- ing from 1000 to 6000 feet in height, and the climate here is healthy ~~for Europeans. These uplands are abundantly watered, and to a considerable extent are suitable for both pastoral and agricultural purposes, particu~~ larly towards the west, south of the Umhla- tuze river. Maize and other cereals form the principal articles of cultivation. All the magistracies are connected by waggon road, and regular postal communication is maintained between them by means of native runners.

As the result of the Boer war, a further addition was made in 1902 to the territory comprised in ISTatal, consisting of a portion of what had previously been included in the Transvaal Republic. The addition resulted from communications which passed between the Natal Government and Lord Milner at the end of 1901, and was sanctioned by the Imperial Government jn March 1902. The Natal Government originally made two proposals for annexing uew territory : â€”

1. It was proposed that the following districts should be transferred to Natal, viz., the district of Vryheid, the district of Utrecht, and such portion of the dis- trict of Wakkerstroom as was comprised by a line drawn from the

north-eastern corner of Natal, east by Volksrust in a northerly direction to the summit of the Drakensberg Range, along that range, passing just north of the towp. of Wakkerstroom, to the head waters of the Pongola river, and thence following the Pongola river to the border of the Utrecht district. In consideration of the advantage to Natal from this addition of territory. Natal should take over Â£700,000 of the Transvaal debt.

2. It was proposed to include in Natal such portions of the Harrismith and Vrede districts as were comprised by a line following the Elands river north from its source on the Basutoland border to its junction with the Wilge river, and thence drawn straight to the point where the

boundaries of Natal, the Transvaal, and the Orange River Colony meet on the Drakensberg. In consider- ation of this addition to her territory. Natal should take over a portion of the Orange River Colony debt, to be raised at the end of the war to the amount of Â£200,000.

The Imperial Government decided to sanction only the first of these two proposals, the reasons for this decision with the result to Natal, being indicated in the following passage from Mr Chamberlain's despatch in March 1902 on the subject :â€" " The (1902) existing boundary between Na-

landon â€¢ St^nfbfV^'s Seqgl Â£stsbt

Sketch Map of Natal.

tal and the Transvaal is not marked by strong natural di- visions, and is undoubtedly inconvenient â€" large wedges of Transvaal territory being interposed between the northern partof Natal and Zululand, while the natives of the districts to be transferred are closely allied to those of the adjoining portions of Natal. With regard to Vryheid this is pre- eminently so. The natives of Vryheid are Zulus, and still, as I understand, consider themselves as part of the nation ; and it therefore will be a natural and convenient arrange- ment that they should be placed under the Zululand administration. The district was only separated from the rest of Zululand in 1883 by a raid of armed Boers, who established a republic, which was incorporated in the late South African Republic in 1888. In handing over

this district to the administration which controls the rest of Zululand, His Majesty's Government feel that they are reuniting what ought never to have been separated. With regard, however, to the proposed transfer of territory from the Orange River Colony, the circum- stances are different. There is no such historical reason

as exists in the case of Vryheid for making the transfer. On the contrary, the districts in question have invariably formed part of the state from which it is now proposed to sever them, and they are separated from Natal by mountains which form a well-delined natural boundary. In these circumstances. His Majesty's Government have decided to confine the territory to be transferred to the districts in the Transvaal. These districts, according to such statistics as are available, appear to contain not less than 8000 white inhabitants and some 50,000 natives, and have an area of upwards of 7000 square miles, which will mean an addition to the white population of Natal of about one-seventh, to her native population of about one-sixteenth, and to her territory of about one-fourth."

Geology. â€" The geology of Natal and Zululand resembles to a great extent that of Cape Colony. The physical features are also very similar. In both cases the upland plateaux consist of the more or less horizontally bedded rocks of the Karroo formation, with its included coal and iron deposits ; and here and there local outcrops of older sedimentary and metamorphic rocks have been exposed by denudation. This formation has produced interesting collections of fossil Reptilian and Batrachian remains, while in its coal-bearing series several genera of plants occur, together with the remains of Palaeoniscid fish. Eeptilian remains have been found in the neighbourhood of Weston, on the Mooi river and other localities in the Drakensberg, while fossil fish have been reported from the Biggarsberg. The coastal area of Natal and the southern portion of the littoral of Zululand are formed chiefly of Dwyka Conglomerate with the overlying Eeca shales, while the northern littoral of Zululand consists of E.ecent and Pleistocene sands overlying

Mesozoic beds of Upper Cretaceous age. The Dwyka Conglomerate is extensively quarried near the mouth of the IJmgeni river near Durban. In places distinct and undoubted evidence exists of the glacial conditions which obtained during its deposition. On the western side of the Inchanga granite this formation forms an extensive outcrop which extends through the colony. To the west of this outcrop the Dwyka and Ecca beds pass under the Karroo forma- tion, and practically exist underlying that formation across the whole South African continent until they again crop out in the district of Kimberley, Griqualand West, and Bushmansland. The country intervening between the upland plateaux and the coastal area consists of granite, metamorphic, and sedimentary rooks which are older than the Dwyka Conglomerate, but which have not yet been satisfactorily correlated with the pre-Mesozoic rocks in other parts of South Africa. Of sedimentary rocks we have the horizontally and false-bedded sandstone series, which form the flat-topped mountains so characteristic of this region, and are classed by Dr Sutherland and Mr Griesbach as Table Mountain sandstones, and by Mr E. J. Dunn as belonging to the Witteberg and Zuurberg series of Cape Colony. Exposures of the fundamental rocks of the colony, granites, gneisses, and schists, occupy a considerable belt of country, passing from the coast near Port Shepstone in a north-easterly direction through Natal by In'ohanga and the Noodsberg Mountain, and extending into Zululand, where they are exposed in the valleys, in the western portion of the province as far north as Melmoth, by the denudation of the overlying coal-bearing formation. To the east of Eshowe the Ungoye Mountains are formed of these rocks, and in the neighbourhood of the Hlabisa magistracy a small area of granite occurs. The minerals that are known to occur in the colony have chiefly been discovered in these gran- itic and metamorphic areas. Eepresentatives of the for- mations younger than the Karroo are of rare occurrence, and are only present as outliers on the coast. These

consist of rocks of Upper Cretaceous age. Wherever they are exposed these rocks contain large quantities of marine organisms. Erom a comparison of these fossils with those from the Cretaceous rocks of Southern India it has been deduced that they are of the same age as the Triehinopoly series of India. In the case of one form, Ammonites Gardeni, its occurrence is common to the Upper Cretaceous of Southern India, Australia, and Van- couver Island, Canada. In the neighbourhood of Lake Sibayi, towards the

borders of Amatongaland, beds of Chalk occur, associated with the fossiliferous rocks. From the highest beds of the Karroo formation down to the lowest portion of the Ecca, the whole series is seamed with intrusive dykes and sills of volcanic rock, chiefly of a basaltic type, and rarely showing olivine as a constituent. In the coal-producing areas the intrusion of these basaltic rocks in close proximity to the seams of coal has frequently rendered them of little value by con- verting them into anthracite coals of inferior quality or altogether burning them up. There are few, if any, coal-seams which have not locally undergone alteration or destruction from this cause. Natal possesses a valuable coalfield in Klip River county. In 1881 Mr F. W. North, who was engaged by the Government to report on the coalfields of the colony, estimated for the coalfield re- ferred to ” a total area of 1350 square miles that may be depended upon for supply.” The number of producing collieries in 1898 was seventeen, situated between Elands- laagte and Newcastle.

The comparative outputs in the years specified were : â€”

1889.

25,609 tons.

1S94. 141,010 tons.

387,81l’tons.

1901.

567,460 tons.

A coalfield which will probably be of equal value exists in the coast and northern districts of Zululand, but in the absence of means of transport it is unworked. The area is at present very imperfectly known, but may be about 800 square miles. When opened the coal appears, as a rule, to be harder than in the Klip river coalfields, the general difference in the nature of the coals being somewhat similar to that between the Welsh and North of England coals. Near the Umlalazi river, on the Zulu- land coast, however, bituminous coals are found. The thickest seam worked on the Klip river

coalfields gives 6 feet 3 inches of coal. One seam opened in a shaft near the Ingalazi river in Zululand gives over 40 feet of coal when cut, but diminishes in thickness away from the shaft. Iron ore and limestone are found on both the coalfields mentioned, but no iron-smelting is at present carried on. i

Climate. â€”The following is the mean for the twelve years 1885-96 :â€”

Mean of Temperature. Maximum Mean Minimum . Rainfall in inches

Defrrees.

80-42 71-82 61-50 40-19

Population. â€” The following return shows the increase of population at intervals of five years : â€”

Tear.

Europeans.

Indians.

Natives.

Total.

1874

18,646

6,787

281,797

307,230

1879

24,054

10,999

319,934

361,587

1^84

35,453

27,270

361,766

424,495

1889

87,390

33,480

459,288

530,158

1894

45,707

35,411

503,208

584,326

1898

63,688

61,103

787,574

902,365

The returns for 1898 include the population returns for the province of Zululand, viz., Europeans, 1305 ; Indians, nil ; natives, 200,330. Of the Indian population, a lai’ge number are under indenture of service in the colony. Of

statistics]

the European population, one-fifth approximately is of Boer extraction. The two principal towns of the colony- are Durban (q.v.) and Pietermaritzburg (q.v.). The third in importance is Ladysmith, situate 119^ miles from Durban on the main line to Johannesburg. It is a military- station, and has a population, exclusive of troops, of 1800 Europeans, 1200 Indians, and about 1000 natives. New- castle, 268 miles by rail from Durban, has a population of about 1200 Europeans, and about 1100 coloured people. The four above-inentioned towns have municipal corpora- tions. Other towns are : Dundee, the centre of the coal- mining industry, with a population of about 2000 ; Verulam, the principal town of Victoria county, distant 20 miles north of Durban, with total population of about 1000; Greyto”wn, Estcourt, Harding, Richmond, Stanger, Howick, Pineto-wn, Umzinto, Weenen, Port Shepstone, Eshowe (Zululand).

The Registrar-G-eneral gave the following returns for 1898 :â€”

Total marriages (by Christian rites) . . . 1211

Total births 2713

Total deaths 1075

Increase of population by births over deaths . 1638

The above returns do not include natives or Indians, there being no complete system of registration as far as they are concerned.

The following is an abstract of the religious returns : â€”

Denomination, Church of England Church of Rome .

Pitidfis of Worship.

120 23

Average Attendance

10,070 7,040

Wesleyan Methodist Other .

405 226

26,656 18,984

A comparatively small number of the South African natives have embraced Christianity.

Constitution. â€” The affairs of the colony were ad- ministered, under the Eoyal Charter of 1856, by a Governor assisted by an Executive and a Legislative Council up to 1893, in which year responsible”- government - was established. The legislative Council, consisting of twelve members, is summoned by the governor in council. The Legislative Assembly is an elective body, and consists of thirty-nine members. There are fifteen electoral dis- tricts, including two for the province of Zululand. The ministers, six in number, must hold seats either in the Legislative Council or Legislative Assembly.

Instruction. â€” Education is not compulsory, nor is it free, except where it is certified that the parents or guardians are unable to pay the school fees. Of the European children, but a very small proportion do not receive education at one or other of the schools. The number of schools under Government inspection is as follows : â€”

European

Native

Indian

Attendance

303

8,674

184

10,243

32

3,214

519 22,131

Included in the above are the following Government schools : â€”

High schools . Primary schools Model

Attendance.

2 264

^}

25

4834 5098

The number of free pupils attending Government schools during the year 1899 was 470. The school fees paid into the treasury for the year ending 30th June 1899 amounted to Â£7904. The expenditure by Government on education for year ending 30th June 1899 was Â£56,048. Although education in Natal is for the most part controlled by Government,. there are a good many schools, both primary and secondary, which are not under inspection. These

private and denominational schools are mostly doing excellent work. To encourage the instruction of the children of farmers and others who reside so far from a Government or Government-aided school that they cannot avail themselves of the education therein provided, the Government pays grants-in-aid at the rate of Â£3 for each pupil under Standard VI., and Â£4 for each pupil in Standards VI. and VII., attending farm schools. An excellent cadet system is in force at all the Government boys' schools, and is very popular. Under this system the boys receive a military training, are taught the use of firearms, and attend an annual encampment.

Finance. â€" The following are the figures for revenue and expenditure : â€"

Kevenue, Expenditure.

1874 -Â£249,249 Â£254,402

1879 . ... 473,478 490,826

1884 610,987 707,529

1889 1,327,105 1,146,080

1895-96 1,169,781 1,148,094

1898-99 2,019,361 1,951,835

â– The largest items of revenue are derived from the railway, customs, and native hut tax. The public debt, which in 1874 was Â£331,600, amounted in

1898-99 to Â£9,019,143.

Defence. â€” Before the Boer war (1899) a large force of Imperial troops was stationed in the colony, the principal garrison towns being Pietermaritzburg and Ladysmith. The local forces consisted of the Natal Police (650 mounted Europeans, 45 Indian constables, and 900 natives) and volunteers numbering nearly 2000, chiefly mounted. Eifle associations also existed all over the colony. Two batteries, of two 6-inch B.L. guns each, commanded the approach to Durban harbour, the guns being manned by the Natial Naval Volunteers.

Stock. â€” Generally speaking, it may be said that the country over a belt of fifteen miles along the coast is unsuited for stock-farming. Horse-breeding is successfully carried on in the upper districts. The higher the altitude the healthier the animals and the greater their immunity from disease. Horse-sickness, a kind of malarial fever, which takes an epidemic form in very wet seasons, causes considerable loss. Cattle-breeding is probably the most lucrative branch of stock-farming, the country being pre- eminently adapted for horned cattle. Rinderpest recently swept through South Africa, and probably carried off in Natal from 30 to 40 per cent, of the stock of Europeans, while the natives' losses were even heavier. Serum and bile inoculation were undoubtedly the means of saving a very large percentage of the herds. The farmers soon began to recover from their losses. Attention has been given to improving the breed of cattle by the introduction of Shorthorn, Devon, and Holstein (or Eriesland) stock. The principal breed of sheep is the merino, which does well in the higher altitudes. A Scab Act is in force, and is stringently carried out by Government inspectors, with most satisfactory results. The Angora goat thrives well in certain districts. Ostriches do well in the dry, arid valleys of the Tugela and]\Iooi rivers. Summary of stock on 31st December 1898 :â€”

Description.

European.

Indian.

Native.

Total.

Horses . Cattle . Sheep . Goats Pigs Mules Donkeys Ostriches

32,771

155,456

543,619

98,510

15,081

2,800

1,360

720

593

1025

7

2352

1124

24,611 122,077

56,403 351,528

20,499

57,975

278,558

600,029

452,390

36,704

2,300

1,360

720

849,817

5101

575,118

1,430,036

These figures are inclusive of the province of Zululand.

80

NATAL

[statistics

Agriculture. â€” Mealies (or maize) continue to be the chief crop, forming the staple food of the natives. Tea is now being largely grown in the coast districts, and the industry is likely to increase in importance. Already the annual yield exceeds a million pounds, and it is be- lieved that other districts will be found suitable for the growth of the plant. Sugar continues to be an important coast product; the output of 1898 was 30,000 tons. Large quantities of the black wattle tree (Acacia mol- lissima) are now being grown, the bark forming an important article of export. The value of the bark shipped in 1898 was Â£57,888 ; the wood of the tree also commands a ready sale. The cultivation on the coast of tropical fruits, such as pineapples, bananas, mangoes, citrus fruits, &e., is being annually

extended. Other fruits â€” apples, peaches, plums, pears, &c. â€” do well in some of the midland and upper districts.

Commerce. â€” In 1898 a Customs Union Convention was concluded between the Governments of the Cape Colony, Orange Free State, and Natal “on the basis, firstly, of a uniform tariff on all importedlgoods con- sumed within the union; and secondly, of free trade between the colonies and states in respect of all South African products.” The union tariff imposes taxes on imported foods and other goods the like of which is pro- duced within the union, and allows the free importation of articles used in such production. The Transvaal did not join the union, but the Convention made provision for a rebate of the whole or any part of the customs duty on imported goods removed to a country outside the union. Of the total imports of merchandise into the colony, about one-third are entered in transit for the Transvaal. The following are the trade and shipping returns for the years specified : â€”

Tear.

Imports.

Exports.

Customs Eevenue.

Shipping. 1

Entered.

Cleared.

1874 1879 1884 1889 1894 1899 1900 1901

Â£

1,121,948 2,176,356 1,675,850 4,527,015 2,316,596 5,359,259 5,912,000 9,416,000

Â£

770,034

583,711

957,918

1,656,318

1,197,611

3,097,184

1,135,320

4,268,820

Â£

109,725 228,558 179,908 369,461 193,199 430,699 655,040 812,375

tons.

64,156

207,029

210,181

513,360

732,997

1,367,306

1,417,539

1,826,526

tons.

62,128

205,054

212,604

499,748

730,925

1,381,346 ”

1,405,180

1,767,900

In addition there were imported goods overland to the value of Â£161,000 in 1900 and of Â£233,000 in 1901. The analysis, as far as can be stated, of the imports for 1901 was as follows ; â€” British manufacture, Â£6,523,000; colonial and Indian, Â£1,416,000; United States, Â£719,000; foreign, Â£898,000. The exports in- clude goods sent in transit to the Transvaal.

Railways. â€” There are open for public traffic in Natal 545 miles of rails of single line and of the standard gauge for South Africa, viz., 3 ft. 6 in., the whole being worked by the colonial Govern- ment. The main lines extend from the port of Durban to Pietermaritzburg, the capital, 70 miles inland, and from thence to Charlestown, on the border of the Transvaal (309 miles distant from port), where it connects with the line to Johannesburg and Pretoria. Near Ladysmith (190^ miles from the port) there is a line of 69-^ miles to Harrismith, Orange Eiver Colony, the property of, and worked by, the Natal Government. Among the extensions is one from Pieter- maritzburg to Greytown (64| miles), of which 40 miles have been opened to Dalton. Another extension from Coal Fields, the terminus of the Dundee branch line to the Buffalo river (13 miles), is in hand, and will form the Natal section of the line between Vryheid, in the

Transvaal, and Natal. A branch line extends northwards from Durban to the Tugela (70 miles), the terminus of the North Coast extension, at the border of the province of Zululand. Another branch runs from South Coast Junction (5 miles from Durban) to Park Rynie (SQ miles), and an extension of that branch to Port Shepstone (about 36 miles) is in course of construction,, as well as a branch of 7 miles to Umzinto. The work of railway con- struction was begun in January 1876, and the sections then authorized were completed in November 1880. Two subsequent sections of 119 and 114 miles respectively were sanctioned, and the last, which completes the main line to Charlestown on the border of the Transvaal, was opened for passenger traffic on 7th April 1891, and for goods traffic on 1st August 1891. The line to Harrismith was opened for traffic on 14th July 1892, with a mileage of 69^ miles, 23^ of which runs through Orange Eiver Colony. Connexion with Johannesburg and Pretoria was opened at the close of 1895. As might be expected in a country possessing the physical features of Natal, the gradients and curves are exceptionally severe. Out of the present mileage not less than 43 miles are upon grades of 1 in 30 and 1 in 36, and curves of 300 to 350 feet radius, while on over 100 miles more there are grades under 1 in 60 and curves of less than 450 feet radius. The main trunk line reaches an altitude of 3054 feet above the level of the sea at a point 68 miles distant from Durban ; after falling 1000 feet in its further progress to Pietermaritz- burg, it again rises, 12 miles after leaving that city, to a height of 3700 feet above the sea; at a point 134 miles from Durban it has reached an altitude of 5152 feet, but on reaching Ladysmith, 191 miles from Port Natal, the altitude has decreased to 3284 feet. The summit of the Biggarsberg chain is crossed at a point 233 miles from the port, at a height of 4800 feet, and when the border is reached, after crossing the western slope of the Drakensberg mountains, the train will have again gained a higher eminence than ever, the altitude being about 5400 feet. The Orange Eiver Colony line, after leaving Ladysmith, ascends by steep gradients the whole of its own course in Natal territory, and when it gains the border on the summit of the more easterly point of the Drakensberg range, it is 6500 feet above the sea. In view of the great development of South Africa, every possible means is being taken in surveys to get lines with easier grades than the earlier lines, even at an enhanced first cost, it being found that the difficulties and expenses connected with working over steep gradients far

outweigh the interest on the ad- ditional capital expenditure involved in obtaining better lines.

The following is a summary of railway statistics cover- ing a period of 19 years : â€”

Miles of

No. of

Tonnage

Capital in-

Net Receipts

Tear.

Line open.

Passengers

of

vested on

Average.

conveyed.

Goods.

Open Lines.

Capital.

diture.

1881

,??^

427,969

171,081

Â£1,204,416

Â£4 IS 10

Â£173.109

Â£113,5^7

110

424,36T

192,457

Â£2,S94,414

0 5 5

Â£185,648

Â£142,,‘iil’>

285

641,648

801,768

Â£S,6.’)0,591

5 4 8

Â£606,718

Â£416,896

189.’)

401

422,002

898,879

Â£6,117,211

4 10

Â£526,494

Â£27S,7.‘i6

1899

518

1,428,817

976,987

Â£7,267,588

4 5 7J

Â£940,100

Â£62S,942

the

Harbour Works. â€” A very important feature in the pro- gress of the colony is the success of the works undertaken to reduce the difficulties presented by the sandbar at the entrance to Durban harbour. These works comprise

chiefly a south breakwater and north pier, narrowing the entrance to 600 feet. Powerful dredgers are also constantly at work on the bar. The effect of these operations has been to treble the depth of water, as will be seen from the following return of average depths on the bar at low water, o.s.t. : â€”

1874.

6′ 61″

1SS4. V If”

1.SS9, 11′ i"

1894. 11′ 11′

19′

history]

NATAL

81

The rise of tide is 6 feet at springs, and 4 feet 1 inch at neaps. The tonnage of ships entering the harbour has increased from 69,532 in 1884 (no previous returns) to 1,147,636 in 1899. The length of wharfage has increased from 266 feet in 1874 to 4900 in 1899, and the area covered by wharf sheds is 26^ times greater than it was in 1884, while the port revenue has more than doubled in that time. The annual expenditure on the work required to effect these changes has of course been con- siderable,‘and amounted during 1899 to Â£136,900. No further extension of the outer works is at present con- templated, but the superstructure of the north pier has yet to be finished. The construction of a quay wall with sheds, hydraulic cranes, lines of way, &c., is being rapidly pushed forward. The depth along the quay wall is 23 feet below low water, and it is proposed later to provide a depth of 27 feet alongside at low water. The site of the quay wall and part of the timber wharfage was a few years ago banks dry at half tide : a vessel of 10,200 tons can now be moored at one of the berths of this part of the

wharf. There are seven dredgers and two steam hopper barges constantly employed, and the annual output from them is about 3,000,000 tons.

Banking and Credit.

Capital subscribed .... Â£8,255,110

Paid up 3,211,238

Notes in circulation 221,710

Deposits 2,486,330

Money, Weights and Measures. English, except as regards the muid = 180tt).

AuTHOKiTiES. â€” Colonial Office List. Annual, London. â€” J. Noble. Illustrated Official Handbook of the Cape and South Africa. London, 1893. â€” J. Forsyth Ingram. Official Illustrated Handbook and Railway Guide of the Colony of Natal. London, 1895.â€” P. Davis and Son. Natal Almanack and Directory. An- nual, Pietermaritzburg. â€” Natal Statistical Year Book, Annual, Pietermaritzburg. â€” John Bird. The Annals of Natal, 1495- 1845. Pietermaritzburg, 1888. â€” Culltnsworth's Natal Almanac. Annual, Durban. â€” J. P. Ingram. Natalia, History of Natal and Zululand. London, 1897. â€” Walter Peace. Our Colony of Natal. London, 1884 ; and Notes on Natal. London, 1893. â€” R. Rdssell. Natal, the Land and its Story. 5th ed., 8vo. Pieter- maritzburg, 1897. (c. J. Bi.)

II. Recent History.

At the conclusion of the first Boer war in 1881, the chief engagements of which were fought in the northern extremity of Natal, Sir Evelyn Wood was commander- in-chief of her Majesty's forces. He was also appointed for a short time administrator of Natal, and on his de- parture for England, after a final arrangement for the cession of the Transvaal, he was succeeded by Colonel (afterwards Sir Charles) Mitchell as administrator. In 1882 Sir Henry Bulwer was sent to Natal with the full title of governor, and in 1886 was succeeded by Sir Arthur Havelock. The feeling of the colonists after

the retro- cession of the Transvaal was extremely bitter. At In- gogo, Majuba, and Laing's Nek, all of them situated within the colony, British forces had been defeated by the Boers. And the treaty of retrocession was never re- garded in Natal as anything but a surrender. Public meetings were held at various towns, and the resolutions passed at them, in the light of subsequent events, are of significance and interest. Thus at Newcastle, on 30th March 1881, a public meeting of loyal refugees and colonists resolved "That the Dutch communities of South Africa, having coalesced, and solicited the assist- ance of Dutch military officers to help them to establish a Boer Eepublican Government over the whole of South Africa, it becomes necessary for British-born colonists to organize in self-defence." On 6th April 1881 a resolution was passed at a public meeting in Durban, presided over

by the mayor, and cabled to members of Parliament in London. " Durban public opinion : Utter disgust with settlement, British prestige with our natives entirely for- feited. No consideration for loyal Boers nor British residents. â– Terms of peace simply mean greater bloodshed at no distant date." The protest was vain. The treaty was finally concluded. The Transvaal Eepublic was established, and the prediction of the practical colonists of Durban, ignored at the time, was afterwards fulfilled to the letter. In justice, however, to the colonists of Natal, it must be recorded that, finding their protest with regard to the Transvaal settlement useless, they made up their minds to shape their policy in conformity with that settlement. But it was not long before their worst fears with regard to the Boers began to be realized, and their patience was once more severely taxed. The Zulu power (see Zululand), which had always been a menace to Natal as well as the Transvaal, was broken in 1879 by British forces. After the settlement intestine quarrels arose among the petty chiefs, and in 1883 some Transvaal Boers intervened, and subsequently, as a re- ward for the assistance they had rendered to one of the combatants, demanded and annexed 8000 square miles of country, which they styled the " New Republic." As the London Convention had stipulated that there should be no trespassing on the part of the Boers over their specified boundaries, and as Natal had been the basis for those operations against the Zulus on the part of the British in 1879, which alone made such an annexation of territory possible, a strong, feeling was once more aroused in Natal. The "

New Republic ” was nevertheless allowed to remain, and in 1887 the British consented to the territory being incorporated with the Transvaal.

In 1884 the discovery of gold in De Kaap Valley, and on Mr Moodie’s farms in the Transvaal, caused a con- siderable rush of colonists from Natal to that country. Railways were still far from the Transvaal border, and Natal not only sent her own colonists to the new fields, but also offered the nearest route for prospectors from Cape Colony or from Europe. Durban was soon thronged ; and Pietermaritzburg, which was then practi- cally the terminus of the Natal railway, was the base from which nearly all the expeditions to the gold-fields were fitted out. Waggons and oxen were in great de- mand, and convoys laden with stores and materials for the camps at Moodie’s and the new township of Barberton were daily despatched from both Durban and Pietermaritz- burg. The journey to De Kaap by bullock-waggon occu- pied about six weeks. ” Kurveying ” (the conducting of transport by bullock-waggon) in itself constituted a great industry. Two years later, in 1885, gold was also dis- covered at the Witwatersrand, and the tide of trade which had already set in with the Transvaal steadily increased. Natal colonists were not merely the first in the field with the transport trafiic to the new gold-fields ; they became some of the earliest proprietors of mines, and for several years many of the largest mining companies had their chief offices at Pietermaritzburg or Durban.

The demand which the new industry made upon the one port of Natal, Durban, encouraged the colonists to redouble their efforts to improve their harbour. The question of a fairway from ocean to harbour has been a difficult one at nearly every port on the African coast. A heavy sea from the Indian Ocean is always breaking on the shore, even in the finest weather, and at the mouth of every natural harbour a bar occurs. The bar in its natural state is a shallow, shifting, submarine mass of sand, on which fresh sand is continually being deposited, and over which the water is frequently not more than a few feet deep. Over the ” bar” the waves break, and often the surf is so high that only Â§urf-boats â€” ^that is, barges

battened down â€” in tow of specially-built steam tugs, can attempt to cross it. To deepen the channel over the bar at Durban so that steamers might enter the harbour was the cause of labour and expenditure for many years. Piers and jetties were constructed, dredges imported, and con- troversy raged over the various schemes for harbour improvement. In 1881 a harbour board was formed, under the chairmanship of Mr (afterwards Sir Harry) Escombe. It controlled the operations for improving the sea entrance until 1893, when on the establishment of responsible government it was abolished. Success so far crowned their efforts that in 1899 the bar channel was reported to have, even at low water, a depth of about 19 feet. In order to cope with the growing trade, however, the railway system has been continually de- veloping.

For many years Sir John Robinson led a party in Natal which agitated for a responsible form of government. In 1893 a Bill in favour of this change was introduced into the Legislative Council, and passed. The British Govern- ment gave their consent to the Bill, and the Constitution Act of 1893 became law. Sir John Robinson, K.C.M.G., was the first colonial secretary and premier under the new constitution, and Mr Harry Escombe, Q.C., the first attorney-general. In the same year the Hon. Sir Walter Hely-Hutchinson was appointed Governor of the colony. In 1898 Natal entered the Customs Union already existing between Cape Colony and Orange Free State.

In May 1899 the Natal Government began to suspect the nature of the military preparations that were being made by the Boers, and their apprehensions were com- municated to the High Commissioner, Sir Alfred Milner, who telegraphed on 25th May to Mr Chamberlain, informing him that Natal was uneasy. When war became probable the Governor expressed his views to the Prime Minister that the Natal Government ought to give the British Government every support, and Sir John Robinson replied that their support would of course be given, but at the same time he feared the consequences to Natal if after all the British Government should draw back. Some further correspondence took place, in the course of which the Natal

ministers pointed out that as in the event of war Natal would probably become the seat of operations, and would support the British Government, they would incur the ” suspicion and unfriendly feelings ” of the Free State and Transvaal. The Natal ministers therefore considered that in the circumstances they should not be exposed to attack by the action of the Imperial Government without first having an opportunity of ex- pressing their opinions. In July the Natal ministry learnt that it was not the intention of the Imperial Government to endeavour to hold the frontier in case hostilities arose, but that a line of defence considerably south of the frontier would be taken up. This led to a request on their part that if the Imperial Government had any reason to anticipate the breakdown of negotiations, ” such steps may be at once taken as may be necessary for the effectual defence of the whole colony.” Sir W. P. Symons, the general commanding the British forces in Natal in September, decided to hold Glencoe. On the arrival of Sir George White from India, he informed the Governor that he considered it dangerous to attempt to hold Glen- coe, and urged the advisability of withdrawing the troops to Lady smith. The Governor was strongly opposed to this step, as he was anxious to protect the coal supply, and also feared the moral effect of a withdrawal. Eventually Sir A. Hunter was consulted, and stated that in his opinion, Glencoe being already occupied, ” it was a case of balancing drawbacks, and advised that, under the circum- stances, the troops be retained at Glencoe.” This course was then adopted.

On 11th October 1899 war broke out. The first act was the seizure by the Boers o^ a Natal train on the Free State border. On the 12th Laing’s Nek was occupied by the Boer forces, who were moved in considerable force over the Natal border. Newcastle was next occupied by the Boers unopposed, and on 20th October occurred the battle of Talana Hill outside Dundee. In this engage- ment the advanced body of British troops, 3000 strong, under Sir W. Penn Symons, held a camp called Craigside which lay between Glencoe and Dundee, and from this position General Symons hoped to be able to hold the northern portion of Natal. There is no doubt that this policy strongly commended itself to the Governor and ministers of Natal, and that they exercised considerable pressure to have it adopted. But from a military point of view it was not at all cordially approved of by Sir George White, and it was afterwards condemned by Lord Roberts.

Fortunately only one Boer division out of three was actually present at the moment of attack, and General Symons was able to inflict a severe defeat upon them at Talana Hill. His bravery cost him his life. General Yule then took command, and an overwhelming force of Boers rendering the further occupation of Dundee danger- ous, he decided to retire his force to Ladysmith. (Jn 21st October General Sir George White defeated at Elands- laagte a strong party of Boers, who threatened to cut off General Yule's retreat. He again attacked the Boer forces at Rietfontein on 24th October, and on the 26th General Yule reached Ladysmith with his force in safety. Lady- smith now became for a time the centre of further opera- tions. The Boers gradually surrounded the town and cut off the communication from the south. Various engage- ments were fought in an attempt to prevent this movement, including the disastrous mishap at Nichol- son's Nek, when on 29th October a large British force was cut off and was compelled to surrender, and the battle of Farquhar's Farm on the 30th, during the course of which Captain Hedworth Lambton arrived from Durban with some naval guns and a party of bluejackets. The siege of Ladysmith continued till 28th February 1900, when, after various attempts to relieve the be- leaguered garrison. Sir Redvers BuUer's forces at last entered the town. During the six weeks previous to the relief, 200 deaths had occurred from disease alone, and altogether as many as 8424 were rejiorted to have passed through the hospitals. The relief of Ladysmith soon led to the evacuation of Natal by the Boer forces, who trekked northwards.

During the Boer invasion the Government and the loyal colonists, constituting the great majority of the inhabitants of the colony, rendered the Imperial forces every assist- ance. One distinguished colonist, Sir Harry Escombe, widely respected and beloved, died before he could see his country once more freed of the enemy. He had gone at the outbreak of hostilities to Newcastle, where he hoped to be able to make some show of defence, but he was com- pelled to leave with the rest of the loyal inhabitants, and took part in the retreat from Dundee. The strain was too much for him, and being in delicate health at the time, he died shortly afterwards. In the actual hostilities the Natal ^'olunteers and other Natal forces took a pro- minent part. The Imperial Light Horse and other irregular corps were recruited in Natal, although the bulk of the men in the forces were Uitlanders from Johannes- b\n-g. As the nearest colony to the

Transvaal, Natal was resorted to by a large number of men, women, and chil- dren who were compelled to leave the Transvaal on the outbreak of the war. Refugee and Uitlander committees were formed both at Durban and Maritzburg, and, in eon- jvmction with the colonists, they did all in their power to assist in recruiting irregular corps, and also in furnishing

relief to the sick and needy. Natal was the theatre of some of the most arduous fighting during the whole course of the war (see Transvaal), and the brunt of it was shared by her colonists with the Imperial forces.

Authorities. â€” Peace. The Colony of Natal. â€” Ingham. Natalia. â€” Pratt. Leading Points in South African History.

(a. p. h.)

Natal, a town and port of Brazil, situated in an estuary of the Rio Grande, and capital of the state of Eio Grande do Norte. It has a naval training school, an agricultural society, four churches, a cotton mill, &c. It is the principal port of the state. The chief exports are cotton, leather, rubber, butter, woods, and spgar. A railway runs from Natal to the frontier of Parahyba, through the most productive part of the state. Population about 60,000.

Natalie, Queen of Seevia. See Milan, King.

Natanz, a minor province of Persia, situated in the hilly district between Isfahan and Kashan, and held in fief by the family of the late Hissam es Saltaneh (Sultan Murad Mirza, died 1882), grand-uncle of the shah. It contains eighty ~~tv70 villages and hamlets, has a yearly revenue of about Â£4000, and a total population of about 23,000. It is divided into four districts : Barzriid, Natanzrud, Tarkrud, and B^driid. Natanz pears are famous throughout the country. The western part of the province is traversed from north to south by the high~~ road between Kashan and Isfa.h^n, and has the well-known stations of Kuhriid (7140 feet) and S6

(7560 feet). The capital of the little province is Natanz, a large village with a population of about 3000, situated 69 miles north of Isfahan, at an elevation of 5670 feet. It has an old mosque, with a minaret 123 feet in height, built in 1315.

Natchez, a city of Mississippi, U.S.A., capital of Adams county, on the east bank of the Mississippi river, and on the New Orleans and North-Western and the Yazoo and Mississippi Valley railways, in the south-western part of the state, at an altitude of 202 feet. Situated in the

midst of a rich cotton-producing region, its industries are mainly connected with that staple. It has cotton mills, cotton-seed oil mills, gins, &c., and has a large cotton trade by rail and river. Population (1890), 10,101; (1900), 12,210, of whom 382 were foreign-born and 7090 negroes.

Natick, a town of Middlesex county, Massachusetts, U.S.A., on the Charles river, a few miles west of Boston, in the eastern pai-t of the state, on the Boston and Albany railroad. It contains a village, of irregular plan, which bears the same name. It has manufactures of varied character, among them boots and shoes and rubber goods. Population (1890), 9118; (1900), 9488, of whom 1778 were foreign-born.

National Debt. â€” Under the headings for the dif- ferent countries of the world will be found details con- cerning the recent history and statistics of their respective â– public debts. The general subject ^T*’* rw of National Debts has been treated fully in the earlier volumes of this Encyclopaedia (ninth edition, vol. xvii.), and in this supplementary article it will only be necessary to summarize the leading facts concerning the principal nations, and to deal with some of the newer problems which have arisen concerning the National Debt of the United Kingdom.

The following table shows the general state of the world’s public indebtedness in 1900, divided according to the more important countries, the bracketed figures in black type indicating the position of the country referred to under each heading in the list. The figures in every case are not to be supposed to be absolutely accurate ; statistics of national debts differ, often remarkably, and it is practically impossible to give a perfectly satisfactory comparison, owing partly to difSculties of computing the

exchange, partly to inaccurate accounts, and partly to the varieties of debt (reproductive or non-reproductive, &c.) ; but, broadly speaking, the table shows the state of affairs, and may be compared with that given in vol. xvii.

Tlie Principal Public Debts of the World, 1900.

Country.

The U^fITED Kingdom British Dominions over Sea-

India ....

Austalian States

New Zealand .

Canada ....

Cape Colony .

Natal .... France .... Russia .... Austria .... Hungary .... Italy . . . . , United States of America . Spain . . . â– ” .

Turkey .... Egypt .... Prussia .... German Empire . Portugal .... Holland .... Belgium .... Japan ....

China ....

Argentina .... Brazil ....

Popnlation.

Total Debt.

Per Head.

Annual Charge.

Per Head.

40,909,925

(3)

Â£628,978,782

(11)

Â£15 7

6

(4)

Â£23,216,657

(11)

Â£0 11 4

230,000,000

r9)

210,-323,937

(24)

0 18

6

(11)

‘ 6,595,732

(23)

0 0 6

3,707,905

(10)

195,324,717

(2)

52 13

0

(9)

7,595,074

(2)

2 10

815,820

(23)

47,874,452

(1)

58 12

0

(22)

1,717.,910

(1)

2 2 0

5,-338,883

(21)

53,254,689

(14)

10 0

0

(21)

2,678,496

(13)

0 10 0

1,527,224

(24)

27,884,078

(8)

18 u

0

(23)

1,331,737

(6)

0 17 5

902,365

(25)

9,019,143

(15)

10 0

0

(24)

350,204

(16)

0 7 9

38,517,975

(1)

1,086,215,525

(4)

28 4

0

(1)

49,844,652

(4)

1 5 11

129,211,113

(2)

656,000,000

(19)

5 2

0

(2)

29,000,000

(18)

0, 4 7

25,886,000

(6)

358,438,000

(12)

13 16

11

(6)

14,067,000

(10)

0 11 6

19,203,531

(11)

184,600,000

(16)

9 14

0

(8)

11,977,640

(9)

0 12 6

32,449,754

(4)

586,000,000

(9)

18 0

0

(3)

27,000,000

(7)

0 16 7

76,303,387

(8)

292,216,265

(21)

3 15

6

(10)

6,709,026

(20)

0 1 9

18,089,500

(5)

433,283,066

(5)

24 1

5

(5)

16,742,285

(5)

0 18 2

23,880,000

(13)

170,000,000

(18)

7 0

0

(13)

5,148,450

(19)

0 4 3

9,734,000

(16)

103,372,000

(13)

10 12

4

(15)

4,222,379

(15)

0 8 8

34,472,509

(7)

329-584,000

(17)

9 7

6

(7)

13,92.3,170

(17)

0 7 5

56,345,000

(14)

118,554,789

(22)

2 2

1

(16)

3,794,461

(22)

0 1 i\

5,049,729

(12)

177,192,795

(3)

35 0

0

(14)

4,434,243

(8)

0 15 10

5,104,137

(18)

96,561,287

(7)

18 18

0

(20)

2,926,553

(12)

0 11 U

6,744,000

(15)

104,551,000

(10)

15 13

6

(17)

3,320,404

(14)

0 9 9

43,759,577

(22)

52,903,000

(23)

1 4

2

(18)

3,176,759

(21)

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390,000,000

(20)

55,000,000

(25)

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(19)

3,000,000

(24)

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4,400,000

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103,000,000

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23 12

0

(12)

6,301,419

(3)

18 7

17,000,000

(19)

81,710,000

(20)

4 16

0

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The total indebtedness of the countries named in the table amounts to Â£6,311,017,478, and the total indebted- ness of the world (i.e., including countries not here mentioned) for the year 1898 was computed by Lord Avebury (Journ. Boy. Stat. Sac. vol. Ixiv. Part I.) as Â£6,432,75,7,000, as against Â£5,097,910,000 in 1888. This

compares (taking figures compiled by Mr Dudley Baxter in Journ. Boy. Stat. Soc. March 1874) with a total indebtedness of 4680 millions sterling in 1874 and 1700 millions sterling in 1848. The United Kingdom had diminished its total debt since 1883 by 127 millions, the amount per head by Â£6, the annual charge by 6 millions, and

the charge per head by 5s. 8d. The United States debt was lower by nearly a hundred millions. Japan, Egypt, and Brazil had sensibly improved their positions. But the following countries had increased their debts : â€” France (by 86 millions), Eussia (by some 240 millions ^), Italy (by 140 millions), Austria-Hungary (by 70 mill- ions), Spain (by 190 millions), Prussia (by 227 millions), Portugal (by 80 millions), Holland (by 18 millions), Bel- gium (by 32 millions), and Argentina (by 73 millions).

The result is that, whereas in 1883 the total debt of the United Kingdom (756 millions) stood second to that of France (1000 millions), in 1900 it stood third to France and Eussia ; whereas in 1883 its weight per head of population was third, in 1900 it was eleventh; whereas in 1883 its annual charge stood second, in 1900 it stood fourth; and whereas the weight of the charge per head of population in 1883 was fifth, in 1900 it was eleventh.

The indebtedness of the great British dependencies, on the other hand, had increased from 302 millions to 544 millions sterling, or by 242 millions ; and the local (municipal) debt of Great Britain had risen from about 100 millions to upwards of 300 millions.

It is interesting to recall the history of the British National Debt during the 19th century. The debt at the close of the Napoleonic war (1816) was nearly TritisbÂ°’ ^^’^ millions sterling, and at the beginning of debt. 1900 this debt had been reduced to 621 millions,^

or a decrease of 266 millions â€” notwithstanding interim additions of about 367 millions, which made the gross reduction during that period 633 millions sterling, an amount actually larger than the whole (dead- weight”) debt at the end of the century. No country (except the United States, to a smaller amoimt) has ever redeemed its obligations on such a scale, and this was done while all other European countries of similar standing were piling up debt.

This enormous reduction was effected at different rates of speed. Between 1817 and 1830, when what was known as Pitt’s Sinking Fund was in operation (de- pending upon the devotion of surplus income to the repayment of debt, but much complicated by the raising of fresh loans), a net reduction was made of Â£29,488,072 â€”an annual average of Â£2,268,313. From 1830 to 1876 the system of using surplus revenue â€” the so-called Old Sinking Fund â€” for redeeming debt, was steadily applied, together with the creation of Terminable Annuities (see Annuities, vol. xxv. p. 452), by which definite blocks of debt were cancelled and the whole amount paid off in a term of years. During this period the debt was re- duced by Â£86,175,782, an annual average of Â£1,851,647. In 1876 Sir Stafford Northcote’s (Lord Iddesleigh’s) New Sinking Fund came into operation, in addition to previous methods of redeeming debt. By this system a definite annual sum was set aside for the service of the debt, the difference between it and the amount required for payment of interest forming a (new^ Sinking Fund devoted to repayment of capital. This Fixed Charge was gradually reduced from about 29 millions to 26 millions in 1888, to 25 millions in 1890, and to 23 millions in 1899. The amount paid off during this period by means of Old Sinking Fund, Terminable Annuities,

and New Sinking Fund, down to March 1900, was Â£155,238,639, or an animal average of Â£6,468,276.

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1 It is diflficult to compute the Russian debt properly, but the figure for 1883 given in vol. xvii. ((!40 millions) is clearly wrong. It should have been Â£416,000,000 for interest-bearing debt.

2 Leaving out of account 8 millions' of unfunded debt raised for the Boer war.

3 The "dead-weight" debt, or national debt proper, excludes what are treated in the public accounts as " other capital liabilities," the interest on which is not included in the fixed charge ; but it is taken to include the new debt of all sorts raised in 1900, 1901, and 1902 for the Boer war.

It will be observed that the burden of the debt in- curred previously to 1817 has thus been borne very un- equally by different ages of "posterity." While the generations immediately succeeding the Napoleonic war paid off about Â£2,000,000 a year, the taxpayers between 1876 and 1900 paid at three times that rate. They did so largely without knowing it, since a large part of the amount was wrapped up in the Terminable Annuities ; but it is very questionable justice that so large a pro- portion of the burden should have been imposed upon them. At any rate, there is clearly a good deal to say on the other side, should present-day financiers argue that posterity (a later posterity still) must not be asked to take its share of the burden of new debt raised to relieve the taxpayers who have been paying so large a proportion of the old one.

The great bulk of the funded National Debt consists of what are known as "Consols." This name dates from 1751, when nine different G-overnment (^^^^j^ annuities at 3 per cent, were consolidated into one, amounting to Â£9,137,821. These "consolidated annuities" formed the germ of what has since become the type of British Government stock. At the same time some of the annuities at a higher rate of interest were combined and the interest reduced to 3 per cent., and this stock was known as " Reduced," the two 3 per cent, stocks remaining side by side, until in 1854 the 3\ per cent.

~~Government stock was also converted into 3 per cents., under the style of " New Threes." " Consols," " Eeduced,"and " New Threes " formed thenceforth asolid body of British Three per Cent, stock, until in 1888 the whole amount was converted by Mr (afterwards Lord) Goschen into 2|~~ per cents, (see Natioxal Debt Convek- siONs). " Consols " were added to from time to time when fresh loans were needed : from 39 millions in 1771 they rose to 71 millions in 1781, to 101 millions in 1783, 278 millions in 1801â€ž 334 millions in 1811, and 400 mill- ions in 1858 ; but in 1888 they had decreased, by redemp- tions, to Â£322,681,035. "Eeduced" were also added to : from 17 millions in 1751 they rose to 164 millions in 1815, and then gradually diminished to 102 millions in 1869, and to Â£68,912,433 in 1887, when they were converted with "Consols" into the ^ew Consols (or "Goschens")at 2| per cent., to be reduced to 2A per cent, in 1903. >

The lowest price e-^er quoted for " Consols " was 47| on 20th September 1797, owing to the mutiny at the Nore ; the highest was 114 in 1896, owing to scarcity of stock, the operation of the sinking funds, and the demand for investment of savings bank moneys.

The high premium to which Consols rose towards the end of the century may be briefly explained. Pari passu with the reduction of the debt went a dwindling of the amount of Consols open to investors, and hence occurred a continued normal appre- ciation of the stock. In 1817 the amount of British Government stock per head of the population was Â£40 10s. ; in 1896 this figure had decreased to Â£14 12s. The ordinary law of supply and demand would therefore in any case tend to increase the price of Govern- ment stock. This has always happened. The amount of Three per Cents, diminished from 528 millions in 1817 to 498 in 1827, and to 497 in 1837, and the average prices in these years were 73, 83, and 90; additions were made to the stock, and in 1847 (the amount being 510 millions) the price was 86| ; aoain the amount decreased, and in 1852 (500 millions) the price" was 98; then a great conversion raised the amount to 734 millions in 1854, and the price went down to 90| ; but by 1887 the amount decreased by about 200 millions, and the price rose well above par; and though the reduction in interest in 1888 set back the price, it rose again as the amount of available stock diminished. Many causes, into which it is not necessary to enter, operated no doubt in keeping up the demand for British Government credit.

More- over, apart from the fact that in 1882 there were 689 millions of Three per Cents., and in 1900 only 501 millions of 2 J per cents, in existence, the amount held by Government departments, and therefore practically locked up from the market, gradually

increased, until from tliis cause alone the amount of available stock -was diminished by upwards of 200 millions; and a large amount more was practically looked up by being held by trustees, or by banks, insurance societies, &c. The savings banks deposits, increasing as they did by about Â£1,000,000 per month (owing partly to the raising in 1894 of the maximum limit), had to be invested in Government securities ; and the compulsory activity of the Government as a buyer of Consols, both on this account and also for Sinking Fund purposes (in order to obtain stock to redeem debt on the increased scale already indicated) operated as an abnormal cause for sending the piice of Consols high above par. Even at that figure (the average prices for Consols bemg 101 y^ in 1894, 106J in 1895, llOf in 1896, 112^| in 1897, llOJ^ in 1898, and 106J â€” having fallen owing to war prospects â€” in 1899) it was diificult for the Government brokers to obtain Consols, and it was principally owing to this state of things that in 1899 Sir Michael Hicks-Beach reduced the fixed annual charge for the debt (and pro tanto the New Sinking Fund) frogi Â£25,000,000 to Â£23,000,000.

It remains to give the figures for the British National Debt in 1902, after the disturbance due to the South African war. During the years 1900 and 1901 the new sinking fund was suspended, as well as the payments on the Terminable Annuity debt applicable to repayment of capital (except in so far as annuities to individuals were concerned); so that the debt was not reduced, as it would otherwise have been, by Â£4,547,000 in 1900 and by Â£4,681,000 in 1901. On the contrary, it was increased by fresh borrowings. Consols were raised (in 1901 and 1902) to the extent of Â£92,000,000; a “War Loan” of 2f per cent, stock and bonds, redeemable in 1910, was raised (1900) to the amount of Â£30,000,000 ; 2f per cent, exchequer bonds were raised (in 1900) to the amount of Â£24,000,000, and

Treasury bills (in 1899 and 1900), Â£13,000,000. The total war borrowing amounted accord- ingly to Â£169,000,000, raised at a discount of (Â£6,585,000) 4‘14 per cent. This includes the whole new borrowing in 1902, a portion of which was intended after the peace to be paid back in the current year ; but for this no allowance can here be made. The accompanying table shows the totals for the “dead-weight debt” in 1900, 1901, and 1902, and, for convenience, also the “other capital liabilities.”

“Dead-weight Debt.”

Chief Cause of Difference.’

” Other Liabilities.”

31st March 1900

1901

1902

July 1902

Â£628,978,782

690,992,621

747,876,000 779,876,000

r+” War Loan,” Â£80,000,000

i +Exoh. Bonds, 24,000,000

[+Treas. Bills, 6,000,000

-I-Consols, 60,000,000

-HOonsols, 82,000,000

Â£10,186,482

14,731,266 20,682,000

” Other liabilities ” it must be remembered, represent money advanced (generally by Terminable Annuity) on reproductive objects â€” ^telegraphs, barracks, public works, Uganda railway, &c.^and they could not, obviously, be properly included in the National Debt unless at the same time a set-off were made for the valuable assets held by the British Government, such as the Suez Canal shares, which in 1902 were alone worth upwards of Â£26,000,000. (h. ch.)

National Debt Conversions. â€” The great bulk of the funded debt of the United Kingdom consists of annuities, which are described as perpetual, because the state is under no obligation to pay off at any time the capital debt which they represent. All that the public creditor can claim is to receive pay- ment of the instalments of annuity as they fall due. On the other hand, the Government has the right to redeem the annuities ultimately by payment of the capital debt ; though it may, and frequently does, bind itself not to exercise that right as regards a particular stock of annuities until after a definite period. So long as a stock is thus guaranteed against redemption, the only way in which the . annual charge for that portion of the debt can be reduced

1 Other causes are redemption of land tax, variation in capital value of Terminable Annuities, and minor Treasury operations.

is by the Government buying back the annuities in the open market at their current price, which may be more or may be less than the nominal debt, according to general financial conditions and to the state of the national credit. The liability of the stock to redemption at par, when the period of guarantee has expired, prevents its market price from risiug materially above that level. To enable the right of compulsory redemption to be enforced, it is only necessary that the Government should have command of sufficient funds for the purpose of paying ofE the stock- holders, or should be able to raise those funds by borrow- ing at a rate of interest lower than that borne by the stock. Any circumstances which might tend to raiie the price of the stock above par would also assist the Government in raising its redemption money on more favourable terms. When the amount of stock to be dealt with is large, the raising by a fresh loan of the amount required for

redemption would occasion great disturbance. A more con- venient method is the conversion of the existing stock to a lower rate of interest by agreement with the stock- holders, whose reluctance to accept a reduction of income is overborne by their knowledge that the power of re- demption exists and will be put in force if necessary. The opportunity for conversion may be looked for when the price of a redeemable stock stands steadily at or barely above par. Observation of the movements in the price of other securities will serve to show whether this stationary price represents the real market value of the stock, or whether that value is subject to depression owing to an expectation' of the stock being converted or redeemed. Accordingly, the course of prices of other Government stocks which are free from the liability to redemption, of the stocks of foreign countries and the colonies, and of the large municipalities, must be watched by Government in order to determine, first, whether the conversion of a redeemable stock is feasible, and, secondly, to what extent the reduction of the interest in the stock may be carried.

The credit for the first measure of conversion belongs to Walpole, though it was carried through by Stanhope, his successor as Chancellor of the Exchequer. In 1714 the legal rate of interest for private trans- actions, which had been fixed at 6 per cent, in the year of the Restoration, was reduced to 5 per cent, by the Act 12 Anne, stat. 2, c. 16. But the bulk of the national debt still bore interest at 6 per cent., the doubtful security of the throne and the too frequent irregularities in public payment having hitherto precluded any considerable borrowing at lower rates. Walpole saw that the first re- quirement was to give increased confidence to the public creditors. Three acts were passed dealing respectively with debts due to the general public, to the Bank of England, and to the South Sea Company. Three separate funds â€" the General Fund, the Aggregate Eund, and the South Sea Fund â€" were assigned to the service of the several classes of debt, each of these funds being credited with the produce of specified taxes, which were made permanent for the purpose ; and it was further provided that any surplus of the funds, after payment of the interest of the debts, should be applied in reduction of the principal. Such was the success of this measure that, in spite of the reduction of interest from 6 to 5 per cent, which was also enacted, the passing of the Acts was followed by a rise in the price of stocks. A curious preliminary to tl^e intro- duction of these measures was

the passing of a resolution by the House of Commons, which invited advances not ex- ceeding Â£600,000, to be repaid with interest at 4 per cent, out of the first supplies of the year. The result showed that the time was not ripe for such a reduction of interest, as only a sum of Â£45,000 was offered on those terms. A further resolution was then passed, substituting 5 per cent.

as the rate of interest, and the whole sum was at once subscribed. Besides accepting the reduction of interest on their own debts, the Bank of England and the South Sea Company agreed to assist the Government by advan- cing 4-1- millions at the reduced rate, to be employed in paying off any of the general creditors who might refuse assent to the conversion. The assistance was not required, as all the creditors signified assent. The debts thus dealt with amounted altogether to about 25| millions, and the annual saving of interest effected (including that upon a large quantity of Exchequer bills for which the Bank had been receiving over 7 per cent.) was Â£329,000.

Walpole had a further opportunity of effecting a con- version in 1737. In the meantime much of the 5 per cent, debt had been reduced to 4 per cent, by arrange- ments with the Bank of England and the South Sea Company, and further borrowings had taken place at that rate, and even at 3 per cent. In 17.37 the 3 per cents, stood above par, and Sir John Barnard proposed to the House of Commons a scheme for the gradual reduction of the 4 per cents. As a financial measure the scheme would doubtless have succeeded; but Walpole, moved apparently by consideration for his capitalist supporters, opposed and for the time defeated it. A scheme on similar lines was carried through by Pelham as Chancellor of the Exchequer in 1749, and embodied in the Act 23 Geo. II. c. 1. By that Act holders of the 4 per cent, securities, amounting to nearly Â£58,000,000, were offered a continuance of interest at 4 per cent, for one year, followed by 3^ per cent, for seven years, during which they were guaranteed against redemption, with a final reduction to 3 per cent, thereafter. It was necessary to continue the rate of 4 per cent, for the first year, ‘ as any objecting stockholders could not be paid off without a

year’s notice. Three months were allowed for signifying assent to the proposal. At first it was viewed with disfavour, and both the Bank and the East India Company opposed it. But the pens of the Govern- ment pamphleteers were busily occupied in showing the advantages of the offer, and at the close of the three months acceptances had been received from the holders of nearly Â£39,000,000 of the stocks, or more than two- thirds of the whole. A further opportunity was afforded to waverers by a second Act (23 Geo. II. c. 22), which allowed three months more for consideration ; but for holders accepting under this Act the intermediate period of 3^ pel- cent, interest was reduced from seven years to five. These terms brought in an additional Â£16,000,000 of stock ; and the balance left outstanding, amounting to less than 3^ millions, was paid off at par by means of a new loan. The annual saving of interest on the stock converted was at first Â£272,000, increasing to Â£544,000 after seven years.

Eor nearly three-quarters of a century no further eon- version was attempted. In that period the total debt had been increased tenfold, and the practice of borrow- â€¢ing in times of war by the issue of an inflated capital, bearing nominally a low rate of interest, prevented recourse to conversion as a means of reducing the burden after peace was restored. But in 1822 Mr Vansittart â€” who four years earlier had effected a conversion in the opposite direction, turning Â£27,000,000 of stock from 3 into ,3 J- per cent., in order to obtain from the holders an advance of Â£3,000,000 without adding to the capital of the debt â€” was able to deal with the 5 per cents. These stocks amounted to Â£162,000,000 out of a total funded debt of Â£796,000,000. The prices at which the chief de- nominations of Government stocks stood in the market in the early part of 1822 indicated a normal rate of interest of more than 4 but considerably less than 4-^ per cent. In these circumstances, to propose the conversion of the

6 per cent, stocks to 4i- per cent, would probably have been futile, unless the new stock were guaranteed for a long period, as holders would have stood in fear of a speedy further reduction. Nor could the Government hope to succeed in a reduction to 4 per cent. Mr Vansittart’s plan was to offer Â£105 of stock bearing 4 per cent, in ex- change for Â£100 of 5 per cent, stock, thus adding slightly to the capital of the debt, but effecting a large annual saving in interest. These terms were highly successful. Holders of

nearly Â£160,000,000 accepted, leaving less than Â£3,000,000 of the stock to be paid off, and the annual saving obtained was Â£1,197,000. The new 4 per cent, stock was made irredeemable for seven years (Act 3 Geo. IV. c. 9).

There were, however, other 4 per cent, stocks, amounting to Â£76,000,000, which were not secured against redemp- tion. Two years later, the conditions being favour- ^^^^ able for their conversion, the Act 6 Geo. IV. c. 24 was passed, offering holders in exchange a 3-|- per cent, stock, irredeemable for five years. The offer was accepted as regards Â£70,000,000, and the rem.aining Â£6,000,000 paid Off, the annual saving on interest being Â£381,000. , In 1830 the guarantee given to the 4 per cent, stock of 1822 had expired, and the stock stood at a price of 102-^. Mr Goulburn decided to attempt its conversion without delay, and accordingly by the Act 11 Geo. IV. c. 13 holders were offered in exchange for each Â£100 of the stock, either Â£100 of a 3^ per cent, stock, irre- deemable for ten years, or Â£70 of a 5 per cent, stock, irredeemable for forty-two years, these two options being considered of approximately equal value. No difficulty was found in securing assent. Over Â£150,000,000 of the stock was converted, almost wholly into the 3^ per cent, stock; the balance of less than Â£3,000,000 was paid off, and an annual saving of Â£764,000 in interest was the result.

It was again Mr Goulburn’s fortune to carry out a large and successful conversion in 1844. At that date the Eunded Debt was made up of 3 per cent, and 3^ per cent, stocks in the proportions of about two ‘**’

to one, the only other denomination being the trifling amount of 5 per cent, stock created in connexion with the conversion of 1830. The price of 3 per cent. Consols ranged about 98, and that of the new 3-J- per cents, created in 1830, about 102. A reduction straightway from 3^ to 3 per cent, was not to be looked for, but it was hoped to ensure that reduction ultimately by offering 3J per cent, for the first few years and a guarantee against re- demption for a long term. Accordingly the holders of the several 3^^ per cent, stocks were offered an exchange to a new stock bearing interest at 3^ per cent, for ten years andiit 3 per cent, for the following twenty years. Practically the whole of the stock, amounting to Â£249,000,000, was converted on these terms, only Â£10,’!,000 being left to be paid off at par.

The im- mediate saving of interest was Â£622,000 a year for ten years, and twice that rate in subsequent years (Acts 7 and 8 Vict. cc. 4 and 5).

Mr Gladstone's only attempt at the conversion of the debt was made in his first year as Chancellor of the Exchequer. His primary purpose was to extinguish some small remnants of 3 per cent, stocks '^^' which stood outside the main stocks of that denomination. The Act 16 A'ict. c. 23 offered to holders of these minor stocks, amounting altogether to about 9^ millions, the option of exchanging every Â£100 for either Â£82, 10s. of a 3^ per cent, stock guaranteed for 40 years, or Â£110 of a 2^ per cent, stock guaranteed for the sanie period, or else for Exchequer bonds at par. In the result stock to the amount of only about Â£1,600,000 was converted, and the remaining Â£8,000,000 had to be paid off at par, with some apparent

loss of capital, as the current market price of the 3 per cents, was less than par. The failure was largely owing to the fact that, between the initiation and the execution of the scheme, the train of events leading up to the Crimean war had become manifest, with unfavourable results to the public credit. iVLr Gladstone had also included, as an optional portion of his plan, liberty to holders of the larger 3 per cent, stocks to exchange into the new 3^ and 2^ per cents. Very little advantage was taken of this permission, but the small amount of 2^ per cent, stock then created has been largely added to in later years by the conversion of stoolj:s of higher denominations held by the National Debt Commissioners for the savings banks and other Government funds.

Little better was the result of a more ambitious attempt made by Mr Childers in 1884. His offer (Act 47 and 48 Vict. c. 23) extended to the holders of all the 3 per cent, stocks, amounting to more than 600 millions, but no attempt was made to compel acceptance. There was offered in exchange for each Â£100 of 3 per cent, stock either Â£102 of a stock at 2f per cent., or Â£108 of a stock at 2^ per cent., both irredeemable for twenty-one years. But the amount exchanged into the new stocks was only 22

millions, of which more than one-half was stock held by Government departments.

The most important of all the conversions of the British debt was effected by Mr Goschen in 1888. It applied to the whole of the 3 per cent, stocks, amounting to a total of Â£568,000,000, made up as follows : â€” Â£323,000,000 of Consols, a stock which dated from 1752, when it was formed by the consolidation of a number of minor stocks ; Â£69,000,000 of Reduced 3 per cents., of which the nucleus was the stock reduced from 4 to 3 per cent, by Pelham's conversion in 1749; Â£166,000,000 of New 3 per cents, resulting from the conversion of 1844. All the three stocks were, and had been for a con- siderable time, well over par. But for the past few years they had remained in almost a stationary position, relatively to the upward movement shown in the jjrices of the Government 2-1- per cent, stock, and of the stocks of foreign governments, of British colonies, and of the leading municipalities. It was clear that the antici- pation of a conversion or redemption scheme was weigh- ing down Consols. Direct evidence of this fact was afforded by the course of a new 3 per cent, stock, the Local Loans stock, which Mr Goschen had created in 1887. Though bearing the same interest and resting upon the same ultimate security as Consols, this stock, which had been made irredeemable for twenty-five years, rose at once to a higher level of price. The opportunity for a great scheme of conversion had evidently come. The risk to be incurred by Government in undertaking the liability to pay off such an enormous body of stock, though less in comparison with the resources of the nation than that which Mr Goulburn had faced in 1844, was still very great, and it was rendered more formidable by the fact that holders of Consols and of Reduced 3 per cents, were entitled at law to a year's notice before their stocks could be redeemed. If that right of notice were to be enforced as regards any large proportion of the stocks, no precau- tion could adequately guard against the risk of untoward circumstances arising to affect the operation before the year expired. Mr Goschen proposed to offer to the holders of each of the three stocks an exchange at par into a new stock bearing interest at 3 per cent, for the first year, at 2f per cent, for the next fourteen years, and at 2i per cent, for twenty years thereafter, the stock to be irre- deemable for the whole of that period, namely till 1923. Acceptance was made compulsory for holders of the New

3 per cents., with the alternative of being paid off at par, as they had no claim to receive notice ; but it was made

optional for the holders of the other two stocks, and a bonus of 5s. per cent, was offered to them a^ an induce- ment to forgo their right of notice. These provisions were duly embodied in the Act 51 Vict. c. 2. The terms were accepted by practically all the holders of the New 3 per cents, and by the great majority of the holders in Consols and Reduced 3's, the amount left outstanding being only Â£42,000,000. To enable that balance to be dealt with, an Act was passed providing for the compul- sory redemption or conversion of the outstanding stock at the expiry of the statutory notice. The funds re- quired for this further operation were raised by the issue of Treasury bills and Exchequer bonds, by temporary advances from the Bank and from the National Debt Commissioners, and by the creation of an additional half-million of the new stock. In the result it was only necessary to find cash for paying off dissentients to the amount of Â£19,000,000. The final outcome of the whole operation was a saving in the annual charge of interest of Â£1,412,000, increasing to twice that amount after fourteen years.

The conversion of the Consols and Reduced 3 per cents, was greatly facilitated by the exercise of a power, which the Act conferred, to pay to recognized agents, such as stockbrokers, bankers, and solicitors, a commission of Is. 6d. per cent, on stocks in respect of which they lodged their clients' assents. These agents were thus afforded an inducement to give their clients explanation and advice, without which many of the fundholders would probably not have moved in the matter. The commissions paid amounted to more than Â£234,000, representing stocks to the amount of over Â£312,000,000. The Government will not again be confronted with this difficulty of having to give long preliminary notice of the intention to convert or redeem a large portion of the debt, as it is provided by the Conversion Act, 1888, that'the present Consols shall be redeemable after 1923 on such notice and in such manner as Parliament may direct.

See Report of the Proceedings of the Commissioners for the Me- duction of the National Debt, Parliamentary Paper C â€" 6569 of 1891. â€" E. W.

Hamilton. Conversion and Redemption. London, 1889. (w. BL. ; E. w. H*.)

Naturalism. â€” “Nature” is a term of very un- certain extent, and the ” natural ” has accordingly several antitheses, often more or less conflicting, and only to be learnt from the context in which they occur. Thus, though Man and the World are often opposed as respect- ively subject and object, yet the word nature is applied to both : hence Naturalism is used in both a subjective and an objective sense. In the subjective sense the natural, as the original or essential, is opposed to what is acquired, artificial, conventional, or accidental. On this opposition the casuistry and paradoxes of the Sophists largely turned; it determined also, at least negatively, the conduct of the Cynics in their contempt for the customary duties and decencies; and it led the Stoics to seek positive rules of life in “conformity to nature.” This deference for the “natural,” generally, and distrust of traditional systems of thought and even of traditional institutions, has played a large part in modern philosophy, especially British philosophy. It was perhaps the inevitable outcome of the reaction, which began with the Renaissance, against the mediseval domination of mere authority. ” L’homme qui medite est un animal deprave,” said Rousseau ; and again, ” Tout est bien sortant des mains de I’auteur des choses, tout degenere entre les mains de l’homme.” ^

In psychology and epistemology, “no one,” as Green has said, ” is more emphatic than Locke in opposing what

1 Quoted by Eisler, “Worterljuch der philosophischen Begriffe, 1899, s.v. Naturalismus.

is real to what we ‘make for ourselves’ â€” the work of nature to the work of the mind. Simple ideas or sensa- tions we certainly do not ‘make for ourselves.’ They therefore, and matter supposed to cause them, are, accord- ing to Locke, real. But relations are neither simple ideas nor their material archetypes. They therefore, as Ijocke explicitly holds, fall under the head of the work of the mind, which is opposed to the real.”’ This opposition again

led Hume, in the first place, to distinguish be- tween natural and philosophical relations â€” the former determined simply by association, the latter by an arbi- trary union of two ideas, which we may think proper to compare â€” and then, in the next, to reduce identity and causality, the two chief “philosophical relations,” to fictions resulting from “natural relations,” that is to say, from associations of similarity and contiguity. Sub- jective naturalism thus tended to become, and in the end became, what is more commonly called Sensationalism or Associationism, thereby approximating towards that objective naturalism which reduces the external world to a mechanism describable in terms of matter and motion â€” a result already foreshadowed when Hartley connected ideas and their association with brain vibrations and vibratiuncles. In ethics, also, the striving to get back to the natural entailed a similar downward trend. From the Cambridge Platonists, from Locke and Clarke, we hear much of rational principles of conduct, compara- ble in respect of intelligibility with the truths of mathe- matics ; but already we find that in Shaftesbury the centre of ethical interest is transferred from the Eeason, conceived as apprehending’ either abstract moral dis- tinctions or laws of divine legislation, to the “natural affections” that prompt to social duty;^ and when we reach Bentham, with pleasure and pain as ” sovereign mas- ters,” and the Mills, with love of virtue explained by the laws of association, all seems to be non-rational.^ There is much resemblance, as well as some historical connexion, between the naturalism of moralists such as Shaftesbury and Hutcheson and the Common-Seuse metaphysics of Reid and his school.^ Hence Kant, distinguishing be- tween a “naturalistic” and ” scientific ” or critical method in metaphysics, styles Eeid and his followers “naturalists of pure reason,” satirically comparing them to people who think they can settle the size and distance of the moon by direct eyesight better than by the roundabout calculations of mathematics.

So far we have seen the natural approximating to the non-rational. But when used in a subjective sense in o^jposition to the supernatural, it means the rational as opposed to what is above reason, or even contrary to reason. It is in this sense that the term Naturalism most frequently occurs ; and it was so applied especially to the doctrines of the English Deists and the German Illuminati of the 17th and 18th centuries : those of them who held that human reason alone was capable of attain- ing to the knowledge of God

were called theological naturalists or rationalists, while those who denied the possibility of revelation altogether were called philosophi- cal naturalists or naturalists simply.** In these contro- versies the term Naturalist was also sometimes used in an objective sense for those who identified God and Nature, but they were more frequently styled Spinozists, Pantheists, or even Atheists. But it is at once obvious that dispute as to what is natural and what supernatural

1 T. H. Green, Prolegomena to Eihict, 1883, Â§ 20.

2 Cf. Sidgwick, History of Ethics, 1886, p. 181.

8 Cf . W. R. Sorley, The Ethics of Naturalism, 1885, pp. Ifi ff.

^ Cf. W. R. Scott, Francis Hutcheson: His Life, Teaching, and Position in Philosophy, 1900, pp. 121, 265 1.

6 See article Rationalism, Ency. Brit. vol. xx. ; Kant, Religion innerhalb der Orenzen der blosen Vernunft, Hartenstein ‘s edition, vi. 253; and Lechler, Geachichte des Englischen Deismus, 1841, pp. 454 Â£f.

is vain and hopeless till the meanings of reason and nature are clearly defined. ” The only distinct meaning of the word” [natural], said Butler, “is stated, fixed, or settled; since what is natural as much requires and presupposes an intelligent agent to render it so, i.e., to effect it continually, or at stated times, as what is superr natural or miraculous does to effect it for once. And from hence it must follow that persons’ notion of what is natural will be enlarged in proportion to their greater knowledge. . . . Nor is there any absurdity in supposing that there may be beings in the universe, whose capaci- ties . . . may be so extensive, as that the whole Christian dispensation may to them appear natural, i.e., analogous or conformable to God’s dealings with other parts of His creation ; as natural as the visible known course of things appears to us.”*

The antithesis of natural to spiritual (or ideal) has mainly determined the use of the term Naturalism in the present day.’ But current naturalism is not to be called materialism, though these terms are often used synony- mously, as by Hegel, Ueberweg, and other historians of philosophy ; nor yet

pantheism, if by that is meant the immanence of all things in one God. We know only material phenomena, it is said; matter is an abstract con- ception simply, not a substantial reality. It is therefore meaningless to describe mind as its effect. Moreover, mind also is but an abstract conception ; and here again all our knowledge is confined to the phenomenal. To identify the two classes of phenomena is, however, impossible, and in- deed absurd; nevertheless we find a constant concomitance of psychosis and neurosis; and the more sensationalist and associationist our psychology, the easier it becomes to correlate the psychical and the physical as but “two aspects” of one and the same fact. It is therefore simplest and sufficient to assume an underlying, albeit unknown, unity connecting the two. A monism â€” so far neutral, neither materialistic nor spiritualistic â€” is thus a characteristic of the prevailing naturalism. But when the question arises, how best to systematize experience as a whole, it is contended that we must begin from the physi- cal side. Here we have precise conceptions, quantitative exactness, and thoroughgoing continuity ; every thought mat has ever stirred the hearts of men, not less than efery breeze that has ever rippled the face of the deep, has meant a perfectly definite redistribution of matter and motion. To the mechanical principles of this redistribu- tion an ultimate analysis brings us down ; and â€” beginning from these â€” the nebular hypothesis and the theory of natural selection will enable us to explain all subsequent synthesis.* Life and mind now clearly take a secondary > place; the cosmical mechanism determines tliem, while they are powerless to modify it. The spiritual becomes the ” epiphenomenal,” amerely incidental phosphorescence, so to say, that regularly accompanies physical processes of a certain type and complexity. (See also Psychology.)

This absolute naturalism, as we may call it, the union, that is, of psychological and cosmological naturalism, is in fact a species of Fatalism, as Kant indeed entitled it.’ It is the logical outcome of a sensationalist psychology, and of the epistemology which this entails. As long as association of ideas (or sensory residua) is held to explain judgment and conscience, so long may naturalism stand.

The naturalistic work oÂ£ cliief account at tlie present day is E. Haeokel’s Die WcUrdtsel, Gemeitiverstdndliche Studien ilber

6 Analogy, part i. cliap. i., end. Cf. also J. S. Mill, Logic, book iii. chap. XXV. Â§ 2, and Essays on Religion.

‘ In aesthetics we find Natura!lism used in a connate sense : the Flemish painters, such writers as Flaubert or Zola, for example, being called naturalistic or realistic, in contrast to the Italian pamters or writers like George Sand or the Brontes.

s Cf. Spencer, First Principles, 1867, p. 398.

” Cf. Prolegomena, Â§ 60.

monistische Philosophie, 5te Ausgabe 1900, of which an English translation has appeared. Effective refutations will be found in the works of two of Haeckel’s colleagues, 0. Liebmann, Zur Ana- lysis der Wirklichkeit, 3te Ausgabe 1900 ; R. Eucken, Die Einheit des Geisteslebens in Bewusstsein und That der Menschheit, 1888 ; Der Eampf um einen geistigen Lebensinhalt, 1898. There is also in English Mr A. J. Balfour’s well-known Foundations of Belief, 8th edition, 1901 ; and Naturalism and Agnosticism, 1899, by J. Wakd. (j. yf*_j

Naturaliiation. â€” Prior” to the Naturalization Act of 1870, 33 and 34 Vict. c. 14 (see Alien and Alle- giance in Ency. Brit, vol i. 9tli ed.), the allegiance owed to the British Crown was regarded as indissoluble, and down to 1868 the same doctrine was held in the United States. Almost at the same time both countries, through conventions with each other, treaties with other foreign Powers an^ by Acts of the legislature within, abandoned this position and opened a free exchange of nationality with foreign states. Naturalization, being a sovereign act, is not governed by the rules of international law, but by those of the public law of each individual state concerned. The Naturalization Act of 1870, sec. 7, subsec. 3, defines and regulates the position of natural- ized British subjects, and provides that an alien to whom a certificate of naturalization has been granted shall en- joy all political and other rights, powers, and privileges, and be subject to all

obligations to which a natural-born British subject is entitled or subject in the United King- dom, provided that he shall not, when within the limits of the foreign state of which he was a subject previously to obtaining his certificate of naturalization, be deemed to be a British subject unless he has ceased to be a subject of that state in pursuance of the laws thereof, or in pursuance of a treaty to that effect (and the same rule obtains also in the case of statutory aliens, i.e., natural-born British sub- jects, to whom certificates of readmission to British nationality have been granted). The italicized clause here referred to is applicable to the very numerous cases where naturalization has been efiiected in fraud of mili- tary service in countries where this is compulsory. Thus naturalization, whilst investing the new citizen with equal rights with one naturally born, does not extinguish the claims which are still in force in the state to which he has hitherto owed allegiance. In such cases the flag of the country of adoption will not protect the naturalized subject, on returning to the country of his birth, from the pains, penalties, and forfeitures visited for such default. (Calvo, Dictionnaire de Droit International, s.v. Naturalisation : ” La naturalisation n’altfere en rien les droits acquis avant son accomplisse- ment, ni mÂ§me les consequences legales qui decoulent de ces droits anterieurs.”) In Germany no permission is given to persons between the ages of seventeen and twenty-five, and liable to conscription, to change their nationality, unless they satisfy the military authorities that they do not seek to divest themselves of German citizenship in order to escape from military duty ; and such permission is likewise refused to officers in active service or reservists called upon to rejoin the colours.

The position of infant children of naturalized British subjects is still obscure. The Naturalization Act referred to provides that where the father, or the mother (being a widow), has obtained a certificate of naturalization in the United Kingdom, every child of such father or mother who during infancy has become resident with such father or mother in any part of the United Kingdom, or with such father while in the service of the Crown out of the’ United Kingdom (68 and 69 Vict. c. 43), shall be deemed to be a naturalized British subject. Mr W. E. Hall (Foreign Jurisdiction, p. 27) says : ” The Act is silent as to children, whether born before or after naturalization, who are not, or at least have not been, resident with the

father or mother in the United Kingdom. It is to be presumed that they remain aliens.”

In most countries a lengthened sojourn is a condition precedent to naturalization. In Belgium, the United Kindgom, North America, and Russia the period of such sojourn is fixed at five years, in Prance, Greece, and Sweden at three, in the Argentine Republic two, whilst in Portugal a residence of one year is sufficient. In Germany, Austria, and Italy no period of residence is prescribed. In France a residence for ten years qualifies for naturalization without further ceremony ; whilst in Austria a ten years’ residence confers per se the rights of citizenship.

As regards naturalization in British colonies, the Naturalization Act provides that all regulations duly made by the legislature of any British possession for conferring the rights of naturalization shall, within such limits, have the authority of law. It seems well estab- lished that such a Colonial Act has only the force of law within the particular colony, and cannot invest a naturalized person with the character of British subject in foreign states ; but says Hall : ” The Naturalization Act does not seem to have been read quite in this sense, and it has been the practice to issue passports to the owners of colonial certificates of naturalization and to protect them in all foreign countries, other than their country of origin.” Naturalization in India, which is not mentioned in the Act, is provided for by local statute, and the position of a person naturalized under such local ordinance is the same as that of a person naturalized in the colonies. In order to avoid the ap- pearance of wishing to protect the naturalized subject who has become a British citizen in fraudem legis, all naturalized British subjects are described as such in the passports issued to them, and all applications for passports must be accompanied by the certificate of naturalization, in addition to those of identity and recommendation, and passports cannot be issued abroad to a colonial naturalized British subject except for a direct journey to the United Kingdom or to the colony in which he has become naturalized.

It is still a vexed question whether British subjects can divest themselves of their nationality in non-civilized countries, but the better opinion seems to be that the permission given to British subjects by the Naturaliza- tion Act

to assume the nationality of a foreign state has regard only to such states as have a definite political organization. In all others British subjects remain amenable to British laws.

Adthorities. â€” ^v. Bar. International Law. â€” Dicey. Conflict of Laws. London, 1896. â€” Hall, “W. E. Treatise on the Foreign Powers and Jurisdiction of the British Crown. Oxford, 1894.

Naucratis. â€” The site of Naucratis was discovered by Professor Flinders Petrie in 1884 ; it is situated on the eastern bank of a canal, about 10 miles to the west of the present Eosetta branch of the Nile. In ancient times it was approached by the Canobic mouth, which was farther to the west. The indentification of the site is placed beyond doubt by the discovery of inscriptions, with the name of the town, and of great masses of early Greek pottery, such as could not have existed anywhere else. The site was excavated in 1884-86 by the Egypt Exploration Fund, and a supplementary excavation was made by the British School at Athens in 1899. A list of the temples of Naucratis is given by Herodotus (ii. 178) ; they were the Hellenion, common to all the colonizing cities, and those dedicated by the jEginetans to Zeus, by the Samians to Hera, and by the Milesians to Apollo. A temple of Aphrodite is also mentioned by Athenaeus.* Traces of all these temples, except that of Zeus, or at

least dedications coming from them, have been, found in the excavations, and another has been added to them, the temple of the Dioscuri. The two chief sites to be cleared were the temples of Apollo and of Aphrodite, in both of which successive buildings of various date were found. Both were remarkable for the great mass of early painted pottery that was found ; in the temple of Apollo this had been buried in a trench ; in that of Aphrodite it was scattered over the whole surface in two distinct strata. A great deal of it was local ware, but there were also imported vases from various Greek sites. In addition to these temples, there was also found a great fortified en-

closure, about 860 feet by 750, in the south-eastern part of the town ; within it was a square tower or fort ; a portico of entrance and an avenue of rows of sphinxes was added in Ptolemaic times, as is shown by the founda- tion deposits found at the corners of the portico ; these consisted of models of the tools and materials used in the buildings, models of instruments for sacrifice or ceremonies, and cartouches of King Ptolemy Philadelphus. Professor Petrie naturally supposed this great enclosure to be the Hellenion or common sanctuary of the G-reeks, but in the most recent excavations Mr Hogarth found traces of another great walled enclosure to the north-east of the town, together with pottery dedicated rots tZv “EXXrjvaiv Oeaiti, and he claims with reason that this enclosure is more likely than the other to be the Hellenion, since no early Greek antiquities have been found in the southern part of the town, which seems rather to have been a native settlement. The cemetery of the ancient town was found on two low mounds to the north, but was mostly of Ptolemaic date.

Apart from the historic interest of the site, as the only Greek colony in Egypt in early times, the chief importance of the excavations lies in the rich finds of early pottery and in the inscriptions upon them, which throw light on the early history of the alphabet. The most flourishing period of the town was from the accession of Amasis in 570 B.C. to the Persian invasion of 520 B.C., when the contents of the temples must have been destroyed. The earlier chronology has been much disputed. There are clear traces of a settlement going back to the 7th cen- tury, including a scarab factory, which yielded numerous scarabs, not of native Egyptian manufacture, bearing the names of the kings that preceded Amasis. Among these were fragments of early Greek pottery. It seems a fair inference that the makers of these were Greeks, and that they probably represent the early Milesian colony, settled here in the time of Psammetichus I., before the official assignment of the site by Amasis to the Greek colonists of various cities. The most important of the antiquities found are now in the British Museum.

See W. M. F. Petrie, &c. Naukratis I. Third Memoir of the Egypt Exploration Fund, 1886. â€” ^B. A. Gardner, &c. Naukratis II. Sixth Memoir of same, 1889. â€” V>. G. Hogarth, &o. Annual of the British School at Athens, 1898-99. (e. Gr.)

Naugatuck, a borough of New Haven county, Connecticut, U.S.A., on the Naugatuck river, and on the New York, New Haven, and Hartford railroad, south- west of the centre of the state. It obtains water-power from the river for its manufactures, which comprise boots and shoes, woollen and rubber goods, cutlery and agricultural implements. Population (1880), 4l!74; (1890) 6218 ; (1900), 10,541, of whom 3432 were foreign- born.

Nauheim, or Bad-Nauheim, a watering-place of Germany, in the grand-duchy of Hesse-Darmstadt, situ- ated on the north-east slope of the Taunus Mountains, Â£4 miles by rail north of Erankfort-on-Main. Its warm waters (84Â° to 95Â° F.) attract nearly 20,000 visi-

tors annually; but, although known for centuries, they were prior to 1835 only employed for the extrac- tion of salt (now about 2000 tons annually). The town has several parks, the largest being the Kur- park (125 acres), in whfch are the elegant Kurhaus and the two chief springs. The waters, which are saline, strongly impregnated with carbonic acid, and to a less extent with iron, are principally used for bathing. Three smaller springs, situated outside the Kurpark, supply water for drinking. In 1899-1900 a new spring (saline) was tapped at a depth of 682 feet. Another attraction of the place is the wooded sur- roundings, including the Johannesberg (773 feet), im-mediately overlooking the town. Population (1900),

4505.

Naumburg, a town of Prussia, province of Saxony, 29 miles south by west of Halle by the railway to Weimar, on the river Saale, near the confluence of the Unstrut. The cathedral (restored in 1883) was provided with a fourth tower in 1894, the gift of the Emperor William II. The town church possesses two pictures by Lucas Cranach the elder. The annual ‘_’ Hussites feast ” is still held here, but its supposed origin in a joyous festival held after deliverance of the town from the Hussites is fabulous, it having been proved that the Hussites never came to the walls of Naumburg. Close by is the pretty little watering-place of Kosen, famed also as the annual meeting-place of the representatives of the German students’ corps. Population (1885), 19,107; (1900),

23,187.

Nautilus. See Cuttlefish and Mollttsca.

Navarra, or Navaeee, a province of northern Spain, area 4046 square miles. It is divided into 15 administrative districts and 269 parishes. Its population was 304,184 in 1877, 304,051 in 1887, and 302,978 in 1897. The birth-rate is 3-47 per cent., the death-rate 2-79 per cent., and the proportion of illegitimate births 3‘05 per cent, of the total births. Many of the inhabitants emigrate to South America and to France, where thousands of able- bodied lads from 19 to 22 years took refuge during the colonial and American wars of 1895-98, to avoid the con- scription. A railway runs through the province to join the main line from Madrid to France at Alsasua junction. All the roads, like those of the three Basque provinces, are kept in excellent repair by the provincial council, assisted by the municipalities. Both bodies attend with some zeal to the primary schools, institutes, and normal schools. The province is agricultural rather than industrial. The wine trade is active, and the products of the vineyards are in great demand in south-west France and at Passages in Guipuzcoa for mixing with the French wines â€” the famous coupages that Spain now aims at carrying on in many of her ports. The industries include manufactures of arms, paper, chocolate, candles, alcohol, leather, coarse linens and cloths. The exports both by rail and by the passes in the Pyrenees consist of live stock, oil,” wine, wool, leather, and paper. The forests have attracted the attention of foreign and native enterprise. Narrow- gauge railways convey the timber to the main lines. In 1897, 144,867 acres were devoted to wheat crops; 71,417 acres to rye, barley, oats, maize; 38,565 acres to pod-fruit, 134,382 acres to vines, and 22,875 acres to olive groves. The live stock included 16,320 horses, 17,447 mules, 14,617 asses, 40,568 cattle, 521.858 sheep, 50,476 goats, and 2(5,949 i)igs. For its area, Navarre is one of the richest provinces of Spain in live stock. There are zinc, copper, iron, and lead mines giving employment to 352 hands. The works emplov a few hundred hands, and turn out about 4000 tons of iron and steel, and 5272 tons of pig-iron.

NAVIES

I. Political and Economical Changes 1870-1900.

WITH the exception of the Eusso-Turkish war of 1878, the year 1870 marks the last of the great European struggles, and is therefore a convenient start- ing-point to consider the subsequent growth of naval armaments. The period witnessed the advent of a new maritime, commercial, and colonial power in the federal tion of the kingdoms and states known as Germany. The final unification of Italy, with Eome as the capital, was also accomplished ; and in the same year there began in Japan the rapid assimilation of an Eastern race to Western civilization. The opportunity of the Franco- German war enabled Russia to abrogate the treaty clauses providing for the neutrality of the Black Sea. It is not without significance that the denunciation of these clauses should have taken place in the year follow- ing the opening of the Suez Canal. Seven years later the Russo-Turkish war forced the conviction on Russia that a strong navy was necessary to the expansion of her empire'. There thus resulted one of the most interesting events in history, where a strong navy was built up by a military power which possessed but an insignificant sea- borne trade and commercial marine, and suffered under the most striking disabilities, owing to its fleets in the Baltic, Black Sea, and Far East being widely separated. Not only could fleets thus situated seldom afford each other eflScient co-operation, but many of the ships were of small dimensions, so as to operate on the shallow coasts, and sacrificed the coal supply which might other-wise have enabled them to effect a junction. The Black Sea fleet was further hampered by restrictions intended to prevent warships from passing through the Darda- nelles. A temporary difficulty lay in the experience of corruption which nearly all navies have undergone, since they deal so largely in consumable and perishable goods. The numerous Black Sea courts-martial in 1900 gave indications of methods which vitally affect the prepared- ness of a navy. In Russia, owing to the same class con- trolling the Government, the navy, and dockyards, and pursuing its way without the safeguard of public criti- cism, the danger resulting from corruption is not one to be lightly estimated. These, however, are factors for which men have to form their opinions independently. While we cannot ignore them in comparing the strength of navies, they can only reveal their full effects under the supreme test of war. In other directions, however, we can measure Russian maritime interests very com- pletely. It is significant that, in spite of the most deter- mined efforts to support the mercantile marine by navigation laws and a monopoly of the coastal trade, it increased but slightly. There are

no statistics available prior to 1895, but in that year Russia (exclusive of Fin- land) possessed 323,000 tons of sailing vessels and 206,000 tons of steamers; and in 1899, 268,000 tons of sailing vessels and 334,000 tons of steamers. This small in- crease is not a matter for surprise, for, if we except the island of Saghalien, Russia could communicate by land with the whole of her extensive empire.

In another continent, the United States of America was rapidly recovering its financial stability after the disastrous Civil War. It was building up industries and commerce destined to excite the apprehension of Europe by the end of the 19th century ; an apprehension founded not alone on the effects of industrial rivalry, but also on the expansion of America into the chief markets of the world. This expansion was necessarily

though tardily followed by the growth of the United States navy, and by the acquisition of transmarine terri- tories in the West Indies, Philippines, Hawaii, and Samoa. The naval organization of 1898 was strained to such an extent, by the war with the third-rate naval Power of Spain, that the Navy Department refused to allow the battleships to be risked in an attack on the Spanish cruis- ers inside the fortified harbour of Santiago, and the United States was generally believed to have been saved from European naval intervention by the action of the British Cabinet. A determined effort was then made to bring the United States into the front rank of naval Powers. At the same time it was recognized that naval operar tions were conducted under great difficulties, owing to the vast distances separating the squadrons on the Pacific and Atlantic coasts. Inquiries and negotiations were opened with the view of cutting a canal either by the Panama or Nicaraguan routes, and an arrangement was made with Great Britain by which the expense, maintenance, and defence of the canal should be in the hands of the United States.

II. The Growth of New Maritime Powers.

These, then, were some of the underlying factors which influenced the maritime rivalry characterizing the closing years of the 19th century. Whereas it might almost be said in 1870 that France and the United Kingdom possessed the only two great fleets of ironclads, the British First Lord of the Admiralty declared that the estimates for 1900-1901 were

framed after a careful consideration of the navies of six great maritime Powers â€” ^viz., France, Russia, Germany, Italy, Japan, and the United States. Beyond the navies of the seven Powers, it cannot be said that there existed any vessels fit to lie in the line of battle. This in itself marks a profound change from the period of the Napoleonic war, when battleships cost one-thirtieth of what they did in 1902. “When small Powers, like Denmark and Portugal, were able to afford the outlay on battleships, the action of their fieets was always a source of anxiety to the British Government. The rapidity with which sailing vessels could be built, and the facility with which small craft could be turned into privateers, had to be taken into consideration. At the end of the 19th century, though considerable progress had been made in the rapidity with which steel ships were built, the rate was not one which would enable the great maritime nations to fight for at least a year after the outbreak of war with any but the ships which were then completed or nearly so. In fact, the most rapid achievements, in favourable circumstances, in the building of battleships, were the Majestic and Magnificent, which were built and commissioned (1895) in twenty-two and twenty-four months after they had been laid down.’ At the same time the special requirements of warships, and the tendency to give armour to even moderate-sized cruisers, had very considerably differentiated them from merchant vessels. T\Tiile all the naval Powers provided for using some of the latter as auxiliaries, it was never contemplated that they should be required to fight ves- sels specially built for war purposes.

The net result of these changes was to enhance the predominance of the great maritime Powers, and while there had been a period when the national navy saved Denmark from Germany, and Turkey from Russia, that state of affairs was no longer possible at the end of the 19th

1 Exceptional efforts were made in the case of these vessels, in order that early experience might be gained from their trials.

century. The great maritime Powers acting in concert, or remaining neutral whilst one of their number was engaged in a demonstration against Turkey, Greece, or China, or any other nation, could always enforce decisions with their ships, or were free to send troops over a sea on which their transports could move unm(plested. So far as maritime strength was concerned, there could only exist groups of the seven naval Powers. Pighting amongst each other the smaller nations could engage in naval operations, as, for instance, when Japan fought China in 1895. It was inevitable that Japan should yield the chief fruits of her victory when Russia, Germany, and Prance interfered, while Great Britain and the United States lent her no active support. Prom that moment it became the settled ambition of the Japanese to become a great naval Power, and six first-class battleships were built in England between 1895 and 1902. In the latter year an alliance was concluded with Great Britain. The Japanese navy at the commencement of the war with China had consisted of only 30,000 tons of warships, while at the beginning of 1901 the aggregate amount was 260,000 tons. In bringing about this increase of the Japanese navy, it is probable that the necessity of gaining colonies for the surplus population of the islands and the expansion of Russia to the sea-coast opposite Japan were leading causes. The increase was in some respects as remarkable as the growth of the German navy, for the first ironclad Japan had possessed was a small one, the Stonewall Jackson, purchased from the United States Government in 1866.

The growth of naval armaments in the opening years of the 20th century became almost feverish, though Italy, crippled financially, tended to drop out and leave the field to the remaining six Powers. With the exception of Italy, we find the vote for new construction for each of the great naval Powers rising to the highest on record ; and while Great Britain resorted to the policy of yearly programmes, Germany brought forward an ambitious scheme in 1900 which extended to the year 1916, though subsequent events pointed to the desire to complete it by a much earlier date. France and Russia also framed” their pro- grammes for a number of years ahead. Only one attempt had been made to cheek the rising tide of naval arma- ments, and that was the Tsar’s Peace Conference at The Hague in 1899. Prior to the assembly of the Conference the First Lord of the Admiralty, from his place in the House of Commons on 9th March 1899, said : â€”

We have been compelled to increase our expenditure as other nations have increased theirs, not taking the lead, not pressing on more than they. As they have increased, so we have increased. I have now to state on behalf of Her Majesty's Government that similarly, if the other great naval Powers should be prepared to diminish their programme of shipbuilding, we should be prepared on our side to meet such a procedure by modifying ours. The difficulties of adjustment are no doubt immense, but our desire that the Conference should succeed in lightening the tremendous burdens which now weigh down all European nations is sincere. But if Europe comes to no agreement, and if the hopes entertained by the Tsar should not be realized, the programme which I have submitted to the House must stand. It is constructed on the basis on which the House itself has always expected us to rest it. It is

the lowest which can be justified by the existing expenditure on shipbuilding of other countries ; it is the lowest by which we can secure the object which the people expect of the navy.

The Conference was fruitless so far as any reduction of naval armaments was concerned, the years 1900 and 1901 having each marked a fresh advance â€" in some cases considerable â€" in the naval budgets of the Powers.

III. The Evolution of Warships.

In 1870 Great Britain and France each had thirty-six ironclads built or building. Ship for ship, the advantage with the former Power was by no means great, and in the number of heavy guns she was inferior. By the end of the 19th century all the ships of 1870 had vanished from the seargoing squadrons. The British Admiralty at that time reckoned 4 per cent, per annum as the depreciation of a battleship, so that her life was estimated at twenty- five years. This obsolescence of ships is caused by the progress of marine engineering and the rivalry between gun and armour (q.v.). Until 1886, when chrome steel shot were invented, the advantage had been with the compound armour. Then came the face-hardening pro- cess, and the Majestic was the first ship in the world actually completed with Harveyed armour (1892). In 1901 the U.S. Naval Intelligence Department were able to report in their Notes on Naval Progress that the armour-plate once more

held the advantage. At that time British naval practice, as in the battleship Queen and the cruisers of the Kent class, was to put 9-inch armour on to the sides of the battleships and 4-inch on to the sides of the cruisers. In 1901 a British Com- mittee on Explosives recommended the adoption of a powder enabling higher velocities to be obtained, and consequently greater penetration (see Gunneet), thus foreshadowing the probability of the advantage resting with the existing thickness of armour for only a few years longer. The following year the old Belleisle of the British navy was fitted up with the armour then used, in order to be actually fired at by modern guns.

Few tasks are more dif&cult or more empirical than comparisons of naval strength. The most modern type of 12-inch gun at the end of the 19th century fired twice as fast as and was superior in all respects, including accuracy of shooting, to the IS^inch gun mounted in other battleships ; while the latest type of 6-inch gun could perforate twice as much armour as an earlier type of 6-inch gun in another ship ; and, again, there was much greater rapidity of fire. When we come to the armour question our difficulties are increased. At the end of the 19th century there were several varieties of armour in the first-class battleships. The usual formula was to assume that Krupp cemented armour was equal to 2-4 times its thickness in wrought iron, Harveyed or Krupp non-cemented to twice, and compound or steel armour to 1-7 times the thickness in wrought iron. The evolution of the armour is well and concisely illustrated by the following table, which is taken from the American Notes on Naval Progress : â€”

Armour Protection of British Battleships.

Date.

Ship.

Thickness of Armour, In Inches.

Weight of

Armour, in

tons.

Displace- ment of Vessel, in tons.

Percentage

of Armour to

Displaco-

mont.

Length of

Vessel, in

feet.

Length of

Belt, in

feet.

Percentage

of Length of

Belt to Length

of Vessel.

Depth of

Wain Armour.

1881 1886 1892 1895 1899 1900

Inflexible Collingwood . Royal Sovereign . Majestic . Canopus . Duncan .

16-24, iron

8-18, compound

Do.

9, Harvey

6, Harvey

7, Krupp

2450 1780 2900 2790 1740 2000

11,880 9,500 14,160 14,900 ,13,000 14,000

20-8 18‘7 20-5 18-9 13-3 14-3

320 325 380 390 390 405

110 140 248 217 198 285

84-3 ,

43

66-2

65 ‘6

60-7

70-3

Ft. in.

15 8

15 8

16 1 15 0 14 0 14 0

NAVIES

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The importance of these details in comparisons of naval strength may be illustrated by comparing some of the British Mediterranean battleships in 1902 with the French ^lediterranean battleships of the St Louis class buUt at the same time. In the British ships the 6-inch guns of the secondary batteries were protected by 6-iuch face- hardened armour, \vrhereas the St Louis class had only 3-inch ordinary steel armour to protect their 5-5-inch guns. All the 6-inch guns in the British battleships could have perforated the French armour at 3000 yards not only with a direct hit but with a shot striking at an angle of 30Â° to the normal. On the other hand, even at the torpedo range of 2000 yards, a better gun than the French ships possessed could not have perforated the 6-inch face-hardened armour of the British ships. In October 1901 the French Minister of Marine was re- ported in Tlie Times as saying at the launch of the Leon Gambetta : ” The duty of tlie French navy is above all to secure superiority of fighting type for French units. Regard should be had to the fighting value of ships rather than to their numbers.” So, in 1901, the French Government followed the British policy of large dimen- sions for battleships, it being recognized that the require- ments of a ship fit to lie in the line of battle as then constituted and to have the coal endurance in order to be able to join the line of battle at a distance from a coaling base, could not be satisfactorily met on a dimen- sion of less than 13,000 tons. On the other hand, it was always hoped that the necessity for relying on coaling bases might be obviated by some system of coaling whilst under way, and in 1902 experiments were satisfactorily carried out by the battleship Trafal- gar which tended to show that a vessel could be coaled at a fair rate from a collier in tow. The need for large dimensions in battleships would still, however, exist in the necessary provision of armour and arma- ment. Thus the 9-2-inch gun was introduced into the secondary armament in 1902 on board battleships in addition to the 6-inch gun, since it might be expected to perforate 6-inch face-hardened plates at 3000 yards and over at nearly all angles of impact. This of course meant increased weight. We find provision was made for battleships in Great Britain in 1902

of 16,500 tons, for Japan 16,200 tons (built in England), France 14,865 tons, Italy 13,500 tons, Russia 13,600 tons, and the United States 17,581 tons. The dimensions of battle- ships laid down by Germany continued to be 11,800 tons until, in 1901, vessels of 13,000 tons were laid down. The chief departures from the British type of battleships were some built in the United States with what were known as superposed turrets. The British system of placing the secondary armament in casemates (abandoned in 1902) was not so largely adopted by other countries. In addition some countries used triple screws and burned liquid fuel.

lY. EeconstetJctioj*^ of Ships.

We have a further source of complication in com- paring the relative strength of navies. All nations in varying degrees have reconstructed vessels to bring them up to modern ideas. In such cases the life would probably be prolonged beyond the twenty-five years which we stated to be the British Admiralty's estimate in 1900 for a battleship. While at a later date the expenditure may be regretted, the system frequently offers a quicker accession of naval strength than is to be obtained by devoting the money to new construction. Both in France and Germany extensive reconstructions were at different times carried out, particularly about 1900-1902, and it appears to have been recognized that the most valuable are those under- taken sufficiently early in the vessel's career. Some of

the most remarkable alterations were those of the Hagen class in Germany. These coast-defence ironclads were cut in two and lengthened by 27 feet. The increase of tonnage from 3500 to 4114 tons enabled the vessels to be generally improved, especially with reference to coal endurance. The experiment was regarded as successful. It was a characteristic of all German reconstructions that woodwork was, as far as possible, removed .and steel substituted. Thfe British trials of the Majestic firing at the Belleisle in 1900 were considered in Great Britain to have proved that there is no danger from fire where wood decks are bolted over steel. As showing the expen- diture sometimes involved by reconstruction, it may be stated that the mere alterations from above-water torpedo tubes to submerged tubes in the Brandenburg were estimated to cost Â£46,000. Though Great Britain lagged behind France and Germany in the attention devoted to

reconstruction, it should be remembered that all her recent battleships had certain advantages in the earlier adoption of submerged tubes and face-hardened armour. Thus we have seen that the Majestic, completed in 1895, was the first ship with face-hardened armour, and the enormous gain over the Royal Sovereign is illustrated by the remark that it was possible to increase the area protected by 50 per cent, for the same weight. In Germany, the Aegir, completed in 1897, or two years after the Majestic, and in France, the Bouvet, completed in the summer of 1898, were the first ships of the respective nations to have face- hardened armour, and this only on the thickly plated bar- bettes and belt. It thus results that the Carnot, Jauri-guiberry, Charles Martel, and Masshia, all completed in 1897 and 1898, had nickel-steel armour, which was not nearly so efficient as face-hardened armour. While on the subject of reconstructions, it may be mentioned that in 1902 the policy was inaugurated in Great Britain of strengthening the armament and protection of ten battle- ships and fifteen protected cruisers. At the same time, owing to the congestion of work in the royal dockyards, the First Lord of the Admiralty intimated the intention of carrying out a great deal of the repair work of the navy in the private yards.

The fact that Great Britain was in advance of the nations in adopting essential improvements formed a significant change from the period of the ‘seventies, when all the Europeannavies adopted breech-loading ordnance, whereas in Great Britain the Ajax, launched in 1880, was armed with muzzle-loading guns. This vessel was removed from the effective list in 1902, at which period the Admiralty appear to have finally determined on removing the reproach from the British navy that could have been levelled at the beginning of 1901, to the effect that, except for four muzzle-loading guns in the Italian navy, the British navy was the only one possessing the obsolete armament to the extent of over 300 guns. These were confined to some sixteen third-class battleships, a few coast-defence vessels, and obsolete cruisers which were not in commission in 1900, and they did not affect the superiority in the total number of breech-loading guns which Great Britain possessed over the second and third navies combined, as can be seen from Table F. These vessels, including the Agamemnon and Ajax, built in 1879 and 1880 respectively, were gradually eliminated in 1901 and 1902.

Y. The Naval Policy of the Powbes.

The British Empire. â€” To the student of naval history it is difficult to understand how the predominant naval power, with traditions from the Armada and Trafalgar periods, should have included coast-defence vessels in the British shipbuilding programmes in 1870 and sub- sequently. When, however, we consider the history

of the controversies raging round imperial defence, we perceive that the coast-defence vessels were but a symptom of false ideals which had swept over Great Britain under the influence of the doctrine that ” steam had bridged the Channel.” It was one Sir Eobert Peel had coined and Palmerston passed into circulation. ” Our great reliance,” St Vincent had said, ” is on the vigilance and activity of our cruisers at sea, any reduction in the numbers of which, by applying them to guard our ports, inlets, and beaches, would, in my judgment, tend to our destruction.” ” The opinion of Sir Prancis Drake,” wrote Howard to Walsing- ham in 1558, ” Mr Hawkyns, Mr Frobisher, and others that be men of greatest judgment (and) experience is that (the) surest way to meet with the Spanish fleet is upon their own (coast) or in any harbours of their own and there defeat them.” ISTo wisdom of the past could stand against a plausible formula that ” steam had bridged the Channel. ” The state of affairs in Great Britain throughout this period 1870-85 was summarized by Sir George Clarke and Mr J. E. Thursfield in the preface to their work on Tlie Navy and the Nation: â€”

The strength of the navy was allowed to decline till the annual vote for shipbuilding was equalled or exceeded “by that of France, who within a few years of the disasters of 1870-71 began steadily to increase her fleet. It is indisputable that the vast expenditure upon measures of passive defence which was in- augurated in 1859 checked and stunted the growth of the navy. Too much, however, may be made of this point, and the actual expen- diture is of small account In comparison with the warping of the national policy and the establishment of false standards, which only a great war can efface. After many millions had been use- lessly squandered, the scares of

1878 and of 1885 were widely felt. It was realized that the nation was quite unprepared, and that measures of passive defence, however academically successful, were quite unsuited to the needs of war.

On the 21st November 1888 a committee consisting of Admirals Sir W. Dowell, Sir Vesey Hamilton, and Vice- Admiral Sir F. Eichards, reported to the Admiralty on the naval mancBuvres of that year. It is a report marked by itnusual directness of language, in which the issues are very plainly stated, while it exercised a great influence on British naval policy. We quote some paragraphs : â€”

The main lesson which these manoeuvres emphasize is that Great Britain, whose maritime supremacy is her life, is very far from being as strong as she should be on the seas, either in per- sonnel or materiel. . . . We are decidedly of opinion that no time should be lost in placing her navy beyond comparison with that of any two Powers.

England ranks among the great Powers of the world by virtue of the naval position she has acquired in the past, which has never been seriously challenged since th^ close of the last great war.

The defeat of her navy means to her the loss of India and her colonies, and of her place among the nations.

“Without any desire to question the sums annually granted by Parliament for the maintenance of the servicfes, we cannot but note the disproportion in the appropriation when the magnitude of the issues involved is taken into consideration.

It would, in our opinion, be far more in consonance with the requirements of the nation by the provision of an adequate fleet to render invasion an impossibility than to enter into costly arrangements to meet an enemy on our shores (instead of destroy- ing his ” Armada ” off our shores), for under the condition in which it would be possible for a great Power successfully to invade England, nothing could avail her, as, the command of the sea once being lost, it would not require the landing of a single man upon her shores to bring her to an ignominious capitulation, for by her n\vy she must stand or fall.

While due allowance is made for the influence of experts and writers, it cannot be doubted that the extra- ordinary growth of British maritime interests led to anxiety on the part of the commercial community which had a great deal to do with the determination to maintain the two-Power standard, or equality in battleships with the two next maritime Powers. This standard cajne into vogue in England in 1889. Thus the foreign trade of the

United Kingdom had increased from 547 million sterling in 1870 to 870 million in 1901, exclusive of the enormous trade in bullion, specie, diamonds, and stock exchange securities. The earnings of British shipping alone in a single year were oyer 60 million sterling. The imports of corn, sugar, wool, and timber had each more than doubled in the three decades; and as these articles are so bulky, and the return cargoes of coal had increased fourfold from 11| million tons in 1870 to 44 million tons in 1900, there was naturally an immense develop- ment in the mercantile shipping which is so absolutely dependent on naval protection in war time. Thus in the year 1870, 73,198,600 tons of shipping employed in the foreign and coastal trades had entered and cleared in the ports of the United Kingdom, whereas in 1900, 208,777,000 tons had entered and cleared. This last was exclusive of 1,572,000 tons employed in the transport of troops and stores for the South African war, which it was seen could never have been carried out had not the Eoyal Navy safeguarded Great Britain from any likelihood of hostile intervention. These figures and statements give, however, but an inadequate measure of the wealth and growth of those maritime interests which the British navy had to protect. Even when we have added the coastal trades and the growing foreign trades of the great depend- encies and colonies of the British empire, there still remains the British shipping emplcyed by other nations. As stated by the Shipping Federation in their petition to Parliament in May 1899, only one-third of British shipping was employed for the requirements of tEe United Kingdom. Then again, some 70 per cent, of the submarine cables of the world were ownedby Great Britain^ and she had become dependent not only for cotton (as in the Lancashire cotton famine of 1861-64) and for timber, but also for food, iron ores, and all raw materials of manu- facture, on countries separated from her by the sea, which in war can tolerate only one master, and becomes a midti- plying power to the strong and an enslaving tyranny to the weak. These necessaries for existence were brought to Great Britain, or were

being paid for by return cargoes, in about 6600 British vessels in winter and 7500 in summer, which would be actually ploughing their way thrortgh the ocean on any one day of the year, exclusive of all in port loading with cargoes, and exclusive also of foreign vessels.

With such stupendous maritime interests to protect, it almost defies investigation as to why there should ever have been a cause for naval scares, and as to how it came about that a country with a past steeped in suc- cessful naval tradition should, in the plenitude of her strength, have had ministers who attempted to provide localized substitutes for the mobile naval defence. The British empire had a coast-line of 43,000 miles, or 10 times that of Germany or Italy, 5 times that of France, and 2\ times the coast-line of Eussia or the United States. From such facts it may be inferred that, when once the essential basis of their faith in the sea had been sapped, the argument that fortifications and garrisons could be substituted for naval defence applied all along the coast- line. As might have been anticipated, with a limited sum of money' available for the purposes of defence, when expenditure was unduly diverted to localized defences, the main issues on the sea, on whieli everything depended, were lost sight of. It was this false doctrine of localized defence which largely militated against the mother country obtaining any substantial aid towards the navy from the outlying empire, as under its spell the idea of Australia and Canada being defended in the Mediterranean appeared inconceivable.

The position was so bad at one time that even the actual ships provided were starved for want of ordnance. Up to 1888 the Ordnance Department was under the "\^"ar Office,

and for yearsthe Admiralty demands had been systematic- ally reduced. The following table, extracted from Sir Vesey Hamilton's Naval Administration, speaks for itself : â€"

1881-82 1882-83 1883-84 1884-85 1885-86 1886-87

Asked for.

Â£647,759

877,001 707,002 899,002

1,145,000

1,516,887

Granted- Â£360,000

616,083 500,491 600,000 850,000 1,000,000

In 1889 the sum of Â£1,717,661 was transferred from the army to the navy estimates for the ordnance vote, and with the augmentation of the navy this vote has consid- erably increased since that date.

The navy estimates of foreign countries embraced details of coast defence, and, as in the French estimates, subsidies for fishing-vessels, &c. With the transfer of the Artillerie et Inf anterie de la Marine to the War Department as the colonial army, the French navy estimates were con- siderably reduced, and it is necessary to bear in mind this fact when comparing the growth of expenditure. The British navy estimates were net ‘expenditure after de- ducting the appropriations in aid and any special provision for permanent works like docks. Thus, owing to the great increase in the navy of vessels of a larger type, it was found desirable to add docks at the following places, pro- vision being made by special Naval Works Acts : â€”

Docks.

Chatliam 1

Malta 2

Gibraltar 2

Bermuda Floating dock.

Cape of Good Hope 1

Hong-Kong 1

In the ten previous years (1889-99) Great Britain had only added two docks at Portsmouth and one at Malta. During this period the longest cruisers had in- creased from the 400 feet of the NoHliumherland to the 600 feet of the Terrible class, and the battleships from 345 feet for the Trafalgar to 400 feet for the Formidable. Even with this development the largest battleships were from 200 to 300 feet and the largest cruisers 100 to 200 feet shorter than the largest passenger steamers, such as those employed in the Atlantic trade. In the same period the Mediterranean squadron had beendoubledfrom 96,000 tons in 1889 to 205,000 tons in 1899, the Channel fleet in- creased fourfold from 37,000 tons to 155,000 tons ; the China squadron was nearly trebled, and the remaining squadrons doubled. Hence the urgent necessity for special expenditure granted apart from the normal navy estimates.

From 1870 to 1885 the British navy estimates were maintained at from Â£10,000,000 to Â£12,000,000 sterling, and the personnel dwindled from 61,000 to 57,000 officers and men. The subsequent course of events is shown in Table C. It is characteristic of the haphazard methods pursued, that with the increase of ships provided for in 1885 no provision was made for increasing the personnel, and the then Board of Admiralty were accused by the succeeding First Lord of having neglected to provide even the money for the ammunition and torpedoes for the ships built. _ Again, with the Naval Defence Act of 1889, when provision was made for doubling the navy and everything, pointed to a scarcity of officers in the future, the number of entries into the Britannia was actually reduced by one- fifth. Where foresight, organization, and business-like methods were vital, the administration of the British navy during those periods of its expansion does not show to advantage beside the carefully thought-out plan by which the German Admiralty proposed to carry out the vast increase of the Imperial Navy. In the latter case we find the expansion of the dockyards, matiriel, and personnel of

the navy going on hand in hand. The faults of the British system were obvious, and had been condemned by the highest authorities in the Government. “The exercise of the Treasury’s powers,” said the Prime

^Minister in 1900, “in governing other departments of the Government is not for the public benefit. On 24th November 1901 the First Lord of the Admiralty de- clared that if business men were appointed to the Admiralty, they would find ” that under an infinite variety of sub-heads they had, fifteen months beforehand, to state what they were going to spend fifteen months hence, and that they could not, in the course of business, ti-ansfer sixpence from one sub-head to the other without .the consent of a totally different firm.” Nothing could more conclusively prove that the fault lay in the system than the fact that we should so often find First Lords of the Admiralty committing mistakes that they them- selves had condemned. It would be difficult to believe that the author of the following words, extracted from “the statement of the First Lord explanatory of the navy estimates 1887-88,” was the same First Lord who reduced the navy estimates in 1887 and 1888, and was forced by “popular pressure” to bring in the Naval Defence Act of 1889. Yet so it was, and we quote his words in full, since they afford a statesmanlike review of a lesson from wMch Great Britain appeared to have profited but little : â€”

A careful review of the expenditure of the past six years is necessary, in order that the significance of our present position, and the causes at work in establishing it, may be understood by Parliament and the country. In the period between 1881 and 1885 every naval Power in Europe, save England, largely increased its naval expenditure. The introduction of slow-burning powder, and the alterations in the design of heavy ordnance which it entailed, while giving increased velocity and accuracy to guns of all calibres, produced a corresponding development in the defensive power of armour-clads and protected vessels. Speed in the per- formance of naval taxitics became an even more essential factor than before, and was so recognized abroad ; and on vessels of com- paratively small displacement successful efforts were made to realize, by engineering ingenuity, a speed wholly unknown to the smaller craft of a few years back. These developments of speed and power necessitated increased expense. England was the last naval Power to recognize these new conditions. ; In 1 885, under popular presstire, the Government of that day admitted the insuffi- ciency of its previous arrangements, and, with the assent of all parties in the State, Lord Northbrook, the then First Lord of the Admiralty, proposed to expend, in addition to the ordinary ship- building programme, a sum of

Â£3,100,000 in the building of ships by contract in private yards. An additional sum of Â£1,600,000 for guns was also proposed to be added to the ordnance votes of the navy, which are included in the annual estimates of expenditure of the “War OfBce [since transferred].

If this great sum had been spread over this period of six years more evenly, and if consideration and a continuous policy had attended its disbursement, the navy at this moment would be far stronger than it is. On the other hand, the increase of strength which this sum will “ultimately give would have been more economi- cally attained if huriy a?id scare had not attended its outlay. The conclusion to be drawn will, I trust, not be lost sight of by subse- quent Administrations and by Parliament.

It may be said that from 1885 the British navy, supported by the public, was fighting against the inertia of previous years, and even the necessary Naval Intelligence Depart- ment which was formed in 1887 had a struggle for exist- ence. In 1901 it consisted of 14 officers, as against 17 for the German Naval Intelligence Department.

By 1901 the evolution of naval opinion had reached as enlarged a conception of the functions of the British navy as Moltke possessed concerning the functions of the German army. Moltke’s method was, on a careful esti- mate of the situation, to organize the army to suit what would be the probable situation in war, without refer- ence to the possibilities which alarmists are prone to place in the foreground of their pictures. In 1901 the First Lord of the Admiralty laid down the true standard on which naval strength should be based, viz., “The navy

ought to be so strong that it can have a reasonable cer- tainty of success in the performance of any duty which it is reasonably probable that it will be called on to perform.” This was emphasized in the House of Commons on 22nd February 1902, by the Financial Secretary of the Ad- miralty, who said, ” Their duty was to have a naval force which should certainly not be less than the standard of two other Powers, and should be equal to any

reasonable emergency with which we might expect to be confronted. This of course involved a power not only equal to, but in excess of, the standard of two Powers.”

The tables accompanying this article show the progress achieved. From these it will be seen that in the 10 years ending 31st December 1900, or the closing decade of the 19th century. Great Britain had built or commenced 38 battleships, France 17, Russia 18, Germany 19, Italy 6, the United States 16, and Japan 6, making a total of 120 battleships built or commenced since 1890. If we exclude Japan, and so confine our attention to those nations likely to wage war on the Atlantic, w.e find that in 1902 one in three of the modern completed battleships was British. When we reflect that the average tonnage of these vessels was higher than that of any of the other Powers by nearly 1000 tons, the position of Great Britain appears to have been a fairly satisfactory one. The same apparently favourable position existed as regards the armoured and protected cruiser classes and the mercantile auxiliaries. Since 1890 Great Britain had built or laid down 96 armoured or protected cruisers, as compared with 41 for France, 19 for the United States, 18 for Japan, 16 for Italy, 15 for Germany, and 13 for Russia. The re- quirements of the British Empire, with its 43,000 miles of coast-line, connected by shipping routes which have to be protected, and the necessity this protection imposes of persistently watching the enemy’s ports, pointed to the need for larger supplies of cruisers than mere comparisons with other nations might suggest. Considering the mat- ter as one of insurance, although there is very little strategic relation between the defence provided and the extent of interests which have to be defended, it is in- teresting to note that a Parliamentary Paper in 1899 gave the naval expenditure per ton of mercantile shipping as in Great Britain Â£2, lis. 3d., France Â£14, 8s. Id., and Russia Â£14, 18s.

It was a subject of controversy at the beginning of the 20th century whether the strain maintained on the British navy during peace was not an unnecessarily severe one, owing to the policy carried out by Great Britain alone of maintaining large squadrons in every part of the world. The opinion was held by many that the British navy would gain both in organization and training if these ships were more concentrated during peace. The growth of Italy, the important colonies whicliÂ»France had

acquired in North Africa, and finally the opening of the Suez Canal, had brought about a concentration of French naval force in the Mediterranean. The Franco-Russian alliance in- duced the British Government to place their Mediter- ranean fleet on what was practically a war footing, and a great deal of expenditure was incu.rred at Gibraltar in the attempt to make it an efficient dockyard. In view of the proximity of the Spanish shore, and the fact that the home dockyards were distant only five days' steaming at moderate speed, this expenditure was very seriously called in question, on the ground that it could have been more usefully applied in other directions. The same law holds good as regards navies as in commerce, that large con- centrated resources, such as great naval yards like Ply- mouth and Malta, work far more efficiently and rapidly than the necessarily small resources of an intermediate and expensively created dockyard such as Gibraltar promised to be. Therefore it is only a superficial view

which would develop Gibraltar merely because naval actions might be fought in its vicinity. There is nothing to show in St Vincent's expressed opinions that even in his day, when England was so distant in time, he attached any value to Gibraltar beyond the opportunity of anchor- age and ordinary supplies which it gave. There is the very good reason that he abandoned the Mediterranean when the over-anxious Admiral Mann carried his squad- ron to England, to show the real and concrete value which- he attached to actual fighting ships. Millions had been diverted from direct naval expenditure on ships and men in the British Empire to what was merely superficial, of local utility, or only supported by the plausible argument that resources and defences were being provided which enabled the fleets to operate more freely.

It appears to be difficult for men to understand that warships are built to fight ships of their class, and are quite-unsuited for the direct attack of fortifications. The threat of interruption when attacking land defencesâ€" as occurred at Lissa, in the war between Italy and Austria â€" deters them from using their ammunition supply, which is even more limited in quantity than was the case in the past. The ammunition supply and the life of the gun have to be husbanded for the purpose of fighting the enemy's ships. It follows, therefore, that the sedentary defence need only be of moderate dimensions, except where it is contemplated, as was done by Lord

Palmerston when he initiated the Portsmouth fortifications, that the sedentary defence should defend the fleet itself. This position was no longer contemplated in British naval policy at the beginning of the 20th century. It should also be re- membered that no amount of defence on shore can safeguard the communications of bases like Malta unbacked by continental territory. Large supplies of coal could not be accumulated because of deterioration, so that the com- munications of the base in war might easily be of equal importance with the base itself. British naval operations must therefore, apart from the fortifications, provide for the defence of the base and its communications. In this connexion the answer of Moltke, when urged to build fortifications on a certain line of march, may be cited. He replied that if the enemy were to go that way the forts might doubtless be useful, but they would be unnecessary, as he should meet the enemy with the field army ; but, he added, if the enemy takes another route, the men in the fortifications and the money which had been spent on them would be lost to the field army. Applying this lesson to the British navy, it was contended by some authorities on imperial defence that the scale on which shore defences were necessary to the British Empire was dictated solely by the probable raids of a few fast vessels and torpedo craft. In the absence of any fortifications, these vessels might otherwise be willing to concur the risk of capture for the sake of the damage which they might hope to inflict before they could be interfered with.

It was also contended that the sedentary garrison should be organized in such a way as not to interfere with the free movement to other parts of a large proportion of the troops. Both in South Africa and in China, in 1899 and 1900, naval forces had to be landed, and the ships denuded of their fighting complements, because the troops could not be sent without grave delays. The Benin expedition of 1897 was another case in point, where ships were denuded of their crews to undertake an inland expedition. When all the facts came out concerning the bombardment of Alexandria in 1882, they did not add to the prestige of the navy, but the final comment must be that the navy was called upon to perform work \‘hich was essentially military in itsi nature, and in which the fleet ought only to have played an indirect part. If in circumstances of

peace Great Britain had so often to employ the navy on military work, the question was suggested by Sir John Colomb as to where the naval commander-in-chief would find the military forces to co-operate with the navy in capturing vessels in a harbour which is secured against attack by - sea, but not against a landing-party. And yet it is the case that in offensive operations a military force, capable of being rapidly transferred by sea, is of the greatest assistance to the work of a pre- dominant navy. Hence there arose a demand at the beginning of the 20th century for arranging that the coaling stations should be under naval control, so that the admiral should have at his disposal the military units which might be quartered on shore, as also the use of the shore guns on board the ships if he should require them.^

In respect of the sense of proportion which enables a statesman to consider the whole of a question before the parts are dealt with, it is doubtful whether imperial defence had made much progress in England or her colonies at the end of the 19th century. The whole system of Parliamentary procedure blocked the way to progress, for no member of Parliament would be in order who attempted to refer to the navy in a debate on the army estimates, or vice versd. No discussion could take place as to the Cabinet Committee of Defence, which was supposed to deal with the whole question of imperial defence, for no salary attached to the secretary or the members of the Committee

If British naval policy betrayed want of clear thinking, it must be confessed that Prance was even worse served. The Ministry of Marine changed its chief more than thirty times in thirty years, and was subjected to repeated cojnmissions of inquiry, which only tended to create confusion. Numerous changes took place in the system of the administration, prepa- ration for war, and policy. As regards shipbuilding, the navy estimates for 1900-1901 made provision for expen- diture on six battleships. In the previous year (1899) the reporter of the Prench Budget Committee said that he approved, ” without reserve, the decision of the Minis- ter of Marine to suspend for 1899 the ordering of a new_ battleship, so as to concentrate all available resources on cruisers, torpedo-boats, and submarine vessels.” It has been the prevailing characteristic of Prench naval policy in the past, that it

seldom exhibited any stability of purpose, such as is stamped on the carefully thought-out German programme. In introducing the estimates for 1900, the Prench Minister of Marine pointed out that the programme of 1871 had been repeatedly modified, and yet was not completed. ” The Government considers that it is indispensable to do away with such errors, and to lay down in definite form what should be the organi- zation of the navy, adapting it, like that of the army, to the needs of defence on the one hand, and to the re- sources in men and money on the other.” The failure of many ships he attributed to repeated modifications, and hence the origin of a fixed programme to be completed in 1906 or 1907. The Minister of Marine

1 In connexion with the above remarks the speech of the First Lord of the Admiralty in the debate on Wei-Hai-Wai in the House of Lords may be quoted from The Times, 19th March 1902. After stating that he had the concurrence of his Board in his remarks, Lord Selborne said : ” Bricks and mortar as applied to naval expenditure are an evil, very often a necessary evil, but they are an evil. What we want are more ships, and every penny that is spent in bricks and mortar and land fortification which could be spent on more ships is money unnecessarily and badly spent. Every garrison that we have to lock up hundreds and thousands of miles away from this country Is an evil, very often a necessary evil, but an evil to be reduced to the smallest dimensions possible. . . . The number of these bases and the money spent on them should be limited in the strictest manner to the absolute necessities of the navy.”

might have added that the programmes of 1891 and 1896 were arrested within three years of their being first sanctioned.

In the above remarks the Prench Minister of Marine laid down the limiting conditions of national and imperial defence. No resources can provide for safety at all points. To find out the vital needs of the probable theatre of war, and to take care that in a limited expenditure of men and money the whole is not sacrificed to the part, â€” these are the conditions on which the maritime supremacy of Great Britain can be maintained. To attempt to pro- vide for all the possibilities of war is to disperse resources and to court defeat. The British empire would start a maritime war with immense

advantages in her favour through the geographical position of Great Britain, the chains of coaling stations supplied from South Wales with the best smokeless steaming coal, and the possession of the greatest mercantile marine and shipbuilding yards in the world. Prance must ever labour under the dis- advantage of her coast-lines being separated by the Iberian peninsula, while Russian fleets in the Baltic and Black Sea are separated by thousands of miles of foreign coast- line, and can only obtain access to the sea through narrow channels. The Sound, the Belts, and the Dardanelles are easily blockaded by a Power which holds the supremacy of the seas. The Baltic and Vladivostok are impeded by ice during the winter months. Port Arthur, closed to the sea by a superior fleet, is isolated expept for a long and uncertain line of railway traversing 4500 miles to St Petersburg. On the other hand, the necessity imposed on the British navy of keeping the sea involved greater risks of navigation. This fact is one which can be deduced from history. In the Prench revolutionary war of 1793-1802 the British losses from causes other than fighting amounted to 18 sail of the line, 3 fifty-gun ships, and 43 frigates ; the allied nations of Prance, Spain, and Holland only lost from these causes 10 sail of the line and 9 frigates. This is a somewhat remarkable fact, when we consider the inexperience and disorganization of the French and Spanish navies. As with those navies at the end of the 18th century, so at the end of the 19th, Prance and Eussia combined lacked the advantages which belong to a homogeneous force. No naval alliance in history has ever been successful against an efiicient tavy except when the allies were numerically far stronger than the homogeneous force, or originated from a common stock speaking the same language. New inventions, such as liquid fuel, aerial navigation, and submarine vessels, may exercise a modifying influence, but a nation which is so conditioned by surroundings as to insure unity of purpose in her policy must have an immense advantage in all circumstances.

Germany. â€” The German Navy Bill of 1900 for doubling the navy in sixteen years, while allowing for the obsoles- cence of vessels, was heralded by the following New Year’s speech of the German emperor to his generals : â€” ” As my grandfather did for the army, so will I for the navy, carry out the work of reorganization. The navy must be equal to the army. Then I shall be enabled to procure for Germany the place among foreign nations which she has not yet obtained.” At the same time, possibly fanned

to a certain extent by the growth of anti-English feeling, an extraordinary outburst of enthusiasm for the navy swept across the Patherland. The German Navy League (founded on 30th April 1898, in imitation of the British Navy League, started on 1st January 1895), with H.R.H. Prince Henry of Prussia as patron, soon had 600,000 members and an income of Â£25,000 a year. A few days after the emperor's New Year speech some German vessels were seized by British cruisers off Delagoa Bay on suspicion of carrying arms and ammunition to the

Boer forces. A wave of angry feeling swept throughout Germany, and the emperor telegraphed to the king of Wiirtemberg his hopes that "the events of the last few days have oonvinoed wider and wider circles that G-ermany's honour, as well as her interests, must be protected on distant seas, and that for this purpose Gnermany must be strong and mighty at sea as well as on land" "When the Navy Bill was passed the emperor telegraphed to the directors of the North G-erman Lloyd, which owned the greatest mercantile fleet of any country in the world, that when the work of building up the imperial navy was complete " we shall be able to impose Igebieten^ peace on sea as well as on land." When the Navy Bill was being discussed in the Eeichstag, a secret session of the Budget Committee was held, respecting which TJie Times' correspondent pointed out that the subsequent public debate revealed that British maritime and imperial power had been the chief subject of discus- sion m camera. On 19th June 1901 the emperor made a speech in which he said that " our future is on the sea." This sentiment, " Unsere Luktmft liegt auf dem Wasser," had been used as a motto for the German nautical display at the Paris Exhibition of 1900.

In February 1902 a German socialistic paper, which had on more than one occasion published secret papers, came out with the announcement of an increase in the navy estimates which the German Government contem-plated presenting in the following year to the Eeichstag in extension of the huge programme of 1900. Only the Bill of 1900 is included in the details

given below. They are alone suflftcient to mark the sacrifices which were being demanded of the German people and the develop- ment of national aims since the Navy Bill of 1897, when the Chancellor declared that the proposals he then brought were directed only to ” the speedy completion of an unfinished institution. ... We do not dream of rival- ling the great naval Powers.” The Bill would ” form the basis of our fleet for many years to come.” No one can complain of this development of national aims. It is, on the contrary, a subject for admiration that a nation in half a century should have reached such high aspirations, for in 1848 Moltke was despairing of his country, and the Prussian navy had consisted of but one corvette and two gunboats. The quotations are simply made with the view of showing the trend of German policy, apart from the more practical outlays involved in the Â£93,000,000 sterling voted for the navy and the expansion of the dockyards, and apart from the expenditure on the Kaiser Wilhelm Canal, which enabled ships to pass from the North Sea into the Baltic in ten hours. The proceedings as a whole form a record of triumph for the emperor over what had been once the hostile opinion of the public This feeling he himself virtually expressed on 18th Octo- ber 1899, when he launched the battleship Kaiser Karl der Orosse : ” If the increase in the navy which I de- manded with urgent prayers and warnings had not been stubbornly refused me during the first eight years of my reign â€” I did not even escape derision and mocking at the time â€” in how different a manner should we now be able to promote our prosperous commerce and our interests oversea! But my hopes that the German will brace him- self to the task have not yet disappeared, for great and mighty is his love of his country.”

By 1901 the personnel consisted of 31,038 officers and men, as against 28,204 officers and men in 1900. It should be remembered that the fixed defences of two of the naval ports were in the hands of the navy, and a certain number of soldiers were occasionally given sea experience by embarkation in the manoeuvres. An in- crease of 33,000 officers and men was intended to take place during the next nineteen years to 1920.

In 1901 the matdriel, including ships under ccmstmc- tion, was made up as follows : â€”

Battleships, 21â€”

Of which 8 first-class completed, 8 building,

5 thlrd-elass completed. Coast-defence ships, 8. Armoured cruisers, 6 â€”

Of which 3 completed (2 were obsolete battleships), 3 building. Protected cruisers, 6. Small cruisers, 32 â€”

Of which 28 completed, 4 building.

The following programme was proposed in 1900: â€”

Cost of Unit.

28 battleships

18 large cruisers .... 45 small ,, ... 16 torpedo-boat divisions .

Total cost of programme .

To complete vessels previously voted

. Â£1,225,000

882,000

269,.50O

294,000

.â– Â£67,007,500

6,630,000

Total cost of new construction .

. Â£73,637,500

Allowing for certain reductions, the annual cost, spread over the sixteen years to 1916, works out at Â£4,900,000. To the Â£74,000,000 for the

active navy, a sum of about Â£20,000,000 has to be added for the increase of the dockyards.

The following was the official scheme for building new vessels to replace old tonnage. The names of the vessels becoming obsolete for each year are given below, and, dis- regarding these vessels, the German navy by 1916 was intended to consist of 38 battleships, 20 large cruisers, 46 small cruisers, and 16 torpedo-boat divisions. As passed, this was reduced by 6 large and 7 small cruisers. It does not follow that because vessels are labelled obso- lete in this look ahead, and left out of the above list, they are not still serviceable, and there was nothing in the scheme to prevent the official programme from being completed long before 1916. As far as could be ascer- tained in 1902, the last but one of the new battleships would be laid down in 1905,

Become

Obsolete.

Larse

Tear.

Battleships and Armmired Coast-Defence Vessels.

large Cruisers.

shws

required

to replace

jearlj’.

1901

Bayem, Sachsen, Wiir-

Konig Wilhelm, Kai-

7

temberg, Baden

ser, and Deutsch- land

1906

Oldenburg .

1

1908

...

Kaiserin Augusta

1

1912

Siegfried

...

1

1914

Kurf iirst Friedrich Wil- helm, Brandenburg, Weissenburg, Worth, Beowulf, Frithjof

â–

6

1916

Hildebraud .

Freya, Victoria Lou- ise, Hertha, Fttrst Bismarck

5

1916

Heimdall, Hagen

Vinetta, Hansa .

4

1917

iEgir, Odin .

Total

2

27

Apart from the obsolete ships, the German navy was intended to consist of 29 battleships by 1908, in addition to 20 large cruisei-s, 61 small cruisei-s, and 16 torpedo divisions, which should make it stronger than France expects to be in 1907. The shipbuilding resources of France had fallen so far behind those of Germany in 1902, that there did not appear to be a likelihood of any other nation, excepting the United States, entering into

active rivalry with Germany in the race for the position of second maritime Power in point of strength. Un- questionably Germany was possessed of great resources, using the imperial dockyards at Danzig, Kiel, and Wilhelmshaven, in addition to a number of private yards. Five of the

dockyards in 1900 ranged from Danzig, employing 4900 men, to Kiel employing 11,700. In all there were 42 dockyards of various dimensions, the 39 private yards employing nearly 25,000 men. The great Krupp iron-works, which controlled dockyards, iron- works, and coal-mines, employed nearly 47,000 men. Whilst these resources gave Germany a great advantage over France, Eussia, and Italy, resort had still to be made very largely by German shipowners to Great Britain, there being building in Great Britain for Germany some 200,000 tons of shipping in 1901. When, however, we consider the insignificance of German shipbuilding until 1884, when Bismarck subsidized the great lines on con- dition that certain ships were built in Germany, the progress made in the later period is seen to be very great.

It is necessary to recall facts like these, for it must be remembered that the burden of naval armaments is not one that is lightly borne by the great maritime islands, which depend wholly on their navy to keep open their sea communications ; and Germany, vitally dependent as she is for the defence of long land frontiers on her army, may find it difficult to face the joint burden in time of great trade depression. This, however, appears to be fully realized by the Government. For the two years 1899 and 1900 the Government spent beyond the esti- mates Â£800,000. In presenting the estimates for 1901, Baron von Thielmann said in the Eeichstag that the estimates in future years would be much harder to balance, owing to “the daily augmenting sums due for pensions, and the yearly increasing demands for the expansion of the navy.” On 8th January 1902 Baron von Thielmann said : ” The Dnperial finances have turned out to be even more unfavourable than could be foreseen a year ago. The advance which characterized the last years of the past century has not only become slower, but a depression has taken its place which has been accompauied by a great collapse of important banking institutions and other undertakings. This could not fail to have an unfavourable effect on the financial situation.” The strength and consistency of German policy are a pro- duct of the passion of the nation for history. A noted French deputy, M. Jules Eoche, in 1895, when comparing the French and German armies and the tradition in Germany in favour of taking the offensive in war, said : “Our neighbours breathe the air of history. They never break the chain of the past. In their conversation and their’ literature, events of the last century are to them as if

they happened only a few years ago. What concerns Barbarossa interests them as much as con- temporary events, and they make a scientific and political theory out of the consequences they deduce from historic events which for us would seem to have utterly faded away.” In the German navy British naval history was closely studied, and the naval programme was framed with the view of taking the offensive, as had always been advocated by the great British sailors.

The principle which animated the German Government in its policy was that naval strength is part and parcel of maritime expansion. For this reason, no detail con- nected with the opening up of harbours or waterways was too insignificant for the Government. Both the personnel of the mercantile marine and the imperial navy are the recipients of the royal favour, and the highest honours have been paid alike to the founder of the North German Lloyd and to the mercantile

captain who brought the Bvlgaria home after great privations. While liberty was conceded in peace to the shipping, in war the Government had the power com- pulsorUy to charter for their own purposes any vessel they might requu-e.

The old law derived from history, that the sea will have only one master, indicates that there can be no finality to naval expenditure. When the Navy Bill of 1900 was being considered, the Secretary of State for the Imperial Marine, Vice-Admiral von Tirpitz, thus defined German policy : â€” ” The geographical position of Germany, the absence of coaling bases, and the con- sequent necessity for replenishing at sea, make a large battle-fleet necessary. The North Sea and Baltic coasts are so much enclosed that a war against commerce only, advantageous as it may be to other nations, is not possible for us, even if our cruisers succeeded in making the open ocean ; they would be unable to return with their prizes ; and where could they obtain coal ? The fleet of a Power like Germany can never be the same as that of France, for instance, whose coast-line forms a projecting angle into the ocean.”

The preamble of the Navy Bill expressed the opinion that ” the enemy’s cruisers on the chief trade routes in the Skager E.ak, in the English Channel, on the northern coasts of Scotland, at the entrance to the Suez Canal, and at

the Cape of Good Hope could make German navigation almost impossible." Great Britain, alone among the Powers, could operate against commerce over this wide sphere, so that we may assume as correctly expressing German views the statement of Vice-Admiral Valois in a pamphlet published in Germany in 1899, that the naval preparations were directed against Great Britain. In these circumstances it is difficult to imagine the German Navy Bill of 1900 as likely to be the last word in the regrettable rivalry of naval armaments.

The coast-line of Germany is about one-tenth that of the British empire, but the coast-line is a factor which bears very slight relation to naval operations until a nation is in a position to establish blockades. The smallness of the German coast-line, and the concentration of over 50 per cent, of the commerce by sea in the single port of Hamburg, would have made it a simple operation for a Power in command of the sea to arrest the whole of the direct sea commerce of Germany. This commerce at the time amounted to about 40 per cent, of Germany's total commerce, but a higher figure was often given through the inclusion of trade by Holland and Belgium. It was evident, therefore, that if Germany contemplated a struggle on the sea and the maintenance of her shipping, there could be no alternative but, either by her own unaided efforts or in conjunction with allies, to continue at an increasing pace the sacrifices which she was making in 1902. We may add that for years past Germany had been making these sacrifices, for in the period 1869-97, prior to the Navy J5ills, the annual naval and military expenditure of Germany increased by 21-|- millions sterling, as compared with Great Britain 17^, France IZ^, and Eussia 20 millions sterling. Only an increasing population and a thriving trade would enable fresh burdens to be easily borne, and this the German Government assumed (whether erroneously or not time must show) would be the case.

France. â€" In the section dealing with British naval policy reference has been made to the vacillation of the French administration as compared with that of Germany. This vacUlation, reflected as it was by the political changes involving a new Minister of Marine on an average of once a year, affected shipbuilding, coast defence, war training, the direction of maritime affairs, and the future conduct of campaigns. It is related of M!oltke that he expressed

the opinion that though a general might choose a plan of campaign which was inferior to several others, concen- tration of purpose in carrying it through would be more likely to bring success than to attempt first one and then another of the wiser courses. It is because the most consistent idea held in common by the majority of French naval officers at the beginning of the 20th century was the old one of the guerre de course, which failed in the French Eevolutionary and Napoleonic wars, that a brief mention of it must be made. At the same time it should be stated that attacks on commerce (when not brought about by the regular process of attaining com- mand of the sea) require the dispersal of warships so as to attack at many points. The fact that in 1902 a con- centration of French men-of-war was effected, so that the whole of the Pacific and Indian Oceans was confided to one squadron, might be taken as a virtual abandonment of the policy of the guerre de course.

In discussing the British navy estimates on 9th March 1899, the First Lord of the Admiralty said : â€”

I want to call the attention of the House very briefly to the fact that some of our rivals are practically giving up the idea that they would be able to meet us in the open sea, or, if they were able to meet us in the open sea, that at all events the better policy would be to endeavour to wear out the patience of this country by prolonged attacks upon our commerce, our food supply, and our sources of production. They think that while our battleships would be lying opposite their ports they would be able to sweep down upon our â– commerce. Until this country tired of the uncer- tainty and the injury inflicted upon us, and of the flag being transferred to other nations. It has been avowed in the most distinct terms. Scientific and professional writers and politicians and statesmen have all commended this plan, and, what is more, they have acted upon it. The plan now is to build very fast cruisers which shall prey upon our commerce, and which shall inflict that damage upon us which I have attempted to describe. We cannot sit still in the face of the construction of cruisers intended for that purpose. We know that purpose, and it is our bounden duty to defeat it.

There can be no doubt that this summary of French naval policy was in agreement not only with the ex- pressed opinions of French naval officers, but also of r.esponsible statesmen. M. Delcasse, when out of office, said, on 12th December 1896 : ” We [the French] must avoid general actions with the same perseverance that England will try to bring them about, and direct our efforts to where she is most vulnerable. For that pur- pose the first quality we require is a high rate of speed, and the power of steaming a long way without having to take in a fresh supply of coal.” M. Lockroy, who had been Minister of Marine, said that ” by launching some fast cruisers or torpedo boats on the great trade high- ways it would be possible for us to starve Great Britain, to suppress her commerce, and to ruin her industries.”

This policy can, of course, only be judged on historical evidence. During the last French wars, when the same policy was tried, the British mercantile marine, during the twenty years of active war, lost to the French on an average 643 vessels yearly. The British mercantile marine varied during this period from 21,000 to about 25,000 vessels. Taking the average as 23,000 vessels, the loss was 2-36 per cent. As Great Britain added to the register 925 vessels per annum during that period, and in 1810 there were no less that 4023 prize ships which had been admitted to the British Eegistry, there was ample tonnage to replace the vaste of war, time, and navigation. There were errors of detail in the Registry in those days, and there were undoubtedly nominal cap- tures of British ships for the purpose of smuggling goods into French territory duty free, but these limiting considerations do not alter the main conclusion to be drawn from history that the guerre de course as an operation of war leads to the dispersal of resources, and cannot hope to assist the main end in view, which is to

bring a war to a successful conclusion. To those who examined the list of French vessels at the end of the 19th century, it was familiar knowledge that there were none available for the attack of commerce if the require- ments of the battleships in scouts and look-out vessels were to be met.

The budget of 1901 provided for 20 additional sub- marine boats of a speed of 8 knots. When all the sub- marines provided for in the budget of 1902 were laid down it was calculated that France would have, built or building, no .less than 44 of these vessels, or more than the programme of 1897

contemplated. A great deal of the enthusiasm for submarine boats was undoubtedly caused by their apparent cheapness, varying from Â£14,000 for the defence class to about Â£40,000 for the offensive class. It had long been realized in France that if Great Britain's sea power was to be overthrown, then, to adopt a military expression, some " turning " movement in naval armaments must be executed which would circum- vent the strength of the battleships. In Great Britain, in 1900, the First Lord of the Admiralty had quoted the reporter of the French Budget Committee, who stated that in building battleships materials in France cost 40 per cent, more than in England, and labour 10 per cent, more. It was evident that a competition in battleships would be ruinous to France,^lthough the estimate above quoted appears to have been an exaggerated one. Much of the enthusiasm for torpedo-boats at one time, and sub- marine boats for defence purposes at a later date, may be attributed to this cause. It was thought that these would prevent hostile ships from operating on the coast, and so the seas would be open for the commerce de- stroyers. Vice-Admiral Fournier (an officer of distinction on the active list of the French navy) had advocated in Le Flotte Necessaire a navy of 117 armoured cruisers of 8300 tons, which, associated with 300 torpedo-boats, he thought could destroy British commerce and maritime power. The Budget Committee of 1894 considered that battleships, cruisers, and torpedo craft were all necessary, a due proportion consisting of three battleships, two cruisers, a torpedo vessel, and a number of torpedo-boats. The reporter of the French Budget Committee (1899) stated that he approved " without reserve the decision of the Minister of Marine to suspend for 1899 the ordering of a new battleship, so as to concentrate all available resources on cruisers, torpedo-boats, and submarine boats." M. de la Porte, in his report on the budget for 1900, declared that French naval policy would involve an offensive defence by small craft on the coast of France, and commercial war carried on by numerous fast cruisers possessing great coal endurance. By 1901 the policy of building all types was again predominant, pos- sibly owing to the growing naval armaments of Germany, which nation had steadfastly refused to order submarine boats, while exhibiting considerable interest i]i the problem of aerial navigation.

The French programme of 1900, which superseded the one of 1896, was designed so that by 1907, subsequently altered by the -Chamber to 1906,

the French fleet would consist of â€”

4 squadrons of 6 battleships, with a reserve of 1 battleship for each squadron ....

Armoured cruisers, 8 divisions of 3 cruisers each .

Commerce destroyers (consisting of second and third class cruisers) about

Torpedo gunboats \

Destroyers â– â€¢â– .....

Torpedo boats

Submarine boats . . . . ‘ ‘ ‘ ‘

Total.

36 21

52 263

.j8

(The programme of 1900 authorized only 26 submarine boats, but 44 were built or begun by 1902.)

NAVIES

101

In all the new battleships it was proposed to follow the British plan of large dimensions.

The United States of America. â€” While it is difficult to trace any clearly thought-out policy in the appropriations made by Congress for the United States navy at the end of the 19th century, the increase in the expenditure serves to indicate a determination to play a great part among the nations.

Having regard to the enormous eurplus of revenue, amounting in the fiscal year ending SOth June 1902 to over 190,000,000, it would be difBcult to place a limit to the ambitions of the United States. The result of the successful war with Spain had made the United States a colonizing power. The report of the Secretary of the Navy, 4th November 1901, dealing with the further increase of the navy proposed for 1902, in- volving an additional expenditure of over Â£4,000,000, had referred to the responsibilities incurred in connexion with the transmarine territories of Porto Eico, Hawaii, the Philippines, and Cuba. ” If we are to have a navy at all,” the report stated, ” it must be commensurate with these great extensions â€” greater in international even than in territorial importance. This necessarily involves the construction of more naval vessels, their manning, exercise, and maintenance.” About the same time Pres- ident Eoosevelt emphasized certain doctrines absolutely dependent on armed force for their ultimate sanction. ” The United States must not shrink from playing its part among the great nations. We cannot avoid here- after having duties to do in the face of other nations. We do not intend to sanction any policy of aggression by one American commonwealth at the expense of any other, nor any policy of commercial discrimination against any foreign Power whatsoever. Commercially, all we wish is a fair field and no favour, but if we are wise we shall strenuously insist that under no pretext whatsoever shall there be any territorial aggrandizement on American soil by a European Power, and this no matter what form such territorial aggrandizement may take.”

In order to be able to trace clearly the leading idea behind this outline of policy, we may quote from the subsequent speech of President Eoosevelt at the Naval Academy, 2nd May 1902 : ” We all of us hope that the occasion for war may never come ; but if it has to come, then this nation must win, and the prime factor in secur- ing victory over any foreign foe must of necessity be the navy. If the navy fails us, then we are doomed to defeat, no matter what may be our material wealth or the high average of our citizenship. It should therefore be an object of prime importance for every patriotic American to see that the navy is constantly built up and, above all, is kept at the highest point of efficiency both in matiriel and personnel.”

In the days of wooden ships the American timber sup- ply had given to the United States a great position in the shipping trade, and there appeared to be

no reason why a similar position should not be won in the opening years of the 20th century. Stress was laid on this point by President Eoosevelt in his message to Congress in 1901. The production of coal and iron, which had been the source of Great Britain's power, had reached a point in the United States at which the coal was cheaper (after due allowance had been made for its lower calo- rific power), and the production exceeded that of Great Britain by many millions of tons. The annual output of pig-iron was twice as large, and an even greater supe- riority had been won in steel production. At the end of the 19th century the United States paid to foreign and American shipowners Â£346,000 for the carriage of the mails. The coasting trade, as formerly, remained an exclusive monopoly for American vessels. Proposals from time to time came before Congress for encouraging

American shipping by the payment of bounties, and the fact that 322 steamers were utilized in the Civil War, and over a hundred in the war with Spain in 1898, was not lost sight of as an argument in favour of en- couraging the ownership of vessels under the Stars and Stripes. Mercantile auxiliaries were the outcome of the high organization of modern naval war requiring col- liers, distilling ships, cold storage and provision ships, hospital ships, ammunition ships, telegraph ships, and parent ships for torpedo craft. It was recognized that most of these could be improvised from the mer- cantile marine if the details were settled beforehand. Such arrangements should prevent the transfer of de- sirable vessels to other flags at the moment they are likely to be required. This actually occurred in the case of the American cable-ship Grappler just prior to the American-Spanish war. An instance of the resort which might be made to auxiliary vessels was afforded in the American-Spanish war by the voyage of the U.S. battleships Oregon and Iowa from the West Indies to the Pacific. They took with them five colliers, one dis- tilling ship, and one cold storage ship, so as to be self- supporting. Apart from auxiliary ships of this nature, the U.S. Government armed 11 fast steamers, 28 yachts, and 28 tugs. The United States has never been a party to the Declaration of Paris concerning privateering, though the Naval War Code (issued in 1900 to the U.S. navy under the approval of the President) lays down very clearly the rules which are to be acted upon as regards belligerent and neutral property. Apart from this, however, the policy of arming auxiliary merchant vessels has been acted on by all nations since the Prus- sian Government created a volunteer

fleet in the war of 1870-71. These ships, it will be remembered, were officered and manned from the mercantile marine under naval discipline, and flew the national flag. While, how- ever, it was recognized in the United States that fast auxiliaries could relieve cruisers of much of the work of scouting, communications, and could fight vessels of their own class, it was never contemplated that they could form efficient substitutes for armoured ships on other occasions. The real object aimed at, after the provision of a mercan- tile marine as a factor of commercial prosperity and an ad- junct of the navy, was the development of the shipbuilding resources of the country. The importance of this con- sideration may be illustrated by the statement that it was possible in 1902 confidently to predict that the ship- building resources of the United States and Germany would enable those nations to take the second, and third places in the navies of the world within the decade, in spite of any efforts of Prance and Eussia based on the national shipbuilding resources. The development of re- sources is of great importance to a country circumstanced as is the United States. The geographical position and the absence of any vital point of attack conferred a power of prolonging a conflict which a country like Great Britain could not obtain except by successful action on the part of the organized fleets. In Great Britain there existed perfect free trade, and in Germany an approximation to free trade for anything to do with the materials of ship-building. Whether as a result of Protection, or of other causes, the fact remained that the cost of construction was in 1902 considerably higher in the United States than in Great Britain and Germany.

It had for a long time been a blot on the United States navy that so large a proportion of the personnel consisted of aliens, or naturalized aliens, instead of native-born Americans. While all the officers of commissioned rank were native-born Americans, 35 per cent, of the whole enlisted force in 1899 was of foreign extraction. In the annual report of the Chief of the Bureau of Navigation,

we are told on SOtli June 1899 there were 14,500 men in the United States navy, classified as follows : â€”

7380 native-born. 2441 naturalized. 1290 “alien, bnt declared.”

622 alien residents of the United States.

544 alien non-residents. 2002 native-born apprentices:

187 foreign-born apprentices.

Fifty-six per cent, of the petty officers were native-bom. To increase the proportion of “^native-born men, efforts were made to train landsmen for the purpose, and in 1901 the Bureau of Navigation was enabled to report that “the training system for landsmen has greatly added to the facility and economy with which the complements of the vessels of the Asiatic station have been kept as nearly full as practicable.” One of the chief lessons derived from the war with Spain was the necessity of a large reserve to provide for expansion in war. This necessity was rendered greater owing to the excessive cost of the personnel, amounting to nearly six times as much per head as that of the German na'y, and nearly twice as much per head as that of the British navy. It was felt that by devoting special attention to the training of a proportion of men, these could be used to stiffen the vast increase of personnel which experience had shown would take place on the outbreak of war. The utility of devoting special attention to the training of the select few was negatively shown by the results of the battle of Santiago, where out of 9474 rounds fired from the American ships only 124 rounds, or 1‘3 per cent., hit the fleeing Spanish vessels. The tendency, however, is one which could be carried too far, and that this had been done was strenuously pointed out by the chief of the Bureau of Navigation in his report issued in 1901. The report said: “It has always been the policy of the Government to regard its regular establishment of the navy and army as a nuclefus about which a larger estab- lishment would be formed in case of war.. The present establishment, however, can no longer be considered as an effective nucleus, for such a purpose. It barely sufficed for the Spanish war ;, and were the fleet to be manned with full complements, as it would necessarily be if called upon to fight a flrst-claas European Power, the present personnel would form barely one-fourth of the total estab- lishment.” Outspoken criticisms of this nature by the heads of the different naval departments were a character- istic of the American naval administration, and afford some indication of whfl,t might have been the

case in the British navy had the recommendation of the Hartington â– Commission been carried out, that annual reports from the different Sea Lords of the Admiralty should be issued.

The position of that vast territory of 3^ million square miles, with a population double that of the United Kingdom, bordering on two oceans which were destined to be brought into closer union by an Isthmian canal, was a source of anxious thought in every (juarter of Europe at the beginning of the 2(Jth century. It was difficult to avoid the conclusion that when such a nation exhausted the tempting investments afforded by its own internal expansion, capital must overflow the borders in an era of maritime expansion and in the development of trans- marine territory involving an increasing reliance on its fleet. To the British empire American capital might mean much, just as British capital in the past had been the prime factor in the development of the United States. In that case American capital might go far to enable the vast colonies and dependencies of Great Britain to come to the support of the maritime power of the mother country, over and beyond the insignificant contribution of

Â£317,600 which they made in. 1902. A cause forfear, however, remained to Great Britain in the probability of the American system of registry being made free enough to enable American combinations to buy up the principal British shipping lines and sail them under the United States flag. It had once been the ease, about the middle of the 19th century, that President Pierce was able to report to Congress that “the United States foreign com- merce has reached a magnitude and extent nearly equal to that of the first maritime Power of the earth, and exceed- ing that of any other” (1854). At this time American shipping was supreme in the Atlantic, though its doom was already sealed for a period by the advent of iron shipbuilding. The subject of its decay was the cause of repeated messages to Congress. On 4th December 1882 President Arthur wrote: “The Secretary forcibly depicts the intimate connexion and interdependence of the navy and the commercial marine, and invites attention to the continual decadence of the latter and the corresponding transfer of our growing commerce to foreign bottoms. This. subject is one of the utmost importance to national welfare.” The remedy which is indicated by the lessons of history appeared in President Cleveland’s ammal message in 1894 : ” The ancient provision of our law

denying American registry to ships built abroad and owned by Americans appears in the light of present con- ditions not only to’ be a failure for good at every point, but to be nearer a relic of barbarism than anything that exists under a permission of a statute of the United States. I earnestly reconunend its prompt repeal.”

Personnel.

The following statistics for the great maritime Powers show their strength so far as the persowwd of their navies is concerned : â€”

.fj-fsKce (1901).

3,0:32 ^aiAorifj/â€” Estimates 1901

111,961

2,000 Estimates

Officers .

Men ....

Dockyard riggers .

Numbers for coast defence

116,9931 14,181

Remainder . 102,812 ,

Tie navy had the following personiid available for coast defence :â€”

Officers and Inscrits

For manning batteries and providingaignekl- Men. Maritimes.2

men for the same 7,000

For manning the torpedo boats of the

” defense mobile ” 5169

For manning submarine boats . . . 333 For manning the “dt^tensea sous-marinea ”

and ” d(5fense3 fixes ” â€¢* . . . 903

Customs guards 493

Semaphore service 283

The French naval system of manning divides itself into three categories. (1) The Inscription Maritime nominally hronght in 139,310 men in 1850 and 114,000 in 1894. It was becoming increasingly evident towards the end of the 19th century that a compulsory system could not adequately provide for the skilled mechanical work of the ships. (2) ^‘olmlteers. These chiefly supply the mechanic ratings, and a system of state schools was adopted to obtain them in 1901. (3) Army recruits, drawn by

‘ 51,243 in permanent force of the navy voted,

2 These were formed into companies at the naval arsenals, and are supplied by the “inscrits” enrolled under category F (volunteers), men aEjed between thirty and thirty-three years. In’ 1900 there were 120,000 men of from 18 to 50 years of age on the rolls of the Inscription Maritime.

^ Tliese services included mine-fields, booms, searchlights, and a numbi’i- of steam launches fitted with torpedo tvjaas or spar torpedoes. These latter were manned by ” marine vetorans,” who in peace time manned the dockyax-d launches and performed other duties in con- nexion with the naval yards. They numbered about 2000, and only a small proportion would have been available in war time.

lots at an age of entry from, eighteen to twenty years. For the purpose of the Inscription Maritime the Newfoundland fisheries were kept up at considerable expense to the nations in subsidies, although the number of iiahermea was less than one-half the number of British fishenneQ in Newfoundland who were left untouched by the British navy, until in 1900 fifty were embarked for training. The French navy eonld only rely on obtaining the servii-es of these men in the latter half of the year, the boats beginning to arrive in June and continuing to come in until Christmas time. On the other hand, the British consul at Bordeaux estimated that not less than 1300 men annually retired from the fisheries and were available for service in the navy. The actual number of French fishermen employed in the Newfoundland cod fisheries in 1898 was 5105.

Musaia.

Total personnel, 1901

Personiiel employed in coast defence

Offlceis.

2131

nil.

Warrant Officers and Men.

57,957

Italy:

Total persormel proposed in estimates for Officers. Men.

1901-1902 1780 25,000

Of these there were to be employed in

coast defenoea ..... â– :-. 3,489

GermaTOf.

Toted, 1901

Naval forees available for coast defence â€”

Officers and Men.

31,157

4 divisions of seamen artUlery (men only) 2 battalions marine infantry (all ranks) . 2 depot companies and 1 field depot company for Kiaochow (stf’cngth variable)

This force was distributed among naval garrisons, have very large reserves, numbers not available. The following rate of increase is fixed by law : â€”

2,295 1,273

These units

Tear.

Executive Offleers.

Other , Fersonne^.

Total.

1900 . ... 1905 . ...

1910 . â– . . .

1915 1920

Total increase 1900 to 1920

876

‘ 1,179

1,482

1,785

2,088

22,476 31,187 39,898 48,609 57,320

23,352 32,366 41,380 60,394 50,408

1,212

34,844

36,056

It is evident that the inoreasa fixed by law was considerably accelerated.

United States.

Officers and Men. Actually serving, 30th June 1901 22,432

Marines. Total,

5845 28,277

Men.

42 . 145

Garrison at Dry Tortugas, Florida . Guam (includes forty seamen)

In his annual report (1901) the Secretary of the Navy said : â€” “The results of the Spanish-American war were such as to assure every one having knowledge of naval matters that steps should at once be taken to meet the one certain and positive requirement which will face the nation upon an outbreak of war â€” the immediate necessity of that exigent time,, if it

comes, of a large increase in the men of the navy from an existing reserve â€” an increase which must, in the main, be made from the seafaring class, who, having acquired the habit of the sea, are at home on the water. There is no better way of insuring such a reserve than by the measure now urged. Our pressing need is for such a reserve â€” a, body to go to. the front on board ship at once upon the outbreak of war, or when it is imminent. Next to this will come the defence of the coast, and for such purpose the Naval Militia will be essential. I see reasons for both organiaations, and have heretofore done all possible to aid- the one now existing, the Naval Militia, and to convince Congress of the necessity for the authorization of the other, the National Naval Reserve.”

Japan.

Officers. Men. Total personnel, 1900 . . . 2027 21,815 Numbers employed in coast defence . Not known.

Lbkgth op Service.

France. â€” (a) The length of service afloat in 1902 was forty-seven months, with a further thirteen months on “unlimited leave,” during which men were liable to recall at any moment.

(b) In addition to (a) men were bound to serve in the first reserve for two years, and the second reserve for twenty-five years.

The conditions under (a) were regulated by the minister, accord- ing to the: requirements and state of foreign affairs.

Mussia (1902). â€” Five to seven years in active fleet, and then complete fifteen years’ total service in the reserves.

Italy (1902). â€” Four years in active fleet and then complete twelve years’ total service in the naval reserve, followed by seven years in the militia, but on unlimited leave during both the latter periods.

Germany (1902). â€” (a) Active service, three years ; (6) reserve, four years. The men then join the ” Seewehr ” until completing their thirty-ninth

year.

United Utates (1902). â€” (a) Active service four years; (V) there is not any naval reserve at present.

Japan. â€” Two methods, volunteers and conscripts. Volunteers â€” eight years in active fleet, four years in second reserve. Con- scriptsâ€” four years in active fleet, three years in first reserve, five years in second reserve.

It is stated that half the seamen and two-thirds of tbe stokers ai-e volunteers.

Great Britain. (1902). â€”Voluntary service for twelve years. Voluntary re-engagement for ten years to qualify for pension. All pensioners are liable to be called upon to serve in times of emergency. There were two schemes for Jorming reserves. The Royal Naval Reserve scheme drew men frofn the mercantile marine and fishing population of the United Kingdom. The Royal Fleet Reserve scheme, introduced in 1901, while it gave a better system of training to the pensioners, was mainly designed to. obtain the services in war of the men who had quitted the navy after the expiration of their twelve years' service. In 1902, 122,500 officers and men were voted for the permanent force, which means that by 1st April 1903, or the end of the financial year, it was hoped to attain that figure. In the Reserves, Class B of the Royal Fleet Reserve (which embraces the men who quitted the navy after twelve years' service) had reached a total of 1768 men on 1st March 1902, consisting of 861 seamen, 262 stokers, and 516 marinea These men were given a week's training in their former duties every year. On 31st December 1901 there were in the Royal Naval Reserve 1500 officers for combatant duties, 400 engineers, 20,627 seamen, and 3714 firemen.

The grand total of the whole force voted in 1902-03, including reserves and pensioners available for service, was 166,249, as corn- paired with 161,640 in 1901-02.

In consequence of a series of articles in The Timies in 1901-02, assailing the war training of the navy, in which an important count was the number of executive officers serving on shore or engaged in service other than sea

service in modern fighting-ships, the First Lord of the Admiralty in 1902 issued the following in- teresting table of the distribution of officers : â€”

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On 31st December 1901.

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679

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Serving in sea-going ships .

718

1909

Employed on shore .

54

116

192

18

380

On passage

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26

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33

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190

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285

Other Government service .

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Full pay leave, oj waiting

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23

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15

104

Not wishing employment

for private,reasons,sick,&c. Total .

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204 1 309

1071

134

354

705

2777

The Extent to- which Navies take Part in Coast Defences.

It is necessary to a clear idea of the personnel of the different navies to understand to what extent coast defence entered into their duties.

France. â€” Under the arrangements of 1902 the organization of coast defence placed the five naval arsenals of Cherbourg, Brest, Loriemt, Rnchefort, and Toulon under the command of vice-admirals, styled “Prefets Maritimes.” The general defence of the littoral was, however, under the

Minister for War. The ” Prefet Maritime,” as governor of the ‘ ‘ place, ” had command of all the batteries and troops (army) quartered within his district, which extended 6J miles (10 kilometres) outside the line of land forts which form the defence of the ‘ ‘ place.” He also commanded all the floating defences and the semaphore system of the whole of his ” arrondissement.” French naval officers strongly advocated the defence of the coasts being entirely in the hands of the navy. The War Office were, however, opposed to this step, and the question was still under

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^pL^pMCMpM&^P^FMP^P^f^^^’‘f‘f^P^P^P^f^f^’’’”’”’‘^’**”*’

p;-<(l<^

eSS

â– sis rt >; fc!

IQPhEh

Sc5

J I liioplcMg

iM-ssi^iiii-illti

]Cj

S5 t-‘aSS ort”Â§^

SMorj-iiBHMnaJi^gCqMHOinnao^Jm

41

B.5,

S. VII.â€” 14

106

NAVIES

discussion. When tlie “Artillerie et Infanterie de la Marine” were transferred to the War Department, under the title of the Colonial Army, by the law of the 7th July 1900, the navy was deprived to a very large extent of the necessary personnel Cor manning coast defences, and this transfer caused a considerable diminution in the cost of the French naval personnel, which has to be talcen into account in comparing the navy estimates for different years. The transfer necessitated a great change in the responsibility for coast defence from the Ministry of Marine to the War Department. The practice resulting was for the navy to provide the personnel for manning only those batteries which had guns trained on the channels and approaches to the harbours or roadsteads of the naval bases.

Bussia. â€” The whole of the coast defence was in the hands of the army in 1902. The navy took no part, except in so far as ships and torpedo-boats may be employed in combination with the military forces.

Italy (1902). â€” The supreme authority in all matters relating to local sea-coast defences was vested in the respective naval .com- manders-in-chief of the maritime departments. With the excep- tion of part of the defence of the naval ports, the personnel and inaUriel for coast defence were provided by the army.

In tlie naval ports the navy provided the personnel for the sub- marine defences, and the shore batteries commanding and protect- ing the mine field, and, in addition, worked all the torpedoes, torpedo batteries, and the electric lights. These absorbed 4527 officers and men. The navy also maintained a small force to work the semaphore stations. The necessary war inaUriel for the above items in the naval ports was provided by the naval estimates.

Germany. â€” Coast defences were being gradually transferred from the army to the navy at the end of the 19th century. In 1902 the navy garrisoned all land and sea-defence works at WiUielms- haven, Bremerhaven, Cuxhaven, Heligoland, and Kiel, which were under the command of naval officers.

The submarine defences were entirely in the hands of the navy.

United States. â€” The navy took no part in the coast-defence system, except that in 1902 Dry Tortugas and Guam wqre tempor- arily garrisoned by the navy.

Japan. â€” The permanent coast fortresses were in the hands of the army in 1902, in so far as that the forts were manned by a military force of fortress artillerymen, and the command of all forts outside the limit of the several naval ports was in the hands of military officers. Where, however, the coast fortresses were situated within the confines of a naval station, the naval com- mander-in-chief was in supreme command.

All floating and submarine defences were in the hands of the navy. The coast-line of the whole country was divided into five naval divisions, each division having its headquarters at one of the five existing naval ports. The commander-in-chief of a naval station is directly responsible to the emperor

in matters of strategy and warfare, but in administrative affairs he is required to abide by the instructions of the Minister of Marine.

When combined naval and military operations were carried out, the duties undertaken by the navy were as follows : â€”

1. Coast watch-towers and look-out service afloat.

2. Construction and maintenance of booms and other obstructions.

3. Submarine mine defences.

4. Communications and other services afloat.

Great Britain (1902). â€” The navy had nothing to do with coast defence, but maintained a coastguard of about 4200 men, which assisted the customs against smuggling, and kept up signal stations. Towards the end of the 19th century the practice arose of the War Office referring questions of coast or port defence to the Admiralty for opinion, and a joint committee of defence investigated these questions. A Cabinet Committee of Defence was supposed to harmonize the actions of the War Office and Admiralty, but the correspondents in naval manceuvres called attention to repeated cases of the forts firing on their own side and hampering the navi- gation of the ships with their searchlights. The naval authorities at the ports took cognizance of the plans of the Royal Engineers for defending the harbours with mines, and approved of these plans. They also possessed the power to veto the laying down of mines if they thought fit. The so-called coast guard ships were really

inferior battleships intended to operate as a fleet in home waters. The Secretary of State for War in 1901 stated that he was willing and anxious to hand over tlie defence of the ports to the navy, while the Admiralty and former First Lords of the Admiralty strenuously opposed the step. This afforded a curious contrast to the reverse state of feeling in France. No clue could be obtained to the opinion of the Cabinet Committee of Defence, which could not be attacked in Parliament, as none of its members drew any salary in respect of work done on the committee. The procedure of the House of Commons at this date enabled a discussion to be raised only by a

member moving the reduction of the responsible minister’s salary, and in this case none was drawn, so that no estimates for discussion were provided. Table C. Tahle showing Increase of the British Navy ietween 1886 and 1903.

Tear.

Total actually expended.

Voted for New Con- struction.

Personnel. |

Numbers voted

Strength of Reserve.-!.

(Figures in

mniion Â£

for the

Officers.

Firemen.

and

Star

ling).

Navy.

Seamen.

1886-87 ^

13-27

3-50

61,400

256

256

18,007

1887-881

12-33

2-82

62,500

287

327

18,672

1888-89

13-00

2-59

62,400

321

439

19,155

1889-90

13-84

3-44

65,400

467

537

19,176

1890-91

14-13

5-43

68,800

673

569

19,207

1891-92

14-15

5-51

71,000

878

572

20,690

1892-93

14-30

4-05

74,100

1101

700

21,700

1893-94

14-05

2-98

76,700

1054

698

21,228

1894-95

17-64

4-78

83,400

1117

1382

22,914

1895-96

19-64

5-88

88,850

1400

2000

21,700

1896-97

22-27

7-33

93,750

1600

2500

24,200

1897-98

22-17

5-05

100,050

1651

2665

24,614

1898-99

24-07

6-73

106,390

1700

3306

26,141

1899-1900

26-00

7-33

110,640

1863

3494

25,456

1900-01

29-52

8-46

114,880

1896

3530

24,659

1901-02

30-88 2

9-00

118,625

1890

3714

24,341

1902-03

SI -25 2

9-06

122,500

1900

3800

26,800

1 In 1888 the cost of the transport service (at tliat time about Â£200,000) was transferred to the army estimates. I^ie vote for naval ordnance, wliich

then amounted to over a million, was transferred from army estimates to navy estimates, so that this has to be allowed for in 1886 and 1887.

2 Net estimates.

In tlie case of the reserves, for the years 1892-93, 1896-96, 1896-97, and 1902-1903, we give the numbers voted. For the other years “the Statement of the First Lord of the Admiralty,” “the Report of the Committee on the Royal ISTaval Reserve (1892),” and records at the Admiralty are used.

Table D. The following table of the numbers actually borne on 1st April of the years named in the active service ratings of the British navy, shows the development of the diilerent branches in the period reviewed. The chief feature is the growth of the engine- room branch.

Year.

Executive Branch.

Engine-Eoom Branch.

Marines.

Other Branches.

1868

31,981

5,391

15,970

11,062

1878

27,911

5,6i7

13,727

8,608

1888

28,232

8,536

12,847

S,914

1898

44,336

22,289

17,099

11,816

1900

49,222

25,959

18,461

12,865

19021

54,260

27,000

19,800

14,300

1 Estimated.

Rate and Cost of Building.

Table E (a) compares the rapidity -with which different European nations would bring vessels to the stage at which they could be launched at the end of the 19th century. Table E (5) shows the compai-ative cost of typical ships.

Table E (a).

Nation.

Name.

Class.

Tonnage.

Begun.

Launched.

Great Britain .

Sutlej

Cruiser, 1st class

12,000

15th August 1898

18th November 1899

>>

Cressy

Armoured cruiser

12,000

12th October 1898

4th December 1899

-France

Montcalm

))

9,373

25th January 1898

27th March 1900

,, ...

Dupleix

J)

7,677

18th January 1899

28th April 1900

„ ...

Gloire

9,821

6th September 1899

27th June 1900

Russia

Pobieda

Battleship Armoured cruiser

12,700

1st August 1898

24th May 1900

„ * . .

Aurora

6,630

31st October 1896

Germany .

Prinz Heinrieh

>Â»

8,880

1st December 1898

23rd March 1900

,, ...

Kaiser Barbarossa

Battleship

11,081

Si-d August 1898

14th April 1900

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Table E (6).

Nation.

Ship.

Tonnage.

Cost.

Cost per Ton.

Great Britain .

Albion

12,950

Â£803,000

G2

)j

Glory

12,950

844,000

85

Formidable

15,000

1,023,000

C7i

Cffisar

14,900

865,000

58

Russia

Poltava

10,960

1,098,000

100

France

Suff’ren

12,527

1,195,000

95

Number of Waeships.

Table F shows the number of the warships of the great maritime Powers in 1901.

It should be noted, however, that this table, compiled from the Admiralty return, includes many doubtful vessels. Ten British battleships of a total of 93,655 tons, armed with M.-L. guns, ought undoubtedly to have been struck out. Five of these ships (the Ajax, Agaviemnon, Tim4raire, Superb, and Alexandra) were withdrawn from the list in 1901-02, reducing the tonnage of

Table F. â€” Warships of the World on 15th January 1901.

Great Britain. |

France.

Hussia.

United States.

GermaEy.

Italy.

Japan.

No.

Displace- ‘ ^ ment. 1 ^

Displace- anent.

Xo.

Displaee- 111 Rnt.

No.

8 10

Displace- ment.

Tons.

83,094

133,800

No.

Displace- ment.

No.

Displace- ment.

No.

Displace- ment.

Battleships â€” Built Building .

50 16

Tons. 1 581,105 i 28 229,900 i 5

Tons.

275,843 62,455

15 1,0

Tons. 1

150,484 1 130,270

19 10

Tons.

123,404 116,770

15 6

Tons.

148,588

70,568

6

1

Tons.

77,220

15,200

811,005

338,298

280,754

216,894

240,174

219,156

92,400

Armoured caruisers â€” Built Building , .

9

20

56,000 226,400

7 15

37,752 148,260

11 1

8.3,231 7,800

2, 9

17,415 109,500

4 3

35,195 26,390

6 1

31,891 7,294

6 1

50,737 9,750

282,400

186,012

91,031

126,915

61,585

39,185

60,487

Protected cnrisers â€” Built Building .

103 4

499,870 24,960

38 2

128,907 13,493

3

11

12,612 60,640

14 6

61,403 21,000

15

7

58,589 18,200

16

41,427

11 3

51,568 4,400

524,830

142,400

73,252

82,403

76,789

55,968

Unprotected cruisers â€” Built Building .

11

23,010

7

22,962

3

8,090

6

11,397

20

40,780

nil

9

13,802

Coast – defence vessels

i

(armoured) â€” Built Building .

10

38,900

14

48,331

14 1

42,873 5,000

15

4!

“43,934 12,940

11

12,001

nil

4

10,280

Special vessels â€” Built Building .

2

13,Â«20

1

5,S94

5 2

5,280 6,000

1 ...

929

3

4,026

“”’

1

4,120

Torpedo vessels â€” Built Building .

35

27,840

15

8,912

17

14.709

nil

2

1,862

14

11,308

1

850

Torpedo-boat de- stroyersâ€” Biiilt Building .

89 24

26,314 8,844

22

â€¢2,700

6,556

10 43

2,890 10,430

3

17:

860 6,9-30

12 15

4,025 6,250

3

8

923 2,560

11 8

3,229 2,734

37,158

9.256

13,320

7,790

9,275

3,483

5,963

Torpedo boats â€” Built Building .

95

7,3S0

720

235 44

16,408 3,343

171 24

9,507 3,730

20 12

2,337 2,040

140

...

11,990

163

8,148

38 36

3,894 3,714

:8,10D

19,751

13,237

4,377

7,608

Submarines- Built Building .

5

““eoo

4 38

485 3,664

1 7

75 840

Total tonnage â€” Built Building .

404 73

1,275,439 491,424

358 126

543,294 237,771

249 92

329,676 222,870

70 65

221,444 287,050

226 35

291,872 166,610

216 15

242,285 80,422

87 49

215,700 35,798

477

1,766,863 484

781,065

341

552,546

135

508,494

261

458,482

231

322,707

136

251,498

battleships by 46,910. Some British cruisers and coast defence vessels armed with M.-L. guns were also withdrawn during

1901-02.

Note. â€” In compiling these tables English tons have been used throughout. The tonnage of warships is always given in dis- placement tons or the actual weight of the ship, but owing to the fact that Franco, Germany, and Italy used metric tons in their ^avy Lists in 1902, while other nations used the English ton, and that reference books repeat the figures simply as tons, there was considerable confusion in comparing the tonnage of warships.

Thus while the Patrie was given in the French Navy List as 14, 865 tons, her tonnage in British measurement would appear as 14,630 tons. The course has therefore been adopted of bringing all to a common measure, this being the only way in which a proper comparison can be obtained.^

SUMMAKT.

The following is a summary of the above tables showing the position on 15th January 1901 (five of the M.-L. gun battleships having been deducted from the battleships of Great Britain) : â€”

108

NAVIGATION

3

Â«

s

1

13 M

i

Â»-3

Vessels built â€”

Battleships .

45

28

15

19

15

8

6

Cruisers, armoured

9

7

11

4

5

2

6

,, protected

103

38

3

15

16

14

14

â€ž unprotected

11

7

3

20

6

9

Coast – defence vessels

armoured .

10

14

14

11

15

4

Special vessels

2

1

5

3

1

1

Torpedo vessels .

35

15

17

2

14

1

Torpedo-boat destroyers

89

9

10

12

3

3

11

Torpedo-boats

95

235

171

140

143

20

33

Submarine boats .

4

1

Vessels building â€”

Battleships .

16

5

10

10

6

10

1

Cruisers, armoured

20

15

1

3

1

9

1

,, protected

i

2

11

7

6

3

,, unprotected

Coast – defence vessels

armoured .

1

4

Special vessels

2

Torpedo vessels .

Torpedo-boat destroyer

3 24

i4

43

15

8

17

8

Torpedo-boats

4

44

24

12

36

Submarine boats .

5

38

7

The previous year’s British Admiralty return for 15th January 1900 as regards armaments was summarized by Mr Schooling : â€”

Class of Guns.

Number of Guns.

Percentage

of France plus

Russia’s Guns to

Great Britain’s

Guns.

Great Britain.

France

plus Russia.

Great Britain.

France

plus Russia.

Breech-loading guns â€”

10 in. to 16-5 in.

4 in. to 9 ‘5 in.

Total breech-loading guns

Quick-firing gims â€” 4 in. to 6‘5 in. . 12 pounders

Smaller quick – firing and machine guns .

Total quick-firing guns .

Muzzle-loading guns â€” 7 in. to 16 in. . Torpedo tubes .

All classes of guns .

205 707

276

588

100 100

135 83

912

1,630 1,018

4,806

864

1,215

57

4,970

100

100 100

100

95

75 6

103

7,454

340 1,534

6,242

nil

1,553

100

100 100

84

nil

101

10,240

8,659

100

8,5

1. J O J

Example.â€” Â¥ra,nae plus Eussia had 84 qniclc-firing guns to every 100 quick-firing gnns possessed by Great Britain.

Authorities. â€” The Navy Estimates ; The Naval Annual ; the Journals of the Royal United Service Institution ; the Proceedings of the Institution of Naval Architects ; Notes on Naval Intelligence, issued by the United States Naval Intelligence Department, and other works. (be.; C. W. Be.)

Na.vig’a.tion. â€” The great development in both size and speed of ships during the last quarter of the 19th century enormously increased the responsibilities of those â– who command and navigate them, and has led to a care- ful examination of the existing modes of determining a ship’s position at all times by day or night, both when in sight of land and on the open ocean. A comparison between the present text-books on the subject of naviga- tion and those in u.se in 1875 .shows how problems and methods which then were considered chiefly as theoretical exercises have now, from the altered conditions of the navigation of very fast ships, become methods of frequent practice, while corresponding improvements have been made in the instruments, such as compasses, charts, and

chronometers, by the aid of which more satisfactory results are now attained. IVfuch has also been done to advance the study of navigation and its numerous allied subjects by the development of the Eoyal Kaval College at Greenwich and the United Service Institution ; also by the establishment of shipmasters' societies (of which the well-known society in London is typical), where during the year valuable papers are read and useful discussions take place among those actually carrying out the practice of navigation. It does not appear to be generally known that the advantage of attending courses of study, both practical and theoretical, at the Eoyal Naval College, is offered to officers of the mercantile marine as well as ^ to those of the royal navy. Arrangements exist by which ten such officers can be received every year and obtain free instruction on almost every subject connected with the nautical profession.

As the reader already has access to the article on this subject which appeared in the earlier volumes of this Encyclopaedia (ninth edition), it will be convenient to trace the principal changes which have occurred since then in the chief subjects relating to the art of navigation.

Compass. â€" The general introduction of compasses with short needles and slow periods of vibration has done very much towards improving the accuracy with which a ship's " dead reckoning " is kept. The original model of these was that patented by Lord Kelvin in 1876, and since adopted in the royal navy as the standard. In this instrument we have a compass specially designed to enable the principles of compensation or correction proposed by Airy in 1837 to be accurately carried out, while its slow period of swing renders it in all circumstances extremely steady. Another conspicuous advantage arising from the use of compasses of this pattern is the readiness with which they admit of correction by the use of the " deflector," a simple instrument devised by Lord Kelvin for the measure- ment of directive force, the successful application of which to compass correction depends on the fact that, when the directive force is equalized on all points, the error of the compass is neutralized. Accompanying the great improve- ments in the construction of compasses, there have been great advances in the art of compass adjustment or correction by mechanical means of the errors due to the various kinds of iron or steel in the ship. Some of those errors (such as that caused by horizontal soft iron), which a few years ago were almost

insignificant in amount, have, especially in men-of-war, become very large quantities, while the formidable source of error known as “heeling error” has increased, until in some vessels before correction a heel of 5Â° alters the direction by 20Â°. It is gratifying to find that the practical application of the principles laid down in the Admiralty Manual enables errors of 70Â° or 80Â° to be dealt with as readily as those of small amount, while the difficulties attending the heeling error â€” which, however accurately corrected originally, must be frequently recorrected on any great change of position â€” have been surmounted by the use of a simple instrument, which in favourable circumstances can be used even at sea. As the whole art of compass adjustment is carried out on the supposition that the compass needle is infini- tesimal in length, it is obvious how much more nearly this fundamental condition is satisfied with the modern compass than with those having long needles which were formerly used. Recognizing the great value of a sound knowledge of compass adjustment, the Board of Trade have included this among the compulsory subjects of examina- tion for the rank of master, thus following the example of the royal navy, where all navigating officers have to attend a practical course of study on the subject. While there is no reason to think that the magnetic character of land above

the water has any disturbing effect on compasses on board ship, modern investigations have shown that in compara- tively shallow water (7 to 8 fathoms) there are several parts of the world where land under water affects them. The most notable case is Cossack, in North Australia, where the disturbance varied from 56Â° E. to 26Â° W. at two posi- tions 1 80 yards apart, and the area of disturbance extended over nearly three miles of navigable waters. The possibility of this insidious danger adds to the anxiety of the navigator when entering or leaving harbour, especially in circum- stances such as occur at night, when he is probably de- pending entirely on compass bearings.

Log. â€” While improved and steMier compasses enable modern ships to shape more accurate courses, there is still great room for improvement in the instruments by which speed is measured. The common or hand log has

ceased to be regarded as anything but the very roughest of guides, and the patent log in its original form of the record of the revolutions of a small screw towed by the ship does not give satisfactory results at great speeds, nor can anything more favourable be said of those forms where pressure on known areas are employed. The revolutions of the engines, with due allowance made for the condition of the ship's bottom, afford now perhaps the best means of estimating speed. (See Log.)

Charts.- â€" The admirable low-priced charts and sailing directions issued by the Admiralty have now largely superseded those supplied by private publishers (familiarly known as " Blue Backs "), and the issue of the Nautical Almanac in its abbreviated and cheaper form has also done much to take the place of those numerous private almanacs and calendars which were necessarily much more liable to error than the original and official sources from which they were derived.

In 1899 the number of charts printed for the Hydro- graphic Office was 428,890, of which 278,701 were sold to the public for Â£16,915 ; and in the same year 15,050 Nautical Almanacs were sold. Among the many excellent modern publications of the Hydrographic Office, perhaps the Ocean Passage Booh is one of the most generally useful, since, when used in combination with the admirable charts of full-powered and auxiliary tracks, it very greatly assists all navigators in planning out a successful voyage. We must here refer to the valuable results arising from the publication of the Monthly Pilot Charts of the North Atlantic by the American Government, and more recently by our own Meteorological Department, where observed meteorological results are skilfully combined with forecasts for the ensuing period, suggested tracks for ships are shown, and an epitome of recent navigational and meteorological experiences is given. (See Chakts.)

Chronometer. â€" The marvellous accuracy with which the modern chronometer is constructed is doubtless greatly stimulated by the annual competition at Greenwich, from which the Admiralty purchase for the royal navy. These chronometers are all fitted with secondary compensation balances, and it is therefore unusual in the royal navy to apply any temperature correction to the rate. The per- fection obtainable in compensation may be illustrated by the performance of a chronometer at the

Koyal Observatory in 1886, which at a mean temperature of 50Â° F. had a weekly rate of 1 â€¢6 seconds losing ; and on being further tested at a mean temperature of 92Â° F., it only changed its weekly rate to 2 ‘9 seconds losing. In the mercantile marine cheaper chronometers without secondary compensa- tion are more commonly used, and temperature corrections applied, calculated from a formula originally proposed by Mr Hartnup, formerly of the Liverpool Observatory. Great success attends this mode of procedure, as illustrated by the following facts. From the discussion of the records

of performance of the chronometers of the Pacific Steam Navigation Company during twenty-six voyages from London to Valparaiso and back, by giving equal weight to each of the three chronometers carried by each ship, the mean error of longitude for an average voyage of 101 days was less than three minutes of arc. As a single instance, in the s.s. Orellana, on applying temperature rates during a voyage of 6.3 days, the mean accumulated error of the three chronometers was only 2-3 seconds of time.

Fixing Position. â€” When a ship is steaming at the rate of 20 knots an hour the navigator remembers that a mile is l)assed over in three minutes, and that if in sight of land and fixing positions by objects on shore, it is essential to adopt some rapid method; otherwise when laid down on the chart the position shows where the ship was, and not where she is. This difficulty has led to the more general use of methods of obtaining positions by angles instead of bearings, and laying them down on the chart by the aid of the station pointer. Many advantages accrue from this, as the observer is not restricted in posi- tion on board, as is the case when usipg the compass, and especially if a double sextant (having two index glasses and one horizon glass) is employed two angles can be measured simultaneously, the result on the chart being very rapidly arrived at. An ingenious combination of sextant and station pointer in one has been proposed, and most simply carried out by attaching vertical sights to the legs of a station pointer, which is put on a suitable horizontal stand, and the legs moved until the sights are in line with the objects observed. To assist the navigator^ in the choice of suitable objects between which to measure the angles, a very useful pamphlet is issued by the Admir- alty, from the diagrams in which it can be seen at a glance which combination of objects in sight gives the most

favourable result, always remembering as a broad principle that nearer objects ai:e more suitable than distant ones, and that the accuracy of position determined depends on the relative distances of the objects as well as on the magnitude of the angles between them. The rougher but at certain times very important method of fixing a ship's position when only one object can be seen, such as a light at night, is often of grfeat value in modern coast navigation. It is well, however, to remember that in all cases where only one object can be seen, the estimate of position is liable to error, owing to any unknown or unallowed-for tide or current during the interval elapsing between the times of the two observations on which, whether using the "four-point" problem or that of "doubling the angle on the bow," the result depends. A simple and useful method, when only one point is in sight, of ascertaining whether with the course maintained a ship will pass at a prudent distance from the point, is to note the reading of the patent log when the object is 26Â° on the bow, and again when it is 45Â° ; the difference between these readings will be the distance the ship will be from the point at time of nearest approach.

Banger Angles. â€" To avoid an unnecessarily wide detour in rounding points and shoals, extensive use is now made of both horizontal and vertical danger angles ; the former is the angle on the arc of a horizontal circle passing through a point at the required distance from the danger, and through two previously selected, easily recognized fixed objects. Should circumstances enable the selec- tion to be made of an angle of about 90Â°, the ship by continually measuring the angle may be steered on the arc of such a circle with great precision, and may even be safely taken through a channel between two dangers. The vertical danger angle enables similar results to be attained by measuring the vertical angle subtended by a known height; but except where the selected object is one whose

height is laell determined, such as alighthcmse, this method is not so trustworthy as the former.

Sounding Machines. â€” The chronicle of progress in the art of navigation would be very incomplete without refer- ence to the extended use of Lord Kelvin’s souuding machines, either in the original form, where the increased pressure at different depths ia recorded by discoloration of chemical tubes, or in the later form known as the ” depth recorder,” where similar results are obtained by the auto- matic record of the position of a piston forced upwards in a tube by this increased pressure. Very satisfac- tory results can be obtained at speeds of 15 or 16 knots, enabling that great safeguard of navigation in many places, viz., a continuous line of soundings, to be accurately and rapidly obtained. In connection with this should be mentioned a most ingenious invention known as the ” submarine sentry,” which on being set for any desired depth and towed overboard remains at that depth whatever the si^eed of the ship may be. On striking bottom it at once floats to the surface and rings a warning bell. Such an instrument is of obvious value in ships where, owing to the small number of avail- able men, it is diflBlcult to maintain a, continuous line of soundings.

Great Circle Sailing. â€” The practice of great circle sail- ing has in modern navigation become far more general than formerly ; not merely has economy of time and fuel to be considered, but on examining tracks laid down on the excellent pilot charts issued by the Admiralty and Meteorological Office, distinct advantages of winds and currents are oftea found to attend the pursuit of the great circle track. It is indeed advantageous for the skilful navigator, in planning out a long voyage, always to lay down on a wind and current chart the three possible tracks, viz., the rhumb track, the great circle, and the polar track, and then realize that a course shaped any- where between the extreme tracks must be attended with some advantage in economy of distance. Great circles are seldom calculated, and are most simply originally laid down upon gnomonio charts, where they are repre- sented by straight lines, and then transferred to Mercator charts, or they may very approximately be drawn upon the latter directly by the use of Airy’s simple method. Azimuth tables or diagrams are sometimes useful in determining great circle courses, siace the true bearing of a heavenly body is the great circle course to a posi- tion where that body is in the zenith. The latitude of such a position being equal to the declination of the body, and its longitude equal to the hour angle of the body Â± the longitude of the observer, the hour angle with which the

azimuth is looked out corresponding to the difference of longitude between the observer aad that of the position referred to. What is known as the polar track is more difficult to draw accurately. It follows that if on a globe we see that the rhumb track always lying on the equatorial side of the great circle is necessarily longer than it, there must be on the polar side of that circle another track equal in length to the rhumb track, and equally distant from the great circle at the point of greatest separation. This curve is difficult to draw accurately, but in practice it will be sufficiently correct to mark on the Mereator chart this point of greatest separation on the polar side of the great circle, and draw the curve by hand throiii;h it and the extreme points. Cases may arise in pr:ictice where, owing to the terminal points of tlie voyage lying somewhat on the same meridian, the advantage of the great circle may not be very obvious, but the polar track may lead through more favourable winds and! currents than the rhumb line, and only traverse the same distance. The excellent idea originally suggested by Maury of establish- ing steam “lanes” in localities where there is much ocean

traffic, so as to minimize the risks of collision between outward- and homeward-bound ships, has been success- fully carried out in the North Atlantic. The leading transatlantic steamship companies now agree to follow great circle routes from the Irish coast to points on the Banks of Newfoundland, which vary somewhat in position with the season of the year, but are published in advance. These ” lanes ” being avoided by sailing vessels, risks of collision are materially lessened.

Sextants â€” The establishment of an observatory at Kew, part of whose work is the examination and testing of sextants, has led to great improvement in the construction of these instruments. The determination of ” centering ” error in a sextant with the means available to an ordinary observer is along and troublesome operation, and although in an instrument made by a maker of repute such error may be usually neglected in observations at sea, yet for the more accurate work involved in finding errors and rates of chronometers it must be considered and allowed for. By a specially devised instrument this error (in- cluding error of graduation) is accurately determined, and for those sextants obtaining A certificates must at no part of the arc exceed 1’, and for those granted B certificates ; the

maximum error must not be greater than 3’. During the five years ending 1899 no fewer than 3443 sextants were tested at this observatory (now .incorporated in the National Physical Laboratory). With a view of measuring angles up to 180Â° sextants have been constructed in which the internal reflection of light from glass prisms has been employed instead of the reflection from mirrors, but great practical difficulties arise in accurately cutting prisms of the desired angle.

Befraction. â€” ^The effect of refraction in displacing the apparent sea horizon was partially investigated by the Prench about a century ago, and the conclusion arrived at was that it mainly depended upon the difference of the surface temperature of the sea and that of the stratum of air resting on it : when the sea surface was the warmer the horizon was apparently depressed, and observed altitudes were too great, and vice versd, diijerences of 3′ to 4′ being found when these temperatures differed 9Â° P. The subject has now been thoroughly reinvestigated, and the orig- inal conclusions confirmed. The errors involved from this uncertainty with regard to the place of the horizon affect the ordinary observations for determinations of lati- tude (such as meridian and ex-meridian observations) by their full amount ; in the determination of hour angles the error introduced will be equal tO’ the error of position of horizon multiplied by the secant of latitude and by the cosecant of azimuth of the body observed. In ” lines of position “the error considered will move such lines from or towards the place ~~where the body observed is in the zenith, and will generally cause a position to err mostly in longitude if found by the intersection of two such lines on the same side of the meridian, and mostly in latitude if the intersect~~ing lines are on opposite sides of the meridian. The interesting experiments referred to were carried out in 1899 by the Austrian navy in the Eed Sea and at Pola, the req^dsite observations being made throughout the day with an alt-azimuth instrument from shore stations atelevutions of 21, 33, 52, and 138 feet respectively, the sea surface and air temperatures being simultan-eously recorded from a steamboat standing off shore. Prom the experienca of over a thousand observations it was found that at an elevation of 33 feet, ivith a difference of 6Â°P. in sea and air temperatures, a displacement of 1|-‘ was observed, which increased to 2’|’ when the difference of 12″ P. occuri’ed in the temperatures. Such results were only found to be true when a windof forceat least2or 3 wasblowing; wi’thwinds of less force the warm air can

apparently remain at a higher level without mixing with the lower cooler air, and abnoi-mal

results follow, amounting in one case to a displacement of 9^’. When navigating the Red Sea or localities such as near the edge of the Gulf Stream, where very great differences of sea and air temperatures prevail, due con- sideration must be made for this source of error, and the practical navigator can also see how greatly this may affect his estimation with regard to currents.

Meridian Altitudes. â€” In ships of great speed, when steering on courses near north or south, the maximum altitude of a heavenly body cannot be considered as identical with the meridian altitude, for the speed of the ship in these circumstances affects the altitude in the same way as if the ship were stationary, and the declination of the body changea at the same rate as the ship was moving and in the opposite direction. If the de- clination of the body observed is also ~~rapidly changing, a still greater difference may occur. In the case of the moon, in a ship steaming 20 knots an hour south (true) and in the latitude of the English Channel, the maximum altitude at a certain period of the lunation may exceed the meridian altitude by nearly 4’, and occur eleven minutes after the time of meridian passage. In the case of the sun the corresponding figures would be in similar circum~~ stances 1|’ and six minutes. Meridian altitudes in such circumstances are usually observed when the ship time indicates the instant of meridian passage. The error considered only affects an observation of altitude when it is required at the instant of a heavenly body being on some particular azimuth, as the sun at noon, and has therefore only to be considered when observing a meridian altitude for latitude.

Star Navigation. â€” A notable feature of the progress of the art of modern navigation is the greatly increased practice of star navigation, and many of the supposed dif&culties of night observations are found to be removed by experience. Determinations of positions at sea by twilight observations, when the brighter stars become visible while the horizon is still well

defined, are probably the most accurate means we possess; and the careful navi- gator, by combining for latitude stars passing north and south of the zenith, and for longitude those near the prime vertical both east and west, can generally depend upon a good result, especially if suitable stars can be found for each pair at about the same altitudes. For these purposes the armillary sphere is extremely useful : this is a small celestial globe on which are depicted the principal stars visible to the naked eye. On elevating the pole to the approximate latitude of the observer, and turning the sphere until the sidereal time is under the fixed meridian, a correct representation of the heavens at the time of observation is obtained ; the stars are then easily identi- fied by their bearings and altitudes. This valuable instru- ment is not merely useful when at twilight, only a few of the brighter stars being visible, the constellations to which they belong are difficult of recognition, but it enables arrangement to be made in advance for such observations as are desired to be taken during the night. By marking in pencil on the globe the positions of the planets in right ascension and declination, the same sphere is also available for their identification. For star observations not made at twilight the invention of some simple and practical form of artificial horizon for use at sea is much to be desired. With the ordinary sea horizon it is well, however, to remember that although indistinct under the star, it may be favourable in the opposite di- rection, and when the altitude admits of the sextant measuring its supplement this may be readily observed. The navigator observing stars on or near the meridian heloio pole has, of course, to remember that the altitude in this case is decreasing, and the direction of movement in azimuth reversed as compared with similar observations

made above pole. Here we may note that in the twilight with a high star good results for longitude can often be obtained by a short equal altitude observed when the star is only a small distance from the meridian on either side, the mean of the chronometer times of observation afford- ing an opportunity of comparing Greenwich and local times of meridian passage, a correction being made for change of position of the ship in the interval.

Observations of the Moon. â€” The value of observations of the moon by day or night has not met with that recognition by navigators which we should have expected ; no doubt in the form of lunars moon observations

have ceased to be practical problems, though probably no finer training for the eye can be found than practice at sea in measuring lunar distances, and, aided by considerable experience, it is surprising the accuracy with which some modem observers can determine longitude by such means. Apart, however, from observations of the moon of this character, we think that it would be more often used for the ordinary methods of finding latitude and longitude, but for the idea conveyed in most text-books on navigation of the necessity of the somewhat lengthy calculations involved. The rapidity with which at times the right ascension and declination of the moon change necessitates the accurate correction of them, but the absence of coiTcction to the other elements taken from the Nautical Almanac would not be found in any circumstances, even the least favourable, to in- volve practical error at sea.

Lines of Position. â€” All modern navigators recognize the great value of ” lines of position ” obtained from the various heavenly bodies, forming as they do a system of celestial cross bearings ; indeed, before the wider publicity given to this method by Captain Sumner, under the auspices of the United States Government, it was always known as ” cross bearings of the sun.” In the original mode of application of this valuable method the lines of position drawn at right angles to the bearing of the sun were laid down on the chart from positions obtained either by calculating the longitude by the ordinary chronometer method, using an assumed latitude, or by computing the latitude by the ex- meridian method from an assumed longitude according to the position in azimuth of the heavenly body observed. In the more modern method originally proposed by M. Marc St Hilaire, a comparison is made between the altitude of a heavenly body as actually observed and that calculated from the supposed position of the ship. For instance, the position of an observer at the instant of observinga (true) altitude of the sun of 40Â° 10′ must be somewhere on a portion of the circumference of a circle (usually of such size that the portion considered may be represented on a chart by a straight line) having its centre in latitude equal to the sun’s declination, and in longitude equal to the Greenwich apparent time at the instant, the radius of such a circle being equal to the sun’s zenith distance of 49Â° 50’. If at the same time the true altitude of the sun is from the estimated position of the ship calculated to be 40Â° 5 ‘, it is evident that the greater observed altitude must be owing to the ship being

nearer to the centre of the circle than was supposed, and a line of position drawn through the estimated position at right angles to the bearing of the sun must be transferred parallel to itself through a distance of 5′ towards the direction of the sun’s bearing. The second line of position, obtained when the sun’s bearing has altered some 26Â°, is dealt with in a similar w^-, and the intersection of the two lines so obtained gives the position of the ship at the time of second observation. This mode of procedure enables all observations, whether near or far from the meridian, to be similarly dealt with; in all cases the altitude the heavenly body should have is computed and compared with what it actually has. The practice of

problems such as the foregoing is greatly facilitated by the extended means of finding at any moment the azimuth or true bearing of a heavenly body. When the azimuth was only required for the determination of compass error, the valuable tables from which the computed results could be obtained by inspection were limited to those cases of most practical importance, but from the ingenious and simple graphical form known as Weir’s azimuth diagram azimuths of all heavenly bodies, whose declinations extend from 60Â° N. to .60Â° S., can be obtained during the whole time they are above the horizon, thus greatly facilitating the laying down lines of position. (w. R. m*.)

Nawabganj, the name of several towns of British India, the most important of which is the administrative headquarters of Bara Banki district in Oudh; station on the Oudh aud Rohilkhand railway, 17 miles east of Lucknow. Population (1891), 14,478 ; municipal income (1897-98), Es.18,940. It has a high school, and there is considerable trade in sugar and cotton. It was the scene of a victory by Sir Hope Grant during the Mutiny.

Nawanagar, or Jamnagar, a native state of India, in Kathiawar, within the Gujurat division of Bombay, situated on the south of the Gulf of Cutch. Area, 3393 square miles. Population (1881), 316,417; (1891), 379,611. Estimated gross revenue, Es.30,83,910, of which Rs.2,44,850 was expended on public works in 1897-98 ; tribute, Es.1,20,093. The chief, whose title is

Jam, is a Jareja Rajput, of the same clan as the rao of Cutch. K. S. Ranjitsinhji,the cricketer, had been adopted by the late Jam, but the adoption was set aside, with British sanction, in favour of a son by a Mahommedan mother. The state was in 1902 under British administra- tion while this son was being educated at the Eajkumar College at Eajkot. A branch railway, constructed mainly at the expense of this state, was opened in 1898 from Eajkot to Nawanagar town (50 miles).

The town of Nawanagak is about five miles from the seaport of Bedi. Population (1881), 39,668; (1891), 48,530. Founded by Jam Rawal in 1540, it is handsomely built of stone, and has special manufactures of silk and gold embroidery, and perfumed oils and red powder for ceremonial purposes. Its water-supply is derived from a reservoir covering 600 acres and an aqueduct 8 miles long. It has a high school, with 383 pupils in 1896-97, and three printing-presses, one of which issues an official gazette.

^Sazareth, now en-Ndsira, in Palestine, the chief town of a kaza in the sanjak of Acre. The population consists of 3600 Moslems and 6500 Christians. It is a centre of missionary enterprise. The Eoman Catholics have a monastery, nunnery, hospice, schools, and orphan- ages ; the Protestants, a hospital, schools, and orphanage ; and the Russians, a seminary, hospice, and schools.

Neamtzu, town of Rumania, on the left bank of the river of the same name, about half-way between Pascani and Piatra. Population (1900), 8578, of whom about half are Jews. In its vicinity are the extensive ruins of the once famous fortress of Neamtzu, constructed in the 13th century by the Teutonic knights of Andre II., king of Hungary, in order to repel the incursions of the Kouman Tatars. It was subsequently the scene of many bloody fights. It was here that the mother of Stephen the Great shut the doors of the fortress on her son, when a fugitive from the Turks, and compelled him to return and give battle to his adversaries, whom he defeated with enormous loss. An Xour’s drive to the west of the town is the famous monastery of the same name, founded in the 14th century, containing two churches and many ancient and interesting relics. Prior to the secularization of the monastic lands it was one of the richest and most im- portant of the Rumanian n;ionasteries, and still contains some curious treasures.

Nebraska, a central state of the American Union. The population in 1880 was 462,402, being an increase during the previous decade of no less than 267 -8 per cent. In 1890 the population was 1,068,910, the increase for the decade being 134-1 per cent. In 1900 the population was 1,066,300, an increase of only ^^ of 1 per cent. Of the 90 counties of the state, 35 showed a decrease in population from 1890 to 1900. Of the 365 incorporated places in the state, 27 had more than 2000 inhabitants in 1900, 7 had more than 6000, and 3 had more than 25,000. These 3 were â€” Omaha, with a population in 1890 of 140,452 and in 1900 of 102,655 ; Lincoln, with 66,154 in 1890 and 40,169 in 1900 ; South Omaha, with 8062 in 1890 and 26,001 in 1900. ‘The decrease in the population of the state probably occurred in the first half of the decade, and was owing to hard times and the reaction from the boom of earlier years. The hard times in their turn occasioned the realignment of political parties and the free silver movement that for a time swept the state. The total land surface is approximately 76,840 square miles ; the average number of persons to the square mile being, in 1890, 13-8, and in 1900, 13-9. Of the total popula,tion in 1900, 564,592 were males and 601,708 were females; 888,963 were native-born and 177,347 were foreign-born; 1,056,526 were white and 9774 were coloured (including 6269 negroes. 180 Chinese, 3 Japanese, and 3322 Indians). Out of 301,091 adult males 7388 were illiterate (unable to write), of whom 4720 were foreign-born.

Agriculture and Forestry. â€” Agriculture is the chief industry, and is the foundation of the manufactures and commerce. There is no mining. Prom 1869 to 1899 there were only 4 crop failures and 3 short crops. In the same period the State Statistical Bureau recorded 18 good crops, 1 fair crop, and 4 great crops. The yearly production of Indian corn runs from 175 millions to 225 millions of bushels. The crop report for 1898 gives corn, 179,699,596 bushels; oats, 48,622,288 bushels; wheat, 39,177,600 bushels. The report for 1899 gives corn, 196,000,285 bushels; oats, 27,335,490 bushels; wheat, 30,545,880 bushels ; rye, 3,141,344 bushels ; and barley, 2,395,880 bushels. No state has done more for the f oresta- tion of its waste and prairie lands. Arbor Day, which has spread through the Union, was instituted by the Nebraska State Board of Agriculture on 4th January 1872, by the adoption of the following resolution, proposed by J. Sterling Morton : â€”

Eesolved that Wednesday, the 10th day of April 1872, be and the same is hereby especially set apart and consecrated for tree- planting in the state of Nebraska, aud the Slate Board of Agri- culture hereby name it Arbor Day.

The 10th of April of the same year was set apart by the governor for tree-planting, and more than three millions of trees and cuttings were set out on that date. Since then Arbor Day has been yearly observed by the public schools throughout the commonwealth. It is estimated that more than 20 billions of trees have been planted on these anniversaries. It is not impossible that before the next fifty years have passed lumber will be shipped from the plains of Nebraska to the eastern states.

Manufactures.â€” Iri 1860 there were 107 manufacturing establish- ments in the state ; in 1870 there were 670 ; in 1880, 1403 ; and in 1890, 3011. The capital invested in 1890 was $.37,569,508. The most prominent manufacturing cities are Omaha, South Omaha, Grand Island, Norfolk, and Nebraska City. At South Omaha the packing interests have reached large proportions. The cash value of cattle and hogs sold in 1900 exceeded 40 millions of dollare, while the value of sheep, horses, and mules sold aggregated at least 2 million dollars more. South (^niaha is the third largest packing metropolis in the world. At Nebraska City there is a packing- house with a capacity of 2000 swine per day.’ At the same place IS a canning establishment that puts up millions of cans of corn,

tomatoes, peas, and fruits of various kinds each year. During the working season (August-November) it employs between 100 and 200 persons. Starch works, also at Nebraska City, employ between 200 and 300 persons, and have a daily average output of 33 tons. The starch is made from Indian corn. At the same place are cereal mills, which employ between 100 and 200 persons, pro- ducing daily 30 tons of oatmeal, and converting 4500 bushels of Indian corn into hominy, grits, and meal. Factories at Grand Island and Norfolk consume the beets from about 10,000 acres of land, and ship large quantities of granulated sugar. At O’Neill, in Holt county, is a chicory factory ; and the legislature, which passed an Act making the sale

of oleomargarine and other substitutes for butter a penal offence in the state, gave a bounty, to be paid out of the treasury, of 1 cent a pound upon chicory which is used only as an adulterant of, or substitute for, coffee. In 1899 Nebraskfj, shipped more than 85 million pounds of flour and 89 millions of other mill products, together with 714,000 head of cattle and 2,477,243 swine, 60,000 head of mules and horses, and 1,700,000 head of sheep.

Railways. â€” Within the boundaries of the state are more than 6000 miles of railway. The chief lines, with their mileage and cost to 30th June 1890, are as follows : â€”

Miles Eoad. of Cost.

Road! Burlington and Missouri River (C. B. & Q.

system) 2252 $84,547,628

Fremont, Elkhorn, and Missouri Valley /

(C. & N. W. system) 985 40,256,515

Union Pacific 943 73,903,339

Chicago, St Paul, Minneapolis, and Omaha

(C. & N. W. system) 271 10,779,507

Chicago, Rock Island, and Pacific . . 245 9,016,209

The Missouri Pacific railway ... 221 10,823,399

Finances. â€” The census of 1890 valued the real and personal property at $1,275,685,514. The state has no bonded debt. The rate of taxation for all purposes is from 6^ to 7 J mills ; through this levy is obtained a revenue of $1,208,984. There are 400 state banks, with a capital of between 13 and 14 millions of dollars, and 113 national banks, whose aggregate capital amounts, in round numbers, to 10 millions of dollars.

Charity. â€” The charitable and penal institutions are as follows: â€” The Asylum for Insane, at Lincoln ; the Home for the Friendless, at Lincoln; the State Penitentiary, at Lincoln; the Industrial Home, at Milford ; the Soldiers' and Sailors' Home, at Milford ; the Girls' Industrial School, at Geneva; the Boys' Industrial Home, at Kearney; the Soldiers' and Sailors' Home, at Grand Island; the Asylum for Chronic Insane, at Hastings; the Asylum for Insane, at Norfolk; the School for Deaf, at Omaha; the School for Feeble-Minded Youth, at Beatrice; the School for Blind, at Nebraska City.

Education. â€" The rate of illiteracy (1890) was 2^',, per cent., the lowest in the Union. The common schools are supported by a general tax, which cannot be less than one-half mill on the entire valuation of the real and personal property. Added to this is the interest on the permanent school fund, derived from the sale of school lands granted by Congress under the Enabling Act of 19th April 1864, which gave the school fund 5 per cent, of the net proceeds derived from the sale of all government lands within the state. This permanent educational fund yields, for semi-annual per caput distribution, between $300,000 and $400,000. The number of pupils of school age is over 400,000; the number of teachers, approximately, 10,000; the number of school-houses, 7000. The value of these school-houses and grounds, together with books, apparatus, and fixtures, amounts to more than 8 millions of dollars. The State Normal School at Peru has 500 students and 21 instructors. The university at Lincoln has 2200 students, 110 instructors, and its annual disbursements amount to

$248,000.

Politics. â€" The people have been realigned as to political organi- zations since 1890. Before that time the Democratic party advo- cated free trade or a tariff- for revenue only, and the Republican party a protective tariff. In 1892, under the leadership of William Jennings Bryan, the Democratic party divided upon the money question, and subsequently amalgamated with the Populist party in the advocacy of the free coinage of silver with gold at the ratio of 16 to 1, forming a party which consisted of Silver Republicans, Democrats, and Populists. The Populists were largely in the majority among the directors of the combination. The Republican party

maintained the necessity of the gold standard. In the national election of 1S96 the Fusionists (Silver Democrats, Silver Republicans, and Populists) polled 115,880 votes, and in 1900, 114,013. The Republicans polled 102,304 in 1896, and 121,835 in 1900. Since 1898 the Populists have named two-thirds or more of the candidates for county and state offices, while Silver Re- publicans and Democrats acting with them have divided the remainder.

The statment that Belle vue was the first capital of Nebraska is an error : Bellevue was never the capital of ‘either the territory or state. The first capital of the territory was Omaha, and it remained the seat of government until 1867, when by act of the legislature the capital was located at Lincoln, where it remains. (â– j. g. m*.)

Nebraska City, a city of Nebraska, U.S.A., capital of Otoe county, on the vpest bank of the Missouri river, and the Burlington and Missouri Eiver and the Missouri Pacific railways, at an altitude of 961 feet. The city is regularly laid out, is well sewered and lighted, and has a good water supply. It is the site of the state school for the blind. It is in a rich farming region, has consider- able manufactures of a varied character, and some com- merce in farm products by rail and river. Population (1880), 4183; (1890), 11,494; (1900), 7380, of whom 882 were foreign-born and 142 negroes.

Neckar, a river of Gerrhany, rising between the Black Forest and the Swabian Alb, near Schwenningen, in Wilrtemberg, at an altitude of 2287 feet. It flows north past Rottweil as far as Horb, thence past Rotten- burg, Tubingen, and Nurtingen in a north-easterly direc- tion, then in a generally northerly direction as far as Eberbaeh, passing on the way Esslingen, Canstatt, and Heilbronn ; from Eberbaeh it pursues a winding west course past Heidelberg, and enters the Ehine (from the right) at Mannheim (296 feet alt.). Its length is 247 miles, and its drainage area 4790 square miles. Its more important tributaries are the Enz (left), and Eils, Rems, Kocher, and Jagst (right). It is navigable for small steamboats up to Heilbronn, for boats up to Canstatt, and for rafts from Rottweil. It is the principal waterway of Wilrtemberg, and greatly used for floating down timber. From Rottenburg downwards its banks are almost every- where planted with vineyards. Up to Frankfort it has been deepened and the channel otherwise improved. A

committee, chiefly promoted by the Wilrtemberg govern- ment and the Stuttgart Chamber of Commerce, reported in 1901 that it was both desirable and practicable to dredge the river and canalize it, from Esslingen down to Mannheim, and that the cost would probably fall between 2 and 2^ millions sterling.

Neemuch, or ISTimach, a town of Central India, with British military cantonment, within the native state of Gwalior, on the border of Rajputana, with a station on the Rajputana railway, 170 miles north of Mhow. Population (1881), 18,230 ; (1891), 21,600. Num- ber of police, 69 men; expenditure on public works (1897-98), Rs.3052.

Neenah, a city of Winnebago county, Wisconsin, U.S.A., on the Fox river, at the foot of Winnebago Lake, / in the eastern part of the state, at an altitude of 754 feet. ‘ The Chicago and North- Western, the Chicago, Milwaukee, and St Paul, and the Wisconsin Central railways intersect at this point. The city has good water-power, and manu- factures of lumber, flour, and paper. It has some reputar tion as a summer resort. It was founded in 1836 as a military post. Population (1880), 4202; (1890), 5083; (1895), 5781 ; (1900), 5954, of whom 1559 were foreign- born.

Negapatam, a seaport town of British India, in the Tanjore district of Madras, forming one municipality with Nagore, a port 3 miles north at the mouth of the Vettar river. It is the terminus of a branch of the South Indian railway, which has been extended to Nagore. Population (1881), 63,855; (1891), 59,221; (1901), 56,455; municipal income (1897-98), Es.75,000. There is a large population of Labbays, Mahommedans of mixed Arab descent, who are keen traders. Jesuit and Wesleyan

missions are carried on. In 1897-98 the total sea-borne trade of the district was valued at Es.1,94,29,666. The chief export is rice to Ceylon. The number of vessels that entered and cleared for foreign trade was 453, with

an aggregate burthen of 191,000 tons. The Wesleyan Mission College was closed in 1895; The two aided high schools (Wesleyan and Catholic) had 411 pupils in 1896-97. There are four printing presses, issuing an English and two vernacular newspapers, besides two large reading-rooms and literary associations.

Negaunee, a city of Marquette county, Michigan, U.S.A., in the Marquette Iron Range, on the Upper Peninsula, 12 miles west of Marquette, and on the Chicago and North-Western, and the Duluth, South Shore, and Atlantic railways, at an altitude of 1564 feet. The city overlies enormous deposits of haematite iron ore, and the industries consist in mining and shipping this ore. Popu- lation (1880), 3931 ; (1890), 6078 ; (1900), 6935, of whom 3270 were foreign-born.

Negligence, in law, is a ground of civil liability, and in criminal law it is an element in several offences, the most conspicuous of which is manslaughter by negli- gence. In order to establish civil liability on the ground of negligence, three things must be proved, â€” a duty to take care, the absence of due care, and actual damage caused directly by the absence of due care. Mere carelessness gives no right of action unless the person injured can show that there was a legal duty to take care. The duty may be to the public in general, on the ground that any person who does anything which may involve risk to the public is bound to take due care to avoid the risk. Por instance, in the words of Lord Blackburn, “those who go personally or bring property where they know that they or it may come into collision with the persons or property of others have by law a duty cast upon them to use reasonable care and skill to avoid such a collision.” Where a special duty to an individual is alleged, the duty must rest on a contract or undertaking or some similar specific ground. Thus, where a surveyor has carelessly given incorrect progress certificates, and a mortgagee who has had no contractual relation with the surveyor has advanced money on the faith of the certificate, the sur- veyor is not liable to the mortgagee in an action of negli- gence, because he owed no duty to the mortgagee to be careful. When a duty to take care is established, the degree of care required is now determined by a well- ascertained standard. This standard is the amount of care which would be exercised in the circumstances by an ” average reasonable man.” This objective stan- dard

excludes consideration of the capacity or state of mind of the particular individual. It also gets rid of the old distinctions between ” grpss,” ” ordinary,” and “slight” negligence, though no doubt the degree of care required varies with the circumstances of the case. The application of such a standard is a task for which a jury is a very appropriate tribunal. In fact the decision of the question whether there has been a want of due care is left almost unreservedlj^ to the jury. There is this amount of control, that if the judge is of opinion that the evidence, if believed, cannot possibly be regarded as showing want of due care, or in technical language that there is “no evi- dence of negligence,” it is his duty to withdraw the case from the jury and give judgment for the defendant. Unless the judge decides that there is no duty to take care, or that there is no evidence of want of care, the question’of negligence or no negligence is wholly for the jury.

Ordinarily a man is responsible only for his own negligence and for that of his servants and agents acting

within the scope of their authority. Por the acts or defaults of the servants of an independent contractor he is not Liable. But in certain cases a stricter obli- gation is imposed on him by law. The occupier of premises is under a duty to all persons who go there on business which concerns him to see that the premises are in a reasonably safe condition so far as reasonable care and skill can make them so. Thus he cannot release himself by employing an independent contractor to maintain or repair the premises. The effect of this doctrine is that the occupier may be liable if it caii be shown that the independent contractor or his ser- vant has been guilty of a want of due care. A similar obligation has been enforced in the case of a wreck stranded in a navigable river, and the owner was held liable for damage caused by the carelessness of the servant of an independent contractor who had under- taken to light the wreck. So too any person who undertakes a work likely to cause danger if due care is not taken is liable for damage caused by the careless- ness of the servant of an independent contractor, so long as the carelessness is not casual or collateral to the ser- vant’s employment.

In an action of negligence a familiar defence is ” con- tributory negligence.” This is a rather misleading expres- sion. It is not a sufficient defence to show that the plaintiif was negligent, and that his negligence contributed to

the harm complained of. The plaintiffs negligence will not disentitle him to recover unless it is such that without it the misfortune would not have happened, nor if the defendant might by the exercise of reasonable care on his part have avoided the consequences of the plaintiff's negligence. The shortest and plainest way of expressing this rule is, that the plaintiffs negligence is no defence unless it was the proximate or decisive cause of the in- jury. There was an attempt in recent times to extend this doctrine so as to make the contributory negligence of a third person a defence, in cases where the plaintiff, though not negligent himself, was travelling in a vehicle or vessel managed by the negligent third person, or was otherwise under his control. In such circumstances it was said that the plaintiff was " identified " with the third person. The court went so far in one case as to " identify '' a child with its grandmother. But the case of The Bernina, decided in 1888, exploded this supposed doctrine, and made it clear that the defence of contri- butory negligence holds good only when the defendant contends and proves that the plaintiff was injured by his own carelessness. (a. ll. d.)

Negro. â€" In recent years the domain of the true African negro, with whom alone we are here concerned (Encij. Brit. vol. xvii. p. 316), has been considerably enlarged by the explorations of Pybowski, Crampel, and Clozel about the Congo-Chad water-parting; of Junker and the Belgian officials aboutthe Congo-Nile water-parting; of Lugard, Jackson, Gregory, and others in British East Africa and Uganda ; of Baumann and Emin Pasha in German East Africa. The main result is that the ethnical divide between the full-blood Sudanese negro and the Negroid Bantu populations has to be shifted more to the south tlian had liitherto been supposed. Owing to numerous over- lappings and interminglings in some districts it is still often difficult to lay down the frontiers between the two domains with any approach to accuracy. But, speaking generally, the parting line may now be traced across the continent along the fifth parallel from the Rio del Key in the extreme west to about 20Â° E., where it roughly coincides with the elevated plateau, which here sepai-ates the waters flowing north to Lake Chad and soutli to the Congo. Farther oq it dips considerably to the south-east

N" E G R 0

along the southern borders of the Niara-Niam and Monbuttu (Mangbattu) territories to the Semliki valley between Lakes Albert and Albert Edward, near the equator. From this point the ethnic boundary follows a somewhat irregular course, lirst north by the east side of Albert ISTyanza to and up the Somerset Nile as far as Mruli, and then round the east side of Usoga and Lake Victoria to Kavirondo Bay, where it turns nearly east to and down the Tana river almost to the Indian Ocean. From the Atlantic to Lake Victoria' the line thus drawn seems to represent the actual relations with some accuracy; but in Kavirondo it enters adebateable region, where much further research will be needed correctly to determine the respective limits of the various Hamitic negro and Bantu peoples â€" Masai, Ttirkana, Galla, WaJcikuyu, ShuJi, and othersâ€" whose territories here converge from the north, east, and south. Meanwhile, this extension of the Sudanese negro domain has broughtwithin its borders a considerable number of fresh groups, some only discovered in recent years, others hitherto supposed to belong to different ethnical connexions. In Western Sudan also, and espe- cially in the region within the Ifiger bend, the explora- tions of the late Col. Ellis and of Col. Binger have not only brought to light many new groups, but have also cleared up some obscure points connected with the inter- relations of the already known peoples. A much wider extension must now be given to the great Mandingan family, as well as to that of Upper Gruinea, which still lacks a satis- factory collective name, but the various sections of which â€" Tslii, Ewe, Yoruba, and others â€" are shown by Ellis to be fundamentally connected in speech,, physique, reUgion, and social usage.

As a consequence of all tkese discoveries tlie tentative classifica- tion of tlie Sudanese negro peoples (vol. xviL p. 319) requires so many readjustments that it will be more convenient to substitute a fresh table Iiarmonizing better with the present state of African ethnology. Here are included the Fulahs, Hausas, and the other historical Negroid nations : â€"

Wolof Group â€" Wolofs proper ; Jolofs ; Seiers ; between the lower

Senegal river and Cape Verde. Felup Group â€" Aiamat ; Tola ; Kabil ; Jngtit ; Fogni ; Kaimut ;

Vaoa; Banjiar; Fulun ; Bayot; Casamanza and Cacheo estu^

aries. Towcouleur {Taouror'} â€" Kaarta disitriot and Senegal river. Mandingan (Mande) Family â€" Mand^ proper; Bambar; Sarakolfi ;

Kassonkfe ; Jallonkfi ; Sazy ; Susn ; Vei ; Mano ; Tom'a ; Lan-

doro ; Kabunga ; Tene ; widespread throughottt Senegambia and

the Uppgr Niger basin. Sonrhmj (Songkay) â€" Middle Niger between Laike Debo and Sokoto

confluence. ,

Temne Group â€" ^Temng (Timneh) proper ; Eissi ; Sherbro ; Gallina ;

Kono ; Bullom ; Solima ; Sierra Leone. Fulah Group â€" Futa-Jallo ; !Futa-Toro ; Jel ; Baa ; So ; Mabnbe ;

Laube ; Beri ; Senegambia, and sporadicalty throughout West

and Central Sudan. Liberian Groups â€" Deh ; Gurra ; Kru ("Kroo Boys") ; Kondo ;

Pessa ; GoUo ; Bassa ; Kabo ; Grebo ; Tebo ; Webo ; Nyambo ;

Grain Coast. Upper Guinea. Family â€" Oshin ; Agni ;, Tslii (Ashanti, Fanti, Was-

sawa, Adansi) ; Ga (Accra, Krobo, Agotine) ; EwÂ© (Awuna,

Agbosimi, Togo, Dahoman, Krepe, Era, Appi) ; Yoruba (.Jebu,

Egba, Oworo,, Ondo, Ife, Oyo) ; Ivory, Gold, and Slave Coasts. Niger-Benue Groups â€" Benin ; Ibo; Nupe; Iju (Akasa) ; Nemp6 ;

Okrika ; Qua ; Efik ; Andoni ; Ebe ; Kambari ; Wuruku ; Tan- gala ; Kali ; Bele ; Akpa ; Mitohi ; Doma ; Niger delta, Oil

Rivers, Lower Benue, and Niger. Adamawa Groups â€” Batta ; E’ala ; Marga ; Holma ; Bula ; Kilba ;

Woka ; Eani ; Longoela, Upper Benue, thence east to Logon. Niger Bend Groups â€” Mossi ; Gurma ; Gonja ; Tombo ; Gurunga ;

Sienuf (Sieneret) ; within the Niger Bend, Savsa â€” From the Niger to Borna; chief nation in Central

Sudan. Zake Chad Gremps â€” Eanembn ; Kantiri ; Tedina ; Kuri ; Bagfeirmi ;

Logon ; iVtandara ; Mosgn ; Gamtergu ; Kerrikerri ; Sara ; Babir;

Chad Basin (Kanem, Bornu, Baghirmi, Logoni, and smrronndimg

districts). Wadai Groatpf-r-Msiba ; Birtit ; Massalrt ; Korunga ; KondangÂ» j

Mubi J Marta ; Wadai and. Eaist Dar-Eur.

History,

Nuha-Fur Family â€” Eur ; Kunjara ; Nuba and Nile Nubians ; Kargo ; Kulfan ; Kolaji ; Tumali ; Tegele ; Dar-Eur, Kordofan, Nubia.

Nilitic Groups â€” Shnli ; Lahore ; Kiriin ; Janghey ; Ealanj ; Luri ; Madi ; Bari ; Nuer ; Shilluk ; Dinka ; Mundu ; Abaka ; Aba- kaya ; Bongo ; llol ; Mittu ; Krej ; Eertit ; White Nile ; Sobat ; northern slopes of Nile-Congo divide.

Welle Groups â€” Niam-Niam (A-Zandeh) ; Mangbattu (Mombuttu) ; Kalaka; A-Bangba ; A-Madi ; A-Kahle ; A-Babua; A-Barambo ; Embata ; Mangballe ; A-Banjia ; Mabenge ; Nsakkara ; A- Ngaddu ; .Welle river from its sourcfe to Mbomu confluence.

Lacustrine Gi’oups â€” Shefalu ; Wa-Kavirondo ; Magaya ; ttlchwezi ; Drugu â€¢, Drudu ; Wa-Konjo ; Wambuba ; Wa-Wamba ; Wa- Lenga ;

Wa^Yerra ; Wa-Tigawa ; Unyoro, Kavirondoland ; Vic- toria Nile ; Semliki river ; Mpororo and Batumi districts.

See Br W. Junker. Travels in Africa. English ed., 3 vols., 1875-86.â€” M. Clozel. Tour du Monde, 1896, p. 1 sq.â€”U. Dybowski. Le Naturaliste. January 1894. â€” Capt. Bingee. Du Niger au Golfe de Guinee, 2 vols., 1892. â€” H. Gann-ett. North America, vol. ii., 1898. â€” Dr O. Baumanm. Jour. Boy. Geo. Soc. 1896-97.â€” I>r J. W. Gregory. The Great Bift-Valley, 1896.â€” Col. A. B. Ellis. The Tshi-speaking Peoples (1887) ; The Ewe-speaking Peoples (1890) ; The Toruba-speaking Peoples (1804).

(a. h. k.)

Neoboes IX United States of Amebica.

The first negro slaves in America were brought by the Spaniards to San Domingo, in the island of Hayti, in 1565. There has been much controversy as to the year when the first negroes were landed on the continent of North America ; and the number brought in the first ship- ment has been given as fourteen by some authorities, and as twenty by others. Williams ^ says that fourteen negroes were landed in the colony of Virginia, in the month of August 1619 from a Dutch man-of-war, claiming to sail under a commission from the prince of Orange. The negroes were exchanged for provisions, and were forced upon the colony. At that period white servi- tude was common ; women were sold for wives, being some- times kidnapped in England and sent to the colony. Slavery grew slowly at fiist. In 162-1 there were only twenty-two negroes in the colony of Virginia. In 1648 the white population of the colony was about 15,000, with 300 slaves. Slavery existed from 1619 to 1662 with- out sanction of law. In 1662 a law was enacted in Vir- ginia that the issue of slave mothers should follow their condition {PaHus sequitur ventreyn). In 1705 a law was passed, by approval of Queen Anne, declaring slaves to be real estate. There is no trustworthy record of slavery in New York under the Dutch between 1609 and 1664, but it undoubtedly existed. When New Netherland became an English colony in 1664, slavery received ofiicial recogni- tion. Slaves were introduced into Massachusetts from Barbados in 1637. In 1676 there were 200 slaves in Massachusetts. At the beginning of the revolution in 1775, there were 601,102 slaves in the American colonies. The last cargo of

slaves brought to the United States con- sisted of thirty full-blooded Dahomeyans landed from the ship Clothilde in 1859. Efforts for emancipation were begun as early as 1780 by the Quakers. One of the first organized attempts at ” abolition agitation ” was that of Benjamin Lundy, begun in 1821. The colony of Liberia, in Africa, was founded by the American Colonization Society as a place of residence for free negroes. The first shipload of emigrants, consisting of 86 negroes, went to the colony in Eelsmary 1820. In 1861, at the beginning of the Civil War, there were about 4,441,000 negroes in the United States, of whom 11 per cent, were free.

Table A shows the white and coloured population of the United States by decadessince 1790. Previous to 1860, Indians and Chinese were inrijadled in the census report as “colonred.”

1 Bistory^ of the Negro Sace in America from 1619 to 1880, George W. Williams. New York : G. P. Putnam’s Sous. The author of this work is himself a negro.

Table A.

Tear.

White.

Coloured.

Proportion of White.

Proportion of Coloured.

1790

3,172,006

757,208

81-12

18-88

1800

4,306,446

1,002,037

81-13

18-87

1810

5,862,073

1,377,808

80-98

19-02

1820

7,862,166

1,771,656

81-62

18-38

1830

10,537,378

2,328,642

81-90

18-10

1840

14,195,805′

2,873,648

83-17

16-83

1850

19,553,068

3,638,808

84-32

15-68

1860

27,001,491

4,441,830

85-88

14-12

1870

33,678,362

4,880,009

87-35

12-65

1880

43,574,990

6,580,798

86-88

13-12

1890

55,152,210

7,470,040

88-07

11-93

1900

66,990,802

8,840,789

88-35

11-65

Table B shows the changes in proportion of coloured to white population in the Southern states.

Table B.

1880.

1860.

1890.

1900.

Maryland .

34-88

24-91

20-69

19-79

District of Columbia

30-81

19-07

32-80

31-12

Virginia

42-69

34-39

38-37

35-64

North Carolina

35-93

36-42

34-67

33-07

South Carolina

55-63

58-59

59-85

58-37

Georgia

42-57

44-05

46-74

46-68

Florida

47-06

44-63

42-46

43-69

Kentucky .

24-73

20-44

14-42

13-26

Tennessee .

21-43

25-50

24-37

23-77

Alabama

38-48

45-40

44-84

45-24

Mississippi .

48-44

55-28

57-58

58-60

Louisiana .

58-54

49-49

49-99

47-14

Texas

30-27

21-84

20-36

Arkansas .

15-52

25-55

27-40

27-94

From 1860 to 1900 the negro population of the entire country increased 100 per cent., and the wliites about 150 per cent, the whites receiving 14,000,000 by immigration, and the negroes practically none. The natural increase of the two races was about equal. Between 1880 and 1900 the whites increased (excluding immigration) nearly 33 per cent., and the negroes nearly 34 per cent. From 1850 to 1900 a perceptible change in the distribution of the negro population was apparent. In 1850 the proportion of negroes in the Southern states was 94-2 per cent. ; in 1900 it had fallen to 89-9. In the upper Southern states, viz. , Delaware, Mary- land, Virginia, West Virginia, North Carolina, South Carolina, Kentucky, Tennessee, and Missouri, there was a loss of 17 per cent. â€” from 54-4 to 37-4 â€” and in the lower Southern states an increase of 12-7 per cent. â€” from 39-8 to 52-5. Alabama alone held its proportion unchanged. ‘ From the upper Southern group of states there were two different movements, one to the south- ward, the other to the north and west. Virginia has afforded the largest migration

to the north and west, while South Carolina, North Carolina, Tennessee, and Virginia, in the order given, have contributed most to the lower Southern group of states. There has been a marked increase of the urban negro population, espe- cially in the larger cities of the North and the states bordering on the North (Table C).

Table C. â€” Negro Population in Twelve Cities having the largest Negro Population.

ISTO.

1880.

1890.

1900.

Washington, D.C.

38,726

52,13rj

75,572

86,702

Baltimore, Md. .

39,558

53,716

67,104

79,258

New Orleans, La.

50,456

57,617

64,491

77,714

Philadelphia, Pa.

22,147

31,699

39,871

62,613

New York, N.Y.

13,072

19,663

33,994

60,666

Memphis, Tenn.

15,471

14,896

28,706

49,910

Louisville, Ky. .

14,956

20,905

28,651

39,139

Atlanta, Ga.

9,929

16,330

28,098

35,912

St Louis, Mo.

22,088

22,256

2(;,865

35,516

Richmond, Va. .

23,110

27,832

82,330

32,230

Charleston, S.C.

26,173

27,276

30,970

81,522

Chicago, 111.

3,691

6,480

14,271

30,160

In the decade 1890-1900 several of the Southern cities made little gain. On the other hand, the four Northern cities, New York, Chicago, Philadelphia, and Pittsburg, show an aggregate increase of 80,978. Four other cities, Washington, Baltimore, New Orleans, and Memphis, show an aggregate increase for the same period of 68,711, but this is much below that of the four Northern cities named.

The relative proportion of the races in the Southern states shows little change, notwithstanding the movements indicated. In the low swampy regions of the Atlantic coast, and in the alluvial regions of the Mississippi valley, 17 per cent, of the total negro population are found, whereas only 4 per cent, of the total popula- tion of the country live there. Seventy per cent, of the negroes live below an altitude of 500 feet. The total population of the country live under a mean average temperature of 53Â° ; the average temperature under which the negro lives is 61Â°.

The negro is mainly occupied in agriculture or personal service. Between 1865 and 1890 there was little progress in manufacture, transportation, and trade, but in the last decade of q^^ f,gg the 19th century there was definite and encouraging ^^^ owner- progress in those directions. In 1890 the total number ^^jp^ of farms in the United States was 4,767,179. Of these the

negi-oes occupied 549,642, or 11-5 per cent. The number of homes, as distinguished from farms, was 7,922,973, and of these the negroes occupied 861,137, or l0-9 per -cent. At the same date the proportion of negroes to the total population was 12-2 per cent. Of the farms occupied by negroes in 1890, 120,738, or 22 per cent., were owned by the occupants. The corresponding proportion for whites was 71-7 per cent. In 1890 negroes owned 19 per cent, of the homes occupied by them, whereas the whites owned 39-4 per cent, of their homes. The property owned by the negroes was acquired in the twenty-five years following their freedom. The progress in acquiring farms and homes in the decade from 1890 to 1900 was marked. The report of the State Comptroller of Georgia showed that in 1901 the assessed value (half actual) of negro property in the state was Â§15,629,811, while negroes owned 1,141,135 acres of land, valued at $4,656,042.

A study of the negro in business, made in 1899 by Professor W. E. B. Du Bois, estimated the capital then invested in negro business enterprises to be .$8,784,637. Seventy-nine per cent, of this was in sums of less than $2500. The same study reported 3 monthly magazines, 3 daily papers, 11 school journals, and 136 weekly papers, owned, edited, and published by negroes.

The absolute poverty of the neei-o after his freedom was re- sponsible for the one-room cabin. Slavery had made family life uncertain or impossible, and this had led to inconstancy, and to a lack of appreciation of the importance of virtue. In these respects there has been a marked improvement. The two-room cabin, making possible separation of the sexes, the ownership of lands, and the general impulse incited in the people for bettering their position, have brought a higher standard of life and morals. The most encouraging result of opportunity and development is the growing differentiation of classes among negroes, even in small communities, and the fact, now clearly defined, that the industri- ous and property-holding class of the negro population represents the general tendency of the race. ” In slavery days marriage or cohabitation was entered upon very early, and the first generation of freemen did the same. The second generation is postponing marriage to better its condition” (Dn Bois). In 1890 there were 9 native white prisoners in gaol to every 10,000 of the white popu- lation, and 33 negroes to every 10,000 of the negro population ;

but as negroes are committed for petty offences in much greater proportion than the whites, the comparison is unfair. It is un- doubtedly true, however, that the proportion of negro criminals is in excess of the whites.

Lynching, or tlie practice of punishment for crimes or offences by unauthoi-ized persons without a legal trial, has been practised against the negro to an alarming extent. ^â€¢J‘“â„¢”’*’- A grouping of the lynchings of negroes for five years, with the alleged causes, gives the figures shown in Table D.

Table D.

Year.

Murder.

Eape.

Other Causes.

Total.

1806 1897 1898 1899 1900

Total

24 55 47 23 30

31 22 16 11 16

81 46 39 56

57

86 123 102

90 103

179

96

229

604

The lynching may occur from any cause, and any crime by a negro is considered in some communities as an inter-racial crime. The punishment is due to race antipathy and the desire to pi-otect the white race. The rape of the negro by the white, when it occurs, is condoned, and is seldom punished. Throughout the four years of the Civil War, when the negroes were left in charge of the homes of the whites, there is no record of a single murder that could be called an outrage on the part of the negro. The health of the negro race suffered by the free license that followed

the restraint m slavery. The introduction of civUized vices into the uncivilized negroes induced excesses, and the lack of self- control brought crime and disease in its path. The birth-rate among the negroes is high, but the death-rate, especially in the cities, is far in excess of that of the whites. This is due to im- proper food, clothing, excesses, and ignorance of the care of infants.

_ By Federal constitutional amendment the negro was given the right of franchise. In the former slave states, where the negro Loral dis P^‘edominates, five statesâ€” Mississippi, South Caro- fraachlse- ’”‘ Â°’^^ Carolina, Louisiana, and Alabamaâ€” have meat. adopted educational and property qualifications in

their constitutions, which practically disfranchise the majority of tlie negroes. The Constitutional Convention of Vir- ginia (1902) adopted the same qualification. The attitude of the white population varies in proportion to the number of negroes. Where there is no fear of negro domination, as in the North and West the relationship is simple. But in some Southern states where the negro largely predominates (in some counties in the ratio of 12 to

1), the relations between the negro and the white are very com- plex. The universal sentiment of the Southern white is that the negro shall neither dominate politically nor shall he have social recognition. He is encouraged, however, to secure a reasonable education, and is respected in proportion to his good citizenship. More trades are open to him in the South than elsewhere, and his labour in agriculture, personal service, and the more laborious trades is appreciated.

Statistics of the progress of the negi-o in education are not com- plete, but all indicate a wonderfully rapid progress in the elements of education. During slavery it was generally held throughout the South to be a crime to teach negroes to read and write. Schools existed, however, to some extent, for the free negroes, and the U.S. censuses of 1850 and 1860 reported a considerable number of adult “Free Coloured People ” in the Southern states who could read and write, 25,490 in 1850 and 29,864 in 1860. The records for literacy and illiteracy among the negroes over ten years of age in eleven of the Southern states since freedom are given in Table E.

Table E.

Bduca Hon

Tear.

Total

Negro

Population.

Total Number over 10.

Literate Numbers over 10.

Illiterate Numbers over 10.

Percentage

of Literates.

Percentage

of Illiterates.

1870 18802 1890 1900

3,939,0821 5,860,298 6,118,592 7,185,617

2,728,748 3,609,208 4,264,271 6,051,828

296,800

887,855

1,622,163

2,563,090

2,432,948 2,771,348 2,642,108 2,488,738

10-8 23-2 83-6 50-7

89-2 76-8 61-4 49-3

Table F shows the literacy of negro males of voting (twenty-one years and over) in the United States.

Table F.

Total.

Literate.

Illiterate.

Percentage

of

Literates.

Percentage

of Illiterates.

1870 1880 1890 1900

1,032,475 1,487,844 1,740,455 2,065,989

170,232

465,193

714,799

1,088,940

862,243 1,022,1513 1,025,656*

977,049

16-5 31-3 41 -1

52-7

83-5 68-7 58-9 47-3

Table G shows the variation in different localities. Table G.â€” Negro Males of Voting Age in Twelve Cities {1900).

Per Cent.

Total.

Literate.

Illiterate.

of Illiterate.

Chicago, 111.

12,414

11,732

682

5-5

New York, N.Y.

18,651

17,365

1286

6-9

Philadelphia, Pa.

20,095

17,905

2190

10-9

St Louis, Mo.

11,727

9,351

2370

20-2

Washington, D.C.

23,072

17,048

6024

26-1

Baltimore, Md. .

21,806

16,021

5785

26-5

Savannah, Ga. .

7,932

5,497

2435

30-7

Louisville, Ky. .

12,416

8,070

4346

35-0

Richmond, Va. .

8,472

5,471

3001

35-4

New Orleans, La.

19,809

12,684

7125

36-0

Memphis, Tenn.

14,251

8,867

5384

37-7

Atlanta, Ga.

7,944

4,915

3029

39-4

1 Estimated from proportions of 1890.

2 Includes Chinese and Indians.

2 Includes Chinese, Japanese, and Indians. * Illiterates twenty years of age and over.

. ^^^^ ’’^is *‘3’l’le may be compared another of twelve counties, in Southern states, having a large proportion of Illiterate negroes.

Table U.â€” Negro Males of Voting Age in Ticelve Sural Counties {1900).

Per Cent.

Total.

Literate.

mterate.

of Illiteracy,

Buckingham, Va.

1545

461

1084

70-8

Wilkes, Ga.

2896

848

2048

70-7

Calhoun, Ga.

1393

401

992

71-2

Macon, Ga.

1899

529

1370

72-1

Greene, Ala.

4342

1264

3078

70-9

Marengo, Ala. .

6140

1751

4389

71-4

Lowndes, Ala. .

6455

1788

4667

72-3

East Feliciana, La.

2831

770

2061

72-8

Concordia, La. .

,3119

690

2429

77-9

St Landry, La. .

5101

1038

4063

79-7

St Martin, La. .

1695

329

1366

80-6

Lafayette, La. .

173S

250

1489

85-6

In New York, Chicago, and Philadelphia few of the negro males of voting age are unable to read and write ; in St Louis, Baltimore, and Washington the number increases; in the more southerly cities it becomes upward of a third ; and in many of the rural districts the literacy is little greater than under slavery. In some two hundred counties upward of 60 per cent, of the negro males of voting age are recorded as illiterate. The large number that have gone from the South into Northern cities during recent years are evidently of the educated classes who have had the benefit of the schools. Their training seems to have given them an inclination to other pursuits than those which would have made them of greatest use to the more needy people of their own race.

The general disposition of the negro is to educate his children, even at great personal saciiflce. Records of public school ex- penditure and attendance in

the sixteen former slave states and the District of Columbia since 1870 give the foDowlng fig- ures : â€”

Table L

School Year.

Estimated Expenditure for each liace.

Estimated School Population, i.e.. Children 5 to 18.

Expenditure per caput.

White.

Coloured.

White.

Coloured.

“White.

Coloured.

1870-1871 1880-1881 1890-1891 1899-1900

$9,605,158 11,312,678 21,245,685 28,297,857

$780,806 2,344,241 5,444,626 7,296,214

8,236,630 4,096,800 5,230,115 6,103,390

1,578,170 2,145,990 2,651,511 2,991,100

$2-97 2-76 4-06 4-64

$0-49 109 2-18 2-44

The total expenditure for the public schools in these states during this time has been .$615,074,209, of which $499,119,910 was for white children, and $115,954,299 was for coloured children.

The U.S. Commissioner of Education reported that for the school year 1900-01 there were 180 institutions for the educa- tion of the negro in the United States, other than the public schools. 145 of these, reporting to the Commission, gave the following figures : â€”

37,696

Number of students

Elementary

22,043

Secondary .

13,267

College grades

2,386

Of this number 15,683 were receiving industrial training. The aggregate income of the 145 schools was $1,182,365. Of this amount there came from public funds, Â§212,950 ; from tuition, $148,506 ; from productive funds, $142,932 ; and from private donations, $677,977.

In addition to generous private benefactions, largely from the North, there have been expended for negro education a portion of the income of the Peabody fund, the Income of the Slater fund, and large sums contributed through the American Mission- ary Association and other societies maintained by different churches.

The training given at Hampton Institute, Hampton, Virginia, at the Tuskegee Normal and Industrial Institute, Tuskegee, Ala- bama, and at similar institutions, has had a marked influence on the education of the

negro race. The aim of such schools Is to give agricultural or Industrial training, together with a practical academic course. The importance of teaching the negro the value of work and how to work is paramount. The

need of fitting Mm for Ms necessary environment is a responsi- bility wliich is gradually being recognized by the whole people. ‘ For a veiy complete bibliography of the negro, see Appendix ” C,” p. 419, of The Philadelphia Negro, published for the TJni- Tersity of Pennsylvania, 1899, PMladelphia, Penn., U.S.A., edited by Prof. W. E. Du Bois. (yf, h. b.)

Negro, Rio= See Amazon.

Nehavend, a small but very fertile and productive province of Persia, situated soutln-vs^est of Hamadan, west of Malayir, and north-west of Buriijird. It has a population of about 15,000, and pays taxes amounting to about Â£9000 per annum. The capital is the ancient city of Nehavend, where Tezdigird, the last monarch of the Sassanian dynasty, was finally defeated by the Arabs. It has a population of about 5000, including 700 to 800 Jews ; there are fine gardens, and an old citadel on a hill. It is situated at an elevation of 5540 feet, 27 miles from Doletabad (Malayir), and 25 miles from Buriijird.

Neisse, two rivers of Germany, both left-hand tributaries of the Oder. 1. The Glatz ISTeisse rises on the Schneeberg, at an altitiide of 1400 feet, flows north past Glatz, turns east and pierces the Enlengebirge in the Wartha pass, then continues east as far as the town of Neisse, and after that fl-ows north-north-east untH it joins (altitude, 453 feet) the Oder between Oppeln and Brieg. It is only nsed for floating down timber, owing to its tor- rential character. It abounds in fish. Its total length is 121 miles. 2. The Lansitz or Gorlitz Neisse rises near Reichenberg in Bohemia, on the south side of the Eiesengebirge, at an altitude of 1130 feet, flows north past Eeichenberg, Gorlitz, Forst, and Gnben, and enters the Oder above Eiirstenberg (altitude, 105 feet). Its length is 140 miles, of which less than 10 miles are navigable.

Neisse, a town of Prussia, province of Silesia, 32 miles by rail south-west of Oppeln, on the Neisse. It has a (Renaissance) exchequer (1604 ; restored in 1890), with frescoes and sculptures on the fagade ; also a fountain (1686), a museom of antiquities, a military school, an indusjirial school, a sanatorium (St Eochus) ; and in the quarter of Friedxichstadt monuments to the poet Eich- endorif (who died here in 1857), to the war of 1866, and the war of 1870-71. Population (1886), 21,837 ; (1900),

24,271.

NeKore, a town and district of India, in the Madras presidency. The town is on the right bank of the Penner river ; a station on the East Coast railway, 109 miles north of Madras city. Population (1881), 27,505 ; (1891), 29,336; municipal income (1897-98), Ks.44,300. There are United Free Church, American Baptist, and Catholic missions ; two high schools, with 668 pupils in 1896-97 ; five printing-presses, issuing three vernacular periodicals, and four reading-rooms and literary associations.

The district of Nellore has an area of 8765 square miles ; popu- lation (1881), 1,220,2.S6; (1891), 1,463,736; (1901), 1,497,796, showing an increase of 20 per cent, after the famine of 1876-77, and of 2-3 per cent, between 1891 and 1901 ; average density, 171 persons per square mile. The land revenue and rates in 1897-98 were Rs.30,80,873, the incidence of assessment being 11.1:12:6 per acre; cultivated area, 1,094,682 acres, of which 301,932 were irrigated, including 130,762 from Government canals ; number of police, 1212 ; boys at school (1896-97), 24,874, being 22-.’, per oent. of the male population of Kchool-soing age; registered death-rate (1897), Kl-f) per tJiousand. The pi-incipai crops are millet, rice, other food grains, indiso, and oil-seeds. The breed of cattle is celebrated. There are altogether 1223 indigo vats, employing 17,4.’,0 hands, with an out-turn valued at Rs.7,66,000 a year ; and 32 saltpetre refineries. There are two important irrigation works, the Penner and Sangam systems. On the former the capital expenditure has been Ks. 18,99,000. In 1897-98 the irrigated area was 70,464 acres, yielding a profit of 4 per cent. On the latter (not quite finished) the capital outlay has been Rs.38,56,000. In 1897-98 the irrigated area was 76,217 acres, yielding a surplus of Es. 16,234. The Kaat Coast

railway, running through the length of the district, was opened throughout for traific in 1899. The section of line from Nellore city to Gudur (24 miles), formerly on tlie metre gauge of the South Indian railway, has been converted to the standard gauge. Previously the chief means of commanication with Madras was by the Buckingham canal. The sear-bome trade is insignificant.

Nelson, a municipal borough (1890) in the Clitheroe parliamentary division of Lancashire, England, 3 miles north of Burnley by rail. Cotton is manufactured. There are a free library, with a largely attended technical school in the same building, and a handsome market halL Recreation grounds have been opened. Population (1881),

10,381 ; (1891), 22,754 ; (1901), 32,816.

Nelson, chief town of the silver-mining localities of West Kootenay, British Columbia. It was one of the earliest mining “camps ” in Kootenay, but was incorpor- ated only in 1897. It is situated on the south shore of a branch of Kootenay Lake, and has rail connexion with Rossland, Robson, the terminus of the Arrow Lake steamers, and with the railways of Washington state. It has banks, churches, and schools, as well as large smelting plant for ores. Population, about 6000.

Nelson, a river of Keewatin, Canada, discharging the waters of Lake Winnipeg into Hudson Bay. It drains an area of 360,000 square miles, and, including its great tribiitary the Saskatchewan, is 1460 miles long. It is unnavigable except for canoes, and has a total fall between the lake and sea of 710 feet. The Saskatchewan rises in the Rocky Mountains in 52Â° 07′ N. and 117Â° 06′ W., and flows in a general easterly direction to Lake Wumi- peg. It has many large tributaries, including the Clearwater, Brazeau, Battle, Carrot, and the South Sas- katchewan, with its afilueuts. Red Deer, Bow and Belly rivers, and is navigable for shallow-draught steamers from Edmonton to the Grand Rapids at its deboucliement into Lake Winnipeg, a distance of 820 miles. Other consider- able streams discharging into Lake Winnipeg are Berens, Poplar, Winnipeg, Red, with its western branch, the As- siniboine and Dauphin rivers.

Nelsonville, a village of Athens county, Ohio, U.S.A., on the Hocking Valley railway, in tlie south- east part of the state. It is in a coal-mining region, and is largely engaged in shipping coal. Population (1890), 4558 ; (1900), 5421, of whom 328 were foreign-born and 204 negroes.

Nematoda â€” Since the date (1884) of the article in the earlier volumes (ninth edition) of this Eneyclopeedia innumeraJble details have been added to our knowledge of the minute anatomy and life-history of the Nematoda, but the present article will be mainly confined to the more important additions to our knowledge of the pathological and economic thread-worms. A word or two, however, must be said about certain organs recently brought into prominence â€” the so-called phagocytic organs. These consist of enormotts cells with nuclei so large as to be in some cases just visible to the naked eve. These cells are disposed in pairs, though the members of each pair axe not always at the same level. The number of cells is not large (some 2 to 8), and as a rule they li along the lateral lines. In some species (vLsram decipiens) the giant cell is replaced by an irregular mass of protoplasm containing a number of small nuclei. Such a plasmodium bears, on’its periphery, groups of rounded projections of protoplasm termed end-organs. Similarly the giant cells are produced at their periphery into a number of branching processes which bear similar end-organs on their surface and in some cases terminate in them. These end-organs are the active agents in taking up foreign granules, or bacteria, which may have found their way into the fluid of the bod}— cavity. From the shape and position of the phagocytic

organs it is obvious that they form admirable strainers through which the fluid of the body-cavity filters (Figs. 1, 2). (See N. Nassonov, Arch. Mikr. Anat, 1900; Arch, parasit, 1898. Kabot, Lab. Warsaw, 1898 ; Zool. Anz., 1898. L. Jagerskiold, Centralbl. Balder., 1898. J. Spengel, Zool. Anz., 1897. H. Ehlers, Arch. Naturg., 1899. 0. Hamann, Die Nemaihelminthen, 1895.)

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Fig. 1. â€” Sclerostomum ormaMm, 5, Fig. 2.—0ne of the phagocytic organs

X about 3^, opened to show the of Sc. armaiwm, highly magnified, 1,

phagocytic organs. 1, Mouth ; 2, Hucleus of giant-cell ; 2, one of the

anterior end of alimentary canal ; processes and end-organs of the same.

8, posterior end of alimentary \From Nasscmov.') canal; 4, oyaiy; 5, 6, and 7, anterior middle and posterior pairs of phagocytic organs. {From, Massonov.)

Agriculturists are paying increased attention to the nematodes that destroy their crops. A good example of a fairly typical case is afforded by Heterodera schachtii, which attacks the beetroot and causes great loss to the Continental sugar manufacturers. The young larvse, nourished by the yolk which remains over from the egg and by the remains of the mother which they have taken into their alimentary canal, make their way through the earth, and ultimately coming across the root of a beet, begin to bore into it. This they do by means of a spine which can be protruded from the month. Once within the root, they absorb the cell sap of the parenchyma and begin to swell until their body projects from the surface of the root in the form of a tubercle (Fig. 3). The reproductive organs do not begin to appear until the larva has twice cast its skin. After this a marked sexual dimorphism sets in. The female, hitherto indistinguish-

able from the male, continues to swell until she attains the outlines of a lemon. Doing this she bursts the epidermis of the rootlet, and her body projects into the surrounding earth. The male has a different life-history (Fig. 4). After the second larval moult, he passes through a passive stage comparable to the^ pupa ~~stadium of an insect, and during this stage, which occurs in~~ side the root, the reproductive organs are per- fected. The male next easts his cuticle, and by means of his spine bores through the tissues of the root and escapes into the earth. Here he seeks a female, pairs, and soon

Fig. 3. â€” A. a, Female Heterodera schacTdii Schmidt, breaking through the epidermis of a root ; the head is still embedded in the parenchyma of the

root. B, a, larvffi boring their way into a root ; h, larva of the immobile kind surrounded by the old skin, living as an ectoparasite on the outside of the root.

{From Stnibell.

afterwards dies. The eggs of the female give rise to em- bryos within the body of the mother ; her other organs undergo a retrogressive change and serve as food for the young, until the body-wall only of the mother remains as a brown capsule. From this the young escape and make their way through the earth to new roots. The whole life-

FiQ. 4. â€” ^A, Male Eeterodera scTiachtii, greatly magnified ; a, head lappets ; &, mouth cavity ; c, spine \ d, muscle of spine ; 6, gland ; /, (esophagus ; g, bulb ; A, nerve-ring ; i, excretory pore ; ^, oesophaguB ; fc, testis ; I, intestine ; OT, muscles moving spicule; Â«, spicule. B, First motile larva. C, Second immovable parasitic larva casting its skin. I), A female with one-half of the body-wall taken away to show the coiUng generative oi^ans : a, boring apparatus; &, (esophageal bulb; Cf excretoiy pore; eZ, alimentary canal; e, anus ; /, ovary. E, A male shortly before casting its larval skin.

histoi-y extends over a period of some 4-5 weeks (Fig. 4), so that some 6-7 generations are born during the warmer months. The number of descendants which arise from a single pair during one summer are enormous. If we assume that each female produces 300 embryos, and that half of these are females, the number of descendants would be, after six generations, some 22,781 milliards (A. Strubell, Bibl. Zed., 1888-89). Other species which have been recorded in the United kingdom are Tylenchus devastatrix (Kuhn), on oats, rye, and clover roots ; T. tritici, causing the ear-cockle of wheat; Cephalobus rigidus (Schn.),

on oats ; Heterodera radicicola (Greef) Mull, on the roots of tomatoes, cucumbers, potatoes, turnips, peach-trees, vines, and lettuce and many other

plants.

Among recent advances having medical import in our knowledge of the Nematodes, the chief are those dealing with the parasites of the blood. Filaria sanguinis homi- nis noctuma {F. bancrofti) is known to live in the lym- phatic glands, and its embryos, passing by the thoracic duct, reach the blood-vessels and circulate in the blood. Manson showed, in 1881, that the larvae were not at all times present in the blood, but that th^ir appearance had a certain periodicity, and that the larvee of F. sanguinis hominis noctuma swarmed in the blood at night-time and disappeared from the circulation during the day. Ten years later Manson discovered a second species whose larvae live in the blood. They, however, show no perio- dicity, and are found continuously both by day and by night; hence they are termed F. sanguinis liominis Per- sians (F. Persians). The adult stages are thought to be certain Nematodes found in the sub-peritoneal connective

Fig. 5. â€” A, View of the heart of a dog infested with Filaria immiiin Leldy ; the right ventricle and base of the pulmonary artery have been opened : a, aorta ; 6, pulmonary artery ; c, vena cava ; d, right ventricle ; e, appendix of left auricle ; /, appendix of right auricle. B, Female I\ iminiUs, x 1, removed from the heart to show its length.

tissue. A third form, F. sanguinis hominis diurna, is found in the larval stage in blood, but only in the day- time. The adult stages of this form are unknown.

The presence of these parasites seems at times to have little effect on the host, and men in whose system it is calculated there are some 40-50 million larvae have shown no signs of disease. In other cases very serious disorders of the lymphatic system are brought about, of which the most marked is perhaps Elephantiasis. Manson and Bancroft suggested that the second host of the parasite is the mosquito or gnat, and for a long time it was thought that they were conveyed to man by the mosquito dying after laying her eggs in water, the larval Nematodes escaping from her body and being swallowed by man. It is now held that the parasite enters the blood of man through the piercing mouth-parts at the time of biting. When first sucked up by the insect from an infected man it passes into its stomach, and thence makes its way into the thoracic muscles, and there for some time it grows.

Next the larvae make their way into the connective tissue in the pro-thorax, and ultimately bore a channel into the base of the piercing apparatus and come to rest between the hypopharynx and the labium. Usually two are

found in this position lying side by side; it would be interesting to know if these are male and female. From their position in the proboscis the larvae can easily enter the blood of man the next time the mosquito bites. (Low, Brit. Med. Jowm., June 1900 ; James, ibid., Sept. 1900.) Shortly after Low had published his results, Grassi and Noe issued a paper dealing with the larvae of F. immiiis, which is spread by means of the mosquito Anopheles (Cenirbl. BaTcter. I. Abth. xxviii., 1900). The larvae of this parasite develop in the Malpighian tubules of the insect ; at a certain stage they cast their cuticle and make their way into the space â€" part of the haemocoel â€" found in the labium. During the act of biting the labium is bent back, and as the piercing stylets enter the skin of the sufferer this bending becomes more and more acute. Grassi and Noe think that if the cavity of the labium be full of the larval Nematodes this bending will burst the tissue, and through the rent the larvae will escape and make their way into the body of the host. Besides Anopheles, two species of C'ulex, C. penicillaris and C pipiens, are also accused of transmitting the larvae. A paper by Noe {Aiti Ace. Lincei, ix.-, 1900) seems to prove beyond doubt that the larvae of F. immitis are transmitted in the manner indicated. The adult worm is chiefly found in the heart of the dog, and usually in the right side, which may be so packed with the worms as seriously to interfere with the circulation (Fig. 5). The females produce thousands of larvae, which circulate in the blood, and show a certain periodicity in their appearance, being much more numerous in the blood at night than during the day. (a. e. s.)

Nemertina. â€" Since the publication of Hubrecht's article on Nemertines in the earlier volumes of this En- cyclopaedia (ninth edition), the most important event in the history of our knowledge of the group has been the appearance of Burger's magnificent monograph.^ As a result of his revision, the author has drawn up a new classification, given below, has added much to our know- ledge of the minute histology, and has cleared up many obscure points. There is little to correct in Hubrecht's article, but something to add. In particular, the struc- ture of the excretory system has been elucidated by Burger, and many naturalists have contributed to our

knowledge of the habits and distribution of Nemertines, and many new genera and species have been described.

The curious neuro-glandular pits (Fig. 1), absent in the Mesonemertine and one or two aberrant species, have been shown to possess large glandular cells at their base which secrete a mucus. The development of these organs, which in the Protonemertine are but grooves in the epi- dermis, not far removed from the similar cephalic slits of many Turbellaria, reaches its height in Drepanophorns. Here the pits split into two, one part ending in a sac lined with sensory epithelium, and embedded in nervous tissue, the other projecting backwards as a long, glandu- lar, blind canal. The exit of these organs takes many shapes, of value in systematic work. Their function is still little understood. Two lateral, shallow pits occur on the side of the body about the level of the hinder end of the proboscis in some species of the genus Carinella, which are termed side-organs. These are capable of being everted, and are probably sensory in function (Fig. 3, 17).

The vascular system is entirely closed, and its main vessels were described and figured in Hubrecht's article. It contains a colourless fluid, with flat, oval, nucleated corpuscles, as a rule colourless, but in some cases tinged with yellow or red haemoglobin. Its presence is one of the most distinctive features which separate the Nemertines

1 "Die Nemertinen," Fauna und Flora des Golfes von Neapel, Bd. xix., 1895. –

from the Platyhelminthes. In origin the vascular system is due to a fusion of spaces which arise in the meso- blast of the larva. The blood is probably circulated

by the general con- traction of the whole animal, since it is very doubtful if there are any in- trinsic muscles in the vessel-walls. Its function is less that of respiration than of conveying the digested food – pro- ducts all over the body and the excre- tory products to the nephridia, and doubtless it serves at

times to assist in the extension and retraction of parts of the body. The vessels in the more highly- develeped genera seem to be partly lacunae and partly true vessels with definite walls. Closely associated with the lateral blood – vessels are the single pair of nephridia. Each consists of a more or less coiled, cili- ated, longitudinal canal, which on its external surface gives origin to one or more transverse canals, which pass to the exterior and open a little way behind the mouth on the sides of the body. On its inner surface the longitudinal canal is adpressed to the lateral blood-vessel, and gives off a number of small, blind caeca or tags, each of which ends in a small clump of cells. These tags indent the blood-vessel. From their inner ends, pro- jecting into the lumen of the tag, hangs a bunch of cilia, which forms the flickering ” flame ” so well known in the

Fia. 1. â€” Lineiis g&niculatue. x J. {From Bur- ger.) 1, Lateral slits on bead ; 2, anus.

2 –

excretory apparatus of the Platyhelminthes and larval Annelids (Fig. 2). There is no communication between the nephridia of one side and the other, but in Eupolia there are ducts opening into the alimentary canal as well as to the exterior, a condition of things which recalls what obtains in certain Oligochsetes. As a rule these organs only extend a short way along the anterior end of the body, a con- centration which we may associate with the development of a vascular system to bring the products of ex- cretion to a fixed spot. In Sticlio- stemma, however, Montgomery ^ has described a series of nephridia lying all along the body, and each with a varying number of external pores. The excretory system is epiblastic in its origin.

In the Metanemertini there is a curious diverticulum of the intes- tine which stretches forward in the median line, ventral to the so-called stomach. It is at times sacculated, but its chief interest is that, as Lebedinsky ^ has shown, the tip of the caecum in embryonic life opens to the exterior as the blastopore. This subsequently closes up, and the newly-formed oesophagus and stomach open in the intestine above and behind it. It is a curi- ous feature in Nemertiues that the alimentary canal seldom con- tains traces of food, and yet as a class they are voracious. The food must be digested, absorbed, and excreted with great rapidity. There is some evidence that in

this group the ectoderm of the oesophagus is chiefly concerned with diges- tion, whereas the endoderm of the intestine is limited to the absorption of the soluble products.

The armed character of the proboscis of the Metanemer- tini is dwelt upon by Hubrecht. The median calcareous stylet is supported by usually two, but in Amphiporus by as many as twelve lateral stylets secreted in sacs, which Burger regards as the vacuoles of certain enormous cells. In many forms the epidermis of the proboscis is provided with nematocysts, which differ from those of the Ccelen-

FiG. 2. â€” Part of the excretory system lying on the lateral vessel of Dr&patiophorTin spectaiiUs. (Magnified about TSO.) 1, The longitudinal excretory canal ; 2, one of the tags containing the flame- cells.

Fig. 8. â€” Anterior end of a CarineUa, partly diag:rammatic. Magnified. (From Burger.) 1. Opening of proboscis; 2, cephalic glands, running to frontal organ; 3, dorsal commissure of brjiin ; 4, cerebral organ ; 5, upper dorsal nerve ; 6, under dorsal nerve ; 7, rhynchocoelic blood-vessel ; 8, fore-gut ; 9, rhynchocoel ; 10, nerve to proboscis; 11, proboscis: 12, genital sac; 18, genital pore; 14, mid-gut; 15, circular nerves; 16. pore of excretoiy system ; IT, lateral organ; IS, excretory canal ; 19, lateral vessel ; 20, lateral nerve ; 21, oesophageal nerve ; 22, mouth ; 23, ventral ganglion of brain ; 24, dorsal ganglion of brain ; 25, rhynehodeeum.

terata only in that they are found several in one cell. Others secrete rhabdites, recalling similar structures in the Turbellaria. The cayity into which the proboscis is retracted, the rhynchoccelum, is formed by a split which appel’ars in the mesoblast surrounding the epiblastic pit, which is the forerunner of the proboscis. It does not seem to be ccelomic in origin or relations (Fig. 3).

The reproductive system is of the simplest, strongly contrasting with the complicated arrangements in the Platyhelminthes. A series of sacs lined with an epi- thelium, the proliferation of which gives rise to the ova or spermatozoa, alternate between the caeca of the intestine.

1 Zool Jahrb. Anat. x., 1897, p. 265.

2 Arch. Mikr. Anat. xlix., 1897, p. .‘i03.

S. VII. â€” 1 6

When mature, each, sac pushes out a process to the ex- terior, and this forms the genital duct. The line of the genital openings is usually dorsal to the lateral nerve. The whole sac, with its epithelial wall and its contained genital cells, arises ultimately from some of the paren- chymatous cells of the body. The walls and contents in some forms arise simultaneously ; in others the walls are first formed, and their lining then proliferates. It has been pointed out that the cavity of the sacs corresponds in many particulars with the coelom of higher animals, and in Lebedinsky’s observations on the development there is some support to the view that a coelom exists. Montgomery has also described certain spaces which may be coelomic lying between the alimentary canal and the inner longitudinal layer of muscles in the Heteronemertini.

The position of the ISTemertines in the animal kingdom is now looked upon as more isolated than was formerly thought, and recent writers have been inclined to treat them as a separate phylum. Whether this viewbe adopted or not, and whether the Turbellaria be regarded as nearly related or only remotely connected, there can be little doubt that the Nemertines resemble the Turbellaria more nearly than they do any other group of animals. Burger even goes so far as to homologize the proboscis with the Turbellarian pharynx, and he sums up their relationship to the Annelids by the statement that to a certain extent the ISTemertines represent Turbellaria, which in the course of time have copied certain features of an Annelid char- acter. The possible relationship to the ancestral forms which must have preceded the Chordata put forward by Hubrecht^ has met with little recent support, and is not accepted by some of the later writers on the subject.

Burger classifies Nemertines into four Orders r â€”

L Protonemertini, iu which there are two layers, of dermal muscles, external circular and internal longitudinal ; the nervous system lies external to the circular muscles ; the mouth Ues be- hind the level of the brain ; the proboscis has no stylet ; there is no csecum to the intestine. Families, CARiifELLiD.E, Hubebcht-

II. Mesonemertini, in which the nervous system has passed into the dermal muscles, and lies amongst them ; other characters as in Protonemertini. Family, Cephalotheicid^.

III. Metanemertini, in which the nervous system lies inside the dermal muscles in the parenchyma ; the mouth lies in front of the level of the brain ; the proboscis as a rule bears stylets ,- the intestine nearly always has a CEecum. Families, Eunemeetirs:,

0TOTYPHLONE:}IEETIDiE, PrOSOEHOCHMIDJE, AmpHIPORIDJS,

TeTEASTEMMATID2E, NECTOKEMERTIDiE, PeI-AGONEMEKTID^,

Malacobdellid^. This order represents the Hoplonemertini of Hubrecht.

IV. Heteronemertini, in which the dermal musculature is in three layers, an external longitudinal, a middle circular, an internal longitudinal ; the nervous system lies between the first and second of these layers ; the outer layer of longitudinal muscles is a new development ; there is no intestinal csecum ; no stylets on the proboscis, and the mouth is behind the level of the brain. Families, Eupolhd^, Liweid^.

This order represents the Schizonemeitini of Hubrecht and the family Eupolidse.

The following families and genera are represented on the British coasts : â€” ^

CAHiNELLiDiE, Cariiudla ; CEPHALOTiiEioiDiE, Cepholothrix, Caiiiiirmn ; Eunemeetidj!;, Eimemertes ; Ototyphlonemektid.k, Ototijphlonemertes ; AMPnipoEinyE, Amphi2Jorus, Drepanophorus ; Tetrastemmidje, Tetrastemma, Prusuroahmus ; MALAConDELLiD.n,

Malacobdella ; EopoLinjjic, Eupolia, Valencinia, Ozypnlia; Lise- iDiE, Linens, Euborlasia, Micrura, Cerebratulus, Mkrella.

(a. e. s.)

Nemours, town, arrondissement of Fontainebleau, department of Seine-et-Marne, France, 18 miles in direct line south of Melun, on the railway f romParis toLyons, and

1 ” Challenger ” Reports, xix. 1887.

2 Riches, J., Mar. Biol. Assoc. N.S. iii. 1893-95, p. 1; and Punnett, Liverpool Mar. Biol. Committee Memoirs, vii. 1901.

the Loing canal. The church, of wMeh the older parts date from the 13th century, has a handsome wooden spire, and there is a castle of the 13th century. A statue of the mathematician Bezout (d. 1783), a native of the town, was erected in 1885, In the vicinity is a group of fine sandstone rocks, and sand is extensively quarried for the supply of glass factories at various places. The total traffic of the port on the Canal de Loing amounted in 1900 to 174,561 tons. Nemours is supposed to deriye its name from the woods {nemora) in the midst of which it formerly stood. In the 10th century it was an important lordship, in the 13th it passed into the possession of the kings of l>ravarre, and in 1425 it was united to the crown of France. From 1628 to 1659 it belonged to the counts of Savoy ; it then passed to the house of Orleans, to a branch of which it still gives titular dignity, though possession was lost at the Revolution: Population (1881),

4156 ; (1901), 4861.

Nepal, an independent state on the northern frontier of India, extending for about 500 miles among the lower ranges of the Himalaya; bounded westwards by the British district of Kumaon, and eastwards by the state of Sikkim. The capital is Khatmandn, situated in a valley of the same name, Â«n the Baghmati river, about 4000 feet above the sea. !N’o accurate statistics are available The area is estimated at 54,000 square miles; the population at more than 2,000,000; the revenue at Rs.1,50,00,000 ; and the army at 50,000 men, in a fair state of efficiency. The ruling class of

Gurkhas or G-urkhalis, to which the raja belongs, claim to be of Rajput descent, and are devout Hindus. The majority of the inhabitants belong to various tribes of Indo- Chinese origin and are Buddhists in religion. The present rnling family dates only from 1768. Since the war of 1814-16, in which the Gurkhas after a stubborn resistance were driven from the conquests they had made iu the plains of India and the adjoining hill states, the relations of Nepal with the British have been friendly. A Resident is stationed at Khatmandn, but no interfer- ence is exercised with the internal administration. The present maharaja, Prithir Bir Bifccam, was bom in 1875, and succeeded in 1881. But by custom of old stand- ing, he is a roi fainiant, all power being vested in the minister. For many years the minister was Jang Bahadur, G.C.B., who established his position by murder- ing his rivals in 1846, and died in 1877. His son and successor was in his turn murdered in 1885 by the head of a rival faction, Bir Shamsher Jang, G.C.S.I., who is the present minister, and has strengthened his position by marrying two of his daughters to the maharaja. In March 1892 Lord Roberts, then commander-in-chief in India, visited Khatmandu, and reviewed the army. The trade of Nepal with British India is registered at several stations along the frontier. In 1900-01 the total exports were valued at Rs.l, 84,78,548, chiefly consisting of rice, oil-seeds, cattle, tobacco, hides, ghee, and timber. The imports were valued at Rs.l,C2,26,456, chiefly cotton piece-goods, silver, salt, spices, brass and copper, sugar, and iron.

Nervi, a town and winter resort of the province of Genoa, Liguria, Italy, on the coast, 6 miles east-south- east of Genoa, on the railway to Spezia. It is frequented because of its mild climate and sheltered situation. It produces lemons, oranges, figs, &c., and manufactures macaroni. There is a small harbour. Population about

3000.

Nesfleld, William Eden, British arch’itect, (1836-1888), one of the leaders of the Gothic revival, was born 2nd April 1835. His father, IMajor Nesfield,

a well-known landscape gardener in his day, laid out Regent's Park and St James's Park, and remodelled Kew. Educated at Eton, JSTesfield was articled first to Mr Burn, a classicist, and then to his tincle, Mr Anthony Salvin, who took the Gothic side in the " battle of the styles," and had an enthusiastic adherent in his nephew. Having had some practical training, Nesfield travelled for study in France, Italy, and Greece, afterwards publishing a volume, Sketches from France and Italy (London, 1862), which by its striking and accurate delineation became one of the text-books of the Gothic revival. In 1859 Nesfield settled down in London. His first important commission was a new wing to Combe Abbey for Lord Craven. In 1862 began a nominal partnership with ISTorman Shaw, the artistic fruits of which have some- times been exaggerated ; they shared rooms in Argyle Street for some years, but never collaborated in any design. It was in Argyle Street that the principal work of Nesfield's life was conceived â€" Combe Abbey, Cloverly Hall, and Kinmel Park. Here he showed a mastery of planning and construction, a conscientious regard for detail, an eye for the picturesque, an un- failing regard for quiet dignity, a refusal to strain after effects, which together make his achievements landmarks in the history of his art. His cottages and lodges are more especially characteristic. He built the lodge in Eegent's Park (1864) and that in Kew Gardens (1866). Combe Abbey and Cloverly are somewhat " early French " in style, but as Nesfield developed he adopted a purely English manner, and presented his newer ideas in Lough- ton Hall and Kinmel Park. The gate lodge at Kinmel Park, Abergele, is entirely " English Eenaissance " ; Clo- verly Hall (1864), planned when he was twenty-nine, with its great hall, fine approaches to the staircase, and the staircase itself, is already half English, and Eastlake in his History of Gothic Bevivai praises it on that very ground. " The whole nature of the design, refined and skilful as it is, may be described as the reverse of preten- tious. Its graces are of a most unobtrusive kind. The work is homely rather than grandiose, and though it bears evidence of well-directed study, it certainly derives its chief charm from its unmistakably national character." To this period, or a little later, belong some notable farm buildings at Shipley Hall near Derby, and at Croxteth Park near Liverpool. The full development of the re- vived classic taste in Nesfield came with his addition to Kinmel Park â€" red brick, stone dressings, grey-green slated roofs â€" which elevated that originally unpretentious 18th-century building into a small Eenaissance palace. The interior is rich in

panelling, in plaster work, and in chimney-pieces, the hall fireplace being especially notable. For contrast in style, harmonious as they are in artistic expression, Cloverly and Kinmel are the typical exam- ples of the artist's style. Other works are Farnham Eoyal House near Slough, Lea Wood, Loughton Hall, and Westeombe Park. His more notable urban works are the bank at Saffron Walden (1873), and the Eose and CrowiT Hotel ; they stand next door to each other and exhibit another contrast, the former being medi- Â£eval and the latter what is called " Queen Anne." Though he built no new important church, K'esfield rebuilt the Early Decorated St Mary's, Farnham Eoyal, near Slough, mainly on the old lines. He restored King's Walden church, Herts (1868), and Eadwinter church, Essex, the latter also an enlargement (1871), and Cora church near Whitchurch, Salop. The Gram- mar School at Newport, Essex, is his, as also is the Boys' School, Eomsey, Hants ; but no great public building came from him. Nesfield's career was a comparatively short one. He had retired from practice some years before his death at Brighton in 1888. He left behind

him a valuable series of sketches and measured drawings, most of which are now in the Library of the Eoyal Institute of British Architects. (j. m. by.)

Nestorians. â€" The Kestorians or East Syrians (Surayi) of Turkey and Persia inhabit a district bounded by Lake Urmia, or Urumia, on the east, stretching west- wards into Kurdistan, to Mosul on the south, and nearly as far as Van on the north. They are divided into the Persian ^Nestorians of the plain of Azerbaijan, and the Turkish ISTestorians, inhabiting chiefly the sanjak of Hakkiari in the vilayet of Van, who are subdivided into the Bayat or subject, and the Ashiret or tribal, the latter being semi-independent in their mountain fastnesses. Forming at once a church and a nation, they own alle- giance to their hereditary patriarch, Mar Shimun, Catholi- cos of the East, who resides at Qudshanis, a village about 7000 feet above the sea-level, near the Kurdish town of Julamerk. They are the representatives of the " Church of the East," planted by St Adai, according to tradition one of the Seventy (St Luke x. 1), and St Mari, his dis- ciple, and until the Council of Ephesus (431) in connexion with the patriarchate of Antioch. Separated from the unity of the Catholic Church, the Church of the East assumed lar^e proportions outside the Eastern Empire, and by the 12th century had spread over the whole of Central Asia. Finally ruined by Tamerlane, it shrank to its

present dimensions, and in 1552 a disputed succession to the patriarchate caused an internal schism. One-third of the whole body, inhabiting the plain of Mosul, seceded, and, with the anti-patriarch, since called the Patriarch of Babylon, submitted to Eome in 1778. These ” Uniat- Chaldeans ” retain their Syriac services and rites in a somewhat modified form. It is only of late years, under the influence of the different missions, that education, ruined by centuries of persecution, has revived amongst the Nestorians ; and even now the mountaineers, cut ofE from the outer world, are as a rule destitute of learning, and greatly resemble their neighbours, the wild and uncivilized Kurds. They are, however, extraordinarily tenacious of their ancient customs, and, almost totally isolated from the rest of Christendom since the 6th century, they afford an interesting study to the eccle- siastical student. Their churches are rude buildings, dimly lighted and destitute of pictures or images, save that of the Cross, which is treated with the deepest vener- ation. The qanici, or sanctuary, is divided from the nave by a solid wall, pierced by a single doorway ; it contains the altar, or madhb’Ma (literally, the sacrijicivg place), and may be entered only by persons in holy orders who are fasting. Here is celebrated the Eucharist {Qurbana, or the offering; cf. “Corban”), by the priest {qasha), attended by his deacon (^hamasha). Vestments are worn only at the ministration of the sacraments ; incense is used invariably at the Eucharist, and frequently at other ser- vices. There are three liturgies â€” of the Holy Apostles, of Theodore, and of Nestorius. The first is quite free from Nestorian taint, dates from some remote period, perhaps prior to 431, and is certainly the most ancient of those now in use in Christendom ; the other two, though early, are undoubtedly of later date. The Nestorian canon of Scripture seems never to have been fully deter- mined, nor is the sacramental system rigidly defined. Nestorian writers, however, generally reckon the myste- ries as seven, i.e.. Priesthood, Oil of Unction, the Offering of the Body and Blood of Christ, Absolution, the Holy Leaven, the Signation of the life-giving Cross. The ” Holy- Leaven” is reputed to be a part of the original bread of the first, Eucharist, brought by Adai and Mari and maintained ever since in the Church ; it is used in the con- fection of the Eueharistic wafers, which are rather thicker

than those used in the Western Church. Communion is given in both kinds, as throughout the East; likewise, confirmation is administered directly after baptism. Sacra- mental confession is enjoined, but has recently become obsolete ; prayers for the departed and invocation of saints form part of the services. The primitive restriction on the marriage of priests and deacons was removed by a synod of Seleucia in 499; the bishops, however, are always celibates, and are chosen from episcopal families. The service-books were wholly in MS. until the press of the archbishop of Canterbury's mission at "Urmia issued the Takhsa (containing the liturgies, baptismal office, &c.) and several other litiirgical texts.

TJie Nestorian Heresy. â€" The Nestorians commemorate Nestorius as a saint, and invoke the aid of the heresiarch and his companions. They reject the Third (Ecumenical Coimcil, and though showing the greatest devotion to the Blessed Virgin, deny her the title of Theotokos, i.e., the mother or bearer of God. The heresy of Nestorius consisted, not in denying either the divinity or the humanity of Christ, but in so dividing the natures as to destroy His " ego " or identity. In other words, Nestorius would not confess a personal union of the Godhead and the Manhood, but only an association between the Eternal Word and the Man born of Mary. He rightly shrank from making the Godhead to originate in Mary, or to be passable on the Cross; but he went farther, and denied that the divine person of Christ could be born or could suffer, secundum liumanitatem ; it was a mere man and not " the everlasting Son of the Father " who did " not abhor the Virgin's womb " ; it was but one of the sons of Adam, energized by God the Word, who " overcame the sharpness of death." Nestorius being condemned at the Council of Ephesus in 431, the Church of the East threw in her lot with the excommunicated patriarch. The question remains, How far do the modern Nestorians embrace the teaching of Nestorius ? That they are in formal heresy there can be, from the foregoing, no doubt, and it would be rash to state, with some writers, that they are free from actual heresy. Their theological teaching is misty and perplexing ; their earliest writings contain no error, and the hymns of their great St Ephrem, still sung in their services, are positively antagonistic to Nestorianism ; their theology dating from the schism is not so satisfactory. They attribute two Kiani, two Qnumi, and one

Parsopa in Christ. Kiani appears to answer to Nature, but the difference between Qnuma and Parsopa, both apparently meaning Person, is not clear to Western scholars. Those who wish to follow this intricate subject may consult Assemanni, a learned but somewhat prejudiced writer, Bibl. Orient, de Syris Nestorianis, and various dissertations in the Quarterly Papers of the archbishop of Canterbury's Assyrian mission (S.P.C.K.). To say that the modern Nestorians are not definitely and firmly orthodox is per- haps fairer than to charge them with being distinctly heretical.

Missions amongst the Nestorians. â€" The peculiar circum- stances, both ecclesiastical and temporal, of the Nestorians have attracted much attention in Western Christendom, and various missionary enterprises amongst them have resulted.

1. The Boman Catholic Misdons. â€" In Turkey these consist of the Dominican mission, established at Mosul during the 18th century, and in Persia of the French Lazarist mission, which sprang out of some schools established hy a French layman and scientific traveller, M. Eugfene Bor6, in 1838. At M. Bor6's entreaty the Propaganda sent the first Lazarist father to Persia in 1840. The chief stations of the Lazarists are at Khosrova and Urmia. At the latter place there is an orphanage under the superintendence of the Sisters of St Vincent de Paul. The work of these missions is to extend and consolidate that Catholicized and partly Latinized offshoot of the Nestorians known as the Uniat- Chaldean Church (see ante).

2. The American Presbyterian Slinsion, established in Persia in 1834-35 by the Rev. Justin Perkins and Dr Grant, comprises large

buildings near Urmia, a college, and a hospital. The influence of this mission does not extend much beyond the Turkish frontier, but it is strong in the Persian plains. The original aim was to influence the old Nestorian Church rather than to set up a new religious body, biit the wide difference between Presbyterians and an Oriental Chui'ch rendered the attempt abortive, and the result of the labours of the Americans has been the establishment since 1862 of a Syrian Protestant community in Persia, with some adherents in Turkey.

3. T!ie Archbishop of Canterbury's Mission to the Assyrian Christians. â€" This Anglican mission was promoted by Archbishop Tait, and finally established by Archbishop Benson in 1886. Its aim is thus officially defined : " To aid an existing Church, . . . not to Anglioanize, . . . not to change any doctrines held by them which are not contrary to that faith which the Holy Spirit, speaking through the OEcumenical Councils of the Undivided Church of Christ, has taught us as necessary to be believed by all Christians, but . . . to strengthen an ancient Church, at the earnest request of the Catholicos, and with the knowledge and blessing of the Catholic patriarch of Antioch, one of the four patriarchs of the Holy Orthodox Eastern Church, and occupant of the Apostolic See from which the Church of the East revolted at the time of Nestorius." This mission has its headquarters at Urmia, with a college for candidates for holy orders and a printing-press. Two mission- priests reside in Turkey, one at Qudshanis with Mar Shimun, the Nestorian Catholicos and Patriarch. The Anglican Church in America co-operates with the mission.

4. The Russian Mission. â€" One of the Nestorian bishops joined the Russian Orthodox Church in 1898, and returned the same year with a small band of missionaries sent by the Holy Synod of Russia. This mission enrolled a very large number of adherents drawn from the old Church, the Protestant Nestorians, and the Uniat-Chaldeans, but it can hardly be said to have commenced any active work, although the Anglican mission withdrew from competition by closing its schools in the dioceses occupied by the Russians.

Authorities. â€" Assemanni. Bill. Orient, de Syris Nestorianis. â€" Maclean and Bkowne. The Catholicos of the East and his People. S.P.C.K., London, 1892. â€" Badger. Nestorians and their Eituals. Masters, London, 1852.â€" TAe Liturgy of the Holy Apostles Adai and Mari, &c. S.P.C.K., London, 1893. (This and other litur- gical works are printed in the original Syriac at Urmia, Persia, and published by the Archbishop of Canterbury's Assyrian Mission.) â€" PiOLET. Les Missions catholiques au XIX^ siecle. Paris (vol. i. published in 1900). â€" See also article on " Persia " in The Encyclo- paedia of Missions. Funk and Wagnalls, New York, 1891 ; and the Quarterly Papers and Ayinual Reports of the Archbishop of Canterbury's Assyrian Mission, Church House, Dean's Yard, Westminster. (j. a. l. e.)

Netherlands. See Holland.

Nettleship, Henry (1839-1893), English classical scholar, was born on 6th May 1839 at Kettering, being the eldest of a distinguished group of brothers. His career at Oxford was a brilliant one, and he had the good fortune to attract the notice of Conington, who invited his co-operation in his edition of Virgil. After Conington's death in 1869 Nettleship saw the whole work through the press. In 1861 he was elected fellow of Lincoln, and for seven years he held a lectureship there. After visiting Berlin, where he attended the lectures of Moritz Haupt, he went to Harrow as assistant master, his recent marriage having compelled him to resign his fellowship at Lincoln. In 1873 he returned to Oxford, and was elected to a fellowship at Corpus, and in 1878 he was appointed to the professorship of Latin formerly held by Conington. Nettleship had been from the first attracted to the study of Virgil, and a good deal of his time was de- voted to his favourite poet. In 1875 he had undertaken to compile a new Latin lexicon for the Clarendon Press, but the work proved more than he could accomplish, and in 1887 he published some of the results of twelve years' labour in a volume entitled Contributions to Latin Le.vi- cograjilnj, a genuine piece of original work. In conjunction with Y)\ Sandys, Nettleship revised and edited anew edition of Seyffert's Dictionary of Classical Antiquities, and he con- tributed to a volume entitled Essays on the Endowment of Research an article on " The Present Relation between Classical Research and Classical Education in England,"

in which he jjointed out the great value of the professorial lecture in Germany, which gave the student the very- latest results of the lecturer's studies. In his views on the research question he was a follower of Mark Pattison, whose essays he edited in 1889 for the Clarendor^ Press. In Lectures and Essays on Subjects connected with Latin Literature and ScJwlarship, Nettleship revised and re- published some of his previous publications. Yet the best of his work was never published, for he reserved this for his lectures, in which he often dealt with some little-known subject, e.g., the study of Latin grammar by the Eomans themselves, or the literary

criticism of antiquity. He had the rare gift of making each subject liv^ in his exposition, and of inspiring his hearers with his own enthusiasm. He died at Oxford on 10th July

1893.

Nettleship, Richard Lewis (1846-1892), Ox- ford tutor and lecturer on philosophy, brother of the foregoing, was born 17th December 1846, and was edu- cated at Uppingham under Thring, and subsequently at Balliol, of which college he was a scholar. He had a distinguished university career, winning the Hertford and the Ireland. ISTor was he indifferent to athletics, rowing in his college Torpid and Eight. He became a fellow and ttitor of his college, and remained in that position until his death on 25th August 1892 from an Alpine accident. His chief work was the editing and preparing for publication of Professor T. H. Green's writings, with a memoir of the author, his friend and master. He left an unfinished work on Plato, part of which was published after his death, together with his lectures on logic and some essays. The tendency of his thought is idealistic and Hegelian. His literary style was clear and agreeable ; but though he had considerable in- fluence, rather of a suggestive than of a positive character, on his generation at Oxford, a certain indecisiveness and nebulousness of view marred his actual teaching, and pre- vented his making any permanent mark in philosophy.

Netze, a river of Prussia, rising in Poland, south-east of Inowrazlaw. It pursues by winding loops a north- westerly direction as far as Nakel (latitude of Bromberg), where it becomes navigable, and where it is connected by the Bromberg canal (17 miles long) with the Vistula. Down to this point its fall, in a distance of 68 miles, has only been about 100 feet. At Nakel it turns westwards, and after a time west^south-westwards, and finally enters the Warthe a little above Landsberg. From Nakel to the confluence, a farther distance of 143 miles, -the fall is again about 100 feet. Its lower valley is very fertile. The area of its basin is 5400 square miles.

Neu-Brandenburg, in Piatt- Deutsch, Niegen- Bbamboeg, a town of Germany, in the grand-duchy of Mecklenburg-Strelitz, on the Tollen lake, 68 miles west by north of Stettin by rail. It possesses a bronze statue of Pritz Renter (1893) ; monuments to Bismarck (1895) and the war of 1870-

71 (1895) ; a small museum of antiquities and an art collection ; and the grand-ducal country-seat of Belvedere. Population (1885), 9134; (1900),. 10,660.

Neuchatei, one of the Swiss cantons, and ranking last in the Confederation save Geneva. Its total area is 311-8 square miles. Of this, 220-9 square miles are reckoned as “productive,” forests occupying 86-8 square miles, vineyards 4^ square miles, and arable and pasture land 129|- square miles. Of the “unproductive” 90-9 square miles, no less than 36^ square miles are covered by the waters of that part of the Lake of NeuchStel that lies within the canton, and 4 square miles by those of the cantonal share of the Lake of Bienne. The asphalte mines in the Val de Travers belong to the state of

Neuchatei, but are worked by an English company. The lace industry is now extinct. Watchmaking is mainly carried on at La Chaux de Fonds and Le Locle. The population (mostly Protestant) of the canton in 1880 was 102,744, while in 1900 it was 126,600. In 1900 the rate of density was 406 inhabitants to each square mile. The Eoman Catholics numbered 11,651 in 1880, and 17,778 in 1900 ; Jews, 689 in 1880, and 1032 in 1900. The language of the canton is practically French, though in 1900 there were 17,638 (in 1880, 24,489) German- speaking and 3687 (in 1880, 1346) Italian -speaking persons.

The present cantonal constitution dates from 1858. The legis- lature is elected (in the proportion of one member per 1000 in- habitants, or fraction over 500), and holds office for three years while by a law of 1891 the principles of proportional representation obtain in these elections. The five members of the executive are named by the legislature for three years. Three thousand citizens have the right since 1879 of “facultative referendum” as to all legislative projects, and since 1848 of “initiative” as to the revision of the cantonal constitution, and (since 1882) also as to all legislative projects. There are no fewer than three “estab- lished and state endowed churches” â€” the National Evangelical, Roman Catholic, and Old Catholic, while the pastors of the Pree Evangelical and Jewish churches are so far recognized as such by the state that they are not required to fulfil their term of military service, like ordinary laymen. The canton is divided into six administrative districts. In 1897 the state revenue was 3,746,417 francs

(a rise of over 59|- per cent, since 1885), and the state ex- penditure 3,490,171 francs (a rise of 48J per cent, since 1886), but in 1898 there was a deficit of 93,876 francs. The public debt in 1897 amounted to 16,632,646 francs.

Neuchatei, the capital of the Swiss canton of the same name, at a height of 1434 feet above the sea. Ad- joining the castle is the collegiate, church of Notre Dame, dating from the 12th and 13th centuries ; now a Pro- testant meeting-house. On the new quay is the Musee des Beaux Arts, in which are the archaeological museum, a good collection of modern Swiss pictures, and also various historical curiosities and relics. The College Latin con- tains the natural history collections and the public library. There is an Academic at NeuchStel (to be raised to the rank of a university), which was attended in the winter of 1898-99 by 102 matriculated students. There is a watchmaking â– school at Neuchatei. Popular tion (1880), 16,370 ; (1900), 21,064. The majority of the inhabitants are Protestants and French- speaking. The railway line to Pontarlier passes through the Val de Travers, and not by Yverdon, while in 1900 a new direct line to Bern vid Kerzers (in French, Chi^tres) was opened. Two miles south-west of Neuchatei is Serrieres, with M. Suchard’s great chocolate manufactory.

Bourgeois. Neuchatei et la Politique Prussienne en Franche ComJe (1702-13). Paris, 1887. â€” Boyve. Annates Historiques du Comte de N. et de Valangin. 6 vols. Bern and Neuchatei, 1855. â€” Matile. Monuments de VHist. de N. 3 vols. Neuchatei, 1844-48 ; Musee Neuchatelois (published by the Cant. Hist. Soc.) from 1864.

Neufahrwasser. See Danzig.

Neuhaus (Czech, Hradec Jindrichuv, which signifies “Henry’s Castle”), the chief town of a government dis- trict in Bohemia, Austria, near the eastern border of the province, at the foot of the Moravian heights. The Gothic parish church and the chateau of Count Czernin both date from the 13th century. The latter contains valuable archives and a collection of pictures. The in- dustries comprise the manufacture of cloth and woollen goods, paper, dyeing, corn-milling, distilling, and brewing. Population (1890), 8502; (1900), 9316, including garrison of 1066 men, chiefly Czech and Catholic.

Neuilly-Sur-Seine, a town in the arrondissement of St Denis, department of Seine, France, 3|- miles west of the centre of Paris, of which it a suburb, between

the fortifications and the Seine. The fine bridge, designed in the 18th century by Perronnet, is noteworthy as the first level bridge constructed in France. The castle of St James, built about 1775 by Claude Baudard, Baron St James, is now occupied as a lunatic asylum. Amongst modern buildings are the large church of St Peter, a Protestant church, and a synagogue. The Galignani Institution, founded by the brothers Galignani for aged booksellers, iDriaters, and others, has accommodation for 100 residents. A steam pump at Henilly supplies daily to Paris 176,000 cubic feet of water. Population (ISSl),

23,805; (1901), 36,437.

Neunkirchen, or, more correctly, Neuenkiechen AM Steinfeld, a market-place in Lower Austria, on the Southern railway, about 8 miles south of Wiener-lSTeustadt. An important centre of the metal and textile industries. Population (1890), 8795 ; (1900), 10,831.

Neuquen, a territory in the west centre of the Argentine Republic, bounded on the N. by Mendoza ; on the S. by the territory of the Eio Negro, from which it is separated by the Rio Limay ; on the E. by Pampa ; and on the W. by Chile. Official area at the census of 1895, 42,345 square miles; population, 14,517; capital, Chos- malal. The territory is divided into five departments. In 1895 there were 888 farms in the province, with 6778 acres planted in cereals, 1,022,844 head of cattle, 57,015 horses, and 357,429 sheep.

Neuropathology. See Pathology.

Neu-Ruppin, a town of Prussia, on Lake Ruppin, 37 miles north-north-west, of Berlin by rail. The educa^ \ tional establishments include a gymnasium, a

normal training college, and a higher grade girls^ school. Popu- lation (1890), 14,684 ; (1900), 17,132.

Neusalz, a town of Prussia, province of Silesia, on the Oder, 20 miles by rail north-west of Glogau. It has numerous iron-works, enamelling works, manufacture of flax, papier-mÂ§x3he, millstones, &c., and tanning. Popular tion (1885), 7716; (1900), 12,586.

Neusandec, or Neu-Sandetz, the chief town of a district in western Galicia, Austria. Population (1890), 12,722 ; (1900), 15,724 (estimated at 97 per cent. Polish, 3 per cent. German ; 64 per cent. Roman Catholic, 2 per cent. Greek Catholic, 32 per cent. Jewish, and 2 per cent. Protestant). There are large workshops belonging to the Austrian State railway. A part of the petroleum district lies to the north-west of the town. Population of the adjoining Altsandeo (Polish, Stary Sdcz), 4537 in 1900. It has an important annual fair and a trade in cattle, wine, furs, honey, yarn, and linen.

Neusatz. See Ujvidbk.

Neutitschein (Czech, Novij Jimi), the chief town of a government district in Moravia, Austria. Popula- tion (1890), 11,562 ; (1900), 11,891, chiefly German and Catholic. It has manufactures of agricultural imple- ments and machinery, and is connected by local railways with several of the surrounding districts and with the Northern railway.

Neutrality. â€” Neutrality is the most progressive branch of modern International Law. It is also that branch of International Law in which the practice of self- restraint takes the place of the direct sanctions of domestic law most effectively. The rapid changes it is under- going are in fact bringing the state-system of the modern world nearer to the realization of the dream of many great writers and thinkers, of a community of nations just as much governed by legal methods as

any community of civilized men. While the right of war was simply the right of the stronger, there was no room for neutral rights, for, without going back to the time of the ancients, the so-called rights of war and conquest are nothing but survivals of the right of brute strength. No nation or community down to comparatively recent times was treated as having a right to what it

could not keep. It is the growth of a law of neutrality, through the modern possibility of concerted action among neutral states, which is bringing about improvement, and, though the signs of our times are not always reassuring, we have taken a long stride forward since Molloy in his De Jure maritimo et navali (1680) wrote : ” As a neuter neither purchases friends nor frees himself from enemies, so commonly he proves a prey to the victor ; hence it is held more advantage to hazard in a conquest with a companion than to remain in a state wherein he is in all probability of being ruined by the one or the other.”

It was the great commercial communities, the Hansa in the north and Venice and the Mediterranean maritime republics in the south, which were first able to insist on some sort of regulation of the usages of war for their o^vn protection. With the growth of intercourse among nations a further advance was made, by treaty stipulations en- tered into in time of peace, to provide rules for their guidance in the event of war, but it is only in our own time that the idea of a substantive neutral right has ob- tained recognition. To our own time belongs the final acceptance of the principle that the neutral flag protects enemy’s goods except contraband, the conception of neutralization of territory, the abolition of fictitious blockades, the practice of declarations of neutrality, the detachment from the high sea and neutralization of the zone called territorial waters, and the Areopagus of nations called the European Concert, in which the right of neutrals is asserted as a brake upon the operation of the still venerated right of conquest. The rights of neutrals have received their most recent afiirmation in several of the decisions of the Peace Conference.

International trade and intercourse haTe become so intricate that war can no longer be waged without causing the most serious loss to neutral nations, which moreover suffer from it without any of the possible contingent benefits it may procure for the immediate parties. So much is it so, that most great Powers have found it necessary for their self-protection to enter into defensive alliances with others, the direct object of which is the preservation of European peace by the threat of making war so gigantic a venture that no State will again embark on it “with a light heai-t.” The next step will probably be alliances between States which, by their nature or by their having reached the limit of their expansion, have nothing further to

gain by war with each other, for the pur- pose of securing perpetual peace as between themselves. Different attempt^ have been made to define neutrality, but the word defines itself, so far as a succinct definition serves any purpose. The subject covers too wide and varied an area of matter to be con- ^^”’“o” densed int6 a short statement of any kind. ”” *”’’^’ Neutrality entails right and duties on both the belligerent and the neutral sides. Theoretically, neutrality, to be coniplete, would require the neuti-al to abstain from every- thing which could even remotely be of assistance to either belligerent. To this obligation would theoretically corre- spond that the belligerent should carry on the war with- out doing anything which could even remotely disturb or interfere with the neutral State or the free activity of its citizens. Neither the one nor the other is found to be practicable. It is not even easy for the belligerent to observe absolutely the duty of doing no direct injury to

neutral territory. A battle may be fougM to the very edge of the neutral frontier, and shells may explode in any neutral town within the firing range of modern artillery. The present respect paid by belligerents to territorial waters is a jjalliative in the case of a seaboard frontier ; but even the three-miles limit acknowledged by most countries would permit belligerent vessels with the present range of artillery to fire landwards far into neutral territory. Compensation, it is true, would be due for any damage done, but this does not alter the fact that acts of war can produce direct consequences on neutral territory which have the character of carrying war into a neutral State. The neutral State, moreover, is obliged to incur heavy expenditure to protect its frontier from being traversed by either belligerent, and thus avoid itself being exposed to claims for compensa^ tion for an act which it would otherwise be powerless to prevent. In the case of a maritime war, the neutral State is also bound to exercise strict supervision to prevent its ports from being used by either belligerent for the purpose of increasing his military strength. In short, war cannot be carried on without heavy expense and inconvenience to neighbouring neutral States. The in- convenience to the intercourse of neutral citizens is still greater. Their ships are liable to be

taken out of their course, and their cargoes to be discharged to the bottom of the hold in search of articles which are con- traband according to circumstances over which they have no control, and they may be confiscated without recourse by judges appointed by one of the interested parties. Even tlieir whole trade with specific ports of the one belligerent may be stopped hy the ships of the other belligerent without indemnity. On the other hand, a great deal of vital assistance can he given by neutral citizens to the one or the other belligerent in money, or hy supplies of arms, ammunition, food, and other commodi- ties, which it is not at present the duty of neutral States to interfere with.

The respective rights and duties of belligerent neutrals in current practice may be subdivided as follows : â€” â€¢

(1) Belligerent duty to respect neutral territory and neutral territorial waters.

(2) Neutral right of official representation, and media- tion; of intercourse of neutral citizens with citizens of either belligerent ; of convoy, &c.

(3) Belligerent right of blockade, angary, visit and search, capture and confiscation of contraband of war.

(4) Neutral duties : (absolute) of abstention from any direct corporate assistance to either belligerent, of en- forcement of respect by both belligerents for neutral territory; (relative) of prevention of any recruiting for either belligerent, or arming or equipping of vessels for their service; and (contingent) of allowing commercial access to the one or other belligerent without distinction, and of granting impartially to on^dr the other belligerent any rights, advantages, or privileges, which, according to the usages recognized among nations, are not considered as an intervention in the struggle.

This subdivision, we believe, covers the whole ground of neutrality. We shall follow it in this article.

Belligerent Duty. â€” It is now universally recog- nized among European States that a belligerent army _ , must make no nse of its strength in the field respect to carry its operations into neutral territory or neutral into

neutral waters. Belligerent forces entering urrUory. neutral territory are by the practice of nations bound to surrender their arms to the neutral State, and remain liors de combat till the close of the war. (See also International â– Convention, The Hague, 29th July 1899, Art. 67.)

Through territorial waters belligerent vessels are

allowed t^pass freely as in time of peace. Nor does the usage of nations forbid a belligerent vessel from entering a neutral port. Motives of humanity have sanctioned this distinction between territorial and maritime warfare. The Admiralty Instructions (1893) set out the rights of belligerents as Great Britain views them as follows : ” Sub- ject to any limit which the neutral authorities may place upon the number of belligerent g^^a^ cruisers to be admitted into any one of their torespect ports at the same time, the captain, by the territorial comity of nations, may enter a neutral port Z^^^”^ with his ship for the purpose of taking shelter from the enemy or from the weather, or of obtaining provisions or repairs that may be pressiegly necessary (I. section 592). He is bound to submit to any regula- tions which the local authorities may make respecting the place of anchorage, the limitation of the length of stay in the port, the interval to elapse after a hostile cruiser has left the port before his ship may leave in pursuit, &c. (I. section 693). He must abstain from any acts of hostility towards the subjects, cruisers, vessels, or other property of the enemy which he may find in the neutral port (section 694). He must also abstain from increasing the number of his guns, from procuring military stores, and from augmenting his crew even by the enrolment of British subjects ” (section

595).

Nor may the commander of a British warship take a capture into a neutral port against the will of the local authorities (Holland, Manual of Naval Prize Law, 1888, section 299).

Neutral Rights. â€” Neutral Powers have the right to remain, as far as possible, unaffected by the war operations, and therefore continue their diplomatic relations with the belligerent States. The immunities ^^g^^, and exterritoriality of their diplomatic agents attach to them as in time of peace, subject only to necessity of war, which may entitle a belligerent to place

resti’icti’Ons on this intercourse. Thus, during the Franco-G-erman war, on the surrounding of Paris, foreign diplomatists in the besieged city were refused by the G-erman authorities all possibility of corresponding with their Governments, except by letters left open for their inspection. Neutral legations may also undertake the representation of private interests of subjects of the one belligerent on the territory of the other. Thus in the Eranco-German war of 1871 the Germans in France were placed under the protection of the United States legation, and the Erench in Germany under that of the British legation ; in the war of 1898 between the United States and Spain, American interests in Spain were committed to the care of the British legation, and those of Spaniards in the United States to that of the Austro-Hungarianlegation. By legations are understood both diplomatic and consular authorities. The protection granted is in the nature of mere mediation. It confers no rights on the belligerent subjects in question, nor does it give the neutral legation any right to protect a belligerent subject or his property against any ordinary rights of war.

Good ofiiees, properly speaking, are a mild form of medi- ationor tentative mediation, i.e., mediation before it has been accepted by the parties. Article 3 of the jjjâ€ž^^â€ž^ Hague Convention of 29th July 1899, however, offering provides that ” Powers, strangers to the dispute, good have the right to offer good offices or mediation, “^f/^’’ even during the course of hostilities,” and that ” the exercise of this right can never be regarded by one or other of the parties in conflict as an unfriendly act ” (see Peace Cowfeebnce). The Hagtie Convention puts an end to the doubt whether a neutral Power can mediate without involving itself in some way with the one or the other side

ia the dispute. Mediation had already been pjovided for in several existing treaties, such as the Treaty of Paris (30th March 1856), which provides that “if any dissen- sion should arise between the Sublime Porte and one or more of the other signatory Powers and threaten the maintenance of their good relations, the Sublime Porte and each of these Powers before resorting to force shall give an opportunity to the other contracting parties in order to

prevent such extreme measures ” (article 8) ; the Treaty of Yedo between the United States and Japan (29th July 1858) stipulating that in the case of difference between Japan or any other State, ” the Presi- dent of the United States, at the request of the Japanese Government, will act as a friendly mediator in such matters of difference as may arise between the Govern- ment of Japan and any other European Power” (article 2) ; and the General Act of Berlin relating to “West Africa (1885), which provides that “in the case of a serious dissension having arisen on the subject of, or within the territories ” iij. question, between the signatory Powers, they undertake, before taking up arms, to have recourse to the mediation of one or more of the friendly Powers (article 12).

In the Venezuela-Guiana boundary question, the medlar tion of the United States Government was declined by Great Britain, but its good offices were accepted. In the diflB.culty which arose between Germany and Spain in connexion with the hoisting of the German flag on one of the Caroline Islands, Spain did not consider arbitration consistent with the sovereign power she claimed to exercise over the island in question, but she accepted the mediation of the Pope, and the matter was settled by protocols, signed at Eome (17th December 1886). These incidents show the uses of variety and graduation in the methods of diplomacy.

Neutral subjecte have the right to carry on trade and intercourse with belligerent subjects in so far as they do not interfere with the operations or necessities neuira/”’ “” ^^^’ ^^^ ^^ ^Â® ^Â° violation of the neutral subjects on character that this trade or intercourse is of belligerent benefit to either side. This is subject always to

â– the belligerent right to capture and confiscate

contraband of war (see below). On the other hand, the property of subjects and citizens of neutral States follows the fortune of the belligerent State within whose territorial jurisdiction it is situated. It is liable to the same charges as that of native subjects and citizens, and in case of military contributions neutral subjects on belligerent soil can claim no protection or exemption (see below. Angary). They have also the same rights to all indemnities for loss as are granted to native subjects and citizens.

The position of neutral public ships and the relative assimilation to them of mail steamers has been the subject of some controversy. A public ship is a ship The rights leaving an official character. It includes not public only warships, but also any ships affected to ships and any specific and exclusive government purpose. Tteamers i*ublic ships in this sense are invested with an extra-territorial character, and the State to which they belong is directly responsible for their acts. They are therefore not liable to visit and search for contraband of war, and are exempt from territorial jurisdiction even in belligerent waters. As regards vessels which are engaged partly in private traffic and partly on public service, such as mail steamers and government packets, the position is necessarily different. Under the Japanese Prize Law, adopted in view of the Chino-Japanese cam- paign, any vessel carrying contraband of war, whose destination is hostile, may be detained, without exception being made for mail steamers. The'United States pro- clamation of April 1898 in connexion with the Spanish

war stated that mail steamers would only be stopped in case of grave suspicion of their carrying contraband or of their violating a blockade. This is obviously not an exemption ; in practice no belligerent State wordd stop a mail steamer without grave suspicion.

On the arrest of the German mail steamers Bundesrath and General during the South African war, the German Government represented to the British Governmeilt that "it was highly desir- able" that steamers flying the German mail-flag should not be stopped, and the British Government thereupon issued orders not to stop them on suspicion only {Parliamentary Papers, Africa, No. 1, 1900)1 This is a precedent of the greatest importance. It would practically assimilate mail steamers to public ships. Yet the mere circumstance of carrying the mails does not manifestly per se change the character of the ship. Both this subject and the position of packets under State ownership, which may carry on trade and may consequently transport contraband, require'deliber- ate adjustment by treaty.^ In fact, it is one of the most pressing questions of neutrality. The tendency seems to be towards exemption, but in this case there should be ofBcial certifica- tion that the ships in question carry nothing in the nature of contraband. â€¢

Connected with the position of public ships is the question of the right of convoy. ISTeutral merchant ships travelling under the escort of a warship or warships of their own flag are held by some oavoy. authorities to be exempt from visit and search. The Japanese Prize Law, which is largely based on English practice, following on this point the recommendations of the Institute of International Law (see R^glem,ent des prises maritimes, Annuaire 1888, p. 221), provides that ” when the commander of a neutral convoy declares that there is no contraband of war on board the vessels under convoy, and that all the papers are in order in these vessels, the vessels shall not be visited” (article 23).^ It is believed that Great Britain is, at the present moment (1902), the only Power which does not in one form or another recognize the principle of the protective character of convoy. The United States, in treaties with Mexico, Venezuela (20th January 1836), Peru (6th September 1870), Salvador (6th December 1870), and Italy (26th February 1871), have agreed to accept the commander’s declaration as provided in the Japanese Prize Law. Wharton quotes in his International Law Digest a passage from a despatch of Mr Secretary Eorsyth (18th May 1837) in which he states that ” it is an ordinary duty of the naval force of a neutral during either civil or foreign wars to convoy merchant vessels of the nation to which it

1 The convention between Great Britain and France respecting postal communications (30th August 1890) provides that ” in tlie case of war between the two nations the packets of the two administra- tions shall continue their navigation, without impediment or molesta- tion, until a notification is made on the part of either of the two Governments of the discontinuance of postal communications, in which case they shall he permitted to return freely to their respective ports ‘ ‘ (article 9) . The position of either as neutral is not dealt with.

2 At the outset of the Chino-Japanese war, Vice-Admiral Sir E. R. Fremantle sent a note to the Japanese admiral requesting him to “give orders to the ships under his command not to board, visit, or interfere in any way with British merchant vessels, observing that the British admiral had directed all British ships under his orders to afford protection to such merchant vessels, and not to allow them to be molested in any way.” Professor Takahashi, in his International Law of the Chino-Japanese War,

relates tliat the Japanese admiral replied that ” as the matters demanded by the British admiral belonged to the sphere of international diplomacy, and consequently were outside his oiflcial responsibility, they should be communicated directly to the Japanese Department of Foreign Affairs.” ” The idea of the British admiral,” observes Professor Takahashi, ” seemed to be not only to claim a right of convoy, which has never been recognized by British prize courts, but also to extend it over all waters of the Far East, where British warships were not actually engaging in convoy. Soon afterwards the matter was settled without any difficulty. On 11th August the Under-Secretary of the Japanese Foreign’ Office received a letter from the British Minister in Tokyo stating that there must be some misunderstanding, and that the British Govern- ment would never try to interfere with belligerent right.”

belongs to the ports of the belligerents. This, however, should not be done in contravention of belligerent rights as defined by the law of nations or by treaty.” The Spanish Naval Instructions (24th April 1898) in the war with the United States granted unconditional exemption to convoyed neutral ships (article 11).

A neutral merchant ship, travelling under enemy’s convoy, places itself, with the assistance of the belligerent force, beyond the application of the belligerent right of visit and search, and thus commits a breach of neutrality.

Belligerent Eights. â€” Since the declaration of Paris pro- viding that blockades (see article under this heading in ninth edition for general information on the sub- ject) ” iu order to be binding must be effective, that is to say, must be maintained by a force sufficient really to prevent access to the enemy’s coast,” the ten- dency has been to give a precise form to all the obliga- tions of the blockading belligerent. Thus it is now gen- erally agreed that notification to the neutral should be sufficiently detailed to enable neutral vessels to estimate, with practical accuracy, the extent of their risks. French writers consider a general diplomatic notification, though desirable, as insufficient, and hold an individual notifica- tion to each neutral ship

which presents itself at the line of blockade as requisite. This theory was applied by Prance in the Franco-German war, and earlier by the Northern States in the American Civil War. The new Japanese Prize Law (1894) does not attempt to prescribe any such notification to each ship, but sets out that notice of blockade to each ship is either actual or con- structive. “Actual” it describes as being when the master is shown to have had knowledge of the blockade, in whatever way he may have acquired such knowledge, whether by direct warning from a Japanese warship or from any other source ; ” constructive,” when a notifica- tion of its existence has been made to the proper authori- ties of the State to which the vessel belongs, and sufficient time has elapsed for such aaithorities to communicate the notification to the subjects of that nation, whether or not they have in fact communicated it. No blockade, however, was attempted by the Japanese Government, and the application of the rules was not put to the test.

In the Spanish war the United States’ proclamation of the investment of Cuba stated that an efficient force would be posted, so as to prevent the entrance and exit of vessels from the blockaded ports, and that any neutral vessel approaching or attempting to leave any of them, ” without notice or knowledge ” of the establishment of the blockade, would be duly warned by the commander of the blockading forces, who would endorse on her register the fact and date of such warning, and where such endorsement was made. The words “without notice or knowledge ” were explained fully in the in- structions to blockading vessels (20th June 1898). ” Neu- tral vessels,” said these instructions, ” are entitled to notification of a blockade before they can be made prize for its attempted violation.” ” The character of this notification is not material. It may be actual, as by a vessel of the blockading force, or constructive, as by a proclamation of the Government maintaining the blockade, or by common notoriety. If a neutral vessel can be shown to have notice of the blockade in any way, she is good prize and should be sent in for adjudication ; but should the formal notice not have been given, the rule of constructive knowledge arising from notoriety should be construed in a manner liberal to the neutral.” Thus the United States Government abandoned the system of indi- vidual notification inserted in the proclamation of 19th April 1861, which was only found practicable in the case of vessels which had presumably sailed without notifica- tion. In such cases it was provided by the more recent

instructions that they should be boarded by an officer, who should enter the notice in the ship’s log, such entry to include the name of the blockading vessel giving notice, the extent of the blockade, and the date and place, verified by his official signatui-e. The vessel was then to be set free, with a warning that, should she again attempt to enter the same or any other blockaded port, she would be good prize.

Angary, or Droit d’Angarie, is a contingent belligerent right, arising out of necessity of war, to dispose over, use, and destroy, if need be, property belonging to neutral States.’ During the Franco-German war ’’^^’^â– imminent necessity was pleaded by the German Govern- ment, as the justification of using force to seize and sink six British coal-ships in the Seine to prevent French gun- boats from running up the river and interfering with the tactics of the German army operating on its banks. The captains of the vessels refused to enter into any agree- ment with the commanding German general, and the ves- sels were then sunk by being fired upon. The British Government raised no objection to the exercise of the right, and confined itself to demanding compensation for the owners, which the German Government declared itself ready to pay. Count Bismarck evidently felt the use which might be made against Germany as a neutral Power, of such an extreme measure, and took care in the correspondence with the British Government to empha- size the pressing character of the danger, which could not be otherwise parried.

A case given in the text-books as another one of angary during the same war was the temporary seizure and con- version to war purposes of Swiss and Austrian rolling- stock in Alsace, without any apparent military necessity. Ordinary private neutral property on belligerent soil, it must be remembered, follows the fate of private property generally. The only distinction between the right of angary and the right of assimilating private neutral pro- perty to private property generally on belligerent soil which seems based on reason is that, whereas private property of neutrals generally which has remained on belligerent soil is sedentary, or, so to speak, domiciled there, neutral vessels are mere visitors with a distinct external domicile. The writer thinks the assimilation of neutral railway car- riages to neutral vessels in this respect not unreasonable.^

A neutral State in its corporate capacity, we have seen, must abstain from acts which can be of assistance to either belligerent, and it is bound to exercise reasonable diligence to prevent its territory being baad^"' used as a base for belligerent operations. The duties of a neutral State as a State go no farther. Com- mercial acts of its citizens, even the export of arms and munitions of war to a belligerent country, do not, in the present state of international usage, so long as both bel- ligerents are free to profit by such acts alike, involve lia- bility on the part of the neutral State. But relief from the obligation of repressing breaches of neutrality by con- traband traffic of subjects has its counterpart in the right granted to belligerent warships o^ visit and search of neutral merchant vessels, and in the possible condemna- tion, according to circumstances, of the ship and con- fiscation of goods held to be contraband.

Contraband is of two kinds â€" absolute contraband, such as arms of all kinds, machinery for manufacturing arms, ammunition, and any materials which are of direct appli- cation in naval or military armaments ; and conditional

1 Angaria (from ayyapoi, a messenger), a post station. The French word hangar or shed is probably of the same origin.

2 Treaties between the Zollverein and Spain (30th March 1868) and between Germany and Portugal (2nd March 1872) contain special pro- visions for the fixing of indemnities in case of any forced utilization by either State of private property of the citizens of the other.

contraband, consisting of articles which are fit for, but not necessarily of direct, application to hostile uses. The British Admiralty Manual of Prize Law (1888), fol- lowing this distinction, enumerates as absolutely contror hand : arms of all kinds and machinery for manufacturing arms ; ammunition and materials for ammunition, includ- ing lead, sulphate of

potash, muriate of potash, chlorate of potash, and nitrate of soda; gunpowder and its materials, saltpetre and brimstone ; also guncotton ; military equipments and clothing ; military stores, naval stores, such as masts, spars, rudders, and ship-timber, hemp and cordage, sail-cloth, pitch and tar, copper fit for sheathing vessels, marine engines and the component parts thereof, including screw propellers, paddle wheels, cylinders, cranks, shafts, boilers, tubes for boilers, boiler plates and fire-bars, marine cement, and the material used in the manufacture thereof, blue lias and Portland cements ; iron in any of the following forms â€” anchors, rivet iron, angle iron, round bars of iron of from f to | of an inch diameter, rivets, strips of iron, sheets, plate iron exceeding i of an inch, and Low Moor and Bowling plates ; â€” and as conditionally contraband : provisions and liquors fit for the consumption of army or navy, money, telegraphic materials, such as wire, porous cups, platina, sulphuric acid, materials for the construction of a rail- way, such as iron bars, sleepers, and so forth, coal, hay, horses, rosin, tallow, timber.^

The classing of coal as conditional contraband has given rise to much controversy. Great Britain has con- sistently held it to be so. During the war of 1870 â– the French and German warships were only al-

lowed to take at English ports enough to return to a French or German port respectively. In 1885, during the Franco- Chinese campaign, after protest by the Chinese Govern- ment, Great Britain applied the same rule at Hong Kong and Singapore. During the Spanish- American war neither belligerent seems to have treated coal as contraband. In the case of the coal ships which were prevented from land- ing their cargoes at Cuba, the prevention seems to have been connected with the blockade only. At the West African conference of 1884 Eussia declared that she would ” categorically refuse her consent to any articles in any treaty, convention, or instrument Whatever which would imply ” the recognition of coal as contraband of war {ParUamentai-y Papers, Africa, jSTo. 4, 1885). Coal, how- ever, is so essential to the prosecution of war that it is impossible to avoid classing it as conditional contraband, so long as such contraband is recognized. The alterna- tive, of course, would be to allow both belligerents freely to supply themselves at neutral ports, and neutral vessels freely to supply belligerent coaling stations.

During the Franco-Chinese campaign of 1885 and the South African war, there was controveray as to the legality of treating food-stuffs as conditional ‘‘iÂ°ft contraband. During the former the subject-

matter was rice, and the circumstances were exceptional. The hostilities being at the outset reprisals, and not actual war, France at first exercised no right of search over British merchant ships. Great Britain, on

1 The Japanese Prize Law (21st August 1894) makes the followiug distinction : (1) Arms of all kinds, brimstone, dynamite, nitrate oJ potash, and all goods fit lor the purpose oÂ£ war exclusively : the above-mentioned goods are contraband when they are on board a vessel which either has a hostile destination or calls at any port of the enemy. (‘2) Provisions and liquors, m

her side, for the same reason did not object to French war vessels coaling, victualling, and repairing at British ports. On China protesting against this indulgence to France, Great Britain, as above stated, put in force her practice of treating coal as contraband, and thereupon France exercised her corresponding belligerent right of searching British vessels. The closing of British coaling stations to French warships was a serious inconvenience to France, and she proclaimed “that in the circumstances in which war was being carried on ” the cargoes of rice which were being- shipped to the northern Chinese ports were contraband. By depriving the Chinese Government of part of the annual tribute sent from the southern provinces in the form of rice she hoped to bring pressure on the Peking Government. This was a manifest stretching of the sense of conditional contraband. Be-sides, no distinction was made as to destination. The British Government protested, but no eases were brought into the French prize courts, and the legality of the measure has never been judicially examined.

The controversy during the South African war was confined to theory. In practice no stoppage of food-stufEs seems to have taken place, though the fact that the whole able-bodied population of the enemy States formed the fighting force opposed to Great Britain made it clear that the free import of food supplies from abroad helped the farmer-soldiers to carry on warfare without the imme- diate care of raising food crops.

The two cases cited show the great diÂ£B.culty of fixing the character of conditional contraband in a way to pre- vent arbitrary seizures.

Trade between neutrals has a primd facie right to go on, in spite of war, without molestation. But if the ulti- mate destination of goods, though shipped first to a neutral port, is enemy's territory, then, ac- ^fâ„¢""* cording to the " doctrine of continuous voyages," the goods may be treated as if they had been shipped to the enemy's territory direct. This doctrine, though Anglo- Saxon in its origin and development, has been put in force by an Italian court in the case of the Doelinjk, a Dutch vessel which was adjudged good prize on the ground that, although bound for Jibouti, a French colonial port, it was laden with a provision of arms of a model which had gone out of use, and which could only be intended for use by the Abyssinians, with whom Italy was at war. The subject has been fully discussed by the Institute of Inter- national Law, by whom the following rule has been adopted : "Destination to the enemy is presumed where the shipment is to one of the enemy's ports, or to a neutral port, if it is unquestionably proved by the facts that the neutral port was only a stage {kape) towards the enemy as the final destination of a single commercial operation." ^

The question of the legality of the doctrine was raised by Chancellor von Billow during the South African war in connexion with the stopping of German ships bound for Delagoa Bay, a neutral port. He contended that such

2 The only person in that eminent assemblage who raised an objec- tion to the principle of the doctrine was the distinguished French writer on maritime law, M. Desjardins, who declined to acknowledge that any theory of continuous voyages was, or could be, consistently with the existing law of neutrality, juridically known to International Law. He admittud, at the same time, that penalties of contraband would be incurred if the shipping to a neutral port were effected merely in order "to deceive the belligerent as to the real destination of the oartjo." This was the French ruling in the Frau Houwina case (2l>th May 1855). He proposed to restrict the operation of the doctrine to this condition, but was opposed by three Italian Professors of International Law, Professors Fusinato, Catellani, and Buzzati, on the

ground that it would exclude, as it obviously would do, the contingency of goods shipped to a neutral port, not for the purpose of defrauding" the belligerent, bnt for that of being ultimately delivered to a belligerent not in possession of a seaport. The article as quoted in the text was also supported by the greatest German authority on International Maritime Law, Director Perels of the German Admiralty.

vessels were quite, and at all times, outside belligerent jurisdiction, and that only the authorities of the neutral port were entitled to stop contraband on its way to a belligerent force. He did not, however, press the point, and only reserved the right of raising it at a future date.'

The procedure employed to ascertain whether a neutral vessel carries contraband or not is called Visit and Search, d a belligerent right universally recognized and s^rch. justified by the considerations that merchant ships of the enemy might evade capture by hoisting a neutral flag, if the belligerent had not the right of ascertaining the real character of the ship, and that private neutral vessels might carry contraband goods and generally help the enemy, if the belligerent had not the right of examining, their cargo. All neutral private ves- sels in time of war are liable to visit by belligerent warships on the high seas and in the territorial waters of the belligerents, but not in the territorial waters of neutral States. Neutral public ships are not liable to visit (see above as to neutral public ships, mail ships, and convoy). Visit and search must be effected at every stage with " as much consideration as possible" (Herr von Biilow, in Peichstag, 19th January 1900). The visiting officer first examines the ship's papers. If satisfied that the vessel is not liable to detention, he immediately quits her. If not so satisfied, he proceeds to search her. If in the course of the search he is satisfied that the vessel is not liable to detention, the search is immediately discontinued. The visiting officer has the right to inspect any lockers, stores, or boxes, and in case of refusal to open them he is justi- fied in using such coercive measure as the case warrants. If after the visit and search the commander has reason to entertain suspicion, he gives the master an opportunity of explanation, and if the explanation is unsatisfactory he

detains the vessel. If the seizure turns out after all not to have been justified, the ship and cargo are immedi- ately released, and compensation is due for the loss through the detention. In the case of the stoppage and search of German vessels during the South African war, the Ger- man Government proposed the appointment of arbitrators to decide upon the claims for compensation, but this was an innovation to which the British Government did not assent.

The consequences of carrying contraband are capture, trial by a belligerent prize court, and possible confiscation of the ship and cargo, or of the cargo alone or Capture, of a part of the cargo, according to the facts of tiom'prize. the case. All are agreed as to articles which are absolute contraband being liable to cap- ture. As regards conditional contraband, British law,^ in so far, at least, as concerns " naval and victualling stores," is less severe, the Lords of the Admiralty being entitled to purchase such stores without condemnation in a prize court. In practice such purchases are made at the mar- ket value of the goods, with an additional 10 per cent, for loss of profit. This proceeding is known in Interna- tional Law as the right of pre-emption. It is not, how- ever, as yet officially recognized on the continent of Europe, though the need of some palliative for confisca- tion, in certain cases, is felt, and some continental jurists, moved by the same desire to distinguish unmistakable from so to speak constructive contraband, and protect trade against the vexation of uncertainty, have tried to argue conditional contraband away altogether.

The tendency, however, among the majority of conti- nental authorities is seen in the rule drawn up in 1896, after several years of discussion, by the institute of International Law, a body composed exclusively of in-

1 Pari. Papers, Africa, No. 1 (1900), pp. 14, 25.

2 The Naval Prize Act, 1864, sect. 38.

ternational jurists of acknowledged status. The majority which adopted it represents authoritative opinion in Ger- many, Denmark, Italy, Holland, and France, showing that the old antagonism between the British and continental views on conditional contraband has ceased to exist. To prevent confusion the Institute declares conditional co>i- trahand abolished, and

then adds that “nevertheless, the belligerent has, at his option and on condition of paying an equitable indemnity, a right of sequestration or ‘pre-emption as to articles {objets) which, on their way to a port of the enemy, may serve equally for use in war or in peace.” The proposed rule goes beyond the directions of the British Prize Act, and it could only come into operation under a verbal alteration of the Declaration of Paris, under which ” contraband ” alone is excepted from the protection of the neutral flag, a fact which seems to have escaped the notice of the Institute.

British prize law is at present governed by the Prize Act of 1864. The Prize Manual for the guidance of British naval commanders was re-edited by Professor T. E. Hol- land, and reissued 1888. Both require alteration to bring them into harmony with changes which have resulted from inroads of legislation even since so recent a date as 1888. A Consolidation Prize Bill, drafted, we believe, by Professor Holland, and dealing with the legislative changes which have become necessary, had by 1902 passed through the House of Lords, and was awaiting its turn in the House of Commons. The British Prize Instruc- tions were, at the time of writing this article, also undergoing revision by a committee, appointed by the Government for this purpose, but whose work of course can only be completed after the adoption of the new Act.

Absolute Duties of Neutrals. â€” Eor abstention from direct corporate assistance, see Inteenatiostal Law, Ency. Brit. vol. xii. p. 195 et seq.

The duty of neutral States to enforce respect for their territory has become a very serious one. A belligerent cannot be allowed to cross the neutral frontier or carry on war operations in neutral waters, entof without the same right being granted to the respect tor other belligerent. Pursuit of one force by the “eutrai other would amount to waging war on the neu- *,,‘*Â°’- tral territory. It is agreed among nations that the avoid- ance of such a contingency is in the interest of them all. During the Pranco-German war both France and Ger- many, as belligerents, and Belgium and England, as neu- trals, rigorously observed their duties and enforced their rights, and no difficulty occurred. It is, nevertheless, conceivable that, under pressure of military necessity, or on account of an overwhelming interest, a powerful Ijel- ligerent State would cross the territory of a weak neutral State, and leave the consequences to diplomacy.

The South African war was exceptional, in that the Portuguese Government exposed itself to no international difficulty through allowing a belligerent, whose final victory was certain, and of necessity entailed total suppression of the conquered belligerent, to cross its colonial territory. At the same time it is an unfortunate precedent of taking advantage of the practical powerlessness of neighbouring neutral States to commit a violation of the law of nations, respect for which it is a primary duty of every self-respecting State to encourage.'

If, by inadvertence or otherwise, belligerent soldiers pass the frontier, they have to be turned back. If they claim the droit d'asile, they are arrested, dis-armed, and kept in such a manner as to render * ^'**' it impossible for them to take any further part in the

8 The right of way claimed and acceded to under the Anglo- Portuguese Treaty of 11th June 1891 was a mere right of transit for merchandise, and could not in any way be construed as diminishing the neutral obligation to a belligerent who was no party to the treaty.

enlist ment, &c

hostilities. In the case of territorial waters, as has already been pointed out, the neutral State is not in the same position as on land, all ships without distinction having a right of innocent passage through them. Belli- gerent ships also have the right to enter neutral ports, but the neutral authority is bound to take precautions to prevent any favour being shown to the one party or the other.^

Relative Duties of Neutrals. â€" Relative duties embrace those duties which citizens are bound to obserye and for which States incur a relative responsibility. It Foreign -ypas the non-observance of these relative duties that led to difficulties between Great Britain and the United States at the close of the Ameri- can Civil War and which brought the two countries themselves to the verge of conflict. The Treaty of Washington (8th May

1871) referring these difficulties to arbitration defined the scope of the duties in question for all future purposes between the two peoples (see below, “Proclamations of Neutrality,” and Interna- tional Law, 9th ed.). Under this treaty the parties bind themselves to use ” due diligeixce,” where they have “reasonable ground” to believe that any acts have a belligerent character, in ” preventing ” them. They are bound to prevent â€”

(1) Pitting out, arming, or equipping any vessel ;

(2) The departure from their jurisdiction of any vessel, having been specially adapted in whole or in part within such jurisdiction to warlike uses ;

(3) The making use by a belligerent of their ports or waters as a base of naval operations against the other ;

1 The rules laid down on this subject by the British authorities during the Spanish- American war were as follows : â€”

Rule 1. During the contiuuance of the present state of war all ships of war of either belligerent are prohibited from making use of any- port or roadstead in the United Kingdom, the Isle of Man, or the Channel Islands, or of any of Her Majesty’s colonies or foreign possessions or dependencies, or of any waters subject to the territorial jurisdiction of the British crown, as a station or place of resort for any warlike purpose, or for the purpose of obtaining any facilities for warlike equipment; and no ship of war of either belligerent shall hereafter be permitted to leave such port, roadstead, or waters from which any vessel of the other belligerent (whether the same shall be a ship of war or a merchant ship) shall have previously departed until after the expiration of at least twenty-four hours from the departure of such last-mentioned vessel beyond the territorial jurisdiction of Her Majesty.

Rule 2. If there is now in any such port, roadstead, or waters subject to the territorial jurisdiction of the British crown any ship of war of either belligerent, such ship shall leave such port, roadstead, or waters within such time, not less than twenty-four hours, as shall be reasonable, haviug regard to all the circumstances and the condition of such ship as to repairs,

provisions, or things necessary for the sub- sistence of her crew ; and if after the date hereof any ship of war of either belligerent shall enter any such port, roadstead, or waters sub- ject to the territorial jurisdiction of the British crown, such ship shall depart and put to sea within twenty-four hours after her entrance into any such port, roadstead, or waters, except in case of stress of weather, or of her requiring provisions or things necessary for the subsistence of her crew, or repairs ; in either of such cases the authorities of the port, or the nearest port (as the case may be), shall require her to put to sea as soon as possible after the expiration of such period of twenty-four hours, without permitting her to take in any supplies beyond what may be necessary for her immediate use ; and no such vessel which may have been allowed to remain within British waters for the purpose of repair shall continue in any such port, roadstead, or waters for a longer period than twenty-four hours after her neces- sary repairs shall have been completed. Provided, nevertheless, that in all cases in which there shall be any vessels (whether ships of war or merchant ships) of both the said belligerent parties in the same port, roadstead, or waters within the territorial jurisdiction of Her Majesty, there shall be an interval of not less than twenty-four hours between the departure therefrom nf any such vessel (whether a ship of war or merchant ship) of the one belligerent and the subsequent departure therefrom of any ship of war of the other belligerent ; and the time hereby limited for the departure of such ships of war respectively shall always, in case of necessity, be extended so far as may be requisite for giving effect to tliis proviso, but no further or otherwise.

(4) The making use thereof for the purpose of the renewal or augmenting of military supplies or arms;

(5) The making use thereof for the recruitment of men. (See International Law, 9th ed.).

The contracting States undertook to bring the rules they adopted on this subject to the knowledge of other maritime Powers, and to invite them to adopt them also, but thus far, it seems, nothing has been done to get them accepted among other States. Provision had already been made to enable the Government to carry them out in the Foreign Enlistment Act (9th August 1870). This Act, which repealed the previous one of 1819 on the

same subject, is minute in its provisions to prevent enlisting or recruiting men, or the building or the equipping of vessels, for the military service ” of a foreign State at war with a friendly State.” Other States, except the United States (which have adopted a similar Act), have not fol- lowed the example of Great Britain, but leave it to the central Government to deal with the cases, when they may arise, as matters of public safety.^

There is evident reluctance among foreign States to commit themselves to the obligation of exercising “due diligence.” It is clear that the duty of a State to forbear from committing any act which may be of assistance to either belligerent can never be formulated as an absolute one in regard to the ~~acts of private persons, merely within the neutral jurisdiction. In recent times it has certainly become possible for States to exercise a more effective control than formerly over these acts ; but at the present moment, though a much greater latitude is left to neutral subjects and citizens than is consistent with the idea of strict neutrality, there is no movement to alter the usages to the disadvantage of neutral interests. That the Geneva Arbitral Tribunal found in favour of the United States in the Alabama case in no way implies that International Law has as yet undergone any change. The tribunal was bound by the antecedent fixation of the Washing~~ ton rules, and laid down no new principle. On the other hand, the magnitude of the Geneva award is not likely to promote change in the direction of increasing neutral duties, except as part of a general regulation of neutral and belligerent rights.

To some extent the difficulty of determining the extent of relative neutral duty is overcome by the issue of procla- mations of neutrality ; but neutrality and its rights and duties are in no respect dependent P”>ciama- on their being proclaimed by the neutral Power, neutrality. Germany issues no proclamation; at least the German empire has issued none in connexion with the different wars which have taken place since 1870. The Austro-Hungarian Government during the same period only in the case of the war of 1870 itself, and in 1877, issued proclamations, and these probably had objects out- side the ordinary purposes of proclamations of neturality, and its usual practice is the same as that of Germany. France usually issues a short general proclamation, and

Rule 3. No ship of war of either belligerent shall hereafter be per- mitted, while in any such port, roadstead, or waters subject to the territorial jurisdiction of Her Majesty, to take iu any supplies, except provisions and such other things as may be requisite for the subsistence of her crew, aud except so much coal only as may be sufficient to carry such vessel to the nearest port of her own country or to some nearer destination; aud no coal shall again be supplied to any such ship of war in the same or any other port, roadstead, or waters subject to the territorial jurisdiction of Her Majesty, without special permission, until after the expiration of tliree mouths from the time when such coal may have been last supplied to her within British waters as aforesaid.

Rule 4. Armed ships of either belligerent are interdicted from carry- ing prizes made by them into the ports, harbours, roadsteads, or waters of the United Kingdom, the Isle of Man, the Channel Islands, or any of Her Majesty's colonies or possessions abroad.

2 The French Penal Code, however, conta,ins the following clauses covering the Government's powers in this respect : â€"

Art. 84. Whoever shall by hostile'acts, not approved by the Govern- ment, expose the State to a declaration of war, shall be punished by banishment, and should war follow, by deportation.

Art. 85. Whoever shall, by acts not approved by the Government, expose Frenchmen to the risk of reprisals, shall be punished by banish- raeut.

Great Britain a more detailed one, which must be as old as the " ancient custoni " of its being publicly read from the steps of the Eoyal Exchange by the sergeant-at- arms and common crier of the City of London.' The British proclamation practically recites the Foreign Enlist- ment Act, 1870 (an Act to regulate the conduct of His Majesty's subjects during the existence of hostilities between foreign States with which His Majesty is at peace), admonishes all persons entitled to British pro- tection to observe and

respect the exercise of those belligerent rights which ” We and Our Koyal Predecessors have always claimed to exercise,” and warns them that any such persons “breaking, or endeavouring to break, any blockade lawfully and actually established ” by either belligerent, “or carrying officers, soldiers, despatches, arms, ammunition, military stores, or materials, or article or articles, considered and deemed to be contraband of war, according to the law or modern usages of nations, for the use or service ” of either belligerent, ” rightfully incur, and are justly liable to, hostile capture and to the penalties denounced by the law of nations in that behalf.” During the South African war no proclamation of neutrality was issued by any country.

Proclamations of neutrality may be made to serve the twofold purpose of warning the belligerent of the length to which the neutral Government considers neutral duty to extend, and neutral subjects of the exceptional measures to which a foreign war ex- poses them. They may also be used to give effect to any modifi- cation of neutral right or duty which the neutral State may consider warranted by special or altered circumstances.

No purely mercantile transactions are considered a violation of neutrality. Six years before the American Civil War, President Pierce, in his message to armfaad ^^^ Thirty-fourth Congress, first session, made amiauni- the following statement : â€” ” The laws of the tioaby United States do not forbid their citizens to neu ra s. ^^^^ ^^ either of the belligerent Powers articles of contraband of war, or to take munitions of war or soldiers on board their private ships for transportation ; and although in so doing the individual exposes his person or property to some of the hazards of war, his acts do not involve a breach of the national neutrality, nor of themselves implicate the Government.” This is as true a statement of international practice to-day as then.

During the Franco-German war there was correspond- ence between the Prussian diplomatic representatives in London and at Washington and the British and United States foreign secretaries concerning shipments of arms and ammunition to the French armies, in which the Prussian Government contended that it was incompatible with strict neutrality that French agents should be permitted to buy up in the neutral country, under the eyes and

with the cognizance of the neutral Government, ” many thousands of breech-loaders, revolvers, and pistols, with the requisite ammunition, in order to arm therewith the French people, and make the formation of fresh army corps possible after the regular armies of France had been defeated and surrounded.” Nothing, however, was done t9 prevent the departure of these supplies. Both the British and United States Governments claimed entire liberty for the traffic in question.

In the case of loans publicly issued or raised on neutral territory the position is a little different, inasmuch as the neutral State is necessarily cognizant of the fact. Raising of Wo restriction, however, is imposed by inter- loaas on national usage, and provided the same rights are territory, granted to both belligerents, either or both can raise money ad libittim in neutral countries. Thus neutral States did not prevent the issue on their

1 The Times, 28th April 1898.

territory of the Russian war loan of 1876-77. Nor in the recent war between China and Japan was any opposition made by Japan to the raising of the Chinese loan in London.

Proposed Neutrality Reforms. â€” It has been seen in the course of this article that the rules relating to neutrality need to be made more clearly ascertainable. At the Hague Peace Conference a suggestion was agreed to. without discussion, that a further State conference should be held for the purpose of dealing specially with neutrality. Later, Count von Billow, the German chancellor, in connexion with German neutrality during the South African war, referred to this proposal. ” Attempts at a settlement,” he said, ” have so far invariably failed, owing to the obstacles created by the divergent views of the different Powers. An en- deavour was even made to include this question in the deliberations of the Peace Conference at The Hague. The sole result was that the Conference gave expres- sion to the wish that an attempt should be made, by means of subsequent international conferences, on the one hand to deal with the rights and duties of neutrals, and, on the other, with the question of private property at sea. The German empire would not withhold its concurrence and support, if a prospect were to arise of defining more distinctly than heretofore, in conjunction with other Powers, the lines for an international settlement of the disputed points

of maritime law.” Both the Institute of International Law and the International Law Association have appointed committees for the examination of the whole subject of neutrality. In fact, there is a distinct movement among the maritime States of the world’in favour of revising belligerent rights and neutral duties.

War at the present day cannot be conducted without involving vital interests of neutral states. Germany in the course of the South African war showed great irritation at the stoppage of certain of her merchant vessels, and Great Britain had to consent to a modifica- tion of belligerent right under International Law â€” a modification which, be it said, is a perfectly justifiable one, viz., to restrict the right of search for contraband of war to a specified area. We may be sure that, in future wars, powerful neutral States will show, in similar cases, quite as much irritation as did Germany.^

How far States would go in accepting responsibility it is difficult to forecast. It has been said that a State is responsible for acts of infringement of neutrality by those within its jurisdiction, though it may not possess a machinery to repress them. Several States, as a fact, have no enactments specifically to punish infringements of neutrality, and others, like France; deal only with viola- tions of the laws of neutrality as productive of public damage or difficulties. On the other hand, it is not un- reasonable to contend that neglect of a State to enforce the laws it possesses entails responsibility for the con- sequences, and the absence of reciprocity would not be a complete answer to a claim by a State whose laws were less stringent. (t. ba.)

Neuville, Alphonse Marie de (1836-1885), French painter, was born, the son of wealthy parents, at Saint-Omer, France, on 31st May 1836. From school he went to college, where he took his degree of bachelier ^s lettres. His taste led him to serve in the navy, and in spite of the opposition of his family he entered the naval school at Lorient. It was here, in 1856, that his artistic in- stincts first declared themselves. He returned to Saint-

2 Nothing shows more the power of neutral opinion than the fact that the United States and Spain during the war of 1898, though they had refused to be parties to the Declaration of Paris, found them- selves obliged to act in accordance with its provisions.

Omer, wliere his father announced his intention of starting the youth in a public office, but de ISTeuville obtained his permission to become a painter. After being refused and discouraged by several painters of repute, he was admitted to work in Picot's studio. He did not, however, remain there long, and he was painting by himself when he pro- duced his first picture, " The Fifth Battalion of Chasseurs at the Gervais Battery (Malakoff)." This work won the good opinion of Delacroix. In 1860 de Neuville painted an " Episode of the taking of Naples by Garibaldi " for the Artists' Club in the Eue de Provence, and sent to the Salon in 1861 " The Light Horse Guards in the Trenches of the Mamelon Vert." He also made successful illustrar tions for Le Tour du Monde and for Guizot's History of France. At the same time he painted a humber of remarkable pictures : " The Attack in the Streets of Magenta by Zouaves and the Light Horse" (1864), "A Zouave Sentinel " (1865), " The Battle of San Lorenzo " (1867), and " Dismounted Cavalry crossing the Tcher- naia " (1869). In these he showed peculiar insight into military life, but his full power was not reached till after- the war of 1870, in which he had fought with courage. He then aimed at depicting in his works the episodes of that war, and began by representing the " Bivouac before Le Bourget " (1872). His fame spread rapidly, and was increased by " The Last Cartridges " (1873 ; see Plate), in which it was easy to discern the vast difference between the conventional treatment of military subjects, as practised by Horace Vernet, and that of a man who had lived through the life he painted. In 1874 the " Fight on a Eailroad " was not less suc- cessful, and was followed by the "Attack on a House at Villersexel " (1875) and the " Railway Brijge at Styring" (1877). In 1878 the painter exhibited (not at the Great Exhibition) " Le Bourget," the " Surprise at ' Daybreak," " The Intercepted Despatch-bearer," and a considerable number of drawings. He also exhibited in London some episodes of the Zulu war. In 1881 he was awarded the grade of officer of the Legion of Honour for his two pictures " The Cemetery of Saint-Privat " and " The Despatch-bearer." During these years de Neuville was at work with Detaille on an important though less artistic work, " The Panorama of R^zonville." De Neuville died in Paris, 18th May 1885. At the sale of his works after his death the State

purchased for the Luxembourg Museum the ” Bourget ” and the ” Attack on a Barricaded House,” both in oils, with a water-colour picture, ” The Parley,” and a drawing of a ” Turco in Fighting Trim.”

See MoNTROsiEK. ” Les Peintres Militaires,” Paris, 1881. â€” ” De Neuville,” La Gazette des Beaux Arts. Paris, 1885. (h. ek.)

Nevada, one of the most westerly of the United States of America, bounded on the N. by Oregon and Idaho, on the E. by Utah, and on the S. and W. by California. Situated in the arid portion of the country, and with few streams available for irrigation, Nevada can never, under the present climatic conditions, become prominent as an agricultural state. In 1900 the area of land reported as improved and irrigated was 604,201 acres, mainly for grass, alfalfa, and other forage plants. The principal crop in 1898, apart from forage crops, was wheat, in which were planted 36,700 acres, the product being 1,064,271 bushels. The live stock interest was proportionately of greater moment than agriculture proper. In 1898 the state contained 44,305 horses, 1394 mules and asses, 240,386 cattle, 576,994 sheep, and 10,441 hogs. In 1900 there were 922 miles of railway (valued at $8,618,477), but little building had been done in the preceding fifteen years. The production of gold and silver, upon which mainly the state depends for its pro-

sperity, has greatly diminished. In 1900 it was as follows : gold, $2,006,200 ; silver, coinage value, $1,766,703 ; giv- ing a total of $3,762,903. Besides this 3388 tons of lead were produced as a by-product. Nevada was never promi- nent as a manufacturing state. In 1900 there were 133 manufacturing establishments (excluding those classified as hand trades and those having a product of less than $500). They had a total capital of $1,349,109, an aver- age number of 634 wage-earners, and products valued at $1,405,827. At the state capitol, Carson, are situated a state prison and an orphan home. A state hospital for the insane is maintained at Eeno. The state maintains an excellent system of public schools. Altogether the schools numbered, in 1898, 310, upon which was expended the sum of $317,762. The State University at Eeno had in 1898 an income from the state of $32,500, while ex- penses amounted to $28,297. The number of instructors was 28, and it was attended by 366 students. In the matter of church membership, about

two-thirds of the inhabitants are connected with the Eoman Catholic Church, the remainder being composed of Episcopalians, Mormons, Methodists, and Presbyterians. In 1898 the total value of real estate, as assessed, was $16,364,666 ; of personal property, $6,822,655. The net proceeds of mines yielded in taxation the sum of $330,034 ; the total amount raised by taxation was $583,492. In 1898 the debt was but $682,611, the revenue $297,997, and expenses $365,461. Before 1892, when parties first divided upon the issue of free silver, Nevada was in most elections a republican state; but since that year the free silver party has carried each election. In the Presidential election of 1896, when silver was adopted by both Democrats and Populists, their party carried the election by a very large majority. The population in 1890 was 46,761, showing a decrease of 16,505, or more than one-fourth, from that in 1880. In 1900 it was 42,335, showing a further decrease. The population in 1900 included 26,603 males and 16,732 females. The foreign-born population numbered 10,093, and the coloured 6930, of whom 134 were negroes, 1352 Chinese, 228 Japanese, and 5216 Indians. Out of 17,710 adult males, 2271 were illiterate (unable to write), of whom 372 were Chinese and 1398 Indians. (h. g*.)

Nevada, a city of Missouri, U.S.A., capital of Vernon county, on the Missouri, Kansas, and Texas and the Missouri Pacific railways, in the western part of the state, at an altitude of 860 feet. It has an elevated level site and a regular plan, divided into five wards. It has varied manufactures, including a large smelter for reduc- ing the zinc ores from the adjoining mining district. It is the seat of Christian University and of Cottery Female College. It contains also a state insane asylum. Popu- lation (1880), 1913 ; (1890), 7262 ; (1900), 7461, of whom 235 were foreign-born and 168 negroes.

Nevis, an island in the Leeward Islands group, British West Indies. Eum, sugar, and molasses are practically the only exports. Other products, chiefly for local consumption, are corn, yams, and sweet potatoes. The island has much declined in prosperity in recent years owing to the decay of sugar production, and it suffered from a severe hurricane in 1899. Population (1881), 11,864 ; (1891), 13,087 ; (1900), estimated at 15,306. Primary education is compulsory. Most of the inhabitants are Protestants.

New Albany, a city of Indiana, U.S.A., capital of Floyd county, on the north bank of the Ohio river, opposite Louisville, Kentucky, in the southern part of the state, at an altitude of 442 feet. It has a level site, a regular street plan, and is divided into seven wards. Besides the river, which is open to navigation throughout

‘ CoMEAT suK LEs ToiTti.” By A. M. i;E Xeuville. {By permission o/Goupil and Co., London.)

‘Lk6 LiEUJN’jEUEti Caktuughes.’’ By A. M. de Neuville. (By permission o/Goupil and Co., London.)

the year, its ways of commerce include four railways, the Baltimore and Ohio South-Western, the Chicago, Indian- apolis and Louisville, the Louisville, Evansville and St Louis, and the Pittsburg, Cincinnati, Chicago and St Louis, bringing the city a large business. Aided by water- power from the falls in the Ohio, New Albany is a manu- facturing city of much importance. In 1890 it had 298 manufacturing establishments, with a total capital of f 5,342,071. The employes numbered 4506, and the pro- ducts were valued at |6,631,9-;4. These consisted in great part of glass and iron and steel goods, the former having a value of .$l,117,000,and the latter of f 1,178,469. Population (1890), 21,059 ; (1900), 20,628, of whom 1363 were foreign-born and 1905 negroes.

Newark, a municipal borough and market-town in the Xewark parliamentary division (since 1885) of Not- tinghamshire, England, on the river Trent, 19 miles north- east by east of Nottingham, and on the Midland and Great Northern railways. There are a new public library and public gardens, the latter including the ruins of New- ark Castle ; and a coffee-palace has been presented by Lady Ossington. Waterworks have been constructed at a cost of Â£120,000. The manufacturing industries of New- ark, especially brewing, malting, and iron-works, have developed considerably of late years. Population (1881),

14,018 ; (1901), 14,986.

Newark, acityof Essex county. New Jersey, U.S.A., the largest city in the state. It is on the Passaic river, 4 miles from Newark Bay. It is irregularly laid out, with broad streets, less than half of which are paved, mainly with granite blocks and asphalte. Newark is upon five great trunk lines of railway, which, connect it with New York, Philadelphia, and other points. These are the Central of JSTew Jersey, the Delaware, Lackawanna and Western, the Erie, the Lehigh Valley, and the Penn- sylvania. It contains an excellent public library. Two of its insurance companies have combined assets excesd- ing $100,000,000, and combined income exceeding, in the year 1899, $34,000,000. In 1900 it contained 3339 manufacturing establishments, with a total capital of $103,191,403. They employed 49,550 hands, and the products were valued at $126,954,049. The manufactures are extremely varied, the chief products being as follows : boots and shoes, $2,530,048; bread, &c., $2,540,245; chemicals, $3,113,095; clothing (men's and women's), $2,682,558 ; corsets, $1,298,754 ; fertilizers, $1,426,285 ; foundry and machine shop products, $5,536,893 ; hard- ware, $1,013,409; fur hats, $3,453,619; iron and steel, $1,169,744 ; jewellery, $7,364,247 ; leather, $10,857,192 ; malt liquors, $8,236,468; saddlery and harness, $1,184,178 ; slaughtering and meat-packing (wholesale), $3,093,396; varnish, $2,401,849. The assessed valuation of real and personal property in 1900 was $150,106,460 ; the tax rate $22.40 per $1000, and the net debt was $14,177,641. The actual income of the city in 1900 was $6,080,707, and the total expenditures (exclusive of loans repaid), $7,011,401. The death-rate in 1900 was 18-44 per thousand. Population (1890), 181,830 ; (1900), 246,070, of whom 71,363 were foreign-born and 6694 negroes.

Newark, a city of Ohio, U.S.A., capital of Licking county, on the Licking river, the Ohio and Erie canal, and the Baltimore and Ohio and the Pittsburg, Cincinnati, Chicago and St Louis railways, in the central part of the state, at an altitude of 868 feet. It is regularly laid out on a level site, and is divided into eight wards. It is in a fertile farming region, a country also underlaid by coal and producing natural gas. The carriage works of the Baltimore and Ohio railroad are situated here, and there are extensive and varied manufactures. Population (1890),

14,270 ; (1900), 18,157, of whom 1342 were foreign-born and 300 negroes.

New Bedford, a seaport city of Massachusetts, U.S.A., capital of Bristol county, on the estuary at the mouth of Acushnet river in Buzzard's Bay, in the south- eastern part of the state. It has an area of 19 square miles of undulating surface, on which the city is laid out with a regular plan and divided into six wards. It has excellent water-supply and sewer systems. It is on a branch of the New York, New Haven and Hartford rail- road, and has regular steamboat communication with other points of Long Island Sound and the neighbourhood. New Bedford was at one time the headquarters of the American whaling fleet, and with the decline of that industry the cjty decreased in prominence. In recent years, however, the development of manufactures has revived it. In 1900 the manufacturing establishments numbered 618, the invested capital was $29,073,410, the average number of hands employed was 16,409, and the value of the products was $25,681,671. Of this sum about two-thirds, $16,748,783, represented cotton goods. The assessed valuation of real and personal property in 1900 was $57,884,452, the net debt was $3,175,011, and the rate of taxation $17.60 per $1000. Population (1890), 40,733 ; (1900), 62,442, of whom 25,529 were foreign-born and 1685 negroes.

Newbern, a city and seaport of North Carolina, U.S.A., capital of Craven county, in the eastern part of the state, at the junction of the Neuse and Trent rivers, at the head of their estuary. It is on the Atlantic and North Carolina and the Atlantic Coast Line railways, and has regular steamboat communication with the principal northern cities. It has a large trade in southern pine lumber, naval stores, tobacco, and cotton. Population (1890), 7843; (1900), 9090, of whom 89 were foreign- born and 5878 negroes.

New Brighton, formerly a village of Richmond county, New York, U.S.A., and since 1st January 1898 a part of the borough of Richmond, one of the five boroughs constituting New York city. Of this borough it forms the first ward. It is situated at the north end of Staten Island, across New York upper harbour from Manhattan borough, with which it is connected by ferry. It has large cotton warehouses and varied manufactures. Population (1880), 12,679 ; (1890), 16,423 ; (1900), 21,441, of whom 6575 were foreign-born and 259 negroes.

New Brighton, a borough of Beaver county, Penn- sylvania, U.S.A., on the Beaver river and on branches of the Pennsylvania railroad, in the western part of the state, at an altitude of 748 feet. It is in the coal region, and has varied manufactures. Population (1880), 3653 ; (1890), 5616 ; (1900), 6820, of whom 487 were foreign- born and 179 negroes.

New Britain, a town and city of Hartford county, Connecticut, U.S.A., on the New York, New Haven and Hartford railroad, near the centre of the state, at an altitude of 179 feet. It has extensive and varied manu- factures, consisting chiefly of iron and brass goods. In 1900 there were 226 manufacturing establishments, having a capital of $14,115,610, employing an average number of 8438 wage-earners, and turning out products valued at $12,260,782. The site was settled about 1660, and was originally comprised in the towns of Berlin and Eraming- ham. It was incorporated as a town in 1850, and in 1871 the city of New Britain, formerly a part only of the town, was chartered. Population of the town, including the city (1890), 19,007 ; of the city' (1890), 16,^19 ; (1900), 26,998, of whom 9293 were foreign-born and 118 negroes.

NEW BRUNSWICK

New Brunswick, a province of the Dominion of Canada, lying between 45Â° 2′ and 48Â° 3′ N. and 63Â° 46′ and 69Â° 3′ ^Y. Along the Bay of Fundy, and reaching inland 30 miles, the country is somewhat rugged and broken, and traversed by ridges rising 500 to 1000 feet above sea-level, with occasional summits 300 feet higher. This area is underlain by rocks of the Lauren- tian, pre-Cambrian, Cambrian, Devonian, and Lower Carboniferous, with considerable masses of intrusive granite. North of this, grey sandstones and conglom- erates of Carboniferous age occupy a triangular area, the apex of which is near Oromocto Lake, the south side ex- tending to Nova Scotia and the north-west side to Bathurst. Along the western border this area is 400 to 600 feet high, but near the coast it is low and flat. North-west of the Carboniferous a belt of 40 to 50 miles wide is occupied by Ordovician and pre-Cambrian forma- tions, with large masses of intrusive granite. The Ordo- vician is composed of schistose, micaceous, and foliated slates and quartzites, in places highly altered and dis- turbed.

The pre-Cambrian rocks consist of very hard crystalline reddish felsite, chloritic quartzites, and fels- pathic and micaceous schists. The surface of this region is rugged and broken, and traversed by mountain ranges having an elevation of 1500 to 2000 feet, with isolated peaks rising 2500 to 2700 feet above searlevel. The remainder of the pirovince to the north-western boundary is occupied by Silurian rocks, mostly calcareous slates, and shales associated with beds of limestone. The general level of this area varies from 500 to 800 feet, with ridges rising much higher, and in it is found some of the best agricultural land. The whole province has been mantled with ice in the Pleistocene period, and boulder- clay and later modified deposits occupy the surface. Marine clay and sand containing fossil shells are found along the coast.

Climate.'- â€" The climate, though subject to extremes, is healthy. The average mean temperature in summer is 60Â° F., and in winter 19Â° F. The average rainfall for twenty-seven years (1874 to 1900 inclusive) was 31-9 inches, and the average snowfall for the same period was 994 inches.

Game. â€" Laws for the protection of game have been in force for some years, and moose, caribou, and deer have of late increased rapidly. The hunting grounds, though many miles in the unbroken forest, are readily accessible. In 1902 an Act was passed authorizing the executive to set apart a large area of the highlands at the sources of the Tobique, Nipisiquit, and Miramichi rivers for a national park and game preserve. Much of this district is covered with the primeval forest, and abounds in beau- tiful lakes and clear sparkling streams. It is the centre of the best hunting grounds in the province, and its selection for a park will preserve many of the fur-bearing animals from total extinction.

Area and Popvlation. â€" The area of the province is about 27,911 square miles, with a population per square mile of 11-9. The following statistics show the population according to sex, occupation, and race : â€"

Total population

1871.

285,591

1881. 321,233

1891. 321,263

1901. 331,120

In 1901 there were 02,700 families, 168,639 males and 162,481 females.

Occupations of the People in 1891. â€” Agriculture, fisheries, and raining, 55,705 ; domestic and personal service, 17,437 ; manufactures and mechanical industries, 18,707; professional, 380.'!; trade and transportation, 12,005; non-productive, 3742.

In the census of 1901 the origin of the people is given as follows:â€” English, 104,701; Irish, 83,385; Scottish,

48,310; Dutch, 3623; French, 79,988; German, 3830; Indian, 1309; negro, 1368, and the remaining 4606 belong to twenty different nationalities. Of the whole population, 329,567 were either born in Canada or are now naturalized citizens.

Constitution and Government. â€” The province is repre- sented in the Federal Parliament by ten senators, ap- pointed for life, and fourteen members of the House of Commons, elected for a term of five years. Since the abolition of the Legislative Council in 1892 provincial affairs have been managed by a lieutenant-governor and executive council of six paid members, and from one to four without portfolios, and the House of Assembly, composed of forty -six members, elected for a term of four years.

Beligion. â€” In 1901 the principal religious denominations and their adherents were as follows : â€” Church of England, 41,767 ; Church of Kome, 125,698 ; Presbyterians, 39,424 ; Methodists, 35,973 ; Baptists, 80,946 ; Congregationalists, 1033; Disciples of Christ, 1640 ; Adventists, 1124.

Education. â€” The total expenditure for schools in 1901 was $600,340, including the Government grant to teachers amounting to $163,952. In 1882, with a population of 321,233, the number of schools was 1411, there

were 1445 teachers, and the pupils numbered 52,667. In 1901, with a population of 331,120, there were 1741 schools, 1841 “teachers, and 66,760 pupils. There are three chartered institutions which grant academic degrees, viz., the University of New Brunswick, Fredericton ; the. University of Mount Allison College, Sackville ; and St Joseph’s College, Memramcook, Westmorland countj-.

Finance.â€” The province has increased its revenue by imposing succession duties on estates above a certain value, by levying a tax on banks, insurance companies, telegraph and telephone companies, &c., and by taking a share of the proceeds of liquor licences. The total revenue i^ 1901 was $1,031,267, including $275,692 received from the Dominion Government on an old rail- way claim ; and the expenditure $910,346, the gross debt $3,476,502, and the assets, not including public buildings, $700,238. Value of public buildings about $370,000. Crown lands, 7,000,000 acres at $1 per acre minimum value.

Defence. â€” New Brunswick forms the eighth military dis- trict in the militia of Canad a. The active force is composed of one regiment of cavalry (4 squadrons), two batteries of field artillery and one regiment of garrison artillery, one company of engineers, and five regiments of infantry and rifles, a total of 209 officers and 2359 non-commissioned officers and men, together with a permanent force, one company (Fredericton) of the Eoyal Canadian Regiment of Infantry, and No. 8 Bearer Company JNIedical Corps.

Production and Industry. â€” Although many minerals of economic importance are known to occur in the province, not much progress has yet been made in mining, as the quantity of ore in most cases has been limited. Borings are now being carried on for coal and oil. The mineral production in 1901 was valued at $460,000. The total number of occupiers of land in 1891 was 40,836 ; of these 37,853 were owners, 2860 tenants, and 123 employes. IMuch attention has been given to the co-operative manufacture of butter and cheese, and the dairy school at Sussex has done good work in dis- seminating knowledge regarding these subjects. In 1901 there were 66 factories in operation, which made 1,887,370 pounds of cheese, the value of which was $175,205 ; there were also 36 factories, which produced 542,626

pounds of butter, valued at 111,043. These amounts are exclusive of large quantities of home-made butter and cheese. The acreage and state of lands occupied is shown as follows : â€” in 1891 the acres were â€” total

occupied, 4,471,250; total improved, 1,509,790; under crop, 1,018,704; in pasture, 479,607; woodland and forest, 2,961,460; gardens and orchards, 11,479. The largest crops are oats, buckwheat, and potatoes, but barley, wheat, pulse, and rye are also grown. In 1901 there were shipped to transatlantic ports 398,874,725 superficial feet of deal, &c., and 6317 tons of timber. Of the former St John contributed 176,295,257, and the port of Miramichi 125,664,411. The total value of the products of the forest exported in 1899 was 16,148,900. Animals and their products in 1891 were: horses, 59,773 ; oxen, 7510 ; milch cows, 106,649 ; other horned cattle, 90,533; sheep, 182,941; swine, 60,945; domestic fowl, 662,433 ; cheese, 39,716 lb ; butter, 7,798,268 ft ; wool, 692,898 ft.

Fisheries. â€” Provision is made for the distribution of $160,000 annually among fishermen and vessels. Of this amount New Brunswick received $13,563 in 1900, divided among 234 vessels (2969 tons) and 890 men, 670 boats and 1184 men. In the same year the total number of vessels employed in the fisheries was 299 (4058 tons) manned by 1080 men, and 7050 boats manned by 11,559 men. 5440 persons were employed in the lobster canneries. The total value of vessels, boats, nets, lobster canneries, fish-houses, and all other material used in the fisheries was approximately $2,361,087. The value of the fisheries for 1900 was $3,769,742, of which the most important items were herring, $919,619; lobsters, $506,383; sardines, $293,945; cod, $345,618; and salmon, $246,540. Fish products, $223,544.

Manufactures. â€” Considerable progress has been made in the manufacture of cotton and pulp. In 1891 there were 5 cotton mills, employing 1752 hands, and the value of the finished product was $1,750,000. Four mills for the manufacture of pulp have been erected, 2 at Chatham and 2 near St John, with a total capacity of 140 tons of pulp every 24 hours. As large

areas are covered by a heavy growth of spruce, the best wood for making pulp, there is room for great expansion in this industry. In 1891 the number of manufacturing establishments was 5429 ; capital invested, 115,821,855 ; hands employed, 26,675 ; total wages, 15,970,914 ; total value of raw material, $12,501,453 ; and the value of the articles produced, $23,849,655. In 1885 the exports amounted to $6,489,293, and the imports to $5,972,836 ; in 1901 the former reached $14,8*6,454, and the latter $6,741,848.

Shipping and Navigation. â€” The registry books for 1900 show that there were 927 sailing vessels and steamers, net tonnage, 78,708 ; of these 122 were steamers, gross tonnage, 10,247. In the same year 22 new vessels were built and registered ; tonnage, 762. Boads and Bailways. â€” The provincial Government has re- placed many wooden highway bridges by permanent structures of masonry and steel. Amongst new railways are the New Bruns- wick and Prince Edward Island railway, from Sackville to Cape Tormentine ; the Moncton and Buctouche railway, from Moncton to Buctouche, on Northumberland Strait; the Kent Northern railway, from the Intercolonial railway to Richibucto and Pal- merston ; the Caraquette railway and Gulf Shore railway, from the Intercolonial near Bathurst to Tracadie ; the Restigouohe and Victoria railway, under construction; the Albert Southern rail- way, from Albert to Alma ; the Central railway, from Norton on the Intercolonial to Chipman in Queen’s county ; the Canada Eastern, connecting Eredericton with Chatham and Loggieville ; St John Valley and Rivifere du Loup railway, from Eredericton to Woodstock (6 miles) , under construction ; York and Carleton railway, from junction with the Canada Eastern railway at Cross Creek station to Stanley ; and the extension of the Central rail- way from Chipman to Eredericton, under construction. The rail- ways west of the St John river and the line on the east side from Eredericton to Andover are owned and worked by the Canadian Pacific Railway Company, except the Shore Line railway, between St John and St Stephen. In 1901 there were 1444 miles of rail- way in operation. Telephone lines connect most of the principal places, and are also used in country settlements.

Towns. â€” The cities and towns are Eredericton, 7117, the capital; St John, 40,711; Moncton, 9026; Chatham, 4868; St Stephen, 2840 ; Campbelltown, 2652 ; Sackville, 1875 ; Wood- stock, 2984 ; Richibucto, 1700 ; Bathurst,

1550 ; St Andrews, a favourite summer resort, 1800 ; St George, the seat of an extensive granite industry, 850 ; Dalhousie, 1000 ; Sussex, noted for its dairy products, 1500 ; Marysville has extensive lumber trade,

and one of the largest cotton mills in the Dominion, 1892 ; Hills- borough, noted for valuable gypsum quarries, 700 ; Milltown has extensive lumber trade and cotton mills, 2146; Dorchester is the seat of the Maritime Penitentiary, 1000.

See Gesnek. New Brunswick, 1847. â€” Hannay. History of Acadia.â€” Dawson. Acadian Geology.â€” Matthew, Bailey, Ells, Chalmers, in Geol Survey Reports, 1870-71 to 1902 ; Bulletins of Natural Sistory Society of New Brunswick; Collections of the Historical Society of New Brunswick ; Proceedings of the Royal Society of Canada. (yf_ j_ Tff\

New Brunswick, a city of New Jersey, U.S.A., capital of Middlesex county, on the Karitan river and the Pennsylvania railroad. It has extensive manufactures, largely of indiarubber and iron and steel goods. Rutgers College, including the state mechanical and agricultural college, now a part of it, in 1899 had 35 instructors and 306 students. Its total income dui-ing that year was $67,253. Population (1890), 18,603 ; (1900), 20,006.

Newburg, a city of Orange county, New York, U.S.A., on the west bank of the Hudson river, 60 miles above New York. It has four railways, the New York, New Haven and Hartford, the New York Central and Hudson Eiver, the Erie, and the West Shore. In 1900 it contained 263 manufacturing establishments, with a total capital of $5,214,536, and employing 3926 hands.’ The products were valued at $6,497,088, the chief items being clothing, valued at $1,694,475, and foundry and machine- shop products, valued at $643,356. Population (1890), 23,087 ; (1900), 24,943, of whom 4346 were foreign-born and 558 negroes.

Newbury, municipal borough and market-town in the Newbury parliamentary division of Berkshire, Eng- land, on the river Kennet, 17 miles west by south of Eeading by rail. Municipal buildings have been erected, and a thorough system of drainage has been laid down. Newbury possesses the right to elect boys and girls to Christ’s Hospital. All householders may vote. A very important wool market is held annually in

July. There are well-preserved specimens of ancient houses. Popu- lation (1881), 10,144 ; (1901), 11,061.

Newbury, John Strong (1822-1892), American geologist, was born at Windsor, Conn., on 22nd December 1822, and received a medical education. In 1851 he settled in practice at Cleveland, but in 1855 he was appointed surgeon and geologist to an exploring party in northern California, and in 1857 his reports on the geology, botany, and zoology were published. Between then and 1861 he was employed on similar work in the region of the Colorado river, and his researches over a large area of previously iinknown country in Colorado, Utah, Arizona, and New Mexico were recognized as of high value. During the Civil War he did important work as a member of the U.S. Sanitary Commission, his organizing capacity being specially marked during the operations in the Mississippi valley. In 1866 he was appointed professor of geology and palseontology at the Columbia School of Mines, where he started a magnificent collection of specimens ; in 1869 he was made state geologist of Ohio and director of the Geological Survey there, and in 1884 palaeontologist to the U.S. Geological Survey. His work was recognized by his inclusion in most of the learned societies of America and the Old World ; he received the Murchison medal of the Geological Society of London in 1888, and was president of the American Association for the Advancement of Science (1867), of the New York Academy of Sciences (1867-91), and of the International Congress of Geologists (1891). He published several volumes dealing with his own subjects. He died at New Haven, Conn., on 7th December 1892.

Newburyport, a city and seaport of Massachusetts, U.S.A., capital of Essex county, on the south side of the jNIerrimac river, 3 miles above its mouth, and on a line of the Boston and Maine railroad, in the north-eastern part of the state. Formerly prominent in shipbuilding and as a whale-fishing port, its industries now mainly comprise the manufacture of boots and shoes, cotton goods, &c. It still possesses some commerce and fisheries.

Population (1890), 13,947 ; (1896), 14,552 ; (1900), 14,478, of whom 2863 were foreign-born and) 97 negroes.

New Caledonia, a French island in the Pacific, at the southern extremity of Melanesia, with an area of 5,187,000 acres, or about 8100 square miles. In 1898 the population numbered 52,756, consisting of 5585 colonists, 1714 soldiers, 1762 officials, 31,874 natives, 1829 labourers from the New Hebrides, India, and China, 7477 convicts condemned to short periods of imprison- ment, and 2515 freed but restricted as to residence. The centres of population are Noumea, the capital, with 6968 inhabitants, of whom 4010 are free, Bourail, an agricul- tural penitentiary (1800), La Foa, in the centre of the coffee plantations, Moindu, St Louis, and St Vincent. Since the great Kanaka insurrection of 1878, order has been maintained without interruption. The colony is ad- ministered by a governor, who exercises military power through a marine infantry colonel, and civil power with the assistance of a privy council, a director of the interior, a judicial head, and a director of the penitentiary ad- ministration. There is also an elective general council. Noumea is the seat of a superior tribunal, a tribunal of first instance, and a tribunal of commerce. The island and its dependencies are divided into five ar- rondissements. Noumea alone has (since 1879) a municipality, other localities being administered by com- missions. The local budget for 1900 balanced at 3,407,876 francs. More than half of the expenditure of France, 6,643,748 francs, is incurred for the penal establishment.

Of the whole area of the colony more than one-half is moun- tain ous : 500 square miles are occupied “by forests capable of being worked ; 1600 are in pasture-land, and 1600 consist of cultivable lands in alluvial valleys, where coffee, maize, tobacco, sugar-cane, the vine, vegetables, potatoes, and some of the cereals are grown with success. Coffee was introduced about 1870, and so well has it prospered that there are now at least 1,500,000 coHee bushes. Cheap agricultural labour is supplied by the convicts, by the liberated convicts, the Kanakas, and labourers from the New Hebrides. The soil is in three domains : that of the state, for the working of which concessions may be granted under the decree of 1897 ; that of the penitentiary administration, 400 square miles ; and that of the native reserve. Notwithstanding their wealth, the forests are not worked. The

colony contains, besides many horses, 130,000 head of cattile and sheep, and the meat-preserving industry has begun. The mineral deposits are abundant. Gold is found in the valley of the Diahot, as well as lead and copper at Balade. Iron is found everywhere. The yearly output of nickel exceeds 20,000 tons ; of chrome, 2500 tons ; and these minerals, with cobalt, constitute the character- istic wealth of the island. Coal covers more than 450 square miles in five basins, and kaolin is found in places. Gypsum and marble also deserve mention. The industries have not made great progress. The chief industrial establishments are smelt- ing furnaces for cobalt, meat-preserving works at Ouaco, sugar- works and distilleries at Noumea and La Foa, tobacco, oil, and soap factories at Noumea. The commerce in 1888 amounted to 4:480,000, of which Â£200,000 represented the trade with France. In 1900 the total was Â£820,000, of which Â£480,000 was for im- ports and Â£340,000 for exports, the share of France in that year having been 45 per cent, of imports and 47 per cent, of exports. The island takes wines, spirits, tissues, clothing, and iron- mongery ; and sends ores, nickel, cobalt, chrome, copper to the amount annually of Â£208,000, preserved meats and hides, Â£20,000 to Â£24,000, coffee and colonial produce to a like amount. In 1898 the shipments of coffee reached 296 tons. There are as yet only 125 miles of carriage roads, but in the mountainous regions there are many footpaths.

Annexed Islands. â€” The islands annexed to New Caledonia are : (1) the Isle of Pines, 30 miles south-east, with a population of

600. A decree of 1886 assigned the island as a place for hardened criminals. (2) The Wai.lis AROHiPELAeo, placed under the French protectorate on 5th April 1887, and for adftiinistrative purposes connected with New Caledonia by decree of 27th November 1888. There is a French Resident in the islands, which since 1891 have been connected by a regular service with Noumea. The archipelago, lying to the north-east of Fiji, in about 13Â° 2′ S. and 176Â° W., has an area of 40 square miles. The principal islands are Ilea, of volcanic formation and surrounded with coral, and Nukuatga. It was a missionary. Father Bataillon, who in 1837 first brought the influence of France to bear on the natives. These, about 4500 in number, are of I’olynesian race and live on yams, and are gentle and industrious. The trade of the islands is mainly with Samoa, whence cottons and iron goods are im-

ported, and to which copra and roots are exported. (3) The Loyalty Islands, 60 miles east of New Caledonia, consist of three large and a multitude of small islands, with a total area of 800 square miles. The population amounts to 14,800. The natives cultivate the banana and yams, and export sandal-wood. (4) The Union Islands, 170 miles north-west of New Caledonia, are almost barren. (5) The islands of Fotuna and Alofa, dis- covered in 1616, to the south-east of the Wallis Islands, were placed under the French protectorate by decree of 16th February 1888. They have 1500 inhabitants.

The New Hebrides are not classed among the possessions of France, but are under the joint supervision and protectorate of France and Great Britain. The convention of 24th October 1887 entrusted to a mixed commission of naval officers on the British and French stations in the Pacific the duty of protecting life and property. France, having withdrawn her garrisons, engaged not to send her convicts to the archipelago.

See Gallet. La Nouvelle Caledonie. Noumea, 1884. â€” Le Chaktier. Neio Caledonia. Paris, 1885. â€” Legrand. Au Pays des Canaques. Paris, 1893. â€” Lemire. La Colonisation en Nouvelle Caledonie. Paris. VAnnee Coloniale, 1900. (p. l.)

Newcastle, the second city of New South Wales, both as regards trade and population, situated at the mouth of the river Hunter, about 62 miles north of Sydney, in 32Â° 65′ S. and 151Â° 49′ E. It is the seat of a Church of England bishopric, and there are numerous churches of all denominations. The New South Wales Government has spent very large sums on the construction of breakwaters and training-walls and on dredging and blasting, so that it, may now be reckoned in most respects an excellent port, though it is dangerous to enter during east-south-east gales. The amount of silt, sand, and rock removed during 1899 was 2,183,000 tons. Newcastle comprises, besides the- city proper, various suburbs : these, with their population in 1901, were New- castle (city), 12,988 ; Stockton, 2549 ; Carrington, 2547 : Wickham, 7752; Hamilton, 6124; Merewether, 4547; Adamstown, 2420 ; Waratah, 3080 ; New Lambton, 1578; Lambton, 3159; Wallsend, 3820; and Plattsburg, 3177, making the total population of the city and suburbs 63,741. There are 23 coal-mines at Newcastle and in its immediate vicinity, as well as 34 mines in the surround- ing district, of

which Newcastle is the shipping port. These mines employed, in 1899, 7815 hands, and the quantity of coal raised was 3,259,700 tons, of which about 600,000 tons were sent to Sydney, and 2,478.400 tons exported to places out,side New South Wales. There is a growing trade in other articles than coal, and in 1899, out of a total export of Â£1,630,814. the value of coal was Â£882,857, and of other goods Â£747,957; in- cluded in this sum was wool valued at Â£529,876, horses Â£32,579, cattle Â£17,289, preserved meat Â£48,000, silver lead Â£36,905, and copper ingots Â£15,674. Biscuit- making is one of the most important manufactures, one establishment employing 500 hands. Newcastle is the fourth port pf Australasia, ranking after Sydney, Mel- bourne, and Adelaide. During 1899, 973 deep-sea vessels, with a tonnage of 1,283,620 tons, entered the port; the majority of these vessels arrived in ‘ballast. In the same year 974 vessels, of 1,283.157 tons, cleared directly from Newcastle, nearly every country of the globe being represented. The Government owns nearly all the

wharfage, and has constructed nearly 13,000 feet of frontage. The wharves are equipped with steam and hydraulic cranes capable of shipping 25,000 tons a day.

Newcastle is represented in Parliament by six members, and there are twelve municipalities looking after the local affairs of the city and suburbs, though one would suffice. The total revenue of these municipalities in 1899 was Â£38,183, of which Â£24,881 was derived from rates and charges placed directly on assessed properties. The disbursements amounted to Â£38,815. The capital value of all properties liable to assessment was Â£6,430,700, and the annual value Â£316,270. The combined debts of the municipalities amounted to Â£142,498. There were, in 1899, 10,414 dwellings in these municipalities, and 247 miles of streets, of which only 96 miles were properly macadamized. Newcastle city, Hamilton, Merewether, and Wickham have each twelve aldermen ; the other eight municipalities have nine each. The water-supply of the Hunter river district, of which the twelve municipalities form part, is pumped direct from the Hunter river, about a mile and a half above West Maitland, and is finally drawn off to six

local reservoirs. The capital cost of the works was Â£519,000. Only a small part of Newcastle and suburbs is regularly drained. In the city proper there were, in 1899, 12| miles of drainage, constructed at a cost of Â£18,251. Newcastle and Lambton are supplied with electric light by their respective municipal councils ; the local council of Waratah owns its own gas-works, and there are also two private companies supplying the city and suburbs with gas. Com- munication between the various parts is maintained by tramways and ferry-boats. The Great Northern railway runs from New- castle to Wallangarra, on the Queensland border, where it joins the Queensland railway system ; at Hamilton the railway from Sydney joins the Northern system, at a point 102 miles distant from Sydney. There is tramway commxmication with Plattsburg, Tighe's Hill, and Merewether. Steam ferry-boats run at short intervals across the harbour to Stockton and Bullock Island. The Government has established a technical college and museum and 17 public schools, several of which have from 750 to 1100 pupils on their rolls. The Roman Catholic Church has 15 schools, some of which are of considerable size, and there are 11 private un- denominational schools and colleges. There is a school of arts or mechanics' institute in the city and in each suburb : the New- castle School of Arts is a handsome building, with a library of 15,000 volumes, fine reading-room, lecture-hall, and class-rooms. There is a large hospital for the insane, two general hospitals subsidized by the state, and the Wallsend Hospital. There are also several subsidized charitable institutions. The Victoria Theatre was erected in 1891, at a cost of Â£20,000. The Anglican Cathedral of Christ Church, in course of erection, will cost Â£20,000. Several of the other churches are handsome buildings. Amongst other prominent public buildings are the Law Courts, the School of Mines and Trades Hall, and the Post and Telegraph Office, all excellently designed. The municipality has provided excellent salt-water swimming-baths in Newcomen Street. The town and harbour are defended by Fort Scratchley, on Allan's Hill. The climate is not unlike that of Sydney, except that it is a little hotter and there is a somewhat smaller rainfall. The mean temperature is 64-6Â°, the mean summer temperature being 72-4Â°, and the mean winter 55-5Â°. The highest recorded tempera- ture over along series of years was 107-5Â°, and the lowest 31-3Â°. The average rainfall is 48 inches per annum, and the number of rainy days 128. (t. A. o.)

Newcastle, a city in the western part of Pennsyl- vania, U.S.A., capital of Lawrence county, at the junction of the Shenango and Neshannock rivers and at the inter- section of five railways ; altitude 814 feet. It is in the coal-mining region, and has extensive paper, glass, iron, and steel works, including blast furnaces and machine shops. Population (1890), 11,600; (1900), 28,339, of whom 5324 were foreign-born and 463 negroes.

Newcastle-on-Tyne, a city of Northumberland, England, 273 miles north-north-west of London by rail, on the river Tyne, 8 miles from its mouth, with stations on the JSTorth-Eastern railway and ~~branch lines. The central station has received very extensive additions, and is connected with the south by a new railway bridge, and with the Blyth and Tyne station by an underground line. Population (1881), 146,000; (1891), 186,300; (1901), 214,803; but in 1899 the area was increased largely east and west â€" following the course of the river â€" ^to 6400 acres. The rateable value of the union in~~

creased from Â£715,000 in 1881 to Â£1,279,713 in 1901. Newcastle is the largest undivided parliamentary con- stituency in the United Kingdom, returning two members, with 35,983 voters. The government is vested in a mayor, 16 aldermen, and 48 town' councillors. In 1899 there were 7780 births, 4887 deaths, and 2280 marriages ; the birth-rate was 31-6 per 1000, and the death-rate 20-9 per 1000. The water-supply is in the hands of a com- pany. The reservoirs have a water area of 854 acres and a capacity of 5,061,316,362 gallons, providing for 500,000 people. A gas company (rate, 2s. per lOOO cubic feet) and two electric light companies light the town. A sys- tem of electric tramcars is in operation. The corporation has organized an excellent police force and fire brigade, and established baths and wash-houses in populous dis- tricts. Clubs for working men, of which there are seven, are an interesting social feature. Very few of the old buildings remain. The Castle, Black Gate, and some Elizabethan houses on the Side and Sandhill are all that point to bygone days. Of churches, the cathedral of St Nicholas has been improved at a cost of Â£20,000 ; espe- cially fine are the choir-stalls, chancel, and alabaster reredos. St George's, Jesmond, built by the late Mr Charles Mitchell, is a landmark for miles around, and is celebrated for its beautiful interior. Pour other new Established churches have been erected, and the Noncon- formists have also built many places of

worship, espe- cially in Jesmond, now the chief residential quarter. Among scientific institutions may be mentioned the Literary and Philosophical Society, the buildings of which, after being burnt down in 1893, have been restored and extended; the Antiquarian Society; the Mining In- stitute ; the Natural History Museum ; and the Tyneside Geographical Society. The Public Library has been in existence since 1880, and two branches have been estab- lished in populous suburbs. The total number of volumes, including patents, is over 110,000, with issues to the ex- tent of 4,840,000 a year. In the news-room there were, in 1882, 420,000 readers; in 1899, 1,650,000. Educa- tional work has made great advances. The University of Durham has its colleges of medicine and science here. In the former, degrees in medicine and surgery are granted; in the latter, with which the school of art has been incor- porated, degrees in science and literature. Both carry on their work in buildings replete with modern scientific ap- paratus. The Eutherford College and the Commercial Institute provide excellent technical and commercial edu- cation. The Royal Grammar School is being removed to new buildings in Jesmond, where there are also two pub- lic day-schools for girls. The school board has accommo- dation in its 21 schools for 23,036 children. The cost per head is Â£2, lis. 7fd., and the rate lOd., as compared with an average rate of 10|-d. in the country (London included). There are also several voluntary schools, with seating for 16,762. The Royal infirmary (1751) is being housed in a new building, to the cost of which the public subscribed Â£100,000, the late Mr John Hall Â£100,000, and Mr Watson-Armstrong Â£100,000. The hospital for sick children. Moor Edge, and the eye infirmary are additions to the charities of the town. The Theatre Royal in Grey Street was destroyed by fire in 1899 and the Vaude- ville Theatre (the old art gallery) in 1900. Of open spaces there are the Town Moor, Castle Leazes, Nun’s Moor, and recreation ground (1269 acres) ; and six well- laid-out parks. The Elswick Works, founded by Messrs Armstrong in 1847, have been largely extended, particu- larly since the amalgamation with Mitchell and Co., the shipbuilders ; and the construction of ships of all sorts, including the largest ironclads with all their armour and guns, is now carried on. Shipping business is centred in the quayside, where every facility for loading and unloading

ships is provided. A large grain warehouse is at the east end of the quay, from which ships run to all parts of the world. The new exchange is in the Guildhall. As regards trade, the vessels that go right up to Newcastle are often claimed at North or South Shields. Any

statistics issued for Newcastle alone in this connexion would in consequence be misleading, and the figures given below are therefore those for the Tyne ports â€” Newcastle and North and South Shields. The shipping returns were as follows : â€”

Tear.

Number and Tonnage Vessels registered.

Number and Tonnage of Vessels entered and cleared, with Cargoes.

Quantities of Coal and Coke exported (tons).

No.

Tonnage.

No.

Tonnage entered.

No.

Tonnage cleared.

Coastwise.

Foreign.

1880 1890 1898

1030 810 844

373,055 390,065 512,799

6847 6110 5485

1,740,979 1,780,241 1,862,992

16,307 14,740 12,767

5,860,224 7,222,145 7,323,458

2,974,705 3,874,956 5,352,012

5,159,624 5,791,802 6,760,021

The following table gives the value of imports and exports : â€”

Tear.

Total Imports.

Total Exports.

Exports of Coal and Coke.

1880 1890 1898

Â£8,505,156

8,100,031 8,959,906

Â£5,110,457

7,711,649 5,688,769

Â£2,041,175

4,497,002 3,122,006

The figures of the exports and imports of the Tyne for 1899 show a general increase in the trade of the port. Coal exports show an increase of 149,963

tons over the figures of 1898. General exports show an increase of 13,300 tons, most countries showing increases except Italy and the Netherlands. Chemicals, especially sulphate of soda, caustic soda, were exported in larger quantities in 1899 than usually. Pig-iron, iron-work, steel, iron bars and plates, castings and machinery, fire-clay goods, and copper were largely exported. The chief imports are fruits, wheat, maize, oats, barley, iron and steel, petroleum, sulphur ore, timber and wood hoops, iron ore, potatoes. The value of imports in 1899 was Â£8,139,700. In 1899, 1235 British and 1711 foreign ships entered the port. (h. sh.)

Newcastle- under- Lyme, parliamentary and municipal borough of England, in the county of and 16 miles north-west from the town of Stafford, and 147 miles by rail north-west of London. Within the last few years the town has been greatly improved, the main streets have been rearranged and widened, and several hand- some public buildings have been erected, notably the new town hall and the high school. It has industries of brew- ing and paper-making. Down to 1885 the town returned two members to Parliament, but since that date only one. Population (1891), 18,452 ; (1901), 19,914.

Newchwang, a treaty port at the head of the Gulf of Pechili, China. It has shown considerable vigour as a port of trade, sharing in the general prosperity of the province of Manchuria, of which it is the outlet. In 1898 the value of the trade was Â£4,634,470 ; in 1899, Â£7,253,650 ; and in 1900, Â£3,418,400 (when trade was disorganized by the Boxer rising), as compared with Â£1,850,000 in 1881. The principal exports (42-7 per cent.) are beans, bean-cake and bean oil, and wild silk. Of imports (57‘3 per cent.) the principal are cotton yarn and cotton cloth, most of the latter being drawn from the United States in preference to English-made goods. The population of the town is estimated at about 60,000, and the number of resident foreigners is about 160. Railways cpnnect the port with Tientsin and Peking on the one hand, and with the Russian territories lying to the north on the other. In 1895 Newchwang was occupied by Japanese troops, and the town was included in the cession of terri- tory originally granted by the treaty of peace. By a sup- plementary convention it was retroceded by the Japanese under pressure of France and Russia. (See also China.)

Newcomb, Simon (1835), American

astronomer, was born in Wallace, Nova Scotia, on 12th March 1835. He became a resident of the United States in 1853, and graduated at the Lawrence Scientific School of Harvard University in 1858, having paid special atten- tion to mathematics and astronomy. He assisted in the preparation of the American Nautical Almanac for 1857. In 1861 he became professor of mathematics in the United States navy, and was put in charge of, the great 26-inch equatorial erected at Washington Observatory in 1873. In 1877 he was appointed director of the Ameri- can Nautical Almanac, a post which he held until March 1897. In 1894 he became professor of matheinatics and astronomy at the Johns Hopkins University, continuing, however, to reside at Washington. He was also editor of the American Journal of Mathematics for many years. In view of the wide extent and importance of his labours, the variety of the subjects of which he treats, and the unity of purpose which has guided him throughout, Simon New- comb must be considered as one of the most distinguished astronomers of his time. A study of his works reveals an unusual combination of skill and originality in the mathe- matical treatment of many of the most difficult problems of astronomy, an unfailing patience and sagacity in dealing with immense masses of numerical results, and a talent for observation, of the highest order. On assuming the directorship of the Nautical Almanac he became very strongly impressed with the diversity existing in the values of the elements and constants of astronomy adopted by different astronomers, and the injurious effect which it exercised on the precision and symmetry of much astrono- mical work. Accordingly he resolved ’’ to devote all the force which he could spare to the work of deriving im- proved values of the fundamental elements and embodying them in new tables of the celestial motions.” The forma- tion of the tables of a planet has been described by Cayley as “the culminating achievement of astronomy,” but the gigantictaskwhiohNewcomb laid outf or himself, and which he carried on for more than twenty years, was the build- ing up, on an absolutely homogeneous basis, of the theory and tables of the whole planetary system. The results of these investigations have, for the most part, appeared in the Astronomical Papers of the American Ephemeris, and have been more or less completely adopted for use in the nautical almanacs of all countries. A valuable summary of a considerable part of this work, containing an account of the methods, adopted, the materials employed, and the resulting values of the various quantities involved, was published in

1895 as a supplement to tlie American Ephemeris for 1897, entitled Tlie Elements of the Four Inner Planets and the Fundamental Constants of Astronomy. In 1867 Newcomb had published^ an important memoir on the orbit of Neptune, which was followed in 1874 by a similar investigation of the orbit of Uranus.^ About twenty-five years later the tables of

1 Smithsonian Contributions to Knowledge, vol. xv. 2 Ibid. vol. xix.

these planets were revised by him in view of all the observations which had accumulated in the meanwhile at Washington, Greenwich, Paris, and Cambridge. In the meantime the theory of Jupiter and Saturn had been thoroughly worked out by G. W. Hill, Newcomb's distin- guished collaborator in the Nautical Almanac office, and thus was completed one important section of the work projected by Newcomb in 1877.

Among Newcomb's most notable achievements are his researches in connexion with the theory of the moon's motion. His first work on this abstruse subject, entitled Theorie des Perturbations de la Lune, qui sont dues d. Taction des Planites^ is remarkable for the boldness Â©f its conception, and constitutes an important addition to theoretical dynamics. For some years after the publicar tion of Hansen's tables of the moon it was generally believed that the theory of that body was at last com- plete, and that its motion could be predicted as accurately as that of the other heavenly bodies. Newcomb showed that this belief was unfounded, and that as a matter of fact the moon was falling rapidly behind the tabular positions. With the view of examining this question, he undertook the reduction of every observation made before 1750 which appeared to be worthy of confidence. In an elaborate memoir^ he showed that the ancient solar eclipses described by Herodotus, Thucydides, and others, which seemed to require an increased value of the secu- lar acceleration of the moon's mean motion to bring them into line with modern results, might safely be neglected, the ambiguity of the accounts in each case rendering uncertain either the totality of the eclipse or the place from which it was visible. In his investigation he em- ployed the eclipses of the moon recorded in the

Almagest, the Arabian eclipses between a.d. 800 and 1004, extracted from Caussin's translation of Ibn Jounis, the eclipses and occulations of Bullialdus, Gassendus, and Hevelius, of the French astronomers at Paris and St Petersbufg, and of Flamsteed at Greenwich, and deduced a secular acceleration of 8".8, agreeing very well with the theo- retical value.

On taking charge of the 26-inch equatorial at the United States Naval Observatory, Newcomb devoted it almost exclusively for the first two years to observations of the satellites of Uranus and Neptune, being of opinion that it was better to do one thing well than many things indifferently. The results of these skilfully conducted observations were published in a memoir on The Uranian and Neptunian Systems.^ From this research it appears that the orbits of all four satellites of Uranus are sen- sibly circular, and although, no special search was made, he concludes that none of Sir William Herschel's sup- posed outer satellites can have any real existence. From the motion of the satellites he finds that the mass of Uranus is ^^loi, of that of the sun, while for the planet Neptune he finds a mass equal to g|a() of the sun, agreeing with the value previously found by him from the perturbations of Uranus within

¯ of its amount. As early as 1860 Newcomb communicated an important memoir to the American Academy,* On the Secular Variations and Mutual Belation of the Orbits of the Asteroids, in which he discussed the two principal hypotheses to account for the origin of these bodies â€" one, that they are the shattered fragments of a single planet (Olber's hypothesis), the other, that they have been formed by the breaking up of a revolving ring of nebulous matter.

In the Astronomical Papers of the American Ephemeris

1 Liouville, t. xvi. (1871), pp. 1^5.

2 Washington Observations, 1875, Appendix II. 8 Ibid., 1873, Appendix I.

- Memoirs of the American Academy, vol. v. pp. 124^-152.

will be found a large number of contributions from New- comb's pen on some fundamental and most important questions of astronomy. Among these are papers on The Recurrence of Solar Eclipses, A Transformation of Hansen's Lunar TJieory, Development of the Perturbative Function and its

Derivatives. His memoir On the Motion of Hyperion, a New Case in Celestial Mechanics, is in some respects one of his most original researches. He has discussed the transits of Venus of 1761 and 1769, and those of Mercury from 1677 to 1881. At the inter- national conference, which met at Paris in 1896 for the purpose of elaborating a common system of constants and fundamental stars to be employed in the various national ephemerides, Newcomb took a leading part, and at its suggestion undertook the task of determining a definite value of the constant of precession, and of com- piling a new catalogue of standard stars. The results of these investigations were published in 1899,* and have been in use since the beginning of 1901. In the inter- vals of these immense labours, on which his reputation as an astronomer will rest, he has found leisure for works of a lighter character, e.g., his Popular Astronomy â€¢ (1878), and his Astronomy for Schools and Colleges (1880), written in conjunction with Professor E. S. Holden. Since his retirement from official life he has published an excellent popular treatise on The Stars, a Study of the Universe. He has also written on questions of finance and economics.

He received the honorary degrees of D.C.L., Oxford, and Sc.D., Cambridge and Dublin. In 1872 he was elected an associate of the Royal Astronomical Society, receiving its gold medal in 1874. In 1877 he was elected a foreign member of the Eoyal Society, which in 1890 awarded him the Copley medal.

New Forest, one of the few woodland regions left in England, covering about 93,000 acres in the south-west of Hampshire, between the Solent, Southampton Water, and the river Avon. About two-thirds of it is Crown property, and is preserved more or less in its natural con- dition as open woodland interspersed with bogs and heaths. The trees principally represented are oak and beech, with some newer plantations of Scotch fir. The trees were formerly felled for building the ships of the navy, and for feeding the iron furnaces of Sussex and Hampshire. Pigs and a hardy breed of ponies find a good living in the forest ; and in spite of an Act in 1851 providing for their exter- mination or removal, a few red deer still survive. I oxes, squirrels, otters, snakes (smooth snake, grass snake, and adder), butterflies (some of them peculiar to the district), and an occasional badger range the forest freely. The tract derives its name from the extensive

afforestation carried through in this region by William the Conqueror in 1089 ; and the deaths of two of his sons within its con- finesâ€” Eichard killed by a stag, and William Eufus by an arrow â€” were regarded in their generation as a judgment of Heaven for the cruelty and injustice perpetrated by their father when appropriating the forest. About one- fourth of the area is under cultivation by private owners and tenants. The principal village within the forest is LvNDHUEST (population, 2167 in 1901); its church contains a fresco by Lord Leighton; and there is the Verderers' Court, which since 1887 has had charge of the Crown portion of the forest. Brockenhukst and Beaulietj, the latter with, the ruins of an abbey founded by King John, are the villages next in importance.

See J. E. "Wise, The New Forest (4tli ed. 1883), with over sixty engravings by W. J. Linton and a dozen etching by H. Smnner ; and Blackmoke, Gradock Nowell (1866).

6 Astronomical Papers of the American Ephemeris vol. viii. pts. i. and il.

newfou:n^dla]^d.

I. Geography and Statistics.

nSTTEWFOUNDLAND, the oldest British colony, and J^N the nearest part of North America to Europe, oc- cupies very nearly the same geographical position relative to the east coast of the New World -which Great Britain does to the west coast of the Old, but lies rather farther south. The area of the island, which has a greatest length from north to south of 350 miles, and an average breadth of about 130 miles, is estimated at 40,200 square miles. The population in 1891 was 19^,934; in 1901 it was 216,615, In 1900 the marriage-rate was 8-63, the birth-rate 31-42, and the death-rate 16-78 per 1000. There is a steady flow of emigrants to Canada and the United States. Including 3634 persons in that part of Labrador (120,000 square miles) over which New- foundland exercises jurisdiction (see Labradoe), the total population of the colony in 1901 was 220,249. Of these 76,259 were Eoman Catholics, 72,650 Episcopalians, 60,812 Wesleyans, and 10,528 members of other denomina- tions, including 6516 of the Salvation Army. iJducation is

purely denominational, with all the defects of such a system. Each religious body receives its own separate grant. and has its own inspector. In 1899 the number â– of schools of all kinds was : Roman Catholic, 316, with 288 teachers ; Church of England, 243, with 240 teachers ; Methodists, 206, with 203 teachers. Of these, the total number aided in 1898 was 662, with 28,~~397 pupils; and the total expenditure, including Government grants, fees, &c., was $176,345, or about Â£35,260. The attend~~ ance at Eoman Catholic Board Schools in 1899 was 12,949; at Church of England, 11,373; at Methodist, 9459 ; giving a total of 33,781. At the colleges of the Eoman Catholic, Church of England, and Methodist bodies there were 244, 199, and 452 students respectively. There is a General Council of Higher Education, on which all the denominations are represented, and which holds examinations, grants prizes, &c. A sum of about Â£800 is placed at its disposal annually. Much good work has been done by this body.

The administration underwent little change in the last quarter of the 19th century, and is still in the, hands of a Governor appointed by the Crown, an Executive Council (increased to 9 members at the end of 1900), a Legislative Council, which must not exceed 15 mem- bers, and a House of Assembly, now consisting of 36 members elected, on a manhood franchise, from 18 districts containing (1897) 49,474 electors. The following table shows the revenue and expenditure in various years : â€”

1S85.

1890.

1895.

1901.

Revenue Expenditure .

Â£207,500

283,000

Â£300,000

410,000

Â£.32.5,721

281,809

Â£402,000

401,800

Of the revenue in 1899, as much as Â£322,000 was derived from the customs; loans provided Â£15,000, and the post office Â£11,000, these three practically supplying the whole of the revenue. The public debt in 1901 was Â£3,475,700, and no less than Â£136,000 of the expenditure went to pay the interest thereon. The other principal items of the expenditure were: public charities, Â£43,500; the post office, Â£43,000 ; education, Â£31,800 ; and the administra- tion of justice, Â£26,800. There is no regularly constituted military organization, but a military police force numbers 150 men.

The mineral resources have been only very partially ex- plored, but important discoveries have been made, and the island is now known to contain considerable deposits of iron, coal,' and copper. Iron is distributed all over the island, but exceptionally large beds of ore have been found and are being worked on Bell Island, in Conception Bay on the east coast, and rich deposits have also been discovered on the west coast. Coal of excellent quality is found near St George's Bay and Codroy on the west coast, and in the Grand Lake district. Copper ores are at present the most valuable mineral product. In the eastern part of the island gold-bearing quartz rock and extensive deposits of silver and lead ore have been found. The Government geologist valued the total export of all minerals in the ten years 1888-98 at Â£1,614,500, in which total copper ore and regulus figures for Â£1,218,000, and iron pyrites for Â£314,000. The principal items in the output for 1898 were : copper ore and regulus, 66,798 tons, valued at Â£56,500 ; pyrites, 32,835 tons, valued at Â£33,000 ; and iron ore, 102,000 tons, valued at Â£21,000. These and smaller items brought the value of the total output up to Â£121,000.

The census of 1891 gave the following as the agricul- tural returns for the island : â€”

Improved land â€” acres 64,494

Turnips â€” barrels

. 60,235

In pasture â€” acres . 20,524

Horses

. 6,138

Wheat and barley â€”

Milch cows

. 10,863

bushels ... 491

Other horned cattle

. 12,959

Oatsâ€” bushels . . 12.900

Sheep

. 60,841

Hayâ€” tons . . 36,032

Swine

. 32,011

Potatoesâ€” barrels 481,024

Fowl

127,420

Since that date there has been a marked increase in the extent of land farmed: a bonus of $20 per acre for cleared land has been offered by the Government, and the area under cultivation is over 100,000 acres. Compared with the neighbouring colonies, Newfoundland as an agricultural country is in a very backward state ; but the soil on the east side of the island, where most of the inhabitants reside, and where the largest amount of cultivation is carried on, is far inferior to the land in the river valleys and on the west coast. Generally speaking, it is simply a thin gravelly loam. With abundance of manure, however, and a moist atmosphere, it produces wonderful crops of hay, oats, barley, potatoes, and turnips. On the west coast, especially in Codroy valley and round St George's Bay, there is excellent land, and a good deal of farming is carried on by settlers of Scottish and Ereuch descent coming from Lake Breton. Everywhere in the island considerable tracts of land are reserved for cattle and sheep grazing.

In spite, however, of the development which has taken place in mining and agricultural industries, these are still overshadowed in importance by the fisheries. In 1891, 53,502 of the inhabitants were engaged in the fisheries of all kinds and subsidiary industries, using 1242 vessels of about 74,600 tons, and 20,000 boats. The deep sea or Bank fishery is engaged in by American, French, Canadian, and Newfoundland ships, to which two or three Portuguese schooners still add themselves. The American Bank fishery is a rapidly declining industry, though supported by such high protective duties that sea fish is ex- cessively dear in the United States. . In 1880 there were 200 American schooners engaged in the Bank fishery; in 1901 the number did not exceed 100, the average annual catch of which may be set down at 150,000 quintals. (A quintal is one-twentieth of a ton.) Many

statistics]

of the American schooners combine halibut fishing with trawling for cod. The French Bank fishery, which once employed over 10,000 men, is also declining, notwith- standing the enormous bounties and prohibitory duties by which the industry is bolstered up. 108 vessels now come from France every year, and 187 from St Pierre, the total number of men employed being something under 5000. In good years the catch may be set down at about 350,000 quintals.

British ships from Canada and Newfoundland at one time prosecuted the Bank fishery to a very large ex- tent, a large bounty being allowed from the Imperial funds. After this bounty was discontinued the in- dustry rapidly declined, and though it revived for a period during 1880- 1900, it has again fallen off. The annual Canadian catch on the Banks and off the coast of Labrador is about 100,000 quintals, but only about sixty ves- sels from ^Newfoundland, employing 900 men, are engaged on the Banks, and the average catch per schooner is about lOOO quintals. In short, the Bank fishery is not at all in a flourishing condition. Though productive, it is attended by heavy ex- penses, and the loss of human life is every year very great, the ‘Americans alone losing from seventy to a hundred hands annually. The mainstay of the fisheries is, how- ever, the shore fishery, prosecuted all round the coasts and off the coast of Labrador, for the total quantity of cod-fish caught annually in Newfoundland waters by ships of all nationalities amounts, on an average, to 2,500,000 quin- tals of the value of from Â£1,800,000 to Â£2,000,000,

and in this total the Newfoundland catch figures for no less than Â£1,200,000. Thus, though the total value of the catch of cod-fish has decreased, owing to the de- cline in the Bank fishery, by about one-third, the value of the Newfoundland catch has remained fairly constant. Statistics for particular years, however, fluctuate greatly, the Â£sheries being largely affected by wind and weather and ice on the coast. The fish caught round the New- foundland coast are generally of good quality, but the Labrador cure, owing to the short season, is often very inferior. The winter herring fishery, though quite sub- sidiary to the cod fishery, is a considerable industry, the principal share in which during the past few years has fallen to Placentia Bay. As soon as caught the fish are frozen and shipped to the United States and Canada. The tinned lobster industry has grown

considerably, nearly 3,000,000 pounds weight being exported in 1898, of the value of Â£127,750, but in 1899 the catch was

50 per cent, short. Since 1880 the question of French rights on the west coast has become one of great import- ance (see below. History). It is only necessary to state here that the French, whose fishery on the west coast is insignificant, are not allowed by the Bait Act of 1888 to obtain bait from Fortune Bay, and that the British, by the modus vivendi of 1890, since renewed at intervals, are not allowed to increase the number of their lobster factories on the west side of the island.

The artificial hatching of cod and lobster, started

56 Long. West of Greenwich 54

Sketch Map of NEWPOTnn>LANT>.

inndon Stanford's Geofl! Estab*

by the Government in Trinity Bay, has been a great success as a scientific experiment, but economically a complete failure. Whale fishing, once carried on ex- tensively, has been successfully revived. Seal fishing is now engaged in almost exclusively by steamers. The seasons are regulated by strict laws : no steamer can sail before 10th March ; no seals can be killed before 12th March or after 1st May ; only one trip is allowed. The catch fluctuates greatly, varying from 297,000 (1896) to 190,262 (1898). The inland salmon fishery, owing to neglect, is only valued at a little over Â£12,000 annually. More attention is now being paid to this subject, however, and there is already manifest improvement. Sea trout and brook trout abound. Latterly Lochleven and the Californian rainbow trout have been introduced and are flourishing. The principal manufacturing establishments are at St John's. In the island generally there are about half a dozen large lumber mills and fifty smaller ones ;

[histoet

340 lobster factories scattered round the coast ; oil factories for making seal oil, cqd oil, and cod-liver oil ; a large factory for the manufacture of fish guano, and one large pulp factory. The value of these and the fourteen chief establishments in St John's is estimated at over Â£184,000 ; their annual production is valued at nearly Â£300,000. Altogether they give employment to about 6360 persons.

The following table shows the annual value of the im- ports and exports at various intervals : â€"

ISSo.

1890.

1895,

1901.

Imports . . Exports . .

Â£1,395,500

948,700

Â£1,313,500

1,258,000

Â£1,233,233

1,364,011

Â£1,520,000

1,672,000

The chief imports and exports in 1899 were : â€"

Exports. Â£300,472 Dried cod . . . Â£913,362

235,205 Cod oil ... 53,880

70,298 Sealskins . . 28,062

45,731 Seal oil . . . 51,788

52,326 Lobsters (tinned) 116,170

32,598 Herring (pickled) . 34,183

22,411 Copper and ore . . 59,974

32,135 Iron ore and pyrites . 66,302

Imports.

Plour (415,738 brls) Textiles, apparel. Salt pork Molasses Hardware . Tea . Butter . Leather

Of the imports, the value of Â£397,607 came from Great Britain; Â£429,060 from Canada; Â£396,336 from the United- States. Of the exports, the value of Â£296,661 went to Great Britain; Â£111,313 to Canada; Â£164,311 to Portugal ; Â£393,055 to Brazil ; Â£127,408 to the United States. The total number of vessels registered at St John's in 1890 was 2207 of 98,619 tons ; in 1899 the total number registered in the whole colony was 2441 sailing vessels of 98.742 tons, 37 steamers of 8426 tons ; total, 2478 vessels of 107,168 tons. The total tonnage of vessels entered and cleared in 1890 was 634,147 (590,006 British); in 1899 the total was 1,241,490 (1,046,672 British).

There are still only about 760 miles of postal roads and 1700 miles of district roads maintained. Eailways have been greatly developed, however, north and west from St John's. A transinsular railway with various branch lines has been completed, and in 1899 there were in all 638 miles of line open. Communication between various points on the coast and between the island and the main- land is maintained by a fleet of eight first-class steamers, each of which connects with some central point on the railway. In

1899 there were 1314 miles of telegraph liuQ open, running north and west from St John’s ; cables start for Europe from Heart’s Content and for Canada and the United States from Placentia. The telegraph lines were given back to the Government in 1902. Throughout the greater part of the year there is regular communication between St John’s and Liverpool. By various contracts the Government has made concessions to private enter- prise, embracing the working of the Newfoundland rail- way ; mail contracts for bays, coasts, &c. (with an annual subsidy of Â£19,160) ; land grants extending to 5,000,000 acres ; the graving dock at St John’s ; and the electric railway in the streets of St John’s. There were in 1902 in St John’s a Government savings bank and three Canadian banks, one of which has a branch at Harbour Grace. Before the bank crash of 1894 there were over 5000 depositors and over 2^ millions of dollars in the savings bank; now there are 3000 depositors and about 1^ millions of dollars.

See Prowse. History of Newfoundland from the Records, 2nd ed. London, 1896. (Contains a very full bibliography.) â€” Dr Harvey. A Handbook and TourisVs Guide, 1895. (Also, an excellent account of caribou shooting by Dr Davis.)

(d. w. p.)

French

Shore

question.

II. HiSTOET.

Since 1884 the island and its affairs have been more prominently before the British public than at any previous period in its history. This prominence has been altogether out of proportion to its popula- tion, wealth, or developed resources, being largely concerned with the revival, in a new form, of that ancient dispute with France known as the ” French Shore” question. In 1884 a convention which had been arranged between the British and the French Govern- ments was submitted to the colonial administration by its promoters. Sir Clare Ford and Mr E. B. Pennell,

C.M.G., but without commanding the support of the Newfoundland Government. In the year following, on a change of ministry in the colony, the Ford-Peunell convention was, in a slightly amended form, again offered to the Newfoundland legislature, but the joint committee of the colonial House of Assembly and the Council absolutely refused to ratify the arrangement unless the French Government would consent either to annul or to amend the system of bounties paid upon French-caught fish in Newfoundland waters. At the same time, to counteract the effect of these bounties, which pressed very hardly upon the British competition, a Bait Act was framed and carried in 1886, empowering the executive to prohibit the capture in Newfoundland waters for exportation or sale of bait fishes, except under special licence to be issued by the colonial Gov- ernment. The consequence of this measure, were its provisions properly enforced, would be to place an embargo upon the local supply of bait requisite to the French fishermen â€" the so-called " metropolitan fleet " â€" on the Grand Banks. Upon being apprised of this enact- ment, the French Government immediately demanded that Great Britain should deny its sanction to this Newfoundland Bait Act, and pressed their objections with such persistence as to induce Lord Salisbury to disallow the measure. Nevertheless, the despatch of the governor, Sir William Des Voeux, to the colonial secretary, Sir H. Holland, was so entirely in favour of the principle of the Bill that the Newfoundland authorities became imbued with a fixed determination to urge forward the measure for Imperial acceptance.

In 1887, therefore, a delegation consisting of Sir Robert Thorburn, the Premier, and Sir Ambrose Shea visited England at a moment most propitious for obtaining the sympathy and support of the Imperial Government and the press and people of the mother country, it being the jubilee year of Queen Victoria's accession to the throne. A conference of colonial premiers was one of the notable events distinguishing that happy period, and the subject was argued before the conference at considerable length. The claim set up by the senic^ colony " to control and legislate for her own fisheries " met with general approval, the single dissentient being the representative of Canada, who feared that Canadian fishermen would suffer under the Bill. When an assurance was tendered that Canada's fishermen would be placed upon the same footing with those of Newfoundland, the British Government somewhat reluctantly sanctioned

the Bait Act. The stipulation was made, however, that it should not be enforced until the spring following (1888). In the meantime the chagrin of the French Foreign Office at the failure of the Ford-Pennell negotiations, and the hostile attitude taken up by the Newfoundlanders in what they deemed to be the con- servation of their interests, induced M. de Freycinet to devise retaliatory measures. Instructions were issued ” to seize and confiscate all instruments of fishing belonging to foreigners, resident or otherwise, who shall fish on that part of the coast which is reserved to our use.” Lord

Rosebery, then Foreign Secretary, protested to the French ambassador against the spirit of these instructions, which he insisted were in direct contravention of the treaty, inasmuch as they ignored the concurrent as well as those sovereign rights of Great Britain which France solemnly undertook by the treaties never to question or dispute. Nor were other opportunities soon wanting to the French to retort severely upon the Newfoundland authorities for their passage .of the Bait Act, as well as to repair in large measure the injury which that Act promised to inflict upon the French industry. About 1874 a Nova Scotian named Eumkey had established the first factory for the canning of lobsters on the west coast. This concern proving profitable, others sprang up, imtil, at the close of the season of 1887, Captain Campbell, E.N., reported that twenty-six factories were at work, employing about 1100 hands. It was at that time understood that this was an industry which, by the very nature of the process and the permanent shore structures it involved, the French were disqualified from pursuing. So clearly was this recognized that in 1886, when Commander Browne of H.M.S. Mallard reported the existence of a French lobster factory at Port-aux-Choix, a substantially-built structure, roofed with corrugated iron, the French au- thorities conceded that the establishment was in violation of the treaties, and issued orders for its removal. But this conciliatory policy was of brief duration. The year of the Bait Act’s first successful application was marked by the stoppage, by order of the French Government, of Messrs

Murphy and Andrew's lobster factory, and by their contention that the lobster-canning industry formed a part of the privileges conceded under the treaties to the French, whose participation by the British fishermen would be forcibly resisted.

An exchange of notes took place between Lord Salis- bury and M. Waddington, the French ambassador, in which the latter expressed an opinion which evoked a spirited protest on the part of the British Foreign Office. " France," it was then declared, " preserved the exclusive right of fishing she always possessed. This right of France to the coast of Newfoundland reserved to her fishermen is only a part of her ancient sovereignty over the island which she retained in ceding the soil to Eng- land, and which she has never weakened or alienated." This claim of the French to an exclusive fishery was held to be wholly untenable, and their classification of the lobster catching and canning industry as amongst the "fishing" privileges granted them by the treaty was denounced as contrary to both letter and spirit of that instrument. Notwithstanding this, the French agents on the Treaty Shore clamoured for the removal of sev- eral of the British factories, which (it was declared) interfered with the exclusive fishing rights of the French. The French Government also voted (1888) a special bounty for the establishment of lobster factories by their subjects on the Treaty Coast. Pending a settlement, the British Foreign Office deemed it expedient, in order not to give offence to France, to invest the French claims with a semblance of right by issuing instructions to Brit- ish naval officers on the North American station to con- tinue to interpret and enforce the treaties with regard to the Newfoundland lobster-canning industry on the same terms as they had done hitherto with regard to the cod- fishery. Acting under a statute passed in the reign of George III. empowering British naval officers to inter- pret and enforce the treaties. Sir Baldwin Walker and others proceeded to destroy or remove a number of British factories at the request of the French agents. In 1890 the unexpected discovery was made that the Act empowering British naval officers to enforce the provisions of the treaties with France had expired in

1832 and had never been renewed. Consequently all the proceedings of which the colonists had been the victims were illegal. One of them, Mr James Baird, immediately took proceedings against Sir Baldwin Walker in

the Su- preme Court, which decided in his favour, mulcting the admiral in $5000.

On an appeal to the Privy Council the decision was upheld. But before this incident had taken place, the controversy between London and Paris culminated in the modus Vivendi of 1890, by which the lobster factories, both British and French, which were in existence on the 1st July 1889, were to continue for the present. In- stantly the colony took alarm, and a deputation consist- ing of the island's leading men was sent to England to protest against both the principle and practice of such an arrangement. On their return they learnt that it was the intention of the Imperial Government to re-enact verbatim et literatim the Act for the enforcement of the treaties which had expired fifty-nine years previously. To prevent such an occurrence, delegates from both parties in Newfoundland visited London in April 1891, and, appearing at the bar of the House of Lords, prom- ised that if the measure which was then on the eve of being introduced into that body were withdrawn, a temporary measure would be passed by the Newfound- land legislature which would answer the same purpose of enabling Great Britain to carry out her treaty obligar tions with France. The hope then generally entertained was that the whole question of French rights in the colony would soon be the subject of definite negotiations looking to their total extinguishment. That hope was, however, not speedily realized. For a number of years the Modus Vivendi Act was annually passed by the leg- islature, each year under protest, the conviction gaining strength in the colony that the Imperial Government was averse from renewing negotiations with France.

In 1898 the Colonial Secretary, Mr Chamberlain, yielding to the urgent requests of the senior colony, despatched a commission consisting of Sir John Bram- ston and Sir James Erskine, with Lord Westmeath as secretary, on a tour of investigation throughout the Treaty Shore ; and the report which the royal commissioners made (though not published) touched all points of the unhappy dispute. Again, in 1901, on a suggestion put forward by the colony, Mr Chamberlain summoned Mr Eobert Bond, the Newfoundland Premier, and Hon. E. P. Morris to London, for a new conference on the French Shore question, in which Lord Lansdowne, ther Foreign Secretary, participated. Nothing came of this, however. Some

months later, on the occasion of the visit of the Prince and Princess of Wal6s, Mr Bond received the honour of knighthood. In 1902 the Legislative As- sembly of the colony again, under protest, passed the Modus Vivendi Act.

Another great source of interest in Newfoundland was the Eeid contract. This instrument was itself the sequence of a period of ambitious railway development in the col- ony, which dates from 1880, when a line from St John's to Hall's Bay was projected, and begun in the following year. In 1885 the construction of a line, 27 miles in length, from Whitbourne to Placentia, the old French capital, was begun and finished in 1888. Shortly after- wards it was decided to resume the line northwards from St John's to Hall's Bay, which, owing to the failure of the contractors, had been discontinued, with a view ulti- mately to a trausinsular railway. Tenders were invited ; one was accepted from a well-known contractor, Mr E. G. Eeid, of Montreal, and the work commenced in October 1890. But before the contractor had proceeded far with the Hall's Bay line a new survey was made, and another route determined for the proposed transinsular railway,

Reld contract

westwards from the Valley of the Exploits, which was regarded as much more favourable than the one originally contemplated. It traversed the Exploits and Humber valleys, passing through the most fer- tile territory in the island, to the Bay of Islands on the west coast; from hence it skirted St George's Bay and the Codroy valley, and terminated at Port-aux- Basques, a commodious harbour 93 miles distant from Sydney, Cape Breton. The new route was chosen, and a contract signed on 16th May 1893, whereby the con- tractor was to be paid $16,600 per mile in Newfoundland bonds, the whole line to be completed in three years. At the same time, in order to

provide for the working of the line, it was agreed between the colonial Government and Mr Reid that the latter should maintain and work it, as well as construct a system of telegraphs, for a period of ten years from the 1st September 1893 at his own expense, in consideration of a ” grant in fee simple to the contractor of 5000 acres of land for each one mile of main line or branch railway throughout the entire length of the lines to be operated.” Should the line, therefore, be 600 miles in length, the land grant would be 2,600,000 acres, to be situated on each side of the railway, in alternate sections of one or two miles in length with the railway, and 8 miles in depth, the colony also retaining an equal amount of land with the contractor along the route. Much hostile criticism was subsequently directed towards this arrangement ; but as the land was an undeveloped wilderness, valued even by the Newfoundland Government at only 30 cents an acre, and as Mr Reid announced his willingness to dispose of it in blocks at the same figure, its chief and perhaps its only value must be considered as lying in the possibili- ties of future development. In any case, the financial disasters which overtook the colony in the following year would probably have rendered the expense of working and maintaining the line a most burdensome one. So far, therefore, the Reid contract, apart from the vast amount of land it placed in the hands of the contractor, presented few extraordinary features. But in 1898 a new proposal was made by Mr Eeid, under the terms of which he undertook to work all the railways in the island for a period of fifty years, free of cost to the Gov- ernment, provided that, at the termination of the said period, the said railways should become his own prop- erty. He was also to receive a further concession of land to the extent of 2,600,000 acres on terms similar to those contained in the former contract. Mr Eeid agreed to build and run seven steamers, one in each of the large bays, and one to ply in Labradpr in summer, to provide an electric street railway for St John’s, and also to pave a certain portion of the capital. The colony was to part with the telegraph system to the contractor, who was to acquire at a fixed price the Government dry-dock at St John’s. On the other hand, to complete the bargain, $1,000,000 in cash was to be paid by the contractor to the Government within a year after the signing of the contract. This remarkable covenant, which was after- wards characterized by Mr Chamberlain as a transaction “without parallel in the history of any country,” was nevertheless ratified by the legislature, and submitted to the governor. Sir Herbert Murray, K.C.B., for his ap- proval. The governor

declined to append his signature to the instrument, but upon its being referred to the im- perial secretary of state, it was decided that the arrange- ment was one relating exclusively to the colony, and this being the case, that it would be ” au unwarrantable inter- ference with the rights of a self-governing colony ’’ to disallow the measure. The Eeid contract was therefore signed by Sir Herbert Murray, who relinquished his post early in 1898. Meanwhile considerable feeling had been

manifested in the colony ; numerous public meetings in support of the governor’s action were held ; and several petitions were despatched to England, but it was not until the spring of 1900 that Sir James Winter and his colleagues were forced to resign on account of the oppo- sition which had been engendered. The general election brought a Liberal, Mr Eobert Bond, into power ; and he had hardly assumed oflfice when the contractor approached the ministry with further proposals to con-vert his prop- erty into a limited liability company with a capital of Â£5,000,000 sterling, for which proceeding the consent of the legislati^re was necessary, under the terms of 1898. Mr Bond refused unless a modification of the contract was agreed to. The modifications demanded were : That the telegraphs should go back at once to the Government ; that the land grants, which included a large amount of private property, should be readjusted so as to conserve the rights of those whose holdings had been confis- cated ; also, that it should be optional for the colony to take over the railways at the end of fifty years by paying back the sum of $1,000,000 with interest, the amount paid by Mr Eeid to the colony ; and a sum to be arrived at by arbitration for all improvements that may have been made on the property within the fiLfty years. After con- siderable dispute these terms were substantially agreed to, and the conversion into a company took place.

The year 1892 was marked Tjy a disastrous conflagration, which, on the 8th and 9th of July, partially destroyed the Newfoundland capital. Eleven thousand of the inhabitants were rendered home- less, and the loss proved to be upwards of $15,000,000, including the destruction of the fine English catehdral, built from designs of Sir Gilbert Scott. Since the fire the city of St John’s has been rebuilt on a considerably improved plan. Commerce, received a shock, but derived a salutary lesson from the bank failures which occurred in December 1894. The Union and Commercial Banks suspended

payment, followed by the suspension of- the savings bank, a Government institution. This at once lowered the credit of the cojony abroad, and caused the utmost misfortune amongst all classes. There is little doubt but that a principal cause of the disaster was the vicious and dangerous system of credit which had been followed by the merchants in their dealings with the “planters” and commission merchants. The insolvent institutions were speedily replaced by branches of three prominent Canadian banks, and a loan of Â§1,000,000, procured in London by Mr Bond soon after the debacle, served to tide the senior colony over its financial difficulties. Since that period a new era of pros- perity has set in, and there is generally a moderate surplus of revenue over expenditure.

In politics, apart from the matters already alluded to, there occurred in 1893 the filing of petitions under the Cormpt Practices Act to unseat Sir William Whiteway and his colleagues, who had been successful at the general election of that year. The charges created no little interest in England, and the new Gov- ernment was subjected to much unfair criticism, arising largely from a misapprehension of the political and administrative condi- tions in the colony. They were examined in detail by the Su- preme Court, which finally pronounced them unsustained, and the Whiteway Government resumed office after a brief period of abdi- cation. On the whole, it may be said that Newfoundland has passed the critical stage in her history. Between 1863 and 1900 it has been estimated that $12,000,000 worth of copper ore has been exported, and since 1898, when a discovery of iron ore made at Bell Island, Conception Bay, led to important and valuable results, the belief in the island’s mineral resources, long ago enter- tained by geologists, received practical corroboration. Whetlier any portion of it will prove profitable for purposes of agriculture is a matter which will be settled when the interior has been inhabited and the capabilities of the soil put to the test on a larger scale than any that has yet been attempted.

In 1900 the British Admiralty, acting upon the repeated suggestions of Sir Charles Dilke and others interested in the mannmg of the navy, decided to initiate a branch of the Imperial Naval Reserve in tlie colony. The experiment proved a success ; but in 1901 a difficulty arose as to paying the men, owing to the lack of any provision for that purpose in the Imperial Reserves Act under which they were enlisted. The colony was asked to bear

the cost ; its refusal was followed (1902) by the enactment of special legislation rendering the enrolment and maintenance of the reserves in Newfoundland a special Imperial undertaking. Several efforts have been made to induce Newfoundland to con-

federate with the Dominion of Canada, but the project has never met with any degree of favour with the electorate, and is not now discussed by either party at the general elections. Much of the disfavour with which confederation is regarded in the colony is said to be due to Sir John Macdonald's opposition on behalf of Canada to the Bond-Blaine commercial treaty, which was negotiated between an emissary from the Government of Newfoundland and Mr Blaine, then Secretary of State of the United States of America, in 1890, but which was subsequently disallowed at his request by the Imperial Government. It is, however, probable that the treaty would never have received the sanction of the American Senate. After the insolvency of the colony in 1894-95, a delegation was sent to Ottawa to see if it were possible to arrange terms of confederation ; but Sir Mackenzie Bowell's Government objected to the assumption by the Dominion of the entire amount of Newfoundland's debt (116,000,000), and the negotiations were abandoned. (b. w*.)

New Granada. See Colombia.

New Guinea, the largest island (excluding Aus- tralia) in the world, lying between the equator and 12Â° S. and 130Â° 50′ and 164Â° 30′ E., separated from Australia by Torres Strait, and having the Arafura Sea on the south-west. Since 1884 extensive explorations have been conducted, chiefly in the portion of the country east of the 141st meridian, which have now supplied us with an accurate outline of its coasts and a largely increased knowledge of the geography of the interior. The additions to our information regarding its biology and ethnography have during the same period been perhaps still larger.

Physical Geography. â€” New Guinea was probably in Miocene. times, if not later, united to the northern part of Queensland. The deeply indented shore of the Gulf of Papua forms the boundary of the subsided area be- tween the two countries, and from it the land stretches out for 200 to 300 miles north and west on both sides of the Fly river in vast plains, little elevated above sear level. From Cape Buru westwards precipitous limestone cliffs, several hundred feet high, face the sea and rise into forest-clad mountains behind. The northern extremity of New Guinea is all but severed from the mainland by the deep Macluer Inlet, running eastwards towards Geelvink Gulf, which deeply indents the northern coast. South- wards from Geelvink Gulf the north-east coast is more regular than the south-western. Off its coast-line, on the parallel of 6Â° S., lies the vast Bismarck Archipelago, of which Neu Pommern is the most important member ; and, on the parallel of 10Â°, the D'Entrecasteaux Islands, with the Bennett group to their north-east ; while stretching out from the south- east promontory of the mainland is the Louisiade Archipelago. The Great Barrier Eeef of Australia can be traced more or less continuously round the Papuan Gulf and along the south-east coast to the extremity of the Louisiades. In a general -way it may be said that on the west coast of New Guinea, from Cape Buru to the Louisiades, the sea is shallow, while on its steeper eastern side the water close in-shore is often too deep for safe anchorage. The islands on the southern margin of the Louisiade Archipelago are raised coral reefs, but the majority are mountainous, rarely, however, exceeding 3000 feet ; all of them are richly forested, but of little agricultural value. The volcanic D'Entrecasteaux Islands are mostly larger, more elevated (the highest being 8000 feet), and stand in deeper water than the Louisiade group. To the east of Kiriwina (Trobriand) lies a small group of uniquely formed islets, each of which is com- pletely surrounded by a steep forest-clad marginal ram- part of coral 300 to 400 feet high, concealing a depressed inhabited central plateau.

Starting in the southern extremity of New Guinea from an abrupt face some 3000 feet high, and traversing its centre nearly parallel to both coasts, run high ranges of

mountains, which, if not continuous, merge into each other in the same general direction. The Owen Stanley range, â€” its highest summit, named

by Huxley in 1850 Mount Owen Stanley, 13,120 feet, â€” the Albert Victor mountains, the Sir Arthur Gordon range, and the Bismarck mountains form a backbone running northwards to unite probably with the westerly-tending Charles Louis range â€” its main summit 16,000 feet, the loftiest in New Guinea, ter- minating in a bluff at Cape Buru. Between this back- bone and the two seas ramify other ranges, mostly of lower altitude, parallel mainly to the east and west coasts. The most important and best-known rivers are the Amberno, in the north, discharging by a wide delta at Point d'Urville; the Kaiserin Augusta, which, rising in the Charles Louis range, and entering the Pacific near Cape della Torre, is navigable by ocean steamers for 180 miles ; the Ottilien, a river of great length, which discharges into the sea a short distance south of the last named; and the Mambare, navigable by steam-launch for 50 miles, which drains the eastern aspect of the Wasigororo mountains and enters the sea near the Anglo-German boundary. Below 8Â° S. the nar- rowness of the country precludes the existence of any very important rivers on either coast. The Purari, how- ever, whose delta is 20 miles long by 20 broad, is navi- gable for 120 miles by steam-launch, while the Fly has been traversed by the same means for 500 and by a whale- boat for over 600 miles. The latter drains an enormous tract of country, which is so little elevated above the sea- level that it can never be of any agricultural or commer- cial value. West of 141Â° E. the geographical features of the coast, except in the region of Macluer Inlet and Geel- vink Gulf, are very little known, and those of the interior even less.

Geology. â€” The geology has hardly begun to be seriously investigated. The mountains on the north coast of the northern peninsula are apparently of Tertiary lime- stones, and the central ranges of sandstones, slates, and volcanic rocks. In the north-west coal deposits occur. To the south of 8Â° S. we find crystalline volcanic rocks, limestones, and bedded sandstones. Mount Trafalgar is an active volcano. The D'Entrecasteaux, Kiriwina, and Louisiade islands, where they are not of upraised coral, are composed of crystalline volcanic rocks and lavas, micaceous schists, limestones, and slates. Fer- gusson Island clearly shows remains of extinct craters, and possesses numerous hot springs, saline lakes, and solfataras depositing sulphur and alum. In Murua (Woodlark I.) are quarries of the banded quaitzite from which the best stone adzes found throughout south-east New Guinea are made. In Eossel Island (Arova) occur crystalline schistose and

volcanic rocks, and in Misima (St Aignan) limestones and lavas in addition. Nearly all the rivers in New Guinea yield “colours” of gold, but only in the Louisiade Archipelago has enough been discovered to constitute the district a goldfield. No auriferous reefs have yet been found. Black magnetic iron sand covers the shore in Milne Bay. In the upper Fly and Purari ranges limestone and sandstones have been observed, with coal in the Purari sandstones. Mount Owen Stanley is composed, according to Sir W. Macgregor, of schist and diorite. In Hall Sound occur Miocene shells identical with those from the same series in Victoria and South Australia. In the Gira river the valuable metal osmiridium has been dis- covered. Mabadauan hill, on the west of the Fly river, is of granite, which occurs again in the Arf ak mountains. No Palaeozoic fossils are yet known, and of Mesozoic a few fragments only have been doubtfully assigned to the Upper Oolite or Lower Cretaceous. “With these excep- tions the oldest fossiliferous beds are of Pliocene age.

Earthquakes are rare on the mainland, but not infrequent in Bismarck and D’Entrecasteaux Archipelagoes.

Climate. â€” Since the mountains as a rule traverse the island parallel to its coasts, the eastern shores have far less rain than the western. The amount which falls, chiefly at night, varies from 30 inches on some parts of the coast to ‘130 at others, and to a far greater but unknown amount in the mountains. Throughout the dry or cool season the wind blows steadily and almost uninterruptedly (except for an hour or so forenoon and afternoon) from the south-east. The temperature has an extreme range of from 72Â° to 95Â° E., with a mean of about 80Â°. At an elevation of 3000 feet the climate is pleasantly cool ; at 13,000 feet ice forms injihe night, but disappears with the heat of the sun. No snow is known certainly to fall, thou gh it is alleged to have been seen from the sea lying on the

summits of the Charles Louis range. Eever is very prevalent on the coasts, and even in the interior at 2000 feet above the sea. Though generally of a

mild character, it is persistently recurrent, and slowly saps and wears out the constitution ; too often it is virulent and rapidly fatal.

Fauna.â€” New Guinea shares in tlie poverty in mammals of the Australian sub-region. Monotremes (2 species) and marsupials (4 families and 44 species) predominate, hut are not abundant. Among the latter two genera, Dismchurus and Dorcopsis, are peculiar. A pig (Suspapuensis), a dingo, several species of mice (of which Chiruromys is a peculiar genus), a few squirrels, and a considerable number of CUroptera (bats) inhabit the country. The island is specially remarkable for the number and beauty of its birds. The most recent lists record over 500 species as found in the Papuan area, and of these between 50 and 60 genera are peculiar to it. The birds of paradise, which are confined to the sub-region, give special celebrity to its fauna. Between 70 and 80 species have already been described, many of them the

most gorgeously adorned, and others, such as the Pteridophora albertisi, the most wonderful of feathered creatures. They are absent from the Louisiades, but species occur in the D'Entrecasteaux Islands which have not been seen on the main- land opposite. The zoology of the Bismarck Archipelago is but little known. The species of birds so far described from it number 178 (referable to 88 families), of which 74 are peculiar to it, though closely allied to Papuan forms. It contains, however, no Paradiseidm. The Amphibia, to which the sea is a barrier, are almost exclusively of Australian aflSnities. Turtles and tortoises are plentiful on the coast. Ceratochelys insculpta of the Fly river, a chelonian peculiar to New Guinea, is remarkable in having its nearest affinities (as have the Papuan tortoises) with South American species. Of the lizards, 3 of the 6 species of Varanidae, 16 of the 30 Scincidx, 8 Qeckonidce, and 8 out of the 11 Agamidce are peculiar. Salamanders, toads, and frogs are numerous, and crocodiles abound. Only 4 genera and 5 species of snakes are peculiar to New Guinea, many of them poisonous. Butterflies, moths, and bees are very abundant, the former being remarkable for their size and splendid coloration ; but these groups have not been exhaustively enough investigated to afiord a correct idea of their number or their true affinities. Although the list of Coleoptera already known is long, it represents only a fraction of the species remaining to be discovered. The land molluscs show relationship

with the Indian and the Malayan sub-regions ; but many forms have here their centre, and have spread hence into Australia and the Pacific islands.

jr^oTO.â€” Most of the foreshores of New Guinea are eucalyptus- dotted grass lands; in the interior dense forests prevail to a height of many thousand feet. Vast tracts of the country have been, however, deforested by fire, and these are ‘covered by the tall ineradicable grass, Imperata arundinacea. So far the highest altitudes yet botanically investigated are those of the Owen

Stanley range and the mountains in the Kaiser “Wilhelms Land, but of the flora of the highest range of all â€” the Charles Louis mountains â€” nothing is known. The vascular plants already described number about 1500 species. In the low and sub- mountainous lands the flora is a mixture of Malayan, Australian, and Polynesian forms. There are according to Miiller, twice as many palms known from New Guinea as from Australia. The alpine flora, commencing at 6000 feet, is specially characterized by its rhododendrons, pines {Araucaria and Libocedrus)^ and palms, by numerous superb species of Agapetes (Ericacem), and on the summits by an extraordinary association of species charac- teristically European (Bubus, SanunculuSy Leoiitodon, Aspidiuni), Himalayan, New Zealandian {Veronica), Antarctic, and South American (Di’ymus Libocedrus). Good pasture grasses are numerous, but pasture lands are limited. The usual tropical food plants are cultivated. Tobacco has been found growing in the interior, and may be indigenous, as is in some districts the Kava pepper {Piper methiisticuni). At Dorey a cotton plant (C?. vitifoMum) grows wild, and is also cultivated.

ITie People. â€” So large an area of New Guinea remains un- explored that it is impossible, except approximately, to state the number of its inhabitants, but probably 600,000 is under rather than over the mark. The people are broken up into numerous isolated tribes differing greatly in feature, colour, and language. Ethnically they belong as a whole to what should be more correctly designated the Melanian race, whose remaining members are the African negroes, the Australians, and the Melanesians of the Western Pacific. The study of their languages and of their arts and customs â€” by Mr Ray and Prof. Haddon â€” has greatly aided in clearing up the tangle of

their affinities. The interior would seem to be inhabited by the aborigines, for there is no evidence of tliere ever having- been any other occupiers. Where they are absent from the coast they have

been forced inland by various more powerful immigrants, by Mela- nesians from the western Pacific on the north, north-east, and south- east coasts, and by Malays on the north-west. The Papuan, who is shorter than the European, less well-built than the Polynesian, but taller than the Malay, is smooth-skinned and in colour sooty-brown â€” deeper than the Melanesian'sâ€" or even black. He has long arms, long thin legs, a small dolichocephalous head, prominent nose, high narrow forehead, and dark eyes. His hair is black and frizzled, worn generally in a mop, often of large dimensions, but some- times worked into plaits with grease or mud. The Melanesian closely resembles him, but is lighter in colour, of stronger build, coarser in feature, and less prognathous. The Papuan scarifies his skin ; the Melanesians, especially the women, practise tattoo- ing ; ceremonies at the initiation of lads into manhood and sym- bolic dances are practised among the former, but are unknown to the Melanesians, who, on the other hand, make pottery, a craft of which the Papuans are ignorant. The Melanesians have ousted the Papuans from the coasts of the Port Moresby region. Hood Bay, South Cape, Milne Bay, and East Cape, and occupy as well the Louisiade, D'Entrecasteaux, and Bismarck Archipelagoes. The stream of Melanesian immigration, in Mr Ray's opinion, passes from the westward round the north of New Guinea to the Bismarck Archipelago, the Solomons, and the New Hebrides, whence a reflex wave has stranded some of the people on its south-eastern shores and among its islands. The Papuan lan- guages have nothing in common with the Melanesian ; their great peculiarity is their extraordinary diversity â€" "one language agrees with another neither in grammatical details, in con- structive particles, nor in vocabulary." They apparently belong to "separate linguistic stocks," but there is "no evidence con- necting them with any others outside the limits of New Guinea, unless there be a connexion with Australia" (Ray). It is not surprising, therefore, that the speech of people of villages only a few miles

apart is quite unintelligible to each other. In char- acter and disposition the Papuan and the Melanesian are equally devoid of forethought or ambition ; they are rude, boisterous, and full of fun. Though they have no idea of hospitality, and at times practise a species of cannibalism, connected with sympathetic magic, they are less savage, cruel, and treacherous than report makes them. They have really been kindly dis- posed and friendly, on their first contact, with Europeans ; they are not of a quarrelsome disposition among themselves or generally, and they are amenable to discipline ; they are affection- ate to their children, and not infrequently commit suicide from grief on the death of a relative or friend. The Papuan's decorative art, which has been copied by the Melanesian, is eminently artistic. The constitution of society is everywhere simple. The people live in village communities whose members appear to be more or less inter-related. There are no priests and no hereditary chiefs. Totemistic clans have been observed in Torres Strait, and on the Finsch and west coE^ts. Throughout the whole island chiefship is quite unrecognized, except on the Keriwina islands. Possessions, such us gardens, houses, pigs, &c., belong to individuals and not to the community, and pass to the owner's heirs, who diSer in relationship in different districts. The land within certain boun- daries belongs to the tribe, but a member may take possession of any unappropriated portion. There are certain degrees of relationship within which a man may not marry. In some districts he may not marry into his own village, or into his mother's tribe ; in others he may select a wife from certain tribes only. Payment, or a present, is always made for a wife to her father, brother, or guardian (who is generally her maternal uncle). Presents are also often made to the bride. Except in the region where is found the communal- house, each family has its own house, or the young people may occasionally share the parent's. Polygamy is practised, but not frequently, and from the wife (or wives) there comes no opposi- tion. The child belongs sometimes to the mother's, sometimes to the father's tribe. The woman is the household drudge, and does the greater part of the outdoor work, but the man assists in clear- ing new gardens and in digging and planting the soil.

It is impossible to say that there is any idea of religion in our sense among the people. They all believe that within them resides an invisible other self, or spirit, which, if it occasionally wanders for^ hurried tour from its home in the hours of sleep, goes forth for good at death, to hover for some period

at least round the scenes of its embodied life before departing to some lone island or inaccessible summit. This ghost acquires super- natural powers, which at any time it may return to exercise inimically to relations or acquaintances who offend it. Being timid and suspicious, the natives live in constant dread of the dark- ness of the night, and in traversing the forest depths or volcanic mountains, as at such times and in such places malevolent â€” never embodied â€” spirits love to be abroad. These are the spirits which, taking up their abode in a village, cause disease and death ; and to escape from such attacks the inhabitants may have to fiy the village for good, and, by dwelling scattered in the recesses of the

forest for a time before choosing a new site, they hope to throw their enemy off their trail. Spu-its of evil, but not of good, there- fore require to be propitiated. The powers of natureâ€” thunder, lightning, and storm, all supposed to be caused by evil and angry spirits â€” are held in the greatest dread. Under the category of religious observances may perhaps come those held previously to the departure of the great trading or lakatoi fleet: their tabu- proclaiming customs, their ceremonial and sacred initiation ceremonies for boys and girls on reaching puberty, when masks are worn and the ” bull-roarer” swung, as also the harvest -festivals, at which great trophies of the produce of field and forest are erected, preparatory to a big feast enlivened with music and dancing. In the north and north-east of New Guinea ancestor-worship is widely practised. Amulets are worn to ensure success in buying, selling, hunting, fishing, and in war, as well as for protection against evil. Circumcision is practised in some regions, although Mahommedanism does not exist.

The more virulent, intractable, and fatal forms of disease are considered the machinations of some evil influence, acting directly, or through the witchcraft of an enemy. The dead are disposed of in various ways. The body is either buried or laid under- ground for a time, and then disinterred and the bones cleaned and deposited in or near the deceased’s dwelling or in some distant cave ; or the body is exposed on a platform or dried over a fire, and the mummy kept for a few years. Sometimes the head and por- tions of the skeleton are preserved as relics. Little houses are fre- quently erected over the grave as a habitation for the spirit. Soon after death food is oiiered to the departed, and that he may have no wants, his earthly possessions, after

being broken, are laid near his resting-place, so that they also, following their owner, may be ready to his needs. A widow must shave her head, smear her body with black and the exudations of the corpse, and wear mourning for a long time. If ever the dead require to be men- tioned, they are referred to by some roundabout phrase, and never by name, for this might have the dangerous result of bringing back the spirit.

In regard to food, yams, taro, and sweet potatoes constitute in some districts the main food of the people, while in others sago is the staple of their diet. Elesh, forest fruits, and vegetables also form additions to their food. Maize and rice â€” which are not indigenous â€” are eagerly sought after, and are now being rapidly introduced into cultivation. Cooking pots, made at various parts of the coast, form one of the great exchanges for sago ; but where such vessels do not reach, food is cooked by the women on the embers, done up in leaves, or in holes in the ground, over heated stones. The sexes eat apart. In the interior salt is an article specially craved and appreciated. In the Fly river region, kava, prepared from Piper methysticiim, is drunk without any ceremonial importance. Tobacco is indigenous in some parts, and is smoked everywhere, except on the north-east coast and on the islands, where its use is quite unknown. In some few districts a species of clay is eaten.

The architectural abilities and taste of the people are seen in their dwellings and bridges. In the north, the east, and south- west of the island immense communal houses are met with. In some districts the sexes live not apart but together in one of these giant structures, each family having a stall for Itself. Communal dwellings on a much smaller scale occur at Meroka, east of the Astrolabe mountains. As a rule, elsewhere each family has its independent dwelling. In some parts of the north-east coast the houses are built on the ground, but oftener they stand on a plat> form or verandah raised on piles, with the ridge-pole pro- jecting considerably at the gables so that the roof may cover it at each end. Under this shade the inmates spend much of their time ; here their meals, which are cooked on the ground beneath the house, are served. In a few districts villages are built at a short distance off the shore, as a protection against raids by the inland tribes. The interior villages are frequently situated on hill crests, or a-top of steep-faced rocks as difficult of access as possible, whence a view clear all round can be had.

Where such natural defences are wanting the village is protected by high palisades and by fighting platforms on high trees commanding its approaches. On the north-east coast many of the villages are tastefully kept, their whole area being clean swept, nicely sanded, and planted with ornamental shrubs, and have in their centre little square palaver-places laid with flat stones, each with an erect stone pillar as a back-rest. Excellent suspension bridges span some of the larger rivers, made of interlaced rattan ropes secured to trees on opposite banks, so very similar to those seen in Sumatra as to suggest some Malay influence.

The arts of war are more conspicuous than those of peace on one's first acquaintance with the Papuan, for every man carries with him some form of weapon (or at least did so till lately). His armoury consists of the bow and arrow (in the Fly river region, the north, and north-east coasts); a beheading knife of a sharp segment of bamboo ; a shafted stone club â€" rayed, disc-shaped,

or ball-headed (in use all over the island) ; spears of various forms, pointed and barbed ; the spear-thrower (on the Finsoh coast) ; and hardwood clubs and shields, widely differing in pattern and orna- mentation with the district of their manufacture. In British New Guinea alone is the man-catcher (a rattan loop at the end of a handle with a pith spike projecting into it) met with. In the D'Entreoasteaux Islands the sling is in use. For war actualities the natives smear themselves in grotesque fashion with lime or ochres, and in some parts hold in their teeth against the chin a face- like mask, supposed to strike terror into the foe, against whom they advance warily (if not timidly) , yelling and blowing their war- trumpets. The war canoe, which is a long, narrow dug-out outrig- ger, capable of holding twenty-eight men, is only a transport, for they never fight in it. Victorious warriors Vfear as insignia of their success large white ovula shells, or the beak of a hornbill sus- pended on their forehead. The conch-shell is the trumpet of alarm and call to arms. The vendetta- â€" resulting, when successful, in the bringing back the head of the slain as a trophy to be set up as a house-ornament â€" is very widely practised.

The arts of peace, on closer knowledge of the people, are after all more conspicuous than those of war. Attention to attire is everywhere observable, notwithstanding that in some districts the men go practically in a state of nudity. Except in one or two localities (on the north-east and west), the women are ~~invariably decently clothed, and they are the most modest and virtuous per~~ haps of any “savages.” The male attire is little more â€” indeed, often less â€” than is necessary for our ideas of decency. With this and the head encircled by a coronet of dogs’ teeth, and covered by a network cap or a piece of bark cloth, the septum of the nose transfixed by a pencil of bone or shell, and perhaps a shell or fibre armlet or two, the Papuan is in complete everyday attire. On festal occasions he decks his well-forked-out and dyed hair with feathers and flowers, and sticks others in his ear-lobe holes and under his armlets ; while a warrior will have ovula shells and various bones of his victims dangling from ringlets of his hair, or fixed to his armbands or girdle. The women alnSost universally wear a longer or shorter petticoat of grass or palm fibre suspended from the waist, the rest of the body, except when in mourning, being uncovered. The adornment of their persons â€” the tattooing of the skin, and the ornamentation of their belongings by carving, burning, or inlay- ing (generally of high artistic excellence) â€” enters largely into the occupation of their lives. The building of canoes is done by all tribes, yet some districts are the seats of professional boat- builders of great skill, the most elegant and most serviceable craft coming from East Cape and the Louisiades. These boats are either plain dug-outs, with or without outriggers, or regularly built by planks tightly laced and well caulked to an excavated keel. The most remarkable, however, of their vessels is the “lakatoi,” composed of several capacious dug-outs, each nearly 50 feet long, which are’ strongly lashed together to a width of some 24 feet, decked, and fitted with two masts, each carrying a huge mat sail picturesquely fashioned. On the deck high crates are built for the reception of some thousands of pieces of pottery for conveyance annually to the Ely river district to exchange for sago. The natives are keen hunters by pursuit and snare. Fish- ing is done from catamarans mainly, the fish being speared, seined in excellent nets, or driven (by beating the water) into weirs. Music is the great peaceful art of the people, and is diligently extracted from Pan-pipes, a Jew’s-harp of the Papuans’ own fabrication, and the flute ; the music of ceremony and occasion, however, can be evoked only from the drum â€” always open at

one end â€” tapped by the fingers. To the accompaniment of the drum, dancing â€” as a rhythmic but stationary movement of the feet or an evolutionary march â€” almost invariably goes, but rarely singing. All sorts of jingling sounds also are music to the ear, especially the ‘ clattering in time of strings of beans in their dry shells, and so these and other rattles are found attached to the drum, leg-bands, and many of the utensils, implements, and weapons. The natives have domesticated no animals except the dog and the pig ; they seldom keep cage birds, and still more rarely fowls, unless where they have been influenced by Europeans or Malays.

itutory. â€” The surveys and reports of Captain Moresby in 187-1 brought home to Queensland (and Australia generally) the dangers possible to her commerce were the coasts opposite to, Torres Strait and the entrance to the splendid waterway inside the Barrier Reef to fall into the possession of a foreign power. By authority, therefore, of Queensland, the mainland of New Guinea, opposite her shores east of the 141st meridian, was annexed to that colony in 1883. But this action was disallowed by the British Government, as Yule’s (in 1846) and Moresby’s (in 1874) had been. Finally, however, in 1884 a British protector- ate was authoritatively proclaimed by Commodore Erskine over the region “lying between the 141st meridian east- ward as far as East Cape, with the adjacent islands as far as Kosman Island.” In 1885, after Germany had established a trading company on the north-east coast, the two countries agreed to fix their boundaries through the then neutral areas of the

country. The result of this was the assignation to Great Britain of the portion now known as British New Guinea, lying be- tween the extreme limits of 5Â° and 12Â° S. and 141Â° and 155Â° E. To Germany were assigned all the territory and islands to the north of the British boundary under the name of Emperor William’s Land (Kaisek Wilhelms Land), while all to the west of the 141st meridian remained under its old flag as Dutch New Guinea.

British New Guinea. â€” The colony as defined above has an area of about 90,000 square miles, and a population estimated at 350,000, of whom only 250 are Europeans.

Government.â€” The British Protectorate, with its seat of gov- ernment at Port Moresby, was subsidized by the three Australian colonies of Queensland, New South Wales, and Victoria, and lasted, under the administration of two successive special commissioners (Major-General Sir Peter Scratchley and the Hon. John Douglas), tfll the 4th September 1888, when it was proclaimed by the first Administratorâ€” afterwards Lieutenant-Governorâ€” Sir William Mac- Gregor, a possession of Queen Victoria. Its constitution is that of a Crown colony in association with Queensland. The Lieutenant- Governor is aided by an executive and a legislative council, and advised by a native regulation board. Justice is administered by petty sessions in the four magisterial districts into which the possession is divided, with a central court at Port Moresby having the jurisdiction of a supreme court, from which in certain cases an appeal lies to the Supreme Court of Queensland. Order is maintained by an armed constabulary force, under a European oflacer, of over 100 natives from different districts, whose mem- bers are found to be very efficient and trustworthy. Queensland guaranteed the colony Â£15,000 for ten years, but that sum is con- tributed to by Victoria and New South Wales as well as Queens- land, so that all the three states have a voice in its administration. The expenditure has been kept more or less to the limit as- signed, and the revenue, mainly derived from customs duties, is rapidly increasing to meet all needs. Only Â£5110 in 1895, it was in 1899 Â£11,68.3.

Commerce and Trade. â€” The making of mats, fishing-nets, shell ornaments, decorated gourds, and stone implements, and the manufacture of pottery, canoes, and sago, constitute the chief native industries, which are the subject of barter between difierent regions. European industries include gold mining, in which 500 miners, besides natives, are engaged (chiefly as yet in the Louisiade Archipelago, where, though small quantities of the metal are found alluvially over a wide area, no reefs have been discovered) , and the bSche de mer and pearl-shell fisheries, which were formerly more productive than at present. Copra is naturally largely prepared, as cocoa-nut palms are very numerous, and are being every year extensively planted. A small amount of tortoise-shell is collected. ‘ The rubber industry is, accorduig to Sir W. MacGregor, “important and promising.” Species of Falaquium, the genus from which, in the Indian Archipel- ago, the best gutta-percha is obtained, occur on the hills, and from their cultivation there

might in time be obtained a large revenue independently of European labour. Timber of economic value is scarce. Red cedar (Cedrilla) abounds in the riverine flats, but the quality is poor and commercially valueless ; and oaks are plentiful, but the wood is coarse. Small quantities of ebony and sandal- wood are exported. “There can be no rea- sonable doubt that the sugar-cane, which is native and present in a great many varieties, sago, cotton, probably also indi- genous and of exceptionally fine quality, will eventually be valuable” (MacGregor). The trade of British New Guinea is exclusively with the Australian colonies. Imports were valued at Â£72,286 in 1899-1900 (an increase of over Â£20,110 in the year), and exports (including the gold mines) at Â£56,167 (Â£68,500 in 1898-99). In foreign trade 112 vessels of 20,733 tons entered and O.”) of 19,110 tons cleared ; in the coasting trade 528 vessels of 13,221 tons entered and cleared. The postal move- ment in 1898-99 included 7767 letters, 2120 newspapers, and 640 packets. (h. o. f.)

German New Guinea. â€” The German protectorate of New Guinea, so called after the island which contributes the greatest area, comprehends, besides the islands which are now commonly called the Bismarck Archipelago â€” viz., Neu I’ommern, Neu Meck- lenburg (New Ireland), with Neu Hannover and the Admiralty Islands (New Britain) â€” the Solomon Islands (Bougainville and Buka). There are besides nearly 200 smaller islands and islets scattered amongst their greater neighbours. The mainland district is designated Kaiser Wilhelms Land, for the physical geography of which see the introduction to this article.

Annexation. â€” New Guinea was annexed on the 16th November 1884, when the German flag was raised in Friedrich Wilhelm Hafen.

European Enterprise. â€” In 1884 New Guinea was absolutely wild, not a single white man living on what is now the Germar part. On the islands Neu Pommern (New Britain) and Mioko

only two trading firms had their establishments ; and on Neu Lauenburg (Duke of York) the Wesleyans had a mission station. After the annexation commercial enterprise set in at once, hand in hand with political administration. Now on the mainland and in the islands plantations have been established and tobacco and cotton have been successfully grown. Three German mission societies formed settlements on New Guinea, with a branch one on the Gazelle peninsula. The protectorate is included in the Uni- versal Postal Union ; each harbour has its post office, also a lead- ing official with a number of assistants to control the natives and the revenue. It is divided into two districts with separate admin- istrations. New Guinea and the Bismarck Archipelago ; over both presides the governor, whose residence is Friedrich Wilhelm Hafen on New Guinea. A small police force of natives has been foi-med. In each district there is a registry of deeds and a court of law, and in New Guinea a court of appeal, of which the governor is presi- dent. A line of steamers plies between New Guinea, the Bismarck Archipelago, and Singapore. A special silver coin of rupee value has been Introduced. The area of the protectorate is approxi- mately 91,000 square miles. It is impossible to speak with any. precision of the number of the population, but a density of 4 per square mile may not give too high a figure.

Statistics. â€” The revenue of New Guinea is derived from taxes, dues, and licences, and amounted on the 31st of March 1892 to about Â£3000 ; on the same rate, 1901, to Â£3750. The annual revenue is averaged at Â£5000, and the expenditure at Â£4200. The New Guinea Company was to receive Â£20,000 for transferring proprietor- ship to Government. The New Guinea Company imported in 1885, Â£.37,145; 1890, Â£24,722; 1895, Â£21,915; 1899, Â£53,000; 1900, Â£36,600 ; and exported in 1895, Â£30,906 ; in 1899, Â£46,955 ; in 1900, Â£17,500. In 1895 there were 138 Europeans, 7 trading firms ; in 1901 there were 301 Europeans, 6 trading firms, with 56 trading stations in various parts of the country.

Adthokities. â€” Rye. Bibliography of New Guinea (complete to 1883), in Supplementary Papers, R.G.S., 1884.â€” Romillt. The Western Pacific and New Guinea. London, 1887. â€” Parkin- sos. Im Bismarck Archipel. Leipzig, 1887. â€” Cooke. Australian Defences and New Guinea. London, 1887. â€” Haddon. Decorative Art of British New Guinea. Royal Irish

Academy, Dublin, 1894. â€” Annual Beports. Brisbane, 1888-98. â€” Forbes. ” British New Guinea as a Colony.” Blackwood’s Magazine, July 1892. â€” Chalmers. Pioneer Life and Work in New Guinea. London, 1895. â€” MacGregor. British Neio , Guinea. London, 1897. â€” â– Semon. Bn Australischen Busch und an den Kusten des Koralles Meeres. Leipzig, 1899 ; Nachrichten uher Kaiser Wilhelms- land. Berlin, 1887-99. â€” “Webster. Through New Guinea. London, 1899. â€” ” Geographische Untersuchungen in der West- halfte von New Guinea,” in Beport of Sixth International Geo-graphical Congress. London, 1895. â€” Haddon. Journal B. G. S., 1900. – (j. VON p.)

Dutch New Guinea comprises all the western portion of the island. The boundary on the east, separating it from British New Guinea and German New Guinea, was finally settled in 1895. Starting from the south coast, it follows 141Â° 1′ 48″ E. up to the Ely river, which it mounts until 141Â° 1′ is reached, when it once more follows the meridian up to the north coast. The area of the territory is about 150,000 square miles, and the inhabitants .have been conjectured to number some 200,000. A few missionaries have established themselves, but otherwise the Dutch have scarcely occupied their possession, which at present merely forms part of the residency of Ternate in the Moluccas. Dutch New Guinea has, however, better natural advantages than either the British or German possessions in the island, and should eventually prove of real value to the Netherlands.

Beceni History. â€” The treaty concluded in May 1895 between Great Britain and Holland finally settled the new boundaries. Roughly speaking, that partition had allotted about 48-6 per cent, of the superficial area of New Guinea to the Dutch East Indian empire, 28-3 per cent, to Germany, and 23-1 per cent, to Great Britain. Dutch New Guinea now covers the western and, accord- ing to some authorities (see, e.g., Guillemard, The Cruise of the ‘â– ^Marchesa “), the best half of the whole island. A great deal has been done since Wallace visited it in 1858 and stayed some months at Dorey in the north. At regular intervals the steamers of the Dutch Royal Steam Packet Company now call at Dorey and other points, whilst administrative posts have been established elsewhere in lieu of , others previously attempted but abandoned. Nominally the sultan of Tidore (see Moluccas) is still the suzerain of western New Guinea, but his authority is

scarcely recognized, except on some few shores and adjacent islands, and practically Dutch New Guinea used to be administered partly from Ternate aud partly from Timor, upon more peaceful lines than was the case when the rule of the Dutch in New Guinea largely consisted of the sending of a warship now and again to some distant island or bay to burn a kampong, to punish rebellious villagers, and thus assert or re-

assert Dutch authority, or that of the sultan, who is their vassal. In 1901, however, a more serious effort was made to establish some kind of government in the southern province of Dutch New Guinea, at Merawkay, where a small Dutch-Indian garrison was stationed with the professed object of preventing raids by bands of savages into the British territory near by. Such raids had ‘ been rather frequent, the invaders attacking the natives who live under British protection, burning their huts, murdering the men, carrying off the women and children as slaves, and returning scot free to their own haunts laden with booty. There is now also an assistant Resident at Merawkay, whose immediate chief is the Dutch Resident at Ternate, and who is the civil administrator of the province of southern Dutch New Guinea. Assistant Residencies have also been established at Manokvary in northern Dutch New Guinea, which has been formed into a new province, under Ternate, and at Fakfak, in western Dutch New Guinea, likewise erected into a new province, also under Ternate. By 1902, therefore, Dutch New Guinea formed a new government, with its headquarters at Ternate, divided into the three provinces aforenamed.

A curious discussion arose in the Dutch States- General when the Government was seeking legislative sanction for the above measures, with a provisional credit to cover the first establish- ment expenses. It was seriously contended in one part of the House that, as eminent men of geographical and ethnographical science had settled the question, whether New Guinea belongs to Asia or Polynesia, in favour of the latter, a New Guinea coloniza^ tion scheme could not properly be proposed and decided upon in a section of the Dutch-Indian budget. This budget concerned only the Asiatic possessions of Holland, not the Polynesian ones, and Dutch New Guinea must, consequently, have its own budget. Finally, the majority of the States-General, backed by Govern- ment, decided that New Guinea must still be reckoned to belong to Asia.

As the so-called “Wallace line ” of demarcation â€” a name pro- posed by Professor Huxley and accepted by the scientific world since Dr Alfred Russel Wallace, the famous naturalist, first pro- ‘ pounded it (October 1859) in the B)is â€” has played a r5le in these discussions, it is well to point out that this line is entirely a zoological boundary, and does not apply at all to the geographical distribution of man. Wallace’s line of demarcation, which runs southwards from the Philippines, separating Borneo from Celebes and Bali from Lombok, was suggested to him, as he explained in a paper written in defence of his scientific boundary against attacks upon it from various quarters, ” by his own observations, showing the abrupt and remarkable change in the forms of life that occur in passing from Bali to Lombok and from Borneo to Celebes.” The sudden change was, he maintained, ” connected with the fact that the sea between those islands suddenly deepens, marking the eastern termination of the great shallow bank which connected the larger Sunda Islands with the Asiatic continent.”

The boundary line between the races inhabiting the Malay Archipelago and Australia lies much farther east than Wallace’s zoological frontier, the Malays extending to Celebes, the Moluccas, Sumbawa, and Timor, but already meeting and mixing with Papuans on several of the easternmost islands of the Malay Archipelago. Professor Huxley believed that the aborigines of New Guinea, generally called Papuans (but only by the Europeans and their descendants, the name being unknown to any native tribe), were more closely allied to the negroes of Africa than any other race. The hypothesis of some later scientists, who have endeavoured to identify the Papuans with the Negritos of the Philippines and the Semangs of the Malay Peninsula, has met with more success. Dr Alfred Russel Wallace pronounced himself against this hypothesis in an appendix to his Malay Archipelago (1883 edition, p. 602), where he observes that “the black, woolly- haired races of the Philippines and the Malay Peninsula . . . have little affinity or resemblance to the Papuans.” But Dr A. B. Meyer, who spent several years of scientific travel and exploration in the Malay Archipelago and New Guinea, and who became the director of the Natural History Museum at Dresden after his return, developed a contrary conclusion in his Die Negritos der Philippinen (1878). Dr Meyer held, after a special inquiry, that the Negritos and Papuans are identical, and that possibly, or even probably, the former are an offshoot of the latter, like

some other Polynesian islanders. Professor Haddon (of Cambridge), while discussing, in Nature (September 1899), a later paper by Dr A. B. Meyer in English on the same sub- ject (The Distribution of the Negritos, Dresden, 1899), practically adopts Meyer's views, after an independent examination of numerous skulls. But Professor Haddon truly remarks that much more needs to be known than is at present available before decid- ing as to how the Papuans, who are undoubtedly the aborigines of New Guinea, may have peopled other islands surrounding their own and much more distant.

Since 1870 Dutch scientific exploring expeditions have pene- trated deeper into many of the unknown parts of Dutch New Guinea than their predecessors, such as Wallace, Beccari, and d'Albertis. Among the more important of such expeditions may be mentioned those of Messrs Van der Crab, Teysmann, Coorengel, Langeveld, Von Hemert, and Swann, undertaken for the Dutch- Indian Government 1871-72, 1875-76 (reports published at The Hague in 1879) ; of Von Rosenberg in the Geelvink Gulf districts in 1869-70 (report published at The Hague in 1875); of Von Oldenboigh in 1879-81 (published at The Hague); of Monod de Froideville and Boreel in 1882 (published at The Hague), &c. Their reports and the reports of various missionary societies, both Dutch and German, having settlements in western and northern New Guinea, in Netherlands territory, have thrown a great deal of light on the natural history of the island, on its resources, and the islanders. Extensive coal-fields have been discovered near the north-western coast.

Authorities. â€" Gkaf v. Pfeil. Studien und Beobachtungen in der Sudsee. Fr. Vieweg, Brunswick, 1899. â€" Kriegek. New Guinea. Verlag der Biicherfreunde, Berlin. â€" K. Bldm. New Guinea und der Bismarck Archipel. Schonfeld und Cie., Berlin. â€" Karnbach. Die bisherige Erforschung von Kaiser Wilhelmsland. Berlin. Besides the various publications of the Dresden Natural Jlistory Museum, the following : Stanford's Compendium of Geography and Travel ; Malaysia and Pacific Archipelagoes (new issue, edited by Dr F. H. H. Guillemard); The Cruise of

the “Marchesa” (1894), by the same (second volume) ; British Empire Series: Australasia (1900). (h. Ti.)

New Hampshire, one of the original thirteen states of the American Union, belonging to the New England group, of vsrhieh it is the third in size. The population is slowly increasing. In 1880 it was 346,991, of whom 170,526 were males and 176,465 females ; in 1890 it was 376,530, of whom 186,566 were males and 189,964 females ; and in 1900 it was 411,588, of whom 205,379 were males and 206,209 were females. The increase in population from 1880 to 1890 was 8-5 per cent. ; from 1890 to 1900, 9-3 per cent. In 1890 the density per square mile was 44-8, and in 1900 it was 45-7. The movement of the population is, as elsewhere, towards the cities. Between 1880 and 1890 three of the four dis- tinctively agricultural counties lost 2528 in population, and from 1890 to 1900 the loss was 2024, while the manu- facturing counties steadily gained. The urban population, classing as such all persons living in cities of more than 4000 inhabitants, increased between the census of 1880 and that of 1890 from 26-3 per cent, to 34-2 per cent, of the total population, and at the taking of the census of 1900 it had reached 46-7 per cent, of the total population. There are eleven incorporated cities in the state, each of which has a population of over 5000, and of these the chief manufacturing centres, as Manchester, Nashua, and Laconia, have in particular largely increased in size since 1880. In 1900 the population of Manchester was 56,987 ; of Nashua, 23,898; of Concord, 19,632; of Dover, 13,207 ; of Portsmouth, 10,637 ; and of Laconia, 8042. The gain in population is partly from natural growth and partly from immigration, mainly from Canada. In 1890 there were resident in New Hampshire 46,321 persons born in Canada or Newfoundland, and also 64,016 persons born in other states of the Union, while 124,520 natives of New Hampshire were resident in other states. In 1880, 86-OG per cent, of the population were native- born ; in 1890, 80-79 per cent.; and in 1900 only 78-6. The total number of foreign-born inhabitants in 1900 was 88,107. There were only 662 negroes in the state. In 1899 there were for each 1000 of the population 18 ‘53 marriages, 21 -yO births, and 17-29 deaths. The size of the family continues to decrease, as it has done since 1850, the average being 4-31 in 1890, against 4-32 in 1880 and 5-15 in 1850. The percentage of births where both parents were foreigners was 3877 in 1896 and 36-67 in 189i). Divorces have pretty steadily in- creased ;

in 1882 there was one divorce to 10-93 marriages, and in 1899 one divorce to 8-90 marriages. Among the

causes of mortality consumption held the first place till 1898, although the percentage of deaths from it fell some- what steadily from 14-01 per cent, of all deaths in 1884 to 9-92 per cent, in 1897, the average being 10-89. Pneumonia came next, varying between 7-06 in 1884 and 9-17 in 1897, averaging 8-67, and now holds the first place, 753 having died from pneumonia in 1899, against 582 from consumption. The ratio of deaths resulting from zymotic diseases during the fourteen years was 13-61 per cent, of the total. The death-rate for the entire state in 1890 was 18-2 ; in 1900 it was 18-52.

Charitable Institutions.â€” In 1900 there were 1303 paupers in the various almshouses of the state, of whom 423 were insane. On 1st October of the same year there were 425 insane patients in the state insane asylum. Within the period 1890-1900 there has been an important movement in the establishment of hospitals, with most of which are connected training-schools for nurses. In nearly all the cities hospitals have been opened, partially at the public expense, and in many of the towns “cottage hospitals” have been erected, mainly or wholly by private generosity. The Mary Hitchcock Hospital at Hanover is a model of its kind.

Manufacturing. â€” Manufacturing is the principal industry, and the amount of capital invested in it, the value of materials employed, and the value of products are steadily advancing, as shown by the comparison of the statistics of 1880, 1890, and 1900 :â€”

1880.

1890.

1900.

dumber of establishments

Capital

Wage-earners (average number) Total wages .... Value of products .

8,181

$51,112,263

48,881

$14,614,793

$73,97S,628

3,229

$79,375,160

60,111

$21,927,290

$85,770,649

4,671

$100,929,661

70,419

$27,620,247

$115;669.80S

New Hampshire ranks sixth in the Union in the manufacture of cotton goods, fifth in that of woollen, and twenty-fourth in the general value of its manufactures. Its eight chief industries in 1900 were as follows: â€”

Industries.

Number of Estab- lish- ments.

Capital.

Wage-earners.

Value of Products.

Average Num- ber.

Total Wages.

Boots and shoes (fac- tory products)

Cotton goods

Wool manufactures

Lumber and timber products

Paper and wood pulp .

Foundry and machine- shop products .

Leather (tanned, cur- ried, and finished)

Hosiery and knit goods

67 28 46

653 29

87

12

22

-

8,123,481

29,261,8-35

11,280,295

11,882,114 8,163,081

2,894,474

1,900,277 2,625,236

12,007 20,454 6,461

4,1 S3

2,891

1,979

552 2,492

$ 4,971,954 6,759,422 2,045,316

1,664,965 1,086,856

946,164

219.292 790,553

$

23,40r,.5.i5

22 993,249 101381,066

9.-21S.310

7,204,783

8,049,334

2,664,942

2,592,329

Agriculture. â€” The agricultural products of the state vary but little from year to year, having had an annual value of Â§13,500,000 to Â§14,500,000 (in 1890, S13,761,0b0); but the census of 1900, with a changed method of computing, gave the value of the product for 1899 as Â§21,929,988. The principal crops in 1899 were as follows : â€”

Acreage.

Production.

Value.

Buckwheat

1,835

43,360 bushels

Â§19,334

Barley

1,696

46,680 â€ž

25,189

Indian corn

25,694

1,080,720 â€ž

638,738

Oats .

12,580

497,110 â€ž

184,026

Potatoes

19,422

2,420.(!fi8 â€ž

1,090,495

Hay and forage .

615,042

654,973 tons

6,336,252

The crop of apples for the same year was 1,978,797 bushels. In 1900 there were 29,324 farms, and their average size was 1231 acres. The total improved acreage was 1,076,879 acres, and the unimproved was 2,532,985. The value of farms, exclu- sive of stock and implements, was 870,124,360. Sheep-raising, which was formerly a prominent industry, has steadily declined, and horses have taken the place of oxen in farm work, but the introduction of creameries has increased the dairy interest. The value of live stock in 1900 was $10,554,646. The* relative proportion of farm stock in various years is shown by the subjoined table : â€”

NEW HAMPSHIEE

153

1880.

1890.

190U.

Horses . . . . Dairy cows Other neat cattle Sheep (notincluding lambs)’ Swine . . . .

46,773

90,564

141,831

211,825

53,437

52,458 109,423 113,465 131,611

58,685

54,866

115,036

111,756

65,318

61,211

A fish and game commission has in charge the stoclcing of the inland waters of the state with flsh. There are eleven hatcheries, from which there were distributed in 1900 to the various ponds and brooks 3,256,000 fry, mainly of salmon, salmon trout, brook trout, and lake trout. The principal fresh-water fish are trout, pickerel, black bass, eels, and pout. Under the operation of the game laws there has been a marked increase of the fish throughout the state, and of deer in the forests of the northern part.

Bailways. â€” There was little railway construction during the period 1880-1900, the total mileage in 1901 being only 1189-5 miles, against 1051 in 1880 ; but there has been a steady move- ment towards consolidation. The sentiment of the state was for- merly very hostile to the absorption, or even the leasing, of one line by another, but the excessive expense of maintenance, and the actual or threatened bankruptcy of many short lines, led in 1883 to the passage of a law, under which, since 1886, when there were thirty-four companies working within the state, one line after another has been leased or absorbed, till now all are merged in three systems â€” the Boston and Maine, the Maine Central, and the Grand Trunk. The Boston and Maine controls 1037 miles of the state mileage. Up to 1889 the cost of the railways of New Hamp- shire was about $40,000,000, and since that time about $7,000,000 have been spent in improvements and enlargements. AH of the three systems have a large or major part of their mileage out of the state. There is some movement towards the building of electric lines in various parts, but few have been actually constructed.

The ordinary highway roads are very poor, varying according to soil and the knowledge and skill of local supervisors. The question of their improvement has become a public one, and the governor has urged upon the legislature the adoption of measures looking towards the intelligent development of a system of good roads throughout the state. ‘ ‘ Good roads ” institutes are also held under the direction of the Board of Agriculture.

Edueation. â€” The ” rural school ” has been and still is one of the most difficult problems in New Hampshire, but there has been a gradual tendency to centralize, when possible, and to diminish the number while increasing the efficiency of the schools. In comparison with 1882 the statistics are as follows : â€”

Number of Schools.

Graded.

High,

Teachers.

1882 1900

2644 2198

481 773

56 61

3075 2740

Enrolment.

Expenditures.

Average Length (Weeks).

Public.

Prirate.

1882 1900

64,349 65,668

4,275 10,315

$584,627.74 1,052,202.36

22-9 29-53

The expenditures of 1900 include $113,423.32 for buildings, per- manent repairs, and the payment of interest and debt. The enrolment includes all who attended school two weeks or more, the average attendance being 47,276. In 1899 an Act was passed allowing towns to form ” supervisory districts for the purpose of employing superintendents of public schools therein.” In certain cases a part of the salary of such superintendents is paid by the state, which annually appropriates $25,000 for that purpose. In 1890 the illiterates over ten years of age formed 6.81 per cent, of the population. The Normal School receives an annual appro- priation of $10,000 from the

state. There are two institutions of higher learning, Dartmouth College at Hanover, and the New Hampshire College of Agriculture and the Mechanic Arts, at Durham. With Dartmouth College, which has classical, literary, and scientific courses, there are connected graduate schools in medicine, civil engineering, and administration and finance. The college has a faculty of 65 members, 768 students, 7164 alumni, and a library of over 85,000 volumes. The College of Agriculture and the Mechanic Arts has a faculty of 23 members, 134 students, 204 graduates, and its library contains about 7000 volumes. In 1891 in connexion with education a law was passed, authorizing the establishment in each town of a free public library, and granting under certain conditions state aid. In 1895 this was changed to a modified requirement, so that in 1898, 15 towns were accumulating a library fund by annual assessment, and 204 towns had free libraries, containing 403,942 volumes, having an

annual appropriation of $48,789. There were also 277 other libraries, containing 703,787 volumes. The state library had 48,810 volumes.

Banks. â€” The banking facilities have undergone little change. On 30th September 1901 there were fifty-two national banks, with a capital of $5,380,000, surplus and undivided profits of $2,329,502, circulation of .$4,599,769, deposits of $14,.S41,009, and loans and discounts oÂ£ $13,467,698. There were also ten state banks and trust companies, with a capital of $610,000 and deposits of 31,073,318. The savings banks made remarkable progress until 1893, the year of their greatest prosperity. Then hard times seriously affected them, no less than twenty-five having gone into voluntary or forced liquidation. The condition of these banks at successive periods is as follows : â€”

Number of Banks.

Depositors.

Average Deposits.

Total Deposits.

1880 1890 1893 1900

67 72 70 52.

89,934 162,782 174,654 129,135

$313.61 411.35 425.85 399.07

$28,204,791 65,727,019 74,-377,278 51,535,748

In 1893 there were also fourteen trust companies with savings bank departments, having deposits of $4,144,097, so that the total savings deposits of the state for that year were $78,521,376 in solvent companies. In 1900 there were seven such solvent in- stitutions having deposits of $2,510,00-5, making the total of such deposits $54,045,753, in addition to $8,445,704 in banks in liqui- dation. In the same year there were seventeen building and loan associations, with assets of $1,863,507.

Finances. â€” In 1900 the assessed valuation ‘ of the state was $208,080,845, and the equalized valuation, including the inven- tories of the towns, savings banks deposits, and capital of railway and insurance companies, was $287,635,476. The total taxation, including the state tax of $425,000, was Â§4,728,337, or $11.49 per caput. The net debt of the state was, 1st June 1900, $1,118,798, that of the counties was $683,889, that of the towns was 37,796,145, and of the precincts Â§1,415,539 â€” a total indebtedness for the state of $11,014,371, or $26.67 per caput. The gross debt was

$13,269,286.

Beligion. â€” The statistics of the larger religious denominations of the state for 1899 are given below. Those of the Methodists in- clude a few towns in Massachusetts, and exclude a few in eastern New Hampshire associated with a Maine conference.

1

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2 Â«S

g

â– 2

g

g-gj

d

H

S

Â£cÂ« =

1^1

Baptist

84

96

9,719

10,490

547,200

F. W. Baptist .

101

86

8,24q

7,098

416,850

Congregational .

196

212

20,25r

21,178

1,500,0001

Episcopal .

46

35

3,894

1,898

443,121

Roman Catholic

77

93

100,000

...

Unitarian .

27

23

3,2521

...

357,2001

Universalist

34

...

1,250

1,600

260,000

There are also two communities of Shakers, three conferences of Christians, four churches, and ten societies of Christian Scientists in the state.

Politics. â€” Since 1874, when it elected a Democratic governor. New Hampshire has been a Republican state, though for many years the elections were very close, and in several years the legislature has chosen the governor, no candidate having attained the majority necessary for election. As showing the relation of the two principal parties, the votes for governor and for President of the United States are given below, the vote for 1896 being specially noticeable, as indicating the split in parties brought about by the silver movement.

Governor.

President.

Republican.

Democratic.

Republican.

Democratic.

1880 1884 1888 1892 1896 1900

44.435 42;513 44,904 43,776 48,387 63,891

40,866 39,637 51,201 41,501 28,383 34,956

44,852 43,250 46,735 45,643 57,444 54,799

40,794 39,189 43,457 42,094 21,271 35,489

The mechanism of the state government has undergone no change during the period 1886-1900, except that since 1888, when slight

1 Figures of 1895.

changes were made in the state constitution, the legislature meets biennially in January instead of June.

In the Spanish-American war New Hampshire furnished under the first call one regiment of 1009 officers and men, which, however, was not called into active service, and was mustered out 12th October 1898. Under the second call 318 volunteers were furnished.

Authorities. â€” The statistics of the industries of the states are given in the reports of the United States census and in reports issued by various state commissions annually or biennially.

(j. K. L*.)

Newhaven, a seaport and parish in the Eastbourne parliamentary division of Sussex, England, 8^ miles oast by south of Brighton by rail, at the mouth of the river Ouse. There is a daily service of fast steamers to Dieppe. . Steamers also leave for Caen, St Nazaire, and Jersey. A new quay has been opened for the Continental service, and two piers and a breakwater (2700 feet long) have been constructed at a cost of Â£562,000. In 1890 1579 vessels of 349,741 tons entered, and 1582 of 354,005 tons cleared; in 1900, 2471 vessels of 605,009 tons entered, and 2426 of 499,020 tons cleared. Population

(1881), 4009 ; (1901), 6772.

New Haven, a town and the largest city of Connecticut, U.S.A., capital of New Haven county, situated at the head of New Haven Harbour, an inlet from ‘ Long Island Sound, in the southern part of the state, and at the intersection of several branches of the New York, New Haven, and Hartford railway. The plan is irregular, with broad, well-shaded streets, which are paved with brick or granite blocks in the business sections, and in the residence sections are in part mac- adamized. It is divided into fifteen wards. Its water supply, derived by pumping from Lake Whitney, is in private hands. It is the seat of Yale University. The city has a large commerce by rail and by steamers on Long Island Sound. In 1900 it

contained 1236 manufacturing establishments, employing a total capital of $30,463,066. The average number of hands was 20,536, and the pro- ducts had a value of $40,762,015. These products were very varied ; carriages and waggons, and materials for the same, had a value of $2,984,953 ; hardware, $2,218,032 ; corsets, $1,893,956 ; and foundry and machine-shop pro- ducts, $1,716,028. The assessed valuation of real and personal property in 1900 was $115,698,807; the net debt was $3,690,909, and the rate of taxation, $16.50 per $1000. The receipts, apart from loans, amounted to $1,680,384, and the expenditures, exclusive of loans repaid, to $1,739,946. The death-rate in 1900 was 15-89. Popu- lation (1890) of the town, including the city, 86,045 ; of the city, 81,298 ; (1900), of the city, 108,027, of whom 30,802 were foreign-born and 2887 negroes.

New Hebrides. See New Caledonia.

New Iberia, a city of Louisiana, U.S.A., capital of Iberia Parish, on the Bayou Teche and on the Southern Pacific railway, in the southern part of the state. It is in a lumber region, and its industries consist chiefly in the manufacture of cypress lumber. Sugar, cotton, and rice are raised, with cultivation, in the surrounding country. Population (1890), 3447; (1900), 6815, of whom 234 were foreign-born and 3309 negroes.

New Ireland, now Neu-Meoklbnbubg. See New Guinea (Gebman).

New Jersey, an eastern state of the United States, situated between 41Â° 21′ 22.6″ N. and 38Â° 55′ 40″ N., and 73Â° 53′ 39″ W. and 75Â° 35′ W. The extreme in length is 166 miles, in breadth 57 miles; its narrowest part is 33^ miles. The total frontier measures 487 miles, of which all but 48 miles is defined by natural boundaries.

rivers, bays, and oceans. The highest land has an elevar tion of 1803 feet. The area is 8,224-44 square miles, or 5,263,641 acres; of this the land surface is 7614-40 square miles, or 4,809,218 acres.

Population. â€” Notwithstanding its comparatively small area. New Jersey stood with a population in 1890 of 1,444,933, just midway among the states, and in 1900 of 1,883,669, of whom 941,760 were males, and 941,909 females, the rate of increase from 1890 to 1900 being 30-4. In

density of population for the land area New Jersey was third in rank in 1900, there being at that time to each square mile of land area an average population of 250-3. There were (1900) ten cities, the population of each of which exceeded 25,000, namely :â€” Newark, 246,070; Jersey City, 206,433 ; Paterson, 106,171; Cam- den, 76,935; Trenton, 73,307; Hoboken, 59,896; Elizabeth, 52,130; Bayonne, 32,722; Atlantic City, 27,838 ; Passaic, 27,777. The percentage of increase of the five largest of these cities during the decade 1890- 1900 was as follows :â€” Newark, 36-5; Jersey City, 26-6; Paterson, 34-2; Camden, 30-2; Trenton, 27-5. The aggregate of population in these ten cities in 1890 was over 900,000, or about half of the total population of the state. In 1900 there were 32 cities or incorporated places, having each a population of more than 2000 and less than 5000, and having an aggregate population of 107,671 ; and 40 places having more than 5000 inhabit- ants each, and an aggregate population of 1,232.669. The village and rural population in 1870 was 469,435, in 1895, 514,176, and in 1900, 643,429. For the last generation, therefore, the rural population has remained comparatively stationary, while the population of the cities has increased about threefold. The proportion of foreign residents in 1880 was 3-65 per cent., and in 1890, 3-56. The state seems, therefore, to have received its full share of immigrants, for the total population of New Jersey in the census of 1890 was 2-25 per cent., and its area one-quarter of 1 per cent, of that of the United States. Since 1870, while the increase of native-born residents has nearly kept pace with the increase of foreign-born, much of the native population has sprung from foreign parentage, the census of 1900 showing that over 60 per cent, of the total population have both parents foreign-born. The percentage of the negro popu- lation to the total population has increased slightly, being 3-7 per cent, in 1900, and numbering 69,844. Proximity to the coast and a milder climate have given the state a somewhat larger j)roportion of coloured persons than western states on the same parallel of latitude.

Instruction. â€” The Constitution provides (1) That the state shall maintain an efficient system of public schools for all children between the ages of five and eighteen ; (2) That the legislature shall not pass any private, local, or special law providing for the management and support of the public schools ; (3) That no apportionments of any kind shall be made for the support’ of denominational schools. The state Boai-d of Education

prescribes rules for the enforcement of the school law, and appoints county superintendents. The state superintendent, appointed by the governor, apportions the school funds among the counties, and has a general oversight of the schools of the state. County superintendents, holding office for three years, apportion school moneys among the several townships and districts, and examine and license teachers. School trustees, nine in number, hold office for three years ; may be women, chosen by voters of the district ; employ teachers and fix their salaries ; erect and keep (in repair school buildings. Cities have separate boards of education and a city superintendent. Under the control of the state Board of Education are â€” a normal school for the training of teaehei-s, with which are connected a model school, a preparatory school, a school for the de

(3) special district tax. Acts of the legislature of 1816 and 1817 began the creation of a school fund by the investment for that purpose of certain stock shares, belonging to the state. The Revised Constitution of 1844 guarantees the security and per- manence of the funds, and the legislature from time to time has provided for its maintenance and increase by diverting to its purposes state revenues, arising from various sources. From the income of this fund annual apportionments are made. The principal of the school fund in 1901 vras |3,773,351, from which the total income was Â§186,428. A large part of the cost of main- taining the schools is met each year by a school tax on the taxable property at the rate of 2| mills on each dollar of rateables, which in 1901 amounted to Â§2,287,395. The largest part of the cost of the schools is met by a district tax and city taxes. In 1901 these special taxes aggregated $4,027,575. By the school census of 1900 the children of school age numbered 463,565 ; of these 322,575 were enrolled in the public schools. The enrolment in the normal school for the year 1901 was 645 ; in the model school, 536. In the year 1900 there were in the state 1091 children over 10 years of age unable to read, and 7236 under 15 employed in factories, mines, and stores. The total value of school buildings is given as $15,634,471. The number of teachers was, men 998, women 6536. The average monthly salary for men was 186.63 ; for women, $50.07.

In 1900 reports were received from twenty-one communities throughout the state showing an ex- penditure for that year for manual and industrial training of $88,944. In New Jersey alone of the thirteen original colonies was there, prior to the War of Independence, more than one chartered institution of higher education. Princeton University received its charter in 1746 as the college of New Jersey, and, though it has never had direct relations with the state, has during its career been of inestimable value to the state and nation. At the sesquicentennial celebration in 1896 this college took the name of Princeton University. Rutgers College, founded in 1766 as Queen's College, is situated at New Brunswick. The Rutgers Scientific School was designated under the auspices of the United States Law of 1862 as the State College for the benefit of agriculture and the mechanic arts, and as such maintains courses in agriculture, biology, chemistry, electricity, and engineering, in which students from New Jersey to the number of 290 are, under certain conditions, admitted to free tuition. As a department of this State College, by a law of the United States of 1887, an agricultural experiment station was organized, which, in co-operation with a similar state station established in 1880, has been of great service to the agriculture of New Jersey, and to agricultural science in general.

Charitable Institutions. â€" There are for the care of the insane two state hospitals and nine county asylums, containing in the aggregate, for 1899, 4063 patients cared for by the state at a cost of Â§334,342.85. Provision was made in the same year for the blind, feeble-minded, and deaf mutes at a cost of about $120,000. A village for epileptics was opened in 1898. The penal institutions are the state prison at Trenton, with 1119 inmates at the close of the year 1899, whose cost of maintenance, exclusive of salaries and gratuities to dis- charged prisoners, was .Â§86,756; the reform school for boys at Jamesburg with 405 inmates ; the industrial school for girls at Trenton, and the new state reformatory at Rahway.

Beligion.- â€" In 1890 the total number of religious organizations in New Jersey was 2085, and of edifices, 2204 ; the value of church property was $29,490,414; the number of communicants or members was 508,351, being 38-18 per cent, of the total population. Reports for the years named give the following statistics for the various denominations : Methodists in 1900, 577 churches, 439 ministers, 91,027 members, value of church property,

$6,425,670; Presbyterians (1900), 328 churches, 452 ministers, 68,278 members, value of church property in 1890, $6,800,000 ; Baptists (1899), 312 churches, 330 ministers, 52,874 members, value of church property, $4,527,526 ; Protestant Episcopal (1900), 243 churches, 237 ministers, 40,311 members, and church property in 1890 valued at $3,860,350 ; the Reformed Church in America (1900), 122 churches, 143 ministers, 26,549 members; the Roman Catholics (1899), 347 priests, 183 churches, the Roman Catholic population in the same year amounting to 329,510.

Agriculture. â€” In 1900 there were 34,650 farms, containing 2,840,966 acres. The improved land amounted to 1,977,042 acres, and the unimproved to 863,924 acres. The total value of farm property was 8189,533,660, and was made up as follows: land improvements and buildings, $162,591,010 ; implements and machinery, $9,330,030 ; live stock, $17,612,620. During the pre- ceding year $6,720,030 was expended on labour, and $2,165,320 on fertilizers. Of the total number of farms, 70-1 per cent, were worked by the owners, 15-3 per cent, by cash tenants, and 14-6 per cent, by share tenants. The total value of farm products in 1899 was $43,657,529 ; the acreages, quantities, and values of the principal crops were as in table following. The three most important orchard fruits are apples, peaches, and pears. The number of trees in 1900 and the quantity of fruit produced the preceding year were : apples,

Crops.

Acres.

Quantity.

Value.

Indian com .

295,258

10,978,800 bushels

$4,5.33,473

Wheat .

132,571

1,902,590 â€ž

1,347,6.50

Oats .

75,959

1,601,610 â€ž

492,.S41

Rye

68,967

831,410 â€ž

442,446

Hay and forage .

444,610

542,796 tons

5,544,070

Potatoes

52,896

4,542,816 bushels

2,192,456

Sweet potatoes .

20,588

2,418,641 â€ž

1,213,010

Miscellaneous vege-

tables

76,897

4,914,803

Small fruits .

25,371

1,406,049

Orchard fruits

80,634

6,168,480 bushels

2,594,981

Flowers and plants

614

1,053,290

Forest products .

...

469.006

1,810,793 trees, 4,640,896 bushels ; peaches, 2,746,607 trees, 620,928 bushels ; and pears, 926,117 trees, 790,818 bushels. The number and value of farm animals in 1900 were as follows : 154,409 dairy cows, $5,840,228 ; 82,577 other ,neat cattle, ,‘i;l,358,879 ; 94,024 horses, $7,582,274 ; 4931 mules and asses, $356,492 ; 26,363 sheep (not including lambs), Â§118,924; 175,387 svrine, $926,179.

Manufacturing. â€” New Jersey ranks among the chief manu- facturing states in the Union. The manufacture of silk goods (included in the following statistics under textiles) is the leading industry, which employed in the year 1900 an average of 24,157 hands, and turned out products valued at Â§39,966,662. The general statistics of manufacture in 1890 and in 1900 were as follows : â€”

1890.

1900.

IncreaFt’.

Establishments .

9,225

15,481

67-8

Capital

$250,805,745

$502,824,082

100-5

Salaried employes

13,620 1

16,283

19-6

Salaries

$13,834,618 1

$19,688,946

42-3

Wage-earners

173,778

241,5822

39-0

Total wages

$82,944,118

$110,088,605

32-7

Miscellaneous expenses

$18,458,052

.Â§42,6-54,076

131-1

Cost of materials used

Â§189,365,740

$360,945,843

90-6

Value of products

$354,573,571

$611,748,983

72-5

The product of each of fifteen leading industries exceeded Â§5,000,000. These wereâ€” chemical products, Â§12,207,289; elec- trical apparatus and supplies, $6,447,154 ; foundry and machine- shop products, Â§32,621,229; glass, $5,093,822; iron and steel, Â§24,381,699; jewellery, Â§7,379,777; leather, Â§13,747,155; malt liquors, $14,386,456 ; lumber, planing-mOl products, includ- ing sashes, doors, and blinds, $5,107,217 ; petroleum refining, $29,649,460; pottery, brick, and fire-clay products, Â§8,940,723; rubber and elastic goods, Â§8,458,274 ; sewing machines and attach- ments, Â§6,643,348; textiles, Â§72,921,528; tobacco, Â§10,435,974.

Bailways. â€” There are 116 railway and canal companies subject to taxation. The total length of railways in 1897 was 2263 miles ; of canals, 173 miles. The total trackage was 4590 miles, of which four-fifths was laid with steel rails, the remainder with iron. The number of railway miles to each 100 square miles of area was 29-72, being largely in excess of that of any other state in the Union. There is scarcely a place that is more than 5 mUes distant from a railway line. The total value of railway property is very consider- able, as the terminals of most of the railways affording transporta- tion to New York City are within New Jersey.

Finance. â€” In 1899 the total taxable property was valued at $866,030,048. The value of all property, including railway and canal property,exemptpropertyanddeductionsfordebt,was$l,223,815,062. The total assessed valuation, for 1898, of railway and canal property was

$222,417,748, and the amount of tax levied thereon in the year 1899 for state uses was Â§1,112,088; for local uses, Â§427,019 ; atotal of $1,539,107. The school tax is the only direct state tax levied upon the people. This in 1899 amounted to $2,284,310. The state is without debt. The last of the bonds issued for the Civil War, amounting to $71,000, fell due upon the 1st of January 1902. On 31st October 1901 there was a balance in the treasury of Â§2,351,683. The disbursements from the state treasury for all purposes for the year ending 31st October 1901 were Â§3,480,350.

Banking. â€” On the Ist of January 1900 there were 108 national banks, with an aggregate paid-up capital of Â§14,795,215 ; resources, Â§110,555,252 ; and with individual deposits amounting to $71,274,754. The 26 savings banks in the state had at the same date total resources of $61,184,322 ; deposits, $54,713,698 ; depositors, 191,572 ; the average amount of each account being $285. The state banks numbered 20, having capital paid up, $1,753,750; total resources, Â§12,315,993; deposits, $8,826,840.

1 Includes proprietors and firm members, with their salaries.

2 Includes 181,879 men, 51,661 women, and 8042 children under sixteen years of age.

The trust companies numbered 25 ; total capital, $3,657,400 ; total resources, $i3,029,692 ; deposits, $33,856,403. These three kinds of banks under state control have aggregate resources of $116,530,007; deposits, $97,396,941. There were in New Jersey in 1897, 334 co-operative building and loan associations, whose net assets were $44,842,336 ; and whose shareholders numbered 116,739 ; and borrowers, 30,842 The total invested on bond and mortgage was $40,941,291 ; the aggregate receipts were $19,833,241 ; and the disbursements, $18,403,551. The number of houses ac- quired or begun building by borrowers from loan associations during the year was 2381.

National Guard. â€” In 1899 a commission was appointed with a view to the reorganization of the national guard, and the codifica- tion and amendment of the National Guard Law. The national guard, well maintained and highly efficient, consists of 238 officers and 3455 enlisted men, organized into 4 regiments of 12 companies each of infantry, 2 Gatling gun companies, and 2 troops of cavaliy. The naval reserve consists of 2 battalions of 2 divisions each. The state expended for the national guard during the year 1899, $277,903 ; and for the naval reserve, $16,528. New Jersey supplied to the United States forces in the Spanish-American War 4 regiments of national guard volunteer infantry of 12 companies each, number- ing 5348 officers and men, and 343 men from the naval reserve.

Legislation. â€” The State Constitution adopted 2nd July 1776 was maintained as the organic law until 1844, when it was thoroughly revised. In 1875 important amendments were incor- porated forbidding the use of public moneys for sectarian purposes ; guaranteeing public schools for ever ; and forbidding special legislation. In 1893 laws were passed legalizing race-track gambling, which were, however, speedily repealed ; and in 1897 the Constitution was amended so as to prohibit the passing of laws authorizing pool-selling, book-making, or gambling of any kind. Legislation permitting the incorporation of so-called trusts has had a vast economic and political importance, but the policy of encouraging by law the massing of capital for the promotion of industries is more than 100 years old in New Jersey. In the first seven months of 1899 there were organized under the laws of New Jersey 1336 corporations, with an aggregate capital of more than $2,000,000,000, and of corporations with a capital of over $10,000,000 there were formed in the same time in New Jersey 61, in all the other states 60. New Jersey was among the very first of the states to pass a law allowing state aid for the improving of public roads. The first State Aid Law of this kind, passed in 1892, appropriated $75,000 annually, to meet equal appropriations on the part of the counties. Later legislation increased this annual appropriation to $300,000. The total outlay for state highways during 1893-1900 was more than $2,150,000, and New Jersey at the end of the 19th century had more miles of improved roads than any state in the Union. Legislation in the interest of labour and laws equalizing taxation and assessing railways and other corporations have been a marked feature.

Political Life. â€” The population of New Jersey, of mixed origin â€” Dutch, Swedish, Scotch, Irish, English â€” embracing early settlements of Quakers, Calvinists, Episcopalians, and other sects, under the successive governments of lords proprietors, royal charters, and republican constitutions, has from the first developed personal independence and democratic ideas. Conservatism has loeen a marked feature of its history. This is noticeable in the judicial system, for example, the Court of Chancery being retained in New Jersey, though rejected by the other original states of the Union ; the judiciary is also appointive and not elective. In recent years the great industrial growth, ready means of quick communi- cation, facilities for easy transportation, a large influx of residents whose business interests are chiefly in the great cities of New York and Philadelphia, have made the state responsive to the influence of forces which dominate in large spheres of action throughout the Union. In twenty of the twenty -nine Presidential elections since the formation of the National Government the vote of New Jersey has been recorded in favour of the successful candidates. Since the Civil War the state has generally favoured the Democratic party. In the Presidential elections of 1896 and 1900, however, the majorities, greater than ever before given by the state, have been in favour of the view of the money question taken by the Republican party. This question and that of racecourse legislation have also in recent years placed the state legislature and administration in the hands of the Republican party. The popularity of the late Vice-President Garret A. Hobart, who was a citizen of New Jersey, contributed to this result. (a. Sc.)

New Kensington, a borough of Westmoreland county, Pennsylvania, U.S.A., on the Allegheny river and the Allegheny Valley railway, 18 miles north-east of Pittsburg, in the western part of the state. It has exten- sive glass, iron and steel, and white-lead works. It was founded in 1891. Population (1900), 4665, of whom 1042 were foreign-born and 86 negroes.

Newlands, John Alexander Reina (1838- 1898), English chemist, was born in 1838. He was one of the first, if not quite the first, to propound the con- ception of periodicity among the chemical elements. His earliest contribution to the question took the form of a letter published in the Chemical Neivs in February 1863. In the succeeding year he showed, in the same journal, that if the elements be arranged in the order of their atomic

weights, those having consecutive numbers frequently either belong to the same group, or occupy similar positions in different groups, and he pointed out that each eighth element starting from a given one is in this arrangement a kind of repetition of the first, like the eighth note of an octave in music. The Law of Octaves thus enunciated was at first ignored or treated with ridicule as a fantastic notion unworthy of serious consideration, but it was subsequently elaborated by Mendeleeff and other workers, and as the Periodic Law has taken its place as one of the most important generalizations in modern chemical theory. Newlands, who was of Italian extraction on his mother's side, and fought as a volunteer in the cause of Italian freedom under Garibaldi in 1860, died in London on 29th July 1898. He collected his various papers on the atomicity of the elements in a little volume on the Dis- covery of the Periodic Law published in London in 1884.

New London, a city and seaport of Connecticut, U.S.A., capital of New London county, on the Thames river, a short distance above its mouth, in Long Island Sound, in the south-eastern part of the state. It has an excellent harbour, probably the best on the Sound, and a large commerce, having daily steamboat communication with New York. It has two railways â€" the New York, New Haven, and Hartford, which passes through it, and the Central Vermont, which has here its southern ter- minus. In the palmy days of the whale industry, New London was one of the principal home ports of vessels engaged in that industry, but with its decline the city lost in importance. In recent years, owing largely to the introduction of manufactures, it has received a new impetus. It produces silk and woollen goods, and other minor products. In 1900 there were 238 manufacturing establishments, having a total capital of $4,522,003, em- ploying 2658 wage-earners, and turning out products valued at $5,669,616. The inter-collegiate races between Yale and Harvard Universities are commonly rowed on the river at New London. Population (1890), 13,767 ; (1900), 17,648, of whom 3743 were foreign-born and 378 were negroes.

Newlyn School of Painting.

Painting.

See Schools or

Newman, Francis William (1805-1897), Eng- lish scholar and miscellaneous writer, younger brother of Cardinal Newman, was born in London, 27th June 1805. Like his brother, he was educated at the Rev. Dr Nicholas's school at Ealing, and subsequently at Oxford, where he had a brilliant career, obtaining a double first class in 1826. He was elected fellow of Balliol in the same year. Conscientious scruples respect- ing the ceremony of infant baptism led him to resign his fellowship in 1830, and he went to Baghdad as assistant in the mission of the Eev. A. N. Groves. In 1833 he returned to England to procure additional support for the mission, but rumours of unsoundness in his views on the doctrine of eternal punishment had preceded him, and finding himself generally looked upon with suspicion, he gave up the vocation of missionary to become classical tutor in an unsectarian college at Bristol. His letters written home during the period of his mission were collected and published in 1856, and form an interesting little volume. Newman's views matured rapidly, and in 1840 he became

professor of Latin in Manchester New College, the cele- brated Unitarian seminary long established at York, and eventually the parent of Manchester College, Oxford. In 1846 he quitted this appointment to become professor in University College, London, w^here he remained until 1869. During all this period he was assiduously carry- ing on his studies in mathematics and Oriental languages, but wrote little until 1848, when he published anony- mously a History of the Hebrew Monarchy, intended to introduce the results of German investigation in this department of Biblical criticism. In 1849 appeared Tlie Soul, her Sorrows and Aspirations, and in 1850, Phases of Faith, or Passages from the History of my Creed â€" the for- mer a tender but searching analysis of the relations of the spirit of man with the Creator ; the latter a religious autobiography detailing the author's passage from Cal- vinism to pure Theism. It is on these two books that Professor Newman's celebrity will principally rest; hav- ing in both to describe his personal experience, his intense earnestness has kept him free from the eccentricity which marred most of his other writings, excepting his contri- butions to

mathematical research and^Oriental philology. There was, indeed, scarcely a crotchet, except ” spiritual- ism,” of which he was not at one time or another the advocate. His versatility was amazing : he wrote on logic, political economy, English reforms, Austrian poli- tics, Eioman history, diet, grammar, the most abstruse departments of mathematics, Arabic, the emendation of Greek texts, and languages as out of the way as the Ber- ber, and as obsolete as the dialect of the Iguvine inscrip- tions. In treating all these subjects he showed signal ability, but, wherever the theme allowed, an incurable crotchetiness ; and in his numerous metrical translations from the classics, especially his version of the Iliad, he betrayed an insensibility to the ridiculous which would almost have justified the irreverent criticism of Matthew Arnold, had this been conveyed in more seemly fashion. His miscellaneous essays, some of much value, were col- lected in several volumes before his death : his last pub- lication, treating of the early life of his celebrated brother, was generally condemned as deficient in fraternal feeling. He was far from possessing his brother’s subtlety of reasoning, but he impresses by a transparent sincerity and singleness of mind not always displayed by the more celebrated writer ; his style is too individual to be taken as a model, but is admirable for its simplicity and clear- ness. His character is vividly drawn by Carlyle in his life of Sterling, of whose son Newman was guardian : ” a man of fine attainments, of the sharpest-cutting and most restlessly advancing intellect, and of the mildest pious enthusiasm.” I-^was his great misfortune that this enthusiasm should have been correlated, as is not un- frequently the case, with an entire insensibility to the humorous side of things. After his retirement from University College, Professor Newman continued to live for some years in London, subsequently removing to Clifton, and eventually to Weston-super-Mare, where he died on 7th October 1897. He had been blind for five years before his death, but retained his faculties to the last. He was twice married. (e. g.)

Newman, John Henry (1801-1890), Cardinal, the most remarkable English ecclesiastic of the 19th century, was born in the City of London, 21st February 1801, the eldest son of Mr John Newman, banker, of the firm of Eamsbottom, Newman, and Co. The family was understood to be of Dutch extraction, and the name itself, spelt ” Newmann ” in an earlier generation, further suggests Hebrew origin. His mother, Jemima Pourdrinier, was of a

Huguenot family, long estab- lished in London as engravers and paper manufac-

turers. John Henry was the eldest of six children. The second son, Charles Robert, a man of ability but of impracticable temper, a professed atheist and a re- cluse, died in 1884. The youngest son, Prancis William, an excellent philologist, was for many years professor of Latin in University College, London. He was a devout theist but a keen critic of orthodox Christianity, and as a humanitarian he gained the reputation of a faddist. He died in 1897. Two of the three daughters, Har- riett Elizabeth and Jemima Charlotte, married brothers, Thomas and John Mozley ; and Anne Mozley, a daughter of the latter,^ edited in 1892 Newman's Anglican Life and Correspondence, having been entrusted by him in 1885 with an autobiography written in the third person to form the basis of a narrative of the first thirty years of his life. The third daughter, Mary Sophia, died unmarried in 1828.

At the age of seven Newman was sent to a private school conducted by Dr Nicholas at Ealing, where he was distinguished by diligence and good conduct, as also by a certain shyness and aloofness, taking no part in the school games. He speaks of himself as having been " very super- stitious " in these early years. He took great delight in reading the Bible, and also the novels of Scott, then in course of publication. At the age of fifteen, during his last year at school, he was " converted," an incident that throughout life remained to him "more certain than that he had hands or feet." It was in the autumn of 1816 that he thus fell under the influence of a definite creed, and received into his intellect impressions of dogma never afterwards effaced. The tone of his mind was at this date evangelical and Calvinistic, and he held that the Pope was anti-Christ. Matriculating at Trinity College, Oxford, 14th December 1816, he went into residence there in June the following year, and in 1818 he gained a scholarship of Â£60, tenable for nine years. But for this he would have been unable to remain at the university, as in 1819 his father's bank suspended payment. In that year his name was entered at Lincoln's Inn. Anxiety to do well in the final schools produced the opposite result ; he broke down in the examination, and so graduated with third-class honours in 1821. Desiring to remain in Oxford, he took private pupils and read for a fellowship at Oriel, then " the acknowledged

centre of Oxford intellectualism.” To his intense relief and delight he was elected, 12th April 1822. E. B. Pusey was elected a fellow of the same society in

1823.

On Trinity Sunday, 13th June 1824, Newman was ordained, and became, at Pusey’s suggestion, curate of St Clement’s, Oxford. Here for two years he was busily engaged in parochial work, but he found time to write articles on ” Apollonius of Tyana,” on ” Cicero,” and on ” Miracles ” for the Encyclopaedia MetropoUtana. In 1825, at Whately’s request, he became vice-principal of St Alban’s Hall, but this post he held for one year only. To his association with Whately at this time he attributed much of his ” mental improvement ” and a partial conquest of his shyness. He assisted Whately in his popular work on logic, and from him he gained his first definite idea of the Christian Church. He broke with him in 1827 on the occasion of the re-election of Peel for the University, Newman opposing this on personal grounds. In 1826 he became tutor of Oriel, and the same year R. H. Proude, described by Newman as ” one of the acutest, cleverest, and deepest men” he ever met, was elected fellow. The two formed a high ideal of the tutorial office as clerical and pastoral rather than secular. In 1827 he was a preacher at Whitehall. The year following Newman supported and secured the election of Hawkins as provost of Oriel in preference to Keble, a choice which he later defended or apologized for as having in effect produced the Oxford

Movement with all its consequences. In the same year he was appointed vicar of St Mary’s, to which the chapelry of Littlemore was attached, and Pusey was made regiiis professor of Hebrew. At this date, though still nominally associated with the Evangelicals, Newman’s views were gradually assuming a higher ecclesiastical tone, and while local secretary of the Church Missionary Society he circu- lated an anonymous letter suggesting a method by which Churchmen might practically oust JSTonconformists from all control of the Society. This resulted in his being

dismissed from the post, 8th March 1830 ; and three months later he withdrew from the Bible Society, thus completing his severance from the Low Church party. In 1831-32 he was select preacher before the University. In 1832, his difference with Hawkins as to the ” sub- stantially religious nature ” of a college tutorship becom- ing acute, he resigned that post, and in December went with E. H. Froude, on account of the latter’s health, for a tour in South Europe. On board the mail steamship Hermes they visited Gibral- tar, Malta, and the Ionian Islands, and subsequently Sicily, Naples, and Eome, where Newman made the acquaintance of Dr Wiseman. In a letter home he described Rome as ” the most wonder- ful place on earth,” but the Roman Catholic religion as “polytheistic, degrading, and idolatrous.” It was during the course of this tour that , he wrote most of the short ‘‘‘M, poems which a year later ‘m i were printed in the Lyra ’’ Apostolica. From Eome Newman returned to Sicily alone, and was dangerously ill with fever at Leonforte, recovering from it with the conviction that he had a work to do in England.

In June 1833 he left â– Palermo for Marseilles in an orange boat, which was be- calmed in the Strait of Bonifacio, and here he wrote the verses, ” Lead, kindly Light,” which later became popular as a hymn. He was at home again in Oxford, 9th July, and on the 14th Keble preached at St Mary’s an assize sermon on “National Apostasy,” which New- man afterwards regarded as the inauguration of the Oxford Movement. In the words of Dean Church, it was ” Keble who inspired, Froude who gave the impetus, and Newman who took up the work ” ; but the first organization of it was due to Mr H. J. Rose, editor of the British Magazine, who has been styled “the Cambridge originator of the Oxford Movement.” It was in his rectory house at Hadleigh, Suffolk, that a meeting of High Church clergymen was held, 25th to 29th July (Newman was not present), at which it was resolved to fight for “the apostolical succession and the integrity of the Prayer-Book.” A few weeks later Newman started, apparently on his own initia- tive, the Tracts for the Times, from which the movement was subsequently named ” Tractarian.” Its aim was to secure for the Church of England a definite basis of doctrine and discipline, in case either of disestablish- ment or of a determination of High Churchmen to quit the establishment, an eventuality that was thought

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Cakdinal Newman. (From a photograph by Barraud, London.)

not impossible in view of the State’s recent high-handed dealings with the sister established Church of Ireland. The teaching of the tracts was supplemented by Newman’s Sunday afternoon sermons at St Mary’s, the influence of which, especially over the junior members of the University, was increasingly marked during a period of eight years. In 1835 Pusey joined the movement, which, so far as concerned ritual observances, was later called ” Puseyite ” ; and in 1836 its supporters secured further coherence by their united opposition to the appointment of Hampden as regius professor of divinity. His Bamp- ton Lectures (in the preparation of which Blanco White had assisted him), were suspected of heresy, and this suspicion was accentuated by a pamphlet put forth by Newman, Elucidations of Dr Hampden’s TJieological State- ments. At this date Newman became editor of the British Critic, and he also gave courses of lectures in a side- chapel of St iMary’s in defence of the via media of the Anglican Church as between Eomanism and popular Pro- testantism. His influence in Oxford was supreme about the year 1839, when, how- ever, his study of the mono- physite heresy first raised in his mind a doubt as to whether the Anglican position was really tenable on those principles of ecclesiastical authority which he had accepted; and this doubt returned when he read, in \ ‘seman’s article in the jJJi Dublin Review on “The *â– Aiigelican Claim,” the words

oL St Augustine against the Donatists, ” securus judicat orbis terrarum,” words which suggested a simpler authori- tative rule than that of the teaching of antiquity. He continued his work, however, as a High Anglican contro- versialist until he had pub- lished, in 1841, Tract 90, the last of the series, in which he put forth, as a kind of proof charge, to test the tenability of all Catholic doctrine within the Church of England, a detailed examination of the XXXIX. Articles, suggesting that their negations were not directed against the authorized creed of Eoman Catholics, but only against popular errors and exaggerations. This theory, though not altogether new, aroused much indignation in Ox- ford, and A. C. Tait (afterwards archbishop of Canter- bury), with three other senior tutors, denounced it as

” suggesting and opening a way by which men might violate their solemn engagements to the University.” The alarm was shared by the heads of houses and by others in authority ; and, at the request of the bishop of Oxford, the publication of the Tracts came to an end. At this date Newman also resigned the editor- ship of the British Critic, and was thenceforth, as he himself later described it, ” on his deathbed as regards membership with the Anglican Church.” He now recog- nized that the position of Anglicans was similar to that of the semi-Arians in the Arian controversy; and the arrangement made at this time that an Anglican bishopric should be established in Jerusalem, the appointment to lie alternately with the British and Prussian Govern- ments, was to him further evidence of the uou-apostolical

character of the Church of England. In 1842 he with- drew to Littlemore, and lived there under monastic conditions with a small band of followers, their life being one of great physical austerity as well as of anxiety and suspense. To his disciples there he assigned the task of writing lives of the English saints, while his own time was largely devoted to the completion of an essay on the development of Christian doctrine, by which principle he sought to reconcile himself to the elaborated creed and the practical system of the Roman Church. In February 1843 he published, as an advertisement in the Oxford Conservative Journal, an anonymous but other- wise formal retractation of all the hard things he had said against Eome ; and in September, after the secession of one of the inmates of the house, he preached his last Anglican sermon at Littlemore and resigned the living of St Mary’s. But still an interval of two years elapsed before he was formally received into the Eoman Catholic Church (9th October 1846) by Father Dominic, an Italian Passionist. In February 1846 he left Oxford for Oscott, where Bishop Wiseman, then vicar-apostolic of the Mid- land district, resided ; and in October he proceeded to Rome, where he was ordained priest and was given the degree of D.D. by the Pope. At the close of 1847 he returned to England as an Orato^ian, and resided first at Maryvale (near Oscott) ; then at St Wilfrid’s College, Cheadle ; then at St Ann’s, Alcester

Street, Birmingham ; and finally at Edgbaston, where spacious premises were built for the community, and where (except for four years in Ireland) he lived a secluded life for nearly forty years. Before the house at Edgbaston was occupied he had established the London Oratory, with Father Faber as its superior, and theire (in King William Street, Strand) he delivered a course of lectures on ” The Present Position of Catholics in England,” in the fifth of which he protested against the anti-Catholic utterances of Dr Achilli, an ex-Dominican friar, whom he accused in detail of numerous acts of immorality. Popular Protestant feeling ran very high at the time, partly in consequence of the recent establishment of a Eoman Catholic diocesan hierarchy by Pius IX., and criminal proceedings against Newman for libel resulted in an acknowledged gross miscarriage of justice. He was found guilty, and was sentenced to pay a fine of Â£100, while his expenses as defendant amounted to about Â£14,000, a sum that was at once raised by public subscription, a surplus being spent on the purchase of Rednall, a small property pic- turesquely situated on the Lickey Hills, with a chapel and cemetery, where Newman now lies buried. In 1864, at the request of the Irish bishops, Newman went to Dublin as rector of the newly-established Catholic uni- versity there. But practical organization was not among his gifts, and the bishops became jealous of his influence, so that after four years he retired, the best outcome of his stay there being a volume of lectures entitled Idea of a University, containing some of his most effective writ- ing. In 1858 he projected a branch house of the Oratory at Oxford ; but this was opposed by Manning and others, as likely to induce Catholics to send their sons to that university, and the scheme was abandoned. In 1859 he established, in connexion with the Birmingham Oratory, a school for the education of the sons of gentlemen on lines similar to those of the English public schools, an important work in which he never ceased to take the greatest interest. But all this time (since 1841) Newman had been under a cloud, so far as concerned the great mass of cultivated Englishmen, and he was now awaiting an opportunity to vindicate his career ; and in 1862 he began to prepare autobiographical and other memoranda for the purpose. The occasion came when, in January 1864, Charles Kingsley, reviewing Fronde’s History of

England in Maanillmi’s Magazine, incidentally asserted that ” Father Newman informs us that truth for its own sake need not be, and on the

whole ought not to be, a virtue of the Roman clergy.” After some preliminary sparring between the two â€” Newman’s pamphlet, “JNlr Kingsley and Dr Newman: a Correspondence on the Question whether Dr Newman teaches that Tmth is no Virtue,” published in 1864 and not reprinted, is unsur- passed in the English language for the vigour of its satire : the anger displayed was later, in a letter to Sir William Cope, admitted to have been largely feigned â€” Newman published in bi-monthly parts his Apologia pro Vita Sua, a religious autobiography of unsurpassed in- terest, the simple confidential tone of which ” revolution- ized the popular estimate of its author,” establishing the strength and sincerity of the convictions which had led him into the Roman Catholic Church. Kingsley’s accu- sation indeed, in so far as it concerned the Roman clergy generally, was not precisely dealt with ; only a passing sentence, in an appendix on lying and equivocation, maintained that English Catholic priests are as truthful as English Catholic laymen ; but of the author’s own personal rectitude no room for doubt was left.

In 1870 he put forth his Grammar of Assent, the most closely reasoned of his works, in which the case for reli- gious belief is maintained by arguments differing some- what from those commonly used by Roman Catholic theologians ; and in 1877, in the republication of his Anglican works, he added to the two volumes containing his defence of the via media a long preface and numerous notes in which he criticized and replied to sundry anti- Catholic arguments of his own in the original issues. At the time of the Vatican Council (1869-70) he was known to be opposed to the definition of Papal infallibility, and in a private letter to his bishop (Ullathorne), surrepti- tiously published, he denounced the ” insolent and aggres- sive faction ” that had pushed the matter forward. But he made no sign of disapproval when the doctrine was de- fined, and subsequently, in a letter nominally addressed to the duke of Norfolk on the occasion of Mr Gladstone’s accusing the Roman Church of having ” equally repudi- ated modern thought and ancient history,” Newman af- firmed that he had always believed the doctrine, and had only feared the deterrent effect of its definition on conver- sions on account of acknowledged historical difficulties. In this letter, and especially in the postscript to the second edition of it, Newman finally silenced all cavillers as to his not being really at ease within the Roman Church. In 1878 his old college (Trinity), to his

great delight, elected him an honorary fellow, and he revisited Oxford after an in- terval of thirty ~~two years. At the same date died Pope Pius IX., who had long mistrusted him ; and Leo XIII. was encouraged by the duke of Norfolk and other distin~~ guished Roman Catholic laymen, to make Newman a cardinal, the distinction being a marked one, because he was a simple priest and not resident in Rome. The offer was made in February 1879, and the announcement of it was received with universal applause throughout the English-speaking world. The ” creation ” took place on 12th May, with the title of St George in Velabro, Newman taking occasion while in Rome to insist on the lifelong consistency of his opposition to ” liberalism in religion.” After an illness that excited apprehension he returned to England, and thenceforward resided at the Oratory until his death, 11th August 1890, making occasional visits to London, and chiefly to his old friend, R. W. Church, dean of St Paul’s, who as proctor had vetoed the condemnation of Tract 90 in 1841. As cardinal Newman published nothing beyond a preface to a work by the present writer on the Anglican Ministry (1879) and an article on Biblical criticism in the Nineteenth Century (February 1884).

jSTewman’s influence as controversialist and preacher (i.e., as reader of his written sermons, for he was .never a speaker) has been very great. For the Roman Cliurch his conversion secured great prestige and the dissipation of many prejudices. Within it his influence was mainly in the direction of a broader spirit and of a recognition of the important part played by development both in doc- trine and in Church government. And although he never called himself a mystic, he showed that in his judgment spiritual truth is apprehended by direct intuition, as an antecedent necessity to the professedly purely rational basis of the Roman Catholic creed. Within the Angli- can Church, and even within the more strictly Protes- tant Churches, his influence has been greater, but in a different direction, viz., in showing the necessity of dogma and the indispensableness of the austere, ascetic, chas- tenedj and graver side of the Christian religion. If his teaching as to the Church has been less widely followed, it is because of doubts as to the thoroughness of his knowledge of history and as to his freedom from bias as

a critic. Some hundreds of clergymen, influenced by the movement of which for ten or twelve years he was the acknowledged leader, made their submission to the Church of Rome ; but a very much larger number, who also came under its influence, failed to learn from him that belief in the Church involves belief in the Pope. The natural tendency of his mind is often (and correctly) spoken of as sceptical. He held that, apart from an interior and unreasoned conviction, there is no cogent proof of the existence of God ; and in Tract 85 he dealt with the diflB-Culties of the Creed and of the canon of Scripture, with the apparent implication that they are insurmountable unless overridden by the authority of an infallible Church. In his own case these views did not lead to scepticism, because he had always possessed the necessary interior conviction ; and in writing Tract 85 his only doubt would have been where the true Church is to be found. But, so far as the rest of the world is concerned, his teaching amounts to this : that the man who has not this interior conviction has no choice but to remain an agnostic, while the man who has it is bound sooner or later to become a Roman Catholic.

He was a man of magnetic personality, with an intense belief in the significance of his own career ; and his char- acter may be described as feminine, both in its strength and in its weakness. As a poet he had inspiration and genuine power. Some of his short and earlier poems, in spite of a characteristic element of fierceness and intolerance in one or two cases, are described by Mr R. H. Hutton as ” unequalled for grandeur of outline, purity of taste, and radiance of total effect ” ; while his latest and longest, ” The Dream of Gerontius,” is generally re- cognized as the happiest effort to represent the unseen world that has been made since the time of Dante. His prose style, especially in his Catholic days, is fresh and vigorous, and is attractive to many who do not sym- pathize with his conclusions, from the apparent candour with which difficulties are admitted and grappled with, while in his private correspondence there is a charm that places it at the head of that branch of English literature. He was too sensitive and self-conscious to be altogether successful as a leader of men, and too impetuous to take part in public affairs ; but he had many of the gifts that go to make a first-rate journalist, for, ” with all his love for and his profound study of antiquity, there was something about him that was conspicuously modern.” Nevertheless, with the scientific and critical literature of the years 1850-90

he was barely acquainted, and he knew no German. There are a few passages in his writings in which he seems to show some sympathy with a broader

theology. Thus he admitted that there was ” something true and divinely revealed in every religion.” He held that ” freedom from symbols and articles is abstractedly the highest state of Christian communion,” but was ” the peculiar privilege of the primitive Church.” And even ia ‘ 1877 he allowed that ” in a religion that embraces large and separate classes of adherents there always is of necessity to a certain extent an exoteric and an esoteric doctrine.” These admissions, together with his elucidar tion of the idea of doctrinal development and his eloquent assertion of the supremacy of conscience, have led some critics to hold that, in spite of all his protests to the contrary, he was himself somewhat of a Liberal. But it is certain that he explained to his own satisfaction and “accepted every item of the Roman Catholic creed, even going beyond it, as in holding the Pope to be infal-lible in canonization ; and while expressing his preference for English as compared with Italian devotional forms, he was himself one of the first to introduce such into England, together with the ritual peculiarities of the local Roman Church. The motto that he adopted for use with the arms emblazoned for him as cardinal â€” Cor ad cor loquitur, and that which he directed to be engraved on his memorial tablet at Edgbaston â€” Ex umbris et imaginibus in veritatem â€” together seem to disclose as much as can be disclosed of the secret of a life which, both to contemporaries and to later students, has been one of almost fascinating interest, at once devout and inquiring, affectionate and yet sternly self- restrained.

There is at Oxford a bust of Newman by Woolner. His portrait by Ouless is at the Birmingham Oratory, and his portrait by Millais is in the possession of the duke of Norfolk, a replica being at the London Oratory. Outside the latter building, and facing the Brompton Road, there is a marble statue of Newman as cardinal.

The chief authorities for Newman’s life are his Apologia, and the Letters and Gorrespondetice, edited hy Miss Mozley, above referred to. The letters and memoranda dealing with the years 1845-90, and entrusted by Newman to the Rev. ^V. Neville as_ literary executor, have not yet been published.

Works by E.’ “W. Church, J. B. Mozley, T. Mozley, and Wilfrid Ward should also be consulted, as well as an appreciation by Mr R. H. â– Hutton. Adverse criticism will be found in the writings of DrE. A. Abbott, while some minor traits and foibles were noted by the present writer in the Expositor, September, October, and November 1890. (a. w. hu.)

Newmarket, a market town in the Newmai-ket parliamentary division of Cambridgeshire, England, partly also in Suffolk, 13 miles east by north of Cambridge by rail. There are generally from 1600 to 2000 horses in training on the downs’, l^pulation (1891), 8631 ; (1901), 10,686. (See also Horse-Racing.)

New Mexico, a south-western territory of the United States, bounded on the N. by Colorado, on the E. by Oklahoma and Texas, on the S. by Texas and Mexico, and on the W. by Arizona. It has advanced rapidly in all material matters since the advent of the first railway in

1879. The population was 91,874 in 1870, 119,665 in

1880, 153,593 in 1890, and 196,310 in 1900. The rate of increase from 1890 to 1900 was 27-2 per cent., as compared with 28-5 per cent, for the preceding decade, and the average number of persons to the square mile in 1900 was 1-6. The principal cities are Albuquerque (population, 6238), Las Vegas (3652), and Santa Fe (5603). In 1900 the males numbered 104,228, the females 91,082 ; the native-born 181,685, and the foreign- born 13,625. The negro population was only 1610, and the Indian 13,144. Of tlie 65,067 males of 21 years and over, 15,686 were illiterate.

Education. â€” In 1891 a law was enacted establishing an excellent public school system, which has very much increased the facilities for general education. At its- head

is a board of four members consisting of the governor, superintendent of public instruction, and two college presidents, the executive functions being

exercised by the superintendent. The la(^ of a school fund of any kind has been a serious impediment to educational progress, but in 1899 sections 16 and 36 in each township of the public domain were granted to the territory as school lands, and each of the territorial institutions received a substantial donation of the public lands. The total average daily attendance in 1900 in the common and city schools was 20,505, as against 12,397 in 1891. Of sectarian schools the Roman Catholics had 18, with 1602 pupils ; the Presbyterians 25, with 1105 pupils ; the Methodists 11, with 462 pupils ; and the New West educational com- mission had 5, with 219-pupils â€” making in all 59 schools, with 3388 pupils. In 1889 and 1890 the University at Albuquerque, the Agricultural College at Las Cruces, and the School of Mines at Socorro began their work with substantial buildings ; soon afterwards a normal school was established at Silver City, and more recently another at Las Vegas. There is also a military institute at Roswell. In 1900 the number of students in the higher institutions was 800. The total amount of money raised for the common and city schools and the territorial institutions was $511,990.

Penal and Charitable Institutions. â€” The penitentiary at Santa F6 is a substantial stone structure. It contained in 1900 over 200 prisoners, and was admirably conducted. The principal business, brick-making, was very successful. The territorial insane asylum Is situated near Las Vegas, and is always full, as its capacity is not equal to the growth of the territory. The number of patients in March 1902 was 109, 56 males and 53 females. Hospitals at Santa r^ and Silver City have been established many years, and are maintained by the territory according to the number of cases treated. The orphan home at Santa F^ has in charge an average of .33 children, and actually received from territorial appropriation about 13300.

Meligion. â€” The prevailing religion is Roman Catholic, as the original settlement was by Spaniards, whose descendants still con- stitute the great body of the population, but Methodists, Baptists, Episcopalians, Congregationalists, Presbyterians, Jews, and Mor- mons have congregations in various localities.

Mining.- â€” Mining progresses favourably in almost all parts. The decrease in the value of silver and the increase of that of lead and copper

have caused more attention to be given to the mines which contain the latter. The most important of the newer mines are those at Bland, which contain vast bodies of gold ore of moderate grade ; those in Taos county, where important copper and gold mines have been put in operation ; those in Rio Arriba, with placer dredging on the Chama river and the production of mica near Petaca, and copper in Copper Canon and near Coyote are progressing ; in Dona Aiia, where important copper properties are being worked in addition to the older silver-lead mines in the Organ mountains ; in Otero county, where extensive deposits of turquoise have been discovered ; and in the vicinity of the old mining districts of Grant, Socorro, and Sierra, where renewed activity has added largely to the output. Iron ore is being shipped in large quantities from the Hanover region of Grant county, and also from the vicinity of Glorieta. The total product of coal in the year ending 30th June 1899 was 1,409,038 tons, principally from Gallup, Cerrillos, and Raton.

Agriculture.â€” ?,iaa6 1880 the cultivation of alfalfa has very largely increased, and sorghum has been introduced in many localities. Extensive orchards have been planted everywhere, as all the fruits of the temperate zone grow to great perfection both as to size and flavour. The cultivation of the sugar beet is very successful ; the percentage of saccharine matter in the roots is found to he larger in New Mexico, and notably in the vicinity of Santa F6, than elsewhere in the United States, averaging 16 per cent, and frequently exceeding 20 per cent. This high percentage is attributed to the almost perpetual sunshine. A beet sugar factory has been established at Eddy, and successfully run for several years. The average yield per acre was somewhat over 16 tons. In all of its products, mineral, horticultural, agricultural, and of animal industry. New Mexico is showing “a steady and healthful progress.

Irrigation. â€” Extensive irrigation systems of a modem character have greatly enlarged the area of cultivated land. These have been established in the north-west, in the vaiUeys of the San Juan and its tributaries ; in the north-east of the great domain of the Maxwell

Grant ; in the south-east on the Pecos, where the system is in certain respects the largest in the entire country ; in the south-west on the Mlmbres,

and in the central west on the Blue Water. An important improvement is the establishment of a modern low-line ditch in the valley of the Rio Grande from Peiia Blanca to Albu- querque.

Manufactures. â€” The following table shows the manufacturing and mechanical industries in 1890 and 1900 :â€”

1890. 1900.

Number of establishments . 127 420

Capital 1965,938 |2,698,786

Wage-earners, average number . 849 2,600

Total wages .... .$470,.361 Â§1,350,586

Cost and material used . . .$691,420 82,914,138

Value of product . . . Â§1,516,195 Â§5,605,295

New Mexico is a mining and stock-raising region, with agriculture

ranking next in importance. The most important manufacturing

industry is railway repair works, followed by carpentering, lumber,

and timber products, and flour and grist mills.

Railways. â€” The chief railways are the Denver and Rio Grande, the Atchison, Topeka, and Santa E^, and the Southern Pacific. The total mileage within the territory in 1900 was 1693.

Banks. â€” There are national banks in all the principal towns, including Santa F6, Albuquerque, Las Vegas, Raton, Roswell, and Silver City. Banks conducted mider the territorial laws, with a capital smaller than that required for national banks, exist in a number of towns, some of the best known being at Taos, Springer, Whiteoaks, Deming, Eddy, Roswell, Hillsboro, and Las Cruces. Several of the large mercantile houses have a

banking department which affords most of the facilities provided by regular banks.

Finan^ce. â€” The financial condition of the territory is good. The assessed valuation has not varied much from 845,000,000 during the decade ‘1890-1900. The territorial indebtedness began to be paid oS in 1891. The rate of interest on parts of the public indebtedness has been reduced to 4 per cent., which speaks well for the credit of the territory.

Land Claims. â€” The most important official event in the closing years of the 19th century was the establishment by Congress of the United States Court of Private Land Claims, which is adjudi- cating the titles of all grants of land made by the Spanish and Mexican authorities, and not previously confirmed. For nearly twenty years earnest efforts had been made without success to secure such a tribunal, and it was finally secured by sending a committee of twenty-five leading citizens, headed by the governor, to Washington, in 1890. It has adjudicated nearly all of the un- confirmed land grants in the territory, thus settling the title to many millions of acres, of which the larger proportion has been restored to the public domain.

Legislation. â€” The judges of the Supreme Court have been in- creased from three to five, each presiding in the courts of his own district, and the entire bench forming the appellate tribunal of the territory. The Public School Act of 1891 provided for a territorial superintendent of public instruction. With these exceptions, the government remains as it was in 1880, and probably no important change will occur until New Mexico becomes a state.

Politics. â€” In politics the territory is Republican, especially on the issues of protection, as the principal products of New Mexico, which are wool, coal, lumber, and lead, are all benefited by a tariff. At the election in 1900 the vote for delegate in Congress was. Republican, 21,567 ; Democratic, 17,857. (l. b. Pe.)

Newmilns, a burgh of barony and police burgh of Ayrshire, Scotland, 7-J-miles east by south of Kilmarnock by rail. Muslin and lace curtain-making is the chief industry, and the manufacture of mosquito-nets has been added.

There are a town hall, a workmen’s institute, a public library, and an endowed school for girls. Popular tion (1881), 2860 ; (1901), 4466.

New Orleans, the twelfth city of the United States in population, the capital of the state of Louisiana, and the chief seaport of the Mississippi valley. Until the end of the third quarter of the, 19th century it owed its growth and importance in the world at large almost wholly to the fact of its being a gate of export for vast agricultural harvests. The close limitation of its business to the handling of raw products, without giving them the larger values of skilled manipulation, tended to keep this great port comparatively unwealthy, and to retard its growth, so that its relative standing among the American cities with which it was obliged to compete was steadUy reduced. Its largest shipments were cotton. After 1875, however, while its cotton exports materially increased,

another source of power and expansion was found in a growth, proportionately much larger, of its exports of other great staples ; and at the same time a number of iiiflnenees, some welcome, others unwelcome, turned an increasing share of the city’s activities into avenues of business more lucrative and even more stimulative of high social conditions than were, or can be, the mere receipt, sale, and reshipment of staple crops. Under these com- bined influences the popiilation expanded from 216,090 in 1880, and 242,039 in 1890, to 287,104 in 1900. Of the last number 30,325 were foreign-born and 77,714 were negroes. Out of 75,440 adult males, 10,078 (of whom 7125 were negroes) were illiterate (unalale to write). The death-rate in 1900, on the basis of the Federal census of that year, was 28-9 per thousand, the highest of any of the lai^ge cities of the United States. This high death- rate is often attributed in great part to the large coloured population, among whom the mortality is estimated to be about 90 per cent, higher than among the whites ; but it must be remembered that in New Orleans the coloured population largely comprises that labouring element whose faulty provision for health and sickness in

every large city swells the death-rate, so that it is an error to explain away the high figure by this means alone.

Manufactures and Commerce. â€” In 1890 there were 1961 manufacturing establishments with 25,221 employes, a capital of 126,319,277, and products valued at f 48,295,449 (or nearly two and one-half times as much as in 1880). In 1900 there were 1525 manufacturing establishments, having a capital of $46,080,061, employing 19,512 hands, and turning out products valued at $63,574,388. The most important industries, and the value of their products, were as follows : bags (other than paper), $3,443,468 ; men's clothing, $2,036,069 ; foundry and machine-shop products, $2,199,854 ; malt liquors, $1,472,062 ; rice, cleaning and polishing, $2,924,564 ; sugar and molasses, refining, $22,684,920. The foreign commerce of the port has increased more . rapidly than the population. During the year ending 30th June 1900, in the for- eign trade 1220 vessels with a tonnage of 1,675,434 entered the port, and 1187 vessels with a tonnage of 1,720,008 cleared. During the same period the princi- pal exports were as follows : mules, $2,978,884 ; In- dian corn, $11,423,335; wheat, $6,587,218; cotton, (unmanufactured), $66,148,722 ; oil-cake and oil-cake meal, $4,838,024 ; cotton-seed oil, $3,347,063 ; tobacco (unmanufactured), $3,115,389. A change calculated to benefit greatly the commerce of the port came into effect 29th May 1901, when the wharves of the city passed from private to municipal control, a marked reduction was made in the port charges from the sched- ule under the previous lease system, and a- number of important improvements were instituted. During the year ending 30th June 1901 the total exports amounted to $152,776,599, and the imports to $20,462,307.

The growth of the city during the last quarter of the 19th century, moreover, was not merely commercial. In the face of grave reverses â€” floods, widely disastrous frosts, and a revisitation of epidemic yellow fever in 1897 after an immunity of nineteen years, with its accompanying commercial blight of outside quarantine â€” visible aspects and social conditions have greatly improved. The modern metamorphosis of the world's carrying trade has altered the inland relations of New Orleans from those of a great river port to those of a still greater railway terminus, and has brought in the more alert energies of modern modes of business. Ocean steamers, loaded in large part by elevators, now bear away the exports for which a swarm of sailing-ships

of much lighter draught and average freight-room once made long stays at its wharves. Its

passenger traffic on the rivers has practically vanished and its shrunken fleets of river steamers are devoted to the carrying of slow freights and the towing of barges ; but railway traffic has grown immensely, and the city is now entered by six trunk lines : the Illinois Cen- tral, Louisville and Nashville, Queen and Crescent, Southern Pacific, Texas and Pacific, and Yazoo and Mississippi Valley. The total number of square yards of streets paved in 1899 was 3,649,000, of streets unpaved, 8,800,000. The mileage of paved streets in 1900 was 205f miles, or two and a quarter times what it was in 1880. In 1900 the streets were lighted by 1624 arc lights. The immense crowds on gala days and nights are handled with an extraordinary efEeetiveness on 163 miles of electric street railway.

Public Improvements. â€” In keeping with this growth and change, unprecedented efforts are in full progress for the establishment of a system of sanitation so complete as to be a guarantee against any return of epidemic fevers, near or remote. This great public improvement was decided upon by a vote of the taxpayers in 1899, and the work of construction is now going forward rapidly. Hitherto the city had been without a sewerage system m the modern sense, open gutters being the only substitute. The main feature of the new system is an underground piping of the entire city that will carry off all sewage, the backwaters of Gulf storms, and the tremendous rainfalls peculiar to the region. A new water system is also pro- jected, the supply for which is to be procured from the Mississippi river, and to be purified by mechanical pre- cipitation and other means. The revenues of the present Sewerage and Water Board are derived from a fixed tax on real and personal estate of two mills on the dollar, the tax being first collected in 1899. To these measures of such vast practical utility are added many aesthetic improvements, conspicuously the embellishment of one or two public parks and several smaller pleasances. Cer- tain drawbacks that remain are of kinds which naturally wait for their removal upon larger changes in manners and custom. The city’s political conditions are variable, and popular modes of improving them are still somewhat too fitful and imperious to ensure the best, if even abiding, results ; nevertheless some admirable reforms have been effected. The cause of public education enjoys

an increased annual outlay ($426,924 in 1900, not including cost of new buildings), bat a very grave proportion of the popula- tion of school age appears to be making no use of either public or pai'ochial schools. In 1890 there were 71 public school buildings (valued at $1,600,000) and 752 teachers, but orjly 31,521 enrolled pupils out of 94,606 persons of school age (5 to 20 years inclusive). Tulane University, named after its benefactor, Paul Tulane, was founded in 1884, and in it was merged the former University of Louisiana. It has grown in many directions, notably by the addition of the H. Sophie Newcomb Memorial College for Women (founded in 1886). In 1900 it had in all its departments 77 instructors and 1145 students,, and supplies valuable facilities for higher education ; but neither the commercial value of an educated working class, nor the unsafety, both political and sanitary, of letting any large element rest in contented ignorance seems as yet to be effectually recognized.

Itvcpnt Hisfort/. â€" The history of New Orleans during the period 1880-1900 has been marked by no more viola- tions of public order than other American cities equally large ; bÂ»t one outbreak, on account of the international character that it assumed, should perhaps be recorded. In October 1890 the city chief of police was assassinated, declaring as he expired that the deed had been committed by Italians. He had been active in proceedings against certain Italians accused of crime, and it was popularly

believed that his death was the work of a maffla, or sworn secret society. The following month eleven Sicilians were indicted for his murder. When nine of them were brought to trial in February 1891, six were acquitted, and three escaped conviction on the ground of a mis-trial. On 14th March 1891 a mob broke into the gaol and lynched the entire eleven. The Italian Government de- manded that the lynchers should be punished, entered claims for indemnity in the case of those of the lynched Sicilians who had been Italian subjects, and, failing to secure a satisfactory answer from the American Govern- ment, withdrew its ambassador from Washington. The dispute was settled the following year by the payment to Italy by the United States of the sum of $25,000.

Among material things probably the leading obstacle to the best advancement of this thriving city is one the removal of which lies within the province of the national Congress, and has suffered an unfortunate delay. The jettied mouth of the Mississippi river, South Pass, has not for several years given a depth of channel suflB.cient for the steadily-increasing draught of the vessels that must make use of it if New Orleans is either to retain its vast shipments of raw produce, expand its manufac- tures, or multiply its markets across the waters of the Mexican Gulf, the Spanish Main, and the Pacific Ocean ; but at length Congress has settled an improvement of South- West Pass destined to establish a channel 1000 feet wide and 38 feet in depth.

The city is governed under a charter passed by the state legislature in 1896, as amended by the Acts of 1898 and 1900. In 1900 the total assessed valuation of pro- perty was $139,230,232, of which $98,809,815 was real estate and $40,420,417 personal property. The rate of tax- ation per $1000 was $29, of which $22 was for city pur- poses. In May 1900 the bonded debt was $20,278,917, which was increased by $12,000,000 later in the year by the sale of public improvement bonds for water and sew- erage purposes. During the decade from 1891 to 1900 the expenditures for permanent public improvements (in- cluding sewerage, lighting, paving, levees, and improve- ments in connexion with street and steam railways, docks, &c.) amounted to about $30,000,000, and nearly as much more was spent in the erection of private resi- dences, stores, and other buildings. In 1900 the Board of Assessors placed the valuation of the real estate belong- ing to the city (including engine-houses, schools, public squares, markets, public buildings, &c.) at $4,731,675. In December 1900 arrangements were made to transfer the extensive markets from the lessee system to direct municipal control. In 1900 the city had a total area of 196-25 square miles, and contained 209 churches, 25 hotels, 7 theatres, and 25 public markets. The total vote cast at the election for mayor, 7th November 1899, was 32,559. In 1900 there were 75,440 males 21 years of age and over.

In the comforts and graces of private life New Orleans retains the peculiar attractiveness for which its society has been noted, while such changes as have taken place have been pointedly advantageous. The old Creole or Franco- American element is at length affiliating socially with the Anglo-

American, and the gain and the charm of this better homogeneity is felt alike by the resident and the sojourner. The growth of social refinements, visible in many ways, is in no external feature more beautifully indicated than in the improved taste of the domestic architecture, and in the multiplication and high keeping of the innumerable private gardens of this city of per- petual bloom. (g. w. ca.)

New Philadelphia, a city of Ohio, U.S.A., capital of Tuscarawas county, on the Tuscarawas river

and the Ohio Canal, at the intersection of several railway lines, in the north-east part of the state. Population (1890), 4456; (1900), 6213, of whom 554 u-ere foreign-bom.

Newport, a municipal borough and market town in the Isle of Wight, Hampshire, England, on the river Me- dina, navigable to the town quay, which is 7 mUes west- south-west from Eyde. A railway line to Freshwater and Yarmouth has been opened. Population (1881),

9357; (1901), 10,911.

Newport, a municipal and county borough, con- tributory parliamentary borough, seaport, and market town, in the Monmouth parliamentary district of bor- oughs, Monmouthshire, England, on the Usk, 4 miles from its confluence with the Severn, 145 miles by rail west of London. The town council consists of 10 alder- men and 30 councillors. In 1889 Maindee was incorpo- rated with Newport, and constitutes one of its five wards. With Monmouth and Usk, Newport returns one member to Parliament. The docks have an area of 60 acres. Modern erections are the town hall (1885), the county council offices (1892), the market hall, almost entirely rebuilt in 1889, baths (1890), and museum and art gal- lery (1896). There are two daily newspapers. The in- dustries include shipbuilding, with dry docks for repair of ships, the making of railway plant, chemical manures, and agricultural implements. In 1888, 112 vessels of 32,146 tons were registered ; in 1900, 82 of 23,664 tons. Ships entering port in 1888 numbered 4164 of 1,729,332 tons ; clearances, 4136 of 1,718,515 tons. In 1900 entrances numbered 6726 vessels of 2,179,300 tons; clearances, 6717 of 2,166,020 tons. Imports of foreign and colonial produce for 1900 were

valued at Â£1,125,869, against Â£764,725 for 1888 ; exports of produce and manu- factures of the United Kingdom for 1900 at Â£3,366,623, against Â£1,816,647 in 1888. Area of county borough, as extended in 1889, 4924 acres. Population (1881), 38,469;

(1891), 64,707 ; (1901), 67,290.

Newport, a city of Campbell county, Kentucky, U.S.A., on the Ohio river, at the mouth of Licking river, opposite Cincinnati, in the northern part of the state, at an altitude of 515 feet. It is connected with Cincinnati and with Covington, on the other side of Licking river, by railway and waggon bridges. It is on the Chesapeake and Ohio and the Louisville and Nashville railways. The city is well laid out, with six wards, has a water supply owned by the city, and is paved mainly with macadam. It is to a large extent a residential suburb of Cincinnati, but it has also im- portant industries of its own. In 1900 its manufactur- ing establishments numbered 272, with a total capital of $2,848,435. The average number of wage-earners employed was 2661, and the products were valued at $4,888,169. The principal item was foundry and ma- chine-shop products, which had a value of $922,014. The assessed valuation of real and personal property was, in 1898, $10,373,900 ; the net debt of the city was $1,303,676, and the rate of taxation $26.35 per $1000. Population (1890), 24,918; (1900), 28,301, of whom 4081 were foreign-born and 424 were negroes.

Newport, a city of Ehode Island, U.S.A., capital of Newport county, and one of the two capitals of the state, at the southern end of Ehode Island in Narra- gansett Bay. It is the most fashionable seaside resort in the United States, the town proper being surrounded by splendid villas, with beautiful drives in different directions. Its pre-eminence as a seaside resort is due probably to the excellence of its harbour, appreciated by the yachting fraternity, its fine bathing beaches, its accessibility, being connected by rail and daily boat

â€¢witli New York, and its insular climate, -which tempers the summer heat. Newport has little commerce: In 1900 theye were 290 manufacturing establishments, with products valued at $3,442,998. The harbour is

defended by Fort Adams, on a point across the harbour from the city. On Coasters Harbour Island are the Naval War College, torpedo station, and naval training school. Population (1890), 19,467 ; (1900), 22,034, of whom 6563 were foreign-born and 1613 negroes. These are the figures of the resident population, excluding summer visitors, who come in large numbers in August.

Newport News, a city and seaport of Virginia, U.S.A., on the point to the north of the entrance to James river and on Chesapeake Bay. Though within the limits of Warwick county, it is independent of county govern- ment. It has a level site and a regular plan, a water supply, and other municipal improvements. It is the eastern terminus of the Chesapeake and Ohio railway, and, having a very tine harbour, is rapidly becoming a sea- port of great importance, rivalling its much older neigh- bour, Norfolk. Its imports for the year ending 30th June 1901 amounted to f 4,090,451 ; its exports amounted to $32,567,912, and consisted mainly of bread-stuffs, cattle, cotton, lard, and tobacco. It has a large iron ship- building plant, the capa:city of which is shown by the fact that several vessels of the U.S. navy have been built there, including two of the largest battleships, which were con- structed simultaneously. In 1900 there were 123 manu- facturing establishments, having a capital of $14,999,735, employing 5676 hands, and turning out products valued at $6,976,670. Population (1890), 4449 ; (1900), 19,635, of whom 1614 were foreign-born and 7698 negroes.

Newquay, a popular English watering-place, in the St Austell parliamentary division of Cornwall, 14 miles north of Truro, with a station on a branch of the Great Western railway. Since 1894 it has been governed by an urban district council. The cliff scenery of the coast is very grand, and there is a fine sandy beach two miles long. The harbour admits vessels of 250 tons. The chief exports are iron and other ores, china-clay, granite, fish, and grain. The imports are coal, salt, and manures. Population of urban district (1891), 1891 ;

(1901), 2935.

New Roche Me, a city of Westchester county. New York, U.S.A., on the shore of Long Island Sound and on the New York, New Haven, and Hartford railroad, in the south-eastern part of the state. It site is undulating

and its plan fairly regular. It is little more than a resi- dential suburb of New York City, having little commerce or manufactures. Population (1880), 5276; (1890), 9067 ; (1900), 14,720, of whom 4425 were foreign-born and 777 negroes.

New Ross, a market town and urban sanitary district, county Wexford, Leinster, Ireland, on the left bank of the Barrow, 85 miles south-south-west of Dublin by rail. It ceased to be a parliamentary borough in 1885, and in 1898 the portion situated in Kilkenny was added to Wexford. New quays have been erected. Population

(1881), 0626 ; (1891), 5847 ; (1901), 5876.

Newry, a maritime town, urban sanitary district, and parliamentary borough (returning one member) in the province of Ulster, Ireland, on the Newry water at the head of Carlingford Lough, 63 miles north of Dublin by rail. In 1898 the portion situated in Armagh was added to Down. The port admits vessels of 2000 tons to Victoria Locks, three miles from the town, but vessels drawing 15 feet can go up the ship canal to the Albert Basin, three miles from the sea. The Newry Navigation have deepened the river at a cost of Â£63,000. In all, 1622 vessels of

198,661 tons entered in 1900, and 1017 of 163,829 tons cleared. A railway connects the Great Northern system with the deep-water harbour at Greenore, and an electric line has been constructed to Bessbrook. Population

(1881), 16,085; (1891), 12,961; (1901), 12,587.

New Siberia Archipelago, a group of islands situated off the Arctic coast of Sibej'ia, from 73Â° to 76Â° 6′ N., and 136Â° 20′ to 148Â° E. The name is loosely applied either to the northern group only of these islands, for which the name of New Siberia Archipelago, or of Anjou Islands, ought properly to be reserved, or to this northern group as well as to the southern, which ought to maintain its name of Lyakhoff Islands. Some confusion prevails also as to whether the islands Bennett, Henrietta, and Jeannette, discovered by the Jeannette expedition, ought to be included in the same archipelago, or described separately as the Jeannette Islands. The first of these three

belongs geographically, and probably geologically, to New Siberia Archipelago, from which it is only 97 English miles distant, but for the present it must be counted separate. As to Henrietta and Jeannette Islands, situated 200 English miles north-east of New Siberia Island, under 157Â° to 159Â° E., they can hardly be included in New Siberia Archipelago.- There seems, more- over, to exist, due north of Kotelnyi Island of New Siberia Archipelago, in 78Â° N., a land which was sighted first by Sannikoff and described as Sannikoff Land. It has been sighted also by Baron Toll.

The New Siberia or Anjou Islands consist, beginning from the west, of Kotelnyi, the largest of them (116 miles long, 100 miles wide), having the small island Byelkovskiy near its western shore ; Thaddeus (Faddy^evskiy), in the middle ; and Xew Siberia (Novaya Sibir), in the east (90 miles long, 40 miles wide). Kotelnyi is the highest and the most massive of the four, reaching a maximum altitude of 1200 feet in the Malakatyn-tras mountain. Its north-east portion consists of Upper Silurian coral limestones (Llandovery division), containing a rich fossil fauna, and represent- ing a series of folds running north-north-west. The same Silurian deposits are widely spread on the mainland as far as Olenek. The western portion of Kotelnyi is built up of Middle Devonian limestones and slates, folded the same way, of which the fossil fauna is similar to that of the Urals. Triassic slates appear in the south-east. Diabases pierce to Devonian rocks, and Olivine rocks appear as dykes amidst the Triassic deposits. The Malakatyn-tras is also made up of volcanic rocks. The eastern portion of the island, named Bunge’s Land, is thickly covered with Post-Tertiary deposits. The geology of Thaddeus Island, which has a long pro- montory, Anjou, protruding north-westwards, is not yet known.

As to New Siberia Island, it attains altitudes of from 200 to 300 feet in its western portion. A range of hills, composed of Tertiary deposits, and named Hedenstrom’s Mountains, runs along its south-western coast, and the same rocks form a promontory protruding northwards. The so-called Wood Mountains, which were supposed to be accumulations of floating wood, are denudations of Miocene deposits containing layers of brown coal with full stems of trees. These Tertiary deposits are characterized by a rich fauna ; fully developed leaves of poplars (^Poptilus arctica and P. Bichardsoni, Heer), numerous fruits of the mammoth tree (Sequoia Lanqsdorfii, Brogt.),

needles of several conifers {Taxites tenuifolia, Schmidt ; Taxodium distichum miocenmn, B.eeT), &c., being found in them, thus testifying to a once very much warmer climate. The only representative of tree vegetation now is a dwarf willow one inch high.

The Lyakhoff Islands consist of the Bolshoi (Large), or Blizhniy (Nearest), which is separated by Lapteff Strait, 27 miles wide, from Cape Svyatoi of Siberia; Malyi (Small), or Dalniy (Farthest), to the north-west of Blizhniy ; and three smaller islandsâ€” Stolbovyi (Pillars), Semenovskiy, and Vasilievskiy â€” to the west of Malyi. Dr Bunge found Large Island consisting of granite protruding from beneath non-fossiliferous deposits ; while Svyatoi Nos promontory represents basalt hills 1400 feet high. Along the southern coast of Large Island Baron Toll found immense layers of fossil ice, 70 feet thick, evidently relics {rom the Ice Age, covered by an upper layer of Post-Tertiary deposits containing numbers of perfectly well-preserved mammoth remains, rhinoceros, Ovibos, and bones of the horse, reindeer, American stag, antelope, saiga, and even the tiger. The proof that these animals lived and fed in this latitude (73Â° 20′ N.), at a time when the islands were not yet separated from

the continent, is given by the relics of the forest vegetation which are found in the same deposits. A stem of Alnus fruticosa, 90 feet high, was found with all its roots and even fruits.

Basalts and Tertiary hrown coal deposits enter into the composi- tion of the southern extremity of Bennett Island, and the moun- tains of Sannikoff Land, seen by Toll, have the aspect of basaltic “table mountains.”

The climate of these islands is very severe. In 1886 the winter ended only in June, to begin anew in August (21st May,â€” 21Â°; 16th October,â€” .37Â° Celsius). The highest summer temperature was 10Â°. Notwithstanding that, floclcs of Larus argentatus, geese, and Somateria spectabilis come to the islands from the north (Bunge and Toll), as also Tringa islandica and the gull Lestris pomarina, which feeds chiefly on the lemming (Lemmus ohensis). The lem- mings are very numerous, and undertake in certain years migra- tions to the mainland and back. Reindeer, followed by wolves, come

also every year to the islands ; the polar fox and the polar bear, both feeding on the lemmings, are numerous. Hunters come in numbers to the Lyakhoffs, which must have been known long since to Arctic hunters. A Yakutsk Cossack, Vaghin, wintered on Large Island in 1712, but it was a merchant, Lyakhoff, who first

described the two greater islands of this group in 1770, and three years later reached on sledges the largest island of the New Siberia f â„¢1?P’ 7’”’ he named Kotelnyi. The Lyakhoffs were mapped in 1777. J. Sannikoff, with a party of hunters, discovered in 1805-8 btolbovyi, Thaddeus, and New Siberia Islands, and a merchant, Byelkoff, the Byelkovskiy Islands. He sighted the land in the north of Kotelnyi and the land in the north-east of New Siberia (now Bennett Island). Hedenstrom, accompanied by Sannikoff, explored the archipelago and published a map of it in 1811. Lieutenant Anjou revisited it in 1821-23. A scientific expedition under Dr Bunge (including Baron Toll) explored these islands in 1885-86. Baron Toll with Lieutenant Shileiko revisited them in 1893, and again in 1900.

Authorities.â€” The works of Hedensthom, Wkangel, and Anjou, Bdnge and Toll in Beitrdge zur Kenntniss des Snssischen Beichs, 3te Folge, Bd. iii. 1887.â€” Baron Toll in Memoirs (Zapiski) of the St Petersburg Academy of Sciences, 7th series, vol. xxxvii. 1889, xlii. 1895 ; and 8th series, vol. ix. 1899, with maps.â€” J. Schmal- HAUSEN, “Tertiare Pflanzen’,’ in same Memoirs, 7th series, vol. xxxvii. 1S90.â€” Geographical Journal, 1900-02. (p a k)

NEW SOUTH WALES.

I. Geography and Statistics.

INTTEW SOUTH WALES, the oldest state of the _L\| Australian Common-wealth, lies on the eastern side of the island-continent, and is bounded on the N. by Queensland, on the E. by the Pacific, on the S. by Victoria, and on the W. by South Australia.

Geology. â€” Exploration has added very materially to our knowledge of the sedimentary formations found in the state. To the Eev. W. B. Clarke is due the credit of mak- ing the first systematic classification of these formations ; this classification has, however, been somewhat modified, and the rocks as they are now known are classified as follows : â€”

‘ Post-Tertiary

Cainozoic . . –

(Recent. I Pleistocene.

r Pliocene.

. Tertiary .| Miocene,

1, Eocene.

f Cretaceous

(Upper Cretaceousâ€” Desert Sjindstone.

j Lower Cretaceous â€” Boiling Downs Formation. Mesoeoio ... i Jurassic.

rWianamatta Sliales. I-Triassic â€” Hawkesbury Series â– { Hawkesbury Sandstones. [Narrabeen Shales.

PalcRoeoic . *

Permo-Carboniferous

Carboniferous. Devonian. Upper Silurian. Lower Silurian.

r Upper Coal Measures.

Derapsey Beds. J Middle Coal Measures. 1 Upper Marine Series.

Lower Coal Measures. [Lower Marine Series.

Palaeozoic rocks extend throughout almost the whole eastern portion of the state, principally on the western watershed of the main dividing range, in the country where the Murrumbidgee, Lachlan, and Abercrombie rivers rise. They appear on the eastern watershed, along part of the coast near Bateman's Bay, and, striking in- land, are found in the basin of the Clyde and the upper valley of the Shoalhaven. Slates containing Lower Silu- rian fossils (graptolites) have been found at three locali- ties in New South Wales, on the border of Victoria, to the south and south-west of Delegate; at Myall Eeefs, near Tomingley, and at Cadia, near Orange. The Upper Silurian rocks extend as far north as Mudgee, where they are overlain by the Permo-Carboniferous strata of the Hunter Valley, and by the belt of volcanic rocks extend- ing along the Liverpool range. They reappear farther north, in the upper valley of the Macleay river on the east slope, and in the basin of the Namoi, on the west side of the dividing range. The Silurian rocks consist of sandstone, slate, and limestone, and exhibit evidence of metamorphism, particularly in the country around

Bathurst and Hill End. Limestone beds of considerable extent are scattered throughout this formation. These are chiefly composed of crinoids and corals, T^ich out- crop prominently in the Wellington district, near Molong and Gulgong, at Tuena, and also in the Murrumbidgee district. In the limestone formations are found magnifi- cent caves, such as the Wellington, Wombeyan, Jenolah, Bungonia, and Abercrombie, the fame of which has spread even beyond the confines of Australia. The caves at Yarrangobilly, in the Kiandra district, are also very attractive. The Devonian rocks are well seen at Mount Lambie, near Rydal, where the late Mr C. S. Wilkinson measured a section of strata showing a thickness of not less than 10,000 feet. They also occur in the northern, southern, and western districts.

The coal-bearing rocks are of three distinctive systems, the first of which is in all probability of Lower Carboni- ferous age ; but the coal is full of bands, and otherwise too dirty to be of any economic value.

The second system, known as the Permo-Carboniferous, contains many seams of workable coal. Productive Coal Measures occiir in this system on three horizons : the first and lowest of these is the Greta (Stony Creek) series, the second the Tomago (East Maitland) series, and the last and

uppermost, the Newcastle series. The total thickness of this system and its assoeiatfed strata at Newcastle is about 11,000 feet, containing a total thick- ness of about 150 feet of coal, without taking into ac- count seams of less than 3 feet in thickness. Borings at Cremorne, a point on the northern margin of Sydney harbour, as well as at Holt-Sutherland and Liverpool, show the continuous extension of at least the upper or Newcastle series of coal-seams between Newcastle on the north and Bulli on the south.

The third system comprises the Clarence Carboniferous basin, and is of Mesozoic age. Professor David estimates the length of that part of it which contains the principal seams to be about 65 miles from east to west, while its width is about 37 miles from north to south. The most remarkable beds in the Clarence basin are a series of massive whitish sandstones, which were considered by Mr C. S. Wilkinson to be ihe equivalents of the Hawkesbury sandstones, and were named by him ” The Middle Clarence Series,” occupying as they do an intermediate position be- tween the upper and lower coal-beds of the basin. None of the seams in this coal-field have as yet been proved to be of commercial value. Professor David estimates the top seam to contain 1 foot 9 inches, out of a total thick- ness of 5 feet 7i inches, of coal fit for ordinary consump- tion, while the second and third seams have not been

sufficiently tested to allo-w of a definite opinion being formed of their value. It is probable, however, that even if the seams prove to be of insuiiicient thickness and purity to yield coal fit for purposes of export, they may supply coal of fair quality for local requirements.

The Hawkesbury and Wianamatta series, which over- lie the Carboniferous formation of that part of the coun- try through which the Hawkesbury and its’ principal tributaries flow, belong to the Mesozoic period. It is in this series that the wonderful gorges of the Blue Moun- tains and the beautiful harbours of Port Jackson, Port Hacking, and Broken Bay occur. The rocks

consist of grey, purple, and chocolate-coloured shales and yellowish- grey sandstones, and the maximum thickness of the strata is estimated at 1700 feet. The Triassic rocks form the principal store-house of the artesian water-supply of the north-western portion of the state, where they underlie the rolling downs or Lower Cretaceous formation. Most of the deeper bores in this arid region obtain the bulk of their supply of water from the Triassic sandstones. The Wianamatta formation extends round Sydney, and covers a space in the shape of an irregular triangle, the angular points of which rest at Picton on the south, Richmond on the north, and Sydney on the east. The beds are com- posed of fine sedimentary deposits of argillaceous shales, and are/ of comparatively little thickness. They appear to have been deposited in hollows worn by denudation out of the sandstone on which they directly rest. Neither the ISTarrabeen shales, nor the Hawkesbury sandstones, nor the Wianamatta shales, contain any remarkable seams of coal. All three formations are intersected by igneous dykes, which ^have also intruded the underlying Permo-Carboniferous rocks ; and where they have come in contact with the coal-seams, the latter have been con- verted into coke, sometimes to a thickness of 3 feet or more. Jurassic rocks have been recognized in only one locality in New South Wales, viz., on the Talbragar river, about 20 miles north of Gulgong, where they occupy a denuded hollow in the Hawkesbury sandstones. They are of small extent, and consist of yellowish shales con- taining numerous fish and plant remains.

The Cretaceous formations occupy the north-western part of the state, extending from the Barwon westwards towards the north-western corner. Water-bearing strata have been reached at depths varying from 89 feet to 2070 feet, and large quantities of water have been obtained, though priTicipally from the underlying Triassic sand- stones. The existence of subterranean water throughout this extensive region has been practically demonstrated.

To the Cainozoic period belong the deposits covering the greater portion of the central and western districts of the state. It therefore embraces the valleys of the great western rivers and their chief tributaries. The formation is, however, intersected by a broad broken belt, chiefly of Silurian rocks, extending across its centre, from the Bogan river towards the Great Barrier Range on the farther side of the Darling. Large patches of Devonian rocks

are also met with in the same region. Making these deductions, the Post-Tertiary rocks cover more than one-third of the whole state. The vast alluvial plaius were formed during the Pliocene and Post- Pliocene periods. The alluvial deposits are of variable thickness, sometimes shallow ; but in the great plains, between the main rivers which intersect the country, the deposits are of very great depth.

The area occupied by Igneous and Metamorphic rocks comprises one-eighth of the colony â€” the principal rocks belonging to the series consisting of varieties of granite, quartz-porphyry and felstone, diorite, basalt, and serpen- tine. Granite occurs for the most part in the northern and southern masses of the great dividing range, but is

found outcropping throughout the Silurian deposits, which cover so large a part of the centre of the state. Diorite and basalt occur principally in the country between the Macleay and Manning rivers, and on both slopes of the Liverpool Range, between the upper waters of the Namoi and Macleay. Serpentine is found scattered in different parts of the state, chiefly at Gundagai, Bingara, Luck- now, Nundle, Yulgilbar on the Clarence river, and Port Macquarie. The granites, quartz;~~porphyries, and fel~~ stones have been recognized as belonging to the Palaeozoic age, whilst the volcanic rocks, basalts, and others are chiefly contemporaneous with the Tertiary series. At Kiama there is’ an immense development of interbedded basalt lavas and tuffs in the Permo-Carboniferous rocks.

Artesian Water. â€” Before actual boring operations proved that the belief was well founded, it had long been scien- tificfvlly demonstrated that there was every probability of water being obtained in the Cretaceous formation which underlies the whole of the north-west portion of New South Wales â€” a region favoured with only a sparse rain- fall ; and from an examination which has been made of this formation occurring in the western and north-western portions of the state, it ‘is considered probable that the artesian water-bearing basin will be found to extend much farther south than it was previously supposed to do. It may, indeed, be yet found to extend approximately along the course of the Lower Darling. An important discovery has also been made that artesian water is obtainable in other than Cretaceous rocks. This is borne out by palseontological evidence ; and

some of the most successful bores, such as those at Coonamble, Moree, Gil Gil (Moree to Boggabilla), and Euroka (Walgett to Coonamble), have pierced rocks of Triassic age, correspond- ing with the Ipswich Coal Measures.

As to the natural features and climate, nothing need be added to what was said in those respects in the ninth edition of this work (vol. xvii. p. 408), the correctness of which extended observations have served to confirm.

Population. â€” The population on the 1st January 1901 was 1,359,943, viz., 713,896 males and 646,047 females. The total includes 10,974 Chinese and 7434 aborigines and half-castes. Since 1860 New South Wales has added more largely to its population than any of the other Australian states. In the year named the population was 348,646; in 1890 the number was 1,121,860. From 1890 to 1901 the population increased 238,083, or at the rate of 21-2 per cent. By far the largest part of the increase is due to excess of births over deaths, for out of the increase of over 1,000,000 since 1860, only 350,000 was due to immigration. In 1899 there were 36,461 births and 15,901 deaths; these figures are equal to 27-10 and 11-82 per thousand respectively. The birth- rate has fallen very much, especially during the last ten years of the 19th century. In 1861-65 it was 42-71 per 1000; in 1896-99 it was only 2792 per thousand. Illegitimacy is increasing in New South Wales, and in 1899 the proportion of illegitimate births was 7-16 per cent, of the total births. In 1871-75 it was 4-09 per cent, of the total births ; in 1896-99 it had risen to 6-84 per cent. The marriage-rate for 1899 was 6-89 per thousand, and the persons married 13-78 per thousand. The mean for 20 years was 7-39. The chief cities are Sydney and suburbs, population in 1901, 488,382; Newcastle and suburbs, 64,991; Broken Hill, 27,518; Parramatta, 12,568; Goulburn, 10,610; and IMaitland (East and West), 10,085. There are nine other towns with between 5000 and 10,000 inhabitants each.

Administration. â€” Some important changes have been made in the electoral system. Tlie number of members of the Legisla- tive Assembly has been fixed at 125, and the boundaries of tlie

statistics]

electoral diBtriote are from time to time adjusted so as to preserve, as far as possible, an equality in the number of electors in every district. The suffrage is extended to all males over twenty-one years of age, with tlie usual restrictions in regard to the pauper and criminal classes. An elector has only one vote, which is at> tached to the district in which he resides. Members of tlie Legis- lative Assembly are allowed a salary of Â£300 a year. There were in

1899 about 325,000 electors. Bach electoral district returns one member. |Local government is confined to the centres of population. There are 180 municipalities, embracing an area of 2824 square miles, which is an insignificant proportion of the whole area of the colony (310,700 square miles). The municipalities, however, con- tain 815,000 persons, out of a total population of 1,369,943. Rates are levied on the estimated fair annual rental of properties liable for assessment, and in 1900 the assessed value was Â£7,905,350, representing a capital value of Â£124,541,800, the value of Sydney and suburbs being Â£5,069,630 annual and Â£88,116,600 capital value. The revenues of all the municipalities in 1900 amounted to Â£806,057. Where water-supply has been provided to municipalities the local bodies control the works. In 1900, 17 municipalities owned their own gasworks and 6 had electric lighting. The various local bodies had outstanding loans to the extent of Â£2,731,334, of which Â£1,344,004 had been raised in London, and the balance in Sydney. The municipalities maintained 7600 miles of road, about half this length being formed ; the state maintained about 42,000 miles, so that there were nearly 60,000 miles of road communications.

Beligion. â€” The proportions of the leading denominations have not altered to any considerable extent since 1891. The pro- portions then were : â€” Church of England, 44-8 per cent. ; Roman Catholic, 25-5 ; Presbyterian, 9-7 ; Wesleyan and other Methodists, 9-8; Congregationalist, 2-1; Baptist, 1-2; others, 0”9. In 1901, 72-18 per cent, of the population were Protestants and 25-96 per cent. Roman Catholics. Sydney is the seat of Anglican and

Roman Catholic archbishoprics ; the Anglican archbishop is also primate of Australia and Tasmania.

Education. â€” The state has in its employ 2756 male and 2308 female teachers, and maintains 2745 schools. The law requires that all children over six years and under fourteen ye^rs shall attend school, and in 1900, 250,000 children of these ages, as well as 49,000 others below or beyond the school ages, were receiving instruction, making a total of 299,000. Of this number 239,000 were in state schools and 60,000 in private schools. The majority of the private schools are controlled by one or other of the religious bodies. The Roman Catholic Church has 325 schools, with 1617 teachers and an attendance of 32,000 pupils. The total expendi- ture of the state on public instructioil, science, and art during the year ended 30th June 1900 was Â£873,824. During the calendar year 1900 a sum of Â£780,216 was expended on primary instruction. The fees from pupils amounted to Â£82,494, making the actual cost of primary instruction Â£697,722. There are a university and a technical college in Sydney.

Finance. â€” ^The revenue is derived from three main sources, viz., taxation, sale and lease of lands, railways, tramways, and other services. In 1900 the sums received under these headings were : â€” From taxation, Â£2,618,066 ; from land, Â£2,116,076 ; and from ser- vices rendered (railways, tramways, posts and telegraphs, &c.), Â£4,992,521 : there were miscellaneous receipts ~~to the extent of Â£244,014, so that the total revenue was Â£9,970,677. The direct taxation is represented by a tax of one penny in the pound on the unimproved value of land, sixpence in the pound on the annual in~~ come derived in the state from all sources, except the use and occu- pation of land and improvements thereon. There are also various stamp duties. The land revenue is derived partly from the aliena- tion of the public estate, either absolutely or under conditions, and partly from the occupation of the public lands. There is also a small revenue from mining lands, timber licences, &c. The state still holds 150 million acres out of a total of 198 million acres, having alienated about 48 million acres. The principal heads of expenditure were :â€” Interest on public debt, Â£2,310,271 ; redemp- tion of loans, Â£264,562; working expensesâ€” railways, Â£2,025,720; posts and telegraphs, Â£722,110; public instruction, Â£769,576 ; hos- pitals and charities, Â£394,637; military and naval,

Â£212,405; other services, Â£3,189,696, making a total of Â£9,888,977. The expendi- ture has been fairly stationary since 1893. The public debt in 1900 was Â£65,332,993, equal to Â£48 per inhabitant. The public debt has risen from Â£14,903,919 since 1880. Of the total debt in

1900 (Â£65,332,99.3) the amount of Â£2,181,584 was unfunded, and Â£65,060,650 was held in London.

Defence.â€” The defence force at 30th June 1900, exclusive of Rifle Club reservists to the number of 1500, mustered 9152; of these 824 ~~sVere permanent troops, 4440 partially paid, 3305 volunteers, and naval volunteer force 583. The annual expendi~~ ture upon defence in 1900 was Â£249,271. Besides the mainten- ance of the military forces, there is an annual expenditure from loans upon fortifications ; this for the year 1900 amounted to Â£29,427. There is also a small expenditure upon the mainten-

ance of the works at the naval station at Port Jackson, which have been erected at a cost to the state of Â£312,481.

ProductiQn. â€” Very material changes have taken place since 1882 in the industrial position, due to a variety of causes, chief amongst which were the opening of the Broken Hill silver mines, the extension of agriculture, and the opening up of the central districts, with the substitution of small holdings for the large pastoral areas under which the land was previously held. In 1880 there were 39,918 holdings over one acre in extent, em- bracing 22,721,603 acres; while in 1900 the separate holdings numbered 68,098, and their area was 45 million acres, in all cases excluding land leased from the Crown. This change in the character of the occupation of the country has had a very Batural effect upon all rural industries and on trade generally. The main changes are briefly alluded to hereunder.

Agriculture. â€” New South Wales is essentially a pastoral coun- try, and the cultivation of the soil has always been secondary to stock-breeding. This circumstance is by no means due to lack of good land, nor can it be ascribed to defects of the climate. But success ‘in tillage in New South Wales is altogether independent of the mere fitness of the soil for cultivation. An irregular rain- fall and a want of uniformity in the seasons, which are the chief characteristics of the climate of a large part of the

interior, have impeded the advance of agriculture, especially on the great western plains. And to these obstacles there may be added the cost of transport, which, owing to the great distance that produce would have to be carried by land before it can reach a seaport, has told greatly against cultivation for export, which must be the chief hope of the farmers in a country so sparsely populated and affording such a small home market. These reasons will explain how it has happened that for many years such slow progress was made in agriculture. In 1882 the breadth of land under cultiva- tion was 733,682 acres, which is slightly less than one acre per inhabitant ; in 1900 the total area under cultivation was 2,440,968 acres, which is equal to 1-86 acres per inhabitant. The area devoted to each of the principal crops was as follows : â€” Wheat, 1,840,979 acres ; maize, 214,697 acres ; oats, 134,529 acres; barley, 8623 ; other cereals, 4885 ; lucerne and other green crops, 107,880 ; sugar-cane, 22,517 ; potatoes, 34,968 ; oranges, 14,533 ; vines, 8278 ; other fruits, 31,716 ; other crops, 17,.363. The total value of all produce harvested in 1900 was Â£5,682,000. Although the coastal districts are still important, as the crops yielding the largest returns per acre are grown there, as regards total area under crop they are of much less importance compared with the wliole state than formerly. For agricultural purposes New South Wales is naturally divided into six zones ; these, with the total area under crop in each, are as follows: â€” Coast districts, 316,403 acres; tablelands, 663,030; western slopes of tableland, 1,004,466; Riverina, 387,710; western plains â€” east>Darling, 23,30.3; western plains â€” trans-Darling, 6066. On the great western plains, comprising an area of 136,896 square mOes, less than 30,000 acres are cultivated. The soil of that part of the country is for the most part suitable for cultivation, and there are large areas of rich land, but the rainfall is too light and irregular for the purposes of agriculture.

In 1898 New South Wales for the first time became an exporter of wheat, but a small import was again necessary in 1899. Hay crops and maize rank next in importance to wheat. The cultiva- tion of various kinds of fruit is receiving increased attention, but the growing of sugar-cane and tobacco and the production of wine, until recently so promising, are, if not declining, at least stationary, in spite of the suitability of the soil of many districts for these crops. The progress of agriculture since 1880 will be seen

from the fact that in that year the total area cropped was 635,641 acres, and in 1900 it was 2,440,968 acres.

Grazing. â€” In spite of the great attention now bestowed upon agriculture, the grazing industry still holds the chief place amongst the productive industries. The number of stock de- pastured in 1900 was, however, much less than in any year since 1886, due solely to the droughts, which during the preceding five years (1895-99) played havoc with the flocks. In 1894 the flocks and herds numbered 618,000 horses, 2,465,000 homed cattle, 57,000,000 sheep, and 273,000 swine ; in 1900 the numbers had fallen to 481,417 horses, 1,983,116 horned cattle, 40,020,606 sheep, and 256,577 swine. The vast majority of the sheep are of the merino breed, but there are about a million long-wooUed sheep, and between two and three million cross-bred.

There are 68,098 holdings exceeding one acre in extent, and the area occupied is 164,886,804 acres, of which 45,086,209 acres are owned by private persons and 119,800,595 acres by the Crown. About 3 million acres are used for purposes of tillage or are in fallow, and the remainder for grazing and dairying.

Mining. â€” The mining industry has made great strides. In 1899 there were about 43,000 men engaged in the various mines, besides 3300 employed in smelting. Nearly half this number (19,350) were employed in gold-mining ; in coal-mining there were

10,300 ; silver, 7900 ; tin, 1500 ; and copper, 2400. The value of min- ing machinery may be approximately set down at Â£2,800,000. The following summary shows the value of the production of the various minerals since their first discovery, as well as the value of minerals won in 1899. It is impossible to separate the values of silver and lead contained in the ore exported from Broken Hill and other fields, but an estimate based upon the

best data available gives their ap- proximate values as â€” silver, Â£21,559,600, and lead, Â£6,458,800.

Minerals.

Produced in

1899.

Total Production.

Metallic â€”

Gold

. Â£1,751,815

Â£47,546,013

Silver and lead

. 2,170,446

28,018,436

Zinc

49,207

112,879

Tin and tin ore

90,482

6,382,538

Copper and regulus

395,451

5,019,480

Iron oxide

846

10,644

Antimony and ore .

2,694

190,621

Bismuth

3,355

50,880

Manganese oxide .

1,331

Chrome iron ore

‘. ‘. 17,416

70,975

Platinum

1,079

11,425

Non-metallic â€”

Coal

. 1,325,799

35,647,004

Coke (not included with

coal) . 77,130

371,106

Kerosene shale

40,823

1,908,482

, Alunite .

. ^ 2,763

37,958

Cobalt .

899

3,380

Diamonds

10,350

> 49,872

Opals

135,000

376,599

Other

4,970

124,322

Total

. Â£6,080,516

Â£125,933,945

The value of gold won in 1899 (Â£1,751,815) was a considerable increase over the production of the previous year and of any year since 1863. As no new fields of importance have been discovered, this increased yield was doubtless due to an improvement in methods. About one-fifth of the gold won is alluvial. The yield of gold from quartz mines was in 1899, 12 dwt. 2 grains per ton, which was some- what below the average for the previous ten years. The Broken Hill silver lode is the largest as yet discovered ; it varies in width from 10 feet to 200 feet, and may be traced for several miles. The Broken Hill Proprietary Company owns the principal mine, and at Port Pirie, in the neighbouring colony of South Australia, has erected a complete smelting plant. Prom the commencement of mining operations in 1855 to the beginning of June 1900 the com- pany treated 4,594,611 tons of ore, producing 103 million ounces of silver and 419,000 tons of lead, valued at Â£21,632,000. The production of tin has rapidly declined since 1881, when the value of ore raised was Â£569,000 ; in 1899 the production was only Â£90,000. One cause of this falling-off was the drop in the price of the metal, but the principal cause was the exhaustion of the shallow deposits of stream tin, from which most of the ore was obtained. The high rates ruling in 1899, however, caused an ad- vance in production in 1900, the output being valued at Â£142,724. The principal deposits of copper are in the central parts between the Macquarie, Bogan, and Darling rivers. The value of the pro- duction fell from Â£473,000 in 1883 to Â£64,000 eleven years later, but in 1900 had again increased to Â£425,301. Iron is widely diffused, principally in the form of magnetite, brown haematite, limonite, and bog iron. Coal-mining is carried on in three districts. In the northern or Hunter river district there were 57 collieries, employing 8000 men, and the

quantity of coal raised was in 1899 about 3,260,000 tons ; in the southern district there were 14 collieries, employing 2100 men and raising 1,120,000 tons of coal. The western or mountain collieries were 17 in number, employing 400 men and raising’ about 218,000 tons. About 70 per cent, of the coal obtained is exported.

Manufacturing Industry. â€” There are a large number of manu- factories, but only 222 employ more than 50 hands. The follow- ing is an analysis of the establishments at the close of 1900 : â€” Establishments witli Numter. Total Hands.

Under 10 hands

. 1888

10,361

11 to 20 â€ž

572

8,449

21 to 50 â€ž

395

12,406

51 to 100 ,,

131

8,862

Over 100 â€ž

91

20,701

Total

3077

60,779

Of the 60,779 hands employed in 1900, 24,312 may be said to find employment in connexion with industries which come into competition with imported goods, while 36,407 were employed in domestic industries treating perishable produce required for im- mediate use, or in industries called into existence by the natural resources of the state. About two-thirds of the hands are em- ployed in Sydney and the adjacent district, where the facilities

for the establishment of large industries are considerable. The total value of the articles produced in manufactories, and the increased value of materials after undergoing treatment, is approximately Â£16,300,000, of which about Â£7,500,000 represents value of material usedâ€” Â£400,000 fuel and Â£4,750,000 wages. Very fair progress was made in the manufacturing industries up to the year 1892, but in the following year the banking crisis so unsettled affairs that there was a large reduction in the number of hands employed. There was a partial recovery iti the follownig year, and in 1898 the lost ground was fully recovered. Of the hands employed in 1900, 50,516 were males and 10,263 females, making a total of 60,779.

Commerce.â€” The over-sea trade required in 1900 the services of 3626 vessels; the tonnage entering the ports, excluding the coastal shipping, was 4,094,088 tons. The value of goods im- ported in 1900 was Â£27,561,071. Of the imports, Â£18,270,043 were retained for home consumption and Â£9,291,028 were re- exported. The average value of imports per inhabitant was, in 1900, Â£20, 4s. 7d., and of exports, Â£20, 13s. 5d. Of purely local produce, the value of the exports in 1900 was Â£18,873,488, or Â£13, 17s. per inhabitant.

Wool is the staple export, and represents in most years nearly one-half the value of the domestic exports. Gold coin and bullion form one of the principal items in the export list, but only a small portion of the export is of local production, the balance being Queensland and New Zealand gold sent to Sydney for coinage. In 1900 the principal articles of domestic produce, with their value, exported were as follows :â€” Sheep, Â£449,633 ; cattle, Â£247,663 ; horses, Â£366,647 ; butter, Â£486,786 ; coal, Â£1,273,034; gold coin and bullion, Â£1,330,249; leather, Â£420,702 ; meat, frozen and preserved, Â£768,245 ; silver and lead, Â£2,743,263 ; skins and hides, Â£360,713 ; tallow, Â£375,855 ; tin, Â£171,874; wool, Â£7,632,213. The total export of coin and bullion was Â£5,912,710. The course of trade since 1880 has been as follows : â€”

Tear.

Imports.

E.\ports.

Total.

Domestic Produce.

1880 1885 1890 1895 1900

Â£14,176,063

23,737,461 22,615,004 15,992,415 27,561,071

Â£15,682,802

16,750,107 22,045,937 21,934,785 28,164,516

Â£12,007,931

12,059,280 17,232,725 16,436,210 18,873,488

Hallways. â€” The railways are almost entirely in the hands of the state, for out of 2896 miles open in 1900 the state owned 2812 miles. The capital expended on the state lines open for traffic was Â£38,477,269, of which sum Â£5,542,510 was expended on rolling stock and equipment, and Â£32,934,759 on construction of roads, stations, and permanent ways. The net earnings amounted to Â£1,394,052, which represents a return of 3-63 per cent, upon the capital invested. The state pays, on an average, 3‘62 per cent, for the money borrowed to construct the lines, and there is therefore a slight surplus to the advantage of the revenue. Â»

Postal and Telegraph Service. â€” The postal business of 1899 was represented by the carriage of 76,742,200 letters and post-cards, 46,807,800 newspapers, and 13,987,000 parcels and books ; the telegrams despatched numbered 3,112,000. To transact the postal business of the country, jnail conveyances travelled 11,638,000 miles. The income of the postal and telegraph de- partment in 1899 was Â£780, (iAS, and the expenditure Â£758,606, but there were some items of expenditure not included in the sum named, such as interest charges, &c. ; the total expenditure was approximately Â£870,000.

Banking. â€” The banks of issue number thirteen ; their paid-up capital amounts to Â£18,092,428, and the capital and reserves to Â£22,583,700, but of this sum only about Â£9,727,000 is used in the state. The coin and bullion in reserve amount to Â£6,041,444, and the note circulation to Â£1,241,426. The banks have on deposit Â£19,679,621 bearing intei-est, and Â£12,976,711 not bearing interest, representing a total of Â£32,656,232. The savings banks had on their books at the close oÂ£ 1899 about! 261,000 depositors, with Â£10,069,434 to their credit. This represents Â£7, 8s. 5d. per inhabitant. The total deposits in all banks therefore amounted to Â£42,725,666. The progress since 1860 has been as follows :â€”

Year Amount on Averajre per

Deposit. Inhabitant.

1860 . . . Â£5,721,208 Â£16 8 3

1870 . . . 7,044,464 14 2 6

1880 . . . 19,958,880 26 13 8

1890 . . . 43,390,141 38 13 6

1899 . . . 42,725,666 31 9 11

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II. HiSTOKY.

New South Wales was discovered by Captain Cook on board the Endeavour, on 20th April 1770. After he had observed the transit of Venus at Tahiti, he circum- navigated New Zealand and went in search of the eastern coast of the great continent whose western shores had long been known to the Dutch. He sighted the Australian coast at Gippsland, Victoria, near Cajje Everard, history which he named Point Hicks, and sailed along the east coast of Australia as far north as Botany Bay, where he landed, and took possession of the continent on behalf of his Majesty King George III. He then continued his voyage along the east coast of Australia, and returned to England by way of Torres Strait and the Indian Ocean. The favourable reports made by Captain Cook of the fertility of the country around Botany Bay induced the British Government, which had lost the North American colonies a few years before, to found a penal settlement on the south-eastern part of what was then known as New HollaM. An expedition, consisting of II.M.S. Sinus of 20 guns, the armed trader Supply, three store-ships, and six transports, left England on 17th May 1787, and after touching at Teqerife, Rio de Janeiro, and the Cape of Good Hope, arrived at Botany Bay on 20th January 1788, under the command of Captain Arthur Phillip, E.N., with Captain John Hunter, E.N., as second. The persons on board the fleet included 564 male and 192 female convicts, and a detachment of marines, consisting of Major Boss, commandant, 16 officers, 24 non-commissioned officers, an adjutant and quartermaster, 160 privates, and 40 women. There were in addition five medical men and a few mechanics. The live stock consisted of one bull and four cows, a stallion and three mares, some sheep, goats, pigs, and a large number of fowls. The expedition was well provided with seeds of all descriptions.

The shores of Botany Bay were found to be unsuitable for residence or cultivation, and Captain Phillip trans- ferred the people under his command to Port Jackson, half a dozen miles away, near the site of the present city of Sydney. Eor some years the history of the infant settlement was that of a large gaol ; the ‘‘Â«‘“â– ’ attempts made to till the soil at Farm Cove

rl^/me.*”’ ^^^^ Sydney and near Parramatta were only partially successfvil, and upon several occasions the residents of the encampment suffered much

priva- tion. But by degrees the difficulties inseparable from the foundation of a remote colony were surmounted, several additional convict-ships landed their living freight on the shores of Port ~~Jackson, and in 1793 an emigrant~~

ship arrived with free settlers, who were furnished with provisions and presented with free grants of land. By the end of the 18th century the inhabitants of Sydney and its neighbourhood numbered 5000. Immediately after the arrival of the first fleet, surveys of the ad- jacent coast were made ; the existence of a strait between Australia and Tasmania was discovered by Surgeon Bass ; and before the retirement of Governor King in 1806 Australia had been circumnavigated and the principal features of its coast-line accurately surveyed by Captain Flinders, E..N. The explorations landward were, how- ever, not so successful, and for many years the Blue Moun- tains, which rise a few miles back from Sydney, formed an impenetrable barrier to the progress of colonization. Penal establishments were formed at Newcastle in New South Wales, at Hobart and Launceston in Tasmania, and an unsuccessful attempt was made to colonize Port Phillip. The most noteworthy incident in the first decade of the 19th century was the forcible deportation by the officers of the New South Wales Corps, a regiment raised in England for service in the colony, of the governor. Captain Bligh, R.N., the naval officer identified with the mutiny of the Bounty. Eor some time the government was administered by the senior officer of the New South Wales Corps, but in 1809 he was succeeded by Captain Macquarie, who retained the governorship for eleven years.

During the regime of this able administrator New South Wales was transformed from a penal settlement to a colony. Prior to the arrival of Macquarie schools and churches had been erected, a newspaper, the Sydney Gazette and New South Wales Advertiser, had _ , . been started, and attempts had been made juacquarie’s to acclimatize the drama. But he was thegovemor- first governor to open up the country. He***’ constructed permanent buildings at Sydney and Parra- matta, formed roads and built bridges in the districts along the coast, and commenced a track across the Blue Mountains, which had been crossed in 1813 by Wentworth and others, thus opening up the rich interior to the in- habitants of Sydney and the settlements in its immediate neighbourhood. It was during Captain

Macquarie’s ad- ministration that the first banking institution, the Bank of New South Wales, was founded. The final fall of Napoleon in 1815 and the cessation of the war, which had lasted with very little intermission since the first establishment of the colony, gave the people of the United Kingdom leisure to think about their possessions at the Antipodes ; and in 1817 free settlers commenced to arrive in con- siderable numbers, attracted by the success of Captain M’Arthur, an officer in the New South Wales Regiment, who had demonstrated that the soil, grass, and climate were well adapted for the growth of merino wool. But although the free settlers enjoyed a considerable amount of material prosperity, and were enabled to purchase land on very easy terms, they were dissatisfied with the ad- ministration of justice, which was in the hands of a judge-advocate assisted by military officers, with the absence of a free press and representative institutions, and they demanded permission to occupy the vast plains of the interior with their flocks and herds, without having to obtain by purchase or by grant the fee-simple of the lands upon which their sheep and cattle grazed. These demands were urged with more or less spirit during the governorships of Sir Thomas Brisbane and General Darling ; but they were not finally conceded, together with perfect religious equality, until the rigime of Sir Richard Bourke, which lasted from 1831 to 1837. At the latter date the population had increased to%si to 76,793, of whom 25,254 males and 2557 females were or had been convicts. Settlement had

progressed at a rapid rate. Parramatta, Eichmond, and Windsor had indeed been founded within the first decade of the colony’s existence; Newcastle, Maitland, and Morpeth, near the coast to the north of Sydney, had been begun during the earlier years of the 19th century ; but the towns of the interior, Goulburn, Bathurst, and others, were not commenced till about 1835, in which year the’ site of Melbourne was first occupied by Batman and Fawkner. The explorations which followed the passage of the Blue

Mountains opened up a large portion of south-eastern Australia. Van Diemen's Land was declared a separate colony in 1823, West Australia in 1829, South Australia in 1836, and New Zealand in 1839 ; so that before 1840 the original area of New South Wales, which at first in- cluded the mainland of Australia and the islands in the South Pacific, had been gi-eatly reduced. In the last-named year the press was free in every part of Australia, trial by jury had been introduced, and every colony possessed a legislature, although to none of them except to New South Wales had the ptinciple of repre- sentation been introduced, and in that colony only to a very limited extent. The policy of granting land with- out payment, originally in force in New South Wales, had been abandoned in favour of sales of the public lainds by auction at the upset price of twenty shillings per acre; and the system of squatting licences, under which colo- nists were allowed to occupy the waste lands on payment of a small annual licence, had been conceded. In 1851, when separate autonomy was granted to Victoria, New South Wales had a population of 187,243, the annual imports were Â£2,078,338, the exports Â£2,399,580, the revenue was Â£575,794, and the colony contained 132,437 horses, 1,738,966 cattle, and 13,059,324 sheep.

Gold was discovered at Lewis Pond Creek, near Bathurst, in May 1851, by Edward Hammond Hargreaves; and at the end of June the first shipment, valued at Â£3500, left Sydney. This discovery made an important change in the position of the colony, and transportation, which had been discontinued during the previous year, was finally abolished. The first mail steamer arrived in August 1852, and in 1863 a branch of the Eoyal Mint was established at Sydney. The New Constitution Bill, passed during the same year by the local legislature, pro- vided for two deliberative chambers, the Assembly to be elected and the Council nominated, and for the responsi- bility of the executive to the legislature. The Sydney University, founded in 1860, was enlarged in 1854, and the first railway in New South Wales, from Sydney to Parramatta, commenced in 1850, was opened in 1855. In the same year the Imperial Parliament passed the

New Constitution Act ; and in June 1856 the espons- g^^ responsible government in Australia was govera- formed, during the governorship of Sir William Tase' Denison, by Mr Stuart Alexander Donaldson.

The first administration lasted only for a few weeks, and the experiment of transporting to the Anti- podes responsible government, modelled upon the British plan, was not immediately successful. Ministry suc- ceeded ministry at short intervals, and it was some years before constitutional government worked smoothly. The powers of the new Parliament were utilized for extend- ing representative institutions. Vote by ballot was introduced; the number of members in the Assembly was increased to 80, and the franchise was granted to every adult male after six months' residence in any electoral area. Meanwhile the material progress of the colony was unchecked. A census taken at the end of 1867 showed that the population of Sydney was, in- cluding the suburbs, 81,327. Telegraphic communication was established between Sydney, Melbourne, Adelaide,

and Tasmania in 1859; and during the same year the Moreton Bay district was separated from New South Wales, and was constituted the colony of Queensland.

During the regime of Sir John Young, afterwards Lord Lisgar, who succeeded Sir William Denison in 1861, several important events occurred. The land policy of previous governments was entirely revised, and the Land Bill, framed by Sir John Kobertson, introduced the principle of deferred payments for the purchase of Crown gj^j^^^ lands, and made residence and cultivation, rather Young's than a sufReient price, the object to be sought z^eraof by the Crown in alienating the public estate. * '''â– This measure, passed with great difSculty and by bring- ing considerable pressure to bear upon the nominated Council, was the outcome of a lengthened agitation throughout the Australian colonies, and was followed by similar legislatipn in all of them. It was during the governorship of Sir John Young that the distinction be- tween the descendants of convicts and the descendants of free settlers, hitherto maintained with great strict- ness, was finally abandoned. In 1862 the agitation against the Chinese assumed importance, and the atti- tude of the miners at Lambing Flat was so threatening that a large force, military and police, was despatched to that goldfield in order to protect the Chinamen from ill- treatment by the miners. The railways were gradually extended, and the condition of the country roads was im- proved. The only drawback to the general progress and prosperity of the country was the recrudescence of bush- ranging, or robbery under arms, in the

country districts. This crime, originally confined to runaway convicts, was now committed by young men born in the colony, familiar with its mountains and forests, who were good horse- men and excellent shots. It was not until a large num- ber of lives had been sacrificed, and many bushrangers brought to the scaffold, that the’offenee was thoroughly stamped out in New South Wales, only to reappear some years afterwards in Victoria under somewhat similar conditions.

The earl of Belmore became governor in 1868, and it was during his first year of oflSce that H.R.H. the duke of Edinburgh visited the colony in comm^d of the Galatea. An attempt made upon his life, during a picnic at Clontarf, caused great excitement throughout Australia, and his assailant, a man named O’Farrell, was hanged. A measure which virtually made primary educa- tion free, compulsory, and unsectarian came into operation. A census taken in 1871 showed that the population was 503,981; the revenue, Â£2,908,155; the expenditure, Â£3,006,576; the imports, Â£9,609,508; and the exports, Â£11,245,032. Sir Hercules Eobinson, afterwards Lord Eosmead, was sworn in as governor in 1872. Dui’ing his rule, which lasted till 1879, the Fiji Islands were annexed ; telegraphic communication with England and mail communication with the United States w’ere estab- lished; and the long series of political struggles, which prevented any administration from remaining in ofiice long enough to develop its policy, was brought to an end by a coalition between Sir Henry Parkes and Sir John Eobertson. Lord Augustus Loftus became governor in 1879, in time to inaugurate the first International Exhibi- tion ever held in Australia. The census taken during the following year gave the population of the colony as 751,468, of whom 411,149 were males and 340,319 fe- males. The railway to Melbourne was completed in 1880 ; and in 1883 valuable deposits of silver were discovered at Broken Hill, near the western frontier of New South Wales, but much nearer to Adelaide than to Sydney. In 1885 the Hon. W. B. Dalley, who was acting Premier during the absence through ill-health of Sir Alexander Stuart, made to the British Government the offer of a contingent

of the armed forces of New South Wales to aid the Imperial troops in the Sudan. The offer was accepted;

the contingent left Sydney in March 1885, on Sudaa . board the Iberia and Australasian, and for Tass”^” ‘ ^^^ ^”^s* irniQ a British colony sent its armed

forces outside its own boundaries to fight on behalf of the mother-country. In July of the same year Dr Moran, the Koman Catholic archbishop of Sydney, became the first Australasian cardinal. Lord Carrington, who was appointed governor in 1888, opened the railway to Queensland, and during the same year the centenary of the colony was celebrated. The agitation against the Chinese, always more or less existent, became intense, and the Government forcibly prevented the Chinese passengers of four ships from landing, and passed laws which practically prohibit the immigration of Chinese.

In 1889 the Premier, Sir Henry Parkes, gave in his adhesion to the movement for Australasian federation, and New South Wales was represented at the first conference held at Melbourne in the beginning of 1890. Lord Jersey assumed oflB.ce 15th January 1891, and a few weeks after- wards the conference to consider the question of federat- ing the Australian colonies was held at Sydney, and the great strike, which at one time had threatened to paralyse the trade of the colony, came to an end. A Boarcl of Arbitration and Conciliation to hear and determine labour questions and disputes was formed, and by later legislation its powers have been strength- ened. A census taken on 5th April 1891 showed that the population was 1,134,207, of whom the aborigines numbered 7705 and the Chinese 12,781. In 1893 a financial crisis resulted in the suspension of ten banks ; but with two exceptions they were reconstructed, and by the following year the effects of the depression had passed away. Pederation was not so popular in New South Wales as in the neighbouring colonies, and no progress was made between 1891 and 1894, although Sir Henry Parkes, who was at that time in Opposition, brought the question before the legislature. The Rt. Hon. Sir William Duff, who followed Lord Jersey as governor, died at Sydney in 1895, and .was succeeded by Lord Hampden.

In 1896 a conference of Australian Premiers was held at Sydney to consider the question of

federation. The then Premier, Mr Reid, was rather lukewarm, as he considered that the free-trade policy of New South Wales would be overridden by its protectionist neighbours and its metropolitan Attitude position interfered with. But his hand was to a fgJerMoa great extent forced by a People's Federation Convention held at Bathurst, and in the early portion of 1897 delegates from New South Wales met those from all the other colonies, except Queensland, at Ade- laide, and drafted the constitution, which with some few modifications eventually became law. The visit of the Australian Premiers to England on the occasion of Queen Victoria's Diamond Jubilee gave an additional impetus to federation, and in September 1897 the con- vention reassembled in Sydney and discussed the modifi- cations in the constitution which had been suggested in the local parliaments. In January 1898 the Bill was finally agreed to and submitted to a popular referendum of the inhabitants of each colony. Those of Victoria, South Australia, and Tasmania agreed to the measure ; but the majority in New South Wales, 5358, was not suflficient to carry the Bill. The local parliament subsequently suggested certain amendments, one of them being that Sydney should be the federal capital. The general election returned a majority pledged to federation, and after some opposition to the federal Bill by the Legislative Council it was again referred to the electors of the colony and agreed to by them, 107,420 votes being lecorded in its favour, and 82,741 against it. One of the provisions of the Bill as finally carried was that the federal metropolis, although in New South Wales, should be more than 100 miles from Sydney. The Enabling Bill passed through all its stages in the British Parliament dur- ing the summer of 1900, all the Australian colonies assenting to its provisions ; and on 1st January 1901 Lord Hopetoun, the governor-general of Australia, and the Federal Ministry, of which the Premier, Mr Barton, and Sir William Lyne, Home Secretary, represented New South Wales, were sworn in at Sydney amidst great rejoic- ings. In the following May the duke and duchess of York visited Sydney. Large contingents of troops from New South Wales were sent to South Africa during 1899 and 1900. (g. c. l.)

J^EWSPAPERS,

THE great advances of journalism during the latter half of the 19th century, and the ever-spreading influence of the daily paper, have at last created a general interest in newspapers as a class of literature and a sub- ject for bibliographical and statistical inquiry. As a result of this interest it has become possible to differentiate, roughly at all events, between newspapers and periodicals, and in the following statistics an attempt has been made to take into account only such papers as deal with current events, and appear daily or weekly, or with intermediate periodicity. In this connexion it may be stated that the London General Post Office adopts for registration as newspapers the limit of publication within eight days. For convenience the term ” weekly, &c.” is used” to in- clude jpapers that appear two or three times in the week.

Great Britain and Ikelajs’d.

Taking the newspapers of London as fairly representa- tive of the general njovement in the great commercial centres, it may be remarked that the ever- statistics. increasing activity of life, especially of commer- cial life, during the last twenty years of the 19th century

was reflected in the history of the newspaper press. Not only are many more papers published now than even ten years ago, but the number of copies of individual papers has increased also, especially in the case of so-called evening papers. In these, rather than in the morning papers, the increased ” pace ” of the present day is more faithfully represented. Such is now the eagerness to be au courant of passing events, that some of the ” evening ” papers are published before eleven o’clock in the morning, and five or six editions, finishing with an ” extra special,” are suc- cessively issued up to 7 p.m., and on occasions even later. Immense numbers of them are hawked about by newspaper- boys, whose parrot-cry of ” All the winners ! ” whether races have taken place or no, might lead the unwary to think that horse-racing is the only subject that interests Londoners.- The figures in the following statistics indicate part only of the progress during the period they cover ; for in the interval many papers have been started and after a brief existence have come to a premature termination. Among the older papers there have been very few cessa- tions ; the most notable, perhaps, being that of the Edinburgh Courant. This was founded in 1705, and

after a prosperous career of a hundred and eighty years was amalgamated with the Glasgow News after the 6th February 1886, under the new name of theScotUsh News, the last number of -whicli was published 11th February 1888. On the other hand, the number of ” localized ” editions â€” i.e., editions of one paper published at different places with a certain proportion of local news and a local title â€” grew from 151 provincial papers in 1890 to 260 in 1900. These localized editions sometimes have the inside pages devoted to general news, but in the greater number of cases that portion in their contents which does not consist of local news is printed from stereotype columns supplied by agencies in London to many journals at a time.

The number of sets of British newspapers received at the British Museum under the Copyright Act was as follows : â€”

England (Provinces), Wales, and Channel 1890. 1900.

Islands 1420 1664

London 647 1226

Ireland 173 222

Scotland 232 288

Total . . . 2472 3400

Single numbers of papers . . 170,838 220,.369

These, however, include fortnightly and monthly papers, which are not comprised in any of the following statistics.

The total number of daily papers published in 1890 was 193 ; in 1900, 258, showing an increase of 65 ; the number of weekly papers â€” i.e.,i published less than five times a week, and for the most part only once a week â€” was in 1890, 2216 ; in 1900, 2644, showing an increase of 398 papers ; the grand totals for 1890 and 1900 respectively being 2439 and 2902, showing an increase of 463.

The following tahles will show these figures in detail :â€”

British Papers. 1S90. 1900.

England (Provinces) 1390 1666

London 541 669

“Wales (in Welsh, 13 in 1890, and 16 in 1900) 86 114

Ireland 181 198

Scotland 218 232

Isle of Man 7 10

Jersey 8 7

Gueirnsey 8 6

Total Showing an increase of 463.

London Papers.

Daily

Weekly

Twice, or more, a week

Total Showing an increase of 128.

Daily Papers. London (morning, 17 in 1890, and 24 in 1900)

Provincial â€” England

Wales

Ireland

Scotland

British Isles

2439

2902

1890.

29 488

24

541

1900.

40 611

18

669

1890. 29 120 6

18

19

1

Total . . 193 Showing an increase of 65.

Daily Papers of the Three Capitals.

isnii. 1900.

London ... 29 40

Dublin . . 9 12

Edinburgh ... 4 3

1900. 40

165

7

22

19

258

42

55

Total

Showing an increase of 13. It would be extremely interesting to ascertain the average number of copies of the leading morning and evening papers issued daily, but it is not considered prudent by newspaper proprietors to disclose the true facts, and the figures sometimes given are not to be absolutely trusted.

England- Birmingham Bradford Brighton Bristol . Exeter . Hull Leeds

Daily Papers in the Principal Towns.

1890.

Liverpool

4 2 3 4 4 4 5

^ 7

London 29

Manchester ^

Newcastle ^

Norwich 3

Nottingham 4

Oldham 4

Plymouth 2

Portsmouth 2

Sheffield 4

Shields 2

Wolverhampton ..... 2 York 2

1900.

6

3

4

5

4

3

4

8 40

9

6

3

5

3

3

2

5

3

2

2

Total

Wales â€”

Cardiff . Swansea .

97 120

Increase 23

4 4

2 3

Total

Scotland â€” Aberdeen Dundee . Edinburgh Glasgow

Ireland â€” Belfast Cork Dublin

Total

Total

4 3 4 5

16

17

Increase 1

4 3 8 6

16

Same

4

4

12

20

Increase 3 Amongst ‘ ‘ class ‘ ‘ papers the greatest increase has been in those relating to finance, 11 ; shipping, 8 ; and sporting, 32.

Principal Class Papers. 1890. 1900.

Agriculture and gardening ... 24

Archaeology 1

Architecture 2

Art 1

Bakers 3

Book Trade 1

Boot Trade 2

Brewing 2

Building 11

Coal 3

Commercial 21

Corn 7

Education 7

Engineering 7

Fashions 8

Finance 34

Furniture 0

Humorous .31

Insurance 9

Iron .4

Juvenile . 16

Mining 2

Music 4

Paper o

Photography 4

Printing 1

Professional â€”

Army 5

Navy 3

Legal 18

Medical . 6

Religious â€”

1890. 1900.

Protestant : Church of England 22 20 1 ,â€ž Nonconformist . 20 21 (

Roman Catholic 8

Jewish 6

26 1 3 2 4 4 2 2

13 3

20 8

11 6

13

45 1

28 9 4

13 3 4 3 4 3

7

3

14

7

41

26

7

LONDON]

NEWSPAPERS

173

1890.

Science 1

Shipping 16

Sporting (general) 43 ‘

,, special : Athletics ... 7 Cricket .... 1 Cycling . . . . 9 66 Fishing .... 2 Pootball ... 4 Yachting . . . 0

Temperance Theatrical .

9

]900.

2 24 62

2

3 12

2 14

3

9′ 10

The great increase in Roman Catholic papers is’ due to the issue of a large number of localized editions, principally of the Catholic Herald.

Archaeology and History. â€” In 1893, when the conference of the Institute of Journalists was held in London, the British Museum arranged an exhibition of newspapers, and the following is a selection of the most important items. The exhibition was unique of its kind, but no catalogue of it was printed. The names of a few papers already described in vol. xvii. of the Encyclopmdia Britannioa are for convenience repeated.

The Mercurius Gallohelgicus, the probable forerunner of news- papers, the full title of which is ” Mercurius Gallobelgicus ab anno 1588 . . . usque ad 1594. ColonicB Agrip. 1594,” 8vo ; the spurious English Mercurie, No. 50, of 23rd July 1588 ; the Weekely Newes of 23rd May 1622 ; No. 1 of the Intelligencer, for 31st August 1663, edited by Sir Roger L’Estrange, just appointed ” Surveyor of the Imprimery and Printing presses ” ; the Mercurius Politicks of 2nd September 1658, giving the account of the death of Crom- well ; the Mercurius Publicus of 30th May 1660, reporting the Proclamation of Charles II. as King on 8th May ; the Mercurius Puhlicus of 24th-31st January 1661, describing the hanging of the carcases of Cromwell, Ireton, and Bradshaw ; No. 1 of the Oxford Gazette, 16th

November 1665, and No. 1 of the Lon- don Gazette, which the former became on 1st February 1665/6 ; No. 85 of the London Gazette, 3rd-10th September 1666, giving an account of the Fire of London ; the Intelligencer of 24th April 1665, giving notice, with reference to touching for the king's evil, "that his Majesty hath declared his positive resolution not to heal any more after the end of this present April until Michaelmas next" ; the Monthly Becorder ot 1681-82, probably the first monthly paper ; the Flying Post of 17th December 1695, in which notice is given that half the paper is left blank for gentlemen sending the paper away, to write their own news on ; No. 1 of the Daily Oouraat, 11th March 1702/3, probably the first daily paper ; Nos. 1-272 of the Tatler, 1709-11 ; Nos. 1-623 of the Spectator, 1st March 1711-15th December 1714 : the numbers for 2nd August 1712 and onwards bear some fine impressions of the newspaper stamp, imposed under the Stamp Act which came into force on the 1st August ; the London Farthing Post of 15th December 1718, probably the first farthing paper ever issued ; No. 14 of the Morning Post, 17th November 1772 ; the Public Advertiser of 21st January 1769, containing the first of the Letters of Junius ; No. 1 of The Times, 1st January 1788, ^Iso a copy of the issue of 29th November 1814, being the first paper printed by steam in England ; No. 2 of the Morning Advertiser, 10th February 1794; The Times of 9th September 1798, In which is a report of a trial of the pro- prietor of a public newspaper-reading-room who was fined Â£5 for allowing the use of his rooms and papers to one of the public on payment of one penny ; the London Gazette, 6th November 1805, reporting the battle of Trafalgar on 21st October (time of transmis- sion, sixteen days) ; The Times of 22nd June 1815, reporting the battle of Waterloo on 18th June (time of transmission, four days) ; The Times, of 11th September 1855, reporting the fall of Sebastopol on 9th September (time of transmission, two days) ; the Daily News of 13th September 1882, reporting the battle of Tel-el-Kebir, 13th September (time of transmission, part of day) ; the Jacobite Journal, No. 1, 5th December 1747. By John Trott-Plaid, Esq. [i.e., Henry Fielding] : illustrated heading attributed to Hogarth; a pigeon-post letter, being The Times of 27th January 1871, re- duced to 2 by 1| inches for transmission into Paris by pigeons during the Franco-German war ; the Pall Mall Gazette of 30th January 1873, in miniature, reduced to 2{ by 4f inches by Dallastype ; the Western Daily Mercury (Plymouth) of 1884, the largest English newspaper. Early provincial newspapers : â€" The Stamford

Mercury, vol. xi.. May 1718 ; the Cirencester Post, No. 18, i6th March 1719; Northampton Mercury, vol. iii.. No. 127, 1st October 1722; Norwich Gazette, vol. xix.. No. 969, 24th April 1725; the earliest Irish paper, Pue^s Occurrences (Dublin), 1704- 1706 ; earliest Scottish paper, Edinburgh Gazette, No. 4, March 1699 ; Le Mercure Anglais, June 1644-December 1648, probably the earliest French paper published in England ; the Wady Haifa Gazette, 13th March 1884, published by the Royal Engineers during the Egyptian campaign in the Sudan, for the amusement of the troops. (g. f. b. ; D. E.)

Recent Developments in London Journalism.

The period from 1882, when the article on News- papers in the earlier volume of this Encyclopaedia (ninth edition) was published, up to 1902, covers many important developments, which are associated either with the immense increase in reading, or with the continuous striving on the part of the increasing crowd of journalistic competitors to attain success by providing the “reading public” of all classes with what suits its taste. Some of the new agencies concerned in the production of newspapers, and other allied subjects, are treated elsewhere in these volumes, in the articles on Paper, Advertisement, Copyright, Type-setting Ma- chines, Printing-Pbesses, Libel, Process, &c. Here we are concerned rather with the changes in the charac- ter of the Press than with the mechanical or legal condi- tions of newspaper production.

The principal feature in the development of modern newspapers is the greater importance attached to obtain- ing and displaying ” news ” of all sorts, and j^g^^^^,^^ incidentally there has been a considerable of modern^ change of view as to what sort of news should Journal- he given prominence. Sport and finance are ‘*“â– treated at greater length and more popularly ; and, partly owing to the largely increased number of papers and con- sequent greater competition, partly to a desire to appeal to a larger public, there has been a tendency to follow the tastes of the vast number of people who can read at all rather than of those to whom reading means literary and intellectual enjoyment. This has involved a more popular form of presenting news, not only in a less literary style and by the presentation of ” tit-bits ” of information with an appeal to cruder sentiments, but also in

a more liberal use of headlines and of similar devices for catching the eye of the reader. ” Personal journalism,” i.e., paragraphs about the private life or personal appear- ance of individuals â€” either men or women â€” of note or notoriety in society or public affairs, has become far more marked ; and in this respect, as in many others, encour- agement has been given to a spirit of inquisitiveuess, and also to a widespread inclination either to flatter or be oneself flattered â€” the latter desire being indeed conspicu- ously prevalent in these ” democratic days ” even among the classes which once affected to despise such publicity. The more responsible and more serious organs of public, opinion have no doubt, in spite of this prevailing spirit, successfully maintained the dignity of British journalism and kept up its high standard and traditions. The great dailies themselves have exhibited, in various directions, the tendency to extend the interest of their “news” columns, without at the same time adopting the clap-trap devices or introducing the personal flavour which during the ‘nineties came to be known as “the New Journalism.” But The Times, or the Standard, or the Spectator, and journals of their class, while remaining the true representatives of the best sort of British journalism, had an old reputation and traditions to keep up; it is rather the newer journals which have given the characteristic tone to the period with which we are dealing. The modern impulse came partly from America, and its characteristics may be found discussed in the section devoted to American papers below, but it was also the result of new conditions of life in Great Britain, and of the democratic movement produced by the Education Act of 1870 and the Reform Act of 1885. On the whole, while American methods of journalism have largely in- fluenced the Press in Great Britain in these new develop- ments, it may be said that in so far as they were adopted they were very considerably modified in deference to English ideas. In no British paper has anything ever

been found approaching the enormous ‘â€¢’ scare ” headlines or inflated language which are common features in the American Press. The most

generally adopted American innovation (for, though not unknown before, it was prac- tically a new thing) has been the ” interview,” which during the early ‘nineties was taken up in varying degrees by almost every paper ; it was ” cheap copy,” and could be made both informing and interesting, and ” interview- ing ” caused a large increase in the journalistic profession, notably among women. In later years the “interview” has declined in vogue, in proportion as people of im- portance have become less ready to talk for publica- tionâ€” or for nothing. In America the interview is notoriously compounded mainly of the journalist’s fertile imagination ; but the purely fictitious article is not adapted to British consumption. The English public â– are still attracted by a reported conversation when it contains a trustworthy account of the real opinions or language of the person interviewed, but they pay little attention to the imaginary article, and English editors, besides themselves objecting to such a practice, know that it is of no use.

From the highest class of paper downwards, however, real news â€” and especially early news â€” hasbeenmore and more

sought after, and all the force of organization ofaews. l^oth within individual newspaper offices and

outside them in the shape of news agencies ‘â– has been applied to the purpose of obtaining early news and publishing it as quickly as possible. In this matter the press has certainly been helped most materially not only by the advance in telegraphic facilities, but by all the other new rapid methods of newspaper production which have been the feature of the period. It is boasted by the Post Office that the acquisition of the telegraphs by the State was a great help to newspaper enterprise. It is, of course, only possible to show results, and it must remain doubtful how far such results would have come about in other circumstances, but it is a fact that in the old days only certain newspapers with special contracts enjoyed a reduction from the ordinary rates, and there were also a good- many embarrassing restrictions. The reduction in rates for press telegrams under the new regime, while causing some loss to the Post Office, brought about a great increase in the number of such messages. In 1871 the number of words handed in for transmission was 22,000,000, but in 1900 it had risen to 835,000,000. The

extent to which Press facilities are utilized may be gauged by the fact that in 1901, on the occasion of the England v. Scotland Association football match at the Crystal Palace, no fewer than 61,193 words of Press matter were handed in to the temporary office in the ground ; and the increased scale of telegraphic business at race meetings may be indicated by the fact that at the Epsom spring meeting in that year nearly 18,000 telegrams, including 668 Press messages containing 51,947 words, were dealt with, whereas in 1871 the total number of all kinds on the corresponding occasion was only 1961. The vastly in- creased amount of telegraphic work now done has perhaps not been all pure gain to the best sort of journalism. It has to some extent weakened the effect of the considered written article, and led to hasty conclusions and precipitate publication, with results that sometimes cannot be com- pensated for by any later contradiction or modification. In some cases a reaction is inevitable. Take for instance the case of war correspondence. Nothing finer in journal- ism was ever done than in Russell's letters to T7te Times

1 The chief news OTganizations are Renter's Teh'graph Company (1865), the Exchange Telegrnph Company, the Central News (1870), and the Press Association (1868). Foreign news is also supplied by Dalziel's and Laffau's Agencies ; and there are a number ol minor agencies.

from the Crimea, or Forbes's work and others' in the Franco-Prussian war ; but more recently, although first- rate abilities have been forthcoming in such men as Mr Bennet Burleigh, Mr E. F. Knight, and Mr John Stuart, the special war correspondent has not seemed to compen- sate the great dailies for their large expenses in connexion with him ; the news agencies, often favoured by the Press censor, have generally been ahead of the " specials," and the individual work that might have been done for isolated papers has beenmuch hampered by restrictions on separate accounts. This is due partly to the increased competition, and the number of correspondents who have been sent out, partly to military jealousy and officialism ; but the result has been to a considerable extent to reduce the value of the "war correspondent" as compared with what was done in the Press in the days of Paissell and Forbes. A letter arriving weeks after the telegraphic account, how- ever meagre, is largely shorn of its interest. Given a brilliant foreign correspondent, the form of letters sent home from abroad on general

subjects is still, no doubt, very effective. Mr G-. ^Y. Steevens's work for the Daily Mail, in various parts of the globe, was a good instance of this, as indeed was that of Mr G. A. Sala among an earlier generation for the Daily Telegraph; and the great dailies still do some of their best work, though only exceptionally, in this way : Mr Burdett- Coutts's letters to The Times concerning hospital ad- ministration in the South African war in 1900 had not been anticipated by telegraphic news. But the tele- gram is necessarily the backbone of the news service of the dafly paper. The principal foreign correspondents supply their papers by this means with long articles com- menting on the news of the day. Among the foreign correspondents the name of M. de Blowitz (b. 1832), the famous Paris correspondent of The Times from 1871, stands supreme ; and among others who have made specially high reputations during the period are Mr G. W. Smalley (b. 1833), Times correspondent in the United States ; Mr W. H. Beatty-Kingston (1837-1900), the Daily Telegraph correspondent in Berlin ; Mr A. E. Houghton, the Standard correspondent in Spain ; and IMrs Emily Crawford, Paris correspondent of the Daily Neios. The Press, be it added, is frequently able to acquaint the public with what is going on while the Government itself is still uninformed : Dr Jlorrison's message to TJie Times from China in 1900, for instance, showed how much can be done on the spot by an alert and enterprising corre- spondent. The work of the official and the statesman is ad- mittedly increased and sometimes embaiTassed by the new strain imposed upon them in consequence, but the public areonthe wholewellservedbytheir emancipation from the obscurity of purely official intelligence and by the obliga- tion of straightforward dealing ynposed upon governments, which in their nature are apt to be secretive. It is note- worthy, by the way, that while reports of political plat- form speeches are given in greater profusion in the Press, parliamentary reporting itself is left to a few of the great dailies, Tlie Times and Standard being almost theonly papers to give full reports ; and with the exception of " scenes " in the House, it is considered sufficient in most papers to give a few Parliamentary notes or a " descriptive sketch " or summary.

Connected with the increased attention given to news is. the greater vogue of the newspaper "poster." This is more evident in London in the evening than in the morning papers. The prevailing habit of '^*'"'Â«- newspa])er readers is to order the same morning paper regularly beforehand and read it

at breakfast, while an evening paper is bought at a railway bookstallÂ»or in the street, partly no doubt according to some settled prefer- ence for one paper in particular, but also to a large extent

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according to the attractiveness of the contents-bill or poster which is exhibited. The desire to secure the pennies or halfpennies of the large afternoon public which buys according to the temptation of the poster has given the latter an increasing importance for indicating the possession of the latest news without revealing its ~~whole nature, and the tendency has been to have fewer lines and fewer words in larger type, in order to catch the eye more impressively. Rotary machines for printing these posters enable them to be turned out with great rapidity; and besides those ordinarily prepared for each edition, it is possible at any time during the afternoon, should import~~ ant news arrive, to issue a new poster and thus secure a large street sale by the insertion of a few words only in the ” stop-press “‘or “fudge” without the necessity of changes in the plates.

Apart from tJae publication of ” news ” and reports, and occasional original articles of a descriptive and miseella^ neous character, the chief function of a news- csm. pg^pgj ~~jg criticism, whether of politics^ or other topics of the moment, or of the drama, art, music, books, sport, or finance. Politics is still the staple subject of the newspapers, and any journalist is expected to write about it. A. single dramatic critic, art critic, and musical critic, on the other hand, usually do the bulk of the work in each of these departments for some one paper. The dramatic critic has to be at the opening nights of new pieces, and to write a criticism in time for publication in the next issue of the paper. Considering the conditions of such a task, the dramatic criticism in the daily Press reflects great credit on its authors, and they have fre~~ quently exercised coiisiderable personal influence on the stage, owing to the wide public interest which is taken in what is written about theatrical affairs. Mr Clement Scott became famous as the dramatic critic for the Daily Telegraph, and among other leading critics have been Mr Joseph Knight,

the late Mr ITisbet, Mr Spenser Wilkinson, Mr Archer, Mr Walkley, Mr A. E. T. Watson, Mr E. F. Spenoe, Mr Davenport-Adams, Mr G. Bernard Shaw, and Mr Malcohn Watson. Art criti- cism has not been in so flonrishing a condition ; only a few people really care about art, or want to read about it in the Press ; and as a rule the art criticism in the newspapers is amateurish and poor. There have been, however, some conspicuous exceptions, notably Mr Humphry WardJ the late Mr E. A. M. Stevenson, Mr E. Wedmore, Mr Claude Phillips, Sir Walter Armstrong, Mr E. G. Stephens, Mr D. S. MacCoU, Mr George Moore, Mr Huish, and Mr C. L. Hind. Musical criticism, not- withstanding the wide public interest in music, offers less opportunities for a readable article, and the notices of concei-ts are usually meagre and of a somewhat stereo- typed pattern; but in critics like Mr Fuller Maitland, Mr Jaquies, Mr Joseph Bennett, Mr Lionel Monckton, Mr Sutherland Edwards, Mr J. S. Shedloek, Mr G. Bernaixi Shaw, Mr E. Hiehens, Mr Streatfield, Mr Hervey, Mi- J. F. Eunciman, Mi- Vernon Blackburn, Mr Charles Graves, Mr Barclay Squire, and Mr Eobin Legge the Press has had the advantage of undeniable copipe- tence and judgment.

As regards sport, the comments of the various news- papers are mainly descriptive; but a prominent feature has been the attention paid to ” tipping ” probable winners on the Turf, and the insertion of betting news. The

1 It Is importamt to note how the balance ol political feeling in the Press haÂ« altered since 1880. That year has been described as the high-water mark of Liberal ascendancy on the Press ; out of 71 penny morning papers in London and the provinces, 47 were Liberal. In 1902, howener., out of 65 only 28 were Liberal. In 1880 the Scotsman and Glasgow Herald were both Liberal ; in 1902 both were Unionist. The Birmingham Post in both years supported Mr Chamberlain, but he had changed from an extreme Radical to a colleague of Lord Salisbury.

publication of the ” odds ” some time before a race, and of starting-prices, has undoubtedly helped to foster the increase of this form of gambling, as was pointed out in the report of the Select Committee on Gambling in 1902, but the efforts to induce the newspapers ^’””* to keep such matter out of their columns have not had much success, though the DaUy News in 1902

st&rted on a new proprietorship with a declared policy of not referring to horse-racing or betting. Among the daily papers, the notes of “Hotspur” in the Daily Telegraph have had a high reputation. The sporting interest {i.e., the desire to know results of racing and cricket, &c.) largely inflates the circulation of some of the London and most of the provincial halfpenny evening papers ; and it has caused a notable increase in purely sporting papers, among which, however, the Sportsman (1865) and the Sporting Life (which, founded in 1859, became a daily in 1883, and in 1886 absorbed Bell’s Life) are stiU the principal dailies.

Books are ” reviewed ” in the Press partly for literary reasons, partly as a quid pro quo for publishers’ advertise- ments. The latter reason does not of course affect the great established journals, which have **’’’*’’’’’~~S’~~ a large assured circulation, to the same extent as those which are more conscious of the struggle for life, but it is not only very generally potent, but has had a bad effect on serious reviewing. Only a limited number of people are really interested in reviews, and in consequence the work is frequently relegated, except La the very highest class of paper, to writers whose function is considered to be fulfilled if they have provided the publishers with ” something to quote.” The desire for ” something to quote,” irrespectively of the responsible nature of the criticism, became in the early ‘nineties a mania with publishers, who in general appear to have considered that their sales depended upon their catching a public which WQuld be satisfied by seeing in the advertise- ment that such and such a book was pronounced by such and such a paper to be “indispensable to any gentleman’s library.” At all events, such a system must be bad for the quality of reviewing, and unfortunately the enormous output of books made it impossible for editors to have them all reviewed, and equally impossible for tkem to be certain of discriminating properly be- tween those which were really worth reviewing or not. The result has been that the work of book-reviewing in the newspapers has been hastily and poorly or very spasmodically done. There have been some honourable exceptions. The Times has always commanded the best literary talent. The Daily Chronicle under Mr A. E. Fletcher’s editorship started a ‘‘literary page ” in 1891, which at first was an excellent feature, and it was imi- tated in varying degrees by a few other papers. Critics of responsibility and eminence contributed signed reviews to the Daily Chronicle, and also to the Daily News, Daily Telegraph, and Morning

Post, and among the evening papers the weekly “Literary World” (by W. P. James) in the St James’s Gazette contained for several years a series of brilliant notes. The ” Literary Supplement ” to The Times is the most ambitious attempt yet made by a daily paper to deal seriously with literature. As a form of journalism, however, the review has during our period taken a lower place, partly owing to the cause named, partly to a tendency among re- viewers either to indiscriminate praise or to irresponsi- ble irrelevance, partly to a suspicion of ” log-rolling ” ; and to a large extent it has become the practice merely to treat the appearance of new books as so much news, to be chronicled, with or without extracts, according as the subject makes good ” copy,” like any other event of the day.

While the connexion between journalism and contem- porary literature is now closer than ever, it must be said that journalism has become less literary and Journalism literature more journalistic. Either as re- ^are. ‘ viewers, leader-writers, or editors, most of the principal ” men of letters ” have worked for longer or shorter periods as writers for some news- paper or other, and much of the published literature of the time has appeared originally in the columns of the newspapers, in the form of essays, poems, short stories, or novels (in serial form). , Publication in this shape has many advantages for anauthor besides that of addi- tional remuneration ; it offers an opportunity for a new writer to try his wings, and it helps to introduce him at once to a large public. Moreover, the newspapers read by the educated classes profit by the superior class of jour- nalist represented by writers of a literary turn, though it has frequently happened that the result of a discern- ing editor’s success in establishing a writer’s reputation is that the latter can then command higher terms than the paper can afford, and his work is lost to it just when he has become valuable. But the increased popu- larity of the newspaper, and the close tie between it and the literary world, have on the whole impressed a journalistic stamp upon much of the literature of the day. However popular at the moment a writer may be, the infection with journalistic methods â€” while rightly employed by

journalists, as such, in dealing with contem- porary events and for strictly contemporary purposes â€” is apt to be responsible for something wanting in his work, the loss of which deprives him of the permanent literary or scientific rank to which he might otherwise aspire. It is unnecessary in this matter to go into detail. The literary and scientific abilities, however, of such a writer as Mr Grant Allen, for instance, were so encumbered by journalistic methods, that in spite of the cleverness of his fiction and the temporary interest of hisjaiological work, both nevertheless missed the character of permanent value which would cause his name to be remembered be- yond his generation. And much of the output of more distinguished writers, whose best work will undoubtedly survive, is fatally marred by the same fault.

As regards the less literary character of the journalism of the day, the f alling-off is mainly noticeable in the more recently established journals, of which the principal half- penny papers and the multitude of new popular magazines are the type, and also in the gradual decline of those literary features which formerly so markedly distinguished such journals as the old Saturday lievieiv, or the Pall Mall and St James's Gazettes in their earlier days. The new point of departure for the journalism of the period is really to be found in the publication of Sir George (then Mr) Newnes's Tit-Bits in 1881. This penny weekly paper, with its appeal to the masses, who liked to read snippets of information brightly put together, opened the eyes of the newspaper world to the enormous profits which were to be made by this style of enterprise; and the multiplication of journals of this description â€” notably Mr Harmsworth's Answers (1888) and Mr Pearson's Pearson's Weekly (1890) â€” had a further influence on public taste, so that even the classes above that which primarily enjoyed these publications were affected in the same direction. A new note was introduced into daily journalism. Whereas before 1885 the notable feature had been the brilliance of the Saturday reviewers and their evening-paper offshoots, the Pall Mall and St James's, in the early 'nineties came a craze for " actuality." Mr T. P. O'Connor with his vivid pen (first in the iStar, then in the Sunday Sun and elsewhere), set the pace for a crowd of imitators ; the successful establishment of the Daily Mail (see "Half- penny Papers " betow) in 1896 by Mr Alfred Harms-

worth, with its system of compressing the news of the day briefly and pointedly into short paragraphs, while at the same time catering for all tastes and employing flrst-rate correspondents and reporters to supply it with special information, gave a distinct shake-up to the older traditions of daily journalism. Even when an attempt was made to provide for a literary public, success came to be generally sought by popular rather than by literary methods. The literary public in the proper sense of the word is inevitably a small one, and the greater part of the Press deals with literature on lines more suited to a larger and less refined clientele. It may be claimed, no doubt, that the best sort of journalism shows a high, and sometimes the highest, literary standard, but the fact remains that the bulk of modern journalism is of a differ- ent sort, and that its conductors realize only too well that their business is to appeal to the masses, and to a stand- ard of education which falls far short of anything that can be called intellectual.

It is often said that leading articles have lost their im- portance, but this is only a half-truth. A leading article in The Times has as much weight as ever it had, on any occasion or on any subject when Jeadiag a decisive attitude is required ; and the lead- article. ing articles in the Sta^idard, Daily Telegraph, Morning Post, and some other papers carry great weight with public opinion. ISTor is this statement true only of the great dailies, for the articles in such journals as the Spectator or Economist must not be excluded. Though in the multitude of papers it is probably true to say that in these later years there has been some falling off in quality (which is really more properly to be described as a con- forming with a more popular style of speaking) in the writing of “leaders,” on the other hand the actual amount of good writing in this department â€” well-informed, schol- arly, andincisive â€” has been, just as probably, equal to any- thing done in what are sometimes considered its palmy days.^ It sometimes suits a minor Cabinet minister or a disappointed politician to sneer at ” what the papers say,” but the usual experience of the leader-writer is either to findhis phrases or arguments repeated some days afterwards by politicians up to the highest ranks as though they were original observations, or else to find the attitude which for the moment is pooh-poohed substantially confirmed or followed within a very short period ; and it may be asserted with confidence that in recent years more real political ” leading ” has been done in the columns of the great newspapers than by any of the professional statesmen.

If it is said that the newspaper writer is ” inspired” by the statesman, this no doubt is frequently true, though there is nothing analogous in Great Britain. to the ” Reptile Press ” in Germany ; but there have been just as many occasions when the statesman, who gets the credit, has really been inspired by the suggestion of some acute journalist, whose very name is most likely unknown to the public. It would be impossible to mention the names of all the best London leader-writers in recent years ; and as regards The Times anonymity is rigorously observed. But some prominent names may well be re- corded. Mr Erederick Greenwood in the original Pall Mall, and later in the St James’s Gazette; Mr IMorley and Mr W. T. Stead in the Liberal Pall Mall (the latter, up to the time of his ” Maiden Tribute ” crusade, showing remarkable ability in focussing public attention suggest- ively on the topics of the day) ; Mr E. T. Cook in the Westminster Gazette and Daily News ;]Mr J. A. Spender in the Westminster; Mr Robert Wilson, Mr William

1 It must be remembered that the style of speeches in Parliament has also altered. Nobody thinks of quoting the classics nowadays in the House of Commons. A more business-like form of speech is. adopted in public life, and the Press reflects this change.

Clarke, Mr H. W.Massingham, and Mr Henry Norman in the Daily Chronicle ; Mr Alfred Austin and Mr Richard- son Evans in the Standard ; Mr Justin McCarthy, Mr Clayden, Mr Herbert Paul, and Mr Whiteing in the Daily News ; Mr Sidney Low in the St James’s Gazette and the Standard ; Mr G. A. Sala, Sir Edwin Arnold, and Mr H. D. Traill in the Daily Telegraph; or Mr Spenser Wilkinson in the Morning Post â€” have written as brilliantly and with as much constructive ability as any in a preceding generation. On the other hand, it is un- doubtedly the case that in the newer type of newspaper, which appeals rather on the score of its tit-bits of news and rapid readableness to a more casual and less serious public, the whole raison d‘6tre of the old-fashioned lead- ing article has disappeared, and its place is taken by a few brief, notes, merely indicating the attitude of the

paper, and not seeking to discuss any subject compre- hensively at all. And though many provincial papers, like the Manchester Guardian, Yorkshire Post, or Scots- man, employ the leading article almost as effectively as any London paper, the majority are content with quoting and following the lead of others. The halfpenny papers usually recognize that their influence lies in displaying news rather than in imposing views, but even here there are exceptions, notably in the Radical Star and Morning Leader, while the Daily Mail on occasions of importance uses the ” leader ” with an effect which is none the less because as a rule it does not rely on this weapon. No doubt there are often days on which the stereotyped “leader” in any of the great dailies only represents a marking of time, and the multitude of such articles in the aggregate gives occasion for doubt as to the influence exercisable by this form of journalism at all. But the doubt is founded on a fallacy : Neque semper arcum ten- dit Apollo. The ” leader ” is to some extent a form of newspaper routine, but on the whole it is a routine which has proved its value by experience. The continuous high standard of the British Press depends more largely than is sometimes realized on the regular industry and skill of those whose business it is to discuss the latest developments of affairs every day or every week in a manner which gives reasonable men something fresh to think about, or interprets for them the thoughts which are only vaguely floating in their minds ; and the stabil- ity of British public opinion, and consequently of British institutions, is in no small degree the outcome. The lib- erty of the Press enables every sort of view, right or wrong, to be discussed in this prominent form, and thus every aspect of a question is brought out in public, to be accepted or rejected according to the weight of evidence and of argument.

The same end is assisted by the devotion of so much

space to “letters to the editor.” It is sometimes said

that The Times owes its position largely to

s’o^deace ^^^ ^^^^ ^^ ^^ ^^^ individual grievance is span eace. ^^^^^ ^^ .^^ generally ventilated by a letter to

The Times. Whatever may be the organization of the Press for reporting the news of the day, the resources of no newspaper staff are great enough to

cover an area of information as large as that represented by its readers ; and the value of the otitlet for opinion and information afforded by the correspondence columns cannot be over- stated. Strange, however, as it may appear to the uninitiated, there is a great deal of diffidence on the part of the public in writing letters to the papers ; apart from a certain number of habitual letter-writers, it takes a considerable stimulus to bring an ordinary man to commit himself in this way. An important condition of his doing so is that he should have confidence in its being considered the right thing to do. One of the advantages possessed by The Times over other papers is that the

tradition in its case has long been fixed, and when any definite subject of importance is before the public, it is always certain that the best opinions will be found ex- pressed in its columns in this shape ; but the other great dailies are not far behind. Sometimes it has been con- sidered a good device to attract public attention by pro- voking a wide correspondence, as in the ” Is Marriage a Failure?” series and others in the Daily Telegraph; but this is really an expedient for attracting readers, rather than a real symptom of popular feeling, though it often results in some interesting conclusions.

The increased public interest taken in m oney matters, and especially in speculative transactions in the stockmarkets, is responsible both for the establishment of a financial daily press (notably the Financial News, f’’’’’’^- 1884, and the Financial Times, 1888), and for the in- creased attention given in the ordinary press to the pub- lication of stock exchange prices and criticism of financial affairs. Another factor which has largely contributed to this result is the importance of financial advertisements, and the pressure exercised by advertisers to have their operations commented upon and their businesses recom- mended The company ~~promoting boom between 1889 and 1893, which brought so much profit to the Press in the shape of advertisements of prospectuses and so forth, had an effect in this direction which was only increased by the subsequent ” slump ” and the corresponding efforts of advertisement canvassers, anxious for their commis~~ sions, and business-managers anxious for revenue, to keep up the advertising income of the papers to which they were attached. It is a legitimate piece of business to insert financial advertisements, and equally legitimate to comment upon financial matters ; and the public in- terest in

such things is so great, and public gullibility so persistent, that well-informed comments, honestly made, are both attractive to readers and a valuable form of journalism. The British Press, so far as the princi- pal newspapers are concerned, has kept its reputation for integrity in these matters satisfactorily clean and sound, and it is under no suspicion of being bribed or having its favour bought ; and though it has been shown on more than one occasion that certain promoters and financiers (generally with the vaguest notion of whom they were .dealing with) have been quite ready to cor- rupt the Press if they could, the few cases which have been brought home have been in connexion with papers and journalists of no account or influence. The danger, however, is obvious, and can only be met by having in control of the great newspapers, and in charge of this particular department, men who are beyond suspicion both as to their acumen and their impartiality.

While certain financial papers were found guilty of lax methods in this particular in the course of the investiga- tions into Mr E. T. Hooley's affairs (1898-99), The sources and those of one or two other promoters, the of news- leading journals of the United Kingdom have p^p^i" fortunately been owned and edited by men " "*""' who were too cautious and too wide awake to fall a prey to such wiles. The history of these great papers, further details of which are given below, is dominated by a succession of proprietors, managers, or editors whose enterprise, insight, and judgment have kept the reputation of the British Press higher than that of any other in the world. Newspapers, like other businesses, are of course conducted with a view to a profit ; and the desire to make a profit out of mere popularity, in its effect on both circula- tion and advertisements, has sometimes led to the exercise of a proprietor's authority in altering the character of a paper against the best interests of high-class journalism ; but the Press in the United Kingdom has in the main been fortunate in having behind it, as owners, men who

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took a personal interest in journalism and had a full sense of their responsibilities in relation both to the guidance of publip opinion and to the position of the jouraalistic pro- fession. It would be impossible to review the period under discussion as regards the London daily press without paying a tribute on this score to the influence among proprietors of such men as Mr Walter of The Times, Lord Glenesk (Sir Algernon Borthwick) of the Morning Post, Sir Edward Lawson of the Daily Telegraph, or Mr Alfred Harms worth of the Daily Mail. Among editors and managers, those who have exercised most inHuence are Mr Gr. E. Buckle and Mr Moberly Bell {The Times), Mr Mudford and Mr G. Byron Curtis (Standard), Sir Edwin Arnold and Mr Le Sage (Daily Telegraph), Sir John Eobinson (Daily Mews), Mr Massingham (Daily Chronicle), Mr J. N. Dunn (Morning Post), Mr E. Greenwood (Pall Mall and St James's Gazette), Sir George Armstrong and Mr W. T. Madge (Globe), Mr Sidney Low (St James's Gazette), Mr W. T. Stead, Mr H. Gust, and Sir Douglas Straight (Pall Mall), Mr E. X- Cook and Mr J. A. Spender {Westminster Gazette), Mr T. P. O'Connor and Mr Ernest Parke (Star). Whatever may be said of a certain degeneration in journalism as a whole, the fact remains that, though most people read more papers than is compatible with a healthy mental digestion, the Press, as such, has to-day a greater influence than ever ; and this is largely due to the reputation maintained by its higher Representatives. The reflected glory is shown in the fact that to be an " editor " involves some prestige even in the case of a comparatively feeble jburnal; and though "medical student" has been supplanted by "journalist" in the " profession or occupation " formula of the police- court, the old Bohemian days of journalism are gone, and it has become a settled profession with as much self- respect as any other. While, individually, the great papers wield considerable influence, due partly to real sagacity and authority, partly to the psychological effect produced by mere print or by reiterated statement, collec- tively the Press* now represents and expresses the Public, and expresses popular opinion more directly than Parlia- ment itself. ' Nor can the social results of the multiplica^ tion of " Press-cutting agencies," or of such publications as Wlio's Who (started by Mr Douglas Sladen in 1897) and similar biographical reference books â€" all tending to increase the publicity of modern life â€" be passed over. With other factors they have

contributed mate- rially to the pervading influence of journalism in every-day life and the constant dependence of society in most of its manifestations on the activity of the “Fourth Estate.”

The serious high-class weeklies have developed no specially important new’ features of their own. To the Spectator and Saturday Review have been added 7re’s *^6 Radical Speaker (1890), edited by Mr J. L. apes. Hammond, the Outlook (1898), edited by Mr Percy Hurd, and the Pilot (1900), edited by Mr Lath- bury; and several new weekly papers, e.g., the Realm (edited by Mr Earl Hodgson), the British Review (edited by Mr Mallock), the Review of the Week (edited by Mr Harold Gorst), came and passed away after showing promise of good things. On the whole, the weekly press has declined in proportion as the daily papers and the monthly magazines have grown. The Spectator alone, among the serious weekly papers, has kept or increased its vogue. Under Mr Hutton and Mr Meredith Townsend the Spectator became an institution, as a thoughtful organ of criticism; and after it passed into the hands of Mr J. St Loe Strachey in 1897 its old characteristics were still maintained. The palmy days of the Saturday Re- vietv, on the other hand, had already gone when in 1894 Mr W. H. Pollock retired from the editorship and Mr

Saintsbury, Mr David Hannay, and the other brilliant members of its old staif ceased to write for it. Under Mr Frank Harris the Saturday failed to regain its posi- tion. In 1899 it was acquired by Lord Hardwicke, and under the editorship of Mr Harold Hodge it remained the chief Conservative weekly. The most important decease has been that of the National (at first the Scots) Observer, which under Mr W. E. Henley’s editorship (1888-93) had a considerable literary success. Mr Henley gathered about him a staff of young literary men who formed to all intents and purposes a schooL It had some mannerisms and preciousnesses, but it was essentially clever and often brilliant. In 1894 Mr Henley ceased to be editor, and Mr J. E. Vincent edited the paper with conspicuous ability till in 1897 the National Observer came to an end. Among weekly illustrated papers. Black and White (1891) and the Sketch (1892), for the immediate success of which Mr Clement Shorter (then editor of the Illustrated London Neivs) was responsible, Country Life Illustrated (1897), edited by Mr J. E. Vincent, and the Sphere (1901), started Tinder Mr Shorter when he left the Illustrated London News,

have prospered without affecting the popularity of the Graphic and Illustrated London News. The “Society” papers. Truth (1877), Vanity Fair (1868), and the World (1874), have well maintained their interest. Mr Edmund Yates’s (q.v.) success with the World contributed largely to the increase of the personal style which he did so miich to introduce. Truth made Mr Labouehere, its proprietor, one of the most prominent men of the day, not so much on account of his cynical Radicalism, as for its vigorous exposure of all sorts of public hnmbug and charlatanry. Vanity Fair’s leading feature is its cartoon (see Caeicatueb), the weekly interest of which has been ably maintained under Mr Oliver Fry’s editorship. Sunday papers have not multiplied as much as might have been expected. The People (conducted by Mr Madge, of the Globe) was started in 1881 ; the Sunday (afterwards Weekly) Sun (1891) began brilliantly under Mr T. P. O’Connor, hut after his connexion ceased it gravitated to a more commonplace type : these, with Lloyd’s (edited after 1884 by Mr T. Catling), now appeal to an uncritical public. The Sunday Special (1897) has been added to the small list of high-class Sunday papers (its competitors being the Suiiday Times and the Observer, the latter of which has reduced its price to twopence) ; the Referee too (1877) has a sporting and theatrical character of its own, and in “Dagonet” (Mr G. K. Sims) has had a paragraphist of original humonr. But British feeling is against Sunday journalism, and in 1899, when a Sunday Daily Mail and Simday Daily Telegraph simul- taneously appeared, the vociferous objections raised by the public â€” added to the fact that they showed no sign of paying their way â€” led to their simultaneous withdrawal.

The old “literary weeklies,” the Athenceum (1828) and Academy (1869), still hold the field. The former con- tinued to be ably edited by Mr Norman MacColl till 1901, when he was succeeded by Mr Vernon Kendall. The Academy, which was bought in 1894 by Mr Morgan Eichards and put under the editorship of Mr Lewis Hind, altered some of its methods and lost a good deal of the academic character it had enjoyed under the editorship of Mr J. S. Cotton ; in 1901 its proprietor bought Literature from Til e Times (q.v.) and amalgamated it with the Academy. The Guardian (1846) reduced its price to threepence, and maintained its high character; in 1900, for reasons con- nected with the ritualistic crisis in the Church, Mr Lath- bury ceased to be its editor, and was succeeded by the Rev. Walter Hobhouse. In

the Economist (1843) and Statist (1878) the world of political economy and finance continued to find admirable critical articles ; and the Field

(1853) has encx)untered no real rival in the world of sport. Punch (an excellent History of which was published by Mr M. H. Spielmann in 1895) remained easily first among humorous journals, being supported by a number of such talented writers as Sir F. C. Btirnand, Mr Anstey Guthrie, Mr E. J. Milliken, Mr Arthur k Beckett (an all-rouud journalist who, besides editing the Sunday Times (1891- 95), became president of the Newspaper Society, 1893, and chairman of the Institute of Journalists, 1901), Mr H. W. Lucy (" Toby, M.P."), and Mr Owen Seaman; but though Fun (1860) died in 1901, and Lika Joko (started by Mr Harry Furniss in 1894) only lived a few months, Judy (1867), Moonshine (1879), and Pick-me-up (1888), served to cater to a wider and rather less discriminating public. Mention must also be made here of the technical and professional journals, which have been produced in increasing numbers ; many of them are . admirably con- ducted, and are models of what such publications should be. The Religious Press has developed considerably, and among its most notable representatives besides the Ouardian may be named the Record (1828), edited by the Rev. A. R. Buckland, the Church Times (1863), Tablet (1868), Weekly Register (1849), Christian World (1857), Methodist Times (1886).

Though Magazines and Reviews are dealt with prop- erly u.nder Pbeiodicals, some reference may be made to

them here. The place of the two old Quarter- Magaziaes ijgg jn public interest has really been taken Reviews, by the modern half-crown monthly reviews, of

which the type is the Nineteenth CerUury, mid After (1877), founded and edited by Mr James Knowles. These high-class monthlies enable the best writers to deal more at length with the subjects of the day than is possible in

a daily or weekly paper. The Fortnightly Bevieio (1865), edited successively by Mr John Morley, Mr T. H. S. Escott, Mr Frank Harris, Mr Oswald Craw- furd, and Mr W. L. Courtney ; the Conservative National Review (1883), edited successively by Mr Alfred Austin, Mr Earl Hodgson, and Mr Leo Maxse ; the Liberal Non- conformist Contemporary Review (1866), edited during this period by Mr Percy Bunting ; and Blackwood's Maga- zine, which has maintained its old standard, are conducted from slightly different standpoints on somewhat similar lines ; and the Monthly Review (1900)^ edited by Mr Henry Newbolt, stands in the same class. These are all serious reviews of an intellectual type; and in Long- man's Magazine (1882, distinguished by Mr Andrew Lang's causeries), Macmillan^s, and Cornhill a diversity of reading matter of good quality is provided at a lower prjce. In addition to these there have gradually come upon the scene a number of popular sixpenny and still lower-priced magazines, the first of which, Sir G. Newnes's Strand Magazine (1891) set the fashion ; including mis- cellaneous articles, copiously illustrated, they appeal to the general public, and are intended solely to entertain. The English Illustrated (1883), and, later, the Pall Mall Magazine (1893), at a shilling, were attempts to carry out the same idea on a somewhat higher plane. A char- acteristic development of the period has been the founda- tion by Mr W. T. Stead, whose personality has been very prominent in the journalism of the time, of the Review of Reviews (1890), containing extracts from and com- ments on all the most interesting articles in the peri- odicals of the month, togetlier with original features of its own. Among the monthly reviews devoted to special subjects, a high type of journalism is represented by, in sport, the Badminton Magazine, and in art, the Art Journal (1839), Magazine of Art (1878), Studio (1893), Connoisseur (1901) ; and the Bookman {1886) has man- aged with some success to combine both popular and literary qualities.

The introduction of women into journalism is one of the new departures of our period. It was indeed no new thing for women to write for the Press. Harriet Martineau was one of the principal ^uTaai- members of the Daily News staff, and Miss itts." Frances Power Cobbe (b. 1822), the advocate of anti-vivisectionism, was an active woman journalist in her day. But these were exceptional cases, in which something in the nature of a personal mission and a peculiar aptitude gave the impulse. It was not till later that

journalism as a profession was resorted to by women, in consequence of the immense increase in women readers and the immensely increased publicity given to matters of primarily feminine interest. In 1880 the only ” ladies’ paper ” of any importance was the Queen, a weekly which, dating from 1861, remains a valuable property. But since then a considerable number of new weeklies have entered the field and become popular : notably the Lady’s Pictorial (1880), the Lady (1885), Woman (1889), the Gentlewoma7i (1890), which owed its success to the ability of Mr J. S. Wood, Madame (1895), and the Ladies’ Field (1898). New monthlies have also appeared, in the Eng- lishwoman, the Ladies’ Realm, and the Woman at Home. The sphere of action of the lady journalist has been by no means confined to the ” ladies’ papers,” or to writing columns on dress or cookery for other journals which found it useful to cultivate feminine readers ; women have invaded every other field of journalism, especially the large new field of fashionable gossip, and though on the whole their success has been very limited, there have been some striking exceptions. Notably is this the case with Miss Flora Shaw (Lady Lugard), whose able co- lonial articles in The Times made her work for that paper up to 1899 one of its most interesting features. Mrs Crawford, the Paris correspondent of the Daily News, Mrs Meynell in articles for the Pall Mall Gazette, and Mrs Humphry Ward have shown what first-rate work can be done by women writers in the press. Lady Randolph Churchill, in connexion with the sumptuous Anglo-Saxon Review, and Lady Jeune, Mrs Alec Tweedie, Mrs Isabella Bishop, and Miss Betham-Edwards have taken a considerable part in the journalism of the day. The names of Miss H. Friederichs, Mrs Hiunphry, Miss Drew, Mrs Aria, Mrs Harcourt Williamson, Lady Colin Campbell, Miss Christabel Coleridge, Miss Black- burne. Miss M. F. Billington, Miss E. N. Hepworth Dixon, Mrs Ballin, Miss M. Bateson, Mrs Belloc- Lowndes, Miss Clo Graves, Mrs Howarth, and Annie S. Swan have also been prominent as regular workers on various papers.

The London Daily Peess.

The Times since 1880 has fully maintained the position it acquired at the beginning of the 19th century as the leading paper not only of the British empire, but of the world. No paper can be said to compete â„¢* Times. with it, or even to attempt competition with it, either in position or influence.

Other papers have a larger circu- lation, may even be sometimes in advance of it with their news, but no other paper can be said to speak with a tenth part of its authority. If it errs, the greater part of the Press follows it in its error ; and the influence of the Press on public opinion is the influence primarily of Tlie Times, either directly or through its giving a cue to the other papers. Unattached to any party, it gave a general support toLordBeaconsfield's cabinet in the crisis of the Eastern Question, while warning them as early as 1876 that their Egyptian policy would inevitably lead the nation into more active interveAtion in that country. It distrusted Mr Gladstone's Midlothian campaign of 1880, but when that resulted in his return to power, it

endeavoured to strengthen his policy in Ireland, and, in particular, it heartily endorsed his denunciation of the leaders of the Home Rule movement. While protesting against the weakness of his Egyptian policy, it supported him in the military occupation which was the inevitable result of it, but commented with just severity on the vacillation of his treatment of General Gordon. On the conversion of Mr Gladstone to Home Rule, The Times was instrumental in forming the Lilperal-Unionist party, and by its opposition may claim to have largely contri- buted to the defeat of the two Home Rule Bills. In the course of its vigorous campaigi^ it published as part of its case a series of articles on " Parnellism and Crime," including the celebrated " Parnell letters " which proved to be forgeries of Pigott. With the exception of those letters, Tlie Times substantiated almost the whole of its charges ; but public opinion had so fastened on that portion of them that the services rendered by The Times to the country were in some measure overlooked. The revelations and the judgment of the Parnell Commission, by exposing the conspiracy, gave a death-blow to Home Rule ; the nation reaped the benefit, and Tlie Times paid the whole cost. After the change produced in English politics by the adoption of Home Rule by the Liberal party, The Times gave a decided but discriminating support to Lord Salisbury and his colleages ; but, during the brief periods of office enjoyed by the Liberals, it

encouraged Lord Rosebery, as Foreign Minister, in his patriotic and largely successful policy of preserving con- tinuity in regard to foreign affairs. In like manner it encouraged the section of Liberals brought into promi- nence by the South African war, who desired the vigor- ous prosecution of hostilities, and were anxious to drop the alliance with the Irish Nationalists. In the Turco- Greek war Tlie Times supported Lord Salisbury's Gov- ernment in its refusal to interfere. It advocated the advance into the Sudan, and the necessity of action in South Africa. During the progress of the Boer war it remained, along with the nation, steadfast in insisting that hostilities should only end in the absolute incor- poration of the two Boer States in the British Empire ; and, while refraining from much comment on mistakes in the field, expressed itself with severity on the blun- ders of omission and commission of of&cials at home. Kept admirably informed by its Peking Correspondent, The Times demanded, for some time in vain, more vigour in the China policy of the Government, and it advocated the treaty with Japan. For a long time it was almost alone in giving prominence to news from the outlying portions of the empire, and it was imperialist before Mr Chamberlain became Colonial Secretary. Tlie Times bore an honourable part in the efforts which were made from time to time to improve the defences of the country. The great increase of the Navy could hardly have been carried through without its persistent advocacy ; and, so far as the nation is awakened to the defects of its Army and War Office and the right methods of amending them, it is largely due to the well-known letters of " Vetus," and the numerous other series of articles in The Times on the subject. In other domestic matters Tlie Times has recognized that it is no longer organic changes of ancient institutions, but rather modest social reforms that are demanded by the people. It has en- deavoured with some success to avxh the inordinate pretensions of trade-unions, and tc combat the insidious advances of Socialism.

In the earlier volumes of this Encyclopaedia the per- sonal history of The Times concluded with an incidental mention of the retirefiient in 1877 of John Thadeus Delane {q.v.), for thirty-six years chief editor of the paper. He was succeeded by Thomas Chenery {q.v.), sometime

Lord Almoner's professor of Arabic at Oxford. Chenery died after a short illness in February 1884, and was suc- ceeded by George Earle Buckle. Mr

John Walter {q.v.), who since 1847 had been the chief proprietor and manager of the paper, died in 1894, and was succeeded by his eldest son Mr Arthur Eraser Walter. The Times has always maintained the principle of anonymity in relation not only to the occasional contributors to its columns, but also to the permanent members of its staff. It is sufficient to say that there are few well-known men who have not in one form or another contributed to its pages.

The bulk and business of the paper greatly increased after 1880. It was stated in the earlier article in vol. xvii. that on one occasion a number of the paper had contained 67 columns of advertisements. This was even then much below the mark. As far back as 1861 a single issue had contained 105 columns of advertisements, and another 98. , Prior to 1884 the paper had only on two occasions consisted of 24 pages in a single issue. Between that year and 1902 more than 80 separate issues of this size WQre published, many of them containing over 80 columns of advertisements. Of the two issues, one con- taining the news of the death and the other the account of the funeral of Queen Victoria, 140,000 copies were printed.

The increasing circulation of Tlie Times between the years 1840 and 1850 made an improvement in the printing-presses necessary, as sometimes the publication could not be completed before the afternoon. To meet this want the Applegath vertical press was introduced in 1848. This press, instead of having a flat printing surface, by which only one sheet could be printed at each movement, had an upright revolving cylinder on which the pages of type were fixed. This cylinder revolved at a speed which enabled eight sheets to be laid on by eight men, and taken off by the same number, thus printing very much faster than the flat press. But it still had the drawback of printing only one side of the paper. To improve upon this machine the American Hoe ten-feeder press was introduced in 1858. This machine required ten ” lay’ers-on,” but no ” takers-off,” and also printed at a faster speed than the Applegath. Meanwhile the idea of stereotyping from the movable types had been making steady progress, but it had many drawbacks in consequence of the ” plaster ” process being continued. About the year 1856, however, a Swiss named Dellagana introduced to Tlie Times Kroning’s idea of casting from papier- mSche instead of plaster, and was allowed to experi- ment in the Times office. After a time the invention was

so much improved that matrices of pages could be taken, and the stereotype plates fixed bodily on the print- ing machine in place of the movable type. This cleared the way for the introduction of the Walter press. Hitherto only one set of ” formes ” could be used, as the type was set up once only â€” one side of the paper being worked on one machine, and the sheet’s then taken to another machine to be “perfected.” Stereotyping enabled the formes to be multiplied to any extent, as several plates could be cast from one matrix. Mr MacDonald of The Times had devoted himself for several years to the produc- tion of a press which could print papers on both sides in one operation from a large reel of paper, the web of paper being cut into the required size after printing, instead of each sheet being ” laid on ” by a man, and then printed. After years of experiment the Walter press was introduced into the Times machine-room in 1869, and the question of printing great numbers in a short time was solved. Each press turned out 12,000 sheets per hour, and it was therefore only a question of multiplying the stereo plates and presses to obtain any number of printed papers by a

certain time. Meanwhile Messrs Hoe and Company had not been idle, but had set about producing something even quicker and better than the Walter press. They succeeded in accomplishing this by multiplying the reels of paper on each press, and also adding folders and stitchers. The result was the production of over 36,000 sheets per hour from each machine, all folded, and, if required, stitched with wire. These presses were adopted by The Times in 1895, and were still in use in

1902.

In 1868 the question of compoMng machines for the quicker setting-up of type was taken up by Tlie Times. A German named Kastenbein had an invention which he brought to the notice of Tlie Times, and arrangements were made for him to continue his experiments in the Times office. In a couple of years a machine was made, which was worked and improved until

in 1874 several machines were ready to set up a portion of the paper ; but it was not until 1879 that the arrangements were sufficiently advanced to make certain that they could do all that was wanted from them. The introduction of composing machines, and the necessary alterations in the office arrangements which followed, led to some trouble among the compositors, which in 1880 culminated in a partial strike ; but a part of the staff remaining loyal, the printer was able by extra effort to produce the paper at the proper time on the morning following the strike. In the course of a few days the places of the strikers were filled, and the business of the paper went on as before. From this time the composing machines took their place as the chief producers of the work. Various improvements were made, until one machine was able to set up as many as 298 lines of The Times in one hour, equal to 16,688 separate types, the compositor being dictated to at the Times office by telephone directly from the House of Commons. This system of telephone dictation was commenced in 1886, and was continued until the House of Commons decided to rise at midnight, which very much reduced the pressure of work, and enabled the more economical method of composing direct from the ” copy ” to be resumed. In connexion with the telephoning it may be mentioned that a special helmet was made for each compositor’s head, with a receiver at each ear, and as fast as the reader at the House of Commons dictated, the compositor set-up the matter at the Times office. Ever since the introduction of the composing machines they had been much hampered by the question of ” distribution ” â€” that is, the breaking- up and sorting of the types after use. Kastenbein had invented a distributing machine to accompany his compos- ing machine, but it proved to be unsatisfactory. Various systems were tried at the Timss office, but for many years the work of the composing machines was to some extent crippled by the distribution difficulty. This had been recognized by Mr Wicks, the inventor of the Wicks Rotary Type-casting Machine, who for many years had been working at amachine which would cast new type so quickly and so cheaply as to do away with the old system of dis- tribution and substitute new type every day. In 1899 his machine was practically perfect, and Tlie Times entered into a contract with him to supply any quantity of new type every day. Since that time the average weekly delivery to The Times has exceeded 6,000,000 types. The difficult question of distribution was thus surmounted, and composition by machines placed on a satisfactory basis. To sum up, we find that during the last half of the 19th

century The Times continued to take the lead in new in- ventions relating to the printing of a newspaper, just as it had in the fifty years preceding. The three most im- portant advances during the later period were practically worked out at the Times office â€” namely, fast-printing presses, stereotyping, and machine composing, and without

these it is safe to say that the cheap newspaper of the present day could not exist.

The growth of Tlie Times is shown in a statement published in the issue of 7th January 1901, from which it appears that the total news, exclusive of advertise- ments, supplied to the public by The Times during the year 1800 amounted to about 2,700,000 words, while during the year 1900 it is estimated to have consisted of over 35,000,000 words. “To pursue the comparison. The Times for the year 1900 contained, always exclusive of advertisements, nearly 20 per cent, more reading matter than the Encyclopcedia Britannica, more than 240 quarterly volumes (60 years) of the Edinburgh Review, and more than five times as much as all Macaulay’s works, Grote’s History of Greece, and Gibbon’s Decline and Fall added together.”

In addition to this colossal daily issue, Tlie Times is the parent of several other newspapers. The Mail, published three times a week at the price of 2d. per number, has 8 pages, and gives a convenient summary of two days’ issue of The Times. The Times Weekly Edition (begun in 1877) is published every Friday, and for 2d. gives a carefully- condensed but necessa,rily brief epitome of The Times for the six days. It includes also a serial story, the character of which is always irreproachable, and a popular chess column. The circulation of Tlie Times Weekly Edition, chiefly in the colonies, almost trebled between 1890 and 1900. The Law Reports (begun in 1884) are conducted by the large staff of Times law reporters, all of them barristers of at least five years’ standing, under the direction of Mr William Frederick Barry of the Inner Temple, and they have acquired a recognized position in the legal world. Commercial Cases, edited by Mr T. E. Aldous of the Inner Temple, deals with cases of a com- mercial nature. Issues is a useful half-yearly pompila- tion of all the company announcements and

demands for new capital, taken from the advertisement columns of The Times.

In 1897 the increasing demand of the public for infor- mation of a literary character encouraged the conductors'! of The Times to issue a weekly literapy organ under the title of Literature. This at first was issued entirely inde- pendently of T7ie Times, under the editorship of the late Dr H. D. Traill, but after his death it was in 1901 deemed advisable to issue in its place a weekly literary supple- ment to Tlie Times, and Literature passed into the hands of the proprietor of the Academy, with which paper it was incorporated as The Academy and Literature. The " Literary Supplement " appears each Friday, is printed in a different form, and separately paged.

Moreover, the publishing department of Tlie Times has of late years invaded several new fields of enterprise. The Times Atlas was first published in 1896, and successive editions, revised, enlarged, and continuously brought up to date, have been published at frequent intervals, and about 60,000 copies were sold up to 1902. By an arrangement with Messrs Longmans, this publication was supplemented by that of Tlie Times Gazetteer. A much larger and more important venture was the issue in 1898 of a reprint of the ninth edition of the Encyclopcedia Britannica. That work was then out of print. The original publishers, Messrs A. and 0. Black, had printed 10,000 copies, and in the fourteen years of its publication, and in the nine years following its completion, had sold little more than 9000. It was recognized by The Times that this small Sale of an invaluable work was due to the high price at which it was issued. Messrs Black had assumed that as the sale would be small the price must be high. Tlie Times recognized that the sale was small because the price was high, and by an arrangement withMessrs Black they issued their reprint at less than half the original price, and on a new system

of terms that enabled the purchaser to receive the whole â– work at once and to pay for it by a series of equal monthly payments. In the first year 18,000 copies were sold, the gross proceeds of sales amounting to almost exactly Â£365,000. Subsequent sales in the United Kingdom alone up to 1902 amounted to nearly another 18,000, apart from considerable sales in India and the colonies. The new method of sale introduced into the United Kingdom by The Times found several imitators, and was repeated by that journal itself in the case of the Century Dictionary and of a reprint of the first fifty years of Punch. The new volumes of the JEncydopceclia Britanuica, supplementing the ninth edition and forming with it the tenth edition, were issued in 1902 on similar terms at brief intervals. Within three weeks of publica^ tion of the first volume more than 10,000 complete sets were subscribed for.

In the year 1895 Tlie Times, through, its Vienna corre- spondent, purchased from the late Dr Busch the MS. and entire copyright of his journals, containing a very minute record of his intimate relations with Bismarck. It was stipulated in the contract that these were not to be published until .after the death of the prince. That event occurred on the 30th July 1898, and on the 12th September of the same year The Times published through Messrs Macmillan (in 3 vols.) Bismarck : Some Secret Pages of his History, by Dr Moritz Busch. The work created an immense sensation, was translated into many languages, and remains the most authentic record of much of the secret history of the period with which it deals (1870-90).

Tlie Times History of the War in South Africa arose out of a desire to preserve in a more readable form the excellent work done by the numerous Times correspon- dents in South Africa. When originally projected in the early days of 1900 it was hoped that the wa,r would be of short duration, and that the history of it could be rapidly completed. The length of the war naturally upset all these “calculations, and the large number of subscribers at the very low price which had originally been deemed sufficient compelled JTie Times to decide between a mere re-editing of its original despatches and a more complete and permanent record of the whole event. The fact that numerous short histories had already been produced decided TJie Times to adopt the latter more costly and more laborious alternative. Mr L. S. Amery, fellow of All Souls, whO’ during the war had not only

served for a short time as its special corre- spondent in the Boer camp, but had ultimately had the direction of the nineteen correspondents representing TJie Times, was selected as the editor. Two volumes had been published by August 1902, and met with gen- eral approval. The comments made in the second volume had the result of causing at length the official publication of the much-disputed Buller heliogram.

The Standard was established as an evening paper in the Tory interest in 1827, its first editor being Stanley Lees Giffard, father of the first earl of Halsbary, who had Alaric Watts and Dr William Maginn, famous Sto d d ^^ Â°^^'^ ^^ ^^^ originators of Fniser's Muf/aziuo, as his chief helpers. In the course of two or three years it became a pecuniary, as it had from the first been a political, success, and gradually ousted the Courier, which was for a time conducted by William Mudford, whose son half a cpntury later became the most dis- tinguished editor of the Standard. In course of time the latter became the property of Mr Charles Baldwin, whose father was proprietor of the Morning Herald, and when the father died the son found himself in posHPssion of both a morning and an evening journal. In his hands neither of them prospered, although the Standard retained a large

circulation and constantly printed early and accurate political information. At length, midway in the 'fifties, both papers were purchased by Mr James Johnstone, Mr John Maxwell, the publisher, being for a time associated with him in the ownership. Mr Johnstone realized that he had before him a great opportunity, and at once set to work to grasp it. He brought out the Standard as a morning paper (29th June 1857), increased its size from four to eight pages, and reduced the price from fourpence to twopence. One of the most curious features of the early numbers was a novel by William Howard Russell. The evening edition was continued. In February 1858 Mr Johnstone again reduced the price, this time to a penny. When that step was taken the Standard announced that its politics were " enlightened amelioration and progress," but that it was " bound to no party " ; and to those inde- pendent lines it in the main adhered. In the course of four or five years it became a financial success, and then began to attract to itself many brilliant pens, one of its contributors in the 'sixties, Lord Kobert Cecil, being destined to become illustrious as marquess of Salisbury. Lord Robert was an occasional leader-writer, whose con- tributions were confined

almost entirely to political sub- jects. It was at this time that the Standard laid the foundation of the great reputation for early and detailed foreign news which it has. ever since enjoyed. During the American Civil War it obtained the services of a represen- tative signing himself ” Manhattan,” whose vivid and for- cible letters from the battlefield arrested attention from the beginning. As the campaign progressed, these full, picturesque, and accurate accounts of the most terrible struggle of modern times were looked for with eager interest. There were no ” special cables ’’ to discount the poignant curiosity of the reader, and the paper reached a circulation far beyond anything hitherto known. The distinction thus acquired was maintained during the Prussian-Austrian war of 1866, and greatly increased by the letters and telegrams describing the triumphs and disasters of the campaign of 1870. In the early ‘sixties the staff had been reinforced by the engagement of Mr William Heseltine Mudford. In the midst of his work as a Parliamentary reporter, he was sent as special corre- spondent to Jamaica in 1865 to report upon the troubles which involved the recall of Governor Eyre ; a further period in the gallery of the House of Commons followed, and in 1873 Mr Mudford became business manager.]\Ir Johnstone’s first editor was Captain Hamber, who after- wards seceded to the short-lived Hour, with whom had been associated Mr David Morier Evans as manager. He was succeeded by the owner’s eldest son, to whom Mr (aftei-wards Sir) John Gorst was joined in a consultative capacity. In 1876 Mr Mudford became editor, still, how- ever, retaining managerial control. Mr Johnstone, the proprietor to whose energy and perspicacity the paper owed so much, died in 1878, and under his will Mr Mudford was appointed editor and manager for life, or until resignation. Already a great property, the Standai-d in Mr iludford’s hands entered upon a very brilliant period. Sturdy independence was the note of his editor- shipâ€”mere party factiousness did not enter into his ideas. The relations between the paper and the Conservative party were still intimate, but they were very different from those which obtained in the old days when a Punch cartoon had represented Lord Derby and Mr Disraeli as followed in the street by an old woman in a ” Gamp ” bonnet â€” since it was as Sairey Gamp that the Standai-d was invariably referred to by its weekly contemporajy. ” Throw her a penny,” says Mr Disraeli, ” or people will think she belongs to us.” No man, however brilliant, is capable of successfully editing a great daily newspaper, with its heavy weight of labour and responsibility, without

an able and trustworthy second in command, and in that respect Mr Mudford “was fortunate throughout. He had for his first assistant-editor Mr Gilbert Venables, who was succeeded after a short term by Mr George Byron Curtis, previously one of the leader-writers, who thus held the position through nearly the whole of Mr Mudford’s long editorship. The staff at this time comprised many men, and some women, whose names are distinguished in letters as well as in journalism. Mr Alfred Austin, Mr T. H. S. Escott, Miss Francis Power Cobbe, and the late Professor Palmer were all writing for the paper at the same time. To them must be added, among others, Mr E. D. J. Wilson, the brilliant political leader-writer (afterwards of The Times), Mr Percy Greg, son of ” Cassandra ” Greg, Mr T. E. Kebbel, and the late Dr Robert Brown, who wrote copiously upon scientific and miscellaneous subjects. Throughout these years the Standard was exceptionally well served by a series of war correspondents who to enterprise and resource added unusual literary ability. Eoremost among them were Mr G. A. Henty, who repre- sented the paper on many a stricken field; Mr John A. Cameron, who was killed at Abu Klea ; and Mr William Maxwell, who added appreciably to the brilliant tradition he inherited. In January 1900 Mr Mudford retired, and was succeeded in the editorship by Mr Byron Curtis, Mr S. H. Jeyes, the biographer of Lord Salisbury and Mr Chamberlain, whose connexion with the paper had begun in 1891, becoming assistant-editor. Under Mr Curtis’s control the Standard is said to have increased in circula- tion, while maintauiing its unique position as the expo- nent of progressive and independent Conservatism. Among the members of his literary staff in .1902 were, in addition to some of those whose names have been mentioned, Mr Sidney Low, Mr Richardson Evans, Mr David Hannay, the Rev. Professor Bonney, and Mr J. Penderel-Brodhurst. Mr A. E. T. Watson and Mr Sutherland Edwards wrote on the theatre, and Mr Erederick Wedmore on art.

The first number of the Daily Telegraph was published on 29th June 1855, as a twopenny newspaper. Its

proprietor was Colonel Sleigh. This gentleman Telegraph. ^^Â°^ found himself in pecuniary straits, and in

satisfaction of the debt for the printing of the paper it was transferred to Mr Joseph Moses Levy in the following September. On 17th September Mr Levy published it as a four-paged penny journal, the first penny newspaper produced in London. His son, afterwards Sir Edward Lawson (b. 1833), immediately entered the office, and after a short time became editor, a post which he only abandoned in 1885, when he became the managing proprietor and sole director. From the outset Mr Levy gathered round him a staff of high literary skill and reputation. Among the first were Mr Thornton Hunt, who acted in collaboration with Sir Edward Lawson, Mr Geoffrey Prowse, Mr George Hooper, and Sir Edwin Arnold (q.v.), as leader-writers. Sir Edwin returned from public service in India immediately after the Mutiny, and became a member of the staff of the Daily Telegraph in response to an advertisement. Mr E. L. Blanchard was among the earliest of the dramatic critics, and Mr Alexander Harper the City editor. Later there came Mr George Augustus Sala (q.v.), then one of Charles Dickens's young men ; Mr Clement Scott (b. 1841), at one time a clerk in the War Office ; and Mr Edward Dicey (b. 1832), then fresh from Cambridge. The Hon. Frank Lawley turned to journalism from official life ; and among the most remarkable of the early contributors to the paper was Mr J. P. Benjamin, Q.C., the great Ameri- can lawyer, who wrote a number of articles, principally on financial and legal subjects, when he took refuge in England in 1866. A distinguished man of letters, who

was on the staff for well-nigh a quarter of a century, was Dr H. D. Traill (q.v.). The active list of the staff in 1902 included Mr J. M. Le Sage, the managing editor, who had been connected with the paper over thirty-five years; Mr W. L. Courtney, editor of the Fortnightly Review; Mr E. J. Iwan-Muller, Mr J. B. Firth, and Mr J. L. Garvin; Mr Joseph Bennett and Mr Lionel Monckton being the musical critics, Mr T. M. Rendle dramatic critic, Mr H. W. Lucy principal Parliamentary reporter, and Mr Bennet Burleigh the principal war correspondent. The Daily Telegraph is famous for its '< special correspondents," Mr John Ellerthorpe and Dr E. J. Dillon having been conspicuous in this capacity ; and Lord Dunraven, the late Lord Russell of Killowen, and Mr Winston Churchill, M.P., have also been on

special missions for the paper. Among the regular correspondents in foreign capitals have been Mr Felix Whitehurst in Paris, Mr W. H. Beatty-Kingston (1837- 1900) in Berlin, Mr Lavino in Vienna, and Sir Campbell Clarke (1835-1902) in Paris. After 1890 Mr Harry Lawson assisted his father in the general control of the paper.

Sir Edward Lawson, with the influence of the paper at his back, took a leading part in the agitation for the abolition of the stamp duties upon newspapers in 1861. On his initiative the Daily Telegraph organized many expeditions for scientific and exploring purposes. In June 1873 it despatched Mr George Smith to carry out a series of archaeological researches in Nineveh, which resulted in the discovery of the missing fragments of the cuneiform account of the Deluge, and many other inscriptions. In co-operation with the New York Herald it equipped Mr (afterwards Sir) Henry Stanley's second great expedition to Central Africa (1875-77), described in his work Through the Dark Continent. During this journey Stanley surveyed Lakes Victoria and Tanganyika, and identified the Lualaba with the Congo. Another geo- graphical feat with which the name of the Daily Telegraph is associated was the exploration of Kilimanjaro (1884-85) by Mr (afterwards Sir) Harry Johnston, whose account of his work appeared in the Daily Telegraph during 1885. And Mr Lionel Decle's march from the Cape to Cairo, in

1899 and 1900, was also undertaken under the auspices of the paper.

The Daily Telegraph has raised many large funds, which Sir Edward Lawson has himself organized and managed free of charge. Almost the first was the subscription for the relief of the sufferers by the cotton famine in Lancashire, in the winter of 1862-63 ; the fund in aid of the starving and impoverished people of Paris at the close of the siege in 1871 ; the prince of Wales's Hospital Fund in commemoration of the Jubilee of 1897, which was collected in the end of that year and the beginning of 1898 ; and the Daily Telegraph Shilling Fund for the soldiers' widows and orphans in connexion with the Boer war. It is interesting to note that while the cotton famine list resulted in a total subscription of Â£6300, that in aid of the Hospitals realized Â£37,840, and the widows and orphans' fund in May

1900 stood at Â£253,000. An undertaking of a more festive kind was the fSte given to 30,000 London school children in Hyde Park on the occasion of Queen Victoria's Jubilee in 1887.

In politics the Daily Telegraph was consistently Liberal up to 1878, wl^en it opposed Mr Gladstone's foreign policy as explained in his Midlothian speeches. After 1886 it represented Unionist opinions. Among special feats of which it can boast was the first news brought to England , of the conclusion of peace after the Franco-German war.

Prior to 1874 the Daily Telegraph was printed by eight- and ten-feeder machines, through which every sheet

had to be passed twice to complete the impression. Un- der these conditions it was necessary to start printing one side of the paper as early as ten or eleven o'clock. The handicap which this imposed on the satisfactory produc- tion of a newspaper was removed by the introduction of Hoe's web machines at the end of 1874. No further change took place until 1891, when they were superseded by others built by the same makers capable of printing a 12-page paper at the rate of about 24,000 an hour, cut, folded, delivered, and counted in quires. In 1896 they were modified so as to be suitable fqr turning out an 8-, 10-, 12-, 14-, or 16-page paper. Up to 1894 the setting of type had been done entirely by hand, but in that year the linotype, after an experimental trial, was introduced on a large scale, the Daily Telegraph being the first of the great London dailies to make the change. There are 36 of theSe machines at work, and with only a few exceptions the whole of the setting is entrusted to them. The difference between the scale of operations in earlier days and present practice may be illustrated by a few figures. The volume which contains the issue of the Daily Telegraph for July to December 1856 â€" the begin- ning of the second year of its, existence â€" consists of 632 pages ; the three volumes required for the same period of 1900 are made up of 2080 (for the first half

of that year the total is 2192). In the second half of 1866 the issue numbered 3792 columns, while in July to Decem- ber 1900 the aggregate was 14,560. This, however, does not indicate the whole addition to the size of the paper. The page is now deeper from top to bottom, with the result that it would take 16,640 of the columns of 1866 to represent the output of the latter half of 1900. An- other example of the volume of work done by the me- chanical departments is afforded in the fact that while in 1860 there were printed 5000 columns of advertise- ments, the total in 1900 was over 16,000. Here, again, for purposes of comparison, the latter figure may be taken as equal to 18,300. Mr Levy acquired the Daily Tele- graph paper-mills at Dartford Creek in 1867, and the whole of the material used for the daily issue of the paper is manufactured at these mills, which are as fully equipped with machinery as the ofBces in Peterborough Court.

During the first three quarters of the 19th century the Morning Post fairly held its own against the constantly increasing pressure of competition, but with- out making any great headway. Amongst its editors were Mr Peter Borthwick, M.P. ; his son, Algernon Borthwick (b. 1830), under whom it acquired great political influence as the official organ of Lord Palm- erston's Government; and Sir William Hardman, for many years chairman of the Surrey sessions, and recorder of Kingston. Por a time the paper passed into the hands of Messrs J. and T. B. Crompton, one of the largest firms of paper manufacturers ; but upon the death of Mr Hideout, the principal surviving partner, Mr Algernon Borthwick (who was knighted in 1880, made a baronet in 1887, and raised to the peerage as Lord Glenesk in 1895) acquired the sole proprietorship. One of his first acts (on 27th June 1881) was to reduce the price of the Morning Post from threepence, at which it had so long stood, to one penny â€" an experiment which many experts predicted would be fatal to the existence of a journal which hith- erto had been regarded as merely the organ of the fash- ionable world. The result exceeded his most sanguine anticipations. The circulation increased in the course of a few months more than tenfold, and with expanding circulation came a corresponding increase of advertise- ments. Under the later editorships of Mr Moore, Mr Algernon Locker (1896-97), and Mr James Nicol Dunn, who became editor in 1897, the Morning Post fully main-

Mornlag Post

tained its position. It claims to have been the first paper to announce the conclusion of the Anglo-Eussian agree- ment in regard to China in April 1899, to have_ been the only newspaper in which the text of the award in the Delagoa Bay Railway Arbitration was published on the day after it was made, and the first to announce the duke of Connaught's renunciation of the Saxe-Coburg succes- sion. Its list of contributors includes such well-known names as those of Andrew Lang, W. E. Henley, George Meredith, Thomas Hardy, Spenser Wilkinson, Professor York Powell, E. E. Knight, and Mr Winston Spencer Churchill, M.P.â€" the last-named as the special corre- spondent in Lord Kitchener's campaign against the Khalifa and the war in the , Transvaal. Mr Spenser Wilkinson's trenchant criticisms of the military opera- tions in South Africa in 1899 and 1900 were a notable feature of the Morning Post during that period. Of re- cent years considerable attention has been devoted to social questions. A short series of articles on the out- casts who frequented the Thames Embankment at night led the readers to provide funds for the Morning Post Embankment Homes, where homeless wanderers are provided with temporary shelter and are afterwards as- sisted to permanent employment. The readers of the paper likewise presented Lord Kitchener with money enough to erect a bronze statue of General Gordon, by Mr Onslow Ford, E.A., in Khartum. Moreover, it is claimed, the articles in the Morning Post induced the Government to open throughout the United Kingdom convalescent homes for soldiers, and to erect a monu- ment in memory of the many nameless heroes among the Chelsea Pensioners buried in Brompton Cemetery. The history of the Daily News has been told by Mr Justin McCarthy and Sir John R. Robinson in a volume (Sampson Low, Marston and Co.) of " political and social retrospect" published in 1896 on New^

the occasion of its jubilee. It could boast of having continuously been the champion of Liberal ideas and principles â€" of what (so long as Mr Gladstone lived) might be called official Liberalism at home and of lib- erty abroad. Its only rival in the history of Liberal journalism in London for many years was the short- lived (1856-70) Morning Star, which in 1870 it absorbed. Notably, it led British public opinion in foreign affairs as champion of the North- in the American Civil War, of the cause of Italy, of

the emancipation of Bulgaria from the Turk, and of Armenia. Its early editors were Charles Dickens (21st January-March 1846), John Eor- ster (March-October 1846), E. E. Crowe (1847-51), P. K. Hunt (1851-64), W. Weir (1854-58)_, T. Walker (1868- 69). In 1868 the paper was reduced in price to a penny, and came under the management of Mr (afterwards Sir) John E. Robinson (b. 1828), who only retired in 1901. Its later editors have included (1868-86) Mr P. H. Hill (the brilliant author of Political Portraits), and subsequently Sir John R. Robinson, as managing editor, in conjunction with Mr P. W. Clayden (b. 1827 ; d. 1902), the author of Life of Samuel Rogers, England under the Coalition, and other able works, as political and literary editor, down to 1896, and Mr E. T. Cook from 1896 to 1901. Mr Cook, during the negotiations with the Boer Government in 1899, strongly supported Sir Alfred Milner; and under him the Daily Xews, as an exponent of Liberal Imperialism, gave no coun- tenance to the pro-Boer views of some of the more active members of the Liberal party. In 1901, however, the proprietary changed, and Mr E. T. Cook, whose views on the Boer war were not shared by the new proprietors, retired ; the journal then becoming an organ of the anti- imperialist section of the Liberal party. After other editorial changes, Mr Gardiner became editor in 1902.

Throughout its career the Daily News has been famous for its war correspondents, among whom may be named Archibald Forbes (Franco-German and Russo-Turkish wars), E. H. Vizetelly (Italy), O’Donovan (of Merv), MacGahan (Bulgaria), , and A. G. Hales (Boer war). Among its other principal writers have been Harriet Martineau, Professor Minto, William Black, Justin McCarthy, E. F. S. Pigott, Sir E. Giffen (City editor). Professor Elliot Cairnes, Grenville Murray, John Hol- lingshead, Richard Whiteing,^ Andrew Lang, Herbert Paul, and (Parliamentary sketch) H. W. Lucy.

The Daily Chronicle arose out of the Clerkenwell News, the latter paper having been purchased by the late Mr Edward Lloyd in 1877, and converted

into Chroaicie. ” ^^ Imperial morning paper” on independent Liberal lines. Under the editorship of Mr K. Whelan Boyle the Daily Chronicle soon took rank among the other London daily journals, the only traces of its original character being shown in the attention paid to metropolitan affairs and the appearance of numerous small advertisements. The independent tone of the journal was conspicuous in its treatment of the Home Rule question. At first deprecating the system of com- bined agitation and outrage with which the term was synonymous, the Daily Chronicle, under the editorship of Mr A. E. Fletcher (1890-95), ceased to be a Unionist journal, and supported Mr Gladstone’s Bill of 1893. Another instance was afforded in the course of the Boer war. During the negotiations and the early stages of the compaign, the Daily Chronicle, which was then edited by Mr H. W. Massingham, strove for peace by supporting the Boer side against the diplomacy of Mr Chamberlain. Mr Massingham’s policy was, however, not to the liking of the proprietors, and he retired from the editorship towards the end of 1899, Mr W. J. Fisher, whose knowledge of international affairs had singled him oat for the post, succeeding him as editor. Mr Massingham during his editorship, ably seconded by Mr Henry Norman, had largely increased the interest of the paper, particularly on its literary side. A new impetus had been given in this direction in 1891, when a ” literary page ” was started, conducted at first by Mr J. A. Manson, and after 1892 by Mr Massing- ham, when he became assistant-editor under Mr Fletcher. The journal can claim to have taken a leading part in many public movements since 1877. It was con- spicuous in its advocacy of the cause of the men in the London dock Strike of 1889; and in the great mining dispute for a ” living wage,” which was brought to a close by Lord Rosebery in November 1893, raised over Â£13,000 for the relief committees. Much atten- tion was given to the theosophical discussion of 1891, and to the exposure of the adventurer ” De Rougemont ” after he had appeared before the British Association at Bristol in 1898. The Daily Chronicle took an active part in the negotiations which led to the Venezuelan Arbitration Treaty of 1897, it energetically pleaded the cause of the Armenians and Cretans during the massacres of 1896, and it encouraged the Greeks in the war with Turkey in 1897. Its foreign policy was, however, more distinguished by goodwill than by discretion â€” and not- ably in the latter instance. The Daily Chronicle also worked strenuously for the Progressive cause in London in regard to the County Council, Borough Councils, and the School Board. Of late years it has

devoted a portion of its space daily to ” the Churches.” Its news successes included the first announcement of the revolution in eastern Rumelia (1885) ; the first circumstantial account of the death of Prince Rudolph (1889) ; Nansen’s own narrative of his expedition towards the North Pole ; and Sir Martin Conway’s journey across Spitsbergen in 1896,

and the first ascent of Aconcagua in the following year. Among its more frequent contributors â€” past and present â€” may be mentioned the late Robert Wilson, B. F. C. Costelloe, Sir Walter Besant, William Clarke, and Lewis Sergeant; Mr William Archer, Mr Edmund Gosse, Mr E. T. Cook (whose association with the paper after 1901 confirmed its adoption of Liberal Imperialistic views), Mr Joseph Pennell, Dr Jessopp, Mr Lionel Johnson, Mr Hfenry Norman, M.P., Mr L. F. Austin, Mr Edward ‘ Clodd, the Hon. R. C. Drummond, Mr Egerton Castle, Sir Martin Conway, Major Martin Hume, Mr Henry Harland, Mr Francis Thompson, Mr Arthur Waugh, and the Rev. Dr R. F. Horton.

The only other important morning papers, other than those of the halfpenny press (see below), are the Morn- ing Advertiser, the organ of the licensed â€žâ€ž; victuallers, which is devoted largely to the Advertiser interests of “the Trade,” and was reduced in and Daily price from threepence to a penny in 1891 **‘â„¢”**”’- (one of its conspicuous features up to 1902 being an alliterative contents bill) ; and the Daily Graphic, founded in 1890 by Mr W. L. Thomas (1830-1901) as an offshoot from the Graphic, and edited by Mr Hammond Hall, assisted by Mr Lucien Wolf. The combination of clear arrangement of news, well-informed comments, and plentiful illustration of the topics of the moment, rapidly made the Daily Graphic a popular addition to London journalism. In 1896 Sir G. Newnes started a new type of penny morning daily in the shape of The Courier, edited by Mr Earl Hodgson; but it only sur- vived for a short time.

We pass, now to the London penny evening papers^ The first number of the Pall Mall Gazette issued on 7th February 1865 from Salisbury Street, Strand. Mr George Smith, of the publishing firm of Pf. â€ž â€ž Smith and Elder, was its first proprietor ; Mr oazette. Frederick Greenwood (b. 1830), its first editor, took the Anti- Jacobin for his model ; the paper was intended to realize Thackeray’s picture of one ” written by gentlemen for

gentlemen.” In spite, however, of brilliant supporters such as Fitzjames Stephen as writer of leading articles (replaced to a certain extent, after 1869, by Sir Henry Maine), R. H. Hutton, Matthew James Higgins (” Jacob Omnium “), James Hannay, and George Henry Lewes, with George Eliot, Anthony Trol- lope, Charles Reade, and Thomas Hughes as occasional contributors, the paper failed to attract until, in the fol- lowing year, Mr Greenwood’s brother, James, furnished it with three articles on ” A Night in a Workhouse : by an Amateur Casual.” A morning edition had already been tried and dropped, and so was a distinct morning paper, attempted in 1870. ‘ In 1867 new premises were taken in Northumberland Street, Strand. Three years later the Pall Mall Gazette was the first to announce the surrender of Napoleon III. at Sedan. Matthew Arnold was repre- sented in it by “Friendship’s Garland” in 1871, and Richard Jefferies by “The Gamekeeper at Home” in 1876 and onwards. Mr Greenwood made the paper un- flinchingly Conservative and strongly adherent to Lord Beaconsfield’s foreign policy. In 1880 Mr Smith handed over the Pall Mall Gazette to his son-in-law, Mr Henry Yates Thompson, who turned it into a Liberal journal. Mr Greenwood retired from the editorship shortly after- wards and started the St James’s Gazette; and Mr John Morley became editor of the Pall Mall, with Mr W. T. Stead (b. 1849) as assistant-editor. The price was reduced in 1882 from twopence to one penny. Many of the old contributors remained, and they were reinforced by Robert Louis Stevenson, who wrote some ” Letters from Davos,” Professor Tyndall, Professor Freeman, James Payn, and Mrs Humphry Ward. Mr Morley exchanged journalism

for politics in 1883, and was succeeded by Mr Stead, with Mr Milner, afterwards Lord Milner, as his assistant. Adopting an adventurous policy, Mr Stead imported the “interview” from America, and a report of General Gordon’s opinions was believed to have been the cause of his ill-fated mission to Khartum. A series of articles called ” The Truth about the Navy

” (1884) forced the Admiralty to lay down more . ships next year. ” The Maiden Tribute of Modern Babylon,” purporting to further the Criminal Law Amendment Bill, consigned Mr Stead to three months’ imprisonment in Holloway Gaol. Mr Stead made a feature of reprints called “extras”; and, edited by Mr Charles Morley, the Pall Mall Budget became an illustrated weekly. Mr Stead was replaced in 1889 by Mr E. T. Cook, who had become assistant-editor in succession to Mr Milner. The Pall Mall Gazette was now steadily Liberal and a strong advocate of Home Rule. On its staff were Mr Edmund Garrett, Mr P. C. Gould the caricaturist, and Mr Alfred Spender. Mr Cook resigned in 1892, on the sale of the paper to Mr William Waldorf Astor, the American multi-millionaire, who turned it again into a Conservative organ, and also changed its shape, abandoning the old small pages for a larger sheet. Mr Henry Cust,]\LP , was appointed editor, with Mr E. B. Iwan-Muller as assistant-editor, and a staff including Mr H. B. Marriott- Watson, Mr G. W. Steevens, Mr John Stuart, Mr Charles Hands, Mr Nicol Dunn (afterwards editor of the Morning Post), Mr Duguid as City editor, the late R. A. M. Stevenson as art critic, and Mr Vernon Blackburn as musical critic. Among the fairly regular contributors may be mentioned Mr H. G. Wells, Mrs Meynell, Miss Violet Hunt, Mr G. S. Street, and Sir Herbgi Maxwell. Being unstinted from a financial point of view, Mr Cust, who came fresh to editorship with enthusiasms as to what a newspaper could do acquired from his experiences in Parliament and in Society, made the columns of the Pall Mall very lively for the next couple of years. It became well known for its “booms,” and its “smartness” gener- ally ; also for the punning head-lines which frequently adorned its leading articles. Some papers contributed to it by Sir Charles Dilke and Mr Spenser Wilkinson resulted in the establishment of the Navy League in 1894. The paper had, too, the first news of Mr Gladstone’s resignation and the appointment of Lord Rosebery to succeed him. But though the Pall Mall under Mr Cust had outshone all its competitors, its independence of those business considerations which ultimately appeal to most proprietors hardly represented a durable state of aifairs ; and event- ually the relations between proprietor and editor became strained. In February 1896 Mr Cust and Mr Iwan- Muller parted company with the Pall Mall Gazette, and were succeeded in their appointments by Sir Douglas Straight and Mr Lloyd Sanders, the latter of whom retired in 1902. A more moderate policy was now pursued. The Pall Mall was the first London paper to announce the

critical character of Mr Gladstone’s last illness ; while its denunciation of the use of water-tube boilers in the Royal Navy produced a Parliamentary Committee of Inquiry. The Pall Mall published its 10,000th number on 14th April 1897.

Founded in 1880 by Mr H. Hucks Gibbs (afterwards Lord Aldenham), with Mr Frederick Greenwood as editor,

the St James’s Gazette represented the more TheSi^ intellectual and literary side of Tory journalism alette. i”^ opposition to the new Liberalism of the

changed Pall Mall Gazette; it was in fact meant to carry on the idea of the original Pall Mall as Mr Greenwood had conceived it, and was more of a daily review than a chronicle of news. In 1888, the paper having then been’sold to Mr E. Steinkopff, Mr Greenwood retired and was succeeded as editor by Mr Sidney Low

(1888-97), who had as his chief assistant-editors Mr S. H. Jeyes (tiU 1891) and Mr Hugh Chisholm (1892-97), the latter succeeding him as editor (1897-1900). The paper was for many years conspicuous for its literary character and for the number of distinguished literary men who wrote for it, some of whom first became known to the public by means of its columns. Among its contributors were Sir J. Fitzjames Stephen, Sir’ Henry Maine, Mr H. D. Traill, Mr Edmund Gosse, Mr Coventry Patmore, Mr J. M. Barrie, Mr Rudyard Kipling, Mr (afterwards Sir) Gilbert Parker, Mr Anthony Hope, Mr F. S. Pulling, Mr David Hannay, Mr T. E. Kebbel, Sir Walter Armstrong, Mr J. K. Stephen, Mr Sutherland Edwards, Mr Marcus B. Huish, Mr J. R. Fisher, Mr Walter Low, Mr Pett Ridge, Mr Harold Boulton, Mr H. A. Kennedy, Mr W. B. Woodgate, Dr A. Shadwell, Mr Henry Newbolt, and Mr W. P. James. In 1895 TmtJi, not prejudiced in favour of a Conservative journal, described the St James’s as the best-edited paper in London. It was one of the earliest supporters of the Imperialist movement, and between 1895 and 1899 was the chief advocate in the Press of resistance to the foreign bounties on sugar which were ruining the West Indies. In 1899 the course taken by Sir Michael Hicks- Beach in reducing the fixed charge on the national debt had previously been advocated in its columns alone. In 1898 the sum of Â£1000 was raised through the medium of the St James’s for endowing a cot in the Great Ormond Street Children’s

Hospital in memory of Lewis Carroll. It may be recalled that under Mr Low's editorship a protest was made on behalf of honi mores by the omission of any report in the columns of the St James's of the Oscar Wilde trial in 1895. This action obtained commendation in responsible circles, and notably from Lord Chancellor Halsbury, but in practice the circulation returns indicated that, while verbally approving the course taken, people bought other papers which contained an account; and the suggestion which was made that judges should in such cases order no report to be published failed to obtain much support. During the years immediately following 1892, when the Pall Mall Gazette again became Conservative, and the competition between Conservative evening papers became acute, it was increasingly difficult to carry on the St James's on its old lines so as to secure a profit to the proprietor; and by degrees modifications were made in the general character of the paper, with a view to its containing more news and less purely literary matter. But it retained its original shape, with sixteen (after 1897, twenty) small pages, a form which the Pull J fall abandoned in 1892. In 1900 Mr Theodore Cook, who had been assistant-editor since 1898, became editor for a brief period, and subsequently Mr Ronald MacNeill acted in this capacity, with Mr W-. D. Ross as manager. The St James's Budget, which up to 1893 had been a weekly edition of the Gazette, was then turned into an independent illustrated weekly, edited from the same office by Mr J. Penderel-Brodhurst, who had been on the editorial staff since 1888 ; and it continued to be published till 1899, when Mr Brodhurst retired and the Budget was converted back into its earlier form.

The Globe (printed on pink paper), founded in 1803, is in the later period associated with the name of Mr George Armstrong, who, first joining its staff in 1872, became editor and proprietor, and in 1892 was ^ created a baronet. In 1895 his son, Lieutenant G. E. Armstrong, became editor. No London paper changed its character in later years less than the Globe, both in policy and in methods. Aggressively Conservative since 1866 in politics, it maintained its reputation for straightforward criticism and well-digested news. One of its regular

halfpenny]

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features was its ” turnover,” a miscellaneovis article always appearing on the last column of the front page and turning over on the second ; another was its ” By the way ” column, containing smart paragraphs and honmots; aad in recent years its articles on naval topics were consistently well informed. Among those connected with the paper, the most prominent has been Mr W. T. Madge, the manager, who also started and edited the People (1881), a popular Sunday journal for the masses.

When the Pall Mall Gazette was sold to Mr Astor in 1892 and converted into a Conservative organ, Mr E. T.

Cook, the editor, and most of his staff, resigned, The West- ^jkJ jjj 1893 they came together again on the oazette. Westminster Gazette, newly started for the

purpose by Sir G. Newnes as a penny Liberal evening paper. It was printed on green paper, but the novelty of this soon wore off. The paper was conducted on the lines of the old Pall Mall, and it had the advantage of a brilliant political cartoonist in Mr P. Carruthers Gould. In 1895 Mr Cook was appointed editor of the Daily News, and his place was ably filled by Mr J. Alfred Spender, who had been his assistant-editor. Apart from Mr Gould’s cartoons, the Westminster became conspicuous in London evening journalism for the admir- able tone of its leading articles, and for Mr C. Duguid’s excellent City notes. One of its greatest successes was the original publication of Mr Anthony Hope’s ” Dolly Dialogues.”

The Evening Standard, founded as we have seen in 1827 as the Standard, has long been the evening edition of the morning paper. It is distinguished by the peculiarly full and detailed character of its reports of the day’s news. (h. ch.)

The Halfpenny Pkess.

One of the problems and surprises that have resulted from the cheapening of telegraphy, of mechanical methods of production, and of the desire to read, is the modern halfpenny newspaper. It is, however, by no means so

new as may appear. For its origin we must go back to the middle of the 16th century, when the Govern- Orizias ot iiisiit of Venice sent out occasional bulletins the halt- of information on political and public affairs. penny These leaflets were called Fogli di Avvisi, ‘”’***â– and were sold at the price oft one gazzetta,

a coin worth a fraction over a halfpenny. Thus arose the use of the word ” gazette ” as a common term for a newspaper, and it is noteworthy that it originally meant what we now know as a. halfpenny. In England we find the first mention of inexpensive news-sheets towards the close of the 17th century, when a number of halfpenny and farthing Posts sprang into existence, and appeared at more or less irregular intervals. These con- sisted of small leaflets, containing a few items of news â€” sometimes accjompanied by advertisements â€” and were commonly sold in the streets by hawkers. The increase of these newspapers, and especially the growing prac^ tice of inserting advertisements, led the Legislature to contemplate a stamp tax of a penny per sheet on all news publications. As a protest, a curious pamphlet â€” of which a copy is preserved in the British Museum â€” was issued in 1701, and sheds an interesting light upon this early phase of cheap journalism. The pamphlet is entitled, “Seasons himibly offered to the Parliament on behalf of several persons concerned in the paper-mak- ing, printing, and publishing of the halfpenny newspapers.” It states that five master printers were engaged in the trade, which used 20,000 reams of paper per annum. The journals are described in the following terms : ” The said newspapers have been always a whole sheet

and a half, and sold for one halfpenny to the poorer sort of people, who are purchasers of it by reason of its cheapness, to divert themselves, and also to allure herewith their young children and entice them to reading ; and should a duty of three halfpence be laid on these mean newspapers (which, by reason of the coarseness of the paper, the generality of gentlemen are above con- versing with), it would utterly extinguish and suppress the same.” The pamphlet goes on to say that hundreds of families, including a considerable number of blind people, were supported by selling the halfpenny journals in the streets.

In 1712 a tax of a halfpenny per sheet was imposed, and the cheap newspapers at once ceased to exist. This tax on the press was increased from time to time, till in 1815 it stood at fourpence per sheet. The usual price of newspapers was then sevenpence a copy. From these facts it seems highly probable that, had not the stamp tax been imposed, the halfpenny paper would soon have become the normal type, and would have continued so to this day. In 1724 a committee of the House of Commons sat to consider the action of certain printers who were evading the stamp tax by publishing cheap newspapers under the guise of pamphlets. They found that there were then two Halfpenny Posts published in London, one by Eead of Whitefriars, and the other by Parker of Salisbury Street. There were also three weekly papers issued at a halfpenny a copy. The tax, after several reductions, was finally repealed on .16th June 1855, and a rush of cheap papers immediately followed.

The first modern English newspaper to be issued at a halfpenny was the London Evening News â€” afterwards known as the Day. It was started in 1855, but soon failed to meet expenses, and disappeared London . from the scene. Between twenty and thirty halfpenny local papers were at once started in London, of p^/’“- which the following were issued at a halfpenny : â€” Clerk-enwell News, Time o’ Day for Hoxton, Islington Gazette, Islington Times, Lambeth Observer, North London Record, St Luke’s News, Shoreditch Observer, South London Times, and Westminster News. Of these it is interesting to note that the Clerkenwell News became the Daily Chroni- cle, while the Islington Gazette still survived in 1902, though not as a daily newspaper. The times, however, were not then ripe for fresh ventures in halfpenny journalism. The high price of paper, the slowness of production, the limited income from advertisements, and inadequate means of distribution, were all against these cheap journals, and one by one they had to raise their price or die. Not infrequently they did both. In 1868 appeared the Echo, the fii’st of present-day evening papers to be issued at a halfpenny. It was published by Messrs Cassell, Patter, and Galpin, and had for its first editor, until 1875, Mr (afterwards Sir) Arthur Arnold (1833- 1902), who afterwards became M.P. for Salford (1880- 1886), and chairman of the London County Council (1895-96), and was well known both as a writer and traveller, and as founder of the Free Land League (1885). Baron Albert Grant (1830-1899), the pioneer of modern mammoth company-promoting, afterwards took it in

1 Albert Grant, who took that name though his father’s was Grottheimer, was given the title of Baron hy King Victor Emmanuel of Italy in 1868 for

his services in connexion with the JDlan picture gallery. He made a large fortune hy company-promoting, and in 1865 became M.P. for Kidderminster. He became a prominent public character in London. In 1873 he built Kensington House, a vast mansion close to Kensington Palace, which in 1883 was demolished and the site seized by his creditors. In 1874 he bought up Leicester Square, converted it into a public garden, and presented it to the Metropolitan Board of Works. But soon afterwards he failed, and from 1876 to his death he constantly figured in the law-courts at the suit of Ms creditors.

hand and wasted a fortune over it. After passing tiirougli troublous days, it was finally put upon a sound basis and turned into a commercial success by the shrewd judgment aud untiring energy of Mr Passmore Edwards. In the following year appeared at Darlington the Northern Echo, which claims to be the first halfpenny morning daily ever issued in any land, though it is on record that the one- cent morning journal is of older origin in the United States. Next came the Eveniyig News, which was begun at a halfpenny in 1881 as a Liberal organ, but was shortly afterwards bought by a Conservative syndicate. It saw stormy times, and at the end of thirteen years it had absorbed Â£298,000 and was heavily in debt. Its shares could then be purchased for threepence or fourpence each. In August 1894 it was purchased by Messrs Harmsworth for Â£25,000, and entered upon a career of prosperity. On 17th January 1888 the first number of the Star appeared, under the editorship of Mr T. P. O’Connor (b. 1848), as a halfpenny evening newspaper in support of Mr Gladstone’s policy. When Mr O’Connor left the paper, Mr H. W. Massingham became its editor, and subsequently Mr Ernest Parke. Erom the first it warmly espoused the cause of the working classes. In 1893 Mr T. P. O’Connor founded the Sun, which eventu- ally passed first into the hands of Mr H. H. Marks and then into those of Mr Bottomley.

Two morning papers at the popular price of a halfpenny appeared in the spring of 1892, the Morning and the Morning Leader. They raced for priority of publication, â– the former winning by a day. The Morning Leader, under the same management as the Star, was still fl.ourishing in 1902, but the Morning had but a brief career. The Daily Mail, which was originated by Mr Alfred Charles Harms- worth (b. 1865) and appeared in 1896, was the first half- penny morning newspaper to place at the disposal of its readers a news service competing with that of any of the higher-priced newspapers. It claimed by 1902 a regular circulation of about a million copies daily (and had occar sionally sold as many as 1,500,000 copies of a single issue), and it was produced simultaneously in London and Manchester, the whole of the contents being telegraphed nightly. The Daily Express, founded by Mr Cyril Arthur Pearson (b. 1866), first appeared in 1900, and won a large clientMe by its eminently readable qualities.

The British provincial press, which had its origin in 1690, when the Worcester Postman â€" now known provincial ^s Berrow's Worcester Journal â€" was started, ad- haifpenny vanced by leaps and bounds during the latter papers. YiaXi of the 19th century (see also below). In- creased facilities for the distribution of news resulted in the establishment of daily newspapers in all the principal towns, and a large proportion of them were in 1902 sold at the popular price of one halfpenny, practically all the evening journals being issued at this price. A list com- piled at the commencement of 1902 gave the names of eighty-seven halfpenny daily newspapers published in English provincial towns, a considerable number of these being morning journals. Of these, sixty -two had been 'issued since 1870, those bearing earlier dates of origin being in most cases sheets which formerly were issued at a penny or more, but had subsequently reduced their prices. An example of this may be seen in the Leeds Mercury, which was issued in 1718 at three-halfpence. Owing to the imposition of the stamp tax its price gradu- ally increased, until in 1797 it stood at sixpence, wlien its circulation was only 800 copies. With the removal of the tax its price was reduced and it became one of the most popular of Yorkshire penny newspapers. In 1901 its price was lowered to a halfpenny and at the same time its news service was greatly improved, with the result that its circulation grew rapidly, and it proved more pro-

fitable at a halfpenny than it had been at a penny. Of halfpenny morning newspapers existing in 1902, the first to be published at that price was, as has been stated above, the Northern Echo, which was issued at Darlington in 1869. It may be interesting to note that of the eighty- seven halfpenny dailies issued in England in 1902, twenty-nine claimed to be Liberal in politics, twenty- three Conservative or Unionist, and nineteen independent, while the rest did not indicate their tendency. Of the sixty-two that were issued since 1870, twenty-seven ap- peared between 1871 and 1882, nineteen, between 1882 and 1892, and sixteen between 1892 and 1902. Scotland at the close of 1901 had eleven halfpenny dailies, three being morning papers ; Ireland had seven, and Wales four.

The growth of the halfpenny newspaper has been practically a simultaneous one throughout the civilized world. This has been notably the case in the United States, France, and Great Britain. The conditions general tendency in newspaper production, as “lon?’^”’” in all other branches of industry, has been towards the lowering of prices while maintaining excel- lence of quality, experience having proved the advantage of large sales with a small margin of profit over a limited circulation with a higher rate of profit. The develop- mentâ€” and indeed the possibility â€” of the halfpenny daily paper was due to a number of causes operating to- gether during the latter half of the 19th century. Among these, the first place must undoubtedly be given to the cheapening of paper, through the introduction of wood pulp and the perfecting of the machinery used in the manufacture. Eroro. 1875 to 1885 paper cheapened rapidly, and it has been estimated that the introduction of wood pulp trebled the circulation of newspapers in England. Keen competition in the paper trade also did much to lower prices. At the same time the prime cost of newspaper production was increased by the introduc- tion of improved machinery into the printing ofiice. The growth of advertisements must also be taken into account in considering the evolution of the halfpenny journal. The income from this source alone made it possible to embark upon journalistic enterprises which would other- wise have been simply to court disaster. At the same time, a properly managed halfpenny paper should show a substantial profit, altogether apart from the income that it derives from advertisements.

The popular journal of the present day does not, how- ever, owe its existence arid success merely to questions of diminished cost and improved methods of pro- duction. Its favourable reception points to a Special change that has come over the public mind. sUcs!,‘ The modern reader demands news rather than opinions, and he likes his news in a brief, handy form, so that he can see at a glance the main facts without the task of reading through wordy articles. This is especially the case with the man of business, who desires to master the news of the past twenty-four hours as he travels to his ofiice in the morning. It is to economize time rather than money that the modern reader would often prefer a halfpenny paper ; while the man of leisure, who likes to peruse leading articles and full descriptive accounts â€” often written by most able thinkers and skilled litterateurs â€” finds what he needs in the more highly priced journals. It is not, then, to the people who cannot afl’ord a penny that the halfpenny paper makes its appeal. To say that it is read by ” the man in the street ” is after all not to disparage it, for it is ” the man in the street ” who goes to the poll and governs his country. The growth of education must also be borne in mind when endeavouring to account for the halfpenny paper. It is happily a A’ery rare thing now to find a young man or woman who can- not read, and every person who can read wants to knu

the news. Even the poorest person does not hesitate much over the expenditure of a halfpenny when an in- teresting line on the contents-bill arrests his attention and awakens his curiosity. The halfpenny paper in England has not had to contend with the opposition that the penny newspaper met from its threepenny contem- poraries in the ‘fifties and ‘sixties. This is largely due to the fact that in most cases the contributors, paper, print- ing, and general management of the cheaper journal do not leave much room for critcism. Mr G. A. Sala’s famous complaint that the reporters of the older sheets objected to work side by side with him when he repre- sented the first penny morning newspaper, through fear of losing caste, does not apply, for in the United King- dom, France, and the United States the cheap journals, owing to their vast circulation, are able to offer

the best rates of remuneration, and can thus command the ser- vices of the best men in all the various departments of journalism.

Turning now to the growth of the cheap press abroad, the first Erench newspaper ever published may be fairly called a halfpenny one. The Gazette de Paris Pressf" ^^^ established by Theophrastus Eenaudot â€" the founder of the Mont de Piete, or pawnshop â€" in the year 1631, at the price of one parisis or six centimes. At first the Gazette consisted of four small pages, increased in the following year to eight and some- times to ten. It still existed in 1902 as an organ of the Legitimist party, though its circulation was presumably very small and its price had been advanced. Le Petit Journal was founded in 1863, and may be regarded as the modern pioneer of the French halfpenny press. It claims to have attained on occasion a circulation of 1,012,050 copies, and dispenses almost entirely with advertisements. Le Petit Journal has a close rival in Le Petit Parisien and in Le Journal. The sou Was in 1902 the recognized price of Parisian newspapers, of which there were about sixty, comparatively few being dearer. French journalism showed a slow but sure" change, the feuilleton giving way to news. Le Matin, which in 1902 was in its nineteenth year, claimed that it was the only French journal receiving by special wires the latest news of the whole world, and it had an advantage in having arranged to obtain the news service of the London Times. In many respects it offered remarkable value for the money. Of a very different type are L' Intransigiant, edited by M. Henri Rochefort, and La Libre Parole, con- ducted by M. E. Drumont, both affording reading matter of the most flamboyant type at the popular price.

To enumerate all the other Parisian newspapers at five centimes would be a lengthy task, but the following are a few of the best known : â€" L'Echo de Paris, an excellent newspaper, in its nineteenth year in 1902, and L'Edair, a typical news-sheet. La Fronde, in its sixth year in 1902, enjoyed the unique distinction of being managed, edited, and written by women only, the directrice being Madame Marguerite Durand. La Ripuhliqiie represented the pro- gressive Republican party since 1872, and La Petite Be- publique had expounded the views of the Socialists since 1875. La Lanteme in 1902 had seen a quarter of a century, and Le Journal, which claimed to be the only French journal appearing every day with six pages at least, was eleven

years old. It may be mentioned that six pages is a favourite size for a French halfpenny pkper. Le Radical was in its twenty-second year, and L'Autorite, under the political direction of M. Paul de Cassagnac, in its seventeenth.

In Belgium the half penny paper is decidedly popular and well established. Among others may be noted La Chrpnique, which in 1902 was in its thirty-fifth year; UEtoile Beige (founded 1869), an eight-page paper, one-

half of which consists of advertisements; and La Gazette, a year younger. Le Petit Bleu makes free and effective use of illustrations, and in 1902 was in its ninth year. Le Soir, Le National Brnxellois, and La Riforme, which last is often illustrated, are sold at the remarkably low price of two centimes (one-fifth of a penny) per copy. These claim to be the cheapest journals in the world. Each is a four-page paper, well edited, and possessing a very fair news service. The first was in 1902 sixteen years old, and the last nineteen.

In Italy all the papers, with a very few exceptions, were in 1902 sold at five centesimi. Among others may be mentioned La Tribuna, which enjoys an excellent news service, and gives very complete accounts of the debates in the Italian Parliament. Published at Rome, it was in its twentieth year. II Secolo, which in 1902 was thirty-seven years old, and the Corriere della Sera, which was twenty-seven, are both issued from Milan ; while La Stampa, a new Piedmontese gazette, has its publishing offices at Turin. Italy has also its halfpenny illustrated press, of which a good example is seen in II Secolo lllustrato, fourteen years old in 1902, which is admirably produced.

The tendency towards extreme cheapness had not yet, in 1902, influenced the German press to so great an extent as in some other European countries, though it is decidedly leaning in that direction. Der LokalrAnzeiger was founded at Berlin by August Scherl, who had gained his journalistic experience in America, and was prepared to introduce entirely novel methods into the Fatherland. The new journal was published on Sunday mornings, and delivered free for two and a half pfennigs per copy, a sum about equal to one farthing. It was subsequently converted into a daily paper, and the price was consider- ably advanced. A 'typical German halfpenny newspaper is seen in Das Kleine Journal, published in Berlin at five pfennigs. It is occupied mainly with finance and trade announcements.

An attempt was made at Vienna in 1902 to establish a paper, the Neue Zeitung, at one kreuzer (one-fifth of a penny), but it lived only two months.

In Switzerland, La Tribune de Gen&ve, founded 1878, is published at five centimes, and is a leading paper of its class. Spain is represented by El Correo, founded 1879, which is published in Madrid at five centimes. It has an ingenious arrangement by which the inevitable feuilleton is so printed that it may be cut off and folded into book form. In ^Mssia a cheap paper has not much encourage- ment, but the Swet contrives to flourish at the equivalent of a halfpenny. Pesti Hirlap is a Hungarian paper, published at Budapest. It contains twenty-four pages â€” of which six are advertisements â€” and costs eight pfen- nigs. Though this is more than a halfpenny, it is less than a penny, and the Pesti Hirlap is certainly a low- priced newspaper.

Down to the year 1833 there were no cheap newspapers in America. The usual price was six cents, and no journal had a sale of over 5000 copies. On 1st January 1833 the Morning Post was started in New York at two cents per copy. This was quickly reduced to one cent, but the paper lived only three weeks. On the 3rd September following, the New York Sun was founded by Benjamin H. Day. It sold at one cent until the outbreak of the war, when the general rise in prices sent it up to two cents, where it remained. The first issue of the Morning Herald of New York, owned by James Gordon Bennett and Company, appeared on 6th May 1853 at the price of one cent. It consisted of four pages, measuring 30 inches by 24, with four columns to the page. Vigorous competition followed, and the rival one-

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cent papers adopted tactics which were as ingenious as they were novel in the newspaper world. The Herald, Sun, Tribune, Times, and World of New York all started at one cent. There were in 1902 an immense number of one-

cent journals published in various parts of the United States, and fresh ones are continually appearing. As an example of the enterprise with which they are conducted, mention may be made of the Journal and World of New York, and the Press of Philadelphia. These and many others often give fourteen or sixteen big pages in return for the purchaser's cent. â€¢ (a. c. h*.)

Eritish Provincial Newspapers.

The London newspaper zone extends eastwards to Ipswich and Norwich, northwards to Leicester, and west- wards to Bristol. In 1870 its northern limits were Not- tingham and Birmingham. Important daily newspapers had then been established in every great centre of intel- lectual, industrial, and mercantile activity. The abolition of the duty on advertisements in 1853, of the stamp duty in 1855, and of the paper duty in 1861, opened the way for a' cheap press, and within ten years of the abolition of the paper duty penny morning newspapers had taken up commanding positions in Edinburgh, Glasgow, Dun- dee, and Aberdeen ; in Liverpool, Manchester, Leeds, Bradford, Newcastle, and Sheffield ; in Birminghaiji and Nottingham; in Bristol, Cardiff, and Plymouth; and across St George's Channel in Dublin, Cork, Belfast, and Water- ford. Halfpenny morning newspapers (see above) had also come into existence. In 1869 the Dundee Courier was started. At Exeter two old papers published twice a week â€" the Daily Gazette in 1863 and the Western Times in 1866 â€" began to issue halfpenny morning edi- tions on four days in the week. At Brighton in 1868 the Sussex Daily News was started as a halfpenny morning paper, but has since been advanced to a penny. Evening newspapers, too, had come into existence. The most successful were the Manchester Evening News and the Glasgow Citizen; but there were also prosperous evening papers at Birmingham, Shields, Exeter, Bolton, Bradford, Leeds, and Brighton. Practically, however, pro- vincial newspapers at the close of the 'sixties consisted of the penny morning newspapers and the old county weeklies, with a few weekly papers of more recent creation in great towns. Since then there has been an enormous increase in the number of evening newspapers, a smaller addition to the number of both penny and half- penny morning papers, and some increase also in the weekly press ; but the great change effected in

provincial journalism during the last thirty years of the 19th century is in the character rather than in the number of the news- papers produced.

So far as the increase in the number of morning news- papers is concerned, politics have been a powerful influ- ence. Dissensions amongst Irish Nationalists led in 1891 to the establishment of the Dublin Daily Independent and its evening ally the Evening Herald as Independent Nationalist newspapers, in opposition to the Freeman's Journal and its evening paper the Evening Telegraph; and in 1897 the Nation, a powerful Irish weekly in the days of '.' Young Ireland " and while it was owned and edited by the Sullivans, was brought out as a daily news- paper. In Newcastle-on-Tyne the adhesion of the New- castle Chronicle to Unionism opened the way for the Newcastle Daily Leader in 1885 as a Liberal paper ; and this journal, with evening and weekly paper attached, is amongst the few new morning newspapers that have in recent years been begun with success. Other places in which morning penny newspapers have been successfully started, as a rule to supply a political want, are Aber- deen, York, Huddersfield, Manchester, Ipswich, Norwich,

Cardiff, and Swansea. Halfpenny morning newspapers have increased in number to almost as large an extent- as their penny contemporaries. At Darlington in 1871 the Northern Echo was started ; and a few years later, when Mr W. T. Stead became its editor, the very advanced views that it advocated goaded the Conservatives of the district into the production of a rival paper, the North Star. Brighton was again given a halfpenny morning paper in 1896 ; and the close of the century was signal- ized by an eruption of morning halfpenny newspapers in Middlesbrough, Newcastle, Shields, and Sunderland, all the outcome. of a labour dispute in the office of the New- castle Leader, and all issued from Newcastle by the same publisher. A still more recent development, the ulti- mate results of which remain to be seen, is the creation in provincial centres of halfpenny morning newspapers in connexion with London halfpenny morning jour- nals. This movement has been inaugurated by Messrs Harmsworth and Messrs C. Arthur Pearson and Co., who have invaded Birmingham, Liverpool, Manchester, Leeds, Newcastle, and Glasgow with halfpenny morn- ing papers that reproduce in the provinces the lead- ing characteristics of the Daily Mail and the Daily Express.

Except in special cases, provincial newspapers began as strictly local journals. Manchester held an exceptional position. Commercially the centre of a trade that ex- tended over the whole of Lancashire and part of Cheshire, and politically the headquarters of advanced views on social and economic reform, the Manchester press from its earliest days regarded current events from a national point of view, and influenced opinion throughout Lanca- shire, Cheshire, and northwards to Carlisle. The Leeds Mercury from its inception was given a character of its own by its founder and first editor, Mr Edward Baines, whose family have left an impress not only upon journal- ism but upon literature in the north of England. Eor many years the Leeds Mercury admitted neither racing news nor notices of theatres to its columns, but it was a powerful influence both in morals and politics in the northern dis- tricts of Lancashire and Yorkshire. In Northumberland and Durham the Netvcastle Chronicle had some influence outside its strictly local sphere. It was in Scotland, how- ever, that localism was first thoroughly broken down. The Scotsman, under the managership of Mr Law and the editorship of Mr Alexander Eussei, led the way. It collected news from the whole of Scotland, opened an office in London, made special arrangements for securing home and foreign news, made liberal use of the telegraphs, reviewed books, discussed general as well as local topics, supplied full parliamentary reports, and in fact realized the present ideal of a morning newspaper. On the busi- ness side, means were taken to circulate the paper all over Scotland by the early morning trains. Glasgow is a better centre than Edinburgh for distribution in the west of Scotland; a publishing office was therefore opened in Glasgow, and a special train engaged to take the Scotsman to it for distribution over the west of Scotland. The same policy was adopted at Perth for the north of Scotland. The Glasgow Herald met this action by arranging for simultaneous publication in Edinburgh, and it and the Dundee Advertiser were equally active in improving their news supply and perfecting their London arrangements. The Dublin and Belfast newspapers being more distinctly severed from Great Britain and from British influence than the Scottish press, naturally organized themselves on Irish lines, the Dublin becoming national and the Belfast more distinctly Ulster organs of public opinion. But London connexions were indispensable, and the leading Irish news- papers were carried along in the stream of general advance. For a time the English press rather lagged behind. Even

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Manchester did not move forward so resolutely as Scot- land. A remarkable result of the Scotsman's energetic policy and lavish expenditure, under the editorship after 1876 of Mr Charles A. Cooper (b. 1829), has been that it has killed every other morning. newspaper in Edinburgh. The Daily Review, once the organ of the Free Church, and the Edinburgh Courant, the oldest Conservative news- paper in Scotland, have both disappeared. They could not stand the Scotsman's pace. A courageous attempt was made by the Liberal party, after the Scotsman became Unionist in 1886, to run the Scottish Leader. To compete with the Scotsman, with its more than princely revenue, its splendid organization for news supply, and its perfect publishing arrangements, required a very long purse. The Scottish Leader did not succeed. In Man- chester the Guardian has shown entei-prise on the Scottish lines. It has perfected its news supply, and promotes circulation by chartering special early trains to Crewe for AVales and the south, Leeds for the Yorkshire district, and Wigan for the north of England. The Manchester Examiner, once the leading Liberal paper in the north of England, did not show similar enterprise, and when it abandoned its traditional advanced Liberalism for Liberal Unionism it forfeited whatever remained of its old popu- larity, and died. The tendency is for one great news- paper to dominate a district, and success falls to the most enterprising and most intelligently conducted. In 1871 the Liverpool Weekly Albion brought out a Daily Albion underthe editorship of Mr William Hind, whose experience in daily journalism was gained on the Scotsman and the Dundee Advertiser. The new daily was edited on the most advanced lines. It presented both local and general news, reviews of books, special articles on both general and local topics, had special London arrangements, was ex- ceptionally strong in commercial news, and discussed general more than local affairs. It failed through defective business management ; but through its three or four years of existence it had given an immense stimulus to the other Liverpool dailies ; and when it was converted into an evening paper in 1874, preliminary to its decease in 1887, its disappearance chiefly benefited the

Liverpool Daily Post, which most closely resembled it in character, and through Sir Edward Kussell (b. 1834), who became editor in 1869, enjoyed political and social connexions and influence, and a reputation for cultured criticism in art, music, the drama, and literature, that placed it above its local contemporaries, and in the front rank of provincial journalism.

General' causes were now beginning to influence the whole provincial press. While the leading journals were content with a merely local circulation, and did not strive very vigorously to push into new and distant ground, the personality and influence of the editor was a factor of first importance. How profoundly the guiding mind of the editor might influence the public usefulness of a news- paper had been shown by Mr (afterwards Sir William) Leng, when in 1867 and 1868, at the peril of his life, he denounced in the Sheffield Teleqrcqih the iniquities of " rattening " and the trade-union terrorism of the saw- grinder Broadhead. How powerful the personality of the editor still is, and ever must be, was shown by the strongly " pro-Boer " attitude maintained by the Man- chester Guardian, under the guidance of Mr C. P. Scott, M.P., from 1899 onwards. But even in 1870 it was beginning to be universally perceived that though the in- fluence of a newspaper depends upon the sagacity, sound judgment, and courage of the editor, its success as a busi- ness enterprise rests mainly with the business manager. Managers demanded less localism, a wider range of news, prompter and fuller reports of all important events, longer Parliamentary reports. Parliamentary sketches, verbatim reports of speeches by statesmen of the first rank. In the

early 'seventies such a thing as a full telegraphic re- port in a provincial morning newspaper of Parliamentary â€¢proceedings, or of a speech by a leading statesman, was almost unheard of. The Press Association ha,d been in existence a short time, but had not then covered the country with its organization. Eeuter's foreign news service very briefly reported important events. Leading articles were written during the day. Between 1870 and 1880 a complete revolution was effected, as the result of social and educational changes that have already been traced. Leader-writers began to discuss the latest topics. Newspapers that had been content to fill their columns with local news and clippings from London and distant provincial papers put such matter aside. Telegraphic news crushed it out. In Eebruary

1870 the Government took over the telegraph system. The advantage of the change was immediately felt by newspapers ‘and their readers. Leading Eng- lish and Irish newspapers, following Scotland’s lead, began to open offices in London. Soon Elect Street began to be an open directory to the provincial press â€” English, Scottish, and Irish. The Scottish and the leading Irish newspapers of necessity, the wealthiest and most enterprising English papers for convenience and advantage, engaged special wires. Others that were near enough to London to do so secured London news and advertisements by railway, and completed their news supply by a liberal use of the telegraph. Com- mercial news, both home and foreign, especially American, was expanded. The Press Association spread its news- collecting organization over the whole country, and was stimulated to activity by the rising opposition of the Central News. All this energy had its counterpart in the business side of the press. Rapid ” perfecting ” printing machines were introduced, and newspaper managers found themselves in possession of newspapers full of the latest news, and procurable in practically un- limited quantities. By the use of special trains and other organizations, circulation increased apace. The development of news agencies, and their universal em- ployment, tended to produce sameness in the provincial press. Erom this fate the more enterprising journals saved themselves by special London letters, Parlia^ mentary sketches, and other special contributions. In 1881 the reporters’ gallery in the House of Commons was opened to some provincial newspapers, and these accordingly enjoyed new facilities for special effort and distinction. A more important matter, however, was the bombardment of Alexandria and the subsequent Egyptian war. The leading provincial newspapers had already emancipated themselves from localism, and in general news and criticism had risen almost, if not quite, to the average level of the first-class London journals. Now they were to step abroad into the field of war. Singly or in syndicates, or by arrangement with London journals, the leading provincial newspapers sieut out war correspondents, and were able to record the history of events as promptly and fully as the metropolitan press. The first syndicate to send out war correspondents was formed by the Glasgow Neios, the Liverpool Daily Post, Manchester Courier, Birmingham Gazette, and Western Moiiiing News. By this combination two very able cor- respondents were sent to Egypt, and the new departure was attended with complete success. The Central News also sent out war correspondents to Egypt and the Sudan.

During the South African war the Press Association, in conjunction with Renter’s Agency, employed correspond- ents, as well as the Central News. The leading provincial newspapers, however, all formed syndicates amongst them- selves to secure war telegrams, and in many cases made arrangements for the simultaneous publication of the

letters and telegrams of leading London journals. The resvilt was that in these provincial journals during the early and most exciting period of the war there was a fuller and better supply of war news than in the London press. This system of securing simulta- neous publication, in provincial newspapers, of special contributions to London morning newspapers was afte’r- wards still further extended, and articles of exceptional interest that have been specially prepared for London journals may now be found on the same day in some of the leading provincial newspapers.

By the beginning of 1880 the country had fallen upon a period of low prices, and extra expenditure upon war telegrams and on an improved supply of general news was to a considerable extent balanced by the reduced cost of paper. Under the stimulus of cheapness the news- sheet was enlarged. More advertisements, more news, more varied contributions, filled up the additional space. The cost of composition increased, and, though circulation and revenue increased also, there was some danger to the margin of profit. Again invention came to the rescue. Type-setting machines had been invented even before web- printing machines came into use, but had not been turned to practical service. The experimental was now to pass into the practical stage. In the ‘eighties some of the leading provincial newspapers began to use type-setting machines. In this forward step the provinces were far ahead of the London papers excepting The Times. The Soutliport Daily News â€” since dead â€” led the way by intro- ducing six Hattersley machines. These instruments subsequently passed into the hands of two northern newspapers, and shortly afterwards the Liverpool Courier and the Liverpool Daily Post adopted the Hattersley machines on a large scale. The Linotype, however, was destined to supersede this invention, and now all the leading provincial journals are supplied with type-setting instruments of this pattern. The immedi- ate results of composition by machinery were important. Fewer compositors were required, the earnings of those employed on machines were greatly increased, and the employers’ wages bill was reduced. But the public were given most of the benefit, for with the enlargement of ne wspapers and an increase in their number, the composing staffs soon rose to their former numbers, or even beyond them, and increased circulation had to meet the increased cost of production. Another development of newspaper enterprise was the introduction of illustrations into the daily press. So long ago as the first Egyptian war the Liverpool Daily Post, under the energetic management of Mr A. G. Jeans, introduced maps and diagrams to illus- trate the progress of events. Some other English provin- cial newspapers have advanced in this direction, but not to any great extent. The displayed advertisements which are now so much in evidence, and have found their way into all English and into some Scottish newspapers, are of American origin. The leading Scottish newspapers, more conservative in their habits and stronger financially than the majority of their English contemporaries, still resist very large type and

unusual display. The English newspapers, however, find whole-page and double-column and other display advertisements remunerative, and relax their general rules ” for a consideration.”

In the general amplification of news in morning news- papers, the enlargement of ideas on sport has been an especially remarkable feature. In 1870 sporting meant horse-racing and little more. Now it embraces athleticism in all its branches, and progressive newspapers are looked to for information on football, hockey, golf, cricket, lawn- tennis, yachting, boating, cycling, wrestling, coursing, hunt- ing, polo, running, bowls, billiards, chess, &c., quite as much as for notices of musical and dramatic perform-

ances, and of other forms of recreation and amusement. No newspaper objects on principle to the publication of athletic news, but some have striven against the publi- cation of betting and other gambling accompaniments of horse-racing. Amongst these the Leeds Mercury was the most conspicuous; but Yorkshire is a great sporting county, and though the Yorkshire Post, under Mr Pe- body’s management, catered well for all classes, the Leeds Daily News Company found it possible in 1895 to start the Yorkshire Sporting Pink. In Manchester so long ago as 1871 a Sporting Chronicle was successfully started, the proprietors of which in 1885 began also a Sunday Chronicle, and in 1897 an Evening Chronicle. Liv- erpool has a Football Echo and a Football Express, pub- lished on Saturdays ; Shef&eld a Football World, published on Mondays ; the Potteries Sporting News is published daily at Hanley; the Midland Sporting Gazette at Not- tingham ; and Newcastle-on-Tyne, Bristol, and Newmarket each has a Sporting News.

Some provincial towns with special characteristics pre- sent journalistic opportunities of their own. Liverpool with its large shipping interests supports a Journal of Commerce, issued daily, which Mr Charles Birchall, its proprietor and manager, afterwards published also in Man- chester. Since 1877 the Swansea Gazette, issued daily, has catered for the shipping trade of South Wales. Liv- erpool has an exceptionally large Roman Catholic popula- tion, which is provided with a weekly Catholic Times. Leeds, with

an exceptionally large Jewish quarter, sup- ports a weekly Jewish Express, established in 1894.

Neither in connexion with sport nor other matters has there been any addition to the number of newspapers in Scotland comparable to English experience, probably be- cause the remarkable completeness of the Scottish morning papers leaves no opening for competitors. Ireland has exhibited more variety, and new journalistic adventures in Dublin speak of increased Irish prosperity. The Freeman's Journal Company in 1881 issued Sport as a weekly, and in 1890 added a daily Sporting News; in 1885 the L-ish Cy- clist appeared as a weekly, and in 1888 the Farming World and the Social Review.

Despite the many changes in provincial journalism resulting from the phenomenal energy that has been brought to bear upon morning newspapers, the most con- spicuous feature in newspaper evolution during the period under review was the development of the evening news- paper. For a long time proprietors of morning news- papers held aloof. They feared that the evening paper would damage the circulation of the morning journal and give them only a halfpenny for a penny. The idea, as has been discovered by experience, was utterly fallacious, but it was strongly held. Even in Scotland, where every morning newspaper now publishes an evening paper, the proprietors of the morning newspapers were almost forced into the new enterprise. In Glasgow, under a new pro- prietary, the Glasgow Evening News was brought out in 1870, in opposition to the Citizen. The Edinburgh Even ing News was started in 1873, and in Paisley an evening Da% Express was issued in 1874. The Glasgow Herald brought out its Evening Times in 1876. In the following year the Dundee Advertiser issued its Evening Telegraph. Two years later the Aberdeen Journal, and again after a two years' interval the Aberdeen Free Press, joined in the movement. Not till 1885 did the Scotsman publish an evening paper. In this matter Ireland moved more quickly than Scotland, for the Freeman's Journal brought out its Evening Telegraph in 1S70. In Belfast a new proprietary was left to introduce in the same year an Evening Telegraph, and a few years later the'C7?sfe)- Echo was started under independent auspices. But beyond the du- plication of evening papers in Dublin through Nationalist

illustrated]

dissensions, and the establishment of an evening paper at Waterford, little success has attended evening journalism in Ireland.

It is in England that the evening press has flourished most, , though, as in Scotland, the morning newspapers were slow to move. The Liverpool Courier and the Birmingham Daily Post were first in the field, and in 1870 issued respectively the Liverpool Evening Express and the Birmingham Daily Mail. The latter paper soon became a great success, and within three or four years of its commencement had a circulation of from 60,000 to 70,000. Other morning papers that during the ‘seventies brought out evening newspapers were the Manchester Courier and the Leicester Post in 1874, the Western Daily Press in 1877, the Nottingham Daily Guardian in 1878, and the Liverpool Daily Post in 1879. This was not striking evidence of appreciation of the value of evening newspapers, during a period in which morning papers were entirely transformed by a widened news supply, and printing power was mul- tiplied by the introduction of web-printing machines. Nor did the Egyptian war, and cheaper paper, and type- setting machines greatly stimulate the issue of evening papers by old dailies.

Between 1880 and 1890 evening newspapers were started by the Sussex Daily News, the Tork Herald, the Eastern Daily Press, the South Wales Daily News, the Nottingham Daily Express, the Newcastle Chronicle, the Western Mail, and the Sheffield Daily Telegraph. Since then the Yorkshire Post, Western Daily Mercury, Man- chester Chronicle, Newcastle Daily Leader, Bristol Mercury, and Western Morning News have done so. But th^re are still a few prominent morning newspapers that have not entered into evening journalism. Amongst these are the Liverpool Mercury, Leeds Mercury, Sheffield Independent, Birmingham Daily Gazette, and Bristol Times.

Comparatively few additions have been made to weekly newspapers since 1870. The most notable new weeklies have been the Liverpool Weekly

Post, the Birmingham Weekly Mercury (issued from the Birmingham Gazette office), the Newcastle Weekly Leader, the Western Weekly Mercury (published at Plymouth), and the Manchester Sunday C/ironicle and the late Sir W. Leng's Sunday paper, the Sunday Telegraph. The old county papers have held their ground, and in many county towns new weeklies have been started ; but the prompt publication of news of all kinds by morning and evening newspapers and their circulation throughout the whole country have compelled weekly newspapers to modify their character and to give attractiveness to their columns by publishing serial stories, notes on gardening, agriculture, &c., notes and queries, and other special contributions.

Taking a general survey of the progress that has been made, evidence is found on every hand of remarkable energy, resourcefulness, and prosperity. The progress of education, the greater use of telegraphs, the organization of news agencies, the introduction of the telephone, and the growth of industry, commerce, and population have been the main influences that have led to a revolution in the supply of news. The improved printing machines, type- setting machines, and cheapness of paper have resulted in cheapening the production of newspapers, and have encouraged their owners to increase their size. At the same time, the multiplication and enlargement of news- papers, notwithstanding the temporary reduction of staffs through the improvement of machinery, have provided employment for a greatly increased number of compositors at higher wages, and the rapid distribution of evening newspapers has utilized the services of an immense army of men and boys and horses. The low price of paper has enabled many new journals to come into existence and

prosper on a comparatively slender income. But the keenness of competition has carried expenditure up- wards. It is only the great newspapers that are indisputably in the front that can feel secure of their position, and those only by a combination of prudence and enterprise and energy in management that do not always coexist. In the financial prosperity and strength of newspapers the public have a very direct interest. Wealthy and flourishing newspapers can resist with impunity all temptations to venality, and perform their functions as vigilant critics and watchful guardians of public interests with fearless independence. The pro-

vincial press has gained and maintained a high reputation for integrity of purpose and superiority to all corrupt influences. It ranges itself on the side of public morality and decency and sobriety, and upholds purity in political and social life and in the administration of both local and national affairs. (w. we*.)

Illustkated Journalism.

Illustrated journalism is the name given to that form of newspaper enterprise which treats of illustration of current news and the events of the passing hour. The great develop- ment in this direction in recent years makes it desirable to trace its origins more in detail than was attempted in the earlier volumes of this work. The earliest attempts at popular illustration of news events took the form of broad- sides. One broadside dated 1587 recounted the Valiant Exploits of Sir Francis Drake ; another dated 1607 gave an account of A wonderful flood in Somersetshire and Norfolk. The series of murder broadsides which lasted almost to our own time commenced in 1613 with one that gave an account of the murder of Mr William Storre, a clergyman of Market Easen, in Lincolnshire, by Francis Cartwright. Earlyinthe reign of Charles I. there appeared a broadside which described a fall of meteors in Berkshire. A little later â€” in 1683 â€” the Weekly News came out with the picture of an island which was supposed to have risen from the sea on the French coast. The execution of Strafford in 1641 was made the subject of a picture pamphlet that is to be seen in the British Museum, and in 1642 the first attempt to portray the House of Commons appeared in A Perfect Diurnall of the Passages in Parliament. In 1643 a pamphlet was published, called Tlie Bloody Prince; or a Declaration of the Most Cruel Practices of Prince Rupert and the rest of the Cavaliers in fighting against God and the True Ministers of His Church. This contains a woodcut representation of Prince Eupert on his charger, one of the first attempts at provid- ing the public with a portrait of a contemporary celebrity.

Soon after this there appeared a journal, entitled Mer- curius Civicus, which frequently gave illustrations, and, allowing for the Weekly Neivs with its one attempt at an illustration above mentioned, must be counted the first illustrated paper. Mercurius Civicus, however, only gave portraits ; it

published Charles I. and his queen. Prince Eupert, Sir Thomas Fairfax, and aU the leading men on both sides in the Civil War. Perhaps the most interesting illustration of the next four years was that contained in a tract intended to evoke sympathy for the conquered and captured king. It represented Charles in Carisbrooke Castle in 1648. There were many later attempts to depict the tragedy of Charles I.‘s execution, and several woodcuts present to us also the execution of the regi- cides after Charles II. came to the throne. A broadside of the reign of the second Charles shows the Frost Fair on the Thames in 1683, and with a broadside describing Great Britain’s Lamentations, or the Funeral Obsequies of that most incomparable Protestant Princess â€” Queen Mary, the wife of William III., in 1695 â€” we close the illustrated journalism of the 17th century.

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Curiously enougli, the 18tli century, so rich, in^journal- istic enterprise and initiation so far as the printed page was concerned, did less than the previous century to illustrate news. In 1731, however, in the Grub Street Journal, there appeared the first illustration of the Lord Mayor’s procession. In 1740 another journal, the Daily Post, gave an illustration of Admiral Vernon’s attack on Portobello. The narrative was introduced by the editor with the information that the letter that he is printing is from a friend who witnessed the conflict between the English and the Spaniards. The writer of the letter, who must be put on record as the father of war corre- spondents, signed himself ” William Eichardson.”

There were some interesting efforts to illustrate maga- zines about this time. In the Gentleman’s Magazine for 1746 there was a lengthy account of the famous rising of 1745, and a map was given of the country round Carlisle, showing the route of the Scottish rebels ; and in the same volume there was a portrait of the duke of Cumberland. In 1747 the Gentleman’s gave a bird’s-eye view of the city of Genoa, illustrating the account of the insurrec-

tion there, and so on year by year there were further pictures. In 1751 an obituary notice was illustrated by a portrait of a certain Edward Bright of Maiden, Essex. Mr Bright died at the age of thirty, and his interest to the public was that he weighed 42^ stones. There were a number of other magazines besides the Gentleman's that came out about this time and continued well into the next century. In the Thespian Magazine for 1793, for ex- ample, there is an illustration of a new theatre at Birming- ham. Then there were the English Magazine, the Maca- roni Magazine, the Monstrous Magazine. Every one of these contained illustrations on copper, more or less topical.

William Clement, the proprietor of the Observer, the first number of which was published in 1791, was the first real pioneer of illustrated journalism, although his ideals fell short in this particular, that he was never prepared to face the illustration of news systematically ; he only attempted to illustrate events when there was a great crisis in public affairs. In 1818 Abraham Thorn- ton, who was tried for. murder, appealed to the wager of battle, which after long arguments before judges was proved to be still in accordance with state law, and he escaped hanging in consequence. Thornton's portrait appeared in the Observer. Clement owned for some time Bell's Life and the Morning Chronicle. All his journals contained occasional topical illustrations. The Observer's illustration of the house where the Cato Street conspir- ators met is really sufficiently elaborate for a journal of to-day, and in 1820 it gave its readers " A Faithful Reproduction of the Interior of the House of Lords as prepared for the Trial of Her Most Gracious Majesty Queen Caroline." In 1821 it published an interior of the House of Commons with the members in their places. The Observer of 22nd July 1821 â€" the Coronation num- berâ€" contained four engravings. Of the George IV. Coronation number Mr Clement sold 60,000 copies, but even that was nothing to the popularity that this journal secured by its illustrations of the once famous murder of Mr Weare and the trial of the murderer Thurtell. The Obsfirver in 1838 gave a picture of the coronation of Queen Victoria. In 1841 there was a fire at the Tower of London, when thÂ« armoury was destroyed. The Ob- server published three illustrations of the tire ; it further published an emblematic engraving on the birth of the prince of Wales, and issued a large page engraving of the christening

ceremony in the following January. Thus it had in it all the elements of pictorial journalism as we know it to-day.

The Jllustraled London Neios was, however, the first illustrated newspaper by virtue of its regularity. It was

the first illustrated paper, because all the illustrations to which we have referred as appearing in the Observer and other publications were irregular. They came at intervals ; they were quite subordinate to the letterpress of the paper; they were given only occasionally in times of excitement, with a view to promoting some little extra sale. That they did not really achieve the result hoped for to any great extent may be gauged by the fact that from 1842 to 1847 the Observer pub- lished scarcely any illustrations at all, and in the mean- time the Illustrated London News had taken an assured place as a journal devoted mainly to the illustration of news week by week. That is why its first publication marked an epoch in journalism. The casual illustration of other journals still went on: the Weekly Chronicle, for example, still published a number of pictures ; the Sun- day Times, also a very old paper, illustrated in these early days many topical subjects. In 1834, indeed, it pictured the ruins of the House of Commons, when that building was barned down. A paper started in 1837 called the Magnet gave illustrations, one of them of the removal from St Helena and delivery of the remains of the Emperor Napoleon to the prince de Join- ville in 1840.

The first number of the Illustrated London News appeared on 14th May 1842. Its founder was Herbert Ingram (1811-1860), who was born in Boston, Lincoln- shire, and started life amid the most humble surroundings, what education he ever received having been secured at the free school of his native town. Apprenticed at fourteen to a printer in Hull, he later settled in Nottingham as a printer and newsagent in a small way. It was during his career as a newsvender at Nottingham that he was seized with the belief that it was possible to produce a paper entirely devoted to illustration of news. In the first num- ber of the Illustrated London News, however, there was not a single picture that was drawn from actual sight, the factor which is the most essentia!! element of the illus- trated journalism of to-day. Sir John Gilbert (1817-1897), the artist, has stated that not one of the events depicted by him â€” a State ball at which the Queen and the Prince Consort

appeared, the Queen with the young prince of Wales in her arms, and other incidental illustrations â€” was taken from life.

The Illustrated London News had not been long in existence before there were many imitators, in America Haiyer's Weekly, in France L' Illustration, and in Germany fiber Land und Meer, and from that day there has been constant development, although in 1902 in the United Kingdom only three other newspapers existed on lines akin to the Illustrated London A^ews, namely the Graphic, Black and White, and the Sphere. Development has taken place, however, in many directions. The photo- graph has in some measure dethroned the artist ; colour- printing has been taken up vigorously, more particularly in France ; wood-engraving has given way to mechanical processes that are much more expeditious ; daily journal- ism has largely taken up with illustration, and the Daily Graphic has systematically illustrated news. Recent illustrated journalism has also expressed itself in a divi- sion of subject. Women's interests are catered for in the Qiit'cii, the Gentleiuoman, and many similar journals, the interests of the stage in the Sketch, and the 'Tatler, while all kinds of interests â€" golf, motoring, field-sports, for example â€" have each aseparate illustrated organ. Further developments of illustrated journalism will probably be in the direction of more complex machinery and quicker production.

See also Pictorial Journalism, by Mason Jackson ; A Treatise on Wood Engraving, by W. A. Chatto and John Jackson.

(C. K. S.)

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NEWSPAPEES

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The United States.

The changes in the newspaper press of the United States of the last fifteen years of the 19th century were little short of revolutionary. It was noted in the ninth edition of the Encyclopedia Britannica that " only one daily

illustrated paper is published in America.” Now it would be easier to enumerate those not illustrated. It was noted then that most of the new papers were of the four-page class, springing from a reaction against large sheets ; that they ” aimed at great condensation of routine news,” but with “special prominence for sensations,” and were coming to be sold for two cents. Now the papers are far larger than ever before, extending in the great cities not infrequently, on special occasions or on Sundays, to sixty pages, and from that to 100, and often ranging from twelve to twenty-four for ordinary week- day issues. Routine news is no longer so rigidly con- densed, and far more of it is collected, while sensational news is apt to be expanded beyond all precedent. There has been a great increase in the number of large one-cent papers and in their circulation, while simultaneously dif- ferent reading habits have appeared among the people, and there has been a distinct diminution of the authority of the press. Several ~~circumstances have combined to promote such changes in the condition and character of American newspapers : â€” (1) Paper has been enormously cheapened. Before and during the Civil War it cost large New York newspapers at times 22 cents per tb for even a poor quality. In 1864 it cost 16 cents in Febru~~ ary, and ran up a cent every month till in midsummer it touched 21 and 22 cents. As late as 1873 it was still sold at from 12 to 13 cents. As new materials were found and machinery was improved, the price slowly declined. When the manufacture from wood-pulp was made commercially successful, the profits tempted great investments of new capital; bigger mills were built, com- petition became keen, and new inventions cheapened the various processes. Thus in New York in 187,5 the average price for the year for fair ” news ” paper was 8-63 cents per lb; in 1880,6-92; in 1885, 6-16; and in 1890, 3-38. At last, about 1897, large contracts for a good average quality, delivered at the press-room, were made in New York at as low a figure as 1-6 cents per lb. Since then advances in raw materials, one or two dry seasons which curtailed the water-power, and combinations resulting from over-competition, have caused some reaction. Yet it could still be said in 1900 that prudent publishers could buy for f 1 as much paper as would have cost them $3 twenty years earlier, or f 10 about 1875. (2) Printing machinery for great newspaper offices has been trans- formed. Instead of the old cylinder presses fed by hand, with the product thenf olded and counted by hand, machines now in common use print, fold, cut, paste, and count and deliver

in bundles, ready either for the carrier or the mail, at rates of speed formerly not dreamed of. The size of the paper may be increased or diminished at will, as late news may require, within an hour of the time when it must be in the hands of its readers. Instead of cutting down other news to make room for something late and important, more pages are added, and this steadily increases the tendency to larger papers. Devices have also been found for printing the same sheet in different colours at the same rate of speed ; and in this way start- ling headlines are made more startling in red ink, or a piece of news for which special attention is desired is made so glaring that no one can help seeing it. (3) Hand- setting (for great newspapers) has been practically abol- ished. Instead of the slow gathering of single types by hand which prevailed since Gutenberg's invention, sepa- rate lines are now produced and cast by machines, capable

when pushed to their utmost capacity of doing each the work of five average compositors. Various circumstances generally prevent anything like this speed in ordinary use ; but in spite of opposition these machines now re- duce the cost of composition in well-organized offices at least to one half the former figure, while helping to ad- vance wages.

Thus between 1880 and 1900 there were reductions in the cost â€" (1) of the raw material for the manufacture of newspapers from two-thirds to three-fourths ; (2) of print- ing, at least as much ; and (3) of composition one-half, while the facilities in each department for a greater pro- duct within a given time were enormously increased. The obvious business tendency of these changes was either a reduction in price or an increase of size, or both.

Electricity became the only news-carrier. New ocean cables broke down the high rates charged at the outset. The American news appetite, growing by what it fed on, soon demanded far fuller cablegrams of European news ; and the wars in which Great Britain and the United States were involved accelerated the movement. The establish- ment of a strong telegraph company, capable of efficient competition with the one which practically controlled the inland service in 1880, likewise cheapened domestic news by telegraph and increased its volume. The companies presently recognized their interest in encouraging rival news associations, and so getting double

work for the wires, while promoting the establishment of new papers. Wild competition between news agencies was thus encour- aged (even in the cases of some already known to be bankrupt) to the extent of credits of a quarter or half a million dollars on telegraphic tolls. The rapid spread of long-distance telephone lines further contributed to this tendency to make the whole continent a whispering gallery for the press. Every great paper now has both telegraph and telephone wires run directly into its newsroom.

Photography and etching were added to the office equipment. Various ” process ” methods were found, by which the popular desire for a picture to make the news clearer could be gratified. Drawings were reproduced successfully in stereotype plates for the fastest rotary presses. The field of political caricature had heretofore belonged exclusively to the weekly papers, but the great dailies now seized upon it, and commanded the service of the cleverest caricaturists. Newspapers found a way to put the “half-tone” etching of a photograph, such as had heretofore been printed only on slow flat presses, bodily into the stereotype plate for the great quadruple and octuple presses ; and thereafter portraits and photographs of important groups on notable occasions began to appear, embodied in the text describing the occurrences, a few hours after the camera had been turned on them, in papers printed at the rate of thirty and forty thousand an hour.

News agencies multiplied and gave cheaper service. The New York Associated Press had been the chief agency for the whole country. It admitted new customers with great caution, and its refusal to admit was almost pro- hibitory, while its withdrawal of news from established papers was practically fatal. It was owned by the leading New York journals. Their disagreements led to the success of a rival, the United Press. The New York Associated Press finally dissolved, most of the New York members became connected with the United Press, and many of their Western and Southern clients organized the Associated Press of Illinois, more nearly on a mutual plan. The United Press finally failed, and most of its New York members went into the Associated Press of Illinois, which in turn was forced into plans for re- organization by decisions of Illinois courts against its rules for confining its services to its own members. One result of these successive changes has been to encourage

new papers by making it easy for them to secure a com- prehensive news service, and thus to threaten the value of the old papers. Another has been the struggle to increase the volume of the service, leading to reports of multitudes of occurrences formerly left without notice in the great hews centres, an extension of agencies into the remotest hamlets, and less scrupulous care in the consideration and preparation of the reports filed at many points for trans- mission. News syndicates for special purposes also devel- oped, as well as small news associations, sometimes with a service sufficient for the wants of many papers. The species of almost official authenticity which the public formerly attached to an Associated Press despatch is measurably dissipated ; and the dailies have at once more difficulty in sifting and deciding upon the news that comes to them, and more individual responsibility for what they print.

The great accumulation of private fortunes has also changed the newspapers. Millionaires have occasionally come to think it advantageous to own newspapers, openly or secretly, which can be conducted without reference to direct profits, for the sake primarily of political, social, or business considerations. To secure large circulations for such enterprises they have been willing to soil the paper for long periods at much below the cost of manufacture, and to spend money for news and writers more lavishly than the legitimate business of established journals would allow. Great business corporations seeking for favour- able or fearing adverse legislation sometimes make secret newspaper investments for the same purpose. Ambitious politicians, men who want newspaper favour to get into politics, or speculators who want it for private schemes, men with suddenly increased incomes who can readily spare a few thousand dollars to promote some end without much certainty of direct return on the investment, are often found ready subscribers for the scheme of any plausible young person with some newspaper experience to start a new paper or buy up and revolutionize an old one, and are not much deterred by occasionally seeing

newspaper capital thus raised disappear entirely in a receivership or a bankruptcy.

These various new conditions, affecting the newspaper press of the United States with ever-increasing force since 1885, are changing the average character of the papers and their effect upon their readers. A craze for great circulation obtains â€” circulation among intelligent and moral classes, if convenient, but at any rate a great circulation, no matter among what classes â€” as the only evidence of success and the only way to make the sale of a newspaper below cost ultimately a source of profit. A disposition to lower the character in order to catch the largest audience naturally follows. Criminal news is reported more fully than formerly, with more piquant details. Competitors outdo each other in the effort to treat all news with unprecedented sensationalism. The lowest possible price is regarded as essential to the largest possible circulation, and so a favourite price even for large newspapers is one cent to the public, and consequently only half a cent to the publishers, whose business is practically all at wholesale with dealers and news com- panies. The feeling that the most must be given for the money prompts also the great increase in size, only made possible by the reductions in paper, composition, press- work, &c., already noted. Yet mere quantity and mere sensation after a time palled on the jaded appetite, and the spice of intense personality became necessary. As most people like to see their names in print, and can bear criticism of their neighbours with composure, these two chords of hiiman nature were played upon incessantly. The appetite thus created soon craved yet greater supplies, so that the average American publisher is now right when he pleads that in practically taking the roof off the house

of everybody of any note, and filling his paper with inane ” social ” or other mention of people of no note, he does not even yet satisfy the interest in personalities which possesses large classes of the community.

The habits of readers have also undergone great changes. In the villages and smaller towns few took more than one daily paper a generation ago, and many were content with weeklies. Even in large cities the average well-to-do householder was apt to be satisfied with one daily, or at the most one morning and one evening paper. Now few content themselves with less than

one of each at the home, and another (preferably of different politics) on the street car or at the office. Orders from prosperous New Yorkers to serve six or seven dailies are so common as to attract no notice ; even the children and the servants have their favourite journals provided. It would not be exact to say that the influence of the press at large has declined in proportion as its circulation has increased and people haVe acquired the habit of reading both sides. When the papers show reasonable agreement on any new question, they still carry the community with them almost unanimously. The

Table I. â€” Newspapers and Periodicals in the United States â€” Census of 1900, with per cent, of Increase.

Number of Publications.

Per cent, of Increase, |

Periods of Issue.

1880.

1890.

1900.

1880-1890.

1890-1900.

Daily .

971

1,610

2,226

. 65-8

38-3

Weekly .

8,633

10,814

12,979

25-3

20-0

Semi-weekly

133

194

637

45-9

228-3

Tri- weekly .

73

34

62

53-41

82-4

Monthly

1,167

1,734

1,817

48-6

4-8

Quarterly .

116

225

237

94-0

5-3

All other . Total

221

290

268

31-2

7-6

11,314

14,901

18,226

31-7

22-3

Table II. â€” Average reported Circulation per Issue,

1880-1900.

Averagre

Circulation per Issue. |

1880.

1890.

1900.

All classes

3,122

4,640

6,271

Daily

4,137

5,209

6,784

“Weekly .

2,113

2,678

3,071

Semi-weekly

2,136

2,896

4,447

Tri-weekly

1,001

1,473

3,687

Monthly .

7,834

11,.S17

21,750

Quarterly .

. 16,505

36,109

47,331

All other classe

s . 6,474

11,851

20,695

most corrupt and most powerful combination cannot long stand, even yet, against a united press. But when papers differ on any great question, people give less serious thoug:ht to what any of them say, and often less to the question itself. In the multitude of contradictory voices one neutralizes another, and the reader thinks of something else. Meanwhile the influence of the press, as measured by the outward appearance of actual subservience to it, has been enhanced, though this is accompanied by a latent distrust, which is becoming general, and by a dislike, often moreopenly expressed than formerly. Thelibellaws, unhappily, are resorted to less by people who have charac- ter to protect than by those who are tempted by lawyers to speculate on inadvertent errors. The possibility of repressive measures, social or legal, for false news and unwarranted personality is sometimes discussed, but not often seriously approached. It would -not be just to omit saying that, while these changes have been increasingly manifest in American newspapers, there has been marked improvement in other directions. Though their flippancy

1 Decrease.

AMERICAN]

NEWSPAPEKS

197

and deplorable addiction to the use and invention of slang continue, they are more generally well written and often more attractively arranged. They enlist large numbers of

young college-bred men, who thus find immediate income and no delay for special training, as in law or medicine. They glean news with amazing thoroughness ; cover the

Table III. –

- Daily Papers in

Chief American Cities, 1880-1900.

Cities.

Year.

Number of Daily Papers pubiislied.

Aggregate Circulation

Population of Cities.

Number of

Inhabitants

to each

Kaiik of Cities according to In- creasing Number of Inhabitants

per Issue.

Copy per

to each Copy per Issue.

Total.

Morning-.

Evening:.

Issue.

Greater New York

1900

58

29

29

2,732,089

3,4.37,202

1-26

(-1880

29

20

9

765,843

1,206,209

1-58

“2

New York, N.Y. .

1890

50

34

16

1,698,553

1,515,301

0-89

1

(1900

47

28

19

2;632,213

2,0.50,600

0-78

5

(â€¢1880

18

10

8

220,577

50.3,185

2-28

9

Chicago, 111

i 1890

27

14

13

644,000

1,099,850

1-71

11

il900

37

16

21

1,099,555

1,698,575

1-54

15

fl880

24

13

11

375,274

847,170

2-26

8

Philadelphia, Pa. .

1890

24

13

11

804,008

1,046,964

1-30

6

(.1900

21

10

11

1,008,752

1,293,697

1-28

9

(-1880

4

4

48,537

568,663

11-67

22

Brooklyn, N.Y. .

n890

5

5

82,448

806,.343

9-78

27

(1900 ,

6

i

5

95,476

1,166,582

12-22

25

(-1880

9

8

1

99,364

350,518

3-52

14

St Louis, Mo.

\ 1890

15

9

6

2.38,525

451,770

1-89

13

(l900

l.S

7

6

373,030

575,238

1-54

15

f 1880

11

6

5

221,315

362,839

1-64

4

Boston, Mass.

J 1890

12

5

7

466,471

448,477

0-96

2

(l900

â– 16

8

8

761,039

560,892

0-74

3

(1880

9

6

3

128,048

332,313

2-58

10

Baltimore, Md.

i 1890

7

6

1

1.33,510

434,439

3-25

22

(l900

9

6

3

232,2.52

508,957

2-19

19

r 1880

21

11

10

143,232

233,959

1-63

3

San Francisco, Cal.

\ 1890

21

14

7

286,912

298,997

1-04

5

‘

(1900

23

15

8

304,185

342,782

1-13

6

fl880

8

2

6

48,730

160,146

3-29

12

Cleveland, Ohio .

\ 1890

13

4

9

133,800

261,3.53

1-95

14

(l900

11

3

8

258,473

381,768

1-48

13

(1880

7

2

5

26,100

155,134

5-94

19

Buffalo, N.Y.

1890

10

3

7

120,800

255,664

2-12

17

(l900

12

3

9

217,989

352,387

1-62

16

(1880

12

8

4

117,549

255,139

2-17

7

Cincinnati, Ohio .

1890

14

10

4

213,-500

296,908

1-39

7

(l900

13

7

6

516,708

325,902

0-63

1

(1880

9

6

3

111,001

156,389

1-41

1

Pittsburg, Pa. . . .

1890

10

7

3

232,462

2.38,617

1-03

4

(l900

11

7

4

421,741

321,616

0-76

4

(1880

10

6

4

37,-565

216,090

5-76

18

New Orleans, La. .

\ 1890

9

4

5

73,900

242,039

3-28

23

(l900

9

5

4

96,.S60

287,104

2-98

22

(1880

6

3

3

41,533

116,340

2-80

11

Detroit, Mich.

â€¢ 1890

8

2

6

134,388

205,876

1-53

8

1900

8

3

5

207,110

285,704

1-38

10

(1880

7

4

3

24,300

115,587

4-76

16

Milwaukee, Wis. .

i 1890

10

5

5

63,200

204,468

3-24

21

(1900

11

4

7

132,805

285,815

2-15

18

(1880

5

3

2

34,500

147,293

4-27

15

Washington, D.C.

\ 1890

4

2

2

62,651

2.30,392

3-68

25

(1900

8

3

5

100,848

278,718

2-76

21

(1880

6

.4

,2

18,.300

136,508

7-46

20

Newark, N.J.

- 1890

6

3

3

50,600

181,830

3-59

24

1900

3

1

2

71,832

246,070

3-43

23

(1880

2

2

11,176

120,722

10-80

21

Jersey City, N.J. .

I 1890

4

“i

3

28,300

166,003

5-76

26

(1900

2

2

19,580

206,433

10-54

24

(1880

5

“4

1

22,215

123,758

5-57

17

Louisville, Ky.

1890

5

3

2

95,100

161,129

1-69

10

(1900

8

5

3

136,950

204,731

1-49

14

(1880

...

Minneapolis, Minn.

\ 1890

“9

“4

“5

92^323

164,‘738

i-78

12

(1900

9

6

3

137,906

202,718

1-47

12

(1880

5

2

3

29,900

104,857

3-51

13

Providence, K.L .

- 1890

3

1

2

52,000

132,146

2-54

20

1900

3

1

2

76,000

175,597

2-31

20

ri880

4

3

1

35,587

75,056

2-11

6

Indianapolis, Ind.

- 1890

7

3

4

64,213

105,436

1-64

9

1900

9

4

5

135,698

169,164

1-25

7

world with their correspondents ; cultivate the fields of art, literature, and science ; and present accounts of discoveries, letters of adventure, details of political, business, educa- tional, reformatory, charitable, and religious movements,

especially in the Sunday issues, in a profusion, variety, and popular attractiveness never before approached. There has been an extraordinary increase in the attention given to the interests of women, and also in the space surrendered,

even in the soberest of journals, to sport. All kinds of special interests find constant and copious notice : cycling, chess, bridge, motoring, spelling reform, amateur photo- graphy, &c. In fact, the great American daily has become a good deal like the great ” department store ” â€” a sort of universal provider.

Table IV. â€” Languages of Newspapers and Periodicals â€” Censuses of 1880 and 1900.

No. of Papers published in Each Tear	1S^U.	1900.
English	10,515	17,194

German

641

613

German and English .

0

20

German and Hebrew .

0

3

Hebrew

0

13

Scandinavian

49

115

Spanish

26

39

French

41

27

French and English .

0

4

Lithuanian .

0

9

Dutch

9

12

Bohemian .

13

28

Polish

2

33

Italian

4

35

Welsh

5

0

In 1880 the number of newspapers and periodicals printed in foreign languages in the United States was 799, and in 1900, 1032. Newspapers and periodicals were printed in the United States in fifteen different languages in 1880, in thirty in 1890, and in twenty-flve in 1900. In 1900 the newspapers and periodicals reported 122,183 employ^ receiving $77,348,842 in wages. The total cost of material used in publication of newspapers and periodicals was reported at $50,214,904. The amounts received from advertising and subscriptions and sales were reported at .$175,789,610, of which the advertising was a larger part than the subscriptions and sales.

The statistics of circulation, capital invested, profit, and the like are notoriously untrustworthy. The Government adhered to its effort to collect them in 1890, and such results of that census as seem valuable are given together â– with those of the census of 1900. In spite of the universal newspaper-reading habit in America, none of its papers yet attains regularly the vast circulations attributed to two or three papers in London and Paris. The reasons are obvious. Each of these is a national capital, situated in the midst of a dense population of between thirty and forty millions, of whom from one-half to three-fourths can be readily reached by the London or Paris paper during daylight on the day of pub- lication. In the greatest American cities the population to be reached within the same time is smaller ; the papers lack the authority of the capital, and are often met, two or three hours after issue, by the papers from other large cities with the same general news service. Thus a New Vork paper meets the papers of Philadelphia in an hour and a half, and those of Boston in two and a half, while Chicago and St Louis eat into each other’s field in the same way. But it is probably true that two or three morning and evening papers in New York pass ordinarily above 200,000 and at times above 300,000 with the com- bined circulatioai of their two editions ; and that the best of the high-priced papers range from 20,000 to 80,000. It is not believed that in the case of the larger morning papers the publication at one cent has proved generally and per- manently profitable. Those in Chicago, after trying it for

several years, finally agreed amongthemselves and doubled the price. One-cent evening newspapers are produced more cheaply and fare better.

The total number of newspapers and periodicals pub- lished in the United States in 1900 was, according to the census returns, 21,272. Of these, however, 3046, or 14 per cent., made no report to the Census Bureau, and as these were the least important, they have been omitted from the tables given (I. to IV.). (w. it.)

France.

The number of newspapers, as distinguished from periodicals, published in France during 1900 was in round numbers 2400. Of these, about 240 appeared in Paris and 2160 in 540 provincial towns. The increase in the Paris newspapers from 160 in 1890 to 240 in 1900 may be taken to fairly represent the general increase through- out the country for the same period ; and as there were about 120 in 1880, it appears that the newspapers of Paris, and similarly of France, have doubled their number between 1880 and 1900.

Of the 146 dailies published in 1900, 81 were political. But in order to have an accurate idea of the balance of parties as represented by the Parisian political ^^^^

press, to the 81 dailies must be added 83 p^ace. periodicals, and it is then found that, of the 146 political organs, 68 are IModerate Eepublican, 30 Eadieal and Socialist, 16 Conservative, 8 Nationalist or anti-Semitic, and 42 independent or nondescript. In the provinces the proportion of Radical to Moderate papers is smaller by one-half, for whereas the numbers in Paris are respectively 30 and 68, in the provinces they stand in the proportion of 223 to 880.

In the following table is shown the proportion of dailies to weeklies in Paris and four of the largest provincial towns : â€”

ISDO.

1900. 1

Population.

Dailies.

Weeklies, A:c.

Population.

Dailies.

Weeklies, ,.>cc.

Paris

Bordeaux . Lyons Marseilles . Toulouse .

2,250,000 221,000 377,000 360,000 140,000

92 6 7 5 4

68

4 4 3 1

2,500,000 257,000 466,000 442,000 150,000

146

6

10

7 5

94 8 5 7 2

The history of the French press during the last twenty years of the 19th century follows very closely that of the country itself, Boulangist and anti-Boulangist, Dreyfusist or anti-Dreyfusist, Republican or Nationalist ; finally

it became either Moderate Republican or Radical-Socialist with a sprinkling of Nationalist organs and a small minority of Royalist and Bonapartist sheets.

At the head of the Moderate Republican organs are Le Temps and Le Journal des Ddbats among the evening pai)ers, and Le Figaro, Le Journal, Le Siide, Le Petit Parisien, and Le Petit Journal among the morning dailies. Le Temps and Le Journal des Debats have been edited respectively by il. Adrien Hebrard and 1\I. E. de Naleche. Le Figaro was until 1901 under the editorship of jNI. F. de Rodaj's, and the brilliant articles of jM. J. Cornelv were one of the features of the paper ; but a dispute among the proprietors in 1901 resulted in the dismissal of M. Comely and the retirement of IsL de Rodays.. M. Jean Dupuy (a member of the AValdeck-Rousseau Government) is the proprietor and editor of Le Petit Parisien, a popular organ rivalling Le Petit Journal ; the circulation of the latter, however, has now reached over one million and a quarter copies daily.

Le Matin and L' Eclair, among the Moderate Republican organs, give less attention to the discussion of political questions from the party point of view than to the collec- tion of news, and they have been followed by the Echo de Paris. Le Matin, which dates from 1884, has from its origin been essentially what is called in France a. Journal d'iiforniutio)i!i, and publishes every morning a mass of telegraphic news from all countries. T>y an arrangement with the London Times, it is in a position to give every day a translation of most of the telegrams published in the latter newspaper. But Le ^Matin contains also very able articles on current topics signed by M. Harduiu and

M. Henri des Houx and a number of distinguished con- tributors.

In April 1901 the proprietorship of Le Si&de was changed, in consequence of the lack of support given by Parisian readers to that journal as edited by

M. Yves Guyot (formerly Minister of Public Works). The latter â– was a staunch free-trader, a courageous defender of Captain Dreyfus, and an eloquent advocate of a good understanding between France and England ; he emphatically endorsed the British policy in South Africa, and tried to explain it to his countrymen. The paper was, however, bought in by a number of friends of M. Yves Guyot, who remained as editor.

The greatest opponent of M. Yves Guyot from the economic point of view has been M. Jules Meline, also a former minister, whose paper. La B&publique, is the recog- nized organ of Protectionism.

The Radical and Socialist ideas which in latter years have made such progress in France are very ably advocated by several newspapers whose influence has been steadily growing. Such are L'Aurore, edited by M. Vaughan, La Lanterne, to which have contributed, besides M. Viviani, who is the editor, men like M. Millerand and M. Baudin (both members of the Waldeck-Eousseau Cabinet), M. Camille Pelletan and M. Eouanet.

It is difficult to assign a proper place to L' Intransigiant which really belongs neither to a well-defined party nor even to a group. It may be said to be simply the organ of M. Henri Eochefort, whose persoHal influence over a large number of readers is still great. Equally difficult is it to speak of M. Clemenceau's organ, Le Bloc, as a news- paper, and yet on account of the writer's ability and political influence, Le Bloc, which belongs to that class of one-man political periodical sheets of which M. Eochef ort's La Lanterne is the best-known type, cannot be ignored. In this periodical M. Clemenceau advocates the practi- cal application of all of the revolutionary republican principles, pure and unadulterated, which form a whole (bloc), no part of which can or ought to be sacrificed to temporary political necessities.

As an intermediate link between the Eepublican organs of all shades and the various Monarchist newspapers, comes the so-called Nationalist press, an offshoot of or successor to the Boulangist press of the preceding decade. As were the Boulangists, so are the Nationalists, a sort of syndicat des micontents. Their chief organs are La Patrie, edited by M. Millevoye, and La Cocarde, and these papers represent the views of those who have vague

hankerings after a different rigime and a decided hostility towards the republican form of govern- ment.

There has been a considerable diminution of influence in the Monarchist press. Le Soleil, however, has a large circle of readers among the Conservative bourgeoisie with Orleanist leanings, and still keeps up the tradition left to it by the late M. iSdouard Herve. Le Gaulois remains a Eoyalist paper of somewhat doubtful tendencies, since the editor, M. Arthur Meyer, seems to have incurred the dis- pleasure of the Pretender whose cause he defended. Of the old Legitimist press there remains the old Gazette de France, which was founded in 1631 and has still a diminishing band of faithful readers whose fidelity to their principles compels respect.

It is impossible to close this rapid review of the existing French newspapers without mentioning the organ of the religious (Eoman Catholic) associations ih France, namely. La Croix, founded in 1880. The name of the editor (now M. Feron-Vrau) matters little ; what is important is the fact that La Croix represents the views of the French religious associations, and discusses all questions from the point of view of Catholic interests. La Croix is published

in Paris, but there are in the provinces one hundred and four local weekly supplements to the Paris edition, each one taking its name from the parent journal and adding to it the name of the department or locality in which it is printed, such as La Croix de VAllier, La Croix de Lyon. The circulation of La Croix is supposed to be about 200,000 copies daily. It is needless to add that the tendencies of this journal are anti-Eepublicau.

To whatever parties the French papers belong, most of them have in recent years taken greater interest in foreign matters, and have much improved their organization for collecting news. Some of them, in fact, were almost exclusively news-sheets as distinguished from ordinary newspapers, and the journal d’informations â€” Le Matin or L’l&clair, for instance â€” took its place beside the journal properly so called more perhaps as a rival than as a com- plement. The natural result followed, and the ordiuary newspapers took steps to provide their readers with news as well as with leading articles, cui’rent and literary topics, society gossip, dramatic criticism, and law reports. The most remai-kable as well as perhaps the earliest attempt to

enlarge the scope of Parisian newspapers was made in 1893 by the late M. Georges Patinot, one of the ablest French editors, who was editing the Journal des Debats. Instead of one edition, that newspaper published two entirely distinct editions, a morning one and an evening one. After some time the plucky attempt had to be given up, and the Journal des Debats became an evening paper. Before that an interesting event had taken place in 1889, when that renowned organ celebrated its hundredth anni- versary by the publication of a most valuable record of its distinguished career in the shape of a splendid volume, Le Litre du Centenaire da Journal des Debats. The bold experiment made by the Journal des Ddbats led the other newspapers to find a happy mean between a four-page paper published twice a day and an eight-page paper on the pattern of English newspapers, and the result was that now most great daily papers in Paris have six pages : the Figaro gave the lead, and the others followed suit.

Another fact to be noted is that as French newspapers increased in size they reduced their price, and the time is fast approaching when all daily political papers will be sold at 5 centimes (|d.). Already most six-page newspapers, with the exception of ie Figaro, are sold at 6 centimes, and the price of 16 centimes, which used to be the rule, is now the exception. At the present time 60 Paris papers (daily and weekly) are sold at 6 centimes, and 51 at 10 centimes, whilst only 11 cost 15 centimes. In 1880 only 23 were 6-centime papers and 24 were 10-centime papers.

At one time the American style’ of journalism was in vogue in Paris, and ” interviews ” were frequent ; they are much more scarce now, and the general tendency of Parisian editors is towards the English rather than the American or sensational methods of journalism. Most of the important Parisian newspapers now have special cor- respondents in the great capitals of Europe, London, Berlin, St Petersburg, Vienna, and Eome, and print every day telegraphic reports from their representatives ; and if they do not make use of the telegraph to the same extent as their English and American confreres, at least their use of it has become regular and of everyday occurrence. This in itself is a great and remarkable change, and nothing perhaps has been so striking since 1890 as the demand of the French public for foreign and colonial news, or the readiness of the papers to supply it by

means of special representatives who make them independent of the news agencies.

In home matters the French press has made greater progress still in the rapid and accurate collection of news, and in this respect the provincial press has shown more

enterprise and more ability than that of Paris. Its de- velopment has been remarkable, for whereas in 1880 the inhabitants of the departments had to await the arrival of the Parisian papers for their news, they now have the advantage of being supplied every morning with local newspapers inferior to none of the best organs of Paris. The provincial press is extremely well-informed, its news is accurate, and its leading articles are well thought out and well written. Among the best provin- cial papers may be mentioned La Gironde and La Petite Gironde of Bordeaux, La DixMhe of Toulouse (215,000), Le Lyon Repuhlicain, L'Eclio du Nord of Lille, Le Jour- nal de Rouen, all of which have a staff in Paris engaged in collecting news, reporting parliamentary proceedings and law cases, the whole of which is telegraphed or telephoned during the night and published early the next morning in their respective localities. Although, in addition to their regular contributors, these papers frequently engage leading Parisian journalists or literary men to give them special articles, they are nevertheless perfectly independent of purely Parisian opinion or even bias, and the decentralization of the French provincial press may be said to be complete.

The influence of the press of the departments is great, for the newspapers of the large towns circulate not only in the city in which they are printed but throughout the region of which it is the centre. Thus the Dipiche of Toulouse, with its twelve editions daily, is read in the whole of the departments extending from the Lot to the Pyrenees, whilst the Fetite Gironde is found in all south- western France.

It may be said here, however, that in the provinces, as in Paris, there prevails an idea that the press is becoming too powerful, and there is a growing feeling against its omnipotence, as M. Avenel says in his book on the French press.^ The power of the newspaper in France differs from that of the English newspaper, in that it seelns to act more on the Government and the Parliament than on public opinion ; and it is needless to insist on the danger of such a state of things, which gives undue power and prominence to individuals and groups of individuals, and may enable them to prevail against a real current of opinion. It is against this system that there exists the feeling to which M. Avenel refers. The French news- papers have taken upon themselves, in many cases, functions which belong more properly to the legislative or to the judicial power than to the press, and the result has not always been successful. The cause of this is that too many men of talent with political ambition look upon journalism as ” leading to everything, provided one gets out of it,” and use it alternately as an antechamber of Parliament or of the Cabinet, and a lounge during their parliamentary or ministerial eclipses. The remedy will be found ultimately in making the press in France what it once was â€” a profession which men will be proud to enter, and in which it will be their ambition to remain and to make their mark.

Since 1880 the French press has, undergone marked changes which can be summed up in a few words. It has become less exclusive, and has given greater and more intelligent, if at times prejudiced, attention to what goes on beyond the frontiers of France ; it has developed its organization for the collection of information, and, without in any way renouncing its literary traditions, it has given to political and current topics of general interest, and to “news” properly so called, a more con- spicuous and important place in its columns than before. As a consequence it has been found necessary to increase the size of newspapers and to reduce their price. All

1 La Fresse franfaise au vingtUme siicle, par Henri Avenel.

1901.

Paris,

these changes are in the right direction, and will probably lead to more important ones in the near future, the ten- dencies of the French press being now more progressive than at any time during th^ 19th century. (p. v*.)

Germany.

In their main characteristics German newspapers are similar to those of Great Britain, but do not approach them in vastness of circulation There are 3278 news- papers altogether in the empire. Berlin in 1890, with a population of 1,300,000, had 18 dailies and 36 weeklies, &c., while in 1900, with 1,660,000 inhabitants, it was credited with 45 dailies and 48 weeklies, &c. Among its leading papers are the VossiscJie Zeitung, which still retains its position and character ; the National Zeitung, the organ of the Liberal party ; the Deutsche Allgemeine Zeitung, the official organ, chiefly inspired by the Foreign Office ; the Berliner Tageblatt, progressist ; and Germania, the organ of the Catholic centre.

For the provinces the following table will show the movement during the last decade of the 19th century : â€”

1890.

1900.

Population.

Dailies.

Weeklies.

Population.

Bailies.

Weeklies, &c.

Leipzig . Munich . Hamburg . Stuttgart . Strasburg .

170,000

200,000

470,000

126,000.

110,000*

3 9 6 3 3

10 4 4 8

12

220,000 292,000 519,000 126,000 124,000

8

12

11

8

6

9 11 11

10 6

At the beginning of the 20th century the position and influence of the German press may be described as pass- ing through a period of change. There can be no doubt that the Germans have become a newspaper-reading people. Indeed, with the remarkable growth of the commercial spirit in Germany there has simultaneously been a change in the intellectual attitude and habits of the mass of the nation. The German of what is cwn- monly called ” the great periOjd ” of recent German his- tory, which had its high-water marks in the years 1866 and 1870, derived his knowledge of his own and other countries to a very great extent from the more or less intelligent

study of books, pamphlets, and magazines. The busy German of the opening years of the 20th cen- tury is almost as much the slave of his newspaper as the average American. He takes the information which it daily places before him as authoritative, not because he has any general faith in the accuracy of German journalism, but because he has no time to investigate the truth of what he reads. In the domains both of home and of foreign politics the result is often a chaos of crude opinions and impulses, the strata of which are only differentiated by certain permanent tendencies of German political thought based upon tradition, class feeling, material interests, or distinctions of religious creed. In these circumstances it is still possible for the Government, as in the days of Prince Bismarck and Dr Moritz Busch, to bring its superior knowledge to bear upon the anarchy of public sentiment through the medium of the inspired press. It is true that this opera- tion must now be performed with greater delicacy and skilL The press has begun to feel its power, though it is still to some extent incapable of wielding it. It is at least able to drive a bargain with those who would officially control it, and it is conscious in its relations with the authorities that the advantage is no longer exclusively on the side of the latter. It would be instructive to compare, with the aid of Dr Busch's " Secret Pages" of the history of Prince Bismarck, the methods by which the first Chancellor used to create and control a movement of public opinion with the devices by which, for instance, count von.

Germany]

Billow and his subordinates have endeavoured to manage the press of a later day. The journalists who placed themselves at the disposal of Prince Bismarck were mostly treated as his menials ; as he himself said, " Decent people do not write for me." Count von Billow's methods, and to a certain extent those of his predecessor. Prince Hohenlohe, might be said to move on somewhat different lines. These methods might be characterized as the psychological treatment of the individual journalist, the endeavour to appeal to his personal vanity or to his legitimate ambition, and only in a minor degree to his fear of the dosnier, the public prosecutor, and the official

boycott. There has also been a further development of Prince Bismarck's system of acknowledging the existence of political and social movements the origin of which is wholly or partially independent. As in Bismarck's time, the tendencies of these movements are carefully observed, and they are turned to account where they seem capable of subserving the main objects of State policy. Thus the pro-Boer and agrarian movements were both employed in support of German foreign and colonial policy, and of an elaborate scheme of naval construction ; while the growth of the commercial spirit on the one hand and the awakening of the lower middle classes on the other have been pressed into the service of Welt-politik and of its auxiliary â€" a system of protective tariffs. It must have required no small skill to bring into line and to hold together the various classes and interests which are from time to time arrayed in the press in support of German foreign policy. The organs of the Government in the press are the sheep-dogs which hold the flock together.

The German journals of which English newspapers hear most belong with few exceptions to the daily press of Berlin. There are, however, one or two provincial or non-Prussian newspapers which from time to time enjoy more careful inspiration from the Government offices than any of their Berlin contemporaries. There is, for example, the Cologne Gazette (Kolnische Zeitung), of which Prince Bismarck once said that it was " worth an army corps on the Rhine." It is difficult to trace all the channels by which information is conveyed to an organ of this kind, but there have undoubtedly been times when leading articles and entre-filets in the Rhenish organ were virtually or actually written in the German Foreign Office. It does not by any means follow that, because an article or a semi-official announcement is inspired or dictated from official quarters, it precisely represents the views of the Government or the facts of the situation. It is often in the interest of German policy that a hypothetical case should be stated or an alternative course of action suggested, in order that public opinion and even the governments of the different German states should be prepared for all eventualities, or should be influenced in favour of the ultimate decisions of the central authority by being led to contrast them with other possible courses of action. Indeed, the methods of the institution which has been called the " Press Bureau," but which in the realm of foreign policy at least represents no concrete organization, are so numerous

and varied that it is hopeless for any one except the most practised observer to trace their manifestations. The advantage of a semi-official press, if it could be manipulated with unvarying success, is that it can easily be disavowed when the suggestions, overtures, or menaces of which it has been the exponent have served their turn or have become inexpedient. Thus during the blockade of Manila the Cologne Gazette gave all the prominence of its first column and of leaded type to an article taken from the Marine Politische Korrespondenz, which practically warned the United States of the intention of Germany to have a share in the Pacific possessions of Spain if these should eventually change hands. Some ten days later the authority of this menace was explicitly disavowed by the North, German Gazette, which announced that the Marine Politische Korrespondenz had never possessed a semi- official character. The Cologne Gazette continues in the west of Germany to serve the German Government much as it did in the time of Prince Bismarck, although for prudential reasons its in- spiration is on the whole more intermittent than it was in the days of the first Chancellor. The Hamburgischer Correspondent, now the leading Hamburg journal, plays a minor role of the same nature in the chief Hanseatic port, while the Hamburger Nachrichten, celebrated especially during the exile of Prince Bismarck and the closing years of his life at Friedrichsruh as the receptacle of in- discreet revelations and violent attacks upon his successors, has

almost lost all significance except as a local organ of violent Anglophobia. The Allgemeine Zeitung of Munich, once famous throughout Europe as the Augsburger Allgemeine Zeitung before its transference to the Bavarian capital, has become in the hands of new proprietors practically an organ of the imperial Chancellor. In Prince Bismarck's days the press bureau of the Pnissian Ministry of the Interior, and a similar organization in the Imperial Home Office, used to furnish hundreds of petty local newspapers known as Kreis-hlatter with whole articles gratis, so that the policy of the Government might be advocated in every nook and corner of the country. The numerous, journals in which these communica- tions used to appear simultaneously and in an identical form were the Government organs to which the Radical and Socialist opposi- tion more particularly applied the term " Reptile Press." Latterly this i^ractice of wholesale inspiration appears to have been abandoned, but there are still many channels, public

and private, through which almost every department of the Government can communicate information and guidance to newspapers in all parts of Germany. The Prussian Ministry of the Interior distributes to all and sundry a news-letter known as the Berliner Korrespondenz, which professes only to give statistics and information and to correct erroneous statements ; but it also frequently contains articles which advocate some proposal of the Government or combat the arguments of its opponents. The Sud-Deutsche Beichs- Korrespondenz is an institution of a similar character, and in 1902 served as an exponent of the policy and tactics of the imperial Chancellor, count von Billow.

The number of “news-letters” â€” which seems the only English term by which the German word Korrespondenz can be approxi- mately rendered â€” is very great. Almost every one of the political parties has its Korrespondenz, which, it ought to be noted, supplies views rather than news. These circular letters deal, in fact, with the policy of the party with which they are associated, although they occasionally also embody information which the party leaders in the Reichstag or in the Prussian Diet have received from representatives of the Government for their own guidance. They form the means of holding the parties together, and of inspiring them with common aims, as they are reproduced throughout the country by all the party organs.

It is in the press of Berlin that the greatest changes have taken place in recent years. During the regime of Prince Bismarck the North German Gazette, and occasionally the Post, used to keep Europe in a state of nervous tension by fulminant communiques which the great Chancellor himself often dictated, or by what he used to call “jets of cold water” {Kaltwasserstraht), which were mostly directed against France or Russia.

So far as France and Russia are concerned, a much more pacific tone prevailed in Berlin after the conclusion of the Dual Alliance, and it was upon England that the press mainly concentrated its attacks. The North German Gazette, which was originally estab- lished by a private individual, in order ” to place a blank sheet of paper at the disposal of Prince Bismarck,” has become, on the whole, a mere record of home news and a summary of foreign in- telligence bearing the semi-official stamp of Wolfi’s

Telegraph Agency. It had doubtless been found that the constant employment of an organ so distinctly official as the Norddeutsche Allgemeine as a medium of expression for the views of the Government was apt to lead to Indiscretions which committed the authorities too deeply. Indeed, immediately before Prince Bismarck's fall he had actually employed this journal in order to attack the labour policy of the Emperor. At the present day communiques dealing with foreign affairs still appear at rare intervals in the columns of the North German Gazette, but they are mostly characterized by a vagueness and awkwardness of style which is in striking contrast to the force and point of Prince Bismarck's poleiriics. The Imperial Gazette {Beichsanzeiger), corresponding to the London (razeJie,' is purely a record of official intelligence, though on rare occasions it publishes in the section marked Nicht Amtlich (non-official), some dementi, some statement of policy, or some official document â€" a proceeding which always requires the express sanction of the Emperor.

The journals which in 1880 were most widely read in Berlin, and which were best known abroad as the exponents of Berlin opinion, were the Liberal or Radical Vossische Zeitung and Berliner Tageblatt, and the National Liberal National Zeitung. These journals still survived in 1902 in a more or less flourishing condition, and the Vossische Zeitung, the oldest of all the Berlin newspapers, was still written with a degree of literary ability which justified its real title, Koniglich priviligierte Berlinische Zeitung fur Staats- und Gelehrten Sachen. The National Zeitung is also ably written, and represents those vestiges of old German Liberalism which still survive in the National Liberal party. The Kreuz Zeitung continues to represent the "small but mighty party " of the reactionary Conservatives and Agrarians in the State, and of the orthodox (Lutheran) Protestants in the Church. In its survey of foreign affairs it occasionally con- tains an important reflection of the views of foreign policy which

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have tieeii acquired by leading Conservatives in their intercourse v^ith members of the Government. It is the favourite journal of officers in the army, of the Conservative gentry (Junker), as well as the medium through which people of social standing prefer to announce births, marriages, and deaths. The Post continues to be subsidized by a small number of industrial and rural magnates in the interests of the Beichspartei, or Free Conservative party, which for the most part subordinates its views to those of the Government. In matters of foreign policy this journal reflects the views entertained in oificial quarters. The Berliner Neueste Nachrichten, like the Post, is a consistent advocate of the develop- ment of the German navy and of a vigorous Welt-politilc. It enjoys an intermittent official inspiration. The Boersen Zeitung and the Borsen- Courier are organs of the Berlin Stock Exchange ; the one is of a National Liberal colour, and the other expresses the views of the Moderate Radicals (Freisinnir/e Vereingung') and of op- ponents of extreme protection. The i'ijrwans is the central organ of the German Social-Democrats, who have established a con- siderable number of other journals throughout Germany. The clericals or Centre party are represented by the Germania, the importance of which is not, however, so great as that of the other leading organ of the Roman Catholic " governing party," the Kolnische Volks-zeitung. The Deutsche Tageszeituiig has recently made itself a name by its advocacy of the agrarian movement, while the Freisinnige Zeitung (founded, and to a great extent edited by the Radical leader Herr Eugen Richter) gives a very full yet concise summary of the news of the day, upon which it comments in luminous editorial articles and notes, written from the Radical point of view. Among the provincial papers the Frankfurter Zeitung (Radical) is distinguished by the excellence of its news, especially on commercial subjects. The Scklesische Zeitung, a leading Conservative organ, has continued to appear in Breslau since the days of Frederick the Great. The Magdeburger Zeitung and the Hannoversche Courier give an independent or National Liberal support to the Government. The Weser Zeitung, published at Bremen, is an exponent of the Liberalism of the commercial classes, while the Strasburger Post is one of the journals which enjoy Government inspiration, and helps to maintain die Wacht am Bhein. A considerable number of journals, published in the Polish language, advocate the Polish cause in the eastern provinces of Prussia.

Great success has attended a new departure in German journalism, represented by newspapers like the Berlin Lokal-Anzeiger, which describe themselves as non-political. Their political philosophy is that of Dr Pangloss, for they generally find that all is done for the best by the best of governments. Tlie Lokal-Anzeiger has a circu- lation in Germany which is comparable with that of the Petit Journal in France, while its news is superior in quantity and in freshness to that of any of its German contemporaries. It has be- come a power with which the Government has to reckon, since it is read “in the palace and in the hovel.” It is often asserted that journals of this kind are read for their news, and have no political influence. It has already been pointed out, however, that the average modern German is too busy to correct by study and reflec- tion the impressions which he derives from the hurried perusal of bis newspaper. The Lokal-Anzeiger undoubtedly exercises a very marked influence upon public opinion in Berlin, and there is plenty of evidence that both in Government and in Court circles it has frequently been used inorder to shape the views of its readers.

The external form and arrangement of German newspapers is often puzzling at first sight to an English reader. There is an absence of the striking headlines, which in English journals direct attention to news of importance, and which in America almost swamp the text. The outside page generally contains the editorial articles and the news of most importance, while the intelligence received immediately before going to press is placed in the last column of the last sheet. The bulk of the paper can apparently be increased indefinitely in accordance with the supply of news or literary matter, or with the number of advertise- ments. The Vossische Zeitung on a Sunday morning assumes, with its numerous supplementary sheets, the dimensions of a thick Blue-book. The quantity of extraneous matter, such as articles on literary, social, and technical subjects, is enormous, and even the most serious political journals invariably publish a novel in serial form, as well as numerous novelettes and sketches. The local news i;i Berlin and other large cities is written with the minuteness and the familiarity of style of a village chronicle, and gives the impression that every one is occupied in observing the doings of his neighbour. The signed article is very much in vogue, and most writers and salaried correspondents have at least a cypher or initial by which they are distinguished. The greatest licence prevails in

reporting and discussing the affairs of other countries, combined with the keenest sensitiveness to foreign criticism of anything that concerns Germany. The example of the Govern- ment is followed in advertising the products of German industry, while those of foreigners are studiously depreciated. (x.)

Austria.

In the period from 1880 to 1888 the only notable paper founded in Austria was the Wiener Allgemeine Zeitung (1880). It appeared three times daily, and attempted to compete with the large dailies already established, but in spite of the impetus communicated to its start by the well- known ” Freilands ” Apostle Theodor Hertzka, it soon fell away, and now only appears as a late evening paper ; it is known as the 6 Uhr Abendblatt, and enjoys a large local circulation. It was -with the rise of the anti-Semitic and Socialistic movements of 1888 onwards that the Vienna daily press first began a fresh increase. The Deutsche Volksblatt (anti-Semitic) was founded in 1888, the Ostdeutsch Rundschau (Radical) in 1893, and the Reichs- post (the organ of the Catholic section of the Christian Socialist party) in 1894. The Labour movement led to the development of the Arheiterzeitung from a weekly, when it succeeded the Gleichheit in 1889, to a daily in 1895. It is therefore the first Social Democratic daily of Austria. In 1893 the Neues Wiener Jownal was founded as a political neutral, and the old Presse at last dis- appeared in 1894, its place being filled by the weekly Reichswehr (military), established in 1888. Since May 1899 the French in Vienna have once more a daily paper in their language, Le Petit Journal de Vienne. There are now nineteen political dailies published in Vienna, but owing to the various nations included in the Austrian empire, the political press of the provinces has more than usual importance. Of the German provincial press the most highly developed is in the German towns of Bohemia and in Prague, and the foundation of the Deutsche Volkszeitung at Reiehenberg in 1885 marks the date of separation of the Deutschfortschrittliche and Deutschvolkliche parties, while the Radical party, which has so greatly increased in Bohemia of late years, was first represented by the weekly Deutscher Volksbote at Prague, and also in 1897 by the Unverfalsehte deutsche Worte, now edited by Iro at Eger. A peculiar feature is the existence of German organs of the Czech national movement, of which the

representative is the Prague daily Politik, which has appeared since 1862. In Silesia the anti-Semitic Freie Schlesische Presse was founded in 1881 at Troppau, and when it changed sides in 1889 it was speedily replaced, 1891, by the Deutsche Wehr. In Moravia the representative papers of the Czech Con- servatives and Radicals are the Mir and the Pozar re- spectively. The newspapers in Galicia, which have been growing steadily since 1870, are both numerous and im- portant. The leading ones are the Slovo Pol.vkie in Lemberg and the Glos Naroda in Cracow. There are 161 newspapers in Polish, as against 10 in 1848 and 50 in 1873.

Of the lesser Slavic nations, the Slovenians have ad- vanced the most, and their latest political newspaper is the Sloreriski List, commenced at the end of 1896.

In Illyrian journalism the chief newspapers founded since 1880 are the Grvena Hrratska, 1891, and the Hrvatttka Krnna, 1893. An attempt at unity amongst the Ruthenian factions in 1885 to 1887 produced the Mir, while the Ruslan, published daily at Lemberg since 1896, advocates joint action by Poles and Ruthenians. The Bi(kowijiia, established in 1886, has developed into the organ of ” Young Ruthenia,” and the Bukoirinska Wido- mosty, established in 1895, represents the Old Ruthenians.

The Italian press in Austria is now represented chiefly by the very popular daily Piccolo, published at Trieste ; it had a formidable rival in the Mattino, which commenced in 1885, but only lasted to the end of 1898. The Fede. e Lavoro, published at Roveredo, is the organ of the (‘atholic Labour party, and L’Avven ire del Lavoro, at Bozen, that of the Socialists. In Dahnatia the Corriere Xazionale,

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founded in 1896 at Zara and now published at Trieste, is the organ of the autonomist Italians, while II Dalmata continues to represent the National Liberals.

The Rumanian press is limited to a few papers in Czer- nowitz. The oldest is the anti-Semitic Dutepazza, founded in 1883 ; but the real representative of the autonomist Eumanians is the Patria, founded in 1897. Economics and social science, in which subject journalism in Austria is of very recent growth, is chieiiy represented by the Zeitschrift fur VblJcswirtschaft, Socialpolitile und Verwal- tung, a paper whi'ch deals exclusively with its own subject.

The technical journals of Austria are very numerous and most highly developed, consisting of 154 agricultural, 263 trade, 25 military and marine, 92 medical and scientific, 60 legal, 88 religious, 130 educational, 52 geographical, statistical, and historical, 189 theatrical, musical, sporting, &c., 169 humorous and literary, 289 economic, and 16 for women. Most of these, however, are not newspapers, but magazines.

In 1890 Vienna, with a population of 1,100,000, had 8 dailies and 44 papers published less frequently but at least weekly. In 1900, with a population of 1,626,000, it had 14 dailies and 36 weeklies, &c. Prague, notwith- standing a large increase in population, had about the same number of papers in 1900 as in 1890, namely, 11 dailies and 2 weeklies, while Trieste, which in 1890, with a population of 144,000, had 5 dailies, had 9 in 1900, with an increase of only 16,000 inhabitants. In the smaller provincial towns there were in 1900, 321 news- papers of various periodicity, but not exceeding a week, which are published in 168 towns.

Zenker, ffeschichte der Journalistik in Osterreich. Vienna, 1900. â€" Haasenstbin and Vooler. Notizlcalendar, 1901, &c.

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Hungary.

Budapest in 1890, with a population of 360,000, had 14 dailies and 10 weeklies, &c. In 1900, with 470,000 inhabitants, it had 21 dailies and 3 weeklies, &c., and 147 papers, mostly weeklies, were published in eighty-nine other towns. The leading papers are the official Budapesti Kozlony, the Liberal Pester Lloyd, and the Budapesti Hirlap. From the Hungarian returns of 1899 (^A Magyar Hirlapirodalom Id. Szinnyei J.) it would appear that

764 newspapers were published in that year, but those returns include a large number of official bulletins and journals that are more correctly described as periodicals. It may be noted here that seven papers in Hungarian are published in America and one in Vienna.

Belgium.

In 1890 Brussels published 34 papers of various periodicity, among which the Moniteur Beige held the lead with a circulation of 90,000, while Le National (founded in 1885) and L'Etoile circulated 21,000 and 6000 respect- ively. In 1900 there were 18 dailies and 14 weeklies, &c. The other large towns compare as follows : â€"

1890.

1900.

Population.

Dailies.

Weeklies, &o.

Population.

Dailies.

Weelclies,

Antwerp .

Ghent

Lifege

191,000 140,000 133,000

7 7 0

2 3

â– 5

186,780 140,000 140,300

7 6 5

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3

In 1890 there were 112 papers published in 90 other towns, and in 1900, 230 papers in 124 other towns. These were mostly weekly, but the towns with upwards of 20,000 inhabitants have usually one or more daily papers.

Le Soir, a Brussels paper, is distributed gratis, and subsists entirely upon its advertisements. Totals : â€”

Brussels Provinces

Belgium

34

142

176

1900.

32

208

290

Holland.

Amsterdam in 1890 had 10 dailies and 16 weeklies, &c. ; and in 1900 the number had increased to 12 dailies (Algemeen Handelsblad, Nieuws van den Dag, &c.), and 26 weeklies, &c. In 1900 The Hague had 6 dailies (Dagblad, Vaderland, &c.) and 5 weeklies, &c. ; and Rotterdam had 5 dailies (Meaive Rotterdammer Conruiit, &c.) and 8 weeklies. In addition to these, about 250 papers, mostly weeklies, were published in 128 other towns. The Haarlemsche Courant, founded in 1666, still appears. The totals for Holland are : â€" Amsterdam, 38 ; provinces, 274 ; kingdom, 312.

Luxemburg.

In the Grand Duchy there were 12 newspapers in 1900â€" ,3 dailies {Luxemhurger Zeitung, &c.), and 9 that appear twice or thrice a week. All the dailies and three others are published in the capital.

Sweden.

In 1890 Stockholm, with a population of 205,000, had 5 dailies and 12 weeklies, &c., in 1900 with an increase of 60,000 inhabit- ants, it had 11 dailies and 4 weeklies, &c., while 93 provincial towns published 197 papers, mostly weeklies, &c. In the period 1890-94 a large number of newspapers appeared at Stockholm, but their duration was in general very short, often only a few months (Lundstadt, Sveriges Periodiska Literatur, ii. 1896). A newspaper in Finnish is published at Haparanda.

Denmark.

In 1890 Copenhagen, with 286,000 inhabitants, produced 8 dailies and 6 weeklies, &o. In 1900, with a population of 410,000, it had 12 dailies and 2 weeklies, while 121 papers appeared in sixty-eight provincial towns.

Iceland.

Reykjavik published two weekly papers in 1890, and the same number in 1900 {Thi6dOlfr and Isafold).

Faroe Islands.

A weekly paper called the Dimmalaeting was published at Thorshavn in 1890, and continued to appear in 1900.

Norway.

In 1890 Christiania, with a population of 128,000, published 12 papers, of which only three appeared daily ; in 1900 although the population increased to 151,000, only 10 papers were produced, but 8 of them were dailies. The Morgenbladet still holds its rank, and the ^/i!eÂ»iposJeH has a-large circulation. In the provinces in 1900 there were 122 papers published in fifty-two towns.

Russia.

In 1890 St Petersburg had 6 dailies and 14 weeklies, &c. ; and in 1900 there were 16 dailies and 22 weeklies, &c. (the St Petersburgskaya Viedomosti, notably anti-British since 1895, the Novoya Vremja, the Journal de St Piters- bourg, &c.). Moscow increased its papers from 5 dailies and 6 weeklies, &c., to 8 dailies and 11 weeklies, &c. (the MoskowskayaViedomosti, &c.). The rest of Russia proper produced about 100 newspapers, of which one-third were dailies. In Russian Poland about 11 papers, one-half being dailies, were published at Warsaw in 1900 (Kurier Warsawski, Gazeta Polska, &c.), and about 18 in the other towns. The Baltic provinces produced 11 dailies and 9 weeklies, &c. ; Siberia, 1 daily and 23 weeklies, &c. ; the Caucasus, 6 dailies and 4 weeklies, &c. ; and Finland, 12 dailies and 29 weeklies. Seven weekly newspapers in Esthonian were published at Reval, Dorpat, and Pernau in 1900. The totals for Russia are therefore â€” St Petersburg and Moscow, 57 ; provinces, 230 ; the Russian Empire, 287.

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Throughout the empire, but especially in Russia proper, Siberia, and the Caucasus, a number both of daily and weekly papers are so intermittent in their publication that they have not been included in the above statistics.

A large number of newspapers in the Russian language are published, chiefly for political reasons, outside Russia, and most of the papers of the non-Russian nations living under Muscovite rule are similarly published outside the empire.

In all the large provincial towns there is a Government newspaper published daily, or at least twice a week, but apart from this but few of the periodicals can justly be considered as newspapers. The provincial press labours under great difficulties, for whereas in St Petersburg or Moscow the editors may publish at their own risk, subject to warnings, every paper that appears in the provinces must duly pass the censor. The more important section of the Russian press tends to develop on the lines of British newspapers, i.e., large papers well filled with advertisements, but no new papers of importance were founded during the period under review. The popular press in the French fashion lias largely developed, and there is a system of giving bonuses to subscribers in the form of books published as supplements.

Italy. In 1890 Rome, with a population of 278,000, published 13 dailies and 1 tri-weekly, and in 1900, with 376,000, 10 dailies and 6 weeklies, &c. The leading Roman papers are â€” the Fanfulla, representing the Court and Government ; the Tribuna, a Liberal paper founded in 1883, which has the largest circulation (150,000) ; the organ of the Vatican, L' Osservatore Romano; and the popular Messagero. The number of papers published in the chief towns between 1880 and 1900 was as follows: â€”

Population.

Dailies.

Weeklies, &c.

Florence

Milan ....

Naples

Turin ....

Venice

170,000 375,900 463,000 253,000 130,000

4 6 9 5 4

5″ ‘3

In addition to these, about 200 papers, one-third being dailies, were published in 123 of the smaller towns, mak- ing the totals â€” Rome, 15 ; provinces, 236 ; Italy, 251.

Malta in 1890 had 3 dailies and 3 weeklies, and in 1900, 8 dailies {Malta Chronicle, II Risorgimento, &c.) and 5 weeklies. Two were in English, one in Maltese, and the rest in Italian.

Spain.

In 1890 Madrid published 38 papers, of which 15 were dailies ; but by 1900 they declined to 28, of which 19 were dailies. Barcelona published only 4 dailies in 1890, the remaining 17 being weekly, &c. ; in 1900 the dailies increased to 15, while the weeklies, &c., decreased to 4, a state of things very consonant with the increased com- mercial activity of the town. The leading Spanish papers are â€” El Correo, Monarchico-Liberal ; La Epoca, Conserva- tive ; El Imparcidl, Independent Liberal ; La Jnntida, an evening Republican paper ; El Liberal, which numbers among its contributors the best writers without distinction of party; and El Pais, the organ of the Progressives. The provincial press is very active, but extremely short- lived. In Badajoz, a typical ordinary provincial town, about 30 newspapers sprang into existence during the twenty years 1881-1900, besides a still larger number of periodicals (Gomez Villafranca, Ilistona y Bibliogra/ia de la Preusa fie Badajoz, 1901). In 1900 there were 287 papers published in 118 provincial towns, thus making the totals â€” Madrid, 28 ; provinces, 306 ; Spain, 334.

Majorca.â€” la 1900 there were 4 daily papers published at Palm a de Mallorca.

Portugal.

In 1890 Lisbon, with 246,000 inhabitants, published 18 papers, of which 11 were dailies ; and in 1900, with a population of 261,000, 21 papers, of which 19 were dailies. The other towns show very little movement since 1880, about 58 papers being published in 30 provincial towns. The totals may be roughly taken as â€” Lisbon, 21 ; provinces, 58 ; Portugal, 79.

Switzerland.

This is one of the countries remarkable for the number of its newspapers in proportion to its size. Among the more important may be mentioned the Journal de Geneve and the Gazette de Lausanne, both Moderate Liberal, and the Catholic Courrier de Gen&ve. The following table shows the increase in the three largest towns : â€”

1890.

1900.

Dailies.

Weclilies.

Dailies.

Weeklies.

Geneva

Basel

Zurich

3

2 2

1

3

5 5 4

4

1 15

In 1896, 587 papers were published in 192 towns, about 270 being weeklies and about 100 dailies. Nearly two- thirds are in German, the remainder being chiefly French, with a few in Italian, in Romansch, and in English. The number of papers founded in the decade ending 1890 showed an increase of 30 per cent, on the previous one. In 1872 only 3 papers were credited with a circulation exceeding 20,000, but there were in 1896 at least 16. The Swiss continue to preserve with jealous care the freedom of the press, and in 1895 they rejected an alteration in their criminal code which appeared likely to interfere with it.

Greece.

Athens, with 85,000 inhabitants in 1900, published 9 dailies and 4 weeklies, &c., and in 1900, with 114,000 inhabitants, 10 dailies and 2 weeklies. The chief papers, the Asty and the Acropolis, are mainly political and on the Liberal side, as indeed are nearly all the Athenian papers. In the smaller towns the number increased from 20 in 1890 to 35 in 1900, most of them being published weekly.

Eumania.

Bucharest, with a population oÂ£ about half a million, bad 7 dailies and 1 weekly in 1890, and 14 dailies (the Somanul, &c.) and 3 weeklies in 1900, when about 30 papers, mostly dailies, were published in the provinces.

Scrvia.

Belgrade has a large number of papers in proportion to its popu- lation of 36,000, but shows no movement in recent years. It had 6 dailies and 8 weeklies, &c., in 1900. The official paper is the Serbske Noviny, and the leading Liberal organ the Videlo. Five smaller towns published one or two papers apiece, appearing twice or thrice in the week.

Bulgaria.

In 1890 only 3 newspapers were published in Bulgaria, namely, 2 at Sofia and 1 at Rustchuk. In 1900 Sofia, with a population of 48,000, had 1 daily, the Swoboda, and 3 on alternate days ; while Philippopolis and five smaller towns produced 11 papers, mostly weeklies.

Montenegro.

Cettigne, with 1500 inhabitants, published 2 weeklies (the Qlas Crnagorca and the Political) in 1900.

Turkey.

In 1890, with a population of 873,000, there were 19 papers, in various languages, published at Constantinople, most of them dailies ; and in 1900, with a decrease in population estimated at 1000, the number of papers decreased to 18. They appeared in the following languages : the Stambotil and 4 others in French, 3 in

foreign]

Turkish, 1 in Turkish and Greek, 3 in Greek, 2 in Armenian, 1 in English and French, and 1 each in Arabic, English, lulian, and Persian. Smyrna, with 200,000 inhabitants, published 8 papers, mostly weeklies, in 1890, and the same number in 1000. Owing to the number of fasts and feasts observed by the Mahommedans, during which Turkish newspapers are not published, they are somewhat irregular in their appearance. Two papers are published

at Adrianople and 2 at Salonica (1 being in Hebrew). Cyprus had 6 weeklies in 1900, the chief being the Owl at Nicosia and the Times of Oypnis at Larnaca.

Fersia.

Tehran, with 200,000 inhabitants, published 2 newspapers in 1890 and 3 in 1900. The Ir&n is the leading, paper, but the papers of Persia, like those of Turkey, appear somewhat irregularly.

AtBeyrout were published in 1900,1 daily (the Erench JoMj-raoi) , and 5 weeklies (1 in Turkish and 4 in Arabic).

China.

With the exception of the Peking Gazette, which is the oflS.cial organ of the Chinese Government, it may be said that all the newspapers published in China, including those in the vernacular, are due to foreign influence, and are under European management. The leading papers of the British colony are the North China Daily News and Shanghai Mercury at Shanghai, and the Hong Kong Daily Press and China Mail at Hong-Kong. In addition to these may be mentioned the Journal at Peking, the Gazette at Amoy, the Herald and Daily Echo at Foochow, the Chinese Times at Tientsin, the Deutsch^Asiatische Warte at Tsintau, and a few Portuguese papers at Macao. Of the few papers in Chinese, the Shun-pao and Hu-pax) of Shanghai have a very large circulation, and there are four Chinese dailies at Hong-Kong and two at Canton. Several newspapers are published by the missionaries in various parts, but they are more of the nature of religious or scientific journals with a few items of news thrown in (J. D. Ball, Tilings Cliinese, 1893). Tlie total number of newspapers published in China in 1900 may be reck- oned at 40, about two-thirds being dailies.

Siam.

Bangkok, with 255,000 inhabitants in 1890, had three dailies and one weekly, while in 1900, with a population of 400,000, it had an additional weekly. The leading papers are the Times and the Siam Free Press.

Straits Settlements.

There are about a dozen papers, half of them dailies, published in the Straits Settlements. The chief are the Straits Times and the Government Gazette at Singapore, the Penang Gazette, &c.

Cochin China.

Two papers, the Courrier and the Mekong, are published at Saigon. Tongking has the Courrier published at Haiphong, and VAvenir at Hanoi.

Japan.

Rapid growth of journalism has been one of the marked features of Japan's modern career. As early as the beginning of the 17th century, a sheet called the Beading for Sale (Yomi-urt) was hawked about the streets of Yedo by a vendor who cried his wares in the familiar European style of later times. This embryo journal was in manuscript. It contained accounts of natural calamities, conflagrations, fights, vendettas, and other striking events. Another more aristocratic sheet, called the Official Intelligence (Go-satorgaki), was compiled by the chief of the tea-cult in the shogun's palace and sold privately. Its contents were taken chiefly from the archives of the Government secretariat, and consisted of appointments and dismissals of officials, copies of administrative ordinances, and notes on current events.

Neither of these publications attained permanent vogue or suggested any expansion of the enterprise. Not until 1863 did a real newspaper make its appearance. Its publisher, Eukuda Meiga, was inspired by the hope that if fuller knowledge of foreign countries were disseminated among the people, the policy of national exclusion might become distasteful. He therefore made translations of the Batavia News, and published them in the form of a journal printed from wood blocks. The following year (1864) Joseph Hiko â€" a Japanese who had just returned from the United States, where he had lived since boy- hood, having been rescued from a sinking junk and carried to San Francisco by an American ship â€" combined with two of his countrymen to publish a periodical which they called Shimbunshi (newspaper), a term destined to become permanent in the language. As yet movable types were not employed. But that innovation followed quickly on

the establishment of English journals for the foreign community in Yokohama, and during the stirring times of the fall of feudalism a demand for news became so keen that one journal after another made its appearance. At first the tone of these sheets reflected the anti-foreign, anti-progressive spirit of the conservative section of the nation, and their influence seemed so pernicious that the Government prohibited their publication and treated the editors as malefactors. But the incongruity of such a policy being quickly perceived, the veto was revoked in 1869, and journalistic ‘ enterprise received official sanction within certain limitations. All discussion of religious questions, of politics, and of legal problems was interdicted ; a general injunction forbade the publication of matter prejudicial to public peace or good morals; official permission had to be obtained before issuing a journal, and the power of fining or imprisoning editors, publishers, and printers, as well as that of suspending or suppressing a newspaper, was vested in administrative officials without any recourse to courts of law. It might have been foreseen that the young journalists of Japan, whose ideas of press liberty were derived from European theories, would not readily submit to these restrictions. A bitter struggle commenced between, on the one hand, irresponsible editors who were influenced partly by honest faith in the value of free speech, but partly by a desire to embarrass the Government, and, on the other, responsible officials who either believed that Japanese society was not yet ripe for the full enfranchisement of newspapers, or were unwilling to place in the hands of their political opponents a weapon which threatened to prove inconveniently effective against themselves. The public, of course, sympa- thized with the editors, and each sentence of imprison- ment or fine pronounced against them brought a fresh access of popular support. Devices, often unscrupu- lous and sometimes ingenious, were employed by the editors to gain popularity or to bring the Government into ridicule. On one occasion they organized impos- ing funeral rites in honour of journals that had been Suppressed by ministerial order. The defunct sheets, placed in a coffin, were borne in solemn procession to the temple of the Goddess of Mercy, where Buddhist priests chanted litanies for the dead, journalists and political agitators read threnodies or burned incense, and all the pomp, parade, and ceremony proper to aristocratic obsequies were observed. The story of this struggle for liberty reads strangely in the context of such a history as that of Japan under the Tokugawa shogunate. Although scarcely a

month passed that did not see an editor fined or imprisoned, a newspaper suspended or suppressed, the representatives of the press grew constantly more defiant, the demand for journals more urgent. The first daily paper, the Mainichi

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Shimbun {Daily News), was published in 1871, and in 1879, despite the severity of the law, there were 192 journals and periodicals, with a total annual circulation of over 11,000,000. In 1897 a law, passed by both Houses and confirmed by the emperor, removed all re- strictions on freedom of speech, except in cases of Use- majeste. In 1900 there were 829 journals and periodicals, with an annual circulation of 46^^ million copies. (See also Japan.)

The more important newspapers appearing in the capital are the official Kwampo, the Conservative Nikon, the Progressive Yomi- uri and Mainichi, and the Kokumin Shimbun (established in 1890), one of the best specimens of Japanese journalism, and remarkable for its liberal spirit, and for having an article in Eng- lish to facilitate the exchange of views between Japanese and foreigners.

JEast Indies.

Philippines. â€” In the Philippines, where the periodical press has now been established for upwards of three-quarters of a century, the first newspaper printed outside Manila was El Eco de Vigan, 1884, which lasted for about a year. In Manila itself a consider- able number of newspapers have been started since 1880, but few have lasted long ; many, indeed, only a few months. The Diarto, Oceania Espanol, and Coinercio are the dailies (Retana, El Period- ismo Filipino, Madrid, 1895).

Java. â€” The newspapers of Java show but little movement. In 1900 there were 6 dailies and 1 weekly published in Batavia, and about 20 papers, half

of them dailies, in other parts of the island.

Sumatra. â€” -In 1890, 3 papers were published in Sumatra, and double that number in 1900 ; they appear, at most, three tunes m the week.

Celebes. â€” The number of papers published at Macassar in 1900 was 3, published once or twice in the week.

West Africa.

In Gambia in 1900 the Gambia Intelligencer was published weekly at Bathurst.

At Accra, in the Gold Coast Colony, there were 2 weekly papers, the Gold Coast Chronicle and the Gold Coast Independent.

In Sierra Leone, Freetown, with a population of 39,000, had 3 weekly papers (the Weekly News, Weekly Times, and West African Beporter).

Lagos, with 32,500 inhabitants, published the Lagos Times daily and 3 weekly papers.

East Africa.

Mauritius. â€” In 1900 the Merchant and Planter’s Gazette and the Vrai Mauricien were published daily at St. Louis, the only other paper being the Weekly News.

Congo Free State.

St Paul de Loanda published 0 Jlercantil daily and 2 weekly papers.

Liberia Bepuhlic.

At Monrovia the Observer and the Liberia Gazette were pub- lished weekly.

3Iorocco.

In this territory were published in 1900 the Times of Morocco, a newspaper in Arabic, one in French, and one in Spanish; their periodicity varies.

German East Africa.

The Deutsch Ostafrikanische Zeitung was published weekly at Dar-es-Salam.

Algeria.

In 1890 there were 11 newspapers published in Algeria. In 1900 Algiers, with a pupulation of 154,000, published (1 dailies (L'Akhhin; La Depeche Ahjeriennr, &o.) and 4 weeklies, and seventeen smaller towns had 25 papers, in most cases weeklies or semi-weeklies.

Tunis.

Two daily papers, the Jmtrnal Officiel and the Petit Tunisien, and 4 weeklies were published at the capital in 1900, while Le Courrier appeared weekly at Bizerta, La Depeche Sfaxinnne daily at Sfax, and VAvenir weekly at Sonese.

Senegal. In 1900 the Moniteur was published weekly at St Louis.

Eeunion. The Journal Officiel was published twice a week, the Nouveau Salazien weekly at St D^nis.

Madagascar. Le Progres, Le Madagascar, and La Cloche, nominally weeklies, appeared at irregular intervals.

Angra Pequena. The Deutsche Colonial Zeitung was published weekly.

Canary Islands.

In 1900 the Diario was published at Las Palmas, and the Diario and the Liberal at Santa Cruz and Tenerife, but at very irregular intervals.

Madeira.

The Diario de Noticias was published daily, and 0 Direito twice weekly at Funchal.

St Helena.

In 1900 the Guardian was published weekly.

Egypt.

In 1900 Alexandria, with 230,000 inhabitants, published 10 dailies (Le Phare d' Alexandria, the Egyptian Gazette, &c.) and 1 weekly ; Cairo, with 380,000, had 8 dailies (Journal Egyptien, Le Progres, &c.) and 3 weeklies; and Port Said 2 dailies, the Phare and the Telegrafo. ' These are exclusive of Arab newspapers.

Portuguese East Africa.

In 1900 0 Futuro was published at Delagoa Bay, the Boletim OJicial and Africa Oriental at Mozambique, and O Africano at Quilimane. These are all weeklies.

Azores.

There were two papers apiece published weekly in Terceira, Fayal, and San Miguel in 1900.

Central America.

In the republics of Central America there has been little or no variation in the number of newspapers, save in Nicaragua, which in 1900 had 4 dailies (El Diario) &c., and 5 weeklies, against 4 weeklies in 1890. The Diaro del Centra de America is the chief paper of the 3 published in Guatemala ; the Diario OJicial and El Siglo NX. were published at San Salvador ; the Correo Espanol, La Bepublica, and El Heraldo at Costa Rica ; and La Paz and La BegeneraciSn at Honduras.

British Honduras in 1900 had 1 daily paper. El Sol, published at Belize.

West Indies.

Cuba. â€” In 1890, 6 dailies and 1 weekly appeared in Cuba. In 1900 there were 9 dailies and 2 weeklies, the Diario de la Marina and 4 other dailies being published at Havana. Seven papers were published in other towns of the island.

Porto Bico. â€” Three newspapers, 1 daily (La Arispa) and 2 tri- weeklies, have appeared in Porto Rico since 1890, to which is now added the Democracia, published daUy.

Hayti in 1900 had 5 dailies and 3 weeklies, being an increase of 2 papers since 1890.

Jamaica in 1900 maintained its number, 5 dailies and 4 week- lies; the leading papers are the Jamaica Daily Telegraph, Evening Express, Gleaner, and Government Gazette.

Barbados published 6 papers, mostly bi-weekly (West Indian, Barbados Ilrrald, &c.), at Bridgetown in 1900.

Trinidad, with 5 weeklies in 1890, had 2 dailies (Daily News- and Times) and 4 weeklies (Boyal Gazette, &c.) in 1900.

Dnminica had 2 weeklies, the Dominican and the Guardian, in

1900.

Grenada, which had only 1 paper in IS’.IO, had 3 (St George’s Chronicle, &c.) in 1900.

St Vincent had 2 weekly papei-s (Sentinel, &c.), and St Lucia the same number (The ^‘oice, &c.), in 1900.

Antigua had 3 weeklies (Lceicnrd Isles Budget, &o.).

Bahamas. â€” In 1900 the Guardian was published twice vs’eekly at Nassau.

Bermudas.â€” ‘in 1900 the Boyal Gazette was published at Hamil- ton, and the Colonist at St George, both weekly.

St Christopher (St Kitts), which had only 1 paper in 1890, had the Daily Express and 2 weeklies in 1900.

Tobago had the Gazette and News, both weekly.

Turks Island. â€” The Boyal Standard, weekly.

1900.

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Martinique. â€” Three papers, ic.s Antilles, Les Colonies, and El Puroenir, were published at St Pierre in 1900, and were still being published up to 8th May 1902, when the town was destroyed (see Maktinique).

Guadeloupe. â€” The Courrier was published twice weekly.

Mexico.

In 1890, 5 dailies and 2 weeklies were published in the capital, with 316,000 inhabitants, and 2 dailies and 1 weekly in other parts of the territory. In 1900 there were 10 dailies {Ml Diario OfirAal, El Nacional, &c.) published in the capital, which has increased its population by 16,000 ; and 20 papers, about half being dailies, appeared in fifteen smaller towns.

Colombia.

Panama, with 35,000 inhabitants, had 3 dailies in 1890, and 3 dailies {La Estrella, &c.) and 1 weekly in 1900. Bogota,, with a population of 100,000, had 3 dailies and 3 weeklies in 1890, and

9 dailies and 23 weeklies in 1900. In the other towns of the republic there were only 3 weeklies in 1890, while there were 17 newspapers, mostly weekly, published in seven towns in 1900.

Venezuela.

Caracas, with a population of 70,500, published only 2 dailies in 1890, but in 1900, with 80,000 inhabitants, it had 5 dailies (El Correo, &c.) and 6 weeklies. The returns from smaller towns were 1 daily and 6 weeklies in 1890, while in seven towns in 1900 there were 10 papers, about half of them appearing daily.

British Guiana.

There has been very little movement in the number of papers. In 1900 the Daily Chronicle and 5 weeklies appeared at George- town, and the Berbice Gazette, a bi-weekly, at New Amsterdam.

Dutch Guiana.

In 1900, 5 weeklies (the Suriname, West Indier, &c.) were pub- lished at Paramaribo, 1 daily and 6 weeklies at Curagoa, and 1 weekly at Nickerie.

French Guiana.

Two weeklies, the Moniteur and the Meveil, were published at Cayenne in 1900.

Ecuador.

In 1890 there were only 3 papers, all weeklies, published in Ecuador. In 1900 Quito, with 80,000 inhabitants, had 1 daily {El Comercio) and 2 weeklies ; Guayaquil had 3 dailies and 1 bi- weekly ; and Cuenca 1 weekly.

Brazil.

In 1890 Rio, with 350,000 inhabitants, had 4 dailies and 1 weekly, while 7 dailies and 2 weeklies were published in other towns. In 1900 Rio had 10 dailies {Diario de Notieias, Diario Oficial, &c.) and 1 weekly, while 33 papers, nearly all dailies, were published in eighteen other towns.

Peru.

In 1890 there were only 2 dailies published at Lima, with 101,400 inhabitants. In 1900, however,’ with a population of 135,000, it had 8 dailies {El Comercio, El Nacional, &c.) and 11 weeklies, while 18 newspapers,’ mostly weeklies, were published in seven other towns.

Bolivia.

In 1900, 6 dailies {El Comercio, El Nacional, &c.) were pub- lished at La Paz, 3 dailies {El Dia, &c.) and 3 weeklies at Sucre, and 10 papers in six smaller towns.

Chile.

In 1890 Santiago, with 200,000 inhabitants, published 2 dailies and 1 weekly ; Valparaiso, with 95,000, had the same number, and 1 daily paper appeared in Iquique. In 1900 Santiago published

10 dailies {El Chileno, El Constitucional, &o.) ; Valparaiso, with 110,000 inhabitants, had 5 dailies {El Imparcial, La Union, &o.) and 1 bi-weekly ; while twelve smaller towns had 13 papers, mostly dailies.

Argentine Republic.

Buenos Aires in 1890, with 398,500 inhabitants, published 18 dailies and 1 weekly, of which 3 were in French and 3 in English ; Rosario, with 80,000, had 7 dailies and 2 weeklies, of which 2 were in English ; and 8 dailies and 1 weekly appeared in the smaller towns. In 1900 Buenos Aires, with its population in- creased by 150,000, had 18 dailies {La Nacion, Buenos Aires

Herald, &c.) and 8 weeklies, which appear in the following lan- guages : 11 in Spanish, 4 in English, 3 in Italian, 3 in German, and 2 in French ; Rosario, with 90,000 inhabitants, had 6 dailies {El Mensayero, &c.) and 2 weeklies ; and ten smaller towns produced 14 papers, nearly all dailies.

Paragua’j.

In 1900, 5 dailies {Diario Oficial, La Bepublica, &c.) and 1 weekly were published at Asuncion, with a population of 30,000 ; and a weekly paper,

the Eco de la Campaha, appeared at Villa Concepoion.

Zfruguay.

The press has made great strides in this republic during 1880- 1900, and especially during the second decade. Montevideo, which in 1890 had 7 dailies, all in Spanish, in 1900 had 10 in Spani.sh, mostly political, 2 in French, and 1 apiece in English and Italian. The chief are El Tt-.iegrafo Marltimo, founded in 1880, El filiglo, La Raz6n, and El Dia. The reduction of the price of El Dia to one-half (2 centesimos) in 1890 was a reform which gave the notable recent impulse to the popular press. Among the more important papers in the departments may be mentioned El I'nehlo and La Paz of San Jos6, El Dia of Pay- sandii, and La Prmsa of El Salto. The only available statistics for the newspapers of the entire republic include periodicals : it appears that, in addition to the above-mentioned daily papers, 42 reviews and periodicals were published in Montevideo in 1900, and about 80 newspapers and periodicals in the provinces, giving a total for the republic of about 136. (Fernandez y Medina, La Imprenta y la Prensa en el Uruguay, Montevideo, 1900.)

India.

It appears from tlie oflS.cial tables that there are about 600 newspapers, so called, published in the Indian empire, of vrhich about one-third, mostly dailies, are in the Indian vernaculars. The numbers, howeyer, are very fluctuating, and in the following statistics of 1900 only the chief and more permanent papers are included : â€"

Popula- tion.

Dailies.

Weeklies.

Calcutta . Bombay . Madras . Rangoon . Allahabad Lahore .

843,487 821,704 452,518 180,000 175.240 176,800

15 {Calcutta Englishman, &c.)

2 {Bombay Gazette, &c.) 4 {Madras Mail, &o.)

3 {Rangoon Times, &c.) 2 (Pioneer, &c.)

2 {Civil and Military Gazette, SiC.)

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Chandernagore has a weekly paper, Le Petit Bengali, and Pondloh^ry Le Progres and the Journal Officiel.

Goa has the Boletin Official and A Voz do Povo, which appear at irregular intervals.

Ceylon.

In 1900 Colombo, with a population of 125,000, pub- lished four dailies (Ceylon Independent, Times, &c.), and six weeklies. These are all in English, and there are several in the native dialects. Also three weeklies were published at Jaffna.

Canada.

Ontario. â€” In 1890 Toronto, with 181,220 inhabitants, had 6 dailies and 26 weeklies ; Ottawa, with 30,000 inhabitants, had 2 dailies and 2 bi-weeklies ; while five smaller towns published 2 dailies and 17 weeklies. In 1900 Toronto had 6 dailies (Evening News, Globe, Mail, Merchant, &c.) and 70 weeklies ; Ottawa had 4 dailies (Citizen Free Press, Le Canada, &c.) and 11 weeklies; while 203 smaller towns issued 341 papers, mostly

weeklies. The Citizen, a Conservative daily paper, is the doyen of Ottawa journals; it was founded as the Packet in 1844, and changed its title in February 1851. (Audet, Historique des Journaux d' Ottaica.')

Quebec. â€" Quebec, with 65,000 inhabitants, had 7 dailies and 5 weeklies in 1890; Montreal, with 250,000, had 9 dailies and 18 weeklies. In 1900 Quebec had 6 dailies and 8 weeklies, 6 of the papers being in English and 8 in

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French {Mercury, Telegraph, Le Courrier du Canada, &c.) ; Montreal had 8 dailies and 48 weeklies, 29 papers being in English and 27 in Trench (Gazette, Herald, LaMinerve, &c.) ; while in twenty-seven smaller towns 44 papers were published, mostly weeklies.

Neio Brunsivick. â€" In the whole of this territory only

4 dailies and 9 weeklies were published in 1890, whereas in 1900 Frederieton had 1 daily and 5 weeklies, St John

5 dailies {Gazette, Globe, &c.) and 4 weeklies ; and 20 other papers, mostly weeklies, appeared in thirteen smaller towns.

Nova Scotia. â€" In 1890, 5 dailies and 8 weeklies were published in Halifax. In 1900 the same number appeared in Halifax, while 47 other papers appeared in thirty of the smaller towns.

Prince Edward Island. â€" In 1890 the 120,000 inhabit- ants of this territory had 2 dailies and 6 weeklies. In 1900 there were 3 dailies and 10 weeklies, most of which were published at Charlottetown.

Manitoba. â€" In 1890 only 2 dailies and 2 weeklies were published at Winnipeg, which in 1900 had 3 dailies {Manitoba Morning Free Press, &c.)

and 17 weeklies; while 26 other papers, mostly weeklies, appeared in nine- teen smaller towns.

North- West Territories. â€” These territories had only 3 newspapers in 1890. In 1900 there were 2 weeklies {Leader and Standard) published at Eegina ; and 16 other papers, mostly weeklies, appeared in thirteen smaller towns.

British Columbia. â€” In 1890 there appear to have been

6 papers published in this territory. In 1900 there were 20, mostly weeklies ; 2 dailies {Colonist and Times) and

2 weeklies were published at Victoria, and 2 dailies {News Advertiser, &c.) and 3 weeklies at Vancouver.

Newfoundland.

In 1890, 3 daily papers were published at St John's, which in 1900 had 2 dailies {Evening Herald, &c.), while Harbor and Twillingate had a weekly paper apiece.

South Africa.

Cape Colony.â€” In 1890 Cape Town, with 46,000 in- habitants, published 13 newspapers of various periodicity. In 1900, with the same population, there were 16 news- papers, of which 3 were dailies and 5 were in Dutch. The leading papers were the Cape Argus, Cape Times, South African Review, 0ns Land, &c. Port Elizabeth, which published 6 newspapers of various periodicity in 1890, published only 3 in 1900 ; but Kimberley increased from 2 to 3 in the decade. The number published in other towns of the colony remained stationary at about 32.

Natal. â€” In 1890 Durban and Pietermaritzburg pub- lished 3 newspapers each, of various periodicity, but in 1900 the former, with 16,600 inhabitants, published 2 dailies, the Natal Advertiser and Natal Mercury, and the latter, with a population of 14,400, published 2 dailies and 2 weeklies, the Natal Witness, &c. ; the Herald, a weekly paper, is published at Newcastle.

Rhodesia.â€” In 1900 Bulawayo published 2 dailies {Chronicle, &c.) and 1 weekly, while five other newspapers, mostly weeklies, were published in three ‘ smaller towns.

Orange River Colony. â€” In 1890 only 2 newspapers were published at Bloemfontein, but in 1900 these had increased to 5 â€” 2 dailies {Daily Express, Government Gazette) and 3 weeklies.

Transvaal Colony. â€” In 1890, 6 newspapers of various periodicity were published at Pretoria, 7 at Johannesburg,

3 at Barberton, and 1 apiece at Lydenburg and Potchef- stroom. In 1900 Pretoria published 2 dailies, the

Advertiser in English, and the Press in Dutch and English; and 1 daily, the Volksstem, and 2 weeklies, the Staatscourant and Land en Volk, in Dutch. At Johannesburg 8 appeared â€” 4 daily (the Standard and Digger’s News, Daily News, Eastern Star, and Times), and 4 weekly (the Mining Journal, &c.). Barberton published only the Gold Fields News, weekly, but Lyden- burg issued the Transvaal and the Lydenburger weekly ; Potchefstroom the Budget, Potchefstroomer, Vryheid, and Nieuwe Republiehen weekly ; while Klerksdorp published the Mining Record twice a week ; Krugersdorp, the Times and 0ns Volk weekly ; and Middelburg the Courant and the District Advertiser also weekly.

Australasia.

The first newspaper established in Australasia was the Sydney Gazette and New South Wales Advertiser. It began 5th March 1803, and continued to 23rd December 1843. The Derwent Star, the first paper in Van Diemen’s Land, started 8th January 1810. The Sydney Morning Herald began as a weekly in 1831, became bi-weekly in 1832, tri-weekly in 1838, and daily in 1840. The Melbourne Argus began 2nd January 1846, the Age 17th October 1864, and the Leader in 1856. Characteristic of the newspapers of Australasia is the large number of advertisements ; in fact, there is a keener appreciation of the value of advertising than in England, and conse- quently a newspaper is first of all ~~an advertising medium. As a natural consequence, except in the case of the great metropolitan dailies, the press does not lead~~

~~public opin~~ ion, but follows it; for in small colonial communities an editor's first care is to avoid alienating any influen- tial section of advertisers. (Grattan Grey, Australasia, London, 1900.)

New South Wales. â€" Sydney, with a population of 332,000, in 1890 had 21 newspapers, about half being dailies ; but in 1900, while the total increased nearly threefold (59), there were only 6 published daily. The largest paper is the Morning Herald, which may' be con- sidered the leader of Conservative journalism in Austral- asia. Its contemporary on the opposite side is the Daily Telegraph, which is run upon similar lines to the Mel- bourne Age. The Bidletin, however, is said to have the widest circulation throughout the whole of the Austral- asian colonies, but it temporarily lost ground through its strenuous opposition to the South African war. The two leading weeklies are Town and Country and the Sydney J/ai7, to which must be added the Eadical and Republican Truth. (Grattan Grey, Australasia, London, 1901.)

In the provinces in 1890 there were 78 papers in 51 towns, mostly dailies, whereas in 1900, 168 papers were published in 118 towns, and the same tendency is shown in favour of weeklies, which, with but few exceptions, is characteristic of Australia.

Queensland. â€" Brisbane in 1890, with 60,000 inhabitants, had 26 papers, 8 of them being dailies, and in thirty-five other towns there were 61 papers, for the most part dailies. In 1900 the capital, with a population of 101,000, had 3 dailies {Courier, Evening Observer, &c.) and 20 weeklies, while 86 papers, mostly weeklies, were published in forty-one other towns.

South Australia. â€" Adelaide in 1890, with a population of 45,000, seems to have had 24 papers, 10 being dailies ; and 18 papers, mostly dailies, appeared in sixteen of the smaller towns. In 1900 Adelaide had 130,000 inhabit- ants, but only 4 daily papers {Register, Advertiser, E.rpress and Telegraph, and Evening Journal) and 13 weeklies {Observer, Australische Zeitung, &c.) ; and 27 papers, mostly weeklies, appeared in twenty-two other towns.

Victoria. â€" Melbourne, with a population of 400,000 in

1890, had 46 town papers, nearly half of them daily, and 21 suburban papers, mostly weekly ; and 82 papers, most of them dailies, appeared in seventy smaller towns. In 1900 Melbourne had a population of 491,800, and out of 131 town and suburban papers had only 4 dailies (Argus, Age Standard, Shipping Gazette). The struggle for the lead between the Argus and the Age has resulted in the viatory of the latter, which both in position and influence has eclipsed its senior contemporary. The Argus, how- ever, is intimately connected with the earliest associations of colonists in Victoria, and maintains a high standard of literary excellence, and the decline in its circulation is due solely to its conservatism. The two leading Mel- bourne weeklies are the Australasian and the Leader, issued respectively from the Argus and the Age offices. Both have an extensive intercolonial circulation. The popular evening paper is the Herald, which enjoys an extensive circulation, but is said to display occasionally a tendency towards “yellow” journalism. (Grattan Grey, Australasia, London, 1901.) 179 papers, mostly weeklies, were published in 122 smaller towns, Ballarat having 9, Geeloug 6, and Bendigo 4.

West Aiistralia.â€”Pen’h in 1890, with 10,000 inhabits ants, had 2 dailies and 3 weeklies ; and 1 weekly, the Herald, was published at Fremantle. In 1900 Perth had 3 dailies and 3 weeklies, and 12 papers, mostly weeklies, were published in nine smaller towns.

Tasmania. â€” In 1890 Hobart, with 29,000 inhabitants, had 4 dailies and 6 weeklies ; Launceston had 2 dailies and 3 weeklies, and La Trobe had 1 daily. In 1900 Hobart had 2 dailies (the Hobart Mercury, &c.) and 7 weeklies, Launceston 2 dailies (the Launceston Examiner, &c.) and 5 weeklies, and Burnie and Devonport West 1 weekly apiece.

New Zealand. â€” Taking its size and population into account, no country in the world has been so productive of newspapers as New Zealand. The newspapers of the country districts are extremely numerous, and in general successful.

Otago. â€” Dunedin in 1890 had 3 dailies and 11 weeklies, and in 1900, witli a population of 24,300, it had 2 dailies {Otago Daily Times, &e.) and 5 weeklies (Witness, &c.). In 1890 there were 12 papers, mostly dailies, puhlished in eleven of the smaller towns, and in 1900, 21 papers, mostly weeklies, in sixteen towns. A nota- ble exception to the vogue of the weekly paper is Invercargill, which has 3 dailies and 1 weekly.

Wellington had in 1900 the same number of papers as in 1890, i.e., 3 dailies and 3 weeklies; but 23 papers, mostly weeklies, ap- peared in seventeen of the smaller towns, as against 14 papers, mostly dailies, in ten smaller towns in 1890.

Auckland, the capital, which had 3 dailies and 6 weeklies in 1890, had in 1900 only 2 dailies {New Zealand Herald, &c.) and 3 weeklies (^Weekly Herald, &c.); but whereas in 1890 there were only 8 other papers, mostly dailies, published in six of the smaller towns, there were in 1900, 12 papers, mostly weeklies, published in eleven towns.

Napier in 1890 had 2 dailies and 1 weekly, and nine smaller towns published 12 papers, mostly dailies. In 1900 Napier had 3 dailies {Telegraph, &c.) and 1 weekly, while 7 papers, mostly weeklies, were published in fire other towns.

Christchurch, which had 4 dailies and 5 weeklies in 1890, had 5 dailies (Press, &c.) and 6 weeklies (Weekly Press, &c.) in 1900, while the numbers in the provinces remained the same, namely, 12 papers in, nine towns, but they were mostly dailies in 1890 and mostly weeklies in 1900.

Nelson.â€” In 1890, 2 daily papers were published in the capital. In 1900, 3 dailies appeared in the capital, and 2 weeklies in the smaller towns.

Marlborough.â€” In 1900, 2 dailies and 2 weeklies were published at Blenheim, being double the number that appeared in 1890, and 2 weeklies were published in the smaller towns.

Taranaki.â€” In 1900, 2 dailies and 2 weeklies were published at New Plymouth, being double as many as appeared in 1890 ; and 2 dailies and 6 weeklies were published in five smaller towns.

Westland Province.- In 1900, 6 dailies and 7 weeklies were pub- lished in seven towns of this province, as against 7 papers, mostly dailies, in 1890.

Great Britain and Ire- land . . . 2,902 United States . . . 15,904 I’rance . . . 2,400 Germany. . . . 3^278 Austria .... 393 Hungary . . . . 171 Sweden .... 213 Denmark . . . 145 Iceland and Faroe Islands 3 Norway .... 132 Belgium . . . .290 Netherlands . . . 312 Luxemburg ... 12 Russia . . . 280 Italy . . . 261 Spain .... 338 Portugal . . . . 79 Switzerland . . . 600 Greece . . . 47 Rumania …. 47 Servia .... 24 Bulgaria .... 15 Montenegro ... 2 Turkey .... 22 Persia .... 3 Syria .... 6 India . .â€¢ . . 600 Ceylon 10

Totals of Newspapers, 1900.

China

Siam

Straits Settlements

Cochin China .

Japan

East Indies

South Africa .

West Africa .

Central Africa, &c.

Egypt .

Canada .

Central and West Indies

South American Republics

Australasia â€”

New South Wales Queensland . South Australia Victoria West Australia Tasmania New Zealand â€” Otago Wellington Auckland Hawkes Bay Canterbury Sundry

40

5

12

4

150

39

109

10

76

21

742

129

340

227

109

44

310

18

18

28 29 17 / 11 23

Total

31,026

AnTHOKiTiES.â€”PressJÂ»irec

Newton, a city of Kansas, U.S.A., capital of Harvey county, on the Atchison, Topeka, and Santa Fe and the Missouri Pacific railways, at an altitude of 1447 feet. Its site is level, its plan regular, and it is divided into four wards. The surrounding country is a fertile agricultu- ral region, for which Newton serves as a supply and dis- tributing point. Population (1900), 6208, of whom 766 were foreign-born and 251 negroes.

Newton, a city of Middlesex county, Massachusetts, U.S.A., on the right bank of the Charles river, and on the Boston and Albany railway, in the eastern part of the state. Including an area of 18 square miles, it for- merly contained several villages, which have extended until they have finally merged into one another, and at present the entire area is covered with urban settlement. Most of the inhabitants have their business interests in Boston. Population (1900), 33,587, of whom 10,068 were foreign-born and 505 negroes.

Newton, Alfred (1829—

, English zoologist, was born at Geneva on llth June lS29. In 1854 he was elected travelling fellow of Magdalene College, Cam- bridge, of which he had been an undergraduate, and subsequently visited many parts of the world, including Lapland, Iceland, Spitsbergen, the West Indies, and North America. In 1866 he became the first occupant of the chair of zoology and comparative anatomy at Cambridge. He is especially known as an authority on ornithology, and his services to ornithology and zoo- geography were recognized by the Koyal Society in 1900, when it awarded him a Royal

medal. He is the author of many books, including Zoology of Ancient Europe (1862), Ootheca WoUeyana (1864), Zoology (1874), and a Dictionary of Birds (1893-96), the last being an ac- knowledged standard work. The articles on Birds (in great part) and Oexithologt in the ninth edition of this Encyclopaedia came from his pen, and he also wrote some of the smaller ones on ornithological subjects. He contributed many memoirs to scientific societies, and edited TJie Ibis (1865-70), the Zoological Record (1870- 1872), and YarrelVs British Birds (1871-82).

S. VILâ€” 27

Newton, Sir Charles Thomas (1816-1894), English archaeologist, was born on 16th September 1816 at Bredwardine in Herefordshire, and educated at Shrewsbury and Christ Church, Oxford. His tastes were rather for classical art than for philology ; he only obtained a second class in the schools, and he entered the British Museum in 1840 as an assistant in the Antiquities Department. All manner of antiquities, classical, Oriental, and medieeval, as well as ethnograr phy, were then lumped together under one administra- tion ; and although the department possessed officers of great distinction as Egyptologists and numismatists, it had not, at the time of Newton's appointment, a single distinguished classical archaeologist. The twelve years which he spent in it were years of assiduous self- instruction. In 1862 he quitted the Museum for a time to become vice-consul at Mitylene, with the object of exploring the coasts and islands of Asia Minor for antiquities. Aided by funds supplied by Lord Stratford de Eedcliffe, then British ambassador at Constantino- ple, he made in 1852 and 1855 important discoveries of inscriptions at the island of Calymnos, off the coast of Caria; and in 1856-57 achieved the great archaeological exploit of his life by the discovery of the remains of the famous mausoleum of Halicarnassus, one of the " seven wonders " of the ancient world. He was greatly assisted by Murdoch Smith, afterwards celebrated in connexion with Persian telegraphs. The results were de- scribed by Newton in his History of Discoveries at Hali- carnassus (1862-63), written in conjunction with Mi R. P. Pullan, and in his Travels and Discoveries in the Levant (1865). These

works included particulars of other important discoveries, especially at Branchidse, where he disinterred the statues which had anciently lined the Sacred Way, and at Cnidos, where Mr Pullan, acting under his direction, found the colossal lion now in the British Museum.

In 1855 the regius professorship of Greek at Oxford was offered to Newton, but he declined it. In 1860 he was made British consul at Rome, but had scarcely en- tered upon the post when an opportunity presented itself of reorganizing the amorphous department of an- tiquities at the British Museum, which was divided into three and ultimately four branches. The Greek and Roman section naturally fell to Newton, who returned as Keeper, and held the office until 1885, declining the offer of the principal librarianship made to him in 18T8. The Mausoleum Room, to accommodate the treasures he had found in Asia Minor, was built under his super- vision, but the most brilliant episode of his administra- tion was the acquisition of the Blacas and Castellani gems and sculptures. The Farnese and Pourtalfes col- lections were also acquired' by him. He maintained an intimate connexion with the important excavations carried on during his term of office in Asia Minor and other regions of the ancient world, and took a leading part in the foundation of the Society for the Promotion of Hellenic Studies, the British School at Athens, and the Egypt Exploration Fund. He was Yates pro- fessor of classical archaeology at University College, London, from 1880 to 1888. When, on his retirement from the Museum, his bust by Boehm, now placed in one of the sculpture galleries, was presented to him as a testimonial, he desired the unexpended balance to be given to the school at Atliens. After his retirement he was for long much occupied with the publication of the Greek inscriptions in the British Museum, but his health failed greatly in the latter years of his life. He died at Margate on 28th November 1894. He had married in 1861 the daughter of his successor in the consulate at Roma, tlie painter Severn, herself a distingxiished artist.

She died after a short illness in 1866. Newton was knighted for his services to classical archaeology. His narrative of his own explorations is somewhat dry, but there is much entertaining as well as instructive reading in his collected Essays on Art and ArcJiceology (1886), especially those on the Mycenaean, Cyprian, Olympian, and other epoch-making discoveries. (e. g.)

Newton, John (1823-1895), American soldier, was born in Norfolk, Va., 24th August 1823, and after grad- uating at the U.S. Military Academy in 1842, was en- gaged on engineering duties. During the Civil War he was detailed upon the defences of Washington, and fought in the great battles of 1862 in the east. Pro- moted from brigadier-general (September 1861) to major- general of volunteers (March 1863), he commanded the corps of General Reynolds at Gettysburg after the death of that officer. In the west, in 1864, he took part in Sherman's invasion of Georgia. Returning to regular engineer duty once more in 1866, he enlarged and im- proved New York harbour and the Hudson and East rivers (1866-85), removing the dangerous rocks at Hell Gate, and solving new problems witlj great success. Appointed chief of engineers in March 1884, with the rank of brigadier-general, he retired from active service in August 1886. In 1887-88 he served as commissioner of public works in New York City, where he died 1st May 1895.

Newton-Stewart, a police burgh of Wigtown- shire, Scotland, on the river Cree, 49| miles west by south of Dumfries. A tweed mill, an agricultural im- pleinent factory, and tanneries are the chief industrial features. There are two secondary schools â€" one for girls and one for boys. Population (1901), 2204.

Newtownards, a market town and urban sanitarv district in the county of Down, Ireland, 9-|- miles east of Belfast by rail. There are a weaving factory and a hosiery factory. A new market occupying 3^ acres has been erected. Population (1881), 8676 ; (1901), 9110.

New Ulm, a city of Minnesota, U.S.A., capital of Brown county, on the south bank of the Minnesota river, and on a line of the Chicago and North-"\^'estern railway, in the southern part of the state. It was founded in 1854, destroyed in 1862 by Indians, but re- built. Population (1890), 3741 ; (1900), 5403, of whom 1924 were foreign-born.

New Westminster, a town on the north bank of the Eraser river, British Columbia, 15 miles from the mouth. It was founded in 1859, and was the capital of British Columbia when the British possessions on the Pacific coast formed two colonies â€" that is, British Columbia (the mainland portion) and Vancouver Island. The city is accessible to ocean-going ships

of 16 feet draught. It is the chief centre of the farming country of the lower Eraser, and has one or two factories, but its chief trade is in connexion with the salmon can- neries of the Eraser river. It has a small export lumber trade. In 1808 the greater portion of the busi- ness part of the city was destroyed by fire, and though much of it was rebuilt the establishment of the city of Vancouver, only eight miles distant, seriously affected New Westminster's prospects of rapid growth. It is connected with Vancouver by an electric railway. Pop- ulation, about 6000.

New Whatcom, a city of Washington, U.S.A., capital of AMiatcom county, at the head of Bellingham Bay, an arm of Puget Sound and on a branch of the Great Northern railway, in the north-western part of the state.

It IS in the lieavily forested region of the north-west, and I ships large quantities of fir timber to southern parts. Its industries are chiefly related to lumber and its manu- Population (1890), 4059 ; (1900), 6834, of whom 142.3 facture. It contains many saw and shingle mills, and | were foreign-born.

^EW YORK.

""VTEW YORK, one of the origin al thirteen UnitedStates _L\| of America, and, from its pre-eminence in popu- lation, wealth, commerce, and industry, popularly known as the Empire State, is situated between 40Â° 29′ 40″ and 45Â° 0′ 42″ N., and 71Â° 61′ and 79Â° 45′ 64-4″ W. Its total land area is 47,620 square miles, or 30,476,800 acres. The climate of New York is in a general sense typical of that of the northern United States, hot in summer and cold in winter, yet healthful and stimu- lating. Apart from elevation, the important sources of local variation are the ocean, the Great Lakes, and certain marked irregularities of land surface which modify the direction and force of the winds. The eifect of the ocean is greatly limited by the general eastwardly drift of the atmosphere. The population in 1880 was 6,082,871 ; in 1890, 5,997,853, exclusive of 6321 specially enumerated ; in 1900, 7,268,894. The total increase in the last ten years of the 19th century

(1,265,720, including those specially enumerated) was greater than in any former decade, while the percentage of increase (21 “1) was greater than at any census since 1860. Since 1820 New York has been the most populous state in the Union. Of 160 cities in the United States (excluding Honolulu, in Hawaii) in 1900 having a population of 25,000 or more, 12 are in New York, namely, Greater New York, 3,437,202; Buffalo, 352,387; Eochester, 162,608; Syracuse, 108,374; Albany, 94,161; Troy, 60,651; Utica, 56,383; Yonkers, 47,931; Binghamton, 39,647 ; Elmira, 36,672 ; Schenectady, 31,682; Auburn, 30,345. The average population per square mile increased from 106-74 in 1880 to 126-1 in 1890, and 152-6 in 1900. New York has always been distinguished tot a diversity of races. Out of 10,039,217 immigrants who arrived at the port of New York between 1st January 1866 and 30th June 1898, the declared destination of 3,930,857, or 39-2 per cent., was New York state, Germans, Irish, and English largely predominating. In 1900, 1,900,425 of the population were foreign-born and 99,232 were negroes. Of the native whites, those of foreign parentage numbered 2,415,845. Of the total population, 3,614,780 were males and 3,654,114 were females.

Recent History. â€” The state, owing to its size and its reflection of changes in political sentiment, has been an important factor in national politics. Since 1864 its electoral vote, which was then cast a second time for Abraham Lincoln, has regularly alternated between the Democratic and Eepublican candidates, till 1900, when it was cast the second time for William McKinley, the Republican candidate ; and in each instance, except in 1868, when it went to Horatio Seymour, the Democrat candidate, and 1876, when the national contest was deter- mined by the Electoral Commission, the candidate receiv- ing the electoral vote of New York became President. The popular vote of the state in the Presidential contest of 1896 was : Republican, 819,838 ; Democratic, 551,369 ; National Democratic, 18,950; Prohibitionist, 16,052; Socialist-Labour, 17,667 â€” a Eepublican plurality of 268,469 ; in tlie Presidential contest of 1900 the vote stood : Republican, 822,013 ; Democratic, 678,462 ; Socialist-Labour, 12,621 ; Prohibitionist, 22,077 ; Social Democratic, 12,869 â€” a Eepublican plurality of 143,551. The pluralities of 1896 and 1900 are to be ascribed largely

to the overwhelming sentiment in favour of the mainten- ance of the gold standard. Party preponderance in the state's delegation in the national House of Representa- tives has often shifted. Since 1860 only three of the United States senators from New York have been Demo- crats. Democratic governors were elected in 1874, 1876, 1882, 1886, 1888, and 1891; Republican governors, in 1879, 1894, 1896, 1898, and 1900. Local causes have sometimes produced marked results in gubernatorial con- tests, as when Cleveland (Democrat) received in 1882 a plurality of 192,864, and Morton (Eepublican) received in 1894 a plurality of 156,108. Since 1876 the control of the legislature has rested about four-fifths of the tiine with the Republicans, and since 1894 inclusive continuously.

During the war with Spain, New York furnished 20,870 men to state volunteer organizations, 3400 (estimated) to the United States navy, 2000 (estimated) to United States volunteer organizations, and 3000 (estimated) to the regular army, making a total of 29,270. The volunteer organizations included 210 cavalry and 325 artillery.

Constitution.â€" The present constitution was adopted 6th November 1894, and came into force 1st January 1895. Its main features are : â€" Separation of city from state and national elections ; safeguards against abuses in legislative procedure, and against abuse of the elective franchise ; provisions for the preservation of the forests ; prohibitions of gambling; abolition of the statutory limitation of the right of recovery for injuries causing death to $5000 ; a new apportionment of senate and assembly districts, under which (1) no county may have more than three senators unless it shall have a full ratio for each senator, although smaller counties may receive a senator, or an additional senator, on a major fraction of a ratio, and (2) no county shall have more than one-third of all the senators, and New York and Kings counties together not more than one-half of all ; the strengthening of civil service reform; the prohibition of the contract-labour system as to convicts ; authority to improve the canals ; provisions for free public schools, and prohibition of use of public money in aid of sectarian schools ; the revision of lAe judiciary system ; provision that there shall be a naval as well as a land force of militia, and that the militia shall not be reduced below 10,000 men. Suffrage is extended to every male citizen, 21 years old, who has fulfilled certain conditions of residence, and

who is not legally disqualified. Legislative power is vested in the Senate and Assembly, the former consisting of 60 members, chosen for two years, and the latter of 150, chosen for one year. Each member of the legislature is allowed a salary of f 1500 a year, and a limited amount for travelling expenses. Restrictions are placed on private or local legislation, and on the debt-incurring power. The legislature meets every year on the first Wednesday in January. The executive power is vested in a Governor, who holds office for two years. A Lieutenant-Governor must be chosen at the same time and for the same term. The Governor is commander-in- chief of the military and naval forces of the state; has the right of appointment, with the advice and consent of the Senate, of different officials ; has the right of removal, generally after hearing, of various state and local officers ; and has power to fill vacancies. He has also extensive

pardoning power. He is required to send an annual message to the legislature, may convene the legislature in extraordinary session, and possesses a limited veto in legislation. He receives f 10,000 a year and a furnished residence. The Lieutenant-Governor, except when he becomes Governor, is president of the Senate, but has only a casting vote. The constitution provides for the election of a Secretary of State, Comptroller, Treasurer, Attorney-General, and State Engineer and Surveyor. The Superintendent of Public Works, the Superintendent of State Prisons, the State Board of Charities, the Prison Commission, and the Lunacy Commission are appointed by the Governor, with the advice and consent of the Senate. Appointments and promotions in the civil service are, by the constitution of the state, required to be made according to merit and fitness â€” to be ascertained, so far as practicable, by competitive examinations ; but a prefer- ence in appointment and promotion, without regard to their standing in the list, is given to honourably-dis- charged soldiers and sailors of the Civil War. In 1900, 3190 persons were examined in the competitive merit class.

Judiciary. â€” The state is divided into four judicial departments, in each of which there is an Appellate Division of the Supreme Court. The justices

composing the Appellate Division in each department are designated by the Governor from all the justices elected to the Supreme Court, but a majority of them must be residents of the department, as must the presiding justice, who is designated by the Governor. By the constitution of 1894, the Superior Court of the city of New York, the Court of Common Pleas for the city and county of New York, the Superior Court of Buffalo, and the City Court of Brooklyn, were abolished, and their jurisdiction, original and appellate, transferred to the Supreme Court and its appellate divisions. The justices of the Supreme Court are chosen at the general election for terms of fourteen years. Circuit courts, and courts of oyer and terminer, were abolished, and their jurisdiction vested in the Supreme Court. The Supreme Court has general jurisdiction in law and equity. The Court of Appeals was continued. It consists of the chief judge and six associates, all chosen by the electors of the state for fourteen years. Five constitute a quorum, and the con- currence of four is necessary to a decision. Jurisdiction, except where judgment is of death, is limited to the review of questions of law. The legislature may restrict the jurisdiction of the court, but cannot make the right to appeal depend upon the amount involved. The exist- ing county courts were continued. Courts of Sessions, except in the county of New York, were abolished from and after 31st December 1895, and their jurisdiction was transferred to the county courts. The Surrogates courts were continued. The electors of the several towns elect justices of the peace. Inferior local courts not of record, with civil and criminal jurisdiction, may be established by the legislature.

Local Government. â€” The state is divided into 61 counties, in each of which, unless it be coextensive with a city, there is a board of supervisors. The constitution provides for the election of the sheriffs, clerks of counties, district attorneys, and registrars by the electors of the respective counties ; but any of them may be removed by the Governor after giving to such officer a copy of the charges against him, and an opportunity of being heard in his defence. All county, city, town, and village officers, whose election or appointment is not provided for by the constitution, are, at the discretion of the legislature, to be chosen by the electors of the various divisions, or appointed by such authorities thereof as the legislature shall designate. No county or city is, as a rule, allowed to ‘become indebted to an amount exceeding 10 per cent, of the assessed valuation of its taxable real estate.

The cities are classified as follows ; â€” Ist class, those having 260,000 or more inhabitants ; 2nd class, 60,000 to 250,000 ; 3rd

class, all other cities. By the census of 1900 Greater New York and Buffalo come within the 1st class ; Rochester, Syracuse, Al- bany, Troy, and Utica within the 2nd ; and the rest in the 3rd. By a law of 16th July 1898 the counties of New York, Kings, Queens, Richmond, and Westchester were constituted a Metropol- itan Elections District, at the head of which was placed a superin- tendent, whose duty it is to prevent violations of the laws relating to elections.

MilUia.â€” This includes aU able-bodied male citizens between the ages of 18 and 45, who are residents of the state, subject to any exemptions created by federal or state law. By the con- stitution, there shall be maintained at all times a force of not less than 10,000 enlisted men, fully uniformed, armed, equipped, disciplined, and ready for active service. Under the Act of 2nd April 1898, the militia of the state consists of two parts â€” the active, comprising the organized and uniform forces known as the National Guard and Naval Militia, and the reserve, consisting of the rest of the militia. In times of peace the National Guard shall be not less than 10,000 and not more than 18,000 enlisted men. On 31st December 1901, 41 armouries were owned by the state, 16 by counties, 1 by the 7th regiment, and the United States was furnishing the use of two ships for the 1st and 2nd Naval Battalions. There was one state arsenal, in New York City.

Correction.â€” By the constitution the legislature is required to provide for the occupation and employment of prisoners sentenced to the state prisons, penitentiaries, gaols, and reformatories, but the products of this labour may be disposed of only to the state or a political division thereof, or to or for public institutions of the state. The penal institutions of the state include the state prisons at Sing Sing, Auburn, and Clinton, the Elmira Reforma- tory, the Eastern Reformatory at Napanoch, the reformatory for women at Bedford, the house of refuge for women at Albion and Hudson, the six penitentiaries situated at New York, Brooklyn, Albany, Syracuse, Rochester, and Buffalo, the county gaols, the state industrial school at Rochester, the house of refuge for juvenile delinquents at New York, and the state hospitals for insane convicts at Matteawan and Dannemora. In the

fiscal year ending 30th September 1901 the daily average number of convicts in the three state prisons was 3492, as against 3468 in 1900. On 1st October 1901 the number of inmates of the various penal in- stitutions was : three state prisons, 3323 ; Elmira Reformatory, 1276 ; Eastern Reformatory, 234 ; houses of refuge for women, 359 ; six penitentiaries, 2206 â€” total 7398, a decrease of 2453 since 1805. Including gaols and workhouses, the total prison population was 11,157, a decrease of 1504 since 1st October 1895. For the year ending 30th September 1901 the cost of care and maintenance of the three state prisons was $483,644 ; the net earnings of the convicts amounted to $45,441. At the Elmira Reformatory in- struction is given in trades, manual training, physical training, military organization, letters, and religious exercises. Three char- acteristics of the system there employed are (1) the indetermin- ate sentence, (2) the parole or conditional release, (3) the grades and marking system. The results have been highly satisfac- tory. The condition of the county gaols and of the penitentiaries in 1898 was pronounced by the Pi-ison Commission to be very bad. The Commission's report for 1901 states that " marked progress has been made during the year in the work of gaol im- provements."

Sanitation. â€" The health of the state is cared for by the Boai'd of Health and the Board of Commissioners of Quarantine. During 1900 there were 130,268 deaths reported for the state, making a death-rate of 17-9 per thousand of the reporting population, as against 19-6 in 1890.

Care of the Insane. â€" The whole number of committed insane in the state, 30th September 1900, was 23,778, an increase of 756 over the previous year. Of these, the whole number in state hospitals, including the Matteawan state hospital for insane criminals (752 patients), was 22,840 ; on 1st October 1899 there were 21,436 inmates of the state hospitals ; on 1st October 1900, 22,088. There are 11 state hospitals, besides that at Matteawan, situated at Utica, Willard, Poughkeepsie, Mid- dletown, Buffalo, Binghamton, Ogdensburg, Rochester, Long Island, New York, and Gowanda. In 1900, of those discharged, 1029 had recovered, 1249 were handed over to the custody of friends or public officials, and 40 were adjudged not insane. The expenditures for the year ending 30th September 1900 for the support of the state hospitals were $3,594,873, or Â§164.79 per inmate.

Charities. â€” By the constitution the legislature is required to provide for a State Board of Charities, which shall visit and inspect, with certain exceptions, all institutions, state, county, or municipal, which are of a charitable, eleemosynary, correc- tional, or reformatory character, and institutions for epileptics or idiots. There are 14 state institutions subject to the authority of the Board, situated at Rochester, Syracuse, Batavia, Newark,

Bath, Iroquois, Albion, Bedford, Rome, Sonyea, Oxford, Hudson, and Tarrytown, and in the Adirondacks. The receipts of these institutions for the fiscal y^ar ending 30th September 1900 amounted to 81,346,720 ; tlieir expenditures to $1,251,223, $837,070 being for maintenance and 8380,000 for improvements, while $36,553 were returned to the state treasurer. The number of their beneficiaries was 7056. Besides these, there are ten other institutions, mainly supported by state appropriations, but under private management. The receipts of these institutions for the fiscal year ending 30th September 1900 were : from cash in hand, $63,925 ; from public sources, $612,471 ; from private ‘sources, $307,699 ; their expendi- tures aggregated $940,189. The total number of their beneficiaries was 3273. Provision is made for the separate care of idiotic and feeble-minded persons. Besides state institutions, the Board also has under its control over 1000 other institutions, societies, and associations under private control, including hospitals, homes, dispensaries, orphan and other asylums, reformatories, day nurseries, general and special relief societies, and other charitable organizations. The almshouses are county, city, and town institutions. Their inspection in 1900 showed general improve- ment. The number of inmates of the county almshouses on 1st October 1899 was 5496 ; on 1st October 1900, 5472. Of the lat- ter, 754 were able-bodied ; 3603 sick or infirm ; 35 insane ; 621 feeble-minded or idiotic ; 152 epileptic ; 154 blind ; 75 deaf ; 78 minors. The total number of persons supported during the year was 15,780. Of these, 8172 were native, 7608 foreign. The total expenditures in direct connexion with the almshouses were $762,572. In the city and town almsh6use institutions, on 1st October 1899, there were 7476

inmates ; on 1st October 1900, 7364. The total supported during the year was 70,409. Of these, 30,915 were native, 39,494 foreign. The total expenditures in direct connexion with these almshouses were $1,495,519. The number of persons receiving temporary relief during the year was 209,092, and the total expenditures were $1,120,876. The number and classification of beneficiaries in institutions subject to the supervision of the Board, on 1st October 1900, was as follows : â€” Aged and friendless persons, 3368 ; almshouse inmates, 10,794 ; blind, 641 ; deaf, 1672 ; dependent children, 26,998 ; disabled soldiers and sailors, 1969 ; epileptics in almshouses, 357 ; epileptics in Craig Colony, 612 ; hospital patients, 6217 ; idiotic and feeble-minded in almshouses, 1257 ; idiotic and feeble-minded in state institutions, 1312 ; juvenile offenders, 3658 ; inmates of reformatories, 1800; total, 60,655. During the year ended 30th September 1900 the institutions under the supervision of the Board had an income of $17,312,302. They expended S16, 107,496, and owned real and personal property conservatively estimated to.be worth $66,805,054. *

Education. â€” By the constitution the legislature is required to maintain a system of free common schools, wherein all the chil- dren of the state may be educated. The use of public money in aid of sectarian schools is forbidden. The public schools are under the supervision of a State Superintendent of Public In- struction, and of local commissioners and superintendents. Be- sides the state normal college at Albany, there are state normal and tra,ining schools at Brockport, Buiialo, Cortland, Fredonia, Geneseo, Jamaica, New Paltz, Oneonta, Oswego, Plattsburg, and Potsdam. On 31st July 1900 there were in the state 11,740 school districts. The number of licensed teachers employed for the legal term of 160 days during the preceding year was 31,768. The number of children of school age was 505,018 in the towns and 1,064,635 in the cities â€” a total in the state of 1,569,653. The number of children attending school some portion of the year was in the towns 454,215 and in the cities 755,359 â€” making a total of 1,209,574 for the state. The average daily attendance in the towns was 305,800 and in the cities 551,688, showing an average attendance for the entire state of 857,488. The amount paid for teachers’ salaries was $19,218,892, and the average annual salary was $604. The sum of $1,030,393 was expended for buildings, sites, and repairs in the towns, and $7,518,250 in the cities. The total reported value of the schoolhouses and

sites was $81,768,495. The total expenditures for the public schools were $33,421,491, an increase over the previous year of $5,368,500. The total expendi- tures for public educational interests directly connected with the department were $34,513,455. The University of the state of New York, incorporated 1st May 1784, and made a constitutional body 1st January 1895, is a supervisory and administrative, not a teaching institution. Its powers are exercised by nineteen elective regents, and by the Governor, Lieutenant-Governor, Secretary of State, and Superintendent of Public Instruction, who are ex officio regents. Regents are elected in the same way as United States senators, and are the only public officers in New York state chosen for life. They are unsalaried. The regents have power to incorporate, and to alter or revoke the charters of universities, colleges, academies, libraries, museums, or other educational institutions ; to distribute to them funds granted by the state for their use ; to inspect their workings, and

require annual reports under oath of their presiding officers ; to establish examinations as to attainments in learning, and confer on successful candidates suitable certificates, diplomas, and degrees. On 30th June 1900 the institutions In the University included 34 colleges, 76 professional and technical schools, 140 academies, 565 high schools, and 175 libraries. During the fiscal year ending 30th September 1900 there was expended for academies $2,018,953, for high schools .$4,077,420, for colleges and for pro- fessional and technical schools, $7,663,037.

Churches.â€” By the census of 1890 there were in the state 8237 religious organizations, 7942 church edifices, church property of the value of $140,123,008; and 2,171,822 church members or communicants. Membership and property were distributed as follows : â€”

Denomination.

Baptist

Catholic .

Congregationalist

Friends

Jewish

Lutheran .

Methodist .

Presbyterian

Protestant Episcopal

Reformed

Unitarian .

Universalist

Wealth. â€” By the census of 1890, New York stood easily first in the valuation of real estate and improvements, gold and silver, coin and bullion, machinery of mills and product on hand (raw and manufactured), railways and equipments, telegraphs, tele- phones, shipping, canals and improvements, and miscellaneous property. She stood third in the value of live stock on farms, farm implements, and machinery ; and ninth in the value of her mines and quarries, including the product on hand. The follow- ing table shows the proportionate valuations of real and personal property for the purposes of taxation from 1875-1900 : â€”

Membership.

Property.

142,736

$13,625,688

. 1,153,650

26,769,478

45,686

5,175,262

7,078

767,450

45,807

4,315,200

89,046

4,693,375

265,551

18,306,200

168,564

22,727,192

127,961

31,142,613

55,973

7,698,280

4,470

1,717,500

8,626

1,798,260

Tear.

Assessed Valuation,

Eeal Property.

Assessed Valuation, Personal Property.

Total Assessed Valaation, Keal and Personal Property.

Percent- age, Real Property.

Percentage, Personal Property.

1875 _1880 1885 1890 1896 1900

1,960,352,708 2,315,400,626 2,762,848,218 3,298,323,981

S,Â«41,582,748

4,811,598,059

407,427,399 322,468,712 832,388,289 885,829,181 460,499,419 649,709,698

$ 2,367,780,102 2,687,869,238 8,094,781,467 8,688,653,062 4;292,082,167 5,461,302,752

82-8 87-8 89-3 89-6 89-6 88-1

17-2 12-2 10-7 10-5 10-5 11-9

The extreme undervaluation, of personal property especially, is evident.

Finances. â€” The debt of the state, 30th September 1901, was $10,075,660. The capital of the several trust funds belonging to the state was : Common School Fund, $4,573,140 ; Litera- ture Fund, $284,201 ; United States Deposit Fund (1837), $4,014,520; Military Record Fund, $39,121â€” total 88.910,982. The balance in the treasury, 1st October 1900, was $7,289,802; receipts from all sources during the fiscal year, $i^,544,694 â€” total, receipts and balances; $37,834,496. The total receipts, however, include temporary loans, transfers to and from various funds, and transactions on account of trust funds. Deducting these, the receipts would amount to $27,704,817, practically representing the â€¢ product of taxation. The payments for all purposes amounted to $28,046,146, leaving in the treasury, 30th September 1901, $9,789,350. The general property tax, at the rate (1900) of 1^ mills on the dollar, amounted to $10,704,163. The receipts from indirect taxes were $16,565,890. Of the latter, the tax on corporations yielded $4,966,680 ; on transfers of property, $4,084,606 ; licences for the sale of liquors, $4,197,858. The appropriations for the year were : for

General Fund, $11,814,481 ; for Canal Fund, $1,760,921 ; for School Fund, $4,225,500 ; for the insane, $4,506,706â€” total, $22,307,607. The liquor-tax law of 1896, since amended, divided licence taxes into six grades : for cities of 1,500,000 or more, $800 ; of 600,000 or more, $660 ; of 60,000 or mor^, $500 ; of 10,000 or more, $350 ; of 5000 or more, $300 ; of 1200 or more, $200. In any other place the tax is f 100. There are different rates for places where liquors are not to be drunk on the premises. In the law there were also local option provisions. For the fiscal year ended 30th September 1901 the net receipts from liquor licences, fines, and penalties were $12,416,046. Of this the state received $4,198,377 ; towns and cities, $8,216,669. The number of licences issued during the last year of the old law, 1895-96, was, in the cities, 22,937 ; out- side cities, 10,320â€” total, 33,257. The number of certificates (saloon, hotel, and club) in force, 30th April 1901, was 26,835.

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Banking. â€” On 12th September 1901 there were 195 banks of deposit and discount in tlie state system, having capital stock, $28,245,700; surplus funds and undivided profits, $29,176,768. The total resources of such hanks, 12th September 1901, were ft403,477,311; of savings banks, 1st July 1901, 81,105,076,764; of trust companies, $966,528,398 ; of safe deposit companies, $5,475,091 ; of foreign mortgage companies, 1st January 1901, $5,690,620 ; of building and loan associations, $59,653,737 â€” total, $2,545,901,921, an increase of $283,899,506 over the previous year. On corresponding dates in 1900 the total resources of the same classes of institutions amounted to $2,185,433,300, an increase of $121,116,072 over the previous year. On 30th September 1901 there vpere 341 national banks in operation in the state, witb an aggregate capital of $104,828,290 and a combined surplus and undivided profits of $107,792,289. There has been a large increase in the organization and business of trust Companies with banking functions. The reports of these institutions, 31st December 1900, showed, among total resources of $797,983,512, loans on collateral, $387,911,415 ; on personal securities, $39,840,060 ; in stock investments, $196,852,583 ; bonds and mortgages, $10,730,576 ; cash on deposit with

other banks, $96,337,243 ; while they showed, among liabilities, general deposits of $392,753,744 ; deposits in trust, $245,367,996 ; surplus funds, $76,123,784 ; capital stock, $47,150,000. These figures show an increase, as compared with the year before, of $59,700,000 in loans on collateral security, of $25,700,000 in cash on deposit with other banks, of $28,600,000 in stock and bond investments, of $31,800,000 in trust deposits, and of $82,700,000 in general deposits. The reports of trust companies, 1st July 1901, showed total resources of $966,528,398 ; deposits, $802,518,096 ; aggregate capital, $47,450,000 ; surplus and undivided profits, $98,391,728 ; earnings for six months, $22,159,857 ; expenses, including interest and taxes, $11,828,393. In 1890 building and loan associations were placed under the suijervision of the Superintendent of Banks. The whole number on the official list, 31st December 1898, was 373, of which 360 were building and loan associations and 13 building lot associations. About 1888 there sprang up in New York state a new type called “national,” whose loaning territory is not limited, and who have soliciting agents. There were 48 of these on the list. The assets of the “nationals ” were $17,729,057 ; of locals, $30,905,857â€” total, $48,634,914.

Insurance. â€” During the year ending 30th September 1900 the total receipts of the insurance department were $297,944 ; total expenditure, $183,752. The gross receipts of life and casualty companies doing lausiness in the state were $392,358,740. The disbursements were $261,467,238, as follows: $120,945,587, paid in claims ; $22,190,804, lapsed and suspended policies ; $22,568,260, dividends to policy-holders ; $980,562 dividends to stockholders ; $45,223,551, commissions; $23,458,090, salaries and medical examiners’ fees; $26,100,380, miscellaneous purposes. The business done in the state during 1900, including “industrial” business, was as follows: policies in force, 3,320,149, insuring $1,476,150,662 ; issued during 1900, 898,073, insuring $332,173,010 ; premiums received, $54,775,074; claims incurred, $21,896,164; claims paid, $21,921,741. For the fire and marine companies the receipts during the year were $158,934,378, the disburse- ments, $155,803,510, being less than the receipts by $3,130,868. In business done in the state the fire premiums received were $22,867,152; fire losses incurred, $16,377,644; tire losses paid, $16,040,452 ; estimated expenses of business, $7,622,383 ; showing,

on the whole, an apparent net excess of fire losses incurred and estimated expenses over fire premiums received of Â§1,132,875. The receipts of fraternal organizations were $41,178,094, and disbursements $38,549,276. The receipts of co-operative associa- tions were $10,222,172 ; payments for claims, $6,613,074 ; and for expenses, $2,589,763. The following table gives other im- portant statistics : â€”

Number nf Companies.

Assets.

Liabilities ex- cept Capital.

Capital.

Surplus.

Eisks in Force.

Fire (169) . Marino (18) . Life (40) . Casualty (3 1)

•

818,87M20

n,407.r,liK

l,723,7:iT,72.;

47,:l2(vi“‘9

i

148,200,787

4,012,649

1,606,459,781

18,805,706

79,269,289

200,000

10,340.500

14,894,000

$ 107,034,939

12,.V.I5,019

158,277,942

18,566,692

$

22,428,834,216

021,203,991

8,345,:!79,158

4,416,101,864

Tolai^ (ij3) 2,102,847,070

1,737, 13-1 f-:’.:”’.

104.093,73!)

291,174,492

86,800,079,214

Transportation. â€” The state canal , system comprises the Erie, Oswego, Champlain, C^ayuga and Seneca, and Black river canals, having a total

length of ()38 miles. The privately-owned Delaware and Hudson canal, from Rondout to the Pennsylvania state line, has been almost entirely abandoned. The Erie canal, extending across the state and forming a low-level route to the west, largely contributed to tlie commercial supremacy of city and state. Lately its relative importance has rapidly declined. In 1890

the value of property transported on all the state canals was $145,761,068, including $112,470,461 on the Erie; in 1900 it was only $84,123,772, including $66,903,696 on the Erie. In 1890 there went from tide-water, by the canals, 1,304,274 tons ; in I'.tOO, 834,481 tons. In 1890 there arrived at tide-water, by the canals, 2,846,980 tons; in 1900, 1,340,631, comprising, by way of the Erie, 596,246 tons from western states and 341,001 from New York, and by the Champlain canal, 134,798 tons from Vermont and Canada and 208,586 from New York. In 1868, 44 per cent, of the tonnage across the state was canal-borne ; in 1898, 5 per cent. A committee of experts in 1900 recommended the enlarge- ment of the Erie canal at a cost of $58,894,668, so as to admit 1000-ton boats. The railway facilities of the state show steady improvement. On 30th June 1901 the length of steam railways (not includins; second track, sidings, or turnouts) in operation was 8143 miles. Of elevated railways (all in Greater New York) there were 73 miles. Of surface lines there were 1545. Only 70 miles of surface lines were worked by horses. The expenses of the steam railways per mile worked, for the year ending 30th June 1901, were, for maintenance of way and structure, $2045 ; for maintenance of equipment, $2100 ; for conducting transportation, $6345; for general expenses, $375; total, $10,805. Eor all the railways doing business in New York the entire passenger train mileage was 79,129,682; the freight mileage, 80,794,862; all other mileage, 31,563,264 ; the number of passengers carried, 199,358,549 ; the tons of freight carried, 197,041,867. The passenger profit per mile worked was $1040 ; the freight profit, $3886 ; the gross earnings, $15,793 ; the net earnings, $4926. In 1900 the st^te appropriated $150,(X)0 for good roads, and in con- sequence 23 roads, covering 53-8 miles, were constructed at a cost of $377,594, one-half being paid by the localities.

Commerce. â€" The value of the foreign imports into the port of New York was, of dutiable goods, in 1900, $304,855,071 ; 1899, $294,505,183; of free goods in 1900, $221,251,710; 1899, $224,290,748; of specie and buUion in

1900, $29,039,486; 18!I9, $31,191,223. The value of exports to foreign ports was, of domestic exports in 1900, $526,153,270; 1899, $467,554,122; of foreign exports in 1900, $12,090,402; 1899, 89,059,156; of specie and bulhon in 1900, $102,933,991 ; 1899, $84,729,255. The total foreign imports were valued at, in 1900, $555,146,267 ; 1899, $549,987,154; the total exports in 1900, $641,177,663; 1899, $561,342,533. For the fiscal year ended 30th June 1900 the value of the imports and exports of the port of New York was $1,168,785,559, of which $140,638,207 was carried in American vessels, $1,024,613,977 in foreign vessels, and $3,533,375 in land vehicles. Of the entire $233,164,871 received from duties at all the ports of the United States in the year ended 3rd June 1900, $152,333,877 was received at the port of New York. Of 34,014 vessels, with a tonnage of 28,163,005, which entered all United States ports in the same year, 12,287, aggregating 10,169,040 tons, entered the ports of the state of New York. Of 23,333 vessels with a tonnage of 5,164,839, registered, enrolled, and licensed in the United States, 30th June 1900, 4988, aggregating 1,354,444 tons, belonged to New York ports.

Manufactures. â€” By the census of 1900 New York stood first in manufactures. Out of a total production of $13,040,013,638 for the whole Union, that of New York was $2,175,766,900. The number of establishments reporting was 78,659 ; capital value, 81,079,906,515; wage-earners, 849,092; wages, $408,804,952; salaried officials, 74,482 ; salaries, $82,077,648. In 1890 the number of establishments was 65,840 ; capital value, SI, 130,161, 195 ; value of product, $1,711,577,671 ; wage-earners, 752,066 ; wages, $370,380,559 ; salaried ofBcials, 98,018 ; salaries, $90,400,083. Out of the 369 industries specified in the census of 1890, New York, in value of product, was first in 164, second in 60, third in 36, fourth in 13, and of importance in almost all. Industries whose product was valued at $20,000,000 or more were baking (bread, &c.), carpentering, chemicals, men’s clothing (factory-made), women’s clothing (factory-made), roasting and grinding of coffee and spices, flour and grist mills, foundries and machine shops, furniture, hosiery and knitted goods, leather, malt liquors, lumber, masonry, plumbing and gas-fitting, printing and publishing (book and job), printing and publishing (newspapers and periodicals), and tobacco, cigars, and cigarettes.

Labour.â€” In 1901 the Bureau of Labour Statistics, the Stati' Factory Inspector's Department, and the Board of Mediation and Arbitration ^Yere superseded by a Department , of Labour. A free public employment bureau was opciiud in New York City in 1890. On 30th September 1901 there were 1881 labour organizations in the state, with a membership of 276,141 personsâ€" 201,523 men, 14,018 women. The whole number of wage-workers was estimated in 1898 at 1,755,000. The general average of wages for organized labour for seven quarters (four in 1897 and three in 1898), per quarter, ^^â– as $167 for men and $80 for women. In 1898,

as compared with 1897, there was a general increase in the earn- ings of men, but an opposite tendency in those of women ; the average quarterly earnings of men approximated, in 1899, $187 ; 1900, |179 ; 1901, $189. Children under 14 are forbidden to be employed in factories. Children between 14 and 10 may be so employed on the certificate of a health officer.

Agriculture. â€" By the census of 1890 New York stood third in the number and in the valuation of farms, second in the value of farm products, and seventh in the number of improved acres. The num- ber of farms was 226,223 ; their valuation. Including implements, machinery, and live stock on hand, $1,139,310,710 ; the value of their product, $161,593,009. The live stock included 004,430 horses, 4386 mules, 37,293 working oxen, 1,440,2.30 milch cows, 653,869 other cattle, 843,342 swine, and 1,528,979 sheep, not including spring lambs. The product of wool was 6,715,686 lb. Dairy pro- ducts, in which, New York stood easily first, embraced 663,917,240 gallons of milk, 98,241,813 flj of butter, and 4,324,028 lb of cheese. The state also stood first in buckwheat, 4,675,735 bushels ; Irish potatoes, 24,616,736 bushels ; maple syrup, 457,[58] gallons ; hops, 20,003 lb ; pears, 588,767 bushels ; grapes for the table, 60,687 tons : second in hay, 6,675,658 tons ; maple sugar, 10,485,623 lb ; grapes for wine, 15,172 tons, making 2,528,250 gallons of wine : third in honey, 4,281,964 lb ; rye, 3,065,623 bushels : fourth in wax, 60,654 lb ; bar- ley, 8,220,242 bushels ; apples, 8,493,846 bushels : seventh in plums and prunes, 73,411 bushels : ninth in oats, 38,896,479 bushels :

tenth in tobacco, 9,316,135 lb : seventeenth in wheat, 8,304,639 bushels: twenty-first in Indian corn, 15,109,969 bushels. In market- garden products, including small fruits, she stood lirst, with a valua

tion of $3,400,172. The production of cereals, hay, and potatoes was as follows in 1900 : barley, 3,751,942 bushels ; buckwheat, 3,280,158 bushels; Indian corn, 17,236,032 bushels ; oats, 44,538,974 â€¢bushels ; rye, 3,189,165 bushels ; wheat, 6,496,166 bushels ; hay, 3,3-‘il,991 tons ; potatoes, 27,481,356 bushels.

Forestry. â€” On 30th September 1899 the state owned, in the TorestPreserve, 1,200,673 acres. On 15th November 1900 the ag- gregate was 1,. 327,315 acres, of which 1,250,803 were In the “Adirondack Preserve” and 76,512. in the ” Catskill Preserve.” Of the increase, 125,478 acres were purchased at a cost of $381, ~~320, an average of $3 an acre. The purchases for the Cats~~ kill Preserve, in the year ended 30th September 1900, amounted to 18,126 acres and cost .542,817, an average of over $2 an acre. On 30th September 1901 the aggregate owned by the state was lj408,181 acres, of which 1,325,851 were in the Adirondack Preserve and 82,330 in the Catskill Preserve. Purchases in the Catskill region during 1901 amounted to 5605 acres, at an aver- age of over Â§2 per acre. The Adirondack Park was increased by 36,458 acres, at nearly .$4 per acre. Of this park, comprising 3,226,144 acres, the state owns 1,163,414 acres. The assessed valuation of the state lands in the Forest Preserve counties in 1901 was $2,459,223. The New York State College of Forestry, which constitutes a department of Cornell University, has the use of a large tract in the Adirondack Preserve.

Fisheries. â€” By the census of 1890 New York stood fourth in fisheries products, with a valuation of $3,798,815, as against $4,380,565 in 1880. In the Menhaden fisheries she still stood first, although in 1880 the value of their product was $1,114,158, and in 1890 only $628,212. In the oyster fisheries she stood third, with a valuation of $1,765,088, as against $1,577,050 in 1880. She stood fifth in her general fisheries, the value of their product being $1,396,767, as against $1,689,357 in 1880. In 1889 the number of persons employed was 9321 ; in 1880, 7266. In 1889 the capital employed was $5,125,361 ; in 1880, $2,629,585. In 1889 the number of vessels employed was 809, net tonnage 9770, value, $1,052,192; in 1880, the number of vessels was 541, tonnage, 11,582 ; value, $777,600. In the

value of inland fisheries New York by the .census of 1890 stood sixth, with a valuation of $82,412 ; in the products of the Great Lake fisheries she stood fifth, with a valuation of $165,116. The Fisheries, Game and Forest Commission is charged with the duty of stocking the waters of the state.

Mineral Resources. â€” According to the census of 1890, New York in 1889 stood sixth among the states in the value of her mineral productions, which embraced iron ores, petroleum, natural gas, stone, gypsum, graphite, corundum, salt, and mineral waters, and were valued at $24,156,206 out of a total of $587,230,662. In 1898 she stood fifth in clay products, including various kinds of- brick, tile, sewer pipes, ornamental terra-cotta, fire-proofing, and pottery, valued at $0,448,989. In 1899 she stood fifth in limestone, valued at $1,545,669; fourth in marble, valued at $338,816 ; second in sandstone, valued at Â§1,218,053 ; and first in mineral waters, with a value of $809,056. Slate for roofing and other purposes is obtained in abundance in the slate belt in eastern New York and western Vermont, and the only cherry-red slate found in the world is in New York. The pro- duction of fibrous talc in the United States is carried on ex- clusively in St Lawrence county. Colourless tourmaline is found

at Dekalb.’ The granite product decreased from $516,847 in 1898 to .Â§306,711 in 1899; natural gas increased from .Â§229,078 to .52y4,.’’,93 ; petroleum, from 1,205,2.50 brls. to 1,320,909 brls., while the price rose from 91J cents per brl. to Sl-29|. In 1899 New York stood sixth in the value of iron ore production, the total product being 443,790 long tons, valued at $1,241,985, including 344,159 long tons of magnetite, 45,503 tons of red and 31,975 of brown haematite, and 22,153 tons of carbonate. The increase of total product over 1898 was 263,839, or nearly 150 per cent. In 1880, 1890, and 1900 New York and Michigan produced more than half the salt mined in the United States.

AtiTHOHiTiEs.â€” New York State ‘BQunianesâ€” Bulletin of the New York Public Library, vol. iv. No. 11, pp. 359-378. Topo- graphy and Climate â€” Annual Report of the New York Weather Bureau for 1896, part vi. Mineral Resourcesâ€” Frederick ,J. H. Merrili,. “Mineral llesources of New York State,” Bulletin of the New York State Museum, vol. iii. pp. 360-595 ; Schedule of City Laws, Special Report of the Commissioners of Statutory

Revision. Trade and Finance â€” The Annual Reports of the Chamber of Commerce. Other subjectsâ€” The Annual Reports of the various State Departments and Commissions, the Reports of Committees of the Legislature, the Annual Messages of the Governors, and the Legislative Manuals. (j. b. m*.)

New York City, the largest city of the state of New York, U.S.A., and of the United States. According to the United States census of June 1900, the city of New York contained a population of 3,4.37,202. Its population by the census of 1890 was 1,515,301. The immense growth of the decade, as shown by this com- parison, was due largely to a change of boundary lines in “the year 1897, by virtue of which there was annexed to the city of New York the populous city of Brooklyn, which in 1890 had a population of 806,343 (or, including suburbs annexed soon afterwards, 838,647), and which, at the time of its absorption into the metropolis, had a popu- lation of over 1,000,000. The original town, named by its Dutch founders New Amsterdam, had been situated at the extreme south end of Manhattan Island, and its growth had been gradually northwards, involving the absorption, of several villages, until at length ‘“P”’^^’”” the boundaries of the city had become co- terminous with those of the island and of the county of New York. Manhattan Island is 13^ miles long, and has an average width of If miles. Its total area is 21 square miles. By an enactment of May 1873, which came into effect on 1st January 1874, there was added what for some time afterwards was known as the Annexed Dis- trict, this being an area somewhat less in extent than Manhattan Island, directly to the north, between the Hudson river on the west and Long Island Sound on the east. Some slight further additions were made in 1896 in rectification of the boundaries of this Annexed Dis- trict, and thus the total area in 1897, before the larger consolidation was effected, was 40-22 square miles. The area of the enlarged city, by virtue of the Act which came into effect on 1st January 1898, is 307^ square miles. The great extent of this area is due to the inclusion of (1) a large part of the suburban county of Queens, adjacent to the city of Brooklyn, comprising about 123-98 square miles; and (2) Staten Island, which had constituted Eichmond county, and which lies between the Upper Bay of New York and the ocean, with an area of 57-19 square miles and a comparatively small population.

As constituted by this important enactment, the area and jurisdiction of the city of New York include all that pertains in the strict sense to the metropolis and the greater part of what may be regarded as the suburban belt â€” in so far as the state of New York is concerned. It happens, however, that the Hudson river, which forjns the western boundary line of Manhattan Island, separates the state of New York from the state of New Jersey ; and on the New Jersey side of the Hudson river very import- ant residential and manufacturing suburbs have grown

NEW YORK CITY.

1. Art Museum

2. Barnard College s. Carnegie Music Hall i. College of the City of Neua Yorfc

6. Columbia University e. Cooper Institute

7. Morningside Heights

8. Natural History Museum

9. Neuj York Public Library

10. Normal College

11. Brooklyn Institute

12. Pratt Institute __S”^” Boundary of Greater New York .â€” â€” Boundaries of Boroughs

Scale of Miles ^ J ^ ^ ^ ? f

:i A: LLH.k.ureU i

up, which would have been included as a part of the new metropolitan aggregation but for the practical impossibility of uniting in a single municipal corporation thepopulations and territories of urban districts which, though adjacent and belonging in the commercial sense to one community, are nevertheless in different states. But for this difficulty an area including Jersey City, Hoboken, Newark, Pater- son, and many smaller New Jersey towns and cities would have been comprised in the consolidation, and the metro- polis would thus at the opening of the 20th century have had an area of approximately 600 square miles and a population of approximately 4,500,000. This New Jersey population, of which, by the census of 1900, more than 1,000,000 lived within 20 miles of the New York City Hall, belongs in the commercial sense to the great com- munity quite as essentially as any other portions of the so-called Greater New York. As actually constituted, the city of New York has an extreme length north and south of about 33 miles, and an extreme width east and west of about 18 miles. The consolidation was brought about by a law bearing the following title : ” An Act to unite into one municipality under the corporate name of the city of New York the various communities lying in and about New York Harbour, including the city and county of New York, the ciby of Brooklyn and the county of Kings, the county of Richmond, and a part of the county of Queens, and to provide for the government

thereof.” This enactment for purposes of administration divided the city of New York as thus constituted into five boroughs, designated respectively Alanhattan, the Bronx, Brooklyn, Queens, and Richmond. Manhattan perpetuates the earlier boundary line of New York City, in that it includes Manhattan Island, together with a few minute adjacent islands lying in the harbour and the East river, which latter separates Manhattan Island from Long Island, which lies to the eastward. The borough of the Bronx includes what had been known as the Annexed District lying beyond the Harlem river (which forms the northern boundary of Manhattan Island), and comprises territory extending from the Hudson river on the west to the East

river and Long Island Sound on the east. The borough of Brooklyn comprises what had formerly been the city of Brooklyn. The borough of Queens (which includes Long Island City, Elushing, College Point, Jamaica, Lawrence, Ear Rockaway, &c.) consists of that part of Queens county lying on Long Island beyond the limits of the city of Brooklyn, which was included in the consolidation. The borough of Richmond comprises what had been Richmond county, and what is still locally known as Staten Island. The two boroughs of Manhattan and Brooklyn, while much smaller in extent than the other three, include the great bulk of the population. The following table shows the areas of these five boroughs, together with their population in 1880, 1890, and 1900 : â€”

Area and Population of New York City by Boroughs.

Area, sq. miles.

Population.

Increase from 1890 to 1900.

Increase from 18S0 to 1890.

1900.

1890.

1S80.

Number,

Per cent.

Number.

Per cent.

New York City

Manhattan Borough . Bronx â€ž Brooklyn â€ž Kichmond â€ž Queens â€ž

307-34

21-07 39-33 65-77 57-19 123-98

3,437,202

1,850,093 200,507

1,166,582

67,021

152,999

2,492,591

1 1,515,-301

838,547 51,693 87,050

1,901,345

1,206,299

599,495 38,991 56,560

944,611

535,299

328,035 15,328 65,949

37-8

35-3

39-1 29-6

75-7

591,246

309,002

239,052 12,702 30,490

31-0

25-6

39-8 32-5 53-9

As shown by the above summary, the boroughs of Man- hattan and Bronx, or what was formerly New York City, increased 36-3 per cent, from 1890 to 1900, as against an increase of 26-6 per cent, from 1880 to 1890. The per- centage of increase in Brooklyn borough was substantially the same from 1890 to 1900 as in the ten years preceding, being 39-1 per cent, and 39-8 per cent, respectively, while Richmond borough increased 29-6 per cent, from 1890 to 1900, and 32-6 per cent, from ,1880 to 1890. The largest percentage of increase is shown in Queens borough, which increased 76-7 per cent, from 1890 to 1900, as against 63-9 per cent, from 1880 to 1890. The rapid develop- ment of well-considered plans for the improvement of transit facilities to the suburbs in all directions has made it certain that the census of 1910 will show an unpre- cedented growth of population in the outer zones.

Not to pause here for review of the earlier history or growth of the city, it may be recalled that in the period immediately before and after the Civil War a great majority of the population was either of foreign birth or of foreign-born parentage ; and of the alien elements, the Irish and the Germans greatly preponderated over all others. The state census of 1876 showed that the popu- lation had passed 1,000,000. The numbers for 1880 had grown to 1,206,299 ; and in that year the American-born were 727,629 and the foreign-born 478,670, of whom almost 200,000 were from Ireland and more than 163,000 from Germany. Many of the American-born were, of course, children of foreign-born parents.

In view of the profound changes in the origin of the

more recent immigration to the United States, it is impor- tant to note the fact that in 1880 there were in the city of New York only 12,233 persons born in Italy, and only 4551 born in the Russian empire. The census of 1890 gave New York City a population of 1,613,601. By this time the density of the population in the more closely inhabited parts of Manhattan Island had reached a point much in excess of that of any other city in the world. The actual growth of the metropolis is in no manner truly indicated by the apparent gain of 300,000 people in the decade, inasmuch as a very large portion of the actual increase had overflown from Manhattan Island into the outer metro- politan zones on Long Island, in New Jersey, or northwards in Westchester county. The analysed returns for 1890 showed a foreign-born population of 875,358, of whom about 150,000 had come from Russia, Austria-Hungary, and Italy. Previous to 1870 the immigration from southern and eastern Europe had been insignificant. It had fairly begun before 1880, and had taken on importance in the following decade. Scarcely any one had come to America from Austria-Hungary before 1870 ; but about 350,000 had come in the decade ending in 1890, and in the last decade of the 19th century there came 697,047. Similarly there had set in a large stream from the Russian empire, chiefly Jews ; and in the last years of the 19th cen- tury the persecution of that race in Russia multiplied the number of pilgrims to America. In the years from 1890 to 1900 the number that came from Russia was 607,089. From Italy there had come to the United States about 70,000 people in the sixty years from 1820 to 1880, and

more than 307,000 in the next ten years. Erom 1890 to 1900 the Italian immigration was 655,694. Thus the Italian immigrants alone at the end of tlie century were as numerous as the Irish, Scottish, English, German, and Scandinavian all put together.

Every succeeding wave of immigration which spread across the North American continent had left some residue in New York City, and in the last

years of the 19th century the establishment of large and distinct elements of Italians and Polish Jews was as marked a fact in the

city’s social and industrial situation as the influx of Irish- men and Germans had been in the period from 1860 to 1870. Newspapers in the Yiddish dialect of the Hebrew language, and Yiddish theatres, marked the advent of hundreds of thousands of Jews.

In 1900 the composition of the population by sex, general nativity, and colour is shown by the following table. The class ” negro ” includes all persons of negro descent; the class “coloured” includes negroes, and also Chinese, Japanese, and Indians.

Borough.

Males.

Females.

I?rative-born.

Foreign-born.

White.

Coloured.

Negro.

Bronx . Brooklyn Manhattan . Queens Richmond .

Total

101,756

573,733

918,259

77,547

34,410

98,751

592,849

931,834

75,452

82,611

138,965

810,885

1,080,751

108.187

48,334

61,542

355,697

789,342

44,812

18,687

197,923 1,146,909 1,808,968

150,235 65,863

2,584

19,673

41,125

2,764

1,158

2,370

18,367

36,246

2,611

1,072

1,705,705

1,731,497

2,167,122

1,270,080

3,369,898

67,304

60,666

Out of 1,007,670 males of voting age (21 years and over) in the entire city in 1900, 460,445 were native-born and 547,225 foreign-born. Of the latter number, 300,660 were naturalized, 45,235 had filed their first naturalization papers, 152,782 were aliens, and the citizenship of 48,548 was returned by the U.S. census enumerators as unknown. Of the total 1,007,670 males of voting age, 65,566 were illiterate (unable to write), of whom 62,628 were foreign-born.

The topographical conditions undoubtedly afford the principal explanation of the unexampled density of the population on Manhattan Island. Practically the entire working-class population of what was New York City proper before the annexation of Brooklyn and the suburbs is lodged in tenement houses of an average height of five or six storeys. The width of the streets being greater than that in most of the Old World centres of dense population, there is comparatively free opj)ortunity for the circulation of air and the admission of light. Eeforms have from time to time been instituted by law in the construction and arrangement of New York tenement houses, especially as a result of an expert commission appointed in the year 1900 to advise the Governor and Legislature of the state. Erom the year 1895 to the end of the decade there was so great an advance as to constitute a transformation in the paving of New York, especially in the congested population areas â€” smooth asphalt being substituted for the former pavements of uneven stone. This movement for asphalt paving was accompanied by a complete change in the method and policy of public cleansing ; so that from the position of a city of unfavourable repute as respects cleanliness of streets and the disposal of waste. New York had become before the year 1900 famous throughout America and of good reputation among municipal and sanitary experts in ICnrope by reason of the excellence of its street cleansing and its removal and disposal of domestic waste. The importance of perfect paving and of such cleansing as to keep the streets clear of dust can scarcely be over-estimated where, as in some parts of New York, from 3000 to 5000 people live in the tall tenement houses of single blocks as constituted by the intersections of the rectangular street system.

While in the older portion of New York, at the southern end of Manhattan Island, there is sonie degree of irregularity in the character of the network of the streets, the system for most of the city is regular in the higliest degree. It consists of broad avenues running north and south on parallel lines about j of a mile apart, intersected at right angles by cross streets extending from one river to the other ^V of a mile apart. Business establishments have more and more tended to concentration at the lower end of Manhattan Island, and the’ consequence has been an ever-increasing

pressure upon facilities for transit and communication up and down the avenues. The chief problem of local transit has been Rapid the devising of means by which to bring an ever-growing transit. nmltitude of people southwards in the morning and then to send them northwards in the latter part of the afternoon. The transit system In the earlier days consisted of omnibuses and horse tramways. The first great innovation was the elevated rail- ways, which were constructed in parallel lines on several avenues in the period between 1877 and 1880, and which almost immediately found their capacity overtaxed. Surface street railways on all of the important avenues, with one exception (Fifth Avenue), were developed to such an extent as was possible with animal power, and later several of them were changed to the cable system. There was delay in the adoption of the electric trolley through the refusal of the authorities to permit the use of overhead wires. Subse- quently, however, the lines were absorbed by one great company (the Metropolitan Street Railway Co.), which entered upon a comprehensive plan of substituting the underground electric trolley for horses and cables. At the end of the year 1900 this change had proceeded so far that, of the several hundred million passengers transported annually by this company, the great majority were patrons of electrical lines.

The demand being still unsatisfied, the municipal authorities, after careful consideration, decided in 1899 upon the construction of a great underground trunk-line railway with four tracks, to begin at a point near the lower end of the city and proceed north- wards some 13 or 14 miles. At its northern end this trunk line will eventually serve several branches, and in like manner there will in all probability be connecting underground railways passing at two or three different points to Brooklyn on the east, and in due time, it may be hoped, more than one passing under the great Hudson (or North river, as it is locally called) to the New Jersey suburbs. Actual work on the construction of this great under- ground railway began in 1900. The capital for the construction of the main line was advanced by the municipal corporation itself, to the extent of $35,000,000, to a constructing and operating lessee, who was obliged to provide full interest and sinking-fund pay- ments, and at the end of fifty yeafs to deliver the railway itself (free of all financial encumbrance and of all costs, direct or indi- rect) to the municipal corporation as public property. This great undertaking in electrical transit was to be completed and in opera- tion by the year 1904. It

must have a profound influence upon the development of the northern suburbs.

In addition to this underground transit scheme which marked the end of the 19th century are to be noted the advanced plans for several additional great bridges, as well as various tunnels, to connect Manhattan Island witli New Jersey on the west and with Brooklyn and the great expanse of Long Island on the east. The first great bridge, built jointly by the cities of New York and Brooklyn, was regarded as one of the engineering wondere of the world. It was begun in 1870, and opened to tr.iffic in â€ž 1883. Some modifications and improvements introduced ” ^*”

from time to time brought its total cost up to about Â§22,000,000 in 1900. The more recent modifications had consisted of very important changes at both terminals, by virtue of which not only the surface electrical railway cars of the Brooklyn transit system were brought across to the Now York terminus at the City Hall Park, but also the cars of the Brooklyn system of elevated railways. ‘I’his arrangement, completed in 1899, added vastly to the practical capacity of the bridge as a means by which the hundreds of thousands of people living in Brooklyn and on Long Island were

enabled to reach Manhattan Island for daily purposes of business. It is estimated that about 140,000 trolley cars cross the bridge each month.

The convergence, however, of enormous systems of local transit at either end of this one bridge had made the congestion at cer- tain hours, morning and evening, almost indescribable. The great necessity for additional bridges had long been perceived, and a second one, also a suspension bridge, was begun in 1897, and was expected to be completed in .1903, the total cost, including approaches, being Â§12,000,000. The bridge spans the river at a clear height above the water-line of 135 feet. Its cables are sus- pended from towers of slteleton steel construction 335 feet high. Its width of 118 feet will permit â€” besides carriage-ways, foot and bicycle paths â€” six railway tracks, four for surface electric cars and two for the elevated

system. One other suspension bridge and one cantilever bridge to cross the East river to the Brooklyn and Long Island portions of the metropolis had also entered the initial stages of construction in or prior to 1901.

The general tendency of great cities at the end of the 19th century towards the concentration of business and trade in the central districts, with the distribution of population through widen- ing suburban zones, was strikingly illustrated in New York. Two American inventions, the results of which are better seen in New York than elsewhere, have lent themselves particularly to the new concentration of business offices and mercantile estab- h iiHi lishments. These inventions are the steel frame for high

ouiiaittgs. ^juii^ings^ and the elevator or “lift.” The distinctive movement toward the construction of high buildings, popularly known in America as “slcy-scrapers,” began earlier in Chicago than in New York, where it was scarcely seen in 1890. Its progress in New York, however, was amazingly rapid, so that by the end of the year 1900 the entire aspect of the city, especially from the bay or the rivers, had undergone a most startling trans- formation. Where there had been buildings of an average height of from four to five storeys, with six as the maximum and seven as a rare extreme, with church spires here and there breaking the monotony of the skyline, there began to appear buildings first of eight or ten storeys, then of fourteen or sixteen, and at length of twenty to twenty-three, twenty-four, and even twenty-nine storeys in height, their upper rows of windows being far above the tops of neighbouring church spires. These buildings were run up as steel skeletons filled in with fireproof materials, and were like portions of streets raised to a vertical position. Some of the largest of these buildings have fully 5000 tenants. Tlie elevators, which in some of the great buildings are numerous and well-operated, are in fact an important part of the passenger traffic system of the city. As a part of the same remarkable movement differentiating central business areas from outlying residential districts must be remarked the rapid growth of vast general stores of magazines known in America as ” department stores,” situated at points of special con- venience for customers using the various traffic lines, and tending to the extinction of thousands of small retail establishments.

With these profound changes working towards a redistribution of the population is to be noted a general improvement in the public health. In spite of the very rapid influx of a comparatively insanitary population from eastern Europe, with its Health, tendency to overcrowding in congested quarters, there ”’^ %‘a ^^^ been a steady reduction of the death-rate of New sew r ge. york, and all conditions would appear favourable for a further reduction in the first quarter of the 20th century. Thus the death-rate for the year 1900 was only 20-4 per thousand of population, whereas in 1895 it was nearly 22, in 1890 about 26-5, and in the years preceding and following 1880 it was nearly 30.’

New York has long been fortunate, as compared with many population centres, in its possession of a wholesome and adequate supply of water. The original Croton Aqueduct, opened in 1842, was in its day the most important municipal water-supply under- taking in the world. This conduit, about 40 miles long, had a capacity of some 75,000,000 gallons per day. The subsequent growth of the city made it necessary to construct another and very much larger aqueduct from the same general source of supply, and this New Croton Aqueduct, so-called, was opened in 1890. Its cost was .1^25,000,000, and its daily capacity is considerably in excess of 300,000,000 gallons. Meanwhile, vast improvements were undertaken in the Croton watershed, where, by means of a series of dams, the drainage area has been increased to such an extent that with the completion of the system the storage capacity will in 1905 be about 75,000,000,000 gallons. The supply is of a pure and wholesome quality. Brooklyn has a separate supply derived from various streams, ponds, and wells on Long Island. With pi’oper care and foresight the existing sources can be made adequate for the supply of the city for perhaps the first three decades of the 20th century. Supplementary supplies for future needs must be obtained by drawing upon more distant sources.

The outward flow of the vast volume of the Hudson river â€” taken in conjunction with certain peculiarly fortunate movements

of the tides through the channel that connects Long Island Sound with the harbour and separates Manhattan from Brooklyn â€” has always availed to sweep sewage out to sea, and New York has thus been spared the difficult

problem of sewage disposal. As compared with other cities of metropolitan rank. New York has for a number of years been exceptionally free from epidemic diseases. The public health department exercises great watchfulness over the crowded tenement-house districts, and through the co-operation of various public and private agencies there has been a marked im- provement of general conditions. There is a comparatively small percentage of sordid and chronic pauperism in New York, and in periods of normal business activity the exhibition of poverty is small as compared with that in European cities. Even among the â€¢ Polish Jews, who at the beginning of the 20th century formed the most notable new factor of the population, the abject conditions of overcrowding and sweat-shop labour were not so discouraging as they might have seemed ; for this population was rapidly improv- ing its economic condition, and its lot in New York was much better than in the towns of Russia and Poland whence it had come. The clothing trades, which had become highly specialized in New York, and had in the aggregate assumed enormous proportions, had in the course of a few years passed very rapidly into the hands of these Jewish newcomers, who by the year 1900 held something like a monopoly of the labour in that class of manufactures.

Until 1896 the administration of public charity was connected with that of correctional institutions, but in that year the admin- istration of charity was placed in the hands of a separate depart- ment. Various hospital dispensary facilities are available, and there was appropriated in the municipal budget for the year 1900, and again for the year 1901, a sum of money falling little short of $2,000,000 for charitable relief, besides which a still greater amount of public money was distributed in form of subsidies to a great number of hospitals, infirmaries, orphanages, and other estab- lishments of an eleemosynary character. It is stated that at ordinary times not more than one family in 200 Charities in New York seeks relief from established charitable ^ . sources, whether public or private. So great is the >’’’*â– *â€¢

development of manufactures and commerce in and about New York that it is only in periods of exceptional business depression that there is suffering through lack of employment. The standard of living among the working classes is high when compared with other metropolitan populations ; and the thrift of the people is to some extent indicated by the statistics of the

savings banks. There is no postal or municipal system for the receipt and custody of the savings of working people, but there were in New York in 1901 49 banks for savings organized and conducted as private enter- prises in conformity with carefully devised laws of the state of New York, and subject to constant state inspection. The deposits in these banks for the year ending 1st January 1902 reached a total of $191,417,073, the number of individual depositors being 1,476,809. This in a total population of 3,437,202 would indicate an average of about two depositors to each family of the population, with an average of perhaps |275 deposited for each family in a single year. The total resources of savings banks were $795,876,362, just $230 for each Inhabitant, or $1150 for ea<;h family of five persons. Large and constant remittances to Ireland and Germany, and those portions of eastern Europe whence the newer elements of the popu- lation have come, give further indication of the relatively high prosperity of the working class.

The situation of New York affords unusually picturesque areas for public parks and places of resort, and while In the earlier period of the city's development there was far too little provision made for open spaces, the closing years of the 19th century dis- closed a very earnest and comprehensive movement for the creation at no slight expense of a number of small parks and playgrounds accessible to the inhabitants of the tenement-house districts, together with recreation piers and .free bathing facilities at con- venient intervals along the extensive water frontage. The best-known recreation ground is Central Park, a ^'' '

beautiful tract conveniently situated in the heart of Manhattan Island, containing 862 acres. The principal park of Brooklyn is Prospect Park, with 516 acres. In the newer portion of New York City north of the Harlem river, and comparatively remote from the present mass of population, are three great tracts of park land, namely, Bronx Park, of 662 acres, in which were opened in 1899- 1900 very extensive botanical and zoological collections ; Pelham Bay Park, of 1756 acres, lying at the north-east end of the munici- pal area, with an irregular frontage on Long Island Sound ; and Van Cortlandt Park, of 1132 acres, lying 5 miles west of Pelham Bay Park. These three great parks are connected by broad park- ways. One of the most attractive bits of park area in America is the strip of high east bank along

the Hudson river, known as Riverside Park, or Drive, which has been considerably extended northwards to connect with a system of new drives and parkways and so become part of the general park system. One of the note- worthy accomplishments of 1901 was that of a park to embrace

the wonderful Palisades of the Hudson river, stretching for nearly 20 miles along the river's west bank. The new Ocean Park in the vicinity of the famous suburban seaside resorts known as Coney Island and Manhattan Beach will prove a great boon to the teeming millions of the metropolis. The total area of parks and open spaces under the care of the Park Commissioners of New York in 1901 was 6766 acres.

Not only the direct activities of the municipal government, but also to some extent the conditions and character of the city in general, may be better appreciated by a glance at the yearly budget of the corporation. The total amount of money appropriated by the fiscal authorities in the budget for 1900 was, in round figures, $90,779,000, and for the year 1901 it was $98, 100,000. Nearly $7,000,000 of this aggregate was payable to the state government at Albany for _, the city's share of state taxes, the remaining $91,000,000

budeei ‘Â®â„¢ ”” Â°Â°^ purposes. The greatest item in this huge budget was that for the municipal debt. The total gross funded debt outstanding on 1st January 1900 was |358,104,.S07. This, however, was offset by the municipal stocks and bonds held as investments by the sinking fund to the total amount of $105,435,871, leaving a net funded debt of $252,668,436. The consolidation of New York, Brooklyn, and other areas involved the assumption of all outstanding indebtedness by the enlarged municipality. The budget for 1901 included in round figures 112,100,000 for interest on the city debt and Â§10,332,000 for debt redemption, being a total of more than $22,000,000.

The next largest item of public expenditure was for education, the amount appropriated in the budget of 1900 being $14,619,111, while in the budget

of 1901 there was a marked increase to $18,512,817. The number of schools under the control of the Board of Education was 507, and the total enrolment of pupils in July 1900 was 418,951, the average daily attendance being 378,211, and the number of teachers 8844. According to the U.S. census of 1900, the number of persons of school age (5 to 20 years inclusive) was 1,028,069. A special effort was made in the period from 1895 to 1900 to improve the system of elementary education and adapt it to the practical requirements of the population. Many of the large schools of the tenement-house districts are composed almost entirely of children whose parents are of foreign birth, and who speak languages other than the English in their homes. Public schools perform an inestimable service in teaching such children the English language, and in training them for citizenship. Evening schools are provided for children who have left the day and’ooUce ‘^Â°Â°^ ^Â° ^^^^ their living, and for such older persons as may choose to attend. Under the compulsory education statute the attendance of children at some suitable school, or their equivalent instruction, is required between the ages of eight and fourteen years. Provision is made for more advanced instruction in ten high schools and in two institutions of still higher grade â€” one for young women, known as the Normal College, and the other for young men, known as the College of the City of New York. Many of the young women who graduate at the Normal College are subsequently employed as teachers in the various elementary schools. The College of the City of New York in 1901 had 2126 students and 80 instructors. Provision had been made for the erection of a new building for this institution, at an estimated cost of more than a million dollars. Besides the children receiving instruction in the schools under control of the Board of Education, 70,061 children were registered, at the begin- ning of the year 1900, in Roman Catholic parochial schools, and there were many thousands of children and youths in other schools under ecclesiastical or private control.

The items of expenditure in the budget of 1900 and 1901 that followed in magnitude the item of education are the police depart- ment, costing approximately $12,000,000 a year, and the depart- ments of fire and street cleaning, the cost of each of which was about $5,000,000. There are eighty police precincts, each with its fully-equipped station-house containing quarters for policemen as well as for prisoners, and temporary

accommodation for homeless and unfortunate persons. In all that pertains to their ordinary duties as guardians of the public peace, the 7000 policemen of New York are a very efficient and admirable body of men. The fire de- partment is more elaborately equipped than that of any other city in the world, and probably possesses the highest average efficiency. The number of fire companies in the metropolitan area approxi- mates 300, with a total force exceeding 3000 men. The statistics of 1899 showed fire losses in New York of $10,000,000, the total number of fires considerably exceeding 7000, and the buildings attacked by flames being of such value as to carry aggregate insur- ance approaching $200,000,000.

The total assessed valuation of real and personal property liable to taxation for general city purposes was $3,787,970,873 in 1901, and the tax rate for such purposes was about 2-3 per cent. This rate would produce $75,687,894 (after deducting $1,613,757 for estimated deficiencies in collection). In addition to the above, the rate of taxation for local county purposes, which varied with

the different boroughs, was estimated to produce altogether $3,661,531. The discrepancy between the sum of these two amounts, $79,349,425, and the total budget for city and county purposes, was covered by estimated revenues from the so-called general fund, such as the tax on stockholders of banks, interest on taxes, school money from the state, licences, fees, proceeds of excise taxes, unexpended balance of previous year, &c.

The following table shows by boroughs the assessed valuation of real estate and personal property liable to taxation for city purposes : â€”

Boroughs.

Eeal Estate.

Personal.

Total.

Manhattan and the

Bronx Brooklyn Queens . Richmond

Grand total

$

2,428,997,016

658,962,119

107,179,620

42,639,506

1

440,468,558

89,241,624

10,826,810

9,655,620

1

2,869,465,574

748,203,743

118,006;430

52,295,1-26

3,237,778,261

550,192,612

3,787,970,873

Oovern- meat

The municipal charters granted by the legislature of the state of New York, under which the city has exercised the functions of a municipal corporation, had been amended and altered many times by successive enactments prior to the great enactment of 1897, which provided an extremely elaborate framework of muni- cipal government and special .code of laws for the government of the consolidated metropolis. This new charter came into force on 1st January 1898. It provided for a mayor, elected for a four- years' term with very extensive executive and appointing powers ; an elective chief financial officer, called a comptroller ; and a municipal assembly composed of two branches, one of them called the council, and consisting of twenty-nine members, and the other a board of aldermen of sixty members. The twenty-ninth member of the council, who served as its president, acted also as vice-mayor, and was elected, like the comptroller and the mayor, by the voters of the entire city for a term of four years. The other municipal officers were appointed by the mayor, and after the first six months of his term they could be removed only upon the presentment of formal charges. The municipal assembly had no such authority as the London County Council, and incom- parably less than the municipal councils of British,' French, and German cities under the respective municipal codes of these countries. The real administrative work was performed by a series of boards, the most important of which was known as the board of estimate and apportionment, consisting of the mayor, comptroller, and the president of the council, all of whom were elected by the people, and the corporation counsel and the president of the department of taxes and assessments, who were both nominees of the mayor. This board was the actual budgetary authority, deciding both upon the total amounts to be raised by taxation and the distribution of the revenues to the various departments. The body that exercised authority over the policy of the metropolis in respect of public improvements, constituting an authority some- what analogous to the old Metropolitan Board of AVorks of London, was entitled the board of public improvements, and consisted of the heads of six important departments, namely, water supply, highways, street cleaning, sewers, public buildings, and bridges. A single commissioner appointed by the mayor was at the head of each of these departments ; and when they met as a metropolitan board, they were presided over by the

mayor himself, or by a president of the board appointed by hira. The police board had formerly consisted of four commissioners, but after 1901 of one commis- sioner appointed by the mayor and exercising a wide range of authority, which at first included also that of the supervision of all elections held within the metropolitan district. This power was taken away, however, by the state legislature in 1898, and vested in a separate bureau of elections, at the head of which was an official appointed by the governor of the state. The board of health consisted of two commissioners, with whom acted as ex-officio members the police commissioner and the president of the health office of the port of New York. There was a park board, consisting of three commissioners, a board of public charities, and a board in charge of the department of public buildings, each of which had three n^embers. At the head of the fire department was a single commissioner, as was also the case in the department of correction. The board of taxes and assessments consisted of a president and three additional commissioners. The board of education had nineteen members, made up of representatives of the school boai-ds of the several boroughs into which the metropolis was divided. There was also a board of docks, made up of three commissioners! In practical administration these boards had extensive power and responsibility, and also very potent influence in the shaping of the general policy to be pursued as respects their departments.

Experience in the working of the charter of 1807 soon showed the need of numerous amendments, some of them important and

fundamental, others merely matters of minor detail. An able commission appointed by Governor Roosevelt to recommend charter changes made a report the recommendations of which were for the most part accepted by the legislature of the state in 1901, so that the revised charter came into effect with the new city administra- tion at the beginning of the year 1902. One of these changes abolished the council and increased the number of members of the board of aldermen, thus providing a single instead of a double chamber. The powers of the board of aldermen were also to some extent increased. An unfortunate change reduced the term of the mayor

from four years to two. It had been found necessary to give a more distinct administrative character to the several boroughs into which the metropolis is divided, and the elective borough presidents became, under the revised charter, ofBcials of very considerable importance, having large authority with respect to public improvements, and becoming members of the board of estimate and apportionment, the membership of which was other- wise modified. A considerable number of small local-improvement districts were created for the better care of such matters as street- paving and the like. The Health Department was placed under the control of a single commissioner. An important new branch of the municipal government was created in the so-called Tenement House Department, with wide authority, under a new and greatly reformed building code, to supervise the structure of tenement houses and their occupancy in the interest of health and the general welfare. The educational system of the city on the administrative side was also changed in the charter amendments, so that the board of education in 1902 consisted of forty-six members appointed by the mayor.

The efficiency of the municipal government is to be tested by an examination of the work of the principal departments. These are to such an extent independent of one another that it is con- ceivable at any given time that the department of education, for example, should meet the demands made upon it with an admir- able intelligence and an almost perfect system, whQe the police department might be relatively inefficient or corrupt. The ulti- mate authority to which appeal is constantly made is the legislature of the state of Xew York, which meets annually at Albany. Hundreds of Bills are introduced at each legislative session relating specifically to the affairs of the metropohs.

Two important American universities are situated in New York City, namely, Columbia University and the University of New York. Columbia, which was chartered as King’s College in 1754, and incorporated as Columbia College in 1784, was removed in 1857 from its old site in Church Street, near the lower end of Manhattan Island, to more spacious buildings in Madison Avenue, between 49th and 60th Streets. In 1896 the name ” University ” was adopted, the institution having outgrown the original school of arts, which still retains within the university the name Higher gf Columbia College. In the following year the univer- edacatioa, gj^y moved

to a group of magnificent buildings which f^^' had been erected on a commanding site, a little more music than three miles north of the old one, known as Mom-

ingside Heights. In 1902 Professor Nicholas Murray Butler was made president of Columbia, to succeed Seth Low, who had become mayor of New York. The university has seven depart- ments, and in 1002 the total number of professors and instructors was nearly 500, and the total number of students about 4000. Affiliated with Columbia University is Barnard College for women and the Teachers' College, both of which also have admirable buildings on Momingside Heights, adjoining the grounds of the university, and the foregoing statistics of teachers and students include these.

The New York University, which, like Columbia University, is a chartered institution under the control of an independent cor- poration, began its career in 1839, and was housed in Washington Square from that time until 1894, when it was removed to its present site, known as University Heights, a little more than four mCes north of the site of Columbia University. Like its neigh- bour, the New York University also occupies an admirable new group of buildings. In all departments it had, in the year 1901, 1824 students and 186 instructors.

Besides the public school system, Brooklyn has several notable educational institutions, among which may be mentioned Adelphi College, an excellent local institution for both sexes, with power to confer degrees ; the Pratt Institute, a well-endowed school for technical training and instruction in the applied arts, with many well-conducted departments ; the Packer Institute for youhg women ; the Brooklyn Institute, which maintains a great variety of popular lecture courses and classes, with museums and other educational facilities. In the borough of Manhattan a great centre of popular instruction has long been the Cooper Institute, founded by the distinguished philanthropist Peter Cooper, which maintains practical trade classes and a, great variety of instruction in even- ing classes, besides an important art school and several lecture courses in the great assembly hall. The Carnegie Music Hall in Manhattan borough is also to be noted as a centre of popular culture.

The Roman Catholic Church maintains several Iferge institutions for advanced education, and the Hebrews, recognizing the needs of a great influx of Jewish population, support some admirable centres for industrial and practical training.

Among important enterprises of a popular educational character is the New York public library, formed by the consolidation of two important existing reference libraries, the Astor and the Lenox, with the fund left by the will of Samuel J. Tilden, and known as the Tilden Trust for the Establishment of a Free Circulating Library. The headquarters of the New York public library are to be in a monumental building, of white marble, the construction of which was begun in the year 1900 by the municipal corporation on the site of an abandoned reservoir extending from 40th to 42nd Streets on Fifth Avenue. This building, the capacity of which can easily be extended in the future, will have shelving space for perhaps a million and a half volumes. A number of libraries under separate control, but receiving large annual subsidies from the municipal treasury, are. according to plans formed in 1900, to be consolidated with the Xew York public library, which is to use their numerous buildings and branches as sub-stations. In addition to this, Mr Andrew Carnegie gave to the city of New York in 1901 the sum of 85,200,000 for the erection of sixty-five more branch library buildings in different parts of the city.

An important educational agency is the American Museum of Natural History, with great collections constantly growing, and housed in a vast edlSce built by the municipal corporation. The municipality has also provided a structure, greatly extended at the end of the 19th century, for the collection of paintings, statuary, and other works of art, belonging to the Metropolitan JIuseum of Art. The Museum of Natural History is situated in a. small park annexed to the Central Park on the west side, and the Metro-politan Museum of Art is within the enclosure of Central Park near Fifth Avenue.

The architectural transformation of New York at the end of the 19th century was notable chiefly from the point of view of its dar- ing and skiUul use of iron and steel, and its marvellous adaptation to the new conditions of industry and commerce, but it had also many specimens to show of

buildings of merit from the standpoint of architectiu-e as a fine art. No great metropolis, however, had done so little as New York to produce those notable effects in architecture that are derived from the symmetrical and balanced placing of buildings of a public character with reference to each other, with suitable approaches and with open spaces about them ; and no other great and rich city of any period of the world's his- tory, perhaps, was so lacking in the embellishment of great public fountains, heroic monuments, and groups of statuary. Neverthe- less, the wealth of the city was so enormous, and its structures, both public and private, in their infinite architectural variety were so costly and substantial, as to create the general impression of a magnificent city. ' And this impression was enhanced by the mar- vellous purity of the atmosphere and clearness of the sky, due not merely to a favourable climate, but also to the exclusion of smoke-producing bituminous coal.

Among other highly-marked tendencies at the end of the century was the development of New York as a musical centre, where grand opera, without Government subsidy, was produced on a more elaborate scale than elsewhere, while various musical interests, fostered in considerable measure by the large popula- tion of German origin, were prosperous to an encouraging degree. There was also to be noted the extremely rapid multiplication of theatres and kindred places of popular entertainment and resort. These had more than doubled in number since 1880 ; and of thea^ tres and music haUs alone there were not fewer than seventy-five. This development of New York as the chief centre of America for purposes of entertainment had, in the last years of the 19th century, brought about a wholly unprecedented inflvix of well-to-do visitors from other parts of the country ; and this influx in turn had made it profitable to build a series of enormous and magnificent hotels for the accommodation of the ever-increasing multitude of prosperous strangers. In these regards New York had begtm to bear a strong resemblance to London. In earlier periods New York had not, in any such sense as London or Paris, been a great national metropolis. Boston, Philadelphia, and Baltimore in the east, and other cities of the south and west, were centres which before 1880, or even 1890, would not for a moment have acknow- ledged themselves provincial with reference to New York as a metropolis. And their pretensions would New York have been fully justified, for in many respects their ^ '*Â® position as

local centres was analogous to that of such ‘“f^Polis German cities as Hamburg, Frankfort, Munich, and ^â€ž^Lj,_ Dresden in their relation to Berlin. But as the aggre- ‘

gallon of all kinds of German interests at Berlin in the last twenty years of the 19th century was at a far higher rate relatively than the development of other German cities, so the progress of New York in the same period, and especially in the closing years of the last decade of the century, was tending to make for the position

not merely of primacy among American cities, but for that of un- questioned metropolitan rank and position as a centre of national and international transportation, trade, and commerce.

Previous to 1880 New York was not recognized in any unqualified sense as the metropolitan centre of the country in respect of such enterprises as the pulflication of books and periodicals, but the publishing trade has steadily tended to concentrate. The growth of New York has been especially marked as the chief centre of North America for the issue of all kinds of periodical literature. While the daily newspapers have a larger circulation and a wider influence than those of other American cities, there is in America no such distinction as in England between the metropolitan and the provincial press. Boston, Philadelphia, Baltimore, Chicago, St Louis, San Francisco, New Orleans, and other American cities are for their own localities important centres of newspaper publishing.

The progress of New York as a great banking and financial centre had been also especially rapid in the closing years of the 19th century, its banking houses and financial institu- tions having multiplied in number, and having devel- oped even more in the extent of their capital and the volume of their transactions. Thus the banks of deposit in the metropolis numbered considerably more than 100, with capital and surplus exceeding .$160,000,000 ; and about 40 trust companies, having a banking character, had an aggregate capital of more than $110,000,000. Besides those

institutions were the savings banks, 49 in number, with total resources of nearly $700,000,000. The position of New York as the banking, financial, and general com- mercial centre of the United States is indicated in the statistics of the New York Clearing-House Association, when compared with the clearings of other cities. All the considerable cities of the United States, to the extent of nearly a hundred, maintain bank clearing-houses, yet in most weeks the clearings of the New York association aggregate more than three-fourths of the total clearings of the entire country. For the calendar year 1901 the average daily clearings of the New York Clearing-House were, in round figures, Â§262,000,000, and the total for the year was $79,420,418,435. Previous to September 1897, the London clearings had generally been considerably larger than those of New York, but in the years 1898, 1899, 1900, and 1901 the New York clearings were greatly in excess of those of the British metropolis. Thus the London clearings for 1901 were Â§46,529,000,000, while those for New York were $79,420,000,000.

The amalgamation of the capital engaged in various branches of industry, which had been brought about with great rapidity in the period from 1896 to 1899, had enhanced the tendency towards the cencentration of banking and financial operations ; and this tendency had in turn increased’ the financial importance of New York as compared with other American cities. The central offices of numerous vast enterprises were, in the closing years of the 19th century, brought to New York, and the metropolis became the home of a rapidly increasing number of individuals of great wealth. Thus New York was fast becoming a centre of luxury, display, and entertainment, and an agreeable place of resort at all times of the yearâ€” but especially in the winter months â€” for thousands of people of refined or luxurious taste from the south, the west, and all portions of the country.

For the fiscal year ending with June 1901 the port of New York handled almost exactly 47 per cent, of the total value of the import and export trade of the United States. Twenty years earlier New York h0,d been credited with about 57 per cent, of this total trade. The proportion had gradually declined with the development of other ports, notably those of the Gulf of Mexico and the Pacific coast. The actual value of New York’s foreign trade, however, had increased enormously, even if the relative proportion had declined. For a few years following Commerce, ~~ᵍ^ ^^^^ j^j^^j foreign trade~~

~~of the United States was about $1,000,000,000. The period from 1880 to 1890 had averaged about Â§1,500,000,000. It gradually increased until for 1900 it exceeded $2,5.33,800,000, of which amount the exports of merchan~~ dise reached nearly Â§1,500,000,000, while the imports of mer- chandise were valued at $829,000,000. Of this total importation, Â§526,100,000 came to the port of New York. Of the total exports of merchandise, somewhat more than Â§-538,000,000 was shipped from New York ; and if one includes the imports and exports of the precious metals, the total foreign commerce of the port of New York for 1900 exceeded $1,196,000,000.

Solne authorities ou the political history of New York have expressed the opinion that the frauds of the Tweed King, which were e,x])0sed in 1871-72, amounted, in the period frona 18G5 to 1871, including issues of fraudulent bonds, to a total of |200,QOO,000. This vast sum repre- sented, in the main, a direct theft of public property. It â– was supposed at the time of the Tweed exposure that

Tammany Hall was hopelessly discredited. The charter of the Tammany Society ought to have been annulled ; but the organization, within a surprisingly short time had regained its control of municipal “sto, affairs. A shrewd local politician named John Kelly became the dominating personality in the Tam- many Society ; and the first move to mislead the public was the selection, as Tammany ” sachems,” of some of the most sincere and most conspicuous of the Democrats who had exposed and overthrown the Tweed regime. Tammany now posed as a reform body, with the objec- tionable elements all excluded. In these circumstances Tammany actually came near winning the mayoralty election of 1S72, and in 1874 it was victorious. There had been much industrial distress, and by its superior system of minute neighbourhood organization Tammany distributed aid to the poor, promised public work to all the unemployed, and built up a strong support. By this time the more obscure members of the old King were re-asserting themselves in Tammany, and the liquor inter- ests were becoming dominant in the district and ward politics of the organizations. The dictatorship of John Kelly lasted from 1874 to 1886. He bore the sobriquet ” Honest John Kelly,” but his political character was far from that of a man of scrupulous views. There was no repetition of the extravagant crimes of

the Tweed regime, but for the most part municipal government was on an exceedingly low and corrupt plane. During a part of this time Tammany yielded to public opinion to the ex- tent of permitting men of upright personal character and excellent intentions to fill the office of mayor, but under the charter as it then was the power of the mayor was comparatively limited. Prom time to time there arose local organizations, which afiiliated with the Democratic party in national politics, and which disputed the right of Tammany Hall to stand as the sole local representa- tive of that great party. But Tammany was generally able to overcome and absorb such dissentient bodies. In 1884 there occurred a transaction of a particularly scandalous nature, the men chiefly guiilty being known as the ” boodle aldermen.” To the aldermanic board there had now been restored a considerable measure of authority which at a former period had been withdrawn. Kival companies were seeking to obtain a franchise for working a street railway on Broadwaj^, the main thoroughfare of the city. This privilege was so valuable that the city could have sold it for several millions of dollars. It was given away by the aldermen, and it was afterwards proved that a large number of them had accepted equal portions of a cash bribe of ^500,000. Some of them were subsequently punished, but Tam- many’s power was not seriously impaired. John Kelly died in 1886, holding up to the date of his death an un- disputed dictatorship in Tammany Hall, and this was equivalent during much of the time to an autocratic direction of all the affairs of the city. After Kelly’s death it was announced that Tammany would hencefoj-th acknowledge no single ” boss,” and for a time a group of three or four leaders jointly managed the affairs of the organization. But one of these, Kichard Croker, gradually strengthened his hold upon the twenty-four district leaders ivho were officially the governing committee ; and Kelly had not been dead more than two years before Croker’s authority came to be generally recognized. This remark- able politician was born near Cork, Ireland, in 1843, and was brought to New “iJork in early childhood. As a youth he worked as a mechanic, but early became active in the politics of his ward, and in 1868 was elected alderman. In 1873, and again in 1876, he was elected coroner. In 1883 he was made a fire commissioner. His great political skill was shown in the campaign of 1886,\vhen Henry

George, who was extremely popular, â– was an independent candidate for mayor, while Theodore Koosevelt was the Republican candidate. The better element of Democrats chose Abram S. Hewitt, and Mr Croker and the Tammany organization, appreciating the nature of the contest, endorsed and accepted Mr Hewitt, and secured his election. Though possessing the highest qualifications and the purest motives, Mr Hewitt's policy as mayor was largely rendered futile by the antagonism of Tam- many Hall. At the next election, in 1888, Tammany did not hesitate to bring forward one of its own chiefs as its candidate, Mr Hewitt running as an independent candidate, and the Eepublicans having a strong nomi- nee in Mr Erhardt. Tammany succeeded through the division of the opposing voters. An investigation of Tammany's government of the city was made by the Eepublican legislature of the state in 1890. Much evidence was secured illustrating the manifold im- proprieties of the Tammany system, but nothing of overwhelming importance was brought to light. There followed, however, an unusually earnest attempt on the part of good citizens, through the so-called People's Muncipal League, to defeat Tammany in the election of 1890. This movement failed, however, and in 1892 Tammany not only won again, but by an overwhelming majority. Again the administration became more care- lessly and more scandalously corrupt; and the state sen- ate again, in 1894, made an investigation. This inquiry brought to light some of the facts respecting an elaborate system of blackmail which had grown up under the joint protection of Tammany Hall and the city goverrunent. Under this system large sums were paid for appointments to office and for promotions, and an elaborate methoiJ had been devised for collecting money regularly from the keepers of gambling-houses, houses of ill-fame, and other disorderly resorts, and from liquor-sellers for permission to violate certain details of the excise laws, such as mid- night and Sunday closing. There followed a great out- cry against Tammany Hall, and at length the so-called Independents were able to unite forces with the Repub- licans in a campaign which elected "William L. Strong, a reijutable and prominent merchant, as mayor. Under the Strong administration Colonel George E. Waring, junior, as head of the street cleaning department, quite revolutionized New York as respects its cleanliness. Theodore Roosevelt, as president of the police board, ren- dered efficient service, the public school

system was vastly improved, and in numerous ways the administration of the city was greatly improved. In 1897, lui fortunately, the opponents of Tammany failed to unite. The Citizens' Union nominated the Hon. Seth Low, president of Columbia University, who, though a prominent Republican, was not endorsed hj the so-called Republican machine. Although]\Ir Low polled a much larger number of votes than the Republican candidate, the Tammany candidate, Robert A. Van Wyck, was successful, and]\lr Richard Croker more than ever before was in control. Another legislative inquiry, under the chairmanship of Mr]\Iazet, was made in 1899, with the usual result of many disclosures that threw light upon the objectionable methods of Tammany rule. Mr Croker's power could not be understood without some knowledge of the relation between the great municipality and the government of the state of New York. Mr Croker was practically in control of the votes of a large portion of the members of the state legislature. The rapid development of vast business interests had made it increasingly important for many companies and individuals to ward off unfavourable legislation, or at times to seek the active favour of the law-making body. Instead of dealing directly with the members of the legislature through old-fashioned lobbies.

so-called, these private interests found it more prudent and more effective to cultivate the favour of Tammany Hall on the one hand and of the Republican organization on the other. The receipt of large funds for political expenditure would naturally increase the authority of the men having charge of the disbursement of such funds, and render it more difficult to dislodge them. On the popular side the strength of Tammany Hall was largely due to the fact that it united in a compact body a great number of men whose livelihoods were directly affected, and whose re- wards were made proportionate to their usefulness to the organization.

An awa,kened public opinion, and many determined and zealous efforts for municipal reform, while generally un- successful in the election of reform candidates for mu- nicipal offices, have nevertheless had beneficial effects of the most marked character upon the methods and results of departmental work. Thus, in spite of a world-wide impression that New York is habitually misgoverned, there was during the last ten years of the 19th century a very remarkable progress made in almost every department of local

administration, in response to an exacting public opinion that demanded good streets, vigilant protection of the public health, an ample supply of good schools, and other municipal facilities such as progressive communities elsewhere had learned to value. Elections in New York had become honest and free from scandal, while the collection and disbursement of a vast public revenue had become relatively free from charges of peculation or fraud. The principal scandals of recent years had risen out of a shai'p discrepancy between the habits and customs of a metropolitan population of diverse origin and certain rigid state laws relating to public morals which it had been made a part of the duty of the police to enforce. These laws, among other things, prohibit the existence of gambling places and other resorts of a so-called '~~dis~~ orderly " nature, and require the closing of drink-shops and various other establishments on Sunday. The existence of such laws, and the extreme difficulty of their enforcement, rendered possible a system of connivances and sale of indulgences that made the police department, and certain influential politicians who controlled it, the partners in a system of blackmail that permitted the eon- duct of a vast number of illegal establishments, and the paid protectors of Sunday opening and various other violations of law. "While such connivances are demoraliz- ing to the tone of a police department, it is obvious that they may exist without radical impairment of the efficiency of many other branches of the municipal administration.

The Citizens' Union and the various reform groups succeeded in the autumn of 1901 in forming a cam- paign union with the Republicans for the overthrow of Tammany rule and Croker domination. This fusion movement agreed upon Seth Low as candidate for mayor. The Tammany party, appreciating the danger of defeat, nominated a Democratic lawyer of the highest repute, Mr Edward jSI. Shepard, who had never been a member of the Tammany organization. Mr Low was elected by a substantial majority, and entered upon his two years' administration on the 1st of January 1902. His administration was marked by excellent appoint- ments to the various administrative posts, and by honest, enlightened, and efficient methods throughout. Under Mayor Low, New York assumed its rightful position as one of the best governed of the world's great municipalities.

Thus the 20th century had opened for New York City in a period of colossal material de-elopment, of great projects, and of great expectations apparently well founded. (a. sw.)

l^TEW ZEALAl^D.

Geography and Statistics.

THE British colony of New Zealand consists of a group of islands lying between 35Â° and 48Â° S. in the south Pacific Ocean. It is situated eastward of Tasmania and south-eastern Australia, and Wellington, its most central seaport, is 1204 miles from Sydney. Its area is 104,471 square miles, of which its two main islands, called North and South, contain 44,468 and 58,625 respectively, and Stewart Island 621. These three form a broken chain divided by ‘Cook Strait, 16 miles wide, separating the first two islands, and Foveaux Strait, which separates Stewart Island from South Island. Outlying groups of islets, included in the colony, are the Chathams, 536- miles eastward of Lyttelton in South Island, which are settled, and carry sheep well ; the Aucklands, three degrees south of Stewart Island, also useful for grazing ; several unin- habited islets farther south; and the Kermadecs, a volcanic cluster about 500 miles north-east of North Island. Of these last, Raoul or Sunday Island, the largest, is fertile. North Island is 515 miles long, and varies in breadth from 6 to 200 miles. The length of South Island is 535 miles, and its greatest breadth 180. Prom the south-west corner of South Island to the Bay of Plenty in North Island run parallel mountain chains which are the chief physical feature of New Zealand. Some remarkable peaks, however, rise apart from these. Such are the active volcanoes Euapehu (9008 feet), Ngauruhoe (7515 feet), and Tongariro, in the centre of North Island. West of these the extinct cone Egmont (8260 feet) curves up from the sea-shore, almost rivalling Pusi-yama in its solitary and symmetrical beauty. On the north-east coast of South Island the Kaikouras are high parallel ranges, among which Tapuae-nuku reaches 9462 feet. In North Island the rivers Waikato, Waihou, Wanganui, and Mana- watu are navigable for small steamers, the first for about 100 miles, the others for about 50. The chief river of South Island, the Clutha, which is 154 miles long, can be ascended by small craft for about 30 miles. Of the

harbours which are commercially important, Auckland and Wellington are naturally the finest ; Lyttelton has been made very commodious, and Port Chalmers, Grey- mouth, and Westport have been greatly improved. The two last-named are the chief outlets for the coal of the west coast. Less successful have been the attempts to improve Napier, New Plymouth, and Gisborne, all ports of rich and productive districts. The famous fiords or sounds of the extreme south-west afford perfect shelter, but are cut off from the inhabited districts by precipitous mountains. They are regularly visited in summer bytourist steamers. The Sutherland waterfall near Milford Sound is 1904 feet high. The southern Alps and the lakes and glaciers on their eastern side have also become noted amongst climbers and travellers. The most beautiful of the lakes is Manapouri. On the west side of the Alps glaciers descend into the forest belt as low as 700 feet above the sea. But the largest glaciers are to the east of the watershed. Their names and extent are as follows : â€”

Name of Glacier.

Area.

Length.

Gi-Gatost Width.

Avcraire Width.

Acres.

Mlle.i. ch.

Miles, ch.

Miles, ch.

Tasman. .

13,664

18 0

2 14

1 15

Murchison

5,800

10 70

1 6

0 66

Godley .

5,312

8 0

1 55

1 3

Mueller

3,200

8 0

0 61

0 50

Hooker

2,416

7 25

0 54

0 41

The region of the thermal springs in North Island covers 660 square miles, and stretches from Mount Euapehu to White Island, an ever-active volcanic cone in the Bay of Plenty. The most striking natural feature of the district, the Pink and White Terraces, was over- whelmed in the eruption of Mount Tarawera in 1886, when for great distances the country was buried beneath mud and dust. Fine lakes and waterfalls, innumerable pools, in temperature from boiling- point to cold, geysers, solfataras, fumaroles, and mud volcanoes still attract tourists in large numbers. The healing virtue of many of the springs, too, becomes more widely known every year. The Government maintains a sanatorium at Lake Eotorua, and there are private bathing establishments in several other places, notably near Lake Taupo. In South Island there are hot pools and a State sanatorium at Hanmer Plains. Experience shows that the most remark- able cures effected by the hot waters are in cases of gout, rheumatism, diseases of the larynx, and in skin disorders.

The healthiness of the climate is attested “by the death- rate, which, varying (1896-1900) from 9 to 10 per thousand, is the lightest in the world. In 1896 it was as low as Climate 9-10, and since 1886 it has not exceeded 10-35. Even in the boroughs the average is below 13. The rainfall in most of the settled districts ranges from 30 to 50 inches a year. There is, however, a drier strip nearly 200 miles long along the middle portion of the eastern coast of South Island. The rainfall at Christchurch is 26 Inches. Nearly all the cereals produced are grown on the east coast.

In 1896 the Maori were reckoned at 42,113, including 5762 lialf-castes. In 1901 the number was 46,518. It is probable that the numbers for 1896 were slightly under-estimated. ^ .

Half-castes have increased by 1327 since 1881. Pulmonary consumption is the chief scourge of the race. About 4600 Maori children are taught in schools, about 3000 of them in sohiols specially maintained for Maori. The tribes still own 5,000,000 acres of land, and draw considerable sums in rent from Europeans, to whom they lease about 2,000,000 acres. They cultivate

the soil, and own cattle, sheep, and horses, but seldom work for wages, and do not engage in trade.

In 1901 the population, excluding the Maori, numbered 772,455, of whom 406,161 were males and 366,294 females. It was dis- tributed thus :â€” North Island, 390,373 ; South Island, 381,617 ; Stewart Island, 253 ; Chathams, 204 ; Ker- madecs, 8. The Chinese amounted to 2792. The last-named numbered 3711 at the census of 1896. The decrease of the Chinese, who in 1881 numbered 5004, has been caused by a landing tax of Â£10 a head, increased to Â£100 in 1896. The colony lost 20,000 by white emigration in the seven years 1885-91. In the worst year, 1888, the departures exceeded the arrivals by 9000 ; while in 1893 the gain from outside was 10,412, and in every subsequent year there has been at least a slight gain, which in 1901 rose to 6522. A noteworthy feature of the vital statistics has been the fall in the birth-rate from 37-97 in 1881 to 25-31 in 1901. This is signitioant, as the colony has been prosperous since 1894, and the marriage-rate has risen from 5-70 in 1894 to 7 67 in 1900. Only the very low death-rate preserves an excess of births over deaths, which range from 11,500 to 13,500 annually. Males still exceed females by 10 per cent. Illegitimate births ranged from 3-20 in the 100 in 1885 to 4-63 in 1900. The population is now 8 to the square mile.

Population.

Year.

Popula- tion.

1880 1885 1890 1895 1900 1901

Popnlation (exclusive

of Maori) OD the

Slat December.

486,029

575,172

625,508

698,706

770,682

772,455

The increase from 1891 to 1901 in the four chief towns is thus shown ; â€”

Census, 1S91.

. 51,287

Auckland and suburbs Wellington and suburbs . Christchurch and suburbs Uuuedin and suburbs

34,190 47,846 45,869

Census,

1901. 67,226 49,. 344 57,041 52,390

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225

A fifth college â€” the Victoria College, Wellington â€” was added in 1899 to the four previously aflfiliated to the Kew Zealand â€ž. , University. The number of undergraduates is about naucaiion. 2QpQ^ ^^ ^^^^^ gg^ ^^^^ keeping terms in 1899. The

proportion of male to female students is about 2 to 1. Excluding Maori schools, the following summary shows the number of schools, teachers, and scholars in 1900 : â€”

Description of Schools.

Number

of Schools.

Teachers.

Scholars.

Public (Government) schools (scho- lars other than Maoris)

Colleges, grammar and high schools

, (aided or endowed)

Private schools

Industrial schools and orphanages

Native village schools, European children attending

Private native boarding-schools, European children attending

School for deaf-mutes

Jubilee Institute for Blind

Totals ....

1674

26 304

85

4 1 1

3580

195 831

...

151

130,724

2665

15,555

1668

3109

72 50 28

2102

4763

153,871

The proportion of persons unable to read or write sank from 21-19 in 1886 to 15-27 in 1901. There are eight schools of art, attendance 3000 ; schools of mines, attendance 300 ; a school of engineering, attendance 106 ; an agricultural college, attendance 34.

The number of convicts in gaol was 508 at the end of 1899 (633 at the end of 1887). From 1888 to 1897 the annual number of convicted persons fell steadily till the decline amounted ‘”’”*â– to 26 per cent. In the two years following 1897 there was a rise of 2-49 per cent. In 1896 New Zealand-born persons (whites) over fifteen years old formed 44 per cent, of the popula- tion, but only supplied 25 per cent, of the convictions. Persons imprisoned for drunkenness fell in number from 1200 in 1885 to 610 in 1899. The proportion of lunatics rose from 1 in 393 for 1896 to 1 in 288 for 1900.

The public finances, embarrassed between 1884 and 1889, have since then yielded annual surpluses of from Â£100,000 to Â£500,000, P, which have

been chiefly spent upon public works. The

public debt is roundly Â£51,000,000. Two thousand two hundred miles of State railways pay somewhat over 3 per cent, on the cost of construction. Telephones as well as telegraphs are a State monopoly. The revenue from lands was Â£270,203 in 1901. The mainstay of the Treasury is customs revenue, which now â– exceeds Â£2,250,000 a year.

Revenue and Expenditure.

Tear.

Total Receipts.

Total E.vpenditiire

1880

Â£3,285,042

Â£4,019,850

1885

8,859,996

4,282,901

1890

4,208,028

4,081,566

1895-96

4,619,402

4,403,749

1900-01

5,906,016

Public Debt.

5,479,704

Amount of

Amount of

Net Indebted-

Debentures

Sinking

Xet In-

ness per Head

and Stock in

Fund

debtedness.

of White

Circulation.

accrued.

Population.

Â£

Â£

Â£

Â£ .>. d.

31st December ISSll

â€¢.‘S..5S3,2.31

2,000,320

26,5S2,911

lSS,i

87,5S7,‘I76

3,469,2M

84,118,512

57 12 9

Slst March 1S90

3S,66-,950

1,8S6,1S5

37,281,765

60 5 3

1S9.T

40.356.964

751,932

89,685,082

57 9 9

1900

4T.S;4.4,-)3

944,375

46,980,077

61 17 3

1901

49,.M 1.246

1,033,494

4S,5o7,751

62 16 10

f, External trade has risen from Â£12,853,736 in 1886 to

.Commerce. Â£24,697,881 in 1901.

Excess of

Imports {excluding

Exports

Exports over

Tear.

(excluding

Imports

Specie).

Specie).

(excluding Specie).

1886

Â£6,319,223

Â£6,534,518

Â£215,290

1888

5,430,050

7,403,206

1,972,156

1890

5,928,895

9,569,316

3,640,421

1892

6,742,544

9,490,920

2,748,376

1894

5,990,177

9,221,550

3,231,373

1895

6,115,958

8,518,119

2,402,166

1896

7,035,379

9,299,907

2,264,528

1897

7,994,201

9,741,222

1,747,021

1899

8,739,633

11,938,335

3,198,702

1900

10,207,326

13,246,161

3,038.835

The re-export trade is extremely small. Trade with the United States has grown from Â£877,000 in 1891 to Â£1,520,000 in 1900. Trade with India and Ceylon reached Â£391,300 in 1900 ; that with Fiji and other Pacific islands was Â£622,000 in 1900. With these exceptions. New Zealand trade is almost all done with Australia and the United Kingdom; the latter's share in 1900 was 70-16 per cent, of the whole.

Industrial progress was checked frOm 1884 to 1895 by the low prices for wool, wheat, and meat, and by the after-effecU of land and other speculation in the 'seventies. During these years, however, two new industries of gi-eat importance were developed, the export of butter and

cheese and frozen meat. The character of the soil and the moist cool climate enable English grasses to be sown almost everywhere, and nearly eleven million acres are now laid down with these. The result is seen in the price obtained for New Zealand sheep in Smithfield Market, which is from Jd. to Id. per ft) higher than that given for frozen mutton from other countries. The figures below show the growth of the trade : â€”

Export of Frozen 2hUton.

lb

. 123,576,544 192,074,451 212,208,968

In 1901 New Zealand sent a little over two million frozen sheep and a million and a quarter lambs to London, thus about equalling in quantity the mutton imported into England from South America. In the market for frozen lambs the colony remains at present without a rival. Frozen beef is also sent to England. The export of butter and cheese has risen in value from Â£207.687 in 1890, till in 1901 it amounted to Â£1,199,000. In London, New Zealand cheese fetches as high a price as Canadian. Though not ranking in importance with wool or frozen meat, dairy-farming is almost entirely carried on by small farmers and their families, who supply milk to factories. Most of these are co-operative, their shareholders being the farmers themselves. The profits of the industry are thus widely distributed among the producers. The development of dairy-farming has led to the spread of settle- ment, especially in the west of North Island, where large tracts of fertile soil formerly covered with forest have now been cleared and converted into dairy-farms.

Live Stock.

Tear.

lb

Tear

1882 . 1886 1891 .

1,707,328

38,758,160

. 110,199,082

1896 1900 1901

Tear.

Horses.

Cattle.

Sheep.

Pigs.

1881

161,736

698,637

12,985,085

200,083

1886

187,382

853.358

16,564,595

277,901

1891

211,040

831,831

18.128,186

.308,812

1896-97

240,813

1,1.38,067

19,138,493

209.834

1900-01

â€¢

266,245

1,2.36,680

20,233,099

250,975

In 1895 gold-mining, after being long at a standstill, began again to make headway. For many years the surface alluvial mining in South Island becan* less and less profit-

able. As in other countries, however, the working of

M In lag.

quartz reefs compensated for this. The cyanide process of gold extraction, and the returns obtained by its means from the Waiki mine in the Upper Thames, caused an outbreak of gold fever, which led to the opening up of a few good and a great many worthless quartz-mines. In South Island the river-beds of Otago province have been successfully worked by means of ingeniously constructed dredges, and good returns secured. In 1901 the gold exported was 455,560 oz., valued at Â£1,753,784. The total value of the gold exported from New Zealand from the discovery of the metal in 1857 to 1901 was slightly over Â£58,000,000. Kauri gum still holds its place as an export, about Â£500,000 worth being dug up annually. The number of Istrians and Dalmatians who came from the Adriatic to dig for kauri gum led to the passing of restrictive laws.

The progressive output of coal from 1880 to 1900 is shown below. The output in 1901 was 1,227,198 tons:â€”

Tear.

Raised in the Colony.

Imported.

Exported (excluding Coal for Fuel by Ocean Steamers).

1880 1885 1890 1895 1900

Tons.

299,923 511,063 637,397 7-26.654 1,093,990

Tons.

123,298 130,202 110,939 11)8,198 124,033

Tons.

7,021

2,371

33,404

26,151

36,699

Land under cultivation increased from 8,489,000 acres in 1891 to 12,679,000 in 1901. The following table shows the comparison

S. YII. â€” 29

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of the official assessments of the value of landed properties in 1888 and 1898:â€”

1888.

1898.

Increase, 1888-98. |

Amount.

Rate per cent.

Unimproved value Value of impi-ovemeDts .

Total

Â£75,497,879

86,640,835

Â£84,401,244

54,190,108

Â£8,908,866

18,549,768

11-79 52-05

Â£111,187,714

Â£138,591,347

Â£27,468,633

24-70

Wool remains at the head of the list of exports. In the eleven years ending 1898 the wool-clip increased 65-14 per cent. But the description changes ; there is much less merino, and tarmlai! ’””’^^ Â°^ ^^^ coarser and longer cross-bred. The number of sheep has increased from 16,564,000 in 1886 to 20,233,000 in 1901, though the increase has been almost all in North Island. The number of the ilocks grows, and the average size diminishes even more rapidly. There were 9149 flocks in 1886 ; in 1901 the number had risen to 19,000 â€” average size of each flock about 1050. The smaller size of the flocks and the breeding of sheep for meat rather than for wool, the cultivation of English grasses and of extensive crops of turnips and other roots on which to fatten sheep and lambs, all tend to change sheep- farming from the mere grazing of huge mobs on wide, unimproved runs held by pastoral licences. The “squatters” still occupy eleven million acres, but even these are more closely subdivided than in former days. How much more extensive is grazing^ â€” of the more scientific order â€” than agriculture, is seen at once from the figures of the amount of land broken up, for crops or other purposes, and the amount under sown grasses. There were 1,646,000 acres of ploughed land and over eleven millions sown with artificial grasses in 1899. This is exclusive of the vast area of native-grass land. It may be noted here that the area now occupied and utilized by whites is about 39,000,000 acres.

Acreage and actual yield in principal corn-crops, 1901 â€” Wheat : acres, 206,465 ; yield per acre, in bushels, 31-61 ; total bushels, 6,527,154. Oats :

acres, 449,534 ; yield per acre, in bushels, 42-45 ; total bushels, 19,085,837. Barley : acres, 30,831 ; yield per acre, in bushels, 33-33 ; total bushels, 1,027,621. Rye : acres, 1388 ; yield per acre, in bushels, 22-45 ; total bushels, 52,214. Maize : acres, 14,232 ; yield per acre, in bushels, 36 ; total bushels, 502,697. This was the largest yield for seven years, except that of 1899, when the figures were: wheat, 13,073,416 bushels; oats, 16,511,388 bushels ; barley, 1,677,908 bushels. The export of cereals has greatly diminished of recent years. Nearly 300,000 tons of potatoes were grown in 1899.

The manufactures have made steady progress. The figures of the census taken in March 1896, and given in the following table, showed a lower rate of increase for the preceding five years than ruled from 1886 to 1891. This is exiSained, firstly by the collapse of the native hemp industry between 1891 and 1896, and, secondly, by the financial depression of 1893 and 1894, caused by low prices and the Australian bank panic. The estimated private wealth of colonists fell from Â£236 per head in 1890 to Â£219 in 1895. It rose in 1900 to Â£296.

Manu’ factures.

Manufactories and Works

1896, 1891, 1886.

April,

1890.

April,

1891.

March,

1886,

Increase,

1891-96.

Increase,

1886-91

Kumber of estab- lishments .

Employed â€” Males Females

Totals

2459

2264

1946

206

308

22,986 4,408

22,664 2,969

19,601 2,494

322 1484

80C8

475

27,889

25,683

22,095

1756

8688

Wages paidâ€” To Males . â€ž Females

Totals

Tear

1895.

Year

1890.

Tear

1886.

Increase,

1890-95.

Increase,

1885-90.

Â£1,776,076

181,516

Â£1,705,641

102,999

Â£70,435

28,517

Â£1,907,592

Â£1,808,640

Â£98,962

Total a p p r 0 X i – mate value of manufactures or produce . / .

Â£9,549,860

Â£8,778,887

Â£0,711,879

Â£77,^,523

Â£2,062,458

Since 1896 progress has been much faster. The returns of trade and the income-tax, the briskness of the building trade in the towns, the almost entire disappearance of unemployed workmen, are admitted on all hands. The figures of the census of 1901 support this contention. The best proof of advance is perhaps

found in the official returns of hands employed in the registered factories and workshops : â€”

Year.

Hands.

Increase

1895

. 29,879

4028

1896

. 32,387

2508

1897

. 36,918

4531

1898

. 39,672

2754

1899

. 45,305

5633

1900

. 48,938

3633

1901

. 53,460

4522

The chief factory industries come under the following heads : â€” meat-freezing and tallow ; tanning and wool-scouring ; saw-mills and grain-mills ; boots and shoes ; woollen and clothing ; butter and cheese ; breweries ;

printing houses ; foundries ; agricultural implement and machine shops ; soap and candle works ; coach- building and furniture ; gasworks. Except in meat-freezing, wool- scouring, butter- and cheese-making, and timber-sawing, manu- facturing is almost entirely for consumption within the colony.

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HiSTOKT,- 1882-1902.

Between 1882 and 1902 five governors represented the Cro-wn in New Zealand. Of tliese Sir Arthur Gordon quitted the colony in June 1882. His successor, Sir William Drummond Jervois, arrived in January 1883, and held office until March 1889. The earl of Onslow, who followed, landed in June 1889, and resigned in February 1892. The next governor, the earl of Glasgow, remained in the colony from June 1892 to February 1897, and was succeeded in August of the last-mentioned year by the earl of Ranfurly. The cabinets which administered the aSairs of the colony during these years were those of Sir Frederick Whitaker, Sir Harry Atkinson (3), Sir Eobert Stout (2), Mr Ballance, and Mr Seddon. Except in one disturbed month, August 1884, when there were three changes of ministry in eighteen days, executives were more stable than in the colony’s earlier years. The party headed by Mr Ballance and Mr Seddon held office without a break for more than eleven years, a result mainly due to the general support given to its agrarian and labour policy by the smaller farmers and the working classes.

The industrial history of New Zealand during these two decadesmaybedividedinto two unequal periods. Thirteen lean years â€” marked, some of them, by great depression â€” were followed by seven years of prosperity. The colony, which in 1882 was under a cloud, has not often been busier and more self-confident than in 1902. A division into two periods also marks the political history of the same time ; but here the dividing line is drawn in a different year. Up to December 1890 the Conservative forces which overthrew Sir George Grey in 1879 controlled Parliament in effect, though not always in name ; and for ten years progressive legislation was confined to a mild experiment in offering Crown lands on perpetual lease, with a right of purchase (1882), and a still milder instal- ment of local option (1881). In September 1889, however. Sir George Grey succeeded in getting Parliament to abolish the last remnant of plural voting. Finance otherwise absorbed attention ; the task of successive ministries was to make the colony's accounts balance, and search for some means of restoring prosperity. The years 1884, 1887, and 1888 were notable for heavy deficits in the treasury. Taxation, direct and indirect, had to be increased, and as

a means of gaining support for this in 1888 Sir Harry- Atkinson, who was responsible for the year's budget, gave the customs tariff a distinctly protectionist com- plexion. In the previous year Atkinson had reduced the scale of public expenditure, retrenching the salaries of public servants, from those of the governor and minis- ters to those of clerks drawing Â£125 a year, but leaving wages untouched. The number of members of the House of Representatives was cut down from 95 to 74, and their pay from Â£205 to Â£150. The cost of government was reduced in other ways, and the amount of State employ- ment diminished. Public borrowing between 1882 and and 1895, if not abandoned, was on a more modest scale. Private economy was also generally practised, and the colony made a resolute effort to live within its means. The commercial revival, however, came but slowly. The heavy borrowing and feverish speculation of the seven years 1872-79 must in any case have been paid for by reaction. The failure of the City of

Glasgow Bank in 1879 precipitated this, and the almost continuous fall in the price of wool and wheat, together with the dwin- dling of the output of alluvial gold, postponed recovery. Landholders and cultivators were almost always mort- gaged, and paid heavy rates of interest, usually from 6 to 9 per cent. An excessive amount of the better land was held in large estates, carrying but little popula- tion. The banks and other money-lending institutions virtually owned wide tracts, which were unsaleable at profitable prices. The principal local bank â€” the Bank of New Zealand â€” was in an unsound condition, and until in 1895 it was taken under control and guaranteed by the colony, the fear of its collapse overshadowed the community. The financial and commercial improvement which began in 1895 was doubtless to some extent con- nected with this venturesome but apparently successful stroke of policy. The revival, however, is mainly attribut- able to the steady conversion of the colony's waste lands into pasture, the development of two new and really great exports â€” frozen meat and dairy produce ; the continuous increase of the output of coal; the invention of gold- dredging; the exploiting of the deposits of kauri gum; the reduction in the rates of interest on mortgage money ; a general rise in wages, obtained without strikes, and partially secured by law, which has increased the spend- ing power of the working classes. Undoubtedly also commercial activity has been stimulated by considerable public loans, while the systems of taxation and rating on land values, adopted in 1891 and 1896, have contributed to check land speculation.

Dm-ing the years 1882-90 the leading political personage was Sir Harry Atkinson. He, however, withdrew from party politics when, in December 1890, he was overthrown by the Progressives under John Ballance. Atkinson's party never rallied from this defeat, and a striking change came over public life, though Ballance, until his death in April 1893, continued the prudent financial policy of his predecessor. The change was emp^iasized by the active intervention in politics of the trade unions. Tlxese bodies, impelled by a socialistic movement felt throughout Aus- tralia and New Zealand, decided in 1899 and 1890 to exert their influence in returning workmen to Parliament, and where this was impossible, to secure pledges from middle- class candidates. This plan was first put into execution at the general election of 1890, which was held during the industrial excitement aroused by the Australasian maritime strike of that year. It is therefore

usually, but wrongly, attributed to the feeling caused by that great conflict of labour and capital. It had, however, been fully arranged before the conflict broke out. The number of labour members thus elected to the General Assembly was small, never more than six, and no independent

labour party was formed. But the influence of labour in the Progressive or, as it preferred to be called. Liberal party, was considerable, and the legislative results note- worthy. Ballance at once raised the pay of members from Â£150 to Â£240 a year, but otherwise directed his energies to constitutional reforms and social experiments. These did not interfere with the general lines of Atkinson's strong and cautious finance, though the first of them was the abolition of his direct tax upon all property, personal as well as real, and the substitution therefor of a gradu- ated tax upon unimproved land values, and an income-tax also graduated, though less elaborately. The land-tax, which is still levied, rises from nothing at all upon the small holdings of peasant farmers to 3d. in the Â£ upon the capital value of the largest estates â€" those worth Â£210,000 and upwards. It must be remembered that buildings, improvements, and live stock are exempted. In the case of mortgaged estates, part of the tax is paid by the mortgagee. In 1896 municipal and rural local bodies were allowed to levy rates upon unimproved land values if authorized to do so by a vote of their electors, and by the end of 1901 some sixty bodies, amongst them the city of Wellington, had made use of this permission. The income-tax is not levied on incomes drawn from land. In 1891 the tenure of members of the Legislative Council or nominated Upper House, which had hitherto been for life, was altered to seven years. In 1892 a new form of land tenure was introduced, under which large areas of Crown lands have since been leased for 999 years, at an unchanging rent of 4 per cent, on the prairie value. Crown tenants under this system have no right of pur- chase. In the same year a law was also passed authoriz- ing Government to repurchase private land for closer settlement. At first the owner's consent to the sale was necessary, but in 1894 power was taken to buy land com- pulsorily. So energetically was the law administered by John Mackenzie, minister of lands from 1891 to 1900, that in March 1901 more than a million acres had been repurchased and subdivided, and over 6000 souls were living thereon. (These figures include the Cheviot estate, 84,000 acres, bought under

another law.) Out of about one hvmdred estates bought, only four have been taken compulsorily.

On BaJlance's sudden death his place was taken by Richard Seddon, minister of mines in the Ballance cabinet, whose first task was to pass the electoral Bill of his pre- decessor, which provided for granting the franchise to all adult women. This was adopted in September 1893, though the majority for it in the Upper House was but two votes. At three general elections after the date mentioned women voted in large and iucreasing numbers, though without affecting the strength or policy of parties. In 1893 was also enacted the Alcoholic Liquor Control Act, greatly extending local option. Under it all male and female electors have the right to vote triennially for the reduction or total refusal of licences in their districts. No compensation is paid. Up to 1902 prohibition had been carried in one rural district (Clutha) only, though the number of licences had been somewhat diminished since 1893 ; there was one licensed house to every 602 persons in the colony. In the Clutha district prohibition was followed by a diminution of drunkenness and minor police offences. In the colony generally drunkenness and petty crime have increased with the years of prosperity. [Summary convictions in 1895, 13,067 ; in 1900, 18,800. Serious crime, however, decreased.] In 1894 the Ad- vances to Settlers Act authorized State loans on mortgage to farmers at 6 per cent., and about Â£2,500,000 has been lent in this way, causing a general decline in the rate of interest. The same year also saw the climax of a series of laws passed by the Progressives affecting the relations

of employers and workmen. These laws deal with track, employers' liability, contractors' workmen, the recovery of workmen's wages, the hours of closing in shops and merchants' offices, conspiracy amongst trade unionists, and with factories, mines, shipping, and seamen. In 1895 a law controlling servants' registry offices was added.

Meanwhile the keystone of the regulative system had been laid by the passing of the Industrial Conciliation and Arbitration Act, under which

disputes between employers and unions of workers are compulsorily settled by State tribunals ; strikes and lock-outs are virtually prohibited in the case of organized work-people, and the conditions of employment in industries may be, and in many cases are, regulated by the awards of public boards and courts. The Arbitration Act, consolidated and extended in 1900, was soon in constant use. In 1896 the chief question before parliament was the reconstruction of the Bank of New Zealand. Under a Government guarantee fresh capital was provided for the bank, its creditors and depositors were secured against loss, and the gradual liqui- dation of its assets was arranged for, subject to govern- mental audit and supervision. Up to 1902 this process was steadily carried out, and the bank's business in- creased. In 1896 the landing-tax on Chinese immigrants, which had been Â£10 since 1881, was raised to Â£100, result- ing in a rapid diminution of the Chinese in the colony : 1896, 1897, and 1898 were marked by struggles over the Old Age Pensions Bill, which became law in November 1898; by 1902 it had become the means of conferring a free pension of Â£18 a year, or less, upon 12,300 men and women of 65 years of age and upwards whose private income was less than Â£1 a week. About 1000 of these pensioners were Maori. The total cost to the colony was about Â£205,000 annually. Complaints were made of certain evasions of the pensions law, and in 1901 an amending Act was adopted to 'check these. In 1898 the divorce law was amended on the lines of the Stephen Act of New Sonth Wales, and the municipal franchise, hitherto confined to ratepayers, was greatly widened ; in 1900 the English system of compensation to workmen for accidents suffered in their trade was adopted with – some changes. In 1895 borrowing on a larger scale was begun, and in seven years as many millions were added to the public debt. Before this the Ballance ministry had organized two new departments, those of Labour and Agriculture. The former supervises the labour laws, and endeavours to deal with unemployment ; the latter has done much practical teaching and inspecting work, manages experimental farms, and is active in stamping out diseases of live stock, noxiou^ weeds, and adulterar tion. Butter, cheese, and New Zealand hemp are by law graded and branded by departmental inspectors before export.

The outbreak of the Boer war in October 1899 was followed in New Zealand by a prompt display of general and persistent warlike enthusiasm : politics ceased to be the chief topic of interest ; the general election of 1899

Avas the most languid held for fifteen years. The desire of New Zealanders to strike a blow for the Mother Country took the practical shape of despatching to South Africa ten successive contingents â€” in all 6000 men and horses. As soldiers the New Zealand riflemen won from their Imperial commanders high praise for courage, intelligence, and discipline.

Noteworthy incidents of the period were the establish- ment in 1883 of direct steam service with London ; a proposal to annex Samoa, vetoed by the Imperial Govern- ment in 1886 ; the volcanic eruptions of 1886, in which the Pink and White Terraces were overwhelmed and 101 lives lost ; the payment of the first annual contribution to the Australasian Naval Squadron under an Act of 1887 ;

the annexation of the Kermadec Islands in the same year ; the maritime strike of 1890 ; the establishment of Victoria College in Wellington in 1899 ; the adoption of universal penny postage on New Year's Day, 1900 ; the addition to the colony of the Cook Islands, Savage Islands, and other Polynesian islets in 1901. In the year last mentioned a Royal Commission reported ex- haustively against the expediency of New Zealand enter- ing the Australian Commonwealth. In 1902 the progress of the Pacific cable brought the colony into telegraphic communication with Norfolk Island and Fiji. (w. p. k.)

Ngami, the central point of an inland water system of South Africa, once forming a small lake 20 miles long and ten wide, but now dry and consisting merely of an expanse of reeds growing in a soft treacherous soil, below which brackish water is found at a depth of 20 feet. It is cut by 20iÂ° S. and 23Â° E. The former feeder of the lake was the Tioghe or Taukhe river, which entered at the north-west end, but which now sends a portion at least of its waters by a channel north of the Ngami into the Botletli or Zuga river, by which the overflow of the lake was formerly carried off eastwards at the time of high water. The lowest 20 miles of the Taukhe are said to have been dry since about 1890, the districts intersected by the old river beds now growing corn in great plenty. The cessation of the river's flow was caused, according to native report, by a blocking of the channel by thousands of rafts on which the Makoba natives brought down their yearly tribute of corn. The Upper Taukhe is known successively as the Kubango

and Okavango, the most remote source lying in about 121Â° s. and 16^Â° E., on the high plateau of Bihe. The Kubango flows first, south, then south-east and east, but its course is still imperfectly known. In about 18Â° S. and 20|-Â° E. it is joined on the north bank by the Kwito, a large navigable stream rising almost as far north as the Kubango, and possibly containing more water. Its general course is south-east, but between 15Â° and 17Â° S. it flows south and even south-west. Below the Kwito the Okavango is a rapid stream with an average breadth of over 100 yards, and generally navigable as far as the Popa falls, in 21Â° 60′ E. In the dry season the water- level is from 4 to 20 feet below the banks, but these are overflowed during the rains. At this period some of the surplus water finds its way ,(in about 19Â° S.) by the Magwekwana to the Kwando or Linyanti (Zambezi sys- tem), to which, in Major Gibbons's opinion, the whole body of water may have once flowed. Below this point the river (now known as the Taukhe) enters a wide swamp-plain, and is broken up into various branches. The only channel by which its waters now reach the Botletli is the Tamalakane, which joins the latter in about 23^Â° E., the Botletli above this point being merely a succession of pools. Below the junction the river when visited by Dr Passarge in 1896, at the close of the dry season, had a breadth of 30 to 60 yards, though its bed reached 160 to 200 yards. The banks are 25 to 30 feet high, and form steep white walls of sand compacted with lime, behind which the dark green forest rises. The stream is fringed with reeds harbouring countless water- fowl, but the game which formerly abounded on its banks was largely destroyed by the rinderpest. The Botletli loses itself in a system of salt-pans â€" round or oval basins of varying size sunk to a depth of 30 to 45 feet in the sandstone, and often bounded by steep banks. The outer pans are dry for a large part of the year, the whole sys- tem being filled only at the height of the flood-season in August. (e. hb.)

Niagara, a river of North America, running north- wards from Lake Erie to Lake Ontario, and carrying the

discharge of all the Laurentian or Great Lakes, except Lake Ontario (see articles Niagara and St Lawkence in the ninth edition of this work). It is

navigable from its head to Chippewa, 16 miles, and from Queens- ton to its mouth, 6 miles. The intervening 9 miles include a series of rapids and the celebrated Falls of Niagara, where the water makes a sheer leap of 160 feet. On the right bank are Buffalo, Tonawanda, Niagara Falls, Lewiston, and Youngstown, of the state of New York ; on the left bank, Chippewa, Niagara Falls, Queenston, and NiagararOn-the-Lake, of the province of Ontario. At mean stage the flow of water is 222,000 cubic feet per second, at low stage 176,000. The theoretic average water power at the Falls

Bird's-eye Sketch of JS'iagara liiver and Gui-ge, from the north. L.E., Lake Erie. B. Buffalo, y. Niagara Falls, TS.Y. F, Niagara Falls, Ont. W, Whirlpool. EE, Escjirpment. L, Lewiston. Q, Queenston. J), St Davids.

equals five million horse-power, the minimum four million. Some 85,000 horse-power is already utilized, and there are extensive plans for future development. The chief part is transferred by electric methods to manufacturers and other consumers in the city of Niagara Falls and Buffalo.

The river has no valley. The belt of land it crosses consists of two plains separated by a high cliff or escarp- The gorge ment facing towards Lake Ontario. The stream audits runs half its length on the upper plain, drops origin. ^^ ^j^g Falls into a narrow gorge through which it courses seven miles to the escarpment, and then traverses the lower plain in a deep channel. Under the lower plain are soft shales. The crest of the escarpment is a bed of limestone, nearly level, and this bed is visible in both walls of the gorge to the falls, where it is 60 feet thick. From this firm brink the cataract plunges do^vn into a deep pool or basin hollowed from the soft shale, and the resulting agitation causes further wear of the shale and the continual undermining of the limestone, which breaks away in blocks. Thus the site of the cataract retreats up stream and the gorge is lengthened ; the average rate, measured from 1842 to 1890, being between 4 and 5 feet a year. It is evident that the whole gorge has been dug out by the river, and many attempts have been made to determine the time consumed in the work.

Problem of the Biver's Age. â€" This problem is of much interest to geologists, because its solution would aid in establishing a relation between

the periods and ages of geologic time and the centuries of human chronology. The great Canadian glacier, which in the

Glacial period alternately crowded forward over the Great Lakes region and melted back again, so modified the face of the land by erosion and by the deposit of drift that the waters afterwards had to find new courses. The Niagara river came into existence when the waning of the glacier laid bare the western part of the Ontario basin, and the making of the gorge was then begun. If it were supposable that the lengthening of the gorge proceeded at a uniform rate, the computation of the time would be easy, but there are various modifying conditions. (1) The limestone is notequally thick all along the gorge ; in one place it is 90 feet, and in several places as little as 35 feet. (2) The height of the cataract has varied' from 160 feet to more than 300 feet. (3) For a short distance at the whirlpool the limestone and shale were replaced by softer material, sand, and clay. The river here touched a more ancient gorge, which had previously been concealed by drift except at the escarpment. The diagram shows the breach in the escarp-' ment directed towards the sharp turn of the river gorge at the whirlpool. (4) The size of the river has varied. While the glacier was gradually melting the lakes underwent a complicated series of metamorphoses, and there were two separate epochs when the discharge from all the basins beyond Lake Erie followed other routes, and, during these, the Niagara drained only one-eighth of its present territory. The last mentioned is the most important of the modifying conditions, and at the same time least amenable to computation.

The parts of the gorge eroded by the full river are now marked by deep pools, the powerful cataract ha-ving dug far down into the shale. The parts eroded by the depleted river are comparatively narrow and shallow, the weaker cataract having been unable to clear away the fallen blocks of limestone. The work of the full river is illustrated by the main division of the present cataract, called the Horseshoe Fall, which wore its cliff back 220 feet in 48 years. The work of the depleted river is less adequately represented by the narrower and shallower American Fall, where 70 years of observation have discovered no change. In making two-thirds of the gorge the full river probably consumed between 5000 and 15,000 years. If the depleted river worked one-tenth as fast, the period required for the

remaining third was five times as long ; but the relative rate is -wholly conjectural, and the ratio of one-tenth is no more plausible than one of one-hundredth. A weighing of the evidence now available indicates 25,000 years as a lower limit for plausible estimates of the age of the river, but yields no suggestion of an upper limit.

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. Niagara Falls (formerly Clifton or Suspension Bridge), a town, port of entry, and railway station of Wel- land county, Ontario, Canada, 40 miles south-south-east of Toronto, on the left bank of the Niagara river and opposite the falls. It is a station on the Grand Trunk, ^Michigan Central, and St Catharines and Niagara Central railvsays, and has electric railway communication with Niagara, Le'wiston, and Buffalo. There are two famous bridges, viz., the Grand Truuk, the largest single-arch railway bridge extant â€" span 550 feet â€" and the road bridge, rest- ing on the greatest steel arch in the world â€" 840 feet span. Population (1891), 3349 ; (1901), 4244.

Niagara Falls, a city of Niagara county. New York, U.S.A., on the east side of the Niagara river at the falls, in the north-western part of the state, at an altitude of 571 feet. The present city was formed by the consolida- tion in 1892 of the former villages of Niagara Falls and Suspension Bridge. It

extends along the level summit of the cliffs, from above the falls to some three miles below. The city is regularly laid out on a level site, is entered by five large railways, and is divided into four wards. The

river is here crossed by three bridges, the steel arch bridge built (1897-98) on the site of the former suspen- sion bridge near the falls, and two railway bridges about two miles farther down the river, viz., the cantilever bridge of the Michigan Central railway and the single steel arch bridge of the Grand Trunk railway. The first named of the three is crossed by double carriage-ways and foot- paths, and by an electric tramway. Population (1890), 6602; (1892, of the present city), 12,638 ; (1900), 19,467.

Niam-Niam. â€” Former estimates of the dominant position held by the Niam-Niam, or Zandeh people, as they call themselves (Ency. Brit. vol. xvii. p. 473), have been more than confirmed by the researches of Junker, Casati, Bohndorff, and the Belgian and French ofiicials in south-east Sudan. Their political ascendancy, already weakened by the incessant attacks of the Arabo-Nubian slave-hunters before the rise of the Mahdi, was no doubt broken, perhaps for ever, by the forces of the Congo Free State advancing from the Ubangi into the Welle, and thence across the Nile-Congo divide into the Bahr-el- Ghazal zeriba lands. But by these very political develop-ments the boundaries of their ethnical domain have been greatly enlarged, and the Zandehs proper, with the kindred peoples, are now found to stretch, with interrup- tions, from the White Nile above the Sobat confluence to the Shari affluent of Lake Chad, and from the Bahr-el- , Arab, about 10Â° N., nearly to the equator.

In this widespread Negroid family are now provisionally grouped the Makarakas, intermingled with the Mundas, the Bari, and the Babukurs in the north-east (Bahr-el-Ghazal) ; the Krej, Bandas, and N’’ Sakkaras in the north-west (Dar-Fertit, and thence to the Upper Shari) ; the Bandzisi, Ndris, Togbos, Langwasi, Dakoas, Ngapus, Wia-Wias, Manjas, Awakas, Akimgas, and others visited by the French explorers â€” Crampel, Dybowski, Maister â€” about both slopes of the Congo-Chad water-parting. These last, who

give such an enormous westward extension to the family, present much the same physical characters as the Zandehs proper, and speak dialects of the widely-diffused Ndris language, which is not Bantu, but appears to show affinities with Zandeh.

In this great division some French ethnologists are even disposed to include the Fulahs of west and central Sudan, and to substitute for the now exploded “Nuba^Fulah” a ” Zandeh-Fulah ” family, resulting from various secular interminglings between the true negroes and the Hamites of North Africa. Such crossings have undoubtedly been in progress since prehistoric times over an enormous area south of the Sahara (Africa : Ethnology’), and are almost everywhere marked by certain constant characters, such as long ringletty or kinky black hair, coppery, reddish, or bronze shades of complexion, brachycephalous (round) head, often highly pronounced, and indicated outwardly by an unusually wide space between the orbits, and generally by somewhat softened negro features. But, owing to the different environments and to the different initial ratios of intermixture, the transitional forms are almost endless, so that it becomes difficult to constitute distinct ethnical groups without calling in the aid of language. Where type and speech correspond, as to a large extent is the case with most of the above-mentioned tribes, even strict systematists will be disposed to constitute separate ethnical groups, at least as working hypotheses, always allowing for the somewhat untrustworthy nature of the linguistic factor. But in the case under consideration Fulah has no kind of connexion with Zandeh speech, both forming, as far as yet known, two absolutely independent negro stock languages. Hence, at leapt for the present, the newly-formed Zandeh-Fulah must share the fate cff Fr. Mtiller’s Nuba-Fulah division of the Hamito-Negroid races.

Besides their speech and the above indicated physical traits, the Zandehs differ in some other respects â€” temperament and social usages â€” from the surrounding Mangbattu, Momfu, A-Barambo, A-Babua, and other Negroid peoples. The Makaraka branch especially is described by Junker as amongst the most trustworthy, industrious, and intelligent people of the Bahr-el-Ghazal, where they are very numerous in the district west of Lado. Their strength and staying-power are extraordinary, and they will carry loads of 75 lb poised on the head for long marches with only one or two

halts during the day. They came originally from the country of the Kibas, north of the Welle, who are typical Niam-Niams, dis- tinguished by their elaborate head-dresses and peculiar tattoo markings â€” square patterns on forehrad, temples, or cheeks, an X- shaped figure in a cartouche below the chest, and various zigzag,

straight, or dotted lines on the upper arm and breast. Most of the Zandeh file the incisors, the better, as they explain, to seize the foe in battle or in wrestling. From the malted grain of a species of eleusine they brew the best beer in Africa, of a sparkling brown or reddish colour, and pleasant bitter taste, derived from the stalk of the same cereal.

By tribal custom the men are all hunters ; the women. Who are treated with great kindness and even affection, all tillers of their fertile soil, which with little toil yields abundant crops of cereals- yams, manioc, colooasia, and Virginian tobacco (gundli). They are great smokers, and and also passionately fond of music, gathering for hours at the concerts, at which fantastically-dressed strolling minstrels accompany their songs with stringed instruments of the guitar and mandolin types. Of the ox, horse, ass, or camel they have no knowledge, the only domestic animals being poultry, and a remarkable breed of dogs, like small wolf-hounds, with smooth red hair, twisted tail like a porker’s, large ears, pointed nose, and four-clawed hind feet. These curious little “greyhounds ” join in the chase with small wooden bells round the neck, and are thus soon found when lost in the woods.

At present the dismembered Zandeh empire and dependent principalities are divided up between France, which claims the “sultanates” of Rafai, Dinda, Zemio, andTambura in the Mbomu valley, with all the peoples in Fertit and the Shari basin ; the Congo State, which administers the eastern section between the Mbomu and the Upper Welle ; and Great Britain, to whose share have fallen the Bari, Makarakas, and other Niam-Niam groups of the Bahr-el-Ghazal region.

See Dr W. Junker. Travels in Africa. English ed., vol. i., 1890. â€” Fr. Bohndorff. Beisen in Central Afrika, 1885.â€” G. Casati. Ten Tears in Equatoria. English ed., 1891.

(a. h. k.)

Nicaragua, a country of Central America, lying between 10Â° 41′ and 15Â° N. and 83Â° 16′ and 87Â° 40′ W. The demarcation of the boundary towards Costa Eica was determined by arbitration under treaties of 1858 and 1896 (see Costa Rica). The climate, healthy on the uplands, is malarial on the coast and plains. The rainy season on the Pacific slope is from the middle of May to the middle of November ; on the eastern coast, from June to December. The fever which prevails on the low-lying regions appears to be of a mild character, yielding to simple remedies. Observations made at San Juan (Grey- ‘town) in 1890 showed the extremes of temperature to be 89Â° Fahr. in September for the maximum, and 70Â° Fahr. in January for the minimum ; the rainfall for the whole year amounted to 297 inches, the rainiest month having been July (52-5 inches), and the driest, May (4-9 inches). Earthquakes are felt at times on the Pacific slope, but in Nicaragua they are never violent, as in the neighbouring countries. The area of Nicaragua is estimated at about 49,000 square miles ; the population in 1897 was 428,000. The country is for political purposes divided into twelve departments and two comarcas (or territories). The de- partments with their population in 1896 are given as follows: â€” Managua, 42,460; Masaya, 33,869; Granada, 18,938; Carazo, 18,546; Eivas, 25,883; Leon, 87,772; Chinandega, 34,614; Chontales, 40,387; Matag’alpa, 29,895; Jinotega, 37,663; Nueva Segovia, 32,642; and Zelaya, 14,641. ‘The Mosquito Eeserve was, by desire of the Indian population, constituted as the department of Zelaya on 20th>November 1894. The mass of the popu- lation of Nicaragua is very mixed, comprising negroes, mulattoes, zambos, mestizos, and other coloured inhabit- ants. The Europeans and descendants of Europeans are estimated at about 1200 ; the uncivilized Indians at about 30,000. The more important towns are Managua, the capital, with 27,000 inhabitants; Leon, the old capital, 45,000; Granada, 21,000; Masaya, 15,000; Chinandega, 10,000; Jinotega, 10,000; Esteli, 8500; Rivas, 6000; Bluefields, 5000; Corinto, 2600; and San Juan del Norte (Greytown), 1200. Within the republic there are alto- gether 110 municipalities.

Qovernj/ient.â€”Vndev the constitution of 11th July 1894, the Legislative Chamber consists of twenty-four members, two from each department, elected for four years by universal suffrage. The

President of the republic, chosen in a similar manner for four years, is assisted by a cabinet of five ministers, heads of Government departments. Justice is administered by a Supreme Court in two sections, one at Leon, the other at Granada, and by subordinate tribunals throughout the country.

Instruction. â€” Public instruction is under the care of Government, but is in a very backward condition. In 1894 there were said to be 1020 schools, with altogether 20,000 pupils. An oflBcial report of 1895, however, stated that in Leon and Granada, the most advanced of the towns, only 30 per cent, of the children were enrolled, and of these only about half learned anything, while of the whole population of school age only about 3 per cent, learned anything. There are two intermediate schools, one for boys, the other for girls, with together 51 teachers and 1441 pupils (724 boys and 717 girls). The universities for teaching law and medicine at Leon and Granada have been united. A library at Managua is supported by Government. For the year 1901 the cost of instruc- tion was put at 491,192 pesos, or Â£32,740.

Defence. â€” Military service is obligatory. To the active army belong all citizens from eighteen to thirty-five years of age ; to the reserve, those from thirty -six to forty-five ; to the national guard, those from forty-six to sixty-five. The number actually serving is from 2000 to 3500. A few steamers used for police purposes are stationed on Lake Managua.

Finance. â€” The revenue of the republic is derived mainly from customs duties, liquor, tobacco, and slaughter taxes, railways and â€¢ steamers, the postal and telegraph services, and the gunpowder monopoly. The principal spending departments are those of war and marine, internal development, and finance. The published accounts, however, present no continuous or clear view of the national receipts and disbursements. For the year 1899 the receipts amounted to 4,475,827 pesos, or (at fifteen pesos to the Â£) Â£298,388 ; and the expenditure to 4,577,794 pesos, or Â£305,186 ; deficit, Â£6798. These receipts, however, are exclusive of the proceeds of the coffee export tax mentioned below, and the ex- penditure is exclusive of external and various internal debt charges. For the year 1901 the revenue

was estimated at Â£384,060, Â£317,480 being from taxation, and Â£66,580 from railways and other national services ; while the expenditure was put at Â£383,928, of which Â£123,002 was for finance, Â£78,640 for internal development, and Â£66,256 for war and marine. In 1886 the republic contracted an external loan to the amount of Â£285,000 at 6 per cent, interest, and in 1894 the interest fell into default. In 1895 an arrangement was made for the reduction of interest, the commencement of amortization, and the creation of ” cofiee warrants ” to be used in the payment of export duties on coffee assigned for the service of the debt. In the four years 1897-1900 the sales of these warrants amounted to 1,028,990 gold pesos, or (at 23d.) Â£98,610. In July 1901 the outstanding amount of the debt was Â£273,900. At the end of 1899 the internal debt amounted to 8,064,935 pesos, or (at fifteen to the Â£) Â£537,662.

Production. â€” The principal agricultural product is coffee, the yield of which increased from 4,528,300 lb in 1880 to 11,382,000 lb in 1890, 19,800,000 ib in 1899, and 26,400,000 lb in 1900. Coffee is grown principally in the Matagalpa region, on the uplands of the interior. On the Caribbean coast bananas are cultivated, and largely ex- ported to the United States. Sugar is grown and exported in con- siderable quantities (1800 tons in 1901). The cocoa export is small ; tobacco is grown for local use, as are also rice, beans, and other crops. Rubber is collected in the forests, and plantations have been formed from which good results are expected. The quantity of rubber exported in the year 1900 amounted to 1,097,6001b. Dye- woods and indigo are still shipped, but the demand for vegetable dyes has decreased. Cattle rearing is successfully pursued, live cattle and hides being important articles of export. There are about 400,000 head of cattle in the republic. In 1899 the Government sold about 52,000 acres of public land lying about 18 miles to the east of Lake Nicaragua for the purpose of colonization. The purchaser undertakes to introduce settlers from northern Europe, to import cattle for the improvement of the Nicaraguan breed, to plant rubber and vanilla trees, and to provide schools for agricultural instruction. Goldrmining is carried on in the Bluefields region, but, though the discovery of rich deposits is announced from time to time, there is no great enterprise In progress. In 1898 the gold dust and bar exports from Bluefields were of the value of Â£25,760 ; in 1899, Â£47,880 ; in 1900, Â£62,000.

Com?rae)‘ce.^The imports consist of cotton and woollen goods, wines and spirits, flour, earthenware, and provisions ; the exports consist of the products already mentioned. Complete returns of the trade are not available. In 1900 the total imports amounted to the value of Â£703,490, and the exports to Â£792,203. The chief imports were cotton goods of the value of Â£321,000 ; flour, Â£35,000; wines and spirits, Â£32,000; woollen goods, Â£19,500; hardware, Â£18,300 ; provisions, Â£15,260. The chief exports were ooSee, of the value of Â£400,000 ; gold and silver bullion, Â£74,000 ; rubber, Â£69,600 ; gold ore, Â£80,690 ; cattle, Â£45,000 ; mahogany.

Â£44,000 ; hides, Â£31,500 ; sugar, Â£7343. The largest trade is with the United Kingdom, both in imports and exports ; then follow, in order of value, the United States, Germany, and France. The largest and most numerous commercial firms are German, but there are also French, British, and even Chinese establishments. The immigration of Chinese is prohibited by law.

Shipping and Communications. â€” At Corinto, the principal port of the republic, there entered, in 1900, 200 ocean-going vessels with an aggregate tonnage of 328,622 tons. The railways, with the exception of a few short lines for local purposes, belong to the Government. Their total length in 1899 was 136 miles. The main system, connected and supplemented by steamboats on Lakes Managua and Nicaragua and the San Juan river, provides com- munication between Corinto on the Pacific and San Juan del Norte (Greytown) on the Atlantic. The railway is year by year extend- ing, and several new lines are now contracted for or projected.

Nicaragua Canal. â€” For the construction of an interoceanio canal across Nicaragua a company obtained a concession which was ratified 15th April 1887. For the carrying out of this project the Maritime Canal Company was organized in May 1899, and in- corporated by charter granted by the United States Congress. In the following year a construction company was incorporated. The proposed route of the canal begins at San Juan (Greytovra), and, passing across the low coast-land to the San Juan river, follows (with the help of 3^ miles of short cuttings) the course of the river as far as Lake Nicaragua. Issuing from the west side of the lake, it passes along the valleys of the river Las Lajas and the Rio Grande to Brito, the

port on the Pacific. The total length of projected waterway is 170 miles, of which 27 miles would be ex- cavated canal. The ascent from the sea-level at each end would be made by three locks, and the summit level would have a length of 154 miles. The question whether the interoceanio canal would be constructed by this route or by the Panama route was still undecided in September 1902. (See also Canals.)

Posts and Telegraphs. â€” Nicaragua joined the Postal Union in 1882. In 1896 the republic had 119 post oflBces ; during that year 1,376,366 pieces of mail were received and 1,242,876 were delivered. The telegraph lines in 1897 had a length of 17-52 miles, and were served by 83 telegraph offices.

Money and Credit. â€” There is one bank of issue, the London Bank of Central America, but in 1898 a concession was granted for the formation of another bank. There is, besides, an agricultural bank. The monetary unit is the silver peso, but no Nicaraguan silver pesos are coined. “The current coin (of which there is little in the country) consists of Mexican and Central and South American dollars. The currency is mostly paper, notes being issued directly by the Treasury and by the bank. The outstanding Treasury notes at the beginning of 1899 amounted to 2,379,642 pesos. For their amortization there is a fund to which in 1900 the sum of 390,000 pesos, or Â£26,000, was paid. The notes issued by the bank must be covered to the extent of 40 per cent, by gold and silver ; the actual bank reserve is stated to be from 65 to 100 per ceut. of the notes issued. The metric system of weights and measures was legalized in January 1893.

History. â€” Few events in the recent history of Niear ragua, beyond those already noticed, require to be men- tioned here. Under the administration of Chamorro, who became president in 1875, a difficulty with Germany occurred. The German Government asserted that one of its consuls had been insulted, and demanded an indemnity of $30,000 (about Â£2800), a demand to which Nicaragua only submitted after all her principal ports had been blockaded. The successor of President Chamorro was General Zavala, whose administration brought Nicaragua to a higher degree of prosperity than she had ever known. He was succeeded in 1883 by Dr Cardenas, during whose presidency the attempt of General Barrios to unite the five Central American states was a cause of war between Guatemala and

Honduras on one side, and Salvador, Nicaragua, and Costa Rica on the other. Cardenas had taken command of the united Nicaraguan and Costa Eican army when Barrios died, and on 11th April 1885 a treaty of peace was signed. Don Evaristo Carazo suc- ceeded Dr Cardenas as president of the republic in 1887, but died when he had served a little over two years, and was succeeded by Dr Eoberto Sacasa. Under Carazo's administration the boundary question between Nicaragua and Costa Eica had been settled by arbitration, the President of the United States acting as arbitrator. While Dr Sacasa was president of Nicaragua, the republics

of Honduras, Salvador, and Guatemala signed a treaty, under -which the United States of Central America were to be formed. The president of Nicaragua adhered to this treaty, but the National Congress refused to ratify it. President Sacasa was overthrown by a revolution in 1893, and was succeeded by a provisional government, which in its turn was deposed soon after by another uprising, at the head of which was General Zelaya. His position was regularized by the constitution of 1894, and he was re-elected president in 1898 for another term of four years. Under his government the incorporation of the Mosquito Reserve into the territory of Nicaragua took place. In 1895 occurred the Hatch incident, which led to the occupation of the port of Coriuto by a British fleet. Mr Hatch, British pro-vice-consul at Bluefields, being accused of conspiracy against the Nicaraguan Govern- ment, was arrested, along with other British subjects, and expelled the country. For this action Nicaragua was required to pay an indemnity of fl6,000. A serious attempt to overthrow Zelaya by force of arms was made in February 1896, but although it developed rapidly into a formidable revolution, it was crushed after several months of severe fighting. There were occasional disturb- ances subsequently, but none sufficient (up to September 1902) to overturn President Zelaya.

For tlie formation and dissolution of the Greater Republic of Central America, composed of Nicaragua, Salvador, and Honduras, see Central America.

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Nice, capital of the department of Alpes-Maritimes, Prance, a winter health resort and seaport on the Medi- terranean, 640 miles from Paris by rail. Its population is continually increasing, and every year fresh districts are built over. Nice now joins on the north-east the ancient episcopal town of Cimiez, in which are situated the largest and most elegantly appointed mansions (the Regina and Riviera Palace), frequented by British Royalties and rich foreigners. From east to west the town is surrounded by a girdle of beautiful towns â€” Carabacel, St Etienne, St Philippe, and the Beaumettes. On the east of the port lie Montboron, Riquier, and St Roch, the last partly occupied by barracks. The entrances to the port of Nice have been improved ; that of the outer port is 300 feet wide, and that of the inner 220 feet. The area of the port is about 15 acres, the length of quayage available 3380 feet, the depth of water 20 feet, its trade, mostly coastal, being shared principally between French and Italian vessels, the arrivals being about 300 vessels of some 100,000 tons annually. Nice, under the command of a governor-general, is the pivot of defence of the Alpes-Maritimes ; hence its girdle of forts. The French Mediterranean squadron is frequently stationed in the deep bays of Villefranche. In 1891 a monument was erected in Nice to the

memory of Garibaldi, who was born here, followed in 1896 by one commemorating the union of Nice with France a century

before, though the final cession did not take place till 1860 (see Nice, ninth edition of this work). The Palais de Justice was completed in 1891, the Gothic church of Notre Dame in 1890. The trade in flowers and fruit (oranges and lemons) increases in importance as the means of transit improve. In winter the railway carries them “daily by the waggon-load. Population (1886), 61,484;

(1896), 106,246 ; (1901), 125,099.

Nichol, John (1833-1894), Scottish man of letters, son of the astronomer J. P. Nichol (1804- 1859), was born 8th September 1833, and educated at Glasgow and Balliol College, Oxford, where he had a brilliant career. After taking his first-class in classics, he remained at Oxford as a coach, but in 1862 he was made professor of English literature at Glasgow. He ‘had already made a reputation as a spirited writer of both verse and prose, an acute critic, and a successful lecturer, and his influence at Glasgow was very marked. He was a frequent visitor to the United States, and in 1882 he wrote the article on American literature for the ninth edition of the EncyclopcBdia Britannica â€” an article which is a good example of his pungent (sometimes unduly pungent) style.’ He left Glasgow for London in 1889, and continued to be very active with his pen until his death on 11th October 1894, a few months after that of his wife, whom he had married in 1861. Among his best works were his drama Hannibal (1873), his Byron in the “English jNIen of Letters” series (1880), his Robert Burns (1882), and Garlyle (1892). A Memoir of Nichol, by Professor Knight, was published in 1896.

Nicholas (1841), Peince of Montenegeo

AND THE Beeda, was bom at the village of Niegush, the ancient home of the reigning family of Petrovitch-Niegush, on the 26th September 1841. His father, Mirko Petro- vitch, a celebrated Montenegrin warrior, was elder brother to Danilo II., who left no male offspring. Since 1696, when the dignity of vladika, or prince-bishop, became hereditary in the Petrovitch family, the sovereign power has descended from uncle to nephew, the

vladikas be- longing to the order of the ” black clergy ” who are forbidden to marry. A change was introduced by Danilo II., who declined the episcopal office, married, and declared the principality hereditary in the direct male line. Mirko Petrovitch having resigned his claim to the throne, his son was nominated heir, and the old system of succession was thus accidentally continued. Prince Nicholas, who had been trained from infancj- in martial and athletic exercises, spent a portion of his early boyhood at Trieste in the household of the Kuetitch family, to which his aunt, the Princess Darinka, wife of Danilo II., belonged. The Princess was an ardent advocate of French culture, and at her suggestion the young heir of the vladikas was sent to the academj’ of Louis le Grand in Paris. Unlike his contemporary, King]\Iilan of Servia, Prince Nicholas was little influenced in his tastes and habits by his Parisian education : the young mountaineer, whose keen patriotism, capability for leadership, and poetic talents early displayed themselves, showed no inclination for the pleasures of the French capital, and eagerly looked forward to returning to his native land. He was still in Paris when, in consequence of the assas- sination of his uncle, he was called to the throne (13th August 1860). In 1862 INlontenegro was engaged in an unfortunatestruggle with Turkey: the prince distinguished himself during the campaign, and on one occasion narrowly escaped with his life. In the period of peace which fol- lowed he carried out a series of military, administrative, and educational reforms. In 1867 he met the Emperor Napoleon III. at Paris, and in 1868 he undertook a journey

to Eussia, where he received an affectionate welcome from the Tsar, Alexander II. He afterwards visited the courts of Berlin and Vienna. His efforts to enlist the sympathies of the Russian imperial family were produc- tive of important results for Montenegro; considerable subventions were granted by the Tsar and Tsaritsa for educational and other purposes, and supplies of arms and ammunition were sent to Cettigne. In 1871 Prince Dolgorouki arrived in Montenegro on a special mission from the Tsar, and distributed large sums of money among the people. In 1869 Prince Nicholas, whose authority was now firmly established, succeeded in pre-

venting the impetuous mountaineers from aiding the Krivoshians in their revolt against the Austrian Govern- ment; more recently, in 1897, he checked the martial excitement caused by the outbreak of the Greco-Turkish war. In 1876 he declared war against Turkey : his mili- tary reputation was enhanced by the ensuing campaign, and still more by that of 1877-78, during which he cap- tured Nikshitch, Antivari, and Dulcigno. The war re- sulted in a considerable extension of the Montenegrin frontier and the acquisition of a seaboard on the Adri- atic. In 1883 Prince Nicholas visited the Sultan, with whom he has latterly maintained the most cordial rela- tions; in 1896 he celebrated the bicentenary of the Petrovitch dynasty, and in the same year he attended the coronation of the Tsar Nicholas II., from whom in 1898 he received a gift of 30,000 rifles and 30 million cartridges ; in May 1898 he visited Queen Victoria at Windsor. In 1901 he assumed the title of “Eoyal Highness.” The descendant of a long line of warriors, gifted with a fine physiqxie and a commanding presence, a successful military leader and a graceful poet. Prince Nicholas possesses many characteristics which awake the enthusiasm of the impressionable Servian race, while his merits as a statesman, diplomatist, administrator, and reformer have received general recognition. His system of government, which may be described as a benevolent despotism, is perhaps that which is best suited to the character of his subjects. He has done much to establish security of life and property in his dominions, to put dovm the vendetta and other barbarous usages, to further the progress of education, and to improve the material condition of the people. His historical dramas, poems, and ballads hold a recognized place in contemporary Slavonic literature ; among them are â€” Balkansha Tzaritza and Kniaz Arvaniti (dramas); Haidana, Potini Abense- rage and Pesnik i Vila (poems) ; Shupliene Pesme and Nova Kola (miscellaneous songs). In November 1860 Prince Nicholas married Milena, daughter of the voievode Petar Vukotitch. Of his three sons, the eldest. Prince Danilo, married (27th July 1899) Duchess Jutta (now Militza) of Mecklenburg-Strelitz ; of his six surviving daughters, Princess Militza is married to the Grand Duke Peter Nikolaievitch, Princess Stana to Duke George of Leuchtenberg, Princess Helena to King Victor Emman- uel III. of Italy, and Princess Anka to Prince Francis Joseph of Battenberg. (For the political and military history of Montenegro under Prince Nicholas see Monte- NBGEo and the more recent authorities there enumer- ated.)

Nicholas II., Empeeoe of Eussia (1868),

eldest son and successor of Alexander III., was born at St Petersburg on thei 18th of May 1868, and received the ordinary education of Russian grand dukes, under the direction of General Danilo vitch, assisted by M. Pobg-donostsef and other eminent professors. Among these was an Englishman, the late Mr Charles Heath, for whom he had great respect and affection. By the death of his grandfather, Alexander II., in 1881, he became

heir-apparent (Cesarevitch). Though he received, like all the heirs-apparent to the Eussian throne, a certain amount of military training, his personal tastes did not lie in that direction, nor did he show any inclination for the boisterous amusements of the jeunesse dorie of St Petersburg. Like his father, he was nowhere hap- pier than in the family circle, and he was particularly attached to his sister, the Grand Duchess Xenia, who was seven years younger than himself. In 1890-91 he made a tour in Greece, Egypt, India, Ceylon, and Japan, where he narrowly escaped assassination at the hands of a Japanese fanatic. On the return journey by Siberia, at Vladivostok, he turned the first sod of the eastern section of the Siberian railway, and two years afterwards (1893) he was appointed president of the imperial com- mittee for that great undertaking. By the death of his

Thb Tsae KiciiOLAs II. {JProm aplwtograph hy TT. and D, Downey, London.)

father on 1st November 1894 he became emperor, and on the 26th of that month he married Princess Alix of Hesse (a grand-daughter of Queen Victoria) to whom he had been betrothed in the presence of his father during the latter’s last illness. Eighteen months later the coronation took place at Moscow with great pomp, but a gloom was thrown over the festivities by the un- fortunate incident of the Khodinskoe Polye, a great open space near the city, whei-e a popular fete had been prepared and where, from defective police arrangements, a large number of men, women, and children, roughly estimated at 2000, were crushed and trampled to death. As a rule, Nicholas II. followed in the footsteps of his father, seeking to preserve peace in foreign relations, and continuing in home affairs, though in a much milder form, the policy of centralization and Eussification which had characterized the previous reign. His pacific tendencies were

shown by his systematic opposition to all bellicose excitement, by his maintaining M. de Giers in the post of minister of foreign affairs, by his offering the post, on the death of that statesman, to 31. de Staal, by his re- straining France from dangerous adventures, by his sup- porting M. de Witte in his efforts to establish close com- mercial relations with Great Britain, and by initiating the

so-called Peace Conference at The Hague. To these ought perhaps to be added the transformation of the Franco- Russian entente cordiale into a formal alliance, since the alliance in question might be regarded as favourable to the preservation of the status quo in Europe. In the internal administration he introduced by his personal in- fluence, and without any great change in the laws, a more humane spirit towards those of his subjects who did not belong by language and tradition to the dominant nationality, and who were not members of the Eastern Orthodox Church ; but he disappointed the men of liberal views by giving it to be clearly understood that he had no intention of circumscribing and weakening the auto- cratic power by constitutional guarantees or parliamentary institutions.

Nicholson, John (1822-1857), British colonel and brigadier-general, eldest son of Alexander Nicholson, a physician of Dublin, was born at Lisburn, Antrim, on 11th December 1822. Educated at Dungannon College, he entered the Bengal Infantry as ensign in 1839. He served in the Afghan war of 1839-42, distinguished himself in the defence of Ghazni (1842), and on its capitulation and the subsequent treachery was made a prisoner and badly treated until removed to Bamian. He escaped with the other prisoners in September 1842, on the occupation of Kabul by Sir George Pollock (medal). He served in the Sutlej campaign, and was present at the battle of Eirozshah in 1845 (medal). He was then sent to Kashmir to instruct the maharaja’s troops, and in 1847 was given the charge of the Sind Sagar district. On the seizure of Multan by Mulraj, Nicholson rendered great service in securing the country from Attock and in putting down rebellion.

He distinguished himself at the Margalla Pass, where he was wounded. In the Punjab campaign of 1848-49 his services were invaluable in furnishing supplies and boats, and in obtaining information of the movements of the enemy, and for these and his gallantry at Chilianwala, Gujrat, and the pursuit of the Sikhs he was mentioned in despatches (medal and clasp and brevet- majority). He was appointed a deputy-commissioner of the annexed Punjab, under Sir Henry Lawrence. His frontier work was most remarkable. At Bannu, among an ignorant and bloodthirsty people, he evolved, in the course of five years, such order and respect for law that murder and highway robbery, previously rife, were un- known in the district. He so impressed his personality on the natives that he became to them a demi-god, and in Hazara a brotherhood of fakirs in 1848 instituted a religious cult for the worship of ” Nikal-Seyn,” which continued to flourish in spite of Nicholson’s efforts to suppress it by punishment. Promoted lieutenant-colonel in 1854, he was deputy-commissioner at Peshawar when the Indian Mutiny began in 1857. He disarmed the sepoy regiment there, and pursued the Mardan mutineers to the borders of Swat. He succeeded Sir Neville Chamberlain in the command of the Punjab force, defeated the rebels at Trimmu Ghat and on the Eavi river, and joined the Delhi field force. He gained a great victory over the rebels at Najafgarh, capturing thirteen guns, and was a tower of strength during the siege and at the assault of Delhi. He led the main storming party, and, having carried the breach, fell mortally wounded in the street while leading on his men. He died a few days later, 23rd September 1857, and was buried in front of the Kashmir gate. (k. h. v.)

Nicobar Islands, a British group, consisting of twelve inhabited and seven uninhabited islands, lying in the Bay of Bengal, between Sumatra and the Andaman Islands, to which latter they are administratively ap- pended. They have an aggregate area of about 636 square miles, Great Nicobar (Loong), the largest and

southernmost of any size, covering 333 square miles. Six others range in area from about 20 square miles to 62 square miles ; the rest are mere islets. A careful census of the natives, taken by Mr E. H. Man in 1901, gave a total population of some 6700, at about which figure the estimates of the number of inhabitants have”al ways stood. â– Car Nicobar (Pu), the most northerlyisland, with an area of 49 square miles, was by far the most

densely populated, and had 3500 inhabitants. Great Nicobar containing only 450. The marine surveys of these islands are still meagre and unsatisfactory, but the whole of the Nicobars and outlying islands were surveyed topographically by the Indian Survey Department in 1886-87, when a number of maps on the scale of two inches to the mile were pro- duced, giving an accurate coastrline. Some of the islands have mere flat, coral-covered surfaces; others, again, are hilly, the Great Nicobar rising to 2105 feet. On that island there are considerable and beautiful streams, but the others generally are badly off for fresh surface water. There is one good harbour, a magnificent land-locked shelter called Nancowry Harbour, formed by the islands of Camorta and Nancowry (both known to natives as Nankauri).

The Nicobars form part of a great submarine chain, of which the Andamans are a continuation. Elaborate geological reports were issued by a Danish scientific expedition in 1846 aeology. and an Austrian expedition in 1858. Dr Rink of the former found no trace of true volcanic rocks, though the chain as a whole is known for its volcanic activity, but features were not wanting to indicate considerable upheavals in the most recent periods. He considered that the islands belonged to the Tertiary age. Von Hochstetter of the Austrian expedition classified the most important formations thus : eruptive, serpentine, and gabbro ; marine deposits, probably late Tertiary, consisting of sandstones, slates, clay, marls, and plastic clay ; recent corals. He considered the whole group connected geologically with the great islands of the Malay Archipelago farther soiith. The vexed question of the presence of coal and tin in the Nicobars has so far received no decided scientific support. The white clay marls of Camorta and Nancowry have become famous as being true polycistinan marls like those of Barbados. Earthquakes of great violence were recorded in 1847 and 1881 (with tidal wave), and mild shocks were experienced in December 1899. It has always been held to be important to maintain a meteorological station on the Nicobars, for the purpose of supplementing the inf orma- Meteor- tion obtained from the Andamans regarding cyclones ology. in the Bay of Bengal. Erom 1869 to 1888 an observatory was properly maintained in Nancowry harbour, but after the latter year observations were recorded only in a more or less desultory way until 1897, when the station was removed to Mus in Car Nicobar. The climate is unhealthy for Europeans. The islands

are exposed to both monsoons, and smooth weather is only experienced from February to April, and in October. Eain falls throughout the year, generally in sharp, heavy showers. During the five years ending 1888 the annual rainfall varied from 91 inches to 133 inches, and the number of wet days per annum from 148 to 222. The highest temperature in the shade was 98‘2Â° E., and the lowest 64Â° F. Although the vegetation of the Nicobars has received much desultory attention from scientific observers, it has not been subjected to a Flora and systematic examination by the Indian Eorest Depart- ’”””*â€¢ ment like that of the Andamans, and indeed the forests are quite inferior in economic value to those of the more northerly group ; be- sides fruit trees â€” such as the cocoanut {Cocos nncifera), the betel-nut (Areca catechu), and the mellori (Pandanus leeram) â€” a thatching palm (Nipa fruticans) and various timber trees have some commer- cial value, but only one timber tree (Myristica iryd) would be consid- ered first-class in the Andamans. The palms of the Nicobars are, however, exceedingly graceful. Instances of the introduction of foreign economic plants are frequently mentioned in the old missionary records, and nowadays a number of familiar Asiatic fruit-trees are carefully and successfully cultivated. As with the geology and the flora, certain phases of the fauna of the islands have been extensively reported. The mammals are not numerous. In the southernmost islands are a small monkey, rats and mice, tree- shrews {Cladohates reic), bats, and flying-foxes, but it is doubtful if the “wild” pig is indigenous; cattle, when introduced and left, have speedily become ” wild.” There are many kinds of birds, notably the megapod (Megapodiws nic), the edible-nest-building swift {CoVocalia-nidiflca), the hackled and pied pigeons {Calocnas nic. and Carpophaga bicolor), a paroquet {Falceornis caniceps),

and an oriole (Oriohis macrourus). Fowls, snipe, and teal thrive after importation or migration. Keptiles â€” snakes, lizards, and chameleons, crocodiles, turtles, and an enormous variant of the edible Indian crab â€” are numerous ; butterflies and insects, the latter very troublesome, have not yet been systematically collected. The fresh-water fish are reported to be of

the types found in Sumatra. The Nicobarese may be best described as a Far Eastern Natives race, having generally the characteristics of the less civilized tribes of the Malay Peninsula and the south- eastern portion of the Asiatic continent, and speaking varieties of the Mon-Annam group of languages, though the several dialects that prevail are mutually unintelligible. Their figure is not graceful, and, owing to their habit of dilating Jthe lips by betel- chewing, the adults of both sexes are often repulsive in appear- ance. Though short according to our standards (average height, man, 6 feet 3| inches ; woman, 5 feet), the Nicobarese are a fine, well-developed race, and live to 70 or 80 years of age. Their mental capacity is considerable, though there is a great difference between the sluggish inhabitant of Great Nicobar and the keen trader of Car Nicobar. The religion is an undisguised animism, and all their very frequent and elaborate ceremonies and festivals are aimed at exorcising and scaring spirits. It has so far proved ineradicable. Though for a very long time they were callous wreckers and pirates, and then very cruel, and though they show great want of feeling in the “devil murders” â€” ceremonial mur- ders of one of themselves for grave offences against the community, which are now being gi-adually put down â€” still on the whole the Nicobarese are a quiet, inoffensive people, friendly to each â€¢ other, and not quarrelsome, and by inclination friendly towards Stnd not dangerous to foreigners. The old charge of cannibalism may be generally said to be quite untrue. Tribes can hardly be, distinguished, but there are distinctions, chiefly territorial. All the differences observed in the several kinds of Nicobarese may with some confidence be referred to habitat and the physical difficulties of communication. Such government as there is, is by the village ; but the village chiefs have not usually much power, though such authority as they have has always been maintained by the foreign Powers who have possessed the islands. The clothing, when not a caricature of European dress, is of the scantiest, and the waggling tags in which the loin-cloths are tied behind early gave rise to fanciful stories that the in- habitants were naked and tailed. The houses are good, and often of considerable size. The natives are skilful with their lands, and thougli they never cultivate cereals, exercise some care and knowledge over the cocoauut and tobacco, and have had much success with the foreign fruits and vegetables introduced by the missionaries. The staple article of trade has always been the ubiquitous cocoanut, of which it is computed that 15 million are produced annually, 10

million being taken by the people, and 5 million exported about equally from Car Nicobar and the rest of the islands. The usual cheap European goods are imported, the foreign trade being carried on with the native traders of the neighbouring Asiatic countries. There is an old-established inter- nal trade, chiefly between the other islands and Chowra for pots (which are only made there) and racing and other canoes.

The situation of the Nicobars along the line of a very ancient trade route has caused them to be reported by traders and sea- Hlstor farers through all historical times. In the 17th century

â– ‘â– the islands began to attract the attention of mission- aries. At various times Fi-ance, Denmark, Austria, and Great Britain all had more or less shadowy rights to the islands, the Danes being the most persistent in their efforts to occupy the group, until in 1869 they relinquished their claims in favour of the British, who at once began to put down the piracies of the islanders, and estab- lished a penal settlement, numbering in all about 350 persons, in Nancowry harbour. The health of the convicts was always bad, though it improved with length of residence and the adoption of better sanitary measures ; and an attempt to found a Chinese colony having failed in 1884 through mismanagement, the settle- ment was withdrawn in 1888. At present there are maintained native agencies at Nancowry Harbour and on Car Nicobar, both of which places are gazetted ports. At the latter is a church of England mission station (the only one the missioners connected with which have not led a miserable- existence) under a native Indian catechist attached to the diocese of Rangoon.

Authorities. â€” Man. Dictionary of the Central Nicobarese Language. London, 1899. â€” Selections from the Records of the Government of India (Home Department), No. Ixxvii. Calcutta, 1870. â€” Maurer. Die Nikobaren. Berlin, 1867 (contains valu- able bibliography, Danish and German) . â€” Svoeoda. Die Bewohoer des Nikoharen-Archpiels. Leyden, 1893 (contains good coloured plates and a Continental bibliography). â€” De Roepstroff. Dic- tionai~y of the yancotory Dialect. Calcutta, 1884. â€” Vocabulary of Dialects in the Nicobar and Andaman Islands. 2nd ed., Calcutta, 1875. â€” Beport on Administration, Andamans and Nicobars, for

lSSS-89. Government, Calcutta, 1890. â€” Pkevost and Heing. Report on Preliminary Tour through the Nicobar Islands. Govern- ment, Rangoon, 1897. â€” Papers in the Journals of the Anthropo- logical Institute, by Distant, Ball, Man (many), Lane-Fox, and Flower ; of the Asiatic Society of Bengal, by Ball and De Roepstroff ; and in the Indian Antiquary, by Man (many), and Temple. (r. c. T.)

Nicosia, the capital of Cyprus. Its earliest name was Ledra, but Leucos, son of Ptolemy Soter (280 b.c), is said to have restored it and changed its name to Leuteon, Leucotheon, or Levcosia. One mUe south-west of the town, lies the very large Bronze- Age necropolis known as Hagia Paraskevi, which has been repeatedly explored with valu- able results. Population in 1881, 11,636 (Moslem, 5393 ; Christian, 6143) ; in 1901, 14,762 (Moslem, 6013 ; Chi-is- tian, 8739). The circuit of the city was reduced in 1667, under the direction of the Venetian engineer G. Savorg- nano, from nine miles to three ; eighty churches and a number of fine houses were sacrificed. The new walls were given a circular shape, with eleven bastions and three gates. Water is supplied by two aqueducts. Govern- ment House, the residence of the High Commissioner, the Government offices, hospital, central prison, and the new English church are without the walls. The fosse has been planted, and part of it used as an experimental gar- den. Carriage roads have been completed to Kyrenia, Kythraia, Pamagusta, Larnaca, Limasol, and Morphou. Within the city something has been done to wards, widen- ing and repairing the streets. The principal monuments of the Lusignan period are the fine cathedral church of St Sophia, an edifice of Prench Gothic, at once solid and elegant (the towers were never completed) ; the church of St Catherine, ” a perfect and finished type of southern Gothic architecture of the last years of the 14th cen- tury ” (both these are now mosques) ; and the church of St Nicolas of the English (now a grain store), built for the order of the Knights of St Thomas of Acre (Bp Stubbs, Lectures on Mediceval and Modem History, Lect. viii. p. 182, Oxford, 1886). A gateway of no great im- portance is nearly all that remains of the palace last used by the Venetian proveditori. It dates from the end of the 16th century. There is a museum, with a valuable catalogue. The chief industries are tanning and hand weaving, both silk and cotton.

Nicotera, Giovanni (1828-1894), Italian patriot and politician, was born at San Biagio on 9th September 1828. Early affiliated to the Giovane Italia, he was among the combatants at Naples in May 1848, and at San Pancrazio with Garibaldi during the defence of Eome. After the fall of Eome he fled to Piedmont, where he organized the expedition of Sapri in 1857, but shortly after landing was defeated and severely wounded by the Bourbon troops. Condemned to death, but re- prieved through the intervention of the British minister, he remained a prisoner at Favignana until 1860, when he joined Garibaldi at Palermo. Sent by Garibaldi to Tuscany, he attempted to invade the Papal States with a volunteer brigade, but his followers were disarmed and disbanded by Eicasoli and Cavour. In 1862 he was with Garibaldi at Aspromonte; in 1866 he commanded a volunteer brigade against Austria; in 1867 he invaded the Papal States from the south, but the defeat of Gari-baldi at Mentana put an end to his enterprise. His parliamentary career dated from 1860. During the first ten years he engaged in violent opposition, but from 1870 onwards joined in supporting the military reforms of Eicotti. Upon the advent of the Left in 1876, Nicotera assumed the portfolio of the Interior, and governed with remarkable firmness. Obliged to resign in December 1877, he joined Crispi, Cairoli, Zanardelli, and Baccarini in forming the ” Pentarchy ” in opposition to Depretis,

but only returned to power, thirteen years later, as Minister of the Interior in the Rudini cabinet of 1891. On this occasion he restored the system of uninominal constituencies, resisted the Socialist May Day agitation, and pressed, though in vain, for the adoption of drastic measures against the false bank-notes put in circulation by the Roman Bank. He fell with the Rudini cabinet in May 1892, and died at Vico Equense on 13th June 1894. (h. w. s.)

Niemes (Czech, Mimofl), a town in the government district of Bohmisch-Leipa, North Bohemia, Austria, on the Polzen river. There are manufactures of cloth, linen, and cotton stuffs, bentwood furniture, chemicals, and pyroligneous vinegar. Population (1890), 5598 ; (1900),

6024.

Nietzsche, Friedrich Wilhelm (1844-1900), German philosopher, was the son of the pastor at Rocken, near Leipzig, where he was born on 15th October 1844. He was educated at Schulpforta, and studied the classics at the universities of Bonn and Leipzig. In 1869, while still an undergraduate, he was, on P. W. Ritschl's recom- mendation, appointed to an extraordinary professorship of classical philology in the University of Basel, and rapidly promoted to an ordinary professorship. Here he almost immediately began a brilliant literary activity, which gradually assumed a more and more philosophical character. In 1876 eye (and brain) trouble caused him to obtain sick leave, and finally, in 1879, to be pensioned. Por the next ten years he lived in various health resorts, in considerable suffering (he declares that the year con- tained for him 200 days of pure pain), but dashing off, at high pressure, the brilliant essays on which his fame rests. Towards the end of 1888, after recovering from an earlier attack, he was pronounced hopelessly insane, and in this condition he remained until he died on 26th August 1900. Nietzsche's writings must be understood in their relation to these circumstances of his life, and as the outcome of a violent revolt against them on the part of an intensely emotional and nervous temperament. His philosophy, consequently, is neither systematic in itself nor expounded in systematic form. It is made up of a number of points of view which successively appeared acceptable to a per- sonality whose self ~~appreciation verges more and more upon the insane, and exhibits neither consecutiveness nor consistency. Its natural form is the aphorism, and to this and to its epigrammatic brilliance, vigour, and uncom~~ promising revolt against all conventions in science and conduct it owes its persuasiveness. Revolt against the whole civilized environment in which he was brought up is the keynote of Nietzsche's literary career. His revolt against Christian faith and morals turns him into a proudly ' atheistic " free-thinker," and preacher of a new " master " morality, which transposes the current valuations, deposes the " Christian virtues," and incites the " over-man " ruth- lessly to trample under foot the servile herd of the weak, degenerate, and poor in spirit. His revolt against the theory of State supremacy turns him into an anarchist and individualist ; his revolt against modern democracy into an aristocrat. His revolt against conventional culture leads him to attack D. P. Strauss as the typical " Philistine of culture " ; his revolt

against the fashion of pessimism to demand a new and more robust affirmation of life, not merely althowjh, but because, it is painful. Indeed, his very love of life may itself be regarded as an indignant revolt against the toils that were inexorably closing in around him. He directs this spirit of revolt also against the sources of his own inspiration ; he turns bitterly against Wagner, whose intimate friend and enthusiastic admirer he had been, and denounces him as the musi-

cian of decadent emotionalism ; he rejects his ” educator ” Schopenhauer’s pessimism, and transforms his will to live into a ” Will to Power.” Nevertheless his reaction does not in this case really carry him beyond the ground of Schopenhauerian philosophy, and his own may perhaps be most truly regarded as the paradoxical development of an inverted Schopenhauerism. Other influences which may be traced in his writings are those of modern natu- ralism and of a somewhat misinterpreted Darwinism (“strength” is generally interpreted as physical endow- ment, but it has sometimes to be reluctantly acknowledged that the physically feeble, by their combination and cun- ning, prove stronger than the ” strong”). His writings in their chronological order are as follows, those so far trans- lated into English being marked with an asterisk : â€” Die Oehurt der Tragodie aus dem Geiste der Musik, 1872 ; Unzeit- genidsse Betrachtungen, 1873-76 (Strauss â€” Vom Nutzen u. Nachtheil der Historie fur das Leben â€” Schopenhauer als Erzieher â€” Richard Wagrier in Bayreuth) ; Menschliches, Allzumenschliches, 1876-80 ; Morgenrothe, 1881 ; D. frohliche Wissenschaft, 1882 ; * Also sprach Zarathustra, 1883-84 ; Jenseits von Gut u. Bose, 1886 ; * Zur Genea- logie der Moral, 1887; * Der Fall Wagner, 1888;

- Gotzenddmmerung, 1888 ; * Nietzsche contra Wagner,
- Der Antichrist, and * Poems first appeared in the complete edition of his works, which also contains the notes for Wille zur Macht, in which Nietzsche had intended to give a more systematic account of his doctrine (1895-1901). His biography, by his sister, Elizabeth Porster-Nietzsche, is in course of publication (vol. i., 1895). (f. c. s. s.)

Nievre, a department in the centre of Prance, trav- ersed by the mountains of Morvan and watered by the Loire, the Allier, the Nievre, and the Yonne.

Area, 2659 square miles. The population, .‘547, 576 in 1881, had decreased to .319,506 in 1901. Births in 1899, 5921, of which 279 were illegitimate ; deaths, 6473 ; marriages, 2.380. There were in 1896, 702 schools, with 53,000 pupils, and 5 per cent, of the popu- lation was illiterate. The area under cultivation in 1896 measured 1,598,150 square miles, of which 795,340 acres were plough-land and 27,170 acres vineyards. The land in wheat in 1899 yielded the value of Â£1,008,000 ; barley, Â£96,000 ; oats, Â£433,000 ; vines, Â£132,000; potatoes, Â£304,000; mangold-wurzel, Â£123,000; green crops (trefoil, lucern, and sainfoin), Â£309,000 ; natural pastures and grass lands, Â£957,000. In 1899 there were in the department 26,230 horses, 195,369 cattle, 147,790 sheep, and 76,570 pigs. In 1898 N”i6vre mined 192,000 metric tons of coal, valued at Â£92,000. It has also some iron mines. The arrondissement of Nevers (Decize, &o.) has important industries in metals, producing in 1898, 5800 metric tons of iron and 19,200 tons of steel, of the total value of Â£245,000. There is a brisk industry in pottery. Distil- lation produced (1899) only some 28,000 gallons of alcohol. Nevers, the capital, had 25,116 inhabitants in 1901.

Nigdeh, the chief town of a sanjak of the same name in the Konia vilayet of Asia Minor, situated on the Kaisarieh-Karaman road. It is remarkable for the beauty of its buildings, dating from the Seljrik period. The population of 20,000 includes large Greek and small Armenian communities.

Niger, a great river of West Africa, inferior only to the Congo and Nile among the rivers of the continent. Rising within 150 miles of the sea in the outer moun- tainous zone of the western limb of Africa, it traverses the interior plateaux in a vast curve, flowing north-east, east, and south-east, until it finally enters the Gulf of Guinea through an immense delta. About 250 miles from its mouth it is joined by its great tributary, the Benue, coming from the east from the mountainous region of Adamawa. The source of the Niger, as fixed by the Anglo-Prench boundary commission in 1896, lies in 9′ 5Â° N. and 10′ 46Â° W., and the most northerly point of the great bend in about 17Â° N., this part of the river’s course having been shifted considerably to the

south as a result of recent surveys. The area of the Niger basin, excluding the arid regions with a slope towards the stream, has been calculated by Dr Bludau at 584,000 square miles.

The additions to our knowledge of the Niger during the last two decades of the 19th century were largely the work of French officers engaged in the extension of French influence throughout the western Sudan. From 1880 onwards Colonel (afterwards General) Gallieni took a leading part in the operations on the upper river, where in 1883 a small gunboat, the Niger, was launched for the protection of the newly-established French posts. In 1885 a first voyage was made by Captain Delanneau past the ruins of Sansandig, as far as Diafarabe, at the junc- tion of the backwater which flows past the town of Jenne. Below Sansandig the stream was found to be split up into a number of channels, while beyond Diafarabe the banks became swampy and treeless. In 1887 the gunboat made a more extended voyage, reaching the port of Timbuktu, and correcting the mapping of the river down to that point. After the occupation of Timbuktu in 1893-94, surveys made in the surrounding region revealed the existence of a series of lakes and back- waters, chiefly on the left of the main stream, with which they are connected by channels conveying the water in one direction or the other according to the sea- son. At high water most of these are united into one general inundation. The largest lake, Faguibini, is nearly 70 miles long, has high shores, and reaches a con- siderable depth. In 1894-95 attention was directed to the middle and lower Niger, to which several expeditions started from the coast of Guinea, the result being the survey of the portion of the river below Say never before visited by Europeans. Say was reached early in 1895 by Captain Deeoeur (French), coming from Dahomey, and by Dr Gruner (German), coming from Togoland, the latter afterwards following the course of the stream down to its mouth. In the same year Captain Toutee (French) ascended the river past the Bussa rapids (the scene of Mungo Park’s death) and Say, to a point within the radius of influence of Timbuktu. During the sub- sequent descent the rapids at Bussa were only passed with the greatest difficulty. A still more important expedition was that of Lieutenant Hourst, who, starting from Timbuktu in January 1896, navigated the whole course of the Niger from that point to its mouth, execut- ing a careful survey of the river and the various obstruc- tions to navigation. These were found to occur in two principal sections â€” the one

commencing at Ansongo, in the territory of the Kel-es-Suk Tuareg, and extending almost to Say, the other beginning below the town of Bussa. In both of these sections the river flows through several rocky passes, the current attaining a tremendous velocity. Rapids do not entirely cease until a little above feabba. A voyage made in 1897 by Lieutenant de Chevigne showed that at low water the section between Timbuktu and Ansongo presents great difficulties, but the voyage from Timbuktu to Say was again successfully accomplished in 1899 by Captain Granderye. In 1901 Captain Leufaut ascended the river with a flotilla from its mouth to Say, experiencing great difficulties in the passage of the rapids.

The delta of the Niger, though still imperfectly known, has been partially surveyed since it became British terri- tory by various ship captains, officials of the Eoyal Niger Company, and others, including Sir Harry Johnston, formerly British consul for the Oil Elvers. East of the Nun, or the main mouth of the Niger, the estuaries known as the Brass, Sombrero, New Calabar, Bonny, Opobo, &c. (with the exception, perhaps, of the first-named), seem to derive most of their water from inde-

pendent streams such as the Orashi, rising in about 6Â° N., which is, however, linked with the Niger by the Onita creek in 5|-Â° N. Behind the town of Okrika, some 30 miles up the Bonny liver, the swampy ground gives place to firm land, partially forest-clad. West of the Nun all the estuaries up to the Forcados, and possibly the next beyond, the Escravos, seem to be true mouths of the great river, while the Benin river, though linked to the others by transverse channels, may be more pro- perly regarded as an independent stream. In this direction the largest mouth is the Forcados, the main outlet of the Wari branch of the Niger, a noble stream with a safe and relatively deep bar. The other western mouths, most of which are still very imperfectly known, have as a rule shallow and difficult bars.

In addition to the main stream, almost the whole of the Niger basin has been made known by recent explora- tion. The journeys of the German traveller G. A. Krause (north from the Gold Coast, 1886-87) and the French Captain Binger (Senegal to Ivory” Coast, 1887-89) first defined its southern limits by revealing the unexpected northward extension of the basins of the

Guinea coast streams, especially the Volta and Komoe, a fact which explained the absence of important tributaries within the Niger bend. This was crossed for the first time, iu its fullest extent, by Monteil (French) iu 1890-91, but has since been traversed iu all directions by French and other travellers. At the eastern end of the basin much light has been thrown on the system of the Benue, the only really important tributary, apart from the right-bank affluents of the upper Niger. The region of the Benue sources was first explored by E. E. Flegel (1882-84), who traversed the whole southern basin of the river and reached the important town of Ngaundere. Other German travellers â€” Zintgraff, Morgen, Uechtritz, and Passarge, &c. â€” added to our knowledge of the southern tributaries, the Tambba, Donga, and others, which in the rains bring down a large body of water from the highlands of southern Adamawa. British travellers who have done work in the same region are Messrs Wallace, Moseley, and Hewby. The Benue itself was ascended to 13\Â° E., and its tributary the Kebbi to the Bif ara marshes, by Colonel (afterwards Sir Claude) Macdonald in 1889, further progress towards the Tuburi marsh, by which a connexion with the Shari system is supposed to exist, being prevented by the shallowness of the water. The upper basin of the Benue was also traversed by the French expeditions of Mizon (1892) and Maistre (1892-93), the latter passing to the south of the Tuburi marsh, without, however, definitely settling the hydrographical question connected with it. Above the Kebbi a considerable stretch of the Benue has not been visited. At this part the stream flows in a curve from the south-west, its source lying in the latter direction, in about 7Â° 40′ N. and 13Â° 15′ E, The Benue, though exceptionally free from obstruction by rapids, falls very low in the dry season, and for seven to eight months is almost useless for navigation.

Politically, the main stream of the Niger is divided between Great Britain and France, the former holding, in the protectorate of Nigeria (see below), the lower course of the river as far as a point just above Ho, in about 11Â° 40′ N., and the latter the whole middle and upper course. The Benue falls within British territory up to a point three miles below the mouth of the Faro, in about 13Â° 8′ E., the head streams beyond that point lying within the German territory of Cameroon.

Authorities. â€” Gallieni. Mission (T exploration du JSaiit Xiger. Paris, 1885. â€” Caron. De Saint Louis au Port de Timhouktou. Paris, 1891. â€” Toltee. Dahome, yiger, Touareg. Paris, 1897. â€” Hourst. Sur le Xiger et au Pays des Touaregs. Paris, 1898. â€” JoHNSToy. “The Niger Delta,” Proc. S.G.S., December 1888. â€” LuGARD. “An Expedition to Borgu on the Niger,”

ibid., September 1895. â€” Mockler-Fekryman. Up the Niger. London, 1892. â€” Bindloss. In the Niger Country. London, 1898. (e. he.)

Nigeria, a British protectorate occupying the -whole lower basin of the Niger, with adjoining territories up to Lake Chad.

The coast-line had long been a field of British commerce, but no British political rights were asserted anywhere in Nigeria until â€ž. , 1884, when the annexation of Cameroon by Germany

s ory. (irg-yy the attention of the Government to the complete insecurity of British interests in those regions. Early in 1844 the first political treaties with native chiefs on the banks of the Niger were concluded by a British company which had foreseen and prepared for the coming general rush for the partition of the con- tinent. It had been founded for this work by Captain Goldie Taubman (afterwards the Right Hon. Sir George Taubman Goldie, K.C.M.G.) as early as 1879, under the name of the United African Company. Finding its capital too small to obtain the desired royal charter, it had expanded in 1882 into the National African Company with a capital of Â£1,000,000 sterling. Just before the West African Conference at Berlin in 1884, it had completed the purchase of all French interests in the basin of the lower Niger, enabling the British ambassador to declare that the British flag was alone represented in those regions. In 1 886 it at last received a royal charter, which recognized the sovereign and other administrative rights it had obtained (or might obtain) by treaties with native sultans, emirs, and chiefs. Its name was then changed to “The Royal Niger Company.” The total number of these political treaties exceeded 400, and

covered territory extend- ing from the Gulf of Guinea to the Sahara. Of the coast-line of Nigeria, about one-half only was within the Royal Niger Company's jurisdiction. The remaining half â€" at the chief ports of which treaties had been made by Consul Hewitt in 1884 for the Imperial Government â€" was administered by Imperial authorities, first as the " Oil Rivers Protectorate," and after May 1898 as the " Niger Coast Protectorate." After many years of struggle between the Niger Company and German agents, final recognition of British rights was obtained from Germany by the agreement of 1893, which defined the south-east frontier, running roughly north-east from the Rio del Rey to LakeChad. An agreement with France in 1890 fixed the northern frontier of the company as a line running from Say on the Niger to Barua on Lake Chad, but left undecided the frontier west of the Niger. This was keenly contested between the Niger Com- pany and the French colonial agents, until the agreement of 1898, which fixed the frontier on the right bank of the Niger, near Ilo, the northern frontier of the company being also modified so as to give to France the left bank below Say, and also a rectangular block, including the important town of Zinder. Two small enclaves on the lower river were also assigned to France â€" the one on the south bank of the Forcados estuary, the other on the right bank of the Niger in about 9JÂ° N. They were occupied in 1901. The sovereign rights of the Niger Company were transferred to the British Crown on 1st January 1900, and the whole territory, including the coast protectorate, became the protectorate of Nigeria, divided into a northern and southern government, each of which is administered by a high commissioner appointed by the Colonial Office. (See also Chartered Companies.)

Physically, Nigeria consists of a series of zones parallel to the coast-line. The swampy delta region, traversed by

innumerable interlacing creeks and broad placid Physical channels fringed with monotonous mangrove

forest, gives place some 40 miles from the coast to an undulating forest-clad country, which in turn yields near the confluence of the Niger and lieuue to a zone of hills, bare in parts, marking the outer margin of the in- terior plateau. This, which extends north with generally similar features through

the remainder of British terri- tory, broken only by the valleys of the two great rivers, does not attain an elevation approaching that of the plateaux of the southern half of the continent, the culminating point (apart from particular mountain dis- tricts), situated in about 10Â° N., reaching a height of 2500 feet only. The valleys of the Niger and Benue, esiJecially the latter, are very much lower, the town of Yola on the Benue, some 750 miles from the sea, lying at an altitude of little over 600 feet. The surface is generally undulating, with isolated hills of granite and sandstone often rising abruptly from the plain. It is clothed largely with thin forest, but becomes more open

to the north until the arid steppes bordering the Sahara are reached. The most mountainous districts are north- ern Bauchi (a little north of 10Â°), where heights of 6000 to 7000 feet occur; parts of Muri, along the north bank of the Benue ; and the southern border of the Benue basin, where the hills (consisting of ironstone, quartz, and granite) appear rich in minerals.

The climate of the coast-lands is moist and hot, and extremely unhealthy, malarial fevers being unusually prevalent and deadly. Inland the mean temperature of the year is high, and at the time when the ” harmattan” blows from the northern deserts, noon temperatures con- siderably over 100’Â° Fahr. are recorded. A great part of the year (eight months in parts) is dry, the rains being limited to the late summer. Though unfavourable for the permanent residence of white men, the interior is, much less deadly than the coast-lands. In the latter, as far inland as 6^Â°-7|Â° N., the oil-palm {Elceis guineensis) is the most noteworthy tree; bananas are largely grown, and, with yams, &c., form an important article of food. Rubber, with many kinds of valuable timber, occurs throughout the inland forest zone. The Benue valley and the plains of northera Nigeria are largely cultivated, pro- ducing abundance of guinea corn (millet), maize, wheat, cassava, rice, onions, cotton, indigo, peas and beans, sweet potatoes, ground nuts, &c. Various economic trees, in- cluding the shea-butter tree (Bassia Parkii), the locust-tree, gambler (used in tanning), tamarind, &c., are allowed to grow in the fields. The last-named supports silk-worms in large quantities, the silk being much valued.

The inhabitants of Nigeria are distributed in accordance with the physical features, the forest-clad coast-lands being peopled by pure negroes, some of

the tribes being given, at least in the past, to cannibalism “n”’‘ and other revolting practices, while others are harmless and peaceable. The interior possesses a mixed population, a negro substratum having been modified by contact with the northern races of the continent, and by them converted to Islam, which forms, however, but a thin veneer. The most important race in northern Nigeria is that of the Hausas, who have been called the Parsees of West Africa for their enterprise and industry. They are keen traders, their caravans ranging from the Mediterranean to the Gulf of Guinea. They are physically well developed, capable of great endurance, and make excellent soldiers. The ruling race of the Hausa States, however, is the Pulah or Pulani, which forms a separate caste of cattle-rearers, but constitutes probably less than a sixth of the total population, the pure-blooded Hausas making up a third, while the remainder consists of slaves chiefly recruited from the pagan races to the south-east. Towns of 10,000 to 30,000 inhabitants are met with about every 50 miles in some parts, and occasional cities of 60,000 to 100,000. The total population of the Hausa States alone has been estimated at from 15 to 20 millions: The nominal sovereign of the Fulah empire is the Sultan of Sokoto, whose power has, however, much declined of late years, many of the subordinate sultans having become almost independent.

The capital is now Wimiu, some 25 miles north-east of Sokoto, the former capital, which has been abandoned for political reasons, ^^‘urnu is a small town of 6,000 inhabit- ants, not to be compared with the other great cities of the empire. Of these the most important is Kauo, the great emporium of trade for the central Sudan, where Tuareg and Arab from the north meet merchants from the Niger, Lake Chad, and the far southern regions. The average daily attendance at the market lias been estimated at 25,000 to 30,000. Kano produces an immense amount of cotton cloth, and is the great centre of the trade in kola nuts, which are imported from behind the Gold

Coast. Other important towns, more or less independent of the central authority, are Katsena, Zaria, Bauclii or Takoba (population, 50,000), Nasarawa, Mtiri, and Tola on the Benue, the last the chief centre of the

province of Adamawa. In the extreme east, between the Benue and Lake Chad, the state of Belda has acquired importance of late years under Hayatu, a Moslem propagandist of the Tuling family of Sokoto. Several of the mountainous â€¢districts, especially south of the Benue, are inhabited by pagan negro tribes. Immediately east of the Niger is the semi-subordinate kingdom of Gandu, with the chief town of the same name, and south of it the small states of Yauri and Nupe. Nupe extends south across the Niger, between 8Â° and 9Â° N. Its capital is Bida, a large walled town of much importance as a centre of trade and of the manufacture of leather goods and glass. It was taken by the Niger Company's forces in 1897. West of the Niger lies the negro kingdom of Borgu (under the king of Bussa), where, however, the Fulahs have gained a footing at Oomba. The bulk of the inhabitants are known as Baribas. Farther south on this side Nigeria includes the northern part of the Yoruba countries, with the important town of llorin, captured by the Niger Company's forces in 1897. Bomu, west of I*,ke Chad, inhabited by the Kanuri, another mixed race, though likewise part of British Nigeria, has for some time been in an unsettled state, firstly through the invasion of the ex-slave Rabah (q.v.), and since 1899 through the French military operations against Eabah and his son Fadel Allah, both of whom lost their lives in battle.

Since its transfer to tlie Britisli Crown Nigeria has been divided

for administrative purposes into tlie two governments of northern

and southern Nigeria, the dividing line running east and

irJtlon ^^^^ " ''Â°'‘ ‘Â° '^' ^â€¢' crossing the Niger a Uttle above Idda. Southern Nigeria thus includes an area many times larger than the old Niger Coast Protectorate. The administrative centre is at Asaba, above the head of the delta, which was the old civil capital of the whole territory under the Niger Company. It is the seat of the supreme court and has various public buildings, including the central gaol. On the â– opposite bank of the Niger is Onitsha, where are both Protestant and Roman Catholic mission stations. The principal port of entry for the Niger is AJcassa, on the main mouth of the river, which Ainder the former regime formed part of the Company's territory. It possesses a slip for the repairing of ships and important engineer- ing workshops. Other trading ports of importance are Old

Calabar, Opobo, Bonny, New Calabar, and Brass to ‘the east; and Warri, Burutti, Sapele, and Benin to the west, of the main Niger mouth. Old Calabar, known also as Duke Town (population about 40,000), lies at the head of a broad tidal estuary unconnected with the Niger system, but carrying off the water of the Old Calabar or Cross river, which rises in German territory in about 10JÂ° E. The K:hief exports from all these ports are palm-oil and kernels. Rubber, ebony, cacao, and coffee also figure in small quantities among the exports from the coast region, and those of the interior which pass out by the Niger mouth include ivory, indigo, gums, camwood, and hides. The total exports of southern Nigeria were valued at Â£774,648 in 1898-99, and the imports (in which the principal item was cotton goods) at Â£732,640. The Church Missionary Society has long been active on the Lower Niger, and has stations at most of ithe chief centres ; while two other British Protestant societies and two French Roman Catholic societies are also at work.

In northern Nigeria the chief British stations are Lokoja (military â– centre under the Royal Niger Company) , Egga, Babba, and Bussa, all on the Niger ; and Loko (port of Nasarawa) and Ibi on the Benue, the latter the company’s military headquarters on tliat liver. Under the administration of Sir F. Lugard good progress has been made in the pacification of the country, and British anfluence has been established at several of the Hausa towns ; while Yola, the capital of Adamawa, was taken by a force under Colonel Morland in 1901. A site for the headquarters of the Government has been chosen near the left bank of the Kaduna river, 9 miles from Wushishi, the limit of navigation, with which it has been .connected by a steam tramway. The portion of the territory brought under British control had in May 1901 been formed into nine provinces, each under a Resident, while others were about to Ibe established. Northern Nigeria, especially the Hausa States, is Tan unusually promising field for commercial enterprise, the principal products being indigo, gum-arabic, kola-nuts, ivory (brought from the south by caravans from the marts of Tibati and Ngaundere,

and from the shores of Lake Chad), kino, hides, gutta-percha, and rice. The military force of northern Nigeria consists of about 2500 native infantiy, with artillery, engineers, and other details, officered by British officers ; the military force of southern Nigeria consists of about 800 native infantry, also

under British officers. In 1898-99 the total revenue of southern Nigeria (then the Niger Coast Protectorate) was Â£169,568, and expenditure Â£146,752.

Authorities. â€” Besides the works quoted under article Nigeh, see RoHLFS. Quer durch Afrika. Leipzig, 1854-75; and “Reise durch Nord Africa,” ii., Fetermann’s Mitteilungen, Ergdnzhft. 34. Gotha, 1872. â€” Thomson. “Trip to Sokoto by the River Niger,” Journal Manchester Geog. iSoc, 1886; and “Niger and Central Sudan Sketches,” Scottish Geog. Mag. 1886. â€” Johnston. “The Bantu Borderland in West Africa,” Geog. Journal, October 1888. â€” STAUDiNGiiR. Im Merzen der Haussalander. Berlin, 1889, Leipzig, 1891. â€” Monteil. Saint Louis a Tripoli. Paris, 1895. â€” Passakge. Adamaua. Berlin, 1895.- â€” Robinson and Wallace. “The Hausa Territories,” Geog. Journal, September 1896. â€” KiNGSLET. Travels in West Africa. London, 1897 ; West African Studies. London, 1899 ; TJie Story of West Africa. London, 1900. â€” Mocklek- Ferryman. British West Africa. London, 1898. â€” Vandeleur. “Nupe and llorin,” Geog. Journal, October 1897 ; Campaigning on the Upper Nile and Niger. London, 1898.^ â€” ^Clive. “Notes of a Journey to . . . the Kingdom of Bauchi,” Geog. Journal, August 1899. â€” Moseley. “Regions of the Benue,” ibid., December 1899. â€” Robinson. Nigeria. London, 1900. â€” Lugard. “Northern Nigeria,” Annual Colonial Eeports, No. 346. London, 1902. (e. he.)

Nightingale, Florence (1820-), younger

daughter of William Edward Nightingale of Embley Park, Hampshire, and Lea Hurst, Derbyshire, was born at Florence, 16th May 1820, and named after that city, but her childhood was spent in England, chiefly in Derbyshire.

FLrtRKNPE Xh.t!tin<;a1-F.. t^From a photograph by the Lvndon Stereoscopic Co.)

From her earliest years her strong love of nature and ani- mals manifested itself. Her games, too, were character- istic, for her great delight was to nurse and bandage her dolls. Her first living patient was a shepherd’s dog. From tending animals she passed to human beings, and wher- ever there

was sorrow or suffering she was sure to be found. Her most ardent desire was to use her talents for

the benefit of humanity. She had a natural shrinking from society ; and though her social position necessitated her presentation at Court, her first season in town was spent in examining into the working of hospitals, re- formatories, and other charitable institutions. This was followed by a tour of inspection of foreign hospitals. At that time England was sadly behind-hand in matters of nursing and sanitation, and Miss Nightingale, who desired to obtain the best possible teaching for herself, went through a course of training in the Institute of Protestant Deaconesses at Kaiserswerth. She remained there six months, learning every detail of hospital man- agement with , a thoroughness rarely equalled. Miss Nightingale neglected nothing that could make her pro- ficient in her self-chosen task. From Kaiserswerth she went to Paris, where she studied the system of nursing aud management in the hospitals under the charge of the sisters of St Vincent de Paul. After her return to England she devoted herself to reorganizing the Govern- esses' Sanatorium in Harley Street (now the Home for Gentlewomen during Temporary Illness), which was at that time badly managed and in great need of funds. Miss Nightingale grudged neither time nor money to this work, and she had the satisfaction of placing it on a thoroughly satisfactory basis.

In the year 1854 England was stirred to its depths by the report of the sufferings of the sick and wounded in the Crimea. There was an utter absence of the com- monest preparations to carry out the first and simplest demands in a place set apart to receive the sick aud wounded of a large army. The condition of the large barrack-hospital at Scutari was deplorable. A Eoyal Commission of Inquiry was appointed, a Patriotic Fund opened, and money fiowed in fast. To Miss Nightin- gale this proved the trumpet-call of duty. She wrote to Sidney Herbert, Secretary at War, and offered her ser- vices. Her letter crossed with one from him inviting her to proceed to the Crimea. She set out on the 24th October with a staff of thirty-seven nurses, partly volun- teers, partly professionals trained in hospitals. They reached Scutari on 4th November, in time to receive the Balaclava

wounded. A day or two later these were joined by 600 from Inkerman. The story of Miss Night- ingale's labours at Scutari is one of the brightest pages in English annals. She gave herself, body and soul, to the work. She would stand for twenty hours at a stretch to see the wounded accommodated. She regularly took her place in the operation-room, to hearten the sufferers by her presence and sympathy, and at night she would make her solitary round of the wards, lamp in hand, stopping here and there to speak a kindly word to some patient. Soon she had 10,000 men under her charge, and the general superintendence of all the hospitals on the Bosphorus. Gradually the effects of the measures adopted were seen in a lowered death-rate. In February 1855 it was as high as 42 per cent., before many months it had sunk to 2. For a time Miss Nightingale was her- self prostrated with fever, but she refused to leave her post, and remained at Scutari till Turkey was evacuated by the British in July 1856. The enthusiasm aroused in England by Miss Nightingale's labours was indescribable. A man-of-war was ordered to bring her home, and London prepared to give her a triumphant reception ; but she re- turned quietly in a French ship, crossed to England, and escaped to her country home before the news of her re- turn could leak out. The experiences of those terrible months permanently affected Miss Nightingale's health, but the quiet life she afterwards led was full of useful- ness. With the Â£50,000 raised in recognition of her ser- vices she founded the Nightingale Home for training nui-ses at St Thomas's and King's College Hospitals.

She also turned her attention to the question of army sanitary reform and army hospitals, and to the work of the Army Medical College at Chatham. In 1868 she published her Notes on Nursing, which gave an enormous stimulus to the study of this subject in England. Accord- ing to Miss Nightingale, nursing ought to signify the propej- use of fresh air, light, warmth, cleanliness, quiet, and the selection and administration of diet â€" all at the least expense of vital force to the patient.

Miss Nightingale followed with interest all the later improvements in sanitation, and was frequently con- sulted about hospital plans both at home and abroad. She has written on sanitation in India, children's hospi- tals, lying-in hospitals, and other cognate subjects. With the help of the County Council Technical Instruction Committee she organized in 1892 a health

crusade in Buckinghamshire. Teachers were sent round among the cottagers to give practical advice on such points as ven- tilation, drainage, disinfectants, cleanliness, &c., a plan which, if widely carried out, would bring the most valu- able knowledge to every home in England. She is understood to have drawn up a confidential report for the Government on the working of the Army Medical Corps in the Crimea, and to have been officially consulted during the American Civil War and the Tranco-German war. She is the subject of a beautiful poem by Long- fellow, ” Santa Filomena,” and the popular estimate of her character and mission was summed up in a particularly felicitous anagram, Flit on, cheering angel.

Nigra, Costantino (1827), Count, Italian

diplomatist and knight of the Annunziata, was born at Villa Castelnuovo in the province of Ivrea on 12th June 1827. During the war of 1848 he interrupted his studies to take up arms against Austria, and on the conclusion of peace entered the Piedmontese Foreign Office. He accompanied Victor Emmanuel and Cavour to London in 1855, and a year later was chosen by Cavour as secretary in the negotiations for the Franco-Italian alliance of 1859. During the war of that year Nigra was attached to the French headquarters, and after the peace of Villa- franca was sent as minister plenipotentiary to Paris. Except for a brief period in 1860-61, when the Piedmon- tese occupation of the Marches and Umbria caused a breach in Franco-Italian relations. Nigra remained Italian representative in Paris until the fall of the Eight in 1876. During this long period the influence possessed by him at the Imperial Court enabled him to render invaluable service to his country, especially in regard to the September Convention, the Italo-Prussian alliance against Austria in 1866, and the French expedi- tion to Eome in 1867. During the Franco-Prussian war Nigra was of material assistance to the French imperial family, but nevertheless succeeded in maintaining, in his dealings with the Eepublican Government, the same in- fluence as he had wielded under the Empire. Upon the advent of the Left in 1876, he was transferred to St Peters- burg, and in 1882 to London, where he a,ctively seconded the Anglophil policy of Mancini. Upon the fall of Mancini he was appointed ambassador at Vienna in suc- cession to Count di Eobilant, the duties of which difficult post he discharged with great tact and skill, the excep- tional value of his diplomatic services being recognized

even by former political opponents. In 1882 he was created count by King Humbert, and in December 1890 was appointed a member of the Italian Senate.

Nihilism may be roughly defined as the Eussian form of revolutionary Socialism, which had at first an academical character, and rapidly developed into an anarchist revolutionary movement. It originated in the early years of the reign of Alexander II., and the term

was first used by Turguenief in his celebrated hovel, Fathers and Children, published iu 1862. Among the students of the universities and the higher technical schools Turguenief had noticed a new and strikingly original type â€” young men and women in slovenly attire, who called in question and ridiculed the generally re- ceived convictions and respectable conventionalities of social life, and who talked of reorganizing society on strictly scientific principles. They reversed the tradi- tional order of things even in trivial matters of external appearance, the males allowing the hair to grow long and the female adepts cutting it short, and adding some- times the additional badge of blue spectacles. Their appearance, manners, and conversation were apt to shock ordinary people, but to this they were profoundly indif- ferent, for they had raised themselves above the level of so-called public opinion, despised Philistine respecta- bility, and rather liked to scandalize people still under the influ.euce of what they considered antiquated preju- dices. For aesthetic culture, sentimentalism, and refine- ment of every kind they had a profound and undisguised contempt. Professing extreme utilitarianism and de- lighting in paradox, they Avere ready to declare that a shoemaker who distinguished himself in his craft was a greater man than a Shakespeare or a Goethe, because humanity had more need of shoes than of poetry. Thanks to Turguenief, these young persons came to be known in common parlance as ” Nihilists,’’ though they never ceased to protest against the term as a ca- lumnious nickname. According to their own account, they were simply earnest students who desired reason- able reforms, and the peculiarities in their appearance and manner arose simply from an excusable neglect of trivialities in view of

graver interests. In reality, what- ever name we may apply to them, they were the extreme representatives of a curious moral awakening and an important intellectual movement among the Russian educated classes (see the article Alexaxdeb II., vol. XXV. p. 258). In material and moral progress Eussia had remained behind the other European nations, and the educated classes felt, after the humiliation of the Crimean war, that the reactionary regime of the Emperor Nicholas must be replaced by a series of drastic reforms. With the impulsiveness of youth and the recklessness of inex- perience, the students went in this direction much farther than their elders, and their reforming zeal natu- rally took an academic, pseudo-scientific form. Having â€¢learned the rudiments of positivism, they conceived the idea that Russia had outlived the religious and meta- physical stages of human development, and was ready to enter on the positivist stage. She ought, therefore, to throw aside all religious and metaphysical conceptions, and to regulate her intellectual, social, and political life by the pure light of natural science. Among the anti- quated institutions which had to be abolished as obsl^ruc- tions to real progress were religion, family life, private property, and centralized administration. Religion was to be replaced by the exact sciences, family life by free love, private property by collectivism, and centralized ad- ministration by a federation of independent communes. Such doctrines could not, of course, be preached openly under a paternal, despotic government, but the press cen- sure had become so permeated with the prevailing spirit of enthusiastic liberalism, that they could be artfully dissemi- nated under the disguise of literary criticism and fiction, and the public very soon learned the ai-t of reading between the lines. The work which had perhaps the greatest influ- ence in popularizing the doctrines was a novel called Shto Dyelati ? (What is to be done ?), written in prison by Tchernishefski, one of the academic leaders of the move- ment, and published with the sanction of the authorities I

Since the time of Peter the Great, Russia had been subjected to a wonderful series of administrative and social transformations, and it seemed to many people quite natural that another great transformation might be effected with the consent and co-operation of the autocratic power. The doctrines spread, therefore, with marvellous rapidity. In the winter of 1861-62 a high official wrote to a friend who had been absent from Russia for a few months : ” If you returned now you would be astonished at the progress which the

opposition â€” one might say, the revolutionary party â€” has made. . . . The revolutionary ideas have taken possession of all classes, all ages, all professions, and they are publicly expressed in the streets, in the barracks, and in the Government ofiices. I believe the police itself is carried away by them.” Certainly the Government was under the influence of the prevailing enthusiasm for reform, for it liberated all the serfs, endowed them liberally with arable land, and made their democratic communal insti- tutions indeiaendent of the landed proprietors ; and it was preparing other important reforms in a simOar spirit, including the extension of self-government in the rural districts and the towns, and the reorganization of the antiquated judicial system and procedure according to the modern principles adopted in western Europe.

The programme of the Government was extensive enough and liberal enough to satisfy, for the moment at least, all reasonable reformers, but the well-intentioned, self-confident young people to whom the term Nihilists was applied were not reasonable. They wanted an immediate, thorough-going transformation of the exist- ing order of things according to the most advanced socialistic principles, and in their youthful, reckless impatience, they determined to undertake the work themselves, independently of and in opposition to the Government. As they had no means of seizing the central power, they adopted the method of endeavour- ing to bring about the desired political, social, and economic changes by converting the masses to their views. They began, therefore, a propaga’nda among the working population of the towns and the rural popu- lation in the villages. The propagandists were recruited chiefly from the faculty of physical science in the universities, from the Technological Institute, and from the medical schools, and a female contingent was sup- plied by the midwifery classes of the Medico-Surgical Academy. Those of each locality were personallj’ known to each other, but there was no attempt to establish among them hierarchical distinctions or discipline. Each individual had entire freedom as to the kind and means of propaganda to be employed. Some disguised them- selves as artisans or ordinary labourers, and sought to convert their uneducated fellow-workmen in the industrial centres, whilst others settled in the villages as school- teachers, and endeavoured to stir up disaffection among the recently’ emancipated peasantry by telling them that the Tsar intended they should have all the land, and that his benevolent intentions

had been frustrated by the self- ish landed proprietors and the dishonest officials. Landed proprietors and officials, it was suggested, should be got rid of, and then the peasants would have arable, pastoral, and forest land in abiuidance, and would not require to pay any texes. To persons of a certain education the agitators *ught to prove that the general economic situ- ation was desperate, that it was the duty of every con- scientious citizen to help the people in such a dilemma, and that the first step towards the attainment of this devoutly to be wished consummation was the limitation or destruction of the uncontrolled supreme power. On the whole the agitators had very little success, and not a few of them fell into the hands of the police, several of

them being denounced to the authorities by the persons in whose interest they professed to be acting ; but the great majority of them were so obstinate and so ready to make any personal sacrifices, that the arrest and punish- ment of some of their number did not deter others from continuing the work. Between 1861 and 1864 there were no less than twenty political trials, with the result that most of the accused were condemned to imprisonment, or to compulsory residence in small provincial towns under police supervision.

The activity of the police naturally produced an ever- increasing hostility to the Government, and in 1866 this feeling took a practical form in an attempt on the part of an obscure individual called Karakozof to assassinate the emperor. The attempt failed, and the judicial inquiry proved that it was the work of merely a few individuals, but it showed the dangerous character of th^ movement, and it induced the authorities to take more energetic measures. Eor the next four years there was an appar- ent lull, during which only one political trial took place, but it was subsequently proved that the Nihilists during this time “vvere by no means inactive. An energetic agitator called Netchaief organized in 1869 a secret association under the title of the Society for the Libera- tion of the People, and when he suspected of

treachery one of the members he caused him to be assassinated. This crime led to the arrest of some members of the society, but their punishment had very little deterrent effect on the Nihilists in general, for during the next few years there was a recrudescence of the propaganda among the labouring classes. Independent circles were created and provided with secret printing-presses in many of the leading provincial towns â€” notably in Moscow, Nijni-Novgorod, Penza, Samara, Saratof, Kharkof, Kief, Odessa, Rostof-on-the-Don, and Taganrog; and closer relations were established with the revolu- tionary Socialists in western Europe, especially with the followers of Bakounine, who considered that a great popular rising should be brought about in Eussia as soon as possible. Bakounine's views did not, it is true, obtain unanimous acceptance. Some of the Nihilists main- tained that things were not yet ripe for a rising of the masses, that the pacific propaganda must be continued for a considerable time, and that before attempting to overthrow the existing social organization some idea should be formed as to the order of things which should take its place. The majority, however, were too im- patient for action to listen to such counsels of prudence, and when they encountered opposition on the part of the Government they urged the necessity of retaliating by acts of terrorism. In a brochure issued in. 1874 one of the most influential leaders (Tkatchef) explained that the object of the revolutionary party should be, not the pre- paration of revolution in general, but the realization of it at tho earliest possible moment, that it was a mistake to attach great importance to questions of future social organization, and that all the energies of the party should be devoted to " a struggle with the Government and the established order of things, a struggle to the last drop of blood and to the last breath." In accordance with the fashionable doctrine of evolution, the reconstruction of society on the tabula rasa might be left, it was thought, to the spontaneous action of natural forces, or, to use a Baconian phrase, to natura naturans.

To this and similar declarations of irreconcilable hos- tility the Government replied by numerous arrests, and in the winter of 1877-78 no less than 193 agitators, selected from 2000 arrested on suspicion, were tried publicly in St Petersburg by a tribunal specially con- stituted for the purpose. Nearly all of them were con- demned to imprisonment or exile, and the revolutionary

organization in the northern provinces was thereby momen- tarily paralysed, but a few energetic leaders who had escaped arrest reorganized their scattered forces and began the work anew. They constituted themselves into a secret executive committee, which endeavoured to keep in touch with, and partially direct, the independent groups in the provincial towns. Though they never succeeded in creating an efficient centralized administration, they contrived to give to the movement the appearance of united, action by assuming the responsibility for terrorist crimes committed by persons who were in reality not acting under their orders. During the years 1878, 1879, and 1880 these terrorist crimes were of frequent occur- rence. General Trepof, prefect of St Petersburg, was shot by Vera Zasulitch under pretence of presenting a petition to him ; General Mezentsof, chief of the political police, was assassinated in broad daylight in one of the prin- cipal streets of St Petersburg, and an attempt was afterwards made on the life of his successor. General Drenteln ; Prince Krapotkin, governor of the province of Kharkof, was assassinated for having introduced stricter prison discipline with regard to political pris- oners ; a murderous attack was made on the emperor in front of the Winter Palace by an ex-student called Solovieff ; repeated attempts were made to blow up the train conveying the Imperial family from the Crimea to St Petersburg ; and a dynamite explosion, by which ten people were killed and thirty-four wounded, took place in the Winter Palace, the Imperial family owing their escape to the accident of not sitting down to dinner punctually at the usual hour. Assassination was used also by the agitators against confederates suspected of giving information to the police, and a number of gen- darmes were murdered when effecting arrests. After each of these crimes a proclamation was issued by the execu- tive committee explaining the motives and accepting the responsibility.

When repressive measures and the efforts of the police were found insufficient to cope with the evil, Alexander II. determined to try a new system. Count Loris Melikof was entrusted with semi-dictatorial powers, relaxed the severity of the police regime, and endeavoured to obtain the support of all loyal Liberals by holding out the prospect of a series of reforms in a liberal sense. His conciliatory methods failed signally, and were repaid by an attack on his life. A ~~semblance of parliamentary institutions was not what the Anarchists wanted. They simply redoubled~~

~~their activity, and hatched a plot for the assassination of * the emperor. In March 1881 the plot was successful. Alexander II., when driving in St Petersburg, was mortally wounded by the explosion of small bombs, and died almost as soon as he had reached the Winter Palace. On the following day the executive committee issued a bom~~ bastic proclamation, in which it declared triumphantly that- the Tsar had been condemned to death by a secret tribunal on 26th August 1879, and that two years of effort and painful losses had at last been crowned with success.

These facts put an end to the policy of killing Anarchism by kindness, and one of the first acts of the new reign was a manifesto in which Alexander III. announced very plainly that he had no intention of limiting the autocratic power, or making concessions of any kind to the revolu- tionary party. The subsequent history of the movement presents little that is interesting or original, merely a continual but gradually subsiding effort to provoke local disturbances with a view to bringing about sooner or later a general rising of the masses and the overthrow not only of the Government, but also of the existing social and economic regime. A serious manifestation on the part of the terrorists took the shape of a plot to assassinate the

emperor by bombs in the streets of St Petersburg in March 1887. It was the work of a very small group, the members of which were being watched by the police, and were all arrested on the day when the crime was to be perpetrated. The movement afterwards showed occasion- ally signs of revival. In 1901, for example, there were troubles in the universities, and in 1902 there were serious disturbances among the peasantry in some of the central rural districts ; and the assassination of M. Sipiaguine, the INIiiiister of the Interior, was a disquieting incident ; hut the revolutionary aspirations no longer received sympathy and support from any large section of the educated classes. The illusions and enthusiasm which produced Nihilism in the young generation during the early years of the reign of Alexander II. had been shattered and dispelled by experience, and” many of those who formerly dreamed of bringing about at once by revolutionary methods a

social millennium became quiet, respectable members of society in the various spheres of ordinary practical life.

The following criminal statistics of the movement during six and a half years of its greatest activity (from 1st July 1881 to 1st Jan- uary 1888) are taken from unpublished official records : â€”

Number of affairs examined in the police department . 1500 Number oÂ£ persons punished 3046

These 3046 punishments may be divided into the following categories : â€”

Death 20

Penal servitude 128

Exile in Siberia 681

Exile under police supervision in European Russia 1500

Lesser punishments 717

3046

From the beginning of the movement up to 1902 the number of Anarchists condemned to death and executed vfas forty-eight, and the number of persons assassinated by the Anarchists was thirty-nine. There is no reason to suspect the accuracy of these statistics, for they were not intended for publication. They are taken from a confidential memorandum presented to the emperor. (d. m. W.)

Niigata, capital of the province of Echigo, Japan, with a population of 53,366, as against 46,393 in 1889. It was originally chosen as one of the five open ports â€” Nagasaki, Kobe, Yokohama, Niigata, and Hakodate â€” but it failed, chiefly owing to a bar which prevents the entry of vessels of any size. The town has been brought within the railway circuit, and it is possible that it may become important, as Echigo promises to yield large quantities of kerosen e, and efforts are in progress to develop that enterprise. The foreign trade is entirely in the hands of Japanese merchants,

and amounted to only Â£13,459 in 1899, namely, exports Â£12,743, and imports Â£716.

Nijar, a town of Spain, in the province of Almeria. It lies in a plain well watered by small streams, and fertile, that produces abundantly wheat, olives, almonds, esparto grass, and fruit. There are lead, iron, manganese, and phosphorite beds in the neighbourhood, and in the town manufactures of fine porcelain and woollen and cotton stuffs are carried on. The streets are regular, and in general contain modern houses, but there are no public buildings worth notice except the massive parish church. The population was 11,568 in 1897.

Nijni- Novgorod, a province of middle Eussia, bounded on the W. by Vladimir, on the N. by Kostroma and Vyatka, on the E. by Kazan and Simbirsk, and on the S. by Penza and Tamboff. It is intersected by the Volga and the Oka, at the junction of which the town of Nijni- Novgorod has grown up. The area of the province is 19,797 square miles. Besides the Carboniferous, Per- mian, and Triassic deposits (” variegated marls”), Jurassic deposits are found in patches, chiefly in the south-east, as

also in the south-west and north. They are covered with Cretaceous black clays and sandstone. Thick layers of Tertiary sands, containing petrified wood, are found in the Ardatoff district, and the whole is overlain with Glacial deposits, sandy gravels, and clays.

The soil has been carefully investigated by Prof. Dokuchaefi. Black earth, known as the ” black earth of the plateau,” prevails on the high plains between the river valleys in the south-east ; the ” valley black earth,” even more fertile than the former, covers the gently-sloping portions of the temtory, also in the south-east. More or less sandy clays are met with elsewhere, and there are also large patches of sand. Forests cover all the territory to the north of the Volga and the Oka, as also in the west and along the Alatyr river in the south. Iron ores (brown and spherosideritic) , alabaster, limestone, sand (used for glass), and phosphorites are the chief

useful minerals. There are also extensive deposits of peat. The population increased from 1,376,000 in 1880 to 1,600,304 in 1897 ; of these 841,245 were women, and 140,347 lived in towns. The population was thus distributed in 1896 :â€” 10,875 nobles, 14,920 clergy, 6368 merchants, 53,585 artisans, 1,430,165 peasants, and 141,433 militaryJ Of the total number 1,525,735 were Orthodox or Old Believers, 75,848 Raskolniks (Nonconformists), 1115 Catholics,723 Protestants, 51,2.S6 Mussulmans, and 3.388 Jews. Both the birth-rate (53 in 1000) and the death-rate (42 in 1000) are high. A little over 92 percent, of the area is available for agriculture, and of this 59 per cent, is owned by noblemen and 16 per cent, only by the peasantry, the remainder being ovmed by merchants and others. Of the cultivable land owned by the peasantry 55 per cent, is under crops, but of similar land owned by noblemen only 30 per cent, is cultivated. The annual average yield of the principal crops in 1894-99 was â€” wheat, 7,643,000 cwt. ; rye, 7,871,000 cvrt. ; oats, 2,369,600 cwt. In some years the crops are quite in.sufBcient for the population. The zemstvo of Nijni-Novgorod supports an agricultural school, an ex- perimental farm, and an agency for the purchase of improved seeds and machinery. There is good gardening in some of the towns, but the cattle-breeding is inferior, as many as 41 per cent, of the peasant families having no horses, and 24 per cent, no cows. In 1896 there were 215,120 horses, 281,180 cattle, and 259,860 sheep in the province. The domestic trades are widely practised, 70 per cent, of the male working population among the peasants earning their livelihood in this way (122,570 persons), as well as by ship- ping (95,760). The last named represents a very large industry ; no fewer than 9311 vessels (565,000 tons, valued at 17 million roubles) were loaded, and 8690 vessels (1,360,000 tons, 30 milUon roubles) unloaded in 1896. To these must be added 1800 rafts. The factories are steadily developing : iron, machinery, and crockery works, tanneries, shipbuilding yards, saw-mills, and distilleries are the chief of them, but their aggregate production is only worth Â£2,206,500 annually, and they employ only some 18,000 persons. Education, owing to the efforts of the zemstvo, is in a better con- dition than in many other provinces. There are 29 schools for secondary education (gymnasia, technical schools), and the total number of schools in 1895 was 1044, with an attendance of 38,104 boys and 9440 girls. A society for primary education supplies the village schools with libraries (330,000 copies distributed in ten years), and organizes lectures in the villages. The

chief towns of the 11 districts into which the government is divided are : Xijnl- Novgorod (95,124), Ardatofi (3538), Arzamas (10,591), Balakhna (5037), Gorbatoff (3950), KnyaÂ«hinin (2962), Lukoyanoff (2113), Makarieff (1443), Semenoff (3748), Sergach (1726), and Tasil- sursk (3729). Other towns of importance are Pavlovo (7414) and Vorsma (3413), centres of cutlery manufacture, and Pochinki (9894). (p. A. K.)

Nijni-Novgorod, or simply Nuxit, capital of the above government, 276 miles by rail east of Moscow, at the confluence of the Oka with the Volga. It is a city of steadily growing importance both as a commercial centre for Eussia and as an intellectual centre for east Russia, Population (1897), 95,124, increasing to nearly 200,000 during the great annual fair. Nijni-Novgorod has 14 secondary schools (gymnasia, technical and professional schools, cadet schools, &c.) and 36 primary schools, in which an aggregate of about 7000 pupils are taught ; 15 libraries, mostly free, one (municipal) being of special value; several museums, historical, art, archaeological, natural sciences; and a number of philanthropic institu- tions. The fair is still a prominent factor in the internal trade of the empire. Several buildings have been erected for the purposes of the fair â€” ^the house of the committee,

with ” passages ” lined with shops ; banks, a theatre, a circus, a new semicircular canal and a second floating bridge, underground galleries, a water-supply, an electrical tramway, temperance tea-shops and restaurants kept by the Society of Tradesmen, and so on. The value of goods brought to the fair has, however, steadily declined from 246,000,000 roubles in 1881 to 176,557,573 in 1896; but the amount of trade operations concluded at the fair greatly exceeds these figures. The total amount of business done was put at 416,000,000 roubles in 1894, of which 161,000,000 only represented the value of goods sold, while 254,000,000 was the return of four banks, excluding, however, the principal bank (the State Bank) and one private bank. It is, however, certain that the facilities offered to Siberian merchants, by the Siberian railway, for dealing directly with Moscow, will lead to a further decrease of business at the fair.

Authorities. â€” Excellent guides to Nijni-Novgorod and its fair were publislied in connexion with tlie Exhibition of 1896. See also the Pamyatnaya Knizhka of the Government, published every year. Excellent works dealing with the province have been pub- lished by A. Gatsisskt {Nizhegorodskiy Sbornik, 10 vols.); the Committee of Arobb/es (Trudy, 16 vols.) ; the Zemstvo (Materialy, for the valuation of the lands; Natural History part, 14 vols.; Economical part, 6 vols.) ; V. Vinogradoff's Nizhegorodskiy Kalendar, illustrated. (p. x. K.)

Nikolaeff, a seaport and the chief naval station of Russia on the Black Sea, at the head of the estuary of the Bug, 41 miles north-west of Kherson. Its population, which was 35,000 in 1881 and 77,210 in 1891, reached 92,060 in 1897, and its importance both as an industrial centre and as a commercial port has been steadily growing. Since 1893 it has been the chief port for the Eussian volun- tary fleet, which transports to Vladivostok all the materials necessary for the Usuri and the Manchurian railways. Its steam flour-mills, iron and machinery works, saw- mills, soap, tobacco, vinegar, carriage and agricultural machinery works show yearly returns pf approximately Â£4,000,000, to which the Admiralty works must be added. Every year no less than 3,000,000 tons of goods are brought by rail, and 100,000 tons by the coasting trade. The port is visited annually by an average of 160 vessels engaged in foreign trade and 760 coasting vessels. The foreign exports amount to from 1,150,000 tons, chiefly of grain (815,000 tons), flour, linseed, hempseed, and sitgar (16,200 tons) to 1,460,000 tons (grain, 1,170,000 tons). The foreign imports are small (26,000 tons), and consist chiefly of coal, metals, and some machinery. Navigation is maintained during the whole winter by the aid of a powerful ice-breaker.

Nikola i stad . See Yasa.

Nikolsburg (Czech, Mikulov), the chief town of a government district in southern Moravia, at the foot of the Polau Mountains, near the border of Upper Austria. It is best known from the preliminary treaty of peace concluded there on the 26th July 1866 between the Prussians and Austrians. The chateau of the Dietrich- stein family contains an extensive library, with some valu- able MSS. and block-books. The Heiliger Berg, in the immediate vicinity, has sixteen chapels, and a church in the Byzantine style.

The principal resources of the inhabitants (in 1890, 8210 ; in 1900, 8091) are viticulture, the manufacture of cloth, and trade in lime and lime- stone.

Nile, the longest river of Africa, and second in length of all the rivers of the globe, draining a vast area in north- east Africa, from the East African lake plateau to the shores of the Mediterranean. Although probably falling short of the length of the Mississippi-Missouri (4194 miles according to the estimate of General Tillo), when the windings of the stream are taken into account the Nile is

at the head of all rivers as regards the length of its basin, which extends through 35 degrees of latitude, or 2450 miles in a direct line; while measured along its major curves its course has a similar pre-eminence. The length along the minor windings has not yet been accurately deter- mined, but a moderate estimate puts it at 4000 niiles.

The area of the Nile basin is reckoned by Dr A. Bludau at 1,082,000 square miles, on the assumption, since shown to be fairly correct, that the southern branches of the Sobat extend to the neighbourhood of Lake Rudolf. This falls con- ‘**â„¢**

siderably short of the area of the Congo basin (1,425,000 square miles), the lesser extent being due to the fact that, though of so great a length, the Nile basin is reduced to a minimum width during the passage of the river across the Sahara. The limits of the basin can now be laid down with an approximation to accuracy. The most southerly extremity has been found to be south-west, not south, of Victoria Nyanza, the streams draining the steppes in the latter direction, between 3JÂ° and 5Â° S., having been proved to enter an independent lake, and to form no part of the Nile basin. No streams of any importance enter the south side of Lake Victo- ria, and the country drained to it by temporary water-courses does not extend farther than about 3JÂ°. Farther west, however, the southernmost feeders of the Kagera river rise as far south as 3Â° 50′ and 30Â° E. Erom this point northwards the western limit of the basin runs first in the close vicinity of the eastern wall of the great central rift valley, where it is formed by considerable ranges of mountains ; then crossing that valley by the line of the Kirunga volcanoes, it follows the western wall of the valley to a point near the north end of Albert Nyanza. It then turns north-west, em- bracing

the wide area watered by the Bahr-el-Ghazal and its tributaries, until about 9Â° N. and 23Â° E., whence it runs north and north-east till it approaches the Nile itself on the southern verge of the Sahara. It is a matter of uncertainty whether the “Wadi Melk, which in its upper course carries down water at certain sea- sons from the highlands of Darfur, should be ascribed to the Nile basin or not.

East of Victoria Nyanza the limit of the Nile basin runs along the high plateaux (8000-9000 feet) west of the East African rift valley, until on reaching 1Â° N. it veers somewhat to the west towards Mount Elgon, which on the north-east sends its waters towards Lake Rudolf. North of Mount Elgon it probably runs between 34JÂ° and 36Â° E. to 9Â° N. , where it veers suddenly eastwards to enclose the greater part of the Abyssinian highlands. Beyond 15Â° N. it keeps generally near the west shore of the Red Sea, except where diverted to the west by the basin of the Khor Baraka.

The Nile basin includes a variety of zones succeeding each other from south to north, and differing in elevation, climate, and natural productions. The southernmost zone, ending in about 2^-4Â° N., belongs to the elevated lake plateau of eastern Africa, and here the altitude is generally over 3500 feet, while extensive areas in the east and west exceed 5000. The most sudden fall north- wards occurs about 2Â° N., and beyond 4Â° the central valley is generally below 1500 feet, though to the east the Abyssinian highlands form another very elevated region. It is the high lake plateau which supplies the chief volume of water to the White Nile, just as the highlands of Abyssinia are the source of the supply of the Blue Nile. Coming in part, however, from this same elevated region, the Sobat contributes an appreciable amount to the total volume of the Nile. Within the Nile basin the most rainy portions of the lake plateau (where alone a rainfall occurs comparable to that of the West African basin â€” 60 inches and over) lie along the eastern edge of the central rift valley, and to the east and north-east of Victoria Nyanza. Through the Kagera and Semliki the former region affords the greater part of the water- supply of the great lakes, while the rainy region to the east, especially that around Mount Elgon, also helps to feed Victoria Nyanza through the Nzoia river. Elsewhere on the lake plateau and along the southern watershed of the Bahr-el-Ghazal the rain- fall probably reaches 40 inches a year, gradually diminishing, however, apart

from isolated districts, to the north-east of a line running from Mount Elgon to the western extremity of the Bahr- el-Ghazal system.

The controversy as to the true source of the Nile has continued to engage the attention of travellers and writers, some holding that nothing but Victoria Nyanza, the gathering- ground of the rain and rivers of three-fourths of the Source upper basin, can be considered the source of the Nile lfÂ°^ proper, while others seek to bestow the honour on some feeders. one ultimate streamlet. If the source be considered â€” somewhat unscientifically, but in accordance with general usage â€” to signify the most remote headstream (measured by the windings of the river) there is no doubt that the distinction belongs to one of the upper branches of the Kagera. Among the feeders of Victoria

Nyanza this is by far the most important, both for length of course and volume of water carried, coming as it does from the region of greatest rainfall round Lake Victoria. Three chief branches unite to form the Kagera, and of these the most important for the volume of vfater carried is said to be the Nyavarongo, explored by the German traveller Dr Kandt in 1898. Its sources appear to lie in about 2Â° 30′ S., at an elevation of some 7000 feet, in a picturesque and bracing mountain region immediately east of the central rift valley. It first flows north to about 1Â° 40′ S., then turning in a sharp bend east and south, and on again reaching 2Â° 30′ joining the Akanyaru in a swamp or small lake in 30Â° 30′ E. The Akanyaru, which comes from the south-west, has been some- times considered the larger stream,’ but in Dr Kandt’s opinion it carries decidedly less water, while its course is shorter than that of the Nyavarongo. The combined stream retains the direction of the Akanyaru, flowing in a swampy valley and joining a little west of 31Â° E. the third branch of the Kagera, the Euvuvu, coming from the south. The source of this river was placed by Baumann (1892) in about .3Â° S., but according to Dfecle (1900) it derives its main water-supply from a range running east from the vicinity of Lake Tanganyika in about 3Â° 50′ S. The combined stream of the Kagera flows north and north-west in a level valley strewn with small lakes until almost 1Â° S., when it

turns east, and finally empties itself into Victoria Nyanza just north of 1Â°, the mouth forming a small projecting delta. Its lower course would be navigable for small steamers. All the other feeders of Victoria Nyanza are small rivers, many carrying water at one time of the year only, the largest being probably the Nzoia, which enters on the north-east from the plateaux south of Mount Elgon.

After leaving the lake at Ripon Falls, the Nile enters a smaller lake of irregular outline, running mainly east and west in 1JÂ° N., and known as Choga (formerly Kioja or Ibrahim). Eastwards the lake breaks up into several long arms, which appear to receive the waters of other lakes lying on the plain west of Mount Elgon. One of these, which has been named Lake Salisbury, lies in 1Â° 40′ N. and 34Â°E. ; another, Mpologoma, south-south-east of the first. Lake Choga also receives a broad lacustrine river, the Seziwa, from the south, while still another lake is said to be connected with it in the north. The altitude of Choga is given as 3320 feet, so that between its western end and Albert Nyanza â€” a distance of 130 miles â€” the Nile falls over 1200 feet, chiefly during the second half of the dis- tance, which is occupied by the Karuma Rapids and Murchison Falls. At Mruli, a little below Choga, the river is 900 yards wide, and at Foweira, at the head of the rapids, 500 yards.

Albert and Albert Edward Nyanzas, lying in the central rift valley, form the western source-reservoirs of the Nile, the latter fed mainly by streams descending the eastern slopes of the Euwenzori range, in the rainy district of Torn. The two lakes are united by the Semliki river (known also as Isango and Itiri), which traverses the level plain â€” in part forested, in part swampy â€” ^between them, receiving countless streams from the western slopes of Ruwenzori. These streams are so charged with sediment that the deposits from the Semliki have filled up a large part of the south end of Lake Albert. The Semliki is a rapid stream running in a winding course between high banks of alluvium, and falling about 1000 feet in a distance of 130 miles. In its upper course the Semliki is 60 yards wide and 1 J to 3 feet deep, but at .30 miles from its mouth it has become a deep stream 100 yards wide. Besides the Semliki, Albert Nyanza has no important feeder.

Between its exit from Albert Nyanza (2100 feet above the sea) and the swamp region which begins in about 6Â° 20′ X., at an altitude of 1450 feet, the Nile receives no important tributary but the Asua, which joins from the east in 3Â° 50′ N. , and even this has little water in the dry season. Its source-region, first explored by the Macdonald expedition in 1898, lies on the western versant of the Karamojo plateau, and among the mountain ranges which run off from that plateau to the north-west, the most remote head- stream running originally due south, and forming, with others, the small Lake Kirkpatriek in 2Â° 20′ S. and 34Â° E. The total length of the Asua is over 300 miles. Just below the old Egyptian fort of Bor in 6Â° 20′ N., an arm was found by Mr Grogan (1899) to diverge from the Bahr-el-Jebel, running more or less parallel with the latter on the eastern edge of the swamps, among which it seems to lose itself near the lower junction of the Bahr-el-Zaraf. Near the Bahr-el-Zaraf divergence a considerable stream enters from the east, but its course is unknown, Owing to the renewed obstruction of the Nile by “sudd” (q.v.), which, during the time that this region was closed to Europeans in 1884 by the JIahdist revolt, acquired an unusual density, the Nile water seems to have spread over an unusually large area, the channel being therefore less defined. In 1899 the Bahr-el-Jebel was totally obstructed, and only after weeks of laborious labour was navigation opened by Major Peake in May 1900. The whole channel of the “White Nile was finally cleared of sudd in 1901.

Recent additions to our knowledge of the Bahr-el-Ghazal system, west of the Bahr-eWebel, have been mainly of the character of

filling in of details respecting streams previously known. The valuable results of Dr Junker’s surveys, published in Germany in 1889, still supply our most complete account of the system. Later surveys have been made by French travellers arriving from the Congo basin, especially by JIajor Marchand, who during his journey across the continent explored the course of the Swe or Jur, and threw light on the relationship of the Bahr-el-Homr and Bahr-el-Arab with the re.st of the system. The system of the Sobat, the next important Nile tributary, was, on the contrary, first brought to light within the last decade of the 19th century by the explorations of Bottego, de Bonehamps, Michel, Wellby, Austin, and others. The most important upper branch is the Baro, which, with its many tributaries, descends the western

slopes of the Abyssinian highlands, flowing in a course slightly north of west. Rising in about 36Â° 10′ E. and 7Â° 50′ N., at an altitude of 6000 to 7000 feet, the Baro has first the character of a torrent descending the plateau escarpment between rocky walls, with a drop of 3000 feet in 45 miles. Some 25 miles after reaching the plains its course becomes free from rocks, and the river is navigable to its mouth, being barred at one spot only at extreme low water. In 32Â° 40′ E. the Baro is joined by the Pibor or Ajubba, formed by the junction of various streams coming from the south and south-east, and having their sources on the western slopes of the Kaffa plateau. The whole region of the lower Pibor and Baro is one of swamps, almost impassable even in the dry season. At its junction with the Baro to form the Sobat the Pibor is over 100 yirds wide, with a depth of 8 feet and a speed of 2-3 feet per second. The Blue Nile and the Atbara tributaries are described under Abtssixia.

On the main stream of the Nile the most valuable results are to be expected from the trigonometrical surveys inaugurated by Colonel Talbot. The telegraphic determination of the longitude of Omdurman (32Â° 29′ 42″ E.), and of other points, both on the AVhite and Blue rivers, has supplied for the first time a trustworthy basis for the mapping of the upper river, showing that previously accepted positions require considerable shifting. On the Lower Nile a most important work is the construction of the great dam at Assuan, which will raise the level of the Nile for 140 miles above the First Cataract, and enormously increase the water-supply available for irrigation in Egypt. Schemes have been set on foot for the improvement of the White Nile channel by means of embankments, and for the storage of its water-supply, and that of the Blue Nile, in reservoirs (see Sir W. Garstin’s Report, ” Egypt,” No. 2, 1901). A measure of scientific interest, but also of some practical importance, is the execution of a fish-survey of the waters of the Nile, chiefly due to the advocacy of the late Dr John Ander^n.

The political relations in the Nile valley have of late years been subject to many vicissitudes. After the abandonment, in 1888, of the old Equatorial Province administered by Emin Pasha, the whole course of the river from the frontiers of Egypt to the neighbourhood of Albert Nyanza was for a time dominated by the Dervish power. After the establishment of a British protectorate in Uganda, British posts were pushed down the stream from the great lakes, while the Belgians also established themselves on the west bank in the territory leased to King Leopold in 1894 by Great Britain, from Lake Albert to 5Â° 30′ N. British posts exist at Jlruli, Foweira, and Fajau, between Lake Choga and Albert Nyanza, and at Wadelai, Afuddu, and Fort Berkeley, between the latter lake and 50Â° N. Of these, Wadelai, the only healthy station in the river valley, is opposite the old Egyptian station of the same name which lay on the west bank. Afuddu lies nearly opposite the old Egyptian post of Duflle (now in Belgian territory), on a spot originally chosen by Sir S. Baker as the site of the capital of the Upper Nile province ; while Fort Berkeley occupies the site of the old Bedden. The chief Belgian posts are at Old Wadelai, Dufile, Lahore, Rejaf, Lado, and at Kero, on the frontier of the leased territory in 5Â° 30′ N. Lado, in Gordon’s time the capital of the Equatorial Province, has sometimes given its name to the whole Belgian territory on the Upper Nile. For the Anglo-Egj-ptian stations established on ‘ the Nile above Khartum since the over- throw of the Dervish power, see Sud.vn.

Authorities. â€” Scott-Mosckieff. “The Nile,” Xature, 7th March 1895. â€” Maktonxe. ‘ ‘ Die Hydrographie des Oberen Nil-Beckens,” Zeits. Ges. Erdkunde. Berlin, 1897. â€” Kasdt, in Mitt, aus den Deuts. Schutzgebieten, 1900 and 1901. â€” Garstin. Report quoted above, and Annual Reports on the Egyptian Public Works Department. â€” Willcooks. The Xile Reservoir Dam at AssuSm and After. London, 1901. â€” Ravexsteix, in Geogr. Journal, October 1901 (Map). (e. he.)

Niles, a city of Trumbull county, Ohio, U.S.A.,“on the Mahoning river and several railway lines, in the north-eastern part of the state. Population (1890), 4289 ;

(1900), 7468.

Political relations.

N I L G I R I S â€” N I P I G 0 N

Niigiris, The, or Neelgherries (=Blue Moun- tains), a range of hills in southern India, which gives its name to a district of the Madras Presidency. The Niigiris are really a plateau rather than a range, rising abruptly from the plains on most sides, with a general elevation of about 6600 feet above the sea.

The district of the Nilgiris is hy far the smallest in Madras. Area, 957 square miles. Population (1881), 91,0.34 ; (1891), 99,797 ; (1901), 111,449, showing an increase of nearly 10 per cent, between 1881 and 1891, and of 11-7 per cent, between 1891 and 1901 : average density, 116 persons per square mile, being the lowest in the Presidency. Of the total population in 1891 Europeans numbered 1790, Eurasians, 1236, and native Christians, 8600. The land revenue and rates in 1897-98 were Rs.l, 73,347, the incidence of assessment being 11 annas per acre ; number of police, 186 ; boys at school (1896-97), 3402, being 40 per cent, of the male population of school-going age ; girls at school, 925, being 14 per cent. Regis- tered death-rate (1897), 25-5 per thousand. In 1897-98, out of a cultivated area of 69,956 acres, food crops covered only 26,343, â– while 26,520 were under coffee, 6867 under tea, and 5097 under cinchona. The Government cinchona factory turned out 5092 lb of quinine and 6889 ft of febrifuge. The export of tea from Madras in 1897-98, practically all of which came from the Nilgiris, was 3,441,840 R), valued at Es.25,77,800. The approach from the plains is by the branch of the Madras railway from Podanur to Mettupalaiyam, whence a metre-gauge line on the rack principle has been constructed to Coonoor (17 miles), which it is proposed to extend to Ootacamund. Unfortunately, this Nilgiri railway, when ready for trafSc in October 1898, was damaged by a storm which caused serious landslips, and the opening has been indefinitely postponed. There are three printing-presses in the district, one of which issues an English newspaper, and q, library and reading- room, with an income of Rs.7660. The chief educational institu- tion is the Lawrence Asylum at Ootacamund, with 304 boys and 71 girls, maintained by Government at a cost of Rs.45,685. There

are three breweries, with a total out-turn of 341,000 gallons. The military quarters are at Wellington.

Nilsson, Christine [Countess de Miranda]

(1843), Swedish singer, was born at Wedersloff,

near Wexio, Sweden, on 3rd August 1843. Her father was a poor working man, and she used as a girl to sing and perform on the violin at popular gatherings. In 1857 a wealthy man, M. Tornerhjelm, perceiving the unusual beauty of her voice, provided the means for giving her a proper musical education, and in 1860 she made her first appearance in opera at Paris with great success. Between that date and 1872, when she married M. Auguste Eouzaud, she was the leading prima donna. Her first appearance in London was at Her Majesty's in 1867, and she visited the United States in 1870. After her marriage she only appeared in public at rare intervals. M. 5'Ouzaud died in 1882, and five years afterwards Madame JSfilsson married Count A. de Miranda.

Nimar, a district of British India, in the Nerbudda division of the Central Provinces. The administrative headquarters are at Khandwa; but the capital in Mahommedan times was Burhanpur, and, yet earlier, the hill fort of Asirgarh.

Area, 3357 square miles. Population (1881), 231,341 ; (1891), 285,944; (1901), 327,042, showing an increase of 24 per cent, between 1881 and 1891, and of 14-4 per cent, between 1891 and 1901 ; average density, 97 persons per square mile, being little more than half of that for the province generally. The land revenue and rates are Rs.3,13,478, the incidence of assessment being R : 0.3 : 10 per acre. The cultivated area in 1897-98 was 562,069 acres, of which 13,752 were irrigated from wells. The number of police is 437. Boys at school (1896-97), 5726, being 30 per cent, of the male popiilation of school-going age, the highest proportion for any rural district in the province. Registered death-rate (1897), 66 per thousand. The Great Indian Peninsula railway runs through the district for 112 miles, with six stations, and a branch of the Rajputana line from Indore joins it at Khandwa. There are seven factories for ginning and pressing cotton at

Khandwa, and manufacture of gold-embroidered cloth at Burhanpur. There is one printing-press, issuing a weekly newspaper in Marathi.

NImburg, an old town on the right bank of the Elbe, in the government district of Podiebrad, in Bohemia, Aus-

tria. It has an interesting Gothic church (1282-1305), and portions of its old wall and gates. It has a sugar- refining factory, the works of the JSTorth-Western rail- way, cattle and horse fairs, and a considerable trade-in corn, timber, and live stock. Population (1890), 6659 ;

(1900), 7843.

Nimeguen, or Numegen, a town of the Nether- lands, province Gelderland, on the south bank of the â€¢ Waal, 11 miles by rail south of Arnhem. Like this town and Cleves (17 miles by rail to the south-east), it is very pleasantly situated amongst wooded hills. The former town walls were taken down and the site converted into a boulevard in 1877-84, and since then a new quarter has grown up on the south. In addition to the Valkhof, there are now three other parks â€” ^the Huner Park on the east, near the Valkhof ; the Emperor Charles's Plain, in the new quarter ; and Kronenburg Park on the west. The town-hall has been restored, also the town weigh-house and meat market. An iron bridge has been thrown across from the Valkhof Park to the Belvedere, at the eastern ex- tremity of the old town. Berg en dal, about 3 miles to the south-east, is a favourite summer resort. Pale ale, Prus- sian blue, leather, tin, pottery, and cigars are the principal industrial products. About 75 per cent, of the inhabitants are Eoman Catholics. Population (1900), 42,756.

N imes, or Nismes, chief town of department of Gard, Prance, 450 miles south-south-east of Paris by rail. It is the seat of a Calvinist consistory, and has a Protestant normal school for females, schools of design, music, manu-factures, chemistry and physics as applied to the arts, and a school of artillery. Since 1894 the museums and the public library (80,000 volumes) have been installed in the old Jesuit College, formerly occupied by the lycee, to which an elegant fagade adorned with statues of Painting and Music by Max Eaphael was added in 1894. The collec- tion of paintings occupies a separate building. Population

(1881), 56,828 ; (1891), 63,625; (1901), 72,479’.

Ningpo, a treaty port in the province of Chekiang, China. It is simply a local distributing centre subordi- nate to Shanghai, from which it is 100 miles distant, and the volume of trade shows little tendency to grow. The population is estimated at 256,000. The foreign residents are very few. There are, however, a great number of mis- sionaries engaged in various parts in the interior of the province (Chekiang). The Church Missionary Society, the China Inland Mission, and the American Baptist and Presbyterian Societies are most strongly represented. The value of the trade passing through the custom house in 1900 was H. taels 15,414,191 (Â£2,312,000), as compared with H. taels 12,.384,000 (Â£3,405,000) in 1880. Cotton and tea are the principal exports, and opium, shirtings, and sugar the chief imports.

Niort, chief town of the department of Deux-S^vres, France, 258 miles south-west of Paris, and an important railway junction. The prefecture was rebuilt in 1893 ; the school of design is installed in a handsome new struc- ture, and behind it is the library, containing 45,000 volumes, while the museum of antiquities is now lodged in the El^nore Palace. Population (1891), 20,082 ; (1901),

20,738.

Nipigon, Nekpigon, or Nepigon, a lake of Thunder Bay district, Ontario, Canada, situated 30 miles north of the bay of the same nameon Lake Superior, at an altitude of 850 feet above ‘the sea. It is 70 miles long and 60 miles wide ; contains over 1000 islands, is very deep, and has a^ much- indented shore-line measuring upwards of 580 miles. The N ipigon river, which discharges its waters,

is the largest stream flowing into Lake Superior. It affords the finest trout- iishing in North America,

Nipissing, a lake of the district of the same name in Ontario, Canada, situated nearly midway between Lake Huron and the Ottawa river, at an altitude of 642 feet above the sea. It is 60 miles long ; greatest breadth, 35 miles; discharges its waters by Trench river into Lake Huron, and is separated from the waters of Mat- tawa river by a low watershed. It has been proposed as the summit level of the projected Ottawa and Georgian Bay canal. With the Ottawa, Mattawa, and French, it formed the old voyageur route from Montreal to the Great Lakes.

Nish (written generally Nisch), after Belgrade the most important town of the kingdom of Servia, situated in a plain on the left shore of the ISTishava, a tributary of the Morava. It is of great strategical and commercial importance, lying at the junction of several of the most important roads of the Balkan Peninsula. The great international railway lines, Vienna-Belgrade-Constanti- nople and Vienna-Belgrade-Sal onica, bifurcate at Nish. There is a project to connect the Rumanian railways with the Servian through the Timok valley to Nish, and it is also intended to carry the line which is to connect the Adriatic with the centre of the peninsula to Nish, through the Toplitza valley. The town has a small ob- solete fortress on the right bank of the Nishava, believed to have been erected on the site of the ancient Roman castle Naissus. The surrounding hills (Vinik, Goritza, Kamenitza) have, since 1886, been fortified by modern earthworks. Since it has ceased to be Turkish, Nish has made much progress, and is becoming a modern European town. The king and the Government reside for at least three months in the year in Nish, where also the National Assembly, before the new constitution of 1901, was reT;ularly held. It is the see of a bishop, the seit of the district prefecture and a tribunal, and the headquarters of the territorial militia corps, having be sides a large number of regular troops in garrison. The administration of the Servian railways has its principal store of material there, and also a factory for repairing engines. On the whole, Nish, with its population of 21,600 (1895), is one of the most prosperous towns in Servia. It is known also for the many picturesque and interesting places in its immediate neighbourhood (Yel- ashnitza, Sityevo, Mramor).

The ancient Roman oity Naissus was mentioned as an already important place by Ptolemy of Alexandria. Under its walls was fought in A.D. 269 the great battle in which Emperor Claudius destroyed the army of the Goths. It

was at Naissus that Constan- tine the Great was born. Though the Emperor Julian improved its defences, the town was destroyed by the Huns under Attila, but the Emperor Justinian did his best to Restore it. In the 9th century the Bulgarians became masters of Naissus, but had to cede it to the Hungarians in the 11th century, from whom the Byzan- tine Emperor Emmanuel reconquered it in 1173. Towards the end of the 12tli century the town was in the hands of the Servian Prince Stephen Nemanya, who there received hospitably the German Emperor Frederic Barbarossa and his Crusaders. lu 1375 the Turks captured Naissus for the first time from the Servians. In 1443 the allied armies of the Hungarians under Hunyadi, and the Servians under George Brankovich, retook it from the Turks, but in 1456 it again came under Turkish dominion, and remained for more than 300 years the most important Turkish military station on the road between Hungary and Constantinople. In the frequent wars between Austria and Turkey during the 17th and 18th centuries the Austrians captured Naissus twice (in 1089 and 1737), but were not able to retain it long. The Servians having, in the beginning of the 19th century, snccessfully cleared Servia of Turks, were emboldened to attack Nish in 1809, but were repulsed with great loss. One of the Servian commanders, Singyelich, died a heroic death on that occasion by blowing up the gunpowder stores of the redoubt of which he found himself the only defender. The Turks raised a gruesome monument of their victory^ â€” a high tower composed entirely of the heads of the Servians slain in the

battle of Nish. The remnants of this monument are still kept up. It stands half a mile to the east from Nish, and is called to this day by the Turkish name” Tyele-Koula,” “the Tower of Skulls.” In the Russo-l\irkish war the Servian army, under the personal com- mand of King Milan, besieged Nish, and forced it to capitulate on the 10th January 1878. The Berlin Congress decided that it should remain with Servia. (c. Mr.)

Nishapur, a province of Persia, situated between Mashad and Sabzvar, in northern Khorassan. It has a population of from 130,000 to 140,000, is divided into twelve districts, and pays a yearly revenue of about Â£12,000. It produces much grain and cotton, and is considered one of the most fertile districts of Persia. One of its subdivisions is that of Bdr-i-Madan, with chief town Madan (situated 32 miles north-west of the city of Nishapur, at an

elevation of 5100 feet, in 36Â° 28′ N., 58Â° 20′ E.), where the famous mines are which have supplied the world with turquoises for at least 2000 years. (For description of mines, vide A. Houtum-Sch’indler, Tur- quoise Mines of Kishdpur, Diplomatic and Consular Re- ports, part ii., 1884.) The province used to be one of the administrative divisions of Khorassan, but is now a separate province, with a governor appointed by the Shah.

Nishapur, the capital of the above province, situ- ated at an elevation of 3920 feet, in 36Â° 12′ X. and 58Â° 40′ E., about 49 miles west of Mashad. It was once one of the four great cities of Khorassan, rivalling Rai (Rhages), ” the mother of cities,” in importance and population, but is now a small and comparatively unim- portant place, with a population of barely 1.j,000. It has post and telegraph offices, and does a lively trade in wool, cotton, and dry fruits (almonds, pistachios). East- wards of the present city, amongst the mounds and remains of the old town, in a ruined mosque, is the tomb of Omar Khayyam, who was also born here â€” an rmsightly mass of plaster, without inscription.

Niue (Savage Island), or Niue-Eekai, as the natives prefer to call it, an island 14 miles long bv 10 miles wide, situated in 19Â° 10′ S. and 169Â° 47′ W., in the South Pacific. The entire island is an old coral reef up- heaved 200 feet, honeycombed with caves and seamed with fissures. The soil, though thin, is, as in other limestone islands, very rich, and coeoanuts, tara, yams, and bananas thrive. There is an abundant rainfall, but owing to the porous nature of the soil the water percolates into deep caves which have commimication with the sea, and becomes brackish. The natives, a branch of the Malayo-Polynesians, with what seems to be an admixture of Micronesian blood, are the most industrious in the Pacific, and about 500 of the young men are generally absent as labourers in other islands. The consequent minority of men has been very destruc- tive to the sexual morality of the women, which formerly stood high. The natives are keen traders, and though uncouth in manners when compared with their nearest neighbours, the Tongans and Samoans, are very friendly to Europeans. Their hostility to Captain Cook, which earned for them the name of ” Savage Islanders,” was due to their fear of foreign disease, a fear that has since been justified. The population, about 4400, is slightly decreasing. The natives are all Christians, and the majority have learned to read and write,

and to speak a little English, under the tuition of the London ^Missionary Society. They wear European clothes. The island became a British protectorate on 20th April 1900, and was made a dependency of New Zealand in October 1900, the native government, of an elected ” king ” and a council of head- men, being maintained for the present. In 1900 there were thirteen Europeans on the island. The exports

are copra (Â£6000), fungus (8 tons), and straw hats, which the women plait very cleverly.

Hood. Notes of a Cruise in H.M.S. “Fawn.” Edinburgh, 1863. â€” Thomson. Savage Island. London, 1902. (b. H. T.)

Nivelles, a town of >^ Belgium, in the province of Brabant, 19 miles south of Brussels. Vegetable parchment is one of the numerous manufactures of the arrondisse- ment, and the railway workshops employ large numbers of men. Population (1890), 10,642 ; (1900), 11,645.

Nizhneudinsk, a growing district town of East Siberia, government, and 351 miles by rail west-north- west of Irkutsk, ou the Siberian railway, and on the Uda. river. It is a centre for the Biryusa gold mines, and in winter the head of a line of communication with the Lena and Bratskiy Ostrog. Population (1896), 6016.

Noakhali, a town and district of British India, in the Chittagong division of Bengal. The town, also known as Sudharam, is on a small river channel 10 miles from the sea. Population (1881), 5124; (1891), 5479. The high school had 269 pupils in 1897-98.

The district of Noakhali has an area of 1645 square miles. Population (1881), 820,772; (1891), 1,009,693; (1901), 1,141,817, showing an increase of 23 per cent, after the storm-wave, and of 13 per cent, between 1891 and 1901. Average density, 695 persons per square mile. Classified according to religion, Mahom- medans in 1891 numbered 760,929; Hindus, 248,123;

Christians, 641, of whom 10 were Europeans. The land revenue and rates in 1897-98 were Rs.7,27,354 ; number of police, 281; boys at school (1896-97), 39,764, being 51 per cent, of the male population of school-going age, compared with 28 per cent, for the province generally. Registered death-rate (1897), 37 per thousand. Besides rice, an important crop is areca-nut. A portion of the district is traversed by the railway from Chittagong towards Assam.

Nobel, Alfred (1833-1896), Swedish chemist and engineer, was born in 1833 at Stockholm. After study- ing at St Petersburg, he began to assist in the conduct of his father's engineering works, but it was not long before he took up the study of explosives. Previously to 1864 many attempts had been made to utilize nitro- glycerine as an explosive for practical purposes, but little success was attained until that year, when Nobel took out his patent for dynamite. He found that by incorjjorating nitro-glycerine with some porous substance, such as powdered charcoal or silica (usually kieselguhr), he obtained it in an altered condition, such that it ceased to be sensitive to shocks and could even be burned in a fire without explosion. He next combined nitro-glycerine with another high explosive, nitro-cotton, into a form that could be safely employed for blasting. Taking about 8 parts of the latter, he dissolved them by the aid of moderate heat in 92 of nitro-glycerine, and thus obtained a transparent, jelly-like substance that was a still more powerful explosive than dynamite. Blasting gelatin, as it was called, was patented in 1876, and was followed by a host of similar combinations, prepared in much the same way, but modified by the addition of nitrate of potash, wood-pulp, and various other substances. Some thirteen years later Nobel produced ballistite, one of the earliest of the nitro-glycerine smokeless powders, which contained in its latest forms about equal parts of gun-cotton and nitro-glycerine. This powder was a pre-cursor of cordite, and Nobel's claim that his patent covered the latter was the occasion of vigorously ~~con~~ tested law-suits between him and the British Govern- ment in 1894 and 1895. Cordite also consists of nitro-glycerine and gun-cotton, but the form of the latter which its inventors wished to use was the most highly nitrated variety, which is not soluble in mixtures of ether and alcohol, whereas Nobel contemijlated using a less nitrated form, which is soluble in such mixtures. The question was complicated by the fact that it is in practice

impossible to prepare either of these two forms without admixture of the other, but eventually the courts decided against him, having come to the conclusion that he meant to employ the soluble variety, not the insoluble one, the method of using the latter being indeed not known at the date of his patent. From the manufacture of dynamite and other explosives, which were produced on a very large scale at the Nobel works at Ardeer, Ayrshire, and from the exploitation of the Baku oil-fields, in the de- velopment of which he and his brothers took a. leading part, he amassed an immense fortune; and at his death, which occurred on 10th December 1896, at San Eemo, he left the bulk of it in trust for the establishment of five prizes, to be awarded annually without distinction of nationality. The first three of these prizes are for the most important discovery or invention in physical science, in chemistry, and in medical science or physiology ; the fourth is for the most remarkable literary work dans le sens d'idialisme; and the fifth is to be given to the person who renders the greatest service to the cause of inter- national brotherhood, in the suppression or reduction of standing armies, or in the establishment or furtherance of peace congresses.

-), British physicist

Noble, Sir Andrew (1832-

and artillerist, was born at Greenock on 15th September 1832, and was educated at Edinburgh Academy and at the Eoyal Military Academy, Woolwich. In 1849 he entered the Eoyal Artillery, attaining the rank of captain in 1855, and in 1857 he became secretary to the Royal Artil- lery Institution. About this time the question of the super- session of the old smooth-bores by rifled guns was coming to the fore, and on the appointment of the Select Com- mittee on Eifled Cannon in 1858 to report on the matter, he was chosen its secretary, a capacity in which he devised an ingenious method for comparing the probable accuracy of the shooting attainable with each type of gun. In 1859 he was appointed Assistant-Inspector of Artillery, and in the following year he became a member of the Ordnance Select Committee and of the Committee on Explosives, serving on the latter for twenty years, until its dissolution. About the same time he was prevailed upon by Sir William, afterwards Lord, Armstrong, to leave the public service and take up a post at Elswick, where beyond doubt the

facilities offered for experimental research enabled him to do more for his country in the way of improving guns and munitions of war than would have been possible under the cramping regulations of an official department. At Elswick, in the first instance, he was put in charge of the ordnance department, but it was not long before his organizing and administrative ability and scientific attainments enlarged the sphere of his in- fluence, and he has probably done more than any other single man to develop Elswick to the commanding position itnowenjoys amongthearsenalsof the world. Immediately on his appointment he began a systematic investigation of the phenomena which occur when a gun is fired, some of his first experiments being designed to discover with accuracy the pressures attained in the largest guns of that time. About 1862 he invented his chronoscope for the measure- ment of exceedingly small intervals of time, and began to apply it in ballistic experiments for ascertaining the velocity with which the shot moves along the barrel of a gun with different powders and diiierent charges. Then he joined Sir Frederick Abel in a classical research on “Fired Gunpowder,” the experimental work being largely carried on at Elswick, and the conclusions they arrived at had a great effect on the progress of gunner}’, for they showed how increased muzzle velocities were to be attained without increased pressures in the gun. These inquiries, in fact, enabled Elswick in 1877 to turn out the

6-inch and 8-incli guns, witli velocities of over 2000 feet per second, that obliged the British Government finally to give up the antiquated muzzle-loaders to which it had so obstinately adhered. Later, when the era of nitro or ” smokeless ” powders had begun, Captain Noble was an early advocate of their advantages, and when at length the British Government awoke to the necessity of selecting a powder of that character for the naval and military services of Great Britain, Elswick extended its hospitality to the committee that invented cordite, and gave the members facilities, which were not offered by the Govern- ment, for the necessary experimental work. Even after the powder was invented and the coiftraittee dissolved, inquiries â€” which itwas nobody’s official business to make, and which therefore

were not made â€” were continued at Elswick to ascertain how by suitable modifications in form, composition, &c., cordite might the better perform the varied duties required of it. Noble became a member of the committee appointed in 1900 by Lord Lansdowne to consider, among other things, the excessive erosion alleged by some of the powder's critics to be produced by it in the barrels of the guns in which it is used. He was made C.B. in 1881, promoted to be K.C.B. in 1893, and was created a baronet among the Coronation honours in 1902 ; he was also the recipient of many foreign decorations and scientific honours, including a Royal medal from the Royal Society in 1880.

Noblesville, a city of Indiana, U.S.A., capital of Hamilton county, on the "\Aliite river and the Chicago and South-Eastern and the Lake Erie and Western railways, in the central part of the state, at an altitude of 772 feet. It is in a rich agricultural region, and has natural gas. Population (1890), SOoi ; (1900), 4792.

Nocera Umbria, a town and bishop's see of the province of Perugia, Umbria, Italy, 12 miles by rail north by east of Foliguo. It has mineral springs (known since IJIO), with a hydropathic, situated 1969 feet above sea- level, on the west slope of Moiint Pennino. There are a cathedral and other churches, in one of which good frescoes, dated 1434, were discovered in 1877. Cement is quarried. The town is the ancient Umbrian Nuceria. Population, about 5000.

Nogent-le-Rotrou, chief town of arrondisse- ment, department of Eure-et-Loir, 38 miles west-south- west of Chartres by rail. It is of great antiquarian interest, and in the early part of the 17th century the overlordship was acquired by Sully, Henri Quatre's great minister of finance. There are statues of him and his wife, of General St Pol, killed at Sebastopol, and of the poet Remy-Belleau, a uati^'s of the town (1897) ; also, a departmental school for deaf mutes. An important in- dustry is the manufacture of hats, employing about 700 persons. Population (1891), 6934 ; (1901), 7620.

Nogent-Sur-Marne, a town in the arrondisse- ment of Sceaux, department of Seine, France, 5 miles east of Paris on the railway to Belfort, which here crosses the j\Iarne valley by a magnificent viaduct of 34 arches, at a height of 100 feet, and with a total length of 870 yards. A belfry dates from the

11th century, with 12th-century spire. A monument was erected in 1865 to Watteau, who died here in 1721. A large town hall was completed in 1884. The principal manufactures are chemicals and toys. The commune of Perreux was detached from Nogent in 1887. Total port traffic on the Marne, 1900, 24,123 tons. Population (1881), 7596;

(1891), 8047 ; (1901), 10,391.

Noldeke, Theodor (1836), German Orien- talist, was born at Harburg on 2nd March 1836, and

studied at Gottingen, Vienna, Leyden, and Berlin. In 1859 his history of the Koran won for him the prize of the French Academic des Inscriptions, and in the follow- ing year he rewrote it in German and published it with additions at Gottingen. In 1861 he began to lecture at this university, and three years later was appointed assist- ant professor there. In 1868 he became regular professor at Kiel, and in 1872 was appointed to the chair of Oriental languages at Strasburg. His range of studies is wide and varied, but in the main his work has followed the two lines already indicated by his prize essay, i.e., Semitic languages, and the history and civilization of Islam. The Semitic religion he regards as simple, not favourable to a complicated mythology, and at the same time violent, exclusive, and fanatical. Professor Xoldeke is a prolific writer, and while a great deal of his work {e.g., his Neu- syrische Granimati'k, his Jlaiidciische Gnoamatik, and his translations from Tabari) is meant for specialists, many of his books are of interest to the general reader as well. Several of his essays first appeared in the Enct/cIo/icnUa 5;~~iYa)mica,andthearticleon the Koran(]\IoHAMMEDAXisji, Ency. Brit. vol. xvi.), with some others, was republished in a volume called Oriental Sketches. The articles dealing with Persia were republished in a (Ttrman volume, Aufsdtze zur persischen Geschichte. Among his best~~ known works are : Das Lehen Jfohammeds, Beitrage zur Kenntnis der Poesie der alten Araher, Die alttestamentlicJie Litteratur, Untersuchungen zur Kritik des alten Testaments. He has been a frequent contributor to the Zeitschrift der deutsch-morgenldndisclien Gesellschaft, the G'Ottinger Gelelirtenanzeiger, and the Expositor.

Norcia, a town and bishop's see of the province of Perugia, Umbria, Italy, 29 miles north-east of Terni, on the south-west footrslopes of the Sibylline

Mountains, still surrounded by old walls. There are a cathedral ; the church of St Benedict, with a Romanesque facade ; the town hall ; and the prefecture, with Romanesque arcades. Xorcia (the ancient Nursia) was the birthplace of Sertorius (slain 72 b.c), of Vespasia, mother of the Emperor Ves- pasian, of Plotina, the wife of the Emperor Trajan, and of St Benedict, founder of the Benedictine order, and of his sister Scholastica. The town is famous for its pork and its cloth, and makes bricks and terra-cotta. Population (1899), about 5000.

Nord, a department of the farthest north-east of France, washed by the North Sea and bordering on Belgium.

Area, 2229 square miles. The population, 1,603,2.50 in 1881, had increased to 1,877,647 in 1901. In respect of population, therefore, Nord stands second among the departments of France. Births in 1899, 51,466, of which 6128 were Olegitimate ; deaths, 37.158 ; marriages, 15,858. In 1896 there were 2001 schools, with 292,000 -pupils, more than 6 per cent, of the population being illiterate. The area under cultivation in 1896 measured 1.296,750 acres; 839,800 acres arable, 24,700 acres in gardens, 419,900 acres in woods and grass. One of the greatest wheat-growing depart- ments, Xord produced in 1899 wheat valued at Â£2.122.000; rye, Â£100,000 ; barley, Â£118.000 ; oats, Â£048,000 ; potatoes. Â£544.000 ; mangold-wurzel, Â£244,000 ; flax, in harl and in seed, Â£45,000 ; tobacco, Â£44,000; hops, Â£72,000. In the production of beetroot Nord holds the first rank among the departments, producing in 1899 Â£1,420,000 worth. Its live stock in 1899 included 81.800 horses, 286,540 cattle, 84,200 sheep, 82,920 pigs, and 15.010 goats. The milk produced In 1899 was valued at Â£3,000,200. The indus- tries dependent on agriculture have made enormous strides. The manufacture of sugar amounted in 1898 to .3.110,000 cwts., and the alcohol produced in 1898 was 18,100,000 gallons, ilining in 1898 produced .5.500,000 metric tons of fuel, valued at Â£2.120.000 sterling, while the industry in metals yielded 294,000 metric tons of cast-iron, 295,000 tons of iron, and 204,000 tons of steel, which, with the industries in other metals added, represented a value of Â£4,080,000. The textile industry is particularly active around Lille, Roubaix, and Tourcoing, which spin and weave cotton and wool, as also around Fourmies, which is specially a weaving town.

The cotton industry is carried on by 3000 looms and 1,300,000 spindles, distributed among 170 establishments. The woollen in- dustry disposes of 20,000 looms and 1,760,000 spindles among 300 factories. Nord possesses one-seventh of the total steam-power of France. The chief towns of this department are Lille, with 215,431 inhabitants in 1901 ; Koubaix, 124,660 ; Tourcoing, 79,468 ; Cambrai, 26,586; Douai, 33,918 ; and Dunkerque, 40,329.

Nord en, a town of Prussia, province of Hanover, 4 miles from the North Sea, and 20 by rail north of Emden. It has a 16th-century town hall, and its parish church was built in 1445. There are various industries â€” gin, sugar, chocolate, yeast, tobacco, and machinery; also a school of agriculture. Norddeich, a small port 4 miles to the north-west, is the shipping place for passengers bound for Norderney. Population (1900), 7048.

Nordenskiold, Nils Adolf Erik, Babon

(1832-1901), geographer and Arctic explorer, was the son of Nils Gustav Nordenskiold, and was born at Helsingfors, 18th November 1832. His ancestors came originally from Sweden, but for several generations had been settled in Finlaind, where several members of the family were distinguished by their enthusiasm for scien- tific research. His father was both an able mineralogist and a considerable traveller, and to his influence may be ascribed that early devotion to geological investigation which laid the basis of Baron Nordenskiold’s career. After a few years at the gymnasium of Borgo, young Nordenskiold entered the University of Helsingfors in 1849, where he applied himself specially to chemistry and mineralogy by spending his holidays in personal in- vestigations of the chief mineral deposits in Finland. In 1853 he accompanied his father to the Ural Mountains, and studied with particular interest the iron and copper mines at Tagilsk. On his return to Helsingfors he received minor appointments both at the university and the mining office, but an unguarded

speech at a con- vivial entertainment in November 1855 drew attention to his political views, and led to dismissal from his posts. He then visited Berlin, continuing his mineralogical studies, and returned to Helsingfors in 1856, where he obtained the Alexander travelling stipend at the univer- sity, and proposed to expend it in studying the geology of Siberia and Kamchatka. But before starting he took his master's and doctor's degrees at the promotion festival in 1857, and again, as in 1855, aroused the suspicion of the authorities during the entertainments to the deputation from Upsala and Lund. Russian officials, always jealous in all that regarded Swedish influence in Finland, again took the matter seriously, and this time Nordenskiold's departure for Sweden was accompanied by deprivation of the' right of ever holding office in the University of Helsingfors.' Settling at Stockholm in 1857, he thence- forward became practically a Swedish citizen, for until 1862 he was refused permission even to visit Finland, and his friends had much difficulty in preventing a de- cree of permanent exile. The far north always had a great fascination for Nordenskiold, and he had been only a few months in Stockholm when he met Otto Torell the geologist, who was making preparations for his first ex- pedition to Spitsbergen, and offered to take Nordenskiold with him. The result was most satisfactory, for to the remarkable observations of Torell on glacial phenomena Nordenskiold added the valuable discovery at Bell Sound of remains of Tertiary plants, which has led to such important conclusions respecting the climates of those regions in former epochs. In 1861 Nordenskiold took part in Torell 's second Spitsbergen expedition, which yielded even more important results as regards the geo- logical history of the islands. Its main object, however, was to take steps for the measurement of an arc of the meridian, and when a further expedition to the same

quarter was promoted by the Swedish Academy in 1864, Nordenskiold accepted the post of leader in the place of Dr Chydenius. But on this occasion the attempt to reach a high northern latitude was frustrated by the necessity of rescuing a party of shipwrecked walrus- hunters. Three years later, however, chiefly through the support of the Swedish Government and Mr Oscar Dickson, who contributed so largely towards the later expeditions of 1872 and 1875, Nordenskiold headed a well-organized expedition in the Sofia, and reached the highest northern latitude attained up to that date in the eastern hemisphere. Arctic exploration had now become his all-

absorbing -‘object, and in 1870, with thfee young naturalists, he visited the vast inland ice-sheet of Green- land. His next expedition in 1872 did not answer expectation, for the tenders were caught in the ice, and the crews of the three vessels were forced to winter in Spitsbergen. In 1875-76, however, a successful voyage eastwards, including the ascent of the Yenisei, led Nor- denskiold to attempt the exploration of the ” North-East passage.” This led to the celebrated voyage of the Vega, in which Nordenskiold navigated for the first time the northern coasts of Europe and Asia. Starting from Karlskrona on 22nd June 1878, the Vega doubled Cape Cheluiskin in the following August, and, after being frozen in at the end of September near Bering Strait, completed the voyage successfully in the following sum- mer. This brought him conspicuously before the world, and, even if the discovery of the long-sought North-East passage has but little direct value, the indirect and scientific results are very far-reaching. The monumental record edited by Nordenskiold, in five closely printed octavos, throws a flood of light on the past and present conditions of life on the north coast of Siberia, while the more popular account in two volumes, written by Norden- skiold himself, is a model of lucid description and a perfect summary of the history of the subject. On his return to Sweden Nordenskiold received a most enthusiastic welcome, and in April 1880 was made a baron and a commander of the Nordstjerne Order. In 1883 he again visited the east coast of Greenland, and succeeded in taking his ship through the great ice barrier, a feat that had been attempted in vain during upwards of three centuries. In addition to his heroic work as an explorer. Baron Nordenskiold made a notable reputation in the field of historical geography by his monumental publications, the Facsimile Atlas, 1889, and the Periplus, 1897. The former contains reproductions of the most important geographical documents printed during the 15th and 16th centuries, and the latter, a work of far greater research, deals with the history of early cartography and the sailing charts in use among mariners during the Middle Ages. Baron Nor- denskiold died at Stockholm on the 12th of August, 1901. (g. f. b.)

Norderney, an island of Prussia, province of Han- over, off the north coast of East Friesland. It is one of the most popular seaside resorts in all Germany, the summer visitors reaching the total of 24,000 annually. The village is situated at the western extremity of the island, and near it are a

military convalescent home and the Empress Frederick's Children's Home. In 1898 the island was cleared by 2806 vessels of 213,340 tons. Norderney is immortalized by its association with Heine's Mrdseebilder. Population (1900), 4018.

Nordhausen, a town of Prussia, province of Sax- ony, 60 miles by rail west of Halle. It possesses a museum of antiquities. In the corn market is a fountain by Hietschel (1825), and in the market-place another to Luther (1888). Population (1885), 27,083; (1900), 28,500.

N 0 E F 0 L K â€" N OEFOLK ISLAND

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Norfolk, an eastern county of England, bounded on the N. and E. by the North Sea, on the S. by Suffolk, and on the W. by Lincolnshire and Cambridgeshire.

Area and Population. â€" In 1901 the area of the ancient (geographical) county was 1,308,440 acres, and the population numbered 464,616 in 1891 and 460,040 in 1901, showing an increase of 9767 between 1881 and 1891, or at the rate of 2 '2 per cent, during the ten years, and of 6524, or at the rate of 1-2, between 1891 and 1901, as compared with an inci-ease at the rate of 1-4 per cent, during the ten years 1871-81. The 1901 returns give 0-35 persons to an acre, and 2-84 acres to a person. In 1891 the area of the registration county -wis 1,291,170 acres, and the population 460,362, of whom 221,688 were males and 238,674 females, and in 1901, 467,614. Particulars of birth-rate, death- rate, and the number of persons married per thousand inhabitants, as well is the illegitimacy-rate per thousand births, are given In the following table : â€" â–

1871-80.

1881-90.

1SS9-98.

1899.

Birth-rate . Death-rate . Marriage-rate Illegitimacy-rate .

30-8 19-8 14-5 84

30 -T

18-3 13-7 63

28-1 17-4 13-6 66

26-9 16-6 14-6 61

In 1891 the county contained 952 persons born in Scotland, 1152 born in Ireland, and 619 foreigners. At the same time there were 448 blind persons, 226 deaf and dumb, and 1856 insane.

Government, (fee. â€” For parliamentary purposes the ancient county is divided into six divisions (North-Western, South-Western, Northern, Eastern, Mid, and Southern), and also includes the parliamentary boroughs of King's Lynn and Norwich, and part of the parliamentary borough of Great Yarmouth ; each returning one member, except the city of Norwich, which returns two members. The administrative county includes the municipal boroughs of King's Lynn and Thetford. Norwich and Great Yarmouth form county and municipal boroughs. There are two courts of quarter sessions, and 25 petty sessional divisions. Each of the four municipal boroughs has a separate commission of the peace and a separate court of quarter sessions. The adminis- trative county contains 692, the county borough of Norwich 1, and the county borough of Great Yarmouth 2, entire civil parishes ; there are also 3 civil parishes which are partly in other adminis- trative counties, and one which is partly in the administrative county of Norfolk and partly In the county borough of Great Yarmouth. The ancient county contains 595 entire ecclesiastical parishes and districts, and parts of 13 others. It is situated partly in the dioceses of Ely, Lincoln, and Norwich.

Education. â€” At Norwich there are the Norwich and Ely Diocesan Training College for Schoolmistresses (founded in 1853, the building dating from 1892) and an institution for the blind, and there are a deaf school and a

blind school at Great Yarmouth. On 31st August 1900 there were in the county 501 elementary schools, of which 156 were board schools and 345 voluntary schools, the latter including 331 National Church of England schools, 4 Roman Catholic, and 10 British and other. The average attendance during the year was 47,686, oj^t of a total of 57,682 on the register. The total receipts of the board schools during the year were Â£127,259, of which Â£4763 were earnings under the Agricultural Rates Act, and Â£386 earnings under the Technical Instruction Act.

Agriculture. â€” For the ten years following 1885 there was a general tendency towards an increase in the areas of pasture land and of meadows, but the latter decreased again after 1895. In 1889 a total of 882,432 acres were farmed by tenants and 212,698 acres by the owners, the corresponding figures in 1895 being 890,773 and 186,840 acres, and in 1900, 896,933 and 170,424 acres.

The following table shows the areas under the difierent kinds of crops at the periods named : â€”

Area in

Area under

Area under

Area of

Area under

Tear.

Cultiva-

Corn

Green

Bare

Permanent

tion.

Crops.

Crops.

Fallow.

Grass.

1880

1,083,737

444,476

202,992

11,002

.. .

1885

1,090,967

438,252

207,295

10,977

271,717

1890

1,093,395

427,039

195,961

13,392

286,651

1895

1,077,613

404,289

191,378

â– 11,480

296,959

1900

1,067,857

409,632

195,950

6,177

289,189

The next table shows the numbers of the live stock at the periods named : â€”

Tear.

Cows and Heifers.

Other Cattle.

Total Cattle.

Horses.

Sheep.

Pigs.

1880 1890 1900

27,937 32,457 35,635

80,341

104,558

98,892

108,278 137,015 134,627

63,840 64,481 66,602

638,791 595,014

547,245

86,483 105,007 100,712

Industries. â€” The total number of persons employed in factories and workshops in the county during the year 1897 was 29,997, of whom 9111 were employed in the clothing industries, 3593 in the making of machinery, implements, tools, &o., 3286 in the preparation of food, 2221 in the paper and printing trades, 1801 in the manufacture of silk, 1732 in brewing, &c., and 1655 in the wood industries.

The Norfolk Broads, which have attracted the attention of tourists, lie within a triangle which has for its angular points Hai)pisburgh (on the coast), Norwich, and Lowestoft. They consist of shallow lakes or marshes, mostly fringed with reeds, and frequently of a picturesque appearance, and

abound in fish and waterfowl. For the most part they belong to the lower basins of the rivers Bure, Yare, and Waveney, which converge upon Yarmouth. In the Bure basin are Wroxham, Hoveton, Hickliiig, Horsey, Martham, Heigham, Ormesby, Filby, Barton, Somerton, and Whitelsea ; in the Yare basin, Rockland and Surlingham ; and in the Waveney basin, Oulton.

Authorities. â€” Victoria History of the County of Norfolk, vol. i., edited^ by H. A. Doubleday. London, 1901. â€” W. Rye. History of Norfolk. London, 1886. â€” P. H. Emerson. Pictures of East Anglian Life (London, 1888), and other works. â€” Rev. A. Jessopf. Arcady (London, 1887), and other works.' â€” Quarterly Review (London, 1897), where other literature is cited. â€” G. C. Davies. Norfolk Broads and Bivers. Edinburgh, 1884.

(j. T. BE.)

Norfolk, a city of Madison county, Nebraska, U.S.A., on the Elkhorn river and the Ereniont, Elk- horn, and Missouri Valley, the Union Pacific, and the Chicago, St. Paul, Minneapolis and Omaha railways, in the north-eastern part of the state, at an altitude of 1623 feet. It is a railway centre of some importance, and a distributing point for a large region of fertile farming country. Population (1880), 647 ; (1890), 3038 ; (1900), 3883, of -whom 622 were foreign-born.

Norfolk, a city and seaport of Norfolk county, Virginia, U.S.A., on Norfolk Harbour, at the mbuth of the Elizabeth river, in the south-eastern part of the state. Its sight is level, it is divided into six wards, and its plan is irregular. It has an excellent water-supply and thorough sewerage, but its streets are ill-paved. It has a good har- bour, accessible to vessels of great draught, and it has con- siderable export trade, consisting mainly of bread-stuffs, cotton, and lard. Eor the year ending 30th June 1901 the exports (including those of the smaller adjacent city of Portsmouth) amounted to $10,308,489. Regular steamship lines connect the city with New York, Boston, and southern ports. In 1900 it had 446 manufacturing establishments, with a total capital of $6,426,099, an average number of 4334 hands, and products valued at |9,397,366. The industries were varied, consisting of the roasting and, grinding of coffee and the grinding of spice, and the pro- duction of clothing, fertilizers, flour, foundry and machine- shop products, and hosiery

and knitted goods, the coffee and spice industry being of the most importance. The assessed valuation of real and personal property in 1900, on a basis of about three-fourths of the full value, was $26,175,980, the net debt $4,177,306, and the rate of taxation $22 per $1000. Population (1890), 34,871 ; (1900), 46,624â€”1705 foreign-born and 20,230 negroes.

Norfolk Island, in the Pacific Ocean, about 800 miles east of New South “Wales, containing 8528 acres, of which about one-fourth remains unalienated. The fertility of the island is very great. Oranges, grapes, passion fruit, figs, pine-apples, and other fruits grow abundantly ; while potatoes, onions, maize, and arrowroot can be largely produced. The inhabitants, however, have by no means made use of their opportunities. Since its constitu- tion as a separate settlement in 1856 its condition has gone from bad to worse. The administration of justice in the hands of an elected magistrate was unsatisfactory. Crime was rarely punished, and debts were not recoverable. A lack of energy was everywhere apparent. Owing to

intermarrying there has been steady deterioration of the race. The population was, in 1895, 882. The total trade barely exceeds Â£6600 annually. An attempt has been made to remedy matters by an improvement in the govern- ment. Although not actually annexed to New South Wales, the island is now more directly under the jurisdic- tion of the Governor of ISlew South Wales, who has the power of legislation until the New South Wales legislature provides otherwise. A chief magistrate, appointed by the Governor, has taken the place of the elected magistrate, and an elected council of elders, consisting of twelve members, has superseded the general gathering of the adult population.

Parliamentary Paper C. 8358, Correspondence relating to the Transfer of Norfolk Island to the Government of New South Wales, 1897. (h. b. eg.)

-), English

Norman, Sir Henry Wylie (1826-

field-marshal and colonial governor, was born 2nd De- cember 1826, and entered the army at the age of seventeen, his first appointment being to the 31st Native Infantry. Until 1840 the Norman family was entirely unconnected with India. In that year Sir Henry's father, who had been for many years a merchant in Cuba, became a partner in a mercantile house in Calcutta, where he was joined by his son in 1842. In 1844 the latter obtained a cadetship, and so began his career without social or pro- fessional influence to help him. Young Norman went through the second Sikh campaign with the 31st Native Infantry, and having attracted the favourable ' notice of Sir Colin Campbell, was selected by him to accompany an expedition against the Kohat Pass Afridis in 1860 as officiating brigade-major. The subaltern of twenty-four was given a substantive appointment in this capacity for a splendid deed of gallantry, which is recorded by Sir Charles Napier in the following terms : " In the pass of Kohat a sepoy picket, descending a precipitous mountain under fire and the rolling of large stones, had some men killed and wounded. Pour of the latter, dreadfully hurt, crept under some rocks for shelter. They were not missed until the picket reached the bottom, but were then dis- covered by our glasses, high up and helpless. Fortunately the enemy did not see them, and some sepoys volunteered a rescue, headed by Norman of the 31st Native Infantry and Ensign Murray of the 70th Native Infantry. These brave men â€" would that the names of all were known to me for record ! â€" ascended the rocks in defiance of the enemy, and brought the wounded men down." Norman served in numerous frontier expeditions between 1850 and 185-1, and in the suppression of the Sonthal rebellion of 1855-56. In the Mutiny campaign he was constantly engaged, being present at the siege of Delhi, the relief of Lucknow, and a number of other affairs. Altogether he was mentioned twenty-five times in despatches. He afterwards became assistant military secretary for Indian affairs at the Horse Guards, military secretary to the Government of India, military member of the Viceroy's Council, and member of the Secretary of State for India's Council. It is generally understood that the Indian Staff Corps owed its origin to Sir Henry Norman, several members of whose family have won distinction in it. In 1883 Sir Henry began his colonial career as Governor of Jamaica, an appointment from which he was transferred in 1888 to the governor- ship of Queensland. Here he remained until 1895, when he came home to act as Agent-General for the colony in London. In 1893 he was offered the

Viceroyalty of India, but, after first accepting, declined it. In 1897 he was chairman of the Royal Commission of Inquiry into the condition of the West Indies, a position for which his experience in Jamaica eminently fitted him. In April 1901 he was appointed Governor of the Royal Hospital,

Chelsea, in succession to Field-marshal Sir Donald Stewart. In 1902 he was made a field-marshal.

Norristown, a borough of Pennsylvania, U.S.A., capital of Montgomery county, on the Schuylkill river, 16 miles from Philadelphia, in the south-eastern part of the state. It has a fairly regular plan, with ten wards, and a good water-supply from Schuylkill river. It has three railways, the Pennsylvania, the Philadelphia and Reading, and the Stony Creek. Though a residential suburb of Philadelphia, it has cc^isiderable manufactures, the pro- ducts of which in 1900 were valued at $4,821,745, and consisted of cotton and woollen goods, carpets, hosiery and kijitted goods, flour, iron and steel goods, &c. Population (1890), 19,791 ; (1900), 22,265, of whom 3048 were foreign-born and 728 negroes.

Norrkoping, a town and port in the province of Ostergotland, Sweden, on the river Motala, just before it enters Bravik, an inlet of the Baltic, 113 miles south-west of Stockholm by the main line to Malmo. The falls in the river afford motive power to the cloth and cotton mills (spinning and weaving)â€” the staple industries â€” and to factories for sugar, paper, lithography, tobacco, and carpets, joinery works, and breweties. There are also shipbuilding yards and docks. Fine granite is quarried at Graf versfors, 7i miles to the north. The inlet of Bravik affords excellent harbour accommodation, there being from 33 feet to 17^- feet of water below the bridges in the town. In 1896 the port was entered and cleared by 4972 vessels of 605,137 tons. The chief new building is St Matthew’s church (1892). Population (1880), 26,735 ;

(1890), 32,826 ; (1900), 41,008.

Norrland, the most northerly of the three territorial divisions of Sweden, embraces the counties of Norrbotten, Vesterbotten, Yesternorrland, Jamtland, and Gefleborg, that is to say, the river basins of the Tornea, Kalix, Lulea, Piteo, Skelleftea, Umea, Angerman, and Indal, correspond- ing to the

â€žold districts of Gestrikland, Helsingland, Medelpad, Angermanland, Herjeadal, Jamtland, Vester- botten, and Lappmark. Its area is 98,771 square miles, or 57-8 per cent, of the whole area of. Sweden. In 1900, however, notwithstanding the very rapid increase of the population, Norrland had only 16-6 per cent, of the total poijulation of the kingdom. Population (1880), 628,742 ;

(1890), 743,704 ; (1900), 860,254.

North Adams, a city of Berkshire county, Massachusetts, U.S.A., at the junction of the north and south branches of the Hoosac river, and the Fitchburg (at the western terminus of the Hoosac Tunnel) and the Boston and Albany railways, in the north-western part of the state, at an altitude of 704 feet. The village of North Adams, the principal population centre of the town, is a thriving manufacturing place. In 1900 there were in the town 231 manufacturing establishments, with a total capital of $14,663,492. They employed an average number of 6796 hands, and turned out products valued at $11,682,663. The most important industries were the manufacture of cotton and woollen goods, and of boots and shoes. Population (1890), 16,074 ; (1900), 24,200, of whom 6821 were foreign-born and 90 negroes.

Northampton. â€” Oneof the south midland counties df England, bounded on the N. by Lincoln, Rutland, and Leicester, on the A^^ by Warwick and Oxford, on the S. by Oxford and liuckingham, and on the E. by Bedford, Huntingdon, and Cambridge.

Area and Population. â€” In 1901 the ~~area of the ancient (geo~~ graphical) county was 641,992 acres, und the population 302,183, of whom 149,759 were males and 162,42-t were females, showing an increase of 29,628 since 1881, or at the rate of 10-8 per cent.

during the ten years, as compared with an increase at the rate of 11-7 per cent, for the ten years 1871-81. In 1901 the population was 338,064, an increase of 35,881, or at the rate of 11-8 per cent, between 1891 and lOul. These last returns give 0-53 persons to an acre, and 1-89 acres to a person. In the year 1891 the area of the registration county was 041,925 acres, and

the popu- lation 308,072, of whom 152,018 were males and 155,154 females, and in 1901, 348,924. Particulars of birth-rate, death-rate, and the number of persons married per thousand inhabitants, as well as the number of illegitimate births per .thousand births, are given in the annexed table : â€”

1S71-S0.

1881-90. 1 1SS9-98.

ISilO.

Birth-rate Death-rate Marriage-rate Illegitimacy-rate .

34-8 19-6 150

47

31-8 17-1 14-1 45

29-8 16-2 15-1 40

29-3 15-5 16-3 41

In 1891 the county contained 869 natives of Scotland, 1095 natives of Ireland, and 378 foreigners. At the same date there were 228 blind persons, 115 deaf and dumb, and 1452 insane.

Government, A'c. â€" For parliamentary purposes the ancient county is divided into four divisions (Northern, Eastern, Mid, and Southern') , the parliamentary borough of Northampton, and part of the parliamentary borough of Peterborough, each returning one member, except the borough of Northampton, which returns two members. The administrative counties of Northampton and the soke of Peterborough include four municipal boroughs, namely, Brackley, Daventry, Higham Ferrers, and Peterborough, together with the municipal and county borough of Northampton. There are one court of quarter sessions and nine petty sessional divisions. The county borough of Northampton and the liberty of the soke of Peterborough have each a separate court of quarter sessions and a separate commission of the

peace. The administrative county contains 301 entire civil parishes _and parts of seven others ; the soke of Peterborough contains twenty-nine entire civil parishes and parts of three others ; and the county borough of Northampton contains five entire civil parishes. The ancient county contains 288 entire ecclesiastical parishes or districts, with parts of ten others, most of them being in the diocese of Peterborough.

Education. â€” There is a diocesan training college for school- masters at Peterborough. On 31st August 1900 the county, in- clusive of the soke of Peterborough, possessed 306 elementary schools, namely, 51 board schools and 255 voluntary schools, the latter including 238 National Church of England schools, three VVesleyan, three Roman Catholic, and 11 British and other. The average attendance during the year was 43,139, out of a total of 51,841 on the register. The school board receipts amounted during the year to Â£76,769, inclusive of Â£40 earned under the Technical Instruction Act and Â£1812 earned under the Agricultural Hates Act.

Agriculture. â€” Since 1880 there has been a very considerable decrease in the area devoted to com crops and in the fallow land, and a slight decrease in the area planted with green crops. On the other hand, there has been an increase in the permanent grass and meadow-land since 1885. In 1889, 455,039 acres were farmed by tenants, 463,082 acres in 1895, and 478,343 acres in 1900 ; whilst in the same three years 104,602, 95,512, and 82,441 acres respec- tively were farmed by their owners.

The following table shows the areas under the different kinds of crops at the periods named : â€”

Are.a in

Are.a under

Area under

Area of

Area under

Tear.

Cultiva-

Corn

Green

Bare

Permanent

tion.

Crops.

Crops.

Fallow.

Grass.

1880

559,117

169,759

38,090

25,393

1885

559,325

153,365

40,419

15,775

309,730

1890

560,305

140,615

37,080

13,928

3.33,800

1895

558,594

127,985

36,703

13,513

343,787

1900

660,784

128,281

35,153

8,462

354,912

The next table shows the numbers of the live stock for the periods named : â€”

Tear.

Cows and Heifers.

Other Cattle.

Total Cattle.

Horses.

Sleep.

Pigs.

1880 1885 1890 1895 1900

24,997 29,457 30,797 27,352 32,404

88,038 100,452 99,265 92,350 93,937

113,035 129,909 130,062 119,702 126,341

21,998 21,953 21,701

22,.S57

22,880

457,412 452,638 429,050 409,043 403,434

29,595

32,713 37,502 39,576 28,340

Industries. â€” The total number of hands employed in the factories and workshops of the county during 1897 was 42,795; and of these by far the

greater portion, namely, 31,922, or 75

per cent, of the whole, was employed in the clothing (boots and shoes) industries. Next in importance came the making of machinery, implements, and tools, giving employment to 3008 persons ; the paper and printing trades, with 1185 hands ; the metal industries, with 1183 ; leather, with 1128 ; and wood, with 1073. Iron ore is extracted at various places in the middle of the county, e.g., Kettering near Northampton, Wellingborough, Thrapston, and near Stamford ; and there are thirteen blast furnaces at the four places named. In 1900, l,(i22,5:;0 tons of ironstone were extracted and 247,908 tons of pig-iron were made. Further, in the same year 168,628 tons of limestone, 303,520 tons of clay, and 53,231 tons of gravel were produced. Altogether 1769 persons were employed in the mines and quarries, the total value of the products of which amounted to Â£191,!)41.

See C. A. Maekham. Tlie Church Plate nf the County of Northampton. London, 1804.â€” T. L. Powys. Xotes on the Birds of Northamptonshire, 2 vols. London, 1895. (j. t. Be.)

Northampton, a parliamentary, county, and mu- nicipal borough of England, capital of Xorthampton- sliire, on the river Nene, 70 miles north-north-west of London by rail. The churches of St Peter and the Holy Sepulchre have been restored since 188.3. St (Crispin’s chapel-of-ease was built in 1SS4. There are nine other ecclesiastical parishes, some with new churches since 1882, e.g., St Mary’s at Far Cotton, in the Early English Grothic; St Paul’s, decorated ; St Matthew’s, Gothic ; and St Michael’s and All Angels’. Besides the cathedral, the Roman Catholics have the church of St John. The town hall was enlarged in 1892. The public buildings erected since 1883 embrace the county council room, the Masonic Hall, the museum and free library (1884), the Friendly Societies’ Medical Institute, and the opera-house. The town also possesses a Eoman Catholic convent, with schools, the Northampton and county modern and tech- nical schools (opened in 1894), and half a dozen clubs. The water-supply of the town was increased by the con- struction of a new reservoir of 100 acres at Teeton in 1888. The parliamentary borough (area, 1972 acres ; population, 23,671 in 1891) returns two members to the House of Commons. The population of the municipal and county borough in 1891, on the then area (1311 acres), was

61,012. In 1898 the area was 1342 acres, and the population on this in 1891 was 75,075 ; in 1901, 87,021.

See Becords of the Borough of Northampton, edited by C. A. Makkham and Rev. J. C. Cox, 2 vols. Norwich, 1898.

Northampton, a city of Massachusetts, U.S.A., capital of Hampshire county, on. the west bank of the Connecticut river, towards the western part of the state. It comprises an area of 37 square miles, mainly in the level Connecticut valley, is divided into seven wards, and includes, besides Northampton proper, the villages of Leeds and Florence. Northampton is irregularly planned, is on branches of the New York, New Haven, and Hartford, and the Boston and Maine railways, and has exten- sive and varied manufactures. Northampton is the site of Smith College, one of the foremost of the colleges for women in the country. It is non-sectarian, was opened in 1875, and in 1899 hp,d 68 instructors and was attended by 1074 students. Its library contained 7500 volumes, its property was valued at $1,566,252, and its income was $182,128. Besides the college library, there is in North- ampton the public library with over 30,000, and the Forbes library with over 75,000 volumes. Population (1890), 14,980 ; (1900), 18,643, of whom 4498 were for- eign-born and 108 negroes.

North Attleboro, a town of Bristol county, Massachusetts, U.S. -A.., in the south-eastern part of the state, and on a line of the New York, New Haven, and Hartford railroad. It has an area of 20 square miles of rolling surface. The principal village, of the same name as the town, is regularly laid out. It is well known for its manufacture of jewellery. Population (1890),

6727; (1900), 7253, of whom 1786 were foreign-born and 59 negroes.

North Berwick, a royal burgh and watering- place of Haddingtonshire, Scotland, at the south corner of the .mouth of the Firth of Forth. It has fine sands and famous golf-links. There is a town house, a library and reading-room, a hospital for infectious diseases, and a fishermen’s hall. Little trade

is done at the harbour, which is not easy of access. There is steamer communi- cation in summer with Leith and Fife. The High School is one of the leading secondary schools in the county. Population (1891), 2376 ; (1901), 2784.

North Bierley, an extensive township in the Shipley parliamentary division of Yorkshire, England, 2 miles south-south-east of Bradford,, on the Lancashire and Yorkshire railway. Ironworks at Low Moor (in the town- ship), established in 1790, provide employment for 3000 to 4000 people. In 1899 it was incorporated with Brad- ford. Population of sub-district, including townships of North Bierley and Wyke (1901), 22,151 (North Bierley, 16,266 ; Wyke, 6885).

Northbrook, Thomas George Baring, 1st

Eakl of (1826- â€¢), the eldest son of the first baron

(long known as Sir Francis Baring), was born on 22nd January 1826, and educated at Christ Church, Oxford, where he graduated with honours in 1846. He entered upon a political career, and was successively private secretary to Mr Labouchere (Lord Taunton), Sir George Grey, and Sir Charles Wood. In 1857 he was returned to the House of Commons in the Liberal interest for Penryn and Falmouth, which constituency he continued to represent until he became a peer on the des,th of his father in 1866. Mr Baring was a Lord of the Admiralty in 1857-58 ; Under-Secretary for War, 1861 ; for India, 1861-64; for the Home Department, 1864-66; and Secretary to the Admiralty, 1866. When Mr Gladstone acceded to power in 1868, Lord Northbrook was again appointed Under-Secretary for War, and this office he held until February 1872, when, upon the assassination of the earl of Mayo, he was appointed Governor-General of India. The terrible famine in Bengal, which began in January 1874, taxed the administrative powers of the Indian authorities to the uttermost, but it was suc- cessfully grappled with. Another important event was the visit of the Prince of Wales to India. In February 1876 Lord Northbrook resigned. It is now admitted that his Government recommended the conclusion of arrange- ments with Shere Ali which would have prevented the second Afghan war; but the Viceroy’s policy was overruled by the duke of Argyll, then Secretary of State. During a debate on Indian affairs in the House of Lords in Febru- ary

1880, Lord Northbrook delivered a remarkable speech, which attracted a great deal of attention at home and abroad. Having traced the developments of Russian and British policy in northern India, he asked whether no stop could be put to a rivalry which was detrimental to the interests of both countries ; and he affirmed that, to any one who looked beyond the events of the moment, there was something almost appalling in the position of the British and Russian empires in Asia. In recognition of his distinguished public services, he was created in 1876 Viscount Baring of Lee in the county of Kent, and earl of Northbrook in the county of Southampton. From 1880 to 1885 the earl held the post of First Lord of the Admir- alty in Mr Gladstone's second Government. In 1884 Lord Northbrook was sent to Egypt as Lord High Com- missioner to inquire into its finances and condition, and the result was a loan of nine millions sterling. When Mr Gladstone formed his third ministry in 1886 Lord North-

brook held aloof, being opposed to the Home Rule policy of the Premier ; and he then ceased to take a prominent part in political life. In 1890 he was appointed lord- lieutenant of Hampshire.

North Carolina, one of the southern states of the American Union, with Virginia on the N., Tennessee on the W., South Carolina on the S., and the Atlantic on the E. The harbour facilities are poor, and for a long time the people were a body of small farmers without towns,- manufactures, or easy access to the world beyond. At the middle of the 19th century came an impetus to railway building, and in 1865 the abolition of slave labour. One of these forces put the state into quick communication with the outside world, and the other made agriculture so much less profitable that a considerable number of small farmers became factory hands. Thus, though agriculture is still the chief industry, a movement towards urban manufacturing communities developed in the closing years of the 19th century. Of this the most striking form has been the manufacture of cotton products, as the following figures show : â€"

Tear.

Number ofMiUs.

Looms.

SpiudleB.

1880 1894 1900

49 167 224

1,790 15,058 29,689

92,385

703,997

1,297,771

In 1890 North Carolina was tenth in the list of cotton manufacturing states of America; in 1900 it was third, while of the Southern states it was first in the number of mills, but second in output. In 1899 its mills consumed as much cotton as was produced in the state. In 1900 the total capital invested in the manufacture of cotton goods amounted to $33,011,616. The industry em- ployed 30,273 hands, and the value of the products was 128,372,789. The greater part of this development has been due to home capital. Next to cotton manufacturing is the lumber industry. The diminution of the forests of the North and West has brought Southern lumber into demand, especially pine lumber. In 1880 the whole lumber product of the state was worth $2,672,796. In 1893, in forty-two pine-producing counties of the east it was worth $4,568,280. In 1898 and 1899 there was a still greater development in the same line, and more capital was embarked. In the western part there are vast forests of hard wood still untouched. In 1900 the total lumber and timber products of the state were worth $14,862,593. Tobacco manufacturing is largely followed in some towns, notably in Durham and Winston-Salem. Here are some of the largest smok- ing and plug tobacco and cigarette factories in the world. In 1900 the state contained 80 tobacco factories, which had an output valued at $13,620,816. In manufactures of all kinds North Carolina ranks twenty-eighth among the states of the Union.

The general development of manufacturing during the decade 1890-1900 is set forth in the following table :â€”

Per

1890.

1900.

cent, of Increase.

Numher of establishments .

3,667

7,226

97-1

Capital ....

$32,745,995

Â§76,503,894

183-6

Salaried ofacials, clerks, &c.

2,5891

8,001

15-9

Salaries ....

$1,278,4151

$2,434,621

90-4

Wage-earners, average number

33,626

70,570

109‘9

Total wages

$6,552,121

$13,868,430

111-7

Miscellaneous expenses

$3,829,101

$9,118,637

178-9

Cost of materials used

$22,789,187

$63,072,388

132-9

Value of products

$40,376,450

$94,919,668

135-1

1 Includes proprietors and firm members, with their salaries.

Agjieulture. â€” Agriculture, which continues to absorb most of the industrial energy, has been devoted to the one-crop form. For this reason it has not been very profitable. Cotton and tobacco have been the chief products, but in recent years these have brought unexpectedly low prices, and real distress has followed. Efforts have been made to secure the adoption of more diversified farming, and with some success, so that the outlook for agri- culture is somewhat better. In those counties of the east which have adequate railway facilities, truck farming has assumed large proportions. In the west considerable progress has been made in raising apples for winter markets. The building of towns has tended to produce diversified farming. In 1900 the number of farms was 224,637, comprising 22,749,356 acres, of which 36‘6 per cent, was improved land. The total value of farm property was $233,834,693, in which was Included: land, improvements, and buildings, 1194,656,920; implements and machinery, $9,072,600; live stock, $30,106,173. The total value of farm products in the preceding year was $89,309,638. In 1900 the statistics of the chief crops were: Indian corn, 29,790,180 bushels, valued at $16,980,403; wheat, 6,960,803 bushels, valued at $4,887,858; cotton, 603,826 bales, valued at $18,146,257. As to tobacco, statistics are wanting since 1889, in which year the product amounted to 36,375,258 lb.

Mining. â€” Mining, which was once thought to have large indus- trial probabilities, has made no considerable advance. A Geological Survey was established in 1899, and has done good in surveying the mineral resources. Gold continues to be mined in paying quantities in a number of small mines ; in 1899 the total reported product was $43,000. An attempt to smelt iron in well-equipped modern furnaces has proved a financial failure. The increased prices for copper have resulted in a revival of copper mining. Certain deposits of mica, corundum, talc, graphite, monazite, and some precious gems have been mined with profit. Yet none of these results are sufficient to make the state a considerable mining state. Building-stone has

also been worked in several places, and some of the granite deposits have established a reputation.

Fisheries. â€” risheries have long been largely worked in the exten- sive sounds on the coast, and the increase in transportation facilities has given them an added impetus. In 1899 the capital employed was $1,218,459, and the total catch was worth $1,316,017.

Population. â€” Social conditions have followed the development of industry. In 1880 the population was 1,399,750, of whom 867,242 were whites and 531,277 were coloured. In 1890 it was 1,617,947, of whom 1,055,382 were white and 661,018 were coloured. In 1900 it was 1,893,810, of whom 1,263,603 were white, 624,469 negro, 6687 Indians, and 51 Chinese. The males numbered 938,677 and the females 956,133; the native-bom 1,889,318 and the foreign-born 4492. The total number of square miles of land surface in the state is 48,580, and the average number of persons to the square mile was 39 in 1900, as compared with 33-3 in 1890. In 1880 there were 50,778 persons in the state living in towns having a population of 2000 and over ; in 1890, 102,053, and in 1900, 202,274. The grovrth of manufacturing explains in large part this increase. The most important towns and their populations are as follows : â€”

Towns.

ISSO.

1S90.

1900.

Wilmington

17,350

20,056

20,976

Raleigh ....

9,265

12,678

13,643

Charlotte ....

7,094

11,557

18,091

Winston-Salem

4,194

10,729

13,650

Asheville ....

2,616

10,235

14,694

Durham ....

2,041

5,485

6,679

Greensboro

2,105

3,317

10,035

The migration into the state is slight but appreciable. Some come for health to the mountains of the west and to the pine-covered plains in the middle part, and others come as skilled labourers in the factories. In 1880 the male population over ten years of age was 465,268, and of these 393,211, or 84-51 per cent., were engaged in gainful occupations. In 1890 this population was 559,764, of whom 422,171, or 75-42 per cent., were likewise engaged. Of females over ten years of age in 1880 there were 494,683, of whom 86,976, or 17-58 per cent., were engaged in gainful occupations ; and in 1890 there were 586,682 females of such an age, of whom 115,192, or 19-6 per cent., were likewise engaged.

Education. â€” The development of public schools has been a matter of severe difficulty. The state is not wealthy, and there are a vast number of negroes who pay small taxes, or none at all, and who are yet as much in need of education as any class in the community. It is to the credit of the state that the blacks are allowed an equal share of the school fund. This fund is realized chiefly from taxation. In 1898 it amounted to $986,514; the average length of the term was 14-06 weeks for the whites and 11-75 for the blacks. In 1898 there were 415,262 white children

of school age, of whom 144,367 attended school. In the same year the coloured children of school age were 213,218, of whom 68,894 attended school. In 1890 there were 4701 teachers in the state, of whom 1817 were males and 2884 were females. The native white population above ten years of age in 1880 was 605,244, of whom 191,913, or 31-71 per cent., were illiterate. The same population in 1890 was 751,302, of whom 173,545, or 23-10 percent., were illiterate. The coloured population of the same age in 1880 was 351,145, of whom 271,943, or 77-44 per cent., were illiterate. The same population in 1890 was 392,589, of whom 235,981, or 60-11 per cent., were illiterate. In 1900 the total white male population over twenty-one years of age numbered 289,263, of whom 54,474, or 18-83 per cent., were illiterate ; at the same time the coloured male population over twenty-

one years numbered 128,315, of whom 68,184, or 53-13 per cent., were illiterate. The general opinion of competent observers is that the illiteracy of the negroes is steadily decreasing. A hopeful feature is the fact that most of the towns have levied special taxes to establish modern graded schools. These are usually open during nine months in the year, and may be considered a permanent feature of the new urban life. In higher education the progress has been good. A number of the smaller colleges, so-called, have been relegated to the position of high schools or closed altogether, whereas new institutions of a higher grade have been established and old ones strengthened. The state has established an agricultural and mechanical college for each race, and a normal and industrial college for white women. The Baptists, the Lutherans, the Quakers, the Christians, and the Roman Catholics have founded institutions of higher learning, and the Methodists have so increased the equipment of their college of Trinity as to make it practically a new institution. The state university has more than doubled its attendance. The higher education of the coloured people is cared for by six institutions, established chiefly through the aid of philantliropic Northern persons or organizations. In 1897 there were 2868 students, male and female, attending in- stitutions of higher learning in the state, with 253 instructors.

Beligion. â€” North Carolina is a decidedly Protestant state, having in 1890 only 2640 Roman Catholics. The most important churches are the Baptist, with 3124 organizations and 310,920 communicants ; the Methodists, with 2413 organizations and 276,336 communicants; the Presbyterians, with 411 organizations and 36,102 communicants; the Christians, with 158 organizations and 12,437 communicants ; the Lutherans, with 131 organizations and 12,326 communicants ; and the Episcopalians, with 178 organi- zations and 8186 communicants.

Charitable and Penal Institutions. â€” There are for the whites two asylums for the insane, at Raleigh and at Morganton, and one for the blacks at Goldsboro. In 1896 these had respectively 420, 654, a,nd 425 inmates. There is also an institution for the deaf, dumb, and blind in Raleigh, with 275 inmates, and another for the deaf and dumb in Morganton, with 175 inmates. There is a ssldiers' home at Raleigh, with 105 inmates. All these are supported by the state. The state has a penitentiary in Raleigh, in which

in 1896 there was 1127 inmates. This institution has connected with it certain farms and other works at which a part of the convicts are kept.

Transportation. â€” The chief railway systems are : the South- ern, which has in the state 1226 miles of track, valued at 816,479,002 ; the Atlantic Coast Line, with a mileage of 949 and a valuation of $13,932,026 ; and the Seaboard Air Line, with a mileage of 614 and a valuation of $8,683,861 ; and other lines with a total mileage of 861 and a valuation of 84,298,837. Thus the railways of the state have a total mileage of 3650 and a total valuation of 842,393,726. The steamboat lines are mainly on the sounds and rivers of the east. In 1900 there were 45 steamboats, valued at 8145,214. The foreign commerce of the state is not great. The ports are Wilmington, New Berne, Beaufort, and Edenton ; but only the first two reported imports and exports in 1899, the total of imports being worth $145,260, and of exports, 87,590,381.

Finance. â€” The total assessed valuation of real and personal property, including transportation and telegraph lines, in 1900 was $287,339,288. The state tax rate was for the same year 25 cents on the 8100 valuation for ordinary purposes, and 18 cents on the $100 for public schools. A poll-tax is collected which by the constitution is equal to the property-tax on $300 in cash. This poll-tax for state and county must not exceed $2, so that it is impossible for the state and county property-tax combined to be more than 66f cents on each $100 valuation. The state debt in 1900 was $6,527,770.

Banks. â€” The statistics of banking in 1901 (except for national banks, for which the figures are for 1897), are as follows : â€” Kind of Bank. Capital. Depnsits.

National . . . $2,701,000 $5,462,497 State 2,578,643 7,083,784

Private . . . 165,500 630,220

Savings bank . . 238,384 2,159,419

In 1900 there were 29 building and loan associations, of which 28 had their home office in the state, and 1 had it out of it.

Political Development.â€” ‘Etovh 1880 till 1894 the political control of the state was in the hands of the Democratic party. In 1892 the People’s party was organized iu the state. It was greatly helped by the feeling on the part of many of the farmers that the control of the old parties was manipulated against their interests. This party was defeated in 1892, but in 1894 it made a combination with the Republicans which carried the state. Two United States senators were to be elected, and by previous agreement each of the victors elected one. In 1898 the Democrats made the election issue th^ opposition to negro office-holders. They were able to do this because their opponents had not been able to withstand the pressure from within their own ranks, and in some cases had appointed negroes to minor political offices. After a bitter cam- paign, in which a great deal of race feeling was aroused, the Democrats regained control of the legislature. So great was the feeling on the race question that the party was impelled to propose an amendment to the state constitution, the purport of which was to disfranchise the negro voters. This amendment provided (1) that every voter shall be able to read and write a section of the constitution and shall have paid his poll-tax, and (2) that no male person who was a qualified voter in 1867, and no lineal descendant of the same, shall be denied the franchise because of inability to read and write, provided he shall be daly registered by 1st November 1908. The latter clause was inserted confessedly because it was believed that without some such guarantee it would be impossible to carry the illiterate white voters for the measure. The amendment, which eliminated about half of the negro vote, was submitted to the people 2nd August 1900, and carried by a majority of 60,000, after a hotly conducted campaign in which there was not wanting a certain amount of force to terrorize the negro voters.

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North Dakota, one of the nortli—western group of states of tlie American Union, lies between 96Â° 26′ and 104Â° W. and 45Â° 55′ and 49Â° N. It has an extreme length east and west of 360 miles, an extreme width north and south of 210 miles, and an area of 70,795 square miles. Its vast expanse of level or rolling prairies is well supplied with surface water by several river systems and numerous small lakes. The most im- portant rivers are the Eed Eiver of the North along the eastern border of the state, the Missouri in the western portion, and the Sheyenne and James in the central portion. The surface features of the state may in a general way be classified as follows : plains of the Eed river valley, highlands of the Pembina and Turtle moun- tains, the rolling prairies of the central region, and the western Coteau of the Missouri. The uniformly level character of its surfa(3e, the absence of uplifts, and the lack of deep erosion over the greater part of the state have given it no very marked geological features. The formations occurring include rocks of the Archaean, Cam- brian, Silurian, Cretaceous, and Tertiary ages, as well as Glacial drift and alluvial deposits. ‘The Dakota sand- stone of the Cretaceous group is especially important as being the water-bearing stratum of the Great Artesian belt, occupying a large part of the state. Many of the clay deposits of the Cretaceous and Tertiary formations, particularly those near Dickinson, Stark county, are re- markably pure, and are utilized in the manufacture of excellent fire and pressed brick. To the same formations belong the immense beds of lignite coal extending west of the Missouri river, from north of the Great Northern railway into South Dakota. In portions of the Eed river valley the drift and alluvial deposits attain a

depth of 300 feet, giving a remarkably strong subsoil and a deep and rich upper soil of black vegetable mould. These deposits thin out westwards, with the gradually increasing altitude, till the high rolling prairies of the central portion of the state are reached.

Flora and i^bwna. â€”Except along river banks, a few isolated lakes,. and over a small area in the Pembina and Turtle mountain regions, the moisture has been msufii- cient for the growth of forest trees. There are nine or ten principal varieties of trees and about twenty different varieties of shrubs in the state, and over one hundred varieties of prairie grasses and forage plants. With the advent of the herdsman and farmer, the bison, which formerly roamed these prairies in vast numbers, have vanished, and the scattered elk, antelope, mountain sheep, and deer are rapidly disappearing. The brown and, very rarely, the grizzly bears, the prairie and timber wolves, the mountain lion, lynx, prairie dog, and rattlesnake are still found in the ” bad lands ” in the south-western part. Among the few remaining fur-bearing animals are the otter, mink, beaver, badger, and raccoon. The gopher or spermophile, by its ubiquity, has given to the state the sobriquet Â« Flickertail.” Grouse, prairie chicken, geese, ducks, and swans furnish excellent hunting in their season.

Climate.â€” ‘Pne. climate is remarkably dry, cool, and invigorating. The temperature occasionally rises to 95Â° F. in summer, and occasionally falls to â€”40Â° in winter, but neither the exceptional heat of summer nor the ex- ceptional cold of wdnter entails the discomfort attending a similar range of temperature in more humid climates. The summer nights are always cool. The mean tempera- ture at. many signal stations in the state for July and January, the hottest and coldest months, during the years 1892-98 inclusive, was 68-9Â° and 3-7Â° P. respec- tively. The mean temperature for the year was 39Â°. The average precipitation is 17-23 inches a year, ranging from more than 20 inches in the extreme eastern part to less than 10 inches in the extreme western. Fully three- fourths of the precipitation occurs during the growing season (April to August inclusive), and is sufiicient for successful dry farming as far west as the 100th meridian. Beyond that meridian, save in localities of exceptional rainfall, the country is better adapted to stock- raising than to agriculture.

Agriculture. â€” Agriculture la the leading industry in the eastern half of the state, as stock-raising is in the western half. In 1900 there were in the state 45,332 farms, containing altogether 15,542,640 acres, of which about 62 per cent, was improved land. The total value of farm property was 8255,266,751, comprising land, improvements, and buildings,

$198,780,700; implements and machinery, $14,055,560 ; and live stock, $42,430,491. The total value of farm products in the preceding year was $04,252,494. The

Quantity or Xumber.

Valne.

Indian corn .

1.284,870 bushels

â– S:i97,278

Wheat . ...

59,888,817 ,,

31,733,76:!

Oats

22,126,331 â€ž

5,852,615

Barley

6,762,060

1,996,082

Rye

368,240 â€ž

138,771

Flax-seed

7,766,610

7,735,640

Hay and forage .

1,748,213 tons

5,182,917

Potatoes ....

2,257,350 bushels

587,498

Dairy cows ....

125,503

4,078,546

Other neat cattle .

531,931

11,732,091

Horses

359,948

22,728,611

Mules and asses .

6,976

489,597

Sheep (not including lambs)

451,437

1,606,730

Swhie . ...

191,798

930,470

Wool

3,030,478 ft

503,744

Milk, butter, and cheese

2,853,133

Animals sold

3,902,074

Animals slaughtered on

farms ....

1,573,688

leading crops are wheat, oats, barley, flax, rye, corn, and potatoes. The most important crop is wheat. Spring wheat is grown ex- clusively, mostly of the Scottish Fife variety, and ranking as No. 1 Hard, the best grain known to the

market. Apples, pears, and peaches are not grown to any extent, but all the small fruits, wild and domestic grasses, and all root crops are grown in great pro- fusion and of excellent quality. The foregoing table shows the yield and estimated value of the leading crops for the year 1899, together with the number and estimated value of live stock and dairy products.

Manufactures and Mines. â€” The following table is a comparative summaiy of the manufacturing and mechanical industries as re- turned at the censuses of 1890 and 1900, with the percentage of increase : â€”

1S90.

1900.

Percentage of Increase.

Number of establishments

382

1,130

195-8

Capital ....

82,894,553

15,396,490

86-4

Wage-earners, average

number

1,499

2,398

60-0

Wages ....

$759,132

$1,222,472

610

Cost of material used

83,087,161

$5,615,793

81-9

Value of products .

$5,028,107

$9,183,114

82-6

The principal products are those of flour and grist mills. While manufacturing is increasing, agriculture and stock-raising are still the principal industries. The western half of North Dakota is largely underlaid with lignite coal, of a superior quality. The mining of this coal, from comparatively recent beginnings, is rapidly becoming an important industry. It is expected that it will soon become the chief source of fuel supply.

Charitable and Penal Institutions. â€” The state maintains the following charitable and penal institutions : â€” The state asylum for the insane, and the school for the feeble-minded at Jamestown (inmates, 24th April 1902, 413 ; 231 males, 182 females) ; the school for the deaf at Devils Lake (attendance, 1st January 1902, 67 â€” males 31, females 26 pupils) ;

soldiers’ home at Lisbon (number of inmates, 1902, 36) ; the state penitentiary at Bismarck (inmates, 1st January 1902, 122 males, 1 female) .

Beligion. â€” The chief religious denominations are the Baptists, Roman Catholics, Congregationalists, Lutherans, Methodists, Presbyte’rians, and Episcopajians. These denominations all have substantial church homes and a large membership in all the important towns. The following statistics are for the year 1901 : â€”

Denommation.

Orjjaniza- tions.

Edifices.

Tnlue of

Church

Pi’operty.

Member- ship.

Baptists.

Roman Catholics .

Congregationalists

Episcopalians

Lutherans ^ .

Methodists .

Presbyterians

67 121 104

35 237 215 115

48 121 62 41 244 180 100

5122,800 171,5501 150,000 101,647 136,2751 335,000 175,000

3,493 26,4271 3,450 1,932 43,603 5,655 4,179

In the Roman Catholic and Lutheran churches all persons who have been baptized are counted as members.

~ Education. â€” There were, on 30th June 1900, 77,680 pupils enrolled in the public schools of the state, with 4083 teachers, and school property, not including lands, valued at $2,587,865. The census of 1890 showed the percentage of illiteracy to be 4-9 for males ten years of age and over, and 7-4 for females. The census of 1900 showed the percentage of illiteracy of males over twenty one years of age to be 3-8 for the native-bom and 6-6 for the foreign-born. The state maintains a state university and school of mines at Grand Forks ; an agricultural college and school of mechanic arts at Fargo ; three normal schools, at Mayville, University, and Valley City respectively ; an industrial school at Ellendale ; and a school for the deaf at Devils Lake. There are about 110 teachers employed in these schools, with more than 2000 pupils in attendance. All grades of public in- struction are closely articulated under the supervision of a Board of Commissioners, consisting of the governor, superintendent of public instruction, and the president of the state university. One-eighteenth of all lands (aggregating 2,531,200 acres) was early set aside for the use of the common schools, while grants ranging from 20,000 to 130,000 acres each were made to the state educational institutions. None of these lands may be sold for less than $10 an acre, the proceeds to constitute a perpetual fund, whose integrity is guaranteed by the state for the use of these schools.

1 Census of 1890.

2 Norwegian and Swedish Lutherans. lu addition to the.se there are about 13,000 Danish, English, German, and Icelandic Lutherans.

Transportation.â€” There were, in 1899, 2866 miles of railway in the state, including sidings. The Great Northern, Northern Pacific and St Paul, Minneapolis, and Sault Ste Marie are the leading railways, the two former crossing the state from east to west near the lines of the 47th and 48th parallels respectively on their way to the Pacific coast, and the latter crossing the state diagonally from the south-east to north-west and connecting with a branch of the Canadian Pacific at the international boundary line. The Chicago, Milwaukee, and St Paul and the Chicago and North-Western railways both have short branch lines in the southern part of the state. The Bismarck, Washburn, and Great Falls railway has been constructed for a distance of about 40 miles north from Bismarck.

The Red River of the North is navigable as far south as Fargo, although boats do not ordinarily go south of Grand Forks. The Missouri river is navigable throughout its entire course in the state.

Finances.â€” ThQ assessed valuation in 1901 was 8124,115,341 (real estate, $77,858,024; personal property, $27,739,423; railways, $17,983,367 ; express companies, $139,220 ; telephone companies, $108,017 ; telegraph companies, $287,290), representing an actual value of approximately $400,000,000. The bonded indebtedness, 1st January 1900, was $845,300. The constitution hmits the bonded indebtedness of the state to $200,000 additional to Xorth Dakota's share of the bonded indebtedness of Dakota territory. The tax rate for state purposes is limited by the constitution to four mills on the dollar of the assessed valuation of the state. This rate, on the basis of the assessment of March 1902, yields an income of about half a million dollars a year.

Banks. â€" There were, 1st January 1900, 23 national banks, with a paid-up capital of $1,450,000 and a surplus of 8194,900, and deposits (7th September 1899) of $5,000,186 ; 169 state banks (1902) with a paid-up capital of 81,641,000 and deposits of $9,391,594. Recent' legislation has forced all private banks to take out charters as state banks.

Population. â€" The population . in 1880 of that part of Dakota territory embraced in the present state of North Dakota was 36,909 (^ to the square mUe) ; the population in 1890 was 182,719 (2t% to the square mile) ; and in 1900 it was 319,140 {i-^ to the square mile), showing an increase for the

decade of 74-7 per cent. Of the population in 1890, 101,590 were males, 81,129 females ; 101,258 native-born, 81,461 foreign-born ; T’JSO Indians, 373 negroes. Of the population in 1900, 177,493 were males, 141,653 females ; 206,055 were native-born, 113,091 foreign- born; 311,712 were white, 286 negroes, 180 Chinese and Japanese, 6968 Indians. Fargo (population in 1900, 9589) and Grand Forks (population in 1900, 7652), the leading towns, are the centres of a large wholesale and retail trade. Bismarck, the capital (popula- tion in 1900, 3319), is situated near the centre of the state, at the junction of the Northern Pacific railway with the Missouri river.

History. â€” Dakota was a part of the Louisiana purchase of 1803. It was organized as an independent territory in 1861. The terri- tory was divided by Act of Congress, 22nd Febraary 1889, and North Dakota admitted as a state 2nd November of the same year. In politics the state has been uniformly Republican, except in 1892, when it was carried by the combined Democrats and Populists by a plurality on the Presidential ticket of 181. (w. He.)

North-Eastern Rhodesia. See Cextbal Africa, British.

Northeim, a tovsm of Prussia, province of Hanover, 12 miles by rail north of Gottingen. It has an interesting church (1519), containing old wood-carving and stained glass. The place is said to date from the 9th century, was a member of the Hanseatic League, and was stormed by the Imperialists in 1627. There are tobacco, sugar, and boot manufactures, besides flour-milling, tanning, and brewing. Population (1900), 7833.

North Plainfield, a borough of Somerset county, New Jersey, U.S.A., in the northern part of the state. It was organized from a part of Xorth Plainfield township. Population (1900), 5009, of whom 749 were foreign-born and 182 negroes.

North Sea. â€” The ISTorth Sea is bounded on the E. by the continent of Europe and on the “W. by Great Britain. At its southern end it communicates posuioa by the narrow Strait of Dover with the English and boua- Channel, and so with the Atlantic, and towards â€¢‘a^‘es. the north it

widens out gradually to 346 miles between St Abb’s Head and the coast of Denmark, and narrows

again to 270 miles between Duncansby Head and the coast of Norway. To the north of Scotland it communi- cates with the Atlantic westwards by the Pentland Tirth and the channel between the Orkney and Shetland Islands, and northwards with the Norwegian Sea.

Its total area is given by Murray as 162,600 square miles, and by Krilmmel as 547,623 square kilometres, or 159,131 square miles. Murray estimates the ^f/’”’ volume of the North Sea at 11,200 cubic miles, and Krilmmel at 48,718 cubic kilometres or 7634 cubic miles, giving mean depths of 61 and 48 fathoms respectively. The North Sea is thus on the whole shallow ; its bed is part of the continental shelf on which the British Isles stand, and it slopes upwards with fair regularity from north to south. In the south and east there is a broad coastal strip over which the depth nowhere exceeds 20 fathoms, and the whole south-eastern part of the area is less than 30 fathoms deep. In about its middle latitude the Dogger Bank crosses the North Sea from east to west, extending for about one-third of the whole distance ; near the English coast the depth here is under 10 fathoms, and it increases eastwards to about 20 fathoms. South of the Dogger there are local depres- sions, mostly of small area, in which the depth is as much as 45 fathoms, as in the ” Silver Pit.” Krilmmel points out that a line drawn from the northern edge of the Dogger to the middle of the Skagerrack constitutes a rough boundary of the shallow southern basin, the depth in- creasing very slowly beyond this line to the ” Norwegian Channel ” â€” a deep gully closely following the Scandinavian coast, and extending into the Skagerrack, in which the depth increases to as much as 400 fathoms.

According to Jukes-Browne, the North Sea, in its present form, first took shape as a result of the tectonic movements indicated by tlie break between the older and newer Pliocene deposits. History. j^ southern end of the North

Sea was probably little affected by the general subsidence which occurred during the Glacial period ; its boundary in this direction was apparently within the present land area of France and Belgium, while a narrow inlet may have run westwards between France and England in the present position of the Strait of Dover. Meanwhile immense quantities of ice detritus from Scotland and Scandinavia were deposited in the North Sea, to a thickness of perhaps 600 feet, and the whole region was subsequently raised above sea-level, constituting the “structural surface” upon which the present river system was developed as a series of tributaries to a great river which formed a continuation of the Rhine. Finally, the land subsided again, the plain of the North Sea was again submerged, and the western inlet of Pleistocene times became the Strait of Dover.

For reasons which will be sufficiently obvious from the historical sketch just given, the coasts of the southern part of the North Sea are of no great height. In England they consist of Coasts. jg^ cliffs with sandy beaches, while on the Continental side are immense flats and marshes, with parts below sea-level pro- tected by sand-dunes and artificial dykes. Suess has shown that no evidence is forthcoming of tectonic movement since the Bronze Age, and the rapid changes of coast-line now taking place in many parts are therefore wholly due to the action of the sea, which is probably specially effective on account of the relatively recent opening of the Strait of Dover. The erosion of the North Sea coasts has been made a subject of minute study (in England especially by the British Association), and recently Harmer has obtained interesting results by comparing the British and Con- tinental coasts as characteristic “weather” and “lee” shores.

The physical conditions of the waters of the North Sea have been extensively studied by expeditions sent out by the Swedish, Norwegian, Danish, German, and British Governments. Professor Pettersson of Stockholm, to whose initiative much of this work is due, classifies the waters found in the North Sea as follows; â€” (1) oceanic water of 35 pro mille salinity or more ; (2) water of salinity .34 to .‘55 pi’o mille, called “North Sea” water; (3) water of salinity 32 to ,34 pro mille, found along the coasts of Holland, Germany, Denmark, and Nor- way, and called “bank-water”; (4) water of 32 pro mille salinity or less, belonging to the stream flowing out from tlie Baltic. Of these (1) and (4) are to be regarded as “in-

flowing ” waters, while the others are due to mixture, which may or may not take place in the North Sea itself. The oceanic water consists of a mixture of waters of Atlantic and Polar origin ; it enters the North Sea from

tlon.

the north-west, and makes its way southwards along the coast of Scotland, especially during the summer months. Dr Fulton, scientific adviser of the Scottish Fishery Board, has, by using floats or ” drifters,” traced a movement of water southwards along the English coast as far as the “Wash, and thence in an east-north- east direction towards the coast of Denmark. The supply of water from the Baltic varies with the seasons (see Baltic Sea).

Apart from its effect on the quantity and composition of the in- flowing waters, the mixing and circulation in the North Sea are almost wholly under the control of the winds. Dickson has shown that (a) calm weather favours the spreading of a thin layer of “North Sea” water over a great part of the surface; (6) strong northerly winds tend to broaden the area covered by oceanic water, and to drive back the fresher out-flowing waters â€” an important effect of this is to send ” bank-water ” southwards along the west coast of Norway ; (c) westerly and south-westerly winds tend to form a continuous band of oceanic water along the central axis of the North Sea, and there is strong upwelling of water along the British coasts; and (d) easterly winds reduce the salinity as a whole by spreading the fresher waters over the surface. The distri- bution and circulation are therefore liable to great variations at different seasons and in different years.

The tides of the North Sea are of great complexity, and have not as yet been fully investigated. The tidal wave of the Atlantic enters by the Strait of Dover and by the channels in ^

the north. In the latter place a division into two parts takes place, one wave travelling southwards along the coast of Scotland in comparatively shallow water, while another moves with greater speed across the deeper water to the Norwegian Channel, and thence southwards to the Skagerrack and the Danish coast. The southwards-moving waves are greatly retarded in the shallow water over the Dogger Bank ; the trough of the ” Silver Pit,”

accordingly, gives the Scottish wave a strong easterly component, and the three systems â€” the Scottish, Norwegian, and Channel waves- â€” meet to the east of the Dogger, producing complicated interference pheno- mena. Along the English coasts the tidal streams are for the most part normal, the flood stream running south to south-east and the ebb north to north-west, but on the Continental coast the move- ments become very complex, on account of the varying influence of the waves from different sources.

The North Sea is particularly rich in organisms of all kinds, and the abundance of food attracts fish in such quantities that the North Sea fisheries are the most productive in the world. _

Flat fishes, and those feeding at the bottom on smooth auns.

ground, are chiefly caught by means of the trawl. The favourite trawling-grounds are the Dogger Bank in winter, and the shallow waters off the Continental coasts in summer ; these yield halibut, soles, turbot, brill, plaice, cod, haddock, whiting, &c. In rough ground where the trawl cannot be used, hook- and line-fishing are carried on most snocessfuUy, and ” mid-water ” fish are also taken in this way, although the trawl and line-fishing overlap consider- ably. Herring and mackerel are caught by means of drift-nets. The herring fishing off the British coasts exhibits a remarkable variation during summer and autumn, beginning in Shetland in June, and becoming progressively later southwards, until it ends off the Norfolk coast in November. Various attempts have been made to connect this succession with the physical changes already described, especially with the periodic influx of Atlantic water, but no very definite relation has as yet been established.

AnxHORiTiES. â€” KKtJMMEL and Boguslawski. Ozeanographie. â€” 0. Petteksson. Various papers in the Svenska Vetenskaps- Akademie Handling ar ; also in Scottish Geographical Magazine (1894) and the Geographical Journal. â€” H. N. Dickson. Journal of the Scottish Meteorological Society, third series, vol. viii. p. 332 ; Twelfth Report of the Fishery Board for Scotland, part iii. p. 336 ; Fifteenth Report of the Fishei-y Board for Scotland, part iii. p. 280 ; Geographical Journal, March 1896 ; and Quarterly Journal of the Royal Meteorological Society, No. 112, 1899. â€” T. Wemtss Fulton, Fifteenth Report of the Fishery Board for Scotland, part

iii. p. 334.â€” Papers by J. T. Cunninohaji, W. Garstang, and others in the Journal of the Marine Biological Association, various years. (jj. n. d.)

North Sea and Baltic Canal. See Canals.

North Tonawanda, a city of Niagara county, New York, U.S.A., on the Niagara river, at the mouth of Tonawanda creek, in the western part of the state. It is entered by three railways, and has had a rapid growth, aided by the development of power at Niagara Falls. Population (1890), 4793 ; (1900), 9069, of whom 2402 were foreign-born.

Northumberland, a northern maritime county of England, on the Scottish border, bounded on the E.

by the North Sea, on the S. by Durham, on the W. by Cumberland, and on the N.W. by Roxburgh and Berwick.

Area and Population. â€” The area of the ancient county is 1,289,756 acres, or 2015 square miles, with a population in 1881 of 433,711, in 1891 of 506,030, of whom 252,283 were males and 253,747 females, and in 1901 of 602,859, the number of persons per square mile being 299, and of acres to a person 2-14. The area of the administrative county (including the county borough of Newcastle-on-Tyne) and the area of the registration county are identical with that of the ancient county. Of the population in 1891, 360,000 were urban and 145,230 rural. The increase of population between 1881 and 1891 was 17-01 per cent., and be- tween 1891 and 1901, 19-1 per cent. Between 1881 and 1891 the excess of births over deaths was 66,340, but this was exceeded by the increase of the population, which was 72,319. The following table gives the number of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 :â€”

Tear.

Marriages.

Births.

Deaths.

Illegitimate Births.

Males.

Females.

1880

1890 1898

3428 4314 5028

15,204 16,553 18,326

9,032 10,239 11,169

469 379 358

447 384 358

The number of marriages in 1899 was 5112, of births 19,123, and of deaths 11,474.

The following table gives the marriage-, birth-, and death-rates, with the percentage of illegitimate births, for a series of years : â€”

18T0-79.

1880.

1880-S9.

1890.

1888-97.

1898.

Marriage-rate

18-7

15-9

15-9

17-2

16-1

17-8

Birth-rate .

38-3

35-2

34-3

33-0

32-7

82 -5

Death-rate .

22-9

20-9

19-9

20-5

19.1

19-8

Percentage of ille-

gitimacy .

5-9

6‘0

5-3

4-6

4-5

3-9

Both the birth-rate and the death-rate are above the average. In 1891 there were in the county 26,155 natives of Scotland, 10,414 natives of Ireland, and 3686 foreigners.

Constitution and Government. â€” The county is divided into four parliamentary divisions, and it also includes the parliamentary boroughs of Newcastle-on-Tyne, returning two members, and of Morpeth and Tynemouth, returning one member each. It con- tains four municipal boroughs: Berwick-on-Tweed (13,437), Morpeth (6158), Newcastle-on-Tyne (214,803), and Tynemouth (51,514). Newcastle-on-Tyne is a county borough. The follow- ing are urban districts : Alnwick (6716), Amble (4426), Ashington (13,956), Bedlingtonshire (18,768), Benwell and Fenham (18,347), Brackley (2467), Cowpen (17,803), Cramlington (6437), Earsdon (9190), Gosforth (10,605), Hexham (7071), Newbiggin-by-the-Sea (2022), Newbui-n (12,503), Kothbury (1303), Seghill (2213), South Blyth (5472), Walker (13,336), Wallsend (20,932), Weetslade (5453), Whitley and Monkseaton (7705), and Wellington Quay (8046). The comity is in the north-eastern circuit, and assizes are held at Newcastle-on-Tyne. The boroughs of Berwick-on- Tweed and Newcastle-on-Tyne have separate

courts of quarter sessions and separate commissions of the peace, and the borough of Tynemouth has only a separate commission of the peace. The ancient county â€” which is in the diocese of Newcastle-on-Tyne â€” contains 159 entire ecclesiastical parishes or districts.

Education. â€” In Newcastle-on-Tyne are the Durham College of Medicine and the Durham College of Science. In connexion with the College of Science there is a day training college for school- masters and schoolmistresses. In Newcastle-on-Tyne is also the Northern Counties Institution for the Deaf, and at Benwell the Eoyal Victorial School for the Blind. The total number of ele- mentary schools on 31st August 1899 was 349, of which 79 were board and 270 voluntary schools, the latter including 179 National Church of England schools, 1 Wesleyan, 28 Eoman Catholic, and 62 ” British and other.” The average attendance at board schools was 37,117, and at voluntary schools 46,468. The total school board receipts for the year ended 29th September 1899 were Â£152,399. The income under the Technical Instruction Act was Â£616, and that under the Agricultural Rates Act was over Â£1214.

Agriculture. â€” Only about five-ninths of the total area is under cultivation, and of this nearly five-sevenths is in permanent pasture. There are also about 470,000 acres under hill pasture, and about 50,000 acres under woods. Northumberland is one of the largest sheep-rearing counties in Great Britain, being much on a par with Argyll, and exceeded only by Lincoln and York- shire. Cattle are also very largely raised, chiefly for fattening purposes. The bulk of the acreage under com crops, which has greatly diminished, is under oats and barley, and turnips occupy

as much as five-sixths of the area under green crops, potatoes occupying only about a tenth. The following table gives the prin- cipal divisions of the cultivated area at intervals from 1880 : â€”

Tear.

Total Area under Cul- tivation.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

FaUow.

1880 1885 1890 1895 1900

704,778 714,432 717,698 707,407 707,486

130,743

118,565

106,610

92,860

88,527

56,096 53,383 50,916 47,617 45,889 .

85,662 90,731 92,743 84,792 76,657

417,184 440,269 458,803 476,182 492,160

15,080

11,476

8,221

5,436

3,681

The following table gives the numbers of the principal live stock for the same years : â€”

Tear.

Total Horses.

Total Cattle.

Cows or Heifers

in Milk or in

Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1900

18,052 17,889 17,505 18,723 17,449

92,927 107,300 104,953 108,022 113,724

19,964 25,197 25,067 25,010 26,618

930,393

935,874

1,002,928

1,000,038

1,065,206

10,428 13,244 14,277 13,377 10,250

Industries and Trade. â€” According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in 1897 in factories and workshops was 56,394, as com- pared with 56,208 in 1896.

The number employed in non-textile factories was 48,763, there being an increase between 1895 and 1896 of 17-3 per cent., and between 1896 and 1897 of 0-6 per cent. As many as 30,467 were employed in the manufacture of machines, appliances, conveyances, and tools, chiefly in the shipbuilding yards and iron works on the north bank of the Tyne, from Newcastle to the sea, 4742 in the founding and conversion of metal, 1744 in clay and stone industries, 2115 in the manufacture of paper, &c., and 1634 in the manufacture of chemicals, most of the other classified industries being also represented. Of the 7334 persons employed in workshops 3809 were employed in clothing industries. The total number of persons employed in connexion with mines and quarries in 1899 was 39,388. In the same year 302,546 tons of clay were raised, 108,682 tons of igneous rocks, 132,462 tons of sandstone, and 103,528 tons of limestone. No iron ore is dug, but some pig-iron is made at Elswick. Lead has almost ceased to be raised. The following table gives particulars regarding the more valuable minerals in 1890 and 1899 : â€”

Tear.

Barytes.

Fireclay.

Coal.

Tons.

Value.

Tons.

Value.

Tons.

Value.

1890 1899

6486 7309

Â£12,972 Â£14,618

183,759 185,266

Â£26,267 Â£27,790

6,761,308 11,184,072

Â£2,503,610 Â£3,946,679

In 1899 there was landed 343,136 cwt. of fish (more than two- thirds at Noj-th Shields), valued at Â£283,800.

Authorities. â€” Among later works are Wildkidge. Nbrth- umbria, Antiquities of Northumberland. London, 1888. â€” Bates. History of Northumberland (Popular County Series). London, 1895 ; Pedigrees recorded at the Heralds Visitation of Northumber- land, 1615-1666. Newcastle-on-Tyne, 1891. â€” Heslop. North- umberland Words (English Dialect Society). London, 1892 ; and Biographical List of Words Illustrative of the Dialect of North- umberland (English Dialect Society). London, 1897. â€” An elaborate Mistory of Northumberland, issued under the direction of the Northumberland County History Committee, was begun in 1893. (t. f. h.)

Northumberland Strait, the strait separating Prince Edward Island from Nova Scotia and New Bruns- wick.

North-Western Rhodesia. â€” See Central Afeica, British.

North-West Frontier Province, The, a

new province of British India, constituted on 9th November 1901, and placed under a Chief Commissioner and Agent to the Governor-General. It was formed by separating from the Punjab two entire districts (Peshawar and Kohat) and portioils of three more (Bannu, Dera Ismail Khan, and Hazara) lying mainly beyond the Indus, together with the political charge of

a large area occupied by frontier tribes extending from Baluchistan to Chitral.

The capital is at Peshawar. The total area of the districts under British administration is 13,197 square miles, with a population (1901) of 2,044,000. The cultivated area is 2,559,000 acres, of which 717,000 are irrigated from canals. The land revenue is Rs.21, 56,000, and the total expenditure is estimated at Es.67,83,824.

North-Western Provinces and Oudh,

formerly the name of a province of British India, under the administration of a lieutenant-governor. It comprises two native states â€” Garhwal amid the Himalaya, and

Eampur in the centre of Kohilkhand. Total area, 112,612 square miles; population (1891), 47,697,576; (1901), 48,545,999. The capital is. Allahabad. The title of the province had long been a misnomer. After the creation of the North-West Frontier province in 1901, it was re- solved to change the name to The United Provinces of Agra and Oudh.

The following table gives the area and population of the several divisions and districts of the North-Western Provinces and Oudh, together with the two native states, in 1891 and 1901 :â€”

Area and Population of

the NorthrWestern Provinces and Oudh (1891 and 1901).

Divisions.

Districts.

Area in Square Miles.

Number of

Towns and

Villages.

Population,

1801.

Population, 1901.

Density of

Population

to Square

Mile.

Males.

Females.

Total.

British Tekritoky.

N. W. Frovinces. Meerut ,

Agra

Gorakhpur Kumaun Kohilkhand .

Allahabad

Benares .

Carried forwa

Dehra Dun

Saharanpur

Muzaffarnagar .

Meerut

Bulandshahr

Aligarh

Muttra

Agra ....

Farukhabad

Mainpuri .

Etawah

Etah ....

Azamgarli . Gorakhpur Basti .

Kuraaun ^(Naini Tal)

Garhwal

Tarai^ (Almora)

Bijnor Moradabad Budauu Bareilly . Shahjahanpur . PilibMt .

Cawnpore . Fatehpur . Banda Hamirpur . Allahabad . Jhansi Jalaun Lalitpur .

Mirzapur . Benares Ghazipur . Ballia Jaunpur

ird ....

1,193 2,242

1,658 2,370 1,911 1,952

440 1,633

900 1,641 1,610 1,731

168,135 1,001,280

772,874 1,391,458

949,914 1,043,172

102,728 561,723 469,828 820,769 599,174 640,858

74,918 484,689 408,156 719,148 539,122 562,189

177,646 1,046,412

877,984 1, .539, 917 1,108,296 1,203,047

141 447 466 587, 497 534

11,326

7,756

5,326,833

3,195,080

2,788,222

6,983,302

470

1,441 1,846 1,720 1,701 1,691 1,741

860 1,204 1,709 1,417 1,492 1,482

713,421 1,003,796 858,687 762,163 727,629 702,063

408,846 570,373 500,003 451,263 437,844 466,310

354,375 490,173 424,657 378,087 368,781 397,409

763,221 1,060,646 924,660 829,350 806,625 863,719

494 544 499 448 430 403

10,139

8,154

4,767,759

2,834,639

2,413,482

5,248,121

470

2,148 4,576 2,767

4,686 7,674 6,863

1,728,625 2,994,057 1,785,844

756,866

1,466,580

935,297

773,689

1,408,963

910,461

1,530,655 2,956,543 1,846,758

805 664 645

9,491

19,123

6,508,626

3,168,743

3,173,113

6,331,856

685

7,151

6,629

963

5,966

3,GG0

583

663,181 407,818 210,568

170,150 211,621 236,823

136,212 218,271 229,053

306,362 429,892 465,876

79

72

219

13,743

10,201

1,181,567

618,594

683,636

1,202,130

85

1,898 2,282 2,017 1,695 1,744 1,372

2,139 2,458 1,856 1,934 2,0:7 1,061

794,070 1,179,398

926,698 1,040,691

918,551

485,366

406,277 631,162 552,487 584,969 494,896 249,692

373,084 561,186 472,401 504,591 426,728 220,997

779,361

1,192,348

1,024,888

1,089,550

921,624

470,689

417 517 418 6:.2 626 354

10,908

11,476

6,343,674

2,919,473

2,558,987

5,478,460

489

2,363 1,633 3,060 2,289 2,852 1,640 1,480 1,948

1,976

1,428

1,200

764

3,516

667

861

680

1,209,695 699,157 705,832 513,720

1,548,737 409,419 396,361 274,200

674,348 349,403 317,917 230,319 744,393 313,686 206,701 ... 2

684,895 337,008 313,420 228,326 743,511 298,058 193,918

... ‘^

1,259,243 686,411 631,337 458,645

1,487,904 611,644 400,619

2

512 428 231 224 543 249 268 141

17,265

11,092

5,767,121

2,836,667

2,699,136

5,535,803

333

5,223 1,099 1,462 1,170 1,550

4,307 1,992 2,614 1,719 3,191

1,161,508 921,943

1,077,909 942,465

1,264,949

529,870 444,784 444,263 456,817 590,551

562,836 438,188 469,885 494,149 612,159

1,082,706 882,972 914,148 949,966

1,202,710

222 912 737 805 810

10,504

13,826

5,368,774

2,465,285

2,567,217

6,032,502

515

83,376

81,626

34,254,254

18,028,481

16,783,693

34,812,174

^ Between the census of 1891 and the census of 1901 the districts of Kuraaun and Tarai were redistributed two new districts

Almora and Naini Tal, being organized out of them. ‘

2 The population of the former district of Lalitpur is enumerated under Jhansi in the 1901 census.

NORTH-WEST

Area and Population of the

ERN PROVINCES AND OUDH 261

Iforth- Western Provinces and Oudh (1891 and 1901) â€” continued.

Divisions.

Districts.

Area in Square Miles.

Number of

Towns and

Villages.

Population,

1891.

Population, 1901

Density of

Population

to SquaTO

Mile.

Males.

Females.

Total.

Ovdh. Lucknow

Fyzabad .

Total Britis

Brought forward

Lucknow . Unao . Sitapur Rae Bareli . Hardoi Kheri

Fyzabad . Bahraich . Gonda Sultanpur . Partabgarh Bara Banki

h Territory .

83,376

967 1,778 2,255 1,751 2,324 2,965

81,626

914 1,667 2,328 1,732 1,885 1,711

34,254,254

774,163

953,636

1,075,413

1,036,521

1,113,211

903,615

18,028,481

414,852 498,386 619,975 509,835 582,684 478,411

16,783,693

378,482 477,469 555,604 524,113 510,517 426,788

34,812,174

793,334

975,855

1,175,579

1,033,948

1,093,201

905,199

417

800 536 477 592 479 305

12,040

10,237

5,856,559

3,104,143

2,872,973

5,977,116

486

1,728 2,680 2,880 1,710 1,439 1,740

2,684 1,886 2,831 2,471 2,188 2,067

1,216,959 1,000,432 1,459,229 1,075,851 910,895 1,130,906

657,776 544,502 713,699 534,449 484,462 603,449

640,310 507,354 688,651 549,666 456,633 576,083

1,298,086 1,051,856 1,402,350 1,084,115 941,095 1,179,532

704 373 507 629 633 649

12,177

14,127

6,794,272

3,538,337

3,418,697

6,957,034

557

107,593

105,990

46,905,085

24,670,961

23,075,363

47,746,321

436

Nativ]

Eampur . Garhwal .

Total Nativ Grand total

: States. e States

945

4,164

1,516 802

551,249 241,242

279,729 132,168

252,338 135,440

532,067 267,608

583

58

5,109

2,318

792,491

411,897

387,778

799,675

155

112,702

108,308

47,6 97,576

25,082,858

23,463,141

48,545,999

423

Since 1891 the population has increased by little more than 1 “6 per cent., which is much below the rate of increase for India generally. In the central Doab there is an actual decrease, while the highest rates of increase are to be found in the Himalayan districts and in the submontane tracts, where waste land is still available for tillage. Elsewhere, it may almost be said that population has reached the stationary stage. It is noteworthy that the urban population, which forms 12 per cent, of the total, has increased at a slower rate than the population gener- ally. The density of population is greatest in the east, â– where the conditions approximate to those of Behar. The purely agricultural districts of Azamgarh and BalUa each support more than 800 persons per square mile. For Oudh alone the average density is 557 persons

per square mile. In Bundelkhand (Allahabad) it falls to less than half, and in tie Himalayan districts to only 85 persons per square mile.

Classiiied according to religion, and excluding native states, Hindus in 1891 numbered 40,413,250, or 86 per cent, of the total population. They were slightly more numerous, in proportion to Mahommedans, in Oudh than in the North-West proper ; and it is noteworthy that they have increased somewhat faster than the Mahommedans, which is contrary to the experience of India generally. Mahommedans numbered 6,346,710, or 13 per cent., being proportionately most numerous in Rohilkhand,

where they formed 23 per cent, of the popidation. Chris- tians numbered 58,441, or “1 per cent., of whom 27,995 were Europeans and 7040 Eurasians, leaving 23,406 for native converts, who were proportionately most numerous in the Himalayan districts and in Rohilkhand. Jains (including Buddhists) numbered 85,988, or “2 per cent, being most numerous in Meerut, Agra, and Jhansi. ” Others,” chiefly Siihs, Parsis, and Jews, numbered 696. The census for the North-Western Provinces ignores aboriginal tribes.

In the North-West proper, out of a total area of 52,597,361 acres, 6,159,711 acres were included under the Bengal permanent settle- ment, the incidence of assessment being nearly 15 sinnas per acre. On the temporarily settled tract, where the assessment is liable to revision every thirty years, the incidence is E.1 : 2 : 6 per acre. Similarly, in Oudh, out of a total area of 15,537,846 acres, the amount in five districts that has been granted in permanent settle- ment is 1,112,921 acres, on an average assessment of nearly 15 annas per acre ; while the incidence on the temporarily settled portion is R. 1 : 1 : 9 per acre. In 1896-97, in the North-“\Vest proper, the total cultivated area was 22,742,416 acres, of which 4,272,569 were cropped more than once. The irrigated area was 7,432,218 acres, of which 2,083,118 acres were watered from Government canals, and the rest from wells, &c. The principal crops are rice, wheat, barley, millet, pulse, maize, cotton, and sugar-cane. Indigo was grown on 413,724 acres, chiefly in the Doab ; opium on 199,1G3 acres, chiefly in the permanently settled tract ; tea on 7919 acres, in Dehra Dun and Kumaun. The Government canals are classified under the headings of (1) protective, (2) major works, and (3)

minor works. The following table gives the financial results of the first two of these classes for 1897-98 : â€”

Capital Outlay.

Total Receipts.

Working Expenses.

Interest.

Net Result.

Profit per cent.

Protective â€”

Betwa Canal .....

Major Works â€”

Ganges Canal

Lower Ganges Canal

Agra Canal

Eastern Jumna Canal Fatehpur Ganges Canal .

Total .

Rs.

43,02,017

Rs.

1,37,700

Rs.

1,14,824

Rs.

1,62,954

Bs.

-1,40, 078′

-S-S6

2,99,43,303

3,49,19,049

95,31,879

38,54,711

24,00,670

43,51,132

31,18,612

9,74,061

16,65,275

11,51,384

9,35,709 â–

2,42,961 3,52,985

11,25,955

12,98,424

3,54,115

1,44,349

70,482

20,73,793 8,84,479 3,76,985

11,67,941 -70,483

6-92

2-53

3-95

30-29

-2-9S

8,06,49,612

1,01,09,080

26,83,039

29,93,325

44,32,716

5-50

In the case of the minor works, on which interest is not charged, the net receipts amounted to Rs. 1,66, 990, heing 5 ‘68 per cent, on a capital outlay of Rs.29, 90,331.

There are no great industries in the Korth-Western Provinces corresponding to the cotton of Bombay or the jute of Bengal. The chief manufacturing centre is Cawnpore, witli 4 cotton mills, 1 woollen mill, 1 jute mill, and several large tanneries and leather factories. There are in all 6 cotton mills, with 1638 looms and 257,622 spindles, employing 7496 hands, of whom nearly all are male adults. The out-turn in 1897-98 was 26,746,853 E> of yarn, mostly between counts Nos. 10 and 20 ; and 3,042,991 lb of cloth, mostly grey goods. There are breweries at the hill stations, and also at Lucknow ; and a large factory for refining sugar and dis- tilling rum near Shahjahanpur. No coal-mines exist, nor any important iron-works. The province is well supplied with rail- ways. The main line of the East Indian runs throughout south of the Ganges, which is bridged at Benares and Cawnpore. North of the river, the Oudh and Rohilkhand system connects with Bengal on the one hand and with the Punjab on the other. From Allahabad, Cawnpore, and Agra trade finds an outlet to the sea at Bombay as well as at Calcutta. In 1897-98 the total rail-borne traffic with other provinces amounted to 57,557,329 maunds (say, two million tons), valued at Es.37,12,12,027. The principal imports are cotton goods, grain, salt, coal, metals, and railway materials. The principal export^ .are wheat, oil-seeds, hides, sugar, raw cotton, indigo, opium, and lac. In 1900-01 the total trade with other provinces by rail amounted to 75,765,863 maunds (2,783,000 tons)' valued at Ks.43,73,99,947, and by river to 24,665,124 maunds (906,000 tons), valued at Rs. 2, 35, 38, 535. The frontier trade is registered with Nepal and with Tibet. In 1897- 1898 the imports from Nepal were valued at Rs.59,54,383, of which nearly half was rice, other important articles being oil-seeds, ghi, timber, and drugs. The exports to Nepal were valued at Rs.33,32,331, of which more than two-thirds were cotton goods, other important articles being salt, sugar, and spices. The im- ports from Tibet were valued at Rs.6, 34,949, chiefly wool, borax, and salt. The exports into Tibet were valued at Rs. 7,84, 830, mostly food-grains, with some sugar and cotton goods.

The administration of the North-Western Provinces is conducted by a lieutenant-governor, who is also chief commissioner of Oudh, with a chief secretary, 2 secretaries, and 3 under -secretaries. As in Bengal, there is no executive council ; but there is a board of revenue, consisting of 2 members. For legislative purposes the lieutenant-governor has a council, first

constituted in 1886 and augmented in 1893. It consists of 15 members, of whom not more than 7 may be officials. Of the remaining members, 6 are nominated on the recommendation of groups of municipalities and district boards, selected public associations, and the senate of Allahabad University. The whole of Oudh, and also the Kumaun division, rank as “non-regulation.” Including Oudh, the number of divisions or commissionerships is 9, with 48 districts or indepen- dent charges under a collector or deputy commissioner. The total number of civil and revenue judges is 727, and of magistrates of all kinds 992. In 1898 the total strength of the police force was 24,888 officers and men, being 1 policeman to every 3673 of the population. In addition, the railway police numbered 783.

Since the reorganization of the Indian army in 1895, the North- Western Provinces and Oudh form part of the Bengal command, containing two first-class and the larger part of three second-class districts. The chief military stations are Meerut, Lucknow, Allahabad, and Bareilly. The volunteer force consists of 5 administrative battalions, with an enrolled strength in 1898 of 4301 men, of whom 372 were mounted.

The number of municipalities is 104, with an aggregate popula- tion of 3,267,308 ; of these, 7 have more than 100,000 inhabitants, and 10 between 50,000- and 100,000. In all but 6 of them the majority of the boards are elected by the ratepayers, who form about 2 per cent, of the municipal population. In the six largest towns the district magistrate is ex-officio chairman of the board, and elsewhere he is almost always elected to that office. Out of a total of 1608 municipal commissioners, 1229 are elected and 338 nominated ; 315 are officials and 1293 non – officials ; 1403 are Indians and 205 Europeans. In 1897-98 the aggregate municipal income was Rs. 44, 83,166, of which R3.32,25,223 was derived from taxation, mainly from octroi. The average incidence of taxation was just under R. 1 per head, but at both Naini Tal and Mussoorie it was more than Rs.5. The aggregate expenditure was Rs.44,86,884, of which R3.9,80,127 was devoted to conservancy, Rs.6,43,578 to public safety, Rs.6,28,226 to water supply, Rs.3,92,785 to public works, Rs. 1,81,087 ‘to drainage, Rs.1,74,890 to hospitals, and Rs. 1,45, 436 to education. The aggregate debt outstanding was Rs. 85, 43, 343. The average death-rate was 45 ‘55 per thousand, compared with 37 ‘69 in the preceding year.

The number of district boards is 44, composed of 1245 elected, 393 nominated, and 100 ex â– officio members, of whom 63 are Europeans. In every case the magistrate of the district is chair- man. In addition, there are 4 district committees, composed

entirely of ex-officio and nominated members. These bodies, which were first constituted in 1883, possess no power of taxation, but administer certain funds made over to them by the Government. In 1897-98 their aggregate income was Rs.39,61,080, of which Rs.28,03,415 was derived from rates. Their aggregate expendituro was Rs.39,67,371, of which Rs.20,16,123 was devoted to public works, Rs.13,16,951 to education, and Rs.5,53,119 to dispensaries, vaccination, &c.

The following was the net revenue and expenditure of the North- Western Provinces and Oudh for 1897-98 (in tens of rupees), distributed under the three heads of imperial, provincial, and local: â€” Net revenue â€” Imperial, 5,068,159; provincial, 2,291,411; local, 824,411 ; total, 8,183,981. Net expenditureâ€” Imperial, 586,682 ; provincial, 2,078,539 ; local, 1,037,283; total, 3,702,504.

The following table gives the gross revenue under five principal heads (in tens of rupees) for the two years 1887-88 and 1897-98 :â€”

1887-88.

Ex.

1897-98.

B.X.

Land . Stamps Excise Forests Assessed taxes .

. 5,699,841 658,887 557,241 124,745 218,828

5,602,180 732,196 451,496 138,667 250,129

The following table gives the chief statistics of education in the North-Western Provinces and Oudh for the years 1886-87 and 1896-97 :â€”

1886-87.

1890-97.

Schools.

Pupils.

1,311

66,579

181,473

3,163 77,055

Schools.

Pupils.

Colleges

Secondary schools Primary schools . Special schools . Private institutions .

Total

18

620

5,322

61 6,866

29

500

6,292

55 6,630

2,435

59,172

216,273

3,581 71,511

12,887

329,581

12,506 ; 352,972

However these figures be looked at, they show little progress. If we compare the number of pupils with the estimated population of school-going age (15 per cent, of the total population), the proportion has remained stationary at 5 per cent. Taking girls alone, the number at school has risen in ten years from 13,242 to 15,461, and the proportion to the female population of school- going age from ‘4 to “5 per cent. In every respect the standard of education in the North-West falls far below that of India generally. But it should be said that a considerable improvement has recently been effected. The following table gives the expenditure on education for the same years, according to sources : â€”

1886-87. 1896-97.

Es. Es.

Provincial revenues . 5,36,902 6,20,410

Local funds . . 13,57,832 13,83,614

Municipal funds . . 75,567 1,06,091

Fees 3,30,010 7,66,235

Other sources . . 5,67,994 7,63,556

Total

28,68,305

36,39,906

The total expenditure on education steadily increased. But the most notable feature was the large increase under fees, which more than doubled during the period. Altogether, the proportion of the total borne by public funds fell in ten years from 69 to 58 per cent., though it was still higher than for India generally. In secondary schools alone public funds contributed only 43 per cent. CoUeciate education was stimulated by the foundation in 1887 of an indepen- dent university at Allahabad, whoso examinations give a larger place to science than in the Calcutta university. During the five years ending 1896-97 the total number of students who matricu- lated was 3621, while 740 graduated B.A. and 108 M.A., and 183 passed examinations in law. At present there is no faculty of medicine.

The North-Western Provinces suffered severely from the famine of 1896-97. Distress first made itself felt in Bundelkhand in March 1896, and relief operations had to be continued until October 1897. Altogether 19 districts were officially recognized as famine- stricken, while in 18 more districts the distress was held to reach the point of scarcity. For several months more than one million persons were in receipt of relief, the maximum being 1,696,722 at the end of February 1897. The total expenditure incurred by Government was Rs.2,17,00,000, the daily cost of each person relieved being just over one anna (= one penny). The Famine Commission reported that the result was a “conspicuous success and a great administrative feat. ” During the twelve months ending September 1897 the mortality in the famine-stricken districts rose only to 39 per thousand, compared with a normal death-rate of S3

N O R T H-W EST TERRITORIES

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per thousand. The North- West was fortunate in almost entirely escaping the subsequent famine of 1899-1900 ; nor has it suffered from the plague in an epidemic form. Down to April 1899 the total number of deaths recorded from plague was only 117, but the disease has since taken a firmer hold of the eastern districts. (j. g. co.)

North-West Territories. â€” Under this name

are comprised tlie , portion of the Labrador peninsula not included in Quebec or the Labrador coast strip, the Arctic islands between C2Â° W. and 141Â° W., and all that part of British Nortli America which lies between Manitoba and Keewatin on the east, and British Columbia and Yukon on the west. It includes the districts of Ungava (see Labka- doe), Assiniboia, Alberta, Saskatchewan, Athabasca, Jlac- kenzie, and Franklin. It formerly included Yukon also, but the latter was erected into a separate territory in 1898.

The Laurentian “plateau’’ occupies the greater portion of Ungava and Mackenzie and the eastern half of Athabasca. The p. . . most striking features are the innumerable lakes, with features iutervening rocky elevations, forest -clad if in the south, but usually bare or covered with moss and lichens in the north, forming the so-called “barren lands.” In this area there are, in addition to the Laurentian rooks, outliers referred to the Cambrian as well as bands of Huronian rocks. Minerals of economic value are almost entirely confined to the latter, and, though imdeveloped, include gold, iron, mica, phos- phate, graphite, marble, and copper. The continental plain is bounded on the E. by the Laurentian plateau, and on the W. by the Rooky Mountains. It extends from the 49th parallel, where it has a width of about 800 miles, north-westward to the Arctic Ocean, where its width has diminished to about 300 miles. South of the North Saskatchewan it includes the prairie country of western Canada, an area of nearly 200, 000 square miles ; beyond it becomes a forest region with occasional tracts of prairie. East of the Missouri Coteau â€” a line of escarpment that crosses the 49th parallel in 103Â° 30′ W. long., and extends in a north-westerly direction to the North Saskatchewan â€” the general elevation is about 1600 feet ; to the west it is about 8000 feet, and rises gradually to the foothills of the Rooky Mountains. With the exception of a belt of Cambro-Siluriau, Silurian, and

Devonian along the eastern and north-eastern border of the plain, it is underlain by Cretaceous and Tertiary rooks to the Peace river ; beyond the latter the Devonian rocks occupy the greater portion of the area and continue to the Arctic, there forming a great part of the northern archi-pelago. There are inamense beds of bituminous and lignite coals in the Cretaceous ; natural gas has been found in large quantities in the Devonian, and extensive outcrops of sandstone saturated with tar evidence the existence of very large deposits of petroleum. The Rocky Mountains extend, with a width seldom exceeding 60 miles, in a north-westerly direction from the international boundary to the Arctic. They are composed of a series of rouglily parallel mountain ridges of Cambrian quartzites and slates, and Carboniferous and Devonian limestones. They are, as a rule, forest-clad, the growth being more luxuriant on the western slopes, and have, in the southern portion, several summits exceeding 11, 000 feet, notably Eobson peak, 13,700 ; Athabasca, 13,500 ; Assini- boine, 11,830 ; Freshfield, 12,000 ; Victoria, 11,250 ; Lefroy, 11,080; Alberta, 13,000; Lyell, 12,000 >. Mummery, 12,000; Temple, 11,658 ; and Geikie, 11,000 ; also Brown, 9050.

The principal river is the Mackenzie, 2350 miles long, including its great tributary the Peace ; the Athabasca, 740 mUes long ; the â€ž. Liard, 650 miles long. Other important tributaries

of the Mackenzie are the Hay, Nahanni, Dahadiuni, Arctic Red, Peel, and Great Bear rivers. The Anderson, Copper- mine (475 miles long), and Backs river (560 miles) also discharge into the Arctic ; the Dubawnt (660 miles) into Chesterfield inlet ; the ChurohiU (925 miles) and the Nelson (1450 miles long), includ- ing its great tributary the Saskatchewan, into Hudson Bay.

The principal lakes in Saskatchewan are Cedar, Moose, Play- green, an expansion of tlie Nelson, La Plonge, and the northern

. portion of Winnipegosis ; in Athabasca, Reindeer, with

**â– an area of 2490 square miles, and 1150 feet above the sea ; WoUastou, area 900 square miles, and altitude, 1300 feet ; Athabasca, 3085 square miles, and 690 feet above the sea ; Clair, La Ronge, Lesser Slave,

and lie a la Crosse, altitude, 1330 feet : in Mackenzie, Kasba, 1270 feet ; Dubawnt, 500 feet, and an area of 1700 square miles ; Pelly, Aylmer, Clinton-Colden, Great Slave, 9770 square miles, and altitude 520 feet, and Great Bear, 11,200 square miles, and 340 feet above the sea.

The salient features of the climate of the southern Territories are

a bright, dry, and bracing atmosphere, cold winters and warm

summers, with a small rainfall and snowfall. In the

”” *â– northern Territories a short, hot summer is followed by a long cold winter with extremely low temperatures. The percent-

age of bright sunshine at Battleford is 42 per cent., and at Winni- peg 46 per cent. The table below gives the average temperature – and precipitation at a number of stations in the Territories : â€”

Elevation.

Mean Temperature.

Average

Precipita-

Summer.

Winter.

tion.

Feot.

Degrees.

Degrees.

Inches.

Regina, Assiniboia

1885

50-0

0-0

9-03

Swift Current â€ž

2423

60-0

9-4

17-04

Maple Creek â€ž Medicine Hat ,,

2495

62-9

15-3

10-18

2171

62-9

14-3

12-69

Norway House, Kee-

watin

710

19-26

York Factory, Kee-

watin

sea level

48-7

12-6

28-73

Prince Albert, Sask.

1402

54-6

0-9

14-45

Battleford

1615

61-4

7-1

13-62

Calgary, Alberta .

3421

.w-s

15-4

12-98

Banff

4515

52-0

15-9

19-44

Edmonton â€ž

2158

56-0

10-3

15-15

Chipewyan, Atha.

700

54-2

-7-3

11-05

Dunvegan â€ž .

1300

...

23-23

Area and popula- tion.

Tho broad and level or rolling plains of Assiniboia and southern Alberta are, with the exception of the river valleys and more undulating lands, almost treeless. Saskatchewan, â€ž,

Athabasca, southern Mackenzie, and northern Alberta P’ora.

are traversed by a belt of forest varying from 550 to 800 miles wide, and including an area of about 1,500,000 square miles. The principal trees are Banksian pina (Pinus ianksiana), white spruce {Ficea alba), black spruce (Picea nigra), tamarack (Larix americana), aspen poplar (Populiis tremidoides), balsam poplar (Populus balsamifera), and paper birch (Betula papyrifera). The principal trees of the Rocky Mountains are aspen and balsam poplars, white spruce, Engelmann’s spruce {Fieca engelm.), mountain balsam (Abies subalpiiia), Douglas fir (Pseudotsiiga douglasii). Rocky Mountain pine {Pinus Jiexilis), black pine (Pinus murrayana), and mountain larch (Larix lyaUii).

In 1895 the unorganized portion of the North-West Territories was divided into the districts of Ungava, Mackenzie, and Franklin, and the eastern boundary of Athabasca was shifted east- wards from approximate 111Â° 38′ W. to 100Â° W. In 1898 the district of Yukon was constituted a separate territory.

Ungava comprises the whole of the Labrador peninsula north of Quebec, and west of the Labrador coast strip, and has an area of 347,000 square miles.

Assiniboia (89,535 square miles) is bounded on the E. by Manitoba, on the S. by the states of North Dakota and Montana, on the W. by Alberta, and on the N. by Saskatchewan. The principal towns are : â€” Regina (population,

-2645), the capital of the Territories ; Broadview, Moosejaw, Swift Current, Medicine Hat, Moosomin, Yorkton, Estevan, and Qu'AppeUe.

Alberta (106,100 square miles) is bounded on the E. by Assiniboia and Saskatchewan, on the S. by the state of Montana, on the W. by the summit of the Rocky Mountains, and on the N. by Athabasca. The principal towns are Calgary (population, 4152) ; Edmonton (2626), the distributing point for the country drained by the Athabasca, Peace, and Mackenzie rivers, and, till the construction of the White Pass and Yukon Railway, the most northerly railway station in America ; Lethbridge (2279), with its coal mines and at the junction of a railway from Great Falls, Mon., with the Crow Nest Pass line of the Canadian Pacific ; Macleod, at the junction of the last-named line with a branch from Calgary and in a fine ranching district ; Red Deer, in the midst of an excellent farming district, and Banff, in the Rocky Mountains, with its national park and famous hot springs.

Saskatchewan (107,090 square miles) is bounded on the E. and S. E. by the Nelson river, Lsike Winnipeg, and Manitoba, on the S. by Assiniboia, on the W. by Alberta, and on the N. by Athabasca and Keewatin. The principal towns are Prince Albert (popula- tion, 2193), on the right bank of the North Saskatchewan, and the terminus of a branch of the Canadian Pacific, Battleford, Carlton, and Saskatoon. â€¢

Athabasca (245,740 square miles) is bounded on the E. by Keewatin, on the S. by Saskatchewan and Alberta, on the W. by British Columbia, and on the N. by Mackenzie. There are small settlements at Dunvegan, in the valley of the Peace ; Chipewyan, on Lake Athabasca, and the see of a Roman Catholic bishop ; Peace River Landing and Lesser Slave. There are also several Hudson Bay Company's posts ; Lesser Slave, at the head of Lesser Slave Lake, Stanley, Vermilion, McKay, He a la Crosse, and Brochet.

Mackeri^ (530,000 square miles) is bounded on the N. by the Arctic Ocean, on the E. by Keewatin, on the S. by Athabasca and British Columbia, and on the W. and S.W. by Yukon territory.

Fort Smith is on the Slave river at the first Inten-uption to navi- gation from the Arctic Ocean, Resolution and Rae on Great Slave Lake, Providence, Simpson, Norman, Wrigley, and Good Hope on the Mackenzie, and M'Pherson on Peel river, the most northerly civilized community in British North America.

Franklin (approximately 690,000 square miles) includes all the Arctic islands of British North America and Boothia and Melville (26,000 square miles) peninsulas. The larger islands and "lands," with their approximate areas, are Baffin Land, 230,000 square miles (including Cockburn Land) ; North Devon, 22,000 ; Ellesmere Land, 18,000 ; Grinnell Land, 86,000 ; North Somerset, .10,000 ; Prince of Wales Land, 15,800 ; King William Land, 6000 ; Prince Albert Land, Victoria Land, and WoUaston Land, 80,000 ; Banks Land and Baring Land, 80,000 ; Prince Patrick and the Parry Island group, including Melville, 17,000 ; and Bathurst Islands.

The following table shows the population in the census years 1881 and 1891 and in 1901, including the district of Keewatin : â€"

1881.

1891.

1901.

Alberta .... Assiniboia …. Saskatchewan . Other Territories

â– 25,615

30,93112

25,277 30,372 11,150 32,16812

â– 146,000

75,000

66,446

98,967

220,0001

In 1901 there were 27,057 Indians in the North- West Territories and Keewatin, made up as follows : â€” Assiniboia, 3214 ; Alberta, 6697 ; Saskatchewan, 6993 ; Athabasca, 3716 ; Mackenzie, 2041 ; Keewatin and Franklin, 5834 ; and Ungava, 562. In the same year there were 14,266 half-breeds in Manitoba and the Terri- tories, as follows : Assiniboia, 2156 ; Alberta, 3686 ; Saskatchewan, 5677 ; Athabasca," 2395 ; and other territories, 373. The Indian population of Manitoba and the treaty limits of the North-West Territories numbered, in 1893, 23,608, and in 1898, 21,316, a decrease of 2292.

In 1901 there was in Alberta 1 person to 1-6 square miles; in Assiniboia, 1 to 1-3 miles ; in Saskatchewan, 1 to 4-2 miles. In the same year there were in the Territories 100,641 males and 83,789 females ; the urban population, 20-7 per cent., and rural, 79-3 per cent. In 1891 there were 13,804 persons engaged in agri- culture and mining ; 2291 in domestic and personal service ; 1669 in manufactures and mechanical industries ; 2299 in trade and transportation ; 1690 in professional avocations, and non-productive, 178. Principal nationalities (by birth) in 1901 : Canada. 116,846 ; England, 10,989 ; Scotland, 4259 ; Ireland, 2500. There were 2691 births, 937 deaths, and 827 marriages in 1901.

The total number of declared settlers that arrived in Canada in the year 1901-02 was 63,700, most of whom settled in Manitoba and the Territories. There were 41,000 from Great Immlgra- Britain and other European countries, and 22,700 from """â– the United States. In 1899 about 8000 Russian Douk-

hobors settled in the Swan river district in Manitoba.

The North-West Territories were at first under the lieutenant- governor of Manitoba, then under a lieutenant-governor and coun- cil nominated by the Dominion Government ; by degrees further powers were conferred, and their aflairs are now administered by a lieutenant-governor appointed by the Governor in Council, and an executive council con- sisting of three

members, responsible to the legislative assembly, which consists of thirty-one members. The powers conferred on the legislature are the same as in other provinces of Canada, except that they cannot borrow money on the credit of the Territories. While Ungava, Mackenzie, and Franklin are under the control of the government of the North-West Territories, and while the latter has power to pass laws dealing with internal matters, the Dominion Government assumes the right of legislating with regard to these districts, and did so in 1898 when creating the territory of Yukon. Classified according to religion, the principal denomi- Rellgloa. nations were in 1901 as follows :â€”

Oovera meat.

Roman Catholics

. 35,200

Baptists

5,416

Presbyterians

. 27,867

Doukhobors

8,700

Church of England

29,027

Other denominations .

25,459

Methodists . Lutherans .

. ‘24,772 . 12,098

Not specified

15,901

In 1901 it was estimated that there were, in the Territories and Keewatin, 18,627 Indians professing the Roman Catholic faith, 4100 Anglicans, 1477 Methodists, 795 Presbyterians, 5606 pagans, and 6.392 unknown, but probably pagans.

The educational system is under the control of a council of public instruction, consisting of the executive committee of three, and of three appointed members without votes. A school district may comprise an ai-ea of not more than 26 square miles, and must

contain four resident heads of families and a school population â€” children between the ages of five and twenty â€” of not less than ten. In 1901 there were 564 schools, with a total of pjuca-

23,837 pupils and 682 teachers. The total expenditure ^^^^ for school purposes amounted to |548,809.

The principal sources of revenue are the subsidy from the Dominion Government, |425,359 in 1902, and fees re- pfâ€žaâ€žce. ceived from the sale of liquor licences, &c.

There are immense beds of coal in the Territories, and it has been estimated that, to the south of the 66th parallel, an area of 60,000 square miles is underlain by beds of bituminous â€ž, , and lignite coals. The lignites are found in the undis- ‘21,^ turbed prairie region, bituminous in the foothills, and flnâ€žiag, bituminous and anthracite in the Rocky Mountains. The principal mines in operation are at Lethbridge, Banff, and Canmore, Alberta ; they produced in 1901, 361,960 tons, valued at $839,376. Great outcrops of Cretaceous sandstone, saturated with inspissated petroleum, are found along the Athabasca river, evidencing the existence of extensive deposits of petroleum in the underlying Devonian rocks. Natural gas has been found in con- siderable quantities in borings, notably in a bore-hole sunk near the

confluence of the Pelican and Athabasca rivers, to test the pre- sence of petroleum, which eventually caused the suspension of the boring operations. Gold, supposed to have been concentrated from drift deposits, has been washed from the sands of the Saskatchewan for years ; yield in 1901, |1 5,000.

The soil in southern Assiniboia and Alberta is of a very fertile character, and produces good crops, though in some sections irri- gation is required. In 1901 there were 169 irrigation ditches, with a total of 469 miles, constructed at a cost culture of $500,000 ; increased value of the land estimated at $1,229,368, and land susceptible of irrigation from constructed ditches, 614,684 acres. To the north of this more or less arid belt are immense partly -wooded districts, with a rich and fertile soil favourable for mixed farming. Up to 1901, 6,500,000 acres had been brought to the uses of the farmer, and 605,795 acres were covered by grazing leases. The following are crop statistics for 1901 :â€”

Acres.

Bushels.

Yield per acre.

Wheat .... Barley .... Oats

508,664

20,044

229,439

12,923,343

736,749

11,113,066

26-40 36-75

Total acreage, wheat, barley, and oats, 1891, 183,915 acres, and 1901, 768,047 acres. In 1900 the Indians in the southern Terri- tories raised the following crops : wheat, 31,930 bushels ; oats, 36,333 ; barley, 4359 ; potatoes, 31,286 ; other roots, 10,693 ; hay and other fodder, 38,442 tons.

The population of the Territories being essentially an agricul- tural one, the manufactures are as yet insignificant. In the census year 1891 the industrial establishments num- bered 376 ; fixed capital, $670,602 ; working capital, $1,042,677 ; persons employed, 1081 ; wages per annum, $425,153 ; raw material, $846,017 ; and value of finished product,

$1,827,310.

The following table gives statistics of exports, &c. at five-year intervals, for the period 1879-1901 : â€”

Manufac- tures.

Commerce.

t^-,9.

1SS4.

1SS9.

1894.

1901.

Imports . Exports . Duty

$

60,1.39

157,462 21,970

$

486,739 70,148

128”756 24,549

$

79,494

117,398

11,012

$ 1,620,936 1,436,249 140,952

‘ Including Keewatin.

Estimated,

In 1901 the railway lines in Assiniboia, Saskatchewan, and Alberta aggregated 2056 miles, equal to 1 mile of track to 147 square miles of area. The systems operating in f^^”^^^- the Territories areâ€” the Canadian Pacific, Canadian Northern, and jVlberta Railway and Coal Company. (j yfs*)

Northwich, a market town in the ISTorth-svicli parlia- mentary division of Cheshire, England, at the confluence of the rivers ‘Weaver aud Dane, 18 miles east-north-east of Chester by rail, connected with the Manchester Ship Canal. The amount of white and rock salt exported from this locality (including Winsford, 6 miles distant) is about 1,500,000 tons annually. The white salt is chiefly shipped to America, Belgium and Prussia importing rock salt. Population (1891), 14,914; (1901), 17,609.

Norton, Charles Eliot (1827), American

scholar and authoi-, was born in Cambridge, Massachusetts,

N 0 R T 0 N â€” N 0 E W A Y

16th November 1827, being the son of Andrews Norton, a Unitarian theologian and doctrinal writer of promi- nence in his time. Having graduated at Harvard in 1846, Norton travelled in India and Europe, and on his return devoted himself to a life of letters and culture. From 1864 to 1868 he edited, with James Eussell Lowell, the North American Review, and from 1875 to his resignation in 1898 he was professor of the history of art at Harvard. Beginning with Notes of Travel and Study in Italy (1869), his principal books have been Historical Studies of Church – Building in the Middle A(/es: Venice, Siena, Florence (1880), annotations on Turner's Liber Studiorum and Blake's Job, a biblio- graphy of Michael Angelo, and a translation of Dante's New Life and of the Divine Comedy in prose, the publican tion of the several parts of which extended from 1858 to 1892. His version of the New Life, in particular, is noteworthy for accuracy and felicity. He took a promi- nent part in the work of editing and publishing letters and other writings of Emerson and Carlyle, after their death, and was appointed his literary executor by John Eviskin.

Norton, Thomas (1532-1584), lawyer, poli- tician, and writer of verse, was born in London in 1532. He was educated at Cambridge, and early became a secretary to the Protector Somerset. In 1555 he was admitted a student at the Inner Temple, and married Margaret Cranmer, the daughter of the archbishop. Several years before this, indeed from his eighteenth year, Norton had begun to compose in verse. We find him connected with Jasper Hey wood; as a writer of " sonnets " he contributed to Tottel's Miscellany, and in 1560 he composed, in company with Sackville, the earliest English tragedy, Oorboduc, a remarkable work in blank verse, which was performed before Queen Elizabeth in the Inner Temple on the 18th of January 1561. In 1562 Norton, who had served in an earlier Parliament as the representative of Gatton, became M.P. for Berwick, and entered with great activity into politics ; he was eminent in the House as a "wise, bold, and eloquent" orator. In his attitude to religion he was inspired by the sentiments of his great deceased father-in-law, and was in possession of Cranmer's MS. code of ecclesiastical law ; this he per- mitted Foxe to publish in 1571. Norton, in fact, became one of the extremest Puritans of that pro-puritanic age. He went to Rome on legal business in 1579, and from 1580 to 1583 frequently

visited the Channel Islands as a commissioner to inquire into the status of these posses-

sions. Norton's Calvinism grew with years, and towards the end of his career he became a rabid fanatic. His punishment of the Catholics, as their official censor from 1581 onwards, led to his being nicknamed " Eackmaster- General." Among the more illustrious victims of his tortures were Edmund Campion and Francis Throgmorton. At last his turbulent puritanism made him an object of fear even to the English bishops ; he was deprived of his office and thrown into the Tower. Walsingham presently released him, but Norton's health was undermined, and on the 10th of March 1584 he died in his house at Sharpenhoe, Bedfordshire. The famous tragedy of Oorboduc was first published, very corruptly, in 1565, and, in better form, as The Tragedy of Ferrex and Porrex, in 1570. Norton's early lyrics have in the main disappeared. The most interesting of his numerous anti-Catholic pamphlets are those on the rebellion of Northumberland and on the projected marriage of Mary Queen of Scots to the duke of Norfolk. Norton also translated Calvin's Institutes and Nowell's Catechism. By far the best account of Thomas Norton is that published in 1895 by Mr Sidney Lee, who destroys the notion, which had gradually gro^ni up among the historians of English literature, that the credit of Oorboduc was entirely, or at all events mainly, due to Sackville. There is more evidence for an opposite thesis, namely, that the principal credit for starting Eng- lish tragedy is due to Thomas Norton. (e. g.)

Norwalk, a town of Fairfield county, Connecticut, U.S.A., on Long Island Sound, in the south-western part of the state. The town has an area of 25 square miles of hilly country, within which are the cities of South Norwalk and Norwalk and the villages of East and West Norwalk, Winnipauk, Four Corners, and Five Corners. It is traversed by the New York, New Haven, and Hartford railroad. South Norwalk has an excellent harbour, with regular steamboat communication with New York and Sound ports, ^ving it a large coasting trade. It has extensive and varied manufactures, the capital invested amounting, according to the census of 1900, to 14,129,841, and the value of the product to $5,097,720. Population of the town (1890), 17,747; (1900), 19,932; of the city (1900), 6125, of whom 1023 were f oieign-born.

Norwalk, a city of Ohio, U.S.A., cajjital of Huron county, in the northern part of the state, on the Lake Shore and Michigan Southern and the Wheeling and Lake Erie railways, at an altitude of 718 feet. It is in a farming district, and has varied manufactures. Population (1890), 7195 ; (1900), 7074.

JN^ORWAY

I. Geogeapht and Statistics.

^VTOEWAY is the western section of the Scandinavian J_\ peninsula, lying between 57Â° 58′ and 71Â° 11′ N. and 4Â° 30′ and 31Â° 12′ E., bounded on the N. by the Arctic Ocean, on the E. by Lapland and Sweden, on the S. by the Skagerrack and the North Sea, and on the W. by the Atlantic. So far as physical features are concerned, the article iu the earlier volumes of this Encyclopaedia (xvii. 575) gives a full account, which it is unnecessary to supplement with further details here ; and it only remains to give the statistics for more recent years.

Popidation and Area. â€” During the course of the 19th century the population of Norway increased 162-7 per cent., from 883,038 in 1801 to 2,231,395 in 1900. During the seven years 1892-98 inclusive the marriage-

rate per thousand of the population averaged 6-58 annually, the birth-rate 31-6, and the death-rate 16-00. Of the births 7-67 per cent, were illegitimate. During the fourteen years 1880-93 inclusive an average of 18,290 persons emigrated every year; during 1894-99 inclusive, an average of 4862. Almost the whole of them went to the United States. In 1900 the rural population amounted to 1,606,864, or 72 per cent, of the whole, and the urban to 624,531, or 28 per cent. In 1891 there were 20,786 Lapps and 9378 Finns (Kvaens). The lunatics numbered 1659 in 1899, as compared with 1581 in 1896. Deaf mutes numbered 2139 in 1891, and blind persons 2665. In the twelve years 1887-98 the suicides averaged 128 annually.

The following table gives the population and density of the counties in 1891 and 1900, together with the

areas :-

s. vn.-34

266

NORWAY

Population

Population

Density

Counties.

as per Census,

as per Census,

Area in 8q. Miles.

per Sq. Mile in

1891.

1900.

1900.

Smaalenene

120,300

136,298

1,600

85-1

Akershus .

99,111

115,113

2,054

56-0

Cliristiania

151,239

225,6861

6-5

.34,720-9

Hedemarken

119,129

125,856

10,618

11-8

Christians .

108,076

115,615

9,790

11-8

Buskerud .

104,769

112,608

5,789

19-2

Jaiisberg and Laurvik

100,957

103,772

896

115-8

Bratsberg .

92,034

98,788

5,863

16-8

Nedenes .

81,043

79,605

3,608-5

22-0

Lister and Mandal .

78,738

81,454

2,804

29-0

Stavanger .

117,008

127,192

3,530-5

36-0

Soutli Bergenhus

128,213

135,337

6,024-5

22-3

Bergen

. 53,6842

72,179

5-5

13,123-4

North Bergenhus

87,552

88,948

7.130

12-4

Eomsdal .

127,806

135,899

5,786

23-5

South Trondhjem

123,817

135,133

7,182

18-8

North Trondhjem

81,236

83,344

8,788-5

9-5

Nordland .

131,850

151,537

14,513

10-4

Tromso .

65,125

74,296

10,131

7-3

Finmarken Totals

29,170

32,735

18,291

1-8

2,000,9173

2,231,395

124,411

17-9

Classified according to occupations, the population (total number and percentage) -was distributed as follows in the year 1891 :â€”

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3

S o

Total

number

885,098

480, 6T3

1”5,641

.W,C67

42,649

46,868

57,686

709,639

Per cent.

16-T

24-0

8-T

2-9

2-1

2-3

2-9

85-4

Religion and Education. â€” Except for 30,685 persons (in 1896), “of whom 8200 were Free Lutherans, 8200 Meth- odists, and 4000 Baptists, the population are adherents of the Evangelical Lutheran Church.

Notwithstanding the sparseness of the pojiulation and the great distances, education in Norway has reached a high standard, being free, and all children between seven and fourteen being obliged to attend school. In the rural districts there are about 6000 primary schools, at which 267,440 out of 272,662 children of school age were educated in 1897 at a cost of Â£2.32,274, an average of 18s. 0|d. per child, or an addition of over 50 per cent, of the cost in 1876. In the towns 69,475 children were educated out of 90,832 of school age in 1897, the total cost being Â£211,626, or at the rate of Â£3, Os. 10,}d. per child. Secondary education is in a transitional stage, the old classical standards having been discarded in 1896. In 1897 there were 164 com- munal burgher and communal middle schools and state lyceums, in which 19,207 children were taught, private secondary schools being also included. The special schools embrace an agricultural high school, 3 technical schools, 2 commercial schools, a military school, and a naval school. There is one university, state-aided, at Christiania.

Agriculture. â€”Although 75 per cent, of the total area is unpro- ductive, and less than 1 per cent, is arable land, the number of people dependent upon agriculture exceeds any other group in the country. Including those who breed and tend live stock, and those employed in the forest industries, agriculture gave occupation to 335,093 persons in 1891, or 28 per cent, of the total working pop- ulation. The Government help to maintain a flock of Cheviot sheep on the island of Rennes, near Stavanger. There is a higher school lof agriculture at Aas (20 miles south of Christiania), and 18 agri- cultural schools in other parts of the country. Barley is almost the

1 The increase is partly due to the extension of the municipal boundaries.

2 The municipal boundaries were extended between the census of 187.‘‘i and the census of 1891.

3 Or, including Norwegian sailors serving abroad on Norwegian vessels, 2,004,102.

only cereal found north of 68Â° N. ; hay and potatoes ripen as far northas Tromso andHammerfest(70Â°39′ N.). The next table shows the number of acres under the principal crops in the years cited: â€”

Tear.

Oats.

Barley.

Oats and Barley mixed.

liye.

Total CeJ-eals.

Potatoes.

1875 1890

249,250 241,660

188,000 127,900

51,000 36,650

35,650 34,000

526,850 469,450

96,900 96,650

In 1897 and 1898 there were some tentative attempts to grow tobacco. In 1890 the live stock numbered 150,900 horses, 1,006,500 cattle, 1,417,500 sheep, 272,500 goats, 121,100 swine, and 170,100 reindeer (domesticated).

Manufacturing Industry.â€” The next largest group of occupations embraces the manufacturing industries, namely, 175,641 persons, or 15 percent, of the working population. During the last decade of the 19th oenturv a great number of waterfalls were sold for industrial purposes to” manufacturers or their agents, English and German capital being invested as well as Norwegian. A powerful Impulse was given to the development of industrial enterprise in Norway by the expiration and non-renewal of the customs

treaty with Sweden in 1897, the effect being virtually to establish in Norway a protective system against the sister kingdom. At the same time (between 1896 and the middle of 1899) there was an extra- ordinary increase in the number of new factories, whilst the im- portation into Norway of manufactured goods from Sweden very greatly decreased in 1898. In 1885 there were altogether 1925 factories, employing 45,313 workpeople ; in 1895, 1910 factories employing 59,796 workpeople; and in 1899, no less than 3074 factories, employing 79,136 workpeople. The chief industrial centre is Christiania (with 402 factories and 17,294 workpeople in 1899) ; next come Eredrikstad and Sarpsborg, then Bergen, Drammen, Skien and Porsgrund, Eredrikshald, Trondhjem, and Stavanger. The most important branches of industry are saw-miUs and planing-mills and wood-pulp factories (17,650 men in 1899) ; foundries and engineering shops (17,385 men); spinning and weaving mills (8943) ; brick and tile works, breweries, paper mills, tobacco factories, flour mills, glass works and potteries (6958 men) ; nail works, shipbuilding yards, match factories, margarine factories, rope walks, factories for preserved foods,fish guano, boots, hosiery ; distilleries and tanneries. The building of small wooden vessels, formerly a very active industry, is rapidly decreasing. Including wood-pulp, but excluding the produce of the forests and i3shing- grounds, the total export of the industrial products of Norway amounted to Â£1,.303,000 in 1887, Â£3,080,700 in 1897, and about Â£2,469,200 in 1900.

Fisheries. â€” In respect of the value of the product, the fisheries of Norway rank next after her timber. The fish principally taken are cod and herrings, with ling and coal-fish (saye), salmon and sea-trout, mackerel, lobsters, and oysters. The total annual value of the coast fisheries of Norway ranges generally from one million to one million and a half sterling. There are three principal fishing-grounds for cod : (i.) the Lofoten, from January to April, when the fishing is carried on by 25,000 to 32,500 men, using 6000 to 8000 boats ; (ii.) the Finmark, carried on by a fluctuating number of men, 12,000 to 29,000, and of boats, 4000 to 7500 ; (iii.) the Romsdal, employing 12,250 to 17,000 men and 2000 to 3000 boats. During the whole of the year 1899 the cod fisheries of Norway gave employment to a total of 77,139 men ; the number of boats employed was 17,892, and the aggregate number of fish caught was 37,584,000, a little more than half the annual average for

the years 1888-97, their value being Â£617,900 (average for the years 1888-97, Â£781,600). Since 1898 there has been a sen- sible falling-of in these fisheries, so much so that in 1901 less than 20 million cod were taken in the Lofoten and Finmark catches, the lowest for many years. The principal fishing-grounds for herrings are off the coast of Nordland, the west coast between Trondhjem and Bergen, off Bukken Fjord and in Christiania Fjord, and along the south coast. In 1897 some 203,600 tons of herrings were caught, the largest quantity since 1874, their value being Â£441,888 ; in 1900 only 120,000 tons were taken, but they realized Â£489,000. As a rule the annual take of herrings ranges between Â£200,000 and Â£8.“i0,000. Of salmon and sea-trout 709 tons, valued at Â£52,590, were taken in 1899; average value, 1881 to 1897 inclusive, Â£35,000. To these must be added Â£17,000 to Â£18,000 for the salmon caught in the fresh-water rivers and lakes. Coal-fish and ling were caught along the coast of Finmark to the value of Â£259,100 in 1899 ; average for 1881 to 1897, Â£156,700. The value of the mackerel (south coast), lobstei- s, and oysters caught in 1899 was Â£51,300. Norwegian fishermen, especially from Tonsberg and the northern ports of Tromso, Hammerfest, A’ardo, and Vadsb, take part in the Arctic whale, seal, shark, and walrus hunting. In 1900 a fishery board for the administration of all the Norwegian fisheries was established at Bergen.

Mercantile Marine. â€” Next after the fisheries comes the merchant navy. It was in 1879 that Norway first took a relatively high

place. In that year 5 per cent, of the total measured tonnage of the world flew the Norwegian flag. It should, however, be mentioned that now there are a large number of British-owned vessels sailing under the Norwegian flag. The principal ship-owning ports in 1809 were, in the order of tonnage : Bergen (579,950 cal- culated!) tons, Christiania (393,600 tons), Tonsberg (261,800), Stavanger (162,400), Arendal (109,450), Haugesund (107,300),]5rammen, Grimstad, Porsgrund, Fredrikstad, Kragero, and Chris- tiansand.

The growth of the Norwegian mercantile marine will be apparent from the following table : â€”

Year.

Steani- ships.

Tonnage.

SaUtD? Sh.ps.

Tonnage.

Total Vessels.

Total Calculated Tonnage.

1887 1897 1900

514 1004 1128

438,458 1,379,232 1,736,089

6755

61Â»3

5698

1,381,778 1,169,079 1,052,687

7269 7147 6826

1,820,236 2,548,311

2,788,776

The rugged coast of Norway is well protected by lighthouses.

Commerce. â€” The subjoined table gives particulars of the total trade with all foreign countries : â€”

Tear.

Imports.

Per Head of Popula- tion.

Exports.

Per Head of Popula- tion.

Total

Imports and

Exports.

Per Head of Popula- tion.

1887 1897 1900

Â£7,427,800 14,051,0^0

17,961,360

Â£3j

8

Â£6,928,800

9,316,480 9,834,400

Â£8

11

Â£18,3.”)1,100

23,967.500 27,785,750

Â£6 Hi

121

In 1887 Great Britain supplied imports to the total value of Â£1,966,000 (26-5 per cent.), and received exports to Â£1,921,000 (32-4 per cent.) ; in 1897 she supplied Â£3,752,000 (25-6 per cent.) of the imports and received Â£3,682,600 of the exports (39 per cent.). In 1900 Great Britain sent 30 per cent, of the imports, and received 42-5 per cent of the exports ; and in the same year the United States contributed 5‘5 per cent, of Norway’s imports, and took 1-1 per cent, of her exports. The most important exports are fish and fish products (Â£3,295,000 in 1899), timber (Â£2,197,700), wood-pulp (Â£1,016,500), paper (Â£452,000), butter and condensed milk (Â£476,100). Next in order come textiles, hides and leather, mineral ores and metals, nails, hewn stone and bricks, ships, matches, and ice. The imports of greatest value are cereals and flour (Â£2,843,450), textiles (Â£1,393,600), groceries and preserved fruits (Â£1,342,800), ironmongery (Â£1,536,100), coal (Â£1,334,400), raw cotton, wool, &c., and yarn (Â£767,500), ships (Â£1,041,450), raw metals (Â£749,400), machinery, &c. (Â£595,400), with timber, skins, bacon and meat, wines and spirits, glass and pottery, books, paper, salt, &c. In 1897 Great Britain took 60 per cent, of the timber. Cape Colony 4 5 per cent., and Australia 2-8 per cent, of the total of 74 million cubic feet.

The subjoined table shows the number of vessels which entered at Norwegian ports in the years mentioned, together with their aggregate tonnage : â€”

Tear.

Total.

British.

German.

United States.i

â– i

i

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â– 3

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B

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H

1SS6

11,209

2,816,278

8348

1,104,248

972

272,417

4S

59,861

1696

13,201

2,908,946

8805

1,458,051

1061

340,159

5T

98,143

In 1898 all the Norwegian ports together were entered and cleared by an aggregate of 6,297,400 tons, of which 4,197,250 tons were Norwegian,

737,000 British, 521,300 Danish, and 414,100 Swedish.

Forests. â€” In 1897 it was estimated that 33,582 square miles, or 26-9 per cent, of the entire area, was under forests. They occupy all the eastern and middle parts of the country from 58Â° up to 68Â° N. Of the timber standing in 1897 it was estimated that 73 per cent, was pine wood (red and white), and the rest umbrageous trees, amongst which the birch predominated.

Mining. â€” Norway has mines of copper pyrites, silver, nickel, zinc, cobalt, molybdenum, iron, and apatite, but none of these is worked on a very extensive scale. In the years 1888-98 inclusive from 1650 to 2500 men were employed annually in mining in Norway; and in 1900 the number was 2750. The total value dropped from Â£206,555 in 1889 to Â£147,777 in 1893, but in 1900 rose to Â£210,800. The average for the ten years 1887-96 was Â£165,746. In 1897 the yield was the largest ever known, and embraced 90,000 tons of copper pyrites and 1450 tons of pure copper, and the aggregate value of the ores delivered at Norwegian ports for export was Â£207, 182. The pyrites and copper mines are at Eoros (100 miles south-south-east of Trondhjem by rail), Sulitjelma (at the head of Salten Fjord, in 67Â° 20'), Ranen (on the west coast, in 66Â° 15'), Lyngen and Alten in the extreme north, at Killingdal,

1 One steam ton is taken as equivalent to 3'6 salUog tons.

Drogset in Meldal, and on Yttero. Silver is mined at Kongsberg ; iron in Hardanger, at Ulef os, and near Arendal ; cobalt at Modum ; molybdenum at Knaben ; nickel at Evje in Ssetersdal, north from Christiansand ; zinc at Sand, between Stavanger and Bergen ; and apatite at Odegaard, between Laurvik and Kragero. Coal exists on Andenas in the Lofotens. Granite is extensively quarried in the vicinity of Fredrikstad, Fredrikshald, and Sarpsborg, and exported as paving setts and kerbstones, mostly to Great Britain and Ger- many. Fine beds of mai-ble, in some parts running 10 to 12 miles on end and several yards thix;k, are worked near Fredrikshald. Other beds occur in the Salten and Ranen districts.

Communications. â€” Norway possesses only one line of railway of any considerable length, namely, that which runs north from Chris- tiania to

Trondhjem ; but there are several short lines, such as the connexions eastwards with the Swedish railway systems from Chris- tiania and Trondhjem, ~~the lines connecting the capital with Dram~~ men and Skien, the Saetersdal railway, the Jsederen railway, and the line from Bergen to Vossevangen. This last is now being con- tinued towards Christiania. Another important line, perhaps the most northerly in the world, is that intended to connect Narvik or Victoria Harbour (on the Ofoten Fjord, in 68Â° .30′ N.) with the iron mines of Gellivara in Sweden. Altogether there were 1230 mUes of railways open in 1900, of which 1119 were State lines; the gross earnings for the year 1899 being Â£804,450, of which Â£259,450 was net profit. In 1895 there were 5991 miles of main roads and 10,776 of communal roads. Most of these have been reconstructed since 1850, and several of them exhibit evidence of considerable engineer- ing skill. By the aid of Government subventions, regular steamboat communication is maintained all the year round on the fjords, coasts, and larger lakes. Even in winter steamboats run regularly to Hammerfest and Vads8. Both telegraph and telephone systems are exceptionally extensive for such a country as Norway. The annexed table gives particulars of the telegraph system : â€”

Tear.

Total Length.

Receipts.

Net Profits.

No. of Telegrams. j

Of Lines.

Of Wires.

At Home.

Abroad.

1899

7164

20,650

Â£120,150

Â£15,950

1,340,708

818,062

In 1887 an aggregate total of 15,801,600 home letters and post-cards passed through the post office, and m 1899, 36,700,000 ; received from and despatched to foreign countries, 2,694,800 in 1887 and 11,797,800 in 1899. The book post and parcel post packets for home numbered 21,557,900 in 1887 and 54,877,400 in 1899; those from and for foreign countries numbered 809,300 in 1887 and 5,648,900 in 1899. The gross earnings of the post office in 1899 amounted to Â£267,870, and the net profits to Â£13,560.

Banks and Finances. â€” ^There are two State banks â€” ^the Bank of Norway and the Mortgage Bank of the Kingdom of Norway. The former is a joints-stock bank, owned in great part by the Govern- ment, its directors being elected by the Storthing or Parliament, except the president of the head office, who is nominated by the king. It is the only bank in Norway authorized to issue bank- notes. There were, further, 411 savings banks in 1900, having 671,241 depositors with Â£16,829,400) or an average of Â£25, Is. 5d. per head, as compared with Â£2.3, 5s. 7d. in 1870) deposits to their credit. Budget particulars, and the amount of the national debt, are contained in the following table : â€”

Tear.

Eeceipts.

Expendi- ture.

Becelpts from

Customs Duos.

s s.

National Debt.

ill

1887

1&9T 1S99

Â£2,387,600

8,885,950 5,315,850

Â£2,449,200

4,262,800 4,959,100

Â£1,141,600

1,578,700 2,079,000

Â£1,419,500

2,019,800 2,731,350

Â£6,023,760

10,074,700 11,030,500

Â£3 11

4 15 6

4 IS 0

The income-tax was first levied in 1892 ; in 1895 it was made “graduated,” the lowest income to be taxed being 1000 kroner (=Â£55, 6s. 8d.). The

produce of the tax increased from Â£158,900 in 1892 to Â£280,229 in 1899 ; and the total incomes upon which the tax was levied increased during the same period from Â£17,028,000 to Â£24,383,400.

Government. â€” In 1899, after long and heated parliamentary action, and after being twice vetoed by the king, Norway extorted the right to remove the sign of union with Sweden from the flag of her merchant marine. There was also a violent agitation for Norwegian consuls abroad distinct from Swedish consuls. In 1898 parliamentary franchise was made universal, the right to vote being given to every man of Norwegian nationality who is twenty- five years of age, who has dwelt five years in the country, and who possesses the necessary property and legal qualifications. In

2 This includes the figures given under the column headed ‘ from Customs Dues.”

each towu and bailiwick there is a court of arbitration, over which two authorities preside who have been selected by tlae (elected) parliamentary voters. As a rule all civil disputes are, in the first instance, brought before these arbitrators. There are now only three courts of appeal, each with three justices, at Christiania, Bergen, and Trondhjem respectively.

Army and Navy. â€” The army embraces the line, the militia or reserve, and the second reserve. AU men of twenty-two years of age and upwards are liable for conscription, and when called they serve five years in the line, four years with the reserve, and four years with the second reserve. The men of the line are the only troops who can be sent out of the country for purposes of war. But, though the nominal period of service is altogether thirteen years, the men only meet for annual military training for periods of eighteen to seventy days in each year. The peace establishment of the line

amounts to 12,000 men, with 750 oificers ; its war footing to 18,000 men, or more. The navy consists of about 850 officers and men on permanent service ; but all seafaring men between the ages of twenty-two and thirty-five are liable for mari- time conscription, and are all put through some preliminary train- ing. The war vessels embrace four turret-ships of 3500 tons each, and about a dozen other modern vessels, some small gunboats, and a torpedo flotilla â€” the whole being intended for coast defence only.

Authorities. â€” Statistisk Aarbog for Kongeriget Norge, 1900 and previous years, and British Consular Reports. â€” A. N. Ki^-er, J. Vibe, B. Strom, and A. Helland. Norges Land og Folk. Christiania, 1885, 1888, 1895-99. â€” N. Eolfsen. Norge i det Nittende Aarhundrede. Christiania, 1900, &c. â€” Norway (official publication for the Paris Exhibition), 1900. â€” Ystgvar Nielsen. Beisehaand- bog over Norge (9th ed. 1899). On the geology, H. H. Reusch. Det Nordlige Norges Geologi. Christiania, 1892, carries on and complements Kjerclf. Xldsigt over det Sydlige Norges Geologi, 1879.â€” E. RiCHTBR. -‘Coast Plain of Norway” in Globus, 1896. â€” ” Hydrographio-Biological Studies of the Norwegian Fisheries,” by J. Hjort, in Videnskabsselsk. Skrifter, 1896 ; comp. also Decker, Heinoke, and Hbnking. ” Die Seefischerei Norwegens,” in Abhandlungen des Deutschen Seefischerei- Vereins. Berlin, 1901 ; and 0. Pettersson. ” Hydrographic Research in the Baltic and North Seas,” in Scot. Geog. Mag., 1894 and 1898. On the avifauna, notes by A. Chapman. Wild Norway, 1897. â€” Consult also H. H. Reusch. Folk og Natur i Finmarken, 1895, and Yngvar Niel- sen, in Det Norske. Geogr. Selsk. Aarbog, 1891, on the Lapp question. On the climate, H. Morn’s ” Klima Tabeller for Norge, 1841-90,” in Videnskabsselsk. Skrifter, 1895. On the Gothenburg system. Foreign Office Beport, Misc. Series, No. 279, 1893 ; and Board of Trade Beport on the Production and Consump- tion of Alcoholic Liquors, 1899; and H. E. Berner. “Brsende- vinsbolagene i Norge,” in Nordisk Tidskrift, 1891, as well as Foreign Office Consular Reports for Norway, 1894 and following years. â€” See also C. E. Keary. Norway and Norwegians, 1892. â€” E. C. Oppenheim. New Climbs in Norway, 1898. â€” Euge. Nor- wegen, 1899. (j. t. be.)

II. History.

After a unioii of nearly 400 years betvreen Norway and Denmark, the Danish king, Frederick VI., without con- sulting the Norwegians, ceded Norway to Sweden by the treaty of Kiel (14th January 1814). By this f^Mngto arbitrary act â€” one of the results of the great the union European upheaval in the early years of the 19th '^"* century â€" Norway, as events proved, benefited

"'* *"â– more than most European states. Some time previously Sweden had joined the Allied Powers in their struggle against Napoleon, while Denmark had, unwisely, sided with the French. In 1813 the Swedish crown prince, Carl Johan (formerly Bernadotte, one of Napoleon's marshals-'), proceeded to Germany and took command of one of the armies of the Allied Powers. After the power of Napoleon had been broken at the battle of Leipzig, Carl Johan advanced against Denmark, and King Frederick soon saw himself compelled to accede to the Swedish demand â€" the cession of Norway, the possession of which had long been the aspiration of the Swedes, especially after the loss of Finland in 1809. In the treaty of Kiel Frederick VI. absolved the Norwegians from their oath of allegiance, and called upon them to become the loyal subjects of the Swedish king. But the Norwegians, who had not been consulted in the matter,

1 In 1810 he was elected heir to the Swedish throne, in succession to the childless King Carl XIII., who died in 1818.

refused to acknowledge the treaty, declaring that, while the Danish king might renounce his right to the Norwegian crown, it was contrary to international law to dispose of an entire kingdom without the consent of its people. They would not tamely submit to be handed over as mere chattels to Sweden; they asserted their independence and their right to decide their own fate. A meeting of delegates from all parts of the country was convened at Eidsvold, not far from the Norwegian capital, where, on the 17th of May 1814, a constitution, frame^ upon the constitutions of America, of France (1791), and of Spam (1812), was adopted. Among its most important features are that the Storthing or National Assembly is a single-chamber institution, and that the king is not given an absolute veto, or the right to dissolve the Storthing. The then Danish governor of Norway, Prince Christian Frederick, was unanimously elected king. Soon after- wards the

Swedes, under Carl Johan, the Swedish crown prince, invaded Norway. They met with a gallant resist- ance, but Prince Christian soon saw the hopelessness of the struggle, and declared himself willing to abdicate. The hostilities lasted only a fortnight, when Carl Johan opened negotiations with the Norwegians. A convention was held at Moss, where it was proposed that the Norwegians should accept the Swedish king as their sovereign, on the condition that their constitution of the 17th of May should remain intact, except with such alterations as the union might render necessary. An extraordinary Storthing was then summoned at Christiania, and on the 4th of November 1814 Norway was declared to be ” a free, independent, and indivisible kingdom, united with Sweden under one king.” A month previously Prince Christian Frederick had laid down his crown and left the country.

The union was more fully defined by the “Act of Union,” which was accepted by the National Assemblies of both countries in the following year. In the preamble to the Act it is clearly stated that the union between the two peoples was accomplished “not by force of arms, but by free conviction,” and the Swedish foreign minister declared to the European Powers, on behalf of Sweden, that the treaty of Kiel had been abandoned, and that it was not to this treaty, but to the confidence of the Norwegian people in the Swedish, that the latter owed the union with Norway. The constitution framed at Eidsvold was retained and forms the Grundlov, or fundamental law of the kingdom. It is generally acknowledged to be the freest and most democratic con- stitution of all monarchical states. The union thus concluded between the two countries was really an offensive and defensive alliance under a common king, each country retaining its own government, parliament, army, navy, customs, &c. The relations between the two countries may be more clearly understood when it is realized that a Norwegian is a foreigner in Sweden, and a Swede in Norway, and that consequently a Norwegian can hold no official appointment in Sweden, and vice versa.

In Sweden the people received only an imperfect and erroneous insight into the nature of the union, and for a long time believed it to be an achievement of the Swedish arms, while to the leading men of the country, who knew the terms of the union better, it was a great disappointment. They had hoped to

make Norway a province of Sweden, and now they had entered into a union in which both countries were equally independent. During the first fifteen years the king was represented in Norway by a Swedish viceroy, while the Government was, of course, composed only of Norwegians, selected from various parties in the country. Count Wedel Jarlsberg was the fii-st to be entrusted with the important office of head of the Norwegian Government, while several of Prince Christian Frederick's councillors of state were retained, or replaced by others holding their political views. The Swedish Count v. Essen was appointed the first viceroy of Norway, and was succeeded two years afterwards by his countryman Count v. Morner, over both of whom Count Wedel exercised considerable influence.

During the first years of the union the condition of Norway was in many respects most unprosperous. The country suffered from poverty and depression of trade, and the finances were in a deplorable condition. The first Stortliing Strained was chiefly occupied with financial and other practical ‘“â€¢“ons measures. In order to improve the finances of the If,*∧”∧ country a Bank of Norway was founded, and the armv stoftMnr was reduced to one half, as the defence of the country *”

was not considered to be of great importance now that the union

history]

had been concluded. The paid-up capital of the bank was pro- cured by the assessment of an extraordinary tax, and this, together with the growing discontent among the peasantry, brought about a rising in Hedemarken and the neighbouring districts, the object of which was to dissolve the Storthing and to obtain a reduction in the taxation. It was also rumoured that the organizers of this agitation intended establishing an absolute government, and many therefore imagined they saw the machinations of the royal power behind the rising ; while, on the other hand, the king himself be- lieved he had to deal with Danish intrigues. The rising, however, soon subsided, and the bountiful harvest of 1819 brought more prosperous times to the

peasantry. Meanwhile, however, the finan- cial position of the country had nearly endangered its independence. The settlement with Denmark with regard to Norway's share of the national debt common to both, which had so long been deferred, and could not be evaded, had assumed threatening proportions. In the interest of Denmark, the Allied Powers asked for a speedy set- tlement, and in order to escape their collective intervention, Carl Johan, who had now succeeded to the throne of Sweden and Nor- way, on the death (5th February 1818) of the old King Carl SIII., accepted England's mediation, and was enabled in September 1819 to conclude a convention vrith Denmark, according to which Norway was held liable for only 3,000,000 specie dollars (nearly Â£700,000). But the Norwegians considered that this was still too much, and the attitude of the Storthing in 1821 had nearly occasioned a fresh interference of the Powers. The Storthing, however, yielded at last, and agreed to raise a loan and pay the anjount stipulated in the convention. Although this matter now seemed to be in a fair way of being settled, the king evidently had his doubts as to whether the Norwegians really intended to fulfil their obligations. As his relations with the Storthing had already become strained, and as he was occupied at that time with plans, which it is now known meant nothing less than a coup d'etat in connexion with the revision of the Norwegian constitution, he decided to adopt military preparations, and in July 1821 he collected a force of 3000 Swedish and 3000 Norwegian troops in the neighbourhood of Christiania, ostensibly for the mere purpose of holding some manoeuvres, but his object was undoubtedly to impress the Storthing with his authority and to frighten it into submission. In a circular note (1st June) to the European Powers, signed by the Swedish foreign minister, Engstromâ€" but it is not difficult to recognize the hand of the king as the real author â€" the minister complained bitterly of the treatment the king had met with at the hands of the Storthing, and represented the Norwegians in anything but a favourable light to the Powers, the intention being to obtain their sympathy for any attempt that might be made to revise the Norwegian constitution, as, for example, by the substitution of an absolute for a suspensive veto, by confemng upon the king the right to dissolve the Storthing and to elect its presidents â€" in short, to adapt the Norwegian constitution to the liking of his less democratic Swedish subjects.

About this time another important question had to be finally settled by the Storthing, which the king was anxious to oppose at all costs. The Storthings of 1815 and 1818 had already passed a bill for the abolition of nobility, but the king had on both occasions refused his sanction. The Norwegians maintained that the country was too poor consistently to keep up an aristocracy, and that the few counts and barons still to be found in Norway were all Danish and of very recent origin, whUe the really true and ancient nobility of the country were the Norwegian peasants, descendants of the old jarls and chieftains, who had no desire for titular distinction. According to the constitution, any bUl which has been passed by three successively elected Storthings (elections are held every third year) becomes law without the king's sanction. When the third reading of the bill came on, the king did everything in his power to obstruct it, but in spite of his opposition the bill was eventually carried and became law. These conflicts with the king had increased the strained relations which for some time had existed between him and the Storthing ; but after the question of the debt to Denmark had been settled, and the king had formally sanctioned the bill for the abolition of nobility, a more conciliatory feeling set in.

In 1822 Count Wedel Jarlsberg retired from the Government. He had become unpopular through his financial policy, and was also at issue with the king on vital matters. In 1821 he had been impeached before the Eigsret (the supreme court of the realm) for having caused the State considerable losses. J. Collett was appointed as his successor to the post of Minister of Finance. The king had by this time apparently abandoned his lioysl plan of a coup d'etat, for in the following August he

^'"'^Jf, submitted to the Storthing several proposals for funda- fatf'na/ â„¢6Â°''^1 changes in the constitution, all of which aimed revision. ^* removing all that was at variance with a monarchical form of government. The changes, in fact, were the same as he had suggested in his circular note to the Powers, and which he knew would be hailed with approval by his Swedish

subjects. It may seem strange that the king, favoured as he was by circumstances, took the constituti(3nal course, when he might easily have gained his end by a coup d'etat; but although Carl Johan was a man of

courage on the battlefield, he seems to have been wanting in courage civil, and he doubtless feared that a coup d'etat might result in unpleasant and humiliating conse- quences for himself. At the same time he knew that the Great Powers looked upon him with distrustful eyes, and that even in Sweden there were powerful enemies working against him.

When the Storthing met again in 1824 the royal proposals for the constitutional changes came on for discussion. The Storthing adopted a friendly attitude towards the king personally, without, however, showing itself subservient; but the assembly unani- mously rejected not only the king's proposals, but also several others by private members for changes in the constitution. The king submitted his proposals again in the foUovring session of the Storthing, and again later on, but they were always unani- mously rejected. In 1830 they were discussed for the last time, with the same result. The king's insistence was viewed by the people as a sign of absolutist tendencies, and naturally excited fresh alarm. They felt they would have to be on their guard against all attempts at encroachment and at amalgamation between Norway and Sweden. In the eyes of the people the members of the Opposition in the Storthing were the true champions of the rights and the independence which they had gained in 1814.

For several years the Norwegians had been celebrating the 17th of May as their day of independence, it being the anniversary of the adoption of the constitution of 1814 ; but as the tension between the Norwegians and the king increased, the latter began to look upon the celebration in the light of a demon- stration directed against himself, and when Collett, ^fâ€ž^UC!f the Minister of Finance, was impeached before the Â° ’” ”’”’

absolutist tendencies.

supreme court of the realm for having made certain payments without the sanction of the Storthing, he also con- sidered this as an attack upon himself and his royal prerogatives in general. His irritation knew no bounds, and although Collett was acquitted by the supreme court, the king, in order to express his irritation with the Storthing and the action they had taken against one of his ministers, dissolved the National Assembly vrith every sign of displeasure. The Swedish viceroy at the time. Count Sandels, had tried to convince him that his prejudice against the celebration of the 17th

of May was groimdless, and for some years the king had made no objection to the celebration. In 1827 it was, however, celebrated in a very marked manner, and later in the same year there was a demonstration against a company of Swedish actors who had been performing a foolish political piece called The Union, and this being privately reported to the king and represented to him in as bad a light as possible, he thought that Count Sandels, who had not considered it worth while to report the occurrence, was not fitted for his post, and had him replaced by Count Platen, an upright but narrow- minded statesman, who was looked upon as a mouthpiece of the prevailing opinion in Sweden, where the people considered them- selves defrauded of the real union they had hoped for.

Count Platen's first act was to issue a proclamation warning the people against celebrating the day of independence ; and in April 1828 the king, against the advice of his ministers, summoned an extraordinary Storthing, in consequence of the judgment of the supreme court and the uncertain basis upon which that judgment seemed to place his royal prerogatives, his intention being to wrest from the Storthing the supremacy it had gained in 1827. He also intended to take steps to prevent the celebration of the 17th of May, and in order to give due emphasis to his proposals he assembled a force of 2000 Norwegian soldiers in the neigh- bourhood of the capital. The king arrived in Christiania soon after the opening of the extraordinary Storthing. He did not succeed, however, in his attempt to make any constitutional changes, but the Storthing met the king's vrishes with regard to the celebration of the 17th of May by deciding not to continue the celebration, and the people all over the country quietly acquiesced. This was all that resulted from the king's great efforts on this occasion; but even this little triumph did not last long. The following year trouble broke out again. The students had decided to celebrate the 17th of May with a festive gathering, which, however, passed off quietly. But it was known that the authorities had made extraordinary preparations, and large masses of the people paraded the streets, out of cvuriosity, singing and shouting, and gathered finally in the market-place. There was no rioting or disturbance, but the Riot Act was read, and the police and the military eventually dispersed â„¢e the people and drove them to their homes with sword "battle and musket. This episode has become known as the " Battle of the Marketr-place," and did much to increase the general iU-feeling against Count

Platen, who. It has since been proved, was no friend of Norway, having actually

oftbe market- place.”

advised the king to try a coup d’etat. His health eventually broke down from disappointment and vexation at the indignities and abuse heaped upon him. He died in Christiania at the end of the year, and owing to the state of public feeling his post was not filled by a Swede, but remained vacant for several years, the presidency of the Norwegian Government in the meantime being taken by Col- lett, its oldest member. Prom this time the day of independence has been celebrated every year with increasing enthusiasm.

By the July Revolution the political situation in Europe became completely changed, and the lessons derived from that great move- ment reached also to Norway. A new generation had locreased grown up, which was more familiar with the forms of political political freedom, and also bolder in adopting them. The ^The representatives of the peasantry, for whom the constitu-

peasantry. ‘”’ ^^^ paved the way to become the ruling element in political life, were also beginning to distinguish them- selves in the National Assembly, where they now had taken up an in- dependent position against the representatives of the official classes, who in 1814 and afterwards had played the leading and most influ- ential part in politics. This party was now under the leadership of the able and gifted Ole Ueland, who remained a member of every Storthing from 1833 to 1869. The Storthing of 1833 was the first of the so-called ” peasant Storthings.” Hitherto the peasantry had never been represented by more than twenty members, but the elections in 1833 brought their number up to forty-five, nearly half of the total representation. The attention of this new party was especially directed to the

finances of the country, in the admin- istration of which they demanded the strictest economy. They often went too far in their zeal, and thereby Incurred considerable ridi- cule, and even the contempt of the official and well-to-do classes, who began to regard the new party with distrustful and hostile feelings.

About this time the peasant party found a champion in the youthful poet Henrik Wergeland, who threw himself heart and soul into the political questions of the day, and soon ‘**’*’’’^’’’’ became one of the leaders of the “Young Norway” ‘Ibaven V^l- He was a republican in politics, and the most zealous upholder of the national independence of Norway and of her full equality with Sweden in the union. He soon became as detested by the “party of intelligence,” as the official and well-to-do classes were called, as the party he had joined. In addition to the political struggles of the day, a literary conflict now began, which lasted for many years, and which in violence and intensity has scarcely ever been equalled in the history of the country. A strong opposition to Wergeland and the peasant party was formed by the upper classes under the leadership of another rising poet and writer, Johan Sebastian Welhaven, and other talented men, who wished to retain the literary and linguistic relationship with Denmark, while Wergeland and his party wished to make the separation from Denmark as complete as possible, and In every way to encourage the growth of the national characteristics and feeling among the people. Wergeland had therefore welcomed with joy the increase of the peasant party : he considered the peasantry the real descendants of the old Norsemen, the kernel of the nation, in fact, and with the prophetic foresight of the poet saw the important part they would play in the future political and intellectual life of the country. He devoted much of his time, by writing and other means, to promote the ‘education of the people ; but although he was most popular with the working and poorer classes, he was not able to form any political party around him, and at the time of his death he stood almost isolated. He died in 1845, and his opponents became now the leaders in the field of literature, and carried on the work of national reconstruction in a more restrained and quiet manner. The peasant party still continued to exist, but restricted itself principally to the assertion of local interests and the maintenance of strict economy in the budget.

The violent agitation that began in 1830 died away, and after Wergeland's death the political life of the country assumed a more quiet and harmonious aspect. The tension between the king and the legislature, however, still continued, and reached its height during the session of 1836, when all the royal proposals for changes in the constitution were laid aside, without even pass- ing through committee, and when various other steps towards up- holding the independence of the country were taken. The king, in his displeasure, decided to dissolve the Storthing ; but before it dispersed it proceeded to impeach Lovenskiold, one of the ministers, before the supreme court of the realm, for having advised the king to dissolve the Storthing. He was eventually sentenced to pay a fine of 10,000 kroner (about Â£550), but he retained his post. CoUett, another minister who had greatly displeased the king by his conduct, was dismissed ; but unity in the Government was brought about by the appointment of Count Wedel Jarlsberg as viceroy of Norway. From this time the rela- tions between the king and the Norwegian people began to improve, whereas in Sweden he was in his later years not a little disliked.

When the king's anger had subsided, he summoned the Storthing

to an extraordinary session, when several important bills were passed. Towards the close of the session an address to the king was agreed to, in which the Storthing urged that steps should be taken to place Norway in political respects upon an equal footing with Sweden, especially in the conduct' of diplomatic affairs with foreign countries. The same iff, , address contained a petition for the use of the national f. or merchant flag in all waters. According to the consti- questloa. tution, Norway was to have her own merchant flag, and in 1821 the Storthing had passed a resolution that the flag should be scarlet, divided into four by a blue cross with white borders. The king, however, refused his sanction to the resolution, but gave permission to use the flag in waters nearer home ; but beyond Cape Finisterre the naval flag, which was really the Swedish flag, with a white cross on a red ground in the upper square, had to be carried. In reply to the Storthing's address the king in 1838 con- ceded the right to all merchant ships to carry the national flag in aU waters. This was hailed with great rejoicings all over the country ; but the question of the national flag for general use had yet to be settled, and later on gave rise to long and violent

strifes before it was finally settled in accordance with the wishes of the people. With regard to the question raised in the address of the Storthing about the conduct of diplomatic affairs, and other matters concerning the equality of Norway in the union, the king in 1839 appointed a committee of four Norwegians and four Swedes, who were to consider and report upon the questions thus raised. In 1835 a royal decree had ordained that when the Swedish minister of foreign affairs transacted business which concerned the two countries, or Norway only, the Norwegian minister in attendance upon the king at Stockholm should be present ; but the Storthing, in its address, declared that it only considered this resolution to be a preparatory step towards a more complete and satisfactory arrangement of this important matter.

During the sitting of this first ” Union Committee,” as it was called, the question of a complete revision of the Act of Union was raised by the division of the Norwegian Government in attend- ance upon the king at Stockholm, but the proposal was not accepted by the Norwegian home Government. The powers of the committee were, however, extended to consider a comprehensive revision of the Act of Union, with the ?^^^’ , limitation that the fundamental conditions of the , f*^ . union must in no way be interfered with. But before ,^-h the committee had finished their report the king i,yOscarl died (8th March 1844), and was succeeded by his son Oscar I. According to the constitution the Norwegian kings must be crowned in Throndhjem cathedral, but the bishop of Throndhjem was in doubt whether the queen, who was a Catholic, could be crowned, and after the question had become the subject of public discussion, the king decided to forego the coronation both of himself and his queen. The new king soon showed his desire to meet the wishes of the Norwegian people. Thus he decided that in all documents concerning the internal govern- ment of the country Norway should stand first where reference was made to the king as sovereign of the two kingdoms. After having received the report of the committee concerning the flag question, he resolved (20th June 1844) that Norway and Sweden should each carry its own national flag as the naval flag, with the mark of union in the upper corner ; and it was also decided that the merchant flag of the two kingdoms should bear the same mark of union, and that only ships sailing under these flags could claim the protection of the State. The Union Committee did eventually present a

report, in which it was proposed that the two countries should have a foreign minister in common, which the Norwegian Government gave their opinion upon, but which the Swedish Government rejected.

The financial and material conditions of the country had now considerably improved, and King Oscar’s reign was marked by the carrying out of important legislative work and reforms, especially in local government, of which Norway now possesses one of the most perfect systems. New roads were planned and built all over the country, the first railway was built, steamship routes along the coast were established, lighthouses were erected, and trade and shipping made great progress. The kind’s reign was not disturbed by any serious conflicts between “the two countries, and the relations between the Government and the Storthing were of a harmonious character, both working for the internal development of the country. No change took place in the ministry under the presidency of the Viceroy Lovenskiold upon King Oscar’s accession to the throne, but on the death or retirement of some of its members the vacant places were filled by younger and talented men, among whom was Frederik Stang, who in 1845 took over the newly established Ministry of the Interior. During the Schleswig-Holstein rebellion (1848-50) and the Crimean war King Oscar succeeded in maintaining the neutrality of Norway and Sweden, by which Norwegian shipping especially benefited. The abolition of tlie English Navigation

Acts (1850) was of great importance to Norway, and opened up a great future for its merchant fleet.

In 1826 a treaty had been concluded with Russia, by which the frontier between that country and the adjoining strip of

Norwegian territory in the Polar region was definitely delations delimited ; but in spite of this treaty Russia in 1851 P . demanded that tlie Russian Lapps on the Norwegian

KISS a. frontier should have the right to fish on the Norwegian coast, and have a portion of the coast on the Varanger fjord allotted to them to settle upon. The Norwegian Government refused to accede to the Russian demands, and serious complica- tions might have ensued if the attention of Russia had not been directed in another direction. While his father had looked to Russia for support, King Oscar was more inclined to secure the Western Powers as his allies, and during the Crimean war (1855) he concluded a treaty vrith England and Prance, according to which these countries promised their assistance in the event of any fresh attempts at encroachment on Norwegian or Swedish territory by Russia. In consequence of this treaty the relations between Norway and Sweden and Russia became somewhat strained ; but after the peace of Paris (1856) and the accession of Alexander 11., whose Government was in favour of a peaceful policy, the Russian ambassador at Stockholm succeeded in bring- ing about more friendly relations.

In 1855 two commissions, consisting of an equal number of Norwegians and Swedes were appointed. One of these was to consider a new bill for regulating the commercial relations between the two countries, which was to take the place of an older one of 1827 ; while the other commission was to prepare a bill for the execution in either country of judicial judgments delivered in the other. The reports of these commissions were laid before and passed by the Swedish Riksdag ; but when they came before the Norwegian Storthing they were rejected as unsuitable for Norway, a decision which caused great irritation in Sweden.

Owing to the king’s ill-health, his son, Crown Prince Carl, was appointed regent in 1857, and two years later, when King Oscar

died, he succeeded to the thrones of the two countries 2””**Â°’. as Cari XV. He was a gifted, genial, and noble ac^ssl’o’tt P6rsoii3,lity, and won the hearts of all who came into olCarlXV. contact with him. He was also of an artistic nature,

and devoted himself to painting, poetry, and music. He had desired to inaugurate his reign by giving the Norwegians a proof of his willingness to acknowledge the claims of Norway, but he did not live to see his vfishes in this respect carried out. According to the constitution, the king had the

power to appoint a viceroy for Norway, who might be either a Norwegian or Swede. Since 1829 no Swede had held the post, and since 1859 no appointment of a viceroy had been made, the general hope being that the office would be abolished altogether. But the paragraph in the constitution still existed, and the Norwegians naturally wished to have this stamp of “provinciality” obliter- ated. A proposal for the abolishment of the office of viceroy was Q ^ -laid before the Storthing in 1859, and passed by it. Norwmclan ‘^^^ ^^Zi whose sympathies on this question were viceroy. known, had been appealed to, and had privately

promised that he would sanction the proposed change in the constitution; but as soon as the resolution of the Storthing became known in Sweden, a violent outcry arose both in the Swedish press and the Swedish Estates. The latter adopted a resolution declaring that the paragraph relating to the office of viceroy was a necessary condition of the union between the two countries, and could not be altered without the consent of the Swedish executive. Under the pressure that was brought to bear upon the king in Sweden, he eventually refused to sanction the resolution of the Storthing ; but he added that he shared the views of his Norwegian counsellors, and would, when ‘ ‘ the convenient moment” came, himself propose the abolition of the office of viceroy. This was but a poor consolation for the Norwegian people, who well knew that it was the dominant feeling in Sweden against the equality of Norway in the union which had come out triumphantly on this occasion. When the Storthing received the news of the refusal, it adopted an address to the king (April 1860) which stated that no Norwegian who had any regard for his country and his own honour would take any share in the revision of the Act of Union on any other basis than that of the complete equality of the two kingdoms in the union.

In the following year the Swedish Government again pressed the demands of the Swedish Estates for a revision of the Act of Union,

which this time included the establishment of a Swedish union or common parliament for the two countries, on posals-^^ basis that, according to the population, there otA^af” should be two Swedish members to every Norwegian. Uaioa. The proposal was sent to the Norwegian Government,

which did not seem at all disposed to entertain it ; but some dissensions arose with regard to the form in which their reply was to be laid before the king. The more obstinate

members of the ministry resigned, and others, of a more pliable nature, were appointed under the presidency of Frederik Stang, who had already been minister of the interior from 1Â«45 to 1856. The reconstructed Government was, however, in accord with the retiring one, that no proposal for the revision of the Act of Union could then be entertained, as the attitude of Sweden towards the claims of the Norwegians for equality in the union seemed to be the same as in 1859 and 1860, and the question was in consequence to be allowed to rest for the time being. The king, however, advocated the desirability of a revision, but insisted that this would have to be based upon the full equality of both countries.

In 1863 the Storthing assented to the appointment by the king of a Union Committee, the second time that such a committee had been called upon to consider this vexatious question. It was not until 1867 that the report of the committee was made public, but it could not come on for discussion in the Storthing till it met again in 1871. During this period the differences between the two countries was somewhat thrust into the background by the Danish complications in 1863-64, which threatened to draw the two king- doms into war. King Carl was himself in favour of a defensive alli- ance with Denmark, but the Norwegian Storthing would only con- sent to this if an alliance could also be effected with two, or at least one, of the Western Powers. Under the circumstances the king felt himself obliged to withdraw from the proposed alliance with Den- mark, as none of the Western Powers showed any sign of assisting the Danes, although they had guaranteed the indivisibility of Denmark.

In 1869 the Storthing passed a resolution by which its sessions from 1871 were made annual instead of triennial according to the constitution of 1814. The first important question which the first yearly Storthing in 1871 had to consider was once more the proposed revision of the Act of Union. The Norwegians had persistently maintained that in any discussion on this question the basis for the negotiations should be (1) the full equality of the two kingdoms, and (2) no extension of the bonds of the union beyond the

line originally defined in the Act of 1815, but the draft of the new Act contained terms in which the supremacy of Sweden was presupposed, and which introduced important exten- siQns of the bonds of the union ; and, strangely enough, the report of the Union Committee was adopted by the new Stang ministry, and even supported by some of the most influential newspapers and in several of the leading circles of the Norwegian community. The reactionary tendencies, which were hidden under the plausible garb of ” Scandinavianism,” reasserted them- selves, and the official classes saw in this new union a safeguard against the growing liberal and democratic fl”””‘‘fji movements in the country. Under these circum- fZ’e^ stances the “lawyers’ party,” under the leadership of national Johan Sverdrup, who was to play such a, prominent party. part in Norwegian politics, and the ” peasant party,” led by Soren Jaaboek, a gifted peasant proprietor, who was also destined to become a prominent figure in the political history of the country, formed an intimate alliance, with the object of guarding against any encroachment upon the liberty and inde- pendence which the country had secured by the constitution of 1814. This was the foundation of the great national party, which became known as the “Venstre” (the left), and which before long became powerful enough to exert the most decisive influence upon the political affairs of the country. When, there- fore, the proposed revision of the Act of Union eventually came before the Storthing of 1871, it was rejected by an overwhelming majority, and this contentious question, which since 1859 from time to time had assumed a most threatening aspect, may now be said to have been finally shelved and disposed of. The position which the Government had taken up on this question helped to open the eyes of the Norwegians to some defects in the con- stitution, which had proved obstacles to the development and strengthening of the parliamentary system, of which the con- stitution had laid the foundation, and to the desirability of a, harmonious co-operation between the executive and legislative powers of the country, in order that the smaller State might more effectively assert its rights and position in the union in opposition to the greater, which seemed ever intent upon assuming the r61e of the predominant partner in the union. And this gave rise to the great question of the admittance of the ministers to seats in the National Assembly, which came to a crisis in the ‘eighties.

In 1872 a private Bill came before the Storthing, proposing that the ministers should be admitted to the Storthing and take part in its proceedings. After a number of stormy debates, the Bill was successfully carried under the leadership Qaestloa of Johan Sverdrup, by a large majority (80 against “ff^”’” 29) ; but the Government, evidently jealous of the ”’”’’ ”

tance of ministers

grovring powers and influence of the new Liberal ^ ^^^^ j^ party in the Storthing, advised the king to refuse his n^e stor- sanction to the Bill, although the Government party tblag. itself had several times in the preceding half -century introduced a similar Bill for admitting the ministers to the

Storthing ; but at that time the Opposition had looked with suspicion on the presence of the ministers in the National Assembly,’ lest their superior skill in debate and political experi- ence should turn the scale too readily in favour of Government measures. Now, on the contrary, the Opposition had gained more experience and confidence in its own strength, and no doubt found that the legislative work could better be carried on if the ministers were present to explain and defend their views ; but the Government saw in the proposed reform the threatened introduction of full parliamentary government, by which the ministry could not remain in office unless supported by a majority in the Storthing. The king’s refusal created great dissatisfaction and irritation both in the Storthing and throughout the country. The relations between the Government and the majority in the Storthing were already considerably strained, and in the refusal the Storthing only saw another ill-timed assertion of govern- mental authority. Before the Storthing separated the Liberals carried a vote of censure against the Government ; but the king declared that the ministers enjoyed his confidence, and that he would uphold his right to appoint and keep what ministers he pleased, and took no further notice of the vote. Two of the

ministers, who had advised the ratification of the Bill, resigned, however ; and a third minister, who had been in the Government since 1848, resigned also, and retired from public life, foreseeing the storm that was brewing on the political horizon. Numerous public meetings were held all â€¢ over the country in support of the proposed reform, fully approving of the step the Storthing had taken by proposing the vote of want of confidence. Among the speakers was Johan Sverdrup, who had now become the acknowledged leader of the Liberal party, and who was hailed with great enthusiasm as the champion of the proposed reform.

This was the political situation when King Carl died (18th September 1872). He was succeeded by his brother, who ascended the throne as Oscar II. In the following year he ‘c^lXV â– ^^^Â® ‘’ sanction to the Bill for the abolition of the Session Â°Â®Â°^ Â°^ viceroy, which the Storthing had again ot Oscar IL pa^sed, and the president of the ministry was after- wards recognized as the prime minister and head of the Government in Chrlstiania. Frederik Stang, who was the presi- dent of the ministry at the time, was the first to fill this office. In the same year Norway celebrated its existence for a thousand years as a kingdom, with great festivities.

In 1874 the Government, in order to show the people that they to some extent were willing to meet their wishes with regard to the great question before the country, laid before the Stor- Proposals thing a royal proposition for the admittance of the min- ^ ‘i? , isters to the National Assembly. But this was to be for full ^‘‘oompanied by certain other constitutional changes, such popular ^^ gi’^ing the king the right of dissolving the Storthing at control. his pleasure and providing fixed pensions for ex-ministers, which they held up as a guarantee against the majority of the assembly misusing its new power. The Liberal party in the meantime received more and more support all over the country for their proposal and for full parliamentary government. Johan Sver- drup well summed up their policy in the following curt sentence : “All power must be gathered in this hall.” The Bill which the Government brought in was unanimously rejected by the Storthing, the Conservatives also voting against it, as they considered the guarantees insufficient. The same year, and again in 1877, the Storthing passed the Bill for admitting the ministers to the National Assembly, but in a somewhat

different form from that of 1872. On both occasions the king refused his sanction to the Bill.

The Storthing then resorted to the procedure provided by the constitution to carry out the people’s will. In 1880 the Bill was passed for the third time, and on this occasion by the overwhelm- ing majority of 93 out of 113. Three Stortliings after three successive elections had now carried the Bill, without any divergent resolution having been adopted in the period between the first and third reading, and according to the constitution the Bill would then become law with or without the king’s sanction. It was, however, generally expected that the king and his Government would at length comply with the wishes of the people, but the . , king on this occasion also refused to sanction the Bill, Theklaga declaring at the same time that his right to the ’’* “â– absolute veto was “above all doubt.” A feeling of

disappointment and irritation pervaded the whole country, and many even of the Conservatives, both in and out of the Storthing, regretted the king’s decision. .Johan Sverdrup, the leader of the Liberal party and president of the Storthing, brought, however, the question to a prompt issue by proposing to the Storthing that the Bill, which had been passed three times, should be declared to be the law of the land without the king’s sanction. This proposal was carried by a large majority on the 9th of June 1880, but the king and his ministers in reply declared that they would not recognize the validity of the resolution. From this moment the struggle may be said to have centred itself

upon the existence or non-existence of an absolute veto on the part of the crown. The king requested the Faculty of Law at the Chrlstiania University to give its opinion on the question at issue, and with one dissentient the learned doctors ?‘f”*fâ€ž upheld the king’s right to the absolute veto in questions ^^^ ^^^^ concerning amendments of the constitution, although gâ€žjfi,e they could not find that it was expressly stated in the storthing. fundamental law of the country. The ministry also ad- Vised the king to claim a veto in questions of supply, which still further increased the ill-feeling in the country against the Govern- ment, and the conflict in consequence grew more and more violent.

In the midst of the struggle between the king and the Storthing, the prime minister, Frederik Stang, resigned, and Christian August Selmer became his successor ; and this, together with the appoint- ment of another member to the ministry, K. H. Schweigaard, plainly indicated that the conflict with the Storthing was to be continued. In June 1882 the king arrived in Chrlstiania to dissolve the Storthing, and on this occasion delivered a speech from the throne, in which he openly censured the representatives of the people for their attitude in legislative work and on the question of the absolute veto, the speech creating con- â€ž, ., siderable surprise throughout the country. Great fjgg preparations were now made by both parties for the impending elections, and public meetings were held during the recess all over the country. Johan Sverdrup and Bjornstjerne Bjornson, the popular poet and dramatist, were the principal speakers, and called upon the people to support the Storthing in upholding the resolution of the 9th of June, and to rouse them- selves to a sense of their political rights. The elections resulted in a great victory for the Liberal party, who returned stronger than ever to the Storthing, the Liberals now numbering 83 and the Conservatives only 31. The ministry, however, showed no sign of yielding or resigning their offices, and when the new Storthing met in February 1883, the Odelsthing (the lower division of the National Assembly) decided upon having the question finally settled by impeaching the whole of the ministry laipeach' before the Rigsret, or the supreme court of the realm, â„¢e"' of the last constitutional means by which the Storthing ^^? * could obtain the dismissal of the ministry, which for Jtorthlae years had continued to govern without the confidence iggs. or support of the National Assembly. The juris- diction of the Rigsret is limited to the trial of offences against the State, and there is no appeal against its decisions. The charges against the ministers were for having acted contrary to the interests of the country by advising the king to refuse his sanction â€" first, to the amendment of the law for admitting the ministers to the Storthing; secondly, to a bill involving a question of supply ; and thirdly, to a bill by which the Storthing could appoint additional directors on the State railways.

The trial of the eleven ministers of the Selmer cabinet began in May 1883, and lasted over ten months. In the end the Rigsret sentenced the prime minister and seven of his ministers to be deprived of their offices, while three, who had either recommended the king to sanction the Bill for

admitting the ministers to the Stor- thing, or had entered the cabinet at a later date, were heavily fined. The excitement in the country, already considerable before the verdict had been given, rose to feverish anxiety in expectation of what the king would do. The Conservative organs of the country openly advised the king to disregard the ^‘‘e judgment of the supreme court, while party feeling ministry everywhere ran high. Rumours of all kinds were ^entenced afloat, and it was generally believed that the king oil t would attempt a covp d’etat. Many of the Conservative *

party in Sweden also encouraged the king to set the judgment aside, and it was even hinted that he might depend upon the Swedish army to assist him in carrying out his policy in Norway. Fortunately the king did not follow this advice, and after some hesitation he issued (11th March) an order in council announcing that the judgment of the supreme court would be carried into effect, and Selmer was then called upon to resign his position as prime minister. The king, however, in his declara- tion upheld the constitutional prerogative of the “l”’^- crown, which, he maintained, was not impaired by f.’‘ the judgment of the, Rigsret. The Conservatives were “^^

much disappointed with the king’s course of action, but consoled themselves by forcing upon the king the urgent necessity of appointing a new Conservative ministry, which would carry on the policy of the late cabinet. The following month the kins, regardless of the large Liberal majority in the Storthing, asked Schweigaard, one of the late ministers, whose punishment con- sisted in a fine, to form a ministry, and the so-called “April ministry” was then appointed. It tried to adopt the policy of its predecessors in a moderate form, but it met with such opposition from the very first that it sent in its resignation in the following month. Professor Broch, a former minister, next attempted to form a ministry, but without success, and the king

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was at last compelled to appoint a ministry in accordance with

the majority in the Storthing. In June 1883 Johan Sverdrup

was aslced to form a ministry. He selected for his

f/h*’ ministers leading men on the Liberal side in the Stor-

- /I tliingi and the first Liberal ministry that Norway had

Tsss ‘ ”” ^^ ^* ^^^S^^^ appointed. The Storthing, in order to

satisfy the king, passed a new resolution admitting the

ministers to the National Assembly, which then received the formal

sanction of the king.

During the following years a series of important reforms were carried through. Thus in 1887 the jury system in criminal matters was introduced into the country after violent opposition from the Conservatives. A Bill intended to give parishioners greater influence in Church matters, and introduced by Jakob Sverdrup, the minister of education, and a nephew of the prime minister, met, however, with strong opposition, and was eventually rejected by the Storthing, the result being a break-up of the ministry and a disorganization of the Liberal party. In June 1889 the Sverdrup ministry resigned, and a Conservative one was formed by Emil Stang, the leader of the Conservatives in the Storthing, and during the next two years the Storthing passed various useful measures ; but the ministry was eventually wrecked on the rock of the great national question which about this time came to the front â€” that of Norway’s share in the transaction of diplomatic affairs. At the time of the union in 1814 nothing had been settled as to how these were to be conducted, but in 1835 a resolution was issued, that when the Swedish foreign minister was Theques- transacting diplomatic matters with the king which Hon ot concerned both countries, or Norway only, the Norwe- dlplomatlc ^^^^ minister of state in attendance upon the king at JaSoD *”” Stockholm should be present. This arrangement has not always proved satisfactory to the Norwegians, especially as the Swedish foreign minister cannot be held responsible to the Norwegian Government or Parliament ; but in the meanwhile this state of

affairs has been allowed to drift on, and gradually the Swedish foreign minister has come to be looked upon as the foreign minister for Norway also. But this is not sanctioned by any paragraph in the constitution or the Act of Union, neither has it been confirmed by any act of the Storthing, and the Norwegians maintain that Norway has not enjoyed equal rights in the union and equal share in the transaction of diplomatic affairs with Sweden, as, according to the Act of Union, it had a right to demand.

By a change in the Swedish constitution in 1885 the ministerial council, in which diplomatic matters are discussed, came to con- sist of the Swedish foreign minister and two other J** members of the cabinet on behalf of Sweden, and of

c/aito***Â° ‘^Â® Norwegian minister at Stockholm on behalf of Norway. The king, wishing to remedy this disparity, proposed that the composition of the council should be determined by an additional paragraph in the Act of Union. The representa- tives of the Norwegian Government in Stockholm proposed that three members of the cabinet of each country should constitute the ministerial council, to which the Swedish Government were willing to agree, but on the assumption that the minister of foreign affairs should continue to be a Swede as before, which the Norwegians, of course, would not accept. The matter was in consequence shelved, and remained in abeyance for some time, but continued to be discussed in the press and at public meetings.

At the king’s instigation the negotiations with- the Swedish Government wei’e resumed at the beginning of 1891, and the Stang ministry succeeded in coming to an agreement with the Swedish Government that a measure should be introduced by which the Norwegians would practically obtain what the Storthing of 1886 had asked for, while the question of the nationality of the minister of foreign affairs was left for settlement In the near future. The Swedish Riksdag, however, rejected the proposal, while the Norwegian Storthing insisted upon “Norway’s right, as an inde- pendent kingdom, to full equality in the union, and therewith her right to watch over her foreign affairs in a constitutional manner.” The Stang ministry then resigned, and a Liberal ministry, with Steen, the recognized leader of the Liberal party after Sverdrup’s withdrawal from politics, as prime minister,

was appointed. In the same year the provision in the constitution empowering the king to instal the crown prince as regent in Norway was repealed, and the resolution was sanctioned by the king.

The new ministry had placed the question of a separate minister of foreign affairs for Norway prominently in their programme, but little progress was made during the next few years. Another and more important question for the country, as far as its Question ot shipping and commerce are concerned, now came to separate ^j^g fj.Qj^t ~~pj^g gtorthing had in 1891 appointed a Venice. committee to inquire into the practicability of estab~~ lishing a separate Norwegian consular service, instead of the existing combination with Sweden, with which the Nor- wegians maintain they have had reason to be dissatisfied. In 1892 the Storthing, acting upon the committee's report, determined

to establish a consular service in accordance with a plan prepared by the department of the interior. The king, no doubt influenced and supported by public opinion in Sweden, which was against the proposed separation ot the consular services, refused his sanction, and the Norwegian Government in consequence sent in their resignation, whereupon a complete deadlock ensued. This was terminated by a compromise to the effect that the ministry would return to office on the understanding that the question be postponed by common consent. The following year the Storthing again passed a resolution calling upon the Norwegian Government to proceed with the necessary measures for establish- ing the proposed consular service for Norway, but the king again refused to take any action in the matter. Upon this the Liberal ministry resigned (May 1893), and the king appointed a Conserva- tive Government, with E., Stang as its chief. Thus matters went on till the end of 1894, when the triennial elections took place, with the result that the majority of the electors declared in favour of national independence on the great question then before the country â€" that of separate consuls for Norway, and eventually of a separate responsible minister of foreign affairs for the country. The ministry did not at once resign, but waited till the king arrived in Christiania to open the Storthing (January 1895). The king would not accept their resignation there and then, but kept the country for over four months without a responsible Govern- ment, during which time the crisis had become more acute than ever. A

coalition ministry was at last formed, with Professor Hagerup as prime minister. A new committee, consisting of an equal number of Norwegians and Swedes, was appointed to consider the question of separate diplomatic representation ; but after sitting for over two years the committee separated without being able to come to any agreement, having, like the two previous “union committees,” proved the impossibility of the two countries coming to an understanding in this important question. While the committee was sitting the disputes concerning the politi- cal relations between the two countries were allowed to lie in abeyance.

The elections in 1897 proved again a great victory for the Liberal party (79 Liberals v. 35 Conservatives), and in February 1898 the Hagerup ministry ;was replaced by a Liberal, once more under the premiei-ship of Steen. Soon afterwards the Bill for the general adoption of the national or “pure” flag, as it was called, was carried for the third time, and became law without the king’s sanction. By this act the device or mark of union in the upper corner of the flag was abolished, but is still retained on men-of- war and fortifications. In 1898 universal political suffrage for men was passed by a large majority (75 v. 36), while the proposal to include women received the support of only 33 votes. In 1901 universal municipal suffrage was given both to men and women ; to the latter, however, with certain limitations. In January 1902 a committee was appointed to consider the consular question, and it was hoped that at last it would be settled. In April 1902 Steen, the prime minister, resigned and retired into private lite. He was succeeded by Otto Albert Blehr. (h. l. b.)

III. Literature sixce 1885

The political crisis of 1884-85, which produced so remarkable an effect upon the material and social life of Norway, was not without its instant influence upon literature. There had followed to the great generation of the ‘sixties, led by Ibsen and Bjbrnson, a race of entirely prosaic writers, of no great talent, much exercised with “problems,” distui-bed by the theories of Zola and Mau- passant, which they failed to comprehend, and ruined for the higher imaginative spheres of work by their obsti- nately doctrinaire attitude towards life. What strikes us as of high interest in the movement which began in 1885 is, firstly, that it brought back the fine masters of a

previous imaginative age ; secondly, that it silenced the problem-setters; and thirdly, that it encoui-aged into eager production a whole generation of new men, realists of a healthier sort, individualists, idealists, and poets. In 1885, then, the field was still held by the three great writers who are the three main names of modern ISTorse literature â€” Ibsen, Bjornson, and Lie. Henrik Ibsen (born 1828) {q-v.) proceeded deliberately with his labours. During the period under review he produced seven dramas, including what many critics hold to be his chef-cVoeuvre, Tlie Master Builder. His tendency was to turn more and more definitely back again

towards the poetic and symbolic maimer of his youth, and his name has at the same time steadily grown in reputation and influence. The advance of Bjornstjerne Bjornson (born 1832) (q.v.) was not so regular, because it was disturbed by political issues ; but he published one of the most remarkable of his novels, In God’s Way, and various tales and dramas. Moreover, his early peasant tales have once more, after having suffered great neglect, grown to be a force, and Bjornson’s example has done much to revive an interest in the art of verse, which had entirely died out in Norway in the previous decade. Jonas Lie (born 1833) (q.v.), still without a rival as the most popular novelist of Norway, continued to publish his pure, fresh, and eminently characteristic stories. Of these, eight or ten appeared after 1885, among them the most prominent being perhaps Tlie Commodore’s Daughter and Dyre Rein. Lie is not a great creative artist, but he contrived to win the ear of his country by his sin- cerity, his skill in narrative, and his remarkable power of identifying himself with the peculiarities of Norwegian feeling. His style, colloquial almost to a fault, has neither the charm of Bjornson nor the art of some of the latest generation. Ibsen, Bjornson, and Lie continue, however, to be the three representative authors of their country, and in their old age they grew to be the objects of extreme reverence and curiosity. Ibsen’s mother-in- law, the venerable novelist,

Magdalene Thoresen (born 1819), who long resided in Denmark, published nothing new for many years. Of the generation which followed hers, Kristofer Janson (born 1841) survived in 1902. In 1882 he left Norway to settle in America as a Uni- tarian minister, and from this exile he sent home in 1885 what is perhaps the best of his books, Tlie Saga of the Prairie. Janson went back to reside in Norway, and published in 1901 the most successful of his recent productions, Mediceval Tales. He writes in dialect, and has essayed lyric and drama, as well as prose fiction. Kjcistian Gloersen (born 1838), though still living in 1902, had not written for many yeais past. Frithiof Foss, (1820-1899) had long been silent before his death.

During the transition an author appeared, Alexander Kielland (born 1849), from whom for a time much was expected, and whose writings were treated with ex- aggerated attention. From 1878 to about 1887 Kielland published in rapid succession a series of novels and short stories, in which he showed himself a rather naive imi- tator of Gruy de Maupassant. He had no real vocation for letters, however, and civic ambition took the place of literary ardour; Kielland was made burgomaster of Star vanger, and has been heard of no more. A far more important talent of the transitional time was that of Arne Garborg (born 1851). He was brought up under sternly pietistic influences in a remote country parish, the child of peasant parents in the south-west corner of Norway, and the gloom of these early surroundings has tinged all his writings. The early novels of Garborg were written in the peasant dialect, and for that reason, perhaps, attracted little attention. It was not until 1890 that he addressed the public in ordinary language, in his extraordinary novel, Th-ed Men, which produced a deep sensation. This was an analysis of the passive type of intelligent decadent, the thinking man without a will, who becomes more and more a feature of modern society. Of late Garborg has returned, with violence, to the culti- vation of the peasant language, and has taken a fore- most part in the maalstrmv. A novelist of considerable crude force is Amalie Skram, settled in Denmark, who continues to write novels destitute of literary beauty, but excellent in their local color, dealing with life in Bergen and the west coast. But the most extravagant product of the prosaic period was Hans Jaeger (born

1864), who accepted the naturalistic formulas wholesale, and outdid Zola himself in the harshness of his pictures of life. The suit brought against his

preposterous novel, KristianiOrBoMmen, in 1885, was the signal for a reaction, and marks the moment of crisis. An author of more talent, in whom many of the qualities of the ” problem ” school are still to be discovered, is Knud Hamsun (born 1860), who has been remarkable for his egotism, and for the bitterness of his attacks upon his ovm fellow- writers and upon the great classic names of literature. He is more pleasantly contemplated in his own novels, which, however, are commonly deformed by a cynical violence and ugliness ; Hamsun is seen at his best in the powerful romance called Hunger (1888). A writer of a much more pleasing, and in its quiet way of a much more original order, is Hans Aanrud (born 1863), in whom the new influences of sweetness and light first made them- selves felt. His humour, applied to the observation of the Ostland peasants â€” Aanrud himself comes from the Gulbrandsdal â€” is exquisite ; he is by far the most amus- ing of recent Norwegian writers, a race whose fault it is to take life too seriously. His story. How our Lord made Hay at Asmund Bergemellum’s, is a little master- piece. His latest volume is The Seminarist (1901). Peter Egge (born 1869) is a young novelist and play- wright from Trondhjem, who is steadily coming to the front with very careful studies of types of Norwegian temperament. In his Jacob and CJiristopher (1901) Egge also proved himself a successful writer of comedy. Gun- nar Heiberg (born 1857), although older than most of the young generation, has but lately come into prominence. His poetical drama, The Balcony, made a sensation in 1894, but ten years earlier his comedy of Aunt Ulrica should have awakened anticipation. Heiberg is ardent and sensual, filled with the joy of life ; his dialogue is brilliant, but it might be possible to wish that it were made the ornament of less momentary issues. He is an author from whom much is expected. Two young writers of great promise have been removed in the very heyday of success, Gabriel Finne (1866-1899) and Sigbjorn Obst- felder (1866-1900). The last-mentioned was much under the sway of the latest mysticism, and not unbiassed by Maeterlinck. But in two books published in 1897, The Bed Drops and The Cross, he achieved an independent effect, obscure but attractive, and giving promise of some- thing quite new in Norwegian literature. Obstfelder, who died in a hospital in Copenhagen in August 1900, left an important book in MS., A Priest’s Diary (1901).

Verse was not merely neglected, but absolutely banished from Norwegian literature, during the years that immedi- ately preceded 1886. The credit of restoring it is given to a writer named Sigurd Bodtker, who wrote an extremely naturalistic piece called Love, in the manner of Heine. The credit of being the earliest real poet of the new generation belongs, however, without question to Niels CoUett Togt (born 1864), who published a little volume of Poems in 1887. In 1891 was printed in a magazine Vilhelm Krag's (born 1871) very remarkable poem called Fandango, and shortly afterwards a collection of his lyrics. Yogt and V. Krag continued to be the leading lyrical writers of the period, and although they have many imitators, they cannot be said to have found any rivals. Vilhelm Krag has of late turned to prose fiction, and his novels Isaac Seehuusen (1900) and Isaac Kapergast (1901) are excel- lent studies of Westland life. More distinguished as a novelist, however, is his brother, Thomas P. Krag (born 1868), who has published a series of romantic novels, of which Ada Wilde (1897) is the most powerful ; he has great charm of presentment, but seems unhappily not to be able to escape from a curious monotony of subject and treatment. His short stories are full of delicate charm :

the latest collection of them is The Happy Comer (1901). Hans E. Kinck (born 1865) is an accomplished writer of short stories from peasant life, written in dialect. He has published ten volumes, from Tlie Fab-y (1892) to Spring Nights (1901). Bernt Lie is the author of nine or ten popular works of fiction, mainly for the young; the latest of these is Sister Judith (1901). Sven Nilssen (born 1864) began to publish sketches and stories in 1894, and is the author of a very successful novel, TJie Barque Prandsha (1901). With him may be mentioned the popular dramatist and memoir-writer, John Paulsen (born 1851), author of TJie Widotv's Son. Jakob Hilditch (born 1864) has writtep many stories and sketches of a purely national kind, and is the anonymous author of a most diverting parody of banal provincial journalism, Tran- viksposten (1900-1). Criticism made some advance in these last years. The leading critics are Carl Naerup (born 1864) and Hjalmar Christensen (born 1869), each of whom has published valuable

collections of essays deal- ing with the aspects of recent Norwegian literature. The sudden death of the leading bibliographer and lexico- grapher of Norway, Jens Braage Halvorsen (1845-1900), inflicted a blow upon the literary history of his country ; his Dictionary of Norwegian Authors, 1885-1900 â€” still unhappily incomplete â€” is one of the most elaborate works of its kind ever undertaken. It is to be finished by Halfdan Koht. Among recent historians of Norway much activity has been shown by Ernst Sars (born 1835) and Yngvar Nielsen (born 1843). In Norwegian system- atic theology no one has arisen to take the place of Carl Paul Caspari (1814-1892), or even of Gisle Johnson (1822-1894). The great historian of Northern juris- prudence was L. M. B. Aubert (1838-1896), and in this connexion T. H. Aschehoug (born 1822) must also be mentioned. The leading philosopher of Norway in these years has been the Hegelian Marcus Jakob Monrad (born 1816), whose uEstlmties of 1889 is his masterpiece.

The close of 1899 and the beginning of 1900 were occu- pied by a discussion, which drowned all other interests, and in which every Norwegian author took part, as to the adoption of the landsmaal, or composite dialect of the peasants, as the national language in place of the rigs- maal or Dano-Norwegian. Political prejudice greatly embittered the controversy, but the proposition that the landsmaal, which dates from the exertions of Ivar Aasen (q.v.) in 1850, should oust the language in which all the classics of Norway are written, was opposed by almost every philologist and writer in the country, particularly by Bj6rnson.and Sophus Bugge (born 1833). On the other side, Arne Garborg’s was almost the only name which carried any literary weight. The maal has no doubt enriched the literary tongue of the country with many valuable words and turns of expression, but there the advantage of it ends, and it is dif&eult to feel the slightest sympathy with a movement in favour of suppressing the language in which every one has hitherto expressed him- self, in order to adopt an artificial dialect which exists mainly on paper, and which is not the natural speech of any one body of persons throughout the whole of Norway.

(e. g.)

Norwich, a city and municipal, county (1888), and parliamentary borough of England, forming a county of itself, situated on the Wensum, a little above its junction with the Yare, in Norfolk, 103 miles from London by rail. “A fine old city, truly, is that, view it from whatever side you will; but it shows best from the east, where the ground, bold and elevated, overlooks the fair and fertile valley in which it stands. ... At the foot of,the heights flows a narrow and deep river, with an antique bridge communicating with a long and narrow suburb, flanked

on either side by rich meadows of the brightest gi’een, beyond which spreads the city ; the fine old city, perhaps the most curious specimen at present extant of the genuine old English town. Yes, there it spreads from north to south, with its venerable houses, its numerous gardens, its thrice twelve churches, its mighty mound. . . . There is a grey old castle upon the tog of that mighty mound ; and yonder, rising 300 [215] feet above the soil, from among those noble forest trees behold that old Norman master-work, that cloud-encircled cathedral spire, around which a garrulous army of rooks and choughs continually wheel their flight” (George Borrow, Lavengro, chap. xiv.). Very many of the churches were restored, either wholly or in part, during the last sixteen years of the 19th century, e.g., the cathedral in 1892 and 1900 ; St Peter Mancroft, St Andrew’s, St Michael’s at Coslany, and its Thorp chapel; St John Maddermarket, St Augustine’s, St George’s, St James’s, St John the Baptist’s, St Margaret’s, St Martin at Oak, St Mary the Virgin, St Michael’s at Plea, St Michael at Thorn. St Thomas’s was consecrated in 1888. St Peter at Southgate was taken down in 1887. The Roman Catholic cathedral of St John the Baptist, begun in 1884 from designs by Mr G. G. Scott, occupies a commanding site outside St Giles’s Gate. In 1884 the corporation purchased the castle, which had been used as a prison, and â€” a new gaol having been built on Mouse- hold Hill â€” converted it (1894) into picture galleries and rooms for the museum. The more notable public build- ings and institutions which have come into existence since 1884 are â€” the volunteer drill haU, the new barracks on Mousehold Heath, the gaol there, the Blind Asylum and schools, the Norwich and Ely Diocesan Training College, the Soldiers’ and Sailors’ Institute, the Jenny Lind In- firmary for Sick Children (1900), and the Municipal Technical Institute, amalgamated with the School of Sci- ence and Art (1901). The Norfolk and Norwich Library was burnt down in 1899,

but was re-erected and opened in 1900. Mousehold Heath has been acquired by the corporation, and laid out as a public recreation ground. Chapel Field Gardens and Castle Gardens are laid out as public recreation grounds. In 1899 the resewering of the city was completed. The numerous and varied industries retain their importance. The municipal and county borough, which is coextensive with the parliamentary borough, and has an area of 7558 acres, is administered by a mayor, 16 aldermen, and 48 councillors. It returns two members to the House of Commons. Population (1891), 100,970; (1901), 111,728. Birth-rate, 29-1 (1899) ; death-rate, 17-3 (1899).

See Kev. W. Hudson, How the City of Xorwich grew into Shape (Norwich, 1897), and other works by the same ; also, boolffi quoted under Norfolk.

Norwich, a city of Connecticut, U.S.A., capital of New London county, on the Thames river, 14 miles above New London, in the south-eastern part of the state. Its plan is very irregular, it has an excellent water-supply, the works of which are owned and operated by the city, and an excellent sewerage system. It has a good harbour and much coastwise commerce, having daily steamers to New York. It is on the New York, New Haven, and Hartford (New England) and the Central Vermont rail- ways. The capital invested in manufactures was, accord- ing to the census of 1900, $8,566,437, and the value of the products was $8,388,343. Population (1890), 16,156 ;

(1900), 17,251. –

Norwich, a village of New York, U.S.A., capital of Chenango county, iu lat. 42Â° 32’, long. 75Â° 31’, on the Chenango river and the Delaware, Lackawanna, and Western and the New York, Ontario, and Western rail- ways, at an altitude of 987 feet. It is in a farming

and dairying region and contains some manufactures, in- cluding the works of the New York, Ontario, and Western railway. Population (1890), 5212 ; (1900), 5766.

Norwood, a village of Hamilton county, Ohio, U.S.A., a few miles north-east of Cincinnati, of which it is a suburb. Population (1900), 6480, of whom 718 were foreign-born and 80 negroes.

Nossi Be, an island and Prench colony off the north-west coast of Madagascar. It has an area of 130 sqiiare miles, and bristles with volcanoes. The climate is similar to that of Mayotte (see Comoro Islands), and the neighbouring island of Nossi Comba serves for a sana- torium. The population, consistingof Sakalavas, increased from 7800 to 9500 between 1888 and 1898. Since 1896 Nossi Be has been under the authority of the governor of Madagascar. It has an administrator at Hellville (popu- lation, 1100), the capital, a port of call for the Messageries steamships from Prance, and an important centre for the coasting trade along the western shores of Madagascar. There is excellent anchorage at this port, which has a magnificent pier 800 feet long; two important German mercantile houses have been established, and there are twenty factories for sugar and rum. The soil of the island is very fertile, and yields coffee, sesame, the sugar- cane, vanilla, and tobacco. The trade with Prance in 1898 amounted to only Â£22,120, of which Â£16,000 was for imports, but the total trade exceeded Â£120,000.

Noto, a town and bishop’s see of the province of Syracuse, Sicily, Italy, 27 miles south-west of Syracuse on the railway to Licata. It possesses a fine town hall and cathedral, a convict prison, and antiquarian and numismatic collections. It manufactures vegetable fibre, macaroni, and olive oil, quarries limestone, and produces wine. Population (1881), 16,262 ; (1899), 18,500.

Nottingham, a north midland county of England, bounded on the E. by Lincoln, on the S. by Leicester, on the W. by Derby and York, and on the N. by York.

Area and Population. â€” In 1891 the area of the ancient (geo- graphical) county was 539,752 acres, and the population 445,823, of whom 214,199 were males and 231,624 females, showing an increase of 54,008 since 1881, an increase at the rate of 12-1 per cent. , as compared with an increase at the rate of 17 ‘3 per cent, during the ten years 1871-81. In 1901 the population was 514,537, showing an increase of 68,714, or at the rate of

15-4 per cent, since 1891. In 1901 there were 0-95 person to an acre and 1-04 acres to a person. The area of the registration county in 1891 was 616,285 acres, and the population 505,311, of whom 245,338 were males and 259,973 females ; and in 1901, 596,668. Particulars of the birth-rate, death-rate, and the number of persons married per thousarid inhabitants, as well as the illegitimacy-rate per thousand births, are given in the annexed table : â€”

1871-SO.

1881-90.

1889-98.

1899.

Birth-rate . Death-rate . lUegitim acy-rate Marriage-rate

36-9 21-4 64

17-8

36-1 19-6 54 16-3

32-5 17-9 54 16-3

32‘2 18-8 48 17-6

In 1891 the county contained 1734 persons of Scottish birth, 1454 of Irish birth, and 12D5 foreigners. At the same date there were 390 blind persons, 200 deaf and dumb, and 1474 insane.

Administration. â€” For parliamentary purposes the ancient county is divided into four divisions (Bassetlaw, Newark, Eusholiffe, and Mansfield), each returning one member, and the parliamentary borough of Nottingham, which returns one member for each of its three divisions (West, East, and South). The administrative county embraces the three municipal boroughs of East Eetford, Mansfield, and Newark, and the county and municipal borough of Nottingham. There are one court of quarter sessions and seven

petty sessional divisions. The boroughs of East Retford, Newark, and Nottingham have separate commissions of the peace, also separate courts of quarter sessions. The administrative county contained 259 and the county borough of Nottingham 9 entire civil parishes in 1891 ; there were also four parishes which were partly situated in the county and partly in the county borough, and three

others which were partly in other administrative counties. Since 1897 the nine parishes and parts of four parishes comprised within the county borough have been constituted one civil parish. The ancient county contains 220 entire ecclesiastical parishes and dis- tricts, and parts of six others ; it is situated principally in the diocese of Southwell and partly in the diocese of York.

Education. â€” University College at Nottingham was attended during the session 1899-1900 by 1914 students ; the college was opened in 1881. Associated with it is a day training college for schoolmasters and schoolmistresses. At Nottingham there are also the Midland Institution for the blind and a school for deaf- mutes. On 31st August 1900 the county contained 245 elementary schools, namely, 60 board schools and 185 voluntary schools, the latter including 164 National Church of England schools, 8 Wesleyan, 5 Eoman Catholic, and 8 “British and other.” The average attendance during the year amounted to 42,873, out of a total of 53,066 on the register. The total school board receipts during the year were Â£188,355, inclusive of Â£563 earned under the Technical Instruction Act and Â£2669 under the Agricultural Rates Act.

Agriculture. â€” Since 1885 there has been an increase in the area of the meadow-lands, but a decrease in the areas sown with com and devoted to fallows ; also an increase in the acreage of per- manent grass. The area cultivated by tenants increased from 378,429 acres in 1889 to 385,319 acres in 1895, and to 395,003 acres in 1900 ; the area cultivated by owners decreased from 76,650 in 1889 to 62,918 acres in 1895, and to 52,686 in 1900.

The following table shows the areas under the different kinds of crops at the periods named : â€”

Area in

Area under

Area under

Area of

Area under

Cultivation.

Corn Crops.

Green Crops.

Bare Fallow.

Grass.

1880

450,862

149,162

51,834

24,232

...

1885

455,077

135,047

51,781

16,304

190,193

1890

455,739

126,691

49,733

13,366

204,333

1895

448,237

119,794

49,987

9,811

208,531

1900

447,689

123,663

51,115

8,418

209,274

The next table shows the number of the live stock at the periods named : â€”

Tear.

Cows and Heifers.

Other Cattle.

Total Cattle.

Horses.

Sheep.

Pigs.

1880 1885 1890 1895 1900

23,735 28,636 28,474 26,834 28,405

53,884 59,619 58,533 54,318 57,686

77,619 88,255 82,007 81,152 86,091

20,348 20,456 21,087 22,836 22,405

258,120 229,983 231,417 -221,642 196,680

23,026 26,605 32,333 33,649 28,295

Industries. â€” ~~During the year 1897 the number of hands em~~ ployed in the factories and workshops of the county amounted to 67,556, of whom 9410 were engaged in making machinery, implements, &c., 8986 in the clothing industries, 8955 in lace- making, 6961 in making hosiery, 4396 in bleaching and dyeing, 3299 in the paper and printing trades, 2965 in the cotton and woollen manufacture, 2852 in manufacturing tobacco and cigars, 1772 in the metal industries, 1549 in the wood industries, and 1460 in brewing, &c. Coal is the principal mineral mined, chiefly on the south-west border of the county, near Mansfield, and near Nottingham. In 1900 the output was 8,626,177 tons of coal (valued at Â£4,708,455), 397,073 tons of clay, 133,610 tons of gravel and sand, 77,492 tons of gypsum, 95,790 tons of limestone, and 6582 tons of sandstone ; the total value of all the mineral products being Â£4,784,322. In the same year 28,009 persons were employed in the mines and quarrie^.

See J. T. Godfrey. Notes on the BiUiography of Nottingham- shire. Ratcliffe-on-Trent, 1891.â€” J. Ward. Descriptive Catalogue of Books

relating to Nottinghamshire. Nottingham, 1892.

(j. T. BE.)

Nottingham, a municipal, county, and parliamen- tary borough of England, officially styled (by letters patent of 7th August 1897) ” the City.of Nottingham and County of the same City,” with a present area of 10,935 acres ; on the Trent, 124 miles from London by rail. Connexion with the London and North-Western line was opened in 1888, and with the Great Central in 1899, the station on the latter railway costing over a million sterling. By the Borough Boundaries Act of 11th June 1887 the parishes or districts of Sneinton, Lenton, Rad- ford, Bulwell, Standard Hill, the Castle, Brewhouse Yard, and parts of Wilford, West Bridgford, and Gedling were

incorporated in the municipal borough, wMcli is now administered by a mayor, 16 aldermen, and 48 coun- cillors, and has its own commission of the peace and a separate court of quarter sessions. Of modern churches may be mentioned St Catherine’s, in the Perpendicular style, St George’s, St Emmanuel’s, St Stephen’s (1898), and St Bartholomew’s, erected in 1899. The following have been restored since about 1875 : St Mary’s, St James’s, St Mark’s, and St Peter’s. In addition to their cathedral, the Roman Catholics own the church of St Edward’s and the Church of Our Lady and St Patrick. Altogether there are over 90 Nonconformist places of worship. In 1899-1900 University College was attended by 1914 students, whilst 16,951 class tickets were issued. There are two technical schools in connexion with the school board. The more notable public buildings are the Guild- hall and City Sessions Courts (1887), the post office, and the poor lasv offices. The county gaol was enlarged in 1894. The Pree Library and the Free iluseum of]SI”atural History have been housed in the University College buildings since 1881 ; the former has 13 branches. In 1886 a new cattle market, covering 7 acres, was opened. New corporation and private baths have been built in Gedling Street, and a new wing added to the Midland Institution for the Blind. There is a high school for girls ; and in 1882 the Midland Baptist Col- lege was transferred to Nottingham. The city

is supplied with water from waterworks at Papplewick, Bestwood, Bellevue, Mapperley, and Burton Joyce, and there is a reservoir at Boughton. The principal industries still re- main the same as in 1884, but the cycle trade is now largely carried on here and in the locality. The city re- turns three members to the House of Commons, being divided for parliamentary purposes into the West, East, and South divisions. Population (1891), 213,877 ; (1901), 239,763. Area, 10,935 acres. Death-rate, 20-0 (1899); birth-rate, 28-8 (1899).

See Records of the Borough of Nottingham, i vols. (1882-89).

Nouzon, town, arrondissement of Mezieres, depart- ment of Ardennes, Prance, 4 miles north of]\Iezieres by rail, picturesquely situated at the confluence of the Gontelle and the Mardreuil with the Meuse. It has numerous foundries and forges turning out all kinds of iron goods. One of the establishments is said to be the largest foundry for malleable metal in Prance. Steam tramways connect Nouzon with Neufmanil, 6 miles, and Gespunsart, 8 miles distant, where also are important iron-works. Population (1891), 6473; (1901), 7795.

Novaliches, Manuel Pavia y Lacy (1814^ 1896), 1st Marquis de, Spanish marshal, was bom at Granada on 6th July 1814. He was the son of Colonel Pavia, and after a few years at the Jesuit school of Valencia he entered the Eoyal ArtilleryAcademy at Segovia. In 1833 he became a lieutenant in the guards of Queen Isabella II., and distinguished himself so much during the Carlist war from 1833 to 1840 that he rose to the rank of general of division in the latter year at the early age of twenty-six. He was offered the post of war minister before he reached his thirtieth year. He then began to take part in politics with the Moderate party, who made him war minister in 1847, and sent him to assume the command in Catalonia, where the great severity he displayed in his efforts to put down a Carlist rising was not attended vrith success. He had been made a senator in 1845 and marquis in 1848. Despite his reluctance, he was sent out to Manila in 1852 as captain-general of the Philippine Islands. In April 1854 he crushed with much sternness a formidable insurrection, shot or hanged all the ringleaders, and carried out many useful reforms after he had pacified the colony. On his return to Spain he married the countess of Santa

Isabel, and commanded the reserves in the Peninsula during the war with Morocco. He refused the war portfolio twice offered him by Marshals O'Donnell and Narvaez, and undertook to form a cabinet of Moderates in 1864 that lived but a few days. He volunteered to assist in crushing the insurrection in the streets of Madrid on 22nd June 1866, and when the revolution broke out decisively in September 1868 he accepted the command of Queen Isabella's troops. At their head he was defeated by Marshal Serrano at the bridge of Alcolea 28th September 1868, and was so badly wounded in the face that he was disfigured for life. He kept apart during the revolution, and went to meet King Alphonso XIII. when he landed at Valencia in January 1875. The Restoration made the marquis de Novaliches a senator, and the new king gave him the Golden Pleece. He died in Madrid on 22nd October 1896.

Novara, a town, episcopal see, and capital of the provrace of the same name. Piedmont, Italy, 31 miles by rail west of Milan. The town possesses a new theatre (1888), a museum of Roman antiquities, a notaries' school, and a technical school ; and is adorned by a bronze statue of Garibaldi and an equestrian monument of Victor Emmanuel (1881). There are two schools of the indus- trial arts. The principal industry is the carding and spinning of silk ; there are, further, iron-works and foundries, cotton mills, rice-husking mills, organ fac- tories, dye-works, and priattag works. Population (1881),

25,181; (1901), 44,928.

Nova Scotia. â€" A province of the Dominion of Canada, lying between 43Â° 25′ and 47Â° N. and 59Â° 40′ and 66Â° 10′ W. The Lower Cambrian formation, which forms an almost continuous belt along the Atlantic coast, where extensive gold-mining operations are carried on, varies in width from 10 to 75 miles and covers an area estimated at 8500 square miles. This belt is interrupted by large masses of intrusive granite, which occupy about 3600 square miles, leaving 5000 square miles of gold- bearing rocks. This part of the province presents a rough, rugged, and sterile appearance, abounding in small lakes and peat bogs. North of this area rocks of Ordo- vician, Silurian, and Devonian ages occur, which are also interrupted by great masses of felspathic and granitic rocks. These formations are capped in places by the Carboniferous and Permian, including two large areas of productive coal

measures in Cumberland and Pictou counties respectively. The Carboniferous area is divided into Carboniferous lime-stone or gypsiferous series, the Millstone Grit and the Coal Measures. The Cobequid Mountains, rising to a height of about 1050 feet and ex- tending from the Bay of Fundy along the shores of Minas Channel and Basin to the vicinity of Pictou, form the most prominent physical feature of this part of the province. The surface of the greater part is, however, imdulating, with fertile uplands and exceedingly rich valleys and marshes. Along the coast of the Bay of Pundy and at Minas Basin and Channel are bright, soft red sandstones of Triassic age associated with masses of contemporaneous trap rich in zeolites. The ridge of trap extending along the coast from Minas Channel to Briar Island is called the North Mountain, and rises about 700 feet high. Besides gold, already referred to, coal, gypsum, grindstones, building stone, and many minerals of economic importance are found in the province. (See Bketon, Cape.)

The following statistics relate to the whole province, including Cape Breton.

Climate. â€” Owing to its insnlax positios, Nova Scotia enjoys a more temperate climate than New Bmnswick. The average summer temperature is 65Â° F. and the winter 25Â° F. The average rainfall for twenty-seven years (1874-1900) was

38-1 inches, and the snowfall for the same period was 75-4 inches ; total precipitation, 45-6 inches.

Game. â€” Large and small game abound, owing to the strict enforcement of the laws, hut the wolf has become extinct.

Area and Population. â€” The area of the province is about 21,068 square miles, and the population is now (1901) 459,574. Popula- tion per square mile, 21-8. The population was 440,572 in 1881 â– in 1891, 450,396. In 1901 there were 89,106 families; average number per family, 5 ; number of

males, 233,642, and the number of females, 225,932. In 1891 the occupations were thus distri- buted : agriculture, fishing, and mining, 83,233 ; domestic and per- sonal service, 23,468 ; manufactures and mechanical industries, 26,548 ; professional, 6100 ; trade and transportation, 18,117 â– non-productive, 2619. In the census of 1901 the origin of the people is given as follows : English, 162,141 ; Irish, 55,830 ; Scottish, 142,207 ; Welsh, 1199 ; Dutch, 2941 ; French, 45,067 ; German, 38,854 ; Indians, 1543 ; negroes, 5984 ; Swiss, 1004 ; all other nationalities, 2804. Of the whole population, 457,948 were either born in Canada or are now naturalized citizens.

Constitution and Government. â€” The provincial executive now consists of three ministers with salaries and six without portfolios, and the members elected to the House of Commons have been reduced from twenty-one to twenty.

Beligion.â€”ln 1901 the principal religious denominations and their adherents were as follows : Church of England, 66,067 ; Church of Rome, 129,578 ; Presbyterians, 106,319 ; Methodists, 57,490 ; Baptists, 83,333 ; Congregationalists, 2938 ; Lutherans, 6572 ; Adventists, 1494 ; Disciples of Christ, 1412 ; Salvation Army, 1251.

Education. â€” In 1901 there were 2387 schools in operation, attended by 98,410 pupils, 91,114 of whom were in the common schools and 7296 In the high schools. There were 2492 teachers, and the total expenditure for public education was $844,762, the cost per pupil in annual enrolment being $8.58, and the cost per pupil daily present on an average $15.75. The following table shows the increase in attendance by decades, the figures giving the average of the summer and winter terms : â€”

Tear.

Teachers.

Pupils.

Total Cost.

1880 1890 1900

1809 2214 2557

76,393

85,482

100,129

$584,959 709,312 887,852

Finance. â€” The total revenue for the year 1901 was $1,090,230, and the expenditure $1,088,927 ; the gross debt $3,771,167, and the assets .11,368,655. Succession duties have been imposed on estates above a certain value.

Defence. â€” -The militia consists of an active cavalry, garrison artillery, and infantry force of .307 officers and 3742 non-commis- sioned officers and men. There are important fortifications at Halifax, where British regiments were formerly stationed, but since 1900 their place has been occupied by Canadian troops.

Minerals and Mining. â€” ^There has been a steady increase in the output of gold and coal, which have about doubled since 1882. The mineral production in 1901 was valued at $8,335,000, including gold, 26,057 oz., $546,963 ; iron ore, 18,169 tons, $46,548 ; coal, 4,158,068 tons, $6,496,982 ; gypsum, 170,100 tons, $136,947.

Agriculture. â€” In common with other provinces of Canada, Nova Scotia has made considerable progress in butter and cheese manufacture. In 1901 there were in operation eight creameries, seven cheese factories, and six factories where both butter and cheese were made, producing 316,180 ft of cheese and 266,109 ft of butter, valued at $83,761. This is exclusive of large quantities of home-made butter and cheese. Increased attention has been given to the cultivation of small fruits, and also to the shipping of apples to the English market. In 1891 the total occupiers of land were 64,643 ; of these 60,069 were owners, 4413 tenants, and 161 employfe. Total lands

occupied, 6,080,695 acres ; improved, 1,993,697 acres ; under crop, 969,548 acres ; in pasture, 994,113 acres ; woodland and forest, 4,086,998 acres ; garden and orchards, 30,036 acres. The principal crops raised were oats, buckwheat, potatoes, turnips, and other roots. Of animals and their products there were in 1891 : horses, 65,047 ; oxen, 28,424 ; milch cows, 141,684 ; other homed cattle, 154,664 ; sheep, 331,492 ; swine, 48,048 ; domestic fowl, 792,184'; butter, 9,011,118 ft ; cheese, 589,363 ft ; wool, 1,072,234 ft.

Fisheries. â€" Under an Act passed by the Dominion Government $160,000 is annually distributed among the fishermen and fishing vessels ; of this amount Nova Scotia received $101,448 in 1900, divided among 526 vessels (22,474 tons) and 5352 men, 6927 boats and 10,645 men. In the same year the total number of vessels employed in the fisheries was 657 (26,064 tons), manned by 5816 men, and 14,766 boats with 19,396 men ; 6447 persons were em- ployed in the lobster canneries. The total value of vessels, boats, nets, lobster factories, fish-houses, and all other material used in the fisheries in the whole province was $3,278,623. The total

value of the fisheries was $7,809,153: lobsters, $1,898,725; cod, $2,294,160; haddock, S489,668 ; mackerel, $1,248,626; herring, $376,476 ; halibut, $163,950 ; and fish products, $443,298, were the largest items.

Manufactures. â€" ^Among the new industries may be mentioned five pulp mills, with a capacity of 100 tons every twenty-four hours ; one factory for condensing milk, and works for the manufacture of railway carriages ; boot and shoe factory, &c. In 1891 there were engaged in manufactures as follows : â€" Industrial establish- ments, 10,496 ; total capital employed, S19,821,986 ; hands employed, 34,965 ; wages paid, $7,240,611 ; value of raw material, $16,099,229 ; value of articles produced, $31,043,392.

Commerce. â€" The volume of trade is shown in the following table : â€"

18T5.

1885.

1895.

1901.

Exports .

$6,979,130

$8,894,085

$11,723,534

$12,720,343

Imports .

11,531,956

8,418,826

9,270,414

12,146,882

Entered for

consumption

10,672,981

8,192,381

8,991,569

12,041,185

Duty .

1,493,149

1,751,637

1,160,101

2,091,537

In 1901 Nova Scotia shipped to transatlantic ports 136,537,100 superficial feet of deals, &c. ^ and the total value of all the products of the forest exported was $2,367,125 (1899).

Shipping. â€” The registry books of the Dominion show that in 1900 Nova Scotia owned 2121 sailing vessels and steamers â€” net tonnage, 226,817 ; of these 155 were steamers â€” gross tonnage, 18,243. In the same year 117 ves.sels and steamers were built â€” net tonnage, 9416.

Boads and Railroads. â€” Road-making machines are employed for the improvement of the ordinary highways, and substantial steel bridges are replacing the wooden structures. Besides the main intercolonial railway from Halifax to Amherst, a branch line runs from Truro to Sydney, and another from Oxford Junction to Pictou and Stellarton. The Dominion Atlantic railway extends from Windsor Junction, near Halifax, to Yarmouth ; the Nova Scotia Central railway from Lunenburg to Middleton on the Dominion Atlantic railway ; and the Dominion Coal Company's railway connects Sydney and Louisburg. There are also several branches connecting the trunk lines with outlying towns and villages. Two lines have been completed â€” one from Windsor to Truro, and another from Point Tupper to Broad Cove ; and two lines are in course of construction â€” one from Port Hawkesbury to Louisburg, and the other from Halifax to Yarmouth, both along the Atlantic coast. In 1901 there were 943 miles of railway in operation. Telegraph and telephone lines extend all over the province, and there are two cable stations, one at Canso and the other at Sydney.

The chief cities and towns are: â€” Halifax (40,832, 1901), the capital ; Yarmouth (6430) ; Pictou (3235) ; Stellarton (1422) ; Westville (2250) ; New Glasgow (4447) ; Sydney (9909) ; North Sydney (4646) ; Liverpool (1937) ; Lunenburg (2916) ; Windsor (3398) ; Annapolis (1019) ; Amherst (4963) ; Antigonish (1526) ; Shelburne (1300) ; Dartmouth (4806) ; Springhill (5178) ; Truro (5993) ; Kentville (1731) ; Digby (1150) ; Wolfville (1412) ; Oxford (1266) ; Baddeok (1000) ; Port Hood (1500) ;

Glace Bay (6945); Louisburg (1588); Sydney Mines (3191) ; Pairsboro(2705); Canso (1734); Bridgewater (1816).

Authorities. â€” Sir J. W. Dawson. Acadian Geology. â€” Fletchek. Geological Survey Reports (1872-79). â€” Hannay. History of Acadia.â€” Campbell. Haliburton'' s and Murdochs Histories of Nova Scotia. (-^^ j_ yf\

Novaya Zemlya. See Polar Eegions.

Novel da, a town of Spain, in the province of Alicante, on the right bank of the river Vinalopd, and on the rail- way from Madrid to Alicante. The population was 9648 in 1887 and 9955 in 1897. The country around is flat and fertile, producing much wine, oil, saffron, aniseed, and cereals. In the town there are tanneries, and manu- factures of alcohol, chocolate, and soap. Five miles off are sulphurous and saline springs. The streets are regular, and there are several squares, with a fine town hall and a palace of the marquess de la Romana. To the north are the ruins of the Mola Castillo, where Alvaro de Luna was imprisoned.

Novgorod, a governmmt of north Russia, bounded on the S. W. by Pskoff, on the N.W. by St Petersburg and Olonets, and on the S.E. by Vologda, Yaroslav, and Tver. Area, 47,236 square miles. Its population was, in 1897,

1,392,933, of whom 720,237 were women, and only 84,947 lived in towns. The chief occupation, agriculture, becomes less and less able to satisfy the needs of the population, the average crop of rye being (about 1895) 0-6 quarter per head of population below the real wants ; that is, the yield amounted to 703,300 quarters, as against 943,000 quarters in 1860. The yield of the crops in 1894-99 was : rye, 4,135,300 cwts. ; oats, 3,847,000 ; all cereals, 8,514,000 cwts. There were, in 1897, 248,500 horses, 475,000 horned cattle, and 275,000 sheep.

Various trades are on the increase, and about 35,000 people find occupation in them (building, smith-work, fishing, shipbuilding,&c.), as also a variety of domestic industries, giving occupation to about 40,000 families. The industries are, however, slow to develop, the aggregate production of all the factories (mainly distilleries, glass, matches, saw-mills), which employed only 11,850 persons in 1898, hardly reaching Â£1,000,000. Considerable efforts have been made by the local government to improve both agriculture and educa- tion, there being on an average over 52,000 pupils in 1200 schools, as also to organize the medical help in the villages. For this purpose there are 47 hospitals, and over 276,000 persons receive every year free medical advice and help. The chief towns of the eleven districts into which the government is divided' are : Novgorod (26,095 inhabitants), the capital of the government, now connected by rail with Chudovo on the St Petersburg to Moscow line (45 miles), and with Staraya Russa, also in regular steam communication down the Volkhov with Novaya Ladoga ; Boro- vichi (9421), Byelozersk (6012), Cherepovets (6916), Demiyansk (1647), Kiriloff (4-304), Krestsy (2587), Staraya Russa (15,234), Tikhvin (6631), Ustyuzhna (5199), and Valdai (3525).

Novograd-Volhynsk, a district town of Eussia, government of Volhynia, 64 miles north-west of Zhitomir, on the Sluch river. It has iron-works, tanneries, and soap-works, and its fairs are animated. It is a very old town, mentioned in the annals in 1257 under the name of Zwiagel, when it belonged to the Vladimir-Volhynia principality. Later it fell into the hands of Lithuania, and was annexed to Russia in 1793. From 7500 in 1865 its population increased to 16,873 in 1897.

Novorossiysk, a seaport and district town of Caucasia, Russia, in the Chernomorsk or Black Sea govern- ment, on a bay of the same name (also named Tsemes), on the north-east coast of the' Black Sea. This bay, nearly 3^ miles wide at its entrance, and 5 miles deep from east to west, is exposed to the north-east wind (bora), which sweeps down from the mountains with such violence that the town is drenched with the spray of the waves, and in winter the thick layer of ic^ formed on the rigging of the ships becomes a danger. A mole has been con- structed at a cost of about Â£700,000, to provide protection from the sea. Novorossiysk is connected by a branch railway to Tikhoryetskaya (169 miles) with the main Caucasus line, which

crosses the Volga near Tsaritsyn. Since this connection was established, Novorossiysk has become an important port for the export of corn, over 600,000 tons being exported every year; and since the naphtha wells of Groznyi have been tapped it has also become an entrepQt for the export of naphtha. It is visited annually by about 376 sea-going vessels and about 350 coasting vessels. Large grain elevators have been built, and altogether a new commercial town has grown up. It is, however, unhealthy, on account of malaria. Population (1897), 16,208.

Novouzensk, a district town of Eussia, govern- ment and 242 miles south-south-west of Samara, on the Uzeii river. It was founded in the 18th century by Nonconformists, who had much to suffer from Kirghiz and Kalmuck raids, until forts were founded to protect them both at this village and-along the whole line to the Volga. In 1897 it had a population of 13,475, and is a centre for the trade with the Kirghiz Steppe. It has four animated fairs. It stands on a branch of the railway

which connects Saratoff, on the Volga, with Uralsk, 88 miles south-east of the Urbach junction.

Novozybkoff, a district town of Eussia, govern- ment and 101 miles north-north-east of Chernigov. It was founded in the 17th century by Nonconformists in the forests of Starodub, and became in the 18th century a centre of Russian Dissent. It is situated on the Bryansk- Gomel railway, 129 miles from the former town, and is the junction for the Novgorod-Syeversk branch. It is surrounded by ponds and marshes, which render it un- healthy. There are several tallow-melting works and tanneries, and it has trade in hemp, hemp-seed oil, cattle, preserved meat, tallow, and leather. Population (1897),

15,480.

Nowgong, a town and district of British India, in the Brahmaputra Valley division of Assam. The town is situated on the Kalang river. Population (1891), 4815 ; municipal income (1897-98), Es.11,781. The Govern- ment high school had 159 pupils in 1896-97.

The district of Nowgong has an area of 3258 square miles ; popu- lation (1881), 310,579; (1891), 344,141 ; (1901), 261,634, showing an increase of 11 per cent, between 1881 and 1891, hut a decrease of 24 per cent, between 1891 and 1901 ; average density, 180 persons per square mile. Classified according to religion, Hindus in 1891 numbered 214,425; Mahommedans, 14,137; hill tribes, 115,044; Christians, 417, of whom 63 were Europeans ; “others,” 1 18. The land revenue is Rs.59,49,105, the incidence of assessment being Rs.2:8:9 per acre; number of police, 162 ; number of boys at school (1896-97), 5527, being 20-72 per cent, of the male population of school-going age ; registered death-rate (1897), 50-4 per thousand. The soil and climate are not so favourable for tea cultivation as in Upper Assam. In 1897 there, were 50 gardens, with 12,659 acres under tea, employing 21,397 persons (of whom 7508 had been imported under contract) , and yielding just over 4 million lb , or at the rate of 355 lb per acre. The section of the Assam-Bengal railway, now under construction from Gauhati to the hills, passes through part of the district, but not very near Nowgong town; and feeder roads to the stations are being made from the main road that runs parallel to the Kalang river.

Nowgong, a town of India, headquarters of the Buudelkhand agency, and a military cantonment, in the native state of Chhatarpur, on the border of the British district of Jhansi. Population (1891), 7492. It has accommodation for a force of all arms. liajkumai College, founded in 1875 in memory of Lord Mayo, for the education of young chiefs on the model of an English public school, had 17 pupils in 1897-98. There are a high school, a dispensary, and a gaol. The number of police is 50 men. The expenditure on public works in 1897-98 was Es.l269. It is proposed to connect Nowgong by a branch line with Harpalpur on the East Indian railway.

Nowo-Radomsk, or Eadomsko, a district town of Russian Poland, government and 28 miles by rail south of Piotrk6w. It has factories for bent-wood furniture, woollens, and cloth, tanneries and saw-mills, and is the centre of a very active trade. Population

(1897), 12,407.

Noya, a coast town of Spain, in the province of Corunna, on the left bank of the Rio de Muros y Noya. Population, 9357 in 1887, and 9156 in 1897.

Quantities of wheat, hemp, and fruit are produced, and much live stock is reared in the neighbourhood. The local industries include manufactures of paper, soap, preserves, lace, and linen. Noya is a very ancient town, and was of more importance in the Middle Ages than at present. Its estuary and port are only accessible to fishing-boats and coasters. The town was a fief of the dukes of Alba, and many noble families once lived in it. The parish church is a stately Gothic pile. There are several convents, schools, an asylum for old people, a bull-ring, and a theatre.

NUBAR PASHA

Nubar Pasha (1825-1899), Egyptian statesman, was born at Smyrna in January 1825, the son of an Armenian merchant named Moghreditch, who had married a relative of Boghos Bey, the influential minister of Mehemet Ali. Boghos had promised to interest himself in the future of his young relative, and at his suggestion he was sent first to Vevey, and then to Toulouse, to be educated by the Jesuits, from whom he acquired a very perfect knowledge of French, and perhaps that singular suppleness and subtlety of character by which he was mainly distinguished. Before he was eighteen he went to Egypt, and after some eighteen months' training as secretary to Boghos, who was then Minister of both Commerce and Foreign Affairs, he was made second secretary to Mehemet Ali, whom he used to read to sleep with Thievs's Histo ire da Consulat et de VEmx>ire. In 1845 he became first secretary to Ibrahim Pasha, the heir apparent, and accompanied him on a special mission to Europe, a period to which Nubar always re- ferred with horror, declaring that he was in continual danger of his life, from the paroxysms of rage with which his master was afflicted. Abbas Pasha, who succeeded Ibrahim in 1848, maintained Nubar in the same capacity, and sent him in 1850 to London as his representative to resist the pretensions of the Sultan, who was seeking to evade the conditions of the treaty under which the vice- royalty of Egypt was secured to the family of Mehemet Ali. Here he was so completely successful that he was made a bey ; in 1853 he was sent to Vienna on a similar mission, and remained there until the death of Abbas in July 1854. The new viceroy, Said, at once dismissed him from office, but two years afterwards appointed

him his chief secretary, and later gave him charge of the important transport service through Egypt to India. Here Nubar was mainly instrumental in the completion of railway communication between Cairo and Suez, and exhibited strong organizing ability combined with readiness of resource. After a second time falling a victim to Said's caprice and being dismissed, he was again sent to Vienna, and returned as principal secretary to Said, a position he held till Said's death in January 1863.

On the accession of Ismail Pasha, Nubar Bey was in the prime of life. He was already on friendly terms with him ; he even claimed to have saved his life â€" at all events, it was a coincidence that the two had together refused to travel by the train the accident to which caused the death of the Prince Ahmed, who would otherwise have succeeded Said. Ismail, himself a more capable man than his immediate predecessors, at once recognized the ability of Nubar, and charged him with a mission to^ Constantinople, not only to notify his accession, but to smooth the way for the many ambitious projects he already entertained, notably the completion of the Suez Canal, the change in title to that of Khedive, and the change in the order of succession. In the first of these he was completely successful ; the Sultan, believing as little as every one else that the canal was anything more than a dream, gave his consent at a price the moderation of which he must afterwards have regretted. The gratified Ismail created Nubar a pasha, and the Sultan himself, persuaded to visit Cairo, confirmed the title so rarely accorded to a Christian. Half the work was, however, yet to be done, and Nubar was sent to Paris to complete the arrangements, and to settle the differences between Egypt and the Canal Company. In what he used to call " an expensive moment of enthusiasm," he left these differences to the arbitration of the Emperor Napoleon III., and cost Egypt four millions sterling. On his return he was made Egypt's first Minister of Public Works, and was distinguished for the energy which he threw into the creation of a new depart-

ment ; but in 1886 he was made Minister of Foreign Affairs, and at once went on a special mission to Constantinople, where he succeeded in the other two projects that had been left in abeyance since his last visit. In June 1867 Ismail was declared Khe- dive of Egypt, with succession in favour of his eldest son. Great as had been Nubar's successes, they had as yet been gained only over the . Sultan. Oriental methods of statecraft he had shown

that he understood ; in his one negotiation with a European Power he had gained only a Pyrrhic victory, and now he had to undertake a very different task. The anti- quated system of ” capitulations ” which had existed in the Ottoman Empire since the 16th century, had grown in Egypt to be a practical creation of seventeen imperia in imperio : seventeen consulates of seventeen different Powers administered seventeen different codes in courts before which alone their subjects were amen- able. A plaintiff could only sue a Frenchman in the French court, with appeal to Aix ; an Italian in the Italian court, with appeal to Ancona ; a Russian in the Russian court, with appeal to Moscow. Had it been limited to the Great Powers, or even to Euro- pean Powers, it would hardly have been tolerable, but a Brazilian claimed the same rights, and in many cases it was practically an impossibility to contemplate judicial action at all. Nubar’s bold design, for which alone he deserves the credit, was to induce these seven- teen Powers to consent to abandon their jurisdiction, to substitute mixed International Courts and a uniform code binding on all. That in spite of the jealousies of all the Powers, in spite of the opposition of the Porte, he should have succeeded, places him at once in the first rank of statesmen of his period. Those who have lived to see the European Concert of four or five Powers reduced almost to impotence before China, Turkey, and Greece, can appreciate the genius of the man who, single- handed as thealmost unknown representative of a mere vas- sal state, brought the seventeen chancelleries into line and induced them voluntarily to surrender, without quid pro quo, privileges which th6y had acquired and maintained during five centuries. Nubar’s fame might rest upon this alone, and perhaps it was rather by accident than by design â€” though he always attributed it to his pre-scienceâ€” that the establishment of the mixed courts had consequences far greater than could have been foreseen. Into the codes was inserted the famous article which rendered Ismail ” justiciable ” before the Tribunals, and it was this article which ultimately caused in 1879 the deposition of Isinail and the substitirtion of his son Tewfik.

The extravagant administration of Ismail, for which perhaps Nubar can hardly be held wholly responsible, had brought Egypt to the verge of bankruptcy, and Ismail’s disregard of the judgments of the Court at last compelled Great Britain and France to interfere (spurred thereto by Bi,smarck, who perhaps hoped that Egypt might embitter the relations

between the two Western Powers). Under pressure, Ismail, who began to regret the establishment of the International Courts, assented to a mixed ministry under Nubar, with Rivers Wilson as Minister of Finance and de Blignieres as Minister of Public Works. Nubar, finding himself supported by both Great Britain and France, tried to reduce Ismail to the position of a constitutional monarch, and Ismail, with an astuteness worthy of a better cause, took advantage of a somewhat injudicious dis- bandment of certain regiments to incite a military rising against the ministry. The Governments of Great Britain and France, instead of supporting the ministry against the Khedive, weakly consented to Nubar's dismissal ; but

when this was shortly followed by that of Eiveys Wilson and de Bligniferes they realized that the situation was a critical one, and they succeeded in obtaining from the Sultan the deposition of Ismail and the substitution of his son Tewfik as Khedive (1879). Nubar remained out of office until 1884.

In the interval Great Britain had intervened in Egypt â€" the battle of Tel-el-Kebir had been fought, Arabi had been banished, and Sir Evelyn Baring (afterwards Earl of Cromer) had succeeded Sir Edward Malet. The British Government, under the advice of Baring, in- sisted on the evacuation of the Sudan, and Sherif having resigned office, the more pliant Nubar was induced to become Premier, and to carry out a policy of which he openly disapproved, but which he considered Egypt was forced to accept under British dictation. At this period he used to say, " I am not here to govern Egypt, but to administer the British government of Egypt. I am sim- ply the greaser of the official wheels." It might have been well if Nubar had confined himself to this modest programme, but it was perhaps hardly to be expected of a man of his ability and restless energy. In justice to him, it must be admitted that some of the tools he was given to work with made his .task a difficult one. Sir Benson Maxwell and Mr Clifford Lloyd were zealous but impracticable officials, and when after the suppres- sion of Le Bosphore Egyptien ISTubar was forced to apolo- gize in person to the French Minister, he may not unnaturally have felt that when he had to bear all the responsibility he ought to be allowed some of the power. Apart from

this, however, it must be admitted that the characters of ISTubar and Lord Cromer were not formed to run in harness, and it was with no surprise that the public learnt in June 1888 that he had resigned office. The ministry of Eiaz Pasha, who succeeded him, lasted for nearly six years, and Nubar returned to office in April 1894. By. that time Lord Cromer had more completely grasped the reins of administration as well as of government, and Nubar had realized more clearly the role which an Egyptian minister was called on to play : the former was the real ruler of Egypt, and the death of Tewfik in 1890 had necessitated a more open exercise of British authority. In November 1896 ISTubar had completed his fifty years of service, and, accepting a pension, retired from office. He lived little more than two years longer, spending his time between Cairo and Paris, where he died in January 1899 at the age of seventy-four. (c. f. m. b.)

Nuevitas, a small land-locked seaport on the north coast of the province of Puerto Principe, Cuba. Many historians assert that this was the site of Columbus's first landing in Cuba. Population (1899), 4228.

Nuevo Leon, a state of Mexico, bounded on the N., N.W., and W. by the state of Coahuila, on the S. and S.W. by San Luis Potosi, and on the E., IST.E., and S.E. by Tamaulipas. Area, 24,324 square miles. Population in 1879, 203,284 ; and in 1900, 326,940. Agriculture has been steadily progressing, rising in value from $717,450 in 1872 to $5,000,000 in 1899. The value of the live stock is estimated at $6,000,000. The mercantile move- ment is estimated at $15,000,000 annually. The Mexi- can National railway crosses Nuevo Leon from west to north-east, and the Monterey and Gulf of Mexico rail- way crosses it from west to south. There are 13 miles of tramways, all starting from Monterey ; also fine wag- gon roads in all directions. The state is divided into 48 municipalities. The capital is Monterey, with 56,326 in- habitants in 1900. The principal towns are Linares (7220), Lampazos (5197), Santiago, Cadereyta, and Garcia.

Number. â€" 1. The most elementary process of thought involves a distinction within an identity â€" the A and the not-^ within the sphere throughout which these terms are intelligible. Again, A may be a generic quality recognizable in different modes, which may be represented by Aa, Ah, Ac, &c. Thus the motions of "one," "two," and the vague "many" are

fundamental, and must have impressed themselves on the human mind at a very early period ; evidence of this fact is afforded, for instance, by the grammatical distinction of singular, dual, and plural which we find in very ancient languages. A more definite idea of number seems to have been gradually acquired by realizing the equivalence, qud plurality, of different concrete groups, such as the fingers of the right hand and those of the left. This led to the invention of a set of names which in the first instance did not even suggest a numerical system, but denoted certain recognized forms of plurality, just as blue, red, green, &c., denote recognized forms of colour. Eventu- ally the conception of the series of natural numbers became sufficiently clear to lead to a systematic termi- nology, and the science of arithmetic was thus rendered possible. But it is only in quite recent times that the notion of number has been submitted to a critical analysis ; it is, in fact, one of the most characteristic results of modern mathematical research that the term number has been made at once more precise and more extensive.

2. Manifolds. â€” Let us assume the possibility of con- structing a permanent system of things such that (1) the system includes all objects to which a certain definite quality belongs ; (2) no object without this quality be- longs to the system; (3) each object of the system is permanently recognizable as the same thing, and as dis- tinct from all other objects of the system. Such a sys- tem is called a manifold ; the separate objects belonging to it are called its elements. A manifold may consist of a single element.

It is further assumed to be possible to select, by a definite process, one or more elements of any manifold A at pleasure ; these selected elements form another mani- fold B. If any element of A remains unselected, B is said to be a part of A (in symbols, B -^ A); if not, B is identical with A. Every element of ^ is a part of A. If B -5 , and 0 – S, then C ^ A.

When a correspondence can be established between two manifolds ^,and B in such a way that to every element of A corresponds one and only one element of B, and con- versely, A and B are said to have the same power, or to be equivalent ; in symbols, AcnB. li Aiy^B and BcnC, then A viC. It is

possible for a manifold to be equivalent to a part of itself; the manifold is then said to be infinite.

3. Suppose that when any two elements a, & of a mani- fold A are taken there can be established, by a definite criterion, one or other of two alternative relations, symbol- ized by a**b, subject to the following conditions : â€” (1) If Â«>&, then ba; (2) If a > 6 and & > c, then a > c. In this cage the criterion is said to arrange the manifold in order. A manifold which can be arranged in order may be called ordinable. An ordin- able manifold may, in general, by the application of dif- ferent criteria, be arranged in order in a variety of ways. According as a<& or a>b we shall speak of a as anterior or posterior to b. These terms are chosen merely for convenience, and must not be taken to imply any mean- ing except what is involved in the definition of the signs > and < for the particular criterion in question. The consideration of a succession of events in time will help to show that the assumptions made are not self-contra- dictory. A manifold arranged in order by a definite criterion will be called an ordered manifold. Let**

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a, h be any two elements of an ordered manifold, and suppose a < 6. All the elements c (if any) such that a

4. The Natural Scale. â€” It will be convenient to use the term progressive manifold, or simply progression, for an ordered manifold in which (1) there is one element anterior to all the rest, and (2) every element a is followed by a definite next element a’, so that a<.a' and no element falls within the interval (a, a'). The generic idea common to all progressions (which are obviously equivalent) is the scale of natural numbers. Thus a natural number is an element of an Ideal manifold defined solely by the con- ditions (1) and (2) above stated. The essence of the natural scale consists in the arrangement of its elements ; if we try to abstract this there is nothing left. Any such scheme as 1, 11, 111,

1111 .... or 1, 2, 3, 4 … is merely a conventional symbolism by which the natural scale can be suggested to the mind. Any manifold equivalent to the whole or a part of the natural scale is said to be numerable. Any element of the natural scale is said to be " the number of " things in the group which consists of itself and all anterior elements, or of any group equivalent thereto. Counting a given set of objects means establish- ing its equivalence to a set consisting of a natural number and all those preceding it.

The natural scale is an infinite manifold. For each element a may be associated with the next succeeding element a’, while the elements a’ (symbolized by 2, 3, 4 . . .) form a part of the manifold. Conversely to every element a’ corresponds a definite element a.

5. Arithmetical Operations. â€” When the natural scale (JV) has once been obtained, it is comparatively easy to define the arithmetical operations of addition, multiplica- tion, and involution, as applied to natural numbers. It can be proved that these operations are free from ambiguity and obey certain formal laws of commutation, &c., which need not be discussed here. Each of the three direct operations leads to an inverse problem which cannot be solved except under certain implied conditions. Let a, b denote any two assigned natural numbers : then it is required to find natural numbers x, y, z such that

a = b-^x, a = by, a = i’

respectively. The solutions, when they exist, are perfectly definite, and may be denoted by a. – 6, a\b and \ja ; but in order that these symbols may be intelligible it is necessarily implied in the first case that a>b, in the second that a is a multiple of b, and in the third that a is a perfect 6th power. It is- found to be possible, by the construction of certain elements, called respectively negative, fractional, and irrational numbers, and zero, to remove all these restric- tions.

6. There are certain properties, common to the manifolds with which we have next to deal, analogous to those possessed by the natural scale, and consequently justifying us in applying the term number to any one of their elements. They are stated here, once for all, to avoid repetition;

the verification, in each case, will be, for the most part, left to the reader. Each of the manifolds in question {A, suppose) is an ordered manifold. If a, /3 are any two elements of A, they may be combined by two definite operations, represented by + and x , so as to

give two definite elements of A represented by a + /? and a X y8 (or afi) ; these operations obey the formal laws satisfied by those of addition and multiplication. The manifold A contains one i element t, such that if u. is any element of A (t included), then a+ i>a, and aL = a. Thus A contains the elements t, H- 1, i+i + i, &c., or, as we may write them, t, 2t, 3t, ...Â«Â«.. . such that mi + nL = (m. + n)i and mixni, = mnb; also t<2(<3t . . . We may express this by saying that A contains an image of the natural scale. The element denoted by i may be called the ground element of A.

7. Negative Numbers. â€” Let any two natural numbers a, b be selected in a definite order a, b (to be distinguished from 6, a, in which the order is reversed). In this way we obtain what we shall call a couple, or more precisely, if necessary, an ordered couple (a, b). These couples may be associated with an ordered manifold according to the following rules : â€”

Two couples (a, b), (a’, V) are said to be equal \i a + V = a’ + b. In other words (a, b), {a’, b’) are then taken to be equivalent symbols for the same thing.

If a Ł 6′ > a’ Ł 6, we write (a, b) > (a’, b’) ; and if a Ł 6′ < a' + b, we write (a, b)<.{a!, b').

The symbols + and x are defined by the formulae

(a, 6) + {a!, V) = (a + a’, b + b’)

(a, b) X (a, V) = {aa! 4- bV, ab’ + a’b)

The manifold thus defined will be denoted by N ; it may be called the scale of relative integers.

If I denotes (2, 1) or any equivalent couple, (a, b) + i = {a + 2, b + l)>{a, 6) and (a, 6)xt = (2a + 6, a + 2b) = {a, b). Hence t is the ground element of N. By definition, 2t=t-|-t=(4, 2) = (3, 1): similarly, we find that 3(. = 2t ŧ I = (5, 2) = (4, 1), and hence by induction mL = im+\, 1). Conversely every element {a, b) in which a>b can be expressed by the symbol (a â€” b)i. If i = (1, 2), it may be proved in the same way that mi' = (l, TO-l- 1), and that every element (a, b) in which b>a can be expressed by the symbol (6 â€” a)i'.

8. It follows as a formal consequence of the definitions that L + i' = {2, l)-(-(l, 2) = (3, 3). Now couples of the type {a, a) cannot properly be said to be ordered : still it is convenient to admit these symbols and associate them all with a definite element of N which we call zero, and denote by 0. Thus finally i + i =0, and we can represent N by the scheme â€”

. . . 3t', 2t', ;', 0, t, 2i, 3t . . .

in which each element is obtained from the next before it by the addition of i. With this notation the rules of operation may be written (m, n, denoting natural numbers) â€”

mi + ni. â€” {m + n)i mi + ni â€”(m + n)i mi + ni = (m â€” n\i if m>n = (ii â€” m)i m

with the special rules for zero, that if a is any element of

a -1-0 = a, ax 0 = 0. To each element, a, of N corresponds a definite element a' such that a-Ha' = 0; if a = 0, then a' = 0, but in every other case a, a' are different and may be denoted by mi, mil'. The natural number m is called the absolute value of mt and m.i'.

9. If o, /3 are any two elements of N, the equation | + /3 = a is satisfied by putting ^ = a + fi'. Thus the symbol a – ^ is always interpretable as a ŧ /3', and we may say that within N subtraction is always possible. On

^ There cannot be more than one such element.

the other hand, a/^ is intelligible only if the absolute value of a is a multiple of the absolute value of p.

The manifold N has no least element and no greatest element. At the same time it is numerable, as we see, for instance, by associating the elements 0, ai, hi! with the natural numbers 1, 2a, 26 + 1 respectively, thus â€”

(,N) 1, 2, 3, 4, 5, 6, . . . {N) 0, t, t’, 2t, 2i’, 3i . . .

It is usual to write + a (or simply a) and – a for ai and ai’ respectively ; that this should be possible without leading to confusion or ambiguity is certainly remarkable.

10. Fractional Numbers. â€” Starting as before with ordered couples chosen from N, we may form a set of symbols [a, 6], and associate them with the elements of an ordered manifold R by the following rules : â€”

The symbols [a, 6], [Â«’, VX are equivalent if ah’ = a’b.

If ah’^alh we write [a, h\>\a’, 6’]; and if ab’

The symbols + and x , as applied to elements of Â£, are defined by the formulae

[a, 6] + [a’, b’] = [ab’ + a’b, bV] [a, 6] X [a’, &’] = \aa’, 66’].

Symbols of the type [a, a] are admissible. It follows from the definitions that they are all equivalent, and that, if we denote [1, 1] by v, then [a, 6] + v = [a + 6, 6] > [a, 6], [a, 6] X V = [a, 6]. Hence v is the ground element of i?.

By definition, 2v = v + v = [2, 1]; similarly 3-u = 2v + v = [3, 1], and by induction mv = \m, 1]. It also follows that if a is a multiple of b, say m6,

the element corresponding to [a, 6] may be denoted by the equivalent symbol mv.

11. The manifold M differs in one important respect from N and N, and from any other ordered manifold in which isolated elements occur. No element of E is isolated either ^rom subsequent or preceding elements : this follows at once from the fact that if [a, 6] = a and [a, 6’] = a! are the symbols of any two elements of R, the element de- noted by [a + a’, h + 6’] falls within the interval (a, a’). On account of this property R is said to be dense. Strange as it appears at first sight, .S is a numerable manifold â€” a fact first proved by G. Cantor. To see this, observe that every element of R may be represented by a ” re- duced” couple [a, 6], in which a, h are prime to each other. If [a, 6], [c, d\ are any two reduced couples, we will say that [a, 6] is anterior to [c, d] if either (1) a + b-

[1, 1], [1, 2], [2, 1], [1, 3], [3, 1], [1, 4], [2, 3], [3, 2], [4,1]...

which is equivalent to the natural scale.

R agrees with N in having no least and no greatest element ; for if a denotes any element [a, 6], then [2a â€” 1, 26]a.

12. The division of one element of R by another is always practicable ; for by definition

[c, d~\ X [ad, be] = [acd, bed] = [a, 6],

and consequently [a, b] ŕ [c, d] is always interpretable as [ad, be]. As a particular case [m, 1] â– – [n, 1] = [m, n], so that every element of R is expressible in one of the forms mv, mv/nv. When m is a multiple of, n, mvjnv = (m/njv. It is usual to omit the symbol ^ altogether, and to repre- sent the element [m, n] by m/n, whether m is a multiple of n or not. This does not lead to any confusion, if it is borne in mind that the symbols 1, 2, 3,

13. Within the manifold R subtraction is not always practicable ; but this limitation may be removed by con- structing a manifold R related

to R in the same way as iiT to If. This may be done in two ways which lead to equivalent results. We may either form symbols of the type (a, j3), where a, /? denote elements of R, and apply the f ormulaB of Â§ 7 ; or else form symbols of the type [a, ^], where a, /3 denote elements of JV, and apply the formulae of Â§ 10. The final result is that R comprises a zero element, 0, a ground element v, an element v such that u + v' = 0, and a set of elements representable by the symbols {mjn)v, (n^jn)v'. In this notation the rules of operation are â€" m , m' /mn' + m'n\ m , , m' , /mn' + m'n\ ,

m , m' , mn' – m,'n in'n – mn' , , ,

â€" vH â€" ;D = ; â€" V, or ; â€" V, as mn >or

n n nn ' nn ' '

m m' mm' m , m' i m m' , mm' , vx -jV = 7-v=â€" V X-rV, â€"vxâ€",v= rv;

nn n n ' n

TO / . m' , mn' m . m'

nn m , m'

TM- .777. -1111 , , -lib , iwih â– lib 'III, , 'lib I VI inn ,

**â€" V-h- â€"rV =â€"V -. >V = â€" 7-V, â€" D-7-â€" , 1/=â€" V -^â€" rV = â€" tV **

n n n n mn ' n n n n mn '

a-/3 = a + |S', where j8 + /8′ = 0; a + 0 = a, axO = 0;

a and /3 denoting any two elements of R. If /? = (m/n)v, then /3′ = (mln)v', and if /3 = {mjn)v', then ^ = {mln)v.

14. When R is constructed by means of couples taken from N, we must put [mi, ni] = [mi, ni] = {mln)v, [mi, ni'] = [mi', ni]=(mjn)v', and [0, a] =

0, if a is any element of JV except 0. The symbols [0, 0] and [a, 0] are inadmissible ; the first because it satisfies the formal definition of equality with every sjrmbol [a, /3], and is therefore indeterminate ; the second because, according to the rule of addition (Â§ 10) â€”

[a, 0] + [., q = [ai, 0] = [a, 0],

which is inconsistent with $ + v>$-

In the same way, if 0 denotes the zero element of R, and ^ any other element, the S3Tnbol 0/0 is indeterminate, and f/0 inadmissible, because, by the formal rules of operation, ^/O + v = ^/O, which conflicts with the defini- tion of the ground element v. It is usual to write

+ â„¢ for simply ””) for ^v, and _â„¢ for â„¢ v'. Each of n \ nj n n n

these elements is said to have the absolute value m/n.

The ultimate ordering criterion of the manifold R is that,

if ^, rj are any two elements of it, ^>rj when f â€” Â»/ is

positive ; that is to say, when it can be expressed in the

form (m/n)v.

15. The manifold R is very important, because it is the simplest type of a domain of rationality, or corpus. An algebraic corpus is a manifold, such that its elements are representable by symbols a, /3, &c., which can be combined according to the laws of ordinary algebra ; every algebraic expression obtained by combining a finite number of symbols by means of a finite chain of rational operations (~~f~~ , – , X , ~~–), being capable of interpretation as repre~~ senting a definite element of the manifold, with the single reservation that division by zero is inadmissible. Since, by the laws of algebra, a â€” a = 0, and a/a=l, every algebraic corpus must contain R, or, more properly, a manifold which is an image of R.

16. Irrational Numbers. â€” Let a denote any element of R ; then a and all anterior elements form a manifold, A say ; the remaining elements form another manifold A!, which we shall call complementary to A, and we may write R = A-^A!. Now the essence of this separation of R into the parts A and A! may be expressed without any reference to a as follows : â€”

I. The manifolds A, ,A! are complementary; that is, their elements, taken together, make up the whole of R.

II. Every element of A is less than every element oiA!.

III. The manifold A has no first element. (This last condition is artificial, but saves a distinction of cases in what follows.)

Every separation R = A^-vA! which satisfies these con- ditions is called a cut, and will be denoted by (A, A). We have seen that every rational number a is associated vrith a definite cut. Conversely, a cut {A, A!) in which A has a last element a is perfectly definite, and specifies a with- out ambiguity. But there are other cuts in which A has no last element. For instance, all the elements (a) of R such that either aÂ«0, or else as- O and a2<2, form a manifold A, while those for which a>0 and <^>1 form the complementary manifold A'. This separation is a cut in which A has no last element ; because if plq is any positive element of A, the element (3^-(~~4g)/(2^(3y) exceeds /i/g, and also belongs to A. Every cut {A, A) of this hind is said to define an irrational number. The justi~~ fication of this is found in the following propositions : â€”

(1) A cut is a definite concept, and the ensemble of cuts is a manifold according to definition ; the generic quality of the manifold being the separation of R into two comple- mentary parts, without altering the order of its elements.

(2) The manifold of cuts may be arranged in order by the rule that {A, A’)<{B, B') if ^ is a part of B.

(3) This criterion of arrangement preserves the order of magnitude of all rational numbers.

(4) Cuts may be combined according to the laws of algebra, and, when the cuts so combined are all rational, the results are in agreement with those derived from the rational theory.

As a partial illustration of proposition (4) let (A, A’), (Â£, B’) be any two cuts; and let C” be the manifold whose elements are obtained by forming all the values of a + /S’, where a! is any element of A’ and j3′ is any element of B’. Then if C is the complement of C”, it can be proved that (C, C) is a cut ; this cut is said to be the sum of {A, A’) and (B, B’). The difi’erence, product and quotient of two cuts may be defined in a similar way. If n de- notes the irrational cut chosen above for purposes of illustration, we shall have n^ = (C, C”) where C” com- prises all the numbers a’/3′ obtained by multiplying any two elements a’, ji’ which are rational and positive, and such that a‘2>2, /8‘2>2. Since a‘2/3‘2>4 it follows that ajB’ is positive and greater than 2 ; it can be proved con- versely that every rational number which is positive and greater than 2 can be expressed in the form a’‘. Hence n = 2, so that the cut n actually gives a real arithmetical meaning to the positive root of the equation x^ -2 = Q ; in other words, we may say that n defines the irrational number ^2. The theory of cuts provides, in fact, a logical basis for the treatment of all numerical irrationalities, and enables us to justify all arithmetical operations involving the use of such quantities.

17. Since the manifold of cuts (XI say) has an order of magnitude, we may construct cuts in this manifold. Thus if a is any element of XX, and ^ is the manifold which consists of a and all anterior elements of XI, we may write H = a -H ^’, and now {% 3’) is a cut in which 3 has a last element a. It is a remarkable fact that no other kind of cut in XI is possible ; in other words, every conceivable cut in Xl is defined by one of its own elements. This fact is expressed by saying that H is a continuous manifold, and Xl itself is referred to as the numerical

continuum. The property of continuity must be carefully distinguished from that of density ; a continuous manifold is necessarily

dense, but a dense manifold is not always continuous. The manifold XI is not numerable.

18. Another way of treating the theory of irrational numbers is by means of sequences. A sequence is an un- limited succession of rational numbers

a^, a^, ctg . . . c^TTi, ctjn+x * ‘ ‘ the elements of which can be assigned by a definite rule of calculation, and such that when any rational number e, however small, has been fixed upon, it is possible to find an integer m, so that for all positive integral values of n the absolute value of am+Â«-Â«fm is less than e. Under these conditions the sequence may be taken to represent a definite number, which is, in fact, the limit of Om. when m increases without limit. Every rational number a can be expressed as a sequence in the form (a, a, a, . . .), but this is only one of an infinite variety of such representa- tions , for instance â€”

1=C9, -99, â€¢999,...) = Q, I \,... ^’...)

and so on. The essential thing is that we have a mode of representation which can be applied to rational and irrational numbers alike, and provides a very convenient symbolism to express the results of arithmetical operations. Thus the rules for the sum and product of two sequences are given by the formulae

(oj, a^, aj, . . .)-h(6i, ^2, 63, . . .)

= (Â«1 + &1, Â«2^+&2′ <*3 + ^3 â€¢ â€¢ â€¢)

(Â«!> Â«2> “3) â€¢â€¢â€¢)>< (*1) \i ^SJ â€¢ â€¢ â€¢)

= (fl-pv o-iK ‘^ah â€¢ â€¢ â€¢) from which the rules for subtraction and division may be at once inferred. It has been proved that the method of sequences is ultimately equivalent to that of cuts. The advantage of the former lies in its convenient notation, that of the latter

in giving a clear definition of an irrational number without having recourse to the .notion of a limit.

19. Transfinite Numbers. â€” In the course of his re- searches in the theory of manifolds, G. Cantor has been led to the construction of the very subtle calculus of transfinite numbers. This has not yet been fully de- veloped, and the terminology is still fluctuating; hence only a very brief account can be attempted here. It has been observed (Â§ 4) that a manifold which can be "counted" may be associated vpith an element of the natural scale, which is called "the number of" the elements of the manifold. An infinite manifold cannot be counted in the ordinary sense ; but if it is numerable, there is some criterion by which its elements may be represented by the scheme

or

1′

2′

M.3

3′

. n'

When the elements of a manifold are arranged accord- ing to the scheme 1', 2', 3′ ... it may be said to be similar, or to be arranged similarly, to the natural scale. Now, just as the number 3 may be associated with the succession 1, 2, 3, or with any equivalent manifold similarly arranged, we may invent a new symbol w, and associate it with the whole of the natural scale, or with any equivalent manifold similarly arranged. For con- venience we shall call w the index of the natural scale, thus â€"

w= ind. iV=ind. (mj, m,,, Mj, . . .)

when Mj, Mj) â– W3, &c. is any manifold arranged similarly to the natural scale.

20. There is no logical diflBculty in constructing a scheme

Â«!, Mj, M3 . . . I t>i,

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where the progression Mj, u^, Ug . . . ia immediately fol- lowed by an element â– Wj. Any manifold represented by this scheme is associated with the index w + 1 ; and in like manner we ma-” form arranged manifolds associated with the indices

a) + 2, a) + 3. . . w + n,

where n is any element of iV, The scheme

Â«i, Ms. Â«Â«3 â€¢ â€¢ â€¢ I â– ”!> ‘“2> â– “s â€¢ â€¢ Â» is associated with w + u = 0)2 ; the scheme

“ill “12. ‘^U â– â– â€¢ \ Â«21> “SS’ ^23 â€¢ â€¢ â€¢ I â€¢ â€¢ â€¢ I ^nij Wmg . . . I . . .

with (0.0) or 0)2 ; and so on. Thus we may construct arrangements of manifolds corresponding to any index of the form

<^(o)) = o)"a + o)â„¢~i6 + . . . + o>k + l,

where n, a, b, . . . I are any elements of iV.

We are thus led to the construction of a scheme of symbols â€”

I. 1, 2, 3, . . . TO . . .

0), 0) + 1, . . . o) + m, . . .

0)2, 0)2 + 1, . . . 0)2 + TO, . . .

II. ^

‘-+1, 0)2-l-2…0)2 + J

III.

(), <(o)) + l, ...^(o)) + Â»,..

‘, 0)” + 1, . . . 0)” +TO, . ..

0)’^ M, o) W + 1, . . . (li^ M’ + Â», .

where the first element of any row is supposed to follow immediately all the elements of the row next before it, and other elements of the row are obtained by successive additions of 1. The first elements of the parts of the scheme denoted by I., II., III. &c., are 1,

21. The index of a finite manifold is a definite integer, however the manifold may be arranged : we may take this index as a symbol for the power of the manifold. But the index of an infinite ordinable manifold depends upon the way in which its elements are arranged ; for instance, ind. (1’, 2’, 3’, . . .) = 0), but ind. (!’, 3’, 5’, . . . | 2’, 4’, 6’, . . .) = 0)2. Or, to take another example, the scheme â€”

1, 3, 5,...(2to-1)...

2, 6, 10, . . .2 (2TO-1)... 4, 12, 20, ...4(2to-1)...

2â„¢, 2â„¢. 3, 2’”. 5, . . . 2â„¢ (2to – 1) . . .

in which each row is supposed to follow the one before it gives a permutation of any manifold (mj, Mji “s â€¢ â– â–) y which the index is changed from o) to .’ It may be proved that if M is any numerable manifold, there is a permutation of M for which the index is <^(o)), any assigned element of (II.) ; and that, conversely, if the index of any arranged manifold is <^(o)), the manifold is numer- able. Thus the power of all manifolds which can be as- sociated with indices of the class (II.) is the same as

that of the natural scale ; this power is indicated by Hg. Since Xq is associated with all manifolds of a particular power, independently of the arrangement of their elements, it is analogous to the integers 1, 2, 3, &c., when used to de- note powers of finite manifolds ; for this reason it is called " the least transfinite cardinal number."

22. There are manifolds (for instance, Zl) which are of higher power than Ngj the next higher power Nj belongs

to manifolds which can be associated with transfinite in- dices of the class (III.). It is not unlikely that there is a natural progression of powers a^, Nj, X2, III., IV., &c., and that every ordinable mani- fold may be associated with one and only one of the cardinal numbers Xj. It has also been conjectured that N]^ is the proper symbol for the power of the numerical continuum ; but this still awaits demonstration or dis- proof. Again, it may be asked whether any meaning can be attached to such a symbol as Nâ€ž, or, more generally, N,;,, where ^ is any ordinal number of the nth class.

23. Transfinite numbers, both ordinal and cardinal, may be combined by operations which are so far analogous to those of ordinary arithmetic that it is convenient to denote them by the same symbols. But the laws of operation are not entirely the same ; for instance, o)2 and 2o) have different meanings : the first has been explained, the second is the index of the scheme (a-^ 6^ | aj 65 | ag 63 | . . . I Ok 6n I . . .) or any similar arrangement.

24. Complex Numbers. â€” If a is an assigned number, rational or irrational, and n a natural number, it can be proved that there is an element of XI satisfying the equa- tion x”- = a, except when to is even, and a is negative ; in this case the equation is not satisfied by any element of XI. The difficulty is removed by the construction of a manifold of ordered couples {x,y] where x, y are any elements of XX. : this may be arranged by the criterion that {x, y}<{x', y'\ ii x-

{x, y} + {x’, i/} = {x + x’, y--y’}; {x,y}-x. {x’, y’} = {xx’ – yy’, xy +x’y}.

Hence the manifold has the ground element {1, 0}, which we may denote by o- ; and, if we write t for the element -{0, 1},

t2={-1, 0}=-o-.

Whenever m,, n are rational {m,, n}=m^ + nr, and we are thus justified in writing, if we like, xtr + yr for {x, y) in all circumstances. A further simplification is gained by writing x instead of oca-, and regarding ^ as a symbol which is such that t^ = â€” 1, but in other respects obeys the ordinary laws of operation. It is usual to write i instead of t ; we thus have a manifold 3 of com- plex numbers x + yi. In this manifold, which includes â– an image of Xl, not only the four rational operations (excluding division by zero), but also the extraction of roots, may be effected without any restriction. Moreover (as first proved by Gauss and Cauchy), if a^, a-^, . . . an are any assigned elements of 3j the equation

aoz”~~f Ojz”~~!~~!~~ . . . +aâ€ž_iz-l-aâ€ž = 0

is always satisfied by precisely n elements of 3) ”^^^ a proper convention as to multiple roots. Thus any algebraic function of any finite number of elements of 3 is also contained in 3- In ^’^{i} sense 3 is a closed arithmetical domain, just as Tt is when we restrict our- selves to rational operations. The power of 3 is the same as that of XX.

2.5. Algebraic Numbers. â€” As explained in the article Numbers, Theory of (Ency. Brit. vol. xvii. p. 614), Gauss distinguished as integral those elements x-‘ryi of 3 ii which X, y are ordinary integers ; and Kummer extended Gauss’s conception by introducing ” complex integers ” of the form

‘pirj) = arj + ai% + ... +ae-irie-i,

where rj, rji, . . . rje_i are the Gaussian periods of / terms associated with the roots of the equation (a* – l)/(a; – 1) = 0, p being a prime, and ef=p – 1. The remarkable fact that an integer ^(77) may be resolvable in more ways than one into the product of irresolvable factors of the

same type, appeared to involve the complete failure of the ordinary laws of divisibility so far as these new integers were concerned ; but Kununer succeeded in restoring a complete analogy by his invention of ideal numbers.

Bionecker and Dedekind independently generalized the results of Gauss and Kummer, and thus laid the founda- tions of a perfectly general theory of algebraic numbers, which is one of the most beautiful results of analysis. In the brief outline which follows, Dedekind's notation and point of view wiQ be adopted.

26. If

/(6l) = aâ€ž^ + ai^-i+ ... +an=0,

where a.(â€ž a^, . . .On are ordinary integers, is an irreducible equation in the domain N (that is, if f{9) cannot be resolved into the product of two integral functions with rational integral coefficients), the n roots 6, 6', 6″ . . . Â»-ii are said to form a set of conjugate algebraic numbers of the rath order. If a^l, the roots are said to form a set of conjugate algebraic integers. Every algebraic number can be expressed in the form oi/a,, where a^ is a natural number and o) an algebraic integer ; in all that follows it will be supposed that a^ = l, and consequently 0 is integral.

Associated with 6 we have a corpus n = B{6) consisting of all rational functions of d with real rational coefficients ; and in like manner we have the conjugate corpora Q.' = R{&), n" = B{e") . . . J2'Â«-i' = i? (5ta-i)) associated with &,&'... e<Â»-i' respectively. The manifold of integers contained in fl is denoted by o.

Every element of 12 can be put into the form

0) = Co + Cie + . . .+Cn—fi^-

where Co, Ci, . . . câ€ž_i are real and rational. If the c-s are integral, co is an integer; but the converse is not neces- sarily true. It is possible, however, to find a set of integers (Oj, co^, . . . wâ€ž belonging to i2, such that every integer in i2 can be uniquely expressed in the form

Q) = AjtOj + AgCOg + ...} hn

where h-^, h^ . . . hn are real integers, which may be called the co-ordinates of (o with respect to the base (wj, (o^ , . . (i>n). The conjugate numbers Wj'", Wj'‘, . . â€¢ W‘ form a base of the manifold o'*', which comprises aU the integers in J2'^'. There exists an infinite number of equivalent bases of a.

The quantity A(i2) =

0)1,

â€ž'"-Â«

,.<Â«-"

,.'"-!)

is a rational integer called the discriminant of the corpus. Its value is the same whatever base (ui, (Oj, . . . u>â€ž) is chosen.

If a is any integer in J2, the product of a and its con- jugates is a rational integer called the norm of a, and written I^{a). Thus â€"

7V^(a) = aa'a" . . . a'Â«-l' = aai,

where Oj is an integer in Â£2. It follows from the definition that if a, jS are any two integers in 12, then iV^(a/?) =

27. Ideals. â€" That form of the theory which has been developed by Dedekind is based upon the notion of an ideal, which is defined by the following properties : â€"

(I.) An ideal m is a manifold of integers belonging to i2.

(II.) If fji., /*' are any two elements of m (the same or different), then /* H- /"â€¢' and /u – /x' are also elements of m.

(III.) If ju is any element of itt, and la any element of 0, then (D/i is an element of m.

It is clear that ideals exist ; for instance, a itself is an

ideal. Again, aU integers in i2 which are divisible by a given integer a (in o) form an ideal; this is called a principal ideal, and is denoted by tsa. In any ideal m a set of elements /ij, /tj, . . â€¢ A*Â» can always be found, such that every element of m is expressible in the form Ihih, where A; is a rational integer. In other words, every ideal has a base (and therefore, of course, an infinite number of bases). If a, fi are any two ideals, and if we form all the products a/3 obtained by multiplying each element of a by each element of i, then these products and sums of such products constitute an ideal which is called the product of a and 6 and written ah. In particular oa=a, 0 = 0, oa.Oy8 = oa^. This law of multipli- cation is commutative and associative. It is clear that every element of ab is contained in a. It can be proved that, conversely, if every element of c is contained in a, there exists an ideal h such that c=al3. In particular, if a is any element of a, there is an ideal a' such that oa = aa'. A prime ideal is one which has no divisors except itself and 0. It is a fundamental theorem that eveiy ideal can be resolved into the product of a finite number of prime ideals, and that this resolution is unique. It is the decomposition of a principal ideal oa into the product of prime ideals that takes the place of the decomposition of an integer into its prime factors in the ordinary theory. It may happen that all the ideals in i2 are principal ideals ; in this case every resolution of an ideal into factors corre- sponds to the resolution of an integer into actual integral factors, and conversely, so that the introduction of ideals is not absolutely necessary. But in every other case the introduction of ideals, or some equivalent notion,' is in- dispensable. When two ideals have been resolved into their prime factors, their greatest common measure and least common multiple are determined by the ordinary rules. Every ideal may be expressed (in an infinite number of ways) as the greatest common measure of two principal ideals.

28. There is a theory of congruences with respect to an ideal modulus. Thus the congruence a = j3 (mod m) means that a – /3 is an element of m. With respect to m, all the integers in 12 may be arranged in a finite

number of classes such that any two elements of the same class are congruent, while no two elements of different classes are congruent. The number of these classes is called the norm of m, and written N(m). The norm of a prime ideal p is some power of a real prime ; if i\^(p) =p^, p is said to be a prime ideal of degree /. If m, n are any two ideals, then #(mn) = A”(m)iV^(n). If N{m) = m, then m = 0 (mod m), and there is an ideal m’ such that am = mm’. The norm of a principal ideal 0a is equal to the absolute value of the norm of a as defined in Â§ 26.

The number of incongruent residues prime to m is â€”

<^(m) = i^r(m)n(l-^^)

If

where the product extends to all prime factors of ~~ttt~~ (0 is any element of o which is prime to m,

(oÂ«’”>=l (modm).

29. Ideal Classes. â€” If m is any ideal, another ideal n can always be found (for instance, A^(m)/m) such that mn is a principal ideal. Two ideals m, m’ are said to be equivalent (m com’), or to belong to the same class, if an ideal n can be found such that mn, m’n are both principal ideals. It can be proved that two ideals each equivalent to a third are equivalent to each other, and that all ideals in a may be distributed into a finite number, A, of ideal classes. That class which contains all principal ideals is called the principal class, and denoted by 0.

If a, b are any two ideals belonging to the classes A, B, then ah belongs to a definite class which depends only

NUMBER

upon A, B and may be denoted by AB or BA. Thus the symbols of the classes form an Abelian group of order h, in which 0 is the unit element." All the known properties of Abelian groups are immediately applicable : thus there is a system of " base classes " A-^, A^, . . . Ak such that every

class is representable by a symbol A'^. Al Al, and so

on. Every class satisfies an equation Af= 0, where / is some factor of h. Hence, also, some power of every ideal is a principal ideal. In the case of a quadratic corpus ideal classes correspond to classes of quadratic forms ; and the multiplication of ideals or of ideal classes corresponds to the composition of quadratic forms.

30. The discriminant of a corpus enjoys some very re- markable properties. Thus its value is always different from Â± 1 ; there can only be a iinite number of corpora of order n which have a given discriminant d ; and the rational prime factors of A(I2) are precisely those rational primes which are divisible, in i2, by the square (or some higher power) of a prime ideal.

31. Every element of o which is not contained in any other ideal is an algebraic unit. If the conjugate corpora fl, 12', . . J2'Â«-i) consist of r^ real and 2r^ imaginary corpora, there is a system of units e^, e^.. .e^^, where /i = rj -f-rg – 1, such that every unit in 12 is expressible in the form e = p ej e| . . . 6^, where /a is a root of unity contained in 12 and a, b, . . .1 are natural numbers. This theorem is due to Dirichlet.

The norm of a unit is, + 1 or – 1 ; and the determina- tion of aU the units contained in a given corpus is in fact the same as the solution of a diophantine equation

F{h^, Ag, .. . Aâ€ž)= + l.

For a quadratic corpus the equation is hj^ – Dh^ = + 1, and the theory of this is complete ; but, except for certain special cubic corpora, little has been done towards solving the important problem of assigning a definite process by which, for a given corpus, a system of fundamental

units may be calculated. The researches of Jacobi, Hermiti, and Minkowski seem to show that a proper extension of the method of continued fractions is necessary.

32. Normal Corpora. â€” The special properties of a par- ticular corpus J2 are closely connected with its relations to the conjugate corpora 12’, 12”, . . . fi’”-!). The most important case is when each of the conjugate corpora is identical with 12 ; the corpus is then said to be Galoisian or normal. The manifold Â£{6, 6’,... 6i’Â»-i’) of all rational functions of the conjugate numbers 6, 6’,... “-i’ is a Galoisian corpus ; so that every arithmetical corpus of order n is either normal, or is contained in a normal corpus. The roots of an equation /(0) = 0 which defines a normal corpus are associated with a group of substitutions ; if this is Abelian, the corpus is called Abelian ; if it is cyclic, the corpus is called cyclic. A cyclotomic corpus is one the elements of which are all expressible as rational functions of roots of unity; in particular the complete cyclotomic corpus Cm is the corpus (of order <(m)) which consists of all rational functions of a primitive with root of unity. To Kronecker is due the very remarkable theorem that all Abelian corpora are cyclotomic ; in other words, if the roots of a rational equation f{6) = 0 are connected by a set of relations 6Â»2 = <^((9i), ^3 = ^(^3) . . . 0n = 4>{0n-i), 61 = , where (d) is an integral function of 0 with rational coefficients, then all the roots 6, 6^, . . . 6^ can be expressed as rational integral functions, with rational co- efficients, of some root of unity. The first published proof of this was given by H. Weber.

33. It may be observed that in the theory of an arith- metical corpus we are not concerned with the actual values (as complex numbers) of its elements ; the symbols are in fact mere umhrce, serving as regulators, so to

speak, of operations which are actually performed on rational integers. When we have once obtained a base of 0, and ha”Ve constructed the “multiplication table,” express- ing the products “a) _â€¢ â€¢ â–)J, where Aj, h, . . . hn are rational integers (called in Â§ 26 the co-ordinates of the number). Then we have rules for combining these symbols, of the form

TAi, Ag, . . . Aâ€ž] Ł [\, k^,... ^â€ž]

= [Ai ~~Hi,, hâ€ž~~-k^ . . . hn + hi] L^i, Ag, . . . Aâ€žJ X [Al, k^... /cj =]>i, p^ . . .pâ€ž] where 1, p,, . . . p^ are lineo-linear functions of the A-s and k-s. The divisibility of [Aj, h^, . . . hn] by an ideal tn may be expressed by one or more ordinary linear congruences satisfied by Aj, Aj, . . . Aâ€ž. For instance, if [x, y] stands for x + yi, the rules of operation are those given in Â§ 24, and if ji = a(b + ci), where a, b, c are real integers, and 6, c are prime to each other, the divisibility of \x, y] by jit is expressed by the congruences

bx + cy=0, cx-by = 0 (mod a{p ~~t~~ c^)), which may be replaced by other equivalent conditions This point of view is indicated by Kummer.

Every linear associative algebra suggests a correspond- ing arithmetical theory.

34. Transcendental Nwmhen. â€” The manifold of real algebraic numbers is numerable. Hence immediately follows the proposition (first proved by Liouville) that there are numbers, both real and complex, which cannot be defined by any combination of a finite number of equa- tions with rational integral coefficients. Such numbers are said to be transcendental. Hermite first completely proved the transcendent character of e. Lindemann, by a similar method, proved the transcendence of tt. Thus, it is now finally established that the quadrature of the circle is impossible, not only by rule and compass, but even with the help of any number of algebraic curves of any order when the coefficients in their equations are rational. (See Hermite, ” Sur la fonction exponentielle,” C.B. t. Ixxvii. 1873 ; and Lindemann, ” Ueber die Zahl w,” Math. Ann. xx. 1882.)

35. It is especially noteworthy that the science of arithmetic has now reached a stage where all its defini- tions, processes, and results are demonstrably independent of any theory of variable or measurable quantities such as those which are postulated in geometry and mathematical physics ; even the notion of a limit may be dispensed with, although this idea, as well as that of a variable, is often convenient. For the questions which arise in the application of arithmetic to geometry and analysis the reader is referred to the article on Fxtnotions or Eeai, Variables.

Authorities. â€” G. Cantob's memoirs on manifolds in Mathe- matische Annalen, vols. xv. xvii. xx. xxi. xxiii. xxv. xlvi. xlix., Crelle , vols. Ixxvii. Ixxxiv. , and Ada Matheinatica, vols. ii. vii. â€" E. Dedeeind. Was sind und was sollen die Zahlen ? Bruns- wick, 1887 ; Stetigkeit und irrationale Zahlen. Ibid. 1872. â€" Dieichlet-Dedekind. Vorlesimgen iiber ZahUntheorie, 3rd and 4th editions. Ibid. 1879, 1894.â€" E. Heine. "Die Elemente der Functionenlehre, " Orelle, vol. Ixxiv. â€" L. Ekonbckee,. "Ueber den Zahlbegriff," Crelle, vol. ci. ; "Grundziige einer arithmet- ischen Theorie der algebraisohen Grbssen, " Crelle, vol. xoii. (these are reprinted in vols. ii. and iii. of Kronecker's collected works, Leipzig, 1895, 1897).â€" D. Hilbert. " Die Theorie der algebra- isohen Zahlkorper," JahresbericM der deutschen, Mathemaiiker- Vereinigung, vol. iv. â€" H. Weber. Lehrbuch der Algebra, 2nd edition. Brunswick, 1898. â€" 0. Stolz. Vorlesungen iiber allge- meine Arithmetik, Leipzig, 1885, and U. DiNi, Fondamenfi per la teoriea delle funzioni di variabili reali, Pisa, 1878 (German translation by J. Luroth, Leipzig, 1892), will also be found very useful. A valuable summary, with an extensive bibliography, is contained in vol. i. of the Encyclopadie der mathematiscken Wissenscha/ten, Leipzig, 1898, 1899, Â§Â§ A 1, 3-5, B 1 6 (0 5). (g. b. M.)

J^UMISMATICS.

I. Coins.

SINCE 1870 a very great advance has been made in the study of the coinages of the ancient world, and also of mediaeval and more recent times. In the Greek series not only has great progress been made Aacieat ^^ ^*Â® geographical classification, but also in ascertaining the chronological sequence of the numerous coinages. This last result has been effected by a careful examination of the principal centres of coinage, by a close study of style and the art dis- played, and by a minute inquiry into the various metri- cal systems of the ancients. The phases of art as illustrated by Greek coius have been defined within certain chronological divisions or periods, the character- istics of which enable the student to group at sight his coins within well-ascertained

limits. Whilst this classification by style has been of great service to the chronology of other objects of antiquity, especially of Greek sculpture, gems, &c., it has served to raise ancient coins to a position which their science had not before attained. In Roman numismatics the progress is not so marked, the scope for inquiry being perhaps much more limited. Mommsen's chronological arrangement of the Roman republican series has not been superseded; and no serious attempt has been made to treat the imperial series in a similar manner ; but until this is done Roman coins as historical records must lose their chief value. In the medieval section the early issues of the Merovingians, the Visigoths, the Anglo-Saxons, the feudal princes of France, the early rulers of Germany, and the Latin princes of the East, have all received much attention, and these have thrown much light on a difS^cult portion of the world's history. The same may also be said of the various Oriental sections, especially in the case of the early coinages of India, of which till recently our knowledge was very vague. The bibliography at the end of this article will give a few of the more important recent works in each branch.

Turning to the coinages of the present day, we shall note the more important changes which have occurred â€ž . since 1870 ; and it is a singular fact that there

are but very few countries in any quarter of the globe which have not made some radical change in this respect.

Tlie United Kingdom. â€" No fundamental alteration has, however, occurred in the case of the British coinage. The standard of gold and silver has remained unchanged for over two hundred years, and until 1887 the demoninations were practically the same as instituted at the great recoinage of 1816. The substitution of a bronze for a copper currency had already taken place in 1860. On the occasion of Queen Victoria's Jubilee in 1887 it was determined to mark the event by a new coinage of gold and silver, and to make the royal portrait more suitable to her Majesty's then age. Two new denominations of five and two pounds were added to the gold series, and the double florin to the silver. For the reverse tyiie of all the gold and of the five-shilling piece,

Pistrucci's design of ^t George and the Dragon was used, and former types of Anne and George IV. were revived for the double florin, florin, half-crown, and sixpence ; that of the last was, however, soon abandoned. This new coinage did not meet with general approval, especially as regards the portrait of the Queen, and in consequence a third portrait was adopted for the gold and silver in 1893, new reverse types were prepared for the half-crown, florin, and shilling, and the issue of the

Fig. 1.â€" Sovereign (gold), England: Queen Victoria (obverse by Brock).

Fig. 2. â€" Sovereign (gold), England : King Edward VII. (obverse by de Saulles).

double florin was discontinued. The new portrait of the Queen was the work of the sculptor, Mr Thomas Brock, R.A. (Fig. 1), who was careful to avoid the defects which had . been somewhat severely criticized in Sir J. Edgar Boehm's design of 1887. The new type for the half- crown, a spade-shaped shield within the garter, was also exe- cuted by Mr Brock; and those for the florin and shilling, three shields placed triangularly, were by Sir Edward Poynter. In 1895 a new issue of bronze money was ordered, when the Queen's bust of 1893 was adopted, and a slight alteration made in the reverse type, the representation of a lighthouse and a ship, which had been added to the design in 1860, being eliminated.

The coinage of Edward VII. (Fig. 2) differs but slightly from that of Queen Victoria. The de- nominations are the same ; but on the obverse the head of the king (by Mr G. W. de Saulles, en- graver to the Mint) is represented bare, and the title " Britariniarum " is changed to " Britanniarum Omnium Rex," and the reverse of the florin shows Britannia standing on a ship, and that of the shilling the royal crest, the lion on a crown, as on the so-called " lion- shillings " of 1826.

France. â€" On the establishment of the Third Republic in France in 1870, the coinage was continued on the same lines as before, the types only being altered. The silver franc of 5 grammes (78 grains) as

ordered in 1793 and con- firmed by the Latin Monetary Union of 1865, which inclu ded Belgium, Italy, and Switzerland, and subsequently in 1868 Greece, has remained the unit of value. The denomina- tions ordered were, in gold, the 100, 50, and 20 francs; in silver, the 5, 2, and 1 franc, and 50 and 20 centimes ; and in bronze, the 10, 6, 2, and 1 centime. The types adopted were those which had been used previously â€" thus for the gold that of a genius inscribing the tables of the law, as designed by Augustin Dupre for the reverse of the con- stitutional coinage of Louis XVI. ; for the silver and copper the head of the Republic as executed by Oudine for the money of 1848. Subsequently, in 1871, the type of the 6 francs was changed for that of Hercules leaning on Liberty and Strength, as made by Dupre for the First Republic. In 1889 the 10 francs in gold was added to the list, having the head of the Republic crowned with corn, the work of Merley for the Republic of 1848 ; but^only a small number of these coins was struck in that year and in 1895. No further alteration was made till after 1895, when, in consequence of suggestions that the types should be modified so as to mark the Third Republic^ the artists MM. Chaplain, Roty, and Dupuis were commissioned to execute new designs â€" the first for the gold, the second for the silver, and the last for the bronze. The types approved were : for the gold 20 francs, the head of the Republic with a Phrygian cap, and the Gallic cock (Fig. 3) ; for the silver 2 and 1 franc and 50 centimes, the sower sowing with the rising sun, and a laurel wreath (Fig. 4);

and for the bronze, the bust of the Eepublic wearing a Phrygian cap, and on the reverse France seated amidst clouds, holding a branch and a flag, and accompanied by a

genius. These coins were not issued simultaneously â€" ^the 50 centimes appear- ing in 1897, the 2 and 1 franc and 10, 5, 2, and 1 centime in 1898, and the 20 francs in 1899. These new coins all show con- siderable skill in their designs, and are characteristic of French medallic art of l^he present time, which has a strong tendency to

imitate that of Italy of the 16th century. We cannot help think- ing, however, that a mistake has been made in giving in some instances the surface of the coin a “blurred” or

Fig. 8.â€” Twenty Francs’ (gold), France (Chaplain).

Fig. 4.â€” Two Francs (silver), France (Roty).

” cloudy ” appearance, such as a cast medal would have before it was tooled or chased. This is contrary to all precedent in the art of coinage, and as it seems to lend itself to forgery and imitation, it is an open question whether it will meet with general favour.

Belgium. â€” Of the other states which formed the Latin Monetary Union, Belgium had already in 1832 adopted the French decimal and bimetallic system, with the franc as the unit of value. Her accession to the Union, there- fore, only entailed a slight modification of type and denominations, which latter were the same as in France, except that the only gold coin was the 20 francs, the 25 centimes in silver was not issued, and the pieces of 10 and 5 centimes are now in nickel. The gold and silver coins have for types the head of the king and the royal shield, those in nickel the Belgic lion and mark of value, and those in bronze the royal monogram and the lion holding the tables of the constitution. Some of the silver coins have the inscriptions in Flemish.

Sivitzerland. â€” Like Belgium, Switzerland had before her adhesion to the Latin Monetary Union adopted the French system, with the franc of 100 centimes or rappen as the unit of value. The denominations in gold and silver were the same as issued for Belgium, but no gold was struck before 1883. The coins of baser metal were the 20, 10, and 5 centimes in billon, which metal was in 1879 changed for nickel, and in copper the 2 and 1 cen- time. Certain changes of type have from time to time occurred. The first issue of the 20 francs in 1883 shows

the head of the Republic and the shield of the Confederation; but this I was changed in 1897 for ‘the head of Helvetia above a range of moun- tains, and on the reverse a wreath with mark of value. On the silver coins from 1874 Helvetia is represented standing instead of seated, and

on the nickel money of 1879 the shield of the Republic is replaced by the head of Helvetia. The mark of value and a wreath from the general reverse type of all the silver, nickel, and

FiQ. S. â€” Twenty Centimes (nickel), Switzerland.

Fig. 6.â€” Two Lire (silver), Italy.

copper coins (Fig. 5). Since 1888 a 5-franc piece, similar in type to the 20 francs of 1883, has been issued.

Italy. â€” When Italy joined the Latin Monetary Union in 1865, she adopted as the unit of her coinage the lira of 100 centesimi, equal to the franc. The coins were of gold, silver, and bronze, and of the same denominations as those struck in Belgium and Switzerland. In 1894 a nickel coinage of 20 centesimi was ordered. The general type for all the coinage is the head of the king and the royal arms (Fig. 6), but on the reverse of the copper is the mark of value ; and the nickel ‘money has on the reverse a crown with a wreath. The coinages of all the small Italian states, including the Papal, have how passed out of currency.

Greece. â€” A special stipulation was made, when Greece was enrolled in the Latin Monetary Union in 1868, that all her money should be struck at a French mint. The unit of the coinage is the drachm of 100 lepta, which, like the lira, is equivalent to the franc. The denominations are â€” in gold, the 100, 60, 20, 10, and 5 drachms ; in silver, the 5, 2, and 1 drachm, and 50 and 20 lepta ; and in bronze, the 10, 5,’ 2, and 1 lepton. In 1893 nickel was substituted for bronze, and coins of the valiie of 20, 10, and 5 lepta were issued in this metal. The types of the coins of Greece are similar to those of Italy.

Germany. â€” Since 1871 the coinage of the German Empire has been entirely remodelled. By a conven- tion in 1867 between the States of Germany, north and south, and Austria a general coinage of a silver standard was established on the basis of the new pound of 600 grammes as sanctioned by the Zollverein. The contracting countries were divided into three sections. North Germany, South Germany, and Austria. From the pound of fine silver of 600 grammes the Northern

States struck 30 thalers, Austria 46 florins, and the Southern States 52|- florins ; their relation being 1 North German thaler =1-^ Austrian florins = If South German florins. The free towns of Hamburg, Lllbeck, and Bremen did not join the convention. The first reform in the coinage of the German Empire occurred in 1871, when a new gold money was introduced, which had for its unit the silver mark (a money of account) of 100 pfennigs weighing 6-555 grammes. The new gold pieces were of the value of 10 and 20 marks, called crowns and double crowns, and the fiuoeness was -^ pure to ji^^ alloy. This new issue necessitated a readjustment of the current values of the various silver coinages in circulation. In 1873 a further step was made by the introduction of an entirely new silver coinage throughout the empire, which was also based on the silver mark, and of a new base metal coinage in nickel and bronze. The silver coins were the 6, 2, and 1 mark and 60 and 20 pfennigs; those in nickel the 10 and 5 pfennigs, and in bronze the 2 and 1 pfennig. The silver coins were, like the gold, ^ fine, so that 90 marks were struck to the pound of pure metal. The gold 6 marks was struck in 1877 and 1878, and the 20 pfennigs in silver was replaced by a coin of the same value in nickel in 1886. The reverse type for all the coins is the imperial eagle, but that of the obverse varies ; the gold and silver showing the portrait of the reigning king or prince (Fig. 7), but the mark, and all

lesser denominations, the current value. An exception was made in the case of the coinage of the Free Towns struck at Hamburg, which has the arms of the city in- stead of a portrait. Each state retained its full rights of coinage, and the various mints throughout the em- pire with their special marks are :â€” iBerlin, A; Hanover, B:

Fig. 7.-Twenty Marks (gold), Germany. I-raukfort,C ; Jluuich,

T> ; Dresden (removed since 1877 to Milldner-Hiltte), E ; Stuttgart, F ; Karlsruhe, G ; Darmstadt, H ; and Ham- burg, J. In 1876 a gold standard was proclaimed, and henceforth no person was legally bound to accept in payment more than 20 marks in silver and the value of 1 mark in nickel or bronze.

Austria-Hungary. â€” After the convention of 1857 with Germany (see above), when Austria based her coinage on the silver standard of the florin, two series were issued â€” (i.) Vereinsmimzen (money of the union), in gold, the crown and half-crown; in silver, the double thaler (=3 florins) and thaler; (ii.) Landesmtinzen (money of the state), in gold, the i and 1 ducat ; in silver, the double florin and florin; in billon, the 20, 10, and 5 kreuzers; and in copper, the 4, 3, 1, and ^ kreuzer. In 1868 Aus- tria abandoned the convention, but made no change in her money ; and in the same year the coinage of Hun- gary was made uniform with that of the empire,- both in standard and denominations. In 1870 the Vereins- mtlnzen crown and half-crown were discontinued, and their place vj^as taken by 8 and 4 florin pieces which were of the current value of 20 and 10 francs. In 1892 the monetary system of Austria-Hungary was entirely reformed on a gold standard, the unit of account being the crown of 100 hellers. This is a decimal coinage, and the denominations are, in gold, the 20 crowns (of 164 from the kilogramme of fine gold), 10 crowns, and ducat (=9 silver crowns 60 hellers); in silver, the crown and half-crown ; in nickel, the 20 and 10 hellers ; and in bronze, the 2 and 1 heller. The gold ducat was a trade-money (handelsmimze) of the current value of 10 francs, and it displaced the 8 and 4 florin pieces of 1870. The types of the Austrian and Hungarian coins

Fig. 8. â€” Florin (silver), Austria-Hungary.

somewhat vary (Fig. 8). The Austrian gold coins show the head of the emperor and the two-headed eagle, but those of Hungary a full-length figure of the emperor and the national shield surmounted by the crown of St Stephen held by angels. The silver coins of both series have the head of the emperor and the mark of value under the imperial or royal crown. The nickel and bronze money of Austria displays the imperial

eagle on the obverse, whilst that of Hungary has the crown of St Stephen. The legends are re- spectively in Latin and Magyar.

Spain. â€” The unit of the Spanish coinage from 1864 to 1868 was the silver escudo of 200 grains divisible into 10 reals. On the dethronement of Isabella in 1868 the provisional government adopted the principles of the

Fig. 9.â€” Peseta (silver), Spain.

Latin Monetary Union and made the peseta the unit of account, this coin being equivalent to the franc. The coins struck during 1869-70 were, in gold, the 100 pesetas ; in silver, the 6, 2, and 1 peseta, and the 50 and 20 centimos ; and in bronze, the 10, 5, 2, and 1 centime. The obverse type of each metal varied; on the gold Spain is standing; on the silver she is reclining; and on the bronze she is seated. During his short reign (1870-73) Amadeus I. struck only gold coins of 100 and 25 pesetas and silver of 5 pesetas, and there was practi- cally no money issued during the Republic which fol- lowed his abdication. Don Carlos during the insur- rection of 1874-75 struck 5 pesetas in silver and 10 and 5 centimos in bronze bearing his portrait and title ” Carolus VII.” After the restoration of Alphonso XII. the coinage consisted of 26 and 10 pesetas in gold ; 5, 2, and 1 peseta and 60 centimos in silver ; and 10 and 5 centimos in bronze; and this coinage was continued by his son Alphonso XIII., who, however, in 1887 substituted the 20 pesetas in gold for the 25 pe- setas, and in 1897 struck large coins of 100 pesetas. The types show the head of the king on the obverse and the shield with (Fig. 9) or without the pillars of Hercules on the reverse; but in the case of Alphonso XIII. changes have been made in the portrait suitable to his age.

Portugal. â€” A gold standard was adopted by Portugal in 1854, the unit of value being the milreis of 1000 reis. The coins are, in gold, the crown or 10 milreis and the half, fifth, and tenth crown or milreis ; in silver, the 5, 2,

I, and -^ testoon or 50 reis ; and in bronze, the 20, 10, and 6 reis. The general type of the gold and silver is the head or bust of the king and

the royal shield ; but the bronze varies in having on the obverse a shield and on the reverse the mark of value.

Denmark, Sweden, and Norway. â€” Previous to 1872 in Denmark the unit of value was the silver rigsbankdaler of 96 shillings ; in Sweden, the rigsdaler of 100 ore ; and in Norway, the speciesthaler of 120 skillings ; but in that year a monetary convention was concluded between these countries establishing a decimal coinage, which had for its unit the krone of 100 ore, and of which the standard was gold. The denominations are, in gold, the 20, 10, and 5 kroner ; in silver, the 2 and 1 krone, and 60, 25, and 10 ore ; and in bronze, the 5, 2, and 1 or. The gold and silver money of Sweden and Norway to the 60 ore bears the head of the king and the royal shield ; the silver of smaller denominations and the bronze, the mono- gram of the king and the mark of value. In Denmark the gold and silver have the head of the king, and for re- verse type, a figure of Denmark, a shield, or the mark of value. The bronze coins are similar to those of Xorway and Sweden.

Russia. â€” The Russian coinage previou.s to 1885 was based on the silver rouble of 278 grains of pure metal ; but during the greater part of the reign of Alexander

II. (18r>5-81) the currency consisted almost entirely of paper money. In 1SS6 Alexander III. determined to place the coinage on a propei; footing, and introduced the rouble of 100 eopeks as the unit of account, with a rela- tive value of gold and silver of 1 to 15^. The coins issued were, in gold, the imperial of 10 roubles, and the half- imperial ; in silver, the rouble, and the 50, 25, 20, 15, 10, and 6 eopeks ; and in copper, the 5, 3, 2, 1, J;-, and \ copek. In 1897 the relative value of gold and silver was

Fig. 10.â€” Seven and one-half Eoubles (^old), Russia.

advanced to 1 to 23^, thus raising the current value of the imperial to 15 roubles ; but no change was made in the

weights of the coins, and the silver rouble remained the unit of account. In the same year apiece of 5 roubles, called the one-third im- perial, was added to the goldcoins. Thegene'ral types of the gold (Fig. 10) and silver show the head of the emperor and the imperial eagle ; and of the copper, the imperial eagle and mark of value.

Georgia, Poland, and Finland. â€" The separate issues of Georgia and Poland were suppressed in 1833 and 1847 respectively ; but Finland in 1878 established a decimal coinage of gold, silver, and bronze on the principles of the Latin Monetary Union, having the Markhaa (=1 franc) as its unit of value. Russia having since 1899 deprived Finland of her autonomy, her separate coinage will probably disappear.

Turkey. â€" There has been practically no change in the money of the Ottoman empire since the reforms of Abdul-Medjid in 1844, when the piastre, or 40-para piece, of the current value of 2^d., was made the unit of the coinage, and of which 100 go to the gold medjidieh or pound. The denominations are, in gold, 600, 250, 100, 60, and 25 piastres ; in silver, the 20, 10, 6, 2, 1, and \ piastre ; and in copper, the 40, 20, 10, 5, and 1 para. The type in all metals is, on the obverse, the Sultan's tiiglira, or cipher, and on the reverse, a wreath, and the name of the mint, date, &c

Balkan States. â€" Since the dismemberment of the Otto- man empire the kingdoms of Eumania and Servia, and the principality of Bulgaria, have each adopted the deci- mal system of the Latin Monetary Union. In Rumania the unit of account is the leu of 100 bani; in Servia, the dinar of 100 paras; and in Bulgaria, the lev of 100 stotinki â€" each of these units being the equivalent of the franc. All these states issue gold and silver money ; but the last two have adopted nickel instead of a bronze coinage.

United States. â€" Turning to the West, we find thatjn the United States the most important event connected with the coinage has been a change of standard. Previous to 1873 the standard was silver, having for its

unit the dol- lar of 412-| grains of ^ fine ; but in that year a gold stand- ard was adopted, the gold dollar of 26-8 grains and ^ fine being the sole unit of value. This change of stand- ard was accompanied by a slight modification of the denom- inations, which were, in gold, the double-eagle, eagle, half, and quarter eagle, three dollars, and dollar ; in silver, the half and quarter dollar, 20 cents, and dime ; in nickel, the 5 and 3 cents ; and in bronze, the cent. In addition to these a silver piece called the ” trade dollar ” of 420 grains was struck, not for circulation in the States, but for export to China. The following changes have since occurred : â€” In 1878 the silver dollar of ^12i grains was resumed, and the 20 cents discontinued; in 1887 the issue of the “trade dollar” was suspended; and in 1890 the same fate befell the three dollars and dollar in gold, and the three cents in nickel. The types are â€” gold, head of Liberty and eagle ; silver, head of Liberty, or Liberty seated, and eagle, except the dime, which has the mark of value; nickel, shield (5 cents) and the head of Liberty (3 cents) ; bronze, head of an Indian ; with reverse types for either metal, the mark of value.

Canada.â€” The currency for the Dominion of Canada, which includes Nova Scotia, New Brunswick, and British Columbia, is of silver and bronze, based on the system of

the United States. The denominations are 60, 25, 20, 10, and 5 cents in silver, and the cent in bronze ; and they also have a uniform type of the sovereign’s head and mark of value. The same system prevails in Newfound- land, which also issues the double dollar in gold: this is the only gold coin issued in a British colony whose standard is not the same as that of the mother country. There is a separate coinage for Jamaica, but of nickel only, and consisting of the penny, halfpenny, and far- thing. Hitherto all the Canadian coins have been struck at the Royal Mint, or by Messrs Heaton of Birmingham, but it is proposed to establish a separate mint at Montreal.

Mexico, &c. â€” We need not give any detailed account of the coins of Mexico, and of the various states of Central and South America, in nearly aU of which there have been radical changes since 1870. Most of them have adopted the decimal system, with a gold, silver, or bi-

metallic standard; the unit of value in the gold standard being generally the peso of 3^225 grammes, and in the silver also the peso, but of silver of 20, 26, or 27 grammes.

India. â€” As to the coins of the East and Far East, we will limit our remarks to the more important countries. In British India the rupee of silver of 160 grains is still the unit of value, but of late years serious steps have been taken to establish a gold currency also, and at present there appears some prospect of this being carried out.

Persia. â€” In Persia since 1879 a decimal system in con- formity with the principles of the Latin Monetary Union has been adopted, having for its unit the krdn weighing 78 grs., thus being equivalent to the franc, but since re- duced to 71 grs. or even less. The denominations are : in gold, the 10, 5, 2, 1, \, and \ toman (the toman =10 krSns) ; in silver, the 6, 2, and 1 krftn (=20 shahis), and the 10 and 5 shahis ; and in copper, the 4, 2, and 1 shahi (=2 pals), and the pal.

Japan. â€” Since 1871 Japan has formed its coinage on the European decimal system in place of the ancient national coins, the obangs and itsibus, the unit being the yen of 100 sen. The standard was bi-metallic, and the relation of gold and silver stood at 1-1647. In 1898 a gold standard was adopted, the issue of the silver yen was suspended, and the weight of the gold money was reduced by one-half. The coins issued since that date are, in gold, the 20, 10, and 5 yen ; in silver, the 60, 20, and 10 sen ; in nickel, the 5 sen; and in broiize, the sen and, half-sen. There is one general type for all the silver, nickel, and bronze coins, being the dragon on the obverse and a wreath of flowers with mark of value on the reverse. The gold varies in having flags and flowers on the reverse. On the silver and bronze coins the legends are in English as well as in Japanese.

CJiina. â€” In 1890 China followed the example of Japan, but only to a limited extent, and instituted a silver coinage having as its unit a dollar of the same value as the United States silver dollar and the Japanese yen. It is calculated in fractions of the tael, a money of ac- count of the value of 2s. llfd. The coins are the dollar, and the 60, 25, 10, and 6 cents, with the Chinese dragon and inscriptions, mint and mark of value in

English on the obverse, and on the reverse the mark of value in Chinese and Manchu. They were first struck at Canton and Wei-Chang, but later other mints have been estab- lished.

Hong-Kong. â€” The only other Asiatic coinage we shall note is that of Hong-Kong, where in 1866 was established a coinage, which was also based on the United States standard, having the silver dollar as its unit. The de- nominations are the dollar and 50, 20, and 5 cents in

silver, and the cent and mill in bronze; and, with the exception of the mill, they all have for type the sover- eign's head and the mark of value. In connexion with this coinage there has been issued since 1896 a " trade dollar" for special currency in the Straits Settlements

Fig. 11.â€" "Trade Dollar" (silver), Hong-Kong.

and Hong-Kong in lieu of the Mexican dollar, the scarcity of which was a considerable hindrance to trade. This coin, which is struck at the Bombay mint, shows on the obverse Britannia holding a trident and shield, and on the reverse within an ornamental design the denomina^ tion in Chinese and Malay (Fig. 11).

Egypt. â€" Glancing cursorily at the coinage of Africa, it may be noted that since 1885 Egypt has adopted a gold standard with the gold pound of 100 piastres as the unit of account. The piastre is no longer divisible into 40 paras, but into 10 ochr-el-guerche or tenths. The types are similar to the Turkish money, and though bearing the legend " struck at Cairo " the coins are really manji- factured at some European mint.

Abyssinia. â€" In Abyssinia since 1893 there has been a silver coinage formed on the basis of the Austrian Maria Theresa dollar. The coins are, in silver, the talm-i (= dollar), ^, \, and ^ talari, and in copper, the guerche and ¦ and ^ guerche. They show on one side the head of the king, and on the other a lion holding a banner.

Zanzibar. â€” Zanzibar has also issued a dollar of the fixed value of 2 rupees and 2 annas, and a copper coin called a,pessa (=136th dollar).

Sudan.- â€” The African coinages which have attracted exceptional attention are those of the Sudan and the South African Republic. The former dates from 1885, when the Mahdi struck the pound of 100 piastres in gold and the twenty piastres in silver, of the same type as the Egyptian coins, but on the silver piece were placed the words ” By order of the Mahdi,” but no mint name. His successor, Abdullah, struck pieces of 20, 10, 5, 2, and 1 piastre in silver and 10 paras in copper, but no gold. They bear the name of the mint, Omdurnian, and the word makbid, i.e., accepted. At first the silver coins were of 6 parts silver and 2 copper, but in a few years they were so debased that they degenerated into mere pieces of copper washed with silver. The last issue is dated 1897 (a.h. 1315).

Transvaal. â€” The first attempt at a separate coinage in the Transvaal was in 1874, when President Burgers issued sovereigns or pounds showing his portrait on the obverse and the shield of the Eepublic on the reverse. They were struck by Messrs. Heaton of Birmingham, but as each piece of the current value of 20s. cost 26s. to strike, only Â£680 worth was issued, and but few of these passed into circula- tion, being preserved as curiosities. No further attempt was made till 1891, when President Kruger induced the Raad to order a coinage in gold, silver, and bronze after the English standard. The first issue occurred in 1892, and consisted of the pound and half-pound in gold; the crown, half-crown, florin, shilling, sixpence, and three-

pence in silver ; and the penny in bronze. They are all of the same type as the pound of 1874, but with the portrait of President Kruger on the obverse. The first issue of the pound, half-pound, and crown was minted at Berlin, and a curious mistake was made in the arms of the state, the waggon being represented with two shafts instead of with one. This blunder was soon noticed, and a recoinage took place in the same year at Pretoria.

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II. Medals.

The art of the medallist developed during the last thirty years of the 19th century beyond most of the other fine arts, consequent on the growing taste of the public and the critics. The medal â€” as it is understood to-day â€” enjoys a life entirely independent of the coin on the one hand, and, on the other, of the sculptured medallion, or bas-relief; and its renascence is one of the phenomena in art witnessed by the present generation. It is in France that it has risen to the greatest perfection, as it is in that country most widely appreciated and most effectually supported. Its popularity there is well- nigh universal ; it is esteemed for its appropriateness not only for memorials of popular events and of public men, but also for private celebrations of all kinds,

and, through religious allusion (communions, fetes, saints' days, and the like), for the gratification of the pious. Other nations, in a degree far inferior, are producing medallists and medals in number, but none approaches in excellence â€" in artistic feeling, treatment, ^nd sensitive- ness of execution â€" the artists and the achievements of France. In England, although the Eoyal Academy seeks to encourage its students to practise the art, the prize it offers commonly induces no competition. The art of the medallist is not properly appreciated or understood, and receives little or no support. The prevailing notion con- cerning it is that it consists in Stamping cheap tokens out of white metal or bronze, on which a design, more or less vulgar, stands out in frosty relief from a dazzling, glitter- ing background. These works, even the majority of mili- tary and civic medals, demonstrate how the exquisite art of the Renaissance had been degraded in England â€" almost without protest or even recognition â€" so that they are, to a work by Roty or Chaplain, what a nameless daub would be to a picture by Rembrandt or Velasquez.

It is probable that Jacques Wiener (died 1899), of Bel- gium, was the last of the medallists of note who habitually cut his steel dies entirely with his own hand without as- sistance, though others in some measure do so still. The fact is that although most modern workers, exclusively medallists, have themselves cut dies, they nowadays take

XI'MISMATH'S.

DUPLESSIS Plaquette. ROTT.

Maurice Albert

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SiUDV. RlJTY.

â– \y ELIDING MeUAL. RuTY.

I’uL’LANCER PlAcjUETTE. RoTY.

Ameroisine JIerlin. From the Jleilal hj Michel Cazin.

XUMISMATICS.

Henki Dubois.

Medal of Award foe the Cope ahd Niool School of Paintixg. F. Bowchei:.

France, 1870. Roty.

Gold Medal, Vienna, 1S94. By Joseph Tautenhatn.

Great Gold Medal, Brxtssels, 1898. Designeil by P. “Wolfbes. Engraved by ^‘inootte.

I’ARis Universal Kxiin;rnoN, 1889. By Louis BoT’i’fcK.

International Exhiiution, CiiirAon, 1893. By Augustus St Gaudens.

NUMISMATICS

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advantage of the newest methods ; and the gmveur en m&dailles has become simply a mMailleur. His know- ledge of effect is the same â€” though the effect sought is different : in earlier times the artist thought chiefly of his shadows; nowadays he mainly regards his ijlanes. Otherwise his aims are not dissimilar ; but he sees no ob- ject in pursuing the slow, laborious system that was for- merly practised, when he can gain freedom, save time, and increase effect by seizing the advantages offered by recent inventions. At the present day the medallist, after mak- ing conscientious studies from life (as if he were

about to paint a picture), commonly works out his design in wax, or similar substance, upon a disc of plaster about 12 or 14 inches in diameter. From that advanced model a simple mould, or matrix, is made, and a plaster cast is taken, whereupon the artist can complete his work in the utmost perfection. Then, if a struck medal is required, a steel cast is made, and from that a reduction to the size required for the final work is produced by means of the machine â€” the tour d riduire. It is this machine which has made possible the modern revival, and has revolutionized the taste of designers and public alike. It was invented by Contamin, who based it upon that tour a portrait which Houlot produced in 1766, and which helped to fame several engravers now celebrated. This machine was first exhibited in Paris in 1839, and was sold to the Munich Mint ; while a similar invention, devised at the same time by the English engraver Hill, was acquired by Wyon for Â£2000, and was ultimately disposed of to a private mint in Paris. From that city comes the machine, based by the French inventor M. Ledru upon the two already referred to, now in use at the Eoyal Mint in London. A well-served medallist, therefore, need trouble himself nowadays about little beyond the primary model- ling and the final resultycorrecting with his own hand only the slightest touches â€” refining, perfecting â€” but sometimes merely confining himself to giving his directions to the professional engraver.^

The great majority of the artistic medals at present in the world (in the great collection of France there is a total of not fewer than 200,000 medals) are cast, not struck. There is in them a charm of surface, of patina, of the metal itself, which the struck medal, with all the added beauties which it allows of delicate finish and exquisite detail, can hardly give. On the other hand, the production of the cast medal is much slower, much more uncertain ; and the number of fine copies that can be produced is infinitely smaller. All the early medals were cast, being first modelled in wax, and then cast by the cire perdue (waste wax) process, and were usually worked over by the chaser afterwards ; indeed, it was not until

1 The method of preparing the dies, &c., is the same for medals as for coins, save that for larger and heavier work more strokes are required,

as in the case of L. Coudray's popular " Orphee " â€" rather a sculpture-relief than a medal. The dies are capable of a great yield before becoming quite worn out ; it is said that no fewer than three million copies were struck of Professor J. Tautenhayn's Austrian jubilee medal of the Emperor Francis Joseph. In Prance, Thonelier's perfected machine, substituting the lever for the screw, has been in use for coins since 1844 ; but for the striking of medals the same old-fashioned screw-press is retained which had till then been employed both for Bolns and medals since the time of Louis XIV. In its present form the machine consists of an iron or bronze frame, of which the upper part is fitted with a hollow screw wherein works an inner screw. This screw, moved by steam or electricity, drives the dies, set in iron collars, so that they strike the blank placed between them. So docile is this powerful machine in the hands of the operator, that it can de- liver a strong blow to produce a high relief, or a delicate touch to add the finest finish. In the Paris mint, where the striking of the beauti- ful modern medals of France is an important tmdertaking, yielding considerable profits, fourteen screw-presses are at work, and the biggest and most recent machine can strike large medals with comparative ease and rapidity. A hydraulic press of nearly two million pounds pressure is utilized for testmg the dies.

the beginning of the 16th century that dies, hitherto used only for coins executed in low relief, were employed for larger and bolder work. The medallists of those days always cast in bronze or lead, and only proceeded to use silver and gold as a luxurious taste began to demand the more precious metals. There is little doubt that the material to be preferred is dull silver (mat or sabld â€" sand- blasted), as the work, with all its variations of light and shade, can be better seen in the delicate grey of the surface. The medal, properly considered, is not sculpture. Vasari was happy in his definition when he described the medallic art as the link between sculpture and painting, that is to say, painting in the round with the colour left out. Less severe than sculpture, it need not be less dignified; it is bound down by the conventions of low relief, and by compulsions of composition and design, dependent on shape, from which sculpture, even when the relief is the lowest, is in a great measure free. In the medal, otherwise than in

sculpture, elaborate perspective and receding planes are not out of place. The genius of the modern Frenchman rebelled against the rule that com- monly governed the medal during the decadence, and has triumphed in _ his revolt, justifying the practice by his success. The modern medal and the plaquette aim at being decorative yet vigorous, reticent and dignified, del- icate and tender, graceful and pure ; it may be, and often is, all these in turn. Imagination, fancy, symbolism, may always be brought into play, allied to a sense of form and colour, of arrangement and execution. By the demon- stration of these qualities the artist is to be differentiated from the skilful, mechanical die-sinker, who spreads over the art the blight of his heavy and insensitive hand and brain. So with portraiture. Accurate likeness of feature as well as character and expression are now to be found in all fine works, such as are seized only by an artist of keenly sensitive temperament. It is thus that he casts the events and the actions of to-day into metallic history, beautifully seen and exquisitely recorded ; thus that the figure on the medal is no longer a mere sculpturesque symbol, but a thing of flesh and blood, suave and grace- ful in composition, and as pleasing in its purely decora- tive design as imagination can inspire or example suggest. It is thus that the art, while offering easy means of per- manent memorial, has afforded to men of restricted means the eagerly seized opportunity of forming small collec- tions of masterpieces of art at a small outlay.

France. â€” In France, the example of Oudinfi, coming after that of David d'Angers, did mucb to revolutionize the spirit animating the modern medallist, but Chapu, by his essentially modem treatment, did more. To Ponscarme (pupil of Oudin6) is chiefly due the idea of rendering mat the ground as well as the subject on the medal, the suppression of the raised rim, and the abandon- ment of the typographic lettering hitherto in vogue, together with the mechanical regularity of its arrangement. Degeorge, with his semi-pictorial treatment, was followed by Daniel Dupuis, whose delicate and playful fancy, almost entirely pictorial, makes us forget alike the material and the die. J. C. Chaplain is unsur- passed as a modeller of noble heads, including those of four presidents of the French Republic â€" Macmahon, Casimir-Perier, Faure, and Loubet â€" and his allegorical designs are finely imagined and admirably worked out (see Plate) ; but L. Oscar Eoty (pupil of Ponscarme) is at the head of the whole modern school, not only by virtue of absolute mastery of the technique of his art, but also of his originality of arrangement, of the poetic charm of his symbolism and his allegories, the delicate fancy, the exquisite touch, the chasteness and purity of taste â€" wedding a modern sentiment to an obvious feeling for the Greek. Though expressly less virile than Chaplain, Roty is never effeminate. To Roty belongs the credit of having first revived the form of the plaquette, or rec- tangular medal, which had been abandoned and forgotten along with many other traditions of the Renaissance (see Plate). Others there are of great talent who do not occupy so high a position. Alphge Dubois, Lagrange, and Borrel must be mentioned among those who are understood to engrave their own dies. Followers are to be found in Mouchon, Leohevrel, Vernon, Henri Dubois, Patey,

Bottle (see Plate) â€" all sterling artists if not themselves innovators. Medallists ot more striking originality but less iinish, and of far less elegance, are Michel Cazin, Levillain (who loves as much as Baudinelli to make over-display of his knowledge of muscular anatomy),

Charpentier, and their school, who aim at a manner â– which makes less demand of highly educated artistry such as that of Eoty or of Chaplain. It is learned and accomplished in its way, but lumpy in its result ; breadth is gained, but refinement and distinction are in a great measure lost. It may be added â€” in order to give some idea of the industry of the modern medallist, and the encouragement accorded to him â€” that between 1879 and 1900 M. Eoty executed more than 150 pieces, each having an obverse and a reverse.

All stria. ^The two leading medallists of the Austrian school are Josef Tautenhayn (see Plate) and Anton Soharff, both highly accomplished, yet neither displaying the highest qualities of taste, ability, and "keeping," which distinguishes the French masters. About 330 pieces have come from the hand of Anton Scharff. Stefan Schwartz, Franz Pawlik, Staniek, Jlarschall, and J. Tauten- hayn, junior, are the only other artists who have risen to eminence.

Germany. â€" A characteristically florid style is here cultivated, such as lends itself to the elaborate treatment of costume, armorial bearings, and the like ; but delicacy, distinction, and the highest excellence in modelling and draughtsmanshipâ€" qualities which should accompany even the most vigorous or elaborate designs â€" are lacking in a great degree. Profs. HUdebrand and Kowarzik have wrought some of the most artistic works there produced.

Belgium. â€" Although sculpture so greatly flourishes in Belgium, medal work shows little promise of rivalling that of France. The influence of the three brothers Wiener (Jacques, Leopold, and Charles) â€" good medallists of the old school â€" has not yet been shaken off. The remarkable architectural series by the first named, and the coinage of the second, have little affinity with the spirit of the modern medal. Lemaire has perhaps done as well as any, followed by Paul Dubois, J. Dillens (a follower of the French), G. Devreese, and Vingotte (see Plate) â€" whose plaquette for the Brussels Exhibition award (1887) is original, but more admirable in design than in finish.

HoUand. â€" In Holland not very much has been done. Patriotism has called forth many medals of the young queen, and the best of them are

doubtless those of Bart van Hove and Wortman. Baars is a more virile artist, who follows Chaplain at a distance. “Wienecke is interesting for the sake of his early Netherlandic manner ; the incongruity is not unpleasant.

Switzerland. â€” The medal is also popular in Switzerland. Here Bovy is the leader of the French tradition, and Hans Frei of a more national sentiment. The last-named, however, is more re- markable as a revivalist than as an original artist.

Great Britain. â€” In England only two medallists of repute can be counted who practically confine themselves to their art â€” G. W. de SauUes, of the Royal Mint, best known by the Diamond Jubilee medal of Queen Victoria and by his medal of Sir Gabriel Stokes, and Frank Bowoher (see Plate) by-thatof Thomas Huxley. These artists both cut their own dies when necessary. Emil Fuchs, working in England in the manner of the French medallists, but with greater freedom than is the wont of the older school, has produced several examples of the art : the medals commemorative of the South African war and of Queen Victoria (two versions), all of 1900 ; and many portrait medals and plaquettes of small size have come from the same hand. Besides these, the leading English sculptors have produced medals â€” Lord Leighton, P.R.A., Sir Edward Poynter, P.R.A., Hamo Thornycroft, R.A.,T. Brock, R.A., Onslow Ford, R.A., G. Frampton, A.R.A., and Goscombe John, A.R.A. ; but, practising more continually In sculpture, they do not claim rank as medallists, nor have they sought to acquire that class of dexterity which constant habit alone can give. Alphonse Le^ros, who has cast a certain number of portrait medals, is usually in- cluded in the French school.

United States. â€” Among American medallists Augustus St Gaudens (see Plate) is perhaps the most prominent ; but he is not, strictly speaking, a medallist, but a sculptor who can model in the flat.

Authorities. â€” F. Paekes Weher. Medals and Medallions of the 19th Centura) relating to England by Foreign Artif^ls. London, 1894. â€” Rogee Marx. “The Renaissance of the Medal in France,” Tlie Studio, vol. xv. 1898. â€” M. H. Spielmann. “Frank Bowcher, Medallist, with

some Comment on the Medallic Art," The Magazine of Art, February 11)00. â€" Spink and Snn's Monthly Numismatic Circular (passim), 1802 onwards (in Knglish, French, and German). â€" Roger SEahx. Les Mnhiillenrs Franrais depuis 1789. Paris, 1897 ; Les Medailleitrs Franrais Contem- porains (Plates). Paris, 1899 ; La Mimnaie de Paris a VExposi- tion Universelle. Paris, 1900 ; Cent Ans de JViiiiiismatiqiie Fran- fflise, 2 vols. 1893-96.â€" F, Mazerollk. L. 0. llofti : nini/raphie et Catalogue de son (Eiivre. Paris, 1897 ; -J. F. Chaplain : Biiigraphie et Catalogue de VCEiirre. Paris, 1897. â€" Dr H. J. he DoMi'iiRE DE Chaueei'ie. Les 3Iedailles et Plaquettes Jlodernes

(in Dutch and French). Haarlem, 1897.â€" A. E. v. Lobhr. Wiener Medailleure, 1899. Vienna, 1899.â€" A. Lichtwark. "Die Wiedererweckung der MedaUle," Pan, 1895 (pp. 34-40), 1896 (pp. 311-318).â€" i>ie Moderne Medaille (a monthly magazine, passim). Vienna.â€" L. Forrek. Biographical Dictionary of Medal- lists, vol. i. A-D. London, 1902. (m. h. s.)

Nuneaton, a market town in the Nuneaton parliar raentary division of Warwickshire, England, 22 miles east by north of Birmingham by rail. Stone is quarried in the neighbourhood, in which are also coal and ironstone mines. Recent buildings include public offices (1897) and free library (1899). The making of drain-pipes, tiles, and blue and red bricks is a considerable industry, besides those for which the town is more generally known. Popu- lation of parish (an urban district) (1891). 11,580 : of the extended urban district (Xuneaton and Chilvers Coton)

(1891), 16,297 ; (1901), 24,995.

Nupe. See ISTiGEEiA.

Nuremberg, a town of Bavaria, Germany, district of IMiddle Franconia, on the Pegnitz, a tributary of the Main, and 124 miles by rail north by west of Munich. The town has lost a good deal of its mediaeval character through thedemolition of large portions of its walls, though considerable sections of them still remain. In 1898 and 1899 more than a dozen outlying communes were incor- porated, with a

total population of 33,448, namely, Sundersbllhl (3871), Erlenstegen (1031), Giebitzenhof- Lichtenhof (5077), Glaishammer (5378), Grossreuth (two communes of 711 and 1363), Kleinreuth (1053), Hofen (1944), Mogeldorf (2414), Schniegling (2263), Schoppers- hof (2271), Schweinau (2640), Thon (403), and Wetzen- dorf (3029), thus extending the area of the town from 2805 to 13,700 acres. Amongst modern structures are the new building (1894-96) for the Bavarian Industrial Museum, the new wing (1884-89) of the town hall, Christ's Church in the suburb of Steinbilhl, the post office in the Sebald quarter, the market hall in the Rag (TrodeV) Market, the massive bridge connecting the suburb of St Johannis with the suburb of Gostenhof , the industrial arts school, the monument to Behaim (1890), and three artistic fountains. The "Walpurgis chapel, a portion of the Burg- gravian castle, destroyed in 1420, was restored in 1892. The Germanic National Museum has developed into one of the largest and most important institutions of its kind in all Germany. The most ntotable of its treasures em- brace prehistoric remains, sculptured monuments of the 15th and 16th centuries, a picture gallery containing especially German works of the 15th and 16th centuries, and collections of domestic furniture, dress, plaster easts of sculptured monuments and tombs, instruments of torture, glass and pottery, weapons and armour, musical instru- ments, scientific and mathematical instruments, industrial models, and so forth. The municipal library now contains 70,000 volumes and 2000 MSS. Amongst the educational and charitable foundations should be mentioned the natural history museum, the Eothermundt collection of antiquities and plaster casts, the municipal archives, a technical, an industrial art, and a commercial school, and blind and deaf and duml) asylums. The ancient linden tree in the castle courtyard died in 1893. There are two parks, the town park and Rosenau. The industries of greatest importance are those concerned with the production of goldsmiths' work (1100 operatives), machinery (2500 operatives), pencils, colours, and brushes (3200), litho- graphy, &p. (1500), mathematical and scientific instru- ments (1000), and toys (700).]\[any industrial establish- ments have moved outside the city, so as to get the advantage of the electric generating works on the river Pegnitz below the town. In 1882, and again in 1896, a large industrial and art exhibition was held at Nuremberg,

and in 1885 an international metal exhibition. Nurem- berg still remains the chief hop market in the middle of Europe, aiid also has a large wool market. Population

(1890), 142,590 ; (1900), 261,022.

Nursing. â€” The development of sick-nursing, which has brought into existence a large, highly-skilled, and organized profession, is one of the most notable features of modern social life. To deal adequately with the subject in all its aspects would require a treatise, which still remains to be written, though Sir Henry Burdett's various publications go far to supply the want. Only the more salient points can be touched upon here.

The evolution of the sick-nurse is mainly due to three

very diverse influences â€” religion, war, and science â€” to

name them in chronological order. It was

- ‘“‘â– “â– religion which first induced ladies, in the earlier centuries of Christianity, to take up the care of the sick as a charitable duty distinct from domestic nursing, which is one of the natural functions of women in all ages and among all races. The earliest forerunner of the great sisterhood of nurses of whom we have any record was Fabiola, a patrician Eoman lady, who in a.d. 380 founded a hospital in Rome with a convalescent home attached, and devoted herself and her fortune to the care of the sick poor. She had a rival in the Empress Elaccilla, the pious consort of Theodosifis I. (a.d. 379- 395), who also personally visited the hospitals and attended on the sick. Some sort of hospital, or at least dispensary, system, with medical attendance by public ofl&cers, can be traced to a far earlier date in Egypt, India, Greece, and Rome ; but that is a different question. Organized

nursing does not appear to have formed any part of medical treatment, except in so far as the deacons of the Church attended on the poor, until the 4th century of the Christian era. After that date the employment of women for this purpose must have developed rapidly, for in the reign of Honorius (a.d. 395-423) six hundred women were engaged in the hospitals of Alexandria. These institutions were managed by the clergy, and throughout the Dark and Middle Ages the hospital and nursing systems were connected with religious bodies, ilfurses were provided by the male and female monastic orders, an arrangement which still continues in most Eoman Catholic countries, though it is gradually being abandoned through the increasing demands of medical science, which have led the hospitals to establish train- ing schools of their own. The names of the oldest foundations which still survive, such as the H5tel Dieu in Paris, St Thomas's and St Bartholomew's in London, the order of St Augustine, and (in the form of a modern revival) that of St John of Jerusalem, snfiiciently indi- cate the original religious connexion. The order of St Vincent de Paul, founded in 1633 for the express purpose, is still the largest nursing organization in ther world. Even in Protestant England, where purely secular train- ing schools have reached their highest development, the generic title of Sister, alike prized by its holders and honoured by the public, remains the popular and pro- fessional synonym for head nurse, and perpetuates the old association. Nursing, as a popular or fashionable occu- pation, is not a modern invention. Sir Henry Burdett quotes an order, dated 30th May 1578, directing the Master and the Prior of the Hotel Dieu, " not to receive henceforth any novices without speaking of it to the company, because there are an excessive number of nuns and novices, who cause great expense to the said Hotel Dieu." He infers that they suffered from a plethora of nurses, or, as one might say, " a plague of women." In Protestant countries a secular nursing system came in wirh the Reformation. The staff appointed for St Bar-

tholomew's, on its re-establishment by Henry VIII. in 1544, consisted of a matron and twelve nurses, who were engaged in domestic occupations

when off duty. Thus nursing became a menial office and an inferior means of livelihood, adopted by women of the lower orders without any training or special skill ; and so it continued down to the middle of the 19th century, when a new movement began which was destined to revolutionize the status of the nurse.

Its distinctive feature was the systematic training of nurses for their vocation. Previously a certain amount of regular instruction had no doubt been given here and there by individual physicians and surgeons ; lectures to nurses were delivered in the New York Hospital as early as 1790. But these were isolated efforts. Such skill as nurses possessed was picked up in the wards. No quali- fications were required, nor indeed would they have been forthcoming, so low had the calling sunk in public estima- tion. The credit of inaugurating the new order of things belongs to Germany, and here again the religious influence came into play. The beginning of the modern system dates from the foundation of the institute for training deaconesses at Kaiserswerth by Pastor Fliedner in 1836. It is true that State training schools for male nurses had previously existed in Prussia, the oldest having been founded at Magdeburg in 1799 ; but the employment of men in hospital wards is a feature of the German system which has not been copied by other advanced countries, and seems to be in process of abandonment in Germany. It is a heritage from the Middle Ages, when the Knights Hospitallers undertook for men the duties discharged in female institutions by the nuns. The male schools there- fore stand somewhat apart, though they mark a stage in the evolution of nursing as the earliest regular training establishments. The Kaiserswerth Institute, on the con- trary, had a far-reaching and lasting influence, and may fairly claim to be the mother of the modern system. England, in particular, owes much to it, for there Florence Nightingale acquired the practical knowledge which enabled her afterwards to turn her remarkable gift of organization to such brilliant account. The example of Kaiserswerth was soon followed, and not in Germany only. In 1838 the Society of Friends founded a nui-sing organization in Philadelphia, and in 1840 Mrs Fry, a member of the same community, started the Institution of Nursing Sisters in London. In 1857 the nurses attached to it numbered ninety. They received their practical training (at Guy’s and St

Thomas's Hospitals. On the Continent institutes for nursing deaconesses were founded at Strasburg, Utrecht, Berlin, Breslau, Konigs- berg, and Carlsruhe between 1842 and 1851. In London a Church of England training institution (St John's House) was opened in 1848. There were three classes â€" (1) sisters, (2) probationers, (3) nurses. The nursing at King's College Hospital was for many years undertaken by this society, whose members were trained at the hospital.

The training system, thus inaugurated on a semi- religious basis, received a new impetus from the Crimean war, which was further emphasized by the Civil "War in America and the subsequent great conflicts on the Con- tinent. There is, of course, a natural connexion between nursing and war, which provides a large supply of surgical cases in need of ministration; and the Crusades, in particular, had raised the care of wounded warriors and toil-worn pilgrims to the level of a pious duty. But the Crimean war had an unprecedented effect on public opinion. This was due to several causes. One of the most important was the publicity given by the press, and notably by The Times newspaper, to the details of the campaign. It brought home to every one the realities

of warfare and the enormous loss of life through sickness, besides disclosing grossly defective organization. The despatch of Miss Nightingale, with a staff of trained nurses, to superintend the administration of the military- hospitals was the direct result, and it formed a new departure which riveted the eyes of the civilized world. The work undertaken and accomplished by this lady was far more important than the mere nursing of sick and wounded soldiers. She had grasped the principles of hygiene, which were then beginning to be understood, and she applied them to the reform of the hospital admin- istration; but the sentimental aspect of the experiment was that which chiefly arrested popular attention. The picture of the delicate lady smoothing the sick soldier's pillow did much to elevate the hospital

nurse's calling in public estimation, and in a measure revived the fervour of earlier centuries, though with less lofty motives. The same stimulus was felt in Eussia, where ladies also devoted their services to the military hospitals. It would be outside the scope of this article to trace the effect of the movement so begun on the care of the sick and wounded in war. That belongs more properly to the subject of war. It must suffice to say that, ~~while on the popular side the Crimea led to the feed Cross organiza~~ tion, on the official side its lessons have largely been for- gotten, especially in relation to the prevention of disease among armies in the field. In civil life it had a marked effect in stimulating the training movement and raising the status of the nurse; but substantial results were only obtained by degrees. It was not until 1860 that the modern hospital school system was definitely inaugurated by the opening of the Nightingale Fund School at St Thomas's Hospital, founded with the money subscribed by the British public in recognition of Miss Nightingale's national services, and worked on principles laid down by her. In the meantime several nursing societies, in addi- tion to those previously mentioned, had been founded in England and elsewhere. Among them the Baden Ladies' Society, founded in 1859 by the Grand Duchess Luise, deserves mention. In the same year the first district nurse began work in Liverpool ; and in 1865 the reform of the much-neglected workhouse nursing was inaugurated by Miss Agnes Jones and twelve nurses from St Thomas's, who took up the work in Liverpool. At this time England took a decided lead, which she has never lost. Other countries gradually followed. In Germany the Albert Nursing Society was founded by Queen Carola of Saxony, and the Alice Society by the Grand Duchess Alice of Hesse, both in 1867. In France, A^'here the nursing was comparatively well performed by the religious orders, no change was made until 1877, when a training school was opened in Paris by the municipality, and two others by the Assistance Publique, in connexion with the Sal- pgtrifere and BieStre Hospitals. In the United States schools were opened in New York, New Haven, and Boston in 1873. The British colonies, Austria, and other European countries followed some years later.

It remained for the third influence to complete the work begun and to develop systematic nursing to its present dimensions. Since 1880 the

increasing demands of medical knowledge have well-nigh revolutionized the craft in the home, the hospital, and the workhouse. A large part of the change may be summed up in the words ” scientific cleanliness.” It enters into all kinds of nursing, general and special ; it is the very life of modern surgery, and it is virtually synonymous with hygiene or sanitation. And scientific cleanliness is quite incompatible with the old style of nurse. There are also other improvements in knowledge, which on the one hand emphasize the importance of good nursing and on the other raise the standard of education, intelligence, skill,

and trustworthiness required for its attainment. _ The outcome of all this has been to raise the dignity of the calling, to induce persons of a superior class to adopt it in increasing numbers, to enlarge the demand for their services, and to multiply the means of edu- cating them. These changes have taken effect in all countries, though in unequal degree. Information is defective with regard to the present state of things in some of them, but full details are available for Great Britain, and some indication of the systems prevailing elsewhere can be given.

Nursing does not appear to be regulated by law in any country ; its organization is voluntary, and even in State or municipal institutions is dependent on the direction of the administration. In Grea,t l^^ortL- Britain nearly all the general and special hospi- ization. tals and many of the poor-law infirmaries offer systematic professional training to nurses. According to Burdett’s annual hand-book (The Nvrsing Profession) for 1902, there are 137 such training schools, having over 100 beds. They are thus distributed â€” England 114, Scotland 13, Ireland 10. Of those in England, 37 are in London and 77 in provincial towns. In addition to these 114 major schools there are about 350 minor ones, consisting of small general hospitals and dispensaries, special hospitals of various kinds, and other institutions. The provisions differ considerably in detail, but in the larger schools the system is uniform in all important respects. Candidates must be between 23 (sometimes 21 or 22) and 36 years of age, and must produce satisfactory evidence of character, education, health, and physique ; after a personal interview and one, two, or three months’ trial they are admitted for three years’

training. During this period they receive regular instruction in theoretical and practical knowledge, and have to pass periodical examinations. At the end of it they are granted certificates and may serve as staff nurses. They pay no premium, and generally receive a salary of Â£8 to Â£12 in the first year, rising annually to Â£30 or Â£35 as staff nurse, and subsequently to Â£40 or Â£50 as sister or head nurse. They live in a home attached to the institution, under a matron, and in the most modern establishments each nurse has a separate bedroom, with common dining and recreation rooms. In addition to these ordinary probationers, many of the large general hospitals take special pupils for short periods of instruction (three or six months), for which they pay a premium (usually 13 guineas a quarter). Their duties in the wards are the same as those of the other probationers. Private nursing staffs are attached to several of the hospitals ; they are recruited from the staff nurses and probationers on completion of their course, and supply nurses to private patients. In the special hospitals the training is shorter, being for one or two years. There seems to be a constant tendency to increase the requirements.- At St Bartholo- mew's, St George's, the London Hospital, St Thomas's, and others, probationers must enter for four years, and at St Bartholomew's they have to pass an entrance examina- tion in elementary anatomy, physiology, and other subjects. At all the more important schools the number of applica- tions is many times greater than the vacancies.

In Great Britain trained and certificated nurses gener- ally belong to a society or association. Iijcluding the private staffs attached to hospitals, there are over 200 of these bodies ; about thirty of them are private concerns, the rest are managed by committees. The most note- worthy of the associations is Queen Victoi-ia's Jubilee Institute for Nurses. It was founded in 1887 with the object of providing skilled nursing for the sick poor in their own homes, and has now 479 branches thus distri- buted throughout the kingdom â€" England 236, Wales (52, Scotland 128, Ireland 63. A great many of the provincial

nursing associations are affiliated to it. The number of nurses supported by each branch varies from one or two in country parishes to as many as 61 (Manchester). In London there are 20 branches and 110 nurses. The qualifications for a Queen's nurse are as follows : (1) training at an approved general hospital or infirmary for two years ; (2) approved training in district nursing for not less than six months, including the nursing of mothers and infants after child-birth ; (3) nurses in country dis- tricts must in adcfition have had at least three months' approved training in midwifery. Candidates possessing the first qualification are received on trial for one month, after which they complete their six months' training for the second qualification, at the same time entering into an agreement to serve as district nurse for one or two years at the end of the six mouths. The salary during training is Â£12, 10s., and afterwards Â£30 to Â£36 a year, with board, lodging, laundry, and uniform. With regard to the earn- ings-of nurses in general, the salaries paid in hospitals have already been mentioned ; for private work the scales in force at different institutions vary considerably, accord- ing to the other advantages and benefits provided. At some the nurses receive all their own earnings, minus a percentage deducted for the maintenance of the institute ;* at others they are paid a fixed salary, as a rule from Â£26 to Â£30 a year, plus a varying percentage on their earn- ings or a periodical bonus according to length of service. This is perhaps the commonest system, but sapie of the best nursing homes give a somewhat higher fixed salary without any percentage. In all these cases the nurses receive in addition board and lodging, laundry, and uni- form, or an equivalent allowance. For special cases â€" infectious, nmssage, mental, and maternity â€" nurses on a fixed salary usually receive extra pay. The fees com- monly charged by high-class institutions for the services of a trained and certificated nurse are â€" for ordinary cases Â£2, 2s. a week, for special cases Â£2, 12s. 6d. or Â£3, 3s. a week ; but many provincial associations supply nurses for Â£1, Is. a week and upwards. The discrepancy between the fees paid by patients and the salaries received by nurses, especially in London, has occasionally excited un- favourable comment, but it is to be remembered that the nurses are maintained when out of work or ill, and have other advantages ; many institutions either provide pen- sions or assist the members of their staff to join the

Royal National Pension Fund. This is the most important of several benefit societies now maintained by and for the profession. It offers insurance against sickness and pro- vision for old age. Individual nurses or institutions can belong to it ; in many cases a joint system is adopted, the premiums being paid partly by the persons to be benefited, and partly by the societies to which they belong.

To complete this acooimt of the organization In Great Britain a few details with regard to special uursing are added.

Fever. â€” Regular training on the same plan as in general hospitals is provided in London at the fever hospitals of the Metropolitan Asylums Board (12 in number, with from 360 to 760 beds each), and at a considerable number of provincial institutions.

Insanity. â€” ^The Medico-Psychological Association of Great Bri- tain and Ireland holds examinations and grants certificates in mental nursing ; candidates must undergo two years' regular training, with instruction by lectures, &c., which may be obtained in a large number of public asylums by arrangement with the Association ; one county asyjum (Northampton) gives its own certificates after a three years' course.

District Nursing. â€” In addition to the Queen's nurses, of whom details have been given above, many local associations train their own nurses for this work. Cottage and village nursing are vari- eties of the same department ; the former is organized on the benefit system, and aims at supplying domestic help and sick- nursing combined in rural districts for an annual subscription of from 2s. to 10s., according to the class in life of the family, and a weekly fee of the same amount during attendance.

Monthly Nursing and Midwifery. â€” Systematic instruction in

these subjects is given at some fifty lying-in institutions in different parts of the kingdom. The usual course for nursing is not less than three months, and for midwifery not less than six months ; a premium

is required of 12 or 13 guineas for three months, and 25 guineas for six months.

Male Nursing. â€” Two or three associations in London supply male nurses (fees 2 to 4 guineas a week), but there appears to be only one institution, apart from the military and naval services, at which they are systematically trained â€” namely, the Kational Hospital for the Paralysed and Epileptic.

Massage is taught regularly at the hospital just named, and at a few other special hospitals. Competent operators are supplied by the Incorporated Society of Trained Masseuses and, to some extent, by other nursing associations ; but this branch of the profession is still imperfectly organized (see MassaAe).

Children. â€” A large number of children's hospitals throughout the country give regular training in the nursing of children ; they take probationers at a â€¢ somewhat earlier age than the general schools ; the course is usually shorter (one or two years) , and the salaries slightly lower.

The State offers employment to nurses in the naval and military hospitals and in the Indian Government service ; the salaries are somewhat higher than in civil life, and a pension is attached.

A movement for the legal registration of trained nurses has been started in Great Britain, but the question is full of difficulties. A similar proposal to regulate the position of midwives, who may be said to stand between the medical and nursing professions, was embodied in a Bill which, after being before Parliament for several sessions, was at last carried and passed as law in 1902.

In the more important British Colonies â€” Australasia, Canada, and South Africa â€” there are now a considerable number of hospital schools and other institutions formed and conducted on the English model. Salaries and fees are very much the same in Australia ; in Canada and South Africa they are higher.

In the United States a similar system prevails in Xew York, Boston, Brooklyn, Chicago, Baltimore, Philadelphia, New Haven, and many other large towns. The period of training is either two or three years. At the Johns Hopkins School at Baltimore twelve scholarships of IJIOO and $120 each are awarded annually; graduate nurses are paid $360 (Â£72) a year. Salaries are altogether much higher in the United States. At the Boston City Hospital graduate nurses receive $120 (Â£84) a year, and at the Indianapolis City Hospital those on private duty are paid $72 a month, which is equivalent to Â£172 a year, with board, lodging, laundry, and uniform. This may be taken to indicate the possible earnings of trained nurses working independently, as they usually do in America. The system of belonging to a societj- and being paid a salary is much less in vogue there than in Great Britain. The fees charged for trained nurses run from $12 to $26 a week, and even more for special cases. Male nurses are trained at the New York City Hospital and at the Grace Hospital, Detroit. In the American schools more attention is paid to the preparation of nurses for private work than in the British (Burdett), and a directory or registry of them is kept in most large towns.

In Germany, their original home, both training schools and societies have multiplied and developed. In the year 1887 there were 14,585 trained nurses, of whom 1614 were men. Their organization was as follows : â€”

Female. Male.

Attached to religious institutions . . 10, -544 584

Attached to lay institutions . . . 1,465 554

Private 962 476

Nursing by religious orders has since been largely re- placed by hospital schools. The period of training appears to be considerably shorter than in Great Britain and America. At many schools it is only one year : the first three months are devoted to house- work, the second three months to theory, and the last six months to practical instruction.

jMembers of the Albert Society of Saxony, however, spend two years in the wards at Dresden, and a third at Leipzig, attending lectures and demonstrations. They are sent out to nurse rich and poor alike, and their

pay is very small. Most of the German institutes have pension funds.

In France a great deal of the nursing has remained in the hands of religious orders, but there too the hospital school system, inaugurated in 1877, has grown. The schools managed by the Assistance Publique in Paris give a very thorough course of instruction. Lay societies exist in several of the large towns, and provide trained nurses for private cases.

In Russia nursing is mainly in the hands of the Red Cross Society, whose members are, however, trained in the hospital schools.

In Italy, Spain, Portugal, and Belgiurn scientific nursing is in a backward state. The old religious system still prevails to a large extent, and, though some of the orders do their work with great devotion, the standard of know- ledge and skill is not up to modern requirements. In Spain and Portugal monks still nurse in the male and nuns in the female wards of hospitals, as in the Middle Ages. At San Remo and Eome institutions have been established for providing English trained nurses to private cases.

Austria is also in a very backward state, in spite of the fame of the Vienna eliniques. The Red Cross Society provides a certain amount of trained nursing, and next to it the best-organized work is done by religious orders ; but many of the hospitals appear to be still as neglected as were the English ones in 1850. The Brothers of Mercy have charge of most of the men’s hospitals, and also carry on a remarkable system of dis- trict nursing.

In Holland and the Scandinavian countries the organiza- tion is more modern and fairly adequate.

Taken altogether, the continent of Europe is far behind Great Britain and the United States with regard to siok-nursing both in the home and the hospitp,!. The calling, as such, has not attained the same dignity, and,’ with some exceptions, is pursued by an inferior class of persons, who are both less capable and less well instructed. But the pressure of modern requirements, particularly in surgery, is being felt even in the most backward quarters, and is compelling gradual improvement.

For full details on this large subject the reader is referred to the numerous text-bookS and other technical

authorities. Only a few general observations Duties and (.n be made here. Many candidates approach IfoLs. ‘‘ the calling with a very imperfect appreciation

of its exacting character. The work is not easy or to be taken up lightly. It demands physical strength, sound health, scrupulous cleanliness, good temper, self- control, intelligence, and a strong sense of duty. It embraces many duties â€” some of them menial and dis- agreeableâ€” besides the purely medical and surgical functions. This is especially the case with district nurs- ing, which is the highest and most exacting branch of the profession, because it imposes the greatest responsibility with the fewest resources and demands the most varied qualifications, while affording none of the attractions incidental to hospital work or private nursing among the rich. A district nurse should be able to do everything for the patient â€” which often means mother and child â€” and for the house : she should be able to cook, do hoilse-work, and manage children, in addition to carrying out the technical details of nursing and applying the principles of hygiene under the most difficult conditions. This may be regarded as the ideal. It is comparatively easy to fulfil routine duties, when every means is at hand and the standing conditions are the most favourable possible; when ventilation, warmth, light, and cleanliness are all provided of the best, and when assistance

can be summoned in a moment. To be thrown ou your own resources and make the best of adverse conditions is an

entirely different matter ; it requires a thorough knowledge not of routine, but of principles. It is impossible, therefore, for nurses to be over-educated in the fullest sense of the word ; but it is possible for them to be inappropriately educated, and perhaps that is sometimes the case now. Some experienced authorities believe that the third year of hospital training, however valuable or necessary it may be for the hospital career, is no advantage, but rather the contrary, for the general business of nursing ; and that during '^it probationers carry technical knowledge to a point which tends to make them self-opinionated and un- fit for the ordinary duties of the sick-room. This opinion is to a certain extent corroborated by not infrequent signs of revolt on the part of the public against the oppressive "airs " of the highly educated modern nurse, and by the experience of general practitioners, on whom she con- siders herself competent to sit in judgment. Probably the meaning of it all is that nursing has been elaborated to the inevitable point of specialization, and that a some-what different preparation is needed for different branches of the art.

Allusion has been made above to the subject of male nursing. It hardly finds a place in the British civil system, and has been condemned for hospitals in Germany, where it is at its best, by so eminent an authority as Professor Virchow. In the South African campaign it was even suggested that female nurses should replace orderlies at the front. . The only valid reason for preferring women to attend men rather than members of their own sex is the difficulty of obtaining a supply of equally well qualified and satisfactory male nurses. But this difficulty need not be permanent, and the assumption is much to be deprecated. It is, indeed, most desirable that men should be nursed by men. The advantages are many and real. Eor one thing, women do not possess the physical strength which is often required. They cannot lift a heavy man, and ought not to be asked to do it. Their inability to move patients who cannot move themselves often explains the occurrence of bed-sores, which might otherwise have been avoided. Xor can they cope with delirious male patients, who sometimes escape and injure or destroy

themselves. Then it is excessively irksome to a sensitive man to be attended by women for various necessary offices. In order to avoid it he wiU endeavour to do without assistance, and seriously prejudice his chances of recovery. There is no doubt that when men are good nurses they are quite unsurpassed ; they possess every qualification for the work, and in a hospital their dress, which raises no dust and makes no sound, is greatly preferable. The writer was much struck by the efficiency of the male nurses in the cholera hospitals at Hamburg in 1892. Strong, quick, deft, and clean, skirtless, and with sleeves rolled up, they moved about their work and handled the patients, many of whom were collapsed, as women could not possibly do. The restoration of male nurses on modern lines may be impossible for lack of the right material, but any movement in that direction is to be welcomed. So far as the preference for women is sentimental, it deserves nothing but condemnar tion. Nursing is not a sentimental, but a serious business. (See also Hospitals.)

Authorities. â€” Burdett. Hospitals and Asylums of the World; The Nursing Profession (annual). â€” Hamptos. Xursing. â€”Lewis. Nursing, its Theory and Practice. â€” LCokes. Hospital

Sisters and their Duties. â€” Morten. How to become a Nurse.

Nightingale. Nntes on Nursing. â€” Nightingale Botd. “Nursing,” Quain’s Dictionary of Medicine, 3rd edition.

Nutrition. See Physiologt.

Nuwara Eliya, the sanatorium of Ceylon, is a town of about 6000 people, with 1000 additional visitors during the “season.” It is situated 6240 feet above sea- level, with the highest mountain in the island, Pedrotal-

lagalla, towering over the plain for 2056 feet more, offering a morning climb to the top, 829G feet above the sea. Nuwara Eliya is reached from Colombo by rail, eight hours to Nanuoya, and thence less than one hour by coach (to be replaced by light railway). The Hakgalla Botanical Gardens are within an easy drive, and other attractions for visitors are provided. The climate is delightfully dry and cool during the "season" (l,st February to 31st May). The average shade temperature for the year is 58Â° ; the rainfall, 95 inches.

Nyasa, the third in size of the great lakes of Central Africa, occupying the southern end of the great rift valley system which traverses the eastern half of the equatorial region from north to south. Extending from 9Â° 29′ to 14Â° 25′ S., or through nearly 5Â° of latitude, the lake measures along its major axis, which is slightly inclined to the west of north, exactly S.jO miles, while the greatest breadth, which occurs near the middle of its length, between 11Â° 30′ and 12Â° 20′ S., is 45 miles. In the northern and southern thirds of the length the breadth varies generally from 20 to 30 miles, and the total area may be estimated at 11,000 square miles. The lake lies somewhat over 1500 feet above the sea. The sides of the valley in which Nyasa lies, which are somewhat irregular towards its southern end, take a decided character of fault scarps in the northern third, and are continued as such beyond the northern extremity. Apart from the recent alluvium on the imipediate shores, the lake lies almost entirely in granite and gneiss forma- tions, broken, however, by a band of horizontally-bedded sandstones, which cuts the axis of the lake in about 10Â° 30′ S., the flat-topped, terraced form of the latter contrast- ing strangely with the jagged or rounded outlines of the former. Near the margin, overlying the sandstones, there are beds of limestone with remains of recent molluscs, pointing, like the raised beaches which occur elsewhere, to an upward movement of the coasts. The depth of the lake seems to vary in accordance with the steepness of the shores, increasing from south to north. The greater part of the northern half shows depths of over 200 fathoms, while a maximum of 430 fathoms was obtained by Mr J. E. iloore in 1899, off the high western coast in about 11Â° 40′ S. A more complete series of soundings, however, since made by Lieut. Rhoades, and published in

the Oeographical Journal in 1902, gives a maximum of 386 fathoms off the same coast in 11Â° 10′ S.

At the north-western end is a plain of great fertility, traversed by the Kivira, Songwe, and other streams, rising either among the volcanic masses to the north or on the western plateau. Just north of 10Â°, on the delta of the Rukuru, is the British station of Karonga, the northern port of call for the lake steamers, though with but an open roadstead. Southwards the plain narrows, and in about 10JÂ° S. the sandstone scarp of Mount Waller rises sheer above the indentation of Florence Bay, the high western plateaux continuing to fall steeply to the water in wooded cliSs for more than 80 miles. In this stretch occur the land-locked bays of Ruarwe (11Â° 5′ S.) and Nkata (11Â° 36′ S.), and the mouth of the Rukuru (10Â° 43′ S.), which drains the plateau from south to north. At Cape Chirombo (11Â° 40′ S.) the coast bends to the west, and soon the plateau escarpments recede, and are separated from the lake along its southern half by an undulat- ing plain of varying width. In 11Â° 56′ S. is the British station of Bandawe, and in 12Â° 55′ that of Kota Kota, on a lake-like inlet, forming a sheltered harbour. A little north of the latter the Bua river, coming from a remote source on the upper plateau, enters by a projecting delta. At Domira Bay, in 13Â° 35’, the coast turns suddenly east, contracting the lake to a comparatively narrow neck, beyond which it runs southwards into two bays separated by a granitoid peninsula, off which lie several small rocky islands. On this peninsula was placed the mission station of Livingstonia, the first to be established on the shores of Nyasa. From the extremity of the eastern bay the Shire makes its exit to the Zambezi. On the eastern side the plateau escarpments keep generally close to the lake, leaving few plains of any extent along its shores. The crest of the eastern watershed runs generally parallel

to the coast, which it approaches in places within 20 miles. From the north point to 10Â° 30′ 8. the coast is formed by the unbroken wall of the Livingstone or Kinga range, rising where highest (9Â° 40′ S.) 6000 feet above the water. (Jn this coast, on a pro- jecting spit of land, is the German station of Langenburg, some 10 miles from the northern extremity. In 10Â° 30′ the plateau is broken by tbe valley of the

Ruhuhu, the only important stream which enters the lake from the east. The formation is here sand- stone, corresponding to that of Mount AValler on the opposite shore. Just north of the Ruhuhu is the German station of Wied- hafen, on an excellent harbour, formerly Amelia Bay. South of the Ruhuhu the wall of mountains recedes somewhat, and the remainder of the eastern shore shows a variation between rocky cliffs, marshy plains of restricted area, and groups of low hills. In 11Â° 16′ is the deep inlet of Mbampa Bay, offering a sheltered anchorage. South of it the coast forms a wide semicircular bay, generally rock-bound, and ending south in Malo Point (12Â° 10′ S.), off which are the largest islands the lake possesses, Likoma and Chisamulu, the former measuring about 4 miles by 3. In the southern half the coast is highest in about 18Â° 10′ 8., where the Mapangi hills rise to 3000 feet. Nyasa reached in 1858 both by Dr Livingstone (from the south) and by the German traveller Roscher (from the east), was explored by the former to about 11Â°, and to its northern end by Young in 1876. From this date onwards it has been thÂ§ scene of much civilizing work on the part of British (principally Scottish) missionaries, traders, and government officials, and, in more recent years, of Germans also. I In the political partition of Africa its shores have been divided between Great Britain, Portugal, and Germany, Great Britain holding (within the British Central Africa Protectorate) all the west coast south of the Songwe and the southern extremity of the east coast (south of 13JÂ° S.) ; Portugal the rest of the east coast south of 11JÂ° S. ; and Germany the remainder. A consider- able number of British steamers, including two or three gunboats, have been launched on Nyasa, which forms an important link in the water-route from the Zambezi mouth to the heart of the con- tinent. Germany also has a gunboat on the lake. The first detailed survey of its shores was executed by Mr James Stewart (1878-83), but this has been superseded by more recent work, especially that of Lieutenants Rhoades and Phillips. (See Proc. B. G. S., 1883, p. 689 ; Geogr. Journal, xii. p. 580. Also Mooee, ibid. X. p. 289.) (e. he.)

Nye, Edgar Wilson (1850-1896), American humorist, was born at .Shirley, Jle., on 25 th August 1850, and after his schoolboy days went to study law in Wyoming, being there called to the bar in 1876. He soon began to contribute humorous articles to the press under the

pseudonym of “Bill ISTye,” and obtained so much success that he devoted himself to writing and lecturing in his own humorous vein. His principal vol- umes were Bill y>/e and the Boomei-ang (1881), The Forty Liars (1883), Bill Nye’s Blossom Rock (1885), and Remarks (1886). He died at Asheville, N.C, on 22nd February 1896.

Nykjdbing, a seaport town of Denmark, county of Maribo, on the west shore of the island of Falster, 91 miles south-south-west of Copenhagen by rail. Its church contains a genealogical tree of the Mecklenburg ducal family, with portraits, dating from 1627 or earlier. Here is the house occupied by Peter the Great of Kussia in 1716, restored in 1898. The harbour was in 1899 entered by 1184 vessels of 74,381 tons, and cleared by 1199 ves- sels of 74,217 tons. Exports, bacon and butter ; import, coal. Population (1880), 4560; (1890), 6087; (1901), 7345. The area was slightly enlarged in 1900.

Nykoping, a seaport town of Sweden, at the head of an inlet on the east coast, 98 miles south-west of Stockholm by a branch line from the Stockholm-Malmo railway. It is a growing place, with engineering works, cotton and cloth factories, and shipbuilding. Its port and the port of Oxelosund (10 miles south-east), at the mouth of the bay, which is seldom closed in winter, together export considerable quantities of iron and zinc ore (536,250 tons in 1900), timber, oats, and wood-pulp, and import principally coal (over 200,000 tons in 1900), with iron, grain, &c. Population (1880), 4813 : (1890),

5978; (1900), 7375.

Oakham, a market town of England, capital of Kutland county, in the fertile vale of Catmos, 90 miles north of London by rail. It is a clean and healthy town, with a school, endowed by Archdeacon Johnson in 1584, reconstituted in 1875 as a first-olass modern school for boys, under the same charity, as Uppingham School. The parish church of All Saints has a fine reredos. There are also a Roman Catholic church

and various Nonconformist chapels, an agricultural hall, the Oakham Institute (1877), and one surviving hall of the 12th-century Norman castle, now used as a county hall. The town is governed by the county magistrates and its own rural district council. Population of the two civil parishes â€" Oakham Deanshold with Barleythorpe and Oakham Lordshold (1891), 3542. In 1894 Barleythorpe was formed into a separate parish outside the bounds of the parish of Oakham. Population of Oakham civil parish, without Barleythorpe (1901),

Oakland, a city of California, U.S.A., capital of Alameda county, on the east side of San Francisco Bay, opposite to and 6 miles distant from the city of San Francisco, of which it is the principal residential suburb, being connected with it by ferries. It has a level site, on which it is laid out with great regularity. It is divided into seven wards, and has a good water-supply ; its streets are broad, well shaded, and macadamized. It is a beautiful residential city. It is the terminus of lines of the Southern Pacific railway, whence passengers are transferred to San Francisco by ferry. Though mainly residential, it has some manufactures. In 1900 it contained 752 manufac- turing establishments with a total capital of $6,364,651. They employed 4012 wage-earners, and the product was valued at $9,174,257. The principal items of production were lumber and foundry and flouring products. It is the seat of California College, a Baptist institution, opened in 1870, which had in 1899 eight instructors and sixty- six ‘students. The assessed valuation of real and personal property in 1900, on a basis of about two-thirds of the full value, was $43,275,381 ; the net debt was only $484,030, and the rate of taxation was $25.33 per $1000. Population (1890), 48,682; (1900), 66,960, of whom 17,256 were foreign-born and 2172 coloured, including 1026 negroes.

Oaxaca de Juarez, a state of Mexico, |bounded on the N. by the states of Puebla and Vera Cruz, on the E. and N.E. by those of Vera Cruz and Chiapas, on the S. by Chiapas and the Pacific, and on the W. and N.W. by Guerrero, with an area of 35,392 square miles. Its coast-line is 530 kilometres long. Its population, 744,000 in 1879, in 1895 was 884,909. It occupies a beautiful and fertile region, watered by a number of rivers; the Sierra Madre Mountains traverse the whole state. The principal

agricultural products are cereals, sugar-cane, cotton, coffee, and tobacco, the total yearly yield being estimated at about $15,000,000. Stock-raising represents a capital of $4,000,000. Silver, gold, iron, lead, and coal are abundant, but as yet little exploited. The South Mexican railway runs froTn Puebla to Oaxaca on its way to the Guatemalan frontier, with a branch line to Puerto Angel, and the Interoceanic railway runs from Salina Cruz on the Pacific to Coatzocoalcos on the Gulf. It has two ports open to foreign and coastwise trade, Salina Cruz and Puerto Angel. The capital, Oaxaca de Juarez, near the Rio Atoyac, with 32,437 inhabitants, is one of the most beautiful and most famous cities of Mexico, has fine public buildings, an institute of sciences and arts, a model school, a general hospital, a mint, fine public gardens, and tram- ways. It is also an important industrial and commercial centre. It was founded in 1 186 under the name of Huax-

yacac. In 1872 it was given its present name. Amongst other towns in the state are Juchitan (10,820), Tehuan tepee (9415), Tlaxiaco (8535), Huantla (5924), Zachila (5814), Ojitlan (6583), Tlacolula (5377), Ejutla (5254).

Oban, a seaport and parliamentary burgh â€" extended 1881â€" (Ayr group) of Argyllshire, Scotland, on the Firth of Lorn, 92 miles north-west by north of Glasgow by rail. Manufactures of aerated waters and sheep dip have been introduced; and modern erections are the parish church. United Free church, Roman Catholic pro-cathedral, cottage hospital, court house, municipal buildings, and an isolation hospital. A large quay and sea wall have been enlarged. The harbour, which will admit vessels up to 600 tons, is 20 acres in extent, and gives 12 feet of water beside the quay. At one end of the fine bay stands Dunollie Castle, beautifully situated on a rocky knoll. On the hill in the heart of the town are the picturesque ruins of a hydro- pathic, built on far too gigantic a scale, from which a magnificent view of the Sound of Mull and the mountains of Morven is to be had. William Black, the novelist, had a villa here for many years, and Professor Blackie was a constant visitor until he took umbrage at the railway and the class of buildings that were being erected to meet the growing popularity of the town. Oban is full of hotels, and has been called the "Charing Cross of the

High- lands.” Some three miles to the north-east are the hoary ruins of Dunstaffnage Castle, with relies of the Spanish Armada, but still more memorable as’ being the resting- place of the Stone of Destiny, prior to its removal to Scone, whence it was conveyed in 1296 by Edward I. to Westminster Abbey, where it now lies beneath the coronar tion chair. Population (1891), 4946 ; (1901), 6374.

Oberammergau, a village of Bavaria, Germany, district of Upper Bavaria, situated amongst the foot-hills of the Alps, 64 miles south-south-west of Munich (of which 57 miles by rail to Oberau), where the famous Passion Play is performed every tenth year (e.g., in 1900). The people make crucifixes, rosaries, &c., and toys. Population,

1400.

Oberlahnstein, a town of Prussia, province of Hesse-Nassau, on the right bank of the Rhine, at the confluence of the Lahn, 4 miles above Coblenz. It still retains parts of its ancient walls and towers, and possesses a former castle ‘ of the electors of Mainz, the castle of Lahneck (restored in 1860), and the chapel in which King Wenceslaus was deposed in 1400. In the, vicinity are iron, lead, and silver mines. It has a trade in wine, and machine factories and saw-mills. Population (1900), 7969.

Oberleutensdorf (Czech, Litvinov horni), a town in the government district of Brtlx in Bohemia. In addition to important coal-mines, the chief industries in- clude textiles, cutlery, and leather-making, besides manu- factures of toys, furniture, hats, &c. Population (1890), 7502 ; (1900), 12,928, German.

Oberlin, a village in Russia township, Lorain county, Ohio, U.S.A., in the northern part of the state, and 34 miles distant (by rail) west-south-west from Cleveland. Besides being on the main line of the Lake Shore and Michigan Southern railway, it is on the Cleveland, Elyria, and Western (electric) railway, which furnishes connexions not only with the cities of Cleveland and Elyria, but also with the village of ^^“ellington,thus giving access to the Cleveland, Cincinnati, Chicago and St Louis, and the Wheeling and Lake Erie railways. The village is

partly paved, and has electric lighting, sewerage, and water-supply systems. Oberlin College, a co-educational institution situated here, had in 1900 (including the theological seminary, the conservatory of music, the

preparatory academy, &c.), 84 instructors and 1357 stu- dents, of whom 825 were women. The college proper had 34 instructors and 428 students, of whom 231 were women. Population (1890), 4376 ; (1900), 4082, .of whom 261 were foreign-born and 641 negroes.

Oberstein, a town of Prussia, grand-duchy of Olden- burg, in the district of Birkenfeld, and on the river ISTahe, 33 miles south-west of Kreuznach. It is famous for the industry of cutting and setting agates and other precious stones, an industry which has been established here since the 16th century. The (Evangelical) parish church is partly hewn out of the solid rock. Population (1885), 5400 ; including Idar (1895), 14,774 ; (1900), 16,729.

Oberwesel, a town of Prussia, in the Khine pro- vince, on the left bank of the Rhine, 26 miles by rail south by east of Coblenz, a former free imperial town. It is still partly surrounded with ruinous walls, having conspicuous towers. It has a couple of Gothic churches, one of the 14th century ; and above the town are the ruins of the castle of Schonburg. A little lower down the river, on the opposite bank, is the romantic rock of the Lorelei, and immediately opposite the town are the rocks of the Seven Sisters. Population (1900), 2601.

Observatory. â€” Since 1884 the instrumental equip- ment of many observatories has been considerably in- creased, chiefly owing to the rapid rise of astronomical photography. In the following list all important addi- tions are mentioned, and the principal new observato- ries founded since 1884 are shortly described. In a few cases improved values of the latitude and longitude of older institutions are also given.

[Abbreviations: ap., aperture; obs., observatory; o.g., object glass; phot., photographic; refl., reflector; refr., refractor; s.g., silvered glass; vis., visual. Where the names of two makers are given, the first is responsible for the optical, the second for the mechanical part of the instrument.]

Great Britain and Ireland. â€” Greenwich. â€” Lassell's 2 foot refl., erected 1884 ; 13 in. phot. refr. with 10 in. vis. o.g. by Grubb ; 28 in. refr. by Grubb ; 26 in. phot. refr. by Grubb, with the old 12-8 in. refr. as guiding telescope ; 9 in. phot. refr. by Grubb, and 30 in. s.g. refl. by Common, the last four being on one stand ; 8 in. altazimuth by Simms, erected 1896. The 26 in. and the 9 in. were presented by Sir H. Thompson.

South Kensington. â€" Solar Physics obs., lat. -1-51Â° 29′ 48"-0, long. Oi> Qm 41′ ~~5 W. Directed by Sir N. Lockyer. 3 foot refl. by Common ; 10 in. refr. by Cooke ; 9 in. refr. by Henry, with attach~~ ments for phot, and spectroscopic work on the sun and fixed stars.

0:r/ord.â€" Radcliffe obs. Mr Barclay's 10 in. refr. erected ; 24 in. phot, and 18 in. vis. refr. by Grubb, erected in 1902. University obs. 13 in. phot. refr. by Grubb.

Cambridge. â€" Mr Newall's 25 in. refr., presented and erected 1891 ; siderostatic telescope on Grubb's plan, with 12^ in. triple photo-vis. o.g. by Cooke, 1898.

Edinburgh. â€" New Royal obs. on Blackford Hill, opened 1896, lat.+55Â° 65′ 28″ ~~0, long. 0" 12"' 44"2 W., contains all the instru~~ ments and library of Lord Crawford's obs. and the 2 foot refl. The Calton Hill obs. has been acquired by the city, and a 21 in. refr. erected.

Grlasgow.â€"20 in. s.g. refl. by Grubb, with spectrograph.

Armagh. â€" 10 in. refr. by Grubb, erected 1885.

Mr Common^s obs. â€" 5 foot refl., erected 1888 ; the 3 foot sold.

Rev. T. E. Espin’s obs., Tow Law, Darlington. â€” 17 in. refl. by Calver.

Mr F. Jf’ Clean’s obs., Eusthall House, Tunbridge Wells.â€” 12 in. phot. refr. by Grubb, with o.g. prism same size.

Dr Isaac Boberts’s obs., Crowborough, Sussex. â€” Lat. -)-51Â° 3′ 7”, long. Oh O” 37Â» E. Erected 1890, 20 in. s.g. refl. by Grubb (with 7 in. refr.), devoted to photography of nebulae and clusters.

Stonyhurst College. â€” 15 in. Perry memorial refr. by Grubb.

Mr W. E. Wilson’s obs., Streete, Co. Westmeath. â€” 2 foot refl. by Grubbj and other instruments for work on solar physics.

The private observatories of Mr Barclay, Lord Crawford, Mr Knott, Mr’NewaJl, and Colonel Tomline have been discontinued.

France.â€” Paris.â€” Equatorial coudg of 10-6 in. ap., erected 1883 ; 13 in. phot. refr. by Henry, 1885 ; equat. coud^ with 28-6 in. vis. and phot. o.g. by Henry and Gautier, completed 1891.

Juvissy (Seine et Oise). â€” M. Flammanon’s obs. 9^ in. refr. by Bardou.

Meudon, lat. +48Â° 48′ 18”, long. O^ 8”> 55Â».6 E. Refr. by Henry and Gautier, with 32 in. vis. and 24 4 in. phot. o.g. ; refl. ot 39 in. ap. by the same. M. Janssen has established a branch on Mont Blanc for solar and spectroscopic observations.

Besanqon, lat. -|-47Â° 14′ 59”-0, long. O”” 23â„¢ 57Â«-2 E. Chrono-metric and meteorological obs., opened 1884. 8 in. refr., 13 in. equat. coud6e, 7| in. transit circle, all by Gautier.

Lyons, lat. +45Â° 41′ 41”-0, long. C 19â„¢ 8Â»-6. 12 in. equat. ooud^.

Marseilles.â€” ‘l\ in. transit circle.

Nice, lat. +43Â° 43′ 16”-9, long. O’l 29â„¢ 12’-2 E. 15 in. refr. and 15 in. equat. coud^e, both by Henry and Gautier.

Bordeaux, lat. 44Â° 50′ 7”-2, long. 0” 2â„¢ .’^‘â– 5 W. Transit circle of 7 in. ap. by Eichens ; 8 in. refr., 14 ui. refr. by Merz and Gautier ; 13 in. phot. refr. by Henry and Gautier.

2’oulouse. â€” 13 in. phot. refr. by Henry and Gautier ; transit circle by Gautier; old 13 in. refl. by Foucault. The Brunner refr. is of 9 in. ap.

Germany. â€” Bamberg. â€” Remeis obs., lat. +49Â° 53′ 6”-0, long. Oh 43â„¢ 33Â»-7 E. 7 in. heliometer by Repsold ; 10 in. refr. by Schroder.

Berlin. â€” Urania Society for Diffusing Natural Knowledge, lat. +52Â° 31′ 30″ -7, long. O^ 53â„¢ 27Â»-5 E. Opened 1889. 12 in. refr. by Schroder.

Breslau. â€” Engelmann’s 8 in. refr., acquired 1898.

Dresden. â€” Instruments given to Kasan obs., 1897.

Dusseldorf. â€” 7 in. refr. by Merz and Bamberg.

Gottingen.â€”6 in. heliometer by Repsold.

Heidelberg.â€” VniveTsitj obs., lat. +49Â° 23′ 56”-6, long. O* 34â„¢ 48′ E. , 1600 feet above the Neckar. Instruments from Karlsruhe, also 6 in. transit cu’cle by Repsold, 8 in. refr. by Merz, 12 in. refr. by Steinheil and Repsold ; 16 in. phot. refr. by Brashear and Grubb.

Konigsberg. â€” 13 in. refr. by Reinfelder and Repsold.

Leipzig. â€” 6 in. heliometer by Repsold ; 12 in. refr. by Rein- felder.

Munich. â€” 6 in. transit circle by Repsold.

Potsdam.â€” 9 in. vis. and 13 in. phot. refr. by Steinheil and by Merz ; phot, spectrograph ; 31 in. phot, and 19-7 in. vis. refr. by Steinheil and Repsold, erected 1899.

Austria-Hungary. â€” Vienna. â€” Imp. and R. obs. 14-9 in. equat. coud6 by Gautier, presented by Baron A. Rothschild.

Vienna â€” Ottakring. â€” Private observatory of M. von Kufiner, lat. +48Â° 12′ 46”-7”, long. 1″ 5â„¢ 11Â«-1 E. 10 in. vis. and 6 in. phot. refr. by Steinheil and Repsold ; 8 in. heliometer by Repsold ; transit circle by same.

Lussinpiccolo (Istria). â€” Manora private obs., lat. +44Â° 32′ ll”-0, long. Oh 57â„¢ 52′ -4 E. 7 in. refr. by Reinfelder.

Kis Kartal. â€” Private obs. of Baron Podmaniezky, lat. 47Â° 41′ 54″ -8, long. Ih 18â„¢ ll”-7 E. 7 in. refr. by Merz and Cooke.

Spain. â€” Cadiz. â€” 13 in. phot. refr. by Henry and Gautier.

Italy.â€” Teramo. â€”Private obs. of V. CeruUi, lat. +42Â° 39′ 27”, long. Qh 54â„¢ 56Â» E. 15-5 in. refr. by Cooke.

Padua. â€” Dembowski’s 7 in. refr., erected 1881.

Borne. â€” Vatican, papal obs., founded 1890, lat. +41Â° 54′ 4 “-S, long. Oh 49â„¢ 49′ -5 E. 13 in. phot. refr. and 5-5 in. photohelio- graph, both by Henry.

Catania, + lat. 37Â° 30′ 13″ -3, long. Ih 0â„¢ 20′ E. 13 in. refr. by Merz and 13 in. phot. refr. by Henry and Gautier.

Russia. â€” St Petersburg. â€” University obs., lat. + 59Â° 56′ 32”, long. 2h 1â„¢ ll’-4 E., with a branch obs. at Domkino for summer use, lat. +58Â° 35′ 36”, long. Ih 59â„¢ 25’-l E. 9 in. refr. used for double stars.

Pulkowa 30 in. refr. by Clark and Repsold. A branch has

been established at Odessa, with a 4 in. transit by Freiberg, and 4 in. vertical circle by Repsold.

Helsingfors. â€” 13 in. phot. refr.

FÂ«BO.â€” Abolished in 1883.

Plon.sk. â€” Discontinued after the owner’s death.

Kasan. â€” New obs. built 1899 (see Dresden).

Sweden.â€” I/psa?a.â€” 13 in. phot, and 14 in. vis. refr. by Steinheil.

Denmark. â€” Copenhagen.â€” \i in. vis. and 8 in. phot. refr. by Steinheil.

Holland.â€” Xej^den.â€” 10-5 in. refr. by Clark and Repsold.

Belgium. â€” Brussels. â€” New obs., lat. +50Â° 47′ 53”, long. Oh 17â„¢ 26Â»-9 E.

iig^e.- University obs., lat. +50Â° 37′ 7”, long. Oh 22â„¢ 15’-2 E. 10 in. refr. by Cooke ; 6 in. transit circle by same.

United S\a.tes.â€” Albany (N.Y.).â€” New obs., lat. +42Â° 39′ 12”-7, long. 4h 55â„¢ 6’-8 W. New 12 in. refr. by Brashear.

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OBSTETRICS

Cambridge (Mass.). â€” Harvard University obs., 12 in. horizontal telescope for photometric obs. of faint stars; 11 in. Draper phot, refr. ; 8 in. Draper refr. for regular photographs of northern slsy several times a year ; 15 in. Draper refl. for phot, trails of stars near the pole ; phot, transit photometer (see Arequi^M, S. America).

Charlottesville (Va.). â€” LeanderM’Cormick obs. of University ef Virginia, lat. +38Â° 2′ l”-2, long. &^ 14â„¢ 5Â«-2 W. 26 in. refr. by Clark.

Columbus. â€” Ohio State University obs. 12 in. refr. by Bra- shear and Warner & Swasey.

Denver (Col.).â€” Cliamberlin obs., lat. +39Â° 40′ 36”-4, long. 6>i 59â„¢ 47Â»‘6 W., 5400 feet above sea^level. 20 in. refr. by Fauth.

Echo Mountain, Los Angeles (Cal.). â€” Lowe obs., 3500 feet above sea-level. 16 in. refr. from Rochester.

Evanston (111.).â€” Dearborn obs., lat. +42^ 3′ 33″ -4, long. 5” 50″ 42″ -3 W. Removed from Chicago in 1889.

Flagstaff (Arizona). â€” Lowell obs., 7300 feet above sea-level. 18 in. refr. by Brashear.

Georgetown (D.C.). â€” 12 in. refr. by Clacey and SaegmuUer ;

9 in. phot, transit instr. by SaegmuUer ; 6 in. phot, zenith tele- scope by Brashear.

Haverford (Pa.).â€” College obs., lat. +40Â° 0′ 40”-l, long. 5i 1”> 12′ -7 ^Y. 10 in. refr. by Clark.

Mount Hamilton (Cal.). â€” Lick obs. of University of Cal., opened 1888, lat. +37Â° 20′ 25″ -6, long. 8^ 6Â°> 34Â«-9 W. The 36 in. refr. has a 33 in. phot, lens ; 6 ins. transit circle by Eepsold ; 3 foot refl. by Common ; 5 in. boriz. photoheliograph.

New Haven (Conn.).â€” The new obs. is in lat. +41Â° 19′ 22”-3, long. 4” 51″ 40”6 VV.

New ro)*.â€” Columbia University obs., lat. +40Â° 45′ 23″ -1, long. 4’Â» 55â„¢ 53Â«-6 W. Contains Rutherfurd’s instruments.

Northfield (Minn.). â€” 16 in. refr. by Brashear and Hastings; 4-8 in. transit circle by Repsold.

Philadelphia. â€” University of Pa. obs., lat. +39Â° 57′ 7”-5, long. 511 0â„¢ 38’-5 W. 18 in. refr., 4 in. transit circle, and 4 in. zenith telescope, all by Brashear and Warner & Swasey.

Poughkeepsie (N.Y.). â€” Vassar College obs., lat. +41Â° 41 18”, long. 4″ 55â„¢ 33Â»-7 W. Pounded 1865. 12J in. refr. by Pitz and Clark ; small transit circle.

Rochester (N.Y.). â€” Discontinued (see Echo Moiintairi).

Washington (D.C.). â€” New naval obs., opened 1893, lat. +38Â° 55′ 14”, long. 5’! 8â„¢ 15”-8 W. In addition to the old instruments, there is g, 40 foot photoheliograph of 5 in. ap. ; 6 in. transit circle built of steel by Warner & Swasey ; 5 in. steel altazimuth by same ;

12 in. refr.

Washington (D.C.). â€” Astrophysical obs. of the Smithsonian Institution, lat. +38Â° 53′ 17”-3, long. 5” 8â„¢ 6Â»-2. Siderostat with 20 in. mirror ; spectrobolometer, &c.

Williams Bay (Wis.). â€” Yerkes obs. of University of Chicago, lat. +42Â° 34′ 15 ‘, long. 51^ 54â„¢ 14= W. Opened 1897. 40 in. refr. by Clark and Warner & Swasey, also a 12 in. refr., 24 in. refl.,

10 in. phot. refr.

Williamstoion (Mass.). â€” The transit circle is in the Field Memorial obs. (1882), lat. +42Â° 42′ 30”, long. 4^ 52â„¢ 50> W.

Mexico. â€” Tacubaya. â€” National obs., lat. +19Â° 24′ 17”-5, long. 6″ 36â„¢ 46Â«-5 W., 7600 feet g-bove sea-level. 15 in. refr. by Grubb ;

13 in. phot. refr. by Henry and Gautier.

South America. â€” Santiago (Chile).â€” 13 in. phot. refr. by Henry and Gautier ; new transit circle.

Arequipa (Peru). â€” Branch of Harvard College obs., lat. â€”16Â° 24’, long. 411 45â„¢ 30′ W., 8060 feet above sea-level. 24 in. Bruce refr. by Clark, and 13 in. Boyden telescope for phot, charts and spectra of faint stars ; 4 in. transit photometer extends the Har- vard photometry to the south pole.

Bio dc Janeiro. â€” 13 in. phot. refr. by Henry and Gautier.

La Plata (Argentina), lat. -?AÂ° 54′ .30”-3, long. 3’> 51â„¢ 37Â» W. 8 in. refr., 18 in. equat. coud^, and 13 in. phot. refr. by Henry and Gautier.

Africa. â€” Gape of Good Hope. â€” 7 in. heliometer by Repsold ; 13 in. phot, and 10 in. vis. refr. by Grubb ; new transit circle by Simms ; 24 in. phot, and 18 in. vis. refr. by Grubb (with 24 in. objective prism), presented by Mr F. M’Clean. A phot, survey of the southern heavens has been made with a 6 in. DalUneyer lens.

Mnnritins.â€”‘Kojal Alfred obs., lat. -20Â° 5′ 39”, long. S^ 50â„¢ 12′ -5 E. Chiefly meteorological, but solar photos regularly taken.

Algiers. â€” 20 in. refl., equat. coud^, and 13 in. phot. refr. by Henry and Gautier ; transit circle.

India.’ â€” Madras. â€” New obs. is being built at Kodaikanal, 7700 feet above sea-level.

Poona. â€” Obs. of College of Science. 16^ in. s.g. refl. by Grubb, with 6 in. refr. by Cooke; spectroscopes, &c., chiefly for solar work.

Dehra Dfln.â€”O’bs. of Indian Survey, lat. +30Â° 19′ 29”-l, long, ^h ; [^iri iie(i E, Regular solar phot. work.

Japan. ^ToArt/S.â€” University obs., lat. +35Â° 39′ 17 “-5, long 9” 18â„¢ 58′ E. 5 in. transit circle hy Repsold.

Australia. â€” Sydney. â€” 13 in. phot. refr. by Grubb.

Windsor (N.S.W.).â€” 8 in. refr. by Grubb. ,

3Ielbiiurne.â€”\Z in. phot. refr. by Grubb.

Perth (West Australia), lat. -31Â° 57′ 2”-4, long. 1^ 43â„¢ 22Â»-6 E. 13 in. phot, and 10 in. vis. refr. by Grubb ; 6 in. transit circle by Simms.

AcTHOEiTiES. â€” In addition to their Annals or Observations, the leading national observatories (Greenwich, Paris, Washington, &c.)

publish annual reports stating the nature of the work and changes in personnel and instruments. Short reports from nearly all British observatories are annually published in the February number of the Monthly Notices B. Astr. Soc, and from most Ger- man and some other Continental observatories in the Vierteljalirs- schrift d. astr. Gesellschaft. Since 1889 much information about American observatories is given in the Publications of the Astr. i^oc. of the Pacific. (j. L. e. d.)

Obstetrics. â€” Along ~~with. Medicine and Surgery, Obstetrics goes to form what has been called the Tripos of the medical profession, because every" person desiring to be registered under the Medical Acts must pass a qualifying examination alike in medicine, surgery, and midwifery. Eegistrates who become general practitioners find that their midwifery cases make up a very large proportion of the patients they visit in their daily round, and in an ordinary practice such patients furnish the most constant contingent to the visiting list. Slidwifery stands related both to medicine proper or internal medicine, as it is sometimes called, and to surgery or external medicine ; and of registrates who in the larger centres of population specialize and devote themselves to one branch of the profession, whilst physicians seek the fellowship of a college of physicians and the surgeons that of a college of surgeons, obstetricians become fellows sometimes of the one college and sometimes of the other â€" it may even be of both. At present, in the capitals of the three king~~ doms, the greater number of the obstetricians are fellows of the colleges of physicians. "When two colleges combine to give a conjoint qualification the examiners in medicine are provided by the Physicians' College, and the examiners in surgery by the Surgeons' College, wiilst the examiners in midwifery are provided in equal numbers by each of the two.

Tlie Scope of Obstetrics. â€" It is required of the candi- date for a qualifying pass in midwifery that he show acquaintance with the physiology and pathology of the female. The term Gynecology, which has come to be applied to the study of the diseases of the female genera- tive system, in its ^irimary sense includes all that pertains to women both in health and disease. This was its earliest application; and while

the midwifery societies of the ‘fifties took the name Obstetrical, 3’ounger societies discussing the same range of subjects adopt the wider name Gj-n ecological. But as the obstetrical section of this branch of medicine preceded the gynecological in its development, so it retains its place of primary importance for those who seek to qualify themselves for practice. To become capable practi- tioners of midwifery’ they have to study woman as she plays her part in the reproduction of the race. This implies, to begin with, a study of Emmeiiologij â€” the science which concerns itself M’ith the cyclical changes in the female that culminate in a menstrual uterine haemorrhage. Like other cyclical processes, menstruation is probably regulated from a nervous centre seated, it is generally believed, in this instance in the lumbar part of the spinal cord; but it is dependent for its healthy flow on the healthy condition of the circulation, and is intimately associatedwith ovula- tionâ€”the escape of an ovum from a dehiscent ovisac. The appearance of themenstrual discharge is the first indication that the individual is susceptible of impregnation, and so long as it continues to recur the susceptibility remains.

EmmeBology, therefore, lias to observe the date of the first menstrual flow at from fourteen to sixteen years of age, aud the modifying influences of climate, heredity, race, and social status in the development of puberty ; the menstrual type, which is most frequently a twenty-eight-day cycle from the commencement of one period to the commence- ment of the next ; the menstrual habit, which expresses the amount and duration of the flow ; and at the end of reproductive life, the climacteric period or menopause, with its wide range of possibilities. Obstetricians recognize that, although the appearance of menstruation indicates the possibility of conception, puberty precedes the physio- logical age of nubility by as much as from seven to ten years. They know that the normal condition for repro- duction is a monogamous union of two individuals, man and woman, mutually consenting and openly declaring their desire to form a family, and that

a woman is not ripe, physically or psychically, for the great functions of wifehood and motherhood till she has attained the age of at least twentyyone years. There is the possibility of con- ception at any point in the menstrual cycle, but the period of greatest conception-probability is within a week after the cessation of the flow, so that if marriage be consum- mated at this date the newly-married wife may find that her next menstrual period fails to appear because the uterus has become the nest for the incubation of a fertilized ovum. The nine months, or, more precisely, the ten menstrual months of utero-gestation, during which the new being keeps growing like a parasite within the womb, test the strength of the pregnant female in every system of her body. This affords a second sphere of interest in the female economy, where obstetricians find occasion for the exercise of all their medical skill. Weaknesses of the brain and nervous system, of the heart, the blood, blood-vessels and blood-glands, of lungs, liver, stomach, or kidneys, or even of the bones, that might otherwise have remained latent, come into view during the strain of pregnancy aud may be a menace to the life of the mother and her child. During epidemics, as of small-pox or typhoid fever, the gravid woman runs risks from which her nongravid sister is free ; and whilst there are some common diseases that take on features of special danger, there are yet others that arise only during the course of pregnancy. The consideration of the health conditions of pregnancy has respect not only to the woman, but to her unborn infant ; not only to individuals, but to the coming race ; and in this regard it becomes part of the function of obstetricians to teach communities and even legislators the need of preventing poor women in the last weeks of pregnancy from toiling at their industries in ways that are detrimental to the race. Considerations of this kind would become urgent in a population thinned by war or fatal epidemics.

Tokology â€” the doctrine of parturition â€” is the most distinctive sphere of interest for obstetricians, and here their activities bring them into a closer approximation to the work of surgeons. As a science it demands a study of the phenomena of labour, which in their ordered succes- sion are seen to present three’ distinct stages: one of preparation, during which the nterus dilates sufiiciently to allow of the escape of the infant ; a second, of progress, during which the infant is

expelled ; and a third, of the extrusion of the after-birth or placenta. In each of the stages analysis of the phenomena reveals the presence of three elements which are known as the factors of labour, viz., the powers or forces which are engaged in the empty- ing of the uterus ; the passages or canals through which the ovum is driven ; and the passenger or body that is being extruded. The mechanism of labour depends on the balance of these factors as they become adjusted to each

other in the varying phenomena of the several stages. The diversities that are met with in different labours even of the same woman have led to their being classified into different groups. A natural labour is commonly defined as one where the child presents by the head and the labour is terminated within twenty-four hours. From this is obvious that no case of labour can be defined at its onset. The relation of the factors may warrant a favourable expectation ; but until the labour is completed, and completed within a reasonably safe period, it cannot be classed as natural. The element of time has this importance, that it is found that, apart from all accidents and interferences, the mortality both to mother and child becomes greater the longer the duration of the labour. Hence lingering or tedious labours, in which the child still presents with the head, but is not expelled within twenty-four hours after the onset of labour-pains, are properly grouped in a separate class, although they are terminated without operative interference. In the class of preternatural labours, where the head comes last instead of first, there are two subdivisions, according as the child presents by the breech and feet, or lies transversely as a cross-birth, and has usually to be delivered artificially. Operative or instrumental labours vary according as the procedures adopted are safe in prin- ciple to mother and child, such as turning and the apjplication of the midwifery forceps ; or as they involve damage to the infant in the various forms of embryotomy, or are more dangerous to the mother, as in the Csesarean section and symphysiotomy. A final class of labours includes the cases where some complication or anomaly arises and becomes a source of danger, independently of disturbances of the mechanism or of any operative interference. These complex labours are due to compli- cations that may be maternal, such as haemorrhage and convulsions ; or foetal, such as twins or prolapse of the umbilical cord. To cope with

these anomalies an obste- trician requires all the resource of a physician and all the dexterity of a surgeon.

The interestof obstetricians in theirpatientsdoes not end with the birth of the children, even after natural labours. The puerpera is still a subject of care. The uterus, that during its nine months' evolution had been increasing enormously in all its elements, has in six weeks to undergo an involution that will restore it to its pre- grayid condition. The allied organs share in their measure in the change, all the systems of the body feel the influence, and especially the mammary glands take on their function of providing milk for the nutriment of the new-born infant. A patient with some latent flaw in her constitution may pass the test of pregnancy and labour with success, only to succumb during the puer- perium. Of patients who become insane in connexion with child-bearing, a half manifest their mental disorder first during the days or weeks immediately succeeding their confinement, and numbers more whilst they are suckling their infants. A woman may have had an easy labour, and may have been thankful at the time for help from a hand that she did not know to be unclean ; three days later germs left by that hand may have so multiplied within her that she is in mortal danger from septicaemia. The management of the puerperal patient requires not only the warding off of deleterious influences, but the watching of the normal processes, because slight deviations in these, undetected and un- corrected now, may become later a source of lifelong invalidism. It remains further to be noted that to obstetricians belong the earliest stages of pediatrics in their care of the new-born child. In some old works practitioners of this branch of the profession are described as o/xipaXoTOfioi, because their first business was to cut

the umbilical cord. Tlie causes of the high death-rate among infants, whether due to ante-natal, intra-natal, or neo-natal conditions, come under their observation. They have charge of the "whole wide field of the hygiene, pathology, and therapeutics of infancy.

Historical Sketch. â€” The origin of midwifery is lost in tlie mists of liuman origins. The learned Jean Astruo, who gave a lead to higher critics in their analysis of the Pentateuch by pointing out the presence of Elohistic and Jehovistic elements, exercised his imagination in fancying how the earliest pair comported themselves at the hirth of their first child, and especially how the husband would have to learn what to do with the placenta and umbilical cord. His speculations are not in the least illuminative. The Mosaic writings let us see women of some experience and au- thority by the side of a Rachel dying in labour or a Tamar giving birth to twins, and superintending the easy labours of Hebrew slaves in Egypt. The Ebers Papyrus (1650 b.c), which Moses may have studied when he grew learned in all the wisdom of the Egyptians, is the oldest known nledical production. It contains prescriptions for causing abortion, for promoting labour, for curing displacements of the uterus, &c. But there is no indication as to how labours are to be managed, and with regard to the child there are only auguries given as to whether it will live or die, according, e. g. , as its first cry after it is born sounds like nl or ba.

The story of the rise and progress of midvpifery is intimately bound up with the history of medicine in general. The obstet- rician, looking for the dawn of his science, turns like his fellow- workers in other medical disciplines to the Hippocratic writings (400 B.C.) . Now the father of medicine was not an oljstetrician. As with Egyptians and Hebrews, the skilled attendants on women in labour among the Greeks were also women. But since nothing that concerned the ailments of humanity was foreign to Hip- pocrates, there are indications in the writings that are accounted genuine of his interest in the disorders of females â€” in their menstrual troubles, in their sterility, in their gestation symptoms, and in their puerperal diseases ; his oath forswears the use of abortifacients, and he recommends the use of sternutatories to hasten the expulsion of the after-birth. In the Hippocratic writ- ings that are supposed to be products of his followers, some of these subjects are more fully dealt with ; but whilst the physician is sometimes called in to give advice in difficult labours, so that he can describe different kinds of presentation and can speak of the possibility of changing an unfavourable into a favourable lie of the infant, it is usually only with

cases where the child is already dead that he has to deal, and then he tells how he has to mutilate and extract it. So these writings furnish us with the earliest account of the accoucheur's armamentarium, and let us see him possessed of a iMxalpi-ov â€" a knife or perforator for opening the head ; a irlea-Tpoi/ â€" a comminutor for breaking up the bones ; and a iXxvirriip â€" an extractor for hooking out the infant. The classical writers of Greece give the same impression as to the primitive stage of obstetrics. Women, like the mother of Socrates, have the charge of parturient women. Where divine aid is sought, goddesses are invoked to facilitate the labour. Gods or men are only called in where graver interference is required, as when Apollo rescued the infant ^sculapius by a Caesareau section performed on the dying Semele. Some midwives are known to history, and extracts from the writings of one Aspasia are em- bedded in the works of later authors. In the great medical school of Alexandria, when the science of human anatomy began to take shape, Herophilus rendered a service to obstetrics in giving a truer idea of the anatomy of the female than had previously prevailed ; other physicians give evidence of their interest in midwifery and the diseases of women, and some experience was gradually being acquired and transmitted through the profession until we find from Celsus (in the reign of Augustus) that when surgeons were called in to help the attendant woman they could sometimes bring about the delivery, without destroying the infant, by the operation of turning. In the 2nd century Soranus wrote a work on midwifery for the guidance of midwives, in which for the first time the uterus is differentiated from the vagina and instruction is given for the use of a speculum. A contem- porary, Moschion, wrote a guide for midwives which, with that of Soranus, may be said to touch the high-water mark of archaic midwifery. It is written in the form of question and answer, was much prized at the time of the Renaissance, and was used as the basis of the first obstetric work that issued from a printing-press. Philumenos wrote a treatise of some value at the same epoch, but it is only known from the free use made of it by subsequent writers, such as Aetius in the beginning of the 6th century. Like Oribasius, who preserved in his compilation the work of Soranus, Aetius draws largely on preceding writers. His treatises on female diseases constitute an

advance on previous knowledge, but there is no progress in midwifery, though he still

makes mention of turning. This operation has disappeared from the pages of Paulus ^gineta, an 8th-century author, the last to treat at length of obstetrics and gynecology ere the night of the Dark Ages settled down on the Roman world, and it is not heard of again till a milennium had passed. During the centuries when the progress of medicine was dependent on the work of the Arabian physicians, the science of obstetrics stood still. We are curious to know what Rhazes and Avicenna in the 9th and 10th centuries have to say on this subject. But they know little but what they have learned from the Greek writers, and they show a great tendency to relapse to the rudest procedures and to have recourse to operative interferences destructive to the child. In- terest attaches to the work of Albucasis in the 12th century, in that he is the first to illustrate his pages with figures of the knives, crushers, and extractors that were employed in their gruesome practices, and that he gives the first history of a case of extra- uterine pregnancy.

We come down to the 16th century before we begin to see any indication of the development of obstetrics towards a place among the sciences. Medicine and surgery profited earlier by the intel- lectual awakenings of the Renaissance and the Reformation. In anatomical theatres and hospital wards associated with universities great anatomists and clinicians began to discard the dogmas of Galen, and to teach their pupils to study the body and its diseases with unprejudiced minds. But the practice of midwifery was still among all people in the hands of women, and when in 1513 Eucharius Roesslin of Frankfort published a work on midwifery, it bore the title Der Schwangeren Frawen und Hebammen Eosengar- ten. Translated into English by Thomas Raynald with the altered title. The Birth of Mankynd, it is mainly compiled from Moschion, and the Soranus and Philumenos fragments of Oribasius and Aetius, and is intended as a guide to pregnant women and their attendant nurses. It was illustrated with fanciful figures of the foetus in utero that were reproduced in other works of later date â€” as in the Bosetigarten of Walter Reiff of

Strasburg in 1546 and the Hebam- menbuch of Jacob Rueff of Zurich in 1554, the latter of which appears in English dress as The Expert Midwife. The greatest impulse to the progress of midwifery was given in the middle of the 16th century by the famous French surgeon Ambroise Par6, who revived the operation of podalic version, and showed how by means of it surgeons could often rescue the infant even in cases of head presentation, instead of breaking it up and extracting it piecemeal. He was ably seconded by his pupil Guillemeau, who â€¢ translated his work into Latin, and at a later period himself wrote a treatise on midwilery, an English translation of which was pub- lished in 1612 with the title Child-Birth ; or. The Happy Deliverie of Women. The close of the 16th century is rendered further memor- able in the annals of midwifery by the publication of a series of works specially devoted to it. Three sets of compilations, contain- ing extracts from the various writers on obstetrics and gynecology from the time of Hippocrates onwards, were published under the â– designation of Gynmcia or Gynceciorum â€" the first edited by Caspar Wolff of Zurich in 1566, the second by Caspar Bauhin of Basle in 1586, and the third by Israel Spach of Strasburg in 1597. Spach includes in his collection not only Park's obstetrical chapters, but the Latin translation of the important Traitte nouveaux de Vhys- terotomotokie, published by the French surgeon Francis Rousset in 1581, which is the first distinct treatise oiNan obstetric operation, and advocates the performance of Csesarean section on living women with difficult labours. From this time onwards evidence accumu- lates of the growing interest of members of the medical profession, and more especially of surgeons, in the practice of midwifery, and after the middle of the 17th century they began to publish the records of their experiences in special treatises. The most im- portant of these writers were French â€" as Mauriceau, Viardel, Paul Portal, Peu, and Dionis. The work of Mauriceau, which first appeared in 1668, is specially interesting from its having been translated into English in 1672 by Hugh Chamberlen, who in his preface made the then incredible statement that his father, his brothers, and himself had long attained to and practised a way to deliver women in difficult labours without hooks, where other artists used them, and without prejudice to mother or child. Many years had still to elapse before the secret of the Chamber- lens leaked out. In the

course of this century some women who had large experience in midwifery appeared as authors. Thus in England Jane Sharp in 1671 wrote The Midioives' Book, or the whole art of Midwifery discovered; in Germany, Justine Siegemund, in 1690, Die Chnr-Brandenburgische Hoff-Wehemutter ; and earlier and better than either, in France, Louise Bourgeois in 1626 pub- lished Observations sur la Sterilite et Maladies des Femmes. Per- haps they were beginning to feel that there was some need to assert their power, for it was during this century that parturient ladies began to call in men to attend them in natural labours. Accord- ing to Astruo, Madame de la Valli6re wished her confinement to be kept secret, and Louis XIV., in June 1663, sent for Jules Clement, the court surgeon, to superintend the delivery. This

was accomplished successfully. The king gave him the title of accoucheur. Clement afterwards attended the dauphiness and other court ladies, and went thrice to Madrid to assist at the confinement of the queen of Philip IV. Up till this epoch physicians and surgeons had only been summoned to the lying-in room by mid wives who found themselves at the end of their resources, to give help in diffi- cult cases where the child was usually dead and the mother often moribund. Now that it began to be a fashion for women in their ordinary confinements to be under the surveillance of a physician, it became possible for men with their scientifio training to study the normal phenomena of natural labour, and through the medium of the printing-press to communicate the results of their observation and experience to their professional brethren. Hence the books of the men already referred to, and of others that appeared later, such, as the Traite Complet des Accouchemens of De la Motte, 1721, which is a storehouse of acute observations and wise discus- sion of obstetric measures. In other countries than France phy- sicians and surgeons began to take up midwifery as a speciality and not as a subsidiary part of their practice, of which they were somewhat ashamed (Le Bon, one of the writers whose work is found in Bauhin's Gynaeaia, says, " Hseo ars viros dedecet"), and it was in Holland ~~that a~~

~~work was produced that has earned for its author the designation of the Father of Modern Midwifery. Heinrich van Deventer, who practised as an obstetrician at The Hague along with his wife (a Vroedvrow, as he was a Vroedmeester) , published in 1696 a preliminary treatise called Dageraat {Aurora) der Vroedvrowen, and in 1701 he followed it up by a more com~~ plete second volume, of which the Latin edition that came out simultaneously with the Dutch has a title beginning Operationes Gliirurgicm Novum Lumen Exhibentes Obstetricantibus. It has the supreme value of being the first work to give a scientific description of the pelvis, and to take some steps towards the development of the mechanism of labour. The " obstetricantes " for whom Deventer wrote are both men and women. In the early part of the 18th century women had still the main and often the sole charge of their parturient sisters ; but the practice of having a doctor to superintend or to supersede the midwives kept spreading among the classes who could afford to pay the doctor's fee ; and by the time Deventer's treatise was doing its educational work in an English translation, as The Art of Midwifery Improved, in 1716, the doctors were getting into their hands the "harmless forceps" with which a living child could be extracted without detriment to the mother, in conditions where formerly her child's life was sacrificed and her own endangered. This life-saving instrument was Invented in London, but by a man not of English birth. The Huguenot, William Chamberlen, fled from Paris to escape the St Bartholomew massacres, carrying with him to Southampton his wife, his two sons, and a daughter. William Chamberlen seems to have been a surgeon, and his descendants through four genera- tions had large and lucrative practices in London. The eldest son Peter, who was old enough when he came to England to be able to attest the birtli and baptism of a younger brother, is, on good grounds, credited with being the Inventor of the forceps, which for a century was kept a secret among brothers, sons, and grandsons. Hugh, indeed, a great-grandson of William, and the translator of Mauriceau, had offered to sell the family secret for 10,000 crowns ; but his failure to effect delivery in a test case that Mauriceau put to him led the profession to believe that he was a boastful quack. Palfyn of Ghent, when in Paris in 1723, putting a work on anatomy through the press, laid before the Academy of Science a pair of forceps, which was figured

in Heister's surgery in 1724. He has thus the honour of first laying before the profession a midwifery forceps. But his implement was ill-constructed, and never came into general use. Meanwhile the knowledge that the Chamberlens were really possessed of a serviceable instrument must have stimu- lated other practitioners. Perhaps a colleague with a keen eye may have got sight of it on some occasion, or an intelligent mid- wife had been able to describe the "tongs" which she had seen one of the family apply. In 1734 Dr Edward Hody published a record of Cases in Midwifery that had been written by Mr William Giffard, "surgeon and man-midwife." The dates range from January 1724 to 1731. Amongst the cases are several where he effected the delivery by means of the forceps â€" "extractor," he calls itâ€" of which a figure is given ; and when Edmund Chapman, who practised first at Halstead and afterwards in London, published his Treatise on the Improvement of Midwifery in 1733, he speaks of the use of the forceps as "now well known to all the principal men of the profession both in town and country. ' '

In the course of the 18th century the development of midwifery in the hands of medical men made greater strides than in all the preceding ages. The progress was accelerated by the establishment of chairs of midwifery in the universities of various countries, Edinburgh taking the lead in the appointment of a professor in 1726, and Strasburg coming closely after In 1728. In Strasburg the chair had the advantage of being at once associated with a clinical service. Lecturing was carried out, moreover, by men who were devoting themselves as specialists in midwifery and the

diseases of women and infants, and were succeeding m developing lying-in institutions for the benefit of poor women in labour that became schools of instruction both for midwifery nurses and for medical students. Two new operations came during this epoch to enhance the powers of the obstetrician, viz., symphysiotomy, first introduced by Sigault in Paris ; and the induction of premature labour, first carried out by Macauley in London in circumstances described by Denman in the preface to his Midwifery. William Hunter in London, Sir Fielding Ould in Dublin, lioderer in Got- tingen, Camper in

Amsterdam, Baudelocque in Paris, Saxtorph in Copenhagen, and many other authors contributed to progress by their atlases and their books. But there are three whose names stand out pre-eminently because of the influence they exerted on the whole obstetric world â€” Levret, Smellie, and Boer. Kilian, in his vidimus of the history of midwifery, calls Levret "one of the greatest masters in the department that ever lived." Of Smellie he says : "Inferior to Levret in nothing, he excels him in much." BoBr he characterizes as " the most meritorious and important of German obstetricians." Levret improved the construction of the forceps, and widened the sphere of their applicability ; Smellie worked in the same direction, and furnished, moreover, descrip- tions and illustrations of natural and morbid labours that are of classical value ; and Boer first clearly placed pregnancy (which Mauriceau, e.g., had spoken of as " a nine months' disease ") and parturition in the category of physiological processes that might be hindered rather than helped by the pragmatical interferences of meddlesome midwives.

Throughout the 19th century midwifery continued to advance, gynecology grew into a special department with an extensive literature, the mechanism of labour developed under the clinical observations of men like Nagele and the study of such frozen sections of cadavera as were made by Braune, the indications for interference became more clear and the methods of interference more simple and safe, and a whole realm of antenatal pathology and teratology was added to the domain of science, while practitioners learned the art of saving premature and delicate infants by the use of the Incubator and proper alimentation. Every advance in all the cog- nate sciences was appreciated and applied for the advancement of obstetrics. But there are two achievements which will make the 19th century for ever memorable in the annals of midwifery â€” the abolition of the pains of labour and the arrest laid on mortality from the so-called puerperal fever. In February 1847 Sir J. Y. Simpson, choosing a case where he had to deliver by turning, put the patient asleep with ether. Seeing that the uterine contractions continued, though the attendant pain was abolished, he proceeded tp admin- ister ether in cases of natural labour, and in November of the same year demonstrated the virtues of chloroform, and so fur- nished the most serviceable ansesthetic, not

only to the obstetrician in the lying-in room, but to the surgeon on the battlefield and to the general practitioner in his everyday work. Ignaz Philipp Semmelweiss, assistant in the maternity hospital of Vienna, was struck and saddened with the appalling mortality that attended the delivery of the women under his care, as many as one (in some months three) out of every ten of the puerperse being carried out dead. He observed that the mortality was much higher in the wards allotted to the tuition of students than in those set apart for the training of nurses. In the spring of 1847 he saw at the post- mortem examination of a young colleague who had died of a poisoned wound, that the appearances were the same as he had too often had occasion to see at the post-mortem examinations of his puerperse. He ordered that every student who assisted a woman in her labour must first wash his hands in a disinfectant solution of chloride of lime, and in 1848 already the mortality was less in the students' than it was in the nurses' wards. Thus the first light was shed on the nature of the mischief of which Â«nulti- tudes of puerperal patients perished, and the first intelligent step was taken to lessen tie mortality. When , some twenty years later, Lister had applied the bacteriological principles of Pasteur with beneflcent results to surgery, obstetricians gladly followed his lead, and the 19th century beheld added to the comfort of anaesthetic midwifery the confidence of midwifery antiseptic and even aseptic.

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0 C A N A â€” 0 C C L E V E

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Ocana, a town of Spain, in the province of Toledo, on the extreme north, of tlie plateau of Ocana, near and to the south-east of Aranjuez, with a station on the line from that place to Cuenca. This plateau produces wine, wheat, oil, fruit, mostly sent to Madrid, and in Ocana there are manufactures of pottery, alcohol, soap, and leather. The town is surrounded by walls in ruinous condition, and there are the remains of an old castle. It has broad regular streets, several squares with arcades, a fine town hall, schools, hospitals, convents, three parish churches, in one of which is the chapel of Our Lady de los Eemedios, in which Ferdinand and Isabella were married. Near the town are the

ruins of the convent of LaEsperanza, which this queen built. Ocana is the Vicus Cuminarius of the Romans, and was the dower that Abden Aled of Seville gave his daughter Zaida on her marriage with Alfonso VI. In Ocana several Cortes of the Middle Ages assembled. Near this town, on 19th November 1809, a battle was fought between the Spanish army under Lacy and the French invaders commanded by Joseph Bonaparte and Marshal Soult, who routed the Castilian forces. Population, about 6000.

Occleve (or Hocclete), Thomas (1368?~~1460?), ranks, like his more voluminous and better known contem~~ porary Lydgate, among those poets who have a historical rather than intrinsic importance in English literature. Their work rarely if ever rises above mediocrity ; inneither is there even any clear evidence of a poetic temperament. They are eclipsed, not only by every poet of the Scottish school, but by more than one of their nameless English successors. Yet they represented for the 15th century the literature of their time, and kept alive, however faintly, the torch handed on to them by their "maister," Chaucer. What is known of Occleve's life has to be gathered mainly from his works. At eighteen or nineteen he obtained a clerkship in the Privy Seal Office, which he retained on and (jff, in spite of much grumbling, for about thirty-five years. He had hoped for a benefice, but none came ; and in 1399 he received instead a small annuity, which was not always paid as regularly as he would have wished. The Letter to Cupid, his first poem to which we can affix a date, was translated from the Erench in 1402, evidently as a sort of antidote to the moral of Troilus and Cressida, to some MSS. of which we find it attached. La Male Regie, one of his most readable poems, written about 1406, gives some interesting glimpses of his " misruly " youth. His contrition for the past, which has brought him, as he bewails, to poverty of body and purse, seems to have been lasting ; and about 1410 he settled down to married life, and to the composition of moral and religious poems, which are interspersed with continual complaints of poverty. His longest work, De Eegimine Principum, written for Prince Hal shortly before his accession, is a tedious homily on the virtues and vices, with appropriate instances from the usual mediaeval sources ; but it is re-

lieved by a Proem, about a third of the whole, containing some further reminiscences of London tavern and club life, in the form of a dialogue between the poet and a beggar. On the accession of Henry V., Occleve turned his muse to the service of orthodoxy and the Church, and one of his poems is a remonstrance addressed to Oldcastle, calling upon him to ” rise out of the slough of heresy.” Then a long illness was followed for a time, as he tells us, by insanity. His Dialog with a Friend, written after his recovery, gives a naive and pathetic picture of the poor poet, now fifty-three, with sight and mind impaired, but with hopes still left of writing a tale he owes his good patron, Humphrey of Gloucester, and of translating a small Latin treatise, ” Scite Mori,” before he dies. His hopes were fulfilled in his moralized tales of Jereslaus’ Wife and of Jonatlms, which with his Learn to die belong to his old age. After finally retiring from his Privy Seal clerkship, he was granted in 1424 sustenance for life in the priory of Southwick, Hants, on which, with his former annuity, he appears to have lived on till about the middle of the century. Besides his De Eegimine, of which there are a number of MSS., his works are comprised in four MS. volumes, of which three have been edited by Dr Eurnivall, and the fourth (Ashburnham j\IS.) is promised by Mr Gollancz, for the Early English Text Society.

The main interest for us in Occleve’s poems is that they are characteristic of his time. His Hymns to the Virgin, Balades to patrons. Complaints to the King and the King’s Treasurer, versified homilies and moral tales, with warnings to heretics like Oldcastle, are illustrative of the blight that had fallen upon poetry on the death of Chaucer. The nearest approach to the realistic touch of his master is to be found in Occleve’s Male Regie. But these pictures of 15th-century London are clouded over by the pale cast of contrition, and are without even the occasional flash of humour that lightens up Lydgate’s London Lackpenny. Yet Occleve has at least the negative virtue of knowing the limits of his powers. Of a modest and even timid nature, he never attempts a flight too high for him. His unassuming downrightness and sincerity of style is in some respects a relief from the colours of rhetoric and trite verbiage with which Lydgate too often wearies his readers. He says simply what he means, and does not affect what he does not feel. A Londoner, to whom the country was evidently a bore, he has not

afflicted us with artificial May mornings; audit is doubtful whether a single reference to nature can be found among his poems. He has yet another distinctionamonghis contemporaries : he wrote no allegory. Whether we ascribe it to his lack of ” engine,” or to the influence of Chaucer when in his later years he had dis- covered the limitations of this poetic form, we cannot but be grateful to the poet who has spared us. As a metrist Occleve is also modest of his powers. He confesses that

Fader Chaucer fayn wolde han me taught, But I was dul aud learned lite or naught ;

and it is true that the scansion of his verses seems occasionally to require, in French fashion, an accent on an unstressed syllable. Yet his seven-line (or rime royale) and eight-line stanzas, to which he limited himself, are perhaps more frequently reminiscent of Chaucer’s rhythm than are those of Lydgate. As for the heroic couplet of Tlie Legende of Good Women and The Canterbury Tales, it may be questioned whether Chaucer ever suc- ceeded in imparting the i secret of its rhythm to any, whether poet or scribe. Lydgate alone had the temerity to attempt it in the doggerel ” riding-rime ” of the Ti oy Book and the Story of Tliebes. Then it disappears from our literature, to be rediscovered from the Italian in the next century. (-w. s. m.)

OCEANOGRAPHY

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Oceanography. â€” The department of geography which deals with the phenomena of the collected waters of the globe is termed by the Italians talussografia, and attempts have been made but without success to intro- duce the name ” Thalassography ” in other languages. The term ” Hydrography ” has been introduced in Sweden ; but this is a misleading expression, as at least two different subjects are already designated by that word. Tn general use Oceanography is the term applied to the study of the oceans and seas, the cognate science of lakes being termed Limnology, and that of rivers Potamology.

The form of the ocean basins, like that of the land,

is the concern of physical geography (see Geography).

Practically, however, the form of the sea-bed is

^’ so intimately associated with all the phenomena

of the water resting on it that both have to be considered together. The primary division of the hydrosphere into oceans and seas is arbitrary, but in each case some parts of the boundary are natural limits. A sea is a detached or partially detached portion of the hydrosphere of considerable size. Elaborate classifications of seas have been proposed, according to their relations to the open oceans and to the land ; but the simplest, that of Sir John Murray, suffices for rnost purposes. A sea may be (1) entirely surrounded by land (inland), like the Caspian; (2) enclosed by land, except for a single entrance (enclosed), like the Mediterranean ; (3) partly enclosed by land, but with two or more openings (paHially enclosed), like the Xorth Sea or Caribbean Sea ; to which we may add (4) divided from the general mass of the oc^an only beneath the surface (barred off) like the Norwegian Sea. In a few instances the name sea is given to a part of the ocean distinguished from the vest by physical peculiar- ities, but not bounded in any part by land, such as the Sargasso Sea.

The largest divisions of the hydrosphere are termed oceans, but it is just as difficult to distinguish an ocean from a sea as it is to distinguish a continent from an island. From the time of the first circumnavigators three great oceans running from north to south have been recognizedâ€” the Atlantic, between Europe-Africa and America ; the Indian, between Africa and Malaysia/- Australia ; and the Pacific or South Sea, between Asia-Malaysia-Australia and America. The extent and limits of the oceans to north and south were variously given by different writers, and much confusion resulted. The question of nomenclature was considered by the Royal Geographical Society in 1845, when a committee drew up provisional rules which were never formally adopted, but nevertheless came into current use.^ They recognized an Arctic and Antarctic Ocean lying wholly within the respective polar circles, and the water area between the north and the south polar circles was divided into the Atlantic, Pacific, and Indian

Oceans by the continental coasts and arbitrary meridians. The advance in physical knowledge, of the oceans has shown it to be desirable to recognize the great ring of un- obstructed water girdling the southern hemisphere, south of the continents, as a natural unit, and it has accordingly become common, if not yet usual, to place the limits of the Atlantic, Indian, and Pacific Oceans at 40Â° S., and to call all the water south of that parallel the Southern Ocean. The Southern Ocean may be considered to stretch to the edge of the Antarctic ice, or, if preferred, the southern portion, within the Antarctic circle, may retain its old name. From several points of view it is ad- visable to call the Arctic Ocean a sea, and to view it as an extension of the Atlantic basin. The chief physical differences between oceans and seas are due to the freedom

1 See Geographical Journal, i. (1893), p. 535.

of the former from the influence of land, which dominates the character and the circulation of the water in the latter.

Historically, it may "be noticed that the early Greek antithesis between the Mediterranean Sea surrounded by the habitable land, and the Ocean Itiver surrounding the known world, gave place gradually to the idea of an Ocean Sea, in which the various continents formed islands or parts of islands, and the term Ocean Sea only went out of use when the three great divisions of Atlahtic, Indian, and Pacific Oceans were recognized. The distribution of depth in the ocean was very vaguely known so long as the question was merely one of scientific curiosity, although ingenious apparatus for ascertaining the depth had been devised by Eobert Hooke and Stephen HaJes in the 17th century, and the use of the lead in shallow water early became habitual with sailors. When the question of laying submarine telegraph cables gave practical importance to a knowledge of the form and temperature of the sea-bed about 1855, the methods of deep-sea sounding and temperature-taking were rapidly improved, and scientific oceanography may be said to date from that period.

The develox^ment of oceanography up to 1870 may be summarized in a few lines. The speculations of the Greeks and the crude observations

of the European navigators of the loth and 16th "'story of centuries led to no definite knowledge beyond grapby. the existence of the trade winds and a few facts as to currents and tides. Athanasius Kircher in 1664 made the first generalization as 'to the circulation of the waters of the ocean, illustrated by a map of the surface currents ; but so little was then known of the depth or configuration of the ocean-bed that he freely introduced subterranean channels to account for local currents, and even suggested a great tunnel through the axis of the Earth as a sort of mainspring to actuate the perpetual motion of the surface water. H. B. de Saussure in 1780 made the first fully satisfactory observations of tempera- ture at a great depth by means of slow-change thermome- ters, and he drew up a fairly comprehensive scheme of oceanic research.-]\Iajor Kennell (1742-1830) placed the slowly increasing knowledge of ocean currents on a scientific basis, and the numerous Arctic voyagers of the early part of the 19th century made isolated and some- times import,ant observations. Sir John Eoss in 1818, by means of his " deep-sea clamms," was the first to obtain large samples of mud from great depths, and to prove the existence of organic life on the floor of the ocean.

The adaptation of Sixe's self-registering thermometer, for use in deep water by the device of surroimding the bulb by an outer glass sheath partly filled with mercury or alcohol, was first tested in 1867 on board H.M.S. Cyclops. This marked an era in oceaiiographieal research. It was, however, the American naval officer M. F. Maury who did most to direct attention to the science of the sea, and his fascinating Physical Geocjrapliy of the Sea, first published in 1856, continues to be one of the most in- spiring scientific works, although the theories of oceanic and atmospheric circulation it puts forth have proved untenable. Maury organized oceanic research under the auspices of the United States Hydrographic Office, and this led to the marine services of other countries taking up similar work, which has been carried out with remark- able success by the British Meteorological Office and the German Marine Observatory.

In 1839 the British Association appointed a committee under the direction of Professor Edward Fi)rbes charged with the investigation of

the marine fauna of the British seas. The activity of this committee extended over many

2 Voyages dans les Alpes, tome iv., Neuchatel, ITiW.

years, and aroused much interest in the bathymetrical distribution of life. Dr W. B. Carpenter took up the study of the physical conditions and the life of the oceans with great enthusiasm, and as a result of his efforts small expeditions were sent out by the British Government on the Porcupine, Lightning, and Shearwater, to different parts of the North Atlantic between 1868 and 1870.

In 1872 the British Government were induced by the Royal Society to send out H.M.S. Challenger for a three years' cruise expressly for the purpose of investigating the physical conditions of the ocean and the distribution of marine life. This was an epoch in oceanography, resulting in a vast increase of knowledge and in the progressive improvement of apparatus and methods of research. Since the return of the Challenger in 1876 the most important advances of oceanography, in addition to those resulting from the cruises of surveying and telegraph ships, have been due to the Norwegian North Atlantic expedition in the Voringen, 1876-78, the French Talisman and Travailleur expeditions in the Bay of Biscay, 1880-83, the foundation of the Scottish Marine Station by Sir John Murray in 1884, the Eussian voyage of the Vityaz in the Pacific in 1886-89, the explorations of the Austro- Hungarian ship Pola in the Mediterranean and Eed Sea, 1890-98, the voyages of the Prince of Monaco in the North Atlantic since 1885, the researches of Professors Ekmau and Petterssou on the Baltic since 1885, drift of the Fram in 1893-96, the Danish Ingolf expedition in 1896, the cruises of the Unitei States Fish Commission steamers Blake and Albatross in the Atlantic, Caribbean Sea, and Pacific, 1877-1901, the voyage of the German ship Valdivia through the Atlantic, Southern, and Indian Oceans in 1898-99, and that of the Dutch Siboga in the Malay Archipelago in 1900.^

Methods and Apparatus. â€” The study of the ocean floor and of the intermediate depths of water has to be carried on under the dis- advantage of inaccessibility ; all information must be obtained by means of instruments attached to a single line of rope or wire, and sunk far out of sight. Attempts to employ bathometers for measur- ing depths â– without the use of a sounding line have been made for over 400 years, but they have hitherto failed in practice, and no efforts to employ tvfo separate lines to work apparatus at a great depth have ever succeeded. The number of ingenious contrivances, and even of successful instruments, for oceanographical work is so great that it is impossible to give details of any special forms in this article ; all that can be attempted is to indicate the principles on which the most satisfactory forms are constructed.

The simplest operation is that of ascertaining the depths of the

water at a given point. Por shallow water, down to 100 fathoms,

the familiar hand-lead (weighing 7 Ri) or the deep-sea

‘”*” lead (weighing 14 lb) and hemp line may be employed soun ag. ^ifj^Quf inaccuracy. In very deep water the amount of line which has to be used is sufSoient to float the lead unless the latter is made very heavy, and if very heavy the line is apt to break on attempting to heave it in. Many experiments were made by Maury to overcome this difficulty, but some of them gave very wild results, and depths of 10 miles and over were reported in different parts of the ocean. Midshipman Brooke of the O.S. navy invented the principle, already foreshadowed by Cusanns in the 15th century and by Hooke in the 17th, of using a heavy weight so hung on the sounding tube that it was automatically released on striking the bottom and left behind, while the light brass tube containing a sample of the deposit was easily hauled up. This principle has been univer- sally adopted for deep soundings, and is now applied in many forms. An essential feature is the tube for bringing up a specimen of -the bottom, Eis without such proof of Its completion no sounding can be accepted. The weights used as a sinker are usually oast-iron seg- ments, which may be built round the sounding rod, and for great depths they weigh 100 lb or more. The next

great advance consisted in the substitution of steel wire for hemp rope, thus practically elimi- nating friction and permitting a great length of line to be stowed in a small space. The disadvantage of wire is that the line is apt to snap when a kink forms, and hence there is a considerably increased risk of loss of instruments. A stranded wire or wire-rope in which a number

1 For a historical summary of oceanography see Sir John Murray, "Summary of Scientific Results," First Part, in the "Challenger" Reports, London, 1895.

of very fine wires are twisted together as in a hawser is free from this objection, and can be made very little bulkier than the single steel wire. Various bronzes have been used instead of steel, but while they have the advantage of greater toughness and flexibility, they are very costly. The depth may be measured either by a registering block, i.e., a pulley fitted with a train of index wheels on the principle of a gas-meter, or by a revolution-counter on the drum on which the wire is wound. The indicator shows the depth and the rate at which the line runs out, a sudden increase in the time intervals being the usual sign that the bottom has been reached. The Lucas and other recent sounding machines auto- matically stop the running out of the wire as soon as the bottom is reached. The wire is usually hauled in by a steam engine, but the experience of the Valdivia expedition showed the great advan- tage of using an electro-motor, especially in polar seas where steam- pipes are apt to be frozen. The instruments usually attached to the sounding line are water-bottles for collecting samples of water, and thermometers for ascertaining its temperature.

Water-bottles ought to be constructed in such a way that they may be filled with water at any given depth and securely closed as soon as filled, so that no interchange can take place between the water inside and outside. They are usually made of brass, and are technically divided into valve, stoi)-oock, and slip watter-bottles.'^ The first class depends on the principle of two valves opening up- wards, which remain open while the bottle descends and allow a continuous current of water to pass through the instrument, but when one begins to pull up

the water-bottle the valves are closed by the pressure of the water outside, and the sample then inside is brought up. The only form now in use is Sigsbee's " Water-cup," in which the valves are locked after the first few fathoms of ascent by the action of a small screw propeller which rotates freely during the descent. In Wille's water-bottle the receiver is a spiral tube open at both ends during descent, and locked on the ascent by a propeller at each end. The stop-cock water-bottle as used on board the Challenger has the form of a long brass tube closed by a very large stop-cock at each end. This was sent down open, and water passed freely through, but when one commenced to pull it up the resistance of the external water acting on a hinged pressure-plate actuated a lever working on both stop-cocks and closed them simultaneously, shutting in the water which it then contained. A modification of this instrument has been introduced by its inventor, Mr i J. Y. Buchanan, by which the stop-cocks may be closed by a weight slid down the line, and thus secured more definitely at any particu- lar depth. The drawback to all these forms is that they collect a mixture of the water from a considerable range of depth, and are thus quite unsuited for use where layers of different salinity are superimposed, or in shallow water. Slip water-bottles are more satisfactory in this and in other ways. The best forms .consist of a metal cylinder open at both ends and of uniform diameter through- out, hung so that the water can pass freely through, and capable of being detached at any given depth so as to fall against a fixed base and be closed by a top plate, all three parts becoming automatically united. On the Challenger the cylinders of the slip water-bottles were very heavy, with finely ground surfaces, which rested upon correspondingly ground fixed portions of cones. In more recent forms, such as Mill's for shallow water and Pettersson's for deep water, the cylinder is locked against indiarubber discs covering the fixed metal plates. The mechanism for releasing the cylinder is usu- ally actuated by a weight slipped along the line which depresses a lever or spring by its impact ; or else by a small screw propeller which revolves freely during the descent, but on being drawn upwards engages with a bolt, and in a certain number of turns, correspond- ing to a definite vertical distance, sets free the cylinder. The use of a propeller can be justified in deep water alone, and there only in default of more serviceable gear. The grand difBculty in the use

of all apparatus which must act at a great distance from the observer and out of his sight is to know whether the action has or has not taken place at the proper position. In shallow water the closing of the water-bottle can be distinctly felt on the line, and it would be very desirable if some method could be found for detecting the impact through a wire at the greatest depth.

The most important physical observation in the deep sea is that of temperature, the problem here being to devise a thermometer which shall bring to the surface a record of the actual temperature at a given depth. One of the most satis- Deep-sea factory, though by far the slowest, of the methods is Thermo- the use of a slow-action thermometer, i.e., an ordinary ‘“Â«‘Â«“â€¢ thermometer, the bulb of which is embedded in a relatively large mass of badly-conducting materialâ€” wax, as originally used by de Saussure in the Mediterranean in 1780 ; gutta-percha and ebonite, as employed by the CJerman observers on the North Sea and Baltic a century later. This thermometer, to be really satisfactory in its working, should be left immersed at the depth from which a

2 For early forms see H. R. Mill, “On Water-bottles,” Proc. Rov. Soc. Edinburgh, xiii. (1885), p. 539.

reading is desired for several hours, and its bulb will retain that temperature long enough to allow it to be hauled up and read in the air. An elegant and quick-working adaptation of this principle is found in the Pettersson-Nansen insulating water-bottle as worked out in 1900. This is a slip water-bottle, the cylinder of whioii is , made up of a number of concentric metal tubes, so that when the instrument closes it shuts in a series of entirely separated concentric layers of water, each of which must have its temperature changed in turn before any effect can be produced on the water iu the cen- tral tube, in the middle of which the bulb of a sensitive thermome- ter is placed, the stem projecting through the lid. Experiment has shown that in cool climates the central

core of water does not change one-hundredth of a degree for many minutes after the water-bottle has been exposed to the temperature of the air, and in the opinion of Professor Nansen this is by far the most accurate method of obtaining deep-sea temperature.^

The method hitherto most frequently used is to employ a register- ing maximum and minimum thermometer on the Miller-Casella modification of Sixe's pattern. When made of a large size with an arbitrary scale of millimetres engraved on the glass, as suggested by Mr J. Y. Buchanan, this thermometer may give the extreme temperatures during the period of its immersion 'with considerable accuracy. The bulb has to be protected from pressure by an outer bulb partially filled with liquid, and the steel indexes (which are set by means of a magnet) have to be provided with springs which will enable them to hold their position in spite of the tremor of the line in heaving in. The drawback to all maximum and minimum thermometers is that the temperature at a given depth can only be deduced from a series of other temperatures, and in some possible distributions of warmth cannot be ascertained at all.

Outflow thermometers of an elaborate form were used by Aim6 as long ago as 1840, but Negretti and Zambra's deep-sea ther- mometer, which was perfected after the return of the Challenger, was the first to give satisfactory results with 'simple working. Its essential feature is that after the thermometer has attained the temperature of its surroundings it is turned over (see Thermome- ter), the column of mercury outside the bulb breaks off at a little constriction of the tube, and runs down into the inverted upper end, which is graduated so as to be read in that position. The inversion is secured either by means of a screw propeller, as in Magnaghi's frame, or preferably, when the depth permits, by means of a lever worked by a weight slipped down the line, as in the frames devised by Rung, Mill, the Prince of Monaco, and others. The worst drawback to the Negretti and Zambra thermometer is that in deep water the vibration of the wire line in heaving in is apt to shake little jets of mercury out of the overflow reservoir outside tiie bulb into the tube, and so to make the readings too high. This difficulty has been overcome' by Herr Martin Knudsen, who em- ployed on the Ingolf

expedition a thermometer the bulb of which lies parallel with the stem, and when the instrument is inverted, rests with its oriiice upwards instead of downwards ; hence it is imppssible for any amount of shaking to pass mercury from the bulb to the tube after inversion. The importance of protecting the whole thermometer from pressure, and not merely the bulb, is now recognized, and the Negretti and Zambra and Knudsen ther- mometers are entirely enclosed in a strong sealed glass tube. The pressure below the surface may be roughly estimated as one ton per square inch for every 1000 fathoms of depth.

Electrical methods of registering deep-sea temperature have frequently been tried and abandoned, but the platinum resistance thermometers of Professor Callender appear likely to lead to good results at sea, as they have been found practicable in the deep lakes of America. Resistance thermometers were experimented with by Knudsen in 1900 in conjunction with an electrical appara- tus for finding the salinity by the resistance of the water in situ, the balancing of the resistances being affected by the use of a tele- phone instead of a galvanometer. ^ The resulting curves, both for temperature and salinity in shallow water, appear to show that the method is of value.

In discussing thermal (as distinct from temperature) changes in water, Mr Buchanan has pointed out the convenience of reckoning by the fathom-degree or metre-degree, both units being practically the same, if the Fatirenheit scale is used with the fathom and the centigrade scale with the metre, since a fathom exceeds a metre in the same ratio as^ a centigrade degree exceeds a Fahrenheit degree.

The physical or chemical examination of sea-water can only be completely carried out in a laboratory on shore when results of the highest precision or complete analyses are required ; but much work may be done on board ship. The density of sea-water is , usually expressed as specific gravity, or the ratio to the density of pure water which is taken as unity. The temperature of both is

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taken as 0Â° C. in pyknometer observations, on account of the con- venience of making direct measurements at that tem- perature. But in hydrometer work it is more convenient to take as the standard some temperature near the ordinary temperature of the air, either 60Â° Fahr. (15-6Â° C.) or 17-5Â° C. being usually chosen. The comparison may be made either with pure water at the same tem- perature, or at its temperature of maximum density, i.e., 4Â° C. It is necessary, therefore, to state the exact meaning of specific gravity in

every case. This is usually expressed in the form S=-,, where t is the

standard temperature of the sea-water sample, and T that of the pure water with which it is compared. The Challenger specific

gravities are published in the form S^Â°'‘Â°””, and those of most of the later Continental expeditions as &

4Â°c. n-BÂ° 0.

1 Geographical Journal, xvi. 1900, p. 469.

2 Beretning fra Kommissionen for videnskabelig UndersogeUe af Danske Farvande, vol. ii. part 3. Copeuhagen, 1900.

~~J . Any of these forms can be converted into the others by calculation. The salinity can always be expressed without ambiguity by the amount of chlorine or of total salts, the latter being preferable, and the most con~~ venient form of expression being in parts per mille. It is very desirable that this datum should be given in all statements of results, by whatever method they are obtained. The chemical study of sea- water at sea is ‘practically confined to the volumetric estimation of chlorine and of alkalinity and the collection of dis- solved gases, the analysis of the gases and determination of the sulphates or other constituents in the water sample being made in a laboratory on shore. The direct determination of total salts is rendered troublesome by the decomposition of the magnesium salts on evaporation, and the variations in the composition of the salts are usually so slight that extraordinary precautions must be taken in order to detect the

differences. The salts pf sea^water taken from enclosed seas or near the mouths of rivers do, however, show some variability in composition. The object of determining the alkalinity is that it gives a measure of the carbonic acid in actual combination with a base as normal carbonate, the alkaline reaction of sea-water being due to the carbonates it contains. When kept in glass bottles sea-water is apt to change In alkalinity on account of chemical action on the glass. The extraction of gases from sea-water on board ship, and the sealing of the samples in tubes, is a troublesome and somewhat delicate operation. If a sample of sea-water is preserved in a stoppered bottle its gaseous contents are sure to undergo change in consequence of changes of temperature, while even if the sample be sealed up in a clean glass tube the dissolved gases are altered in nature and amount by the decomposition of the minute plant and animal organisms which the water contained. By Pettersson's method two specimens of each sample of sea-water, brought up by his insulating water- bottle withqut change of temperature, are taken in glass tubes which have been previously coated internally with mercuric chloride (corrosive sublimate), exhausted of air, and sealed. The tip of the tube is broken off in the water-bottle, and when filled the tube is again sealed up ; the corrosive sublimate kills all the organisms and prevents their decomposition, and the sample keeps unchanged. One tube is used for determining the absorbed oxygen and nitrogen, the other for the carbon dioxide. The sub- stantial uniformity of the composition of the salts of ocean-water makes it possible to determine the salinity (i.e., the proportion of total salts to the mass of water) quite accurately by determining any one of the chemical constituents. That selected is always the total halogen estimated as chlorine.

The relations of salinity to density at constant temperature and of density to temperature at constant salinity have been worked out with great accuracy by Professors Thorpe and Rticker, Professor Dittmar, Herr Martin Knudsen, '^yf"'"l and others. The problem of finding both density and Â°J^Â°^' salinity may thus be solved by measuring directly either ^^^ ^' the density or the total halogen. If p stands for the chlorine. salinity expressed in parts per thousand by weight

{i.e., 1 gram of total salts in 1 kilogram of sea- water), S= for

specific gravity at temperature tÂ° compared with pure water at temperature TÂ°, and % ‘^le chlorine (total halogen) in grams per kilogram of sea-water, the relation between chlorine and salinity is usually given asâ€”

p = lâ€¢83x-0â€¢0012x^ but Knudsen finds the simpler formula p=0‘03-(-l ~~81 x to give ex~~ cellent results. The relation between salinity and specific gravity is â€”

P-

where

=1300;

but for S^Â»oÂ° ‘^’ the value of

.17-5Â° 0. IT’So c’

‘4Â°C.

1410 for S^-|^ = 1-010 and 1340 for S^

= 1-028.

310

OCEANOGEAPHT

Hydro’ meters.

The determination of chlorine is simple, accurate, and direct, and can easily be carried out by titration on board ship, the standard solutions being previously prepared on shore. The measurement of density or specific gravity demands more attention. The only method admitting of the highest accuracy is weighing on a delicate balance a measured portion of distilled water at a constant tem- perature (usually 0Â° C.)

in a glass tube known as a pyknometer, and again weighing the same tube filled to the same point with the sample of sea-water at the same standard temperature. This is an operation requiring skill and care, and as it must be conducted in a laboratory on shore, the samples require to be secured in such a manner as to prevent any change occurring in the salinity.

The use of hydrometers or areometers is much more simple, and they are as sensitive as the pyknometer, though not so trust- worthy. They have the immense advantage of not requiring a rigid table, and thus being capable of employment at sea in moderate weather. The usual form of instrument consists of a cylindrical glass body of considerable size, terminating above in a narrow glass stem, immersed in a sample which comes within the range of salinity for which the instrument is adapted. The scale is usually graduated so as to enable specific gravity to be read directly, the temperature of the water being ascertained at the same time, and the reading reduced to a standard temperature by reference to a table of corrections. IVIr J. Y. Buchanan intro- duced an extremely sensitive and accurate form on the voyage of the Challenger, and has since greatly improved it.^ The stem contains a scale, divided into millimetres, and the specific gravity is obtained by the use of tables. The instrument is absolute, inasmuch as its weight is determined beforehand, and several accurately weighed coils of wire are provided which can be used to increase the weight of the whole instrument by small increments in such a way that a series of half a dozen readings may be made at different parts of the scale in a few minutes. The volume of the body of the hydrometer and of each millimetre of the stem may be previously ascertained by experiment in distilled water, and its expansion with temperature determined in the same way. Thus each reading gives the volume of the instrument immersed, and the total weight of that volume of the water under examination. The temperature correction can be much simplified by using the hydrometer in distilled water at the temperature of the' air before placing it in the sample of sea- water at the same temperature, and thus comparing directly the weight of equal volumes of sea-water and pure water. By this process the chief difBculty in the use of the hydrometer â€" the effect of surface tension â€" is eliminated if the surface of the

sea-water and pure water be equally clean. Many ooeanographers, however, using direct-reading hydrometers, have found the uncertainty due to the variations of surface-tension so serious as greatly to detract from the value of the instrument.

The total-immersion hydrometer is sometimes used to evade sur- face tension : it is a cylinder with a very short stem, which is loaded by the addition of coils of wire until it just sinks in the water, the final adjustment being made either by titration with sea^water and distilled water, as in Pisati's method of 1890, or more elegantly, as in Nansen's method of 1900, by varying the temperature of the water in the jar by a fraction of a degree, so as to fix the exact temperature at which the immersed hydrometer and the water have the same density.^ Experiments have been made with the refracto- meter to measure the specific gravity of sea-water by the refractive index, which is a function of the density. The method has the advantages of being independent of the motion of the ship, and requiring only a minute quantity of water as a sample. Electrical resistance has also been utilized ; in Tornoe's method, as tested on the Fram, the resistance of a small sample was observed, and the instrument calibrated by experiment on standard solutions ; in Knudsen's method the variations in resistance due to salinity are measured in situ, and, if this is found practicable in deep water, it will constitute an immense advance in oceanography.

The transparency of sea-water is usually measured by'sinking a white enamelled disc, and noting the depth at which it ceases to be visible. The test is a rough one, the depth of Traaspar- yigibility depending not only on the transparency but ency and ¯^^ ‚ ^^^ amount of sunlight and the powers of vision of ”” ”” ‘ the observer. The colour of sea-water as seen on looking through the depth of a fathom or so at a white disc may be measured with a considerable degree of approximation by the use of Forel's. xantliometer. Assuming that the water of lakes varies from pure blue to clear green. Professor Eorel constructed a scale of which the extremes were solutions of copper sulphate in ammonia for blue,

l”A Retrospect of Oceanography” in Report of VI. Int. Geog. Conc/ress, London, 18115, p. 403.

2 For a summary of discussions on the hydrometer in oceano- graphy, with references, see F. Nansen, “Hydrometers and the Surface-tension of Liquids,” in the firi.cntific Rfsalts of the Norwerihui North Polar Expedition, vol. iii., London, &o.,]iJ02.

and of neutral potassium chromate for yellow, the intermediate tints being supplied by mixtures of the two in definite proportions. Dr W. Ule, with the advice of Professor von Drygalski, introduced a brownish tint (a solution of cobalt Bulphate) in order to measure the gradations which actually occur in the ocean. ^

The measurement of ocean currents has been attempted in many ways, none of which can be looked upon as wholly satisfactory, especially in deep water and in the open sea. Rapid sur- face currents, exceeding say 1 mile per hour in velocity, ^fV”^f’ may be easily measured by watching the drift of a buoy ^u”^gÂ°fg_ from an anchored ship or mark. It is difficult, however, to anchor even a small vessel in water exceeding a few hundred fathoms in depth. Under-currents are much more difficult to investigate. Their direction can usually be ascertained by the iise of a current drag, exposing two large surfaces at right angles to each other and both in a vertical plane. This, when sunk to the proper depth and attached by a line to a float offering a very small surface, will show, with reterence to a fixed mark, a certain approximation to the movement of the layer in which the drag is immersed.* A more sensitive arrangement is a light drag hung by a wire from a spar projecting over a boat which is kept by the use of the oars in such a position that the wire remains parallel with a plumb-line hung from the end of the same spar. When this is done, the boat moves on the surface in the direction towards which the water of the undercurrent flows and at the same rate.

Much attention has been devoted to the construction of current gauges intended to record the directions and velocities of currents at great depths by rotating vanes, meter- wheels, and other mechan- ical devices

; but the results have not as yet rewarded the labour and ingenuity expended.

The slow-moving currents which carry out most of the superficial circulation of the oceans may be roughly measured in calm weather by the difference between the observed and calculated positions of a vessel, and, in certain circumstances, by the use of floats. Floats are only of great value for determining the speed of currents in the case of oceans the coasts of which are thickly peopled by an intelligent population, and at.the present time the North Atlantic alone can be profitably investigated in this way.

For merely testing the direction of currents, without estimating their rate, floats are always useful, and Sir IT. C. Russell has shown that much information of the drifts even in the Southern Ocean may be thus obtained. It is essential that a current float should be submerged so as to present as little surface as possible for wind to catch ; it should be strong enough not to be damaged when thrown on shore, and sufficiently conspicuous to attract the attention of a passer-by. The experiment of using glass balls of specific gravity a little greater than that of sear-water, to roll along the bottom, in places like the North Sea, where they might be recovered by trawlers, and thus to trace the movements of the deepest layers of shallow seas, has not as yet been fairly tried. The interpretation of current-floats is really satisfactory only when many have been launched simultaneously, or in close succes-sion, along definite lines. Then the first to be found sets a minimum velocity for the current, and the direction of the current may be Inferred by laying' down on a map the line joining the launching place and the point at which the float nearest to it was found, drawing the course of the next nearest parallel to the first so far as it goes, then straight to its destination, and so with the rest. Treated thus, the "bottle charts" of the North Atlantic give an excellent idea of the superficial circulation of the waters. *

Accidental floats, like derelicts or logs, and natural floats such as icebergs and volcanic ashes, often map out the main lines of a current very clearly ; and the plankton, or drifting organisms, may also be

looked upon as ear-marking definite bodies of water. lii the same way, temperature, salinity, and gas-contents are of value in suggesting, and sometimes in demonstrating, the place of origin of the sea- water under examination.

The apparatus for scientific biological research at sea has been f orthe most part developed from that used in fishing. The dredge and trawl differ little from those of the oyster-boat and the trawling smack. The Prince of Monaco has introduced a sort of Blotoglcat gigantic lobster pot, with the happiest effect in very deep "Â«"'"â– water. The continuous study of plankton on a voyage is Â°"^' usually carried out by straining the sea- water as it is pumped on board for the use of the condensers or to fill tanks. The tow-net, however, a strong silken or canvas bag drawn after the ship to capture the drift- ing organisms, is purely scientific in its origin. The surface tow-net has been developed into a series of ingenious devices for obtaining specimens from atay depth, or even just skimming the mud of the bottom, without catching anything from an intermediate position.**

s retermanns Mifteilungen, .38, 1892, p. 70; 40, 1894, p. 214.

^ For methods of current observation, see A. S. Thomson in EepoH of 1 1. Int. Geog. Congress, London, 1895, p. 443.

f For the general question of current floats, see G. Schott, Die Jf .ccschenposten der Deutschen Seewarte, Hamburg, 1897.

Results of OceanograpJiiccd Study (see also the articles on the different oceans). â€" On account of the small number and irregular distribution of deep-sea sound- ba^as. ^Â°SÂ®' except in the North Atlantic, it is impos- sible to generalize with any confidence as to the form of the ocean hollows.| It is, however, known that the relief of the ocean floor is almost always more gentle and less varied than that of the land. Being pro- tected by the water from the rapid sub-aerial erosion which

sharpens the features of the land, and subjected to the regular accumulation of deposits, the whole ocean floor has assumed some approach to uniformity. The continental slopes and the elevations from which some islands rise are, however, often as steep as land slopes. The general arrangement of depths is unsymmetrical ; as a rule, the deepest depressions occur near the margins of the oceans, while the greater and more continuous ele- vations of the sea-bed occur near the centre, and are usually marked on the surface by islands which rise from them. The average depth of the oceans, as calcu- lated by Karstens in 1894,' disregarding the shallow seas, is 2170 fathoms, but the actual average depth is probably somewhat greater. Depressions exceeding 3000 fathoms in depth occur in four places in the Atlantic, near the continental slopes ; in the angle between the Sunda Islands and Australia, in the Indian Ocean ; and in the centre and north-west of the Pacific. The only ex- tensive area over 4000 fathoms in depth is a narrow trough in the north-west Pacific along the oceanic slope of Japan and the Kurile Islands. Individual soundings exceeding 5000 fathoms have been obtained in various parts of the Pacific, the deepest on record being 5269 fathoms at a point east of the Ladrones. A sounding of over 4000 fathoms reported by Sir James Eoss in the Southern Ocean, south of the Atlantic, has never been verified, and a definite object of the Scottish Antarctic expedition (1902) was to test the existence of a great depression in that region. The distance of -the remotest part of the ocean (as deduced by Eohrbach) from the nearest continental land exceeds 3000 miles only in the South Pacific in 20Â° S., 130Â° W. ; but if islands be taken into account, De Windt shows that no part of the ocean is more than 1300 miles from land, the remotest spots occurring in the centre of the North Atlantic, at 25Â° N., 43Â° W., and at three points in the eastern Pacific, respectively 15Â° N., 135Â° W. ; 8Â° S., 115Â° Y. ; and 45Â° S., 106Â° W.

The question of sea-level is involved in the comparison of depths, for in all calculations of vertical relief, either above or below the surface, the surface of the *"' "^ â– ocean is assumed to be uniform. The attraction of the elevated portions of the lithosphere, granted that the whole crust were of uniform density, should cause a rise of the level of the sea along the shores. The survey of India demonstrated that the sea-surface was

300 feet farther from the centre of the Earth at the head of the Arabian Sea than at Ceylon, presumably in consequence of the gravitational attraction of the Himalayan range. Geodetic operations of the necessary delicacy to measure such differences of absolute level have been made as yet in few parts of the Earth, and the problem of the true form of the geoid remains to the future. Minor variations in level between enclosed seas or gulfs and the open ocean may be due to the set of the tidal streams, the excess of rainfall or evaporation in particular areas, the melting or the formation of sea ice, or to the direction and force of the prevailing winds. (For the movements of the ocean

1 K. Karstens, Mne neue Serechnung tier mittleren Tiefen der Oceane, Kiel, 1894.

2"Sur les distances moyennes k la c6te dans les Oceans," Mem. couronnis de I' Acad, des Sciences de Belgique, Ml. (1898).

due to the differential gravitational attraction of external bodies in the solar system, see Tides.)

The salinity of the water of the oceans, as mapped by Mr J. Y. Buchanan, Dr A. Buchan, and others, shows a general banded arrangement. In the far north saiiaUy and the far south, bordering the polar ice, the of the surface water is comparatively fresh. Two zones oceans. of maximum salinity occupy the trade-wind regions and are crossed by the tropics, while a belt of low salinity lies a little north of the eqiiator. The average salinity of the whole surface of the oceans is about 35-0 per mille, the areas of high salinity in the tropics reach about 37-0 per mille as a maximum, andnear the edge of the ice the salinity is only about 33-0. Enclosed seas in dry regions, like the Red Sea and ^Mediterranean, may have a salinity approach- ing 40 0, while seas in a rainy climate, or those fed by many rivers, such as the Baltic, may have an average salinity under 30-0. The high salinity of the trade-wind areas is due to the rapid evaporation from the surface ; while the check to evaporation, perhaps as much as the heavier pre- cipitation of the calms, accounts for their lower salinity. The deeper water of the ocean is usually somewhat fresher than that on the sui-face, although,

on account of lower temperature, it is, at equal pressures, actually denser.

The salts of average ocean water differ greatly from those of any ‘ ‘ fresh ” water, and the composition is practically constant so far as regards the open ocean, the following table (from Dittmar) representing a probable grouping of the salts in the proportion in which their constituents occur.

Composition of Ocean Salts.

Sodium chloride 77-8

Magnesium chloride 10-8

Magnesium sulphate 4-3

Calcium sulphate 4-1

Potassium sulphate 2‘5

Magnesium carbonate 0-.3

Magnesium bromide 0-2

Total

100-0

A complex solution of this nature exercises a certain amount of chemical action on the substances exposed to it, and is also acted upon in various ways by the life-processes and the decomposition of organisms. The salts of average river water contain over 50 per cent, of calcium and magnesium carbonates, and 10 per cent, of free siUca, with only about 2 per cent, of sodium chloride, thus, differing very greatly fi’om those of the sea. There has been much speculation as to whether the salts of the ocean are the result of the action of the hot water which iirst condensed on the surface of the cooling Earth, or the product of the concentration of river water, changed by chemical and vital

processes. On the latter assumption, the present salinity of the ocean has been taken by Professor Joly as a measure of the age of the Earth. In ocean water the only distinct local variation of saline composition is a very slight increase in the proportion of dissolved carbonates and calcium salts with increase of depth ; but in the water which is contained in the muds, oozes, and clays of the ocean floor there is a remarkable difference. Sir John Murray and Mr Irvine have shown that the sea-water mixed with the blue muds, the typical shallow water terrigenous deposit, is not only of higher salinity than the overlying water, but contains a much smaller proportion of sul- phates and thus a relatively higher proportion of chlorides. The chemical action of the iron In the mud reduces sulphates, producing ultimately ferrous sulphide, to which the dark colour of the mud is due. When iron is deficient to take up the reduced sulphur, sul- phuretted hydrogen is produced, as in the deep water of the Black Sea, where this gas occurs in a proportion as high as 6-55 cubic centimetres per litre of water.s Researches have shown that the presence of bacteria in the mud may be a necessary accompani- ment, and possibly the cause of this chemical action.

The chemical action of the salts of sea-water on the organic matter of deposits produces decompositions., which lead in some cases to the formation of petroleum. Chemical precipitation ap- pears to cover the floor of the sea in some places with a deposit in the form of a stony crust, the physical action of which by the diffusion through it of the different salts is held by Dr batterer of the Austrian Pola expedition to exercise a considerable influence on the chemical processes which occur in the deep sea.

3 Trans. Roy. Soc. Edinburgh, xxxvil. (Pt. 2), Xo. 23 (1892) ; also Proe. Roy. Soc. Edinburgh, xxi. (1896), pp. 25 and 35.

Sea-water in contact with the air absorbs oxygen and nitrogen in an amount dependent on the temperature and salinity of the water,

the solubility of the gases and the proportion in which Absorbed ^^lej occur in the atmosphere. Fully aerated normal fea-Â»‘afer ocean water at 32Â° Fahr. contains 8-2 c.c. of ojcygen and

15”6 c.c. of nitrogen per litre, the amount absorbed diminishing as the temperature rises : thus at 70Â° Fahr. only 5-2 c.c. of oxygen and 10-0 of nitrogen are absorbed. It will be observed that on account of the greater solubility of oxygen the dissolved air in sea-water contains one-third of its volume of that gas, instead of only one-fifth, which is the proportion in the atmosphere. The action of living organisms in the water alters the proportion of oxygen and carbon dioxide, while that of nitrogen remains prac- tically unchanged, and is proportional to the temperature at which the atmospheric gases had been absorbed at the surface. Hence when the nitrogen extracted from a sample of water has been estimated it is possible to tell the temperature which the water possessed when at the surface, and the amount of oxygen it origi- nally contained. Herr Martin Knudsen has shown in the Ingolf expedition that wherever vegetable plankton (diatoms, &c.) is abundant the absorbed gases contain more oxygen than should normally be associated with the nitrogen, while where animal plank- ton prevails there is a deficit of oxygen and a larger quantity of car- bonic acid. He has even been able to detect a distinct difference between the amount of oxygen in solution in sea-water by day and by night when diatoms are present. – The extreme variability of the dissolved gases in the presence of living organisms explains many of the discrepancies in the earlier observations which were formerly very puzzling. The fact that no sample of ocean water, even from the greatest depth, has ever been found entirely without absorbed oxygen proves that the whole mass of water in the ocean is subject to a general circulatory movement. In deep enclosed seas, on the other hand, of which the Black Sea is the best example, the absorbed oxygen disappears and carbonic acid and sulphuretted hydrogen take its place. In such conditions the deep water is incapable of supporting life.

Carbonic acid in sea- water is troublesome to estimate because it rarely exists as a free gas ; unless the proportion is very large it

forms a bicarbonate with the normal carbonates which m la Â§'^^ "Â° sea-water its alkaline reaction. The amount of

se^water carbonic acid present as normal carbonate is given by

the alkalinity determination, and the total carbonic acid may be determined very accurately by Pettersson's method of boiling acidified sea-water under greatly reduced pressure. The amount of carbonic acid absorbed by sea-water from the air must always be very small ; but the respiration of organisms may, in places, convert almost all the absorbed oxygen into carbon dioxide. Ammonia salts occur in a small and varying proportion in sea- water, as a result of the decomposition of organic matter, and they appear to play an important part in the secretion of calcium car- bonate by marine organisms. The combined carbonic acid in sea- water, even if all associated with lime, would only allow a very small proportion of the total salts to exist in the form of calcium carbonate, while the amount of calcium carbonate withdrawn from the water lay living organisms is relatively large. It has been shown, however, that ammonium carbonate generated from the waste pro- ducts of animal life causes a precipitation of calcium carbonate from the sulphate or other salts of calcium present in sea^water, and this is probably the source of the Immense quantities of calcareous matter accumulated as oceanic deposits or coral reefs.i

The classification of marine deposits generally accepted was arrived at by Sir John Murray and Professor Renard

as the result of studying all the specimens d ^"s/fe brought back by the deep-sea expeditions of all '"' ' nations up to the completion of the volume of the " Challenger" Reports dealing with the subject in 1891. The system of classification is twofold, according to origin and according to the depth of water.

Classification of Marine Deposits.

1. Deep Sea Deposits (5e- yond 100 fathoms).

2. Shallow Water Deposits

{in less than WOfathoms).

8. Littoral Deposits (between I hif/h ii’kI low water warks). J

Bed Cloy Kadiolarian Ooze Diatom Ooze Globi^erina Ooze Pteronod Ooze Blue Mud Ked Mud Greon Mud Volcanic Mud Coral Mud Sands, Gravels, Muds, &o.

Sands, Gravels, Muds, &c.

Pelagic Deposits. â€” Formed in deep water remotefrom land.

Terrigenous Deposits. â€” Formed in deep and shallow water close to land.

Estimated Area covered by Marine Deposits, &c. (Murray, ‘1889).

Deposit.

Estimated

Area in Sq. Miles.

Mean

Depth,

Fathoms.

Mean per cent. ofCaCOa.

(â– Red Clay Eadiolarian Ooze Pelagic -1 Diatom Ooze

Globigerina Ooze [Pteropod Ooze Coral Sands and Muds Terrigenous \ Other Terrigenous De- [posits, blue muds, &c.

50,290,000 2,790,000 10,420,000 47,750,000 900,000 3,200,000

27,900,000

2780 2890 1480 2000 1120 710

1020

6-70 4-01 22-96 64-58 79-26 86-41

19.20

1 R. Irvine and G. S. AVoodhead in Proc. Roy. Soc. Edinburgh, xv. (1888), p. .308.

In the tropical oceans far from land, where the depth is less than 600 fathoms the typical pteropod ooze formed by the accumulation of the dead shells of mol- luscs, foraminifera, and other organisms which /eposHs. live a,t the surface may contain as much as 90 per cent, of calcium carbonate. With precisely the same surface conditions and with equal abundance of the same organisms in the water the deposits at a depth of about 2000 fathoms have only about 60 per cent, of calcium carbonate ; the pteropod shells have disappeared, and the deposit is a globigerina ooze composed mainly of forami- nifera. If the depth is 2400 fathoms, the proportion of calcium carbonate is reduced to 30 per cent., and at 2600 fathoms to 10 per cent., while in deeper water it is rare to find anything more than a trace of calcium carbonate in the deposit. This gradual elimination of calcium carbonate with depth points to solution by the sea-water under pressure, and perhaps in presence of carbonic acid due to decomposition of the organic matter in the shells. The slight increase of dissolved calcium salts in water from great depths tends to confirm this deduction. As the fora- miniferal remains diminish, the residual deposit is named Radiolarian or Diatom ooze, if the skeletons or spicules of one or other of these silicious organisms are conspicuous or Red clay if they are practically absent.

Red clay is the most remarkable as well as the most widespread of all deposits. It is made up partly of the disintegrated fragments of volcanic rocks, such as pumice, partly of the non- ogHclav calcareous remnants of marine organisms which had lived on the surface, and partly of the teeth of sharks, and the ear- bones of whales, very often crusted over with, or even embedded in, masses of iron and manganese oxides which

have been formed by the decomposition of the volcanic rock fragments. Crystals of zeolites, evidently produced in situ, are frequently found in the Red clay, and particles of meteoritic iron are also found in consider- able quantity. The chemical changes which take place in deep- sea deposits are still very imperfectly known, but it is certain that the Red clay increases in thickness at an excessively slow rate. It is not to be supposed that the remains of more sharks or whales, or more meteorites fall to the ocean floor in the Red clay areas than in other places, but it is evident that if these remnants have been uniformly distributed over the oceans, the more rapid accumulation of the other deposits has covered them up, and they only remain unburied in the Red clay. Sir John Murray believes that not more than a, few feet of Red clay have accumulated in the deepest depressions since the close of the Tertiary period, many of the sharks' teeth belonging to fossil species. The existence of this deposit is the main argument for the theory of the permanence of the oceanic and continental areas. Since no rock similar to Red clay has been found in any geological formation, it appears im- probable that any part of the present land was ever an ocean floor in the abysmal area.

Terrigenous deposits pass from the stones and rough pebbles of the beach to shingle and sand between tide marks, and to fine mud on the outer margin of the continental shelf. The finer deposits are Terri- classified as sands or muds according to the size deposits. of the particles composing them. The composi- tion of the deposits depends mainly on the nature of the rocks from which they are derived ; thus, oceanic islands, if of coral, are surrounded by coral sands and muds, and if volcanic, by volcanic sands and muds. Off continental shores beyond the continental shelf, blue, green, or red

muds are found, the colour of green mud being due to the formation of the secondary mineral glauconite on the grains of rock. Phosphatic nodules are also formed in the same positions by secondary

decomposition. The blue and red muds owe their colour to the less or greater degree of oxidation of the iron they contain.

The distribution of the various kinds of deposit over the ocean floor has been provisionally mapped by Sir John

Murray.^ A belt of sea-bed averaging 200 miles Distribu- ii^ width around the land is occupied by terri- depasits. genous deposits, which are the only deposits

found in seas. Only in exceptional cases, e.g., where a great river carries its muddy water several hundred miles out to sea, or where a current floats icebergs laden with mud and boulders far from land, or where a prevail- ing off-shore wind bears desert dust hialf across an ocean, is this limit exceeded. Diatom ooze appears to be character- istic of the Southern Ocean, where it probably forms a ring north of the belt of terrigenous deposits which encircles the Antarctic ice. It is always most abundant under relatively fresh and cold water. The moderate depths of the temperate and tropical oceans, down to say 2000 fathoms, are typically covered with globigerina ooze, which closely resembles chalk in its composition, and may be said to be the' characteristic deposit of the North Atlantic. Below the depth of 2600 fathoms Red clay prevails, its occurrence being clearly a function of depth, and in places the admixture of a small proportion of radiolarian spicules gives to it the name of Radiolarian ooze. Red clay is the typical deposit in the Indian and Pacific Oceans.

The water of the ocean has a somewhat lower specific heat than pure water. Professor Thoulet having determined the specific heat of sea-water of salinity 35'0 per mille as 0-935, if that of pure water is 1-000. In other words, while 100 units of heat are required to raise the tempera- ture of 100 lb of fresh water by 1Â°, only 93-5 units of heat are required to raise the same weight of sea-water through the same range. The thermal conductivity of sea- water is somewhat greater than that of fresh water ; hence the sea heats and cools throughout its mass by conduction

more rapidly than an equal mass of fresh water Tempera- ~~svrould do in like Conditions. It must be remem~~ sea-water. bered, however, that the difference is small, and

that when compared with the difference between the thermal capacity and conductivity of water and of rocks or soil it is inappreciable. The greatest difference between fresh water and sea-water with regard to the action of heat is that, whereas fresh water on cooling contracts until 39Â° Fahr. is reached, and then expands until it freezes at 32Â°, sea-water contracts steadily until it freezes at a tem- pejTature of about 26Â° Fahr. for normal ocean water. There is thus no temperature at which water of uniform salinity becomes less dense as it cools.

Apparently neither the light nor the heat-rays of the sun pene- trate deeper than 100 fathoms, so that changes due to heating and cooling by radiation are confined to the surface layers, the great mass of oceau water changing its temperature only by the very slow and almost imperceptible process of conduction or by the direct mixture by convection or mechanical agitation of bodies of water of differing temperature. ‘

The surface water of the ocean has a very slight diurnal range of temperature at any point, the difierence between the daily maximum and minimum not probably exceeding 1Â° Fahr. The Challenger found the extreme daily range for the North Atlantic to be only 0-8Â° Fahr., while that of the air resting upon it was 3-2Â°. Dr Schott, on a long voyage on a sailing ship through the Atlantic, Indian, and West Pacific Oceans, found the daily range of surface temperature in the tropics to be about 1 -6Â° Fahr., while in temperate latitudes it was from 0-5Â° to 0-7Â° Fahr., his results thus confirming those of the Challenger. He also observed that the daily range was much reduced by strong winds

1 ” Challenger” Reportsâ€” Deep-Sea Deposits.

and a cloudy sky.^ The coldest sea-water known is that in the Arctic and Antarctic regions, which may sink as low as 26Â° Fahr. when freezmg ; the warmest is in the Red Sea and Persian Gulf, where maxima have been recorded as high as 96Â° Fahr.

The ocean surface is divided into zones of temperature roughly parallel to the equator, though on account of wind and currents the arrangement in some places is very irregular. The tropical zone has a high surface temperature (for the most part over 80Â° Fahr.), and an extreme range between the absolute annual maximum and mini- mum of less than- 10Â°. It practically coincides with the belt in which reef-building corals can live. To the north and south the mean annual temperature falls off rapidly, and the annual range increases ; until in the two circumpolar zones the average surface temperature is below 40Â° Fahr., and the extreme annual range is again slight (under 10Â°), on account of the low maximum. Â» The eiiect of great range of temperature on water of uniform salinity is to set up convection currents at the period of annual minimum, whereby the surface water, becoming denser than the lower layers in consequence of fall of temperature, sinks and so cools and agrates the mass of the ocean. When the surface water is much fresher than that of the lower layers no degree of cold will cause it to sink, unless sea-ice forms In such quantity that the exclusion of most of the salt causes an increase of salinity, and thus of density, in the unfrozen portion, .which will then sink and produce a very low tem- perature in the lower layers. The action of heat also, which in fresh water ensures the continuance of the upper layers at the surface, produces a concentration of sea- water by evaporation, and thus an in- crease of density, which may lead to a mixture with the lower layers, as in the Red Sea. It may be noted, however, that evaporation proceeds more slowly from the surface of salt than of fresh water.

While the annual range at 60 fathoms atf any one spot rarely exceeds 2Â° Fahr., and at 100 fathoms is inappreciable, different parts of the ocean at the same depth may differ in temperature to the extent of : â€”

Surface <

70Â°

100 fathoms 42Â°

1500 fathoms

600 fathoms 1000 fathoms

20Â° 11Â° 8Â°

It is evident, from the rapidity with which temperature diminishes from the surface downwards in the upper layers, and the slowness with which the diminution continues in deeper water, that the ocean is a great mass of cold water, on the surface of which, in the extra-polar regions, a thin layer of warm water floats.

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Diagram illtjStrating DisTRiBrTioN of Sea Tempeeatdke.

The normal vertical distribution of temperature is illustrated in curve A in the above diagram, which represents a sounding in the South Atlantic. Curve B shows the typical distribution of temperature in an enclosed sea (in this case the Sulu Sea), where from the level of the barrier to the bottom the temperature is

2 Petermanns Mitteilungen, Erganzungsheft, No. 109 (1894). 8 Sir John Murray, ” Annual Range of Temperature in the Surface Waters of the Ocean,” Geog. Journ. xii. (1898), 113-134.

uniform. Curve C shows a typical summer polar curve where layers of water of different temperatures are superimposed. Sir John Murray calculates that no less than 80 per cent, of the mass of the ocean has a mean temperature below 40Â° Fahr.

The temperature of the floor of the ocean beyond the continental shelf, i.e., about 90 per cent, of the whole oceanic area, is strik- ingly uniform. Water above 40Â° occupies only a narrow strip along the continental slope, and fills up the basins of the Red Sea and Mediterranean. Water at temperatures from 40Â° to 35Â° covers tlie whole floor of the North Atlantic south of the Wyville Thomson Eidge, and most of the Pacific, while water from 35Â° to 30Â° covers the floor of the whole Southern Ocean, the Indian Ocean, the South Atlantic and some small areas in the Pacific, the relations of which to each other have not yet been clearly made out. Water below 30Â° is found in the Arctic basin and in the Antarctic seas.i

The study of the bottom temperature shows that the main cooling agency in the hydrosphere is the melting of ice in the Antarctic area, for the oceans most open to the Antarctic are the coldest. Thus the Indian Ocean and the South Atlantic have a bottom temperature 2Â° lower than the North Atlantic, and about 1Â° lower than the Pacific. Sir John Murray points out that 92 per cent, of the ocean floor, but only 16 per cent, of the surface, have a temperature under 40Â° Fahr., and he shows how the deposits now being laid down contain mixed together the remains of forms of animal life which flourished in water at 90Â° and at 35Â° Fahr., a fact which has very important geological bearings.

The areas occupied by surface water at different temperatures may be given as follows : â€”

Mean Annual Surface.

Bottom.

Square miles.

Per cent.

Square miles.

Per cent.

Area from 80Â°-90Â°F.

30,100,000

21-94

70Â°-80Â°F.

38,200,000

27-84

60Â°-70Â° F.

18,800,000

13-70

4,360,000

3-18

50Â°-60Â° F.

13,400,000

9-77

2,710,000

1-97

40Â°-50Â° F.

14,900,000

10-86

3,470,000

2-53

.35Â°-40Â°F.-l 30Â°-35Â°F.J

14,400,000

10-50

/ 67,060,000

\ 55,760,000

48-88 40-64

under 30Â° F.

7,400,000

5-39

3,840,000

2-80

Total .

137,200,000

100-00

137,200,000

100-00

In shallow seas, especially where there is a complex configuration and tidal currents, the form of the ground completely dominates the seasonal thermal changes in the water, which become extremely complicated and differ entirely from the conditions in the open ocean. 2

The facts which have been mentioned as to the practical constancy in the composition of the salts of ocean water and the nature of the absorbed gases are accepted Oceanic \yj almost all oceanographers as proof that the tion. ‘ water of the ocean is everywhere moving and nowhere at rest. Professor Thoulet, however, maintains that the great depths of the ocean are practically stagnant, any circulation being a molecular transference which is chemical rather than mechanical in its nature.

The movements producing the circulation of the ocean are of different velocities and directions, and are due to different causes, of which sometimes one and sometimes another has been considered to bejfhe

most important. Much weight was formerly given to the difference of temperature producing expansion of the water in the tropics as compared with the polar area, and thus initiating a difference of level which caused the surface currents to run on the whole from the equator towards the poles. Calculations have shown, however, that on account of the thinness of the heated layer the total thermal increase of level in the tropics must be very slight indeed, and quite insuificient to produce any sensible flow of water. Other theorists have pointed to the reduction of level in the heated areas in consequence

1 Sir John Murray, ” On the Temperature of the Floor of the Ocean, &c.,” Geog. Journ. xiv. (18fl9) , 34-i31.

2 H. R. Mill, ” The Clyde Sea Area,” Trans. Roy. Soc. E’linburqh, XXXV. Pt. III. No. 23; xxxviii. Pt. I. No. 1 (1894). 0. Pettersson, “Recent Swedish Research in the Baltic, &c.,” Scot. Geog. Mag. x.

(1894) .

of evaporation as sufficient to cause an indraught of the surrounding waters on the surface, especially from places where the level is raised by heavy rain. This undoubtedly must produce some effect even in the open ocean, and is a chief cause of the circulation of many enclosed seas. The Red Sea and the Mediterranean appear to owe their circulation almost entirely to evaporation, and the Baltic very largely to dilution. The melting of ice in the polar seas must have a considerable effect in raising the level of the surface by the liberation of fresh water, not on the surface only, but at the depth, sometimes over 100 fathoms, at which the bottoms of the icebergs float. The escape of the fresh water thus set free causes an up-welling round the bergs and a general outflow from the edge of the ice. Professor Otto Pettersson believes that this action is sufficient to set in motion the whole machinery of oceanic circulation, which thus would start from the edge of the polar ice towards the equator, the poleward-flowing currents being of secondary origin and serving to restore equili- brium.^ It has been suggested by others that the originating cause of ocean currents is essentially tidal ; but since the voyage of the Cliallenger most oceanographers have looked on the prevailing winds as the main cause of oceanic circulation,

both horizontal and vertical. The suggestion of wind as the motive power of currents is old, the remarkable coincidence of direction in winds and currents having been appreciated by navigators at an early period. It is difficult to devise any crucial observation which should decide the truth of any one theory as against the others, since the currents of the ocean are all parts of a complete circulation, the impelling force for which may be applied at any part of the system with similar effect. It seems probable indeed that many causes, direct and indirect, conspire to produce the final result; wind and difference of density due to evaporation, rain, temperature, ice-formation, and ice-melting, all pushing or pulling to produce movement in the same direction.

Zoppritz has proved theoretically that the friction of moving air on the surface of the water at rest is sufficient to move forward the upper layer and to increase its velocity to nearly that of the air. The internal friction of water is sufficient to pass on the movement to deeper and deeper layers, although very slowly, the calculation being that with a uniformly acting wind it would require more than a month before water at the depth of one metre was travelling as fast as that at the surface.

It has been proved by experiment that whenever a current of water is set in motion by any cause it exercises a complex influence on the surrounding water, dragging some of it forward in the same direction and impressing on another part a movement, either on the surface or in some deeper layer, in the opposite direction. These deep reaction-currents are especially noticeable where rivers enter the sea or where strong surface currents run through narrow straits.*

A condition which may produce feeble currents not due directly to wind but to the cause of wind â€” unequal dis- tribui;ion of atmosphere pressure â€” is known as a seiche. This is most easily observed in lakes or bodies of water not affected by tide, and consists of a surge of the water top slow, gradual, and flat to be called a wave, con- stituting a rising at one place where the atmospheric pressure is low and a falling

at another where it is high. AVhen it is remembered that the pressure of an inch of

8 O. Pettersson, ” Ueber den Einfiuss der Eis.schmelzun? auf die Oceauische Cii-c-ulation,” Ofvers. kong. Vetensk. Acad. Forhand.. Stockholm, Ivi. (1899), 141-1Â«6.

- The literature of the theoi-y of oceanic currents is too voluminous to summarize here. It will be found excellently treated In Bogus-lawski and Krummel’s OzeanograpJiie, vol. ii. chaps, iii. and iv., and contmued m the annual volumes of AVaguer’s Geographisches Jahrhuch since 1888.

mercury is equal to that of a foot of water, and that temporary differences of barometric pressure considerably exceeding one inch of mercury between places njuch less than a hundred miles apart are not uncommon, the small and fugitive irregularities of the sea^surface and their associated temporary currents due to this cause can be understood.

The direct action of wind on moving water is modified by the influence of the land, the movements due to wind which may occur even in the open sea being intensified under the guiding influence of land-slopes. An off-shore wind has the effect of driving the surface water out to sea, raising the level at some place to leeward and necessitating an upwelling of the deeper layers along the land. A steady off-shore wind thus causes a constant upwelling of deep, and consequently comparatively cold, water near shore.’- This fact and the similar effect produced by shoals which rise nearly to sea-level has been known to sailors for more than a century, and the thermometer was suggested as a guide to warn the mariner of shallow water as early as 1799.^ An on-shore wind, on the other hand, drives in the surface-water, skimmed from a considerable extent of ocean, against the shore, raising the level of the sea near the laud, and so causing a return movement. This takes

place either in the deeper layers, or, if the wind acts only along a narrow path, a counter-current will escape on the surface on one or both sides of .the direct current. The result is that off a lee-shore the water has a higher temperature at great depths than in the open sea. In consequence of this action, physical similarities in the configuration of the ocean basins lead to similarities in the movements of the water, which in all are closely related to the prevailing winds. Where the trade-winds blow off the land, as on the north-west and south-west coasts of Africa and of South America and the north-west of Australia, cold currents are found, welling up from below, those in the south probably reinforced by branches of the Antarctic surface drift. In the North Indian Ocean and in other places where the direction of the winds changes twice a year, the currents show a similar change and are known as monsoon currents.^

By whatever cause the water of the ocean is set in motion, and in whatever direction it may flow, a force arising from the Earth's rotation causes the current or drift to deviate from a straight line towards the right in the northern hemisphere and towards the left in the southern. In the northern oceans the direction of the coastlines conspires with this deviation to give to the whole of the water a general horizontal circulation in the same direction as the hands of a watch, a fact which has been very clearly proved in the North Atlantic, and is distinctly suggested in the North Pacific. In the South Atlantic, the South Indian Ocean, and the South Pacific a similar horizontal circulation, but in the direc- tion opposite to that of the hands of a watch, as is required by Ferrell's Law of Deviation, has been partially made out.

When a current chart which is not generalized but

compiled from actual observations, such as those of the

British Admiralty, is attentively examined, it

cur^^tl! P- ^Â® ^^Â®^ ^^ *^^ arrows indicating the directions of the observed movements are not parallel to each other, but frequently

present the appear- ance of small eddies or divergent streams. Yet, on view- ing the chart more generally, certain main directions will

1 The first recognition oi this fact is claimed liy E. “Witte in 1870: see Annalen der Hydrographie, xxviii. (1900), p. 74.

2 Jonatlian Williams, Thermometrical Navigation, Philadelphia,

1799.

8 J. Y. Buchanan, “Similarities in the Physical Geography of the Great Oceans,” Proc. Roy. Geog. Soc. viii. (18S6), 753.

be noticed to recur so frequently as to make it possible to assign a definite resultant direction to considerable bands of water. It is usual to distinguish between currents, which are comparatively rapid, fairly definite in their boundaries, uniform and permanent in direction even during temporary changes of wind, and drifts, which are less defined movements of the water, less certain in direc- tion and velocity, and liable to alter with e^‘ery prolonged change of wind. But notwithstanding these differences, drifts and currents are part of one system of general oceanic movement, and they must be considered as sup- plementary and not contrasted. They can never be fully studied by observations of horizontal movement at the surface alone, for the movements of the surface are only the visible portion of the great system of circulation in three dimensions of the mass of the ocean. So little is known of the movements of the deeper layers that the complete system of circulation can only be divined as yet by the use of theoretical reasoning supported in part by facts of observation. The evidence points to the South- ern Ocean as the great meeting- and mixing-place of the waters of the world, and it is there, between 40Â° S. and the Antarctic ice, that the want of systematic observations at all depths taken by exact modern methods is most seriously felt.

An ingenious system of representing the dynamical conditions determining marine circulation by means of sections has been put forward by Bjerknes and Sandstrom. The sections combine isotherms and isohalines into curves of equal density in situ, the corresponding

surfaces of equal density serving to indicate the direction and strength of the movement of the water, as isobaric surfaces indicate the direction and strength of the movements of the air.

The importance of the ocean in the economy of the â– world is perhaps greatest as a regulator of climate, and recent researches indicate that the relation i t^ â– between the atmosphere and hydrosphere is action much more intimate arid sympathetic than was of ocean formerly supposed. The general contrast of "â– ""“â– â€¢ the maritime and continental climate is too well known to require emphasizing, but it is useful to remember that the influence of prevailing winds from the sea may carry a maritime climate far inland over level country, as in the North German plain, while prevailing winds from the land may carry a continental climate to islands across narrow seas, as in Japan and the Kurile group in winter. The researches of Mohn, O. Pettersson, and H. N. Dick- son have shown that the distribution of sea temperature has a direct relation to the distribution of atmospheric pressure and to the resulting types of weather. The ocean surface not only affords a fair field for the develop- ment of unobstructed atmospheric circulation, but helps to fix the position of the great low and high pressure areas, on the margins of which the moving cyclones which dictate the weather of temperate latitudes are generally initiated. The subject is a promising one for future research, and it seems a hopeful direction in which to look for a guide as to the prediction of weather some considerable time in advance.

The practical importance of exact oceanographical research lies in its applications to practical meteorology, to the art of navigation, to the placing of submarine cables, and most directly to fisheries. With regard to the latter, an international council of the nations surround- ing the North and Baltic Seas, which was inaugu'rated at Copenhagen in 1902 after preliminary conferences at Stockholm in 1899 and at Christiania in 1901, formed comprehensive plans for co-operation in the systematic study of the North- West Atlantic and its neighbouring seas at all seasons, with the object of definitely testing the assertions as to the practical value of the study.

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Ochakoff, a fortified tovim of Russia, government of Kherson, district of Odessa, 41 miles east-north-east of Odessa, on a cape of the Black Sea, at the entrance tp the estuary of the Dnieper. Its population was 10,784 in 1897. The port is visited chiefly by coasting vessels (about 250, 6500 tons) for the export of grain to Odessa. It has large brickvirorks, a steam flour-mill, and a few small factories. Strong fortifications have

been built between Ochakoff and the Kinburn promontory, to pro- tect the entrance to the Dnieper.

Ochakoff stands on the site of the old Miletan colony Olvia and of the Greek colony Alektor. The fortress of Kara-kerman or Ozu-kaleh was built on this spot by the khan of Crimea, Mengli-ghirei, in 1492. At a later date it became the centre of a Turkish province which included Ajiber (Ovidiopol), Haji-bei (Odessa), and Dubossary, as well as about 150 villages. Moscow, Poland, and the Zaporogue Cossacks, and later the Ukrainian Hetmans, often attacked it. Russia, regarding it as the main obstacle to the possession of the Black Sea littoral, besieged it in 1737, when it was captured by Minioh ; but next year it was

abandoned, and restored in 1739 to Turkey. The second siege was begun in 1788, and lasted six months, until the fortress was stormed and taken, after a terrible loss of life. By the peace of 1791 it became Russian.

Oconto, a city of Wisconsin, U.S.A., capital of Oconto county, on the shore of Green Bay and on the Chicago and North-Western and the Chicago, Milwaukee, and St Paul railways, in the eastern part of the state, at an altitude of 593 feet. It is in a lumber region, and contains saw and planing mills, and has a large lumber trade. Population (1880), 4171; (1890), 5219; (1900), 6646, of whom 1544 were foreign-born.

Odenkirchen, a town of Prussia, in the Rhine province, 21 miles by rail south-west of Dtlsseldorf. It has linen, cotton, silk, woollen, dyeing, tanning, and other industries. There is also an agricultural school. Popu- lation (1885), 10,161 ; (1900), 14,745.

Odense, a seaport town and bishop’s see of Den- mark, the principal town on the island of Funen, near the north coast. A canal, 4 miles long and 15|- to 21 feet deep, gives access to the town from Odense Fjord. Modern buildings include the town hall (Italian Gothic, 1880-83) ;the museum (built 1883-85, extended in 1897), with valuable collections of antiquities of the Stone Age, coins and medals, paintings, minerals, &c. ; the Renais- sance provincial archives (1892-93) ; and the cathedral school (1892-94). ‘In the industrial quarter, Albani, are tanneries,

breweries, distilleries, tobacco factories, iron- foundries and machine-shops, and the Mechanics' Insti- tute (1890). In 1899 the port was entered by 876 vessels of 95,999 tons, and cleared by 949 vessels of 114,820 tons, the exports being mostly agricultural produce (bacon, butter, eggs), and the imports iron, groceries, petroleum, coal, yarn, and timber. Population (1880), 20,804 ; (1890), 30,268 ; (1901), 40,138, the boundaries having been sev- eral times extended between 1882 and 1901.

Odenwald, a wooded mountainous region of Ger- many, almost entirely in the grand-duchy of Hesse- Darmstadt, with small portions in Bavaria and Baden. It stretches between the Neckar and the ilain, and is some 60 miles long by 20 to 30 broad. Its highest eleva- tion is the hill of Katzenbuckel, 2057 feet, overlooking Eberbach on the Neckar. The western part, which rises steeply from the Rhine valley above the Bergstrasse (which connects Darmstadt and Heidelberg), is composed principally of crystalline slates and primary rocks ; the eastern portions of New Red Sandstone. The wooded heights overlooking the Bergstrasse are studded with castles and medieeval ruins ; and other ruined castles and sites are associated with some of the most memorable adventures of German tradition, e.g., Rodenstein, the reputed home of the Wild Huntsman, and near Grasellen- bach, the spot where Siegfried of the Xibelungenlied is said to have been slain by Hagen.

Oder, one of the chief rivers of Germany. The navigability of this, as of the other North German rivers, has been very greatly improved since 1875 ; nevertheless it still shows a strong tendency to choke itself with sand in certain places. The alterations consist principally of three systems of works:â€" (1) The canalization of 'the main stream (4 miles) at Breslau, and from the confiuenee of the ISTeisse of Glatz up to the mouth of the Klodnitz canal, a distance of over 50 miles, the two costing nearly Â£1,100,000. These engineering works were completed in 1896. (2) In 1887-91 the Oder-Spree canal was made to connect the two rivers named. The canal leaves the Oder at Ftirstenburg (132 miles above its mouth) at an altitude of 9.") feet, and after 15 miles enters the Friedrich- Wilhelm canal (134 feet). After coinciding with this for

7 miles, it makes another cut of 5 miles to the Spree at Ftlrstenwalde (126 feet). Then it follows the Spree for 12 miles, and at Gross Tranke (121 feet) passes out and goes to Lake Seddin (106 feet), 15 miles. Depth throughout, 8^ feet ; width, 60 to 90 feet ; cost Â£630,000. (3) The deepening and regulation of the mouth and lower course of the stream,, consisting of the Kaiserfahrt, 3 miles long, affording a', waterway between the Stettin HafE and the river Swine for the largest ocean-going vessels; a new cut, 4|- miles long, from Woltzig on the Stettin Haff to Mellin Island; the Parnitz-Dunzig and Dunzig-Oder canals, together 1 mile long, constitut- ing the immediate approach to Stettin. Vessels drawing 24 feet are now able to go right up to Stettin. A project has been mooted for connecting Stettin vid the Oder and canals (to be constructed) with Berlin. Including the older canals (Finow, &c.), there are altogether 361 miles of canal and canalized river in the Oder basin, and in addition 93^ miles connect it with the Elbe. The stream has a total length of 660 miles, of which 480 miles are navigable for boats, though above Glogau the depth does not exceed 3 feet. The drainage basin has an area of 43,300 square miles. Between the source and Breslau the total fall amounts to 1342 feet, between Frankfort and the sea only 66 feet. Alto- gether a total of 3,640,400 tons of merchandise pass through Breslau (up and down together) on the Oder in the year. There is valuable fishing in the lower part of the river, near Stettin.

For minor canalizations, see the official work, Der Oderslrom, &c., 3 vols. (Berlin, 1896) ; and consult also A. Penck, "Ber Oderstrom," m Geog. Zeitschrift (1899), pp. 19-47 and 84-94; Hedbach, Die Verkehrsentimckelung auf den Wasserstrassen und Eisenbahnen des Elbe- Oder Gebietes in deni Zeitraum von 1882- 1896 (Berlin, 1898) ; and Leonhakd, Der Stromlauf d. mittleren Oder (Breslau, 1893).

Odessa, the chief city and seaport of Russia on the Black Sea. Its population, which increased from 225,000 in 1884 to 405,041 in 1897, is very varied, and out of a population of 340,526 in 1892, in the Odessa township (which includes the suburbs), there were 188,082 Russians,

112,235 Jews, 13,462 Poles, 8897 Germans, 5272 Greeks, 1129 French, and 11,449 of different nationalities. The industrial development has been rather slow, there being in the township only 261 factories, employing 12,000 workers, and showing a yearly return of about Â£2,600,000, steam flour-mills, sugar refineries, iron and mechanical works, factories of jute sacks, colour and varnish, soap, candle, confectionery, and chemical works being the chief. Commercially the city is now the chief seaport of Russia for exports, which in favourable years are twice as high as those of St Petersburg, . while as regards the value of the imports it is second only to the northern capital. The total returns amount to nearly 150,000,000 roubles a year, representing about one-eighth of the entire Russian foreign trade, and 14 per cent, if the coast trade be included as well. The total exports are valued at Â£10,820,700 yearly (Â£11,000,000 including the transit trade), and the imports at Â£3,825,400 ; i.e., about 9 per cent, of all the imports to Russia. Grain, and especially wheat, is the chief article of export (1,990,000 tons,. Â£7,000 000, in 1895; wheat alone,, Â£3,900,000). The chief customer for the exports is Great Britain ; then follow Holland, Germany, France, Belgium, Denmark, Italy, and Scandinavia. Refined sugar (Â£850,000) comes next, and then seed, fish, raw wool, iron and iron goods, cottons (Â£200,000), small arms, furniture, tobacco, spirits, wooden wares, &c. These articles are exported to east Siberia, Turkey, Great Britain, France, Rumania, and so on. The chief imports are raw cotton, ships, iron, olive oil, fruit, tea, agricultural machinery, coal, chemicals, Â«&c. The port was visited in 1895 by 1207 steamers (1,798,000

tons) and 70 sailing vessels (18,150 tons) ; and in the coasting trade by 1930 steamers (1,047,000 tons) and 2167 sailing vessels (120,000 tons). A new and spacious harbour, especially for the naphtha trade, was built in 1894-1900. Regular steam navigation is maintained with the Mediterranean and Baltic ports by a fleet of 75 steamers, with the Far East by 10 steamers, and with the Black Sea ports by a number of smaller steamers. The town has been provided with a costly system of drainage, electric light in the ports, a beautiful new theatre, a monument to Pushkin, and a ijumber of schools, technical and general.

Oels, a town of Prussia, province of Silesia, 20 miles east-north-east of Breslau by rail. The castle was restored in 1894. In 1884 the extinction of the ducal line of Brunswick caused the principality of Oels to lapse to the Prussian Crown. Population (1885), 10,276 ; (1900),

10,680.

Oelsnitz/a town of Germany, on the Weisse Elster, 26 miles by rail south-south-west of the town and in the circle of Zwickau, kingdom of Saxony. The making of Axminster carpets (one firm employing 1000 workmen), corsets, worsteds, curtains, ticks, and table-covers, jute-weaving and printing, are carried on. Population (1890),

9426 ; (1900), 13,606.

Oelwein, a city of Fayette county, Iowa, U.S.A., in the north-eastern part of the state, at the inter- section of the Burlington, Cedar Rapids, and Northern, and the Chicago Great Western railways, a railway junction and shipping point of some importance. Popu- lation (1890), 830; (1900), 6142, of whom 789 were foreign-born.

Offenburg, a town of Germany, grand-duchy of Baden, 27 niiles by rail south by west of Baden, on the river Kinzig. It has three churches ; a memorial fountain to Lorenz Oken (1779-1861), who was born at Bohlsbach close by ; a statue of Francis Drake (1863), as the alleged introducer of the potato into Europe ; a commercial and a technical school ; and manufactures of cottons, hats, cigars, machinery, glass, &c. Population (1885), 7765; (1896),

9727 ; (1900), 13,669.

Offenburg was founded towards the end of the 12th century, and early in the 13th became an imperial town, and so continued down to 1351. It again occupied the same status from the middle of the 16th century to the year 1802, when it was transferred to Baden.

Ogden, a city of Weber county, Utah, U.S.A., at the junction of the Weber and Ogden rivers, near the shores of Great Salt Lake, in the

northern part of the state, at an altitude of 4310 feet. Its site slopes gently from the Wasatch Mountains on the east towards the lake, and its plan is perfectly regular, with broad, well- shaded streets, and a good water supply. Four railways, the Oregon Short Line, the Rio Grande Western, the Southern Pacific, and the Union Pacific, have termini at this point, making it the most important railway centre in the state and, next to Salt Lake, the largest city. Population (1890), 14,889; (1900), 16,313, of whom 3302 were foreign-born and 133 coloured, including 43 negroes.

Ogdensburg, a city of St Lawrence county, New York, U.S.A., on the St Lawrence river, at the mouth of the Oswegatchie, in the northern part of the state, at an altitude of 248 feet. The city has a regular plan, is divided into four wards, has broad, well-shaded streets, few of which are paved, and a good water supply by the Holly pumping system. Its harbour is fair, and it has considerable commerce on the Great Lakes. It has two railways, the New York Central and Hudson River and the Rutland. Population (1890), 11,662 ; (1900), 12,633, of whom 3222 were foreign-born.

Ogowe, one of the largest of the African rivers of the second class, rising in 3Â° S. in the zone of West African highlands sometimes known as the Cristal range, and flowing north-west and west to the Atlantic Ocean a little south of the Equator. Its course, which may be estimated at 700 miles, lies wholly within the territory of French Congo. Its upper basin, between 2Â° and 3Â° S., is still imperfectly known, but from 2Â° to its mouth it has been fully explored by French travellers. In spite of its considerable size, the river is of comparatively little use for navigation, as rapids constantly occur as it descends the successive steps of the interior table- lands. The principal obstructions are the falls of Dume, in 13Â° E. ; Bunji, in 12Â° 36′ ; Chengwe, in 12Â° 16′ ; Bowe, in 11Â° 53′ ; and the rapids formed in the passes by which it breaks through the outer chains of the mountainous zone, between 10|Â° and llf Â° E. It has a large number of

tributaries, especially in its upper course, but of these few are navigable. The most important are the Lolo, which joins on the south bank in 12Â° 20′ E., and the Ivindo, from the north, a few miles lower down. The latter â€” explored in 1899 by Eourneau, and in 1901 by Lesieur â€” has proved to be a large stream, though ob- structed by rapids in its lower course. It is even said to contain more water than the upper Ogowe. Below the Ivindo, the largest tributaries are the Ofowe, 400 yards wide at its mouth (11Â° 47′ E.), but unnavigable except in the rains, and the Ngunye, the largest southern tributary, navigable for 60 miles to the Samba or Eugenie Falls.

Ohio, the fourth of the states of the American Union in population, bounded on the IST. by Michigan and Lake Erie, on the E. by Pennsylvania and West Virginia, on the S. by West Virginia and Kentucky, and on the W. by Indiana.

Population. â€” The total population rose from 3,198,062 in 1880 to 3,672,316 in 1890, and to 4,167,546 in 1900. The percentage of increase for the decade ending in 1900 was 13-2, as compared with 14-8 for the ten yekrs before. Between 1880 and 1890′ the percentage of persons of foreign birth remained unchanged. Of the foreigners, numbering 459,293 in 1890, 50^947 were born in Eng- land, 70,127 in Ireland, 23,180 in Scotland and Wales, and 236,668 in Germany ; and there was also a decided increase in the number of Italians, Russians, Hunga- rians, and Bohemians, this tendency being accentuated after 1890. The total land surface of Ohio is approxi- mately 40,760 square miles, and the density of the population was therefore 102-0 in 1900, as compared with 90‘1 in 1890. In 1900 the native-born numbered 3,698,811 and the foreign-born 458,734, the latter show- ing a slight decrease for the decade. At the same date there were 96,901 negroes in the state. There were, in 1900, 143 incorporated places with a population of 2000 or over : of these 72 had a population of less than 5000 ; 43 had more than 5000 but less than 10,000 ; 19 had more than 10,000 but less than 25,000 ; and 9 had more than 25,000, namely, Cleveland, 381,768 (increase since 1890, 120,415); Cincinnati, 326,902 (increase, 28,994); Toledo, 131,422 (increase, 50,388); Columbus, 125,560 (increase, 37,410); Dayton, 85,333; Youngs- town, 44,885; Akron, 42,728;

Springfield, 38,263; Can- ton, 30,667. The urban population in 1900 was 38-6 of the total population, as compared with 31-6 in 1890. Prosecutions for crimes against the person have not increased since 1882, but prosecutions for crimes against property have increased slightly from 2049 to 2210, the latter including 2560 individuals. In the five years from 1882 to 1886 the divorces equalled 5-^ per cent. of the marriages, while in the five years from 1896 to 1900 they constituted 9 per cent, of the marriages.

Because of its situation with water routes to all ports of the Mississippi valley and of the Great Lakes, its manu- factures and commerce have outstripped its agricultural interests in development. Between 1880 and 1890 the number of farmers increased from 260,620 to 275,221, while the number of persons engaged in trade and trans- portation increased from 101,446 to 180,978, and those engaged in manufacturing and the mechanical arts from 204,787 to 273,660. Moreover, the percentage of the urban population to the total population increased in the same time from 23-3 to 31-6. And the rate of in- crease in the six principal lake towns, Cleveland, Toledo, Sandusky, Lorain, Conneaut, and Ashtabula, was 61 per cent., although the rate for the total population was only 14 per cent.

Agriculture. â€" During the years from 1882 to 1899 the agricultural interests grew slowly but steadily. Culti- vated land increased from 9,388,018 acres to 10,239,866. Pasture land remained about the same, while woodland decreased from 4,208,247 acres to 2,817,599. The aver- age production of wheat in the five years from 1882 to 1886 inclusive was 33,504,000 bushels, aud from. 1895 to 1899 inclusive, 33,700,000. Of shelled corn the yield for the same periods amounted to 88,733,000 bushels and 156,124,000. There was an increase in the corn acreage, but no substantial increase in the acreage of wheat. In 1882 the orchards covered 388,674 acres; in 1899, 369,256. The crop showed great fluctuations from year to year, but no decided tendency to increase or to dimin- ish. The acreage of vineyards, situated principally along the lake shore, increased ; and the product rose from 11,678,646 lb of grapes in 1882 to 31,127,743 ft in 1889. The number of horses and cattle fell off about one-fourth. Certain dairy products, eggs and milk,

were increased, while there was a decrease in the production of butter and cheese. The wool clip fell off decidedly through the whole period, rallying slightly in 1898 and 1899, and was apparently little affected by changes in the tariff. In 1882 the amount was 23,629,424 ft ; in 1890, 18,629,961 ; and in 1899, 13,017,052.

The following table shows the growth of manufactures in recent years: â€”

Percentap-e

18S0.

1890.

1900.

of Increase,

1890-1900.

Number of establish-

ments

20,099

28,6T3

82,398

18-0

Capital ....

$188,939,614

$402,T98,019

$605,792,266

60-4

Wage-earners, average

number

133,609

292,982

345,869

18-1

^ aiue of product .

$348,298,890

$611,688,064

$SM,438,118

29-7

The leading industries were iron and steel, the value of the products of which increased from $66,206,828 in 1890 to $138,936,256 in 1900 ; foundry and machine shops, with products valued in 1900 at $72,399,632; flouring and grist-mills, $37,390,367; liquors, $31,771,591; and lumber and timber, $20,790,854. In the value of its manufactures Ohio ranks as fifth among the states.

Minerals.â€” Tlh^ mining of iron ore has been almost abandoned, the product falling from 276,286 tons in 1884 to 62,266 in 1900 ; while the product of bituminous coal has risen from 9,450,000 tons in 1882 to 11,788,869 tons in 1890, and to 12,448,822 in 1897. In 1884 natural gas was discovered at a deeper level than that at which it had been believed to exist. In January 1880 a well was drilled at Findlay to a depth of

1144 feet. For a time the daily yield was 12,080,000 cubic feet. Findlay soon had a daily product of 25,000,000 feet. These discoveries led to others in various parts of the state and of neighbouring states, but the supply was waste- fully used, so that after a time it became uncertain, and its commercial value decreased.

Riiihrnijx and Trrinsp(irtation.â€”The- natural highways afforded by Lake Erie and the Ohio river are supplemented by systems of canals and of railways. With the development of the railways, the receipts from the canals have fallen off, so that there lias

long been an annual deficit ; yet the General Assemblj' has main- tained the canals, wisely seeing in them a means of keeping rates of transportation from becoming oppressive. The mileage of rail- ways, includins main line, second line, branches, and side tracks, in 1882 was SV.U ; in 1890, 10,504; and in 1898, 13,289. The valuation of railways for taxation increased 18 millions during the same period. The receipts for 1898 were $68,764,938, and the expenditures $49,002,218. There has been a decided tendency towards consolidation. Such through lines as the Lake Shore and Michigan Southern, the Pennsylvania, the Erie, the Baltimore and Ohio, and the Cleveland, Columbus, Cincinnati, and St Louis have acquired control by purchase or by lease of many of the minor lines. So far has this movement for consolidation gone that the Lake Shore and Michigan Southern and the Baltimore and Ohio have passed under the control of other and larger railway com- panies.

Banks. â€” Tlie national banks increased from 189 in 1882, with a capital of $.n,4'U,000, to 228 in 1890, with a capital of $39,692,719, and to 268 in 1900, with a capital of Â§45,880,670. The state banks and banking associations grew even more rapidly, from 30 in 1882 to 181 in 1900, with a capital of $14,895,532.

Finances -From 1882 to 1900 the valuation increased from

$1,634,910,734 to $1,834,053,228. The Â£tate tax remained about the same, while the local taxation increased 5 millions. The net receipts of the state treasury for 1900 were â– $5,222,355, and the disbursements $5,104,769. The funded debt on 15th November 1900 was $701,665. In 1882 it waj3 61,901,665. More than half of this debt became due in 1880, and was refunded at 3 per cent., a reduction of one-half in the rate of interest. The local debts increased from $45,766,551 in 1882 to $62,992,957 in 1890 and $96,193,514 in 1899.

Education. â€” The number of children of school age rose from 1,081,321 in 1882 to 1,226,366 in 1900. Of these 829,160 were en- rolled, and 616,365 in daily attendance. The number of teachers employed was 26,017. The receipts amounted to $14,426,858, and the expen'litures to $14,266,973. There were, in 1882, 25 colleges granting a degree; in 1890, 30; in 1900, 32. The number of in- structors increased from 222 to 1031. Of the 222 instructors in 1882, 27 psr cent, were in four institutions, i.e., Oberlin College, Ohio State, Ohio Wesleyan, and Western Reserve universities; but of the 1031 instructors in 1900, 47 per cent, were in these institu- tions. In 1898 the total property reported was $14,716,782; the income, $1,242,135; and the expenditures, exclusive of permanent improvements, $902,714. In nearly all the colleges men and women are admitted, but the co-educational system was abandoned by Adelbert College, of Western Reserve University, formerly Western Reserve College at Hudson, and a separate college for women was organized as a department of the university. In 1890 the total number of students in universities and colleges was 3963, of whom 1163 were women ; in 1898 it was 6530, of whom 1582 were women.

Churches. â€” The organized churches in 1890 numbered 9345. The Catholics were the leading denomination, with 336,114 commu- nicants In 586 churches, and a property of $7,395,640 ; although the Methodists, with a smaller number of communicants (272,737), had 2798 churches and a property of .?9,600,820. In number of communicants and in property the Presbyterians come third, but they have fewer churches than the Baptists. The Episcopalians, though

seventh in number of communicants and ninth in number of churches, are fifth in property.

Pahlic Institutions. â€” There are 17 charitable institutions, maintained by the state at an expense of $3,085,880. They include 8 hospitals for the insane, 2 asylums for juvenile offenders, 1 reformatory, 5 educational and benevolent institutions, and the penitentiary.

Legislation. â€” Legislation regulating or taxing the liquor traffic has been diificult, owing to a section in the con- stitation which forbids the granting of licences for the sale of liquors. After some futile attempts at legal control, the Dow tax law was passed in 1886, and success- fully defended in the courts as a tax and not a licence. The organization of the state government, with a General Assembly uncontrolled by executive veto and with an independent executive, has been unchanged, except that circuit courts have been substituted for the district courts, and that the constitutional provision for biennial sessions of the General Assembly, after remaining a dead letter since 1851, was in 1894 carried out by the passing of an appropriation bill covering the expenses of two years and by an adjournment sine die. The election laws were changed by introducing the Australian ballot system in 1891, and by granting in 1894 the suffrage to women for

the election of school officials. The results of the last measure have been unsatisfactory, even to its advocates. Politics. â€” Since 1882 the Republicans have uniformly been successful, except in the elections for governor in 1883 and 1889; in the latter year their failure was attributed to personal rather than political reasons. The Prohibitionist party gradually lost strength, and was finally disorganized by the famous struggle between the Eepublicans and Democrats in 1896. It polled only one- fourth of its average vote at that election, and rallied only slightly in 1897 and 1898, to fall back again in 1899. In the Presidential election of 1884, 784,610 votes were cast as follows : â€” Republican, 400,082 ; Democratic, 368,280; Prohibitionist, 11,069; Greenback, 5179. In the election of 1888, 840,361 votes were cast as follows : ‘ â€”Republican, 416,064; Democratic, 396,4r5; Prohibitionist, 24,356 ; Union Labour, 3496. In the election of 1892, 860,164

votes were cast as follows : â€” Republican, 405,187; Democratic, 404,116; People's Party, 14,850; Prohibitionist, 26,012. In 1896, 1,014,295 votes were cast as follows: â€” Republican, 525,991; Democratic, 474,882; People's, 2615; Prohibitionist, 5068; National Party, 2716; Social Labour, 1165; National Democrat, 1858. In 1900, 1,040,073 votes were cast as follows :â€” Republican, 543,918; Democratic, 474,882; Union Re- form, 4284; Prohibitionist, 10,203; Social Labour, 1688; People's, 251 ; Social Democrat, 4847.

See Ohio Statistics (annual), published by the Secretary of State, and reports of various State Boards. â€” Publications of the Ohio Arohsological and Historical Society, 7 vols. 1893-99. â€” Historical Collections of Ohio, 3 vols. Columbus, 1889-91 . â€” List of Books on Ohio. Cincinnati, 1893. â€” King. Ohio. (American Common- wealth Series.) Boston, 1889. â€” Hinsdale. The Old North-West. New York, 1888. â€” Knight and Commons. History of Higher Education in Ohio. Washington, 1891. (h. E. B.)

Ohio River, the largest eastern branch of the Mis- sissippi river, U.S.A., formed by two main forks, the Allegheny river, which rises in southern New York, an 1 the Monongahela, rising in West Virginia. These two streams join at Pittsburg. Its general course from Pittsburg to its mouth at Cairo is south-west, although in detail it flows in nearly every direction except east- wards. Its length is 963 miles. It is navigable through- out, with the exception of the falls at Louisville, which are overcome by means of a canal and lock. Its drainage basin comprises 201,720 square miles, including parts of New York and Pennsylvania, nearly all of West Virginia and part of Virginia, most of Ohio and Indiana, and a large part of Illinois, all of Kentucky, nearly all of Tennessee, and parts of North Carolina, Alabama, and Mississippi. Besides its parent streams, the Allegheny and Monongahela, the Ohio has numerous large branches. On the north it receives the waters of the Muskingum, Scioto, Miami, and Wabash- rivers, and on the south those of the Kanawha, Big Sandy, Kentucky, Green, Cumberland, and Tennessee rivers. The Ohio drains the western slope of the Cumberland-Allegheny plateau from New York south to Alabama, and also most of the east side of the Mississippi valley. Several large cities

are on its banks, among them Pittsburg, ~~Cincin~~ nati, and Louisville. Por a century the Ohio has been one of the great highways of internal commerce, and even now, in spite of the competition of the railways, its waters are laden with boats which transport the heavier and bulkier articles of freight, such as coal and lumber.

Ohiau, a town of Prussia, province of Silesia, 16 miles by rail south-east of Breslau, on the left bank of the Oder. It is the centre of a tobacco-growing district and has manufactures of cigars, machinery, white lead, beer, &c. In the 17th and 18th centuries it was often

the residence of the dukes of Brieg and of the Sobieskis. Population (1885), 8575 ; (1900), 9235.

Ohiigs, a town of Prussia, in the Ehine province, 17 miles by rail north of Cologne. It is an industrial place, manufacturing cutlery, hardware, silks, and bricks, and possessing iron-foundries and flour-mills. Down to 1891 it was known as Merscheid. Population (1885),

12,646 ; (1900), 20,682.

Ohrdruf, a town of Germany, duchy of Saxe- Coburg-Gotha, 11 miles by rail south by east of Gotha. It has manufactures of porcelain, paper, copper goods, small wares (buttons, &c.). It has a castle, a couple of churches, and a technical school. Close by is the summer resort of Luisenthal. Population (1900), 6295.

Oil City, a city of Venango county, Pennsylvania, U.S.A., on the Allegheny river, at the mouth of Oil Creek, in the , north-western part of the state, at an altitude of 1005 feet. It is in the centre of the Pennsyl- vania oil region, and owes its existence to the develop- ment of the petroleum industry. It contains petroleum refineries, and its manufactures are in great part related to the production and refining of oil. It is at the inter- section of four railways, the Allegheny Valley, the

Erie, the Lake Shore and Michigan Southern, and the Western New York and Pennsylvania. Populatipn (1890), 10,932 ; (1900), 13,264â€”2001 foreign-born and 184 negroes.

Oil Engines. See Engines, 3.

Oise, a department of northern Prance, traversed by the Oise.

Area, 2272 square miles. The population, 404,555 in 1881, was 405,642 in 1901. Births in 1899, 8933, of which 861 were illegiti- mate ; deaths, 9387 ; marriages, 3174. The soliools in 1896 num- bered 1134, with 57,000 pupils, and 4 per cent, of the population was illiterate. Out of 1,417,780 acres cultivated in 1896, 948,480 were plough-land, 32,110 gardens, and the rest grass and woodland. The wheat produce of 1899 returned the value of Â£1,640,000 ; rye, Â£120,000; oats, Â£1,005,000 ; mangold-wurzel, Â£208,000; potatoes, Â£260,000 ; beetroot, Â£1,280,000 ; apples, Â£52,000. Oise owned in 1899, 48,990 horses, 126,180 cattle, 354,500 sheep, and 35,280 pigs. With the exception of building-stone, the department raised (1898) only 8300 metric tons of peat ; but the industry in metals yielded, in 1898, 17,000 tons of iron and 41,000 tons of steel, of a total value of nearly Â£400,000. Oise ranks fifth among the departments for the production of sugar â€” 1,400,000 cwts. in 1899 â€” while its alcoholic production in the same year amounted to 1,760,000 gallons. These, with tapestry, are the principal industries. Beauvais, the capital, had in 1901, 20,300 inhabitants.

Okehampton, a municipal borough, parish, and market town in the Tavistock parliamentary division of Devonshire, England, on the East and West Okement rivers, 22 miles west by north of Exeter by ra,il. Its earliest charter dates from 1623. In 1886 the electric light was adopted by the town, a complete scheme of drainage was carried out in 1886-87, and the market premises were rebuilt in 1900. The curfew bell is still tolled here. Population (1891), 1879 ; (1901), 2568.

Oici, a group of islands belonging to Japan, lying due north of the province of Izumo, at the intersection of 36Â° N.‘and 133Â° E. The group consists of one large island called D5go, and three smaller islesâ€” Chiburi-shima, Nishi-no-shima, and Naka-shima â€” which are

collectively known as Dozen. These four islands have a coast-line of 182 miles, an area of 130 square miles, and a population of 62,759. The island of Dogo has two high peaks, Daimanji-mine (2185 feet) and Omine-yama (2128 feet). The chief town is Saigo in Dogo, distant about 40 miles from the port of Sakai in Izumo. The name Oki-no-shima signifies ” islands in the offing,” and the place is celebrated in Japanese history not only because the possession of the islands was much disputed in feudal days, but also because

an ex-emperor and an emperor were banished thither by the Hojo regents in the 13th century. Great quantities of cuttle-fish are taken at the archipelago.

Oklahoma, a territory lying in the south central part of the United States, organized under an Act of Congress, passed 2nd May 1890. It was formed from the western part of Indian Territory, and included all that part of it not occupied by the Eive Civilized’ Tribes, and the Indian tribes within the Quapaw Agency, except the Cherokee outlet lands. The Cherokee outlet and “No Man’s Land” were added by proclamation of the President in September 1893. Lying between 34Â° and 37Â° K and 96Â° and 103Â° W., it is bounded on the N. by Colorado and Kansas, on the E. by Indian Territory, on the S. by Texas, and on the W. by Texas and New Mexico. There are contained within its boundaries 39,030 square miles, of which 4600 square miles are reserved. Geologically it is divided into regions of mountains, prairie plains, and great plains. The group or range, in the southern part, known as the Wichita Mountains, is of granitic formation, and rises through Silurian limestones and red beds to an altitude of about 2700 feet above the sea-level. The prairie plains in the north-east are a continuation of the residual soils of the Carboniferous prairies to the east, extending west- wards to about 97Â° 30′ W., marked by red sandy clays, or red beds, and further characterized by great deposits of gypsum and salt. Here and there over the prairies are areas of C!retaceous formation, the sandy beds of which are covered with oak timber (” Cross timbers “). The great plains in Oklahoma are eastern breaks of the Great Plains plateau to the west, making a ragged line through the western part, with sandy tongue-like divides between the

streams. Soils and rocks are sandstone, gravel, and marl, and there are great salt deposits in the north-western corner along Beaver Creek.

Geography. â€” There is very little relief to the surface, which is generally flat or rolling prairie, with the single exception of the isolated Wichita Mountains, situated in the middle southern portion. The principal rivers, which are the characteristic broad shallow streams of the semi- arid west, flowing through wide valleys, are the Arkansas, Cimarron, North Fork of Canadian, Washita, North Fork of Red, and Red rivers. The extreme -western portion is a semi-arid, treeless plain, while the extreme eastern part is wooded by the belt of forest known as the ” Cross timbers ” ; between lie fertile prairies and valleys partly wooded and principally along streams. The forest is composed largely of varieties of oak on the higher ground, with ash, elm, and Cottonwood by the rivers in the valleys. The climate is about the same as Arkansas and Tennessee, except that it is less humid, the mean annual rainfall being about 32 inches in the eastern part of the Territory and about 20 inches in the western. Among the wild animals and birds are deer, antelope, wolf,^ coyote, fox, prairie dog, rabbit, squirrel, turkey, prairie chicken, quail, hawk, and buzzard.

History. â€” For a number of years before the opening of this country, public lands in adjoining territory had been so over-populated that many illegal attempts were made by covetous squatters to obtain possession. When finally the lands had been purchased of the Indians by the Govern- ment, and thrown open to settlement, the rush to secure homesteads and town lots was unprecedented, there being five or six persons for every available claim, and innumera- ble contests arose in consequence. Probably no agricultural country was ever settled with such rapidity. Towns were started without a single inhabitant in the morning and by night contained a population of five thousand, housed in tents or without shelter. Railways already built facilitated

this rapid growth by landing building material and sup- plies without delay. “No Man’s Land,” the extreme western strip of land, was for many years unattached to any state or territory, and designated on the maps as ” Public Land.” Greer county, in the south-western cor- ner, was disputed territory for many years, the state of Texas claiming that the North Pork of the Red river was the main stream, and therefore the boundary line. A decision of the United States Supreme Court was against this claim and it remains attached to Oklahoma.

Products.â€” The eastern and middle parts are agricultural lands, the richest soil being in the bottom lands of the broad river valleys, devoted to the cultivation of various farm products, the most important of which are wheat, oats, cotton, and corn. Indian corn, castor beans, melons, pea-nuts, alfalfa, and many fruits and vegetables are raised. The rainfall is occasionally much below the average, when failures result, but with normal conditions the soil produces luxuriantly. The western part is a grazing land, affording pasturage for cattle in large num- bers. Horses, sheep, and swine are also raised. No trustworthy statistics have been gathered since the set- tlement of the country in regard to farm products or domestic animals, but from the best obtainable data it is estimated that during 1901 26,000,000 bushels of wheat, 60,000,000 bushels of corn, and 140,000 bales of cotton were raised, and that 36,235 horses, 52,580 mules, 617,750 cattle, 42,000 sheep, and 277,289 hogs were owned in the Territory.

Population. â€” The population in 1900 was 398,331, as compared with 61,834 in 1890 ; 214,359 were males and 183,972 were females; 382,661 were native and 15,680 were foreign-born; 367,624 were whites, 18,831 were negro, 11,945 were Indians, and 31 were Chinese. The population materially increased in 1901 by the open- ing to settlement of the Kiowa and Comanche Indian Eeservation. The average number of persons to the square mile was 10-3, as compared with 1-6 in 1890. There were fifty incorporated cities and towns in 1900, but of these only two had a population of over 4000, namely, Oklahoma city with 10,037, and Guthrie (the capital) with 10,006 inhabitants. There are 700 churches and 2000 public schools, several normal schools, and an agricultural college, the school attendance being 110,000. One thousand and

seventy-five miles of railway had been built at the beginning of 1901, four trunk lines extend- ing across the Territory. There are about 12,000 Indians upon the several reservations and allotted lands set apart for their use, representing members of the following tribes : Kiowa, Comanche, Apache, Wichita, Cheyenne, Arapaho, Sac and Fox, Ponca, Pawnee, Caddo, Delaware, Kansas, Osage, and Shawnee. Some of the tribes are dependent upon the Government for support, while others are self-sustaining. Several Government schools are maintained, attended by 2000 Indian children. Many acres of their land are leased for grazing purposes, but some of it is used by the Indians themselves for agricul- ture and grazing. There is a military post at Port Sill and also at Port Eeno. About 400 Apache Indians, prisoners of war, are held on a small reservation near Port Sill, where they are slowly becoming civilized, and are taught farming and cattle-raising.

There has been a remarkable increase in the manufac- tures and mechanical industries since 1890, an increase even more striking than, the increase in population (644-2 per cent.), and exceeding that of any other state or terri- tory. Compared with older localities, the amount of manufacturing is still insignificant. A notable product is the manufacture of cotton-seed oil, which has grown with the rapid development of the cotton crop. The accompanying table is a comparative summary of the

Per cent.

1890.

1900.

of Increase.

Number of establishments

72

870

1,108-3

Capital ....

$95,519

$3,352,064

3,409-3

“Wage – earners, average

number ....

147

2,054

1,297-3

Total wages

$52,326

$807,826

1,443-8

Miscellaneous expenses .

$21,970

$246,081

1,020-1

Cost of materials used

$56,518

$4,449,944

7,773-5

“Value of products, includ-

ing custom work and

,

repairing

$180,445

87,083,938

3,825-8

manufacturing and mechanical industries of the Territory for 1890 and 1900. (c. h. f.)

Oklahoma, a city of Oklahoma Territory, U.S.A., capital of Oklahoma county, on the north fork of the Canadian river and on the Atchison, Topeka, and Santa Pd, the Choctaw, Oklahoma, and Gulf, and the St Louis and San Francisco railways, in the south-eastern portion of the territory, at an altitude of 1195 feet. The city is regularly laid out on a level site, has considerable trade in cotton, and contains cotton gins and flour and other mills or factories. It was settled in 1889. Population (1890), 4151 ; (1900), 10,037, of whom 671 were foreign- born and 1219 negroes.

Okuma (Shigenobu), Count (1837), Jap- anese statesman, was born in the province of Hizen in the year 1837. His father was an officer in the artillery, and during his early years his education consisted mainly of the study of Chinese literature. Happily for him, how- ever, he was able to acquire in his youth a knowledge of English and Dutch, and by the help of some missionaries he succeeded in obtaining books in those languages on both scientific and political subjects. These works effected a complete revolution in his mind. He had been designed by his parents

for the military profession, but the new light which now broke in upon him determined him to devote his entire energies to the abolition of the existing feudal system and to the establishment of a constitutional government. “With impetuous zeal he urged his views on his countrymen, and though he took no active part in the revolution of 1868, the effect of his opinions exercised no slight weight in the struggle. Already he was a marked man, and no sooner was the Government reorganized, with the Mikado as the sole wielder of power, than he was appointed chief assistant in the department of Foreign Affairs. In the following year he succeeded to the post of secretary of the joint departments of the Interior and of Finance, and for the next fourteen years he devoted him- self wholly to politics. In 1870 he was made a councillor of state, and a few months later he accepted the office of president of the commission which represented the Japa- nese Government at the Vienna Exhibition. In 1872 he was again appointed minister of finance, and when the expedi- tion under General Saigo was sent to Formosa (1874) to chastise the natives of that island for the murder of some shipwrecked fishermen, he was nominated president of the commission appointed to supervise the campaign. Through- out his political career Count Okuma was a leader of the progressive party, and with indefatigable energy he in 1887 advocated the revision of the treaties. By one of those waves of popular feeling to which the Japanese people are peculiarly liable, the nation which had supported him up to a certain point suddenly veered round and opposed him with heated violence. So strong was the feeling against him that on one occasion a would-be assassin threw at him a dynamite shell, which blew off one of his legs. During the whole of his public life he recognized the necessity of promoting education. “When he resigned office in the early

‘eighties he established the Semmon Gako, or school for special studies, at the cost of the 30,000 yen which had been voted him when he received the title of count, and subsequently he was instrumental in

founding other schools and colleges. He was a consistent advocate for the higher education of women, and did much to elevate the position of his countrywomen in the social scale. In 1896 he joined the Matsukata cabinet, and re- signed in the following year in consequence of intrigues which produced an estrangement between him and the prime minister. On the retirement of Marquis Tto in 1898 he again took office, combining the duties of premier with those of minister of foreign affairs. But dissensions having arisen iu the cabinet, he resigned a few months later, and retired into private life, cultivating his beautiful garden at Waseda near Tokyo.

Oland, an island of Sweden, lying off the east coast, from which it is separated by Calmar Sound. The prin- cipal products are cattle, game, fish, cement, lime, and building stone. The town of Borgholm (population, 926 in 1900) has now a certain repute as a seaside resort. Population of island (1900), 30,408, scarcely more than in the middle of the 19th century.

Old-Age Pensions. â€” The organization of an- nuities for the poor by the State was proposed in the 18th century â€” e.g., by Francis Maseres, cursitor baron of the Exchequer, in 1772, and by Mr Mark Eolle, M.P., in 1787. Suggestions for subsidizing friendly societies have also been frequent â€” e.g., by T. Paine in 1795, tentatively in ^turges Bourne's Eeport on the Poor Laws, 1817, and by Lord Lansdowne in 1837. The subject has been revived in the present day. Many persons unfortunately become destitute in old age, and it has been tacitly assumed by advocates of State pensions that destitution in old age is entitled to greater public sympathy, and that it can advantageously be dealt with in a manner more liberal, than the destitution of widows, orphans, and persons prematurely stricken with permanent ill- ness. No such plea, however, was originally put for- ward by Canon Blackley, the reviver of the controversy towards the close of the 19th century. His plan assumed the ability of the great mass of the population to provide for themselves. He proposed, therefore, to compel every one to insure with a State department against sickness and old age, and essentially his scheme was one for the relief of the ratepayers and a more equitable readjust- ment of the poor-rate. The terms provisionally put for- ward

by him required that every one in youth should pay Â£10, in return for which the State was to grant 8s. a week sick allowance and 4s. pension after seventy. These proposals were submitted to the Select Com- mittee on National Provident Insurance, 1886-1887. This body reported unfavourably, more especially on the sick insurance part of the scheme, but the idea of old-age pension survived, and was taken up by the National Provident League, of which Mr (afterwards Sir) J. Rankin, M.P., was chairman. The subject was dis- cussed in the constituencies and expectation was aroused. An unofficial parliamentary committee was formed, with Mr Chamberlain as chairman. This committee published proposals in March 1892, which show a very interesting change of attitude on the part of the promoters. Com- pulsion, which at the earlier period had found favour with Canon Blackley, Sir J. Eankin, and even Mr Cham- berlain, was no longer urged. The annuitant was no longer required to pay a premium adequate to the bene- fits promised, as in Canon Blackley's proposal. The benefit was no longer a pure annuity, but premiums were, in certain cases, returnable, and allowances were provided for widows, children (if any), and for the next

of kin. Canon Blackley's professed object was to super- sede the friendly societies, which, he alleged, were more or less insolvent ; a proposal was now introduced to double every half-crown of pension derived by members from their friendly societies. Several alternative schemes were put forward, but the figures were only provisional, and it is enough to say that the principle suggested was to double, by subsidy from public funds, the value of the contribution made by the annuitant himself. Adverse criticism has been directed against these voluntary and contributory schemes, not only by those who are entirely opposed to State intervention, but by an influential sec- tion of those who favour that principle. Of these, Mr Charles Booth has been the most prominent spokesman. There is only one point of agreement between these two schools. They both assume, not only what all admit, that the destitution of old age is entitled to sympathy, but that it is entitled to a special treatment not accorded to other forms of destitution. Mr Chamberlain's scheme proposes State assistance, on condition that the annuitant voluntarily contributes one-half the requisite amount. Mr

Booth points out that this condition will not be ful- filled by the class from which pauperism is drawn. Unless the pension is gratuitous, this class either would not or coidd not profit by it. Accordingly Mr Booth has proposed that there shall be a general endowment of old age, i.e., as originally proposed, 6s. a week to every one at the age of sixty-five. The details have been varied, but the principle is the same. This proposal involves an expenditure of Â£18,000,000 for England and Wales and Â£24,000,000 for the United Kingdom, exclusive of the cost of administration. So large an expenditure has been felt to be a difficulty, and proposals have been made to limit the gratuity either to a special class, e.g., persons with an income of less than 10s. weekly or to members of a friendly society, or to those who require it and are of good character. Mr Booth, however, considers univer- sality to be of the essence of his scheme. The difficulty of drawing a line between those who are, and those who are not, entitled to such assistance seems to him insuper- able; and to limit the endowment to those who plead destitution is to reduce the system to a form of poor-law relief, which ex hypotJiesi is supposed to be unsatisfactory. Mr Booth throughout has been anxious to append to his scheme the further condition, that, on its adoption, out- door poor-law relief shall be discontinued. How far this is accepted by those who act with him is not clear. While Mr Booth has severely criticized the weak points of the contributory and voluntary schemes, their most influential advocate, Mr Chamberlain, has not spared Mr Booth's proposals. Speaking at Highbury, for instance, on 24th May 1899, he described Mr Booth's universal scheme as " a gigantic system of out-door relief for every one, good and bad, thrifty and unthrifty, the waster, drunkard, and idler, as well as the industrious," and very forcibly stated his inability to support it.

Notwithstanding these differences of opinion, the advo- cacy of these gentlemen has raised considerable expecta- tion, and the subject has been referred to a succession of commissions and committees, but without any practical result. In 1893 Mr Gladstone's Government was pressed to declare a policy, and sought refuge in a royal com- mission (Lord Aberdare, chairman). A majority report, adverse to the principle of State pensions, was issued in 1896. A minority report, signed by Mr Chamberlain and others, dissented, mainly on the gr'ound that public

expecta- tion would be disappointed, if nothing was done. In 1896 Lord Salisbury appointed a committee ” of experts ” (Lord Rothschild, chairman) to report on schemes submitted, and, if necessary, to devise a scheme. The committee were unable to recommend any of the schemes submitted,

and added that, ” we ourselves are unable, after repeated attempts, to devise any proposal free from grave inherent disadvantages.” This second condemnation was not con- sidered conclusive, and a select committee of the House of Commons (Mr Chaplin, chairman) was appointed to consider the condition of “the aged deserving poor.” After an ineffectual attempt by Mr Chaplin to induce the committee to drop the pension idea, and to consider the provision made for the aged by the poor law, the committee somewhat hastily promulgated a scheme of gratuitous pensions for persons possessing certain qualifi- cations. Of these the following were the most important : â€” age of sixty-five; no conviction for crime; no poor- law relief, “unless under exceptional circumstances,” within twenty years ; non-possession of income of 10s. a week ; proved industry, or proved exercise of reasonable providence by some definite mode of thrift. The com- mittee refrained from explaining the machinery and from estimating the cost, and suggested that this last problem should be submitted to yet another committee.

Accordingly a departmental committee (chairman. Sir E. Hamilton) was appointed, which reported in January 1900. The estimated cost of the above plan was, by this committee, calculated at Â£10,300,000 in 1901, rising to Â£15,650,000 in 1921. Mr Chaplin had publicly sug- gested that Â£2,000,000, the proceeds of a Is. duty on corn, would go a long way to meet the needs of the case â€” a conjecture which was obviously far too sanguine. These unfavourable reports appear to have discouraged the more responsible advocates of State pensions. Mr Chamberlain appealed to the friendly societies to formu- late a plan, an invitation which they showed no disposi- tion to accept. Efforts continued to be made to press for- ward Mr Booth’s universal

endowment scheme or some modification of it. To this Mr Chamberlain declared his hostility. And here up to 1902 the matter rested.

The scheme throughout has been strongly opposed by the school of poor-law reformers generally identified with the London Charity Organization Society. Mr Booth's universal proposal they consider impracticable, and un- necessary to a large extent ; and, where necessary, not to be distinguished in its moral and economic effects from poor-law relief. They object also to State-assisted pen- sions, on the ground that they attempt to popularize a form of investment which probably is not the best use of a poor man's savings. The leaders of the great friendly society movement have also, with few exceptions, opposed or stood aloof from the proposal. Their aim is the abso- lute independence of their members. The offer of gratuity to their own associations, though very tempting, has been rejected partly on grounds of principle, and also from the belief that State aid would mean more State supervision and ultimately State management.

The movement in favour of State aid to provision for old age has been largely due to the example of Germany. The German system (which for old age dates from 1891) is compulsory and contributory. The element of compulsion was very early deemed unsuitable for the United Kingdom, and the precedent of Germany, therefore, no longer applies. One half of the premium payable is there paid by the labourer, the other half by the employer. The State adds a subvention to the allowances paid to the annuitant. (See The German Law of Insurance against Invalidity and Old Age, by T. E. Young, actuary of the Commercial Union Assurance Com- pany, 1891.) A well-informed article by Mr H. W. Wolff in the Charity Organization Meview, December 1899, describes another phase of the question. He points out that the law is unpopular both with the workmen and the employer, and that the financial diflBculty of employing the insurance fund is considerable and pro- gressive. Continuous pressure seems to be exerted in favour of raising the amount of pension and of relaxing the conditions of contributory thrift. The Government, much against its will, is being pushed away from the endowment of thrift, which has

been its ideal, towards the mere endowment of old age, which it has always condemned.

The Danish system of old-age pensions differs entirely from the above. It has been disavowed and condemned by Dr Bodeker, the late President of the German State Insurance Department, as a mere extension of out-door relief, as an endowment, and therefore an encouragement not of thrift but of need. The Danish system has been described by Mr A. W. Flux in a pamphlet reprinted from the Tale Beview, February 1899, and by Mr J. S. Davy of the Local Government Board in evidence given to the Select Committee on the Aged Deserving Poor, 1809. By the law of 1891, the burden of maintaining the aged is in part transferred from the local to the national taxes, and relief from this latter source is called a pension. The committee remark on the Danish plan, ” It is difficult to see what substantial difference there is in practice between the pensions in Denmark and the out-relief given in this country [Great Britain] to the deserving poor, except that in Denmark such relief can be claimed as a matter of right, and conveys no civil disqualification.” The gi-ant of a pension, though it can be claimed as a right, can be refused, if the applicant is of bad character, has been in receipt of poor-law relief within ten years, or if from other sources he has enough to maintain him. The allowance given, it is stated, like the British system of out-door relief, tends to be inadequate, for it is assumed that applicants as a rule do not fully disclose their resources. As might be expected, the change of incidence of the burden, though it has decreased the demand on the local rates, has increased expenditure by a more than commensurate addition to the central taxes. The idea that, while to be a recipient of poor- law relief is derogatory from the part of a good citizen, the depend- ency of a pensioner is an honourable status, has gained some sort of currency. Accordingly, promises to extend the scope and amen- ity of pension-endowment, a form of dependency that is not injuri- ous, are put forward in the rivalry of party politics.

New Zealand. â€” In 1898 a Bill, introduced by the Et. Hon. R. J. Seddon, premier, became law which provided for the payment of an old-age pension out of the consolidated fund (revenue of the gen- eral

government) to persons duly qualified, without contribution by the beneficiaries. The claimants must be 65 years of age, resident in the colony, and have so resided for 25 years. They must be free from conviction for lesser legal offences for 12 years, and for more serious breaches of the law for 25 years, previous to the application. They must be of good moral character and have a record of sobriety and respectability for five years. Their yearly income must not exceed Â£62, and they must not be owners of property exceeding in value Â£270. Aliens, aborigines, Chinese, and Asiatics are ex- cluded. The pensions are for Â£18 per annum, but for each Â£1 of yearly income over and above Â£34, and also for each Â£15 of capital over and above Â£50, Â£1 is deducted from the amount of the pen- sion. Applications have to be made to the deputy registrars of one of 72 districts into which the colony is for this purpose divided. The claim is then recorded and submitted to a stipendiary magis- trate, before whom the claimant has to prove his qualifications and submit to cross-examination. If the claim is admitted, a certificate is issued to the deputy registrar and in due course handed to the claimant. Payment is made through the local post-office as desired by the pensioner. The Act came into force 1st November 1898. Up to March 1899, 7487 pensions had been granted, amounting to a liability of Â£128,082 per annum. The average pension was Â£17, 2s. See New Zealand Official Tear Book for 1899. In March 1900 the number of pensions was 11,285, and the cost Â£193,718. The act was avowedly experimental, and only provided for payments out of revenue until the close of the second session of the next parliament. The cost considerably exceeded the estimate of Â£100,000 per annum which was originally put forward. The authors of the measure maintain that it is a great success, while others point to the invidious character of the cross-examination re- quired in proving the necessary degree of poverty, and allege that the arrangement penalizes the thrifty members of the poorer class, and is a direct incentive to transfer of property, of a more or less fraudulent character, between members of a family. It is too early as yet to pronounce an authoritative verdict on the facts.

Victoria.â€" By the Old Age Pensions Act, 1900, Â£75,000 was appropriated for the purpose of paying a pension of not more than 10s. per week to any person who fulfilled the necessary conditions, of which

the following were the principal : â€” ^The pensioner must be 65 years of age or permanently disabled, must fill up a declara- tion that he has lived twenty years in the state ; has not been convicted of drunkenness, wife-desertion, &c. ; that his weekly income and his property do not exceed a given sum (the regula- tion of this and other details is intrusted to the Governor in Council). Further sums have since been appropriated to the purposes of the Act, but it is not yet possible to say how far the Act is regarded as a success.

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Old bury, a township and parish in the northern parliamentary division of Worcestershire, England, 5 miles west of Birlningham by rail. It is controlled, to- gether with Langley and W^irley, by an urban district council. Public buildings erected in 1891 contain its various ofaces. Population (1891) 22,697 ; (1901), 25,191.

Old Calabar. See Ni&eria.

Old Catholics. â€” Since 1878 there is little to record about Old Catholicism. Its position has disappointed the expectation of its friends and of its enemies. It has neither advanced rapidly, as the former had hoped, nor retrograded, as the latter have frequently predicted it would do. In Germany there are 90 congregations, served by 60 priests, and the number of adherents is estimated at about 60,000. In Switzerland there are 40 parishes (of which only one, that at Lucerne, is in the Roman Catholic cantons), 58 clergy, and about 50,000 adherents. In Austria, where very considerable accessions have been received since the Los von Rom movement commenced in 1899, there are 8 priests, 12 churches (besides three more in course of erection), and about 15,000 adherents. In Holland, where the Old Catholic Church has existed independently of the PapÂ§,cy for nearly two centuries, an addition has taken place in the number of adherents which is very gratifying to the authorities of that Church. There are 3 bishops, 27 congregations, and 8030 adherents. France possesses but one congregation, in Paris, where it has built for itself a church. It is now under the supervision of the Old Catholic archbishops of Utrecht. In Italy a branch of the Old Catholic communion was established in 1881 by Count Enrico di Campello, a former canon of St Peter's at Rome. A church was opened in Rome by Monsignor Savarese and Count Campello, under the su- pervision of the bishop of Long Island in the United States, who undertook the superintendence of the con- gregation in accordance with the regulations laid down by the Lambeth conference. But dissensions arose be- tween the two men. The church in Rome was closed ; Savarese returned to the Roman Church ; and Campello commenced a reform work in the rural districts of Umbria, under the episcopal guidance of the bishop of Salisbury. This was in 1885. In 1900 Campello returned to Rome, and once more opened a church there. In

1902 Count Campello retired from active participation in the work, on account of age and bodily infirmity; and his place at the head of it was taken by the Rev. Professor ,Cicchitti of Milan. In 1902 there were six priests, who are either in Roman or Old Catholic orders. No statistics have been issued, but there are thirteen congregations. Old Catholicism has spread to America. The Polish Romanists there, in 1899, complained of the rule of Ipish bishops ; elected a bishop of their own, * Herr Anton

Kozlowski; presented him to the Old Catholic bishops in Europe for consecration ; and he presides over seven congregations in Chicago and the neighbourhood. The Austrian and Italian churches possess no bishops, and the Austrian Government refuses to allow the Old Cath- olic bishops of other countries to perform their functions in Austria. In 1878 a question arose which threatened the existence of Old Catholicism. The Swiss and Ger- man laity insisted that their clergy should be free to marry. The Dutch church protested, and threatened excommunication. Dollinger strongly disapproved of the step. But though it checked adhesions from Romanism, the difference has been accommodated. Every Old Cath- olic congregation has its choral union, its poor relief, and its mutual improvement society. Theological faculties exist at Bonn and Bern, and at the former a residential college for theological students was established by Bishop Reinkens. Old Catholicism has eight organs in the pub- lic press â€” two in Italy, two in Switzerland, and one each in Holland, Germany, Austria, and France. It has built several churches, of which that at Karlsruhe is the most imposing. It has held reunion conferences at Lucerne in 1892, at Rotterdam in 1894, and at Vienna in 1897. At these, members of the various episcopal bodies have been welcomed. It has also established a quarterly pub- lication, the Revue Internationale de ThMogie, which has admitted articles in French, German, and English, con- tributed not merely by Old Catholics, but by members of the Anglican, Russian, Greek, and Slavonic churches. Old Catholic theologians have been very active since 1878, and the work of Dollinger and Reusch on the Jesuits and the history of the Roman Church by Professor Langen have attained a European reputation.

The only history of Old Catholicism is that published at Giessen in 1887 by the celebrated canonist Von Schulte. (j. j. i*

Oldenburg, a grand-duchy of Germany, with an area of 2479 square miles, and population (1885), 341,525 ; (1900), 398,499, thus distributedâ€" duchy of Oldenburg, 317,842 ; principality of Llibeck, 37,337 ; principality of Birkenfeld, 43,320. Of the total in 1900, 197,954 were males and 200,545 females. The density is 160 inhabit- ants to the square mile. In 1895, 26-6 per cent." of the population were classified as urban, and 73-4 per cent, as rural. The number of emigrants decreased from 1296 in 1892 to 255 in 1900. Classified according to religion in 1895, 289,620 of the people (77-5 per cent.) were Protest- ants, 81,492 (21-8 per cent.) Roman Catholics, and there were 1430 Jews. In 1897 there were 157 secondary schools for boys, 21 for girls, 13 theological seminaries, a school of navigation, &e. About one-half of the popula- tion are engaged in agriculture and pastoral pursuits, the crops principally grown being hay, potatoes, oats, wheat, and barley. The farms are mostly under 25 acres. In 1900 the live stock numbered 264,885 cattle, 210,808 pigs, 112,064 sheep, and 41,849 horses. The breweries in 1899 produced 4,796,000 gallons of beer. There were 334 miles of railway in 1899, all, except 25 miles, under State control. The mercantile fieet, which belongs to the ports of Oldenburg, Elsfleth, and Brake, consisted in 1900 of 150 sea-going vessels of 77,467 tons. The public revenue for the entire grand-duchy in 1900 amounted to Â£390,650, and the expenditure to Â£478,700. In 1900 the public debt was Â£2,793,200; and in 1901 the contribu- tion to the imperial treasury, Â£202,030.

Oldenburg, a town of Germany, capital of the grand-duchy of Oldenburg, on the Hunts, 27 miles by rail west of Bremen. The more important modern buildings are the town hall (1885-87) ; a west wing (1894-99) to the castle, with frescoes by Fitger ; the antiquarian museum

(1876-79); the palace of the heir-apparent (1896); the theatre (1891), rebuilt after a fire ; the provincial bank (1896); and the Peace church (1893-94). The grand- ducal palace has been adorned with pictures by modern German artists (Gode, Mackart, Bocklin, Siemiradzki, &c.). Additional pictures by these and other modern painters {e.g., Tischbein) have been collected in the castle. The church of St Lambert was restored in 1874-86. The town possesses, further, an industrial museum, a memorial of the war of 1870-71, a military school, and a teachers' seminary. There is an important horse fair. Population

(1885), 19,937 ; (1900), 26,636.

Old Forge, a borough of Lackawanna county, Penn- sylvania, U.S.A. It is in the anthracite coal region, in the north-eastern part of the state, and its industries are mainly devoted to handling and shipping coal. Popula- tion (1900), 5630, of whom 2494 were foreign-born.

Oldham, a municipal, county (1888), and parliar mentary borough and market town of Lancashire, Eng- land, on the Medlock, 200 miles by rail from London. The municipal technical school has been taken over by the corporation. Modern buildings include an Established church, Hulme Grammar School (1895), a free library, art gallery and museum, and the county court. The infirmary was enlarged in 1889. There are 2 daily newspapers. The factories number about 230, and the spindles over 13,000,000. The consumption of cotton is about one-fifth of the total importation into the United Kingdom. In 1891 there were 14,691 males and 20,170 females employed in the manufacture of cotton goods ; 1735 males as fitters and turners (engine and machine) ; 544 persons in the iron and steel manufacture. Area of municipal borough, 4730 acres. Population (1881),

111,343; (1891), 131,463; (1901), 137,238.

Old Town, a city of Penobscot county, Maine, U.S.A., on the west bank of the Penobscot river, and on the Maine Central and the Bangor and Aroostook railways, at an altitude of 95 feet. It is known as the home of a remnant of the Penobscot tribe of Indians, and as one of the termini of the second railway constructed in the country, running thence to

Bangor, and built in 1836. Population (1880), 3395; (1890), 5312; (1900), 5763, of whom 1247 were foreign-born.

Olean, a city of Cattaraugus county, New York, U.S.A., on the north bank of the Allegheny river, in the south-western part of the state, at an altitude of 1437 feet. Its site is in the level valley, and its plan is regular. It is on three railways, the Erie, the Pittsburg, Shawmut, and Northern, and the Western New York and Pennsylvania. It is in the midst of the oil and natural gas region, and the surrounding country is diversified with oil tanks and derricks. It contains large refineries and storage tanks, and is the eastern terminus of the Ohio pipe line and the western terminus of a pipe line to the seaboard. Population (1880), 3036 ; (1890), 7358 ; (1900), 9462, of whom 1514 were foreign-born and 122 negroes.

Olhao, a town of Portugal, district Earo, 5 miles east of Faro, on the coast. Its people are good seamen, and employ themselves in fishing. Population (1900), 9993.

Oliphant, Laurence (1829-1888), English author, son of Anthony Oliphant, a member of a family of ancient descent but moderate fortune, long settled in central Scot- land, was born at Cape Town in 1829. His father was then Attorney-General in Cape Colony, but was soon transferred as Chief Justice to Ceylon. The boy's edu- cation was of the most desultory kind. Par the least useless portion of it belonged to the years 1848 and 1849, when he accompanied his parents on a tour on the con-

tinent of Europe. In 1851 he accompanied Jung Bahadur from Colombo to Nepaul. He passed an agreeable time there, and saw enough that was new to enable him to write his first book, A Journey to Khatmandu (1852). Erom Nepaul he returned to Ceylon and thence to Engr land, dallied a little with the English bar, so far at least as to eat dinners at Lincoln's Inn, and then with the Scottish bar, so far at least as to pass an examination in Eoman law. He was more happily inspired when he threw over his legal studies and went to travel in Eussia. The outcome of that tour was his book on The Russian Shores of the Black Sea (1853). Between 1853 and 1861 he was successively secretary to

Lord Elgin during the negotiation of the Canada Eeciprocity Treaty at Wash- ington, the companion of the duke of Newcastle on a visit to the Circassian coast during the Crimean war, and Lord Elgin's private secretary on his expedition to China. Each of these experiences produced a pleasant book of travel. In 1861 he was appointed First Secretary in Japan, and might have made a successful diplomatic career if it had not been interrupted, almost at the outset, by a night attack on the Legation, in which he nearly lost his life. It seems probable that he never properly recovered from this affair. He returned to England and resigned the service, and was elected to Parliament in 1865 for the Stirling Burghs. Oliphant did not show any conspicuous parliamentary abUity, but made a great success by his vivacious and witty novel, Piccadilly (1870). He fell, however, under the influence of the spiritualistic prophet Thomas Lake Harris, who was at the head of a small community at Brocton on Lake Erie. This man obtained so strange an ascendancy over Oliphant that the latter left Parliament in 1868, fol- lowed him to Brocton, and lived there the life of a farm labourer, in obedience to the imperious will of his spir- itual guide. The cause of this painful and grotesque aberration has never been made quite clear. It was part of the Brocton regime that members of the Com- munity should be allowed to return into the world from time to time, to make money for its advantage. After three years this was permitted to Oliphant, who, when once more in Europe, acted as correspondent of The Times during the Eranco-German war, and spent after- wards several years at Paris in the service of that journal. There he met Miss Alice le Strange, whom he married. In 1873 he went back to Brocton, taking with him his wife and mother. During the years which followed he continued to be employed in the service of the Com- munity and its head, but on work very different from that with which he had been occupied on his first sojourn. His new work was chiefly financial, and took him much to New York and a good deal to England. As late as December 1878 he continued to believe that Harris was an incarnation of the Deity. By that time, however, his mind was occupied with a large project of colonization in Palestine, and he made in 1879 an extensive journey in that country, going also to Constantinople, in the vain hope of obtaining a lease of the northern half of the Holy Land with a view to settle large numbers of Jews there. This he conceived

would be an easy task from a financial point of view, as there were so many persons in England and America ” anxious to fulfil the prophecies, and bring about the end of the world.” He landed once more in England without having accomplished anything definite ; but his wife, who had been banished from him for years and had been living in California, was allowed to rejoin him, and they went to Egypt together. In 1881 he crossed again to America. It was on this visit that he became utterly disgusted with Harris, and escaped finally from the long and squalid tyranny under which he and his had suffered. He was at first a little afraid that his wife

would not follow him in his renunciation of ” the prophet,” but this was not the case, and they settled themselves very agreeably, with one house in the midst of the German community at Haifa, and another about twelve miles off at Dalieh on Mount Carmel. It was at Haifa in 1884 that they wrote together the strange book called Sympneuniata, and in the next year Oliphant produced there his novel MasoUam, which may be taken to eon- tain its author’s latest views with regard to the personage whom he long considered as “a new Avatar.” One of his cleverest works, Altiora Peto, had been published in 1883. In 1886 an attack of fever, caught on the shores of the Lake of Tiberias, resulted in the death of his wife, whose constitution had been undermined by the hardships of her American life. He was persuaded that after death he was in much closer relation with her than when she was still alive, and conceived that it was under her influence that he wrote the book to which he gave the name of Scientific Religion. In November 1887 he went to England to publish that book. By the Whitsuntide of 1888 he had completed it and started for America. There he determined to marry again, his second wife being a granddaughter of Robert Owen the Socialist. They were married at Malvern, and meant to have gone to Haifa, but Oliphant was taken very ill at Twickenham, and died on 23rd December 1888. Although a very clever man and a delightful companion, full of high aspiration and noble feeling, Oliphant was only

partially sane. In any case, his education was ludicrously inappropriate for a man who aspired to be an authority on religion and philosophy. He had gone through no philosophical discipline in his early life, and knew next to nothing of the subjects with regard to which he imagined it was in his power to pour a flood of new light upon the world. His shortcomings and eccentricities, however, did not prevent his being a brilliant writer and talker, and a notable figure in the world in which he happened to move.

See also Memoir of the Life of Laurence Oliphant and of Alice Oliphant his Wife, by Margaret Oliphant. (m. 6. D.)

Oliphant, Margaret Oliphant Wilson (1828- 1897), novelist and historical writer, was born at Wally- ford, near Musselburgh, Midlothian, in 1828. Her childhood was spent at Lasswade (near Dalkeith), Glasgow, and Liverpool. As a girl she constantly occupied her- self with literary experiments, and in 1849 published her first novel, Passages in the Life of Mrs Margaret Maitland, which had some success. This she followed up in 1851 with Caleb Field, and in the same year met Major Blackwood in Edinburgh, and was invited by him to contribute to the famous Blackwood's Magazine. The connexion thus early commenced lasted during her whole lifetime, and she contributed considerably more than 100 articles to its pages. In May 1852 she married her cousin, Frank Oliphant, at Birkenhead, and settled at Harrington Square, in London. Her husband was an artist, of very delicate health, and two of their children died in infancy, while the father himself de- veloped alarming symptoms of consumption. For the sake of his health they moved in January 1869 to Florence, and thence to Eome, where Frank Oliphant died. His wife, left almost entirely without resources, re- turned to England and took up the burden of supporting her three children by her own literary activity. She had now become a popular writer, and worked wi,th amazing industry to sustain her position. Unfortunately, her home life was full of sorrow and disappointment. In January 1864 her only daughter died in Rome, and was buried in her father's grave. Her brother was shortly afterwards involved in financial ruin, and Mrs Oliphant

offered a home to him and his children, and added their support to her already heavy responsibilities. In November 1865 she settled at Windsor, which remained her home for the rest of her life, and for more than thirty years she pursued a varied literary career with courage scarcely broken by a series of the gravest troubles. Her son Cyril died in 1890, and Frank, the youngest, in 1894. With the last of her children lost to her, she had but little further interest in life. Her health steadily declined, and she died at Wimbledon, 25th June 1897. Her life had been one long sacrifice to others, and she had enjoyed a very small share of happiness or peace.

In the course of her long struggle with circumstances, Mrs Oliphant produced more than 120 separate works, including novels, books of travel and description, histories, and volumes of literary criticism. Among the best known of her works of fiction are Adam Graeme (1852), Magdalen Hepburn (1854), Lilliesleaf (1855), The Laird of Nor-law (1858), Tlie Chronicles of Carlingford, which, origi- nally appearing in Blackwood's Magazine, did much to widen her reputation (1861-64), Salem Chapel (1863), Madonna Mary (1867), Squire Arden (1871), He that will not when he may (1880), Hester (1883), Kirsteen (1890), and The Marriage of Elinor (1892). Her friends often regretted that she did not work more slowly, and so give full play to her faculties ; but it is probable that she was one of those who do best what they do quickly, and who must work at high pressure to succeed at all. Her inventive faculty was fertile and vigorous ; she had humour and sympathy, but no depth of insight ; she saw superficial details with great accuracy and complexity, but she was no philosopher. Her fiction was of the class that entertains the imagination and touches the emotion without appeal to the more strenuous activities of the brain. In other fields of literary work she was industrious, but unequal. Her biographies of Edward Irving (1862) and Laurence Oliphant (1891), together with her life of Sheridan in the " English Men of Letters " (1883), have vivacity and a sympathetic touch, but are not important contributions to the biographical library. She also wrote historical and critical works of considerable variety, in- cluding Historical Sketches of the Reign of Oeorge II. (1869), Tlie Makers of Florence (1876), A Literary History of England from 1790 to 1825 (1882), Jlie Makers of

Venice (1887), Royal Edinburgh (1890), Jerusalem (1891), and Tlie Makers of Modern Rome (1895), while at the tiine of her death she was still occupied upon Annals of a Publishing House, a record of the progress and achievement of the firm of Blackwood, with which she had been so long and honourably con- nected. Many of these works show to great advantage her singular power of assimilation and arrangement; they are compilations of much charm and effect. But they rarely add anything to what is already known of the subject, and are rather exercises in agreeable presentation than storehouses of research and discovery. She wrote easily, and with a free, unaffected style, but she had little care for niceties of expression, and was herself in the habit of declaring that she had never consciously sought for literary form or finish. â€¢ It was this natural facility and nonchalance that deprived her work of the highest qualities of distinction, and will probably prevent it from surviving the work of some of her less popular contemporaries. (a. wa.)

Oliva, a town of Spain, in the province of Valencia, near the sea, on the railway from Carcagente to Alicante. The population was 8779 in 1887, and 7949 in 1897. It is a port for small coasting vessels. There are no im- portant local industries, and only some trade in agricul-

tural products, especially wine, rice, raisins, oils. There are two parish churches, and a palace of the dutes of Gandi^

Olivenza, a town of Spain, in the province of and south of the town of Badajoz, near the left bank of the river Olivenza. The local indiistries include the making of porcelain, leather, and hats, besides flour-mills. It was a fortified town down to 1857, when walls and bastions were razed and the stone given to the people. There are two parish churches, Santa Maria deLCastillo of the 13th century and restored in the 16th, and Santa Maria Mag- dalena of the 16th century, with three naves and a high altar of pluteresque style. Olivenza has good prome- nades, a theatre, a bull-ring, hospitals, barracks. This town, so near the frontier,

has played an important part in the wars between Spain and Portugal, remaining from 1688 to 1801 in the hands of the latter. Population, about 8200.

Ollivier, Olivier ^mile(1825), French states-

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man, was born at Marseilles on 2nd July 1826. Prom his father, Demosthene Ollivier, a prominent member of the Assembly of 1848, he inherited pronounced republi- can opinions. He had just been called to the bar at Paris when the revolution broke out, and though only twenty-three years old, was appointed, through his father's influence with Ledru-Rollin, commissary-general of the Republic in his native department of the Bouches-du- Rhone. His vigour in repressing a Socialist outbreak at Marseilles caused him to be confirmed in his functions by Cavagnari with the title of prefect ; but his adminis- tration roused much adverse criticism, and he was re- moved to the prefecture of the Haute-Marne, which he resigned in January 1849. When he resumed his prac- tice at the bar, his great abilities, and especially his fer- vid and remarkably lucid oratory, rapidly brought him into the front rank. At the general election of 1867 he was returned for the 3rd circonscription of the Seine as a representative of the constitutional Opposition. He did not refuse, like some other Republicans who were returned at the same election, to take the oath of allegiance to the emperor ; he felt that, setting aside an appeal to arms, which he abhorred, the Opposition could win liberty for the nation only by making use of such powers as the con- stitution permitted. Together with Darimon, Jules Favre, Henon, and Picard, he formed the group known as les Cinq. Their unanswerable attacks forced the Govern- ment to make concessions to public opinion. The decree of 24th November 1860 was a first step towards an effec- tive parliamentary government. Most of the Opposition regarded it as ludicrously inadequate. Ollivier, so re- cently as 30th December 1859, had appeared as counsel for M. Vacherot, on his trial for the publication of La Dimocratie, and had attacked the Government in terms which caused him to be debarred from pleading for three montns. But he now

electrified the House by an elo- quent speech in which he thanked the emperor for this first instalment of reform, and promised his support to further steps in the same direction. The divergence between him and the Irreconcilables, led by Jules Favre, widened in ensuing sessions till he stood alone. But one of the traits of his character was a self-reliance amount- ing to obstinacy. He brought Morny round to his views, and through him worked upon the emperor. The session of 1866 saw the formation of a "third party," to which M. Ollivier attached himself. Napoleon, seeing himself forced to yield, tried to enlist the honesty and ability of M. Ollivier in his service. An outward mark of M. Olli- vier's adherence to the emperor was given by his accept- ance of the post of arbitrator on the Suez Canal question. He had in July 1865 been appointed by the Egyptian

Government as their representative in Paris in this mat- terâ€" a post that necessitated his retirement from the bar. The negotiations begun by Morny were continued by his successor in the presidency of the Chamber, Walewski, a convinced supporter of Liberal measures. On 31st Decem- ber 1866 he offered M. Ollivier, in the emperor's name, the ministry of Public Instruction, with the function of representing the general policy of the Government in the Chamber. M. Ollivier laid down a number of conditions, of which the most important were a policy of peace, involving the abandonment of the military law; the presence of the ministers in the Chamber ; a law grant- ing liberty of the press ; and the abandonment of official candidatures. To these reforms he considered himself pledged. In an audience granted him on 10th January, he believed himself to have converted the emperor to his views ; but the reactionary counsels of Rouher prevailed. The emperor's letter of 19th January 1867, announcing the new reforms, did not satisfy M. Ollivier's demands, and such reforms as were granted were executed in a grudgikg spirit. He therefore broke off negotiations with the emperor. His views were explained in his Dimocratie et Liberty (1867) and, above all, in his 19 Janvier, a defence of his political career, addressed to his constituents on the eve of the general election of

1869. In this he declared that the models he endeav- oured to copy were Mirabeau and Benjamin Constant. At length, on 27th December 1869, the emperor entrusted him with the formation of a constitutional cabinet, in which were included several members of the Moderate Left, and in which M. Ollivier himself took the ministry of Justice. The cabinet was completed on 2nd January

1870. Though the constitution did not recognize the oflBce of premier, M. Ollivier was the guiding spirit of the ministry in council and its chief spokesman in debate. But he fell upon troubled times. On 10th January Victor Noir was shot by Prince Pierre Bonaparte. M. Ollivier tried with great skill to satisfy the public indig- nation without compromising the position of the dynasty, but the passions aroused by this unfortunate event showed how the difficulties of his task had increased in the three years since he had first refused to accept office. That refusal he never ceased to regret. Nevertheless, he laid numerous reforms before the Chamber. He ordered the prefects to refrain from applying official infiuence at the elections, and the magistrates to administer justice without regard to politics. By Rouher's advice, the nation was asked to declare by a plebiscite whether it approved the new " Liberal Empire." The three most distinguished members of the left. Buffet, Daru, and Talhouet, resigned office rather than consent to this measure. Among their successors was Gramont, who was soon to prove M. Olli- vier's evil genius. The people were told that a vote in the affirmative would be a vote for peace, and the prefects, in spite of M. Ollivier's instructions, exhausted the re- sources of official pressure. He himself, though at first reluctant to accede to the plebiscite, hailed its result as a "French Sadowa." The lapse of years had turned the once violent Republican into a very cautious Liberal, animated by a strong regard for the emperor, to whom he had promised " a happy old age." All his plans were suddenly disconcerted by the candidature of Leopold of Hohenzollern for the throne of Spain. The Ollivier government, not content with securing the withdrawal of the candidature, required the king of Prussia to guarantee that it should never be repeated. JI. (!)Ilivier, hitherto the strenuous advocate of peace, allowed himself to be won over by the war party. On 16th July he declared to the Chamber that the Prussian Government had addressed a despatch to

the foreign Powers, announcing that the king had affronted the French ambassador. Thiers and his

followers in vain pointed out that no such despatch existed, and that the ambassador had not considered him- self insulted. M. Ollivier obtained a war vote of 500 million francs, and used the fatal words that he accepted the responsibility for the war ” with a light heart.” He went on to explain that this war was forced upon France by the requirements of honour, and was not sought by the ministry. But the phrase remained when its explana- tion was forgotten. The country turned savagely upon the authors of its disasters. M. Ollivier convoked the Chamber for the 9th August, when a large maj ority declared the Government incapable of providing for the safety of the country. In apportioning the blame for the disasters of 1870, it must be remembered that M. Ollivier was deceived, both by the Foreign Minister, Gramont, who misled him as to the attitude of Austria and the South German states, and whose rash and ignorant diplomacy hastened the crisis, and by the Minister of War, Leboeuf, who declared that the army was ready ” down to the last button on its gaiters.” But had M. Ollivier been as clear-sighted as Thiers, had he adhered at this crisis to that policy of peace with which he entered office, he could have averted war by the threat of resignation. He com- mitted the fault against which he had in 1867 warned the emperor, of “entering, in company with an exhausted Austria, upon a new Seven Years’ War, in which this time we should find Russia on the side of Prussia, without being sure of carrying Italy with us.” After his fall he quitted France, and did not return till 1873. His sub- sequent attempts to enter parliament were unsuccessful, but he carried on an active political campaign in the Estafette. In 1885 he declared himself not anti-Republican but anti-Radical. Debarred from public life at forty-five by his one fatal mistake, he expressed his views in a series of books, the most important of which are Prmcipes et conduite (1875), Solutions politiques et sociales (1893), and L’Empire Liberal (1895, &c.). His support of the decrees of 1880 against the

religious Congregations in- volved him in a bitter controversy with the section of the Bonapartists represented by M. Paul de Cassagnac. Be- sides his political writings on this subject he published in 1885 a Nouveau Manuel de Droit EccUsiastique Frangais. He was elected a member of the French Academy in April 1870. His formal reception was to have taken place in 1873, but owing to his refusal to omit certain political references from his inaugural speech, was indefi- nitely postponed.

Olmsted, Frederick Law (1822-

~~), Ameri~~

can author and landscape architect, was born at Hartford, Conn., 26th April 1822. In 1840 he shipped as seaman for the East Indies and China. In 1845-46 he studied agricultural science and engineering at Yale College, after which he became a practical farmer for several years. In 1850 he made a pedestrian tour in Great Britain and the continent of Europe, and in 1852-1853 made a horseback trip through the southern and south- western United States. His observations on these travels were published in his books : Walks and T

tion of the big-tree reservations of the Yosemite Valley. In 1866 he was again engaged with Mr. Vaux in planning and superintending the improvements of Prospect Park in Brooklyn, N.Y. After this he was engaged in most of. the important works of park improvement in the United States. Special mention may be made of the Buffalo, N.Y, parks, the Mount Royal Park at Montreal, the Capitol Grounds at Washington, the grounds of Leland Stanford Jr. University in California, the Vanderbilt es- tate at Biltmore, N.C, the system of parks and parkways in Boston, and the landscape improvements for the World's Fair at Chicago. In 1893 he received honorary degrees from Harvard and Yale Universities.

Olmiitz, the second city and the ecclesiastical metropolis of Moravia, Austria. Population (1890), 19,761 ; (1900), 21,933, including garrison of 3632 men (estimated at 67 per cent. German, 33 per cent. Czech ; 92-5 per cent. Catholic, 6-5 per cent. Jewish, and 1 per cent. Protestant).

The fortifications were removed in 1886 and their place is occupied by a town park, gardens, and promenades. The modern public buildings include an industrial museum, a German upper rea?-school, and a Czech gymnasium. The industries include brewing and distilling and the manufactures of malt, sugar, starch, &c.

OIney, a city of Illinois, U.S.A., capital of Richland county, situated at the intersection of the Baltimore and Ohio South-Western, the Illinois Central, and the Indiana, Decatur, and Western railways, in the south-eastern part of the state, at an altitude of 481 feet. It has a level site and regular plan, and derives its chief importance from the fact that it is the point of intersection of railway lines. Population (1880), 3512; (1890), 3831; (1900), 4260, of whom 235 were foreign-born.

OIney, Richard (1835), American states- man, was born at Oxford, Mass., 15th September 1835. Educated at Brown University and the Harvard Law School, he attained a high position at the Massachusetts bar, but was not known in public life till, in 1893, President Cleveland induced him to enter his cabinet as Attorney-General. Upon the death of Secretary Gresham, Mr. OIney succeeded him as Secretary of Siate, 10th June 1895. He conducted the correspondence with the British Government concerning the boundary dispute with Venezuela, and excited general comment by the vigour with which he sustained the right of the United States to intervene, and by the wide interpretation which he put upon the Monroe Doctrine. At the expiration of Presi-dent Cleveland's. term he resumed his law practice.

OlonetS, a government of northern Russia, having Finland on the W., and the governments of Archangel on the IST.E., Vologda on the E., and Novgorod and St Petersburg on the S. Its area covers 57,439 square miles. Its popula- tion was 321,250 in 1881, and 366,715 in 1897, of whom 193,001 were women (111 women to 100 men), and 24,412 lived in towns. Agriculture is still insufficient for the population, the crops in 1894-99 being : rye, 888,700 cwt. ; oats, 847,000; and all cereals, 2,029,000 cwt. There were in 1895, 63,520 horses, 133,300 horned cattle, and 102,300 swine. Industries are still in their infancy (aggregate returns, Â£2,840,000, chiefly saw mills). Olouets is divided

into seven districts, of which the chief towns and their populations in 1897 were : Petrozavodsk, capital of the government (12,621 inhabitants), Kargopol (29.”)2), Lodeinoye Pole (4500), Olonets (1303), Povyenets (1409), Pudozh (1469), and Vytegra (4.^01).

Oltenitz^, a small town in Rumania, in the district of Ilfov (Bucharest), on the left bank of the Danube.

It is the ancient Constantiola, which was the seat of the first bishopric established in Dacia. In the Crimean war the Turks forced the river at this point and inflicted heavy losses on the Russians. Population, about’ 5500.

Olympia, a city of Washington, U.S.A., capital of Thurston county and of the state, at the head of Hood canal, an arm of I’uget Sound, in the western part of the state. It has a level site and a regular plan, with broad streets. It has good water-supply and sewerage systems, and is the terminus of two branches of the Northern Pacific railway and of two other short railways. It is in the great forest region of western Washington, and its principal industry is in lumber. It has several large mills and considerable trade by steamer on the Sound, and by rail, in lumber, fish, and oysters. Population (1880), 1232; (1890), 4698; (1900), 4082, of whom 591 were foreign-born.

Omaha, the largest city in Nebraska, U.S.A., on the west bank of the Missouri river, about 20 miles above the mouth of the Platte, occupying an elongated plateau skirted dn three sides by undulating hills on which the residential districts are distributed, 962 feet above sea- level. Within the corporate boundaries are included 24 square miles. Its rectilinear street plan gives numbered streets north and south, and named streets east and west. Three bridges (two railway bridges and one waggon bridge â€” the last traversed by electric cars) span the Missouri, connecting Omaha and Council Bluffs, la. Its electric street railway system has 65 miles of trackage. The city was laid out in 1854.

Population (1880), 30,518 ; (1890), 140,452; (1900), 102,555, exclusive of South Omaha. The smaller figures for the last decade are almost wholly due to a padding of the previous census, although growth was affected somewhat by the drought and crop failures of 1893 and 1894 in the agricultural territory, upon which the city is largely dependent. The death-rate in 1900 was 13-5. In 1901 there were 38 schools with 419 teachers, and an average daily attendance of 14,845. The annual expense of maintenance was $644,058, of which $202,624 is from direct taxes. The school district debt (1900, $835,000) and municipal debt (1900, $4,776,800) repre- sent investment in school-houses, public buildings, pave- ments, drainage, and parks. The electric lighting plant, gas, and water-works are owned by private corporations. As a trade and distribution centre Omaha ranks high. Originally the eastern terminus of the first trans-continen- tal railway (Union Pacific) it now has fourteen different railways radiating in all directions, five of which constitute trunk lines between the Missouri and the Great Lakes. There are 100 wholesale establishments and 176 manu- facturing institutions ; notable among these are the silver and lead smelting and refining works, employing 600 men, extensive car and locomotive construction and repair works, white-lead works, linseed-oil mill, six breweries, distillery, and bag factories. As a live-stock market South Omaha (founded in 1887, but still a distinct municipal corporation, although immediately adjoining) ranks next to Chicago and Kansas City. Receipts for 1901 : cattle, 818,003 ; hogs, 2,414,052 ; sheep, 1,314,841. The seven national banks at Omaha held (March 1902) $25,837,653 in deposits, with $3,050,000 aggregate capital. The bank clearings for 1901 aggregated $329,043,688. Omaha is the headquarters of the military department of the Missouri, with military posts at Fort Omaha (immediately north) and at Fort Crook (10 miles south). An interest- ing example of local enterprise was the Trans-Mississippi Exposition, 1898, illustrating the progress and resources of the states west of the Mississippi. It represented an investment of $2,000,000. Although begun in time of discouraging financial depression, and held during the

war with Spain, over 2,600,000 people attended it, and 90 per cent, of their subscriptions were returned in divi- dends to stockholders. (v. e.)

Oman, a kingdom occupying the south-eastern coast districts of Arabia, its southern limits being a little to the west of the meridian of 55Â° E. long., and the boun- dary on the north the southern borders of El Hasa. Oman and Hasa between them occupy the eastern coast districts of Arabia to the head of the Persian Gulf. The Oman- Hasa boundary has been usually drawn north of the promontory of Katar. This is, however, incorrect. In 1870 Katar was under Wahabi rule, but in the year 1871 Turkish assistance was requested to aid the settlement of a family quarrel between certain Wahabi chiefs, and the Turks thus obtained a footing in Katar, which they have retained ever since. Turkish occupation (now firmly established throughout El Hasa) includes Katif (the ancient Gerrh^) and El Bidia on the coast of Katar. But the pearl fisheries of Katar are still under the pro- tection of the chiefs of Bahrein, who are themselves under British suzerainty. In 1895 the chief of Katar (Sheikh Jasim ben Thani), instigated by the Turks, attacked Sheikh Isa of Bahrein, but his fleet of dhows was destroyed by a British gunboat, and Bahrein (like Zanzibar) has since been detached from Oman and placed directly under British protection.

Physiography. â€" Oman is a mountainous district dominated by a range called Jebel Akhdar (or the Green Mountain), which is 6000 â– feet in altitude, and is flanked by minor ranges running approximately parallel to the coast, and shutting off the harbours from the interior. They inclose long lateral valleys, some of which are fertile and highly cultivated, and traversed by narrow precipitous gorges at intervals, which form the only means of access to the interior from the sea. Beyond the mountains which flank the cultivated valleys of Semail and Tyin, to the west, there stretches the great Rhoba el Khali, or Dehna, the central desert of southern Arabia, which reaches across the continent to the borders of Yemen, isolating the province on the landward side just as the rugged mountain barriers shut it off from the sea. The wadis (or valleys) of Oman (like the wadis of Arabia generally) are merely torrential channels, dry for the greater part of the year. Water is obtained from wells and springs in sufficient quantity to supply an extensive system of irrigation.

Harbours and Boads. â€” The only good harbour on the coast is that of Muskat, the capital of the kingdom, which, however, is not directly connected with the interior by any mountain route. The little port of Matrah, immediately contiguous to Muskat, offers the only opportunity for penetrating into the interior by the wadi Kahza, a rough pass which is held for the Sultan or Imam of Muskat by the Kehbiyin chief. In 1883, owing to the treachery of this chief, Muskat was besieged by a rebel army, and disaster was only averted by the guns of H.M.S. Philomel. About 50 miles south of Muskat the port of Kuryat is again connected with the inland valleys by the wadi Hail, leading to the gorges of the wadi Thaika or "Devil's Gap." Both routes give access to the wadi Tyin, which, enclosed between the moun- tain of El Beideh and Hallowi (from 2000 to 3000 feet high), is the 'garden of Oman. Fifty miles to the north-west of Muskat this interior region may again be reached by the transverse val- ley of Semail, leading into the wadi Munsab, and from thence to Tyin. This is generally reckoned the easiest line for travel- lers. But all routes are difficult, winding between granite and limestone rocks, and abounding in narrow defiles and rugged torrent beds. Vegetation is, however, tolerably abundant â€" tama^ risks, oleanders, kafas, euphorbias, the milk bush, rhamnus, and acacias being the most common and most characteristic forms of vegetable life, and pools of water are frequent. The rich oasis of Tyin contains many villages embosomed in palm groves and surrounded with orchards and fields. '

Cultivation. â€" In addition to cereals and vegetables, the cultiva- tion of fruit is abundant throughout the valley. After the date, vines, peaches, apricots, oranges, mangoes, melons, and mulberries find special favour with the Kehbiyin, who exhibit all the skill and perseverance of the Arab agriculturist of Yemen, and culti- vate everything that the soil is capable of producing.

The present Sultan, a descendant of those Yemenite Imams who consolidated Arab power in Zanzibar and on the East African^ coast, and raised Oman to its position as the most powerful state in Arabia during the first half of the 19th century, resides at Muskat, where his palace directly faces the harbour, not far from the British

residency. The little port of Gwadur, on the Makran coast of the Arabian Sea, a station of the Persian Gulf telegraph system, is still a dependency of Oman.

See Colonel Miles. Geographical Journal, vol. vii., 1896. â€” Commander I. :s'. Steppe. Geographical Journal, 1899.

(t. H. H*.)

Omdurman. See Sudan, Anglo-Egyptian.

Omsk, a town of Eussia, capital of the province of Akmolinsk, formerly capital of western Siberia, now cap- ital of the General-G-overnorship of the Steppes. It is the seat of administration of Siberian Cossacks, and see of the bishop of Omsk. It is situated on the right bank of the Irtysh, at its junction with the Om, in an altitude of 260 feet, on the main Siberian trunk railway, 1013 miles by rail from Samara (the Volga), and 1624 miles from Moscow. It is also the meeting-place of the highways to middle Eussia, Orenburg, East Siberia, and Turkestan. Steamers ply down the Irtysh and the Ob, and up the former to the Altai towns and Lake Zaisan. The climate is dry and relatively temperate, but marked by violent snow- and sand-storms. The average temperatures are, for the year, 31Â° E. ; for January, 6Â° ; for July, 68Â° ; the annual rainfall is 12-4 inches. It is poorly built. Its population, from 31,000 in 1881, has grown to 37,470 in 1897 ; this figure seems, however, to be incomplete, as in 1895 it was 43,226, of whom 8468 were military. Its industries remain unimportant (steam saw-mill, tanneries) and show a yearly return of only Â£50,000 ; but the trade, especially since the construction of the railway, is growing, Omsk becoming a depot for goods imported from Europe for the neighbouring provinces. The two yearly fairs show an aggregate return of about Â£100,000. It has a society for education, which organizes

schools, kindergartens, libraries, and lectures for the people. There are a corps of cadets, two gymnasia for boys and for girls, and various lower schools, besides medical, dramatic, and musical societies, and also the West Siberian section of the Eussian Geographical Society.

Onega, a lake of northern Eussia, with an area of 3765 square miles. Its altitude, which was formerly supposed to be 236 feet, is only 125 feet. It appears from the works of the hydrographical expedition, com- pleted in 1895 (Izvestia of the Euss. Geogr. Soc. 1895), that the depth of the lake had been greatly exaggerated. The greatest depths, of from 53 to 68 fathoms, are at the entrance to the double bay, Lizhemsk and Unitsk, which projects westwards in the west of the Zaonezhie peninsula. On the continuation of this line, several spots are found where the depth exceeds 40 fathoms. In the middle of the lake the depth is from 20 to 47 fathoms, and less than 20 fathoms in the south. The lake is 145 miles long, with an average breadth of 50 miles.

Oneida, a village of Madison county, New York, U.S.A., on Oneida Creek, 6 miles from Oneida Lake, at an altitude of 440 feet. The site is level, but the plan of the city irregular. It has two railways, the New York Cen- tral and Hudson Eiver, and the New York, Ontario, and Western. Population (1880), 1649; (1890), 6083; (1900), 6364, of whom 784 were foreign-born and 82 negroes.

Oneonta, a village of Otsego county, New York, U.S.A., on Susquehanna river and on the Delaware and Hudson and the Ulster and Delaware railways, at an altitude of 1083 feet. It contains the car works of the railway, saw and planing mills, and other manufactories, together with grain elevators. One of the state normal schools is located here. Population (1880), 3002 ; (1890), 6272 ; (1900), 71 47, of whom 456 were foreign-born.

Ongole, a town of British India, in the Nellore dis- trict of Madras, situated on the East Coast railway, 181 miles north of Madras. Population (1891), 10,832;

municipal income (1897-98), Es.13,310. There are a college managed by the American Baptist mission, a high school with 330 pupils, a

Government training school, a printing-press, and a reading-room.

Onitsha. See Nigeria.

Ontario, a province of Canada, bounded on the E. and N.E. by Quebec and the Ottawa river, on the S. and S.E. by the St Lawrence and the Great Lakes, on the W. by Manitoba, and on the N. by James Bay and the Albany and English rivers. The south-eastern and south-western portions of the province are occupied by the great plain of Canada, and are underlain by rocks of Cambro-Silurian, Silurian, and Devonian age. The south-eastern tract lies in the angle between the Ottawa and St Lawrence, in- cludes an area of 4500 square miles, and has an elevation of 100 to 400 feet above the sea. The south-western is divided into two tracts, the first lying to the north and east of the Niagara escarpment, with an area of 9000 square miles, and an altitude of 400 to 1000 feet ; and the second, the tract to the south and west of the Niagara escarpment, has an area of 15,700 square miles, and an elevation of 600 to 1500 feet. In the last of these petro- leum, natural gas, salt, and gypsum are important pro- ducts, but in the others no minerals, with the exception of building materials, are found. The country to the north of the great plain is occupied by rocks of Archaean age, which form, in a general way, a great plateau or table-land. Its average elevation increases from about 1000 feet in the vicinity of the Ottawa river to about 1600 feet to the north of Lake Superior. It is every- where studded with lakes, with intervening hills wooded to their summits. Minerals of economic value are almost entirely confined to the bands of Huronian rocks, and include mica, apatite, marble, graphite, and iron.

Both the St Lawrence and its principal tributary the Ottawa receive many affluents from the province. The Trent and Moira fall into Lake Ontario, the Grand into Lake Erie, the Thames into Lake f^^^J^^s. St Clair, the Severn, Muskoka, Maganatawan, Erench, Wahnapitai, and Mississauga into Lake Huron, and the Michipicoten, Pic, Nipigon, Kaministikwia, and Pigeon into Lake Superior. Beyond the Height-of-Land the Winnipeg and English rivers flow westward to Lake Winnipeg, and the Albany, Kenogami, and the Moose with its afftuents, the Mattagami and Abitibi, empty into James Bay. The principal lakes

are : Lake Simcoe, with an area of 300 square miles, and an elevation of 720 feet above the sea; Nipissing, at an elevation of 642 feet; Nipigon, 852; Mille Lacs, 1496; Shebandowan, 1473; Eainy, 1109; St Joseph, 1172; Seul, 1150; and Lake of the Woods, 1060. The principal islands are Wolfe, Howe, and Amherst, at the foot of Lake Ontario; Manitoulin, Cockburn, and St Joseph in Lake Huron, and Michipicoten and St Ignace in Lake Superior.

The climate is very diversified ; in the south-western portion the winters are not severe, and the summers, owing to the tempering influence of the Great Lakes, are not oppressively hot ; in the Ottawa and St Lawrence valleys the winters are Climate. moderately cold, but bracing and exhilarating; to the north and north-west of Lake Superior the winters are long and cold, and at times extremely low temperatures are registered. The normal temperatures for three points in the south-western, eastern, and north-western portions are given below : â€”

Toronto.

Ottawa.

Port Ai-thur.

December, January, and February . March, April, and May June, July, and August September, October, and November .

Average annual precipitation .

23-7 40-6 65-4 47-0

in.

33-944

13-3 38-5 67-4 44-8

in.

32-650

7-3

31-1

58-9

38-5

in.

23-580

ONTARIO

331

The area included within tlie limits of the province is 222,000 square miles. The northern and western boundaries, as defined by- arbitrators in 1878, were the Albany and English rivers, Areaaad and a meridian line from the north-west angle of the papula- Lake of the Woods, respectively. This decision, on appeal to the Imperial Privy Council, was upheld, and was finally confirmed by an Act of the Imperial Parliament in 1889. The following table shows the population classified by townships, towns and villages, and cities :â€”

1881.

1891.

1900.

Townships . Towns and villages Cities .

1,346,623 323,188 257,111

1,283,281 432,912 398,128

1,247,190 1 935,752

1,926,922

2,114,321

2,182,942

Owen

7169; 5755;

The principal cities and towns, with their respective populations in 1901, were; â€” Toronto, the provincial capital, 208,040; Ottawa, the capital of Canada, 59,928 ; Hamilton, 62,634 ; London, 37,981 ; Kingston, 17,961; Brantford, 16,619; Windsor, 12,1.53; Guelph, 11,496 ; St Thomas, 11,485 ; Peterborough, 11,239 ; Stratford, 9959 ; St Catharine's, 9946 ; Berlin, 9747 ; Belleville, 9117 Chatham, 9068 ; Brockville, 8940 ; Woodstock, 8833 ; Sound, 8776 ; Sarnia, 8176 ; Gait, 7866 ; Sault Ste Marie, Lindsay, 7003 ; Cornwall, 6704 ; Barrie, 5949 ; Collingwood, Rat Portage, 5202 ; Pembroke, 5156 ; Smith's Falls, 5155. In 1901 the urban population was 935,752, and the rural 1,247,190. Density, 9-8 inhabitants to the square mile. In 1901 there were 1,096,641 males and 1,086,306 females. Indians, 19,597 ; and half-breeds, 5100. Classified according to place of birth, the prin- cipal nationalities in- 1901 were as follows :â€" Canada, 1,858,788; England and Wales, 121,506; Ireland, 68,093 ; Scotland, 49,881; other British possessions, 2913 ; United States, 44,175 ; Germany, 18,699 ; Scandinavia, 2005 ; Italy, 3283 ; France, 1254 ; other countries, 12,350. In 1891 there were 341,714 persons engaged in agricultural pursuits ; fishermen, 1421 ; mining, 1666 ; domestic and personal service, 109,328 ; manufactures and mechanical industries, 158,831 ; professional, 30,101 ; trade and transportation, 87,174 ; and non-productive, 20,053. The following table gives vital statistics for the period 1878-1900 : â€"

1ST8.

1888.

1900.

Births .

40,236

46,953

46,127

Marriages

12,729

14,551

17,104

Deaths .

17,808

23,734

29,494

Still-bom

334

(not

678

Â») 1) â€¢ â€¢

0-8%

classified)

1-3%

Illegitimate births .

575

618

800

TÂ» 1)

1-4%

1-3%

1-7%

Educa- tion.

The executive power consists of a lieutenant-governor, appointed for five years, assisted by an executive council of eight ministers Admlnis- ‘* portfolios, who have seats in the local legislature tratloa. Â°^ House of Assembly. The latter consists of ninety- eight members. Classified according to Religion, the principal denominations In 1901 were as follows: â€” Methodists, 666,S!60 ; Presbyterians, _ â€ž , 477,383 ; Episcopalians, 367,940 ; Roman Catholics,

Keiigion. 390 355. Baptists, 116,180; Lutherans, 48,016; Con- gregationalists, 15,286 ; Salvation Aimy, 6479 ; Disciples of Christ, 10,123 ; Quakers, 3648 ; Brethren, 6416 ; Jews, 5336.

In 1900 there ~~were 5655 public elementary schools, taught by 9440 teachers, of whom 2630 were men and 6810 women ; Roman Catholic separate schools, 355 ; Protestant separate schools, 7 ; secondary public schools, 131 (including 38 collegiate institutes), taught by 573 teachers; and 120 kindergartens, taught by 250 teachers. The pupils enrolled in the public elementary schools of all kinds numbered 420,097, with an average attendance of 237,306 ; pupOs in Roman Catholic separate schools, 42,397, with an average attendance of 25,875 ; Protestant~~

~~separate schools, 416 pupils, and average attendance 238. Total amount expended on public schools during the year, $4,228,532, and on high schools, $718,601. For the professional training of teachers there are (1) county model schools, fifty~~ five in number ; (2) three normal schools, and (3) one normal college ; their non-professional training is obtained in the secondary schools and universities. There is an agricultural college at Guelph, and at Belleville and Brantford there are institutes for the education of the dumb and the blind. Of the six universities in the province only one, the University of Toronto, is a State institution. The others are Victoria (now "federated" with Toronto), Queens of Kingston, Trinity and McMaster of Toronto, Western of London, and the University of Ottawa.

There is no direct taxation, except a special tax on insurance, loan, and railway companies doing business in the province, the revenue being derived from the sale of Crown lands, â€ž. timber, and minerals, liquor licences, and other fees, "^^ce.

supplemented by a subsidy from the Dominion Government. The principal items of revenue and expenditure for the year 1901 are tabulated below : â€"

Revenue

Expenditure

Dominion subsidy

$1,116,873

Civil government .

1281,136

Specific grant from

Legislation .

134,139

Dominion Govern

Justice, administra^

ment

80,000

tion of

416,043

Interest .

189,176

Education

782,103

Crown lands .

1,634,724

Agriculture .

209,859

Licences

376,373

Hospitals and chari-

Succession duties

366,582

ties

192,280

Prgvincial tax

237,507

Public institutions .

833,164

Miscellaneous

464,810

Miscellaneous

1,190,020

Â§4,466,044

$4,038,834

In December 1901 the province had â€” cash on hand, $1,468,493 ; funds in hands of Dominion Government, Â§6,212,407 ; and direct investments, $220,898â€” in all, $7,901,888: liabilities, $5,330,596, leaving a cash surplus of $2,571,292. In 1898 the total receipts of all the municipalities were $30,921,578 ; disbursements, 829,071,839; assets, $61,926,795; liabilities, $61,390,107 ; and bonded debt, $54,506,372. In 1899 the total assessment of the townships was Â§4.50,952,948 ; towns and villages, Â§125,982,155 ; cities, $239,825,370 ; and grand total, $816,760,473. The taxes for the same year were : townships, $4,621,803 ; towns and villages, Â§2,691,534 ; cities, Â§5,221,947 ; and total, Â§12,535,284.

The mineral resources, though important, are largely undeveloped, owing to the concentration of the greater part of the population in the fertile Palaeozoic tract of the province, where, with Minerals the exception of building materials, salt, petroleum, and natural gas, no minerals of economic value are found. Gold has been found along the

whole length of the Northern Archaean border of the province, but the richest and most numerous dis- coveries have been made in the country between Thunder Bay, on the north shore of Lake Superior, and the western boundary. Mining on a small scale is also carried on in Hastings county. The most important silver mine is that of Silver Islet, the total production of which between 1870 and 1884 amounted to $3,250,000. A number of silver mines yielding rich ores have been worked in the Thunder Bay district. The nickel deposits of the Sudbury region are, with the possible exception of Ne'w Caledonia, the richest in the world. Practically the whole of the copper produced in the province is obtained as a by-product of the nickel, the Bruce mines on the north shore of Lake Superior having ceased producing in 1876. There are also extensive deposits at Parry Sound, now under development, on Michipicoten island and the north shore of Lake Superior. The production of iron was tUl recently confined to a few mines in Hastings and Frontenac counties, and near Michipicoten. There are also immense deposits of magnetite and hematite in the country between Port Arthur and Rainy Lake, but lack of railways and cheap fuel has prevented their development. Natural gas is produced in the Welland and Essex gas-fields, the greater portion of which is exported to Bufialo and Detroit.

The mineral production for 1901 was as follows : â€"

Copper Gold . Iron ore Pig iron Nickel Silver

Non-metallic : â€" Natural gas Petroleum

Cement .... Other minerals and structural materials

Â§14,167,947

Ontario is pre-eminently an agricultural country, as (1) about 67 per cent, of its inhabitants are engaged in agricultural pursuits, and (2) the amount invested in lands, buildings, imple- ments, and stockâ€" Â§974,814,931â€" is two and a half *'" times that invested in the manufactures of the whole "" "" Dominion. The statistics of farm

lands, as taken by the muni- cipal assessors, are given in the following table : â€”

Quantity.

. 8,695,831 a

272,538 tons . 116,371 â€ž . 9,189,047 lb

151,400 oz.

Value.

$1,401,507

244,837

174,428

1,599,413

4,594,523

84,830

Total metallic .

$8,099,538

612,000 barrels 408,394 â€ž

336,183 979,200 592,030

4,160,996

332

0 N T A R I 0 â€” 0 PORTO

Land under crop

Pasture

Orchards and gardens

Fallow land, &c.

Total cleared land Swamp and waste

land. Woodland .

Total assessed .

Acres.

7,542,623

2,996,934

10,539,557

2,093,173 8,825,337

21,458,067

1S9S.

Acres.

8,054,612 2,682,180 1,394,772

12,131,564

2,694,487 8,133,229

22,959,280

Acres.

8,794,953 2,694,600

350,098 1,457,555

13,297,206

3,143,535 7,127,363

23,568,104

The following table gives statistics of the principal field crops : â€”

18S9.

1900.

Product.

Value.

Product.

Value.

Wheat .

Barley .

Oats

Rye and buck-

Bii^h.

20,261,162 16,235,295 64,346,301

$.

17,556,065

7,992,105

19,625,622

Bush.

30,310,070 16,909,751 89,693,327

$

20,202,230

6,577,893

23,768,732

wheat .

3,361,576

1,474,880

4,231,896

1,962,505

Pease and

beans . Potatoes . Other roots Corn, husk-

13,881,130 14,355,529 48,071,545

7,995,833 6,531,766 6,533,265

14,878,571 21,476,439 87,528,043

8,845,143 5,605,351 8,344,962

ing Corn, fodder .

27,093,561

8,588,659 4,295,064

All field crops :

Acres in Crop.

Market Value of Crop.

Market Value per Acre.

1889 1894 1900

7,758,583 8,227,153 ‘8,794,953

1106,500,799

94,055,392

114,758,761

114-37 11-45 13-06

In 1900 there were in the province 617,309 horses, valued at $46,916,999 ; cattle, 2,429,330, value 156,320,810 ; sheep, 1,797,213, value $7,711,496; hogs, 1,771,641, value $9,598,153; poultry, 9,541,241, value $2,727,363. Total value of live stock. sold or slaughtered during the year, Â§41,642,617 ; wool clip, 5,805,921 lb, value $894,112. There were, in 1883, 635 cheese factories produc- ing 53,513,032 R) of cheese, valued at $5,589,339, and in 1900, 1173 factories producing 127,789,543 ft, value $13,023,025. In 1893 74 creameries produced 2,707,570 ft butter, value $574,156, and in 1900, 308 creameries produced 9,041,468 ft, value $1,819,290. Value of farm land in 1900, $574,727,610 ; buildings, $219,488,370 ; implements, $57,324,130; and live stock, $123,274,821; total,

$974,814,931.

â– The principal fishes, in the order of their relative commercial

importance, are troat, whiteflsh, herring, pickerel, sturgeon, &c.

â€” all fresh-water fish. In 1900 the value of the catch

Hisberies. ^^ $1,333,294; vessels, boats and outfit, $789,042;

and exports, $381,045.

The northern portion of the province possesses immense timber resources, and beyond the Height>of-Land a great spruce forest ex- tends to the shores of Hudson Bay. White pine is still Timber. ^^^ most important as regards value and commercial importance, but the gi-eat and increasing demand for spruce for paper-making makes it one of the most valuable assets of the pro- vince. Other valuable timber trees

are oak, elm, walnut, hemlock, basswood, cherry, and butternut. The cut of logs in 1899 aggre- gated 875,000,000 feet.

Manu- The following table gives statistics of the principal

factutes. manufactures in 1891 : â€”

Number of

Number of

Value of

Establishments.

Employes.

Product.

Flour and grist mills

1078

3453

$36,558,320

Saw-mills

1895

23,851

26,987,259

Foundries

337

6198

7,803,152

Leather manufactures .

3234

6262

7,446,540

Agricultural implements

130

4029

6,927,887

Carriage works

1561

5096

5,906,679

Woollen mills.

303

5191

5,873,685

Distilleries and brew-

eries ....

89

1435

5,673,474

In 1891 there were 32,151 industrial establishments with a total fixed capital of $81,551,232 ; working capital, $94,420,789 ; em- ploying 164,326 persons ; paying in wages $49,733,359 per annum ; using raw material valued at $128,142,371, and with a product of value $239,781,926. â– , j ^

The following table gives statistics of exports, imports, and duty collected for the period 1874-1900 at the custom-houses within the province, but a large amount of the merchandise entered Commerce. inwards and outwards at the port of Montreal should properly be credited to Ontario : â€”

Exports.

Imports.

Duty.

1874 1884 1894 1900

$25,157,087 26,891,017 32,726,074 56,116,756

$49,443,977 41,967,215 42,025,638 71,258,544

$4,371,625 6,979,026

7,475jl42

10,763,214

In 1901 there were 1647 vessels with a tonnage of 145,981 on the registry books of the province. In the year ending 30th June 1898, 31,983 vessels with an aggregate tonnage of 11,257,361 shipping. were entered and cleared at the ports of the province.

Ontario had, in 1901, 6605 miles of steam railway, and 36-1 per cent, of the railway mileage of the Dominion. The principal sys- tems are the Grand Trunk, Canadian Pacific, Canada jf^u^^gyg Atlantic, and'Michigan Central. There are 24 electric ^ '

railways with nearly 400 miles of track, 480 motor cars, an aggre- gate of over 30,000 horse-power, and a capital investment of upwards of $10,000,000. The principal suburban roads are the Hamilton, Grimsby, and Beamsville, Hamilton Radial, Niagara Falls Park and River, Gait, Preston and Hespeler, and Metro- politan.

The St Lawrence canal system overcomes the diiference of elevation â€" 222 feet â€" between the river at Montreal and Lake Ontario, and consists of six canals : Lachine, 8J miles ; canals Soulanges, 14 ; Cornwall, 11 J ; Farrens Point, { ; Morris- burg, 3t^ ; and Galops, 7T^"miles. The Welland canal is 26J miles long ; has 25 lift-locks to overcome the difierence of elevation â€" 327 feet â€" between Lakes Ontario and Erie. The locks of the Welland and St Lawrence systems are 270 feet long, 45 feet wide, and have a depth at low water of 14 feet on the sills. The Sault Ste Marie canal, \^-^ mile long, with 1 lock 900 feet long, 60 wide, and with a depth tti 20J feet on the sill, overcomes the fall of 18^ feet at the foot of Lake Superior. The Ste Anne canal, \ mile, Corillon, I mile, and Grenville, 5| miles, render the Ottawa river between its confluence with the St Lawrence and Ottawa city navigable for vessels of 9 feet draught. The Rideau canal system connects the Ottawa river, at the city of the same name, with Lake Ontario at Kingston, and has a navigation depth of i\ feet. The Trent Valley canal, when completed, will give a direct route from the Bay of Quints, Lake Ontario, to the south end of Georgian Bay for vessels of 7J feet draught. The total amount expended on the works and maintenance (chargeable to capital) of the above canals to 30th June 1901 was $79,997,403. In addition, nearly $17,000,000 has been expended from income, making a total expenditure of $97,000,000. (j. -vth*.)

Ontario, Lake. See St Lawrence.

Onteniente, a town of Spain, in the province of Valencia, to the west of Albaida, on a hill on the right bank of the river Clariano. The

population was 11,165 in 1887, and 11,078 in 1897. The town is well built, with broad streets and a parish church that is remarkable for a lofty square tower. There is a large new suburb outside the old town, which was a walled city in days gone by; some vestiges of the rampai-ts still remain. The local industries are manufactures of woollen and linen stuffs, alcohol, paper, and furniture, and there is an active trade in the agricultural products of the sur- rounding districts.

Oporto, the second city of Portugal, an episcopal see and seaport, and capital of the district of Oporto, on the right bank of the Douro, 3 miles above its mouth. AVith the view of avoiding the bar at the mouth of the river, on which the depth of water varies between 16 and 19 feet, an artificial port has been made at Leixoes, on the coast, 2\ miles north of the Douro. In 1900 the port was entered and cleared by 1797 vessels of 777,657 tons (Oporto), and 968 vessels of 1,044,22;> tons (LeixBes), or in all 2765 vessels of 1,821,780 tons, but a portion of the

shipping is counted twice over, that is, in both ports. The total trade is valued at about five millions sterling, of which about three and a half millions represent imports. The principal exports are timber, stone, onions, cork, salt, wool, and port wine. The last-named goes principally to Great Britain, Brazil, and Hamburg, and Norway and Sweden. The combined port possesses a fishing fleet of some 360 vessels, manned by about 1600 men and boys, who catch fish to the annual aggre- gate value of Â£50,000 to Â£100,000. A third of the population are engaged in manufacturing industry, the chief objects of which are leather, tobacco, spirits, woollens, cottons, silk, hats, preserved foods, beer, aerated waters, soap, pottery, corks, and gold and silver filigree work. The Douro is crossed by a fine bridge, built in 1877, and measuring 1158 feet in length; the central arch has a span of 525 feet. Amongst the public buildings should be mentioned the exchange (which cost Â£133,500), the royal palace of Torre da Marca, and the crystal palace (350 feet long by 48 feet wide), used for exhibitions. The educational institutions embrace a medical college, polytechnic academy, industrial

institute, academy of the fine arts, seminary, lyceum of secondary education, two normal schools, trade schools, and a naval training school. There are also a meteorological observa- tory and the commercial athenaeum. Population (1890), 138,860 ; (1900), 172,421. Area, 13^ square miles.

The district of Opokto has an area of 885 square miles, and population (1900), 601,688, giving 680 inhabitants to the square mile, and consequently the most densely peopled district in the kingdom. The soil is very fertile, and intensely cultivated, except on certain of the higher parts and along the low-lying sandy coast. A large proportion of the surface is covered with wood. The vine is the chief object of cultivation ; in 1892 it covered 39,400 acres, the yield being 7,656,000 gallons of wine, valued at Â£240,000. During the four years 1896-99 inclusive an average of 4,208,200 gallons of port wine produced in this district was exported to the United liingdom. The districts formerly ravaged by the phyl- loxera and other diseases are being gradually replanted with vines, though the port wine industry as a whole cannot be said to be in a flourishing condition. In respect of the value of its live stock, especially cattle and pigs, this district ranks as the first in the kingdom. Coal, antimony, and gold are mined, with a little iron and lead, the average yield annually being 7500 tons, valued at Â£26,900. Slates are quarried, and granite is plentiful. It is esti- mated that 82,000 persons are employed in industrial pursuits ; in addition to the branches mentioned under the city of Oporto (above) and Villa Nova de Gaia, cottons and woollens are manu- factured at Vallongo and Santo Thyrso, and at Amarante.

Oppein, a town of Prussia, province of Silesia, 51 miles by rail south-east of Breslau, on the Oder. The sole surviving fragment, a tower, of the former ducal palace was incorporated in a new gymnasium (school) in 1898. A new Jewish synagogue was built in 1897. There is also a statue to the Emperor William I. (1891). Oppein is the seat of the provincial administration of Upper Silesia. Population (1885), 16,975 ; (1895), 23,017 ;

(1900), 30,115.

Oppert, Julius (1825), Assyriologist, was

born at Hamburg of Jewish parents on the 9th of July 1825. After studying at Heidelberg, Bonn, and Berlin, he graduated at Kiel in 1847, and in the following year went to Prance, where he became professor of German- at Laval. His leisure was given to Oriental studies, in which he had made great progress in Germany, and in 1854 he joined M. Fresnel's archaeological expedition to Mesopotamia. On his return he occupied himself in digesting the results of the expedition in so far as they concerned cuneiform inscriptions, and published an im- portant work upon them in 1864. In 1857 he was appointed professor of Sanscrit in the school of languages connected with the National Library, and in this capacity produced a Sanscrit grammar ; but his attention has been chiefly given to Assyrian and cognate subjects, and he has

been especially prominent in establishing the Turanian character of the language originally spoken in Assyria. In 1865 he published a history of Assyria and Chaldaea in the light of the results of the different exploring _ expeditions. At a later period he devoted much attention to the language and antiquities of ancient Media, writ- ing Le Peuple et la Lcmgue des MMes (1879). He has published a very considerable number of separate memoirs upon Assyrian mythology, jurisprudence, and other sub- jects connected with the ancient civilizations of the East.

Oran, the second port of Algeria, capital of the department, on the Gulf of Oran, between Cape Aiguille on the east and Cape Palcon on the west, 260 miles by rail west-south-west of Algiers, 220 miles east of Gibral- tar. Owing to the fact that it is the Mediterranean port in the most direct line with Timbuktu and the Niger, it has experienced a large development. Among fine new edifices are the hotel de ville, the prefecture, the bank, and the hotel des postes. Since 1878 there has been an archaeological and geological society, which holds the fore- most rank in Algeria. Oran has a considerable trade in wines, cereals, oils, and wools. The harbour has been so much improved that ships which formerly stopped at the harbour formed by the promontory of Mers el Kebir, about 3 miles to the west, now enter the port. A pier,

three lighthouses, and a breakwater all greatly assist commerce and navigation. Oran owes its importance as a seaport to its proximity to Spain, being only eight hours' distance (about 140 miles) from Carthagena and Almeria. The tonnage, 650,000 in 1875, mounted to 1,231,000 in 1884, 2,064,000 in 1895, and 2,310,000 in 1898. The population in 1886 was 67,681, of whom 13,853 were French; in 1896 it was 80,211, of whom 24,038 were French; and in 1900 it was 85,081, of whom 25,088 were French. The foreign element, chiefly Spaniards, exceeds 34,000.

Orange, chief town of arrondissement, department of Vaucluse, France, 17 miles north of Avignon, on the railway from Paris to Marseilles. The ancient Koman theatre has been restored (1897) and now serves as a National Theatre ; the h6tel de ville, erected in the 17th century, was restored in 1888. Amongst modern erec- tions are a colossal statue of the Virgin on the hill above the theatre, and a monument to the soldiers who fell in the war of 1870-71. Population (1881), 6118; (1891),

6099; (1901), 9705.

Orange, a town of Australia, New South Wales, in the counties of Wellington and Bathurst, 192 miles by rail west of Sydney. It lies 'in a fruit and wheat produc- ing district, in which gold, copper, and silver also abound. Its suburb. East Orange, in the county of Bathurst, is a separate municipality. The mean rainfall (16 years) is 35-84 inches. Population (1901), including East Orange,

6331.

Orange, a city of Essex county. New Jersey, U.S.A., situated at the undulating base of the Watchung Moun- tain, in the north-eastern part of the state, at an altitude of 187 feet. Two railways â€" the Delaware, Lackawanna and Western, and the Erie â€" connect it with New York, 16 miles distant, of which it is a residential suburb. It is also connected with neighbouring cities by trolley lines. It is irregularly laid out, even in the closely-built portions. It has an excellent water-supply and sewer system, and is divided into five wards. Population (1890), 18,844 ; (1900), 24,141, of whom 6598 were foreign-born and 1903 negroes.

Orange River Colony, a division of South Africa, kno-ten as the Obange Free State from 1854 to 1900, situated between 27Â° and 31Â° S. and 24Â° 20′ and

29Â° 40′ E. It reverted ta the position of a British colony as the result of the Boer war, the capital, Bloemfontein, being occupied by the British on 28th February 1900. Under the Boer rule the country had made considerable material progress and reached a fair standard of general comfort, although the population showed but a relatively small increase of from 133,000 in 1880 to 208,000 (78,000 whites and 130,000 natives) in 1890. But this is no doubt partly to be explained by the considerable loss of territory under the Keate award in 1871, when the Kimberley diamond fields, with Griqualand West, were assigned to Great Britain. The economic prosperity of the land is indicated by the rapid development of its agricultural resources, of railway and mining enterprise, of its exports and its sound financial condition before the outbreak of hostilities. The revenue rose from Â£310,000 in 1892 to Â£800,000 in 1898, including Â£408,000 from the railways, which have now a total length of nearly 400 miles, and afford direct communication southwards across the Orange with Cape Town, Port Elizabeth, and East London, and northwards across the Vaal with Pretoria. The total imports (general merchandise of all kinds) advanced from Â£900,000 in 1895 to Â£1,192,00Q in 1898, while in the latter year the exports (wool, hides, corn, diamonds) exceeded Â£2,000,000. Much coal continues to be gained from the extensive Kroonstad deposits, while the yield of diamonds in the Fauresmith district, near the Kimberlev fields, rose from 99,225 carats, valued at Â£224,000, in 1890, to 307,000 carats, valued at Â£1,508,000, in 1898. The area of cultivated lands is encroaching on the pastures, especially in the fertile tracts along the banks of the Caledon river, and in the sheltered and well- watered upland valleys to the north-east of Thaba N’chu. At present the agricultural holdings considerably exceed 10,000, with a total of about 30,000,000 acres, of which 256,600 were under tillage in 1890. In the

same year the live stock comprised 890,000 horned cattle, 260,000 horses, and 6,620,000 merino and fat-tailed sheep. Former reports of the dry and salubrious nature of the climate have been fully confirmed, and there can be no doubt that, with the development of irrigation works, vast tracts might be rendered suitable for European settlers. Besides the capital, there are several townships, villages, and other centres of population, which present some in- terest as markets for farm produce, or for their strategic position and historic associations. Subjoined are the most important arranged in alphabetical order : â€”

Albertiim, a railway station on the line (60 miles long) running from Ladysmlth in Natal to Hariasmith, not far from Van Eeenens Pass.

Bethanie, a railway station on the main line from Bloemfontein to Springfontein junction, founded by the French missionaries amongst the Basutos, who formerly occupied this district.

Bethlehem, a market on the Zand river, 56 miles west of Harri- smith, and 83 miles east of Smaldeel railway station.

Belhulie, a station at the head of the railway bridge which here crosses the Orange river just below the Caledon confluence ; occu- pied by the British, 28th February 1900.

Boshof, a township near the west frontier, a few miles north-east of Kimberley; here fell the leader of the "European Legion," Colonel de Villebois-Mareuil, 5th April 1900.

Brandford, an important railway station on the main line from Bloemfontein to Pretoria ; occupied by the British 5th May 1900.

Edenburg, railway station on the main line between Bloemfontein and Springfontein, south of the Riet river.

Fauresmith, a township in the south-western district, at the junction of several roads, and close to the Jagersfontein diamond mines, the most productive in the colony. Here was found the largest African stone, weighing 500 carats uncut, but of imperfect quality.

Harrismith, a town near the eastern frontier, present terminus of the railway which runs from Ladysmith, on the Durban-l'retoria line, through Van Eeenens Pass, and is to be continued to Kroon- stad on the Bloemfontein-Pretoria line. Harrismith, which is distant 20 miles from Van Reenens Pass, lies in the valley of the

Wilge tributary of the Vaal, and is the most important place in the eastern part of the colony.

Jacobsdal, a market in the south-western district, close to the " Griqualand frontier," on the right bank of the Riet river ; occu- pied by the British, 16th February 1900.

Kroonstad, a town and railway station on the BloemfonteiB- Pretoria line, 127 miles from the former place, and 86 miles from the Vaal river ; was chosen by President Steyn as his capital after the fall of Bloemfontein, but was occupied by the British on 12th May 1900 ; is the centre of the chief coal-mining industry in the colony.

Ladybrand, a thriving agricultural town on the right bank of the Caledon, near Maseru in Basutoland.

Lindley, a market on the Valsch tributary of the Vaal, east of Kroonstad.

Paardeberg, a post on the right bank of the Modder, 30 miles south-east of Kimberley ; here the Boer leader, Cronje, surrendered with over 4000 men, 27th February 1900.

Philippolis, a town near the Orange river, south of Fauresmith ; occupied by the British, 23rd March 1900.

Bouxville, a flourishing agricultural station near the Orange river at Aliwal North, above the Caledon confluence ; occupied by the British, 19th March 1900.

SeneJcal, a market on the Bloemspruit, south-east of Kroonstad ; occupied by the British, 25th May 1900.

Smaldeel, a railway station on the main line, 63 miles north of Bloemfontein ; headquarters of General Roberts, 6th May 1900.

Smithfleld, a large market on the Lower Caledon, 50 miles above its confluence with the Orange.

Springfontein, a railway station at the junction of the two main lines from Cape Town and Port Elizabeth.

Thaba N'chu, a station in the hilly eastern district near Lady- brand, former capital of the petty Barolong State, which was deprived of its autonomy by the Orange Free State in 1884.

Wepener, a station on the lower Caledon, occupied, 29th March 1900, by the British, who successfully held the place against a greatly superior Boer force, 9th-24tb April 1900.

Winburg, a large market connected by a short branch with the Smaldeel station on the Bloemfontein-Pretoria main line.

(a. h. k.)

History. â€" In 1853 a convention was entered into between representatives of the Free State and the British Government for transferring the government of the Orange Eiver sovereignty to representatives delegated by the inhabitants to receive it. By means of this transfer the Imperial Government established the future independence of the country, and further stated that the British Government had no alliance whatever with any native chiefs or tribes to the north of the Orange river, with the exception of the Griqua chief, Adam Kok. It was also stipulated that the Orange Eiver government should, as hitherto, permit no slavery or trade in slaves in their territory north of the Orange river. At the time of this transfer some Boers, leading residents of the Free State, protested against the abandonment, but the duke of New- castle, who was then British colonial secretary, stated that, in his opinion. Imperial authority had already been extended too far in South Africa. He therefore could not

entertain the request made to him to retain the administration of the country.

The new state of things had only been one year in exist- ence when the Free State government found themselves victims to an intrigue of Messrs Pretorius and Kruger, within the Transvaal, to bring about, by force if necessary, a confederation between the two countries. In the first instance, peaceful overtures were made, but the Free Staters declined to accept the proposal. Thereupon Pretorius, aided by Paul Kruger, organized and conducted a raid into the Free State territory, in the hope of over- awing the Free State government, and compelling it to fall in with the views of the minority of the Free Staters, who were co-operating with Pretorius. On learning of the invasion, Boshof, President of the Free State, proclaimed martial law throughout the country, and called out his burghers. The majority of the burghers rallied to his sup- port, and in a very short time a formidable force was got together to oppose the invaders. On the 25th of May

1854 the two opposing forces faced one another on the banks of the Rhenoster. President Boshof not only- managed to get together a considerable force within the Free State, but he received an offer of support from General Schoeman, the Transvaal leader in the Zoutpans- berg district. Pretorius and Kruger, when they learnt what had occurred, realized that they would have to sustain attack from both north and south, and abandoned their enterprise (see Transvaal). Before leaving, a treaty was signed, which amounted to an apology on the part of Pretorius. Several of the malcontents in the Free State, who had joined the Transvaal party, returned with them over the Vaal river, and permanently settled in the Transvaal. Other Free Staters who had been guilty of high treason were arrested and punished.

In 1858 the Volksraad of the Free State were so tired of the responsibilities of independence, that they passed a resolution in favour of a confederation in some shape or form with the Cape Colony. This

proposition re- ceived the strong support of Sir George Grey, at that time governor of Cape Colony, but his view did not com- mend itself to the home authorities, and was not adopted.

From the date of their first settlement in the Orange Eiver territories, the Boers were continually at feud with their Basuto neighbours on the eastern border (see Basu- toland). In 1866 they organized a powerful expedition, and attacked Moshesh. The expedition was successful, Moshesh was defeated, and a treaty was arrived at, by which he gave up possession of a portion of Basutoland, and acknowledged himself the subject of the Free State. This treaty did not, however, by any means terminate the strife ; a period of feud continued, in the course of which Moshesh and his followers were reduced to very dire straits. They appealed to Great Britain for assistance, and in 1869 a treaty was agreed to between the High Com- missioner and the Orange Free State, defining the borders between the Orange Free State and Basutoland. All the fertile tract of country lying to the north of the Orange river and west of the Caledon, originally a part of Basu- toland, was ceded to the Free State. This tract of coun- try, some hundred miles long and nearly thirty wide, is a fertile stretch of agricultural land on the lower slopes of the Maluti Mountains. It lies at an altitude of nearly 6000 feet, and is well watered by the Caledon and its tributaries. It has ever since been known as the Conquered Territory, and it forms to-day one of the richest corn-growing districts in South Africa.

The Basutoland difficulties were no sooner arranged than the Free Staters found themselves confronted with a serious difficulty on their western border. In the years 1870-71 a large number of diggers had settled on the diamMid fields, which were situated on the boundary between the Griqua chief Waterboer and the Free State. At the time both the Free State and Waterboer claimed the district, and the Free State es- tablished a temporary government over the diamond fields, but the administration of this body was satis- factory neither to the Free State nor to the diggers. At this juncture Waterboer offered to place the territory under the administration of Queen Victoria. The offer was accepted, and on 27th October 1870 the district was proclaimed, under the name of Griqualand West, British territory. To

criticize the grounds on which Waterboer's claims were based is difficult. But what- ever the justice of the decision to annex may have been, it is certain that President Brand contended at the time that Waterboer's title was a bad one. The matter involved much correspondence and no little irritation between the British Government and the Free State until 1876. It was then finally disposed of by Lord Carnarvon, who granted to the Free State Â£90,000 in

compensation for any possible harm or wrong which the Free State might have sustained from the annexation. In making this concession, it is right to state that Lord Carnarvon, having gone into the question, declined to acknowledge any validity in the Free State claim to the territory in question. One thing at least is certain with regard to the diamond fields â€" they were the means of restoring the credit and prosperity of the Free State. In the opinion, moreover, of Dr Theal, who has written the history of the Boer Eepublies and has been a consistent supporter of the Boers, the annexation of Griqualand West was probably in the best interests of the Free State. Fortunately at the time the Fre6 State had an enlightened and liberal-minded ruler in President Brand, who avoided collisions and encouraged amicable relations with the British authorities.

In spite of the troubles on her borders, the Free State, under Brand's beneficent and tactful guidance, made progress in various directions. Villages sprang up, roads were constructed, and a postal service was established. Tea-planting was encouraged by the gov- ernment. At the same time the Free State Boers, like their Transvaal neighbours, had drifted into financial straits. A paper currency had been instituted, and the notes â€" currently known as "bluebacks" â€" soon dropped to less than half their nominal value. Commerce was largely carried on by barter, and many cases of bank- ruptcy occurred in the State. But as British annexation in 1877 saved the Transvaal from bankruptcy, so did the influx of British and other immigrants to the diamond fields, in the early 'seventies, restore public credit and individual prosperity to the Boers of the Free State. The diamond fields offered a ready market for stock and other agricultural produce. Money flowed into the pock- ets of the farmers. Public credit was restored. " Blue- backs" recovered

par value, and were duly called in and redeemed by the government. At a later date valuable diamond mines were discovered within the Free State, of which the one at Jagersfontein is the richest. Capi- tal from Kimberley and London was soon provided with which to work them. The relations between the diggers and the Free State Boers, after the question of the boun- dary was once settled, remained perfectly amicable down to the outbreak of the Boer war in 1899. In 1880, when a rising of the Boers in the Transvaal against Sir Oweu Lanyon was threatening. President Brand showed every desire to avert the conflict. He suggested to the authori- ties at Cape Town that Sir Henry De Villiers, Chief Justice of Cape Colony, should be sent into the Trans- vaal to endeavour to gauge the true state of affairs in that country. This suggestion was not acted upon, but when, in 1881, the Boers in the Transvaal broke out into open rebellion and war followed. Brand declined to take any part in the struggle. At a later date he urged that peace should be brought about, and expressed his friendly sentiments towards the British Government. In spite of the neutral attitude taken by Brand during this period, there can be no question that a certain number of the Free State Boers, living in the northern part of the Free State, went to the Transvaal and joined their breth- ren then in arms against the British Government. In 1888 Sir John Brand died. He had been President of the country siifce 1863, and in him the Boers, not only in the Free State but in the whole of South Africa, lost one of the most enlightened and most upright rulers and leaders they have ever had. Brand had always realized the liberal character of the British Govern- ment in South Africa, and while differences from time to time did occur between him and the representatives of Queen Victoria, he nevertheless in the main ac- cepted the broad lines of British policy, and supported

them. Througlioiit his long official career he remained on cordial terms of friendship with Great Britain.

In 1889 an agreement was come to between the Free State and the Gape Colony government, whereby the latter were empowered to extend, at their own cost, their railway system to Bloemfontein. The Free State retained the right to purchase this extension at cost, a right which they exercised within the course of a few years. In the same year Mr Eeitz was elected President of the Free State. His accession to the Presidency marked the commencement of a new and disastrous line of policy in the public affairs of the country. Mr Eeitz had no sooner got into office than a meeting was arranged with Presi- dent Kruger, at which various terms of the agreement dealing with the railways, terms of a treaty of amity and commerce, and what was called a political treaty, were discussed and decided upon. The political treaty referred in general terms to a federal union between the two states, and bound each of them to help the other, when- ever the independence of either should be assailed or threatened from without, unless the state so called upon for assistance should be able to show the injustice of the cause of quarrel in which the other state had engaged. In 1889 the Free State, having accepted the assistance of the Cape governtae,nt in constructing its railway, entered into a Customs Union Convention with them. The con- vention was the outcome of a conference held at Cape Town in the previous year, at which delegates from Natal, the Free State, and the Colony attended. Natal at this time had not seen its way to entering the Customs Union, but did so at a later ~~date. In 1896 the Free State Volksraad passed a resolution, in which they declared their readiness to entertain a proposition from the Transvaal in favour of some form of federal union. In the same year President Eeitz retired from the presi~~ dency of the Free State on the ground of ill-liealth, and was succeeded by Judge Steyn. In 1896 President Steyn visited Pretoria, where he received quite an ovation as the future probable President of the two Eepublics. A further offensive and defensive alliance between the two Eepublics was then entered into, under which the Free State took up arms on the outbreak of hostilities with the Transvaal in 1899.

In 1897 President Kruger, being bent on still further cementing the union with the Free State, himself visited Bloemfontein. It was on this occasion that President Kruger, referring to the London Convention, spoke of Queen Victoria as a ” kwaaje Frau,” an expression which

caused a good deal of offence in England at the time, but which, to any one familiar with the homely phraseology of the Boers, obviously was not meant by President Kruger as insulting. In order to understand the atti- tude which the Free State took at this time in relation to the Transvaal, it is necessary to review the history of Mr Eeitz from an earlier date. Previous to his becoming President of the Free State he had acted as its Chief Justice, and still earlier in life had practised as an advo- cate in Cape Colony. In 1881 Mr Eeitz had, in conjunc- tion with his successor President Steyn, come under the influence of a clever German named Borckenhagen, the editor of the Bloemfontein Expre^a. These three men were principally responsible for the formation of the Afrikander Bond (see Cape CJolony). From 1881 on- wards there is no doubt that they cherished the one idea of an independent South Africa, in which a monopoly of independence was to be held by the Boers. Brand during his lifetime had been far too sagacious to be led away by this pseudo-nationalist dream. He did his utmost to dis- countenance the Bond when it was started by Mr Eeitz and Mr Borckenhagen, inasmuch as he saw full well that it was calculated to cause mischief in the future. At the

same time his policy was guided by a sincere patriotism, which looked to the true prosperity of the Free State as well as to that of the whole of South Africa. It was only after his death that the fatal development of an exclu- sively Dutch policy arose in the Free State. From his death may be dated the disastrous line of policy which led to the extinction of the state as a republic. The one prominent member of the Volksraad who inherited the traditions and enlightened views of President Brand with regard to the future of the Free State was Mr G. J. Fraser. Mr Fraser was the son of a Presbyterian minis- ter, who had acted as a minister in the Dutch Eeformed Church since the middle of the century. He grew up in the country of his father's adoption, and he consistently warned the Free State of the inevitable result which must follow their mischievous policy in being led by the Transvaal. His protests, however, were vain, and the mass of Boers in the Free State, deluded by a belief in Great Britain's weakness, paid no heed to his remon- strances. Mr Fraser lived to see the fulfilment of these prophecies. After the British occupation of Bloemfontein he cast in his

lot with the Imperial Government, realiz- ing that it had fought for those very principles which President Brand and he had laboured for in bygone years.

The economic progress of the Free State, which began with the discovery of the diamond fields, has been re- doubled since the construction of the railway through its territory to Johannesburg, thus fully justifying the for- ward commercial policy adopted in the teeth of Trans- vaal opposition. In illustration of this we have only to cite the fact that, in 1898-99, out of a total revenue of about Â£650,000, Â£325,000, or more than half, represented the earnings of the railway.

On entering Bloemfontein in 1900 the British obtained possession of certain state papers which contained records of negotiations between the Transvaal and the Orange Free State. The evidence contained in these state records so clearly marks the difference between the policy of Mr Kruger and the pacific, commercial policy of President Brand and his followers, that the documents call for care- ful consideration. From these papers it was found that, in 1887, two secret conferences had taken place between the Eepublics, dealing with various political and economical questions. At the first of these conferences, held in Pre- toria, there were present President Kruger, with his state secretary and state attorney, Messrs Bok and Leyds, and a commission of the Transvaal Volksraad, consisting of Messrs Wolmarans, Klopper, Taljaard, Lombard, and Spies. On the other side the deputation from the Free State Volksraad was composed of Messrs Fraser, Klynveld, and Myburgh.

An interesting account of this interview was given by a corre- spondent of The Times on 24th May 1900. The account was evidently compiled after a careful study of the papers, and the correspondent states that pre-eminent at that conference, and practically leading it, stood President Kruger, knowing exactly what he wanted, ” indiiJerent to argument, returning again and again to the same point, however often it was refuted ; incapable of conviction, though ready as a last resort to lower his demands step by step, and claim that he had made a great concession “â€”in fact, the same Kruger, as twelve years later at

Bloemfontein, only here not on the defensive against a superior intellect and a will as strong as his own (both of which he met in Sir Alfred Milner), but active, persuasive, impassioned, appealing to men more capable of being brought under his influence. On the Free State side was Mr Fraser, resolutely endeavouring to carry out the traditions of Brand's policy.

The objects of the Free State deputies at this confer- ence were apparently straightforward. They were to arrange a general treaty of amity and commerce which would knit the states more closely together, and to come to some agreement with reference to the scheme for building a railway across the Free State from the Cape,

to connect ~~with a further extension in the Transvaal to Pretoria. Another proposition of the deputation, which they urged upon the Transvaal, was that of joining the South African Customs Union. Both of these sugges~~ tions were strongly disapproved of by Mr Kruger, inas- much as they obviously meant knitting South Africa together with the British possessions, instead of' merely bringing the Free State into completer dependence on the Transvaal. From the minutes of this conference it is clear that the two deputg.tions were practically at cross purposes. In the minds of President Kruger and his immediate followers one idea was dominant, that of oust- ing and keeping out at all costs British influence and interests in every shape or form. On the part of the Free State, on the other hand, there was obviously a genuine desire to further the best interests of the state, together with the general prosperity of the whole of South Africa. In President Kruger's eyes British trade meant ruin ; he desired to keep it out of the Republic at all costs, and he begged the Free State to delay the con- struction of their railway until the Delagoa Bay line was completed. He said, " Delagoa is a life or death question for us. Help us : if yOu hook on to the Colony you cut our throat. . . . How can our state exist without the Delagoa railway ? Keep free." With regard to the Cus- toms Union President Kruger was equally emphatic ; he begged the Free State to

steer clear of it. “Customs Unions,” he said, ” are made between equal states with equal access to harbours. We are striving to settle the question of our own harbour peacefully. The English will only use their position to swindle the Transvaal of its proper receipts.” In response, Mr Fraser remarked that a harbour requires forts, soldiers, ships, and sailors to man them, or else it would be at the mercy of the first gunboat that happened to assail it. President Kruger replied that once the Transvaal had a harbour foreign Powers would intervene. Mr Wolmarans was as em- phatic as President Kruger. “Wait a few years. . . . You know our secret policy. We cannot treat the Colony as we would treat you. The Colony would destroy us. It is not the Dutch there we are fighting against. Time shall show what we mean to do with them ; for the pres- ent we must keep them off.” This last sentence pro- bably refers to an intrigue with certain Dutchmen in the Cape Colony. If it did not refer to an actual intrigue, the least it could have meant was the intention to intrigue when occasion arose.

The result of this conference was a secret session of the Transvaal Volksraad and the proposition of a secret treaty with the Free State, by which each state should bind itself not to build railways to its frontier without the consent of the other, the eastern and northern fron- tiers of the Transvaal being excepted. The railway from Pretoria to Bloemfontein was to be proceeded with; neither party, was to enter the Customs Union without the consent of the other. The Transvaal was to pay Â£20,000 annually to the Free State for loss incurred for not having the railway to Cape Colony. Such a treaty as the one proposed would simply have enslaved the Free State to the Transvaal. It was rejected by the Free State Volksraad in due course, but President Kruger, not content with this resolution, determined on a still more active measure, and proceeded with Dr Leyds to inter- view President Brand at Bloemfontein. A series of meetings took place in October of the same year (1887). President Kruger had come to Bloemfontein nominally with the intention of discussing railway and commercial matters, and also of promoting closer union between the two Eepublics. President Brand, therefore, opened the proceedings by proposing a treaty of friend- ship and free trade between the two Republics, in which

a number of useful and thoroughly practical provisions occurred. President Kruger, however, soon brushed these propositions aside, and responded by stating that, in consideration of the common enemy and the dangers which threatened the Republic, an offensive and defensive alliance must be preliminary to any closer union. To this Brand rejoined that, as far as the offensive was con- cerned, he did not desire to be a party to attacking any one, and as for the defensive, where was the pressing danger of the enemy which Kruger feared ? The Free State was on terms of friendship with its neighbours, nor (added Brand) would the Transvaal have need for such an alliance as the one proposed if its policy would only remain peaceful and conciliatory. At a later date in the conference (see Transvaal) President Brand apparently changed his policy, and himself drafted a constitution resembling that of the United States. This constitution appears to have been modelled on terms a great deal too liberal and enlightened to please Mr Kruger, whose one idea was to have at his command the armed forces of the Free State when he should require them, and who pressed for an offensive and defensive alliance. Brand refused to allow the Free State to be committed to a suicidal treaty, or dragged into any wild policy which the Transvaal might deem it expedient to adopt. The result of the whole conference was that Kruger re- turned to Pretoria completely bafled, and for a time the Free State was saved from being a party to the fatal policy into which others subsequently drew it. Inde- pendent power of action was retained by Brand for the Free State in both the railway and Customs Union questions.

After Sir John Brand's death, as already stated, Mr. Reitz became President, and consistently followed out that policy which, as one of the founders of the Bond, he had endeavoured to inaugurate throughout Dutch South Africa. A series of agreements and measures in the Volksraad gradually subordinated those true Free State interests which Brand had always protected to the mis- taken ambition and narrow views of the Transvaal. Mr Fraser in vain tried to stem the tide of Krugerism within the Free State, but the extent to which it had travelled after Brand's death was evidenced by the election for President in February 1896, when Mr. Steyn was elected against Mr Fraser by forty-one votes to nineteen. That this election should have

taken place immediately after the Jameson Raid probably increased President Steyn's majority. At the same time the history of the state after Brand's death renders it probable that Mr Fraser's defeat was only a question of degree. Mr Fraser continued, down to the outbreak of the war of 1899, consistently to denounce the policy on which the Free State had em- barked, warning his countrymen continually that this policy could have but one end â€" the loss of their inde- pendence. Underlying the state policy there was un- doubtedly the belief, if not with President Steyn himself, at least with his followers, that the two Republics com- bined would be more than a match for the power of Great Britain should hostilities eventually occur.

In December 1897 the Free State revised its constitu- tion in reference to the franchise law, and the process of naturalization was reduced from five to three years. The oath of allegiance to the state was alone required, and no renunciation of nationality was insisted upon. In 1898 the Free State also acquiesced in the fresh convention arranged with regard to the Customs Unions between the Cape Colony, Basutoland, and the Bechuanaland Pro- tectorate. These measures suggest that already a slight reaction against the extreme policy of President Kruger had set in. But events were moving rapidly in the Transvaal, and matters had proceeded too far for the

Free State to turn back. In 1899 President Steyn sug- gested the conference at Bloemfontein between President Kruger and Sir Alfred Milner, but this act, if it expressed at all a genuine desire for reconciliation, was too late. President Kruger had got the Free State ensnared in his meshes. The Pree Staters were bound practically hand and foot, under the offensive and defensive alliance, in case hostilities arose with Great Britain, either to denounce the policy to which they had so unwisely been secretly party, or to throw in their lot with the Transvaal. War occurred, and they accepted the inevitable

consequence. In September 1899 Sir Alfred Milner sent a despatch to President Steyn, informing him that the exigencies of the situation demanded that he should take some steps to protect his line of communications, and that he was stationing a force near the Orange Pree State frontier. Sir Alfred Milner at the same time expressed the hope that the difference between the British Government and the Transvaal might still be adjusted, but if this hope were disappointed, he should look to the Pree State to preserve strict neutrality, in which case the integrity of their territory would in all circumstances be respected. In similar circumstances Sir John Brand had remained neutral in 1881, but he was unfettered by any treaty with the Transvaal. Por President Steyn and the Pree State of 1899, in the light of the negotiations we have recorded, neutrality was impossible. Before war had actually broken out the Pree State began to expel British subjects, and the very first act of war was committed by Pree State Boers, who, on 11th October, seized a train upon the border belonging to Natal (see also Steyn and South Africa).

AuTHOKiTiES. â€” The AL. History of South Africa ; South African History and Geography ; The Story of the Nations â€” South Africa. â€” HiLLiER. South African Studies. â€” Mackenzie. South Africa: Losing it or Buling it. â€” Mackenzie and Stead. South Africa : Its History, Heroes, and War. â€” Pkatt. Leading Points in South African History. â€” The Times'' History of the War. (a. p. h.)

Orbetello, a town and bishop's see of the province of Grosseto, Tuscany, Italy, 24 miles south by east of Grosseto. It is situated on an artificial causeway, which connects the mainland with the peninsula of Monte Argentario. The town still has the bastions which the Spaniards built during the period (1557-1713) when they were masters of this corner of Italy, and possesses a cathedral and an Etruscan museum. There is a large convict prison, with which is connected another at Porto Ercole, on the east side of the peninsula. The mother- house of the Passionist order crowns an eminence of Monte Argentario. The salt-water lagoon (11 square miles in extent), in the middle of which the town stands, abounds in white fish, soles, and eels. Population (1881), 4449; (1899), about 3800.

Orchardson, William Quilier (1835-

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British painter, was born in Edinburgh, where his father was engaged in business, in 1835. ” Orchardson ” is a variation of ” Urquhartson,” the name of a Highland sept settled on Loch Ness, from which the painter is descended. At the age of fifteen he was sent to the Trustees’ Academy, then under the mastership of Robert Scott Lauder, where he had as fellow-students most of those who afterwards shed lustre on the Scottish school of the second half of the 19th century. As a student he was not especially pre- cocious or industrious, but his work was distinguished by a peculiar reserve, by an unusual determination that his hand should be subdued to his eye, with the result that his early things reach their own ideal as surely as those of his maturity. At the time he was twenty, Orchardson had mastered the essentials of his art, and had produced at least one picture which might be accepted as represen- tative, a portrait of Mr John Hutchison, the sculptor.

Por seven years after this he worked in Edinburgh, some of his attention being given to ” black and white,” his practice in which had been partly acquired at a sketch club which included among its members Mr Hugh Cam- eron, Mr Peter Graham, Mr George Hay, Mr M’Taggart, Mr John Hutchison, and others. In 1862 he came to London, and established himself in 37 Pitzroy Square, where he was joined twelve months later by his friend John Pettie. The same house was afterwards inhabited by Ford Madox Brown.

The English public was not immediately attracted by Orchardson’s work. It was too quiet to compel atten- tion at the Royal Academy, and Pettie, Orchardson’s junior by four years, stepped before him for a time, and became the most readily accepted member of the school. Orchardson confined himself to the simplest themes and designs, to the most reticent schemes of color. Among his best pictures during the first eighteen years after his migration to London were “The Challenge,” “Christopher Sly,” “Queen of the Swords,” “Conditional Neutrality,” “Hard Hit” â€” perhaps the best of all â€” and portraits of Mr Charles Moxon, his father-in-law, and of his own wife. In all these good

judgment and a refined imagination were united to a restrained but consummate technical dexterity. During these same years he made a few drawings on wood, turning to account his early facility in this mode. The period between 1862 and 1880 was one of quiet ambitions, of a characteristic insouciance, of life accepted as a thing of many-balanced interests rather than as a matter of sturm und drang. In 1865 Pettie married, and the Pitzroy Square minage was broken up. In 1868 Orchardson was elected A.R.A. In 1870 he spent the summer in Venice, travelling home in the early autumn through a France overrun by the Ger- man armies. ^ 1873 he married Miss Helen Moxon, and in 1877 he ” ‘as elected to the full membership of the Royal Acaden /. In this same year he finished building a house at Westgate-on-Sea, with an open tennis-court and a studio in the garden.

Orchardson’s wider popularity dates from 1881. To that year’s Academy he sent the large ” On Board the Bellerophon” which now hangs in the Tate Gallery. Its success with the public was great and instantaneous, and for ten or twelve years Orchardson’s work was more eagerly looked for at the Academy than that of any one else. He followed up the ” Bellerophon ” with the still finer “Voltaire” (see Plate) now in the Kunst- halle at Hamburg. Technically the ” Voltaire ” is, per- haps, his high-water mark. Pine both in design and colour, it is carried out with a supple dexterity of hand which has scarcely been equalled in the British school since the death of Gainsborough. The subject is not entirely happy, for it does not explain itself, but requires a previous knowledge on the part of the spectator of how Voltaire was beaten by the servants of the Chevalier de Rohan-Cabot, and how the due de Sully failed to avenge his guest. The painter was attracted by the opportunity it gave for effective opposition of character, line, colour, and movement. The ” Voltaire ” was at the Academy of 1883; it was followed, in 1884, by the “Mariage de Oon- venance,” perhaps the most popular of all Orchardson’s pictures; in 1885, by “The Salon of Madame R&amier”; in 1886, by “After,” the sequel to the “Mariage de Convenance,” and “A Tender Chord,” one of his most exquisite productions; in 1887, by “The First Cloud”; in 1888, by “Her Mother’s Voice”; and in 1889, by “The Young Duke,” a canvas on which he returned to much the same pictorial scheme as that of the “Voltaire.”

Subsequently he exhibited a series of pictures in which fine pictorial use was made of the furniture and costumes of the early years of the 19th century, the subjects, as a

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rule, being only just enough to suggest a title: “An Enigma,” ” A Social Eddy,” Â« Reflections,” ” If music be the food of love, play on ! ” ” Music, when sweet voices die, vibrates on the memory,” ” Her Eirst Dance,” â€” in these opportunities are made to introduce old harpsichords, spinets, early pianofortes. Empire chairs, sofas, and tables, Aubusson carpets, long-waisted gowns, delicate in material and primitive in ornament. Between such things and Orchardson’s methods as a painter the sympathy is close, so that the best among them, “A Tender Chord,” for instance, or ” Music, when sweet voices die,” have a rare distinction.

As a portrait-painter Orchardson must be placed in the first class. His portraits are not numerous, but among them are a few which rise to the highest level reached by modern art. ” Master Baby,” a picture, connecting subject-painting with portraiture, is a masterpiece of design, colour, and broad execution. ” Mrs Joseph,” “Mrs Ralli,” “Sir Andrew Walker, Bart.,” “Charles Moxon, Esq.,” ” Mrs Orchardson,” ” Conditional Neutral- ity” (a portrait of Mr Orchardson’s eldest son as a boy of six), “Lord Eookwood,” “The Provost of Aberdeen,” and, above all, “Sir Walter Gilbey, Bart.,” would all deserve a place in any list of the best portraits of the 19th century. In this branch of art the ” Sir Walter Gilbey,” may fairly be called the painter’smasterpiece, although the sumptuous full-length of the Scottish Provost, in his robes, runs it closely. The scheme of colour is reticent ; had the picture been exhibited after 1900 the colour would have been called khaki ; the design is simple, uniting nature to art with a rare felicity ; and the likeness has }ieen found satisfactory by the sitter’s friends. The most important commission ever received by Mr Orchardson as a portrait-painter was that for a group of Queen Victoria, with her son (afterwards King Edward VII.), grandson, and great-grandson, to be

painted on one canvas for the Royal Agricultural Society. The painter hit upon a happy notion for the bringing of the four figures together, and as time goes on and the picture slowly turns into history, ;ts merit is likely to be better appreciated.

Orchardson's method is that of one who works under a creative, decorative, and subjective impulse, rather than under one derived from a wish to observe and record. His affiliation is with Watteau, and Gainsborough, rather than with those who would base all pictorial art on a keen eye for actuality and " value." Among Erench painters his pictures have excited particular admiration. t Orchha, or Uechha (also called Tehki), a native state of Central India, in the Bundelkhand Agency. Area, about 2000 square miles ; population (1881), 311,515 ; (1891), 333,020, showing an increase of 7 per cent. Esti- mated gross revenue, Es.9,00,000 ; no tribute. The town of Orchha, the fojmer capital, is on the river Betwa, not far from Jhansi. It contains an imposing fort, with a palace. The town of Tehri, where the chief now resides, is about 40 miles south of Orchha. Population (1881), 18,344 ; (1891), 17,610. It contains the fort of Tikam- garh,.by which name the town is sometimes called.

Orders of Knighthood. â€" The article Knight- hood in the ninth edition of this work, in the course of a general historical sketch of the origin and institution of orders of chivalry, describes in some detail the lead- ing British, and refers incidentally to certain of the more illustrious foreign, orders.

When orders ceased to be fraternities, and became more and tmore marks of favour and a means of recognizing meritorious services to the Crown and country, the term "orders" became loosely applied to the insignia and decorations themselves. Thus " orders," irrespective of

the title or other specific designation they confer, fall in Great Britain generally into three main categories, accord- ing as the recipients are made "Knights Grand Cross" (having for their outward adornment a cross or star and ribbon, worn over the shoulder), "Knights Commanders" (with a star or other badge, but with the ribbon worn round the neck), and "Companions" (who have a badge only, but no

star). In some orders the classes are more numerous, as in the Royal Victorian, for instance (vide infra), which has 5, numerous foreign orders a like number, some 6, while the Chinese “Dragon” boasts no less than 11 degrees.

Orders may, again, be grouped according as they are (1) Peime Oedees op Christendom, conferred upon an ex- clusive class only. Here belong, inter alia, the well-known orders of the Garter (England), Golden Fleece (Austria and Spain), Annunciata (Italy), Black Eagle (Prussia), St Andrew (Russia), Elephant (Denmark), and Seraphin (Sweden). Of these the first three only, which are usually held to rank inter se in the order given, are historically identified with chivalry. (2) Family Oedees, bestowed upon members of the royal or princely class, or upon humbler individuals according to classes, in respect of ” personal ” services rendered to the family. To this category belong such orders as the Royal Victorian and the Hohenzollern (Prussia). (3) Oedees of Meeit, whether military, civil, or joint orders. Such have, as a rule, at least three, oftener five, classes, and here belong such as the Order of the Bath (England), Red Eagle (Prussia), Legion of Honour (Prance). There are also cer- tain orders, such as the recently-instituted Order of Merit (England), and the Pour le mArite (Prussia), which have but one class, aU members being on an equality of rank within the order.

Of the seven British orders of knighthood which existed in 1883, three â€” the Garter, the Thistle, and the St Patrick â€” still remain within their former limits, while the Bath, the St Michael and St George, the Star of India, and the Indian Empire have been all exceeded, and the last named enlarged.

Until recently Great Britain had, practically, but one order for the recognition of civil merit in the home country, that of the Bath â€” the Garter, Thistle, and St Patrick being confined to nobles, the St Michael and St George generally to colonial dignitaries and officials, the Star of India&ni the Indian Empire to princes and officials connected with that country. The closing years of the reign of Queen Victoria and the first two of the reign of King Edward VII. saw the institution of several British orders, the leading characteristic of which may be said to

consist in a tendency to I recognize merit without conferring knighthood ; that is, that while the designation in the form of letters to be appended to the name of the recipient denotes membership of the order, the style or appellation of knight is absent.

77ie Most Eminent Order of the Indian Empire, which from its institution down to 1887 consisted of one class only â€” Companions â€” was, however, on the occasion of the Queen's Jubilee enlarged by the addition of the two higher classes of knights, viz., Knights Grand Commanders (G.C.I.E.) and Knights Commanders (K.C.I.E.), yet these two classes are less regarded as orders of merit than as conferring a certain social precedence.

The Royal Victorian Order was instituted by Queen Victoria on the 25th April 1896, and conferred for per- sonal services rendered to her late Majesty and her succes- sors on the throne. It consists of a sovereign, chancellor, secretary, and five classes â€” ^knights grand commanders (G.C.V.O.), knights commanders (K.C.V.O.), commanders (C.V.O.), and members of the fourth and fifth classes (M. V.O.), the distinction between these last divisions lying in the badge and in the precedence enjoyed by the

members. The knights of this order rank in their respective classes immediately after those of the Indian Empire, and its numbers are unlimited. The precedence enjoyed by its commanders tends to support the view above expressed that membership of an order shall, as denoting inclusion in a select brotherhood or fraternity, be held more in honour than heretofore, and knighthood regarded more as an incident than an essential.

To the class of orders without the titular appellation " knight " belong (1) the newly-cieated Order of Merit, founded by King Edward VII. oh the occasion of his coronation, fixed for 26th June 1902, but, owing to the King's serious illness, postponed to 9th August. The order is

founded on the lines of the Prussian Ordre pour le mirite (q.v. infra), yet more comprehensive, in- cluding those who have gained distinction in the military and naval services of the Empire, and such as have made themselves a great name in the fields of science, art, and literature. The number of British members has been fixed at twenty-four, with the addition of such foreign persons as the Sovereign shall appoint. The nature of the order may be seen from the names of the re-cipients : â€" Earl Roberts, Viscount Wolseley, Viscount Kitchener, Sir Henry Keppel, Sir Edward Seymour, Lord Lister, Lord Rayleigh, Lord Kelvin, Mr John Morley, Mr Lecky, Mr G. F. Watts, and Sir William Huggins.

(2) The Imperial Service Order was likewise instituted on 26th June 1902, to commemorate King Edward's coronar tion, and is specially designed as a recognition of faithful and meritorious services rendered to the British Crown by members of the Civil Service in various parts of the Empire, and is to consist of companions only. The numbers are limited to 426, of whom 250 belong to the home and 175 to the civil services of the colonies and protectorates. The members of the order have the dis- tinction of adding the letters I.S.O. after their names.

(3) The Distinguished Service Order, an order of military merit, was founded on the 6th of September 1886 by Queen Victoria, its object being to recognize the special services of officers in the army and navy. Its num- bers are unlimited, and its designation the letters D.S.O. It consists of one class only, who take pre- cedence immediately after the 4th class of the Royal Victorian Order.

In addition to the above, there are two British orders confined to ladies. The Royal Order of Victoria and Albert, which was instituted in 1862, is a purely court distinction. It consists of four classes, and it has as designation the letters V.A. The Imperial Order of the Orown of India is conferred for like purposes as the order of the Indian Empire. Its primary object is to recognize the services of ladies connected with the Court of India. The letters C.I. are its designation.

Among decorations which are constantly seen, and are not " orders," may be mentioned the Victoria Cross for conspicuous bravery in battle,

having as its designation the letters V.C. ; the Royal Red Cross, instituted in 1833 for the purpose of rewarding services rendered in nursing the sick and wounded of the army and navy. It is confined to ladies, whether subjects or foreigners. The Volunteer Officers' Decoration, in recognition of twenty years' service as officers of the volunteer force ; the Kaisar i Hind Medal for public services in India, con- sisting of two classes; the naval Conspicuous Service Cross, established 15th June 1901 ; and the Albert Medal for saving life, consisting of two classes.

The order of St John of Jerusalem (or Knights of Malta), closely allied to, if not actually identical with, the Teutonic orders of Austria, the Netherlands, and Prussia, (vide ivfra), was instituted in 1048 as an order of knighthood in the Hospital of St John at Jerusalem.

The fraternity emigrating in 1309 to Rhodes became known as that of the "Knights of Rhodes," and was in 1330 divided into eight languages, England taking sixth place. In 1530 it established itself at Malta, whence the name " Knights of Malta " (a Maltese cross being still the badge). During the ensuing centuries it decayed in importance, and, on the death of the Grand Master Era Thomasi de Cortone in 1805, virtually ceased to exist. It was, however, revived in 1879, and the parent stem now flourishes in Malta. A branch became established in England at the Priory of St John, Clerken- well, its present habitation, about the year 1100, as a charitable brotherhood for the relief of necessitous pilgrims to the Holy Land ; and the main object of its institution was pursued under various forms until 1830, when it was revised for the purpose of performing charitable and ambulance work. Originally a Catholic order, in 1888 a royal charter of incorporation was granted, and it now, although not conferring any style like a rank or distinc- tion, exists as a properly-constituted order. The sovereign head and patron of this order is the King ; the present Grand Prior is the Prince of Wales; Baliif of Egle, duke of Connaught. It has executive officers, knights of justice (and honorary), ladies of justice (and honorary), chaplain, knights of grace, ladies of grace, and equerries. Its badges â€" a Maltese cross and medal (according to the classes) â€" may be worn in England.

The following is a list of the better-known foreign orders : â€”

Austria-Hungary. â€” (1) The order of the Golden Fleece, above referred to, consists of 1 class only, and was instituted in 1429 by Philip the Good, duke of Burgundy, its statutes dating from the following year. It is common to Austria and Spain, and is conferred only upon members of sovereign houses and the highest nobles in the two countries. (2) The royal, Hungarian order of St Stephen, instituted in 1764 by the Empress Maria Theresa, con- sists of the Grand Master (the sovereign), twenty knights grand cross, thirty knights commanders, and fifty knights. The ribbon is crimson with two green stripes. (3) The Austrian Iron Cross, founded by Napoleon I. as king of Italy in 1805, consisting of 3 classes, and conferred for personal merit. (4) The Teutonic Order of Chivalry, founded, it is said, in 1190 by Duke Frederick de Souabe, abolished by Napoleon in 1809, was revived in 1834. It is akin to the British order of St John of Jerusalem, and is conferred upon Roman Catholics (gentlemen and ladies) who devote them- selves to the interests ot the ambulance service. (5) The order of the Starry Cross, limited to high-born ladies, was instituted in 1668 by Eleanor, widow of the Emperor Ferdinand III., in per- petual commemoration of the discovery of a piece of the true cross.

Besides those enumerated, there are several orders given for personal merit, such as the military orders of Maria JTieresa, Elizabeth Theresa, and the Leopold.

Belgium. â€” Order of Leopold, of 5 classes, instituted by King Leopold I. in 1832 for civil and military merit. The civil Iron Cross, instituted in 1867, and the military cross (2 classes) dating: from 1886. There are also 4 ordere connected with the Congo State, instituted by Leopold II., viz., the African Star (6 classes), the jRoyal Lion (6 classes), the Congo Star, and the Order of the Crown.

Bulgaria.â€” The principal order is that of St Alexander, insti- tuted in 1881, of 6 classes.

Cliina.â€”The order of the Double Dragon, originally founded in 1862 as that of the Imperial Dragon, to reward the services of foreigners in

Chinese service, was reorganized in 1882 and has 5 classes, the first 3 being each again subdivided into 3 grades.”

Denmark.â€” The Order of the Elephant, said to have been instituted in 1464 by King Christian I., and remodelled in 1693 by Christian V., has only 1 class of about 30 knights, in addition to princes of royal descent. Its distinguishing ribbon is watered light blue. (2) The Dannebrog, an order of merit in 5 classes, said to have been founded in 1219 by Waldemar II., was re- modelled in 1693, and again in 1808. Its distinguishing ribbon is white with red edging.

France.â€” The Legion of Honour, instituted in 1802 by Bona- parte, first consul, was enlarged and its statutes modified in, 1816 and 1852, and is, apart from some military decorations and a few colonial orders belonging to vassal states, such as Annam, Cam- bodge, Porto-Novo, &c., the only order now conferred in France. There are 5 classes, and the ribbon is crimson.

Germany. â€” All German sovereign states have orders in the sense of decorations or badges bestowed for civil or military merit, but certain of the principal countries possess orders vfhich are held in great esteem, viz. : â€”

1. Anhalt. â€” The order of Albert the Bear, instituted in 1836, but possibly, as is claimed for it, dating back to the Crusades, and lately revised, has 5 classes.

2. Baden has 3 illustrious orders : Order of Fidelity, instituted 1715 by the Margrave Charles William ; the military order of Charles Frederick (3 classes), founded in 1807 ; and that of the Zahringen Lion (5 classes), founded in 1812, of which, however, the original first class has since 1877 been instituted as a special order of 4 classes under the name of Berthold I.

3. Bavaria has the high order of St Hubert (founded in 1444 by Gerhard V.) , limited to members of the Royal House of Bavaria and to foreign sovereigns and to nobles ; ribbon red, watered, with green edging. The St George, instituted during the Crusades in the Holy Land, later revised by Maximilian I. at the end of the 15th century but revised by the Elector Charles Albert in 1729, is confined to Roman Catholics and to such as have no other order. In addition to the military Order of Maximilian Joseph (3 classes), and the 4 illustrious ladies' orders of Theresa (1827), St Elizabeth (1766), St Anne of Munich (1784), and St Anne of Wurzburg (1803), Bavaria possesses several minor orders and decorations for military and civil merit.

4. Brunswick. â€" Henry the Lion (founded in 1834 by the Duke William) has 5 classes, in addition to a cross of merit of 2 grades.

5. Hanover. â€" The Order of St George (1 class only) was insti- tuted in 1839. by King Ernest August I., as the family order of the House of Hanover ; the Boyal Guelphic Order (3 classes) was founded in 1815 by George, Prince Regent, and afterwards King George IV. of Great Britain ; the order of Ernest Augustus, instituted by King George V., 1865. These orders have not been conferred since 1866, when Hanover ceased to be a kingdom, and the Boyal Guelphic Order, which from its institution is more Eng- lish than Hanoverian, not since the death of King William IV. in 1837. The sole surviving British Knight Grahd Cross (G.C.H.) is his Royal Highness Field- Marshal the duke of Cambridge.

6. Hesse-Darmstadt, grand-duchy, has 2 grand orders, the Golden Lion (instituted 1790), consisting of 1 class only, and the Order of Louis (1807), of 5 classes. The first named is, with few exceptions, conferred only upon such as are members of the grand- ducal house of Hesse-Darmstadt and the electoral house of Hesse- Cassel, which ceased to be a reigning house in 1866.

7. Mecklenburg (Schwerin and Strelitz). â€" These gi'and -duchies jointly possess 1 order, that of the Wendish Crown, founded in 1864 by the Grand Dukes Frederick Francis and Frederick William. It consists

of 3 classes, a cross of merit, and a grand cross of the first class for ladies of Schwerin.

8. Oldenburg. â€” Order of Merit, of tvvo divisions, each of which has 5 classes, conferred for distinction in art and science.

9. Prussia has 5 principal ordersâ€” the Black Eagle, founded in 1701 by the Elector Frederick I. to commemorate his connexion as King of Prussia ; it is bestowed only upon such as are of royal lineage and upon high officers of state. It is limited to knights, ex- clusive of ^princes, and confers the title "von" of hereditary no- bility ; the ribbon is orange. Order of the Bed Eagle, instituted in 1705 by George William, hereditary prince of Brandenburg-Bay- reuth, was reorganized in 1712, 1810, and lastly in 1861, and, con- sisting of 5 classes, is given for civil and military merit. Order of the Crown (4 classes), founded in 1861 by King William I., is con- ferred for merit on the field of battle. Order of Merit, military and civil, originally founded by the Elector Frederick in 1667, was remodelled in 1740 by Frederick II. , under the title of Ordre pour le mirite, and in 1842 Frederick William IV. added a special civil class for merit in arts and sciences. This order has always been highly prized, and it is worthy of note that it is the only distinc- tion which Thomas Carlyle would accept. The family Order of the House of Hohenzollern (instituted 1851) ; the Johanniter Order or Order of St John of Jerusalem {vide supra"), instituted in 1812, a revival of the old order of the Hospitallers. Of ladies' orders Prussia has that of Louise (instituted 1814), of 2 classes.

10. Saxony, Kingdom of â€" The Order of the Crown of Rue {Bauten-Krone), founded in 1807 by King Frederick Augustus. It has but one class ; ribbon watered green. The military Order of St Henry, for valour on the field, founded 1736, has 4 classes. The Albert Order {Albrecht Orden), founded 1850, originally instituted as a distinction for merit in arts and sciences, has been enlarged by the addition of a military class. The Order of Sidonia (in- stituted 1870 for services during the war) is conferred on ladies.

11. Saxon Duchies, including Saxe-Altenburg, Saxe-Coburg- Gotha, and Saxe-Meiningen, have in common a general order of merit in 4

classes : that of Ernest, founded 1690 by Duke Frederick I.

12. Saxe-Weimar has as its principal order that of the White Falcon (founded 1732), which is by its statutes confined to twenty- four illustrious personages in the civil and military service.

13. Wurtemberg. â€” The Order of the Crown of Wurtemberg, instituted in 1818 by King William I., has been frequently remodelled, and now consists of 5 classes.

Greeceâ€”The Order of the Bedeemer, founded in 1829 by the fourth General Assembly of the Greeks at Argos, and modified and enlarged by King Otho in 1833, consists of 5 classes, and is a general order of merit.

Holland.â€” The Order of the Netherlands Lion (instituted 1815), to reward civil merit, consists of 3 classes ; the Order of William (instituted 1815) for military merit; and the family order of the House of Nassau, the Golden Lion (instituted 1858). The Teutonic Order (Ballei Utrecht; see also under Austria), was established in the Netherlands by the States-General in 1580; abolished by Napoleon I. in 1809, it was revived by King William I. after Waterloo. It has 3 classes.

Italy. â€” The Order of the Annunciata, said to have been founded in 1355 by Amadeus VI. of Savoy, frequently modified, last in 1809, when the number of knights, exclusive of foreign recipients, was limited to twenty, consists of 1 class only. St Maurice and Lazarus, instituted in 1434, when the ” Lazarus,” sup- posed to have been founded in the Holy Land in 1000, was merged into the later creation, consists of 5 classes, and is bestowed for meritorious services in all capacities rendered to the state. The numbers are unlimited. The Military and Civil Orders of Savoy, the former of 4 classes, instituted in 1815, and the latter instituted in 1831, of 1 class only, and limited to sixty knights “who have deserved well of their sovereign and their country.” The Crown of Italy, founded in 1831 to commemorate the incorporation of Venetia, has 5 classes, and its numbers are practically unlimited.

Japan. â€” The Sublime Order of the Chrysanthemum, of 1 class only, and practically limited to sovereigns and members of reign- ing houses, was founded in 1876 by the Emperor Mutsu-Hito. The Eastern Sun (instituted in 1876), for civil and military merit, has 8 classes ; the Order of the Crown (instituted 1888), 5 classes for ladies.

Luxemburg. â€” The Golden Lion (see Holland), the civil and military order of Adolphus of Nassau (instituted 1858), has 4 classes; to it is attached a special cross of merit for arts and sciences, of 2 classes ; the Oaken Crown (instituted in 1841), remodelled in 1858, and consisting of 5 classes ; it is conferred as a general order of merit. /

Monaco. â€” The Order of St Charles, of 6 classes, founded by Prince Charles III. in 1863.

Montenegro. â€” St Peter (instituted 1852), 1 class only, for members of the princely family; Danilo (1855), for merit, of 5 classes.

Papal. â€” Of the seven orders bestowed by the Pope, two stand out pre-eminent in respect of antiquity of foundation and general estimation: that of the Holy Sepulchre ranks with that of St John of Jerusalem (,q.v.), being instituted almost simultaneously with that order and for like objects. It derives its name from the fact that investitures took place in the Holy Land. Sup- posed to date from 1099, it was revived by Benedict XIV. in 1746, and remodelled by Pius IX. in 1868. It has 3 classes. Order of Christ, instituted in 1318 by St Denis to replace on its abolition the order of Knights Templars. It has 1 class, and is conferred also by Portugal, the limitation there being to such only as are of noble lineage. The Holy See also has the orders of Pius IX. (instituted 1847), of 2 classes; St Gregory the Great (instituted 1831), 4 classes; and St Sylvester, of 2 classes (instituted 1559), conferred for services to the Roman Catholic Church.

Persia. â€” Order of the Sun and the Lion, instituted in 1808 by the Shah Fatu All for merit, has 5 classes. Order of the Nichane- Aftab for ladies, instituted in 1873 by Nassir-ed-Din. There is also a medal (in 4 classes) for science and art.

Portugal. â€” Order of Christ (see preceding notice under Papal) ; the military order of St Benedict of Aviz, founded in 1158 under the designation of the Order of Calatrava, was transferred to Aviz in 1187, and changed in 1789 into an order of mihtary and civil merit, with 3 classes; St James of the Sword, jointly with Spain, where it was founded in 1175, since 1862 has 5 classes, and is conferred for science, literature, and art; Tower and the Sword, for merit, with 5 classes (since being remodelled in 1832), was instituted by Alphonso V. in 1450; St Isabella, a ladies' order, was founded in 1801.

Bumania. â€" The orders in this country^ are of recent founda- tion, and are two in number : Order of the Star (instituted 1877) , for civil and military merit, has 5 classes ; Order of the Crown of Bumania, founded in 1881, also of 5 classes.

Bussia.â€"The St Andrew, founded in 1698, by the Tsar Peter L, is the highest order, and admission to it confers also member- ship of the orders of St Anne, Alexander Newsky, and the (whilom) order of St Stanislas of Poland. These Russian orders likewise bestow a patent of hereditary nobility. The order of St Andrew is of 1 class only, the ribbon sky blue, watered ; St Anne,

founded in 1735 by Charles Frederick, duke of Schleswig- Holstein Gottorp, was in 1797 made a Russian order by the Emperor Paul, and has 3 classes ; Alexander NewsTcy is of 1 class only, and. was founded by the Empress Catharine in 1725; the order of St Stanislas (of Poland), instituted in 1765 by King Stanislas II., revived by the Emperor Alexander in 1815 as a Russian order, has 4 classes. The White Eagle, also originally of Poland, where it is supposed to have been founded in 1325, was in 1831 revived as a Russian order. It has 1 class only. There are also the orders of St Catharine (instituted 1714) for ladies, and the St Vladimir for bravery, in addition to minor orders, medals, &c.

Seroia. â€” Orders of St Lazarus, worn only by the king ; White Eagle (5 classes), founded in 1883 by King Milan I. ; Takovo, for distinguished services in the cause of Servian independence, founded 1865 by Prince Michel Obrenovitch IV. (5 classes) ; St Sava, bestowed for literature, art, and science, instituted 1883, has 5 classes ; Miloch the Great, instituted by King Alexander I. for distinguished services.

Siam. â€” The Star of the Nine Precious Stones, exclusively conferred upon Buddhists, founded in 1869 ; the White Elephant, instituted in 1861, consists of 5 classes. In addition to these two chief orders there are the Maha Chakri, of 2 classes, instituted 1884, and conferred only on personages of princely rank ; the Mongut-Siam, of 5 classes, instituted 1869 ; the order of Chulachonclao, of 3 classes, conferred only on natives, and a medal, 2 classes, founded 1887, for art and science.

Spain. â€” The Golden Fleece (vide Austria-Hungary, supra) ; the Order of Calatrava, founded in 1158 by King Sancho III. to commemorate the recovery of that town from the Moors, and confirmed in 1164 by Pope Alexander III., is an essentially military order; that of Alcantara, founded in 1156 by the brothers Don Suero and Gomez Fernando Barricutes under the name of order of St Julian, was confirmed in 1177 by Pope Alexander, and on the capture of the town of that name in 1213 became known as that of Alcantara. St James of the Sword, or Compostella, was instituted in 1175 to commemorate the finding at Compostella of the bones of the patron saint of Spain. It is purely military. The grandmastership of these last three orders was vested in the Crown of Spain by

Charles V. in 1523. In addition to the above and the military order of Malta, or John the Baptist (vide supra, order of St John of Jerusalem), Spain has the orders of St Ferdinand (instituted 1811 by the Cortes) ; Notre Dame de Montesa (instituted 1319 by James II., king of Aragon), purely military ; St Hermenegilde (instituted 1814), military ; the royal order of Isabella the Catholic,

3 classes (instituted 1815 by King Ferdinand VII.) ; Isabella IL (instituted 1833) ; the Illustrious Order of Charles III., 4 classes

(instituted 1771) ; three naval and military orders of merit; the ladies' order, Maria-Louise (instituted 1792), for noble ladies ; and the order of Bienfaisance, for distinguished and humane services, in 3 classes.

Sweden.â€" Order of the Seraphim (blue ribbon), said to have been founded in 1285, and reinstituted in 1748, consists of 1 class, and is limited to twenty-four Swedish and eight foreign members. Order of the Sword (yellow ribbon), instituted m 1522 by Gustavus Wasa, and remodelled, the last time in 1814, has 6 classes ; order of the Pole Star (black ribbon), has now

4 classes, and was founded in 1748 and remodelled in 1844 ; the Order of Wasa (green ribbon), instituted in 1772, has 6 classes ; Charles XIII., for Freemasons of the higher ranks, has a red ribbon.

iVbnoot/.â€" Order of St Olaf, founded in 1847, has 5 classes, and is a general order of merit.

Turkey.â€" Mchan-i-Iontiaz, an order of merit, of 1 class only, instituted in 1879 by Abdul Hamid II. ; Nichan-i-Iftikhar, or Order of Glory, instituted in 1831 by the Sultan Mahmoud II. ; the Imperial Order of the Osmanie, instituted in 1862 by Sultan Abdul Aziz, has (since 1867) 4 classes ; the Medjidie, founded in 1851, has 5 classes, and is largely bestowed, the lowest class con- sisting of more than 6000 member.s, irrespective of foreigners ; order of Hanedani-al-Osman, of 1 class only, instituted in 1895, and conferred solely on Turkish princes ; the ladies' order of Nichan-i-Chefakat (instituted in 1878) has 3 classes.

The writer is much indebted to Sir Albert W. Woods, K.C.B., Garter King of Arms, for kind assistance in the portion of the article affecting the British Empire. In compiling the list of foreign orders the Almanack de Gotha has been largely utilized. (p. a. A.)

ORDI^A^CE.

I. Naval Gunnbbt (British).

THE ordnance carried in recent British warships ranges from the 12-inch 46-ton gun forming the armament of the turrets of the Majestic class of battleship to the rifle- calibre Maxims carried by all ships for the armament of their boats and as field guns. The heaviest gun actually afloat in the British navy is the 16-25-inch B.L. gun of 111 tons, two of which are mounted in the Benbow and two in the Sanspareil. Though in themselves efiicient weapons, the great weight of these guns limited the number carried in any ship to two, and owing to the undesirability of risking so large a proportion of the armament if an accident occurred to one of these guns, the type has not been, and is not likely to be, repeated. The next gun in point of weight is the 16-inch M.L. 80-ton gun, of which four are mounted ia the Inflexible; this gun was the last developmentof the obsolete muzzle-loading principle. The 13-5-inch B.L. 67-ton gun forms the turret or barbette armament of many of the battleships which, if not quite in the first rank in view of the very rapid development of battleship construction in recent years, are at any rate worthy of a place in the line of battle in the most powerful squadron afloat. These guns form the barbette armament of the six battleships of the Royal Sovereign class, and are mounted in the turrets of the Hood, Nile, and Trafalgar. In the Majestic class and subsequent classes of battle- ships the 12-inch 46-ton gun has been substituted for the 13-6-inch gun.

As compared with the 13-5-inch gun, the 12-inch offers the following advantages : â€”

1. Beduced Weight. â€” This must always be a most important consideration governing the choice of guns for the sea service. Not only is the weight of the gun itself a matter of importance, but a lighter gun will admit of lighter Ipading appliances and

mounting ; a smaller area of armour will be required for its pro-tection, and its ammunition will be lighter. The saving of weight in the armament can then be devoted to improved armour protection, increased supply of ammunition, or to increased strength of hull or weight of propelling machinery.

2. Improved Facility of Working. â€” It is obviously an advantage that as much as possible of the working of the gun should be performed by manual labour, provided that the rapidity of fire is not diminished, and that those operations for the performance of which hydraulic or other power is employed should be capable of being performed, in the event of the failure of such power, by manual labour. In practice the breech of the 12-inch gun is always opened and closed by hand, while every other operation in loading and firing the gun can be similarly performed in case of breakdown of the hydraulic arrangements. In the case of the 13-5-inch guns, though the operations of opening and closing the breech and of loading can be performed by hand, the means of doing so are exceedingly inconvenient and involve considerable reduction in the rate of fire, while for the other operations of elevating the gun, running it in and out, and training the turret, is the gun entirely dependent on hydraulic power. In the British navy hydraulic power is universally used for the manipulation of the heaviest guns, though in several foreign navies electricity is preferred. The chief advantages of hydraulic power are noise- lessness, and facility in locating the cause of a failure.

3. Increased Sapidity of Fire. â€” Improvements in the form of mounting, the reduced weight of the projectile, and the substitu- tion of a cordite charge for the heavier powder charge, have diminished the time required to load and fire a round from 2 min. 30 sees, to about 1 minute.

4. Improved Ballistics. â€” The advance in the sciences of gun construction and of explosives has enabled tlie ballistic power to be so increased that the penetrative power of the 12-inch gun is slightly greater than that of the 13-5-inch, in spite of the reduction in the weight of the projectile.

5. The possibility of loading the guns in any position of the turret. To load the 13-5-inch guns it was necessary to train the turret (or barbette) to a fixed position, in which the hydraulic rammers, which were entirely outside the turret, could ram the projectile and charge into the gun. The arrangements for this “fixed loading position” are found in

the eai-lier ships of the Majestic class, but are accompanied by arrangements for loading

naval]

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the guns in any position of the turret by means of hydraulic rammers. ‘ In addition to the gain in rapidity of loading, the guns can be kept continually pointed in the direction of the enemy, and will thus expose the smallest possible target to his fire. Fig. 1, which has been kindly supplied by Sir W. G. Armstrong, Whitworth and Co., shows a 12-inch gun with its mounting and loading arrangements as fitted in the Canopus class of battleships. Authorities differ as to whether the armoured structure shown in Fig. 1 is more properly designated a ” turret ” or a “barbette.” A turret is essentially a circular armoured structure which pro-

tects the breech portion of the guns and revolves with them, and in which elliptical ports are cut, through which the guns pass ; while the armour of a barbette is fixed, the whole of the gun when in its firing position being above it and unprotected, the barbette armour protecting the loading and other maohineiy only. The turret system involved a much greater weight’ of armour and, as this weight could not be carried high up in the ship, a less height of the guns above the water-line, and consequently increased difficulty in fighting them in a heavy sea. It was considered that these disadvantages were too great a price to pay

Fig. 1. â€” ^Diagram of a 12-iiich Gun, with Mounting and Loading’ Arrangements. A, Slide ; B, recoil cylinder ; C, eleyating cylinder ; D, sighting hood ; E, hydraulic turning engine ; F, brake on turning shaft ; G, winch handles for turning by hand-power ; H, training rack ; J, ammunition trunk ; K, cartridge hoist ; L, hydraulic and hand arrangements for lifting shell in shell-room ; M, platform for working hand-winch for shell hoist ; N, hydraulic cylinder and ram for raising

shell to shell chamber; P, shell chamber; Q, loading-hoist; R, hydraulic cylinder and ram for working loading-hoist; S, travelling crane ; T, hand-winch for working loading-hoist ; U, hydrauUc rammer ; V, hand-loading arrangement ; W, hand-loading chamber ; X, securing bolt ; T, buffer stop ; Z, Z, rollers.

for the protection of the breech portion only of the guns, and the barbette system has therefore been almost universally adopted in British naval construction since 1890. In the Majestic class and subsequent battleships, while the guns are entirely above the thick fixed armour, they are protected by a shield revolving with them, and the thickness of this shield, which varies from lOJ inches in front to 4 inches in rear, is such that it is a moot point whether it is justifiable or not to designate it a "turret."

The 12-inch gun shown in Fig. 1, known as Mark VIII., forms the main armament of all the most recent British battleships. The 12-inoh Mark IX., which embodies certain improvements in breech mechanism an4 ballistics, is mounted in the Formidable and her sisters.

The modem gun next in size to the 12-inch is the 10-inch, weighing 29 tons. It was adopted for the "main armament" of three battleships only, the Benown, Barfleur, and Centurion, and is worked entirely by hand, the barbettes in which the guns

are mounted (in pairs) being trained by steam. The lO-inch gun has also been used in the re-armament of the Thunderer and Devastation, which originally had M.L. guns in their turrets ; but no more are being made.

The object of the main armament of battleships, generally speaking, is to pierce the heavy armour of the enemy, and to inflict damage on his materiel by the explosion of heavy shell. The object of the secondary armament, composed in all British modem battleships of 6-inch Q.F. guns, is to demoralize the enemy by a rapid and continuous shell fire.

Modern first-class cruisers have in some cases a couple of 9'2-inch guns mounted forward and aft, and capable of training from right ahead

and right astern respectively through an arc of about 120Â° on either side. These guns are known usually as “chase guns” and their objects are, in

the first place, to enable the cruiser to deliver a very- heavy blow when chasing or being chased, with accuracy at long ranges, and secondly, to pierce the armour of battleships or armoured cruisers and to inflict serious damage on their maUriel by the explosion of heavy shell.

The 9-2-inoh guns are worked entirely by hand, with the exception that the turn-tables on which they are mounted are in some cases turned by electricity. In the British navy they are not known as “quick-firing” guns, although their rate of fire probably compares favourably with similar guns in foreign navies which are called ” quick-firing.”

Mention should also be made of the 8-inch Q.F. gun, the designs of which are due to the Elswick firm, and which has been largely utilized by them in the armament of the cruisers they have built for foreign Powers. The gun has not, however, been adopted in the British service. Four rounds have been fired from this gun in 64 seconds.

The 6-inch Q.F. gun is the next modern gun, in order of size, to the 9-2-inch, and is used for the secondary armament of all British modern battleships, dating from the Boyal Sovereign class, and as it is also used in all recently-built first and second class cruisers, it exists afloat in larger numbers than any other gun.

It is also the largest gun whose projectiles, each weighing 100 ft, can be loaded into the gun by manual labour without thaÂ»aid of me- chanical appliances, and it is consequently the largest gun to which the ” quick-firing ” principle, properly so called, can be applied.

Comparing the 6-inch Q.F. gun, whose normal rate of aimed fire may be taken as about a round every 15 seconds, with its immediate predecessor, the so-called ” 6-inch B.L.” gun, firmg at an average rate of about a round every 45 seconds, there are the following differences of principle in the gun, mounting, and ammu- nition. (1) The charge is contained in a brass cylinder, instead of a silk clotb bag. This renders unnecessary the operation of sponging, required in the 6-inch B.L. to ensure no fragments of smouldering silk cloth remaining in the chamber after firing. (2) The gun recoils in a cradle to which the sights are attached, consequently the sights do not move as the gun recoils, and the gun layer is enabled to keep his eye continually along the sights. (3) By the adoption of the coned breech screw, or in the latest designs the “Welin” breech screw, the means of actuating the breech mechanism enables the motions of unscrewing and then turning the breech screw clear of the bore of the gun, in order that the gun may be reloaded, to be effected by a single motion of an ” actualing lever.” (4) The gun, with its mounting and shield, is balanced about a central pivot, and the gun and cradle are accurately balanced about the trunnions of the cradle, so that the labour of training the gun

Fia. 2.â€” Diagram of a 6-inch Q.F. Gun and Mounting. A, Bracket of carriage ; B, trunnion bearing ; 0, S-incli shield ; D, pivot piece ; E, bar and drum sight; F, shoulder-piece; 6, web-plate for supporting battery box; H, protecting shield; J, electi’ic iiring battery box; K, breech ring; L, training wheel.

and mounting and elevating the gun is reduced to a minimum. (5) The charge is fired by means of an electric primer screwed into the base of the brass cartridge case, against which the final motion of closing the breech causes the end of a striker to butt. The striker is insulated electrically, and forms part of the breech mechanism, and the effect of the arrangement is that the gun is ready to be fired immediately the breech is closed. In the B.L. guns a “tube ” was required to ignite the cartridge, which had to be inserted after the breech was closed. (6) The introduction of the brass cartridge case enables the rammer, which was used to push the projectile home to its place, to be abolished, the cartridge itself doing this duty.

The features above described differentiate the Q.F. from the B.L. gun, although all of them are not necessarily applied in any particular gun and^mounting. Thus in the latest type of (j-inch gun (known as the Mark VIZ.), which is mounted in the Formidable and her sisters, the cartridge case is not employed, the charge being contained in a silk cloth bag. Thus a sponge has to be employed, and a tube has to be used, which is, however, inserted with the breech open, so that its use does not entail delay. Fig. 2 shows a 6-inch Q.F. gun and mounting, as fitted to the Canopus class of battleships.

Naval nomenclature divides the Q.F. guns into two classes, the "heavy" and the "light." The "heavy Q.F." guns include the 6-inch, 4-7-inch, and 4-inch guns, the "lightQ.F." guns, thel2-prs., 6-prs., and 3-prs. In connexion with smaller guns than the 6-inoh, the question of ' ' simultaneous ' ' versus ' ' separate ' ' loading arises. In simultaneous loading, the projectile is secured into the mouth of the cartridge case, and cartridge and projectile are entered together, one operation being thus saved as against separate loading, in which cartridge and projectile are entered separately. Some foreign navies employ simultaneous loading with the 4-7-inch and all smaller Q.F. guns, but in the Royal Navy it has been adopted

only with the 6-prs. and 3-prs. There is a slight gain in rapidity of fire by its use, but on the other hand there are grave objections to the stowage of filled and fuzed shell in the same magazines as the cartridges, and ammunition supply is facilitated by the separate stowage and supply of projectiles and cartridges, as it is considered safe to keep a considerable number of projectiles in racks close to the guns, so that when a sharp burst of rapid fire is required for a short time, cartridges only have to be provided.

The 4-7-inch, 4-inch, and 12-pr. (3-inch) guns, and their mountings, are generally similar to the 6-inch, on a smaller scale. The 4-7-inch Q.F. gun is largely used in the armament of second and third class cruisers of modern types, while the 4-inch gun is used in third-class cruisers.

The general introduction of the heavy Q.F. gun may be said to date from 1890. There were at that time large numbers of 6-inch B.L. guns

in the service, and although after that date no new ships were armed with this gun, it was not feasible to re-arm with the Q.F. gun the ships designed for the B.L. gun. In addition to its greatly increased length, the change of mounting would have entailed great constructive alterations and considerable expense. The 6-inch B.L. guns have, however, been considerably altered with a view to improving their rapidity of fire. Practically all 6-inoh B.L. guns now afloat have been so altered, and they are known as ” Quick-Firing Converted,” or Q.F.C. guns.

In the British navy modern guns of calibres below that of 4 inches are designated in accordance with the weight of the projectile they fire. There are three modern guns of under 4-inch calibre, the 12-pr., 6-pr., and 3-pr., and thev are all light Q.F. guns. The principal duty of the light Q.F. gun in ” modern ship armaments is the repelling of torpedo-boat attack. They might also be used in a ship action for the attack of unprotected or partially protected guns’ crews and for the destruction of

unprotected parts of the hull and superstructure of the enemy by shell-fire. Opinions are, however, divided as to whether their effect in a ship action would be sufficient to warrant the exposure of their crews, as owing to the number of the guns, they are necessarily mounted in unprotected positions, and are protected only by shields. The 6-pr. was introduced about 1880 for defence against torpedo-boat attack, the 3-pr. being introduced at the same time as a lighter gun for the same purpose, capable of being more conveniently mounted in the tops, boats, and parts of the superstructure not sufficiently strong to withstand the effects of the recoil of the 6-prs. The rate of aimed fire with these guns is from ten to fifteen rounds per minute.

About 1893 the increase in size of torpedo-boats and the advent of the destroyer gave rise to a demand for a heavier projectile than that of the 6-pr. gun to ensure their disablement. The 12-pr. gun was therefore introduced for that purpose, and has taken the place of the 6-pr. in all ships built since that date. No 6-prs. are now being made except for the arpiament of destroyers, but the 3-pr. is retained for the armament of the fighting tops and of boats, and also for torpedo-boats. The mounting, breech mechanism, and loading and firing arrangements of the 12-pr. are generally similar to those of the 6-inch and other Q.F. guns. There are two 12-prs. in the service, known as the 12-owt. and 8-owt. guns. They are generally similar, except in length and in weight of charge of cordite. The 12-cwt. gun is that mounted on board ship for defence against torpedo-boat attack, while one or two 8-cwt. guns are carried in each ship for use as field guns, and as armament of the 42-feet launches, the largest puUing-boats carried. These 8-cwt. guns, whose energy of recoil is of course considerably less than that of the 12-owt. guns, are also provided with mountings on board the ship, whence they can be used as ship guns.

Machine guns for naval purposes do not differ from those used in the land service. They are supplied to ships primarily for the armament of the boats, and for landing as field guns.

All double-banked puUing-boats and steam-boats are fitted with arrangements for mounting one or two guns, according to the size of the boat ; the object of the boat armaments being for use in river operations or as guard boats, and for covering a landing. Three descriptions of gun are used, the 12-pr. 8-cwt. and 3-pr. light Q.F. guns, and the Maxim gun.

Ammunition. â€” Five descriptions of projectile are in use in the navy, in all cases the weights of the different natures of projectile for any gun being the same, in order that the ballistics of the gun may not vary.

These projectiles are the armour-piercing shot, and armour-pierc- ing, common (filled either with powder or lyddite) and shrapnel shell. The last-mentioned projectile may be dismissed from consideration in a few words. A small quantity only is supplied, for such special purposes as

covering a landing, or for use in a bombardment. Shrapnel would not be used in a ship action, and none is supplied for the most modern guns of large calibre, such as the 12-inch. A small proportion of armour-piercing shot is supplied to ships for all guns of 6-inoh and larger calibres. As their name implies, they are designed with a view to piercing the thick armour of the enemy, which protects her most vulnerable parts, such as her water-line and her engines and boilers. An armour- piercing shot striking a lightly armoured or unarmoured part of the enemy's side will do a comparatively small amount of damage, as its effect will be limited to its own path. Taking into consideration the extreme difficulty of striking the exact point aimed at when both one's own ship and the enemy are moving rapidly, and both the bearing and the range are quickly changing, it is not generally considered that the chance of injuring a vital part of the enemy Is compensated for by the small amount of damage which would be done if another part of her were struck. By far the larger proportion of the projectiles carried on board ship is composed of common shell, which may be looked upon as the projectiles, par excellence, of naval artillery. The design of a common shell provides for the maximum weight of bursting charge consistent with the walls of the shell being sufficiently strong to withstand the shock of discharge and the pressures in the bore of the gun. All the common shell constructed of recent years have pointed heads, and in the case of powder-filled shells are ignited by means of a percussion fuze screwed into the base of the shell. Shells filled with lyddite have their fuze in the nose of the shell, which is of course not pointed, as there appears to be a slight risk of â– Â» premature burst of the shell occurring with a base fuze, and this risk cannot be accepted in the case of lyddite shell. Common shells, whether filled with powder or lyddite, are only effective against very thin armour, or against the unarmoured portions of a ship's structure. A common shell, generally speaking, is capable of penetrating a thickness of mild steel armour equal to about \ of its calibre before bursting, and if it penetrates the ship's side, will burst from 4 to 10 feet in rear of it. An effective shell should on bursting break up into a number of fragments which

will be projected with great velocity in all directions, and it will probably set fire to any inflammable material in its vicinity.

The effect of common shell was shown in the battles of the Yalu and of Santiago. In the former case the Chinese sliips, with the exception of the two battleships, were wrecked by common-shell fire ; their guns were disabled, communications to the engine-rooms shot away, and personnel destroyed, and eventually the water- lines suffered so much that the ships sank, although intact below the protective deck. The Chinese ships were, as a rule, not provided with common shell, but one such shell bursting in the 4-7-inch gun battery of the Matsushima disabled three guns, exploded a quantity of 4-7-inch cartridges, and killed or wounded some seventy officers and men. At Santiago, although their water-line belts saved the Spanish ships from sinking, the ships were set on fire by the American shells ; and as the fire-mains were shot away, the fires could not be put out, and the ships had to be run ashore, after suffering enormous loss among the crews of their unprotected guns.

Comparing the effects of the lyddite and powder-filled common shells â€" the former will detonate with extraordinary rapidity on striking even a i^inch steel plate. If a lyddite shell strikes thin armour, its effect will probably be only a splash on the armour, as the detonation takes place before the shell has time to penetrate. If the shell strikes an unarmoured side, it will make a very large hole, and its 'effect inside the ship, though violent enough to pulverize everything in close proximity to it, will be much more local than that of a powder-filled shell, and as the lyddite shell breaks up into smaller pieces, it will probably do less damage to material than will be done by the larger pieces of the powder-filled shell. On the whole, the greatest effect will be obtained from lyddite shells when they strike and detonate on the funnel or other casings amidships. The large area of 4-inch and 6-inch armour employed in ships of recent construction for the protection of their secondary batteries and their ammunition supply has led to the introduction into the service of a third type of shell, known^as the armour-piercing shell. This shell is filled with powder, and differs only from the common shell in that its walls are thicker and consequently its

bursting charge smaller, generally about 5 per cent, of the total weight of the shell. The shell is made witli a special view to carrying its bursting charge through the thin armour of the enemy, and will penetrate before bursting about two-thirds of its calibre of mild steel ai-mour.

The adoption of smokeless powder has conferred greater advantages on the attack in the navy even than in the land service. With the large number of guns which are necessarily carried comparatively closely together on board ship, firing was frequently impeded by the clouds of smoke ; indeed, under certain conditions, such as a following wind, the advantage conferred by the increase in the rate of fire of Q.F. guns was well-nigh neutralized by the impossibility of distinguishing the target owing to smoke. The reduced weight of the cordite as compared with the powder ammunition is also an advantage of great value in the naval service.

Armaments. â€” The gun armament of a modern battleship is divided into four classes, known as the main, secondary, auxiliary, and machine-gun armaments. Some account has already been given of the guns constituting these four divisions : as far as the number of the guns is concerned, we appear in the battleships of the British navy to have reached a point at which there is a consensus of opinion that the general principles governing the number and disposition of the guns cannot be improved upon, since the four last classes of battleships built vary but very slightly in this respect. Taking the Canopus (Fig. 3) as a typical ship for description, her main armament consists of four 12-inch B.L. guns. These guns are mounted in pairs in turrets on the quarter-deck and forecastle, each turret having a total arc of training of 240Â°, the fore turret training from ahead through 120Â° in either direction, and the after turret from astern through 120Â° in either direction. This principle of mounting the heavy guns, which has for many years been that adopted in the British navy, has the advantages that while the ahead and astern fire is carried out over parts of the ship which would be unoccupied in action, and while the remainder of the armament would in no way be interfered with, it enables the whole of the four heaviest guns to be in action at the same time through an arc

of 120Â°, namely 30Â° before and abaft either beam. It is open to the disadvantage, which is, however, more apparent than real, that two of these guns only can be brought to bear ahead or astern. An alternative plan, which has been largely adopted in the French and other navies, for mounting the guns of the main armament is to have one gun only on the forecastle and one on the quarter-deck, the other two being mounted a|midships, one on either side, with arcs of training of 180Â°, namely, from ahead to astern. In theory this plan enables three guns to fire ahead and three astern, but in practice it is probable that so much damage would be caused to the superstructure, and the guns of the secondary armament would be so much interfered with if the 'midship guns were fired on or close to the middle line, that the advantage is a very doubtful one. The disadvantage that only three guns can

be brought to bear on or about either beam is undoubtedly a grave one.

The secondary armament, in the Canopus as in all the most modern British battleships, consists of twelve 6-inch Q.F. guns (Fig. 2). Four of these guns are mounted on the main deck and two on the upper deck, on each side. Each gun has an arc of training of 120Â°. The foremost upper-deck and the foremost main-deck gun on each side train from ahead to 30Â° abaft the beam, and the after upper-deck and after main-deck guns from astern to 30Â° before the beam, while the two middle guns on each side train from 60Â° before to 60Â° abaft the beam. Thus all the guns 'of the secondary armament can be brought to bear on or about the beam bearing, while four guns can train ahead and four astern. Bach gun is isolated in a separate casemate, protected in front by 6-inch and in rear by 2-inch armour, a system by which the maximum protection from shell-fire is obtained, and the disposition of the casemates is such that the fire of one gun cannot interfere

appreciably with the crews of adjacent guns. This point is one to which special attention has been paid in British ships, but the same cannot be said for many foreign battleships, in which the attempt to provide for a heavy bow and stem fire has led to a probability of considerable interference between adjacent guns.

The auxiliary armament of the Canopus consists of ten 12-pr. Q.F. guns, four of which are mounted on the main deck and six

on the upper deck. These guns are primarily intended to repel attacks by torpedo-boats, and are unprotected except by shields. It is doubtful whether they would even be manned in a ship action, as their crews would be exposed to almost certain destruc- tion, and they could exert no very great influence on the result of the action. In addition to the 12-pr. guns, three 3-pr. Q.F. guns are mounted in each of the fighting tops, on carriages which admit of being traversed throughout the circumference of the top. These guns also are of great value for repelling a torpedo- boat attack, and are used also for the armament of the larger boats. The machine-gun armament, consisting of eight rifle-calibre Maxims, is disposed as conveniently as possible about the bridges and superstructure. The guns are intended principally for the armament of boats, and it is highly improbable that they would be manned in a ship actio5. Fig. 3 shows the position of the roain and secondary armaments in the Canopus with their arcs of training. The armaments of first, second, and third class cruisers re- semble generally in principle those of battleships. The first- class cririsers carry in some cases a 9-2-inch gun at either end as their main armament, and in all cases their secondary armament is similarly disposed and protected to that of a battleship. The Europa class, however, carry no guns heavier than the 6-inch, the 9-2-inch guns being replaced by two pairs of 6-inch guns on the forecastle and quarter-deck respectively. These guns are protected by shields only, which are open in rear, and are

Fig. 3. â€” Plan of G-un Decks of H.M.S. CoTwpus.

undoubtedly extremely vulnerable ; it is, further, questionable whether a ship of the size of the Europa, which could not decline action with any

foreign cruiser, would not fight at a considerable disadvantage, having no gun of greater armour-piercing power than the 6-inch. The same remark applies to the somewhat smaller Kent class, but their 6-inch guns on the forecastle and quarter- deck are mounted in pairs in small turrets, and so are better protected. Recent second-class cruisers carry an armament of 6-inch and 4-7-uich guns. The latest and largest, i.e., the Hermes class, carry eleven 6-inch guns, while the Apollo class, which are some 2000 tpns smaller, carry a 6-inch on the poop and forecastle and three 4-7-inch guns on each side. All the guns of the second-class cruisers are on the upper deck, and are protected only by shields. Third-class cruisers, the class being known as the P class, from the initial letter of their name, carry 4-7-inch and 4-inch guns. The armament of torpedo-boat de- stroyers consists of a 12-pr. on the conning platform forward and five 6-prs. The small armament of the modern British cruisers has excited much controversy ; many foreign cruisers*, and notably some built at Elswick for the Japanese and Chilian Governments, carry a much greater weight of armament on the same or a smaller displacement. Thus the Japanese Asama and Tokiwa, of 9700 tons, carry an armament of four 8-inch and fourteen 6-inch guns ; whilst the British Drake class, of approximately the same dis- placement (9800), carry fourteen 6-inch guns only.

Organization. â€” The organization of a large ship for action is necessarily highly elaborate ; the complement is based upon it, and each man borne upon the books, what- ever duty he may perform in the internal economy of the ship, has his station and duty in action allotted to him.

The most important duty is, of course, that of manning the guns. Taking the Canopus again as a typical battleship, we find that twenty - two men are required as the ” turret’s crew ” to man each pair of 12- inch guns. Of these three the captain of the turret and the captains of the two guns are men specially selected for general smartness and aptitude, and as being quick and accurate shots ; a certain number more are seamen gunners trained in one of the gunnery schools at Portsmouth, Devonport, or Sheerness ; these men are required for the responsible duties of working the hydraulic levers other than those for

training the turret and elevating the guns ; while the remainder of the turret's crew are

usually younger men who have received only such gunnery train- ing as can be given on board their own ship, and are called ' ' trained men." The 6-inch guns are each manned by a crew of eight men, one of whom has been specially selected or trained and is known as the "captain of the gun," while the remainder of the gun's crew consists partly of seamen gunners, who perform the more important duties at the gun, and any one of whom is prepared to take the captain of the gun's place in case of necessity, and of " trained men." The 12-prs. have each a crew of four men, the 3-prs. of three, and the Maxims of two, one of whom at each gun is always a seaman gunner. A proportion of the guns, generally four 6-inch and four 12-prs., is allotted to the Royal Marines, who receive a training in naval gunnery similar to that given to the seamen, the Royal Marine Artillery corresponding in this respect to the seamen gunners, and the Royal Marine Light Infantry all being trained men.

The guns are of course dependent for their efficiency on the arrangements for the supply of ammunition to them, and the greater rate of fire possessed by modern guns of all calibres has caused increased attention to be given to this point. As far as organization of the personnel is concerned, no difficulties are pre- sented by the supply to the 12-inch guns, each pair of which is provided with its own magazine and shell-room, which are manned by some twenty-five men to each pair of guns. The arrange- ments for the supply of 6-inch and 12-pr. ammunition are briefly as follows, the important principle to be borne in mind being that while the supply must be rapid enough to conform to the rate of fire of the guns, no accumulation of ammunition can be permitted, on account of the danger of its ignition by bui-sting shell. At the fore and after ends of the spaces devoted to the engines and boilers, and immediately below the protective deck, is a space usually known as the "cross-passage." Into this space the hatches open from the 6-inch and 12-pr. magazines and shell-rooms, which are situated below the cross-passages. The cross-passages are connected on each side of the ship by a long passage cut out of the coal bunkers or

out of the engine- or boiler- rooms, from which a direct supply of ammunition to each 6-inch gun is arranged by means of an endless rope whip passing from the casemate in which the gun is mounted through a vertical armoured tube into the ammunition passage. The supply to the 12-pr. guns is similarly arranged, but the whips are not pro- tected by armour, and each hoist has usually to serve for a pair of guns. The 6-inch shells having been removed from tlieir

racks in the shell-rooms and the cartridges from their boxes in the magazines, are placed in bags fitted with rope beckets for hooking to the whips. They are then hoisted by endless whips into the cross-passages, carried to the bottoms of the ammunition tubes, and thence whipped up as required by the guns. It will be seen that a considerable number of men are required for these opera- tions, all of which are performed by hand, and in the Canopus class some eighty men are actually required for the 6-inch ammuni- tion supply and another eighty men for the 12-pr. The supply of 3-pr. and Maxim ammunition is not of such importance. A con- siderable quantity of 3-pr. ammunition is arranged to be stowed in the tops, and would be placed there before going into action, and the Maxims, as has already been observed, would probably not be manned in a ship action. The torpedo-tubes, of which the latest British ships carry four only, all of which are submerged, are manned by crews consisting principally of highly-trained "S.G.T.'s" or seamen gunner torpedo-men.

In addition to the crews for guns and torpedo-tubes, and to the men employed in the supply of ammunition in action, men are required for the following duties: buglers, messengers, men to attend voice-tubes and to man steering-wheels, fire brigade (con- sisting of the carpenters and shipwrights and a portion of the stokers) , men to transport and attend the woimded, and armourers.

It is not easy to foresee the future developments of naval gunnery ; generally speaking, the tendencies are towards lighter but more powerful guns with rucreased rates of fire, using bare charges and firing shell of increased armour- piercing capability; better protection for guns and their crews and for ammunition supply ; constructive improve- ments having for their object the acceleration of the am- munition supply, and more careful selection of and higher training for captains of guns and gunnery ratings gener- ally. (S. FR.)

II. Aemy (British), (a) Guns.

The controversy of M.L. versus B.L. guns, carried on for several years prior to 1880, was finally settled in favour of the B.L. gun. The necessity for a very long gun in order to develop the high power required in modern ordnance was one of the main factors in the case.

The following table gives the various descriptions of B.L. ordnance in the service and their use, exclusive of .those purely naval and dealt with under “Naval Gunnery ” : â€”

Description.

}

ft

f.s.

yards.

Use and Eemarks.

m.

2-5 inch

400

1440

4,000

“(Jointed or screw guns for / mountain artillery.

10-pr.

418

1289

6,000

cwts.

12-pr. .

6

1585

6,000

E.H.A. batteries : light short gun for mobility.

15 â€ž . .

n

1681

6,000

R.r.A. batteries : as power- ful as possible without loss of mobility.

30 â€ž .

20

1621

6,300

Heavy Indian field batteries.

4-in. .

26

1900

7,700

“I Siege train and guns of J position.

5 â€ž . .

40

1750

8,700

6 â€ž (up to

tons.

Mark VI.)

5

1960

10,000

Guns of 6-in. and upwards

6 â€ž (Mark

are employed for coast bat-

VII.)

7-4

2456

12,000

teries. The latest marks of

8â€ž . r

13

2000

8,000

6-in. and 9-2-in. are new

9-2,, (up to

types, of great length, with

Mark VII.)

22

2065

10,000

high muzzle velocity.

9 -2,, (Marks

IX. & X.)

27

2601

13,800

10 â€ž .

29

2040

11,500

12 â€ž (up to

Mark VII.)

46

cwts.

1914

8,000

5-in. howitzer

9

4,900

Field and siege purposes in Imperial service.

5-4 ,, â€ž â–

13

...

4,800

Field and siege purposes in Indian service.

6 1))i

25

â– â€¢â€¢

5,200

Siege equipment in India.

6 ji)>

30

5,200

Medium unit of siege trains in Imperial service.

The howitzers are short pieces, and of large calibre compared to their weight, to enable them to fire a shell containing a large quan- tity of explosive. As they use charges of various weights in order to obtain any angle of descent for the shell, no muzzle velocity is given in the table.

Q.F. Guns. â€” About the year 1881 it was found that a more rapid rate of fire than could be obtained by means of the B.L. guns of that day was necessary. This was due to various causes, such as increased speed of torpedo-boats and the necessity for attacking the unarmoured or lightly armoured portions of ships with a heavy shell fire, &c. This high rate of fire was obtained by the intro- duction of guns known as Q.F. (quick-firing), in which some of the main features were â€” (1) Rapid means of opening the breech ;

(2) the charge being contained in a brass case with its own means of ignition, and in the lighter descriptions in one with the shell ;

(3) the mounting being adapted for the rapid service of the gun. Until the year 1898 guns of this type, up to and inclusive of 6-iuch calibre, continued to be made. Except with the 3- and 6-prs., per- cussion firing was by no means rapid. In endeavouring to overcome this difficulty and to produce a more powerful gun than the then existing 6-inch Q.F., it was found that, at any rate for certain cali- bres, a B.L. gun could be produced which could be fired quite as rapidly as the corresponding Q.F., and was free from the disadvan- tage mentioned above. The main features which cause this gun to be classified as B.L. are : (1) The charge is bare (not in a brass case) ; (2) the system of obturation and firing is similar to that of other B.L. guns, viz., pad obturator, and lock and tubes for firing. Only in mounting and style of opening the breech does it resemble the Q.F. type. A Q.F. gun may now therefore be defined as one which employs “case ammunition,” the nomenclature being en- tirely unconnected with the rate of fire.

Q.F. Ouns in the Land Service.

***!**

0) >>

Method

Description.

1

II

of Closing

Use and Eemarks.

^

^^

Breech.

cwts.

15-pr. .

H

1608

Breech

Screw.

A certain number of field batteries are armed with these guns.

3-pr. and 6-pr.

5

1873

Hotohkiss

and

Wedge.

8

1818

Chiefly as armament of

3-pr. and 6-pr.

4

1920

Wedge

coast batteries, against

Nordenfelt

and

and

Y torpedo-boat attack, de-

6

1818

block.

fence of mine fields.

12-pr. .

12

2197

Coned breech screw.

Against ships’ tops, &c.

4-7 inch

41

tons.

2150

Coned breech

screw.

Armament of coast batteries

for the attack of lightly

- armoured parts of ships.

6-mch .

7

2154

Coned breech screw.

The 4-7-inch can also be used as a gun of position.

The following table enables a comparison to be drawn between the ballistics of the old and newer descriptions of service ordnance : â€”

Bate of

Fire.

Aimed

rounds

per min.

(approx.).

Penetration

Description.

Muzzle Velocity.

Weight Projectile.

Muzzle Energy.

MUd

Harveyed

Steel.

Inches.

f.s.

ft.

tons inÂ»

64-pr. E.M.L.

6-3 inch

1390

64

897

1

6- inch B.L.

(Mark VI.)

old type

1960

100

2663

1

9-9

6 -inch B.L.

(Mark VII.)

new type

2456

ioo

4185

4

13-77

6-inch Q.F. .

2154

100

3217

4

11-4

Heavy Gu

ns.

One round.

9-inch R.M.L.

1440

256

3,695

1′ 30″

12-961

9-2 B.L. (Mark VII.)

old type B.L.

2065

380

10,348

1′ 30″

18

9-2 B.L. (Mark X.)

new type B.L.

2601

380

17,830

f min.

24.5

1 Wrought iron.

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ORDNANCE

Length of Bore 420′ 325 or 46-66 Calibres

[aemt

^

44-2 “35 Total Length –

Fie. 1. â€”Section of 9-2-lnoh B.L. gun, Mark X. 28 tons.

Fig. 2.-8ection of 9-inch E-M.L Gun, Mark V. 12 tons ; length of bore, 125 mclles. ‘

Fig. 8.â€” Oyiindrical Block -mth Interrupted Screw (ordinary pattern).

Fia. 4.â€” Interrupted Screw (Welin pattern).

Fig. 6.â€” Pad Obturator.

a Breech Scratr b Cam ierer c Head Axi'a/ SfopBo/f

Hoha

FiGS. C and 7.-Dlagram of Breech Mechanism of Ordnance B.L, IS-pr' Gnn^lark I.

Construction.â€" 'SR\iev^ B.L. guns were first introduced their construction was very similar to that of the later R.M.L. gunsâ€" that is, they consisted of an inner tube of

steel supported by one or more coils of wrought iron. At this date the manufacture of steel had nSt arrived at the state of perfection to which it has now attained and

4BMT]

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e=c:::33c

noRM SmHDLC WITH WORM

mr/ORU WHEEL hcLUTCH

Fig. 8.â€" Apparatus for turning Breech Screw.

FiQ. 10.â€" Diagram of the Breech Mechanism of 9'!i-iuch B.L. Gun, Mark IX.

Fig. 9. â€" ^Apparatus for withdrawing and swinging Breech Screw of Heavy Gun.

consequently for gun construction its use was limited ; but as themanufactureimprovedit gradually replaced wrouglit iron, and in the

majority of the B.L. guns. is the only material used. In the earlier classes, in which the guns are composed of steel hoops and tubes, the "building up is on the same lines as with K.M.L. guns ; that is, the outer parts are shrunk on, and so placed in a state of initial tension, while the inner tubes are correspondingly compressed.

During the last few years, however, the "wire system of con- struction" has been applied to many guns. The wire, the section of which is '06 inch thick and '25 inch wide, merely takes the place of some of the intermediate tubes, and is wound on in successive layers, of which there are a considerable number. As the tension can be varied at every layer if necessary, the gun is, as it were, one made up with an enormous number of outside hoops all put on at a different shrinkage : in this way full advantage can be taken of the strength of the material ; in a thick hoop, shrunk on, it is impossible to do so. Other advantages are : (1) that the material can be tested all over ; (2) that a flaw cannot spread ; (3) that for a less external diameter than formerly a gun of equal strength can be obtained ; (4) that the material in itself is stronger than steel in the mass. Although thus giving great circumferential strength to a gun, it gives little or none longitudinally ; this has to be obtained by means of tubes either under or over the wire, or by a combination of the two.

Fig. 1 shows the construction of one of the latest B.L. guns

Fio. 11.â€" Diagram of Breech Mechanism of Ordnance B.L. 9'2-inch, Mark X.

Fia.l2. â€" Breech Mechanism.

used in both land and naval services. It consists of an " inner A tube," fitted into an "A tube"; the wire is then wound on these at the

necessary tension. Over the wire are fitted first a “B tube” and then the “jacket,” the two connected by a shoulder. In rear screw bushes are inserted, one to carry the breech screw and the other to connect the A tube and jacket. The circumferential strength is almost entirely obtained from the wire coil, and the longitudinal strength from the A and outer tubes. When the inner tube is worn it can be bored out and replaced by a new one, thus rendering the gun as fit for service as when first issued. The diagram of a 9-inch B.M.L. gun is given (Fig. 2)

to show the revolution which has taken place in gun construction since the time of muzzle-loaders.

Before deaUng with breech mechanisms as a whole, it will oe well to consider (1) the means adopted for closing the breech of the gun, (2) the system of obturation, (3) the method of firing^

(1) The ordinary method is by means of a breech screw. That first introduced and extensively used with B.L. guns is (Fig. 3) the cylindrical block with interrupted screw thread: this type necessitates a withdrawing motion from the gun before it can be swung clear of the breech opening ; hence the introduction for Q.F. guns of the coned type (Fig. 23), which being cut away

Fig. 18.â€” Diagram of Breeeli Mechanism of Ordnance B.L. 9-2-inch, Mark X. Part of carrier frame and gun removed to show gearing of pinion and links.

FlQ. 22.â€” “B” or Single Motion Mechanism. A, Breech screw ; B, screw fixing breech screw ; C, carrier arm ; D, stud ; E, S, safety stop ; F, lever ; 6, link; H, sliding block; I, J, parts of striker ; V, bush ; T, trigger.

Fig. 28.-” B’

or Single Motion Al echanism, (For lettering see Fig. 22.)

FlQ. 14.â€” Look for 9‘2-Inoh Gun, Mark X.

in front, obviates the diflBculty. The latest is known as the “Welin” (Fig. 4) : it has all the advantages of the foregoing, and in addition a much larger portion of its surface covered with screw thread, so that equal holding power can be obtained for less length of screw ; for example, in a 6-inch gun | of the screw is threaded, while with the ordinary screw only J can be made use of for holding it in the gun.

(2) By system of obturation is meant ” the method employed to prevent escape of gas over the breech screw.” With B.L. guns the system is usually that known as the “pad” or ” De Bange” (Fig. 5). It consists of a pad of asbestos (B) between two discs (D, C), the whole carried on a spindle (A) with mush- room head, passing through the breech screw. The pad, when the breech is closed, fits tightly on a coned seating, and on firing is expanded against the walls of the gun, so sealing the escape of

Fig. 24.â€” Striker (electric and percussion).

gas. With Q.F. guns the charge is contained in a brass case, which on firing expands and so closes the breech.

(3) B.L. field and siege ordnance are fired by friction, and otlier classes by percussion or electric tubes. With the two latter, locks are employed to keep the tube in position and carry the firing mechanism. In the latest type of guns, a lock, combined for both electric and percussion firing, has been introduced ; it will be dealt with in connexion with the mechanism of the 9-2 Mark X.; the tubes used with it are “wireless,” while in most guns in the land service “wired” tubes are employed. Friction tubes are retained in place by a head with bayonet joint on the end of the vent (Fig. 7) or by some similar device. With Q.F. guns ” locks” are not employed. In the case of the 3- and 6-prs. Q.F., percussion firing gear only is fitted to the mechanism, and acts in connexion with a cap in the cartridge case. With the higher calibres a

aemy]

OEDNANCE

“striker” is used; it can be adapted for either “electric” or “percussion” firing in connexion with either a “primer” or “tube ” in the case (Fig. 24).

Turning now to the breech mechanisms themselves, that of the 15-pr. Mark I. field gun (Figs. 6, 7) is simple and effective, though not so rapid in action as that of the latest pattern Mark IV., which is classed as a “single motion” mechanism. The breech is opened by raising a cam lever (6) and turning it to the left as far as it will go ; the breech screw is then withdrawn from the opening through a ring carrier (/) for a certain distance, and afterwards carrier and screw together swing round on the hinge bolt to the right. In the closed position a projection or cam on

the lever folds down into a recess in the carrier or gun, and so prevents the screw from turning when the gun is fired ; this is a very important point with all B.L. or Q.F. guns, and is technically termed “looking the breech screw.” The older-pattern medium guns, such as 4-inch and 5-iiich, &c., have mechanisms of a similar nature for opening and closing the breech, but with the higher calibres, such as the 9-2-inch guns and upwards, some form of power-gaining appliance is necessary. In the case of the older descriptions this consists of a “ratchet lever gear” for turning the screw, and ” control mechanism ” for withdrawing and swing- ing into the open position. These are shown in Figs. 8 and 9. An improvement on this is found in a few modem guns, such as the

Fig. 15.

A. Wedga

B. Cranh

c. Screw sfop weaga

D Hammer

E Rocfong Shaft.

f Mam Spring

C Trigger Soar

M. Trigger Sear Sfiritig

Fia. 16.

1 . Trigger J . Trigger Cuara K. Extractor I Shoulder Piece n. Cocking Lever N Cocking Toe

0. fiecoGkingijayer

Fig. 17.â€” Diagram of Breech Mechanism of HotchkisB 6-pr. Q.F. Gun.

Fm. 18.

Fig. 19.

Fig. 20.

aATTERY ELECTRIC

Fig. 21.

9-2 IX., where the ratchet lever gear is done away with, and a crank and pinion worked by the ” control mechanism ” is fitted to the top of the hinge bolt for the purpose of turning the screw, so that in this case the mechanism may be said to be “single motion” ; for instance, turning the lever A (Fig. 10) opens the breech, by first turning the crank B into the roller path C on the screw and forcing it over, then by means of a pinion (D) on the hinge bolt, acting on a horizontal rack on the side of the screw, drawing the latter out and finally swinging it round into the open position.

The latest type of mechanism will now be described in con- nexion with the 9-2 X. (Figs. 11, 12, 13). The screw A is of the ” Welin ” pattern, and is carried on an arm (D) instead of in a ring ; the obturator is of the pad system, only known as the “steep cone” pattern, as will be seen on comparing it with that of the 15-pr. ; the advantage gained thereby is that the least with- drawal movement cleaiB it off its seating and enables it to be

swung round into the open position. The turning of the screw is effected by means of a hand-wheel i (Z) working a shaft with worm, connected to a worm wheel (I) on the hinge bolt L ; the latter revolving causes a pinion (N) which is on it to , act on another pinion (T) on which are skew bevel teeth ; these cause a link (U) pivoted at M to revolve, and draw with it another link (B), to which it is pivoted. Now B fits at A’ on to a stud on the breech screw, and so the turning is effected. When sufficient turn has been given to the screw it becomes fixed to the arm by a catch (C), consequently further liiovement of the lever Z causes the arm and screw to swing round into the open position. The breech screw is connected to the arm by an interrupted screw thread (D’), so that in turning it moves slightly to the rear on the arm and presses against a sleeve (0) which conveys the pressure back through a spring (E) and washer (Q) to the nut P

I This has now been replaced by a lever across the face of the breech.

FtG. 25.â€” Extractor.

on the axial vent ; in this way the pad is pulled ofl its seating and made to follow up the screw.

The lock which is combined for electric and percussion firing is shown in Fig. 14 ; it is carried on a slide box (L) and has a guide bolt (W) (Fig.

11) which fits into the sliding plate V. This plate is actuated by being connected to a cam groove (U’) carried by the link U ; as soon as the link revolves the plate is drawn to the right, carrying the lock with it, and so the gun cannot be fired unless the breech is properly closed. The move- ment of the lock actuates an extractor which ejects the fired tube ; a new tube is then put in, and in closing the breech the lock resumes the firing position. Por electric firing, a lead passes along the arm D and mafies contact with the insulated needle G through which the current is conveyed to the tube ; the return circuit is an ” earth one.” For percussion firing the handle B is pulled to the rear ; this draws back the striker F which includes needle G ^d firing pin H, against the main spring J, until the trigger K engages in front of the projection S on the striker and holds it back ; the ,gun can then be fired by means of a lanyard hooked to the trigger at Y.

Q.F. Mechanisms. â€” Of the smaller descriptions, the Hotchkiss (Figs. 15, 16, 17) is the one chiefly in use. The breech is closed by a wedge (A) actuated by a crank (B) and handles, the

turning of which causes a projection (M) to bear on the toe (N) of a rocking shaft (E), which in revolv- ing effects the cooking. On closing the breech, a trigger sear (G) comes up under a trigger, which on being pulled forces down the sear, releases it from the cock notch, and allows the hammer D to fly forward and fire the gun. An ex- tractor for throwing out the cartridge case is actuated by a groove in the wedge. Of the mechanisms for the heavier descriptions employing breech screws, one of the earlier types will be found on many 4-7-inch guns (Figs. 18, 19, 20, 21). A cam lever is employed to look, turn, and swing the coned screw, which is carried on an arm. A striker is used, which for percussion firing is automatically cocked in opening the breech. The latest type is often known as the “single motion,” having been one of the first of this kind introduced. It will be found in the more modern Q.F. guns such as the 12-prs., and also on the later-built 4-7-inch and 6-inoh (Figs. 22, 23, 24, 25). The action is as follows : On drawing the lever F from left to right, the link G and sliding block H are moved in the same direction. In the block is a gun-metal bush (V) with vertical play, and in the bush a stud (D) from the breech screw. Consequently

this stud travels with a circular motion from left to right, and so turns the screw until it is held on the arm by a catch ; an extractor to start the cartridge case is acted on at C (Fig. 25) by the carrier arm in swinging round. A striker for electric and percussion firing is pro- vided. For percussion firing this striker has to be withdrawn by hand until held by the trigger T. The arrangement shown at E is purely one of safety, and keeps the striker needle off the primer or tube at all times except when the lever F is pro- perly home. On the first movement of this lever, a groove on the top of it acts on the turning lever S at the bottom of the spindle E, and causes it and a cam projection on top to turn ; the cam then presses against the part I of the striker and forces it back. (o. P. M.)

(6) Ammunition.

The smokeless propellant adopted by tlie British – Government is known as ” cordite ” (see Peopellants). It is used for all arms, the only variation being in the diameter and length of the sticks employed. On account of the importance of a clear front, in order to sustain a rapid fire, smokeless powder is a necessity with quick- firing guns, and confers advantages upon the defenders of a position which can scarcely be too highly estimated.

Cartridges. â€” The charge of a gun is made up in a con- venient form for handling and loading, for which pur- pose the cordite is enclosed in a cartridge, made of silk cloth or of red shalloon. These materials fulfil the necessary conditions for a cartridge : to be strong enough to bear reasonable knocking about on service, to allow the flash from the tube to penetrate and still be of close texture,

and â€” most important â€” to consume entirely and not leave smouldering fragments in the bore.

Cordite is somewhat difficult to ignite in a gun, and so every cartridge has a primer of fine-grain gunpowder, placed so as to intercept the flash from the tube ; the outer side of this primer is made of shalloon, to allow the flash to penetrate with greater ease. The charge for heavy guns, above the 6-inch, is made up in separate cartridges containing ^

and J charges, both for convenience in handling and to allow a reduced charge to be used. In order to ensure uniform results, the space allowed for the charge in the chamber of the gun should not vary from round to round.

For B.L. guns, below the 6-inch, the cartridge consists of a bundle of cordite, inserted in a cylindrical bag, of shalloon for the field guns (12-pr. and 15-pr.), and of silk cloth for the remainder. These cartridges have a primer of fine-grain powder covering each end, except the 15-pr., which has a piece of gun-cotton yam wrapped round each end.

The cartridges for B.L. guns, 6-inch and upwards, are generally similar; some are cylindrical and some slightly coned. Fig. 1

fHillboard Disc

.’ 1 steeped in Shellac

Silk cloth attached

Co milboard disc —^Primer stitched acmsÂ» 4 places

Plan of Top shewing ^isc to be torn off

â€”‘“Silk braid becket

Fie. 1.â€” 10-inoh B.L. Gun Cartridge.

shows a typical coned cartridge. The cordite is built up in layers, and tied tightly with silk. The bag is silk cloth, the top being closed by the primer stitched on. A sUk cord becket runs up the centre, forming a loop outside the top. Above the primer is a mill- board and silk cloth cover, lightly attached, and intended to be removed before loading, for which purpose it is provided with a loop, upon which the words ” Tear off” are printed.

Howitzers, being designed to give a plunging fire, require different charges, and the charge must be made up so that its weight can be

Zoz ring ofetrditc connd

-‘th shaUbor’

Silk twist

jlOoz bundle

of eartlite

V.â€ž.“V

^ Shalloon J. Rf.C Powder

‘â€¢* oz. ring of cordite round bundle Fia. 2.â€” 6-inch B.L. Howitzer Cartridge.

easily altered. B.L. howitzer cartridges are all made on the same model, the material being shalloon. Small-sized cordite is used, and the charge is formed of a mushroom-shaped core, on the stalk of which three rings containing cordite are placed. The bottom

ammunition]

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of the core contains the primer. The rings can be tied to the core by two silk braids, and thus a handy means of varying the charge

is provided, since the core alone,

Brass Washer

. . . Brass Bodq BrassStn’ker

- Percussion Cap

. Anvil

fine Oram Powdei

...Cork Plug Fig. 8.

or core and one or more rings, may be used (Fig. 2). The table at the end gives the weights of a few important cartridges.

These cartridges are ignited in the gun by means of ” tubes,” fired by percussion, electricity, or friction. They are known as “vent-sealing tubes,” by which is understood a tube which fits accurately into the top of the vent and is held in it by the look of the gun. The force of the explosion expands the tube against the walls of the vent, and so’ prevents escape of gas past it, while the internal arrangements of the tube pre- clude the possibility of gas forcing its way through. This system is necessary because B.L. guns are axially vented, and the forcible expulsion of a tube

might injure the men behind the gun ; and also because the rush

. Right hand spiral .Sarcenet

Plan of Head

. â€ž oiled silk

-t-r-

Copper wire insulated ixith silk Brass body

. , Ebonite

.Copper poles coated with pure lin

- . Platinum silver wire -..Sheet Ebonite

-.Composition priming

V Paper discs

-Powder

â– JCork disc Fig. 4.

of gas through a vent wears it out quickly. B.L. guns use tubes designated by the letter “P,” except in the case of field guns and

howitzers, which take ‘< T " friction tubes. There are three " p " tubes, one percussion and two electric. The "T" tube is held m the vent by a bayonet joint at the end of the vent. The outer dimensions of the three "P" tubes are the same; their con- struction will be understood from the figures.

Fig. 3. â€” The percussion tube has a striker, below which is a per- cussion cap on an anvil, the body of the tube bein^ filled with pistol powder. The striker of the gun lock forces the striker against the cap and so fires the tube.

Fig. 4. â€” The Electric “P” tube has two insulated wires led into the interior and attached to two insulated brass cones. These cones are connected by a thin wire

or “bridge” of platinum- silver, which is surrounded by “priming composition” (gun-cotton dust and mealed powder). The remainder of the tube is filled with powder. The tube is held in by the lock and the wires connected to the leads from a battery ; on a current passing, the bridge is heated to incandes- cence and thus fires the prim- ing composition.

Fig. 5. â€” In the Wireless Electric “P” tube the mech- anism of the lock makes electrical contact with an insulated patch in the head of the tube. This patch is connected by an insulated wire with a brass cone, also insulated, between which and the side of the tube is the “bridge,” surrounded by priming composition. The current passes through the lock to the insulated patch, thence through the bridge, which it heats, to the side of the tube, and back to the battery through the metal of the

gun and mounting â€” technically known as an “earth return.” This tube is used by guns having ” wireless ” electric locks.

Fig. 6. â€” The ” T ” tube is simple in its construction. The head fits into the bayonet joint, and the tube is fired by the withdrawal of the friction wire by means of a lanyard, which fires the friction

Contact disc. -^.Insulated Wire Brass Body

â€” Ebonite Insulation – . Brass Cone

â€” Composition Priming ... Platinum Silrer Bridge

Paper Disc ,

. . Powder ... Capper Po/a

.- . Co.rkP/uy Fig. 6.

- Half round Copper wire twisted ond roughened . Gun Metal Head

-Loop dipped in solder

Shearing nire tin and anfimoni^

Soft copper ball 3 Holes

Brass Bodg Loose powditr

Cork plug shellaced Shellac cement

Fig. 6.

composition and so the tube. The copper ball is driven by the explosion into the cone above it, and so prevents escape of gas through the tube. The larger muzzle-loading guns use vent-sealing tubes, friction and electric ; distinguished by the letter “V.”

Projectiles. â€” The following projectiles, which will be briefly considered in their order, are fired from B.L. guns : common, lyddite, and shrapnel shell, armour-piercing (A. P.) shot and shell, and case shot. A few fire star- shell, and Palliser shot are occasionally used. The shells are made of steel.

For the same calibre, the weight of a modern B.L. projectile is greater than that of a E.M.L. ; for example : â€”

12-inch E.M.L., weight of projectile, 714 R).

12-inch B.L. Mark VIII., weight of projectile, 850 lb. A convenient way of expressing the relation between the weight

of a projectile and the calibre of the gun is given by the fraction -=

(w)=weight of projectile in pounds, d=diameter of bore in inches). For the latest guns â€” is approximately equal to 0-5.

These projectiles are caused to rotate by a ” driving band ” of copper, pressed into a groove round the base, which takes the

rifling of the gun. It is known as the ” Vavasseur broad driving band.” The heavier projectiles have a driving band with a lip or gas-check.

This is intended to prevent rush of gas past it and so help to lessen the erosion of the bore. A white band painted round a

r n

I . Drmng Bend .—t-Base Plug

.Ofiving Band

...Lifting Htndlai

Fig. 7. â€” Pointed Common Shell (cast steel) .^

Fig. 8.â€” Lyddite Shell (forged steel).

Fig. 9.â€” Shrapnel Shell (steel).

projectile near the point denotes that it is made of steel, though

‘a red band signifies that the shell is filled or “live.”

Common shells are of two sorts, the ordinary com- mon taking a fuze in the nose, and the pointed com- mon taking a base fuze. These shells are really locomotive mines contain- ing bursting charges of powder. The bursting charge is in a bag, to pre- vent premature ignition from friction with the walls of the shell, and con- sists of a mixture of pebble and fine-grain powders, known as ” P ” mixture. A common shell will penetrate a little over half its calibre of Harveyed steel with a striking velocity of 2000 feet per second. They are painted black (Fig. 7).

all steel shells have not got it ; and Safety Plug

- â– Needle & Needle Disc â– – QeConaOng Composition

- Powder

.. Bottom Plug

Fig. 11. â€” Direct-Action Percussion Fuze (scale I).

Fig. 10.â€” Case Shot.

^Powder Pellet , Detonating Cap

Spring

Needle Pellet

Body

â– Locking Nut – -, Centrifugal Bolt

Spindle ..Pressure Place

..l …^..-iffoles Grr Key

Fig. 12.â€” Base Percussion Fuze (scale |).

4 Clamping Nu

â€” Dome -f, â€” ~~â€”r.r~~ -i

Shearing Wire -, -< –

â€ž HammBr-

.,â€ž Steel Needle

””^Safety Pin

Detonating Cap

..^^â€¢Safety Pin

Sheering Wire

Safety Pellet

Brass Ball

Needle Pellet

Centrifugal Bolt

Brass Washer – Copper Detonator

. Asbestos Lining _ Powder Composition -Calf Skirt Washer .J'owder Pellet Perforated

- F. C. Powder

. . Brass Disc ..Leather Washer

.Steel Needle

â– S Fire Holes

- Paper Disc P. C. Powder [Brass Washer Shalloon Disc and Paper Disc

{Shalloon Disc and Brass Washer

-i;

Fig. 13, â€" Time and Percussion Fuze (scale |).

The long-felt want of a shell containing a high explosive, to be] detonated on impact, is now supplied by Lyddite shells. These are

carefully made of forged steel with a solid base, to prevent any chance of premature explosion in the gun, which would be disastrous.

ammunition]

ORDNANCE

355

They resemble common shell. The shell is filled with lyddite, with a central hole for the exploder ; a percussion fuze is used. The same shell will contain a greater weight of lyddite than of P mixture, and roughly the explosive effect of a lyddite shell may he taken as about three times as great as that of a powder shell of the

Steal Shell-

yDrivinj Band

**.Cap **

**..Needk\ r Sprinq **

FelleCllf Lead

0tidy

HoHhklss Base Futt MorliJF

(._~_Brss9 Caee-~â€”

^Bunting Cham *oi Powder

,i/fa/eMtiss fuse

Al2 Threads per

inch left hand

atPapor trad

iCoidiig

. Silk twist

[Silk twist for ‘ {securing prirti^ â– tceam of c

\\to bocedm of cOrdite. Ignicer or ‘Primer-

Percussion Cap

Sechon

FiQ. 14.â€” Â«-pr. Q.r. Cartridge (scale J).

same size. Lyddite shells, when properly detonated, have great local shattering effect ; the tough steel Is broken up into a large number of

fragments, ranging in size from a pea to pieces weigh- ing three or four pounds. These pieces are projected in every direction with great force, some even having a backward effect.

The greatest effect is perhaps to the right and left of the line of fire, and any living creature near the explosion would be riddled by tiny fragments of steel. It has been stated that the blast kills at considerable distances, but the evidence of this is inconclusive, and the effect may rather be looked for in the small pieces of steel. In this respect the effect is entirely different from that of a powder charge, which would tear the same shell into a few large pieces and would have no backward effect at all. Lyddite shells are used with B.L. and Q.P. guns, the smallest being the 4-inch. The largest at present is the 10-inch. They are practi- cally the only shell fired from the 5-inch and 6-inch B.L. howitzers. They are painted yellow (Fig. 8).

The shrapnel shell is essentially a man-kUling projectile, and depends for its effect upon the number of bullets it contains. The bursting charge is in the base, and is only sufficient to blow off the head, which is lightly attached, and thus release the bullets with which the body of the shell is filled. A central pipe conveys the flash from the fuze to the bursting charge. A time fuze is used, and is set so as to burst the shell while it is in the air, from 60 to 80 yards short of the target, and the bullets then stream forward in a cone-shaped shower, covering a large front. For effect the bullets should have a striking velocity of not less than 400 feet per second. Field guns use practically only shrapnel. They are painted black with a red tip (Fig. 9).

Armour-piercing shot are fired from the heavier guns, and, as their name indicates, are used for the destruction of armour, and have no bursting charge. They are pointed projectiles made of steel specially hardened. Koughly, with a striking velocity of 2000 feet per second an A.P. shot should perforate two calibres of wrought iron, one calibre of Harveyed steel, or ft calibre of Krupped armour. They are painted black with a white tip and a white band below it. A.P. shells are fired from B.L. and Q.F. guns, and are made of hardened steel. They have a small bursting charge of powder and a base fuze. They are thicker in

the point and shoulder than a common shell. Their penetrative power is slightly below that of A.P. shot. They are painted black with two white bands near the tip.

Case shot are fired from the majority of B.L. guns, and are used at short ranges. They consist merely of a weak envelope filled with bullets. The envelope must be strong enough not to break up before leaving the gun (Fig. 10).

In order to explode shell at the right moment ” fuzes ” are used. These are either ” percussion ” (of which there are two

***r**

Lubrleatihq Lfd Felt Wad’

suit Braids

Brass Case

Silk Braid Cordite Charge 5lb.7oz., Sizi 20

Cordito Cylinder Powder Igniter

Shalloon Bag

- — Electric Primer

Fio. 15. â€” 4‘7-iiioh Q.r. Cartridge (greatly reduced scale).

descriptions, one to act on “impact” and the other on “graze”) or “time” fuzes, which can be set so as to act after some pre- determined interval of time. Time fuzes usually contain an alter- native percussion arrangement, and are known as “time and percussion ” fuzes. An example of each kind is illustrated in the figures.

^Waterproof Cement

<"'^1JA -tm^l^ze board Disc

Gun-cotton Oust “ and Mealed Powder.**

..^Platinum silver wire â– jittTun of gun-cotton yarn

jKiiPure tin Jet Crown metal poh jf^Brass screw collar ^^Ebonite washer .K. Oiled Silk ^.Brass Cone jSi.BIack Thread

jstuCopper wire insulated witn silk, bared at end with one turn in head

^e. Ebonite cup, screwed

-Â« White metal contact

Sechon full Size

Fia. 16.â€” Electric Primer.

The direct-action fuze is intended to act upon impact, and its construction will be understood from the figure. On impact the needle is crushed in against the detonator and so fires the fuze. This fuze screws into the nose of the shell (Fig. 11).

The base fuze is of the graze type. In it a needle pellet is pre- vented from movement by a “centrifugal bolt,” which has a

heavy head and is withdrawn by the spin of the shell, thus unlocking the pellet and permitting it to strike the detonator, when the shell is checked by grazing. For saiety the centrifugal bolt is kept in position by a locking nut on a spindle connected to a pressure plate, which is forced in on discharge and so raises the nut. The spiral spring round the top of the pellet prevents premature action while the shell is in flight. This fuze is used with pointed common and A.P. shell (Fig. 12).

The time and percussion fuze consists of two distinct parts. The lower half of the fuze contains the percussion part, on the graze principle. A needle pellet is looked by a centrifugal bolt, as in the base fuze, and has also a ball preventing its forward movement. This ball is kept in place by the safety pellet,. which is suspended on a shearing wire. On discharge the inertia of the pellet breaks this wire, the pellet falls into a recess, and the ball follows it. On graze the needle pellet flies forward. Connecting this part with the time part is a channel flUed with powder. Opposite this channel, on the outside of the fuze, is the setting mark, a black triangle. The time part consists of a ring covered by a dome and clamped by a nut. On the under side of this ring is a groove, running nearly round, filled with slow-burning com- position. At one end of the composition is a percussion cap with a hammer suspended on a thin wire above it. On discharge the hammer falls and lights the end of the composition, which burns slowly round until it reaches the connecting channel, when the fuze is flred. The outside of the ring is graduated from 0 to 18, and the fuze is set by turning the ring tUl the required graduation is opposite the setting mark, and clamping the nut. The gas evolved by the burning composition escapes through a side hole. Before use the safety pellet and the hammer are supported by safety pins, which are withdrawn before loading. The fuze burns about 12-5 seconds, corresponding to a range of about 3700 yards in the 12-pr. of 6 cwt., or 4100 yards in the 15-pr. A larger fuze of similar design bums 16 seconds. These fuzes are used in shrapnel shell (Fig. 13). A fuze of similar size and design to the first of the two above described, but burning for 22 seconds, has recently been issued. This time fuze corresponds to a range of about 5800 yards in both these guns.

Q.F. Ammunition. â€” The ammunition for quick-firing (Q.F.) guns differs from that already described in having

the charge enclosed in a metal case, containing means of ignition at the base. The case acts as an obturator by- being expanded against the inside of the gun. In the smallest Q.F. guns, the 6-pr. and 3-pr., ” fixed ammuni- tion” is used; that is, the shell is attached to the case and the two are loaded together. In the other Q.F. guns the projectiles are loaded separately. The metal cases enable the charge to carry its own

means of ignition, and simplify the mechanism of the gun, but they increase the vi^eight to be carried and add to cost of manufacture.

The 6-pr. ammunition is shown in Fig. 14; the ^-pr._ is similar. The case is of solid-drawn brass, and has a percussion cap in the base. The cordite charge is dropped in, and has a primer tied to the bottom ; the space above it is filled by a brown- paper cylinder. The shell is of the A.P. type, and is secured in the case by indents. The fuze used is the "Hotchkiss" base fuze. In it, the lead pellet sets back on shock of discharge, and thus unmasks the needle point. On graze, needle and pellet fly forward and fire the cap. The spiral spring prevents premature action during flight.

The ammunition for the larger Q.F. guns is all simOar ; that of the 4-7-inoh is illustrated as a type. The projectiles fired are the same as already described ; all except the 12-pr. fire lyddite. The cartridge case is of solid-drawn brass, having an " electric primer" screwed into the base (Figs. 15, 16). This primer is really a wire- less electric tube on the same principle as already described ; and the figures sufficiently show its construction. The cordite charge is tied in a bundle and dropped into the case. In the bottom of the bundle is a hollow cordite cylinder, with a gunpowder igniter inside it. The nose of the electric primer fits into the end of this cylinder. Above the charge is a wad, and the case is closed by a lid, con- taining lubricating material to prevent fouling. Should anything go wrong with the primer, a steel "adapter" is provided which will screw into the case, and is bored out to take a percussion tube, by which the gun may be fired.

A few of the weights of charges and projectiles, and muzzle velocities, are given in the following table : â€"

Table of Weights of Charges and Projectiles.

Gan.

WeigM of Charge.

Made up in i or J Car-

Weight of Pro-

Bursting Charge of

Muzzle Velocity. Feet per Second.

Kemarks.

Cordite,

tridges.

jectile.

SheU.

ft oz.

ft

ft oz.

13-5-inch B.L. gun

187 0

Jandl

1250

85 9

2016

12 â€ž â€ž Mark VIII.

174 0

)Â» Â»)

850

80 13J

2367

9-2 â€ž

IX. &X.

103 0

17 1*

380

31 14

2643

Lyddite shell for all 9-2-inch guns

in land service

6 „ „ „

VII.

20 0

J and full

100

9 13

2493

Lyddite shell

15-pr. „

0 15i

14

1569

Only shrapnel and case shot

12-pr.

OllA

12i

1553

1) 1) >Â»

6-inch Q.F. gun

13 14

f Same as I \ 6-inch B.L. (

2154

Fires lyddite shell

4-7 „

5 7

45

4 14

2150

11 11

3 9

26

3 3

2300

11 11

12-pr. of 12’cwt. Q.F.

1 15

m

1 8i

2197

6-inch B.L. Howitzer

1 12

120

18 14*

779

Lyddite shell only

5 ,1 11 ,

oUtV

50

9 15*

782

â€ž ,, as a rule

- **Lyddite.**

T. H. C.

(c) Caebiagbs.^

Coast Artillery. â€” Since the introduction of B.L. guns many important improvements have been introduced in gun mountings. One of the first of these, though not entirely novel, was the substitution of a tension buffer for one in compression, i.e., the piston is pulled out of, instead of being pushed into, the buffer on recoil. This places the piston rod in a better position to stand the strain, and enables the pressure in the cylinder to be equalized, thus making the pull on the piston rod uniform throughout recoil. Another important change is loading in the firing position, time being thus saved and a simplification of gears effected. Again,, the gun-layer can now stand to the hand-wheel vrhilst the gun is fired. An improvement in the principle of construction was the lowering of the

1 The following abbreviations are employed in this article. R.M.L., Rifled muzzle-loader. B.L., Breech-loader. Q.F., Quick-firing. H.P., Hydro-pneumatic.

carriage, considerably reducing the “jump,” i.e., the tendency of the front of the carriage to hft on firing.

Hydro-Pneumatic Mountings. â€” In 1888 was introduced the first of a large and important group of hydro-pneumatic disappearing mountings. The essential principle is that the gun, mounted on a low site, shall on firing recoil below the level of the protecting parapet. In doing so, the energy of recoil is absorbed, chiefly by forcing a large volume of liquid through a narrow opening or “recoil valve,” but pai-

tly also by still further compressing a large volume of already highly compressed air. When recoil ceases the recoil valve closes, and the air is retained at a very high pressure, ready to raise the gun to the firing position again after loading.

Pig. 1 shows a general view of the 6-inch B.L. disappearing mounting, Mark IV. ; Fig. 2 is a vertical, and Fig. 3 m u-ansverse section through the recoil cylinder.

The gun trunnions (Fig. 1) are supported by tlie two arms of the elevator A , which is pivoted to the front of the lower carriage at B. The breech is supported by tlie two elevating bars C, whose lower ends are attached to the elevating arcs D. ” These arcs are worked by the elevating gear actuated by the hand-wheel E. The arcs are struck with the bars C as radii and their centres are

carriages]

the positions of the upper ends of these bars with the gun in the loading position, so that elevation can be given whilst the gun is being loaded. The lower carriage rests on a ring of live rollers G which are free to traverse round on a circular racer H, motion being given by traversing gear actuated by the hand-wheel I. Supported by vertical stanchions attached to the lower carriage is a horizontal circular shield J through which the gun rises to the firing position. Shield sights by which the gun can be laid for line are shown at KK. The manganese bronze ram F which is

attached to the elevator by the crosshead L, is forced on recoil mto the central chamber of the recoil cylinder (Figs. 2 and 3), the cylinder being supported by trunnions resting in the brackets of the lower carriage at M. There are ten chambers NN’ (Figs. 2, 3) all of which are connected at the bottom with the recoil valve chamber 0, and therefore with one another. Nine of these contain liquid in their lower portions, and highly

compressed air above, and are connected at the top by a channel P to equalize the pressures in each chamber. The tenth chamber N', which is

Tra. 1.â€" Diagram of a 6-incli B.L. Disappearing Mounting, Mark IV.

situated lowest in the cylinder, contains liquid alone, and has at its upper end the raising valve Q. On recoil, the liquid in the central chamber is forced by the ram through the recoil valve R, into the outer chambers N, thus further compressing the air. K being a non-return valve the air is maintained in this highly

"^S

Fig. 4.â€" Longitudinal section through cradle of 9'2-inch B.L. Gun shown in Fig. 5.

compressed state during loading. The gun is raised by pushing the lever S (Fig. 1) to the front, which actuates the rack T, thus opening Q, which allows the air in the nine chambers to force liquid from the tenth chamber N' into the central ram chamber, lifting the ram. U is a pump by which the gun can be pumped down at drill. Worked by the lever V, it sucks the liquid from the ram chamber and delivers it against the air-pressure into the nine chambers N.

A serious drawback to this type of mounting is the aeration of the liquid due to the churirtng it receives on recoil. The liquid

used consists of methylated spirits, mineral oil, distilled water, and carbonate of soda.

Heavy Barbette Mountings. â€" Figs. 4 and 6 represent the Mark V. mounting for the 9-2-inch B.L. gun, the latest development in heavy barbette mountings. Though resembling the H.P.

group in the joint use of liquid and air, this mounting pos- sesses the great advantage of having a separate chamber for each, thus eliminating aeration. 9-2-inch Mounting. â€" Fig. 5 shows a general view of the mount- ing. Fig. 4 a longitudinal section through the cradle

to a larger scale. The gun, which is trun- nionless, and to which is attached the crosshead A, recoils in the cradle C, supported by guides D, which slide in longitudinal grooves in the cradle. To the crosshead is attached the buffer cylinder B, so that on recoil, the gun, guides, crosshead, and buffer move together. The cradle of cast steel with trunnions E resting in trunnion holes in the lower carriage, has attached to it in rear the air- chambers F and G in one manganese bronze casting, in which a high initial pressure is maintained. To the front of the cradle is attached the piston and piston rod L, in one forging. On recoil the bufier is drawn over the piston, whilst simultaneously the buffer cylinder is forced into the front air-chamber F, further compressing the air and forcing the bulk of it through the valve H into the inner chamber G. At the conclusion of recoil the expansion of the air forces the bufier, and with it the gun, to the front. The valve H closes

and the air has to pass through a narrow hole before it can act on the end of the buffer, thus preventing any violent action. To prevent leakage of air between the air-chamber and buffer there is an ingenious arrangement consisting of a gland K, packed with a viscous liquid. This liquid packing is in communication with an “intensifier” I by means of a pipe J. This consists of a cyl- inder containing a piston and rod, the front face of which is in communication with the air-chamber, whilst in rear of it there is liquid communicating with the pipe. On recoil, since the front face of the piston is greater than the rear, the pressure exerted

FiQ. 2.â€” Vertical Section through Eecoil Cylinder of Fig. 1 (on enlarged scale).

Fio. 8.-

-Transverse Section through Eecoil Cylinder of Fig. 1 (on enlarged scale).

on the liquid is greater than that of the air, and the gland K is made air-tight. To prevent the gun from returning too violently to the firing position there is a “control ram ” M bolted into the rear end of the buffer, the action of which is the same as that described for the 6-inch (^.F. It is adjusted by means of a long valve spindle and sleeve projecting from the end of the piston-rod at N. To lessen the labour of elevating, the cradle trunnions are supported on a ring of hard steel balls, but since the jar of firing would damage them, it is arranged that the trunnions shall take a bearing in the solid trunnion holes of the lower carriage at the instant of firing. The mounting is supplied with an automatic sight, and the gears used for elevating and traversing the gun present no very special features. The arrangements for loading present a good example of the way in which heavy charges are

Fio. 5.â€” Diagram of Mark V. mounHIng for 9-a-inch B.L. Gun.

handled. The projectiles as seen in the recess at 0 are tilted into the carrier P, which runs on the circular rails V until the shot is over the ram W by which it is raised, and transferred to the carrier Q, which runs on circular rails underneath the shield

RR to Q’. Here it is raised hy the ram S, until opposite the breech. There is a hydraulic accumulator T.

QuicTc-firing Qun Mountings.â€” la 1890 the first of the im- portant group of Q.F. gun mountings was introduced, and the

Fig. 7. â€” Longitudinal Section of part of Cradle of Hg. 6 througli Ajiis of Buffer.

Fia. 6.â€” Diagram of Side Eieyation of 6-incli Mounting, with half of Sliield removed.

Fig. 9. â€” Showing Fig. 8 lowered and with Wheel removed.

Six-Inch llounting (Figs. 6, 7). â€” The principles aimed

at in its design are â€”

.â€ž .â€ž ;. ,. T. ^ „.â€¢,. T. T o- -1 -4. Ist,, Compactness ; 2nd, adequate protection for the

Fio 10 â€” Hydraulic Buffers of 6-mch B.L. Bieffe Howitzer. j j. u j. j.- j i i j?

xiii.iu. iij/an.ui.i,i.uuci=ui u.u^-uu.i^. Dice g^jj (Jetachmeut, gears, mountmg and breech of gun;

latest development of this type is the Mark II. mounting for the I 3rd, increased rate of fire, by arranging that the gun shall return 6-inoh gun. I to ^^^ ^ loaded in the firing position, at any angle of elevation.

instantly after recoil ; by enabling the gun-layer personally to elevate and train the gun ; by the introduction of “an automatic sight,” thus doing away with the necessity for setting sights, and making the gun independent of range-finders ; by placing the sights on the cradle, thus enabling the layer to keep his eye to the sight whilst actually firing ; and by the use of ball bearings which lighten the work of traversing.

Fig. 6 shows a side elevation of the mounting with half the shield removed ; Fig. 7, a longitudinal section of part of the cradle through the axis of the buffer. The gun, which is trunnionless, recoils in the cradle A. The cradle contains a buffer B and two cylindrical boxes

containing springs S. Attached to the breech of the gun is a piston-rod C with piston D. The piston is supplied with a “port” or opening E, through which the oil passes on recoil. The pressure inside the buffer, which would otherwise vary with the varying velocities at each point of recoil, is equalized throughout by varying the size of the port E. This is done by inserting in the buffer an “equalizing strip” E of varying section, over which the port has to pass. On recoil, the rods J which are attached to the gun in rear and screwed into the flanged cylinder H in front, force back the front of

the springs S, whose rear ends butt up against the rear of the spring boxes. After recoil the springs return the gun to the nr- ing position. To prevent their doing this too violently, the pis- ton rod has â€ž. cylindrical hole in front which becomes filled with oil on recoil. Before the piston can come up against the front of the buffer, this oil must be displaced by the control ram” G which checks the forward movement of the gun. ine cradle trunnions resting in trunnion holes in the lower carriage allow of the elevation of the gun by the elevating gear K, which drives the elevating arc L attached to the cradle at M. In iig. o the lower carriage is almost entirely hidden by the gears carried upon it, namely the elevating gear K ; the traversing gear ^, which works a spur pinion gearing into the rack O attached to the pedestal P; the elevation indicator Q and B for recording the angle of elevation of the gun ; and the brackets S which support the 6-inch armour plate T. The whole weight of the lower carriage, cradle, and gun is taken by a horizontal ring ot hard steel balls resting on the top of a massive forged steel “pivot” U, the lower portion of which is shown supported in the cast-iron pedestal P. The elevation indicator consists of a sector Q bolted to the cradle trunnion. To its edge is attached

Fig. 11.â€” Diagram of 15-pr. B.L. Carriage, Mart III.

a metal tape, the other end of which is fixed to the spindle sup- porting a pointer reading angles of elevation on the drum R. As the gun elevates the tape is paid up, the slack being taken in and the pointer revolved by a clock spring.

The Auto-sight depends on the following principle :â€” If the gun has a certain fixed charge and height above the sea, then for any position of a target there is only one suitable elevation of the gun to strike it at the water-line, and only one suitable Inclination of the sight bar, carrying hind and fore sights, to intersect the water-line at the same point. This is effected (Fig. 6) by pivoting the sight bar V to the cradle at W. The bar has a vertical arm X rigidly fixed to it, and the bottom of the arm works in a cam groove Y fixed to the mounting. The cam groove is cut to such a shape that when the gun takes up any angle of elevation, the sight bar is forced to assume such an inclination that the line of the sights cuts the water-line at the spot where the projectile will hit it. Owing to the rise and fall of the tide, however, the height of the gun above the sea varies, but this is allowed for approximately by slightly altering the position of the cam.

Siege Carriages. â€” The typical siege howitzer is the 6-inch B.L. of 30 cwt. (Figs. 8, 9, 10).

Six-inch Howitzer Carriage.â€” Fig. 8 shows the gun and cradle A mounted on its travelling carriage, from which it can be fired up to angles of 35Â° ; whilst in Fig. 9 the wheels have been removed, the trail B has been lowered on to the pivot plate C, and secured to a pivot plug screwed into the plate ; to the trail is fitted the top carriage D, and when the gun and cradle are mounted thus, 70Â° elevation can be given. The gun recoils through the cradle in

Fig. 12. â€” Plan of Carriage shown in Fig. 11.

which are two hydraulic buffers side by side (Fig. 10), the piston- rods B of which are attached to the gun, so that the recoil of the gun draws the pistons J to the rear. Considering now the right buffer only, forged in one with the piston and piston-rod is a tail rod F of larger diameter than the piston-rod. This rod on recoil is dragged into tlie buffer, displacing some of the oil which entirely fills the cylinder. The displacement of the oil forces the front of the buffers G, against which rest the rear ends of the springs, forward, the front of the springs being prevented from moving by the rods H. After recoil the springs expand, setting up a liquid pressure which acts on both faces of the piston J.

The rear face being the largest, the piston and with it the howitzer are returned to the firing position. The elevating gear, which can be placed on the left side of either the trail or the top carriage, actuates the arc K bolted to the left side of the cradle. The mounting, as in Fig. 8, is traversed by handspikes ; whilst in Fig. 9, the ends of a chain which is passed round the capstan L are attached to hold-fasts riglit and left. “With the gun on its travelling carriage an anchorage buffer M is used to check the recoil of the whole mounting, and springs to run it up again.

Field ArtiUcri/. â€” A great change has been effected in the mountings for the field artillery gun by the addition of brake gear and a non-recoil attachment designed by Sir G. Clarke. The object has been by controlling the re- coil of the carriage to increase the rate of fire, and reduce the labour of running up. Most of the Continental Powers have tried to attain the same object, the usual plan being

amebican]

the adoption of some form of plough attached to the point of the trail, digging into the ground, and reducing recoil.

The design of field artillery guns and carriages is so absolutely limited by tlie weight that can fairly be put behind a team of six horses, that the field artillery equipment must necessarily be only a compromise.

Figs. 11 and 12 represent the Mark III. carriage for the 15-pr. B.L. gun â€” Fig. 11 in elevation, Fig. 12 in plan.

15-pr. Carriage. â€” The trail A is built up of plate and angle steel. There is a socket B for the handspike used in laying. The axletree C is of tubular steel and fastened to the breast of the trail. The elevating screw E is telescopic, thus giving increased rapidity in laying. It is worked by bevel gearing actuated by the hand-wheel D. Two rounds of

ammunition are ‘ carried in each of the axletree boxes F, which are fitted as . seats for the gunners. The travelling brake consists of the shaft G with arms and brake blocks H, the whole being forced on to the wheels when necessary by a system of levers and rods, actuated by the screw with handles J. The arrangement for checking recoil consists of a spade K attached to the bottom of a tele- scopic case, containing springs L, and hinged under- neath the breast of the carriage. The spade is attached by a steel wire rope to a rod compressing a second set of springs in the steel cylinder M. On recoil the plough is forced into the ground. The cylinder L telescopes, compressing the springs and allowing the carriage to recoil. The rope simul- taneously tautens and compresses the springs in M, which after recoil expand and return the gun to the firing position.

Mountain Carriages. â€” The carriage for the 2-5-inch gun is packed for transport on three mules. One carries the axletree, a second the wheels and elevating gear, and a third the trail. Each mule in addition carries a number of small stores. It requires about ten seconds to assemble the carriage. (c. r. b. o.)

III. United States.

The material of the United States artillery is divided into four general classes, namely, mountain, field, seige, and sea-coast guns.

The mountain artillery comprises the l”-65 and 3″ i

Hotchkiss rifles, and their ^jBfâ€”

mounts and ammunition. The field artillery comprises the 3”-2 and 3”-6 rifles, and tlie 3″ -6 mortar. These pieces are all breech-loaders of gun- steel, and have conical gas check seats, cylindrical powder chambers of larger diameter than the bores and connecting with them by a slope forming a seat for the rotating band. The tops of the lands at the beginning of rifling are also cut away, forming a slope to allow the band to be gradually forced to its full depth in the rifling. These general features are followed in the manufacture of all guns. The 3″ ‘2 and3”~~6 rifles consist of a tube and jacket assembled by shrink~~ age. The

former gun is in- tended for horse artillery, the latter for field batteries. In practice, however, the former is generally used for all pur- poses. The field ca,rriage is made of steel, weighing 1300 pounds. It is of the' usual type, having recoil on the ground, which is restrained by bowspring brakes fastened to the axle and engaging over the wheels. This brake also serves as a travelling

brake, a simple arrangement permitting it to be thrown on or off the wheels when desired. The wheels used in the field and siege service are of the Archibald pattern. The limbers, except in minor details, are the same for carriage, caisson, and battery waggon, the bodies of which are made of metal. The limber and caisson chests are the same, and are made of wood covered with canvas and reinforced by iron. Each is divided into three compartments, the end ones containing twenty-one projectiles each in bronze sup- ports, and the middle one forty-two cartridges and two haversacks,

Fig. 1. â€" Diagram of Breeeh MechaniBm of 8-inch B.L. Eifle (steel, li\ tons). A, breech-plate ; B, breech-block; C, cam ; CL, cam links ; D, gas check disc ; H, hinge-pin ; LB, lock bolt ; LC, tray-latch catch ; N,, spindle nut ; Nj, lock nnt ; P, gas check pad ; Ri, Eg, Es, spht rings ; EC, rotating crank ; EL, rotating crank lock ; EP, rotating pinion ; EE, rotating ring ; S, obturating spindle ; SB, spring bolt ; SO, securing catch ; 8L, seciiring latch ; SW, spindle-washers ; T, tray (console); TO, translating crank; TL, 1 ‘ ‘ ‘ ”” ‘ ‘ â– â€¢ ^.-.t __ ,

, tray -latch ; TE, translating roller ; T8, translating stud ; V, vent-cover.

The limber complete with ammunition weighs 1780 pounds, and the caisson and limber complete with ammunition, 4607 pounds. The ordnance department of the army has designed a 3″ field rifle to supplant those now in service, when a suitable non-recoil carriage shall have been selected. It has also decided upon a 5″ field

S. VII.â€" 46

[ameeicast

howitzer, the carriage for which will resemble the field carriage, and awaits the determination of the latter. The data for these two guns are included in the tables at the end. The 3”~~6 mortar, consisting of a single forging of steel, is a short piece intended for vertical fire against troops protected by entrenchments or irregu~~ larities of the ground from the direct fire of field guns, and will be largely supplanted by the field howitzer. The maximum range is about 3450 yards, and the charges requii-ed to cover all ranges from 400 to 3450 yards are four in number. The carriage, weigh- ing 275 pounds, is made of cast steel in one piece. Elevation is given by a quadrant, and a clamp is provided to fix the mortar at any elevation. The carriage rests on a wooden platform, and is restrained in recoil by heavy ropes attached to stakes in front. Changes in azimuth are given by means of a pointing scale gradu- ated to T^j^ of the range.

The field artillery ammunition comprises cast-iron shell, shrapnel, and canister. A steel shell holding a larger bursting charge is also provided for the howitzer. The canister, contaipnig 226 balls, consists of a hollow cylinder of malleable iron, the rear end closed by a cast head. Around the case are several slits, their ends overlapping to secure a thorough breaking up on dis- charge. There are several small holes through the head through which the gas enters on discharge, driving the balls forward and assisting in the desti-uction of the case. The shrapnel contams 162 hard lead balls, assembled in circular layers, and held m position by cast-iron separators, which increase the effect of the explosion by furnishing additional fragments. The base is made of cast-iron threaded to the interior of the cylindrical case. Recent improvements have had in view the omission of the separators permitting the addition of a number of lead balls con-

Fio. 2.â€” Diagram of Breech Mechanism of 12-inch B.L. Eifle (steel, 52 tons). B, breech-block ; BB, bronze bushing ; C, crank ; CB, catch bolt ; D, gas check disc ; H, hinge-plate ; HP, hinge-pin ; LO, tray-latch catch ; N,, spindle nut ; Nj, lock nut ; P, gas check pad ;Ei, Ej, Ej, split

rings ; S, obturating spindle ; SB, spring bolt ; SBB, spindle ball-bearing ; SG, spiral gear ; T, tray (console) ; TB, tray ball-bearing ; TL, tray latch ; V, vent-cover ; W, worm ; WS, worm-shaft ; WSB, worm-shaft ball-bearings ; WW, worm-wheel.

tained in steel jackets. The head of the shrapnel, containing the powder chamber, is made of cast-iron, bored and threaded to i-eceive the fuse. T|ie body is made of a lap-welded tube weakened for fracture by grooves in the sides.

Siege Artillery.â€” Hhia comprises the 5″ rifle, the 7″ howitzer, and 7″ mortar, all breech-loading rifled pieces, following the general description of the field guns. Excepting the mortar, which is a single forging, they are constructed on the ” built-up ” principle. The rifle consists principally of a tube, jacket, and sleeve, the tube being unsupported for a distance of 56 inches from the muzzle. The carriage for the rifle consists essentially of two steel flasks parallel to each other, connected by a bottom and top plate and transom. The carriage is similar in general design to the field caiTiage, except that the trunnions of the gun are relatively much higher from the ground, the axes of the trunnion beds being 72 inches above the horizontal platform upon which the carriage rests. The elevating apparatus is a double screw similar to that in the field carriage. A limber is provided for travelling, which also serves for the howitzer carriage. This and the howitzer carriage are mounted on a wooden platform weighing about 5100 pounds, and having a metal pintle to which

H, hinge-plate ; HP, hinge-pin ; LO, tray-latch catch ; N,, spindle nut ; Nj, lock nut ; P, gas check pad ;Ei, Ej, Ej, split rings ; S, obturating spindle ; SB, spring bolt ; B, spindle ball-bearing; S(}, spiral gear; T, tray (console); TB, tray ball-bearing; TL, tray latch; V, r-^’ ” ^^ ‘ ~ ” ‘ ~

the carriages are attached through the medium of a hydraulic cylinder to restrain their movement in I’ecoil, after which they are moved forward by handspikes. The carriage weighs 2820 pounds, and permits the gun to be fired at any elevation from minus 10 degrees to plus 38 degrees. The howitzer consists essentially of the same parts as the rifle.

The can-iage, while somewhat similar to that for the rifle, differs from it in that the howitzer is permitted to recoil upon it, thus reducing the strains. The piece is mounted on two trunnion carriages upon slides inclining to the rear and downwards at an angle of 18Â°, upon which it has a recoil of 6 inches. Recoil on the slides is checked by hydraulic cylinders placed in front of the trunnion carriages, and in the rear by two courses of springs, one on each side, serving also to return the piece to the firing position. The height of the trunnions of the piece is the same as that for the siege rifle, although in a more recent design this height has been reduced to 60 inches. The wheels, weighing 375 pounds each, are the same as for the siege rifle. The weight of the carriage, including the wheels and hydraulic brakes, is about 3000 pounds, and the howitzer can be elevated from minus 5Â° to plus 40Â°. The 7″ mortar fills the need of the service for a piece for vertical firing in.

siege operations against strongly entrenclied and covered positions, and is adapted to use the same projectiles as the howitzer. It con- sists of a , single forging with trunnions combined, whereby a con- struction of satisfactory strength with minimum weight is best obtained. The service required is to deliver relatively heavy pro- jectiles at short or moderate ranges, to supplement the curved fire of the howitzer by vertical fire at medium ranges, and to cover the field at shorter ranges which are inaccessible to the howitzer. The projectile of normal weight is fixed at 125 pounds, having a velocity of 700 P.S., with a maximum range of about 4200 yards. The carriage is made of steel plate, and in its method of checking recoil aad returning the piece to the firing position resembles the howitzer carriage. It is, however, not a wheeled carriage, but rests upon a wooden platform to which it is fastened by cast steel clip plates bolted down. Traversing is effected by pinch bars engaging in teeth cast in the plates. Elevation is accomplished by bars fitted

Platform for Chassis si(jk

‘Em. 8.â€” Diagram of Barbette Carriage for 8-moh B.L. Etfie.

into sockets bolted to the faces of the trunnions, the piece being clamped in any position by a screw through the left cap square. The limits of elevation for ordinary fire are from plus 30Â° to plus 65Â°. The wooden platform weighs 3720 pounds and the carriage 1720 pounds. This platform is not quite heavy enough to secure proper stability, at least in loose soil, but in view of the fact that it must be transported, reliance must be had on material gathered near the place of use for a solid suboonstruction, to which the platform can be secured by means of holding-down bolts provided for the pur- pose. Cast-iron and steel shell and shrapnel are used with siege artillery depending upon the results desired. The shrapnel is similar to that described for field artillery, except that a central tube extends from the powder chamber to the head of the base. The 5″ shrapnel contains 280 hard lead balls and other parts, making the number of pieces before firing 356. The howitzer shrapnel contains 390 balls, and a total of 461 pieces. The mortar shrapnel contains 449 balls and other parts, making the total number of pieces before firing 550. As an instance of the manner in which these shrapnel behave in service, it may he noted that in some recent firings the howitzer shrapnel gave about 800 dangerous fragments.

Coast Artillery. â€” The sea-coast artillery consists of 5-inoh and

6-inch rapid-fire guns, 8-inoh (Fig. 1), 10-inch, and 12-inch rifles (Fig. 2), and 12-inch mortars ; with the exception of the mortars model of 1886, which have cast-iron bodies with steel jackets, these are built up of gun steel, and are all hreech-loading with rifled bores. The number of hoops has been successively reduced, as steel manufacturers have become able to make larger forgings, and the greater length of the hoops much increases the stiffness of the guns. In the 5-inch guns the tube is given an initial tension, in addition to that caused by the shrinkage of the jacket, by heating and cooling from the interior. There are also a number . of 6-pounder rapid-flre guns on wheeled carriages, and 15-pounder rapid-fire guns on a form of pillar-mounting. The 5-

inch rapid- flre guns are mounted in barbette on pillar- mount carriages, similar to the Armstrong pattern, and on pedestal mounts, which are very similar in all countries. The 6-inch rapid-fire guns are mounted on pedestal mounts and on disappearing carriages, arranged to be manoeuvred by one man. In the latter mounting rapidity of fire is somewhat sacri- ficed for cover, but six or seven rounds per minute can be attained.

The 8-inch, 10-inch, and 12-inch rifles are mounted on barbette or disappearing car- riages, depending upon their situation. The barbette carriages are all of the same design, and differ only in size and weight (Fig. 3). They are of the centre pintle form, and con- sist essentially of two side frames mounted on a turn-table, and a top carriage, consist- ing of trunnion beds and recoil cylinders. Where strength permits a superior quality of oast-iron is used for the construction of the larger parts. The turn-table proper for all carriages consists of an upper and lower roller path, between which are forged steel conical rollers, securely held in place by concentric distance rings. The top car- riage rests, on each side, on steel rollers mounted in U-shaped recesses in the tops of the side frames, which have an inclination upwards and to the rear of 4Â°. The piston- rods pass through lugs which project up- wards from the front ends of the rails, and are secured by the necessary nuts and check- nuts. The front Surface of these lugs and rails is planed as a shoulder for a shield to protect the cannoneers, which has not yet been supplied. During recoil the' pistons remain stationary, the top carriage with its cylinders being drawn over them. The energy of recoil is taken up by the uniform resistance which the liquid in the cylinders offers to being driven through varying orifices caused by throttling bars, whose inner surfaces are curved. After recoil, the gun returns to the firing position by the action of gravity.

The gun is pointed in azimuth and elevation by suitable gearing. A crane is provided for raising the projectile to the breech of the piece, and a loading platform of suitable dimensions to permit the operation of loading to he performed by the necessary number of men, is attached in rear. The carriage permits the gun to be traversed 320Â°, and elevated from minus 7Â° to plus 15Â°. The gun can be laid by means of

a telescopic sight attached to the right trunnion, or to a standard on the right side frame, or by the indirect method.

The disappearing carriages are of the ” BufBngton-Crozier ” type (Fig. 4). The turn-table, chassis rails, or side frames, and top carriage, are similar in general design to those for barbette carriages. The trunnions of the gun rest in trunnion beds at the upper ends of the gun levers, which are pivoted near the middle point upon an axle resting in beds in the top carriage. The lower ends of these levers are joined to a steel crosshead, from which the counter-weight is suspended. This crosshead clips over vertical guides cast on the inside of the chassis rails, by which it is constrained to move in a vertical direction. Ratchet teeth are cut on the front faces of the clips to be caught by pawls pivoted to the chassis rails, and in this way the counter- weight is held up, and the gun is prevented from returning to the firing position after recoiling. The counter-weight is just suffi- cient to raise the gun to the firing position when loaded. The energy of recoil is absorbed as described for barbette carriages. Equality of resistance in the cylinders, as in the barbette car- riages, is obtained by connecting their pressure ends hy an equalizing pipe. Pointing in azimuth is performed by suitable

1

MOUNTAIN ABTILLBRT.

FIELD ARTILLERY.

Â«

3-2-INOH B.L. Rifles.

WEIGHTS, DIMENSIONS, &0.

HOTGH-

8-INOH

8-6-IHOH

3-6-INCH

KTRR

HOTCHKISB

B.L.

B.L.

B.L.

5-INCH B.L.

1‘66-IHCH

S-INOH B.L.

Rifle,

Rifle,

MOKTAB,

Howitzer,

B.L.

Rule.

Model

Model

MODEIfl

Model

Model

Model

Model 1898.

Rifle.

1898.

1885.

1890 AHD

1890 M.I.

1897. ^

1891.

1890.

Weight , .

/ Pounds . \Tons

121

216

835

829

794

830 ‘ 1,200

245

1,160

Totallength .

. Feet

8-83

3-76

7-43

7-56

7’-31

7-31

7-79

2-65

6’-66

Length of bore

. Calibres .

26-0

13-0

28-0

26-0

26-2

26-2

23-6

5-3

12-0

Maximum diameter, breech

. Inches .

6-03

6-7

8-8

9-56

9-0

9-0

9-8

7-8

11-8

Diameter of muzzle

â€¢

2-65

3-94

4-6

5-1

6-0

6 0

6-0

5-4

7-0

Diameter of trunnions

1-8

2-66

3-8

3-8

3-8

3-8

3-8

Length of trunnions

.

1-8

2-44

2-25

2-7

2-7

3-0

2-5

Distance between rim bases

”

4-r

7-09

9-5

9-5

9-5

9-5

9-5

Distance of axis of trunnions f^om muzzle .

â€¢

27-3

26-5

60-4

57-719

67-35

67-26

14-6

/â– Number of grooves ....

10

24

24″

24

24

24 26

20

36′

Width â€ž â€ž ...

. Inch

0-36

0-276

0-2927

0-3

0-3

0-3

0-3162

0-4464

0-3736

Rifling , J Depth â€ž

0-012

0-026

0-03

0-06

0-04

0-04

0-04

0-046

0-06

Width of lands ....

>i

0-157

0-117

0-10

0-1188

0-1188

0-1188

0-1188

0-12

0-15

l.Twist

. Calibres .

1 in 29-83

1 in 25-59

1 in 60 to

lin30

1 in 60 to

1 in 60 to

1 in 60 to

1 in 40 to

1 in 60 to

1 in 25

1 in 26 1 in 25

lin25

lin26

1 in 26

Powder f?S^=^

chamber {^^^X : . ;] ! !

. Inches .

1-8

3-16

3-2

3-8 max.

3-6 3-82

8-9

3-8

5-2

. Cubic inches .

4-6 11-71

3-72 27-12

6-58 55 0

11-508 109-7

10-7 6-68 110-3 60-0

12-276 148-6

2-836 33-2

3-85 92 0

Total capacity of bore

^-Kind

”

93-6

292-0

630-2

714-7

690-6 j 648-3

905-5

200-0

â– ;

C.I.

Case.

C.I.

Shr.

Case.

C.I.

Shr.

C. 1.

Shrapnel. . C. I.

Shr.

C. I.

Shr.

C. I.

Shr.

C.I.

c.s.

Shr.

Shell

Shell

Shell

Shell.

Shell

Shell

Shell

Shell

Shell

Weight, fiUed

. Pounds .

2-0

2-8

12

12

12

16

16

13-5

13-5

13-6

13-5

20

20

20

20

45

46

46

Proiectile J Ratio, weight to weight of piece .

1 Weight of bursting charge, rifle powder

^.

Js A

\

A

A

^

A

A

A

^

A

A

A

A

A

iV

A’

. Pounds or ozs.

1-7*

. . 6-8Â»

1-9*

9-6Â»

3-0Â«

7-0*

3-5*

7-0*

3-6* 112-8*

4-0*

12-8*

4-0*

2-3

1-211

12*

Length ...;..

W \^Sectional density â€” ^ â€¢ , .

Travel of shot . . .

. Calibres .

3-5

3-6

4-2

3-1

3-0

2-411

3-0

2-411

3-3

2 511

3-3

2-611

3-0

2-6

2-4)1

. Inches

0-91

1-31 1-70

1-70

1-70

2-12

2-12

1-68

1-68

1-68

1-68

1-96

1-96

1-96

1-96

2-3

2-3

2-3

37-2

36-2

77-42

71-991

69-8

76-06

72-275

16-066

56-15

/

f Brown or Black

Mortar.

I. K. Granular.

Sphero

Sphero

Sphero

Sphero

Sphero hex.

hex. Field

hex. Field

hex. Field

hex. Field

Field Cannon.

Cannon.

Cannon.

Cannon.

Cannon.

Smokeless

..

..

3-0”Field

3-2″ Field

3-2″ Field

S-2″ Field

3-2″ Field

-aO-Calibre

Field Gun.

Kind .

Gun.

Gun, models

Gun, models

Gun, model

Gun, models

Rifle.J

Powder ./

1886 and

1890.

1886 and

1890.

1897, and Siege Gun,

and Howitzer.

1885 and

1890.

Weight (see note) . {fSeless

. Pounds or ozs.

6-5*

2AÂ»

14-0*

4iÂ»

20*

3-5 18-76*

3-6 18-75*

16-26*

4-375 23*

15-0*t 6-0*t

4-0 1-4

1^ Density of loading, jf^^less

0-8127 0-3416

0-9 0-2870

0-6606

0-8832 0-2952

0-8783 0-2936

0-5276

0-8165

0-26S0

0 -78161

0-3127t

1-2807

0-44S2

Muzzle velocity . . . j^^Xless

. F.S, . F.S.

1,460 1,313

870 885

1,725

1,685 1,685

1,686 1,686

1,685

1,660 1,660

660t 690t

1,000

1,000

27,000

20,000

812

312

2-6

2-6

Maximum pressure per square inch i smcAeless Muzzle energy .... {g^‘okeles;

. Pounds . . Foot-tons

13,340 13,000 29-6 23-9

15,000 13,500 63-0 65-2

82,000 310

35,000

35,000

266

266

36,000

35,000

266

266

35,000

â– 266

35,000

85,000

383

383

le.ooot

17,000t 69t 66t 1-lt l-2t

C-MT 1 /Brown ^enet^ation ^^^^^^ â– â€¢ â€¢ \ Smokeless

, Inches .

1-C

1-3

1-4 1-5

4-5

3-8 3-8

8-8 3-8

s-s

8-9 3-9

in steel at , ,.Â«â€ž , j Brown . (De Marre J ^^^^ ^^^^ â€¢ â€¢ (Smokeless

))

Form u 1 a, 1 ngoQ / Brown . normalim- ”” Â»Â» â€¢ â€¢ “(Smokeless

M

n

pact). â€ž-Â«Â« /Brown . ^^^^^ ” ‘ ‘ t Smokeless

>i

â€¢â–

Projectiles (abbreviations) : 0. I. = cast iron. Shr. = shrapnel,

C. S. = common steol. A. P.=armour-piorcing.

D. P. = deck-piercing.

Powder Note.â€” The weights given are approximate. The exact weight giving tho standard muzzle velocity is determined from the acceptance test and issue for charges

American]

ORDNANCE

365

CANNON, 1900,

SIEGE ARTILLERY.

)-INCH B.L.

Rifles,

Model

1890.

12-15 27-0 15-0 8-0 6-8 8-3

16>0

96‘25 30 0-8736 0-05 0-16

1 in 60 to lm25

5-7 16-15 402-6 2,824-5

Model

1898.

3,639

11-91 27-0 16-0

8-0

6-8

8-3 150 95-8 80

0-3786

0-05

0-16

1 in 60 to lin26

5-7

16-15

402-5

2,816-7

CI,

C. S.

Shell.

Shell.

46

46

A-

1^

2-3

1-211

3-0

2-6

2-30

2-30

Shr.

45

12Â»

2-411

Sphero hex. Siege Gannon,

Gun and How- itzer.

13-0

4-26

0-9096

0-2923

1,830

1,830 35,000 80,000

1,045

1,045

6-2

6-2

4-6

4-6

3-0

3-0

2-5

2-5

Sphero hex. Siege Cannon.

Siege Gun and How- itzer.

13-0

4-26

0-9096

0-2923

1,830

, 1,830

85,000

80,000

1,045

1,045

6-2

6-2

4-6

4-6

3-0 ‘ 8-0

2-5

2-6

7-lNOH B.L. Howitzers.

Model

1890.

3,710

8-48 12-7 16-7 10-0 7-0 4-0 18-0 64-6 42 0-3736 0-06 0-16

1 in 60 to lin 26

7-2 7-466 316-7 3,499-0

Model

1898.

3,650

8-27 12-7 16-6 10-0 7-0 4-26 18-0 64-2 42 0-8736 0-05 0-16

lin 50 to 1 in 26

7-2 7-465 316-7 3,499-0

0. I.

Shell,

105

Steel

Shell.

106

4-3t

2-6

Shr.

106

1-9 2-011

2-70 2-70 2-70 81-386

81-885

Sphero hex. Siege Cannon.

Gun and How- itzer.

10-5 3-6

0-9177

0-3059

1,100

1,100

28,000

20,000

881

881

3-8 3-8

2-7 2-7 2-5 2-5

7-INCH B.L.

Mortar, Model 1892.

1,716

4-86 ‘

7-0 13-8 10-5

7-0

4-0 14-3 34-16

0-6854 0-065 0-15

1 in 40 to lin 15

7-25 4-18 182-8 1,951-0

0,1,

Steel

Shell

Shell

125

126

â€¢h

ft

12-5

6-811

3-6

3-0

8-26

8-25

Shr,

126

ft

1-9

2-411

44-8176

Sphero Sphero hex,

hex. Siege Siege Cannon,} Cannon.

Siege i 3-2″ Field Giin,

Gun and models 1886

How- and 1890. itzer.

10-6 8-6

0-9177 0-8069 1,100 1,100 28,000 20,000 881 881

2-7 2-5

6-Ot

l-75t

0-9086t

0-2105t 700t 710t 20,000t 17,000t 426t 437t

2-3t

2-3t

SEA-COAST ARTILLERY.

8-INOH B.L.

BirLE, Model

1888 M.ii.

82,218 14-5 23-21 32-0 80-0 14-0 10-0

6-0 82-5 183 -0 48

0-3736

0-06

0-15

1 in 60 to

lin 25

9-5 51-0

8,619 14,109

A. P.

A, P.

Shot

Shell

300

300

T*7

T*T

11-611

3-6

4-0

5-97

6-97

C. L

Shot

300

tJt

3-6

8”B. L, Rifle.

135-0

70 0 1-0331 0-5354 2,025 2,300

88,000

37,000 8,628

10,628

16-8

19-6

15-0

17-4

12-6

14-6

11-4

13-0 ,

10-iHOH B.L. Rifles,

Model

Model

1388 M.iL

1896.

67,183

66,700

30-0

80-0

80-6

80-76

84-0

36-0

88-5

37-0

16-8

17-6

12-0

12-0

6-76

6-75

42-0

42-0

243-06

240-8

60

60

0-8786

0-3786

0-06

0-06

0-16

0-16

1 in 50 to

1 in 60 to

lin 26

1 in 26

11-8

11-8

65-49

65-49

V,123

7,123

29,008

29,788

A. P.

A. P.

Shot.

Shell.

675

575

tK

â– rb

22-4t

3-‘5

4-0

7-33

7-33

0. L

Shot.

675

Th

3-5

Brown

Pris.

10″ B. L, Rifle,

280-0 140-0 1-0886 0-6441 2,025 2,300

88,000

87,000

16,345

21,086

21-1

25-3

19-2

23-0

16-6

20-0

16-1

18-1

Brown Pris,

10″ B, L, Rifle,

280-0 140-0 1-0886 0-5441 2,025 2,300 38,000 37,000 16,345 21,086 21-1 25-8 19-2 23-0 16-6 20-0 , 15-1 18-1

12-IlIOH B.L. BiFLEB.

Model 1888 M.II.

117,127 62-0 36-66 34-0 46-2 20-2 14-5 8-0 60-2 291-1 72 . 0-3736 0-06 0-15

1 in 60 to lin 25

14-2 77-68 12,186 60,900

Model

1896.

115,000

61-0

36-88

36-0

44-5

210

14-6 8-0

60-2 289-6

72 0-3786 0-06 0-15

1 in 50 to

lin 25

14-2

77-68

12,185

51,371

A. P.

A. P.

Shot.

Shell.

1,000 3-5

1,000

89^-tt

4-0

8-94

8-94

C. I.

Shot.

1,000

liT

3-5

Brown Pris,

12″ B. L, Rifle.

490 240 1-1133 0-5452 2,026 2,300

38,000

87,000

28,426

36,671

26-8

30-9

23-8

28-6

21-2

25-6

19-6

23-5

Brown Pris.

12″ B. L, Bifle.

490 240 1-1183 0-5452 2,025 2,300

38,000

37,000

28,426

86,671

26-8

30-9

23-8

28-5

21-2

25-5

19-5

28-5

16-INOK B,L,

Rifle, Model

1896,

282,000 126-0

49-25

36-0

600

28-0

379-65 96 0-3736 0-06 0-16

1 in 60 to lin 25

18-8 107-2 29,387 121,391

A. P.

Shot

2,400

A.P.I C.T.

Shell

2,400

Shot

2,400

3-‘5 11-94

Brown Pris.

16″ B. L. Bifle.

1,176 676 1-1077 0-5425 2,025 2,800

88,000

87,000

68,256

83,050

35-3

42-3

38-4

40-0

30-6

36-7

28-8

34-6

10-INCH

B.L.

Mortar, Model

1890.

Brown Pris.

10″ Mortar.

68 -Ot 30 -Ot

l-1222t

0-6344t

l,020t

l,150t 31,000t 38,000t

4,147t

6,272t

7-9t

9-4t

7-5t

8 -71

7-Ot

7-9t

6-7t

7-6t

12-INCa B.L. UOBTABS.

Cast-Ibon

Body, Model

1886.

Steel, Model 1890 U.I.

31,920

14-25

10-75

9 0 41-75 22-5 12-0

6-0 44-0 79-1 68

0-379

0-07

0175

1 in 40 to

lin 25

12-4

Iff 06

2,021 12,598

D. P. I Torpedo I C. I. Shell. Shell. Shell.

29,120

18-0

11-76

10-0

33 -0

21-0

12-0

8-0 40-0 89-6 72

0-8786

0-06

0-15

1 in 40 to

lin 20

12-6

21-13

2,676 14,269

800

ft

22-111 3-0

7-08

ft

39-41 4-0

800 11,000 800 |1,000

ft ft 1 ft 67-7ir84-61[a2-5 4-0 6-0 j 3-0

7-08 I 8-94 7-08

ft

19-6 3-5

8-94

Brown Pris.

12″ Mortar t or

Siege Gun and

Howitzer.

S75-0t Â§41 -6t l-0272t 0-5684t

Â§l,020t

Â§l,200t Â§27,500t Â§26,000t

Â§6,769t

Â§7,986t

Â§8-2t Â§10-4t

Â§7-8t

Â§9-6t

Â§7-3t

Â§8-6t

Â§6-8t

Â§8-lt

Brown Pris.

12″ Mortar t or

Siege Gun and

Howitzer.

fllOSt

Â«60t

l-0861t

0-5172t

Â«l,020t

Â»l,160t

981,000t

e33,000t

e7,212t

e9,168t

e9-7t eii-6t

e9-3t eio-7t

Â«8-7t 99 -9t

e8-4t

99-4t

- **Ounces.**

t Maximum. The weight ot charge varies with the range ; for issues in bulk the average charge is assumed to he f the maximum. >

X The kind of powder varies with the range.

Â§ For 800-pound shell.

II Without fiize. ‘ ,

1[Gun-cotton.

cfi The use of the 16i lb projectile with this rifle is to he discontinued. The charge for this projectile was 12-87 ozs. smokeless powder, resulting in a velocity of 1450 P.S. with a pressure of 85,000 lb per square inch.

e For lOOOponiid shell ; with the 800-pound shell the velocities are 1150 and 1325 P.S. with brown and smokeless powder respectively.

gearing. The gun is elevated and depressed by means of a rack on the chassis rails, connected to tlie gun by two long arms ; any movement of the rack up or down is thus communicated to the gun. While theory requires, in order that the gun shall always return to the same angle for loading whatever may be the firing angle, that the rack and its guide shall be struck witb a radius equal to the length of the elevating arms, using the point of attach- ment to the gun in the loading position as a centre, the expense of manufacture has made it desirable to make them

straight. These are so placed, however, as to cause only a slight variation in the loading angle, which is about 4Â°.” Ammunition is served to the guu on ammunition trucks, permitting.the projectile to be raised to the*proper height for loading and to be given the same inclination that the guu has in the loading position. The gun can be pointed by means of indirect laying, or of a telescope sight placed on the rigbt trunnion or on a sight standard attached to the rear of the carriage at sucb a height as to look over the interior crest.

In these carriages the centre of gravity of the gun-counter- weight system moves some distance to the rear, greatly relieving the firing strains. The character of motion also permits the muzzle to project some distance over the interior crest. From the fact that the lower ends of the gun levers are constrained to move verti- cally, and their centres nearly horizontally to the rear, the path of the trunnion of the gun is an ellipse. The breech of the gun.

being connected by a fixed arm to the elevating rack, travels in the arc of a circle. The combination of these two movements causes the muzzle of the gun to move almost directly to the rear, parallel to the superior slope, until it has passed the interior crest, when it turns suddenly downwards. These carriages are hardly more complicated than barbette carriages, having the same hydraulic cylinders and the same slide rails. There are no valves and no fluid under compression, except during the instants of recoil, and after long standing they can be prepared for immediate use by simply filling the cylinders with oil. The character of motion has other advantages besides that of causing the piece to describe a suitable path in recoil. The top carriage starts with only about one-half the acceleration of the piece, thus dimimshmg the shocks and strains brought upon it and the gun levers. At the beginning of the motion, when the gun has its greatest velocity, the counter - weight has relatively the least, so that the latter starts from rest very slowly, and the operation brings no sudden or undue strains upon any part of the mechanism.

The barbette and disappearing carriages are manoeuvred and loaded by hand power. Electric power may be applied if desired. Guns

mounted on the former carriages have not quite the rapidity of fire of corresponding calibres on disappearing carriages. This is due to the fact that guns on the latter carriages always return to the loading position with the proper loading angle, while on

Fia. 4.â€” Diagram of Disappearing Carriage L.F. for 10-inch B.L. KiflS.

the former they must be brought nearly to a horizontal position for loading, the operations of which are performed on a platform at some distance from the ground, to which the charge and pro- jectile must be raised at each discharge. Recent trials with disappearing carriages indicate that ten rounds can be fired from 8-inch guns in twelve minutes, from 10-inch guns in fourteen minutes, and from 12-inch guns in seventeen minutes, meaning in the latter case that 14,500 pounds of ammunition are handled for the ten rounds.

There are two kinds of mortar carriages, designated respectively as ” model of 1891 ” and ” model of 1896.” The former is of the ” Easkasoff, Easton, and Anderson” type, in which two triangular side frames are mounted on a turn-table, and the mortar recoils downwards and to the rear at an angle of 60Â° to the horizon, the mortar being held in the firing position by two columns of springs placed in spring cylinders cast in the side frames. The turn-table of the model of 1896 carriage (Fig. 5) is similar to that of the model of 1891. The top carriage or saddle in which the mortar is mounted consists of two arms connected by a heavy web, inclined to the rear and upwards at an angle of 46Â°. The upper ends of the arms form the trunnion beds, while the lower ends are held by a fulcrum shaft attached to the turn-table. The saddle is sup- ported at a point about one-third of its length from the fulcrum by five columns of double springs arranged in a row side by side. The recoil is checked by two hydraulic cylinders, one on each side, the pistons of which are attached to the cradle near the gun trunnions. The action of the carriage when the piece is fired is as follows: The saddle revolves about its fulcrum to the rear and downwards, carrying the mortar and compressing the spring columns. As the piece moves down

the two crank pins force down the crossheads and piston-rods until the resistance of the hydraulic

cylinders stops the motion. The springs, acting against the saddle, reverse the motion and raise the piece to the firing position. The mortar must be brought to a horizontal position for loading, and the shot is served to it by means of a truck, passing the shell direct from the truck into the mortar.

Ammunition. â€” Armour-piercing shot and shell are used with the rifles, the difference between them being as regards penetrative power and interior capacity for high explosive charge. Deck- piercing and torpedo shells, weighing 800 and 1000 pounds, are used with the mortals, depending upon the range. The heavy torpedo shells are 4J calibres long, and are designed to carry a large bursting charge, so as to have great effect on striking in the vicinity of a battleship. The extreme range of these mortars is about six miles, but they are intended to cover all ranges by variation of charge and projectile and angle of elevation.

Sreech Mechanisms. â€” In all of the guns, except tlie mountain guns, the breech mechanism belongs to tie interrupted screw system, using the plastic pad for obturation, excepting only the 3-6” mortar, which has the ” Freyre ” check. In the guns of larger calibre the gas-check cups are replaced by split rings, which are slightly larger than the conical seats, and are sprung together by being forced into their places. In action they are held against the walls of the gun by the plastic pad, thus pre- venting an escape of gas. In the field and siege guns the block is carried in a ring, which supports it- when open. Rotation is given by means of a handle fixed or pivoted near the top, and the block is withdrawn through the carrier ring and swung open by hand. The breech-blocks of the rifles of old model and of the mortars are rotated by means of crank handles, and withdrawn from the piece on to a bronze tray by means of a screw, and are then swung open by hand. In the latest improved mechanism the

FOKBIGNJ

continuous movement of rotation, translation, and swinging of the block and tray are effected by the operation of a single crank. The newer mechanisms for field and siege material will conform to those for the rapid-fire guns, where the block is opened by the single movement of a lever, of which there are numerous similar types.

Wire Ouns. â€” Several systems of wire guns have been tested in the United States with a view to their adoption. All have failed under test, or have had objections which were not overcome, excepting the Crozier, in accordance with which a 10-inoh gun was constructed and exhaustively tested at the Army Proving Ground. The test of this gun was highly successful, but up to 1901 none had been installed in fortifications.

Means of Sighting. â€” All field, siege, and sea-coast guns, except- ing the mortars, are provided with both open and telescopic sights. The mortars are pointed by indirect laying, elevation being given by a quadrant. The telescopic sight is somewhat similar to the Scott, erecting the image and having a larger field. For the rapid-fire guns a bar sight is used, having a peep sight and a tele- scopic sight side by side. Electric night sights are also provided.

Fuzes. â€” Three kinds of fuzes are used: the base percussion, the point combination time and percussion, and a detonating fuze for high explosive shells. The first is used with all shells not con- taining high explosive, and the combination fuze is used with

shrapnel alone. There are two sizes of the latter fuze, one burn- ing to 15 seconds and the other to 28 seconds. The former is adapted to high-velocity fire with field and siege guns, and the latter for firings with the field and siege mortars and the siege howitzer. These fuzes are graduated to sixths of seconds. This method has been preferred to one giving the range in yards, since it permits the interchange of fuzes in projectiles for guns of different calibres. The fuzes for the field

projectiles and 5-inch shrapnel are issued and transported with the projectiles ready for firing. The remaining fuzes for siege and sea-coast service are packed in tin waterproof cases for separate transportation, to be inserted in the projectile at or near the firing ground.

Powder. â€” The sphero-hexagonal black powders and brown prismatic powder in store will be used principally for practice until the supply is exhausted, after which smokeless powders will alone be supplied. Many experiments to determine the most suitable smokeless powders have been made since 1890. At present that which appears to meet with most favour is a pure gun-cotton powder made from cotton, of which only about 1 per cent, is in- soluble. This has a cylindrical multi-perforated grain, the size depending upon the calibre. All powders are stored in hermetic- ally sealed cases to prevent deterioration.

High Explosives. â€” Various high explosive charges for shells have been recommended and provisionally adopted, but this matter

^^IS. 5. â€” Diagram of Carriage for 12-incli B.L. Mortar.

cannot as yet be considered settled. The war with Spain caused renewed activity in the field of invention, and recent experiments indicate two or three promising explosives for shells of all calibres to replace gun-cotton, which is now used.

Eange-Finders. â€” The only range-finder thus far issued is the ” Lewis Depression Range and Position Finder,” of which there are two types. The type “A” is an instrument weighing about 700 pounds, designed for permanent installation on a concrete founda- tion at a considerable distance from the guns of a battery. A complete automatic replotter is carried on the table of each in- strument, by the use of which the observer can instantly convert the range and direction of the target as read from the instrument into the corresponding range and direction from the gun itself. The corrections necessary for effects of curvature and normal refraction are made in the construction of the range scale, and corrections for changes in tide and abnormal refraction are controlled by the observer through mechanical devices. The type ” B ”

instrument is light and portable, and somewhat resembles a transit in the ease and quickness of its adjustment. This type Is designed as an emergency instrument, to be used in case of accident to the type "A," or when the lines of communication between the main ^position-finder and the gun are broken. The accuracy of this instrument is not so great as that of the larger one, but the error in range is said not to exceed 1 per cent, up to 8000 yards.

(c. B. W.) IV. Othbe Powees.

The readiest method of presenting information in regard to the ordnance of foreign countries is to take the descrip-

tion of the British ordnance as a basis, and to state the principal differences exhibited in others. It is in a com- parison of strength that the interest reaUy lies. The following are the chief elements to note as indicating power in various ways : â€"

Muzzle Energy. â€" This is an expression for the actual blow delivered by a projectile leaving the muzzle of the

gun. It is written â€"^; W, on the British system, being

the shot-weight in lb, V^ the square of velocity in feet per second, and g the force of gravity in feet per second. The result is divided by 2240 to convert pounds into tons, the blow being most conveniently expressed in foot tons, i.e., the number of tons that could be lifted through one foot by the energy of the blow if applied in a suitable shape. A comparison of energies is then a comparison of the blows delivered. The cost of manufacture and the necessary provision for the carriage of a gun mainly depend on its weight, and the simplest estimate of the success of any gun, as an investment, is the blow produced for each ton of metal. This is obtained by dividing the total energy by the weight of the gun in tons. The 12- inch wire-gun, Mark IX., gives 718, and the old 12-ineh muzzle-loader only 273 foot tons per ton of gun.

ORDNANCE

[foreign

Fire Energy per Minute. â€” The introduction of quick fire made it imperative to consider speed in any comparison of efficiency. This is done by multiplying the energy of the blow by the number of rounds delivered in a minute, the result being the total hitting or energy per minute. Thus, a 6-iuch Q.F. gun, with a muzzle energy of 4840 foot tons, if it fires three times in a minute, has an energy per minute of 14,620 foot tons.

With these remarks the comparison of energies and other data given in tables will be intelligible. As, how- ever, continual progress is made, it may be well to direct attention to certain annual publications givingtrustworthy information. The Austrian Marine Almanack, published at Pola, is the first authority on Continental armaments. Much of its data is official, but not by any means all, and, in common with all works, it is apt to be specially behind- hand in Eussian g'uns. Brassey's Naval Annual gives official figures obtained directly concerning British and American guns, as well as Elswick, Krupp, Schneider- Canet, and Vickers Q.F. guns. Its figures on Continental guns are taken from the Pola Annual, with occasional corrections obtained from other sources.

French guns closely resemble British. M. Canet, the leading French constructor, was formerly on the stafP of Mr Vavasseur of Elswick, so that it would naturally be supposed that considerable similarity in design might exist. Canet has pushed length farther, especially for coast-service guns, than is thought desirable by most authorities. Though both Elswick and Krupp guns have been made of enormous length for experimental purposes, 40 calibres for heavy and 50 for light guns is their limit for service length, while Canet's tables give lengths to 60 and even 80 calibres. In one case a Canet gun shows a muzzle velocity of 3281 f.s. This, however, is only a design, not an existing gun. Doubtless it could be achieved, but the question is whether the inconvenience in length does not counterbalance the gain in velocity. The muzzle velocity of French guns generally is higher, and the

projectile lighter, than in British and German guns. In many tables the velocities of the French guns are only estimated, as is obvious from the roundness of the numbers when expressed in metres, and in the repetition of the

same exact figures for many guns in tables converted into British units. German heavy guns made by Krupp are of about the same length as British pieces of the same calibre, but generally discharge heavier projectiles, the velocity being lower. The following table gives a comparison of the most powerful guns afloat in British, French, and German battleships, an American piece being added : â€”

Nation.

Calibre

in inches.

Weight of Gun in tons.

Length

Bore in calibre.

Weight

of

Shot

in ft.

Muzzle Velocity

in ft. sec.

Muzzle Energy

in ft. tons.

Energy

per Ton of

Gun,

British wire French German U.S.A. .

12 12

11-02 12

46 45-9 43-4 45-2

35-4 40 40 35-0

850 643-8 562 850

2367 2625 2362 2100

33,020 30,750 20.750 25,985

718 670 501 575

There is a German 12-inch gun, but of an old type, giving inferior results and not mounted in the newest ships, so that the 11-inch is a fairer representative piece. It may be seen here that the British gun hits far the hardest blow and shows the greatest energy per ton. The United States gun most closely resembles it. It may fairly be asked whether the superiority shown in this table is not due to the fact that the British gun is more severely taxed. The reply is, that supposing the pressure to be somewhat greater in the British piece, the wire construc- tion has been found to be considerably stronger than the ordinary steel tube. The weight and length of the piece are also slightly in excess of that of the United States gun. The 100- and 105-ton guns of the Italian navy, like the British 110-ton guns, are not now considered such good weapons as the last 12-iQch guns. With regard to the heavy guns of other Powers, no trustworthy data as to the newest Russian guns exist, but their latest battleships carry 12-inch guns, which may be assumed to bear a close

resemblance to the above. As wire construction has been adopted, it would be safer to credit B-ussia with guns of the same power as the British than to guess at a lower standard. The following table shows a comparison of typical British, French, and German guns such as might form the primary armament of armoured cruisers : â€”

Nation.

Calibre

in inches.

Weight

of Gun in

tons.

Length

of Bore in

calibres.

Weight of Shot in ft.

Muzzle Velocity

in ft. sees.

Muzzle

Energy in

ft. tons.

Energy per Ton of Gun. ft. tons.

Perforation wrought-iron in ins.

At muzzle.

At 2000 yds.

At 8000 yds.

British wire French . German .

9-2 9-45 9 ‘45

25

22-4

25.4

40 40 40

380

317-5 474

2347 2625 2067

14,520 15,170 14,050

581 677 553

27-6 29-4 26-8

20-7 20-6 20-0

18-0

17-2 17-7

The velocity of the French gun (800 metres) is doubtless only estimated, nine guns in the table having the same identical round figures. Practically it might probably prove to be somewhat less than here

shown. Taking the figures as they stand, the French piece looks best at the muzzle, where its energy is highest, and its energy per ton of gun is nearly 20 per cent, better than the others. At 2000 yards, however, the British gun has passed it in penetration, and at 3000 yards the German also, owing to the resistance of the air telling more on the light projectile. Italian and Japanese guns, being principally supplied by Elswick and Krupp, closely resemble the British and German armaments. In some cases Elswick supplied to Japan rather longer pieces and Q,F. guns of larger calibre than had at that time been adopted in the British service. In short, the newer Japanese ships are likely to be in the very front in power of armament. Austria, Holland, and Denmark have obtained their most powerful and newest guns from Krupp, although the two latter

countries have some Elswick guns. The same is generally true of Sweden and Norway, China, and the South American Governments. The latter are chiefly remark- able for cruisers obtained from Elswick, mounting Q.F. ba,tteries of extraordinary power. The energy of fire per minute of the broadside of these cruisers is enormous.

With regard to heavy guns, then, the state of matters maybe summed up thus : â€” The ordnance of foreign Powers closely resembles that of the United Kingdom, the greater number of guns being furnished by Krupp, Elswick, or Canet. New guns differ but slightly in proportions, and therefore when similarly charged deliver similar blows ; but experiments indicate that the wire construction adopted in Great Britain, and to some extent in Russia, increases the strength of the piece. Consequently, such guns are capable of delivering harder blows than others when all are worked to the same limit of safety.

Probably the most important guns at the present time for naval warfare are not the heavy primary guns, but

the heavier classes of Q.F. guns mounted on broadside or secondary armaments behind medium armour. The reason for this is that the blows delivered by the heavy primary guns are comparatively few, and the light unprotected guns may be too much exposed for them to be manned in close action, while their small destructive capacity limits their scope to unarmoured structures. In the adoption of this important class, i.e., the more powerful Q.F. guns, Great Britain took the lead, the first pieces made at Elswick having been proposed and designed by Sir Andrew Noble. In 1886 Elswick had 30-pounder Q.F. guns. In 1890 Krupp and Gruson, and doubtless Canet, had perfected light Q.F. guns; but the appear- ance in 1888 of 4-7-inch Q.F. pieces in the armaments of the JSfile and Trafalgar, and of those of 6-inch, discharging 100-lb shelly, in the Ramillies class in 1890, marked a great stride in British naval armaments. The French at that time had only small 65-mm. (2‘67-inch) Q.F. pieces, discharging a shell weighing 8^1b in the Camot, and Germany had 10-6-cm. pieces in the Brandenburg class. I^or was the advantage limited to priority in time. From an early date Elswick guns were laid by sights on the^ fixed part of the carriage, so that the eye would be right on the sights,’ undisturbed by the recoil of the gun. This feature, on which special stress was laid some years afterwards in the French parliamentary discussions, was found ,in very few Q.F. guns even in the Chicago Exhibition in 1893. N”ow things are greatly changed : Germany shows the entire armaments of her new turret-ships as Q.F. guns, including the 9-4-inch pieces of the turrets ; andFrance shows6-4-inch Q.F. guns inher new cruisers and battleships. In the British navy some of the features of quick firing are embodied in the heaviest pieces, including the 12-inch, which probably compares well in speed of loading with, foreign guns of the same calibre ; but quick-firing proper is considered to cease in England when the projectile becomes too heavy for ready manipulation by hand ; and this consideration has caused the 6-inch gun Q.F. armament to be retained up to the present time, although Elswick has long advocated the 8-inch embodied in the armaments of Chilian and other cruisers. At the present time a Q.F. gun of about 7-5 inches calibre is likely to be adopted in the British navy. The important matter is the relation of the power of the Q.F. gun to the armour protecting that of the enemy, and, conversely, of the enemy’s fire to British protection. So far the

advantage on the side of the British armaments has been so marked that it is hardly too much to say that their Q.F. guns are able easily to attack those on nearly all foreign war-vessels with success, while well protected themselves from counter-attack. The official tables of Schneider-Canet Q.F. guns begin at 37-mm. (1-46-inch), and extend up to 24-cm. (9-45-ineh). Those of Krupp begin similarly at 37-min* (1-46-inch) and extend to 30-6- em. (12-01-inch). In short, all now apply means for increasing the speed of fire to all guns, but their means gradually cease to be applicable as the calibre increases.

Land-Service Guns. â€" Siege guns in many cases corre- spond with the heavier Q.F. guns mentioned above, so that the pieces deserving notice are the field guns, including howitzers. The most important feature is the application of quick fire ; and as it is necessary for quick laying that the gun should not recoil or depart far from the direction in which the previous round was laid, field guns which are free to move instead of being on fixed mountings require brakes to check their recoil ; so that one necessary element in the power of field artillery is an efficient brake. The gun generally has a measure of recoil and recovery pro- vided by means of a recoil cylinder fixed in the carriage, the latter being checked from running back by a spade,

rope, or other brake. France up to 1902 kept its newest field equipment secret, but it is known that Q.F. guns exist in some proportion, and the calibre is said to be 2-95 inches. The gun acts on a recoil cylinder on the carriage, and the latter has a strong spade brake fixed on the trail. Germany has completely introduced Q.F. field guns ; the gun breech opens to the side on the wedge system. It seems doubtful if it is nearly as quick as some systems. There is no recoil cylinder on the carriage, which is checked by rope and spade brakes. The gun ordinarily fires shrapnel shell, but high explosive shells with a wide- spreading burst are issued, to search behind cover and act as a substitute for a howitzer shell. In Austria the existing field guns have been improved and modified for temporary need, so as to achieve about five rounds per min- ute; a spade brake is used. Russia has introduced quick fire into her field equipment. The carriage is checked in recoil by a spade brake. There is . also a sliding ar- rangement, and a system of indiarubber

pads in the body of the carriage. The gun is kept secret, but is said to fire from four to five rounds a minute. Italy, Spain, and Belgium have experimented with Q.F. guns. (c. o.-b.)

Ordu, the ancient Cotyora, a town on the north coast of Asia Minor, between Samsun and Kerasund, con- nected with Sivas by a carriage road, and with Constanti- nople and Trebizond by steamer. Population, 5800 (900 Moslems, 3000 Greeks, 1900 Armenians).

Orebro, an ancient town of Sweden, near the west extremity of Lake Hjelmar, 124 miles west of Stockholm by rail. It has a considerable trade in iron by way of the lakes Hjelmar and Malar. Population (1880), 11,785;

(1890), 14,547; (1900), 22,013.

Ore-dressing.â€" When the miner hoists his ore to the surface, the contained metal may be either in the native uncombined state, or combined with other sub- stances forming minerals of more or less complex com- position. In both eases the valuable mineral is always associated with minerals of no value. The province of the ore-dresser is to separate the " values " from the waste by mechanical means, obtaining thereby "concentrates" and "tailings." The province of the metallurgist is to extract the pure metal from the concentrates by chemical means, with or without the aid of heat. There are also a number of non-metallic minerals which do not have any value, or at best do not reach their highest value until they have been subjected to some form of mechanical pre- paration ; among them are diamonds, graphite, corundum, garnet, asbestos, and coal. Ore-dressing, for the purposes of this article, may be divided into three parts : (1) pro- perties of minerals which render aid in their separation ; (2) simple operations ; (3) operations combined to form processes or mills.

(1) The specific gravity of minerals varies greatly, some being heavy, others light. The rate of settling in water is affected by the specific gravity in this way : p^ ^^^^^ of two particles of the same size but different specific gravity, the heavier settles more rapidly than the lighter, while of two particles of different specific gravity which settle at

the same rate in water, that of higher specific gravity is of smaller diameter than the other. The same statements are true in regard to settling in air, and in regard to momentum in air when the particles are thrown out in a horizontal direction. Colour, lustre, and fracture are of especial value in hand-picking, to aid the eye in selecting the mineral sought. Instances are, of colours, the white of quartz, the pale straw colour of feld- spar, the dull yellow of limonite, the brass yellow of chal-copyrite, the pale metallic yellow of pyrites ; of lustres, the vitreous of quartz, the adamantine of diamond and

cemssite, the resinous of blende, the earthy of limonite, and the metallic of pyrite ; and of fractures, the cleavage planes of feldspar and galena, the conchoidal fracture of quartz and pyrite, the granular of some forms of mag- netite and blende. Magnetism is a most direct and simple method of separating minerals where it is avail- able. The discovery that by the use of electro-magnets of great power, minerals formerly regarded as non-mag- netic are attracted, has made it possible to separate several classed of minerals present in an ore; for ex- ample, the strongly magnetic mineral may first be taken out, then the mildly magnetic, and last the weakly mag- netic, the non-magnetic being left behind. Adhesion acts when brightly burnished particles of gold issuing with the sand from the stamp mill come in contact with an amalgamated copper plate, for they are instantly plated with mercury and adhere to the copper, while the sand is carried forward by the water. â– In this way a very perfect separation of the gold from the sand is effected. In the South African diamond fields it has been found that if the diamond-bearing sand is taken in a stream of water over a smooth surface covered with a suitable coating of grease, the diamonds will adhere to the grease while the sand does not. Decrepitation is the property possessed by some minerals of flying to pieces when heated suddenly. If, for example, blende and barite occur together in a product where the grains are about the same size, they cannot be separated by

water, being of nearly the same specific gravity, but when dropped upon a heated iron plate, the barite flies into small par- ticles, and can then be separated from the blende by sift- ing. This principle, however, can only rarely be applied. (2) The concentration of ores always proceeds by steps or stages. Thus the ore must be crushed before the minerals can be separated, and certain prelimi- V^rltions ^^'^y steps, such as sizing and classifying, must precede the final operations which produce the finished concentrates. The more important of these simple operations will now be described.

The ore as mined contains the valuable minerals attached to and enclosed in lumps of waste rock. The province of crushing or disintegrating is to sever or unlock the values from the waste, so that the methods of separation are then able to part the one from the other. In crushing ores it is found wise to progress by stages, coarse crushing being best done by one class of machine,

medium by another, and fine by a third. Coarse crushing is accomplished by breakers of the Blake type (Fig. 1) or of the Gates Comet type (Fig. 2). All of these machines break by di- rect pressure, caused by a movable jaw, a (Figs.l, 2), approach- ing towards and receding from a fixed jaw, b. The largest size ever fed to a breaker is 24 inches in diameter, and the smallest size to which the finest crushing commonly done by these machines brings the ore is about -|-inch diameter. The machine is generally supplied with ore in lumps not larger than 9 inches in diameter, and crushes them to about 1^ inch in diameter. Medium-size crushing is done mostly by rolls or steam stamps. Bolls (Fig. 3) crush by direct pressure caused by the ore being drawn between two revolving rolls held closely together. They make the least fine slimes or fines to be lost in the subse- quent treatment, and are therefore preferred for all brittle minerals. The steam, stamp works upon the same principle

PiQ. 1,â€" Blake Breaker, a. Movable jaw ; &, fixed jaw.

Fig. 2.â€" Gates Breaker, a, Movable jaw ; &, fixed jaw ; c, gear with ecceD- tric hub and with loose fit on the spindle.

as a steam hammer, the pestle being forced down by steam pressure acting through piston and cylinder with great crushing force in the mortar. Steam stamps have been very successful with the native copper rock, because they break up the little leaves, flakes, and filaments of copper, and render them susceptible of concentration, which rolls do not. Fine crushing is done by gravity stamps, pneumatic stamps,

by centrifugal roller mills, by amalga- mating pans, by ball mills, by Chile

edgestone mills, and by arrastras.

The gravity stamp (Fig. 4) is a pestle

of 800 ft weight more or less, which

is lifted by a revolving cam and falls

by the force of gravity to strike a

heavy blow in the mortar and do the

work of crushing ; the frequent revo- lution of the cam gives a more or less

rapid succession of blows. Gravity

stamps are especially adapted to the

fine crushing of gold ores, which they reduce to i^-vnch.

and sometimes even to ^inch grains. The blow of the

stamp upon the fragments of quartz not only liberates the fine particles of gold, but brightens them so that they are quickly caught upon the amalgamated plates. The pneumatic stamp has a heavy pestle, which is moved up and down by direct

Fia.3.-CrushingEoUs. gQ^^exJo^ ^^h a Crank ; but since the

height of the ore in the mortar varies, the pestle must have the means also of varying its movement to avoid breakage. To this end an air cylinder with piston is inserted in the stem, the elasticity of the air within the cylinder not only giving the needed variation of throw, but increasing the force of the blow in the mortar. The centrifugal roller

mills are suited to fine crushing of middle pro- ducts, namely, by-products com- posed of grains containing both values and waste, since they avoid making much fine slimes. They crush by the action of a roller, rolling on the inside of a steel ring, both having vertical axes. The amalgamating pan is suitable for grinding silver ores for amal- gamation where the finest grind- ing is sought, together with the chemical action from the contact with iron. It crushes by a true grinding action of one surface sliding upon another. The Civile edgestone mill is employed for the finest grinding ever used prepara- tory to concentration. The arras- tra or drag-stone mill grinds still finer for amalgamating.

A considerable class of workable minerals, among which are surface ores of iron and surface phos- phates, contain worthless clay mixed with the valuable material, the removal of which is accomplished by the log washer. This is a disintegrator consisting of a long narrow cylinder revolving in a trough which is nearly horizontal. Upon the cylinder are knives or paddles set at an angle, which serve the double purpose of bruising and disintegrating the clay and of conveying the cleaned lump ore to be discharged at the iipper end

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Fig. 4.â€” Gravity Stamp.

of the trough, the water meanwhile washing away the clay ab the lower end.

Boasting for Friability. â€” When two minerals â€” for ex- ample, pyrites and cassiterite, â€” one of which is decom- posed and rendered porous and friable by heat and oxygen, are roasted in a furnace, the pyrites becomes porous oxide of iron, while the cassiterite is not changed. A gentle crushing and washing operation will then break and float away the lighter iron oxide, leaving the cassiterite behind. Sizing.

â€” If crushed ore be sifted upon a screen with holes of definite size, two products will result â€” the over- size which is unable to pass through the screen and the undersize which does pass. If the latter size be sifted upon another screen with smaller holes, it will again make oversize and undersize. Eittinger adopted for close sizing the following diameters in millimetres for the holes in a set of screens : 64, 46‘2, 32, 22-6, 16, 11-3, 8, 6-6, 4, 2-8, 2, 1-4, 1. Each of these holes has an area double that of the one next below it; this may be called the screen ratio. A process which does not need such close sizing might use every other screen of the above set, and in extrem e cases even every fourth screen. In mills the screen ratio for coarse sizes often differs from that for fine. Sizing is done by cylindrical screens revolving upon their axes (Fig.

5), by flat shaking screens, and by fixed screens with a compara- tively steep slope. Wire cloth with square holes and steel plate punched with round holes

Fig. 5.â€” Trommel or Revolving are both USed. To remove the

^Â°“â„¢” largest lumps in the prelimi-

nary sizing fixed-bar screens are preferred, on account of their strength and durability.

Sizes smaller than can be satisfactorily handled by screens are treated by means of hydraulic classifiers and box classifiers (spitzkasten). The lower limit of screening and therefore the beginning of this work varies from grains of 6 millimetres to grains of 1 millimetre in diameter. A hydraulic classifier (Fig. 6) is a trough-like washer through which the water and sand flow from one end to the other. In the bottom, at regular intervals, are pockets or pits with hydraulic devices which hinder the outflowing discharge of sand, b, by an inflowing stream of water, a. By regulating the speed of these water currents, the size of the grains in the several discharges can be regulated, the first being the

f – ” ^

Fig. 6 Hydraulic ClaBslfler.

coarsest and the overfiow at the end the finest. Box classifiers are similar, except that the pockets are much larger and no inflowing clear water is used; they there- fore do their work much less perfectly. Classifiers do not truly size the ore, but merely class together grains which have equal settling power. In any given product, except the first, the grain of high specific gravity will always be smaller than that of low. The box classifiers are suited to treating finer sizes than the hydraulic classifiers, and therefore follow them in the mill treat- ment.

Picking floors are areas on which men, boys, or girls pick out valuable mineral which is rich enough to ship at once to the smelter. The picking is often accompanied and aided by breaking with a hammer. Picki^ig tables are generally so constructed that the pickers can sit still and have the ore pass before them on a moving surface, such as a revolving circular table or travelling belt. Stationary picking tables require the ore to be wheeled to

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and dumped in front of the pickers. Picking out the values by hand has the double advantage that it saves the power and time of crushing, and prevents the for- mation of a good deal of fine slimes which are difiicult to save.

Jigs treat ores ranging from 1^ inch in diameter down to -j^ inch. If an intermittently pulsating current of water is passed up through a horizontal sieve on which is a bed of ore, the heavy mineral and the quartz quickly form layers, the former beneath the latter. The machine by which this work is done is called ja jig (Fig. 7), and the operation is
^

called jigging. The pulsating current is obtained by placing a vertical longitu- dinal partition, c, extending part of the way down to the “^

bottom of the jig Fia. T.-Harz Jig.

box. The sieve a is firmly fastened on one side of the partition, and on the other a piston, d, is moved rapidly up and down by an eccentric,

causing an up-and-down current of water through the sieve, a. The sieve is fed at one end, e, with a constant supply of water and ore, and the quartz overflows at the other. The constantly accumulating bed of concentrates is either discharged through the sieve into the space below, g, called the hutch, or by some special device at the side. On jigs where the concentrates pass through the sieve, a bed of heavy mineral grains too large to pass holds back the lighter quartz. The quartz overflow from one sieve, a, generally carries too much value to be thrown away, and it is therefore jigged again upon a second sieve, 6. In jigging difficult ores, three, four, five, and even six sieves are used. A succession of sieves gives a set of products graded both in kind and in richness, the heavier mineral, as galena, coming first, the lighter, as pyrites and blende, coming later. The best- jigging is done upon closely sized products using a large amount of hydraulic water added beneath the sieve. Very good jigging may, however, be done upon the products of hy- draulic classifiers, where the heavy mineral is in sm^l grains and the quartz is large, by using a bed on the sieve anddiminishedhydraulic water, which increases the suction or downward pull by the returning plunger.

Bumping Tables. â€” Rittinger's table is a rectangular gently-sloping plane surface which by a bumping motion throws the heavy particles to one side while the current of water washes down the quartz to another, a wedge-shaped divider separating and guiding the concentrates and tailings into their respective hoppers. The capacity on pulp of -^ to -^inch size is some 4 tons in twenty -four hours. In the Wilfley table (Fig. 8) and those derived from it a

Fig. 8.â€” Wilfley Table.

gentler vanning motion is substituted for the harsh bump; they have a greatly increased width and a set of riffle blocks, &,at right angles to the direction of flow c, tapering in height towards the s'ide where the concentrates are dis- charged, d. This combination has produced a table of great efficiency and capacity for treating grains from ^ inch in diameter down to ^^ inch or even finer. The capacity on ^inch pulp is from 15 to 25 tons in twenty- four hours.

Fig. 9.â€” Prue Vanner.

Vanners are machines wliich treat ores on endless belts, generally of rubber with flanges on the two sides. The belt (Fig. 9) travels up a gentle slope, a, on horizontal trans- verse rollers, and is shaken about 200 times a minute, either sidewise or endwise, to the extent of about one inch. The lower 10 feet is called the concentrating plane, 6, and slopes 2-78 per cent, more or less from the horizontal ; the

upper 2 feet of length is called the cleaning plane, c, and slopes 4-46 per cent, more or less. The ore is fed on with water at the intersection of the two planes, d. The vibra- tion separates the ore into layers, the heavy beneath and the light above. The downward flow of the water carries the light waste off and discharges it over the tail roller e into the waste launder, while the upward travel of the belt carries up the heavy mineral. On the cleaning plane the latter passes under a row of jets, /, of clean water, which remove the last of the waste rock ; it clings to the belt while it passes over the head roller, and only leaves it when the belt is forced by the dipping roller to dip in the water of the concentrates tank g. The cleaned belt then continues its return journey over the guide roller li to the tail roller e, which it passes round, and again does concentration duty. Experience proves that for exceedingly fine ores the end shake with steep slope and rapid travel does better work than the side-shake vanner.” Tor ordinary gold stamp-mill pulp, where clean- ness of tailings is the most important end, and where to gain it the engineer is willing to throw a little quartz into the heads, the end-shake vanner is again probably a little better than the side shake, but where cleanness of concentrates is souglit the side-shake vanner is the most satisfactory.

Slime-tables are circular revolving tables (Fig. 10) with flattened conical surfaces, and a slope of 1-|- inch more or less per foot from centre to circumference ; a common size is 17 feet in diameter, and a common speed one revolution

Fig. 10. â€” Convex Revolving Slime-table.

per minute. These tables treat material of â– ‘ inch and less in diameter comingfrom box classifiers. The principle on which the table works is that the film of water upon the smooth surface rolls the larger grains (quartz) towards the margin of the table faster than the smaller grains (heavy mineral) which are in the slow-moving bottom current. The revolution of the table then discharges the quartz earlier at a, a, a, a, an intermediate middling product next at b, and the heavy mineral last at c. Suitable waste- launders and catch-boxes are supplied for the three pro- ducts. The capacity of such a table is 12 tons or more of pulp, dry weight, in twenty-four hours. Frames are rectangular slime-tables which separate the waste from the concentrates on the same principle as the circular tables, though they run intermittently. They treat very fine pulp, and after being fed for a short period (about fifteen minutes) the pulp is shut off, the concentrates are flushed off with a douche of water and caught in a box, and the

feed pulp is again turned on. They are much used in the Cornish tin works. Canvas tables are rectangular tables with plane surfaces covered with cotton duck (canvas) free from seams ; they slope about 1| inch to the foot. They are fed with stamp-mill pulp, with the tailings of vanners, or, best of all, with very fine pulp overflowing from a fine classifier. The rough surface of the duck is such an efficient catching surface that they can run for an hour before the concentrates are removed â€” an opera- tion which is effected by shutting off the feed pulp, rins- ing the surface with a little clean water, and hosing or brooming off the concentrates into a catch-box. The feed-pulp is then again turned on and the work re- sumed. They have been more successful than any other machine in treating the finest pulp, especially when their concentrates are. finally cleaned on a steep slope end-shake vanner.

Buddies act in principle like slime-tables, but they are stationary, and they allow the sand to build itself up upon the conical surface, which is surrounded by a retaining wall. When charged, the tailings are shovelled from the outer part of the circle, the middlings from the

intervening annular part, and the concentrates from the inner part. They treat somewhat coarser sizes than the slime-table. When wooden blocks or cobble-stones of uniform size are placed in the bottom of a sluice, the spaces between them are called riffles; and when gold-bearing gravel is carried through the sluice by a current of water, a great many eddies are produced, in which the gold and other heavy minerals settle. The Meve or dolly-tub is a tub as large or larger than an ordinary oil barrel, with sides flaring slightly upwards all the way from the bottom. In the centre is a little vertical shaft, with hand-crank at the top and stirring blades like those of a propeller at the bottom. Fine concentrates from buddies or slime-tables are still further enriched by treatment in the kieve. The kieve is filled perhaps half full of water, and the paddles set in motion ; concentrates are now shovelled in until it is nearly full, the rotation is continued a little longer, and then the shaft is quickly withdrawn and the side of the kieve steadily thumped by a bum ping-bar as long as settling continues. When this is completed, the water is syphoned off, the top sand skimmed off and sent back to the buddle, and the enriched bottom material shovelled out and sent to the smelter. ,

(3) In designing concentration works, the millwright seeks so to combine the various methods of coarse and fine crushing and of preliminary and final concentra- tion that he will obtain the maximum return ‘”’>‘Â°<' from the ore with the minimum cost. Some of '"'*â„¢ the more important of these mill schemes will now be described.

The hand-jig process used for the zinc and lead ores of Missouri is first to clean the ore from adhering clay by raking it hack and forth in a sluice with a running stream of water, and then shovel it upon a sloping screen with holes of ahout one inch, where it yields oversize and undersize. The former is hand-picked into lead ore, zinc ore, and waste, while the latter is jigged upon a hand-jig and yields several layers of minerals removed by a hand-skimmer. The top skimmings are waste, the middle skimmings come back with the next charge to be jigged over, and the bottom skimmings go to a second jig with finer screen. The coarsest of the hutch product goes to the second jig, the finest is sold to a sludge mill. The second jig makes top skimmings which are

sent back to the first jig, middle skimmings which are zinc concentrates, and bottom skimmings and hutch, which are both lead concentrates.

In the Missouri zinc-concentrating mill the ore carrying blende and calamine with a little galena is in very large crystallizations and contains, when crushed, very little in the way of included grains. It is crushed by Blake breaker and rolls, to pass through a sieve with holes | inch in diameter, and is then treated on a jig with six consecutive sieves, yielding discharge and hutch products from each sieve, and tailings to waste. The earlier discharges are finished products, while the later are re-crushed and re-treated on the same jig. The hutch products are treated on a finishing-jig

with five sieves, and yield galena from the first discharge and hutch, and zinc ore from the others. The capacity of such jigs is very large, even to 75 or 100 tons per day of ten hours.

In the diamond washing of Kimberley, South Africa, the material taken from the mine is vreathered by exposure to the air and rain for several months, and the softening and disintegration thus vrell started are completed by stirring in vats with water. Breaker and rolls were tried in order to hasten the process, but the larger diamonds were broken and ruined thereby. The material from the vats is screened and jigged, ^nd of the jig con- centrates containing about 2 per cent, of diamonds the coarser are hand-picked and the finer are treated on a greased surface.

Lead and oopper ores contain their values in brittle minerals, and are concentrated in mills which vary somewhat according to local conditions ; the one here outlined is typical of the class. The ore is crushed by breaker and rolls, and separated into a series of products diminishing in size by a set of screens, hydraulic classifier, and box classifier. All the products of screens and hydraulic classifiers are

jigged on separate jigs yielding concen- trates, middlings, and tailings ; those of the box classifier are treated on the slime-table, vanner, or Wilfley table, yielding con- centrates and tailings and perhaps middlings. The coarser mid- dlings contain values attached to grains of quartz and are therefore sent back to be re-crushed and re-treated. The finer middlings contain values diflficult to save from their shape only, and are sent back to the same machine or to another to be finished.

The native oopper rock of Lake Superior is broken by powerful breakers, sometimes preceded by a heavy drop-hammer weighing nearly a ton. The operation is accompanied by hand-picking, yielding rich nuggets with perhaps 75 per cent, of copper ready for the smelter ; at some mines a second grade is also picked out which goes to a steam finishing-hammer and yields cleaned mass copper for the smelter and rich stamp stuff. The run of rock wliich passes by the hand-pickers is of a size that will pass through bars 3 inches apart, and goes to the steam stamps. The stamps crush the rock to pass through a screen with round holes ^j inch in diameter. This sand is treated in hydraulic classifiers with four pockets, the products from the pockets being jigged by four roughing-jigs yielding finished mineral Copper for the smelter, included grains for the grinder, partially concen- trated products for the finishing-jigs, and tailings which go to waste. The overflow of the hydraulic classifier runs to a tank of which the overflow is sent to waste in order to diminish the quan- tity of water, while the discharge from beneath, treated upon slime-tables, yields concentrates, middlings, and tailings. The, middlings are re-treated. The stamp mortars are cleaned out periodically, even several times a day, and yield rich nuggets of copper and unfinished material which is sent back to the mill. Putting all the finished concentrates together, they will assay from 60 to 80 per cent, of copper according to circumstances. The extraction from the rock is from 50 to 80 per cent, of the copper contained in it.

Cornwall Tin. â€” Tinstone in Cornwall occurs associated with sulphides, wolfram, quartz, feldspar, slate, &c. , and is broken by spalling-hammers to 3-inch lumps. Hammers make less slimes than the rock-breakers, and they also break the ore more advan- tageously for the hand-picking. The latter rejects waste, removes as far as possible

the hurtful wolfram, and classes the values Into groups according to richness. Gravity or pneumatic stamps then crush the ore to -^ inch, and stripes (a species of long rectangular buddle) yield heads, middlings, tailings, and fine slimes : the first three are sent separately to circular buddies, and the last to frames. The buddies yield heads, middlings, and tailings : the middlings are re-treated, the tailings are all waste ; the heads are still further enriched by kieves, which yield tops to the buddle again and bottoms shipped to the smelter. The fine slimes are treated on frames, the concentrates of which go to buddies ; of these the heads go to kieves.

The Missouri zinc-lead sludge mill takes the finest- part of the hutch product of the hand-jigs. The treatment begins on revolv- ing screens with two sizes of holes, 25 mm. and 1 mm. : these take out two coarser sizes, of which the coarser is waste and the other is jigged, yielding concentrates and waste. The main treatment begins with the finest size, which is much the largest product. It is fed to a convex circular buddle (first buddle), and yields a coarser product at the outer part of the circle and a finer product in the inner. The finer product is treated by a series of buddlings which vary somewhat, but in general are as follows : fed to a second buddle it yields zinc and lead ore in the centre, next zinc ore, next middlings which come back, and, outside of all, tailings. The zinc-lead ore is set on one side until enough has accumulated to make a buddle run, when it is run upon a third buddle yielding in the central part pure lead concentrates, next lead ore (which is returned to this treatment), next zinc ore, and outside of all a zinc product which is fed to the second buddle. The coarse out- side product of the first buddle is treated in much the same way

as the fine, but it yields practically no lead zinc product, which simplifies the series of buddlings necessary.

Oold Mill. â€” Gold ores usually contain their value in two con- ditionsâ€” the free gold, which can be taken out by mercury, and the ccjmbined gold, in which the metal is either coated with or combined with compounds of sulphur, tellurium, &c. The usual gold-milling scheme is to crush the ore by rock-breaker to about IJ inch diameter,

and then to crush with water by gravity stamps, a little mercury being added to the mortar from time to time to begin the amalgamation at the first moment the gold is liberated. The pulp leaves the mortar through a screen with holes or slots ^ to -jij inch in width, and is then passed over amalgamated plates of copper or silver-plated copper. The free gold, amal- gamated by the mercury, adheres to the mercurial surface on the plate ; the rest of the pulp flows on through mercury traps to catch any of the mercury, which drains off the end of the plate. The plates and mortar are periodically cleaned up, the plates being scraped to recover the amalgam and leave them in good condition to do their work : if plates are used inside the mortar, they are cleaned in the same way. The residue of partly crushed ore in the mortar, with amalgam and free mercury scattered through it, is ground for a time in a ball mill, panned to recover the amalgam, and returned to the mortar. The pulp flowing away from the mercury traps flows to a Frue vanner or Wilfley table, on which it yields concentrates for the chlorination plant or smelter, and tailings : these are waste when the heavy mineral is of low grade, but if the vanner concentrates are of high grade, they still contain values in very fine sizes which can and should be saved. Recent improvements in California for saving this material have been made. The vanner tailings are sent to a fine classifier, from which the light overflow only is saved ; this is treated upon canvas tables yielding concentrates and tailings, and these concentrates, treated upon a little end-shake vanner with steep slope and rapid travel, give clean, very fine, high-grade concentrates for the chlorination works.

Iron Ores. â€” The brown ores of iron from surface deposits are contaminated with a considerable amount of clay and some quartz. The crude ore from surface pits or shallow underground workings is treated in a log washer and yields the fine clay, which runs to waste, and the coarse material which is caught upon a screen and hand-picked, to free it from the little quartz, or jigged if it contains too much quartz. The magnetic oxide of Iron occurs associated with feldspar and quartz, and can often be separated from them by the magnet. The ore, after being broken by breaker and rolls to a size varying from \to ^ ot an inch in diam- eter, goes to a magnetic machine which yields (1) the strongly magnetic, (2) the weakly magnetic, and (3) the non-magnetic

por- tions. The second or middlings product contains grains of mag- netite attached to quartz, and is therefore re-crushed and sent back to the magnets ; the strongly magnetic portion is shipped to the furnace ; and the waste to the dump heap. In concentrating cer- tain zinc sulphides, siderite (carbonate of iron) follows the zinc, and wrould seriously injure the furnace work. By a carefully adjusted roasting of the product in a furnace the siderite is con- verted into magnetic oxide of iron, and can then be separated from the zinc ore. A special magnet of very high power has been de- signed for treating the franMinite of New Jersey, a mineral which . is non-magnetic in the usual machines. The ore, crushed by breaker and rolls and hand-picked to remove garnet, is treated upon a belt with a roughing magnet to take out the most magnetic por- tion, and then very closely sized by screens with 16, 24, 30, and 50 meshes per linear inch. The several products are treated each on its own magnetic machine, yielding the franklinite for the zinc oxide grates, and followed by spiegel furnace ; the residue, which is jigged, yields the zinc silicate and oxide for the smelter furnaces, and waste carrying the calcite quartz and mica.

Gold dredging is the method employed for saving the values from gold-bearing sand and gravel in river bottoms. A flat boat is built, provided with guy-ropes or spuds, or both, for holding it still. The spuds are vertical posts or legs which can be forced down by powerful tackles through sockets in the boat, and so lift it as it were upon legs. At one end of the boat is a powerful endless-chain bucket-dredge, which scrapes the gravel from the bottom and elevates it to a revolving screen in the boat. This in turn sifts out the boulders, which are at once elevated to the bank of the river, while the fine material flows over tables covered with cocoa matting which acts like fine riffles, catching the gold in the interstices. The matting is periodically lifted up and thoroughly rinsed off, the rinsings are panned for gold, and the matting returned for another charge. The fine sand and gravel passing over the end of the tables is sent by the elevator to the river bank.

Ashestos, when of good quality, is in compact masses, which by suitable bruising and beating are resolved into fine flexible fibres. The

Canadian asbestos is associated with serpentine, and is crushed by breakers to | inch, screened on i-inch screens to

reject fines. The values are removed by hand-picking and are crushed by rolls carefully set so as not to break the fibre ; this product' is then sized by screens and the various sizes are sent to the Cyclone pulverizer, whioh by beating liberates the indi- vidual fibres. It then goes to a screen, with eleven holes to the linear inch, and yields a granular undersize and oversize, and a fibrous oversize which is drawn off by a suction fan to a settling- chamber with air outlets covered by fine screen cloth. This fibrous product is the clean mineral for the market. A special treatment separates the fibres of different lengths.

The usual method of dressing corundum and emery, after the preliminary breaking, is to treat the material in an edge-stone mill fitted with light wooden rollers. The action is that of grinding one particle against another, whereby the talc, chlorite', mica, &c., are worn off from the harder mineral. A constant current of water carries off the light impurities. This is called the "muller" process. At Corundum Hill, North Carolina, the first step in removing the impurities from "sand" corundum is to subject it to the scouring action of a stream of water while it is being sluiced from the mine to the mill, the action being increased by several vertical drops of 5 to 10 feet in the sluice. After reaching the mill all that will not pass through a 14-mesh screen is crushed by rolls, and the undersize of the screen is treated in a washing trough ; this removes part of the light waste, and the " muUers " mentioned above complete the cleaning.

Graphite occurs in schist, but being of less specific gravity than the other minerals which enter into the composition of the schist, it settles later than they do. It also breaks into thin scales, which reduces its settling rate still further. The ore is broken by breakers, and by Chile edge-stone mills or by gravity stamps, to a size varying with the character of the minerals from perhaps - to /del> ~~inch diameter. The~~

~~pulp is then con- veyed thi;ough a series of settling tanks of which the later are larger than the earlier. The quartz and other waste minerals settle in the earlier tanks, while the graphite settles later : the latest tank gives the best graphite. In the Dixon Company's works in New York some forms of concentrators are believed to have replaced the slower settling tanks.~~

Gold Eydraulicking. â€" The gold contained in surface gravel deposits is saved by one of the several schemes included in hydraulicking. A source of water power with very high head furnishes the water to a powerful jet called a "giant"; this washes down the gravel bank and conveys the coarse and fine material first to a head-sluice with riffles, which may be one hundred feet or more long, and then to a tail sluice, also with riffl.es, which may be several miles long. Periodically, once a month perhaps, the head-sluice is cleaned up, the riffle-blocks being removed and cleaned, and the sand which is washed down and caught in a temporary tank at the foot panned for its gold with hand-pans. The riffle-blocks are then replaced and work proceeds as before. At the end of the season the long tail-sluice also is cleaned up in the same way. Gravel containing 5 cents a cubic yard has in places paid well.

The phosphates of Florida are of four kinds : hard rock, soft rock, land pebble, and river pebble. The hard rock is crushed by toothed rolls, and cleaned in log washers. The washed product is screened ; the sizes finer than -^ inch are thrown away because too poor ; the other sizes are dried and sold, some waste having been picked out of the coarsest. The soft rock is simply dried, ground, and sold. Land pebble is treated by log washers, any clay balls remaining being removed by a screen, and the phosphate dried and sold. In special cases land pebble is treated by hydraulicking, followed by a log washer, and this again by a powerful jet washer, to remove the last of the clay. River pebble is taken from the river by centrifugal pumps, and screened on two screens with 1-inch and ^j-inch holes respec- tively ; the qversize of the first sieve and the undersize of the second sieve are thrown away because of too low grade. (h. h. e.)

Oregon, one of the north-western stateg of the American Union, situated on the Pacific coast, bounded on the]Sr. by the state of Washington, on the E. by the state of Idaho, on the S. by the states of California and Nevada, and on the W. by the Pacific Ocean.

Population. â€” In 1880 the population was 174,768 ; in 1890 it had risen to .313,767, and in 1900 to 413,636, giving a density per square mile of 4-4 in 1900, as com- pared with 3-3 in 1890. The population - was classified in 1900 as follows: males, 2;!2,985; females, 180,561; native-born, 347,788 ; foreign-born, 05,748 (white, 394,682 ; negro, 1105 ; Chinese, 10,397 ; Japanese, 2501). Of the 116 incorporated cities, towns, and villages, twelve had a population of over 2000, but only three had over 6000, namely, Portland, one of the most important towns on the

Pacific coast, with 90,426; Astoria, with 8381 ; and Baker City, with 6663 inhabitants. The urban population was 23-9 per cent, of the total. The school population (from 4 to 20 years) was, in 1890, 99,543 ; and in 1899, 133,181. The total land surface is approximately 94,560 square miles.

Agriculture.â€” Oi farm products there were raised in 1899 21,949,536 bushels of wheat, of the value of $11,633,254; 1,255,264 tons of hay, of the value of $8,598,555, and 14,400,000 K) of hops. Other farm products included barley, com, rye, buckwheat, and potatoes. The total farm and orchard products for the year amounted to 145,530,737, including 10,999,251 lb of butter, of the value of $3,024,508. The wool crop was 18,028,776 lb. On 1st January 1900 there were in the state 189,427 horses and mules, valued at $5,727,164; 637,433 cattle, valued at $15,776,411 ; 2,446,695 sheep, valued at $6,532,676 ; and 87,532 swine, valued at $700,256.

Lumber. â€” The manufacture of lumber in 1900 amounted to 776,978,000 feet board measure, exclusive of custom sawing, as compared with 470,146,000 feet in 1890. The total ,number of wage-earners employed in this industry in 1900 was 4084, and the lumber products were valued at .Â§10,352,167. The standing timber in the state, as appears from a survey made by the general Government in

1899, reaches a total of 234,653,000,000 feet board measure, and consists mainly of the Douglas fir, known in the lumber trade as the Oregon pine. The Bull Run national forest reserve, from which the city of Portland obtains its water- supply, consisting of 142,080 acres, and the Cascade national forest reserve, consisting of 4,492,800 acres, are contiguous, and con- stitute the largest forest reserve in the United States. Besides these there is the Ashland reserve.

Fish Canning and Preserving. â€” This is one of the most im- portant industries in the state. The methods employed in taking fish tend to exhaust the fisheries and lessen the catch. The pro- duct of the Columbia river for 1895, as shown by the report of the United States Fish Commission, exceeded in value that of any other river in the world. The use of refrigerator cars has resulted in large annual shipments of fresh fish from Portland to the Eastern states and Europe, and this has lessened the canned product, the value of which in 1900 was Â§1,788,809.

Mining. â€” Gold mining has largely increased, the estimated output for 1900 exceeding $5,000,000 in value. The most pro- ductive gold-fields are in the counties of Baker and Grant. There is a constantly growing yield of gold from the mines of southern Oregon, and from the recently developed district in Lane county known as the Bohemia.

Manufacturing. â€” The following table shows the manufacturing and mechanical industries as returned at the censuses of 1890 and 1900, and the percentage of increase for the decade : â€”

1890.

1900.

Percentage of Increase.

Number of establishments

Capital

Wage-earners, average number

Total wages

Cost of material used

Value of products ....

1,523 $82,122,001 16,760

$9,559,TS4 $21,T98,5TS

$41,482,174

3,088

$88,422,898

1T,236

***26,099,S5S ;f46,0U0,:wT**

102-8 4-0 2-8 12-81 19-8 11-0

Those of most importance are lumber and' timber products, flouring and grist mill products, canning and preserving fish, and slaughter- ing and meat-packing. A beet-sugar factory, in operation in the eastern part of the state, employed in 1899 between 130 and 140 employes. It cut during that season 11,295 tons of beets, and manufactured 2,200,000 R) of sugar. The product of the paper and pulp industry of the state for 1900 was of the value of $856,646. There were five manufactories, employing 716 wage-earners, en- gaged in this industry, and the capital invested was $2,161,186.

Sailways ond Commerce. â€" The Oregon Railway and Naviga- tion Company owns and works 1130 miles of railway, including extensions of branch lines into portions of the state of "Washing- ton. It is the connecting line for two of the transcontinental railways of the stateâ€" the Union Pacific and its allied line, the Oregon Short Line, with which

it connects at the eastern boundary of the state, and the Great Northern railway, with which it con- nects at Spokane, in the state of Washington. It works river steamers on the Columbia and lower Willamette and Snake rivers, and a line of ocean steamships between Portland and San Francisco. The Southern Pacific railway works O'lS-TO miles in the state; the Corvallis and Eastern, 142 miles; and the Astoria and Columbia River, 82 J miles.

In 1899 the foreign commerce was $10,639,068, of which $1,522,095 consisted of imports. AVheat shipments from the port

1 Decrease.

of Portland were 12,431,807 bushels, of which 8,946,335 were shipped to Europe and Africa.

Banks. â€" Individual deposits in the national banks of the state during 1899 reached 111,781,130, and the hank clearings for the same year were 191,662,230. There are no statistics of the busi- ness done by private banks, of which there is a large number.

State Finances.- â€" The state has no debt. The value of taxable property in 1898 was 1133,533,577, and the rate of levy Sj^ mills. The revenue raised was |761,141. The lowest rate of levy was 3 mills, in 1894 ; the highest, 7 mills, in 1892. The average rate for twelve years ending with 1898 was 4-73 mills.

Education. â€" The cost of public education in 1880 was |339,080; in 1890, Â§1,062,890 ; and in 1899, Â§1,327,781. The average annual expenditure of public funds on this account for ten years ending with 1899 was $1,267,321. The state maintains a university, an agricultural college, and four normal schools. The two former have endowments from the sale of public lands granted to the state for these objects by Congress. The university has a further endow- ment of $-50,000

derived from a private source. All are supported by liberal appropriations of public money by the Legislature. The general faculty of the university, including lecturers in the schools of law and medicine, consists of the president and fifty ~~three pro~~ fessors, instructors, and assistants. The number of students in 1899-1900 was 320. The agricultural college has, in common with such colleges in all the states, and in addition to the funds derived from the state grant and appropriations, endowments from the general Government of $25,000 annually for the benefit of agri- cutlure and the mechanic arts, and $15,000 annually for an agri- cultural experiment station in connexion with the college. The object of the college, in its general scope, is ” to promote the liberal and practical education of the industrial classes ” by teaching such branches as are related to agriculture and the mechanic arts, and including military â€¢tactics. The endowments permit scientific and classical studies. The faculty of instructors consists of a president and twenty-eight professors, assistants, and instructors. The en- rolment of students for 1888-89 was 151, and for 1899-1900, 405.

Charitable and Penal Institutions. â€” The state maintains at Salem, the capital, an asylum for the insane, a penitentiary, and a reform school. The insane asylum had 628 inmates in 1891 and 1160 in 1899. The penitentiary had 324 inmates in 1891 and 322 in 1899. The reform school had 99 inmates in 1899. The state also maintains separate schools for deaf mutes and for the blind, and also makes liberal appropriations for various “homes” and societies, organized as private charities.

Beligion. â€” In 1890 the state had 969 religious organizations, with an aggregate of 70,524 members. The total value of church property was $2,829,150. In respect of numbers the principal denominations rank in the following order: Roman Catholic, Methodist, Baptist, Presbyterian, Congregational, Episcopalian.

ConstitiLtional Changes : Politics. â€” ^There is a strong conserva- tive tendency in the state. Constitutional amendments submitted to popular vote from time to time, since the admission of the state into the Union

in 1859, have uniformly been defeated ; among them an amendment repealing an obsolete provision to exclude free negroes from the state. The election of 1900, however, showed a growing sentiment in favour of woman suffrage. When the woman sufirage amendment was first submitted in 1884, it vflas defeated by a large majority. The vote in 1900 upon the same amendment stood, for the amendment, 26,265, against 28,402. The Republican party, is dominant. In 1896, with three opposition candidates for Congress in one district and four in the other, its plurality was 441, while the combined opposition vote was 25,510 greater than the Republican vote. This result was due in large part to the equivocal position of the party in that year on the money question, and the nomination in consequence of a distinctively gold standard candidate for Congress in the largest district. In 1900 the Repub- lican candidates for Congress had a plurality in the state of 12,407 votes, and a majority over the combined vote of three opposition parties of 3670. (c. b. b*.)

Oregon City, a city of Oregon, U.S.A., capital of Clackamas county, on the Willamette river, at the falls, and on the Southern Pacific railway, 12 miles south of Portland, in the north-western part of the state, at an altitude of 100 feet. Fine water-power is afforded by the falls, 40 feet high, which is utilized in lumber, flour, paper, and pulp mills. The surplus power from the falls is wired to neighbouring cities for manufacturing, transportation, and lighting purposes. Population (1880), 1263; (1890), 3062; (1900), 3494, of whom 535 were foreign-born.

Orel, a government of Middle Eussia, bounded by Kaluga and Tula on the N., Voronezh and TambofE on

the E., ‘Kursk on the S., Tchernigoff and Smolensk on the W. Its area covers 18,040 square miles. Beside the Jurassic clays (Oxford and Kellowey), which were known to cover the Devonian deposits, Cretaceous deposits were found to have a wide extension. They consist of marls, white chalk, sandy chalk, phosphorite sands, very rich in fossils, and white and yellow sands and sandstones. Tertiary sands,

sandstoues, and glauconite clays are found in the south-west. Loess has a wide development.

In January 1897 the population reached 2,054,749, of whom 1,052,765 were women, and 228,618 lived in towns. The area under culture has slightly increased, from 59 per cent, of the total surface to 62 per cent., and the average annual crops of 1894-99 were: rye, 9,623,000 cwts. ; wheat, 768,000 ; oats, 5,912,000 ; all cereals, 17,753,000 cwts. The eastern black-earth districts grow enough of their own crops for the whole year ; to the others grain has to be imported. There were, in 1897, 427,410 horses, 243,370 cattle, 639,880 sheep, and 153,270 swine. Industrial activity is on the in- crease, and the aggregate return of ~~all the 8537 large and small fac~~ tories attained Â£1,569,800. The government is divided into twelve districts, of which the chief towns and their population in 1897 are: Orel, capital of the government (69,858), Bolkhoff (20,703), Bryansk (23,520), Dmitrovsk (6259), Elets (37,455), Karachefe (15,605), Kromy (5429), Livny (20,574), Maloarkhangelsk (7799), Mtsensk (9355), Syevsk (9167), and Trubchevsk (6899).

Orenburg, a province of East Eussia, in the south- ern Urals, bounded by Ufa and Perm on the]^., by Tobolsk on the E., by Turgai on the S.E., by Uralsk and Samara on the ‘V[. It has an area of 73,816 square miles. Its population has nearly doubled since 1860, and was 1,609,388 in 1897, of whom 149,373 lived in towns. It is rich in various minerals : gold, copper, and iron ore, rock and lake salt, semi-precious stones, sand- stones, &c. Traces of coal have been discovered. Gold is extracted chiefly from alluvial deposits, about 116,400 oz. every year; as also some silver, 2160 oz. Nearly one-fifth of all the copper ore extracted in Eussia comes from Orenburg (about 16,000 tons annually). Iron ores, including magnetic ore, exist in large quantities, and every year 16,000 to 20,000 tons of cast iron and 11,600 tons of iron are obtained. Coal has also been found on the Mias and near Uetsk. The extremely rich layers of rock salt at Iletsk yield about 24,000 tons of salt every year. Owing to the fertility of the soil, agriculture is carried on on a large scale ; in an average year nearly 6,000,000 cwts. of grain â€” chiefly wheat and oats â€” are available for export. The annual average of the

crops for 1894-99 was : wheat, 7,309,300 cwts. ; rye, 1,362,000; oats, 3,117,000 ; all cereals, 12,999,000 cwts. Kitchen-gar- dening is carried on on a large scale, and gives occupation to nearly 11,000 persons. Cattle-breeding is conducted on an extensive scale by both Eussians and Bashkirs, there being in 1896, 531,000 horses, 609,800 horned cattle, and 730,000 sheep. Various kinds of animal produce are largely exported, and by knitting "Orenburg shawls" of goat's wool the women earn Â£10,000 every year. The growth of the industries is slow, but trade, especially with the. Kirghiz, is prosperous, and the annual returns of the Orenburg and Troitsk markets are estimated at Â£700,000. The chief towns of the five districts into which the government is divided are : Orenburg, Orsk (14,036), Tchelyabinsk (19,891), Troitsk (23,128), and Verkhneuralsk (11,802).

Orenburg, capital of the above government, on the Ural river, and connected by rail with Samara (262 miles). It is a large city, and had in 1897 a population of 72,740 (34,927 women), of whom about 30 per cent, were Tatars, Jews, Bashkirs, &c. The fortress has lost its former importance. A " Barter House," one mile from the town, has been built in the shape of a fort. The import- ance of Orenburg as a centre of trade with central Asia

has decreased since the opening of the Transcaspian railway; but, on the other hand, it has become an important centre for the export of horses, cattle, and meat to markets in the interior of Russia. From 20,000 to 100,000 horses, 40,000 to 160,000 cattle, and 460,000 to 750,000 sheep are sold every year at the Barter House. Formerly most of these were sent alive to Russia ; now, from 50,000 to 60,000 head of cattle and sheep are killed every year at the municipal slavighter-houses, and 150,000 sheep in private abattoirs, the whole being exported in cold-storage waggons. Cattle are also bought by wandering merchants in the Steppe provinces and Turkestan. Every year from 8950 to 23,500 tons of frozen meat, tallow, hams, sausages, butter, cheese, and game are exported by rail to Samara. Besides these, nearly

a million of hides and sheep-skins, goat and astrakhan skins, as well as wool, horse hair, bristle, down, horns, bones, &c., are exported. There are gymnasia for boys and for girls, two cadet corps, one theological semi- nary, seminaries for Russian and Kirghiz teachers, a museum, a theatre, branches of the Russian Geographical Society and the Gardening Society, a military arsenal, and a custom-hou.se.

Orense, an inland province in the north-west of Spain. Its area is 2738 square miles, and it is divided into 11 administrative districts and 97 parishes. Popular tion, 388,836 in 1877, and 402,873 in 1897. The birth-rate is 3-13 per cent., the death-rate 2-93, and the propor- tion of illegitimate births 6-07 per cent, of the total births. The climate is very varied, mild in some valleys, cold and damp in the highlands, rainy near the northern border, and subject to rapid changes of temperature. The rail- way from Monforte to Vigo runs through the province, but the means of communication are very crude. The provincial industries are in a backward condition. There are a few iron foundries of a primitive sort, but lack of transport and of cheap coal hinder the growth of mining and manufactures.

Though the soil is fertile and well watered, agricultural products are not so important as arboriculture. The oak, beech, pine, chestnut, walnut, and plane grow in abundance on the hills and mountains ; pears, apples, cherries, almonds, figs, roses, olives, and the laurel in the valleys, and even oranges and lemons in sheltered spots like Ribadavia. In 1897 the vine was grown on 29,760 acres, wheat on 3972, and a large area was devoted to pod- fruit, rye, and oats. The live stock included 3716 horses, 2463 mules, 5443 asses, 35,958 cattle, 105,303 sheep, 31,487 goats, and 72,227 pigs.

Orense, the capital of the above province, stands on the left bank of the Mifio, and on the railway from Monforte to Juy and Portugal. It has a theatre, primary schools, and an institute, seminary, training schools for teachers of both sexes, and public libraries. In the older streets some residences of the nobility are good specimens of mediaeval architecture. Population (1887), 14,168;

(1897), 16,250.

Orghyeeff, a district town of Russia, in the province of Bessarabia, 28 miles north of Kishineff railway star tion. It stands on the seat of an old Dacian fortress, Petrodava, or Orhei, of which the ruins still exist. Population (1897), 13,356, chiefly Russian, but containing also Armenians, Jews, and Germans. It was annexed to Russia in 1812.

Oriente, or La Region Obientale, a vast undefined territory belonging to the republic of Ecuador, compris- ing the whole eastern part of the republic. It was formed in 1884 of the older territories of Napo, Canelos, and Zamora. The boundaries have still to be settled by treaties with the coterminous republics. Its southern

boundary is the Maranon river from its source to its mouth. Its eastern boundary runs along the 70Â° of W. long. Its northern boundary is a conventional line nearly parallel to the course of the Rio Putumayo. The population of El Oriente, nearly entirely composed of wild Indian tribes, was estimated in 1887 to be about

80,000.

Orihuela, a town of Spain, province of Alicante, on the river Segura, which divides the city into two parts, Roig and San Augustus, connected by two bridges. There has been progress in agriculture, and in the manu- factures of silk, linen, wool, leather, and starch, and tanning. The streets have been improved and many public buildings restored. Population (1887), 24,364;

(1897), 26,961.

Orillia, a town and port of entry of Simcoe county, Ontario, Canada, situated 64 miles north of Toronto, on Lake Couchiching and on the Grand Trunk railway. It is a favourite summer resort, and has steamboat communication with other ports on Lakes Simcoe and Couchiching. It contains an asylum maintained by the provincial government, also saw and grist mills and iron foundries. Population (1881), 2910; (1891), 4752;

(1901), 4907.

Ori noco, The, a river in the north of South America, falling north-east into the Atlantic between 60Â° 20′ and 62Â° 30′ W. It is approximately 1600 mUes long, but it is several hundred miles longer if measured by its Guaviare branch. Lying south and east of the main river is a vast, densely forested region called Venezuelan Guiana, di- versified by ranges of low mountains, irregular broken ridges and granitic masses, which define the courses of many unexplored tributaries of the Orinoco. The upper part of the river was ascended in 1857 by Michelena y Rojas to the Mawaca, a point about 170 miles above the northern entrance to the eai‘^J. Casiquiare canal, and then a few miles up the Mawaca. A little knowledge about its sources above these points was gi”-en by the savages to de la Fuente in 1759 and to Mendoza in 1764, and we are also indebted to Humboldt for some vague data.

The principal affluent of the Orinoco from the Guiana district is the Ventuari, the head-waters of which are also unknown. It is an important stream, which, running south-west, joins the Orinoco about 90 miles above its Guaviare branch. Two other large tribu- taries of the Orinoco flow north from the interior of this mysterious Guiana region, the Caura and the Caroni. The former has recently been explored by AndrS, who found it greatly obstructed by falls and rapids ; the latter is about 800 miles long, 400 of which are more or less navij

South of the Guaviare, as far as the divortiuni aquarum, between it and the Rio Negro branch of the Amazon, the country is dry and unswept by moisture-laden winds, so that no streams of moment are found in its southern drainage area; but north of it, as far as 6Â° 30′ -N., the north-east trade winds, which have escaped condensation in the hot lower valley of the Orinoco, beat against the cold eastern slopes of the lofty Colombian Andes, and ceaselessly pour down such vast volumes of water that the almost countless streams which flow across the plains of Colombia and western Venezuela are taxed beyond their capacity to carry it to the Orinoco, and for several months of the year they flood tens of thousan,ds of square miles of the districts they traverse. Among these the Apure, Arauca, Meta, and Guaviare hold the first rank.

The Apure is formed by two great rivers, the Uribante and Sarare. The former, which rises in the Sierra de Merida, which overlooks the Lake of Maracaibo, has 10 large affluents ; the

latter has its sources near the Colombian city of Pamplona, and they are only separated from the basin of the river Magdalena by the ” Oriental ” Andean range. From the Uribante-Sarare junc- tion to the Orinoco the length of the Apure is 645 miles, of which Codazzi makes the doubtful claim that 564 are navigable, for there are some troublesome rapids 114 miles above its mouth, where the Apure is three miles wide. The numerous aflfluents which enter it from the north water the beautiful eastern and southern slopes of the Merida, Caraboso, and Caracas mountain ranges. A few of them are navigable for a short distance ; among these the most important is the many-armed Portugueza, on the main route south from the Caribbean coast to the llanos. A few large streams enter the lower Apure from the south, but they are fre- quently entangled in lateral canals, due to the slight elevation of the plains above sea-level, the waters of the Apure, especially during flood time, having opened a great number of caraos before reaching the Orinoco.

The ” Oriental” Andes of Colombia give birth to another great affluent of the Orinoco, the Arauca, which soon reaches the plain and parallels the Apure on the south. Perez says that the Sarare branch of the Apure has formed a gigantic dam across its own course by prodigious quantities of trees, brush, vines, and roots, and thus, impounding its own waters, has cut a new channel to the southward across the lowlands and joined the Arauca, from which the Sarare may be reached in small craft and ascended to the vicin- ity of Pamplona. The Arauca is navigable for large boats and barges up to the Andes, and by sail to its middle course. In floods, unable to carry the additional water contributed by the Sarare, it overflows its banks, and by several canos gives its surplus to the Capanaparo, which, about 18 miles further south, joins the Ori- noco.

The Meta is known as such from the union of two Andean streams, the Negro and Humadea, which rise near Bogota. At their junction, 700 feet above sea-level, it is 1000 feet wide and 7 feet deep in the dry season, but in flood the Meta rises 30 feet. It is navigable up to the old " Apostadero," about 150 miles above its mouth, but launches may ascend it, in the wet season, about 500 miles, to the junction of the Negro with the Humadea. In the dry season, however, it is obstructed by reefs, sandbanks, shallows, snags, trees, and floating timber from the "Apostadero" up, so that even canoes find its ascent difficult, while savage hordes along its banks add to the dangers to be encountered.

The Guaviare is the next great western tributary of the Orinoco. Eugenio Alvarado, a Spanish commissioner for the boundary de-limitation of Colombia with Brazil in 1759, informed the viceroy at Bogoti that the rivers Arivari and Guayabero rise between Neiva and Popayan, and unite to take the composite name of Guaviare. In those times they called it Guaibari, or Guayuare. The Guaviare is about 500 miles long, of which 300 are called navigable, although not free from obstructions. Its upper portion has many rapids and falls. The banks are forested throughout, and the river is infested by numerous alligators, so ferocious that they attack canoes. Two- thirds of the way up, it receives its Ariari tributary from the north-west, which is navigable for large boats. Near its mouth the Guaviare is joined by its great south-western affluent, the Tnirida. Above its rapid of Mariapiri, 180 miles up, this stream runs swiftly through a rough country, but for a long distance is a succession of lakes and shallow, overflowed areas. Its head-waters do not reach the Andes.

Between the Guaviare and the Meta the Orinoco is obstructed by the famous Maipures cataract, where, in several channels, it breaks through a granite spur of the Guiana highlands for a length of about 4 miles, with a total fall of about 40 feet, and then, after passing two minor reefs, reaches the Atures rapids, where it plunges through a succession of gorges for a distance of about 6 miles, winding among confusedmasses of granite boulders, and falling about 30 feet. At the mouth of the Meta it is about a mile wide, 'but as it flows northwards it increases its width until, at the point where it receives its Apure

affluent, it is over 2 miles wide in the dry season and about 7 in floods. It rises 32 feet at Cariben, but at the An- gostura, or narrows, where the river is but 800 feet wide, the difference between high and low river is 60 feet, and was even 60 in 1892.

The Orinoco finds its way to the ocean through a delta of about 700 square miles area, so little above sea-level that much of it is periodically flooded. The river is navigable for large steamers up to the raudal or rapid of Cariben, 700 miles from the sea, and to within 6 mil^s of the mouth of the Meta. Maintaining its

eastern course from the Apure, the main stream finds its way along the southern side of the delta, where it is called the Gorosimi river, and enters the sea at the Boca Grande; but in front of the Tortola island, at the commencement of the Gorosimi and 100 miles from the sea, it throws northwards to the Gulf of Paria another great arm which, about 100 miles long, and known as the Rio Vagre, bounds the western side of the delta. En route to the gulf the Vagre sends across the delta, east and north, two caUos or canals of considerable volume, called the Macareo and Ouscuino. The delta is also cut into many irregular divisions by other canals which derive their flow from its great boundary rivers, the Gorosimi and Vagre, and its numerous islands and vast swamps are covered with a dense vegetation. The Boca Grande out- let is the deepest, and is the main navigable entrance to the Orinoco at all seasons, the muddy bar usually main- taining a depth of 16 feet.

The Casiquiare Canal. â€” A missionary explorer, Padre Roman, in 1743, was the first to report that the upper Orinoco river was con- nected with the Negro branch of the Amazon by a canal. Little faith was attached to the statement until it was verified, in 1756. by the Spanish boundary-line commission of Yturriaga y Solano. The actual elevation of this ” canal ” above sea-level is not known, but a knowledge of it is of primary importance to a study of the hydrography of South America. Travellers in general give it as from 400 to 900 feet, but, after considerable study of the question of elevations in South America, the writer believes that the Casi- quiare canal does not exceed 300 feet elevation. It is about 300 miles long, with an average depth of

30 feet, and has a violent cur- rent towards the Kio Negro. From its own extensive drainage basin it receives several rivers of considerable volume, so that, part- ing from the Orinoco with a width of only 220 feet, it swells to about five times that before reaching its Negro outlet, thus show- ing that the quantity of water contributed to it by the Orinoco is small in comparison to what it gathers en route. It is not, as is generally supposed, a sluggish canal on a flat tableland, but a great, rapid river, which, if its upper waters had not found con- tact with the Orinoco, would belong entirely to the Negro affluent of the Amazon. To the west of the Casiquiare there is a much shorter and more facile connexion between the Orinoco and Amazon basins, called the isthmus of Pimichin, which is reached by ascending the Terni branch of the Atabapo affluent of the Orinoco. Although the Terni is somewhat obstructed, it is be- lieved that it could easily be made navigable for small craft. The isthmus is 10 miles across, with undulating ground, nowhere over 50 feet high, with swamps and marshes. It is much used for the transit of large canoes, which are hauled across it from the Terni river, and which reach the Negro by the little stream called the Pimichin.

The Spanish conquistador and his descendants have not been a blessing to the basin of the Orinoco. All they can boast of is the destruction of its population and products, so that the number of inhabitants Popaia- of one of the richest valleys in the world is less Â°f ‘ *””’ to-day than it was four centuries ago. The entire river trade centres upon Ciudad Bolivar, on the right bank of the Orinoco, 373 miles above its mouth. It has a population estimated at 16,000. The only other river port of any importance is San Fernando (3000 inhabitants), on the Apure. It is a stopping-point for the incipient steamer traffic of the valley, which is principally confined to the Apure and lower Orinoco. It occupies, however, but a few small steam craft. There is steam connexion between Ciudad Bolivar and the island of Trinidad, which supplies 90 per cent, of the foreign im- ports of the Orinoco. A Erench steamer carries cattle from the valley to the neighbouring- foreign colonies, and a few local steamers do a coasting trade between the river and the Caribbean ports of Venezuela. A transit trade with Colombia, vid the

Meta river, was lately carried on, with promising results, by two small steamers, but was suspended by order of the Venezuelan Government.

According to British consular reports, the tonnage of commerce for Ciudad Bolivar was as follows : â€”

S. VIL â€” 48

378

O R I S S A â€” 0 R K N E Y

1897.

1898.

1900.

Registered tonnage entered . â€ž „ cleared .

Total movement

Total vessels entered . „ „ cleared .

29,549 28,818

22,326

21,762

22,917 23,470

58,367

44,088

46,387

64 69

70 59

73 74

This table represents the foreign and river trade of the Orinoco river and its branches at the close of the 19th century. ((j. e. c.)

OriSSa,, a province of Britisli India, in Bengal, consisting of four British districts and about sixteen tributary states.

The historical capital is Outtack ; and Puri, with its temple of Jagannath, is world-famous. It differs from the rest of Bengal in being under a temporary settlement of land revenue. A new settlement for a term of thirty years has just been concluded, which will raise the total land revenue from Rs.13,84,000 to Rs.21,05,000, or by more than one half; but the greater part of this increase will be levied gradually during the first eleven years of the term. To obviate destructive inundations and famines the Orissa system of canals has been constructed, with a capital outlay of Rs.2,64,91,769, or nearly two millions sterling. In 1897-98 the total area irrigated was 200,943 acres, yielding a revenue of Rs.3, 14,729. In addition, tolls on navigation yielded Rs.l, 62,939. The net profits were Rs. 12,005, not including any charge for interest. Embankments were maintained at a further cost in that year of Rs.2,04,797. The province is traversed by the East Coast Railway, which was opened throughout from Cal- cutta to Madras in 1901.

The division of Omssa consists of the three British districts of Cuttack, Puri, and Balasore, together with the forfeited state of Angul and the tract known as the Khondmals. Total area, 9853 square miles ; population (1881), 3,789,799 ; (1891), 4,047,362 ; (1901) 4,350,372, showing an increase of 7 per cent, between both 1881 and 1891 and 1891 and 1901 ; average density, 442 persons per square mile. According to the census of 1891, the total number of persons in all India speaking Uriya is 9,010,957, showing that the linguistic area (extending into Madras and the Central Provinces) is much larger than the political province.

The tributary states of Orissa occupy the hills between the British districts and the Central Provinces. The most important are Moharbhanj, Keonjhar, Dhenkanal, Bod, and Nayagarh. Total area, 14,387 square miles; population (1881), 1,410,183; (1891), 1,696,710; (1901), 1,959,656 ; showing between 1881 and 1891 an apparent increase of 21 per cent., partly due to improved enumeration, and between 1891 and 1901 an increase of 15‘5 per cent. In 1897-98 four states under British administration (including Dhenkanal) hada total revenue of Rs.4,80,000. Mohar- bhanj and Dhenkanal have each an eificient English high school, with a boarding-house attached. In 1897-98 the total number of schools was 1314, attended by 17,658 pupils. The raja of Moharbhanj is distinguished for his intelligent administration. He has declared 1075 square miles, or more than one-fourth of the area of his state, to be reserved forest.

Orista.no, a tovs^n and archiepiscopal see of the province of Cagliari, Sardinia, Italy, near the west coast, 58 miles by rail north-north-vfest of Cagliari, in a marshy and unhealthy position, near the mouth of the river Tirso. The cathedral is an 18th-century structure. There are remains of the medisBval walls. Its industries embrace the manufacture of pottery, flour-milling, linen and hemp weaving, and tunny-fishing. Population (1899), 7000.

Orkney, a county of Scotland, formed of a group of islands in the North Sea, the most southerly being separated from Caithness by the Pentland Firth.

Area and Population. â€” According to the latest official estimate, the area of the islands (foreshore included) is 249,565 acres, or about 300 square miles. Of the 68 islands and islets, 29 are in- habited. The population was in 1881, 32,044 ; in 1891, 30,453 ; and in 1901, 28,698, of whom 14,027 were males and 14,671 were females. Taking the land area only (240,476 acres, or 37.57 square miles), the number of persons to the square mile was 81, and the number of acr&s to the person 7 ‘9. The population decreased betwpon 1881 and 1891 by 4‘9 per cent., .and between 1891 and 1901 by 5 ‘8 per cent. Between 1881 and 1891 the

excess of births over deaths was 2665, and the decrease of the resident population

1591. The following table gives births, deaths, and marriages, with the percentage of illegitimate births : â€”

Year.

1880 1890 1899

Deaths.

466 502 446

Marriages.

174 126 164

Births.

755 625 553

Percentage of Illegitimate.

6-0

4-96

61

The birth-rate, death-rate, and marriage-rate are all below the rates for Scotland. The following table gives the birth-rate, death- rate, and marriage-rate per thousand of the population for a series of years :-

1886.

1881-90.

1890.

1891-98.

1899.

Birth-rate . Death-rate . Marriage-rate

23-60

14-67

5-44

23-08

14-56

4-81

20-44

16-42

4-12

20-26

14-48

4-65

19-00

15-29

5-63

There were 88 Gaelic – speaking persons in the county in 1891, and 31 foreigners. Valuation in 1889-90, Â£65,910 ; 1899-1900, Â£64,092.

Administration. â€” Orkney unites with Shetland to send a member to Parliament, and Kirkwall (3660), its county town, and the only royal burgh, is one of the Wick group of parliamentary burghs. There are 21 civil parishes, with a combination poorhouse at Kirk- wall ; the number of paupers and dependents in September 1899 was 871. Orkney forms a sheriffdom with Shetland and Caithness, and there is a resident sheriff – substitnte at Kirkwall. Twenty school boards manage 61 schools, which had in 1898-99 an average attendance of 4327. Kirkwall and Stromness public schools give secondary education.

Agriculture. â€” In 1898 the percentage of cultivated area was 42-7. In 1896 the average size of the 3267 holdings was 33 acres. The percentage under 6 acres was 14-66, between 5 and 50 acres 70-89, and over 60 acres 14-45. There were 306 farms between 60 and 100 acres, 135 between 100 and 300, and 31 over 300, one being above 1000 acres in extent. Farming is, on the whole, not below the average lowland Scottish standard. The crofters' houses are now superior to those in almost any part of the Highlands, being rebuilt of stone and lime, instead of stones and clay. The following table gives the principal acreages at intervals of five years from 1880 :â€"

Year.

Area under Crops.

Com Crops.

Green Crops.

Clover.

Perma- nent Pasture.

FaUow.

1880 1885 1890 1895 1899

104,958 113,246 110,435 106,188 107,376

37,278 38,616 38,498 38,525 38,268

17,147 17,675 17,624 17,596 17,606

30,575 32,297 33,004 32,283 33,805

18,656 23,689 20,406 17,644 17,440

1,302

1,069

898

241

257

The following table gives the live stock during the same years :

Year.

Total Horses.

Total Cattle.

Cows or

Heifers in

Milk or Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1899

6,100 6,094 5,861 6,360 6,839

25,416 25,239 24,040 26,832 28,428

9,101 9,476 8,989 9,390 9,858

29,692 32,178 82,408 32,060 36,836

3,312 4,398 4,587 3,680 2,586

There were only 11 acres under wood in 1895. At the census of 1891, 5349 men and 637 women were returned as being connected with agriculture.

Industries and Trade. â€” The principal industry, apart from agriculture, is fishing. There are 22 stations in the Orkney fishery district, some statistics about which are given in the following table : â€”

Year.

Boats.

V.alue of Gear.

Â£12,532

Â£10,229

Â£4,317

Â£12,397

Resident Fishermen and Boys.

Total Value of all Fish.

No.

Tons.

Value.

1890 1894 1898 1899

666 692 501 502

3816 3265 2789″ 2876

Â£17,013 Â£11,464 Â£10,800 Â£10,777

2,142 1,706 1,292 1,309

Â£39,733 Â£60,555 Â£63,359 Â£44,394

Of the total value of fish in 1899, Â£28,369 was the value of the herring catch, and Â£7474 the value of shellfish. In 1899, 2050 persons wure employed in the district in the various branches of the sea fisheries.

Authorities.â€” G. Barry. History of Orkney (third edition, with prefatory note), 1867. â€”Sir George Dasent. “Rolls” edition of the Orhwyinga Saga.â€” J. B. Craven. History of the

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Episcopal Church in Orkney, 1883. â€” W. Z. Dennison. Orcadian Sketch-Book. Kirkwall, 1880. â€” J. Ferguson. The Brocks and Jiude Stone Monmnents of the Orkney Islands. London, 1877. â€” D. GoRRiB. Summers and Winters in the Orkneys. London, 1879.â€” J. R. TuDOE. Orkney amd Shetland. London, 1883.â€” Brand. Brief Description of Orkney (reprint). Edinburgh, 1883. â€” D. Balfour. Odal Bights and Feudal Wrongs. Edin- burgh, 1860. â€” M. J. B. Baddblet. Orkney and Shetland. London, 1866. (w. Wa.)

Orlea.ns, chief town of department Loiret, France, 75 miles south-west of Paris by rail. It is the headquarters of the 5th army corps, the seat of the Court of Appeal for departments Loiret, Indre-et-Loire, and Loir-et-Cher; of the central prison for the same departments, of a Protestant consistory for the departments of Loiret, Loir-et-Cher, and Yonne, and of a school of artillery. The Corn Exchange now serves as a hall for

fetes. Amongst modern buildings may be noted the churches of St Marc (1886), St Marceau (1892), in the suburbs of the same names, and in the latter suburb also a church commemorative of Joan of Arc (1895), and St Lawrence in the Madeleine suburb. A large hair-pin factory employs about 100 persons, and turns out 100,000 pins per day. Orleans was the ancient Cenabvm,, not Genahwn, as has been proved by several ancient inscriptions. It was reduced to ruins by Caesar in 52 B.C. Population (1891), 54,270; (1901), 59,568.

Orlea,ns. â€" Since the article in Ency. Brit. vol. xvii. on the Orleanist princes was published, some addi- tional names of importance require to be added to the account there given. For a complete list of the Orleans family reference must be made to the Almanack de Gotka, but the accompanying genealogical table of the descendants of Louis Philippe will be of assistance.

Reference may be made to the articles Paris, Comte DE (with his son, the Due d'Obleans) and Joinville, PiiiNCB DB, for information concerning those members of the family. It is only necessary here to give further details about two others whose names won distinction in recent years, the due d'Aumale and Prince Henri d'Orleans.

Henei – EuGfeNE – Philippe – Louis d'Oel^ans, due d'Aumale (1822-1897), was the fourth son of King Louis Philippe I. and of his wife Marie Am^lie. He was born at Paris, 16th January 1822, and was educated at the College of Henry IV. At seventeen he entered the army, and saw service in Algeria, where he distinguished him- self. In May 1843, after the capture of Abd-el-Kader, he was made lieutenant-general. In 1847 he was made governor of the French possessions in Africa, but in 1848, when the February revolution broke out, he handed over his office to General Cavaignac and went to England, where he lived for some years, occupying himself with historical work and contributing to the Bevue des Deux Mondes. He married in 1844 the Princess Caroline, daughter of the prince of Salerno; she died in 1869. They had two sons, the prince de Conde (d. 1866) and the due de Guise (d. 1872). In 1869 two volumes of the duke's Histoire des Princes de Conde were published. In 1870, when the Franco-German war

broke out, his request for employment in the field was refused. In 1871 he was elected a deputy for the department of Oise, and in 1872 was elected a member of the French Academy. He took an important part in the events leading to the down- fall of Thiers. In 1873 he presided at the Bazaine court- martial, and was then given the command of the 7th army corps. In 1879 he was made inspector-general of the army corps, and in 1880 a member of the Academic des Beaux Arts, In 1883, however, he was included in the decree against the Orleanist princes, by which they now retired from the army; and in 1886 the due d'Aumale formally protested to the President of the Republic against

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ORLEANS â€” OEMEROD

his treatment by General Boulanger, but the only result was that he was formally exiled from French territory, and retired to Brussels. The due d’Aumale had an immense fortime, and in 1886 he announced that, after his death, his chateau of Chantilly with its contents would go to the French Institute. On its request the Govern- ment repealed in 1889 his decree of exile, and he returned to France. He died in Sicily on the 7th of May 1897, his death being undoiibtedly accelerated by the disaster of the fire at tjie charity bazaar in Paris, where his niece, the duchesse d’Alenqon, lost her life.

Hexei, Peixce of Obleans (1867-1901), eldest son of Robert, due de Chartres, was born at Ham, near Eichmond, Surrey, on the 16th of October 1867. In 1889, at the instance of his father, who paid the

expenses of the tour, he undertook, in company with MM. Bon- valot and Dedecken, a journey through Siberia to Siam. In the course of their travels they crossed the mountain range of Tibet, and the fruits of their observations, sub- mitted to the Geographical Society of Paris (and later incorporated in De Paris au Tonkm d, travers le Tibet inconnu, published in 1892), brought them conjointly the gold medal of that society. In 1892 the prince made a short journey of exploration in East Africa, and shortly afterwards visited Madagascar, proceeding thence to Tongking. From this point he set out for Assam, and was successful in discovering the soiirces of the river Irrawaddy, a brilliant geographical achievement which secured the medal of the Geographical Society of Paris and the cross of the Legion of Honour. In 1897 he revisited Abyssinia, and political differences arising from this trip led to a duel with the comte de Turin, in which both combatants were wounded. While on a trip to Assam in 1901 he died at Saigon of dysentery on 9th August. Prince Henri was a somewhat violent Anglo-phobe, and his diatribes against Great Britain contrasted rather curiously with the cordial reception which his position as a traveller obtained for him in London, where he was given the gold medal of the Royal Geographical Society.

Orleans, Louis Philippe Robert, Due b'

(1869), eldest son of the comte de Paris, was

born at York House, Twickenham, 6th February 1869. The law of exile against the French princes having been abrogated in 1871, he returned with his parents to France. He was first educated by a private tutor, and then followed the courses of the municipal college at Eu. In 1882 he entered the College Stanislas, Paris, and took a first prize in a competitive Latin translation. On the death of the comte de Chambord, the comte de Paris became head of the Bourbons; and in 1886 he and his son were exiled from France. Queen Victoria appointed the duke of Orleans a supernumerary cadet at the Eoyal Military College, Sandhurst. After passing his examinations he received a commission in the 4th battalion of the 60th Rifles, then quartered in India. In January 1888 the duke went out to India, accompanied by Colonel de Parseval

as military governor and adviser. At Bombay he was received by the duke of Connaught and Lord Reay, and at Calcutta he became the guest of the Viceroy, the marquis of Dufferin, who organized for the duke and his cousin, Prince Henry of (Jrleans, a grand tiger-shooting expedition in Nepaul. The duke now reported himself to the commander-in-chief (now Earl Roberts)^ and joined his regiment at Chakrata. After seeing considerable service, the duke ceased his connexion with the Indian army in February 1889, and returned to England. On attaining his majority, he entered Paris, and proceeding to the mairie, expressed his desire, as a Frenchman, to perform his military service. This act caused great excitement,

and he was arrested in conformity with the law of 1886, which forbade the soil of France to the direct heirs of the families which had reigned there. He was tried, and sentenced to two years' imprisonment ; but he was liberated by President Carnot after a few months' nomi- nal incarceration, and conducted to the Swiss frontier. This escapade won for him the title of "Le Premier Conscrit." After the comte de Paris's funeral, the duke received his adherents in London, and then removed to Brussels, as being nearer France. On 6th November 1890 the duke married the Archduchess Maria Dorothea of Austria, the ceremony taking place at Vienna. It was alleged that some of his followers were implicated in the conspiracies against the French Republic in 1899. A letter which the duke wrote in 1900, approving the artist whose caricatures were grossly insulting to Queen Victoria, excited great indignation both in England and in many French circles, and estranged him from many with whom he had formerly been upon friendly terms ; but after Queen Victoria's death it was allowed to become known that this affair had been forgotten and forgiven by the British royal family.

Ormerod, Eleanor A. (1828-1901), English entomologist, was the daughter of George Ormerod, F.R.S., author of The History of Cheshire, and was born at Sedbury Park, Gloucestershire, on the 11th of May 1828. From her earliest childhood insects were her delight, and the opportunity afforded for entomological study by the large estate upon which she grew up and the interest she took in agriculture generally soon made her a local authority upon this subject. When, in

1868, the Royal Horticultural Society began forming a collec- tion of insect pests of the farm for practical purposes, Miss Ormerod largely contributed to it, and was awarded the Flora medal of the society. In 1877 she issued a pamphlet, Notes for Observations on Injurious Insects, which was distributed among persons interested in this line of inquiry, who readily sent in the results of their researches, and was thus the beginning of the well-known Annual Series of Heports on Injurious Insects and Farm Pests. In 1881 Miss Ormerod published a special report upon the ” turnip-fly,” and in 1882 was appointed con- sulting entomologist to the Royal Agricultural Society, a post she held until 1892. For several years she was lecturer on scientific entomology at the Eoyal Agricultural College, Cirencester. Her fame was not confined to England : she received silver and gold medals from the University of jVIoscow for her models of insects injurious to plants, and her treatise on TJie Injurious Insects of South Africa showed how wide was her range. In 1899 she received the large silver medal from the Society Rationale d’Acclimatation de France. Among others of her works are the Cobden Joimuds, Manual of Injurious Insects;, and Handbook of Insects injurious to Orchard and Bush Fruits. Almost the last honour which fell to her was the honorary degree of LL.D. of Edinburgh University â€” a unique distinction, for she was the first woman upon whom the university had conferred this degree. The dean of the legal faculty in making the presentationaptlysummedupjMissOrmerod’s services as follows : ” The pre-eminent position which jMiss Ormerod holds in the world of science is the reward of patient study and unwearying observation. Her investiga- tions have been chiefly directed towards the discovery of methods for the prevention of the ravages of those insects which are injurious to orchard, field, and forest. Her labours have been crowned with such success that she is entitled to be hailed the protectress of agriculture and the fruits of the earth â€” a beneficent Demeter of the 19th century.” She died at St Albans on the 19th of July 1901.

0 R M S K I E K â€” 0 R T A

Ormskirk, a market town and, since 1894, urban district in the Ormskirk parliamentary division of Lanca- shire, England, 11 miles north-east of Liverpool by rail. In 1896 a corn exchange and news-room were erected. Public pleasure grounds were opened in 1894, and in the same year an isolation hospital. Population (1881),

6651; (1891), 6298; (1901), 6857.

Ornament. â€” Ornament is in its nature accessory, and implies a thing to be ornamented, which is its active cause and by rights suggests its design. It does not exist apart from its application. Nor is it properly added to a thing already in existence (that is but a make- shift for design), but is rather such modification of the thing in the making as may be determined by the con- sideration of beauty. For example, the construction and proportions of a chair are determined by use (by the necessity of combining the maximum of strength with the minimum of weight, and of fitting it to the propor- tions of the human body, &c.) ; and any modification of the plan, such as the turning of legs, the shaping of arms and back, carving, inlay, mouldings, &c. â€” any reconsider- ation even of the merely utilitarian plan from the point of view of art â€” has strictly to do with Ornament, which thus, far from being an afterthought, belongs to the very inception of the thing. Ornament is good only in so far as it is an indispensable part of something, helping its effect without hurt to its use. It is begotten of use by the consideration of beauty. The test of ornament is its fitness. It must occupy a space, fulfil a purpose, be adapted to the material in which and the process by which it is executed. This implies treatment. The treatment befitting a wall space does not equally befit a floor space of the same dimensions. What is suitable to hand-paint- ing is not equally suitable to stencilling; nor what is proper to mosaic proper to carpet-weaving. Neither the purposes of decoration nor the conditions of production allow great scope for naturalism in ornament. Its forms are derived from nature, more or less ; but repose is best secured by some removedness from nature^necessitated also by the due treatment of material after its kind and according to its fashioning. In the case of recurring ornament it is inept to multiply natural flowers, &c., which at every repetition lose something of their natural attrac- tion. The

artist in ornament does not imitate natural forms. Such as he may employ he transfigures. He does not necessarily set out with any idea of natural form (this comes to him by the way) ; his first thought is to solve a given problem in design, and he solves it perhaps most surely by means of abstract ornament â€” witness the work of the Greeks and of the Arabs. The extremity of tasteless naturalism, reached towards the beginning of the Victorian era, was the opportunity of English re-formers, prominent ainongst whom was Owen Jones, whose fault was in insisting upon a form of ornament too abstract to suit English ideas. William Morris and others led the way back to nature, but to nature trained in the way of ornament. The Styles of ornament, so- called, mark the evolution of design, being the direct outcome of Greek, Roman, Byzantine, Gothic, or other conditions, in days when fashion moved slowly. Post- Renaissance ornament goes by the name of the reigning king; but the character of the historic periods was not sought by artists ; it came of their working in the way natural to theln and doing their best. "Style," as distinguished from " the Styles," comes of an artist's intelligent and sympathetic treatment of his material, and of his personal sincerity and strength. Inter- national traffic has gone far to do away with national characteristics in ornament, which becomes yearly more and more alike all the world over. The subsidiary

nature of ornament and its subjection to conditions lead to its frequent repetition, which results in pattern, re- peated forms falling inevitably into lines, always self- asserting, and liable to annoy in proportion as they were not foreseen by the designer. He cannot, therefore, safely disregard them. Indeed, his first business is to build pattern upon lines, if not intrinsically beautiful, at least helpful to the scheme of decoration. He may dis- guise them ; but capable designers are generally quite frank about the construction of their pattern, and not afraid of pronounced lines. Of course, adaptation being all-essential to pattern, an artist must be versed in the technique of any manufacture for which he designs. His art is in being equal to the occasion. (l. f. d.)

Orne, a department of the north-west of France, watered by the Orne.

Area, 2372 square miles. Thepopula-tion decreased from 376,126 in 1881 to 325,445 in 1901. Births in 1899, 5961, of which 315 were illegitimate ; deaths, 7554 ; marriages, 2311. Out of 1,414,780 acres of land cultivated in 1896, 773,110 acres were arable, and nearly 494,000 acres were green crop and grass lands. In 1899 the wheat crop was valued at Â£682,000 ; barley, Â£206,000 ; oats, Â£402,000 ; potatoes, Â£336,000 ; green crop (trefoil, luceru, and sain- foin), Â£278,000 ; natural pastures, Â£448,000 ; grass lands, Â£496,000 ; cider-apples, Â£480,000. The live stock in 1899 included 62,000 horses, 216,100 cattle, 70,460 sheep, and 37,000 pigs. Though without metallic ores, Orne possesses industries in metals â€" pin fac- tories at Laigle, &c. The textile industry is especially developed around Flers and Alengon, where cotton stuffs are manufactured. Alengon, the capital, had 14,886 inhabitants in 1901.

Oroshaza, a market town of Hungary, in the county of B4kes, 33 miles north-east of Szegedin. The inhabitants are mainly agriculturists and artisans, and carry on a brisk trade ia swine. There are five steam mills and many financial institutions. Population (1891), 19,966; (1901), 21,385. ^

Orsha, a district town of Russia, government of Moghileff, and 112 miles by rail west-south-west of Smolensk on the Moscow-Brest railway, on the Dnieper. Its industries are insignificant, but it is an important entrepot for grain, seeds, and timber, which are shipped both by rail and on the Dnieper. Population (1897),

13,161.-

It is a very old town, mentioned in the annals under the name of Ksha in 1067. In the 13th century it was taken by the Lithua- nians, who fortified it. In 1604 the Poles founded there a Jesuit college. The Russians besieged Orsha more than once in the 16th and 17th centuries, and finally annexed it in 1772.

Orsk, a district town of Russia, government and 150 miles south-east of Orenburg, on the right bank of the Ural river. Being situated on the prairies, cattle-breed- ing prospers. It has tanneries and tallow-melting

estab- lishments, and is a centre for trade in cattle and various animal produce imported from central Asia. Population

(1897), 14,036.

Orsova, a market town of Hungary, in the county of Krassd-Szoreny, near the pass of Vaskapii (Iron- Gates), on the Danube. As an important railway station on the frontiers of Hungary, Servia, and Rumania, it has a thriving trade. It has numerous financial institutions, a saw-mill, and several Government edifices. The private walls of the old Roman city of Tierna have been de- molished. Near the railway station stands a handsome chapel, called the Crown Chapel, which was erected in 1866 on the spot where Louis Kossuth concealed the crown at the close of the Hungarian war of liberty. The islet of Ada-Kaleh, opposite to the town, was ceded in 1878 by the Turkish Government to Hungary. Popula- tion (1891), 3564 ; (1901), 4610.

Orta, a lake of Italy, lying west from Lago Maggiore, and due north of Vercelli. It has an area of 7 square

miles, and is 8 miles long and from ^ to 4| miles wide. A subaqueous ridge divides it into two basins, of which the north is the deeper, descending to a maximum depth of 469 feet. The altitude of the lake is 961 feet above sea- level. The area of the drainage basin is 39 square miles. The temperature of the bottom never falls below 39-2Â° F. This lake Seems to owe its origin to glacial action. By- means of the Strona, which flows out of its northern extremity, it communicates with the Toce, which flows into Lago Maggiore.

prthodox Eastern Church The object of this

article is to enumerate all the Christian Churches of the East, and to sketch shortly their present condition ; i.e., both those which together constitute the Orthodox Eastern Church and also those which have a

common origin with it, but which, for one reason or another, have separated from communion with it. (See Ency. Brit., ninth edition, art. Gkbek Chuech.)

I. The Orthodox Easteen Chuech, which is frequently spoken of as "the Greek Church," and which has for its full oificial title "The Holy Orthodox Catholic Apostolic Eastern Church" (17 ctyta op^oSo^os KaOoXtKTj avaroXiKr) eKKX-qaia) is the historical representative of the chujches of the ancient East. It consists of (a) those churches which have accepted all the decrees of the successive general councils and have remained in full communion with one another, (&) such churches as have derived their origin from these by missionary activity, or by abscission without loss of communion. In the Eastern churches, unlike the Western, there has never been any pronounced tendency towards an organized unity under a single head, of the kind which in the Eoman world gave rise to the Papacy. Their bishops preserve, indeed, their ancient dignities and precedence, but are equals m their inherent power; and the authority of patriarchs and metropolitans is recognized as being committed to them by the synodical voice of their brethren. Again, not only is it the fact that the ancient patriarchs and other heads of local churches have independent authority within their own spheres, but it has been fully recognized, from the end of the 16th century at any rate, that a separate and independent organization is the natural corollary of complete political separation. On the other hand, the Orthodox Eastern Church has always laid especial stress upon the unchanging tradition of the faith, and has claimed orthodoxy as its especial character- istic. The "Eeast of Orthodoxy" (17 KvpiaKT] t^s SpOo- 8o|tas), celebrated annually on the first Sunday of the Greek Lent, was founded in honour of the restoration of the Holy Images to the churches after the downfall of Iconoclasm (19th February 842) ; but it has gradually assumed a wider significance as the celebration of victory over all heresies, and is now one of the most characteris- tic festivals of the Eastern Church. In addition to the ancient churches which have separated themselves from the orthodox faith, many have ceased to have an in- dependent existence, owing either to the conquests of Islam or to their absorption by other churches. For example, the church of Mount Sinai may be regarded as all that survives of the

ancient church of northern Arabia ; the autocephalous Slavonic churches of Ipek and Okhrida, which derived their iiltimate origin from the missions of Cyril and Methodius, were absorbed in the patriarchate of Constantinople in 1766 and 1767 respectively ; and the Church of Georgia has been part of the Eussian Chvirch since 1801. At the present day, then, the Orthodox Eastern Church consists of twelve mutually independent churches (or thirteen if we reckon the Bulgarian Church) using their own language in divine service (or some ancient form of it, as in Russia) and varying not a little in points

of detail, but standing in full communion with one another, and united as equals in what has been described as one great ecclesiastical federation. However, in using such language it must be remembered that we are not dealing with bodies which were originally separated from one another and have now entered into fellowship, but with bodies which have grown naturally from a single origin and have not become estranged. These bodies are the following : â€”

1. TJie Patriarchate of Constantinople or New Borne. â€” The Ecumenical Patriarch, as he has been called since early in the 6th century, is the most exalted ecclesiastic of the Eastern churches, and his influence reaches far outside the lands of the patriarchate. His jurisdiction extends over the dominions of the Sultan in Turkey, together with Asia Minor and the Turkish islands of the Aegean; there are eighty-two metropolitans under him, and the ” monastic republic ” of Mount Athos. He has great privileges and responsibilities as the recognized head of the Greek community in Turkey, and enjoys also many personal honours which have survived from the days of the Byzantine emperors.

The Patriarch has his own court at Phanar, and his own prison, with a large civil jurisdiction over, and responsibility for, the Greek community. In ecclesiastical affairs he acts with two gov- erning bodies â€” (a) a permanent Holy Synod (‘Ie/)a ‘ZivoSos ttjs “EKK\riojv) ; the Chief Syndic {irptjiTdiSiKoi), who is a judge of lesser causes ; the Recorder (kpoiivfifiuv) ; and so on, down to the cleaners of the lamps

1 The numbers have varied from time to time.

(Xafiiraddptoi), the attendant of the lights (Tepieurepx&i'^yos'), and the bearer of the images (/SacrTavdpios) and of the holy ointment (aiuPo56t7)s).

2. The Patriarchate of Alexandria, consisting of Egypt and its dependencies, was at one time the most powerful of all, and the Patriarch still preserves his ancient titles of " pope " and "father of fathers, pastor of pastors, arch- priest of archpriests, thirteenth apostle, and oecumenical judge." But the secession of the greater part of his church to Monophysitism [Coptic Chuech], and the Mahommedan conquest of Egypt, have left him but the shadow of his former greatness ; and at the present time he has only the bishop of Libya under him, and rules over some 20,000 people at the outside, mostof whom are settlers from elsewhere. 3. The Patriarchate of Antioch, includ- ing Cilicia, Syria (all but Palestine), and Mesopotamia, with fourteen metropolitans. The Patriarch is "father of fathers and pastor of pastors," but retains little of his ancient importance. 4. The Patriarchate of Jerusalem, which comprises Palestine only, and derives its chief influence' from the position of Jerusalem as a place of pilgrimage. The Patriarch has under him five arch- bishops and five bishops. 5. The ancient Church of Cyprus. 6. The Church of Mount Sinai, consisting of little more than the famous monastery of St Catherine, under an archbishop who frequently resides in Egypt. It has, however, a few branch houses (/*â,¬tox"i) in Turkey and G-reece. The archbishop is chosen, from a list of can- didates submitted by the monks of St Catherine, by the Patriarch of Jerusalem and his Synod ; and the Patriarch consecrates him. 7. The Hellenic Church, i.e., the church of the kingdom of Greece, which declared itself independent in 1833, though the claim was not admitted by the Patriarch of Constantinople till 1850. By the Greek constitution of 16th/28th ISTovember 1864 "the Orthodox Church of Greece remains indissolubly united, as regards dogmas, to the great Church of Constantinople, and to every other church professing the same

doctrines, and, like these churches, it preserves in their integrity the apostolical constitutions and those of the councils of the Church, together with the holy traditions; it is airoKe<^aAos, it exercises its sovereign rights independently of every other church, and it is governed by a synod of bishops." 8. 27ie Servian Church. â€” After the suppression of the Church of Ipek in 1766, Servia became ecclesiastically subject to Constantinople; but in 1830 the Sultan per- mitted the Serbs to elect a Patriarch (as a matter of fact he is merely styled Metropolitan), subject to the confir- mation of the Patriarch of Constantinople. Eight years later the seat of ecclesiastical government was fixed at Belgrade ; and when Servia gained its independence its church became autoeephalous. 9. TJie Bumanian Church. â€”The fall of the church of Okhrida in 1767 had made Moldavia and Wallachia ecclesiastically subject to Con- stantinople. On the union of the two principalities under Alexander Couza (December 1861) the Church was declared autoeephalous under a Metropolitan at Bucharest; and the fact was recognized by the patriarchs, as it was in the case of Servia, after the Treaty of Berlin had guaranteed their independence. 10. The Church of Mon- tenegro has from early times been independent under its bishops, who from 1516 to 1851 were also the temporal rulers, under the title of Vladikas, or prince-bishops. 11. The Orthodox Church in Austria-Hungary, which, however, really consists of three independent sections : the Servians of Hungary and Croatia, under the Patriarch of Carlowitz ; the Rumanians of Transylvania, under the Archbishop of Hermannstadt ; and the Euthenians of Bukovina, under the Metropolitan of Czernowitz. 12. The Russian Church, with which is incorporated the ancient Church of Georgia, now under a Russian Exarch

who is a member ex officio of the Holy Synod of Moscow.

13. The Bulgarian Church, unless indeed it be classed with the separated churches. It differs from the national churches already mentioned in that it had its origin in a revolt of Turkish subjects against the patriarchal authority. From the earliest times the Bulgarians had occupied an anomalous position on the borders of Eastern and Western Christendom, but they had ultimately become

subject to Constantinople. The revival of Bulgarian national feeling near the middle of the 19th century led to a movement for religious independence, the leaders of which were the archimandrite Neophit Bozveli and the bishop Ilarion Mikhailovsky. The Porte espoused the cause of the Bulgarians, partly to pacify them, but still more to strengthen its hold on all the Christians of Turkey by fostering their differences. Ultimately, on 28th February 1870, the Sultan issued a firman con- stituting a new church, including all Bulgarians who desired to join it within the vilayet of the Danube (i.e., the subsequently-formed principality of Bulgaria), and those of Adrianople, Salonica, Kossovo, and Monastir {i.e., part of Macedonia, Eastern Eumelia, and a tract farther south). The members of this ~~Church were to constitute a millet or community, enjoying equal rights with the Greeks and Armenians ; and its head, the Bulgarian Exarch, was to reside at Constantinople. Naturally, this was resented by the Patriarch Anthimus, who stigmatized the racial basis of the Bulgarian Church under the name of Phyletism. A local synod at Con-~~ stantinople, in August 1872, pronounced it schismatical ; Antioch, Alexandria, and Greece followed suit ; Jerusalem pronounced a modified condemnation ; and the Servian and Rumanian churches avoided any definite expression of opinion. Russia was more favourable. It never actually acknowledged the Bulgarian Church, and Bul- garian prelates may not ofl&ciate publicly in Russian churches ; on the other hand, the Holy Synod of Moscow refused to recognize the Patriarch's condemnation, and Russian ecclesiastics have secretly supplied the Bul- garians with the holy oil. Above all, when Prince Boris, the heir-apparent of the principality, was received into the Bulgarian Church on 14th February 1896, the Tsar was his godfather. The future of the Church remains doubtful. On the one hand, on accepted ortho- dox principles every believer ought to wish to see it once more under the Patriarch, since even the princi- pality is still under Turkish suzerainty ; on the other hand, its independence has a high value to the Bul- garians as the expression of their national hopes. If Bulgaria were to be constituted a kingdom, this would naturally affect the status of the Bulgarian Church in that kingdom, so far as the Patriarch is concerned ; and the regulation of the Church in the principality (as apart from the Turkish provinces) by statute of 1883,

into eleven eparchies or metropolitan dioceses, may be regarded as a step in this direction. But this could of course do nothing to validate the sections of the Bulgarian Church in Macedonia and other Turkish provinces. The position is further complicated by the fact that many Bulgarians, both within and without the principality, still remain subject to the Patriarch. Nevertheless, owing to its schools and other activities, the Bulgarian Church un- doubtedly makes headway both in the principality and in Macedonia.

At the present day, although the signs of weakness which have characterized the past are still present, the condition of the Greek orthodox churches is on the whole satisfactory, and signs of improvement are not wanting. The encyclical on unity of Pope Leo XIII. (1895) called forth a reply from the Patriarch Anthimus V. of

Constantinople and his Synod, which is eminently learned, dignified, and charitable. The theological school of the patriarchate, at Halke, is not undistinguished, and the University of Athens has an excellent record. Whilst the parochial clergy are still as unlearned as ever, there are not a few amongst the higher clergy who are distinguished for their learning beyond the limits of their own com- munion: for example, the metropolitan Ph. Bryennios, who discovered and edited the Didache; the archbishop N. Kalogeras, who discovered and edited the second part of the commentary of Euthymius Zigabenus on the New Testament; the archimandrite D. Latas, author of a valuable work on Christian archaeology (Athens, 1883) ; and the Logothete S. d'Aristarchi, who has published a valuable collection of the recently discovered homilies of the Patriarch Photius. This latter work is published at the Phanar press, erected as a memorial to Theodore of Tarsus, archbishop of Canterbury, by Greek and English churchmen, which was set up by the Patriarch Constantine V. in 1899, and at which is being prepared also an authorized version of the Scriptures in ancient Greek. (On the other hand, an attempt made in 1901 by the Holy Synod at Athens, with the co-operation of the Queen of Greece, to

circulate a modern Greek version of the New Testament led to an ebullition of popular feeling which could only be pacified by the withdrawal of the obnoxious version and the abdi- cation of the Metropolitan of Athens.) The Patriarch Constantine V. was deposed 12th April 1901, and was succeeded on 28th May by Joachim III. (and V.), who had previously occupied the patriarchal throne from October 1873 to April 1884, when he was deposed through the ill-will of the Porte and banished to Mount Athos. His re-election has therefore no little impor- tance. He is a strong man and a resolute reformer, inclined to look favourably upon the plans for reorgan- ization and reconstruction which find no little support amongst the laity and the younger monastic clergy. Like his predecessor, and in this resembling also many of the leading Russian clergy, he is very well disposed towards the English Church ; and not a little has been done in the way of establishing friendly communication between the Orthodox and the Anglican Churches, as, for example, in providing for spiritual ministrations to the sick, the dying, and the dead of either communion when their own clergy are out of reach. But un- doubtedly the question of the most pressing importance with regard to the future of Eastern Christendom is the relation between Russia and Constantinople. The CEou- menical Patriarch is, of course, officially the superior; but the Russian Church is numerically by far the greatest, and the tendency to regard Russia as the head, not only of the Slav races, but of all orthodox nations, inevitably reacts upon the Church, in the form of what has been called pan-orthodoxy. The Russian Church is the only one which is in a position to display any missionary activity. It has been a powerful factor in the develop- ment of several of the churches already spoken of, especially those of Servia and Montenegro, which are usually very much subject to Russian influences (‘Pwo-cro- ippovK or ‘Pa)cro-u)^iA.ot). It has taken great interest iu non-orthodox, churches, such as those of Assyria, Abys- sinia, and Egypt. Above all, it has shown an increasing tendency to intervene in the affairs of the three lesser patriarchates, the ultimate result of which it is not easy to foresee.

II. The Separated Churches of the Bast. â€” These are the various churches which have severed themselves or drifted into separation

from the Orthodox Eastern Chui-ch for reasons either doctrinal or practical, mostly through their dissent from the decrees of councils of the 5th

century. (1) The Church of Armenia (see Ency. Brit, ninth edition, vol. ii. p. 548), a national church dating from the earliest days, was hindered by persecution from taking any part in the council of Chalcedon, a.d. 451, and subsequently repudiated it. But although it un- doubtedly accepted the Henoticon of the Emperor Zeno (an abortive attempt to bring together the two parties), at the synod of Varalschapad, in 491, the Patriarch Narses definitely repudiated the Eutychian heresy in 1166. The writings of Armenian theologians have certain "aphtharto- docetic" tendencies {e.g., the human body of the Lord is spoken of as being by nature incorruptible), but they appear to show no signs of Eutychianism properly so called. At the present day the relations between the Armenian Church and the (Ecumenical Patriarch are decidedly friendly, and in certain circumstances single Armenians may be admitted to communion in Greek churches. The head of the Church is the Patriarch of Etchmiadzin, in the Russian province of Erivan, who bears the title of Catholicos {Katoghfkos) of Armenia. There are also Patriarchs of Sis, Aghtamar, Constantino- ple, and Jerusalem. The two last-named are only bishops with the honorary rank of patriarch, their importance springing from their relations with the Turkish Govern- ment. Owing, however, to the Turkish practice of organ- izing and governing its peoples by their religion, the Armenian Patriarch of Constantinople has become the official representative of the Armenian community in Turkey, and is thus of little less practical importance than the Catholicos himself. (2) The West Syrian or Jacobite Church, which is definitely Monophysite, under a head who bears the title of patriarch of Antioch and is always called (since the 14th century) Mar (= Lord) Ignatius (see Ency. Brit., ninth edition, vol. xiii. p. 538). (3) The Coptic Church of Egypt, which is also Monophysite. (4) The Abyssinian Cliurch, also Monophysite, and dependent upon that of Egypt. (5) The East Syrian, Assyrian, or Chaldee Church, which is scattered over Kurdistan, and is Nestorian in doctrine [ISTestoeians]. (6) A few more or less independent communities, such as the so-called Cliristians oj St Thomas in South

India, who were Nestorian iu origin, but have become Jacobite in modern days (see Ency. Brit., ninth edition, vol. xxiii. p. 308). In addition to these sep- arated churches, there are a number of ” Uniat ” bodies, i.e., bodies which have been incorporated in the Roman communion without giving up their ancient rites and customs (see Ency. Brit., ninth edition, vol. xx. p. 630) ; and there are also certain isolated dissenting bodies.

Authorities (in addition to those given in the article Greek Chwrch in the ninth edition). â€” Td ll7iS6.\i.ov, second edition, Zante, 1874. â€” M. Theotokas. No^i6\o7ia toC 0(KoU|Uei’iicoS rtarpiapxeiou. Constantinople, \SQ1.â€” Answer of the Great Church of Constantinople to the Papal Encyclical on Unity, with a trans- lation by the archimandrite E. Metallinos. Manchester, 1896. â€” Isin. SiLBERNAOL. Verfassung und gegenwdrtiger Bestand sammtlicher Kirchen des Orients. Landshut, 1865. â€” “Odysseus.” Turkey in Europe. London, 1900. â€” Cl. NiroLAiDES. La Mace- doine. Berlin, 1899.â€” H. F. B. Lynch. Armenia, Travels and Sttidies. London, 1901.â€” G. M. Rae. The Syrian Church in India. Edinburgh and London, 1892. â€” Wetzer and Welte. Kirchen- lexicon, ed. Hergenrothek and Kaulen, vol. v. Freib. i. B., 1888. Art. ” Griecliische Kirohe.“â€” Herzog-Plitt. Sealencyklopddie, vol. V. Leipzig, 1879. Art. ” Griechische und gi-iechische- russische Kirohe.‘“â€” Dublin Bevieio, July 1880. Art. “The Greek Church.” By Prof. T. J. Lamt. (y,r_ j.. co.)

Oruro, a department of Bolivia, bounded on the N. by the department of La Paz, on the E. and S. by Cocha- bamba and Potosi, on the W. bv Peru. Area, 21,350 square miles. Population (in 1893),“l89,840 ; in 1898, estimated at 112,300, of whom 85,000 were Indians. Capital,

Oruro (16,000). The department is divided into three provinces. In 1898 it had 29 schools and 1280 pupils.

OrvietO, a town and bishop's see of the province of Perugia, Umbria, Italy, on the Paglia, 78 miles by rail north by west of Rome. It crowns an isolated eminence (1165 feet), and is approached on the east by a funicular railway. In addition to the cathedral may be mentioned the church of San Andrea, with 11th-century tower ; the church of San Giovenale, of the 11th century ; the palace of the Popes, which since 1898 has sheltered the munici- pal museum, the latter rich in ancient Etruscan remains and mediaeval sculptures, cathedral plans, &c. ; and the communal offices, dating from the 12th century, but rebuilt in the 14th, the faqade in 1586. The citadel, planned in 1364 by Cardinal Albomoz, is now laid out as a public garden. A noteworthy Etruscan necropolis, discovered in 1874, has yielded numerous Greek and Etruscan funereal urns, &c. Good wine is made. Popu- lation (1899), 7500.

Oscar II., King of Sweden and Norway (1829- -), was born at Stockholm on the 21st of January

1829, and succeeded his brother, Carl XV., upon the throne of Sweden and Norway on the 18th of September 1872. He was the third son of Oscar I. and Josephine, the daughter of Eugene de Beauharnais, Prince of Leuch- tenberg, the son of the Empress Josephine. His elder brother Gustav had died young. His younger brother Auguste died in 1873. In 1857 he married Princess Sophia, youngest daughter of Duke Wilhelm of Nassau and Princess Pauline of Wtirtemberg, by whom he had issue Gustaf, the crown prince, born at Drottningholm on the 16th of June 1858 ; Oscar, who took the title of Prince Be^nadotte, and renounced his royal rights on his marriage with Miss Ebba Munck (afterwards Countess Wisborg) at Bournemouth ; Carl, duke of Westergotland, who married Princess Ingeborg of Denmark ; and Eugene, duke of Nerike, who has devoted the greater portion of his time to painting in his studio at Stockholm. It was not only as monarch of the double Scandinavian throne, or as grandson of the famous Marshal Bernadotte, that King Oscar II. won a reputation in far wider circles than those which are influenced by considerations of dynasty or descent, for his chief title to the recognition of posterity is to be found in the tact with which he has handled delicate and difficult

international problems, and the artis- tic and literary work by which he has been distinguished. Tall and dark, with flashing eyes, and well-moulded head npon a pair of massive shoulders, Oscar II. could never have been mistaken for anything but a true Bernadotte. Faced by the constant preoccupations of a domestic struggle whenever he turned to the politics of the two nations, it was only natural that the king should seek what solace was possible, in the scanty leisure of a throne, in those artistic and literary pursuits, which had almost wholly claimed his interest as duke of Ostergotland. The list of his published works, which contains poetry, history, research, translations, speeches, criticisms, would not dis- grace the reputation of an author whose life had been â€¢entirely subordinated to the labours of his pen. In 1881 an exhaustive bibliography of the writings of Oscar II. was issued by ” C. M. C,” who asserts; that the king’s first appearance in print was made in 1849, when he contributed an article on the battle of Eckern- forde to the Journal of Army Veterinary Science. In 1858, as an anonymous competitor, Oscar II. won the second prize of the Swedish Academy with a collection of lyrical and narrative poems called Memorials of the Swedish Fleet, which contained some touching lines on the death of the captain of the frigate Euginie, the ship â– on which he paid his first of many visits to British

shores. Between 1859 and 1872 he published five pam- phlets of occasional verse, which he collected in the latter year under the general title of New and Old by 0* *. In 1859 he published, in the Annals of the Swedish Academy, “Contributions to the Military History of Sweden in the years 1711, 1712, 1713,” and these he brought out as a separate volume in 1865. In the same year appeared his translation of Herder’s Cid, which he always considered one of his best literary efforts ; and in 1861 he published a poetical version of Goethe’s Torquato Tasso, with a charming dedication to his wife. In re- cognition of these scholarly labours hewaselectedacorre- sponding member of the Frankfort Academy of Sciences. The king published his Collected Works in two volumes in 1875-76, three years after he came to the throne. His poems have since been translated into French, German, Danish, Italian, and Magyar. The lines entitled In My Home have especially appealed to his own subjects, for they were written in that**

castle by the Sound of Helsing- borg called after his Queen Sophia; and, besides the ten- der picture of family happiness and love which they reveal, they recall a number of those old sagas which are so dear to the heart of every Scandinavian. His first drama. Castle Cronberg, was also written under the same gentle influences, within a year of his marriage. It was originally composed in French, and is still a favourite piece in Swedish theatres. An English version of his Memoirs of Charles XII. was brought out in 1879, and while it astonished foreign readers by the skill with which it treated a subject already handled by the masterly eloquence of Voltaire, it also impressed them with far deeper evidences of accuracy and research. In 1885 King Oscar's Address tothe Academy of Music was published with annotations. His majesty's fine collection of old printed and manuscript music, ever at the service of the intelligent amateur, is but one sign of his enthusiasm for the subject. The first English version of the most celebrated of these musical essays appeared, with the king's approval, in Literature for 19th May 1900. Whether in the case of his poetry, his prose, his military and naval knowledge, or the scholarship which made him worthy to be the only Swedish king who ever fairly earned his degree of Doctor of Philosophy at Lund â€" King Oscar II. conscientiously tried to lay all his varied talents, in their highest sense, at the service of his subjects. Nor was his wide culture limited by its merely personal expression. He welcomed many International Congresses to Sweden. He encour- aged the universities and the cause of general edu- cation throughout Scandinavia, a movement in which he had already become deeply interested before his accession.

The progress of parliamentary and of party government in Sweden and Norway has led to many contentions. But whetherthe pressing problems for themomentwere the question of separate foreign ministries, of separate fiags, or of separate consulates, unity under his royal standard was the invariable policy of the monarch. In questions of in- ternational arbitration he was always deeply interested, and on several occasions took a prominent part. In 1889 he appointed the chief justice of Samoa, at the request of Great Britain, Germany, and the United States. In 1897 he was given the power to appoint a fifth arbitrator in certain circumstances in the dispute between Great

Britain and Venezuela. In the same year he accepted the position of decisive umpire in the Anglo-American Arbitration Treaty which was signed at Washington, but did not secure a sufficient majority of votes in the Senate. In 1899 he again accepted the office of arbitrator in the matter of certain claims in Samoa affecting Great Britain, Germany, and the United States. His peculiar position among the sovereigns of Europe, outside their dynastic

complications, yet essential to the balance of their powers, especially fitted him for these international services, to which he brought an acute and scholarly intelligence. But his well-known impartiality did not prevent him from occasionally asserting his opinions with no uncer- tain sound. In an outspoken declaration published in the columns of Tlie Times of 2nd May 1900, he asserted his full sympathy with the United Kingdom in the course which had been thrust upon her in South Africa. The courage with which such sentiments were uttered, at a time when European opinion was almost universally hostile, was only less admired than the evident sincerity of which they were as graceful an expression.

The king's eldest son married in 1881 at Carlsruhe (being then in his twenty-third year) the Princess Vic- toria, daughter of Trederick William Louis, grand duke of Baden, by his wife Louise, princess of Prussia. This lady was therefore first cousin to the German Emperor William II. through her grandfather, the Kaiser Wil- helm I. ; and throiTgh her grandmother Sophia, princess of Sweden, she was descended from the old royal Scan- dinavian stock of Gustavus Vasa. This interesting alli- ance connects the Bernadottes with one of the great ruling houses of Europe, and in years to come promises to set upon the throne of Sweden and Norway a sovereign who will unite in his veins the blood of Napo- leon's famous marshal and of Sweden's warrior-king. The sons living (1902) by this marriage are Gustavus

Adolphus, duke of Scania, born at Stockholm in Novem- ber 1882 ; William, born in 1884 ; and Eric, born in

1889.

Oschatz, a town of Germany, on the Dollnitz, 18 miles by rail north-west of Meissen, in the circle of Leipzig, kingdom of Saxony. There are burgher, real, and commercial schools, and a seminary for teachers, as also the making of sugar, felt, weighing machines, woollens, and leather. Population (1890), 9392 ; (1900),

10,652.

Oschersleben, a town of Prussia, province of Saxony, 24 miles by rail west-south-west of Magdeburg. It has lignite mines, sugar refining, iron foundries, ma- chine shops, breweries, brick-kilns, &c. The place is first mentioned in 803. Population (1886), 9671; (1900),

13,413.

Osh, a district town of Russian Turkestan, govern- ment of Fergana, 31 miles east-south-east of Andijan railway terminus, on the Akbura, altitude 3300 feet. It consists of two parts, native and Russian, of which the latter is quite new and has its streets planted with trees. Its population in 1897 was 36,474, of whom only about 400 were Russians. It has a Russian and a Russian and Sart school, four Mussulman schools, and a small hospi- tal. Its trade with China is considerable.

O'Shanassy, Sir John (1818-1883), British colo- nial statesman, was born in 1818 at Holycross Abbey, near Thurles, Tipperary, his father being a land surveyor. He married in 1839, and the same year emigrated to the Port Phillip district of New South Wales, where he was for some time engaged in farming, and subsequently com- menced business in Melbourne. His remarkable abilities attracted the attention of Dr Geoghegan, who afterwards became Roman Catholic bishop of Adelaide, by whom he was induced to take part in public affairs. He was one of the founders, and later the president, of the St Patrick's Society of Melbourne, represented the Roman Catholic body on the

denominational board of education, and was a member of the Melbourne corporation. When Port Phillip was separated from New South Wales in 1851 and became the colony of Victoria, Mr O'Shanassy

was returned to the Legislative Council as one of the members for Melbourne. A few weeks after the new colony began its independent existence gold was dis- covered, and the local government had to solve a number of difficult problems. The only member of the first executive who possessed any great talent for administra- tion was the Attorney-General, Mr (afterwards Sir) W. P. Stawell. The Legislature was composed partly of elected representatives, and partly of nominees, official and non- official, appointed by the governor in council. The great natural ability of Mr O'Shanassy forced him to the front, and for some time the policy of the country was virtually shaped by him and Mr Stawell. It was very much owing to the strong position taken by Mr O'Shanassy that the powers of the Legislative Council were enlarged by the duke of Newcastle, who was at that date Secretary of State for the Colonies, and that it was allowed to control not only the ordinary revenue raised by taxation, but also the territorial, which was derived from the proceeds of the sale and occupation of Crown lands. Erom that date the Legislative Council, led by Mr O'Shanassy, be- came Virtually supreme, and was enabled to expend the large sums which came into the exchequer of the colony, directly or indirectly through the discovery of gold, upon public works and the various services of the Government. After the Ballarat riots in 1854, Mr O'Shanassy was one of the members of a commission appointed to inquire into the condition of the gold-fields, and his report and that of his colleagues was the foundation of the mining legislation which, initiated in Victoria, was gradually fol- lowed by all the Australasian colonies. Mr O'Shanassy, together with Sir Andrew Clarke, was one of the framers of the constitution under which not only was the whole of the Legislature elected by the people, but the ministry became responsible to the local parliament. Under this constitution Mr O'Shanassy was returned in 1856 to the Legislative Assembly for Melbourne and Kilmore, but took his seat for the latter constituency. Early in 1857 the Haines Government, the first formed after the concession of responsible

government, from among the members of the old Executive Council, was defeated, and Mr O'Shanassy having been sent for by the governor, Sir Henry Barkly, formed a ministry of which he became the premier. But he encountered strong opposition as soon as he met parliament, and was defeated after hold- ing office for little more than six weeks. He returned to power in 1858 as chief secretary and premier, on the defeat of the Haines Government through the rejection of the schedule to their increase of members Bill, and was again elected for Kilmore. One of the first duties of the new ministry was to inaugurate the system of railways, and to raise the necessary funds for their construction. Several propositions were made to the Government of Victoria by the great finance houses of the United Kingdom, and the propositions of Baring Brothers were brought to the colony by Mr Childers. Mr O'Shanassy decided to float a loan of eight millions sterling through the instrumentality of six of the Melbourne banks, and he commenced the series of borrowings by the Australian governments which subse- quently attained such large proportion s. In 1859 the second O'Shanassy ministry had to resign after a vote of want of confidence, and its leader remained in opposition till August 1861, when he defeated the Heales ministry on their budget, and formed his third administration. During the two years that it held office the Government passed an Education, a Local Government, a Civil Service, and a Land Act. The object of this last was to abolish the old system of selling the Crown lands by auction, and to substitute another which insisted rather upon residence and cultivation than upon obtaining the highest possible price. The Act did not carry out all the intentions of its framers, but

it was a step in the right direction. The O'Shanassy Government was defeated in June 1863, and its chief never again succeeded in regaining office. He remained in opposition, and as leader of the Conservative or, as it was termed, the Constitutional party, was a steady op- ponent of the measures introduced by Mr M'Culloch and advocated by Mr

Higinbotham. In 1864 he was re- elected for Kilmore, but he did not stand at the general election of 1866, and paid a visit to Europe. In that year he was created by Pope Pius IX., in recognition of his services in the cause of Roman Catholic education, a Knight of the Order of St Gregory the Great. In 1867 he returned to Victoria, and was elected a member for the central province in the Legislative Council. In 1870 he was created C.M.G., and in 1874 K.C.M.G. In the latter year he resigned his seat in the Council, and did not re-enter public life until 1877, when he was returned to the Assembly for Belfast. His strongly expressed Conservative opinions and his devotion to the interests of the Roman Catholic Church impaired his influence in the Legislature, which had become extremely demo- cratic during the eleven years that he had been absent from it ; and although Sir John was a fearless critic of the policy of the Government, he never succeeded in defeating it. He had a singularly comprehensive grasp of all constitutional questions, was an eloquent speaker, and an ardent free-trader. He retired from Parliament in 1880, and died in 1883. (g. c. l.)

O'Sh augh n essy , Arthur William Edgar (1844-1881), English poet, was born in London, on 14th March 1844, and at the age of seventeen obtained through the first Lord Lytton, who took a peculiar interest in him, the post of transcriber in the library of the British Museum. Two years later he was promoted to be an assistant in the natural history department, and took up the ichthyological branch of the work; for this he had probably little natural aptitude, but he so carefully qualified himself as to become in time an authority. He published his Epic of Women in 1870, Lays of France in 1872, and Music and Mooiv- light in 1874. In his thirtieth year he married a daughter of John Westland Marston, and during the last seven years of his life printed no volume Of poetry. Songs of a Worker was published posthumously in 1881, O'Shaughnessy dying on the 30th of January in that year from the effects of a chill upon a delicate constitution. The qualities of O'Shaughnessy's poetry are those of the true singer ; its defect the lack of importance in theme and dignity in thought. His melodies are often mag- nificent ; and, as in Tlie Fountain of Tears, the richness of his imagery conceals a certain vagueness and indecision of the creative faculty. He was also very f elieitious in bold uses of repetition and echo,

by which he secured effects which for haunting melody are almost inimitable. His spirit is that of a mild melancholy, drifting helplessly through the realities of life and spending itself in song. Where the inspiration of the momentfails him,andnothing but the music is left, the insubstantiality of his talent becomes clear. By some critics he has been occasionally disparaged, but reparation was done to his memory by Francis Turner Palgrave, who, in the second series of the Golden Treasury, said with some exaggeration that his metrical gift was the finest, after Tennyson, of any of the later poets, and that he had ” a haunting music all his own.” (a.wa.)

Oshima, a group of three small islands belonging to Japan, lying southwards of Kiushiu, in 30Â° 50′ N. and 130Â° E. Their names, from west to east, are Kuro- shima, Iwo-jima and Taka-shima. Kuro-shima rises to a

height of 2475 feet, and Iwo-jima has an active volcano 2480 feet high. These islands are not to be confounded with Oshima, the most northerly island of the Izu-no- shichito, or with the northern group of the Luchu Islands. There are several other islands of the same name in Japan, the term Oshima signifying merely ” big island.” One of the best known lies off the Kii promontory, and has been the scene of many maritime disasters.

Oshkosh, a city of Wisconsin, U.S.A., capital of Winnebago county, on the Eox river, at its mouth in Winnebago Lake, in the eastern part of the state, at an altitude of 756 feet. The city is divided into thirteen wards ; its streets are paved with wood or are gravelled, and it has a water-supply by the Holly system. The schools are excellent, and there is a public library. It is on three railways, the Chicago and North-Western, the Chicago, Milwaukee, and St Paul, and the Wisconsin Central. It has extensive manufactures. In 1900 the number of establishments reported was 285, with a total capital of $8,018,038, employes numbering 4587, and a product valued at f 8,781,248. The largest item was lumber, valued at $2,449,430. Besides this, carriages and waggons, furniture, flour, and iron and steel goods were produced, and other minor articles. The city con- tains the state normal school

and an insane asylum. The assessed valuation of real and personal property was, in 1898, $9,279,993 ; the net debt of the city was $375,316 ; and the rate of taxation was $26.50 per $1000. Popular tion (1890), 22,836 ; (1900), 28,284, of whom 7356 were foreign-born. There were 9490 persons of school age (five to twenty years). Of 7513 males, twenty-one years of age and over, 252 were illiterate (unable to write).

Osimo, a town and episcopal see of the province of Ancona, the Marches, Italy, 10 miles south of Ancona. It still retains a portion of its ancient town wall (2nd cent. B.C.), and possesses a cathedral, and a town hall with antiquities. Silk-spinning and the raising of cocoons are carried on. It is the ancient Picenian town of Auximum. Population (1899), about 5000.

Oskaloosa, a city of Iowa, U.S.A., capital of Mahaska county, between the Des Moines and Skuijk rivers, on the Chicago, Burlington, and Quiney, the Iowa Central, and the Chicago, Rock Island, and Pacific rail- ways, south-east of the centre of the state, at an altitude of 833 feet. It is in an agricultural and coal-mining region. Penn College, situated here, had, in 1899, 14 instructors and 300 students. Population (1890), 6558 ; (1900), 9212, of whom 649 were foreign-born and 344 negroes.

Oskarshamn, a seaport town of Sweden, county of Calmar, on a bay of the east coast, opposite the north end of the island of Oland, 40 miles north of Calmar. It was called Doderhultsvik down to 1856. It exports timber (3|- to 4^ million cubic feet annually) and granite ; and imports coal, petroleum, salt, and groceries. The port is often closed for a couple of months in the depth of winter. The industries embrace iron-works, match fac- tories, &c. There are two dry docks. Population (1880),

5382; (1890), 5853 ; (1900), 7077.

OS man (1832-1900), Turkish mushir (field- marshal), was born at Tokat, in Asia Minor, in 1832. Educated at the military academy at Constantinople, he entered the cavalry in 1853, and served under Omar Pasha in the Russian war of 1853-56, in Wallachia and the

Crimea. Appointed a captain in the Imperial Guard, he went through the campaigns of the Lebanon in 1860 and of Crete in 1867 to 1869, under Mustapha Pasha, when

he distinguished himself at the capture of the convent of Hagia Georgia, and was promoted lieutenant-colonel. He served under Eedif Pasha in suppressing an insurrection in Yemen in 1871, Was promoted major-general in 1874, and general of division in 1876. Appointed to command the army corps at Widin in 1876 on the declaration of war by Servia, he defeated TchnernaiefE at Saitschar and again at Yavor in July, invaded Servia and captured Alexinatz and Deligrad in October, when the war ended. Osman was promoted to be mushir, and continued in the command of the army corps at Widin. When the Russians crossed the Danube in July 1877, Osman moved his force to Plevna, and, with the assistance of his engineer, Tewfik Pasha, entrenched himself there on the right flank of the Russian line of communication, and gradually jnade the position a most formidable one. He repulsed the three general assaults of the Russians on the 20th and 30th July and the 11th September, inflicting on them great loss â€” some 30,000 men in the three battles. He held the position, after being closely invested, until the 9th December, when, compelled by want to cut his way out, he was severely wounded and forced to capitulate. This famous improvised defence of a position delayed the Russians for five months, and entailed their crossing the Balkan range in the depth of winter after the third battle of Plevna. The Sultan conferred on Osman the Grand Cross of the Osmanie in brilliants and the title of ” Ghazi ” (victorious), and, when he returned from impris- onment in Russia, made him commandant of the Imperial Guard, grand-master of the artillery, and marshal of the palace. In December 1878 he became War Minister, and held the post, with a small break, until 1885. He died at Constantinople, in the palace built for him by the Sultan near Yildiz Kiosk, on 4th April 1900, and his body was buried with great pomp in the Sultan Muhammad Mosque. (b. h. v.)

Osman Digna. See Egypt: Military Operations.

Osnabriick, a town and episcopal see of Prussia, province of Hanover, 31 miles by rail north-east of Miinster, in a valley on the north side of the Teut'oburger Porest. The town is adorned with a bronze equestrian statue of the Emperor William I. (1899), a monument of the war of 1870-71 (1880), and statues of Justus Moser (1836) and the Hanoverian minister Stiive (1882). The cathedral is undergoing extensive alteration. Osnabriick is a place of considerable industry, possessing iron and coal mines, iron foundries, machine shops, stone quarries, and various iron manufactures. Population (1885),

35,899 ; (1900), 51,674.

Ossett, with' Gawthobpb, a municipal borough (in- corporated 1890), railway station, and parish in the Morley parliamentary division of Yorkshire, England, 3 miles west- north-west of Wakefield. It has baths similar in their properties to those of Cheltenham. New technical school buildings were erected in 1890, and a public library has been opened. Population (1891), 11,123; (1901), 12,886.

Ossining, a village of Westchester county. New York, U.S.A., known as Sing-Sing previous to 1901. It is situated on the east bank of the Hudson River, where it widens into Tappan Bay, 31 miles north of New York (Jity, and on the New York Central railroad. Its situation is on a steep slope descending from a height of from 200 to 300 feet to the river, on which it is laid out irregularly. Sing-Sing prison is located here, and several excellent schools for boys and girls. Population (1900), 7939, of whom 1642 were foreign-born and 308 negroes.

Ostashkoff, a district town of Russia, government and 16-! miles west-north-west of Tver, on Lake Seliger,

situated in a damp and insalubrious climate. Its popula- tion grows, nevertheless, by immigration, and was 10,457 in 1897. It has several tanneries, and is a great centre for the making of boots and shoes as a domestic trade (400,000 pairs per annum), agricultural implements,

fishing-nets, and building of boats. It has good fishing, and steamers ply on the lake.

Ostend, or Ostbnde, a seaport of Belgium, in the province of West Planders, 14 miles' by rail west of Bruges. It is the seaward terminus of important Conti- nental main lines of railway, e.g., from the north of France, from Switzerland, vid Strasburg, and from Cologne and central Germany, and a landing-place in one of the principal express routes (Dover-Ostend) between England and the Continent. The mail service between Dover and Ostend was started on 3rd March 1846, and between then and the end of that year 4525 passengers were carried between the two ports ; but by 1899 the number of passengers so carried had increased to 124,724 annually. The growth of the general trafiic of the port is shown by the following statistics : in 1860, 704 vessels of 66,950 tons entered ; in 1880, 1308 vessels of 244,831 tons; and in 1899, 2000 vessels of 1,166,907 tons (of which 1927, of 1,124,026 tons, were steam vessels). In 1898 what was virtually an additional new harbour was planned and begun, the cost of the necessary works being borne partly by the State, partly by the municipal- ity of Ostend. The excavations extend inland as far as the hamlet of Slykens, a distance of three-quarters of a mile ; and the works embrace a basin for the royal mail steamers (Dover-Ostend boats) and other Government vessels, with a depth of 26^ to 32f feet beside the quays; another basin for shipping generally, 3300 feet long, 295 to 820 feet wide, and 23 feet deep during the height of the tide; two dry docks; and a new harbour railway station. The approach to the old har- bour, as well as the anchorage outside, has been improved by cutting three gaps, each 16^ feet minimum depth, and 1640 feet, 1160 feet, and 2620 feet wide respectively, through the Strombank sandbar, which stretches 12 miles parallel to the shore at a distance of 1^ miles from it. Ostend is also one of the principal fishing ports of the kingdom, the deep-sea fishing being carried on by about 300 men in sailing smacks and 1300 men in steam trawlers. Oysters and lobsters are preserved and fat- tened on a large scale, being brought in the first instance from the east of England, Prance, and Norway. Ostend is even more celebrated as a seaside resort than as a seaport. In the height of the season, which lasts from 1st May to 15th October, it is visited by some 40,000 per- sons, attracted partly

by the excellent sea-bathing, partly by the fashionable social life and the amusements which minister to it, and partly by the licensed gambling which takes place in the kursaal. Along the sea-front of the town extends for a distance of ^\ miles, that is, as far west as Mariakerke (which was incorporated with Ostend in 1899), a magnificent promenade, 100 feet broad, constructed entirely of hardened bricks, and backed by handsome villas with open fronts; by a crowd of hotels, some of them built on a palatial scale ; by the kursaal, which has a concert hall capable of seating 5000 persons ; and by the villa of the king of the Belgians. Out of the season almost all the hotels on the sea^front are closed. The licence for public gaming in Ostend was extended, to the lessees who then held it, for the space of two yeaa-s from the autumn of 1901. The two principal churches are both quite new â€” St Peter and St Paul's, originally founded in 1072, has been rebuilt, after being burnt down in 1896; and St Catherine's was built in 1883, on the model of a Ghent church of the 13th century. There

is also a third church, St Joseph's (1901). The pleasure- resorts embrace the large Leopold Park, the Marie Henriette Park, the casino or ball-rooms in the Hotel de Ville, and the restaurant at the pier-head (estacade). Ostend vies with Scheveningen in Holland for priority as the most expensive seaside resort on the Continental shores of the North Sea. It is connected by steam tramway with the quieter sea-bathing resorts of Blanken- berghe (13 miles), to the north-east, and Middelkerke, West- ende, and Nieuport (11 miles), to the south-west. By the Canal de Bruges, Ostend has water communication with the city of Bruges, and thence by other canals with Ghent, Eecloo, Sluis, and other towns of Belgium. Population

(1880), 19,307 ; (1890), 24,688 ; (1900), 39,484.

Osterode, a town of Prussia, province of Hanover, at the south foot of the Harz Mountains, 34 miles north- west of Nordhausen by rail. It is the seat of various industries â€” woollens, cottons, white lead, copper

and puddling works, tanning, gypsum quarries, dyeworks, &c. The church of St ^Egidius contains tombs of the dukes of Grubenhagen. Population (1885), 6436 ; (1900), 7099.

Osterode, a town of Prussia, province of East Prussia, 75 miles by rail north-east of Thorn, on Lake Drewenz. It has three churches, a synagogue, a castle built by the Teutonic knights in 1270, and a normal school (males). The place has a trade in agricultural products and timber, and such industries as saw-milling, tar production, dyeing, brewing, and manufacture of paper and machinery. Population (1886), 7123; (1900), 13,163.

Ostersund, a town\ of Sweden, capital of the county of Jamtland, situated on the east shore of Stor (Great) Lake, 364 miles north by west of Stockholm by rail. Immediately facing the town is the lofty island of Pros, with which it is connected by a bridge 1418 feet long. It was founded in 1786. Population (1880), 2864;

(1890), 5333; (1900), 6866.

Ostia, the ancient port of Rome, Italy, situated at the mouth of the Tiber. The principal survivals of the place are graves, from which numerous remains have been taken ; baths, excavated in 1891 ; the headquarters of the fire-cohort ; the forum, excavated in 1880-81, with the basement of a temple, 82 feet long by 39 feet broad ; theatre ; sanctuary of Mithras ; three tiny temples, one dedicated to Venus; the sanctuary of Cybele; and another large temple. The modern village of Ostia, which gives name to one of the most important episcopal sees of the Church of Eome, was founded by Pope Gregory IV. in 830. At Porto the chief edifices are the cathedral of Santa Eufina, dating from the 10th century, but modern- ized; the bishop's palace; and the villa of Prince Torlonia. At Piumicino, a port since 1825, there is sea-bathing. Population of all three places, about 1200. In 1884 a_ beginning was made with the draining of the Agro Romano, that is, the marshes of Ostia, the Isola Sacra, and Mac- carese, by constructing banks and canals, and lifting out the water from the enclosed marshes by turbines.

Ostrau, the name of two Austrian towns in the Ostrau-Karwin coal-mining district. 1. Maheisch- OsTEAu (Moravian Ostrau), situated on the right bank of the Ostrawitza, near its confluence with the Oder. It has a station on the Austrian Northern railway, between Vienna and Cracow. It derives its importance from the extensive neighbouring coal-mines, and the blast furnaces and iron- works which they have called into existence. The manu- factures comprise sheet-iron, boilers, zinc, brick and tiles, paraffin, petroleum, soap, rum, liqueurs, &c. The Rothschild iron-works at Witkowitz are in the vicinity. Population (1890), 19,243 ; (1900), 30,125. 2. Polnisch-

OsTEAu (Polish Ostrau), a mining town in the govern- ment district of Preistadt in Austrian Silesia, opposite Mahrisch-Ostrau. It has large coal-mines, which form the south-western portion of the extensive Upper Silesian coal-fields, the largest Austrian deposit. Population

(1890), 13,176; (1900), 18,761.

Ostrofsky, Alexander Nikolaivich (1823- 1886), Russian dramatic author, was born on the 12th of April 1823 in Moscow, where his father was an oflBcial of the Senate. After passing through the gymnasium, he studied law in the university, which he quitted with- out having submitted to the final examination. He was then employed as a clerk in the office of the "Court of Conscience," and subsequently in that of the Commercial Court at Moscow. Both Tribunals were called upon to settle disputes chiefly among the Russian merchant class, from which Ostrofsky was thus enabled to draw the chief characters for his earliest comedies. Among these are Byednaya Nivesta (" The Poor Bride "), Byednost ne PoroJc ("Poverty not a Vice "), and Ne v'svoi sanine sadis (literally "Don't put yourself in another's sledge," but really meaning " Don't put yourself in a position for which you are not suited"). Of this last Nicholas I. said, " it was not a play, but a lesson." The uncultured, self-satisfied Moscow merchants are strikingly portrayed in Gi-ozd ("The Tempest") and Svoyi lyudi sochtyomsya ("Between near relatives no accounts are needed "), which was originally called " The Bankrupt." The last-mentioned comedy was prohibited for ten years, until the accession of Alexander II., and Ostrofsky was dismissed the

Government service and placed under the supervision of the police. The Liberal tendencies of the new reign, however, soon brought relief, and with a view to the great reforms of the 'sixties, then under consideration, Ostrofsky was one of several well- known literary men who were sent into the provinces to report on the condition of the people. Ostrofsky's field of inquiry lay along the upper Volga, a part of the country memorable for some of the most important events in Russian history. This mission induced him to write several historical dramas of great merit, such as Kuzma Zakharich Minin Soukhorouk (the full name of the famous butcher who saved Moscow from the Poles) ; " The Palse Demetrius " and " Vassily Shuisky " ; Vassilisa Melentieva (the name of a favourite Court lady of Ivan the Terrible), and the comedy, Voivoda eeli Son na Volge (" The Military Commander," or "A Dream on the Volga"). Many of his later works treat of the Russian nobility, and include Byeshani Dengi (literally "Mad Money"), Vos- peetinitsa ("A Girl brought up in a Stranger's Pamily"), and Volki e Ovtsi (" Wolves and Sheep ") ; others relate to the world of actors, such as Liess ("Forest"), Bez vini vinovatiya (" Guiltlessly guilty "), and Talenti e Poklomki (" Talents and their Admirers "). Ostrofsky enjoyed the patronage of Alexander III., and received a pension of 3000 roubles a year. With the help of Moscow capitalists he established in that city a model theatre and school of dramaticart, of which he became the first director. He also founded the Society of Russian Dramatic Art and Opera Composers. His death took place on 24th June 1886, while travelling to his estate in Kostroma. (g. d.)

Ostrog, a district town of Russia, government of Volhynia, 90 miles west of Zhitomir and near the Zdol- bunovo railway junction, at the confluence of the Wilia with the Goryn. It has, besides the usual primary schools, gymnasia for boys and for girls, and a brother- hood of Cyril and Methodius, which also maintains schools of its own. The tanning of lighter leather is a widely- spread domestic trade. Population (1897), 14,530.

OSTROGOZHSKâ€” OTTAWA

Ostrogozhsk, a district town of Eussia, govern- ment and 86 miles by rail south, of Voronezh (vid Liski), on the Tikhaya Sosna. It was founded by Little Eussians in 1652. It is a centre for wholesale trade in horses, cattle, and tallow, and has several tanneries. Population (1897), 21,891.

Ostrow (Eussian, Ostrov), a town of Eussian Poland, government of iomza, 63 miles north-east of Warsaw, 10 miles north of the railway to St Petersburg. It has agricultural machinery works. Population (1897), 11,264. Another town of the same name is in the government of Siedlce, district of Wtodawa. Population, 4410. A third town of the same name is the Eussian district town Ostrov, in the government of and 33 miles by rail south-south-west of Pskoff, on Velikaya river. It is a centre for trade in flax and linseed. Population, 6252.

Oswego, a city of New York, U.S.A., capital of Oswego county on the southern shore of Lake Ontario, at an altitude of 300 feet. It is regularly laid out on a level site, with broad, mainly unpaved streets, is divided into eight wards, and its water-supply is pumped from the Oswego river, the works being owned by private parties. Oswego is on the Delaware, Lackawanna, and Western, the New York Central and Hudson River, and the New York, Ontario, and Western railways, and these, with boats on the lake, give it a large commerce, principally in coal, grain, and lumber. The ample water-power furnished by the Oswego river has caused a great development in manufactures. In 1900 the city contained 207 manfac- turing establishments, with a total capital of $7,322,907. They employed 3845 hands, and the product was valued at $8,137,950. Chief among these products are those of foundry and machine shops, hosiery and knitted goods, and malt. Population (1890), 21,842 ; (1900), 22,199, of whom 3989 were foreign-born and 67 negroes.

Oswestry, a municipal borough and market town in the Oswestry parliamentary division of Shropshire, England, 18 miles north-west of Shrewsbury, on the Great Western and Cambrian railways. The old town hall has been demolished and new municipal buildings have been

opened. The Cambrian Eailway Company employ some 300 men at their carriage and engine works here. The castle grounds, laid out by public subscription, were opened in 1890. Population (1891), 8496 ; (1900), 9579.

Otago. See New Zealand.

Otaheite. See Tahiti.

Otiey, a market town and railway station in the Otley parliamentary division of Yorkshire, England, 10 miles north of Bradford. A recreation hall was opened in 1895. In 1897 premises for art and science schools were erected. One of the chief industries is the making of printing machines. The neighbouring range of hills, known as the Chevin, abounds in good stone for building purposes, which was used for the foundations of the Houses of Parliament, and is despatched to all parts of England. Population (1891), 7838 ; (1901), 9230.

Ottawa, a river of Canada, and the largest tributary of the >St Lawrence. It rises in northern Quebec, in 75Â° 36′ W. and 47Â° 53′ N., and flows westwards 3.30 miles to Lake Temiscaming; from the outlet of the latter it flows in a south-easterly direction for 250 miles, and then easterly to its confluence with the St Lawrence at the island of Montreal. It drains an area of 56,470 square miles, and is 730 miles long. The principal tributaries from the left bank are the Eouge (120 miles

long). North Nation, Petite Nation, Lievre (216 miles), Gatineau (245 miles), Coulonge, Black, Dumoine, and Keepawa; from the right bank, the South Nation, Mis- sissippi, Madawaska, Petewawa, Mattawa, Montreal, and Blanche. Canals at St Anne, Carillon, and Grenville permit the passage of vessels, drawing 9 feet, up to Ottawa city ; thence the Ottawa and Georgian Bay canal is projected, by way of the Ottawa, Mattawa, and French rivers, to Lake Huron. This canal, if constructed, will form the shortest route from Chicago, Duluth, &c., to the searboard.

Ottawa (formerly Bytown), a city of Carleton county, Ontario, and the capital of the Dominion of Canada, situated on the right bank of the river of the same name, 101 miles west of Montreal. The main tower of the parliament buildings is in 76Â° 42′ 03″ W. and 46Â° 25′ 28″ N. The city stands on ground elevated from 60 to 165 feet above the river â€” 185 to 280 feet above the sea â€” and is underlain by rocks of the Trenton and Utica groups, the former outcropping in precipitous bluffs on the river front. It is on the main line of the Canadian Pacific railway and is the terminus of the Canada At- lantic, Ottawa and Parry Sound, Ottawa and New York, and Ottawa and Gatineau railways, and of the Montreal and Ottawa, Prescott and Brockville branches of the first-named railway. Electric railways afford rapid and easy communication with all parts of the city and with the neighbouring towns of Aylmer and Britannia, and during the summer months steamers ply to Montreal and ports on the Ottawa river and Eideau canal. A railway bridge and a road bridge â€” ^the latter a new structure re- placing the famous Chaudiere suspension bridge â€” connect Ottawa with the city of Hull on the opposite or Quebec bank of the river, and a third for railway and vehicular traffic gives the Pontiac Pacific Junction and Ottawa and Gatineau railways access to the centre of the city. Ottawa is the seat of the Dominion Government, the supreme and exchequer courts, and residence of the Governor-General. The parliament and departmental buildings are beautifully situated on Parliament Hill, a park of about 26 acres in extent, elevated 160 feet above the river and with pre- cipitous limestone bluffs facing the river and canal. The parliament and eastern and western departmental buildings are in Italian Gothic of the 13th century, and form three sides of a great quadrangle, the fourth side being occupied by the Langevin departmental building. The latter, a fine massive structure, built of brown sandstone from New Brunswick, stands just outside the parliament grounds proper and on the opposite side of Wellington Street. The University of Ottawa â€” the Roman Catholic univer- sity of Ontario â€” occupies an advantageous situation on Wilbrod Street. It grants degrees in arts and sciences, and has about 475 students, drawn from all parts of (Janada and the United States. Other prominent buildings are the post office, city hall, normal school, collegiate institute, printing Ijureau, court-house, Christ Church

Cathedral, and the Basilica. The city charities are numerous, and include eight hospitals (three general hospitals and five others), nine homes for children and the aged and infirm, and two training schools for nurses. There are eighteen public schools, with 109 teachers and 6146 pupils, including kindergartens ; twenty-four Roman Catholic separate schools, with 96 teachers and 4140 pupils ; also a collegiate institute, the normal school for eastern Ontario, model school, ladies' college, six convents, and two monasteries. Ottawa contains many flourishing industries, including large saw, flour, and planing mills, foundries and manufactories of calcium carbide, street cars,waggons, and porcelain and carbon for electrical purposes. It is the seat of the head office of the Bank of Ottawa, and

0 T T A W A â€" 0 U S E L E Y

contains eleven branches of other banks. Incorporated as a city in 1854, the population in 1881 numbered 27,412; in 1887 New Edinburgh was annexed, and in 1889 three other suburbs, Stewarton, Rochesterville and Mount Sherwood, were brought in. In 1891 the population had increased to 44,154, and in 1901 to 69,928. The total assessment in 1885, exclusive of corporation and Govern- ment property, was $11,545,735; in 1895, $21,247,220; and in 1902, $27,420,740; exemptions in 1902, $16,337,150 ; assessed value of real estate, $24,738,690. The value of the exports for the year ending 30th June 1901 was $464,587; imports, $3,356,791; customs duty, $592,445. The city returns two members to the Dominion House of Commons, and two to the provincial legislature. A mayor and twenty-four aldermen â€” the latter representing the eight wards into which the city is divided â€” constitute the municipal government. It is the seat of a Eoman Catholic archbishop and an Anglican bishop. (j. wh*.)

Ottawa, a city of Illinois, U.S.A., capital of Lasalle county, on the Illinois river, at the mouth of the Pox, on the Illinois and Michigan canal, and on the Chicago, Burlington, and Quincy, and the Chicago, Kock Island, and Pacific railways, north of the centre of the state, at an altitude of 484 feet. The city is on a level site on the first terrace above the river, and its plan is regular. Its water-supply is derived from artesian wells, and it has a good sewer system. In 1900 it contained 120 manu- facturing establishments having a capital of $2,783,357, 1233 wage-earners, and a product valued at $2,042,148. Population (1890), 9985; (1900), 10,688, of whom 1804 were foreign-born.

Ottawa, a city of Kansas, U.S.A., capital of Eranklin county, on the Osage river, which here is not navigable, and on the Atchison, Topeka, and Santa Fe and the Missouri Pacific railways, in the eastern part of the state, at an altitude of 891 feet. The site of the ‘ city is level and .its plan regular. Its manufacturing establishments consist in part of railway works, flour mills, and beet-sugar factories. Population (1880), 4032 ; (1890), 6248; (1900), 6934, of whom 333 were foreign- born and 650 negroes.

Ottensen, formerly a town of Prussia, province of Schleswig-Holstein. It has since 1889 been united with Altona.

Ottumwa, a city of Iowa, U.S.A., capital of Wapello county, on the Des Moines river, in the south- eastern part of the state, at an altitude of 649 feet. The city spreads back from the river over a succession of terraces, rising one above another, and is well laid out, with good water-supply and sewerage systems and a steam heating plant. It is on the Chicago, Burlington, and Quincy, the Chicago, Fort Madison, and Des Moines, the Chicago, Milwaukee, and St Paul, the Chicago, Rock Island, and Pacific, and the Wabash railways, which give it a large trade. This is mainly in coal, since the city is in the midst of the great I^wa coal-field. In 1900 it had 160 manufacturing es- tablishments with $3,403,321 capital, 2095 wage-earners, and products valued at $9,129,862. Population (1890), 14,001 ; (1900), 18,197, of whom 1759 were foreign-born and 698 negroes.

Oudh, or AwADH (Ajodhija), a historic tract in northern India, and still a separate administration not completely amalgamated with the Korth- Western Pro- vinces. Area, 23,965 square miles; population (1891), 12,650,831; (1901), 12,884,150, showing an increase of 2 per cent. The capital is Lucknow. Oudh is a "non-

regulation " province, with an independent judicial system ; and the existence of the taluMars will always preserve an interesting distinction.

The statistics of Oudh are for the most part included under the North-Western Provinces (_q.v.). Between 1881 and 1891 the population increased by 11 per cent., or more than twice as fast as in the North-West, owing to the extension of cultivation in the submontane tract. Excluding the two cities of Lnoknow and Fyzabad, the average density ranged from 305 persons per square mile in the northern district of Kheri to 649 persons in the central district of Bara Banki. Classified according to religion, Hindus numbered 11,016,209, or 87 per cent, of the total popular tion ; Mahommedans, 1,620,930, or nearly 13 per cent. ; Christians, 9312, of whom 5493 were Europeans and 1545 Eurasians, leaving 2274 for native converts ; " others " (chiefly Sikhs

and Jains), 4380. Out of a total area of 15,337,846 acres, the amount permanently settled with talukdars on privileged terms is 1,112,921, chiefly in the two districts of Gonda and Bahraioh. The incidence of assessment is E.l : 1 : 9 oh the temporarily settled and Es.O : 14 : 7 on the permanently settled land. In 1896-97 the total culti- vated area was 8,072,586 acres, of which 2,398,200 acres were cropped more than once. The irrigated area was 2,266,346 acres, entirely from wells and tanks, for there are no Government canals in Oudh. The principal crops are rice, wheat, barley, pulse, millet, sugar-cane, and opium. The area under indigo was 22,877 acres. Oudh has no manufactures or mines. The only large factory is one for making paper at Lucknow. The chief railway system is that of the Oudh and Eohilkhand, which crosses the Ganges opposite Cawnpore and Benares, and is now connected with northern Bengal.

Ougr6e, a town of Belgium, in the province and four miles south-west of the town of Liege by rail. It has five blast-furnaces and large industrial establishments, and is situated in the Lifege coalfield district. Population

(1880), 797.8 ; (1890), 10,241 ; (1900), 13,020.

Ouseley, Sir Frederick Arthur Core (1825- 1889), English composer, was the son of Sir Gore Ouseley, ambassador to Persia, and nephew to Sir William Ouseley, the eminent Oriental scholar. He was born 12th August 1826 in London, and very soon manifested an extra- ordinary precocity in music, composing an opera at the age of eight years. In 1844, having succeeded to the baronetcy, he entered at Christ Church, and graduated B.A. in 1846 and M.A. in 1849. He was ordained in the latter year, and, as curate of St Paul's, Knightsbridge, served the parish of St Barnabas, Pimlieo, until 1851. In 1850 he took the degree of Mus.B. at Oxford, and four years afterwards that of Mus.D., his exercise being the oratorio St Polycarp. In 1865 he succeeded Sir Henry Bishop as professor of music in the University of Oxford, was ordained priest, and appointed precentor of Hereford. In 1856 he became vicar of St Michael's, Tenbury, and warden of St Michael's College, which under him became an important educational institution both in music

and general subjects. His works include a second oratorio, Hagar (Hereford, 1873), a great number 9f services and anthems, chamber music, songs, &c., and theoretical works of great importance, such as Harmony (1868) and Counter- point (1869), and Musical Form (1876). One of his most useful works is a series of chapters on English music , added to the translation of Emil Naumann's History of Music, the subject having been practically ignored in the German treatise. A profoundly learned musician, and a man of great general culture, Ouseley's influence on younger men was wholly for good, and he helped forward the cause of musical progress in England perhaps more effectually than if he himself had been among the more enthusiastic supporters of " advanced " music. The work by which he is best known, St Polycarp, shows, like most compositions of its date, the strong influence of Mendelssohn, at least in its plan and scope ; but if Ouseley had little individuality of expression, his models in other works were the English church writers of the noblest school. He died at Here- ford, 6th April 1889. (j. A. f. m.)

OVA Râ€" 0 V I E D 0

Ovar, a town of Portugal, district Aveiro, situated at the north extremity of the lagoon (ria) of Aveiro, and 21 miles south of Oporto. Millet, wheat, and vegetables (especially onions) are the chief products. The people are principally engaged in the fisheries. Population, about 12,000.

Overbury, Sir Thomas (1581-1613), English poet and essayist, and the victim of one of the most sensar tional crimes in English history, was the son of Nicholas Overbury, of Bourton-on-the-Hill, and was born in 1581 at Compton Scorfen, near Wilmington, in Warwickshire. In the autumn of 1595 he became a gentleman commoner of Queen's College, Oxford, took his degree of B.A. in 1598, and came to London to study law in the Middle Temple. He found favour with Sir Robert Cecil, travelled on the Continent, and began to enjoy a reputation for an accomplished mind and free manners. About the year 1601, being in Edinburgh on a holiday, he met Eobert Carr, then an obscure page to

the earl of Dunbar; and so great a friendship was struck up between the two youths that they came up to London together. The early history of Carr remains obscure, and it is probable that Overbury secured an introduction to Court before his young associate contrived to do so. At all events, when Carr attracted the attention of James I., in 1606, by breaking his leg in the tilt-yard, Overbury had for some time been servitor-in-ordinary to the king. He was knighted in June 1608, and in 1609 he travelled in Eranee and the Low Countries. He seems to have followed the fortunes of Carr very closely, and "such was the warmth of the friendship, that they were in- separable, . . . nor could Overbury enjoy any felicity but in the company of him he loved [Carr]." When the latter was made Lord Rochester, in 1610, the intimacy seems to have been sustained. But it was now destroyed by a new element. Early in 1611 the Court became aware of the mutual attraction between Rochester and the infamous and youthful countess of Essex, who seemed to have bewitched the handsome Scots adven- turer. To this intrigue Overbury was from the first violently opposed, pointing out to Rochester that an indulgence in it would be hurtful to his preferment, and that the woman, even at this early stage in her career, was already " noted for her injury and immodesty." He went so far as to use, in describing her, a word which was not more just than scandalous. But Rochester was now infatuated, and he repeated to the countess what Overbury had said. It was at this time, too, that Overbury wrote, and circulated widely in MS., the poem called "His Wife," which was a picture of the virtues which a young man should demand in a woman before he has the rashness to marry her. It was represented to Lady Essex that Overbury's object in writing this poem was to open the eyes of Rochester to her defects. The situation now resolved itself into a deadly duel for the person of Rochester between the mistress and the friend. The countess contrived to lead Overbury into such a trap as to make him seem disrespectful to the king, and she suc- ceeded so completely that he was thrown into the Tower on the 22nd of April 1613. It was not known at the time, and it is not certain now, how far Rochester partici- pated in this first crime, or whether he was ignorant of it. But the Queen, by a foolish phrase, had sown discord between the friends; she had called Overbury Rochester's " governor." It is, indeed, apparent that Overbury had become arrogant with success, and was no

longer a favour- ite at Court. Lady Essex, however, was not satisfied with having had him shut up ; she was determined that "he should return no more to this stage." She had Sir William Wade, the honest Governor of the Tower,

removed to make way for a creature of her own. Sir Gervaise Elvis (or Helwys) ; and a gaoler, of whom it was ominously said that he was "a man well acquainted with the power of drugs," was set to attend on Overbury. This fellow, afterwards aided- by Mrs Turner, the widow of a physician, and by an apothecary called Franklin, plied the miserable poet with sulphuric acid in the form of copper vitriol. But his constitution long withstood the timid doses they gave him, and he lingered in ex- quisite sufferings until the 15th of September 1613, when more violent measures put an end to his existence. Two months later Rochester, now' earl of Somerset, married the chief murderess, Lady Essex. More than a year passed before suspicion was roused, and when it was, the king showed a hateful disinclination to bring the offend- ers to justice. In the celebrated trial which followed, however, the wicked plot was all discovered. The four accomplices were hanged; the countess of Somerset pleaded guilty but was spared, and Somerset himself was disgraced. Meanwhile, Overbury's poem, TJie Wife, was published in 1614, and ran through six editions within a year, the scandal connected with the murder of the author greatly aiding its success. It was abundantly reprinted within the next sixty years, and it continued to be one of the most widely popular books of the 17th cen- tury. Combined with later editions of The Wife, and gradually adding to its bulk, were "Characters" (first printed in the second of the 1614 editions), "The Remedy of Love "(1620), and "Observations in Foreign Travels" (1626). Later, much that must be spurious was added to the gathering snow-ball of Overbury's Works. Posterity has found the praise of his contemporaries for the sen- tentious and graceful moral verse of Overbury extrava^ gantly expressed. The Wife is smooth and elegant, but uninspired. There is no question that the horrible death of the writer, and the extraordinary way in which his murderers were brought to justice, gave an extraneous charm to his writings. Nor can we be quite sure that Overbury was in fact such a " glorious constellation " of all the religious virtues as the 17th century believed.

He certainly kept very bad company, and positive evidence of his goodness is wanting. But no one was ever more transcendently canonized by becoming the victim of conspirators whose crimes were equally detestable and unpopular. (e. g.)

Overyssel, a Dutch province east of the Yssel, bordering on the Zuider Zee. Five basins are to be distinguished : (1) the Almelo, which communicates with (2) the Regge. These two are divided by a range of hills to the west of them from the basins of (3) the Salland, which discharges its waters into (4) the Vecht, which again has its outfall in (5) the Zwarte Water, which com- municates by the Zwollsche Diep with the Zuider Zee and by the Willemsvaart with the Yssel. Meppeler Diep from Drenthe and Dedemsvaart from the north-east of Overyssel both discharge into the Zwarte Water. IMost of the uncultivated land lies in the east of the province, the cultivated land in the west and on the banks of the small rivers. About 18 per cent, of the surface consists of ploughland, 32 per cent, of natural pastures and grass- lands, and fully 30 per cent, of uncultivated land. Popu- lation (1879), 247,136 ; (1900), 338,408.

Oviedo, a maritime province of northern Spain. It has an area of 4091 miles, and is divided into 16 administra- tive districts and 79 parishes. Population, 595,420 in 1S87, and 612,663 in 1897. The birth-rate is 2-85 per cent., the death-rate 2-49 percent., and the proportion of illegitimate births 4-01 per cent, of the total births. That section of the Cantabrian mountains which forms its southern border includes about a dozen peaks ranging from 3800 to 8000

feet. There are picturesque lakes among the mountains, and the principal rivers that descend to the coast are the Nalon, Narcea, Navia, Pilona, Sella, and Eo, which wind through well-wooded and frequently fertile, well-cultivated vales. The climate is generally mild and temperate, with abundant rains, though bitterly cold during some months in the higher mountains. The means of communication have

been much improved. A railway has been con- structed through some of the most difficult parts of the Cantabrian chain, the construction of the line affording remarkable evidence of engineering skill. A branch runs from Oviedo to Trubia, where the Government arms factory and foundries occupy more than a thousand hands. There are also several other railways, including numerou.s narrow-gauge lines built by mining companies and metallurgic establishments. Oviedo is rich in forests, coal mines, streams and waterfalls that have materially contributed to the development of its manufacturing and metallurgical industries, especially the latter, there being an abundant supply of ores in the province. There are flourishing copper works in Aviles ; manufactures of fine textiles, coarse cloth, and ribbons in Salas, Pilona, Casas, and Aviles ; of paper in Pianton ; of porcelain anxi glass in Grijon, Aviles, and Pola de Surro; of arms in Oviedo and Trubia ; while foundries and works for the manu- facture of agricultural implements, rails, and pig-iron are numerous. One company uses annually 35,000 tons of coal, 25,000 tons of coke, 33,000 tons of iron ore, and employs 2300 hands to turn out over 30,000 tons of iron ; another consumes 100,000 tons of coal, 46,000 tons of ore, and turns out nearly 50,000 tons of iron, mostly for consumption in Spain. The fisheries and the salting of tunny and sardines are important, and much butter and cheese is made in the province for the interior of Spain. The principal exports are fruit, preserved meats and fruit, cheese, butter, fish, wheat, flour, cider, oil, soap, coal, glass, and iron.

Agriculture is not very important in Oviedo. In 1897 wheat was grown on 18,855 acres ; rye, oats, barley, maize, on 6662 acres ; pod-fruit on 14,712 acres ; and vines on 57,370 acres. The live stock included 8494 horses, 2018 mules, 3619 asses, 363,977 cattle, 116,402 sheep, 31,122 goats, and 134,955 pigs. It is the mines that furnish the real wealth. There are 19 quicksilver, 3 zinc, 3 copper, 55 iron, 453 coal, and 2 manganese mines actually worked, giving employment in 1899 to 12,050 hands, of whom 11,279 worked in the coal mines alone. The output was 10,907 tons of quicksilver ore, 360 of zinc, 886 of copper, 63,965 of iron, 1,397,152 of coal, and 340 of manganese. The mining industries further employed 4874 hands, of whom 3853 were engaged in the ironworks. The output for 1898 was 92 tons of quicksilver, 6031

tons of zinc in bars or sheet, 14,925 tons of steel, 2900 of wire, 38,216 of iron in different shapes, 138,643 tons of coke, 120,176 tons of coal agglomerate. (a. e. h.)

Oviedo, the capital of the above province, on the river ISTalon, 16 miles from the coast, in a broad and picturesque valley. Its population was 42,716 in 1887 and 46,376 in 1897. The town has grown chiefly in the suburb near the station and in the modern suburb of Uria, near the great hospital and fine promenade close to the convent of San Prancisco. Few towns in Spain have better schools for primary and higher education, and there are an institute, a meteorological observatory, schools for teachers and fine arts, adult classes for the working classes, an archaeological museum, several public libraries, and a university (with a fine library). The markets are the centre of a thriving trade in agricultural products, and the principal industries are manufactures of arms, tex- tiles of cotton and wool, iron goods, marble, leather, and matches.

Owatonna, a city of Minnesota, U.S.A., capital of Steele county, in the south-eastern part of the state, at the intersection of lines of the Chicago and North- West-

ern, the Chicago, Milwaukee, and St Paul, and the Bur- lington, Cedar Rapids, and Northern railways, in a rich farming country. Population (1890), 3849 ; (1900), 6561, of whom 1160 were foreign-born.

Owego, a village of New York, U.S.A., capital of Tioga county, on the north branch of the Susquehanna river, at the mouth of Owego creek, in the southern part of the state, at an altitude of 822 feet. It is on three railways, the Erie, the Delaware, Lackawanna, and West- ern, and the Lehigh Valley. It is in a rich agricultural region, and has manufactures of flour, lumber, and woollen goods. Population (1890), 5141; (1900), 5039, of whom 301 were foreign-born and 214 negroes.

Owen, Sir Richard (1804-1892), English biolo- gist, was born at Lancaster on 20th July 1804, and re- ceived his early education at the grammar school of that town. In 1820 he was apprenticed to a local surgeon and apothecary, and in 1824 he proceeded as a medical student

to the University of Edinburgh. He left the university in the following year, and completed his medical course in St Bartholomew's Hospital, London, where he came under the influence of the eminent surgeon, John Abernethy. He then contemplated the usual professional career ; but his bent was evidently in the direction of anatomical research, and he was induced by Abernethy to accept the position of assistant to William Clift, conservator of the museum of the Boyal College of Surgeons. This con- genial occupation soon led him to abandon his intention of medical practice, and his life henceforth was devoted to purely scientific labours. He prepared an important series of catalogues of the Hunterian collection in the Eoyal College of Surgeons ; and in the course of this work he acquired the unrivalled knowledge of comparative anatomy which enabled him to enrich all departments of the science, and specially facilitated his researches on the remains of extinct animals. In 1837 he was appointed Hunterian professor in the Royal College of Surgeons, and in 1849 he succeeded Clift as conservator. He held the latter office until 1866, when he became superintendent of the natural history department of the British Museum. He then devoted much of his energies to a great scheme for a National Museum of Natural History, which eventually resulted in the removal of the natural history collections of the British Museum to a new building at South Kensing- ton, the British Museum (Natural History). He retained office until the completion of this work in 1884, when he received the distinction of K.C.B. Sir Richard Owen lived quietly in retirement at Sheen Lodge, Richmond Park, until his death on 18th December 1892.

While occupied with the cataloguing of the Hunterian collection, Owen did not confine his attention to the pre- parations before him, but also seized every opportunity of dissecting fresh subjects. He was especially favoured with the privilege of investigating the animals which died in the Zoological Society's gardens ; and when that society began to publish scientific proceedings in 1831, he was the most voluminous contributor of anatomical papers. His first notable publication, however, was his Memoir on the Pearly Nautilus (London, 1832), which was soon recog- nized as a classic. Henceforth he continued to make im- portant contributions to every department of comparative anatomy

and zoology for a period of over fifty years. In the sponges Owen was the first to describe the now well- known" Venus's flower basket " or Euplectella (1841, 1867). Among Entozoa his most noteworthy discovery was that of Trichina spiralis (1836), the parasite infesting the muscles of man in the disease now termed trichinosis (see also Paget, Sir James). Of Brachiopoda he made very special studies, which much advanced knowledge and

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settled the classification which has long been adopted. Among Mollusca, he not only described the pearly nautilus, but also Spvfula (1850) and other Cephalopoda, both living and extinct; and it was he who proposed the universally-accepted subdivision of this class into the two orders of Dibranchiata and Tetrabranchiata (1832). The problematical crustacean Limulus was also the subject of a special memoir by him in 1873.

Owen's technical descriptions of the Vertebrata were still more numerous and extensive than those of the invertebrate animals. His Comparative Anatomy and Physiology of Vertebrates (3 vols., London, 1866-68) was indeed the result of more personal research than any similar work since Cuvier's Legons d'Anatomie Comparee. He not only studied existing forms, but also devoted great attention to the remains of extinct groups, and immediately followed Cuvier as a pioneer in vertebrate palseontology. Early in his career he made ex- haustive studies of teeth, both of existing and extinct animals, and published his profusely il- lustrated work on Odontography (1840-45) .(He discovered and described the remarkably com- plex structure of the teeth of the extinct animals which he named Labyrinthodonts. Among his writings on fishes, his memoir on the African mud-fish, which he named Pro- topterus, laid the foundations for the recognition of the Dipnoi by MilUer. He also pointed out later the serial con- nexion between the teleostean and ganoid fishes, grouping them in one sub-

class, the Teleostomi. Most of his work on reptiles related to the skeletons of extinct forms, and his chief memoirs on British speci- mens were reprinted in a con- nected series in his History of British Fossil Reptiles (4 vols., London, 1849-84). He pub- lished the first important gen- eral account of the great group of Mesozoic land -reptiles, to which he gave the now familiar name of Dinosauria. He also first recognized the curious early Mesozoic land-reptiles, with affinities both to amphibians and mammals, which he termed Anomo- dontia. Most of these were obtained from South Africa, beginning in 1845 {Dicynodon), and eventually furnished materials for his Catalogue of the Fossil Reptilia of South Africa, issued by the British Museum in 1876. Among his writings on birds, his classical memoir on the Apteryx (1840-46), a long series of papers on the ex- tinct Dinornithidse of New Zealand, other memoirs on Aptornis, Notornis, the dodo, and the great auk, may be specially mentioned. His monograph on Ardwopteryx (1863), the long-tailed, toothed bird from the Bavarian Lithographic Stone, is also an epoch-making work. With regard to living mammals, the more striking of Owen's contributions relate to the monotremes, marsupials, and the anthropoid apes. He was also the first to recognize and name the two natural groups of typical tJngulata, the odd-toed (Perissodactyla) and the even-toed (Artio- dactyla), while describing some fossil remains in 1848. Most of his writings on mammals, however, deal with extinct forms, to which his attention seems to have

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{From a photograph 'by Elliott and. Fry, London.)

been first directed by the remarkable fossils collected by Darwin in South America. Toxodon, from the pampas, was then described, and gave the earliest clear evidence of an extinct generalized hoofed animal, a "pachyderm with affinities to the Eodentia, Edentata^ and Herbivorous Cetacea." Owen's interest in South American extinct mammals then led to the recognition of the giant armadillo, which he named Glyptodon (1839), and to classic memoirs on the giant ground-sloths, Mylo- don (1842) and Megatherium (1860), besides other im- portant contributions. At the same time Sir Thomas Mitchell's

discovery of fossil bones in ISTew South Wales provided material for the first of Owen's long series of papers on the extinct mammals of Australia, which were eventually reprinted in book-form in 1877. He discovered Diprotodon and Thylacoleo, besides extinct kangaroos and wombats of gigantic size. While occupied with so much

material from abroad, Owen was also busily colleeting facts for an exhaustive work on similar fossils from the British Isles, and in 1844^6 he pub- lished his History of British Fossil Mammals and Birds^ which was followed by many later memoirs, notably his Monograph of the Fossil Mam- malia of the Mesozoic Forma- tions (Palseont. Soc, 1871). One of his latest publications was a little work entitled Antiquity of Man as deduced from the Discovery of a Human Skeleton during Excavations of the Docks at Tilbury (London,

1884).

Owen's detailed memoirs and descriptions require laborious attention in reading, on account of their nomenclature and am- biguous modes of expression ; and the circumstance that very little of his terminology has found universal favour causes them to be more generally neglected than they otherwise would be. At the same time it must be remembered that he

was a pioneer m concise ana- tomical nomenclature ; and, so far at least as the verte- brate skeleton is concerned, his terms were based on a carefully reasoned philosophical scheme, which first clearly distinguished between the now familiar phe- nomena of "analogy" and "homology." Owen's theory of the Archetype and Homologies of the Vertebrate Skele- ton (1848), subsequently illustrated also by his little work On the Nature of Limbs (1849), regarded the vertebrate frame as consisting of a series of funda- mentally identical segments, each modified according to its position and functions. INIuch of it was fanci- ful, and failed when tested by the facts of embryology, which Owen systematically ignored throughout his work. However, though an imperfect and distorted view of certain great truths, it possessed a distinct value at the time of its conception. To the discussion of the deeper problems of biological philosophy he made scarcely any direct

and definite contributions. His generalities rarely extended beyond strict comparative anatomy, the phenomena of adaptation to function, and the facts of geographical or geological distribution. His lecture on “virgin reproduction” or Parthenogenesis, however,

published in 1849, contained the essence of the theory of the germ-plasm elaborated several years afterwards by Weismann ; and he made several vague statements con- cerning the geological succession of genera and species of animals and their possible derivation one from another. He referred especially to the changes exhibited by the successive forerunners of the crocodiles (1884) and horses (1868) ; but it has never become clear how much of the modern doctrines of organic evolution he admitted. He contented himself with the bare remark that ” the induc- tive demonstration of the nature and mode of operation” of the laws governing life would ” henceforth be the great aim of the philosophical naturalist.”

See The Life of Bichard Owen. By his grandson, Rev. Riohaed Owen. 2 vols. London, 1894. (a. s. Wo.)

Owensboro, a city of Kentucky, U.S.A., capital of Daviess county, on the south bank of the Ohio river in the north-western part of the state, at an altitude of 386 feet. It has three railways, the Illinois Central, the Louisville, Henderson, and St Louis, and the Louisville and Nashville, and through these and boats on the river it has a large trade. It is in the Indiana-Kentucky coal field, and some coal is mined in its vicinity. Its industries consist largely in the manufacture of tobacco and distilling of whisky. Population (1890), 9837; (1900), 13,189, of whom 308 were foreign-born and 3061 negroes.

Owen Sound, a town and port of entry in Ontario, Canada, and capital of Grey county, situated 99 miles north-west of Toronto, on Georgian Bay. It is the ter- minus of branches of the Canadian Pacific and Grand Trunk railways, and of the Canadian Pacific and other steamship lines

plying to ports on Lakes Huron and Superior. Its harbour is one of the best on Lake Huron, and navigable by lake vessels of the largest size. It contains manufactories of mill machinery, agricultural implements, furniture, and sewing-machines, flour-mills, saw-mills, and large grain elevators. Population (1881),

4426 ; (1891), 7497 ; (1901), 8776.

Owosso, a city of Shiawassee county, Michigan, U.S.A., on the Shiawassee river, and on the Ann Arbor, the Grand Trunk, and the Michigan Central rail- ways, east of the centre of the Lower Peninsula, at an altitude of 744 feet. It has a regular plan, is divided into five wards, and has a good water-supply. The river furnishes power for its manufactures, which consist in large part of lumber and furniture. Population (1880), 2601 ; (1890), 6564 ; (1900), 8696, of whom 1396 were foreign-born.

Oxford, a midland county of England, bounded on the S. by the Thames, on the W. by Gloucester, on the N. by Warwick, on the N.E. by Northampton, and on the E. by Buckingham.

Area and Population. â€” The area of the ancient county is 488,614 acres, or 756 square miles, with a population in 1881 of 179,551 and in 1891 of 185,669, of whom 89,649 were males and 96,020 females ; and in 1901, 182,768, the number of persons per square mile being 242, and of acres to a person 2-6. The area of the administrative county as given in the census returns was 480,608 acres, with a population in 1891 of 145,449, or including the county borough of Oxford, 485,322 acres, with a population in 1891 of 191,193; but certain changes in the administrative area have since taken place. In 1895 there were transferred to Buckingham the part of the parish of Ibstone in Oxford and the parish of Stoken- churoh ; and in the same year there were transferred to Oxford the parish of Kingsey in Buckingham, and the parish of Mollington in Warwick. The area of the registration county is 490,146 acres, with a population in 1891 of 188,220, of whom 83,862 were urban and 104,358 rural ; and in 1901, 186,767, of whom 88,558 were males and 98,209 females. Within the registration area the per-centage of increase between 1881 and 1891 was 3-49, but between

1891 and 1901 there was a decrease of -7 per cent. Between 1881 and 1891 the excess of births over deaths was 23,710, and the actual increase of population was 6353. The following table gives the numbers of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 :â€”

Tear.

Marriages.

Births.

Deaths.

Illegitimate Births.

Males.

Females,

1880 1890 1898

1063 1184 1287

5725 5182 4635

3266 3203 2710

145 111

126

146 113 131

The number of marriages in 1899 was 1815, of births 4543, and of deaths 2899. The following table shows the marriage-, birth-, and death-rate, with the percentage of illegitimate births, for a series of years : â€”

18tO-T9.

1880.

1880-89.

1890.

I888-9T.

1&9S.

Marriage-rate

13-4

11-1

12-6

12-6

12-8

13-4

Birth-rate

31-7

31-5

.30-0

27-6

27-0

24-1

Death-rate .

19-3

18-0

16-9

17 a

10 -1

14-1

Percentage of ille-

-gitimacy .

6-0

5-1

5-4

4-3

5-1

5-4

In 1891 there were in the county 649 natives of Scotland, 584 natives of Ireland, and 359 foreigners.

Constitution and Government. â€” The ancient county is divided into three parliamentary divisions, and it also includes part of the parliamentary borough of Oxford, returning one member, in addition to which the University of Oxford returns two members. The administrative county contains five municipal boroughs â€” â– Banbury (12,967), Chipping Norton (3780), Henley-on-Thames (5984),

Oxford (49,413), and Woodstock (1684). Oxford isacounty borough. The following are urban districts: Bicester (3023), Caversham (6580), Thame (2911), Wheatley (872), and Witney (3574). Oxfordshire is in the Oxford circuit, and assizes are held at Oxford. The boroughs of Banbury, Henley-on-Thames, and Oxford have separate commissions of the peace, and Banbury and Oxford have in addition separate courts of quarter sessions. The ancient county, which is mostly in the diocese of Oxford, contains 234 ecclesiastical parishes or districts, and parts of 10 others.

Education. â€" On account of the famous university in the borough of Oxford and other educational institutions there, the county as regards education holds perhaps the premier position in Eng- land. In connexion with the university there is a day training college for schoolmasters, and there is also in Oxford a residential training college for schoolmistresses (diocesan), which takes day students. The total number of elementary schools in the county on 31st August 1899 was 266, of which 28 were board and 238 voluntary schools, the latter including 219 National Church of England schools, 3 Wesleyan, 6 Roman Catholic, and 10 "British and other." The total school board receipts for the year ended 29th September 1899 were over Â£20,138. The income under the Agricultural Rates Act was over Â£663.

Communications. â€" An Important addition to the railway facilities of the county has been made by a branch line of the Great Central running from Princes Risborough in Bucks to the Great Western at Banbury.

Agriculture. â€" Nearly seven-eighths of the area of the county is under cultivation, and of this area about three-tenths is under com crops and nine-twentieths in permanent pasture. Over 2000 acres are under orchards and about 26,000 under woods. Although with the diminution of the acreage under com crops the acreage under wheat has somewhat diminished, it and barley still occupy each about a third of the corn crop area, while oats occupy about a fourth, and there is also a considerable acreage under beans. More than half the total acreage under green crops is occupied by turnips, and vetches and tares are

also largely grown. The following table gives the larger main divisions of the cultivated area at intervals from 1880 :â€”

Tear.

Total Area under Cultiva- tion.

Corn Crops.

Green Crops.

Clover,

Permanent Pasture.

FaUow.

1880 1885 1890 1895 1900

418,811 417,822 414,960 415,616 411,682

158,404 147,349 136,700 123,419 120,898

54,201 53,524 46,684 45,663 4.3,215

46,297 49,735 48,161 50,201 50,111

146,029 158,593 176,113 187,068 193,716

12,478 8,610 7,192 8,345 3,522

The following table gives particulars regarding the principal live stock for the same years : â€”

Year.

Total Horses.

Total Cattle.

Cows or Heifers

inMUkorin

Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1900

17,276 18,193 17,739 17,798 17,276

51,204 60,124 56,443 53,434 61,851

17,286 20,185 20,353 19,165 20,653

279,159 299,172 266,594 241,742 230,325

31,559 38,536 44,110 44,737 31,032

Manufactures and Minerals. â€” According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 6774, as compared with 6721 in 1896. Of the 4432 persons employed in non-textile factories, 1354 were employed in the manufacture of paper. Work-shops employed 1608 persons, of whom 1048 were employed in clothing industries. Banbury is famed for its cakes ; there is some decline in the glove trade at "Woodstock. In 1899 from quarries under 20 feet deep 166,163 tons of iron ore, valued at about Â£18,000, were raised. The other minerals include clay (30,002 tons) .

Authorities. â€" The Natural History of Oxfordshire. Oxford, 1677 ; 2nd edition, 1705. â€" Shelton. Engraved Illustrations of the Principal

Antiquities of Oxfordshire from drawings by T. Mackenzie. Oxford, 1823. â€” Sir T. Phillips. Oxfordshire Pedigrees. Evesham, 1825.â€” Walker. The Flora of Oxfordshire. Oxford, 1833.â€” Davenport. Lords Lieutenant and High Sheriffs of Oxford, 1086. Oxford, 1868 ; and Oxfordshire Annals. Oxford, 1869. â€” Graves. The Way about Oxfordshire. London, 1896.â€” Murray. Hand- book for Oxfordshire. â€” And the Transactions of the North Oxford Arehaiological Society.

Oxford. â€” Tlie county town of Oxfordshire lies at the junction of the Thames (locally known as the Isis) and the Cherwell, 55 miles from London by road and 63|- by. rail. Population (1881), 35,264; (1891), 45,742; (1901), 49,413. The rateable value is Â£387,609. It is represented in Parliament by one member, having lost its second by the redistribution of 1885, before which date it had been disfranchised entirely for a year owing to the bribery practised at the election of 1881. The number of voters on the register at the election of 1885 was 6983 ; at that of 1892, 7476 ; at that of 1895, 7637; in 1901, 8310. Since 1889 the govern- ment has been in the hands of a city council, appointed under the Local Grovernment Act of 1888, and consisting of 45 councillors (36 from the city and 9 from the University) and 16 aldermen (12 from the city and 3 from the University). In this joint body are vested the powers of the former municipality and of the local board ; to it also has been transferred the share in the control of' the police once exercised by the proctors of the University. At the time of the formation of the city council the out- lying districts of Summertown on the north, Cowley St John on the east, and Grandpont and New Hincksey on the south were incorporated. The growth of the city has been rapid since 1880. Although no new manufactures of importance have been introduced, Oxford has become to a very large extent a " residential " town, owing partly to its proximity to London, but chiefly to the opening up of University society through the abolition of compulsory celibacy by the statutes of the University Commission (1882). The most important new buildings are the theatre (1886), the Corn Exchange (1896), both in George Street, and the municipal buildings, designed by Mr Hare, and opened by the prince of Wales in May 1897. As a result of this development the city has in some respects lost its picturesqueness ; old houses have disappeared everywhere. The

most important piece of destruction has been the removal of Carfax church (1896). The tower, however, remains, and is now used for an illuminated clock (1898). Magdalen ‘bridge was widened in 1885 to accommodate the increased traffic. Electric light was introduced in 1892. The water-supply has been greatly improved by a new pumping station above the King’s Weir (1887), and by new filter beds (1884). A hospital for infectious diseases

has been opened at Cold Harbour (1886), the Oxford Eye Hospital has obtained a permanent home in Walton Street (1894), and the Eadcliffe Infirmary has been considerably enlarged (1894) ; so too has the Acland Nursing Home (1897), which is now in the Banbury Road. Outside cemeteries at EoseHill, at Summertown, and near Botley were opened in 1893. As a result of improved water and drainage the death-rate of Oxford has fallen. In 1885 it was 16-8 ; in 1890, 17 ; in 1896, 16-66 ; in 1901, 13-85.

Magdalen College opened the new buildings (designed by Sir A. Blomfield) for its school in 1894, and technical schools have been started in St Ebbe’s (1894) and St Clement’s. The progress in the numbers of the University has been comparatively slow, as the following table will show : â€”

Matriculations.

B.A.‘s.

HoDours In the Final Schools.

1880

758

483

315

1885

749

622

366

1890

771

584

376

1895

863

608

413

1900

839

558

429

1901

837

594

444

The average of matriculations in the last decade of the 19th century was about 60 above that in the previous decade (829 as against 770),

while the increase in graduB/- tions, especially in honours, has been much larger. In one other department of the University â€” its revenue â€” there has been no appreciable progress ; but in every other respect there has been rapid development. The Bodleian Library steadily increases, and the basement of the Ash- molean has been fitted up to receive books. The collec- tions once housed there have been transferred to a New Ashmolean Museum, in close proximity to the University Galleries in Beaumont Street; these have been twice extended (1888 and 1894). The Science Museum is ever growing. Apart from minor developments, the Physio- logical Laboratory was opened in 1885, and the depart- ment of Human Anatomy in 1893; the new Library (the gift of the Drapers' Company) was begun in 1898, and a Morphological and a Pathological Laboratory was opened in 1901. The block of the New Schools has also been completed by the addition of the Non-Collegiate Delegacy at its north-east corner (1888). In 1887 the Pitt Elvers anthropological collection found a home in a new annex on the north-east side of the Science Museum. The Picture Gallery has received the Combe bequest of the works of Pre-Eaphaelite painters, especially of Holman Hunt ; and the Art Museum has been enormously increased by the gifts of Mr Drury Fortnum (d. 1899). The Indian Institute, too, has been completed (1896). Of a different kind has been the work at St Mary's church, where the spire was rebuilt in 1896, after being sheathed in scaffold- ing for three years. During the last twenty years of the 19th century there was a greater amount of college building than in any, similar period in the history of the University. St Swithun's quad at Magdalen (finished 1884) and the President's house (1888) (the work of Messrs Bodley and Garnier), the new quad (1887) and the President's house (1888) at Trinity (the work of Mr T. G. Jackson, E.A.), and the new quad at Brasenose College, with its front to the High Street (also IMr Jackson's work), are only the most conspicuous amongst many in- stances. The religious life of the University has been enriched by a number of new foundations. The Pusey House (1884) led the way, and its example has been followed by such Nonconformist institutions as Mansfield College (1889) and Manchester New College (1893). All three of these are centres of theological study, but

not residences for undergraduates. Private halls for Jesuit (1896), Benedictine (1900), and Unitarian (1900) students have also now been opened ; the first of these is called Campion Hall. Hannington Hall (1897) has been founded as a centre of missionary interest, on the site of the old New Inn Hall. New Final Schools have been founded in Oriental languages (first held 1887), and in English language and literature (1897). New degrees for the encouragement of research, the B.Lit. and B.Sc. (founded in 1895, and completed in 1900 by the institution of research doctorates), have attracted graduates from the universities of other countries. In 1899 a geographical department was opened, which is jointly supported by the University and by the Eoyal Geographical Society. Of more bearing on practical life are the Day Training College Delegacy (1892) and the diploma in education (1896). Under the former elementary school teachers are en- abled to take their training course at Oxford, and do so in growing numbers ; the latter is under the super- vision of the Locals Delegacy, and is increasingly taken by secondary teachers every year. To the two original foundatioiis for the education of women, Somerville College and Lady Margaret Hall (which have both largely increased their buildings), are now added two more wo- men's hallsâ€" St Hugh's (1886) and St Hilda's (1893). The number of women students is over 200. An attempt to obtain their admission to the degrees of the University (as well as to its examinations) was very decisively defeated in 1896.

There has, too, been a great increase in the work done by Oxford in the world outside. The number of candidates examined by the Delegacy for Local Exami- nations has increased froni 2301 in 1885 to 10,337 in 1901. The University Extension movement has become as important as at Cambridge, where it originated. Started in Oxford in 1877, it had at first little success ; since 1885, however, it has rapidly advanced, and has been under a special Delegacy since 1892. In 1900-01, 177 courses of lectures were given to nearly 18,000 stu- dents (aggregate average attendance). Special features of the Oxford work have been the "

summer meetings ” and the foundation of the Extension College at Reading (1892). The former were begun in August 1888. There were nearly 1200 students from all parts of the world at that (the tenth) of August 1901. Similarly, Oxford has become a great centre for educational conferences of all kinds. The Headmasters’ Conference met there in 1890, the National Unioii of Teachers in 1894, and the British Association in the same year. There have been countless others, great and small, for which the New Examination Schools furnish an admirable meeting- place. But with all its developments the life of the University itself has changed but little. “Town and Gown rows ” have practically disappeared, though there may probably be some of the old feeling under the sur- face. At all events, the privileges of the University in jurisdiction and other departments are still attacked, and a suggested compromise as to them was rejected by the city in 1893.

Authorities. â€” The Oxford Historical Society has eontinued its series of publications. The early history of the University has heen admirably treated by H. Eashdall, Universities of Europe in Middle Ages, 3 vols. Oxford, 1895 (Oxford is dealt with in the third volume). The various colleges are described by members of their foundations in the College History Series, published by Robinson. (j. we*.)

Oxus. â€” Prior to the meeting of the commissions appointed for the determination of the Eusso-Afghan boundary in 1885, no very accurate geographical know- ledge of the Upper Oxus regions existed, and the course

of the river itself was but roughly mapped. Eussian explorers and natives of India trained for geographical reconnaissance, and employed in connexion with the great trigonometrical survey of India, had done so much towards clearing away the mists which enveloped the actual bounds of the river, that all the primary affluents were known, although their relative value was misunderstood, but the nature of the districts which bordered the river in Afghan Turkestan was so imperfectly mapped as to give rise to considerable political complication in framing the boundary agreement between Great Britain and Eussia. Erom Lake Victoria, in the Pamirs, which was

origin- ally reckoned as the true source of the river, to Khamiab, on the edge of the Andkhui district of Afghan Turkestan, for a distance of about 680 miles, the Oxus forms the boundary between Afghanistan and Eussia. For another 550 miles below Khamiab it follows an open and sluggish course till it is lost in the Sea of Aral, being spanned at Charjui, 150 miles below Khamiab, by the wooden bridge which carries the Eussian railway from Merv to Samar- kand. The level of Lake Victoria is 13,400 feet above sea. At Khamiab the river is probably rather less than 500 feet.

Sources. â€” For many years a lively geographical con- troversy circled about the sources, and the discussion derived some political significance from the fact that the true source, wherever it might be found, was claimed as a point in the Eusso-Afghan boundary. The final survey of the Pamir region (the Bam-i-dunya, or ” the Eoof of the World “), wherein the heads of all the chief tributaries of the river lay hidden, by the Pamir Boundary Commission of 1895 established the following topographical facts in connexion with this question. The elevated mountain chain which is now called the Nicolas range, which divides the Great from the Little Pamir, is a region of vast glaciers and snow-fields, from which the lakes lying imme- diately north and south derive the greater part of their water-supply. On the north the principal glacial tribu- tary of Lake Victoria forms, within the folds of the gigantic spurs of the Nicolas mountains, a series of smaller lakes, or lakelets, before joining the great lake itself. On the south a similar stream starting farther east, called Burgutai, denoting the position of a difficult and dangerous pass across the range, sweeps downwards towards Lake Chakmaktin, the lake of the Little Pamir, which is some 400 feet lower than Victoria. But at the foot of the mountain this stream bifurcates in the swamps which lie to the west of Chakmaktin, and part of its waters find their way eastwards into the lake, and part flow away westwards into the Ab-i-Panja, which joins the Pamir river from Lake Victoria at Kala Panja. This at least is the action of the Burgutai stream during certain seasons of the year, so that the glaciers and snow-fields of the Nicolas range may be regarded as the chief fountain-head of at least two of the upper tributaries of the Oxus, namely, the Aksu (or Murghab) and the Pamir river, and as contributing largely to a

third, the Ab-i-Panja. Neither Lake Victoria nor Lake Chakmaktin derives any very large contributions from glacial sources other than those of the Nicolas range. It is possible that there may be warm springs on the bed of Lake Victoria, as such springs are of frequent occurrence in the Pamirs; but there is no indication of them in the Chakmaktin basin, and the latter lake must be regarded rather as an incident in the course of the Aksu â€” a widening of the river channel in the midst of this high-level, glacier- formed valley â€” than as the fountain-head of the infant stream. There are indications that the bed of Lake Victoria, as well as that of Chakmaktin, is rapidly silting, and that the shores of the latter are gradually receding farther from the foot of the hills. The glacial origin of

the Pamir valleys is everywhere apparent in their terrace formations and the erratic blocks and boulders that lie scattered about their surface. It is probable that the lakes themselves are evidence of (geologically) a com- paratively recent deliverance from the thraldom of the ice covering, which has worn and rounded the lower ridges into the smooth outlines of undulating downs.

Tlie Ah-i-Wdkhun Source. â€” Another important source of the river (considered by Curzon to be the chief source) is to be found in the enormous glaciers which lie about the upper or main branch of the Ab-i-Panja (called the Ab-i-Wakhan), which rises under the mountains enclos- ing the head of the Taghdumbash Pamirs. Although the superficial area of glacial ice from which the Ab-i-Wakhan derives the greater part of its volume is not equal to that found on the Nicolas range, it is quite impossible to frame any estimate of comparative depth or bulk, or to separate the volume of its contributions at any time from those which, combined, derive their origin from the Nicolas range. If the Aksu, or Murghab, and the Pamir river from Lake Victoria are to be considered in the light of independent tributaries, it is probable that the Ab-i- Panja contributes as large a volume of glacial flood to the Oxus as either of them.

Surveys. â€” Prom tlie point where the rivers of the Great and Little Pamirs join their forces at Kala Panja to Ishkashim, at the elbow of the great bend of the Oxus northwards, the river valley- has been surveyed by Woodthorpe ; and the northern slopes of the Hindu Kush, which near Ishkashim extend in slopes of barely 10 miles in length from the main watershed to the river banks, have been carefully mapped. These slopes represent the extent of Afghan territory which exists north of the Hindu Kush between Kala Panja and Ishkashim. From Ishkashim northwards the river passes through the narrow rock-bound valleys of Shignan and Koshan ere it sweeps north and west through the mountains and defiles of Darwaz. By the terms of the boundary agreement with Russia this part of the river now parts Badakshan and Darwaz from the districts of Roshan, Shignan, and Bokhara, which formerly maintained an uncertain claim over a part of the territory on the left bank of the river. All this part of the Oxus, until the river once again emerges from the Bokhara hills into the open plains bordering Badakshan on the north, falls within the area of Russian surveys, with which a, junction from India has been effected both on the Pamirs and in Turkestan.

Bussian Posts on the Oxus. â€” At Langar Kisht, a little to the east of the Oxus bend, there is a small Russian post of observation. About 50 miles north of the bend, where the Suchan or Ghund joins the Oxus from the Alichur Pamir, there is another and larger post called Charog. Here there are four officers with a guard of fifty Cossacks and two Maxims, according to Cobbold, who visited this part of the Oxus valley in 1900. On the left bank of the river the Afghans maintain a frontier post at the fort of Kala dar Panja. A road will connect Charog with the Alichur Pamir, following the general course of the Ghund stream, a road which will form a valu- able link in the chain of communications between Bokhara and Sarikol. Eighty-five miles north of Ishkashim, at Kala Wamar, the river which rises in the Little Pamir, and which is called Aksu, Murghab, or Bartang, joins the Oxus from the east. It is on this river that the Russian outpost, Murghabi (or Pamirski), is situated, at an elevation of 12,150 feet above the sea. Fort Murghabi is connected by a good military road with Osh. At this point the

measurement of the comparative lengths of the chief Pamir tributaries of the Oxus is as follows : â€”

To the head of the Aksu at Lake Chakmaktin . 260 miles.

To the head of the most easterly tributary of Lake

Victoria, in the Great Pamir, about . . 230 „

To the glacial sources of the Ab-i-Wakhan, about . 230 „ For 120 miles the two latter are united in the main stream of the Oxus, the volume of which has been further increased by the united forces of the Ghund and Shakhdara draining the Alichur Pamir and the heights of Shignan.

Nature of the Oxus Valley.â€” Tha narrow cramped valley of the river between Ishkashim and Kala "Wamar is hedged in on the west by a long ridge flanking the highlands of Badakshan ; on the east the buttresses and spurs of the Shignan mountains (of which the strike is transverse to the direction of the river and more or less parallel to that of the main Hindu Kush watershed) overhang its channel like a wall, and afford but little room either for cultivation or for the maintenance of a practicable road. Yet the lower elevation (for this part of the Oxus stream is not more

than about 7000 feet above sea-level) and comparatively mild climate give opportunities to the industrious Tajik population for successful agriculture, of which they are not slow to avail themselves, and a track exists on the left b&nk of the river to Kala dar Panja opposite the Ghund (or Suchan) debouchment, which is practicable for mules. There are no bridges, and the transit of the river from bank to bank can only be effected by the use of inflated skins. Beyond the Bartang (or Murghab) conflu- ence the valley narrows, and the difficulties of the river route increase. Between Kala Wamar (6580 feet) and Kila Khum (4400 feet), where the Oxus again bends southwards, its course to the north-west is almost at right angles to the general strike of the Darwaz mountains, which is from north-east to south-west, following the usual conformation of all this part of high Asia. Thus its chief affluents from the north-east, the Wanj and the Yaz Ghulam, drain valleys which are

comparatively open, and which are said to be splendidly fertile. At Kila Khum the river is 480 feet wide, narrowing to 350 feet in the narrowest gorge. Its level varies with the obstructions formed by ice, falling as much as 28 feet when its upper channels are blocked.

Climate and Productions.â€” 'The climate of eastern Bokhara and Darwaz is delightful in summer, and Dr Kegel vn-ites of its Alpine scenery and flora in terms of enthusiastic admiration. In the valleys of the Waksh and the Surkhab to the north of Darwaz, which form an important part of the province of Kara^ tegin, maple, ash, hawthom, pistachio, and juniper grow freely in the mountain forests, and beetroot, kohl rabi, and other vegetables are widely cultivated. About the cliffs and precipices of the Panja valley near Kila Khum the wild vine, cerasus, and pomegranate are to be found, and the plane tree and mulberry flourish in groups near the villages. Here also, amongst other plants, the sunflower decorates village gardens. The houses are built of stone and mortar, and above the thatched straw roof which surmounts the double-storeyed buUdings the square watch- tower rises gracefully. Every house possesses its staircase, its well, and cisterns for irrigation ; and on the whole the Aryan Tajiks of this northern section of the Oxus valley seem to be well provided with most of the comforts, if not the luxuries, of life. Their language is the language of Bokhara and Samarkand. Bokharan supremacy was re-established in 1878, when Kila Khum was occupied by Bokharan troops. Since then the right bank of the river has been politically divided from the left, and the latter now belongs to Afghanistan.

Between the Mountains and the Plains. â€" From Kila Khum, which fort about marks the most northerly point of the great bend of the Oxus round Badakshan, the river follows a south- westerly course for another 50 miles through a close mountain- ous region ere it vridens into the more open valley to the south of Kolab. It now becomes a river of the plains, from which the mountains on either side stand back.

Darwaz Affluents. â€" The topography of Darwaz south of the river is not accurately known, but at least one considerable stream of some 60 miles in length drains to the north-east, parallel to the general strike of

the mountain system into the transverse course of the Oxus, which it joins nearly opposite to the lateral valleys of Yaz Ghulam and Wanj. This stream is called Pangi-Shiwa, or Shiwa, but not much is known about it. Another of about equal length, starting from the same central water-parting of this mountain block, and included within the Oxus bend, follows a transverse direction at almost right angles to the Shiwa, and joins the Oxus valley near its debouchment into the more open Kolab plains, where the course of the Oxus has again assumed a direction parallel to the mountain strike. All that we know about this river (which is called the Ragh or Sadda) is that towards its junction with the Oxus it cuts through successive mountain ridges, which renders its course impracticable as a roadway. It is necessary to avoid the river, and to pass by mountain tracks which surmount a series of local spurs or off- shoots from the central plateau, in order to reach the Oxus. The existence of this route, which traverses the Darwaz mountains from east to west, cutting off the northern bend of the Oxus, and connecting those easterly routes which intei-sect the Pamii-s by means of the Ghund and Shakhdara (and which concentrate about Lake Shiwa) with Kolab in eastern Bokhara, is important. (See Badakshan.)

Karategin Affluents. â€" From about the point where the Oxus commences to separate the Bokharan province of Kolab from the comparatively open Afghan districts of Rustak and Kataghan, the channel of the river is no longer confined within walls of mountains of volcanic and schistose "formation. The Kolab and the Surkhab (or Waksh) flow into it in broad muddy streams from the highlands of Karategin, and the river at once commences to adopt an uncertain channel wherever the outstretched arms of the hills fail to confine it within definite limits. It divides its waters, splitting into many channels, leaving broad central islands ; and as the width increases, and the depth during

dry seasons diminishes, opportunities for fords become compara/-tively frequent. Between Kolat) and Pata Kesar, immediately north of the Turkestan capital of Mazar-i-Sharif , there are at least three well-known “guzars” or fords, and there are probably more. Besides the great muddy affluents from Karategin on the north, the Kabadian, the Sijrkhan, and the Darbant are all of them very considerable tributaries from Bokhara. The last of the three is the river on which the well-known trade centre of Shirabad is built, some 20 miles north of the river. Near the junction of the Surkhan with the Oxus are the ruins of the ancient city of Tarmez, on the northern or Bokharau bank, and the ferry at Pata Kesar (not far from the ruins of an old bridge) is the connecting link between Bokhara and Mazar hereabouts.

Badakshan Affluents. â€” From the south two very remarkable affluents of the Oxus join their streams to the main river between Kolab and the Mazar crossings. The Kokcha and the Khanabad (or Kunduz) are the two great rivers of Badakshan. The valley of the Kokcha leads directly from the Oxus to Faizabad, the capital of Badakshan, and its head is close above Ishkashim at the southern elbow of the great Oxus bend, a low pass of only 9500 feet dividing its waters from those of the main river. This undoubtedly was a section of the great central trade route of Asia, which once connected Fergana and Herat with Kashgar and China. (See Badakshan.) Both these rivers tap the northern slopes of the Hindu Kush, and claim their sources in the unmapped moun- tain wilderness of Kafiristan. The Khanabad, or Kunduz, is also called locally the Aksarai. All the rivers of Central Asia are known by several names. To the west of the Kunduz no rivers find their way through the southern banks of the Oxus. Through- out the plains of Afghan Turkestan the drainage from the southern hills is arrested and lost in the desert sands.

Island. â€” The only island of any size in the bed of the river is the island of Paighambar, a little below the ruins of Tarmez. The inhabitants of this island, and of a smaller one in the neighbourhood called Zarshoi, wash for gold in the bed of the river.

Buins.â€” At Airatan, a little above the Pata Kesar ferry, there are ruins,‘as also at Khisht Tapa (where the road from Kabadian to Tashkurghan leaves the river) and at Kalukh Tapa. At Khisht Tapa there is a tradition of a bridge having once existed.

Channel of the Oxus. â€” The Oxus river, as seen in flood at this part of its course, is an imposing stream. It Is rarely less than 1000 yards wide, and in some places it is fully a mile across. Its winter channel may be estimated at from two-thirds to three- fourths of its flood channel, except where it is confined within narrow limits by a rocky bed, as at Kilif, where its unvarying width is only 540 yards. The average strength of the current in flood is about 4 miles per hour, varying from 2^ to 5 miles. The left bank of the Oxus above Kilif is, as a rule, low and flat, with reed swamps bordering the stream and a strip of jungle between the reeds and the edge of the elevated sandy desert. The jungle is chiefly tamarisk and padah (willow). Swamp deer, pheasants, and occasionally tigers are found in it. The right bank is gen- erally higher, drier, more fertile, and more populated than the left.

Cultivation. â€” A wide belt of blown sand (or Chul), sprinkled with saxaul jungle, separates the swamps on the south side of the river from the cultivated plains of Afghan Turkestan ; but in places, notably for about 12 miles above Khamiab, where the Kusso-Afghan boundary touches the river, through the districts which are best known by the name of Khwaya Salar, and again in a less degree for 50 miles above the ferry at Kilif, a very suc- cessful war has been waged by the agricultural Turkman (of the Ersari tribes) against the encroaching sand-waves of the desert ; and a strip of riverain soil averaging about a mile in width has been reclaimed and cultivated by irrigation. The cultivation, supported by canals drawn from the Oxus, the heads of which are constantly being destroyed by flood and again renewed, is of a veiy high order. Wheat and barley spread in broad crops over many square miles of rich soil ; the fields are intersected by nar- row little stone-walled lanes, bright with wayside flowers, amongst which the poppy and the purple thistle of Badghis are predomi- nant ; the houses are neatly built of stone, and stand scattered about the landscape in single homesteads, substantial and comfort- able-; and the spreading

willow and the mulberry offer a most grateful shade to the wayfarer in summer-time, when the heat is often insupportable. The fiery blasts of summer, furnace-heated over the red-hot Kizil Kum, are hardly less to be feared than the ice-cold shamshir (or north-western blizzard) of winter, which freezes men when it finds them in the open desert, and frequently destroys whole caravans.

Oxus Ferries. â€” The principle on which the Oxus ferries are worked is peculiar to those regions. Large fiat-bottomed boats are towed across the river by small horses attached to an out- rigger projecting beyond the gunwale by means of a surcingle or bellyband. They are thus partially supported in the water whilst

they swim. The horses are guided from the boat, and a twenty- or thirty ~~foot barge with a heavy load of men and goods will be towed across the river at Kilif (where, as already stated, the width of the river is between 500 and 600 yards only) with ease by two of these animals. The Kilif ferry is on the direct high~~ road between Samarkand and Akcha. It is perhaps the best-used ferry on the Oxus.

Khwaya Salar. â€” Khwaya Salar derives some historical signifi- cance from the fact that it presented a substantial difficulty to the settlement of the Kusso-Afghan boundary, in which it was assigned by agreement as the point of junction between that boandaiy and the Oxus. It had been defined in the agreement as a “post” on the river banks, and had been so described by Burnes in his writings some fifty years previously. But no post such as that indicated could be discovered. There was a district of that name extending from Khamiab to the neighbourhood of Kilif, and at the Kilif end of the district was a ziarat sacred to the Khwaya who bore the name. It was only after long inquiry amongst local cul- tivators and landowners that, about 2 miles below the ziarat, and nearly opposite to the site of the present Karkin bazaar, the posi- tion of a lost ferry was identified, which had once been marked by a riverside hamlet called by the name of the sainj. The ferry had long disappeared, and with it a considerable slice of the riverside alluvial soil, which had been washed into the stream by the action of fioods. The post had, in fact, subsided to the bottom of the river, but the

consequences of its disappearance had been both far-reaching and expensive.

Lower Oxus. â€” Below Khamiab, to its final disappearance in the Aral Sea, the great river rolls in silent majesty through a vast expanse of sand and desert. Under Russian auspices a consider- able strip of alluvial soil on the left bank has been brought under cultivation, measuring 4 or 5 miles in width, and there is more cultivation on the banks of the Oxus now than there is in the Merv oasis itself, but it is confined to the immediate neighbourhood of the river, for no affluents of any considerable size exist. The river is navigable below Charjui, and takes its place as an important unit in the general scheme of Russian frontier communications.

Junction with the Aral Sea. â€” An important feature in con- nexion with the course of the Oxus is the discussion that has arisen with regard to its former debouchment into the Caspian Sea. On this point much recent evidence has been collected, and it appears certain that there was a time in the post-Pliocene Age when a long gulf of the Caspian Sea protruded eastwards nearly as far as the longitude of Merv, covering the Kara Kum sands, but not the Kara Kum plateau to the north of the sands, which is separated from the sands by a distant sea beach. At the same time another branch of the same gulf protruded northwards in the direction of the Aral, probably as far as the Sary Kamish depression, which lies to the west of the Khivan delta of the Oxus, separated from it by wide beds of loess, clays, and gravel, covering rocks of an unknown age. The Murghab river and the Hari Rud, which terminate in the oases of Merv and Sarakhs, almost certainly penetrated to the gulf of the Kara Kum, but the question whether the Oxus was ever deflected so as to enter the gulf with the Murghab cannot be said to be answered decisively at present. The former connexion between the Caspian and Aral by means of the gulf now represented by the Sary Kamish depres- sion seems to be admitted by Russian scientists, nor would there appear to be much doubt about the connexion between the Khivan oasis and the northern extremity of the Sary Kamish. In this discussion the names of Kaulbars, Lessar, Annenkoff, Konshin, and other Russian geographers are conspicuous.

The general con- clusions are ably summed up by P. Kropotkin in the September number of the Journal of the Royal Geographical Society for

AuTHOKiTiES. â€” Although much has been written of late years about the sources of the Oxus within the region of the Pamirs, there is very little to be found in the writings of geographers of modern date descriptive of that part of its course which sepa^ rates Darwaz and Afghan Turkestan from Bokhara, and that little is chiefiy in the pages of reports and gazettes, &c., which are not available to the public. The following authorities may be consulted : The Report of the Pamir Boundary Commission of 1895, published at Calcutta, 1897. â€” Regel, Dr A. "Journey in Karategin and Darwaz," Investia, Russian Geog. Soc, vol. xiii. 1882; translation, vol. iv. Froc. B.G.S. â€" Michell. "Regions of the Upper Oxus," vol. vi. Froc. B.G.S. 1884. â€" Griesbach. "Geological Field Notes," No. 3, Afghan Boundary Commission, 1885. â€" Yate, C. Northern Afghanistan. London, 1888. â€" Chrzon. "The Pamirs," vol. viii. Jour. B.G.S. 1896.â€" KROPOTKHf. "Old Beds of the Oxus," Jour. B.G.S., September 1898. â€" Coebold. Innermost Asia. London, 1900. To the above may be added the Reports of the Russo-Afghan Boundary Commission of 1884^5, and that of Lockhart's Mission in 1885, and the Indian Survey Reports. (t. H. H*.")

OYSTER INDUSTR Y â€" P A C H I N 0

Oyster Industry.â€" Oysters are more valuable than any other single product of the fisheries, and in at least twenty-five countries are an important factor in the food- supply. The approximate value of the world's oyster crop approaches Â£4,000,000 annually, representing over 30,000,000 bushels, or nearly 10 billion oysters. Not less than 160,000 persons are engaged in the industry, and the total number dependent thereon is fully half a million. The following table shows in general terms the yearly oyster product of the world : â€"

Oountly. Bushels. Value.

United States .... 26,853,760 Â£2,533,481

Canada 134,140 43,405

Great Britain and Ireland . . 113,700 154,722

France 3,260,190 716,778

Holland 100,000 84,400

Italy 68,750 44,000

Other European countries . . 29,930 40,250

Asia, Africa, and Oceania . . 275,000 111,400

Total

. 30,835,470 Â£3,728,436

The distinctive feature of oyster culture in continental Europe is the setting of tiles, wooden frames, and brush, on which the spat from adjacent beds is deposited ; the young are subsequently reared in suitable enclosures. In Great Britain brood seed oysters, purchased in France and elsewhere, are placed on prepared grounds and left to spawn or to grow before marketing. Oyster culture in America consists in preparing the ground by the removal of rubbish and sowing shells of oysters and other mol- luscs, gravel, and broken stone, to which the spat will become attached.

United States. â€" The oyster is the chief fishery product in the United States. The states which lead in the quantity of oysters taken are Maryland, Virginia, New York, New Jersey, and Con- necticut ; the annual value of the output in each of these is over $1,000,000. Other states with important oyster interests are Rhode Island, North Carolina, Louisiana, and California. The oyster fisheries give employment to over 56,000 fishermen, who man 4000 vessels, valued at $4,000,000, and 23,000 hoats, valued at $1,470,000 ; the value of the 11,000 dredges and 37,000 tongs, rakes, and other appliances used is

$365,000. The quantity of oysters taken in 1898 was 26,853,760 bushels, with a value of $12,667,405. The output of cultivated oysters in 1899 was about 9,800,000 bushels, worth $8,700,000.

Canada. â€” Oyster banks of some importance exist in the Gulf of St Lawrence and on the coast of British Columbia. All of the

grounds have suffered depletion, and cultural methods to main- tain the supply have been instituted. The oyster output of the Dominion has never exceeded 200,000 bushels in a single year, and in 1898 was 134,140 bushels, valued at $217,024.

United Kingdom. â€” The natural oyster beds of Great Britain and Ireland have been among the most valuable of the fishery resources, and British oysters have been famoifs from time immemorial. _ The most important oyster region is the Thames estuary, the site of extensive planting operations. The present supply is largely from cultivated grounds. Important oyster-producing centres are Whit- stable, Colchester, and Brightlingsea. The oysters landed on the coasts of England and Wales in 1898 numbered 35,809,000, valued at Â£122,320, and in 1899, 38,978,000, valued at Â£143,841. The Scottish fishery has its centre at Inveraray and Ballantrae, and in 1899 yielded 470,100 oysters, valued at Â£2356. Public oyster grounds of Ireland in 1898 produced 1,981,900 oysters, valued at Â£3559. The fishery is most extensive at Wicklow, Queenstovra, Ballyheige, Galway, and Moville. Planting is carried on in seven counties ; the oysters taken from cultivated beds in 1898 numbered 3,204,200, valued at Â£4966.

France. â€” The industry owes its importance to the attention given to oyster cultivation. In the fishery on public grounds in 1896 only 6370 fishermen were engaged, employing 1627 vessels and boats, valued at 1,473,449 francs, and apparatus worth 211,495 francs, while only 13,127,217 kilograms of oysters were taken, or about 320,000 bushels, valued at 414,830 francs. In the parks, Claires, and reservoirs the private culture of oysters has attained great perfection. Fully 40,000 men, women, and children are em- ployed, and the output in 1896 was 1,536,417,968 oysters, worth 17,537,778 francs. The principal centre is

Arcachon, where in 1896 there were raised 802,880,000 oysters, valued at 4,663,040 francs.

Other Countries. â€” The natural oyster ,beds of Holland having become exhausted through neglect and over fishing, the Govern- ment about 1870 suspended all operations on public grounds and leased the available oyster-producing areas. The Scheldt estuary has become the region of greatest production. In 1897 the Dutch waters yielded 401^00,000 marketable oysters, valued at Â£84,000. Oyster culture in Italy is of great historic interest; the annual crop, which is almost wholly from cultivated grounds, does not exceed 25,000,000 to 30,000,000 oysters. The oyster industry of Germany, Belgium, Spain, Portugal, Eussia, Denmark, and other countries of Europe does not yield over 30,000 bushels yearly, valued at about Â£40,000. Outside of Europe and America the industry is of little consequence. Algeria has a small fishery, the output in 1896 being valued at 33,739 francs. Oysters of large size and excellent flavour exist in Japan, and are cultivated to some extent. The annual output is estimated at 100,000 bushels, with a value of Â£14,000. In China the oyster product is doubtless large, but the extent of the industry is unknown. For centuries the Chinese have practised a rude form of oyster culture. The oyster grounds of New South Wales, Queensland, Tasmania, and other British colonies in the Pacific are rather extensive, but have been depleted. (h. m. s*.)

Paardeberg. See Orange Eiver Colony and Transvaal (War).

Paarl, a town of Cape Colony, a few miles north of Stellenbosch, 30 miles (36 by rail) east-north-east of Cape Town, with both of which places it is connected by rail. It stands at the point where the main line is deflected northwards by the steep Drakenstein escarpments of the outer coast range. Paarl (” Pearl “) is one of the oldest places in the colony, and was so named by its Dutch settlers from a granite block crowning a rocky pedestal like a gem on a coronet. The gardens, orange groves, vineyards, and woodlands of the surrounding district make it a favourite summer resort for the citizens of Cape Town. Population (1891), 21,363 (white, 8226; natives, 13,137). (a. h. k.)

Pabianice, a town of Eussian Poland, in the goverli- ment and 22 miles north-west of the town of Piotrkow, 10 miles from 4/6dz railway station. It lies amidst the extensive forests round the head-waters of the Ner, which were the hunting-grounds of the Polish kings. It has woollen, cloth, and paper mills, and manufactures agri- cultural implements. Population (1897), 26,900.

Pabna, or Pubna, a town and district of British India, in the Eajshahi division of Bengal, on the river Ichhamati, near the old bed of the Ganges. Population (1881), 15,267 ; (1891), 16,486. The high school had 388 pupils in 1896-97.

The district of Pabna has an area of 1839 square miles ; popula- tion (1881) 1,311,728, (1891) 1,362,392, (1901) 1,420,352, showing an increase of 4 per cent, between 1881 and 1891, and also between 1891 and 1901 ; average density, 772 persons per square mile. Classified according to religion, Mahommedans in 1891 numbered 99g,776; Hindus, 361,957; Christians, 162, of whom 96 were Europeans; "others," 1497. The land revenue and rates in 1897-98 were Rs.4,e9,337; the number of police was 403; boys at school in 1806-97 were 19,812, being 19-5 per cent, of the male population of school-going age ; the registered death-rate in 1897 was 40 per thousand. The two staple crops are rice and jute. There are 18 jute presses, with an out-turn of 259,000 bales, valued at Rs. 30,00,000. Sirajganj, on the Brahmaputra, is the largest mart for jute in Bengal, with a jute mill established in 1864. In- digo has ceased to be grown. The Eastern Bengal railway outs across the south-west corner of the district for five miles, near the Ganges. The district was affected by the earthquake of 12th June 1897, which was most severely felt at Sirajganj.

Pachino, a town of the province of Syracuse, Sicily, Italy, 4 miles from Cape Passaro, 26 miles south-south- west of Syracuse. It carries on the manufacture of

vegetable fibre and baskets, fish-curing, cultivation of the vine, and herring-fishing (port 21- miles to the north-east). Popvilation (1881), 8229; (1899), 10,000.

Pachuca, a city of Mexico, and capital of Hidalgo. It is connected with the city of Mexico by the Hidalgo, Mexican, and Central railways. It is the principal town of the state on account of its commerce, population (40,487), and mining industries. Amongst several fine buildings are the palace of justice, the scientific and literary insti- tute, the meteorological observatory, and the school of mines and public library. The town has tramways, and several private railways in connexion with adjacent mines.

Pacific Blockade. â€" Pacific blockade is a term invented by Hautefeuille, the French writer on Interna- tional Maritime Law, to describe a blockade exercised by a great Power for the purpose of bringing pressure to bear on a weaker state, without actual war. That it is an act of violence, and therefore in the nature of war, is undeni- able, seeing that it can only be employed as a measure of coercion by maritime Powers able to bring into action such vastly superior forces to those the resisting state can dispose of, that resistance is out of the question. In this respect it is an act of war, and any attempt to exercise it against a Power strong enough to resist would be a commencement of hostilities and at once bring into play the rights and duties affecting neutrals. On the other hand, the object and justification of a pacific blockade being to avoid war, that is, general hostilities, and disturb- ance of international traffic with the state against which the operation is carried on, rights of war cannot consistently be exercised against ships belonging to other states than those concerned. And yet, if neutrals were not to be affected by it, the coercive effect of such a blockade might be completely lost. Eecent practice has been to limit in- terference with them to the extent barely necessary to carry out the purpose of the blockading Powers.

It is usual to refer to the intervention of France, England, and Russia in Turkish affairs in 1827 as the first occasion on which the coercive value of pacific blockades was put to the test. – Neutral vessels were not

affected tiy it. This was followed by a number of other coercive measures described in the text-books as pacific blockades. The first case, however, in which the operation was really a blockade, unaccompanied by hostilities, and which there- fore can be properly called a "pacific blockade," was that which in 1837 Great Britain exercised against New Granada. A British subject and consul by the name of Kussell was accused of stab- bing a native of the country in a street brawl. He was arrested, and after being kept in detention for some months he was tried for the unlawful carrying of arms and sentenced to six years' im- prisonment. The British Government resented this treatment as " not only cruel and unjust towards Mr Russell, but disrespectful towards the British nation," and demanded the dismissal of the officials implicated and Â£1000 damages " as some compensation for the cruel injuries vyhich had been inflicted upon Mr Russell " (State Papers, 1837-38, p. 183). The New Granada Government refused to comply with these demands, and the British representative, act- ing upon his instructions, called in the assistance of the West India fleet, but observed in his communication to the British naval officer in command that it was desirable to avoid hostilities, and to en- deavour to bring about the desired result by a strict blockade only. This seems to be the first occasion on which it had occurred to anybody that a blockade without war might serve the purpose of war. This precedent was shortly afterwards followed by another somewhat similar case in which, from 16th April to 28th November 1838, the French Government blockaded the Mexican ports, to coerce the Mexican Government into acceptance of certain demands on behalf of French subjects who had suffered injury to their per- sons and damage to their property, through insufficient protection by the Mexican authorities.

The blockade of Buenos Aires and the Argentine Coast from 28th March 1838 to 7th November 1840 by the French fieet, a coercive measure consequent upon vexatious laws affecting foreign residents in the Argentine Republic, seems to have been the first case in which the operation was notified to the different represen- tatives of foreign states. This notification was given in Paris, and at Buenos Aires, and to

every ship approaching the blockaded places. This precedent of notification was, a few years later

(1845), followed in another blockade against the same country by Great Britain and France, and in one in 1842 and 1844 by Great Bri- tain against the port of San Juan in Nicaragua. In 1850 Great Bri- tain blockaded the ports of Greece in order to compel the Hellenic Government to give satisfaction in the Don Pacifico case. Don Pacifico, a British subject, claimed Â£32,000 as damages for unpro- voked pillage of his house by an Athenian mob. Greek vessels only were seized, and these were only sequestered. Greek vessels bona fide carrying cargoes belonging to foreigners were allowed to enter the blockaded ports.

Before the next case of blockade which can be described as "pacific" occurred, came the Declaration of Paris (15th April 1856), requiring that "blockades in order to be binding must be effective, that is to say, maintained by a force sufficient really to prevent access to the coast of the enemy."

Some ill-defined measures of blockade followed, such as that of 1860, when Victor Emmanuel, then king of Sardinia, joined the revolutionary government of Naples in blockading ports in Sicily, then held by the king of Naples, without any rupture of pacific relations between the two governments ; that of 1862 in which Great Britain blockaded the port of Rio de Janeiro, to exact redress for pillage of an English vessel by the local population, at the same time declaring that she continued to be on friendly terms with the emperor of Brazil ; and that of 1880, when a demonstration was made before the port of Dulcigno by a fieet of British, German, French, Austrian, Russian, and Italian men-of-war, to compel the Turkish Government to carry out the treaty conceding this town to Montenegro, and it was announced that, if the town was not given up by the Turkish forces, it would be blockaded.

The blockade which first gave rise to serious theoretical dis- cussion on the subject was that Instituted by France in 1884 in Chinese waters. On 20th October 1884 Admiral Courbet declared a blockade of all the ports and roadsteads between certain speci- fied points of the island of

Formosa. The British Government pro- tested that Admiral Courbet had not enough ships to render the blockade effective, and that it was therefore a violation of one of the articles of the Declaration of Paris of 1856 ; moreover, that the French Government could only interfere with neutral vessels violating the blockade if there was a state of war. If a state of war existed, England as a neutral was bound to close her coaling stations to belligerents. The British Government held that, in the circumstances, France was waging war, and not entitled to com- bine the rights of peace and warfare for her own benefit. Since then pacific blockades have only been exercised by the Great Powers as a joint measure in their common interest, which has also been that of peace, and in this respect the term is taking a new signification in accordance with the ordinary sense of the word "pacific." 1

In 1886 Greece was blockaded by Great Britain, Austria, Ger- many, Italy, and Russia, to prevent her from engaging in war with Turkey, and thus forcing the Powers to define their attitude to- wards the latter Power. The instructions given to the British commander were to detain every ship under the Greek flag, coming out of or entering any of the blockaded ports or harbours or com- municating with any ports within the limit blockaded ; but if any parts of the cargo on board of such ships belonged to any subject or citizen of any foreign Power other than Greece, and other than Austria, Germany, Italy, and Russia, and had been shipped before notification of the blockade or after such notification but under a charter made before the notification, such ship was not to be de- tained.

On the blockade of Crete in 1897 it was notified that " the ad- mirals in command of the British, Austro-Hungarian, French, Ger- man, Italian, and Russian naval forces " had decided to put the island of Crete in a state of blockade, that " the blockade would be general for all ships under the Greek flag," and that " ships of the six Powers or neutral Powers may enter into the ports occupied by the Powers and land their merchandise, but only if it is not for the Greek troops or the interior of the island," and that "these ships may be visited by the ships of the international fleets."

(t. Ba.)

Pacific Islands. See Melanesia, Micronesia, Polynesia.

Pacific Ocean, the largest division of the hydro- sphere, lying between Asia and Australia and North and South America. It is nearly landlocked to the north, com- municating with the Arctic Ocean only by Bering Strait, which is 36 miles wide and of small depth. The southern boundary is now generally regarded as the parallel of 40Â° S., but sometimes the part of the great Southern

1 The blockade in 1888 by Great Britain, Germany, Italy, and Portu- gal of Zanzibar was peculiar, being directed not against the reigning authority, hut against a slave trade which that authority was power- less to stop.

Coasts and seas.

Ocean (40Â° to 66-|-Â° S.) between the meridians passing through South Cape in Tasmania and Cape Horn is included. The north to south distance from Bering Strait to the Antarctic circle is 9000 miles, and the Pacific attains its greatest breadth, 10,000 miles, at the equator. The coasts of the Pacific are of varied contour. The American coasts are for the most part mountain- ous and unbroken, the chief indentation being the Gulf of California ; but the general type is departed from in the extreme north and south, the southern coast of South America consisting of bays and fjords with scattered islands, while the coast of Alaska is similarly broken in the south, and becomes low and swampy towards the north. The coast of Australia is high and unbroken ; there are no inlets of considerable size, although the small openings include some of the finest harbours in the world, as Moreton Bay and Port Jackson. The Asiatic coasts are for the most part low and irregular, and

a number of seas are more or less completely enclosed and cut off from communication with the open ocean. Bering Sea is bounded by the Alaskan peninsula and the chain of the Aleutian Islands ; the Sea of Okhotsk is enclosed by the peninsula of Kamchatka and the Kurile Islands ; the Sea of Japan is shut off by Sakhalin Island, the Japanese Islands, and the peninsula of Korea ; the Yellow Sea is an opening between the coast of China and Korea ; the China Sea lies between the Asiatic continent and the island of Formosa, the Philippine group, Palawan, and Borneo. Amongst the islands of the Malay Archipelago are a number of enclosed areas, the Sulu, Celebes, Java, Banda, and Arafura seas. The Arafura Sea extends east- wards to Torres Strait, and beyond the strait is the Coral Sea, bounded by 'New Guinea, the islands of Melanesia, and north-eastern Australia.

Extent, The following table gives the area and volume

volume, of the Pacific Ocean and its seas, with the mean

and mean depths calculated therefrom, as estimated by Murray

depth. (1888) :â€"

Area

Volume

Mean Depth

(sq. miles).

(cub, miles).

(.fatlioms).

Pacific Ocean (to 40Â° S.)

50,308,450

141,516,050

2475

Southern Ocean (S. of

the Pacific)

10,278,500

24,980,200

2139

Pacific Ocean to 66JÂ° S

60,586,950

166,496,250

2418

Bering Sea .

859,450

621,500

636

Sea of Okhotsk

542,000

197,600

292

Sea of Japan

375,550

220,800

517

Yellow Sea .

468,450

. 55,050

103

China Sea

1,366,600

835,200

538

Celebes Sea .

181,950

288,150

1394

Sulu Sea

174,200

136,800

691

Banda Sea

422,000

417,750

871

Java Sea

360,050

34,900

85

Arafura Sea

Total

565,200

79,150

123

65,902,400

169,383,150

2253

Adopting a somewhat different arrangement, Karstens (1894) obtains the following : â€”

Area

Volume

Mean Depth

(sq. kilom.).

(cub. kllom.).

(fathoms).

Pacific Ocean to 66^Â° S.

161,137,973

657,926,344

2233

Bering Sea

2,264,664

2,513,558

607

Sea of Okhotsk .

1,507,609

1,895,065

695

â– Sea of Japan .

1,043,824

1,148,206

602

China Seas and . \ Gulf of Siam . . /

4,583,473

3,436,093

410

Sunda Archipelago

3,241,128

2,640,721

446

Sulu and Celebes Seas “|

with V

1,499,659

1,983,291

723

Gulf of Carpentaria J

Gulf of California . Total .

166,788

164,586

540

175,445,118

671,707,864

2094

The Pacific Ocean has therefore one and three-quarter times the area of the Atlantic, the next largest division of the hydrosphere, and has more than double its volume of water. Its area is greater than the whole

land surface of the. globe, and the volume of its waters is six times that of all the land above sea^level. The total land area draining to the Pacific is estimated by Murray at 7,500,000 square miles, or little more than one-fourth of the area draining to the Atlantic. The American rivers draining to the Pacific are, with the exception of the Yukon, unimportant. The chief Asian rivers are the Amur, the Hwang-ho, and the Yangtse-kiang, none of which enters the open Pacific directly. Hence the proportion of purely oceanic area to the total area is greater in the Pacific than in the Atlantic, the supply of detritus being smaller, and terrigenous deposits are not borne so far from land.

The bed of the Pacific is not naturally divided into physical regions, but for descriptive purposes the parts of the area lying east and west of 150Â° "W. are conveniently dealt ^^^^^^

with separately (Fig. 1). The eastern region is characterized by great uniformity of depth ; the 2000-fathom line keeps close to the American coast except off the Isthmus of Panama, whence an ill-defined ridge of less than 2000 fathoms runs south-westwards, and again off the coast of South America in about 40Â° S., where a similar bank runs west and unites with the former. The bank then continues south to the Antarctic Ocean, in about 120Â° W. Practically the whole of the north- east Pacific is therefore more than 2000 fathoms deep, and the south-east has two roughly triangular spaces, including the greater part of the area, between 2000 and 3000 fathoms. Notwith- standing this great average depth, the "deeps" or areas over 3000 fathoms are small in number and extent. Five small deeps are recognized along a line close to the coast of South America and parallel to it, in the depression enclosed by the two banks mentionedâ€" they extend from about 12Â° to 30Â° S.â€" and are named, from north to south, Milne-Edwards deep, Knimmel deep, Bar- tholomew deep, Richards deep, and Haeckel deep. In the north- east the deeps are again few and small, but they are quite irregularly distributed, and not near the land. East of 150Â° W. the Pacific has few islands ; the oceanic islands are volcanic, and coral formations are of course scanty. The most important group is the Galapagos Islands.

The western Pacific is in complete contrast to the part just described. Depths of less than 2000 fathoms occur continuously on a bank extending from south-eastern Asia, on which stands the Malay Archipelago. This bank continues southwards to the Antartic Ocean, expanding into a plateau on which Australia stands, and a branch runs eastwards and then southwards from the north-east of Australia through New Zealand. The most considerable areas over 3000 fathoms are the Aldrich deep, an irregular triangle nearly as large as Australia, situated to the east of New Zealand, in which a sounding of 5155 fathoms was obtained by H.M.S. Penguin, near the Friendly Islands: and the Tuscarora deep, a long, narrow trough running immediately to the east of Kamchatka, the Kurile Islands, and Japan. A long strip within the Tuscarora deep forms the largest con- tinuous area with a depth greater than 4000 fathoms. All the rest of the western Pacific is a region of quite irregular contour. The average depth varies from 1500 to 2500 fathoms, and from this level innumerable volcanic ridges and peaks rise almost or quite to the surface, their summits for the most part occupied by atolls and reefs of coral formation, while interspersed with these are depressions, mostly of small area, amongst which the deepest sound- ings recorded have been obtained. Recently the United States telegraph ship Nero, while surveying for a cable between Hawaii and the Philippines, sounded the greatest depth yet known between Midway Island and Guam, in 5269 fathoms, or almost exactly six miles.

The following table, showing the area of the floor of the Pacific (to 40Â° S.) and the volume of water at different levels, is due to Murray: â€”

Fathoms.

0-100 100-500 500-1000 1000-2000 2000-3000 3000-4000

over 4000

Areas (sq. miles).

3,379,700 1,753,450 1,707,650 6,902,550 39,621,560 2,164,150 94,850

56,623,900

Volume

(cub. miles).

6,128,500

23,348,350

28,323,700

52,628,600

32,645,400

1,367,900

70,600

144,402,950

So far as our knowledge goes, the present contours of the open Pacific Ocean are almost as they were in Palfeozoio times, and in the intervening ages changes of level and form have been slight. There is no reason to suppose that any considerable part of the vast area now covered by the waters of the Pacific has ever been exposed as dry land. Hence the Pacific basin may be regarded as

a stable and homogeneous geograpMcal unit, clearly marked off round nearly all its margin by steep sharp slopes, extending in places through the whole known range of elevation above sea-level and of depression below it â€” ^frnm the Cordilleras of South America to the island chains of fSiberia mid Australia. The deeper parts of the bed of the Pacific are covered by deposits

Fathoms 0 to 1000 1000 â– â€¢ 2000 2000 â€¢â€¢ 3000 beyond 3000

ps)

^â€” ^^gc-Chart of^e Depths of the FaciUc.

of red clay, which occupies an area estimated at no less than 105,672,000 square kilometres, or three-fifths of the Deposits. ^ijgjg j.j,;g_ 2). Over a large part of the central Pacific, far removed from any possible land-infiuences or deposits of ooze, the red-clay region is characterized by the occurrence of manganese, which gives the clay a chocolate colour, and manganese nodules are found in vast numbers, along with sharks' teeth and the ear-bones and other bones of whales. Eadiolarian ooze is found in the central Pacific in a region between 15Â° N., to 10Â° S. and 140Â° E. to 150Â° W., occurring in seven distinct localities, and covering an area of about 3,007,000 square kilometres. The Challenger discovered an area of radiolarian ooze between 7Â°-12Â° N. and 147Â°- 152Â° W., and another in 2Â°-10Â° S., 152Â°-153Â° W. Between these two areas, almost on the equator, a strip of globigerina ooze was found, corresponding to the zone of globigerina in the equatorial region of the Atlantic. Globigerina ooze covers considerable areas in the intermediate depths of the west and south Pacific â€" west of New Zealand, and along the parallel of 40Â° S., between 80Â°-98Â° W. and 150Â°-118Â° "W.â€" but this deposit is not known in the north-eastern part of the basin. The total area covered by it is es- timated at 38,332,000 square kilometres â€" about two- thirds of that in the Atlantic. Pteropod ooze occurs only in the neighbourhood of Piji and other islands of the western Pacific, passing up into fine coral sands and mud. All the enclosed seas are occupied by characteristic terrigenous deposits.

Partly on account of its great extent, and partly because there is no wide opening to the Arctic . regions, the normal wind circulation is on the whole less modified in the north Pacific than in the Atlantic, except in the west, where the south-west monsoon of southern Asia controls the prevailing winds, its influence extending eastwards to 145Â° E., near the Ladrones, and southwards to the equator. In the south Pacific the north-west monsoon of Australia affects a belt running east of New Guinea to the Solomon Islands. In the east the north- east trade belt

extends between 5Â° and 25Â° N. ; the south-east trade crosses the equator, and its mean southern limit is 25Â° S. The trade winds are generally weaker and less persistent in the Pacific than in the Atlantic, and the intervening belt of equatorial calms is broader. Except in the east of the Pacific, the south-east trade is

only fully developed during the southern winter ; at other seasons the regular trade belt is cut across from north-west to south-east by a band twenty to thirty degrees wide, in which the trades alternate with winds from north-east and north, and with calms, the calms prevailing chiefly at the boundary of the monsoon region (6Â° in. -15Â° S., 160Â°-186Â° E). This area, in which the south-east trade is interrupted, includes the i"iji, Navigator, and Society groups, and the Paumotus. In the Marquesas group the trade-wind is con- stant. Within the southern monsoon region there is a gradual transition to the north-west monsoon of New Guinea in low latitudes, and in higher lati- tudes to the north-east wind of the Queensland coast. The great warming and abundant rainfall of the island regions of the western Pacific, and the low temperature of the surface water in the east, cause a displacement of the southern tropical maximum of pressure to the east ; hence we have a permanent "south Pacific anticyclone " close to the coast of South America. The characteristic feature of the south-western Pacific is therefore the relatively low pressure and the existence of a true monsoon region in the middle of the trade- wind belt. It is to be noted that the climate of the islands of the Pacific becomes more and more healthy the farther they are from the monsoon region. The island regions of the Pacific are every- where characterized by uniform high air tempera^ tures ; the mean annual range varies from 1Â° to 9Â° E. , with extremes of 24Â° to 27Â°, and the diurnal range from 9Â° to 16Â°. In the monsoon region relative humidity is high â€" 80 to 90 per cent. The rainfall is abundant ; in the western island groups there is no well-marked rainy season, but over the whole region the greater part of the rain- fall takes place during the southern summer, even as far north as Hawaii. In the trade-wind region we find the characteristic heavy rainfall on the weather sides of the islands, and a shorter rainy season at the season of highest sun on the lee side. Buchan describes the island-studded portion of the western Pacific as the most extensive region of

the globe characterized by an un- usually heavy rainfall. Beyond the tropical high-pressure belt, the winds of the north Pacific are unde? the control of an area of low pressure, which, however, attains neither the size nor the inten-

Blue Mud Olobigerina Ooze Red Clay Radiolarian Ooze CoraJ Mud Diatom Ooze

Meteoro- logy.

Fig. 2. â€” Chart of Deposits in the Pacific.

sity of the ‘ ‘ Iceland ‘ ‘ depression in the north Atlantic. The result is that north-westerly winds, which in winter are exceedingly dry and cold, blow over the western or Asiatic area ; westerly winds prevail in the centre, and south-westerly and southerly winds ofi the Amer- ican coast. In the southern hemisphere there is a transition to the low-pressure belt encircling the Southern Ocean, in which westerly and north-westerly winds continue all the year round.

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PACIFIC OCEAN

In the equatorial regions of the Paciiic the mean annual temperar- ture of the surface water is over 80Â°, except between 117Â° and 145Â° W., where a temperature of 75Â° to 80Â°, below the normal for the latitude, is found (Fig. 3). In the eastern Pacific the belt of high temperature lies wholly north of the equator, but in the west the temperature is over 80Â° from

Tempera’ ture.

Fig. 8. â€” Chart of the Mean Surface Temperature of the Pacific. {The numbers indicate degrees Falir.)

20Â° N. to 20Â° S., to the east of Australia. In higher latitudes the eastern Pacific is colder than the western, at least to the parallels of

40Â° N. and S., but beyond this the isothermals run almost due east and west. Beyond the tropics the north Pacific is everywhere colder than the north Atlantic, especi- ally in the east. In the open ocean the temperature everywhere falls from the surface downwards. The bottom temperature in the north Pacific averages 35‘1Â° ; south of the Sandwich Islands it is 35-0Â° ; in the Low Archipelago it is 35-1Â° ; and in 40Â° S. it. is 34‘7Â° in deep water. The isothermobaths of 50Â° to 70Â° rise nearer the surface in the equatorial regions, as in the Atlantic ; and in the north Pacific, as in the north Atlantic, warm water is found at greater depths in the west than in the east. The greatest excess in the lower levels is found south-east of Japan, where in 30Â° N. the temperature Is 60Â° in 200 fathoms. From this region temperature dimin- ishes in all directions; even at the equator the temperature at 200 fathoms is only 48Â°. The isother- mobaths sink farther below the surface near the equator, and temperatures are generally lower than in the Atlantic ; in 21Â° S. a temperature of 36 -5Â° occurs at a depth of 8-50 fathoms, compared with 1400 fathoms in the same latitude in the Atlantic. The characteristic feature of the temperature distribu- tion in the Pacific is the thinness- of warm surface layers compared with the enormous masses of cold water below, and this is specially marked in the north Pacific, where the surface layers having a temperature between 39Â° and 40Â° are not more than 20 to 30 fathoms in thickness, compared with 400 to 600 fathoms in the north Atlantic. The Pacific presents a further strong contrast with the Atlantic, inasmuch as the northern part is much colder than the southern. In the enclosed seas of the western Pacific temperature usually falls till a depth corre- sponding to that of the summit of the barriers which cut them off from the open ocean is reached, and below that point temperature is uniform to the bottom. In the Sulu Sea, for example, a temperature of 50-5Â° is reached at 400 fathoms, and this remains constant till the bottom is reached in 2500 fathoms. The surface waters of the north Pacific are relatively fresh, the

salinity being on the whole much lower than in the other great oceans. The saltest waters are found along a belt extending westwards from the American coast on the Tropic of salinity Cancer to 160Â° E. , then turning southwards to the ”

equator. North of this salinity diminishes steadily, especially to the north-west, the Sea of Okhotsk showing the lowest salinity observed in any part of the globe. South and east of the axis mentioned salinity becomes less to just north of the equator, where it increases again, and the saltest waters o,f the whole Pacific are found, as we should expect, in the south-east trade- wind region, the maximum occurring in about 18Â° S. and 120Â° W. South of the Tropic of Capricorn the isohalines run nearly east and west, salinity dimin- ishing quickly to the Southern Ocean. The bottom waters have almost uniformly a salinity of 34‘8 per mille, corresponding closely with the bottom waters of the south Atlantic, but fresher than those of the north Atlantic.

The surface currents of the Pacific (Fig. 4) have not been studied in the same detail as those of the Atlantic, and their seasonal variations are little known except in the monsoon tlo^ ‘ regions. Speaking generally, however, it may be said that they are for the most part under the direct control of the prevailing winds. The North Equatorial Current is due to the action of the north-east trades. It splits into two parts east of the Philippines, one division flowing northwards as the Kuro Siwo or Black Stream, the analogue of the Gulf Stream, to feed a drift circulation which follows the winds of the north Pacific, and finally forms the Californian Current flowing southwards along the American coast. Part of this rejoins the North Equatorial Current, and part probably forms the variable Mexican Current, which follows the coasts of Mexico and California close to the land. The Equatorial Counter-Current flowing eastwards is largely assisted during the latter half of the year by the south-west monsoon, and from July to Octo- ber the south-west winds prevailing east of 150Â° E. further strengthen the current, but later in the year the easterly winds weaken or even destroy it. The South Equa- torial Current is produced by the south-east trades, and is more vigorous than its northern counterpart. On reaching the western Pacific part of this current passes southwards, east of New Zealand,

Warm. Fig. 4.â€” Chart of the Cnirents of the Pacific.

and again east of Australia, as the East Australian Cmrent, part northwards to join the Equatorial Counter-Current, and during the north-east monsoon part makes its way through the China Sea towards the Indian Ocean. During the south-west monsoon this last branch is reversed, and the surface waters of the China Sea

probably unite with the Kuro Siwo. Between the Kuro Siwo and the Asiatic coast a band of cold water, with a slight movement to the southward, known as the Oya Siwo, forms the analogue of the "Cold Wall" of the Atlantic. In the higher latitudes of the south Pacific the surface movement forms part of the west wind-drift of the Roaring Forties. On the west coast of South America the cold waters of the Humboldt or Peruvian Current, corresponding to the Benguela Current of the south Atlantic, make their way northwards, ultimately joining the South Equa- torial Current. The surface circulation of the Pacific is, on the whole, less active than that of the Atlantic. The centres of the rotational movement are marked by "Sargasso Seas" in the north and south basins, but they are of small extent compared with the Sargasso Seas of the north Atlantic. Prom the known peculiarities of the distribution of temperature, it is probable that definite circulation of water is in the Pacific con- fined to levels very near the surface, except in the region of the Kuro Siwo, and possibly also in parts of the Peruvian Current. The only movement in the depths is the slow creep of ice-cold water northwards along the bottom from the Southern Ocean ; but this is more marked, and apparently penetrates farther north, than in the Atlantic. (jH. N. D.)

Paderborn, a town and episcopal see of Prussia, province of Westphalia, 63 miles east-north-east of Dort- mund by the railway to Hanover. The town hall (13th century) was restored in 1877-80, and the cathedral in 1891-93. There is a Eoman Catholic seminary, with faculties in theology and philosophy. Printing and brew- ing are carried on, besides a trade in wool, corn, and cattle. There are mineral springs

(65-5Â° Fahr.). Popu- lation (1885), 16,624; (1895), 19,980; (1900), 23,502.

Padron, a town of Spain, province of Corunna and diocese of Santiago, on the river ITlla, and on the Santiago- Carril railway. The population was 7662 in 1887 and 7287 in 1897. Eloods are frequent. The country around is mountainous, and produces wine, wheat, and fruit. There are manufactures of cotton and woollen goods. The estuary from the bridge of Cesures at Padron to the mouth of the TJlla, a distance of 10 miles, is now only accessible for vessels of light draught, coasters, and fishing boats. Padronwas one of the earliest Christian bishoprics. Normans and Saracens destroyed the ancient cathedral, of which only two towers and tie 13th-century portico are still standing.

Padua, a city and capital of the province of Padua, Venetia, Italy. Its industry has greatly developed, many new factories and mills having been founded and those already existing enlarged. Corn and saw mills, distilleries, chemical factories, breweries, candle- works, ink-works, foundries, agricultural machine and automobile works, have been established and are flourishing. The trade of the district has grown to such an extent that Padua has become the central market for the whole of Venetia. The increase of railway traffic has also been noteworthy. Whereas in 1886 Padua stood twelfth on the list of important stations of the Adriatic line, it now holds the seventh place with a net revenue of nearly Â£80,000 per annum. The traffic of secondary and interprovincial railways has correspondingly developed. The growth of population consequent upon this agricultural, indus- trial, and commercial advance has led to the extension of the inhabited area of the city. Population (1880),

70,753; (1900), 93,560.

Paducah, a city of Kentucky, U.S.A., capital of McCracken county. It is on the south bank of the Ohio river, at the mouth of the Tennessee, and on the Illinois Central and the Nashville, Chattanooga, and St Louis railways, in the western part of the state, at an altitude of 433 feet. Its trade is next in volume to that of Louisville in the state. Its traffic is in

part by rail, in part by river, as it is connected by steamboat lines with all Ohio and Mississippi river ports. It is one of the

largest tobacco markets, and contains many warehouses, and factories for its manufacture. There are also ship- yards and a marine railway. Population (1890), 12,797 ; (1900), 19,446, of whom 616 were foreign-bom and 5814 negroes.

Pagan, a subdivision and township of the Myingyan district of Upper Burma, 92 miles south-west by west of Mandalay. It was formerly for a period of four and a half centuries the capital of the Burmese empire. It was founded by King Pyinbya in a.d. 847, and remained the capital until the extinction of the dy- nasty in A.D. 1298. Pagan itself is a mere village now, but hundreds of pagodas in various stages of decay meet the eye in every direction. These are de- scribed in Yule's Mission to Ava. The bulk of the pagodas were built by King Anawra-hta, who overcame the Peguan king, Manuha of ThatSn. It was Anawra^- hta who introduced the Buddhist religion in Upper Burma, and he carried off nearly the whole Thaton popu- lation to build the pagodas at Pagan on the model of the Thaton originals.

Pagani, a town of the province of Salerno, Cam- pania, Italy, 12 miles north-west of Salerno by the railway to Naples. In the church is buried Alfonso de Liguori (1696-1787), founder of the order of the Ee- demptorists. It has cotton mills and macaroni factories ; vegetables are grown for export. Population (1881), 12,780; (1899), about 13,000.

Paget, Sir James, Babt. (1814-1899\ British surgeon, born at Yarmouth 11th January 1814, was the son of a brewer and shipowner. He was one of a large, family, and his brother Sir George Paget (1809-1892), who became regius professor of physic at Cambridge in 1872, also had a distinguished career in medicine, and besides these honours was made a K.C.B. He attended a day-school in Yarmouth, and afterwards was destined for the navy ; but this plan was given up, and at the age of sixteen he was apprenticed to a general practitioner, whom he served for four and a half years, during which time he gave his leisure hours to botanizing and made a great collection of the flora of East Norfolk. At the end of his apprenticeship he published with one of his brothers a

very careful Sketch of the Natural History of Yarmouth and its Neighbourhood. In October 1834 he entered as a student at St Bartholomew's Hospital. Medical students in those days were left very much to themselves ; there was no close supervision of their work, and it is probable that Paget gained rather than lost by having to fight his own way. He swept the board of prizes in 1835, and again in 1836; and in his first winter session he detected the presence of the Trichina srpiralis, a minute parasite that infests the muscles of the human body.^ In May 1836 he passed his examination at the Eoyal College of Surgeons, and became qualified to practise. The next seven years (1836^3) were spent in London lodgings, and were a time of poverty ; for he made only Â£16 a year by practice, and his father failed in business, and could not give him any help. He managed to keep himself by writ- ing for the medical journals, and preparing the catalogues of the hospital museum and of the pathological museum

1 This discovery is usually credited to Owen (g.Â«.) . The facts appear to be as follows. Paget was a first-year's student, and, by means of a pocket lens, found in the dissecting room that the specks in the infected muscles were parasitic worms and not, as previously thought, spicules of hone. Thomas Wormald, the senior demonstrator, who was no pathologist, sent a piece of the same muscle to Owen, who authorita- tively pronounced the specks to he parasites and gave them their scientific name. It is probable that Owen did not realize that Paget had already made the discovery, and it was naturally associated with the name of the professor.

of the Eoyal College of Surgeons. In 1836 he had been made curator of the hospital museiim, and in 1838 de- monstrator of morbid anatomy at the hospital ; but his advancement there was hindered by the privileges of the hospital apprentices, and by the fact that he had been too poor to afford a house-surgeoncy, or even a dressership. In 1841 he was made surgeon to the Finsbury Dispensary ; but this appointment did not give him any experience in the graver operations of surgery. In 1843 he was

appointed lecturer on general anatomy (microscopic anatomy) and physiology at the hospital, and warden of the hospital college then founded. For the next eight years he lived within the walls of the hospital, in charge of about thirty students resident in the little college. Besides his lectures and his superintendence of the resident students, he had to enter all new students, to advise them how td work, 'and to manage the finances and the general affairs of the school. Thus he was constantly occupied with the business of the school, and often passed a week, or more, without going outside the hospital gates. In 1844 he married Lydia, youngest daughter of the Rev. Henry North. In 1847 he was appointed an assistant- surgeon to the hospital, and Arris and Gale professor at the College of Surgeons. He held this professorship for six years, and each year gave six lectures in surgical pathology. (The first edition of these lectures, which were the chief scientific work of his life, was published in 1863.) In 1851 he was elected a Fellow of the Eoyal Society. In October 1851 he resigned the war- denship of the hospital. He had now become known as a great physiologist and pathologist; he had done for pathology in England what Virchow had done in Germany ; but he had hardly begun to get into practice, and he had kept himself poor that he might pay his share of his father's debts â€" a task that it took him four- teen years to fulfil. ,

It is probable that no famous surgeon, not even John Hunter, ever founded his practice deeper in science than Paget did, or waited longer for his work to come back to him. In physiology he had mastered the chief English, French, German, Dutch, and Italian literature of the subject, and by incessant study and microscope work had put himself level with the most advanced knowledge of his time ; so that it was said of him by Professor Owen, in 1851, that he had his choice, either to be the first physi- ologist in Europe, or to have the first surgical practice in London, with a baronetcy. His physiological lectures at the hospital were a chief cause of the raising again of its school, which in 1843 had gone down to a low point of its fortunes. In pathology his work was even more important. He fills the place in pathology that had been left empty by Hunter's death in 1793 â€" ^the time of transi- tion from Hunter's teaching, which for all its greatness was hindered by want of the modern microscope, to the pathology and bacteriology of the

present day. It is Paget's greatest achievement that he made pathology dependent, in everything, on the use of the microscope â€" especially the pathology of tumours. He and Virchow may truly be called the founders of modern pathology ; they stand together, Paget's Lectures on Surgical Patho- logy and Virchow's Cellular-PatJiologie. "When Paget, in 1851, began practice near Cavendish Square, he had still to wait a few years more for success in professional life. The " turn of the tide " came about 1854 or 1865 ; and in 1868 he was appointed surgeon extraordinary to Queen Victoria, and in 1863 surgeon in ordinary to the prince of Wales. He had for many yeats the largest and most arduous surgical practice in London. His day's work was seldom less than sixteen or seventeen hours. Cases sent to him for final judgment, with especial fre- quency, were those of tumours, and of all kinds of disease

of the bones and joints, and all "neurotic" cases having symptoms of surgical disease. His supremacy lay rather in the science than in the art of surgery, but his name is associated also with certain great practical advances. He discovered the disease of the breast and the disease of the bones (osteitis deformans) which are called after his name ; and he was the first at the hospital to urge enucleation of the tumour, instead of amputation of the limb, in cases of myeloid sarcoma.

In 1871 he nearly died from infection at a post-mortem examination, and, to lighten the weight of his work, was obliged to resign his surgeoncy to the hospital. In this same year he received the honour of a baronetcy. In 1875 he was president of the Eoyal College of Surgeons, and in 1877 Hunterian orator. In 1878 he gave up operat- ing, but for eight or ten years longer he still had a very heavy consulting practice. In 1881 he was president of the International Medical Congress held in London ; in 1880 he gave, at Cambridge, a memorable address on "Elemental Pathology," setting forth the likeness of cer- tain diseases of plants and trees to those of the human body. Besides his shorter writings, he published Lectures on Surgical Pathology (1863), Clinical Lectures and Essays (1st ed. 1876), and Studies of Old Case-Books (1891). In 1883, on the death of Sir George Jessel, he was appointed Vice-Chancellor of the University of London. In 1889 he was appointed

a member of the Eoyal Commission on Vaccination. He died on 30th December 1899, in his eighty-fifth year. Sir James Paget had the gift of elo- quence, and was one of the. most careful and most delight- ful speakers of his time. He had a natural and unaffected pleasure in society, and he loved music. He possessed the rare gift of ability to turn swiftly from work to play ; enjoying his holidays like a school-boy, easily moved to laughter, keen to get the maximum of happiness out of very ordinary amusements, emotional in spite of incessant self-restraint, vigorous in spite of constant over-work. In him a certain light-hearted enjoyment was combined with the utmost reserve, unfailing religious faith, and the most scrupulous honour. He was, all his life, profoundly indifferent toward politics, both imperial and medical; his ideal was the unity of science and practice in the professional life. (s. p.)

Pahang. See Malay States (Federated).

Paignton, a seaside invalid resort, in the Torquay parliamentary division of Devonshire, England, on Tor Bay, 2| miles south-west of Torquay by rail. The remains still exist of a palace of the bishops of Exeter. The Bible Tower, said to have been last occupied as a residence by Miles Coverdale, the translator of the Bible into English, consecrated bishop in 1551, has been again made habit- able. The church of St John the Evangelist is ancient, and contains interesting monuments. There is a novitiate of the Marist Fathers, a town hall, a science and art school, a cottage hospital, various public halls, and a promenade pier. In the neighbourhood cider is made in great quantities. Population (1891), 6783 ; (1901), 8385.

Painesville, a village of Ohio, U.S.A., capital of Lake county, on the Grand river, near the shore of Lake Erie and on three railways, in the north-eastern part of the state. Population (1890), 4765 ; (1900), 5024, of whom 499 were foreign-born and 179 negroes.

Painting. See Schools of Paixting.

Paisley, a municipal and parliamentary burgh of Eenfrewshire, Scotland, on the river Cart, 7 miles west by south of Glasgow by rail (5

stations). Borrowing powers for Â£130,000 were obtained in 1885-90 for the deepening of the Cart, which falls into the Clyde 3 miles below Paisley ;

but the scheme was abandoned in 1891 for the time, and the debt on the river is now Â£123,664. Meanwhile the trustees have equipped the harbour with steam cranes, and a railway siding has been formed in connexion with it. The ancient abbey is being restored. The town hall, pre- sented in 1882, cost Â£100,000. An observatory (1884- 1898), three United Free churches, a court house, two Roman Catholic churches, county buildings (1891), a new post office, an Established church, an Episcopal church, a grammar school and academy (1898), a technical school, a drill hall, a magnificent memorial (Baptist) church, a new (1899) infirmary (Â£75,000), and a fire station are included in the erections since 1884. Electric light has been introduced (1899). The Dunn Square (1892) and the old quarry grounds converted into a recreation ground are additions to the parks and open spaces. A statue of Burns was erected in 1896, and statues of Sir Peter and Mr Thomas Coats in 1898. Thread and cotton spinning continues to be the staple industry. Of 3008 males and 7453 females who in 1891 were engaged in textile fac- tories, 639 men and 5144 women were connected with the manufacture of cotton and linen, including thread. The thread mills form the governing factor in the combination which regulates the larger part of the thread trade of the world. Erom the shipbuilding yards in 1889, 15 vessels of 6423 tons were launched, and in 1899, 18 vessels of 8020 tons. The ISTeilson Endowed Institution had an average attendance in 1898-99 of 735. Population (1881),

65,638; (1891), 66,425 ; (1901), 79,356.

Pakhoi, a treaty port in the province of Kwangtung, China. The trade has declined rather than increased. In 1896 it reached a total of Â£773,636, whereas in 1900 the total was only Â£601,654; and it is probable that with the opening of the port of Kwang-chow-Wan and of the West river to steam traffic it will decline still moje. The preparation of dried fish is a specialty of Pakhoi, the fish being exported to Hong-

Kong. The population is estimated at 25,000. The French obtained a concession to build a railway from this port to Nanning on the West

Pakokku, a district in the Minbu division of Upper Burma, lying west of the Irrawaddy river and south of Mandalay, with the line of the Chin hills as a general boundary on the west. It has an area of 6210 square miles and a population of 311,959 (1891) ; 355,099 (1901). In 1898-99 there were 1364 villages in the district, pay- ing Es.8,22,535 revenue. The part of the district along the Irrawaddy and Chindwin rivers is peat and alluvial. Beyond this, however, the country rises gradually to the low Shinmadaung and Tangyi ridges, where it is very arid. To the westward there is a rapid drop to the well- watered valley of the Yaw river, and then a rise over broken, dry country before the valleys of the Myit-tha and Moln rivers are reached.. The principal products are millet, sesamum, and sugar produced from toddy-palms in the riverain districts, which also grow rice, grain, peas, and beans. Tobacco and vegetables are also produced in some quantity, and maize is grown largely for the sake of the husk, which is used for native cheroot-wrappers, under the name of yawpet. The Yenangyat oil-fields, which produce quantities of petroleum, are in the south of the district, and iron used to be worked in a small way. There were 1053 square miles of reserved forests in the district. A good deal of teak and cutch is worked out. The yaw cutch is particularly esteemed. The average rainfall does not exceed 35 inches annually, and in many places water has to be carted for miles. West of the Pondaung ridge, however, under the Chin hills, the rain- fall exceeds 60 inches. The heat in May and June is

very great, and the thermometer rises considerably above 100Â° F. in the shade; 110Â° is a common record during these months.

The great majority of the population is Burmese, but in Yaw there is a peculiar race called Taungthas, wlio claim to be quite distinct from both Burmese and Chins. The population in 1891 was classified thus: â€” Buddhists and Jains, 306,121; Hindus, 1665 ; Mahommedans, 1318 ; aborigines, Taungthas, and Chins, 2655 ; and Christians, 200. Of a total acreage of 3,974,147 there were 407,299 acres cropped in 1898-99. There were 492,223 acres available for cultivation, besides 19,898 acres

of current fallow ; 101,120 acres were under forest ; and 1,196,782 were not cultivated. The headquarters town, Pakdkku, stands on the right bank of the Irrawaddy, and has grown into importance since the British occupation. It is the great boat-building centre of Upper Burma. The population in 1898 was 19,972. It may be described as the emporium of the trade of the Chindwin and Yaw river valleys. The steamers of the Irrawaddy Flotilla Company call here regiilarly, ajid it is the starting-point for the vessels plying on the Chindwin.

Palacio Valdes, Armando (1853-

-), Spanish

novelist apd critic, was born at Entralgo, in the province of Asturias, on 4th October 1853. His first writings were printed in the Revista Europea. These were pungent essays, remarkable for independent judgment and refined humour, and found so much favour with the public that the young beginner was soon appointed editor of the Revista. The best of his critical work is collected in Los Oradores del Ateneo (1878), Los Novelistas espafloles (1878), Nuevo Viaje al Parnaso and La Literatura en 1881 (1882), this last being written in collaboration with Leopoldo Alas. In 1881 he published a novel, E. Sefiorito Octavio, which shows an uncommon power of observation, and the promise of better things to come. In Maria y Maria (1883), a portrayal of the struggle between religious vocation and earthly passion, somewhat in the manner of Valera, Palacio Valdes achieved a very popular triumph which placed him in the first rank of contemporary Spanish novelists. El Idilio de un Enfermo (1884), a most interesting fragment of autobiography, has scarcely met with the recognition which it deserves : perhaps because the pathos of the story is too sincere and unadorned. The publication of Pereda's Sotileza is doubtless responsible for the conception of Josi (1885), in which Palacio Valdes gives a realistic picture of the manners and customs of seafaring folk, creates the two convincing characters whom he names Jose and Leonarda, and embellishes the whole with passages of animated description barely inferior to the finest penned byPereda himself. The emotional imagination of the writer ex- pressed itself anew in the

charming story Riverita (1886), one of whose most attractive characters develops into the heroine of Maximina (1887) ; and from Maximina, in its turn, is taken the novice who figures as a professed nun among the personages of La Hennana San Stilpicio (1889), in which the love-passages between Zeferino Sanjurjo and Gloria Bermiidez are set off with elaborate, romantic descriptions of Seville. El Ciiarto Poder (1888) is, as its name implies, concerned with the details, not always edifying, of journalistic life. Two novels issued in 1892, Im Espuma and La Fe, were enthusiasti- cally praised in foreign countries, but in Spain their recep- tion was cold. The explanation is to be found in the fact that the first of these books is an avowed satire on the Spanish aristocracy, and that the second was construed into an attack upon the Roman Catholic, Church. During the acrimonious discussion which followed the publication of La Espuma, it was frequently asserted that the artist had improvised a fantastic caricature of originals whom he had never seen; yet as the characters in Coloma's Pequeneces are painted in darker tones, and as the very critics who were foremost in charging Palacio Valdes wifli

incompetenoe and ignorance are almost unanimous in praising Coloma's fidelity, it is manifest that the indict- ment against La Espuma cannot be maintained. Of late, Palacio Valdes has returned to his earlier and better manner in Los Majos de Cddiz (1896) and in La Algeria del Capitdn Ribot (1899), in both of which he contrives to

free himself from the reproach of undue submission to French influences. It can scarcely be said that he has fulfilled all the hopes that were once set upon him ; but nevertheless he takes a prominent place in modern Spanish literature as a keen analyst of emotion and a sympathetic, delicate, humorous observer.

PALJEOBOTA^Y.

IN the present article the subject of vegetable palaeonto- logy is treated from a botanical point of view. .The science of botany is concerned with the vegetable kingdom as a whole, and not merely with the flora now living. The remains of the plants of former periods, which have come down to us in the fossilized state, are almost always fragmentary, and often impesf ectly preserved ; but their \ investigation is of the utmost importance to the botanist, as affording the only direct evidence of the past history of vegetable organisms. Since the publication of the Origin of Species the general acceptance of the doctrine of evolu- tion has given a vastly increased significance to palseonto- logical data. The determination of the course of descent has now become the ultimate problem for the systematist : this is a historical question, and the historical documents available are the remains of the ancient organisms pre- served in the rocks. The palaeobotanist thus endeavours to trace the history of plants in the past, with the hope of throwing light on their natural affinities and on the origin of the various groups. His investigations must embrace not only the comparative morphology and anat- omy of fo'ssil plants, but also their distribution over the earth's surface at different periods â€" a part of the subject which, besides its direct biological interest, ,has obvious bearings on ancient climatology and geography.

Preservation. â€" Before considering the results of palseobotanical research, some account must be given of the way in which the evidence is presented, or, in other words, of the modes of preserva- tion of vegetable remains. These fall under two main heads. On the one hand, there is the mode of preservation which gives rise to oasts, moulds, and generally impressions, exhibiting the super- ficial features of the specimen. The great majority of vegetable fossils are of this kind, and the term incrustation is used as a general term to cover all such methods of fossilization. On the other hand, there are specimens in which the tissues of the plant have been permeated by some "mineral in solution, which, subse- quently setting hard, has fixed and preserved the internal structure, often with astonishing perfection of detail. This second method of fossilization is termed petrifaction. In the case of incrustation the whole substance of the fossilized specimen â€" e.g., a stem of Sigillaria â€" may be replaced by mineral matter, such as

sandstone or sljale, giving a cast of the whole, on the outer surface of which the external markings, such as the bases of leaves and the scars left by their fall, are visible in their natural form. Usually the original organic substance remains as a thin carbonaceous layer forming the surface of the cast, but sometimes it has entirely disappeared. The surrounding matrix will of course show the mould of the cast, with its elevations and depressions reversed. In the case of thin, tlat organs such as leaves, the whole organ may be spread out in the plane of stratification, leaving its impress on the overlying and underlying layers. Here there has not necessarily been any replacement of organic by inorganic material ; the whole leaf, for example, may remain, though reduced to a carbonaceous film. In such carbonaceous impression, not only are the form and markings, such as venation, perfectly preserved, but something of the actual structure may remain. The cuti- cularized epidermis, especially, is often thus preserved, and may be removed by the use of appropriate reagents and examined microscopically. If sporangia and spores are present, they also may persist in a perfectly recognizable form, and in fact much of our knowledge of the fructification of fossil Ferns has been derived from specimens of this kind.

In many cases internal casts have been formed, some large cavity, such as a fistular pith, having become filled with mineral substance, which has taken the impress of the surrounding structures, sucji as the wood. The common casts of Calamites are of this nature, representing the form of the hollow medulla,

and bearing on their surface the print of the nodal constrictions and of the ridges and furrows on the inner surface of the wood. The whole organic substance may have been removed, or may persist merely as a thin carbonaceous layer. Mistakes have often arisen from confusing these medullary casts with those of the stem as a whole.

Although some information as to minute structure may occasionally be gleaned from the carbonaceous coating of im- pressions, the fossils preserved by petrifaction are the main source of our knowledge of the structural characters of ancient plants. The chemical bodies which

have played the most important part as agents of petrifaction are sUioic acid and calcium carbonate, though other substances, such as piagnesium carbonate, calcium sulphate, and ferric oxide have also been con- cerned, either as the chief constituents of petrifactions, or mixed with other bodies. A large number of the most important remains of plants with structure preserved are silicious ; this is the case, for example, with the famous French Permo-Carbon- iferous fossils of St lEtienne, Autun, &c., which in the hands of Brongniart, Renault, and others have yielded such brilliant scientific results. At a more recent horizon, the silicified speci- mens of the Mesozoic Gymnosperms from Great Britain, France, and especially North America, are no less important. Calcified specimens are especially characteristic of the British Carboniferous formation ; their preservation is equally perfect with that of the silicified fossils, and their investigation by Witham, Binney, Williamson, and others has proved no less fertile. In the Coal Sleasures of England and of certain German districts {e.g., Langendreer in Westphalia) calcareous nodules, crowded with vegetable fragments of every kind, occur in certain mines em- bedded in the substance of the coal and representing its raw material in a petrified condition. Even the most delicate tissues, such as cambium and phloem, or even the endosperm of seeds, are frequently preserved cell for cell, both in calcareous and silicious material. As a rule, the petrified remains, all-im- portant for the revelation of structure, are fragmentary, and give little idea of the habit or external characters of the plants from which they were derived. Hence they must be brought into relation with the specimens preserved as casts or impressions, in order to gain a better conception of the plant as a whole. This is often a difficult task, and generally the fragmentary nature of practically all vegetable fossils is the chief hindrance to their investigation. Owing to this, it has become the common practice of palseobotanists to give distinct generic names to detached parts of plants which may even have belonged to one and the same species. Thus the roots of Sigillaria are called Stigmaria, detached leaves Sigillariophyllum, and the fructifica- tions Sigillariostrobus ; the name Sigillaria applies to the stem, which, however, when old and partly decorticated has been called Syringodendron, while its woody cylinder has often been described under the name Dijjloxylon. This naming of

portions of plants, however objectionable, is often not to be avoided ; for detached organs constantly have to be described long before their relation to other parts is established â€” which, indeed, may never be accomplished. For example, the form and structure of Stigmaria have long been well known, but it has so far proved impossible to determine which Stigmarise belonged to the genus Sigillaria and which to Lepidodendron. The correct piecing togeflier of the fragmentary remains is one of the first problems of the palseo- botanist, and the gradual disappearance of superfluous names affords a fair measure of the progress of his science. The recent advance of fossil botany has depended in a very great degree on the study of petrified specimens with their structure preserved ; so far, at least, as the older strata are concerned, it is, as a rule, only with the help of specimens showing structure that any safe conclusions as to the affinities of fossil plants can be arrived at.

The subject of coal is treated elsewhere (see Coal, Ency. Brit. vol. vi.). Here it need only be said that the masses of vegetable substance, more or less carbonized and chemically altered, of which coal is composed, frequently contain cells and fragments of tissue in a condition recognizable under the microscope, as for example spores (sometimes present in great quantities), elements of the wood, fibres of the bark, &c. These remnants, however, though interesting as revealing something of the sources of coal, are too

fragmentary and imperfect to be of any botanical importance. In lignite, on the other hand, the organized structure is sometimes excellently preserved. In the Wealden of Belgium, for example, specimens of Ferns and Conifers occur, in the form of lignite, â€¢which can be sectioned, like recent plants, with a razor, and exhibit an almost unaltered structure.

I. PaLvBOZOIC.

The present section is concerned with the botany of the Palaeozoic age, from the oldest rocks in which vegetable remains have been found up to the close of the Permian period. The Glossopteris flora of India and the southern hemisphere, the age of which has been disputed, but is often regarded as Permo-Carboniferous, is, however, dealt with in the succeeding section, in connexion with the Mesozoic floras. The various groups of plants repre- sented in the Palaeozoic rocks will first be considered in systematic order, after which some account will be given of the succession and distribution of the various floras during the period.

In dealing with the plants of such remote epochs, the relative importance of the various groups, so far as they are known to us, is naturally very different from that which they assume at the present day. There is no evidence that the Angiospermous flowering plants, now the dominant class, existed during the Palaeozoic period ; they do not appear till far on in the Mesozoic epoch, and their earlier history is as yet entirely unknown. On the other hand, Gymnosperms were abundant, though belong- ing almost entirely to families now extinct, while the Pteridophyta attained a development far exceeding in every respect anything that they can now show. Among the lower classes of plants we have scarcely any know- ledge of Palaeozoic Bryophyta; Pungi were probably abundant, but their remains give us little information ; while well-characterized specimens are scanty among the Algae, whicli, however, are better represented.

With few. exceptions, the remains Â«f Palaeozoic Algse are of comparatively little botanical interest. A vast number of Alzee "species" have been described, but, as has been

‘ said, ” by far the greater number of the supposed

fossil Algse have no claim to be regarded as authentic records of this class of Thallophytes ” (Seward, 1898). The investigations of Nathorst, Williamson, and others have shown that a very large proportion of the casts and impressions attributed to Algse had in all probability a totally

different origin. Some represent the tracks or burrows of worms, crustaceans, or other animals ; others, the course of rills of water on a sandy or muddy shore ; others, again, the marks left on the bottom by bodies drifted along by the waves. In cases of doubt, evidence may be obtained from traces of organic structure, from the presence of carbonaceous matter, or, as Zeiller has pointed out, by the remains of animals such as Bryozoa being attached to the cast, showing that it represents a solid body and not a mere cavity or furrow. Evi- dence from traces of organization is alone conclusive ; the presence of carbonaceous matter, though a useful indication, may be deceptive, for the organic substance may have been derived from other sources than the body which left the impression. The mere external form of the supposed Algae is rarely so char- acteristic as to afford satisfactory evidence of their nature. Some of the better-attested examples, among which are a few of con- siderable interest, may now be considered. Of Cyanophyceee, as we should expect, the Palseozoio remains are very doubtful. Gloioconis, found -by Renault in a coprolite of Permian age, is regarded by him as a Cyanophycean allied to Glxoeapsa ; this may be so, but the argument which he draws from the absence of nuclei, considering the extreme rarity of recognizable nuclei even in the best-preserved fossil tissues, can hardly be taken seriously. Oirvanella, found in Cambrian, Ordovician, and Silurian rocks, as well as in later deposits, appears to have played a part in the origination of oolitic rock-structure. It consists of minute interwoven tubular filaments, and has been variously interpreted as possibly representing the sheaths of a Cyanophycean Alga, and as constituting a Siphonequs thallus of the type of the Codiess. The non-cellular order Siphonese is fairly well represented in Palaeozoic strata, especially by cal- careous verticillate forms referable to the family Dasycladese ; the separate tubular joints of the articulated thallus, bearing the prints of the whorled branches, are sometimes cylindrical

(Arthroporella, Vermiporella, &o.), sometimes oval (Sycidium) or spherical {Cyclocrimis) . These forms, and others like them, go back to the Silurian and Ordovician ; while Gyroporella, from the Permian, is another fairly characteristic Siphoneous type. There can be no doubt that the verticillate Siphonese, a group much isolated among recent

organisms, are among the most ancient families [of plants. The gigantic Nematophycus, to be described below, has been regarded as having Siphoneous afl&nities. Little trace of Confervaceae has been found ; Conferoites chantransioides, apparently consisting of branched cellular filaments, may perhaps represent a Cambrian Confervoid. Cladiscothallus, from the Culm of Russia, in which the filaments are united to form hemispherical or globular tufts, has been compared by Renault to a Chxtophora. This is one of the somewhat doubtful Algae occurring in boghead coal or torbanite, a carbonaceous rock the nature of which has been much disputed, in the law courts as well as in scientific literature. The bogheaxi of Scotland, Autun, and New South Wales is regarded by Renault and Bertrand as mainly composed of gelatinous Algae {Pila and Meinschia), having a hollow, saccate thallus formed of a single layer of cells. It is diflScult to believe that a body containing 65 per cent, of carbon can be so largely made up of gelatinous Algae in a comparatively little altered condition ; even the organic nature of the supposed thalli is not absolutely beyond doubt. Scarcely anything is known of Palaeozoic Florideae ; Solenopora, ranging from the Ordovician to the Jurassic, resembles, in the structure of its thallus, with definite zones of growth, Corallinaceae such as Lithothamnion, and may probably be of the same nature. A branched filamentous organ- ism from the Lower Carboniferous of Scotland, described by Kidston under the name of BythotrepMs worstoniensis, shows some remains of cellular structure, and may probably be a true Alga, resembling some of the filamentous Florideae in habit.

Apart from the multitude of supposed fossil Algae described as ” Puooids,” but usually not of Algal nature, and never presenting determinable characters, very little remains that can be referred to Palaeozoic Brown Algse. The most striking of all fossil Algae, however, Nematophycus, may possibly be a Phaeophyoean. The first species of the genus, Nematophycus Logani, was discovered by Dawson in 1856 in the Lower and Middle Devonian of Canada, and was described by him as a Conifer under the name of Prototaxites. Carruthers, however, in 1872 established its Algal nature, and gave it the more appropriate name of Nematophycus. In N. Logani the stem, which is found in a

silicified state, may be as much as 3 feet in diameter. The tissue is made up of large, unseptate, occasionally branching tubes, with an undulating vertical course, among which much smaller tubes are irreguarly interwoven. Radially placed gaps in the tissue (erroneously interpreted at first as medullary rays, but subsequently more aptly compared to the air-spaces of large Algae) contain very sparse hyphse, which here branch more freely than elsewhere. The concentric rings of growth, which form a characteristic feature, are due to periodic variations in the size of the larger tubes. Transverse septa have occasionally, but rarely, been detected in the smaller hyphae. Penhallow maintains that these smaller tubes arise as branches from the larger, but other ob- servers have failed to confirm this. In N. Storriei, from the Silurian (Wenlock) of South Wales, described by Barber, there is no sharp differentiation of the two kinds of tubes ; they are rarely observed to branch, except in the gaps, which in this species are not radially directed. In N, Ortoni (Penhallow), from the Devonian of Canada, the tubes are quite uniform, and there are no spaces or concentric rings.' The tubes have their cavity dilated at intervals, and Penhallow has therefore com- pared them with the trumpet-hyphse of Laminariaceae; but no tranverse septa are anywhere visible. Several other species have been described. Carruthers compared the usually non- cellular structure of Nematophycus with that of Siphonese such as Halimeda, while recognizing the points of resemblance to Laminariaceae {e.g., Lessonia) in the dimensions of the stem and its concentric rings of growth. Later writers, influenced by the occasional occurrence of transverse walls in the smaller hyphse, have laid more stress on Laminariaceous afSnities. The existence of these gigantic Algse in Palaeozoic times, attested by such well- preserved specimens, is a fact of great interest, though their systematic position is still an open question. Fachytheca, a spherical organism, usually about the size of a small pea, found in rocks of Silurian and Devonian age, has been much investi- gated and discussed, without any decisive light having been thrown on its nature. It was once regarded as connected with Nematophycus (with which it sometimes occurs in association), possibly as its fructification. For this view, however, there is no evidence, though the tissues of the two fossils are somewhat similar. Fachytheca is formed of cellular filaments resembling those of a Cladophora,

irregularly interwoven in the central region, radiating towards the periphery, and often forked. In one case the spherical thallus was found seated in a cup-like

receptacle. There can be little doubt of the Algal nature of the fossil, but beyond this it is impossible at present to carry its determination.

On the whole, it cannot be said that the Palaeozoic remains have as yet thrown much light on the evolution of the Algae, though we may not be prepared to maintain, with Zeiller, that plants of this class appear never to have assumed a form very different from that which they present at the present day.

The first evidence for the existence of Palseozoio Bacteria was obtained in 1879 by Van Tieghem, who found that in silioifled Bacteria "^^getable remains from the Coal Measures of St iltienne the cellulose membranes showed traces of subjection to butyric fermentation, such as is produced at the present day by Bacillus Amylobacter ; he also claimed to have detected the organism itself. Since that time a number of fossil Bacteria, mainly from Palaeozoic strata, have been described by Renault, occurring in all kinds of fossilized vegetable and animal dgbris. The supposed 3Iicrococci present little that is characteristic ; the more definite rod-like form of the Bacilli offers a better means of recognition, though far from an infallible one ; in a few cases dark granules, suggestive of endospores, have been found within the rods. On the whole, the occurrence of Bacteria in Palaeozoic times â€" so probable a priori â€" may be taken as established, though the attempt to discriminate species among them is probably futile.

Pungi were no doubt abundant among Palaeozoic vegetation. In examining the tissues of fossil plants of that epoch, nothing is more common than to meet with mycelial hyphss in ""^^ and among the

cells; in many cases the hyphae are septate, showing that the higher Fungi (Mycomy cetes) , as dis- tinguished from the more algoid Phycomycetea, already existed. An endophytic Fungus of the latter group {Feronosporites anti- quarius, W. Smith) bears very definite terminal, or intercalary, spherical vesicles, which may probably be regarded as repro- ductive organs â€” either oogonia or sporangia. A minute Fungus bearing sporangia, found by Renault in the wood of a Lepi- dodendron, and named by him Obchytrium lepidodendri, is re- ferred with much probability to the Chytridinese. Small spores, almost certainly those of Fungi, are very common in the petrified tissues of Palaeozoic plants. Spherical sacs, bearing forked spines, described by Williamson under the name of Zygosporites, are frequent, usually in an isolated state. Mr Seward, however, has found a, Zygosporites in situ, terminating an apparently fungal hypha : he suggests a possible comparison with the mould Mucor. Bodies closely resembling the perithecia of Sphaeriaceous Fungi have often been observed on impressions of Palaeozoic plants, and may probably belong to the group indicated. Conoeptacles con- taining spores, and strongly suggesting the perithecia of some Pyrenomycetous Fungus, have recently been found, in petrified material, on the leaves of an Alethopteris, which appears to have undergone decay before fossilization set in. The few and incom- plete data which we at present possess as to Palaeozoic Fungi do not as yet justify any inferences as to the evolution of these plants. The writer is not aware of any evidence for the occurrence of Palaeozoic Lichens.

The important class of the Bryophyta, which, on theoretical grounds, is commonly regarded as more primitive than the Pteridophyta, is as yet '^Â°" ^ ' scarcely represented among known fossils of Palaeozoic age. In the Lower Carboniferous of Scotland Mr Kidston has found several specimens of a large dichotomous thallus, with a very distinct midrib; the specimens, referred to the provisional genus Marcliantites, much resemble the larger thalloid Liverworts. Similar fossils have been described from still older rocks. In one or two cases Palaeozoic plants resembling the true Mosses in habit, have been discovered ; the best example is the Musdtes polytrichaceus of Renault and Zeiller, from the Coal Measures of Commentry. In the absence, however, both of

reproductive organs and of anatomical structure, it cannot be said that there is at present conclusive evidence for the existence of either Hepaticee or Musci in Paleeozoic times.

Our knowledge of the Vascular Cryptogams of the Palaeozoic period is more extensive than of any other class of plants, and in fact it is here that the evidence of Palaeontology first becomes of essen- tial importanoe to the botanist. They extend back through the Devonian, possibly to the Silurian system, but the systematic summary now to be given

Pteri- dophyta.

[pALiozoio

is based primarily on the rich materials .afforded by the Carboniferous and Permian formations, from which our detailed knowledge of Palaeozoic plants has been chiefly derived.

In addition to the three classes, Equisetales, Lyeo- podiales, and Filicales, under which recent Pteridophytes naturally group themselves, a fourth class, Spheno- phyllales, existed in Palaeozoic times, related to the Horsetails on the one side and to the Club-mosses on the other, but with peculiarities of its own demanding an independent position. We further find that, whereas the Perns of the present day form a well-defined and even isolated class, this was not the case at the time when the Primary rocks were deposited. A considerable number of Paleeozoic plants, showing evident affinity to Perns, have proved to exhibit at the same time characters common to Gymnosperms, especially Cycads. This interesting group of plants will be treated as an appen- dix to the Filicales, under Potonie's name of Cycado- filices. The arrangement which we shall adopt for the Palaeozoic Pteridophyta is therefore as follows : â€" I. Equisetales. II. Sphenophyllales.

III. Lycopodiales.

IV. Filicales, with the Cycadqfilices.

The last-named group appears to form the natural tran- sition to the Gymnosperms which follow. We must bear in mind that throughout the Palaeozoic period, and indeed far beyond it, Vascular plants, so far as the existing evidence shows, were represented only by the Pteridophyta and Gymnosperms. Although the history of the Angiosperms may probably go much farther back than present records show, it is certain that they played no considerable part in Palaeozoic vegetation. Consequently, the Pteridophytes and Gymnosperms had the field to themselves, so far as regards the higher plants, and filled places in nature which 'have now for the most part been seized on by families of more modern origin. Hence it is not surprising to find that the early Vascular Crypto- gams were, beyond comparison, more varied and more highly organized than their displaced and often degraded successors. It is among the fossils of the Palseozoie rocks that we first learn the possibilities of Pteridophytic organization.

I. Equisetales. â€" This class, represented in the recent Flora by the single genus Equisetum, with about twenty species, was one of the dominant groups of plants in Car- boniferous times. The Calamarieae, now known to have been the chief Palaeozoic representatives of the Horsetail stock, attained the dimensions of trees, reaching, accord- ing to Grand' Eury, a height of from 30 to 60 metres, and show in all respects a higher and more varied organization than their recent successors.

Their remains occur in three principal forms of preservation : (1) carbonaceous impressions of the leafy branches, the fructifi- cations, and other parts ; (2) casts of the stem ; these are usually internal or medullary casts, as described above. Around the cast the organic tissues may be represented by a carbonaceous layer, on the outer surface of which the external features, such as the remains of leaves, can sometimes be traced. More usually, however, the carbonaceous film is thin, and merely shows the impress of the medullary cast within ; (3) petrified specimens of all partsâ€" stem, roots, leaves, and fructiflcations^showing the internal structure, more or less perfectly preserved. The correla- tion of these various remains presents considerable difficulties. Casts surrounded by wood, with its structure

preserved, have sometimes been found, and have established their true relations. The position of the branches is shown both on casts and in petrified specimens, and has helped in their identification, while the petrified remains sometimes show enough of the external char- acters to allow of their correlation with impressions. Fructifications have often been found in connexion with leafy shoots, and the anatomical structure of the axis in sterile and fertile specimens has proved a valuable means of identification.

In habit the Calamarieae appear to have borne, on the whole, a general resemblance to the recent Equisetacese, in spite of their enormously greater bulk. The leaves were constantly in whorls, and were usually of comparatively small size and of simple form. In the_ oldest known Calamarian, however, Archceocalamites (Devonian and Lower Carboniferous), the leaves were repeatedly forked. There is evidence that in some, at least, of the Calam- ariesB the leaves of each verticil were united at the base to form a sheath. The free lamina, however, was always considerably more developed than in the recent family ; in form it was usually linear, or narrowly lanceolate. Different genera have been founded on leaf-bearing branches of Calamariess ; apart from Archceocalamites, already mentioned, and Autophyllites (Grand' Eury), in both of which the leaves were dichotomous, we have Annularia, Astero- phyllites, and Calaniocladus (in Grand' Eury's limited sense), \vith simple leaves. In some species of Annularia the extremely deli- cate ultimate twigs, bearing whorls of small lanceolate leaves, give a characteristic habit, suggesting that they may have belonged to herbaceous plants ; other Annulariaa, however, have been traced with certainty into connexion with the stems of large Calamites. In Asterophyllites, the generic distinction of which from Annularia is not always clear, the narrow linear leaves are in crowded whorls, and the ultimate branches distichously arranged ; in the Calam- ocladus of Grand' Eury â€" characteristic of the Upper Coal Meas- uresâ€" the

whorls are more remote, and the twigs polystiohous in arrangement. In all these groups a leaf-sheath has been recognized. The distribution of the branches on the main stem shows con- siderable variations, on which genera or sub-genera have been founded by C. E. Weiss. In Archaeocalamites, which certainly deserves generic rank, the branches may occur on every node, but only in certain parts of the stem ; the ribs of successive in- ternodes do not alternate, but are continuous, indicating that the leaves were superposed. Using Calamites as a generic name for all those Calamarian stems in which the ribs alternate at the nodes, we have, on Weiss's system, the following sub-genera : â€" Stylocalamites, branches rare and irregularly arranged ; Cala- mitina, branches in regular verticils, limited to certain nodes, which surmount specially short intemodes ; Eucalamites, branches present on every node. These distinctions can be recognized on petrified specimens, as well as on the casts, but their taxonomic value is somewhat doubtful. In many Calamites there is evidence that the aerial stem sprang from a horizontal rhizome, as in the common species C. {Stylocalamites) Suckowi; in other specimens the aerial stem had an independent, rooting base.

The anatomical structure of all parts of the plant is now known, in various Calamarieae, thanks more especially to the work of Williamson in England and of Renault in France. The stem has a structure which may be briefly characterized as that of an Equisetum with secondary growth In thickness (Fig. 1, Plate). The usually fistular pith is surrounded by a ring of collateral vascular bundles (see Anatojiy of Plants, and Pteridophyta), each of which, with rare exceptions, has an intercellular canal at its inner edge containing the disorganized spiral tracheae, just as in the recent genus. The cortex is often preserved ; in certain oases it was strengthened by hypodermal strands of fibres, as in Equisetum. It is only in the rare cases where a very young twig is preserved that the primary structure of the stem is found unaltered. In all the larger specimens a broad zone of wood, with its elements in radial series, had been added. This secondary wood, in the true Calamites (Arthropitys, Goeppert), has a simple structure com- parable to that of the simplest Coniferous woods ; it is made up entirely of radial bands of tracheides interspersed with medullary rays. The

pitting of the tracheides is more or less scalariform in character, and is limited to the radial walls. In favourable cases remains of the cambium are found on the outer border of the wood, and phloem is also present in the normal position, though it does not seem to have attained any considerable thickness. In the old stems the primary cortex was replaced by periderm, giving rise to a, thick mass of bark. The above description applies to the stems of Calamites in the narrower sense (Arthropitys of the French authors) to which the specimens from the British Coal Measures mostly belong. Archceocalamites appears to have had a similar structure, but in some specimens from the Lower Carbon- iferous of Burntisland, perhaps referable to this genus, centri-petal wood was present in' the stem. In Calamodendron (Upper Coal Measures) the wood has a more complex structure than in Calamites, the principal rays including radial tracts of fibrous tissue, in addition to the usual parenchyma. Artlirodendron (Lower Coal Measures) approaches Calamodendron in this respect. The longitudinal course of the vascular bundles and their relation to the leaves in Calamariese generally followed the Equisetum type, though more variable and sometimes more complex. The attach- ment of the branches was immediately above the node, and usually between two foliar traces, as in the recent genus. Where the structure of the leaves is preserved it proves to be. of an extremely simple type ; the narrow lamina is traversed by' a single vascular

bundle, separated by a sheath from the surrounding palisade-parenchyma. Stomata of the usual structure have been detected in the epidermis.

The roots (formerly described as a separate genus, Astromyelon) were borne directly on the nodes, not on short lateral branches as in Equisetum. They are of similar structure in all known Cala- marieae, the main roots having a large pith, while the rootlets had little or none. The structure is in all respects that typical of roots, as shown by the centripetal primary wood, and the alternation of xylem and phloem groups observable in exceptionally favourable young specimens. A striking feature is the presence of large, radiating intercellular cavities in the cortex, suggesting an aquatic habit.

A considerable number of Calamarian fructifications are known, preserved, some as carbonaceous impressions, others as petrified specimens, exhibiting the internal structure. In many cases the cones have been found in connexion with branches bearing charac- teristic Calamarian foliage. Almost all strobili of the Calamarieae are constrncted on the same general lines as those of Equisetum, with which some agree exactly ; in most, however, the organization was more complex, the complexity consisting in the intercalation of whorls of sterile bracts, between those of the sporangiophores. In several cases heterospory, unknown among recent Equisetacese, has been demonstrated in their Palaeozoic representatives.

Four main types of structure may be distinguished among Cala^ marian strobili.

1. Calamostachys, Schimper. Here the whorls of peltate spor- angiophores alternate regularly with those of sterile bracts, the former being inserted on the axis

midway between the latter (Fig. 2). The sporangiophores, which are usually half as numerous in each verticil as the bracts, have the same form as in Equisetum, but each bears four sporangia only. The spores are frequently found to be still united in tet- rads. In some species, e.g., the British C. binneyana, numerous specimens have been examined and only one kind of spore ob- served ; here, then, there is a strong presumption that the spe- cies was homosporous. In other cases, however, e.g., C. casheana, s" . Will., two kinds of spore occur, sm. in difierent sporangia, but on the same strobilus and even on the ,^_,

same sporangiophore. The mega^ "â– " !"â€¢

spores, of which there are many ig- 2. â€" Calamostachys. Diagram- in the megasporangium, have a ""Â° longitudinal section of the diameter about three times that of the microspores. The abor- tion of certain spores, which is known to have taken place both in the homosporous C binneyana and in the megasporangia of C. casheana, may throw some light on the origin of the heterosporous condition. The bracts were sometimes coherent in their lower part (e.g., C. binneyana), some-

times free (e.g., C. Lugwigi) ; in all cases their free extremities formed a protection to the fertile whorl above. In some Conti- nental species (e.g., C. Grand' Euryi, Ren.) radial membranous plates hung down from each verticil of bracts, forming compart- ments in which the subjacent sporangiophores were enclosed. The anatomy of the axis is essentially similar to that of a young Cala- marian twig, with some variations in detail. Strobili of the Cala- mostachys type occur in connexion both with Aymularia and Asterophyllites foliage.

2. PalcEostachya, Weiss. Here, as in the previous genus, sterile and fertile verticils are ranged alternately on the axis of the cone. The only difference is that in Palxostachya the sporangiophores, instead of standing midway between the whorls of bracts, are inserted immediately above them, springing, as it were, from the axil of the sterile verticil (Fig. 3, A). This singular arrangement suggests doubts as to the correctness of the current interpretation of the Equisetaceous sporangiophore as a modified leaf (cf. Chei- rostrobus below). In all other respects the two genera agree; there is evidence for the occurrence of heterospory in some strobili referred to Falmostachya. The anatomy of the axis is that of a young branch of a Calamite. According to Grand' Eury, the Palceostachya fructification was most commonly associated with Asterophyllites foliage. The external aspect of a Palxostachya is shown in Fig. 4 (Plate).

3. Equisetum type of strobilus. In certain cases the strobili of Palseozoic- Calamarieae appear to have had essentially the same organization as in the recent genus, the axis bearing sporangio-

cone, showing the axis (ax) bearing alternate whorls of bracts (ftr) and peltate sporangiophores (sp) with their sporangia (.sm). The upturned tips of the bracts are only shown in every alternate verticil.

pliores only, without intercalated bracts. It is remarkable that fructifications of this kind have been found by Renault in close association with the most ancient of the Calamariese â€” Arehaio-calamites. In these strobili the peltate scales, like the vegetative leaves of the plant, are in superposed verticils ; each appears to have borne four sporangia (Fig. 3, B). Other cones, however, namely, those known as Pothocites, have also been attributed on good grounds to the genus Archxocalamites ; they are long strobili,

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Fig. 3.â€” a, PalcRostachya. Dia^ammatic longitudinal section of cone, showing the axis {ax) bearing the bracts (6r) with peltate sporangiophores {sp) spring- ing from their axils ; sm, sporangia. B, Areh(soealamite8, Part of cone, showing the axis {ax} bearing peltate sporangiophores (sp) without bracts ; Â«m, sporangia. {After Renault) {Scott, ” StudieB.^^)

constricted at intervals, and it is probable that here the succession of fertile sporangiophores was interrupted here and there by the intercalation of sterile bracts. Cones from the Middle Coal Meas- ures, described by Kidston under the name of Equisetum Heming- wayi, but probably belonging to one of the Calamariese, bear a striking external resemblance to those of a recent Equisetum.

4. Gingularia, Weiss. This form of strobilus, from the Coal Measures of Germany, is imperfectly known, and its relation to Calamariese not beyond doubt. In the lax strobili the sporangio- phores, which are not peltate, but strap-shaped, were borne, according to Weiss, immediately below the verticils of bracts, the position thus being the reverse of that in Palaeostachya.

The Palaeozoic Calamariese, though so far surpassing recent Equisetacese, both in stature and complexity of organization, clearly belonged to the same class of Vas- cular Cryptogams. There is no satisfactory evidence for attributing Phanerogamic af&nities to any

members of the group, and the view, of which Williamson was the chief advocate, that they form a homogeneous Cryptogamic family, is now fully established.

II. Sphenophyllales. â€” The class of Sphenophyllhles, as known to us at present, is of limited extent, embracing the two genera Sphenophyllum and CJieirostrobus, which may serve as types of two families within the class. The characters of Sphenophyllum are known with some completeness, while our knowledge of Cheirostrobus is confined to the fructification ; the former will therefore be described first.

1. Sphenophyllum. â€” The genus Sphenophyllum, of which a number of species have been described, ranging probably from the Middle Devonian, through the Carboniferous, to the Permian, consisted of herbaceous plants of moderate dimensions. The long, slender stems, somewhat tumid at the nodes, were ribbed, the ribs running continuously through the nodes, a fact correlated

with the superposition of the whorled leaves, the number of which in each verticil was some multiple of 3, and usually 6. In the species on which the genus was founded the leaves, as the generic name implies, are ouneate, entire, or toothed on their anterior margin ; 'â– in other cases they are deeply divided by dichotomy into narrow segments, or the whorl consists of a larger number (up to 24) of apparently simple, linear leaves, which may represent the segments of a smaller number. The different forms of leaf may occur on the same plant, the deeply divided foliage often characterizing the main stem, while the cuneate leaves were borne on lateral shoots. A comparison, formerly suggested, with the two forms of leaf in Batrachian Ranunculi has not proved to hold good ; the idea of an aquatic habit is contradicted by the anatomical structure, and the hypothesis that the plants were of scandent growth is more probable. The species of Sphenophyllum have a graceful appearance, which has been compared with that of the trailing Galiums of hedgerows. Branches sprang from the nodes, though perhaps not truly axil- lary in position. The cones, more or less sharply differentiated, terminated certain of the branches.

The anatomy of the stem of Sphenophyllum, investigated by Renault, Williamson, and others, is highly characteristic (Fig. 5, Plate). The stem is traversed by a single stele, with solid wood, without pith ; the primary xylem is triangular in section, the spiral elements forming one or two groups at each angle, while the phloem occupied the bays, so that the structure resembles that of a triarch root. The leaf-trace bundles started from the angles of the stele, and forked, in passing through the cortex, to supply the veins of the leaf, or its subdivisions. The cortex was deeply furrowed on its outer surface. The primary structure is only found unaltered in the youngest stems ; secondary growth by means of a cambium set in very early, xylem being formed internally and phloem externally in a perfectly normal manner. At the same time a deep-seated periderm arose, by which the primary cortex was soon entirely cut off. The secondary wood in the Lower Carboniferous species, S. insigne, has scalariform tracheides, and is traversed by regular medullary rays, but in the forms from later horizons the tracheides are reticulately pitted, and the rays are for the most part replaced by a network of xylem-parenchyma. There are no recent stems with a structure like that of Sphenophyllum; so far as the primary structure is concerned, the nearest approach is among the Psiloteae, with which other characters indicate some affinity. The diarch roots of a Sphenophyllum have been described by Renault, who has also investigated the leaves ; they were strongly constructed mechanically, and traversed by slender vascular bundles branch- ing dichotomously.

Fructification. â€” WiUiamson thoroughly worked out, in petrified specimens, the organization of a cone which he named Bowmanites Dawsoni; it was subsequently demonstrated by Zeiller that this fructification belonged to a Sphe- nophyllum, the cones of the well-known species 8. cuneifolittm having a practically identical structure. The type of fructifica- tion described by Williamson and now named Sphenophyllum Daw- soni consists of long cylindrical cones, in external habit not unlike those of some Calamariese. The axis, which in structure resembles the vegetative stem in its primary condition, Itears numerous ver- l. ticils of bracts, those of each ” verticil being coherent in their lower part, so as to form a disc or cup from the margin of

which the free limbs of the bracts arise. The sporangia, which are about twice as numerous as the bracts, are seated singly on pedicels or sporangiophores springing from ”

the upper surface of the bract- ‘^^^â– â€”Sp’ienophynvm Dawsoni. verticil, near its insertion on the feXr^SstSI^”! axis (Fig. 6). As a rule two spor- sporangiophores, each bearing a angiophores belong to each bract. sporangium, sm ; br\ whorl of The sporangium is attached to “â„¢’=” ’” â„¢”’^’”=’ ”’“‘â€¢ the enlarged distal end of its pedicel, from which it hangs down, so as to suggest an anatropous ovule on its funiculus. Dehiscence appears to have taken place at the free end of the sporangium ; the spores are numerous, and, so far as observed, of one kind only. Each sporangiophore is traversed throughout its length by a vascular bundle connected with that which supplies

1 Sometimes the leaves in a whorl were of unequal size ; see Fig. 3.

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the subtending bract. This form of fructification appears, from Zeiller's researches, to have been common to several species of Sphenophyllum, but others show important differences. Thus Bowmanites Bomeri, a fructification fully investigated by Solms-Laubach, differs from 8. Dawsoni in the fact that each sporan-giophore bears two sporangia, attached to a distal expansion approaching the peltate scale of the Equisetales. It is thus proved that the sporangiophore – is not a mere sporangial stalk, but a distinct organ, in all probability representing a ventral lobe of the subtending bract. In Sphenophyllum majus, where the cones are less sharply defined, the forked bract bears a group of four sporangia, but their mode of insertion has not yet been made out.

2. Cheirostrobeoe. â€" The family CheirostrobecB is only known from a petrified fructification (Cheirostrobus pettycurensis) derived from the Lower Carboniferous of Burntisland in Scotland. The excellence of the preservation has, however, rendered it possible to investigate the complex structure in detail. The cone is of large size â€" 3-5 cm. in diameter ; the stout axis bears numerous whorls of compound sporophylls, the members of successive verticils being superposed. The sporophylls, of which there are twelve in a whorl, are each composed of six segments, three being inferior or dorsal, and three superior or ventral. The dorsal segments are sterile, corresponding to the bracts of Spheno- phyllum Dawsoni, while the ventral segments constitute peltate sporangiophores, each bearing four sporangia, just as in a Calamarian fructification (Fig. 7). The great length and slender

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Ax.

Fig. 7. â€” Clteirostrobus. Diagram of cone, the upper part in transverse, the lower in longitudinal section. In the transverse section six sporophylls, each showing three segments, are represented. Sp.a, section through sterile segments ; Sp.b, section through sporangiophores ; st, laminse of sterile seg- ments; /, peltate expansions of sporangiophores ; ftm, sporangia; ^.&, vascular bundles ; cy, stele of axis (Ax), In the longitudinal section the corresponding parts are shown. (^coU, ^^ S^udieB,^^)

proportions of the segments give the cone a peculiar character, but the relations of position appear to leave no doubt as to the homologies with the fructification of Sphenophylleae ; as regards the sporangiophores, Bowmanites Bomeri occupies exactly the middle place between S. Dawsoni and Cheirostrobus. The axis of the cone in Cheirostrobus contains a dodecarch stele, with solid wood, from the angles of which vascular bundles pass out, dividing in the cortex, to supply the various segments of the sporophylls. In the peduncle of the strobilus secondary tissues are formed. While the anatomy has a somewhat Lycopodia- ceous character, the arrangement of the appendages is altogether that of the Sphenophylleae ; at the same time Calamarian affin- ities are indicated by the characters of the sporangiophores and sporangia.

The Sphenophyllales as a whole are best regarded as a synthetic group, combining the characters of the Lycopods and Equisetales, -while showing marked peculiarities of their own. Among existing plants their nearest affinities would appear to be with the Psiloteae, -as indicated not

merely by the anatomy, but much more strongly by the way in which the sporangia are borne. There is good reason to believe that the ventral synangium of the Psiloteae corresponds to the ventral sporangiophore with its sporangia in the Sphenophyllales. Professor Thomas of New Zealand has brought forward some interesting

variations in Tmesipteris which appear to afford additional support to this view.

III. Lycopodiales. â€” In Palaeozoic ages the Lycopods formed one of the dominant groups of plants, remarkable alike for the number of species and for the great stature which many of them attained. The best known of the Palaeozoic Lycopods were trees, reaching 100 feet or more in height, but side by side with these gigantic representar fives of the class, small herbaceous Club-mosses, resem- bling those of the present day, also occurred. Broadly speaking, the Palaeozoic Lycopods, whatever their dimen- sions, show a general agreement in habit and structure with our living forms, though often attaining a much higher grade of organization. We will first take the arborescent Lycopods, as in every respect the more important group. They may all be classed under the one family Lepidoden- drese, which is here taken to include Sigillaria.

Lepidodendreoe. â€” The genus Zepidodendron, with very numerous species, ranging from the Devonian to the Permian, consisted of trees, with a tall upright shaft, bearing a dense crown of dioho- tomous branches, clothed with simple narrow leaves, ranged in some complex spiral phyllotaxis. In some cases the foliage is preserved in situ; more often, however, especially in the main stem and larger branches, the leaves had been shed, leaving behind them their soars and persistent bases, on which the characteristic sculpturing of the Lepidodendroid surface depends. The cones, often of large size, were either terminal on certain of the smaller twigs, or borne laterally on special branches of con- siderable dimensions. In the latter case the cones have left peculiar marks on the fertile branches, for which special genera have been founded. At its base the main stem terminated in dichotomous roots or rhizophores, bearing numerous rootlets. To these underground organs the name Stigmaria is applied ; they are not clearly distinguishable from the corresponding parts of Sigillaria. The numerous described species of Lepidodendron are founded on the peculiarities of the leaf-cushions and scars, as shown on casts or impressions of the stem. The usually crowded leaf-cushions are spirally arranged, and present no obvious ortho- stiohies, thus differing from those of Sigillaria. Each

leaf-cushion is slightly prominent; towards its upper end is the diamond-shaped or triangular scar left by the fall of the actual leaf (Eig. 8). On the scar are three prints, the central one alone representing the vascular bundle, while the lateral prints (parichnos) mark the position of merely parenchymatous strands. In the median line, immediately above the leaf-scar, is a print re- presenting the ligule, or rather the pit in which it was seated. On the flanks of the cushion, below the scar, are two superficial prints, perhaps comparable to lenticels. In the genus Lepidophloios the leaf -cushions are more prominent than in Lepidodendron, and their greatest diameter is in the transverse direction ; on the older stems the leaf -scar lies towards the lower side of the cushion. The genus Bothrodendron, going back to the Upper Devonian, differs from Lepidodendron in its minute leaf-scars and the absence of leaf-cushions, the scars being flush with' the smooth surface of the stem. In the Lower Carboniferous of central Russia beds of coal occur consisting of the cuticles of a Bothrodendron, which are not fossilized, but retain the consistency and chemical composition of similar tissues in recent plants.

The anatomy of Lepidodendron is now well known in a number of species ; the Carboniferous rocks of Great Britain are especially rich in petrified specimens, which formed the subject of William- son's extensive investigations. The stem is in all cases mono- stelic; in mosfr of the forms the central cylinder underwent secondary growth, and the distinction between primary and secondary wood is very sharply marked. In L. Harcourtii, how- ever, the species earliest investigated (b^ Witham, 1833, and

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Fig. 8.â€" Leaf-base of a Zepidoden- dron, S.C., sear left by the leaf; â– u.ft., print of vascular bundle ; p, p, parichnos ; I, ligule ; a, a, superficial prints below scar. (After Siur.) (ScoU, â€¢â€¢Studies.")

Brongniart, 1837), no secondary wood has yet been found. The primary wood of Lepidodendron forms a. continuous cylinder, not broken up into distinct bundles ; its development was clearly cen- tripetal, the spiral elements forming more or less prominent peri- pheral groups. In the larger stems of most species there was a central pith, but in certain of the smaller branches, and throughout the stem in some species (i. rhodumnense, L. selaginoides) , the wood was solid. A single leaf-trace, usually collateral in structure, passed out into each leaf. The primary structure of the stem was thus of a simple Lycopodiaoeous type, resembling on a larger scale what we find in the upright stem of Selaginella spinosa. In most species {e.g. L. selaginoides, L. wunschianum, L. veltheimianum) secondary growth in thickness took place, and secondary wood was added, in the centrifugal direction, showing a regular radial arrangement, with medullary rays between the series of traoheides (Fig. 9). The tissue thus formed often attained a considerable thickness. While primary phloem can be recognized with certainty in favorable cases, the question of the formation of secondary phloem by the cambium is not yet fully cleared up. In the Lepi- dodendron fuliginosum of Williamson, shown by its leaf-bases to

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Fig. 9. â€” Lepidod&ncl/ron veltheimianum. Transverse section of stem, p, pith, almost destroyed ; x, zone of primary wood ; pa^, protoxylem ; a:, secondary â– wood ; ph phloem and pericycle ; hi\ stele of a branch ; pd, periderm ; l.b^ leaf-bases. The primary cortex between stele and periderm has perished, x-ij, (Scott, ” Studies.’”)

have been a Lepidophloios, the secondary wood is very irregular, and consists largely of parenchyma. The occurrence of secondary growth in these plants, demonstrated by Williamson’s researches, is a point of great interest. Some analogy among recent Lyco- pods is afforded by the stem of Isoetes, and by the base of the stem in Selaginella spinosa ; in the fossils the process was of a more normal type, but some of its details need further investigation. The cortex, often sharply differentiated into sclerotic and paren- chymatous zones, is bordered

externally by the persistent leaf-bases. The development of periderm was a constant feature, and this tissue attained a great thickness, consisting chiefly of a phelloderm, pro- duced on the inner side of the formative layer.

The most interesting point in the structure of the leaf-base is the presence of a ligule, like that of Isoetes or Selaginella, which was seated in a deep pit, opening on the upper surface of the cushion, just above the insertion of the lamina. The latter shows marked xerophytic adaptations ; the single vascular bundle was surrounded by a sheath of short traoheides, and the stomata were sheltered in two deep furrows of the lower surface.

The cones of Lepidodendron and its immediate allies are for the most part grouped under the name Lepidostrobns. These cones, varying from an inch to a foot in length, according to the species, were borne either on the ordinary twigs, or on the .special branches (Ulodendron and lialonia) above referred to. In Ulodendron the large circular, distichou.sly arranged prints appear to have been

10. â€" L&pidostrohus. Diagram of cone, in longitudinal section, ax, axis, bearing the sporophylls (aph), on each of which a. spor- angium (sm) is seated ; Ig, ligule. The upper sporangia contain numerous microspores ; In each of the lower sporangia four megaspores are shown.

formed by the pressure of the bases of sessile cones, while in the Halonial branches characteristic of the genus XepidtopAZoios the tu- bercles mark the points of insertion of pedunculate strobih. The organization of Lepidostrobns Is essentially that of a Lycopodia- oeous cone. The axis, which in anatomical structure resembles a vegetative twig, bears numerous spirally arranged sporophylls-, each of which carries a single large sporangium on its upper sur- face (Fig. 10). The sporophyll, usually al- most horizontal in posi- tion, has an upturned lamina beyond the spor- angium, and a shorter dorsal lobe, so that the form of the whole is somewhat peltate. A ligule is present im- mediately below the lamina, its position showing that the whole of the elongated hori- zontal pedicel on which ,the sporangium is seated, corresponds to

the short Yia. base of a vegetative leaf. The sporangia, usually of very large size compared with those of most re- cent Lycopods, have a palisade-like outer wall,

and contain either an immense number of minute spores or a very small number of exceedingly large spores (Fig. 10). It is very doubtful whether any homosporous Lepidostrobi existed, but there is reason to believe that here, as in the closely allied Lepidocarpon, microsporangia and megasporangia were in some cases borne on different strobili. In other species (e.g., in the cone attributed to the Lower Carboniferous Lepidodendron velt- heimianum) the arrangement was that usual-in Selaginella, the microsporangia occurring above and the megasporangia below in the same strobilus (diagram. Fig. 10). The genus Spen- cerites (Lower Coal Measures) differs from Lepidostrobns mainly in the insertion of the sporangium, which, instead of being attached along the whole upper surface of the sporophyll, was only connected with it by a small neck of tissue towards the distal end. The spores of this genus are curiously winged, and intermediate in size between the microspores and megaspores of Lepidostrobns ; the question of homospory or heterospory is not yet decided. A more important deviation from ordinary Lepido- stroboid structure is shown by the new genus Ijepidocarpon, from the English Coal Measures and the Lower Carboniferous of Scotland. ‘ In this fructification the organization is at first . iâ€ž altogether that of a

Lepidostrobus ; in each megasporangium, how- ever, only a single megaspore came to maturity, occupying almost the whole of the sporangia! cavity, but accompanied by the remains of its three abortive sister cells. An integument grew up from the superior surface of the sporophyll, completely enveloping the spor- angium, except for a narrow crevice left open along the top. In favourable cases the prothallus is found preserved, within the â– ^“‘â– . V.~-“15’.’?“â„¢r‹’” ₣“,”””^*- Pl^rammatio functional megaspore

and

section of “seed” in plane tangential to the ,

parent strobilus. fiph, sporophyll ; vb, its vas- *^” emoryo-sac,

oular bundle; i, integument; m, mlcropylar the whole appearance,

crevice ; a, base, sm, wall of sporangium ; mg, especially as seen in a

membrane of functional megaspore, which is â€ž_â€ž,:â€žâ€ž tâ€žâ€žâ€žâ€ž_f:â€ži +â€ž

filled by the prothallus, y-r. section tangential, to

the strobilus, is then remarkably seed-like (see diagram. Fig. 11). The seed-like body was detached as a whole from the cone, and in this condition has been known for many years under the name of Cardiocarpon anomalum, having been wrongly identified with a true Gymnospermous seed so named by Carruthers. The analogies with the seed are obvious ; the chief difference is in the micropyle, which is not tubular, but forms a

long crevice, running in a direction radial to the strobilus. Lepidoearpon affords a striking instance of homoplastic modifica- tion, for there is no reason to suppose that the Lycopods were on the line of descent of any existing Spermophyte. In a male cone, probably belonging to Lepidoearpon Lomaxi, the microsporangia are provided with incomplete integuments.

Sigillaria. â€” The great genus Sigillaria, even richer in “species” than Lepidodendron, ranges throughout the Carbon- iferous, but has not yet been detected in earlier rocks. The Sigillarise, like the Lepidodendra, were large trees, but must have differed from those of the previous group in habit, for they appear to have branched sparingly or not at all, the lofty upright shaft terminating, like some modern

Xanthorrhcea, in a great sheaf of long, grass-like leaves. The strobili were stalked, and borne on the main stem, among the leaves. The roots, or at least their functional representatives, resembled those of Lepido-dendron. The chief distinctive character of Sigillaria lies in the arrangement of the leaf-scars, which form conspicuous vertical series on the surface of the stem. In one great division of the genus â€" the Eusigillarise â€" the stems are ribbed, each rib bearing a vertical row of leaf-scars ; the ribbed Sigillarise were formerly

divided into two sub – genera â€" Ehyti- dolepis, with the scars on each rib rather widely spaced, and Favu- laria, where they are approximated and separated by transverse furrows, each rib thus con-sisting of a series of contiguous leaf- bases. This distinc- tion, however, has proved to have no constant taxonomio value, for both arrangements may occur on different parts of the same specimen. The species without ribs â€" Subsigillarise â€" were in like manner grouped under the two sub – genera Clathraria and Leiodermaria ; in the former each scar is seated on a prominent cushion, while in the latter the surface of the stem (as in Bothro- dendroh) is perfectly smooth. Here also the distinction has proved not to hold good, S. Brardi, for example, showing both conditions on the same stem. All these names, however, are still in use as descriptive terms. Generally, the Eusigillarise are charac- teristic of the older Carboniferous strata, the Subsigillariaa of the Upper Coal Measures and Permian. The leaf-scars throughout the genus show essentially the same prints as in Lepidodendron, differ- ing only in details, and here also a ligule was present (Fig. 12).

The anatomy of Sigillaria is not so well known as that of Lepidodendron, for specimens showing structure are rare, a fact which may be correlated with the infrequency of branching in the genus. The structure of a Clathrarian Sigillaria {S. Menardi), from the Permian of Autun, was accurately described by Brong- niart as long ago as 1839, and a similar species, 8. spinulosa (= S. Brardi) was investigated by Renault in 1875, but it was long before we had any trustworthy data for the anatomy of the ribbed forms. This gap in our knowledge has now been partially filled up, owing especially to Bertrand's

investigation of a speci- men referred by him to S. elongata. The structure of the ribbed Sigillarise, as at present known, essentially resembles that of a medullate Lepidodendron, though the ring of primary wood was narrower. Its outer margin was crenulated, the leaf-traces being given off from the middle of each bay. Secondary wood was formed in abundance, precisely as in most species of Lepidoden-dron. In the Subsigillarian species S. Menardi the primary wood is broken up into distinct bundles, while in S. spinulosa their separation is sometimes incomplete. The secondary cortex or periderm attained a great development, and in some cases shows considerable differentiation. On the whole, the anatomy of Sigil- laria is closely related to that of the preceding group, and in fact a continuous series can be traced from the anatomically simplest species of Lepidodendron to the most modified Sigillarice. The leaves of Sigillaria are practically identical in structure with those of Lepidodendron. The nature of the fructiflcation of Sigillaria was first satis-

FiG,]2. â€” Sigillaria Brardi. showing five leaf-scars, bundle ; pa, parichnos ; Ig, ligule. Weiss.) {Scott, * Studies.^)

Part of surface of stem,

tjb, print of vascular

â– ” â– X 11/2. {After

factorily determined in 1884 ijy Zeiller, who found the character- istic Sigillarian leaf-scars on the peduncles of certain large strobili (Sigillariostrobus) . The cones, of which several species have been described, bear a strong general resemblance to Lepido- strobus, differing somewhat in the form of the sporophylls and some other details. The megaspores (reaching 2 mm. or more in diameter) were found lying loose on the sporophylls by Zeiller; the sporangia containing them were first observed by Kidston, in a species from the Coal Measures of Yorkshire. That the cones were heterosporous there can be no doubt, though little is known as yet of the microsporangia. The discovery of Sigillariostrobus, which was the fructification of SubsigillarisB as well as of the ribbed species, has finally determined

the question of the afBnities of the genus, once keenly discussed ; Sigillaria is now clearly proved to have been a genus of heterosporous Lycopods, with the closest affinities to Lepidodendron.

Stigmaria. â€” On present evidence there is no satisfactory dis- tinction to be drawn between the subterranean organs of Sigil- laria and those of Lepidodendron and its immediate allies. These organs, still known by the name Stigmaria given them by Brong- niart, have been found in connexion with the upright stems both of Sigillaria and Lepidodendron. In the Coal Measures they commonly occur in the underclay beneath the coal-seams. Com- plete specimens of the stumps show that from the base of the agrial stem four Stigmarian branches were given off, which took a horizontal or obliquely descending course, forking at least twice. These main Stigmarian axes may be 2 to 3 feet in diameter at the base, and 30 or 40 feet in length. Their surface is studded with the characteristic scars of their appendages or rootlets, which radiated in all directions into the mud. Petrified specimens of the main Stigmaria are frequent, and those of its rootlets extraor- dinarily abundant. The two parts are very different in structure : in the main axis, as shown in the common Coal Measure form Stigmaria flcoides, the centre was occupied by the pith, which was surrounded by a zone of wood, centrifugally developed throughout. In other species, however, the centripetal primary xylem is represented. Phloem, surrounding the wood, is recognizable in good specimens; in the cortex the main feature is the great development of periderm. The rootlets, which branched by dichotomy, contain a slender monarch stele exactly like that in the roots of Isoetes and some Selaginellce at the present day. The morphology of Stigmaria has been much discussed ; possibly the main axes, which flo not agree perfectly either with rhizomes or roots, may best be regarded as comparable with the rhizophores of Selaginella; the homologies of the appendages with the roots of recent Lycopods appear manifest. It has been maintained by some palseobotanists that the aerial stems of Sigillaria arose as buds on a creeping rhizome, but the evidence for this conclusion is as yet unconvincing.

LycopoditecB. â€” Under the name Lycopoditece are included those Palaeozoic Lycopods â€” for the most part referred to the provisional

genus Lycopodites â€” which from their habit appear to have been herbaceous plants ; such specimens occur occasionally from the Devonian onwards. While some have uniform spirally arranged leaves, like most species of the recent Lycopodium, others have tetrastichous, dimorphic foliage, such as is usually found in Sela- ginella, though it must be remembered that a similar arrangement exists in certain species of Lycopodium. In some cases the sporangia of Lycopodites have been recognized, borne either on special sporophylls forming definite strobili (e.g., L. StocJdi), or on ordinary leaves (e.g., L. ciliatus), as in the recent Lycopodium Selago. A form described by Zeiller, from the French Upper Coal Measures, closely resembles Selaginella, both in the foliage and the arrangement of the sporangia. The megaspores were, however, more numerous in each sporangium than in the recent genus. Miadesmia, English Lower Coal Measures, discovered by Bertrand, is the only member of the Lycopoditese so far found with structure preserved. In the presence of a ligule and other points there is here also an approach to the organization of Sela- ginella. Some evidence has been adduced for the heterospory of Miadesmia ; the megasporangia attributed to it appear to present some analogies with those of Lepidoearpon. Although our know- ledge of the Lycopoditeas is very imperfect, their existence in Palseozoic times makes it probable that the recent genera i^co- podium and Selaginella may have been derived from forms which have always been herbaceous, rather than by reduction from the aboresoent Lepidodendre*. There is, however, some evidence that Isoetes, which in several points agrees most nearly with the latter group, may actually represent its last degenerate survivors. (See Pleuromeia, in section II., Mesozoic.)

IV. Filicales. â€” Of all Vascular Cryptogams, the Ferns have best maintained their position down to the present day. The class was well represented in the Palaeozoic period, when, indeed, it was relatively, and perhaps

absolutely, far richer in species even than in the recent Flora. The great majority of specimens of fossil Ferns are preserved in the form of carbonaceous impressions of fronds, often of remarkable perfection and beauty. The characters shown by such specimens, however, when, as is usually the case, they are in the barren state, are notori- ously unstable, or of small taxonomic value, among recent Ferns. Hence palseobotanists have found it necessary to adopt a purely artificial system of classification, based on form and venation of the frond, in the absence of adequate data for a more natural grouping/ The well-known form- genera Pecopteris, Sphenopteris, Odontopteris, &o., are of this provisional nature. In the meantime, however, a number of Palaeozoic fern-fructifications have been brought to light, often in connexion with the fronds that bore them, and such discoveries, aided in some cases by the observation of anatomical characters in the petrified speci- mens, have afforded the basis for a more natural arrange- ment, though as yet this is very incomplete. In habit the Palaeozoic Ferns show as great variety as their recent allies : most, no doubt, were herbaceous plants, with a creeping or upright rhizome ; some were climbers, using larger plants as supports ; while many were tree-ferns, often of large size, and resembling the tree-ferns of the present day, though, as we shall see, of very different affinities. In the great majority the fronds were com- pound, perfectly comparable to the typical fern-fronds of to-day ; then, as now, a certain number of simple-leaved forms were present. In one respect the fronds of many PalaBozoic Ferns were peculiar, namely, in the presence in their rachis, and at the base of their pinnae, of anomal- ous leaflets, often totally different in form and venation from the ordinary pinnules. These curious appendages (AphlebicB), at first regarded as parasitic growths, have been compared with the feathery outgrowths which occur on the rachis in the Cyatheaceous genus Hemitelia, and with the anomalous pinnules found in certain species of Oleichenia, at the points of bifurcation of the frond.

Marattiacece. â€” A large number of the Palseozoic Filices show indications â€” more or less decisive â€” of Marattiaceous afi&nities ; some account of this group will first he given. The reference of these

ferns to the family Marattiacese, so restricted in the recent Flora, rests, of course, primarily on evidence drawn from the fructifications. Typically Marattiaceous sori, consisting of ex- annulate sporangia united to form synangia, are frequent, and are almost always found on fronds with the character of Peco- pteris, large, repeatedly pinnate leaves, resembling those of Cyatheacese or some species of Nephrodium. In certain oases the anatomical structure of these leaves is known, and found to agree generally with that of recent coriaceous fern-fronds. The petiole was usually traversed by a single vascular bundle, hippo- erepiform in section â€" a marked point of difference from the more complex petioles of recent Marattiacefe. There is evidence that in most cases these Peoopteroid fronds belonged to tree-ferns, the stems on which they were borne reaching a height of as much as 60 feet. These stems, known as Megaphytum when the leaves were in two rows, and as Oaulopteris in the case of poly- stichous arrangement, are frequent, especially in the Permian of the Contiaent ; when petrified, so that their internal structure is preserved, the name Psaronius is employed. Their structure is a complex one, the central region containing an elaborate system of numerous anastomosing steles, accompanied by sclerenchyma ; the cortex is permeated or coated by a multitude of adven- titious roots, forming a thick envelope to the stem. The whole structure bears a general resemblance to that of recent Maratti- aoese, though differing in detail. We will now describe some of the fructifications, which are grouped under generic names of their own ; these genera, as having a more natural basis, tend to supersede the artificial groups founded on vegetative characters. The genus Asterotheca includes a number of Ferns, chiefly of Coal Measure age, with fronds of the Peco-pterU type. The sori, or synangia, ranged in two series on the under-side of the fertile pinnules, are circular, each consisting of 3 to 6 sporangia, at- tached to a central receptacle and partly united to each other (Fig. 13, A) ; the sporangia separated when mature, dehiscing by a ventral slit. Stur's genus Hawlea (Fig. 13, II), char- acterized by the separation of the sporangia, may only represent

an advanced stage of an Asterotheca. In Ptychocarpus the fusion of the sporangia to form the synangium was much more complete ; Scolecopteris Tesemhles Asterotheca, but each synangium is stalked. In

all these genera there is an obvious similarity to the synangia of Kaulfussia, while in some respects Marattia or Dawxa is approached. In another Pecopteroid genus, Sturiella, the syn- angia resemble those of Asterotheca, but each sporangium is provided with a band of enlarged cells of the nature of an annulus (Fig. 13, D). As a similar differentiation, though less marked, appears in the recent genus Angiopteris, the presumption is in favour of the Marattiaceous afflnities of Sturiella. In the genus Danceites, from the Coal Measures of the Saar, the synangia are much like those of the recent Danma, each sporangium opening by an apical pore. In the Grand' Eurya of Stur the sporangia appear to have been free from each other, as m Angio- pteris. On the whole there is thus abundant evidence for the frequency of Marattiacea! in the Paleozoic period, and there can be no doubt that this group of Eusporangiate Ferns was far more prominent then than in any later fiora. In a certain number of genera the reference to Marattiacese is much more doubtful. In

Fig. 13. â€" Group of PalEeozoic Forn-fructifications. A, Asterotlig^^a, 1, Pinnule bearing 8 synangia ; 2. synangium in side view ; 8, in section, magnified.

B, Ee-naulUa. 1, Fertile Pinnule, nat. size ; 2. sporangium, enlarged.

C, Vactylotheea, as in B. D, Sittriella. Section of pinnule and synangium. a, vascular bundle; o, hairs; &, d, annulus, m.agnified. E. Oligocarpia. Sorus in surface-view, magnified. F, O'oasothcea. Fertile pinnule, bearing several tufts of sporangia, mni^^nitled. G, Sen/tenbergia. Group of annulate sporangia, magnified. H, Hiucfen. Synangium after dehiscence, magnified. J, Wmatopieris, 1, Part of fertile pinna, nat. size : 2, sporaniria. showing apical pores, magnified. {After various authors.) (Scott, "studies.")

Bactylotheca, for example (Fig 13, C), a Pecopteroid genus, ranging throughout the Carboniferous, the elongated sporangia individually resemble those of Marattiacese, but they are com- pletely isolated, the characteristic grouping in sori being absent ; the same remark applies to the Sphenopteroid Fern Eenatdtia of Zeiller (Fig. 13, B) ; the foliage of Sphniopteris, one of the most extensive of Palfeozoic frond-genera,

with many different types of fructification, resembled that of various species of A^plenimn or DavaUia. In many Ferns of this period the fronds were dimorphic, the fertile leaves or pinnÂ» having a form quite difierent from that of the vegetative portions. This was the case in Urnato- pteris (Kidston), with Sphenopteroid sterile foliage ; the sporangia, borne on the filiform pinnules of the fertile rachis, appear to have dehisced by an apical pore (Fig. 13, J) suggesting Maratti- aceous analogies. Another curious dimorphic genus is Crosso- thrra, Zeiller (Fig. 13, F), with the sterile fronds either of Peco- pteris or Sphenopteris, according to the species; the sporangia, according to Zeiller's interpretation, hung down from the edges of the fertile pinnules. Here we have no clue to the affinities. The magnificent Devonian Fern Palceopteris hibernica, with a

somewhat Adiantiform habit, bore specially fertile pinnie ; the fructification is still imperfectly understood, but the presence of stipules, observed by Kidston, has been adduced in support of Marattiaceous affinities.

Other Families. â€" The MarattiaceÂ» are the only recent family of Ferns which can be said to have existed in anything like its present form in Palaeozoic times. Of other recent orders the indications are meagre and dubious, and there can be no doubt that a large proportion of Ferns from the older rocks belonged to families quite distinct from any which we recognize in the Flora of our own day. Little or nothing is known of Palaeozoic Ophio- glossacese ; a species of the genus Bhacopteria, from the Lower Carboniferous, which had somewhat the habit, though not the morphology, of a Sotrychium, has been referred to this family on insufficient grounds, and other indications are also doubtful. Certain fructifications have been referred to Gleicheniacete {OUgocarpia, Fig. 13,. E), Sohizxacex (Senftenbergia, Fig. 13, G), Hymenophyllaceae, and Osmundacese, and on good grounds, so far as

the external characters of the sporangia are concerned ; our knowledge of the Ferns in question is, however, far too in- complete to justify us in asserting that they actually belonged to the families indicated. Numerous more or less isolated fern- sporangia occur in the petrified material of the Carboniferous formation ; the presence of an annulus is a frequent character among these specimens, while synangic sori are rare ; it is thus certain that families remote from the Marattiaceas were abun- dantly represented during this period.

Botryoptericlem. â€” The family Botryopteridece, first discovered by Renault, stands out with striking clearness among the Palseozoic Ferns, and differs widely from any group now in existence. The Botryopteridem are chiefly known from petrified specimens ; in the two genera Botryopteris and Zygopteris we have a fairly complete knowledge of all parts of the plant. The type-genus Botryopteris, represented both in the Permo-Carboniferous of France and in the Coal Measures' of Great Britain, had a rhizome, with a very simple monostelic structure, bearing spirally-arranged compound leaves, with lobed pinnules, probably of a somewhat fleshy texture. In the French species, B. forensis, the plant was covered with characteristic jointed hairs, which have served to identify the various organs on which they occur. The Sporangia were large pyriform sacs, shortly stalked, and borne in tufts on the branches of the fertile rachis, which developed no lamina. Each sporangium had, on one side only, a longitudinal or slightly oblique annulus, several cells in width ; the numerous spores were all of the same size ; certain dift'erences among them, which have been interpreted as indi- cating heterospory, have now proved to depend merely on the state of pre- servation. The genus Zygopteris, of which several Carboniferous and Per- ^, â€ž ^ . . mian species are known, likewise had

^T, "vTulfof ^0,~~fngT ?n a monostelic stem, but the structure surface view. B, Single of its vascular cylinder was somewhat sporangium, in transverse complex, resembling that of the most rott^sidetZgfiflrti//~~ highly differentiated Hymenophyl- SenauU.) lacese, with which Zygopteris also

agreed in the presence of axillary shoots. There is evidence that the stem in some species was a climbing one ; the pinnate leaves, arranged on the stem in a two-fifths spiral, were dimorphic, the sterile fronds resembling some forms of Sphenopteris. On the fertile rachis the sporangia were borne in tufts, much as in the preceding genus ; they were still larger, reaching 2‘5 mm. in length, and had a multiseriate annulus, extending, however, to both sides of the sporangium *(see Fig. 14, A and B). The genus Corynepteris of Baily is interesting from the fact that its sporangia, while individually similar to those of Zygopteris, were grouped in sori or synangia, resembling those of an Asterotheca. The family BotryopteridcEe appears to have included a number of other genera, though in most cases the evidence from vegetative structure is alone available. The genus Diplolabis of Renault, probably identical with the Asterochlcena of Corda, and showing much in common with Zygopteris as regards anatomical structure, resembles Corynepteris in possessing a synangic fructification. The family as a whole is of great Interest, as presenting points of â– con- tact with various recent orders, especially Hymenophyllaceae, Osmundaoese, and Ophioglossacese ; the group appears to have been a synthetic one, from which several lines of descent may have sprung.

A number of genera of Palasozoic fern-fronds have been described, of the fructification of which nothing is known. This is the case, for example, with Diplotmema, a genus only differing

from Sphenopteris in the dichotomy of the primary pinnae, and with Mariopteris, which bears a similar relation to Pecopteris. The same holds good of the Pecopteroid Ferns included under Calli- pteris and OalUpteridium. In many such cases the apparent absence of fructification may be probably explained by dimorphism, the fertile fronds or pinnse not having been as yet brought into relation with the sterile foliage. Several examples of fern-like fronds will be best considered under the heading Cycadofilices, for there is reason to believe that they belonged to plants which were in some respects intermediate between Ferns and Gymnosperms.

A natural classification of the Palasozoic Ferns will only be attainable when our knowledge of their reproduc- tion and structural characters has become much more complete than it is at present. The great relative im- portance, in early periods, of eusporangiate Ferns of the Marattiaceous type is one of the most striking results hitherto arrived at. The Botryopteridese also stand out definitely as a group now vsrhoUy extinct, but possibly having genetic relations with certain existing families. There are some indications that Ferns approaching the recent Schizseacese, Osmundaceae, and Hymenophyllaceae may have already existed in Palaeozoic times, while Cyatheaceae and Polypodiacese, so predominant in the recent Flora, appear, on present evidence, to have been wholly unrepresented.

Cycadojilices. â€" A considerable nlimber of Palaeozoic genera are now known which in habit were more or less completely fern-like, while in their anatomical struc- ture they combined the characters of Ferns with those of Gymnosperms. To this group the convenient name Cycadofilices has been given by Potonie. In some of the plants in question the fern-characters still predominate, in others the balance inclines to the Gymnospermous side. Unfortunately we have as yet no satisfactory knowledge of the fructification of any member of the group ; the evidence at present before us is, however, sufficient to show- that ill the Palaeozoic period a class of plants existed which, to judge by their known characters, held a position intermediate between Ferns and Gymnosperms, having a special afiinity with the Cycadales and with the extinct family Cordaiteae. A number of the most familiar fossil " fern fronds " have proved to belong to this transitional group, in which several families have been distinguished ; the Lyginodendreae are perhaps the most interesting from an evolutionary point of view.

Lyginodendrece. â€" Of the genus Heterangium, which still stands very near the true Ferns, several species are known, the oldest being H. Grievii, of Williamson, from the Lower Carboniferous of Scot- land. This plant had a long, somewhat slender ridged stem, the ridges corresponding to the decurrent bases of the spirally arranged leaves (Fig. 15). The specimens on which the genus was founded are petrified, showing structure rather than habit, but conclusive evidence has now

been obtained that the foliage of H. Grievii was of the type of Sphenopteris (Diplotmema) elegans (Fig. 16), and was thus in appearance altogether that of a Fern, with somewhat the habit of an Asplenium. The stem has a single stele, resembling in general primary structure that of one of the simpler species of (tleichenia ; there is no pith, the wood ex- tending to the centre of the stele. The leaf-traces, where they tra- verse the cortex, have the structure of the foliar bundles in Cycads, for they are of the collateral type, and their xylem is mesarch, the spiral elements lying in the interior of the ligneous strand. The leaf-traces can be distinguished as distinct strands at the periphery of the stele, as shown in Fig. 17. Most of the specimens have formed a zone of secondary wood and phloem resembling the corresponding tissues in a recent Cycad ; the similarity extended to minute histological details, as is shown especially in H. tiliceoides, a Coal Measures species, where the preservation is remarkably perfect. The cortex was strongly constructed mechanically ; in addition to the strands of fibres at the periphery, horizontal plates of stone-cells were present in the inner cortex, giving both stem and petiole a transversely striated appearance, which has served to identify the different parts of the plant, even in the carbonized condition (cf. Figs. 15 and 16). The single vascular bundle which traversed the petiole and its branches was concentric, the leaves resembling those of Ferns in structure as well as in habit. Heterangium shows, on the whole, a decided preponderance of Filiclnean characters, though in the leaf-traces and the secoildary

tissues the Cycads are approached. In the Coal Measures genus l poses, and was adapted rather for water-storage. In the genus Megaloxylon, of Seward, which in structure bears a general | Lyginodendron, of which L. oldhamium, from the Coal Measures,

Fiii. 15. â€” llettrangium GrUvU. lieaioration of stem, shown partly in transverse and longitudinal section, partly in surface view, x, primary, x^, secondary wood ; p.o, phloem and pericycle ; c, cortex ; hy, hypoderma ; l.t, l.t, leaf-traces ; r, ad- ventitious root. Tlie several leaf-bases are shown. {After Williamson.) (Scott,

I'lQ. 17. â€" Jlei^'tMigium Gri&oii. Part of the . stele of the stem in trans- verse section, showing a primary xylem-strand and adjacent tissues. 2?x, protoxylem of strand ; x, centripetal, Â£r^, centrifugal primary wood ; mx, part of the internal wood ; e.p, conjunctive tissue ; a-2 secondary wood ; c&, cambium ; ph^, phloem. xl35. (Scott, " Studies,'^)

resemblance to Heterangium, the primary wood consists for the

Fig, 16. â€" SphenopteHa elegans (foliage of JTeteratigiitm Grimii), size. (After Stmr.) (Saoti, " Studies.")

Part of frond, | nat.

most part of short wide traoheides ; probably, as the secondary tissues increased, it had become superfluous for conducting pur-

is the best-known species, the central wood has disappeared alto- gether and is replaced by pith ; the primary wood is only re- presented in the leaf-trace strands, which form a ring of distinct collateral bundles around the pith; thus the " medullate-mono- stelio" structure characteristic of the higher plants was already attained. The individual bundles, however, have the same structure as in Heterangium, and agree exactly with the foliar bundles of Cycads. The secondary tissues, which are highly developed, are also of a Cycadean character (Fig. 18, Plate). The vegetative organs of the plant are very completely known ; the foliage has proved to be that of a Sphenopteris, identical with the species long known under the name of S. Honinghausi. Apart from the important advance shown in the anatomy of the stem, Lyginodendron agrees structurally with Heterangium. There is reason to believe that Lyginodendron oldhamium was a climbing plant, comparable in some respects to such recent ferns as DavaUia aculeata. As regards the

fructification of Lyginodendron there is still much uncertainty ; the evidence, however, indicates that it was of the type known as Calymmatotheca, consisting of tufts of long capsules pendent from the ultimate branches of a naked rachis ; unfortunately the microscopic structure of this fructifica- tion is not certainly known, and it has even been doubted whether the capsules were of the nature of sporangia or sporocarps. In spite of tliis serious gap in our knowledge, there can be no question that the genus Lyginodendron, while having much in common with true Ferns, shows anatomically an unmistakable approach to Cy- cadean structure.

CycadoxyJea;. â€” A few Coal Measures and Permian stems (Cycadoxylon and Ptyclwxylon) resemble Lyginodendron in the general character of their tissues, but show a marked reduction of the primary wood, together with an extensive development of anomalous wood and bast around the pith", a peculiarity which appears as an indi- vidual variation in some specimens of Lyginodendron oldhamium. It is probable that these stems belonged to plants with the fructificaton and foliage of Cycads, taking that group in the widest sense. It is only" quite at the close of the PaUBozoic period that Cycads begin to appear. The Lyginodendrem type of structure, however, appears to have formed the transition not only to the Cycadales, but also to the extinct family Cordaiteii;, tlie characteristic Palaeozoic Gymnosperms (see p. 419).

ilcdnlloseai.â€" In some respects the most remarkable family of the Cycad-fern alliance is that of the Medul- loseaj, plants often of great size, with a fern-like foliage, and a singularly complex anatomical structure without parallel among recent plants. Some of the Medullosefe must have had a habit not unlike that of tree-ferns, with compound leaves of enormous dimensions, belonging to various frond-genera â€" especially, as has now been proved, to Alethopteris and Neiiropteris ; these are among the most abundant of the Carboniferous fronds commonly attri- buted to Ferns, and extend back to the Devonian. In habit

some species of Alethopteris resembled the recent Angiopteris, while the Nevropteris foliage may he compared with that of an Osmunda. The Medulloaa stems have heen found chiefly in the Permo-Carboniferous of France and Germany, but a Coal Measures species {M. anglica) has been discovered in Lancashire. The great anatomical characteristic of the stem of the MeduUosese is its polystelic structure with secondary development of wood and bast around each stele. lu M. anglica, the simplest species known, the steles are uniform, and usually only three in number ; the structure of the stem is essentially that of a polystelic Heter- angiuni. In the Permo-Carboniferous species, such as M. stellata and M. Leuckarti, the arrangement is more complicated, the steles showing a differentiation into a central and a peripheral system ; the secondary growth was extensive and unequal, usually attaining its maximum on the outer side of the peri- pheral steles. In certain cases the structure was further com- plicated by the appearance of extrafasoicular zones exterior to the whole stelar system. The spirally arranged petioles {Myelo- xylon) were of great size, and their decurrent bases clothed the surface of the stem ; their structure is closely similar to that of recent Cycadean petioles ; in fact, the leaves generally, like those of Stangeria at the present day, while fern-like in habit, were Cycadean in structure. In the case of Medullosa anglica we have an almost complete knowledge of the vegetative organs â€” stem, leaf, and root ; Cycadean characters no doubt predomi- nate,‘but the primary organization of the stem was that of a polystelic Fern. Some authors have been so much impressed by the similarity of this extinct family to the Cycads, that they have regarded them as being on the direct line of descent of the latter group ; it is more probable, however, that they formed a short divergent phylum, distinct, though not remote, from the Cycadean stock. We have as yet no good evidence as to the fructification of the MeduUosese ; the fronds belonging to them scarcely ever shovr any trace of reproductive organs, and where any such indications have been detected, they are too obscure to be of any real assistance. There is, however, some indirect evidence for regarding it as not improbable that some of the Isolated seeds found in the Carboniferous deposits may have belonged to members of this group.

The Cyoadofilices, of whicli only a few examples have been mentioned, were probably very numerous during the Palaeozoic periods, though it is only in the comparatively rare cases where structure is preserved that the attribution is certain ; in a large number of the so-called fern-fronds there is no evidence for Filicinean fructification, and it is probable that many of these belonged to this transitional or rather synthetic group, which may have been almost as extensive in early periods as that of the true Ferns.

Gymnospermous remains are common in Palaeozoic strata from the Devonian onwards. The investigations of the

last quarter of the 19th century have established spews'. ^^ these early representatives of the class did

not, as a rule, belong to any of its existing families, but formed for the most part a distinct group, that of the Cordaitese, which has long since died out. Specimens of true Cycads or Conifers are rare or doubtful until we come to the latest PalaBozoic rocks. Our present knowledge of the family Cordaiteae is chiefly due to the two French investigators. Grand' Eury and Eenault, who have successfully brought into connexion the various fragmentary remains, and made known their exact structure.

The discovery of the fossil trunks and of their rooted bases has shown that the Cordaitese were large trees, reaching 30 metres or more in height ; the lofty shaft bore a dense crown of branches, clothed with long simple leaves, spirally arranged. Fig. 19, founded on one of Grand' Eury's restorations, gives an idea of the habit of a tree of the genus Dorycordaites, character- ized by its lanceolate acute leaves ; in the typical Cordaites they were of a blunter shape, while in Poacordaites they were narrow and grass-like. The leaves as a rule far exceeded in size those of any of the Coniferse, attaining in some species a length of a metre. Of living genera, Agathis probably comes nearest to the extinct family in habit, though at a long interval. The stem resembled that of Cycads in having a large pith, sometimes as much as 4 inches in diameter ; the wood, however, was dense, and had the structure of that of an Araucarian Conifer ; speci- mens of the wood have accordingly

been commonly referred to the genus Arauearioxylon, and at one time the idea prevailed that wood of this type indicated actual afBnity with Araucariese.

Other characters, however, prove that the Cordaitese were far remote from that family, and the name Arauearioxylon is best limited to wood from later horizons, where a near relationship to Araucariese is more probable. i In some cases the external tissues of the Cordaitean stem are well preserved ; the cortex possessed a system of hypodermal strands of fibres, comparable to those found in the Lyginodendreae. In some cases the leaf-traces passed out from the stem in pairs, as in the recent Ginkgo ; in others the bundles of each trace were more numerous. In many CordaiteEe the pith was discoid, i.e., fistular, and partitioned by frequent diaphragms, as in some species of Pinus and other plants at the present day. The curious, transversely-ribbed fossils known as Sternbergia or Artisia have proved to be casts of the medullary cavity of Cordaitese ; their true natui-e was first

Fig. 19. â€” Dorycordaites. Eestoration, Bhowing roots, trank, and branches bearing long lanceolate leaves and frnctifications. The trunk is shown too short. {Jfi&r Orand^ Eurt/^ modified.) (Scvii, ” Studies.”)

demonstrated by Williamson in 1850. In those stems which have been referred with certainty to the Cordaitese there is no centripetal wood ; the spiral elements are adjacent to the pith, as in a recent Conifer or Cycad ; certain stems, however, are known which connect this type of structure with that of the Lygino- dendrese ; this, for example, is the case in the Permian genus Poroxylon, investigated by Bertrand and Renault, which in general structure has much in common with Cordaitese, but possesses strands of primary wood, mainly centripetal, at the boundary of the pith, as is the case in Lyginodendron. Corre-sponding strands of primary xylem have been observed in stems of the genus Pitys (Witham), of Lower Carboniferous age, which consisted of large trees, probably closely allied to Cordaites. There appears, in fact, so far as stem-structure is concerned, to have been no sharp break between the typical Palfeozoic Gymnosperms and pronounced Cyoadofilices such as Lyginodendron.

The long, parallel-veined leaves of the Cordaitese, which were commonly referred to Monocotyledons before their structure or

1 Endlicher's name Dadoxylon is conveniently used for Palaeozoic specimens of the kind in question when nothing beyond the wood-structure is knovm.

connexion with otherparts of the plant was known, have been shown by Renault to have essentially the same anatomy as a single leaflet of a Cycad such as Zamia. The vascular bundles, in particular, show precisely the characteristic collateral mesarch structure which is so consitant in the recent family (see Anatomy of Plants). In fact, if the foliage alone were taken into account, the Cordaiteae might be described as simple-leaved Cycads. The reproductive organs, however, show that the two groups were in reality very dis- tinct. Both male and female inilorescences have frequently been found in connexion with leaf-bearing branches (see restoration, Fig. 19) . The inflorescence is usually a spike bearing lateral flowers or catkins, arranged sometimes distichously, sometimes in a spiral order. The investigation of silicifled specimens has, in the hands of Renault, yielded striking results. A longitudinal section of a male Cordaianthus (the name applied to isolated flowers) is shown in Fig. 20, A, Plate. The organ figured is one of the catkins (about a centimetre in length) which were borne laterally on the spike. Some of the stamens are inserted between the bracts, in an appar- ently axillary position, while others are grouped about the apex of the axis. Each stamen consists of a long filament, bearing several erect, cylindrical pollen-sacs at its summit (cf. Fig. 20, B, Plate). Some of the pollen-sacs had dehisced, while others still retained their pollen. The stamens are probably best compared with those of Ginkgo, but they have also been interpreted as corresponding to the male "flowers " of the Gnetacese. In any case the morphology of the male Cordaitean flower is clearly very remote from that of any of the Cycads or true

Coniferae. The female inflorescences vary considerably in organization ; in some species the axis of the spike bears solitary ovules, each accompanied by a few bracts, while in others the lateral appendages are catkins, each containing from two to several ovules. In the catkin shown in longitudinal section in Fig. 21, A, it appears that each ovule was borne ter- minally, on an extremely short axillary shoot, as in Taxus among recent Gymuosperms. The ovule consists of an integument (regarded by some writers as double) enclosing the nucellus. In the upper part of the nucellus is a cavity or pollen-chamber, with a narrow canal leading into it, precisely as in the ovules of Stangeria or other Cycads at the present day (Fig. 21, B). Within the pollen-chamber, and in the canal, pollen-grains are fountl, agreeing with those in the anthers, but usually of larger size (Fig. 21, C). It was in this case that Renault first made the exceedingly interesting discovery that each pollen-grain contains a group of cells, presumably representing an antheridium (Fig. 21, C). Recent observations have completely confirmed Renault's interpretation of the facts, on which some doubt had been cast. In the isolated seeds of Cordaiteae and allied Palaeozoic Gymno- sperms, pollen-grains are often found within the pollen-chamber, and the pluricellular structure of these pollen-grains has been repeatedly demonstrated. In the light of recent discoveries in Ginkgo and the Cycads there can scarcely be a doubt that spermatozoids were formed in the cells of the antheridium of the Cordaitean pollen-grain ; the antheridium is much more developed than in any recent Gymnosperm, and it may be doubted whether any pollen-tube was formed. The morphology of the female inflorescence of Cordaiteae has not yet been cleared up, but Tax^ts and Ginkgo among recent plants appear to offer the nearest analogies. Much further investigation will be needed before the homologies between Cordaitean flowers and the fructification of the higher Cryptogams can be established. Anatomically the con- nexion of the family with the Cycadofilices (and through them, presumably, with some primitive group Of Ferns) seems clear, but we have as yet no indications of the stages in the evolution of their productive organs. The family Cordaiteje extends back to the Devonian, ahd it must be borne in mind that our knowledge of their fructifications is practically limited to speci- mens from the latest Paleozoic horizons.

Isolated fossil seeds are common in the Carboniferous and Permian strata ; in all cases they are of the orthotropous type, and resemble the seeds of Cycads or Ginkgo more nearly than those of any other living plants. Their internal structure is sometimes admirably preserved, so that the endosperm with its archegonia is clearly shown (Fig. 21, D). It is a curious fact that in no case has an embryo been found in any of these seeds ; probably fertilization took place after they were shed, and was followed immediately by germination. There is good evidence that many of the seeds belonged to Cordaitero, especially those seeds which had a flattened form, such as Cardiocarpus, Cycadinocarpus, Samaropsis, &c. Seeds of this kind have been found in con- nexion with the Cordaianthus inflorescences ; the winged seeds of Samaropsis, borne on long pedicels, are attributed by Grand' Eury to the genus Dorycordaites. Other forms of seed, and especially those which show radial symmetry, as for example Trigonocarpon, Stephanospermum, and Lagenostoma, are still of doubtful nature, and may have belonged, in part at least, to some of the plants grouped under Cycadofilices. The abundance and variety of Palaeozoic seeds, so often of undetermined nature,

indicate how much still remains to be done in the investigation of the Gymnosperms of that period.

The modern Gymnospermous orders have but few authentic representatives in Paleozoic rocks. The history of the Gmkgoales will be found in the Mesozoic section of this article, and m the article Gymnospekms ; their nearest Palaeozoic representatives "were probably members of the Cordaitales, an extinct stock with which the Ginkgoaceae are closely connected" (Seward). Remains referable to Cyoadales, so extraordinarily abundant m the succeeding period, are scanty. The curious genus Dolero- phvllum (Saporta) may be mentioned in this connexion. This genus from the Permo-Carboniferous of Autun, is represented by laro-e fleshy, reniform leaves or leaflets, with radiating dicho- tomous venation ; the vascular bundles have in all respects the structure of those in leaves of Cycads or Cordaiteae. The male sporophylls are similar in form to the vegetative leaves, but

Fig. 21. â€” Oordaianihua. A, 0. Williamsoni. Part of loD^tudinal section of $ catkin ; a, axis, showing v. bundles in tangential section ; &r, bracts ; d, sliort axillary slioot, bearing a bracteole and a terminal ovule ; i, integu- ment ; n, nucellus of ovule ; ov^ anotlier ovule seen from the outside. X about 10. B, C. Oramd^ Euryi. Nucellus of an ovule; tj.c, pollen- chamber; s, canal leading to p.c; p, pollen-grains in ji.e; p^, do. in canal. X about 80. O, C. Grand^ Euryi. Lowe> part of canal, enlarged, o, cavity of canal, surrounded by a sheet of cells, dilated towards the bottom of canals, in which a large pollen-grain is caught ; ex, exterior of pollen-grain ; in, internal group of prothelial or antheridial cells, x 150. D, Cyca^dino- carpus AuffusiodtMienais. Upper part of seed, in longitudinal section ; i, integument ; mi, micropyle ; n, remains of nucellus ; p.c, pollen-chamber (containing, pollen-grains), with its canal extending up to the micropyle; pr, part of prothallus ; ar, archegonia, magnified. {^AU after Renault.)

smaller ; sunk in their parenchyma are numerous tubular loculi, containing large pollen-grains, which are pluricellular like those of Cordaites; the female fructification is still unknown. The curious male sporophylls may perhaps be remotely comparable to those recently discovered in Mesozoic Cycadales of the group Bennettiteas. Some leaves of Cycadean habit {e.g., Pterophyllum, Sphenozamites) occur in the Coal Measures and Permian, and it is possible that the obscure Coal Measures genus Noeggerathia may have Cycadean affinities. An inflorescence from the Permian of Autun, named Cycadospadix milleryensis by Renault, appears to belong without doubt to this family.

Now that the numerous specimens of wood formerly referred to Coniferae are known to have belonged to distinct orders, but few true Palaeozoic Conifers remain to be considered. The most important are the upper Coal Measures or Permian genera Walchia, TJllmannia, and Pagiophyllum, all of which resembled certain Arauoariese in habit. In the case of Walchia there is some evidence as to the fructifications, which in one species (PT. flliciformis) appear to be comparable to female Araucarian cones. There are also some anatomical points of agreement with that family. It is probable, however, that under the

same generic name very heterogeneous plants have been confounded. In the

case of Ullmannia the anatomical structure of the leaf, investi- gated by Solms-Laubach, proves at any rate that the tree was Coniferous.

There is no proof of the existence of Gnetaceae in Palaeozoic times. The very remarkable plumose seeds described by Renault under the name Gnetopsis are of uncertain affinity.

Succession of Floras.

Our knowledge of vegetation older than the Carbonif- erous is still far too scanty for any satisfactory history of the Palaeozoic Floras to be even attempted ; a few, however, of the facts may be advantageously recapitu- lated in chronological order.

No recognizable plant-remains, if we except one or two doubtful Algal specimens, have so far been yielded by the Cambrian. From the Ordovician and Silurian, however, a certain number of authentic remains of Algse (among many more that are questionable) have been investi- gated; they are for the most part either verticillate Siphoneae, or the large â€” possibly Laminariaceousâ€” Algse named Nematophycus, with the problematical but perhaps allied Pachytheca. The evidence for terrestrial Silurian vegetation is still dubious; apart from some obscure North American specimens, the true nature of which is not established, Potonid has described well-characterized Pteridophytes (such as a Fern, Sphenopteridium, and Bothrodendron among Lycopods) from supposed Silurian strata in North Germany ; the horizon, however, appears to be open to much doubt, and the specimens agree so nearly with some from the Lower Carboniferous as to render their Silurian age difficult of credence. The high development

of the terrestrial flora in Devonian times shows, however, that land-plants must have existed far back in the Silurian ages, or still earlier. Even in the Lower Devonian, Ferns and Lepidodendreae have been recognized ; the Middle and Upper Devonian beds con- tain a flora in which all the chief groups of Carboniferous plants are already represented. Considering the compara- tive meagreness of the Devonian record, we can scarcely doubt that the vegetation of that period, if adequately known, would prove to have been practically as rich as that of the succeeding age. Among Devonian plants, Equisetales, including not only Archceocalamites,‘bvLt forms referred to Asterophyllites and Annularia, occur ; Sphe- nopliyllum is known from Devonian strata in North America and Bear Island ; Lycopods are represented by Bothrodendron, Lepidodendron and the characteristic Psil- ophytoii, as to the true nature of which, however, there is much doubt. Ferns such as Sphenopteridese, Palceopteris, and Adiantites with occasional arborescent Pecopterideae, are frequent; other genera, Alethopteris, Neuropteris, and Megalopteris, more probably belonged, not to true Ferns, but to Cycadofilices ; in the absence, as a rule, of any structural evidence, it is impossible to be certain of the true nature of many of the plants. The presence of Cordaitean leaves indicates that Gymnosperms of high organization already existed, a striking fact, showing the immense antiquity of this class compared with the angio-spermous flowering plants. Any detailed account of the horizons of Carboniferous plants would carry us much too far. For our present purpose we may divide the formation into Lower Carboniferous, and Lower and Upper Coal Measures. In the Lower Carboniferous (Culm of Continental authors) many Devonian types survive â€” e.g., ArcJicBocalamites, Botli^dendron, Palceopterif!, Megal- opteris, &c. Among Ferns, Diplotmema and Rhacopteris are characteristic ; some of the Lepidodendreae appear to approach Sigillarice in external characters. Sphe- nophylleae are still rare ; it is to this horizon that the isolated type Cheirostrobus belongs. Many specimens with structure preserved are known from the Lower Car- boniferous, and among them Cycadofilices {Heterangium,

Calamopitys, Cladoxylon, Protopitys) are well represented. Of Gymnosperms we have Cordaitean leaves, and the stems known as

Pitys, which probably belonged to the same family.

The Lower Coal Measures (Westphalian) have an enormously rich flora, embracing most of the types referred to in our systematic description. Calamariece with the Arthropitys type of stem-structure abound, and Sphenophylleae are now well represented. Bothrodendron still survives, but Lepidodendroyi, Lepidophloios, and the ribbed Sigillariae are the characteristic Lycopods. The heterogeneous ” Ferns ” grouped under Sphenopterideae are especially abundant. Marattiaceous Ferns are com- mon, but arborescent stems of the Psaronius type are still comparatively rare. Numerous fronds such as Alethop- teris, Neuropteris, and possibly Mariopteria, belonged, in part at least, to Cycadofilices, of which specimens show- ing structure are frequent in certain beds. Cordaites, Dorycordaites, and many stems of the Dadoxylon type represent Gymnosperms, of which the seeds begin to be common. The Upper Coal Measures (Stephanian) are characterized among the Calamarieaa, now more than ever abundant, by the prevalence of the Calamodendreae ; new species of Sphenophyllum make their appearance ; among the Lycopods, Lepidodendron and its immediate allies diminish, and smooth-barked Sigillariae are the charac- teristic representatives. Ferns are even more strongly represented than before, and this is the age in which Marattiaceous tree-ferns reached their maximum develop- ment. Among Cycadofilices it is the family MeduUoseae which is especially characteristic. Cordaiteae still in- crease, and Gymnospermous seeds become extraordinarily abundant. In the Upper Coal Measures the first Cyca- dales and Coniferae make their appearance. The Permian, so far at least as its lower beds are concerned, shows little change from the Stephanian; Conifers of the Walchia type are especially characteristic. The remark- able Permo-Carboniferous flora of India and the southern hemisphere is described in the next section of this article. During the earlier part of the Carboniferous epoch the vegetation of the world appea^ to have been remarkably uniform ; while the deposition of the Coal Measures, however, was in progress, a differentiation of floral regions began. The sketch given above extends, for the later periods, to the vegetation of the northern hemi- sphere only.

AuTHOKiTiES. â€” ^PoTONiE. Lehrbuch der Pflanzenpalaontologie. Berlin, 1899. â€” Renault. Cours de Botanique Fossile, vols, i.-iv. Paris, 1881-85. â€” Scott. Studies in Fossil Botany. London, 1900. â€” Seward. Fossil Plants (in course of publication), vol. i. Cam- bridge, 1898. â€” SoLMS-LAnBACH. Introduction to Fossil Botany. Oxford, 1892. â€” Zeiller. Elements de Paleobotaniqiie. Paris, 1900. â€” In these general works references to all important memoirs will be found. (d. h. s.)

II. Mesozoio.

The period dealt with in this section does not strictly correspond with that which it is customary to include within the limits of the Mesozoic system. The !Mesozoic era, as defined in geological text-books, includes the Triassic, Jurassic, and Cretaceous epochs ; but from the point of view of the evolution of plants and the succes- sion of floras, this division is not the most natural or most convenient. Our aim is not simply to give a summary of the most striking botanical features of the several floras that have left traces in the sedimentary rocks, but rather to attempt to follow the different phases in the development of the vegetation of the world, as expressed by the contrasts exhibited by a comparison of the vege- tation of the Coal period forests with that of the succeeding Mesozoic era up to the close of the Wealden period.

Towards the close of the Palaeozoic era, as represented

by the Upper Carboniferous and Permian plant-bearing strata, the vegetation of the northern hemisphere, and that of several regions in the southern hemisphere, consisted of numerous types of Vascular Cryptogams, with some mem- bers of the Gymnosperniffi, and several genera referred to the Cycadofilices (see section I. Paleozoic). In the

succeeding Permian period the vegetation retained for the most part the same general character; some of the Carboniferous genera died out, and a few new types made their appearance. The Upper Carboniferous and Permian plants may be grouped together as constituting a Permo-Carboniferous flora characterized by the predominance of Vascular Cryptogams. This flora had a wide distribu- tion in North America, Europe, and parts of Asia ; it extended to China and to the Zambezi region of tropical Africa (Map A, I. and II.).

On the other hand, the plant-beds of the Permo-Carbo- niferous age in South Africa, South America, India, and Australia demonstrate the existence of a widely- aiosso- distributed vegetation which agrees in age with the Upper Carboniferous and Permian vegeta- tion of the north, but differs from it to such an extent as to constitute a distinct flora. We must begin by briefly considering this southern Palaeozoic province if we would trace the Mesozoic floras to their origin, and obtain a connected view of the vegetation of the globe as it existed in late Palseozoic times and at the beginning of the succeeding era.

In Australia, South America, and South Africa a few plants have been found which agree closely with Lower Carboniferous types of the northern hemisphere. In New South Wales, for example, we have such genera as Bhacopteris and Lepidodendron represented by species very similar to those recorded from Lower Carboniferous or Culm rocks in Germany, Austria, England, Spitzbergen, North and South America, and elsewhere. It is, in short, clear that the Culm flora, as we know it in the northern hemisphere, existed in the extreme south, and it is probable that during the earlier part of the Carboniferous period the vegetation of the world was uniform in character. We may possibly go a step farther, and assume that the climatic conditions under which the Cnlm plants of the Arctic regions flourished were not very different from those which pre- vailed in Europe, Asia, Chile, and South Australia. Erom strata in New South Wales overlying Devonian and Lower Carboniferous rocks certain plants were discovered in the early part of the 19th century which were compared with European Jurassic genera, and for several years it was believed that these plant-beds belonged to the Mesozoic period. These supposed Mesozoic plants

include certain genera which are of special interest. Foremost among these is the genus CrJossopteris (Eig. 1), founded by Brongniart in

Fig. . â€” Glo88opteri8 frond, with portion enLarged to sliow tlie venation. (Naturiil in length.) From Lower Goudwaua rocks of India.

1828 on specimens from India and Australia, a fern characterized by simple sub-lanceolate or tongue-shaped leaves, with a central midrib giving off lateral veins which repeatedly anastomose and form a network, like that in the leaves of Anthrophyum, an existing member of the Polypodiaoese. The stems, long known from Australia and India as Vertehraria, have in recent years been proved to be the rhizomes of GI ossopteris. Associated with Glos- sopteris occurs another fern, Gangamopteris, usually recognized by the absence of a well-marked midrib, though this character does not always afford a satisf actoi'y distingutshing feature. An Equiseta- ceous plant, which Brongniart nojmeA Phyllotheca in 1828, is another member of the same flora; this type bears a close resemblance to Equisetum in the long internodes and the whorled leaves encircling the nodes, but differs in the looser leaf-sheaths and in the long spread- ing filiform leaf-segments, as also in the strvioture of the cones. Phyllotheca has been recognized in Europe in strata of Palt^ozoic age, and Professor Zeiller has discovered a new species â€" P. Eallii

in Upper Carboniferousrocks in Asia Minor (Map A, VII.), which

points to a close agreement between this genus and the well-known Palfeozoio Anmdaria. Phyllotheca occurs also in Jurassic rocks in Italy, and in Siberian strata originally described as Jurassic, but which Zeiller has shown are no doubt of Permian age. Some examples of thisgenus, described by EtheridgefromPermo-Carboniferous beds in New South Wales, differ in some respects from the ordinary form, and bear a superficial resemblance to the Equisetaceous genus Oin- gxilaria from the Coal Measures of Germany. Other genera characteristic of this southern flora are- mentioned later. The extraordinary abundance of Qlossopteris in Pernio-Carboniferous rocks of Australia, and in strata of the same age in India and South Africa, gave rise to the term" Glossopteris flora" for the assemblage of plants obtained from

southern hemisphere rocks overlying beds containing Devonian and Lower Carboniferous fossils. The Glossopteris flora of Australia occurs in certain regions in associa- tion with deposits which are now recogiiized as true boulder-beds, formed during widespread glacial conditions. In India the same flora occurs in a thick series of fresh-water sediments, known as the Lower Gondwana system, including basal boulder-beds like those of Australia. Similar glacial deposits occur also in South America, and members of the Glossopteris flora have been discovered in Brazil and elsewhere. In South Africa, Glossopteris, Gainjamopteris, and other genera, identical with those from Australia and India, are abundantly represented, and here again, as in India and South America, the plants are found in association with extensive deposits of undoubted glacial origin. To state the case in a few words, there is in South Africa, South America, Australia, and India an extensive series of sediments containing Glossopteris, Gangamopteris, and othergenera, andinoluding beds full of ice-scratchedboulders. These strata are homotaxial with Permo-Carboniferous rocks in Europe and North America, as determined by the order of succession of the rocks, and by the occurrence of typical Palaeozoic shells in associated marine deposits. The mo.st important evidence on which this conclusion is based is afforded by the occurrence of European forms of Carboniferous shells in marine strata in New South Wales, which are intercalated between Coal Measures con- taining members of the Glossopteris flora, and by the discovery of similar shells, many of which are identical with the Australian species, in strata in the north-west of India and in Afghanistan, forming part of a thick series of marine beds known as the Salt Range group. This group of sediments in the extra-peninsular area of India includes a basal boulder-bed, referred on convincing evidence to the same geological horizon as the glacial deposits of the Indian peninsula (Talohir boulder- beds). South Africa (Eeca boulder-beds), Australia and Tasmania (Bacchus Marsh boulder- beds, &c.), and South America, which are associated with Glosso- pteris-bearing strata. We have a flora of wide distribution in South Africa, South America, Borneo, Australia, Tasmania, and India, which is clearly of Permo-Carboniferous age, but which differs In its composition from the flora of the same age in other parts of the world. This flora appears to have abruptly succeeded an older flora in

Australia and elsewhere, which was precisely similar to that of Lower Carboniferous age in the northern hemisphere. The frequent occurrence of ice-formed deposits at the base of the beds in which Glossopteris and other genera make their appearance, almost necessitates the conclusion that the change in the character of the vegetation was connected with a lowering of temperature and the prevalence of glacial conditions over a wide area in India and the southern hemisphere. There can be little doubt that the Indian Lower Gondwana rocks, in which the boulder-beds and the Glosso- pteris flora occur, must be regarded as belonging to a vast continental area of which remnants are preserved in Australia, South Africa, and South America. This continental area has been described as "Gondwana Land," a tract of enormous extent occupying an area, part of which has since given place to a southern ocean, while detached masses persist as portions of more modern continents, which have enabled us to read in their f ossilplants and ice-scratched boulders the records of a lostcontinent inwhich the Mesozoic vegetation of the northern hemisphere had its birth. Of the rocks of this southern continent those of the Indian Gondwana system are the richest in fossil plants ; the most promi- nent types recorded from these Permo-Carboniferous strata are Glos- sopteris,Gangamopteris, specKsreferred to Splienopteris, Pecopten's, Macrotainiopteris, and other Ferns; Schizonenra (Fig. 2) and Phyl- lotheca among the Equisetales, Na;ggei- athwpsis and Euryphijllvm, probably members of the Cordaita'les (q.v. in section I. Pal^.:o- zoic) ; Glossoeamites and Pterophyllum among the Cycadales, and various vegetative shoots recalling those of the coniferous genus Vollzia, a well-known Permian and Triassic plant of northern lati- tudes. ^ There are no undoubted species of Lepidodendron, SigiUa- ria, Stigmaria, or Oalamites â€" genera which played so great a share in the vegetation of the same age in the northern hemisphere.

We may next inquire what types occur in the Glossopteris flora agreeing more or less closely with members of the rich Permo-Carboniferous vegetation of the north. The genus Sphenophyllum, abundant in the Coal Measures and Permian rocks of Europe and America, is represented by a single species recorded from India, Sphenophyllum speciosum (Fig. 3) ; Annularia, another common

northern genus, is recorded from Australia, and the closely allied Phyllotheca constitutes another link between the two Pei-mo-Carboniferous floras. The genus Cordaites may be compared with certain forms recorded from India, South America, South Africa, and Australia. “While a few similar or even identical types may be recognized in both floras, there can be no doubt that, during

Map a. â€” Gi-Ge, Glossopteris Flora. I, II. Upper Carboniferous plants of the northern hemisphere facies, iu the Zambezi district and in China ; III. Rhfietic ” ” ‘ * ‘ ‘ â– &c. ; associated with northern types’) ; IV. Carboniferous mants (prov. Kansu) ; V. Glossopteris, .fcc., in Permian rocks iu

flora of Tonffkingr {Glossopteris, &c. , ...

prov. Vologda; VI. Permian (Pechora valley); VII. Upper Carboniferous (Herakleion) ;

(Argentine) ; X. Bhstic (Persia) ; XI. Trias’sic â€” Cretaceous.

VIII. Ehsetic (Honduras) ; IX. Lower Jurassic, Upper Gondwana

a considerable period subsequent to that represented by the Lower Carboniferous or Culm rocks, there existed two distinct floras, one of which had its headquarters in the northern hemisphere, while the other flourished in a vast continental area in the south. Kecent discoveries have shown that representatives of the two floras coexisted in certain regions ; there was, in fact, a dovetail- ing between the northern and southern botanical provinces. In 1895 Professor Zeiller described several plants from the province of Rio Grande do Sul in South America (Map A, G 2) , including a few typical members of the

Glossopteris flora associated with a Euro- pean species, Lepidophloios laricinus, one of the characteristic types of the Coal period, and with certain ferns resembling some species from European Permian rocks. A similar association was found also in Argentine rocks by Kurtz (Map A, Gj), and from South Africa Sigillaria Brardi, another northern type, is re- corded in company with Glossopteris, Gangamopteris, and Nmggerathiopsis.

The Coal-bearing strata which occupy a considerable area in China (Map A, II.), contain abundant samples of a vegetation which appears to have agreed in the main features with the Permo-Carboniferous floras of the northern hemisphere. In his account of some plants from the Coal Mea- sures of Kansu (Map A, IV.) Dr Krasser has drawn attention to the apparent identity of certain leaf-fragments with those of Naeggera- thiopsis Hislopi, a typical member of the Glossopteris flora ; but this plant, so far as the evidence of vegetative leaves may be of value, dif- fers in no essential'respects from certain species of a European genus Cordaites. A comparatively rich fossil flora was described in 1882 from Tongking (Map A, III.) by Professor Zeiller â€" and this author has recently made important additions to his original account â€"

Fig. 2. â€" Sehisoneura Gond- wanensis, from Lower Gondwana rocks of India. iAfter Feistmantel.)

which demonstrates an admixture of Glossopteris types with others which were recognized as identical with plants characteristic of Rhsetic strata in Europe. In the Tongking area, therefore, a flora existed during the Rhsetic period consisting in part of genera which are abundant in the older Glossopteris beds of the south,

Fig. 3. â€" Sphenophyllum speciosum. From Lower Gondwana rocks, India. A, nat. size ; B, leaflet enlarged. {After FeisiTtiantel.)

and in part of well-known constituents of European Ehsetic floras. A characteristic member of the southern botanical province, Schizoneura Gondwanensis (Fig. 2) of India, is represented also'by a closely allied if not an identical species â€" 8. paradoxa â€" ^in the Lower Trias

(Bunter) sandstones of the Vosges Mountains, associated with European species which do not occur in the Glossopteris flora. Another plant found in the Vosges sandstones â€” Neuropteridium grandifoliumâ€”is also closely allied to species of

Fig. 4.â€”N6'uropieridium vali- dwn. From Lower Gond- wana rocks, India. {After Feihtmant&l^

the same fern recorded from the Lower Gondwana strata of India (Fig. 4) and South America, and recently discovered, but not yet described, by Mr Leslie at Vereeniging in South Africa. These two instances â€” the Tongking beds of RhsBtio age and the Bunter sandstones of the Vosges â€” afiord evidence of a northern extension of Glossopteris types and their associa- tion ~~with European species. In 1898 an important discovery was made by Professor Amalitzky, which carries us a step farther in our search for a connexion between the northern and southern floras. Amalitzky found in beds of Upper Permian age in the pro~~ vince of Vologda (Russia) (Map A, V.) species of Olossopteris and Nxggera- thiopsis, typical members of the Glosso- pteris flora, associated with species of the ferns Tatniopteris, Gallipteris, and Sphenopteris, a striking instance of a commingling in the far north of the northern hemisphere Permian species with migrants from " Gondwana Land."

f"'Â» , ffi^ This association of types clearly points

v â– ^ '.'â– '* JT to a penetration of representatives of

â– * J – â€¢ the Glossopteris flora to the north of

Europe towards the close of the Per- f ‘,ij ‘ ‘^i’ mian. period. Evidence of the same

\ ‘ ‘ ” ‘ fc northern extension is supplied by floras

described by Schmalhausen from Per-

f~ , ‘ ^ mian rocks in the Pechora valley (Map

_ B A, “VI.), the Siberian genus Bhipto- ~ zamites being very similar to, and

probably generically identical with, NaeggeratMopsis of the Glossopteris flora. The Permo-Carboniferous beds of South Africa, India, and Australia are succeeded by other plant-bearing strata, containing numerous species agreeing closely with members of the Rhsetic and Jurassic floras of the northern hemisphere. These post-Permian floras, as represented by the Upper Gondwana beds of India and corresponding strata in Australia, South Africa, and South America, differ but slightly from the northern floras, and point to a uniformity in the Ehsetic and Jurassic vegetation which is in contrast to the existence of two botanical provinces during the latter part of the Palaeozoic period. A few plants recently described by Potoni^ from German and Portuguese East Africa demonstrate the occurrence of Glossopteris and a few other genera, referred to a Permo-Triassic horizon, in a region slightly to the north of Tete in the Zambezi district (Map A, I.), where typical European plants agreeing with Upper Carboniferous types were discovered several years ago, and described by Zeiller in 1882 and 1901. The existence of Upper Gondwana plants, resembling Jurassic species from the Eajmahal beds of India, has recently been demonstrated in the Argentine by Dr Kurtz.

Having seen how the Glossopteris flora of the south gradually spread to the north in the Permian period, we

may now take a brief survey of the succession Mesozoic qÂ£ floras in the northern hemisphere, which have

left traces in Mesozoic rocks of North America, Europe, and Asia. Our knowledge of the Triassic vegeta- tion is far from extensive ; this is no doubt due in part to the fact that the conditions under which the Triassic rocks were deposited were not favourable to the existence of a luxuriant vegetation. Moreover, the Triassic rocks of southern Europe and other regions are typical marine sediments. The Bunter sandstones of the Vosges have afforded several species of Lower Triassic plants ; these include the Equisetaceous genus Scliizoneura â€" a member also of the Glossopteris flora â€" bipinnate fern fronds re- ferred to the genus Avomopteris, another fern, described originally as Neuropteris grandifolid, which agrees very closely with a southern hemisj)here type {Neiiroptoridhnn validiim, Eig. 4), some large Equisetaceous stems appa- rently identical, except in size, with modern Horsetails. With these occur several Conifers, among others Voltzia heterophylla and some twigs referred to the genus Alhertia, bearing large leaves' like those of Agathis anstndis and some of the Araucarias, also a few representatives of the Cycadales. Among plants from Lower Triassic strata

there are a few which form connecting links with the older Permo-Carboniferous flora; of these we have a species, de- scribed by Blankenhorn as SigiUaria oculina, which may be correctly referred to that genus, although an inspec- tion of a plaster-cast of the type-specimen in the Berlin Bergakademie leaves a little doubt as to the sufficiency of the evidence for adopting the generic name SigiUaria. Another Triassic genus, Pleuromeia, is of interest as exhibiting, on the one hand, a striking resemblaiiee to the recent genus Isoetes, from which it differs in its much larger stem, and on the other as agreeing fairly closely with the Palasozoic genera Lepidodendron and SigiUaria. There is, however, a marked difference, as re- gards the floras as a whole, between the uppermost Palaeo- zoic flora of the northern hemisphere and such species as have been recorded from Lower Triassic beds. There is evidence of a distinct break in the succession of the northern floras which is not apparent between the Per- mian and Trias floras of the south. Passing over the few known species of plants from the middle Trias (Muschel- kalk) to the more abundant and more widely-spread Upper Triassic species as recorded from Germany,

Austria, Swit- zerland, North America, and elsewhere, we find a vegeta- tion characterized chiefly by an abundance of Ferns and Cycads, exhibiting the same general facies as that of the succeeding Ehaetic and Lower Jurassic floras. Among Cycads may be mentioned species of PterophyUum {e.g., P. Jaegeri), represented by large pinnate fronds not unlike those of existing species of Zamia, some Equisetaceous plants and numerous Ferns which may be referred to such families as Gleicheniaceae, Dipteridinse, and Matonineee. Representatives of the Ginkgoales constitute character- istic members of the later Triassic floras, and these, with other types, carry us on without any break in continuity to the Ehaetic floras of Scania, Germany, Asia, Chile, Tong-king, and Honduras (Map A, VIII.), and to the Jurassic and Wealden floras of many regions in both the north and south hemispheres. A comparative view of the plants found in various parts of the world, in beds ranging from the Upper Trias to the top of the Jurassic system, reveals a striking uniformity in the vegetation both in northern and southern latitudes during this long succession of ages. The Palaeozoic types are barely re- presented; the arborescent Vascular Cryptogams have been replaced by Cycads, Ginkgoales, and Conifers as the dominant classes, while Ferns continue to hold their own. No undoubted Angiosperms have yet been found below the Cretaceous system. From the close of the Permian period, which marks the limit of the Upper Palaeozoic floras, to the period immediately preceding the apparently sudden appearance of Angiosperms, we have a succession of floras differing from one another in certain minor de- tails, but linked together by the possession of many characters in common. It is impossible to consider in detail this long period in the history of plant-evolution, but we may briefly pass in review the most striking fea- tures of the vegetation as exhibited in the dominant types of the various classes of plants.

Under the head of Algse there is little of primary importance to record, but it is of interest to notice the occun-enoe of certain forms which throw light on the antiquity of existing families . .

of AlgBB. Species referred on good evidence to the ‘*5’Â«-

Charophyta are represented by a few casts of oogonia and stem fragments, found in Jurassic and AVealden beds, which bear a striking resemblance to existing species. There is some evidence for the occurrence of similar Chara “fruits” in middle Triassic rocks ; some doubtful fossils from the much older Devonian rocks have also been quoted as possible examples of the Charophyta. The oldest known Diatoms are represented by some specimens found entangled in the spicules of a Liassio sponge, and identified by Rothpletz as species of the recent genus Pyxidiciiht. The calcareous Siphonece are represented by several forms, identified

as species of Diplopora, Triploporella, Neomeris, and other genera, from strata ranging from the Lower Trias limestones of Tirol to the Cretaceous roolts of Mexico and elsewhere. It is probable that the Jurassic Goniolina, described from French localities, and other genera which need not be mentioned, may also be reckoned among the Mesozoic Siphonese. A genus Zonatrichites, compared with species of Cyanophyceae, has been described as a Calcareous alga from Liassic limestones of Silesia.

The geological history of Mosses and Liverworts is at present very incomplete, and founded on few and generally unsatisfactory Bryoohyta ^^offlsnts- It is hardly too much to say, that no

” P ” â€¢ absolutely trustworthy examples of Mosses have so far been found in Mesozoic strata. Of Liverworts there are a few species, such as Palceohepatica Bostajinskii from the Lower Jurassic rocks of Cracow, Marchantites erectus from the Interior Oolite rocks of Yorkshire, and M. Zeilleri from the Wealden beds of Sussex. These fossil Hepaticse are unfortunately founded only on sterile fragments, and placed in the Liverworts on the strength of their resemblance to the thallus of Marchantia and other recent genera.

The Palaeozoic Calamites were succeeded in the Triassic period by large Mquisetites, differing, so far as we know, in no essential respect from existing Equisetums. The large stems re- taceiB*’ presented by casts of Triassic age, Equisetites arenaceus and other species, probably possessed the power of secondary growth in thickness ; the cones were of the modern type, and tlie rhizomes occasionally formed large underground tubers like those frequently met with iu EquiseUim anense, E. sylvaticum, and other species. Equisetites Muensteri is a char- acteristic and fairly widely spread Rhjetic and Liassic species, having, a comparatively slender stem, with leaf-sheaths consisting of a few broad and short leaf-segments. Equisetites columnaris, a common fossil in the Jurassic plant-beds of the Yorkshire coast, represents another type with relatively stout and occasionally branched vegetative shoots, bearing leaf-sheaths very like those of Equisetum maximum and other Horsetails. In the Wealden strata more slender forms have been found â€” e.g., Equisetites Burchardti and E. Lyelli â€” in England, Germany, Portugal, Japan, and elsewhere, differing still less in dimensions from modern species. Of other Equisetales there are Schizoneura and Phyllo- theea; the former first appears in Lower Gondwana rooks as a member of the Glossopteris iiora, migrating at a later epoch into Europe, where it is represented by a Triassic species. The latter genus ranges from Upper Carboniferous to Jurassic rocks ; it occurs in India, Australia, and elsewhere in the ” Gondwana Land” vegetation, as well as in Palseozoic rocks of Asia Minor, in Permian rocks of Siberia, and in Jurassic plant-beds of Italy. This genus, like the allied Calamites, appears to have possessed cones of more than one type ; but we know little of the structure of these Mesozoic Equisetaceous genera as compared with our much more complete knowledge of Calamites and Archmooala- mites. (See section I., Paleozoic.)

Reference has already been made to Sigillaria oculina and to the genus Pleuromeia. Of other Mesozoic representatives of the Lycopodiales, there are practically none of botanical bales’’ interest. Palasobotanical literature contains several records of species of Lycopodites and Selaginellites ; nearly all of them are sterile fragments, bearing a more or less close resemblance to living Club-Mosses and Selaginellas, but

lacking the more important reproductive organs. A recent investigation of a plant long known from KhEetic rocks in the Severn valley as Naiadita acuminata has shown that this genus is in all probability a small Lycopodiaceous plant, and neither a Moss nor a Monocotyledon, as some writers have supposed. One of the most satisfactory species from European rocks is Lycopodites falcatus, originally described by Lindley and Button in 1831 from the Inferior Oolite of Yorkshire.

Among the large number of Mesozoic Ferns there are several species founded on sterile fronds which possess but little interest Flllcales fi”oâ„¢ ‘^ botanical standpoint. Some plants, again, have been referred by certain authors to Ferns, while others have relegated them to the Cycads. As examples of these doubtful forms may be mentioned Thinnfeldia, characteristic of Rhsetic and Lower Jurassic rocks ; Dichopteris, represented by some exceptionally fine Jurassic specimens, described by Zigno, from Italy ; and Ctenis, a genus chiefly from Jurassic beds, founded on pinnate fronds like those of Zamia and other Cycads, with linear pinnae characterized by anastomosing, veins. Plants referred to Schimper’s genus Lomatopteris and to Cycadopteris of Zigno afford other instances of the difficulty of distinguishing between the foliage of Ferns and Cycads. The close resemblance between specimens from Jurassic rocks placed in one or other of the genera Thinnfeldia, Dichopteris, Cycadopteris, &c., illustrates the unsatis- factory custom of founding new names on imperfect fronds. It is of interest to note that some leaf -fragments recently found in Permian rocks of Kansas, and placed in a new genus Glenopteris, are hardly distinguishable from specimens of Jurassic and Ehaetic

age referred to Thinnfeldia and other Mesozoic genera. The diffi- culty of distinguishing between Ferns and Cycads is a necessary consequence of the common origin of these two classes ; in Palaeo- zoic times the Cycadofilices [see section I., Palaeozoic] played a prominent part, and even among recent Cycads and Ferns we still see a few indications of their close relationship. There is reaison to believe that compound or synthetic types â€” partly Ferns and partly Cycads â€” persisted into the Mesozoic era ; but without more anatomical knowledge than we at present possess, it is impossible to do more than to point to a few

indications afforded by external, and to a slight extent by internal structure, of the survival of Cycadofilicinean types. The genus Otozamites, which it js customary and probably correct to include in the Cyoadales, is represented by certain species, such as Otozamites Beani (Fig. 5, A), a characteristic Yorkshire fossil of Jurassic age, which in the form of the frond, bearing broad and relatively short pinnae, exhibits a striking agreement with the sterile portions of the fronds of Aneimia rotundifolia. Again, another species of the same genus, 0. Bunhury- anus (Fig. 5, B), suggests a comparison with fern fronds like that of the recent species Nephrolepis Duffi. The scaly ramenta which occur in abundance on the leaf-stalk bases .of fossil Cycads constitute another fern-character sur- viving in Mesozoic Cyoadales. Without a fuller knowledge of internal structure and of the reproductive organs, we are compelled to speak of some of the Meso- zoic plants as possibly Ferns or possibly Cycads, and not referable with certainty to one or other class. It has been found useful in some cases to examine micro- scopically the thin film of coal that often covers the pinnae of fossil fronds, in Tig. 5.â€" A Otozamites .Bearej. order to determine the form of the Lâ€ž?- oS,' E^gS: '" epidermal cells which may be preserved

in the carbonized cuticle ; rectilinear epidermal cell-walls are usually considered characteristic of Cycads, while cells with un- dulating walls are more likely tp belong to Ferns. This distinction does not, however, afford a safe guide ; the epidermal cells of some ferns, e.g., Angiopteris, have straight walls, and occasionally the surface cells of a Cycadean leaf-segment exhibit a fern-like charac- ter. Leaving out of account the numerous sterile fronds which cannot be certainly referred to particular families of Ferns, there are several genera which bear evidence in their sori, and to some extent in the form of the leaf, of their relationship to existing types.

The abundance of Palaeozoic Ferns with sporangia and sori of the Marattiaceous type is in striking contrast to the scarcity of Mesozoic species which can be reasonably included in Â« /

the Marattiaceae. One of the few forms so far recorded marat-

is that known as Marattia Muensteri from Ehaetic aceÂ«.

localities in Europe and Asia. Some species included in the genus Danmites or Danoeopsis from Jurassic rocks of Poland, Austria, and Switzerland may possibly be closely allied to the recent tropical genus Danoia. Of the Ophioglossaceae there are no satisfactory examples ; one of the few fossils compared with a recent species, Ophioglosstim palmatum, was described several years ago from Triassic rocks under the name Cheiropteris, but the resemblance is one of external form only, and practically valueless as a taxonomic criterion. It would appear that the eusporangiate Ferns suddenly sank to a very subordinate position after the Palaeozoic era.

The Osmundaceae, represented by a few forms of Palaeozoic age, played a more prominent part in -the Mesozoic floras. A species described by Schenk from Rhaetic rocks of Franconia as Acrostichites princeps is hardly distinguishable from Todites Williamsoni, a widely-distributed species in In- ferior Oolite strata. This Jurassic species bore bipinnate fronds not unlike those of the South African, Australian, and New Zealand Fern Todea barhara, which were characterized by a stout rachis and short broad pinnules bearing numerous large sporangia covering the under surface of the lamina. Specimens of Todites have been obtained from England, Poland, and elsewhere, sufficiently well preserved to afford good evidence of a correspondence in the structure of their sporangia with those of recent Osmundaceae. This Jurassic and Rhaetic type occurs in England, Germany, Poland, Italy, East Greenland, North America, Japan, China, and Persia (Map A, X.). Bipinnate sterile fronds of Todites have in some instances been described under the designation Pecopteris Whit- hiensis. This and other names, such as Asplenium Whiibiense, A. nebbense, Asplenites Boesserti, &c., have been given to bipinnate fronds of a type frequently met with in different genera and

[mesozoic

Fig. 6. â€” CladophUMs denticulata. Oolite, England.

Schizse- aceÂ£e.

Inferior

families of recent Ferns, e.g., Onodea struthiopteris, species of Cyathea, Aspleniuni, Gh/mnogramme, &o. In most cases the Ehaetio, Jurassic, and “Wealden Perns included under one or other

of these names are sterile, and cannot be assigned to a particular family, but some are undoubtedly the leaves of Todites, a genus which may often be recognized by the broad and relatively short bluntly – termi- nated pinnules. The Jurassic species Clado- phlebis denticulata (Fig. 6), recorded from several European local- ities, including Born- holm and the Arctic regions, as well as from North America, Japan, Ch ina, Australia, India, and Persia, affords an instance of a common type of bipinnate frond simi- lar to Todites William- soni, which has been included in the Poly- podiaoBEe ; but such meagre evidence of the soral characters as we possess also points to a comparison with the recent Osmundaceous fern Todea barbara. The systematic position of this Jurassic form is still undetermined. The Schizseacese include a widely spread species, originally named Pecopteris exilis, and recently placed in a new genus, Klukia (Fig. 7), which is characterized by tripinnate fronds with short linear ultimate segments, bearing a single row of sporangia with an apical annulus (“monangic sorl” of Prantl) on either side of the midrib. This type occurs in Rhsetic and Lower Jurassic rocks of England, Poland, the Arctic regions, and Japan. Buffordia Gcepperti, a Wealden type, and pro- bably a member of the Schizseacese, has been re- corded from England (Yorkshire and Sussex), Belgium, other European countries, and Japan.

The Gleicheniacese ap- pear to have been repre- sented by Triassio species in North America andEurope, and more abundantly in Ju^rassic, “Wealden, or Lower Cretaceous rocks in Belgium, Greenland, Poland, and elsewhere. Some exceptionally perfect

fragments of rhizomes have been found by Dr C. Bommer of Brussels in some Wealden deposits at Braoquegnies (not aielchen- jg^j, from Baurae) in Belgium ; but these are not yet lacex. described. The dichotomously-branched fronds of

the type represented by several i-ecent species of Gleichenia, e.g., O. dichotoma, &c., are abundant in Lower Cretaceous plant-beds of Greenland, and suggest that in the latter part of the Mesozoio period the GleioheniacBEe held a position in the vegetation of the far north similar to that which they now occupy in the southern tropics of India and other regions.

The recent Malayan genus Mntonia (Map B, Matonia), repre- sented by two species, M. pectinata and M. sarmentosa, is clearly a survival in tropical latitudes of a family which occupied an important place in the vegetation of the Eheetic, Jurassic, and Wealden periods. The genera Laccopteris and Matonidium (Fig. 8) may be cited as the two most important types, both as regards geogi'aphical and geological range, of this Mesozoic family ; these Ferns are recorded from England, France, Belgium, Germany, Austria, Portugal, Poland, and Italy (Map B, Ml), also from Greenland (Map B, Ms), Spitsbergen (Map B, Ma), and Persia (Map B, M4). From the southern hemisphere, on the other hand, we know of one or two fragments only which can reasonably be referred to the Matoninese (Map B, M5), a fact which may point to a northern origin for this

Fia. 7. â€" Klukia exiUs. 1-3, sporangia enlarged ; i. single fertile pinnule slightly enlarged ;

5, fragment of pinna, land.

Inferior Oolite, Eng-

Matoal-

family, with its two surviving species almost confined to the Malayan region.

Fia, 8.

~~MatonAdiwm~~ Go&pperfl. A, summit of petiole ; B, fertile pinnules. Inferior Oolite, England.

Dlpterl- dlnse.

The recent genus, Dipteris, with its four existing species, occurring chiefly in the Indo-Malayan region (Map B, Dipteris), is also a modem survival of several Mesozoic types represented by such genera as Dictyophyllum (Fig. 9), Prothorhipis, and Camptopteris, which were abundant during the Ehsetic and Jurassic periods in England, Germany, Sweden, and else- where in Europe (Map B, Di). The Dipteridinse are re- presented also by species from Meso- zoic rocks of Persia (MapB,D2), Green- land (Map B, D3), North America (Dj), South Amer- ica (D5), and China

(Do).

The Oyatheacefe constitute another family of leptospo- rangiate Ferns which had several representatives in Mesozoic floras. The numerous species of fronds from Jurassic and Wealden rocks of North America and Europe referred to Thyrsop- teris, a recent monotypic genus confined to Juan Fernandez, are in the majority of cases founded on sterile leaves, and of little or no botanical value. On the other hand, there are several fossil Ferns of Jurassic age possessing cup-like sori like those of Thyrsopteris and other Cyatheaceous Ferns, which in- Cyatbea- dicate a wide Mesozoic distribution for this family. '^' Among Jurassic species which should probably be classed as Cyatheacefe, Coniopteris hymenophylloides is recorded from Eng- land, France, Poland, Bornholm, Italy, the Arctic regions. North America, Japan, China, Australia, and India. A few tree-ferns which may be included in this family, such as Protopteris, have been described from Wealden and Lower Cretaceous rocks of Eng- land, Germany, and Austria. It is by no means easy in dealing with fossil Ferns to di.stinguish between certain Polypodiacese â€" such as species of Darallia â€" and members of the Cyatheaceae.**

It is a striking fact that among the numerous Mesozoic Ferns there are comparatively few that can with good reason be referred to the Polypodiaceae, a family which plays so dominant a r61e at the present day. The frequent occurrence of ”’’^’ such names as Aspleniuni, Adiantum, DavaUia, and ‘Â«”’’’’*Â«â€¢ other Polypodiaceous genera in lists of fossil Ferns is thoroughly misleading. There are, indeed, a certain number of species which show traces of sori like those of modern species of Asplenium and other genera, but in most cases the names of recent Ferns have been

Fig. 9. â€” DlctyophyUum,. Ehsetic rocks of Eurojie. i^After Scherik.)

used on insufficient grounds. The Wealden and Jurassic genus, Onychiopsis of England, Portugal, Belgium, Germany, Japan, and Australia, bears a close resemblance totberecent Onychium (Orypto-gamme) . Other Jurassic Ferns described by Raciborski from Poland suggest a comparison with Dmallia. Supposed fertile fronds of Olossopteris have been described by several authors and referred to the Polypodiacese, but in no instance is the evidence enough to Vfarrant more than the suggestion that’ this abundant southern Fern is a Polypodiaceous genus. The majority of the specimens included in the genus Cladophlebis, the Mesozoic representative of the Palseozoic Pecopteris type of frond, are known only in a sterile condition,

and cannot be assigned to their family position. A Wealden plant, Weichselia MantelU, is worthy of mention as a species of very wide geographical distribution, and one of the most characteristic members of the Wealden flora. This type is distinguished by its large bipinnate fronds bearing long and narrow pinnae with close- set pinnules, characterized by the anastomosing secondary veins. No traces of sori have so far been found in the fronds. Similarly, the genus Sagenopteris, cliaraoterized by a habit like that of Marsilia, and represented by

fronds consisting of a few spreading broadly oval or narrow segments, with anastomosing veins, borne on the apex of a common petiole, is abundant in rocks ranging from

Map B. â€” M^-Mg, Distribution of the Matoninea-. Dj-Dg, Distribution of the Vipteridinw. G1-G17, Distribution of the Ghihgoalen durinf^ the Mesozoic and Tertiary Periods.- G^ (Trias-Tertiary); G2, G3 (lihietic-Jurassic) ; G4 (Tertiarj^, Salihalin I,); G5 (Jurassic); G^ (Jurassic and Tertiary); G7 (Jnrassic); Gg (Ehsetic-Jurassic) ; Gg (Trias-RhBBtic) ; G]o (Rhatic, Chile) ; G,i (Trias) ; Gia (Cretaceous-Tertiary) ; G13 (Tertiary,^ Alaska) ; G14 (Cretaceous-Tertiary) ; G15 (Jurassic) ; G^g (Jurassic, Spitsbergen) ; (ju (Jurassic, Franz Josef Land).

the Rheetio to the Wealden, but has not so far been satisfactorily placed. The evidence which led Nathorst and some other writers to refer this plant to the Marsiliacese is not convincing, and until we find well-preserved sporooarps we incline to the opinion that Sagenopteris is probably a genus of Ferns.

The abundance of Cycadean plants is one of the most striking features of Mesozoic floras. In most cases we have, only the evidence of sterile fronds, and this is necessarily un- yca a es. satisfactory ; but the occurrence of numerous stems and fertile shoots demonstrates the wealth of Cycadean plants in many parts of the world, more particularly during the Jurassic and Wealden periods. From Palseo-zoio rooks a few fronds have been described, such as Pterophyllum Fayoli, F. Combrayi, Plagio- zamites, and Sphenozamites, chiefly from French localities, which are referred to the Cycads be- cause of their similarity to the pinnate fronds of modern CyoadaoeEe. In the succeeding Triassic system Cycadean plants become much more abundant, especially in the Keuper period ; from Rhsetio rocks a still greater number of types have been recorded, among which may be mentioned Nilssonia (Fig. 10) , Anomozamites, Pterophyllum, Otozamites, Cycadites (Fig. 11). The species of Nilssonia shown in Fig. 10 (iV. compta) is a characteristic member of the Jurassic flora, practically identical with a form from RhEetic rocks described as

Nilssonia polymorpha. The large frond of Cycadites represented in Fig. 1 1 (C. Saportx) is from the Wealden strata of Sussex, and possibly identical with Cycadites tenuisectus from Portugal. In addition to these genera there are others, such as Ctenozamites, Ctenis, and Podozamites, the position of which is less certain. Ctenozamites occurs chiefly in the Rhsetic coal-bearing beds of Scania, and has been found also in the Liassio clays of Dorsetshire and in the Inferior Oolite

beds of Yorkshire, as well as in Rhaetic strata in Persia and else- where ; it is characterized by its bipinnate fronds, and may be compared with the recent Australian genus Bowenia â€" peculiar among living Cycads in having bipinnate fronds. Ctenis has been placed among the ferns by more than one author, on account of the occurrence of supposed sporangia on its pinnae ; but there is reason to believe that these so-called sporangia are probably nothing more than prominent papillose cells of the epidermis. Podo- zamites (Fig. 12) is usually considered to be a Cycad, but the broad pinnae (or leaves) and their arrangement on the axis suggests

^T^6

Fi&. 10. â€" Nilssonia' Compta. Inferior Oolite, England.

a possible relationship with the southern Coniferous genus Agathis, represented by the Kauri Pine and other recent species. The con-siderable variation in the size of the pinnae of Podozamites, as represented by species from the Jurassic rooks in the Arctic regions and various European localities, recalls the variation in length and breadth of the leaves of Agathis. With regard to the distinguishing features and the distribution of the numerous Cycadean leaves of Mesozoic age, the most striking fact is the abundance of fronds, which there is good reason to refer to the Cycadales in Upper Triassic, Rhastic, Jurassic, and Wealden rocks in India, Australia, Japan, China, and elsewhere in the southern hemisphere, as well in North America, Greenland, and other Arctic

[mesozoic

lands and throughout Europe. It is noteworthy that Tertiary plant-beds have yielded hardly any specimens that can be recog- nized as Cycads.

A more important question is, “What knowledge have we of the reproductive organs and stems of these fossil Cycads ? Cycadean stems have recently been found in extraordinary abundance in

Jurassic and possibly higher strata in Wyo- ming and other parts of the United States. Cycadean stems have been found also in the uppermost Jurassic, Wealden, and Lower Cretaceous rooks of England, India, and other parts of the world. An example of an Indian Cycadean stem from Upper Gond- wana rocks is repre- sented in Eig. 13 ; the surface of the trunk is covered with persistent bases (Eig. 13, A) of the fronds known as Ptilophyllum Cutch- ense^ which are prac- tically the same as the European species Williamsonia pecten (Eig. 17). In a section of the stem (Eig. 13, B) a large pith is seen to occupy the axial region, and this is sur- rounded by a zone of secondary wood, which appears to differ from the characteristic wood of modern Cycads (see Gtmnosperms) in hav- ^^ ing a more compact

-Fia. U.~~CycaditMSaportcc. Wealden, England. Structure. The lozenge~~ shaped areas external to the axis of the stem represent the sections of petioles, some of which are shown in Eig. 13, A, attached to the stem. The majority of Mesozoic stems agree in external appearance with those of recent species of Encephalartos, Macrozamia, and some other genera ; the trunk is encased in a mass of persistent petiole-bases separated from one another by a dense felt or packing of scaly ramenta. The structure of thg leaf-stalks is like that of modern

Fig. 12. â€” Podoeamiti’n lavreolatuB. Inferior Oolite, England.

Fig. 13. â€” Cycadean stem, from

Prondwana rocks, India. A, suffice view: 13, transverse section of stem.

Cycads, but the ramenta, instead of having the form of long uni- cellular hairs like tho.se on the petioles and bud-scales of existing species, are exactly like the paleso or ramental scales character- istic of the majority of ferns. This fern-like character affords an interesting survival of the close relationship between f!yoads and Eerns. Rome recently discovered Jurassic Cycadean steins from Wyoming are characterized by an unusually rich development

of ramental scales ; the ramenta from the old leaf-bases form an almost complete covering over the surface of the trunk. Professor Lester Ward has instituted a new generic name, Cycadella, for these woolly forms. In a few cases the fossil stems show no trace of any lateral flowering shoots, and in that respect agree with modern forms : an instance of this is afforded by a large Cycadean trunk discovered a few years ago in one of the Portland quarries, and named Cycadeoidea giganle.a (Eig. 14). In this stem the flowers may have been terminal, as in existing Cycads. As a rule, however, the fossil stems show a marked dif- ference from modern forms in the possession of lateral shoots given off from the axils of leaves, and termi- nating in a flower of complex structure containing numerous or- thotropous seeds. These reproduc- tive shoots differ in many important respects from the flowers of recent Cycads, and, chiefly on this account, it is customary to include the plants in a separate genus, Bennettites, and in a family â€” the Bennettitacese â€” distinct from that of the Cyoa- dacese as represented by. existing Cycads. The best preserved speci- mens of the true Bennettites type so far described are from the Lower Greensand and Wealden of Eng- land, and from Upper Mesozoic strata in North America, Italy, and Erance. A study of the anatomical structure of the vegetative stem, which on the whole is very similar to that of recent Cycads (Eig. 15, 1 and 2), reveals certain characters which are not met with in modern Cycads. The chief distinguishing feature is afforded by the leaf- traces ; in recent species (see Gymnospeems) these pursue a somewhat complicated course as they pass from the petiole towards the vascular cylinder of the stem, but in Bennettites the vascular bundles from the leaves followed

a more direct course through the cortex of the stem (Eig. 15, 3). Among existing types the genus Macrozamia appears to show the nearest approach to this simpler structure of the leaf-traces. The typical Bennettites female flower (Eig. 15, 4 and 7), as investigated in English, Erench, Italian, and American specimens, may be briefly described as a short lateral shoot or peduncle, arising in a leaf-axil and terminating in a bluntly rounded apex, bearing numer- ous linear bracts enclosing a central group of appendages, some of which consist of slender pedicels traversed by a vascular strand and bearing a single terminal ovule enclosed in an integument, which forms a distal canal or mioropyle. Associated with these seminifer- ous pedicels occur sterile appendages consisting of slender stalks, ter- minating in distal expansions, which form a fleshy covering over the surface of the flower, leaving small apertures immediately above the micropyles for the entrance of the pollen-grains. The seeds have in some oases been preserved in wonderful perfection, enabling one to make out the structure of the embryo, with its bluntly conical radicle and two fleshy cotyledons fiUingthe exalbuminousseed (Eig. 15, 11). Our knowledge of the reproductive organs of the Bennettitacefe has until recently been confined to the female flowers, as described by Carruthcrs, Solms-Laubach, Lignier, and others. The fortunate discovery of several hundred Cycadean stems in the United States, of Lower Cretaceous and Upper Jurassic age, has supplied abundant material, which is now being examined by Mr Wieland. This investigator has already published several short accounts of his discoveries, which give valuable infonnation as to the morphology of the male organs, and lead us to expect results in the future "of the greatest importance and interest. On some of the American stems flowers have been found, borne at the ape.x of lateral shoots, which possess fully developed male organs consisting of sporangia with spores (pollen-grains), surrounding a conical central receptacle bearing numerous small and probably funotionless or immature ovules (Fig. 15, 10). The structure of this type of flower may be briefly described as follows. In shape and size the flower is similar to that long known as the female flower of Bennettites and Williamsonia. A number of hairy linear bracts enclose the whole ; internal to these occur 12 to 20 crowded pinnate leaves (sporophylls)', with their apical portions bent over towards the axis of the flowei', the

bases of the petioles being fused laterally into a disc surrounding the base of the conical receptacle. Numerous pairs of pinnules are attached to the rachis of each sporophyll, and

Fig. 14. â€” Cycadeoidea gigantea. Portland rocliS, England.

the larger pinnules bear 20 to 30 synangia (sori or plurilocular sporangia) (Fig. 15, 8 and 9). The synangia consist of a stout wall composed of thick-walled cells, succeeded by a layer of more delicate and smaller elements ; and internal to the wall occur two rows of sporangial loouli containing microspores. “When the synangia are ripe dehiscence takes place along a median line between the two rows of loculi. In size, position, arrangement, and manner of dehiscence the sporangia bear a striking resem- blance to those of Marattia and Daiicea among recent Marattiaceae. The most important point elucidated by this discovery is the very close correspondence of the male organs of the Bennettites flower with the sporophylls and synangia of Marattiaceous Perns â€” a

those described as Cycadean flowers and seeds were borne by plants which should be included in the Cycadales ; a few female flowers have been described from Khsetic rocks of Scania and elsewhere under the name Zamiostrobus â€” these consist of an axis with slender pedicels or carpophylls given off at a wide angle and bearing two ovules at the distal end ; the structure is in fact similar to that of a Zamia female flower, in which the internodes of the peduncle have been elongated so as to give a looser arrangement to the carpels. It has been suggested that one at least of the flowers, that originally described by Mr Carruthers from the Inferior Oolite of Yorkshire as Seania gracilis, may have been borne by a member of the Ginltgoales. Prom Jurassic rocks of Prance and Italy a few

Fig. 16.-

-Frond of WilUatnsonia gigas. Oolite, Engrland.

Fig. 15. â€” 1, Sennettites stem : portion of transverse section of stem ; a, vascular cylinder; &, leaf-traces ; o, pith ; d, cortex. 2, Bennettites stem, tangential section ; 6, ilower- peduncles. 3, Bennettites stem, leaf-traces attached to the vascular cylinder and passing as simple strands through the cortex \ dt cortex. 4, WilUamsonia, Wealden, England. 6, Young leaf of Bennettites, 6, Eamenta of Bennettites in transverse section. 7, BeTi- nettiieSt female flower in longitudinal section ; /, apex of peduncle ; g, bracts (shown in surface view in 4) ; A., seeds and seminiferous pedicels ; i, interseminal scales. 8, Ben- netiites, synanglum of male flower, showing line of dehiscence, A, and microspores, I.

9, Synanglum, in transverse section, showing sporangial groups, m, and microspores, I.

10, Benneiiiies flower in vertical section, showing the central female portion, n, two sporophylls bearing synangia (male), o, and hairy bracts, g. 11, Bennettites seed in longitudinal section, showing the dicotyledonous embryo ; p, cotyledons ; ,r, radicle ; s, testa. (1-3, after Carruthers ; 5, 8, 9, and 10, after Wieland ; 7, after Scott; 11, after SolmS'Laubac/i.)

further relic of the common origin of Cycads and Ferns. It remains to be seen if the ovuliferous cone in the centre of the flower repre- sents simply a funotionless gyncecium, as in Welwitschia and abnor- mal cones of certain Coniferse, or if the flowers were hermaphrodite, with both male and female organs fully developed. We have a com- bination in the same flower of stalked ovules, the structure of which has already beeu described, and interseminal scales constituting a complex gynoecium, which exhibits in certain features an approach to the Angiospermous type, and differs in structure from other Gymnosperm flowers, associated with male organs constructed on a plan almost identical with that of the sporophylls in Marattiaceae.

It is clear that Bennettites differed in many essential respects from the few modern survivors of the Cycadales. The flowers were more complex in structure, and in the case of the female flowers the almost complete covering of the ovule by sterile foliar organs offers a point of contact with the ovary of the Angiosperms, suggesting a foreshadowing in the Mesozoio Cycadales of the more efBcient pro- tection of the ovule characteristic of Monocotyledons and Dicoty- ledons. Fossil flowers of a type more like that of modern Cycads are few in number, and it is not by any means certain that all of

imperfect specimens have been described as carpels of Cycads, like those of the recent genus Cycas (see Gymno- SPEEMs) ; while a few of these may have been correctly identified, an inspection of some of the original examples in the Paris ooUectipns leads one to express the opinion that others are too imperfect to determine. Pinnate fronds of the Cycas type, characterized by the presence of a midrib and no lateral veins in the linear pinnae, are recorded from Rhaetic rocks of Germany, from Wealden strata in England (Fig. 11) and Portugal, and from Liassic beds in Dorsetshire. One large specimen is figured by Heer from Lower Cretaceous rocks of Greenland, and by the side of the frond is shown a carpel with lateral ovules, as in the female fiower of Cycas ; but an ex- amination of the type-specimen in the Copenhagen Museum led the .present writer to regard this supposed carpel as value- less. Another well-known Cycadean genus is Williamsonia, so named by Mr Carruthers in 1870, and now applied to certain pinnate fronds â€” e.g., those previously described as Zamites gigas (Fig. 16), and others known under such names as Ptero- phyllum or Ptilophyllum pecten, &c., both common Jurassic species â€” as well as to stems bearing peduncles with terminal oval flowers, similar in form to those of Bennettites. There is good evidence for supporting Professor Williamson's conclusions as to the organic connexion between the flowers, originally described from Inferior Oolite rocks of Yorkshire and subsequently named Williamsonia (Pig. 15), and the fronds of Zamites gigas, now known as Williamsonia gigas (Fig. 16). There can be little doubt that the majority of the Cycadean fronds of Jurassic and Wealden age, which are nearly always found detached from the rest of the plant, were borne on stems of the Bennettites type. Williamson was

the first to express the opinion that the Bennettitean flowers known as Williamsonia were borne on the trunks which terminated in a crown of pinnate fronds of the type long known as Zamites gigas ;

this view was regarded by Saporta and others as incorrect, and the nature of the Bennettitean foliage was left an open question. A recent re-examination of the English material in the museums of Paris and elsewhere has confirmed Williamson's conclusions. Mr Wieland of Yale has also described young bipinnate fronds, very like those of recent species of Zamia and Encephalartos, attached to a Bennettites stem, and exhibiting the vernation characters of

Fig. 17. â€" Fronds of Williamsonia pecten.

many recent Cycads (Fig. 15, 5). In Williamsonia the stem bore comparatively long fertile shoots,- which, in contrast to those of Bennettites, projected several inches beyond the surface of the main trunk, and terminated in a flower which appears to have resembled those of the true Bennettites, so far at least as can be ascertained without the assistance of internal structure. The genus William- sonia occurs in the Upper Gondwana rocks of India ; it is recorded also from strata ranging from the Ehsetic to the Lower Cretaceous period in England, Portugal, Sweden, Bornholm, Greenland, Italy, Canada, and the United States. Another member of the Bennet- titese has been described by Nathorst from Rhsetic beds in Scania, where" certain Cycadean fronds, origi- nally named by Brongniart Anomozamites minor, have been found in connexion with Bennettitean flowers; the specimens in the Stockholm Museum bear out Professor Nathorst's description. It would seem a safe statement to make, that the Cycadales, including both Cycadaceae and Bennettitese, were represented during the Mesozoic period by a large number of species of almost world-wide distribu- tion. These included some forms with

flowers very similar to those of living genera, e.g., Androstrobus Balduini from Bathonian rooks of France ; Zamites familiaris, described many years ago by Corda, from Lower Cretaceous rocks of Bohemia, and Androstrobus Nathorsti, from "Wealden beds in Sussex ; but the majority of the species were char- acterized by flowers of a different type known as Bennettites and Williamsonia.

The living Maidenhair tree. Ginkgo hiloba (see Gymnospekms), remains, like Matonia and I)ip- teris among the ferns, as an isolated relic in the midst of recent vegetation. In Rha^tic, Jurassic, and Wealden floras the Ginkgoales were exceedingly abundant (Map B, Gj-Git) ; in addition to leaves agreeing almost exactly with those of the recent species (Fig. 18), there are others separated as a distinct genus, Baiera (Fig. 18, G), characterized by the greater number and narrower form of the segments, which may be best compared with such leaves as those of the recent fern Actiniopteris and of certain species of Sehizcea. Male flowers, like those of Ginkgo biloha, but usually characterized by a rather larger number of oval pollen-sacs on the stamens, have been found in England, Germany, Siberia, and elsewhere in association with Ginkgo and Baiera foliage. The occasional occurrence of three or even four pollen-sacs on the stamens of the recent species affords a still closer agreement between the extinct and living types. Seeds like those of Ginkgo biloba have also been recorded

Coal- ferales.

as fossils in Jurassic rooks, and it is not improbable that the type of flower known as Beania, from the Inferior Oolite rocks of Yorkshire, may have been borne by Ginkgo or Baiera. The regions from which satisfactory examples of Ginkgoales (Baiera or Ginkgo) have been recorded are shown in Map B (G1-G17). Both Tertiary and Mesozoio localities are indicated in the map.

An adequate account of fossil Mesozoic Conifers is impossible within the limits of this article. Coniferous twigs are very common in Mesozoic strata, but in most cases we are compelled to refer them to provisional genera, as the evidence of vegetative shoots alone is not sufficient to enable us to determine their position within the Coniferse. There are,

however, several forms which it is reasonable to include in the Araucariese ; that this family was to the fore in the vegetation of the Jurassic period is unquestionable. We have not merely the striking resem- blance of vegetative shoots to those of recent species of Araucaria and Agathis, e.g., species of Nageiopsis, abundantly represented in the Upper Jurassic beds of the Potomac area in North America, species of Fagiophyllum and other genera of Jurassic and Wealden age, but an abundance of fossil wood (Araucarioxylon) from Jurassic and Cretaceous strata in Europe, North America, Mada- gascar, and elsewhere agreeing with that of recent Araucariese, in addition to several well-preserved female flowers. Some of the fossils referred to the genus Kaidocarpon, and originally described as monocotyledonous inflorescences, are undoubted Arauearian cones ; other cones of the same type have been placed in the genus Cycadeostrobus and referred to Cycads. Araucarites JSudlestoni, described by Mr Carruthers from the Coralline Oolite rocks of Malton in Yorkshire, Araucarites sphmrocarpa from the Inferior Oolite of Somerset, also another cone found in the Northampton Sands, which is probably specifically identical with A. Sudle- stoni, and named by Carruthers Kaidocarpon ooUticum, afford good illustrations of British Arauearian flowers. A flower of a rather different type, Pseudaraucaria major, exhibiting in the occurrence of two seeds in each scale an approach to the cones of AbietineEe, has been described by Professor Fliche from Lower Cretaceous rocks of Argonne. The well-known Whitby jet of Upper Liassic age appears to have been formed to a large extent from Arauearian wood. Among the more abundant Conifers of Jurassic age may be mentioned such genera as Thmjtes and Gupressites, which agree in their vegetative characters with members of the Cupressinese, but our knowledge of the cones is far from satisfactory. Many of the small female flowers borne on shoots with foliage of the Cupressus type consist of spirally disposed and not verticillate scales, e.g., those of Thuytes expansus, a common Jurassic species.

Fossil wood, described under the name Cupressinoxylon, has been recorded from several Mesozoic horizons in Europe and elsewhere.

aiak- goales.

FlQ. 18.â€” Leayos of Ginkgoales. leaves.

V, Giiikgodium, Japan (Jurassic). _ ^ _

?! ‘)?â„¢ 1“â„¢”^ ”,Â°S’P?’,”“‘li’J,‘Jâ„¢,s*”) ;.y. Greenland (Lower Cretaceous) : iS, Siberia

B, C, D, E, F, IT, Ginkgo

(Jurassic) ; Jl, Germany (Wealden) ; F, Knsland (Jurassic) ; H, China (Eliastlc) ; G, Baiera leaf, Inferior Oolite, Lngland. (A, after Yohoyama; B, aftw Nathorst : 0, D, after Ileer ; E, after Sohenk ; \l, after Krasser. All the figures J nat. size.)

but this term has been employed in a wide sense as a designation for a type of structure met with not only in the Cupressineas, but in members of other families of Coniterue. The Abietinese do not appear to have played a prominent part before the Wealden period ; various older species, e.g., Rhjetic specimens from Scania, are re- corded, but it is not until we come to the Upper Jurassic and Wealdon periods that this modern family was abundantly repre- sented. Fossil wood of the Pinites type {Pityoxylon) has been described from England, France, Germany, Sweden, Spitsbergen,

North America, and elsewhere ; some of the best British examples have been obtained from the so-called Pine-raft, the remains of water-logged and petrified wood of Lower Greensand age, seen at low water near Brook Point in the Isle of Wight. Well-preserved Abietineous female flowers have been obtained from the Wealden rocks of England and Belgium, e.g., Pinites Dunkeri, P. Solmsi, &c. ; specimens of seeds and

vegetative shoots are recorded also from Spitsbergen, Franz Josef Land, and other regions. Cones of Lower Cretaceous age have been described by Fliche from Argonne, which bear a close resemblance to the female flowers of recent species of Cedrus. The striking resemblance between such a fossil genus as Brmlvjphyllum and the Tasmanian Conifer Athrotaxis is striking enough to warrant a comparison ; but in this case actual proof of close relationship is lacking. The two surviving species of Sequoia afford an illustration of the persistence of an old type, but unfortunately most of the Mesozoic species referred to this genus do not possess sufficiently perfect cones to confirm their identification as examples of Sequoia. Some of the best examples of cones and twigs which have been referred to Sequoia are those described by Heer from Cretaceous rocks of Greenland.

There are a few points suggested by a general survey of the Mesozoic floras, which may be briefly touched on in conclusion. In following the progress of plant- life through those periods in the history of the earth of which records are left in ancient sediments, seams of coal, or old land-surfaces, we recognize at certain stages a want of continuity between the floras of successive ages. The imperfection of the geological record, con- sidered from the point of view of evolution, has been rendered familiar by Darwin's remarkable chapter in the Origin of Species. Breaks in the chain of life, as repre- sented by gaps in the blurred and incomplete documents afforded by fragmentary fossils, are a necessary conse- quence of the general plan of geological evolution ; they mark missing chapters rather than sudden breaks in an evolutionary series. On the other hand, a study of the plant-life of past ages tends to the conviction that too much stress may be laid on the imperfection of the geo- logical record as a factor in the interpretation of paleeon- tological data. The doctrine of Uuiformitarianism, as propounded by Lyell, served to establish geology on a firmer and more rational basis than it had previously possessed ; but latterly the tendency has been to modify the Lyellian view by an admission of the probability of a more intense action of groups of forces at certain stages of the earth's history. As a definite instance, a short review may be given of the evidence of palseobotanical records as regards their bearing on plant-evolution. Starting with the Permo-Carboniferous

vegetation, and omitting for the moment the Glossopteris flora, we find a comparatively homogeneous flora of wide geographical range, consisting to a large extent of arborescent Lyco- pods, Calamites, and other Vascular Cryptogams, plants which occapied a place comparable with that of Gym- nosperms and Angiosperms in our modern forests ; with these were other types of the greatest phylogenetic importance, which serve as finger-posts pointing to lines of evolution of which we have but the faintest signs among existing plants. Other types, again, which may be referred to the Oymnosperms, played a not unim- portant part in the Palaeozoic vegetation. No conclusive proof has so far been adduced of the existence in those days of the Cycads, nor is there more than partial evi- dence of the occurrence of genera "which can be placed with confidence in any of the existing families of Conifers. There are, moreover, no facts furnished by fossil plants in support of the view that Angiosperms were represented either in the low-lying forests or on the slopes of the mountains of the Coal period. Passing higher up the geo- logical series, we find but scanty records of the vegetation that existed during the closing ages of the Permian period, and of the plants which witnessed the beginning of the Triassic period we haTe to be content with the most frag-

mentary relics. It is in rocks of Upper Triassic and Rheetic age that abundant remains of rich floras are met with, and an examination of the general features of the vegetation reveals a striking contrast between the Lower Mesozoic plants and those of the Palaeozoic period. Arborescent Pteridophytes are barely represented, but such dominant types as Lepidodendron, Sirjillaria, Cala- mites, and Splienophyllum have practicallj^ ceased to exist; Cycads and Conifers have assumed the leading role, and the still luxuriant fern vegetation has put on a different aspect. This description applies almost equally to the floras of the succeeding Jurassic and Wealden periods. The change to this newer type of vegetation was no doubt less sudden than it appears as read from palseobotanical records, but the transition period between the Palaeozoic type of vegetation and that which flourished in the Lower Mesozoic era, and continued to the close of the Wealden age, was probably characterized by rapid or almost sudden changes. In the southern hemisphere the Glossopteris flora succeeded a Lower

Carboniferous vegetation with a rapidity similar to that ~~which marked the passage in the north from Palaeozoic to Mesozoic floras. This apparently rapid alteration in the character of the southern vegeta~~ tion took place at an earlier period than that which witnessed the transformation in the northern hemisphere. The appearance of a new type of vegetation in India and the southern hemisphere was probably connected with a widespread lowering of temperature, to which reference has already been made. It was from this Glossopteris flora that several types gradually migrated across the equator, where they formed part of the vegetation of more northern regions. The difference between the Glossopteris flora and those which have left traces in the Upper Gondwana rocks of India, in the "Wianamatta and Hawkes-bury beds of Australia, and in the Stormberg series of South Africa is much less marked than that between the Permo-Carboniferous flora of the northern hemisphere and the succeeding IMesozoic vegetation. In other words, the change took place at an earlier period in the south than in the north. To return to the northern hemisphere, it is clear that the Wealden flora, as represented by plants recorded from England, Prance, Belgium, Portugal, Russia, Germany, and other European regions, as also from Japan and elsewhere, carries on, with minor differences, the facies of the older Jurassic floras. It was at the close of the Wealden period that a second evolutionary wave swept over the vegetation of the world. This change is most strikinglj illustrated by the inrush of Angiosperms, in the equally marked decrease in the Cycads, and in the altered character of the Ferns. It would appear that in this case the new influence, supplied by ttie advent of Angiosperms, had its origin in the north. Unfortunately, our knowledge of the later floras in the southern hemisphere is very in- complete, but a similai transformation appears to have characterized the vegetation south of the equator. As to the nature of the chief factors concerned in the two revolutions in the vegetable kingdom, if it is admissible to use so strong a term, only a guess can be hazarded. Physical conditions no doubt played an important part, but whatever cause may have had the greatest share in disturbing the equilibrium of evolutionary forces, it would seem that the apparently sudden appearance of Cycads and other types at the close of the Palaeozoic period made a widespread and sudden impression on the whole character of the vegetation. At a later

stage â€” in post- Wealden days – â€” it was the appearance of Angiosperms, probably in northern latitudes, that formed the chief motive power in accelerating the transition in the fades of plant-life from that which marked what we have called the Mesozoic floras, to the vegetation of the Upper Cretaceous and Tertiary periods. With the advent of Angiosperms began,

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as the late Marquis of Saporta expressed it, ” Une revolu- tion, ainsi rapide dans sa marche qu’universelle dans ses effets.” From the floras of Tertiary age we pass by gradual stages to those which characterize the present phase of evolutionary progress. Among modern floras we find here and there isolated types, such as Ginkgo, Sequoia, Matonia, Dipteris, and the Cycads, persisting as more successful survivals whiqli have held their own through the course of ages ; these plants remain as vestiges from a remote past, and as links connecting the vegetation of to-day with that of the Mesozoic era.

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III. Tektiaky.

After the Wealden period, and before the deposition of the lowest strata of the Chalk, so remarkable a change

takes place in the character of the vegetation Lower f;jjat this break must be taken as, botanically, ceoas. the transition point from a Secondary to a

Tertiary flora. A flora consisting entirely, with a single doubtful exception, of Gymnosperms and Crypto- gams gives place to one containing many flowering plants; and these increase so rapidly that before long they seem to have crowded out many of the earlier types, and to have themselves become the dominant forms. ISTot only do Angiosperms suddenly become dominant in all known plant-bearing deposits of Upper Cretaceous age, but strangely enough the earliest found seem to belong to living orders, and commonly are referable to existing genera. From Cretaceous times onwards local distribu- tion may change ; yet the successive floras can be analysed in the same way as, and compared with, the living floras of different regions. World-

wide floras, such as seem to characterize some of the older periods, have ceased to be, and plants are distributed more markedly according to geographical provinces and in climatic zones. This being the case, it will be most convenient to discuss the Tertiary floras in successive order of appearance, since the main interest no longer lies in the occurrence of strange extinct plants or of transitional forms connecting orders now completely isolated.

The accurate correlation in time of the various scattered

plant-bearing deposits is a matter of considerable difiiculty, for plant-remains are preserved principally in lacustrine strata laid down in separate basins of small extent. This it is obvious must commonly be the case, as most leaves and fruits are not calculated to drift far in the sea with- out injury or in abundance ; nor are they likely as a rule to be associated with marine organisms. Deposits con- taining marine fossils can be compared even when widely separated, for the ocean is continuous and many marine species are world-wide. Plants, on the other hand, like land and fresh-water animals, occupied areas which may or may not have been continuous. Therefore, without a knowledge of the physical geography of any particular period, we cannot know whether like or unlike floras might be expected in neighbouring areas during that period. If, however, we discover plant-bearing strata interstratified with deposits containing marine fossils, we can fix the period to which the plants belong, and may be able to correlate them in distinct areas, even though the floras be unlike. This clear stratigraphical evidence is, however, so rarely found, that much uncertainty still remains as to the true age of several of the floras now to be described.

In rocks approximately equivalent to the Lower Green- sand of England, or slightly earlier, Angiosperms make their first appearance ; but as the only strata of this age in Britain are of marine origin, we have to turn to other countries for the evidence. The earliest Angiosperm yet found in Europe is a single monocotyledonous leaf of doubtful affinities, named by Saporta Alismacites primcevus (Fig. 1) and found in the Valenginian strata of Portugal. These deposits seem to

be equivalent to British Wealden rocks, though in the ‘latter, even in their upper part, no trace of Angiosperms has been discovered. No other un- doubted Angiosperm has yet been dis- covered in Europe in strata of this age, but Heer records a poplar-like leaf from Urgonian strata, a stage newer than the Valenginian, in Greenland, and Saporta has described from strata of the same date in

Portugal a Euphorbiaceous plant apparently closely allied to the living Phyll- anihus and named by him Clioffatia Francheti (Fig. 2). We must turn to North America for a fuller know- ledge of the earliest flower- ing plants.

In Dakota a remarkable series has been discovered, lying unmistakably be- tween marine Upper Jur- assic rocks below and Upper Cretaceous above. There has been a certain amount of confusion as to the exact strata in which the plants occur, but this has now been cleared up by the researches of Lester Ward, who has shown how the Secondary flora gives place to one of Ter- tiary character. The lower strata â€” i.e., those >*‘“Â«‘â– ‘Â«Â«Â» most allied to the Jurassicâ€” contain only Gym- 2^^^” nosperms and Cryptogams. The next division (Dakota No. 2 of Meek and Hayden) contains Gymno-

FiG. 1. â€” Alismacites priTnmvus.

Fig. 2.â€” Clioffatia Francheti.

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sperms and Ferns of Neocomian types, or even of Neo- comian species; but mingled with these occur a few dicotyledonous leaves belonging to four genera. The specimens are very fragmentary, and all that can be said is that one of the forms may be allied to oak, another to fig, a third to Sapindus, and the fourth may perhaps be near to elm. The “Potomac Formation” of Virginia and Maryland is doubtless also mainly of

Neocomian age, for though it rests unconformably on much older strata, the successive floras found in it are so allied to those of Dakota as to leave little doubt as to the general homotaxis of the series. Lester Ward records no fewer than 737 distinct forms, consisting chiefly of Ferns, Cycads, Conifers, and Dicotyledons, the Ferns and Cycads being confined mainly to the Older Potomac, while the Dicotyledons are principally represented in the Newer Potomac, though occurring more rarely even down to the base of the series. Six successive stages have been defined in the Potomac formation. The Mount Vernon beds, which occur about the middle of the series, have as yet yielded only a small number of species, though these include the most interesting early Angiosperms. Among them are recorded a Casuarina, a leaf of Sagittaria (which however, as observed by Zeiller, may belong to Smilax), two species of poplar-like leaves with remarkably cordate bases, Menispermites (possibly a water-lily), and Celastro- phyllum (perhaps allied to Celastrus). Proteophyllum, found in the same bed, and also in the Infra-Cretaceous of Portugal, seems to have belonged to a Proteaceous plant, though only leaves without fruits have yet been discovered in deposits of this early date. Whatever doubt may be left as to the exact botanical position of these early Lower Cretaceous Angiosperms, it is clear that both Monocotyledons and Dicotyledons are repre- sented by several types of leaves, and that the flora extended over wide areas in North America and Green- land, and is found again at a few points in Europe. There is as yet no clear evidence either of climatic zones or of the existence of geographical provinces during this period. The next strata, the Aquila Creek series, contain a well-marked dicotyledonous flora, in which both the form and nervation of the leaves begin to approximate to those of recent times. The leading characteristic of this Middle Potomac flora is the proportion of Dicotyledons. Not- withstanding this apparent passage-bed, there is a marked difference between the Older and the Newer Potomac floras, very few species passing from the one to the other. Only 15 out of 405 plants in the older series occur in the beds above, though already more than 350 species have been determined from this newer series. The plants from the Amboy Clays, which form the most important division of the Newer Potomac series and were monographed in 1895 by Newberry, seem to belong to the commencement of the Upper

Cretaceous period. It is remarkable that nearly 80 per cent, of the species are Dicotyledons, and that no Monocotyledons have been found. The mere enumeration of the genera will indicate how close the flowering plants are to living forms. Newberry records Juglans, Myrica (7 species), Populus, Salix (6 species), Quercus, Planera, Ficus (3 species), Persoonia and another extinct Proteaceous genus named Proteoides, Magnolia (7 species), Liriodendron (4 species), Menispermites, Laurus, and allied plants. Sassafras (3 species), Cinnamovium, Primus, Hymenma, Dalbergia, Bauliinia, Caesalpinia, Fontainea, Colutea, and other Leguminosse, Ilex, Celastrus, Celastrophyllum (10 species), Acer, Rhamnites, Paliurus, Cissites, Tilicephyllum, Passiflora, Eucalyptus (5 species), Hedera, Aralia (8 species), Cornophyllum, Andromeda (4 species), Myrsine, Sapotacites, Diospyros, Acerates, Vibur- num, and various genera of uncertain aflRnities. The points that suggest themselves with regard to this flora

are, that it includes a fair representation of the existing orders of warm-temperate deciduous trees ; that the more primitive types, such as the Amentacece, do not appear to preponderate to a greater extent than they do in the existing temperate flora; that the assemblage somewhat suggests American afBnities; and that when we take into account deficient collecting, local conditions, and the non-preservation of succulent plants, there is no reason for saying that certain other orders must have been absent. The great rarity of Monocotyledons is a common characteristic of fossil floras known only, as this one is, from leaves principally belonging to deciduous trees. With regard to suggested American afiinities, it must be borne in mind that the Neocomian Angiosperms are little known except in America and in Greenland, and that we therefore cannot yet say whether families now mainly American were not formerly of world-wide distribution. We know that this was the case with some, such as Liriodendron; and in Eucalyptus we see the con- verse, where a genus formerly American is now confined to a far distant region. The Neocomian flora has been collected from an area extending over about 30Â° of lati- tude; but there is little evidence of any corresponding climatic change. We cannot yet say, however, that the deposits are exactly contemporaneous, and the great climatic variations that have taken place in the northern

hemisphere during the existence of our living flora should make us hesitate to correlate too minutely from the evi- dence of plants alone.

The highest division of the Dakota series (known as Dakota No. 1) which lies immediately beneath Upper Cretaceous strata with marine fossils, contains a flora so like that of the Tertiary deposits that only the clearest geological evidence has been considered sufficient to prove that Heer was wrong when he spoke of the plants as Miocene. These highest plant-bearing strata rest, accord- ing to Lester Ward, somewhat unconformably on the Dakota No. 2 ; they show also a marked difference in the included plants. The genera of Dicotyledons represented are Quercus, Sassafras, Platanus, Celastrophyllum, Cissites, Vihurnites.

In the central parts of North America the lacustrine plant-bearing deposits are of enormous thickness/ the Dakota series being followed by marine Cretaceous strata known as the Colorado and Montana groups, and these being succeeded conformably by a thousand feet or more of lacustrine shales, sandstones, and coal-seams belonging to the Laramie series. This also contains occasional marine Upper Cretaceous fossils, as well as reptiles of Cretaceous types. An extensive literature has grown up relating to these Laramie strata, for owing to the Tertiary aspect of the contained plants, geologists were slow to recognize that they could be truly contemporaneous and inter- bedded with others yielding Cretaceous animals. In addi- tion to this, the earlier writers included in the Laramie series many deposits now known to be of later date and truly Tertiary, and the process of separation is even now only partially completed. It will be safest in these cir-^ cumstances to accept as our guide to the true Laramie flora the carefully compiled "Catalogue" of Mr Knowlton. According to this catalogue, the true Laramie flora includes about 260 species, more than half of which are deciduous forest trees, herbaceous Dicotyledons, Monocotyledons, and Cryptogams, all being but poorly represented. Among the few Monocotyledons are leaves and fruits of palms, and traces of grasses and sedges. The Dicotyledons include several water-lilies, a somewhat doubtful Trapa, and many genera of forest trees still common in America. The genera best represented a.Te Ficus (21 species), Quercus

(16 species), Popidus (11 species), Rhamnus (9 species), Platanus (8 species), Viburnum (7 species). Magnolia

(6 species), Cornus (5 species), Oiyinamomum (5 species), Juglans (4 species), Acer (4 species), Salix (4 species), Aralia (3 species), Bhus (3 species). Sequoia (3 species). Of trees now extinct in America, Eucalyptus and Ginkgo are perhaps the most noticeable. So large a proportion of the trees still belongs to the flora of North America that one is apt to overlook the fact that among the more specialized plants some of the largest American orders, such as the Compositce, are still missing from strata be- longing to the Cretaceous period.

The imperfection and want of continuity of the records in Europe have made it necessary in dealing with the

Cretaceous floras for us to give the first place Cretaceous. *Â° America. But it is now advisable to return

to Europe, where Upper Cretaceous plants are not uncommon, and the position, of the deposits in the Cretaceous series can often be fixed accurately by their close association with marine strata belonging to definite subdivisions. As these divisions of Cretaceous time will have to be referred to more than once, it will be useful to tabulate them, thus showing which plant-beds seem to be referable to each, an.d what are the British strata of like age. It has not yet been found possible so closely to correlate the strata of Europe with those of America, where distance has allowed geographical difilerences in both fauna and flora to come into play ; therefore, beyond the references to Lower or Upper Cretaceous, no classification of the American Cretaceous strata has

here been given. In Europe the most com- monly accepted divisions of the Cretaceous period are as follows : â€”

Em”GLAN”D.

Wanting Upper Chalk Middle Chalk Lower Chalk) Upper Greensand) Gault

Lower Greensand

Wealden

Eeancb, &c. Danian Senonian Turonian

Cenomanian

Albian

Aptian

Valenginian

Urgonian

Neocomian

In the Continental classification the deposits from the Gault downwards are grouped as Lower Cretaceous ; but in Great Britain there is a strong break below the Gault and none above ; and the Gault is therefore classed as Upper Cretaceous. The limits of the divisions in other places do not correspond, the British and Continental strata often being so unlike that it is almost impossible to com- pare them. The doubt as to the exact British equivalent of the Valenginian strata of Portugal, which yield the earliest Dicotyledon, has already been alluded to. The plant-bearing deposits next in age, which have yielded Angiosperms, appear to belong to the Cenomanian, though from Westphaliaa few species belonging to the Cryptogams and Gymnosperms, found in deposits correlated with the Gault, have been described by Hosius and von der Marck.

In Great Britain the whole of the Upper Cretaceous strata are of marine origin, and have yielded no land-plants beyond a few fir-cones, drift-wood, and rare Dicotyledonous leaves in the Lower Chalk. Most of the deposits which have yielded Angiosperms of Cretaceous age in central Europe correspond in age with the English Upper Chalk (Senonian) but a small Cenomanian flora has, been collected from the Unter Quader in Moravia. Heer described from this deposit at Moletein 13 genera, of which 7 are still living, containing 18 species, viz., 1 fern, 4 Conifers, 1 palm, 2 figs, 1 Cred- neria, 2 laurels, 1 Aralia, 1 Ghov.rlrophyllum (of un- certain affinities), 2 magnolias, 2 species of Myrtacem, and a species of walnut. Saxony yields from strata of this

Fig. 3. â€” Credtieria tr-iacumivata.

period at Niederschoena 42 species, described by Ettings- hausen. This small flora is most remarkable, for no fewer than 6 genera, containing 8 species, are referred to the Froteacem. The Cenomanian flora of Bohemia is larger and equally peculiar. Among the Dicotyledons described by Velenovsky are the following : â€” Credneria (6 species),

Araliacem (17 species), Proteacem (8 species), Myrica (2 species), Ficus (5 species), Quercus (2 species), MagnoHacece (6 species), Bombacece (3 species), Laurinece (2 species), Ebenacece (2 species), Verbenacem, Combre- tucem, Sapindace'ce (2 species), Camelliacece, Avipelidem, MimosecB, Caesalpiniem (5 species), Eucalyptus (2 species), Pisonia, Phillyrea, Bhus, Primus, Bignonia, Laurus, Salix, Benthamia. To this list Bayer adds Aris- tolochia. The Cenomanian flora of central Europe appears to be a sub- tropical one, with marked approaches to the living flora of Australia. The majority of its Dicotyledons belong to existing genera, but one of the most proliflc and charac- teristic Cretaceous forms is Credneria (Fig. 3), a genus of doubtful affinities, which has been com- pared by different authors to the poplars, planes, limes, and other orders.

The Cretaceous plant-beds of Westphalia include both Upper and Lower Senonian, the two floras being very distinct. Hosius and von der Marck describe, for instance, 12 species of oak from the Upper and 6 from the Lower strata, but no species is common to the two. The same occurs with the figs, with 3 species above and 8 below. The 6 species of Credneria are all confined to the older deposits. In fact, not a single Dicotyledon is common to these two closely allied divisions of the Cretaceous series ; a circumstance not easy to explain, when we see how well the oaks and figs are represented in each. Four species of Dewalquea, a ranunculaceous genus allied to the hellebore, make their appearance in the Upper Senonian of Westphalia, other species occurring at Aix- la-Chapelle in deposits of about the same age. The Se- nonian flora of the last-named place, and that of Maestricht, are still only imperfectly known. It is unnecessary to trace the variations of the Upper Cretaceous flora from point to point; but the discoveries within the Arctic circle have been so surprising that attention must again be called to them. Besides the Lower Cretaceous plants already mentioned, Heer has described from Greenland a flora of Cenomanian age, and another belonging to the Senonian. The Cenomanian strata have yielded already 177 species, the different groups being represented in these proportions: â€" Cryptogams, 37, '30 of which are Perns; Cycads, 8; Conifers, 27; Monocotyledons, 8; Apetalae, 31 ; other Dicotyledons, 66. The Senonian strata have yielded 118 species, 21 of

which are Crypto- gams, 11 Conifers, 6 Monocotyledons, 76 Dicotyledons. Forest trees, especially oaks, are plentiful, and many of the species are identical with those found in Cretaceous deposits in more southern latitudes. Both of these floras suggest, however, that the climate of Greenland was somewhat colder than that of Westphalia, though scarcely colder than warm-temperate.

The Cretaceous deposits just described are followed by a series of Tertiary formations, but in Europe the con- tinuity between Cretaceous and Tertiary is not quite complete. The Tertiary formations have been assigned to six periods ; these are termed â€” Palaeocene, Eocene, Oligocene, Miocene, Pliocene, Pleistocene, and each has its own botanical peculiarities. During the first period the plants were not markedly different from those of the Upper Cretaceous. Its flora is still but imperfectly known, for we are dependent on two or three pflatsf”^ localities for the plants. There is found at Sezanne, about 60 miles east of Paris, an isolated deposit of calcareous tufa full of leaves, which gives a curious insight into the vegetation which flour- ished in Palaeocene times around a waterfall. Sezanne yields Perns in profusion, mingled with other shade- loving plants such as would grow under the trees in a moist ravine; its vegetation is comparable to that of an island in the tropical seas. Monocotyledons are rare, the only ones of much interest being some fragments of pandanaceous leaves. The absence of Gj’mnosperms is noticeable. The Proteaceje are also missing; but other Dicotyledons occur in profusion, many of them being remarkable for the large size of their deciduous leaves. Among the flowering plants are Dewalquea, a ranuncula- ceous genus already mentioned as occurring in the Upper Cretaceous, and numerous living genera of forest-treeS; such as occur throughout the Tertiary period, and are readily comparable /with living forms. Saporta has described about seventy Dicotyledons, most of which are peculiar to this locality. The plant-bearing marls of Gelinden, near Liege, contain the debris of a

palaeocene forest. The trees seemed to have flourished on neighbouring chalky heights. The most abundant species of this forest were the oaks and chestnuts, of which a dozen have been collected ; laurels, Viburnum, ivy, several Aralias, Deivalquea, a TJmja, and several Ferns may be added. This flora is compared by Saporta and Marion with that of southern Japan. Other deposits of this age in France have furnished plants of a more varied aspect, including myrtles, araucarias, a bamboo, and several fan- leaved palms. Saporta points out the presence of these Palaeocene deposits of certain types common, on the one hand, to the American Tertiary strata between the Missouri and the Rocky Mountains, and on the other, to the Tertiary flora of Greenland. The Palaeocene deposits of Great Britain are of Marine origin, and only yield pine-cones and fragments of Osmunda.

The British Eocene and Oligocene strata yield so large a flora, and contain plant-beds belonging to so many different stages, that it is unfortunate we have ^ocene ^^^^y q monograph on the subject, the one com- oiigoceae menced by Gardner and Ettingshausen in 1879 B rta/* having reached no farther than the Ferns and Gymnosperms. This deficiency makes it impossible adequately to deal with the British Eocene plants, most of the material being either unpublished or needing re-examination. In the earliest Eocene plant- beds, in the Woolwich and Reading series, a small but interesting flora is found, which suggests a temperate climate less warm than that of earlier or of later periods. Leaves of planes are abundant, and among the plants re- corded are two figs, a laurel, a Hobinia, a Grevillea, and a palm. Ferns are scarce, Ettingshausen and Gardner re- cording only Anemia subcretacea and Pteris (?) Prestwichii. The only Gymnosperms determined are Libocedrus adpressa, which is close to L. decurrens of the Yoseipite, and Taxodium europceum. A few plants have been found in the next stage, the Oldhaven beds, and among these are fig and cinnamon. Gardner considers the plants to point to subtropical conditions. The London Clay has

yielded a large number of plants, but most of the species are represented by fruits alone, not by leaves. This circumstance makes it difficult to compare the flora with that of other formations, for not only

is it uncertain which leaves and fruits belong to the same plant, but there is the additional source of doubt, that different elements of the same flora may be represented at differ- ent localities. Of some plants only the deciduous leaves are likely to be preserved, whilst other succulent-leaved forms will only be known from their woody fruits. Among the 200 plants of the London Clay are no Ferns, but 6 genera of Gymnosperms, viz., Callitris (2 species). Sequoia, Athrotaxis (?) Ginkgo, Podocarpris, Pinns ; and several genera of palms, of which the tropical Nipa is the most abundant and most characteristic, among the others being fan-palms of the genera Sabal and Cham

The next stage is represented by the Lower Bagshot leaf-b^ds of Alum Bay. These pipeclays yield a varied flora, Ettingshausen recoi?ding 274 species, belonging to 116 genera and 63 families. Gardner, however, is un- able to reconcile this estimated richness with our know- ledge of the flora, and surmises that fossil plants from other localities must have been inadvertently included. He considers the flora to be the most tropical of any that has so far been studied in the northern hemisphere. Its most conspicuous plants are Ficus Boiverbankii, Aralia primigenia, Comptonia acutiloba, Dryandra Bunbui~yi, Gassia Uhgeri, and the fruits of Gcesalpiinia. The floras which it chiefly resembles are first, that of Monte Bolca, and second, that of the Gres du Soissonais, which latter Gardner thinks may be of the same age, and not earlier, as is generally supposed. The total number of species found at Alum Bay, according to this author, is only about 60 or 60.

To the Bagshot Sand succeeds the thick mass of sands with intercalated plant-beds seen in Bournemouth cliffs. Each bed yields peculiar forms, the total number of species amounting to many hundred, most of them differing from those occurring in the strata below. The plants suggest a comparison of the climate and forests with those of the Malay Ajchipelago and tropical America. At one place we find drifted fruits of Nipa, Hightea, and Anona ; at another perfect limbs of an American form of cactus, found also at Bovey Tracey. Other beds yield principally palms, willows, laurels. Eucalyptus, or Ferns ; but there are no Cycads. As- showing the richness of this flora, we may mention that in the only orders which have yet been monographed, Ferns are

represented by 17 species and Gymnosperms by 10, though these are not the groups best represented. Gardner speaks of the Bournemouth flora as appearing to consist principally of trees or hard-wooded shrubs, comparatively few remains of the herbaceous vegetation being preserved. The lignite deposits and pipeclays of Bovey Tracey, in Devon, referred by Heer and Pengelly to the Miocene period, have now been shown by Gardner to be of the same age ds the Bournemouth Beds.; many of the species, including all the Dicotyledo- nous leaves of Bovey, occurring also at Bournemouth. One of the commonest Ferns at both localities, Osmunda lignita, is scarcely distinguishable from a species found in the Philippines. The higher Eocene strata of England â€" those above the Bournemouth Beds â€" are of marine origin, and yield only drifted fruits, principally fir-cones.

In the volcanic districts of the south-west of Scotland

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and the north-east of Ireland plant-beds are found inter- calated between the lava-flows. These also, like the lignites of BoveyTracey,have been referred to the Miocene period, on the supposed evidence of the plants ; but more recent discoveries by Gardner tend to throw doubt on this allocation, and suggest that, though of various ages, the first-formed of these deposits may date back to early Eocene times. The flora found in Mull points distinctly to temperate conditions ; but it is not yet clear whether this indicates a different period from the sub-tropical flora of the south of England, or whether the difference depends on latitude or local conditions. The plants include a Eern, Onoclea Jiebrklica, close to a living American form ; four Gymnosperms belonging to the genera Cri/ptome>~~m,G^wi%o, Taxvs and Podocarpus; Dicotyledons of about 30 species, several of which have been figured. Among the Dico~~ tyledons may be mentioned Platanus, Acer(?), Quercusi?), Viburnum, Alnus, Magnolia, Corylus (?), Castanea (?), Zizyphus, Populus, and the

nettle-like Boehmeria antiqua. The absence of the so-called cinnamon-leaves and the Smilaceoe, which always enter into the composition of Middle Eocene and Oligocene floras, is noticeable. The Irish strata yield two Ferns ; 7 Gym- nosperms, Cupressus, Crypitomeria, Taxus, Podocarpus, Pinus (2 species), Tsuga ; and leaves of about 26 Dico-tyledons. The most abundant leaf, according to Gardner, does not seem distinct from Celastrophyllum Bene- deni, of the Palseocene strata of Gelinden ; a water-lily, Nelumbium Buchii, occurs also in Oligocene beds on the Continent ; the species of Mac- Clintockia (Eig. 4) is found both in the Arctic floras and at Gelinden. Among the other plants are an alder, an oak, and a doubtful cinnamon;

Leaving these Scottish and Irish deposits of doubtful age, we find in the Hampshire Basin a thick series of fluviatile, lacustrine, and marine de-Fia. i.~~MauOiintockia posits undoubtedly of Lower and trinev'vata. Middle Oligocene date. Their flora is still a singularly poor one, though plants have been obtained at many different levels ; they perhaps indicate a somewhat cooler climate than that of the Bourne~~ mouth series. Among the more abundant plants are nucules of several species of Chara, and drifted fruits and seeds of water-lilies, of Folliculites (a genus probably close to Stratiotes) and of Limnocarpus (allied to PotOr mogeton) ; there is little else mixed with these. Other seams are full of the twigs and cones of Athrotaxis, a Conifer now confined to Tasmania. Ferns are repre- sented by Gleichenia, Lygodium, and Chrysodium Lanzce- anum, which last has a very wide range in time ; Monoco-tyledons, by a Sabal and a feather-palm, as well as by the two aquatic genera above mentioned ; Gymnosperms, by the extinct araucarian genus DoUostrobus, by rare pine- cones, and by Athrotaxis. Dicotyledonous leaves are not plentiful, the genera recorded being Andromeda, Cinnor momum, Zizyphus, Rhus, Viburnum. Above the Oligocene strata in Great Britain there is a complete break, no species of plant ranging upwards into the next fossil- iferous division.

Space will not allow us to deal with the numerous scattered deposits which have yielded Tertiary plants. It will be more to the purpose to take distant areas, where

the order of Ijhe strata is clear, and compare the succession of the floras with that met with in other geographical regions and in other latitudes. For this study it will be most convenient to take next south and central France, for in that area can be found a series of plant-centtai bearing strata in which is preserved a nearly and continuous history of the vegetation from Upper southern Eocene down to Pliocene. The account is taken â„¢Â°'^Â®- mainly from the writings of Saporta. The gypsuin-deposit of Upper Eocene date at Aix in Provence commences this series, and is remarkable for the variety and perfect preservation of its organic remains. Among its Gymno- sperms are numerous Cupressinece of African afBnity belonging to the genera Callitris and Widdringtonia, and a juniper close to one indigenous in Greece. Fan-palms, several species of dragon-tree, and a banana like one living in Abyssinia represent the more peculiar Monocotyledons. Among the noticeable Dicotyledons are the Myricacea, Proteacece, Laurineoe, Bombax, the Judas-tree, Acacia, Ailanthus, while the most plentiful forms are the Arali- acece. Willows and poplars, with a few other plants of more temperate regions, are found rarely at Aix, and seemingly point to casual introduction from surrounding mountains. In a general way, spiny plants, with stiff branches and dry and coriaceous leaves, dominate the flora, as they now do in Central Africa, to which region on the whole Saporta considers the flora to be most allied.

The succeeding Oligocene flora appears to be more characterized by a gradual replacement of the Eocene species by allied forms, than by any marked change in the assemblage or in the climatic conditions. It forms a perfectly gradual transition to the still newer Miocene period, the newer species slowly appearing and increasing in number. Saporta considers that in central and south- ern Europe the alternate dry and moist heat of the Eocene period gave place to a climate more equally and more universally humid, and that these conditions continued without material change into the succeeding Miocene stage. Among the types of vegetation which make their appearance in Europe during the Oligocene period may be mentioned the Conifers Libocedrus salicornioides, several species of CJiamcecyparis and Sequoia, Taxodium distichum, and Glyptostrobus europceus. The palms in-clude Sabal hceringiana, S. major and Flabellaria. Among the

MyricacecB several species of Comptonia are common. These new-comers are all of American type. Aquatic plants, especially water-lilies, are abundant and varied; the dry-soil Callitris and Widdnngtonia become scarce.

Though we do not propose to deal with the other European localities for Eocene and Oligocene plants, there is one district to which attention should be drawn, on account of the exceptional state of preservation of the specimens. On the Baltic shores of Prussia there is found a quantity of amber, containing remains of insects and plants. This is derived from strata ^^j^ ’” of Oligocene age, and is particularly valuable ”” ”’ because it preserves perfectly various soft parts of the plants, which are usually lost in fossil specimens. The tissues, in fact, are preserved just as they would be in Canada balsam. The amber yields such things as fallen flowers, perfect catkins of oak, pollen grains, and fungi. It enables us to determine accurately orders and genera which otherwise are unknown in the fossil state, and it thus aids us in forming a truer idea of the flora of the period than can be formed at any locality where the hai’der partg alone are recognizable. No doubt this amber flora is still imperfectly known, but it is valuable as giving a good idea of the vegetation, during Oligocene times, of a mixed wood of pine and oak, in which there is a mixture of herbaceous and woody plants, such as would now be

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found under similar conditions. The plants of which the floral organs or perfect fruits are preserved include the amber-bearing Pinus succhiifera, Sviilax, Phoenix, the spike of an aroid, 11 species of oak, 2 of chestnut, a beech, Urticacece, 2 cinnamons and Trianthera among the LauracecB, representatives of the Cistaceoe, Ternstroe- , mmcece, Dilleniacece (3 species of Hibbertia), Geraniacecie (Geranium and Erodium), Oxalidacece, Acer, Celastracece, Olacacece, Pittesporacew, Ilex (2 species), Euphorbiacece, Uvibelliferce {dicerophyUum),

Saocifragacece' {3 genera), Hammnelidaceve, Rosacece, Connaracece, Ericaceae {Andro- meda and Glethra), Myrsinacece (3 species), RubiaccK, Sambucus (2 species), Santalacece, Loranthacece (3 species). We here discover for the first time various living families and genera, but there is still a noticeable absence ' of many of our most prolific existing groups. Whether this deficiency is accidental or real time will show.

The Miocene flora, which succeeds to that just described, is well represented in Europe ; but till recently there has been an unfortunate tendency to refer Tertiary floras of all dates to the Miocene period, unless the geological position of the strata was so clear as obviously to forbid this â€ž. assignment. Thus the Eocene lignites of Devon

and the plant-beds in the basalt of Scotland and Ireland were called Miocene ; and in the Arctic regions and in North America even plant-beds of Upper Cretaceous age were referred to the same period. The reason for this was that some of the first Tertiary floras to be examined were certainly Miocene, and, when these plants had been studied, it was considered that somewhat similar assem- blages found elsewhere in deposits of doubtful geological age must also be Miocene. For a long time it was not recognized that changes in the marine fauna, on which our geological classification mainly depends, correspond scarcely at all with changes in the land plants. It was not suspected, or the fact was ignored, that the break between Cretaceous and Tertiary â€" made so conspicuous by strik- ing changes in the aquatic animals â€" had little or no im- portance in botanical history. It was not realized that an Upper Cretaceous flora needed critical e^xamination to distinguish it from one of Miocene age, and that the two periods were not characterized by a sweeping change of generic type, such as took place among the marine inverte- brates. It may appear absurd to a geologist that any one could mistake a Cretaceous flora for one of Miocene date, since the marine animals are completely different and the differences are striking. In the case of the plants, how- ever, the Tertiary generic types in large part appeared in Upper Cretaceous times.. Few or no extinct types are to be found in these older strata â€" there is nothing among the plants equivalent to the unmistakably extinct Amr monites,

Belemnites, and a hundred other groups, and we only meet with constant variations in the same genus or family, these variations having seldom any obvious rela- tion to phylogeny.

The Miocene period is unrepresented by any deposits in Great Britain ; we will therefore commence with the best known region â€” that of central Europe and especially of Switzerland, whence a prolific flora has been collected and described by Oswald Heer. The Miocene lacustrine deposits are contained in a number of silted-up lake-basins, which were successively formed and obliterated during the uprise of the Alps and the continuous folding and bending of the earth's crust which was so striking a feature of the period. These undulations tended to transform valleys into chains of lakes, into which the plants and animals of the surrounding area fell or were washed. We thus find preserved in the Upper Miocene lacustrine deposits of Switzerland a larger flora than is known from any other period of similar length; in fact, an analysis of its com-

position suggests that the Miocene flora of Switzerland must have been both larger and more varied than that now living in the same country. The best known locality for the Upper Miocene plants is Oeningen, on the Lake of Constance, where have been collected nearly 500 species of plants, the total number of Miocene plants found in Switzerland being stated to be now over 900. Among the characteristics of this Miocene flora are the large number of families represented, the marked increase in the deciduous-leaved plants, the gradual decrease in the number of palms and of tropical plants, and the replace- ment of these latter by Mediterranean or North American forms. According to Heer, the tropical forms in the Swiss Miocene agree rather with Asiatic types, while the subtropical and temperate plants are allied to forms now living in the temperate zone in North America. Of the 920 species described by Heer, 114 are Cryptogams and 806 flowering plants. Mosses are extremely rare, Heer only describing 3 species. Vascular Cryptogams still include one or two large Horsetails with stems over an inch thick, and also 37 species of Fern^ amongst the most interesting of which are 5 species belonging to the climb- ing Lygodium, a genus now living in Java. The number of Ferns is just equal to that now found in

Switzerland. Gycads are only represented by fragments of two species, and this seems to be the last appearance of Cycads in Europe. The Coniferse include no fewer than 94 species of Oiqoi'essinece and 17 of Abietinece, including several species of Sequoia. Monocotyledons form one-sixth of the known Miocene flora, 25 of them being grasses and 39 sedges ; but most of these need further study, and are very insuflBciently characterized. Heer records one species of rice and four of millet. Most of the other Monocotyledons call for little remark, though among them is an Iris, a Bromelia, and a ginger. Smilax, as in earlier times, was common. Palms, referred to 11 species, are found, though they seem to have decreased in abundance; of them 7 are fan-palms, the others including Phcenicites â€" a form allied to the date â€" and a trailing palm, Calamopsis, allied to the canes and rattans. .Among the Dicotyledons, the Leguminosae take the first place with 131 species, including Acacia, Ccesalpinia, and Cassia, each represented by several forms. The occur- rence of 90 species of Amentacese shows that, as the climate became less tropical, the relative proportion of this group to the total flora increased. Evergreen oaks are a marked characteristic of the period, more than half the Swiss species being allied to living American forms. Fig-trees referred to 17 species occur, all with undivided leathery leaves ; one is close to the banyan, another to the indiarubber tree. The Laurineae were plentiful, and include various true laurels, camphor-trees, cinnamon, Persea, and Sassafras. The Proteacese, accord- ing to Heer, are still common, the Australian genera Hakea, Dryandra, Grevillea, and Banlcsia being repre- sented. Amongst gamopetalous plants several of our largest living families, including Campanulacese, Labiatae, Solanaceae, and Primulacese, are still missing ; and of Boragineae, Scrophularineae, G-entianeae, and Caprifoliaceae there are only faint and doubtful indications. The Compositae are represented by isolated fruits of various species. Twining lianas are met with in a species of Bignonia; Umbelliferae, Eanunculaeeae, and Cruciferae are represented by a few fruits. These fanii,lies, how- ever, do not appear to have had anything like their present importance in the temperate flora, though, as they are mainly herbaceous plants with fruits of moderate hard- ness, they may have decayed and left no trace. The Amer- ican Liriodendron still flourished

in Europe. Water-lilies of the genera Nymphcea and Nelumbium occur. Maples were still plentiful, 20 species having been described.

Eosacese are rare, Cratcegiis Primus, and Amygdalus, being the only genera recorded. It is obvious that many of these Swiss Miocene plants will need more close study before their specific characters, or even their ge- neric position, can be accepted as thoroughly made out ; still, this will not affect the general composition of the flora, with its large proportion of deciduous trees and evergreens, and its noticeable deficiency in many of our largest living families.

From Europe it will be convenient to pass to a distant region of similar latitude, so that we may see to what extent botanical provinces existed in Eocene and Oligo- cene times. It so happens that the interior of temperate Tertiary North America is almost the only region ou1> of North side Europe in which a series of plant-beariug America, strata give a connected history of these periods, and in which the plants have been collected and studied. It is unfortunately still very diflBcult to correlate even approximately the strata on the two sides of the Atlantic, and there is great doubt as to what strata belong to each division of the Tertiary period even in different parts of North America. This difficulty will disappear as the strata become better known, but at present each of the silted-up lakes has to be studied separately, for we can- not expect so close a correspondence in their faunas and floras as is found in the more crowded and smaller basins in central Europe.

Perhaps the most striking characteristic of the Ter- tiary floras of North America, as distinguished from those of Europe, is the greater continuity in their his- tory and greater connexion with the existing flora of the same regions. ^This difference is readily explained when we remember that in Europe the main barriers which stop migration, such as the Alps and the Medi- terranean, run east and west, while in

America the only barriers of any importance run north and south. In consequence of this peculiarity, climatic or oro- graphic changes in Europe tend to drive animals and plants into a cid de sac, from which there is no escape ; but in America similar climatic waves merely cause the species alternately to retreat and advance. This difficulty in migration is probably the reason why the existing European flora is so poor in large-fruited trees compared with what it was in Miocene times or with the existing flora of North America. In America the con- trast between the Eocene forests and those now living is much less striking, and this fact has led to the wrong as- sumption that the present American flora had its origin in the American continent. Such a conclusion is by no means warranted by the facts, for in Tertiary times, as we have seen, the European flora had a distinctly ” Ameri- can ” facies. Therefore the so-called American forms may have originated in the Old World, or more probably, as Saporta suggests, in the polar regions, whence they were driven by the increase of cold southwards into Europe and into America. The American Tertiary flora is so large, and the geology of the deposits is so intricate, that it is out of the question to discuss them more fully within the limits of this article. We may point out, how- ever, that the early Tertiary floras seem to indicate a much closer connexion and a greater community of si)e- cies than is found between the existing plants of Europe and America. Or, rather, we should perhaps say that ancient floras suggest recent dispersal from the place of origin, and less time in which to vary and become modified iDy the loss of different groups in the two con- tinents. Geographical provinces are certainly indicated by the Eocene flora of Europe and America, but these are less marked than those now existing.

If we turn to a more isolated region, like Australia, we find a Lower Eocene flora distinctly related to the existing

flora of Australia and not to that of other continents. Australasia had then as now a peculiar flora of ^^gf^gng^ its own, though the former wide dispersal of the Proteaceae and Myrtacese, and also the large number of Amentacese then found in Australia, make the Eocene plants of Europe and Australia much less unlike than are the present floras.

Within the Arctic circle a large number of Tertiary plants have been collected. These were described by Heer, who referred them to the Miocene period; he recognized, in fact, two periods during which Angio- sperms flourished within the Arctic regions, the one Upper Cretaceous, the other Miocene. To this view of the Miocene age of the plant-bearing strata in Greenland and Spitsbergen there are serious objections, which we will again refer to when the flora has been described. .

The Tertiary flora of Greenland is of great interest, from the extremely high latitude at which the plants flourished, thirty of the species having been Arctic collected so far north as lat. 81Â°. Taking first regions. this most northerly locality, in Grinnell Land, we find the flora to comprise 2 horsetails, 11 Conifers (including the living Pimis Abies), 2 grasses, a sedge, 2 poplars, a willow, 2 birches, 2 hazels, an elm, a Viburnum, a water- lily, and a lime. Such an assemblage at the present day would suggest a latitude quite 25Â° farther south ; but it shows decidedly colder conditions than any of the European Eocene, Oligocene, or IMiocene strata. From lat. 78Â° in Spitsbergen Heer records 136 species of fossil plants. More to the south, at Disco Island in lat. 70Â°, the Tertiary wood seem to have been principally composed of planes and Sequoias ; but a large number of other genera occur, the total number of plants already recorded being 137. From various parts of Greenland they now amount to at least 280. Among the plants from Disco, more than a quarter are also found in the Miocene of central Europe. The plants of Disco include, besides the plane and Sequoia, such warm-temperate trees as Ginkgo, oak, beech, poplar, maple, walnut, lime, and magnolia. If these different deposits are contemporaneous, as is not improbable, there is a distinct change in the flora as we move farther from the pole, which suggests that difference of latitude then as now was accompanied by a difference in the flora. But if this process is continuous from latitude to latitude, then we ought not to look for a flora of equivalent age in the warm-temperate Miocene deposits of central Europe, but should rather expect to find that the temperate plants of Greenland were contemporaneous with a tropical flora in central Europe. As Mr Starkie Gardner has pointed out, it does not seem reasonable to assume that tlae same flora could

have ranged then through 40Â° of latitude ; it is more probable that an Eocene tem- perate flora found in the Arctic regions travelled south- wards as the climate became cooler, till it became the Miocene temperate flora of central Europe. ISIr Gardner suggests, therefore, that the plant-beds of Greenland and Spitsbergen represent the period of greatest heat, and are therefore wrongly referred to the Miocene. At pres- ent the evidence is scarcely sufficient to decide the ques- tion, for if this view is right, we ought to find within the Arctic circle truly Arctic floras equivalent to the cool Lower Eocene and Aliocene periods ; but these have not yet been met with.

A steady decrease of temperature marked the Pliocene period throughout Europe, and gradually brought the climatic conditions into correspondence with those now existing, till towards the end of the ”’“*’ period neither climate nor physical geography differed greatly from those now existing. Concurrently with this change, the tropical and extinct forms disappeared, and the flora approached more and more nearly to that now

existing in the districts where the fossil plants are found, though in the older deposits, at any rate, the geographieat distribution still differed considerably from that now met with. Atlast, in the latest Pliocene strata (often called ” pre-Glacial “) we find a flora consisting almost entirely of existing species belonging to the Paleearctic regions, and nearly all still living in the country where the fossils are found. This flora, however, is associated with a fauna of large mammals, the majority of which are extinct.

The plants of the Older Pliocene period are unknown in Great Britain, and little known throughout Europe except in central France and the Mediterranean region. The forests of central France during this epoch showed, according to Saporta, a singular admixture of living European

species, with trees now characteristic of the Canary Isles and of North America. For instance, of the living species found at Meximieux, near Lyons, one is American, eight at least belong to the Canaries (six being characteristic of those islands), two are Asiatic, and ten still live in Europe. Taking into account, how- ever, the closest living allies of the fossil plants, we find about equal affinities with the floras of Europe, America, and Asia. There is also a decided resemblance to the earlier Miocene flora. Among the more interesting plants of this deposit may be mentioned Torreya niicifera, now Japanese; an evergreen oak close to the common Quercus Hex ; Lani-us canariensis, Apollonias canariensis, Persea caroUnensis, a.n

and others are extinct. The flora, however, is essentially Palaearctio, American and Australian types having dis- appeared.

The latest Pliocene, or pre-Glacial, flora of northern Europe is best known from the Cromer Forest-bed of Norfolk and Suffolk, a fluvio-marine deposit which lies beneath the whole of the Glacial deposits of these counties, and passes downwards into the Crag, many of the animals actually associated with the plants being characteristic Pliocene species which seem immediately afterwards to have been exterminated by the increasing cold. The plants contained in the Cromer Forest-bed fall into two groups â€” the forest-trees, and the marsh and aquatic plants. V/e know little or nothing at present of the upland plants, or of those of dry or chalky soils. Forest trees are well represented ; they are, in fact, better known than in any of the later English deposits. We find the living British species of maple, sloe, hawthorn, white-beam, cornel, elm, birch, alder, hornbeam, hazel, oak, beech, willow, yew, and pine, and also the spruce. This is an assemblage that could not well be found under conditions differing greatly from those now holding in Norfolk; there is an absence of both Arctic and south European plants. The variety of trees shows that the climate was mild and moist. Among the aquatic and marsh plants we find, mingled with a number that still live in Norfolk, the “water-chestnut (Trapa nutans) and Najas minor, neither of which is now British. On the Norfolk coast another thin plant-bed occurs locally above the Forest-bed and immediately beneath the Boulder Clay. This deposit shows no

trace of forest-trees, but it is full of remains of Arctic mosses, and of the dwarf willow, and birch; in short, it yields the flora now found within the Arctic circle. The incoming of the Glacial toÂ«ne epoch does not appear to have been accompanied by any acclimatization of the plants â€” the species belonging to temperate Europe were locally exterminated, and Arctic â€¢forms took their places. The same Arctic flora reappears in deposits immediately above the highest Boulder Clay, deposits formed after the ice had passed away. These fossil Arctic plants have now been found as far south as Bovey Tracey in Devonshire, where Pengelly and Heer discovered the bear-berry and dwarf birch ; London, where also Betula nana occurs ; and at Deuben in Saxony, which lies nearly as far south as lat. 50Â°, but has yielded to Professor Nathorst's researches several Arctic species of willow and saxifrage. The cold period, however, was not continuous, for both in Great Britain and on the continent of Europe, as well as in Canada, it was broken by the recurrence of a milder climate and the reappearance of a flora almost identical with that now living in the same regions. This " inter-Glacial " flora, though so like that now found in the district, has interesting peculiarities. In England, for instance, it includes Acer monspessulanum, a southern maple which does not now extend nearer than central Europe; also JSfajas graminea and JSf. minor, both southern forms not now native of Britain. Brassenia peltata, a water-lily found in the warmer regions almost throughout the world, except in Europe, occurs abundantly in north Germany, but not in Great Britain. Similar inter- Glacial deposits in Tirol contain leaves of Rhododendron ponticum.

Space will not permit us to enter into any full discus- sion of the recurrence of Glacial and inter-Glacial periods, and the influence they may have had on the flora. It is evident, however, that if climatic alternations such as those just described are part of the normal routine that has gone on through all geological periods, and are not merely con-fined to the latest, then such changes must evidently have had great influence on the evolution and geographical distribution both of species and of floras. Whether this

was so, is a question still to be decided, for in dealing with extinct floras it is difficult to decide, except in the most general way, to what climatic conditions they point. We seem to find indications of long-period climatic oscillations in Tertiary times, but none of the sudden invasion of an Arctic flora, like that which occurred during more recent times. It should not be forgotten, however, that an Arctic flora is mainly distinguishable from a temperate one by its poverty and dwarfed vegetation, its deciduous leaves and small fruits, rather than by the occurrence of any characteristic genera or families. Careful and long-continued study would therefore be needed before we could say of any extinct dwarfed flora Jhat it in- cluded only plants which could withstand Arctic con- ditions.

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PAL^OaRAPHY.

THE principal discoveries made during recent years in the field of Palaeography concern the history of Greek writing. At the time when the article on Palaeography appeared in vol. xviii. (ninth edition) of this Encyclopaedia, the anterior limit of our knowledge of the forms of writing to be found in documents of Greek origin was the 2nd century b.c. We are now in a position to carry back our investigations a century earlier. It is true that a few documents which have since been shown to be of the 3rd century B.C. were extant in European libraries, but they were undated, and their value as specimens of early writing was not recognized. But now the very large number of Greek papyri recovered in Egypt since 1880 have furnished material which not only extends our knowledge, but also enables us to confirm or modify views formerly held. In the history of Latin Palaeography little has been added to the material already known. Comparatively few Latin documents have been found among the papyri of Egypt ; still, such as they are, they are not without interest in providing us with specimens of writing of the time of the early Roman occupation of the country. It follows, then, that this supplement must mainly be a survey of the history and palaeography of Greek papyri, a subject which has been most ably dealt with by Mr F. G. Kenyon in The Paloiography of Gvpek Papyri, to which the student may be referred for fuller details than cau be given in these pages.

The history of Greek writing on papyrus can now be followed with more or less fulness of material for more than nine hundred years. Actual dated examples range from ^270 b.c. to a.d. 680. We have a fair knowledge of the leading features of the writing of the 3rd and

2nd centuries B.C. ; a less perfect acquaintance with those of the 1st century B.C. Eor the first two centuries of the Christian era and to the middle of the 3rd cen- tury there is an almost uninterrupted series of docu- ments ; then again for two centuries there is a decline, only to be followed by abundance of material for the 6th and early 7th centuries.

Thus it will be seen that, while for some periods we may be justified in draw- ing certain conclusions and laying down certain rules, for others we are still in a very imperfect condition of knowledge. But our knowledge will no doubt almost yearly become more exact, as fresh material is brought to light from the excavations which are now continually proceeding ; and those periods in which the lack of papyri breaks the chain of evidence will sooner or later be as fully represented as the rest. The material certainly lies buried in the sands ; it is our misfortune that the exact sites have not yet been struck.

The first discovery of Greek papyri was made in Europe, in 1752, when the excavations on the site of Herculaneum yielded a number of charred rolls which proved to be of a literary character. All subsequent discoveries we owe to Egypt ; and it is to be observed that the papyri which are found in that country have come down to us under different conditions. Some, gene- rally of a literary nature, were carefully deposited with the bodies of their owners in the tomb with the express intention of being preserved ; hence such MSS. in several instanceshave come to our hands in fairly perfect con- dition. On the other hand, by far the larger number of those recently brought to light have been found on the sites of towns and villages, particularly in the district

of the Fayum, where they had been either accidentally lost or purposely thrown aside as of no value, or had even been used up as material for other purposes besides their original one. These are consequently for the most part in an imperfect and even fragmentary condition, although not a few of them have proved to be of the highest palseographical and literary importance.

The date of the first find of Greek papyri in Egypt was in 1778, when some forty or fifty rolls were dis- covered by some native diggers, who, however, kept only one of them. After this, scarcely anything appeared until the year 1820, when was found on the site of the Serapeum at Memphis, as it was reported, the group of documents of the 2nd

century B.C. which have been referred to in the article Pal^eogeaphy (Ency. Brit. vol. xviii. p. 149). Then followed a fruitful period when several important literary papyri were secured : in 1821, the Bankes Homer, coiltaining the last book of the Iliad; in 1847, the roll containing the Lycophron and other orations of Hyperides ; in 1849 and 1850, the Harris Homer, book xviii. of the Iliad, and a MS. of books ii.-iv. ; and in 1856, the Funeral Oration of Hyperides.

But the great bulk of the Greek papyri from Egypt is the result of excavations undertaken during the last quarter of the 19th century. Within this time three very important discoveries of documents in large quan- tities have taken place. In 1877 a great mass of papyri was found on the site of Arsinoe in the Eayum, being chiefly of a non-literary nature and unfortunately in a very fragmentary state ; they are also late in date, being of the Byzantine period. The greater number passed into the possession of the Archduke Eainer, and are now at Vienna; the rest are divided between London, Oxford, Paris, and Berlin. After an interval, this find was followed by the recovery in 1892, in the same , neighbourhood, and chiefly on the site of a village named Socnopsei Nesus, of an extensive series of documents of the Roman period, ranging from the 1st century to the middle of the 3rd century. These papyri, being of an earlier date and in better condition than the Arsinoite collection, are consequently of greater palseographical value. Most of them are now in Berlin ; many are in the British Museum ; and some are at Vienna, Geneva, and elsewhere. The third great find, and the most important of all, was made by Messrs Grenfell and Hunt, when excavating, in the season 1896-97, for the Egypt Exploration Fund, at Behnesa, the ancient Oxyrhynchus. Thousands of papyri were here recovered, including, among the non- literary material, a number of rolls in good condition, and comprising also a great store of fragments of literary works, among which occur the now well-known "Logia" or " Sayings of Our Lord," and fragments of the Gospel of St Matthew and of writings of various classical authors. This great collection ranges in dat^ over the first seven hundred years of the Christian era ; but in what proportion the documents fall to the several centuries cannot be determined until the series of volumes in which

they are to be described for the Graeco-Eoman branch of the Egypt Exploration Fund shall have made some substan- tial progress.

These three great collections of miscellaneous documents have been supplemented by finds of other smaller groups, which fit into them and serve to make more complete the chronological series. Such are the correspondence of a Roman officer named Abinnasus of the middle of the 4th century, shared between the British Museum and the library of Geneva in the year 1892 ; and a miscel- laneous collection, ranging from the 2nd century B.C. to the 3rd or 4th century a.d., acquired for the Egypt Exploration Fund and published by that society {FayUm

Towns and their Papyn, 1900). But of these smaller groups by far the most interesting is that which Mr Flinders Petrie extracted, in 1889-90, from a set of mummy-cases found in the necropolis of the village of Gurob in the Fayum. In the manufacture of these coflBjis numbers of inscribed papyri had been employed, being cut into pieces and pasted together in order to form the cartonnage. The fragments thus recovered proved to be the most valuable documents for the history of Greek palaeography hitherto found, supplying us with examples of writing of the 3rd century b.c. in fairly ample numbers, and thus carrying back our knowledge of the subject to a period which up to that time had remained a blank. Besides miscellaneous documents, there are included the remains of registers of wills entered up from time to time by different scribes, and thus affording a variety of handwritings for study ; and, further, the value of the collectiou is enhanced by the presence of fragments of the Phcedo and Laches of Plato and of the lost Antiope of Euripides and of other classi- cal works.

The last decade of the 19th century has also been distinguished by the recovery of several literary works of the first importance, inscribed on papyri which had been deposited with the dead, and had thus remained in a fairly perfect condition. In 1889 the Trustees of the British Museum acquired a copy of the lost ‘ABrjvaLoiv IloXircta. of Aristotle, a papyrus of the Mimes of the poet Herodas, and a portion of the oration of Hyperides against Philippides; and in 1896 they had the

further good fortune to secure a papyrus containing considerable portions of the odes of Bacchylides, the contemporary of Pindar. And to the series of the orations of Hyperides the Louvre was enabled to add, in 1892, a MS. of the greater part of the oration against Athenogenes. The recovery of so many great classical works within a few years may be accepted as an earnest of further finds of the same nature, now that excavations are being carried on systematically in Egypt.

From a study of the material thus placed at our dis- posal, certain conclusions have been arrived at which satisfy us that the periodical changes which passed over the character of Greek writing as practised in Egypt coincide pretty nearly with the changes in the political administration of the country. The period of the rule of the Ptolemies from 323 to 30 b.c. has, in general, its'own style of writing, which we recognize as the Ptole- maic; the period of Roman supremacy, beginning with the conquest by Augustus and ending with the reorgan- izati6n of the empire by Diocletian in a.d. 284, is accom- panied by a characteristic Soman hand ; and with the change of administration which placed Egypt under the Byzantine division of the empire, and lasted down to the time of the Arab conquest in a.d. 640, there is a corresponding change to the Byzantine class of writing. These changes must obviously be attributed to the influ- ence of the official handwritings of the time. A change of government naturally led to a change of the of&cials employed, and with the change of officials would naturally follow a change in the style of production of official docu- ments. In illustration of this view, it is enough to call to mind the instances of such variations to be- met with in the history of the palaeography of mediaeval Europe, due in the same way to political causes. It is interesting, too, to observe that in our own time the teaching in schools of a particular type of handwriting which finds favour in clerical examinations for the public service has not been without its influence on the general handwriting of the people.

Classifying, then, the writing of the papyri into the three groups, the Ptolemaic, the Roman, and the Byzan-

tine, the next step is to determine, by a closer examination of the documents, the changes which characterize the several centuries traversed by those groups. In doing this, we cannot apply the exact terms which are employed in describing the MSS. of the Middle Ages. We have to do with writing which has not yet been cast into the formal literary moulds of the later times; and it has therefore been found necessary, as well as convenient, to divide the papyri simply into two series, representative of their contents and not of their style of production, namely, literary papyri and non-literary papyri. Neither series, however, it is to be remembered, has a style of writing peculiar to itself. While the literary works are, as a rule, vn-itten with more or less formality, not a few of even the more valuable of them are copies in the ordinary cursive hands of the day. Conversely, while we find non-literary documents generally written in ordin- ary cursive hands, whether by official scribes or by private individuals, yet occasionally we meet with one produced in the formal style more common to literary examples. Again, while applying to particular letters in papyri such technical terms as capitals, or uncials, or minuscules, we cannot convey by those terms the exact ideas which we convey when thus describing the individual letters of mediajval manuscripts. For the letters of the papyrus period were not cast in finished moulds, while the uncial writing and the minuscule writing of the Middle Ages were settled literary hands. As will presently be seen, the mediaeval uncial developed directly from the literary writing of the papyri; the minuscule was a new type moulded from the cursive into a fixed literary style.

Necessarily, the non-literary papyri are much more numerous than the literary documents, and present a much greater variety of handwriting, being in fact the result of the daily transactions of ordinary life ; and how very widespread was the knowledge of writing among the Greek-speaking population of Egypt is suflBciently testified by the surviving examples, coming as they do from the hands of aU sorts and conditions

of men. We wiU first examine these specimens of the current handwriting of the day before passing to the review of the more or less arti- ficial book-vsriting of the literary papyri.

As already stated, the oldest material is chiefly contri- buted by the papyri discovered at Gurob. Among them are not only the fragments of official registers which have been mentioned, but also a variety of miscellaneous documents relating to private affairs, and in various hands of the 3rd century and early 2nd century B.C. â€¢ The series of non-literary papyri bears actual dates ranging from 270 to 186 B.C. The leading characteristic of Greek writing of the 3rd century B.C. is its strength and facility. While it may not compare with some later styles in the precise formation of particular letters, yet its freedom and spontaneous air lend it a particular charm and please the eye, very mncli in the same way that a scholar's practised and unconscious handwriting of a good type is more attractive than the more exact formality of a clerk's hand. The letters generally are widely spread and shallow, and, particularly in the official hands, they are linked together with horizontal connecting strokes to such an extent that the text has almost the appearance of depending from a continuous horizontal line. The ex- treme shallowness or flatness of many of the letters is very striking, especially in the case of delta, mu, mi, pi, and omega. A significant indication of the antiquity of Greek cursive writing is found in connexion with one of the forms of the letter alpha, which is reduced to a mere angle or wedge.

A few lines from an official order of the year 250 B.C.

will serve to convey an idea of the trained cursive style of this century : â€"

'7^ i J^pn Qr\ioc 7-)~

Fio. 1.â€" Official Order, 260 B.C.

(etS TOTTOV^OV Kai TTji â€"

â€” rerpa /cai eiKOCTTTjsâ€” â€” 6eis Tots 6rj(TavpoL^ â,¬ir â€” â€” rerpa /cat eiKocrrr]'; â€” â€” oviKov /cat Tovs Â£prjfji,o â€” â€” crippayicrajjLevoi aTroo" â€")

As a contrast to this excellent hand, we give a facsimile of a section from a roughly vsritten letter from a land steward to his employer, of about the same date : â€"

Fig 2. â€" Letter of a Land Steward, 3rd century B.c.

(e^^et Swts y â,¬-)(prj

VOWp CKaCTTOS TOiV OpwV T7}V

ap/KiXov KJyvTevofJLefrjv TrpoTcpov)

Here there is none of the linking of the letters which is seen in the other example : every letter stands distinct. But while the individual letters are clumsily written, the same laws govern their formation as in the other docu- ment. The shallow, wide-spread mn, the cursive nu, the small tketa, omihron, and rho, are repeated. Here also is seen the tau, with its horizontal stroke confined to the left of the vertical instead of crossing it, and the undeveloped omega, which has the appearance of being clipped â€" both forms being characteristic of the 3rd century B.C.

The trained clerical hands of the 2nd century B.C., if we may form a judgment from the e'idence of such documents as those connected with the Serapeum at Memphis, already referred to, differ generally from those of the earlier century in the larger size of the lettering, and in a more perfect and less cursive formation, the older shallow tyg^ gradually disappearing, and the linking of letters by horizontal strokes being less continuous. But the Ptolemaic character marks the handwriting well through the century ; and it is only towards the close of that period and as the next century is entered, that the

hand begins to give way and to lose altogether its linked style and the peculiar crispness of the strokes which give it its distinctive appearance.

With the Eoman period comes roundness of style, in strong contrast to the stiffness and rigid linking of the Ptolemaic hand. Curves take the place of straight strokes in the individual letters, and even ligatures are formed in pliant sweeps of the pen. This transition from the stiff to the flexible finds something of a parallel in the development of the curving and flexible English charter- hand of the 14th century from the rigid hand of the 13th century; following, it would seem, the natural law of relaxation. Koundness of style, then, is characteristic of Greek cursive vreiting in the papyri of the first three centuries of the Christian era, however much individual hands, or groups of hands, might vary among themselves. After that time, if we may judge from the meagre material that has been recovered, there appears to have been a reform of the Roman hand which marks the entry of Greek writing into the new phase of the Byzantine period, the characteristic features of the new style being its large scale and its formality â€” a deliberate calligraphic effort which culminated in the bold but artificial hand of the 6th and 7th centuries.

A specimen of cursive writing of the Roman type is selected from a pap3rrus (Brit. Mus. No. cxxxi.) which is of more than usual interest, as it is on the verso side of the rolls of which it is composed that the text of Aristotle's Constitution of Athens has been transcribed. It contains the farming accounts of the bailiff of Epi- maohus, son of Polydeuces, the owner of an estate in the nome of Hermopolis in the 9th and 10th years of the reign of Vespasian, that is, a.d. 78-79 : â€”

2s^?^/ TQt A.K^i oo p<>

Fia. 3. â€” Fann Accounts, a.d. 78-79.

(cTous evSeKarov a â€” ovecnracnavov cre^acrrov â€” SaTravat tov fi-ajvoi ;^ â€” TO 8i avTOv ewiixa^ov e â€”)

The fully developed Byzantine hand of the legal type is shown in a few lines from a fragmentary lease of a farm (Fig. 4) in the 6th century (Brit. Mus. pap. cxiii. 3). In the long range covered by the Greek papyri under our hands, the formation of individual letters necessarily varied under different influences ; but in not a few in- stances the original shapes were remarkably maintained. From those which thus remained conservative it is rash to attempt to draw conclusions as to the precise age of the several documents in which they occur. On the other hand, there are some which at certain periods adopted shapes which were in vogue for a limited time and then disappeared, never to be resumed. Such forms can very properly be regarded as sure guides to the palaeographer in assigning dates. We may take a brief survey of the Greek cursive alphabet of the papyri and note some of the peculiarities of individual letters. The incipient form of the alpha, which gradually developed into the min- uscule letter of the Middle Ages, may be traced back to the Ptolemaic documents of the 2nd century B.C. ; but the

more cursive letter, which was a simple acute angle, re- presenting only two of the three strokes of which the

wj^

KP

^irhNcj

(y^Nq-D^

FlC5. 4.â€” Lease of a Farm, 6th Century.

(â€” 9 avTwv TOV SiKaiov Â£ â€” â€” s Kai avTrjq kolL ek tcov â€” â€” iVTLVOi /J-epyj Tpcia Ka â€” â– â€” (0 ra Trpos rrjv KaX-Xiep â€” â€” at Tr/v iecriv tov tt â€”)

primitive letter was composed, was characteristic of the 3rd century B.C., and seems to have gone out of use within the Ptolemaic period. The development of the cursive beta is interesting. At the very beginning we find two forms in use : the primitive capital letter and a

cursive shape somewhat resembling a small n, being in fact an imperfectly written B in which the lower bow is disregarded. This form lasted through the Ptolemaic period. Then arose the natural tendency to reverse the strokes and to form the letter on the priuciple of u ; but still the capital letter also continued in use, so that through the Roman and Byzantine periods the M-shape and the 5-shape run on side by side. Analogously the letter happa, formed on somewhat the same lines as the beta, runs a similar course in developing a cursive M-shaped form by the side of the primitive capital. Delta remained fairly true to its primitive form until the Byzantine period, when the elongation of the head into a flourish led on to the minuscule letter which is familiar to us in the mediaeval and modem alphabet. Epsilon, the most frequently recurring letter in Greek texts, departs less from its original rounded uncial form than might have been expected. Frequent and varied as its cursive formations are, yet the original shape is seldom quite disguised, the variations almost in all instances arising from the devices of the scribe to dispose swiftly and conveniently of the cross-bar by incorporating it with the rest of the letter. The tendency to curtail the second vertical limb of eta, leading eventually to the A-shape, is in evidence from the first. But in the development of this letter we have one of the instances of temporary forms which lasted only within a fixed period. In the 1st century, side by side with the more usual form, there appears a modification of it, somewhat resembling the contemporary xipsilon, consisting of a shallow horizontal curve with a vertical limb slightly turned in at the foot, “3. Its development from the original H is e^^dent : the first vertical limb is slurred, and survives only in the beginning of the hori- zontal curve, while the cross-bar and the second vertical are combined in. the rest of the letter. This form was in general use from the middle of the 1st to the

middle of the 2nd century, becoming less common after about a.d. 160, and practically disappearing about a.d”. 200. The letters formed wholly or in part by circles or loops, theta, omikron, rho, phi, in the earlier

centuries have such circles or loops of a small size. Just as there is an analogy between beta and kappa in their develop- ments, as already noticed, so also do mu and pi advance on somewhat similar lines. From the earliest time there is a resemblance between the broad shallow forms of the two letters in the 3rd century B.C., and particularly when they adopt the form of a convex stroke the likeness is very close; and again, in both Koman and Byzantine periods an 7i-shaped development appears among the forms â€¢of both letters. There is also one phase in the develop- ment of sigma which aifords a useful criterion for fixing the date of documents within a fixed limit of time. In the Ptolemaic period the letter, always of the C-form, is upright, with a flattened horizontal head ; in the Koman period a tendency sets in to curve the head, and in the course of the 1st century, by the side of the old stiffer form of the letter another more cursive one appears, in which the head is drawn down more and more in a curve, C C. This form is in common use from the latter part of the 1st century to the beginning of the 3rd century. The cursive form of tau, in which the horizontal stroke is kept to the left of the vertical limb, without crossing it, is one of the early shapes of the letter. Lastly, the early Ptolemaic form of the w-shaped omega is noticeable from having its second curve undeveloped, the letter having the appearance of being clipped.

Before taking leave of the non-literary hands, we may briefly notice certain literary papyri which are written in cursive writing. The most important are : the astronomical treatise derived from Eudoxus, of the 2nd century B.C., among the collections of the Louvre ; an anonymous work on diseases, with extracts from Menon's latrica, of the 1st or 2nd century, now in the British Museum ; and, above all, Aristotle's Constitution of Athens, written at the end of the 1st century, also in the British Museum. To these are to be added : a pap5TUS containing a small portion of- the eleventh book of the Iliad, of the 2nd cen- tury B.C., now at Geneva ; an erotic fragment of the same time, in the British Museum ; and the fragment of the lyric poet Alcman, of the 1st century, in the Louvre.

Literary papyri written in book-hands, distinct from the cursive writing which has been under consideration, may be divided into two

classes : those which were produced by skilled scribes, and therefore presumably for the market, and those which were written less elegantly, but still in a literary hand, and were probably copied by or for scholars for their own use. By rare good fortune important literary fragments were recovered in the Gurob collection, which yielded the most ancient dated cursive documents of the 3rd century B.C., so that, from the beginning, we start with coeval specimens of both the cursive and of the book- hand, and we are in a position to compare the two styles on equal terms, and thus approximately to date the literary papyri. Palaeographically, this is a matter of the first importance ; for while cursive documents, from their nature, in most instances bear actual dates, the periods of literary examples have chiefly to be decided by comparison, and often by conjecture.

The literary fragments from Gurob fall into the two groups just indicated, MSS. written for sale, and scholars' copies. Of the former are some considerable portions of two works, the Phcedo of Plato and the lost Antiope of Euripides. Both are written in carefully formed characters of a smaU type, but of the two the Phaedo is the better executed. As the cursive fragments among which they were found date back to before the middle of the 3rd

century B.C., it is reasonable to place these literary remains also about the middle of that century. Their survival is a particularly interesting fact in the history of Greek palaeography, for in them we have specimens of literary rolls which may be fairly assumed to diifer very little in appearance from the manuscripts of the great classical authors of Greece. Indeed, the Phcedo was probably written within a hundred years of the death of the author.

In the facsimile of a few lines from this papyrus here placed before the reader, the characteristics of the cursive hand are also to some extent to be observed in the formal book-hand : â€"

rev*, yjpr e / ^ Â« jtA^E'F> ^-.~"Tta.v -?{'^â– f ~~rKjo~~EftfAY-T-Hf-JcT AfYfc A\rt)frT-frniJ-AtMH^frJlAA'M*l

Fia. 6.â€” The Phcedo of Plato, 3rd century B.C.

(â€” cre(i)v iriiOovtra Se Â£k tovtw/a, â€” avaKwpuv oa-o/J. fj-rj avayiaj ypria\6'\KOLL aOpoi^arOai, Trapa/ce A.Â£uecr[^]at ina-Tfveiv 8e /tijSevt aAAo)i)

The general breadth of the square letters, the smaUness of the letters formed of circles and loops, and the particular formation of such letters as pi and the clipped omega, are repeated. The approach also of many of the letters to the lapidary forms is to be remarked, such as the precisely- shaped alpha, and the epsilon in many instances made square with a long head stroke. All such peculiarities must be accepted as indications of antiquity.

Of the 2nd century B.C. there are extant only ^wo papyri of literary works vrritten in the formal book-hand, and both are now preserved in the Louvre. The one, a dialectical treatise containing quotations from classical authors, has long been known, and was referred to in the article in the ninth edition of this work. The other is the oration of Hyperides against Athenogenes, which is an acquisition of recent date. The dialectical treatise must belong to the first h^lf of the century, as there is on the verso side of the papyrus writing subsequently added in the year 160 B.C. The period of the H3'perides cannot be so closely defined ; but the existence on the verso of later demotic writing, said to be of the Ptolemaic time, aifords a limit, and the MS. has been accordingly placed in the second half of the century. While the writing of the earlier papyrus is of a light and rather sloping character, that of the Hyperides is particularly firm and square and upright.

Passing to the 1st century B.C., the papyri which have been recovered from the ashes of Herculaneum come into account.]\Iany of them, the texts of which are of a philosophical nature, are written in literary hands, and are conjectured to have actually formed part of the library of their author, the]ihilosopher Philodemus ; they are there- fore placed about the middle of the century. To the same time are assigned the remains of a roll containing the oration of Hyperides against Philippides and the third Epistle of Demosthenes (Brit.]\Ius. papp. cxxxiii., cxxxiv.). But the most important addition to the period is the

hs^ndsomely written papyrus containing the poems of Bacchylides, which retains in the forms of the letters much

of the character of the Ptolemaic style, although for other reasons it can hardly be placed earlier than about the middle of the century : â€”

>c f- 1 f ^j- jKH -r t f M -Â» Â»~< n f Â» f /^r>^

fin f-j*^KHe/>-t><Â«>T

Fio. 6.â€” Bocohylides, 1st century B.a

(j(â,¬ipai avTiivuiv Trpoi auyas i7nrcoKÂ£os aeXtou TCKva 8iÂ«7Tai/oio A,vcrcras 7rap

With the latter half of the 1st century B.C. we quit the Ptolemaic period and pass to the consideration of the literary papyri of the Eoman period ; and it is especially in this latter period that our extended knowledge, acquired from recent discoveries, has led to the modification of views formerly held with regard to the dates to be attributed to certain important literary MSS. As in the case of non-literary documents, the literary writing of the Eoman period differs from that of the Ptolemaic in adopting rounded forms and greater uniformity in the size of the letters.

Just on the threshold of the Eoman period, near the end of the 1st century B.C., stands a fragmentary papyrus of the last two books of the Iliad, now in the British Museum (pap. cxxviii.), which is of sufficient extent to be noted. Then, emerging on the Christian era, we come upon one of the most beautiful surviving specimens of literary writing, which we have satisfactory reason for placing near the beginning of the 1st century. It is a fragment of the third book of the Odyssey, the writing of which closely resembles that of an official document (Brit. Mus. pap. cccliv.) which happens to be written in a formal literary hand, and

which from internal evidence can be dated vfithin a few years of the close of the 1st century B.C. There can be no hesitation, therefore,! in grouping the Odyssey with that document. The contrast between the round Eoman style and the stiff and firm Ptolemaic hands is here well shown in the facsimiles from this papyrus (Fig. 7) and the Phmdo and Bacchylides.

In a similar style of beautiful writing are two fragments of Hesiodic poems recently published, with facsimiles, in the Sitzungsberichte (1900, p. 839) of the Berlin Academy. The earliest of the two, now at Strasburg, may be assigned to the first half of the 1st century ; the other, at Berlin, appears to be of the 2nd century.

At this point two MSS. come into the series, in regard to which there is now held to be reason for revising views formerly entertained. The papyrus known as the Harris Homer (Brit. Mus. pap. cvii.), containing portions of the eighteenth book of the Eiad, which was formerly placed in the 1st century B.C., it is thought should be now brought down to a later date, and should be rather assigned to the 1st century of the Christian era. The great papyrus, too, of Hyperides, containing his orations against Demosthenes and for Lycophron and Euxenippus, which has been commonly placed also in the 1st century B.C., and by some even earlier, is now adjudged to belong to the latter part of the 1st century a.d.

At the end of the 1st or early in the 2nd century is placed a papyrus of great literary interest, containing

the Mimes of the Alexandrian writer Herodas, which was discovered a few years ago and is now in the British

HA I A,ec ewoj <}.reTii \e>u A^cu!

CUCeyjiQ 0 lAAPATOY^AXkJJieN/

ic^p n Miua>c2ue;re Y^^w Y(j)^P

AM lerYNH TXXJLl t-(CITO W K^I

o+j^reorAe^OYCfXf orpecpe khi AAf .krt-ixcAa^ocneprKAX TT

ecXl^p 0 M AXN CB X,l N eJc^l HJSi

Fia. 7. â€” The Odyssey ^ beginning of Ist century.

(iraiScs ip,OL aye TrjXeiMVf^tnL â€” evia$ v 01 8 apa rov ;U.a\a p-ev â€” Kap7raXt/x ap â€” av &e yvvYj Tap.vrj (tltov Kai â€” oij/a Tâ,¬ Ota eBovcri Siorpecfje â€” â– av 8 apa -n^Ac/iap^os wepiKaX â€” Trap 8 apa veoroptSrjs Tretcrto” â€” â,¬s Sicjipov S avejiaive /cat rjv â€”

Museum. The writing of this MS. differs from the usual type of literary hand, being a rough and ill-formed uncial, inscribed on narrow, and therefore inexpensive, papyrus; and if the roll were written for the market, it was a cheap copy, if indeed it was not made for private use. Of the same period is a papyrus of Isocrates, de Pace (Brit. Mus. pap. cxxxii.), written in two hands, the one more clerical than the other ; and two papyri of Homer, Iliad iii.-iv. (Brit. Mus. pap. cxxxvi.), and Iliad, xiii.~~xiv. (Brit. Mus. pap. dccxxxii.), the first in a rough uneducated hand, but the latter a fine specimen of uncial writing. Then follows another famous papyrus, the Bankes Homer, con~~ taining the last book of the Iliad, which belongs to the 2nd century and is also written in a careful style of uncial writing.

With regard to the later literary works on papyrus that have been recovered, the period which they occupy is somewhat uncertain. The follovsdng are, however, placed in the 3rd century, during which a sloping literary hand seems to have been developed, curiously anticipating a similar change which took place in the course of develop-metit of the uncial writing of the vellum MSS., the upright hand of the 4th to 6th centuries being followed by a sloping hand in the 7th and 8th centuries : â€” A MS., now in the British Museum, of portions of books ii.-iv. of the Iliad, written on eighteen leaves of papyrus, put together in book-form, but inscribed on only one side ; on the verso of some of the leaves is a short grammatical treatise attributed to Tryphon : portion of Iliad v., among the Oxyrhynchus papyri (No. ccxxiii.) : a fragment of Plato’s Laws (Ox. pap. xxiii.) : a papyrus of Isocrates, in Nicodem, now

at Marseilles : a fragment of Ezekiel, in book form, in the Bodleian Library : and a fragment of the ” Shepherd ” of Hermas, at Berlin.

Of the 3rd century also are some fragments which are paleeographically of interest, as they are written neither in the recognized literary hand nor in simple cursive, but in cursive characters moulded and adapted in a set form for literary useâ€” thus anticipating the early stages of the development of the minuscule book-hand of the 9th century from the cursive writing of that time.

PALEOGRAPHY

With the 3rd century the literary hand on papyrus appears to lose most of its importance. We are within measurable distance of the age of vellum, and of the formal uncial writing of the vellum MSS. which is found in some existing examples of the ith century and in more abundant numbers of the 5th century. W”e have now to see how the connexion can be established between the literary handwriting of the papyri and the firmer and heavier literary uncial writing of the veUum codices. The literary hands on papyrus which have been reviewed above are distinctly of the style inscribed with a light touch most suitable to the comparatively frail material of papyrus. Only in the Bankes Homer may one detect some indication of the fulness that characterizes the vellum uncial writing. But it now appears that a larger and rounder hand was also employed on papyrus at least as early as the 1st century. In proof of this we are able to cite a non-literary document bearing an actual date, which happens to be written in characters that, exclusive of certain less formally-made letters, are of a large uncial literary type. This writing, though not actually of the finished style familiar to us in the early vellum MSS., yet resembles it so generally that it may be assumed, almost as a certainty, that there was in the 1st century a full literary uncial hand formed on this pattern, which was the direct ancestor of the vellum uncial. The tendency to emjjloy at this period a calligraphic style, as seen in the fragments of the Odyssey and one of the Hesiodic poems mentioned above, supports this assumption. The document now referred to is a

deed of sale written in the seventh year of Domitian, A.D. 88 (Brit. Mus. pap. cxli.). The letters still retaining a cursive element are alpJia, wpsilon, and in some in- stances epsilon.

g MrrroAe^Af^ e-ref re 2JC01 K^\ytT^XTQrrXr^ xTOTn e-Â©aecoc a:>ceTa;

ereni rr^f -^ iM ATTOTttc

Fio. 8.â€” Deed of Sale, a.d. 88.

(â€” fv TrToXefJuxiSi evepye â€” â€” fwot /cat r] TOVTOV yvv â€”

V TOV TTiOeW; MS CTO) â€”

â€” ereiriypac^ijv otto ttjs â€” â€” avTov Tre^ea eXatcov â€”)

As evidence in support of this view that the uncial hand of the vellum MSS. is to be traced back to the period of the document just quoted, we have the important papyrus found by Mr Flinders Petrie at Hawara in Egypt, and now in the Bodleian Library, which contains a portion of the second book of the Iliad. The writing is of the large uncial type under consideration ; and there is now full reason for assign- ing it to the 2nd century at latest. Before the dis- covery of the document of the year 88 there was nothing to give a clue to the real period of the Homer ; and now the date which has been suggested is corroborated by a fragment of papyrus from Ox3Thynchus inscribed with some lines from the same book of the Iliad (Fig. 9) in the same large uncial type (Ox. Pap. vol. i. no. 20, pi. v.). In this latter instance there can be no question of the early date of the writing, as on the verso of the pap3TU3 accounts of the end of the 2nd century or of the beginning of the 3rd century have been subsequently added.

Thus, then, in the 1st and 2nd centuries there was in use a large uncial hand which was evidently the fore-

cuKi rAcoccxrroAycrTGP

OCK^ KPCRUAIKIGTCJUO GlCecX>K0CJLJLHCAJJ.GNO

Fig. 9. â€” The Iliad, 2nd century.

(â€” (ov yAcocrcra iroXvcnrip â€” â€” o5 avrjp a”rjp,aiveT(o o â€” â€” uarOm Koa/j.r]cra/ji.evo â€”)

runner of the literary uncial hand of the early veUum codices. It is also to be noted that the two literary examples just mentioned are MSS. of Homer ; and hence one is tempted to suggest â€¢ that, as in the production of sumptuous copies on papyrus of a work of such universal popularity and veneration as the Iliad this large and handsome uncial was specially employed, so also the use of a similar type for the early veUum copies of the sacred text of the Scriptures naturally followed.

While such large results in Greek papyri have rewarded recent researches in Egypt, we have to record the discovery of only a very small number of papyri inscribed in Latin, and of those very few are in perfect condition. Among the Archduke Rainer’s collection at Vienna, for example, and among the large mass of documents found at Oxy-rhynchus for the Egypt Exploration Fund, here and there a letter, or fragment, or military document is found. But it is hardly to be expected that any very extensive series of Latin documents should come to light in Egypt, unless by chance the archives of some Eoman military station should be recovered.

We may briefly enumerate the few more important documents recently found. Among Lord Amherst’s papyri is a fragment containing three of the fables of Babrius, each accompanied with a Latin version, of the 3rd or 4th century (Amherst Papyri, pt. ii. no. xxvi.). At Berlin are the remains of an Imperial edict, suggested to be of the time of Tiberius, which are published, with a photograph, in Aegyptische Urhunden aus den konigl. Museen, No. 628. At Geneva is a papyrus containing Eoman military money accounts, published by Nicole and Morel, Archives Militaires du piremier siecle. A papjTus of a similar nature, of the 2nd century, is printed by Grenfell and Hunt, Fayum Towns (Eg. Expl. Fund), No. cv. And a roll, now at Berlin, of the First Augustan Cohort of Spain, quartered at Apollinopolis Major in Egypt, in A.D. 156, is

given in facsimile in the series of the Palceographical Society, ii. 165. The most perfect Latin document on papyrus, as yet recovered, is in the British

Fia. 10.â€” Sale of a Slave, a.d. 166.

(â€” et si quia eum pueruin â€” cerit simplatn peoiiiiiam â€” te dare atipulatus est Fabul â€” Julius Prisons id fide sua â€” C. Julius Antioclius mani â€”)

Museum, and records the purchase of a slave-boy by an officer in the Eoman fleet of Misenum stationed on the

Syrian coast, a.d. 166 {Pcd. Soc. i. 190 ; ArchoBologia, liv. p. 433). The writing of the body of the document is in a formal cursive, generally of the same formation as the inscriptions on the Dacian waxen tablets of the 2nd century, as will be seen from the accompanying facsimile of a few lines (Fig. 10).

With this example of legal handwriting of the 2nd century it is interesting to compare two specimens of more ordinary cursive in different styles found in private letters of about the same time. The first is taken from a fragmentary letter of the year 167, published by Grenfell and Hunt, Greek Papyri, series ii. No. cviii. : â€”

Fia. 11.â€” Letter, a.d. 167.

(Octobrium ad Puluinos ad â€” interueniente Minucium â€” et Apuleium nepotem soribam â€” nonis Ootobris imp. Uero ter â€”)

The second (Fig. 12) is from a letter written by one Aurelius Archelaus to Julius Domitius, tribwius militum, recommending a friend named Theon, of the 2nd century. (Printed by Grenfell and Hunt, Oxyrhynchus Papyri (Eg. ExpL Fund), i. No. xxxii.)

1:

FiQ. 12.â€” Letter, 2na century.

(Jam tibi et pristine commen daueram Theonem amicum meuin et mod[o qu]oque puto domine ut eum ant oculos habeas tanquam nie est e nim tales omo ut anietur a te)

Authorities. â€” Of general handbooks and guides for the study of Greek and Latin palaeography there have been issued : â€” E. M. Thompson, ffaiidbook of Greek and Latin Palseography (1893) ; a third edition of Wa i'te >f bach's Schriftwesen im Mittelalter (1S96) ; DziATZKO, Untersuchungen iiher ausgewdMte Kapitel des antiken Buchwesens (1900); and Kenyon's article on "Writing" in Hastings' Dictimmry of the Bible (1902) ; also Protj's Manuel de PaUographie Latine et Fran(;aise (1891), and Ketjsbns' Elements de Paleographie (1897). The Palasographioal Society has completed the issue of two large series of facsimiles from manuscripts (1873- 1894) with classified indices (1901) ; and Vitelli and Paoli have published their Collezione Fiorentina di Faesimili PaZeografici Greci e Latini (1884-1896). For the Falseograpliy of Greek Papyri a large number of works have been published : â€" Kenyon, The Palceography of Greek Papyri (1899), and Catalogue of Greek Papyri in the British Museum, 2 vols., with atlases of facsimiles (1893, 1898).â€" Mahaffy. On the Flinders Petrie Papyri (Royal Irish Academy, 1891, 1893). â€" MUtheilungen aus der Sammlung der Papyrus F!rzherzog Eainer (1886, &o.), and Fiihrer durch die

Ausstellung der Papyrus Firzk. Pudner (1892). â€" Wbssely, Corpus Papyrorum Baineri (1895). â€" Gbenfell and Hunt. Greek Papyri (two series, 1896, 1897), The Oxyrhynchus Papyri (tu o parts, 1898, 1899), FayUm Tovms and their Papyri (1900).â€" Geenfell. Bevenue Laws of Ptolemy Philadelphus (1896). â€" Kenyon. Aristotle on the Constitution of Athens (1891, 1892), with facsimile. Classical Texts from Greek Papyri (1891, 1892), including Herodas, with facsimile, and The Poems of Bacchylides (1897), with fac- simile.â€" Revillout. Le Plaidoyer d'Hypiride contre AthdTwgene (1892), with facsimile. â€" Wiloken. Tafeln zur dlteren griech. Palceographie (1891). For Greek

Falieography generally : â€” Wattenbach. Anleitu/ng zur griech. Palceographie (3rd ed., 1Â»95). â€” Omont. FacsimiUs des i^lus anciens Manuscrits Grecs en on,ciale et en minuscule de la Bibliotkique JNationalc du, ill. au xii. siicle (1892) ; FacsimiUs des Manuscrits datis de la Bibl. Nat. du ix. au xiv. siecle (1890) ; Facsimiles des McmuscrUs Grecs des xv. et xvi. sUcles (1887). â€” Martin. FacsimiUs des Mamiscrits (frees cCEspagne (1891). â€” Allen. Notes on Abbreviations in Greek Manuscripts (1889). â€” Zerbteli. De compendiis Scriptures codicum Grcecorum, prceeipue Petropolitanorum, et Mosqucnsium (1896). â€” GlTLBAtTEE. Lie drei Systems der griech. Tachygraphie (1894). â€” Wessely. Fin System altgriech. Tachygraphie (1895). For Latin Palseograpliy : â€” The waxen tablets found at Pompeii in 1875 and 1887 have been edited by Zangemeister, Tabulae Ceratae Pompeis repertae, in the supplement to vol. iv. of the Corpus Inscriptionum Latinarum of the Royal Prussian Academy (1898). â€” Chatelain. PaUographie des Olassiques Latins (1884- 1896), and Uncialis Scriptura codicum Latinarum novis exemplis illustrata (1901). â€” Delislb. Album PaUographique (1887); Becueil de FacsimiUs d I' usage de Vticole des Charles (1880, &c.) â€” MONAOI and Paoli. Archivio Paleografico Italiano (1882, 1890). Wessely. Schrifttafeln zur alleren iateinischen Palaeographie (1898). â€” Chroust. Monumenta Palceographica (1899, &c.). â€” Giry. Manuel de Diplomcdiqim (1894). â€” Martin. The Becord Interpreter (1892). â€” Cappblli. Dizionario di Abbreviature Latine editaliane (1899). â€” Chatelain. Introduction d la Lecture des Notes Tironi- ennes (1900). Several large MSS. have been reproduced, in full or in part, in photographic facsimile, namely: â€” The Codex Alexan- drinus (Cod. A) and the Codex Vaticanus (Cod. B), of the Bible in Greek ; the Codex Bezae (Cod. D), Gospels and Acts, in Greek and Latin ; the Vienna Genesis, in Greek ; the Codex Sarravianus of the Pentateuch, in Greek ; the Codex Rossanensis of the Gospels, in Greek ; the Ashburnham Genesis, in Latin ; the Qtrecht Psalter, in Latin ; Homer's Hiad (Cod. Venetus A) ; the Laurentian jEschylus ; the Laurentian Sophocles ; the Paris Demosthenes ; the Oxford Plato (Cod. Clark.) ; the Heidelberg Plautus (Cod. Palatin.) ; the Vatican Virgil (Cod. Vat. 3225) ; the Bern Horace (Cod. 363) ; and the Venice Aristophanes (in progress). (e. m. T.)

Pa,la,mcllJ, a district of British India, in the Chota Nagpur division of Bengal. It was formed out of Lohardaga, and takes its name from a former state or chiefship. The administrative headquarters are at Daltonganj. It consists of the lower spurs of the Chota Nagpur plateau, sloping north to the valley of the Sone. Area, 4905 square miles; population (1881), 551,075 ; (1891), 596,770 ; (1901), 619,421 ; showing an increase of 8 per cent, between 1881 and 1891, and of 3‘8 per cent, between 1891 and 1901 ; average density, 126 persons per square mile, being the lowest in all Bengal. Classified according to religion, Hindus in 1891 numbered 496,426; Mahommedans, 50,445 ; Christians, 6676 ; aborigines, 43,223. The land revenue and rates in 1897-98 were Ks.l, 23,780; number of poKce, 256; boys at school (1896- 1897), 6860, being 15‘5 per cent, of the male population of school-going age; registered death-rate (1897), 39”4 per thousand. Palamau suffered severely from drought in 1897-98. Sanction has been given for a branch of the East Indian Railway from the Sone valley, which will open up the valuable coalfield near Daltonganj ; and other lines have been surveyed to afford a shorter route to Calcutta. The only articles of export are jungle produce, such as lac and tasar silk. The forests are unprofitable.

Pa.la.lTICOtta,h, a town of British India, in the Tinnevelly district of Madras, situated on the opposite bank of the Tambraparni river to Tinnevelly town, with which it shares a station on the South Indian Eailway, 444 miles south of Madras. Population (1891), 18,612 ; municipal income (1897-98), Rs.25,360. It is the

residence of the officials of the district. The Sarah Tucker college for women was founded in 1895 ; the two high schools (Church Mission and Jesuit) have nearly 600 pupils. There are three printing-presses, besides a library and reading-room.

Palanpur, a native state of India, in the Gujarat division of Bombay, on the southern border of Eajputana. Area, 3177 square miles; population (1881), 234,402:

(1891), 274,864 ; (1901), 222,627.

The estimated gross revenue is Ils.6, 59,530, of which Rs.48,680 was expended on public worlis in 1897-98 ; tribute to the Gaekwar of Baroda, Rs. 50,000. The chief, whose title is diwan, is an Afghan by descent. The state is traversed by the main line of the Rajputana-Malwa railway, and contains the British cantonment of Deesa. The state suffered severely from the ‘ plague, the number of deaths to July 1898 having been 1119. The town of Palanpur is a railway junction for Deesa, 18 miles distant. Population (1881), 17,547 ; (1891), 21,092 ; (1901), 17,799. There are a high school, with 138 pupils in 1896-97 ; the Jackson town hall ; the Scott Hospital, opened in 1898 ; and a printing-press. Palanpur also gives its name to a political agency, or collection of native states ; total area, 4775 square miles ; population (1891), 645,526 ; (1901), 467,691, showing a decrease of 28 per cent., due to the efiects of famine.

Palean. See Malay Peninsu-la.

Palencia, an inland province of Spain; area, 3127 square miles. Population, 188,845 in 1887, and 193,668 in 1897. It is divided into seven districts and 250 parishes. The birth-rate is 4-43 per cent., the death-rate 3‘76 per cent., and the proportion of illegitimate births 2-03 per cent. The climate is cold and damp in the northern mountainous and well-wooded part, but tem- perate and dry in the vast plain of the Tierra de Campos, which is rich in agricultural products.

In 1897 wheat was grown on 269,687 acres ; rye, oats, barley, maize on 314,217 acres ; pod fruit on 99,930 acres ; vines on 57,370 acres. The province is rich in live stock. Besides all its bread- stuffs, Palencia produces good, strongly alcoholic wines, much hemp, fruit, and vegetables. The most important industry is flour- milling. There are manufactures of oil, porcelain, leather, paper, cloths, and especially of rugs (in great demand in the whole peninsula). The mining interests have been chiefly developed by the opening of narrow-gauge railways, putting the province in communication with Bilbao vi^ Robla, and very advantageous for the coal-mines near the rivers Carrion, Pisuera, and

Rubagon. There are one copper and ninety coal mines, and the output is 500 tons of copper and 106,666 tons of coal a year.

Palencia, capital of the above province, on the left bank of the river Carrion and of the canal of Castilla, in a fertile country. Population, 15,060 in 1887, and 16,118 in 1897. The streets of the old town are narrow and irregular, but studded with more modern houses and public buildings. The Puente Mayer, Puente Nuevo, and Puente- cillos span the river, and communicate with some new suburbs. Much has joeen done for education ; besides an institute, there are many primary schools, a school for teachers of both sexes, a municipal academy of fkie arts, a school of arts and handicrafts, and a meteorological observatory. The town is well provided with hospitals, a foundling refuge, barracks, and a bull-ring for 8000 sightseers. Local industries include the making of rugs, alcohol, leather, soap, porcelain, linen, cotton, wool, foundries, machinery, and matches.

Palermo, a city of Italy, capital of the former kingdom of Sicily, standing on a bay of the same name situated on the northern coast of the island. It is surrounded by a plain about 70 square miles in extent, bounded at a distance of from 4 to 6 miles by a semi- circular mountain chain which terminates in the two promontories of Zaffarano and Monte Pellegrino. Until a century ago the form of the city was perfectly rectangular. It occupied an area of about 1 square mile. This more ancient part of the town is intersected by the two great

streets, Toledo and Macqueda, which, cutting each other at right angles in the centre of the city, terminate at the four old gates called Porta Telice, Porta Nuova, Porta di S. Antonino, and Porta Macqueda. At the point where the two streets cross is the little Piazza of the Four Corners (Quattro Cantoni), which is still the centre of Palermitan life. With the increase of the population vast new quarters have grown up, especially outside Porta Nuova and Porta Macqueda. These quarters are charac- terized by fine squares, large straight streets planted with trees, several public gardens, and numerous villas in the English style surrounded by gardens. Among the modern edifices are the two theatres, called the Politeama and the Teatro Massimo, which are two of the most gorgeous

in Italy. The city is the commercial centre of western Sicily. The climate in winter is extremely mild, “the sky usually clear, and the atmosphere always free from fog. The plain is planted with orange and lemon groves and with abundance of palm-trees, which, though their fruit does not attain maturity, give to the landscape an Oriental aspect â€” an aspect further enhanced by the numerous acanthus, cactus, stone-pine, and gigantic plane trees. The interior of the city â€” now well supplied with good water â€” does not wear that neglected and dirty aspect often noticeable in southern cities. Shops and streets are extremely clean, and the bearing of the population is reserved and dignified. The inhabitants, indeed, present the appearance of an econotnic well- being possibly out of keeping with their financial con-dition. Industrial development is as yet slight, although a large shipbuilding yard has been established. But owing to the university, the libraries, the museum, and the scientific institutions, Palermo remains the centre of Sicilian culture and exerts great moral and intellectual influence over the rest of the island. Population, 291,000.

Like most other Italian universities, the university is subject to the general laws upon higher education, namely, the funda- mental Casati Law of 1859, the Matteuoci Law of 1860, and the Baccelli Law of 1881. It was given first-class status ,in 1860, and since then has possessed the four faculties which exist in all Italian universities of the first class â€” jurisprudence, medicine and surgery, letters and philosophy ,,natural sciences and mathematics. A school of pharmacy and a school of practical engineering have been added. The ordinary and extraordinary professors in all the faculties numbered seventy-one in 1899. The number of liberi docenti or free chairs (corresponding to the agregation of French universities, or, more exactly, to the Privat-docenten of German universities) was almost equal to that of the official pro- fessors. The institution known as a Consorzio Universitario arranges for the payment by the communal and provincial authorities of a part of the cost of the scientific laboratories annexed to the chairs of experimental science, and of the train- ing school connected with the faculty of philosophy and letters. The number of students grew from 300 in 1872 to 1495 in 1897, but the number has since somewhat decreased, having been 1225 in 1898, 1148 in 1899, and 1161 in 1900.

The chief cause of this diminution is the increasing emigration of Sicilian students â€” especially those who intend to study electricity, for which no provision exists at Palermo â€” to the better-equipped universities of Naples, Rome, or Turin. A number of professors have also migrated from Sicily to the northern Italian universities.

The number of entrances and clearances at the port in 1896 was 7192 vessels of 3,164,465 tons, unloading and loading 681,014 tons of goods ; in 1898 the figures were 6921 vessels of 8,266,833 tons, unloading and loading 077,932 tons of goods.

Palestine, or the Holy Land, the southern third of Syria, bounded on the W. by the Mediterranean, on the S. by a line somewhat indeterminately drawn from the southern end of the Dead Sea westwards, on the E. by the desert of Syria and Arabia, and on the IST., rather indefinitely, by the Lebanon and Anti-Lebanon, between 31Â° and 34Â° N. and 34Â° and 37Â° AV.

Geology. â€” The physical features closely conform to its geological structure. Proceeding from west to east, they are : (1) A maritime district, of varying width, that

extends along the coast of the Mediterranean, and is formed of raised beaches and sea-beds which range from the Pliocene period downwards, and rest upon calcareous sandstones of Upper Eocene age. (2) The hill-country which stretches southwards from Lebanon through Galilee, Samaria, and Judaea, to the desert tableland called Badiet et-Tih. It is composed of cretaceous lime- stone, with beds and bands of marl and flint, which is covered here and there by outlying patches of nummulitic limestone. Westwards the limestone passes under th^ calcareous sandstone; eastwards, though concealed by more recent deposits, it underlies nearly the whole of the Jordan valley, and is broken off, along the line of the great fault, against older formations. (3) The Jordan- ‘Araba depression, which follows the line of a fault, or

fracture of the earth's crust that has produced a vertical displacement of the strata, those on the west side of the depression being lowered, and those on the east side elevated. In the valley itself there are remains of lake- deposits which reach to a height of 1200 feet, and indi- cate the varying levels of the great inland sea of the Pliocene period (see Dead Sea). (4) The hill-country of Gilead and the table-land of Moab, formed of cretaceous limestone resting, in descending order, upon variegated "Nubian" sandstone of Lower Cretaceous age, limestone of the Carboniferous period, red sandstone, conglomerates, and crystalline rocks of great geological antiquity. East of the Dead Sea and the Jordan the limestone is overlaid in places by sheets of basalt of post- Tertiary date, most conspicuous in the north, where they form the surface of the Hauran, JauMn, and Leja districts. West of Jordan volcanic lavas are found round the sea of Galilee, in the plain of Jezreel, and in a few other localities.

Political Geography. â€" Considerable light has been thrown upon the condition of Palestine in the 14th century B.C. by the discovery of the Tell el-'Amarna letters, which describe the breaking up of the Egyptian empire in that country during the last years of Amen- hotep III. and the reign of Akhenaten, and the extension southwards of the Amorite and Hittite power prior to the Hebrew invasion. Palestine, except for the inde- pendent sanjak of el-Khuds (Jerusalem), now forms part of the vilayets of Beirut and Suriya (Damascus), including the sanjaks of 'Akka, Nablus, Hauran, Belka, and Kerak.

Recent History. â€" Since 1880 great changes have taken place. The effective occupation, by Turkish troo^js, of the country east of Jordan, from Damascus to M.ki.n. and the Gulf of 'Akabah, has secured both sides of the river from the incursions of the Bedawm, and given security to life and property. New villages have been built, and large areas of rich land which were formerly waste have been brought under cultivation. A railway now connects Jaffa with Jerusalem ; another runs through the Hauran from Mezeirib to Damascus, where it joins the line to Beirut; and a third, intended to connect Haifa with Damascus, is in course of construction.^ Metalled roads have been made, and upon these wheeled transport has largely taken the place of

the mule and camel. But the most interesting changes are those due to the efforts that have been made to establish European and Jewish agri- cultural colonies in the land. The first attempts, by Germans at Urtas in 1850, and by Americans at the same place in 1851, and near Jaffa in 1863 and 1866, failed. But in 1868 the German community of the "Temple" successfully founded colonies at Haifa and Jaffa, and afterwards at Sarona, north-east of Jaifa, and at Jerusalem. The community now numbers about 1200, and has its own schools and hospitals. Its mem-

1 The construction of this line was suspended in 1901.

bers are engaged in trade, or in agricultural pursuits and the production of wine, or work as artisans. They have done much to promote the agricultural development of the country, and have introduced a higher standard of life, which is slowly but surely influencing the native peasantry. The Christian attempts at colonization at- tracted the attention of the Jews. In 1863 Sir iloses Montefiore purchased land near Jaffa for the use of the American colony ; in 1870 the Alliance Israelite Univer- selle established an agricultural school for Jews near Jaffa; and in 1878 an abortive attempt was made to settle a colony of Jerusalem Jews at Mulebbis on the Jaffar-Nablus road. In 1881 and the following years the persecution of the Jews in Rumania and Russia led to emigration on a large scale, and many of the emigrants selected Palestine as their future home. Land was purchased, not always in suitable localities, and there was much suffering amongst the settlers from fever and ignorance of the country. Many died, and failure was almost certain, when Baron Edmond de Rothschild inter- vened with that financial assistance and intelligent direction without which there could be no measure of success.^ His example was followed by the Alliance Israelite, the Jewish Colonization Association, the Cho- vevi Zion, and other societies, and numerous settlements had been established before the movement was checked by the action of the Porte in forbidding further immigra- tion and the sale of land to Jews. At present there are more than twenty colonies, with about 6000 colonists, scattered over the country from the Merj 'Aydn to the vicinity of Ashdod. The land held exceeds 40,000

acres, and the whole of this has been brought under cultivation. In the face of obstacles created by local officials, crush- ing taxation, and the opposition of Prance and Russia, the colonization has been on the whole successful. The land has proved to be highly productive, and to respond readily to improved methods of agriculture ; and under a better system of government the financial success of the colonies, which thus far has not been complete, would be assured. The influence of the colonies on the aspect and well-being of the country is marked. Forests of eucalyptus, extensive orchards, olive groves, vineyards, and cornfields have taken the place of arid waste lands ; clusters of well-built houses are frequently seen ; roads have been made ; native landowners have adopted the agricultural methods of the Jews ; industries have sprung up to meet the requirements of the colonies, and a great impetus has been given to the culture of silk, the manu- facture of wine and perfumes, and the re-cultivation of the soil. How far the next generation will be able to resist the enervating tendency of the climate, and avoid the danger of assimilation with the natives, are questions that cannot be discussed here. Circassian colonies have been planted at Jerash, 'Amman, Kaisarieh, and other places, where the colonists, although they have done irre- parable damage to the ruins of the ancient cities, have introduced wheeled transport and improved methods of cultivation.

The Sultan, in pursuance of a scheme which had its origin about 1886, has taken up waste lands and pur- chased landed property throughout the Asiatic provinces of his empire. In Palestine he now holds as his private property (ardzir-i-seniye) the whole of the Jordan valley south of the Sea of Galilee, and large estates in Wadi es-Surar and other places. These Crown properties, which are under an independent administration managed from Constantinople, serve as model farms, and have in some respects an influence for good. But they pay

2 In 1900 the Rothschild interest in the colonies was handed over to the Jewish Colonization Association.

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no taxes to the State, and the officials attached to them act not only in the name but in the personal interests of the head of the State.

Accompanying, and partly consequent upon, the process of colonization there has been a change in the position of the peasantry who were formerly freeholders of the soil. In most of the fertile districts capitalists, to whom the peasant proprietors were hopelessly in debt, have fore- closed their mortgages, and the owners, obliged to give up their title-deeds, are now working as tenants at will (sherlk el-hawa) on lands that had been handed down to them through many generations.

An interesting feature is the great increase in the number of monastic, missionary, educational, and philan- thropic establishments. The scene of nearly every event connected with New Testament history has been localized, the site purchased, and a commemorative chapel and monastery erected. There has also been great missionary activity on the part of all the Churches, and latterly the Russians have sought to gain influence by subsidizing Greek Orthodox schools in which Russian is taught, by opening schools in the villages and seminaries in the towns, and by sending promising students to complete their education in Russia. The object of this propa- ganda is, apparently, to form a national Arab Church, looking to Russia for protection, and to weaken the position now held in Turkey by the Greek Orthodox Church. Amongst the philanthropic establishments none are more worthy of notice than the hospitals founded at Jerusalem, Nazareth, Tiberias, and other places by English and Scottish societies. As a result of this activity on the part of the Greek, Protestant, Roman Catholic, and Russian Churches, Palestine is now covered with churches, chapels, monasteries, nunneries, hospices, and hospitals, and filled with clergy, monks, nuns, and pilgrims, as it has not been since the fall of the Latin kingdom. The old theory that all Roman Catholic institutions in the Levant should be under French protection has been abandoned. In Egypt they are now under Austrian protection, and in Palestine, since the German emperor’s visit in 1898, all German Roman Catholic subjects and institutions are under German protection.

The trade and prosperity are to a large extent derived from the various religious interests centred in the land. There has been a large import of building materia.1, and general trade has increased; but although this has benefited Europeans and the upper and educated classes amongst the natives, the condition of the peasants is perhaps worse than it was before the inrush of Euro- peans commenced. There are no trustworthy statistics of the population. There has been a large increase since 1880 in the number of Europeans and Jews, but the native population apparently has been stationary, and in some districts even seems to have decreased.

Exploration. â€” Since 1885 important surveys, covering JauMn and parts of Hauran, and Gilead, have been made by Schumacher ; excavations have been carried out for the Palestine Exploration Fund by Petrie, Bliss, and Macalister at Tell el-Hesi (Lachish), Jerusalem, Tell es- Safi, and other sites; the Sea of Galilee has been examined by Barrois ; and Petra, with parts of Moab and Edom, has been surveyed by Brilnnow. The results of the excavations show generally that an advanced state of civilization, sometimes under Mycenaean, sometimes under Egyptian influence, existed in the country during the pre-Israelite period.

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Palestine, a city of Texas, U.S.A., capital of Ander- son county. It is on the International and Great Northern railroad, in the eastern part of the state, at an altitude of 496 feet. It is in an agricultural and forested region, and has varied manufactures. Population (1880), 2997 ; (1890), 6838; (1900), 8297, of whom 356 were foreign- born and 2872 were negroes.

Palfrey, John Corham (1796-1881), American historian, was born in Boston, Massachusetts, 2nd May 1796. He graduated at Harvard, 1815, and became a Unitarian minister, being pastor of the Brattle Square church, Boston, 1818-31. He was professor of sacred literature in the Harvard divinity school, 1831-39. Entering political life, he was secretary of state of Massa- chusetts, 1844-47; member of Congress, 1847-49; and postmaster of Boston, 1861-67. During his public career he was an earnest abolitionist. As a writer he edited the Worth American Review, 1836-43, and produced Biblical, sermonic, apologetic, and grammatical works now for- gotten ; but he is best known by a solid, rather than rhetorically interesting, Histoi-y of Xeiu England to the revolutionary war, in five volumes, of which the first appeared in 1859 and the last posthumously in 1890. He died at Cambridge, Massachusetts, 26th April 1881.

Palghat, a town of British India, in the Malabar district of Madras, on the Madras railway, 74 miles east of Beypur. Population (1881), 36,339 ; (1891), 39,367 ; municipal income (1897-98), Rs.65,850. It is a busy centre of trade with the western coast. The Basel Protestant mission has quarters here. The municipality manages the Victoria Jubilee College, with 97 students in 1896-97. There are two liigh schools with 481 pupils, two printing-presses, a reading-room, and a law library.

Palgrave, Francis Turner (1824-1897), English critic and poet, eldest son of Sir Francis Palgrave, the historian, was born at Great Yarmouth, 28th September 1824. His brothers, William Gifford, traveller, author, and colonial official (1826-1888), and Sir Reginald P. D, (1829), who was Clerk of the House of Commons

from 1886 to 1900, also had distinguislied careers. At fourteen Francis was sent to Charterhouse ; and in 1843, having in the meanwhile travelled extensively in Italy and other parts of the Continent, he proceeded to Ox- ford, having won a scholarship at Balliol. In 1846 he

interrupted his university career to serve as assistant private secretary to Gladstone, but returned to Oxford the next year,^ and took a first-class in LiterÂ® Humar niores. From' 1847 to 1862 he was fellow of Exeter College, and in 1849, in which year began his long friendship with Tennyson, was appointed examiner in the Education Department at Whitehall, afterwards be- coming assistant secretary. In 1850 he accepted the vice-principalship of Kneller Hall Training College. He married, in 1862, Cecil Grenville Milnes, daughter of James Milnes-Gaskell. In 1884 he resigned his position at the Education Department, and in the following year was elected professor of poetry at Oxford. He died in London, 24th October 1897, and was buried in the ceme- tery on Barnes Common. Palgrave published both criti- cism and poetry, but his work as a critic was by far the more important. Indeed, considering his admirable sense of the qualities and differentiations of true poetry, it is strange that he should have been content with the cold formality of much of his own verse. His Visions of England (1880-81) contains the last of his work in metre; it has dignity and lucidity, but little of the " natural magic " which the greatest of his predecessors in the Oxford chair considered rightly to be the test of inspiration. His lyrics were mildly delicate, but quite without lyrical fervour. On the other hand, his criticism was always marked by fine and sensitive tact, quick in- tuitive perception, and generally sound judgment. His Handbook to the Fine Arts Collection, International Exhi- bition, 1862, and his Essays on Art (1866), though not free from dogmatism and over-emphasis, were sincere contributions to art criticism, full of striking judgments strikingly expressed. His Landscape in Poetry (1897) showed wide knowledge and critical appreciation of one of the most attractive aspects of poetic interpreta/- tion. But Palgrave's principal contribution to the de- velopment of literary taste was contained in his Golden Treasury of English Songs and Lyrics (1861), an anthol- ogy of the best poetry in the language constructed upon a plan sound and spacious, and followed out with a delicacy of feeling which could scarcely be surpassed. The influence of this treasure-house of poetry, with the standards which it set up to taste and selection, has been incalculable. Palgrave followed it with a Treaswy of Sacred Song (1889), and a second series of the Golden Treasury (1897) ; but in

neither of these was quite the same exquisiteness of judgment preserved. (a. wa.)

Pal it. See Malay Peninsula.

Pallanza, an industrial town and summer and winter resort of the province of Novara, Piedmont, Italy, occupying a position of great natural beauty, on a promontory on the west side of Lago Maggiore, with a semi- circle of mountains behind and the lake and Borromean Islands in front, 62 miles north of Novara (56 by rail to Gravellona on the Simplon railway). The annual mean temperature is 55Â° Eahi'. ; January, 37-1Â° ; July, 74Â°. There is a fine botanical garden. There are cotton, silk, and jute manufactures, saw-mills and turnery shops, and a school of design. Population (1900), 3500.

Raima, capital of the province of Baleares,in the island of Majorca, the largest of the Balearic Isles, in the most northern part of the bay of the same name. It has a seminary founded in 1700, a depot of archives since the 14th century, schools of fine arts and museums of paintings, a nautical school, an institute, many pri-

mary schools, and a school for training teachers of both sexes. There are fine public buildings, and most of the streets have been improved with new houses in striking contrast with interesting old residences and palaces of the local nobility. Palma has a thriving trade in agri- cultural products, wine, oil, almonds, fruit, vegetables, silk, and food-stuffs, as well as live stock. There are manufactures of alcohol, liqueurs, chocolate, starch, sugar, preserves, flour, soap, leather, earthenware, glass, matches, paper, linen, woollen goods, and rugs. The port has been so much improved that large merchant steamers can enter and remain in even rough weather, and foreign war-vessels often visit the port. Population

(1887), 61,052 ; (1897), 62,525.

Palmer, a town of Hampden county, Massachu- setts, U.S.A. It has an area of 25 square miles of hill country, and is situated south-west of the centre of the state. The village of Palmer is on the Chicopee river, and

on the Boston and Albany and the Central Vermont railways, at an altitude of 332 feet. It is irregular in plan, and has varied manufactures, consisting in part of cotton and woollen goods, iron and steel goods of various sorts, and carpets. Population (1880), 5504 ; (1890), 6520; (1900), 7801, of whom 2780 were foreign-born.

Palmer, John McCauley (1817-1900), Ameri- can politician, was born at Eagle Creek, Ky., on 13th September 1817. In 1831 his family removed to Illi- nois, where he rose to some prominence as a Democrat. On the slavery question he joined the Eepublican party at its foundation. During the war he served in the Western armies, and rose to the rank of major-general. Prom 1868 to 1872 he was governor of Illinois, but joined the Liberal Eepublican movement in the latter year. As governor he resented strongly the assumption of police authority by General Sheridan and the federal troops at the time of the great Chicago fire (October 1872). In 1891 he was elected to the United States Senate by the Democrats, and served one term. Upon the adop- tion of the free-silver platform, and the nomination of Bryan by the Democratic Convention in 1896, General Palmer was nominated for the Presidency by the " Gold Democrats," but failed to receive any electoral votes. He then lived in retirement tUl his death, 25th Septem- ber 1900.

Pal mi, a town of the province of Eeggio, Calabria, Italy, 26 miles north by east of Eeggio on the west coast railway to Naples, standing halfway up the slope of Mount Elia, 450 feet above searlevel. It has olive-oil presses, and fishing for tunny and sword-fish. The town was almost entirely rebuilt after the earthquake of 1783. Population (1881), 9705 ; (1889), 16,600.

Palmyra Island. See Polynesia.

Palo Alto, a town of Santa Clara county, California, U.S.A., on the west side of Santa Clara valley, between two of the coast ranges, on the coast division of the Southern Pacific railway, 34 miles nearly south of San Francisco. Its site is perfectly level and plan strictly regular. It has a water-supply pumped from artesian wells, and a good sewer system. It is the railway sta- tion for Leland Stanford Jr. University, which is 1^

miles south-west. The name of the town was derived from a solitary redwood, standing near the railway track on the outskirts of the town. Population (1900), 1658.

Paludan-iVluller, Frederilc (1809-1876), the most distinguished of the recent poets of Denmark, was the third son of Jens Paludan-Miiller, from 1830 to 1845 bishop of Aarhus. He was born at Kjerteminde in Fiinen, on the 7th of February 1809. In 1819 his father was transferred to Odense, and the future poet began to at- tend the Latin school there. He went to Copenhagen

as a student in 1828. After several efforts, he attracted general attention in 1833 by The Dancing Girl, a poetical narrative embroidered with charming melody and colour. Paludan-Miiller was accepted by criticism without a struggle, and few writers have ever excited less hostility than he. He was, however, not entirely well inspired in his lyrical drama of Amor and Psyche in 1834, and his next productions were too vividly influenced by Byron. From 1838 to 1840 Paludan-Miiller was making the grand tour in Europe, and his genius greatly expanded. In Italy he wrote Venus, a lyrical poem of extreme beauty, a hymn to the majesty of Eros. In 1841 he began to publish a great work on which he had long been engaged, and which he did not conclude until 1848 ; this was Adam Homo, a narrative epic, satirical, modern, and descriptive, into which Paludan-Miiller wove all his variegated impres- sions of Denmark and of love. This remains the typical classic of Danish poetical literature. While this virile work was in slow progress the poet was engaged in shorter and more eicquisite productions. In 1844 he was absolutely in flower, for he completed three enchanting idyls. The Dryad’s Wedding, Tithonus, and The Death of Abel, each separate, and each one of the poet’s most characteristic and most highly finished compositions. In Tithonus, perhaps, the genius of Paludan-Miillei: reaches its most personal expression. Prom 1850 a certain decline in the poet’s physical powers became manifest, and he wrote less. His majestic drama of Kalanus belongs to 1854.

Then for seven years hie kept silence. Paradise (1861) bears evidence of malady, both physical and mental. Paludan- Miiller wrote considerably after this, but never recovered his early raptures, except in the very latest of all his poems, the enchanting welcome to death, called Adonis (1874). After long ill-health, he died at Copenhagen on the 27th of December 1876. He was a poetic artist of the finest order, perhaps the greatest purely plastic poet that the]S”orth has seen. (b. g.)

Pamiers, chief town of arrondissement, department of Arifege, Prance, 12 miles north of Poix, on the railway from Toulouse to Ax-les-Thermes. It has a communal college, consultative chamber of arts and manufactures, and a hospital. Iron and steel of excellent quality, sheet-iron, iron-ware, chains, and carriage springs are among the products of its important metallurgical indus- tries. It has also paper and saw mills and tanneries, and commerce in grain, flour, fodder, fruit, and vegetables. Population (1891), 8166; (1901), 9409.

Pamirs. â€” Since 1875 the Pamirs have probably been the best explored region in High Asia. Not only have many traveller^ of many nationalities directed their steps towards the Bam-i-dunya (” the Eoof of the World “) in search of adventure or of scientific information, but the Government surveys of Russia and India have met in these high altitudes, and there effected a connexion which will help to solve many of the geodetic problems which surround the superficial survey of Asia. Since Wood first discovered a source of the Oxus in Lake Victoria in 1837, and left us a somewhat erroneous conception of the physiography of the Pamirs, with a legacy of political dispute arising therefrom, the gradual approach of Kussia from the north has stimulated the processes of exploration from the side of India, until con- flicting political interests have been set at rest by the discovery that no serious dispute is worth maintaining about those bleak, wind-swept, glacial regions, which are blocked by snow for half the year, and offer no right of way to more than the passing traveller at any time. oST ative explorers from India first began to be busy in the Pamirs about 1860, and continued their investigations for

the following fifteen years. In 1874 the mission of Sir D. Porsyth to Yarkand led to the first systematic geographical exploitation of the Pamir country, and native attaches of the mission subsequently extended their re- searches into Turkestan. In 1885 Ney Elias made his famous journey across the Pamirs from east to west, identifying the Rang Kul as the Dragon Lake of Chinese geographers â€" a distinction which has also been claimed by some geographers for Lake Victoria. Then Lockhart and Woodthorpe, in 1886, passed along the Wakhan tributary of the Oxus from its head to Ishkashim in Badakshan, and completed an enduring record of most excellent geograph- ical research. Bonvalot in 1887, Littledale in 1888, Cumberland, Bower, and Dauvergne, followed by Young- husband in succeeding years, extending to 1890 ; Dunmore in 1892, and Sven Hedin in 1894-96, have all contributed more or less to Pamir geography ; but the honours of suc- cessful inquiry in those high altitudes still fall to Curzon, whose researches in 1894 led to a singularly clear and comprehensive description of Pamir physiography, as well as to the best map compilation that till then had existed. Meanwhile Russian explorers and Russian topographers had been equally busy from the north. The great soldier Skobeleff was probably the first European to visit the great Kara Kul. He was followed by scientific missions systematically organized by the Russian G-overnment. In 1883 Putiata's mission started south. Grombchefski was hard at work from 1888 to 1892. Yanoff began again in 1891, after a short spell of rest, and has left his mark as a permanent record in the valley of Sarhad (or Wakhan), between the Baroghel pass and Bozai Gumbaz. Pinally, in 1895, the Russian mission under General Schveikofski met the British mission under General Gerard on the banks of Victoria Lake, and from that point to the Chinese frontier eastward demarcated the line which thereafter was to divide Russian from British interests in highest Asia. Since then other travellers have visited the Pamirs, but the junction of the Russian and British surveys (the latter based on triangulation carried across the Hindu Kush from India) disposes of any further claim to the honours of geographical explora- tion (see Asia).

Our estimate of the extent of Pamir conformation de- pends much on the significance of the word Pamir. If we accept the Persian derivation

of the term (which pamir is advanced by Curzon as being perhaps the most coatorma- plausible), pai-mir, or ” the foot of mountain *’““â– peaks,” we have a definition which is by no means an in- apt illustration of the actual facts of configuration. It has been too often assumed that the plateau of Tibet and the uplands of the Pamirs are analogous in physiography, and that they merge into each other. This is hardly the case. Littledale points out (vol. vii., R.G.S. JournaJ) that the high-level valleys of glacial formation which distinguish the Pamirs, which are never very wide, and which are sepa- rated from each other by bands of mountain formation, with crests rounded by the action of the ice-cap and troughs filled with beds of detritus and alluvium, have no real coun- terpart in the Chang or plains of Tibet, The latter are 2000 feet higher ; they are intersected by narrow ranges, and are drained by no rivers of importance. They form a region of salt lakes and stagnant marshes, relieved by wide flat spaces of open plateau country. The absence of any vegetation beyond grass or scrub is a striking feature common to both Pamir and Chang, and it is a remarkable fact that, from the Pamirs to eastern Tibet, a traveller may pass through 30 degrees of longitude without meeting with any vegetable growth ” higher than an umbrella ” ; but there the resemblance ceases, and the physical conforma- tion of mountain and valley to the east and to the west of the upper sources of the Zarafshan is radically distinct.

The axis, or backbone, of Pamir formation is the great meridional mountain chain of Sarikol â€” the ancient Taurus of tradition and history â€” on which stands the highest peak north of the Himalaya, the Muztagh Ata (25,000 feet). This chain divides off thehigh-level sources Pamirs. Â°^ *^Â® Oxus On the west from the streams which sweep downwards into the Turkestan depression of Kashgar on the east. There are the true Pamirs (i.e., valleys reaching up in long slopes to the foot of mountain peaks) on either side, and the Pamirs on the west differ in some essential respects from those of the east. On the west

the following are generally recognized as distinct Pamirs : (1) the Great Pamir, of which the dominant feature is Lake Victoria ; (2) the Little Pamir, separated from the Great Pamir on the north by what is now known as the Nicolas range ; (3) the Pamir-i-Wakhan, which is the narrow trough of the Wakhan tributary of the Oxus, the term Pamir applying to its upper reaches only ; (4) the Alichur â€" the Pamir of the Yeshil Kul and Gund-dara â€" immediately to the north of the Great Pamir ; (5) the Sarez Pamir, which forms the valley of the Murghab river, which has here found its way round the eastern head of the Great Pamir, and the Alichur from the Little Pamir, and now makes westwards for the Oxus. This branch was considered by many geographers as the main Oxus stream, and Lake Chakmaktin, at its head, was by them regarded as the Oxus source. At the foot of the Sarez Pamir stands the most advanced Eussian outpost of Murghabi. To the north-east of the Alichur are the Rang KuJ and the Kara Kul (or Kargosh) Pamirs. Rang Kul Lake occupies a central basin or depression ; but the Kara Kul drains away north-eastwards through the Sarikol (as the latter, bending westwards, merges into the Trans-Alai) to Kashgar and the Turkestan plains. Similar characteristics distinguish all these Pamirs. They are hemmed in and separated by snow-capped mountain peaks and ridges, which are seamed with glaciers terminating in moraines and shingle slopes at the base of the foot-hills. Long sweeps of grassy up- land bestrewn with boulders lead from the stream beds up to the snow-fields, yellow, grey, or vivid green, according to the season and the measiire of sunlight, fold upon fold in interminable succession, their bleak monotony being only relieved by the grace of flowers for a short space during the summer months.

To the east of the Sarikol chain is the Taghdumbash Pamir, which claims many of the characteristics of the western Pamirs at its upper or western extremity, where the Karachukar, which drains it, is a comparatively small stream. But where the Karachukar, joining forces with the Khunjerab, stretches out northwards for a com- paratively straight run to Tashkurghan, dividing asunder the two parallel ranges of Sarikol and Kandar, which together form the Sarikol chain, the appellation Pamir can hardly be maintained. This is the richest portion of the Sarikol province. Here are stone-built houses collected in

scattered detachments, with a spread of cul- tivation reaching down to the river. Here are water-mills and many permanent appliances of civilization suited to the lower altitude (11,600 feet, the average height of the upper Pamirs being about 13,000), and here we are no longer near the sources of the river at the foot of the mountain peaks. One other so-called Pamir exists to the east of Sarikol, separated therefrom by the eastern range (the Kandar) of the Sarikol, which is known as Mariom or Mariong. But this Pamir is situated nowhere near the sources of the Zarafshan or Raskam river, which it borders, and possesses little in common with the Pamirs of the west. The Mariom Pamir defines the western ex- tremity of the Kuen Lun, which stretches eastwards for 260 miles before' it .becomes the political boundary of northern Tibet.

^- dumbasb

The Muztagh chain, which holds within its grasp the mightiest system of glaciers in the world, forms a junction with the Sarikol at the head of the Taghdumbash, where also another great system (that of the Hindu Kush) has its eastern, roots. The political boundary between the extreme north of â„¢Â« the Kashmir dependencies and the extreme south of Muztagh Chinese Turkestan is carried by the Zarafshan or Raskam Â«'" Â«Â«<' river, which runs parallel to the Muztagh at its north- avteoÂ»toÂ«'" em foot (its valley dividing the Muztagh from the "”’”*”’”- Kuen Lun) to a point in about 79Â° 20′ E. , where it is transferred to the watershed of the Kuen Lun. Within the limits of these partially explored highlands, lying between the Pamirs and the Tibetan table-land, exact geographical definition is impossible. But we may follow Godwin-Austen in accepting the main drain of the Muztagh as merging into the central mountain system of the Tibetan Chang, its axis being defined and divided by the transverse stream of the Shyok at its westward bend, whilst the Karakoram range, in which the Shyok rises, is a subsidiary northern branch. The pass over the Karakoram (18,500 feet) is the most formidable obstacle on the main trade route between Leh and Kashgar.

The Taghdumbash Pamir occupies a geographical position of some political significance. One important pass (the Beyik, 15,100 feet) leads from the Russian Pamirs into Sarikol across its northern border. A second pass (the Wakhjir, 16,150 feet) connects the head of the Wakhan pâ„¢â„¢. valley of Afghanistan with the Sarikol province across its western head, whilst a third (the Kilik, 15,600 feet) leads into the head of the Hunza river and opens a difficult and dangerous route to Gilgit. The Taghdumbash is claimed both by China and Kunjut (or Hunza) , and there is consequently an open boundary question at this comer of the Pamirs.

From Lake Victoria of the Great Pamir the northern boun- dary of that extended strip of Afghanistan which reaches out to the head of the Taghdumbash from Badakshan ilorth of the Hindu Kush is to be traced, westwards, Boundary in the Victoria Lake aflduent of the Oxus ; and east- **’“‘Â«*” wards, on the Nicolas range, dividing the Great and g^f Little Pamirs, till it overlooks a point on the Aksu (or istaa. Murghab) river in about 74Â° 40′ E. Here it diverges southwards to the Sarikol chain, north of Taghdumbash. This east- ward extension was laid down by the Pamir Boundary Commission of 1895. All the head of the Little Pamir with the Wakhan valley is consequently Afghan territory, but no military posts have been established so far. The Alichur, Rang Kul, Kargosh (Kara Kul), and Sarez are Russian Pamirs. The Mariom Pamir is Chinese.

The Wakhan glaciers under the Wakhjir water-parting, Lake Chakmaktin near the sources of the Aksu, and Victoria Lake of the Great Pamir have all been claimed as indicating the true source of the Oxus. But detailed Olaclal examination of their hydrographical conditions proves Â«<>“‘â– Â«Â« ot that neither of the two lakes, Victoria (13,400 feet) or ””^ Â°^”^- Chakmaktin (13,020 feet), can justly be regarded as sources, both of them being derived from the same mighty system of glacial snow- fields on the summit of the Nicolas range. Both may be regarded as incidents in the course of glacial streams (incidents which are dimin- ishing in volume day by day) , rather than original springs or sources. The same glacial beds of the Nicolas range send down tributary waters to the Panja or Wakhan

river, below its junction with the ice stream from Wakhjir, and thus it becomes impossible to decide whether the glaciers of the Wakhjir or the glaciers of Nicolas should be regarded as effecting the most important contribution to the main stream. There is evidence also that glacial moraine formations from time to time may have largely affected the catchment area of these tributary streams. It would be as rash to assert that from Victoria Lake no waters could ever have issued with an east- ward flow as it would be to state that from Chakmaktin none ever flow westwards. The measure of the veracity of Chinese pilgrims and geographers in the early centuries of our era must not be balanced on such points as these.

There is no evidence that the Pamirs were ever the support of permanent settlements. The few mud-built buildings which once existed at Chakmaktin and at Lungar only decide recent occupation which could hardly have possessed a PoP"'^"" permanent character, and the few shrines and domed â„¢ ^â€ž "" tombs which are scattered here and there about the * '^ '* empty desolation of the Pamir slopes are all of them of recent construction. The nomadic population which seeks pasturage during the summer months in these dreary altitudes is entirely Kirghiz, and we may take it for granted that it will soon be entirely Eussian. The non-Russian population during the summer of 1895 could not have amounted to more than a few hundred souls â€" occupying a^ few encampments in the Little Pamir and in the Taghdumbash. The total population of the Russian Pamirs has been reckoned at 250 "kibitkas," or 1500 souls. There is no ethnographical distinction to be traced between the Kirghiz of the Alichur Pamir and the Kirghiz of the Taghdumbash.

Trade routes.

The Kirghiz are Sunni Mahommedans by faith, but amongst them there are curious survivals of an ancient ritual of which the origin is to be traced to those Nestorian Christian Bylaences communities of

Central Asia which existed in the "survival of i'’l Ages. A Christian bishopric existed at Yark- Chtlstlan -‘^ iÂ° Marco Polo's time, and is supposed to have sur- symbols. vived for another century (1350). The last Gurkhan of the Kara Khitay empire in the early part of the 13th century (the legendary Prester John) was a member of a Christian tribe called Naiman, which is one of the four chief tribal divisions mentioned by Ney Elias. The Naiman tribe claim kinship with the Kipchaks. It is curious that the same survival of Christian ceremonial should be found amongst the Sarikoli, a Shiah people of Aryan descent akin to the Tajiks of Badakshan, as may be traced amongst the Kirghiz. The discoveries of Christian symbols in the southern towns of Chinese Turkestan by Sven Hedin may throw further light upon this interesting question.

The total area of the Pamir country may be estimated as about 150 miles long by 150 miles broad, of which about one-tenth is grass pasture land and the rest mountainous. All of it Area of ^j^gg formed part of the ancient kingdom of Bolor, Pamirs itself a survival of the yet more ancient empire of the Yuchi, Tokharistan ; and across it, in spite of its bleak inhospitality, there have been one or two recognized trade routes from east to west throughout all ages. The most important com- mercially was that which passed north-west vid, Tash- kurghan and Rang Kul, from Chinese Turkestan to the khanates north of the Oxus ; but the route viS. Tash- kurghan and Lake Victoria to Badakshan was also well trodden. The great pilgrim route of Buddhist days was that which connects the ancient Buddhist cities of the Takla Makan in Chinese Turk- estan with Chitral (Kashkar), by the Baroghel Pass across the Hindu Kush. This was but one link in a chain of devout pere- grination which stretched from China to India, and which included every Intervening Buddhist centre of note which existed in the early centuries of our era.

For six or seven months of the year (November to April) the Pamirs are covered with snow, the lakes are frozen, and the passes Cll tB f ‘8‘^^y impracticable. The mean temperature during ^^gâ„¢* " the month of January recorded by Russian observers Pamirs. ^t *^s Murghabi â€" or Pamirski â€" post is ~~13Â° F. In July this rises to 62Â° F. , the~~

elevation of the station being 12,150 feet. During the spring and summer months the preva lence of fierce cutting winds, which are shaped by the conformation of the valleys into blasts as through a funnel, following the strike of the valleys either up or down, makes travelling painful and existence in camp most unpleasant. In the absence of wind the summer atmosphere is often bright and exhilarating, but there is a constant tendency to sudden squalls of wind and rain, which pass as quickly as they gather. The most settled record of the Pamir Boundary Commission of 1895 lasted from the 19th of August to the 1 1th of September, the maximum temperature being recorded at 77Â° on the 21st August at Kizil Robat (12,570 feet) ; and yet on the 16th August snow had fallen to the depth of 6 inches and the Beyik Pass was blocked. There were indications that monsoon influences extended as far north at least as the Great Pamir, and a definite analogy was established between the record of barometric pressure on the Pamirs and that of the outer ranges of the Himalaya.

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Pampa, a territory in the centre of the Argentine Eepublic, bounded on the N. by Cordoba, San Luis, and Mendoza, on the S. by the territory of Rio Kegro, on the E. by Buenos Aires, and on the W. by Mendoza and the territory of Neuquen. Oiiicial area at the census of 18’.);”), 66,320 square miles ; population, 25,914. It is divided into fifteen departments. The capital. General Acha, has a population of about 1500. In 1896 there were 630,162 -head of cattle, 232,489 head of horses, and 5,295,177 head of sheep in the territory.

Pamplona, capital of the province and ancient kingdom of Navarre, Spain, on the Arga. Population, 26,656 in 1887, and 29,763 in 1897. Modern detached

forts have been erected. The imposing forts on the peak of San Cristobal and on Miravalles Hill command the approach of Pamplona in view of a French invasion, exactly as the fort of San Marcos, the entrenched camp of Choritogueta, and the fort of Guadalupe near Puent- arabia sweep the approaches to Irun and San Sebastian in Guipuzcoa. Part of the old outworks of Pamplona has been demolished, and suburbs are springing up near the walls and bastions. In the new part of the town are many industries, including cloth, linen stuffs, flour, soap, leather, cards, paper, earthenware, iron, and nails. The fairs are' the centre of a trade in agricultural products and live stock, especially in July, when the Navarrese flock to their provincial capital for the patron saint's day, San Firmin. The town is well provided with schools for both sexes, and has an institute, normal schools, and a seminary, hospitals, and fine municipal buildings, kept in order, like their roads and streets, by the autonomous provincial council and municipality. The interior of the walled town has preserved its old-world aspect.

Pana, a city of Christian county, Illinois, U.S.A., near the centre of the state, on the Baltimore and Ohio South-Western, the Cleveland, Cincinnati, Chicago, and St Louis, and the Illinois Central railways, at an alti- tude of 697 feet. Its site is the level prairie and its plan is fairly regular. It is in a coal region, and it has some trade and manufactures. Population (1880), 3009 ; (1890), 5077 ; (1900), 5530, of whom 727 were foreign- born.

Panama, the chief town of the department of the same name in the republic of Colombia, South America, situated at the upper extremity of the Gulf of Panama. La Boca dock at the Pacific terminus of the canal, three miles from the city, was completed in 1898. Its wharf, 1000 feet in length, can be approached by large steamers, which formerly had to anchor ofE Flamenco Island and load and unload from small vessels. The city is well laid out, and possesses beautiful squares, parks, and promenades. Among modern buildings are the hospital erected at

the expense of the Canal Company, and the Grand Hotel. In October 1899 plans were prepared for a new aqueduct to supply the city with water. The chief exports are hides, deerskins, mother-of-pearl shells, and ivory ; the imports include all kinds of dress goods, hardware, furniture, drugs, perfumery, &c. There is a line of steamers from Panama to San Francisco, and also lines south to Valparaiso. Over 200 vessels enter the port annually, with a total tonnage of over 260,000. (For the canal, see Canals.) Population about

25,000.

Panch Mahals (=Five Districts), a district of British India, in the Gujarat division of Bombay. It includes the ancient Hindu capital of Champaner, now a ruin, and the hill sanatorium of Pawagarh. The admin- istrative headquarters are at Godhra.

Area, 1613 square miles; population (1881), 255,479; (1891), 313,417 ; (1901), 261,870 ; showing an increase of 23 per cent, between 1881 and 1891, but a decrease of 16-4 per cent, between 1891 and 1901 ; average density, 162 persons per square mile. The land revenue is Rs.3,28,000, the incidence of assessment being just over R.l per acre; cultivated area (18’.)7-98), 357,099 acres, of which 2471 were irrigated from wells, &c., including 175 from Government canals ; number of police, 699 ; children at school (1897-98), 5-560, beins 2-17 per cent, of the total population; registered deatli-rate (1897), “20 per thousand. The principal crops are inferior grain, rice, pulse, and oil-seeds ; there are manu- factures of lac bracelets and lacquered toys. Both portions of the district are now crossed by the branch of the Bombay and Baroda railway from Anand, through Godhra and llohad, to Rutlam ; and a chord line from Godhra to Baroda city is pro- jected. The district suffered very severely from the famine of

1899-1900.

Panderma, the ancient Panormus, a town of Asia Minor, situated on the south shore of the Sea of Marmora, near the site of Cyzicus. It has a trade in cereals, cot- ton, opium, and boracite. Its population comprises 4000 Moslems and 2000 Christians.

Pandharpur, a town of British India, in the Sholapur district of Bombay, on the right bank of the river Bhima, 38 miles west of Sholapur town. Population (1881), 16,910 ; (1891), 19,963. Pandharpur is the most popular place of pilgrimage in the Deccan. Three as- semblages are held annually. The municipal high school had 101 pupils in 1896-97, and there is also an industrial school. There are two printing-presses, each issuing a vernacular newspaper. In 1900 a light railway was con- structed from Barsi Eoad, 32 miles, partly as a famine relief work, which it is proposed to extend 20 miles farther to Sangola.

Panipat, a town of British India, in the Karnal district of the Punjab, near the old right bank of the Jumna, 53 miles north of Delhi by rail. Population (1881), 25,022; (1891), 27,547; municipal income (1897- 98), E.s.24,475. It is a centre of trade, and has manu- factures of cotton cloth, metal-ware, and glass. There are a municipal school, and two factories for ginning and pressing cotton. The neighbourhood, which was the scene of three historic battles, is now a favourite mancBuvring-ground for British camps of instruction. ^

Panna, or Punna, a native state of Central India, in the Bundelkhand agency. Area, 2568 square miles ; population (1881), 227,306; (1891), 239,333, showing an increase of 5 per cent. ; average density, 93 persons per square mile.

Estimated revenue, Rs.50,00,000 ; tribute, Ks.9,950. The chief, whose title is maharaja, is a rajput of the Bundela clan, de- scended from Chhatar Sal, the champion of the independence of Bundelkhand in the 18th century. The late maharaja died in 1898, leaving an only son, Madho Singh. In 1902 this son was found guilty by a special commission on the charge of poison- ing his uncle. The diamond mines, for which the state was formerly famous, are no longer profitable. The state suffered severely during the famine of 1896-97. There are no railways, but one or two good roads.

The town of Panna is 62 miles south of Banda. Population (1881), 14,676; (1891), 14,705. The town is well laid out, with some handsome stone buildings, and has a high school.

Pannonhalma (Mons Pannoniae, Mons Sancti Maetini), or Gyor SzentMakton (German, J(/ar

Pantin, a town in the arrondissement of St Denis, department of Seine, France, ^ mile east of the fortifica^ tions of Paris by rail, on the canal d'Ourcq. The con- struction of steam engines, boilers, railway waggons, electric bells,, glass, and perfumery, and the operations of dye-works, forges, foundries, distilleries, and saw-mills represent some of the varied branches of its industrial activity. Population (1891), 21,761 ; (1901), 29,646.

Panton, a township of Spain in the province of Lugo, in a mountainous district, watered by the rivers Sil and Cabe. Live stock is extensively reared, and large quantities of wheat, wine, oafs, and potatoes^re produced. The industries are distilling and linen manufacture. Population (1887), 11,652 ; (1897), 12,492.

Papenburg, a town of Prussia, province of Han- over, 27 miles by rail south by west of Emden, and near the right bank of the Ems, with which it is connected by a canal 5 miles long. It is a Dutch-looking place, built in 1676. It is, next after Emden, the most pros- perous port of the province ; was cleared by 631 vessels of 64,294 tons in 1900 ; and the trade is growing steadily. The canal is to be deepened to 17-18 feet, whilst new locks (300 feet long, 57 feet wide, and 18 feet deep) will connect the town with the Dortmund-Ems canal. The industries include shipbuilding, oil and glass mills, metal (nickel) and moss-litter factories. There is a school of navigation. Population (1885), 6916 ; (1900), 7611.

Paper may best be described as a more or less thin tissue composed of any fibrous material, whose individual fibres, first separated by mechanical action, are then de- posited and felted together on wire cloth while suspended in water. The main constituent in the structure of all plants is the vegetable fibre or cellulose, which forms the casing or

walls of the different cells, being the woody portion of the plant freed from all foreign substances, which forms, so to speak, the skeleton of vegetable fibre to the amount of 75 to 78 per cent. Its forms and combinations are extremely varied, but it always consists of the same chemical elements, carbon, hydrogen, and oxygen, and in the same proportions. The glutinous, resinous, silicious, and other intercellular matters sur- rounding the cells together constitute the perfect plant, and it is the object of the paper-maker to eliminate these impurities, and to produce the fibre as pure and as strong as possible. Elax, hemp, and cotton rags, having already undergone a process of manufacture, consist of almost pure fibres with the addition of fatty and colouring matters which can be got rid of by simple boiling under a low pressure of steam with a weak alkaline solution ; but the substitutes for rags, such as esparto, wood, straw, &c., being used as they come from the soil, contain all the intercellular matter in its original form, which has to be dissolved by strong chemical treatment under a high temperature. The vegetable fibre or cellulose, being of a tougher and stronger nature, is untouched by the action of caustic soda (which is the chemical generally employed for the purpose), unless the treatment be carried too far, whilst animal fibres or other organic matters are rendered soluble or destroyed by it. The cellulose, after its reso- lution by chemical treatment, is still impregnated with insoluble colouring matters, which have to be eliminated or destroyed by treatment with the solution of chlorine or bleaching powder. The object of the paper-maker in treating any one particular fibre is to carry the action of the dissolving and bleaching agents just so far as to obtain the fibre as free from impurities and as white in colour as is necessary for the kind of paper he wishes to make from it. The usefulness of a plant for a good white

paper depends upon the strength and elasticity of its fibres, upon the proportion of cellular tissue contained in them, and upon the ease with which this can be freed from the encrusting and intercellular matters.

Eags arrive at the mill from the rag merchants, either roughly sorted into grades or mixed in quality and

material, and the first process is to free them o/ra^T"' f^,Â°â„¢ ^^'^^> dust, and other impurities. To

effect this they are usually passed in bulk through an ordinary revolving duster. They are then sorted into grades to suit the paper manufactured, and cut to a workable size about 4 inches square. For the best work, hand witting, done by women, is still preferred, but it is expensive, and good machines have now been designed to perform the work. After further thrashing and dusting the rags are ready for boiling, the object of which is not only to get rid of the dirt still remaining in the rags, and to remove some of the colouring matter, but also to decompose a particular glutinous substance which would impair the flexibility of the fibres and

Fig, 1. â€" Eevolving Spherical Ea^ Boiler.

render them too harsh and stiff for readily making into paper. Various forms of vessels are used for boiling, but usually they are made to revolve by means of suitable gearing, and are either cylindrical or spherical (Fig. 1). In these the rags are boiled with an alkaline solution under a low steam pressure for six to twelve hours, according to the quality. The next step is that of washing and "breaking in," which takes place in an engine called the "breaker." (For description and illustration, see Ency. Brit. vol. xviii. p. 220.)

In treating esparto, the use of which for paper-making purposes is almost entirely confined to Great Britain, the object is to free it from all encrusting and inter- Bsparto. ggii,jia^r matter. To effect this it is digested with a strong solution of caustic soda under a high temperature, in boilers which are almost invariably stationary. The most usual form is that known as Sinclair's patent (Fig. 2). This boiler is constructed of wrought-iron or steel plates, and holds from 2l to 3 tons of grass. It is charged through the opening at the top .A, and the boiled material taken out from a door B at the side ; the grass rests on a false bottom of perforated plates C, through which the liquor drains,

and by means of two ” vomiting ” pipes D, D, at the sides of the boiler connecting the space at the bottom with a similar space at the top, a continuous circulation of steam

and liquor is maintained through the grass. The steam pressure is kept up to 35 to 40 lb per s’quare inch for about three or four hours ; then the strong liquor or lye, which contains all the resinous and intercellular matters of the esparto grass dissolved by the action of the caustic soda, is run off and stored in suitable tanks for subse- quent recovery of the soda, while the grass is taken to the ” potcher ” or washing engine. In construction and working this is similar to the breaking engine used for rags : in it the grass is reduced to pulp, and washed for about twenty minutes to free it from the last traces of soda liquor remaining after the partial washing in the boiler. As soon as the wash water is running clear and free from colouring matter, it is shut off, and the neces- sary quantity of a solution of bleaching powder, or chlorine (averaging about 6 to 8 per cent, on the raw material), is run into the potcher, and the contents are heated by steam to a temperature of about 90Â° Fahr. After about four to six hours the bleaching is complete, the drum-washer is let down, fresh water run into the potcher, and the grass washed to free it from all traces of chlorine, an operation generally assisted by the use of a little antichlor. The esparto, as shipped in bales from the Spanish or African fields, is mixed with a certain quantity of roots, weeds, and other impurities unavoid- able in the process of plucking ; and as most of these do not boil or bleach as rapidly as the esparto, they would, if not taken out in the pulp, show up in the finished paper as specks and spots, and destroy its value. To get rid of them the esparto pulp when washed and bleached is run from the potcher into storage chests, from which it is pumped over a long narrow serpentine settling-table or ” sand-table,” made of wood and fitted with divisions or ” weirs,” behind which the heavy impurities or weeds fall to the bottom and are caught. The pulp is next passed over what is known as a ” presse-pSte ” (Fig. 3) or ” half- stuff” machine, very similar to the wet end of a paper machine, consisting of strainers fitted with coarse-cut strainer plates, a short wire, and a pair of couch and press rolls. The pulp is drawn through the strainers by suction, which keep back the finer impurities which have passed the sand-table,

and then flows on to the wire-cloth in the form of a thick web of pulp. After passing through the couch and press rolls, the pulp leaves the machine with about 70 per cent, of moisture, and is ready for the beating engine, the first operation of paper-making proper. This is the general and usual process, though various modifications are introduced in different mills and for different purposes.

Most kinds of straw can be utilized for making into paper, the varieties generally used being rye, oat, wheat, and barley ; of these, the two former are the most im- portant, as they give the largest yield in fibre. Germany and France are the two principal users of straw, which closely resembles esparto in its chemical constitution, and is reduced to pulp by a somewhat similar process.

Scandinavia, Germany, the United States, and Canada are the countries which mainly use wood as a material for paper-making, owing to their possession of large forest areas. They also export large quantities ”’*”“‘â– of wood-pulp to other countries. The timbers chiefly used for the manufacture of wood-pulp are the spruces, pines, and poplars of various kinds. In Europe the Scotch fir {Finns syh’estris), the spruce (Picea excelsa), the poplar {Popvlus alba^, and the aspen (Pop?(ZÂ»,s tremido), are the timbers principally employed ; and in America the black spruce (Picpa nigra), the hemlock (Tsuga Canadeiisis), the poplar {Populus grandidentata), and the aspen (Poj^u- lus tremvloides). There are two kinds of wood-pulp pre- pared for paper manufacture, one prepared mechanically and the other chemically. The former is obtained by

disintegrating the wood entirely by means of machinery without the use of chemicals, and is, as may readily be understood, a very inferior pulp, only used in the cheapest sorts, for news papers, &c. In the manufacture of chemical wood-pulp very great advances and improve- ments have been made since 1880, and the consumption

of timber of various kinds for this purpose has enormously increased, so that wood-pulp has grown to be one of the most important fibres for paper-making purposes. There are two methods in use, known respectively as the soda or alkaline process and the sulphite or acid process, according as soda or sulphur (or rather sulphurous acid) forms the base of

Hot VValvr Pipe.

Liquor Pipe. Steam Pipe Cold Water Pipe.

SECTIOff.

etEVATION

-Sinclair Esparto Boiler.

the reagent employed. Trees of medium age are usually selected, varying from seventy to eighty years' growth, and running from 8 to 12 inches in diameter. They are felled in winter, and arrive at the mill in the form of logs about four feet long. After being freed from bark, and the knots taken out by suitable machinery, the logs are cut

into small cubical chips about |- to f inch in size by a revolving cutter. The chips are then bruised by passing them between two heavy iron rolls, to allow the boiling solution thoroughly to penetrate them, and are conveyed to the boilers over a screen of coarse wire-cloth, which separates out the fine sawdust as well as any dirt or sand.

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Fig. 8.â€"" Presae-Pate," or Half-stuff Machine.

In the soda process the wood is boiled in large revolving or upright stationary boilers for about seven or eight hours, in a similar manner to esparto and straw, though it requires much severer treatment. The steam pressure varies from 90 R) to as much as 160 lb per square inch, and the amount of soda required is about 16 per cent, of NaaO, estimated on the barked and cleaned wood. The essential feature of the sulphite process is the employment

of a solution of sulphurous acid combined with a certain amount of base, either magnesia or lime.- As the acid reaction of the bi-sulphite solution would attack any exposed ironwork with which it comes in contact, it is necessary that the boilers in all cases should be lined with lead. The type of boiler employed varies according to the process adopted. The principal patents connected with the sulphite process are those of Tilghman, Ekman,

Francke, Eitter-Kellner, Mitscherlich, and Partington. The subsequent operations, in both the acid arid alkaline processes, of washing, bleaching, and straining the pulp, are all very similar to those described for esparto, and require no further particular description. Wood-pulp pro- duced by the sulphite process differs in a marked degree from that made by the soda process: the fibre in the former casd is harsher and stronger, and papers made from it are characterized by their hardness and transparency, whereas those made from soda pulp are softer and more mellow in handle, corresponding in some way to the difference between linen and cotton fibres. Each class of pulp is largely used, both alone and mixed with other materials, the choice depending upon the class of paper desired.

Fibres like jute, hemp, manila, &c., are chiefly used for the manufacture of coarse papers where strength is of more importance than appearance, such as wrapping- papers, paper for telegraph forms,

&c. The boiling processes for them are similar to those used for esparto and straw.

The alkaline liquora or lyes in which rags, esparto, and other paper-making materials had been boiled, were formerly run into the nearest water-course ; but now, partly because i,t is recorerv insisted upon by the Elvers Pollution Acts, and partly ^' because the recovery of the soda can be made re- munerative, all these liquors are preserved and the soda they contain utilized. One of the best and most economical of the simple recovery plants is that invented by Porion, a French distiller, and named after him. (See, for description and illustration, Ency. Brit. vol. xviii. p. 226.) It is open, however, to the objection that the whole of the sulphur in the coal employed for the furnaces finds its way into the recovered soda, and forms sulphur compounds, thus reducing the value of the ash for boiling purposes ; in addition, a considerable amount of

â€¢ soda is volatilized during the evaporation, and the percentage of recovery is reduced. By the application of the system of multiple-effect evaporation to the recovery of waste liquors these drawbacks disappear, and an important change has been made in the soda-recovery plant of the paper-mill. This system of multi- ple-effect evaporation, originally introduced by M. Eillieux, has been perfected by the invention of Mr Homer T. Yaryan, of Toledo, I Ohio, U.S.A. The Yaryan evaporator was originally applied in the United States to the concentration of the waste alkaline liquors of paper-mills ; it then came into extensive use for the manufacture and refining of sugar, the production of glucose, and a variety of other purposes. The principle of multiple-effect evaporation is to utilize the latent heat of a vapour given off from a liquid under a certain pressure to vapor- ize a further quantity of the liquid under a pressure main- tained by mechanical means below that of the first. , The essential feature which distinguishes the Yaryan evaporator consists in the boiling of the liquor to be treated while it is passing through a series of tubes, which constitute a coil and are heated externally by steam or vapour. The quantity of liquor entering the coil is so controlled that it is only permitted partially to , fill the tubes, and thus leaves room for the instantaneous liberation of the vapour and its free escape. As the liquor descends from tube to

tube, it becomes concentrated and reduced in volume until ultimately it passes into a ” separator,” where it

â– impinges on a plate or disc, which causes a complete separation of the vapour and liquid ; each then passes on to the next ” effect,” the liquid through the second coil of tubes and the vapour to the chamber enclo.sing them. This combination of a series of tubes or coil, and separator, constitutes a vessel or ” effect,” and the evaporator consists of a series, usually three or more, of these vessels, one above the other. The vital feature, it will be under- stood, is therefore that the latent heat of the original steam, after performing its function in the first effect, is passed on to the second and then to the third or more effects, in each of which an equal amount of work is done before passing to the final con- denser, where a vacuum is maintained. Thus, if the total temperature be divided three times, the result is a triple effect ; if four times, a quadruple effect. Taking an evaporation of 10 fb of water per pound of coal, a single-effect apparatus will evaporate 10 ft) of water, a double-effect 20 lb, a triple-effect 30 lb, and so on. The liquor to be concentrated is pumped from the storage tanks to the top or first effect of the Yaryan appai-atus through a series of multiple-effect heaters, corresponding to the number of effects in the machine, by means of which the liquor is heated to as near the boiling-point as possible of the liquor in the tubes

of the first effect. Live steam is introduced into the chamber surrounding the tubes of the first effect, and from the separator of the last effect the concentrated liquor is pumped to the incinerator. Any form of incinerating hearth can be used in conjunction with the multiple-effect evaporator, but one very suitable to the continuous work of, and the high degree of con- centration produced by, the Yaryan machine is that known as the Warren rotary furnace. This consists of a revolting iron cylinder lined with brick, about 12 feet long by 10 feet in diameter. The lining being 6 inches thicker at the inlet than at the discharge, the interior of the furnace is conical in form, so that the ash gradually works forward and is eventually dis- charged fully burnt into trucks for storage, or on a travelling band, and so carried automatically to the dissolving or lixiviating tanks. The’ strong

liquor runs in at one end in a slow con- tinuous stream ; by the rotation of the hearth the burning mass is carried up the sides and drops through the flame again to the bottom, much in the same manner as rags do in a revolving duster. In this way all the labour required, to stir the ash of the ordinary hearth is dispensed with, and the burning material comes con- tinuously in close contact with the flame, a complete and thorough combustion being the result. The fire-box is situated at the delivery end of the furnace, and is mounted jon trucks so that it can be run back when cleaning or repairing the brickwork. The waste heat is utilized in raising steam in a steam boiler set behind the furnace, and finally in heating the weak liquor before concentration.

Paper-making proper, from prepared pulp, whether of rags, esparto, wood, or other raw material, may be said to commence with the operation technically known Beatiaz as ” beating,” which is carried out in one of the various forms of beating engine or “Hollander.” The object of the beater is to reduce the fibres to a length suitable for the class of paper to be made from them, and also to beat or bruise them into a stiff pulp of sufficient consistency to absorb and carry the water necessary to felt them together on the wire-cloth of the paper-machine. This operation is one of the most important and most delicate processes in the manufacture, requiring ex- perience, skill, and careful manipulation. Not only does every class of fibre demand its own special treatment, but this treatment has to be modified and varied in each case to suit the qualities and substances of the papers to be made from it. One form of beater lias already been referred to in Ency. Brit. vol. xviii. p. 220 ; but engines of quite a different construction are now used largely in American mills, and also to some extent in Great Britain. These are known as ” refiners,” and the most important forms are the Jordan and Kingsland beaters (so called from the names of the inventors), or modifications of them.

The first (Fig. 4) consists of a conical plug or roll fixed on a shaft and revolving at a high rate of speed within an outer casing

Jhflofl-

Fig. 4. â€” Jordan Beater.

of corresponding shape ; both the plug and the casing are fur- nished with steel bars parallel with the shaft, but set at slightly different angles, taking the place of the bare in the roll and plate of the ordinary beater. This conical plug or roll can be moved

in either direction parallel to its axis, and by this means the cutting action of the two sets of bars can be increased or reduced. The pulp flows into the top of the beater at the smaller end of the cone through a box provided with an arrangement for regulating the flow, and passes out through an opening in the casing at the other end. The roll or plug revolves at from 350 to 400 revolutions per minute, and requires a power to drive it of from 25 to 40 h.p. according to the work done, and one engine is capable of passing as much as 1000 lb weight of dry pulp per hour. The Kingsland beater consists of a circular box or casing, on both inside faces of which are fixed a number of knives or bars of steel or bronze ; inside the case is a revolving disc of metal fittbd on both sides with corresponding and similar bars. The contact between the revolving and stationary bars can be regu- lated, as in the Jordan engine, to give the required amount of beating action on the pulp. The refiner is essentially a finishing process as an adjunct to the beating process proper. The advan- tages to be derived from its use are twofold, viz., a considerable saving in the time occupied in beating, and the production of a more uniformly and more evenly divided pulp, particularly where a mixture of different fibres is used. By the use of the refiner the time occupied in the beater can be reduced by nearly one-half, the half-beaten pulp passing through the refiner from the beater on its way to the paper-machine. It is not, however, generally employed for the best kinds of paper.

During the operation of beating various materials and chemicals are added to the pulp for the purpose of sizing, . . loading, colouring, &c. Papers for writing and

most of those for printing purposes must be rendered non-absorbent of ink or other liquid applied to them, or they would partake of the nature of blotting- paper. To effect this some form of animal or vegetable size or glue must be applied to the paper, either as a coating on the finished web or sheet, or mixed with the pulpdn the beating-engine. The latter, which is known as ” engine-sizing,” consists in filling up the interstices of the fibres with a chemical precipitate of finely divided rosin, which, when dried and heated on the cylinders of the paper-machine, possesses the property of being with difficulty wetted with water. Except in the very best qualities of paper, it is usual to add to the pulp a certain quantity of a cheap loading material, such as china-clay or kaolin, or pearl-hardening, a chemically precipitated form of sulphate of lime. The addition of such loading material to a moderate extent, say 10 or 15 per cent., is not entirely in the nature of an adulterant, as it serves to close up the pores of the paper, and for ordinary writing, printing, and lithographic papers renders the material softer^ enabling it to take a much better and more even surface or glaze. But if added in excess it is detrimental to the strength and hardness of the sheet. Most materials, however well bleached, have a more or less yellowish tinge ; to correct this, and produce the desired white shade in the paper, certain quantities of red and blue in the form of pigments or dyes must be added to the pulp. The blues usually employed are ultramarine, smalts, and the aniline blues, while the red dyes are generally prepa^ rations of either cochineal or the aniline dyes. In addi- tion to these two colours, others are required in the manu- facture of papers of different tints, and with one or two exceptions they must be-mixed with the pulp in the beater.

There are two distinct processes of producing the fin- ished paper from the pulp, known respectively as ” hand- made ” and ” machine-made.” Hand-made pa- ffl^A^e. PÂ®’‘ 6<^^P* for certain of the best classes, has been almost superseded by machine-made, the expense of manufacture and consequent high price ren- dering it too costly for ordinary use ; the entire process on the machine occupies at most a few minutes, which in the ordinary state of the weather could not be done by hand in less than a week. The paper-machine consists essentially of an endless mould of fine wire-cloth, on which the pulp flows and on

which a continuous sheet of paper is formed ; the sheet then passes through a series

of rolls and over a number of steam-heated cylinders until it is dry. It need not be further described here, as details and illustrations may be found in the article in the ninth edition of this work (vol. xviii.), where also the other remaining processes of glazing, cutting, and sheeting are noticed. Paper-machines are now usually driven by two separate steam engines. The first, run- ning at a constant speed, drives the strainers, pumps, shake motion, &c., while the second, working the paper-machine proper, varies in speed according to the rate at which it requires to be driven. The power consumed by the two engines will average from 40 to 100 h.p. The drying cylinders of the paper-machine form a convenient and economical condenser for the two steam engines, and it is customary to exhaust the driving en- gines into the drying cylinders and utilize the latent heat in the steam for drying the paper, supplementing the sup- ply when necessary with live steam. The speed of the machine has frequently to be altered while in motion. An alteration of a few feet per minute can be effected by changing the driving speed of the steam engine governor ; for a greater change, the machine must be stopped and other driving wheels substituted. Arrange- ments are made in the driving gear by which the various parts of the machine can be slightly altered in speed relatively to one another, to allow for the varying contrac- tion or expansion of the paper web for different kinds and thicknesses of paper. The average speed of a paper- machine on fine writing-papers of medium weight is from 60 to 90 feet per minute ; but for printing-papers, news- papers, &c., the machine is driven from 120 up to as much as 300 and 400 feet per minute. The width of machines varies greatly in diiferent mills, from about 60 inches to as much as 150 inches wide. Mills running on higher classes of papers as a rule use narrow machines, as these make a closer and more even sheet of paper than wider ones ; but for the cheaper and commoner qualities the wide machines are in vogue, as the cost of labour, &c., per ton of paper turned out is considerably reduced. The weight of paper that a machine can produce will of course depend upon its width and speed, and the thick- ness of the web of paper; on fine writing-papers an average machine will make from 20 to 40 tons

per week, while for common printing and news papers the weekly output will amount to as much as 50 or 70 tons.

With the enormously increased production of paper and the great reduction in price within recent years, due to the growing demand for cheap literature and publications, it has been found that the ” science ” f/”^^^ of paper-making has scarcely advanced with the same rapid strides as the art itself. Although a sheet of paper made to-day differs but little as a fabric from the papers of earlier epochs, the introduction of new and cheaper forms of vegetable fibres and the auxiliary methods of treating them up to the point of putting them together as a sheet of paper have caused a great change in the quality, strength, and lasting power of the manufactured article. The undue introduction of excessive quantities of mechanical or ground wood-pulp in the period 1870-80 into the cheaper qualities of printing-papers, particularly in Germany, first drew attention to this matter, since it was noticed that books printed on paper in which much of this material had been used soon began to dis- colour and turn brown where exposed to the air or light, and after a time the paper became brittle. This import- ant question began to be scientifically investigated in Germany about the year 1885 by the Imperial Testing Institution in Berlin. A scheme of testing papers has been formulated and officially adopted by which the chemical and physical properties of different papers are compared

and brought to numerical expression. The result of these investigations has been the fixing of certain standards of quality for papers intended for different purposes, these qualities are grouped and defined under such heads as : â€”

Strength, expressed in terms of the weight or strain which the paper will support ;

Elasticity and texture, measured by elongation under strain and resistance to crumpling or rubbing ;

Bulk, expressed in the precise terms of specific gravity or weight per unit of volume.

Of not less importance are the qualities which belong to paper as a chemical substance or mixture, which are : (1) Its actual composition ; (2) the liability to change under whatever conditions of storage and use it may be subjected to. For all papers that are to be used for any permanent purpose these physical and chemical qualities must come more and more into practical consideration, and ultimately rank as regulating the consumption and production of papers. For fuller information on this subject the reader is referred to the Mitteilungen der Koniglichen Versuchs-Anstalt, Berlin, 1885 and onwards ; and to the report of the committee of the Society of Arts on the ” Deterioration of Paper,” London, 1898.

British Paper-trade. â€” The Directory of Paper-makers for 1899 shows that in England and Wales there were 206 makers, employ- ing 441 machines ; in Scotland, 59 makers and 114 machines ; in Ireland, 8 makers and 12 machines. These figures include 31 makers of hand-made paper, using 154 vats, in England ; and 2 makers, 4 vats, in Scotland. A rough estimate of the amount of capital embarked in the industry may be formed on the basis that average mills would represent from Â£20,000 to Â£30,000 per machine. The following figures, abstracted from the Board of Trade returns for the year 1899, give the amounts and values of the imports and exports of paper and paper-making materials for Great Britain : â€”

Imports.

Exports.

Weight.

Value.

Weight,

Value.

Cwts.

Â£

Civts.

Â£

Paper and boards .

5,307,079

Tons.

3,724,254

71,757

Tons.

929,370

Rags

Esparto . “Wood-pulp â€” .

Chemical .

Mechanical

20,617 207,604

196,926 218,180

174,661 806,354

1,441,809 547,897

65,041

Authorities. â€” Aenot. Technology of the Paper-trade. Cantor Lecture, Society of Arts. London, 1877. â€” Clappbrton. Prac- tical Paper-making. London, 1894. â€” Cross and Bevan. Re- port on Indian Fibres and Fibrous Substances. London, 1887 ; Cellulose. London, 1895 ; Text-book of Paper-making. London, 1888.â€” Davis. The Manufacture of Paper. Philadelphia, 1886. â€” Dropisch. Die Papiermaschine. Brunswick, 1878 ; Papier- fabrikation (with atlas). “Weimar, 1881. â€” Geifi’in and Little. The Chemistry of Paper-making. New York, 1894. â€” Herzberg. Papier-ptrufung. Berlin, 1888 (English translation by P. N. Evans, London). â€” Hofmann. Handbuch der Papierfabrikation. Berlin, 1897. â€” Hoter. Fabrikation des Papiers. Brunswick, 1886. â€” KiRCHNER. Das Papier (handbook appearing since 1897). Biberach. â€” Muller. Die Fabrikation des Papiers, 4th edition. Berlin, 1877. â€” ” La Fabrication du Papier et du Carton,” Biblio- theque Scieiitiflque, Industrielle et Agricole des Arts et Iletiers, viii. Paris, 1881. â€” Schubert. Die Gellulosefabrikation, 2nd edi- tion. Berlin, 1897 ; Die Praxis der Papierfabrikation. Berlin, 1898 ; Die Holzstojf Oder Holzschlifffabrikation. Berlin, 1898. â€” Spon’s Encyclopedia of Arts and Manufactures, “Fibrous , Substances” and “Paper.” London, 1882.â€” Wyatt. ” Paper- ” making,” Proc. Inst. C. E., vol. Ixxix., London, 1885; “Sizing Paper with Rosin,” Proc. Inst. G. E., vol. xci., London, 1887.â€” Paper-makers’’ Monthly Journal. London, since 1872. â€” Paper- trade Journal. New York, since 1872. â€” Papier Zeitung. Berlin, since 1876. (j. w. w.)

Paphos. See Cyprus.

Paraguay, an inland republican state of South America, lying between 20Â° 16′ 14″ and 26Â° 31′ S. and 64Â° 37′ and 62Â° W. It is bounded by the territories

of the Argentine, Brazilian, and Bolivian republics, but the frontier line towards Bolivia has not yet been defi- nitely fixed. The river Paraguay, running from north to south, divides the territory of the republic into two sections, the eastern section, or Paraguay Oriental, being the more important. The country as a whole is not well known. Outside the

valley which stretches from Asuncion, the capital, to Villa Encarnacion, and away from certain frequented roads leading to the yerhales, there are few routes familiar to travellers. ‘ The western region, called the Gran Chaco, is to a large extent un- explored. The area comprised within the limits of the republic is estimated at about 97,700 square miles. According to the census of 1900, the population num- bered 636,571, including an estimate of 80,000 for the Indians of the Chaco. The great majority of the inhab- itants are of Indian descend, with very slight traces of foreign blood in their veins. Civilization has not made much progress, and the quaint habits and customs of the people have little similarity to those in the more advanced neighbouring republics. By nature the coun- try people are gentle and patient, merry and smiling. As a general rule the Paraguayans are indolent, espe- cially the men. Climatic conditions obviate the necessity of any superfluity of clothing. A cotton chemise, and a white manta wrapped in Moorish fashion over head and body, constitute the dress of the women ; a cotton shirt and trousers that of the men. Boots and shoes are worn only by the upper classes. The common language of the country is Guarani, although in a few districts Tupi is spoken. The country people as a rule understand a little Spanish, if living near any trading centre. In 1893 a group of Australians, imbued with Socialistic tendencies, obtained a concession of 30 square leagues of land â€” about 136,000 acres â€” from the Paraguayan Govern- ment, and a number of immigrants from Australia settled on t’his tract. These colonists laboured under the condi- tion that all property should be held in common. ” IsTew Australia” did not, however, prove a success. Disputes arose, and in the following year the project was abandoned, the land reverting to the Government. Thirty of the colonists with their families, in all ninety-three persons, agreed to stay and found a new settlement to be called “San Cosme.” This experiment has succeeded some- what better than the first, the settlers gaining a living by growing fruit and vegetables and occasionally working for wages when occasion offers. Another colony was founded with 150 Sicilian families, but this is by no means in a satisfactory condition. Immigration is small and does not increase. In 1892 there were only 539 im- migrants ; in 1897, 197 ; in 1898, 337 ; in 1899, 340 ; and in 1900, 170. The towns are few, small, and backward. Asuncion, the capital, with about 24,000

inhabitants, has neither water nor drainage works, and the streets are lighted with kerosene lamps placed at long intervals apart. Other towns are Concepcion, with 6000 inhab- itants ; Villa Rica, with 8000 ; San Pedro and Villa del Pilar, with 4000 each ; and Villa Encarnacion, with 3000. The municipalities are all poor, and unable to bear further taxation for public works.

AdminLstration.â€” The country is divided into 84 departments, grouped into 24 political districts, and the political constitution of 1870 is still in force. For the administration of justice there is a High Court, with lower tribunals and local magistrates accredited with judicial powers. The criminal courts are ineflSoient and dila- tory, and crime as a rule is most inadequately punished. The death penalty nominally exists, but is rarely carried out. The civil courts are corrupt, and most tedious in procedure. The civil and criminal codes of Argentina, with a few modifications, have been adopted by Paraguay. The police system can hardly be said to extend beyond the cities, the expense of providing proper pro- tection for life and property in the country districts being beyond the resources of the Government.

â– Religion and Instruction. â€” The Paraguayans adhere to the tenets of the Roman Catholic religion, implanted among them by the Jesuit missionaries in the 16th century, but they understand very little about religious principles. Education is in a most backward and neglected condition. Compulsory attendance at the schools for all children is nominally the law, but is never enforced. According to the official returns, there are 358 public and private elementary schools, with a staff of 680 teachers and 23,000 enrolled pupils. The actual attendance of children, however, does not exceed 12,000. The selection of the teaching staff is made without any regard to the capabilities of the applicants ; salaries are on a very low scale, and frequently many months in anear. At Asuncion a national college has been established with a staff of 15 professors, and 205 students were enrolled in 1898. The educational value of the col- lege is not great. There are also an

agricultural school, supported by the State ; a school of arts and sciences, founded by the Sicilian friars ; and a seminary.

Defence. â€” The army consists of 1 battalion of infantry, containing 1000 men ; 2 squadrons of cavalry, with 1500 men ; and 1 battery of artillery, with 750 men ; total, 3250 men. There is also a na- tional guard which may be called out in any emergency. Every Paraguayan between the ages of 20 and 50 is bound to serve. The republic has 1 gunboat with 4 guns, and 2 steam launches.

Finance.â€” Thft financial situation of the Paraguayan Government has been a source of anxiety for many years. In 1885, after interest had been unpaid for 11 years on bonds amounting to Â£1,505,400, an agreement was made for the issue of new scrip to the value of Â£850,000 in quittance of all claims for capital and arreas of interest, certain public lands being also ceded to the bondholders as compen- sation for their losses. In 1892 the Government again defaulted, and in 1895 an arrangement was made for a reduction of the rate of interest, for the funding of the arrears, and for the creation of a sinking fund. The Government were unable to meet their obliga- tions under the new contract, and in 1898 the outstanding amount had risen to Â£994,600 sterling. Provision has now been made for the service of this foreign debt, and the authorities have been able regularly to meet the service of the coupons. Besides the London debt, there are many other claims on Paraguay. The national obligations are briefly set forth in the following statement as they stood at the end of 1898, gold debts being converted at the rate of $5 to the Â£, and the currency debts at the rate of |40 to the Â£.

Gold Debts-

London debt .

Â£994,640

Brazilian debt

1,792,037

Arrears of interest .

183,256

Argentine debt

2,026,727

Arrears of interest .

657,957

Argentine National Bank

8,517

General bonds

500,000

Paraguayan Central Railwaj

‘ Company

429,471

Total gold

Â£6,592,605

Currency debts â€”

Notes in circulation

$9,876,000

Â£246,875

Internal bonds

702,093

17,552

Floating debt

567,256

14,181

Total currency

$11,1443,51

Â£278,608

Total debt

Â£6,871,213

The revenue of the republic is derived mainly from import duties, and the most important branches of expenditure are the salaries of public officials, the army, public instruction, and debt. The receipts and expenditure in 1891 and in each of the years 1896-99 were as follows : â€”

Tears.

Eeceipts.

Expenditure.

Receipts.

Expenditure.

$ Cnrrency.

$ Currency.

1891

1,647,717

2,485,203

Â£41,190

Â£62,130

1896

5,832,867

6,526,518

145,820

163,160

1897

4,200,009

6,852,334

105,000

171,308

1898

8,977,299

8,441,275

224,430

211,032

1899

9,866,000

8,122,139

246,650

203,054

The conversions in this statement are only approximate, the cur- rency dollar being taken at 6d. for each of the years. The import and export duties in 1899 amounted to $7,996,440, and various taxes and contributions to 11,869,560. The estimated revenue for 1900 was $8,065,781, and expenditure $8,122,179, or, approxi- mately, Â£201,640 and Â£203,050.

Industry. â€" The principal industries of the republic are the culti- vation and preparation of yerba mate (Paraguayan tea), cattle-

farming, fi'uit-growing, tobacco-planting, and timber-cutting. Yerha mat&, classified as Ilexparaguayensis, is a shrub. The leaves are stripped, withered, rolled, and sorted, then packed in saclsB and exported to Argentina for sale. This Paraguayan tea is used in place of the ordinary tea or coffee in many parts of South America. Medical experts state that the beverage infused from the leaves has a stimulating effect, and is also slightly diuretic. The total amount exported from Paraguay in 1896 was 5141 tons ; in 1897 the total was 6548 tons ; and in 1898, 7000 tons. The value of the yerba exported in 1899 was Â£97,360. The majority of the yerbales (tea plantations) were

formerly the property of the national Government, but of late years private enterprise has stepped in and bought or leased .the plantations. An important feature about yerba mate is the small expense necessary for its production, and the cheap rate, notwithstanding the high tariff on its importation, at which it can be placed on the Argentine market as compared with ordinary tea or Brazilian coffee.

The cattle industry comes next in importance. The number of animals is said to exceed 2,500,000, but exact figures are unOfbtain- able. Hitherto the surplus stock has only found an outlet in the demands for local consumption, or for the value of the hides for export. The animals are small, but Durham and Hereford bulls are being introduced from Argentina to improve and enlarge the breed. The increase in the herds of recent years has caused the owners of saladero establishments in Argentina and Uruguay to try the working of factories in Paraguay for the preparation of tasajo (jerked beef) and the manufacture of extract of meat â€" the first for the Brazilian and Cuban markets, the latter for European consumption. The number of horses is estimated at 300,000 ; donkeys, 20,000; yaks, 10,000; pigs, 50,000; and sheep and goats, 240,000. Both grasses and climate are against sheep-farm- ing on a large scale.

The fruit trade is confined to the exportation of oranges and pine-apples to the Buenos Aires, Rosario, and Montevidean markets. The orange groves are uncultivated, but yield abun- dantly. The demand for oranges is so large in Argentina that a ready sale could be found for a much larger quantity than is now exported. Both climate and soil in Paraguay could be turned to useful purpose for the cultivation of many tropical fruits and vegetables for sale in Argentina, and already some attempts are being made to develop a trade in this direction. Tobacco, although of inferior quality, is grown to a considerable extent, the total production for 1900 being about 280 tons, about one-eighth of which was exported. This industry might be largely increased in value if more attention were devoted to cultivation and curing.

The forests are a source of wealth as yet scarcely touched, and abound in such valuable timbers as quebracho, cedar, curupey, lapacho, and

urundey. The difficulty and cost of transport at present block the development of this industry. In Buenos Aires, where the demand for lumber is constantly increasing, it is found cheaper to import from North America or Europe, a distance of 6000 miles, rather than from Paraguay, less than 1000 miles distant. In order to remove this anomalous condition of affairs, it is necessary that the great waterway formed by the Rio de la Plata, the Parana, and the Paraguay should be properly utilized.

The development of the agricultural and pastoral industries is encouraged, and land is assigned to colonists by the Government. In 1897 there were seven agricultural settlements, with altogether about 10,000 acres under cultivation. The climate is enervating, and otherwise â€¢ there is no great inducement for European emi- grants to go to Paraguay, since the best portion of the national lands is already in the hands of private individuals. During the year 1899 the Anglo-Paraguayan Land Company, the owners of the land ceded to the bondholders, sold 11 leagues (51,600 acres) at prices varying from Â£250 to Â£1000 per league.

Commerce. â€" The commercial situation of Paraguay has improved somewhat in consequence of the investment of some small amounts of foreign capital in industrial enterprise. The principal articles imported are textiles, hardware, wines, rice, flour, canned goods, and general provisions ; the exports are yerba mate, hides, wood, oranges, hair, tobacco. Most of the trade is with Buenos Aires or Montevideo, direct dealing with Europe being the exception. The values since 1895 have been : â€"

1895.

1896.

1897.

1898.

1899.

1900.

Imports . Exports .

Â£492,010

424,290

Â£557,260

409,660

Â£440,690

480,320

Â£621,700

492,660

Â£429,570

404,210

Â£867,724

412,868

The textiles are mostly of British origin; the wines are from Prance. A promising trade was done with the adjoining Brazilian state of Matto Grosso for some time, under the terms of a treaty allowing free trade with that province of Brazil. In 1898, however, this arrangement with the Brazilian Government was rescinded, and business between Paraguay and Matto Grosso came to an end.

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PARAGUAY

Whilst the commerce of Paraguay is extremely limited, it is, on the whole, fairly sound, and promises to increase in volume.

Communications. â€” There are two lines of passenger steamers plying between the port of Asuncion and Rio de la Plata, each of which runs one steamer weekly. There is also a fortnightly service of the Brazilian Lloyd's boats (cargo only) between Monte- video and Corumba, calling at Buenos Aires and Asuncion. In 1898, 418 ocean-going vessels and 750 coasting vessels entered at the port of Asuncion, and 408 ocean-going and 706 coasting ves- sels cleared. There are' some fairly good waggon roads, and the Government appropriates annually a considerable sum for their extension. The transport of heavy goods is effected by bullock carts of antiquated type. In the capital there are half a dozen public vehicles and three private carriages. The only railway undertaking is that of the Paraguay Central Railway Company. The total length of line open to trafBo is 156 miles. An extension has been projected for some years, but the failure of the Govern- ment to pay the guaranteed interest on the capital of the company has hi|herto prevented the accomplishment of the work. A steam tramway connects Asuncion with San Lorenzo, 20 miles distant, and horse tramways run through the streets of the capital. In 1900 the railway carried 624,741 passengers and 75,503 tons of goods; the receipts being $1,568,037 (or about Â£39,200), and the working expenses about 79 per cent. The tramway carried 870,546 passengers in 1899.

Post and Telegraph. â€" Paraguay entered the Universal Postal Union in 1884. In 1899 there were 139 post ofBces in the country, and in the same year 1,254,864 pieces of mail matter were handled. Four telegraph lines, of a total length of about 485 miles, connect Asuncion with other towns, and a submarine cable line puts the republic in communication with the rest of the world by way of Corrientes. In 1899 the inland telegrams numbered 18,925, and the international, 39,458. Telephone services are in operation at Asuncion and at Concepcion.

Money and Credit. â€" There are three banking companies, one of which in 1898 paid a dividend at the rate of 18 per cent, on a capital of

$1,000,000 currency. The capital invested in works for the development of the resources of the country is mostly foreign. The three British companies (railway, tramway, and land) have invested altogether about Â£1,430,000 ; a Belgian syndicate, working yerbales, cattle ranches, &c., Â£60,000 ; and a French" company, for miscellaneous investments, Â£72,000. The money invested in private trading concerns probably amounts to about Â£1,000,000.

The money in circulation at the end of 1900 consisted almost entirely of $12,000,000 paper (Â£300,000). The gold dollar (4 shil- lings) in 1900 was at a premium averaging over 800 per cent.

Weights and Measures. â€" The metric system is of&cially adopted, but the weights in common use are the tonelada (2025 lb), the quintal (101-4 lb), the arroba (25-35 lb), the libra (1-014 lb), and the onza (-OBieR)). The unit for liquid measure is the cuarta (-1665 gallon) ; that for dry measure, the almud (-66 bushel). The land measure is the legua (2-689 miles).

(w. w. E.; I. P. A. E.)

Recent Political History. â€" The modern political history of Paraguay dates from the death of Don Francisco Lopez in 1870. Succeeding his father, Don Carlos Lopez, as President in 1862, he made no pretence of governing the country according to the constitution of 1844, but arrogated to himself absolutely autocratic powers. In 1864 a dispute arose between Lopez and the Brazilian Government. The Paraguayan dictator, in order to enforce his demands, marched an army through Argen- tine territory for the purpose of invading the southern provinces of Brazil, and occupied the town of Uru- guayana in Rio Grande do Sul. This act induced the Governments of Brazil, Uruguay, and Argentina to combine for the pu.rpose of suppressing Lopez, whose aggressive behaviour and ambitious policy constituted a constant menace to the three countries. The invasion of Paraguay then took place, and a struggle involving an enormous sacrifice of life and treasure lasted for five years, only coming to a close when the Paraguayan forces were totally defeated and Lopez was killed at the battle of Aquidaban on 1st March 1870. During this warfare every

male Paraguayan capable of bearing arms was forced into the fighting ranks, whole regiments be- ing formed of boys of from 12 to 15 years of age. ISTor were the women spared : they w6re used as beasts of burden to carry ammunition and stores, and when no

longer capable of work were left to die by the roadside or ruthlessly murdered to avoid any ill consequences occurring from their capture by the enemy. When the war broke out, the population of Paraguay was 1,337,439 souls ; when hostilities ceased the total number of inhabitants was 221,079 personsâ€" 28,746 men, 106,264 women above 15 years of age, and 86,079 children. Lopez was merciless in his treatment of his own people, and any attempt to evade military service was punished by death, as also was any evidence of hesi- tation to face the enemy. When gradually the Para- guayans were forced to retreat, the dictator ordered every town and village passed through to be razed to the ground, and every living animal for which no use could be found to be slaughtered. When the end came the country and people were in a state of absolute prostration.

After the death of Lopez, the Government was admin- istered by a triumvirate consisting of Cirilo Rivarola, Carlos Loizaga, and Jose Diaz de Bedoza. In November 1870 a new constitution was formulated. The executive power was vested in the hands of a President elected by Congress for a term of four years, and assisted by five responsible ministers â€" namely. Interior, Finance, War and Marine, Worship and Instruction, and Foreign Affairs. Provision was also made for a Vice-President to act in case of the absence, death, resignation, or inability of the President. The legislative authority was to be exercised by a Congress consisting of two chambers, the Senate and the Chamber of Deputies, elected by the people, in the propor- tion of one senator for every 12,000 inhabitants and one deputy for every 6000, although in certain thinly popu- lated districts a lesser number was required. The consti- tution provided that senators and. deputies should receive an annual stipend of 1000 gold dollars. The chpice for President of the republic fell upon Senor Cirilo Rivarola, and he was declared duly elected. The constitution of 1870 is still in force, but the majority of the Paraguayans have never availed themselves of the privilege of voting

accorded to them. This inauguration of new political conditions did not mean, however, that all was plain sailing for the men in charge of Paraguayan destinies. The policy of Brazil had for many years leaned towards the annexation of Paraguay, in order that the Paraguay river might become the boundary to the south-west of the Brazilian empire. President Rivarola found himself thwarted in all directions by Brazilian intrigues, and in little more than a year after his election he resigned office, and was succeeded by the Vice-President, Senor Salvador Jovellanos. President Rivarola had aroused some strong hostile feelings during his tenure of power, and was shortly afterwards assassinated. President Jovellanos completed the term of office for which Rivarola had been originally selected, and in 1874 President Gill was chosen to succeed him. Brazilian intrigues were now once more set afoot, and the opposition to this policy, combined with the introduction of certain reform measures and the suppression of many flagrant abuses, resulted in a conspiracy against the President and his assassination in 1875. Vice-President Uriarte then 'assumed the Presidency, and served the remainder of the term. In 1878 Senor Baredo was elected, but died suddenly shortly afterwards, Vice-President Saguier succeeding to power. A conspiracy aided by the military element overthrew Saguier in 1881, and Congress then nominated General Caballero to hold office. He filled the position until 1886, when Congress elected Senor Escobar to the Presidency for the ensuing four years. The next chief magistrate was Senor Gonzalez, who made himself unpopular with the prominent politicians of Asuncion, and was eventually deposed in the beginning of 1894. The story of the conspiracy against him is an apt illustration of some South

American political methods. Tlie malcontents approached the principal military officers, who gave promises of assistance to any movement against the President. Two deputies were then nominated to interview President Gonzalez and inform him that he would be required immediately to abdicate his office and leave the country. They went to

Government House and found Senor Gonzalez in his office. Presenting their revolvers at his head, the deputies delivered the message with which they were charged. The President made no resistance, and was marched as a prisoner to the military barracks. The following day Senor Gonzalez was placed on board a steamer bound for Buenos Aires, and instructed not to return to Paraguay if he had any respect for his personal safety. Vice-President Morifiigo fulfilled the duties of President for the few months remaining of the term for which Senor Gonzalez had been elected, and in November 1894 was succeeded by Senor J. B. Egusquiza, who had been duly nominated by Congress. No noteworthy occurrences marked his term of office, with the exception of a dispute with Bolivia on the question of the bound- ary, and the rupture of official relations with Ura- guay. The Uruguayan minister, in a despatch to his Government, had expressed the opinion that the Bolivian claim was just and reasonable. This despatch was, unfortunately, made public while the minister was absent from Asuncion. On his return to that city the hostile demonstrations against him were so strong that he was unable to land from his steamer. He went back to Montevideo; the formal rupture of rela)- tions then took place. Senor Aceval was nominated to the Presidency in 1898.

The dense ignorance of the mass of the people renders difficult the application of any political measures for the improvement of the general condition of the inhabitants. The constant penury of the Government is a further bar to legislation for the improvement ~~of the educational system, the establishment of a more effective police force, or the carrying out of any important public works. Pro~~ jects have been mooted from time to time for the entry of Paraguay into the ArgentineConfederationorthe Brazilian Union, but the idea has not been acceptable to the majority of the politicians who control the national destinies. The military element is always a stumbling- block in the way of any genuine political reform, such a policy virtually signifying the extinction of the power of the army to influence political events. The majority of the population care very little about the composition of the Government as long as taxation is not made too onerous and the men are not impressed for military service. (c. b. a.)

Paraguay River. See Plata, Eio de la.

Parahyba do Norte, an Atlantic state of Brazil, situated between 6Â° 15′ and 7Â° 50′ S., and 34Â° 45′ and 38Â° 5′ W. Area, 28,854 square mUes. Population in 1872, 382,587 ; in 1890, 497,000. It is bounded on the E. by the Atlantic, on the N. by the state of Eio Grande do Norte, on the W. by that of Ceara, and on the S. by that of Pernambuco. Capital, Parahyba, 10,000 inhabitants, with seven churches, a treasury, and other public buildings ; the port, distant 30 kilometres, is called Cabedelo. Other towns are Ar8a, Bananeiras, Cajazeiras, Campina Grande, Guarabira, Mamanguape, Pombal Souza, and Itabaiana.

Paramaribo, the administrative and commercial capital of Dutch Guiana, on the Surinam, at a point where the river is navigable for ships of 16 feet draught. The town covers an area of 1976 acres, and is divided into six inner and two outer quarters, and had in 1852 a population of only 6000, the fifth part of that of the

colony (30,000). In 1900 its population amounted to 31,427, nearly one-half of the population of Dutch Guiana. A large number of the inhabitants of the colony have therefore withdrawn from the rural districts to the town, whose population is a conglomerate of dift'er- ent nations and religions. For statistics of trade and navigation, &c., see Guiana, Dutch.

Parana. See Plata, Eio de la.

Parana, a city of the Argentine Republic, capital of the province of Entre Eios, on the river Parani, nearly opposite to Santa Fe, about 240 miles north-west, in direct line, of Buenos Aires, situated in 31Â° 43′ S. and 60Â° 31′ W. It is the terminus of the provincial rail- way system, connecting with Concepcion in Uruguay. Various tramways run through the city. There is an important trade in lime; cereals are exported. At Bajada Grande, near Parana, a magnificent wharf with all appliances for quick handling of ships' cargoes has been constructed. ParanEi was the capital of the republic from 1852 to 1861. Population (1895),

24,261.

Parana, a state of Brazil, between 22Â° 45′ and 26Â° 29′ S. and 47Â° 55′ and 55Â° 3′ W., bounded on the N. by Sao Paulo, on the W. by Matto Grosso and the Argentine Eepublic, on the S. by Santa Catharina, and on the E. by Sao Faulo and the Atlantic. Area, 85,453 square mUes. Population in 1872, 126,722; in 1890, 626,722. The capital, Curitiba, has a population of about 20,000. Other towns are Paranagua (8000), Ponta Grossa (7000), Castro (4000), Antonina(4000), Eio Negro (3000), Palmeira (2500), Campo Largo, Morretes, Sao Jose dos Pinhaes and Lapa, each with about 2000. There is a railway from Paranagua to Curitiba. The principal article of export is matS, or Paraguay tea. Nearly the whole population is in the eastern half. Over 56,000 of the inhabitants are foreigners, and 60,000 foreign-born.

Paranagua, a town of Brazil, in the state of Parana, of which it is the principal port. Population, about 8000. A railway connects tie town with Curitiba. The principal article of export is mati, or Paraguay tea. The value of the foreign goods imported in 1893 was $264,868 (gold). In 1896 about 475 vessels of 243,000 tons visited this port, and in 1897, 431 vessels of 222,514 tons. A line of steamers runs directly between Paranagu^ and Hamturg.

Parasitic Diseases. See Pathology.

Parch im, a town of Germany, grand-duchy of Mecklenburg-Schwerin, 23 miles south-east of Schwerin. It was the birthplace of Field-Marshal Moltke (1800- 1891), to whom a monument was erected in 1876. It is an ancient place, with town walls, a Gothic town hall, a couple of interesting churches (one 13th century, the other 14th century), a synagogue, and a mineral spring. Population (1885), 9726 ; (1900), 10,170.

-), Spanish

Pardo Bazan, Emilia (1851- author, was born at La Coruna, Spain, on 16th September 1851. Married in her eighteenth year to Sr D. Jose Quiroga, a Galician country gentleman, she interested her- self in

politics, and is believed to have taken an active part in the subterranean campaign against Amadeo of Savoy and, later, against the republic. In 1876 she came into noticeas the successful competitor for a literary prize offered by the municipality of Oviedo, the subject of her essay being the Benedictine monk, Benito Jer6nimo Feijdo, a figure of im- portance in the Spanish literature of the 18th century, and one of the glories of the province of Galicia. This was fol- lowed by a series of articles inserted in La Ciencia Cristv- ana, a magazine of the purest orthodoxy, edited by Juan

M. Orti y Lara. At this period the Sra Pardo Bazan, who has persistently published under her maiden name, was considered as a light among the Carlist party, and therefore as an aggressive Ultramontane. There is some reason for thinking that she has modified her earlier views concerning religious and civil policy, and in litera^ tiire her progress is easily traced. Her first novel, Pascual Ldpez (1879), is a simple exercise in fantasy of no remarkable promise, though it contains good descrip- tive passages of the romantic type. It was followed by the much more striking story, JJn Viaje de Novios (1881), in which a discreet attempt was made to introduce into Spain the methods of French realism, then at the height of its fashion. The book caused a sensation among the literary cliques, and this sensation was increased by the appearance of another naturalistic tale. La Tribuna (1885), wherein the influence of M. Zola and his school is unmistakable. Meanwhile, the writer's reply to her critics was issued under the title of La Cuestidn pcdpitante (1883), a clever piece of rhetoric, but of no special value as regards criticism or dialectics. The naturalistic scenes of El Cisne de Vilamorta (1885) are more numerous, more pronounced, than in any of its predecessors, though the authoress shrinks from the logical application of her theories by supplying a romantic and inappropriate ending. Probably the best of Sra Pardo Bazan's work is embodied in Los Pazos de Ulloa (1886), the painfully exact history of a decadent aristocratic family, as notable for its portraits of types like

Nucha and Julian as for its creation of characters like those of the political bravos, Barbacana and Tram- peta. Yet perhaps its most abiding merit lies in its delightful pictures of country life, its poetic realization of Galician scenery set down in an elaborate, highly-coloured style, which, if not always academically correct, is invariably effective. A sequel, with the significant title of La Madre Naturaleza (1887), marks a further advance in the path of naturalism, and henceforward the Sra Pardo Bazan was universally recognized as one of the chiefs of the new naturalistic movement in Spain. The title was confirmed by the publication of Insolacidn and Morrina, both issued in 1889. In this year her reputation as a novelist reached its highest point. Her

later stories, La Cristiana (1890), La Pnieba (1890), Cmntos de Amor (1894), and Arco Iris (1895), though not wanting in simple charm, have failed to interest or to please. It might almost seem as though her mission was ended ; but her energy has led her to seek success in literary criticism, in verse, in books of travel, in lectures, and in polemics. To this ambitious versa- tility we owe her biography of St Francis of Assisi, her sketches of the teachers of the Eenaissance, her examination of the Eussian novel, her speculations on Columbus, her discussion of John Stuart Mill's theories concerning the political position of women. These essays are executed with spirit and vigour, and they are interesting as the expression of a very individual temperament, as examples of popular exposition. Los Pazos de Ulloa and La Madre Naturaleza will outlive them, for both are characteristic products of an important movement.

Pardubitz, the chief town of a government district in Bohemia, Austria, 12-|- miles south by west of Konig- gratz. Population, including suburbs (1890), 12,367; (1900), 17,029 (estimated at 97 per cent. Czech, 3 per cent. German; 95-5 per cent. Catholic, 3 per cent. Jewish, and 1 per cent. Protestant). The Gothic chapel of the old chateau was restored in 1880, and a new town hall completed in 1894.

Parenro, a seaport town in Istria, Austria, the seat of the Provincial Diet and an episcopal see. Population (1890), 8485 ; (1900), 9962,

mostly Italian and Catholic. It is a station of the Austrian Lloyd Steamship Company. The principal resoui-ce of the inhabitants is fishing, ship- building, and seafaring pursuits. The trade is chiefly in wine, timber, and fish. It has extensive mulberry plantations'.

Pari.S, a city of Illinois, U.S.A., capital of Edgar county. It is at the intersection of the Vandalia line and the Cleveland, Cincinnati, Chicago, and St Louis railway, in the eastern part of the state, at an altitude of 700 feet. It has a level site and is regular in plan. It is in a rich farming region, and has a large trade. Population (1880), 4373; (1890), 4996; (1900), 6105, of whom 179 were foreign-born and 277 negroes.

PARIS.

PARIS, the capital of France, is situated on both banks of the Seine, 124 miles from its mouth, and 211 miles south-south-east of London, in 48Â° 50′ 49″ N. and 2Â° 20′ 15″ E. Its central position has always facili- tated its commercial relations. The general character of its climate, somewhat continental in winter and oceanic in summer, has been more and more closely observed since the three observatories at different heights on the Eiffel Tower were added in 1889 to the old-established ones of Pare St Maur and Montsouris. The observatory at the Tour St Jacques, in the very centre of the city, and since 1896 a municipal establishment, is of special interest on account of the study made there of the transparency and purity of the air. There are barely 100 days in the year when the air is very clear. Generally the city is covered by a mantle of floating mists, possibly 1500 feet in thickness, which are chiefly brought by south-west winds. During the prev- alence of north-easterly winds the sky is most obscured, since on that side lies the greatest number of factories with smoking chimneys. A chemical analysis of the air â€" taken in the first instance from Montsouris, on the outskirts, in the second from the centre of the city â€" shows that the former yields only 8 bacteria per cubic foot, whilst the latter yields as many as 200. To the

hard winters mentioned in the ninth edition of the Ency. Brit, must be added those of 1890-91 (when for twenty days the Seine drifted large

quantities of ice, and the frost lasted, almost without a break, for eighty days, from the end of November 1890 to the 15th of February 1891) and 1895 (when the Seine, during the whole month of February, a ve^y late date for svich great cold, either bore drifted ice or was frozen across).

Since 1840 Paris has been completely surrounded by a wall, which since 1860 has served also as the limit for the collection of municipal customs dues (octroi). Proposals are constantly being brought forward to demolish, this wall â€" which, with its talus, is encircled by a broad and deep ditch â€" either entirely or at least from the Point du Jour, where the Seine intersects the wall below the city, to Pantin, so as to extend the limits of the city as far as the Seine, which runs almost parallel with the wall for that distance. The forts of St Jamme and of Aigremont, which the ninth edition indicates to the west of St Germain-en-Laye, had in 1902 not yet been built. On the other hand, those of Champigny and Sucy-en-Brie have been erected (between the forts of Villiers-sur-Marne and Villeneuve St Georges), commanding the mouth of the Marne and the battlefields of the 30th of November and the 2nd of December 1870. The Rue du Quatre

Septembre, wiiich unites the Place de I'Opera to that of la Bourse, is now prolonged, under the name of Rue Eeaumur,

from the Bourse to the Square du Temple near the Place de la Â«Eepublique, and runs parallel with the Grands

Boulevards through the busiest and most bustling part of the city. The business quarters of the east have been intersected by the Avenue de la Republique, between the place of that name and the cemetery of Pere la Chaise. The Avenue Parmentier runs from the St Louis Hospital to the Place Voltaire, and the Avenue Ledru E-ollin from the latter place to the Pont d'Austerlitz. On the Place de la Nation, where the statues of Philippe Auguste and St Louis already stand on high columns at the entrance to the Cours de Vincennes, the Triumph of the Republic, by Dalou, has been erected. Two new iron bridges for vehicles and pedestrians cross the Seine. The bridge Alexandre III., commemorating the Franco-Russian Alliance, connects the Esplanade des Invalides on the left bank with the Champs Elysees on the right ; and the Pont Mirabeau, between the bridges of Grenelle and Point du Jour, unites the increasingly populous districts of Auteuil (right bank) and G-renelle (left bank) . In addition a skew bridge, between the footbridge of Passy and the Grenelle bridge, carries the new line of railway from the Gare St Lazare to the Champ de Mars. The banks of the Seine, especially in the part below the city, have been further regulated by additional landing-stages, largely provided to meet the requirements of the Exhibition of 1900, the buildings of which extended along the river for a con- siderable distance. An important port has been designed at Ivry, just above the city on the left bank, at â– which the railway from Orleans terminates.

The district of Passy has more and more come to be a fashionable suburb, and a new quarter has sprung up near la Muette, on the former site of the municipal con- servatories (serres de laville), which have been transferred to the Pare aux Princes, on the southern boundary of the Bois de Boulogne. Here, in a number of nurseries, all the trees for the plantations of the town are grown. At the entrance to the Bois de Vincennes from the Avenue Daumesnil is a collection of different varieties of orna- mental trees. The Bois de Boulogne, which has been devoted for some time to various sports (skating, pigeon-shooting, &c.), is now the headquarters of the Racing Club, which, however, has for its object the promotion of all sports. On the site of the Palais de I'Industrie, built in the Champs Elysees for the Exhibition of 1855, two Palais des Beaux Arts have arisen, built for the Exhibition of

1900, but designed to survive it. It is between these two edifices that the Avenue ISTicolas II. passes, which opens upon the bridge Alexandre III., connecting the palace of the Elysee with the Hotel des Invalides. The old church of St Genevieve, no longer used as a eh arch, serves as a Pantheon for the burial of citizens to whom such honour is assigned. President Sadi Carnot, his grandfather Lazare Carnot, Victor Hugo, and others, lie in its vaults. The inner walls of the building are decorated with frescoes by eminent artists illustrating the history of St Genevifeve, Jeanne d'Arc, and St Louis.

â€¢\ The only notable church built since 1875 is that of the Saorfi Coeur, on the heights of Montmartre. This church is a national votive offering, decreed by the Constituent Assembly in 1871 and paid for by private subscriptions and collections. It was begun in 1876, but the ground not being solid enough for the first foundations, new and deeper ones, with pits 108 feet in depth, were made. The edifice is in Roman style, with a Byzantine dome 197 feet high, surmounted by a tower 263 feet high. Dominating Paris in every direction, it is one of the most colossal and also one of the most unsightly public monuments of modern times. It has a formidable bell called the Savoyarde, which is 10 feet high, and 31 feet in circumference. This bell was a gift of four parishes in Savoy ; it cost 65,500 francs, and was rung for the first time on 20th November 1895.

The Sorbonne has been completed. Its large, luxurious amphitheatres, and the spacious quarters of the University of Paris and of the faculties of science and literature

form a striking contrast to the old and narrow quarters in which these institutions were formerly situated. The ficole de Medecine is being completed, the ;ficole de Droit considerably enlargedj and the Lyc^e Louis le Grand re- built. All these new buildings have greatly altered the appearance of the old^Quartier Latin. Monuments have been raised to Francis Garnier, the hero of Tongking, on the Carrefour de I'Observatoire ; Guy de Maupassant, the novelist, in the Pare Monceau ; Alphand, the celebrated engineer, who for forty years has carried out the improve- ment of modern Paris, at the entrance to the Bois de

Boulogne; and Charcot, the great doctor, opposite the hospital which he made famous, in the Place de la Salpetrifere. A monument to the chemist Lavoisier has been raised in the Place de la Madeleine, and a statue of Jeanne d'Arc, by Paul Dubois, in the Place St Augustin. The Opera Comique, destroyed by fire (23rd February 1887), has been rebuilt on the old site in the Boulevard des Italiens. The house in which it found temporary accommodation in the Place du Chatelet has been rented by Sarah Bernhardt,*the great tragedienne. The Theatre Antoine has acquired a certain reputation for the audacity and originality of the pieces played there. A new hippo- drome has been erected at Montmartre.

The population of Paris numbered 2,269,023 in 1881, 2,424,705 in 1891, and 2,660,559 in 1901, population showing an increase of 6-8 per cent, between and vital 1881 and 1891, and of 9-7 per cent, between statistics. 1891 and 1901.

The population shows an increasing tendency to spread out over the north-west region, in the districts of Passy and Auteuil ; but the most populous quarters are still those of the centre and the north, particularly the Bonne-Nouvelle district. The Marboeuf quarter, just off the Champs Elysees, was entirely laid out between 1880 and 1885. Since 1870 the houses have always been built several storeys. In the rich quarters, Passy excepted, there are now scarcely any one-storey houses. The simple explanation is that formerly land was cheap, and the owner, having only a small capital, found it advantageous to construct his dwelling with materials of inferior quality, which could not support the weight of more than one storey, and to-day it is not possible to add other storeys to these light constructions. But since 1875 land, particularly in the north-west districts, has almost quadrupled in price, so that owners now find it to their interest to construct vast blocks of flats five or six storeys high, the rentals being thus proportionate to the capital invested in the land. In 1875 there were 66,850 houses and factories in Paris, representing rents to the value of 417,500,000 francs. In 1897 there were 75,000 houses, the rents of which aggregated 785,000,000 ; and a com- parison of these totals is a sufficient demonstration of what we have just said, namely, that if the

number of houses has increased in relatively small propajtions (about 400 a year), on the other hand the rents of the nouses have almost doubled. Here is another total : the approximate value of all the buildings in Paris, except some 400″ belonging to the State, calculated at the price they would fetch, is now fourteen milliard francs, or Â£560,000,000, instead of seven and a half milliard francs in 1875. An interesting movement was begunin 1875 by JIM.Mallerand Cacheux, who were the first to have constructed upon 500,000 metres of land several hundred houses on the principle of building companies. The press giving its aid to this social and philanthropic enterprise, the result was the formation of the “Working-men’s Lodgings Company, of Passy-Auteuil, and of the Philanthropic Association, founded with a generous gift from M. Michel Heine, which began by constructing three houses of several storeys, each divided into small lodgings and rented at a price that would yield 3i per cent, on the capital. The net income from these houses was devoted to the construction of similar dwellings. As the result of a congress held after the close of the Exhibition of 1889, a Cheap Lodgings Association wasformed. Finally, the law of 30th November 1894 conferred certain advan- tages upon builders of small lodgings. In 1897 there were 810,468 premises used as dwellings, and 303,328 used for commercial or industrial purposes. Factories occupied 23,169 sites. The value of the total rental of these various properties was estimated at Â£31,400,000, and their marketable value at Â£440,000,000.

On comparing the following tables with those given in the ninth edition of the Encij. Brit., it will be seen that the population is deserting the centre for the suburbs : â€”

PARIS

467

Arrondisaements.

Population present on the 29tll March 1896.

Variation since

Population

1S81.

pcv acre.

Louvre

66,183

-9,257 â€¢

140

Bourse .

66,784

-9,610

275

Temple .

87,335

-6,919

304

H6tel de Ville .

97,674

-6,086

249

Pantheon .

115,947

+ 1,503

188

Luxembourg .

100,692

+2,957

192

Palais-Bourbon

97,832

+ 14,505

98

Elys^e .

102,003

+12,999

108

Op^ra

119,985

-2,911

228

St Laurent

153,785

-6,024

216

Popincourt

222,009

+ 12,763

249

Reuilly .

117,715

+ 15,280

84

Gobelins .

114,711

+23,396

74

Obseryatolre .

122,126

+ 30,413

106

Vaugirard

133,177

+32,498

75

Passy

101,564

+40,862

57

BatignoUes-Monceau

182,071

+ 38,884

166

Montmartre .

224,488

+45,652

174

Buttes-Chaumont .

134,128

+ 16,243

96

M6nilmontant .

151,796

+24,879

118

As to the civil condition of the population, there were in 1891, amongst 2,424,705 inhabitants, 1,165,576 men, of whom 628,765 were single, 480,642 married, 51,885 widowers, 4284 divorced. In the same year women numbered 1,259,129, of whom 604,382 were single, 490,073 mamed, 158,533 widowed, 6141 divorced. The birth-rate is low â€” on an average 61,000 births per annum, or 25 per thousand inhabitants. The deatii-rate also is low, 55,000 to 68,000 deaths per annum, averaging 22 to 23 deaths per thousand inhabitants. This is accounted for by the fact that Paris is pre- eminently a town of adults, as the following table, referring to the year 1891, shows : â€”

Ages from

Ages from

Oto 4

Shears

150,490

55 to 59 years

102,263

5 â€ž 9

155,933

60 â€ž 64 â€ž

80,434

10 â€ž 14

154,084

65 â€ž 69

54,580

15 â€ž 19

196,018

70 â€ž 74

33,895

20 â€ž 24

230,984

75 â€ž 79

17,808

25 â€ž 29

272,087

80 â€ž 84

7,333

30 â€ž 34

256,058

85 â€ž 89

2,360

35 â€ž 39

220,088

90 â€ž 94

557

40 â€ž 44

188,171

95 â€ž 99

124

45 â€ž 49

161,914

100 and over

9

50 â€ž 54

132,102

Ages unkno

wn

7,513

In these circumstances there is nothing remarkable in the annual number of marriages in Paris, 23,000, a high marriage-rate for the total number of inhabitants, but a low one compared with the number of marriageable persons.

A large number of the inhabitants (on an average 636 out of every 1000) are not Parisians by birth. In 1891 there were 2,196,627 of French parentage, 47,116 naturalized and 180,962 foreigners. Most of the latter belong to the following nationalities : â€” Belgians, 44,817 ; Germans, 26,863 ; Swiss, 24,786 ; Italians, 21,125 ; Luxem- bourgers, 13,157 ; English, 12,727 ; Russians, 9284 ; Americans, 4237 ; Austrians, 4387 ; Dutch, 4205 ; Spaniards, 4115. The Bel- gians, Germans, and Italians, mostly artisans, live chiefly in the industrial districts in the north and east of the city. The English and Americans, on the other hand, congregate in the wealthy districts of the Champs Elys6es and Passy.

The census of 1891 divided the population according to occupa- tion as follows : â€” Oc^pa- Q^^ Agriculture. â€” Total number of persons engaged

in agricultural pursuits, 8158, of whom 1767 were pro- prietors cultivating their own land, 384 farmers, 5861 horticulturists, 146 foresters.

(2) Industries â€” ^Total number of persons employed, 1,071,254, of whom there were engaged in textile industries, 32,929 ; in min- ing and quarrying, 767 ; metallurgical industries, 2999 ; the manu- facture of metal goods, 117,656 ; leather industry, 28,992 ; wood industry, 36,546 ; pottery, 8656 ; chemical industries, 13,814; build- ing trade, 171,414 ; lighting, 8533 ; furnishing, 60,509 ; clothing and the toUette, 395,491 ; food supply, 46,665 ; industries connected with the sciences, arts, and literature, 76,625 ; watchmalters, jewellers, makers of ohjets d’art, &c., 67,015; State industries (manufacturers of carpets and tobacco), 2643.

(3) Carrying Trade. â€” Total niunber of persons employed, 138,690, of whom there were engaged in the building of ships, 218 ; in sea transport, 657 ; on canals and rivers, 2143 ; inland transport and towage on canals, 1039 ; making and repairing roads and bridges, 10,587 ; transport by railway, 40,600 ; street porters and messengers, 7442 ; carriers, 17,936 ; drivers of vehicles, 43,792 ; postmen and telegraph messengers, 14,276.

(4) Commerce. â€” Total number of persons employed, 560,066, among whom stockbrokers and bankers numbered 30,873 ; brokers, commission agents, or wholesale merchants, 30,955 ; keepers of hotels, coffee-houses, and public-houses, 120,296 ; retail provision dealers, 91,462 ; furniture dealers, 12,441 ; clothiers, 42,782 ; various, 231,257.

(5) Army, Navy, and Police.â€” Total number of persons em- ployed, 42,926, of whom there were in the land force, 22,204 ; in the sea force, 1033 (the infanterie de marine is no longer actually represented in Paris) ; gendarmerie, 4360 ; police, 14,409.

(6) Administration. â€” Total number of persons employed, 37,798, of whom 17,978 were State officials, and 19,820 departmental and communal officials.

(7) Liberal Professions. â€” Total number of persons, 157,788, among whom members of the secular Catholic clergy numbered 2725 ; those belonging to Catholic religious communities, 6638, and to other religions, 829 ; while there were 3473 magistrates, 7268 barristers, 6926 legal officers, and 2995 solicitors ; 9550 doctors, 719 veterinary surgeons, 8806 pharmaceutical chemists, 2648 dentists, 2108 mid-wives, and 5218 hospital assistants; 12,982 public lecturers and teachers, 10,807 private teachers, and 7276 teachers of accomplish-ments ; 9847 savants or literary men, 20,352 civil engineers and architects, 3003 photographers, 5595 musicians, 20,654 sculptors, painters, and engravers, and 7369 lyric and dramatic artistes.

(8) Besides the above, there were 102,902 landed proprietors other than agricultural, 137,751 independent persons (rentiers'), 12,910 pension-holders and retired persons living on their incomes, and 156,162 persons without definite occupation or unclassified.

The Chamber of Commerce has attempted to tabulate the alteration in the average daily wage in various trades ^j, between 1853 and 1892, as follows :â€” Wages.

1868.

1892.

1858.

1892.

Francs.

Francs.

Francs.

Francs.

Jewellers .

4-25

7-50

Plumbers .

4

6

Butchers .

4-50

6

Bookbinders

3-50

6-50

Bakers .

5

7

Ornamental \ Sculptors/ â–

4

7

Brewers .

3-50

5

Coachbuilders .

4

6

Locksmiths

4

6-50

Hatters .

4

6-50

Tailors .

3

5

Coalheavers

3

5

Upholsterers .

4

5

Carpenters

5

8-60

Diggers .

3

5

Wheelwrights .

4

6

Turners (wood)

4

5

Coppersmiths .

4-50

6

Turners (metal)

5

7

Shoemakers .

3

3-60

Glaciers .

3-75

5-50

Cutlers .

4

6

Women Workers.

Slaters

5

7-75

Laundresses .

2-50

4

Cabinetmakers

3-50

7-75

Embroiderers .

2

3

Tinplaters

3-50

5

Corset-makers .

1-50

2

Blacksmiths

5

7

Dressmakers

1-75

2

Watchmakers .

4-50

6

Trouser-makers

2-50

4

Masons .

4-25

7-50

Lace-makers .

2-50

3

Joiners .

3-50

7-50

Florists .

2-50

3

Hbuse Painters

4

8

Seamstresses .

1-50

2

Hairdressers .

2

3

Boot^stitchers .

2-50

3

The municipal debt of Paris has greatly increased since 1860, owing to the extensive works undertaken in widening streets, im- proving sanitation, facilitating traffic, building schools. Municipal extending the system of aqueducts, and drainage. The budget budget of 1895 allowed the sum of Â£4,371,440 for interest on and amortization of the debt. The follovnng are the chief items of expenditure for the year 1900 : â€”

Municipal debt Â£4,519,037

Prefecture of police and republican guard . 1,446,051

Poor relief 1,269,620

Education 1,213,082

Streets and roads 1,018,717

Public walks, plantation, and lighting . . 541,277

Central administratiou 411,680

Collection of municipal customs dues (octroi) 463,974

Waterworks and drainage .... 471,027 Management of public works (salaries and

material) 237,654

Architecture and fine arts . ” . . . 135,480

To sum up, the total budget of expenditure amounted to Â£12,848,870 on account of ordinary expenditure, Â£89,340 of extraor- dinary expenditure due to the debt, while Â£248,000 was applied to the liquidation of expenses incurred in previous years. The principal items of revenue in 1900 were : â€”

Municipal customs dues (^octroi) . . . Â£6,651,774 Direct contributions 1,400,528

Income from water and canals . . . 826,339 Markets, market-places, and slaughter-houses 538,310

468 p A

Gas rates Â£625,604

Government subsidy and receipts of the

prefecture of police 488,532

Ee venues from public vehicles . . . 368,773 Contributory taxes towards paving and

cleaning streets 205,118

Eevenue for public instruction (legacies, &c.) 183,504

Stands in public places 211,234

Burial and cemetery dues .... 136,786 Government subsidy towards the paving of

the town 176,000

Night-soil and sewage 182,630

Householders' street-cleaning tax {taxe de

halayage) 138,040

The chief items in the octroi in 1897 were : â€"

Beverages Â£2,691,133

Eatables 1,370,944

Oil 684,473

Fuel 667,229

As a result of efforts to reform these taxes, since 1st January 1901 no octroi have been levied on wine, beer, and cider (all classed as hygienic drinks), but the duty on alcohol has been increased, and now about 4 francs 30 centimes Is paid on each litre of alcohol that enters Paris. On 1st January 1898 the length of public streets bordered with trees was 162 miles ; unplanted, 445 miles (86,333 trees and 8024 Tratti â€¢ seats). The area unbuilt over covered 4090 acres. On vehicles ^^ ^Â®' Â° January 1898 the stone paving covered 1495 acres, metalled roadways 343 acres, asphalt 94 acres, Vfood pavement 286 acres, earthen roadways 7 acres. The number of wheeled vehicles of all kinds, carts and carriages, automobiles and bicycles, goes on steadily increasing. Pedestrians would be endangered at the principal cross-roads if policemen were not stationed to interrupt now the one and now the other stream of traifio. Refuges in the centre of the widest public thoroughfares have become more numerous, and facilitate the crossing of pedes- trians. The Place de I'Op^ra is traversed by 60,000 vehicles, 70,000 horses, and 400,000 foot passengers during certain hours of the day. Through the Rue de Eivoli, on the other hand, 43,000 vehicles and 53,000 horses pass partly by night with consignments for the central markets. Steamers ply on the Seine from Charenton to Auteuil, others

in connexion with them running as far up as Ablon and down to Suresnes. Thus more than a hundred boats, accommodating from 225 to 400 persons, convey an increasing number of passengers, 13,080,000 in 1880 ; 21,000,000 in 1890 ; 24,9.S1,879 in 1897. Tramways are more and more replacing the old lines of omnibus (though new ‘bus routes still continue to be opened) and mechanical traction of various kinds tends to supersede the use of horses on the tram-lines. In 1894 the General Omnibus Com- pany carried on its different routes (tramway and other) 227,868,392 passengers, other companies carrying 60,384,560. In 1897 the General Omnibus Company carried 256,000,000, and other com- panies 62,000,000. The General Omnibus Company owned in 1897 16,000 horses, and circulated 1130 vehicles daily, which covered daily a distance equal to two and a half times the circumference of the earth. Railway traffic round Paris has for many years been provided by the Chemin de Fer de Ceinture, which has thirty stations along the length of the rampart or near it. In 1897 there were 27,507,797 travellers between stations other than Traffic: those from Paris to Auteuil, while for those latter there ra ways. ^^^^ 23,711,512 passengers. Very frequent circular trains leave the station of St Lazare, running west, south, east, north, and finally again west to their terminus at Courcelles, from which they return to St Lazare by the reverse route. Another service following the same course leaves the Gare du’Nord. Several years ago the line between Paris, Sceaux, and Llmours was extended from the Place Denfert-Rochereau, south of the city, to the Place de Medicis, near the Luxembourg. This line will be prolonged inwards from the Place de Medicis to the Place St Michel, there to join the new inner line of the Paris- Orlfians railway, running into the heart of the city. This is con- tinued along the Seine from the Quai d’Austerlitz as far as the Quai d’Orsay, opposite the Tuileries. A new western line, taking a new route from Paris (Meudon) to Versailles (making, with the old lines known as the “right bank ” and “left bank” lines, three distinct railways) has its terminus at the Esplanade des Invalides. It is to be placed in connexion with the circular railway from St Lazare. The Champ de Mars is connected with the Gare St Lazare by a line which accompanies at some distance the Cein- ture railway between St Lazare and Passy, traversing the latter quarter through a tunnel which opens opposite the skew bridge above mentioned, crossing

by which it reaches Grenelle. Finally it has been decided to provide Paris with a metropolitan railway. The above-mentioned lines (that of the Champ de Mars excepted) are termed lignes de penetration, and serve to facilitate com- munication between the city and outlying districts. The Metro-

politan, on the contrary, is to be purely urban and to serve only the inner traffic of the city. Although its rolling stock will be able to pass over the rails of the main line, which are on the same gauge, the latter will not be able to make use of the Metro- politan lines on account of the decorative structures of the latter being provided with a moulding which does not permit them to do so. The Metropolitan will connect Parisian stations on different lines, but ‘a train coming from Marseilles or Bordeaux will be unable to pass over its rails en route for Calais or Havre unless it be composed of Metropolitan carriages. The Metropolitan runs from the Porte de Vincennes to the Arc de Triomphe de I’Etoile, whence it forks towards the Porte Maillot and the Porte Dauphine, both at the entrance to the Bois de Boulogne, and also towards the Trocadero. The working of the Porte de Vincennes-Porte Maillot line has so far been very successful. A circular line follows the old outer boulevards (until 1860 the wall of Paris). A third line is to connect Porte Maillot with M^nilmontant on the north of the city, and a fourth to cross the city from north to south from the Porte de Clignancourt to that of Orleans. Short lines are to unite the Boulevard de Strasbourg with the Pont d’Auster- litz and the Cours de Vincennes with the Porte d’ltalie. The combined length of all these lines will be 40 miles, 70 per cent, of which will run underground, 16 per cent, over viaducts, and 14 per cent, through cuttings. The cost of construction and the purchase of material is estimated at Â£6,600,000. The traction is electric.

The following table shows the number of passengers arriving at and departing from the various main stations in 1897 : â€”

StatiOD.

:6tat.

Nord.

Est and

Vin- cennes.

Quest

Orleans

and Sceaux.

Paris- Lyons- Mediter- ranean.

Arrivals Departures

99,058 96,853

9,966,000 10,080,000

18,894,627 14,068,085

24,088,495 24,406,612

4,476,531 4,538,451

8,754,621 3,446,436

In all, then â€" apart from the Circle railway â€" 56,278,532 passengers arrived in Paris, and 56,626,437 left. (Passengers travelling with season tickets or free passes have not been included.) The companies have been obliged to extend their stations. The Gare d'Orl&ns has, as already noted, been removed to the Quai d'Orsay in the centre of Paris. The Gare St Lazare has been rebuilt and considerably enlarged ; the Gare de Lyon is also undergoing reconstruction. The Gare de I'Est and the Gare Mont- parnasse are being greatly extended. The terminus of the railway du Nord is being

enlarged to accommodate an increased number of lines. The road railways running into Paris must also be men- tioned, also one from Paris to St Germain which has its terminus in the Place de I'Etoile, and one from Arpajon, the trains running on which stop by day in the Rue de Medicis, near the Luxembourg, but at night run up to the central markets.

The goods traffic has not increased at the same rate as the passenger traffic. The following table shows in tons the quantity of goods that entered and left Paris in 1897 : â€"

station.

***tat.**

Nord.

Est and

Vin- cennes.

Quest.

Origans.

Paris- Lyons- Mediter- ranean.

Entered Left

57,568 28,767

2,052,218 606,759

828,602 311,559

1,488,244 694,086

766,527 345,465

1,006,288 511,857

Thus, in all, the main lines brought in 6,149,447 tons and carried out 2,397,993 tons. (The figures for the Est et Vincennes and Orleans et Sceaux lines give the tonnage carried by goods train only.)

A new aqueduct, 62 miles long, carries the waters of the Avre, drawn off near Verneuil, in the department of Eure, to the reser- voir at Montretout beyond St Cloud on the left bank of the Seine, 334 feet above sea-level. New supplies Wate'- acquired by the city in the Loing and Lunain basins ^"PP'y- are about to be added to those of the Vanne, which come from an adjoining district. The average daily supply from various sources during 1897 was as follows:â€"

Source.

Artesian

WeUs,

***c.**

Dhuls.

A^imne.

Avre.

Ourcq.

Seine.

Marne.

Cubic feet.

741,720

8,724,494

3,781,288

4,753,188

3,499,611

2,717,591

228,681

Thus each inhabitant may consume, on an average, 63 gallons (22 of which are spring water) in twenty-four hours. Actually the daily consumption per head in 1894 was only 45 gallons; in London it was only 40 gallons. To guard against the dearth which might arise in times of augmented consumption and diminished supply, improved filters have been fitted up for the purpose of purifying the river water. An Anderson filter, which purifies 706,397 cubic

feet of water in twenty-four hours, was established in J 896 at St Maur on the Marne. The water is distributed throughout the city by two systems : the low pressure, carrying the river water for use in the streets, courts, and industrial premises ; the high pressure, taking the spring water to the various floors of build- ings, and supplying pumps, Wallace fountains, and (on Is* January 1898) 6170 fire-plugs. On the same date the total length of pipes was 1493 miles. The water arrives in all cases from two different directions, so that in case of accident the interruptions of the supply may be reduced to a minimum.

Great changes have been made in the drainage of Paris owing to the underground operations necessitated by the constraction of Dralaaee ^^^ Orleans and Metropolitan railways. The chief im- * â– provement has consisted in keeping the Seine (except in certain cases of exceptional pressure, such as sudden and violent storms) free from sewage water, which is now utilized on sewage farms. The main sewers

converge at Clichy, on the right bank of the Seine, where a powerful elevator forces the sewage partly across the bridge, partly through a tunnel acting as a syphon below the river-level, to the left bank. Thence part of the sewage is dis- tributed over the estate of Gennevilliers, from which it returns purified, after having fertilized the plots, to the Seine. At Colombes a second elevator drives the surplus unused sewage to the hills above Argenteuil (right bank). A third elevator at Pierrelaye distributes another portion on the hills of Mfiry . The remainder is employed to water the Pare d'Ach6res (left bank), the irrigation fields of Car- ri6res-sous-Poissy (right bank), and. finally those of Mureaux, opposite Meulan. New works are undertaken as the sewage in- creases, and as its value is better realized by the agricultural classes. The rent of an acre of land at Gennevilliers has now risen to nearly Â£10. Certain parts of Paris lie too low for their drains to run into the main sewers. Special elevators are required to raise the sewage of the districts of Bercy, Javel, and the Cit6. The quantity of sewage carried through the drains will be enormously increased when the scheme of drainage by means of sewers, which would clear all the water-closets of all the houses in this manner, is com- pleted. In 1896 only 8800 premises employed this system. Since then the administration has decided to apply it to all the houses of certain streets indicated from year to year, and on 1st January 1898 it was in use in 12,475 dwellings. But owners resist this claim, which presses heavily upon them, because the town Is as yet unable to furnish them with the water necessary for the scheme. On 1st January 1898 there were still 58,430 cesspools, 15,028 movable buckets, and 29,207 tinettes.

The consumption of gas in Paris increases but slowly since the

extension of the electric lighting system. The annual consumption

is from 10,000,000,000 to 11,000,000,000 cubic feet of gas.

***â– "S- gjj different companies have obtained concessions from the city authorities for the electric lighting of prescribed sections for a period of eighteen years. These concessions do not confer a monopoly, but are simply authorizations. The city has retained the management of the municipal electrical works under the central markets (Halles**

Centrales) . The difficulties introduced into the ad- ministration by these arrangements have left Paris far behind many lesser towns in its application of the system of electric lighting.

The services Whygiene of the city have developed rapidly. The Conseil d'Hygifene et de Salubrity of the department of the Seine, composed of 24 members nominated by the prefect of PuW/c police and 17 members called to it in virtue of their

bealtb. office, has published since 1895 an account of its bi-

monthly meetings. It inquired into and reported upon six hundred cases in 1896. To it are referred such questions as the sources from which to obtain drinking-water for the town, the sanitary measures to be taken during important works, the work connected with the main sewers for the cleaning of the Seine and the utilization of the sewage water, the health of workpeople employed in factories, the sanitary condition of the occupants of schools and prisons, ques- tions relating to the disinfection of infected districts, the heating of public vehicles and dwellings, the conveyance of infected persons, night shelters, &c. Since 1892 the service des epidemics has been active, inquiring into the origin of these scourges and seeking to arrest their progress. It is this body that receives the compulsory declarations of doctors on the subject of contagious affections under their treatment. Special vehicles are now set apart for the convey- ance of persons suffering from contagions diseases, whereas formerly public vehicles which had carried such persons were afterwards used, without undergoing disinfection, to convey healthy persons. Special municipal hot chambers disinfect all personal belongings believed to be infected, while houses are attended to by special dis- infectors. A laboratory has been fitted up for the diagnosing of certain complaints' (diphtheria and typhoid fever, for example) which cannot be identified without scientific tests. A central sani- tary association has been formed and has commenced the registration of every house, entering against the name of each all information as to its sanitary condition. This association will be the chief auxiliary of the commission, long established, on insanitary dwellings, which

issues orders for landlords to execute, voluntarily or under compulsion, any repairs or alterations which it deems necessary.

The old salles Wasile are now called ecoles maternelles. In 1897 there were 153 such schools belonging to the municipality, with 53,888 scholars ; 23 Idiques privies (that is, voluntary . schools taught by lay mistresses) with 1284 scholars ; ‘’”””^ ” â€¢ and 41 congreganistes (that is, voluntary schools taught by religieuses) with 8162 scholars. The children are divided into three classes according to age, from 2 years to 3J, from 3J years to 5, from 5 years to 7. Seventeen ecoles enfantines, exclusively managed, as are the ecoles maternelles, by women teachers, serve as a link between the latter schools and the ecoles primaires, of which there are 392 public with 156,070 scholars, 562 Idiques privies with 29,.S47 scholars, and 230 congreganistes with 56,276 scholars. Every year the city continues to open fresh groups of schools either to replace or complete old ones, and to the six upper ecoles primaires for boys (Chaptal, Turgot, Lavoisier, Colbert, J. B. Say, Arago) have been added two for girls (Sophie Germaip founded in 1882, Edgard Quinet in 1892). The capital invested in the building of the 153 public icoles maternelles and the 392 public icoles primaires must be close on Â£9,000,000. The cantines seolaires annually disburse Â£28,000 in providing the children with hot dinners. The caisses des icoles give assistance to indigent children; the classes de garde retain some children beyond ordinary school hours, and the classes de vacances beyond the duration of the ordinary scholastic course. Eor several years a certain number of children have been sent to spend a few days at school colonies or in travelling, but notwithstanding the progress of the secularization of municipal schools, there are in every parish free icoles primaires conducted by religious societies. Of these 57 are conducted by Christian Brothers, 76 by nuns. The icoles professionnelles â€” Diderot, Ger- main Pilon, Bernard Palissy â€” train apprentices in the application of the fine arts to industries ; the ifccole BouUe trains cabinet- makers, and the !^cole Estienne trains in all processes connected vrith the production of a book. The Municipal School of Physics and Chemistry imparts both theoretical and (specially) practical knowledge of these sciences. Six ecoles menageres train girls in the duties and employments of their sex. The number of

State lycies giving secondary education has been increased. Louis le Grand has been divided into two distinct establishments â€” Louis le Grand and Montaigne, the former including the higher classes, the second the lower classes, corresponding to the grand and petit Condorcet. St Louis specially prepares for the great scientific schools. Henri IV., Charlemagne, Janson de Sailly, Buffon, Voltaire, Carnot (formerly the ecole Monge), Lakanal (at Sceaux), and Michelet (at Vanves) share with Stanilas (under church man- agement) and the municipal College RoUin, the education of students in classics and modern subjects, the latter especially in reference to commerce and its practical application. In all these establishments the number of day pupils is increasing, that of boarders decreasing. There are now five lycees in which girls can receive secondary education: F&^lon, Racine, Molifere, Lamar- tine, and Victor Hugo. The five faculties of medicine, law, science, literature, and Protestant theology, and the higher school of pharmacy form the body of faculties, the association of which has taken the name of the University of Paris. This university has acquired corporate rights which allow of its receiving gifts. At the Sorbonne (seat of the university) there is also established the Ecole des Chartes. The faculty of Roman Catholic theology no longer depends upon the State. This course is given at the independent Roman Catholic University, which includes also faculties of science, literature, and law. But no university except that of the state can confer a degree. The city of Paris, besides founding special chairs at the Sorbonne, has opened special courses at the H6tel de Ville. The Agricultural Institute, now installed in a separate building from that of the Conservatoire des Arts et Metiers, has developed greatly. The Pasteur Institute not only treats patients threatened with hydrophobia and prepares serums which successfully combat certain diseases, but gives a course of biological chemistry in con- nexion with the faculty of science. The ifccole du Louvre imparts such practibal instruction as can be drawn from collections and museums. The ficole Coloniale prepares colonial officials, teaches natives from French colonies, and trains pupils for colonial life.

Paris has 70 Roman Catholic churches, without reckoning the chapels attached to the Invalides and the Sorbonne or those of the religious

orders, which have services mostly open to the public. The reformed or Calvinist Church ‘““Â«“Â«â€¢ has 17 places of worship, and the Lutherans or Confession of Augsburg, the adherents of which are mainly Alsatians, have 10. The’ Jews have 4 synagogues. The priests, pastors, and rabbis of these four bodies receive stipends from the State. The Protes tant Free Church, a secession from the Reformed Church, has 4 congregations ; and French Protestantism also comprises 1 Sweden- borgian, 2 Methodist, and 3 Baptist commimities. The English- speaking colonies have 3 Anglican churches, 1 Scottish, 1 Wesleyan, 1 Independent, 2 American Episcopal, 1 American

Ontlerles

and

museums.

Presbyterian, and 1 Roman Catholic. The other foreign colonies have a United Greek, a Russian, an Armenian, a Spanish, a Ger- man Lutheran, and a Swedish Protestant church. The mission founded in 1872 by the late Dr R. “W. MoAU, chiefly supported by American and British subscriptions, has 17 stations, and the Salva- tion Army 8. No religious census has been taken in Prance since

1872.

The old Salle des iltats at the Louvre has received a Rubens col- lection, which was opened at the same time as fourteen rooms con- taining pictures of the Dutch school. This necessitated a general rearrangement of the Louvre, and the artistic collections of the town of Paris have been installed in the small palace of the Champs Elys^es. The Musfe Historique de I’Arm^e has been set up at tbe Invalides ; the museum of the town of Paris, called the MusSe Carnavalet, has been completely remodelled, and the town library established at the H6tel Le Pelletier

St Fargeau, Rue de S6vign6. The Mus^e des Arts D^coratifs still awaits its installation in the pavilion de Marsan, in the Tuileries. Th^ MusSe Guimet, near the Trocadero, con- tains a collection of objects illustrative of the religions of the Far East. The Mus^e Cernuschi, bequeathed to the town, consists chiefly of Japanese and Chinese collections ; the Grandidier collec- tion at the Louvre includes Chinese and Oriental articles. The Mus6e Galli^ra contains very fine tapestry belonging to the town of Paris. The sum dispensed in public charity in 1896 amounted to Â£1,473,345, about two-thirds of whic^h was appropriated by Charity ^^^ medical department, the remaining third to out- door relief. In that year 511,880 persons in Paris received public charity. The hospitals provided 26,294 beds, and 110,000 patients were treated in their own homes ; 48,000 paupers and 73,000 indigent persons received assistance, the number of charity children being 48,000. The cost of public charity has con- siderably increased, having risen from Â£1,000,000 to Â£1,500,000 since 1880 without a proportionate increase in the population dur- ing that period. The sum of Â£360,000 is devoted to the maintenance of charity children or those deserted by their parents. Several new societies have devoted themselves to the protection of abandoned children, to the suppression of begging, to finding work for the unemployed, and to the reformation of prisoners. The Society for the Protection of Deserted and Criminal Children has assisted thousands of children. Other associations attend to the treatment of consumptives and sick children.

Several new hospitals have been built. Amongst them may be named the Bichat, for important surgical operations ; Harold, â€ž , , Broussais, chiefly for epidemic cases ; and Boucicaut, Hospitals. foujj^g(j by the liberality of the founder of the Bon March^ establishment. On the other hand, the military hospital of Gros Caillou has been demolished to make way for a new quarter. The Mont de Pi6t6, which formerly lent only upon tbe pledging of portable property, has for several years made loans to the bearer of certain financial securities quoted on the Bourse. There is now no limit fixed to the magnitude of transactions on the former security, but on the latter not more than Â£20 can be lent. The number of loans con- tinues to decUne. Li 1897, 1,155,564 securities to the value of Â£1,315,215 were pledged, 1,026,271 to the value of

Â£1,208,553 were cleared, 729,205 to the value of Â£916,678 were renewed, and 129,442 to the value of Â£88,563 were sold.

The amount of the deposits at the Caisse d'Epargne, or savings bank, of Paris continuing to increase (in 1895 it reached the sum of Â£6,400,000), the rate of interest on deposits has Banks. -h^en reduced from 3 per cent, to 2f per cent., and the maximum deposit permitted to each depositor has been reduced from Â£80 to Â£60. Beyond this sum the surplus is employed in the purchase of rentes (stock) on behalf of the depositor. The deposits were thus reduced to Â£6,098,386 at the end of 1896, and to Â£5,906,377 at the end of 1897. The National Savings Bank, which transacts its operations at the various State post ofB.ces, in 1895 had 2,280,000 depositors and Â£28,000,000 in deposits. One quarter of its transactions took place within Paris. In the same proportion Paris was concerned in the business done by the National Office for Old Age Pensions, which in 1894 paid out Â£1,328,673 to 196,987 annuitants. The interest paid when the association was founded in 1852 was 5 per cent. ; since 1894 it has fallen to 3J per cent. The privilege of issuing bank notes enjoyed by the Bank of France has been extended from 1897 to 1920. The maximum issue has been fixed at 5,000,000,000 francs, or Â£200,000,000. The bank can now discount the stock of the agricultural syndicates, and has a branch in the capital of each department and in numerous other commercial centres, in addition to sub-offices which yearly increase in number ; all its officials must be French. The circulation of bank notes in 1897 amounted in value to Â£151,361,227. (See also the article Banking.)

The Court of Appeal now consists of seven civil chambers, besides one for preliminary proceedings and one for appeal from the cor- rectional police. The prisons of Mazas, Ste Pelagic, and La Grande

Pawa- broklag.

Roquette have been closed, demolished* and replaced by the. new prison of Fresnes-les-Rungis. This establishment covers 50 acres. The prisoners, kept in solitary confinement, are divided justice into three groups: those undergoing short sentences, those sentenced to hard labour while awaiting transference to their â– final place of detention

or to sentences over a year, and sick pris- oners occupying the central infirmary of the prison. The Petite Roquette (occupied by children) is also to be demolished, and to be replaced by the agricultural and horticultural colony of Moutes- son. Paris is to retain only the Conciergerie and depot of the Prefecture of Police, both within the walls of the Palais de Justice, and the prison of La Sant6, which will receive prisoners awaiting trial and political prisoners.

The only crematorium in France has been built at P6re la Chaise, for the cremation of those who have expressed a desire Cremation for it and for the destruction of human remains from the dissecting rooms.

The fire brigade (sapeurs-pompiers) is a regiment of the army, consisting of 2 battalions and 12 companies, the "War Office sharing the control of it with the Prefect of Police and the Min- ister of the Interior. It consists of 52 officers, 185 non- commissioned officers, 291 corporals, and 1225 privates. *"

It is composed of volunteer conscripts who have been brought up to the building trades. They have a dark blue uniform, with a gilt helmet. Like soldiers in the regular army, they serve three years, but may re-enlist for seven years. They have nightly duties at the theatres, and may be engaged for private entertainments. There are 24 stations, each provided with 4 engines, 2 vans, a fire-escape, and a steam pump. There are 184 horses, the property of a con- tractor. There are 6928 fire-plugs, placed at intervals of 100 metres, and the pressure at most of these is sufficient to dispense with pumps ; but formerly, when the water supply was less per- fect, by-standers had to be impressed to pass the buckets from hand to hand. There were in 1901, besides 1544 chimney fires and 436 false alarms, 1422 calls, but only 23 of these were serious fires. The aggregate damage was 5,927,000 francs, but in the previous year the burning down of the ComMie Fran9aise had raised the total to 10,346,000 francs. The cost of the force in 1901 was 2,729,000 francs, besides 892,000 francs supplementary expense for plant, repairs, and rebuilding. The charge falls on the Paris munici- pality. In recognition of the unquestionable efficiency and courage of

the force. President Loubet, at the Longchamps review of the 14th July 1902, affixed to its flag the cross of the Legion of Honour.

The 2,511,955 inhabitants of the city consumed in 1896, 352,021 tons 8 cwt. of bread ; 123,362,426 gallons of vrine and spirits ; 171,043 tons 9 cwt. of meat; 26,737 tons 14 cwt. of fish ; 27,724 tons 4 cwt. of poultry and game ; Markets. 491,799,240 eggs ; 20,199 tons of butter ; 8572 tons 8 cwt. of oysters ; 667 tons 8 cwt. of cheese ; 1207 tons 15 cwt. of early fruits and vegetables (only the fish and early produce arriv- ing at the central markets are reckoned ; those arriving elsewhere escape computation). The March6 de la Villette continues to be the great centre for the supply of cattle, and its abattoir is still the principal one in the city. But on the left bank of the Seine the abattoirs of Crenelle, Yillejuif, and les Foumeaux have been re- placed by that of Morillons, which occupies an area of 25 acres near the station of the Brittaliy railway. The com trade is still carried on at the old corn-market {halle anx Ues} transformed into the bourse du commerce, fiour dealers meeting in the district between the Louvre and St Germain I'auxerrois. For several years manual labour has been the subject of supply and demand at the Labour Exchange {bourse du travail).

The following are the general results of the navigation statistics of the Seine for 1898 : entrances, 5,202,700 tons ; traffic clearances, 1,689,000 tons; transit, 1,897,800 tons; ^'â€¢'PP"V- local, 641,300; total, 8,930,800 tons. Detailed results for 1897 are given in the following table : â€"

Entrances.

Clearances.

Transit.

Total Move- ment.

Lower Seine.

Upper Seine.

Towards

the Lower Seine.

Towards

tlie

Upper

Seine.

Towards

tlio

Lower

Sftne.

Towards

the

Upper

Seine.

Tons.

1,066,026

Tons, 1,TSB,149

Tons.

612,120

Tons.

713,171

Tons.

957,118

Tons.

9&7,608

Tons.

6,071,192

Navigation of the Canals in 1S97.

Ourcq Canal.

St Denis Canal.

St Martin's Canal.

Total for

tlio tliree

Canals.

Up.

Down.

Up.

Down.

Up.

Down.

Tons.

97,685

Tons.

525,148

Tons.

1,400,497

Tons.

899,171

Tons.

768,687

Tons.

351,417

Tons.

3,587,485

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The postal department of Paris was served in 1897 by 98 offices (exclusive of the great central office), 96 of vfhich were- telegraph offices ; there were also 48 auxiliary offices managed by shopkeepers, &c. These sub-offices continue to in- crease in number, as also do the letter-boxes, of which there are no less than 2000. The circulation of letters for specified years is shown by the following tables : â€”

Post office, &c.

Yeai-.

1886 1890 1895 1897

Prepaid.

Letters.

49,193,000 57,930,000 67,011,000 67,352,348

Unpaid Letters.

478,000 473,000 467,918 460,075

There were also despatched from Paris in- 1897, 15,264,000 post- cards, price 10 centimes ; 3,127,400 letter-cards, price 15 centimes; 53,110 cards, reply prepaid, price 20 centimes ; 19,580 foreign letter-cards, price 25 centimes ; 502,055 registered letters for Paris, 4,492,315 registered letters for Prance, 770,472 registered foreign letters, 862,424 registered packets for France, 410,160 registered foreign packets ; 85,299 letters containing money orders for Paris, 1,059,700 letters containing money orders for France, and 260,027 for abroad ; 31,656 boxes containing money orders for Paris, and 408,002 for France.

Tear.

French Money Orders.

International Money Orders.

Amounts

re- covered.

Un- recovered.

Issued.

Paid.

Issued.

Paid.

lbS7 1S94 1S97

Â£8,388,000

4,024,000 4,174,040

Â£5,424,000

6,688,000 6,794,510

Â£452,000

428,000 461,090

Â£680,000

728,000 817,510

Â£212,000

476,000

506,523

Â£148,000

372,000 154,08:3

The following table shows the number of newspapers sent by post in specified years to addresses (a) in the department of the Seine, (6) in other departments or abroad : â€”

Political and Periodical Journals.

Non-political Periodicals.

Tear.

Department, of the Seine.

Other Depts. or Foreign Countries.

Department of the Seine.

Other Depts. or Foreign Countnes.

1887 1890 1895 1897

18,000,000 20,000,000 22,216,000 22,774,812

104,000,000 112,000,000 119,000,000 120,992,934

17,000,000 18,000,000 22,300,000 22,974,945

40,000,000 48,000,000 52,913,815 53,475,201

In XhQ parcel post department 4,508,277 packages were received in Paris from places in France, 735,783 from abroad ; 16,232,742 were despatched from Paris into the provinces, 1,834,314 abroad. The receipts of the Paris post office amounted in 1887 to Â£2,320,000, in 1894 to Â£2,600,000. The personnel of the service on the 31st December 1896 consisted of 211 higher officials, 1696 clerks, 271 women assistants, 2972 letter-carriers. It employed 300 horses, 120 drivers, 35 two-horse vans, 53 one-horse vans, 59 tilburys, 37 factors' omnibuses. Cyclists carry special collections to the railway stations. Automobiles have been employed in col- lecting the contents of letter-boxes.

In connexion with the telegraph service of Paris there are 104 offices. The telegraphic circulation is tabulated thus (numbers in thousands) : â€"

Tear.

Despatched to

Received from 1

Paris.

The Provinces.

Abroad.

Paris.

The Provinces.

Abroad.

1886 1890 1895 1897

3168

4058 4490 4692

3394 7551 8563 8967

1244 1487 1591 1374

3168 4058 4490 4692

3337 7722 8817 9035

959 1170 1250 1063

To this number must be added the telegrams passing through Paris, which in 1886 numbered 16,798,000 ; in 1897, 25,402,000. A large number of the messages sent in Paris for delivery within the city are forwarded through pneumatic tubes. In 1886 the number so despatched was 3,095,997 ; in 1897, 4,410,400. The staff consisted on the 31st December 1896 of 24 higher officials, 1220 clerks, and 839 women assistants.

The telephone service, like the postal and telegraph services monopolized by the State, consists of a central office communicating with eleven divisional offices, to which subscribers in various districts come for connexion. The public can make use of telephone boxes In the post, telegraph, and telephone offices, and in certain railway

stations. The time, allowed for conversation is usually fixed at five minutes. The rate of charge varies according as the communication is exchanged with Paris or beyond, and the distance from the inner office. Telephonic messages can be conveyed, if desired, from the receiving office to specified addresses. Conversations are most fre- quent between Paris and, among foreign towns, Brussels, London, and Geneva. In France, Rouen, Havre, Lille, Lyons, Marseilles, and Keims are the towns that most frequently communicate with the capital. On the 31st December 1896 the telephone staff com- prised four higher officials, 230 clerks, 1401 women assistants, 148 under-officials. The network of telephones increases continuously, and about 2500 new subscribers are added every year.

The International Exhibitions which may be said to follow one another periodically in Paris (1855, 1867, 1878, 1889, 1900) offer a means of reviewing the progress made during the intervals between them in the various branches of art 1 and industry, especially as each Exhibition carries out ”’”’*’ *’ a programme vaster than that of iia predecessor. Thus, whilst the 1855 Exhibition concerned itself only with contemporary art and industry, that of 1867 told the story of their development. In 1878 the Rue des Nations reproduced in Paris a monument of every foreign country with its local colour. In 1889 the Rue du Cairo enabled one to live for a time in that celebrated capital. But these, after all, were but temporary shows, designed for the entertainment of crowds. The progress of greatest importance demonstrated in 1889 was that made in the art of construction in iron, as illustrated by two notable examples â€” the Eiffel Tower, the most gigantic tower of the whole world, 990 feet high, and the Gallery of Machinery, with its boldly designed girders (remarkable for their immense span). Glass buildings are features of the time ; and in place of the flat and uniform faqades which border the boulevards opened during the Second Empire,

contem- porary architects build carved and sculptured facades, with ledges and projections. And notwithstanding the heavy cost of the disasters of 1870, several important public buildings have been erected since â€” the Op^ra, the Tuileries, the new Sorbonne, the schools of medicine and law, the general post office, central tele- phone office, the galleries of the natural history museum, the Op^ra Comique, amongst others. Several lycees and hospitals and numerous schools have been either built or enlarged ; the railway stations are magnificent structures ; among bank buildings those of the Credit Lyonnais may be quoted as models of their kind, and several handsome new museums have been opened, mainly by private individuals who see in such foundations the best means of safeguarding the future of their collections. Dwelling- houses, too, are much more intelligently arranged than those of older date, and are fitted with all the latest improvements devised by science for the comfort of man. (g.Ms.)

Parisian Events since 1875. â€” After the adoptiou of the Constitution of 1875, the first important political event in Paris was the dissolution of the Chamber of Deputies, pronounced by the Senate on 19th June 1877, at the request of Marshal MacMahon, then President of the Republic. Theelectionsthatfollowedthis act gave a large majority to the Republicans. The Universal Exhibition of 1878, destined to show Europe that France had re- covered her material prosperity and moral power, attracted a large concourse, but the different sovereigns abstained. The number of admissions was about 13,000,000. A grand fgte, full of gaiety and enthusiasm, was held on 30th June. This was the first public rejoicing since the war. Marshal Macilahon resigned the Presidency inl879, and was succeeded by INI. Jules Grevy. The terrible winter of 1879-80 was the severest of the century ; the Seine, entirely frozen, resembled a sea of ice. The 14th of July, the anniversary of the taking of the Bastille, was adopted as the Erenchnational holiday, and celebrated for the first time in 1880. A grand military review was held in the Bois de Boulogne, at which President Grevy distributed flags to all the regiments of the army. On 17th March 1881 a national loan of a thousand million francs was issued for the purpose of executing important public works. This loan was covered fifteen times, Paris alone subscribing for ten thousand millions. At the time of the

legislative elections, on 21st August and 4th September 1881, several tumults occurred in the Belleville district. Gambetta, who was a candidate in the two wards of that district, vainly tried to address the electors.

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The great orator died in the following year, on the 31st of December, from the effects of an accident, and his funeral, celebrated in Paris at the expense of the State, was attended by an immense gathering. A slight Legiti- mist agitation followed Gambetta's death. An unfortunate event occurred on 29th September 1883, the day when the king of Spain, Alphonso XII., returned from his visit to Berlin, where he had reviewed the 15th regiment of Prussian Uhlans, of which he was the honorary colonel. The cries of " Down with the Uhlan ! " with which he was greeted by the Paris crowd, gave rise to serious diplomatic incidents. On 26th May 1885 the following decree was rendered : " The Pantheon is restored to its primitive and legal destination. The remains of the great men who have merited natiohal recognition willbe disposed therein." But it was only on 4th August 1899 that the ashes of Lazare Carnot, Hoohe, Marceau, Latour d'Auvergne, and Baudin were solemnly transported to the Pantheon. Victor Hugo's funeral was celebrated on 1st June 1885, and by an urgency vote they were made national obsequies. It was decided that the corpse should be exposed one day and one night under the Arc de Triomphe, veiled with an immense crape. A few days before, upon the oc- casion of the anniversary of the fall of the Commune, a tumultuous political manifestation had been made in front of the tomb of the Communists buried in Pere Lachaise cemetery.

M. Jules Grevy was re-elected President of the French Eepublic in 1885. The following year the Monarchists renewed their political demonstrations; the most important one was the reception given by the Count of Paris at the Galliera mansion on the occasion of v the marriage of his daughter with the King of Portugal. The Count of Paris had invited to this reception all the foreign ambassadors, and some

disturbance having taken place, the Chamber of Deputies, on 11th June 1886, voted a law interdicting sojourn upon Prench territory to the Orleanist and Bonapartist pretenders to the throne of France, and also to their direct heirs. At that epoch Paris was in a state of agitation and discontent, and various catastrophies occurred. First of all came the disastrous bankruptcy of a large financial concern called the Union Generale; then the scandal concerning the traffic in decorations, in which M. Wilson, son-in- law of M. Jules Grevy, was compromised, and which eventually led to the resignation of the President ; finally, the deplorable Panama affair profoundly enervated the Parisians, and made them feel the necessity of shouting for a military master, some adventurer who would promise them a revenge. All this led to Boulangism. It was by wild acclamations and frantic shouts that GeneralBoulanger was greeted, first at the review of the army on the 14th of July, then two days later at the opening of the Military Club, afterwards at the Winter Circus, where the Patriots' League held a mass meeting under the presidency of Paul Deroul^de, and finally, on 8th July, at an immense demon- stration at the Lyons railway station, when "le brav' General " left Paris to take command of the 13th army corps at Clermont Ferrand. Popular refrains were sung in the streets in the midst of immense excitement on 27th January 1889 at the time of the election of General Boulanger as deputy for the Seine department. A maj ority of 80,000 votes had invested him with an immense moral authority, and he appeared as though elected as the candi- date of the entire country ; but he lacked the necessary audacity to complete his triumph, and the Government having decided to prosecute him for conspiracy against the security of the State, before the Senate acting as a High Court of Justice, he fled with his accomplices, Eochefort and Dillon. All three were condemned by default, on 14th August, to imprisonment in a fortified enclosure.

Other events had also troubled this astonishing inter- lude of Boulangism. On 23rd February 1887 a terrible fire destroyed the Opera Comique during a performance, and a great many of the audience perished in the flames. The first performance of Lohengrin, which took place at the Eden Theatre on 1st May 1878, was also the cause of street rioting. In 1888 there were several strikes. That of the,

day labourers, which lasted more than a month, occasioned violent scenes, owing to the sudden death of l^mile Eudes, a Communist, while he was speaking in favour of the strike at a public meet- ing. On 2nd December there were manifestations in memory of Baudin, a representative of the people, killed upon the barricades in 1851 while fighting in the defence of the Eepublic. But a calm finally came, and then the Parisians thought only of celebrating the centenary of the Eevolution of 1789 by a universal exhibition. This Exhibition contained a profusion of marvels such as had never before been seen, and in- dicated what enormous industrial progress had been accomplished. Sadi' Carnot, who had succeeded M.Jules Grevy as President of the Eepublic on 3rd December 1887, ofacially opened the Exhibition on 6th May 1889. ISTumerous fStes were held in the grounds while the exhibition lasted. The Eiffel Tower and the illuminated fountains enraptured the crowd of visitors, while the Eue du Caire, with its Egyptian donkey-drivers, obtained a prodigious success. Most of the nations were represented at this Exhibition. Germany alone confined her co-opera- tion to the display of some paintings. The Shah of Persia, in honour of whom splendid f8tes were organized, and the King of Greece, the Prince of Wales, the Lord Mayor of London, several Eussian grand dukes, Annamite, Tun- isian, Moorish, Egyptian, and African princes, successively visited the Exhibition. There were 30,000,000 visitors. On the 18th of August a banquet was offered in the Palais de I'Industrie by the Paris Municipal Council to all the mayors in France, and 15,000 of these ofiicials were present.

In 1890 the duke of Orleans, having attained his majority, came to Paris to draw for military service with the young conscripts of his class. He was arrested, and placed, first in the Conciergerie, and later in the prison at Clairvaux, but was released after a few months' in- carceration. The following years were remarkable for more strikes and several demonstrations by the students, which Ifed in 1893 to conflicts with the police, in one of which a student was killed. On the 17th of October an enthusiastic welcome was extended to Admiral Avellan and the Eussian sailors upon their arrival in Paris. It was about this time that dynamite began to be used by the Anarchists. After Eavachol, who com- menced the sinister exploits of the " propaganda by acts," it was

Vaillant that threw a bomb into the ” Temple of the Laws ” on 9th December 1893, and wounded forty- six deputies. Then there was a succession of these attacks during the two following months, for Eavachol and Vaillant had found emulators. Henry scattered fright and death among the peaceable customers of a brasserie, while bombs were thrown into the doorways and staircases of houses inhabited by wealthy people. Upon the steps of the Madeleine Church, Parvels, who was already the author of two dynamite plots, was struck down by the destructive machine that he -was about to throw into the body of the church. Laurent Tailhade himself, who had celebrated with his pen the beauty of Vaillant’s gesture, was subsequently wounded by dynamite thrown into the Caf^ Foy, where he was lunching. Finally came the attack on President Carnot, who, on, 24th June 1894, fell at Lyons under the blow of the Italian anarchist Caserio’s dagger. His funeral was

celebrated at Paris on 1st July. M. Casimir-Perier, elected President of the Republic on the preceding day, followed the procession on foot. He resigned office on 15th January 1895, and on the 17th M. Felix Paure was chosen as his successor.

The visit of the Emperor and Empress of Eussia, on the 5th, 6th, and 7th of October 1896 was celebrated by incomparable fgtes. The Kue de la Paix was decorated with ropes and sails, stretched across the street like the rigging of a vast vessel, in honour of the Russian sailors. Nothing could be seen anywhere except flags, cockades, and badges formed of the colours of the two friendly nations. In the evening there were open-air balls, with farandoles and orchestras at all the street corners. Popular enthusiasm was again manifested on 31st August, when President Eaure returned from his visit to the Russian court. On 4th May 1897 the terrible conflagration at the Charity Bazaar in the Rue Jean Goujon threw into mourning one hundred and forty families of the nobility or the aristocracy of Paris, and spread sorrow among the class always considerate in its benevolence. Then all minds were again

troubled and disturbances occurred in the streets for more than two years over the Dreyfus case, dividing the Erench people into two camps. Certain newspapers kept up the agitation, which was the cause of numerous prose- cutions.

Fdlix Eaure died suddenly on the 18th of February 1899. The very day of his funeral, Paul Deroulede and Marcel Habert tried to make a coup d'etat by urging General Roget to lead his troops, which had formed part of the guard of honour at the obsequies, against the Elysee. Immediately arrested and put on trial, DeroulMe and Habert were acquitted by a timorous Jury.

Mr ifimile Loubet, President of the Senate, was chosen as successor to M. Felix Eaure. Upon his return to Paris from the Versailles Congress, where he had been elected President of the French Republic, he was greeted by hisses and cries of " Panama ! " cries in no wise justifiable. Some time afterwards, Jules Guerin, by a desperate resistance against a summons of the police to give himself up, made the public believe for two months in the existence of an impregnable fortress in the Rue Chabrol, in the very centre of Paris. On the 4th of June there was a great scandal at the Auteuil Races, which President Loubet had been, according to custom, invited to attend. He was insulted and struck by Baron de Christiani, who was encouraged by the young royalists of the " QSillets Blancs " Association. A week later, the extraordinary and excessive police measures taken to prevent a disturbance at the Grand Prix occasioned the downfall of the Dupuy ministry. M. Waldeck-Rousseau then formed a cabinet, himself becoming President of the Council. The new premier immediately took energetic measures against the enemiesof the Republic. Compromis- ing documents found in various domiciliary searches made among the Monarchists and Nationalists formed the basis of prosecutions before the High Court of Justice. The trial resulted in the condemnation of Jules Guerin to a' term of im- prisonment, and the banishment of Paul Deroulede, Marcel Habert, Andre BufEet, and the Marquis de Lur Saluces, thereby ridding France of all these promoters of disorder, and opening a new era of peace, which lasted throughout the Universal Exhibition of 1890. This Exhibition covered an enormous space, including the slope of the

Trocadero, the Champ de Mars, the Esplanade of the Invalides, and both sides of the Seine bordered by the Rue de Paris and the Rue des Nations. Seen from the new Alexandre III. bridge, the spectacle was as fairy-like as a stage setting. Close beside, at the left, were the palaces of the different nations, each one showing its characteristic architecture.

and all being of an astonishing diversity. To the right were the pavilion of the city of Paris and the enormous greenhouses, and in the distance Old Paris, so pic- turesquely constructed by Robida. In short, exotic edifices and scintillating cupolas arose with unparalleled profusion, creating in the heart of Paris a veritable city of dreams and illusion. The most distant countries sent their art treasures or the marvels of their industry. The number of visitors was 51,000,000, and the personages of mark in- cluded the Shah of Persia, the King of Sweden, the King of the Belgians, and the King of Greece, all of whom were successively the guests of France. On the 22nd of September 22,000 mayors accepted the invitation to the banquet offered in their honour by President Loubet, and thus solemnly affirmed their Republican faith. This admirably organized banquet was spread in the Tuileries Gardens. The Exhibition of 1900, a brilliant epilogue of the closing century, was a grand manifestation of uni- versal concord, of the union of peoples by art, science, industry, all branches of human genius.

(de b.)

Paris, a city of Texas, U.S.A., capital of Lamar county. It is in the north-eastern part of the state, on the Gulf, Colorado, and Santa Fe, the St Louis and San Francisco, the Texas and Pacific, and the Texas Midland railways, at an altitude of 563 feet. It is in a grain and cotton region, for which it is a collecting and distributing point, and has a large trade and some manu- factures. Population (1880), 3980; (1890), 8254; (1900), 9358, of whom 182 were foreign-born and 3061 negroes.

Paris, Louis Philippe Albert d’Orleans,

CoMTB DE (1838-1894), son of the Due d’Orleans, the eldest son of King Louis Philippe, was born on 24th August 1838. His mother was the Princess Helen of Mecklenburg-Schwerin, a Protestant. By the

death of his father through a carriage accident in 1842, the count, who was then only four years of age, became heir-apparent to the French throne. On the deposition of Louis Philippe in 1848, the Duchess of Orleans struggled to secure the succession to her son, and bore him through an excited populace to the Chamber of Deputies. The Chamber itself was soon invaded, however, and the Republic proclaimed. The Orleanists were driven into exile, and the duchess proceeded with her two sons, the Comte de Paris and the Due de Chartres, first to Eisenach in Saxony, and then to Claremont in Surrey. At the latter place tlje count's education was conducted by his mother. He was reared in the Roman Catholic faith, and received his first communion at>the hands of Cardinal Wiseman in 1850. After his mother's death in 1858, the count made a long foreign tour. In 1861 he and his brother accompanied their uncle, the Prince de Joinville, to the United States. During the campaign on the Potomac the brothers were attached to the staff of General McClellan. In April 1862 the count took part in the siege of Yorktotvn and was present at the battle of Williams-burg on 5th May. He was also with McClellan at the battle of Fair Oaks, and was personally engaged in the sanguinary encounter at Gaines Mill on the 27th of June. When difficulties arose between France and the United States with regard to the affairs of Mexico, the Orleans princes withdrew from the American army and returned to Europe, paying a visit to President Lincoln before embark- ing. During the winter of 1862-63 the coimt took a special interest in the organization of the Lancashire Cotton Famine Fund, and contributed an article to the Revue des Deicx Mondes entitled " Christmas Week in Lancashire." On 30th May 1864 he married his cousin, the Princess

Marie Isabelle, daughter of the Due de Montpensier, and his son and heir, the Due d'Orleans, was bom at York House, Twickenham, in 1869. The count was refused permission to serve in the Franco-Prussian war, but after the fall of Napoleon III. he returned to France. Abstain- ing

from putting himself forward, he lived quietly on his estates, which had been restored to him by a vote of the Assembly. He gave considerable study to social ques- tions, and the relations between capital and labour, and published a valuable little work on trades unions. In August 1873 there was an important political conference at Frohsdorf, the result of which was that a fusion was effected, by which the Comte de Paris agreed to waive his claims to the throne in favour of those of the Comte de Chambord. By the death of the latter in 1883 thp count became undisputed head of the House of Bourbon ; but the old Legitimists did not hail him with much enthusiasm, nor did the count show any disposition to push his claims. The popularity of the Orleans family, however, was shown on the occasion of the marriage of the Comte de Paris's eldest daughter with the Duke of Braganza, son of the King of Portugal, in May 1886. This so alarmed the French Government that it led to a new law of expulsion, by which direct claimants to the French throne and their heirs were banished from France. The Comte de Paris again retired to England, taking up his abode at Sheen House, near Richmond Park. Here he devoted his leisure to his favourite studies. In addi- tion to his work Les Associations Ouvriires en Angleterre, which was published in 1869 and translated into English, the count edited the letters of his father, and published at intervals in eight volumes his Histoire de la Ouerre Civile en Am&rique. In his later years the count seriously compromised the prospects of the Eoyalist party by the relations into which he entered with General Boulanger. He died 8th September 1894.

~~), English Congrega~~

Parker, Joseph (1830- tional minister, was born at Hexham-on-Tyn'e, 9th April 1830, his father being a stone-cutter. In 1852 he attended classes at University College, London. Ordained (1853) to the career of a Congregational pastor, he was called to Banbury, where he worked from 1853 to 1868, and then to Manchester, where in 1868 he published Ecce Deus (a reply to Ecce Homo) ; but in 1869 he came to London, and became minister of the Poultney Chapel in Holborn, in substitution for which afterwards the great City Temple was built in 1874, by his exertions, at a cost of Â£70,000. He became famous as a vigorous,

stirring, and original preacher on conservative theological lines. In 1880 he visited the United States, where he was compared with Henry Ward Beecher, who had just died ; and Parker was expected at the moment to take his place, but he returned to England with the degree of D.D. from Chicago Uni- versity. In 1889 he issued The People's Prayer-book, and in 1885 began the publication 'of TIte People's Bible (in 25 vols.), a series of discourses which came out at intervals up to 1895. Among his other works may be mentioned City Temple Sermons (1869-70), The Inner Life of Christ ri881). Apostolic Life (1884), Mtj Life and Teaching (1889), A Preacher's Life (1899), and some autobio- graphical sketches of ministerial life, Springdale Abbey (1869) and Tyne Chylde (1883). Dr Parker shared for many years with Mr Spurgeou the reputation of being the most impressive Dissenting preacher in England., He became chairman of the London Congregational Board and of the Congregational Union. He married twice, first in 1851, and secondly in 1864, and the death of his second wife in 1898 deprived him of a devoted helper.

Parkersburg, a city of West Virginia, U.S.A.,

capital of Wood county, on the west bank of the Ohio river, at the mouth of the Little Kanawha river, in the western part of the state, at an altitude of 616 feet. Next to Wheeling it is the largest city in West Virginia. It has four railways, the Baltimore and Ohio, the Baltimore and Ohio South-Western, the Little Kanawha, and the Ohio River. It has a large trade, both by rail and river. It is in a coal, oil, and natural gas region, and contains the shops of the Ohio Eiver railway, oil refineries, iron- works, lumber-mills, &c. Population (1890), 8408; (1900), 11,703, of whom 515 were foreign-born and 783 negroes.

Parkes, Sir Harry Smith (1828-1885), Eng- lish diplomatist, son of Harry Parkes, the founder of the firm of Parkes, Otway and Co., ironmasters, was J)orn at Birchills Hall, near Walsall in Staffordshire, in 1828. When but four years old his mother died, and in the following year his father was killed in a carriage accident. Being thus left an orphan, he found a home with his uncle, a retired naval officer, at Birmingham. He received his early education at a boarding-school at

Balsall Heath, and afterwards at King Edward's Grammar School. In 1837 his uncle died, and in 1841 he sailed for Macao in China, to take up his residence at the house of his cousin, Mrs Gutzlaff. At this time what was known as the " Opium War " had broken out, and Parkes eg-gerly prepared himself to take part in the events which were passing around him by diligently applying himself to the study of Chinese. In this pursuit he was fortunate to have the help and supervision of Dr Gutzlaff and John Robert Morrison, secretary and interpreter to Sir Henry Pottinger. Under these congenial influences he made rapid progress, and in 1842 he received his first appointment in the consular service. Fortunately for him, he was privileged to accompany Sir Henry Pottinger in his expedition up the Yangtse-kiang to Nanking, and after having taken part in the capture of Chinkiang and the surrender of Nanking, he witnessed the signing of the treaty on board the Cornwallis in August 1842. By this treaty the five ports of Canton, Amoy,Foocho w,Ningpo,and Shanghai were opened to trade. After short residences at Canton and the newly opened Amoy, Parkes was appointed to the consulate at Foochow. Here he served under Mr (afterwards Sir) Rutherford Alcock, who was one of the few Englishmen who knew how to manage the Chinese. Though the war was over, the people were still hostile to foreigners, and it was only by the exercise of strong pressure that Alcock and his young interpreter were able to protect themselves and their countrymen from the assaults of the natives. In 1846 he was transferred with Alcock to Shanghai, which was even then beginning to show signs of developing into the place of importance which it has since become. In 1849 he re- turned to England on leave, and after visiting the Conti- neat and doing some hard work for the Foreign Office, he returned to China in 1851. After a short stay at Amoy he was transferred to Canton as interpreter, and there he was first brought into contact with Commissioner Yeh, whose insolence and obstinacy led up to the second China war. Yeh had now met a nian of even greater determi- nation and power than himself, and when, as a climax to many outrages, Yeh seized the British lorcha Arrow and made prisoners of her crew, Parkes at once closed with his enemy. In response to a strongly-worded despatch from Parkes, Sir John Bowring placed matters in the hands of the admiral, who took Canton and, with Parkes's personal help, made a prisoner of Yeh. As the city was to be

held, an allied commission was appointed to govern it, consist- ing of two Englishmen, of whom one was Parkes, and a French naval officer. Being the only one of the three who had any experience of the Chinese character, the

burden of the workfelluponParkes, who virtually governed this city of a million inhabitants for three years. Mean- while the treacherous attack at Taku upon Sir Frederick Bruce, who was on his way to Peking to exchange the ratifications of the treaty concluded in 1858, led to a renewal of hostilities in the north, and Parkes was ordered up to serve as interpreter and adviser to Lord Elgin. In pursuance of these duties he wfent in advance of the army to the city of Tungchow, near Peking, to arrange a meeting between Lord Elgin and the Chinese commissioners who had been appointed to draw up the preliminaries of peace. While thus engaged he, Mr (afterwards Lord) Loch, Mr de Norman, Lord Elgin's secretary of legation, Mr Bowlby, the Times correspondent, and others, were treacherously taken prisoners. Parkes and Loch were carried off to the prison of the Board of Punishments at Peking, where they were separately herded with the lowest class of criminals. After ten days' confinement in this den of iniquity they were removed to a temple in the city, where they were comfortably housed and fed, and from which, after a further detention, they were granted their liberty. The other captives were not so fortunate, and a number were deliberately tortured to death. For this signal instance of treachery Lord Elgin burned down the Summer Palace of the emperor, and the ruins of this building, which have since been left unrestored, mark the horror and indignation with which this baseness and inhuman cruelty were universally regarded. At the conclusion of peace Parkes returned to England on leave, when he was made K.C.B. for his services ; he had received the Companionship of the Order in 1860. On his return to China he served for a short time as consul at Shanghai, and was then ap- pointed minister in Japan (1865). For eighteen years he held this post, and throughout that time he stren- uously used his

influence in support of the Liberal party of Japan, whose first object was to abolish the native feudal system of government and to substitute for it a more enlightened form of administration. So earnestly did he throw in his lot with these reformers, that he be- came a marked man, and incurred the bitter hostility of the reactionaries, who on three separate occasions at- tempted to assassinate him. In 1882 he was transferred to Peking, where, with his usual energy, he worked for the good of his country ; and although in conducting negotiar tions he had many serious contentions with the mandarins, he retained throughout their respect and regard. While in Peking his health failed, and he died of malarial fever on the 21st of March 1885. In 1856 Sir H. (then Mr) Parkes married Miss Fanny Plumer, who died in 1879. (r. k. d.)

Parkes, Sir Henry (1815-1896), Australian states- man, was born at Stoueleigh, in Warwickshire, on 27th May 1816. The son of parents in very humble cir- cumstances, he received only a rudimentary education, and at an early age was obliged to earn his living as a common labourer. Failing to make his way in England, he emigrated to Australia in 1839, and after a time settled in Sydney as an ivory-turner. Conscious of his great powers, he worked unremittingly to repair the deficiencies of his education, and developed a genuine taste for literature, and a gift for versification which won the approval of so severe a judge as Tennyson. His first volume of poems was published in 1842, under the title of Stolen Mmnents. He now began to take an active part in politics, and soon showed himself the wielder of an incisive style as a leader-writer, and a popular orator of unrivalled influence. He took a promi- nent part in the movement against the transportation of convicts, and in 1849 started the Empire newspaper to

inculcate his policy of attacking abuses while remaining loyal to the Crown. The paper at once made its mark, but owing to financial difficulties ceased to appear in 1858. One of the reforms for which Parkes fought most strenuously was the full introduction of responsible gov- ernment. He was triumphantly returned to the Leg- islative Council under the old constitution as member for Sydney, and on the establishment of a legislative assembly in 1856 was returned for East

Sydney. In the debates on the new constitution he successfully attacked the proposal to create a hereditary Upper House, but vainly endeavoured to exclude the principle of nomina- tion. His parliamentary career was twice interrupted by pecuniary embarrassments ; indeed, he never acquired the art of making money, and in spite of a public subscription raised in 1887, died in absolute penury. He was elected for East Sydney in 1859 at the first general election under the new electoral Act, and sat till 1861, when he was sent to England as a commissioner for promoting emigration. He made a prolonged stay in England, and described his impressions in a series of letters to the Sydney Morning Herald, some of which were reprinted in 1869 under the title of Australian Views of England. He returned to Australia in 1863, and, re-entering the Assembly, became colonial secretary in the Martin ministry from 1866 to 1868. He succeeded in passing the Public Schools Act of 1866, which for the first time instituted an efBcient system of primary education in the colony; but the Roman Catholic and Anglican communities, holding that the position of the denominational schools was menaced, displayed a bitter hostility to Parkes which survived the passing of the Bill. His great chance came in 1872, when the Martin ministry resigned on the question of the siim payable by Victoria in lieu of border duties. Parkes, who during his visit to England had fallen deeply under the influence of Cobden, had persistently advocated free-trade as a remedy for the financial distress of the colony. He now^became prime minister and colonial secretary ; and rising to the height of his opportunity, he not only re- moved the cause of dispute by throwing the colony open to trade, but made Sydney the chief port on the continent. It was due solely to his influence that New South Wales for many years alone of the Australian colonies adhered to a free-trade policy. He held office till 1876, and on the fall of the Eobertson ministry again became premier and colonial secretary from March till August 1877. At the end of this year he was made K.C.M.G. Finding that the state of parties did not allow of the existence of a stable ministry, he formed a coalition with Sir John Robertson, and became premier and colonial secretary for the Jhird time from December 1878 to January 1883. This administration was distinguished by a wide pro- gramme of social legislation, including temperance and employers' liability Acts, aud reform of education and

of the electoral law. In 1882 and in 1883-84 he paid pro- longed visits to England. Already distinguished among Australian statesmen for breadth of outlook and passionate devotion to the Empire, he returned with those qualities enhanced. For a time he found himself almost in a position of isolation, but in 1887 the disastrous policy of protection adopted hj his successors brought him again into office. His free-trade policy was once more success- ful. Other important measures of his administration were the reform of the civil service, the prohibition of Chinese immigration, and the Railways and Public Works Acts. He fell from office in January 1889, but in the following March became for the fifth time premier and colonial secretary. The remainder of his life was chiefly devoted to the question of Australian federation. He had from his early days been an advocate of this idea ; but that inability to recognize the merits of his opponents,

which, combined with excessive self-esteem, formed the chief defect of his character, prevented his co-operating in subsequent attempts at federation. The Federal Conven- tion at Melbourne in 1890 was mainly his work ; and he presided over the Convention at Sydney in 1891, and was chiefly responsible for the draft constitution there carried. Defeated in October 1891 on his refusal to accept an eight hours' day for coal miners, he remained in opposition for the rest of his career, sacrificing even free- trade in the hope of smoothing the path of federation. He died at Sydney on 27th April 1896 ; but though he did not live to see the realization of his efforts, he may justly be called the Father of the Australian Common- wealth. He published, in addition to the works already named and numerous volumes of verse, a collection of speeches on the Federal Gcyvemment of Australia (1890), and an autobiography, Fifty Years in the making of Australian History (1892). (h. St.)

Parkman, Francis (1823-1893), American his- torian, was born in Boston, 16th September 1823. His great-grandfather, Ebenezer Parkman, a graduate of Har- vard in 1741, was for nearly sixty years minister of the Congregational Church in Westborough, and was noted for his devotion to the study of history. One of this good clergyman's sons, Samuel Parkman, became an emi- nent merchant in Boston, and exhibited much skill in horticulture. Samuel's son, Prancis Parkman, a graduate of Harvard in 1807, was one of the most eminent of the Boston clergymen, a pupil and friend of Channing, and noted among Unitarians for a broadly tolerant disposition. This Doctor Parkman, a man of rare sagacity and exquisite humour, was the father of Francis Parkman, the historian. His mother was a descendant of the celebrated John Cotton. She was the daughter of ISTathaniel Hall of Medford, member of a family which was represented in the convention that framed the constitution of Massa- chusetts in 1780. 4

Francis Parkman was the eldest of her six children. As a boy, his health was delicate, so that it was thought best for him to spend much of his time at his grand- father Hall's home in Medford rather than in the city. That home was situated on the border of the Middlesex Fells, a rough and rocky woodland, 4000 acres in extent, as wild and savage in many places as the primeval forest. The place is within 8 miles of Boston, and it may be doubted if anywhere else can be found another such magnificent piece of wilderness so near to a great city. There young Parkman spent his leisure hours in collect- ing eggs, insects, and reptiles, trapping squirrels and woodchucks, and shooting birds with arrows. This breezy life saved him from the artificial stupidity which is too often superinduced in boys by their school train- ing. At the age of fourteen Parkman began to show a strong taste for literary composition. In 1841, while a student at Harvard, he made a rough journey of explora- tion in the woods of northern New Hampshire, where he had a taste of adventure slightly spiced with hardship. About this time he made up his mind to write a history of the last French war in America, which ended in the conquest of Canada, and some time afterwards he enlarged the plan so as to include the whole course of the American conflict between France and Great Britain ; or, to use his

own words, ” The history of the American forest ; for this was the light in which I regarded it. My theme fas- cinated me, and I was haunted with wilderness images day and night.” The way* in which true genius works could not be more happily described. In the course of 1842 an attack of iUness led to his making a journey in Italy, where he spent some time in a monastery belong- ing to one of the strictest of all the monastic orders, the

Passionists, brethren addicted to wearing hair shirts and scourging themselves without mercy. In the young his- torian’s eyes these good brethren were of much value as living and breathing historic material. In 1844 he graduated at Harvard with high rank.

He now made up his mind to study the real wilder- ness in its gloom and vastness, and to meet face to face the dusky warriors of the Stone Age. To-day such a thing can hardly be done within the United States, for nowhere does the primitive wilderness exist save here and there in shreds and patches. So recently as the middle of the 19th century, however, it covered the western half of the continent, and could be reached by a journey of 1600 or 1700 miles from Boston to the plains of Nebraska. Parkman had become an adept in wood- craft and a dead shot with the rifle, and could do such things with horses, tame or wild, as civilized people never see done except in a circus. In company with his friend

Fkascis Parkman.

and class-mate, Mr Quincy Shaw, he passed several months with the Ogillalah band of Sioux. Knowledge, intrepidity, and tact carried Parkman through these experiences rm.- scathed, and good luck kept him clear of encounters with hostile Indians, in which these qualities might not have sufficed to avert destruction. It was a very important experience in relation to his life work. This outdoor life, however, did not suffice to recruit Parkman’s health, and by 1848, when he began writing TJie Conspiracy of Pontiac, he had reached a truly pitiable condition. The trouble seems to have been some form of nervous exhaustion, accompanied with such hypersensitiveness of the eyes that it was impossible to keep them open except in a dark room. Against

these difficulties he struggled with char- acteristic obstinacy. He invented a machine which so supported his hand that he could write legibly with closed eyes. Books and documents were read aloud to him, while notes were made by him with eyes shut, and were afterwards deciphered and read aloud to him tiU he had mastered them. After half an hour his strength would give out, and in these circumstances his rate of composi- tion for a long time averaged scarcely six lines a day. The superb historical monograph composed under such difficulties was published in 1851. It had but a small sale, as the American public was then too ignorant to feel much interest in American history.

Undeterred by this inhospitable reception, Parkman

took up at the beginning his great work on France and England in the New World, to which the book just men- tioned was in reality the sequel. This work obliged him to trace out, collect, arrange, and digest a great mass of incongruous material scattered on both sides of the At- lantic, a large portion of which was in manuscript, and required much tedious exploration and the employment of trained copyists. This work involved several journeys to Europe, and was performed with a thoroughness approaching finality. In 1866 the first volume of the great work appeared, under the title of Pioneers of Prance in the New World; and then seven-and-twenty years more elapsed before the final volumes came out in 1892. Nowhere can we find a better illustration of the French critic's definition of a great life â€" a thought con- ceived in youth, and realized in later years. After the Pioneers the sequence is The Jesuits in North America, La Salle and the Discovery of the Cheat West, The Old Regime in Canada, Frontenac and New France and Louis XIV., Montcalm and Wolfe, A Half Century of Conflict. As one obstacle after another was surmounted, as one grand division of the work after another became an accomplished fact, the effect upon Parkman's condition seems to have been bracing, and he acquired fresh im- petus as he approached the goal. There can be little doubt that his physical condition was much improved by his habit of

cultivating plants in garden and conserva- tory. He was a horticulturist of profound attainments, and himself originated several new varieties of flowers. His work in this department made him an enthusiastic adherent of the views of Darwin. He was professor of horticulture in the Agricultural School of Harvard in 1871-72, and published a few books on the subject of gardening. He died at Jamaica Plain, near Boston, on 8th November 1893.

The significance of Parkman's work consists partly in the success with which he has depicted the North American Indians, those belated children of the Stone Age, who have been so persistently misunderstood alike by romancers, such as Cooper, and by detractors like Dr Palfrey. Parkman was the first great literary author who really understood the Indian's character and motives. Against this savage background of the forest Parkman shows the rise, progress, and dramatic termination of the colossal struggle between France and Great Britain for colonial empire. With true philosophic insight he shows that France failed in the struggle not because of any in- feriority in the ability and character of the men to whom the work was entrusted, but chiefiy by reason of her despotic and protective regime. There is no more eloquent commentary upon the wholesome results of British self- government than is to be found in Parkman's book. But while the author deals with history philosophically, he â€¢ does not, like Buckle, hurl at the reader's head huge generalizations, or, like Carlyle, preach him into somno- lence. With all its manifold instruetiveness, his book is a narrative as entertaining as those of Maeaulay or Froude. In judicial impartiality Parkman may be com- pared with Gardiner, and for depth and accuracy of learning, with Bishop Stubbs. Take liim for all in all, he is incomparably .the greatest historian that America has produced. (j. fi.)

Paria Kimedl, a town of British India, in the Ganjam district of Madras. Population (1881), 10,812; (1891), 16,379; municipal income (1897-98), Es.13,600. It is the residence of a raja, who claims descent from the ancient kings of Orissa. His estate covers an area of 764 square miles, and pays a revenue of Â£8782 out of an estimated income of Â£53,274. He maintains a college, with 32 students in 1896-97; a high school, with 302

pupils ; a printing-press, issuing an English newspaper ; and two libraries. A steam tramway of 2 feet gauge, for 25 miles, has been sanctioned.

Parliament. â€” Procedure. â€” The change in the char- acter of the House of Commons since 1832 has rendered necessary important changes in its rules of procedure. No fewer than seventeen committees made recommendations for the improvement of procedure between that date and 1902, but until the forms of the House were openly utilized to delay the progress of Government business the changes made were comparatively insignificant. They were necessi- tated by the increased volume of business with which the re- formed Parliaments had to deal, andby the gradual transfer to Government of the whole work of controversial legisla^ tion. They consisted in (1) the discontinuance of super- fluous forms, questions, and amendments ; (2) restrictions of debates upon questions of form ; (3) improved arrange- ments for the distribution of business ; (4) the delegation of some of the minor functions of the House to committees and officers of the House ; and (5) increased publicity in the proceedings of the House.

With the entry of Mr Parnell and his Irish Nationalist followers into Parliament (1875-1880) a new era began in the history of the House of Commons. Parnell's professed object was to discredit that assembly, and, by demonstrat- ing its insufficiency to deal with the affairs of the United Kingdom, to prove the necessity of Home Rule for Ireland. His tactics were to oppose all business of whatever kind, and at all hours. The Speaker could only administer the rules as they stood. They had '[i^J^^'â€ž been evolved out of the experience of centuries, during which the House had been on the whole homo- geneous, and, however much members might differ in politics, they were wholly loyal to the historic assembly to which they had been elected, and were, moreover, answer- able to the public opinion of their fellow-countrymen. But it was to public opinion in Ireland, not in England, that Mr Parnell looked for support, and so far were his efforts to discredit the House of Commons from exciting resent- ment there, that they gained for him a popularity un- rivalled since the days of O'Connell. In one sense, indeed, his tactics were justified by their success, for after ten years'

persistence in this novel method of opposition he succeeded in convincing one of the great political parties that the Irish claims could no longer be safely resisted, for the reason, among others, that " Ireland blocked the way" to British legislative reforms. It was not until February 1880 that the House so far overcame its reluc- tance to restrict liberty of discussion as to pass, in its ear- liest form, the rule dealing with " order in debate." It provided that whenever a member was named by the Speaker or Chairman as " disregarding the authority of the Chair, or abusing the rules of the House by persist- ently and wilfully obstructing the rules of the House," a motion might be made, to be decided without amendment, or debate, for his suspension from the service of the House during the remainder of the sitting ; and that if the same member should be suspended three times in one session, his suspension on the third occasion shouldcontinueforaweek, and until a motion had been made upon which it should be decided, at one sitting, by the House, whether the suspension – should then cease or not. The general election, which took place two months later, restored Mr Gladstone to power and to tli^leadership of the House. Mr Parnell returned to Par- lian/ent vrith a more numerous following and resumed his foritier tactics. In January 1881 the Protection of Persons and Property (Ireland) Bill was introduced. For twenty- two hours Parnell fought the motion giving precedence to the Bill, and for four sittings its introduction. The fourth sittingl lasted forty-one hours. Then Mr Speaker Brand

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intervened, and declined to call on any other member who might rise to address the House, because repeated dilatory- motions had been supported by small minorities in opposi- tion to the general sense of the House. He added : " A crisis has thus arisen which demands the prompt inter- position of the Chair and of the House. The usual rules have proved powerless to ensure orderly and effective debate. An important measure, recommended by her Majesty nearly a month

since, and declared to be urgent in the interests of the State by a decisive majority, is being arrested by the action of an inconsiderable minority, the members of which have resorted to those modes of obstruction which have been recognized by the House as a parliamentary offence. The dignity, the credit, and the authority of this House are seriously threatened, and it is necessary they should be vindicated. . . . Future measures for ensuring orderly debate I must leave to the judgment of the House. But the House must either assume more effectual control over its debates, or entrust greater powers to the Chair." The Speaker then put the question, which was carried by an overwhelming majority. Then followed the decisive struggle. Mr Gladstone gave notice for the next day (3rd February) of an urgency rule, which ordered, " That if the House shall resolve by a majority of three to one that the state of public business is urgent, the whole power of the House to make rules shall be and remain with the Speaker until he shall declare that the state of public business is no longer urgent." On the next day a scene of great dis- order ended in the suspension of the Ifationalist members, at first singly, and afterwards in groups. The urgency rule was then passed without further difficulty, and the House proceeded to resolve, "That the state of public business is urgent." The Speaker laid upon the table rules of sufficient stringency, and while they remained in force progress in public business was possible. During this session the Speaker had to intervene on points of order 936 times, and the Chairman of Committees 939 times ; so that, allowing only five minutes on each occa- sion, the wrangling between the Chair and members occupied 150 hours.

The events of the session of 1881 and the direct appeal of the Speaker to the- House proved the necessity of changes in the rules of procedure more drastic than had hitherto been proposed. Accordingly, in the first week of the session of 1882 Mr Gladstone laid his proposals on the table, and in moving the first resolution on 20th February, he reviewed, in an eloquent speech, the history of the Standing Orders. It was his opinion, on general grounds, that the House should settle its own procedure, but he showed that the numerous committees which, since 1832, had sat on the subject, had failed for the most part to carry their recommendations into eJEect from the lack of the requisite " propelling

power," and he expressed his regret that the concentration of this power in the hands of the Government had ren- dered it necessary that they should undertake a task not properly theirs. He noted two main features in the history of the case : (1) the constantly increasing labours of the House, and (2) its constantly decreasing power to despatch its duties; and while he declared that "the â€¢fundamental change which has occurred is owing to the passing of the first great Eeform Bill," he pointed out that the strain had not become intolerable till the develop- ment in recent years of obstructive tactics. He defined obstruction as " the disposition either of the minority of the House, or of individuals, to resist the prevailing will of the House otherwise than by argument," and reached the conclusion that the only remedy for a state of things by which the dignity and efficiency of the House were alike compromised, was the adoption in a carefully guarded

The closure.

form of the process known on the Continent as the " cloture." He explained that in his early years the House was virtually possessed of a closing power, because it was possessed of a means of sufficiently making known its inclinations ; and to those inclinations uniform defer- ence was paid by members, but that since this moral sanction had ceased to be operative, it was necessary to substitute for it a written law. The power to close debate had been of necessity assumed by almost all the European and American assemblies, the conduct of whose members was shaped by no traditional considerations; and the entry into Parliament of a body of men to whom the traditions of the House were as nothing, made it necessary for the House of Commons to follow this example. He proposed, therefore, that when it appeared to the Speaker, or to the Chairman of Committees, during any debate to be the evident sense of the House, or of the committee, that the question be now put, he might so inform the House, and that thereupon on a motion being made, " That the question be now put," the question under discussion should be forthwith put from the Chair, and decided in the affirmative if supported by more than 200 members, or, when less than 40 members had voted against it, by more than 100 members. This resolu- tion was vehemently contested by the Opposition, who

denounced it as an unprecedented interference with the liberty of debate, but was eventually carried in the autumn session of the same year, after a discussion extending over nineteen sittings.

On 20th November the Standing Order of 28th February 1880, providing for the suspension of members who persistently and wilfully obstructed the business of the House- or disregarded the authority of the Chair, was amended by the increase of the penalty to suspension on the first occasion for one week, on the second occasion for a fortnight, and on the third, or any subsequent occasion, for a month. The other rules, framed with a view to freeing the wheels of the parliamentary machine, and for the most part identical with the regulations adopted by Mr Speaker Brand under the urgency reso- lution of 1881, were carried in the course of the autumn session, and became Standing Orders on 27th November.

Mr Gladstone's closure rule verified neither the hopes of its supporters nor the fears of its opponents. It was not put into operation until 20th February 1885, when the Speaker's declaration of the evident sense of the House was ratified by a majority of 207 â€" a margin of but seven votes over the necessary quorum. It was clear that no Speaker was likely to run the risk of a rebuff â€¢ by again assuming the initiative imless in the face of extreme urgency, and, in fact, the rule was enforced twice only during the five years of its existence.

In 1887 the Conservative Government, before the introduction of a new Coercion Bill for Ireland, gave efficiency to the rule by an important amendment. They proposed that any member during a debate might claim to move, "That the question be now put," and that with the consent of the Chair this question shall be put forthwith, and decided without amendment or debate. Thus the initiative was transferred from the Speaker to the House. Mr Gladstone objected strongly to this alteration, chiefly on the ground that it would throw an unfair burden of responsibility upon the Speaker, , who would now have to decide on a ques- tion of opinion, whereas under the old rule he was only called upon to determine a question of evident fact. The alternative most generally advocated by the Opposition was the automatic closure by a

bare majority at the end of each sitting, an arrangement by which the Chair would be relieved from an invidi- ous responsibility; but it was pointed out that vinder

such a system the length of debates would not vary with the importance of the questions debated. After fourteen sittings the closure rule was passed on 18th March and made a Standing Order.

In the next session, on 28th February 1888, the rule was yet further strengthened by the reduction of the majority necessary for its enforcement from 200 tb 100. No further alteration was made up to 1902, so that the rule in its present form stands as follows : â€”

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That, after a question has been proposed, a member rising in his place may claim to move, “That the question be now put,” and, unless it shall appear to the Chair that such motion is an abuse of the rules of the House, or an infringement of the rights of the minority, the question, “That the question be now put,” shall be put forthwith, and decided without amendment or debate.

When the motion “That the question be now put,” has been carried, and the question consequent thereon has been decided, any further motion may be made (the assent of the Chair as aforesaid not having been withheld), which may be requisite to bring to a decision any question already proposed from the Chair ; and also if a clause be then under consideration, a motion may be made (the assent of the Chair as aforesaid not having been with- held) , ” That the question ‘ That certain words of the clause defined in the motion stand part of the clause,’ or ‘That the clause stand part of, or be added to, the Bill, ‘ be now put. ‘ ‘ Such motions shall be put forthwith, and decided without amendment or debate.

That questions for the closure of debate shall be decided in the affirmative, if, when a division be taken, it appears by the num- bers declared from the Chair that not less than one hundred mem- bers voted in the majority in support of the motion.

The closure, originally brought into being to defeat the tactics of obstruction in special emergencies, has now become a part of parliamentary routine. The modern practice of retarding the progress of Government measures by amendments moved to every line, has unhappily been adopted by both the great political parties when in Opposi- tion, and has led on two occasions to the forcing through

Parliament by means of the process known as â„¢Â® the "guillotine" of important Bills, most of

Ha"."" the clauses in which had been undiscussed. On

17th June 1887, after prolonged debates on the Crimes Bill in committee, clause 6 only having been reached, the remaining 14 clauses were put without dis- cussion, and the Bill was reported in accordance with previous notice. "This precedent was followed by Mr Gladstone in 1893, when many of the clauses of the Home Eule Bill were carried through committee and on report by the same machinery. Thus to the Conserva- tives must be imputed the invention of this irrational method of legislation, to their opponents the use of it to carry a great constitutional innovation to which the majority of English and Scottish representatives were opposed.

The principle of closure has been extended to the debates on Supply. The old rule, that the redress of grievances should precede the granting of money, dating from a time when the minister of the Grown was so far from commanding the confidence of the majority in the House of Commons that he was the chief object of their attacks, nevertheless continued to govern the proceedings of the House in relation to Supply without much resultant inconvenience, until the period when the new methods adopted by the Irish Nationalist party created a new situation. Until 1872 it continued to be possible to discuss any subject by an

amendment to the motion for going into Supply. In that year a resolution was passed

limiting the amendments to matters relevant to fute*’ ^^^ ^^^^^ Â°^ estimates about to be considered,

and these relevant amendments were further restricted to the first day on which it was proposed to go into committee. This resolution was continued in 1873, but was allowed to drop in 1874. It was revived in a modified form in 1876, but was again allowed to drop in 1877. In

1879, on the recommendation of the Northcote committee, itwas provided in a Sessional Order that whenever the com- mittees of Supply or of Ways and Means stood as the first order on a Monday, the Speaker should leave the chair with- out question put, except on first going into committee on the Army, Navy, and Civil Service estimates respectively. In 1882 Thursday was added to Monday for the purposes of the Order, and, some further exceptions having been made to the operation of the rule, it became a Standing Order. The conditions, however, under which the estimates were voted remained unsatisfactory. The most useful function of the Opposition is the exposure of abuses in the various departments of administration, and this can best be per- formed upon the estimates. But ministers, occupied with their legislative proposals, were irresistibly tempted to postpone the consideration of the estimates until the last weeks of the session, when they were hurried through thin Houses, the members of which were impatient to be gone. In order to meet this abuse, and to distribute with some regard to the comparative importance of the subjects discussed the limited time which it was possible to allot to the estimates, Mr Balfour in 1896 proposed and carried a Sessional Order iqi the closure of Supply. By this, Supply, unimpeded by any dilatory motion, was to be the first order of the day on every Friday. A maximum of twenty-three, days was to be given to its consideration, of which the last three alone might be taken after 6th August. On the last but one of the allotted days at 10 o’clock the Chairman was to put the outstanding votes, and on the last day the Speaker at the same hour was to put the remaining questions necessary to complete the reports of

Supply. During the course of the session Mr Balfour consulted the leaders both of the Liberal and of the Nationalist Oppositions as to the estimates which they desired to discuss, and those were placed first on the paper on the succeeding Fridays. This Order was renewed in successive sessions until 1901, when an alteration was made in it by which logic was sacrificed to expediency. Year after year, when the closure of Supply came on, many hours were spent in the division lobby owing to the necessity under the order of a decision on every vote separately. In 1901 Mr Balfour so altered the resolution that the question was put, not with respect to each vote, but to each class of votes in the Civil Service estimates, and to the total amounts of the outstanding votes in the Army, Navy, and Revenue estimates. It is in this form that the Order was carried in the earlier session of 1902, with the view of making it a Standing Order.

The appointment of standing committees, competent to represent the general opinion of the House, and aided by members appointed specially to serve in regard standing to particular Bills, was suggested by Sir Erskine com. May in his evidence before the Northcote com- oiittees. mittee of 1878. Effect was given to this suggestion by the resolutions of November and December 1882, when two standing committees were appointed for the considerar tion of all Bills relating to law and courts of justice and of trade, which might, by order of the House, be referred to them. In accordance with these resolutions the standing committees were set up in the session of 1883. The Criminal Procedure Bill was referred to the standing committee on law, and the Bankruptcy Bill to the stand- ing committee on trade. In the latter instance the ex- periment proved a success, but the Criminal Procedure Bill was withdrawn. Between 1883 and 1888 the stand- ing committees were not reconstituted. By 1886 it had become clear to most of the opponents of Home Rule that some alternative scheme of delegation to relieve the labours of Parliament was necessaryto their position. Accordingly, the Hartington committee of 1886 made in their repoi-t a recommendation which, had it been adopted, would have

PARLIAMENT

Time of business.

reTolutionized parliamentary procedure. They advised that the whole House should be divided at the com- mencement of the session into four standing committees, twenty members being a quorum in each, and that to these committees every public Bill, after the second reading, should be referred, except those originating in the committee of Ways and Means. This suggestion did not recommend itself to the House, but in 1888 the resolutions of 1882 were revived, and, after trade had been defined to include agriculture and fishing, they were made Standing Orders.

As constituted in 1902, these committees consisted of not less than sixty nor more than eighty members, nominated by the committee of selection, who have regard to the classes of Bills committed to such com- mittees, to the composition of the House, and to the qualifications of the members selected; and who have power to discharge members from time to time, and to appoint others in their place. The quorum of each committee is twenty. The committee of selection have also power to add fifteen members to a standing com- mittee in respect of any particular Bill. Bills reported from the standing committees are proceeded with as if they had been reported from committees of the whole House. The system of standing committees has worked well on the whole. At first it was understood that controversial Bills were not to he referred to them, but there has been a tendency to dispense with this limitation.

Important alterations have been made in the time-table of the House of Commons in recent years. The Stand- ing Order of February 1879, under which no opposed business, except money Bills, Bills to which no notice of opposition had been given, and proceedings under any Act of Parliament, might be taken after 12.30 a.m., was amended in 1882, by exempting from the operation of the Order motions for leave to bring in Bills, and Bills which had passed through committee of the whole House. By the Stand- ing Order of 24th February 1888 the Hovise resolved to meet at 3 o'clock, instead of at 4, on every Monday,

Tuesday, Thursday, and Friday. The sittings, under the Order, continued till midnight, when the business then under consideration was interrupted, and no further opposed business was taken. At 1 o'clock the Speaker adjourned the House without question put. On Wednes- days, when the House met at 12, the interruption of busi- ness was at 5.30 p.m., and the House stood adjourned at 6. Closure might be moved at the interruption of busi- ness, on the question then under consideration, and on the questions consequent thereon. Bills originating in committee of Ways and Means, and proceedings under any Act of Parliament, were exempted from the pro- visions of this Order.

The sittings of the House continued to be regulated by the Standing Order of 1888 until May 1902, when further important changes were made. The chief inconvenience experienced under the Order of 1888 was the frequent postponement of the orders of the day by the unexpected intervention of motions for adjournment or of private bjisi- ness. A main object of the amended rule was to give cer- tainty to members as to the business to be taken at any particular sitting. Thursday was substituted for Friday as the day on which Supply is to be taken, with the addi- tional proviso that no business other than the business of Supply may be taken before 12 o'clock on that night, and Friday took the place of Wednesday for the morning sit- tings. It was further ordered that the House shall meet every Monday, Tuesday, Wednesday, and Thursday, at 2 o'clock for an afternoon sitting, and at 9 o'clock for an evening sitting. The afternoon sittings last till 7.30, when

the speaker adj ourns the House without question put. The 12 o'clock rule of 1888 holds good for the evening sittings. No alteration has been made in the hours of the morning sittings. To secure the afternoon sittings from interrup- tion, it has been ordered that all private business not dis- posed of by 2.16 shall be postponed until such time as the Chairman of Ways and Means may determine, and that motions for adjournment for the discussion of a " definite matter of urgent public importance " shall stand over until the evening sitting of the same day, when they take pre- cedence of private business. These motions for

adjourn- ment, in accordance with the Standing Order of November 1882, must be made after the questions asked at the com- mencement of public business have been disposed of. The member who proposes to make such a motion must obtain the acquiescence of the Speaker in his claim that the ques- tion he wishes to discuss is a definite matter of urgent public importance, and also the support of at least forty members, signified by their rising in their places on the Speaker's invitation. Another change in procedure in- troduced in 1902 relates to questions addressed to minis- ters. These questions are now taken at 2.15 p.m., and may be asked until 2.55, when, with the exception of questions unanswered owing to the absence of the minister addressed, or those of an urgent nature which have not appeared upon the paper, they give way to the business of the House. But the most important change is contained in the follow- ing provisions : â€"

Any memlDer who desires an oral answer to his question may distinguish it by an asterisl!:, but notice of any such question must appear at latest on the notice paper circulated on the day before that on which an answer is desired.

If any member does not distinguish his question by an asterisk, or if he, or any other member deputed by him, is not present to ask it, or if it is not reached by five minutes before 3 of the clock, the minister to whom it is addressed shall cause an answer to be printed and circulated with the votes, unless the member has signified his desire to postpone the question.

This rule worked well, and much time was saved for public business.

The consequences of the rise of obstruction and of the 12 o'clock rule, together with the mandate of the elec- tors, having combined to place in the Government all the motive power of the House of Commons, it had followed of necessity that in successive sessions- ministers had taken by resolution most of the time at the disposal of that assembly. To this allocation of time a formal sanction was given by the Order of 11th April 1902. Government business now enjoys precedence at every sitting except the evening sitting on Tuesday and Wednesday, and the sitting on Friday. After Easter it has precedence at the evening sittings

on Tuesday, and after Whitsuntide at all evening sittings, and at all Friday sittings except the sittings on the third and fourth Fridays after Whit- sunday. At the evening sittings allocated to private members, notices of motion take precedence of the orders of the day. It is therefore only on Fridays before Whit- suntide and on two Fridays subsequently that the Bills introduced by private members can now be discussed.

On 5th March 1901 certain Irish Nationalist members refused to leave the House for a division on a motion for closure moved by]\[r Balfour. They were there- upon suspended for wilfully obstructing the Suspea- business of the House, and as they declined to ^J,Tâ€ž,ttrs. withdraw, the Speaker was obliged to direct the Serjeant-at-Arms to cause them to be removed by force. Action had to be taken to preclude the recurrence of so scandalous a scene. On 7th March, afr the instance of Mr Balfour, a paragraph was added to the Standing Order of 1882 relating to order in debate, to the effect that in cases where recourse to force had been found necessary to compel any member, or members acting jointly, to

obey the direction of the Speaker, such member or mem- bers shall thereupon, and without further question put, be suspended from the House during the remainder of the session. It was proposed still further to increase the several periods of suspension for disregarding the author- ity of the Chair â€” on the first occasion so as to last for 20 days on which the House sits, on the second occasion for 40 days, and on the third or any subsequent occasion for 80 days. The amendments embodying this alteration were proposed in February 1902, but their further con- sideration was postponed till the autumn session.

Histori]. â€” The Reform Act of 1884 was ultimately carried with the goodwill of both the great political parties. The Conservatives resisted Mr Gladstone’s attempt to carry a great extension of the franchise be- fore he had disclosed his scheme of redistribution, and the Bill was

thrown out by the House of Lords in August 1884. But after a conference of Mr Glad- stone with Lord Salisbury, to whom the whole scheme was confided, an agreement was reached, and the Bill was passed in the autumn session. In the following session (1885) the Redistribution Act was passed.

A uniform household and lodger franchise was estab- lished in counties and boroughs. If a dwelling was held as part payment for service, the occupier was not deprived of his vote because his home was the property of his master. The obligation was thrown on the overseers of ascertaining whether any other man besides the owner was entitled to be registered as an inhabitant occupier, and the owner was bound to supply the overseers with the information. The Registration Acts were otherwise widely amended. Polling-places were multiplied, so that little time need be lost in recording a vote. These and other beneficial changes went a long way towards giving a vote to every one who had a decent home. By the Redistribution of Seats Act, 1885, all boroughs with less than 15,000 inhabitants ceased to return a member. These small towns were merged into their counties, and the counties were subdivided into a great number of single member constituencies, so that the inhabitants of the disfranchised boroughs voted for the member for the division of the county in which they were situated. Boroughs with less than 50,000 inhabitants returning two members were in future to return only one, and towns of over 100,000 were divided into sep- arate constituencies, and received additional members in proportion to their population. The members for the City of London were reduced to two, but Greater London, including Croydon, returned sixty. Divided Liverpool returned nine, Glasgow seven, Edinburgh, Dublin, and Belfast each four, and so on. Six addi- tional seats were given to England and twelve to Scotland, so that, allowing for a diminution by disfran- chisement for corruption, the numbers of the House of Commons were raised to 670 members.

The most noteworthy effect from a constitutional stand- point of the successive Reform Acts has been the gain in power, of the executive on the one hand and of the elec- torate on ~~the other, at the expense of the House of Com~~ mons. Before 1832 the functions of ministers were

mainly administrative, and Parliament was able to deal much as it pleased with their rare legislative proposals Avithout thereby depriving them of office. Moreover, since before that date ministers were, generally speaking, in fact as well as in theory appointed by the king, while the general confidence of the majority in the House of Commons followed the confidence, not of the electorate, but of the Crown, that House was able on occasions to exercise an effective control over foreign policy. Pitt, after 1784, was defeated several times on foreign and

domestic issues, yet his resignation was neither expected nor desired. In 1788, when the regency of the prince of Wales appeared probable, and again in 1812, it was generally assumed that it would be in his power to dismiss his father's ministers and to maintain the ^Vhigs in of&ce without dissolving Parliament. This system, while it gave to ministers security of tenure, left much effective freedom of action to the House of Commons. But the Reform Act of 1832 introduced a new order of things. In 1835 the result of a general election was for the first time the direct cause of a change of ministry, and in 1841 a House of Commons was elected for the express purpose of bringing a particular statesman into power. The electorate voted foy Sir Robert Peel, and it would have been as impossible for the House then elected to deny him their support as it would be for the college of electors in the United States to exercise their private judgment in the selection of a President. The Premier now derives his power neither from the Crown, nor from Parliament, but from the electorate, and to the electorate he is able to appeal if deserted by his majority. Unless it is prepared to drive him from the oflBce in which it was elected to support him, that majority will not venture to defeat, or even seriously to modify, his legislative proposals, or to pass any censure on his foreign policy, for all such action is now held to be eqtiivalent to a vote of no confidence. Prom the pass- ing of the Reform Act of 1867 down to 1900 (with a sin- gle exception due to the lowering of the franchise and the redistribution of seats) the electorate voted alter- nately for the rival party leaders, and it was the function of the Houses elected for that purpose to pass the meas- ures and to endorse the general policy with which those leaders were respectively identified. The Cabinet tends to become an executive committee acting on behalf

of the electorate, charged to make certain changes in the law, pledged to govern the country in accordance with certain general principles ascertained beforehand, and removable only after a dissolution. This change of system has greatly added to the power of the Cabinet, because the control to which they were subject when dependent on the House of Commons was constant and immediate, whereas it is only at long intervals of time that they have to settle acconnts with the electorate. On the other hand, the virtual identification of the electorate with the nation by the successive extensions of the franchise has added im- mensely to its power, the chief remaining limitations of which are supplied by the Septennial Act and the non- payment of members. The House of Lords restricts the action rather of the House of Commons than of the elec- torate, for the acquiescence of the Upper House in the decision of the electors, when they have been appealed to on a specific point at issue between the two Houses, has been affirmed in principle by Lord Salisbury, and may now be regarded as a constitutional convention.

Between 1885 and 1902 there was no further change in the constitution of either House of Parliament. But the frequent differences between the two Houses during the Parliament of 1880-85, culminating in the postponement by the Upper House of the Reform Bill, caused the status of that House to be much discussed during the general election of 1885, and proposals for its ” mending or ending” to be freely canvassed on radical platforms. On 5th March 1886 Mr Labouchere moved a resolution in the House of Commons condemning the hereditary^ principle. This was resisted by Mr Gladstone, then Prime Minister, on the ground that he had never supported an abstract resolution unless he was prepared to follow it up by action, and that the time for this had not arrived. On a division the motion was negatived by 202 votes against 166. The question of the constitution of the

House of Lords was much agitated in 1888. The Con- servatives were again in power, but many of them thought that it would be prudent to forestall by a moderate reform the more drastic remedies now openly advocated by their opponents. On the other hand, Radicals were disposed to resist all changes involving the maintenance of the hereditary principle, lest they should thereby strengthen the House of Lords. On 9th March Mr Labouchere again moved his resolution in the House of Commons. Mr W. H. Smith, the leader of the House, in resisting the mo- tion, admitted that some changes were desirable, and agreed with a previous speaker that it was by the Con- servatives that such changes ought to be effected. On 19th March in the same year Lord Rosebery, in the House of Lords, moved for a select committee to inquire into the subject. He took the opportunity to explain his own plan of reform. While he did not wish to abolish the hereditary principle, he desired that no peer, outside the Royal family, should be a member of the House by right of birth alone. To the representatives of the Peers he proposed to add other men who had achieved distinction in a public career. He attached a high importance to the existence of a second chamber. His motion was negatived by 97 votes against 50. On 26th April Lord Dunraven withdrew a Bill for the reform of the House of Lords on the promise of the Government to deal with the matter, and on 18th June Lord Salisbury fulfilled this pledge. He introduced a Bill on that day to provide for the crea- tion of a limited number of life peers and for the exclu- sion of unworthy members from the House. Under this measure a maximum of five life-peerages in any one year might be created, but the total number was never to exceed fifty. In respect of three out of these five life- peers the choice of the Crown was restricted to judges, generals, admirals, ambassadors, privy councillors, and ex-governors of colonies. The two additional life-peers were to be appointed in regard to some special qualifica- tion to be stated in the message to the House announcing the intention of the Crown to make the appointment. Power was also to be given to the House to expel mem- bers for the period of the current Parliament by an address to the Crown praying that their writs of summons might be cancelled. The Bill was read a second time on 10th July, but it met with a cold reception and was dropped. The only outcome of all that was written and said in this year was that in 1889, after the report of a select

committee set up in 1888, the Lords made a few changes in their Standing Orders, among which the order establishing a quorum of thirty in divisions and those for the constitution of standing committees were the most important.

The Parliament which met at Westmiaster in August 1892 was more democratic in its tendencies than any of its predecessors. At the beginning of the session of 1893, Iq the course of which the Home Rule Bill was passed by the House of Commons, Government Bills were introduced for quinquennial parliaments, for the amendment of registration, and for the limitation of each elector to a single vote. The introduction of these Bills served merely as a declaration of Government policy, and they were not further pressed. On 24th March a reso- lution in favour of payment of members was carried by 276 votes against 229, and again in 1895 by 176 to 158. But the rejection of the Home Rule Bill by the House of Lords, with the apparent acquiescence of the country, combined with the retirement of Mr Gladstone to weaken the influence of this House of Commons, and small im- portance was attached. to its abstract resolutions. In the ensuing session of 1894 an amendment to the Address condemning the hereditary principle'was moved by Mr Labouchere, and carried by 147 to 145. The Govern-

ment, however, holding that this was not the way in which a great question should be raised, withdrew the Address, and carried another without the insertion. In his last public utterance Mr Gladstone directed the atten- tion of his party to the reform of the House of Lords, and Lord Rosebery endeavoured to concentrate on such a policy the energies of his supporters at the general election. But the result of the dissolution of 1895, showing, as it did, that on the chief political issue of the day the electorate had agreed with the House of Lords, and had disagreed with the House of Commons, greatly strengthened the Upper House, and after that date the subject was but little discussed. The House of Lords claims the right to resist changes made by the House of Commons until the will of the people has been definitely declared, and its defenders contend that its ultimate dependence on the electorate,

now generally acknowledged, renders the freedom from ministerial con- trol secured to it by its constitution a national safeguard.

The transfer of all real legislative power from the House of Commons, as such, to the Government has been completed since 1888 by the working of the 12 o'clock rule. The new position of ministers after the Reform Act, when they gradually became, as it were, the man- datories of the electorate, inaugurated the change. Sir Charles Wood, speaking in 1855, remarked that in 1828 "changes in our laws were proposed by independent members and carried, not as party questions, by the com- bined action of both sides of the House. Now," he added, " when an independent member brings forward a subject, it is not to propose himself a measure, but to call to it the attention of the Government. Our defects as legislators, which is not our business, damage us as administrators, which is our business." In 1825 a pri- vate member was able to carry through the House of Commons a measure so bitterly contested as Catholic Emancipation, and though this could not have been done after 1832, it was still, for another half century, possible for private members to surmount the opposition to Bills of less importance. But when a limit was fixed to the time during which opposed business might be taken, and when Government became accustomed to monopolize nearly all the time within that limit, controversial legis- lation initiated by private members became impossible. A resolute minority, however inconsiderable numerically, can stop the progress of any private member's Bill. The Deceased Wife's Sister Bill won the first place in the ballot in the session of 1902. It was read a second time by a majority of more than two to one on the first Wednesday of the session available for private members' Bills, but, though more favourably circum- stanced than any other Bill not introduced by the Govern- ment, it made no further progress. Thus the separation of the legislative from the executive power accomplished, after long struggles, by the early parliaments has practi- cally ceased to exist.

Procedure in Foreign Legislative Asseviblies. â€" The average time occupied by a single sitting of the House of Commons is at least double that found necessary by any other European assembly. The usual length of a sitting in each of the French chambers is from four to five

hours, from 2 P.M. to about 6.30 p.m. The German Reichstag meets at 1 p.m., and sits on an average for four hours. The Austrian Reichsrath sits from 11 a.m. till about 4 p.m. The Italian Senate sits from 3.30 p.m. till about 6,30 p.^., and the Chamber of Deputies from 2 till about 6 p.m. In the United States, on the other hand, the sittings are even longer than at Westminster. Thus, the House of Representatives meets at 11 a.m., the Senate at noon, and both Houses often sit till late at night. The ordinary methodof taking divisions which obtains in the Parliaments

of France, Germany, Italy, Austria, and the United States is par assis et leui. Members in favour of a motion rise in their places, while those opposed to it remain sitting. This method is more expeditious than that in use at West- minster, the process usually occupying only five min- utes, but it must be remembered that in most foreign Chambers members sit in a rising half-circle round the presidential chair, and it is consequently easier for the president to take the opinion of the House in this way than it would be for the Speaker in the existing House of Commons. When the president is in doubt as to the result obtained by assis et lev&, or at the request of a group of members varying in number in the different assemblies, or, finally, on certain specified occasions, such as the final passing of a Bill, recoursd is had to other methods of taking a vote : e.g., in France, to the public ballot ; in Austria and Italy, to the roll-call or the ballot ; in Germany, to ballot, or to a process resembling that of the British Parliament ; and in the United States to the roll-call. In the Senate of the United States divisions are always taken by .the roll-call. The number of mem- bers necessary to form a quorum is in most assemblies much larger than at Westminster. In the American House of Representatives and in the German Eeichstag a quorum consists of an absolute majority of the whole House ; in the Austrian Eeichsrath, of one hundred members. It is possible’ that an increase in the quo- rum of the House of Commons,

at present consisting of forty members, might tend to shorten the length of its sittings. â€¢

Foreign assemblies, as a rule, meet in the autumn and rise in the early summer. In March 1890 a resolution moved by Sir George Trevelyan, proposing that the House of Commons should in this respect follow their example, was negatived by a majority of only four votes (173 to 169). The French Chamber of Deputies sits on an average about 125 days in the year, and the Senate about 90 days ; there are some 86 working days in the session of the German Reichstag; the Italian Chamber sits about 140 days in the year ; and the Austrian Lower House about 150 days. The power to suspend the sitting in cases of grave disorder is everywhere possessed by presidents of foreign legislative assemblies. This power was given to the Speaker of the Hou'Se of Commons on 17th February 1902 by a sessional order which it was proposed to make a Standing Order. In the French and other assemblies Bills do not lapse at a prorogation. Proposals have often been made to introduce this practice into British proced- ure. A committee, presided over by Mr Goschen, was ap- pointed in 1890 to inquire into the subject. In their report they postulated three principles : (1) That it was desirable to increase the power of the House of Commons to deal with long controversial measures ; (2) That it was desir- able to shorten the length of sessions ; (3) That it was not desirable, so long as any alternative remained, to increase the stringency of the closing power. From these princi- ples they deduced the necessity of freeing Parliament in certain cases from the obligation of repeating in two suc- cessive sessions the same debate upon the same questions. This report was adopted by a majority of 11 to 9, Mr Glad- stone and his Liberal colleagues constituting the minority. Mr Gladstone drew up a counter report, in which he sum- marized his objections to the proposal. These were in substance : (1) That the advantage of altering the scope of a Bill in a new session would be lost ; (2) That the motions at the end of a session for suspending Bills would waste more time than would be economized by the suspensions ; (3) That the powers of closure already possessed by the House rendered the change unnecessary ; and (4) That the House of Lords might, by a

similar Standing Order, as- sume an unlimited power of postponing Bills passed by

the House of Commons. No steps were taken to give effect to the recommendations of the committee.

(a. j. s. m.; f. c. h.)

Parma, a town, episcopal see, and capital of the province of Parma, Emilia, Italy, between the Apennines and the Po, 55 miles north-west of Bologna by rail. The university, which was attended by 550 students, with 42 professors, in 1898, and has faculties of law, medicine, and natural science, possesses an observatory and natural science collections, amongst the latter being the Eritrean Zoological Museum. Parma has three theatres, in addi- tion to the ruined Farnese Theatre. It also possesses an officers' school, which is adorned with frescoes by A. Caracci ; a royal college, a royal school of music, an agricultural institute, and a technical school. Statues to Garibaldi (1893), Victor Emmanuel (1893), Correggio (1872), and Parmegianino (1879) adorn the town. From archaeological discoveries it would appear that the ancient Gallic town was preceded by an Etruscan, and this again by a prehistoric settlement of the Bronze Age, the dwell- ings of which rested upon piles. Population (1881),

44,492; (1901), 49,370.

Parnell, Charles Stewart (1846-1891), Irish Nationalist leader, was born at Avondale, county Wick- low, on 27th June 1846. His father was John Henry Parnell, a country gentleman of strong Nationalist and Liberal sympathies, who married in 1834 Delia Tudor, daughter of Commodore Charles Stewart of the United States navy. The Parnell family was of English origin, and more than one of its members attained civic note at Congleton in Cheshire under the Stuarts and during the Commonwealth. Among them was Thomas Parnell, who migrated to Ireland after the Restoration. He had two sons, Thomas Parnell the poet and John Parnell, who became an Irish judge. From the latter Charles Stewart Parnell was lineally descended in the fifth generation. Sir John Parnell, Chancellor of the Exchequer in Grattan's Parliament,

and one of O'Connell's lieutenants in the Parliament of the United Kingdom, was the grandson of Parnell the judge. The estate of Avondale was settled on him by a friend and bequeathed by him to his youngest son William (grandfather of Charles Stewart Parnell). His eldest son was imbecile. His second son was Sir Henry Parnell, a noted politician and financier in the early part of the 19th century. Sir Henry Parnell moved the resolution which displaced Wellington's Government in 1830. He held office under Grey and Melbourne, and after being raised to the peerage as Baron Congleton, he died by his own hand in 1842. William Parnell was no active politician, though he was a keen student of Irish politics, with a strong leaning towards the popular side, and in 1805 he published a pamphlet entitled " Thoughts on the Causes of Popular Discontents," which was favour- ably noticed by Sydney Smith in the Edinburgh Review. Thus by birth and ancestry, and especially by the in- fluence of his mother, who inherited a hatred of England from her father, Charles Stewart Parnell was, as it were, dedicated to the Irish national cause. He was of English extraction, land-owner, and a Protestant. Educated at private schools in England and at Magdalene College, Cambridge, his temperament and demeanour were singu- larly un-Irish on the surface, reserved, cold, repellent, and imemotional ; and yet no man was ever less English in his political sympathies, methods, and aims. He ap- pears to have been rather turbulent as a school-boy, con- tentious, insubordinate, and not over-scrupulous. He had few friends, and was not popular with his companions. He was fond of cricket and devoted to mathematics, but had little taste for other studies or other games. He was subject to somnambulism, and liable to severe fits of

depression â€" facts which, taken in connexion with the existence of mental aflELiction among his ancestors, with his love of solitude and mystery, and his invincible superstitions about omens, numbers, . and the like, may perhaps suggest that his own mental equilibrium was not always stable. He was as little at home in an English school or an

English university as he was afterwards in the House of Commons. ” These English,” he said to his brother at school, ” despise us because we are Irish ; but we must stand up to them. That’s the way to treat an Englishman â€” stand up to him.”

Parnell was not an active politician in his early years. He found salvation as a Nationalist and even as a potential rebel over the execution of the ” Manchester Martyrs ” in 1867, but it was not until some years after- wards that he resolved to enter Parliament. In the meanwhile he paid a length- ened visit to the United States. At the general elec- tion of 1874 he desired to stand for the county of Wick- low, of which he was high sheriff at the time. The Lord-Lieutenant declined to relieve him of his disquali- fying ofBee, and his brother John stood in his place, but was unsuccessful at the poll. Shortly afterwards a bye- election occurred in Dublin, owing to Colonel Taylor having accepted office in the Disraeli Government, and Parnell resolved to oppose him as a supporter of Isaac Butt, but was heavily beaten. He was, however, elected for Meath in the spring of

1875.

Butt had scrupulously re- spected the dignity of Parlia- ment and the traditions and courtesy of debate. He looked very coldly on the method of ” obstruction ” â€” a method invented by certain members of the Conservative party in opposition to the first Gladstone Administration. Parnell, however, entered Parliament as a virtual rebel who knew that physical force was of no avail, but believed that political exaspera- tion might attain the desired results. It would consoli- date the national feeling of Ireland, and might convince the party of physical force that by giving him their covert support he could achieve in the senate what they could never achieve in the field. It was not for nothing that Mr Gladstone had declared that the Manchester murder and the Clerkenwell outrage had ” drawn the attention of the people of Great Britain to the Irish question.” Parnell resolved to make obstruction in Parliament do the work of outrage in the country, to set the church-bell ringing â€” to borrow Mr Gladstone’s meta- ~~pixoT â€” and to keep it ringing in season and out of season in the ears of the House of~~

~~Commons. He did not choose to condemn outrages to gratify the I'harisaism of English members of Parliament. He courted the alli~~ ance of the physical force party, and he had to pay the price for it. He invented and encouraged " boycotting," and did not discourage outrage. When a supporter in America offered him twenty-five dollars, "five for bread and twenty for lead," he accepted the gift, and he sul)sp- quently told the story on at least one Irish platform. In

Charles Stewart Parnell. {Frotn a photograph by WlUiam Lairretice, Dublin.)

the course of the negotiations in 1882, which resulted in what was known as the Kilmainham Treaty, he wrote to Captain O'Shea : " If the arrears question be settled upon the lines indicated by us, I have every confidence that the exertions we should be able to make strenuotisly and unremittingly would be effective in stopping outrages and intimidation of all kinds." This is at least an admission that he had, or could place, his hand on the stop-valve, even if it be not open to the gloss placed on it by Cap- tain O'Shea in a conversation repeated in the House of Commons by Mr Eorster, "that the conspiracy which has been used to get up boycotting and outrage will now be used to put them down."

In 1877 Parnell entered on an organized course of obstruction. He and Mr Joseph Gillis Biggar, one of

his henchmen, were gradu- ally joined' by a small band of the more advanced Home Rulers, and occasionally as- sisted up to a certain point by one or two English mem- bers. Butt was practically deposed and worried into his grave. Shaw, a " transient and embarrassed phantom," was elected in his place, but Parnell became the real leader of a Nationalist party. The original Home Eule party was split in twain, and after the general election of 1880 the more moderate sec- tion of it ceased to exist. (3b- strnction in Parnell's hands was no mere weapon of delay and exasperation ; it was a calculated policy^ the initial stage of a campaign designed to show the mal- contents in Ireland and their kinsmen in other lands that Butt's strictly constitutional naethods were quite helpless, but that the parliamen- tary armoury still contained

weapons which he could so handle as to convince the Irish people and even the Fenian and other physical force societies that the way to Irish legislative independence lay through the House of Commons. The Fenians were hard to convince, but in the autumn of 1877 Parnell persuaded the Home Rule Confederation of Great Britain (an association founded by Butt, but largely supported by Fenians) to depose Butt from its presi- dency and to elect himself in his place. He defined his attitude quite clearly in a speech delivered in New York early in 1880 : â€” " A true revolutionary movement in Ireland should, in my opinion, partake both of a consti- tutional and illegal character. It should be both an open and a secret organization, using the constitution for its own purposes, but also taking advantage of its secret combination. â– ' Parnell's opportun ity came with the general election of 1880, which displaced the Conservative Gov- ernment of Lord Beaconsfield and restored Mr Gladstone to powei' with a majority strong enough at the outset to overpower the Opposition, even should the latter be rein- forced by the whole of Parnell's contingent. Distress was acute in Ireland, and famine was imminent. Ministers had taken measures to relieve the situation before the dissolution was announced, but Lord Beaconsfield had warned the country that there \'as a danger ahead in Ireland " in its ultimate results scarcely less disastrous

than pestilence and famine. ... A portion of its popula- tion is attempting to sever the constitutional tie which unites it to Great Britain in that bond which has favoured the power and prosperity of both. It is to be hoped that all men of light and leading will resist this destruc- tive doctrine." The Liberal party and its leaders retorted that they were as strongly opposed to Home Rule as their opponents, but Lord Beaconsfield's manifesto undoubtedly had the effect of alienating the Irish vote in the English constituencies from the Tory party and throwing it on the side of the Liberal candidates. This was Parnell's deliberate policy. He would have no alliance with either English party. He would support each in turn with a sole regard to the balance of

political power in Parliament and a iixed determination to hold it in his own hands if he could. From the time that he became its leader the Home' Rule party sat together in the House of Commons and always on the Opposition side. Even when Mr Gladstone had formed a Home Rule Government 4n 1886 and introduced a Home Rule Bill, Parnell declined to follow the precedent set by O'Connell, who crossed the House with his followers and took his place on the ministerial side under the second Government of Lord Melbourne.

In the Government formed by Mr Gladstone in 1880 Lord Cowper became viceroy and 'Mr W. E. Forster chief secretary for Ireland. The outlook was gloomy enough, but the Gladstone Government does not seem to have an- ticipated, as Peel anticipated in 1841, that Ireland would be their difficulty. Yet the Land League had been formed by Mr Michael Davitt and others in the autumn of 1879 for the purpose of agrarian agitation, and Parnell after some hesitation had given it his sanction. He visited the United States at the close of 1879. It was then and there that the " new departure "~~â€" the alliance of the open and the secret organizations â€" was confirmed and consoli~~ dated. Parnell obtained the countenance and support of the Clan-na-Gael, a revolutionary organization of the American-Irish, and the Land League began to absorb all the more violent spirits in Ireland, though, the Fenian brotherhood still held officially aloof from it. As soon as the general election was announced Parnell returned to Ireland in order to direct the campaign in person. Though, he had supported the Liberals at the election, he soon found himself in conflict with a Government which could neither tolerate distiu'bance nor countenance a Nationalist agitation, and he entered on the struggle with forces organized, with money in his chest, and with a definite but still undeveloped plan of action. The prevailing distress increased and outrages began to multiply. A fresh Relief Bill was introduced by the Government, and in order to stave off a measure to prevent evictions intro- duced by the Irish party, Mr Forster consented to add a clause to the Relief Bill for giving compensation in certain circumstances to tenants evicted for non-payment of rent. This clause was afterwards embodied in a separate measure known as the Compensation for Dis- turbance Bill,

which after a stormy career in the House of Commons was summarily rejected by the House of Lords.

The whole Irish question was once more opened up in its more dangerous and more exasperating form. It became clear that the land question â€" supposed to have been settled by Mr Gladstone's Act of 1870â€" would have to be reconsidered in all its bearings, and a commission was appointed for the purpose. In Ireland things went from bad to worse. Evictions increased and outrages were multiplied. Intimidation and boycotting were rampant. As the winter wore on, Mr Forster persuaded his colleagues that exceptional measures were needed. An abortive prosecution of Parnell and some of his leading colleagues

had by this time intensified the situation. Parliament was summoned early, and a Coercion Bill for one year, practically suspending the Habeas Corpus Act and allow- ing the arrest of suspects at the discretion of the Government, was introduced, to be followed shortly by an Arms Bill. Parnell regarded the measure as a declara- tion of war, and met it in that spirit. Its discussion was doggedly obstructed at every stage, and on one occasion the debate was only brought to a close, after lasting for forty-one hours, by the Speaker's claiming to interpret the general sense of the House and resolving to put the question without further discussion. The rules of pro- cedure were then amended afresh in a very drastic sense, and as soon as the Bill was passed Mr Gladstone intro- duced a new Land Bill, which occupied the greater part of the session. Parnell accepted it with many reserves. He could not ignore its concessions, and was not disposed to undervalue them, but he had to make it clear to the revolutionary party, whose support was indispensable, that he regarded it only as a payment on account, even from the agrarian point of view, and no payment at all from the national point of view. Accordingly the Land League at his instigation determined to " test " the Act by advising tenants in general to refrain from taking their cases into court until certain cases selected by the Land League had been decided. The Government treated this policy, which was certainly not designed to make the Act work freely and beneficially, as a deliberate attempt to intercept its benefits and to keep

the Irish people in subjection to the Land League ; and on this and other grounds â€” notably the attitude of the League and its leaders towards crime and outrage â€” Parnell was arrested under the Coercion Act and lodged in Kilmainham gaol (17th October 1881).

Parnell in prison at once became more powerful for evil than he had ever been, either for good or for evil, outside. He may have known that the policy of Mr Forster was little favoured by several of his colleagues, and he probably calculated that the detention of large numbers of suspects without cause assigned and without trial would sooner or later create opposition in England. Mr Forster had assured his colleagues and the House of Commons that the power of arbitrary arrest would enable the police to lay their hands on the chief agents of disturbance, and it was Parnell's policy to show that so long as the grievances of the Irish tenants remained unredressed no number of arrests could either cheek the tide of outrage or restore the country to tranquillity. Several of his leading col- leagues followed him into captivity at Kilmainham, and the Land League was dissolved, its treasurer, Patrick Egan, escaping to Paris and carrying with him its books and accounts. Before it was formally suppressed the League had issued a manifesto, signed by Parnell and several of his fellow-prisoners, calling upon the tenants to pay no rents until the Government had restored the con- stitutional rights of the people. Discouraged by the priests, the No-Rent manifesto had little effect, but it embittered the struggle and exasperated the temper of the people on both sides of the Irish Channel.

Lord Cowper and Mr Forster were compelled to ask for a renewal of the Coercion Act with enlarged powers. But there were members of the Cabinet who had only accepted it with reluctance, and were now convinced not only that it had failed, but that it could never succeed. A modus Vivendi was desired on both sides. Parnell was tired of imprisonment and solicitous for his ascendancy in Ireland; Mr Gladstone was impatient of failure. Negotiations were set on foot through the agency of Captain O'Shea â€” at that time and for long afterwards a firm political and personal friend of Parnell, but ultimately his accuser in the Divorce Court â€” and after asomewhat intricate course they resulted

in what was known as the Kilmainham Treaty. As a consequence of this informal agreement, Parnell and two of his friends were to be released at once, the understanding being, as Mr Gladstone stated in a letter to Lord Cowper, "that Parnell and his friends are ready to abandon 'No Eent' formally, and to declare against outrage energeti- cally, intimidation included, if and when the Government announce a satisfactory plan for dealing with arrears." Parnell's own version of the understanding has been quoted above. It also included a hope that the Govern- ment would allow the Coercion Act to lapse and govern the country by the same laws as in England. Parnell and his friends were released, and Lord Cowper and Mr Forster at once resigned.

The Phoenix Park murders (7th May 1882) followed (see Ireland : History). Parnell was prostrated by this catastrophe. In a public manifesto to the Irish people he declared that "no act has ever been perpetrated in our country, during the exciting struggle for social and political rights of the past fifty years, that has so stained the name of hospitable Ireland as this cowardly and unprovoked assassination of a friendly stranger." Pri- vately to his own friends and to Mr Gladstone he ex- pressed his desire to withdraw from public life. There were those who believed that nevertheless he was privy to the Invincible conspiracy. There is some primd facie foundation for this belief in the indifference he had always displayed towards crime and outrage when crime and outrage could be made to serve his purpose ; in his equivocal relation to the more violent and unscrupulous forms of Irish sedition, and in the fact that Byrne, an official of the Land League, was in collusion with the Invincibles, that the knives with which the murder was done had been concealed at the offices of the Land League in London, and had been conveyed to Dublin by Byrne's wife. But the maxim is fecit cui prodest dis- allows these suspicions. Parnell gained nothing by the murders, and seemed for a time to have lost everything. A new Crimes Bill was introduced and made operative for a period of three years. A regime of renewed coer- cion was maintained by Lord

Spencer and Mr (after- wards Sir George) Trevelyan, who had succeeded Lord Frederick Cavendish in the office of Chief Secretary ; Ireland was tortured for three years by the necessary severity of its administration, and England was exasper- ated by a succession of dynamite outrages organized chiefly in America, which Parnell was powerless to pre- vent. The Phoenix Park murders did more than any other incident of his time and career to frustrate Parnell's policy and render Home Rule impossible. He liad denounced the murders ; forthwith the Irish revolution- aries began to suspect him as a mere Whig and time- server. He had connived at other crimes, and seemed to the majority of Englishmen to be a reckless and unscrupulous conspirator, the friend of murderers and assassins.

Eor more than two years after the Phoenix Park mur- ders Parnell's influence in Parliament, and even in Ire- land, was only intermittently and not very energetically exerted. His health was indifferent, his absences from the House of Commons were frequent and mysterious, and he had already formed those relations with Mrs O'Shea which were ultimately to bring him to the Divorce Court. The Phcenix Park murderers were arrested and brought to justice early in 1883. Mr Forster seized the opportunity to deliver a scathing indictment of Parnell in the House of Commons. In an almost contemptuous reply Parnell repudiate.d the charges in general terms, disavowed all sympathy with dynamite outrages, their authors, and abettors â€" the only occasion' on which he ever did so â€" declined to plead in detail "before an English

tribunal, and declared that he sought only the approba- tion of the Irish people. This last was shortly after- wards manifested in the form of a subscription known as the " Parnell Tribute," which quickly reached the amount of Â£37,000, and was presented to Parnell, partly for the liquidation of debts he was known to have contracted, but mainly in recognition of his public services. The Irish National League, a successor to the suppressed Land League, was founded in the autumn of 1882 at a meeting over which Parnell presided, but he looked on it at first with little favour, and its action was largely paralysed by the

operation of the Crimes Act and the vigorous administration of Lord Spencer.

The Crimes Act, passed in 1882, was to expire in 1886, but the Government of Mr Gladstone was in no position to renew it as it stood. In May notice was given for its partial renewal, subject to changes more of form than of substance. The second reading was fixed for 10th June. On 8th June Parnell, with thirty-nine of his followers, voted with the Opposition against the Budget, and defeated the Government by a majority of 264 votes to 262. Mr Gladstone forthwith resigned. Lord Salis- bury undertook to form a Government, and Lord Carnar- von became viceroy. The session was rapidly brought to an end with a view to the dissolution rendered neces- sary by the Franchise Act passed in 1884 â€" a measure which was certain to increase the number of Parnell's adherents in Parliament. It seems probable that Parnell had convinced himself before he resolved to join forces with the Opposition that a Conservative Government would not renew the Crimes Act. At any rate, no at- tempt to renew it was made by the new Government, which showed itself strangely complaisant towards Par- nell and his followers by consenting to an inquiry, which Lord Spencer and his colleagues had steadfastly refused, into certain matters connected with recent agrarian murders and their punishment. Moreover, Lord Carnar- von, the new viceroy, was known to Parnell and to some others among the Irish leaders to be not unfavourable to some form of Home Eule if due regard were paid to im- perial unity and security. He sought and obtained a personal interview with Parnell, explicitly declared that he was speaking for himself alone, heard Parnell's views, expounded his own, and forthwith reported what had taken place to the Prime Minister. In the result the new Cabinet refused to move in the direction apparently desired by Lord Carnarvon.

Parnell opened the electoral campaign with a speech in Dublin, in which he pronounced unequivocally in favour of self-government for Ireland, and expressed his confident hope " that it may not be necessary for us in the new Parliament to devote our attentionto subsidiary measures, and that it may be possible for us to have a programme and a platform with only one plank, and that one plank

National Independence." This was startling to English ears. The Press denounced Parnell; Lord Hartington (after- wards the Duke of Devonshire) protested against so fatal andmischievousaprogramme ; Mr Chamberlain repudiated it with even greater emphasis. Meanwhile Mr Gladstone was slowly convincing himself that the passing of the Fran- chise Act had made it the duty of English statesmen and English party leaders to give a respectful hearing to the Irish National demand, and to consider how far it could be satisfied subject to the governing principle of " main- taining the supremacy of the Crown, the unity of the Empire, and all the authority of Parliament necessary for the conservation of the unity." This was the position he took up in the Hawarden Manifesto issued in September before the general election of 1885. Speaking later at Newport in October, Lord Salisbury treated the Irish leader with unwonted deference, and respect, as though he

were willing to parley with him, though he repudiated the analogy of Austria and Hungary as indicating a possible solution of the Irish problem in a federal sense. Parnell, however, took no notice of the Newport speech, and waited for Mr Gladstone to declare himself more fully in Midlothian. But in this he was disappointed. Mr Gladstone went no farther than he had gone at Hawarden, and he implored the electorate to give him a majority independent of the Irish vote. Subsequently Parnell invited him in a public speech to declare his policy and to sketch the constitution he would give to Ireland subject to the limitations he had insisted on. To this Mr Gladstone replied, " through the same confi- dential channel," that he could not consider the Irish demand before it had been constitutionally formulated, and that, not being in an official position, he could not usurp the functions of a Government. The reply to this was the issue of a manifesto to the Irish electors of Great Britain violently denouncing the Liberal party and direct- ing all Irish Nationalists to give their votes to the Tories. In these circumstances the general election was fought, and resulted in the

return of 336 Liberals, four of whom were classed as “independent,” 249 Conservatives, and 86 followers of Parnell.

Mr Gladstone had now ascertained the strength of the Irish demand, but was left absolutely dependent on the votes of those who represented it. Through Mr Arthur Balfour he made informal overtures to Lord Salisbury proffering his own support in case the Pi;ime Minister should be disposed to consider the Irish demand in a “just and liberal spirit”; but he received no encourage- ment. Towards the close of the year it became known through various channels that he himself was consider- ing the matter and had advanced as far as accepting the principle of an Irish Parliament in Dublin for the trans- action of Irish affairs. Before the end of January Lord Salisbury’s Government was defeated on the Address, the Opposition including the full strength of the Irish party. Mr Gladstone once more became Prime Minister, with Mr John Morley (an old Home Ruler) as Chief Secretary, and Mr Chamberlain provisionally included in the Cabi- net. Lord Hartington, Mr Bright, and some other Liberal chiefs, however, declined to join him.

Mr Gladstone’s return to power at the head of an Administration conditionally committed to Home Eule marks the culminating point of Parnell’s influence on English politics and English parties. The history of the Home Rule Government and of the Home Rule Bill intro- duced by it is narrated under Ireland and ENGiAND : History. It must suffice to say here, that after the defeat of the Home Rule Ministry in 1886, Parnell associated himself more closely with the Liberal Opposition. At the same time he withdrew himself largely from active interposition in current parliamentary affairs, and relaxed his control over the action and policy of his followers in Ireland. He entered occasionally into London society â€” where in certain quarters he was now a welcome guest â€” but in general he lived apart, often concealing his where- abouts and giving no address but the House of Commons, answering no letters, and seldom fulfilling engagements. He seems to have thought that Home Rule being now in the keeping of an English party, it was time to show that he had in him the qualities of a statesman as well as those of a revolutionary and a rebel His influence on the remedial legislation proposed by the Unionist Gov- ernment for Ireland was

considerable, and he seldom missed an opportunity of making it felt. It more than once happened to him to find measures, which had been contemptuously rejected when he had proposed them, ultimately adopted by the Government ; and it may be that the comparative tranquillity which Ireland enjoyed

at the close of the 19th century was due quite as much to legislation inspired and recommended by himself as to the disintegration of his following which ensued upon his appearance in the Divorce Court and long survived his death. No sooner was Lord Salisbury's new Government installed in office in 1886, than Parnell introduced a com- prehensive Tenants' Relief Bill. The Government would have none of it, though in the following session they adopted and carried many of its leading provisions. Its rejection was followed by renewed agitation in Ireland, in which Parnell took no part. He was ill â€" 'â– dangerously ill," he said himself at the time â€" and some of his more hot-headed followers devised the famous " Plan of Cam- paign," on which he was never consulted and which never had his approval. Ireland was once more thrown into a turmoil of agitation, turbulence, and crime, and the Unionist Government, which had hoped to be able to govern the country by means of the ordinary law, was compelled to resort to severe repressive measures and fresh coercive legislation. Mr Balfour became Chief Sec- retary, and early in the session of 1887 the new measure was introduced and carried. Parnell took no very promi- nent part in resisting it. In the course of the spring Tlie Times had begun publishing a series of articles entitled " Parnellism and Crime," on lines following Mr Forster's indictment of Parnell in 1883, though with much greater detail of circumstance and accusation. Some of the charges were undoubtedly well founded, some were exag- gerated, some were merely the colourable fictions of political prepossession, pronounced to be not proven by the special commission which ultimately inquired into them. One of the articles, which appeared on 18th April, was accom- panied by the facsimile of a letter purporting to be signed but not written by Parnell, in which he apologized for his attitude on the Phoenix Park murders, and specially excused the murder of Mr Burke. On the same evening, in the House of Commons, Parnell declared the letter to be a forgery, and denied that he had ever

written any letter to the same effect. He was not believed, and the second reading of the Crimes Act followed. Later in the session the attention of the House was again called to the subject, and it was invited by Sir Charles Lewis, an Ulster mem- ber and a bitter antagonist of the Nationalists, to declare the charges of The Times a breach of privilege. The Government met this proposal by an offer to pay the ex- penses of a libel action against The Times to be brought on behalf of the Irish members incriminated. This offer was refused. Mr Gladstone then proposed that a select committee should inquire into the charges, including the letter attributed to Parnell, and. to this Parnell assented. But the Government rejected the proposal. For the rest, Parnell continued to maintain for the most part an attitude of moderation, reserve, and retreat, though he more than once came forward to protest against the harshness of the Irish administration and to plead for further remedial legislation. In July 1888 he announced that Mr Cecil Rhodes had sent him a sum of Â£10,000 in support of the Home Rule movement, subject to the condition that the Irish representation should be retained in the House of Commons in any future measure dealing with the question. About the same time the question of "Parnellism and Crime" again became acute. Mr F. H. O'Donnell, an ex- M.P. and former member of the Irish party, brought an action against Tlie Times for libel. His case was a weak one, and a verdict was obtained by the defendants. But in the course of the proceedings the Attorney-General, counsel for The Times, affirmed the readiness of his clients to establish all the charges advanced, including the genuine- ness of the letter which Parnell had declared to be a forg~ ery. Parnell once more invited the House of Commons to refer this particular issue â€" that of the letter â€" to a

select committee. This was again refused ; but after some hesitation the Government resolved to appoint by Act of Parliament a special commission, composed of three judges of the High Court, to inquire into all the charges advanced by TJie Times. This led to what was in

sub- stance, though not perhaps in judicial form, the most remarkable State trial of the 19th century. The com- mission began to sit in September 1888, and issued its report in February 1890. It heard evidence of immense volume and variety, and the speech of Sir Charles Russell in defence was afterwards published in a bulky volume. Parnell gave evidence at great length, with much com- posure and some cynicism. On the whole he produced a not unfavourable impression, though some of his state- ments might seem to justify Mr Gladstone's opinion that he was not a man of exact veracity. The report of the commission was a very voluminous document, and was very variously interpreted by different parties to the con- troversy. Their conclusions may be left to speak for themselves : â€"

" I. We find that the respondent memhers of Parliament collec- tively were not members of a conspiracy having for its object to establish the absolute independence of Ireland, but we find that some of them, together with Mr Davitt, established and joined in the Land League organization with the intention, by its means, to bring about the absolute independence of Ireland as a separate nation.

"II. We find that the respondents did enter into a conspiracy, by a system of coercion and intimidation, to promote an agrarian^ agitation against the payment of agricultural rents, for the purpose of impoverishing and expellingfrom the country the Irish landlords, who were styled ' the English garrison.'

" III. We find that the charge that 'when on certain occasions they thought it politic to denounce, and did denounce, certain crimes in public, they afterwards led their supporters to believe such denunciations were not sincere,' is not established. We entirely acquit Mr Parnell and the other respondents of the charge of insincerity in their denn'nciation of the Phosnix Park murders, and find that the ' facsimile ' letter, on which this charge was chiefly based as against Mr Parnell, is a forgery.

" IV. We find that the respondents did disseminate the Irish World and other newspapers tending to incite to sedition and the commission of other crime.

“V. We find that the respondents did not directly incite persons to the commission of crime other than intimidation, but that they did incite to intimidation, and that the consequence of that incite- ment was that crime and outrage were committed by the persons incited. We find that it has not been proved that the respondents made payments for the purpose of inciting persons to commit crime.

“VI. We find, as to the allegation that the respondents did nothing to prevent crime, and expressed no bonS, fide disapproval, that some of the respondents, and in particular Mr Davitt, did express boiid. fide disapproval of crime and outrage, but that the respondents did not denounce the system of intimidation that led to crime and outrage, but persisted in it with knowledge of its effect.

” VII. We find that the respondents did defend persons charged with agrarian crime, and supported their families ; but that it has not been proved that they subscribed to testimonials for, or were intimately associated with, notorious criminals, or that) they made payments to procure the escape of criminals from justice.

‘ ‘ VIII.’ We find, as to the allegation that the respondents made payments to compensate persons who had been injured in the com- mission of crime, that they did make such payments.

” IX. As to the allegation that the respondents invited the assistance and co-operation of, and accepted subscriptions of money from, known advocates of crime and the use of dynamite, we find that the respondents did invite the assistance and co-operation of, and accepted subscriptions of money from, Patrick Pord, a known advocate of crime and the use of dynamite ; but that it has not been proved that the respondents, or any of them, knew that the Clan-na-Gael controlled the League, or was collecting money for the Parliamentary Fund. It has been proved that the respondents invited and obtained the assistance and co-operation of the Physical Force Party in America, including the Clan-na-Gael, and in order to obtain that assistance abstained from repudiating or condemning the action of that party.”

The specific charges brought against Parnell personally were thus dealt with by the commissioners : â€”

” (a) That at the time of the Kilmainham negotiations Mr

Parnell knew that Sheridan and Boyton had been organizing outrage, and therefore wished to use them to put down outrage. ” We find that this charge has not been proved. ” (&) That Mr Parnell was intimate with the leading Invinci- bles ; that he probably learned from them what they were about when he was released on parole in April 1882 ; and that he recognized the Phoenix Park murders as their handiwork. ” We find that there is no foundation for this charge. We have already stated that the Invincibles were not a branch of the Land League.

” (c) That Mr Parnell on 23rd January 1883, by an opportune remittance, enabled F. Byrne to escape from justice to France. “We find that Mr Parnell did not make any remittance to enable F. Byrne to escape from justice.”

The case of the facsimile letter alleged to have been written by Parnell Isroke down altogether. It was proved to be a forgery. It had been purchased with other docu- ments from one Pigott, a needy and disreputable Irish journalist, who afterwards tried to blackmail Archbishop Walsh by offering, in a letter which was produced in court, to confess its forgery. Mercilessly cross-examined by Sir Charles Eussell on this letter to the archbishop. Pigott broke down utterly. Before the commission sat again he fled to Madrid, and there blew his brains out. He had confessed the forgery to Mr Labouchere in the presence of Mr G. A. Sala, but did not stay to be cross- examined on his confession. The Attorney-General withdrew the letter on behalf of Hie Times, and the commission pronounced it to be a forgery. Shortly after the letter had been withdrawn, Parnell filed an action against The Times for libel, claiming damages to the amount of Â£100,000. The action was compromised with- out going into court by a payment of Â£6000.

Practically, the damaging effect of some of the findings of the commission was neutralized by Parnell’s trium- phant vindication in

the matter of the jfacsitnile letter and of the darker charges levelled at him. Parties remained of the same opinion as before : the Unionists still holding that Parnell was steeped to the lips in treason, if not in crime ; while the Home Rulers made abundance of capital out of his personal vindication, and sought to excuse the incriminating findings of the commission by the historic antecedents of the Nationalist cause and party. The failure to produce the books and papers of the Land League was overlooked, and little importance was attached by partisans to the fact that in spite of this default (leav- ing unexplained the mannbr in which over Â£100,000 had been expended), the commissioners " found that the respondents did make payments to compensate persons who had been injured in the commission of crime." Parnell and his colleagues were accepted as allies worthy of the confidence of an English party; they were made much of in Gladstonian Liberal society; and towards the close of 1889, before the commission had reported, but some months after the forged letter had been withdrawn, Parnell visited Hawarden to confer with j\Ir Gladstone on the measure of Home Rule to be introduced by the latter should he again be restored to power. "\Vhat occurred at this conference was afterwards disclosed by Parnell, but Mr. Gladstone vehemently denied the accu- racy of his statements on the subject.

But Parnell's fall was at hand. ' In December 1889 Captain O'Shea filed a petition for divorce on the ground of his wife's adultery with Parnell. Parnell's intimacy with Mrs C)'Shea had begun in 1881, though at what date it became a guilty one is not in evidence. Captain O'Shea had in that year challenged him to a duel, but was paci- fied by the explanations of Mrs O'Shea. It is known that Captain O'Sheahad been Parnell's confidential agent in the negotiation of the Kilmainham Treaty, and in 1885 Parnell had strained his personal authority to the utmost to secure

Captain O'Sliea's return for Galway, and had quelled a formidable revolt among some of his most influential followers in doing so. It is not

known why Captain O'Shea, who, if not blind to a matter of notoriety, must have been complaisant in 1885, became vindictive in 1889. Xo defence being offered, a decree of divorce was pro- nounced, and in June 1891 Parnell and liirs O'Shea were married.

At first the Irish party determined to stand by Par- nell. The decree was pronounced on 17th November 1890. On the 20th a great meeting of his political friends and supporters was held in Dublin, and a reso- lution that in all political matters Parnell possessed the confidence of the Irish nation was carried by acclama- tion. But the Irish party reckoned without its English allies. The " STonconformist conscience," which had swallowed the report of the commission, was shocked by the decree of the Divorce Court. At a meeting of the National Liberal Tederation held at SheflB.eld on 21st November, Mr John Morley was privately but firmly given to understand that the Nonconformists would insist on Parnell's resignation. Parliament was to meet on the 25th. Mr Gladstone tried to convey to Parnell privately his conviction that unless Parnell retired the cause of Home Rule was lost. But the message never reached Parnell. Mr Gladstone then requested Mr John Morley to see Parnell ; but he could not be found. Finally, on the 24th, Mr Gladstone wrote to Mr Morley the famous and fatal letter, in which he declared his conviction "that, notwithstanding the splendid services rendered by Mr Parnell to his country, his continuance at the present moment in the leader- ship would be disastrous in the highest degree to the cause of Ireland," and that " the continuance I speak of would not only place many hearty and effective friends of the Irish cause in a position of great embarrassment, but would render my retention of the leadership of the Liberal party, based as it has been mainly upon the presentation of the Irish cause, almost a nullity." This letter was not published until after the Irish parlia- mentary party had met in the Houge of Commons and re-elected Parnell as its chairman without a dissentient voice. But its publication was a thunder-clap. A few days later Parnell was requested by a majority of the party to convene a fresh meeting. It took place in Com- mittee Room No. 15, which became historic by the occa sion, and after several days of angry recrimination and passionate discussion, during which Parnell, who occu- pied the chair, scornfully refused to put to the vote a resolution for his own deposition, 46 members retired to another room and there declared his leadership at an end. The remainder, twenty-six in number, stood by him. The party was thus divided into Parnellites and anti- Parnellites, and the schism was not healed until several years after Parnell's death.

This was practically the end of Parnell's political career in England. The scene of operations was trans- ferred to Ireland, and there Parnell fought incessantly a bitter and a losing fight, which ended only with his death. He declared that Ireland could never achieve her emancipation by force, and that if she was to achieve it by constitutional methods, it could only be through the agency of a united Nationalist" party, rigidly eschewing alliance with any English party. This was the policy he proclaimed in a manifesto issued before the opening of the sittings in Committee Room No. 15, and with this policy, when deserted by the bulk of his former followers, lie appealed to the Eenians in Ireland â€" "the hillside men,'.' as Mr Davitt, who had abandoned him early in the crisis, contemptuously called them. The Eenians rallied to his side, giving him their votes and their support, but

they were no match for the Church, which had declared against him. An attempt at reconciliation was made in the spring, at what was known as " the Boulogne nego- tiations," where Mr William O'Brien endeavoured to arrange an understanding ; but it came to nothing in the end. Probably Parnell was never very anxious for its success. He seems to have regarded the situation as fatally compromised by the extent to which his former followers were committed to an English alliance, and he probably saw that the only way to recover his lost posi- tion was to build up a new independent party. He knew well enough that this would take time â€" five years was the shortest period he allowed himself â€" but before many months were passed he wa$ dead. The life he led, the agonies he endured, the labours he undertook from the beginning of 1891, travelling weekly to Ireland and intoxicating himself with the atmosphere of passionate nationalism in which he moved, would have broken down a much stronger man. He who had been the most im- passive of men became restless, nervous, almost distracted at times, unwilling to be alone, strange in his ways and demeanour. He visited Ireland for the last time late in September, and the last public meeting he attended was on the 27th of that month. The next day he sent for his friend Dr Kenny, who found him suffering from acute rheumatism and general debility. He left Ireland on the 30th, promising to return on the following Satur- day week. He did return on that day, but it was in his coffin. He took to his bed shortly

after his return to his home at Brighton, and on 6th October he died. His remains were conveyed to Dublin, and on Sunday, 11th October, they were laid to rest in the presence of a vast assemblage of the Irish people in Glasnevin Cemetery, not far from the grave of O'Connell.

The principal materials for a biography of Parnell and the history of the Parnellite movement are to be found in Hansard" s Parliamentary Debates, 1875-91 ; in the Annual Register for the .same period ; in the Beport of the Special Commission issued in 1890 ; in The Life of Charles Stewart Parnell, by B. Babey O'Brien; in The Parnellite Movement, by T. P. O'Connor, M.P. ; and in a copious biography of Parnell contributed by an anony- mous but well-informed writer to the Dictionary of National Biography, vol. xliii. (j. k. t.)

Paropamisus. See Herat.

Parramatta, a town of Australia, New South Wales, on the Parramatta river, in the county of Cum- berland, 14 miles west of Sydney by rail. It is the oldest town in all Australia, and round it the first grain of the colony was grown. It is now noted for its orangeries and orchards. The mean rainfall (15 years) is 38-95 inches. Population (1891), 11,677; (1901),

12,560.

Parry, Sir Charles Hubert Hastings, Babt.,

English musical composer (1848), the second son

of Thomas Gambler Parry, of Highnam Court, Glou- cester, was born at Bournemouth, 27th Pebruary 1848. He was educated at Malvern, Twyford, near Winchester, Eton (from 1861), and Exeter College, Oxford. While still at Eton he wrote music, two anthems being published in 1865 ; a service in D was dedicated to Sir John Stainer. He took the degree of Mus.B. at Oxford at the age of eighteen, and that of B.A. in 1870 ; he then left Oxford for London, where in the following year he entered Lloyd's, abandoning business for art soon afterwards. He studied successively withH. H. Pierson (at Stuttgart), Sterndale

Bennett, and Macf arren ; but the man to whom the most important part of his artistic development was due was Mr Edward Dannreuther, at whose private concerts his chamber compositions were frequently per- formed. Among the larger works of this earlier period must be mentioned an overture, Guillem de Cabestanh

(Crystal Palace, 1879), a pianoforte concerto in F sharp minor, played by Dannreuther at the Crystal Palace and Eichter Concerts in 1880, and his first choral work, the Scenes from Prometheus Unbound, produced at the Gloucester Festival, 1880. These, like a symphony in G, given at the Birmingham Festival of 1882, were dis- tinctly caviare to the general ; the ideas seemed strange even to educated hearers, who were further confused by the intricacy of their treatment. It was not until Shirley's ode, The Glories of our Blood and State, was brought out at Gloucester, 1883, and the Partita for violin and pianoforte was published about the same time, that Parry's importance came to be realized. With his sublime eight- part setting of Milton's Blest Pair of Sirens (Bach Choir, 1887) began a fine series of compositions to sacred or semi-sacred words. In Judith (Birmingham, 1888), the Ode on St Cecilia'^ Day (Leeds, 1889), L' Allegro ed it Penseroso (Norwich, 1890), De Profundis (Hereford, 1891), The Lotus Eaters (Cambridge, 1892), Job (Glouces- ter, 1892), King Said (Birmingham, 1894), Invocation to Music (Leeds, i895). Magnificat (Hereford, 1897), A Song of Darkness and Light (Gloucester, 1898), and Te Deuin (Hereford, 1900), are revealed the highest qualities of music. Skill in piling up climax after climax, and com- mand of every choral resource, are the technical qualities most prominent in these works ; but in his orchestral compositions, such as the three later symphonies, in F, C, and E minor, in two suites, one for strings alone, and above all in his Symphonic Variations (1897^, he shows himself a master of the orchestra, and his experiments in modification of the conventional classical forms, such as appear in the work last named, or in the Nineteen Variations for

Pianoforte Solo, are always successful. His music to The Birds of Aristophanes (Cambridge, 1883) and Tlie Frogs (Oxford, 1892) are striking examj)les of humour in music ; and that to Agamemnon (Cambridge, 1900) is among the most im- pressive compositions of the kind. His chamber music, exquisite part songs, and solo songs maintain the high standard of his greater works. At the opening of the Eoyal College of Music in 1883 he was appointed professor of composition and of musical history, and in 1894, on the retirement of Sir George Grove, Parry succeeded him as principal. He was appointed Choragus of Oxford University in 1^83, succeeding Stainer in the professor- ship of the University in 1900. He received the honorary degree of Mus.D. at Cambridge 1883, Oxford 1884, Dublin 1891 ; and was knighted in 1898. Outside the domain of creative music. Parry's work for the art has been of the greatest importance: as a contributor of many of the most important articles on musical forms, &c., in Grove's dictionary, his literary work first attracted attention; in his Studies of Great Composers musical biography was treated, almost for the first time, in a really enlightened and enlightening way ; and his Art of Music is a splendid monument of musical literature, in which the theory of evolution is appljpd to musical history with wonderful skill and success.

Parsons, a city of Labette county, Kansas, U.S.A. It is situated at the intersection of the Kansas City, Fort Scott and Memphis, and the Missouri, Kansas, and Texas railways, in tlie south-eastern part of the state, at an altitude of 900 feet. Its site is level and its plan regular. It is in a rich farming country, and has a large trade. It contains railway offices and works, foundries and furni- ture factories. Population (1880), 4199; (1890), 6736; (1900), 7682, of whom 378 were foreign-born and 807 negroes.

Partabgarh, or Pkatapgaeh, a district of British

India, in the Fyzabad division of Oudh. The administra- tive headquarters are at Bela. Area, 1439 square miles ; population (1881), 847,047; (1891), 910,895; (1901), 891,095, showing an increase of nearly 8 per cent, between 1881 and 1891, but a decrease of 2-2 per cent,

between 1891 and 1901 ; average density, 619 persons per square mile, or almost one person to every acre in a tract that is entirely rural.

The land revenue and rates are Es.10,71,800, the incidence of assessment being R.l:5:3 per acre; cultivated area (1896-97), 463,808 acres, of which 273,848 were irrigated from wells and tanks ; number of police, 730 ; vernacular schools, 132, with 5225 pupils; registered death-rate (1897), 42 per thousand. The principal crops are rice, pulse, barley, sugar-cane, opium, and indigo. There are 47 indigo factories, with an out-turn valued at Es. 1,46,000. The district is traversed by the branch of the Oudh and Rohilkhand railway from Rae Bareli to Benares, which was opened in 1 898. There are no Government canals. It manufactures sugar, and has a hemp-pressing factory.

Partabgarh, or Peetabgaeh, a native state of India, in the Eajputana agency. Area, 959 square miles ; population (1881), 79,298 ; (1891), 87,975 ; (1901), 62,029, showing an increase of 11 per cent, between 1881 and 1891, but a decrease of 40-9 between 1891 and 1901 ; average density, 54 persons per square mile ; revenue (1896-97), Es.4,01,387. A metalled road has been opened from Paetabgaeh town to Mandesaur, on the Eajputana rail- way, 19 miles. The mint was closed in 1897. The town has a population of 13,000.

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Partap [or Peetab] Singh, Sir (1844- tive Indian soldier and statesman, belonging to the Eathor rajputsof the Jodha class, was born in 1844, being the son of Maharaja Takht Singh, ruler of Marwar (or Jodhpur). In 1878 and again in 1879 he was chief minister of Jodhpur. In the following year he accompanied the British mission to Afghanistan, and on his return he resumed his duties as chief minister, carrying out many judicious reforms and administering Jodhpur with remarkable success. He vis- ited England to take part in the celebration of the 1887 Jubilee of Queen Victoria's reign. His high soldierly in- stincts induced him ta offer his services when war broke out on the north-western frontier of India, and he served on the staffs of Sir William Lockhart and General Elles in the Tirah and Momand expeditions beyond the Punjab border in the campaigns of 1897-98. He was slightly wounded,

and he was mentioned in despatches, being promoted to the rank of full colonel for his services. He is reputed to be one of the keenest sportsmen and the best riders that ever;. Eajputana has produced. When it was decided to send a force from India to China in 1900 to relieve the foreign embassies besieged in Peking, Sir Partap Singh at once offered the services of the Jodhpur Lancers, and himself proceeded with them to the seat of military operations. His father rendered good services to the British Government in the Mutiny, and Partap Singh always esteemed it a point of honour and a matter of filial duty to identify the famous state of Jodhpur with the British Government in times of trouble or foreign war. He cherished the memory of the protection given by the East India Company in 1818, when Jodhpur had suffered from internal dissension and the ravages of the Marathas, and was taken into subordinate alliance with the British on terms honourable to both parties. In social matters the Maharaja favoured the party of moderate reform, but it was as a rajput soldier and a loyal prince that he was most distinguished. No prince in India has ever won so many proofs of public estimation from the British Government and English society as Sir Partap Singh. From Queen Victoria he received the honour of knighthood and the decorations of the Bath and the Star of India; from King Edward VII. the distinction of ” aide-de-camp ” ; from the

War. Office the rank of colonel iu the King’s army ; and from the University of Cambridge the degree of LL.D. From his own state of Jodhpur he obtained the title of M;aharajarDhiraj. In 1901 he succeeded to the rulership of the state of Idar.

Parthenay, chief town of arrondissement, depart- ment of Deiix-Sfevres, France, 26 miles north-north-east of Niort, on railway from Paris to Bordeaux. The town is picturesquely situated on a promontory overlooking the Thouet, and still retains considerable portions of its 13th- century ramparts, with large round towers, offering, next to Aigues-Mortes, the finest example of the fortifications of that period.

Amongst ancient buildings of interest are the church of Ste Croix, of the 12th century, restored 1886, and with 16th-century belfry ; the church of St Laurent, also rest-Ored in modern times, but portions of whose walls date from the 11th century; a ruined portal of Notre Dame de la Couldre, with beautiful sculpture and two equestrian statues ; and 1 mile south-west of the town the ancient church of Parthenay -le-Vieux. The manufacture of knitted woollen goods and wool-spinning are the prin- cipal local industries. Population (1881), 3899 ; (1891), ^361 ; (1901), 6426.

Partick, a police burgh in the parish of Govan, Lanarkshire, Scotland, on the north bank of the Clyde, adjoining and continuous with Glasgow. Since 1860 it has grown from a village to be a large and wealthy residential quarter of Greater Glasgow. Five shipbuild- ing yards are situated in the burgh, which contains also the industries of paper- staining, flour-milling, hydraulic- machine making, weighing-machine making, brass-found- ing, and galvanizing. It has a town hall and a Victoria public park (1887). Partick forms the major part of the Partick division of Lanarkshire, which returns a member to Parliament. The municipality maintains a separate police force and a fire brigade, but uses Glasgow gas and water. One of the public schools has a secondary de- partment. Area, 1006 acres. Population (1891), 36,638 ;

(1901), 54,274.

Partnership. â€” In 1890 the Partnership Act of that year was passed to declare and amend the law of part- nership ; the Act came into operation on 1st January 1891. With one important exception (Â§ 23), it applies to the whole United Kingdom. It is not a complete code of partnership law ; it contains no provisions regulating the administration of partnership assets in the event of death or bankruptcy, and is silent on the subject of goodwill. The existing rules of equity and common law continue in force, except so far as they are inconsistent with the express provisions of the Act. The article on Partnership in the ninth edition of this work contains a short account of the state of the law before the Act. The decisions which established

that law show the prin- ciples which underlie the Act, and will be found useful as illustrations of its application and guides to its inter- pretation when its language is obscure. On all points specifically dealt with by the Act it is now the one bind- ing authority. The Act has made no important changes in the law, except in respect of the mode of making a part- ner's share of the partnership assets available for pay- ment of his separate debts. This change does not affect Scotland. The Act is divided into the four main divisions mentioned below.

I. Nature of Partnership. â€" Partnership is defined to be the " relation which subsists between persons carrying on a business in common with' a view of profit." From this definition corporations and companies, such as joint-stock companies and cost-book mining companies, which differ from ordinary partnerships in many important respects, are expressly excluded. The Act also contains several

subsidiary rules for determining the existence of a part- nership. These rules are of a fragmentary nature, and for the most part are expressed in a negative form ; they have not introduced any change in the law. Co-owner- ship of property does not of itself create a partnership, nor does the sharing of gross returns. The sharing of profits, though not of itself sufficient to create a partner- ship, is primd facie evidence of one. This means that if all that is known is that two persons are sharing profits, the inference is that such persons are partners ; but if the participation in profits is only one amongst other cir- cumstances, all the circumstances must be considered, and the participation in profits must not be treated as rais- ing a presumption of partnership, which has to be re- butted. To illustrate ,the rule that persons may share profits without being partners, the Act gives statutory expression to the decision in Cox v. Hickman (1860, 8 House of Lords Cases, 268), viz., that the receipt by a person of a debt or other fixed sum by instalments, or otherwise, out of the accruing profits of a business does not of itself make him a partner ; and it re-enacts with some slight modification the repealed provisions of Bovill's Act (28 and 29 Vict. c. 86). Whenever the question of partnership oj- no partnership arises, it must not be forgotten (though this is not stated in the Act) that partnership is a

relation arising out of a contract ; regard must be paid to the true contract and intention of the parties as appearing from the whole facts of the case. If a partnership be the legal consequence of the true agreement, the parties thereto will be partners, though they may have intended to avoid this consequence {Adam v. Newhigging, 1888, L.R. 13 App. Cas. 315). Partners are called collectively a ” firm ” ; the name under which they carry on business is called the firm name. Under English law the firm is not a corporation, nor is it recognized as distinct from the members composing it ; any change amongst them destroys the identity of the firm. In Scotland a firm is a legal person distinct from its meinbers, but each partner can be compelled to pay its debts.

II. Relations of Partners to Persons dealing with them. â€” Every partner is an agent of the firm and of his co- partners for the purpose of the partnership business ; if a partner does an act for carrying on the partnership busi- ness in the usual way in which businesses of a like kind are carried on â€” in other words, if he acts within his ap- parent authority â€” he thereby primd facie binds his firm. The partners may by agreement between themselves re- strict the power of any of their number to bind the firm. If there be such an agreement, no act done in con- travention of it is binding on the firm with respect to persons who have notice of the agreement. Such an agreement does not affect persons who have no notice of it, unless indeed they do not know or believe the person with whom they are dealing to be a partner ; in that case he has neither real, nor, so far as they are concerned, ap- parent authority to bind his firm, and his firm will not be bound. If a partner does an act, e.g., pledges the credit of the firm, for a purpose apparently not connected with the firm’s ordinary course of business, he is not acting in pursuance of his apparent authority, and whatever lia- bility he may personally incur, his partners will not be bound unless he had in fact authority from them.

Apart from any general rule of law relating to the ex- ecution of deeds or negotiable instruments, a firm and all the partners will be bound by any act relating to the business of the firm, and done in the firm name, or in any other manner showing an intention to bind the firm, by any person thereto authorized. An admission or representation by a

partner, acting within his apparent authority, is evi- dence against his firm. Notice to an acting partner of

any matter relating to the partnership affairs is, apart from fraud, notice to his firm.

A firm is liable for loss or injury caused to any person not a partner, or for any penalty incurred by any wrong- ful act or omission of a partner acting in the ordinary course of the partnership business, or with the authority of his co-partners ; the extent of the firm's liability is the same as that of the individual partner. The firm is also liable to make good the loss (a) where one partner, acting within his apparent authority, receives money or prop- erty of a third person and misapplies it ; and (b) whfere a firm in the course of its business receives money or prop- erty of a third person, and such money or property while in the custody of the firm is misapplied by a partner. It is not sufl&cient, in order to fix innocent partners with liability for the misapplication of money belonging to a third party, merely to show that such money was em- ployed in the business of the partnership, otherwise all the members of a firm would in all cases be liable to those beneficially interested therein for trust money im- properly employed in this manner by one partner. This is not the case. To fix the other partners with liability, notice of the breach of trust must be brought home to them individually.

The liability of partners for the debts and obligations of their firm arising ex contractu, is joint, and in Scotland several also ; the estate of a deceased partner is also sev- erally liable in a due course of administration, but sub- ject, in England or Ireland, to the prior payment of his separate debt. The liability of partners for the obliga- tions of their firm arising ex delicto, is joint and several.

The authority of a partner to bind his co-partners com- mences with the partnership. A person therefore who enters into a jDartnership

does not thereby become liable to the creditors of his partners for anything done before he became a partner. But a partner who retires from a firm does not thereby cease to be liable for debts or obligations incurred before his retirement. He may be discharged from existing liabilities by an agreement to that effect between himself and the members of the firm as newly constituted and the creditors. This agreement may be either express or inferred as a fact from the course of dealing between the creditors and the new firm. The other ways in which a partner may be freed from part- nership liabilities incurred before his retirement are not peculiar to partnership liabilities, and are not therefore dealt with by the Partnership Act.

A continuing guaranty given to a firm, or in respect of the transactions of a firm, is, in the absence of agreement to ihe contrary, revoked as to the future by a change in the firm. The reason is that such a change destroys its identity.

Any person, not a partner in the firm, who represents himself, (or, as the phrase is, "holds himself out") or kno-vsingly suffers himself to be represented, as a partner, is liable as a partner to any person who has given credit to the firm on the faith of the representation. The rep- resentation may be by words spoken or written, or by conduct. The liability will attach, although the person who makes the representation does not know that the person who has acted on it knew of it. The continued use of a deceased partner's name does not impose liability on his estate.

III. Relations of Partners to one another. â€" The mutual rights and duties of partners depend upon the agreement between them. Many of these rights and duties are stated in the Partnership Act ; but, whether stated in the Act or ascertained by agreement, they may be varied by the consent of all the partners ; such consent may be express or inferred from conduct- Subject to any agreement, partners share equally in the capital and profits of their

business, and must contribute equally to losses, whether of capital or otherwise; they are entitled to be indemni- fied by their firm against liabilities incurred in the proper and ordinary conduct of the

partnership business, and for anything necessarily done for its preservation; they are entitled to interest at 5 per cent, on their advances to the firm, but'not on their capital. Every partner may take part in the management of the partnership business, but no partner is entitled to remuneration for so doing. The majority can bind the minority in ordinary matters connected with the partnership business, but cannot change its nature nor expel a partner, unless expressly authorized so to do. No partner may be introduced into the firm without the consent of all the pjlrtners. The partnership books must be kept at the principal place of business, and every partner may inspect and copy them. Partners must render to each other true accounts and full information of all things affecting the partnership. A partner may not make use of anything belonging to his firm for his private purposes, nor may he compete with it in business. If he does so he must account to his firm for any profit he may make.

Partners may agree what shall and what shall not be partnership property, and can by agreement convert partnership property into the separate property of the individual partners, and vice versd. Subject to any such agreement, all property originally brought into the part- nership stock, or acquired on account of the firm or for the purposes and in the course of its business, is declared by the Act to be partnership property. Prop- erty bought with money of the firm is primd facie bought on account of the firm. Partnership property must be applied exclusively for partnership purposes and in accordance with the partnership agreement. Go- owners of land may be partners in the profits of the land without the land being partnership property ; if such co-owners purchase other lands out of the profits, these lands will also belong to them (in the absence of any agreement to the contrary) as co-owners and not as partners. The legal estate in partnership land devolves according to the general law, but in trust â– for the persons beneficially interested therein. As be- tween partners and as between the heirs of a deceased partner and his executors or administrators, such land is treated as personal or movable estate, unless a contrary intention appears.

When no fixed term has been agreed upon for the duration of the partnership, it is at will, and may be determined by notice at any time by any partner. If a partnership for a fixed term is continued after the term has expired without any express new agreement, the rights and duties of the partners remain as before, so far as they are consistent with a partnership at will.

A partner may assign his share in the partnership either absolutely or by way of mortgage. The assignee does not become a partner ; during the continuance of the partnership he has the right to receive the share of profits to which his assignor would have been entitled, but he has no right to interfere in the partnership business, or to require any accounts of the partnership transactions, or to inspect the partnership books. On a dissolution he is entitled to receive the share of the partnership assets to which his assignor is entitled as between himself and his partners, and for this purpose to an account as from the date of dissolution.

Since the Act came into operation no writ of execution may issue in England or Ireland against anv partnership property, except on a judgment against the firm. If in either of these countries a judgment creditor of a partner wishes to enforce his judgment against that partner's share in the partnership, he must obtain an order of

court charging such share with payment of his debt and interest. The court may appoint a receiver of the partner's share, and may order a sale of such share. If a sale be ordered the other- partners may buy the share ; they may also at any time redeem the charge. The mode of making a partner's share liable for his separate debts in Scotland has not been altered by the Act.

IV. Dissolution of Partnership. â€" A partnership for a fixed term, or for a single adventure, is dissolved by the expiration of the term or the termination of the adventure. A partnership for an undefined time is

dis- solved by notice of dissolution, which may be given at any time by any partner. The death or bankruptcy of any partener dissolves the partnership as between all its mem- bers. If a partner suffers his share in the partnership to be charged under the Act for his separate debts, his partners may dissolve the partnership. The foregoing rules are subject to any agreement there may be between the partners. A partnership is in every case dissolved by any event which makes the partnership or its business unlawful. The court may order a dissolution in any of the following cases, viz. ; â€" When a partner is found lu- natic or is of permanently unsound mind, or otherwise permanently incapable of performing his duties as a partner ; when a partner has been guilty of conduct cal- culated to injure the partnership business, or wilfully or persistently breaks the partnership agreement, or so conducts himself in partnership matters that it is not reasonably practicable for his partners to carry on busi- ness with him ; when the partnership can only be carried on at a loss ; and lastly, whenever a dissolution appears to the court to be just and equitable. The Act is silent as to the effect of the assignment by a partner of his share in the partnership as a cause of dissolution ; proba- bly it is now no more than a circumstance enabling the court, if it thinks fit, to grant a dissolution on the ground that it is just and equitable to do so. A dissolution usually is not complete as against persons who are not partners, until notice of it has been given ; until then such persons may treat all apparent partners as still members of the firm. Consequently, if notice is not given when it is necessary, a partner may be made liable for partnership debts contracted after he ceased to be a partner. Notice is not necessary to protect the estate of a dead or bankrupt partner from partnership debts contracted after his death or bankruptcy ; nor is notice necessary when a person not known to be a partner leaves a firm. If a person not generally known to be a partner is known to be so to certain individuals, notice must be given to them. Notice in the Gazette is sufficient as regards all persons who were not previously ctistomers of the firm ; notice in fact must be given to old customers. On a dissolution, or the retirement of a partner, any partner may notify the fact and require his co-partners to concur in doing so.

After a dissolution, the authority of each partner (unless he be a bankrupt) to bind the firm, and the other rights and obligations of the partners, continue so far as may be necessary to wind up the partnership affairs and to complete unfinished transactions. The partners are entitled to have the partnership property applied in payment of the debts of the firm, and to have any sur- plus divided between them. Before a partner can receive any part of the surplus, he must make good whatever may be due from him as a partner to the firm. To en- force these rights, any partner or his representatives may apply to the court to wind up the partnership busi- ness. It was well established before the Act, and is still law, that in the absence of special agreement the right of each partner is to have the partnership property â€" including the goodwill of its business, if it be saleable

â€" realized by a sale. The value of the goodwill depends largely on the right of the seller to compete with the purchaser after the sale. The Act makes no mention of goodwill, but the rights of a seller in this respect were fully discussed in the House of Lords in Trego v. Hunt (L.R. 1896, App. Cas. 7). lu the absence of special agreement, the seller may set up business in competition with, and in the immediate neighbourhood of, the pur- chaser, and advertise his business and deal with his former customers, but may not represent himself as carrying on his former business, nor canvass his former customers. The purchaser may advertise himself as carrying on the former business, canvass its customers, and trade under the old name, unless that name is or contains the name of the vendor, and the purchaser by using it without qualification would expose the vendor to the liability of being sued as a partner in the business. If, on a dissolution or change in the constitution of a firm, the goodwill belongs under the partnership agree- ment exclusively to one or more of the partners, the partner who is not entitled to the goodwill has the rights of a seller, and those to whom the goodwill belongs have the rights of a purchaser.

When a partner has paid a premium on entering into a partnership for a fixed term, and the partnership is deter- mined before the expiration of the term, the court may, except in certain cases, order a return of the premium or of some part of it. In the absence of fraud or misrepre-

sentation, the court cannot make such an order when the partnership was at will, or, being for a fixed term, has been terminated by death or by reason of the misconduct of the partner who paid the premium ; nor can it do so if terms of dissolution have been agreed upon, and the agreement makes no provision for the return of premium. When the court makes an order it usually orders the return of so much of the premium as bears the same pro- portion to the whole as the actual bears to the agreed duration of the partnership.

When a person is induced by the fraud or misrepre- sentation of others to become a partner with them, the court will rescind the contract at his instance (Adam v. Newbigging, 1888, R. 13 App. Cas. 308). Inasmuch as such a person is under the same liability to third parties for liabilities of the firm incurred before rescission as he would have been under had the contract been valid, he is entitled on the rescission to be indemnified by the person guilty of the fraud or making the representation against these liabilities. He is also entitled, without prejudice to any other rights, to receive out of the sur- plus assets of the partnership, after satisfying the part- nership liabilities, any money he may have paid as a premium or contributed as capital, and to stand in the place of the creditors of the firm for any payments made by him in respect of the partnership liabilities.

If a partner ceases to be a member of a firm, and his former partners continue to carry on business with the partnership assets without any final settlement of accounts, he, or, if he be dead, his estate, is, in the absence of agreement, entitled to such part of the subsequent profits as can be attributed to the use of his share of the partnership assets, or, if he or his representatives prefer it, to interest at 5 per cent, on the amount of his share. If his former partners have by agreement an option to purchase his share, and exercise the option and comply with its terms, he is not entitled to any further or other share in profits than that given him by the agreement. If, however, his former partners, as- suming to exercise such an option, do not comply with its terms, they are liable to account for subsequent profits or interest to the extent mentioned above. Subject to any agreement between the partners, the amount due from the surviving or continuing partners to an outgoing

partner, or the representatives of a deceased partner, in respect of his share in the partnership, is a debt accruing at the date of the dissolution or death.

In the absence of any special agreement on a final settlement of accounts between partners, losses (iacluding losses of capital) are paid first out of profits, next out of capital, and lastly by the partners in the proportions in which they share profits. The assets of the firm, includ- ing all sums contributed to make up losses of capital, are applied in paying the debts and liabilities of the firm to persons who are not partners; then in paying to each partner rateably what is due from the firm to him, first for advances and next in respect of capital ; and the ulti- mate residue (if any) is divisible among the partners in the proportion in which profits are divisible.

See Sir Nathaniel Lindley. A Treatise on the Law of Partner- ship, 6th edition. London, 1893. â€” Sir Fkisbiprick Pollock. A Digest of the Law of Partnership, incorporating the Partnership Act, 1890, 6th edition. London, 189.5. â€” Also article on “Partner- ship” in the Encyclopmdia of the Laws of England, to the pub- lishers of which (Messrs Sweet and Maxwell, Limited, London, and Messrs W. Green and Sons, Edinburgh) the writer’s thanks are due. (^. b. l.)

The following points in United States law may be added. An ordinary partnershij; between miners for working a mine is not dissolved by the death of one of the partners, nor by the transfer by one of his interest in the concern. Contract is not deemed the basis of the relation between the partners, but rather a common property and co-opera- tion in its exploitation (Parsons, Principles of Partnership, sect. 15). A corporation cannot become a partner in any mercantile adventure, unless specially authorized by charter or general statute. If it could, the management of its affairs would no longer be exclusively in the hands of its directors, to whom the law has entrusted it. Hence, corporations

cannot associate for the formation of a “trust” to be managed by the associated partners.

(s. B. B.)

Pasadena, a city of Los Angeles county, Cali- fornia, U.S.A., at the base of the San Gabriel Mountains, in southern California, at an altitude of 827 feet. It is 9 mUes north-east of Los Angeles, with which it is con- nected by lines of steam and trolley cars. It is on the Southern Pacific and the Southern California (Atchison, Topeka, and Santa Fe) railways. Its site is level, its plan regular. It has an excellent water- supply, and is well sewered. The surrounding country is to a large extent highly cultivated, producing sub-tropical fruits in great variety and quantity. Pasadena is noted for its mild, soft climate, especially in winter, and for the beauty of its surroundings, with the San Gabriel range rising to the north, and southwards the beautiful valley, rendered fruitful by hundreds of artesian w%lls and irrigation ditches. On these accounts it has become a very popular winter resort, especially for consumptives. The Mount Low railway, partly trolley, partly cable, ascends the San Gabriel range from this point. Population (1880), 391 ; (1890), 4882 ; (1900), 9117, of whom 1278 were foreign- born and 336 coloured, including 218 negroes.

Pasages, a town and seaport of Spain, province of Guipuzcoa, 10 miles from the mouth of the river Urumen, with a station on the railway from the French frontier to Madrid. This seaport, of which the population was only 1744 in 1887 and 2601 in 1897, has developed very considerably in importance since 1890. The town only consisted until 1875 of two comparativelj” unimportant but picturesque groups of housesor “carries.” Vessels find a good anchorage in 30 feet of water in the centre of the land-locked bay and near the quays built along the shore opposite. An attempt has been made to dredge the bay and turn it into a port of refuge and emporium of

trade. On the peak of San Marcos is the modern fortress erected to command all the approaches to San Sebastian and Pasages. The new town of Pasages contains liqueur factories, cellars for the preparation of wines, the famed ” coupage ” of the product of the French vineyards

with strongly alcoholic Navarre and Aragon wines or alcohol now manufactured in Spain on a large scale. In 1897, 41,500 tons of British coal were landed at Pasages. Forty British vessels entered and cleared in the same year.

Pas-de-Calais, a department on the northern coast of France, bordering on' the English channel.

Area, 2606 square mUes. From 819,022 in 1881 the population increased to 949,968 in 1901. Births in 1899, 28,384, of which 2994 were illegitimate ; deaths, 19,119 ; marriages, 7809. There were in 1896, 1785 schools, with 158,000 pupils, the illiterate con- stituting 7 per cent, of the population. The area under cultivation measured (1896) 1,531,400 acres, of which 1,230,060 acres were plough-land. Wheat, which, relatively to its size, this department grows in considerably more than average quantity, returned in 1899 the <(falue of Â£2,040,000 : rye, Â£136,000 ; barley, Â£192,000 ; oats, Â£1,360,000 ; potatoes, Â£441,000 ; mangold-wurzel, Â£245,000 ; garden-poppy, Â£68,000; beetroot, Â£1,208,000; tobacco, Â£78,000; apples, Â£44,000. The live stock comprised in 1899, 76,480 horses, 220,540 cattle, 217,650 sheep, 164,780 pigs, and 23,460 goats. The production of milk amounted (1899) to the value of Â£1,680,000. Pas-de-Calais surpasses all the other departments of France In the abundance and extent of its coaliields. In 1898 it produced not less than 12,800,000 metric tons of fuel, valued at Â£5,000,000, nearly half of the total output of France. Yet the industry in metals is much less active in this department than in Nord. Its production in 1898 amounted to 90,000 metric tons of cast-iron and 63,000 tons of steel, which, with the other minerals added, were valued at Â£995,000. The sugar refineries yielded in 1898, 1,820,000 cwt., and the distilleries 7,200,000 gallons of alcohol. Calais (population, 59,793 in 1901) is celebrated for its lace. Spin- ning is likewise a source of revenue to the department. Arras, the capital, had 25,813 inhabitants in 1901, and Boulogne 49,083 in the same year.

Pasewal k, a town of Prussia, province of Pomerania, 26 miles west-north-west of Stettin by rail. It is an old and historically interesting town, having been frequently burnt and sacked in the 17th and 18th

centuries. A. bronze statue was erected to the Emperor Frederick III. in 1895. It manufactures tobacco, beer, and iron, and has various mills. Population (1885), 9514; (1900),

10,300.

Pasig, a town on the Pasig river, near the Laguna de Bay, Luzon, Philippine Islands. It was almost com- pletely destroyed by fire in 1899 during the insurrection, but has since been rebuilt, and was made the capital of the province of Manila in June 1901. It is an important commercial centre for the whole lake region, as its inhab- itants are largely engaged in transporting the products of the neighbouring towns to Manila. Large quantities of fresh-water fish are taken in the shallow waters of the marshes. Although built on low ground, the town is fairly healthy. The language is Tagalog. Population, 22,000.

Passaglia, Carlo (1812-1887), Eoman Catholic divine, was born at Lucca on 2nd May 1812. Passaglia was soon destined for the priesthood, and was placed under the care of the Jesuit body at the age of fifteen. He became successively Doctor in Mathematics, Philosophy, and Theology in the University of Rome. In 1844 he was made professor in the CoUegio Romano, the well- known Jesuit college in Rome. In 1845 he took the vows as a member of the Jesuit order. In 1848, during the expulsion of the Jesuits from Rome which folloA-ed on the revolutionary troubles in the Italian peninsula, he paid a brief visit to England. On his return to Italy he founded, with the assistance of Father Curci and Robert Tapparelli d'Azeglio, the celebrated organ of the Jesuit order entitled the Civiltd CattoUca. In 1854 came the decision of the Roman Church on the long-dehated question of the Immaculate Conception of the Virgin. Into

the agitation for the promulgation of this dogma Passaglia threw himself with great eagerness, and by so doing recommended himself strongly to the then Pope, Pius IX. But his favour with the Pope was of

short duration. In 1859, when the war between Austria and France (the first step towards the unification of Italy) broke out, Passaglia espoused the popular side. He took refuge at Turin, and under the influence of Cavour he wrote an Epistola ad Episcopos CaihoUcos pro causa Italica, in which, like Liverani before him, he boldly attacked the temporal power of the Pope. For this he was ex- jjelled from the order of Jesuits, his book was put on the Index, and his figure struck out, by the Pope's order, from a picture painted to commemorate the proclamation of the Dogma of the Immaculate Conception. A refuge from the anger of the Pope was afforded him in the Casa Cavour, of Turin, the house in which Cavour was born. There he laboured for Italian unity with indomitable energy in the north of Italy, in conjunction with Cardinal d' Andrea in the south, and he collected the signatures of 9000 priests to an address to the Pope in opposition to the temporal power, and in favour of abandoning all resistance to the union of Italy under a king of the House of Savoy. He and the 9000 priests were excommunicated on 6th October 1862. Passaglia dis- regarded his excommunication, and continued his work as professor of moral philosophy at Turin, to which he had been appointed in 1861, and commenced a series of Advent addresses in the church of San Carlo at Milan. But on arriving in order to preach his second sermon, he found himself met by an inhibition on the part of Mgr Caccia, the administrator of the archdiocese of Milan. Elected deputy in the Italian Parliament, he still advocated strongly the cause of Italian independ- ence, and at a later period wrote a defence of the rights of the Episcopate under the title of La causa di sxia eminenza il Cardinale d^ Andrea. He also (1864) wrote against Eenan's Vie de Jesus. The later years of his life were spent in obscurity. Eight days before his death he endeavoured to be reconciled to the Pope, and made a full retractation. He died at Turin, 12th March 1887. (j. J. L*.)

Passaic, a city of Passaic county, New Jersey, U.S.A., on the west bank of the Passaic river, in the north-eastern part of the state, at an altitude of 100 feet. Its site is hilly and its plan irregular. It is divided into four wards, and has a water-supply derived from Passaic river above the falls. In 1900 it contained 185 manu- facturing establishments, employing 7102 hands, and having a capital of $23,279,421 and an output valued at $14,031,254. To some extent it serves as a residence

suburb to New York. Population (1880), 6532 ; (1890), 13,028; (1900), 27,777, of whom 12,900 were foreign- born and 443 negroes. There were 9274 persons of school age (5 to 20 years). Of 7552 males, 21 years of age and over, 1011 were illiterate (unable to write).

Passau, a town and episcopal see of Bavaria, Ger- many, district of Lower Bavaria, on both banks of the Danube, at the confluence of the rivers Inn and Hz, 74 miles by rail south-east of Eatisbon. The towers of the cathedral were finished in 1896-98. The church of St Gertrude, in Innstadt, restored in 1888 ; the votive church (1564), restored in 1864 ; the Pilgrimage church of Our Lady of Succour ; and St John's Hospital church, with its wood carvings, are all noteworthy. The town hall was enlarged in 1888-93. Two scholastic institutes of the English Sisters, an agricultural school, a textile school, and a theological seminary are the chief educational insti- tutions. Population (1885), 15,583 ; (1900), 17,988.

Pastel. â€" Since 1870 there has been a revival of the art of pastel, the result of a better understanding and appreciation on the part of the public. Grimm's denunciation of it to Diderot â€" " exvry one is agreed that pastel is unworthy the notice of a great painter " â€" which for many years found ge)ieral acceptance, is now seen to have been based on ignorance of the virtues of the method. Artists have always recognized its beauties, but the prejudice and indifference of the public and even of " connoisseurs " had up to recent years rendered fruitless their efforts to restore its practice. It was thought that "coloured chalks," as it used to be called, promised nothing but sketches of an ephemeral kind, so fragile that they were at the mercy of every chance blow or every touch of dampness. The fact is, that with care no greater than is accorded to every work of art, pastel properly used is not more perishable than the oil-painting or the water-colour. Damp will affect it seriously, but so also will it ruin the water-colour; and violence is to be feared for the oil-picture not less than for the pastel. Moreover, pastel possesses advantages that can be claimed by neither oil-painting nor water- colour. That is to say, if pictures in these three mediums be hung side by side for a hundred years in a fair light and in a dry place, the oil-painting will have darkened and most probably have cracked; the

water-colour will have faded ; but the pastel will remain as bright, fresh, and pure as the day it was painted. If Time and Varnish, which Hogarth and Millais declared the two greatest of the old masters, will do nothing to “improve” a pastel, neither will they ruin it; so that the pastel- painter, having no adventitious assistance to hope for, or cj fear, must secure at once the utmost of which his method is capable.

The advantages of pastel are threefold : those of work- ing, those of results, and those of permanence. The artist has at his command, without necessity of mixing his colours, every hue to be found in nature, so that fresh- ness and luminosity can always be secured without fear of that loss of brilliancy commonly attendant on the mixing of colour on the palette. Moreover, the fact of pastel being dry permits the artist to leave his work and take it up again as he may choose ; and he is free from many of the technical troubles and anxieties natural to oil and water-colour painting. Applied with knowledge, pastel, which has been likened for delicacy of beauty to ” the coloured dust upon the velvet of butterflies’ wings,” will not fall off. It can, if desired â€” though this is hardly necessary or even desirable â€” be ” fixed,” most commonly by a fixatif. If intending so to treat his work, the artist must paint in a somewhat lighter key, as the effect of the fixing medium is slightly to lower the general tone. But whether it be fixed or left unfixed, the unfettered artist who employs pastel has been enabled to enjoy the ad- vantages it offers of rapidity, spontaneity, directness, adaptability, and variety â€” conveniences to be sought for in vain in other colour mediums.

The inherent qualities of pastel are those of charm, of subtlety, softness, and exquisite depths of tone, unsurpass- able harmonies and unique freshness of colour, sweetness, delicacy, mystery â€” all the virtues sought for by the artist of daintiness and refinement. Pastel-painting is essenti- ally, therefore, the art of the colourist. Now, these very qualities suggest its limitations. Although it is unfair to relegate it â€” as fashion has foolishly done for so long â€” to the bunch of pretty triflings which Carlyle called ” Pom- padourisms,” we must recognize that a medium which suggests the bloom upon the peach is not proper to be employed for rendering ” grand,” or even genre subjects, or for the covering of

large surfaces of canvas. It is inappropriate to the painting of classic compositions,

although in point of fact it has been so used, not with- out success. It is best adapted to the rendering of still life, of landscape, and of portraiture. But in these cases it is not advisable to aim at that solidity which is the virtue of oil-painting, if only because oil can bring about a better result. The real reason is that, in securing solidity, pastel tends to forfeit that lightness and grace which constitute its especial charm and merit. Strength belongs to oil, tenderness and subtlety to pastel, together with freshness and elegance.

The pre-eminent technical advantage, in addition to those already mentioned, is the permanence of the tones. In water-colours there is an admixture of gum and gly- cerine which may attract moisture from the air; and, besides, the pigment is used in very thin washes. In oil-painting, not only does the oil darken with age, but sometimes draws oxygen from a pigment and changes its hue. In pastel the colour" is put on without any moist admixture, and can be laid on thick. Moreover, the permanence may arise from the method of manu- facture. In a very rare work, Tlie Excellency of the Pen and Pencil (1668), a chapter on " how to make pastils " (sic) " of several colours, for drawing figure, landskip, architecture, &c., on blew paper," describes the manner of grinding up the pigments with grease. This used to be the secret of pastel â€" that every grain of colour was separately and securely locked up in grease, and so was rescued from any chemical change that miglit have come about through contact of the colours with one another or with the atmosphere. Thus, for example, if in water-colour indigo be mixed with Indian red (as for the painting of a sky), in course of time the indigo will be chased off the paper and a red sky be left. This is often seen in the works of the earlier water-colour painters. With pastel nothing of the kind could occur ; and the works of Quen- tin Latour, Perroneau, Watteau, St Jean, and Chardin, m France, and Russell and Cotes, in England â€" to name no others â€" testify to the permanency

of the colours. Some manufacturers nowadays employ gum as the binding medium ; others beeswax (which at one time was more frequently used than it is at present) ; others, again, a very small proportion of tallow, and sometimes a little soap. But this introduction of binding medium is now adopted only in the case of certain colours. Whether the point or edge of the stick be used (as in pastel draw- iriij), or the side of it, helped with the tips of the dingers (as in pastel painting), the result is equally perma^ nent ; and if, when the work is done, it be struck two or three times, and then touched up by hand-crayons, no dropping of colour from the paper will ever occur. The drawing is made on a grained paper that Avill hold the chalk, or on a specially manufactured toothed cloth. The crisji touches of the pastel can be placed side by side, or the â– ” vibrations ” which the artist seeks may be obtained by glazes and superposed tones.

The art of pastel, as M. Roger Ballu expressed it, “was slum- bering a little,” until in 1870 the Sooi^t^ des Pastellistes was founded in Trance and met with ready appreciation. With many- artists it was a matter of “coloured chalks,” as, for example, with Millet, Lhermitte, and Degas in France, and with Whistler in PIngland. With the majority the full possibilities were seized, and a great number of artists abroad then practised the art for the sake of colour, among whom may be mentioned Adrien Moreau, A. Besnard, ^femile L6vy, Machard, Pointelin, Georges Picard, IwiU, Ren6 Billotte, and L6vy-Dhurmer, in Prance ; in Belgium, l<;mile Wauters (who has produced a great series of life-sized portraits of amazing strength, vitality, and completeness) and Fernand Khnopff ; In Italy, C. Laurenti, P. Fragiacomo, and the late Giovanni Segantini ; in Holland, Josselin ile Jong ; in Germany, F. von Lenbach, Max Liebermann, and Franz Stuck ; and in Norway, Fritz Thaulow.

In England the revival of pastel dates from 1880, when the first exhibition of the Pastel Society was held in the Grosvenor Gallery.

The exhibition was a sticces d'estime, but after a while the society languished until, in 1899, it was reconstituted, and obtained the adhesion of many of the most distinguished artists practising in the country, as well as of a score of eminent foreign painters. In that year, and since, it has held exhibitions of a high order, and intelligent public appreciation has been directed to the work of the most noteworthy contributors. Among these are E. A. Abbey, R.A., M'Lure Hamilton, J. M. Swan, A.R.A., J. Lorimer, R.S. A., A. Peppercorn, Anning Bell, J. J. Shannon, A.R.A., James Guthrie, H. Brabazon, Walter Crane, Melton Fisher, Edward Stott, S. J. Solomon, A.R.A., and W. Rothenstein.

See Kakl Robert [Georges Meosnier]. Le Pastel. Laurens, Paris, 1890. â€" J. L. Sprinok. A Gidde to Pastel Painting. Rowney, London. (m. h. s.)

Pasteur, Louis (1822-1895), French chemist, was born, on 27th December 1822, at Dole, Franche Comte, where his father carried on the business of a tanner. Shortly afterwards the family Pasteur removed to Arbois, where Louis attended the ecole primaire, and later the "college" of that place. Here he apparently did not especially distinguish himself, belonging to the class of " bons ordinaires." Fortunately at Arbois he came under the influence of an excellent teacher in the person of the director of the " college," who must have discerned in the quiet boy the germs of greatness, as he constantly spoke to him of his future career at the !ficole ISTormale in Paris. In October 1838 Louis was sent with a friend to the me- tropolis, to a school in the Quartier Latin, preparatory to the !^cole Normale. But he did not remain long in Paris, for, being a nervous and excitable boy, his health broke down, and he yearned for his home in Franche Comte. " If only I could smell the tannery once more," said he to his companion, " I should feel well." So home he went, though not for long, as his ambition was still to become a " normalien," and to this end he entered the Eoyal Col- lege of BesauQon, "en attendant I'heureux jour ou je serai admis a I'Ecole !N"ormale." Step by step he attained his end ; in 1840 he won his "baehelier es lettres," and shortly afterwards he received an appointment as assistant mathe- matical master in the

college. Two years later he passed the examination for the “bacalaureat es sciences” en- abling him to become candidate for the ificole ISformale. But here something (probably the examiner) was at fault, for a note was attached to Pasteur’s diploma stating that he was only “mediocre” in chemistrj-. In those early days and early trials the dominant note of Pasteur’s life was sounded. To his sisters he writes : ” Ces trois choses, la volonte, le travail, le succes, se partagent toute I’exis- tence humaine. La volonte ouvre Id porte aux carrieres brillantes et heureuses ; le travail les frauchit, et une f ois arrive au terme du voyage, le succes vient couronner I’ceuvre.” Throughout his life, and to the very end, ” work ” was his constant inspiration. On his deathbed he turned to the devoted pupils who watched over their master’s last hours. ” Oil en gtes-vous ? ” he exclaimed, ” Que faites-vous ? ” and ended by repeating his favourite words, ” II faut travailler.”

The first incentive to his serious study of chemistry was given by hearing Dumas, the most celebrated chemist of the time, lecture at the Sorbonne ; and ere long he broke new ground for himself, Balard having given him an opportunity for chemical work by appointing him to the post of laboratory assistant. A few words of explanation concerning Pasteur’s first research aYe necessary to give the key to all his future work. What was the secret power which enabled him to bring under the domain of scientific laws phenomena of disease which had so far baf- fle(l human endeavour ? It simply consisted in the appli- cation to the elucidation of these complex problems of the exact methods of chemical and physical research. Perhaps the most remarkable discovery of modern chemistry is the existence of compounds, which, whilst possessing an iden- tical composition, are absolutely different bodies, judged

of by their properties. The first of the numerous eases of isonierisni now known was noted, but unexplained, by Berzelius. It was that of two tartaric acids, deposited from wine-lees. The different behaviour of

these two acids to a ray of polarized light was subsequently observed by Biot. One possessed the power of turning the plane of the polarized ray to the right ; the other possessed no rotary power. Still no explanation of this singular fact was forthcoming, and it was reserved for the young chemist from Franche Comte to solve a problem which had bafELed the greatest chemists and physicists of the time. Pastern- proved that the inactivity of the one acid depended upon the fact that it was composed of two isomeric constituents : one the ordinary or dextro-rotary acid, and the other a new acid which possessed an equally powerful left-handed action. The veteran Biot, whose acquaintance Pasteur had made, was incredulous. He insisted on the repetition of the experiment in his pre- sence ; and when convinced of the truth of the explanation he exclaimed to the discoverer, " Mon cher enfant, j'ai tant aime les sciences dans ma vie que cela me fait battre le coeur." Thus at one step Pasteur gained a place of honour among the chemists of the day, and was immedi- ately appointed professor of chemistry at the Faculte of Science at Strasburg, where he soon afterwards married Mile Laurent, who proved herself to be a true and noble helpmeet. Next he sought to prepare the inactive form of the acid by artificial means ; and after great and long-con- tinued labour he succeeded, and was led to the commence- ment of his classical researches on fermentation, by the obser- vation that when the inactive acid was placed in contact with a special form of mould (perncillmm glaucum) the right-handed acid alone was destroyed, the left-handed variety remaining un- changed. So well was his position as a leading man of science now established that in 1854 he was ap- pointed professor of chemistry and dean of the Faculte des Sciences at Lille. In his inaugural address he ' used significant words, the truth of which was soon manifested in his case, "In the field of observation chance only favours those who are prepared." The dis- eases or sicknesses of beer and wine had from time im- memorial baf9.ed all attempts at cure. Pasteur one day visited a brewery containing both sound and un- sound beer. He examined the yeasts under the micro- scope, and at once saw that the globules from the sound beer were nearly spherical, whilst those from the sour beer were elongated; and this led him to a discovery, the consequences of which have revolutionized chemical as well as biological science, inasmuch as it was the beginning of that wonderful series of experimental researches

in which he proved conclusively that the notion of spontaneous generation is a chimera. Up to this time the phenomenon of fermentation was considered strange and obscure. Explanations had indeed been put forward

Louis V {From a photograph hy Pi'

by men as eminent as Berzelius and Liebig, but they lacked experimental foundation. This was given in the most complete degree by Pasteur. For he proved that the various changes occurring in the several processes of fer- mentationâ€" as, for example, in the vinous, where alcohol is the chief product ; in the acetous, where vinegar appears ; and in the lactic, where milk turns sour â€" are invariably due to the presence and growth of minute organisms called ferments. Exclude every trace of these organisms, and no change occurs. Brewers' wort remains unchanged for years, milk keeps permanently sweet, and these and other complex liquids remain unaltered when freely exposed to air from which all these minute organisms are removed.

" The chemical act of fermen- tation," writes Pasteur, "is essentially a correlative phe- nomenon of a vital act begin- ning and ending with it."

But we may ask, as Pasteur did, why does beer or milk become sour on exposure to ordinary air? Are these 111 dsible germs which cause t(rmentation always present in the atmosphere? or are tliey not generated from the 01 janic, but the non-organized (oQstituents of the ferment- al le liquid ? In other words. Ml} these organisms not spon- t meously generated ? The (ontroversy on this question \v IS waged with spirit on bdbh sides ; but in the end J'listeur came off victorious, I lid in a series of the most d^ licate and most intricate t \ perimental researches he pioved that when the atmos- pheric germs are absolutely excluded no changes take place. In the interior of the grape, in the healthy blood, no such germs exist; crush the grape, wound the flesh, and expose them to the ordi- nary air, then changes, either fermentative or putrefactive, run their course. But place the crushed fruit or the wounded animal under conditions which preclude the presence or destroy the life of the germ, and again no change takes place ; the grape

juice remains sweet and the wound clean. The application of these facts to surgical operations has, in the able hands of Lister, been productive of the most beneficent residts, and has indeed revolutionized surgical practice.

Pasteur was now the acknowledged head of the greatest chemical movem^jat of the time, the recipient of honours both from his own country and abroad, and installed at the ficole ^ormale in Paris in a dignified and important post. Not, however, was it without grave opposition from pov?6rful friends in the Academy that Pasteur carried on his* work. Biot â€” who loved and admired him as a son â€” publicly announced that his enterprise was chimerical and the problem insoluble ; Dumas evidently thought so too, for he advised Pasteur not to spend more of his time on such a subj ect. Yet he persevered : " Travailler, travailler toujours " was his motto, and his patience was rewarded by results which have not merely rendered his name immortal, but have benefited humanity in a way and to a degree for which no one could have ventured to hope. To begin '

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with, a comparatively small, though not unimportant, matter, Pasteur's discoveries on fermentation inaugurated a new era in the brewing and wine-making industries. Empiricism, hitherto the only guide, if indeed a guide at all, was replaced by exact scientific knowledge ; the connection of each phenomenon with a controllable cause was established, and rule of thumlD and quackery banished for ever by the free gift to the world of the results of his researches. '

But his powers of patient research and of quick and exact observation were about to be put to a severe test. An epidemic of a fatal character had ruined the French silk producers. Dumas, a native of the Alais district, where the disease was rampant, urged Pasteur to under- take its investigation. Up to that time he had never seen a silk-worm, and hesitated to attempt so difilcult a task; but at the reiterated request of his friend he consented, and in June 1865 went to the south of Prance for the purpose of studying the disease on the spot. In September of the same year he was able to announce results which pointed to the means of secur- ing immunity from the dreaded plague. The history of this research, of the gradual elimination of the un- important conditions, of the recognition of those which controlled the disease, is one of the most fascinating chapters of scientific discovery. Suffice it here to say that careful experiment and accurate observation suc- ceeded in ascertaining the cause of the disease and in preventing its recurrence, thus bringing back to pros- perity the silk trade of France, with all that this entails. ” There is no greater charm,” says Pasteur, ” for the inves- tigator than to make new disceveries ; but his pleasure is heightened when he sees that they have a direct appli- cation to practical life.” Pasteur had the good fortune, and just reward, of seeing the results of his work applied to the benefit both of the human race and of the animal world. The starting-point of all his investigations in pre- ventive medicine was the original observation of Jenner, that of vaccination, or the replacement of a slight disease for a serious one, by which the subject vras rendered immune. But Jenner’s discovery was up to recent times an isolated one, and it is to Pasteur that the world is indebted for the generalization of Jenner’s discovery, and for the introduction of methods which have already worked wonders, and bid fair to render possible the preventive, treatment of all infectious diseases. Just as each kind of fermentation posse^sses a definite organized ferment, so each disease is dependent on the presence of a distinct microbe ; and just as the gardener can pick out and grow a given plant or vegetable, so the bacteriologist can (in most cases) eliminate the adventitious and grow the special organism â€” in other words, can obtain a pure cultivation which has the power of bringing about the special disease. But by a process of successive and continued artificial cultures under different conditions, the virus of the organism is found to become attenuated ;

and when this weakened virus is administered, only a slight attack of the disease occurs, but the animal is rendered immune from further attacks. The virus has become a vaccine. The first disease investigated by Pasteur was that of chicken cholera, an epidemic which destroyed 10 per cent, of the French fowls ; after the application of the preventive method the death-rate was reduced to below 1 per cent. Next came the successful attempt to deal with the fatal cattle scourge known as anthrax. This is also caused by the presence of a microbe, of which the virus can also be attenuated, and by inoculation of this weakened virus the animal rendered immune. Many millions of sheep and oxen all over the world have thus been treated, and the rate of mortality reduced from 10 to less than 1 per cent. As to the money value of these discoveries, Huxley has

given it as his opinion that it was sufficient to cover the whole cost of the war indemnity paid by France to Germany in 1870.

The most interesting of Pasteur's investigations in preventive and curative medicine remains to be told. It is no less than a cure for the dread disease of hydro- phobia in man and of rabies in animals ; and the interest of the achievement is not only that he successfully com- bated one of the most mysterious and most fell diseases to which man is subject, but also that this was accom- plished in spite of the fact that the special microbe causing the disease has not been isolated. To begin with, Pasteur, in studying the malady in dogs, came to the conclusion that the virus had its seat in the nerve centres, and he proved that the injection of a portion of the matter of the spinal column of a rabid dog into the body of a healthy one produces in the latter with certainty the symptoms of rabies. The next step was to endeavour so to modify and weaken the virus as to enable it to be used as a preventive or as an antitoxin. This, after long and serious labour, he effected : the dog thus inoculated proved to be immune when bitten by a rabid animal. But this was not enough. Would the inoculation of the attenuated virus have a remedial effect on an animal already bitten? If so, it might be possible to save the lives of persons bitten by mad dogs. Here again experiment was successful. A num- ber of dogs were inoculated, the same number were untreated, and both sets were bitten by rabid animals. All the

treated dogs lived ; all the untreated died from rabies. It was, however, one thing to experiment on dogs, and quite another to do so on human beings. Neverthe- less Pasteur was bold enough to try. The trial was suc- cessful, and by so doing he earned the gratitude of the human race. Then the Institut Pasteur was founded. Thousands of people suffering from bites from rabid animals, from all lands, have been treated at this institute, and the death-rate from this most horrible of all diseases has been reduced to less than 1 per cent. Not only in Paris, but in mafly cities throughout the world, institutes on the model of the original one have been set up and are doing beneficent work, all arising from the genius and labours of one man. At the inauguration of the institute Pasteur closed his oration with the following words : â€”

" Two opposing laws seem to me now in contest. The one, a law of blood and death, opening out each day new modes of destructioti, forces nations to be always ready for the battle. The other, a law of peace, work, and health, whose only aim is to deliver man from the calamities which beset him. The one seeks violent conquests, the other the relief of mankind. The one places a single life above all victories, the other sacrifices hundreds of thousands of lives to the ambition of a single individual. The law of which we are the instruments strives even through the carnage to cure the wounds due to the law of war. Treatment by our antiseptic methods may preserve the lives of thousands of soldiers. Which of these two laws will prevail ? God only knows ! ^ But of this we may be sure, that science, in obeying the law of hu- manity, will always labour to enlarge the frontiers of life."

Rich in years and in honours, but simple-minded and affectionate as a child, this great benefactor to his spe- cies passed quietly away near St Cloud on the 28th September 1895.

Mention need only be made of Pasteur's chief works, as follows â– .â€"Etudes siir le rin (1866), Etudes sur Je vinaigre (1868), Etudes sur la maladie des vers d. soie (1870), Etudes sur ia hih-e (1876). He began the practice of inoculation for hydrophobia in 1885.

See Vie de Pasteur, par Renk Vallekey-Radot. Hachette. Paris, 1900. (g. e. e.)

PATAGONIA

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Patagonia, the name given to that portion of South America which, to the east of the Andes, lies south of the Eio Negro (41Â° S.), and to the west of the Andes, south of the Chilian province of Chiloe (42Â° S.). The Chilian portion embraces the two provinces of Llanqui- hue and Magallanes. East of the Andes the Argentine portion of Patagonia is divided into four territories, viz. : â€" (1) Xeiiquen, 80,000 square miles approximately, with 9261 inhabitants in 1895, formed by a portion of the triangle situated to the west of the rivers Limay and Neuquen, between the northern shore of Lalie Nahuel- Huapi (41Â° S.) and Eio Barrancas (37Â° S.) ; (2) Eio Negro, 44,000 square miles approximately, with a popu- lation of 14,517 in 1895, extending from the Atlantic to the Cordillera of the Andes, to the north of 42Â° S. ; (3) Chubut, 95,000 square miles approximately, with a popu- lation of 3748 (1895), embracing the regions between 42Â° and 46Â° S. ; and (4) that portion of the province of Santa Cruz which stretches from the last-named parallel as far south as the dividing line with Chile, and between Dun- geness Point and the watershed of the Cordillera, an area approximately of 106,000 square miles, with a population (1895) of 1058. The general character of the Argentine portion of Patagonia is for the most part a region of vast steppe-like plains rising in a succession of abrupt terraces about 300 feet. at a time, and covered with an enormous bed of shingle almost bare of vegetation. This peculiar tract of shingle is of Tertiary marine origin, and has been designated by geologists the Patagonian formation. Be- neath the shingle is a vast deposit of sands and clays of .marine and lacustrine origin, and volcanic lavas and tuffs. In the hollows of the plains are ponds or lakes of brack- ish and fresh water. Towards the Andes the shingle gives place to porphyry, granite, and basalt lavas, animal life becomes more abundant and vegetation more luxu- riant, acquiring the characteristics of the flora of the western coast, principally the beech and conifers.

Since 1880 explorations of a scientific character have been carried on in both the interior and coast regions of Patagonia by Moreno, Moyano, Rogers, Lista, Bertrand, Ziemiradzky, Steffen, Kruger, Stange, Hauthal, Wherti, Burckhardt, Nor- denskiold , Hatclier, and the surveyors of the Argentine and Chilian Boundary Commissions, and an appreciable modifica- tion of current ideas has been effected. Although the general character of the country is that of table-land, diversified by the beds of former lakes and rivers, the examination of the region close to the Cordillera has revealed striking features that give it a peculiar and interesting character. Among the depressions by which the plateau is intersected trans- versely, the principal is the Hualichvt, south of the Rio Negro, the Maquinchau and Balcheta (through which pre- viously flowed the waters of Lake Nahuel-Huapi, wliich now feed the river Limay) ; others between the latter and the Chubut, Senguerr, Chico, Deseado ; others between the Desire and the San Julian, now totally disappeared, the Shehuen depression, and those of Santa Cmz â€" Coile and Gallegos. Besides these transverse depressions (some of them marking lines of ancient inter-oceanic communication), there are others which were occupied by more or less extensive lakes, such as the YagagtOQ, Musters, and Colhue, and others situated to the south of Port Desire, in the centre of the country. Over the greater part of its surface the plateau is covered by a loose glacial, and in some parts fluvio-glacial, gravel, which barely supports the growth of herbage. Good pastures are found only on the watered lowlands, where bushes are more numerous, and where, by irrigation, extensive areas can be cultivated, and in the neighbourhood of the Andes, where are situated extensive tracts of land suitable for cultivation. In the central region volcanic erup- tions, which have taken part in the formation of the plateau from the Tertiary period down to the present era, cover a large part with basaltic lava-caps ; and in the western third more recent glacial deposits appear above the lava. There, in contact with folded Cretaceous rocks, uplifted by the Tertiary granite, erosion, caused principally by the sudden melting and retreat of the ice, aided by tectonic changes, has scooped out a deep longitudinal depression, which generally separates the plateau from the first lofty hills, the ridges generally called the Pre-Cordillera, while on the west of these there is a similar longitudinal depression all along the foot

Explora- tion.

Physio- graphy.

of the snowy Andean Cordillera. This latter depression contains the richest and most fertile land of Patagonia.

The geological constitution is in accordance with the orographic physiognomy. The Tertiary plateau, flat on the east, gradually rising on the west, shows Upper Cretaceous caps at . its base. First come Lower Cretaceous hills, raised by “Â«o’

coasts became converted into bays during tlie subsequent advance of tiie sea. Tliere are besides, in the neigiibourliood of tlie present coast, deposits of volcanic ashes, and the ocean throws up on its shores blocks of basaltic lava, which in all probability proceed from eruptions of submerged volcanoes now extinct. One fact, however, which apparently demonstrates with greater certainty the existence in recent times of land that is now lost, is the presence of remains of pampean mammals in Pleistocene deposits in the bay of San Julian and in Santa Cruz. The animals undoubtedly reached these localities from the east ; it is not at all probable that they advanced from the north southwards across the plateau intersected at that time by great rivers and covered by the ice-sheet. With the exception of the discoveries at Last Hope Inlet, in close com- munication with the Atlantic valley of Gallegos, none of these remainshave been discovered in the Andean regions.

On th’e upper plains of Neuquen territory thousands of cattle can be fed, and the forests around Lakes Traful and Nahuel-Huapi

yield large quantities of valuable timber. The Neuquen Neuquen. j.j^gj. jg jjqj navigable, but as its waters are capable of being easily dammed in places, large stretches of land in its valley are utilized ; but the lands on each side of its lower part are of little commercial value. As the

Cordillera is approached the soil becomes more fertile, and suitable districts for the rearing of cattle and other agricultural purposes exist between the regions which surround the Tromen volcano and the first ridges of the Andes. Chosmalal, the capital of the territory, is situated in one of these valleys. More to the west is the mining region, as yet almost unexplored, but which contains deposits of gold, silver, copper, and lignite. In the centre of the territory, also in the neighbourhood of the mining districts, are the valleys of Norquin and Las Lajas, the general camp of the Argentine army in Patagonia, with excellent timber in the forest on the Andean slope. The regions of Las Lajas, Alumine, Pulmary, Rucachoroy, Quillen, Tromen, and Huechulafquen are extremely picturesque, being overlooked on the west by the snows of the Lonquimay, Villarica, Yaimas, Quetropillan and Lanin volcanoes, which are scored by deep ravines and their sides dotted vsrith araucaria {A. imbricata) and an abundant crop of strawberries (Fragaria chilensis). The wide valleys occur near Rio Malleco, Lake Huechulafquen, the river Chimehuin, and Vega de Chapelco, near Lake Lacar, where are situated villages of some importance, such as Juuin de los Andes and San Martin de los Andes. Close to these are the famous apple orchards supposed to have been planted by the Jesuits in the 17th and 18th centuries. These regions are drained by the river CoUon- Cura, the principal af&uent of the river Limay. Lake Lacar is now a contributary of the Pacific, its outlet having been changed to the west, owing to a passage having been opened through the Cordillera. To the south of the valley of the Chimehuin are the depressions of the rivers Caleufu and Traful, also tributaries of the Limay, which receive the waters of the eastern slope of the Cordillera and of Lakes Hermoso, Metiquina, Villarino, Falkner, Traful, and Tilohuehuen. Lakes Espejo and Carrentoso originally formed part of Lake Nahuel-Huapi, but now empty their waters into that lake by a narrow channel. The landscape around these lakes is very beautiful, and the forest very rich in timber.

The Rio Negro runs along a wide transverse depression, now followed by the railway which goes to the confluence of the rivers

Limay and Neuquen, and in this depression are several Kio Negro, settlements, among them Viedma, the capital of the Rio Negro territory,

Pringles, Conesa, Choele Choel and Roca. To the south of the Rio Negro the Patagonian plateau is inter- sected by the depressions of the Gualicho and Maquinohau, which in former times directed the waters of ‘two great rivers (now dis- appeared) to San Antonio Bay, the first-named depression draining the network of the CoUon-Cura and the second the Nahuel-Huapi lake system. To the south of the second of these valleys rises a volcanic plateau, with small craters perfectly preserved ; and in the centre of the territory a longitudinal granite chain, with por- phyritic trachitic rocks, runs southwai-ds, being the end of the northern chains of central Argentina hidden under the Tertiary sandstone as far south as 38” S. This chain continues towards the centre of the Chubut territory, ending in porphyritic rocks at j\tlas Point and Port Desire on the Atlantic coast. In the valleys and depressions amongst these rocks there are beautiful tracts of country, which are now beginning to be inhabited. In 42Â° S. there is a third broad transverse depression, apparently the bed of another great river, now perished, which carried to the Atlantic the waters of a portion of the eastern slope of the Andes, between 41Â° and 42Â° 30′ S. The soil of this depression close to the Atlantic, near the eruptive mountains of San Antonio, and of the central part is of relatively small value as pasturage, but towards the Cordillera the soil becomes richer and the scenery grand. The network of small lakes, e.(j., Hess, Fonck, Vidal Gormaz, Mas- cardi, GutieiTez, Guilielmo, Martin, and Steffen, survivals of a former extension of Lake Nahuel-Huapi, drain excellent districts, all alike picturesque, over the whole of the Valle Nuevo, which

extends between Lake Nahuel-Huapi and Lake Puelo. In this region two recent breaches through the Andes carry off the waters of these eastern valleys to the Pacific.

Chubut territory presents the same characteristics as the Rio Negro territory. Rawson, the capital, is situated at the mouth of the river Chubut on the Atlantic (42Â° 30′ S.), and is , connected by railway with Golfo Nuevo at Port Madrin. ” ‘

The town was founded in 1865 by a group of colonists from Wales, assisted by the Argentine Government ; and its prosperity has led to

the foundation of other important centres in the valley, such as Treleu and Gaiman. Here is the seat of the governor of the territory, and in 1895 the inhabitants of this part of the territory, composed principally of Argentines, Welsh, and Italians, num- bered 2585. The valley has been irrigated tod cultivated, and produces the best wheat of the Argentine Republic. At 75 miles from its mouth the river Chubut receives the Rio Chico del Chubut, which was formerly a considerable river, but is now diminished on account of the waters of the Rio Senguerr having ceased to feed it. The latter river is the outflow of Lakes La Plata and Foutana, and receives the waters of the rivers Tenoa, Mayo, Chalia, and Guenguel. It is finally absorbed in Lakes Musters and Colhue, and from 1888 its flow into the Rio Chico grew gradually less and less, until in 1896 it ceased altogether. Between the Chubut and the Senguerr there are vast stretches of fertile land, spreading over the Andean region to the foot of the Cordillera and the lateral ridges of the Pre-Cordillera, and flUing the basins of some desiccated lakes, which have been occupied since 1885, and farms and colonies founded upon them. The chief of these colonies is that of 16 de Octobre, formed in 1886, mainly by the inhabitants of Chubut colony, in the longitudinal valley which extends to the eastern foot of the Cordillera. In 1895 its population numbered 1164 ; they devote themselves to cattle-rear- ing and agriculture, for which some of the valleys are admirably adapted. Other rivers in this territory flow into the Pacific through breaches in the Cordillera, e.g., the upper aflSuents of the Feta- leufu, Palena, and Rio Cisnes. The first is formed by the watA^ of the Cholila, Rivadavia, Fetalafquen, and other smaller lakes lying at the eastern foot of the main chain. To the north of these, and separated from them by an extensive moraine, lies Lake Epnyen, which empties into Lake Puelo and is the source – of the river Puelo, which flows into the Paciflc at Reloncavi Bay. Fetaleufu river also receives the Corinto river, which issues from the lateral cordon of the Andes and flows into the fluvio-glacial plains of Esquel through the valley of 16 de Octobre, which it also irrigates. The principal affluent of the Palena, the Carrenleufu, carries off the waters of Lake General Paz, situated on the eastern slope of the Cordillera. Rio Pico, an affluent of the same river and of the Rio Cisnes, receives nearly the whole of the waters of the extensive undulating plain which lies between the Rio Teka and the

Rio Senguerr to the east of the Cordillera, whilst the remainder are carried away by the affluents of Rio Jehua, viz., the Cherque, Omkel, and Appeleg. This region, representing a pre-Glacial lacustrine basin, is being occupied by Argentine cattle- breeders. It likewise contains auriferous drifts, but these, like the auriferous deposits, veins of galena and lignite in the mountains farther west which flank the Cordillera, have not been properly investigated. At Lake Fontana there are auriferous drifts and lignite deposits which abound in fossil plants of the Cretaceous age. The Rio Senguerr, a river of considerable volume, but not navigable, flows out of this lake, and when it reaches the plain breaks up into a number of small channels. The valley of the Rio Verde, an alHuent of the Senguerr, contains rich soil, and is the site of several prosperous Argentine farms. To the south of the Senguerr stretches the Patagonian plain in all its monotony, and there the continental watershed, which is distinct from and inde- pendent of the Cordillera, frequently changes, so that it is not possible to determine it with certainty. The streams which form the rivers Mayo and Chalia, affluents of the Senguerr, join the tributaries of the Rio Aisen, which flows into the Pacific, watering in its course extensive and valuable districts where colonization has been initiated by Argentine settlers. Colonies have also been formed in the basin of Lakes Musters and Colhue; and on the coasts near the Atlantic, between Bahia Camarones, Tilly Road, and the Gulf of Saint George, there are extensive farms.

The territory of Santa "Cvuz is arid along the Atlantic coast and in the central portion between 4()Â° and 50Â° S. With the ex- ception of certain valleys at Port Desire and in the transverse basins which occur as far south as Puerto 5^*"

San Julian, and which contain several cattle farms, *"

few spots are capable of cultivation, the pastures being poor, water insufficient, and salt lagunas fairly numerous. Port Desire is the outlet for the produce of the Andean region situated between Lakes Buonos Aires and Pueyrredon. Into this inlet there flowed at the time of the conquest a voluminous river, which subsequently disappeared, but

returned again to its an- cient bed, owing to the river Fenix, one of its affluents, whicli

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had deviated to the west, regaining its original direction. Lake Buenos Aires, the largest lake in Patagonia, measuring 75 miles in length, poured its waters into the Atlantic even in post-Glacial times by means of the river Desire, and it is so depicted on the maps of the 17th and 18th centuries ; and so too did Lake Pueyrredon, which, through the action of erosion, now empties itself westwards, through the river Las Heras, into the Calen inlet of the Pacific, in 48Â° S. Port San Julian, where Hernando de Magallanes wintered, has lately been colonized by cattle farmers, who are also pushing into the interior up the valley of a now extinct river which in com- paratively recent times carried down to Port San Julian the waters of Lakes Volcan, Belgrano, Azara, Nansen, and of some other lakes which now drain into the river Mayer and so into Lake San Martin. The Rio Chico, which represents the large extinct river just mentioned, empties itself into Santa Cruz Bay a little to the south of San Julian, after receiving the Rio Shehuen, a former outlet of Lake San Martin and of Lake Viedma. The latter now sends its waters to Lake Argentino by the Rio Leona, whUe the waters of Lake San Martin pierce the Cordillera of the Andes and empty westwards into the southern arm of Calen inlet. The valleys of the Rio Chico througliout their whole extent, as well as those of Lake Shehuen, afford excellent grazing, and around Lakes Belgrano, Burmeister, and Rio Mayer and San Martin there are spots suitable for cultivation. In the Cretaceous hills which flank the Cordillera important lignite beds and deposits of mineral oils have been discovered. The Rio Santa Cruz, originally explored by Captain Fitzroy and Charles Darwin, is an important artery of communica^ tion between the regions bordering upon the Cordillera and the Atlantic. It has been ascended at various times in small craft to its source in Lake Argentino, and by the river Leona as far as Lake Viedma. Upon the southern border of Lake Argentino there are cattle-rearing settlements, as well as on the banks

of the Rio Santa Cruz. In the bay an important trade centre has been established. But the present cattle region par excellence of Patagonia is the department of Rio Gallegos, the farms extending from the Atlantic to the Cordillera. Gallegos itself is an important business centre, which bids fair to rival the Chilian colony of Punta Arenas. The western region of this department, as well as tlie remainder of the Andean region, contains several lakes, the principal one being the picturesque Maravilla. The others, e.g,, Lakes Dickson, Norden- skiold, Sarmiento, Paine,, Hauthal, and Tyndall, are smaller. Glaciers come down to as far as the waters of the first two of these lakes, and the waters of the whole series are received by the Rio Serrano, which passes through the Cordillera from the east, by means of a narrow breach, to Last Hope Inlet. Owing to the produce of the cattle farms established there, the working of coal in the neighbourhood, and the export of timber from the surround- ing forests, the town of Punta Arenas is in a flourishing condition. Its population numbers about 4000. But the colonization of the western (Chilian) coast has failed, principally owing to the adverse climatic conditions of the Cordillera in those latitudes.

In the extreme south (Magallanes) the existence of fossils and other features in the Cordillera similar to those in the more northern Andes gives support to the supposition that Magal- â€¢ ^jjg upheaval of at least a portion of this territory took aaes. place at a very modern epoch ; there^s also additional

evidence of this in the fact that the country at the present day differs from that depicted by the early navigators. The recent volcanic eruptions in this territory extend from 41Â° S. up to the straits in the same zone, Mount Aymond being the principal crater.

The natives of Patagonia are nearly extinct. Here and there one may find a Tehuelchian or Gennaken encampment, but natives of Natives pure race are now very scarce, and the two races all told probably do not number more than 100 male individuals. The remaining population is composed of Araucanians, a, mixture of the Tehuelches and Gennaken. But these are not the only type of people who have dwelt in Patagonia. The ancient burial-places have yielded the bones of other

races quite distinct from the present inhabitants, some of them having greatly resembled the primitive types which are met with more to the north, in the Argentine Chaco and in Brazil ; while others, again, strongly resembled certain of the Paicific races, in that they possesseji ethnic characteristics which have not been observed elsewhere in South America. Among these remains every type of artificial deformity of the skull hitherto known has been found, while at the present time the natives only practise the occipital deformation which is so conjmon among the western tribes of America.

Patagonia has ceased to be isolated from the rest of America, and the influx of population has led to navigation being established on the Rio Negro, on Lake Nahuel-Huapi, and on the Commual- jjjq ganta Cruz ; and communication is regularly main- cailoas. tained on the first^named river as far as the confluence of the Limay and the Neuquen, to which point also the railway reaches. The telegraph extends to Chosmalal, the capital of Nequen territory, and to San Martin de los Andes on the west and to Bahia Camarones, near 46Â° S., and is being extended to

the colony of 16 de Octobre and to Cape Virgenes, at the eastern entrance of Magellan Strait. As already mentioned, a small railway connects Puerto Madrin in Golfo Nuevo with Rawson. Between Buenos Aires and tlie principal ports of the Atlantic coast as far as Punta Arenas and Tierra del Fuego a monthly service of steamers exists, and surveys have been commenced for the laying of light railways between the port of San Antonio on the Atlantic coast to San Martin and Junin de los Andes, Nahuel- Huapi, and 16 de Octobre ; also from Tilly Road in Saint George Gulf to Lake Buenos Aires and 16 de Octobre, and from Rio Gallegos up to the slope of the Cordillera. Various other parts are in communication by roads. Surveys for utilizing the waters of Lakes Nahuel-Huapi and Argentino for the irrigation of land near the Rio Negro and the Santa Cruz were made in 1898.

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Patel, Framjee Nasarwanjee (1804-1894), Parsee merchant and philanthropist, vras born in 1804, and had a sound vernacular education, with a smattering of English’ received during a short period of study in the then solitary English school in Bombay. At the age of fifteen he entered upon a business career, and its pursuit proved so congenial that by 1827 he had worked his way to a partnership in the firm of Frith, Bomanjee, and Co. The Parsees of those days evinced a great aptitude for commerce, and their simple manner of life, frugal habits, business capacity, and strict honesty made them desirable coadjutors with the mercantile firms which by that time had opened a regular and growing business with England. Banking facilities being then exceedingly scanty, such Parsees as had any capital at command acted as bankers and brokers to the rising English firms. Patel’s experience enabled him in a few years to raise the status of his compatriots to the higher level of independent merchauts, and he founded in 1844 a business house under the name of AYallace and Co., in which he was himself a partner with the English members of the firm. When he retired in 1858 he had amassed a large competence, and in the following year he established a firm on the same lines under the style of Eramjee, Sands and Co., of which the members were some of his sons, together with English partners. This system of partnership with English mer- chants was a landmark in the business history of the Parsees, though it has not been much developed owing to the preference of the younger men for professional and official pursuits. The improvement effected in the com- mercial status of the Parsees in Bombay is none the less to the credit of Eramjee Nasarwanjee Patel. It was, how- ever, not so much for his success as a merchant, as for his

spirit and liberality as an educationist, reformer, and philanthropist, that his name is notable in the annals of western India. He entered on his civic labours in 1837, and in all public movements figured prominently as an accredited representative of his community. As a pioneer of education, both for boys and girls, his example inspired the younger men of his time, like Dadabhoy Xaoroji, formerly member of the Imperial Parliament for East Finsbury, and the late Naoroji Fardoonjee and Sorabjee Shapurjee Bengallee. When Mountstuart Elphinstone, during his governorship, conceived the idea of concentrat- ing the literary and educational activity which had arisen from isolated efforts on the part of men who had them- selves been brought into contact with Western culture,

among his cliief collaborators were Framjee Cowasjee Baaajee and Framjee Patel. To their initiative was due the establishment of the Elphinstone Institution, which comprised a high school and, after some years, a college, which continue to hold foremost rank among the similar academies since established in western India. But Mr Patel's most remarkable public service was performed in connexion with the Parsee Law Association, of which he was president. Since their exodus from Persia the domestic affairs of the Parsees had been in a very un- settled state. Matrimonial obligations and the rights of succession in cases of intestacy had fallen into hope- less confusion, and the adjudication of disputes in relation thereto was effected by certain elders of the community, who had neither the knowledge and help of j&xed principles to guide their judgments, nor any authority to enforce their decisions. The case of Ardesir Cursetjee V. JPeeroxebai, which came up on appeal before the Privy Council in England, broiight to light the strange fact that even the Supreme Court of Bombay had no juris- diction over matrimonial and ecclesiastic disputes among Parsees. This state of lawlessness was recognized by that community as intolerable, and the agitation which ensued thereupon led to the appointment of a commission, of which the distinguished jurist Sir

Joseph Arnould was the president and Mr Framjee Patel the chief Parsee member. The Parsee Law Association, under the guid- ance of Mr Patel and Mr Sorabjee Bengallee, rendered invaluable help to the commission, and their joint efforts resulted in the passing by the Government of India of the Parsee Marriage and Divorce Act and the Parsee Intestate Succession Act (15 and 21 of 1865). These Acts form the charter of matrimonial and ecclesiastical status for the Parsees. At the time of his death in 1894, at the ripe age of nearly ninety years, Mr Framjee Patel was the most revered and best beloved of the dis- tinguished natives of India, having during an eventful public life extending over sixty years worked in co- operation with three generations of the most prominent of his compatriots to better the condition of their country. During that period Framjee Patel was primus inter pares among a succession of enlightened and public- spirited Parsees, who, under the guidance and encouragement of men like the Rev. Dr John Wilson, Sir Bartle Frere, and Sir George Birdwood, brought about the regeneration of the old civilization of western India by British methods. He thus fully justified the term applied to him by the last-named, in the dedication to him of his work on the old records of the India OflBce, of "the Nestor of the Parsees." His family surname refers to the title of Patel, that is, " Mayor," of Bombay, conferred on its founder for services rendered to the English in 1692. (m. m. bh.)

Patents (see also Letters Patent). â€" In this article patents for inventions alone are considered. Few mate- rial alterations in the English law have been made since the article Patents in the ninth edition of this work was published, and the account there given of the subject-matter of valid letters patent, and of legal pro- ceedings for the infringement and revocation of patents, is still substantially correct. But the following points deserve notice.

(i.) Exhibitions. â€" The exhibition of an invention at an industrial or international exhibition certified as such by the Board of Trade, or the publication of any description of the invention during the period of the holding of the exhibition, or its use for the purpose of the exhibition in the place where it is held, or during the period of the exhibition by any

person elsewhere, without the privity or consent of the inventor, is not .to prejudice the right of the inventor or of his legal personal representative to apply

for and obtain a patent, or the validity of any patent granted on the application, provided that two conditions are complied with, viz., (a) the exhibitor must, before exhibiting the invention, give the Comptroller-General a prescribed notice of his intention to do so ; and (b) the application for the patent must be made before or within six months from the date of the opening of the exhibition (Patents Act, 1883). The Patents Act, 1886, enables the Sovereign, by Order in Council, to extend the provision above mentioned to industrial and international exhibitions held out of the United Kingdom.

(ii.) Prior Publication. â€" Whereas " user " in public is sufficient prior publication to invalidate a subsequent patent for the invention so used, publication in books, &c., will not be a bar to novelty unless its effect is to make the invention actually a part of public knowledge ; and in dealing with alleged anticipations by patents that have never come into general use the courts will not invalidate a subsequent patent unless a person of ordinary knowledge of the subject, on having the alleged anticipation brought under his notice, would at once perceive, understand, and be able practically to apply the invention without making experiments or seeking for further information.

(iii.) Variance or Disconformity. â€" Since the introduc- tion of the patent specification, it has been necessary that an invention protected by patent should be accurately described by the inventor. Formerly, when the condition on which letters patent issued was that the patentee should file a specification completely describing the nature of his invention within a certain time after the grant, the function of giving the necessary preliminary in- formation on the subject was to some extent discharged by the title; at any rate, the validity of the grant was liable to be objected to on the ground of the title being too general. Under the present law the task of preliminary disclosure falls to the provisional specifica- tion, introduced by the Patent Law Amendment Act, 1852, and continued by the Patents Act of 1883, although a

patentee may, under the latter statute, dispense with a provisional specification if he thinks proper to file a complete one in the first instance. Where, however, these two specifications are filed, it becomes of vital moment to an inventor that the true relation between them should be maintained. That relation, as settled by recent cases, may be stated thus : It is the duty and the office of the provisional specification to declare the nature of the invention in general terms. The function of the complete specification subsequently filed is to explain the invention in detail, and to show how it is to be carried out. The object of the provisional specification is to secure immediate protection, and to enable a patentee to work at and improve his invention without the risk of his patent being invalidated by premature publication. He is therefore entitled to embody in his complete specification any improved method of working his invention which he may discover in the interval ; and he is indeed bound to do so, since the price that a man who desires a patent has to pay to the public for the privilege is that he should make a full disclosure of his invention in his complete specification. But there is a limit to what the patentee may do in this respect. He must not describe in his complete specification an invention different from that declared in the provisional. If he falls into this error there is said to be a ” variance ” or “disconformity” between the two specifications, andlhe patent will be bad. The Patents Act, 1883, Â§ 9, made it the duty of the examiners of the Patent Office to consider the question of disconformity between specifications on applications for patents, and it was thought at one time that if the Comptroller-General accepted a patent after the examiner had reported on it, there could no longer be any objection on the ground of disconformity. But this view

has been rejected, and disconformity is still a good answer to an action for infringement and makes a patent void.

(iv.) Compulsory Licences. â€” For about fifteen years the provisions introduced into the Patents Act, 1883, for the compulsory licensing of patents under the authority of the Board of Trade, remained

practically a dead letter. Up to the end of 1887 there had been onJy one informal application, which was by leave withdrawn. In 1888 there was also one application. Probably the fact that the compulsory licence provisions did not apply to patents granted, or applications pending, before the Patents Act, 1883, came into operation, may account for this circumstance. There have been several cases since 1897. It may be noted at this point that by English patent law a patentee is not obliged to bring his inven- tion into practice within a specified time (compulsory working, or exploitation) : there is no preliminary exam- ination into, or guarantee of, novelty by the Patent Office ; and a patentee is not prohibited from importing into the country articles manufactured under his patent abroad. The law is different, as will be seen by refer- ence to the headings (x.) and (xi.) infra, in many British colonies >and foreign countries. With reference to pre- liminary examination in England, however, it should be added that the Board of Trade recently appointed a strong committee, with Sir Edward Pry as its chairman and Lord Alverstone and Mr Fletcher Moulton, K.C., among its members, to inquire into and report upon, inter alia, the question whether any, and, if so, what, additional powers should be given to the Patent Office to (a) control, (6) impose conditions on, or (c) otherwise liipit the issue of letters patent in respect of inventions which are obviously old, or which the information recorded in the office shows to have been previously protected by letters patent in Great Britain.

(v.) Legal Bemedies. â€” Several additional forms of legal proceedings in connexion with patents should be noted, (a) At common law a person who, alleging that he has a patent, threatens his rivals in trade, is liable to an action for damages, but the plaintiff cannot succeed without show- ing that the threats were made maliciously. (6) The Patents Act, 1883, provides another remedy â€” what is known as “the threats action” (see sec. 32). The stat- ute makes the good faith of the patentee threatening legal proceedings no answer to an action brought against him by any person aggrieved by his threats if the acts complained of are not in fact an infringement of the patent, and if the patentee fails with due diligence to commence and prosecute an action for infringement, (c) The point has recently been raised whether a patentee

threatening legal proceedings for infringement could not be sued under section 4 of the Statute of Monopolies, which gives to any person " hindered, grieved, disturbed or disquieted ... by occasion or pretext of any mono- poly or letters patent," a right to treble damages.

(vi.) Extent and Construction. â€" The patent when sealed is to have effect in the United Kingdom and the Isle of Man. The present Act, unlike the Patent Law Amend- ment Act of 1852, does not extend the monopoly to the Channel Islands. The statutory form of letters patent for inventions provides that "These our letters patent shall be construed in the most beneficial sense for the advantage of the said patentee." It is now settled, however, after considerable judicial discussion, that a specification should be subjected neither to what was oncecalleda "benevolent" construction nor to a strict one, but that the language should be construed according to its ordinary meaning.

(vii.) Fees. â€" By an order of the Board of Trade which came into operation on 1st October 1892, the following important reductions in the renewal fees payable on patents were made. Before the expiration of the 4th

year from the date of the patent, Â£5 instead of Â£10 ; of the 5th year, Â£6 instead of Â£10 ; of the 6th year, Â£7 instead of Â£10 ; of the 7th year, Â£8 instead of Â£10 ; of the 8th year, Â£9 instead of Â£15; of the 10th year, Â£11 instead of Â£20 ; of the 11th year, Â£12 instead of Â£20 ; of the 12th year, Â£13 instead of Â£20; and of the 13th year, Â£14 instead of Â£20. The preliminary fees amount- ing to Â£4 were left untouched by the order, the result of which was to reduce the entire cost of a patent from Â£154 to Â£99.

(viii.) Business. â€" A new Patent Office has been con- structed in London on the site of the old buildings, the frontage extending from Southampton Buildings into Staple Inn. The number of applications for patents, which sprang from 6993 in 1883 to 17,110 in 1884, culminated in a total of 30,952 for the year 1892, since which date a steady decline has set in. The number of patents sealed on application for a given year shows less variation, the minimum being 8775 for 1886 against 14,465 for 1897. The proportion of seals to applications varied from 46 to 60

per cent, during 1890-1900. The receipts from patent fees in 1899 were Â£202,977, against a total expenditure of Â£123,216. The latter sum includes Â£24,118 expended chiefly on the new office.

The official publications of the Patent Office deserve some notice, as, in the absence of official investigation into novelty, the onus of search rests with the applicant or his agent. The procedure has been greatly simplified by the publication, on a uniform system and at a low rate (Is. per volume), of illustrated abridgments of specifications. From 1877 practically to date the searcher obtains a chronological digest of all specifications falling within a given class. To these classes there is a refer- ence index, known as the ” abridgment class and index key,” which at once directs the searcher to his proper class and index heading. The periods already issued in volume form are 1877-83, 1884-88, 1889-92, 1893-96. The series for 1897-1900 was issued sheet by sheet to subscribers. The first sheets of a similar series for 1867-76 have also been published, while it is pro- posed to reissue on similar lines abridgments of all specifications filed since the initiation of the English patent system.

(ix.) Patent Agents. â€” The position of patent agents is now regulated by statute. By the Patents Act, 1888, it was provided that no person should, after 1st July 1889, be entitled to describe himself (and whoever does so know- ingly incurs liability to a maximum penalty of Â£20) as a patent agent whether by advertisement, description on his place of business, or otherwise, without being registered as such in pursuance of the Act. But the Act preserves the right to registration of every person who, to the satisfaction of the Board of Trade, shows that he had been bond fide practising as a patent agent before it passed. The Board of Trade is empowered by this statute to make from time to time general rules for the purpose of carrying out its provisions, and by rules issued in 1889, and reissued in 1891, the Board of Trade delegated to the Institute of Patent Agents (which obtained a royal charter in 1891) the care of the register of patent agents and the duty of holding the necessary examinations for entrance into the profession.

(x.) India and the British Colonies [see also (vi.) and (xii.)]. â€” Little more can be attempted under the present heading or the following one â€” (xi.) Foreign Patent Laivs â€” than to touch upon a few distinctive feat.ires, such as duration, fees, preliminary examination into novelty, &c.

Australian States. â€” In New South Wales the regulating Act is No. 19 of 1899. It amends the law on a variety, of matters, pro- vides for the appointment of an examiner of patents, and is prac- tically a transcript of the provisions of the Imperial Patents Act,

1883, as to amendment of specifications, disclaimers, and revocation of patents. It appears tliat there may be a preliminary examina- tion as to novelty (see Â§Â§ 5 (1) and 22). The duration is not less than 7 nor more than 14 years. In Queensland the Patents Acts are No. 13 of 1884, No. 5 of 1886, and No. 8 of 1890. The provisions of these statutes closely follow the Imperial legislation on the subject. But there is a preliminary examination as to novelty (see No. 5 of 1886). In South Australia the latest Act is No. 421 of 1887. A preliminary examination as to novelty may be ordered (see No. 78 of 1877). Patent law is now regulated in Victoria by No. 1123 of 1890, which is modelled on the English Acts. There is a preliminary examination as to novelty. The fees payable before the expiration of the 3rd and 7th years are now respectively reduced from Â£15 and Â£20 to a sum in each case of Â£2 10s. In West Australia the governing Acts are now No. 5 of 1888, No. 15 of 1892, and No. 4 of 1894. There is apparently no preliminary examination as to novelty. The general provisions are similar to those of the English statutes. The renewal fees are prescribed by the Patent Rules 1898, and amount to a sum of Â£5 before the end of the 4th year and Â£10 before the end of the 7th year from the date of the patent. See also New Zealand and Tasmania.

Bahama Islands. â€” The law is regulated by the following Acts of the colony :â€” 52 Vict. c. 23, 53 Vict. c. 2, and 54 Vict. c. 12. Duration of

patent 7 years, with power in governor to renew for another 7 years, and thereafter for a third period of 7 years. The fees are Â£3 on filing specification, Â£10 for second renewal, and Â£20 for third. Apparently there is no preliminary examination as to novelty.

Barbados. â€” Cp. Acts of Colony of 12th December 1883 and No. 37 of 1892-93. Duration of patent 7 years, with possible extensions for two further periods of 7 years each, but no more. Fees are Â£3 6s. 8d. on filing specification, Â£10 for second renewal, and Â£20 for third. No preliminary examination as to novelty.

Bermuda. â€” There is apparently no statutory patent law in this colony.

British Guiana. â€” The law is still regulated by ordinance No. 1 of 1861. It may be noted in addition that there is no preliminary examination for novelty.

British Honduras. â€” The law of 10th September 1862 has been re-enacted with slight modifications (see supplement to Patent Laws of the World, No. 4). There is no examination as to novelty.

British India. â€” The law is now governed by Act 5 of 1888, which applies to the whole of British India. Duration of patent is 14 years. A preliminary examination into novelty might apparently be ordered. The following taxes are payable : â€” Annual sums of Es.50 from the 4th to the 8th year, and of Rs.lOO from the 8th to the 13th year of the term.

British New Guinea. â€” -The Queensland Patents Acts, No. 13 of 1884 and No. 5 of 1886, have been adopted. See British New Guinea Ordinance No. 6 of 1889, Schedule A.

British North Borneo. â€” Straits Settlements law (No. 12 of 1871), adofSted by Patents Proclamation 1887 (No. 1 of 1887).

Canada. â€” Patent legislation belongs exclusively to the Dominion Parliament [B.N.A. Act, 1867, Â§ 91 (22)]. The existing Acts are c. 61 of

1886 ; 55 and 56 Vict. o. 24, and 56 Vict. c. 34. The duration of the patent is 18 years. At the time of application the applicant may pay the full fee required for that term (viz., 60 dollars) or the partial fee required for the term of 6 years (20 dollars) or for the term of 12 years (40 dollars). If a partial fee only is paid, the amount is stated in the patent, and the patent ceases at the end of the term covered by such partial payment, unless before the expiration of such term the patentee pays the fee required for the further term of 6 or 12 years, viz., 20 dollars in the former case and 40 in the latter. There is a preliminary examination into novelty by examiners, with an appeal from the decision of the Commissioner of Patents to the Governor in Council. The patent is void unless it is worked in Canada within 2 years, or if after the expiration of 12 months, or any authorized extension of either of these periods, the patentee imports the invention into Canada.

Cape of Good Hope. â€" The law is still regulated by Act No. 17 of 1860. There is no preliminary examination into novelty, and the Act contains no provisions for compulsory working, or as to the importation of patented articles from abroad.

Ceylon. â€" The law is now regulated by Act 16 of 1892. The duration of the patent is 14 years, with power vested in the governor in council to grant extensions of 7 and 14 years. There is no preliminary examination as to novelty, and there are no pro- visions as to compulsory working or the importation of patented articles from abroad. The renewal fees are Rs.60 annually from before the expiration of the 4th to before the expiration of the 8th year from the filing of the specification, and Rs.lOO annually from before the expiration of the 9th to before the expiration of the 13th year. See also No. 6 of 1897.

Channel Islands. â€" These are not now included in grant of letters

patent. See form of grant. Schedule I, Form D, Patents Act,

1883.

Falkland Islands.â€" ^o regulations exist.

Piji Islands. â€” The law depends on ordinances No. 3 of 1879 and 7 of 1882, and Order of 29th December 1890. The duration of the patent is 14 years. There is no preliminary examination, and there are no provisions as to compulsory working or importation from abroad. The patent is not subject to any payment after issue. A fee of 5 guineas is payable on deposit of petition and specification. The fee for provisional protection is 5 guineas ; on obtaining letters patent the applicant pays 10 guineas.

&‘am6ia.â€” No regulations exist. An ordinance practically iden- tical with that of the Gold Coast is being adopted.

Gibraltar.â€” There is no patent law in Gibraltar, but special ordinances are sometimes passed extending the privileges of BHtlsh patentees to the dependency for the unexpired residues of the original terms. See as examples No. 5 of 1890, No. I of 1896, and No. 1 of 1898.

Gold Coast.â€” The law is now regulated by ordinance No. 1 of 1900, which closely resembles the Imperial Act.

Hong-Kong. â€” The law is regulated by ordinance No. 2 of 1892. The inventor or assignee of any invention patented in England may obtain protection in the colony for the unexpired residue of the original term. If the English patent is extended by the advice of the Judicial Committee, an extension of the colonial patent may be obtained, or a new patent granted for the extended period. A fee of 25 dollars is payable on grant of patent, and another fee of the same amount on grant of extension or original letters in lieu of extension. There is no preliminary examination, and there are no provisions as to compulsory working or importation from abroad.

Jamaica.â€” The law is still in substance governed by c. 30 of 1857. But under ordinance No. 15 of 1891 the stamp duty on letters patent is now Â£2 instead of Â£6 10s., and there is no longer any fee payable on the reference to the Attorney-General. There is no preliminary examination as to novelty, and there are no pro- visions as to importation from abi;oad.

Lagos. â€” No regulations exist, but an ordinance practically iden- tical with that of the Gold Coast is being adopted.

Leeward Islands. â€” The principal Acts still are No. 12 of 1876 and No. 16 of 1878. There is no preliminary examination into novelty, and there are no provisions as to compulsory working or importation from abroad. A retrospective power of granting ex- tensions of time for any Act or payment is conferred on the gov- ernor in council by No. 2 of 1891.

Malta. â€” The law is governed by ordinance No. xi. of 1899, the duration of the patent is 14 years. There is no express provision for a preliminary examination into novelty. Provision is made for compulsory assignation or licence, where the invention has not been put into use within 12 months subsequent to the grant or its working has been suspended for 12 months continuously. The annual fees are Â£5 before the expiration of the 4th year from the date of the patent ; Â£6 before the expiration of the 5th ; Â£7 and Â£8 respectively before the expiration of the 6th and 7th years ; Â£9 and Â£10 before the expiration of the 8th and 9th ; and from Â£11 to Â£14 before the expiration of the 10th, 11th, 12th, and 13th years.

Mauritius. â€” The law is still regulated by ordinance No. 16 of 1875. There is no preliminary examination ag to novelty, and there are no provisions for compulsory working or importation from abroad.

Natal. â€” The law is still regulated by No. 4 of 1870. But certain details of practice are amended by No. 2 of 1895. There is no preliminary examination as to novelty, and there are no provisions as to compulsory working or importation from abroad.

NeirfmiuUand. â€” The law is contained in the Consolidated Statutes, Title xii. c. 109. There is no preliminary examination into novelty. In addition to the office fees, the patentee is required to deposit with the Colonial Secretary the sum of 25 dollars, to be paid by him to the Receiver-General for the use of the colony.

New Zealand.â€” The law now depends on No. 12 of 1889, amended in details by No. 8 of 1897. The duration of a patent is 14 years. There is no preliminary examination as to novelty, and there are no provisions as to compulsory workiui; or importa- tion from abroad. The following fees are payable :â€” Â£2 on obtain- ing letters patent, Â£5 before the expiration of the 4th year, and Â£10 before the expiration of the 7th.

St Helena.-â€” The law is regulated by ordinance No. 3 of 1872. The grantee of an English patent, or his representatives, can have the grant extended to the colony. All cases of doubt and difficulty not provided for by the laws of the colony are governed by the law in force in England. A fee of one guinea is payable on filing copy of letters patent and specification with the registrar of the Supreme Court.

Sierra Leone.â€” 'No special regulations exist, but an ordinance practically identical with that of the Gold Coast is being adopted.

Straits Settlements.â€” The law is prescribed by ordinance No. 12

of 1871. The duration of a patent is 14 years. There is no preliminary examination as to novelty, and there are no pro- visions as to compulsory vyorking or importation from abroad. There is a stamp duty of 50 dollars on the petition. No renewal fees are payable.

Tasmania. â€” The law is now regulated by Act No. 6 of 1893. The duration of the patent is 14 years. There is no preliminary exami- nation as to novelty (but see Â§ 110), and there are no provisions as to compulsory working or importation from abroad. The fees pay- able are Â£2 on obtaining patent, Â£15 at or before the expiration of the 3rd year, and Â£20 at or before the expiration of the 7th.

Trinidad and Tobago. â€” The law is regulated by ordinance No. 10 of 1900. The duration of the patent is 14 years. There is no- preliminary examination into novelty, and there are no provisions as to compulsory

working or importation from abroad. A fee of Â£10 is payable on ai)plioation for a patent.

Turks and Oaieos Islands. â€” The law of Jamaica has been ex- tended to these islands by No. 7 of 1897. See supplement to Patent Laws of the World, No. 3. v

Windward Islands. â€” In tlae Windward Islands other than Barbados, viz., Grenada, St Lucia, and St Vincent, patents for invention were granted until recently only by special ordinances. See, e.g., 'â€¢St Lucia, ordinance No. 41 of 1875 (Tooth's patent). A stamp duty of Â£10 was payable in this island on letters patent for inventions (No. 6 of 1881, schedule). But ordinances based on the Imperial Act have now been passed, St Vincent (No. 5 of 1898), Grenada (No. 4 of 1898), and St Lucia (No. 14 of 1899).

(xi.) Foreign Patent Laivs. â€" T'or the text of these see Patent Laws of the World, ed. 1899. But the following are the essential facts.

Algeria. â€" French law applied by decree of 5th June 1850.

Argentine Bepublic. â€" ^The law of 11th October 1864 is still In force. There is no provision as to importation from abroad.

Aiistria. â€" A newlaw(llth January 1897) came into force on 1st January 1899. The principal changes introduced by this measure are these : There is now a strict preliminary examination into nov- elty. The term of the patent Ls now fixed at 15 years, and besides an application fee of 10 florins, there are annual fees rising from 20 florins for the first year to 340 florins for the fifteenth. The period for compulsory working is raised from 1 year to 3 years from the date of the publication of the grant of the patent in the patent journal. Provision is made for the conversion of patents under the old law of 15th August 1852 (extended to Hungary by law of 27th June 1878, and to Bosnia and Herzegovina by law of 20th December 1879) into patents under the new law.

Belgium. â€” The law is still governed by the law of 24th May 1854, Patents are granted, as in France, without guarantee of novelty.

Bolivia. â€” The patent law depends on a law of 8th May 1858. The duration of the grant is in the case of a patent of invention not less than 10 nor more than 15 years ; in the case of an imported invention, 3 years if its establishment requires an outlay of 25,000 dollars, if it reaches 50,000 dollars, 6 years, and if 100,000 or more, 10 years. The novelty neither of patents for invention nor of patents for imported inventions is guaranteed. The patent lapses unless the invention is put into complete practice within a. year and a day from the date of the privilege, unless the omission is excused by justifiable causes according to law.

Brazil. â€” Patents are granted under the law of 14th October 1882. The patent lapses unless the invention is brought into effective use within 3 years from the date of the grant, or if such use is suspended for more than a year, except by reason of force maje ii re admitted by Government to be a sufllcient excuse. Besides expenses and fees, patents of invention are subject to an annual and progressive tax, commencing at 20 dollars and increasing at the rate of 10 dollars a year. The patents issued are without guarantee of novelty or utility.

Ohile. â€” The law is regulated by the law of 9th September 1840, decree of 1st August 1851, and laws of 25th July 1872, 20th January 1883, and 20th January 1888. There is a preliminary examination as to novelty and utility. Though the duration of a patent does not ordinarily exceed 10 years, the term may be ex- tended to 20 years by the President of the Republic, if the report of the experts on the nature and importance of the invention seem to justify it. There are no provisions as to importation from abroad.

Colombia. â€” Patents are granted under law No. 35 of 1869. The term varies from 5 to 20 years at the option of the applicant. There is no preliminary examination as to novelty, and there is no provi- sion as to importation from abroad. A patent for a new industry is void when such industry is idle for a whole year, unless inevitable circumstances have intervened. An applicant pays a sum of 10 pesos, which is

forfeited if the patent is refused, and taken in part payment of the patent fee if it is granted. The patent tax is from 5 to 10 pesos a year for every year of the privilege.

Congo. â€” Patents are issued under a law of 29th October 1886 and a decree of 30th October 1886. They are of three kinds, patents of invention, of importation, and of improvement. There is no preliminary examination as to novelty, and the patent ex- pressly mentions that the grant is made without guarantee. The term of a patent of invention is 20 years. A patent of importa^ tion or of improvement expires in the former case with the foreign, in the latter with the principal patent. Patents of improvement are not liable to any tax ; on other patents a payment of 100 francs is required. There are no provisions as to compulsory working or prohibiting the importation of patented articles.

Costa Rica. â€” Prior to 26th June 1896, applications for patents had to be made to the Constitutional Congress. The. matter is now dealt with by a law of the above-mentioned date. The dura- tion of the term is 20 years. There is apparently no preliminary examination into novelty. The period for compulsory working is 2 years, and a patent which ceases to be worked during any 3 consecutive years becomes public property.

Denmark. â€” Patents are now granted under a law of 28th March 1894. The duration of the patent is 15 years, and no extension can be granted. There is a preliminary examination into novelty. The patent may, on terms, be appropriated by the State if the public interest demands it. The period for compulsory working is 3 years, and the patent will also lapse if the exercise of the inven- tion is discontinued for more than a year. The patent commission may release the patentee from the obligation of manufacturing the patented article in Denmark, if satisfied that the cost of such manufacture would be unreasoriable, on condition that the patented article is always kept on sale in Denmark. The tax is an annual fee of 25 kroner for the first 3 years, 50 kroner for the next 3, 100 for the following 3 ; then for 3 years 200 kroner yearly, and for the last 3, 300 kroner yearly.

Ecicador. â€” Patents are granted under a, law of 18th October 1880. The provisions are identical with those given for Bolivia.

Finland. â€” The law is regulated by ordinances of 21st January 1898. The term of the patent is 15 years. There is a preliminary examination into novelty. The period for compulsory working is 3 years, the penalty for non-compliance being an obligation on the part of the patentee to grant compulsory licences. The tax consists of annual fees, commencing with the second year of the patent, and of the following amounts : â€” 20 marks yearly for the 2nd and 3rd years ; 40 marks from the 4th to and including the 6th year ; 50 marks from the 7th to and including the 9th ; 60 marks from the 10th to and including the 12th year ; and 70 marks from the 13th to and including the 15th.

France. â€” The law is still regulated by the law of 5th July 1844. The following additional points should be noted : â€” The term of a patent of invention is 5, or 10, or 15 years, at the option of the patentee. Every such patent is subject to the following taxes, payable by annual instalments of 100 francs : â€” 500 francs for a patent of 5 years, 1000 francs for a patent of 10 years, and 1500 francs for a patent of 15 years. A tax of 20 francs is payable on application for a patent of addition. Patents of addition are not subject to annual taxes. There is no preliminary examination as to novelty. A patentee is not obliged to mark patented articles as such, but, if he does, the words Sans Garantie du Oouvernement, or the initial letters of these words- â€” S. G. U. G. â€” must be added, under liability to a penalty for omission of from 50 francs to 1000 francs. The provisions as to compulsory working {exploitation') are in the main so interpreted as to strike only at voluntary and calculated inactivity. The law of 5th July 1844 is applied to the French colonies by a decree of 21st October 1848, and as to French Indo-China, see decree of 24th June 1893.

Germany. â€” Patents (the law as to which is not affected by the new civil code) are granted under a law of 7th April 1891. The duration of the patent is 15 years. There is a strict preliminary examination into novelty. The period for compulsory working is 3 years, but it is sufScient if the patentee has done everything that is necessary to ensure

the carrying out of the invention. A tax of 30 marks has to be paid before the grant. In addition to this there has to be paid at the commencement of the second and every following year of the term a tax amounting to 50 marks for the first year and increasing by 50 marks every subsequent year.

Greece. â€” No special patent law apparently exists. A private Act is required, which can be introduced by a deputy and is treated like any other Bill.

Guatemala. â€” Patents are granted under the law of 21st May 1886 and a decree of 17th December 1897. The term of the patent ranges from 5 to 15 years. An annual tax of 30 pesos is payable. The period of compulsory working is 1 year, and aban- donment of working for a year forfeits the patent. There is apparently a preliminary examination as to novelty (see Art. 16 of the decree of 17th December 1897), but thefe is no prohibition of the importation of patented articles.

Hawaiian Islands. â€” Patents were issued till recently under the

civil code (Â§Â§ 255, 256) and a law of 29th August 1884, which were not at first affected hy the annexation of the islands by the United States. There was a preliminary examination as to novelty. The maximum duration of the patent was 10 years. On application a fee of 5 dollars was payable, the Commissioner of Patents received 20 dollars for his examination, and a fee of 5 dollars was payable when the patent was issued. No further payments. Now the United States law applies.

Honduras. â€” No. 177 of 10th March 1898. Term not to exceed 20 years. Annual tax 5 to 10 silver pesos ; in the case of foreigners 10 to 50 gold pesos.

Hungary. â€” The^ law in force is that of 7th July 1895. The duration of the patent is 15 years. The period for compulsory working is ordinarily 3 years. The annual taxes range from 40 kroner for the 1st year to 500 for the 15th.

Italy. â€” The law is still governed by that of 31st January 1864, extending the Sardinian law of 30th October 1859 to the whole kingdom. There is no preliminary examination into novelty, and there is no provision prohibiting the importation of patented articles. Patents are subject (i.) to a proportional tax of as many times 10 lire as the years for which the patent is applied for, and (ii.) to an annual tax of 40 lire for the first 3 years ; 65 lire for the following 3 ; 90 lire for the 7th, 8th, and 9th; 115 lire for the 10th and 11th; and 140 lire for the remaining 3 years.

Japan. â€” Patents are issued under an Act which came into opera- tion on 16th July 1899. The law as to subject-matter resembles that of England and the United States. The term of a patent is 15 years from the date of registration. The patent may be annulled if the patentee has not worked his invention within 3 years from the date of the certificate of grant, or if, having discontinued such use for 3 years, he has refused a reasonaljle request by a third party for an assignment or a licence. An applicant not domiciled in the empire must appoint witliin 6 months a duly qualified agent by power of attorney. There is apparently a preliminary examination into novelty. The patent owner must affix his mark to the patent. The fees are calculated on a gradually ascending scale.

Liberia. â€” Patents are issued under a law of 23rd December 1864. The maximum term is 20 years. There is a preliminary examination as to novelty. A sum of 25 or 50 dollars is payable on application, according as the applicant is a citizen or an alien. An invention patented by an alien must be put in practical operation within 3 years. There is no prohibition of the importation of patented articles.

Luxembourg (law of 30th June 1880). â€” The term of the patent is 15 years. There is no preliminary examination as to novelty, and the importation of patented articles is not prohibited. An annual and

progressive tax, commencing at 10 francs and increasing by 10 francs annually, is payable in advance. The period for compulsory working is 3 years, and after the expiration of that period com- pulsory licences may be ordered.

Mexico (laws of 7th June 1890 and 2nd June 1896).â€” The dura- tion of a patent is 20 years, with possible extension for another 5 years. There is no preliminary examination as to novelty or utility. There are apparently no provisions as to compulsory working (but compulsory licences may be ordered) or prohibiting the importation of patented articles. The tax ranges from 50 to 180 dollars.- The patentee must also at the end of each 5 years of the grant, in order to keep the patent in force for another 6 years, pay 50 pesos at the end of the first 5 years, 75 pesos at the end of 10 years, and at the end of 15 years, 100 pesos.

Nicaragua. â€” Patents were, as a general rule, until recently, granted only by special Act of Congress. But see now supplement 720, No. 15, Patent Laws of the World.

Norway (law of 10th June 1885). â€” The term of the patent is 15 years. There is a preliminary examination into novelty. The invention must be worked within 3 years, and the working must not be discontinued for a year on pain of forfeiture. For each patent an annual tax is payable amounting to 10 crowns for the second year and increasing by 5 crowns each year.

Orange Biver Colony, formerly The Orange Free State. â€” Up to the outbreak of war in 1899 the law was regulated by ordinance No. 10 of 1888. The term of a patent was 14 years. No preliminary examination as to novelty. Compulsory licences might be obtained. No prohibition of the importation of patented articles. The fee for signing and sealing the patent was not less than Â£10 nor more than Â£50. Taxes of Â£5 and Â£10 were payable before or at the expiration of the 3rd and 7th years of the term respectively.

Peru (law of 28th January 1869 and law of 3rd January 1896).. â€” The maximum term of the patent is 10 year.s, and the tax is an annual sum of 100 dollars. There is no preliminary exam- ination into novelty. The

period for compulsory working is 2 years, and the importation of patented articles from abroad (except models of machinery whose introduction is fiuthorized by the Government) is prohibited.

Portugal (law of 15th December 1894) .^The maximum term is 15 years. The patent tax is 3000 reis, payable in advance, for each year of the term for which the privilege is granted or renewed. There

is no preliminary examination into novelty. The period for compul- sory working is 2 years, and discontinuance of working for any 2 years at astretch forfeits the patent unless the inaction can be justified. The importation of patented articles from abroad is not prohibited.

Russia (law of 20th May 1896).â€” The maximum term is 15 years ; the tax ranges from 15 roubles for the 1st year to 400 roubles for the 15th. There is apparently (see Arts. 3 and 13) a pre-, liminary examination into novelty, but none into utility. The period for compulsory working is 5 years. There is no prohibition of importation of patented articles.

Spain. â€” Patents are still issued under the law of 30th July 1878. There is no preliminary examination as to novelty, and the im- portation of patented articles is not prohibited.

Sweden (law of 16th May 1884).â€” The term is 15 years. The annual tax is 25 crowns for the 2nd, 3rd, 4th, and 5th years ; 50 crowns for each of the following 5 years ; and 75 crowns for each of the remaining 5 years. There is a preliminary examination as to novelty, the period for compulsory working is 3 years, and dis- continuance during any entire year entails forfeiture. There is no prohibition of the importation of patented articles.

Switzerland (laws of 29th November 1888 and 23rd March 1893).â€” The term of the patent is 15 years. There is an annual and progressive tax, rising from 20 francs for the 1st year by an annual increase of 10 francs up to 160 francs for the 15th. There is no preliminary examination as to novelty. The patent is for- feited if the invention has not been carried into practice by the end of the 3rd year, or if patented articles are imported from abroad, while at the same time the

proprietor has refused applications on equitable terms for Swiss licences. Patented articles must be marked with the Federal cross and the number of the patent.

Transvaal Colony, formerly The South African Republic. â€” At the outbreak of war in 1899 law No. 10 of 1898 was in force. Patents were granted on payment of prescribed fees ranging from Â£20 up to Â£200, according to duration, for periods of 3, 5, 8, and 11 years.

Tunis (law of 22nd Kabia-et-Tani, 1306 ; 26th December 1888).â€” The term is either 5 years (fee 500 piastres) or 10 years (fee 1000 piastres) or 15 years (fee 1500 piastres). There is no preliminary examination as to novelty. The period for compulsory working is 2 years, and two consecutive years' discontinuance of such working, unless justified, forfeits the patent. So also does the importation of patented articles, but the introduction may be authorized (i.) of models of machines, and (ii.) of articles, made abroad, intended for public exhibitions or for trials.

Turkey. â€" ^Patents are still granted under the law of 2nd March 1880. There is no preliminary examination as to novelty, and a patentee who mentions his title as such without adding the words "without guarantee of Government," is liable to a maximum penalty of 45 Turkish pounds.

United States. â€" The American law may be considered at greater length. The Federal Constitution empowered Congress "to pro- mote the progress of science and useful arts by securing for limited times to . . . inventors the exclusive right to their . . . dis- coveries." The existing American patent law is based on a series of Acts of Congress passed in virtue of this provision in the con- stitution, and on the judicial interpretation of these statutes. Between American and English patent law there is, as will appear in the course of this sketch, a considerable degree of similarity. The fact, is not surprising when it is remembered that the Statute of Monopolies (21 Jam. I. c. 3) was, except in limiting the maximum duration of letters patent for inventions at fourteen years, only declaratory of the common law, and there- ^^^^" fore formed part of the original common law of America. "" "" ""

law and procedure.

The English and American patent systems further agree in this, that they contain no provision as to compulsory working, and no prohibition of the importation of patented articles. But there are important differences between the two systems, not merely in points of detail, but in matters affecting the theory and practical working of the law. In England the consideration for the grant of a patent has all along been mainly the benefit which the public derives from the introduction of a new manufacture. In America greater emphasis is placed on the right of an inventor to have his merits rewarded. Again, under the Statute of Mono- polies an inventor's exclusive privilege arises only in regard to inventions not known or used at the date of the grant, although it should be observed that under the modern Patents Acts the date of a patent, once granted, relates back to the date of the application. In the United States, on the other hand, the right is conferred on inventors to an exclusive privilege in such inventions as were not known or used before their d'iscovery by the patentees. The practical bearing of this difference is explained in an admirable note on "The Statute of Monopolies " in Puling Cases, snh tit. " Patent" (vol. XX. p. 5) :â€" " It shifts the point of view in the important question of novelty. Many good American inventions have been given away in England by the premature publication in America of the inventor's proceedings. He is interviewed, and an article in the New York Sun, or some other paper, in due time finds its way

to England. This does no harm in America ; on the contrary, it is good evidence of the date of the actual invention. But it is fatal to a subsequent application in England." (Certain other differences between English and American patent law (such as the less generous provision by tbe former than by the latter for disclaimers, the preliminary examination into novelty in American law, and the statutory right of patentees whose inventions are used by the Government to fair compensation) owe their origin to the fact that in

England a patent is, in legal contemplation, a grant made by "the especial grace" of the sovereign, whereas in American legislation it is treated as a right.

The definition of patentability in American law is contained in section 4888 of the Revised Statutes of the United States as amended by an Act of 3rd March 1897. In the following passage the amendments are indicated by italics : â€"

" Any person who has invented or discovered any new and useful art, machine, manufacture or composition of matter, or any new and'useful improvement thereof, not known or used by others in this country before his invention or discovery thereof, and not pa- tented or described in any printed publication in this or any foreign country before his invention or discovery thereof or more than two years prior to his application, and not in public use or on sale for more than two years prior to his application, unless the same is proved to have been abandoned, may, upon payment of the fees required by law and other due proceedings had, obtain a patent therefor."

The effect of the two amendments made by the Act of 1897 should first be noted : (i.) The old law failed to state at what time the invention should be known or used by others in America so as to bar a patent ; whether before the application or before the invention. This ambiguity is removed by the use of the words "before his invention or discovery thereof." (ii.) Under the old law a foreign patentee could take out a patent in America for the same invention at any time during the life of the foreign patent, provided it had not been in use in America more than two years prior to his application, unless anticipated by a prior invention or publication. The words " or more than two years prior to his application," merely give the same force to a foreign patent or publication that had previously been given to prior use. An inven- tion to be patentable must, according to American law, be both novel and useful. Utility may be evidence of novelty and vice versS., and commercial success is relevant evidence of utility. As in England, a bare principle is not patentable. A "process" is included under the words " useful art" in the above definition of patentability, and is good subject-

matter for a patent when the term is used to represent a practical method of producing a beneficial result or effect. The word ” machine” in the definition includes every mechanical device or combination of devices for pro- ducing certain results. Such a device or combination is patentable when it possesses utility and novelty, and produces either a new result or an old result in a better form.

Under the law of 1790, which was exclusively American in spirit, the duty of granting letters patent for inventions was discharged by the Secretary of State, the Secretary of War, and the Attorney- General, or any two of them. The law from 1793 to 1836 was ex- clusively English in spirit, and during that period the duty fell to the Secretary of State, subject to the Attorney-General’s approval. It was in 1837 that the marked divergence between the English and American patent system began. In that year the patent business of the United States had attained to such dimensions that the powers and duties of the Secretary of Slate in regard to patents were transferred to a sub-department of the State department known as the Patent Office. The American Patent Office consists of a Commissioner of Patents, one assistant commissioner, and three examiners-in-chief, who are appointed by the President of the United States with the advice and consent of the Senate ; and also of other examiners, and a staff of officers, clerks, and employ^, appointed by the Secretary of the Interior on the nomination of the Commissioner of Patents. The Commissioner of Patents, under the direction of the Secretary of the Interior, is charged with the superintendence or performance of all duties respecting the grant and issue of patents, and has the control and custody of all books, records, papers, &c., belonging to the Patent Office. He is authorized to make, from time to time, regulations not inconsistent with law, for the conduct of proceedings in the Patent Office, and prepares an annual report which is laid before Congress, and which is framed on the same lines as that of the Comptroller-General in England. ” He is the final judge, so far as the Patent Office is con- cerned, of all controverted questions arising in the office, and in granting or withholding patents he is not bound by the decisions of his inferiors ” (Robinson on Patents, vol. i. p. 84). The exami- ners-in-chief are required to be persons of competent legal know- ledge and ability. Their duties are : â€” On the written

petition of inventors to revise and determine upon the validity of the adverse decisions of subordinate examiners, upon applications for patents, and for reissues of patents, and in interference cases, and, when required by the Commissioner of Patents, to hear and report upon

claims for extension, and to do such other similar wotk as he may assign to them. The Patent Office publishes an Official Gazette corresponding to the English Patent Office Illustrated Journal, and discharges similar functions to those of the English Patent Office in regard to the public dissemination of information as to patented inventions. The number of original applications for patents in the period covered by the report of the Commissioner of Patents for 1898-99 was 35,352 ; the number of patents granted was 23,550 ; the receipts amounted to 11,209,554, the expenditure to $1,148,663, leaving a surplus of |60,891.

The first step in the procedure to obtain a patent is the lodging by the inventor at the Patent Office of .a written application, to- gether with a specification or particular written description of his invention, and a claim distinctly pointing out and claiming what he alleges to be his invention or discovery. The specification and claim are signed by the inventor and attested by two witnesses. Drawings, specimens of ingredients, and models may be required to be furnished. On the filing of each original application for a patent, a fee of fifteen dollars is payable. The applicant is required to verify his claim to the invention on oath, taken, if he resides within the United States, before any person authorized by Ameri- can law to administer oaths ; if he resides in a foreign country, before any diplomatic or commercial agent of the United States, or any notary public of the foreign country in which the applicant may be. The Commissioner of Patents then causes an examination to be made into the novelty of the invention, and if the result is satisfactory the patent issues. On the issuing of each original patent, a fee of twenty dollars is payable. A patent is issued in the name of the United States of America and under the seal of the Patent Office. It consists of a short title or description of the invention or discovery, correctly indicating its nature and design, and a grant to the patentee,

his heirs and assigns. Patents, it may be observed in passing, may be granted and issued or re- issued to the assignee of the inventor or discoverer, and every patent or any interest in It is assignable, the assignment being re- corded in the Patent Office, for the term of seventeen years of the exclusive right to make use of and vend the invention or discovery throughout the United States and the territories thereof. The rights of property in patents granted in Cuba, Porto Rico, the Philippines, and other ceded territory under Spanish law, are to be respected in thofe territories as if that law were still in force there. A patent is dated as of a day not later than six months from the time at which it was passed, and if the fee is not paid within that time the patent is withheld. No fewer than 4021 patents were withheld, in the period covered by the report of the Commissioner of Patents for 1898-99, for non-payment of fees. In case, however, the issue of a patent has been prevented by a failure to pay the fee within the prescribed period, the application may be renewed within two years after the allowance of the original application. But the applicant has no right to damages for any use of the invention in the interval, and on the hearing of the renewed application abandonment may be considered as a question of fact. So far we have followed the procedure to obtain a patent where its course is uninterrupted. A double form of interruption is, however, possible. A claim for a patent may be rejected on the ground of want of novelty in the alleged invention. In this case, the fact of the rejection, together with the reasons for it, is com- municated to the applicant by the commissioner ; and if he persists in his claim, a re-examination is ordered. Or, again, an application may appear to the commissioner to interfere with a pending appli- cation,! or with any expired patent. In these circumstancfes, he gives notice to the applicant, and directs the primary examiner to proceed to determine the question of priority of invention. This interruption of the course of the proceedings to obtain a patent is called an “interference.” In either of the cases above mentioned an appeal lies, on payment of a fee of ten dollars, from the primary examiner to the board of examiners-in-chief,. and, on pay- ment of a fee of twenty dollars, from the examiners-in-chief to the commissioner in person. An applicant for a patent, but not a party to an interference, may appeal from the decision of the com- missioner to the Supreme Court of the District of Columbia sitting in banc. In

interference cases the appeal lies to the District of Columbia Court of Appeals. There is an ultimate right of appeal, in cases involving the validity of a patent, to the Supreme Court of the United States. Patents are obtainable by Bill in equity, although the Commissioner of Patents (or, on appeal, the Supreme Court of the District of Columbia) may have refused them. The circuit courts of the United States have original jurisdiction in all patent suits. Appellate jurisdiction is vested in the circuit court of appeals ; and on the certificate of that court, or by certiorari, an appeal may be brought to the Supreme Court of the United States.

1 A citizen of the United States, or an alien who has within the preceding twelve months given notice of his intention to become one, may, by filing in the Patent Office a ” caveat,” the fee for which is ten dollars, secure for himself notice of possibly conflicting applications.

Section 4887 of the Revised Statutes provides tliat : â€”

“No person otherwise entitled thereto shall be debarred from re- ceiving a patent for his invention or discovery, nor shall any patent be declared invalid by reason of its having been first patented or caused to be patented hy the inventor or his legal representa- tives or assigns in a foreign country, unless the application for the said foreign patent loas filed more than seven months prior to the filing of the application in this country, in which case no patent shall be granted in this country.”” .

The words italicized in the above section were added by an Amending Act of 3rd March 1897. In its original form the sec- tion provided that no person should be debarred from receiving a patent because the invention was first patented in a foreign country, whether he was otherwise entitled to the patent or not. The words ” otherwise entitled to ” merely postulate that no other bar to the issue of the patent shall exist. The words ” by the inventor or his legal representatives or

assigns ” safeguard the inventor to some extent against fraud by third parties ; while the provision requiring the application in the United States to be filed within seven months of the filing of the foreign patent is intended to carry out the provisions of the International Convention. It should be noted that the duration of an American patent for an invention already patented abroad is no longer limited by that of the prior foreign patent, but is granted for 17 years from the date of issue.

Patented articles are required to be marked as such, either by the word “patented,” together with the day and the year the patent was granted, being affixed to them, or, when from the character of the article this cannot be done, by fixing to it, on the package containing one or more of such articles, a label containing the like notice ; and in any suit for infringement by a party failing so to mark, no damages shall be recovered by the plaintiff, except on proof that the defendant was duly notified of the infringement, and continued after such notice to make, use, or vend the article so patented. A penalty of not less than 100 dollars is attached to falsely marking or labelling articles as patented.

When through inadvertence, accident, or mistake, and without fraudulent or deceptive intention, a patentee has claimed more than he is entitled to, his patent is valid for all that part which is truly and justly his own ; provided this is a material or sub- stantial part of the thing patented, and the patentee or his heirs or assigns, on payment of the prescribed fee (ten dollars), disclaim the surplusage. The disclaimer must be in writing, and attested by one or more witnesses ; it is recorded in the Patent Office, and is thereafter considered a part of the original specification. But no disclaimer affects any action pending at the time of its being filed, except so far as may relate to the question of unreasonable neglect or delay in filing it.

In the same circumstances, or where a patent is inoperative or invalid by reason of a defective or insufficient specification, the patentee may surrender his patent, and the Commissioner of Patents may, on the application of the patentee and on payment of a fee of .30 dollars, issue a new patent in accordance with the amended specification.

Uruguay (law of 12th November 1885).â€” The term is 3, 6, or 9 years, at the option of the applicant. There is an annual tax of 25 dollars for every year of the privilege. The invention must be worked within a time fixed by the executive, and the working must not be discontinued for a year, on pain of forfeiture. There is no preliminary examination as to novelty.

Venezuela (law of 19th March 1900).â€” The term is 5, 10, or 15 years. The tax is 250 francs (bolivars) a year if the patent is for an invention or discovery, and 200 francs (bolivars) a year if it relates to an improved process. There is no preliminary exami- nation as to novelty. The invention must be worked within the period fixed by the grant, and a year's discontinuance, unless the inaction is justified, entails forfeiture.

(xii.) International Patents. â€” The International Con- vention for the protection of industrial property was signed at Paris on 20th March 1883 ; the necessary ratifi- cations were exchanged on 6th June 1884, and the Conven- tion came into force a month later. Provision was made by sections 103 and 104 of the Patents Act, 1883, for carrying out the ('onvention in Great Britain by Orders in Council, applying it from time to time to (a) British possessions whose legislatures had made satisfactory arrangements for the protection of inventions patented in Great Britain ; (6) foreign states with which the Sovereign had made arrangements for the mutual protection of inventions.

(a} The following is a list of the Orders in Council issued under the first category and now in force applying the provisions of the Patents Act, 1883, Â§ 103, to British possessions : â€"

Stato.

. Date of Order in Council.

New Zealand .

Queensland

Tasmania ....

West Australia

February 8, 1890. September 17, 1885. April 30, 1894. May 11, 1895.

(6) The following is a list of the Orders in Council issued under the second category and now in force applying the provisions of the Act of 1883, Â§ 103, to foreign states :â€”

Foreifrn State.

Date of Order in Council.

Belgium . . . ‘ .

.Tune 26, 1884.

Brazil

June 26, 1884.

Denmark (including the Faroe

Islands)

November 20, 1894.

Dominican Republic

October 21, 1890.

France

June 26, 1884.

Italy

June 29, 1884.

Japan

October 7, 1899./

Mexico

May 28, 1880.

Netherlands . . . .

June 26, 1884.

â€ž (East Indian Colo-

nies)

November 17, 1888.

„ (Curagoa and Suri-

nam)

May 17, 1890.

Paraguay

September 24, 1886.

Portugal .

June 26, 1884.

Servia

June 26, -1884.

Spain ...

June 26, 1884.

Sweden and Norway

July 9, 1885.

Switzerland

June 26, 1884.

Tunis

June 26, 1884.

United States

July 12, 1887.

Uruguay .

September 24, 1886.

Under the powers of the Foreign Jurisdiction Act, 1890, penalties have been imposed on British subjects com- mitting offences against the Patents, &c., Acts, 1883-88, and the Orders in Council issued thereunder, in Africa, East Africa, Morocco, Persia, Persian coast, and Zanzibar.

An International Bureau in connexion with the Con- vention has been established at Bern, where an official monthly periodical. La Propriiti Indiistrielle, is published. Conferences were held under the Convention at Eome in April and May 1886, and at Madrid in April 1890. At the latter conference an important article was adopted, under which it is left to each country to define and apply "compulsory working" (e.rjjloitation) for the purposes of the Convention in the sense that it chooses. In the j^ear 1898 there were 264 applications in Great Britain for patents under the Convention.

Authorities.â€" In addition to the works noted incidentally above, see Edmunds, Patents, 2nd ed. London, 1897 ; Wallace and WiLLiAjisoN, Patents, London, 1900 ; Feost, Patent Law and Practice, 2nd ed.

London, 1898 ; Teriiell, Letters Patent, 3rd ed. London, 1895 ; Cuntngiiame, Patents. London, 1894 ; Lawson, The Patents, tic. Acts, 3rd ed. London, 1898. For the old law, Werster, Patent Cases, London, 1844 ; Hindjiarsh, Patents, London, 1846 ; and the very valuable Parliamentarv Reports of 1829, 1851, 1865, 1872. Gordon, Jlonopolies by Patents, London, 1897 ; Gould and Tucker, Xotes on Per. Stat, of the U.S., vol. ii. (1887-97); Robinsox, Patents, 3 vols. Boston, U.S.A., 1890; Whitman, Patent Laws, Washington, 1871; Law, Copyright and Patent Laws of the United States, 1790-18156, New York, 1866; Curtis, Law of Patents, 4th ed. Boston and London, 1873; Campbell, U.S. Patent Si/.ftem: a Ilistorii. Washington, 1891 ” â– (A. w. E.)

Pater, Walter Horatio (1839-1894), English man of letters, was born at Shadwell, 4th August 1839. He was the second son of Richard Glode Pater, a medical man, of Dutch extraction, born in New York. Eichard Pater moved to Shadwell early in the century, and continued to practise there among the poorer classes. He died while his son \‘alter was yet an infant, and the family then moved to Enfield, where the children were brought up.

P A T E R S 0 N â€” P A T E Y

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Tn 1853 Walter Pater was sent to King’s School, Canter- bury, where he was e.arly impressed by the aesthetic beauties of the cathedral. These associations remained with him through life. As a schoolboy he read Modern Painters, and was attracted to the study of art, but he did not make any conspicuous mark in school studies, and showed no signs of the literary taste which he was afterwards to develop. Plis progress was always gradual. He gained a school exhibition, however, with which he proceeded in 1858 to Queen’s College, Oxford. His undergraduate life was xinusually uneventful ; he was a shy, ” reading man,” making few friends. Jowett, how- ever, was struck by his promise, and volunteered to give him private tuition. But Pater’s class was a disappoint- ment, and he only took a second in Literae Humaniores in 1862. After taking his degree he settled in Oxford and read with private pupils. As a boy he had cherished the idea of entering

the Anglican Church, but, under the influence of his Oxford reading, his faith in Christianity became shaken, and by the time he took his degree he had thoughts of graduating as a Unitarian minister. This project, too, he resigned ; and when, in 1864, he was elected to a fellowship at Brasenose, he had settled down easily into a university career. But it was no part of his ambition to sink into academic torpor. With the assumption of his duties as fellow the sphere of his in- terests widened rapidly ; he became acutely interested in literature, and even began to write articles and criticisms himself. The first of these to be printed was a brief essay upon Coleridge, which he contributed in 1866 to the Westminster Review. A few months later (January 1867) appeared in the same review his now well-known essay on AVinckelmann, the first expression of his idealism. In the following year his study of ” ^Esthetic Poetry ” appeared in the Fortnightly Review, to be succeeded by essays on Lionardo da Vinci, Sandro Botticelli, Pico della Mirandula, and Michelangelo. These, with other studies of the same kind, were in 1878 collected in his Studies in the History of the Renaissance. Pater was now the centre of a small but very interesting circle in Oxford. Such men as cherished aesthetic tastes were naturally drawn to him ; and, though always retiring and, in a sense, remote in manner, he was continually spreading his influence, not only in the university, but among men of letters in London and elsewhere. The little body of Pre-Raphaelites were among his friends, and by the time that Marius the Epicurean appeared he had quite a following of disciples to hail it as a gospel. This fine and polished work, the chief of all his contributions to literature, was published early in 1885. In it Pater displays,‘with perfected fulness and loving elaboration, his ideal of the aesthetic life, his cult of beauty as opposed to bare asceticism, and his theory of the stimulating effect of the pursuit of beauty as an ideal of its own. In 1887 he published Imaginai- y Por- traits, a series of essays in philosophic fiction ; in 1889, Appreciations, with an Essay on Style; in 1893, Plaio and Platonisin; and in 1894, Tlie Child in the House. His Greek Studies and his Miscellaneous Studies were collected posthumously in 1895 ; his posthumous romahce of Gaston de Latour in 1896 ; and his Essays from the ” Guardian” were privately printed in 1897. A collected edition of Pater’s works was issued in 1901. Pater changed his

residence from time to time, liviogsometimes at Kensington and in different parts of Oxford ; but the centre of his work and influence was always his rooms at Brasenose. Here he laboured, with a wonderful particularity of care and choice, upon perfecting the expression of his theory of life and art. He wrote with difficulty, correcting and recorrecting with imperturbable assiduity. His mind, moreover, returned to the religious fervour of his youth, and those who knew him best believed that had he lived

longer he would have resumed his boyish intention of taking holy orders. He was cut off, however, in the prime of his powers. Seized with rheumatic fever, he rallied, and sank again, dying on the staircase of his house, in his sister's arms, on the morning of Monday, 30th July 1894. Pater's nature was so contemplative, and in a way so centred upon reflection, that he never perhaps gave full utterance to his individuality. His peculiar literary style, too, burnished like the surface of hard metal, was too austerely magnificent to be always j)ersuasive. Since his death. Pater has exercised a re- markable and a growing influence, although this must always be restricted to those who have themselves some- thing of his own love for beauty and the beautiful phrase. But the cumulative richness and sonorous depth of his language harmonized intimately with his deep and earnest philosophy of life ; and those who can sympathize with a nervous idealism will always find inspiration in his sincere and sustained desire to "burn with a hard, gem- like flame," and to live in harmony with the highest.

(a. wa.)

Paterson, a city of New Jersey, U.S.A., capital of Passiac county, in the north-eastern part of the state, on the Passaic river at the falls, at an altitude of 193 feet. It is entered by the Morris canal, and the Delaware, Lackawanna, and Western, the Erie, and the New York, Susquehanna, and Western railways. It is built partly upon a plain, from which it stretches up the slopes of the surrounding hills. Its plan is irregular. It is divided into eight wards, audits water-supply is obtained by pumping from the river. It is well sewered, but few of its streets are paved, except with macadam. Passaic Falls, 72 feet in height, furnish ample water-

power, and have induced the concentration of manufactures here. Paterson is the centre of silk manufacture. In 1900 the census enumerated 995 manufacturing establishments, with a total capital of $43,510,481. They employed 30,190 hands, and the product was valued at $62,287,975. Of this large total almost exactly one-half, or $26,006,156, con- sisted of silk goods. In this industry there were 136 establishments, with a capital of $19,025,564, employing 15,943 hands. Of the other manufactures, foundry and machine-shop products were valued at $5,906,517, dyeing and finishing textiles at $3,836,409, and malt liquors at $1,859,537. Tlie assessed valuation of real and per- sonal property in 1899 was $47,575,563; the net debt, $3,435,820; and the tax rate, $25 per $1000. Popula- tion (1890), 78,347; (1900), 105,171, of whom 38,791 were foreign-born and 1182 negroes.

Patey, Janet Monach (1842-1894), English vocalist, was born in London, 1st May 1842, her maiden name being Whytock. She had a fine alto voice, which developed into a contralto, and she studied singing under J. Wass, Pinsuti, and Mrs Sims Reeves in succession. Miss Whytock's first appearance, as a child, was made at Birmingham, and her first regular engagement was in 1865, in the provinces. Prom 1866, in which year she sang at the Worcester Festival, and married John Patey, a bass singer, she was recognized as one of the leading contraltos ; and on the retirement of ilme Sainton-Dolby in 1870 succeeded her as the prime favourite of the public, whether in oratorio or in ballad music. She toured in America in 1871, sang in Paris in 1875, and in Australia in 1890. She kept her leading position until within a very short time of her death, which took place at Sheffield, 28tli February 1894, after she had put too severe a strain upon her powers in order to give an encore to an importunate audience. Her voice had great power, sweetness, and compass, and she had a true instinct for the amount of dramatic effect that was legitimate on the concert platform.

PATHOLOaY.

I. General.

THE outstanding feature in the history of pathology during the 19th century, and more particularly of the latter half of it, was the completion of its rescue from the thraldom of abstract philosophy, and its elevation to the dignity of one of the natural sciences. Our fore-fathers, if one may venture to criticize them, were too impatient. Influenced by the prevailing philosophy of the day, they interpreted the phenomena of disease through its lights, and endeavoured from time to time to reduce the study of pathology to philosophical order when the very elements of philosophical order were wanting. The pathology of the present day is more modes't : it is con- tent to labour and to wait. Whatever its faults may be â€" and it is for our successors to judge of these â€" there is this to be said in its favour, that it is in nowise dogmatic. The eloquence of facts appeals to the scientific mind now-adays much more than the assertion of crude and unproven principles. The complexity and mystery of action inherent in living matter have probably been accountable for much of the vague philosophy of disease in the past, and have furnished one reason at least why pathology has been so long in asserting its independence as a science. This, indeed, holds good of the study of biology in general. There are other factors, however, which have kept path- ology in the background. Its existence as a science could never have been recognized so long as the subjects of physics, chemistry, and biology, in the widest accepta- tion of the term, remained unevolved. Pathology, in fact, is the child of this ancestry ; it begins where they end.

Since the article in the ninth edition of the Eneyclopoedia Britannica was written, progress in the study of pathology has been greatly facilitated by the introduction of improv-ed Receat methods of technique. The certainty with which tissues

progress. ^^^ ^^^ ^^ fixed in the state they were in when living, and the delicacy with which they can be stained differentially, have been the means of opening up a new world for exploration. Experimental pathology has benefited by the use of antiseptic surgery in operations upon animals, and by the adoption of exact methods of recording ; while the employment of solid culture media in bacteriblogy â€" the product of Koch's fertile genius â€" is responsible for a great part of

the extraordinary development which has taken place in this department of pathological research. The discoveries made in pathological bacteriology, indeed, must be held to be among the most brilliant of the age. Inaugurated by Pasteur's early work, progress in this subject was first marked by the dis- covery of the parasite of anthrax, and of those organisms productive of fowl-cholera and septic disease. Then followed Koch's great revelation in 1882 of the bacillus of tubercle (Fig. 5, Plate III.), succeeded by the isolation of the organisms of typhoid, cholera, diphtheria (Fig. 6, Plate III.), actinomycosis, tetanus, &c. The knowledge we now possess of the causes of immunity from con- tagious disease has resulted from this study of pathological bac- teriology, and the prosecution of that branch of treatment known as "serum-therapeutics,-" at the hands of Roux, Behring, Ehrlich, and others, has also followed upon it, accompanied by momentous practical issues. Before the discovery of the bacillus of tubercle, scrofula and tuberculosis were regarded as two distinct diseases, and it was supposed that the scrofulous constitution could be distinguished from the tubercular. It was always felt, however, that there was a close bond of relationship between them. The fact that the tubercle bacillus is to be found in the lesions of both has set at rest any misgiving on the subject, and put beyond dispute the fact that so-called scrofulous affections are simply local manifestations of tuberculosis. A knowledge of the bac- teriology of scrofulous affections of bone and joints, such as caries and gelatinous degeneration, has shown that they also are tubercular diseases â€" that is to say, diseases due to the presence locally of the tubercle bacillus. At a very early period it was held by Virohow that the large cheesy masses found in tuberculosis of the lung are to be regarded as pneumonic infiltrations of the air-vesicles. Their pneumonic nature has been amply substantiated

in later times ; they are now regarded simply as evidence of pneumonic reaction to the stimulus of the tubercle bacillus. The caseous necrosis of the implicated mass of lung tissue, and indeed of tubercles generally, is held to be, in great measure, the result of the necrotic influence of the secretions from the bacillus. Tubercular pneumonia may thus be looked upon as comparable to pneumonia excited by any other specific agent (Fig. 3, Plate II.).

In the ‘seventies, feeling ran somewhat high over the rival doctrines concerning the origin of pus-corpuscles, Cohnheim and his school maintaining that they were derived exclusively from the blood, that they were leucocytes which had emigrated through the walls of the vessels and escaped into the surrounding tissue- spaces, while Strieker and his followers, although not denying their origin in part from the blood, traced them, in considerable propor- tion, to the fixed elements, such as fibrous tissues and endothelia. Our present-day knowledge prompts the adoption of a middle course between the two theories. The cells found in an inflamed part are undoubtedly drawn from both sources, but while the blood leucocytes have a great tendency to become fatty and to die, those cells derived from the fixed tissues incline more to organiza^ tion ; the latter are, in fact, the source of , the cicatrix which follows upon the cessation of suppuration (Figs. 7, 8, and 9, Plate III.). Organization and healing have been keenly inquired into, with result^ which seem to point the lesson that all methods of healing are to be regarded as extensions of the natural phenomena of growth. Normal cytology, of late, has become a science of itself, and has had a direct bearing upon that which is pathological.

At no time has so much been done to advance our knowledge of diseases of the nervous system as during the last thirty years of the 19th century. The localization of function in the cerebral and in the cerebellar cortex has doubtless been the main cause of this progress, and has proceeded pari passu with an extended insight into the structure and connexions of the parts concerned. Thepathology of aphasia, as worked out by a combination of the experimental, the pathological, and the anatomical lines of inquiry, is a favourable ex- ample of what has been accomplished. The origin, nature, and pro- pagation of neoplasms of all kinds, especially of those which are malignant, are engaging much attention. The tendency has been to refer these back to the influence of parasites, â€” a view, however, which has not met with universal acceptance. Much light has been thrown upon the functions and diseases of the blood-forming glands. The origin of the corpuscles, previously a matter of so much differ- ence of opinion, is now pretty fairly set at rest, and has proved the key to tlie interpretation of the pathology of many diseases of the blood,

such as the different forms of ansemia, of leucocythsemia, &c. The deleterious Influence of high blood-pressure has engaged the attention of physicians and pathologists in later years, and the conclusion arrived at is, that although it may arise from accidental causes, such as malcomposition of the blood, yet that in many in- stances it is a hereditary or family defect, and is bound up with the tendency to gout and cirrhotic degeneration of the kidney. The pathology of intra-cardiac and vascular murmurs has also been inquired into experimentally, the general impression being that these abnormal sounds result, in most cases at least, from the production of a sonorous liquid vein. Pneumonia of the croupous type has been proved to be, as a rule, a germ disease, the nature of the germ varying according to circumstances. The structural changes occurring in the bronchi in catarrhal bronchitis have also been ascertained, and, as in the case of pneumonia, have been shown to be frequently excited by the presence of a microphyte. The vexed question of the diagnosis of diphtheria is now a~‘thing of the past. Quite irrespective of the nature of the anatomical lesion, the finding of the diphtheria bacillus on the part affected, and the inooulability of this upon a suitable fresh host, are the sole means by which the diagnosis can be made certain.

The part played by the thyroid body in the internal economy of the organism has also received much attention. The gland evidently excretes, or at any rate gets rid of, a certain waste pro- duct of a proteid nature, which otherwise tends to accumulate in the tissues and to excite certain nervous and tissue phenomena. It wastes in the disease known as “myxoedema,” and the above product^ gathers in the tissues, in that disease, to such an extent as to give rise to what has been termed a “solid oedema.” It is questionable if the substance in question is mucoid. The pituitary body probably subserves a like purpose. When the pancreas is excised in an animal, or when it is destroyed in man by disease, grape-sugar appears in the urine. The gland is supposed to secrete a ferment, which, being absorbed into the portal circulation, breaks up a certain portion at least of the grape-sugar contained in the portal blood, and so prevents this overflowing into the circulation in general. The transplantation of a piece of living pancreas into

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PLATE 11.

Fig. 1. â€” Genito -urinary Tuberculosis, sho'wing cavities in the kidneys and miliary tubercles on mucosa of bladder.

YiQ. 4. Reticular Tubercle of Lung, a, a, a, Giant-cells ; 6, vacuole in one of these ; c, peri- pheral capsule-like condensation of reticulum ; d, reticulum"; e, endothelium-like cells ; /, smaller lymphoid cells ; g, peripheral fibrous-looking border of the giant-celL (X 450 diams.)

Pio. 2.â€" Tubercular Disease of the Hip-joint, show- ing ulceration of the acetabulum and head of the femur.

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Fig. 3. â€" Tubercular Pneumoniaâ€" Caseous Stage. The figure represents a segment of a caseous nodule from periphery to centre. A, B, C, and D correspond to different areas from periphery to centre respectively, fl, Injected capillaries of alveolar walls; b, catarrhal cells in alveolar cavities ; c, an alveolar wall, (x 350 diams., injected.)

PLATE III.

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Fio. f). â€" ^Tiibercular Meningitis, a, Arachuoid ; 6, small tubprcle lyinii in truliecalte between jjia and anu'lmoid ; 'â– , ett'iisinii of Jibriu and leucocytes into sub-aracVitiiii4 spu^s; d, fatarrlial-like cells deri^'ed from tiMli>'i'nl;i.' ; i\ tubercle bacillus lying in a tubercle <â€ ¢[' rDnshlprablo size ; /, small cell effusion ; j;, small blood-vessel obliterated by a tlirombus ; h, blood-vessel containing blood-corpuscles, (x 300 diams.)

Fir;. 7,^Diapedcsis rif a Leucocyte tliroup;li tin ~~wall of a r’;ipillar\~~, in which tlie blooi.l is motion l(-ss. (Metchniko’n.)

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Fto. 6. â€” Free Surface of Diphtlicritic J.arynx. A, lif^posit of

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Fin. f). â€” Omnntniii in sliilr i.r :u-iiti- iiilNiiiima- linri. I., Kiali.tli.‘liHiii as .Tt uiiaitenal ; /., ciaiii- tlielivim bi’~~iiiiiii~~^ 1(1 jioriiiiiiate ; i’. c, riMin llii’liiini .u’r’i iiiiiiialiiiK aiiivrly. (::ii(l iliams.”, ataiiirii Willi ailver.)

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general]

PATHOLOGY

the tissues of an animal, thus rendered artificially diabetic, is said to restore it to health.

Pathological chemistry* has been remarkable chiefly for the knowledge we have obtained of the nature of bacterial poisons. Certain of these are alkaloids, others appear to he albumoses. The publication of Ehrlich's chemical, or rather physical, theory of immunity has thrown much light upon this very intricate and obscure subject.

Germany and France have been in the van of progress during the period under contemplation. The success of the great patholo- gists of the United Kingdom has been the result of Inborn merit and personal effort, rather than the outcome of a systematized method of training, whereas Continental nations have recognized the importance of fostering the subject by the endowment of centres of research and the equipment of laboratories. In Great Bi^tain, on the other hand, pathologists have had, until quite lately, to fight the battle almost single-handed.

Pathology is the science of disease in all its manifesta^ tions, whether structural or functional, progressive or regressive. In times past it has been the habit Conaexion to look upon its sphere as lying really within Xioiogy. t-'i^t of practical medicine, and human medicine more particularly; as something tagged on to the treatment of human disease, but unworthy of being studied for its own sake as a branch of knowledge. Such a view can recommend itself to only the narrowest of minds. A bearing, and of course an essential bearing, on the study of medicine it must always have. A system of medicine reared upon anything but a pathological basis would be unworthy of consideration. Yet it may well be asked whether this is the final goal to be aimed at. Our starting-point in this, as in all departments of biological study, must be the biological unit, and it is to the alterations to which this is subject, under varying conditions of nutrition and stimulation, that the science of pathology must apply itself. Man can never be the only object of appeal in this inquiry. The human organism is far too complex to enable us to understand the true significance of diseased processes. Our

range must embrace a much wider area â€” must comprise, in fact, all living matter â€” if we are ever to arrive at a. scientific conception of what disease really means. Hence not only must the study of our subject include the dis- eases peculiar to man and the higher animals, but those of the lowest forms of animal life, and of plant life, must be held equally worthy of attention. Modern research seems to show that living protoplasm, wherever it exists, is subject tp certain laws and manifests itself by certain phenomena, and that there is no hard and fast line between what prevails in the two kingdoms. So it is with the diseased conditions to which it is a prey : there is a wonderful community of design, if the term may be used in such a sense, between the diseases of animals and plants, which becomes singularly striking and instructive the more they are inquired into. Utilitarian, or perhaps rather practical, considerations have very little to do with the subject from a scientific point of view â€” no more so than the science of chemistry has to do with the art of the manufacturing chemist. The practical bearings of a science, it will be granted, are sirnply, as it were, the summation of its facts, with the legitimate con- clusions from them, the natural application of the data ascertained, and have not necessarily any direct relation- ship to its pursuit. It is when studied on these lines that pathology finds its proper place as a department of biology. Disease as an entity, as something to which all living matter is subject, is what the pathologist has to recognize and to investigate, and the practical application of the knowledge thus acquired follows as a natural consequence.

Since pathology is the science of disease, we are met at the very threshold by the question : What is Disease ? This may best be answered by defining what we under-

stand by Health. What do we mean when we talk of a healthy organism ? Our ideas upon the subject are purely arbitrary, and depend upon our everyday ex- perience. Health is simply that condition of structure and function which, on exajnination ^^J^g”””” of a sufficient number of examples, we find to be commonest. The term, in fact, has the same significance as “the normal.” Disease we may define, accordingly, as any departure from the nornml standard of structure or function of a

tissue or organ. If, for instance, we find that instead of the natural number of Malpighian bodies in the kidney, there are only half that number, then we are entitled to say that this defect represents disease of structure; and if we find that the, organ is excreting a new substance, such as albumen, we can affirm logically that its function is abnormal. Once grant the above definition of disease, and even the most trivial aberrations from the normal must be regarded as diseased conditions, quite irrespective of whether, when structural, they in- terfere with the function of the part or not. Thus an abortive supernumerary finger may not cause much, if any, inconvenience to the possessor, but nevertheless it must be regarded as a type of disease, which, trivial as it may appear, has a profound meaning in phylogeny and ontogeny.

Ulassification. â€" From the foregoing it will be gathered that the problems in pathology are many-sided and require to be attacked from all points of vantage ; and the subject falls naturally into certain great divisions, the chief of which are the following : â€" I. Morbid Anatomy.

(a) Naked-eye or macroscopic.

(b) Morbid histology or microscopic. II. Pathological Physiology.

III. Pathogenesis.

IV. etiology.

V. Pathological Chemistry.

The term "Pathogenesis" has reference to the generation and development of disease, and that of "Etiology," in its present bearing, has to do with its causes. The use of the term "Patho- logical Physiology " may at first appear strange, for if we define physiology as the sum of the normal functions of the body or organism, it may be hard to see how there can be a physiology which is pathological. The difficulty, however, is more apparent than real, and in this sense, that if we start with a diseased organ as our subject of inquiry, we can quite properly, and without committing a solecism, treat of the functions of that organ in terms of its diseased state.

Influences Woeking fob Evil upon the Okganism.

(1) Malnutrition. â€” When the blood supply is entirely cut off from a tissue, the tissue dies, and in the act of dying, or afterwards, it suffers certain alterations depend- ent upon its surroundings. Thus, when the circulation to an external part is obstructed completely, as in the case of a limb where the main artery has been occluded and where the auastomatic communications have not sufficed to continue the supply, of blood, the part becomes gangrenous ; that is to say, it dies and falls a prey to the organisms which excite putrefaction, just as would happen to any other dead animal tissue were it unconnected with the body. Fermentative changes are set up in it, characterized by the evolution of gas and the forma- tion of products of suboxidation, some of which, being volatile, account for the characteristic odour. In the formation of these the tissues break dovm, and in course of time lose their characteristic histological features. The blood suffers first; its pigment is dissolved out and soaks into the surroundings, imparting to them the pink hue so diagnostic of commencing gangrene. Muscle and white fibrous tissue follow next in order, while elastic tissue and bone are the last to show signs of dis- integration. The oil separates from the fat-cells and is

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found lying free, while the sulphuretted hydrogen evolved as one of the products of putrefaction reacts upon the iron of the blood and throws down a precipitate of sulphide of iron, which in course of time imparts to the limb a range of colour commencing in green and terminating in black. The temperature at which the limb is kept, no doubt, favours and hastens the natural process of destruction, so that putrefaction shows itself sooner than would be the case with a dead tissue removed from the body and kept ‘ at a lower temperature. Nevertheless, gangrene is noth- ing more or less than the 2?utrefactive fermentation of an animal tissue still attached to the body. If the amount of liquid

contained in the tissue be small in quantity, the part mummifies, giving rise to what is known as “dry gangrene.” If the dead part be protected from the ingress of putrefactive organisms, however, it separates from that which is living without the ordinary evidences of gangrene, and is then known as an ” aseptic slough.” Should the portion of tissue deprived of its circulation be contained in an internal organ, as is so often the case where the obstruction in the artery is due to embolism, it becomes converted into what is known as an ” infarction.” These infarcts are most common in organs provided with a terminal circulation, such as prevails in the kidney and spleen (Fig. 10, Plate IV.). The terminal branches of the arteries supplying these organs do not anastomose ; therefore, when one of them is obstructed, the area irrigated by it dies from malnutrition. Being protected from the ravages of the organisms which induce putre- faction, however, it does not become gangrenous ; it is only where the obstructing agent contains these organisms that a gangrenous slough follows, or, in the case of the contaminating organisms being of a suppurative variety, ends in the formation of a so-called “pysemic abscess,” followed by rapid dissolution of the dead tissue (Fig. 11, Plate IV.). In ordinary circumstances, where the artery is obstructed by an agent free from such organismal contaip-ination, the part becomes hard and well defined from the precipitation of the fibrinogen contained in its liquids (coagulative necrosis), and at a later period assumes a yellow colour. Its condition, in fact, comes to resemble very closely, if it is not identical with, the casea- tion of a tubercular nodule. Examined microscopically, it is found to be very granular, and minute oil-globules show themselves within it, the result of a fatty degenera- tion of its tissue elements. Later, it is absorbed, and, as in the case of all such dead tissues left in the midst of living surroundings, apparently by a double agency â€” in the first place, by the histolytic influence of the tissue liquids, and, in the second place, by the phagocytal cells at its margin.

Where the malnutrition is the effect of poorness in the quality of the blood, the results are of course more wide- spread. The muscles suffer at an early period : they fall off in bulk, and later suffer from fatty degeneration, the heart being probably the first muscle to give way. Indeed, all tissues when undernourished, either locally as the result of

an ischsemia, or generally as from some impair- ment of the blood, such as that prevailing in pernicious aneemia, tend to suffer from fatty degeneration ; and at first sight it seems somewhat remarkable that undernourished tissues should develop fat in their substance (Figs. 12 and 13, Plate IV.). The fatty matter, however, it must be borne in mind, is the expression of dissimilation of the actual substance of the proteids of the tissues, not of the splitting up of proteid or other carbonaceous nourishment supplied to them.

A part deprived of its natural nerve-supply sooner or later suffers from the effects of malnutrition. When the trigeminus is divided (Majendie), or when its root is compressed injuriously, say by a tubercular tumour, the cornea begins to show points of ulceration,

which, increasing in area, may bring about total disintegration of the eyeball. The earliest interpretation put upon this experiment was that the trophic influence of the nerve having been with- drawn, the tissue failed to nourish itself, and that degeneration ensued as a consequence. The subsequent experiments of Snellen, Senftleben, and, more lately, of Turner, seem to show that if the eyeball be protected from the impingement of foreign particles, an accident to which it is liable owing to its state of ansesthesia, the ulceration may be warded off indefinitely. The bed-sores which follow paralysis of the limbs are often quoted as proof of the direct trophic action of the nerve-supply upon the tissues, yet even here the evidence is somewhat contradictory. Still, there are facts Which, for want of a better explanation, we are almost bound to conclude are to be accounted for on the direct nerve-control theory. Thus a fractured bone in a paralysed limb often fails to unite, while another in the opposite sound limb unites readily, and an ulcerated sui;face on a paralysed limb shows little healing reaction. A salivary gland degenerates when its nerve-supply is cut off ; and the nerves leading up to the symmetrical sloughs in Raynaud's disease have been found in an advanced state of degeneration (Affleck and Wiglesworth). It is Just a question, however, whether, even in instances such as these, the nutritional failure may not be explained upon the assumption of withdrawal of the local vasomotor control. There seems to be little doubt, notwith- standing, that one of the chief functions of the nerve

cell is that of the propagation of a trophic influence along its axon. When a nerve-trunk is separated from its central connexion, the distal portion falls into a state of fatty degeneration (Wallerian or secondary degeneration) . That special trophic nerves, however, exist throughout the body, seems to be a myth. It is much more likely, as Verworn alleges, that the nerves which influence the characteristic function of any tissue regulate thereby the meta- bolism, of the cells in question â€" in other words, that every nerve serves as a trophic nerve for the tissue it supplies. It is a signifl- cant fact that neoplasms contain very few nerve-fibres, even although growing luxuriantly, and there is a doubt whether the few twigs contained in them may not merely have been dragged into their midst as the tumour mass expanded (Young).

(2) Senile Decay. â€" It may naturally be supposed that as old age is approached the tissues fail to regenerate themselves, so as to make up for the ordinary wear and tear to which they are subject, with the same readiness as in youth. They lose also a certain amount of their power of assimilation. From both these causes a certain shrink- age is liable to occur, more evident in some parts of the body than in others. Thus the brain falls off in bulk, and the muscles become attenuated, and in no muscle is this more notable than in the case of the heart. A tendency to pigmentation also develops in certain tissues of the body, such as the nerve and muscle cells. As a result of these various senile degenerations, the functions of the body deteriorate, the faculties become blunted, and the muscular energy of the bod^- is below what it was in earlier life, while the secreting glands in certain instances become functionally obsolescent.

(3) Overwork. â€" The effect of overwork upon an organ or tissue varies in accordance with (a) the particular organ or tissue concerned, (6) the amount of nourishment con- veyed to it, and (c) the power of assimilation possessed by its cells. In the case of muscle, if the available nourishment be sufficient, and if the power of assimila- tion of the muscle cells remain unimpaired, its bulk in- creases, that is to say, it becomes hypertrophied. The hypertrophy in this case is due chiefly to the numerical increase of the muscle fibres, partly to slight augmenta- tion in their bulk. Where hypertrophy of muscle takes place from

increased blood-supply, as sometimes happens, the enlargement is partly due to numerical increase, but chiefly to increase in bulk of the individual fibres (Zielonko).

It may be advisable to define exactly what is meant by “hyper- trophy,’ ‘ as the torm is often used in a loose and insignificant sen^e. Mere enlargement of an organ does not imply that it is in a state of hypertrophy, for some of the largest organs met with in morbid anatomy are in a condition of extreme atrophy. Some organs are subject to enlargement from deposition within them of a foreign substance (amyloid, fat, &c.). This, it need hardly be said, has nothnia: to do with hypertrophy ; enlargcinent is simply one of the

PLATE IV.

Fig 10.â€” Embolic Infarct of Spleen. The pale half of the figure corresponds to the dead tissue or infarct, a, Empty sinuses of spleen ; &, the infarct ; c, pigment around it ; d, splenic sinuses in neighbouring living tissue ; e, a trabecula. (x 40 diams.)

Fia, 12. â€” Catarrhal Nephritis, showing fatty de- generation of epithelium of the tubes of the kidney. a, a. Convoluted tubes filled with fatty epithelium ; 6, 6, convoluted tubes with epithelium still in stage of cloudy swelling ; e, glomerulus very swollen, granular, and probably (Edematous ; d, a few catarrhal cells in the intracapsular space; e, spindle-shaped lymph -spaces in interstitial tissue filled with oil globules; /, same in Bowman’s capsule, (x 350 diams., stained with perosmic acid.)

Fig. 11. â€” Pysemic Abscess of Lung, a, Walls of alveoli ; 6, effused small cells ; c, fibrin lying in alveolar cavities ; d, cell entangled in meshes of same ; e, e, e, masses of micro- coccus (staphylococcus) lyin^ in the exudation ; /, effused cell becoming iafcty. (x 350 diams.)

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Fig. 13.â€” Fatty Degeneration of Nerve-fibresof Phrenic Nerve in Diphtheria (Meyer).

PLATE V.

Fio. 14. â€” Atrophy of Liver from Valvular Disease of Heart, a, a, Distended capillaries of hepatic vein â– with entire disappearance of liver-cells from atrophy ; &, branch of portal vein; c, liver-cells still left in portal vein area, (x60diams.)

Pig. 15.â€” Anthraoosis. a, Superficial layer of pleura free from pigment; fj, deep layer much in- filtrated by it ; o, c, c, ac- cumulations of pigment round branches of pul- monary artery; d, inter- lobiilar septum, much pigmented ; e, alveolar walls. (X 20diams.)

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Fio. 16. â€” Lithosis or Stone-mason's Disease. Section through a nodule in the lung, a, Concentric llbrous tissue of the nodule ; 6, 6, stone particles ;

c, c, soot particles mixed with those from stone;

d, d, soot particles at periphery of nodule. (X 300 diams.)

Fig. 17.â€” Healing by First Intention. Cicatrix ten days old, Linea alba, ovariotomy, a. Neigh- bouring epidermis ; h, corium continuous with cicatrix (e) ; c, c, neigh- bouring tissues ; d, united epidermis ; /, portion of same included in cicatrix; g, fat -cells in side of wound. (X 60 diams.)

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Fig. 18. â€” Healing by Second Intention. Per- pendicular section through edge of healthy granulat- ing wound, old ulcer of leg. a, The discharge ; 6, the bluish -pink pellicle of young epidermi.s; c, older epidermis ; d, granulation-tissue ; c, injected blood- vessels ; /, deep organizing layer beneath cicatrix ; /l, same beneath granulations, (x 60 diams.)

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Fia. 111.â€” Perpendicular section through indurat’^‘l eil^ii^ of old indolent ulcer of \vis.. a, Superficial di>ail fpidi’nnis; b, h, piimilation-loops ; c, half-organized granulation-tissue beneath the vih^e \ ih accnnudated mass of epidermis ; f, pigment fruiii bluoil ~~extravasa~~ tion ; /, abortive granulation – surface ; <;, divided fibrous tissues of the leg forming practioally the floor of the ulcer ; h, small artery, (x 40 diams.)

general]

PATHOLOGY

attributes of a hypertrophied part. Hypertrophy in the scientific sense of the term may be defined as a condition of parts where the normal bulk of an organ or other tissue is augmented universally py an additional number or by increased dimensions of its tissue ‘elements.

In order tliat the overgrowth of an organ may come under the designation of ” hypertrophy,” the enlargement must be universal ; a local increase of its tissue is known as a neoplasm (myoma, adenoma). When epidermis is overworked by having to withstand intermittent pressure, as in the use of tools in various avocations, it certainly hypertrophies. The pressure, as probably is the case in all overwork causing hypertrophy, must be intermittent ; con- tinuous pressure on any part induces atrophy. Glands, however, do not seem to suffer hypertrophy when overworked. On the con- trary, they tend rather to degenerate. There is no evidence to show that the liver, the pancreas, or a salivary gland ever becomes hypertrophied from having increased strain put upon it ; the first response of the liver to such strain is derangement of structure and function. The compensatory enlargement of the kidney, when that on the opposite side is removed experimentally or by disease, is often quoted as evidence of a gland becoming hypertrophied from overwork. The enlargement here, however, is something quite different from what occurs in muscle or epidermis : it is apparently unaccompanied by Increase in true gland tissue, and is accounted for by distension of blood-vessels and lymphatics.

(4) Continuous Over-pressure. â€” The tissues of an animal or plant are all under a certain pressure, caused, in the one case, by the expulsive action of the heart and the restraint of the skin and other elastic tissues, and, in the other case, by the force of the rising sap and the restraint of the periderm or bark. Under this normal amount of pressure they can live and grow. But when- ever, from any cause, the degree of pressure which they are naturally intended to withstand is surpassed, they fail to’ nourish themselves, become granular, die, and, falling to pieces, are absorbed. This is what we see in a typically atrophic part such as a cirrhotic kidney, a mus- cle withered by the pressure of a contracting

cicatrix, or a tissue like that of the liver (Fig. 14, Plate V.) subjected to unduly great pressure from distension of its own capillaries (cyanotic atrophy).

Here again it is necessary to define in strict terms what is meant by "atrophy," for as mere enlargement of an organ does not necessarily signify that it is hypertrophied, so diminution in size does not necessarily imply that it is in a state of atrophy ; atrophied organs, as previously remarked, are sometimes much enlarged. Atrophy is the diminution in size or partial destruction of apart which results from direct and continuous over-pressure where the blood-supply is not deficient. The pressure must be continuous, otherwise the part may become hypertrophied. Intermittent pressure exerted upon the epidermis causes it to hypertrophy, while continuous pressure, such as that of a badly-applied splint, will induce atrophy. The soft texture of an aneurysmal sac will cause atrophy of a hard texture, such as bone, so long as the pressure it exerts is continuous ; and the over-pressure of the hepatic capillaries in regurgitant valvular disease of the heart will induce the most typical atrophy of the liver cells lying between them. Atrophic organs usually contain abundant blood-vessels ; the arteries of a cirrhotic liver are relatively more abundant than in health, and in the case of the atrophy of the liver resulting from regurgitant valvular disease the compressing agent is the blood itself. Hence the degeneration from which the tissue suffers cannot be due to deficient blood-supply, but, apparently, is consequent upon failure in the tissue cells to assimilate the nourishment supplied to them on account of the over-pressure to which they are subjected. This is borne out by the actual degeneration from which the tissue suffers. We have seen that when a tissue is undernourished it begins to suffer from fatty degeneration. This is not the form of degenera^ tion found in truly atrophic parts : the cell simply shrinks, falls to pieces, and is removed, without necessarily any fatty matter result- ing from the breaking down of its protoplasm. Atrophy is a true and distinct form of degeneration, as distinct as any of the other forms of degeneration to which tissues are liable.

(5) Deleterious Surroundings. â€” There can be little doubt that all unnatural and artificial modes of life tend to deterioration of the powers of resistance of the organism to disease. We see it exemplified in plant life in circum- stances which are unnatural to the life of the plant, and the prevalence of certain constitutional tendencies among the inhabitantsof crowded cities bears evidence to the samelaw.

Man, like other animals, was naturally intended to lead an out- door life. He was originally a hunter and a tiller of the ground, breathing a pure atmosphere, living on a frugal diet, and exer- cising his muscles. Whenever these conditions are infringed, his powers of resistance to disease are lessened, and certain tendencies begin to show themselves, which are generally termed constitutional. Thus the liability to tubercular infection is far commoner in the midst of a depraved population than in one fulfilling the primary laws of Nature ; rickets is a disease of great cities rather than of rural districts ; and syphilis is more disastrous and protracted in its course in the depraved in health than in the robust. Cattle kept within doors are in a large proportion of cases tubercular, while those leading an outdoor life are much less liable to infection. The improvement which has taken place in the general health of the Inhabitants of cities during recent years, concurrent with hygienic legislation, is ample proof of the above assertions. The^ diminution in the number of deaths from tuberculosis during the' last forty to fifty years of the 19th century of itself points in this direction. Every living organism, animal and vegetable, tends to maintain a normal state of health ; it is when the natural laws of health are violated that the liability to disease begins to assert itself. If, in these circumstances, the food supply he also insuf- ficient, the combination of influences is sure, in course of time, to bring about a physical deterioration of the race. Certain avoca- tions have a direct and immediate influence in causing diseased states of body. Thus workers in lead suffer from the effects of this substance as a poison, those who work in phosphorus are liable to necrosis of bone and fatty degeneration of the blood-vessels and organs, and the many occupations in which dust is inhaled (coal- mining, stone-dressing, steel-polishing, &c. ;â– Figs. 15 and 16, Plate v.) are fraught with the greatest danger, owing to the destructive influence exerted upon the

lungs by the inhaled par- ticles. Among the most dangerous of the last class (the pneumo- konioses) is perhaps that in which the dust particles take the form of finely-divided freestone, as in stone-dressing and the dry-polishing on the grindstone of steel. The particles in this case set up a form of fibrosis of the lung, which, either of itself or by rendering the organ liable to tubercular infection, is extremely fatal. The abuse of alcohol may also be mentioned here as a factor in the production of disease.

(6) Parasitism. â€” Of all external agents acting for evil, however, probably vegetable and animal micro-organisms with a pathological bent are most to be feared. The sub- ject is considered in extenso under Parasitic Diseases, and the reader is referred to that section of this subject for specific information. When we consider that tuber- culosis, diphtheria, cholera, tetanus, typhoid fever, anthrax, malaria, and a host of other contagious diseases have each been proved to be of parasitical origin, an idea may be conveyed of the range of the subject. The living organism may be regarded as constantly engaged in a warfare with these silent and apparently insignificant messengers of destruction and death, with the result that too often the battle ends in favour of the attacking enemy.

(7) Heredity. â€” The tendencies to disease are in great part hereditary. They probably express a variation which may have occurred in a far-back ancestor, or in one more recent, and render the individual vulnerable to the attacks of parasitic fungi, or, it may be, become manifest as errors of metabolism. The psychopathic, the tubercular, the rickety, and the gouty constitution may all be transmitted through a line of ascendants, and only require the neces- sary exciting agents to render them apparent. A dis- tinction must be drawn between the above and diseases, like syphilis and small-pox, in which the contagion of, not the tendency to, the disease is transmitted directly to the foetus in utero (see Hereditx).

The Cellular Doctrine in Pathology.

The cellular pathology is the pathology of to-day; indeed, protoplasm â€” its vital characteristics under abnor- mal influences and its decay

â€” will be regarded most likely as the basis of pathology in all time. Its history dates back to Virchow's great discovery. When Virchow wrote, in 1850, "every animal presents itself as a sum of vital unities, every one of which manifests all the characteristics of life," he expressed a doctrine whose

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sway since then has practically been uninterrupted. The somatic cells represent communities or republics, as it were, -which we name organs and tissues, but each cell possesses a certain autonomy and independence of action, and exhibits phenomena which are indicative of vitality.

Still, it must be borne in mind tliat this alleged autonomy of actix)n is said to be founded upon an erroneous supposition, on the sirp- position that each cell is structurally, and, it may be said, function- ally, separated from those in its neighbourhood. It is well known that in the vegetable liingdom the protoplasm of one cell fre- quently overflows into that of cells adjacent â€” that there is, as it were, a continuous network of protoplasm (idioplasm of Nageli) prevailing throughout vegetable tissues, rather than an aggregation of isolated units. The same intercommunication prevails between adjacent cells in some animal tissues, and more particularly in those which are pathological, as in the case of the epithelial cells of cancer. Assuming, with Sedgwick and others, this amassed and bound condition of the tissues to be true, it would be necessary to reject the cell-doctrine in pathology altogether, and to re- gard the living basis of the organism as a continuous substance whose parts are incapable of living independently of the whole. Until, however, further evidence is forthcoming in support of this syncytial theory of structure, it would be unwise to regard it as established sufficiently to constitute a serviceable working hypothe- sis

; hence, for the time being, we must accept the assertion that the cell represents the Ultimate tissue-unit.

The only definition of a cell permissible at the present day is that of a nucleated mass of protoplasm. The cells structure “^^^ with in morbid parts which are in a state of patho- of active vitality are built up of the same logical components as those found in normal tissues. cells. (Plate I}). Thus they are provided with a

nucleus in the midst of which are chromosomes, true nucleoli (plasmosomes), and netknots (karyosomes). In- side the nucleolus there may be a second body known as the nueleoluolus (Auerbach). Within the cytoplasm are the granular bodies known as microsomes, and, either lying within the nucleus or at one side of it, is the cen- trosome, which, during mitotic division, splits into two, each half becoming surrounded by an attraction-sphere (astrosphere) defining the polar limits of the achromatic

1 DESCRIPTION OF PLATE I. Series oif Pigurks illustative of Irregular Division of Cells. Figs. AtoF are from, the epithelial cells of a cancer of the mamma. (After Galeotti.) ,, G to W are from a sarcoma. {After Trambusti.) Fig. a. â€” Resting epithelial cell. â€ž B.â€” Asymmetrical dyaster. â€ž C. â€” Tripolar division in which the splitting of the loops has com-

mencBd. â€ž D.â€” Tetrapolar karyokinesis. ,, E. â€” Another form of tetrapolar division. J, F.â€” Cell in a state of degeneration and ohromatolysis ; the large

rounded body in the cell is a cancer parasite. â€ž G.â€” Polynucleated cell with nuclei of normal size arising from

multiple karyokinetic division. j^ H. â€” Pigmented cell with resting nucleus. The attraction-sphere

and centrosome lie in the cytoplasma in the neighbour- hood of the nucleus. â€ž I.â€” Hypertrophic nucleolus. ,, K.â€” Large cell with a single nucleus; nucleoli in a state of

degeneration . â€ž L. â€” Multinucleated giant-cell, the nuclei small and produced

amitotically. â€ž M.â€” Karyokinetic figure, the one centrosome much larger than

the other. „ N.â€” Cell in process of karyokinetic division with retention of the

nucleolus during division. â€ž O.â€” Division of the nucleolus and formation of nuclear plate.

The nucleolus is elongated, and its longest measurement

lies in the direction of the equatorial plane of the nucleus. „ P.â€” Division ol the nucleolus by elongation, constriction, and

equilateral division of the nucleus. â€ž Q.â€” Division of the nucleolus without any evidence of division of

the nucleus. â€ž R.â€” Nucleus with many nucleoli. ^^ S.â€” Direct division of nucleus. „ T.â€” Multiple direct division of the nucleus. „ v.â€” Nail-like nucleolus. „ W. â€” Fragmentation of the nucleus.

amphiaster. Some pathological cells, such as the giant- cells of tumours, of bone, and those of tubercle, are polynu- cleated ; in some instances they may contain as many as thirty or more nuclei. The only evidence we have in pathology of living structures in which apparently a differ- entiation into cell-body and nucleus does not exist, is in the case of bacteria, but then there comes the question whether they may not possess chromatin distributed through their substance, in the form of metachromatic points, as is the case in some infusoria (Trachelocerca, Gruber).

The nucleoli of pathological growths (e.g., sarcomata) sometimes vary in shape. They are mostly round, but elliptical elongated, and nail-shaped forms may be met with. They usually stain with acid aniline dyes, but occasionally lose this property and be- come sensitive to those

which are basic, a transformation which probably indicates a retrograde or degenerate state (Trambusti). They may be located either at the centre or at the periphery of the nucleus. As a rule they vanish during indirect division. Under the title of ” Slumber cells,” Grawitz drew attention to ceruin cells which he supposes to exist in connective tissues, and which are invis- ible even with refined methods of histological demonstration. They come into view only when the connective tissue is stimulated, and he affirms that the cell-material found in the regeneration of ten- dons, &c., is derived partly from this source. Ehrlich described cer- tain cells of the leucocyte type which are found in normal, and particularly in pathological, circumstances in the blood and con- nective tissues, and which he names ” Mastzellen. ” The granules within them are large and are basophil in reaction. They are present in considerable numbers in the blood of leucocythsemia. They have also been found by Westphal in chronic inflammatory conditions of connective tissue, and in cancers, and he supposes that they are simply connective-tissue cells, altered by abnormal conditions of nutrition. Under the title of “Plasma-cells” Unna drew attention to certain peculiar bodies found in lupus, in various skin affections, and in granulations. They are cells of round, oval, polygonal, or elongated shape, whose protoplasm is usually free from granules, and stains intensely with methylene-blue. The nucleus is placed excentrically, contains several large chromatin granules, and is surrounded by a clear area. Kronipecher traces the most of them to lymphocytes, some to polymorphous-nucleated leucocytes, but states that they may become transformed into con- nective-tissue cells.

Although the methods of cell-division prevailing in normal structures are maintained generally in those which are pathological, yet certain modifications of thesemethods are more noticeable in the latter than in the former. Thus in the neoplasmata direct cell-division is more the rule than in healthy piarts. In actively-growing neoplasmata, cer- tainly, the indirect method prevails largely, but seems to go on side by side with the direct.

A curious and interesting modification of the indirect method, known as ” asymmetrical division,” occurs frequently in epithelio- mata,

sarcomata, &c. (Hansemann). It consists in an unequal number of chromosomes passingoverto each of the daughter nuclei, so that one may become hypochromatic, the other hyperchromatic. When this happens, the resulting cleavage of the cytoplasm and nucleus is also unequal. Several explanations have been given of the meaning of these irregularly cliromatic cells, but that which most lends itself to the facts of the case seems to be that they represent a condition of abnormal karyorhexis.

In many pathological cells undergoing indirect segmentation, centrosomes appear to be absent, or at any rate do not manifest themselves at the poles of the achromatic spindle. When they are present, that at one end of the spindle may be unusually large, the other of natural size, and they may vary in shape. In pathological cell-division it happens occasionally that the segmentation ol the cytoplasm is delayed beyond that of the mitotic network. The daughter nuclei may have arrived at the anaphase stage, and have even gone the lensith of forming a nuclear membrane, without any equatorial depression having shown itself in the cell-body. Some- times the equatorial depression fails entirely, and the separation, as in some vegetable cells, takes place through the construction of a cell-plate. Intranuclear plexuses arenot usually found in giant-ceUs, but have been described in the giant-cells of sarcomata by Klebs and Hansemann, and in those of tubercle by Baumgarten. Some of the nuclei within multinucleated cells may occasionally be en- gaged in mitotic division, the others being in the resting state.

In the earlier accepted notion of direct segmentation, usually known as the schema of Remak, division was described as com- mencing in the nucleolus, as ther-eafter spreading to the nucleus, and as ultimately implicating the cell-substance. Trambusti,

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curiously, finds confirmatxjry evidence of this in the division of cells in sarcoma. Contrary, however, to the experience of others, he has never found that the attraction-spheres play an important part in direct cell-division, or, indeed, that they exert any influence whatever upon the mechanism of the process. Where pigment was present within the cells (sarcoma), the attraction-spheres were represented by quite clear unpigmented areas, sometimes with a centrosome in their midst.

Eepaik op Injuries.

Healing by First Intention. â€” After a linear incision has been made with a sharp knife into the young stem of a plant, and the severed edges of the wound brought together by the application of pressure, the few cells which are actually cut through by the instrument in making the incision die and are removed, a number of cells just sufficient to fill the gap is generated from cells of a like nature on each surface of the wound, and the wound heals by their coalescence among themselves and with those on the immediate surface of the severed tissues (Shattock). After a like incision has been made into an animal tissue, if the wound be kept free from organismal contamination and the surfaces placed in accurate contact by pressure, without blood-clot or excess of lymph inter- vening, exactly the same method of healing is pursued in closing the breach of continuity. Those cells which have been injured by the knife die and are absorbed, and a few new cells, springing from the adjacent white fibrous tissues, organize and become interwoven with the parts on each side. New epidermic cells thrown off from the old soon cover the young cicatrix, and in course of time develop a horny layer (Fig. 17, Plate V.).' In each of these instances of healing, the one from the animal, the other from the vegetable kingdom, it is only the tissues lying in the immediate proximity of the wound which are stimulated, to growth ; those at even a short distance from the wound remain uninfluenced, and consequently in each ease the cicatrix is extremely fine â€" so fine, indeed, as to be scarcely visible even with the aid of the microscope. The above is the simplest means of healing, and is the type upon which all repair of wounded parts is effected ; it is, as will be observed, simply a method of growth, in which, as in all natural growth, each new tissue element of the cicatrix is

reproduced from its like in the pre-existing parts. Any other appearances met with in the healing of an injury are epiphenomena, and bear witness to an interruption in the natural course of events. In the case of the vegetable organism, it is mainly the deep cambium layer from which the reparative parenchyma is derived for the closure of the vacuity, while the cork cambium on the surface renews the protective covering ; in that of the animal organism, it is chiefly the white fibrous tissue which furnishes the bond of union, while the epidermis generated from pre- existing epidermis grows overthis as its natural investment.

White fibrous tissue and epidermis have more power of re- generating than any other tissues in the adult body. Separately, or conjointly, they represent the materials out of which all cicatrices and all fibrous new formations are constructed. In like manner, the cambium layer in plants is the tissue of reaction. The wood of the tree has little power of regeneration, being composed mostly of cells which are dead or whose segmental capacity is exhausted. The few living cells it contains may be stimulated to activity, say, in grafting, where the cut surfaces of scion and stock are brought into intimate contact, and its exposed vessels may become occluded by the ingrowth of tyloses, but otherwise it shows little evidence of reaction under the influence of a stimulus.

Healing by Second Intention. â€” Should the wound of the plant be larger than in the case we have supposed, and should the margins of the cambium layer remain widely apart, as where, for instance, a branch of a tree has been lopped off, numbers of complications arise, for here the floor of the wound is composed mainly of wood and pith â€” tissues, as we have just seen, having alow power

of reaction. The cambium margins are thus separated by a space whose floor is composed of material in great part useless in the effort at repair, while the absence of any lasting protective covering exposes the wound to excessive damp and the ravages of parasites.

Nature, so far, tends to protect such a surface artificially by the exudation of gum, resin, turpentine, &c., but this can be of only temporary effloacy, seeing that many of these large wounds of trees take years to heal. The healing is accomplished by the gradual

encroachment of new tissue derived from the cambium at the mar- gin. A cushion-like pad of callus, composed of cells traceable to those of the cambium, rises up at the circumference and gradu- ally invests the exposed wood. II the exposed wood be surmounted by dead tissue, this may become encapsuled by the encroaching callus, very much as a piece of dead bone may become encysted in the tissues of a living animal. The wound, after a time, comes to resemble very closely an indolent ulcer in man. The floor is covered by dead or dying unorganizable materials, without any layer of regenerative cells, and over this naturally the reparative callus at the margin runs with difBcuIty, so that it tends to ac- cumulate in a pad-like ring around the gap. In the case of the indolent ulcer this pad of callus is represented by the indurated and elevated edge (Fig. 19, Plate V.). The floor of such a wound is devoid of any layer of young growing cicatrix elements ; the tendons and fascise of underlying parts may be exposed on it, and the surfaces of these may be dead or dying. Over such a surface the epithelium will not spread, and as a result accumulates with other (connective tissue) reparative material at the margin, thus giving rise to the pad-Uke indurated edge. It is not until, under appropriate treatment, such a surface becomes invested with embryonic connective tissue, and is provided with just sufficient Â» vascularity to aid in repair, that the wound will close. When this happens, the epidermis spreads over the young connective tissue layer covering the floor, and reassnmes its original vocation as a protective investment. The elevation and induration of the margin of the wound, which, as just said, are caused in great part by accumulated epidermis, vanish as a consequence, and the wound assumes a more uniform level (Fig. 18, Plate V.).

Where a large gap is made in an animal tissue, as, say, by an injury, and where the skin and subcutaneous areolar tissue have been removed, the exposed surface is liable to the same vicissitudes as in the like case in a plant. The floor may be constituted, in great measure, of tissues of low vital reaction, such as muscle ; the epithelial margins are widely apart; and now that the surface is broken and the underlying vulnerable tissues and liquids are exposed, these become a prey to destructive vegetable parasites. The wound may be covered with lymph

or blood-clot, but neither of these has much power of resisting germ invasion, and both are evanescent substances, incapable of gener- ating cicatrix. Hence they can serve only a temporary and ephemeral purpose in protecting the exposed surface, , and when they lie in any quantity within a wound they rather hinder than aid its healing. They must be re- moved before the true cicatrix-forming elements of the tissues can come into play.

Like all porous substances (sponge, elder-pith, &c. ; Fig. 21, Plate VI.), the clot may act as a framework or mould in which the future cicatrix is oast (Fig. 20, Plate VI.), that is to say, its po- rosities may be penetrated by connective tissue and blood-vessels, and it may thus aid in the healing of the part ; but of itself it has absolutely no more power of generating tissue than coagulated white- of-egg, which it closely resembles in composition. When blood-clot or other extraneous substance has complicated and retarded the natural course of events, the resulting cicatrix is unnecessarily abundant : what ensues is an avowal on Nature's part of a certain clumsiness of procedure ; it is not instinct of her best effort.

Such gaping wounds tend to granulate, and the granulations are often regarded as a provision for aiding in organization (Fig. 18, Plate v.). This notion is diametrically opposed to all the facts of pathology bearing upon the matter. A ons"'" certain amount of vascularity is of course necessary for organization, but anything in excess of what is absolutely necessary in all circumstances tends to favour disorganization rather than to aid organization. The parts wliich heal quickest in the animal body are those in which blood-vessels are either absent (cornea) , or in which they are sparsely distributed (linea alba of abdomen). Indeed, the advent of granulation loops, as Hamilton has sought to demonstrate, is probably an accident of the part, conditional upon

its surface restraint having been removed, and usually, when at all exuberant, such granulations are the chieÂ£ means of retarding organization. In the healing of exposed wounds in plants, there is nothing exactly corresponding to the granulating surface in animals. The vessels are not driven out on the surface, possibly because they are more rigidly bound to their surroundings than the animal vessels are. Still the means by which vegetable callus is formed presents certain analogies. It begins in the soft bast and in the embryonic tissue lying along the edge of the wound, namely, the cambium. According to Hartig, the initiation of this callus- production is at first purely mechanical, and is consequent upon the pressure exerted naturally on the subjacent parts being reduced. In normal circumstances there is always a certain amount of tension in the cortical mantle, whereby a considerable pressure is exerted upon the cambium. Should this pressure be lessened by a wound reaching to the wood, cell-division within the cambium is acceler- ated not only along the edges of the wound, but for some distance around. This cell-division proceeds most energetically in the direction of the surface of the wound, where, of course, the restrain- ing counter-pressure is least. Masses of new callus can be seen protruding from between .cortex and wood, in these circumstances, quite comparable to the luxuriant cell-tissue of granulations. The plan of healing by granulation, or, rather, in spite of granulation, is essentially alike with that known as healing by first intention, and both are really extensions of natural growth.

Fibrosis. â€” Where a chronic inflammatory process has taken possession of an organ, or, let us say, has been located in peri- osteum or other fibrous part, there is a great tendency to the pro- duction of cicatricial fibrous tissue in mass. Thus it is laid down in large quantity In cirrhosis of the liver (Fig. 22, Plate VI.), kidney, or lung, and reacts upon these organs by contracting and inducing atrophy. The term ”

cirrhosis ” or “fibrosis” is usually applied to such a condition of organs ; that of ” sclerosis ” is used when such a deposition of fibrous tissue occurs within the central nervous system (Fig. 23, Plate VI.). Gull and Sutton asserted that in particular states of body, and more especially in the condition associated with cirrhotic kidney, such a fibrosis becomes general, running, as they alleged it does, along the adventitia of arteries and spreading to their capillaries. They supposed that it was accompanied by a peculiar hyaline thickening of the arterial wall, usually of the tunica intima, and hence they termed the supposed diseased state ” arterio-capillary fibrosis,” and gave the fibrous substance the name “hyaline-fibroid.” They held that the cirrhotic kidney is simply a local manifestation of a general fibrous disease. Their theory, however, has fallen into disfavour of late years.

j35tiology of Malignant Neoplasms. Tor long it has been suspected that malignant tumours are contagious, and that the contagion depends upon a micro-parasite. Cases of the supposed trans- ference of cancer from one individual to another have been put on record from time to time, and it has been alleged that sarcoma has been successfully trans- planted into the tissues of animals of the same species. Most of the cancer experiments, however, in this direction have proved negative. Still, the parasitical theory has gained a strong hold on the minds of pathologists, and has been reinforced by the discovery of bodies in cancer tumours vi^hich are not only alleged to be parasitical, but, it is asserted, are capable of communicating cancer afresh to suitable hosts. The bodies in question (Fig. Â¥, Plate I.) for the most part inhabit the cytoplasm of the epithelial cells, but are also found in the nucleus. They are discovered in greatest abundance in the actively-grow- ing parts of the tumour and in these regions are present sometimes in almost every individual cell, and occasionally in great numbers in a single cell. In their youngest state they appear to be rounded bodies vyhichare refractile and stain differentially with certain reagents such as Biondi’s fluid. Later, they develop a double-contoured capsule with clear contents and a body which is generally called a nucleus. A peculiar radiate arrangement of their sub- stance is noticed occasionally in hardened preparations. Plimmer stated that he had cultivated them artificially, and that on inoculation he produced an eruption of tumours

having an endothelial structure. They have been referred to the protozoa (Metchnikoff), but Plimmer looks upon them rather as being related to the saccha- romycetes.

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Russell's fuchsin-bodies are peculiar structures â€" round, homo-geneous, and refractile â€" which occur in various kinds of neoplasm. They range in size from about that of a coloured blood-corpuscle up to six, eight, or more times as large. They probably have no setiologial relationship to the tumours in whicli they occur, although Russell supposed that they were the infective agents in cancer. They have variously been supposed to be protozoa, degenerated blood-corpuscles, yeast-cells, &c. None of these theories has been conclusively established.

Secondary cancer tumours present the same variety of epithelium as that which prevails in the primary tumour. Hence it is in a manner proved that, whatever the actual agency at work in their production, a transportation of the epithelial element of the tumour must take place, and that it is from this as a nucleus that the secondary tumour springs. That cells and actual fragments of an organ can be transported by the blood-vessels into the lung, has been demonstrated by Turner, Jurgens, Lubarsch, Maximoff, and others ; and there is every reason to believe, from collateral observations on the production of metastatic tumours by Zahn and Ernst, that, in the case of the neoplasms, individual cells and small portions of the primary tumour are carried along in the blood-current and give rise to an auto-infection of distant parts. It is curious, in view of this, that' there should be such difficulty in reproducing the tumour by transplantation into a fresh host.

Pathological Tissue Products.

Colloid. â€" This term is usually applied to a semi-solid substance of homogeneous and gelatinous consistence formed in certain pathological circumstances. It results from a degeneration of cellular structures, and more particularly of those of an epithelial type. . Hence cancer tumours, especially those of the stomach and intes- tine, are liable to

give rise to it, and the cysts in ovarian adenomata usually contain a ropy gelatinous substance which falls under this designation. In various diseases of the kidney there is often found within the urinary tubules a hyaline structureless sub- stance in the form of a tube-cast, which, in certain instances at least, is to be reckoned as a degeneration of the epithelium, and as of the nature of colloid. The catarrhal cells in certain varieties of tubercular pneu- monia are sometimes destroyed by colloid degeneration. Colloid degeneration of cancerous tumours appears to implicate exclusively the epithelial cells of the tumour (Fig. 24, Plate VI.). The stroma of the tumour remains unaffected, and lies dissected out in the surrounding homogeneous glassy substance.

Within the thyroid vesicles there accumulates a homo- geneous and gelatinous product which often goes by the name of ” colloid.” The usual idea of its origin is that it is secreted by the thyroid. Notkin, however, takes a different view of the matter. He names the substance in question thyro-proteid, and looks upon it as an ex- crementitious substance formed in the tissues and merely removed from the blood by the thyroid. When the thyroid is destroyed in myxoedema, or when it is removed artificially in a healthy animal, this substance, thyro- proteid, accumulates in the soft tissues and occasions a characteristic swelling. He looks upon the substance as quite different from mucoid. As regards the composition of colloid found in other situations, it appears to vary â€” to be, in fact, a mixture of albuminoid substances. Scherer found a peculiar albumen-like constituent in the ropy viscid fluid from an ovarian cyst, to which he gave the name of paralbwiihi.

Mucoid.â€” By this is understood a gelatinous substance something like the foregoing in its physical characters, but differing from it in the fact of its being a substance of connective tissue origin, and in containing a large

PLATE VI.

Fig. 20. â€” Organizing Thrombus. Internal saphen- ous vein, a, Laminje of thrombus ; 6, tunica intiina from which processes (g, g,) are being jjrojected into the thrombus ; c, ninscularis ; d, areolar coat ; e, fat outside same ; /, small artery, (x 50 diams.)

Fio. 21.â€” Organization of Sponge. Section through pJHce of sponge placed in abdomen for ten days, which had become adherent to the bowel, a, a, Loops of blood- capillaries pushed into the sponge from surface of the bowel ; 6, &, colourless blood- corpuscles lying in meshes of sponge frame-work (c, c) ; d, fibrin in same ; e, e, e, true organizing cells derived ft-ora the bowel and supplanting the fibrin (d) ; /, stem of capillary – loops which are being projected into the sponge. (X 300 diams.)

Fig. 22, â€” Cirrhotic Li^‘er, showing Fibrosis, a, Super- ficial layer of capsule not much altered ; h, deep layer very much thickened ; c, c, islands of liver tissue sur- rounded by fibrous bands ; d, small congested blood- vessel ; e, e, depots of small round cells in the fibrous bands ; /, /, fibrous bands ; g, branch of portal vein. (X 50 diams.)

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Fig. 25. â€” Myxomatous (cystic) Tumour of the Mamma, m.f., Myxomatous tissue; c.o., cystic acini. (X 300 diams.)

Fig. 24. â€” Colloid De- generation of the Epi- thelial Cells of a Can- cerous Till n our of the Mamma, (x iOO diams.)

Fig. 23. â€” Sclerosis of Spinal Cnrd. ^c, A sclerotic patch in lateral coliunn ; p.c, same in posterior column, (x 50 diams.)

Fin. 26.â€” Four Leucocytes from the frog, euclos- iu;^ iinthrax bacilli.

general]

PATHOLOGY

percentage of mucin. Mucin is either absent from true colloid, or is present only in small quantity. Mucoid is met with in pathology chiefly as a constituent of connective tissue tumours â€” myxo-sarcomata (Fig. 25, Plate VI.), myxo-lipomata, fibromata, enchondromata, &c. The substance is either quite homogeneous and structureless, or is faintly stringy. The cells of the tumour lie embedded in it, and begin to throw out processes in all directions, which by anastomosing constitute a network. The processes are said by Kickhefel to constitute a system of plasma canals. The mucoid appears to result from a partial liquefaction of the fibrous stroma of the tumour, such as that contained in the adventitia of blood-vessels, partly also from a mucoid transformation of the bodies of the cells of the growth (Kickhefel). It may be mentioned that some holothurians have the remarkable property of converting their tough, brown, leather-like skin into mucoid within a few hours, on their being brought into air. The whole skin may undergo this viscous trans- formation.

Hyaloid. â€” The hyaloid degeneration seems to be closely related to the mucoid, and affects chiefly lymphatic glands (Wieger and Schiippel), the vessels and neuroglia of the brain ,(Arndt), and the stroma of epithelial tumours (Malassez). The part becomes infiltrated with a trans- parent homogeneous substance â€” particularly within and around blood-vessels â€” which does not give the reactions of amyloid, and does not exhibit the histological characters of the mucoid degeneration. It differs from the colloid in being a degeneration chiefly of fibrous tissues. In the brain-cortex it sometimes gives rise to deposits of a cartilage-like lustre and consistence.

Amyloid. â€” The wax-like or amyloid substance has a certain resemblance to the colloid, mucoid, and hyaloid. It has a firm gelatinous consistence and wax-like lustre, and microscopically is found to be homogeneous and structureless, with atranslucency like that of ground-glass. The name “amyloid” was applied to it by Virchow on account of the blue reaction which it gives occasionally with iodine and sulphuric acid, resembling that given with vegetable cellulose. It is now known to have nothing in common with vegetable cellulose, but is regarded as one of the many albuminoid substances existing in the

body under pathological conditions. Its percentage com position, according to Friedreich and Kekule, is C53-6, H7-0, N15-0, and 0 and S24-4. It is quite insoluble in water, resists putrefaction, and is not acted upon by pepsin- or trypsin-ferment in solution at a body-temperature. This last circumstance has been taken advantage of in the isolation of the substance in a pure condition. Unlike â€¢the colloid, it appears always to take on the character of a true infiltrate. The albumen (possibly serum- albumen), of which it is a derivative, is most likely poured into the affected organ in a soluble form, and subsequently becomes insoluble. There appears, however, to be a preamyloid stage, or several of them, leading up to the construction of the completely developed amyloid, in which the substance does not give the diagnostic colour reactions. These colour reactions are forthcoming only in the fully formed amyloid, and ai:p as follows : (1) Watery solution of iodine imparts to it a deep mahogany brown colour; (3) iodine and sulphuric acid give occasionally, but not always, an azure-blue colour; (3) methyl-violet imparts to it a brilliant rose-pink ; (4) methyl-green gives a reaction very much like that of methyl-violet, but not so vivid. The reaction with iodine is seen best with direct light, the reactions with the other substances are visible only with transmitted light. Chitin gives a brown reaction with iodine, and a violet, or blue, with iodine and sulphuric acid; methyl-violet stains it violet-red, but methyl-green has no effect upon it. In view of

these positive staining reactions, Krawkow supposed that amyloid is chitinous in its nature, a combination of an albuminous body with chitin, and might be known con- sequently as “chitinoid.” Oddi has isolated from the amyloid liver a substance which Schmiedeberg had previously obtained from cartilage and named “chon- droitinic-sulphuric acid” (Chondroitinschwefelsaure). It also occurs in bones and elastic tissue, but is not present in the normal human liver. Oddi does not regard it as the essential constituent of amyloid, chiefly because the colour reactions are forthcoming in the residuum after the substance has been- removed, while the sub- stance itself does not give these reactions. Quite likely the amyloid may be a combination of the substance with a proteid. The soda combination of the acid as obtained

from, the nasal cartilage of pigs had the com- position CisHasNaaN'SOi,.

Amyloid develops, in various organs and tissues in connexion with simple chronic abscess, tubercular abscess and other suppura- tive states of body, and a number of interesting experiments, designed to test the relationship between the condition of suppura- tion and the production of amyloid, have been made of late years. The animal most suitable for experimenting upon is the fowl, but other animals have been found to react. Thus Krawkow and Nowak, employing the continuous injection subcutaneously of the usual organisms of suppuration, have induced in the fowl the deposition within the tissues of a homogeneous substance giving the colour reactions of true amyloid. When hardened in spirit, however, the greater part of this experimental amyloid in the fowl vanishes, and the reactions are not forthcoming. They were unable to verify any direct connexion between its production and the organism of tubercle. These observations have been verified in the rabbit, mouse, fowl, guinea-pig, and cat by Davidsohn, occasionally in the dog by Lubarsoh ; and confirmatory observations have also been made by Czemy and Maximoff. Lubarsch succeeded in inducing it merely by the subcutaneous injection of turpentine, a result which it has been asserted is due to the turpentine exciting an abscess. Nowak, however, found later that he could generate it where the turpentine failed to induce suppuration, and he believes that It may arise quite apart from the influence of the organisms of suppuration, that it is not a biological product of the micro- organisms of disease, and also that it has nothing to do with emaciation.

Amyloid Bodies. â€" These are peculiar bodies which are found in the prostate, in the central nervous system, in the lung, and in other localities, and which get their name from being very like starch-corpuscles, and from giving certain colour reactions closely resembling those of vegetable cellulose, or even starch itself. They are minute structures having a round or oval shape, concentrically striated, and frequently showing a small nucleus-like body or cavity in their centre. Iodine gives usually a dark brown reaction, some- times a deep blue ; iodine and sulphuric acid almost always call forth an intense deep blue

reaction ; and methyl-violet usually a brilliant pini, quite resembling that of true amyloid. They are probably a degeneration-product of cells.

Spurious Amyloid. â€” If a healthy spinal cord be hung up in spirit for a matter of six months or more, a glassy substance develops within it quite like true amyloid. It further resembles true amyloid in giving all its colour reactions. The reaction with methyl-violet, however, differs from that with true amyloid in being evanescent.

Response op Tissues to Stimulation.

A stimulus may be defined as every change of the external agencies acting upon an organism ; and if a stimulus come in contact with a body possessing the property of irritability, i.e. the capability of reacting to stimuli, the result is stimulation (Verworn). Stimuli comprise chemical, mechanical, thermal, photic, and electrical changes in the environment of the organism. ‘A stimulus may act on all sides and induce a general effect without direction of movement, but in the production of movement in a definite direction the stimulus must be applied unilaterally. Stimuli applied generally, not uni- laterally, in most cases induce increased divisibility of the cells of the part.

Thus the poison of various insects induces in plants the cellular new formation known as a gall-nut ; a foreign body implanted in a limb

may become encysted in a capsule of fibrous tissue ; septic matter introduced into tbe abdomen will cause proliferation of the lining endo(epi)thelium ; and placing an animal (salamander, Galeotti) in an ambient medium at a higher temperature than that to which it is accustomed naturally, increases the rapidity of cell-division of its ej)ithelium with augmentation of the number of karyokinetio figures.

Hair and some other like structures grow luxuriantly on a part to which there is an excessive flux of blood. Bone (e.g., drill- bones) may develop in a soft tissue with no natural bone-forming tendencies, as a result of interrupted pressure, or a fatty tumour may arise in the midst of the natural subcutaneous fat in the same circumstances.

Among stimuli acting unilaterally, perhaps none has proved more interesting, in late times, than what is known as Chemotaxis. By it is meant the property an organism endowed with the power of movement has to move towards or away from a chemical stimulus applied uni- laterally, or, at any rate, where it is applied in a more concentrated state on the one side than on the others, and more particularly where the concentration increases grad- ually in one direction away from the living organism acted upon. Observed originally by Engelmann in bacteria, by Stahl in myxomycetes, and by Pf effer in ferns, mosses, &c., it has now become recognized as a widespread phe- nomenon. The influence of the chemical substance is either that of attraction or repulsion, the one being known as positive, the other as negative chemotaxis.

The female organs of certain cryptogams, for instance, exert a positive chemotactic action upon the sperm atozoids, and probably, as Pfeffer suggests, the chemical agent which exerts the influence is malic acid. No other substance, at least, with which he experi- mented had a like effect, and it is possible that in the arohegonium which contains the ovum malic acid is present. Massart and Bordet, Leber, Metchnikoff, and others have studied the pheno- menon in leucocytes, with the result that while there is evidence of their being positively chemotactic to the toxines of many patho- genic microbes, it is also apparent that they are negatively influenced by such substances as lactic acid.

Erom a pathological point of view the subject of chemotaxis must be considered along with that of pliago- cytosis. Certain free mobile cells within the body, such as blood-leucocytes, as well as others which are fixed, as for instance the endothelium of the hepatic capillaries, have the property of seizing upon some kinds of particulate matter brought within their reach. Within a quarter of an hour after a quantity of

cinnabar has been injected into the blood of the frog, nearly every particle will be found engulfed by the protoplasm of the leucocytes of the cir- culating blood. Some bacteria, such as those of anthrax (Fig. 26, Plate VI.), are seized upon in the same manner, indeed, very much as small algae and other particles are incorporated and devoured by amoeba. Melanine particles formed in the spleen in malaria, which pass along with the blood through the liver, are appropriated by the endothelial cells of the hepatic capillaries, and are found embedded within their substance. If the particle enveloped by the protoplasm be of an organic nature, such as a bacterium, it undergoes digestion, and ultimately becomes destroyed, and accordingly the term " phagocyte " is now in common use to indicate cells having the above properties. This phagocytal action ~of certain cells of the body is held by Metchnikoff and his followers to have an important bear- ing on the pathology of immunity. Phagocytes act as scavengers in ridding the body of noxious particles, and more especially of harmful bacteria.

A further application of the facts of chemotaxis and phagocytosis has been made by Metchnikoff to the case of Inflammation. It is well known that many attempts to define the process of inflammation have been made from time to time, all of them more or less unsatisfactory. Among the latest is that of Metchnikoff: "Inflammation generally," he says, "must be regarded as a phagocytic reaction on the part of the organism against irritants.

This reaction is carried out by the mobile phagocytes sometimes alone, sometimes with the aid of the vascular phagocytes, or of the nervous system." Given a noxious agent in a tissue, such, let us say, as a localized deposit of certain bacteria, the phagocytes swarm towards the locality where the bacteria have taken up their residence. They surround individual bacteria, absorb them into their substance, and ultiinately destroy them by digestion. The phagocytes are attracted from the blood-vessels and else- where towards the noxious focus by the chemotaxis exerted upon them by the toxines secreted by the bacteria contained within it. The chemotaxis in this instance is positive, but the toxines from certain other bacteria may act negatively ; and such bacteria are fraught with par- ticular danger from the fact that they

can spread through the body unopposed by the phagocytes, which may be looked upon as their natural enemies.

jSTaTUEAL PBOTECTlbN AGAINST PARASITISM.

The living organism is a rich storehouse of the very materials from which parasites, both animal and vegetable, can best derive their nourishment. Some means is neces- sary, therefore, to protect the one from the encroachments of the other. A plant or animal in perfect health is more resistant to parasitical invasion than one which is ill-nourished and weakly. Of a number of plants growing side by side, those which become infected with moulds are the most weakly, and an animal in low health is more subject to contagious disease than one which is robust. Each organism possesses within itself the means of protec- tion against its parasitical enemies, and these properties are more in evidence when the organism is in perfect health than when it is debilitated.

One chief means employed by Nature in accomplishing this object is the investment of those parts of the organism liable to be attacked with an armour-like covering of epidermis, periderm, bark, &c. The grape is proof against the inroads of the yeast-plant so long as the husk is intact, but on the husk being injured, the yeast-plant finds its way into the interior and sets up vinous fermentation of its sugar. The root of the French vine is attacked by the Phylloxera, but that of the American vine, whose epidermis is thicker, is protected from it. Tbe larch remains free from para- sitism so long ^s its covering is intact, but as soon as this is punctured by insects, or its continuity interfered with by cracks or fissures, the Peziza penetrates, and before long brings about the destruction of the branch. So long as the epidermis of animals remains sound, disease germs may come in contact with it almost with impunity, but immediately on its being fissured, or a larger wound made through it, the underlying parts, the blood and soft tissues, are attacked by them. A very remarkable instance of an acquired means of protecting a wound against parasitical invasion is to be found in granulations. Should these remain unbroken, they constitute a natural barrier to the penetration of most pathogenic and other forms of germ-life into the

parts beneath. Bacteria of various kinds which alight upon their surfaces begin to fructify in abundance, but are rapidly destroyed as they burrow deeply. This is accomplished by a twofold agency, for while numbers of them are seized upon iDy the granulation phagocytes, othere are broken up and dissolved by the liquid filling the granulation inter- spaces (Afanassieff). This latter, or histolytic, property is not con- fined to the liquid of granulations ; normal blood-serum possesses it to a certain extent, and under bacterial influence it may become very much exalted. JilrgeKinas makes out that when an animal is rendered immune to a particular micro-organism this histolytic property becomes exalted.

Deopsy.

During conditions of health a certain quantity of lymphy liquid is constantly being infused into the tissues and serous cavities of the body, but in the case of the tissues it never accumulates to excess, and in that of the serous cavities it is never more than sufficient to keep them moist. When any excessive accumulation takes place, the condition is known as “hydrops” or “dropsy.” A “transudate ” is a liquid having a composition resembling that of blood-serum, while the term “exudate ” is applied

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to an effused liquid whose composition approaches that of the blood- plasma in the relationship of its solid and liquid parts, besides in most eases containing numbers of colour- less blood-corpuscles. Exudates are poured out under in- flammatory conditions, while none of the truly dropsical effusions are of inflammatory origin ; and hence the class of exudates, as above defined, may be rejected from the category of liquids we are at present considering. Where the dropsical condition is more or less general, the term ” anasarca ” is applied to it ; if the ti,ssues are infiltrated locally, the term ” oedema ” is employed ; and

various names are applied, with a local significance, to dropsies .of individual parts or cavities, such as ” hydrothorax,” ” hydroperitoneum ” or “ascites,” “hydrocephalus,” and so on. In ” anasarca ” the tissues which suffer most are those which are peculiarly lax, such as the lower eyelids, the scrotum, and the backs of the hands and feet. It is in- variably the result of some cause acting generally, such as renal disease,valvular defect of the hp,art,or animpoverished state of the blood ; while a mere oedema is usually depend- ent upon some local obstruction to the return of blood or lymph, or of both, the presence of parasites within the tissue, such as the filaria sanguinis hominis or trichina spiralis, or the poisonous bites of insects. Dropsy of the serous cavities is very commonly merely part of a general anasarca, although occasionally it may be, as in the case of ascites, the sequel to an obstruction in the venous return. Dropsical liquids are usually pale yellow or greenish, limpid, with a saltish taste and alkaline reaction, and a specific gravity ranging from 1005 to 1024. They all contain albumen and throw down a precipitate with heat and nitric acid. None of them, in man, coagulates spontaneously, although they contain fibrinogen. The addition of some of the liquid squeezed out from a blood-clot, of the squeezed blood-clot itself, or of a little blood-serum, is sufficient to throw down a fibrinous coagulum (Buchanan), evidently by these substances sup- plying the fibrin-ferment. The proteid constituents are very much like those of blood-serum, although they never come up to them in amount (Runeberg). The quantity of proteid matter in a purely dropsical effusion never amounts to that of an inflammatory exudation (Lassar). Certain peculiar substances, probably degenerative pro- ducts, some of them reducing copper, are occasionally met with. The liquid of ascites sometimes contains chyle in abundance (hydrops lacteus), the escape having taken place from a ruptured receptaculum chyli.

In a given case of anasarca due to a cause acting generally, it â– will be found that the liquid of the pleural cavity always contains the highest percentage of proteid, that of the peritoneal cavity comes next, that of the cerebral ventricles follows this, and the liquid of the subcutaneous areolar tissue contains the lowest. The reason of this is apparently that the negative pressure of the pleural, and partly of the peritoneal, cavity

tends to aspirate a liquid relatively thicker, so to speak, than that effused where no such extraneous mechanism is at work (James).

The subject of the conditions under which dropsical liquids are poured out opens up a very wide question, and one about which there is the greatest diversity of opinion. It turns in part, but in part only, upon the laws regulating the effusion of lymph, and physiologists are by no means at one in their conclusions on this subject. Thus Ludwig was of opinion that the lymph-flow is dependent upon two factors, first, difference in pressure of the blood in the capillaries and the liquid in the plasma spaces outside ; and, secondly, chemical interchanges setting up osmotic currents through the vessel-walls. His results, so far, have been confirmed by Starling, who finds that the amount of lymph-flow from the thoracic duct is dependent upon difference in pressure. It varies with the increase of the intracapillary or decrease of the extra-capillary pressure, and is also in part regulated by the greater or lesser permeability of the vessel-walls. Heidenhain, on the other hand, rejected entirely the filtration view of lymph-formation, believing that the passage of lymph across the capillary wall is a true secretion brought about by the secretory function of the endothelial plates. Starling does not accept this view, and cannot

regard as an article of faith Heidenhain's dictum that normally filtration plays no part in the formation of lymph. Lazarus- Barlow, again, looks upon the pouring out of lymph as evidence of the demands of the tissue-elements for nutrition. An impulse is communicated to the blood-vessels in accordance with this demand, and a greater or smaller outflow is the result. He traces various local dropsies to the starvation from which the tissues are suffering, the liquid accumulating in excess in accordance with the demand for more nourishment. It may be asked, however, whether a dropsical tissue is being held in a high state of nutrition, and whether, on the contrary, the presence of lymph in excess in its interstices does not tend to impair its vitality rather than to lend it support. Accord- ing to Rogowicz and Heidenhain, certain substances increase the quantity of lymph given off from a part by acting upon the cells of the capillary wall ; they hold, in fact, that these substances are true lymphagogues. Heidenhain recogirizes two classes, first, such

substances as peptone, leech extract, and cray-fish extract ; and, secondly, crystalloids such as sugar, salt, &c. Starling sees no reason to believe that members of either class act otherwise than by increasing the pressure in the capillaries or by injuring the endo- thelial wall. The members of the first class influence the endo- thelial plates of the capillaries injuriously, inducing thereby increased permeability ; those of the second class (sugar, &c.), on injection into the blood, attract water from the tissues and cause a condition of hydrsemio plethora with increased capillary pressure. The increased flow of lymph is due to the increased pressure in the abdominal capillaries.

Increased flow of lymph, however, is one thing, the production of dropsy is another. For, even granted that the amount of lymph poured into a part varies with circumstances, there is not the' slightest evidence to show, so long as the paths by which it is naturally removed, namely, the lymph and blood-vessels, remain open and unimpaired, and so long as the composition of the blood remains normal, that the increased liquid tends to accumulate in the part. In fact, even where these paths are partially obstructed, there is great difficulty in rendering the part oedematous. The obstruction in the veins or lymphatics of a limb requires to be widespread in order to call forth any amount of local dropsy. Obstruction of the veins and lymphatics simultaneously is, how- ever, more potent in occasioning such dropsy than any other measure. Feeble or obstructed action of the heart, combined with malcomposition of the blood, probably explains the tendency to dropsy in conditions of ansemia, the poor quality of the blood tending to bring about malnutrition of the capillary endothelium, and the feeble heart being insufficient to drive the lymph onwards. It is a question whether the malcomposition of the blood, in certain forms of renal diseases, may not be one of the main factors in the production of dropsy accompanying these diseases.

Practical Applications.

Medicine and Surgery have never been slow to appro- priate and apply the biological facts of Pathology, and at no period have they followed more closely in its wake than during the last quarter of the 19th

century. When, for instance, the cause of septic infection had been revealed, the prophylaxis of the disease became a possibility. Seldom has it happened, since the discovery of the law of gravity, that so profound an impression has been made upon the scientific world at large as by the revelation of the part played by germ-life in nature ; seldom has any discovery been fraught with such momentous issues in so many spheres of science and industry.

The names of Pasteur and Lister will descend to posterity as those of two of the greatest figures in the annals of medical science, and indeed of science in general, during the 19th century. The whole system of treatment of tubercular disease has been altered "by the discovery of the tubercle microphyte. Previously consumptive individuals were carefully excluded from contact with fresh air, and were advised to live in rooms almost hermetically sealed and kept at a high temperature. The treatment of the disease has now gone off in the opposite direction. Sanatoria have started up all over Europe and elsewhere for its treatment on the open-air principle. Individuals suffering from pulmonai-y phthisis are encouraged to live night and day in the open, and with the best results. The rapid diagnosis of diphtheria, by recognizing its bacillus, has enabled the practitioner of medicine to commence the treatment early, and it has also enabled the medical officer of health to step in and insist on the isolation of affected persons before the disease has had time to spread. The discovery of the parasite of malaria by Laveran, and of the method by which it gains entrance to the human body, through the bite of a particular variety of mosquito, by Manson and Ross, promises much in the

â– way of eradication of the disease in the future. One of the most remarkable practical outcomes of germ-pathology, however, has been the production of the immunized sera now employed so ex- tensively in the treatment of diphtheria and other contagious diseases. By the

continuous injections under the skin, in increas- ing doses, of the toxines of certain pathogenic micro-organisms, such as that of diphtheria, an animal â€” usually the horse â€” may be rendered completely refractory to the disease. Its serum in course of time is found to contain something (antitoxine) which has the power of neutralizing the toxine secreted by the organism when parasitical upon the body. This immunity can be transferred to a fresh host {e.g., man) by injecting such serum subcutaneously. In the general summary of the progress of pathology given in the commencement of this article, it was stated that myxoedema is to be traced to destruction of the thyroid gland. The continuous administration of extract of the gland, or of the gland itself jjei- os, has been found to remove the symptoms of the disease. The modern system of hygiene is in great part founded upon recent pathology. The recognition of the dangers accompanying the drinking of polluted water or milk, or of those attached to the breathing of a germ-polluted atmosphere, has been the natural sequence of an improved knowledge of pathology in its bacterio- logical relationships. Skin-grafting and regeneration of bone are among not the least remarkable applications of pathological prin- ciples to the combat with disease in recent times ; and in this con- nexion may also be mentioned the daring acts of surgery for the relief of tumours of the brain, rendered practicable by improved methods of localization, as well as operations upon the serous cavi- ties for diseased conditions within them or in their vicinity.

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(d. j. h.)

II. Parasitic Diseases.

It has long been recognized that various specific patho- logical conditions are due to the presence and action of parasites in the human body, but since the publication of the ninth edition of this work the part played in the causation of the so-called infective diseases by various members of the Schizoniycetes â€” fission fungi â€” has been more widely and more thoroughly investigated, and the knowledge gained has not only modified our conception of the pathology of these diseases, but has had a most import- ant influence upon our methods of treatment of sufferers, both as individuals and as members of communities. The present article deals chiefly with these infective diseases, and with them only so far as new light has been thrown on their aetiology and pathology; and several diseases mentioned in the following classification are not further referred to in the text, because little or nothing, beyond what has already appeared, can be given. For example, Boil and Carbuncle, and Anthrax or Splenic Fever, had been as fully studied when the articles for the ninth edition were written as they are at the present time; it is there- fore unnecessary to write what could only be of the nature of repetition. In certain conditions, such as Rheumatism, Vaccinia, Mumps, Dengue, Epidemic Dropsy, Oriental Sore, Verruga, Frambcesia or Yaws, Beriberi,

PATHOLOGY (PARASITIC DISEASES). Plate VII.

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Fig. 17

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Fig. U

Fli;. I. â€” Staph v’I’jccjcijus pyogellrs aureu—. from ;i l 2-hnurs’ agar culturL’. â– l(X)Odiam. â€ž 0.â€” Microcuccus melitensis vel Brurri (M ii-nioccu-, ol Malta hfvrr), Inan a 24-hoiirs’ ai;ar riiliurc. v 1000 iliam. ,, 8.â€” Frafiil^el’.s iliplococcus I’neunicinia; (pni.aMniii;cKX-u.sl, Irum a IJ-lmurs’ ” Muoil agar” culturL-. ;â– , \ooo diam. â€ž 1.3. â€” I’reparatiim of Glanders Bacillus (I!. nuillL’i), trum a 12 hunrs’ agar rulUirc. \ 1000 diaiii,

14. â€” Sc Tti(jn iif gland from a guinea-pig inoi-ulatud with the Cllanders Uacillu.s (1>. mallei). â– â– 1000 diam.. ,, 17. â€”Branched hyphal threads of the Ray fungus (Actin.imyces), clubbed through thickening of the sheath. \ 1000 diam.

IS. â€” Malaria, l.ife-cyrle in the blood of the Tertian iMahirial Parasite from the small anicfl.uhc through the spore-bearin” .‘ilai’ to the group of aniojbuhc. The large nucleated white blood corpuscle contains altered blood pigment. x 1000 diam.

PARASITIC diseases]

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and Syphilis, the disease is probably the result of the action of specific micro-organisms, though as yet it has not been possible to demonstrate any setiological relation- ship between any micro-organisms found and the special disease. Recent work on Rheumatism and Scarlet Fever may render it necessary to revise this statement, but for the present it is advisable to allow it to stand. In addi- tion to the above, one or two conditions in which the presence of animal parasites in the blood as causative fac- tors of disease has been demonstrated are briefly described, but those which have for long been known to be due to the presence and action of the higher vegetable and ani- mal parasites, and which have been adequately dealt with in the ninth edition, are not here considered. Such dis- eases as Haemoglobinuric Fever or Black- Water Fever and Kala-Azar, which are also presumably parasitic diseases, are not included, as they are probably associated directly with Malaria ; this supposition is the more probable in that both of them arerecognized as occurring specially in those patients who have been weakened by malaria, intestinal haemorrhage, and similar conditions.

The following classification is based partly upon the biological relations of the parasites and partly on the pathological phenomena of individual diseases : â€”

A. Diseases due to Vegetable Parasites :

I. To SomzoMYCETES, Bacteria or Pission FnNGi :

1. Caused by the Pyogenetic Micrococci :

Suppuration and Septicaemia. Infective Endocarditis. Erysipelas. GonorrlioBa.

2. Caused by Specific Bacilli :

(a) Acute Infective Diseases : Ciiolera.

Typlioid Group. Typhoid, Malta Fever, &c. Relapsing Fever. Plague. Pneumonia. Infective Meningitis. Influenza.

Yellow Fever and Weil's Disease. Diphtheria. Tetanus. (A) More Chronic Infective Diseases (tissue parasites) : Tuberculosis. Leprosy. Glanders. ^ (c) Infective Diseases In which organisms have not yet been discovered : Hydrophobia.

Typhus Fever, Scarlet Fever, Measles, Mumps, Whooping-Cough, &c., &c. II. To Higher Vegetable Parasites :

Actinomycosis. '

Madura Foot, Aspergillosis, and other Mycoses.

B. Diseases due to Animal Parasites :

L To Protozoa : Malaria. Dysentery.

Hsemoglobinuric Fever. Kala-Azar. II. To other Animal Parasites : Filariasis, &c.

A. Diseases due to Vegetable Parasites.

I. To ScHizoMYCETEs, Bactebia or Fission Fungi.

1. Caused by the Pyogenetic Micrococci.

Suppuration and Septicaemia. â€” It is now recognized that although nitrate of silver, turpentine, castor oil, perchloride of mercury, and certain other chemical sub- stances are capable of producing suppuration, the most common causes of this condition are undoubtedly the so- called pus-producing bacteria. Of these perhaps the most important are the staphylococci (Fig. 1, Plate VII.) (cocci arranged like bunches of grapes), streptococci (Fig. 2, Plate VIII-) (cocci arranged in chains), and pneumococci, though certain other organisms not usually associated

with pus-formation are undoubtedly capable of setting up this condition, e.g,, bacillus pyocyaneus, bacillus coli communis, and the typhoid bacillus. These organisms (the products of which, by chemical irritation, stimulate the leucocytes to emigration) bring about the death and digestion of the tissues and fluids (which no longer ” clot “) with which they come in contact, pus (matter) being thus formed: this accumulates in the tissues, in the serous cavities, or even on mucous surfaces ; septicaemia ‘ or blood-poisoning, secondary infection of tissues and organs at a distance from the original site of infection, or pyaemia, with the formation of secondary abscesses, may thus be set up.

In septicaemia the pus-forming organisms grow at the seat of introduction, and produce special poisons or toxins, which, absorbed into the blood, give rise to symptoms of fever. From the point of introduction, however, the organisms may be swept away either by the lymph or by the blood, and carried to positions in which they set up , further inflammatory or suppui’ative changes. In the streptococcal inflammations, spreading by the lymph channels appears to be more common. In the blood the organisms are usually destroyed by the powerful bacteri- cidal action of the plasma ; but should they escape, they are carried without multiplication into the systemic capillaries of the general circulation, of the lung, or the liver, where, being stopped, they may give rise to a second focus of infection, especially if at the point of impaction the vitality of the tissues is in any way lowered.

Unless the blood is very much impoverished, its b^actericidal action is usually sufficiently powerful to bring about the de- struction of anything but comparatively large masses of pyogenetic organisms. This bactericidal power, how- ever, may be lost, when the pus-forming organisms may actually multiply, a general haemic infection resulting. Should micro-organisms be conveyed by the veins to the heart, and there be deposited on an injured valve, an in- fective endocarditis is the result ; from such a deposit numerous organisms may be continuously poured into the circulation. Simple thrombi or clots may also become in- fected with micro-organisms. Fragments of these, washed away, may form septic plugs in the vessels and give rise to abscesses at the point of impaction. A distinction must be drawn between saprsemia and septicaemia. In sapraemia the toxic products of saprophytic organisms are absorbed from a gangrenous or necrotic mass, from an ulcerating surface, or from a large surface on which saprophytic organisms are living and feeding on dead tissues : for ex- ample, in the clots that sometimes remain after child- birth on the inner surface of the wall of, the womb. So long as no micro-organisms follow the toxins, the condition is purely sapraemic, but should any organisms make their way into and multiply in the blood, the condition be- comes one of septicaemia. The term pyaemia is usually associated with the formation of fresh secondary foci of suppuration in distant parts of the body. If the primary abscess occurs in the lungs, the secondary or metastatic abscesses usually occur in the vessels of the general or systemic circulation, and less frequently in other vessels of the lung. When the primary abscess occurs in the systemic area, the secondary abscesses occur first in the lung, and less frequently in the systemic vessels ; whilst if the primary abscess be in the portal area (the veins of the digestive tract), the secondary abscesses are usually distributed over the same area, the lungs and systemic vessels being more rarely affected.

Infective Endocarditis. â€” Acute malignant or ulcerative endocarditis occurs in certain forms of septicaemia or pyaemia. It is brought about by the streptococcus pyo- genes, the pneumococcus, or the staphylococcus pyogenes aureus, or, more rarely, by the gonococcus, the typhoid

bacillus or tlie tubercle bacillus, as they gain access to acute or cbronic valvular lesions of the heart. The aortic and mitral valves are usually affected, the pulmonary and tricuspid valves much more rarely, though Wash- bourn states that the infective form occurs on the right side more frequently than does simple endocarditis. A rapid necrosis of the surface of the valve is early fol- lowed by a deposition of fibrin and leucocytes on the necrosed tissue ; the bacteria, though not present in the circulating blood during life, are found in these vegeta- tions which break down very rapidly ; ulcerative lesions are thus formed, and fragments of the septic clot (i.e. the fibrinous vegetations with their enclosed bacteria) are carried in the circulating blood to different parts of the body, and, becoming impacted in the smaller vessels, give rise to septic infarcts and abscesses. The ulceration of the valves, or in the first part of the aorta, may be so extensive that aneurysm, or even perforation, may ensue. In certain cases of streptococcic endocarditis the use of anti-streptococcic serum appears to have been attended with good results.

Suppurative Meningitis (see Infective Meningitis).

Erysipelas. â€” ~~In 1883, Fehleisen demonstrated that in all cases of active erysipelatous inflammation a strepto~~ coccus or chain of micrococci (similar to those m et with in certain forms of suppuration) may be found in the lymph spaces in the skin. The multiplying streptococci found in the lymph spaces form an active poison, which, acting on the blood-vessels, causes them to dilate ; it also ” attracts ” leucocytes, and usually induces proliferation of the endo- thelial cells lining the lymphatics. These cells â€” per- haps by using up all available oxygen â€” interfere with the growth of the streptococcus and act as phagocytes, taking up or devouring the dead or weakened micro-

organisms. Both mild and severe phlegmonous eases of erysipelas are the result of the action of this special coccus, alone, or in combination with other organisms. It has been observed that cancerous and other malignant tumours appear to recede under an attack of erysipelas, and certain cases have been recorded in which complete cessation of growth and degeneration of the tumour have followed such an attack. As the streptococcus of erysipelas can be isolated and grown in pure culture in broth, it was thought that a subcutaneous injection of such a cultivation might be of value in the treatment of cancerous tumours. No diffi- culty was experienced in setting up erysipelas by inocu- lation, but in some cases the process was so acute that the remedy was more fatal than the disease. The virulence of the streptococcus of erysipelas is greatly exalted when the coccus is grown alongside the bacillus prodigiosus and certain other saprophytic organisms which flourish at the body-temperatnre. It is an easier matter to control the action of a non-multiplying poison, even though exceed- ingly virulent, than of one capable, under favourable conditions, of producing an indefinite amount of even a weaker poison. The erysipelatous virus having been raised to as high a degree of activity as possible by-culti- vating it along with the bacillus prodigiosus â€” the bacillus of bleeding bread â€” in broth, it is killcil by heat, and the resulting fluid, which contains a quantity of the toxic substances that set up the characteristic erysipelatous changes, is utilized for the production of an inflammatory process â€” which can now be a(Â«urately controlled, and which is said to be very beneficial in the treatment of certain malignant tumours. The accurate determination of the Eetiulogy of erysipelas has led to the adoption of a scientific method of treatment of the disease. The strepto-coccus erysij)elatis is found, not specially in the zone in which inflammation has become evident, but in the tissues outside this zone : in fact, the streptococci appear to be most numerous in the lymphatics of the tissues in which

there is least change. Before the appearance of any red- ness there is a dilatation of the lymph spaces with fluid, and the tissues become slightly ajdematous. As soon, however, as the distension of vessels and the emigration of leucocytes, with the accompanying swelling and red-ness, become marked, the streptococci disappear or are imperfectly

stained â€” they are undergoing degenerative changes â€” ^the inflammatory ” reaction ” apparently beijig sufiicient to bring about this result.

If it were possible to set up the same reaction outside the advanc- ing streptococci, might not a barrier be raised against their advance ? This theory was tested on animals, and it was found that the appli- cation of iodine, oil of mustard, oaatharides, and similar rube- facients, would prevent the advance of certain micro-organisms. This treatment was applied to eiysipelas patients with the most satisfactory result, the spread of the disease being prevented when- ever the zone of inflammation was extended over a sufficiently wide area. The mere “ringing” of the red patch by nitrate of silver or some other similar irritant, as was at one time recom- mended, was not sufficient : it is necessary that the reaction should extend for some little distance beyond the zone to which the streptococci have already advanced.

Gonorrhoea. â€” A micro-organism, the gonococcus, is the cause of gonorrhoea. It is found in the pus of the urethra and in the conjunctiva lying between the epithelial cells, where it sets up considerable irritation and exudation ; it occurs in the fluid of joints of patients affected with gonorrhoeal arthritis ; also in the pleuritic effusion and in the vegetations of gonorrhoeal endocarditis. It is a small diplococcus, the elements of which are flattened or slightly concave discs apposed to one another; these, dividing transversely, sometimes form tetrads. They are found in large numbers, usually in the leucocytes, adherent to the epithelial cells or lying free. They stain readily with the basic aniline dyes, but lose this stain when treated by Gram’s method. The gonococcus is best groAvn on human blood-serum mixed with agar (Wertheim), though it grows on ordinary solidified blood-serum or on blood- agar. Like the pneumococcus, it soon dies out, usually before the eighth or ninth day, unless reinoculations are made. It forms a semi-transparent disc-like growth, with somewhat irregular margins, or with small processes run- ning out beyond the main colony. It acts by means of toxins, which have been found to set up irritative changes when injected, without the gonococcij into the anterior chamber of the eye of the rabbit.

2. Caused by Specific Bacilli.

(a) Acute Infective Fevers.

Cholera. â€” In 1884, Koch, in the report of the German Cholera Commission in Egypt and India, brought forward overwhelming evidence in proof of his thesis that a special bacterium is the causal agent of cholera; subsequent observers in all countries in which cholera has been met with have confirmed Koch's observation. The organism described is the "comma" bacillus, one of the spirilla, which usually occurs as a slightly-curved rod 1 to 2/i in length and 0-5 to 0-6/x in thickness. These comma-shaped rods occur singly or in pairs ; they may be joined together to form circles, half-circles, or "S "-shaped curves (Fig. 3, I'late VIII.).

In cultivations in specially-prepared media they may be so grouped as to form long wavy or spiral threads, each of which may be made up of ten, twenty, or even thirty of the short curved rods ; in the stools of cholera patients, especially during the earlier stages of the disease, they are found in considerable numbers ; they may also be found in the contents of the lower bowel and in the substance of the mucous membrane of the lower part of the small intestine, especially in the crypts and in and around the epithelium lining the follicles. It is sometimes difBcult, in the later stages of the disease, to obtain these organisms in siifficiently ' large numbers to be able to distinguish them by direct microscopic examination, but by using the Dunbar-Schottelius method they

can be detected even wlien present in small numbers. A quantity of faintly-alkaline meat broth, with 2 per cent, of peptone and 1 per cent, common salt, is inoculated witb some of the contents of the intestine, and is placed in an incubator at a temperature of 35Â° C. for about

twelve hours, when, if any cholera bacilli are present, a delicate pellicle, consisting almost entirely of short ” comma ” bacilli, appears on the sni-face. If the growth be allowed to go on, tlie bacilli increase in length, but after a time the pellicle is gradually lost, the cholera organisms being overgrown, as it were, by the other organisms. In order to obtain a pure culture of the cholera bacillus, remove a small frag- ment of the young film, shake it up thoroughly in a little broth, and then make gelatin-plate cultivations, when most characteristic colonies appear as small greyish or white points. Each of these, when examined under a low-power lens, has a yellow tinge; the margins are wavy or crenated ; the surface is granular and has a peculiar ground-glass appearance ; around the growing colony liquefaction takes place, and the colony gradually sinks to the bottom of the liquefying area, which now appears as a clear ring. The organism grows very luxuriantly in milk, in which, however, it gives rise to no very noticeable alteration ; its presence can only be recognized by a faint aromatic and sweetish smell, which can scarcely be distinguished from the aromatic smell of the milk itself, except by the most practised nose.

The cliolera bacillus may remain alive in water for some time, but it appears to be less resistant than many of the putrefactive and saprophytic organisms. It grows better in a saline solution (brackish water) than in perfectly fresh water ; it flourishes in serum and other albuminous fluids, especially when peptones are present. Its power of forming poisonous substances appears to vary directly with the amount and nature of the albumen present in the nutrient medium ; and though it grows most readily in the presence of peptone, it appears to form the most virulent poison when grown in some form or other of crude albumen to which there is not too free access of oxygen. Erom the experiments carried out by Koch, Nicati and Eietsch, and Macleod, there appears to be no doubt that the healthy stomach and intestine are not favourable breeding-grounds for the cholera bacillus. In the first place, it requires an alkaline.medium for its full and active development, and the acid found in a healthy stomach seems to exert an exceedingly deleterions influence upon it. Secondly, it appears to be incapable of developing except when left at rest, so tliat the active peristaltic movement of the intestine interferes with its development.

Moreover, it forms its poison most easUy in the presence of crude albumen. It is interesting to note what an important bearing these facts have on the personal and general spread of cholera. Large quantities of the cholera bacil- lus may be injected into the stomach of a guinea-pig without any intoxicative or other symptoms of cholera making their appearance. Further, several healthy indi- viduals have swallowed, without anyill effect, pills contain- ing the dejecta from cholera cases. If, however, previous to the injection of the cholera bacillus, the acidity of the stomach be neutralized by an alkaline fluid, especially if at the same time the peristaltic action of the intestine be paralysed by an injection of morphia, a characteristic attack of cholera is developed, the animal is poisoned, and in the large intestine a considerable quantity of fluid faeces containing numerous cholera bacilli may be found. There appear to be slight differences in the cholera organisms found in connexion with different outbreaks, but the main characteristics are preserved throughout, and are sufficiently distinctive to mark out the organisms as be- longing to the cholera group. Amongst the known pre-disposing causes of cholera are the incautious use of purgative medicines, the use of unripe fruit, insufficient food, and intemperance. These may all be looked upon as playing the part of the alkaline solution in altering the composition of the gastric juices, and especially as setting up alkaline fermentation in the stomach and small intestine; beyond this, however, the irritation set up

may bring about an accumulation of inflammatory serous fluid, from the albumens of which, as we have seen, the cholera organism has the power of producing very active toxins.

The part played by want of personal cleanliness, over- crowding, and unfavourable hygienic conditions, may be readily understood if it be remembered that the cholera bacillus may grow outside the body. The number of cases in which epidemics of cholera have been traced to the use of drinking-water contaminated with the dis- charges from cholera patients is now considerable. The more organic matter present, the greater is the virulence of water so contaminated ; and the addition of such water to milk has, in one instance at least, led to an outbreak. If cholera dejecta be sprinkled on moist soil or damp linen, and kept at

blood-heat, the bacillus multiplies at an enor- mous rate in the first twenty-four or thirty-six hours ; but, as seenintheDunbar-Schottelius method, at the end of three or four days it is gradually overcome by the other bacteria present, which, growing strongly and asserting themselves, cause it to die out. The importance of this saprophytic growth in the propagation of the disease can scarcely be over-estimated. Water which contains an ordinary amount of organic and inorganic matter in solution does not allow of the multiplication of this organism, which may soon die out ; but when organic matter is present in excess, as at the margin of stagnant pools and tanks, develop- ment occurs, especially on the floating solid particles. This bacillus grows at a temperature of 30Â° C. on meat, eggs, vegetables, and moistened bread; also on cheese, coffee, chocolate, and dilute sugar solutions. In some experiments carried out by . Cartwright "Wood and the writer in connexion with the passage of the cholera oi"ganism through filters, it remained alive in the charcoal filtering medium for a period of at least forty-two days, and probably for a couple of months. It must be remem- bered that cholera bacilli are gradually overcome by other organisms, as only in this way can the immunity enjoyed by certain regions, even after the water and soil have been contaminated, provided that no fresh supply is brought in " to relight the torch," be explained. In most of the regions in which cholera remains endemic the wells are merely dug-out pits beneath the slightly-raised houses, and are open for the reception of sewage and excreta at all times. These dejecta contain organic material which serves as a nutriment on which infective organisms, derived from the soil and ground-water, may flourish. Not only dejecta, but also the rinsings from soiled linen and uten- sils used by cholera patients, should be removed as soon as possible, " without allowing them to come into contact with the surface of the soil, with wells," or with vegetables and the like. The discovery of Koch's comma bacillus has so altered our conceptions of the aetiology of this disease, that we now study the conditions under which the bacillus can multiply and be disseminated, instead of concerning ourselves with the cholera itself as some definite entity. Telluric agencies merely become secondary factors, the dissemination of the disease by vrinds from country to country is no longer regarded as being possible, whilst the spread of cholera epidemics along the lines of

human intercourse and travel is now recognized. The virulent bacillus requires the human organism to carry it from those localities in which it is endemic to those in which epidemics occur. The epidemiologist has come to look upon the study of the cholera organism and the conditions under which it exists as of more importance than mere local conditions, which are only important in so far as they contribute to the propagation and distribution of the cholera bacillus, and he knows that the only means of pre- venting its spread is the careful inspection of everything coming from cholera-stricken regions. He also recognizes

that the herding together of people of depressed vitality, under unhygienic and often filthy conditions, in quarantine stations or ships, is one of the surest means of promoting an epidemic of the disease ; that attention should be con- fined to the careful isolation of all patients, and to the disinfection of articles of clothing, feeding utensils, and the like ; that the comma bacillus can only be driven out of rooms by means of light and fresh air ; that thorough personal, culinary, and household cleanliness is necessary ; that all water except that known to be pure should be carefully boiled ; and that all excess, both in eating and drinking, should be avoided. The object of the physician in such cases must be, first, to isolate as completely as possible all his cholera patients, and then to get rid of all predisposing causes in the patients themselves, causes which have already been indicated in connexion with the aetiology of the disease.

Attention has frequently been drawn to the fact that patients who have lived for some time in a cholera region, or who have already suffered from an attack of cholera, appear to enjoy a partial immunity against the disease. Haffkine, working on tlie assumption that the symptoms of cholera are produced by a toxin formed by the cholera organism, came to the conclusion that, by introducing first a modified and then a more virulent poison directly into the tissues under the skin, and not into the

ali- mentary canal, it would be possible to obtain a certain insusceptibility to the action of this poison. He found that for this purpose the cholera bacillus, as ordinarily obtained in pure culture from the intestinal canal, is too potent for the preliminary inoculation, but is not sufficiently active for the second, if any marked pro- tection is to be obtained. By allowing the organism to grow in a well-aerated culture the virulence is gradually diminished, and this virulence, once abolished, does not return even when numerous successive cultures are made on agar or other nutrient media. On the other hand, by passing the cholera bacillus successively through the peritoneal cavities of a series of about thirty guinea-pigs, he obtains a virus of great activity ; this activity is soon lost on agar cultivations, and it is necessary from time to time again to pass the bacillus through guinea-pigs, three or four passages now being sufficient to reinforce the activity.

From these two cultures the vaccines are prepared as follows : â€” The surface of a slant agar tube is smeared with the modified cholera organism. After this has been allowed to grow for twenty- four hours, a small quantity of sterile water is poured into the tube, and the surface-growth is carefully scraped off and made into au emulsion in the water ; this is then poured off, and the process is repeated until the whole of the growth has been removed. The mixture is made up with water to a bulk of 8 c.c, so that if 1 o.c. is injected the patient receives | of a surface-growth ; it is found that this quantity, when injected subcutaneously into a guinea-pig, gives a distinct reaction, but does not cause necrosis of the tissues. If the vaccine is to be kept for any length of time, the emulsion is made with 0-5 per cent, carbolic acid solution, prepared with carefully sterilized water, and the mixture is made up to 6 c.c. instead of 8 c.c, since the carbolic acid appears to interfere slightly with the activity of the virus. Tlie stronger virus is prepared in exactly the same way. The preliminary injection, which is made in the left flank, is followed by a rise in temperature and by local reaction. After three or four hours there is noticeable swelling and some pain ; and after ten hours a rise in temperature, usually not very marked, occurs. These signs soon disappear, and at the end of three or four days the second injection is made, usually on the opposite side. This is also followed by a rise of temperature, by swelling, pfiin and local redness :

these, however, as before, soon pass off, and leave no ill effects behind. A guinea-pig treated in this fashion is now immune against some eight or ten times the lethal dose of cholera poison, and, from all statistics that can be obtained, a similar protection is conferred upon the human being.

Evidence has been collected that spirilla, almost identical in appearance with the cholera bacillus, may be present in water and in healthy stools, and that it

is in many cases almost impossible to diagnose between these and the cholera bacillus; but although these spirilla may interfere with the diagnosis, they do not invalidate Koch's main contention, that a special form of the comma bacillus, which gives a complete group of reactions, is the cause of this disease, especially when these reactions are met with in an organism that comes from the human intestine.

Typhoid Fever. â€" Our information concerning the aetiology of typhoid fever was largely increased during the last twenty years of the 19th century. In 1880 Eberth and Klebs independently, and in 1882 Coats, described a bacillus which has since been found to be intimately asso- ciated with typhoid fever. This organism (Fig. 4, Plate VIII.) usually appears in the form of a short bacillus from 2 to 3/i in length and 0-3 to 0-5;a in breadth; it has slightly rounded ends and is stained at the poles ; it may also occur as a somewhat longer rod more equally stained throughout. Surrounding the young organism are numerous long and well-formed flagella, which give it a very characteristic appearance under the microscope. At present there is no evidence that the typhoid bacillus forms spores. These bacilli are found in the aderioid follicles or lymphatic tissues of the intestine, in the mesenteric glands, in the spleen, liver, and kidneys, and may also be detected even in the small lymphoid masses in the lung, and in the post-typhoid abscesses formed in the bones, kidneys, or other parts of the body ; indeed, it is probable that they were first seen by von Eecklinghausen in 1871 in such abscesses. They undoubtedly occur in the dejecta of patients suffering from typhoid fever, whilst in recent years it has been demonstrated that they may also be found in the urine. It is evident,

therefore, that the urine, as well as the faeces, may be the vehicle by means of which the disease has been unwittingly spread in certain otherwise inexplicable out- breaks of typhoid fever, especially as the bacillus may be present in the urine when the acute stage of the disease has gone by, and when it has been assumed that, as the patient is convalescent, he is no longer a focus from which the infection may be spread. There can be little doubt that typhoid bacilli are not, as is very frequently assumed, present merely in the lymphatic glands and in the spleen (Fig. 5, Plate VIII.) : they may be found in almost any part of the lymphatic system, in lymph spaces, in the connective tissues, where they appear to give rise to marked prolifera- tion of the endothelial cells, and especially in the various secreting organs. It is probable that the proliferation often noticed in the minute portal spaces in the liver, in cases of typhoid fever, is simply a type of a similar pro- liferation going on in other parts and tissues of the body. It was for long assumed that the typhoid bacillus could multiply freely in water, but recent experiments appear to indicate that this is not the case, unless a much larger quantity of soluble organic matter is present than is usually met with in water. The fact, however, that the organism may remain alive in water is of great importance ; and, as in the case of cholera, it must be recognized that certain of the great epidemics of typhoid or enteric fever have been the result of ” water-borne infection.” The bacillus, a facultative parasite, grows outside the body, with somewhat characteristic appearances and reactions: it flourishes specially well^n a slightly acid medium; in the presence of putrefactive organisms wliich develop strongly alkaline products it may gradually die out, but it api)ears to retain its vitality longer in the presence of acid-forming organisms. It may, however, be stated generally, that after a time the typhoid bacillus becomes weakened, and may even die out, in the presence of rapidly- growing putrefactive organisms. In distilled water it may remain alive for a considerable period â€” five or six weeks, or even longer. It grows on all the ordinary nutrient media.

PARASITIC diseases]

PATHOLOGY

It does not coagulate milk ; hence it may grow luxuriantly in that medium without giving rise to any alteration in that fluid : milk, therefore, is a specially dangerous vehicle for its dissemination. When inoculated on potato, careful examination will reveal the fact that certain almost invisible moist patches are present ; these are made up of rapidly-multiplying typhoid bacilli. The typhoid bacillus grows in gelatin, especially on the surface, somewhat like the bacillus coli communis, but with a less luxuriant growth. This organism, when taken from young broth cultures twelve to twenty-four hours old â€” during the period at which flagella are best seen â€” and examined microscopically, exhibits very lively move- ments. When, as pointed out by Gruber and Durham, blood-serum, in certain dilutions, from a case of typhoid fever is added to such a culture, the broth, at first turbid, owing to the suspended and moving micro-organisms, gradually becomes clear, and a deposit is formed which is found to be made up of masses or clumps of typhoid bacilli which have lost their motility. This reaction is so characteristic and definite, that when the mixture is kept under examination under the microscope, it is quite possible to follow the slowing-down and massing together of the organisms. It is found, moreover, that normal diluted blood-serum has no such effect on the bacilli. This property of the blood-serum is acquired at such an early date of the disease â€” sometimes even at the end of the first week â€” and occurs with such regularity, that typhoid fever may now actually be diagnosed by the presence or absence of this ” agglutinating” property in the blood. If serum taken from a patient supposed to be suffering from typhoid fever, and diluted with saline solution to 1 in 10, to 1 in 60, or in still greater dilution, causes the bacilli to lose their motility and to become aggregated into clumps within an hour, it may be concluded that the patient is suffering from typhoid fever ; if this agglutination be not obtained with a dilution of 1 in 10, in from 15 to 30 minutes, experience has shown that the patient is not suffering from this disease. Certain other diseases, such as cholera, give a similar specific serum reaction with their specific organisms. These sera have, in addition, a slight common action â€” a general agglutinating powerâ€” which, however, is not manifested except in concentrated

solutions, the higher dilutions failing to give any clumping action at all, except with the specific bacillus associated with the disease from which the patient from whom the serum is taken is suffering.

Mediterranean or Malta Fever, â€” Until recently Medi- terranean Fever was looked upon as a form of typhoid fever, which in certain respects it resembles ; the temperature curve, however, has a more undulatory character, except in the malignant type, where the temperature remains high throughout the course of the attack. According to Hughes, this disease is widely distributed in the countries bordering upon the Mediter- ranean south of latitude 46Â° N., and along the Red Sea littoral. Analogous forms of fever giving a'" specific" serum reaction with the micrococcus of this disease are also met with in parts of India, China, Africa, and America.

The Micrococcus melitensis vel Brncei, which is found most abundantly in the enlarged spleen of the patient suffering from Malta fever, is a very minute organism (0'33|U in diameter), ovoid or nearly round, arranged in pairs or in very short chains (Fig. 6, Plate VII.). If a drop of the blood taken directly from the spleen be smeared over the surface of agar nutrient medium, minute trans- parent colourless colonies appear ; in thirty-six hours these have a slight amber tinge, and in four or five days from their first appear- ance they become opaque. These colonies, wlftch flourish at the temperature of the human blood, cease to grow at the room-tem- perature except in summer ; and if kept moist, soon die at anything below 60Â° F. , though when dried they retain their vitality for some time. They cause opacity of broth at the end of five or six days.

forming a precipitate with a comparatively clear supernatant fluid. They grow best on media slightly less alkaline than human blood.

This organism is distinctly pathogenetic to monkeys, and its virulence may be so increased that other animals may be affected by it. Though unable to live in clean'or virgin soil, it may lead a saprophytic existence in soil polluted with faecal matter. Hughes maintains that the " virus " usually enters the body with inspired air, and leaves it with the faeces and urine ; it seldom appears to be carried for any considerable

distance. He divides this fever into three types. In the malignant form the onset is sudden, there are headache, racking pain over the whole body, nausea, and sometimes vomiting ; the tongue is foul, coated, antl swollen, and the breath very offensive ; the temperature may continue for some time at 103Â° to 105Â° F. The stools in the diarrhoea which is sometimes present may be most offensive. At the end of a few days the lungs become congested and pneumonic, the pulse weak, hyperpyrexia appears, and death ensues. A second type, by far the most common, is the ” undulatory ” type, in which there is remittent pyrexia, separated by periods in which the patient appears to be improving. These pyrexial curves, from one to seven in number, average about ten days each, the first being the longest, eighteen to twenty-three days. In an intermittent type, in which the temperature-curve closely resembles the hectic pyrexial curve of phthisis or suppuration, the ” undulatory ” char- acter is also marked. A considerable number of toxic symptoms make their appearance â€” localized neuritis, synovitis, anaemia, emaciation, bronchial catarrh, weakness of the heart, neuralgia, profuse night sweats, and similar conditions. Patients otherwise healthy usually recover, even after prolonged attacks of the disease, but the mortality amongst patients suffering from organic mis- chief of any kind may be comparatively high. The diagnosis from malaria, phthisis, rheumatic affections, and pneumonia may in most cases be made fairly easily, but the serum reaction with cultures of the micrococcus melitensis, corresponding to the typhoid reaction with the typhoid bacillus, is sometimes the only trustworthy diag- nostic feature between this fever and the above-mentioned diseases. The best preventive me^ures are : the avoid- ance of chills, good drainage, and disinfection of stools and urine from the patients affected, so as to stop pollu- tion of the soil.

Belapsing Fever. â€” The specific cause of relapsing fever (famine fever) appears to be the Spirillum Obermeieri, an organism which occurs in the blood of patients suffering from this disease (during the febrile stages). Between the febrile stages are periods of intermission, during which the spirillum disappears from the blood and apparently retires to the spleen. This disease, in epidemic form, follows in the footsteps of famine and destitution, specially affecting young people

between the ages of fifteen and twenty ; it seldom attacks children under five years of age, but in patients over thirty it assumes a more virulent form. In mor^keys inoculated with blood containing the Spir- illum Obermeieri the first symptoms appear between the second and sixth days. In the human subject this incuba- tion period may last as long as three weeks ; then comes an attack of fever, which continues for about a week, and is followed by a similar period of apparent convalescence, on which ensues apyrexial relapse, continuing about half as long as the first. The spirilla, the cause of this disease, are fine spirals with pointed ends, three or four times as long as the diameter of a red blood corpuscle. Although it has as yet been found impossible to cultivate these spirilla outside the body, human beings, and monkeys injected with blood containing them, contract the disease ; and in monkeys it has been found that during the period before the relapse the spirilla have made their way into the cells of the

spleen. As yet little is known as to the mode of devel- opment of these organisms, and of the method of their transmission from one patient to another, but it is thought that, as in the case of malaria and the tsetse-fly disease, they may be carried by bloodsucking insects. Eelapsing fever is distinguished from typhoid by its sudden onset, and by the distinct intermissions ; and from influenza by the enlargement of the spleen and liver. The most satisfactory method of diagnosis is the exami- nation of the blood for the presence of the spirillum during the febrile period. The post-mortem appearances are those of a toxic (bacterial) poisoning. Curious infarc- tion-like masses, in which are numerous spirilla, are found in the spleen ; in the liver there is evidence of acute in- terstitial hepatitis, with cloudy swelling of the liver cells ; and similar changes occur in the kidney. Fatty degeneration of the heart and voluntary muscles may also be met with.

Plague.^Dvjcing recent years opportunities for tlie study of plague have unfortunately been only too numer- ous. In patients suffering from this disease, a micro- organism, capable of leading either a saprophytic life or a parasitic existence in the human body, and in some of the lower animals, was described independently by Kitasato and by Yersin, in 1894, in Hong-Kong. It is a short, moderately thick bacillus, with rounded ends, which stain deeply, leaving a clear band in the centre (Fig. 7, Plate VIII.). It thus resembles the short diphtheria bacillus and the influenza bacillus. Certain other forms are met with, bu|; the above is the most characteristic. It grows readily on most media at the temperature of the body, but, like the glanders bacillus, soon loses its virulence in cultivations. It may be obtained in pure cultures from the lymph glands, and from the abscesses that are formed in the groin or other pcjsitions in which the glands become enlarged and softened. It may also be found in the spleen and in the blood, and, in the case of patients suffering from the pneumonic form of the disease, even in the lungs and in the sputum. It has also been found in the faces and urine. (It is very important that these excretions from plague patients should always be most carefully disin- fected.) This organism, when obtained in pure culture and inoculated into rats, mice, guinea-pigs, or rabbits, produces exactly the same symptoms as does material taken fresh from the softened glands. The symptoms are local swelling, enlargement and softening of the lymphatic glands, and high fever. The fact that rats are susceptible to the disease is one of peculiar significance, as these animals by their habits have special facilities for carrying the plague bacillus from point to point, and thus of spreading the infection very rapidly. It has been noticed that large numbers of rats succumb to plague before the disease as- sumes the epidemic form ; and in Bombay, at an early period of the last outbreak, it was almost impossible to obtain a rat on which to carry out experiments for the purpose of determining whether the organism was really the plague bacillus or not. In India, where the notions of cleanliness are somewhat different from those recog- nized in Great Britain, most of the conditions favourable to the spread of the plague bacillus are of the most per- fect character. This organism may pass into the soil with feeces ; it may there remain for some time, and then be taken into the body of one of the lower animals, or of man, and give

rise to a fresh outbreak. Kitasato and Yersin were both able to prove that soil and dust from infected houses contain the bacillus, that such bacillus is capable of inducing an attack of plague in the lower animals, and that flies fed on the dejecta or other bacillus-containing material, die, and in turn contain Bacilli which are capa- ble of setting up infection. Hankin claims that ants, and Simonds that fleas, may carry the plague to and from rats.

and so to the human being. It has already been mentioned that the organism rapidly loses its virulence when culti- vated outside the body; on the other hand, on being passed through a series of animals its virulence gradually increases. Thus may be explained the i^t that in most outbreaks of plague there is an 6arly period during which the death-rate is very low; after a time the percentage mortality is enormously increased, the virulence of the disease being very great and its course rapid. There seem to be notable differences in the degree of suscepti- bility of different races and different individuals, and those who have passed safely through an attack appear to have acquired a marked degree of immunity. Two methods of treatment, both of which seem to have been attended with a certain degree of success, are now being tried. Haifkine, applying his inoculation method (first used with cholera) to plague, appears to have produced a certain active immunity, inoculated patients becoming less susceptible to the action of the plague bacillus. This method of treatment, however, is of no use in the case of patients already attacked ; for such cases Yersin has used a serum taken from horses into which graduated and systematic injections of the plague bacillus and its pro- ducts have been made. This ‘â– ’ anti-pest ” serum, it is claimed, has induced a favourable turn in the disease in cases which otherwise must inevitably have succumbed.

Pneumonia. â€” The case in favour of acute lobar pneu- monia being an infective disease was a very strong one, even before it was possible to show that a special organism bore any aetiological relation to it. In 1880, Friedlander claimed that he had isolated such an organism, but the pneumobacillus then described appears to be inactive as compared with the pneumococcus isolated by Fraenkel and Talamon. This latter organism, which is usually found in the sputum, is an encapsuled

diplococcus (Fig. 8, Plate VII.). Grown on serum or agar over which sterile blood has been smeared, it occurs as minute, glistening, rather prominent points, almost like a fine spray of water Or dew. When the organism is cultivated in broth the capsule disappears, and chains of diplococci are seen. It resembles the influenza bacillus in a most remarkable manner. It may be found, in almost every case of pneumonia, in the “rusty “or “prune-juice”’ sputum. Injected into rabbits, it produces death with very great certainty; and by passing the organism through these animals its virulence may be markedly increased. Like the influenza bacillus and even the diphtheria bacillus, this organism may be present in the mouth and lungs of perfectly healthy individuals, and it is only when the vitality of the system is lowered by cold or other depressing influences that pneumonia is in- duced; two factors, the presence of the bacillus and the lowered vitality, being both necessary for the produc- tion of this disease in the human subject. It is quite possible, however, that, as in the case of cholera, a slight inflammatory exudation may supply a nutrient medium in which the bacillus rapidly acquires greatly increased virulence, and so becomes a much more acth-e agent of infection.

It is claimed by the brothers Klemperer, by Washbouru, and by others, that they have been able to produce an anti-pneumococcic serum, by means of whiiii they are able to treat successfully severe cases of pneumonia. The catarrhal pneumonia so frequently met with during the course of whooping-cough, measles, and other specific infective fevers, is also in all probability due to the action of some organism of which the influenza bacillus and the diplococcus pn^monise are types.

Infective meniugitis is, in most of the recent works on medicine, divided into four forms : (1) the acute epidemic cerebro-spinal form ; (2) a posterior basic form, which

however, is closely allied to the first; (3) suppurative meningitis, usually associated with pneumonia, Â«rysipela/S, and pyaemia ; and (4) tubercular meningitis, due to the specific tubercle bacillus.

(1) The first form is usually associated with Weich- selbaum's diplooocus hitraoellularis meningitidis (two closely-apposed discs), which is found in the purnlent exudate, especially in the leucocytes, of the meninges of the brain and cord. It grows, as transparent colonies, on blood-agar at the temperature of the body, but dies out very rapidly unless reinoculated, and has little patho- genetic effect on the lower animals, though under certain conditions it has been found to produce meningitis when injected under the dura mater. (2) Posterior-basic menin- gitis, according to Dr Still, "is frequently seen during the first six months of life, a period at which tuberculous and epidemic cerebro-spinal meningitis are quite un- common." The organism found in this disease resembles very closely the diplooocus intracellular is meningitidis, but differs from it in that it remains alive without reculti- vation for a considerably longer period. It is less patho- genetic than that organism, of which possibly it is simply a more highly saprophytic form. This is a somewhat important point, as it would account for thÂ« great resemblance that exists between the sporadic and the epidemic forms of meningitis. (3) In svppurative men- ingitis these two organisms may still be found in a certain proportion of the cases, but their place may be taken by the pneumococcus or diplococcus pneumoniae or Fraenkel's pneumococcus â€" diplococcus lanceolatus â€" which appears to grow in two forms. In the first it is an encapsulated organism, consisting of small oval cocci arranged in pairs or in short chains ; the capsule is un- stained. When the pneumococcus grows in chainsâ€" the second form â€" as when cultivated outside the body, on blood-serum or on agar over the surface of which a small quantity of sterile blood has been smeared, it produces very minute translucent colonies. Like Weichselbaum's bacillus, it must be recultivated every three or four days, otherwise it soon dies out. Unlike the other forms pre- viously described, it may, when passed through animals, become .extremely virulent, very small quantities being sufBcient to kill a rabbit. Although the pneumococcus is found in the majority of these cases, especially in chil- dren, suppurative meningitis

may also accompany or fol- low the various diseases that are set up by the streptococ- cus pyogenes and streptococcus erysipelatis ; whUst along with it staphylococci and the bacillus coli communis have sometimes been found. In other cases, again, there is a mixed infection of the pneumococcus and the streptococcus pyogenes, especially in cases of disease of the middle ear. As might be expected in meningitis occurring in connexion with the specific infective diseases, e.g., influenza and typhoid fever, the presence of the specific bacilli of these diseases may usually be demonstrated in the meningeal pus or fluid. (4) The fourth form, tubercular meningitis (acute hydrocephalus), is met with most frequently in young children. It is now generally accepted that this condition is the result of the introduction of the tubercle bacillus into the blood-vessels and lymph spaces of the meninges at the base of tlie brain, and aloag the fissures of Sylvius.

Influenza. â€” From 1889 up to the present time, infliaenza has every year with unfailing regularity broken out in epidemic form in some part of the United Kingdom, and often has swept over the whole country. The fact that the period of incubation is short, and that the infective agent is extremely active at a very early stage of the disease, renders it one of the most rapidly-spreading maladies with which we have to deal. The infective agent, first observed by Pfeiffer and Canon, is a minute bacillus

or diplococcus less than 1^ in length and 0-5/t in thick- ness ; it is found in little groups or in pairs. Each diplococcus is stained at the poles, a clear band remain- ing in the middle ; in this respect it resembles the plague bacillus. It is found in the blood â€” though here it seems to be comparatively inactive â€” and in enormous numbers in the bronchial mucus. It is not easily stained in a solution of carbol-fuchsin, but in some cases such numbers are present that a cover-glass preparation may show practically no other organisms. Agar, smeared with blood and inoculated, gives an almost pure cultiva- tion of very minute transparent colonies, similar to those of the diplococcus pneumonias, but as a rule somewhat smaller. This organism, found only in cases of influenza, appears to have the power of forming toxins which con- tinue to act for some time after recovery seems to have taken place ; it

appears to exert such a general devitaliz- ing effect on the tissues, that micro-organisms which ordinarily are held iu check are allowed to become active, with the result that catarrh, pneumonia, and similar conditions are developed,, especially when cold and other lowering conditions co-operate with the poison. This toxin produces special results in those organs which, through over-use, impaired nutrition, or disease, are al- ready only just able to carry on their work. Hence in cases of influenza the cause of death is usually associated with the failure of some organ that had already been working up to its full capacity, and in which the margin of reserve power had been reduced to a minimum. It is for this reason that rest, nutrition, warmth, and tonics are such important and successful factors in treatment.

Yellow Fever, endemic in the West Indies and the north-eastern coasts of South America, may become epidemic wherever the temperature and humidity are high, especially along the seashore in the tropical Atlan- tic coast of North America. It appears to be one of the specific infective fevers in which the liver, kidney, and gastro-intestinal systems, and esisecially their blood-vessels, are affected. In 1897, Sanarelli reported, in the Annales de I'Institut Pasteur, that he had found a bacillus in the blood-vessels of the liver and kidneys, and in the cells of the peritoneal fluid, but never in the alimentary tract, of yellow fever patients. These, he maintained, were per- fectly distinct from the putrefactive microbes occurring in the tissues in the later stages, their colonies not growing like those of the bacillus coli communis. They grow read- ily on all the ordinary artificial nutrient media, as short rods with rounded ends, usually about 2 to ifx in length and about half as broad as they are long. They are stained by Gram's method and readily by most of the aniline dyes, are ciliated, and do not liquefy gelatin. They flourish specially well alongside moulds, in the dark, in badly-ventilated, warm, moist places, and remain alive for some time in sea- water : these facts, as Sanarelli points out, afford an explanation of the special persistence of yellow fever in old, badly-ventilated ships, and in dark, dirty, and insanitary seacoast towns. Once the organism, whatever it may be, finds its way into the system, it soon makes its presence felt, and toxic symptoms are developed. The temperature rises ; the pulse, at first rapid, gradually slows down ; and after some time

persistent vomiting of bile comes on. At the end of three or four days the temperature and pulse fall, and there is a period during which the patient appears comparatively well ; this is followed in a few hours by icterus and scanty secretion of urine. There maybe actual anuria, or the small quantity of urine passed may be loaded with casts and albumen ; delirium, convulsions, and haemorrhages from all themucous surfaces may now set in, or secondary infections of various kinds, boils, abscesses, suppurations, and septicaemia, may

result. These often prove fatal when the patient appears to be almost convalescent from the original disease. As regards prognosis, it has been found that the ” lower the initial temperature the milder will the case be ” (Mac- pherson). An initial temperature of 106Â° P. is an ex- ceedingly unfavourable sign. Patients addicted to the use of alcohol are, as a rule, much more severely affected than are others. The treatment is principally directed towards prevention and towards the alleviation of symp- toms, though Sanarelli has hopes that an “anti “-serum may be useful. More recently Flexner, working with the American Commission, has isolated another organism, which, he maintains, is the pathogenetic agent in the production of yellow fever; whilst Durham and Myers maintain that a small bacillus previously observed by Sternberg and others is the true cause of this disease.

WeiVs disease, a disease which may be considered along with acute yellow atrophy and yellow fever, is one in which there is an acute febrile condition, associated with jaundice, inflammation of the kidney, and enlargement of the spleen. It appears to be a toxic condition of a less acute character, however, than the other two, in which the functions and structure of the liver and kidney are spe- cially interfered with. There is a marked affection of the gastro- intestinal system, and the nervous system is also in some cases profoundly involved. Haemorrhage into the mucous and serous membranes is a marked

feature. The liver cells and kidney epi- thelium undergo fatty changes, though in the earlier stages there is a cloudy swelling, probably also toxic in its origin. Certain organisms of the Proteus group, which appear to have the power in certain circumstances of forming toxic substances in larger quantities than can be readily destroyed by the liver, and which then make their appearance in the kidney and spleen, are supposed to be the cause of this condition.

Diphtheria. â€” In regard to no disease has medical opin- ion undergone greater modification than it has in respect of diphtheria. Accurately applied, bacteriology has here gained one of its greatest triumphs. Not only have the aetiology and diagnosis of this disease been made clear, but knowledge acquired in connexion with the production of the disease has been applied to a most successful method of its treatment. In 1875, Klebs described a small bacillus with rounded ends, and with here and there small clear unstained spaces in its substance. He, however, also described streptococci as present in certain cases of diphtheria, and concluded that there must be two kinds of diphtheria, one associated with each of these organisms. In 1883 he again took up the question; and in the following year Loefder gave a systematic description of what is now known as the Klebs-Loeffler bacillus, which was afterwards proved by Roux and Yersin and many other observers to be the causa causans of diphtheria. This bacillus is a slightly-curved rod with rounded, pointed, or club-shaped end or ends (Fig. 9, Plate VIII.'). It is usually from 1-2 to 6/* or more in length and from 0-3 to O-Sfn, in breadth; rarely it may be considerably larger in both dimensions. It is non-motile, and may ex- hibit great variety of form, according to the age of the culture and the nature of the medium upon which it is growing. It is stained by Gram's method if the decolor- izing process be not too prolonged, and also by Loeffler's methylene-blue method. Except in the very young forms, it is readily recognizable by a series of transverse alter- nate stained and unstained bands. The bacillus may be wedge-shaped, spindle-shaped, comma-shaped, or ovoid. In the shorter forms the polar staining is usually well marked; in the longer bacilli, the transverse striation. Very characteristic club-shaped forms or branching fila- ments are met with in old cultures, or where there is a superabundance of nutritive material. In what may be

called the handle of the club the banded appearance is specially well marked. These specific bacilli are found in large numbers on the surface of the diphtheritic membrane (Fig. 10, Plate VIII.^), and may easily be detached for

bacteriological examination. In certain cases they may* be found by direct microscopic examination, especially when they are stained by Gram's method, but it is far more easy to demonstrate their presence by the culture method. On Loefiler's special medium the bacilli flourish so well at body-temperature â€" about 37Â° C. â€" that, like the cholera bacillus, they outgrow the other organisms present, and may be obtained in comparatively pure culture. Distinct colonies may often be found as early as the eighth or twelfth hour of incubation; in from eighteen to twenty-four hours they appear as rounded, elevated, moderately translucent, greyish white colonies, with a yellow tinge, the surface moist, and the margins slightly irregular or scalloped. They are thicker and somewhat more opaque in the centre. When the colonies are few and widely separated, each may grow to a con- siderable size, 4 to 5 mm. ; but when more numerous and closer together, they remain small and almost invariably discrete, with distinct intervals between them. In older growths the central opacity becomes more marked and the crenation more distinct, the moist, shiny appearance being lost. When the surface of the serum is dry, the growth, as a rule, does not attain any very large size.

These " pure " colonies, when sown in slightly alkaline broth, grow with great vigour; and if a small amount of such a forty-eight hours' culture be injected under the skin of a guinearpig, the animal succumbs, with a marked local reaction and distinct symptoms of toxic poisoning very similarto those met with incases of diphtheria of the human subject. Roux and Yersin demonstrated that the poison was not contained in the bodies of the bacilli, but that it was formed and thrown out by them from and into the nutrient medium. Moreover, they could produce all the toxic symptoms, the local reactions, and even the paralysis which often, follows the disease in the human subject, by injecting the culture from which they had previously removed the whole of the diphtheria bacilli by filtration. This cultivation,

then,contains a poisonous material,which, incapable of multiplying in the tissues, may be given in carefully graduated doses. If, therefore, there is any- thing in the theory that tissues may be gradually ” acclimatized ” to the poisons of these toxic substances, they saw that it should be possible to prove it in con- nexion with this disease. Behring, going still farther, found that the tissues so acclimatized have the power of producing a substance capable of neutralizing the toxin, a substance which, at first confined to the cells, when formed in large quantities overflows into the fluids of the blood.

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1 REFERENCES TO PLATE VIII. Parasitic Diseases.

-Streptococcus pyogenes, red blood corpuscles and pus cells In the pus from a case of empyaema. X 1000 diams.

-Cholera spirillum, from eight days' agar culture, showing many involution forms. Flagella well stained. X 1000.

~~Bacillus typhi abdominalis (typhoid bacillus), with well~~ stained flagella. Young agar cultivation. xlOOO.

-Group of typhoid bacilli, in a section of spleen. x 1000.

-Preparation from young cultivation of Bacillus pestis (plague bacillus). Flagella well stained. xlOOO.

-Bacillus diphtheria;, from tweuty-four hours' culture. X 1000.

~~Free edge of false membrane from case of diphtheria con~~ taining numerous diphtheria bacilli. XlOOO.

-Bacillus tetani with well-stained flagella. Twenty-four hours' culture. X 1000.

-Scraping from a wound in a case of tetanus, showing several spore-bearing and a few non-spore-bearing tetanus bacilli. XlOOO.

-Bacillus tuberculosis. Bacilli in a giant-cell in the human liver in a case of acute tuberculosis. XlOOO.

-Bacillus leprse. Bacilli in endothelial cells of splenic tissue. XlOOO.

~~AmcEbEB in wall of dysenteric abscess of liver, from a speci~~ men kindly lent by Professor Greenfield. x 1000.

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with which it is distributed throughout the body. The bulk of this toxin-neutralizing substance remains in the blood-serum after separation of the clot. In proof of this he showed that (1) if this serum be injected into an ani- mal before it is inoculated with even more than a lethal dose of the diphtheria bacillus or its products, the animal remains perfectly well; (2) a certain quantity of this serum, mixed with diphtheria toxin and injected into a guinea-pig, gives rise to no ill effects ; and (3) that even when injected some hours after the bacillus or its toxins, the serum is still capable of neutralizing the action of these substances. In these experiments we have the germ of the present antitoxic treatment which has so materi- ally diminished the percentage mortality in diphtheria. This serum may also be used as a prophylactic agent.

The antitoxic serum as now used is prepared by injecting into the subcutaneous tissues of a hoi'se the products of the diphtheria bacillus. The bacillus, grown in broth containing peptone and blood-serum or blood plasma, is filtered and heated to a tempera- ture of 68Â° or 70Â° C. for one hour. It then contains only a small amount of active toxin, but it renders the horse highly insuscep- tible to the action 'of strong diphtheria toxins, and even induces the production of a considerable amount of antitoxin. This pro- duction of antitoxin, however, may be accelerated by repeated and increasing injections of strong diphtheria toxin, which may be so powerful that J to | of a drop, or even less, is a fatal dose for a medium-sized guinea-pig. The antitoxic serum so prepared may contain 200, 400, 600, or even more " units " of antitoxin per c.c. â€" the unit being that quantity of antitoxin that will so far neutralize 100 lethal doses (a lethal dose is the smallest quantity that will kill a 250-gramme guinea-pig on the fifth day) of toxinfora250-gramme guinea-pig, that the animal continues alive on the fifth day from the injection. This, however, is a purely arbitrary standard of neutralizing power, as it is found that, owing to the complicated structure of the toxin, the neutralizing and the lethal powers do not always go hand in hand ; but as the toxin used in testing the antitoxin is always compared with the original standard, accurate results are easily obtained.

Diphtheria, though still prevalent in cities, has now lost many of its terrors. In large hospitals the death- rate has fallen from nearly 40 per cent, to under 14 per cent. ; and if antitoxin could be given as soon as the dis- ease manifests itself, the mortality ^ight be brought down to a very insignificant figure. It has been maintained that as soon as antitoxin came into use the number of cases of paralysis increased rather than diminished. This may be readily understood when it is borne in mind that many patients recover under the use of antitoxin who would undoubtedly have succumbed in the pre-anti- toxin days ; and it cannot be too strongly insisted, that although the antitoxin introduced neutralizes the free toxin and prevents its further action on the tissues, it cannot entirely neutralize that which is already acting on the cells, nor can it make good damage already done before it is injected. Even allowing that antitoxin is not accountable for the whole of the improvement in the percentage mortality statistics since 1896 or so, it has undoubtedly accounted for a very large proportion of re- coveries. Antitoxin often cuts short functional albumin- uria, but it cannot repair damage already done to the renal epithelium before the antitoxin was given. The clinical evidence of the value of antitoxin in the relief that it affords to the patient is even greater than that derived from the consideration of statistics.

The diphtheria bacillus or its poison acts locally as a caustic and irritant, and generally or constitutionally as a protoplasmic poison, the most evident lesions produced by it being degeneration of nerves and muscles, and in acute cases changes in the walls of the blood-vessels. Other organisms, streptococci or staphylococci, when present, may undoubtedly increase the mortality by pro- ducing secondary complications, which end in suppura- tion. Diphtheria bacilli may also be found in pus, as in the discharges from cases of otorrhoea.

Tetanus (Lockjaw). â€” Although tetanus was one of the last of the diseases to which a definite micro-organismal origin could be assigned, it has long been looked upon as a disease typical of the “septic” group. Nicolaier described in 1885 an organism multiplying outside the body and capable of setting up tetanus, bat this was only obtained in pure culture by Kitasato, a Japanese, a,nd by the Italians in 1889. It has a

very characteristic series of appearances at different stages of its development. It grows first of all as long, very slender threads, which rapidly break up into shorter sections from 4 to 5 /t in length (Fig. 12, Plate VIII.). In these shorter rods spores may appear on the second or up to the seventh day, according to the temperature at which the growth goes on. The rods then assume a very characteristic pin or drumstick form ; they are non-motile, are somewhat rounded at the ends, and at one end the spore, which is of considerably greater diameter than the rod, causes a very considerable expansion. Before sporulation the organisms are distinctly motile, occurring in rods of different lengths, in most cases surrounded by bundles of beautiful flagella, which at a later stage are thrown off, the presence of flagella corresponding very closely with the "motile" period (Fig. 11, Plate VIII.). The bacillus grows best at the temperature of the body ; it becomes inactive at 14Â° C. at the one extreme, and at from 42Â° to 43Â° C. at the other ; in the latter case involution forms, clubs and branching and degenerated forms, often make their appearance. It is killed by exposure for an hour to a temperature of from 60Â° to 65Â° C. ; but the spores are very resistent to the action of heat, as they withstand the temperature of boil- ing water for several minutes. The organism has been found in garden earth, in the excrement of animals â€" especially horses â€" and in dust taken from the streets or from living-rooms, especially when it has been allowed to remain at rest for a considerable period. It has also been demonstrated in, and separated from, the pus of wounds (Fig. 12, Plate VIII.) in patients suffering from lockjaw, though it is then invariably found associated with the micro-organisms that give rise to suppuration.

It is important to remember that this bacillus is a strict anaerobe, and can only grow when free oxygen has been removed from the cultivation medium. It may be cultivated in gelatin to which has been added from 2 to 3 per cent, of grape sugar, when, along the line of the stab culture, it forms a delicate growth, almost like a fir-tree, the tip of which never comes quite to the surface of the gelatin. The most luxuriant growth â€" evidenced by the longest branches â€" occurs in the depth of the gelatin away from free oxygen. After a time the gelatin becomes sticky, and then under- goes slow liquefaction, the growth sinking and leaving

the upper layers comparatively clear. This organism is not an obligate, but a facultative, parasite ; it may grow outside the body and remain, alive for long periods.

Lockjaw is most common amongst agricultural labourers, gardeners, soldiers on campaign, in those who go about with bare feet, or who, like young children, are liable to get their knees or hands accidentally wounded by contact with the ground. Anything which devitalizes the tissues â€” such as cold, bruising, malnutrition, the action of other organisms and their products â€” may all be predisposing factors, in so far as they place the tissue at a disadvantage and allow of the full development of the specific bacillus of tetanus. In order to produce the disease, it is not sufficient merely to inoculate tetanus bacilli, especially where resistent animals are concerned: they must be injected along with some of their toxins or with other organisms, the presence of which seems to increase the power of, or assist, the tetanus organism, by diverting the activity of the cells and so allowing the bacillus to develop. The poison formed by this organism resembles the enzymes and diphtheria poison, in that it is destroyed at a temperature of 65Â° C. in about five minutes, and

even at the temperature of the body soon loses its strength, although, when kept on ice and protected from the action of light, it retains its special properties for months. Though slowly formed, it is tremendously potent, ^ g ^(, (, D part of a drop (the five-millionth part of a c.c.) of the broth in which an active culture has been allowed to grow for three weeks or a month, being sufficient to kill a mouse in twenty-four hours, ^^ of a drop killing a rabbit, -^Jj a dog, or Jj of a drop a fowl or a pigeon ; it is from 100 to 400 times as active as strychnine, and 400 times as poisonous as atropine. It has been observed that, quite apart from size, animals exhibit a varying degree of susceptibility. Frogs kept at their ordinary temperature are exceedingly insusceptible, but when they are kept warm it is possible to tetanize them, though only after a somewhat prolonged incubation period, such as is met with in very chronic cases of tetanus in the human subject. In experimentally-produced tetanus the spasms usually commence and are most pronounced in the muscles near the site of inoculation. It was at one time supposed that this was because the poison acted directly upon the nerve terminations, or possibly upon the muscles; but as it is now known that it acts directly on the cells of the central nervous system, it may, as in the case of rabies, find its way along the lymphatic channels of the nerves to those points of the central nervoussystem with which these nerves are directly connected,spasms occurring in the course of the muscular distribution of the nerves that receive their impulses from the cells of that area. As the amount of toxin introduced may be contained in a very small quantity of fluid and still be very dilute, the local reaction of the connective-tissue cells may be exceedingly slight ; consequently a very small wound may allow of the introduction of a strong poisonous dose. Many of the cases of so-called idiopathic tetanus are only idiopathic because the wound is trifling in character, and, unless suppuration has taken place, has healed rapidly after the poison has been introduced. In tetanus, as in diphtheria, the organisms producing the poison, if found in the body at all, are developed only at the seat of inoculation; they do not make their way into the surrounding tissues. In this we have an explanation of the

fact that all the earlier experiments with the blood from tetanus patients gave absolutely negative results. It is sometimes stated that the production of tetanus toxin in a wound soon ceases, owing to the arrest of the development of the bacillus, even in cases that ultimately succumb to the disease. Roux and Vaillard, however, maintain that no case of tetanus can be treated with any prospect of success, unless the focus into which the bacilli have been introduced is freely removed. The antitetanic serum was the first antitoxic serum produced. It is found, however, that though the antitetanic serum is capable of acting as a prophylactic, and of preventing the appearance of tetanic symptoms in animals that are afterwards, or simultaneously, injected with tetanus toxin, it does not give very satisfactory results when it is injected after tetanic symptoms have made their appearance. It would appear that in such eases the' tetanus poison has become too firmly bound up with the protoplasm of the nerve cells, and has already done a considerable amount of damage.

(b) More Chronic Infective Diseases (tissue parasites).

Tiiberculo.v's. â€" In no quarter of the field of preventive medicine have more important results accrued from the discovery of a specific infective organism than in the case of Koch's demonstration and separation in pure culture of the tubercle bacillus and the association of this bacillus with the transmission of tuberculosis. In connexion with

diagnosis â€" both directly from observation of the organism in the sputum and urine of tuberculous patients, and in- directly through the tuberculin test, especially on animals â€" this discovery, has been of very great importance ; and through a study of the life-history of the bacillus and its relation to animal tissues much has been learned as to the prevention of tuberculosis, and something even as to methods of treatment. One of the great difficulties met with in the earlier periods of study of this organ- ism was its slow, though persistent, growth. At first cultivations in fluid media were not kept sufficiently long under observation to allow of its growth ; it was exceedingly difficult to obtain pure cultures, and then to keep them, and in impure cultures the tubercle bacilli were rapidly overgrown. Taken directly from the body,

they do not grow on most of the ordinary media, and it was only when Koch used solidified blood-serum that he obtained pure cultures. Though they may now be demonstrated by what appear to be very simple methods, before these methods were devised it was practically impossible to obtain any satisfactory results.

The principle involved in the staining of the tubercle bacillus is that when once it has taken up fuchsin, or gentian violet, it retains the stain much more firmly than do most organisms and tissues, so that if a specimen be thoroughly stained with fuchsin and then decolorized in a mineral acid â€" 25 per cent, of sulphuric acid, say â€" although the colour is washed out of the tissues and most other organisms, the tubercle bacilli retain it ; and even after the section has been stained with methylene-blue, to bring the other tissues andorganisms into view, these bacilli still remain bright red, and stand out prominently on a blue background. If a small fragment of tuberculous tissue be pounded in a sterile mortar and smeared over the sur- face of inspissated blood-serum solidified at a comparatively low temperature, and if evaporation be prevented, dry scaly growths make their appearance at the end of some fourteen days. If these be reinoculated through several generations, they ultimately assume a more saprophytic character, and will grow in broth containing 5 per cent, of glycerin, or on a peptone beef-agar to which a similar quantity of glycerin has been added. On these media the tubercle bacillus grows more luxuriantly, though after a time its virulence appears to be diminished. On blood- serum, its virulence is preserved for long periods if success- ive cultivations are made. It occurs in the tissues or in cultivations as a delicate rod or thread 1-5 to 3-5fjL in length and about 0-2 to 0-5/^ in thickness (Fig. 16, Plate VIII.). It is usually slightly curved, and two rods may be arranged end to end at an open angle. There is some doubt as to whether tubercle bacilli contain spores, but little masses of deeply-stained protoplasm can be seen, alternating with clear spaces within the sheath ; these clear spaces have been held to be spores. This organism is found in the lungs and sputum in various forms of consumption, in tubercular ulcers of the intestine, in the lymph spaces around the vessels in tubercular meningitis, m tubercular nodules in all parts of the body, and m tubercular disease of the skinâ€" lupus. It is found also

m the tubercular lesions of animals; in the throat- glands, tonsils, spleen, and bones of the pig; in the spleen of the horse; and in the lungs and plura of the cow. Tuberculosis may be produced artificially by injecting the tubercle bacillus into animals, some being much more susceptible than others. Milk drawn from an udder in which there are breaking-down tuberc^ular foci, mav con- tain an enormous number of active tubercle bacilli'; and pigs fed upon this, milk develop a typical tuberculosis, which can be traced from point to point, commencing in the glands of the throat, with the utmost precision It

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must be assumed that what takes place in the pig may also take place in the hunfau subject ; and a sufficient number of cases are now on record to show that the swallowing of tuberculous material is a cause of tuber- culosis, especially amongst children and adolescents. Inhaled tubercle bacilli from the recently-dried sputum of phthisical patients, like milk derived from tubercu- lous udders, may set up tuberculosis of the lungs or of the alimentary tract, especially when the epithelial layer is unhealthy or imperfect. The two main causes of the prevalence of tuberculosis in the human subject are :

(1) tubercle bacilli may become so modified that they can flourish saprophytically ; as yet it has not been possible to trace the exact conditions imder which they live, but we are gradually coming to recognize that although when they come from the body they are almost obligate para- sites, they may gradually acquire saprophytic characters.

(2) Many of the domestic animals are readily infected with tuberculosis, and in turn may become additional centres from which infection may radiate.

Although Koch's tuberculin, from which at one time so much was expected therapeutically, has not entirely fulfilled its promise, it is of greatiuse in early diagnosis, and therefore should prove invaluable in the eradication of tuberculosis.

Tuberculin, from which the tuberculin test derives its name, consists of the products of the tubercle bacillus when grown for a month or six weeks in peptone meat-broth to which a small pro- portion, say 5 or 6 per cent., of glycerin has been added. The tubercle bacilli are then killed at boiling temperature, and are partially removed by sedimentation, and completely by filtration through a Berkfeld or Pasteur-Chamberland filter. If a large dose of this filtered fluid be injected under the skin of a healthy man or brute, it is possible to produce some local swelling and to induce a rise of temperature ; but in a similar patient suffering from tuber- culosis a very much smaller dose (one which does not affect the healthy individual in the slightest degree) is suffi.cient to bring about the characteristic swelling and rise of temperature. To obtain trust- worthy results the dosage must always be carefully attended to. The reaction is only obtained under certain well-defined conditions. Driven animals seldom, if ever, react properly. Cattle to be tested should be allowed to remain at rest for some time ; they should be well fed, and be carefully protected from cold or draughts. After an injection of tuberculin into the subcutaneous tissues (usually in \ v^y front of the shoulder or on the chest-wall) they should be kept under the same conditions and should be watered very carefully ; the temperature should be taken at the sixth hour, and every three hours aiterwards up to the twenty-first or even twenty-fourth hour. If daring this time the temperature rises to 104Â° P., there can be little doubt .that the animal is tuberculous ; but if it remains under 103Â°, the aijimal must be considered free from disease.: if the temperature remains between these points, the case is a doubtful one, and, according to Principal M'Fadyean, should be retested at the end of a month. It is interesting to note that the test is not trustworthy in the case of animals in which tuberculosis is far advanced, especially when the temperature is already high â€" 103Â° F. In such cases, however, it is an easy matter to diagnose the disease by the ordinary clinical methods. At first objections were raised to this test on two grounds: (1) that mistakes in diagnosis are sometimes made ; (2) that tuberculin may affect the milk of healthy animals into which it is injected. As the methods of using the tuberculin have been perfected, and as the conditions under which the reaction is obtained have become better known, mistakes have rapidly become fewer ; further, it has

been amply proved that tuberculin has not the slightest deteriorating effect on the quality of the milk.

Leprosy. â€” Armauer Hansen in 1871, and Xeisser in 1881, described a " leprosy bacillus " corresponding in size and in certain points of staining reaction to the tubercle bacillus, and it is now generally accepted that this bacillus is the direct and specific causal agent of leprosy. The discovery of this organism paved the way for the proof that the tubercular and anaesthetic forms of leprosy are essentially the same disease, or rather are the manifestations, of the action of a common organism attacking different series of tissues.

To demonstrate the presence of the leprosj' bacillus,

tie an indiarubber ring firmly around the base of one of the leprosy tubercles. As soon as the blood is driven out, leaving the nodule pale, make a puncture with the point of a sharp knife. From this puncture a clear fluid exudes ; this, dried on a cover-glass, stained with carbol-fuchsin, and rapidly decolorized with a weak mineral acid, shows bacilli stained red and very like tubercle bacilli; they differ from that organism, however, in that they are somewhat shorter, and that if the acid be too strong, or be allowed to act on them for too long a time, the colour is discharged from them much more readily. These organisms, which are from 4 to 6/a in length and 0-3/A in breadth, are as al^ule more rigid and more pointed than are the tubercle bacilli (Fig. 16, Plate VIII.). It is doubtful whether they form spores. They are found in large numbers lying embedded, in a kind of gelatinous substance in the lymphatics of the skin, in certain cells of which they appear to be taken up.

It is curious that these bacilli affect specially the skin and nerves, and rarely the lungs and serous membranes, thus being in sharp contrast to the tubercle bacillus, which affects the latter very frequently and the former rarely. They are seldom found in the blood, though they have been described as occurring there in the later stages of the disease. It is stated that leprosy has been inoculated directly into the human subject, the patient dying some five or six years after the inoculation had been made ; but up to the present no pure culture of the leprosy bacillus has

been obtained ; it has therefore been impossible to produce the disease by the inocula- tion of the bacillus only. What evidence we have at our disposal, however, is all in favour of the transmissi- bility of the disease from patient to patient and through the agency of the leprosy bacillus. None of the numer- ous non-bacillary theories of leprosy account at all satis- factorily for this transmissibility of the disease, for its progressive nature, and for the peculiar series of histo- logical changes that are met with in various parts and organs of the leprous body. Leprosy occurs in all cli- mates. It is found where no fi^h diet can be obtained, and where pork and rice are never used, though to these substances has been assigned the power of giving rise to the disease. Locality appears to influence it but little, and with improved sanitation and increased cleanliness it is being gradually eradicated. The only factor that is common in all forms of leprosy, and is met with in every case, is the specific bacillus ; and in spite of the fact that it has yet been found impossible to trace the method of transmission, we must, from what is known of the pres- ence and action of baciUi in other diseases, especially in tuberculosis, assign to the leprosy bacillus the r61e of leprosy-producer, until much stronger evidence than has yet been obtained can be brought forward in favour of any of the other numerous causes that have been assigned. Two cases are recorded in which people have con- tracted leprosy from pricking their fingers with needles whilst sewing a leper's clothes ; and a man who had never been out of Dublin is said to have contracted the disease by sleeping with his brother, a soldier who had returned from India suffering from leprosy.

Glanders. â€" Farcy iu the human subject resembles the same disease experimentally produced in animals with material from a glandered animal, and as there is no pathological distinction between the two, from the aetio- logical standpoint, they may be considered together. If the pus from a glanders abscess be mixed with a little sterile saline solution and spread over the cut surface of a boiled potato kept at the body-temperature, bright yellow or honey-coloured, thick, moist-looking colonies grow very rapidly and luxuriantly. These colonies gradually become darker in colour, until they assume a cafi-aw-lait, or even a

chocolate, tint. On examining one of them microscopic- ally, it is found to be made up of bacilli 2 to 5 /jl long and ^ to “I of their own length broad (Figs. 13 and 14, Plate VII.). The bacillus is usually straight or slightly curved and rounded at one end ; it appears to be non- motile. As first pointed out by Loeffler and Schiitz, when a portion of a culture is inoculated subcutaneously, typical farcy, with the acute septicaemia or blood-poisoning so characteristic of certain cases of glanders and farcy, is the result. The human subject is usually inoculated through wounds or scratches, or through the application of the nasal’ discharge of a glandered animal to the mucous membrane of the nose or mouth. Man is not specially susceptible to the glanders virus ; cattle never take it in the usual way, and even when inoculated exhibit nothing more than localized ulceration. The goat appears to occupy an intermediate position between cattle and the horse in this respect; in sheep, which are fairly sus- ceptible, the disease runs its course slowly, and appears to resemble chronic farcy in man. In rabbits and the dog the disease runs a very ‘slow and modiiied course. Although field-mice are extraordinarily susceptible, white mice and house mice, unless previously fed on sugar or with phloridzin, are unaffected. The pigeon is the only bird in which glanders has been produced. Lions and tigers are said to contract the disease, and to take it in a very severe and rapidly fatal form. The glanders ‘ organism rapidly loses its virulence and even its vitality. Dry, it dies in about ten days; placed in distilled water, in about five days ; but kept moist, or when grown on culture media, it retains its vitality for about a month, although its activity soon becomes con- siderably lessened. These bacilli are readily killed at a temperature of 55Â° C. ; they can pass through the kidneys even when there is no lesion to be made out either with the naked eye or under the microscope (Sherrington and Bonome).

The glanders bacillus grows best in the presence of oxygen, but it may grow anaerobically ; it then appears to have the power of forming

toxin, either more in quantity or of greater activity than when it has access to a free supply of oxygen. This poison (mallein) is used for the purpose of diagnosing the presence of glanders. A culti- vation is made in peptonized bouillon to which a small portion of glycerine has been added. This is allowed to grow at the temperature of the body for a month or six weeks ; the bacilli are killed by heat, and 0-5 per cent, carbolic acid is added. The cultivation is then filtered through a porcelain filter in order to remove the bodies of the bacilli, and the resulting fluid, clear and amber- coloured, should have the power, when injected in quanti- ties of 1 c.c, of giving the glanders reaction in an animal suffering from that disease; in a healtlay animal 6 c.c. should give no reaction. The suspected animal should be kept at rest and in a warm stable for twenty ~~four to forty~~ eight hours before the test is applied. The temperature should be normal, as no proper reaction is obtained in an animal in which the temperature is high. This reaction, which is a very definite one, consists in a rise of tempera- ture of from 2Â° to 4Â° F., and the appearance of a swelling, of from 3 to 4 inches in diameter and from 1 to 1^ inches in height, before the sixteenth or eighteenth hour; this swelling should continue to increase for some hours. It has been suggested that the injection of -^ to y'^ c.c. of mallein, at intervals of two or three days, may be used with advantage in the treatment of glanders. Glandered horses seem to improve under this treatment, and certainly do not react even to much larger doses of mallein. The mallein test has revealed the fact that glanders is a far more common and more widespread disease than was at one time supposed.

(c) Infective Diseases in which Organisms have not yet been discovered.

Hydrophobia is usually contracted by man through inoculation of an abraded surface with the saliva of an animal affected with rabies â€" through the bite of a dog, the animal in which the so-called rabies of the streets occurs. The other animals that may be affected "natur- ally" are wolves, cats, foxes, horses, cows, and deer; but all warm-blooded animals may be inoculated with the disease. The principal changes are in the nervous system, and include distension of perivascular lymphatic sheaths ; dilatation of blood-vessels and haemorrhages, especially in the

floor of the fourth ventricle of the brain, and in the varioiis mucous and serous membranes; hyaline changes in and around the walls of blood-vessels; pro- liferation of the endothelium; swelling and vacuolation of nerve cells; pericellular infiltration with leucocytes, and also infiltration of the salivary glands with leucocytes (Coates). An increased number of leucocytes and mi- crocytes in the blood has also been made out. As yet the definite form of the virus is unknown, but, whatever it may be, it has a power of multiplying in the tissues and of producing a toxic .substance which, as in the case of tetanus toxin, appears to act specially on the central nervous system. At present two organisms are being studied in connexion with this disease â€" one a yeast de- scribed by Dr G. Memmo, the other an organism some- thing like Fraenkel's diplococcus, by Bruschettini â€" but neither of them has as yet been satisfactorily worked out. The nature of the disease produced by the inoculation of saliva from a rabid animal appears to depend upon (1) the quantity of the rabic virus introduced ; (2) the point of its introduction ; (3) the activity of the virus. Thus by diluting the poison with distilled water or saline solution and injecting small quantities, the period of incubation may be prolonged. Slight wounds of the skin, of the limbs, and of the back are followed by a long incubation period; but when the inoculation takes place in the tips of the fingers or in the skin of the face, where nerves are numerous, and especially where the wound is lacer- ated or deep, the incubation period is much shorter and the attack usually more severe. This, as in tetanus, is accounted for by the fact that the lymphatics of the nerves are much more directly continuous with the cen- tral nervous system than are any other set of lymphatics. The poison appears to act directly upon the cells of the central nervous system.

Arising out of recent researches on hydrophobia, two methods of treatment â€" one of which, at any rate, has been attended by conspicuous success â€" have been put into practice. The first of these, Pasteur's, is based upon the fact that rabic virus may be intensified or attenuated at will. Pasteur found that although the virus taken from the cerebrospinal fluid of the dog always produces death in the same period when inoculated into the same animal, virus taken from other animals has not the same activity. If passed through a succession of

monkeys it may become so attenuated that it is no longer lethal. If either the “monkey virus,” which is not fatal to the rabbit, or the ” dog virus,” which kills in twelve to fourteen days, be passed through a series of rabbits, the virulence may be so exalted that it may kill in about six days, though its activity cannot be increased beyond this point by any means at present at our disposal. This intensified virus was therefore named by Pasteur the virus fixe, and it forms a standard from which to work. He” found, too, that under certain conditions of temperature the virus may be readily attenuated, one hour at 60Â° C. or half an hour at 60Â° completely destroying it. A 5 per cent, solution of carbolic acid acting for half an hour, or a 1 per 1000 solution of bichloride of mercury or acetic acid

PARASITIC diseases]

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or permanganate of potash, brings about the same result as do also exposure to air and sunlight. The poison contained in the spiaal cords of rabbits exposed to dry air and not allowed to undergo putrefactive changes, gradually loses its activity, and at the end of fourteen to fifteen days is incapable of setting up rabid symptoms. A series of cords from rabbits inoculated with the virus fixe are cut into short segments, which, held in series by the dura mater, are suspended in sterile glass flasks plugged with cotton-wool and containing a quantity of potassium hydrate â€” a powerful absorbent of water. At the end of twenty-four hours the activity of the virus is found to have fallen but slightly; at the end of forty- eight hours there is a still further falling off, until on the fourteenth or fifteenth day the virus is no longer lethal. With material so obtained Pasteur treated patients who had been bitten by mad dogs. On the first day of treatment small quantities of an emulsion of the cord exposed for thirteen or fourteen days in saline solution are injected subcutaneously, and the treatment is continued for from fifteen to twenty-one days, accord- ing to the severity of the bite, a stronger emulsion â€” i.e. an emulsion made of a cord that has been desiccated for a shorter period â€” being used for each succeeding in- jection,

until at last the patient is injected with an emulsion which has been exposed to the air for only three days. In the human subject the period of incu- bation of the disease is comparatively prolonged, owing to the insusceptibility of the tissues to the action of this poison ; there is therefore some chance of obtaining a complete protection or acclimatization of the tissues before the incubation period is completed. The virus introduced at the bite has then no more chance of affecting the nerve centres than has the strong virus injected in the late stages of the protective inoculation : the nerve cen- tres, having become gradually acclimatized to the poisons of the rabic virus, are able to carry on their proper functions in its presence, until in time, as in the case of microbial pdisons, the virus is gradually neutralized and eliminated from the body. Various modifications and improvements of this method have from time to time been devised, but all are based on, and are merely exten- sions of, Pasteur's original work and method. As soon as it was found that antitoxins were formed in the tissues in the case of an attack of tetanus, attention was drawn to the necessity of determining whether something similar might not be done in the production of an antirabic serum for the treatment of rabies. Babes and Lepp, and then Tizzoni and his colleagues Schwarz and Centanni, starting from vims fixe, obtained a series of weaker inocu- lating materials by submitting it for different periods to the action of gastric juice. Beginning with a weak virus so prepared, and from time to time injecting successively stronger emulsions (seventeen injections in twenty days) into a sheep, they succeeded in obtaining a serum of such antirabic power that if injected in the proportion of 1 to 25,000 of body-weight, an animal is protected against a lethal dose of virus fixe. The activity of this serum is still further reinforced if a fresh series of injections is made at intervals varying from two to five months, according to the condition of the animal, each series occupying twelve days. This antirabic substance stored in the blood has not only the power of anticipating (neutralizing ?) the action of the poison, but also of acting as a direct curative agent ; as a prophylactic agent, readily kept in stock and easily and rapidly exhibited, it possesses very great advan- tages. It must be borne in mind that the longer the period after the inoculation, the greater must be the amount of serum used to obtain^ a successful result.

There can be little doubt that hydrophobia is a specific disease due to a multiplication of virus in the nervous

system, in the elements of which it is ultimately fixed ; that it passes from the wound to the central nervous system by the lymphatics ; and that, as in tetanus, the muscular spasms are the result of the action of some special poison on the central nervous system.

Small-pox^ â€" There have been few recent additions to our knowledge of the aetiology of small-pox, though Dr Monckton Copeman now holds that the small-pox organ- ism, like that of vaccine, is probably a very minute bacillus, which, from its behaviour in the presence of glycerin, is possessed of the power of forming spores. If vaccine lymph, taken from the calf, be protected from all extraneous spore-bearing organisms and treated with 50 per cent, solution of glycerin, it in time becomes absolutely sterile as regards ordinary non-spore-bearing organisms. Even the staphylococci and streptococci, usually found in calf lymph, cannot withstand the pro- longed action of this substance, but spore-bearing organ- isms still remain alive and active. Moreover, the lymph still retains its power of producing vaccine vesicles, so that the vaccine organism, in its powers of resistance, resem- bles the spore-bearing, and not the non-spore-bearing, organisms with which we are acquainted. This vaccine organism is very minute; it is stated that it can be cultivated only on special media, though it multiplies freely in the superficial cutaneous tissues of the calf, the monkey, and the human subject. Perhaps the most im- portant outcome of Dr Copeman's work on this subject is that he has obtained a vaccine lymph from which are eliminated all streptococci and staphylococci, and, if the lymph be taken with reasonable care, any other organisms which could possibly give rise to untoward results.

Typhus Fever. â€" Up to the present time, although it is fully recognized that typhus must be one of the specific infective fevers brought about by the action of a special micro-organism, no definite information as to the bacterial aetiology of this condition has been obtained. It is always looked upon as a " filth " disease ; and from the frequency of minute haemorrhages, and from the resemblance to the

haemorrhagic septicaemias in other respects, it appears probable that the bacillus of typhus is the organism described by Mott in 1883 as an actively motile dumb-bell coccus, and ten years later by Dubieff and Bruhl as the diplococcus typhosus exanthematicus ; the polar staining and general resemblance to the diplococcus of fowl cholera, the plague bacillus, the diplococcus of ” Wildseuche,” certain forms of swine fever and hog cholera, and others of the haemorrhagic septicaemias, are sufl&cient to suggest the generic aflSnity of this organism to this septicaemic group. We have as yet, however, no absolute proof of the aetiological relation of the bacillus to this disease, such as has been obtained in connection with other diseases, and it is impossible to add anything beyond this to the article contributed by Dr Affleck to the ninth edition.

Scarlet Fever. â€” In scarlet fever recent observations have been comparatively few and unimportant. Crooke, and later Klein, and others have, however, shown that in the glands and throats of scarlet fever patients a streptococcus, to which is assigned the chief aetiological role in connexion with this disease, is present. On the other hand, it is maintained by many observers that these streptococci are nothing more than the streptococci found in puerperal fever, erysipelas, and similar infective conditions, and certainly the organisms described closely resemble strep- tococcus pyogenes.

Measles. â€” In measles, as in scarlet fever, micrococci have had ascribed to them the power of setting up the specific disease. Canon and Pielicke have, however, de- scribed minute bacilli somewhat resembling those described as occurring in vaccine lymph. These are found in the blood in the early stages of the disease, and also in the

profuse catarrhal secretions so characteristic of this condition. There are no records of the successful inocu- lation of this minute bacillus,

and until such evidence is forthcoming this organism must be looked upon as being an accessory, possibly, but not the prime cause, of measles.

Slumps. â€” It is generally accepted that mumps is pro- bably caused by a specific micro-organism, the infective material making its way in the first instance through the ducts to the parotid and other salivary glands. It appears to bring about a peculiar oedematous inflammation of the interstitial tissue of the glands, but slight paren- chymatous changes may also be observed. The virus is present in the tissues for some days before there is any manifestation of parotid swelling, but during this period it is extremely active, and the disease may be readily transmitted from patient to patient. The inf ectivity con- tinues for some time, probably for nearly a week after naked-eye manifestations of the diseased condition have disappeared. The specific organism has not yet been isolated.

Whooping-CoiigJi. â€” Within the last few years there has been little addition to our knowledge either of the aetiology, course, or treatment of whooping-cough, although a diplo- coccus, a streptococcus, and various higher fungi have in turn been put down as the cause of this disease. It must, from its resemblance to the other specific infective fevers, be considered as an infective disease of microbic origin, which goes through a regular period of incubation and invasion, and in which true nervous lesions, especially of the pneumogastric and superior laryngeal nerves, are somewhat common.

Affanassieff, and later Koplick, have described a minute bacillus, with rounded ends and bi-polar staining, which occurs in the mucus discharged at the end of a paroxysm of whooping-cough. Koplick examined sixteen cases, and found this organism in thirteen of them. There can be little doubt that the infective material is contained in the expectoration. It may remain active for a considerable period, but is then usually attached to solid particles. It is not readily carried by the breath, and multiplies specially in the mucous membranes, setting up inflam- mation, probably through its toxic products, which appear to be absorbed, and, as in the case of the tetanus poison, to travel specially

along the lymphatics of the local nerves. Affections of the lungs â€” bronchitis and broncho-pneumo- niaâ€”may be directly associated with the disease, but it is much more likely that these affections are the result of secondary infection of tissues already in a weakened condition.

II. To Higher Vegetable Parasites.

ArJinomycosis. â€” A disease very prevalent in certain low-lying districts, especially amongst cattle, giving rise to the condition know as ” sarcoma,” ” wooden tongue,” ” wens,” ” bony growths on the jaw,” &c. It is character- ized by the presence of a fungus, which, at first growing in the form of long slender threads that may be broken up into short rods and cocci, ultimately, as the result of a degenerative process, assumes the form of a ” ray-fungus,” in which a series of club-like rays are arranged around a common centre. It is probably a streptothrix â€” strepto- thrix Forsteri (Fig. 17, Plate VII.). Numerous cases have been observed in the human subject. Suppuration and the formation of fistulous openings, surrounded by exu- berant granulations, “proud flesh,” usually supervene, and in the pus discharged are found yellowish green or reddish brown points, each made up of a central irregular mycelium composed of short rods and spores, along with the clubs already described. The mycelial threads may reach a considerable length (20 to 100/x) ; some of them

become thicker, and are thus differentiated from the rest ; the peripheral club is the result of swelling of the sheath ; the filaments nearer the centre contain the spores, which measure from 1 to 2(U, in diameter. This f imgus appears to lead a saprophytic existence, but it has the power of living in the tissues of the animal body, to which it makes its way through or around carious or loose teeth, or through abrasions of the tongue or tonsils. After the above positions, the abdomen, especially near the vermiform appendix, is a special seat of election, or ia some cases the thorax, the lesions being traceable downwards ffom the neck. Any of the abdominal or thoracic organs may thus be affected. The process spreads somewhat slowly, but once started may extend in any direction, its track being marked by the formation of a large quantity of fibrous tissue, often around a long

fistula. In the more recent growths, and in solid organs, cavities of some size, containing a soft semi-purulent cheesy-looking material, may be found, this mass in some cases being surrounded by dense fibrous tissue. When once a sinus is formed the diagnosis is easy, but before this the disease, where tumours of considerable size are rapidly formed, may readily be mistaken for sarcoma, or, when the lungs are affected, for tuberculosis, especially as bronchitis and pleuritic effusion are frequently associated with both actinomycosis and tubercidosis.

Mycetoma, the Madura foot of India, is a disease very similar to actinomycosis, and, like that disease, is pro- duced by a somewhat characteristic streptothrix. It usually attacks the feet and legs, however, and appears to be the result of infection through injured tissues. Under certain conditions and in long-standing cases the fungus appears to become pigmented (black) and degen- erated.

Other forms of fungus disease or Mycoses are described. Aspergillosis, or pigeon-breeders' disease, is the result of the infection with the Aspergillus fumigatus. Certain tumours appear to be the result of the action of a yeast, Blastomycosis or Saccharomycosis. The spores of the Penicillium glaucum, and of some of the Mucors, are also said to have the power of setting up irritation, which may end in the formation of a so-called granuloma or granula- tion tissue tumour. These, however, are comparatively rare.

B. Diseases due to Animal Parasites.

I. To Protozoa.

Malaria. â€" Following Laveran's discovery, in 1880, of a parasite in the blood of patients suffering from malaria, our knowledge of the disease has increased by leaps and bounds, and one of the most important questions concerning tropical diseases has now been cleared up. Numerous observations have been carried out to determine the different parasites found in different forms of malaria â€" the tertian, quartan, and sestivo-autumnal fever â€" in each of Avhich, in the red blood corpuscles, a series of developmental stages of a parasite from a small pale translucent ama'biform body may be followed. This small

body first becomes lobulated, nucleated, and pigmented ; it then, after assuming a more or less marked rosette-shape with a deeply pigmented centre, breaks up into a series of small rounded'hyaline masses of protoplasm, each of which has a central bright point. The number of these, contained in a kind of capsule, varies from 12 to 20 in the tertian and ajstivo- autumnal forms, and from 8 to 10 in the quartan form. There are certain differences in the arrangement of the pigment, which is present in larger quantities and over a wider area in the somewhat larger parasites that ai-e found in the tertian and quartan fevers. In the parasite of the ajstivo-autumnal fever the pigment is usually found in minute dots, dividing near the pole at the point of division

of the organism, along with it in the earlier stages (Fig. 18, Plate VII.). Here, too, the rosette form is not so distinct as in the parasite of tertian fever, and in that not so distinct as in the quartan parasites. These divid- ing forms make their appearance immediately before the onset of a malarial paroxysm, and their presence is diag- nostic. The process of division takes place especially in the blood-forming organs, and is therefore found more frequently in the spleen and in bone-marrow than in any other situations. The parasites, at certain stages of their development, may escape from the red blood corpuscles, in which case (especially when exposed to the air for a few minutes) they send out long processes of protoplasm and become very active, moving about in the plasma and between the corpuscles, sometimes los- ing their processes, which, however, continue in active movement. In the sestivo-autumnal fever curious cres- cent-shaped or ovoid bodies were amongst the first of the parasitic organisms described as occurring in the blood, in the red corpuscles of which they develop. Manson maintains that from these arise the flagellate forms, all of which, he thinks, are developed in order that the life of the malarial parasite may be continued outside the human body. It is probable that most of the pigment found in the organs taken from malarial patients is derived

from red blood corpuscles broken down by the malarial parasites ; many of these, in turn, are devoured by leucocytes, which in malarial blood are usually greatly increased in number, and frequently contain much pigment, which they have obtained either directly from the fluid plasma or from the pigmented parasitic organism. The work recently carried out by Bruce on the tsetse-fly parasite, by Smith on Texas fever, and by Thayer and Hewitson on the blood para- sites of birds, has opened, up the way for the further study of the malarial parasites outside the human body. There can be no doubt as to the close relation of the multiplication and sporulation of the malarial parasite with the ague paroxysm : the anaemia results from the breaking down of blood corpuscles. Toxic substances are present in the blood during the setting free of the spores ; of this we have proof in the increased toxicity of the urine during the paroxysmal phases of the disease ; necrotic areas, similar to those found in acute toxic fevers produced by other micro-organisms, are also met with. It is well to bear in mind that the accumulation of debris of parasites and corpuscles in the capillaries may be an additional factor in this necrosis, especially when to this is added the impairment of nutrition necessarily involved by the impoverished condition of the malarial blood. It is interesting to note that, although, as pointed out by]N'uttall, the Italian and Tyrolese peasantry have long been firmly of the opinion that malaria is transmitted through the mosquito, and although Nott of New Orleans as early as 1848 " refers to malaria as if the mosquito theory had already been advanced," little attention has been given to this question by most observers. StiU earlier, Easori (in 1846) had stated that " for many years I have held the opinion that intermittent fevers are pro-duced by parasites, which renew the paroxysm by the act of their reproduction, which recurs more or less rapidly according to the variety of the. species " ; and this appears to be the first well-authenticated reference to this subject. Nuttall, wjio gives an excellent summary of the literature on the mosquito theory of malaria, assigns to King the honour of again drawing attention to this question. Laveran in 1891, Koch in 1892, Manson in 1894, Bignami and Mendini in 1896, and Grassi in 1898, all turned their attention to the mosquito theory, ilanson, basing his theory upon what he had observed as regards the transmission of Filaria by the mosquito, suggested a

series of experiments to Major Eonald Eoss. These were carried out in 1895, when it was found that in mosquitoes that had taken up blood containing amoeboid parasites, crescents, which were first described as cells, a;ppeared in the stomach-wall after four or five days ; these contained a number of stationary vacuoles and pigment granules, ten to twenty in number, bunched together or distributed in lines. Grassi, Bignami, and Bastianelli have confirmed and added to Eoss's observations ; they find that anopheles daviger, taking the blood from a patient suffering from malaria, soon develops haemosporidia in the intestine. These parasites are then found between the muscular fibres of the stomach ; they increase in size, become pig- mented, and more and more vacuolated, until they pro- ject into the body-cavity. On the sixth day these large spheres contain an enormous number of minute bodies, refractive droplets like fat, and a diminishing amount of pigment. On the seventh day numerous filaments, arranged in rows around several foci, are seen. They are very delicate, are stained with difficulty, and appear to be perfectly independent ' of each other, though grouped within a capsule. After the capsule has rup- tured, these thread-like " sporozooites," escaping into the body-cavity, gradually njake their way to, and ac- cumulate in, the cells or tubules of the salivary glands, whence their passage through the proboscis into the human blood is easily understood. Two phases or cycles of existence have then been demon- meaiÂ°ot strated â€" one within the human body, the sec- the ond in the mosquito. That within the human â€ ¢malarial body appears to be capable of going on almost '"^ indefinitely as long as the patient lives, but that in the mosquito appears to be, as it were, an intermediate stage. The minute specks of protoplasm, the amoebulae, which have already been described as occurring in the red blood Corpuscles of the higher animals, increase in size, take up blood pigment, probably from the red corpuscles, and then become developedintosporocytesorgametocytes. Thespo- rocyte is the form which, rem aining in the body, ultimately breaks up, as already seen, into a series of minute spores or amcebulee, which in turn go through the same cycle again, increasing in size and forming spores, and so on indefinitely. Gametocytes (the true sexual form) are in certain species, to outward appearance, very similar to the sporocyte, but in others they assume the crescentic shape, and can thus be

recognized. The male cell resembles the female cell very closely, except that the protoplasm is hyaline and homo- geneous-looking, whilst that of the female cell is granular. It has already been noted that when the blood is with- drawn from the body certain of the malarial parasites become flagellated. These flagella may be looked upon as sperm elements, which, forming in the male gametocyte, are extruded from that cell, and, once set free, seek out the granular female gametocytes. A single flagellum becomes attached to a small projection that appears on the female cell; it then makes its way into the protoplasm of the female cell, in which rapid streaming movements are then developed. In certain species the female cell is somewhat elongated, and may be peculiarly constricted. It becomes motile, and appears to have the power of piercing the tissues. In this way the first stages of development in the mosquito are passed. The gametocytes, taken along with the blood into the stomach of this insect, pass through the various phases above mentioned, though the zygote form has not yet been traced in the human malarial parasite. In the blood of a patient bitten by an infected mosquito, the ordinary malarial parasite may be demonstrated with- out any diflaculty at the end of a week or ten days, and the cycle recommences. This theory, in which the mosquito acts as an intermediary host for one sta^e of the parasite and transmits the parasite to man, affords an explanation

of many apparently anomalous conditions associated with

the transmission of malaria, whilst it harmonizes ioel^m'ai. '^^*^ many facts which, though frequently aria'ipara- observed, were very difficult of explanation. sites, aad Malaria was supposed to be associated with have'the "^^atery exhalations and with the fall of dew, samegeo- but a wall or a row of trees was seemingly d^strib"'- ^^^^^ sufficient to prevent the passage of infec- tioa. ' tion. It was met with on wet soils, on broken

ground, in marshes, swamps, and jungles ; on the other hand, it was supposed to be due to the poison- ous exhalations from rocks. All this is now explained by the fact that these are the positions in which mosqui- toes occur: wherever there are stagnant pools, even of a temporary nature, mosquitoes may breed. It has been observed that although the malarial “miasma” never produces any ill effects in patients living at more than a few feet from the surface of the ground, malaria may be found at a height of from 7000 to 9000 feet above the sea-level ; and the fact that a belt of trees or a wall will stop the passage of the poison is readily explicable on the mosquito theory. These insects are incapable, owing to their limited power of flight, of rising more than a few feet from the ground, and cannot make their way through a belt of trees of even moderate thickness. The fact that broken ground, such as is found in con- nexion with railway cuttings and canals, may be a focus from which malaria may spread, is further support of this theory, from the fact that in such broken ground pools are of common occurrence, and afford the condi- tions for the development of the mosquito, whilst the infected tools used in one area may easily convey the germs to another. The conditions of climate under which malaria is most rife are those which are most suitable for the development of the mosquito. The protection afforded by fires, the recognized value of mosquito cur- tains, the simultaneous disappearance of anopheles and malaria on the complete draining of a neighbourhood, the coincidence of malaria and mosquitoes, and the protection afforded by large expanses of water near walls and trees, are all important in this connexion.

The mosquitoes specially associated with the trans- mission of malaria in the human subject belong apparently

to the genus Anopheles, Anopheles claviger Species ot (macuUpennis) and Anopheles Mfurcatus, both Tonceraed. species found in Great Britain, and Anopheles

pictus, another species found in Europe, but so far not in Great Britain. The important member of the genus Culex is the grey mosquito or Culex fatigans, the intermediate host of the proteosoma of birds, on which many of the intermediate phases of the life-history of these

malarial parasites has been studied. Ross describes a dappled-wing mosquito as the one with which he performed his experiments on birds in India. Anopheles claviger is a British species, an interesting fact in association with the former prevalence of malaria in Great Britain. The remedy for malaria appears to be thorough drainage of pools and puddles, or, where this cannot be easily effected, the throwing of a certain amount ” of kerosene on the surface of these pools ” (Nuttall”).

Amoebic Dysentery. â€” In addition to the dysentery set up by bacteria, a ‘form has been described which is said to be due to an animal parasite â€” amcBbic dysentery or amoebic enteritis â€” and it has been proposed to separate the various types of dysentery according to their astiology, in which case the amoebic group is probably more specific than any other. The amoeba supposed to give rise to this condition was first described by Losch in 1875. Since then it has been described either as a harmless parasite or as a cause of dysentery in Eutope, Africa, the United States, and in Brazil, and more recently in India.

[PAKASITIC DISEASES

This organism, which is usually placed amongst the rhizopods, consists of a small globule of protopla,sm, varying in size from 6 to 35/x, though, as Laileur points out, these limits are seldom reached, the organism being usually from one and a half to three times the diameter of a leucocyteâ€” from 12 to 26/t (Fig. 19, Plate VIII.). Its margins are well defined, and the body appears to consist of a granular inner portion and a homogeneous outer portion, the latter being somewhat lighter in colour than the inner ; in the resting stage this division .cannot be made out. The organism appears to pass through at least two phases, one corresponding to a cystic, the other to an amoeboid, stage. In the latter stage, if the organ- ism be examined on a warm stage, it is seen to send out processes, and, as in other amosbse, vacuoles may be seen as clear spaces lying in the granular and darker-coloured inner protoplasm. In some cases these vacuoles are so numerous that they occupy the whole of the spaces usually occupied by the granular protoplasm, and are merely sur- rounded by a zone of variable

thickness, which “has the appearance of finely granular glass of a distinctly pale green tint” (Lafleur). In the cystic stage it is often easy to make out the presence of a nucleus which appears amongst the vacuoles, usually towards one side of the amoeba. This nucleus is of considerable size, i.e. nearly as large as a red blood corpuscle, and is readily dis- tinguishable from the surrounding protoplasm. When stained by the Benda method (safranin and light green) a nucleolus may be seen in the nucleus. The nucleus is perhaps best seen when stained by this method, but it is always difficult to obtain well-stained specimens of this organism. Red blood corpuscles are often englobed by this amoeba, as are also micrococci and bacilli. The movements of the amoebae are most active at a tempera- ture of about 90Â° to 98Â° F. From the fact that pigment is contained in these organisms, it is supposed that they take in the red blood corpuscles as nutritive material, and that other substances may be taken in to serve a similar purpose. Nothing is known of the method of multiplication of the amoeba, but it is supposed that it may be both by fission and by spore formation. These organisms are present in the early stage of the acute disease, and disappear at the later stages. A similar organism, however, may be found even in the normal intestine. Perhaps of some importance is the fact that the abscesses foimd in the liver and lung, which occur so frequently in cases of dysentery, usually contain, especially in the portions immediately adjoining the sup- purating mass, a considerable number of these amoebce. In the very small abscesses the amoebae are numerous and active, and occupy the capillaries in the tissues. It is quite possible that this plugging of the capillaries with amoebae is the cause both of the heemorrhages and of the small areas of necrosed tissue, the supply of nutriment being cut off from the liver cells and from the lung tissues, and that suppuration only occurs as a secondary process, though Councilman and Lafleur maintain that the amoeba itself is the primary cause of suppuration. It is possible, of course, that the suppuration is due to the action of pus-forming organisms conveyed along with, or following, the amoeba, as we know that the growth of suppurating organisms can go on in dead tissues when these organisms have no chance of surviving in the healthy tissues and fluids of the body. Lafleur holds that the amoeba forms a toxic substance which exerts a direct devitalizing effect on the liver

cells, and that the amoeba itself causes suppuration. The abscesses in the lung, which invariably extend directly from the liver and occur at the base of the right lung, also contain tliese amoebae. It is for these reasons that this organism is looked upon as the cause of dysentery and of certain forms of dysenteric abscess.

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Tsetse-Fly Disease. â€” The interesting observations car- ried out by Surgeon-Major Bruce have invested the tsetse- fly with an entirely new significance and importance. In 1895, Bruce first observed that in the tsetse disease â€” nagana â€” there may be found a flagellated haematozoon closely resembling the Trypanosoma Evansii found in Surra. This, like the Surra organism, is very similar in appearance to, but considerably smaller than, the haema- tozoon often found in the blood of the healthy rat. It has, however, as a rule a single flagellum only. A small quantity of blood, taken from an affected buffalo, wilde- beest, koodoo, bushbuck, or hysena â€” in all of which ani- mals it was found by Bruce â€” when inoculated into a horse, mule, donkey, cow, dog, cat, rabbit, guinea-pig, or rat, produces a similar disease, the organisms sometimes being found in enormous numbers in the blood of the in- oculated animal, especially in the dog and in the rat. He then found that the tsetse-fly can only produce the disease in a healthy animal when it has first charged it- self with blood from a diseased animal, and he produced evidence that Glossina morsitans is not capable of pro- ducing the disease, except by carrying the parasites from one animal to another in the blood that it takes through its proboscis into its stomach. The parasites taken in along with such blood may remain in the stomach and alive for a period of 118 hours, but shortly after that the stomach is found to be empty, and the parasites contained in the excrement no longer retain their vitality. The mode of multiplication of these organisms has been studied by Eose- Bradford and Plimmer, who maintain that the multiplication takes place principally in the spleen and lymphatic glands. The tsetse-fly

parasite, however, is still imperfectly understood, though much attention is now being paid to its life-history and devel- opment.

Surra. â€” In Surra, Evans described a hsematozoon â€” Trypanosoma Evansii â€” which in many points resembles the Trypanosoma of tsetse disease. This disease, which specially affects horses, mules, and camels in India, and, according to Steel, the dog and the monkey, was at one time supposed to correspond to relapsing fever, but care- ful comparison of the spirillum or spirochsete with the organism found in the tsetse disease and the haematozoon of the rat, has led to the conclusion that the two parasites are perfectly distinct, and these latter are now recognized as an animal parasite â€” Trichomonas. When this para- site is found in the blood of an animal, especially in ad- vanced forms of the disease, there is marked fever, often jaundice and minute haemorrhages â€” especially in the mucous membranes, and sometimes the serous mem- branesâ€” marked general malaise, muscular weakness, and great wasting. The disease does not appear to be in- fectious or contagious in the ordinary sense of the term ; but when blood from an infected animal is introduced into the stomach or subcutaneous tissues of an animal, the latter is rapidly attacked, the Trypanosoma making its way into the blood and multiplying with extraordi- nary rapidity. The exact site and method of multipli- cation have not yet been fully worked out. There is sufficient resemblance between this organism and the tsetse-fly parasite to render a comparison between the two unavoidable, but the general opinion of those who have worked at these parasites is that not only are the species distinct, but that they give rise to somewhat different lesions and symptoms in the animals in which they multiply.

II. To OTHEK Animal Parasites. Filariasis. â€” Since Bancroft and Manson first described Filaria nocturna and its relation to the common form of filariasis, the most important contribution to our know- ledge has been made, at the suggestion of the younger

Bancroft, by Dr G. C. Low, who has demonstrated that the embryos of the filaria may be found in the proboscis of the mosquito (Culex ciliaris), whence they probably find their way into the circulating blood

of the human subject. It axJpears that the filaria embryo, after being taken with the blood of the patient into the stomach of the mosquito, loses its sheath ; after which, leaving the stomach, it passes into the thoracic muscles of its inter- mediate host, and becomes more fully developed, in- creasing considerably in size and attaining a mouth, an alimentary canal, and the characteristic trilobed caudal appendage. It now leaves the thoracic muscles, and, passing towards the head, makes its way "into the loose cellular tissue which abounds in the prothorax in the neighbourhood of the salivary glands." Most of them then " pass along the neck, enter the lower part of the head," whence they may pass into the proboscis. Although it has never been demonstrated that the filaria is directly inoculated into the human subject from the proboscis of the mosquito, it seems impossible to doubt, that when the mosquito " strikes," the filaria makes its way into the circulation directly from the proboscis. It is important to note that the mosquito, when fed on ba- nana pulp, does not get rid of the filaria from its probos- cis. This, however, is not to be wondered at, as the filaria is apparently unable to live on the juices of the banana, whilst the consistence of the banana is very dif- ferent from that of the human skin. The importance of this observation, as affording an additional reason for taking measures to get rid of the mosquito in districts in which filariasis is rife, can scarcely be over-estimated.

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Note. â€” Reference may further be made, under eaeh heading, to the various articles and bibliographies in Allbutt’.s System of Medicine, aud other works quoted under ” general ” literature.

(g. S. W.) III. Nbueopathologt.

The morbid processes affecting the nervous system are numerous and varied, but usually they are clinically

divided into two great groups of (1) organic disease, (2) functional disturbance. Such a classification depends upon whether or not symptoms observed during life can be associated with recognizable changes of the nervous system, gross or microscopical, after death. Sometimes this is the morbid process itself, sometimes only the ultimate result of the process. It must be remarked, however, that many diseases which we now look upon as functional may be found due to recognizable changes when suitable methods of investigation shall have been discovered. The paroxysmal neuroses and psychoses may be considered a priori to be due to temporary morbid functional conditions. Our knowledge of the first group is naturally much more advanced than of the latter, for, given certain symptoms during life, we are able, as a rule, to predict not only the nature of the morbid process, but its particular locality.

The histological elements which make up the nervous system may also be divided into two groups: (1) the nervous units or neurones, (2) the supporting, protecting, and nutrient tissues. Organic diseases may start prima- rily in the nervous, iinits or neurones and cause their degeneration ; such are true diseases of the nervous sys- tem. But the nervous units may be affected secondarily by diseases starting in the supporting, protecting, and nutrient tissues of the nervous system ; such are essen- tially diseases within the nervous system, and include diseases of the blood-vessels, lymphatics, membranes, and the special nervous connective tissue, neuroglia (a residue of the embryonal

structure from which the ner- vous ‘system was developed). Tumors and new growths must also be included.

The modern conception of the ” neurone ” as an independent complex cell with branching processes, in physiological rather than anatomical association with other neurones, has modified our ideas of the morbid processes affecting the nervous system, especially as regards degenerations of systems, communities, or collec- tions of neurones subserving special functions. It was formerly believed, and generally taught, that the primary systemic degenerations were due to a sclerosis ; thus locomotor ataxy was believed to be caused by an over- growth of the supporting glia tissue of the posterior columns of the spinal cord, which caused a secondary atrophy of the nervous tissue. We now know that this overgrowth of glia tissue is secondary to the atrophy of the nervous elements, and the only true primary over- growth of glia tissue is really of the nature of the new growth (gliosis). But even in this case it is doubtful if the mere proliferation of the glia tissue elements could destroy the nervous elements, if it were not for the fact that it leads to changes in the vessel walls and to heemorrhages.

The symptoms manifested during life depend upon the nature of the morbid process and the portion of the ner- vous system affected. A correct understanding of neuro- pathology involves the study of (1) the causes which give rise to morbid conditions, which are often complex and due to various combinations of factors arising from without and within the body, and (2) the changes in the structure and functions of the nervous system brought about by intrinsic and extrinsic causes. It will be assumed that the reader has already acquired a knowledge of the anatomy and physiology of the nervous system.

The ransfis of pnthologicaJ processes occurring in the nervous units (neurones) maybe divided into internal and external, and it may be remarked that in all cases except direct injury the two groups are generally more or less combined.

A. Infernal Causes. â€” Of all the causes of nervous disease, hereditary predisposition stands pre-eminently

first ; it may be convergent, paternal, maternal ; from grandparents or even more remote ancestors. Especially does this statement apply to functional neuroses, e.g., epilepsy, migraine, hysteria, and neurasthenia; and to psychoses, e.g., delusional insanity, mania and melan- cholia. In 70 per cent, of 150 cases of idiocy or imbecility in the London county asylums, Dr Tredgold found a family history of insanity in some form or another. Strictly speaking, it is the tendency to nervous disease rather than the disease itself that is inherited, and this is frequently spoken of as a neuropathic or psychopathic taint. There are, besides, a number of inherited diseases, which, although somewhat rare, are of interest inasmuch as they affect members of a family, the same disease frequently commencing in each individual at about the same age. These are termed family diseases, and include hereditary ataxia (Friedreich's disease), myotonia (Thoni- sen's disease), hereditary (Huntingdon's) chorea, amau- rotic idiocy, and various forms of idiopathic muscular atrophy. Alcoholism, tuberculosis, and syphilis in the parents, especially if one or both come from a neuro- pathic or psychopathic stock, frequently engender idiocy, imbecility, epilepsy, and general paralysis in the off- spring, by the production of defects in the vitality of the germinal plasm, causing arrest, imperfect develop- ment, or premature decay of groups, communities, or systems of neurones, especially those which are latest developed â€" the symptoms manifested depending upon the portions of the nervous system affected. To explain the hereditary neuropathic tendency morphologically, we may suppose that there is an inherited defect in the germinal plasm which is concerned in the formation of the neurones. We may regard the neurone as a complex cell, and the nervous system as a community of neurones arranged in systems and groups having special functions. Like all cells, the neurone nourishes itself and is not nourished ; certainly it depends for its development, life, and functional activity upon a suitable environment, but it must

also possess an inherent vital energy by which it can assimilate and store up nutrient material which may be regarded as potential (latent nerve energy), to be con- verted into nerve force as required. A constant construc- tive and destructive bio-chemical process occurs in the neurones of a healthy nervous system, latent nervous energy is high, and the sense of fatigue is the natural indication for sleep and repose, whereby it is constantly recuperated. In the neuropathic or psychopathic indi- vidual it may be conceived that in some portion of the nervous system, especially the brain, there may exist communities, systems, or groups of neurones with inherited low potential, readily becoming exhausted, and, under the influence of altered blood states or stress, especially liable to functional depression, from which arise function- paralysis and melancholia. Again, the bio-chemical sub- stance which represents potential in the nervous system may be in a chemically unstable condition, so as readily to fulminate when excited by abnormal conditions (e.g'., toxic conditions of the blood), thus acting as a centre of dis- charge of nervous energy, which may be manifested by mental or bodily symptoms. We know that in strychnia and tetanus poisoning the most localized peripheral exci- tation will cause general muscular spasm ; in both toxic conditions the spread is probably due to a bio-chemical change in the protoplasm of the spinal neurones, where- by the excitability is greatly increased and a slight stimulus is sufBcient to fulminate the whole system of motor neurones. In epilepsy and other paroxysmal neuroses and psychoses it is possible that some altered condition of the blood, when associated with an inherited bio-chemical instability of certain groups, systems, or communities of neurones, may act as & fulminating agent.

In neuralgia and local hypereesthesia the slightest general or distant local irritation suffices to produce pain ; thus coughing, the vibration of a passing train, or the slam- ming of a door, may produce pain by the stimulation of the hyper-excitable neurones. Moreover, it must be borne in mind that the symptoms of nervous disease are due as much to normal physiological functional activity improperly applied, as to actual loss of function occa- sioned by disease. Thus squint, caused by paralysis of one of the muscles of the eyeball, causes less trouble to the patient than the double vision occasioned by the physio- logical activity

of the two retinae, upon the correspond- ing points of which the images are prevented by the paralysis from falling.

B. The external causes producing morbid changes in the nervous elements are : â€”

I. Abnormal conditions of the blood and lymph, by

which the neurones are poisoned and their

metabolism morbidly affected. II. Excess or deficiency of normal stimulation, or

existence of abnormal stimulation. III. Injury or diseases of supporting, enclosing, or

vascular tissues. I. Abnormal Conditions of the Blood and Lymph. â€” The immediate environment of all the cellular elements of the body is lymph, and in the central nervous system there is a special form" of lymph, the cerebro-spinal fluid. The neurones, like other cellular elements, are bathed in the lymph, and extract from it the materials necessary for their growth and vital activities, casting out the waste products incidental to the bio-chemical changes which are continually taking place. The lymph, therefore, serves as a medium of exchange between the blood and the tissues, consequently the essential causes of change in environment of the nervous elements (neurones) are : (1) Deficiency or absence of blood supply to the nervous system in general (as after severe haemorrhage), or to some particular portion, owing to local vascular disturbance or occlusion. (2) Alterations in the normal condition of the blood, due to (a) deficiency or absence of certain essential con- stituents, (&) excess of certain normal constituents, (c) the presence of certain abnormal constituents produced within the body, or entering it from without.

(1) Quantity of Blood Supp)ly. â€" Syncope or fainting occurs when the blood supply suddenly fails to reach the higher centres of the brain ; this usually arises from sudden reflex arrest of the heart's action. If a portion of the central nervous system is cut off from its arterial blood

supply by embolic plugging or by clotting of the blood in a vessel with diseased walls, the portion of the brain substance thus deprived of blood undergoes soften- ing, the nervous elements are destroyed, and the systems of nerve fibres, which have bad their trophic and genetic centres in the area destroyed, undergo secondary degenera- tion. Clotting of the blood in the veins may also give rise to destructive s(jftening of the brain, and similar secondary degeneration.

(2) Quality of Blood Supply. â€" (a) Insufficiency of oxygen, due to poverty of the colouring matter or of the number of the red corpuscles, which constitutes the various forms of aneemia, leads to functional depression, lassitude, and mental fatigue. Impoverishment of the blood in women by frequent pregnancies and excessive lactation causes neuralgia, nervous exhaustion, and, in the neuropath, hysteria, neurasthenia, melancholia, and mania. The mental depression, and the tendency that the various neuroses and psychoses have to occur and recur at the time of the menstrual and climacteric periods in women, suggests the possibility of an alteration in the composition of the blood, either in the nature of an auto- intoxication or " sub-minimal deficiency," as the probable

contributory factor of the mental disturbance. It may be remarked that eclampsia, puerperal and lactational mania, are relatively common forms of insanity in women; al- though sometimes of septic origin, they more frequently are occasioned by some morbid metabolism as yet little understood. The most striking examples we have, how- ever, of the eifect of absence or " sub-minimal " deficiency of a normal constituent of the blood upon the develop- ment and functions of the nervous system, are afforded by cretinous idiots, who are born without thyroid glands, and whose brains never develop in consequence ; and by those people who suffer from the disease known as myxcedema, occasioned by the absence of iodothyrin, a product of 'the internal secretion of the

thyroid gland. The proof of this is shown by the disappearance of the nervous phenomena, slowness of thought, slowness of speech, &c., after a preparation of the gland has been continuously administered by the mouth. Even cretin- ous idiots, when subjected in early life to thyroid treat- ment, improve considerably. The removal of the testicles in the male. may produce a profound effect upon the ner- ,vous temperament ; for probably there is an internal secretion of this gland in the male, as of the ovary in the female, which has some subtle influence upon the functional activity of the nervous system. The seminal fluid contains a large amount of complex phosphorus- containing substances, which, lost to the body by sexual excess or onanism, have to be replaced by the blood ; the nervous system, which also needs these complex organic phosphorus compounds, is thereby robbed, and neuras- thenia ensues. Brown-Sequard's testicular injection treat- ment for many nervous complaints, based upon this idea, has not, however, met with much success.

(6) Excess of certain Normal Constituents in tJie Blood. â€" Excess of carbonic acid causes drowsiness, and probably in asphyxia is one of the causes of the convulsions. All the series of the nitrogenous waste products â€" the most highly oxidized, most soluble, and least harmful of which is urea â€" are normal constituents of the blood ; but should the oxidation process be incomplete, owing to functional or organic disease of the liver, or should these substances accumulate in the blood, owing to inadequate function of the kidneys, a toxic condition, called uraemia, may supervene, the nervous manifestations of which are head- ache, drowiness, unconsciousness or coma, epileptiform convulsions, and sometimes symptoms of polyneuritis. Again, in Graves's disease, nervous phenomena, in the form of exophthalmos, fine tremors, palpitation, and mental excitemlnt, have by some authorities been ex- plained by the excess of thyroid internal secretion, due to the enlargement and increased functional activity of the gland.

(c) The presence of abnormal constituents in the blood is a most important cause of disease of the nervous ele- ments. We may consider the subject under the following headings : Poisons produced within the body (a) by perverted function of organs or tissues, auto-intoxication ;

(j8) by the action of micro-organisms upon the living fluids and tissues of the body ; (y) poisons introduced into the body from without, in the food and drink, or by inhalation.

(a) Poisons resulting from perverted Function of the Organs. â€” In the process of digestion a number of poison- ous substances, e.g., albumoses, &c., are produced, wliich, although absorbed in the alimentary canal, are prevented by the living epithelium, and possibly by the liver, from entering the systemic circulation. Fatigue products, e.g., sarcolactic acid in prolonged muscular spasms, may lead to auto-intoxication. Excess of uric acid in the blood is associated with high arterial pressure, deposits of lithates in the urine, headache and nervous irritability ; it is an

indication of imperfect metabolism and auto-intoxication, as shown by the fact that marked improvement occurs by suitable diet and treatment. Phosphoruria, oxaluria, and glycosuria, tokens of deranged metabolism, may be associated with various nervous phenomena. Bile in the blood, cholsemia, resulting from obstructive jaundice, may be attended by stupor and psychical depression ; and the term melancholia, signifying ” black bile,” indicates the importance which has long been attached to the liver as an organ the derangement of which causes nervous depression. The rapidly fatal results attending acute yellow atrophy of the liver, namely, the profound changes in the urine, the jaundice, and the nervous phenomena of delirium, motor irritation, delusions, stupor, and coma, demonstrate the important part this organ plays in pre- serving the normal quality of the blood. The delirium and coma which sometimes supervene in diabetes, heralded by acetonsemia, is another instance of auto-intoxication. The coma is very possibly due to the saturation of the sodium salts of the blood by aceto-acetic and oxybutyric acids, products of imperfect proteid metabolism. The effect of this would be an interference with the elimina- tion of carbonic acid in the processes of tissue and pul- monary respiration. Again, in pernicious and certain grave anaemias, the degenerative changes in the spinal cord found in some cases is due, not so much to the defect in the red corpuscles, as to some neuro-toxin, which probably arises from imperfect metabolism or absorption from

the alimentary canal. In this question of auto- intoxication, it must be remarked that all the tissues of the body are mutually interdependent. If one suffers, all suffer, and a disease of one organ or tissue is thereby apt to establish a vicious circle which is constantly en- larging ; therefore nervous symptoms manifesting them- selves in the course of a disease add much to the gravity of the complaint.

(P) Poisons produced by infective 3Â£icro-organisms. â€” Some of these poisons have a general devitalizing in- fluence, by an alteration of the blood and the produc- tion of fever. In the course of the acute infectious diseases, typhoid, typhus, small-pox, scarlet fever, measles, influenza, also tuberculosis and septicaemia, delirium is a frequent complication ; it may be the result of high fever or prolonged fever, or directly due to the poison, or the two combined. In severe cases stupor and coma may occur, and it has been shown that in this extreme stage the nerve cells undergo an acute morbid bio-chemical change. These particular poisons have no selective toxic action upon a particular part of the ner- vous system, and symptoms not only during, but after, the acute illness are liable to supervene, especially in a neuropathic individual. Thus many cases of neuras- thenia, insanity, neurosis, also neiuritis, date their origin from an acute specific fever. In cerebro-spinal menin- gitis, tubercular meningitis, acute delirious mania, and lepros neuritis, the inflammation of the membranes of the brain and spinal cord, is due to the growth of the specific organism in the lymph and interstitial tissue elements.

Poisons may have a selective influence upon some part of the nervous system. The syphilitic poison is the most important factor in the production of two progressive degenerations of the nervous system â€” one affecting espe- cially the afferent conducting tracts of the spinal cord, namely, locomotor ataxy, and the other affecting especially the frontal and central convolutions of the cerebral hemi- spheres, namely, general paralysis of the insane. A striking instance of the selective action of the syphilitic poison is shown in the fact that only in persons affected with acquired or inherited syphilis is a symptom known as Argyll-Robertson pupil found ; this is the absence of

the pupil reflex contraction to light, while that for accom- modation persists. Seeing that this is the most common objective phenomenon in the two diseases mentioned, it strengthens the presumption, based on experience, that the syphilitic poison is the cause of these diseases in the majority of instances. Again, syphilis. When it attacks the supporting, enclosing, and nutrient vascular tissues, shows a predilection to affect structures about the base of the brain, and paralyses of the third nerve are almost pathognomonic of this disease. In rabies, although the whole nervous system is charged with the poison, the medulla oblongata (as shown by the symp- toms) is especially affected. Again, in tetanus the bacilli are only found in the wound; they must therefore be comparatively few in number, but they elaborate a viru- lent poison, which affects particular groups of neurones. The fact that lockjaw nearly always occurs first, shows that the poison selects the motor nucleus of the fifth nerve; but it is remarkable that experiment has shown that the tetanus toxin, if mixed with an emulsion of nervous matter before injection into an animal, loses its toxicity. This fact indicates its affinity for nervous matter, and also a power of absorption of the poison by some chemical substance in the nervous matter. Another example is offered by diphtheria. A neuro-toxin is pro- duced by the local action of the bacilli, for they do not become freely generalized in the blood and tissues. Whether the poison is a direct production of the bacilli themselves, or is an auto-toxin created in the body itself, by an influence exerted on the living fluids and tissues by a ferment-like product of the bacilli, is not determined. But whatever may be the source of the toxin, its effects upon the neurones are constant, as shown by the suffer- ings of the patients â€” paralysis of the soft palate, with nasal speech and regurgitation of fluids through the nose when swallowing is attempted ; inability to read, owing to the paralysis of the muscle of accommodation ; weak- ness and

incoordination of the limbs, which may amount to paralysis; absence of the knee-jerks; and often skin anaesthesia.

(y) Poisons introduced into the Body. â€" The most wide- spread and potent cause of nervous and mental disease is the abuse of alcoholic stimulants. At least 20 per cent, of the inmates of the asylums of London are suffering from the effects of the abuse of alcohol. Most of these patients, however, inherit the neuropathic tendency, and it is a rare thing, among such, to find cirrhosis of the liver with ascites, a condition which indicates long per- sistent spirit-drinking. The writer, from a very large experience as pathologist to the asylums of London, only remembers one such case, and that was in a notorious woman who was convicted nearly four hundred times for drunkenness before she could be certified as of un- sound mind, a fact which indicates that she inherited a very stable nervous constitution. To people with un- stable nervous systems a relatively small quantity of alcohol may act as a poison. Alcohol may produce acute delirium, with fine tremors, and, generally, visual hallu- cinations of a horrible nature, indicating acute toxic influence upon the brain. This acute form of alcohol poisoning is much commoner in men than in women, and it is remarkable how a severe injury or illness, such as I pneumonia, will bring out delirium tremens in a drunkard. Alcohol acts especially upon the higher centres of the brain, and a drunken man may exhibit " the abstract and brief chronicle of insanity, going through its successive phases in a short period of time" (Maudsley). The effect on the nervous system of chronic tippling is dementia, a very characteristic manifestation of the mental degradation being absence of knowledge of time and place, personal illusions, and loss of memory of

recent events, indicating a failure of receptivity and of the formation of memory-pictures in the higher centres. A certain amount of improvement may occur when total abstinence is enforced, which shows the poison has dam- aged but not destroyed the nervous elements. Besides mental symptoms of alcoholic poisoning, there is fre- quently paralysis, affecting especially the lower limbs (structures suffer most where vitality is least), although the upper limbs, and even the respiratory muscles, may be affected in severe cases. The patient

becomes help- less and bedridden, and death frequently occurs from heart failure. Characteristic features of this affection are great tenderness on pressure of the muscles, especially of the calves, absence of reflexes, a variable degree of skin anaesthesia, wasting of muscles and alteration of the normal electrical reactions, and frequently pyrexia. There is no loss of control over the bladder and bowels, unless there is very marked dementia. This "complex of symptoms " points to a peripheral polyneuritis, although frequently changes occur also in the ganglion cells, from which the axis cylinders of the nerves have their origin (vide Plate X., Nos. 6, 7, 8, and 9). Many other poisons, notably lead and arsenic, the specific fevers before men- tioned, syphilis, and alterations of the blood due to imperfect metabolism, such as occur in diabetes and gout, may produce, or become important factors in pro- ducing, peripheral neuritis. The outbreak of arsenical neuritis from beer containing this poison in Manchester in 1900 is of interest, from the fact that the symptoms closely resemble acute alcoholic neuritis. A distinctive feature, however, was the pigmentation of the skin and the severity of the nervous symptoms. A disease which is common in the East, termed Beriberi, is a form of neu- ritis, the cause of which is not exactly known, although it is possibly infective, and due to elaboration by micro- organisms of some chemical poison which escapes into the blood. Still, the fact that it has almost disappeared from the Japanese navy with improved diet and better hygiene would suggest that it is due to auto-intoxication from defective metabolism. Anaesthetic leprosy is an interstitial inflammation of the nerves due to the Lepra bacillus. Among the nervous diseases due to occupation may be cited lead- poisoning. This is peculiar in select- ing the nerve which supplies the extensor muscles of the wrist and fingers, so that dropped wrist is almost charac- teristic of this form of toxic neuritis. Lead also pro- duces a chronic inflammation of the cerebral cortex, Encephalitis saturnina, causing a complex of symptoms, namely, dementia, loss of memory, weakened intellect, paresis and epileptiform seizures, hallucinations of sight and hearing, and mental exaltation or depression. Mirror- makers suffer with characteristic fine tremors, from the slow absorption of mercury into the system. Workmen at indiarubber factories may suffer from severe mental symptoms, owing to the inhalation of the fumes of bisulphide of carbon.

There are a certain number of poisons, besides alcohol, which act upou the nervous system when continually entering the body as the result of a habit, namely, absinthe, ether, cocaine, opium, morphia, haschish, and tobacco. Each of these poisons produces a train of symp- toms denoting a selective influence upon certain parts of the nervous system. In illustration thereof may be men- tioned impairment of central vision in tobacco amblyopia.

Unsound Food. â€” In northern Italy and Egypt numbers of people suffer with Pellagra, an affection of the skin associated with degenerative changes in the brain and spinal cord. The symptoms of the disease are generally a fatuous melancholy with suicidal impulses, sometimes mania associated with paresis. It is supposed that this disease is due to the bad maize upon which the people at

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times have to subsist. Another disease, ergotism, in an epidemic form, has affected poor people in Kussia and North Germany when obliged to subsist upon bread made of rye which has been attacked by the ergot fungus. The poison thus introduced into the system produces progres- sive degenerative changes in the brain and spinal cord, which are manifested by psychical disturbances, such as slowness of thought, weakness of memory, dulness of perception, sometimes delirium and incoherence; other symptoms are blunted sensibility, dilated pupils, muscu- lar spasms, perhaps even epileptiform seizures and ataxy, and, lastly, stupor deepening into coma. Sausage dis- ease, due to eating decayed meat and fish infected with Bacillus hoUdinns, is associated with symptoms which frequently terminate fatally, and it has been shown that the symptoms are due to a poison which has a very destructive effect upon the nerve cells (Plate X., No. 10).

II. Normal and Abnormal Stimulation. â€" The nervous system, in order to develop and manifest functional activity, requires suitable stimulation from without. Structure and function are mutually reciprocal and inter- dependent ; for a structure which is not used will gradu- ally lose its function, while its nutrition will also suffer, and in time atrophy may occur. Consciously and uncon- sciously, a continuous stream of impulses is pouring into the nervous system from without by the sensory chan- nels, which are the avenues of experience and intelligence, and our somatic and psychical life depends upon the existence of such stimuli. The nervous system in the form of systems, groups, and communities of neurones, each with special functions, yet all woven together in one harmonious whole, develops in a particular way in conse- quence of the awakening influence of these stimuli from without. Consequently nervous structures which are not used are liable to undergo regressive metamorphosis and atrophy ; thus amputation of a limb in early life causes atrophy of the nervous structures which presided over the sensation and movement of the part. This is seen both in the grey and white matter of the spinal cord. A healthy physical, intellectual, and moral environment of the individual is an essential factor in the prevention and cure of psychoses and neuroses, because it tends to de- velop and strengthen body and mind, deliberation, judg-

ment, and the higher coatrolling functions of the brain. A function not used will gradually disappear, and become more and more difficult to evoke. This fact is of import- ance in functional neuroses and psychoses, e.g., hysteri- cal paralysis, melancholia, and delusional insanity, because the longer mental or bodily function is left in abeyance, the more likely is the defect to become perma- nently installed. The converse is also true : the longer a perverted function existsy the inore unlikely it is to dis- appear. Thus auditory hallucinations, a very important and frequent symptom in the insane, commence with in- distinct noises ; these are followed by " voices," which eventually become so distinct and real that the greater part of the patient's psychical existence is concentrated upon, and determined by, this abnormal stimulus from within, indicating progressive strengthening and fixation of the perverted functions of the mind, and progressive weakening and dissolution of the normal functions.

Mental pain in the form of grief, worry, anxiety, fright, shock, violent emotions (pleasurable or painful), dis- appointed love, sexual excesses or perversions, and ex- cessive brain work, frequently precede and determine, in persons with the insane or neuropathic taint, various forms (a) of psychoses, e.g., mania, melancholia, delu- sional insanity; (b) of neuroses, e.g., chorea, hysteria, epilepsy, hystero-epilepsy ; (c) of organic brain disease, e.g., apoplexy, thrombosis, general paralysis.

Visceral reflex irritation affords many examples of neuroses and psychoses, the symptoms of which are set up by irritation of the viscera, e.g., intestinal worms. Teething and indigestible food are often the exciting cause in infants and young children of convulsions, spasms of the glottis, and tetany. Various functional and organic diseases of the female reproductive organs act as exciting causes in the production of hysteria, hystero-epilepsy, melancholia, and mania; moreover, paroxysmal attacks in these diseases are more liable to occur at the menstrual period or menopause. The irrita- tion of a carious tooth may produce spasmodic tic and trigeminal neuralgia. Wax in the ear may occasion ver- tigo and tinnitus; and errors of refraction iu the eyes may be the cause of attacks of migraine, and even tend to excite epileptic fits in a person suffering from epilepsy. Numerous other examples of

peripheral disturbance could be mentioned as exciting causes of nervous affection in neurotic individuals. Irritation of the terminals of the vagus in almost any part of its widespread visceral distribution may lead to vomiting. The characteristic pain of angina pectoris, which radiates d6vm the inner side of the left arm, is explained by the fact that the car- diac branches of the sympathetic arise from the same segments of the spinal cord as the sensory branches of the ulnar nerve ; consequently the pain is referred to the corresponding skin area supplied by this nerve. This is one example of a great nujnber of referred pains.

III. Injury or disease of enclosing or siqjporting structures may lead to paralytic or irritative lesions of the nervous system, or the two may be combined. Blows or wounds of the head and spine may damage or destroy the nervous structures by shock or direct injury. Concussion of the brain or spinal cord may occur, as a result of injury, without any recognizable serious damage of the enclosing structures or even the central nervous system. Shock, due to concussion, can only be explained by a molecular or bio-chemical change in the nervous structures.

Direct injury or a fall fracturing the skull, driving the fragments into the brain, will cause direct destruction of the nervous tissue ; but wounds and diseases of the en- closing and supporting structures, if producing simple non-infective inflammation, give rise only to such symp- toms as accord with the nerve structure irritated or destroyed. Should, however, the wound or diseased structure become infected with micro-organisms, the dis- ease spreads and becomes generalized, likewise the symp- toms. Of all the causes of infective inflammation, middle- ear disease, on account of its frequency and insidious onset, is the most important. It is very liable, when neglected, to be followed by a septic meningitis, enceph- alitis, and brain abscess, the most frequent seat of which is in the adjacent temporal lobe, but it may be in other parts of the brain, e.g., the cerebellum and frontal lobe (Fig. 2, Plate IX.). The peripheral nerves may be de- stroyed or irritated by direct injury, disease, or new growth in adjacent tissues, or they may be involved in the callus thrown out round the seat of a fracture.

Diseases ofthe blood-vessels are amongthemost frequent causes of organic brain disease. Arteries or veins â€” more frequently the former â€” may become blocked or ruptured from various causes, the result being destruction of some portion or portions of the nervous tissue,with corresponding loss anil disturbance of function. The cerebral arteries may be occluded by embolism ; a portion of a clot or vegeta- tion from a diseased valve of the left side of the heart may be detached, and escape into the circulation; and this is carried into one of the arteries of the brain, usually the middle cerebral, more often of the left side than the right. The area of brain tissue supplied by that artery is deprived of blood, and undergoes softening in consequence.

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resulting in paralysis of the opposite half of the body (hemiplegia), associated with aphasia when the paralysis affects the right side in a right-handed person. Softening may also arise from coagulation of the blood (thrombosis) in an artery the walls of which are diseased. This is a very common cause of paralysis and dementia in people who have passed middle life. General disease of the arteries of the body, associated especially with chronic Bright's disease and high arterial pressure, is frequently attended with the formation of minute miliary aneurysms upon the cerebral arteries, which may rupture and cause apoplexy. Haemorrhage into the brain from this cause is especially liable to occur in certain situations ; one vessel iu particular, supplying the basal ganglia, most frequently gives way, the effused blood tearing through the motor efferent fibres, which, proceeding from the cerebral cortex in the shape of a funnel, become aggregated together to form the neck between the two masses of grey matter â€” the optic thalamus and the corpus striatum (Fig. 4, Plate IX.). The result is hemiplegia of the opposite side of the body. Disease of the arteries of the central nervous system, occurring in a person under forty, is generally due to syphilis, the poison of which produces an inflammation of the coats of the vessel, especially the inner. Occlusion and softening may arise ; and seeing that

any or all the arteries of the brain may be affected successively, simultaneously, or at random, the symptoms may be manifold. They may be general or local, and not uncommonly are associated with inflammation of the membranes. The disease, under treatment, may abate, and the paralytic or mental phenomena partially or completely disappear, indicating the restoration, or partial restoration, of the circulation in the diseased arteries ; sometimes with the lapse of treat- ment and sometimes without, new symptoms, such as paralysis of a fresh group of muscles or of the opposite side of the body, may manifest themselves, showing that the disease has attacked a fresh set of arteries. Dissemi- nated sclerosis (insular) is another random morbid process, affecting especially the white matter, with certain charac- teristic symptoms of a progressive character, the pathology of which is not understood fully. Islands of nervous tis- sue undergo a morbid change, commencing in the myelin sheath and ending in an increase of the supporting neu- roglia tissue at the expense of the true nervous tissue.

Tumours and new growths in the central and peripheral nervpus systems may be primary or secondary r the former arise in the supporting, enclosing, or nutrient tissue elements ; the latter are metastatic deposits from tumours originating elsewhere. Tumours may be single or multi- ple, the special symptoms occasioned depending upon the seat of the tumour and whether it destroys or only irri- tates the adjacent nervous tissue. Tumours situated within the cranial cavity cause general symptoms, namely, optic neuritis, severe headache, and vomiting ; these symp- toms, which are caused by increased intracranial pressure, are more severe in rapidly-growing vascular tumours, even though small, than in large slow-growing tumours. If the growth is situated in a portion of the cortex having some special localizing function, e.g., the motor area (vide Fig. 1), it may give rise to epileptiform convulsions, starting in a limb or definite group of muscles ; but the irritation usually spreads to the whole motor area of the same side, and even extends to the opposite hemisphere, by an overflow of the discharge through the corpus callo- sum. In such case there is loss of consciousness. If, however, the tumour destroys the cerebral cortex of a particular region, it may give rise to a paralytic lesion, e.g., paralysis of the arm (vide Fig. 3, Plate IX.).

Organic diseases of the blood-vessels, or of supporting and enclosing tissues, produce secondary degenerations of the nervous system. The symptoms, like the lesion, are

obvious, coarse, and obtrusive ; frequently arising suddenly, they may in a short time terminate fatally, or tend towards

Fig. 1. â€” Diagram of left cerebral hemisphere, showing localization of function. The motor region is situated in front of the central sulcus, and is arranged in a series from ” toe to larynx ” downwards, corre- sponding in an inverse manner to the spinal series. Irritation of any part of this area will cause localized convulsive spasms, which may spread in a definite inarch to the whole motor area, as in Jacksonian epilepsy. “Destructive lesions will cause paralysis. The centre for taste and smell” is represented at the tip of the uncinate convolu- tion. The centre for “half-vision” is only in small part represented, for the larger part is on the mesial sni-tAce. “Hearing” is repre- sented occupying the posterior half of the first tempor;^ convolution. Included in this area, but in the left hemisphere only, is the centre for “auditory word memory”; destruction of this causes inability to understand the meaning of words uttered, although the patient is able to read aloud. Behind this, in the angular gyrus, is the centre for “visual word memory”; destruction of this causes loss of power of understanding of written or printed words â€” therefore inabihty to read. In front of the motor area is Broca’s convolution, the centre of “motor speech”; destruction of this produces motor aphasia, or Inability to articulate words. Above this is a centre which is con- nected with wi-itten sjieech. These four centres concerned with verbal and written language are connected by commissural fibres, and destruction of these connexions leads to various defects in verbal and written language. It will be understood from this diagram that diseases of the left hemisphere in right-handed persons are associated with results of more significance than similar affections of the right hemisphere.

partial or complete recovery. Various forms of motor and sensory loss and disturbance of function may arise, in- dicating destruction or disturbance of particular regions of the central nervous system; and

degenerations in certain tracts and systems of fibres arise, corresponding in histo- logical character with those observed when a nerve fibre

Fig. 2. â€” Diagram of section of the spinal cord in the upper cervical region, showing recent degeneration of the crossed pyramidal tract of the right side and direct pyramidal tract of the left side. The black dots indicate the degenerated fibres stained by the Marchi method. This degeneration is secondary to haBmorrhage into the internal capsule of the left hemisphere, and it will be observed by the number of degenerated fibres that the greater bulk have crossed over to the right side of the spinal cord, thus agreeing with the fact that the paralysis is of the right half of the body. '

is separated from its cell of origin by section (secondary degeneration of Waller and Tarek) (vide Fig. 2, with explanation). This form of degeneration must be dis- tinguished from primary degeneration, which is due to an inherent nutritional defect of the nerve cell and all its

processes (the neurone), in which a regressive metamor- phosis occurs ; it starts in the structures of the neurones latest developed (namely, the myelin sheath and the fine terminal twigs of the axis cylinder and dendrons), and proceeds back to the main branches and trunk, eventually destroying the trophic and genetic centre itself, the nerve cell. These primary degeneration processes are insidious in origin, progressive in character, and nearly always fatal in termination ; they affect definite systems, groups, and communities of neurones in a progressive manner, and therefore are associated with a progressive evolution of symptoms, related to the structure affected (vide Figs. 3 and 4). To cite some examples : (1) Locomotor ataxy, on the one hand, is a primary degeneration affecting the

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Fig, 8,â€” a diagram to indicate aiferent, eflTerent, and association systems of neurones. It will be observed that there are three nervous circles indicated by the arrowsâ€” spinal, cerebellar, and cerebral. In every perfect ,co-ordinate movement impulses properly adjusted are liowing along these three systems of neurones. In systemic degenerations one or more of these systems may be affected, and the symptoms will depend partly upon the function which is lost or disturbed, and partly upon the disturbance of equilibrium of the three co-ordinated systems.

afferent system of neurones ; it is characterized by muscular inco-ordination without wasting, inability to stand with the eyes shut, lightning pains in the limbs, absent knee- jerks, Argyll-Eobertson pupils, and other symptoms point- ing to a morbid process affecting especially the afferent sensory system of neurones. (2) Progressive muscular atrophy, on the other hand, is a disease of the e^ereni motor system of neurones of the brain and spinal cord, character- ized by progressive wasting of groups of muscles innervated by groups of neurones which are undergoing degeneration. A fatal termination to this disease frequently arises from affection of the medulla oblongata, causing what is known as bulbar paralysis. Infantile paralysis is an acute in- flammation of the anterior horns of the spinal cord, causing destruction of the spinal motor neurones of the anterior

horn. It differs from the above chronic disease in its sudden onset and non-progressive character ; it resembles

Fia. 4.â€” Diagram of spinal cord, fifth lumbar segment, iV-om a case of advanced tabes dorsalia. The])08terior column is shrunken, and but faintly stained, except in the anterior part ; the shrinkage and the loss of stainability are due to the absence of fibres of the posterior roots, which normally form the greater part of this region of the cord. The fibres which are seen in the anterior part of the posterior column are derived from cells within the spinal cord, and belong to spinal association neurones.

it in producing paralysis of muscles without sensory dis- turbance. (3) General paralysis of the insane is a degeneration which begins in the association system of neurones of the cerebral cortex, hut which may be, and frequently is, associated with degeneration of the afferent or efferent systems (Fig. 3).

It is not attempted in this article to explain neuroses and psychoses by morphological changes in the brain (Fig. 1, Plate IX.). We know little or nothing accurately about the morbid histology of insanity, except as regards the morphological changes met with in cases of amentia and dementia. The conditions of amentia, namely, idiocy and imbecility, are associated with arrest of development of the brain, as a whole or in part, the naked-eye evidence of which may be afforded by small size and simplicity of convolutions of the brain as a whole or in a part (Figs. 7, 8, and 9, Plate IX.) ; and the microscopical evidence by arrest of development, or imperfect development, of structures connected with the higher functions of the mind, namely, the association neurones in the superficial layers of the cerebral cortex (Fig. 5). Conditions of dementia, primary or secondary, are associated with progressive decay and atrophy of the superficial layers of the grey matter of the cortex, and naked-eye evidence thereof is afforded by partial or general wasting of the cerebral hemispheres, accompanied with thickening of the pia- arachnoid membrane, atrophy of the convolutions, and with deepening and widening of the intervening sulci (Figs. 5 and 6, Plate IX.). This wasting is especially due to atrophy of the cells and fibres of

the superficial grey matter of the cortex, sections of which, examined micro- scopically, after suitable methods of staining have been employed, show great poverty, or complete loss, of three sets of delicate myelinated fibres, namely, tangential, super-radial, and the inter-radial corresponding to the line of Baillarger. This degeneration of the superficial association fibres of the cerebral cortex affects especi- ally the frontal and central convolutions, and is the earliest and most constant microscopical change in progressive dementia; it is accompanied usually by vascular changes, atrophy of the nerve cells, and prolifera- tion of the neuroglia (Fig. 6). Possibly new methods may enable us to show changes of structure in diseases such as epilepsy and delusional insanity, in which hitherto

PLATE IX.

(For explanation, see page 546.)

PLATE X.

virions ;>Totor Cnlls, drawn from microphotographs of preparations stained by Xissl mctlioil to show luifrncliemical clifingos produced by various diseases. 1. Normal motor cell from eereliral cortex, showing a niosaic pattcvu of tlie cytoplasm due to a substancr sti^inable liy basic aniline (|y<5s; this stainable substance exists also on the di'iKlruns. By comparing the apiirnrnnces of this cell with the othor figures a just idea can ho. oitLained of the morbid changes wliicli result in various patholofiical conditions. '2. Oell IVom a c;isi' of byper-pyrexia â€” disajipearance of the niosaio pattern, substance uniformly sUiini'd ; absence of the chromatic clfnionts on the ilcudiniis, dm^ to a precipit;ition of t-Ldl-globulin by the heat. 3. Cell in an advanced stage of coa^'ulutiou necrosis, complete absence of mosaic pattern ; dilfusc line dust-like stain ; breaking off of the processes ; all caused by softi'ning of tlie brain from vascular obstruction. 4. Another specimen from the same brain in a still more advanced stage of destruction, and showing a phagocyte attached to tlm cell and devouring the decayed structure. 5. A cell with enormously swollen nucleus, the result of hydration due to ahsoi'iition of fluid after ligature of cerebral vessels. Such a cell will probably recn\'cr. 0, 7, 8. and â€¢>. spinal motor cells in

various stages of destruction, from a case of acute alcoholic poly-neuritis, illustrating, 6, chromatolysis ; 7, ditto with eccentric nucleus; s. extrusion of nucleus; 9 vacuolation. 10. Cell illustrating swelling of nucleus and chromatolysis in acute toxiemia produced by poison of bacillus botuUnus.

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no naked-eye or microscopical structural defects account- ing for the symptoms have been certainly demonstrated.

Fitt. 5. â€” Diagram illustrating the relative number and wealth of cells, and fibres in the cerebral cortex in the normal brain, in amentia and dementia. The horizontal systems of fibres are association systems, and it will be observed that these are especially diminished in amentia, and still more in dementia, whereas the radial fibres are less aflFected. In the normal,' there are five layers of cells arranged in columns (Meynert's) ; in the pathological conditions it will be observed that the pyramidal-shaped cells no longer have their apical processes point- ing vertically upwards. The processes are broken oif, the cells are distorted in shape and diminished in numbers, and the degree of dementia in a wasted brain is proportional to the atrophy and destruc- tion of the small and medium-sized pyramids of the whole cerebral cortex, and the disappearance of the superficial layers of fibres. This is especially manifested in paralytic dementia and the dementia of chronic insanity.

In conditions of acute mania there is usually considerable vascular engorgement.

Microscopical changes in degeneration of the neurone. â€" About 1860, Waller demonstrated that a nerve fibre underwent degeneration to its termination when separated from its cell of origin ; hence the term " Wallerian de- generation." Embryological researches by Professor His showed that the axis-cylinder process (the essential con- ducting

portion of the nerve fibre) is an outgrowth of the nerve cell. The cell, therefore, is the trophic and genetic centre of the nerve fibre. Acute alterations and death of the nerve cells may occur from toxic conditions of the blood; from high fever (107-110Â° P.); arrest of the blood supply, as in thrombosis and embolism; or actual destruc- tion by injury, haemorrhage, or inflammation. These morbid processes produce, as a rule, bio-chemical as well as morphological changes in the nerve cell and its pro- cesses. Space will not allow of a full description, but some of these changes are indicated in Plate X. When a nerve cell dies, the nerve fibre undergoes secondary de- generation and death ; that is to say, the whole neurone dies, and regeneration, at any rate in the higher vertebrates, does not take place. Restoration, or partial restoration, of function is due to other structures taking on the function, and the more specialized that function is, the less likely is restoration to take place. If, however, a peripheral nerve is divided, its component fibres are merely severed from their cells of origin. All that portion of the nerve which

is in connexion with the nerve cells of origin practically undergoes no change. The peripheral portion undergoes degeneration, but from the central end of the nerve new axis-cylinders again grow out and a new nerve is formed. With this regeneration comes restoration of function, which may be hastened by suturing the ends of the cut nerve. A similar regeneration, however, does not occur after section of fibres of the white matter of the central nervous system, and this may be due to the fact that the nerve fibres of the white matter of the cerebro-spinal axis possess no nucleated sheath of Schwann, which, by the light of recent investigations, is shown to play an inj- portanfc pSi^t in regeneration ; in the writer's opinion, the neurilemma! sheath of the old fibre forms a new proto- plasmic basis, into which the axis-cylinder from above grows, the passage of stimulus determining its function. The accompanying Fig. 6, Nos. 1-8, with explanatory

Fig. 6. â€" Diagram to illustrate various stages in degeneration and regenera- tion of medullated nerve fibres. 1. Normal medullated nerve with node of Kanvier. 3. Degenerated nerve, ten days after section, show- ing degenerated myelin stained black ; disappearance of axis-cylinder. 3. Central end of cut nei-ve, showing at the top an axis-

cylinder budding out, proliferated neurilemmal cells, and still some degenerated myelin in sheath. 4. Peripheral cut end of same, showing proliferated netlri- lemmal cells, still some degenerated myehn. 5. Complete absorption of degenerated myelin, protoplasmic basis of new fibre formed out of neurilemmal cells. 6. A new fibre, with axis-cylinder. 7. Central end of cut nerve at .iunction, showing an axis-cylinder sprouting and forming a number of axis-cylinder processes, which grow into the peripheral end to form new channels of conduction. 8. is a new regenerated fibre resembling a sympathetic fibre in having as yet no myehn sheath ; as the nerve becomes excitable and stimulus passes, a myelin sheath is formed.

text, shows the changes which occur in degeneration and regeneration of a peripheral nerve after section, with loss of function; and subsequent union, with restoration of function. The writer, in conjunction with Professor Halli- burton, has shown that the characteristic microscopical changes in the myelin sheath which occur in the process of degeneration are due to a splitting up of the complex phosphoretted substance ” protagon ” into glycero-phos- phoric acid, choline, and oleic acid by a process of hydration. The Marchi reaction, which has been found so useful for demonstrating degeneration of the central and peripheral nervous systems, is dependent upon the

fact that the myelin sheath, after hardening in a solution of bichromate of potash, does not turn black when acted upon by osmic acid, whereas the simpler non-phosphoretted fatty product of degeneration is stained black. When the Marchi reaction of degeneration is fully developed, it has been ascertained that the nerve yields no phos- phorus. The degeneration resulting from section of a nerve is termed secondary, to distinguish it from another, primary, due to slow and progressive decay

of the whole neurone, beginning usually at the terminal twigs and proceeding back towards the cell body with its contained nucleus. These primary degenerations involve systems of neurones, corre-

lated by function ”^ ”” ” rather than by ana- tomical situation. Examples are af- forded by locomotor ataxy and progress- ive muscular at- rophy, the former being a degenera- tion of the afferent sensory system of neurones, the latter of the motor efferent system. The cause of primary degene- rations is probably a defect inherited or acquired in the ” vita propria ” of the neurones af- fected. They slowly atrophy and disap- pear, and their- place is filled up by an of the supporting neuroglia tissue (Figs.

Fig. 7. â€” DLograra drawn from micro-photograpli to show different forms of neuroglia cells in a patch of sclerosis secondary to degeneration and dis- appearance of the neurones. Observe the large branched cells of Deiters.

overgrowth , 4 and 7). This overgrowth of dense tissue is termed sclerosis, and was erroneously considered to be the cause, instead of the effect, of the atrophy of the nervous tissue.

For further information tlie reader may consult the Croonian Lectures on the Degeneration of the Neurone, by the writer of this article, published in the Lancet, 1900 ; also Gower’s Handbook of the Nervous 8ystem,Yon Monakow’s Oehirn Pathologie, and Ford- Robertson’s Pathology of Mental Diseases. (-p, w. Mo.)

EXPLANATIONS OF PLATE IX.

Photographs of the Brain (about ^ their Natural Size) Illustrating Various Pathological Conditions.

1. Left hemisphere, case of delusional insanity; this in all re- spects might pass for a normal brain.

2. Left hemisphere, case of abscess of the frontal lobe : the convolutions and sulci are obliterated and the membranes thickened, so that the fore part of the brain presents the appearance of a membranous bag; this contained a large amount of pus.

3. Right hemisphere seen from above instead of laterally : a hole corresponding to the middle of the central convolutions is seen, out of which a tumour is displaced towards the middle line. This tumour was situated over the region of the arm area, and gave rise at first to fits commencing in the left arm and hand, and eventually to paralysis.

4. I3riiin from a case of apoplexy : the tops of the hemispheres have been sliced off to show the haemorrhage (dark patch) in the right centrum ovale, which has ruptured the fibres proceeding from the motor area of the brain, situated between the basal gaii^'lia.

5. Case of paralytic dementia with thickened membranes, which have been stripped off the frontal lobe and thrown back.

6. Left hemisphere : a case of advanced dementia, showing atrophy of the convolutions, with deep and wide sulci intervening.

7. Left hemisphere of low-grade imbecile, with simple convolutioual pattern, and small in size.

8. Brain of extreme case of microcephalic idiocy. The couvolutional pattern is simpler than tliat of an embryo of eight months.

!l. Left hemisphere and cerebellum of a case of porencephaly. A local atrophy of the convolutions, owing to a vascular lesion before birth, is seen in the parietal lobe.

IV. Digestive System.

Several facts of importance have to be borne in mind for a proper appreciation of the pathology of the organs concerned in digestive processes. In the first place, more than all other systems, the digestive comprises greater range of structure and exhibits wider diversity of

func- tion within its domain. Each separate structure and each different function presents special pathological signs and symptoms. Again, the duties imposed upon the system have to be performed notwithstanding constant variations in the work set them. The crude articles of diet offered them vary immensely in nature, bulk, and utility, from which they must elaborate simple food-elements for absorption, incorporate them after absorption into complex organic substances properly designed to supply the con- stant needs of cellular activity, of growth and repair, and fitly harmonized to fulfil the many requirements of very divergent processes and functions. Any form of un- physiological diet, each failure to cater for the wants of any special tissue engaged in, or of any processes of, metabolism, carry with them pathological signs. Perhaps in greater degree than elsewhere are the individual sections of the digestive system dependent upon, and closely correlated with, one another. The lungs can only yield oxygen to the blood when the oxygen is un- combined ; no compounds are of use. The digestive organs have to deal with an enormous variety of com- pound bodies, from which to obtain the elements neces- sary for protoplasmic upkeep and activity. Morbid lesiqns of the respiratory and circulatory systems are frequently capable of compensation through increased activity elsewhere, and the symptoms they give rise to follow chiefly along one line ; diseases of the digestive organs are more liable to occasion disorders elsewhere than to excite compensatory actions. The digestive sys- tem includes every organ, function, and process concerned with the utilization of food-stuffs, from the moment of their entrance into the mouth, their preparation in the canal, assimilation with the tissues, their em- ployment therein, up to their excretion or ex- pulsion in the form of waste. Each portion resembles a link of a continuous chain ; each link depends upon the integrity of the others, the weakening or breaking of one straining or making impotent the chain as a whole.

Descriptions of the different organs of the digestive system are given elsewhere. (See Ax atomy.) The mucous membrane lining the alimentary tract is the part most subject to pathological alterations, and in this connexion it should be remembered that this membrane differs both in structure and functions throughout the tract. Chiefly

protective from the mouth to the cardia, it is secretory and absorbent in the stomach and bowel ; while the glandular cells forming part of it secrete both acid and alkaline fluids, several ferments, or mucus. Over the dorsum of the tongue its modified cells subserve the sense of taste. ''ithout, connected with it by the submucous connective tissue, is placed the muscular coat, and. externally over the greater portion of its length the peritoneal serous membrane. All parts are supplied with blood-vessels, lymph-ducts, and nerves, the last belonging either to local or to central circuits. Associated with the tract are the salivary glands, the liver, and the pancreas ; while, in addition, lymphoid tissue is met with diffusely scattered throughout the lining membranes in the tonsils, apiiendix, solitary glands and Peyer's patches, and the mesenteric glands. The functions of the various parts of the system in whose lesions we are here in- terested are many in number. It would take up too much space to enumerate all their proved and suggested

functions. Broadly, they may be given as : (1) Ingestion and swallowing of food, transmission of it through the tract, and expulsion of the waste material ; (2) secretion of acids arid alkalies for the performance of digestive processes, aided by (3) elaboration and addition of com- plex bodies, termed enzymes or ferments ; (4) secretion of mucus ; (5) protection of the body against organismal infection, and. against toxic products; (6) absorption of food elements and reconstitution of them into complex substances fitted for metabolic application; and (7) ex- cretion of the waste products of protoplasmic action. These functions may be altered by disease, singly or in conjunction ; it is rare, however, to find but one affected, while an apparently identical disturbance of function may often arise from totally different organic lesions. Another point of importance is seen in the close inter- dependence which exists between the secretions of acid and those of alkaline reaction. The difference in reaction seems to act mutatis mutandis as a stimulant in each instance.

General Diseases.

In all sections of the alimentary canal actively engaged in the digestion of food, a well-marked local engorgement

of the blood-vessels supplying the walls occurs. fes/ons" The hypersemia abates soon after completion of

the special duties of the individual sections. This normal condition may be abnormally exaggerated by over-stimulation from irritant poisons introduced into the canal ; from too rich, too copious, or indigestible articles of diet; or from too prolonged an experience of some unvaried kind of food-stuff, especially if large quantities of it are necessary for metabolic needs ; enter- ing into the first stage of inflammation, acute hypersemia. More important, becaiise productive of less tractable lesions, is passive congestion of the digestive organs. Whenever the flow of blood into the right side of the heart is hindered, whether it arise from disease of the heart itself, or of the lungs, or proceed from obstruction in some part of the portal system, the damming-back of the venous circulation speedily produces a more or less pronounced stasis of the blood in the walls of the alimen- tary canal and in the associated abdominal glands. The lack of a sufficiently vigorous flow of blood is followed by deficient secretion of digestive agents from the glan- dular elements involved, by decreased motility of the muscular coats of the stomach and bowel, and lessened adaptability throughout for dealing with even slight irregular demands on their powers. The mucous mem- brane of the stomach and bowel, less able to withstand the effects of irritation, even of a minor character, readily passes into a condition of chronic catarrh, while it fre- quently is the seat of small abrasions, hsemorrhagic erosions, which may cause vomiting of blood and the appearance of blood in the stools. Obstruction to the flow of blood from the liver leads to dilatation of its blood-vessels, consequent pressure upon the hepatic cells adjoining them, and their gradual loss of function, or even atrophy and degeneration. In addition to the re- sults of such passive congestion exhibited by the stomach and bowel as noted above, passive congestion of the liver is often accompanied by varicose enlargement of the abdominal veins, in particular of those which

surround the lower end of the oesophagus, the lowest part of the rectum and anus. In the latter position these dilated veins constitute what are known as haemorrhoids or piles, internal or external as their site lies within or outside the anal aperture.

The mucous and serous membranes of the canal and the glandular elements of the associated organs are the parts most subject to inflammatory affections. Among the

several sections of the digestive tract itself, the oesophagus and jejunum are singularly exempt from inflammatory processes; the fauces, stomach, caecum and appendix, ileum, mouth and duodenum (including the opening of the common bile duct), are more commonly involved. Carious teeth, accumulations of latram- sordes, and attacks of acute fevers frequently Zt^Z. are the causal agents in stomatitis or inflam- mation of the mouth; while a more local form of the ailment over the dorsum of the tongue is commonly a sympathetic condition accompanying gastric or hepatic derangements. An ordinary ” sore throat ” usually sig- nifies acute catarrh of the fauces, and is in all likelihood of purely organismal origin, ” catching cold ” being only a secondary and minor cause. In ” relaxed throats ” there is a chronic catarrhal state of the lining membrane, with some passive congestion. The tonsils are peculiarly liable to catarrhal attacks, as might a priori be expected by reason of their Cerberus-like function with regard to bacterial intruders. Still, acute attacks of tonsillitis appear on good evidence to be more common among in- dividuals predisposed constitutionally to rheumatic mani- festations. Cases of acute tonsillitis may or may not go on to suppuration or quinsy ; in all there is great con- gestion of the glands, increased mucus secretion, and often secondary involvement of the lymphatic glands of the neck. Repeated acute attacks often lead to chronic inflammation, in which the glands are enlarged, and often hypertrophied in the true sense of the term. In chil- dren, however, hypertrophy of the tonsils seems to occur sui generis. The oesophagus is the seat of catarrh but seldom ; too hot food and strong solutions of corrosive or irritant substances, if swallowed, may cause the symp- toms common to inflamed tissues. The physical changes presented by the coats of the stomach and the intestine, the

subjects of catarrhal attacks, closely resemble one another, but differ symptomatically. Acute catarrh of the stomach is associated with intense hypereemia of its lining coats, with visible engorgement and swelling of the mucous membrane, and an excessive secretion of mucus. The formation of active gastric juice is arrested, digestion ceases, peristaltic movements are sluggish or absent, unless so over-stimulated that they act in a direction the reverse of the normal, and induce expulsion of the gastric contents by vomiting. The gastric contents, in whatever degree of dilution or concentration they may have been ingested, when ejected are of porridge- thick consistency, and often but slightly digested. Such conditions may succeed a severe alcoholic bout, be caused by irritant substances taken in by the mouth, or arise from fermentative processes in the stomach contents them- selves. Should the irritating material succeed in passing from the stomach into the bowel, similar physical signs are present; but as the quickest path offered for the expulsion of the offending substances from the body is downwards, peristalsis is increased, the flow of fluid from the intestinal glands is larger in bulk, though of less potency as regards its normal actions, than in health, and diarrhoea, with removal of the irritant, follows. As a general rule, the more marked the involvement of the large bowel, the severer and more fluid is the resultant diarrhoea.

Catarrhal affections of the cseeum and its attached appendix vermiformis are very common, and give rise to several special symptoms and signs. Acute inflam- matory appendicitis appears to be increasing in fre- quency, and is caused without doubt, in the great majority of instances, by faecal accumulation, with the entrance of a small feecal mass into the lumen of the organ, or by the occurrence of bacterial fermentation of a malign type, along with, it may be, and because of,

fseeal stasis. Occasionally the entrance of some foreign body, a cherry-stone, a fish-bone, or a pin, sets up an attack ; but exciting agents of this type are less commonly met with than popular ideas would suggest. Very similar symptomatically is the condition termed perityphlitis, doubtless in former days frequently due to the appendix, an acute or chronic inflammation of the walls of the ceecum often leading to abscess formation outside the gut, with or without direct communication with the canal. The colon and sigmoid flexure are more subject to chronic inflammatory attacks than to acute, save in eases of acute gastro-enteritis and diarrhosa, or of special infections. Prolonged constipation, with fseeal accumulation in the large bowel, "may lead to a secondary diarrhcea, from the severe irritation of the mucous membrane of the gut occasioned by the scybalous masses. Acute simple hepa- titis is a rare disease; acute pancreatitis is usually of septic origin.

Chronic catarrhal affections of the stomach are very common, and often follow upon repeated acute attacks. In them the connective tissue increases at the expense of the glandular eleaents; the mucous membrane becomes thickened and less active in function. Should the muscular coat be involved, the elasticity and contractility of the organ sufifer ; peristaltic movement is weakened ; expulsion of the contents through the pylorus hindered ; and, aggravated by these effects, the condition becomes worse, atonic dyspepsia in its most pronounced form results, with or without dilatation. Chronic vascular congestion may occasion in process of time similar signs and symptoms.

Duodenal catarrh is constantly associated with jaundice, indeed is most probably the commonest cause of catarrhal jaundice; often it is accompanied by catarrh of the common bile duct. Chronic inflammation of the small intestine gives rise to less prominent symptoms than in the stomach. It generally arises from more than one cause; or rather secondary causes rapidly become as important as the primary in its incidence. Chronic congestion and prolonged irritation lead to deficient secretion and sluggish peristalsis ; these effects encourage intestinal putrefaction and auto-intoxication ; and these latter, in turn, increase the local unrest. Chronic catarrh of the colon is frequently characterized by secretion of an excessive amount of mucus

from the goblet cells and its appearance in the stools â€” mucous colitis ; or, again, by the passage of membranous shreds and casts of the bowel â€” membranous colitis â€” the casts really consisting of a mucous skin from the surface of the gut, including some of the epithelial cells. The rectum may suffer in the same way â€” proctitis. Membranous colitis is stated to be closely associated with disordered nervous control. Simple chronic peritonitis is not of frequent occurrence, nor are the views held as to its causation very clear. In common with the acute form, it may be localized or general. A hyperplastic variety is met with in which the peritoneal membrane is greatly thickened. Undoubtedly some cases arise from pelvic disease in women. Distinct localized forms occur over the liver and spleen â€” peri- hepatitis and perisplenitis â€” in which an external chronic fibroid change coincides with similar conditions within the organs.

The intestinal mucous membrane, the peritoneum, and the mesenteric glands are the chief sites of tubercular infection in the digestive organs. Rarely met ‘lesloJsf “^^*^ ^^ ^^^ gullet and stomach, and compara- tively seldom in the mouth and lips, tubercular inflammation of the small intestine and peritoneum is common. Tubercular enteritis is a frequent accompani- ment of phthisis pulmonum, but may occur apart from tubercle of other organs. Children are especially subject

to the primary form. Tubercular peritonitis often is present also. The inflammatory process readily tends towards ulcer formation, with haemorrhage and some- times perforation. If in the large bowel, the symptoms are usually less acute than those characterizing tuber- cular inflammation of the small intestine. The appendix has been found to be the seat of tubercular processes; in the rectum they form the general cause of the fistulas and abscesses so commonly met with here. Tubercular peritonitis may be primary or secondary, acute or chronic ; occasionally very acute cases are seen running a rapid course ; the majority are chronic in type. The tubercles spread over the surface of the serous membrane, and if small and not very numerous, may give rise in chronic cases to few symptoms ; if larger, and especially when they involve and obstruct the lymph- and blood- vessels, ascites follows. It is hardly possible that tubercular invasion of the mesenteric glands

can ever occur unaccompanied by peritoneal infection ; but when the infection of the glands constitutes the most promi- nent sign, the term tabes mesenterica is sometimes employed. Here the glands, enlarged, form a doughy mass in the abdomen, leading to marked protrusion of the abdominal walls, with wasting elsewhere, and diarrhoea.

The liver is seldom attacked by tubercle, unless in cases of general miliary tuberculosis. Now and then it contains large caseous tubercular masses in its substance.

An important fact with regard to the tubercular pro- cesses in the digestive organs lies in the ready response to treatment shown by many cases of peritoneal or mes- enteric invasion, particularly in the young.

The later sequelae of syphilis display a predilection for the rectum and the liver, usually leading to the development of a stricture in the former, to a diffuse hepatitis or the formation of gummata in the second. The upper incisor teeth in cases of congenital syphilis are often stunted and peg-shaped. As the result both of syphilis and of tubercle, the tissues of the liver and bowel may present a peculiar alteration; they become amyloid, or lardaceous, a condition in which they appear “waxy,” are coloured dark mahogany brown with dilute iodine solutions, and show degenerative changes in the connective tissue.

Malarial cirrhosis of the liver is described, but the con- nexion between it and abuse of alcohol requires further study.

The bacillus of Eberth, which appears to be the invariable associate and probable causal agent of typhoid fever, has its chief seat of activity in the small intestine, more especially in the lower half of the ileum. Attacking the lymphoid follicles in the mucous membrane, it causes first inflammatory enlargement, then necrosis and ulceration. The adjacent portions of the mucous membrane show acute catarrhal changes. Diarrhoea, of a special “pea-soup” type, may or may not be present; while hemorrhage from the bowel, if ulcers have formed, is common. As the ulcers fre- quently extend down to the peritoneal coat of the bowel, perforation of this membrane and extrava- sation into the peritoneal cavity is easily induced by irritants introduced into or

elaborated in the bowel, acting physically or by the excitation of hyper-peri- stalsis.

True Asiatic cholera has been shown to be due to the presence of a spirillum in the contents of the bowel, and to its growth therein ; more rarely, and only in chronic types, to its development in the tissues of the intestinal wall. The spirillum of cholera produces an intense irritation of thebowel, seldom of the stomach, witliout giving rise locally to any marked physical change ; it causes violent diarrhcea

and copious discharges of ” rice-water ” stools, consisting largely of serum swarming with the organism.

The lesions in dysentery are almost entirely confined to the large bowel ; at first inflammatory, later ulcerative. The stools are chiefly composed of gelatinous mucus and blood. Two forms are distinguished â€” the non-amcebic, ascribed to famine and close confinement, and the amoebic, from the amoeba coli (Losch) constantly found with it; the disease is common to the warmer climates.

Acute parotitis, or mumps, is an infectious disease of the parotid glands, chiefly interesting because of the asso- ciation between it and the testes in .males, inflammation of these glands occasionally following or replacing the afEection of the parotids. The causal agent is probably organismal, but has as yet escaped detection.

The relative frequency with which malignant growths occur in the different organs of the digestive system may be gathered from the following tabular analysis of 1768 cases recorded in the books of the Edinburgh Royal Infirmary as having been treated in the medical and surgical wards between the years 1892 to 1899 inclusive. Of these, 1263, or 71-44 per cent., were males ; 506, or 28-56 per cent., females : â€”

New growths.

Males.

Females.

Both Sexes.

Organ or Tissue

Per-

Organ or Tissue

Per-

Organ or Tissue

Per-

in Order

cent-

in Order

cent-

in Order

cent-

of Frequency.

age.

of Frequency.

age.

of Frequency.

age.

1 Stomach

22-60

1 Stomach . .

22-87

1 Stomach . .

22-49

2 Lip .

12-94

2 Eectum .

17-24

2 Eectum . .

13-12

8 Rectum .

11-57

8 Liver . . .

15-50

3 Liver

10-02

4 Tongue . . .

11-86

4 Peritoneum

7-86

4 Lip ... .

9-89

5 (Esophagus

10-90

5 CBsophagus ,

5-33

5 (Esophagus ,

9-29

6 Liver . .

7-80

6 Sigmoid .

4-53

6 Tongue .

8-96

7. Taw . . .

6-88

7 Pancreas . .

8-52

7 Jaw ....

6-65

3 Mouth . .

2-88

8 Tongue .

812

8 Peritoneum .

2-94

9 Tonsils . .

2-09

9 Omentum . .

2-98

9 Sigmoid . .

2-66

10 Sigmoid flex-

10 Lip . . .

2-57

10 Mouth . . .

2-40

ure ....

1-77

llJaw . . . .

1-97

11 Pancreas .

1-80

11 Parotid . . 1

1-10

12 Colon . . j

1-84

12 Tonsils . . .

1-85

12 Pancreas . f

18 Abdomen > (

13 Omentum . .

1-26

18 CiBcum .. . 1 14 Peritoneum, f

0-94

14 Intestine

1-56

14 Parotid . . 1

15 Colon 1

1-12

15 Cfficum

1-37

15 Colon . .

0-89

16 Mouth . 1

1-18

16 Cfficum . . .

1-08

16 Pharynx . ”

17 Parotid . . (

17 Intestine 1

1-00

17 Intestine

0-79

18 Splenic flex-

18 Abdomen]

{site un-

ure ....

0-98

19 Pharynx . .

0-62

known)

19 Jejunum and

20 Mesentery . .

0-52

18 Abdomen

0-71

ileum . .

0-78

21 Jejunum and ‘

19 Mesentery 1

0-55

20 Tonsils . .

0-68

ileum .

ao Omentum . j

21 Pharynx . “I

22 Hepatic

flexure .

0-44

21 Hepatic flex-

22 Hepatic . .

0-40

ure , . . .

0-89

flexure

28 Splenic

â€¢12 Submaxillary ‘

28 Mesentery . J

flexure .

gland . .

0-81

24 Submaxilary

0-20

24 Submaxillary

0-28

28 Jejunum and

25 Duodenum

25 Duodenum

0-22

ileum . .

24 Duodenum

0-23

25 Splenic flex-

ure ….

0-15

2^ote. â€” The figures where several organs are bracketed apply to each organ separately.

If the figures given above be classified upon broader lines, the results are as follows, and speak for them- selves : â€”

Per-

Per-

Per-

Males.

cent-

Females.

cent-

Total.

cent-

age.

age.

age.

1 Mouth and

1 Intestines . .

28-9

1 (Esophagus and

81-78

phai-ynx . .

37-86

2 (Esophagus and

stomach . .

2 (Esophagus and

stomach .

27-7

2 Mouth and

stomach . .

88-46

3 Liver ....

15-6

pharynx

80-27

8 Intestines . .

17-04

4 Peritoneum . .

13-1

3 Intestines . .

20-42

4 Liver ....

7-8

5 Mouth and

4 Liver . .

10-02

5 Peritoneum

2-75

pharynx . ,

11-8

5 Peritoneum . .

5-71

6 Pancreas

1-1

6 Pancreas . . .

8-5

6 Pancreas . . .

1-80

The digestive organs are peculiarly subject to malignant disease, a result of the incessant changes from passive to active conditions, and vice versd, called for by repeated introduction of food; while the comparative frequency with which different parts are attacked depends, in part.

upon the degree of irritation or changes of function imposed upon them. Scirrhous, encephaloid, and colloid forms of carcinoma occur. In the stomach and oesophagus the scirrhous form is most common, the soft encephaloid form coming next. The most common situation for can- cerous growth in the stomach is the pyloric region. Walsh out of 1300 cases found 60-8 per cent, near the pylorus, 11-4 per cent, over the lesser curvature, and 4-7 per cent, more or less over the whole organ. The small intestine is rarely attacked by cancer ; the large intestine frequently. The rectum, sigmoid flexure, caecum, and colon are affected, and in this order, the cylindrical-celled form being the most common. Carcinoma of the peritoneum is gener- ally colloid in character, and is often secondary to growths in other organs. Cancer of the liver follows cancer of the stomach and rectum in frequency of occurrence, and is relatively more common in females than males. Second- ary invasion of the liver is a frequent sequel to gastric cancer. The pancreas occasionally is the seat of cancerous growth.

Sarcomata are not so often met with in the digestive organs. When present, they generally involve the peri- toneum or the mesenteric glands. The liver is sometimes attacked, the stomach rarely.

Benign tumours are not of common occurrence in the digestive organs. Simple gro”wths of the salivary glands, cysts of the pancreas, and polypoid tumours of the rectum are the most frequent.

The intestinal canal is the habitat of the majority of animal parasites found in man. Frequently their presence leads to no morbid symptoms, local or general ; nor are the symptoms, when they do arise, always pg’^^les characteristic of the presence of parasites alone. Discovery of their bodies, or of their eggs, in the stools is in most instances the only satisfactory proof of their pre- sence. The parasites found in the bowel belong princi- pally to two natural groups. Protozoa and Metazoa. The great class of the Protozoa furnish amoebae, members of Sporozoa, and Infusoria. The amoebae are almost invari- ably found in the large intestine ; one species, indeed, is termed amoeba coli. The frequently ~~observed relation be~~ tween attacks of dysentery and the presence of amoebae in the stools has led to the proposition that an amoeba dysenterica exists, causing the disease, â€” a theory supported by the detection of amoebae in the contents of dysenteric abscesses of the liver. No symptoms of injury to health appear to accompany the presence of Sporozoa in the bowel, while the species of Infusoria found in it, the Oercomonas, and Trichom,onas intestincdis, and the Balanti- dium coli, may or may not be guilty of prolonging con- ditions within the bowel such as have previously set up diarrhoea.

The Metazoa supply examples of intestinal parasites from the classes Annuloida and Nematoidea. To the for- mer class belong the various tapeworms found in the small intestine of man. They, like other intestinal parasites, are destitute of any power of active digestion, simply absorbing the nutritious proceeds of the digestive processes of their hosts. Nematode worms infest both the small and large intestine ; Ascaris lumbricoides, the common round worm, and the male Oxyuris vermicularis are found in the small bowel, the adult female Oxyuris vermicularis and the Tricocephalus dispar in the large.

The eggs of the Trichina spiralis, when introduced with the food, develop in the bowel into larval forms which invade the tissues of the body, to find in the muscles congenial spots wherein to reach maturity. Similarly, the eggs of the Echinococcus are hatched in the bowel, and the embryos proceed to take up their abode in the tissues of the body, developing into cysts capable of growth into mature worms after their ingestion by dogs.

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[digestive system

Table showing the moke important Vegetable Okganisms and Animal Parasites.

VeG JET ABLE 0

RGANISMS.

Mouth and Fauces.

Stomach.

Small Intestine.

Large Intestine.

A. Simple.

Spirochaeta buccalis.

Bacillus acidi

Bacillus coli com-

Moulds.

Leptothnx buccalis.

lactici.

munis.

Yeasts.

Micrococcus tetra-

Bacterium lactis

Bacillus butyri-

Bacillus coll

genus.

aerogenes.

cas.

communis.

TariouB fission ba-

Bacillus coli com-

B. amylobacter. B. acidi lactici.

B. subtilis.

cilli.

munis.

Micrococci.

Sarcina ventri-

B. lactis aero-

culi.

genes.

Bacillus subtilis.

Streptococcus

Proteus vulgaris.

liquefaciens

Bacillus pyocy-

ilel.

aneus.

Bacterium lique-

Yeasts. Moulds.

faciens ilei.

Bacillus genicu-

Bacterium ilei.

latus.

Micrococci.

Bacillus buty-

Yeasts.

ricus.

Moulds.

Bacillus amylo-

bacter.

B. mycoides.

Vibrio rugula.

Micrococcus

tetragenus.

Bacillus ramosus.

B. Pathogenic.

Tubercle baciUus.

Comma bacillus

Bacillus typhos-

Bacillus typhos-

Bacillus diphtherias.

(rarely).

us.

us.

Pneumococcus.

Tubercle bacillus.

Comma bacillus

Comma bacil-

Staphylococcus

Actinomycosis.

(cholera).

lus.

pyogenes aureus.

Bacillus typhos-

Tubercle bacillus.

Amoebae coli.

Staphylococcus

us.

(Bacillus coli

Tubercle bacU-

pyogenes aureus.

communis.)

lus.

Staphylococcus

Finkler- Prior

albus.

bacillus.

Streptococcus pyo-

(Bacillus coli

genes albus.

communis.)

Oidiura albicans.

Actinomycosis.

Animal Pa

RASITES.

Mouth.

Small Intestines.

Large Intestines.

Larvae.

Coccidia.

Monadlnes.

Cercomonas.

Coccidia.

Tfenia solium.

Oxyuris vermicularis.

Tteuia saginata.

Larvffi of insects.

Bothriocephalus latus.

Distoma hepaticum.

D. lanceolatus.

Ascaris lumbricoides.

Anchylostoma duodenale.

Tricocephalus dispar.

Trichina spiralis.

Numbers of bacterial forms habitually infest the ali- mentary canal. The names of the more common species are given in the foregoing table. Many of parodies, them are non-pathogenic; some develop patho- genic characters only under provocation or when a suitable environment induces them to act in such a manner ; others may form the materies morbi of special lesions, or be casual visitors capable of originating dis- ease if opportunity occurs. Apart from those organisms associated ~~with acute infective diseases, disturbances of function and physical lesions may be the result of abnormal bacterial activity in the canal ; and these disturbances may be both local and general. Many of the bacteria commonly present produce putrefactive changes in the contents of the tract by their metabolic processes. They render the medium they grow in alka~~ line, produce different gases, and elaborate more or less virulent toxins. Other species set up an acid fermenta- tion, seldom accompanied by gas or toxin formation. The products of either class are inimical to the free growth of members of the other. The species which produce acids are more resistant to the action of acids. Thus, when the contents of the stomach possess a normal or excessive proportion of free hydrochloric acid, a much larger number of putrefactive and pathogenic organisms in the food are destroyed or inhibited than of the

bacteria of acid fermentation. Diminished gastric acidity allows of the entry of a greater number of putrefactive (and pathogenic) types, with, as a conse- quence, increased facilities for their growth and activity, and the appearance of intestinal derangements.

It is still a moot question if bacteria can penetrate the coats of the bowel and enter surrounding tissues when no solution of continuity exists. The frequent septic condi- tions of abscesses adjoining but not communicating with the bowel seem to favour the possibility of bacterial penetration ; and the occurrence of acute peritonitis with- out any appreciable peritoneal lesion supports it. Bacte- rial forms are said to be able to pass through the mucous membrane of the canal and reach the blood-stream, where, unless they are of excessive number, they are killed. Passage of bacteria from the blood through the peri- toneal membrane into the abdominal cavity has been recorded.

Whenever putrefactive processes are excessive in the bowel, and in prolonged constipation, symptoms of auto- intoxication may occur, caused by absorption of poisonous bacterial products in larger amount than can be dealt with by the defensive power of the liver.

The faeces have been shown to be composed in large part of various species of bacteria.

Hare-lip, cleft palate, hernia, and imperforate anus be- long to the subject of Surgeey. The oesophagus may be the seat of a diverticulum, or blind pouch, physical usually situated in its lower half, which in abnorma- most instances is probably partly acquired and “”’*â€¢ partly congenital ; a local weakness succumbing to press- ure. Hypertrophy of the muscular coat of the pyloric region is an infrequent congenital gastric anomaly in infants, preventing the passage of food into the bowel, and causing death in a short time. Incomplete closure of the vitelline duct results in the presence of a diver- ticulumâ€” Meckel’s â€” generally connected with the ileum, mainly important by reason of the readiness with which it occasions intestinal obstruction. Idiopathic congenital dilatation of the colon has been described.

Traction diverticula of the OBSophagus not uncommonly occur as sequels to suppurative inflammation of cervical lymphatic glands. More frequently dilatation of a section is met with, due as a rule to the presence of a stricture. The stomach often diverges from the normal in size, shape, and position. Normally capable in the adult of containing from fifty to sixty ounces, either by reason of organic disease, or as the result of functional disturbance, its capacity may vary enormously. The writer has seen post mortem a stomach which held a gallon (160 ounces), and again, one holding only two ounces. Cancer spread over a large area and cirrhosis of the stomach wall cause diminution in capacity ; pyloric obstruction, weak- ness of the muscular coat, and nervous influences are associated with dilatation. A peculiar distortion of the shape of the stomach follows cicatrization of ulcers of greater or lesser curvature ; the gastric cavity becomes “hour-glass” in shape. In addition, the stomach may be displaced downwards as a whole, a condition known as gastroptosis : if the pyloric portion only be

displaced, the lesion is termed pyloroptosis. Ptoses of other ab- dominal organs are described ; the liver, transverse colon, spleen, and kidneys may be involved. Displacements downwards of the stomach and transverse colon, along with a movable right kidney and associated with dyspepsia and neurasthenia, form the malady termed by 'Glenard enteroptosis. Displacements of the abdominal viscera are almost invariably accompanied by symptoms of dyspepsia of a neurotic type. The rectum "is liable to prolapse, con- sequent upon constipation and straining at stool, or fol- lowing local injuries of the perineal floor.

DIGESTIVE system]

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Every pathological lesion shown by digestive organs is closely associated with the state of the nervous sys- latiuence ^^^i general or local ; so stoppage of active gas- ot the trie digestive processes after profound nervous nervous shock, and occurrence of nervous diarrhoea from sys em. ^^^^ same cause. Gastric dyspepsia of nervous origin presents most varied and contradictory symptoms : diminished acidity of the gastric juice; hyperacidity; over-production ; arrest of secretion ; lessened or increased movements ; greater sensitiveness to the presence of con- tents ; dilatation ; or spasm. Often the nervous cause can be traced back farther. In females, frequently to the pelvic organs ; in both sexes, to the condition of the blood, the brain, or the bowel. Unhealthy conditions related to evacuation of the bowel-contents commonly in- duce reflex nervous manifestations of abnormal character referred to the stomach and liver. Gastric disturbances similarly react upon the proper conduct of intestinal functions.

Local Diseases.

Tlie Mouth. â€" The lining membrane of the cheeks inside the mouth, of the gums and the under-surface and edges of the tongue, is often the seat of small irritable ulcers, usually associated with some digestive derangement. A crop of minute vesicles over these parts has been lately

stated by Koplik to be an early symptom of measles. Xerostomia, or dry mouth, is a rare condition, connected with lack of salivary secretion. Gangrenous stomatitis, cancrum oris, or noma, occasionally attacks debilitated children, or patients convalescing from acute fevers, more especially after measles. It commences in the gums or cheeks, and causes widespread sloughing of the adjacent soft parts ; it may be of the bones.

Tlie Stomach. â€” It were futile to attempt to enumerate all the protean manifestations of disturbance which pro- ceed from a disordered stomach. The possible permuta- tions and combinations of the causes of gastric vagaries almost reach infinity. Idiosyncrasy, past and present gastric education, penury or plethora, actual digestive power, motility, bodily requirements and conditions, en- vironment, mental influences, local or adjacent organic lesions, and, not least, reflex impressions from other organs, all contribute to the variance.

Ulcer of the stomach, however â€” ~~the perforating gas~~ tric ulcer â€” occupies a unique position among diseases of this organ. Gastric ulcers are circumscribed, punched out, rarely larger than a sixpenny-bit, funnel-shaped, the narrower end towards the peritoneal coat, and distri- buted in those regions of the stomach wall which are most exposed to the action of the gastric contents. They occur most frequently in females, especially if anaemic, and are usually accompanied by excess of acid, actual or relative to the state of the blood, in the stomach con- tents. Local pain, dorsal pain, generally to the left of the eighth or ninth dorsal spinous process, and heema^ temesis or melsena, are symptomatic of it. The amount of blood lost varies with the rapidity of ulcer formation and the size of vessel opened into. Fatal results arise from ulceration into large blood-vessels, followed by copious haemorrhage, or by perforation of the ulcer into the peritoneal cavity. Scars of stich ulcers may be found post mortem, although no symptoms of gastric disease have been exhibited during life; gastric ulcers, therefore, may be latent.

Irritation of the sensory nerve-endings in the stomach wall from the presence of an increased proportion of acid, organic or mineral, in the

stomach contents is accountable for the well-known symptom, heartburn. Water-brash is a term applied to eructation of a colour- less, almost tasteless fluid, probably saliva which has

collected in the lower part of the oesophagus from failure of the cardiac sphincter of the stomach to relax ; reversed oesophageal peristalsis causing regurgitation. A similar reversed action serves in meryeism, or rumination, occa- sionally found in man, to raise part of the food, lately ingested, from the stomach to the mouth. Vomiting also is aided by reversed peristaltic action, both of the stomach and the oesophagus, with the help of the dia- phragm and the muscles of the anterior abdominal wall. Emesis may be caused both by local nervous influence, and through the central nervoiis mechanism either reflexly or from the direct action of substances circulating in the blood. Further, the causal agent acting on the central nervous apparatus may be organic or functional, as well as medicinal. Vomiting without any apparent cause sug- gests nervous lesions, organic or reflex. The obstinate vomiting of pregnancy is a case in point. Here the pri- mary cause proceeds reflexly from the pelvis. In females the pelvic organs are often the true source of emesis. Haeraatemesis accompanies gastric ulcer, cancer, chronic congestion with hsemorrhagic erosion, congestion of the liver, or may follow violent acts of vomiting. In cases of ulcer the blood is usually bright and in considerable amount ; in cancer, darker, like coffee-grounds ; and in cases of erosion, in smaller quantity and of bright colour. The reaction of the stomach contents, if the cause be doubtful, yields valuable aid towards a diagnosis. Of normal or increased acidity in gastric ulcer, normal in hepatic congestion, it is diminished in cancer ; but as the acid present in cancer is largely lactic, analysis of the gastric contents must often be a sine qud nan, because hyperacidity from lactic may obscure hypoacidity of hydrochloric acid.

Flatulence usually results from fermentative processes in the stomach and bowel, as the outcome of bacterial activity. The gases evolved are various and complex in nature. Proteid decomposition sometimes leads to the formation of sulphuretted hydrogen ; while inflammable marsh gas, formed by the same in the stomach, has been accidentally- set alight at the mouth in a few instances. – A different form of flatulence

is common in neurotic individuals ; in such the gas evolved consists simply in carbonic acid liberated from the blood, and its evolution is generally characterized by rapid development and by lack of all fermentative signs.

Tlie Liver. â€” The liver is an organ frequently libelled for the delinquencies of other organs, and regarded as a common source of ill. In catarrhal jaundice it is in most cases the bowel that is at fault, the liver acting properly, but unable to get rid of all the bile produced. The liver suffers, however, from several diseases of its own. Its fibrous or connective tissue is very apt to increase at the expense of the cellular elements, de- stroying their functions. This cirrhotic process usually follows long-continued irritation, such as is produced by too much alcohol absorbed from the bowel habitually, the organ gradually becoming harder in texture and smaller in bulk. Hypertrophic cirrhosis of the liver is not uncommonly met with, in which the liver is mu.ch increased in size, the ” unilobular ” form, also of alcoholic origin. In still-born children and in some infants a form of hypertrophic cirrhosis is occasionally seen, probably of hereditary syphilitic origin. Acute congestion of the liver forms an important symptom of malarial fever, and often leads in time to establishment of cirrhotic changes ; here the liver is generally enlarged, but not invariably so, and the part played by alcohol in its causation has still to be investigated. Acute yellow atrophy of the liver is a disease sui genereis. Of rare occurrence, possibly of toxic origin, it is marked by jaundice, at first of usual type, later becoming most intense ; by vomiting ; haemorrhages

widely distributed ; rapid diminution in the size of the liver ; the appearance of leucin and tyrosin in the urine, with lessened urea; and in two or three days, death. The liver after death is soft, of a reddish colour, dotted with yellow patches, and weighs only about a third part of the normal â€” about li lb in place of 3| lb. A closely analogous

affection of the liver, known as Weil's disease, is of infectious type, and has been noted in epidemic form. Hepatic abscess is another condition not infrequent among dwellers in tropical climates, especially should they have suffered previously from dysentery. There is strong reason to believe that the amoeba coli has a direct connexion with its causation. Injuries of the liver are sometimes followed by abscess formation, while septic abscesses in this organ are common in blood-poisoning.

The Qall-Bladder. â€" The formation of biliary calculi in the gall-bladder is the chief point of interest here. At least 75 per cent, of such cases occur in women, espe- cially in those who have borne children. Tight-lacing has been stated to act as an exciting cause, owing to the consequent retardation of the flow of bile. Gall-stones may number from one to many thousands. They are largely composed of cholesterin, combined with small amounts of bile-pigments and acids, lime and magnesium salts. Their presence may give rise to no symptoms, or may cause violent biliary colic, and if the bile-stream be obstructed, to jaundice. Inflammatory processes niay be initiated in the gall-bladder or the bile-ducts, catarrhal or suppurative in character.

The Poflicreas. â€" Haemorrhages into the body of the pancreas, acute and chronic inflammation, calculi, cysts, and tumours, among which cancer is by far the most com- mon, are recognized as occurring in this organ ; the point of greatest interest regarding them lies in the relations established between pancreatic disease and diabetes mellitus, affections of the gland frequently being compli- cated by, and probably causing, the appearance of sugar in the urine.

The Small Intestine. â€" Little remains to be added to the account of inflammatory lesions in connexion with the small intestine. It offers but few conditions peculiar to itself, save in typhoid fever, and the ease with which it contrives to become kinked, or intussuscepted, pro- ducing obstruction, or to take part in hernial protru- sions, for which the article on Surgery should be consulted. The first section, the duodenum, is subject to development of ulcers very similar to those of the gastric mucous membrane. !Por long duodenal ulcera- tion has been regarded as a common complication of extensive burns of the

skin, but the relationship between them still lacks evidence sufficiently trustworthy to dis- prove the possibility of coincidence in lieu of effect. The condition of colic in the bowel usually arises from over-distension of some part of the small gut with gas, the frequent sharp turns of the gut facilitating temporary closure of its lumen by pressure of the dilated gut near a curve against the part beyond. In the large bowel accu- mulations of gas seldom cause such acute symptoms, having a readier exit.

The Large Intestine. â€” ~~The colon, especially the ascend~~ ing portion, may become immensely dilated, usually after prolonged constipation and paralysis of the gut; occasion- ally the condition is congenital. Straining efforts made in defsecation may often account for prolapse of the lower end of the rectum through the anus. Haemorrhage from the bowel is usually a sign of disease situated in the large intestine : if bright in colour, the source is probably low down ; if dark, from the caecum or from above the ileo- csecal valve. Blood after a short stay in any section of the alimentary canal darkens, and eventually becomes almost black in colour. (a. l. ((.)

V. E-BSPiRATOEY System.

The term respiratory system comprises the nose, part of the pharynx, the larynx, trachea, bronchial tubes, lungs and pleura, together with the framework of the chest, the muscles of respiration, and that part of the nervous and circulatory systems concerned in the aera- tion of the blood. It is proposed, however, in the present article not to consider in detail the morbid changes affecting all these parts, but to give an account of the more important pathological processes which affect the lungs, pleurse, and bronchial tubes. In the aetiology of pulmonary affections, the relations between the lungs and the external air, and also between them and the cir- culatory system, are important. The lungs are, so to speak, placed between the right and left cavities of the heart, and the only way for the blood to pass from the right ventricle to the left side of the heart, except in cases of a patent foramen ovale or other congenital defect forming a communication between the two sides of the organ, is by passing through them. The result is that not only may

they become diseased by foreign material carried into them by the blood,- but any obstruction to the flow of blood through the left side of the heart tends sooner or later to engorge or congest them, and lead to further changes. Through the nose and mouth they are in direct connexion with the external atmosphere. Hence the variable condition of the air as regards temperature, degree of moisture, and density, is liable to produce directly various changes in the lungs, or to predispose them to disease ; and the contamination of the .air with various pathogenic germs and irritating particles in the shape of dust, is a direct source of many lung affections.

Bronchitis, or inflammation of the bronchial tubes, is one of those affections generally attributed to exposure to inclement atmospheric conditions, although we â€ž are quite unaware what is the essential condi- tion that gives rise to it. We know, however, that it is much more common in the winter than the summer months in the United Kingdom, and that exposure to inclement weather is apt to be followed by the disease, especially when the nasal and laryngeal passages are themselves in a state of catarrh, the catarrhal inflamma- tion apparently then spreading directly from the upper respiratory passages to the bronchi. Although it is pos- sible that micro-organisms play a part in the production of bronchitis, we know of no specific organism which is its cause. Bronchitis may affect the whole bronchial tract, or more especially the larger or the smaller tubes. It may occur as an acute or as a chronic affection. In the acute form the infiammation may remain limited to the bronchial tubes and gradually subside, or it may lead to inflammation of the surrounding lung tissue, giving rise to disseminated foci of inflammation of greater or less extent throughout the lungs (catarrhal or broncho- pneumonia). This is a common complication of bron- chitis, especially where the smaller tubes are affected, and is more frequently seen in children than adults. In cases of chronic bronchitis the affection as a rule begins as a slight ailment during the winter, and recurs in suc- ceeding winters. The intervals of freedom from the trouble get shorter, and in the course of a few years it persists during the summer as well as the winter months. A condition of chronic bronchitis is thus established. The persistent cough which this occasions is one of the chief causes of the development of the condition

of emphysema, where there is a jiermanent enlargement of the air cells of the lungs with an atrophy of the walls of the air vesicles. The emphysema occasions an increase in the shortness of breath from which the per- son had previously suffered, and later, in consequence of

the greater difficulty with which the blood circulates through the emphysematous lungs, the right side of the heart becomes dilated, and from that we have the develop- ment of a general dropsy of the subcutaneous tissues, and less and less perfect aeration of the blood.

Diseases of Occupations. â€" We all inhale a considerable amount of carbonaceous and otiier foreign particles, which in health are partly got rid of by the action of the ciliated cells lining the bronchial tubes, and are partly absorbed by cells in the wall of the tubes, and carried in the lymph channels to the bronchial lymphatic glands, where they are deposited, and cause a more or less marked pigmentation of the tissues. Part of such pigment is also deposited in the walls of the bronchial tubes and the inter- stitial tissue of the lungs, giving rise to the grey appearance presented by the lungs of all adults who live in large cities. The ordinary occupations of life are, however, not associated with the presence of such an amount of foreign particles in the atmosphere as to cause any serious inconvenience, the foreign particles being either got rid of or stored up in the tissues in the manner above described without causing the individual any great discomfort. In certain dusty occupations, however, such as those of stonemasons, knife-grinders, colliers, &o., the foreign particles inhaled do cause trouble. The most-common affection so pro- duced is chronic bronchitis, to which becomes added emphysema. Ill some cases not only is bronchitis developed, but the foreign particles lead to an increase of the fibrous tissue round the bronchi and in the interstitial tissue of the lungs, and so to a greater or lesser extent of fibroid consolidation. As this fibrous tissue may later undergo softening and cavities be formed, a form of

consumption is produced, which is named according to the particular occupation giving rise to it ; e.g,, stonemasons' phthisis, knife-grinders' phthisis, colliers' phthisis. It should, however, be pointed out that these dusty occupations are probably not so fre- quently the cause as was at one time taught of these simple inflammatory fibroid changes in the lungs with their subsequent cavity formation ; individuals engaged in such occupations are apt to suffer from a chronic tuberculosis of the lung associated with the formation of much fibrous tissue, and the occupation simply predisposes the lung to the attacks of the tubercular virus.

The term pneumonia is frequently used of different forms of inflammation of the lungs, and includes affections

which run different clinical courses, present ^oafa. diverse appearances after death, and probably

have different exciting causes. It would be better if the term acute pneumonia were reserved for that form of acute inflammation of the lungs which is usually characterized by sudden onset, and runs an acute course, which terminates generally by crisis from the fifth to the tenth day, the inflammation leading to the consolidation by fibrinous effusion of the greater part or whole of one lobe of a lung. Acute pneumonia usually occurs in a sporadic form, and is most prevalent in the United Kingdom from November to March. Occasionally, however, it is epi- demic, and there is evidence to show that sometimes it is an infective disease, a healthy individual contracting it directly from an affected one. There is great difficulty, however, in being quite certain that the occurrence of the disease in those who have been attending upon or brought into intimate connection with sufferers from pneumonia is the result of infection, for such cases may be due to an epidemic of the disease, or to the various individuals attacked having been exposed to the same cause. Still, after allowing for this fallacy, it seems probable that some cases of pneumonia are infective, presenting a virulence and danger to the attendants not associated with the ordinary run of cases. Formerly acute pneumonia was considered to be a disease occasioned by what was termed " catching cold," and by some

it is still so regarded. The tendency, however, at the present time is to look upon it as caused by the invasion of a specific virus, a micro-organism, and to relegate the exposure to inclement weather to the less important position of a predisposing cause, by which the conditions are rendered favourable for the development and growth of the germ. It cannot, however, be said that we are at present certain of the particular micro-organism which is the cause of pneumonia.

or that all cases of acute pneumonia as above defined are due to one and the same germ. The various forms of pneumonia do not appear to have been sufficiently dif- ferentiated by the observers who have considered the relationship of the micro-organisms found in the inflamed lung to the aetiology of the disease, and it is probable that they are not all excited by one and the same micro- organism. Fraenkel's pneumocoocus is an organism which is found in the inflamed lung in the large majority of cases, though not in all, and it has further been shown to be capable of producing pneumonia when inoculated into mice and guinea-pigs. But in other cases different forms of micro-organisms have been detected, and it is a debatable point what relation these bear to the causation of the disease. Traenkel's pneumococcus is the organism most commonly present, and has the largest amount of evidence in its favour as the exciting cause of the dis-ease. It mu'st, however, be remembered that an organ- ism which is apparently identical with that bearing Fraenkel's name frequently occurs in the saliva of healthy individuals. If, therefore, it is the most common exciting factor, some other element must be necessary before it can exert its action and produce pneumonia. This other element is commonly supposed to be the resist- ing power of the individual, by virtue of which the tissues of healthy persons, in whose saliva the pneumococcus is present, are able to offer a resistance to the multiplica- tion of the germ and to the production of the inflamma-tory process in the lungs. Many conditions appear to lessen this resisting power. Exposure to inclement weather has already been referred to in this connexion, but even in idiopathic pneumonia it is frequently im- possible to satisfy one's self that the patient has been exposed to unsuitable atmospheric conditions immediately before the attack. In other words, the eifects of a so- called chill as a frequent

cause of acute pneumonia have probably been exaggerated. A lowered state of general health usually precedes the onset of the disease, and any- thing producing a depressed nervous condition would appear to be important as a predisposing cause. Chronic alcoholism is one of the most important of such causes, and pneumonia frequently comes on in the course of Bright's disease and acute rheumatism, or as a sequela of influenza. Unlike many acute diseases, pneumonia does not render a person less liable to future attacks ; on the contrary, those who have been once attacked must be looked upon as more prone to be affected again. Acute pneumonia usually attacks the whole or greater part of one lobe of one lung, but more than one lobe may be afiiected, or both lungs may be involved. The disease produces a solid and airless condition of the affected part owing to a fibrinous exudation taking place into the air cells and smaller bronchial passages. In favourable cases the exudation is partly absorbed and partly expectorated, and the lung returns to its normal healthy condition ; in others, death may ensue from the extent of lung aifected, or from the spread of the infiammation to other parts, as for instance the pericardium or meninges of the brain. In such cases it is interesting to note that the same micro- organism has been found in the inflammatory exudation in the pericardium or on the meninges as in the pneumonic lung ; probably the organism had been absorbed from the lung, and was the cause of the secondary inflammations. In cases of death from uncomplicated pneumonia a very variable extent of lung is involved. Sometimes it is com- paratively small, and we are surprised that it has been sufficient to lead to a fatal termination. In som e such cases this result may be ascribed to the weakness of the in- dividual and especially of the^ heart, but in others the virulence of the micro-organisms and the toxins which they have produced is probably the more correct ex-

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planation. The improvement in a patient suffering from pneumonia usually commences suddenly, with a rapid fall in the temperature. The day on -which this ” crisis ” takes place varies, but most commonly it appears to be the seventh from the initial rigor (22 per cent, of the cases, Jurgensen). It may, however, occur a few days earlier or later, being observed in about 74 per cent, between the fifth and the ninth day of the disease (Jurgensen). The disease occasionally ends in the formation of an abscess, in gangrene, or in fibroid induration of the lung, but these terminations are rare.

Broncho-pneumonia. â€” It is usual to recognize a form of inflammation of the lungs which differs from the above lobar pneumonia, and in which small patches of consolidation are usually scattered throughout the lower lobes of both lungs. This broncho or catarrhal i pneumonia is usually preceded by an attack of bronchitis, to which it bears an intimate relation. In some cases the small foci of inflammation ma/ run together so as to affect the greater part of a lobe of a lung, and the distinction between such a form of broncho-pneumonia and lobar pneumonia presents such difficulties in the view of some observers, that they have refused to recognize any essential difference between the two. Usually, however, it is not difficult to distinguish the two affections both clinically and anatomically. Broncho-pneumonia is especially seen as a complication of bronchitis, and while it more frequently attacks children than young adults, it is not uncommon in old people, especially secondary to bronchitis. It is frequent in children after acute infectious fevers,, especially measles and diphtheria, and in cases of whooping-cough. It differs from the above-mentioned pneumonia in that it does not usually attack the whole of a lobe of a lung, but occurs in small disseminated patches more especially throughout the lower lobe of both lungs. The accompanying fever is more irregular than in the preceding form, and the disease usually runs a more prolonged course. It is an extremely fatal affection in both the very young and old. Young persons who have suffered from it are not unfrequently attacked Ijy pulmonary tuberculosis subsequently. It must be admitted that we are even less certain of its bacteriology than we are of that of lobar pneumonia. In

some cases Fraenkel's pneumococcus is found, and in others various other micro-organisms. Many of the latter are doubtless saprophytic, and are not the essential cause of the disease, but it is not probable that any one particidar form of organism accounts for all forms of broncho-pneumonia.

The tubercular virus, the tubercle bacilli, may gain entrance to the lungs through the inspired air or by means of the blood or lymph currents. In the latter cases an acute eruption of tubercle takes place throughout the lungs in the form of small scattered foci forming the so-called miliary tubercles. Such miliary tuberculosis of the lungs is frequently only a part of a general tuberculosis, a similar tubercular affection being found in other organs of the body. In other cases the lungs rnay be the only or the principal seat of the affection. The source whence the tubercular virus is derived varies in different cases. Old tuber- cular glands in the abdomen, neck, and elsewhere, and tubercular disease of bones or joints, are common sources whence tubercular bacilli may become absorbed, and occasion a general dissemination of miliary tubercles in which the lungs participate. Where the source of in- fection is an old tubercular bronchial gland or a focus of old tubercle in the lung, the pulmonary organs may be the only seat of the development of miliary tuberculosis for a time ; but even then, if life is sufficiently prolonged, other parts of the body become involved. Acute miliary tuberculosis of the lungs is not unfrequently a final stage in the more chronic tubercular lesions of the different forms of pulmonary phthisis.

Tubercle.

iThe term catarrhal pneumonia has been usually regarded as synonymous with the term brDDcho-pneumonia, .iiiil this usual nomen- clature has been maintained in the present article. We must, how- ever, recognize that all simple acute broncho-pneumonias are not purely catarrhal in the strict pathological sense. For instance, a considerable amount of fibrinous exudation is not unfrequently present in the patches of broncho-pneumonia, and some of the cases of septic broncho-pneumonia can scarcely be accurately termed catarrhal.

Pulmonary phthisis, or consumption, arises from the action of tubercle bacilli which have usually gained entrance with the inspired air. The disease p^^j^yj. usually commences at the apex of one lung, but runs a very variable course. In a large majority of cases it remains confined to one small focus, and not only does not spread, but undergoes retrograde changes and becomes arrested. In such cases fibrous tissue develops round the focus of disease and the tubercular patch dries up, often becoming the seat of the deposit of calcareous salts. This arrest of small tubercular foci in the lung is doubtless of very frequent occurrence, and in posf>mortem examinations of persons who have died from injuries or various diseases other than tubercle it is common to find in the lungs arrested foci of tubercle, which in the majority of instances have never been suspected during life, and probably have occasioned few, if any, symptoms. It has been shown that in more than 37 per cent, of persons, over 21 years of age, dying in a general hospital of various diseases, there is evidence of arrested tubercle in the lungs. As such persons are chiefly drawn from the poorer classes, among whom tubercle is more common than among the well-to-do, this high percentage may not be an accurate indication of the frequency with which pulmonary tubercle does become arrested among the members of the community in general. It does, however, show that the arrest and the healing of tuberculosis of the lungs is by no means infrequent, and that it occurs among those who from their position in life are not only very prone to become infected, but whose circumstances commonly preclude them from putting themselves in the most favourable circumstances to promote the arrest of the disease. These facts indicate that the human organism does offer a resistance to the growth of the tubercle bacilli, and that the tissues of man, although so frequently attacked by the disease, do not aEord the best conditions for the spread of tubercular disease. The knowledge of the frequency with which early cases of pulmonary tubercle become arrested must also be of the greatest comfort to those who are attacked, and one of the most encouraging factors for treatment. Consumption is still too frequently regarded by the general public as an incurable disease. In the advanced cases that view is doubtless correct, but in the early stage of the disease the process may become arrested, and the in- dividual restored to health and rendered capable of lead- ing a useful life.

A focus of pulmonary tubercle may become arrested for a time and then resume activity. In many cases it is difficult to say why this is so, but often it is clearly associated with a lowering in the general health of the individual, so that we must assume his resisting power to have been lessened. Frequently this is due to his pre- mature return to his occupation and previous habits of life. It cannot be too strongly insisted that the arrest of a tubercular focus in the lung is a slow process and requires a long time. Commonly a person in the early stage of phthisis goes away to a health resort, and in the course of a few weeks or months improves so much that he returns to a densely populated town and resumes his former employment. In a short time his symptoms return and the disease shows renewed activity, because the improved conditions under which he was placed were not maintained long enough to ensure the complete arrest of the disease.

Insteadof the tubercular focus becoming arrested, it may coiitinue to spread and to give rise to other sepai'ate foci in its immediate neighbourhood. The original focus and the secondary ones are at first patches of consolidated lung. Later, their central jiarts soften and burst into a bronchus ; then the softened portion is coughed up, and a small cavity is left, â– \'hich tends gradually to increase in size by

peripheric extension and by merging with other cavities. This process is repeated again and again, and sooner or later the other lung becomes similarly affected. At any stage of the softening process the blood-vessels may become involved and give rise by rupture to a large or a small haemorrhage (Jiceitioptysis). It not unfrequently happens that such haemoptysis occurs at a very early stage of the disease, and it may be the first symptom that seriously attracts attention. At a later period haemorrhage frequently takes place in large or small amounts from the rupture of vessels, which frequently are dilated and form small aneurysms in the walls of cavities. A fatal termination may be hastened by

the absorption by means of the blood-vessels and lymphatics of the tubercular virus from some of the foci of disease, and the occurrence therefrom of a local miliary tuberculosis of the lungs or a general tuberculosis of other organs. The rapidity with which the destructive process spreads throughout the lung varies considerably. In some cases we have extensive destruction in the course of a few weeks, iu others the disease progresses slowly and extends over many years. We therefore recognize acute phthisis or galloping consumption, and chronic phthisis. In the acute cases the softening progresses rapidly and is associated with the development of very little fibrous tissue ; probably various forms of micro-organisms other than the tubercle bacilli assist in the rapid softening. In the more chronic cases there is development of much fibroid tissue, and the disease is associated with periods of temporary arrest of the tubercular process.

The expectoration from cases of phthisis contains tubercle bacilli, and under favourable conditions is a source of danger to healthy-individuals, in whom it may produce the disease. There is very little danger of infection from the sputum when freshly expector- ated, but when it becomes dry and pulverized it is undoubtedly dangerous ; hence the prevention of this drying is an important sanitary precaution. Attendance on persons suffering from phthisis involves very little risk of infection if proper care is taken to prevent the expectoration becoming dry and disseminated as dust ; but it has been conclusively shown that the dust? taken from rooms inhabited by phthisical persons does contain the virus of tubercle, and is capable of producing the disease when inoculated into healthy animals. Perfect cleanliness is therefore to be insisted upon in the rooms inhabited by a phthisical person. The tubercle baciUi soon lose their virulence in the presence of fre'sh air and sunshine, and therefore these agents are not only desirable for the direct benefit of the phthisical patient, but also are agents in preventing the development of fresh disease in healthy individuals.

Although the tubercle bacilli are the essential agents in the development of pulmonary tuberculosis, there are other conditions which must be present before they will produce the disease. Were this

not so, tuberculosis would certainly be a much more common ~~malady in the human subject than it is at present. It is probable that large numbers of individuals are exposed to the action of tubercle bacilli which gain entrance to the pulmonary tract, and yet do not give rise to the disease because the conditions of their growth and multiplication do not exist. In such cases we may consider that the seed is present, but that the soil is unsuitable for its growth. We do not know all the conditions that are favourable or inimical to the growth of the tubercular virus, but we are aware of some. Certain families appear more predisposed to tuberculosis than others. In some instances there would appear to be a direct transmission from parent to offspring of a liability to the disease, but in others a large number of cases of tuberculosis occur in a family though neither parent is apparently affected. Age has an important influence on the development of phthisis, which is most frequent in early adult life. Insanitary conditions of all kinds, especially overcrowding and the absence of fresh air and sunlight from dwellings and workrooms, are important predisposing causes. Anything which impairs the general health is likewise of import~~ ance, such as insufficient and improper food, chronic alcoholism, frequent childbearing, and prolonged lactation. Occupations asso- ciated with deficient ventilation and the presence of much dust in the atmosphere also furnish a large number of cases of consumption. The deteriorated state of health brought about by diabetes is not uncommonly associated with the development of pulmonary phthisis, and previous disease' of the lungs also renders them more liable to a tubercular affection.

The most important circulatory disturbances met with

Con- gestion.

in the lungs are those seen in cases of dilated heart, with or without disease of the mitral valve, when engorgement of the pulmonary vessels sets up a condition of venous engorgement of the lungs. This may lead to various changes. After it has lasted a variable time, and if it is very intense, serous transudation occurs into the substance of the lung and the alveoli, and thus a condition of pulmonary dropsy or oedema is

established. The venous engorgement also predisposes the subjects of such heart affections to bronchitis and pneu- monia. In disease of the mitral valve, in cardiac dilata- tion, and in simple feebleness of the heart, such as is seen in old age and after debilitating fevers, especially typhoid, there is commonly developed a venous congestion of the bases of the lungs, forming the so-called hypostatic congestion of those organs, and to this is frequently added pneumonia. In long-standing cases of pulmonary congestion brought about by disease of the mitral valve and dilatation of the heart, a certain amount of fibrous tissue may be found in the interstitial tissue of the lungs, and from transudation of certain elements of the blood we get the formation in the newly-formed fibrous tissue of blood pigment. In these cases blood pigment is found in the cells, in the pulmonary alveoli, and such cells also carry the pigment into the interstitial tissue. This con- dition constitutes the state known as brovm induration of the lungs. Acute congestion of the lungs occurs as part of the first stage of pneumonia. It also probably exists during violent exertion, and may possibly be brought about by excitement.

Embolism and Thrombosis. â€” Another circulatory dis- turbance of great importance is that arising from blocking of the pulmonary artery or its branches by an embolus or thrombus. Where the obstruction takes place in the main vessel, death rapidly ensues. Where, however, a small branch of the vessel is occluded, as frequently occurs from a coagulum forming in the right side of the heart, or in the pulmonary vessels iu cases of disease of the mitral valve, or in dilatation of the heart, or from the detachment of a small vegetation from disease of the tricuspid or pulmonary valves, a hsemorrhagic exudation takes place, forming a patch of consolidation in the lung (hcemorrhagic infarct). As this haemorrhagic exudation takes place not only into the substance of the lung, but also into the bronchial tubes, such lesions are usually associated with spitting of blood (haemoptysis). The increased tension produced in the pulmonary vessels in cases of mitral disease may also probably lead to the formation of haemorrhagic exudations into the lungs, apart from the occurrence of embolism or thrombosis. Usually the occurrence of pulmonary embolism and the formation of haemorrhagic infarcts in the lungs mark an important epoch in the

course of a case of heart disease. It usually occurs at a late stage of the affection, and not unfrequently contributes materially to a fatal termination. It is probable that many of the cases of pneu- monia and pleuritic effusion, coming on in cases of valvular heart disease and of cardiac dilatation, owe their origin to an embolus and to the formation of a haemorrhagic infarct.

The term asthma is commonly applied to a paroxysmal dyspnoea of a special type which is associated with a variety of conditions. In true spasmodic asthma there may be no detectable organic disease, and ~~*Â«”““Â«â— the paroxysms are generally believed to be due to a nervous influence lyhich, acting upon the bronchial muscles, produces a spasm of the tubes, or, acting through the vaso~~ motor branches of the sympathetic, produces a congestion of the bronchial mucous membrane. The exciting cause may not be at all apparent even on the most careful ob- servation and examination of the sufferer, but in other

cases the attacks may be brought about by some reflex irritation. Nasal polypi and other diseases of nasal mucous membrane have been shown in some cases to be a cause of asthma. Flatulence and constipation are other occasional exciting causes. Irritation of the bronchial mucous membrane appears to be one of the most common, but it is usually difl&cult to say exactly in what the irri- tation consists. It is known that a locality is sometimes responsible, and change of residence to a very short dis- tance may make all the difference. The condition of the weather has a very variable infl.uence. In some asthmatic subjects dust and fog in the atmosphere have a marked effect ; in other cases, however, a foggy atmosphere has no influence, and an asthmatic individual may be actually better in foggy weather than in a clear dry atmosphere. Emotion and various nervous disturbances may occasion- ally produce the attacks. Allied to true asthma is the bronchial asthma frequently met with in the subjects of bronchitis and emphysema. In

such cases the irritation evidently proceeds from the inflamed bronchial mucous menibrane. Hay asthma is the variety in which the pollen of certain plants, especially grasses, is the exciting cause of the paroxysms. In cardiac feebleness, in valvular disease of the heart, and in cardiac dilatation, we may get dyspnoeic attacks of a more or less paroxysmal nature, to which the term cardiac asthma has been applied. Simi- larly, to a form of dyspncBa met with occasionally as a manifestation of ursemia in chronic Bright's disease the term of renal asthma has been given. It is probable that in both these latter conditions the state of the cen- tral nervous system brought about by the cardiac and renal affections respectively is the important element producing the paroxysms of dyspnoea.

Pleurisy, or inflammation of the pleura, is a very common affection, and is met with under different forms. In many instances we have simply the pouring out, over a greater or less area of the surface of the pleura, of a fibrinous exudation which may become absorbed or undergo organization, a certain amount of thickening of the pleura, and adhesions of the two layers resulting. Such cases form the group known as cases of dry pleurisy. In other instances a greater or lesser amount of serous

eur sy. g^udation takes place into one or other pleural cavity, forming the cases of serous pleuritic effusion. In others the exudation into the pleural cavity is purulent, giving rise to the condition known as empyema or purulent pleuritic effusion. The occurrence of dry pleurisy is pro- bably very frequent, and leads to small pleural adhesions which cause little or no inconvenience. In post-mortem ex- aminations of persons who have died from various diseases, it is common to find such pleural adhesions present, although they have never been suspected during life. Pleurisy in one or other of the above forms may come on in a person apparently in good health (idiopathic pleurisy), or it may follow a fracture of the ribs or other injury to the chest.' It is not uncommonly secondary to some other disease ; thus it is almost a constant accompaniment of acute lobar pneumonia. In such cases the effusion is most commonly a simple fibrinous one, which with the subsidence of the primary disease is in great part absorbed. In other

cases of pneumonia we get a certain amount of serous effusion into the pleura; and sometimes, especially in children, the pneumonia is followed by the development of an empyema. Pleurisy with effusion is also frequently a complication of valvular heart disease and dilatation of the heart, and in such cases is often associated with the formation of super- ficial pulmonary infarcts. It is also seen in many other diseases of the lungs. For instance, in chronic phthisis pleuritic adhesions over various parts of the lungs are the rule ; and we also frequently get serous effusion into the pleura as a complication of the various forms of pulmo-

nary tuberculosis. Purulent effusion is less common in phthisis, but it is the rule where the pleura is perforated by the necrosis of a tubercular focus in the lung and the establishment of a communication between the pleura and a tubercular cavity and the bronchial tubes (pyo-pneumonothorax), a combination in which there is both air and pus in the plural cavity. Secondary pleurisy is also seen in an extension of the disease from neighbour- ing parts, as from peritonitis, sub-diaphragmatic abscess, and suppuration in the liver or spleen. As a secondary disease pleurisy is also known in the course of various forms of nephritis, rheumatism, and the acute specific diseases.

The oases of so-called idiopatliio pleurisy arising in apparently healthy individuals are very interesting and of great importance from an etiological point of view. In them the pleurisy is com- monly attributed to catching cold, but, as in pneumonia, such an occurrence is now generally regarded rather as a predisposing element, and as rendering the pleura a favourable seat for the action of various micro-organisms. It has long been known that persons who have been the subjects of apparently idiopathic serous pleur- itic effusion become at a later date the subjects of pulmonary phthisis. More recently it has been shown that the effusion removed from the pleura in such cases is frequently capable of pro- ducing tuberculosis when inoculated into guinea-pigs, and hence it is probable that a large number of what are apparently cases of simple inflammation of the pleura are really cases of tuberculosis of the pleura. In many such cases, although at the time of the pleuritic effusion no sign of disease is manifest in the lungs, a

tubercular focus does exist which remains for a time latent and subsequently assumes renewed activity. In other cases the pneumococcus appears to be the cause of a purulent or, in rarer instances, of a serous pleuritic effusion ; and this may be in cases where pneumonia is, or previously has been, present. It is pro- bable also that the pneumococcus sometimes produces a pleurisy without the intervention of pneumonia. In other cases, again, of purulent effusion into the pleura, streptococci seem to be the essential agents of the disease, and account for the production of the pleurisy secondary to various lung affections, and for the spread of inflammation from the peritoneum and other parts, secondary to various general diseases, such as the acute specific diseases, scarlet fever, diphtheria, and erysipelas. (t. h*.)

VI. The Blood.

The changes in the blood in disease are probably as numerous and varied as the diseases which attack the body, for the blood is not only the medium of respiration, but also of nutrition, of defence against organisms, and of many other functions, none of which can be affected without corresponding alterations occurring in the circu- lating fluid. The immense majority of these changes are, however, so subtle that they escape detection by our present methods. We are beginning to recognize such reactions of infection as the agglutination of the typhoid bacillus by the blood of patients suffering from enteric fever; we are groping for the changes associated with immunity from various diseases ; but, speaking generally, we know comparatively little about changes in the blood unless these betray themselves by somewhat coarse altera- tions in its morphological elements. The changes in the plasma are as yet very imperfectly known, and chemical methods of investigation are still only clinical curiosities. The methods at present employed in examining the blood are: the enumeration of the red and white corpuscles per cubic millimetre; the estimation of the percentage of haemoglobin and of the specific gravity of the blood ; the microscopic examination of freshly-drawn blood and of blood films made upon cover-glasses, fixed and stained. In special cases the alkalinity and the rapidity of coagu- lation may be ascertained, or the

blood may be exam|ined bacteriologically. We have no universally accepted means of estimating, during life, the total amount of blood in the body, though the method of Haldane and Lorrain Smith, in which the total oxygen capacity of the blood is estimated, and its total volume worked out from that

datum, seems to promise important results (Journ. of Physiol, vol. xxv., p. .331, 1900). After death the amount of blood sometimes seems to be increased, and sometimes, as in pernicious anaemia, it is certainly dimin- ished. But the high counts of red corpuscles which are occasionally reported as evidence of plethora or in- crease of the total blood, are really only indications of concentration of the fluid. It is necessary, therefore, in examining blood diseases, to confine ourselves to the study of the blood-unit, which is always taken as the cubic millimetre, without reference to the number of units in the body.

Ancemia is often used as a generic term for all blood diseases, for in almost all of them the haemoglobin is diminished, either as a result of diminution in the number of red corpuscles in which it is contained, or because the individual red corpuscles contain a smaller amount of haemoglobin than the normal. As haemoglobin is the medium of respiratory interchange, its diminution causes obvious symptoms, which are much more easily appreci- ated by the patient than those caused by alterations in the plasma or the leucocytes. It is customary to divide anaemias into ” primary” and “secondary” : the primary are those for which no adequate cause has as yet been discovered ; the secondary, those whose cause is known. Among the former are usually included chlorosis, per- nicious anaemia, and sometim es the leucocy thaemias ; among the latter, the anaemias due to such agencies as malig- nant disease, malaria, chronic metallic poisoning, chronic haemorrhage, tubercle, Bright’s disease, infective processes, &c. As our knowledge advances, however, this distinction will probably be given

up, for the causes of several of the primary anaemias have been discovered. For example the anaemias due to bothriocephalus, an intestinal parasite, is clinically indistinguishable from the other forms of pernicious anaemia with which it used to be included, and leucocythaemia has been declared by Lowit, though probably erroneously, to be due to a blood parasite closely related to that of malaria. In all these conditions there is a considerable similarity in the symptoms produced and in the pathological anatomy. The general symptoms are pallor of the skin and mucous membranes, weakness and lassitude, shortness of breath, palpitation, a tendency to fainting, and usually also gastro-intestinal disturbance, headache, and neuralgia. The heart is often dilated, and on auscultation the systolic murmurs associated with that condition are heard. In fatal cases the internal organs are found to be pale, and very often their cells contain an excessive amount of fat. In many anaemias there is a special tendency to haemorrhage. Most of the above symptoms and organic changes are directly due to dimin- ished respiratory interchange from the loss of haemoglobin, and to its effect on the various organs involved. The diagnosis depends ultimately in all cases upon the ex- amination of the blood.

Though the relative proportions of the leucocytes are probably continually undergoing change even in health, especially as the result of taking food, the number of red corpuscles remains much more constant. Through the agency of some unknown mechanism, the supply of fresh red corpuscles from the bone-marrow keeps pace with the destruction of effete corpuscles, and in health each cor- puscle contains a definite and constant amount of haemo- globin. The disturbance of this arrangement in anasmia may be due to loss or to increased destruction of corpuscles, to the supply of a smaller number of new ones, to a diminu- tion of the amount of haemoglobin in the individual new corpuscles, or to a combination of these causes. It is most easy to illustrate this by describing what happens after a haemorrhage. If this is small, the loss is replaced by the fully formed corpuscles held in reserve in the

marrow, and there is no disturbance. If it is larger, the amount of fluid lost is first made up by fluid drawn from the tissues, so that the number of corpuscles is apparently diminished by dilution of the blood; the erythroblasts, or formative red corpuscles, of the bone- marrow are stimulated to proliferation, and new cor- puscles are quickly thrown into the circulation. These are apt, however, to be small and to contain a subnormal amount of heepioglobin, and it is only after some time that they are destroyed and their place taken by normal corpuscles. If the loss has been vei-y great, nucleated red corpuscles may even be carried into the blood-stream. The blood possesses a great power of recovery, if time be given it, because the organ (bone-marrow) which forms so many of its elements never, in health, works at high pressure. Only a part of the marrow, the so-called red marrow, is normally occupied by erythroblastic tissue, the rest of the medullary cavity of the bones being taken up by fat. If any long-continued demand for red corpuscles is made, the fat is absorbed, and its place gradually taken by red maixow. This compensatory change is found in all chronic anaemias, no matter what their cause may be.

It is often very difficult, especially in ” secondary ” anaemias, to say which of the above processes is mainly at work. In acute anaemias, such as those associated with septicaemia, there is no doubt that blood destruction plays the principal part. But if the cause of anaemia is a chronic one, a gastric cancer, for instance, though there may possibly be an increased amount of destruction of corpuscles in some cases, and though there is often loss by haemorrhage, the cancer interferes with nutrition, the blood is impoverished and does not nourish the erythroblasts in the marrow suificiently, and the new corpuscles which are turned out are few and poor in haemoglobin. In chronic anaemias, regeneration always goes on side by side with destruction, and it is important to remember that the state of the blood in these conditions gives the measure, not of the amount of destruction which is taking place so much as of the amount of regeneration of which the organism is capable. The evidence of destruction has often to be sought for in other organs, or in secretions or excretions.

Of the so-called primary anaemias the most common is chlorosis, an anaemia which occurs only in the female sex, between the ages of fifteen and twenty-five as a rule. Its symptoms are those caused by a diminution of haemoglobin, and though it is never directly fatal, and is extremely amenable to treatment with iron preparations, its subjects very frequently suffer from relapses at varying intervals after the first attack. Its causation is probably complex. Bad hygienic conditions, over-fatigue, want of proper food, especially of the iron-containing proteids of meat, the strain put upon the blood and blood-forming organs by the accession of puberty and the occurrence of men- struation, all probably play a part in it. It has also been suggested that internal secretions may be concerned in stimulating the bone-marrow, and that in the female sex in particular the genital organs may act in this way. Imperfect assumption of function by these organs at pu- berty, caused perhaps by some of the above-mentioned con- ditions, might lead to sluggishness in the bone-marrow, and to the supply to the blood of the poorly-formed cor- puscles deficient in haemoglobin which are characteristic of the disease. Chlorosis is the type of anaemias from imperfect blood-formation. Lorrain Smith has produced evidence to show that the total amount of haemoglobin in the body is not diminished in this disease, but that the blood-plasma is greatly increased in amount, so that the haemoglobin is diluted and the amount in each blood- unit greatly lessened.

Pernicious anrnmia is a mucli rarer disease than chlo- rosis, occurs usually later in life, and is distributed nearly equally between the two sexes. But it is of great importance because of its almost uniformly fatal termina- tion, though its downward course is generally broken by temporary improvement on one or more occasions. The symptoms are those of a progressive anaemia, in which gastro-intestinal disturbance usually plays a large part, and they become at last much more severe than those of any secondary anaemia. The .patient may die in the first

attack, but more usually, when things seem to be at their worst, improvement sets in, either spontaneously or as the result of treatment, and the patient slowly regains apparent health. This remission may be followed by a relapse, that again by a remission, and so on, but as a rule the disease is fatal within, at the outside, two or three years. The outstanding feature in its pathology is the occurrence of blood-destruction in some part of the portal system, as is proved by the storage in the liver of the iron from the broken-down red corpuscles, and by other facts. This blood-destruction is almost certainly caused by the absorption of toxic substances from the stomach and intestine, but the source of these substances is quite unknown, except in one set of cases, those in which the dead and decomposing bothriocephalus poisons its host. The statement of Hunter, that the disease is due to a chronic poisoning by streptococcal micro-organisms, is in direct contradiction to all our knowledge of the be- haviour of the blood in streptococcous infections. The condition of the blood in this disease is sharply distin- guished from that in any other anaemia. The red cor- puscles are enormously diminished; it is usual to find 1,000,000 or less in the cubic millimetre, instead of the normal 5,000,000. The special characteristic of the dis- ease is that though the haemoglobin is of course absolutely diminished, it is often present in relatively higher per- centage than the blood corpuscles. The meaning of this is that the individual corpuscles are on the average larger than usual, and this again occurs because the erythro- blasts of the hypertrophied bone-marrow are not of the normal size (normoblasts), but are much larger than normal (megaloblasts). This is a reversion to the type of blood-formation in the foetus, and the occurrence of megaloblasts in the circulating blood is practically pathognomonic of pernicious anaemia.

Other anaemias, such as those known as lymphadenoma, or Hodgkin's disease, splenic ancemia, and the anaemia pseudo-leucoemica of children, need not be described here, as they are either rare or their occurrence or nature is still too much under discussion.

The number and nature of the leucocytes in the blood bears no constant or necessary relation to the number or condition of the red corpuscles, and their variations de- pend on entirely different

conditions. The number in the cubic millimetre is usually about 7000, but may vary in health from 5000 to 10,000. A diminution in their number is known as leucopenia, and is found in starvation, in some infective diseases, as for example in the later weeks of typhoid fever, and in pernicious anaemia. An increase is very much more frequent, and is known as leucocytosis, though in this term is usually connoted a relative increase in the proportion of the polymorphonuclear neutrophile leucocytes (see Anatomy). Leucocytosis occurs under a great variety of conditions, normally to a slight extent dur- ing digestion and after violent exercise, and abnormally after haemorrhage, in the course of inflammations and many infective diseases, in malignant disease, in such toxic states as uraemia, and after the ingestion of nuclein and other substances. It does not occur in some infective diseases, the most important of which are typhoid fever, malaria, influenza, measles, and uncomplicated tubercu-

losis. In all cases where it is sufficiently severe and long continued, the reserve space in the bone-marrow is filled up by the active proliferation of the leucocytes normally found there, and is used as a nursery for the leucocytes required in the blood. The nature and cause of leucocy- tosis are not yet determined for all cases, but in many it is known to be associated with the defence of the organ- ism from injurious influences, and its amount depends on the relation between the severity of the attack and the power of resistance. There may be an increase in the proportions present in the blood of lymphocytes (lymplio- cytosis), and of eosinophile cells (eosinopMlia), but these are of interest only to the clinician.

The disease in which the number of leucocytes in the blood is greatest is leucocythoemia or leucaemia. There are two main form^ of this disease, in both of which there are anaemia, enlargement of the spleen and lymphatic glands, or of either of them, leucocytic hypertrophy of the bone- marrow, and deposits of leucocytes in the liver, kidney, and other organs. The difference lies in the kind of leucocytes present in excess in the blood, blood-forming organs, and deposits in the tissues. In the one formthese are lymphocytes, which are found in health mainly in the lymph glands and in the lymphatic tissue round the

alimentary canal; in the other they are the kinds of leucocytes normally found in the bone-marrow â€” myelo- cytes, neutrophile and eosinophile, and polymorphonuclear cells, also both neutrophile and eosinophile. The clinical course of the two forms may differ. The first, known as lymphatic leucaemia or lymphcemia, may be acute, and prove fatal in a few weeks or even days, or may be chronic and last for one or two years or longer. The second, known as spleno-myelogenous leucaemia or mydcemia, is almost always chronic, and may last for several years- Recovery does not take place, though remissions may occur. The most recent view of the pathology of the disease is that of Lowit, who believes, on grounds of pathological ob- servation and experimental inoculation, that both forms are due to blood parasites, sporozoa not unlike the mala- rial Plasmodium, which are found in myelaemia in the leucocytes of the peripheral blood, in lymphaemia in those of the blood-forming organs, and differ somewhat in ap- pearance in the two forms. The former disease he regards as the expression of parasitism in the leucocytes ; the latter as due to the poison produced by the parasites stimulating the lymphocytes to proliferation and to passage into the blood. It is right to say that Lowit's observations ai-e as yet unconfirmed, and do not seem altogether conclusive.

iJe/erereces.â€" Ehklich and Lazarus. "Die Anfemie." Vol. viii. of Nothnagel's Specielle Pathologie und Therapie. Vienna. Part I., 1898; Part II., 1900; Part III., 1901.â€" Von Noorden. "Die Bleichsuoht," in same volume as tlie preceding. â€" Cabot. Clinical Examination of the Blood. 3rd ed., revised. London, 1900. â€" Bramwell. Ancemia and Diseases of the Blood-forming Organs. Edinburgti, 1899. â€" Lowit. Die Leuhmmie als Protozoen- infection. Wiesbaden, 1900. ((j, l. q\

VII. ClKCULATION.

On account of its intimate relations with every part of the body, the circulation is prone to disturbances arising from a great series of causes. Some of these produce effects which may be regarded as functional â€" mere changes in metabolism, whose disturbances react upon the rest of the body ; others give rise to definite struc- tural

alterations. In considering the pathology of the circulation, it is useful to take up the subject under the headings of (1) Cm.fes, (2) Processes, and (3) Effects.

1. Causes. â€” The factors leading to abnormal conditions of the circulation naturally fall into two groups. I. In- trinsic, i.e. belonging to the individual. Chief “kmongst these are: heredity â€” certain families inherit tendencies

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to reactive processes in the cardiac serous membranes, or to degenerative changes in the heart and vessels ; age â€” young persons are more prone to acute reaction changes in the serous membranes, while elderly people are more liable to chronic degenerativa alterations in the walls of the heart and of the blood-vessels ; sex â€” males are more subject to degenerative, and females to acute, diseases of the heart ; occupation â€” those engaged in physical over- exertion are liable to sclerotic changes in the vessels and hypertrophy of the heart, while sufiicient, but not excessive, muscular activity only serves to maintain a healthy condition of the circulation; habits â€” healthy modes of life preserve the integrity of the circulatory mechanism, while indolence and indulgence induce fatty changes. II. Extrinsic, i.e. arising from without. These causes may be classified under two heads. (1) General. â€” Infective agents, as in the different fevers, give rise to acute affections of the serous membranes of the heart, and to some extent also of the muscular walls ; metabolic disturbances, as in gout and its allies, produce chronic fibrous changes, particularly in the vessels, but also to a certain degree in the heart itself ; wasting diseases and blood impoverishment lead to retrograde processes, such as fatty degeneration of the heart muscle. (2) Local. â€” Certain diseases originally restricted in distribution pro- duce considerable effects on the circulation. Thus some diseases of the kidneys involve alterations in the systemic arteries and in the left side of the heart, while many

affections of the lungs cause analogous effects in the pul- mony blood-vessels and in the right side of the heart.

2. Processes. â€” The changes undergone by the heart and vessels in disease are similar to those which occur in other parts of the body, but are necessarily modified by the special conditions of the circulatory system. Arising in consequence of one or more of the factors just mentioned, the changes may be regarded, for convenience, as belong- ing to one or other of two great classes â€” degenerative or retrograde, and inflammatory or reactive.

Degenerative. â€” From the presence of toxic substances in the blood (whether introduced from without or arising within the body) the cells of the muscle fibres are apt to undergo what is termed cloudy swelling â€” the simplest form of degenerative process. The cells become larger and duller, with a granular appearance, and the nuclei are less distinct. As a result of interference with nutrition, whether by simple diminution or perverted processes, fatty degeneration ensues. It may be associated, but is not necessarily connected, with adipose accumulation and encroach- ment, commonly termed infiltration. In true fatty degeneration the muscle cells have part of their protoplasm converted into adi- pose tissue. The fibres become granular, and the cells lose their definition, while the nuclei are obscure. In some of the acute infective diseases hyaline degeneration of muscle fibre takes place, apparently as the effect of csagulative processes. The tissues assume a somewhat glassy appearance, with a distinct tendency towards segmentatio'n. Calcareous infiltration is brought about by the deposition of lime salts in tissues which have previously under- gone fatty or fibroid changes ; it particularly affects the arteries in senile affections. In elderly persons, as well as in cachectic condi- tions at early periods of life, pigmentary atrophy takes place. The change consists in a diminution of the size of the muscle fibres, with a great increase of pigment around the nuclei of the cells. And, lastly, simple atrophy occurs, through a diminution in the number as well as in the size of the cells in cases of wasting disease.

Reactive. â€” The acute and chronic processes grouped together under this head form a series characterized by many points of resemblance, but differing widely, according to the tissues in which they are found. They are all due to the reaction of the tissues to irritation, but they vary as they occur in serous membranes, muscular textures, or connective tissues. As regards the serous membranes, their results are quite different in the case of the pericardium, which is highly vascular, and the endocardium upon the valves, which is not rich in blood-vessels. In the case of the pericardium, an exudation of a sero-fibrinous character, which may tend more towards either of these types â€” serous and fibrinous â€” is poured out, and to some extent coagulates in most instances, but little emigration or proliferation of cells is found. Analogous processes affecting the endocardium produce granulations

or vegetations, sometimes attended by sclerotic changes, causing retraction and deformity of the cusps, at other times accompanied by destructive lesions leading to loss of tissue. The myocardium undergoes both acute and chronic reaction changes. In the former there is enlargement of the nuclei, with proliferation but without karyokinesis. The muscle cells become swollen and lose their striation, while they are softer in texture and altered in outline. The intermuscular tissues are swollen, and may be invaded by leucocytes ; this may end in abscess formation, or in the production of newly-formed fibrous tissue. Chronic processes affecting the myocardium give rise to a large amount of fibrosis, and the newly- formed fibrous tissixe separates and compresses the areas of muscle fibres, giving rise to what is commonly known as chronic inter- stitial myocarditis. The analogous changes occurring in connective tissues, such as enter so largely into the structure of the aorta and other large vessels, may be also acute or chronic. In the acute form there are considerable swelling and softening, attended both by exudation and proliferation, the latter of which may, but does not by any means frequently, go on to the formation of pus. The chronic type is characterized by the development of a large amount of newly-formed fibrous tissue, resulting in considerable thickening of the walls, and leading to fatty or calcareous changes.

As a sequel to what has been said regarding pathological processes, it may be added that there are certain efforts of nature by which some of their effects are obviated or lessened. Hypertrophy, when within physiological limits, is to be considered as a means of adaptation. When occurring in pathological circumstances, it must be regarded as a method of compensation. Every structure and every function in a healthy body has greater or lesser reserve of energy. In healthy conditions the ordinary demands made upon various organs are far below their possible responses, and if these be excessive in extent or duration, the organs adapt them- selves to the conditions imposed on them. In abnormal circum- stances the process of hypertrophy is brought about by the power which the structures have of responding to the demands made upon them, and so long as the process is adequate, all disturbances may be averted. As an example of such readjustment may be cited the fact that in chronic renal cirrhosis, with increased thickness of the middle tunic of the arteries, there is hypertrophy of the left ventricle.

Restitution or recovery may occur to a varying extent in almost all of the disease-processes which have been considered, but it has to be kept in view that in certain of the degenerative affections there is little if any possibility of getting rid of the results of the process, while in the reactive changes terminating in the formation of much fibrous tissue, or its conversion into adipose or calcareous material, the same holds true. Many of the changes, which are no doubt in their essence conservative, lead to far-reaching con- sequences, by their interference with nutritive possibilities.

3. Effects. â€” The disturbances of the circulation result- ing from the processes which have been analysed can be conveniently arranged in a limited number of groups, according as their chief morbid effects are experienced by the heart, the vessels, or the blood. ISfo doubt many factors operate by influencing two or all of these divisions, but it renders the subject clearer to classify the various agencies.

Disturbances connected with the heart may, in the first place, be mainly of pericardial origin. An effusion of serous fluid into the pericardial sac

causes consider- able embarrassment to the course of the blood, by render- ing the negative pressure, normally present in the sac, positive. The reason for the interference with the circula- tion, brought about by this alteration of pressure, is that the auricles are by compression rendered incapable of accommodating the blood-return from the veins. Ana- logous effects are produced by pressure upon the heart from without, whether by aneurysm or tumour, and pleural effusion or pneumothorax, affecting the viscera from without. In pericarditis it has further to be re- membered that the effect of the process itself upon the muscle fibres lying beneath the membrane is to cause a softening of texture and weakening of function, whereby the driving power of the heart is diminished. In ob- literation of the pericardium, again, the presence of the adhesions between these two layers leads to interference with the contraction of the myocardium, whereby its functions are interfered with. Alterations in the endo- cardial tissues bring into play another group of causes. The affections of the orifices and valves, so largely

produced by alterations of the endocardium, lead to mucli disturbance of the circulation, either by obstructing the orifices or by permitting regurgitation. In the case of obstruction there must be a lessened current through the orifice, unless the obstacle is in some way overcome ; while in the case of regurgitation, unless it be in some way compensated, too little blood is present in the cardiac cavities for propulsion in the right direction. In both lesions, therefore, whether obstructive or regurgitant, the onward flow of the blood is lessened, either by an obstacle to the ongoing current, or a loss of part of it backwards. The action of the ventricles in drawing blood into them is also interfered with directly or indirectly, since obstruc- tion interferes with the direct aspiratory action, while re- gurgitation, in consequence of the backward escape, causes some of the blood to be drawn towards the heart more than once.

The causes which operate by means of the myocardium are almost invariably of a secondary character. The various degenerations already detailed, and the different forms of myocarditis, as well as simple debility of the muscle, are all examples of changes due to general or local disturbance. All processes which directly or indirectly interfere with the energy of the walls of the heart produce twofold effects, by diminishing the aspiratory or suction- pump action during diastole, and by lessening its expulsive or force-pump action during systole. The immediate result upoij the heart itself of such disturbances is dilatation of that cavity immediately affected. This may occur under perfectly healthy conditions. In these, however, the dila- tation is evanescent, while in the circumstances now under consideration it is permanent, and, although compensated, it leads to persistent dilatation. Upon the blood-vessels the result, whether on account of diminished aspiratory or propulsive energy, is that the amount of blood in the arterial system is decreased, while it is increased in the venous. It is not a necessary conseqiience that because there is less blood in the arteries the arterial pressure will be diminished, or the venous pressure increased because the veins contain more than their normal amount of blood, seeing that the blood pressure depends upon many different factors. It is a fact, nevertheless, that in con- sequence of the alteration in the relative amount of blood in the arteries and veins there is a considerable disturbance of blood pressure. Gravitation may overcome the con- tractile and elastic factors, and several consequences arise from the resulting venous engorgement. From transuda- tion, oedema of the dependent parts of the body and the serous membranes occurs. Prom the sluggish nature of the current, the blood absorbs too much carbonic acid and loses too much oxygen, hence cyanosis is the result. On account, also,, of the slowness of the circulation, there is a longer period for radiation of heat, and the superficial parts of the body accordingly become cold.

The engorgement of internal organs leads to distinct changes in them. The solid viscera, such as the liver, the spleen, the kidney, and the lung, become enlarged and hypergemic, and if the disturbance be continued, cyanotic atrophy ensues. Change in structure, with loss of func- tion, takes place from blocking of the vessels by blood- clot, whether due to

coagulation on the spot, or by the conveyance thither of clots formed elsewhere ; a cirrhotic termination also is not infrequent, although there is still some doubt whether in this latter condition other con- comitant causes have not at the same time been operative. The brain, although suffering less from hypersemia, is subject to disturbance of the circulation through it, while it is a common seat of embolic and thrombotic processes. The heart itself, lastly, sniffers in consequence of the dis- turbed circulation through it, and by undergoing venous stasis, with weakening of its walls and increase of its

fibrous tissue, it completes the final link in a vicious circle. Effusion into the serous sacs, such as the pleura, the peri- cardium, and the peritoneum, leads to great disturbance of the viscera with which they are connected. The mucous membranes, both respiratory, and digestive, become the seat of catarrhal changes in consequence of the backward pressure and impure blood.

The bloodrvessels possess the properties of contractility and elasticity in different degrees. Their contractility is characterized by great tonicity, considerable rhythmic action, and little or no rapidity of contraction. Their elasticity stores up energy a in potential condition, and this may be liberated in kinetic form as required. The vessels are supported in various degrees by the different tissues in which they are found. In the more solid viscera they are strongly supported, as in the liver and kidney, while in those which are less dense, as in the case of the brain and the lungs, they are not so well sustained.

In many conditions the contractility and elasticity of the blood-vessels become diminished. As part of a senile change, in consequence of many toxic agencies and as the effect of long-continued stress, the blood- vessels undergo a loss of their normal properties. This is com- pensated by the growth of an excessive amount of fibrous tissue, leading to various forms of arterial sclerosis. As the result of these fibrous changes there is interference with the blood current, since the vessels become unyield- ing yet frangible, instead of distensile and elastic, tubes. The sclerotic changes lead, moreover, to dilatation of blood-

vessels, as well as to the formation of definite aneurysms. They also pave the way for coagulation of blood within them, i.e. thrombosis, while in certain situa- tions, more particularly in the brain and in the kidney, rupture is apt to take place. Upon the heart also these . changes bring about far-reaching effects. Dilatation, accompanied by hypertrophy, is a certain result of generalized arterial degeneration, while changes in the coronary arteries lead to some of the definite results in the walls of the heart which have already been considered.

The condition of the blood is always in a state of fluc- tuation in consequence of the tissue changes throughout the entire system. It may be temporarily increased or diminished in quantity, and it undergoes great changes not merely as regards the proportion of its different ele- ments, but in respect of many different substances which are apt to circulate through it. The result of such changes is to produce degenerative and reactive processes in the heart and blood-vessels such as have been fully referred to.

The various disturbances which have been considered are compensated by certain of the processes which have been detailed. Chief amongst the compensatory changes is cardiac hypertrophy. A considerable amount of dis- turbance may take place without the production of hyper- tropliy, seeing that there is so much reserve of energy in the healthy heart. If the disturbances are permanent, so that the organ labours under continuous stress, the changes summed up under the term hypertrophy ensue, whereby the circulation is sustained. In addition to an absolute increase in the size and number of the muscle fibres of the heart, there is very commonly some fibroid change, and not infrequently some fatty degeneration along with the hypertrophy. Hyperti'ophy is only possi- ble when the nutrition of the heart is good â€" when the blood is healthy and the coronary arteries are adequate. It is, however, subject to individual possibilities.

The loss of the normal properties in the blood-vessels is followed by the fibroid changes which have been remarked upon, and these may be regarded as compensatory ; but they lead, as has been seen, to further changes, and are to be regarded also as part of a vicious circle.

The alterations in the blood are probably compensated for by an increase in those elements which are of vital importance, such as the coloured and colourless corpuscles.

(g. a. g.)

VIII. Metabolic Diseases.

All disease is primarily due to alterations, quantitative or qualitative, in the chemical changes in the protoplasm of some or all of the tissues of the body. But while in some pathological states these modifications lead to struc- tural changes, in others they do not produce gross lesions, and these latter conditions are commonly classified as Functional Diseases. When such functional disturbances affect the general nutrition of the body they have been termed Metabolic Diseases {Stoffwechselkrankheiten). It is impossible to draw a hard and fast line between func- tional and organic disease, since the one passes gradually into the other, as is well seen in gout. Nor is it always easy to decide how far the condition* are due merely to â– quantitative alterations in the metabolism and how far to actual qualitative changes, for, as is pointed out in the article Physiology, it is highly probable that many of the apparently qualitative alterations are really quantita^ tive disturbances in one part of the protoplasmic mech- anism, leading to an apparent qualitative change in the total result of the activity. The clinical features of such metabolic diseases have been fully treated in the ninth edition of this work, and in the present article the advances in our knowledge of their pathology are alone considered.

A. Olianges >n Metabolism mainly Quantitative.

Obesity. â€” It is as fat that the surplus food absorbed is stored in the body ; but the power of storing fat varies enormously in different

individuals, and in some it may be considered ~~pathological. The reasons of this are very imperfectly understood. One undoubted cause of obesity is taking a supply of food in excess of the energy re~~ quirements of the individual. The amount of food may be absolutely large or large relatively to the muscular energy evolved in mechanical work or in heat-production ; but in either case, when fat begins to be deposited, the muscular activity of the body tends to diminish and the loss of heat from the surface is reduced; and thus the energy requirements become less, and a smaller diet is sufficient to yield the surplus for further storage of fat. Eat is formed from carbohydrates, and either directly or indirectly from proteids (see Physiology : Nutrition). Individuals probably vary in their mode of dealing with these substances, some having the tendency to convert them to fat, some to burn them off at once. VonNoorden, however, who has studied the metabolism in cases of obesity, finds no marked departure from the normal. It may be that in some there is a very perfect absorption of food, but so far no scientific evidence for this view is forthcoming. In all cases the fat stored is available as a source of energy, and this circumstance is taken advantage of in the various fat ” cures,” which consist in giving a diet containing enough i)roteids to cover the requirements of the body, with a supply of fats and carbohydrates in- sufficient to meet the energy requirement of the individual. This is illustrated by the dietaries of some of the best known of these ” cures ” : â€”

In Grms. per Diem.

Proteid.

Fat.

Carbo- hydrates.

Calories.

Banting’s cure

Oertel’s ” . â€¢

Ebstein's " . â€¢

172

156-170

102

8 25-45 85

81 75-120

47

1112

1180-1608

1401

In a normal individual in moderate muscular activity about 3000 to 3500 calories per diem are required (see Dietetics), and therefore under the diets of these " cures," especially when accompanied by a proper amount of muscular exercise, the fats stored in the body are rapidly used up.

Diabetes is produced by a diminution in the power of the tissues to use sugar, which thus accumulates in the blood and escapes in the urine. One great source of energy being unavailable, the tissues have to use more fats and more proteids to procure the necessary amount, and hence, unless these are supplied in very large amounts, there is a tendency to emaciation.

The power of using sugar in the tissues is strictly limited and varies considerably in healtjiy individuals. Normally, when about 200 grms. of glucose is taken at one time, some of it appears in the urine within one hour. In some individuals the taking of even 100 grms. leads to a transient glycosuria, while others can take 260 grms. or more and use it all. But even in the same healthy in- dividual the power of using sugar

varies at different times and in different conditions, muscular exercise markedly increasing the combustion. Again, some sugars are more readily used than others, and therefore have a less tendency to appear in the urine when taken in the food. Milk- sugar and Isevulose appear in the urine more readily than glucose. This power of using sugar possessed by an individual may depend to a small extent on the capacity of the liver to store as glycogen any excess of carbohydrates absorbed from the food, and some slight cases of transient glycosuria may be accounted for by a diminution of this capacity. But the typical form of diabetes cannot be thus explained. It has been maintained that increased production of sugar is a cause of some cases of the disease, and this view has been supported by Bernard's classical experiment of producing glycosuria by puncturing the floor of the fourth ventricle. But after such puncture the glycosuria occurs only when glycogen is present in the liver, and it is transient and has nothing to do with true diabetes. The fact that various toxic substances, e.g., carbon monoxide, produce glycosuria has been used as an argument in support of this view, but they too seem to act by causing a conversion of glycogen to glucose, and are effective only when the liver is charged with the former substance. At one time it was thought that the occurrence of glycosuria under the administration of phloridzin proved that diabetes is due to a poison. But the fact that, while sugar appears abundantly in the urine under phloridzin, it is not increased in the blood, shows that the drug acts not by diminishing the power of the tissues to use sugar, but by increasing the excretion of sugar through the kidneys and thus causing its loss to the body. Hence the tissues have to fall back upon the pro- teids, and an increased excretion of nitrogen is produced. This, however, is a totally different condition from diabetes.

Anything which produces a marked diminution in the normally limited power of the tissues to use sugar will cause the disease in a lighter or graver form. As age advances the activity of the various metabolic processes may diminish irregularly in certain individuals, and it is possible that the loss of the power of using sugar may be sooner impaired in some than in others, and thus diabetes be produced. But Minkowski and von Mering have demonstrated, by experiments upon animals, that pathological changes in the pancreas have probably a

causal relationship with the disease. They found that excision of that organ in dogs, &c., produced all the symptoms of diabetes â€” the appearances of sugar in the urine, its increased amount in the blood, the rapid breaking- down of proteids, and the resulting emaciation and azoturia. At the same time the absorption from the intestine of

proteids, fats, and carbohydrates was diminislied. How this pancreatic diabetes is produced has not been explained. It has been suggested that the pancreas forms an internal secretion which stimulates the utilization of sugar in the tissues. Though in a certain number of cases of diabetes disease of the pancreas has been found, other cases are recorded where grave disease of that organ has not pro- duced this condition. But the apparent extent of a lesion is often no measure of the depth to which the functions of the structure in which it is situated are altered, and it is very possible that the functions of the pancreas may in many cases be profoundly modified without our methods of research being able to detect the change. The pancreas consists of two parts, the secret- ing structure and the epithelial islets, and one or other of these may be more specially involved, and thus alter- ation in digestion and absorption on the one hand, and changes in the utilization of carbohydrates on the other, may be separately produced. The subcutaneous injec- tion of large doses of extracts of the supra-renal bodies causes glycosuria and an increase of sugar in the blood, but the relationship of this condition to diabetes has not yet been investigated.

The disease may be divided into two forms : â€” 1. Slight cases. â€” The individual can use small quanti- ties of sugar, but the taking of larger amounts causes glycosuria. Supposing that the energy requirements of an individual are met by a diet of â€”

Proteid .

100 grms.

410 calories

Fat

100 â€ž

930

Carboliydrate

400 â€ž

1640

2980 â€ž

then if only 100 grms. of glucose can be used, the energy value of 300 grms., i.e., 1230 calories, must be supplied from proteids and fats. To yield this, 300 grms. of proteids or 132 grms. of fats would be required. If these are not forthcoming in the diet, they must be sup- plied from the tissues, and the individual will become emaciated ; hence a diabetic on an ordinary diet is badly nourished, and hence the huge appetite characteristic of the disease.

2. Grave cases. â€" From the products of the splitting of proteids sugar can be formed, probably in the liver, and in the more serious form of the disease, even where carbohydrates are excluded from the food, a greater or lesser quantity of the sugar thus formed escapes consump- tion and may be excreted. Theoretically, 100 grms. of proteid can yield 113-6 grms. of glucose, i.e., 1 grm. of nitrogen will be set free for each 7-5 grms. of glucose formed. In the urine of grave cases of diabetes on a proteid diet, the proportion of nitrogen to sugar is about 1 to 2. This may mean that the theoretically possible amount of sugar is not yielded, or that some of the sugar formed is used in the economy. Both hypotheses may be correct, but the latter is supported by the fact that

even in grave cases the decomposition of proteid may be dimin- ished by giving sugar, and that in muscular exercise the proportion of sugar falls.

In the course of the disease the amount of sugar which the tissues can use varies from day to day. It is in the utilization of glucose â€” the normal sugar of the body â€” that the tissues chiefly fail. Many diabetics are able to use laevulose, or the inulin from which it is derived, and lactose (milk-sugar) to a very considerable extent. It has, however, been observed that under the adminis- tration of these sugars the excretion of glucose may be increased, the tissues, apparently by using the foreign sugar, allowing part of the glucose which they would have consumed to escape. The increased decomposition of proteid, rendered necessary to supply the energy not

forthcoming in the sugar, leads to the appearance of a large quantity of nitrogen in the urine â€” azoturia â€” and it also leads to the formation of various acids. Sulphuric acid and phosphoric acid are formed by oxidation of the sulphur and phosphorus in the proteid molecule, and they are neutralized by the production of ammonia. Hence in the urine of diabetics the proportion of nitrogen as ammonia to the nitrogen as urea is always high. But in the breaking-down of proteids organic acids are also liberated, chiefly belonging to the lower fatty acid series â€”lactic acid, aceto-acetio acid, and /3-oxybutyric acidâ€” and these also are, in part at least, neutralized by am- monia. By the development of these various acids the alkalinity of the blood is diminished. These acids appear in the urine, and their presence in large quan- tities is indicative of extensive decomposition of pro- teid, and is sometimes associated with the onset of a comatose condition, which seems to be due rather to an acid intoxication than to the special toxic action of any particular acid.

Myxoedema. â€” The thyroid gland forms a material which has the power of increasing the metabolism of proteids and of fats ; and when the thyroid is removed, a condition of sluggish metabolism, with low temperature and a return of the connective tissues to an embryonic condition, super- venes, accompanied by the appearance of depression

of the mental functions and other nervous symptoms. The disease myxoedema, which was first described by Gull in 1873, was shown by Ord in 1878 to be due to degenerat- ive changes in the thyroid gland. It affects both sexes, but chiefly females, and is characterized by a peculiar puffy appearance of the face and hands, shedding of the hair, a low temperature, and mental hebetude. The symptoms are similar to those produced by removal of the thyroid, andare indicative of a condition of diminished activity of metabolism. The nervous symptoms may be in part due to some alteration in the metabolism, leading to the formation of toxic substances. The administration of thyroid gland extract causes all the symptoms to disappear.

Cretinism, the symptoms of which are fully described in the ninth edition, may now be defined as myxoedema in the infant, and it has been definitely proved to be asso- ciated with non-development or degeneration of the thyroid gland. The characters of the disease are all due to diminished metabolism, leading to retarded develop- ment, and the treatment which has proved of service, at least in some sporadic cases, is the administration of various thyroid preparations.

Exophthalmic Goitre â€” Graves's Disease or Basedoiv's Disease. â€” This disease chiefly affects young women, and is characterized by three main symptoms : increased rate and force of the heart's action, protrusion of the eyeballs, and enlargement of the thyroid gland. The patient is nerv- ous, often sleepless, and generally becomes emaciated and suffers from slight febrile attacks. The increased action of the heart is the most constant symptom, and the en- largement of the thyroid gland may not be manifest. Various theories as to the pathology of the condition have been advanced, but in the light of our knowledge of the physiology of the thyroid the most probable explanation is an increased functional activity of that gland.]!. Changes in Metabolism probably Qualitative.

At one time the list of diseases ascribed to quantitative changes in the metabolism was considerable. Thus oxaluria was looked upon as a disease due to increased formation of oxalic acid, rheumatism as due to excessive formation of lactic acid, and gout as caused by the formation

of uric acid in too large quantities. But oxaluria is now regarded as a form of acid dyspepsia, and rheumatism as an acute infective disease, while evidence against the causal relationship between uric acid and gout is accumu-

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lating. Pi'imary qualitative alterations in the metabolism are doubtful. Possibly the production of such substances as glycuronic acid in apparently normal individuals is one of the best examples of such a condition, while probably acute gout is due to a change of this nature.

Gout has often been divided into the typical and atypical forms. The first is undoubtedly a clinical and patho- logical entity, but the second, though containing cases of less severe forms of true gout, is largely constituted of imperfectly diagnosed morbid conditions. The accumula-tion of urate of soda in the tissues in gout formerly led physicians to believe in a causal relationship between an increased formation of that substance and the onset of the disease. Garrod's investigations, however, seemed to indicate that diminished excretion rather than increased production is the cause of the condition. He found an accumulation of uric acid in the blood and a diminution in its amount in the urine during the attack. That uric acid is increased in the blood is undoubted, but the changes described by Garrod in the urine, and considered by him as indicative of diminished excretion and retention, are rendered of less value by the imper- fections of the analytic method employed. More recent work with better methods has thrown still further doubt upon the existence of such a relationship, and points rather to the accumulation of uric acid being, like the other symptoms of the condition, a result of some unknown modification in the metabolism, and a purely secondary phenomenon. The important fact that in leucsemia (von Jaksch), in lead-poisoning (Garrod), and in other patho- logical conditions, uric acid may be increased in the blood and in the urine without any gouty symptoms supervening, is one of the

strongest arguments against the older views. That the gouty inflammation is not caused by the deposit of urate of soda, seems to be indicated by the occurrence of cases in which there is no such deposition. The results of modern scientific investigation have overthrown the uric-acid theory of gout, but so far they offer no definite explanation of the aetiology of the disease. Nevertheless, while they have not confirmed the view as to the causal relationship of the uric acid to the inflammation and other symptoms of the gouty paroxysm, they have thrown interesting light upon the probable source of the uric acid which is so apt to be deposited, and they also offer a more or less intel- ligible explanation of the process of deposition. Prom the true nucleins, which form so important a constit- uent of living protoplasm, a series of bodies which were formerly classed as the xanthin bases, but which are now more generally known as the purin bases, are formed. Uric acid is a member of this series, and its excre- tion is increased when substances rich in nuclein, e.g., sweetbreads, &c., are administered. While uric acid itself has not been demonstrated to have any injurious action, the closely allied adenin has been found to produce toxic symptoms. After the discovery of this source of uric acid, physiologists for a time inclined to regard it as the only mode of production. But it must be remembered that in birds uric acid is formed from the lactate of ammonia of the intestine and muscles, just as urea is formed from the same substance in mammals. Uric acid is a di-ureide â€" a body composed of two urea molecules linked by acrylic acid â€" an unsaturated pro- pionic acid. Now sarolactic acid is a hydroxy-propionic acid, and hence uric acid is either upon the direct road, or very slightly off the direct road, of the transformation of lactate of ammonia to urea. It is therefore highly probable that in many conditions the conversion of lactate of ammonia to urea is not complete, and that a certain amount of uric acid is formed apart from the decomposition of nucleins.

Sir William Eoberts has adduced evidence to show that uric acid circulates in the blood in a freely soluble combination or quadurate â€" that is, a compound in which one molecule of an acid salt BHXJ is linked to a molecule of the acid BHU. HjU. These compounds are said to be readily decomposed and the bi-urates formed, which are at first

gelatinous but become crystalline. The deposition of urate of soda in joints, &e., has been ascribed to this change. Tunnieliffe, however, has published the results of certain investigations which throw doubt upon this explanation. â™¦

Rheumatism. â€” Rheumatic fever was formerly regarded as due to some disturbance in the metabolism, but at the present time the trend of opinion is towards the view that it is a specific micro-organismal disease. The whole clini- cal picture is that of an infective fever, and it is closely related to gonorrhceal rheumatism and to certain types of pyaemia. A number of independent observers, among them Poynton and Paine in Great Britain, have succeeded in isolating from cases of rheumatic fever a diplococcus which produces similar symptoms in the rabbit to those which characterize the disease in ‘ man.

Excluding the peculiar changes in the joints which occur in- rheumatoid arthritis and in Charcot’s disease, and which are almost certainly primary affections of the nervous system, it is found that a large number of indi- viduals suffer from pain in the joints, in the muscles, and in the fibrous tissues, chiefly on exposure to cold and damp or after indiscretions of diet. This so-called chronic rheumatism appears to be a totally distinct condition from rheumatic fever ; and although its pathology is not investigated, it looks as if it were due either to a diminished elimination or an increased production of some toxic substance or substances, but so far we have no evidence as to their nature.

Rickets is undoubtedly a manifestation of a profound alteration of the metabolism in childhood, but how far it is an idiopathic condition and how far a result of the action of toxine introduced from without is not yet defi- nitely known. Kassowitz long ago showed that the bone changes are similar to those which can be produced in animals by chronic phosphorus poisoning, and that they are really irritative in nature. Spillmann, in his work Le Rachitisme, discusses the evidence as regards the action of various conditions, and comes to the conclusion that there is no evidence that it is due to a mere primary disturbance of the metabolism, or to excessive production of lactic acid, or to any

specific micro-organismal poisoning. But he adduces evidence, perhaps not very convincing, that in the disease there is a specific intoxication derived from the alimentary canal and provoking inflammatory lesions in the bones.

See Dr Cakl von Nookden, Lehrbuch der Pathologie des Stoff- wechsels. Berlin, 1893. (d. n. p.)

IX. Pevbe.

The term fever is generally used to include all conditions in which the normal temperature of the body is markedly exceeded for any length of time. Every rise of temperature is due to a disturbance in the heat-regulating mechanism, the chief variable in which is the action of the skin in eliminating heat (see Physiology : Animal Heat). Al- though for all practical purposes this mechanism works satisfactorily, it is not by any means perfect, and many physiological conditions cause a transient rise of temperar ture ; e.g., severe muscular exercise, in which the cutaneous eliminating mechanism is unable at once to dispose of the increased amount of heat produced in the muscles. Pathologically, the heat-regulating mechanism may be

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disturbed in three different ways : 1st, by mechanical interference with the nervous system ; 2nd, by interfer- ence witli heat elimination ; 3rd, by the action of various poisons.

1. In the human subject, fever the result of mechanical interference with the nervous system rarely occurs, but it can readily be produced in the lower animals by stimulat- ing certain parts of the great brain, e.g., the anterior por- tion of the corpus striatum. This leads to a rise of tem- perature with increased heat production and increased excretion of carbonic acid and of urea. Possibly some of the cases of high

temperature recorded after injuries to the nervous system may be caused in this way ; but some may also be due to stimulation of vaso-constrictor fibres to the cutaneous vessels diminishing heat elimination. So far the pathology of this condition has not been studied with the same care that has been devoted to the investigation of the third type of fever.

2. Fever may readily be produced by interference with heat elimination. This has been done by submitting dogs to a temperature slightly below that of the rectum, and it is seen in man in Sunstroke (Ency. Brit, 9th edition, vol. xxii. p. 666). The typical nervous symptoms of fever are thus produced, and the rate of chemical change in the tissues is accelerated, as is shown by the increased excretion of carbonic acid. The protoplasm is also injured and the proteids are broken down, and thus an increased excretion of nitrogen is produced and the cells undergo degenerative changes.

3. The products of various micro-organisms have a toxic action on the protoplasm of a large number of animals, and among the symptoms of this toxic action one of the most frequent is a rise in temperature. While this is by no means a necessary accompaniment, its occurrence is so general that the term Fever has been applied to the general reaction of the organism to the microbial poison. Toxins which cause a marked rise of temperature in men may cause a fall in other animals. It is not the alteration of temperature which is the great index of the severity of the struggle between the host and the parasite, but the death and removal to a greater or lesser extent of the protoplasm of the host. In this respect fever resembles poisoning with phosphorus and arsenic and other similar substances. The true measure of the intensity of a fever is the extent of disintegra- tion of protoplasm., and this may be 'estimated by the amount of nitrogen excreted in the urine. The increased disintegration of protoplasm is also indicated by the rise in the excretion of sulphur and phosphorus and by the appearance in the urine of acetone, diacetic acid, and oxybutyria acids (see Physiology : Nutrition). Since the temperature is generally proportionate to the intensity of the toxic action, its height is usually proportionate to the excretion of nitrogen. But sometimes the rise of tempera- ture is not

marked, while the excretion of nitrogen is very decidedly increased. When the temperature is sufficiently elevated, the heat has of itself an injurious action on the protoplasm, and tends to increase disintegration just as when heat eliminationis experimentally retarded. But the increase due to rise of temperature is small compared to that produced by the destructive action of the microbial products. In the beginning of a fever the activity of the m,etabolism is not increased to any marked extent, and any increase is probably due to the greater activity of the muscles of the heart and respiratory mechanism, and to the muscular contractions which produce the initial rigours. Thus the excretion of carbon dioxide â€" the great measure of the activity of metabolism â€" is not usually increased, and there is no evidence of an increased combustion. In the later stages the increased temperature may bring about an acceleration in the rate of chemical change ; but this

is comparatively slight, less in fact than the increase ob- served on taking muscular exercise after rest. The rise of temperature is really due to diminished heat elimination. This diminished giving off of heat was demonstrated by means of the calorimeter by Rosenthal, while Maragliano showed that the cutaneous vessels are contracted. Even in the later stages, until defervescence occurs, heat elimina- tion is inadequate to get rid of the heat produced.

The toxic action is manifested not only by the in- creased disintegration of protoplasm, but also by dis- turbances in the functions of the various organs. The activity of the digestive glands is diminished and appetite is lost. Food is therefore not taken, although when taken it appears to be absorbed in undiminished quantities. As a result of this the patient suffers from inanition, and lives largely on his own fats and proteids, and for this reason rapidly emaciates. The functions of the liver are also diminished in activity. Glycogen is not stored in the cells, and the bile secretion is modified, the essential constituents disappearing almost entirely in some cases. The production of urea is also interfered with, and the proportion of nitrogen in the urine not in the urea increases. This is in part due to the increased disintegration of proteids setting free sulphur and phosphorus, which, oxidized into sulphuric and phos- phoric acids, coinbine with the ammonia which would other- wise have

been changed to urea. Thus the proportion of ammonia in the urine is increased. Concurrently with these alterations in the functions of the liver-cells, a con- dition of granular degeneration and probably a state of fatty degeneration makes its appearance. That the func- tional activity of the kidneys is modified, is shown by the frequent appearance of proteoses or of albumen and globu- lin in the urine. Frequently the toxin acts very markedly on the protoplasm of the kidney epithelium, and causes a shedding of the cells and sometimes inflammatory re-action. The muscles are weakened, but so far no satisfactory study has been made of the influence of microbial poisons on muscular contraction. A granular and fatty degenera- tion supervenes, and the fibres waste. The nervous struc- tures, especially the nerve-cells, are acted upon, and not only is their functional activity modified, but they also undergo structural changes of a chromatolytic nature. The blood shows two important changes â€" first, a fall in the alkalinity due to the products of disintegration of protoplasm, and, secondly, an increase in the number of leucocytes, and chiefly in the polymorpho-nuclear variety. This is best marked in pneumonia, when the normal number is often increased twofold and sometimes more than tenfold, while it is altogether absent in enteric fever.

An interesting general modification in the metabolism is the enormous fall in the excretion of chlorine, a fall far in excess of what could be accounted for by inanition, and out of all proportion to the fall in the sodium and potassium with which the chlorine is usually combined in the urine. The fevered animal in fact stores chlorine in its tissues, though in what manner and for what reason is not at present known.

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(d. n. p.)

X. The Kidneys. The results of morbid processes in the kidney may be grouped under three heads : (1) the actual lesions produced

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in the kidneys, (2) the effects of these on the composition of the urine, and (3) the effects of the kidney lesion on the body at large.

(1) Lesions of the kidney are either congenital or acquired, and when acquired they may be either the sole result of a pathological process limited to the kidney, in which case they are spoken of as primary, or else the morbid process in the kidney may be an accompaniment or sequel of disease in other parts of the body, and they are then often spoken of as secondary.

Congenital Lesions. â€" The principal congenital lesions are â€" (1) anomalies in the number or position of the kidneys or of their ducts, (2^ atrophy of one liidney, (3) cystic disease of the kidney, and (4) growths. The most common abnormality is the existence of a single kidney â€" very rarely a third or supernumerary kidney may be presentâ€" or both may be absent; the last, however, is only of embryological interest, and is found most frequently in acephalous monsters. The presence of a single kidney may be due to the absence of development of one, or to the atrophy of one, in fcetal life ; it may also be dependent on the fusion of originally separate kidneys, and this fusion commonly occurs in such a way as to lead to the formation of a horse-shoe kidney, the two organs being connected at their lower extremities by a mass of renal tissue. In some cases the apparently single horse-shoe kidney is really double, the organs being united by fibrous tissue. Occasionally the two kidneys are fused end to end, producing an apparently single organ with two ureters opening in their normal situations. A third variety is that where the fusion is more complete, produc- ing a disc-like mass from which the ureters issue and follow their normal course. The kidneys may be situated in abnormal posi- tions ; thus they may be found in front of the sacro-iliac articulation, or they may sink into the pelvis or the iliac fossa. The main importance of such displacements lies in the fact that the organs may be mistaken clinically for tumours. Congenital displacements of one or other kidney are sometimes associated with malformation of the large intestine. The causes of atrophy during foetal life are obscure. In some oases it is associated with mal-development, so that only the medullary portion of the kidney is developed; in others it is apparently associated with arterial obstruction, and sometimes it may be dependent upon obstruction of the ureter, as this has been found

experimentally to be capable of causing very complete atrophy. Congenital cystic disease is not uncom- mon, the organ being transformed into a mass of cysts, and the enlargement of the kidneys may be so great as to produce difficul- ties in birth. The cystic degeneration is generally looked upon as dependent upon either obstruction of the urinlferous tubules or else upon anomalies in development, with persistence of portions of the Wolffian body. In some cases cystic degeneration of the kidneys is accompanied by anomalies in the ureters and in the arterial supply ; in others these are normal. Orowths of the kidney are sometimes found in infants. They are not uncommonly malig- nant, and may consist of a peculiar form of sarcoma, which has been spoken of as rhabdo-sarcoma owing to the presence in the tumour mass of involuntary muscular fibre. The existence of these peculiar tumours is thought to be dependent on anomalies of development, inasmuch as the tissue which forms the primitive kidney belongs to the same layer as that which gives rise to the muscular system (mesoblast). Anomalies of the excretory ducts of the kidneys are of no great importance. Sometimes the ureter is double, in others it is greatly dilated ; In others the pelvis of the kidney may be greatly dilated, with or without dilatation of the ureter.

Acquired Diseases.

One or both kidneys in the adult may be preternaturally mobile (nephroptosis) . This condition is more common in women than in men ; and although sometimes dependent on congenital anomalies, it is more usually acquired as a result of injury, or owing to the abdominal walls becoming lax as a sequel to abdominal distention or to the effects of tight lacing. The more extreme forms of movable kidney are dependent, generally, on congenital anomalies in the arrangement of the peritoneum, so that the organ has a partial mesentery ; and to this condition, where the kidney can be moved more or leas freely from one part of the abdomen to another, the term floating kidney is applied. More usually the organ is loose under the peritoneum, and is not efficiently supported in its fatty bed by peritoneal bands. It is possible that, in addition to the causes just enumerated, emaciation may produce mobility of the kidney. Movable kidney produces a variety of

symptoms â€” pain in the loin and back, nausea, and vomiting â€” and the function of the organ may be seriously interfered with owing to the structures in the hilum becoming kinked. In this way hydro- nephrosis, or distension of the kidney with urine, may be produced.

The return of blood through the renal vein may also be hindered, and in this way temporary vascular engorgement of the kidney, with hsematuria, may be produced.

1. Embolism. â€” The anatomical arrangement of the kidney vessels is one which is peculiarly favourable to the production of wedge- shaped areas of necrosis dependent on blocking of the renal arterioles by emboli, and renal infarcts are commonly seen in all conditions in which embolism is liable to occur. Sometimes the embolus is a blood-clot detached from the interior of the heart, or even a calcareous plate from the interior of the aorta, and the effects produced are simply mechanical, from the arrest of the circulation in the part of the kidney supplied by the blocked artery. In other cases, the embolus, in addition, is infective owing to the presence of a variety of micro-organisms ; and in these circumstances the necrotic area undergoes other changes dependent on the presence of these organisms, leading not uncommonly to abscess in the kidney. The small vessels are sometimes blocked by masses of organisms only, producing minute embolisms. It is exceptional for the larger branches of the renal artery to be blocked by emboli, so that the symptoms produced in the ordinary cases are only temporary derangements of the secretion, e.g.,, the sudden appearance of hsematuria, albuminuria, and pain in the back.

2. Thrombosis, or blocking of the renal vessels as a result of disease of the walls of the vessels, is also not uncommon, and in exceptional cases it may lead to complete disorganization of one or both kidneys. Thrombosis of the veins, leading to extreme congestion of the kidney, also occurs, either limited to the renal vein or extending into it from the vena cava. It is most frequently seen in cachectic conditions produced by general diseases causing extreme weakness and wasting, sometimes in septic conditions, as in puerperal pysemia, where a clot, formed first in one of the pelvic veins, may spread up the vena cava and secondarily

block the renal veins. Thrombosis of the renal vein also occurs in malignant disease of the kidney, and in certain forms of chronic Bright's disease.

3. Passive congestion of the kidneys is seen more especially in heart diseases and lung diseases, where the return of venous blood to the heart is seriously interfered with. It may also be produced by tumours and other lesions .pressing on or involving the vena cava. The passively engorged kidneys become brownish red in colour, considerably enlarged and fibroid, and they secrete a scanty high-coloured dense urine.

4. Active congestion is difficult to separate from the earlier stages of inflammation or nephritis, and these two conditions are often produced by the excretion in the urine of irritating bodies, e.g., turpentine and cantharides, and the toxins of various diseases. These irritants produce engorgement and inflammation of the kidney, much in the same way as they would' that of other struc- tures with which they come in contact. It is probable that a great many varieties of active congestion of the kidney and of nephritis in general diseases are produced by the excretion of microbic poisons. Further, it is thought that extreme congestion of the kidneys may be produced by exposure to cold, owing to some Intimate relation- ship existing between the skin vessels and the kidney vessels, the constriction of the one being accompanied by the dilatation of the other. There is at present no experimental evidence to justify this view. Infective diseases, such as typhoid fever, pneumonia, scarlet fever, and, in fact, most acute specific diseases, produce during their height a transitory or temporary nephritis, which is not usually followed by any permanent or serious alteration in the kidney ; but some acute specifics tend, in addition, to cause a more severe nephritis, which may lay the foundation of fatal dr permanent renal disease. This is much more frequent as a result of scarlet fever than as a sequel to pneumonia, typhoid, or other febrile diseases. It is probable that the lesions in so-called tran- sitory nephritis are often partial, involving only some portion of the kidney.

5. Bright’s disease is the term applied to certain varieties of acute and chronic nephritis. Three fonns are usually recognized â€” acute, chronic, and the granular or cirrhotic kidney. The position of this third lesion, however, is a little doubtful, as one form of cirrhotic or contracted kidney is sometimes the sequel to acute or chronic Bright’s disease, and in these cases it is a purely kidney lesion and a variety of Bright’s disease. In the other and more common form of granular kidney the kidney lesion is only part of a widespread affection involving the whole arterial system, and is not in any way related to Bright’s disease. Chronic Bright’s disease is sometimes the sequel to acute Bright’s disease, but in a great number of cases the malady is chronic from the beginning. The lesions of the kidney are probably produced in the majority of cases by the irritation of the kidney structures owing to the ex- cretion of toxic substances which have either been ingested or formed in the body ; it is thought by some that the malady may sometimes arise simply as a result of exposure to cold. The . principal causes of Bright’s disease are alcoholism, pregnancy, the action of certain poisons, e.g., lead, gout, &o. ; it may also occur as

a sequel to acute diseases, more especially acute specifics such as scarlet fever. Persons following certain occupations are peculiarly- liable to certain forms of Bright’s disease, e.g., engineers who work in hot shops and pass out into the cold air scantily clothed ; and painters, in whom the malady is apparently dependent on the action of lead on the kidney. In the case of alcohol and lead the poison is ingested ; in the case of scarlet fever, pneumonia, and perhaps pregnancy, the toxic agent causing the renal lesion is formed in the body and probably excreted by the urine. In Bright’s disease all the elements of the kidney, the glomeruli, the tubular epithelium, and the interstitial tissue, are affected. In the different varieties of the disease these structures are affected to different degrees. Thus in Bright’s disease following scarlet fever, the glomerular structures are mostly affected, the capsules being

greatly thickened by the formation of fibrous tissue, and the glomerular tuft compressed, atrophied, and degenerated. The epithelium of the convoluted tubules undergoes degeneration, and considerable quantities of it are shed, and form the well-known casts that are found in the urine. The tubules, too, become blocked by the shed epithelium, and become distended above with the pent-up urine ; this is one of the causes of the very considerable increase in size that the kidneys undergo in certain forms of Bright's disease. The lesions in the tubules and in the glomeruli are not usually uniform, certain portions being more affected than others. The interstitial tissue is always affected to a certain extent, and exuda- tion, proliferation, and formation of fibrous tissue all occur. In the granular and contracted kidney the lesion in the interstitial tissue reaches a high degree of development, so that in advanced cases but little renal secreting tissue is left in many places. Such renal tubules as remain are often dilated, and the epithelium lining them is greatly altered, the cells becoming hyaline and losing their characteristic structure. The vessels also undergo changes, becoming greatly narrowed owing to thickening of the sub-eudo- thelial layer of the inner coat ;' and the muscular coat undergoes hypertrophy and fibroid changes, so that the vessels are abnormally rigid as well as narrow. When the overgrowth of fibroiis tissue is considerable, the surface of the organ loses its smooth character and becomes uneven, owing to the irregular development of fibrous tissue, and it is for this reason that the term gra,nular kidney has been applied to this condition. In acute Bright's disease the kidney is considerably increased in size, engorged with blood, and the changes described above are in active progress. In the chronic form the kidney may be large or small, and is usually white or mottled in colour. If large, the cortex is thickened, pale and waxy-looking on section, and the pyramids are congested ; if small, the fibrotic change has advanced to a greater extent, and the cortex is greatly diminished in width.,, Bright's disease, both in its acute and chronic forms, is essentially a disease of the cortical secreting portion of the kidney. The true granular kidney, classi- fied by some as a third variety of Bright's disease, is usually part of a general arterial degeneration, and the overgrowth of fibrous tissue in the kidney and the lesions in the arteries are well marked.

6. Degenerations. â€” The principal degenerations affecting the kidney are the fatty and the albuminoid. Fatty degeneration of the kidney often reaches a high degree in alcoholics, where fatty degeneration of the heart and liver are also present. Albuminoid disease of the kidney is frequently associated with some varieties of Bright's disease, and is also seen as a result of chronic bone disease, suppuration, and syphilis, involving other parts of the body ; it is not so common as it was formerly, owing to the progress in the surgical treatment of the diseases causing it.

7. Growths of the Kidney. â€” The principal growths affecting the kidney are tubercle, adenoma, sarcoma, and carcinoma. In addi- tion to these, lipomata and fibromata, tne nodules of glanders and the gummata of syphilis, are sometimes found. Tuberculous disease of the kidney is sometimes primary ; more frequently it is secondary to tubercle in other portions of the genito-urinary appa- ratus. The genito-urinary tract may be infected by tubercle in two ways, one ascending, the other descending. By ascending tuber- culosis is meant a condition in which the primary lesion is in the testicle, epididymis, or urinary bladder, and the kidney becomes secondarily involved by the lesion travelling up the ureter or lym- phatics to the kidney. A descending infection, on the other hand, is usually a result of a blood infection, where the tubercle bacillus reaches the kidney through the blood-vessels. In these circum- stances, miliary tubercle, the condition in which scattered tuber- culous granules are seen, more especially in the cortex of the kidney, is usually produced. With descending infection of the kidney the lesion is necessarily generally bilateral ; in primary tuberculosis of the kidney and in ascending tuberculosis the lesion is at first unilateral. Malignant disease of the kidney generally takes the form of sarcoma or carcinoma. Sometimes it is dependent on the malignant growths starting in what are spoken of as adrenal rests in the cortex of the kidney. Sarcoma of the kidney is a con- dition most often seen in the -young, carcinoma in the middle-aged and elderly. Carcinoma may be primary or secondary, but the

kidney is an organ of the body that is not so prone to malignant disease as other organs, such as the stomach, bowel, &c.

8. Cystic Kidneys. â€” Several different varieties of cysts are found in the kidney. Thus single cysts occur, sometimes of large size, while scattered small cysts are more especially seen in cases of chronic Bright's disease and in the granular contracted kidney, where the dilatation of certain tubules reaches a. high degree of development, ultimately forming cysts. Certain growths of the kidney, again, such as adenomata, are liable to undergo cystic degeneration, and in some cases of malignant disease cysts are found. Finally, there is a rare condition of general cystic disease somewhat similar to that seen congenitally. In this form the kidneys are greatly enlarged, and consist of a congeries of cysts separated by the remains of renal tissue.

9. Parasitic Affections. â€" The more common parasites aflfecting the kidney, or some other portion of the urinary tract, and causing disease, are filaria, bilharzia, and the cysticercus form of the taenia echinocoocus. The presence of filaria in the thoracic duct and other lymph channels may cause the presence of chyle in the urine, together with the ova and young forma of the filaria, owing to the distension and rupture of a lymphatic vessel into some portion of the urinary tract. This is the common cause of chyluria in hot climates, but chyluria is occasionally seen in the United Kingdom without the presence of filaria. Bilharzia, especially in Egypt and South Africa, causes haematuria. The cysticercus form of the tasnia echinococcus leads to the production of hydatid cysts in the kidney. This organ, however, is not so often affected in this manner as the liver.

10. Nephrolithiasis. â€" Calculi are freqiiently found in the kidney, consisting dsually of uric acid, sometimes of oxalates, more rarely of phosphates. Calculous disease of the bladder is generally the sequel to the formation of a stone in the kidney, which passing down into the bladder, and owing to secondary changes produced by its presence in the bladder, is followed by the deposition of the salts in the urine round it as a nucleus. Calculi are usually formed in the pelvis of the kidney, and their formation is dependent either on the excessive amounts of uric acid, oxalic acid, &c., in the urine, or on an alteration in the composition of the urine, such as increased acidity, or on the crystals of the uric acid or of the oxalate of lime being present in an abnormal and

large form. The formation of abnormal crystals is often dependent on the presence of some col- loid, such as blood, mucus, or albumen, in the secretion, modifying the crystalline form. Once a minute calculus has been formed, its subsequent growth, owing to the deposition on it of the urinary constituent forming it, is easily understood. Calculi formed in the pelvis may be single and may reach a very large size, forming, indeed, an actual cast of the pelvis and calyces of the kidney. At other times they are multiple and of very varying size. When formed, they may give rise to no symptoms, or, on the other hand, they may give rise to renal colic of varying degrees of severity, especially when they are passed or attempted to be passed. A great variety of complications may result from the presence of a stone, such as hydronephrosis, from the urinary secretion being pent up behind the obstruction, or complete suppression, which is apparently produced reflexly through the nervous system, the presence of the stone in the pelvis or ureter leading to complete arrest of the function of the kidney. In such cases the surgical removal of the stone is often followed by the restoration of the renal secretion. Pyonephrosis, distension of the pelvis of the kid- ney with pus, abscesses of the kidney, and perinephritic abscess, are not uncommon complications of renal calculus. Finally, can- cer of the kidney is thought by many to be associated with the long-continued irritation produced by the presence of stones.

11. Pyelitis. â€” Inflammation of the pelvis of the kidney is gen- erally produced by the extension of inflammation upwards from the bladder and lower urinary tract, or by the presence of stones or of tubercle in the pelvis of the kidney. Pyonephrosis, distension of the kidney with pus, may result as a sequel to pyelitis or as a com- plication of hydronephrosis, and in many such cases the inflamma- tion spreads to the capsule of the kidney, leading to the formation of what is described as a perinephritic abscess. In some cases a perinephritic abscess results from a septic infarct of kidney, or may occur primarily, as the result of traumatism or of other causes, in the loose cellular tissue surrounding the kidney, without any lesion of the kidney or pelvis of the kidney.

12. Hydronephrosis, or distension of the kidney with pent-up urine, results from obstruction of the ureter, although all obstruc- tions of the

ureter are not followed by it, e.g., calculous obstruction often causing complete suppression. Obstruction of the ureter, causing hydronephrosis, is most frequently dependent on the presence of a stone, or on pressure on the ureter from a tumour in the pelvisâ€” as, for instance, cancer of the uterusâ€” or on some abnormality of the ureter, more especially an abnormality in its attachment to the pelvis of the kidney, as, for instance, when attached at an angle, or when preternaturally narrow. Sometimes the ureter is obstructed sufficiently to cause hydronephrosis by

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unnatural mobility of the kidney. The hydronephrosis produced by obstruction of the ureter is sometimes intermittent ; and when a certain degree of distension is produced, either as a result of the shifting of the calculus or of some other cause, the obstruction is temporarily relieved and the urinary flow re-established. When the hydronephrosis has existed for any considerable length of time, the kidney is converted into a sac, the remains of the renal tissues being spread out as a thin layer.

(2) Effects on the Urine. â€” Diseases of the kidney pro- duce alterations of two kinds in the composition of the urine : either the proportion of the normal constituents is altered, or substances not normally present are excreted in greater or less abundance. In most diseases the quan- tity of urinary water is diminished, especially in those in which the activity of the circulation is impaired. There are certain diseases, however, more especially the granular kidney and certain forms of chronic Bright's disease, in which the quantity of urinary water is con- siderably increased, notwithstanding the profound ana- tomical changes that have occurred in the kidney. When the quantity is diminished there may be actual suppression, and two forms of this are recognized â€” (1) obstructive suppression, seen where the ureter is blocked by stone or other morbid process, and (2) non-obstructive suppression, a condition which is more especially seen as a

terminal phenomenon in advanced diseases of the kid- ney of inflammatory or other nature. In some cases complete suppression may occur as the result of injuries to other parts of the body. In some diseases in which the quantity of urinary water excreted is normal, or even greater than normal, the efficiency of the renal activity is really diminished, inasmuch as the urine secreted is very dilute and contains but few solids. In estimating the efficiency of the kidneys, it is necessary to take into con- sideration the so-called ” solid urine,” that is to say, the quantity of solid matter excreted per diem. The nitro- genous constituents â€” urea, uric acid, creatinin, &c. â€” vary greatly in amount in different diseases. In most renal diseases the quantities of these substances are diminished. The most important abnormal constituents of the urine present in disease are serum albumen, serum globulin, albumoses (albuminuria), blood (heematuria) , blood pigment (heemoglobinuria), pus (pyuria), chyle (chyluria), and abnormal pigments (melanuria, urobili- nuria, &c.).

(3) Effects on the Body at large. â€” Diseases of the kidney tend to produce certain effects on the body at large, all of which are not usually seen to accompany any single disease of the kidney, nor are they equally developed in different cases of the same disease. These effects may be divided into the persistent and the intermittent or transitory. The most important persistent remote effects produced by disease of the kindey are, first, nutritional changes leading to wasting, cachexia, &c. ; and, secondly, certain cardio-vascular phenomena, such as enlargement (hyper- trophy) of the heart, and thickening of the inner and degeneration of the middle coats of the smaller arteries. The intermittent or transitory effects liable to be produced by kidney disease are : (1) dropsy, (2) secondary inflam- mations of certain organs and serous cavities, and (3) uraemia. Some of these effects are seen in every form of severe kidney disease ; thus uraemia may occur in any kidney disease which progresses to an extent sufficient to inflict serious damage on the kidneys. On the other hand, renal dropsy is more especially seen in certain forms of Bright’s disease, and the cardiac and arterial changes are particularly common in the granular or contracted kidney, but may be conspicuous by their absence in other diseases which destroy the kidney tissue, such as hydronephrosis. Uraemia is a

toxic condition, and clinically three varieties are usually recognized: the acute, the chronic, and the

“latent, according to the severity and character of the

symptoms. Many of these effects are dependent upon the action of poisons retained in the body owing to the deficient action of the kidneys as excretory organs. It is also probable that abnormal substances having a toxic action are produced as a result of a perverted metabolism. All observers are agreed that uraemia is of toxic origin, and it is probable that the dropsy of renal disease is due to effects produced in the capillaries by the presence of abnormal substances in the blood. Some pathologists consider that high arterial tension, cardiac hypertrophy, and arterial degeneration are also of toxic origin, whilst others regard these results as produced by an attempt on the part of the body to maintain an active circulation through the greatly diminished amount of kidney tissue available. The exact manner in which high tension and all its results are produced is not thoroughly understood.

(j. E. B.)

XI. Skin.

The diseases of the skin do not essentially differ from those of the other organs of the body. Like these, the skin is composed of cells resting on a connective tissue framework, in which run the vessels which nourish it and the nerves which keep up its communications with the rest of the body. But it has certain differ- ences from other organs, some dependent on its struc^ ture and some on its exposed position. Thus, instead of, like the kidney, to which it may best be compared, having its epithelium faced by epithelium, all lies open, and the various processes are all ” one-sided.” There are no depths to be attacked, and any diseases, if they spread, must do so superficially : spreading as they often do equally in all directions, the diseases of the skin have a tendency to assume a circular form, independently of any parasitic cause, though when such cause is present the patches are of a more perfectly circular shape. Further, from the extent of its superficial area

and its exposed position, the skin is liable to be attacked by more forms of irritation, parasitic or other, than any other organ of the body. Every stage and variety of disease is open to view ; minute differences, minor or important, are at once noted ; and thus it is that the recognized distinct maladies of the skin are so numerous. In no other organ, with the partial exception of the eye, can the changes be watched from day to day ; in none can so many stages of the same disease be simultaneously observed ; and in no other is it so simple a matter to remove and instantly fix for microscopic examination the living tissue. It is possible to distinguish on the skin between the effects of organisms which it is hardly possible to tell from each other by any other method, cultural or tinctorial ; and the relative harmlessness of inoculation makes confirma- tory experiments easy.

The multitude of its affections renders the difficulties of arranging the diseases of the skin very great, and the absence of any generally accepted scheme of classification has always been and still remains one of the main obsta- cles to their intelligent study. The older syste'ms, con- structed before the days of bacteriology, were commonly based on the form which the eruption assumed (scaly, moist, purulent), but they usually contained in addition a certain number of diseases under the heading of Parasitic. Though obviously illogical, such systems served well enough while the recognized parasitic diseases were few, such as those caused by such gross parasites as the Acarus scabiei (the itch mite), the pediculi (lice), and the hypho- mycetic fungi snc\ as the Achorion Schonleinii. The discoveries of bacteriology have enormously enlarged this class, but the difficulty is that one and the same disease is regarded as parasitic by one authority, as dependent on nerve influence by another, while a third assumes an

agnostic position. Dermatologists m ay perhaps be divided into three schools, though it must be understood that these merely represent the

general trend of the countries referred to, and that members of each are found in all. The German school, most of its leaders being pupils of the great Hebra, tend to look to external irritants as the cause of the great majority of diseases, and they are often described as " externalists." The discoveries of bacteri- ology have greatly strengthened their position, for it seems a reasonable assumption that if a disease closely resembles in its course another which can be proved to be due to some micro-organism, it probably owns a simi- lar origin, though the actual causa causans may have escaped detection. There are few who do not admit this argument in the case of small-pox, measles, and scarlatina. It is, however, incorrect to conclude that the German school regards all diseases as of external origin : some are manifestly due to internal causes, and it is in regard to the disputed cases that the term " externalist" is applied. The French school inclines to the theory of internal causes, and lays great stress on the influence of the ner- vous system and on diatheses (e.g., rheumatic, lymphatic, and dartrous) as the cause or modifying factor in many diseases. The Anglo-Saxon school (Great Britain and America) endeavours to take the best from both. Of the disputed diseases it puts some in the one class and some in the other, while it confesses its inability to decide with regard to the remainder. The following is a useful working classification, based mainly on the lines laid down by Unna in his great work on the Histo- Pathology of the Skin : â€"

I. Anomalies of Sensation : Pruritus AncestJiesia, Dermatalgia. II. Anomalies ov Secretion : Hyperidrosis, Ghromi- drosis, Anidrosis.

III. Anomalies of- Circulation : Urticaria Purpura.

IV. Inflammations : â€"

Traumatic: Dermatitis venenata, Trade derma- titis. Dermatitis medicamentosa, Dermatitis artefacta. Neurotic : Erythema, Prurigo, Hydroa, Pemphi- gus, Herpes. Infective: Inflammations of the surface epi- dermis (cutaneous catarrh) â€" Scabies, Chei- ropompliolyx. Miliaria, Impetigo, Ecthyma, Eczema, Seborrhosa, Psoriasis, Pityriasis rosea. Pityriasis rubra. Pityriasis rubra pilaris, Ich- thyosis. Inflammations of the deep or sub- merged epidermis (glands and

follicles) â€” Acne, Sycosis, Favus, Ringworm, Alopecia areata. Diseases of the nails. Inflamma- tions- of the corium â€” Erysipelas, Furuncle, Anthrax, Glanders, Actinomycosis, Rhinoj scleroma, Yclws, Mycosis fungoides. Lichen, ! Syphilis, Tuberculosis (lupus). Leprosy. V. New Growths : Benignant and malignant. VI. Retrogressive Changes (Atrophies) : Lupus ery- thematosus. Scleroderma, Sclerema neonatorum. VII. Malformations : Hyperkeratosis congenitalis, Hy- piertricliosis. VIII. Saprophytes ; Pityriasis versicolor, Erythrasma. IX. Anomalies of Pigmentation : Ephelis, Chloasma, Vitiligo.

The diseases grouped under the first two headings do not lend themselves to pathological description. They are usually depend- ent on some systemic disease the discussion of which would here be out of place. In the diseases plaofed under the heading "Anomalies of Circulation " many phenomena suggest a depend- ence on irritants brought to the skin by the blood. Thus in the group of diseases known as purpura, where haemorrhages of vary- ing size make their appearance on widely-separated parts of the

skin, we know that in some cases the cause is a poison, either inorganic (phosphorus, mercury) or organic (small ~~pox, measles, typhus) , and it does not seem too much to assume that in other cases, such as those associated with Bright's disease, a similar cause is at work, and that in all these oases the poisons, by weak~~ ening the vessels' walls, predispose them to rupture, for a lesion is found in all carefully examined specimens. In the disease known as urticaria or nettle-rash we meet with many cases of unknown origin. Reasoning from our knowledge of what happens wliere the disease is produced by some irritant poison introduced into the stomach, we may conjecture that in such cases some unknown irritant is circulating in the blood. The pathology of the lesions in this disease is as follows : reacting to some irritant, the blood-vessels dilate, serum is poured out from them into the tissues around, and compressing the vessels from without empties them of blood. This explains the white centre of the urticarial wheal, the red margin of which is the clinical expression of the dilated and uncompressed vessels at the border. In those diseases grouped together under the name of erythema, although the majority of authors place them under the

heading of inflammation, there is a good deal suggestive of a close relation to urticaria. Some cases are caused by the ingestion of certain drugs, a good many are directly associated with the rheumatic poison, while others are apparently connected with fermentative changes in the gastro- intestinal tract. Thus all those examples of the disease with the cause of which we are approximately acquainted are readily enough attributed to some circulating irritant. This disease differs histo- logically from urticaria in the persistent dilatation of the vessels. Although serum is poured out from them as freely as in urticaria, the dilatation of the vessels is so active that they are not compressed as in that disease, while the presence of numerous cells around the vessels seems to suggest a more severe irritant, and the fact that the lesions are clinically more persistent further confirms that suggestion.

The inflammations of the skin are divided by Unna into trau- matic (due to the application of some mechanical, chemical, or physical irritant), neurotic (a somewhat doubtful class, from which we have already suggested the removal of the diseases grouped as erythema), and infective (a group which includes the majority of the commoner skin diseases). With reference to this last class, it has already been pointed out that a large amount of assumption in regard to many of the diseases is necessary, for only in some of them has the actual infective agent been demonstrated. The in- flammatory reaction takes many different forms, each no doubt due to some subtle variant in the irritant or in the surface to which it is applied, for the same irritant will produce different results on different subjects j.but as yet we are only on the threshold of a knowledge by which we shall be able to recognize the irritant from the effects which it produces. If scabies be excluded, probably half the rest of the diseases of the skin are written down as eczema. A discussion of the pathological changes found in that and allied diseases will probably be the best method of explaining the pathology of the skin.

When certain irritants are applied to the skin we know before- hand what effects they will produce. Thus croton oil produces a vesicular and pustular eruption, that of cantharides is vesicular or bulbous, while other drugs are followed by results dependent on their concentration,

ranging from a mere redness produced by dilute applications to actual death of the skin from concentrated ones. With the milder irritants which produce the results clin- ically known as eczema we have invariably more or less pro- nounced certain definite phenomena. The blood-vessels dilate ; serum is exuded from them â€” it may be merely into the deeper layers of the skin, or it may reach into and among the epidermic cells, or burst its way through these and appear in drops on the surface. The epithelial cells are, immediately if the irritation be slight, later if it be more severe, stimulated to increased activity of growth and production ; and this activity, often misdirected, is so great that the normal process of hardening in the cells is interfered with, and we have what is known as parakeratosis (irregular cornification) and the consequent production of scales. Should this be the prominent pathological change, the exudation spends itself among the cells of the scales, and a condition pathologically moist appears to the clinical observer as a dry eruption. Thus according to the reactionâ€” which is presumably largely dependent on the irritant to which it is dueâ€” we have various degrees and forms of inflammation of the skin, all of them covered clinically by the term eczema. When such a dermatitis is produced experimentally by the application of such an irritant as croton oil we can more or less accurately predict the duration of the inflammation, which gradually becomes less and less and usually terminates in dry scaling. So in eczema, as long as the irritant continues to act so long will its results be evident on tlve skin. Unfortunately the irritant which is the cause of eczem^x still remains to be discovered.

In studying other inflammations we have the advantage of

eye]

definitely knowing their cause. TIius in Impetigo contagiosa all ol Koch’s postulates have been fulfilled, and we now know, mainly owing to the work of Saboraud, that the cause of the disease is the streptococcus pyogenes. The first result of inoculation is a minute red

spot (dilatation of the vessels), which is rapidly followed by the appearance on the surface of a vesicle or bleb (exudation of serum), which is soon converted into a pustule (exudation of leucocytes). The leucocytes apparently have a restraining influence on the activity of the organisms, for tlae whole dries up into a scab, which when thrown off discloses a healthy or slightly reddened skin. The organisms are not destroyed by the leucocytes, for if the case be not properly treated fresh areas are constantly attacked, and the disease lasts in- definitely.

In ringworm, where the cause of the disease is the growth in the superficial layers of the skin of one or other of the different varieties of fungus grouped together under the common name of ringworm, a reaction more resembling that of eczema is produced. There is the same dilatation of the vessel with exudation of fluid, sometimes reaching the surface in the form of vesicles, sometimes spending itself through and among the epidermic cells and only evidenced clinically by the presence of more or less scaling. In other cases the exudation early becomes purulent (this is said to occur regularly when the disease is contracted from the horse), a change which, though occasionally noted, is by no means frequent in eczema.

The inflammations of the corium or deeper layer of the skin are due, with very few exceptions, to the growth of well-known organisms, and where none have yet been discovered their exist- ence is generally accepted. Erysipelas, furuncle, anthrax, and glanders are diseases which run an acute course and rapidly ter- minate, the two former usually in recovery, the two latter often fatally. The other more chronic affections all follow one course ; in their earlier stages there is a new growth of connective tissue cells in their lowest forms (granuloma), and this later breaks down, either rapidly, as in syphilis, or slowly, as in tuberculosis and leprosy. Most of these diseases leave behind them a well- defined scar. I

The new growths of the skin are the same as those found else- where. Only two present special characters requiring notice here. Keloid is a peculiar form of fibroma which, although be- nignant as regards any general infection, invariably recurs locally after removal. Modent ulcer

is a form of cancer which occurs usually on the face, and whose malignancy is almost entirely local. The class of atrophies of the skin comprises those dis- eases where the atrophy is primary, and those where it succeeds to previous hypertrophic or inflammatory changes. Under saprophytes are included those fungi which vegetate on the skin but produce very slight if any symptoms. Anomalies of pig- mentation are those of excess and lack. Chloasma, in which dark patches appear, most frequently on the face, is usually associated with disease of some internal organ, such as the liver or uterus, being frequently observed in pregnancy. The cause of vitiligo, in which the pigment normally present disappears from certain areas, a phenomenon more striking in coloured than in white races, is unknown. (n. w.)

XII. Eye.

The specially important diseases of the eye are those which temporarily or permanently interfere with sight. In considering the pathology of the eye it may in the first place be remembered that it is a double organ.

A. The two eyes act together, under normal condi- tions, for all practical purposes exactly as if there were but one eye placed in the middle of the face. All im- pressions made upon either retina, to the one side of a vertical line through the fovea centralis, before giving rise to conscious perception cause a stimulation of the same area in the brain. Impressions formed simultaneously, for instance, on the right side of the right retina and on corresponding areas of the right side of the left retina, are conveyed to the same spots on the right occipital lobe of the brain. Pathological processes, therefore, which are localized in the right or left occipital lobes, or along any part of the course of the fibres which pass from the right or left optic tracts to these ” visual centres,” cause defects in function of the right or left halves of the two retinae. Hemianopia, or half-blindness, arising from these patho- logical changes, is of very varing degrees of severity, according to the nature and extent of the particular lesion. The blind areas in the two fields of vision, corresponding

to the outward projection of the paralysed retinal areas, are always symmetrical both in shape and degree. The central lesion may for

instance be very small, but at the same time destructive to the nerve tissue. This will be revealed as a sector-shaped or insular symmetrical com- plete blindness in the fields of vision to the opposite side. Or a large central area, or an area comprising many or all of the nerve fibres which pass to the visual centre on one side, may be involved in a lesion which causes impairment of function but no actual destruction of the nerve tissue. There is thus caused a symmetrical weakening of vision {amblyopia) in the opposite fields. In such cases the col- our vision is so much more evidently affected than the sense of form that the condition has been called liemia- chromatopsia, or half-colour-blindness. Hemianopia may be caused by haemorrhage, by embolism, by tumour growth which either directly involves the visual nerve elements or affects them by compression and by inflammation.

The two eyes also act as if they were one in accom- modating. It is impossible for the two eyes to accom- modate simultaneously to different extents, so that where there is, as occasionally happens, a difference in focus between them, this difference remains the same for all distances for which, they are adapted. In such cases, therefore, both eyes cannot ever be accurately adapted at the same time, though either may be alone. It often happens as a consequence that th^ one eye is used to re- ceive the sharpest images of distant, and the other of near objects. Any pathological change which leads to an interference in the accommodating power of one eye alone must have its origin in a lesion which lies peri- pherally to the nucleus of the third cranial nerve. Such a lesion is usually one of the third nerve itself. Conse- quently, a unilateral accommodation paresis is almost invariably associated with pareses of some of the oculo- motor muscles. A bilateral accommodation paresis is not uncommon. It is due to a nuclear or more central cerebral disturbance. Unlike a hemianopia, which is practically always permanent, a double accommodation paresis is frequently transitory. It is often a post-diphtheritic con- dition, appearing alone or associated with other paresis.

Both eyes are also normally intimately associated in their movements. They move in response to a stimulus, or a combination of stimuli, emanating from different centres of the brain, but always equally

distributed to the corresponding muscles in both eyes, so that the two lines of fixation meet at the succession of points on which attention is directed. The movements are thus associated in the same direction, to the right or left, upwards or downwards, &c. In addition, owing to the space which separates the two eyes, convergent movements, caused by stimuli equally distributed between the two internal recti, are required for the fixation of nearer and nearer-lying objects. These movements would not be necessary in the case of a single eye. It would merely have to accommo- date. The converging movements of the double eye occur in association with accommodation, and thus a close connexion becomes established between the stimuli to accommodation and convergence. All combinations of convergent and associated movements are constantly tak- ing place normally, just as if a single centrally-placed eye were moved in all directions and altered its accom- modation according to the distance, in any direction, of the object which it fixed.

Associated and convergent movements may be interfered with pathologically in different ways. Cerebral lesions may abolish them altogether or impair them, or may give rise to involuntary spasmodic action, as the result of paralysing or irritating the centres from which the various co-ordinated impulses are controlled or emanate. Lesions which do not involve the centres may prevent the response

to associated impulses in one eye alone by interfering witli the functional activity of one or more of the nerves along “which the stimuli are conveyed. Paralysis of oculo-motor nerves is thus a common cause of defects of association in the movements of the double eye. The great advan- tage of simultaneous binocular vision â€” viz., the apprecia- tion of depth, or stereoscopic vision â€” is thus lost for some,

or it may be all directions of fixation. Instead of seeing singly with two eyes, there is then double-vision (diplopia). This persists so long as the defect of associa- tion continues, or so long as the habit of mentally sup- pressing the image of the faultily-directed eye is not acquired.

In the absence of any nerve lesions, central or other, interfering with their associated movements, the eyes continue throughout life to respond equally to the stimuli which cause these movements, even when, owing to a visual defect of the one eye, binocular vision has become impossible. It is otherwise, however, with the proper co- ordination of convergent movements. These are pri- marily regulated by the unconscious desire for binocular vision, and more or less firmly associated with accommoda- tion. When one eye becomes blind, or when binocular vision for other reasons is lost, the impulse is gradually, as it were, unlearnt. This is the cause of divergent concomi- tant squint. Under somewhat similar conditions a degree of convergence, which is in excess of the requirements of fixation, may be acquired from different causes. This gives rise to convergent concomitant squint.

B. Taking each eye as a single organ, we find it to be subject to many diseases. In some cases both eyes may be affected in the same way as where the local disease is a manifestation of some general disturbance. Apart from the fibrous coat of the eye, the sclera, which is little prone to disease, and the external muscles and other adnexa, the eye may be looked upon as composed of two elements, (a) the dioptric media, and (6) the parts more ,or less directly connected with perception. Pathological condi- tions affecting either of these elements may interfere with sight.

(a) The dioptric media, or the transparent portions which are concerned in the transmission of light to, and the formation of images upon, the retina, are the following : â€” the cornea, the aqueous humour, the crystalline lens, and the vitreous humour. Loss of transparency in any of these media leads to blurring of the retinal images of external objects. In addition to loss of transparency, the cornea may have its curvature altered by pathological processes. This

necessarily causes imperfection of sight. The crystalline lens, on the other hand, may be dislocated, and thus cause image distortion.

(i.) The transparency of the cornea is mainly lost by inflammation, which causes either an infiltration of its tissues with leucocytes, or a more focal, more destructive ulcerative process. In the process of repair the loss of substance sustained in the latter case is made good by cicatricial tissue. This newly-formed tissue is always in- transparent, and remains so, except in very young chil- dren, in whom it gradually, to a great extent, clears up, owing to the more rapid and more complete tissue changes of early life. The intransparency caused by a mere infil- tration generally clears away in the course of time, though often not entirely. The process of clearing is usually associated with the formation of blood-vessels in the cornea. These eventually also undergo absorption. A vascularization of the cornea generally also accompanies ulceration, and is, indeed, often a necessary part of the process of reparation. According to the position occupied by the cicatrix following a corneal ulcer, and to its extent and density, is the decree of the resulting visual defect. Centrally placed intransparencies, which cover the pupil,

are relatively the most disturbing. The larger losses of substance, even though marginal, may interfere greatly with sight, by causing changes in the corneal curvature. This is principally the case where the cicatricial tissue yields to the intra-ocular pressure before consolidation, and gives rise to partial staphyloma of the cornea. The same yielding may be met with, though rarely, where there has been an excessive degree of infiltration alone. Corneal ulcers, which perforate, lead not infrequently to hernia of the iris, a portion of which then becomes incor- porated in the scar. A special form of corneal opacity is what is called pannus. This consists of a more or less dense development of superficial blood-vessels, offshoots of the conjunctival arteries and veins, with some infiltra- tion of the outer layers of the cornea. Pannus is a frequent accompaniment of trachoma, a chronic destruc- tive form of conjunctival inflammation. A somewhat rare condition of the cornea, by which, without any in- flammatory symptoms, a marked change in its curvature is slowly produced, is

what is called conical cornea. The pathology of this condition is unknown. Primary tumours of ftie cornea are exceedingly rare.

(ii.) Intransparency of the aqueous humour is always due to some exudation. This comes either from the iris or the ciliary processes, and may be blood, pus, or fibrin. An exudation in this situation tends naturally to gravi- tate to the most dependent part, and, in the case of blood or pus, is known as hyphcema or hypopyon.

(iii.) Intransparency of the crystalline lens is techni- cally known as cataract. Cataract may be idiopathic and uncomplicated, or traumatic, or secondary to disease in the deeper parts of the eye. The modified epithelial structure of which the lens is composed is always being added to throughout life. The older portions of the lens are consequently the more central. They are harder and less elastic. This arrangement seems to predispose to difficulties of nutrition. In many people, in the absence altogether of general or local disease, the transparency of the lens is lost owing to degeneration of the incompletely- nourished fibres. This idiopathic cataract mostly occurs in old people ; hence the term senile cataract. So-called senile cataract is not, however, necessarily associated with any general senile changes. An idiopathic uncomplicated cataract is also met with as a congenital defect due to faulty development of the crystalline lens. A particular and not uncommon form of this kind of cataract, which may also develop during infancy, is lamellar or zomdar cataract. This is a partial and stationary form of cata- ract in which, while the greater part of the lens retains its transparency, some of the lamellae are intransparent. Traumatic cataract occurs in two ways : by laceration or rupture of the lens capsule, or by nutritional changes consequent upon injuries to the deeper structures of the eye. The transparency of the lens is dependent upon the integrity of its capsule. Penetrating wounds of the eye involving the capsule, or rupture of the capsule from severe blows on the eye without perforation of its coats, are followed by rapidly developing cataract. Severe non- penetrating injuries, which do not cailse rupture of the capsule, are sometimes followed, after a time, by slowly- progressing cataract. Secondary cataract is due to abnor- malities in the nutrient matter supplied to the lens owing to disease of

the ciliary body, choroid, or retina. In some diseases, as diabetes, the altered general nutri- tion tells in the same way on the crystalline lens. Cataract is then rapidly formed. All cases of cata- ract in diabetes are not, however, necessarily true diabetic cataracts in the above sense. Dislocations of the lens are traumatic or congenital. In old-stand- ing disease of the eye the suspensory ligament may yield in part, and thus lead to lens dislocation. The

lens is practically always cataractous before this takes place.

(iv.) The vitreous humour loses its transparency owing to exudation from the inflamed ciliary body or choroid. The exudation may be fibrinous or purulent ; the latter only as a result of injuries by which foreign bodies or septic matter are introduced into the eye, or in metastatic choroiditis. Blood may also be effused into the vitreous from rupture of retinal, ciliary, or choroidal vessels. The pathological significance of the various effusions into the vitreous depends greatly upon the cause. In many cases effusion and absorption are constantly taking place simultaneously. The extent of possible clearing depends greatly upon the preponderance of the latter process.

(&) Inflammations of the uveal tract, the iris, ciliary body, and choroid, are of common occurrence. Inflammar tions of the iris {iritis), the causes of which are numerous, may lead, when untreated, to serious consequences. This is owing to the tendency towards adhesions being formed by the consolidation of plastic exudation between the posterior surface of the iris and the lens capsule. These so-called synechice, besides interfering with the free move- ments of the pupil, may introduce nutritional diflBculties, especially in the case of recurrent attacks of inflamma- tion. Inflammation of the ciliary body (cycUtis) leads to effusion into the anterior part of the vitreous. It may coexist with iritis (irido-cyclitis) or with inflammation of the choroid (choroido-cyclitis). The most serious form of irido-cyclitis is that which may follow penetrating wounds of the eye. Under certain conditions

this leads to a similar inflammation in the other eye. This so-called sympathetic ophthalmitis is of a malignant type, causing destruction of the sympathizing eye. Choroidal inflam- mations are generally patchy, various foci of inflamma- tion being scattered over the choroid. These patches may in course of time become more or less confluent. The effect upon vision depends upon the extent to which the external or percipient elements of the retina become involved. It is especially serious when the more centred portions of the retina are thus affected (Ohoroido-retinitis centralis).

A peculiar and grave pathological condition of the eye is what is known as glaucoma. A characteristic of this condition is increase of the intra-ocular tension, which has a deleterious effect on the optic nerve end and its rami- fications in the retina. The cause of the rise of tension is partly congestive, partly mechanical. The effect of glaucoma, when untreated, is to cause ever-increasing loss of sight, although the time occupied by the process before it leads to complete blindness varies within such extraordinarily wide limits as from a few hours to many years. The uveal tract may be the site of sarcoma.

The retina is subject to inflammation, to detachment from the choroid, to haemorrhages from the blood-vessels, and to tumour. Eetinal inflammation may primarily affect either the nerve elements or the connective tissue framework. The former is usually associated with some general disease such as albuminuria or diabetes, and is bilateral. The tissufe changes are oedema, the formation of exudative patches, and haemorrhage. Where the con- nective tissue elements are primarily affected, the condi- tion is a' slow one, similar to sclerosis of the central nervous system. The gradual blindness which this causes is due to compression

the retina are met with in phlebitis of the central retinal vein, which is almost invariably unilateral, and in certain conditions of the blood, as pernicious anaemia, when they are always bilateral.

The optic nerve is subject to inflammation (optic neuritis), and atrophy. Double optic neuritis, affecting, however, only the intra-ocular ends of the nerves, is an almost constant accompaniment of brain tumour.

Unilat- eral neuritis^has a different causation, depending upon an inflammation, mainly perineuritic, of the nerve in the orbit. It is analogous to peripheral inflammation of other nerves, such as the third, fourth, sixth, and seventh cranial nerves. (g. a. bb.)

Pathology of Plants. â€” Phytopathology comprises our knowledge of the symptoms, course, causes, and remedies of the maladies which threaten the life of plants, or which result in abnormalities of structure that are regarded, whether directly injurious or not to life, as unsightly or undesirable. In its systematized form, as a branch of botanical study, it is of recent date, and, as now understood, the subject first received special attention about 1850, when the nature of parasitism began to be intelligible ; but many disjointed references to diseased conditions of plants had appeared long before this. The existence of blights and mildews of cereals had been ob- served and recorded in very ancient times, as witness the Bible, where half a dozen references to such scourges occur in the Old Testament alone. The epidemic nature of wheat-rust was known to Aristotle about 360 e.g., and the Greeks and Eomans knew these epidemics well, their phi- losophers having shrewd speculations as to causes, while the people held characteristic superstitions regarding them, which found vent in the dedication of special festi- vals^and deities to the pests. Pliny knew that flies emerge from galls. The few records during the Middle Ages are borne out by what is known of famines and pestilence. Shakespeare's reference in King Lear (Act III., sc. 4) may be quoted as evincing acquaintance with mildew in the 17th century, as also the interesting Eouen law of Loverdo (1660). Malpighi in 1679 gave excellent figures and ac- counts of leaf-rolling and gall insects, and Grew in 1682 equally good descriptions of a leaf-mining caterpillar. During the 18th century more academic treatment of the subject began to replace the scattered notes. Hales (1727- 33) discussed the rotting of wounds, cankers, &c., but much had to be done with the microscope before any real progress was possible, and it is easily intelligible that until the theory of nutrition of the higher plants had been founded by the- work of Ingenhouss, Priestley, and De Saussure, the way was not even prepared for accu- rate knowlege of cryptogamic parasites and the diseases they induce. Even in 1833 Turpin, and a far better observer, Unger, regarded

parasitic fungi as diseased out- growths of the plants themselves, views from which Meyen (1837) and Schleiden (1846) had not yet escaped. We can do no more than refer to the treatises of Wiegmann (1839), Meyer (1841), Easpail (1846), Kiihn (1859), and other books as showing the interest the new subject was awakening, but the reader will find an admirable sum- mary of what was known in 1854 in Berkeley's articles in the Gardener's Chronicle of that year. It was not till De Bary (1866) made known the true nature of parasitic Fungi, based on his researches between 1853-63, that the vast domain of epidemic diseases of plants was opened up to fruitful investigation, and such modern treatises as those of Frank (1880 and 1895), Sorauer (1886), Kirchner (1890), were gradually made possible.

The proper study of plant pathology involves knowledge of the physiology of plants â€" i.e., of the normal relations of plants to the environment, and of the normal internal

structure and working of the oiganism itself. It cannot be too strongly emphasized that pathology â€" disease â€" is abnormal physiology, and that the commonest misappre- hensions and blunders arise from ignorance of this, and of the simplest principles of physiology. It is true, the boundary lines between normal physiology â€" ('.(?., health â€" and disease are not fixed, and are often difficult to draw, but all our knowledge points to the conclusion that the statement. Disease is ill-health, is not a mere matter of words, but expresses the fact.

Plant pathology embraces several branches of study, and may be conveniently divided as follows : â€"

1. The observation and accurate description of symptoms (Diagnosis).

2. The study of causes or agencies inducing disease {^'Etiology).

3. The practice of preventive and remedial measures (Thera2wutics) .

In plants, however, the symptoms of disease are apt to exhibit themselves in a very general manner. Our per- ceptions differentiate but imperfectly symptoms which are due to very different causes and reactions, probably because the organization of the plant is so much less highly specialized than that of higher animals. The yellowing and subsequent casting of leaves, for instance, is a very general symptom of disease in plants, and may be induced by drought, extremes of temperature, insufiicient or exces- sive illumination, excess of water at the roots, the action of parasitic Fungi, insects, worms, &c., or of poisonous gases, and so forth ; and extreme caution is necessary in dealing with amateur descriptions of such symptoms, especially when the untrained eye has taken no cognizance of, or has only vaguely observed, the numerous collateral circum- stances of the case. It is chiefly due to these difficulties that most works on plant pathology, which classify the subject according to the causes, themselves often imper- fectly understood, leave such vague impressions on the reader. It should be regarded as the distinct aim of future workers to perfect a system whereby classification of symptoms is possible ; for, although remedial measures must always depend on the understanding of the causes at work in disease, the rational classification of symptoms is necessary to direct attention to the probable course of events.

The causes of disease may be provisionally classified somewhat as follows, but it may be remarked at the out- set that no one of these proximal causes, or agents, is ever solely responsible ; and it is very easy to err in attributing a diseased condition to any of them, unless the relative importance of primary and subordinate agencies is dis- coverable. For instance, a Fungus epidemic is impossible unless the climatic conditions are such as to favour the dispersal and germination of the spores ; and when plants are killed off owing to the supersaturation of the soil with water, it is by no means obvious whether the excess of water and dissolved materials, or the exclusion of oxygen from the root-hairs, or the lowering of, the temperature, or the accumulation of foul products of decomposition should be put into the foreground. In every case there are chains of causatj.on concerned, and the same factors will be differently grouped in different cases.

Bearing in mind these precautions, we may classify the proximal causal agents of disease as â€”

I. External agencies. A. Non-living. 0. Material.

1. Physical â€” Soil. Water. Atmosphere.

2. Chemical â€” Soil. Water. Atmosphere. b. Non-material â€”

1. Temperature.

2. Illumination.

3. Other agencies. B. Living.

a. Animals.

1. Vertebrata.

2. Invertebrata.

b. Plants.

1. Phanerogams.

2. Cryptogams. II. Internal agencies.

While such a classification may serve its purpose as a sort of index, it must be confessed that the limits of its usefulness are soon reached. In the first place, the so- called "internal causes" of disease is probably a mere phrase covering our ignorance of the factors at work, and although a certain convenience attaches to the distinction between those cases where tender breeds of plants appar- ently exhibit internal predisposition to suffer more readily than others from parasites, low temperatures, excessive growth, &c. â€" as is the case with some grafted plants, culti- vated hybrids, &c. â€" the mystery involved in the phrase "internal causes" only exists until we find what action of the living or non-living environment of the essential mechanism of the plant has upset its equilibrium.

I. Passing to the recognized external agencies, the physical condition of the soil is a fruitful source of dis- ease. If too closely packed, the soil particles present mechanical obstacles to growth ; if too retentive of mois- ture, the root-hairs suffer, as already hinted ; if too open or over-drained, the plant succumbs to drought. All those properties of soil known as texture, porosity, depth, inclination to the horizon, &c., are concerned here. Many maladies of plants are traceable to the chemical composi- tion of soils â€" e.g., deficiency of nutritive salts, especially nitrates and phosphates ; the presence of poisonous salts of iron, copper, &c., or (in the soil about the roots of trees in towns) of coal-gas, and so forth. But it is worthy of special attention that the mere chemical composition of agricultural and garden soils is, as a rule, the least important feature about them, popular opinion to the con- trary notwithstanding. Ordinary soils will almost always provide the necessary chemical ingredients if of proper physical texture, depth, &c. But, as showing how im- possible it is sharply to classify the factors concerned, the absence of nitrifying bacteria, of humus constituents and my corrhiza Fungi, of earth-worms and other organisms which beneficially affect plants, may decide the question of health or disease of plants in soils otherwise admirably suited to them (see articles Fuxgi, and Bactekiology : Schizomycetes).

As regards tvatei; its deficiency or excess is a relative matter, and although many of the minor maladies of pot- plants in windows and greenhouses controlled by amateurs depend on its misuse, water alone is probably never a primary cause of disease. Its over-supply is, however, a frequent cause of predisposition to the attacks of para- sitic Fungiâ€" e.g-., the damping off of seedlingsâ€" and in saturated soils not only are the roots and root-hairs killed by asphyxiation, but the whole course of soil fermentation is altered, and it takes time to " sweeten " such by drain- ing, because not only must the noxious bodies be gradually washed out and the lost salts restored, but the balance of suitable bacterial and fungal life must be restored. â€¢

The atmosphere is a cause of disease in the neighbour-

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hood of chemical works, large towns, volcanoes, &e., in so far as it carries acid gases and poisons to the leaves and roots; but it is usual to associate with it the action of excessive humidity which brings about those tender watery and more or less etiolated conditions which favour parasitic Fungi, and diminish transpiration and therefore nutrition. It is customary to speak of the disastrous effects of cold winds, snow, hail and frost, lightning, &c., under the heading of atmospheric influences, which only shows once more how impossible it is to separate causes individually.

Turning to the non-material external agents, probably no factors are more responsible for ill-health in plants than temperature and light. Every plant is constrained to carry out its functions of germination, growth, nutrition, reproduction, &c., between certain limits of temperature, and somewhere between the extremes of these limits each function finds an optimum temperature at which the working of the living machinery is at its best, and, other things being equal, any great departure from this may induce pathological conditions ; and many disasters are due to the failure to provide such suitable tempera- turesâ€” e.g., in greenhouses where plants requiring very different optimum temperatures and^ illumination are kept together. Equally disastrous are those climatic or seasonal changes which involve temperatures in them- selves not excessive but in wrong sequence : how many more useful plants could be grown in the open in the United Kingdom if the deceptively mild springs were not so often followed by frosts in May and June ! The indirect effects of temperature are also important. Trees, of which the young buds are “nipped” by frost, would frequently not suffer material injury, were it not that the small frost-cracks serve as points of entry for Eungi; and numerous cases are known where even high tempera- tures can be endured on rich, deep, retentive soils by plants which at once succumb to drought on shallow or non-retentive soils. Nay, even on similar soils, a given plant may die where the surface is ” caked,” and live if the surface has been well stirred, again bringing out the complex interaction of various factors.

All chlorophyll plants require light, but in very different degrees, as exemplified even in the United Kingdom by the shade-bearing beech and yew contrasted with the light-demanding larch and birch; and as with tempera- ture so with light, every plant and even every organ has its optimum of illumination. The ” drawn ” or etiolated condition of over-shaded plants is a case in point, though here again the soft, watery plant often really. succumbs to other disease agents â€” e.g., parasitic Fungi â€” supervening on its non-resistant condition.

Animals and plants as agents of disease or injury form part of the larger subject of the struggle for existence between living organisms, as is recognized even by those who do not so readily apprehend that diseased conditions in general are always signs of defeat in the struggle for existence between the suffering organism and its environ- ment, living and non-living. Indeed, a comprehensive definition of disease generally would be : Variations in directions which threaten the existence of the patient.

The Vertebrata come within the scope of our subject, chiefly as destructive agents which cause wounds or devour young shoots and foliage, &c. Rabbits and other burrowing animals injure roots, squirrels and birds snip off buds, horned cattle strip off bark, and so forth. It is among the Invertebrata that epidemics of destruction are referred to, though we should bear in mind that it is only the difference in numerical proportion that pre- vents our speaking of an epidemic of elephants or of rabbits, though we use the term when speaking of blight insects ; there is little consistency in the matter, as it

is usual to speak of an invasion or scourge of locusts, caterpillars, &c. Insect injuries are very varied in degree and in kind. Locusts devour all before them ; cater- pillars defoliate the plant, and necessitate the premature utilization of its reserves ; other insects {e.g., GraplioUtha) eat the buds, or the roots {e.g., wireworms), and so maim the plant that its foliage suffers from want of water and assimilation is diminished, or actual withering fol- lows. Many aphides, &c., puncture the leaves, suck out the sap, and induce various local deformations, arrest of growth, pustular swellings, &c., and if numerous all the evils of

defoliation may follow. Others {e.g,, miners) tunnel into the leaf parenchyma, and so put the assimi- lating areas out of action in another way. It should be remembered that a single complete defoliation of a herbaceous annual may so incapacitate the assimilation that no stores are available for seeds, tubers, &c., for another year, or at most so little that feeble plants only come up. In the case of a tree matters run some- what differently : most large trees in full foliage have far more assimilatory surface than is immediately necessary, and if the injury is confined to a single year it may be a small event in the life of the tree, but if repeated the cambium, bud-stores, and fruiting may all suffer. Many larvae of beetles, moths, &c., bore into bark, and injure the cambium, or even the wood and pith ; in addition to direct injury, the interference with the transpiration current and the access of other parasites through the wounds are also to be feared in proportion to the num- bers of insects at work. Various local hypertrophies, including galls, result from the increased , growth of young tissues irritated by the punctures of insects, or by the presence of eggs or larvae left behind. They may occur on all parts, buds, leaves, stems, or roots, as shown by the numerous species of Cynips on oak, Phylloxera on vines, &c. The local damage is small, but the general injury to assimilation, absorption, and other functions may be important if the numbers increase. In addition to insects, various kinds of worms, molluscs, &c., are sometimes of importance as pests. The so-oalled eel-worms {Nematodes) may do immense damage on roots and in the grains of cereals, and every one knows how predatory slugs and snails are.

Plants as agents of damage and disease may be divided into those larger forms which as weeds, epiphytes, and so forth do injury by dominating and shading more deli- cate species, or by gradually exhausting the soil, &c., and true parasites which actually live on and in the tissues of the plants. It must be remembered that phanerogams also include parasitic species â€” e.g,, Cuscuta, Loranthus, Viscum, Thesium, Rhinanthus, &c. â€” with various capacities for injury. These enemies are as a rule so conspicuous that we do not look on their depredations as diseases, though the gradual deterioration of hay unde* the exhaust- ing effects of root-parasites like Rhinanthus, and

the onslaught of Cuscuta when unduly abundant, should teach us how unimportant to the definition the question of size may be. Weeds often do as much damage indi- rectly as directly. If grass and herbage are grown in orchards, they may increase the moisture and shade which favour certain Fungi at one season, and dry up the soil over the finer roots of the trees at another, as well as compete with these for nutritive salts. On the other hand, the action of such weeds in checking the develop- ment of surface roots has been claimed as advantageous, and it is evident that the nature and composition of the weed herbage in different localities may, affect the matter.

It is, however, among the Fungi that we find the most disastrous and elusive agents of disease. Parasitic Fungi may be, as regards their direct action, purely local â€” e.g., Schinzia, which forms gall-like swellings on the

roots of rushes ; Gymnosporangium, causing excrescences on juniper stems; numerous leaf Fungi such as Puccinia, ^cklium, Septoria, &c., causing yellow, brown, or black spots on leaves; or Ustilago in the anthers of certain flowers. In such cases the immediate damage done may be slight ; but the effects of prolonged action and the summation of numerous attacks at numerous points are often enormous, certain of these leaf-diseases costing millions sterling annually to some planting and agricul- tural communities. In other cases the Tungus is viru- lent and rampant, and, instead of a local effect, exerts a general destructive action throughout the plant â€” e.g., Pytlivim, which causes the " damping off " of seedlings, reducing them to a putrid mass in a few hours, and Phytophtlwra, the agent of the potato disease. Many Fungi, in themselves not very aggressive, slowly bring about important and far-reaching secondary effects. Thus, many Hymenomycetes (Agarics, Polyporei, &c.) live on the wood of trees. This wood is in great part already dead substance, but the mycelium gradually invades the vessels occupied with the transmission of water up the trunk, cuts off the current, and so kills the tree ; in other cases such Fungi attack the

roots, and so induce rot and starvation of oxygen, resulting in "fouling." We may not inaptly compare the procedure to various methods of reducing a besieged community by cutting off or poisoning the water supplies. Numerous Fungi, though conspicuous as parasites, cannot be said to do much individual injury to the host. The extraordinary mal- formations known as " Witches' Brooms," caused by the repeated branching and tufting of twigs in which the mycelium of Exoascus (on birch) or ^cidium (on silver fir) are living, may be borne in considerable numbers for years without any very extensive apparent injury to the tree. Again, the curious distortions on the stems of nettles attacked by the .^cidium form of the heteroecious Puccinia caricis (see Fungi for Heteroecism), or on maize stems and leaves attacked by Ustilago May- dis, or on the inflorescence of cruciferee infested with Cystopus, &c., are not individually very destructive ; it is the cumulative effects of numerous attacks or of ex- tensive epidemics which eventually tell. Some very curious details are observable in these cases of mal- formation. For instance, the .^cidium Elatinum first referred to causes the new shoots to differ in direction, duration, and arrangement, and even shape of foliage leaves from the normal; and the shoots of Euphorbia infested with the gecidia of Uromyces pisi depart so much from the normal in appearance that the attacked plants have been taken for a different species. Similarly with Anemone infested with Puccinia and Vacciiiium with Calyptospora, and many other cases of deformations due to hypertrophy or atrophy. Instances of what we may term tolerated parasitism, where the host plant seems to accom- modate itself very well to the presence of the Fungus, pay- ing the tax it extorts and nevertheless not succumbing but managing to provide itself with suflS.cient material to go on with, are not rare ; and these seem to lead to those cases where the mutual accommodation between host and guest has been carried so far that each derives some benefit from the association â€" symbiosis (see Fungi).

II. Tlie Icinds of disease due to these various agencies are very different. A plant may be diseased as a whole, because nearly all its tissues are in a morbid or patho- logical condition, owing to some Fungus pervading the whole â€" e.g., Pytliium in seedlings â€" or to a poison diffusing from cell to cell ; in the case of unicellular plants â€"

e.g., an alga infested with a Chytridium â€” indeed, matters can hardly be otherwise. But the case is obviously different where a plant dies because some essential organ or tissue- tract has been destroyed, and other parts have suffered

because supplies are cut off â€” e.g., when the upper parts of a tree die off owing to destruction of the roots, or to the ringing of the stem lower down, and consequent interfer- ence with the transpiration current. In a large number of cases, however, the disease is purely local, and does not itself extend far into the organ or tissue affected ; e.g., when an insect punctures a leaf at some minute point with its proboscis or ovipositor, killing a few cells and irritating those in the immediate neighbourhood; or when a knife-cut wounds the cambium, which soon covers up the injury by means of callus ; or wlien a Fungus such as Uromyces infects a leaf by way of a stoma, the myce- lium not spreading more than a few millimetres round the point of entry.

Attempts have been made to classify diseases according to the organs or tissues attacked â€” to speak of leaf diseases, root diseases, timber diseases, diseases of the bark, and so forth. Neither these nor any arrangement according to the functions deranged have proved satisfactory, and it is doubtful if in any circumstances phrases like “general functional disease,” diseases of the absorptive organs, or of the respiratory organs can be usefully employed in plant pathology, the various organs and functions of plants be- ing too vaguely marked off one from the other. Current terminology is responsible in part for some confusion of thought in other directions. Strictly speaking, wheat-rust is not a disease, but a symptom betraying the presence of a disease-inducing Fungus ; similarly, chlorosis is a symp- tom of imperfect chlorophyll production. In both cases the fundamental disease itself consists in the starvation of the cell-protoplasm of carbohydrates, in the one case because the parasite steals them as fast as they are made, in the other because the machinery is too imperfect to make them.

If a mass of living plant-tissue is cut, the first change observed is one of colour : the white ” flesh ” of a potato or an apple turns brown as the air enters, and closer examination shows that cell walls and contents

are alike affected. The cut cells die, and oxidized products are concerned in the change of colour, the brown juices exuding and soaking into the cell-walls. The next change observable after some hours is that the untouched cells below the cut grow larger, push up the dead surface, and divide by walls tangential to it, with the formation of tabloid cork-cells. The layer of cork thus formed cuts out the dead debris and serves to protect the uninjured cells below. Such healing by cork formation is accompanied by a rise of temperature : the active growth of the dividing cells is accompanied by vigorous metabolism and respira- tion, and a state of ” wound fever ” supervenes imtil the healing is completed. The phenomena described occur in all cases of cicatrization of wounds in nature â€” e.g., leaf- tissue, young stems, roots, &c., when cut or pierced by insects, thorns, and so forth. They are concerned in the occlusion of broken twigs and of falling leaves, and it is from the ajCtively growing ” callus ” developed at the sur- face of the wounded tissues of cuttings, buddings, prun- ings, &c., that the healing and renewal of tissues occur of which advantage is taken in the practice of what might well be termed plant surgery. A third phenomenon ob- servable ill such healing tissues is the increased flow and accumulation of plastic materials at the seat of injury. The enhanced metabolism creates a current of draught on the supplies of available food-stuffs around. The phe- nomenon of irritability here concerned is well shown in certain cases T'here a parasitic organism gains access to a cell â€” e.g., Pleotrachelus causes the invaded Pilobolus to swell up, and changes the whole course of its cell me- tabolism, and similarly with Plasmodiopliora in the roots of turnips, and many other cases.

Irritation and hypertrophy of cells are common signs

of the presence of parasites, as evinced by the numerous malformations, galls, witches’-brooms, &c., on diseased plants. The now well-known fact that small doses of poisonous substances may act as stimuli to living proto- plasm, and that respiratory activity and

growth may be accelerated by chloroform, ether, and even powerful mineral poisons, such as mercuric chloride, in minimal doses, offers some explanation of these phenomena of hypertrophy, ” wound fever,” and other responses to the presence of irritating agents. Still further insight is afforded by our increasing knowledge of the enzymes, and it is to be remarked that both poisons and enzymes are very common in just such parasitic Fungi as induce dis- eolorations, hypertrophies, and the death of cells â€” e.g., Botrytis, Ergot, &c. Now it is clear that if an organism gains access to all parts of a plant, and stimulates all or most of its cells to hypertrophy, we may have the latter behaving abnormally â€” i.e., it may be diseased throughout ; and such actually occurs in the case oi Euphorbia pervaded with Uromyces pisi, the presence of which alters the whole aspect of the host-plant. If such a general parasite carries its activities further, every cell may be killed and the plant forthwith destroyed â€” e.g., Phytophthora in potatoes. If, on the other hand, the irritating agent is local in its action, causing only a few cells to react, we have the various pimples, excrescences, outgrowths, &c., exhibited in such cases as Ustilago Maydis on the maize, various galls, witches’-brooms, &c. If, again, a few cells are killed on one side only of a young organ, they and their progeny can no longer take part in growth, and so the still active cells on the other side of the organ push the newly-forming tissues over to the arrested side, as in lily buds deformed by Botrytis, currant leaves pierced by mites, pine shoots contorted by Oceoma pinitorquam, &c.

It must not be overlooked that the living cells of the plant react upon the parasite â€¢ as well as to all external agencies, and the nature of disease becomes intelligible only if we bear in mind that it consists in such altered metabolism â€” deflected physiology â€” as is here implied. The reaction of the cells may be in two directions, more- over. For instance, suppose the effect of a lowering tem- perature is to so modify the metabolism of the cells that they fill up more and more with watery sap ; as the freezing-point is reached this may result in destructive changes, and death from cold may result. If, on the con- trary, the gradual cooling is met by a corresponding de- pletion of the cells of water, even intense cold may be sustained without injury.

Or, take another case. If the attack of a parasite is met by the formation of some substance in the protoplasm which is chemotactically repulsive to the invader, it may be totally incapable of penetrating the cell, even though equipped with a whole armoury of cytases, diastatic and other enzymes, and poisons which would easily overcome the more passive resistances offered by mere cell-walls and cell-contents of other plants, the protoplasm of which forms bodies chemotactically attractive to the Fungus. Only in some such way as this can we explain why a given Uredine parasite on one species of grass is quite incapable of penetrating a closely-allied species, and why a Fungus, such as Penicillium, one of the most pronounced saprophytes known, may be trained to parasitic habits by artificial treatment of the host-plants.

The various degrees of parasitism are to a certain extent explained by the f oregsing. In order that a Fungus may enter a plant, it must be able to overcome not merely the resistance of cell-walls, but that of the living proto- plasm : if it cannot do this, it must remain outside as a mere epiphyte, e.g., Fumago, Herpotrichia, &c., or, at most, vegetate in the intercellular spaces and anchor itself to the cell-walls, e.g., Trichosplimria. The inability to enter the

cells may be due to the lack of chemotactic bodies, to incapacity to form cellulose-dissolving enzymes, to the existence in the host-cells of antagonistic bodies which neutralize or destroy the acids, enzymes, or poisons formed by the hyphae, or even to the formation and excretion of bodies which poison the Fungus. But even when inside it does not follow that the Fungus can kill the cell, and many cases are known where the Fungus can break through the cell's first lines of defence (cell-wall and protoplasmic lining) ; but the struggle goes on at close quarters, and various degrees of hypertrophy, accumula- tion of plastic bodies or secretions, discolorations, &c., â– indicate the suffering of the still living cell. Finally, cases occur where the invaded cell so adapts itself to the presence of the intruder that life in common â€" symbiosis â€" results.

The dissemination of plant parasites is favoured by many circumstances not always obvious, whence an air of mystery regarding

epidemics was easily created in earlier times. The spores of Rusts, Erysipheee, and other Fungi may be conveyed from plant to plant by snails ; those of tree-killing polyporei, &c., by mice, rabbits, rats, &c., which rub their fur against the hymenophores. Bees carry the spores of Sclerotinia as they do the pollen of the bilberries, and flies convey the conidia of ergot from grain to grain. Insects, indeed, are largely concerned in disseminating Fungi, either on their bodies or vid the alimentary canal. Worms bring spores to the surface of soil, ducks and other birds convey them on their muddy feet, and, as is well known, wind and other physical agencies are very efficient in dissemination. The part played by man also counts for much. Gardeners and farm labourers convey spores from one bed or field to another ; carted soil, manure, &c., may abound in spores of Smuts, Fusarium, Polyporei, and in sclerotia; and articles through the post and so forth often carry infec- tive spores. Every time a carpenter saws fresh timber with a saw recently put through wood attacked with dry-rot, he risks infecting it with the Fungus ; and simi- larly in pruning, in propagating by cuttings, &c. Nor are the Fungi themselves always passive agents, as their odours, mechanisms for disjunction, ejaculation, &c., show.

The annual losses due to epidemic plant diseases attain proportions not easily estimated. As regards money value alone the following figures may serve in illustration. In 1882 the United States was calculated to have lost Â£40,000,000 to Â£60,000,000 from insect and other pests. The wheat-rust costs Australia Â£2,000,000 to Â£3,000,000 annually, and in 1891 alone the loss which Prussia suffered from grain-rusts was estimated at Â£20,000,000 sterling. These and numerous similar statistics lead to the con- clusion that it is probable that we might put the average annual loss the world endures from epidemic and other plant diseases at not less than Â£100,000,000 sterling.

The terrible losses sustained by whole communities of farmers, planters, foresters, &c., from plant diseases have naturally stimulated the search for remedies, but even now the search is too often conducted in the spirit of the believer in quack medicines, although the agricultural world is awakening to the fact that before any measures likely to be successful can be attempted, the whole chain of causa- tion

of the disease must be investigated. Experience with epidemics, dearly bought in the past, has shown that one fruitful cause is the laying open to the inroads of some Fungus or insect, hitherto leading a quiet ^endemic life in the fields and forests, large tracts of its "special food, along which it may range rampant without check to its dispersal, nutrition, and reproduction. Numerous wild hypotheses as to changes in the constitution of the host- plant, leading to supposed vulnerability previously non-

existent, ~~would probably never have seen the light had the full significance of the truth that an epidemic results when the external factors favour a parasite somewhat more than they do the host, been grasped. It may be that in par~~ ticular cases particular modes of cultivation disfavour the host ; or that the soil, climate, or seasons do so ; but over- whelming evidence exists to show that the principal causes of epidemics reside in circumstances which favour the spread, nutrition, and reproduction of the pest, and the lesson to be learnt is that precautions against the establish- ment of such favouring conditions must be sought. Never- theless, epidemics occur, and practical measures are devised to meet the various cases and to check the ravages already begun. The procedure consists in most cases in spraying the affected plants with poisonous solutions or emulsions, or in dusting them with fungicidal or insecticidal powders, or applying the fumes of lethal gases. For the composition of the numerous liquids and powders special works must be consulted, but the following principles apply generally. The poison must not be strong enough to injure the roots, leaves, &c., of the host-plant, or allowed to act long enough to bring about such injury. Care and intelligence are especially needful with certain insecticides such as poison- ous gases, or the operators may suffer. It is worse than useless to apply drastic remedies if the main facts of the life-history of the pest are not known ; e.g., the application of ordinary antiseptic powders to leaves inside which a Fungus, such as a Uredo or Ustilago, is growing can only result in

failure, and similarly if tobacco fumes, for instance, are applied when the insects concerned are hibernating in the ground beneath. Such applications at the moment when .spores are germinating on the leaves, e.g., Peronospora, or to the young mycelia of epiphytic parasites, e.g., Erysiphe, or the steeping in hot water of thoroughly ripe hard grains to which spores are attached, e.g., Ustilago, and filling a greenhouse with hydrocyanic acid gas when young insects are commencing their ravages, e.g., Eed-spider â€" all these and similar pro- cedures timed to catch the pest at a vulnerable stage are intelligent and profitable prophylactic measures, as has been repeatedly shown. Numerous special methods of preventing the spread of Fungi, or the migrations of insects, or of trapping various animals ; of leaving infested ground fallow, or of growing another crop useless to the pest, &c.,- are also to be found in the practical treatises. More indirect methods, such as the grafting of less re- sistant scions on more vigorous stocks, of raising special late or early varieties by crossing or selection, and so on, have also met with success; but it must be understood that " resistant " in such cases usually means that some peculiarity of quick growth, early ripening, or other life- feature in the plant is for the time l)eing taken advantage of. Although we are not devoid of hope that certain varieties may prove inimical in other ways to Fungi or insects, very few of the alleged cases of " disease-resist- ing " plants will bear scientific examination. Among the most interesting modern means of waging war against epidemic pests is that of introducing other epidemics among the pests themselves â€" e.g'., the infection of rats and mice with disease bacilli, or of locusts with insect-killing Fungi, and signs of the successful carrying out of such measures are not wanting. That the encouragement of insectivorous birds has been profitable is well established, and it is equally well known that their destruction may lead to disastrous insect plagues. Much can be done, in forests for iijstance, by growing mixed crops, thus avoid- ing the risks of epidemics due to the rapid spread of Fungi over large continuous tracts of suitable host-plants. Diseases and Symptoms. â€" The symptoms of plant diseases are, as already said, apt to be very general in their nature, and are sometimes so vaguely defined that

little can be learned from them as to the causes at work. We may often distinguish between primary symptoms and secondary or subordinate symptoms, but for the purposes of classification in an article of this scope I shall only attempt to group the various cases under the more obvious signs of disease exhibited.

1. Discolorations are among the commonest of all Signs that a plant is ” sickly ” or diseased. The principal symptom may show itself in general pallor, including all cases where the normal healthy green hue is replaced by a sickly yellowish hue indicating that the chlorophyll apparatus is deficient. It may be due to insufficient illumination {Etiolation), as seen in geraniums kept in too shaded a situation, and is then accompanied by soft tissues, elongation of internodes, leaves usually reduced in size, &c. The laying of wheat is a particular case. False etiolation may occur from too low a temperature, often seen in young wheat in cold springs. Cases of pallor due to too intense illumination and destruction of chloro- phyll must also be distinguished. Chlorosis is a form of pallor where the chlorophyll remains in abeyance owing to a want of iron, and can be cured by adding ferrous salts. Lack of other ingredients may also induce chlorotic conditions. Yellowing is a common sign of water-logged roots, and if accompanied by wilting may be due to drought. Over-transpiration in bright wintry weather, when the roots are not absorbing, often results in yellowing. In other cases the presence of insects, Fungi, or poisons at the roots may be looked for. Albinism, with which variegated foliage may be considered, concerns a different set of causes, still obscure, and usually regarded as internal, though experiments go to show that some variegations are infectious.

2. Spotted Leaves, &c. â€” Discoloured spots or patches on leaves and other herbaceous parts are common symptoms of disease, and often furnish clues to identification of causes, though it must be remembered that no sharp line divides this class of symptoms from the preceding. By far the greater number of spot-diseases are due to Fungi, as indicated by the numerous ” leaf -diseases ” described, but such is by no means always the case. The spot or patch is an area of injury ; on, or in, it the cell-contents are suffering destruc- tion from shading,

blocking of stomata, loss of substance, or direct mechanical injury, and the plant suffers in proportion to the area of leaf surface put out of action. It is somewhat artificial to classify these diseases according to the colour of the spots, and often impossible, because the colour may differ according to the age of the part attacked and the stage of injury attained ; many Fungi, for instance, induce yellow spots which become red, brown, or black as they get older, and so on. White or grey spots may be due to Peronospora, Erysiphe, Ct/stoptis, Entyloma, and other Fungi, the mycelium of which will be detected in the discoloured area ; or they may be scale insects, or the results of punctures by Eed-spider, &c. Yellow spots, and especially bright orange spots, commonly indicate Eust Fungi or other Uredinese ; but Phyllosticta, Exoascns, Clasterosporium, Syncliytrium, &c., also induce similar symptoms. Certain Aphides, Eed-spider, Phylloxera, and other insects also betray their presence by such spots. It is a very common event to find the early stages of injury indicated by pale yellow spots, which turn darker, brown, red, black, &c., laterâ€" e.gf., Dilophia, Rhytisma, &c. Moreover, variegations deceptively like these disease spots are known â€" e.^., Senecio Ka'mpferi. Eed spots may indicate the presence of Fungi â€" e.g., Pohisiigmaâ€"OT insectsâ€" e..gr., Phytoptus. Brown spots are characteristic of Phytophthora, Pumnia, &c., and black ones of Fusicladium, Ustilago, Hhytisma, &c. Both are common as advanced symptoms of destruction by Fungi and insects. Brilliantly-coloured spots and patches follow the action of acid fumes on the vegetation near towns and factories, and such parti- coloured leaves often present striking resemblances to autumn foliage. Symptoms of scorching owing to abnormal isolationâ€" e-g., in greenhouses where the sun's rays are concentrated on particular spots â€" and a certain class of obscure diseases, such as "silver-leaf" in plums, "foxy leaves " in various plants, may also be placed here.

3. Wounds.â€" The principal phenomena resulting from a simple wound, and the response of the irritated" cells in healing by cork and in the formation of callus, have been indicated above. Any clean cut, fracture, or bruise which injures the cambium over a limited area is met with the same response. The injured cells die and turn brown ; the living cells beneath grow out, and form cork, and under the released

pressure bulge outwards and repeatedly divide, forrning a mass of succulent regenerative tissue known as callus. Liviiig cells of the pith, phloem, cortex, &o., may also co-operate in this formation of regenerative tissue, and if the' wound is a mere knife-cut in the "bark," the protruding lips of callus formed at the edges of the wound soon meet, and Uie slit is healed over- occluded. If a piece of bark and cortex are torn off, the occlusion takes longer, because the tissues have to creep over the exposed area of wood ; and the same is true of a transveree cut severing the

branch, as may be seen in any properly pruned tree. The details of healing by occlusion with callus must be sought in the special works, and are important in order to understand the results due to various checks and delays in the process, which have for their con- sequences the formation of cankers, wood-rot, &c. Here it must suffice to point out that wounds open the way to numerous Fungi and insects incapable of penetrating sound timber, and that their occurrence in nature is due to a variety of accidents, breakage by wind, overweighting by snow, abrasions, lightning strokes, hail, the gnawing of animals, such as rabbits, rats, squirrels, &c., the rubbing of horns by cattle and deer, and all kinds of minor injuries due to small animals being among the causes. Wounds may be artificially grouped under such heads as the following : Burrows and excavations in bark and wood due to boring insects, especially beetles. Breakages and abrasions due to wind, snow, lightning, and other climatic agents. Cuts, breakages, &o., due to man and other vertebrate animals. Erosions of leaves and herbaceous parts by caterpillars, slugs, earwigs, and so forth. Frost-cracks, scorching of bark by sun and fire, &c., and wounds due to plants which entwine, pierce, or otherwise materially injure trees, &c. , on a large scale.

4. Excrescences. â€" Outgrowths, more or less abnormal in charac- ter, are frequent signs of diseased organs. They are due to hyper- trophy of young tissues, which may undergo profound alterations subsequently, and occur on all parts of the plants. The injury which initiates them

may be very slight in the first place â€” a mere abrasion, puncture, or Fungus infection â€” but the minute wound or other disturbance, instead of 'healing over normally, is frequently maintained as a perennial source of irritation, and the regenerative tissues grow on month after month or year after year, resulting in extraordinary outgrowths often of large size and remarkable shape. Excrescences may be divided into those occurring on herbaceous tissues, of which Galls are well-known examples, and those found on the woody stem, branches, &c., and themselves eventually wOody, of which Burrs of various kinds afford common illustrations. Among the simplest examples of the former are the hairs which follow the irritation of the cells by mites. These hairs often occur in tufts, and are so coloured and arranged that they were long taken for Fungi and placed in the " genus " Erineum.

Ceoidia or galls arise by the hypertrophy of the subepidermal cells of a leaf, cortex, &c., which has been pierced by the ovipositor of an insect, and in which the egg is deposited. The irritation set up by the hatching egg and its resulting larva appears to be the stimulus to development, and not a poison or enzyme injected by the insect. The extraordinary forms, colours, and textures of the true galls have always formed some of the most interesting of biological questions, for not only is there definite co-operation between a given species of insect and of plant, as shown by the facts that the same insect may induce galls of different kinds on different plants or organs, while different insects induce different galls on the same plant â€" e.g. , the numerous galls on the oak â€" but the gall itself furnishes well-adapted protection and abundant stores of nutriment to its particular larva, and often appears to be borne witliout injury to the plant. This latter fact is no doubt due to the production of an excess of plastic materials over and above what the tree requires for its immediate needs. Galls in the wide sense â€" technically Cecidia â€" are not always due to insects. The nodules on the roots of leguminous plants are induced by the presence of a minute organism now known to do no injury to the plant (see Bacteriology : Sohizomycetes) . Those on turnips and other CruoifersB are due to the infection of Plasmodiophora, a dangerously parasitic Myxomyoete. Nodules due to " eel-worms " (Nematodes) are produced on numerous

classes of plants, and frequently result in great losses â€” e.g., tomatoes, cucumbers, &c. ; and the only too well-known Phylloxera, which cost France and other vine-growing countries many millions sterling, is another case in point. Fungus- galls on leaves and stems are exemplified by the “pocket-plums ” caused by the Exoasceas, the black blistering swellings of tfstilago Maydis, the yellow swellings on nettles due to ^cidium, &c.

In many cases the swellings on leaves are minute, and may be levm&A pustules â€” e.g., those due to Synchytrimn, Protomyces, Cysiopus, many Ustilagineae, &c. These cases are not easily dis- tinguished superficially from the pustular outgrowth of actual my- celia and spores (stromata) of such Fungi as Nectria, Puccinia, &c. The cylindrical stem-swellings due to Oalyptospora, Epichloe, &c., may also be mentioned here, and the tyro may easily confound with these the layers and cushions of eggs laid on similar organs by moths. There is a class of gall-like or pustular outgrowths for which no external cause has as yet been determined, and which are therefore often ascribed to internal causes of disease. Such are the cork- warts on elms, maples, &c., and the class of outgrowths known as Intumescences. Recent researches point to definite external con- ditions of moisture, affecting the processes of respiration and tran- spiration, &c., as being responsible for some of these. The ” scab ” of potatoes is another case in point. Frost blisters are pustular swellings due to the up-gro wth of callus-tissue into cavities caused by the uprising of the superficial cortex under the action of intense cold.

Turning now to outgrowths of a woody nature, the well-known burrs, or “knaurs,” so common on elms and other trees are cases in point. They are due to some injury â€” e.g., bruising by a cart- wheel, insects â€” having started a callus on which adventitious buds arise, or to the destruction of buds at an early stage. Then, stores of food-material being accumulated at the injured place, other buds arise at the base of or around the injured one. If matters are pro- pitious to the development of these buds, then a tuft of twigs is formed and no bun’ ; but if the incipient twigs are also destroyed at an early stage, new buds are again formed, and in larger numbers than before, and the

continued repetition of these processes leads to a sort of conglomerate woody mass of fused bud-bases, not dead, but unable to grow out, and thus each contributing a crowded portion of woody material as it slowly grows. There are many varieties of burrs, though all woody outgrowths of old trees are not to be confounded with them, e.g., the "knees" of Taxodium, &c. Many typical burrs might be described as witches' -brooms, with all the twigs arrested to extremely short outgrowths'. Witches' -brooms are the tufted bunches of twigs found on silver firs, birches, and other trees, and often present resemblances to birds' nests or clumps of mistletoe if only seen from a distance. They are branches in which a perennial Fungus {JScidium, Exoascus, &c.) has obtained a hold. This Fungus stimulates the main twig to shoot out more twigs than usual ; the mycelium then enters each incipient twig and stimulates it to a repetition of the process, and so in the course of years large broom-like tufts result, often markedly different from the normal.

But undoubtedly the most important of the woody excrescences on trees are cankers. A canker is the result of repeated frustrated attempts on the part of the callus to heal up a wound. If a clean cut remains clean, the cambium and cortical tissues soon form callus over it, and in this callus â€" regenerative tissue â€" new wood, &c., soon forms, and if the wound was a small one, no trace is visible after a few years. But the occluding callus is a mass of delicate succulent cells, and offers a, dainty morsel to certain insects â€" e.g., Aphides â€" and may be easily penetrated by certain Fungi such as Peziza, Nectria ; and when thus attacked, the repeated conflicts between the cambium and callus, on the one hand, trying to heal over the wound, and the insect or Fungus, on the other, destroying the new tissues as they are formed, results in iiTegular growths : the still uninjured cambium area goes on thickening the branch, the dead parts, of course, remain un- thickened, and the portion in which the Fungus is at work may for the time being grow more rapidly. Such cankers often com- mence in mere insect punctures, frosted buds, cracks in the cortex, &c., into which a germinating spore sends its hypha. The serious- ness of the damage done is illustrated by the ravages of the larch disease, apple canker, &c.

5. â€¢ Exudations and Hotting. â€” The outward symptoms of many diseases consist in excessive discharges of moisture, often accom- panied by bursting of over-turgid cells, and eventually by putre- factive changes. Conditions of hyper-turgesoence are common in herbaceous plants in wet seasons, or when overcrowded and in situations too moist for them. This unhealthy state is frequently combined with etiolation : what is termed rankness is a particular case, and if the factors concerned are removed by drainage, weed- â€¢ ing out, free transpiration, &c., no permanent harm may result. With seedlings and tender plants, however, matters are frequently complicated by the onslaughts of Fungi â€" e.g., Pythmm, Pero- nospora, Completoria, Volutella, Botrytis, &c. That such over- turgesoence should lead to the bursting of fleshy fruits, such as gooseberries, tomatoes, and grapes, is not surprising, nor can we wonder that fermentation and mould Fungi rapidly spread in such fruits ; and the same is true for bulbs and herbaceous organs gen- erally. The rotting of rhizomes, roots, &c., also comes into this category ; but while it is extremely difficult in given cases to explain the course of events in detail, certain Fungi and bacteria have been so deflnitely associated with these rots â€" e. g. , beet-rot, turnip disease, wet-rot of potatoes â€" that we have to consider each case separately. It is, of course, impossible to do this here, but I will briefly discuss one or two groups of cases.

Honey-dew. â€" The sticky condition of leaves of trees â€" e.jr., lime â€" in hot weather is owing to exudations of sugar. In many cases the punctures of Aphides and Coccidese are shown to be responsible for such exudations, and at least one instance is known where a Fungus â€" Claviceps â€" causes it. But it also appears that honey-dew may be excreted by ordinary processes of over-turgescence pressing the liquid through water-pores, as in the tropical Coesalpinia, Calli- andra, &c. That these exudations on leaves should afterwards serve as pabulum for Fungi â€" e.g., Fumago, Antennaria â€" is not surprising, and the leaves of limes are often black with them.

Flux.â€" A common event is the exudation of turbid, frothing liquids from wounds in the bark of trees, and the odours of putre- faction and even alcoholic fermentation in these are sufficiently explained by the

coexistence of albuminous and saccharine matters with Fungi, yeasts, and bacteria in such fluxes. It is clear that in these cases the obvious symptom â€” the flux â€” is not the primary one.

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Some wound in the succulent tissues has become infected by the organisms referred to, and their continued action prevents healing. At certain seasons the wound “bleeds,” and the organisms â€” some of which, by the bye, are remarkable and interesting forms â€” multiply in the nutritious sap and ferment it. The phenomenon is, in fact, very like that of the fermentation of palm wine and pulque, where the juices are obtained from artificial cuts.

Comparable with these cases is that of Cuckoo-spit, due to the juices sucked out by Aphrophthora on herbaceous plants of all kinds. Outflows of resin â€” Besinosis â€” also come under this general heading ; but although some resin-fluxes are traced to the destructive action of Agaricus melleus in Conifers, others, as well as certain forms of Gummosis, are still in need of explanation.

Bacteriosis. â€” Many of the plant diseases involving rot have been ascribed to the action of bacteria, and in some cases â€” e. g., cabbage-rot, bulb-rot of hyacinths, &c., carnation disease â€” the evidence supports the contention that bacteria are causally connected with the disease. It is not sufficient to find bacteria in the rotting tissues, however, nor even to be successful in infecting the plant through an artificial wound, unless very special and critical pre- cautions are taken, and in most of the alleged cases of bacteriosis the saprophytic bacteria in the tissues are to be regarded as merely secondary agents.

(For further details the reader is referred to special works and to the article Bacteriology.)

6. N’ecrosis. â€” A number of diseases the obvious symptoms of which are the local drying up and death of tissues, in many cases with secondary results on organs or parts of organs, may be brought together under this heading. No sharp line can be drawn between these diseases and some of the preceding, inasmuch as it often depends on the external conditions whether necrosis is a dry-rot, in the sense I employ the term here, or a wet-rot, when it would come under the preceding category. The “dying back” of the twigs of trees and shrubs is a frequent case. The cortical tissues gradually shrink and dry up, turning brown and black in patches or vail over, and when at length the cambium and medullary ray tissues dry up the whole twig dies oft. This may be due to frost, especially in “thin-barked” trees, and often occurs in. beeches, pears, &c. ; or it may result from bruising by wind, hailstones, gun- shot wounds in coverts, &c. , the latter of course very local. It is the common result of fires passing along too rapidly to burn the trees; and “thin-barked” trees â€” ^hornbeam, beech, firs, &c. â€” may exhibit it as the results of sunburn, especially when exposed to the south-west after the removal of shelter. The efiects of frost and of sunburn are frequently quite local. The usual necrosis of the injured cortex occurs â€” drying up, shrivelling, and consequent stretching and cracking of the dead cortex on the wood beneath. Such frost-cracks, sun-cracks, &c., may then be slowly healed over by callus, but if the conditions for necrosis recur the crack may be again opened, or if Fungi, &o., interfere with occlusion, the healing is prevented ; in such cases the local necrosis may give rise to cankers. The dying back of twigs may be brought about by many causes. General attacks of leaf-diseases invariably lead to starvation and necrosis of twigs, and similarly with the ravages of caterpillars and other insects. Drought and consequent defoliation result in the same, and these considerations help us to understand how old- established trees in parks, &c., apparently in good general health, become “stag-headed” by the necrosis of their upper twigs and smaller branches : the roots have here penetrated into subsoil or other unsuitable medium, or some drainage scheme has deprived them of water, &c., and a dry summer just turns the scale. Such phenomena are not uncommon in towns, where trees with their roots under pavement or other impervious covering do well

for a time, but suddenly fail to supply the crown sufficiently with water during some hot summer.

7. Monstrosities. â€” A large class of cases of departure from the normal form, depending on different and often obscure causes, may be grouped together under this heading ; most of them are of the kind termed Teratological, and it is difficult to decide how far they should be regarded as pathological if we insist that a disease threatens the existence of the plant, since many of these malforma- tionsâ€” e.g., double fiowers, phyllody of floral parte, contortions and fascinations, dwarfing, malformed leaves, &o. â€” can not only be transmitted in cultivation, but occur in nature without evident injury to the variety. In many cases, however, monstrosities of flowers have been shown to be due to the irritating action of minute insects or Fungi, and others are known which, although induced by causes unknown to us, and regarded as internal, would not be lilcely to survive in the wild condition. This subject brings the domain of pathology, however, into touch with that of varia- tion, and we are profoundly ignorant as to the complex of external conditions which would d(!cide in any given case how far a viiviatlon in form woulil be prejudicial or othei'wise to the continued existence of a species. Under the head of malformations we place cases of atrophy of parts or general dwarfing, due to starvation, the attacks of Fungi or minute insects, the presence of unsuitable food-materials, and so on, as well as cases of transformation of stamens into petals.

carpels into leaves, and so forth. Roots are often flattened, twisted, and otherwise distorted by mechanical obstacles ; stems by excess of food in rich soils, the attacks of minute parasites, overgrowth by climbing plants, &c. Leaves are especially apt to vary, and although the formation of crests, pitchers, puckers, &c., must be put down to the results of abnormal development, it is often difficult to draw the line between teratological and merely varietal phenomena. For instance, the difference between the â– long-stalked and finely-cut leaves of Anemone attacked with rust and the normal leaves with broad segments, or between the urceolate leaves occasionally found on cabbages and the ordinary form â€” in these cases undoubtedly

pathological and teratological respectively â€” is nothing like so great as between the upper and lower normal leaves of many UmbelliferÂ» or the submerged and floating leaves of an aquatic Banunculus or Cabomba. When we come to phenomena such as proliferations, vivipary, the development of ” Lammas shoots,” adventitious buds, epicormic branches, and to those malformations of flowers known as peloria, phyllody, viresoence, &c., whUe assured that definite, and in many cases recognizable, physiological disturbances are at work, we find ourselves on the boriierland between pathological and physiological variation, where each case must be examined with due regard to all the circumstances, and no generalization seems possible beyond what has been sketched. This is equally true of the phenomena of apogamy and apospoiy in the light of recent researches into the effects of external conditions on reproduction.

In conclusion, this sketch of an enormous subject shows us that the pathology of plants is a special depart- ment of the study of variations which threaten injury to the plant, and passes imperceptibly into the study of varia- tions in general. Moreover, we have good reasons for inferring that different coustel-lations of external causes may determine whether the internal physiological disturb- ances induced by a given agent shall lead to pathological and dangerous variation, or to changes which may be harmless or even advantageous to the plant concerned. This position seems fully warranted by the recent pro- gress of oecology and the study of the influence of external conditions on plants in a state of nature, and especially by what we now know of symbiosis, artificial cultures, grafting, and cross-breeding.

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Patiala, or Putttala, a native state of India, -witliin the Punjab. Area, 6951 square miles; population (1881), 1,467,433 ; (1891), 1,583,621 ; (1901), 1,586,030, showing an increase of 8 per cent, between 1881 and 1891, but of less than -2 per cent, between 1891 and 1901; average density, 266 persons per square mile ; estimated gross revenue, Es.68,54,000 ; military force (including police), 8673 men ; no tribute. The late maharaja, who died in 1900, was devoted to riding and sport. He personally took part in the Tirah campaign of 1897-98 with a battalion of his own Imperial Service infantry and a field troop of Imperial Service lancers. In recognition of his services on’this occasion he received the G.C.S.I. The financial administration of the state is not altogether satisfactory. It is crossed by two lines of railway, and irrigated by the Sirhind canal and its branches. In 1896-97 the total number of schools was 186, attended by 9197 pupils, of whom 479 were girls ; the proportion of boys at school was 1 to every 94 of the total male population. There is one college, with 86 students (including 52 in the Oriental department), of whom 13 passed university examinations ; also thirteen Anglo-vernacular schools, with 2268 pupils, of whom 14 matriculated. The town of Patiala is situated in 30Â° 20′ N. and 76Â°

25′ E., and has a station on the branch railway from Eajpura to Bhatinda. Popu- lation (1891), 55,786.

Patmore, Coventry Kersey Dighton (1823- 1896), English poet and critic, the eldest son of Peter George Patmore, himself an author, was born at Wood- ford in Essex, 23rd July 1823. He was privately edu- cated, being his father's intimate and constant compan- ion, and derived from him his early literary enthusiasm. It was his first ambition to become an artist, and he showed much promise, being awarded the silver palette of the Society of Arts in 1838. In the following year he was sent to school in France, where he studied for six months, and began to write poetry. On his return his father contemplated the publication of some of these youthful poems ; but in the meanwhile Coventry had evinced a passion for science, and the poetry was set aside. He soon, however, returned to literary interests, moved towards them by the sudden success of Tennyson ; and in 1844 he published a small volume of Poems, which was not without individuality, but marred by inequalities of workmanship. It was widely criticized, both in praise and blame ; and Patmore, distressed at its reception, bought up the remainder of the edition and caused it to be destroyed. What chiefly wounded him was a cruel review in Blackioood, written in the worst style of unreasoning abuse; but the enthusiasm of private friends, together with their wiser criticism, did much to help him and to foster his talent. Indeed, the publication of this little

volume bore immediate fruit in introducing its author to various men of letters, among whom was Dante Gabriel Rossetti, through whose offices Patmore became known to Mr Holman Hunt, and was thus drawn into the eddies of the Pre-Raphaelite movement, contributing his poem " The Seasons " to The Germ. At this time Patm ore's father became involved in financial embarrassments, which obliged the son to adopt some professional call- ing; and in 1846 Monckton Milnes secured him an as- sistant-librarianship in the British Museum, a post which he occupied industriously for nineteen years, devoting his spare time to poetry. In 1847 he married Emily, daughter of Dr Andrews of Camberwell. At the Museum he was austere and remote among his

companions, but was nevertheless instrumental in 1852 in starting the Volunteer movement. He wrote an important letter to Tlie Times upon the subject, and stirred up much martial enthusiasm among his colleagues. In the next year he republished, in Tamerton Church Tower, the more suc- cessful pieces from the Poems of 1844, adding several new poems which showed distinct advance, both in con- ception and treatment ; and in the following year (1854) appeared the first part of his best poem, ” The Angel in the House,” which was continued in ” The Espousals ” (1856), ” Faithful for Ever Â» (1860), and ” The Victories of Love ” (1863). In 1862 he lost his wife, after a long and lingering illness, and shortly afterwards joined the Roman Catholic Church. In 1865 he married again, his second wife being Miss Mariane Byles, second daugh- ter of James Byles of Bowden Hall, Gloucester ; and a year later purchased an estate in East Grinstead, the history of which may be read in How I managed my Estate, published in 1886. In 1877 appeared The Un- hnown Eros, which unquestionably contains his finest work in poetry, and in the following year Amelia, his own favourite among his poems, together with an interesting, though by no means indisputable, essay on English Metrical Law. This departure into criticism he continued further in 1879 with a volume of papers, entitled Prirtr ciple in Art, and again in 1893 with Beligio Poetce. Meanwhile his second wife died in 1880, and in the next year he married Miss Harriet Robson. The last years of his life were spent at Lymington, where he died 26th November 1896. A collected edition of his poems appeared in two volumes in 1886, with a characteristic preface which might serve as the author’s epitaph. “I have written little,” it runs; “but it is all my best; I have never spoken when I had nothing to say, nor spared time or labour to make my words true. I have respected posterity ; a’nd should there be a posterity which cares for letters, I dare to hojie that it will respect me.” The obvious sincerity which underlies this statement, combined with a certain lack of humour which peers through its naivete, points to two of the principal characteristics of Patmore’s earlier poetry ; characteristics which came to be almost unconsciously merged and harmonized as his style and his intention drew together into unity. Earnestness of view and purpose marks every line which he wrote ; and yet a rather keener appreciation of the unpoetic aspects of a too naked simplicity would have saved him

from many of those sublimations of the trivialities of life which have already begun to seem old- fashioned, and were, indeed, never in the fashion of high poetry at all. But when Patmore is not occupied with the railway guard and the shop assistant, and when he discards pure narrative for philosophic reflection, he is a poet of the first and indisputable rank. His initial misfortune was that of subject, commonplace married life not being a topic rich in poetic opportunities; in particular, to one who saw details with Patmore's minute- ness the theme was particularly dangerous. But in the

higher flights, to which he arose as his practice in the art grew perfected, he is always noble and often sublime. His best work is found in the volume of odes called The Unknown Eros, which is full not only of passages but of entire poems in which exalted thought is expressed in poetry of the richest and most dignified melody. The animating spirit of love, moreover, has here deepened and intensified into a crystalline harmony of earthly passion with the love that is divine and transcending ; the outward manifestation is regarded as a symbol of a sentiment at once eternal and quintessential. Spirituality informs his inspiration; the poetry is of the finest elements, glowing and alive. The magnificent piece in praise of winter, the solemn and beautiful cadences of " Departure," and the homely but elevated pathos of " The Toys," are in their various manners unsurpassed in English poetry for sublimity of thought and perfection of expression. Patmore is one of the few Victorian poets of whom it may confidently be predicted that the memory of his greater achievements will outlive all consideration of occasional lapses from taste and dignity. He wrote, at his best, in the grand manner, melody and thought according with perfection of expression, and his finest poems have that indefinable air of the inevitable which is after all the touchstone of the poetic quality. (a. wa.)

Patna, a city, district, and division of British India, in the Behar province of Bengal. The city lies on the right bank of the Ganges, a little distance below the confluence of the Soane and the Gogra, and

opposite the confluence of the Gandak ; it has a railway station, 332 miles north-west of Calcutta. Including the civil station of Bankipur to the west, the city stretches along the river bank for nearly 9 miles. Still farther west is the military cantonment of Dinapur. Municipal area, 6184 acres ; population (1881), 170,664; (1891), 166,192; (1901), 135,172. One of the most interesting buildings in the city is the huge gola, or storehouse for grain, constructed in 1786, but never seriously used. Patna is the head- quarters of the Government opium agency, where the drug grown throughout Behar is prepared for the Chinese market. ‘ Government College, founded in 1862, had 188 pupils in 1896-97. Other educational institutions include collegiate and zilla high schools, with 668 pupils ; a law class, with 32 students ; the Temple medical school, \^ith 132 students, of whom 4 were women ; the Behar school of engineering, organized in 1897, with 194 students ; a normal school, with 51 students. There are nine printing- presses, most of which issue a newspaper either in English or in the vernacular, and there is an Oriental public library.

The district of Patna has an area of 2076 square miles ; population (1881), 1,751,834; (1891), 1,772,352; (1901), 1,623,856, showing an increase of only 1 per cent, be- tween 1881 and 1891, but a decrease of 8-4 per cent, between 1891 and 1901 ; average density, 782 persons per square mile. Classified according to religion, Hindus in 1891 numbered 1,568,131; Mahommedans, 201,106; Christians, 2833, of whom 1662 were Europeans ; “others,” 282. The land revenue and rates in 1897-98 were Es.l7,17y939 ; number of police, 1325; boys at school (1896-97), 43,895, being 33-8 per cent, of the male popu- lation of school-going age ; registered death-rate (1897), 31-92 per thousand. The district is traversed throughout by the main line of the East Indian railway (84 miles), with a branch south to Gaya.

The division of Patna extends across both sides of the Ganges. It comprises the seven districts of Patna, Gaya, Shahabad, Saran, Champaran, Muzaffarpur, and Darbhan- garh. Total area, 23,676 square miles ; population (1891),

16,811,014.

Patna, a feudatory state of India, in the Chhattis- garh division of the Central Provinces. Area, 2399 square miles; population (1881), 257,969; (1891), 332,197; (1901), 277,666 ; average density, 134 persons per square mile ; estimated revenue, Es. 1,47,000 ; tribute, Es.8500. The chief is a rajput of high lineage, whose ancestors formerly ruled over a large territory. The state was for many years under British administration, and the present chief was educated at the Eajkumar College.

Paton, Sir Joseph Noel (1821-1901), British painter, was born, on 13th December 1821,' in Woolers Alley, Dunfermline, where his father, a fellow of the Scottish Society of Antiquaries, carried on the trade of a damask manufacturer. He showed strong artistic in- clinations in early childhood, but had no regular art training, except a brief period of study in the Eoyal Academy School in 1843. He gained a prize of Â£200 in the first Westminster Hall competition, in 1845, for his cartoon, " The Spirit of Eeligion," and in the following year he exhibited at the Eoyal Scottish Academy his " Quarrel of Oberon and Titania " (see Plate). A com- panion fairy picture, " The Eeconciliation of Oberon and Titania " (see Plate), went to Westminster Hall in 1847, and for it and his picture of " Christ bearing the Cross " he was awarded a prize of Â£300 by the Eine Arts Com- missioners. The two Oberon pictures are in the National Gallery of Scotland, where they have long been a centre of attraction. His first exhibited picture, " Euth Gleaning," appeared at the Eoyal Scottish Academy in 1844. He began to contribute to the Eoyal Academy of London in 1856. Throughout his career his preference was for allegorical, fairy, and religious subjects. Among his most famous pictures are " The Pursuit of Pleasure " (1865), " Mors Janua Vitse " (1866), " Oskold and the Elle-maids " (1874), and Â« In Die Malo " (1882). Sir Noel Paton also produced a certain amount of sculpture, more notable for design than for searching execution. He was elected an associate of the Eoyal Scottish Academy in 1847, and a full member in 1860 ; he was appointed Queen's Limner for Scotland in 1866, and received knighthood in 1867. In 1878 the University of Edinburgh conferred upon him the degree of LL.D. He was a poet of distinct merit, as his Poems hy a Painter (1861) and Spindrift (1867) pleasantly exemplified. He was also well known as an

antiquary, his hobby, indeed, being the collection of arms and armoiir. Sir Noel died in Edinburgh on the 26th of December 1901.

Patras (Greek, Paired), the chief fortified seaport town on the west coast of Greece, and chief town of the province of Achaia and Elis, on a gulf of the same name, 70 miles west-north-west of Corinth. It has been rebuilt since 1821 (the War of Liberation), and is the seat of a Greek archbishop and an appeal court. It has a citadel and castle, and is the chief port of Greece, from which the great bulk of its currants are despatched. The port, formed by a mole and a breakwater, offers a fair harbour for vessels drawing up to 22 feet. The exports consist of currants, sultanas, valonea, tobacco, olive oil, olives in brine, figs, citrons, wine, brandy, cocoons, and lamb, goat, and kid skins. The imports consist chiefly of colonial produce, manufactured goods, and sulphate of copper. There are two railway stations, one in the north-east on the line to Athens {vid Corinth), the other on the line to Pyrgos. Population (1889), 33,629 ; (1896), 37,958.

Patti, a town and episcopal see of the province of Messina, Sicily, Italy, 43 miles west by south of Messina by the north coast railway to Palermo, one mile from the shore of the Gulf of Patti. It has a modern cathedral, and silk and olive-oil mills, lime-kilns, sandstone quarries,

‘The Quakeel of Oberon and Titania.” By Sir J. Noel Paton.

‘The Reconciliation- of Oberon and Titania.” By Sir J, Noel Baton. (The National Gallery, Ediniurgh.)

flour-mills, terra-cotta works, and tunny fishing. A little to the east are the ruins of the ancient city of Tyndaris. Population (1881), 7612 ; (1899), 9500.

Patti, Adelina (Baroness Cedeestrom), the famous vocalist, daughter of an Italian, Salvalin Patti, was born at Madrid, 19th February 1843.

Gifted with a fine soprano voice, she was trained in America under Maurice Strakosch, her brother-in-law, and made her first appearance as Lucia in Lucia di Lammermoor in New York in 1869. Her marvellous execution and brilliant singing at once made her famous. In 1861 she sang in La Sonnambula at Covent Garden, and from this time she became the leading operatic prima donna, her appear- ances in London, Paris, and the other principal musical centres being a long succession of triumphs, and her rdles covering all the great parts in Italian opera. In 1868 she married the marquis de Caux, from whom she was divorced in 1885 ; she then married Nicolini,' the tenor, who died in 1898 ; and in 1899 she became the wife of Baron Cederstrom, a Swede, who was naturalized as an Englishman. Madame Patti ceased to appear on the operatic stage in public after the 'eighties, but at Craig-y- Nos, her place in Wales, she built a private theatre, and her occasional appearances for enormous fees at concerts at the Albert Hall continued to attract enthusiastic audiences, her singing of " Home, Sweet Home " becom- ing peculiarly associated with those events. Partly owing to her fine original training, partly to her splendid method, and partly to her avoidance of Wagnerian rdles, Madame Patti wonderfully preserved the freslyiess of her voice and her beautiful execution, and she will be remembered as, after Jenny Lind, the greatest singer of the 19th century.

Pattison, Mark (1813-1884), rector of Lincoln College, Oxford, born 10th October 1813, was the son of the rector of Hauxwell, Yorkshire, where he spent his younger days, being privately educated by his father. His youngest sister was the well-known Sister Dora. In 1832 he matriculated at Oriel College, where he took his B.A. degree in 1836 with second-class honours. After failing four times to obtain a fellowship, he was elected in 1839 to a Yorkshire fellowship at Lincoln, an anti-Puseyite College, then described as "low and slow." Pattison was at this time a Puseyite, and greatly under the influ- ence of J. H. Newman, for whom he worked, translating Aquinas, and writing in the British Critic and Christian Jtemembrancer. He was ordained priest in 1843, and in the same year became tutor of Lincoln College, where he rapidly made a reputation as a clear and stimulating teacher and as a sympathetic friend of youth. The management of the college was

practically in his hands, and his reputation as a scholar became high in the Uni- versity. In 1851 the rectorship of Lincoln became vacant, and it seemed certain that Pattison would be elected, but he lost it by a disagreeable intrigue. The disappointment was acute, and his health suffered. In 1855 he resigned the tutorship, travelled in Germany to investigate Continental systems of education, and began ^his researches into the lives of Casaubon and Scaliger, which occupied the remainder of his life. In 1861 he was elected rector of Lincoln, marrying in the same year Emilia Frances Strong (afterwards Lady Dilke). The rector contributed largely to various reviews on literary subjects, and took a considerable interest in social science, even presiding over a section at a congress in 1876. The routine of university business he avoided with contempt, and refused the vice-chancellorship. But while living the life of a student, he was fond of society, and espe- cially of female society. He was a keen flsherman, and

interested in Nature. He died on the 30th of July 1884 at Harrogate, where he was buried. His principal works are Isaac Casaubon, 1875 ; Milton, in Macmillan's English Men of Letters series, 1879. The 18th century, alike in its literature and its theology, was a favourite study, as is illustrated by his contribution to the once famous Essays and Reviews (1860), and by his edition of Pope's Essay on M(f,n (1869), &c. His Sermons and Collected Essays were published posthumously, as well as the painfully interesting Memoirs, an autobiography deeply tinged with melancholy and bitterness. His projected Life of Scaliger was never finished. Mark Pattison possessed an extraordinary distinction of mind. He was a true scholar, who lived entirely in the things of the intellect. He writes of himself, excusing the com- position of his memoirs, that he has known little or nothing of contemporary celebrities, and that his memory is inaccurate : " All my energy was directed upon one end â€" to improve myself, to form my own mind, to sound things thoroughly, to free myself from the bondage of unreason. ... If there is anything of interest in my story, it is as a story of mental development" (Memoirs, pp. 1, 2). He was never satisfied with his work : " It is impossible," he writes, " for me to see anything done without an immediate suggestion of how it might be better done " {Memoirs, p. 254). His aim was purely in- tellectual ; he says of himself in 1857, " My

ideal at this time was polluted and disfigured by literary ambition ” (Memoirs, p. 309). Again, he says : ” Since the year 1851, I have lived wholly for study. There can be no vanity in making this confession, for, strange to say, in a university ostensibly endowed for the cultivation of science and let- ters such a life is hardly regarded as a creditable one ” (Memoirs, p. 331). The Memoirs is a morbid book, and Mark Pattison is merciless to himself throughout. He certainly cherished a rare and unique ide^i, which he pur- sued through disappointments which nearly unhinged his mind. It is evident from his Memoirs that he carried rationalism in religion to an extent that seems hardly consistent with his position as an ordained minister of the English Church. (a. o. be.)

Pau , chief town of the department of Basses-Pyrenees, France, 470 miles south-south-west of Paris, on the rail- way from Toulouse to Bayonne. A winter palace was erected in 1896 in Beaumont Park (24 acres), at the east end of the town. A stdtue of Marechal Bosquet was unveiled in 1894. Pau is the seat of a Court of Appeal for the departments Basses- and Hautes-Pyrenees and Landes. It has a library of 65,000 volumes and a museum. Population (1881), 25,734; (1901), 30,811.

Pauli, Ceorg Reinhold (1823-1882), German historian, was born in Berlin, 25th May 1823. After an education at Berlin and Bonn Universities, he went to England in 1847, and before long was immersed in the study of English literature and history. From 1860 to 1852 he acted as private secretary to the Prussian ambassador in London. In 1851 he published his Konig Aelfred und seine Stelle in der Geschichte Englands, a work which aroused considerable interest and was translated into English in the following year. On his return to Germany in 1855 he was for a short time at the University of Bonn as privat-docent, and subsequently at Eostock from 1857 to 1869, and at Tubingen from 1859 to 1867 as professor of history. His political convictions, which strongly favoured the Prussians, were the cause of his removal from Tubingen to Marburg in 1867. From there he went, in 1870, to Gottingen, where he filled the chair of history till his death. He was an enthusiastic and successful teacher, and may be said to

have founded the school of historical research with which Sir John Seeley's reputation is associated in England. Besides the work on King Alfred mentioned above, his chief publications were a continuation in three volumes of Lappenberg's Geschichte von Ev"^"nd (1853-58) ; Bilder aus Alt-Eiirjland (1860) ; three volumes, dealing with the history of England from 1815 to 1852, in the Staaten- geschichte der neueren Zeit ; Simo7i de Montfort (1867) ; Aufsatze zia- englischen Geschichte, 2 series (1869, 1883). His historical researches gained him honorary degrees from the Universities of Oxford and Edinburgh. He died at Bremen, 3rd June 1882. (e. f. s.)

Pauiicians. â€" An important Oriental sect, probably named after Paul of Samosata. Their older name was Pauliani ; the form Pauiicians is from an Armenian diminutive meaning "contemptible Paul," as Manichean from jManes. Paul was bishop of Antioch from c. 260 to 268, and was affected by the Jewish tone, which spread from the Jewish population of Antioch, and long in- fluenced the Christians there. He taught what is now called Adoptionist Monarchianism, i.e., a form of uni- tarianism which denied that Jesus is God incarnate, but held that at His baptism He was made a partial sharer of the divine nature, and thus the adopted son of God. Opinions like those of Paul were held earlier by the Ebionites, and were introduced at Rome c. 190. Eecent attempts to trace them in Palestine to the apostolic age, or in Eome before 190, rest merely on conjecture or error. Paul's teaching spread among the Syrians. The Acts of Archelaus, c. 300, represent a Syriac-speaking bishop of Karkhar upholding it against the views of Manes.

The followers of Paul are mentioned by the council of Nicaea and Athanasius (4th century) ; Innocent I., Augustine, Theodoret (6th century). Eor a long time they are no more heard of : when they reappear it is as a religious sect in or near Armenia (see Ency. Brit., 9th ed., vol. xviii. p. 433). We learn of it from various Armenian and Greek writers. Among the latter are Photius (c. 850) and his contemporary, Peter Siculus, and Georgius Monachus (especially the Madrid MS.) :

all these use one older document, now lost. About 654 the Armenian ” Catholicos ” Nerses tried to suppress it ; about the same date Constantine Silvanus was born, and preached Paulicianism with success at Cibossa. In 719 the Armenian, John of Otzun, spoke and wrote against it. Evidence contradicts the recent theory that the earliest Armenian church was Paulician, but from the 6th century there was a nationalist anti-Greek Armenian Christianity which opposed the Armenian Church. Out of this tend- ency Smbat, c. 840, organized a strong Paulician sect, named Thonraki from the region of Thonrak, where he laboured. It is hard to determine the exact nature of his teaching. Old writers describe the Pauiicians as Mani- chean. On the other hand, the Key of Truth,^ the only known Paulician book (Armenian) is not Manichean, but Adoptionist. Nevertheless, as the Armenian Pauiicians hated infant baptism, perhaps deferred communion till old age, rejected the ministry and ritual of the Church, gave divine honours to their ” elect,” ” anointed ones,” or ministers, denied that Christ is God while they worshipped Him, and apparently denied that He took His flesh really of Mary, it is not strange that the Greeks confused them with the Manicheans. According to the Key, Jesus Christ ” in the season of His maturity . . . received baptism . . . received authority, I’cceived the priesthood, received the kingdom and the office of chief shei)lierd. Moreover,

lEdited by F. C. Conybeare (Oxford, 1898). Much of the introduc- tion is seriously marred by the editor’s slight acquaiutauco with Greek theology.

He was then chosen, then He won lordship . . . then He became the chief of beings heavenly and earthly, then He became the light of the world, then He became the way, the truth, and the life.” And the fact that their teaching incorporates many Catholic survivals, such as a trine affusion in ba]3tism, and that they made use of the Armenian authorized version of the New Testament and not the older version, shows clearly that their position is a ” protestant ” one â€” i.e., that it is a reaction against and a dissension from a developed ecclesiastical system, not a primitive type which has survived side by side with a later development. About 750 Constantine Copronymus, himself probably a

Paulician, removed many from Arme- nia to Thrace as a barrier against the Slavs. Later Byzantine rulers persecuted them. Erom 846 to 880 they fought desperately, and, joining with the Moslems, plun- dered Asia Minor. In 874 Tephrice, their stronghold, was taken by the emperor Basil. About 980 many were moved to Thrace by John Zimisces to prevent an alliance between the Pauiicians and the Moslems. About 1110 the Thracian Pauiicians were harried by Alexius Com- nenus for deserting hiin in war. At the end of the 17th century they lingered in the valleys of Haemus. In 1717 Lady Mary Wortley Montagu found some at Philippopolis. By 1819 the last Thracian Pauiicians had become Eoman Catholics. That they greatly influenced the Bulgarian Manicheans, known as Bogomils, who arose c. 950, and through them the Western movements of the Cathars and the Albigenses, seems to be indicated by the fact that not a few of their beliefs and practices were held in common â€" e.g., their eucharistic doctrine and the worship offered to their " anointed ones."

In the East they survived later. After the Eusso- Turkish war of 1828-29 a body of Thondraketzi (Thon- raki), who had left their homes in the Turkish canton of Khnus, settled in the village of ArkhivSli, in the newly- acquired Russian territory between Akhaltzik and Erivan. Here they were before long subjected to persecution by the authorities of the Armenian Church ; and in 1837, in the course of the persecution, the, Key (in which they said " everything was written ") was taken from them, having been mutilated previously in order to hide some of the more objectionable tenets, and deposited in the library of the Holy Synod at Etchmiadzin, where IMr Conybeare found it. According to its colophon, it was "written [i.e., it would appear, copied, for the substance of the book must be much earlier] in the province of Taron in the year of the Lord 1782"; and the evidence of five Paulician witne'sses tells us that it was "composed" by an Armenian priest Ohaunes (John) who had joined the sect, and who subsequently, under pressure from the gov- ernment, became a Mahommedan. The Pauiicians still existed in 1845, since which date they have been unmo- lested, and have probably died out. Mr H. F. B. Lynch {Armenia, Travels and Studies, London, 1901, i. 285) asserts that those who

survived have been absorbed by the American Protestant missions in Armenia, but gives no authority for the statement.

For authorities see Professor Bury's edition of Gibbon's Decline and Fall of the Roman Empire, vol. vi., appendix 6. But Profes- sor Bury copies the mistake of Mr Conybeare in calling the Shep- hprd of Hennas AAo^Xiomst. See also A. Lombakd, "Pa!7(iiV(en.'i, Bnlgares, et Bons-Hommes en Orient et en Occident, Geneva and Basel, 1879. (l. P. ; w. E. Co.)

Pauline Epistles.â€" O^he familiar grouping of the I'auline Epistles, (1) 1 and 2 Thessaloniaus, (2) Galatians, 1 and 2 Corinthians, Romans, (3) Colossians, Philemon, Ephesians, Philippians, (4) Pastorals, may help in considering this subject in regard to the later research on (a) authenticity, (&) date, (c) contents.

PAULINE EPISTLES

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(a) Eecent attacks iipon the generally received second group (the Haupthriefe) are mainly confined to a school of Dutch theologians, as isolated attacks else- tici^y."' "where can scarcely be credited to a " school " (Holtzmann, Einleitung*, p. 183 ; Clemen, Chro- nologie der Paulinischen Briefe, p. 30). Van Manen, chief representative of this hypercritical movement, has set forth his views in the Eoopository Times, 1898 ; Encycl. Bibl. iii. ; and more especially in the three parts of his Paulus. But as he maintains that these Epistles, as well as the rest referred to Paul, are pseudepigrapha dating at least from the close of the 1st century, we cannot be sur- prised that the positive external evidence of Clement of Eome, Corinthians, xlvi. (Salmon, Introd., 36o, and so Schmiedel, Encycl. Bibl. ii., " Galatians "), is entirely dis- regarded, to say nothing of that of other writers, and that Clement is relegated " at any rate to the 2nd century." But if an imposing array of names may fairly be quoted for the Haupthriefe, similar strong testimony accepts 1 Thessalonians (Holsten, only notable exception), Phile- mon, Philippians, and, with a few interpolations, Colos- sians (Clemen, u.s. p. 37 ; Weiss, Einleitung, p. 149). In groap 1, 2

Thessalonians was rejected by advanced critics, until it became almost an axiom to accept 1 Thessalonians and not 2 (see Holtzmann, Zeitschrift fiir die neutest. Wissenschaft, ii., 1901). But Jiilicher, if he does not positively accept 2 Thessalonians, regards the doubts raised against it as not insurmountable {Einleitung, pp. 34, 40), whilst in England Dr J. Drummond (Interna- tional Handbooks, 1899) accepts it at least provisionally, and in America Bacon (Introd. 76; cf. also Moffatt, His- torical JSf. T., p. 144 ff.).

The chief objection alleged is the representation of the Man of Sin. Not only, however, is it unlikely that a forger would introduce a passage so unlike anything in Paul's writings, but no one has defended the Epistle more acutely than Clemen in maintaining that the Apostle might easily have derived his picture from Jewish sources (so Jiilicher), although the Jewish traditional element may be pushed too far (cf. Bousset, Der Antichrist ; Charles, Ascension of Isaiah, Introd. ; and on the other hand, Askwith, Introduction to Thessalonians, 1902).

Of Ephesians and Colossians, Arnold Meyer writes that the recent criticism of Jiilicher and Harnack is much more friendly than that of Weizsacker and others (Die moderne Forschung iiber die Geschichte des Urchristentums, p. 39, 1898), and admits that a much earlier stage of Gnosis is represented than that of the great Gnostic systems, whilst English readers will remember that the specious appeal to advanced Gnosticism was repudiated by Dr Hort in tracing the Colossian heresy to Jewish soil and influences (Hastings, B. D., " Colossians," and for additional influ- ences Eamsay, " Colossae "). No criticism of any wide acceptance reckons Philemon spurious, although Van Manen would refer it to some unknown writer, a.d. 125- 130. But he has no word of explanation as to how the epistle found a place some ten years later in the heretic Marcion's canon. But Philemon carries with it Colossians, and if Colossians is Paul's, " the subtle intricacies of like- ness and unlikeness between it and Ephesians are a peculiarly strong kind of evidence for identical author- ship " (Hort, Proleg. to Ephesians, 168 ; Robertson, B.D.^ (Smith), "Ephesians"; Harnack, Chron. i. 239).

Group 4 Clemen ranks as “doubtless unauthentic” with the majority of advanced critics. But Eamsay, by his searching inquiry into the historical position which the Pastorals presuppose, maintains that their tone is incon- sistent with a late date; the undeveloped type of per- secution which they represent cannot be referred to the middle of the 2nd century, or to the formulated perse- cutions of the 1st (C. B. E. 246, 345, Weiss, Meyer’s Kommentar, p. 40, 1894).

Another adverse argument is weakened by the fact that much of the language formerly regarded as characteristic of the 2nd century may be referred to early Jewish sources, e.g., the reference of ” endless genealogies ” to pseudo-Philo’s Book concerning Biblical Antiquities (before a.d. 70) ; Dr James, iV^. T. Apocrypha, Church Congress, 1898 ; Hort, Judaistia Christianity, p. 130. From another point of view such references are of value, because, whilst in our best commentaries it is usual to illustrate freely from con- temporary and other Jewish documents, these and similar illustra- tions mark not only comparisons, but also contrasts (see, e.g., Charles, Apoc. of Baruch, Introd.).

A peculiar stumbling-block to the rejection of these Epistles lies in their abundance of personal notices (Zahn, Einleitung, ii. 457; Salmon, Introd. 409; and Weiss, Einleitung^, p. 304); It is difficult to see why a later writer should introduce these, since he ran the serious risk of making some fatal mistake; but if, as genuine Pauline fragments, they were introduced into letters the avowed aim of which was to secure the health- ful development of the Church, it is evident that, as they are not in themselves connected with this aim, they could only have been designedly inserted to palm off the letter in which they occur as the work of Paul. In such case the language of Weiss, u.s., will not seem too strong.

The acceptance of the Pastorals naturally implies a liberation and second imprisonment, as the attempts to fit them into an earlier part of Paul’s life have not been successful (Steinmetz, Die zweite romische Gefangenschaft des Apostels Paulus, 121, 1897). Mr Vernon Bartlet has lately made an ingenious attempt in this direc- tion (Apostolic Age, 198) ; e.g., he asks us to transfer 2 Timothy iv. 20 to the close of 1 Timothy

as a postscript, and to suppose that the reference to Trophimus is connected with the voyage from Miletus to Jerusalem, Acts xx. 21. Trophimus falls sick at the last moment, and could not sail with Paul from Miletus, and Paul refers to this in 1 Timothy â€" a letter written on board ship to his son in the faith at, or soon after leaving, Miletus. But Trophimus, it would seem, was certainly at Jerusalem very soon after. Acts xxi. 29, and on Mr Bartlet's theory it is difficult to see any sense in such a notice as 1 Timothy iii. 14, which he apparently admits to be from Paul. If Paul, Acts xx. 25, had just told the Ephesian elders that they should see his face no more, upon which Mr Bartlet insists (p. 201), it is difficult to believe that he had no sooner left Miletus than he writes to Timothy at Ephesus (p. 180) that he hopes to come unto him shortly. Moreover, the positive evidence for Paul's release and subsequent labours cannot be calmly ruled out of court. Amongst moderns Spitta and Harnack accept it, and both lay stress upon the fact that in Clem. Rom., Cor. v. 7, "the limit of the West" could not be used of Rome by one writing in Rome (cf. Ramsay, St Paul, 455 ; Zahn, u.s., p. 448).

(b) With regard to dates, Clemen, in accordance with his view of development of Pauline thought, placed 1 and 2 Thessalonians, 47, 48, before the Apostolic Council (see below), while Harnack places them 48, 49 (47, 48), and McGiffert, c. 48, in accordance with their early chronology, but after the Council. The greatest diversity of opinion gathers round Galatians. McGiffert places it earliest of the Epistles, at Antioch, before the second missionary journey, whilst Eendall, holding with McGiffert the South Galatian theory, maintains that it was written during this journey, at Corinth. Mr V. Bartlet would apparently place it earlier still, either on Paul's way to Jerusalem for the Council or during the dispute at Antioch with the Judaizers before the Council. These writers thus agree in so far that they rank Galatians earliest. In Germany Prof. V. Weber, the fullest advo- cate of the South Galatian theory and of the identification of Gal. ii. with Acts xi. 30, places Galatians earliest, in 49, during the period Acts xiv. 28; and he is now-followed by Belser, Einleitung, pp. 170, 436 ff., 1901. Zahn also places it earliest, but in the beginning of 63, and 1, 2 Thessalonians within the first half of the year, these three Epistles thus forming his first group.

He too, holding the South Galatian theory for the Epistle, dates it with Eendall from Corinth, and both writers consider vi. 17 a reference to the scourging at Philippi, of which Paul still bore the scars. Eamsay, however.

Date.

gives strong reasons for placing Galatians later in Paul's life, at Antioch, at the close of the second journey. The most remarkable change of opinion in favour of the early date of Galatians is that of Clemen, who, after placing it subsequent to Eomans (1897), now considers it the earliest of all, in view of the South Galatian theory, placing it in the second missionary journey before 1 and 2 Thess. ; on this cf. TJieol. Rundschau, 12, 1901.

The inquiry gains additional interest from Mr Askwith's discus- sion {Galatians, 1899) of points at issue between Ramsay and Liglitfoot, and his contention tliat the later date assigned by the latter, during the third missionary journey, need not interfere with maintaining the South Galatian theory. The later date is adopted by Lightfoot chiefly from similarity of style and language between Galatians and Romans, but undoubted resemblance of language between two writings does not of necessity involve any certain inference as to date (Sanday and Headlam, Somans, xxxviii.). Sieffert (Meyer's Kommentar, 1899) follows most Continental critics, placing Galatians first in the second group, but, as an upholder of the North Galatian theory, in the third journey, at Ephesus, 54-55. There is no reason, he argues, for assigning a later date because of the developed teaching on justification, since the essential features of that doctrine belong so inseparably to the foundations of Paul's Gentile Gospel that they must have been early fixed, and would find at different times a kindred representation. It is not surpris- ing that Harnack should find it impossible to assign any date pre- cisely; see further Hastings, B. D., "Galatians." Halmel (1895) stands almost alone in supporting the view, once widely held, that Galatians was written in Rome, or elsewhere in Italy, because of the terms of Roman law. But Sieffert (p. 24) points out that in the Roman provinces there were numbers of Roman citizens, and the Roman legal rights would be widely known amongst other provin- cials ; and still more strikingly Ramsay maintains that the peculiar legal procedures are applicable to South Galatian cities of the first missionary journey, in which Seleucid and Greek law, not Roman law, prevailed {Gfalalians, p. 370).

In group 3 Philippians is now often placed last (first, by Lightfoot). Kamsay maintains that Paul's trial had begun, and favourably ; hence the undercurrent of hope and eagerness for the issue (St Paul, 357). Prom this stand- point Mommsen's interpretation of i. 13 as the supreme imperial court carries weight : before these judges Paul had appeared, his bonds became manifest in Christ, sympathy was awakened, inasmuch as he is no longer regarded as a dangerous

seditious leader, a sympathy corroborated perhaps by the greetings, iv. 22.

In i. 7 two legal terms afford confirmatory evidence, diraXoyla, iSe^oiwiris, whilst i. 14 (Job xiii. 6, LXX.) indicates speedy deliver- ance from imprisonment (Zahn, Einleitung, i. 380, although differ- ing from Mommsen ; Kennedy, Expository Times, 1898 ; R. R. Smith, Epistle of the Trial, 1899; Belser, Einleitung, p. 570, 1901).

(c) With regard to the contents of these Epistles, recent criticism strengthens the subtle but undesigned coinci- dences with Acts. In group 1, topics referred to in Thes- salonian Epistles may well have given colour to the charge of proclaiming " another Emperor," Acts xvii. 7, in Thessalonica (Pindlay, Paul; Hastings, B. D., and, further, McGiffert, Apostolic Age, 246). In Commen- tary on Galatians, p. 399, Ramsay strikingly enumerates many coincidences between this Epistle and the address at Pisidian Antioch, Acts xiii., and thus affords additional support to the South Galatian theory. The stress laid upon the collection for the saints, so marked in these Epistles of group 2, and the fuller recognition of its im- portance in creating a deeper sense of Church unity, give fresh vividness to Paley's argument from undesigned coincidences. Acts xxiv. 7, Eomans xv. 25 ff. ; whilst the tone of apprehension with which Paul regarded his final visit to Jerusalem fitly agrees with the sense of danger, Romans xv. 30, 31 (also emphasized by Paley) (Hort, Proleg. to Eomans, 42; Ramsay, u.s. 459; Eendall, Expositor, 1893).

In connexion with the great (circular) Epistle of group 3, Ephesians, Paley remarked that we cannot expect many agree- ments with Acts, but if Ephesians was addressed to various Churches, a strong tradition makes Ephesus one of them, and

resemblances between Paul's address of Miletus and the phraseology of Ephesians may not unfairly help to confirm this tradition (Lock, Ephesians; Hastings, S. Z>.).

These writings supply another evidential argument from their corroborative witness to facts and teaching of the Gospels, as also from

the knowledge of these facts which they presuppose in their readers (Zahn, Einleitung, ii. 158, 166; Uhlhorn, Das Leben Jesu in seinen neueren Darstellungen, p. 113 ; Drescher, Das Leben Jesu bei Paulus, 1900 ; for literature, Pindlay, Paul ; Hastings, B. D.).

If we confine ourselves to those Epistles which we claim as authentic, and if we take the earliest, e.g., 1 Thessalonians or Galatians, this testimony is forthcomingâ€" a testimony which can be further traced through each of the four groupsâ€" Zahn, u.s. ; e.g., 1 Thessalonians i. 10; ii. 15, 19; ill. 13; iv. 2, 16; v. 1-5, 23; and especially Zahn, u.s., p. 159; Galatians, i. 1, 4, 17-19; ii. 9, 20 ; iii. 1, 13 ; iv. 4, 6 ; v. 24 ; vi. 2 ; and for evidence of probable Johannine tradition, P. Ewald, HauptproUem der Evangelienfrage, pp. 84-94.

The Epistles thus constitute "a fifth Gospel," and it is not surprising that even Pfleiderer acknowledges that the Apostle's work would be a castle in the clouds without some historical data of the personal life of Jesus.

Moreover, Dr Sanday has forcibly urged that the teach- ing of Paul, a Jewish monotheist, as to our Lord's relation to the Father in 1 and 2 Thessalonians is best explained by believing that behind it lay the knowledge of teaching of Jesus in the Gospels (Hastings, B. D., " Jesus Christ "). But this may also be said of the Galatian Epistle, cf. 1, 2 Corinthians; e.g., Galatians i. 1, 3; ii. 20; iv. 4; 1 Corinthians viii. 6 ; 2 Corinthians xiii. 14, to say nothing of others. Thus, whilst the doctrine of the divine Person of Christ received in later Epistles its greatest prominence â€" as, e.g., Colossians i. 18 â€" in answer to the angel-worship of false Jewish teaching, and whilst the language of Hellenism may have enabled Paul to give adequate expres- sion to his thoughts, the doctrine itself " had underlain all his teaching and each earlier Epistle " (Hicks, Studia Biblica, iv. 10).

Another point emphasized by recent criticism is the naturalness, the conventionality of these Epistles ; i.e., not merely the directness and simplicity with which the writer passes, as in Colossians and Ephesians, from highest doctrinal themes to commonest relationships of life, but the "manner of men " which he adopts in phraseology, salutations,

prayers. The instances in Deissmann, Bibelstudien, i. 210-216 (of. Neue Bibelstudien, 65, 76-84), afford parallels and illus- trations to each of the four groups â€” e.g,, the unceasing mention of Paul's converts in his prayers : 1 Thessalonians i. 2 ; Eomans i. 9 ; Philemon, v. 1 ; Ephesians i. 6 ; 2 Timothy i. 3, has an interesting parallel in an Egyptian letter (172 e.g.), oJ ev oIk irdin-es crov Sia- Travrbs fivelav wowifievoi ("all at home make constant mention of y ou ") , especially as the context mentions constant prayer to the gods. The simplest letters, moreover, took in earliest times the form of con- versation between people separated, and hence the possibility of re- storing a lost letter, to which we have a reply in some extant epistle, by noting the conversational elements which have been incorporated in the answer. This possibility has been skilfully maintained by Dr Rendel Harris with reference to 1 Thessalonians (Expositor, Sep- tember 1898), with which we may compare Dr Lock's valuable con- tribution to Expositor (July 1897), in which he explains how many passages of St Paul's Epistlesâ€" e.jr., in 1 and 2 Corinthiansâ€" are best understood by supposing that he had before him the actual words, written perhaps, or at least employed, by his opponents in taunt, question, argument, and that the phrase so used is caught up, as it were, by the Apostle in his reply, according to the common custom of letter-writers ; cf. a similar suggestion, Ramsay, Gala- tians, p. 462 ; Pindlay, Expositor (June 1900). Such traits do not render Paul's letters weak or contemptible, like his presence and speech in the estimation of his foes ; rather do they help to confer a power and a charm which make them known and read of all ^^ (b. j. K*.)

1 With regard to attempts to break up 2 Corinthians, it cannot be said that they have proved successful (see Sanday, Encycl. Bibl. i.,

Coniitluans " (1899); JUlicher, Einleitung, p. 43 ff., who also pro- nounces in favour of the integrity of the Epistle, and even against the hypothesis of Vierkapitel Brief, x.-xiii. or x. 1-xiii. 10, as a separate ilrni^x'‘ J ‘ ‘‘ ^' Kennedy's articles (E-xpositor, September, October 1S97) and Mr White's reply in favour of the integrity of 2 Corinthians, February 1898, should also be consulted. See further Sehmiedel, Theol. Rundschau, 12, 1901.

P A V I A â€” P AWNBEOKING

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Pavia, capital of the province of the same name, Lombardy, Italy, 18 miles south of Milan by rail. The population remained stationary during the last thirty years of the 19th century, since its increase from 34,614 in December 1871 to 36,107 in December 1899 was due to the inclusion of part of the commune of Mirabello in 1883. In consequence of this change the area, previously less than 700 acres, was increased to nearly 7000 acres. Having in 1872 ceased to be a fortress, the fortifications were ceded to the commune in 1876, and the bastions have been gradually transformed into boulevards and public gardens. Inside the city, changes have been limited to partial straightening of old streets and the construction of some new ones, and to the arrangement of public squares in front of the Castle, the Municipal Palace, and other sites. Among the public buildings may be mentioned the Palazzo Mezzabarba, converted into the Municipal Palace ; the Prefecture, enlarged and rebuilt; the covered market, with post, telegraph, and telephone offices; the new people's agricultural bank; and the public slaughter-house. The University, founded in 1361, has been increased by the addition of schools of general chemistry, pharmaceutical chemistry, physiology, and by the foundation of chairs of pathological anatopay, histology, legal medicine and hygiene, while in the old University buildiijg the geological, paleeontological, and mineralogical collections have been enlarged. The num- ber of students in 1899-1900 was 1308, of whom 503 were inscribed in the faculty of medicine. The buildings de- voted to secondary education and technical instruction have been enlarged and improved. In 1881 a new cem- etery was laid out and the old cemetery of Borgo Ticino suppressed. Por the promotion of athletics a rifle club, a gymnastic hall, and several boating clubs have been established. In 1884 a monument was erected to Gari- baldi, and in 1900 another monument to the Cairoli family. The communal fine arts museum has been en- larged and reorganized to make room for numismatic, archaeological, and natural history departments. The cathedral, begun at the end of 1500, has been crowned with a cupola and the faqade begun. The old basilicas of S.

Michele Maggiore, S. Pietro in Ciel d'Oro, and S. Teodoro have been restored aad isolated. Since 1880 there has been a considerable increase in iron foundries, military engineering works, and electrical production works. In addition, numerous cement factories, factories of antiseptic preparations, and establishments for rearing silk-worms have been founded.

Pavia y Albuquerque, Manuel (1828-1895), Spanish general, was born at Cadiz on 2nd August 1828. He was the son of Admiral Pavia, a naval ofiicer of some note in the early part of the 19th century. He entered the Royal Artillery College at Segovia in 1841 ; became a lieutenant in 1846, a captain in 1855, and major in 1862. Three years later he joined the staff of Marshall Prim, and was his devoted follower during the last years of Isabella's reign, when Prim was the moving spirit of the Progressist party. Pavia took part in the two unsuccessful revolutionary movements concerted by Prim in 1866, and, after two years of exile, in the suc- cessful revolution of 1868. Prim employed him in high commands, in which Pavia showed much vigour against the republican risings in the southern provinces ; the governments of King Amadeus of Savoy, from 1871 to 1873, also showed him much favour. After the abdica- tion of that Prince, General Pavia was called upon by the short-lived cabinets of the federal republic to lead their armies first against the Carlists and then against the cantonal insurrections of the chief towns of the south, which he quelled with great energy. On three occasions

during the eventful year 1873, as captain-general of Madrid, he frankly offered his services to the govern- ments of the day to put an end to the anarchy that was raging in the provinces and to the disorganization preva- lent in the Cortes. To all he used the same arguments, namely, that they had to choose between an Alphonsist restoration or a dictatorial, military, and political re- public, which would rally round its standard all the most Conservative groups that had made the revolution of 1868. This he hoped to realize with Castelar, but the plan was interrupted by the military jyi'onundamiento for the purpose of dissolving the Cortes of 1873. As soon as the federal Cortes had defeated Castelar, Pavia made his coup d'itat of 3rd January 1874, for

which he had, on his own confession in his memoirs, prepared the garrison of Madrid umier his command, with the assent of all the leaders of the army in the provinces. After his pronvn- ciamiento, Pavia was absolute master of the situation, and might have played the part of a Cromwell, Prim, or Monk. Having no personal ambition, he sent for Mar- shal Serrano to form a government with Sagasta, Martos, UUoa, and other Conservatives and Radicals of the revo- lution. Prom that moment Pavia carefully abstained from taking an active part in politics ; but he sat in the Cortes of the Restoration several times, and once in a famous retrospective debate he defended himself skilfully against no less an orator than Emilio Castelar, who up- braided him for the part he had played on 3rd January 1874. He died suddenly on 4th January 1895, at the age of sixty-seven. (a. e. h.)

Pavlodar, a town of Asiatic Russia, in the province and 225 miles north-west of the town of Semipalatinsk, 259 miles south-east of Omsk railway station, on the right bank of the Irtysh. It has regular steamer com- munication with the Ob and Irtysh ports, and is a centre for trade with the Kirghiz, who exchange animals and animal products for grain, flour, and manufactured goods. Population (1897), 7730.

Pavlovo, an industrial town of Russia, in the government and 40 miles south-west of the town of Nijni-Novgorod, on the Oka river. It is the centre of a considerable cutlery, hardware, and locksmith trade, which, carried on in cottages and small workshops, en- gages, besides Pavlovo itself, no less than 119 villages, and the output of which reaches an annual value of over Â£200,000. There are also steel works and match factories. Pavlovo is well provided with schools, and has a museum of cutlery models and a library. Population (1897), 12,200.

Pavlovskiy Posad, or Vokhna, a town of Russia, in the government and 42 miles by rail east of the town of Moscow, on the Klyazma river. It is the centre of an important manufacturing district, comprising woollen mills, and dyeing and printing works, turning out goods to the value of Â£111,300 annually. Population (1897),

10,020.

Pawnbroking. â€” If we desire to trace with minute- ness the history of pawnbroking we must go back to the earliest ages of the world, since the busi- ness of lending money on portable security is one of the most ancient of human occupations. Even in the remote ages when the Old Testament was being written, the practice was already familiar, although it was hardly regarded with a benevolent eye. " If a man be poor, thou shaltnot sleep with his pledge," says the Penta- teuch ; " and if thou at all take his raiment to pledge, thou shalt deliver it to him by that the sun goeth down . . . that he may sleep in his own raiment, and bless thee." No man might take the upper or the nether millstone in pawn, since that was equivalent to taking a man's life in pledge.

Nor might the widoVs ox be taken. The Mosaic Law struck at the root of pawnbroking as a profitable business, since it forbade the taking of interest from a poor borrower, while no Jew was to pay another for timely accommoda- tion. And it is curious to reflect that, although the Jew was the almost universal usurer and money-lender upon security of the Middle Ages, it is now very rare in Great Britain to find a Hebrew pawnbroker.

In China, whioh was venerable before most of the rest of the world had learned the elements of civilization, the pawnshop was probably as familiar two or three thousand years ago as it is to-day, and its condaot is still regulated quite as strictly as in England. The Chi- nese conditions, too, are decidedly favourable to the borrower. He may, as a rule, take three years to redeem his property, and he cannot be charged a higher rate than 3 per cent, per annum â€" a regu- lation which would close every pawnshop in England in a month. Both Rome and Greece were as familiar with the operation of pawn- ing as the modern poor all the world over ; indeed, from the Roman jurisprudence most of the contemporary law on the subject is de- rived. The chief difference between Roman and English law is that under the former

certain things, such as wearing apparel, furniture, and instruments of tillage, could not be pledged, whereas there is no such restriction in English legislation. The Emperor Augustus was himself an illustrious pawnbroker. He converted the surplus arising to the State from the confiscated property of criminals into , , . a fund from which sums of money were lent, without *f^^^*. interest, to those who could pledge vahiables equal to â– double the amount borrowed. It was, indeed, in Italy, and in more modern times, that the pledge system which is now almost universal on the continent of Europe arose. In its origin that system was purely benevolent, the early Monts de Pike established by the authority of the Popes lending money to the poor only, with- out interest, on the sole condition of the advances being covered by the value of the pledges. This was virtually the Augustan system, but it is obvious that an institution which costs money to manage and derives no income from its operations must either limit its use- fulness to the extent of the voluntary support it can command, or must come to a speedy end. This is probably the explanation of the failure of some very early attempts to establish charitable pawn- shops. Thus as early as 1198 something of the kind was started at Ereising in Bavaria ; while in 1,350 a similar endeavour was made at Salins in Franche Comt6, where interest at the rate of 7J per cent, was charged. Nor was England backward, for in 1361 Michael Northbury, or de jSTorthborough, bishop of London, bequeathed 1000 silver marks for the establishment of a free pawnshop. These primitive efforts, like the later Italian ones, all failed. The Vatican was therefore constrained to allow the Sacri Monti di Piet^râ€” no satisfactory derivation of the phrase has yet been suggested â€” to charge sufficient interest to their customers to enable them to defray expenses. Thereupon a learned and tedious controversy arose upon the lawfulness of charging interest. In time it died away, extin- guished by its own futility, but about the beginning of the 16th century it was revived, and was only finally set at rest by the issue of a papal bull. By that document Pope Leo X. , in the tenth sit- ting of the Council of the Lateran, declared that the pawnshop was a lawful and valuable institution, and threatened with excommuni- cation those who should presume to express doubts on the subject. The Council of Trent inferentially confirmed this decision, and at a

somewhat later date we find St Charles Borromeo counselling the establishment of State or municipal pawnshops.

Long before this, however, Monti di Piet^ charging interest for

their loans had become common in Italy. The precise date of their

establishment is not clear, but it is certain that it was not

*r"^rf; la-ter than 1464, when the earliest of which there appears

mtit *Â° ^Â® ^"y record in that country â€" it was at Orvieto â€" was

- ' confirmed by Pius II. Three years later another was

opened at Perugia by the efforts of two Franciscans, Barnabus Interamnensis and Fortunatus de Copolis. The one had been a physician and the other a lawyer, and both had gone to the cloister late in lite. They collected the necessary capital by preaching, and the Perugian pawnshop was opened with such success that there was a substantial balance of profit at the end of the first year. The Dominicans, who were perhaps jealous of the Franciscans, en- deavoured to preach down the "lending-house," but without avail, and others were established in rapid succession. Thus Viterbo obtained one in 1469, and Sixtus IV. confirmed another to his native town of Savona in 1479. After the death of Brother Barnabus in 1474, a strong impulse was given to the creation of these establish- ments by the preaching of another Franciscan, Father Bernandino di Feltre, who was in due course canonized. By his efforts Monti di Pieta, were opened at Assisi, Mantua, Parma, Lucca, Piacenza, Padua, Vicenza, Pavja, and a number of places of less importance. At Florence the veiled opposition of the municipality and the open hostility of the Jews prevailed against him, and it was reserved to

Savonarola, who was a Dominican, to create the first Florentine pawnshop, after the local theologians had declared that there was "no sin, even venial," in charging interest. The activity of the Church in this matter, and the readiness of the Popes to give per- mission for

pawnshops all over Italy, make it the more remarkable that the papal capital itself possessed nothing of the kind until 1539, and that even then Rome, like so many other cities, owed the con- venience to the exertions of a Franciscan. The Naples establish- ment, opened about the same year, became famous in time as not only the largest in Europe, but as containing a larger accumulation of valuable articles than any other. From Italy the pawnshop spread gradually all over Europe. Augsburg adopted the system in 1691, Nuremberg copied the Augsburg regulations in 1618, and by 1622 it was established at Amsterdam, Brussels, Antwerp, and Ghent. Madrid followed suit in 1705, when a priest opened a charitable pawnshop with a capital of fivepence taken from an ftlms-box.

The institution was, however, very slow in obtaining a footing in France. It was adopted at Avignon in 1577, and at Arras in 1024. The doctors of the once powerful Sorbonne could , ^^j not, despite the action of the Popes, reconcile themselves ^^^^ ,^ to the idea of the lawfulness of interest, and when a France. pawnshop was opened in Paris in 1626, it had to be closed within a year. Then it was that Jean Boucher published his Defense des Monts de Fiete. Marseilles obtained one in 1695 ; but it was not until 1777, after the idea had been pressed upon the Government for more than a century, that the first Mont de Pi^te was founded in Paris by royal patent, to the great satisfac- tion of M. Necker. The statistics which have been preserved relative to the business done in the first few years of its existence show that it was resorted to by a much better class than that from which most pawnshops now draw their customers. In the twelve years between 1777 and the Revolution, the average value of the pledges was 42 francs 50 centimes, which is double the present average. The interest charged was 10 per cent, per annum, and large profits were made upon the sixteen million livres that were lent every year. The National Assembly, in an evil moment, destroyed the monopoly of the Mont de Pi6t^, but it struggled on until 1795, when the competition of the money-lenders compelled it to close its doors. So great, however, were the extortions of the usurers that the people began to clamour for its reopening, and in July 1797 it recommenced business with a fund of Â£20,000 fomid by five private capitalists. At first it charged interest at the rate of 36 per

cent, per annum, which was gradually reduced, the gradations being 30, 24, 18, 15, and finally 12 per cent, in 1804. In 1806 it fell to 9 percent., and in 1887 to its present level of 7 per cent. In 1806 Napoleon I. re-established its monopoly, while Napoleon III. , as Prince-President, regulated it by new laws that are still in force. In Paris the pledge-shop is, in efiect, a department of the Administration ; in the French provinces it is a municipal monopoly ; and this remark holds good, with modifications, for most parts of the continent of Europe.

In England the pawnbroker, like so many other dis- tinguished personages, "came in with the Conqueror." From that time, indeed, to the famous legisla- tion of Edward I., the Jew money-lender, who as 'eriuiia often as not advanced money upon the security of valuable property which passed into his temporary X^ossession pending its redemption, was the only pawn- broker. Yet, despite the valuable services which the class rendered, not infrequently to the Crown itself, it is matter of familiar history that the usurer was treated with studied cruelty â€" Sir Walter Scott's Isaac of York was no mere creation of fiction. These barbarities, by diminishing the number of Jews in the country, had, long before Edward's decree of banishment, begun to make it worth the while of the Lombard merchants to settle in England. It is now as well established as anything of the kind can be that the three golden balls, which have for so long been the trade sign of the pawnbroker, were the symbol which these Lombard merchants hung up in front of "their houses, and not, as has often been suggested, the arms of the Medici family. It has, indeed, loeen conjectured that the golden balls were originally three flat yellow efiigies of byzants, or gold coins, laid heraldically upon a sable field, but that they were])resently converted into balls the better to attract attention. That these sharp, and not always very scrupulous, men of business from the South did actually advance money on pledges can hardly be questioned when we remember that in 1338 Edward III.

pawned his jewels to the Lombards to raise money for his war with France. An equally great king â€” Henry V. â€” did much the same in 1415. It has indeed been said, with no great touch of extravagance, that both Creqy and Agincourt owed something to the pawn- broker.

The Lombards were not a popular class, and Henry VII. harried them a good deal. But, whatever parliaments and kings might enact, usury and broking went on clandestinely when the business was too perilous to be conducted openly, and it would appear that the principal City companies were not above acting as pawnbrokers. By the time Bacon wrote his essay on Usury a juster estimate of the subject had begun to prevail. "Brokers of pawn" were, however, still regarded as the lineal business descendants of the 14th-century Jew usurers and the unpopular Lombards, and in the very first year of James I. " An Act against Brokers " was passed and remained on the statute-book until Queen Victoria had been thirty-flve years on the throne. It was aimed at " counterfeit brokers," of whom there were then many in London. They were described as men of " manual occupations and handicrafts-men," and were denounced for having "set up a trade of buying and selling and taking in pawn of all kinds of wearing apparel, household stuff, and goods of all kinds soever, finding thereby that the same is a more idle and easier kind of trade and living, and that there ariseth and groweth to them a more ready, more great, more profitable, and speedier advantage and gain than by their former manual labours." This type of broker was evidently regarded as a mere receiver of stolen goods, for the Act provided that "no sale or pawn of any stolen jewels, plate, or other goods, to any pawnbroker in London, Westminster, or Southwark, shall alter the property therein," and that "pawnbrokers refusing to produce goods to their owner from whom stolen shall forfeit double the value."

In the time of Charles I. there was another Act which made it quite clear that the pawnbroker was not deemed to be a very respect- able or trustworthy person. Nevertheless' a plan was mooted for setting that king up in the business. The Civil War was approach- ing and supplies were badly needed, when a too ingenious Royalist proposed the establishment of a State "pawnhouse." The pre- amble of the scheme

recited how “the intolerable injuries done to the poore subjects by brokers and usurers that take 30, 40, 50, 60, and more in the hundredth, may be remedied and redressed, the poor thereby greatly relieved and eased, and His Majestic much benefited.” That the king would have been “much benefited” is obvious, since he was to enjoy two-thirds of the profits, while the working capital of Â£100,000 was to be found by the City of Loudon. The reform of what Shakespeare calls ‘ ‘ broking pawn ‘ ‘ was in the air at that time, although nothing ever came of it, and in the early days of the Commonwealth it was proposed to establish a kind of Mont de Pi6t6. The idea was emphasized in a pamphlet of 1651 entitled Observations manifesting the Conveniency and Com- modity of Mount Pieteyes, or Public Bancks for Meliefofthe Poor or Others in Distress, upon Pawns. No doubt many a ruined Cavalier would have been glad enough of some such means of raising money, but this radical change in the principles of English pawnbroking was never brought about. It is said that the Bank of England, under its charter, has power to establish pawnshops ; and we learn from^ Short History of the Bank of England, published in its very early days, that it was the intention of the directors, ‘ ‘ for the ease of the poor,” to institute ” a Lombard” “for small pawns at a penny a pound interest per month.”

Throughout both the 17th and 18th centuries the general suspicion of the pawnbroker appears to have been only too well founded. It would appear from the references Fielding makes to the subject in Amelia, which was written when George II. was on the throne, that, taken in the mass, he was not a very scrupulous tradesman. The householder, whose stolen property had been pledged much below its value, appeals to the justice for some penalty on the pawnbroker, ” who plainly appears to have known that these goods were stolen “; and he adds, ” The shops of these fellows are, indeed, the fountains of theft.” Down to about that time it had been customary for publicans to lend money on pledges that their customers might have the means of drinking, but the practice was at last stopped by Act of Parliament. Nor was respect for the honesty of the business increased by the attempt of ” The Charitable Corporation ” to conduct pawnbroking on a large scale. Established by charter in 1707, ” this nefarious corpora- tion, ‘ ‘ as

Smollett called it, was a swindle on a large scale. Its ostensible object was benevolence â€” it would lend money at legal interest to the poor upon the smallest pledges. The capital was Â£30,000, which before long was increased to Â£600,000. With an ofifice in the City and another at the West End, the undertaking was an almost immediate success for the promoters ; but there was no attempt at circumspection in the conduct of the business, and the facilities which it offered for the disposal of stolen goods were far

greater than had ever been reproached against the private broker. The directors gambled wildly with the shareholders' money, and in the end the Common Council of the City of London petitioned Parliament for the dissolution of this dishonest concern, on the ground that "the corporation, by affording an easy method of raising money upon valuables, furnishes the thief and pickpocket with a better opportunity of selling their stolen goods, and enables an intending bankrupt to dispose of the goods he buys on credit for ready money, to the defrauding of his creditors." Yet the ^corporation had managed to keep its doors open for a good many years, a,nd was, as is not usual with such schemes, officered by persons of the greatest outward respectability. When the concern collapsed in 1731 its cashier was Mr George Robinson, M.P. for Marlow. In company with another principal official he dis- appeared, less than Â£30,000 being left of a capital which had once been twenty times as much.

The pawnbroker's licence dates from 1786, the duty being fixed at Â£10 in London and Â£5 in the country ; and at the same time the interest chargeable was settled at "I" per cent, per month, the duration of loans being confined to one year. Five years later the interest on advances over Â£2 and under Â£10 was raised to ju ^ m 15 per cent. The modern history of legislation reguia- affecting pawnbroking begins, however, in 1800, "o"* '" when the Act of 39 and 40 George III. c. 99 "–'"""'â– was passed, in great measure by the influence of Lord Eldon, who never made any secret of the fact that, when he was a young barrister without briefs, he had often been indebted to the timely aid of the pawnshop. The pavrabrokers were grateful, and for many years after Lord Eldon's death they continued to drink his health at

their trade dinners. The measure treated the broker a good deal less like an outcast and a potential criminal than the legislation of the previous two cen- turies, but it was far from being a liberal enactment. It increased the rate of interest to a halfpenny per half-crown per month, or fourpence in the pound per mensem â€” that is to say, 20 per cent, per annum. Loans Were to be granted for a year, although pledges might be redeemed up to fifteen months, and the first week of the second month was not to count for interest. The Act worked well, on the whole, for three-quarters of a century, but it was thrice found necessary to amend it. Thus in 1816 the licence duties were raised to Â£15 and Â£7, 10s. for London and the country respec- tively ; another Act of 1840 abolished the reward to the ” common informer ” for reporting illegal rates of interest ; while in 1860 the pawnbroker was empow- ered to charge a halfpenny for the pawn-ticket when the loan was under five shillings. As time went on, how- ever, the main provisions of the Act of 1800 were found to be very irksome, and the Pawnbrokers' National Asso- ciation and the Pawnbrokers' Defence Association worked hard to obtain a liberal revision of the law. It was argued that the usury laws had been abolished for the whole of the community with the single exception of the pawn- broker who advanced less than Â£10. The limitations of the Act of 1800 interfered so considerably with the pawn- brokers' profits that, it was argued, they could not afford to lend money on bulky articles requiring extensive storage room. So many books and documents and official forms had to be filled up that an undue amount of clerical assist- ance was required, and the profit upon short pledges was so small that he was only able to keep his shutters down by what he could make on those for longer terms. Yet, however seriously the old law may have checked the prosperity of the lender, it was evidently no deterrent to borrowers. In 1870 the House of Commons appointed a Select Committee on Pawnbrokers, and it was stated in evidence before that body that in the previous year 207,780,000 pledges were lodged, of which between thirty and forty millions were lodged in London. The average value of pledges appeared to be about 4s., and the proportion of articles pawned dishonestly was found to

be only 1 in 14,000. More recent ofBcial statistics show that of the forfeited pledges sold in London less than' 20 per million are claimed by the police. Another inter- esting fact brought out in the inquiry of 1870 was that, contrary to the popular belief, the profits of the pawnbroker were small, rarely indeed exceeding 6 per cent.

The result of the Select Committee was the Pawn- brokers Act of 1872, which repealed, altered, and con- solidated all previous legislation on the subject, 'and is still the measure which regulates the relations between the public and the "brokers of pawn." Based mainly upon the Irish law passed by the Union Parliament, it put an end to the old irritating restrictions, and re- duced the annual tax in London from Â£15 to the Â£7, 10s. paid in the provinces. By the provisions of the Act (which does not affect loans above Â£10), a pledge is redeemable within one year, and seven days of grace added to the year. Pledges pawned for 10s. or under and not redeemed in time become the property of the pawnbroker, but pledges above 10s. are redeemable until sale, which must be by public auction. In addi- tion to one halfpenny for the pawn-ticket â€" which is sometimes not charged for very small pawns â€" the pawnbroker is entitled to charge as interest one half- penny per month oh every 2s. or part of 2s. lent where the loan is under 40s., and on every 2s. 6d. where the loan is above 40s. " Special contracts " may be made where the loan is above 40s., at a rate of interest agreed upon between lender and borrower. Unlawful pawning of goods not the property of the pawner, and taking in pawn any article from a person under the age of twelve, or intoxicated, or any linen, or apparel, dr unfinished goods or materials entrusted to wash, make up, &c., are (inter alia) made offences punishable by summary conviction. A new pawnbroker must pro- duce a magistrate's certificate before he can receive a licence ; but the permit cannot be refused if the appli- cant gives suflScient evidence that he is a person of good character. The word " Pawnbroker " must always be inscribed in large letters over the door of the shop. Elaborate provisions are made to safeguard the interests of borrowers whose unredeemed pledges are sold under the Act. Thus the sales by auction may take place only on the first Monday

of January, April, July, and October, and on the following days should one not be sufiicient. This legislation was, no doubt, favourable to the pawn- broker rather than to the borrower. The annual interest on loans of 2s. had been increased by successive Acts of Parliament from the 6 per cent, at which it stood in 1784 to 25 per cent, in 1800, and to 27 in 1860â€” a rate which was continued by the measure of 1872. The annual interest upon a loan of half-a-crown is now 260 per cent., as compared with 173 in 1860 and 86 in 1784 ; while the extreme point is reached in the case of a loan of Is. for three days, in which case the interest is at the rate of 1014 per cent, per annum. It must be remembered, however, that it has always been contended by the pawnbrokers that under the old arrangement there was no profit at all upon the small transactions, in which the bulk of their business consists. The foreign Mont de Pi^te often disposes of this difficulty in a manner not possible to the English trader, by refusing to advance very small sums. It thus retains the profitable work, while rejecting that which is unremunerative. An English Mont de Pi^te was once projected by the Salvation Army, and in 1894 the London County Council considered the practicability of municipal effort on similar lines ; but in neither case was anything done.

The growth of pawnbroking in Scotland, where the law as to pledge agrees generally with that of England, is

remarkable. Early in the 19th century there was only one pawnbroker in that country, and in 1833 the number reached only 62. Even in 1866 fâ„¢”^”” there were no more than 312. It is probable Ireland. that at the present moment Glasgow and Edin- burgh together contain nearly as many as that total. There was a time, however, when the second city of the Empire supported an enormous number of illegitimate pawnbrokers. Thus in 1840 there were known to be some 700 ” leaving shops,” advancing money chiefly upon objects of exceedingly small value, and charging, as usual with such contraband places â€” which are still numerous in great towns, and especially in the poor dis- tricts of London â€” interest at the rate of 400 or 500 per cent, per annum. In Ireland the rates for loans are practically identical with those charged in England, but a penny instead of a halfpenny is paid for the ticket.

Articles pledged for less than Â£1 must be re- deemed within six months, but nine months are allowed when the amount is between 30s. and Â£2. Eor sums over Â£2 the period is a year, as in England. In Ireland, too, a fraction of a month is calculated as a full month for purposes of interest, whereas in England, after the first month, fortnights are recognized. In 1838 there was an endeavour to establish Monts de Piete in Ireland, but the mistake was made of opening establishments in small towns and ignoring large ones, and the scheme was so unsuccessful that in 1841 the eight charitable pawnshops that had been opened had a total adverse balance of Â£5340. By 1847 only three were left, and eventually they collapsed likewise.

The pawnbroker in the United States is, generally speaking, controlled very stringently. There are no federal laws on the subject, each state having its own regulations, but those of New York and states. Massachusetts may be taken as fairly represen- tative. ” Brokers of pawn ” are usually licensed by the mayors, or by the mayors and aldermen, but in Boston the police commissioners are the licensing authority. In the state of New York permits are renewable annually on payment of $500, and the pawnbroker must file a bond with the mayor, executed by himself and two re- sponsible sureties, in the sum of $10,000. The business is conducted on much the same lines as in England, and the rate of interest is 3 per cent, per month for the first six months, and 2 per cent, monthly afterwards. Where, however, the loan exceeds 100 dollars, the rates are 2 and 1 per cent, respectively. To exact higher rates is a misdemeanour. Unredeemed pledges may be sold at the end of a year. Pawnbrokers are not allowed to engage in any kind of second-hand business. New York contains one pawnshop to every 12,000 inhabitants, and most of the pawnbrokers are Jews. In the state of Massachusetts unredeemed pledges may be sold four months after the date of deposit. The licensing authority may fix the rate of interest, which may vary for different amounts, and in Boston every pawnbroker is bound to furnish to the police daily a list of the pledges taken in during the preceding twenty-four hours, specifying the hour of each transaction and the amount lent.

The fact that on the continent of Europe Monts de Piete are almost invariably either a State or a municipal mono- poly necessarily places them upon an entirely different footing from the British pawnshop, ^““leipai which, as we have seen, any respectable person is ^^”” at liberty to open. It has often been argued that the foreign, system might be introduced into England with advantage. Indeed, unsuccessful attempts have been made to introduce it; but, compared with the English system, it is very elaborate and rather cumbersome. Moreover, in addition to being slow in its pperation, it is, generally

speaking, based upon the supposition that the borrower carries in his pocket ” papers ” testifying to his identity. On the other hand, it is argued that the English borrower of more than Â£2 is at the mercy of the pawnbroker in the matter of interest, that sum being the highest for which a legal limit of interest is fixed. The rate of interest upon a ” special contract ” may be, and often is, high. For the matter of that, indeed, this system of obtaining loans is always expensive, either in actual interest or in collateral disadvantages, whether the lender be a pawnbroker intent upon profit, or the official of a Mont de Piet^. In Paris the rate charged is 7 per cent., and even then the business is conducted at a loss except in regard to long and valuable pledges, Some of the French provincial rates are as high as 12 per cent., but in almost every case they are less than they were prior to the legislation of 1861 and 1852. The French estab- lishments can only be created by decree of the President of the Republic, with the consent of the local Conseil Communal. In Paris the prefect of the Seine presides over the business ; in the provinces the mayor is the president. The administrative council is drawn one-third each from the Conseil Communal, the governors of chari- table societies, and the townspeople. A large proportion of the capital required for conducting the institutions has to be raised by loan, while some part of the property they possess is the product of gifts and legacies. The profits of the Paris Mont de Piet^ are paid over to the ” Assistance Publique,” the comprehensive term used

by France to indicate the body of charitable foundations. Originally this was the rule throughout France, but now many of them are entirely independent of the charitable institutions. Counting the head office, the branches, and the auxiliary shops, the Paris establishment has its doors open in some fifty or sixty districts ; but the volume of its annua] business is infinitely smaller than that trans- acted by the London pawnbrokers. This may be the result of the system, or it may be explained by the thrif- tier character of the French people â€" while something must of course be allowed for smaller population. The amount to be advanced by a municipal pawnshop is fixed by an oflB.cial called the commissaire-priseur, who is com- pelled to load the scales against the borrower, since, should the pledge remain unredeemed, and be sold for less than was lent upon it, he has to make good the dif- ference. This oflB-cial is paid at the rate of Ƒ per cent, upon loans and renewals, and 3 per cent, on the amount obtained by the sales of forfeited pledges. This is ob- viously the weakest part of the French system. The Paris Mont de Piete undertakes to lend four-fifths of the intrinsic value of articles made from the precious metals, and two-thirds of that of other articles. The maximum and minimum that may be advanced are also fixed. The latter varies in different parts of the country from one to three francs, and the former from a very small sum to the 10,000 francs which is the rule in Paris. Loans are granted for twelve months with right of renewal, and unredeemed pledges may then be sold by auction, but the proceeds may be claimed by the borrower at any time within three years. Pledges may be redeemed by instalments.

Somewhere between forty and fifty French towns possess muni- cipal pawnshops, a few of which, like those of Grenoble and Mont- pellier, having been endowed, charge no interest. Elsewhere the rate varies from nil in some towns, for very small pledges, to 10 per cent. The constant tendency throughout France has been to reduce the rate. The great establishment in Paris obtains part of its working capital â€" reserves and surplus forming the balanceâ€" by borrowing money at a rate varying from 2 to 3 per cent, according to the length of time for which the loan is made. Under a law passed in 1891 the Paris Mont de

Fi6t6 makes advances upon securities at 6 per cent., plus a duty of 5 centimes upon every

hundred francs. The maximum that can be lent in this way is Â£20. Up to 80 per cent, is lent on the face valug of Government stock and on its own bonds, and 75 per cent, upon other securities ; but 60 per cent, only may be advanced on railway shares. These advances are made for six months. Persons wishing to borrow a larger sum than sixteen francs from the Paris Mont de Â¥1616 have to produce their papers of identity. In every case a numbered metal check is given to the customer, and a duplicate is attached to the article itself. The appraising clerks decide upon the sum that can be len^, and the amount is called out with the number. If the borrower is dissatisfied he can take away his property, but if he accepts the offer he has to give full particulars of his name, address, and occupation. The experts calculate that every transaction in- volving less than twenty-two francs results in a loss to the Paris Mont de Pi^t^,, while it is only those exceeding eighty-five francs which can be counted upon to be invariably profitable. The average loan is under thirty francs.

The borrowing of money on the security of goods deposited has been the subject of minute regulations in the Low Countries from an early date. So far back as the year 1600 the " Archdukes " Albert "j/"" and Isabella, Governors of the Spanish Nether- Belgium. lands under Philip III., reduced the lawful rate of interest from 32^ to 21|- per cent. ; but since extortion continued, they introduced the Mont de Pidtd in 1618, and, as we have already seen, in the course of a dozen years the institution was established in all the populous Belgian towns, with one or two exceptions. The interest chargeable to borrowers was fixed originally at 15 per cent., but was shortly afterwards reduced, to be again increased to nearly the old level. The early history of these ofiices was chequered ; the interest on the stock which had been created to provide working capital could not always be paid, and many changes in management were necessary before a stable equilibrium could be established. Meanwhile various towns possessed chari- table funds for gratuitous loans, apart from the official institutions. Shortly after the Mont de Pi^te was intro- duced in the Spanish provinces, the prince-

bishop of Liege (Ferdinand of Bavaria) followed the example set by the archdukes. He ordained that the net profits were to ac- cumulate, and the interest upon the fund to be used in reduction of the charges. The original rate was 15 per cent., when the Lombard money-lenders had been charg- ing 43 ; but the prince-bishop's Monts de Piete were so successful that for many years their rate of interest did not exceed 6 per cent. â€" it was, indeed, not until 1788 that it was increased by one-half. These flourishing institutions, along with those in Belgium proper, were ruined by the French Revolution. They were, however, re-established under French dominion, and for many years the laws governing them were constantly altered by the French, Dutch, and Belgian Governments in turn. The whole subject is now regulated by a law of 1848, supplemented by a new constitution for the Brussels Mont de Piete dating from 1891.

The working capital of these official pawnshops is furnished by charitable institutions or the municipalities, but the Brussels one possesses a certain capital of its own in addition. The rate of interest charged in various parts of the country varies from 4 to 16 per cent., but in/Brussels it is usually less than half the maxi- mum. The management is very similar to that of the French Monts de Pi^t^, but the arrangements are much more favourable to the borrower. The ordinary limit of loans is Â£120. In Antwerp there is an " anonymous " pawnshop, where the customer need not give his name or any other particulars. In Holland private pawn- brokers flourish side by side with the municipal "Banken van Leening," nor are there any limitations upon the interest that may be charged. The rules of the official institutions are very similar to those of the Monts de Pi^t^ in the Latin countries, and unre- deemed pledges are sold publicly fifteen months after being pawned. A large proportion of the advances are made upon gold and dia- monds ; workmen's tools are not taken in pledge, and the amount lent varies from 8d. upwards. On condition of finding such sum of money as may be required for working capital over and above loans from public institutions, and the " caution money " deposited by the city officials, the municipality receives the profits.

PAWNBROKING

Pawnbroking in Germany is conducted at once by the State, by the municipalities, and by private enterprise; but of all these institutions the State loan office Germaay j^ Berlin is the most interesting. It dates from Austria. 1834, and the working capital was found, and still continues to be in part provided, by the Prussian State Bank. The profits are invested, and the interest devoted to charitable purposes. The maximum and minimum rates of interest are fixed, but the rate varies, and often stands at about 12 per cent. Two-thirds of the estimated value is the usual extent of a loan ; four-fifths is advanced on silver, and five-sixths on fine gold. State and municipal bonds may be pledged up to a maximum of Â£150, the advance being 80 per cent, of the value, and a fixed interest of 6 per cent, is charged upon these securities. The values are fixed by profes- sional valuers, who are liable to make good any loss that may result from over-estimation. The bulk of the loans are under Â£5, and the State ofBce is used less by the poor than by the middle classes. Loans run for six months, but a further six months' grace is allowed for redemption before the article pledged can be sold by auction. The net annual profit usually amounts to little more than 1 per cent, upon the capital employed. The pawnbroking laws of Austria-Hungary are very similar to those which prevail in England. Pree trade exists, and the private trader, who does most of the business, has to obtain a Government concession, and deposit caution-money varying in amount from Â£80 to Â£800, according to the size of the town. He has, however, to compete with the Monts de Piete or Versatzaemter, which are sometimes municipal and sometimes State institutions. The chief of these is the imperial pawn office of Vienna, which was founded with charitable objects by the Emperor Joseph I. in 1707, and one-half of the annual surplus has still to be paid over to the Vienna poor fund. Here, as in Berlin, the profits are relatively small. Interest is charged at the uniform rate of 10 per cent., which is calculated in fortnightly periods, however speedily redemption may follow upon pawning. Por small loans varying from two to three kronen, 5 per cent, only is charged. Many of the poorest clients of the " Lombard merchants " resort to the private pawnbroker, partly because of the high rates of the State office, arid partly because it is open only

from eight in the morning until two in the afternoon. There is the usual Mont de Piete arrangement of official values. The Hungarian State and municipal institutions appear, on the whole, to compete somewhat more successfully with the private firms than is the case in Vienna.

In Italy, the ” country of origin ” of the Mont de Piete, the institution still flourishes. It is, as a rule, managed by a committee or commission, and the regula- tions follow pretty closely the lines of the one in Pome, which never lends less than lOd. or more than Â£40. Pour-fifths of the value is lent upon gold, silver, and jewels, and two-thirds upon other articles. The interest, which is reckoned monthly, varies with the amount of the loan from 5 to 7 per cent., but no interest is chargeable upon loans up to 6 lire. A loan runs for six months, and may be renewed for similar periods up to a maxi- mum of five years. If the renewal does not take place within a fortnight of the expiration of the ticket, the pledge is sold, any surplus there may be being paid to the pawner. When more than 10 lire is lent there is a charge of 1 per cent, for the ticket. Agencies of the Mont de Piete are scattered about Pome, and carry on their busi- ness under the same rules as the central office, with the disadvantage to the borrower that he has to pay an “agent’s fee” of 2 per cent., which is deducted from the loan. Private pawnshops also exist in Italy, under police

Italy.

authority ; but they charge very high interest â€” sometimes as much as 60 per cent. â€” and those who conduct them, by buying pawn-tickets, speculate upon the proceeds of the sale of the pledges.

The Monts de Piete in Spain have for a generation past been inseparably connected with the savings banks: We have already seen that the institution owes its origin in that country to the charitable exer- ^^” ^” tions of a priest who charged no interest, and the system grew until in 1840, a century after his death, the Mout de Piete began to receive the sums deposited in the savings bank, which had just been established, for which it paid 6 per cent, interest. In 1869 the two insti- tutions were united. This official pawnshop charges 6 per cent, upon advances which run for periods varying from four to twelve months,

according to the nature of the article pledged, and a further month's grace is allowed before the pledges are sold by auction. The system has been very successful, and the Mont de Piete has increased its capital without any assistance from public authorities, while enabling the poor to borrow at a reasonable rate. Private pawnbrokers are also very numerous, epecially in Madrid ; but their usual charges amount to about 60 per cent, per annum. They appear, however, to derive ad- vantage from making larger advances than their official rivals, and from doing business during more convenient hours. In Portugal the Monte Pio is an amalgamation of bank, benefit society, and pawnshop. Its business con- sists chiefly in lending money upon marketable securities, but it also makes advances upon plate, jewellery, and precious stones, and it employs officially-licensed valuers. The rate of interest varies with the bank rate, which it slightly exceeds, and the amount advanced upon each article is about three-fourths of its certified value. There is in Portugal a second class of loan establishment answering exactly to the English pawnshop. The pawn- broker is licensed and strictly controlled, but this class of business is practically limited to the larger towns. When he starts in business he is compelled to deposit a sum, in acceptable securities, equal to the capital he pro- poses to embark, and the register of his transactions must be submitted quarterly to the chief of the police for examination. As regards small transactions, there ap- pears to be no legal limit to the rate of interest. The sale of unredeemed pledges is governed by the law affect- ing the "Monte Pio Geral."

In Russia the State maintains two pawnbroking estab- lishments, one at St Petersburg and the other at Moscow, but only articles of gold and silver, precious stones, and ingots of the precious metals are '^"s' accepted by them. Advances are made upon such securi- ties at 6 per cent, per annum, and the amounts of the loans are officially limited. Loans run for twelve months, with a month's grace before unredeemed pledges are put up to auction. The bulk of this class of business in Russia is, however, conducted by private companies, which ad- vance money upon all descriptions of movable property except stocks and shares. The interest charged is not allowed to exceed 1 per cent, per month, but there is an ad- ditional charge of \ per cent, per month for "

insurance and safe keeping.” The loan runs for a year, with two months’ grace for redemption before sale. There are also a certain number of pawnshops conducted by individuals, who find it very difficult to compete with the companies. These shops can only be opened by a police permit, which runs for five years, and security, varying from Â£100 to Â£700, has to be deposited. Two per cent, per month is the limit of interest fixed, and two months’ grace is allowed for re- demption after the period for which an article is pledged.

Pawnbroking in Denmark dates from 1763, when the Pvoyal Naval Hospital was granted the monopoly of

advancing money on pledges and of charging higher interest than the law permitted. The duration of a loan is three months, renewals being allowed. The a^d’”-” ^^^ ^^^ “^^^ extended in 1867, and now all Norway. pawnbrokers have to be licensed by the munici- palities and to pay a small annual licence fee. The rate of interest varies from 6 to 12 per cent., according to the amount of the loan, which must not be less than 7d., and unredeemed pledges must be sold by auction. In Sweden there are no special statutes affect- ing pawnbroking, with the exception of a proclamation by the governor of Stockholm prohibiting the lending of money upon articles which may be suspected of having been stolen. Individuals still carry on the business on a small scale, but the bulk of it is now conducted by companies, which give general satisfaction. The change from private pawnbrokers to the companies was caused by the extortionate interest formerly charged, which often amounted to 60 per cent, per annum. Eor many years there was in Stockholm a municipal establishment charging 10 per cent, for loans paid out of the city funds. The Cost of administration was, however, so great that there was an annual loss upon its working, and the opportunity was taken to abolish it when, in 1880, a private com- pany was formed called the ” Pant Aktie Bank,” to lend money on furniture and wearing apparel at the rate of 3 ore per krona a month, and 2 ore per krona a month on gold, silver, and other valuables : a krona, which

equals Is. l^d., contains 100 ore. Some years later an opposition was started which charged only half these rates, with the result that the original enterprise reduced its interest to the same level, charging, however, 2 ore per krona per mensem for bulky articlesâ€” ^a figure which is now usual for pledges of that description. The money is lent for three months, and at the end of five months the pledge, if unredeemed, is sold by auction under very carefully prescribed conditions. In Norway a police licence is required for lending money on pawn where the amount advanced does not exceed Â£4, 10s. Beyond that sum no licence is necessary, but the in- terest charged must not exceed such a rate as the king may decide.

The fate of pawnbroking in Switzerland appears to be not very dissimilar from that of the Jew who is fabled to have once started in business at Aberdeen. IrJd”’^ Nevertheless the cantons of Bern and Zurich have elaborate laws for the regulation of the business. In Zurich the broker must be licensed by the cantonal government, and the permit can be refused only when the applicant is ” known to be a person undeserving of confidence.” Regular books have to be kept, which must be at all times open to the inspection of the police, and not more than 1 per cent, interest per month must be charged. A loan runs for six months, and unredeemed pledges may be sold by auction a month after the expira- tion of the fixed period, and then the sale must take place in the parish in which the article was pledged. No more than two persons at a time have ever been licensed under this law, the business being unprofitable owing to the low rate of interest. In the canton of Bern there were once two pawnbrokers. One died and the other put up his shutters. The Zurich cantonal bank, however, conducts a pawnbroking department, which lends nothing under 4s. or over Â£40 without the special sanction of the bank com- mission. Loans must not exceed two-thirds of the trade value of the pledge, but 80 per cent, may be lent upon the intrinsic value of gold and silver articles. The establish- ment makes practically no profit. The Swiss disinclination to go to the pawnshop is, perhaps, accounted for in some measure by the growing number of dealers in second-hand articles, to whom persons in want of ready money sell out-

right such things as are usually pledged, in the hope of subsequently buying them back. Since, however, the dealer is at liberty to ask his own price for re-purchase, the expectation is often illusory, and can usually be fulfilled only upon ruinous terms. (j. g. j. p.-b.)

Pawtucket, a city of Providence county, Rhode Island, U.S.A., on the Pawtucket river, four miles north of Providence, and on the New York, New Haven, and Hartford railroad, in the north-eastern part of the state, at an altitude of 76 feet. The plan of the city is ir- regular, it is divided into five wards, has a water-supply from works owned by the city, and good sewerage. It has fine water-power in the river, which has been utilized in extensive manufactures, mainly cotton goods, in which industry this city was the pioneer in America. In 1900 ‘ the total number of manufacturing establishments was 534, with a total capital of 122,399,187. They em- ployed 12,776 hands, and the product was valued at 124,080,328. Of this, $4,935,309 consisted of cotton goods, while fl,600,916 was the value of dyed and finished textiles. Worsted goods were manufactured to the value of $3,733,219. The product of foundries and machine shops was valued at f 1,833,379. The assessed valuation of real and personal property was, in 1900, 133,670,000, the net debt $4,251,106, and the rate of taxation f 16.50 per $1000. Population (1890), 27,633; (1900), 39,231, of whom 13,087 were foreign-born and 173 negroes.

Payn, James (1830-1898), English novelist, was born at Cheltenham, 28th February 1830, his father being clerk to the Thames Commissioners and treasurer to the county of Berks. He was educated at Eton, and after- wards entered the Military Academy at Woolwich ; but his health was not equal to the demands o^a military career, and he proceeded to Trinity College, Cambridge. He was not an assiduous ” reading man,” but was among the most popular men of his time, and served as president of the Union. Before going to Cambridge he had published some verses in Leigh Hunt’s Journal, and while still an undergraduate put forth a volume of Stories from, Boccaccio in 1851, and another collection of Poems in 1863. In the same year he left Cambridge, and shortly afterwards married Miss Louisa Adelaide Edlin, sister of Sir Peter Edlin. He then settled down to a literary

career, con- tributed to Household Words and Chambers's Journal, and was in 1858 appointed editor of the latter periodical, conducting it with much success for sixteen years. In its pages he published in 1864 his most popular story, Lost Sir Massingherd, a serial which attracted so much attention that its appearance in Chambers's is said to have increased the circulation by 20,000 copies. Prom this time he was always engaged in novel-writing, among the most popular of his productions being Married Beneath Him (1866), Carlyon's Tear (1868), By Proxy (1878), and The Talk of the Toivn (1886). In 1882 he succeeded Mr Leslie Stephen as editor of the Cornhill Magazine, and continued in the post until the breakdown of his health in 1896. He was also literary adviser to Messrs Smith, Elder and Company, and may be described as one of the last of the old-fashioned school of "readers"â€" a school which did much to foster literary talent, and to surround the in- dividual firm with a loyal and competent body of men of letters. Payn was the means of introducing many promis- ing writers to the public, and his advice and tact were in harmony with the highest traditions of the literary pro- fession. As a novelist he was entertaining rather than profound. He told a good story easily and naturally ; he possessed some dramatic force, and was skilful in the arrangement of incidents. He was not without a Dickens- ian sense of character, but his female figures are ingenuous

and simple rather than subtly interesting. In other departments of the literary life he was a prolific writer. He published a Handbook to the English Lakes (1859), and various volumes of occasional essays, such as Maxims by a Man of the World (1869), Some Private Views (1881), Literary Recollections (1884), and a posthumous work. The Backwater of Life, revealed much of his own personality in a mood of kindly, sensible re- flection upon familiar topics. For years he contributed a weekly column of literary and social gossip to the Illustrated London News. He died in London, 26th March 1898. (a. w.)

Paysandu, a city of Uruguay and capital of the department of the same name, situated on the Rio Uruguay, 131 miles above Montevideo. It is the third city of the republic in importance, with fine public build- ings, good streets, and tramways. In 1898 the imports were valued at $760,892, and the exports at $3,964,548. Ill other words, it has about 3 per cent, of the total import trade of the republic, and over 12 per cent, of the export trade. In 1900 the imports were valued at $626,214 (gold), and the exports at $2,720,870 (gold). In 1898 the entries were 787 steamers of 460,492 tons and 461 sailing ships of 23,177 tons. Population,

14,000.

Paz Soldan, Mariano Felipe (1821-1886), Peruvian historian and geographer, was born at Arequipa, 22nd August 1821. He studied law, and after holding some minor judicial offices, was minister to Colombia in 1853. After his return he occupied himself with plans for the establishment of a model penitentiary at Lima, which he was enabled to accomplish through, the support of General, Castilla, the most eminent of the rulers of Peru. In 1860 Castilla made him director of public works, in which capacity he superintended the erection of the Lima statue of Bolivar, the finest work of sculpture in South America. He was also concerned in the reform of the currency by the withdrawal of the debased Bolivian coins, which had long circulated at the same nominal value as the Peruvian. In 1861 he published his great atlas of the republic of Peru, and in 1868 the first volume of his history of Peru after the acquisition of her inde- pendence. A second volume followed, and a third, bringing the history down to 1839, was published after his death by his son. In 1870 he was minister of justice and worship under President Balta, but shortly afterwards retired from public life to devote himself to his great geographical dictionary of Peru, which was published in 1877. During the disastrous war with Chile he sought refuge at Buenos Aires, where he was received with distinguished hospitality and made professor in the National College, and where he wrote and published the history of his country's misfortunes. He died on 31st December 1886.

Peabody, a town of Essex county, Massachusetts, U.S.A., containing an area of 17 square miles of level country, dotted over with glacial hills, situated in the north-eastern part of the state, adjoining Salem on the west. The principal village bears the same name as the town, is laid out very irregularly, and is on a line of the Boston and Maine railroad. Its chief industry is the manufacture of leather, for which there are several estab- lishments. Population (1890), 10,158; (1900), 11,623 of whom 2870 were foreign-born.

Peace Conference, the official name of the International Conference, held at the instance of the emperor of Eussia in 1899, at The Hague, " with the object of seeking the most eflScacious means of assuring to all

peoples the blessings of real and lasting peace, and, above all, in order to put a stop to the progressive development of the present armaments." The subject matter proposed for discussion embraced the following elements : â€"

1. An understanding not to increase for a fixed period the present effective of the armed military and naval forces, and at the same time not to increase the budgets pertaining thereto ; and a preliminary examina- tion of the means by which a reduction might even be effected in future.

2. To prohibit the use in the armies and fleets of any new kinds of firearms whatever, and of new explosives or any powder more powerful than those now in use either for rifles or cannon.

3. To restrict the use in military warfare of the formid- able explosives already existing, and to prohibit the throw- ing of projectiles or explosives of any kind from balloons or by any similar means.

4. To prohibit the use in naval warfare of submarine torpedo-boats or plungers, or other similar engines of destruction ; to give an undertaking not to construct ves- sels with raims in future.

5. To apply to naval warfare the stipulations of the Geneva Convention of 1864 on the basis of the Additional Articles of 1868.

6. To neutralize ships and boats employed in saving those overboard during or after an engagement.

7. To revise the Declaration concerning the laws and customs of war, elaborated in 1874, by the Conference of Brussels, which remained unratified.

8. To accept in principle the employment of good offices of mediation and facultative arbitration in cases lending themselves thereto, with the object of preventing armed conflicts between nations ; to come to an understanding with respect to the mode of applying these good offices, and to establish a uniform practice in using them.

In accepting the invitation to attend the Conference, Lord Salisbury, referring to the 8th point, specially men- tioned Great Britain's " earnest desire to promote by all possible means the principle of recourse to mediation and arbitration for the prevention of war."

The delegates appointed by the respective governments met at The Hague on 20th May 1899. The work, set out as above in the Russian scheme, was divided up among three committees, appointed : the first, to deal with points 1, 2, 3, and 4 ; the second with points 6, 6, and 7 ; and the third with point 8. The work of the third committee, which resulted in an " International Convention for the Pacific Settlement of International Disputes," has already been summarized in the article on Arbitration (In- ternational).^ The work of the second committee was embodied in declarations to which Great Britain was not a party, and that of the third in two International Con- ventionsâ€" the one completing and adopting the work prepared by the Brussels Conference in 1874 on "the laws and customs of war by land," and the other " adapt- ing to maritime warfare the principles of the Geneva Convention of 22nd August 1864." These two Conventions will be dealt with in the article on War. The question of restriction of armaments, which was placed at the head of the Russian proposal and referred to the first com- mittee, was abandoned as impracticable. All three Con- ventions are dated 29th July 1899. (t. ba.)

1 The United States representatives signed it subject to the recording alongside olit of the following declaration:â€”

” Nothing contained in this Convention is to be interpreted as obliging the United States of America to depart from their traditional policy, in accordance with which they abstain from intervening, meddling, or mixing in the political questions, policy, or internal administration of a foreign State. It is also understood that nothing in the Convention is to be construed as implying that the United States of America abandon their traditional attitude with respect to purely American questions.”

Peace River. See Mackenzie.

Peacock, Sir Barnes ‘(1810-1890), English judge, was born in 1810, and was the son of Lewis Peacock, a solicitor. After practising as a special pleader, he was called to the bar in 1836, and in 1844 obtained great reputation by pointing out the flaw which invalidated the conviction of Daniel O’Connell and his fellow- defendants. In 1852 he went to India as legal member of the G-overnor-General’s Council. He here displayed great activity as a law reformer, but sometimes, in his laudable anxiety to extirpate abuses, manifested too little consideration for native susceptibilities, and too im- perfect a recognition of the limited extent of his own acquaintance with the country. The Legislative Council was established soon after his arrival, and although no orator, he was so frequent a speaker that legislation en- joining councillors to deliver their speeches sitting was said to have been devised with the sole object of restrain- ing him. As a member of Lord Dalhousie’s council he supported the annexation of Oudh, and he stood by Lord Canning all through the Mutiny. In 1859 he became chief justice of the Supreme Court, and presided over it with great industry and efficiency, although upon one important occasion, a case involving the rights of land- holders, he found himself in a minority of one. He returned to England in 1870, and in 1872 was placed upon the judicial committee of the Privy Council, where his Indian experience rendered him invaluable.

He laboured there for the rest of his life with unremitting energy, having sat only three days before nis decease on 3rd December 1890.

Pearsall, Robert Lucas de (1795-1856),English composer, was born, 14th March 1795, at Cliiton, edu- cated for the bar, and practised till 1825, when he left England for Germany. He studied composition under Panny of Mainz ; and with the exception of three com- paratively short visits to England, during one of which he made the acquaintance of the English school of madri- gals, he lived abroad for the remainder of his life, selling his family property of Willsbridge and settling in the castle of Wartensee, on the Lake of Constance, where he emulated the style of the grandees of the Middle Ages, and devoted himself to the arts, with special preference for music. Notwithstanding the diffusion of his gifts and the circumstances of his career, he produced many works of lasting beauty, nearly all of them for voices in com- bination : from his part songs, such as ” Oh, who will o'er the downs," to his elaborate and scholarly madrigals, such as the admirable eight-part compositions, ” Great God of Love ” and ” Lay a Garland," or the beautiful ” Light of my Soul," his genius ranged over a wide field. He combined great technical knowledge of the various styles he employed with a spontaneity of invention that gives his works a peculiar beauty. His reception into the Roman Church in his later years may have suggested the composition of some beautiful sacred music, among other things a ” Salve Eegina ” that will not soon be for- gotten. He wrote many valuable treatises on music, and edited a Catholic hymn-book of considerable merit. He died 5th August 1866.

Pearson, Charles Henry (1830-1894), British historian and colonial statesman, was born in London on 7th September 1830. After receiving his early education at Rugby and King's College, London, he went up to Oxford, where he was generally regarded as the most brilliant of an exceptionally able set, and in 1854 ob- tained a fellowship at Oriel College. His constitutional weakness and bad eyesight forced him to abandon his chosen profession of medicine, and in 1855 he returned

to King's College as lecturer in English language and literature, a post which he almost immediately quitted for the professorship of modern

history. Erom his undergraduate days he had been a keen student of foreign countries and literatures. Of his numerous journeys abroad the most important were his visit to Russia in 1868, his account of which was published anonymously in 1869 under the title of Russia, by a Recent Traveller ; an adventurous journey through Poland during the in- surrection of 1863, of which he gave a sympathetic and much-praised account in the Spectator; and a visit to the United States in 1868, where he gathered materials for his subsequent discussion of the negro problem in his National Life and Character. In the meantime, be-sides contributing regularly, first to the Saturday Review and then to the Spectator, and editing the National Re- view, he wrote the first volume of Tlie Early and Middle Ages of England (1861). The work was bitterly attacked by Freeman, whose ” extravagant Saxonism ” Pearson had been unable to adopt. It appeared in 1868 in a revised form with the title of History of England during the Early and Middle Ages, accompanied by a second volume which met with general recognition. Still better was the reception of his admirable Maps of England in the First Thirteen Centuries (1870). But as the result of these labours he was threatened with total blindness ; and, disappointed of receiving a professorship at Oxford, the goal of his ambition, he threw up the lectureship of modern history at Trinity College, Cambridge, which he had held for a short time, and in 1871 emigrated to Australia, which he had already visited on a voyage undertaken for his health's sake. Here he married and settled down to the life of a sheep-farmer ; but finding his health and eyesight greatly improved, he came to Melbourne as lecturer on history at the University. Soon afterwards he became headmaster of the Presby-terian Ladies' College, and in this position practically organized the whole system of higher education for women in Victoria. In 1877 he was appointed by the Liberal Government to inquire into the state of educa- tion in the colony. His report, issued in the following year, was recognized as a classic, and many of its suggestions were adopted both in Europe and in the other Australian colonies. He had for some time been an influential contributor to the great Liberal organ, T/ie Age, and on his election in 1878 to the Legislative Assembly definitely adopted politics as his career. His views on the land question and secular education aroused the bitter hostility of the rich squatters and

the clergy ; but his singular nobility of character, no less than his powers of mind, at once made him one of the most influential men in the Assembly. He was minister without portfolio in the Berry cabinet (1880- 81), and when the ministry was on the eve of quitting office, was offered the post of Agent-General, but felt that in the circumstances he could not honourably accept it. As minister of education in the coalition government of 1886 to 1890, he was able to pass into law many of the recommendations of his report. His reforms, which entirely remodelled state education in Victoria, included the establishment of a system of state scholarships, the reorganization of industrial schools and of the teaching of art, and the improvement of the position of teachers. He obtained the appointment of a commission on technical education, as chairman of which he drew up a valuable report. During the intervals of his public work he pre- pared an edition of Juvenal in collaboration with Professor Strong (1887). In 1892 a fresh attack of illness decided him to return to England. Here he published in 1893 the one of his works which attracted most general notice. National Life and Character. It is an attempt to

show that the white man can flourish only in the temperate zones, that the yellow and black races must increase out of all proportion to the white, and must in time by their industrial competition crush out his civilization, both material and intellectual. He died in London on 29th May 1894. A volume of his Reviews and Critical Essays was published in 1896, and was followed in 1900 by his autobiography, completed by his friends, a work of great interest. (h. sy.)

Pearson, John Loughborough (1817-1897), English architect, son of William Pearson, etcher, of Durham, was born in Brussels on 5th July 1817. He was articled at the age of fourteen to Ignatius Bonomi, architect, of Durham, but soon removed to London, and worked under the elder Hardwicke. Durham Cathedral and the churches and abbeys

of Yorkshire seem to have influenced his studies. He revived and practised largely the art of vaulting, and acquired in it a proficiency un- rivalled in his generation. He was, however, by no means a Gothic puiist, and was also fond of Renascence and thoroughly grounded in classical architecture. Prom the erection of his first church of Ellerker, in Yorkshire, in 1843, to that of St Peter's, Vauxhall, in 1864, his buildings are Geometrical in manner and exhibit a close adherence to precedent, but elegance of proportion and refinement of detail lift them out of the commonplace of mere imitation. Holy Trinity, Westminster (1848), and St Mary's, Dalton Holme (1868), are notable examples of this phase. St Peter's, Vauxhall (1864), his first groined church, was also the first of a series of buildings which brought Pearson to the forefront among his contemporaries. In these he applied the Early English style to modern needs and modern economy with unrivalled success. St Augustine's, Kilburn (1871), St John's, Eed Lion Square, London (1874), St Alban's, Birmingham (1880), St Michael's, Croydon (1880), St John's, Norwood (1881), St Stephen's, Bournemouth (1889), and All Saints', Hove (1889), are characteristic examples of his matured work. He is best known by Truro Cathedral (1880), which has a special interest in its apt incorporation of the south aisle of the ancient church. Pearson's conservative spirit fitted him for the reparation of ancient edifices, and among cathedrals and other historical buildings placed under his care were Lincoln, Chichester, Peterboroiigh, Bristol, and Exeter Cathedrals, St George's Chapel, Windsor, West- minster Hall, and Westminster Abbey, in the surveyorship of which last he succeeded Sir G. G. Scott. Except as to the porches, the work of Scott, he re-faced the north transept of Westminster Abbey, and also designed the vigorous organ cases. In his handling of ancient build- ings he was repeatedly opposed by the ultra anti-restorers (as in the case of the west front of Peterborough Cathe- dral in 1896), but he generally proved the soundness of his judgment by his executed work. Pearson's practice was not confined to church building. Treber- fydd House (1850), Quar Wood (1858), Lechlade Manor, an Elizabethan house (1873), Westwood House, Syden- ham, in the Erench Eenaissance style (1880), the Astor estate offices (1892) upon the Victoria Embankment, Lon- don, the remodelling of the interiors of Clieveden House (1893) and No. 18 Carlton House Terrace

(1894), with many parsonages, show his aptitude for domestic architecture. Pearson's church plans possess great variety and interest. The management of choir and sanctuary evidences much individuality, and the side chapel is frequently treated so as to give additional scale to the rest of the building. In general design he first aimed at form, embracing both proportion and contour ; and his Avork may be recognized by accurate scholarship coupled with harmonious detail. Its keynotes are cautiousness and

refinement rather than boldness. After a continuous progress up to the last days of his long career, he died on the 11th of December 1897, and was buried in the nave of Westminster Abbey, where his grave is marked by the appropriate motto Sustinuit et abstinuit. He was elected A.R.A. in 1874, K.A. in 1880, was a fel- low of the Society of Antiquaries, and a fellow and member of the Council of the Eoyal Institute of British Architects.

The following are some of Pearson's more important works, not already named :â€" Ferriby Church, 1846 ; Stow, Lincolnshire (restorar- tion), 18-50 ; Weybridge, St James's, 1863 ; Freeland Church, Parsonage, and Schools, 1866 ; Kilburn, St Peter's Home, 1868 ; Wentworth Church, 1872 ; Horsforth Church, 1874 ; Cullercoats, St George's, 1882; Chiswick, St Michael's (restoration), 1882; Great Yarmouth Church (restoration), 188.3 ; Liverpool, St Agnes',

1883 ; Woking Convalescent Home, 1884 ; Headingley Church,

1884 ; Torquay, All Saints', 1884 ; Maidstone, All Saints' (restora- tion), 188.5; Shrewsbury Abbey, 1886; Ayr, Holy Trinity, 1886; Hythe Church (restoration), 1887 ; Oxford, New College, Reredos (completion), 1889; Cambridge University Library (additions), 1889 ; Priern Barnet, St John's, 1890 ; Cambridge, Sidney Sussex College (additions), 1890 ; Middlesex Hospital Chapel, 1890 ; Bishopsgate, St Helen's (restoration), 1891 ; Maida Hill (Irvingite) Church, 1891; Barking, All Hallows' (restoration), 1893; Cam- bridge, Emmanuel College (additions), 1893 ; Ledbury, St Michael's (restoration), 1894; Malta, Memorial Church, 1894; Port Talbot Church, 1895. (w. D. C.)

Pecs (German, Fi'mfkircJien), a municipal town, cap- ital of the province of Baranya, Hungary. It has an upper reaZ-school, a commercial academy, an orphanage, and a foundling hospital. In the 14th century it pos- sessed also a university, which existed until the disaster of Mohacs. Its industry and commerce are thriving. It is famous for its porcelain, organs, and sparkling wine. There are in the vicinity extensive coal-mines, which pro- duce yearly five million tons of good coal. Population

(1890), 34,100 ; (1900), 43,982.

Ped ro 1 1 . (1825-1891), Empeeoe of Brazil, came to the throne in childhood, having been born on 2nd December 1825, and proclaimed emperor in April 1831, upon the abdication of his father. He was declared of full age in 1840, and, after some troubles had been overcome, found himself reigning peacefully over a united people. For a long period few thrones appeared more secure, and his prosperous and beneficent rule might have endured throughout his life, but for his want of energy and inatten- tion to the signs of the times. The rising generation had become honeycombed with republicanism, the prospects of the imperial succession were justly regarded as unsatis- factory, the higher classes had been estranged by the eman- cipation of the slaves, and all these causes of discontent found expression in a military revolt, which in Xovember 1889 overthrew the seemingly solid edifice of the Brazilian empire in a few hours. Dom Pedro retired to Europe, and died in Paris on the 5th of December 1891. The chief events of his long reign had been the emancipation of the slaves already adverted to, and the sanguinary and costly, though ultimately successful, war with Paraguaj' in 1864- 1870. Dom Pedro was a model constitutional sovereign, and, like Prospero, carried study to such an extent as to undermine his authority by impairing his efficiency as a ruler. He was a munificent patron of science and letters, travelled in the United States (1876), and thrice visited Europe (1871-72, 187(i-77, 1886-89).

Peebles, a midland county of Scotland, bounded on the N. and N.E. by iMidlothian, on the E. and S.E. by Selkirk, on the S. by Dumfries, and

on the W. by Lanark.

Area aÂ»d Population. â€” In 1891 the boundaries between Peebles and Selkirk were rearranged, the parishes of Innerleithen and Peebles being placed wholly in Peeblesshire, and a detached portion

of the Peebles parish of Lyne and Megget transferred to the Selkirk parish of Yarrow ; the boundary was also rearranged between Peebles and Lanark shires in the parish of Coulter, which was placed wholly in the latter county, its Peebles portion being transferred to the Peebles parish of Broughton. The area of the county is 223,295 acres, or about 349 square miles. The population was, in 1881, 13,822 ; in 1891, 14,761 ; in 1891 on the above area 14,750 ; and in 1901, 15,066, of whom 7129 were males and 7937 females. On the old area, taking land only (226,899 acres, or 354‘5 square miles), the number of persons to the square mile in 1891 was 42, and the number of acres to the person 15-4. In the registration county the increase of population between 1881 and 1891 was 6-9. Between 1881 and 1891 the excess of births over deaths was 1902,, and the increase of the resident population 950. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 :â€”

Tear.

Deaths.

Marrifvges.

Births.

Percentage of Illegitimate.

1880 1890 1899

194 198 209

71 78 74

423 302 363

10-4 5-63 4-7

The following table gives the birth-rate, death-rate, and marriage- rate per thousand of the population for a series of years : â€”

18S0.

1881-90.

1890.

1891-93.

1S99.

Birth-rate . Death-rate . Marriage-rate

31-17

14-29

5-23

27-45

14-02

5-20

20-73

18-58

5-35

23-91

14-41

6-14

23-41 13-48

4-77

In 1891 there were 68 Gaelic-speaking persons in the county, and 15 foreigners. Valuation in 1889-90, Â£144,036 ; 1899-1900, Â£144,066.

Administration. â€” The county unites with Selkirkshire in sending a member to Parliament. Peebles (5266) is the only royal burgh, and its constituency is merged in that of the county. There are 14 civil parishes, of which four are not assessed for poor. Tlie num- ber of paupers and dependants in September 1899 was 214, and there Is a combination poorhouse at Peebles. Peebles forms a sheriffdom with the Lothians, and a sheriff-substitute sits in the county town.

Education. â€” Fourteen school boards manage 20 schools, with an average attendance of 1995 in 1898-99, and three other schools (one Episcopal) had an average attendance of 80 in the same year. Peebles has a high school, and another school in the county earned grants in 1898 for giving secondary education. Most of the ” residue ” grant is spent by the county council in subsidizing science and art, and technical classes and evening classes in Peebles, Innerleithen, and elsewhere.

Agriculture. â€” In 1898, 21-5 per cent, of the acreage was under cultivation. The following table gives the principal acreages for the years specified : â€”

Tear.

Area under Crops.

Corn Crops.

Green Crops.

Glover.

Perma- nent Pasture.

Fallow.

1880 1885 1890 1895 1899

42,010 42,514 42,731 46,814 48,607

10,382 9,600 8,988 8,782 8,648

6245 5441 5500 5237 5018

13,995 11,301 13,372 17,938 18,254

11,297 16,168 14,824 14,846 16,669

91 4

41 6 5

The following table gives particulars of the , live stock for the same years : â€”

Tear.

Total Horses.

Total Cattle.

Cows or

Heifers in

Milk or Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1899

1184 1164 1046 1176 1098

5934 6530 6843 6789 7498

1991 2128 1929 2112 2204

199,512 192,367 188,0.33 186,221 201,538

719 1043 876 707 618

In 1891, 1407 men and 108 women in the county were engaged in agriculture. There were 9490 acres under wood in 1895. Of the 300 holdings in the county in the same year, the average size was 156 acres ; 8 per cent, were under 5 acres, 27 per cent, between 5 and 50 acres, and 65 per cent, over 50. There were 29 farms between 50 and 100 acres, 1 15 between 100 and 300, 42 between 300 and 500, and 9 over 500. A normal farm is about 200 acres arable, with pasturage for 600 or 800 sheep.

Industry. â€” The minerals â€” coal, limestone, and iron oreâ€” scarcely repay working. Of 3686 persons registered in 1891 as being con- nected with industrial pursuits, 1008 men and 1082 women were empUq^ed about textiles.

Adthoeities.â€” CraWe to Peeblesshire. Peebles, 1881. â€” Robert Renwick. Historical Notes on Peeblesshire Localities. Peebles, 1897 ; Aisle and Monastery. Glasgow, 1897 ; Gleanings from Peebles Burgh Becords. Peebles, 1802.â€” Alexander Williamson. Glimpses of Peebles. Selkirk, 1895.â€” Dr C. B. Gcnn. Tlie lliree Tales of the Three Priests of Peebles. Selkirk, 1894 Innerleithen and Traqnair. Innerleithen, 1867. â€” Sir George Reid. The Biver Tweed from its Source to the Sea (text by Professor Veitch). Edinburgh, 1884.â€” Professor Veitch. Border Essays. Edinburgh, 1806 ; History and Poetry of the Scottish Border. Edinburgh, 1893.â€” William Chambers. History of Peeblesshire. Edin- burgh, 1864 ; Bemlniscences of Innerleithen. Innerleithen, 1898.

â€”James Gkosart. Chronicles of Peebles Briggate. Peebles, 1899. (w. WA.)

Peebles, a royal burgh and the ‘county town of Peeblesshire, at the junction of the Eddlestone water with the Tweed, 23 miles south of Edinburgh by road. The town grows in favour as a health resort. Tweed bridge has been widened, and an established church has been erected. Population (1881), 3495 ; (1901), 5266.

Peekskill, a village of Westchester county. New Yoi-k, U.S.A., on the east bank of the Hudson river and on the New York Central and Hudson River railroad, 43 miles above New York, in the south-eastern part of the state. Its site is hilly and its street plan irregular. It has a good water-supply and sewerage system, and con- tains a number of private schools for boys and girls. Its manufactures are varied, and include iron-works, flour- miUs, and cigar factories. It is the site of the annual camp of the State National Guard. Population (1890), 9676 ; (1900), 10,358, of whom 1341 were foreign-born and 243 negroes.

Peel, Arthur Wellesley Peel, 1st Viscount

(1829), youngest son of the eminent statesman.

Sir Robert Peel, was born on 3rd August 1829, and was educated at Eton and Balliol College, Oxford. Destined for a political career, he unsuccessfully contested Coventry in 1863 ; but two years later he was elected in the Liberal interest for Warwick, for which he sat until his elevation to the peerage. Soon after his entrance into the House of Commons, he evinced great business capacity and wide knowledge of constitutional forms, and in December 1868 was appointed parliamentary secretary to the Poor Law Board. This oiEce he filled until 1871, when he became secretary to the Board of Trade, an appointment which he held for two years. In 1873-74 he was patronage secre- tary to the Treasury, and when the Liberals again returned to power in 1880 he became under-secretary for the Home Department. On the retirement of Mr Brand (afterwards Viscount Hampden) in 1884, Mr Peel was elected Speaker, and his speech on accepting the office was one of marked dignity. He was thrice re-elected to the post,

twice in 1886, and again in 1892. Throughout his career as Speaker he exhibited the greatest impartiality, combined with a perfect knowledge of the traditions, usages, and forms of the House, soundness of judgment, and readiness of decision upon all occasions. On 8th April 1895, in a very full gathering of the House of Commons, Speaker Peel announced that in consequence of failing health he was compelled to retire from the chair. The farewell ceremony was of a most impressive character, and warm tributes were paid from all parts of the House. The dignity of a viscount was subsequently conferred upon him, and he was granted by statute a pension of Â£4000 for life. Lord Peel received the honorary degree of D.C.L. from Oxford University in 1887, and he was presented with the freedom of the City of London in a gold casket in July '1895. A Eoyal Commission was appointed in April 1896 to inquire into the operation and administration of the licensing laws. The Commission was of a most com- prehensive and representative character, and Viscount

Peel was appointed chairman. It held 123 sittings and examined 260 persons. The taking of evidence was con- cluded in July 1898, when the commissioners adjourned, and Lord Peel drew up a draft report for discussion, in five parts, dealing with England, Wales, Scotland, Ireland, Cl,ubs,and the Reduction of Licences, Compensation, Local Option or Prohibition, and Municipal Management. Some differences of opinion arose in connexion with the report, and at a meeting of the commissioners on 12th April 1899, when part 5 of the draft report was to be considered, a proposal was made to substitute an alternative draft for Lord Peel's, and also a series of alternative drafts for the four sections already discussed. Lord Peel declined to put these proposals, and left the room. Sir Algernon West was elected to the chair, and ultimately two main reports were presented, one section agreeing with Lord Peel, and the other â€" including the majority of the commissioners â€" presenting a report which differed from his in several im- portant respects. The Peel Report recommended that a

large reduction in the number of licensed houses should be immediately effected, and that no compensation should be paid from the public rates or taxes, the money for this purpose being raised by an annual licence-rental levied on the rateable value of the licensed premises. Lord Peel's Report at once became a valuable weapon in the hands of temperance reformers.

Peesemsky, Alexey Feofilactovich

(1820-1881), a well-known Russian novelist of an extremely sceptical and pessimistic character, was born on his father's estate, in the province of Kostroma, 10th/22nd March 1820. In his autobiography he de- scribes his family as belonging to the ancient Russian nobility, one of his ancestors having been sent as ambas- sador to London by Ivan the Terrible to see a niece of Queen Elizabeth, whom the Tsar wished to marry, and another having been canonized after death as a saint. His more immediate progenitors, however, were all very poor, and quite unable to read or write. His grandfather ploughed the fields as a simple peasant, and his father, as Peesemsky himself said, was washed and clothed by a rich relative, and placed as a soldier in the army, from which he retired, after thirty years' service, with the rank of major. Peesemsky 's first teachers were a village curate, and a priest expelled from the Church for drunkenness. During childhood he read eagerly the translated works of Walter Scott and Victor Hugo, and later those of Shakespeare, Schiller, Goethe, Rousseau, Voltaire, and George Sand. Erom the gymnasium of Kostroma, where he exhibited some talent for acting, he passed through Moscow University, and in 1884 entered the Government service as a clerk in the office of the Crown Domains in his native province. Between 1854 and 1872, when he finally quitted the civil service, he occu- pied similar posts in St Petersburg and Moscow. His early works exhibit a profound disbelief in the higher qualities of humanity, and one of his singular traits was a disdain for the other sex, although he appears to have been attached to a particularly devoted and sensible wife. His first novel, Boyarstchiua, was forbidden for its unflattering description of the Russian nobility. His principal novels are Tufak ("A Muff"), 1850; Teesicha Doush (" A Thousand Sou Is"), 1862, whichis considered his best work of the kind ; and

Vzbalomoucheneoe Morr ("A Troubled Sea"), giving a picture of the excited state of Russian society about the year 1862. He also produced a comedy, Gorkaya Soudbina ("A Bitter Pate"), depicting the dark sides of the Russian peasantry, and resembling Zola's La Terre, which obtained for him the Ouvaroff prize of the Russian Academy. In 1856 he was sent, together with other literary men, to report on the ethno-

graphical and commercial condition of the Russian interior, his particular field of inquiry having beeii Astrakhan and the region of the Caspian Sea. His scepticism in regard to the liberal reforms of the 'sixties made him very unpopular among the more progressive writers of that time. His death occurred at Moscow on the 2nd February 1881 (21st January, Russian style). (g. d.)

Pegu, a division of Lower Burma comprising the districts of Rangoon town, Hanthawaddy, Pegu, Tharra- waddy, and Prome, with a total area of 13,083 square miles and a population in 1891 of 1,522,511, and of 1,818,845 in 1901. In 1898-99 it paid a revenue of Rs.74,14,902. Pegu district is the largest in the divi- sion, and has an area of 4276 square miles, with a popula- tion in 1891 of 237,594, and in 1901 of 339,942, with 782 villages paying a revenue in 1898-99 of Rs.17,61,123. Of the population in 1891, 218,889 were Buddhists and Jains, 7777 were Hindus, 2407 Mahommedans, 2939 aborigines (mostly Karens), and 5582 Christians, 5387 of whom were natives, chiefly Karens. Of a total acreage of 2,736,640, there were 612,968 acres cultivated in 1898-99, 741,618 remained uncultivable, and 481,168 acres apart from fallow were cultivable. The rainfall in 1898-99 was 114-42 inches, taken at Pegu town. The vast bulk of the cultivation is rice. The chief town, Pegu, has increased greatly in prosperity since the opening of the railway. It had a population of 5891 in 1881, and in 1891 of 10,762. It has a municipal committee of twelve elective and four ex officio members.

Peine, a town of Prussia, province of Hanover, 16 miles by rail west-north-west of Brunswick. It has iron- works, breweries, manufactures of starch and artificial manure, brickworks, and distilleries. There are also large horse and cattle markets. Population (1885), 7868;

(1900), 15,427.

Pekin, a city of Illinois, U.S.A., capital of Tazewell county, is on the Illinois river, at the intersection of six large railways, north-west of the centre of the state. It has a level site, and its street plan is regular. It is in a rich agricultural region and in the Illinois coalfield, and is a shipping point and grain market of great importance. Its manufactures are varied, including agricultural imple- ments, lumber, brick and tiles, &c. Population (1890), 6347 ; (1900), 8420, of whom 1366 were foreign-born.

Peking, the capital of the Chinese empire, on a sandy alluvial plain on the Peiho and its tributary the Hunho, nearly equidistant from both, 36 miles south-east of the Great Wall, at the head of the Great Canal. Not being open to foreign trade, there is no general right of residence for foreign merchants at Peking, and consequently it has not shared in the industrial growth and progress that have benefited so many other Chinese cities. The only foreign commercial institution which has so far suc- ceeded in gaining a foothold within the walls is the Hong- Kong and Shanghai Bank, a branch of which has been established there for several years. A branch of the Russo-Chinese Bank has also been opened. With these exceptions the foreign residents are either the diplomatic representatives, or employes of the Chinese Government, or missionaries. The most important fact to be noted is the opening of the railway between Tientsin and Peking in 1897. This was only accomplished after great opposition from the ultra-Conservatives, but once accomplished the facilities were gladly accepted by all classes, and the traffic both in goods and passengers is already enormous. Out of deference to the scruples of the ultra-Conservatives, the terminus was fixed at a place called Lu-Ko-chiao,

some four miles outside the walls, but this distance has since been covered by an electric tramway. The trunk line constructed by the Franco-Belgian syndicate will connect Lu-Ko-ehiao, the original

terminus, with Hankow â€” hence the name Lu-Han by which this trunk line is generally spoken of, Lu being short for Lu-Ko-chiao and Han for Hankow. Since the first advent of foreigners in Peking in 1860 nothing whatever had been done until 1900 to improve the streets or the drainage. The streets as originally laid out were wide and spacious, but being unpaved and undrained they were no bettfer than mud tracks diversified by piles of garbage and foul-smelling stagnant pools. Such drainage as had at one time existed was allowed to get choked up, giving rise to typhoid fever of a virulent type. Some attempt has been made to improve ijaatters by macadamizing one of the principal thoroughfares, but it will be the labour of a Hercules to cleanse this vast city from the accumulated filth of ages of neglect. Fortunately the space inside the walls is so great that the houses are not crowded together, and there is a great number of large enclosures, mostly garden ground, the residence of one or other of theManchu princes and nobility. One of such enclosures constitutes the British legation, and most of the other foreign lega- tions are similarly, though not so sumptuously, lodged. The exact population of Peking is not known even to the Chinese themselves. In the ninth edition of this work it was stated to be about one million, and this figure is probably the highest at which it can yet be put. Many estimates make it considerably less. Peking suffered severely during the Boxer movement and the siege of the legations in the summer of 1900. Not only were most of the foreign buildings destroyed, but also a large num- ber of important Chinese buildings in the vicinity of the foreign quarter, including the ancient Hanlin, the Boards of War, of Eites, &c. Almost tlje whole of the business quarter, the wealthiest part of the Chinese city, was laid in ashes. (For a fuller account of the siege, see China : History.’)

Pelew Islands. See Micronesia.

Pelloux, Luigl (1839), Italian general and

politician, was born, on 1st March 1839, at La Eoche, in Savoy, of parents who retained their Italian nationality when Savoy was annexed to France. Entering the army as lieutenant of artillery in 1867, he gained the medal for military valour at the battle of Custozza in 1866,

and in 1870 commanded the brigade of artillery which battered the breach in. the wall of Rome at Porta Pia. Manifest- ing aptitude for a political career, he was elected deputy in 1880, and, after having been secretary-general of the War Ofl&ce, became minister of war in the Eudini and Giolitti Cabinets of 1891^93. In July 1896 he resumed the portfolio of war in the Eudini Cabinet, and was appointed senator. In May 1897 he secured the adoption of the Army Eef orm Bill, fixing Italian military expendi- ture at a maximum of Â£9,560,000 a year, but in December of that year he was defeated in the Chamber on a techni- cal issue. Eesigning ofiice, he was in May 1898 sent as royal commissioner to Bari, where, without recourse to martial law, he succeeded in restoring public order. Upon the fall of Eudini, in June 1898, General Pelloux was entrusted by King Humbert with the formation of a Cabinet. An excellent administrator but an indifferent politician, he accomplished little in the legislative field, and turned his attention chiefiy to the maintenance of order and to sound management of public affairs. The Public Safety Bill for the reform of the police laws, taken over by him from the Eudini Cabinet, and eventually promulgated by royal decree, was fiercely obstructed by the Socialist party, which, with the help of the other

groups of the Left and Extreme Left, succeeded in forcing General Pelloux to dissolve the Chamber in May 1900, and to resign ofiice shortly after the general election in the following June. In the autumn of 1901 he was ap- pointed to the command of the Turin army corps.

Pembroke, a maritime county of South Wales, bounded on the E. by Carmarthen, on the N.E. by Cardigan, on the S.E. and S. by the Bristol Channel, and on the W. and IST.W. by St George's Channel.

Area and Population.â€" The area of the ancient county is 395,151 acres, or 617 square miles, with a population in 1881 of 91,824 ; in 1891 of 89,133, of whom 41,685 were males and 47,448 females ; in 1901 of 88,749, the number of persons per square mile being 144, and of acres to a person 4-4. The area of the administrative county is 392,710 acres, with a population in 1891 of 80,296. The registration county comprises 357,118 acres, with a population in 1891 of 82,003. Within this area the

decrease of population between 1881 and 1891 was 2-00 per cent. The excess of births over deaths between 1881 and 1891 was 9914, but the resident population nevertheless decreased by 1674. The following table gives the numbers of marriages, births, and deaths, with the number and percentage of illegitimate births, for 1880, 1890, and 1898 :â€”

Tear,

Marriages,

Births.

Deaths.

Illegitimate Births,

No,

Per Cent,

1880 1890 1898

563

574 564

2604 2,305 2222

1540 1566 1448

163 153 115

6-3 6-5 5-2

In 1891 there were in the county 342 natives of Scotland, 784 natives of Ireland, and 127 foreigners, while 51,959 persons could speak English, 13,673 Welsh, and 10,804 English and Welsh.

Constitution and Government. â€” The county returns one member to Parliament, and it also includes the Pembroke and Haverford- west district of parliamentary boroughs (consisting of Fishguard, Haverfordwest, Milford, Narberth, Pembroke, Tenby, and Weston), returning one member. There are three municipal boroughs: Haverfordwest (6007), Pembroke (15,853), and Tenby, (4400). Haverfordwest is a county in itself and has its own lord-lieutenant. There is only one urban district, Milford Haven (5101). Pem- brokeshire is in the South Wales and Chester circuit, and assizes are held at Haverfordwest. The boroughs of Haverfordwest, Pem- broke, and Tenby have separate commissions of the peace, and Haverfordwest has also a separate court of quarter sessions. The ancient county, which is entirely in the diocese of St Davids, con- tains 114 entire ecclesiastical parishes and districts and parts of 5 others.

Education. â€” The total number of elementary schools on 31st August 1899 was 127, of which 57 were board and 70 voluntary schools, the latter including 58 National Church of England schools, 1 Wesleyan, and 11 " British and other." The average attendance at board schools was 6413, and at voluntary schools 5790. The total school board receipts for the year ended 29th September 1899 were over Â£22,198. The income under the Agricultural Rates Act was over Â£1424.

Agriculture. â€" About four-fifths of the total area of the county is under cultivation, and of this about two-thirds is in permanent pasture. Only about 33,000 acres are in hill pasture, and less than 10,000 acres are under woods. Of the corn crops oats are the principal, occupying considerably more than half the acreage, while barley occupies about three-eighths, and wheat not much more than a fourteenth. The acreage under green crops is not large, but about seven-twelfths is occupied by turnips, cattle being largely kept both for feeding and milking. Only about one-fifth of the green crop acreage is occupied by potatoes, and about one-fifth also is under mangold, cabbage, &c. The following table gives the larger main divisions of the cultivated area at intervals from 1880 : â€"

Tear.

Total Area under Cultiva- tion.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1880 1885 1890 1895 1900

302,780

306,783 309,293 315,303 313,346

57,573 52,250 52,455 49,689 49,929

12,471 13,633 13,455 13,222 12,191

28,789 31,214 42,365 41,655 39,998

199,913 207,808 199,507 209,661 210,485

4034 1878 1503 1041 716

The table on the next page gives particulars regarding the principal live stock for the same years.

Tear.

Total Horses.

Total Cattle.

Cows or Heifers

In Milk or in

Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1900

14,376 14,667 14,682 16,131 15,984

85,138 90,250 88,266 87,548 93,744

31,817

33,567 33,186 32,280 32,998

99,030 102,655 115,384 119,817 138,199

21,537 20,318 31,095 32,278 29,482

Industries and Trade. â€” According to the report for 1898 of the chief inspector of faptories (1900), the total number of persons employed in factories and workshops in 1897 was 4654, as compared with 4217 in 1896. Of the 3370 persons employed in non-textile factories, 2730 were employed in the manufacture of machines, appliances, conveyances, and tools, mostly in connexion with the shipbuilding yards at the different ports. Only 1133 persons were employed in workshops. The number of persons employed in con- nexion with mines and quarries in 1899 was 946. Iii the same year 246,330 tons of igneous rocks were raised, and 22,998 tons of limestone. Lead mining has practically ceased, and little or no iron ore is obtained. The coal production (wholly anthracite) is rather fluctuating, 52,642 tons valued at Â£13,160 being obtained in 1885, 71,908 tons valued at Â£35,9-54 in 1890, 82,384 tons valued at Â£45,311 in 1898, and 59,419 tons valued at Â£32,680 in 1899. The fisheries are of considerable importance. At

Tenby, Newland, andMilford (almost entirely the last two) 448,449 cwt. of fish valued at Â£381,610 was landed in 1899-

See A Historical Tour through FembroJceshire. London, 1811. â€" Tombs. Concerning Pembrokeshire. Haverfordwest, 1863. â€" The guide-books to South Wales. (t. f. h.)

Pembroke, a municipal and contributory parlia- mentary borough of Pembrokeshire, Wales, in the Pem- broke and Haverfordwest district of boroughs, 272 miles west of London by rail. The dock has a length of 404 feet, with a depth on sill, at high water ordinary spring tides, of 26 feet. Population (1881), 14,156; (1891),

14,978 ; (1901), 15,853.

Pembroke, a town of Ontario, Canada, capital of Renfrew county, 74 miles west-north-west of Ottawa by rail, on the south shore of AUumette Lake, and on the Canadian Pacific and Canada Atlantic railways. It is the seat of a Roman Catholic bishop, and contains saw, grist, and woollen mills, axe factory, &c. The Muskrat river, which flows through the town, affords excellent water-power. Population (1881), 2820 ; (1891), 4401 ; (1901), 5156.

Penang. See Peim-ce of Wales Island.

Penarth, a seaport, urban district (1894), and rail- way station in the Southern parliamentary division of Glamorganshire, Wales, onthe river Taff, opposite Cardiff. The town is rapidly spreading. Gardens have been laid out along the cliff, numerous villas built in the western district, and a promenade and landing-pier opened, with a length of 630 feet. The chief buildings of modern erection are an Established church (1891) and an inter- mediate and technical school (1894). Three miles to the west is Dinas Powis Castle. Penarth dock, which cost Â£775,000 and comprised 17-|- acres, was extended in 1884 at a cost of Â£250,000, and now covers 23 acres. It is 2900 feet in length, has a minimum depth of 26 feet, and is furnished with every convenience for facilitating the export of coal, of which from 20,000 to 30,000 tons can be stored in the sidings near by. The trade of the dock in one year

totalled a tonnage of 3,464,964, and a still further extension is contemplated. Penarth harbour (55 acres) and basin (3 acres) have a minimum depth of 20 feet. A considerable import trade is carried on at the Penarth-Ely tidal harbour, mainly through coasting vessels. Commodious store-houses have been erected there ; also tanks to hold about 6000 tons of oil. Population (1881)

6228; (1891), 12,424 ; (1901), 14,227.

Pender, Sir John (1816-1896), was born in the Vale of Leven, Scotland, on 10th September 1816, and.

after attending school in Glasgow, entered on a successful business career in that city and in Manchester. His name is chiefly known in connexion with submarine cables. He was one of the 346 contributors who each risked a thousand pounds in the transatlantic cable in 1857, and when, after many disappointments, the Atlantic Cable Company was ruined by the loss of the 1865 cable, he did not lose faith in submarine telegraphy, but formed the Anglo-American Telegraph Company to continue the work. His faith, however, was not generally shared, and it was not till he had given his personal guarantee for payment to the amount of a quarter of a million that the makers would undertake the manufacture of a new cable. But in the end he was justified, and telegraphic communication with America became a commercial success. Subsequently he fostered cable enterprise in all parts of the world â€” to the Mediterranean, India and China, Australia and Africa â€” with the result that at the time of his death, which occurred in London on 7th July 1896, he controlled companies having a capital of 16 millions sterling and owning 73,640 nautical miles of cable.

Pennsylvania, a central eastern state of the American Union. The area is 45,215 square miles (44,985 land and 230 water), with a mean elevation of 1100 feet. The distribution of this atea in altitude is as follows : â€”

Elevation.

0 to 100 feet

100 to 500 ,,

500 to 1000 ,,

1000 to 1500 ,,

1500 to 2000 â€ž

2000 to 3000 ,,

Area.

600 square miles

5,550

12,700

15,900

8,215

2,300

The first two elevations are in the south-eastern end of the state, and represent Philadelphia and the adjacent region. The third, largest in the western end of the state, is a continuation of the southern Ohio plain, and includes Pittsburg. The third and fourth are two coal tracts. The fifth is a central plateau, whose population, the largest at this elevation of any state but Colorado, is drawn thither by the oil wells. The sixth is a mountain region. The state is also rudely divided between the Delaware valley, 11,000 square miles, the Susquehanna, 24,000 square miles, and the Monongahela and Allegheny, 18,000 square miles. The census of 1890 showed a total popula- tion of 5,258,014, of whom 2,666,331 were males and 2,591,683 females; 4,412,294 were native-born, and 845,720 were foreign-born. The negroes numbered 107,596. Of the male population over 16 years of age 1,602,153, or 89-

95 per cent., and of the female popula- tion 311,296, or 14-88 per cent., were engaged in different occupations. Owing to legislation requiring school attend- ance and forbidding employment under twelve, a decided decrease oceui-red between 1880 and 1890 in the number of children employed. The families were 1,061,626, and^ dwellings 999,364; 5-2(l persons to a dwelling and 4-95 to a family. The number of persons to a family has fallen, from 1850 to 1890, from 5-66 to 4-9.”;, and the persons to a dwelling from 5-99 to 5-26. The decrease in persons to a family is apparently still in progress with accelerated rapidity. While the general population in- creased, from 1880 to 1890, 22-77 per cent., the number of children under five in 1880 was 652,174, and in 1890, 477,591, a decrease of 74,583, or 13-48 per cent. According to the census of 1900, the population of the state was 6,302,115, an increase for the decade of 1,044,101, or 19-9 per cent. The average number to the square mile had increased to 140-1, as compared with 116-9 in 1890. The males numbered 3,204,541, the females, 3,097,574; the native-born, 5,316,866; the foreign-born, 986,250; the negroes, 156,845. The pro-

portion of foreign-born has for a long period varied within narrow limits, having been 13-12 per cent, in 1850, 16-08 per cent, in 1890, and 15-6 in 1900. The foreign-born take the place of an equal number of native- born ~~who have moved west. The proportion of Ger~~ mans has always been large, being estimated at one-half in 1750.

State and Local Government. â€” To the executive, legis- lature, and judiciary provided by the constitution of 1874, legislation has added commissioners of insurance (1872), ^banking (1891), a department of agriculture (1876), a factory inspector (1893), and mine inspectors (1891-93) ; a board of health (1885), board of charities, with a lunacy committee (1883), fishery commission (1873), and game commission (1895) ; also boards and other lesser commis- sions to manage the lands, parks, soldier and orphan asylums, public buildings, and other state properties. Each commission has its body of special statutes, and

collectively they constitute an important part of the development of state administration. A superior court between the common pleas and supreme court has been added (1897). The exercise of suffrage, conferred on male citizens over twenty-one years old, has been regulated by the adoption of the Australian ballot (1893-97), and by a series of laws (1881, 1883, 1897) imposing penalties for false voting and providing for the judicial determina- tion of nominations by party organizations. The two leading parties have, under these laws, become strongly organized, with clearly-defined membership, rules, and elections, whose choice is usually decisive of the final result for the state and most of the counties in it. Stringent provisions forbid special legislation, particularly legislation for corporate or municipal purposes. The constitution, by prohibiting special municipal legislatjon, made necessary the adoption of general charters for the cities of the state. For charter purposes these are divided into first-class cities (over 600,000 : Philadelphia alone), second-class (over 100,000 and less than 600,000 : first Pittsburg, and later Allegheny and Scranton), and third-class (all below 100,000, comprising all the cities of the state but the four named). The three classes of charters are substantially the same. They provide for a mayor, elected, with wide executive powers, who appoints and removes the heads of city police, public works and charities, and lower officers, such appointments being subject, except in the case of lower officials, to the con- firmation of the upper branch of the municipal legislature. The city legislature, which consists of two branches elected by districts, levies all taxes, votes all appropriations, and through standing committees exercises a close supervision over public works. In 1901 the Legislature placed the government of Pittsburg and Scranton temporarily in the hands of officers appointed by the governor. Education and the parks in first-class cities are in the hands of a separate body, appointed by judges, which submits estimates to and receives appropriations from the city council. In second and third class cities the schools are in the hands of an appointed board. Any local popu- lation over 300, not within a city, can, on application to a court of quarter sessions, receive a charter as a borough, electing a chief burgess, a council of five, and two poor trustees. Such a body can, by taxation, supply drainage, water, and light within its area, and can provide for its police and poor, but in small boroughs little use is made

of these powers. The remainder of the area is divided into townships, whose officers have lesser power, collecting taxes for roads, the poor, &c., but cannot issue bonds. The right to issue bonded indebtedness for municipalities and boroughs is limited to 7 per cent, of the assessed valuation in the former and 1 per cent, in the latter. Bonds to the amount of 2 per cent, of the assessed valua- |

tion can be issued by the officers of a municipality. A larger amount must be authorized at a regular election, and this authorization must be repeated when such issue has been redeemed by the sinking fund required by law. The total local debt of the state was reduced under this plan from $93,318,471 in 1880 to $66,973,065 in 1890.

The population of the state has been distributed at each census under these five forms of local government : â€”

isso.

1890.

1900.

Cities, flrst-olass

847,170

1,040,964

1,293,697

„ seoond-olass .

156,.389

343,904

553, .5.38

„ third-class

430,792

522,095

700,540

Boroughs over 4000

population

224,172

444,744

670,462

Townships and smaller

boroughs Total

2,624,368

2,900,.S07

3,083,878

4,282,891

5,258,014

0,302,115

Finances. â€” The receipts and expenditures in the whole state, including state, county, municipal, and local govern- ments, were in 1890: receipts, $49,859,913, and ex- penditures, $46,589,937. Of these receipts, $36,111,124 was derived from the direct taxation of real and personal property. The true valuation for the state, as determined by the census of 1890, in gross and per capita of this pro- perty, has been

as follows, the figures being corrected and differing from the assessment of county officials : â€”

1870.

18S0.

1800.

Total Per caput

.Â§3,806,340,112

1,081

$4,942,000,000 1,154

Â§6,190,746,550

1,177

The assessed valuation amountedin 1890 to $2,659,796,909, of which $2,042,016,599 was realty and $617,780,310 per- sonalty. In 1899 the aggregate was $3,027,649,299 ; in 1850, $492,898,829. The census returns of this assessed valuation ia realty have been : â€”

1810.

1880.

1890.

Total Per caput

81,071,680,934 373.38

.Â§1,540,007,957

427.93

Â§2,042,016,599

494.29

Philadelphia raises two-thirds of its income from direct taxation, lesser cities a larger proportion. The state receives one-tenth of its income from this source, the rest from the taxation of corporations. Of the gross expenditures for public purposes in 1890, $5,512,128 was disbursed by the state. Of the remainder, amount- ing to $40,077,809, over one-third or $15,430,983 was expended by five cities of 50,000 or more in population. Por school education $12,828,645 was dispensed. The per capita expenditure for all purposes was $8.67 through the state, but this was made up of a per capita ex- penditui-e of $13.90 in five cities and of $6.54 in the remainder of the state. The aggregate receipts of state and all local taxation in 1899 were : state, $15,158,462; local, $55,808,685â€" a total of $70,967,047. Nearly one- third of this aggregate, or $21,733,586, was raised by Philadelphia. In the decade state revenue had more than doubled, and local taxation increased 32 per cent. The local expenditures have grown by tolerably steady increments from the settlement of the state, the best example being in Philadelphia. The expenditures of the state government are the creation of the 19th century. Cut off by the Federal G-overnment from customs revenue and by its own system of local finance from a direct land or property tax, the state government was forced to create a source of revenue for itself, and this did not develop to a point which met its necessities until the growth of corporations had provided a field of taxation

independent of customs on the one side and realty or personal taxation on the other. Of the total state revenue in 1899, viz., 116,158,462, $8,617,343 was derived from taxes on corporations, $2,764,268 from taxes on personal property, and the remainder from a great variety of small taxes. Of the state expenditures in 1899, $16,063,467, over one-half, or $8,301,662, was returned to local agen- cies for disbursement,

of vsrhich $5,871,984 was for schools, $2,360,308 from the personal tax was for the use of counties, and $69,270 from fire insurance taxes was for fire departments. With one-half of its taxation the ~~state government therefore supports the executive, legislature, numerous commissions, penitentiaries ($122,907), insane asylums ($882,478), and various charitable corporations, which in 1899 received grants amounting to $1,278,594. The other half aids local government, the grant for educa~~ tion meeting all the expenses of the public schools in many rural districts,

History. â€” In 1882 and in 1892 the continuous election of Republican candidates as governor was broken by the election of Eobert E. Pattison, his majority being due in one case to the presence of two Republican candidates, and in the other to a wide change of votes from the Republican to the Democratic party. Both elections were part of a continuous protest by a small but energetic body, variously designated, in favour of administrative reform, and against the increasing control of party and political action by individuals â€” a control due in great measure to the growth through custom and law of a stricter and more systematic organization. Industrial disputes, both as to the rate of wages and the recognition of a union, led, on 6th July 1892, to the Homestead steel strike over the employment of non-union workers by Carnegie and Company, in which several persons on both sides were killed, and the riot was only suppressed by the presence of state militia on 1st October. A coal strike, on 10th September 1897, led to a collision between deputy-sheriffs and a mob at Lattimer, in which twenty persons were killed. Another and still more serious strike, with riots, occurred in the coal-mining region in the summer of 1902. The Johnstown flood, 31st May 1889, in the Conemaugh valley, swept away the town and 3600 lives, though only 1440 bodies were recovered. ISTo estimate of the property loss was possible. The fund disbursed by the relief fund commission was $2,899,727.

Education. â€” The legal system of public tax-supported education has remained unchanged since 1880, but its development only became possible when the constitution of 1874 changed the varying

appropriations of the legislature in aid of local grants into a mandatory appropriation of at least $1,000,000 annually.

Schools,

Teachers.

students.

rnmmnn / ^^’-

15,999

18,368

975,753

common -j^ ^ggg

14,666

28,080

1,173,082

Normal { J^^^

11 15

140 359

2,191 10,656

r 1872 Secondary jjggg

44 292

272 1,022

5,015 27,082

High f 1872 schools \ 1898

427

1,878

35,700

Colleges {1^^2

22 30

293 544

1,625 6,203

Law f 1872 schools 1 1898

3

3

62

3

36

4-88

Medical j 1872 schools \ 1898

6

50

942

6

227

2,415

Dental ‘ f 1872 schools 1 1898

2

13

63

5

91

1,387

Pharmacy / 1872

1

3

239

schools 11898

2

13

501

This sum has been as high as |5, 500,000, though reduced in 1899 to â– Â¥5,000,000. The amount levied by local taxation for educational purposes in 1880 was $6,634,072. In 1899-1900 this amount was

$14,700,512. The state had therefore increased its appropriation 450 per cent., and local taxation 168 per cent., during a period in which the children in attendance had increased from 937,310 to 1,151,880, or 22‘89 per cent., and the average attendance from 601,627 to 854,640, or 40-37 per cent. The estimated growth of population in the same period, taking the growth in previous decades, was 42 -82. The best comparative view of the educational progress of the state is offered by the reports of the U.S. Bureau of Education, from which the foregoing table is compiled. The common schools, of which the high schools are a part, are wholly supported by taxation ; the normal schfiols are partly dependent on state grants and partly on fees ; the remaining schools are all conducted by private bodies, though appropriations are made from time to J;ime by the state in aid of higher education. Illiterates, unable to read and write, have for thirty years been almost an unchanged fraction of the population, an indication that the education offered by the state and by private enterprise had reached all but that fraction which could be educated only under a compulsory system. Provision for a yearly count of school children and fines for non-attendance were fitrst arranged for in

1897, and enforced only in the largest cities. Another decade will be needed to decide whether this measure and policy can deal with what has hitherto been a proportion whose reduction has been slow. Illiterates were in 1870, 8-5 per cent, of those over ten years of age; in 1880, 7-12; in’ 1890, 6-78; and in 1900, 6-1. Of this illiterate population one-half was in each census of foreign birth, the illiterate proportion of the foreign population, over ten years of age, 191,706, or 19-9 per cent., being ninefold, and of the small coloured population 20,298, or 15-3 per cent., fourteenfold that of the illiterate proportion of native white population, 87,372, or 2-3 per cent. The problem of complete elementary education turns on reaching this fraction. As this can be done only by a compulsory system, the great increase in expenditure has been attended by no increase in relative attendance. In 1900 the male illiterates of 21 years of age and over numbered 139,982. Of these 41,324 were native-born and 98,658 were foreign-born.

Crime and Charity. â€” From 1880 to 1898, 93 pensons were executed for murder in the first degree. The prison population in 1898 was 7603, as compared with 4623 in 1880. The proportion of convicts had risen from 1 to 1555 inhabitants to 1 to 1272. Two juvenile reformatories had 835 inmates in 1881, and 1567 in

1898, an increase about twice that of the population. Insane patients in 1898 were 10,565, of whom 672 were in private insti- tutions. In 1886 the same institutions had 5923. County alms- houses had in 1881, 8566 inmates, including pauper insane, and in 1898, 11,722. In addition, in 1898, 22,187 persons received outdoor relief. Four deaf and dumb institutions held in 1898, 815 inmates ; two for the blind, 266 ; and two for the feeble-minded, 1487. Hospitals had 6477 inmates, and "homes," for the most part for children and the aged, 16,080. These institutions receive yearly appropriations from the state aggregating about $1,500,000.

Communications. â€" The general railway system, complete as to main lines in 1880, consists of the Pennsylvania, whose trunk line occupies the middle of the state and crosses it by repeated branches, and the Reading, which reticulates the anthracite coal region, while the trunk lines of other states cross portions of the state. A railway mileage of 5500 in 1880 in the state had increased to 10,330 in 1900. The capital shares and debt, funded and floating, of railways in whole or in part in the state had risen within these years from $1,030,683,638 to $2,310,968,116, divided nearly equally between capital shares and debt. Gross receipts rose from $133,945,771 to $377,825,660, and expenses from $75,815,377 to $334,570,957, re- ducing the balance from $58,130,394 to $43,254,703, though the capital had doubled and the tonnage advanced from 111,348,416 to 400,548,087. WTiile the Pennsylvania, with 3385 miles in the state, with an east and west traffic, and with an ownership of profitable lines outside of the state amounting to 6644 miles, has maintained a credit and prosperity unequalled, the Reading, 961 miles in and 39 out of the state, has thrice been in the hands of receivers. The street car lines of the state have a mileage of 1498, and a total capitalization of $242,628,019. Their present cost, all having been re-equipped with electric power since

1885, is Â§197,161,214, prin- cipally represented by the capital of opei^ating companies, â– 1147,570,893â€” $103,122,319 shares and $31,309,426 bond.sT The remammg sum in the total capital represents for the most part the franchises of corporations formerly working the lines by horse-power. These lines have 5864 oars, employ 12,680 pereons, and in 1899 carried 473,313,258 passengers. About 80 telephone companies operate telephone lines in the state. Telegraph facilities are furnished by inter-state lines, of which the "Western Union is the largest. Three canal companies manage canals, now almost unused, 293 miles long.

Forestry.â€" 'Th^ territory composing the state began with an exceptional wealth of forest, the conifers of the north and the deciduous trees of the south meeting within its limits. They contain 35 genera, and over 80 species of indigenous trees, of which

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78 have economic value, or nearly as many as the entire continent of Europe, whose number Asa Gray estimates as 33 genera and 85 species. Nearly one-third of the state's area in 1896, 9,099,817 acres out of 28,937,600, was returned by assessors as woodland â€" much being scrub-oak and hrush, but all abandoned to wood growth or but partly cleared. There ha-s probably never been a time when nearly one-third of its area was not so overgrown with trees, large or small, as not to be open to cultivation, though the share of this in timber is not over a quarter of the area of the state. In its original condition, a yield of hemlock (spruce) of 80,000 feet board measure to the acre, or of white pme of 50,000 feet board measure, was usual. The Delaware, Allegheny, and Susque- hanna were successively lumber centres. In 1880 the lumber product was |22,457,359, only exceeded by Michigan ($52,449,928). In 1890 this product, was 127,772,834, and that of Michigan $73,484,306. Local statistics of the yield were not preserved, but at Williamsport, the last great lumbering centre, in the seven years 1873-80 the pine yield was 7,395,456 logs and 1,266,608,045 feet board measure. The yield of the four Delaware river counties was estimated,

prior to exhaustion, at 12,000,000,000 feet board measure of pine. In 1897 the state forester, Dr J. T. Rothrock, reported white pine at 500,000,000 feet; spruce, 70,000,000; and hemlock, 5,000,000,000. By the close of the ninth decade of the 19th century exhaustion was seen to be near. In the eastern fifth of the state only 12 per cent, of the area was under timber ; in the elevated west, 28 per cent. ; and in the valleys of the east and west, 24 per cent. Over a sixth of the area of the state is at an elevation of 1500 to 2000 feet, and a broad belt 2000 to 3000 feet high is economically unfit for any cultivation but forestry, having a mean annual temperature of 40Â° to 45Â° F., a climate similar to that of northern New England. Forest fires yearly sweep broad areas of this region, which would otherwise reforest. In 1880, 685,738 acres were burned, with a loss of $3,043,723. During the decade ending with 1890 the annual loss was estimated at $1,000,000. In 1896 it was $557,056, in 1897, $394,327, and in 1898, $53,345. This reduction is believed to be due to legislation for reforesting the state. Penn, in his regulations, provided that one acre in four of woodland should be preserved. This wise provision was alto- gether neglected, and desultory statutes in regard to fires, the first in 1735, were the only legislation for the preservation of timber. In 1860, 1870, and 1879 statutes more stringent were formed to prevent fires. In 1887 a yearly bounty of 45 cents an acre was oSered for timber ; in 1893 a state forestry commission was established ; and in 1897 Acts were passed for fire-wardens, provid- ing means for detecting forest fires, for lorest reserves, and for the state purchase of waste land sold for taxes, of which about 2300 square miles are yearly sold, usually land from which the timber has been stripped. Forest reserves of 40,000 acres each have been (1900) bought on the head- waters of the Delaware in Pike and Monroe counties, in Clinton, Cameron, and Center counties on the Susquehanna, and on the Allegheny.

Agriculture. â€” Of the total area of the state, only one-half has ever been reduced to cultivation in improved farm lands. This reached its maximum in 1880 in 213,542 farms of 19,791,341 acres, 13,423,007 improved and 6,368,334 unimproved. In 1900 the farms were 224,248, of 19,371,015 acres, 13,209,183 acres improved and 6,161,832 unimproved, employing 331,119 persons, 30,007 more than in 1880. The

change measures the increase of lands used as woodland for collieries, and for industrial purposes. Tanneries in 1892 held 749,017 acres of bark lands, valued at $11,383,920. The growth of paper and other industries constantly turns farm lands near the margin of cultivation to other purposes. The valuation of farm lands was in 1870, $1,119,786,853 (gold at 15 per cent, premium); in 1890 it was $1,062,939,846; and in 1900 was $1,051,629,173. From 1870 to 1900 the Belling value of farm lands in the eastern and centre parts of the state fell about one-third, many failing under foreclosure to reach their mortgage value. In the decade 1880-90 the farms cultivated by own- ers fell from 168,220 to 162,219, but rose again in 1900 to 165,982. Of the area under cultivation, one-third, 4,738,194 acres, in 1899 was under cereals and 3,269,441 acres under hay, producing 4,020,388 tons. Over one-half the farm area is devoted to these crops, whose yield has been stationary since 1880 (the increase from 1850 to 1899 keeping pace with acreage) and in 1899 the crop was : Indian corn, 51,869,780 bushels ; wheat, 20,632,680 ; and oats, 37,242,810. The great change in the agriculture of the state is in sheep â€" 1,749,301 in 1870 and 959,483 in 1900. Milch cows have in part taken their placeâ€" 706,437 in 1870 ; 943,773 in 1900. Tobacco is the largest special cropâ€" in 1899, 27,760 acres, 41,502,620 ft.

Manufactures. â€" Pre-eminence in iron and steel industries made Pennsylvania the leading manufacturing state up to 1890. The relative increase of textiles and lesser industries has advanced other states,-.but in 1890, with 39,339 establishments, a capital of $991,243,115, and an output of $1,331,794,901, one-third in iron, and 620,562 persons employed, Pennsylvania was exceeded only by

New York. In 1900 it still ranked as the second manufacturing state, having 52,185 establishments, with $1,551,548,712 of capital, employing 733,834 hands, and with a product valued at !?1, 834,790,860. The percentage of increase in the value of the product for the preceding decade was 37-8. In 1850 Pennsylvania had approximately one-sixth of the manufacturing capital and product of the country, and in 1900 over one-seventh of each, so that its relative position has been-fairly maintained.

The following table shows the leading industries and the value of the product in 1890 and 1900 :â€”

Industry.

Iron and steel

Foundry and machine-shop

products Leather ...

Cars and repairs by railway

companies Flouring and grist mill pro.

ducts Printing and publishing Sugar and molasses refining Lumber products . Petroleum refining Liquors Tobacco

Silk and silk goods Cotton goods Woollen goods Slaughtering and meat-packing

1890. 1900.

$264,571,624 $434,445,200

67,587,025 127,292,440

49,931,716 55,615,009

28,769,728 43,065,171

39,478,076 34,408,493 46,599,754 29,087,920 18,498,777 22,698,423 23,387,910 19,357,546 18,431,773 29,878,010 21,991,604

36,639.423 36,455,629 36,163,817 35,749,965 34,977,706 34,520,358 33,355,932 31,072,926 25,447,697 25.389,344 25,238,772

Other important industries were men's clothing, newspapers and periodicals, carpets and rugs, worsted goods, coke, glass, and hosiery

and knitted goods.

Mineral Products. â€” The petroleum, coal, coke, and iron deposits of the state, after standing almost alone to 1880, entered during the following 20 years on a competition whose results were apparent in labour disturbances and a reduction of profits on pre- viously invested capital. In 1880 the production of petroleum, 26,027,631 barrels, was practically that of the country. In 1898 the Pennsylvania field yielded 15,948,464 barrels, 28-83 per. cent, of the entire yield of 55,364,233 barrels. In natural gas the state yield in 1895, valued at $4,500,000, was nearly that of the whole country. In 1898 the Pennsylvania product was valued at $6,806,742, or 44-12 per cent, of all the states. In 1880 the bituminous coal mined in the state, 26,229,031 short tons, was 61-28 per cent, of the total. In

1898 a yield of 65,165,133 tons was but 39-49 per cent, of the entire product. The anthracite coal, which nearly doubled from 1870 to 1880 (1870, 15,596,257 tons; 1880, 28,612,575), under this competi- tion made but about the same advance in the next 18 years, reaching, in 1898, 53,382,644 tons. The coke yield, 1880, 2,821,384 tons, 84-72 per cent, of the total, rose to 10,715,302 tons in 1898, but sank to 66-97 per cent, of the whole American yield. Iron ore in 1880, 1,820,561 long tons, was 20-59 per cent, of the total product, and in 1898, 1,773,082 tons, 3-98 per cent, of the entire ore output of the United States. Cheap fuel and high skill, however, maintained the iron supremacy of the state. In 1870 the state yield of pig iron, 1,836,808 tons, was 50-32 per cent, of the total for the country, and in

1899 it was 6,558,878 tons, or 48-23 per cent., never having been less than 46 percent, in the interval, coke taking the place of anthracite and Lake Superior of local ores. Bessemer steel, 1899, 4,473,493 tons, was 54-42 per cent., a slightly larger proportion than a decade before. Boiled steel and iron in all forms in 1873, 835,584 tons, was 42-63 per cent., in 1898, 4,622,770 tons, 54-32 per cent, of all rolled in the United States. In 1 901 the pig iron produced in the state was 7, .343,257 tons ; the bituminous coal, 80,914,236 tons ; and the anthracite coal, 59,905,951 tons. In stone, the state's product in 1880 was $1,944,208,

10-62 per cent, of the total, and in 1898, $5,993,616, or 15-60 per cent. This was due to the increase in slate, $2,421,756, 1898, 64-29 per cent, of the total, the state product having trebled since 1880, whenitraised 56-83 per cent, o* all. Clay products, 1898, $9,642,098, were 13-47 per cent, of the total. The Portland cement yield, 221,000 barrels, then 65-91 per cent, of the total, increased to, 1898, 2,095,114 barrels, but sank to 26-30 per cent, of all produced. (t. w*.)

Pennsylvania, University of. â€” The University of Pennsylvania, situated at Philadelphia, Pa., had its beginning in 1740, and was incorporated under its present name in 1791. In 1850 it had 22 instructors and 686 students ; in 1880, 97 instructors and 972 students ; in 1890, 180 instructors and 1579 students ; in

1900 it had 260 instructors and 2673 students. The student body represented 41 states of the Union and 30 foreign countries. The university property consisted (1901) of 57 acres, on which are 32 buildings. Of these

only 4 existed prior to 1880, and 20 were erected between 1890 and 1900. The buildings and equipments were valued at 16,456,218, of which $4,965,261 had been ex- pended since 1890. For the year 1901 the expenditure for educational purposes was $716,380. The undergrad- uate (college) courses are in arts, sciences, finance and economy, and music. There are graduate (philosophy) courses ; schools of law, medicine, dentistry, veterinary medicine, hygiene ; hospitals of medicine and surgery, and of veterinary surgery ; a school for nurses ; a general museum of science and art, especially archseological ; a special institute of anatomy and biology ; an astronomi- cal observatory ; a general and some special libraries. Athletics and physical education are under careful offi- cial supervision, and a large athletic iield is provided. There are a students' club house, a dining hall, and a system of dormitory houses of the latest hygienic con- struction, and several substantial fraternity houses. (See also Education and Universities.) (o. c. h*.)

Penn Yan, a village of New York, U.S.A., capital of Yates county, at the foot of Keuka Lake, on the Northern Central and the Fall Brook railways, west of the central part of the state, at an altitude of 750 feet.

It is in the grape-growing region of central New York, for which it serves as a shipping point. Population (1880), 3475 ; (1890), 4254 ; (1900), 4650, of whom 449 were foreign- born and 67 negroes.

Penryn, a municipal borough (since 1216), parliar- mentary borough, and market town in the Truro parlia- mentary division of Cornwall, England, situated on an arm of Falmouth harbour, 2 miles north-west of Fal- mouth, on the Great Western railway. The borough returned two members to Parliament until 1885, when the number was reduced to one. A Wesleyan chapel was built in 1891. Granite, which is extensively quarried in the county, is dressed and polished here ; chemical and bone manure is also manufactured, and there are engineer- ing works and an iron foundry. Population (1881), 3466 ;

(1891), 3256; (1901), 3190.

Pensacola, a city and seaport of Florida, U. S. A., capital of Escambia county, on Pensacola Bay, in the western part of the state. The harbour is excellent, with 24 feet of water at the entrance, and the city has an extensive export commerce, consisting largely of lumber, fruit, vegetables, and cotton. It has two railways, the Louisville and Nashville, and the Pensacola, Alabama, and Tennessee. Its street plan is regular, it has a good water-supply and sewer system, and varied manufactures. Population (1890), 11,750; (1900), 17,747, of whom 1105 were foreign-born and 8561 negroes.

Pensions {United States). â€” The American “Pension Fund” is so singular a feature of the national budget, that

it is desirable to give here an account of the Old war different clas ses of allowances which are granted.

In the United States allowances for services in wars prior to 4th March 1861 are called “old war” pensions, and may be divided into three classes, viz., (1) invalid pensions, based upon wounds or injuries received, or disease contracted in the course of duty, (2) ” service ” ‘pensions, and (3) land bounties, both granted for service irrespective of injuries.

The first provision made by Congress for pensions was a resolu- tion passed 26tli August 1776, promising invalid pensions toofflcera and men of the army or navy who lost a limb or were otherwise dis- abled in the Revolutionary war, at a rate equal to half of their monthly pay as oflBoers or soldiers during life or continuance of the disability, those not totally disabled to receive an adequate m'onthly pension not to exceed half of their pay. Then followed various Acts of Congress enlarging the provisions for invalid pensions and ex- tending them to those who had been in the war of 1812, and to the

widows and children of those who died in the war or from wounds received in the war. The Act of 3rd May 1846 provided for the prosecution of the war with Mexico and for pensioning those volunteers wounded or otherwise disabled in service. Other Acts were subsequently passed making further provision for pension on account of service in the Mexican war. The first general law grant- ing "service" pensions was not passed until 18th March 1818, thirty ~~five years after the termination of the war of the American Revolution. Its beneficiaries were required to be in indigent cir~~ cumstances and in need of assistance from their country. Two years later Congress became alarmed by reason of the large number of claims filed (about 8000), and enacted what was known as the " Alarm Act," requiring each applicant for pension and each pen- sioner on the rolls to furnish a schedule of his whole estate and income, clothing and beading excepted. Many pensioners were dropped who were possessed of as much as $150 worth of property. Numerous Acts were, however, passed from time to time liberaliz- ing the law or dealing more generously with the survivors of the Revolution. Service pensions were not granted to widows of the soldiers of this war until 1836, and then only for a period of five years and on condition that the marriage of the soldier was prior to his last service, and that the soldier's service was not less than six months. In 1853, seventy years after the close of the war, the limitation as to the time of marriage was removed. The rolls in 1901 contained nine pensions based upon service in the Revolution- ary war. The firet law granting service pensions on account of the war of 1812 was passed in 1871, fifty-six years after the close of the war. This Act required sixty days' service. Widows were not pensionable unless the marriage to the

soldier had taken place prior to the treaty of peace of 15th February 1815. On 9th March 1878, sixty-three years after the war, an Act was passed reducing the requisite period of service to fourteen days and removing the limi- tations as to date of marriage. In 1901 the pension rolls con- tained the names of one survivor and 1527 widows of this war. Service pensions were provided for those who served in the Black Hawk war. Creek war, Cherokee disturbances, and the Seminole war (1832 to 1842), on 27th July 1892, fifty years after the period embraced in the Act : they were granted to those who had served for thirty days and were honourably discharged, and to their widows. In 1901 there were 1086 survivors and 3479 widows pen- sioned under this Act. Service pensions were granted to the sur- vivors of the war with Mexico by an Act passed 29th January 1887, thirty-nine years after the Guadeloupe-Hidalgo treaty. The pen- sions were granted to those who were honourably discharged, and to their widows, for service of sixty days, if sixty-two years of age, or disabled or dependent. This law was liberalized by the Acts of 5th January 1893 and 23rd April 1900, increasing from -88 to S12 per month the pension to survivors who are totally disabled and destitute. In 1901 the pension rolls contained the names of 7568 survivors and 8109 widows on account of service in the Mexican war. To give title to bounty land, service must have been for at least fourteen days or in a battle prior to 3rd March 1855 ; and if in the navy or regular army, must have been in some war in which the United States was engaged. Bounty land waiTants are issued for 160 acres, and over 70,000,000 acres have been granted under the different Bounty Land Acts.

For services rendered in the War of the Eebellion (1861-66) in the army or navy of the United States, or in their various branches, the law provided two distinct systems of pensioning â€" (1) the general Sns/ons." laws, granting pensions for wounds or injuries received, or disease contracted in service in the line of duty, the pensions ranging from $6 to $100 per month; and (2) the so-called Dependent Pension Act, granting pensions for permanent disabilities regardless of the time and manner of their origin, provided they were not the result of vicious habits, the pensions ranging from $6 to $12 per month. What is known as the general law for disabilities incurred in service and in the course

of duty was constituted in the Act of 14th July 1862 as amended by the Act of 3rd IMarch 1873. Under its provisions the following classes of persons are entitled to benefit, viz., any officer of the army, including regulars, volunteers, and militia, or any officer in the navy or marine corps, or any enlisted man, however employed, in the military or naval service of the United States, or in its marine corps, whether regularly mustered or not ; any master serving on a gunboat, or any pilot, engineer, sailor, or other person not regularly mustered, serving upon any gunboat or war-vessel of the United States"; any acting assistant or

contract surgeon; any provost-marshal, deputy provost- marshal, or enrolling officer ; subject to the several condi- tions in each particular case prescribed in the law. This law also embraces in its provisions the following classes, each class being subject to certain specified conditions, viz., widows, children under sixteen years of age, dependent parents, and brothers and sisters. This Act has-been the subject of numerous amendments along more liberal lines. As an illustration a case may be cited where a soldier lost both hands in the service in the course of duty, and was discharged in 1862. He is entitled to a pension of $8 per month from the date of his discharge. Under subsequent Acts he is entitled to $25 per month from 4th July 1864 ; $31.25 from 4th June 1872 ; $50 from 4th June 1874 ; f 72 from 17th June 1878, and $100 from 12th February

1889.

Under the general law a widow or dependent relative cannot be pensioned unless the cause of the soldier's death originated in service in the line of duty ; if it is so shown, a widow may be pensioned whether she is rich or poor. Upon the death or remarriage of the widow the minor children of the soldier under the age of sixteen years are entitled to pension. If the soldier died of causes due to his service, and left no widow or minor children, his other relatives become entitled, if dependent, in the following order, viz.: First, the mother; secondly, the

father ; thirdly, orphan sisters and brothers under sixteen years of age, who shall be pensioned jointly. In 1901 the number of invalids pensioned under the general law was 301,230, and the number of widows and dependent relatives was 90,851.

The so-called Dependent Pension Act is based upon an Act of Congress approved 27th June 1890, which was amended on 9th May 1900. Properly speaking, it may be called ” dependent ” only as regards widows and parents. The main conditions as to the sbldier or sailor are, ninety days’ service, an honourable discharge, and a permanent disability from, disease or otherwise, not the result of his own vicious habits, to such an extent as to render him unable to maintain himself by manual labour. The rates of pension under this Act are $6, $8, $10, and $12 per month. Widows become entitled under this law if they married the soldier or sailor prior to 27th June 1890, provided they are without means of support other than their daily labour, and an actual net income not exceeding $250 per year, and have not remarried. Claims of children under sixteen years of age are governed by the same conditions as apply to claims of widows, except that their dependence is presumed, and need not be shown by evidence. If a minor child is insane, idiotic, or otherwise physically or mentally helpless, the pension continues during the life of said child or during the period of disability. In 1901 there were 438,114 invalids on the rolls, and 145,111 widows and dependents. All women employed by compe- tent authority as nurses during the War of thte Rebellion for six months or more, who are unable to earn a support, are granted a pension of $12 per month by an Act of 5th August 1892. In 1901 the pen- sion rolls contained the names of 650 pensioners under this Act.

In addition to pensions, the United States Government grants the following gratuities : â€” First : If a soldier lost a limb in the service, or as a result of his service in line of duty, he ?’Â«/ is furnished with an artificial limb free of cost every three benefits. years, or commutation therefor, and transportation to and from a place where he shall select the artificial limb. Second : An honourably discharged soldier or sailor is given preference for appointment to places of trust and profit, and preference for reten- tion in all civil service positions. Third : There are**

nine National Soldiers' Homes situated at convenient and healthy points in differ- ent parts of the country, where comfortable quarters, clothing, medical attendance, library, and amusements of different kinds are

provided free of all expense; Government providing the soldiers free transportation to the home, continuing payments of pension while they are members of the home, and increasing the same as disabilities increase. Foitrth : There are twenty-nine homes main- tained by the different states, which are similar in their purpose to the National Homes, the sum of $100 per year being paid by the general Government for each inmate. ~~Many of these state homes also provide for the wives and children of the inmates, so that they need not be separated while they are members of such home. Fifth : Schools are established by the different states for the main~~ tenance and education of soldiers' orphans until they attain the age of sixteen years.

From the close of the Civil War in 1866 to 1901 the Government of the United States paid to its pensioners the sum of $2,666,904,589. The payments for the fiscal year ended 30th June 1901 were ^'"Â°""* $138,531,483. Over $17,000,000 has been %nsioas. paid to surgeons for making medical examina- tions of pensioners and applicants for pensions. The amount paid to pensioners under the so-called Dependent Pensions Act is over $600,000,000. The total amount paid for pensions from 1st July 1790 to 30th, June 1865 was $96,445,444, making a total disbursement for pen- sions from 1790 to 1901 of $2,763,350,033. No other nation or government in all time has dealt so liberally with its defenders.

The appropriations for the support of the National Homes for 1900 amounted to $3,783,450, and appropria- tion for artificial limbs to $549,275. The money appropri- ated by Congress for the payment of pensions is disbursed by eighteen pension agents established in different parts of the country. Pensions are paid quarterly, and the agencies are divided into three classes, one of which pays on the 4th of every month. (h. o. e.)

Penza, a government of east central Russia, south of Nijni-Novgorod, with an area of 14,997 square miles. Population (1881), 1,356,600 ; (1897), 1,491,215, of whom 767,391 were women, and 137,560 lived in towns. It is divided into ten districts, the chief towns of which are Penza, Gorodische (3973), Insar (4264), Kerensk (4006), Krasnoslobodsk (7378), Mokshany (10,072), Narovchat (4695), Mjni Lomoff (9984), Saransk (13,743), Chembar (5335). The schools, chiefly owing to the efforts of the zemstvo (provincial council), are comparatively good; school farms and gardens have increased. More than one-sixth of the area is still under forests (1,661,900 acres in 1898, as against 2,564,400 acres in 1869). More than one-half (4,955,000 acres) is owned by the village com- munities, while 3,482,000 acres are in the hands of private owners. No less than 3,381,100 acres were under cereals in 1900, and 263,700 acres under roots, flax, tobacco, &c. The annual average yield of the crops in 1895-99 was: rye, 11,263,000 cwt.; wheat, 484,000; oats, 4,007,000. Total crop of cereals, 17,811,000 cwt. ; pota- toes, 5,676,000 cwt. Grain and flour are considerable exports. The local authorities have established depots for the sale of improved agricultural machinery, the use of which is rapidly spreading among the peasants. There are also several agricultural and horticultural schools, and two model dairy-farms. Cattle-breeding and espe- cially horse-breeding are comparatively flourishing, there being (1896) 352,500 horses, 270,130 horned cattle, 945,600 sheep, and 200,900 pigs in the government. The peasants are relatively well provided with cattle, there being 112 horses, 86 horned cattle, and 255 sheep to every 100 households. Bees are kept in large numbers. Factories afford employment to only about 14,000 persons (annual returns about Â£1,000,000). Spirits, oils, matches, paper, and timber are the principal manufactures.

Penza, the capital of the above province, 440 miles by rail south-east of Moscow. It has four lyceums for

boys and girls, one real-schide, several technical schools (railway, gardening, and drawing, the last with a fine art gallery), five public libraries, a museum of antiquities, a theatre, and ten hospitals. There is a considerable trade in grain, spirits, and timber. Population (1897), 61,861.

Penzance, a municipal borough, seaport, and market town in the St Ives parliamentary division of Cornwall, England, at the head of Mounts Bay, 26 miles west-south-west of Truro by rail. The spacious new dock was completed in 1887. The harbour has a total area of 24 acres, with 12 to 16 feet depth of water ; and there are a floating dock and a graving dock. Modern erections are public baths, swimming baths, mining and science schools, a free library, and a convalescent home. The West Cornwall Infirmary has been extended. Penzance became a meteorological station in 1893. In 1900 the registered shipping totalled 63 vessels of 6616 tons. In the same year the port was entered by 1476 vessels of 229,608 tons and cleared by 1424 vessels of 220,877 tons. The whole value 9f the trade was Â£71,205, about three-fourths of this beirig for imports. Area, 472 acres. Population (1881), 12,409 ; (1891), 12,432 ; (1901), 13,123.

Peoria, a city of Illinois, U.S.A., capital of Peoria county, on the Illinois river, north-west of the centre of the state, at an altitude of 459 feet. Most of the city is built on a terrace above the river, whence it spreads to the bluff at the back, on which is a fine residential quarter. Its street plan is regular, and it is divided into seven wards. Its water-works are owned by the city, and it has a good sewerage system. Its streets are well paved, mainly with brick. Peoria is in a fertile agricultural region, and is one of the great grain markets of the Mississippi valley. It is the centre of no fewer than thirteen railways, which, with the river, here navigable, give it a large commerce. In 1900 it con- tained 871 manufacturing establishments, with a total capital of $27,971,613, employing 8022 hands. The products were valued at f 48,871,596. These were ex- tremely varied, but over one-half, or $26,792,354, were distilled liquors. The city contains, moreover, several large grain elevators. The assessed valuation of real and personal property was in 1900 placed at the extremely low estimate of $9,353,906, the net debt of

the city was $779,685, and the rate of taxation was $89.10 per $1000. Population (1890), 41,024 ; (1900), 56,100, of whom 8946 were foreign-born and 1402 negroes.

Pepper, William (1843-1898), American physi- cian, was born in Philadelphia, 21st August 1843. He wag educated at the University of Pennsylvania, graduat- ing from the academic department in 1862 and from the medical department in 1864. In 1868 he became lecturer on morbid anatomy in the same institution, and in 1870 lecturer on clinical medicine. From 1876 to 1887 he was professor of clinical medicine, and in 1887 succeeded Dr Stille as professor of theory and practice of medicine. He was elected provost of the university in 1881, resign- ing that position in 1894. Por his services as medical director of the Centennial Exposition in 1876 he received the decoration of knight commander of the order of St Olaf from the king of Sweden. He founded the Medical Times, and was editor of that journal in 1870-71. Among the members of his jirofession he was known particularly for his contributions to the literature on the subject of the theory and practice of medicine, and the System of Medicine which he edited in 1885-86 became one of the standard text-books in America. He contributed to the medical and scientific journals of the day, including ” Trephining in Cerebral Disease,” 1871 ; “Local Treatment in Pulmonary Cavities,” 1874; “Ca- tarrhal Irrigation,” 1881 ;” Epilepsy,” 1883; and “Higher

Medical Education : the i’rue Interest of the Public and the Profession.” He died 28th July 1898. (e. h. w.) Pdrak. See Malay States (Fbdbeatbd).

Pereda, Jose Maria de (1834-

-), one of

the most distinguished of Spanish novelists, was born at Polanco near Santander in 1834. He was educated at Santander grammar school, whence he went to Madrid, where he studied engineering with the vague purpose of entering the artillery corps. Abandoning this design after three years’ trial, he returned home and began his literary career

by contributing articles to a local journal. La Abeja Montafiesa in 1859. He also wrote much in a weekly paper. El Tio Cayetdn, and in 1864 he collected his sketches under the title of Escenas Montanesas. These studies of local life and manners gained Pereda a considerable reputation in his province, but they failed to please the general public. Their originality, their total lack of sentimentalism, and their powerful realism were unacceptable novelties, and a popular novelist of the period, Antonio de Trueba, rebuked the author for his pessimistic view of life. Pereda fought against the revolution of 1868 in M Tlo Cayetdn, vo-iting the news- paper almost single-handed. His articles against the revolutionists were more widely read than his Ensayos dramdticos (1869), and in 1871 he was elected as the Carlist deputy for Cabdrniga. In this same year he published a second series of Escenas Montanesas; and in 1876 appeared Bocetos al temple, three tales, in one of which the author describes his disenchanting political experiences. The Tipos trashumantes belongs to the year 1877, as does El Buey suelto, which is intended as a reply to the thesis of Balzac's work, Les petites misires de la vie conjugate. More and more pessimistic as to the political future of his country, Pereda takes occasion in Don Gonzdlez de la Oonzalera (1878) to ridicule the revolution as he had seen it at work, and to pour scorn upon the nouveaux riches who exploited Liberalism for their personal ends. Two novels by his friend Perez Galdds, Doria Perfecta and Olori-a, drew from Pereda a reply. Be tal palo tal astilla (1879), in which he endeavours to show that tolerance in religious matters is disastrous alike to nations and to individuals. The Eshozos y Basgunos (1881) is of lighter material, and is less attractive than El Sabor de la Tierruca (1882), a striking piece of landscape which won immediate apprecia- tion. New ground was broken in Pedro Sdnchez (1883), where Pereda leaves his native province to portray the disillusion of a sincere enthusiast who has plunged into the political life of the capital. The book was a danger- ous experiment, upon which Pereda ventured with much hesitation; but the result has justified his boldness, for, though Pedro Sdnchez is not actually his best work, it would suffice to make the reputation of any writer. Pereda's masterpiece is Sotileza (1884\ a vigorous render- ing of marine life by an artist who perceives and admires the daily heroisms of his fisher-folk. It has often been alleged against the author that he confines himself to provincial life, to lowly

personages and to unrefined subjects, and no doubt an anxiety to clear himself from this absurd reproach led him to attempt a description of society at the capital in La Montdlvez (1888). If not an absolute failure, La Montdlvez is certainly the least interest- ing of his performances. In La Puchera (1889) he returned to the marine subjects which he knows and loves best. Again, in Penas arriba (1895), the love of country life is manifested in the masterly contrast between the healthy, moral labour of the fields and the corrupt, squalid life of cities. Pereda belongs to the native realistic school of Spain, which, founded by the unknown author of LazariUo de Tormes, was continued by Mateo Alem^n, by Cervantes,

by Quevedo, by Castillo Sol6rzano, and many others. With ^he single exception of Cervantes, however, the picaresque writers are almost entirely wanting in the spirit of generous sympathy and tenderness which con- stitutes a great part of Pereda's charm. His realism is purely Spanish, as remote from M. Zola's moroseness as it is remote from the graceful sentimentality of Pierre Loti. Few writers in any country possess the virile temperament of Pereda, and, with the single exception of Tolstoi, none keeps a moral end more steadily in view. This didactic tendency unquestionably injures his effects. Moreover, his grim satire occasionally de- generates into somewhat truculent caricature, and the excessive use of dialect and technical terms (which has caused the author to supply Sotileza with a brief vocabu- lary) is a grave artistic blemish. But he sees, knows, understands character; he creates not only types, but living personages, such as Andres, Cleto, and Muergo in Sotileza, as Pedro Juan and Pilara in La Puchera; and he personifies the tumult and calm of the sea with more power than Victor Hugo displayed in Les Travailleurs de la Mer. His descriptive powers are of the highest order, and his style, pure of all affectations and embel- lishments, is of singular force and suppleness. The statutes of the Spanish Academy, which require mem- bers to reside in Madrid, were specially suspended in his favour. The compliment was no more than

Pereda deserved, for, with all his limitations, he is as original a genius as Spain has produced during the 19th century.

Perez Caldos, Benito (1845-

-), was born at

Las Palmas, in the Canary Islands, in 1845. In 1863 he was sent to Madrid to study law, drifted into literature, and was speedily recognized as one of the most promising recruits on the Liberal side. Shortly after the revolution of 1868 he abandoned journalism, and employed fiction as the vehicle for propagating advanced opinions. His first novel. La Fontana de Oro, was printed in 1871, and later in the same year appeared El Audaz; from the very be- ginning Perez Galdds was copious. The reception given to these early essays encouraged the writer to adopt novel- writing as a profession. He had already determined upon his scheme â€" and he proceeded with incredible labour to prepare himself for the task before him â€" of producing in the " Episodios Nacionales " a series which might compare with the "Comedie Humaine." Old char- ters, old letters, old newspapers were collected by him with the minuteness of a German archivist ; no novelist was ever more thoroughly equipped as regards the details of his period. Trafalgar, the first volume of the "Episo- dios Nacionales," appeared in 1879 ; the remaining books of this first series are entitled La Oort de Carlos IV., El 19 de Marzo y el 2 de Mayo, Bailin, Napoledn en Chamartin, Zaragoza, Qerona, Cddiz, Juan Mai-tin el Empecinado, and La Batalla de Arpiles. As the names suffice to show, the author's aim is to write the national epic of the 19th century in prose ; and he so greatly suc- ceeded that, long before the first series ended in 1881, he took rank among the foremost novelists of his time. A second series of " Episodios]Sraciona,les," beginning with El Equipaje del Bey Jos6 and ending with a tenth volume, Un Faccioso mds y Algunas Frailes Menos, was brought to a close in 1883, and is, like its predecessor, a monument of industry and exact knowledge, of realism and romantic conception. A third series of "Episodios Nacionales" now in progress will raise the total to thirty volumes. In fecundity and in the power of creating characters, Perez Galdds vies with Balzac. Parallel with this im- mense

achievement in historical fiction, Perez Galdds has published a collection of romances dealing with contem-

porary life, its social problems and religious difficulties. Of these the best known, and perhaps the best, are Dona Perfecta (1876) ; Gloria (1877) ; La Familia de Leon Eoch (1878) ; Marianela (1878) ; Fortunata y Jacinta (1887); and Angel Guerra (1891). Nor does this ex- haust his prodigious activity. Besides adapting several of his novels for stage purposes, he has written original dramas such as La Loca de la Casa (1893), and San Quintin (1894). As experiments these plays are pecu- liarly interesting ; but the very diffuse, exuberant genius of Perez Galdds can scarcely accommodate itself to the narrow convention of the theatrical form, and his in- cessant preoccupation with politico-social theories is a very serious blemish upon his art. This defect, though present, is less obvious in his novels ; yet the rapidity with which these are produced â€" four yearly â€" naturally affects their style. Still, when all allowances are made, it must be admitted that in Perez Galdds Spain possesses a genuinely national novelist of extraordinary talent, a fertile inventor of types, and a most happy humorist, who in his eccentrics and oddities is scarcely inferior to Dickens. He is a member of the Spanish Academy and is a deputy in the Cortes ; but it is solely as the romancer that his name is familiar wherever Spanish is spoken.

Perigueux, chief town of the department of Dordogne, France, 297 miles south-south-west of Paris, on the railway from Bordeaux to Lyons and the river Isle, on the left bank of which is the suburb of Barris. The large seminary, rebuilt 1887-89, is one of the finest in France. P^rigueux is said to be the most important market in France for young pigs. Excellent building stone is quarried. Population (1881), 22,331; (1901),

28,876.

Periodicals. â€" The history of the origin and de- velopment of periodicals (apart from newspapers) in all languages down to 1884 is traced in the article on the subject in vol. xviii. of this Encyclopaedia (ninth edition). Since that date the number of periodicals in every

country, especially in Great Britain and the United States, has increased enormously, and the ten- dency has been to specialize in every direction. All professions and trades have not only their general class- periodicals, but every section has its special review or magazine. There were 7 cycling periodicals published in Great Britain in 1884 ; in 1902 there were 16, besides 5 for motors and motoring. There were 15 insurance and 18 medical periodicals in 1884 ; in 1902 they numbered 33 and 47. Cheap periodicals appealing to a class of readers hitherto unprovided for, such as Tit-Bits (1881) and Answers (1888), and profusely illustrated magazines like the Strand (1891) and Pearson's (1896), which owe much to process-printing from photographs, have multi- plied. Most of these publications do not preserve liter- ary matter of permanent value, but the high-class reviews and the archaeological, artistic, and scientific magazines contain a great mass of valuable facts, so that general and special indexes have become necessary to all literary workers. The Edinburgh and Quarterly Reviews, the Revue de Deux Mondes, the Revue Historique, Deutsche Rundschau, and others issue from time to time general indexes of their contents, while the periodical literature of special departments of study and research are noted in the various Jahresberichte published in Germany, and indexed monthly in such English and American maga- zines as the Engineering Magazine, the Geographical Journal, English Historical Review, American Historical Review, Economic Journal (for political economy). Library Journal and Library Association Record (for biblio-

graphy), aad the Educational Review. There are also annual indexes, such as those in the Zoological Becord and the Annales cle Giographie.

The most complete collection of periodicals in all languages ever brought together is that preserved in the British Museum, and the excerpt from the printed cata- logue of the library, entitled Periodical Publications (London, 1899-1900, 6 parts folio, with index), includes journals, reviews, magazines, and other works issued periodically, with

the exception of transactions and pro- ceedings of learned societies and of British and colonial newspapers later than 1700. The titles of these periodi- cals, which number about 23,000, are arranged under the town or place of their publication. The collection is very complete as regards Great Britain and Ireland, less perfect as regards the British colonies and the United States, and it includes the leading periodicals belonging to every other country in the world. An examination of the catalogue shows that about 3840 were published since 1880, many, of course, being of an ephemeral nature. Arranged geographically, these fall into the following divisions :â€" United Kingdom : England (1956), Wales (26), Scotland (106), Ireland (30) ; total, 2118. British Colonies ajstd Possessions : Europe (22), Asia, in- cluding India (120), Africa, including Cape Colony (81), America (11), Canada (37), Australia (63), New Zealand (20); total, 354. Europe ; Austria (72), Bel- gium (37), Bulgaria (5), Denmark (23), France (312), Germany (268), Greece (9), Holland (32), Italy (133), Portugal (15), Eussia (39), Spain (37), Sweden and Norway (21), Switzerland (30), Turkey (2) ; total 1025. Asia : China (16), Japan (6), other countries (21) ; total, 43. Africa : Egypt (6), other countries (6) ; total, 11. North America: United States (260), other countries (4) ; total, 264. South America : Argentine (6), Brazil (4), other countries (15) ; total, 25.

The magazines published in the United Kingdom number 2486 (Mitchell's Newspaper Press Directory, 1902). In 1884 the London monthlies were 699, and the quarterlies 129. In 1902 they numbered 1010 and 215 (May's British and Irish Press Guide, 1884, and Willing's Press Guide, 1902).

It is difficult sometimes to define a magazine or review as distinguished from a newspaper or a trade or pro- fessional journal, but the following is a representative list, omitting publications of societies, of existing British, American, French, German, Italian, and Spanish periodi- cals founded since 1880 : â€"

BRiTisH.>)icestor (1902); Anglican Church Magazine (1886); Anr/lo-Oatholic (1899); Anglo-Saxon Beview (1899); Annals of Botany (1887) ; Annals of Surgery (1885) ; Answers (1888) ; Antiquary (1888) ; Architects" Magazine (1900) ; Architectural Review (1896) ;

Archives of Surgery (1889) ; Artist (1880) ; Author (1890); Babylonian and Oriental Becord (1887); Bacon- iana (1886) ; Badminton Magazine (1895) ; Bankers" Journal (1889); Beekeepers" Becord (1883); Bill Poster (1887); Bimetallist (1895); Black and White (1891); Board of Trade Journal (1886); Bookman (1891); Book-Prices Current (1887); Books of Tn-Daij and Books of To-Murrow (1894) ; British Dental Journal (1898) ; British Empire Review (1899) ; British Gynaecological Journal (1885); British Journal of Dermalologij (1888); Broadway (1899); Builders Journal (1895); Cabinet Maker (1880); Camera Maga- zine (1901); Canadian Gaxctte (1883); Candid Friend (1901); Caxton Magazine (1901) ; Century Guild Hohhy Ilnrse (1893) ; Chamber of Commerce Journal (1882); Chimes (1896); Classi- cal Beview (1887) ; Connoisseur (1901),; Ciimnopolitan (1886) ; Country Life (1894); Economic Journal (1891); Economic Review (1891); Educational Beview (1890); Enriineering Magnzine (1881); English Historical Review (1886); English niiistrated Magazine (1883); Feilden's Magazine (1898); Folldore (1888); Gardener

(1892) ; Genealogical 3Rigazine (1897) ; Geographical Journal

(1893) ; liarmsworth Magazine (1898) ; Harper's Magazine, English edition (1880); Hibernia (1897); Home Counties Maga- zine (1895); Idler (1892); Imperial and Asiatic Quarterly Review (1886) ; Index of Archceological Papers (1891) ; Index to the

Periodical Literature of the World (1890) ; International Journal of Ethics (1889) ; Investors" Review (1889) ; Jewish Quarterly Beview (1888) ; Journal of Balneology and Climatology (1897) ; Journal of Hellenic Studies (1881); Journal of Hygiene (1901); Journal of Indian Art (1886) ; Journal of Laryngology (1887) ; Journal of Malacology (1892); Journal of Obstetrics (1902); Journal of Pathology (1892); Journal of Physical Therapeutics (1900); Journal of State Medicine (1892); Journal of the Board of Agriculture (1896); King (1899); Lady"s Magazine (1901); Lady's Bealm (1896) ; Laryngoscope (1893) ; Law Notes (1882) ; Law Quarterly Review (1885); Legal Literature (1899); Library (1889); Library Assistant (1898) ; Library Association Record (1899) ; Library World (1898); Literary Gazette (1898); Literature (1897; combined with Academy, 1901) ; Longman's Magazine (1882) ; IPClure's Magazine, English edition (1894); Medical

Magazine (1892) ; Medical World (1896) ; Metaphysical Magazine (1896) ; Modern Language Quarterly (1897); Monthly Magazine of Fiction (1885); Monthly Beview (1900); Moring's Quarterly (1896); 3Iotor Car World (1899); Munsey's Magazine (1900); Museums Journal (1901); Musical News (1891); National Beview (1883); Nature Notes (1890); New Ireland Review (1894); New Liberal Beview (1901); Onlooker (WOO); Open Court (IS87); Ophthalmic Beview (1881); Optician (1891); Outlook (1898); Page s Magazine (1901); Pall Mall Magazine (1893); Patents (1895); Pearson" s Magazine (1896) ; Pearson"s Weekly (1890) ; Philatelic Journal (1901) ; Physical Beview (\?,m) ; Pick-me-up (1888); PÂ«ot {'i^OO); Playgoer (1901); Positivist Beview (1895); Quarterly Medical Index (1900); Quarterly Medical Journal (1890) ; Bailway Engineer (1880) ; Beporters' Magazine (1880) ; Beview of Reviews (1890) ; Royal Magazine (IS<3S); St George (1S9S); St Martin' s-le-Grand (1890); Sandow's Magazine (1898) ; Scandinavian (1881) ; Science Abstracts (1898); Science Siftings (1891); Scientific Roll (1880); Scribner's Magazine, English edition (1887) ; Secretary's Journal (1893) ; Sketch (1893); Smart Set, English edition (1901; Something to Read (1881) ; Speaker (1890) ; Sphere (1900) ; Stage (1880) ; Strand Magazine (1891); Studio (1893); Sunday Strand (1899); Tatler (1901); Temple Magazine (1896); Tit-Bits (1881); To-Day (189S); Travel (1896) ; Twentieth Century (1900) ; Universal Magazine (1900); Wide World Magazine (1898); Windsor Magazine (1895) ; Toung Man (1887); Young Woman (1892); Zoophilist (1881).

Ameetcan. â€" Alienist and Neurologist (1880); American Ama- teur Photographer (1888); American Book Lore (1888); American Geologist (1888); American Engineer (1893 ; commenced as Rail- road and Engineering Journal, 1887) ; Am,erican Journal of Archceology (1885); American Jewish Year Book (1899); American Journal of Philology (1880) ; American Journal of Psychology (1887) ; American Journal of Semitic Languages (1893 ; commenced as Hebraica, 1884); American Journal of Sociology; Annual of the Universal Medical Sciences (1888) ; Annual Literary Index (1892); Arena (1889); Astrophysical Journal (1895; commenced as Sidereal Messenger, 1882) ; Biblical World ; Bibliographer (1902) ; Book Chat (1886) ; Bookman (1895) ; Book Lover ; British American (1887); Cassier's Magazine (1891); Chapbook

(1894); Chataitquan (1880) ; Christian Science Journal (1896) ; Church- ma!n(1893); Collector (1887); Cosmopolitan (1886) ; Critic (1881); Educational Review (1891); Electricity (1891); Engineering and ^lining Journal (1893); Esoteric (1888); Forum (1886); Gunton's Magazine of American Economics (1896 ; commenced as Social Economist, 1891); Federal Reporter (1880); Harvard Laio Recieuj (1894); Humanitarian (1892); Intelligence (1897; commenced as Metaphysical Magazine, 1895) ; Journal of Morphology (1887) ; Journal of Political Economy (1892) ; Journal of Practical Metaphysics (1896) ; Journal of U.S. Artillery (1891) ; Kipling Note Book (1899); Ladies' Home Journal (18t<2); Library N^tes (1886); Literary News (1880); McClure's Magazine (1893); Mazama (1897); Medico-Legal Journal (1882); Modern Language Notes (1886); Monist (1890); Municipal Affairs (1897); Nautilus (1889); New Church Review (1894); New Science Review (1894); New York Genealogical and Biographical Record ; Neio World (1892); Notes on New Books (1890) ; Open Court (1881); Pediatrics (1896) ; Philosophical Reciew (1892) ; Photo American Review (1891); Poet Lore (1889); Popular Astronomy (1893); Prxco Lntinus; Presbyterian and Reformed Review (1890); Psychological Review (1894); Quarterly .lournal of Economics ; Records of the Past; Ring Record (1890); ,SV)V'wc. (1883); Scrihner's Magazine (1887) ; Select Notes (1895) ; Sewanee Review (1892) ; Statistician and Economist (1893; conunenced as McCarty's Annual Statistician, 1884) ; Street Raihvay Gazette (1886) ; Terrestrial Magnetism (1896) ; Virginia Magazine ; West American Scientist (1885) ; K Oman's Journal ; Yale Review (1892).

FREjicu.â€"Aerophile (189:!) ; Ami des 2Ionuments (1887) ; Annales de Droit Commercial (1S87) ; Annales Economiqms (founded as La France Commerciale in 1886) ; Annales de Geographic (189 1) ; Annales de VEcolc Libre des Sciences Politiques 0886); Annales du dliili (1889); Annales des Sciences Psychiqucs (1891); Anthropologic (1890); Archives de Biologie ; Archives de

V Anthropologie Criminelle; Annales de Neurologic (1880); Les Arts {1002) ; Botaniate (1888) ; Bulletin Critique (1882) ; Bulletin, de Geographic Historique ; Bulletin de Numismatique (1891) ; Bul- letin des Musees (1890) ; Bulletin des Sommaires des Journaux

(1888) ; Cocarde (1888) ; Diatomiste (1890) ; Le Droit d'Avteur (Bern, 1888) ; jSclairage Mlectrique (1894) ; Â£lectricien (1881) ; Etudes Beligieuses ; France Noire (1894) ; Oenlc Civil (1880) ; Grande Dame (1893) ; Hermine (1889) ; Initiation (1888) ; Inter- mediaire des Mathimaticiens (1894) ; Intransigeant (1880) ; Jour- nal de Botanique (1887) ; Justice (1880) ; La Lecture (1887) ; Lotus Bleu (1890) ; Manuscrit (1894) ; Minerva (1902) ; Mouvement Geographique (Brussels, 1884) ; Moyen Age (1885"l ; Nouvelle Revue Betrospective (1894) ; Orient (1889) ; Politique Coloniale (1892) ; Question Sociale (Brussels, 1893) ; Beforme Sociale (1881); Benaissance Latine (1902) ; Bepertoire des Ventes (1894) ; Bevolu- tion Frani^nise (1881) ; Bemie Africaine ; Bevue Albanaise (Brus- sels, 1897); Bevue Algerienne ; llevue Anglo-Bomaine (1895); Bevue Biblique (1892) ; Bevue Blanche (1891, new series) ; Bevue d'Art Dramatique (1886) ; Bevue d^ Assyriologie (1884) ; Revue de Cavalerie (1885); Bevue de Chirurgie (1881) ; Bevue d"Sconomie Politique (1887) ; Bevue de VArt Ohretien; Bevue de VArt Ancien etModerne (1897) ; Bevue de T Histoire des Beligions (1880) ; Bevue de r Orient Latin (1893) ; Bevue de V Univ. de Bruxelles (1896) ; Bevue de Mathematiques sphciales (1890) ; Bevue de Midecine (1881) ; Bevue de Metaphysique (1893) ; Bevue de Paris (1894) ; Bevue des Bibliotheques (1891) ; Bevue du Clerge Fran(^ais (1894) ; Bevue du Droit Public (1894) ; Bevue du Genie Militaire (1887) ; Bevue du Monde Latin (1883; now published as Le Monde Latin et le Monde Slave) ; Bevue Frangnise de V Stranger (1885) ; Bevue Generale de Botanique (1889) ; Bevue Hispanique (1894) ; Bevue Historique de V Quest (1885); Bevue Illustree (1886); Bevue Independante (1882) ; Bevue Internationale de Sociologie (1893) ; Bevue Pedagogique (1882); Bevue Politique et Parlementaire (1894) ; Bevue Semitique (1893) ; Bevue Socialiste (1885) ; Science Sociale (1886) ; Sciences Populaires (1886) ; Semaine Medicale (1884) ; La SociHe Nouvelle (Brussels, 1885).

German. â€” Academische Monatshefte (Stuttgart, 1884) ; Afrika (1894) \AllgeineinerAnzeigerf.Buchbindereien (1885) ; Allgemeine Deutsche Universitdtsneitung (1887) ; Die Arbeiter-Versorgung (1884) ; Annuaire Genealogique par H. B. Hiort Lorenzen (1882) ; Archiv f. lutein Lexikographie (1884) ; Archiv f. Geschichte der Philosophie (1888) ; Archiv f. Litt. u. Kirchengeschichte des Mittelalters (1885) ; Argo (1892) ; Berliner philol. Wochenschrift (1885 ; commenced as Phil. Wochenschrift, 1881) ; Biographisches Jahrbuch (1897 ; commenced as Biogr. Blatter, 1895) ; Biologisches Centralblatt (1882) ; Blatter f. pommersche Volks/cunde (1893) ; Blatter f. Taubstummbildung (1887) ; Botanisches Centralblatt (1880) ; Buchgewerbeblatt (1892) ; BurschenschaftUche Blatter (1887) ; Byzantanische Zeitschrift (1892) ; Gdcilia (1893) ; Central- blatt f. allgein. Pathologic (1890) ; Centralblatt f. Anthropologie

(1896) ; Centralblatt f. Bakteriologie (1887) ; Centralblatt/. Biblio-thekswesen (1884) ; Centralblatt/. d. gewerbliche Unterrichtswesen in Ostp.rreich (1883) ; Centralblatt /. d. gesamte Medicin (1889) ; Cen-tralblatt/. Physiologie (1887); Dermatologische Zeitschrift (1894); Deutsche Dichtung (1886); Deutsche Dramaturgic (1895) ; Deutsche evangel. Kirchenzeitung (1887) ; Deutsche Litteraturzeitung (1880) ; Deutsche Mundarten (1895) ; Deutsche Worte (1880) ; Deutsches Kolonialblatt (1890) ; Deutsches Wochenblatt (1888) ; Elektro-technische Zeitschrift (1880) ; La Esperantisto (1889) ; Euphorion (1894) ; Fdrberzeitimg (1889) ; Finanz-archiv (1884) ; Forschungen z. Geschichte Bayerns (1897) ; Fortschritte d. Elektrotechnik (1888) ; Franco-Gallia (1884; commenced as Gallia, 1883) ; Freie Buhne

(1889) ; Freie Worte (1901) ; Geographische Zeitschrift (1893) ; Geologisches Centralblatt (1901) ; Die Gesellschaft (1888) ; Die Gleichheit (1891) ; Goethe-Jahrbuch (1880) ; Heimat (1896) ; Hessen-land (1887) ; Himmel u. Erde (1888) ; Historische Vierteljahrschri/t (1898 ; commenced as Deutsche Zeitschrift/ Geschichtswissenscha/t, 1889) ; Hygieia (1885) ; Indogermanische Forschungen (1891) ; Internationale Litteraturberichte (1896) ; Internationale Bevue u. d. gesammten Armeen u. Flotten (1882) ; Internationale theolog. Zeitschrift (Bern, 1893) ; .lahrbuch der hamburg. wiss. Anstalten

(1884) ; Jahrbuch d. kunsthistorischen Sammlungen des Kaiser- hauses (Vienna, 1883) ; Jahrbuch der Naturwissenscha/ten (1886) ; Jahrbuch des k. preuss. Kunstsammlungen (1880) ; Jahresberichte der Geschichtsieissenscha/t (1880) ; Jahresberichte /. n. deutsche Litteraturgeschichte (1890) ; Jahresberichte u. d. hohere Schulwesen (1887) ; Journal /. Landwirtscha/t (1894) ; Kantstudien (1896) ; Klinisches Jahrbuch (1889) ; Dns katoUsche Seelsorger (1889) ; Koloniales Jahrbuch (1889) ; Eritik (1894) ; Kultur (1890) ; Die Kunst f. Alle (1885) ; Litterarische Echo (1898) ; Litteraturblatt f. germ. u. rom. Philologie (1880) ; iofse (1900) ; Minerva (1891) ; Mittheilungen von Forschungsreisenden (1884) ; Moderne Kunst

(1897) ; Monatshefte f. prak. Dermatologie (1882) ; Monatsschrift /. neue Litt. u. Kunst (1896) ; Monthly International Journal o/ Anatomy and Histology (1885 ; German title, 1884) ; Nation (1882) ; Naturwissenscha/tl. Bundschau (1886) ; Neue Christoterpe (1880) ; Neue philolog. Bundschau (1886) ; Neues Archiv /. sdchsische

Geschichte (1 880) ; Neuphilologische Blatter (1894) ; Osterreichisch-Ungarische Bevue (1886) ; Orientalische Bibliographic (1888) ; OrientalistischeLitt.~~Zeitung (1898) ; Prdhistorische Blatter (1889) ; Pan (1895) ; Der Protestant (1897) ; Bheinische Geschichtsbldtter (1894 ; commenced as Bonner Archiv, 1889) ; Bomanische For~~ schungen (1883) ; Sociale Praxis (1895 ; commenced as Social- poUlisches Centralblatt, 1891) ; Staats-, Ho/-, u. kommunal Hand- huch (1888); Theologisehe Bundschau (1897) ; TheologischerJahres- bericht (1882) ; Therapeutische Monatshefte (1887); Umschau (1897); Der Xfrquell (1897 ; commenced as Am Ur-Quell, 1890) ; Versoh- nung (1893 ; commenced as Einiges Christenthum, 1892) ; Vienna Oriental Journal (1887) ; Viertelsjahrsschri/t f. Staats- u. Volks- wirtschaft (1895 ; commenced as Z. f. Litt. v. gesch., 1893) ; Die Welt (1897) ; Der Weltmarkt (1887) ; Westdeutsche Zeitschri/t (1882) ; Westostliche Bundschau (1894) ~~Das Wetter (188i) ; Wiener entomol. Zeitung (1882) ; Zeitschrift/. a/rikan. u. ocean. Sprachen (1895) ; Zeitschri/t ‘/. Assyriologie (1886) ; Zeitschri/t /. Bucher~~ freunde (1893) ; Zeitschrift/ celtische Philologie (1896) ; Zeitschrift f. christliche Kunst (1888) ; Zeitschrift f. d. deutschen Uhterricht (1887) ; Zeitschrift f. hebraeische

Bibliographic (1896) ; Zeitschrift f. Hygiene (1886) ; Zeitschrift f. Hypnotismus (1892) ; Zeitschrift f. Instrumentenkunde (1881) ; Zeitschri/t f. internat. Privat- u. Strafrecht (1890) ; Zeitschrift f. Nahrungsmittel-Untersuchung (1887) ; Zeitschrift f. orthopdd. Chirurgie (1892) ; Zeitschrift f. physikal. Chemie (1887) ; Zeitschrift f. Psychologic (1890) ; Zeit- schrift f. Social- u. Wirthschaftsgeschichte (1893) ; Zeitschrift f. vergleich. Litteraturgeschichte (188ii) ; Zeitschrift f. Volkswirtschaft (1892) ; Zeitschri/t/. wiss. Mikroskopie (1884) {Die Zukun/t (1892). Italian. â€" Alaud(Z (1889) ; V Alighieri ; Archivio di Psichiatria

(1880) ; Archivio Storico delV Arte (1888) ; Archivio Storico per Trieste (1881) ; Atene e Boma (1898) ; VAvvenire (1897) ; Bes- sarione (1896) ; Bollettino di Bibl. e Storia delle Sc. Matematiche (1898) ; Bollettino di Filologia Olassica (1894) ; Nuovo Bollettino di Archeologia Cristiana (1895) ; II Corriere dei Teatri (1898) ; Ephemerides LiturgiccB (1887) ; II Foro Penale (1891) ; Giornale Dantesco (1893) ; Giornale degli Economisti (1886) ; Italian Beview (1900) ; Italia Evangelica (1881) ; La Libreria Italiana (1897) ; Minerva (1891) ; Muratori (1892) ; Naturalista Siciliana (1881) ; Poliantea Polemica ed Oratoria (1880) ; Bassegna Bibliografica delta Lett. Ital. (1893) ; Bassegna di Scienze Sociali (1883) ; Bi- /orma Sociale (1894) ; Bivista di Bibliografia Italiana (1896) ; Bivista Filosojica (1886) ; Bivista d' Italia (1898) ; Bivista delle Biblioteche (1888) ; Bivista Geogra/lca Italiana (1893) ; Bivista Italiana Numismatica (1888) ; Bivista di Paleontologia (1895) ; Bivista per le Scienze Giuridiche (1886) ; Bivista Musicale Italiana (1894) ; Bivista Storica del Bisorgimento Ital. (1895) ; Bivista Politica e Letteraria (1897) ; Studi Storici (1892).

Spanish. â€" La Administracion (1894) ; Anuario del Comercio

(1881) ; La Biblioteca (Buenos Aires, 1896) ; Boletin de la Biqueza publica de Venezuela (1891) ; Boletin Bibliogrdjico Espahol (1897) ; La Ciudad de Dios (commenced as Bevista Augustiniana in 1882) ; Cronica Comercial (1886) ; Espana Moderna (1889) ; Nuestro Tiempo ; Bevista Critica (1895).

The eighth volume of the Tenth Report of the U.S. Census (1884) contains a statistical report on the newspaper and periodical press of America by S. IST. D. North.

Indexes to Periodicals. â€” Poole“s Index, by W. I. Fletcher, revised ed., 1880-81, 2 vols. 8vo ; Poolers Index, 1st Supplement, 1882-87, by W. F. Poole and W. I. Fletcher, 1888, 8vo ; 2nd Supplement, 1887-92, by W. I. Fletcher, 1893, 8vo ; 3rd Supplement, 1892-96, by “W”. I. Fletcher and F. O. Poole, 1897, 8vo ; The Co-operative Index to Periodicals, 1885-94, ed. W. I. Fletcher, 1886-94, 9 pts. ; The Annual Literary Index, including Periodicals, ed. by W. I. Fletcher and R. R. Bowker, 1892-1901, New York, 11 vols. 8vo ; Index to Periodicals /or 1890, &c. (Beview o/ Beviews), by Miss Hetherington, 1891- 1901, 11 vols. 4to ; Q. P. Indexes; Cotgreave’s Contents Subject Index to General and Periodical Literature, 1900.

Among special indexes may be mentioned : Index to Legal Periodical Literature, by L. A. Jones, Boston, U.S., 1888, 8vo ; Index o/ Archceological Papers, 1891, &c. ; The Catalogue o/ Scientific Papers, compiled by the Royal Society, 1800-83, 12 vols. 4to ; Index Catalogue of the Library of the Surgeon- GeneraVs Office, Washington, 1880-95, 16 vols, large 8vo, and Index Medicus (monthly) ; Bejiertorium der technischen Journal Litteratur, Berlin, published by the German Patent Office ; Bepertoire Biblio- graphique des principales Bevucs Fran^^aises, par D. Jordell, Paris, 1898, &c., 8vo ; Bibliographic der deutschen Zeitschriften Litteratur, von F. Dietrich, 1897-98.

Bibliography of Recent and Current Periodicals. â€” Periodical Publications, British Museum Catalogue, 1899-1900, 6 pts. ; R. Mosse’s Guide to Newspapers and Periodicals of Europe, Berlin, 1885 ; Willing’s Press Guide, 1902 ; Mitchell’s Newspaper Press Directory, 1902 ; Sell^s Dictionary o/ the World’s Press, 1902 ; Street’s List of Newspapers, 1902 ;

Rowell’s American Newspaper Directory, 1902 ; Bolton’s Cata- logue of Scientific and Technical Periodicals, 1665-1882 (Smith- sonian Institution) ; Scudder’s Catalogue of Scientific Serials, 1613-1876 (Harvard University) ; 0. Gracklauer’s Deutscher Journal-Katalog fiir 190S, Leipzig, 1902 ; Sper- li;:5g’s Kl. zeitschriflen Katalog, 1896 ; Catalogue ^

des Journaux, Bevues, &c., par H. Le SonciEE, 1902. (h. e. t.)

Peripatus. â€” ^Peripatus is a genus of animals belonging to the air-breathing division of the phylum Arthropoda. It differs, how- ever, from all other Arthropoda in such im- portant respects that a special class, equivalent in rank to the old-established Arthropod classes, has been created for its sole occupancy. This class has been named the Prototracheata or Onychophora, and may be most appropriately

last pair, or it may be subterminal. The colour varies con- siderably in the different species, and even in different indi- viduals of the same species. The skin has a velvety appearance, and is thrown into a number of transverse ridges, along which

placed in the system in the neighbourhood of the Myriapoda, though it must not be forgotten that it differs from the Myriapoda more than the Myriapoda differ from other Arthropoda, and that in some respects it presents features which recall the segmented worms (Annelida). The genus has a wide distribution (see later), but it has not been found in Europe or in North America. There is but little variety of structure in the genus, and the species are limited in number. They live beneath the bark of trees, in the crevices of rock and of rotten stumps of trees, and beneath stones. They require a moist atmosphere, and are exceedingly susceptible to drought. They avoid light, and are therefore rarely seen. They move slowly, picking their course by means of their antennae. When irritated they eject with considerable force the contents of their slime reservoirs by means of the sudden contractiion of the muscular body-wall. The slime, which appears to be harmless, is extremely sticky, but it easily comes away from the skin of the animal itself. Locomotion is eif ected by means of the legs, with the body fully extended. Hutton describes his specimens as sucking the juices of flies,

which they had stuck down with their slime, and they have been observed in captivity to devour the entrails which have been removed from their fellows, and to eat raw sheep's liver. They move their mouths in a suctorial manner, tearing the food with their jaws. They have the power of extruding their jaws from the mouth, and of working them alternately backwards and forwards. They are viviparous ; the young are fully formed at birth, and differ from the adult only in size and colour. The mother does not appear to pay any special attention to her offspring, which wander away and get their own living. It has lately been stated that some of the Australian species are normally oviparous, but this has not been fully proved. Sexual differences are not strongly marked, and are sometimes absent. There does not appear to be any true copulation. In some species the male deposits small oval sperjnatophores indiscriminately on any part of the body of the female. It seems probable that in such cases the spermatozoa make their way from the adhereilt sperm atophore through the body-wall into the body, and so by traversing the tissues reach the ovary. In other species which possess receptacula seminis it is probable that fertilization is effected once only in early life before any ova pass into the uterus.

External Features. â€" The anterior part of the body may be called the head, though it is not sharply marked off from the rest of the body (Fig. 1). The head carries three pairs of appendages, a pair of simple eyes, and a ventrally-placed mouth. The body is elongated and vermiform ; it bears a number of paired appendages, each terminating in a pair of claws, and all very much alike. The number varies in the different species. The anus is always at the posterior end of the body, and the generative opening is on the ventral surface, just in front of the anus ; it may be between the legs of the penultimate pair, or between the legs of the

{After Sedgwick.) papillae, which are found

Fig. 1. â€" Peripatus capensis, drawn from life. Life size.

wart-like papillae are placed. These papillae, which are everywhere, are the primary papillae ; they are covered with small, scale-like projections called secondary papillae, and are specially developed on

the dorsal surface, less so on the ventral. Each papilla carries at its extremity a well-marked spine. Among the primary papillfe smaller accessory papillae are sometimes present. The appendages of the head are the antennae, the jaws, and the oral papillae. The mouth is at the hinder end of a depression

called the buccal cavity, and is surrounded by an annular tumid lip, raised into papilliform ridges and bearing a few spines (Fig. 2). Within the buccal cavity are the two jaws. They are short, stump-like, muscular structures,, armed at their free extremities by a pair of cutting blades or claws, and are placed one on each side of the mouth. In the median line of the buccal cavity in front is placed a thick muscular protuberance which may be called the tongue, though attached to the dorsal instead of to the ventral wall of the mouth (Fig. 2). The tongue row of small, teeth. The (Figs. 3 and 4),

Fig. 2.â€” Ventral view of the head of P. cape7m.'i {Afie/r Sedgwick.) ant, antennae ; or.p, oral bears a papilla. ; JT.l, first leg ; T, tongue. chitinous

jaw-claws ^ ^ . ^, which resemble in all essential points the claws borne by the feet, and, like these, are thickenings of the cuticle, are sickle-shaped. They have their convex edge directed forwards, and their concave or cutting edge turned backwards. The inner cutting plate ^Fig. 3) usually bears a number of cutting teeth. The oral papillae are placed at the sides of the head (Fig. 2) . The ducts of the slime-glands open at their free end. They possess two main rings of projecting tissue,

Fig. 3,-

Inner jaw-claw of P. â– (After Balfour.)

FiÂ«. 4.â€” Outer jaw-claw of P. capeniris. (After Savour.)

and their extremities bear papillae irregularly arranged. The ambulatory appendages vary in number. There are seventeen pairs in P. capensis and eighteen in P. Balfouri, while in P. jamai- censis the

number varies from twenty-nine to forty-three. They consist of two main divisions, which we may call the leg and the foot (Fig. 6). The leg (I) has the form of a truncated cone, the broad end of which is attached to the ventro-lateral wall of the body, of which it is a prolongation. It is marked by a number of nngs of papillae placed transversely to its long axis, the dorsal of which are pigmented like the dorsal surface of the body, and the ventral like the ventral surface. At the narrow distal end of the leg there are on the ventral surface three or four (rarely five) spmiferous pads, each of which is continued dorsally into a row of

papillse. The foot is attached to the distal end of the leg. It is slightly narrower at its attached extremity than at its free end. It bears two sickle-shaped claws, and at its distal end three (rarely

four) papillse. The part of the

foot which carries the claws is

especially retractile, and is gener-

. Â¥,â–)](â– ‘if ^lly found more or less telescoped

J- â€” til. J intd the proximal part. The legs

of the fourth and fifth pairs differ

\iÂ» \Â»- from the others in the fact that

Fir. 5.â€” VeDtralTiewof lastlegofa male P. capensis. {After Sedg-wick.) /, foot ; I, leg ; p, splni- ferous pads. The white papilla on the proximal part of- this leg: is characteristic of the male of this species.

the third pad (counting from the distal end of the leg) carries the opening of the enlarged nephridia of these segments. In some species certain of the legs bear on their ventral sides furrows with tumid lips

and lined by smooth non-tuberculate epithelium ; they are called coxal organs, and it appears that they can be everted. The males are generally rather smaller and less numerous than the females. In those species in which the number of legs varies the male has a smaller number of legs than the female.

Breeding. â€” As already stated, Peripatus is viviparous. The Australasian species come nearest to laying eggs, inasmuch as the eggs are large, full of yolk, and enclosed in a shell ; but development normally takes place in the uterus, though, abnormally, incompletely developed eggs F,a. s.â€”Periimtus mpen- are extruded. The uterus always con- sis dissected so as to show- tains several young, which are usually at different stages of development and are born at different times' of the year. In most of the African species, however, the embryos of the uterus are almost of the same age and are born at a definite season. The young of P. capensis are born in April and May. They are almost colourless at birth, excepting the antennae, which are green, and their length is 10 to 15 mm. A large female will produce thirty to forty young in one year. The period of gestation is thirteen months, that is to say, the ova pass into the oviducts about one month before the

young of the pneceding year are born.

Anatomy. â€" 'fa& alimentary canal (Fig. 0). The buccal cavity, as explained above, is a secondary formation around the true mouth, which is at its dorsal posterior end. It contains the tongue and the jaws, which have already been described, and into the hind end of it there open ventrally by a median opening the salivary glands. The mouth leads into a muscular pharynx, which is con- nected by a short oesophagus with the .stomach. The stomach forms by far the largest part of the alimentary canal. It is a dilated soft-walled tube, and leads behind into the short narrow rectum,

the alimentary canal, slime glands, and salivary glands. {Aft&F Balfour.) The dissection is viewed from the ventral side, and the hps (Z) have been cut through in themiddleline behind and pulled out- wards so as to expose the jaws (J), which have been turned outwards, and the tongue (T) bearing a median row of chitinous teeth, which branches be-

hind into two. The mus- cular pharynx, extending back into the space be- tween thefirstand second pairs of legs, is followed by a short tubular oeso- phagus. The latter opens into the large stomach with plicated walls, ex- tending almost to the hind end of the animal. The stomach at its point of junction with the. rectum presents an S- shaped ventre – dorsal curve. A, Anus ; at, antenna ; P.\, F.i, first and second feet ; j. jaws ; L, hps ; 06, cesopha^us ; OT.p. oral papilla; ph, pharynx ; B, rectum ; s.rf, salivary duct; s.g, sali- vary gland ; sl.d, slime reservoir ; fil.g, portion of tubules of slime gland; s<, stomach ; T^ tongue in roof of mouth.

The central nervous

which opens at the anus. There are no

glands opening into the alimentary canal.

system, the anterior part of which is shown in Fig. 7, is described

in the ninth edition of this work (see vol. xvii. p. 116).

The cuticle is a thin layer, of which the spines, jaws, and claws

,â€” dtn.

are special developments. Its surface is not, however, smooth, but is everywhere, with the exception of the perioral region, raised into minute secondary papillse, which in most in- stances bear at their free ex- tremity a somewhat prominent spine. The epidermis, placed immediately within the cuticle, is composed of a single row of cells. The pigment which gives the characteristic colour to the skin is deposited in the protoplasm of the outer ends of the cells in the form of small granules. Beneath the epidermis is a thin cutis, which is foUgwed by the mus- cular layers (external circular and internal longitudinal). The muscular fibres of the jaws are transversely striated, the other muscles are unstriated.

The apertures of the tracheal system are placed in the de- pressions between the papillae or ridges of the skin. Each of them leads into a tube, which may be called the tracheal pit (Fig. 8) ; the walls of this are formed of epithelial cells, bounded towards the lumen of the pit by a very delicate cutioular membrane continu- ous with the cuticle covering the surface of the body. In- ternally it expands in the trans- verse plane, and from the expanded portion the tracheal tubes arise in diverging bundles. The tracheae are minute tubes exhibiting a faint transverse striation which is pro- bably the indication of a spiral fibre. They appear to branch, but only exceptionally. The tracheal apertures are diffused over

Fig. 7. â€” Brain and anterior part of the ventral nerve-cords of PeripatuB capensis enlarged and viewed from tbeventral surface. (After Balfour.) atr\, antennary nerves ; co, commis- sures between ventral cords ; d. ven- tral appendages of brain ; E, eye ; en, nerves passing outwards from ventral cord; h\g.. ganglionic enlargements from which nerves to feet pass off ; jn, nerves to jaws ; org, ganglionic en- largement from which nerves to oral papillae pass off ; orn, nerves to oral pa- pillaj ; pc, posterior lobe of brain ; pn, nerves to feet ; sy, sympathetic nerves.

â€” tv.o

Fig. 8. â€” Section through a tracheal pit and diverging bundles of tracheal tubes taken transversely to the long axis of the body. {After Balfour.) tr, tracheae, showing rudimentary spiral fibre ; tr.c, cells resembling those lining the tracheal i)its, which occur at intervals along the course of the tracheie ; t/r.o, tracheal stigma ; t/r.p, tracheal pit.

the surface of the body, but are especially developed in certain regions.

The vascular system consists of a dorsal tubular heart with paired ostia leading into it from the pericardium, of the peri- cardium, and the various other divisions of the perivisceral cavity (Fig. 12, D). As in all Arthropoda, the perivisceral cavity is a hsemocoele ; i.e., contains blood, and forms part of the vascular system. It is divided by septa into chambers (Fig. 12, D), of which the most important are the central

chamber containing the alimentary canal and the dorsal chamber or pericardium. Nephridia are present in all the legs. In all of them (except the first three) the following parts may be recognized (Fig. 9) : (1) a vesicular portion (s) opening to the exterior on the ventral surface of the legs by a narrow passage (s.d) ; (2) a coiled portion, which is again subdivided into several sections {s.a) ; (3) a section with closely-packed nuclei ending by a somewhat enlarged opening (p./) ; (4) the terminal portion, which consists of a thin- walled vesicle. The nephridia of the first three pairs of legs are smaller than the rest, consisting only of a vesicle and duct. The fourth and fifth pairs are larger than those behind, and are in other respects peculiar ; for instance, they open on the third pad

(counting from the distal end of the leg), and the external vesi- cular portion is not dilated. The external opening of the other nephridia is placed at the outer end of a transverse groove at the

Fig. 9. â€” Nephridiom from the ninth pair of legs of P. capenais. o.s, externa] opening of segmental organ ; p.f, internal opening of nephridium into the body cavity (lateral compartment) ; s, vesicle of segmental organ ; s.e.l, S.C.2, S.C.3, S.C.4, successive regions of coiled portion of nephridium ; 5.0. i, third portion of nephi'idium broken off at p.f from the internal vesicle, "which is not shown.

base of the legs. The salivary glands are the modified nephridia of the segment of the oral papillae.

The male generative organs (Fig. 10) consist of a pair of testes (te), a pair of seminal vesicles (u), vasa deferentia (v.d.), and

Fig. 10.â€" Male generative organs of PeWoa^ws ect^jewsM, dorsal view. (After Sal- foiir.) a.g, enlarged crural glands of fast pair of legs ;

F,16,1'I, last pairs of legs ; /, small accessory glandular tubes ; p, common duct into which vasa deferentia open ; ie^ testes ; v, seminal vesicles ; v.c, nerve-cord ; 'V.d, vas deferens.

accessory glandular tubules (/). All the above parts lie in the central compartment of the body cavity. The ovaries consist of a pair of tubes closely applied together, and continued posteriorly into the oviducts. Each oviduct, after a short course, becomes dilated into the uterus. The two uteri join behind and open to the exterior by a median opening. The ovaries always contain spermatozoa, some of which project through the ovarian wall into the body cavity. Spermatozoa are not found in the uterus and oviducts, and it appears probable, as we have said, that they reach the ovary directly by boring through the skin and traversing the body cavity. In all the species except the African species there is a globular receptaculum seminis opening by two short ducts close together into the oviduct, and in the neotropical species there is in addition a small receptaculum ovorum, with ex- tremely thin walls, opening into the oviduct by a short duct just in front of the receptaculum seminis. The epithelium of the latter structure is clothed with actively moving cilia. There appear to be present in most, if not all, of the legs some accessory glandular structures openins just externally to the nephridia. They are called the crural glands.

ences relating to the structure of the female generative organs and to the number of the legs. They, however, differ in the most striking manner in the structure of the ovum and the early development. In all the Australasian species the egg is large and heavily charged with food-yolk, and is surrounded by a tough membrane. In the Cape species the eggs are smaller, though still of consider- able size ; the yolk is much less developed, and the egg membrane is thinner though dense. In the New Britain species the egg is still smaller (~~1 mm.), and there is a large trophic vesicle. In the neotropical species the egg is minute, and almost entirely devoid of yolk.. The unseg~~ mented uterine ovum of P. novae zealandim measures 1-5 mm. in length by -8 mm. in breadth; that of P. capensis is -56 mm. in length; and that of P. trinidadensis -04 mm. in diameter. In correspondence with these differences in the ovum there

are differences in the early development, though the later stages are closely similar.

The development has been worked out in F. capensis, to which species the following description refers. The segmentation is peculiar, and leads to the formation of a solid gastrula, consisting of a cortex of ectoderm nuclei surrounding a central endodermal mass, which is exposed at one point â€” the blastopore. The enteron arises as a space in the endoderm, and an opacity â€” the primitive streak â€” appears at the hind end of the blastopore (Fig. 11, B). The elongation of the embryo is accompanied by an elongation of the blastopore, which soon becomes dumb-bell shaped (Fig.ll, C). At the same time the mesoblastic somites (embryonic seg- ments of mesoderm) make their appearance in pairs at the hind end, and gradually travel forwards on each side of the blastopore to the front end, where the somites of the anterior pair soon meet in front of the blastopore (Fig. 11, I)). Meanwhile the narrow middle part of the blastopore has closed by a fusion of its lips, so that the blastopore is represented by two openings, the future mouth and anus. A primitive groove makes its appearance behind the blastopore (Fig. 11, D). At this stage the hind end of the body becomes curved ventrally into a, spiral (Fig. 11, E), and at the same time the appendages appear as hollow processes of the body-wall, a mesoblastic somite being prolonged into each of them. The first to appear are the antenuse, into which the prssoral somites are prolonged. The remainder appear from before backwards in regular order, viz., jaw, oral papillae, legs 1-17. The full number of somites and their appendages is not, however, completed until a later stage. The nervous system is formed as an annular thickening of ectoderm passing in front of the mouth and behind the anus, and lying on each side of the blastopore along the Unes of the somites. The prseoral part of this thickening, which gives rise to the cerebral ganglia, becomes pitted inwards on each side (Fig. 11, F, eg). These pits are eventually closed, and form the hollow ventral appendages of the supra- pharyngeal ganglia of the adult (Fig. 7, d). The lips are formed as folds of the side wall of the body, extending from the prseoral lobes to just behind the jaw (Fig. 11, I”, i). They enclose the jaws (j), mouth {M), and opening of the salivary

iryos of p. capensis. The hind end of embryos B, C, D is uppermost primitive sti-eak is the white patch behind the blastopore. (After Sedir-

Development. â€” Peripalvs is found in Africa, in Australasia, in South America and the West Indies, in New Britain, and in the Malay Peninsula and Sumatra. The species found in these various localities are closely similar in their anatomical characters, the principal differ-

Fio. 11.â€” A series of embryos c

in the figures, the primitive ououk. is me wnite paten Douina the blastopo â– Â»‘Â«:*.) A, Gastrula stage, ventral view, showing blastopore. B, Older ffastfula stage, ventral view, showing elongated blastopore and primitive streak. C, Ventral view of em- bryo witlitlireo pairs of mesoblastic somites, dumb-hell shaped blastopore and primitive streak. DA entro view of embryo, in which tlie blastopore has completelv closed in its middle portion The anterior pair of somites have moved to the front end oT the body. E, vlltJn^\,f ff T''^\ I'.antenna; ^ ? Â£ri?J â– ’â– “‘jr, -s. “7”’”? i>t base of jaws ; L, lips ; Jf, mouth ; or.p, on\ papillae ; o..?, opening of salivary gland, li . side view of older embryo ‘ – ^ ;’ ‘

glands (o.s), and so give rise to the buccal cavity. The embryo has now lost its spiral curvature, and becomes coi’npletely doubled upon Itself, the hind end being in contact with the mouth (Fig. 11, (j). It remains in this position until birth. The just-born young are from 10 to 16 mm. in length, and have green antennse.

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but the rest of the body is either quite white or of a reddish colour. This red colour differs from the colour of the adult in boing soluble in spirit. The rnesoblastic somites are paired sacs formed from the anterior lateral portions of the primitive streak (Fig. 11, C). As they are formed they become placed in pairs on each side of the blastopore. The somites of the first pair eventu- ally obtain a position entirely in front of the blastopore (Fig. 11, D). They form the somites of the prffioral lobes.

The full com- plement of somites is acquired at about the stage of Fig. 11, E. The relation of the mesoblastic somites is shown in Fig. 12, A,

Fig. 12. â€” A series of diagrams of transverse sections through Peripaius embryos to show the relations of the coelom at successive stages. (^After S&dgwicJc,) A, Early stage ; no trace of the vascular space ; endoderm and ectoderm in contact. Ji, Endoderm has separated from the dorsal and ventral ectoderm. The somite is represented as having divided on the left side into a dorsal and ventral portion. C, The haemoccele (8) has become divided up into a number of spaces, the arrangement of which is unimportant. The dorsal part of the somite has travelled dorsalwards, and now constitutes a small space (triangular in section) just dorsal to the gut. The ventral portion (2) has assumed a tubular character, and has acquired an external opening. The internal vesicle is already indicated, and is shown in the diagram by the thinner black line; 1, gut; 2, somite; 2', nepbridial part of coBJom ; 3, ha?nioccele; 8', part of haemoccele which wifl form the heart â€" the part of the haemocffile on each side of this will form the peri- cardium ; 4, nerve-cord ; 5, slime glands. D represents the conditions at the time of birth. The coalom is represented as surrounded by a thick black hue, except in the part which forms the internal vesicle of the nephridium.

which represents a transverse section taken between the mouth and anus of an embryo of the stage of Fig. 11, J). The history of these somites is an exceedingly interesting one, and may be described shortly as follows: They divide into two parts â€" a ventral part, which extends into the appendage, and a dorsal part (Fig. 12, B). Each of the ventral parts acquires an opening to the exterior, just outside the nerve-cord, and becomes entirely transformed into a nephridium (Fig. 12, D, 2'). The dorsal part shifts dorsalwards and diminishes relatively in size (Fig. 12, C). Its fate differs in the different parts of the body. In the anterior somites it dwindles and disappears, but in the posterior part it unites with the dorsal divisions of contiguous somites of the same side, and forms a tube â€" the generative tube (Fig. 12, D, 2). The last section of this tube retains its connexion with the ventral portion of the somite, and so acquires an external opening, which is at first lateral,

but soon shifts to the middle line, and fuses with its fellow, to form the single generative opening. The prseoral somite develops the rudiment of a nephridium, but eventually en- tirely disappears. The jaw somite also disappears ; the oral papilla somite forms ventrally the salivary glands, which are thus serially homologous with nephridia. The various divisions of the perivis- ceral cavity develop as a series of spaces between the ectoderm and endoderm, and later in the mesoderm. The mesoderm seems to be formed entirely from the proliferation of the cells of the meso- blastic somites. It thus appears that in Peripatus the ccelom does not develop a perivisceral portion, but gives rise only to the renal and reproductive organs.

The genus Peripatus was established in 1826 by Guild- ing, who first obtained specimens of it from St Vincent in the Antilles. He regarded it as a Mollusc, being no doubt deceived by the slug-like appearance given by the antennae. Specimens were subsequently obtained from other parts of the neotropical region, and from South Africaand Australia, and the animal was variously assigned by the zoologists of the day to the Annelida and Myriar

poda. Its true place in the system, as a primitive mem- ber of the group Arthropoda, was first established in 1874 by Moseley, who discovered the tracheae. Peripatus is an Arthropod, as shown by (1) the presence of appendages modified as jaws ; (2) the presence of paired lateral ostia perforating the wall of the heart and putting its cavity in communication with the pericardium ; (3) the presence of a vascular body cavity and pericardium (haeinocoelic body cavity) ; (4) absence of a perivisceral section of the coslom. Finally, the tracheae, though not characteristic of all the classes of the Arthropoda, are found nowhere out- side that group, and constitute a very im- portant additional reason for uniting Peri- patus with it. Peripatus, though indubitably an Arthropod, differs in such important respects from all the old-established Ar- thropod classes, that a special class, equiva- lent in rank to the others, and called Proto- tracheata or Onychophora, has had, as we have seen, to be created for its sole occupancy. This unlikeness to other Arthropoda is mainly due to the Annelidan affinities which it presents, but in part to the presence of the following peculiar features :

(1) the number and diffusion of the tracheal apertures ; (2) the restriction of the jaws to a single pair;

(3) the disposition of the generative organs ;

(4) the texture of the skin; and (6) the simplicity and similarity of all the segments of the body behind the head. The Annelidan affinities are" superficially indicated in so marked a manner by the thinness of the cuticle, the dermo-muscular body-wall, the hollow appendages, that, as already stated, many of the earlier zoologists who examined Peripatus placed it among the segmented worms; and the discovery that there is some solid morphological basis for this determina- tion constitutes one of the most interesting

points of the recent work on the genus. The Annelidan features are: (1) the paired nephridia in every segment of the body behind the first two (Saenger, Balfour) ; ^2) the presence of cilia in the generative tracts (Gaffron). It is true that neither of these features is absolutely distinctive of the Annelida, but when taken in conjunc- tion with the Annelidan disposition of the chief systems of organs, viz., the central nervous system, and the main vascular trunk or heart, they may be considered as indi- cating affinities in that direction.

Synopsis or Species.

Peripatus (Guilding). Soft-bodied vermiform animals, with one pair of ringed antennse, one pair of jaws, one pair of oral papillse, and a varying number of claw-bearing ambulatory legs. Dorsal surface arched and more darkly pigmented than the flat ventral surface. Skui transversely ridged and beset by wart-like spiniferous papOlse. Mouth anterior, ventral ; anus posterior, terminal. Generative opening single, median, ventral, and pos- terior. One pair of simple eyes. Brain large, with two ven- tral hollow appendages ; ventral cords widely divaricated, without distinct ganglia. Alimentary canal simple, uncoiled. Segmen- tally arranged paired nephridia are present. Body cavity is con- tinuous with the vascular system, and does not communicate with the paired nephridia. Heart tubular, with paired ostia. Respiration by means of tracheae. Dioecious ; males smaller and

generally less numerous than females. Generative glands tubular, continuous with the ducts. Viviparous. Young born fully devel- oped. Distribution: Africa (Cape Colony, Natal, and the Gaboon), New Zealand, Australia and Tasmania, New Britain, South and Central America and the "West Indies, the Malay Peninsida [and in Sumatra ?].

The genus Peripatus, so far as adult conformation is concerned, is a very homogeneous one. It is true, as was pointed out by

Sedgwick, that the species from the same part of the world re- semlDle one another more closely than they do species from other regions, but recent researches have shown that the line between them cannot be so sharply drawn as was at first supposed, and it is certainly not desirable in the present state of our knowledge to divide them into generic or subgeneric groups, as has been done by some zoologists. (The following genera have been pro- posed : Peripatus for the neotropical species, Peripatoides for the Australasian, Peripatopsis and Opistliopatus for the African, Paraperipatus for the New Britain, Eoperipatus for the Malayan species, and Ooperipatiis for the supposed oviparous species of Australia and New Zealand.) The colour is highly variable in species from all regions ; it is perhaps more constant in the species from the neotropical region than in those from elsewhere. The number of legs tends to be variable whenever it exceeds 19 praegenital pairs ; when the number is less than that, it is usually, though not always, constant. More constant points of difference are the form of the jaws, the position of the generative orifice, the presence of a receptaculum seminis and a receptaculum ovorum, the arrangement of the primary papillae on the distal end of the feet, and above all the early development.

South African Species. â€" With three spinous pads on the legs, and feet with two primary papillae on the anterior side and one on the posterior side ; outer jaw with one minor tooth at the base of the main tooth, inner jaw with no interval between the large tooth and the seizes

of small ones ; last fully-developed leg of the male with enlarged crural gland opening on a large papilla placed on its ventral surface ; coxal organs absent ; the nephridial open- ings of the 4th and 5th pairs of legs are placed in the proximal spinous pad. Genital opening subterminal, behind the last pair of fully developed legs ; oviduct without receptacula seminis or receptacula ovorum ; the terminal unpaired portion of vas deferens short. Ova of considerable size, but with only a small quantity of yolk. The embryos in the uterus are all nearly of the same age, except for a month or two before birth, when two broods overlap.

The following species are aberrant in respect of these characters : Peripatus {Opisthopatus') cinctipes Purcell (Cape Colony and Natal) presents a few Australasian features ; there is a small receptaculum seminis on each oviduct, some of the legs are pro- vided with well-developed coxal organs, the feet have one anterior, one posterior, and one dorsal papilla, and the successive difference in the ages of the embryos in the uterus, though nothing like that found in the neotropical species, is slightly greater than that found in other investigated African species. Several pairs of legs in the middle region of the body are provided with enlarged crural glands which open on a large papilla. Male with four accessory glands, opening on each side of and behind the genital aperture. P. tholloni Bouvier (equatorial West Africa [Gaboon]) shows some neotropical features ; there are 24 to 25 pairs of legs, the genital opening is between the penultimate legs, and though there are only three spinous pads, the nephridial openings of the 4th and 5th legs are proximal to the 3rd pad, coxal organs are present, and the jaws are of the neotropical type ; the oviducts have receptacula seminis. The following South African species may be mentioned : " P. capensis (Grube), with 17 (rarely 18) pairs of claw-bearing legs ; P. Balfouri (Sedgw.), with 18 (rarely 19) pairs ; P. Moseleyi (Wood-M.), with 20 to 24 pairs.

Australasian Species. â€" With 14, 15, or 16 pairs of claw-bearing ambulatory legs, with three spinous pads on the legs, and ne- phridial opening of the 4th and 5th legs on the proximal pad ; feet with one anterior, one posterior, and one dorsal primary papilla ; inner faw

without diastema, outer with or without a minor tooth. Last leg of the male with or without a large white papilla on its ventral surface for the opening of a gland, and marked papillae for the crural glands are sometimes present on other legs of the male ; well-developed coxal glands absent. Geni- tal opening between the legs of the last pair ; oviducts with recep- tacula seminis, without receptacula ovorum ; the terminal portion of the vas deferens long and complicated ; the accessory male glands open between the genital aperture and the anuÂ», near the latter. Ova large and heavily charged with yolk, and provided with a stoutish shell. The uterus appears to contain embryos of. different ages. Specimens are recorded from West Australia, Queensland, New South Wales, Victoria, and New Zealand. The Australasian species are in some confusion. The number of claw-bearing legs varies from 14 to 16 pairs, but the number most often found is 15. Whether the number varies in the same species is not clear. There appears to be evidence that some species are occasionally or normally oviparous, and in the supposed oviparous species the oviduct opens at the end of a papilla called from its supposed function an ovipositor, but the oviparity has not yet been certainly proved as a normal occur- rence. Among the species described may be mentioned P. Leuckarti (Saengei) , P. insignis (Dendy), P. oviparus (Dendy), P. viridimaculatus (Dendy), P. novai zealandim (Hutton), but it is by no means certain that future research will maintain these.

Mr J. J. Fletcher, indeed, is of opinion that the Australian forms are all varieties of one species, P. Leuckarti.

Neotropical Species. â€” With 3 to 5 spinous pads on the legs, nephridial opening of the 4th and 5th legs usually proximal to the 3rd pad, and feet either with two primary papillae on the anterior side and one on the posterior, or with two on the anterior and two on the posterior; outer jaw with small minor tooth or teeth at the base of the main tooth, inner jaw with diastema. A variable number of posterior legs of the males anterior to the genital opening with one or two large papillae carrying the openings of the crural glands ; well-developed coxal organs present on most of the legs. The primary papillae usually divided into two portions. Genital opening between the legs of the

penultimate pair ; oviduct provided with receptacula seminis and ovorum ; unpaired part of vas deferens long and complicated ; accessory organs of male opening at the sides of the anus. Ova minute, with little food-yolk ; embryos in the uterus at very different stages of development. The number of legs usually if not always variable in the same species; 'the usual number is 28 to 32 pairs, but in some species 40 to 43 pairs are found. The neotropical species appear to fall into two groups : (1) the so- called Andean species, viz., those which inhabit the high plateaux or Pacific slope of the Andes ; in these there are 4 (sometimes 5) pedal papillae, and the nephridial openings of the 4th and 5th legs are on the third pad ; and (2) the Caribbean species, viz. , the remaining neotropical species, in which there are 3 papillae on the foot and the nephridial openings of the 4th and 5th legs are between the 3rd and 4th pads. The Andean species are P. eisenii (Wh.),, P. tuberculatus (Bouv.), P. Lankesteri (Bouv.), P. quitensis (Sohm.), P. Corradi (Cam.), P. Cameranoi (Bouv.), and P. Balzani (Cam.). Of the remaining species, which are the majority, may be mentioned P. Edwardsii (Blanch), P. jamai- censis (Gr. and Cock.), P. trinidadensis (Sedgw.), P. torquatus (Ken.), P. im Thurmi (Scl.).

New Britain Peripatus. â€" With 22 to 24 pairs of claw-bearing legs, with 3 spinous pads on the legs, and nephridial openings of legs 4 and 5 (sometimes of 6 also) on the proximal pad ; feet with one primary papilla on the anterior, one on the posterior side, and one on the dorsal side (median or submedian) ; outer jaw with a minor tooth, inner jaw without diastema ; crural glands absent ; well-developed coxal organs absent. Genital opening subterminal behind the last pair of legs ; oviduct with receptaculum seminis without recept. ovorum ; unpaired part of vas deferens very short ; accessory glands two, opening medianly and dorsally. Ova small, -1 mm. in diameter, with little yolk, and the embryos provided with large trophic vesicles (Willey). Embryos in the uterus of very different ages, and probably born all the year round. One species only known, P. novce britaniuoe (Willey).

Sumatran Peripatus. â€" Peripatus with 24 pairs of ambulatory legs, and 4 spinous pads on the legs. The primary papillae of the neotropical character with conical bases. Generative opening between the legs of

the penultimate pair. Feet with only two papillK. Single species. P. sumatranus (Sedgw.). The exist- ence of this species Is doubtful.

Peripatus from the Malay Peninsula.â€” With 23 to 25 pairs of claw-bearing legs, 4 spinous pads on the legs, and nephridial open- ings of legs 4 and 5 in the middle of the proximal pad or on its proximal side ; feet with two primary papillae, one anterior and one posterior ; outer jaw with 2, inner jaw with 2 or 3 minor teeth at the base of the main tooth, separated by a diastema from the row of small teeth ; crural glands present in the male only, in the two pairs of legs preceding the generative opening ; coxal glands present. Genital opening between the penultimate legs; oviduct with receptacula seminis and ovorum ; unpaired part of vas deferens long ; male accessory glands two, opening medianly between the legs of the last pair. Ova large, with much yolk and thick membrane, like those of Australasian species ; embryos with sht-hke blastopore and of very difierent ages in the same uterus, probably born all the year round. The species are P. Weldoni (Evans), P. Horsti (Evans), and P. Bntleri (Evans). It will thus be seen that the Malay species, while resembling the neotropical species m the generative organs, differ from these in many features of the legs and feet, in the important characters furnished by the size and structure of the ovum, and by their early development.

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PERITYPHLITI S â€” P E R M

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Perityphlitis. See Appendicitis. Perkin, William Henry (1888-

), English chemist, was born in London on 12th March 1838. Prom an early age he determined to adopt, chemistry as his profession, altliough his father, who was a builder, would have preferred him to be an

~~architect. Attend~~ ing the City of London School â€” one of the few which at that time included natural science in its curriculum â€” he devoted all his spare time to chemistry, and on leav- ing, in 1853, entered the Royal College of Chemistry, then under the direction of A. W. Hofmann, in whose own research laboratory he was in the course of a year or two promoted to be an assistant. Devoting his evenings to private investigations m a rough laboratory fitted up at his home, Perkin was fired by some remarks of Hofmann's to undertake the artificial production of quinine. In this attempt he was unsuccessful, but the observations he made in the course of his experiments induced him, early in 1856, to try the effect of treating aniline sulphate with bichromate of potash. The result was a black precipitate, which he found to contain the colouring matter subsequently known as aniline blue or mauve. He lost no time in introducing this substance to the notice of Messrs PuUar, the well-known dyers, and they expressed a favourable opinion of it, if only it should not prove too expensive in use. Thus encouraged, he took out a patent for his process, and leaving the College of Chemistry, a boy of eighteen, he proceeded, with the aid of his father and brother, to erect works at.^ G-reenford Green, near Harrow, for the manufacture of the newly-discovered colouring matter. Various prelim- inary difficulties were encountered, not only in designing suitable plant, but also in obtaining supplies of raw materials; but these were successfully overcome, and by the end of 1857 the works were in operation. That date may therefore be reckoned as that of the founda- tion of the coal-tar colour industry, which has since attained such important dimensions â€” in Germany, how- ever, rather than in England, the country where it orig- inated. The further difficulties of finding methods of successfully dyeing with the material were also grappled

with, and it soon came into wide use, first for dyeing silk in London, and then for calico-printing in Scotland. Dr Perkin also had a large share in the introduction of artificial alizarin, the red dye of the madder root. Graebe and Liebermann in 1868 prepared that sub- stance synthetically from anthracene, but their process was not practicable on a large scale, and it was left to him to patent a method that was commercially valuable. This he did in 1869, thus securing for

the Greenford Green Works a monopoly of alizarin manufacture for several years. About the same time he also carried out a series of investigations into kindred substances, such as anthrapurpurin. About 1874 he abandoned the man- ufacture of coal-tar colours, and devoted himself exclu- sively to research in pure chemistry, which, however, he had by no means neglected even while his atten- tion was occupied with the practical problems of man- ufacture; and among the discoveries he made in this field was that of the reaction known by his name, depending on the condensation of aldehydes with fatty acids. Later still he engaged in the study of the rela- tions between chemical constitution and rotation of the plane of polarization in a magnetic field, and enunciated a law expressing the variation of such rotation in bodies belonging to homologous series. For this work he was in 1889 awarded a Davy medal by the Royal Society, which ten years previously had bestowed upon him a Royal medal in recognition of his investigations in the coal-tar colours. The Chemical Society, of which he be- came secretary in 1869 and president in 1883, presented him with its Longstaff medal in 1889, and in 1890 he received the Albert medal of the Society of Arts. His eldest son, William Henry Perkin, junior, who was born at Sudbury, near Harrow, on 17th June 1860, and was educated at the City of London School, the Royal College of Science, and the Universities of Wilrzburg and Munich, became professor of chemistry at the Heriot- Watt College, Edinburgh, in 1887, and professor of organic chemistry at Owens College, Manchester, in

1892.

Perm, a government of East Russia, on both slopes of the Ural Mountains, with an area of 128,211 square miles. Population (1881), 2,520,100 ; (1897), 3,003,208, of whom 1,552,551 were women, and 176,255 urban. The immense majority of tlÂ«.s population are peasants (2,604,207 in 1896), and according to religion they were distributed as follows : Greek Orthodox 2,566,475, Nonconformists 250,361, Mussulmans 141,294, pagans 19,464, Catholics 1610, Jews 1164, and Lutherans 841, leaving 22,119 as nondescript. Agriculture is carried on everywhere, but in the north and north-west the crops are insufficient for the population. Nearly 8,000,000 acres, i.e., 9‘6 per cent, of the total

area, are under cereals â€” chiefly rye, oats, barley, and wheat in the south â€” tha average annual yield of the crops in 1895-99 being : rye, 9,424,000 cwt. ; wheat, 6,179,000; oats, 11,358,000; barley, 2,862; various, 734,000 ; and potatoes, 2,878,000 cwt. Bees are kept in large numbers. Cattle-breed- ing is active, especially among the Bashkirs, there being in the province more than 1,200,000 horned cattle, 1,200,000 sheep, and 900,000 horses. Various domestic trades are carried on in the villages, and several new in- dustries, such as the manufacture of agricultural ma- chinery, have sprung up. Mining is developing steadily, but slowly. The iron- works employ some 194,360 workers (11,850 in the Crown works),/ and their aggregate output in 1898 was : pig-iron, 9,568,000 cwt. ; iron, 3,902,000 cwt.; steel, 2,366,300 cwt.; metal goods, 700,000 cwt. ; copper, 40,000 cwt. ; of a total estimated value of 66,320,000 roubles. There were also 16,160

persons engaged in the working of gold and platinum, the annual production of gold being valued at Â£487,000, and of platinum at Â£240,800; coal and coke (7,233,000 cwt.), salt (6,930,000 cwt.), asbestos (30,000 cwt.), iron chro- mates (240,000 cwt.), and sulphates (323,800 cwt.). In 1897, 1090 factories employed 9835 workers, producing goods to the annual value of Â£2,200,000; and 12,475 work- shops employed 37,000 workers, whose production was valued at Â£5,240,000 annually. The government is inter- sected by a railway from Perm eastwards across the Urals, and thence southwards along the eastern slope of the Urals to Ekaterinburg, Chelyabinsk (main Siberian trunk line), and Tyumen; also by a railway from Perm to Kotlas, at the head of the northern Dvina. Of schools the pro- vince had, in 1896, 827 (66,740 pupils) under the Ministry of Public Instruction, and 782 (31,475 pupils) Church primary schools. There are also several mining schools, and 116 village schools have school-farms or gardens attached to them. The Perm zemstvo is one of the most active in Russia in promoting the spread of education and agricultural knowledge among the peasants.

The province is divided into 12 districts, the chief towns of which are, in Europe, Perm (45,403), Kungur (14,324), Krasnoufimsk (6427), Okhansk (1896), Osa (5176), Soli- kamsk (4069), and Tcherdyn (3662); and in Asia, Ekaterinburg (55,488), Irbit (20,064), Kamyshloff (8064), Shadrinsk (11,686), and Verkhoturiye (3178). The chief iron-works forming important towns are : ISTijne-Taghilsk (30,000), Keviansk (16,066), Kyshtym (12,331), Revdinsk (9914), Upper and Lower Turinsk (10,795), Bogoslovsk (4510), Suksunsk (3130), jSTyazepetrovsk, Verkh-Iset, Nijne-Iset, and Verkhne-Tagilsk. The chief salt-works are at Usolie (7785).

Perm, the capital of the above province, had in 1897 a population of 46,403, as compared with 32,350 in 1879. It has several scientific institutions (the Ural Society of Natural Sciences, Archives Committee, Technical Society), a scientific museum, a theatre, and various philanthropic institutions. Its industries develop but slowly, the chief works being shipbuilding yards, tanneries, chemical works, and rope works, their total annual production being valued at Â£300,000. Its river port is visited every year by more than 1160 vessels (nearly 150,000 tons, and Â£360,000 worth of goods being imported, and nearly as much ex- ported), and its connexion by rail with Vyatka and i^otlas, now completed, will probably make it a port for the export of Siberian grain and raw produce to Archangelsk.

Pernambuco, an Atlantic state of Brazil, situated between 7Â° and 10Â° 40′ S. and 34Â° 45′ and 42Â° 10′ W. Area, 49,626 square miles. It is bounded on the E. by

the Atlantic, on the IST. by the states of Parahyba and Cear^, on the VI. by Piauhy and Bahia, on the S. by Alagoas. Population (1872), 841,639; (1890), 1,101,539. The capital, Recife, and the islands of S. Antonio, S. Jose, and Boa Vista, are known by the name of Pernambuco, and have a population of 190,000. The total trade was valued at Â£6,848,360 in 1900â€” imports, Â£2,748,360 ; ex- ports, Â£3,100,000 (sugar, Â£1,850,000 ; cotton, Â£760,000 ; and rum, skins, and minor exports, Â£500,000). Amongst the chief towns in the state are Bezerros, Bom Jardim, Brejo da Madre de Deus, Cabo, Caruarii,

Escada, Garan- huns, Gloria de Goita, Goyana (10,000 inhabitants), Olinda, Rio Eormoso (8000 inhabitants). Railways connect Recife with Goyana, Timbaiiba, Limoeiro, Caruarii, Palmares, &c. Total length of lines, 186 miles.

Perovsk, formerly Ak-mechet, a fortress of Kokand, and later Fort Perovskiy, a district town of Russian Central Asia, province of Syr-Daria, on the right bank of the navigable Syr-Daria river, 357 miles north-west of the Tashkent railway station. It carries on a considerable trade in cattle. Population (1897), 4062.

Perpignan, chief town' of the department of Pyrenees-Orientales, 526 miles south-south-east of Paris, on the railway from Narbonne to the Spanish frontier. A monument to the soldiers who fell in the war of 1870-71 has been erected. Perpignau is the seat of the superior tribunal of the republic of Andorra. Population (1881),

21,896 ; (1891), 25,167 ; (1901), 32,950.

Perry, a city of Oklahoma, U.S.A., capital of Noble county, in the north-eastern part of the territory, on the Atchison, Topeka, and Santa Fe railway. It is regularly laid out on a level site, contains a U.S. Land Office, and has a large trade, as it is the supplj'-point for a wide range of country. It was settled in 1893. Population (1900), 3351, of whom 127 were foreign-born and 399 negroes.

Perry. See Cidee.

Perryville, a town of Boyle county, Kentucky, U.S.A., near the centre of the state. It is famous as the scene of a sharp battle on 8th October 1862, between the retreating forces of General Bragg and the Union forces under General Buell. General Bragg had entered Ken- tucky, hoping to secure the addition of that state to the Confederacy. His plan, however, was frustrated by General Buell, and he was obliged to retreat into Tennessee. The Union losses were heavy, and the Con- federates were allowed to continue their retreat, taking with them a large waggon-train of provisions. Population

(1900), 431.

PERSIA.

I. Geogeaphy and Statistics.

SINCE the publication of the ninth edition of the EncydopcerUa Britunnica the labours of many trav- ellers and explorers have materially added to our know- ledge of the geography of Persia, but as regards the salient physical features of the country there is little to add.

Mountains.â€” The Persians have no special names for the great ranges. Mountains and valleys are known only by local names which frequently cover but a few miles. Even the name Elburz, which European geographers apply to the chains and ranges that extend for a length of over 600 miles from Azerbaijan in the west to Khorassan (Khoras^n) in the east, stands with the Persians only for the 60 or 70 miles of mountains north and north-east of

TeherfCn (Tehran), including the cone of Demavend ; and, as its meaning, ” high mountain ” (Zend, Ham-be rezaiti), implies, it probably stood in ancient times for many other high mountains as well. The great central range, which extends, almost unbroken, for nearly 800 miles from Azerbflijan in the north-west to Baluchistan in the south-east, may aptly be called the Central Range. It has many peaks of 9000 to 10.000 feet in height, and some of its summits rise to an eh’vation of 11,000 feet, and near Kermdn of nearly 13,000 feet (Kiih-i-Jiip^r). The valleys and plains west of the central range, as for instance those of IMahallat, J(5shekan, Isfahiin, Si’rjan, have an elevation of 5000 to 6500 feet; those within the range, as Jasp, Ardah^l, So, I’ari’z, are about 1000 feet higher ; and those east of it slope from an elevation of

5000 to 6000 feet dowu to the depressions of the central plateau which, east of Kom, are not more than 2600 feet and east of KermSLn 1500 to 1700 feet above the sea-level. Some of ,the ranges west of the Central Range, which form the highlands of Kurdistan, Lurist^n, Bakhti^ri, and Fars, and are parallel to it, end near the Persian Gulf ; others follow the central range, and take a direction to the east at some point between Kerman and the sea on the western frontier of Baluchistan. Some of these western ranges rise to considerable elevations ; those forming the Turko-Persian frontier west of the lake of Urmia have peaks 11,000 feet in height, while the Sahand, east of the lake and south of Tabriz, has an elevation of 12,000 feet. Farther south, the Takht-i-Bilkis, in the Afshar district, rises to 11,200 feet, the Elvend (ancient Orontes), near Hamaddln, to 11,600. The Shuturun Kiih, south of Buriijird, is over 11,000 feet in height, the Sh^h^n Kuh, Kiih-i-Gerra, Zardeh Kiih and Kiih-i-Kuran (by some writers called Kiih-i-Eang), all in the Bakhtiari country west of Isfahan, are 12,800 to 13,000 feet in height ; and the Kiih-i-Dina (by some writers wrongly called Kiih-i-Din^r) has an elevation of over 14,000 feet. Still farther south, towards Kerman, there are several peaks (Bid-Khiin, Ld.lehz^r, Shah-Kiih, Jamd,lbariz, &c.) which rise to an elevation of 13,000 feet or more, and the Kiih-i-Haz^r, ‘ south of Kerman, is 14,700 feet in height. Commencing near Ardabil in Azerbaijan, where the cone of Savalan rises to an elevation of 15,792 feet (Russian trigonometrical survey), andendinginKhorasdln, the great Elburz range presents on its southern, or inward, face a more or less abrupt scarp rising above immense gravel slopes, and reaches in some of its summits a height of nearly 13,000 feet ; and the peak of Demavend, north- west of TeherEin, has a height of at least 18,000 feet. There are several important ranges in Khorasan, and one of them, the Binalud, west of Meshed and north of I^ishEipur, has several peaks of 11,000 to 12,000 feet in height. In south-eastern Persia the Kuh-i-Basm^n, a dormant volcano, 11,000 to 12,000 feet in height, in the Basman district, apd the Kiih-i-Taftan, i.e., the hot, or burning mountain (also called Kiih-i-Nushadar from the ” sal ammoniac,” n-Ashddar, found on its slopes), an active triple-peaked volcano in the Sarhad, district and 12,681 feet in height (Capt. Jennings), are notable features.

Geology. â€” ^Since Mr W. T. Blanford's sketch of the geology of Persia was written (see Ency. Brit., 9th edit., xviii. pp. 621-622) several travellers and explorers have gathered much valuable information, but no writer of note has as yet combined the new information into a general siu'vey, and Mr Blanford's sketch is still the only trustworthy one. The following short sketch of the geology of the country between Teher&n and Isfdh^n, including a part of the Elburz, is given in the author's Eastern Persian Ir&k (London, 1896) :â€"

"The part of the Elburz in the neighbourhood of Teheran is composed of Â» few granitoid and schistose rooks, sedimentary rocks of various ages from Devonian to Miocene, and volcanic rocks of various periods. There is no central axis of crystalline rocks, and Palaeozoic rocks are very sparsely represented. In the L&r district, north-east of Teheran, are some Old Red Sandstone strata and Carboniferous limes with Fuselina ; and at Hi'v, north- west of Teherdn, there is a thin layer of Carboniferous limestone with Productus, Jurassic rooks form most of the southern slopes, and immediately under them, in Liassic formations, most of the coal which supplies Teheran is obtained. Betveeen the Palseozoio and Liassic strata occur some rocks which have been classed as Triadic, although no fossils were found in them to prove it ; and some of the volcanic rocks and tuffs which enter into the com- position of the Elburz also seem to belong to the Triadic period. Cretaceous rocks with hippurites run out from the Elburz and form a ridge south-east of Teher&n. Some of the volcanic rocks of the Elburz belong to the Miocene age, but the trachytic Demavend, raised up at the southern end of the Caspian depres- sion, is probably post-Tertiary. The hills parallel to the Elburz, and between it and the central range, form a zone of trachytic rocks and tuffs and other volcanic formations associated with Cretaceous limes, sandstones, shales, and newer Tertiary forma-

tions. The hills south of HIv, and south-west of Teherftn as far as Savah, are composed of volcanic rocks â€" dolerites, quartz-porphyries, andesites, rhyolites â€" and of Cretaceous limes without fossils. Eocene limes with corals, Miocene sandstones, limes with Echinidm and Pecten, and Miocene gypsiferous strata and con-

glomerates. Most of the ridges between Teherto and Kom are composted of trachytic and gypsiferous formations. Near Hawz-i-Sultan, Cretaceous limes and sandstones rest on trachytic rocks. The Siah K;ih, south-east of Teheran, is com- posed of trachytes and green trachytic tuffs of the Cretaceous period, underlying limes and sandstones of the lower Miocene and Miocene gypsiferous formations of variegated marls, salt, and gypsum. The hills through which the " Caspian Gates " (Sarderreh Pass) east of Teheran lead also belong to the gypsiferous formation. The great central range possesses a distinct axis of crystalline rocks and granite, and granitoid formations form a great zone or band extending from Azerbaijan to -Kermto. Volcanic formations, mostly of the Cretaceous period, occupy an extensive area, and are associated with Cretaceous and Tertiary beds, which generally rest on old rocks. Between Kom and Isf&h&n we see black slates and massive Cretaceous limes interstratified with diorites, andesites, trachytes, and other volcanic formations of the same age, resting on granites, syenites, and tonalites which occasionally pass into gneissose and schistose rocks. The hills of the IsfÂ§,h4n valley are composed of Cretaceous limes resting on black slates and shaly limestones. On the outer edges of the central range, particularly towards the east, Miocene formations, principally of the gypsiferous series, and resting on crystalline schists and dolerites, andesites and trachytes, abound. South-east of Natanz, and towards Nal'n, the schists are broken through by basalts, and south of the Isfdhfi,n-lira!in road the Gavkhinl depression, which takes up the Isfdhdn river, is in the gypsifer- ous series resting on trachytes. The rocks composing the hills parallel to and east of the central range are similar to those of the central range, and comprise Cretaceous and Miocene forma- tions resting on gneiss, granite, and volcanic rocks."

Prom this sketch it will be seen that the Palaeozoic rooks are rare, but that, from the Trias upwards, nearly all the principal formations are represented. The Miocene salt formation, "the gypsiferous series" of Loftus, covers vast extents of ground. During the Cretaceous period, when much volcanic action took place, the central desert of Persia was a sea ; but the Miocene salt formation, which is so largely represented in inner Persia, is completely wanting on the Caspian side of the

Elburz, proving that the Elburz range must already then have been a dividing wall between the Caspian depression and inner Persia. The greatest changes probably took place at the end of the Miocene, or perhaps during the Pliocene period, and the volcanic forces acted most at those places which offered the least resistance â€” as, for instance, all along the precipitous inner sides of the ranges and towards the depressions of central Persia. During the post-Ter- tiary period, when the hills and valleys were very much as they are now, Demavend was formed ; and then also the immense recent, or sub-recent, accumulations of gravel, pebbles, and boulders, which form gentle inclines from tlie base of the hUls down to the alluvial flats and fill up with long slopes the broad valleys opening into the plains, were deposited from the detritus of the hills. The lowest portion of these accumulations consist of fine alluvial loam, shifting sands, and sometimes swamp or marsh ; then follows the gravel, first fine, then getting coarser as one ascends. The most remarkable gravel slopes are that south of KS,sh5n and that on which the city of Teher&n is situated. The former extends from Gebr^bM, at the foot of the Kuhriid hills, to Kfehdn, a distance of about 12 miles, and the latter from the foot of the Elburz to five or six miles south of Teheran, a distance of 16 miles. The depth of these deposits must be great : a well bored at Teherdn, 10 miles away from the base qf the hills, had not reached the end of the gravel at a depth of over 500 feet.

Risers.- â€” Three rivers, Kizil Uzain, Atrak, and Gitrgdn, are men- tioned in the ninth edition (p. 620), as belonging essentially to Persia in reference to the Caspian watershed, but there is a fourth, the Serhdz, which, though not important in length of course or drainage, also, like the Kizil Uzain, breaks through the Elburz range from the inner southern scarp to the north. It rises on the slopes of the Kasil Kuh, a peak 12,000 feet in height within the Elburz and about 25 miles north of TeherS,n, flows in an easterly direction through the L^r plateau, where it is known as the L4r river, and takes up several affluents ; turns to the north- east at the foot of Demavend, leaving that mountain to the left, and flows due north past Amol to the Caspian. ‘ Its length is about 120 miles. The late Sir Oliver St John estimated the drain- age of the rivers which have no outlet to the sea, and form inland salt lakes

and swamps (kavirs) at 380,000 square miles. Including the drainage into the lake of Urmia, which he estimated at 20,000 miles. There are fourteen rivers which flow into the lake of Urmia :

Ajl Chd'i, Sd,fi ChM, Murdf Ch^'i, and Jaghatii from the east, the Tatav^ (Tataii) from the south, and nine smaller rivers from tlie west. During heavy rains and at the end of winter, when the snows on the hills melt, thousands of streams, mostly nameless, flow from all directions into the innumerable depressions of inner Persia, or help to swell the perennial rivers which have no outlet to the sea. These latter are few in number, and some of them barely sufBoe for purposes of agricultural irrigation, and in summer dwindle down to small rills. The perennial streams which help to form the kavfrs (salt swamps) east of Kom and Kashan are the Hableh-rud, rising east of Bemavend, the Jajriid, rising north of Teherfi,n, the Kend and Kerej rivers, rising north- west of Teheran, the Shureh-riid (also called Abhar-riid), rising near Sultanieh on the road between Kazvin and Tabriz, and the Kara-sii, which rises near Hamadan and is joined by the Zarln- riid (also known as D6-ab), the Rezi Chai (also called Mazdakan- riid), the Jehriid river and the Kom-riid. The river of Isfahan, Zendeh-rud, i.e., "the great river" (from Persian zendeft [PehlevI, zendelc], great), but now generally known as Zdyendeh-riid, i.e., "the life-giving river," flows into the Gavkhinl or Gavkhaneh swamp, east of Isfahan. In Fars the Kur with its affluents forms the lake of Bakhtegan (also known as lake of Nairlz), and is, in its lower course, generally called BandAmlr (made famous by Thomas Moore) from the band (dam) constructed by the Amir (prince) Azud-ed-dowleh in the 10th century. ("Note on the Kur River in Pars," Proc. JRoyal Geogr. Soc, London, 1891.) With regard to the rivers which flow into the Persian Gulf and the Indian Ocean, St John, after mentioning the Shatt-el-Arab, Jerrahi, and T4b, states that ' ' after this, not a single stream un- fordable at all seasons bars the passage of the traveller along the coast till he reaches the Indus, eighteen degrees of longitude to the east and five degrees of

latitude farther south, a stretch of riverless waste perhaps unequalled save on the neighbouring shores of Arabia and the Red Sea" (Eastern Persia, i. 8). There are, however, many streams which though fordable at most seasons (some of them are often quite dry) are quite unfordable during the rains. Two of these may be mentioned here, viz., the Mand, erroneously mentioned as Mira in the ninth edition (p. 620), and the Mfndb, which St John (loc. cit. p. 9) considered as being " of far more im- portance than the maps would lead the observer to suppose." The former, after a run of over 300 miles from its sources in the hills west of Shiriz, debouches at Khor-i-Zi^ret, about 60 miles south of Bushire. It is mentioned by the old Arab and Persian geographers as the Sitakan (in some MSS. misspelt Sakkan) , and is the Sitakos of Arriau and the Sitioganus of Pliny. In its upper course it is now known as the Kara-aghach (Wych-elm) river (cf. " Notes on the River Mand in Southern Persia," Poyal Geogr. Soc, Loudon, December 1883). The Mlndb has two outlets into the Persian Gulf, one the Khor-i-Mlnab, a salt-water creek into which the river overflows during the rains, about 30 miles east of Bander Abbdsi, the other the true Minab, at Khag\in, "some miles south of the creek. It rises in the hills about 100 miles north of Bander AbbAsi, and has a considerable drainage. Its bed near the town of Minab (15 miles from the coast) is nearly a mile in width, and during the rains the water covers the whole bed, rendering it quite un-fordable. During ordinary weather, in March 1884, the water flowing past the town was 100 yards fn width and 2 feet deep (Preeoe, Proc. Poyal Geogr. Soc, January 1885). In ordinary seasons very little water of the river runs in its original bed, being diverted into canals, &c. The creek, the Anamis of Nearchus, is navigable nearly all through the year as far as Shahbander, the custom-house, about 7 miles inland, for vessels of 20 tons burden.

Climate. â€" Since the paragraphs " rainfall and winds " and "climate" in the article Persia of the ninth edition were written (pp. 621, 623), many meteorological observations have been taken at various places in and near Persia, and much addi- tional information can now be given. For the rainfall on the watershed of the Persian Gulf we have two places of observation, Bushire and Jask; at the former place it is a little in excess of that of inner Persia, while at the latter place it is very much

less. The rainfall on the Caspian watershed greatly exceeds that of inner Persia ; at AstrS,bAd and Ashilrada, in the south- eastern corner of the Caspian, it is about 50 per cent, more ; and at Resht and Lenkoran, in the south-western corner, it is four and five 'times that of the adjoining districts across the ridges to the south. With the exception of the Caspian watershed and that of the Urmia basin, the country has probably in no part a yearly rainfall exceeding 13 to 14 inches, and throughout the greater part of central and south-eastern Persia the yearly rainfall probably does not exceed 6 inches. The following mean values of the rainfall at Teheritn have been derived from observations taken by Dr Tcherepnine during the years 1884-87 (Symons's Monthly Mctimrological Mag,, November 1893) and by the writer during the years 1892-99 :â€"

Mean

Jan.

Feb.

Mar.

April.

May.

June.

Total for Year.

in. 10^71

in.

2-00

in,

1-69

in.

2-09

in.

1-55

in. â– 49

in. â€¢12 ,

July.

Aug.

Sept.

Oct.

Nov.

Doc,

in.

.03

in.

â– 04

in. â€¢05

in,

â– 30

in. 1^10

in, 1^25

Good harvests depend on the rainfall from October to April, and on an amount of snow sufficient to cover the crops during frosts. During normal winters in Teheran and surrounding districts the rainfall amounts to 9 or 10 inches, with 3 to 4 of snow, but in the winter 1898-99 it was only 5J inches, with only 1 inch of snow ; and in 1899-1900 the harvests were in consequence exceptionally bad, and large quantities of wheat and flour had to be brought from the provinces and even from Russia at high freights, causing the price of bread at Teherd,n to rise 200 per cent. The following table, which has been compiled from the latest available informa- tion, shows the mean annual rainfall in inches at fifteen stations in and near Persia : â€”

o o

Station.

Lat.

N.

Long.

E.

Alti- tude.

II O

Tear.

Authority.

Feet.

Tears.

38Â° 46′

48Â° 51′

-60

28i

46-82

Supan.i

â– EeBtit .

87Â° 17′

49Â° 85′

-50

2

56-45

British Consul.!

ABhilrada .

86Â° 64′

68Â° 55′

-80

19

17-17

Supan.i

AstardbM .

86Â° 51′

54Â° 25′

-40

7

16-28

Symons.3

36Â° 17′

59Â° 86′

8J80

6

6-48

British Consul.4

Quetta .

80Â° 11′

67Â° 3′

6500

19

10-09

Supan.i

Kelat

28Â° 68′

66Â° 28′

6500

15

8-98

”

Maskat .

23Â° 29′

68Â° 83′

3

6-13

”

Jask

25Â° 89′

57Â° 46′

10

8-24

English Telegraph.’

28Â° 59′

50Â° 49′

19

18-86

Supan.i

IsffibAn

82Â° 87′

61Â° 40′

5870

6

8-23

Eng’ish Telegraph.’

TelierAn

85Â° 41′

61Â° 26′

3810

12

10-71

The -writer.

Urmia (Sair)

87Â° 28′

45Â° 8′

6225

1

21-61

SvraonB.3

Baghdad

8.3Â° 19′

44Â° 26′

7

10-59

Supan.i

Merv

37Â° 85′

61Â° 50′

700

1

6-36

Symons.^

The figures for Meshed and Isfahan do not give the total rain-‘ fall at those places, because the observers have measured only the falls of rain and neglected those of snow. The mean annual rain- fall of Meshed and Isfd-han, as given in the table, is therefore con- siderably less than what it ought to be, and would no doubt, if the falls of snow were added,

amount to quite as much as that of Teheran, or 10 to 11 inches instead of 6J and 3^ as given in the table. Among the prevailing winds should be noted the dry and warm wind which comes down from the sno-wy Elburz to Gilan in December and January, and much resembles the foehn of the Alps (Dr Tholozan, ” Sur les vents du Nord de la Perse et sur le foehn du Guilan,” Comptes Pendus, Acad. d. Sciences, March 1882). Observations for temperature have been taken for many years at the stations of the Indo-European Telegraph and for a few years at the British consulate in Meshed, and the monthly and annual means shown in the table on the following page have been derived from the indications of maximum and minimum ther- mometers in degrees Fahrenheit.

Very few hygrometrical observations have been taken, and only those of the British Residency at Bushire are more or less trustworthy, and have been regularly registered for a number of years. In inner Persia the air is exceptionally dry, and in many districts polished steel may be exposed in the open’ during a great part of the year without becoming tarnished. Along the shores of the Caspian, particularly in Gildn and MazandarAn, and of the Persian Gulf from the mouth of the Shatt-el-Arab down to Bander Abbdsi, the air during a great part of the year contains much moisture â€” dry- and wet-bulb thermometers at times indicating the same temperature â€” and at nights there are heavy falls of dew. In GilAn and MflzandarAn the air contains much moisture up to con- siderable elevations and as far as 30 to 40 miles away from the sea ; but along the Persian Gulf, where vegetation is very scanty, stations only a few miles ;> way from the coast and not more than 20 or 30 feet above the sea-level have a comparatively dry climate.

1 Dr A. feup.-vn, ” Die Vertheihing des Niederschlag’s auf der festen Erduberflaclie,” Pet. Milt., Suppl. 124, 1898.

‘- Consular report, Gilan, 1897.

8 Symons’s Monthly Meteorological Mag,, December 1893.

4 Consular reports for Khorasitn.

6 Observatiiins taken at the telegraph stations, and kindly communicated by Mr R. C. Barker, C.I.E., director of the Indo-Europeaa Telegraph Department iu Persia.

PERSIA

617

^^

o ^ ^:

â€¢Li â€” ^

station.

Jan.

Feb.

March.

April.

May.

June.

July.

August.

Sept.

Oct.

Not.

Dec.

Tear.

Â§1

? >

t^-g

^â,¬

Meshed

32

34

49

59

68

76

78

70

67

55

48

40

56-3

91

15

76

Teher&n

38

38

48

61

71

81

84

81

73

64

53

43

60-4

111

3

108

Tabriz 1

17

25

39

54

63

74

79

81

73

62

48

34

54-1

99

-18

117

Kashan^

35

36

43

60

74

83

90

85

77

68

83

42

62-2

113

9

104

Isf^hin

..

â€¢ *â€¢

58-0

100

-3

103

Abadehs

41

41

47

56

68

75

79

75

71

59

55

46

59-5

96

14

82

Dehbfd* .

27

30

38

45

57

65

69

65

61

52

43

36

49-0

91

-19

110

Shiraz^

48

47

55

63

73

80

85

81

76

67

55

49

650

113

21

92

Kazeriin” .

51

50

52

67

84

93

95

94

87

79

70

56

73-2

110

36

74

Borazjiin’ .

55

67

66

80

94

97

100

99

92

83

72

64

80-0

117

48

69

Bushire

58

60

65

74

82

86

90

90

87

80

71

62

75-4

109

41

68

Frequently when the temperature in the shade at Bushire is not more than 85Â° or 90Â°, and the great humidity of the air causes much bodily discomfort, life is almost pleasant 12 or 20 miles inland with a temperature of over 100Â°.

Area and Population. â€” In 1880, when a great part of the northern and the whole of the eastern and western frontiers were not defined,

the area of Persia was estimated at 1,647,070 square kilometres, or 635,934 square miles (" Die Bevolkerung der Erde," Pet. Mitt. Erg. Heft. 69, p. 28). Since then the northern and eastern frontiers have been demarcated, but the Turco-Persian frontier, from Mount Ararat in the north to Muhamrah in the south, a distance of 700 miles, is still an undefined line lying within a border-strip of from 20 to 40 miles in width, and the area has been estimated at 628,000 square miles. In 1881 the writer estimated the population of Persia at 7,663,600; 1,963,800 urban, 3,780,000 rural, and 1,909,800 wandering (" Bevolkerung der Erde," p. 28 ; ninth edit. Ency. Brit., p. 628) ; and, allowing for an increase of about 1 per cent, per annum, the population for 1900 may be estimated at 9 to 9^^ millions. E. Lorini {La Persia economica contemporanea, Roma, 1900, p. 378) estimates it at 9,333,000. No statistics whatever being kept, nothing precise is known of the movement of the population. During the 'eighties many Persian subj ects emigrated, and a number of Persian villages were deserted andf ell to ruins ; since then a small immigration has set in and new villages have been founded. In some districts the population increases very slowly, perhaps only ^ per cent, per annum ; in others the increase exceeds 1^ per cent, and even reaches 2 per cent. Persians say that the females exceed the males by 10 to 20 per cent., but wherever the present writer has been able to obtain trustworthy information, he found the excess to be less than 2 per cent. Of the deaths in any place the only check obtainable is from the public body -washers, but many corpses are buried without the aid of the puMic body washers ; and the population of the place not being accurately known, the number of deaths, however correct, is useless for statistical purposes. Medical men have stated that the number of deaths, in times when there are no epidemics, amounts to 19 or 20 per thousand, and the number of births to 25 to 40 per thousand.

The prices of the staple articles of food Snd all necessaries of life have risen considerably since 1880, and, particularly in the large cities, are now very high. As salaries and wages have not increased at the same rate, many of the upper classes and officials are not so well off as formerly. By dismissing their servants in order to reduce expenditure, they have thrown great numbers of men out of employ, while many

labourers and workmen are living very poorly and often suffer want. Tradesmen are less affected, because they can sell the articles which they manufacture at values which are more in proportion with the increased prices

46Â° 18′ E. ; altitude 4423 feet.

â€ž 3190 â€ž

Â» 6200 â€ž

â€ž 8000 â€ž

â€ž 5000 â€ž

â€ž 2800 â€ž

100 â€ž

138Â° 5′

N.

; 46Â° 18′

2 34Â°

, 51Â° 27′

3 31Â° 18′

; 52Â° 38′

i 30Â° 37′

; 53Â° 10′

6 29Â° 37′

52Â° 32′

6 29Â° 37′

51Â° 43′

^ 29Â° 15′

51Â° 3′

of food. In 1880 a labourer earning 25 krans, or Â£1 sterling a month, could afford to keep a family ; by 1901, in krans, he earned double what he did then, but his wage, expressed in sterling, was the same, and wherever the prices of food have risen more than his wages he could not afford to keep a family. In many districts and cities the number of births is therefore reduced, while at the same time the mortality, in consequence of bad and often insufficient food, is considerably increased.

Constitution and Government. â€" The government of Persia is an absolute monarchy, and resembles in its prin- cipal features that of the Ottoman empire, with the excep- tion, however, that the monarch is not the religious head of the community. His powers over his subjects and their property are absolute, but only in so far as they are not opposed to the shar', or " divine law," which consists of the doctrines of the Mahommedan religion, as laid down in the Koran, the oral commentaries and sayings of the Prophet, and the interpretations of the same by his successors and the high priesthood. The government is, therefore, much like that of the Erench monarchy until a few centuries ago, viz., on the principle of the old Roman " quod principi placuit, legis habet vigorem," with the restriction, as the French lawyer Beaumanoir has it, " pourvu qu'il ne soit pas fet contre Dieu, ne centre bonnes meurs, car s'il. le feroit, ne le devroient pas si souget soufrir."

The form of government as it now ex^ists is admirably described by Lord Curzon of Kedleston in Persia and the Persian Question. " The language," says that author, " in which the Shah addresses his subjects and is addressed by them, recalls the proud tone in which an

Artaxerxes or Darius spoke to his tributary millions, and which may still be read in the graven record of rock-wall and tomb. He remains the Sh&hansh&h,^ or ‘ King of Kings ‘ ; the Zill UUah, or ‘ Shadow of God ‘ ; the Kibleh, Alam, or ‘ Centre of the Universe ‘ ; ‘ Exalted like the planet Saturn ; Well of Science ; Footpath of Heaven ; Sublime Sovereign, whose standard is the Sun, whose splendour is that of the Firmament ; Monarch of armies numerous as the Stars.’ Still would the Persian subject endorse the precept of Sadi, that ‘The vice approved by the king becomes â– a virtue ; to seek opposite council is to embrue one’s hands in his own blood.’ The march of time has imposed upon him neither religious council nor secular council, neither ulema nor senate. Elective and representative institutions have not yet intruded their irreverent features. No written check exists upon the royal prerogative.

” And yet the power of the Persian king by no means corre- sponds to its arrogant definition, nor is it now equal to what it once was. In the first place, the Shah is no longer the religious head even of the Shiah community of the Mussulman world. At no time have the sovereigns of Persia enjoyed the spiritual supremacy that was conceded to the caliphs of Baghdad and that is still claimed for the sultan of Constantinople. But the Sefavi monarchs, by virtue of their descent from a famous saint, who was himself a Seyid, or descendant of Ali, the son-in-law of the Prophet, were invested with a semi-sacred character, to which

8 We see this title in its old Persian form, Khshdyathiya Ehshdya- thiy, in the cuneiform inscriptions; as BainXias Baa-iXeuv on the coins of the Arsacides, and as the Pehlevi Malkdn Malkd, on the coins and in the inscriptions of the Sassanians. With the Mahommedan conquest of Persia and the fall of the Sassanians the title was abolished; it was in use for a short time during the 10th century, having been granted to Shah Ismail Samani by the Caliph Motadhid A.D. 900 ; it appeared again on coins of Nadir Shah, 1736-47’, and was assumed by the present dynasty, the Kajars, in 1799.

alone can we attribute the passiveness with which, for a whole century, their suhjects submitted to the rule of a succession of capricious and dissolute drunkards. Chardin says that they were regarded as vicars and successors of the Imams; and Kaempfer records that the water in which they had washed was deemed holy, and was eagerly sought after as a cure for all complaints. No such pretensions, however, have been made, or could be made, on behalf of any subsequent dynasty ; least of all on)3ehalf of a family lilie the Kajars, of Turkish extraction. Tlie Shah of Persia, therefore, must be dissociated from any claims of personal sanctity, and both the scope and limitations of his prerogative must be sought on purely secular grounds.

"Besides the respect for the religious teachers and law, there are many other restraints upon the Shah's powers. Regard for established usage has been found a stronger deterrent. So long as the revenue is collected and robbery is suppressed, the com- plete assertion of the royal power is not, in hazardous cases, too rigorously pressed. In other words, political expendiency acts as a further deterrent. But, strongest of all, in the case of the reign- ing monarch and of great interest as proving the extent to which Persia has been drawn into the vortex of civilized states, is the deterrent of foreign opinion, which, in the absence of any indi- genous public opinion worthy of the name, has taken its place, and has operated as a safeguard for which tlie Persian people are probably quite without gratitude, and of which they are, as may be suspected, wholly unaware. It may safely be predicted that any extravagant or savage exercise of the royal prerogative, such as has been a familiar incident in the Persian history of the past, will rarely occur, if at all, in the future, and that in any case it will prove an exceptional instead of a normal feature of govern- ment. This remarkable change is to be attributed to the permanent presence of foreign ministers and to the electric telegraph."

In the task of government the Shah is assisted by the Sadr Azam ("Grand Vizir"), a number of vizirs, minis- ters, or heads of departments somewhat on European lines, and a " grand council of

state," composed of some ministers and other members nominated by the Shah himself as occasion may require. Many of the " min- isters " would be considered in Europe merely as chiefs of departments of a ministry, as, for instance, the minister for Crown buildings, that for Crown domains, the minister of ceremonies, those for arsenals, army accounts, &c. ; also an accumulation of several offices without any connexion between their functions, in the hands of a single person, has frequently been a characteristic departure from the European model. The ministers are not responsible to the Crown in a way that ministers of a European Government are ; they rarely take any initiative, and generally refer their affairs to the Grand Vizir or to the Shah for final dicision. This irresponsibility on the part of the min- isters, and the system of referring all aif airs, even unim- portant ones, to the head of the State, makes the Shah, whenever the office of Grand Vizir is vacant â€" which has frequently happened â€" one of the hardest-worked sovereigns in the world, and the post of Grand Vizir is anything but a sinecure.

The oflBcial Sdlndmih ("Year-book") for 1899 enumerates twenty ~~seven vizirs (ministers), but only some of them are con~~ sulted on affairs of State. The departments that have a vizir at their head are tlie following : Court, Ceremonies, Shah's secretarial department, Interior, Correspondence between Court and Gov- ernors, Revenue accounts and budget. Finance, Treasury, Out- standing accounts, Foreign Affairs, War, Army accounts, iVIilitary stores. Arsenals, Justice, Commerce, Mines and industries. Agri- culture and Crown domains, Crown buildings,. Public Works, Public Instruction, Telegraphs, Posts, Mint, Religious endowments and pensions. Customs, Press. In addition to these twenty-seven vizirs with portfolios, there are some tilulary vizirs at Court, like Vizir i Uiizur i Humayun (Minister of the Imperial Presence). Vizir i makhsus (Extraordinary Minister), &c., and a number in the provinces assisting the governors in the same way as the Grand Vizir assists the Shah.

Political and Administrative Divisions. â€" The empire of Persia, officially known as 3Iuii(dlili i Mahrnseh i Irdn, "the protected

kingdoms of Persia," is divided into a number of provinces, which, when lart,'e, an

"kingdom," when smaller, vildyat and aydto, and are ruled by governor-generals and governors appointed by and directly responsible to the Crown. These provinces are further divided into sub-provinces, vildyats, districts, sub-districts, and parishes, buMk, nahlyeh, malidl, and towns, cities, parishes, and villages, shehr, kassdbeh, malialleh, dih, which are ruled by lieutenant-governors and other functionaries appointed by and responsible to the governors. The administrative system of Persia is practically the same as it was in ancient times when the empire of the Shdhanshdh, the " Great King," Paa-LXtv<; /ueyas of the Arsacides, was divided into a number of provinces ruled by satraps, or governors, who were responsible for the due payment of the tributes and taxes. All governors are called hdhim, or hukmrdn, but those of large provinces generally have the title of vdli, and sometimes firmdn-firmd. A gov- ernor of a small district is a zdUt ; a deputy-governor is called ndih el hukumeh, or na:ih el aydleh; an administra- tive division is a Jcalamrd, or hukumat. Until recently the principal governorships were conferred upon the Shah's sons, brothers, uncles, and other near relatives, but now many of them are held by men who have little if any connexion with the royal family. Also, the governors are now, as a rule, resident in their provinces instead of being absentees at the capital.

Every town has a mayor, or chief magistrate, called beglerbegi, " lord of lords," kcddntar, " the greater " (same as mayor), and sometimes ddrogJia, "overseer," or chief of police ; every ward or parish, tnahalleh, of a town and every village has a head-man called ked-khodd, "house- lord." These officers are responsible to the governor for the collection of the taxes and the orderly state of their towns, parishes, and villages. In the important provinces and sub-provinces the governors are assisted by a man of experience, to whom the accounts and details of the govern- ment are entrusted. This person, called vizrr or plshkdr, is often nominated by the Shah, and his functions in the provincial government are similar to those of the Grand Vizir in the central government, and comprise very extended administrative

powers, including at times the command of the military forces in his province. Among the nomads a different system of titles prevails, the chiefs who are responsible for the taxes and the orderly conduct of their tribes and clans being known as ilkhdni, ilbegi (both meaning "tribe-lord," but the latter being considered an inferior title to the former), khdn, rais, amir, mir, shaikh, tushmdl, &c.

The governors and chiefs, excepting those possessing hereditary rights, are frequently changed ; appointments are for one year only and are sometimes renewed, but it does not often occur that an official holds the same govern- ment for longer than that period, while it happens rarely that a province is governed by the same person for two or three years. This was not so formerly, when not infre- quently an official, generally a near relation of the Shah, held the same governorship for five, ten, or even more years. The governorship of the province of Azerbaijan is an exception, and has, under the. now reigning dynasty, always been held by the valiahd, " heir-appaxent," or " Crown Prince."

The political divisions of Persia, provinces, sub-provinces, dis- tricts, &c., ruled by hi'ikims number over 200 (cf. the statement in Noldeke's Geschichte des ArtacMIr PSlpakUn, " after Alexander's death tliere were in Irdn 240 local governore "), but the adminis- trative divisions, hukumat, or kalamrd, with governors appointed by the Crown and responsible to it for the revenues, have been under fifty for sixty-flve years or more. In 1840 there were twenty-nine administrative divisions, in 18C8 twenty-two, in 1876 twenty-nine, in 1884 nineteen, in 1890 forty-six, and in 1900 thirty-live.

Va&yats. â€" 1. Teher&n ; 2. Isfd,hd,n ; 3. Nishdpiir ; 4. Kerman- shdh, and frontier (Turkish) ; 5. Kurdistdn ; 6. Gerriis ;' 7. Astra^ bad and Gurg^n ; 8. Mazandarin ; 0. Irik, Kamareh, Gulpaigan, and Khunsar ; 10. Luristan and Buriijird ; 11. Yezd ; 12. Kazvin ; 13.

Malayir, Tiisirkan, and Neh^vand ; 14. Hamaddn ; 16. Kash^n ; 16. Khamseli ; 17. Kharkan ; 18. Shahriid and Bostiim ; 19. Sem- nan and DamghhSln ; 20. Kom ; 21. SAveh, Zerend and Sliah- sev6n-i-BaghdMl ; 22. Arabistd,n and Bakhtiari ; 28. riruzkiih ; 24. Deniavend ; 25. Natanz ; 26. KangSiver ; 27. Kliir ; 28. J6she- kan ; 29. Talikdn ; 30. TS,rom 'ulid.

Justice. â€" By the theory of a Mahommedan State there should be no other courts oÂ£ justice except those established for the adminis- tration of the shar\ the "divine, or written law," but in Persia there is another judicature, which is called hirfund represents the "customary," or "known and unwritten law." This 'Â«?â– / may be considered an emanation of the supreme temporal authorities sub- ordinate to the Shah, while the shar^ is interpreted and administered by the ecclesiastical authorities, the Udemd, or clergy. Justice, therefore, is administered by the Shah and his representatives according to one law and by the clergy according to another, but necessarily the decisions of the former must not be opposed to the fundamental doctrines of Islam. On the other hand, it frequently happens that decisions by the ecclesiastical authorities are not in ac- cordance with the views, or wishes, of the authorities administering the 'Ml/, and much friction between the two authorities, leading sometimes to serious disorders, ensues, but generally ends in favour of the clergy. The Shah's representatives for the administration of justice are the governors and other officers already mentioned. The officials charged with the administration of justice according to the shar' are judges, called shaikh-ul-isl&m and It&zi (JcadM, kadi of Arabs and Turks) , members of the clergy appointed by the Govern- ment and receiving a fixed salary, but at present some cities are with- out regular appointed judges and the title of kdzi is almost obsolete ; decisions according to the shar' are given by all members of the clergy, ranging from ignorant mullds of little villages and cantons to learned mujtahids of the great cities. A judgment given by a lower member of the ecclesiastical hierarchy is not always executed, for, if the parties to the suit are dissatisfied with the judgment, they may appeal to a priest who stands higher in public estima- tion, or one of the parties may induce a higher authority by bribery to quash the judgment of the first. Unfortunately,

many members of the clergy are cormpt, but the mujtahids, as a rule, are honest and entirely trustworthy. The functions of the representatives of the shar' are now limited to civil cases, while all criminal cases are referred to the 'wr/, which, however, also takes cognizance of civil disputes, should the parties desire it.

In criminal cases the dispensation of justice is always summary, and, when the offence is small, the whole procedure, including the examination of witnesses and criminal, as well as the decision and the punishment, a bastinado, is a matter of some minutes. For commercial oases, not paying a bill in time, bankruptcies, &c. , a kind of jurisdiction is exercised by the Minister of Commerce, or a board of merchants, but the decisions of the minister, or those of the board, are rarely final. In Teheran the board of merchants is presided over by the malik ut tujjdr, " King of Merchants," in the provincial cities by a person called malik, amin, and muin of merchants.

After his second journey to Europe in 1878 the late Shah desired to organize a police for the whole of Persia on the European system, but this intention was not carried out in its entirety, and only a small body of police, whose services were confined to the capital and its immediate neighbourhood, was created in 1879. Its strength is 60 mounted policemen and 190 foot, with 11 superior and 40 subaltern officers. There are also 280 men for cleaning streets. Two battalion.? of infantry have been attached to the police department, and the whole force is under the "Minister of Police."

There is also a "Tribunal of the Ministry for Foreign Affairs," presided over at Teherdn by an official of the Foreign Office, and in the provincial cities hj the kdrguzdrs, "agents," of that depart- ment. The functions of this tribunal are to inquire into and judge differences and suits between Persian subjects and foreigners, and it is stipulated in the treaty of Turkmanchai, which is the basis of all existing treaties between Persia and other countries, that "such differences and suits shall only be examined and judgment given in the presence of the dragoman of the mission or consulate (of the foreign subject), and that, once judicially concluded, such suits shall not give cause to a second

inquiry. If, however, cir- cumstances should be of a nature to require a second inquiry, it shall not take place without previous notice given to the minister, or the charge d'affaires, or the consul, and in this case the busi- ness shall only be proceeded with at the supreme chancery of the Shah at Tabriz or Teherdn, likewise in the presence of a dragoman of the mission, or of the consulate." (Article vii.)

A foreign subject implicated in a criminal suit cannot be pursued or molested in any way unless there exist full proofs of his having

taken part in the crime imputed to him, and should he be duly con- victed of the crime, he is handed over to his legation, which either sends him back to his own country to undergo the punishment estab- lished by law, or, according to more recent usage, punishes him in Persia by fine, imprisonment, &c. In this respect the powers of the foreign representatives in Persia, now numbering ten (Gi-eat Britain, Russia, France, Turkey, Austria- Hungary, Germany, United States of America, Italy, Belgium, and the Netherlands) vary con- siderably, some having the power of condemning a criminal to death, while others cannot do more than fine and imprison for short periods. Suits, civil and criminal, between foreign subjects are altogether out of Persian jurisdiction, and are judged by the repre- sentatives of the foreign powers accredited to Persia.

In 1889, after the late Shah's return from his third visit to Europe, the Council of State was instructed to compile a code of law for the regulation of justice. A beginning was made by ordering the translation of the Code Napoleon, the Indian Mahommedan code, and the Code Napoleon as modified for Algeria; but, as Lord Curzon says, "one more excellent scheme went into the waste-paper basket, and one more stone had to be added to the cairn of abortive reforms so conscientiously piled by Nfesir-ed-dln Shah."

Religion. â€" About 8,000,000 of the population are Mahom- medans of the Shia'h faith, and 800,000 or 900,000, principally Kurds in north-western Persia, are said to belong to the other great branch of IsMm, the Sunni, which differs from the former in religious doctrine and historical belief, and is the State religion of the Turkish empire and

other Mahommedan countries. Other religions are represented in Persia by about 80,000 to 90,000 Christians (Armenians, Nestorians, Greek Orthodox and Roman Catholics, Protestants), 36,000 Jews, and 9000 Zoroastrians.

Society in Persia, being based almost exclusively on religious law, is much as it was in Biblical times among the Jews, with this difference, however, that there exists no sacerdotal caste. In Persia any person capable of reading the Koran and interpreting its laws may act as a priest {mulld), and as soon as such a priest becomes known for his just interpretation of the shar' and his superior knowledge of the traditions and articles of faith, he becomes a mujtahid, literally meaning "one who strives" (to acquire knowledge), and is a chief priest. The mullds are referred to in questions concerning religious law, hold religions assemblies, preach iu mosques, teach in colleges, and are appointed by the Government as judges, head-preachers, &c. Thus the dignitaries, whose character seems to us specially a religious one, are in reality doctors, or expounders and interpreters of the law, and officiating ministers charged with the ordinaiy accomplishment of certain ceremonies, which every other Mussulman, ' ' true believer, ' ' has an equal right to fulfill. Formerly there were only four or five mujtahids in Persia, now there are many, sometimes several in one city â€" Teheran, for instance, has ten ; but there are only a few whose decisions are accepted as final and without appeal. The highest authority of all is vested in the mujtahid who resides at Kerbela, or Najaf, near Baghdad, and is considered by many Shia'hs as the vice-regent of the Prophet and representative of the imam. The Shah and the Government have no voice what- ever in the matter of appointing mullds or mujtahids, but fre- quently appoint shaikhs-ul-isldm and kazis, and occasionally chief priests of mosques that receive important subsidies out of Government funds. The chief priest of the principal mosque of a city, the masjid i jdmi', is called imdm i juma'h, and he, or a representative appointed by him, reads the Khutbeh, "Friday oration," and also preaches. The reader of the Khutbeh is also called khatih. The leader of the prayers in a mosque is the pishnamdz, and the crier to prayers is the mu'azzin. Many priests are appointed guardia*is of shrines and tombs of members of the ProiJhet's family (imams and imamzddehs) and are re-

sponsible for the proper administration of the property and funds with which the establishments are endowed. Some shrines possess much landed property with considerable revenues. The guardian of a shrine is called mutavali, or, if the shrine is an important one with much property and many attendants, muta- vali-bdshi, and is not necessarily an ecclesiastic ; for instance, the guardianship of the great shrine of Imam Eeza in Meshed is generally given to a high court functionary or minister as a reward for long services to the State. A mutavali of a great shrine like that at Meshed is a very important personage, fre- quently equalling, or even surpassing, the governor in influence. He has on his staff a large number of priests, and other officials and attendants as secretaries, accountants, librarians, treasurers, inspectors, guards, doorkeepers, &c. The important shrines and their precincts afford inviolable sanctuary, or bast, to any male- factor who succeeds in entering them. In the precincts of a great shrine a malefactor finds a safe refuge from his pursuers and is lodged and fed, and from the security of his retreat he can arrange the ransom which is to purchase his immunity when he comes out.

Formerly all cases, civil and criminal, were referred to the clergy, and until the 17th century the clergy were subordinate to a kind of chief pontiff, named sadr-us-sudur, who possessed a very extended jurisdiction, nominated the judges, and managed all the religious endowments of the mosques, colleges, shrines, &c. Shah Safi (1629-1642), in order to diminish the influence of the clergy, appointed two such pontiffs, one for the court and nobility, the other for the people. Nadir Shah (1736-1747) abolished these offices altogether, and seized most of the endowments of the ecclesiastical establishments in order to pay his troops, and, the lands appropriated by him not having been restored, the clergy have never regained the power they once possessed.

Many members of the clergy, particularly those of the higher ranks, have very liberal ideas and are in favour of progress and reforms so

long as they are not against the shar\ or divine law ; but, unfortunately, they form the minority.

The At'meiiians of Persia, in so far as regards their ecclesiastical state, are divided into the two dioceses of Azerbaijan and Isfahan, and, since the late troubles in Turkey, which caused many to take refuge in Persia, are said to number over 50,000. About three- fifths of this number belong to the diocese of Azerbaijan, with a bishop at Tabriz, and reside in the cities of Tabriz, Kho'i, Selm^, Urmia, and Maragha, and in about thirty villages close to the north-western frontier ; the other two-fifths, under the diocese of Isfahan, with a, bishop in Julfa, reside in Teherdn, Hamad^n, Julfa, Shiraz, Bushire, Resht, Enzeli, and other towns, and in some villages in the districts of Chahar MahAl, Ferldan, Bar- barud, Kamareh, KazAz, Kharakan, &o. Many Persian Armenians are engaged in trade and commerce, and some of their merchants dispose of much capital, but the bulk live on the proceeds of agriculture and are poor.

The Nestonans, or Chaldeans, in Persia, all living in cities and villages close to the Turkish frontier, numbered about 25,000 to 30,000, but many of them, some say half, together with two or three bishops, recently went over to the Greek Orthodox (Russian) Church, in consequence of the unsatisfactory protection afforded them by their patriarch, who resides in Mosul. These latter are now cared for by an archimandrite of Russian nationality and some Russian priests.

The Greek Orthodox Catholics are represented by Russians, who reside in northern Persia ; they have a church at the Russian lega- tion in Teheran, and another at the Russian consulate in Tabriz.

The Boman Catholics in Persia, Europeans and natives (mostly Armenians), number about three or four thousand, and have churches in Teherin, Julfa, and Azerbaijan, served by members of the French Lazarist Mission. They also have some orphanages, schools, and medical dispensaries, under the care of Sisters of Charity of St "Vincent de Paul.

The Protestants, Europeans and natives (converted Armenians and Nestorians), number about 6500. The religious missions ministering to their spiritual welfare are : â€”

1. The Board of Foreign Missions of the Presbyterian Church in the United States of America, which has four establishments in Persia : Urmia since 1835, Teheran since 1872, Tabriz since 1873, and Hamadan since 1880. The establishments of Tabriz and Urmia form the Western Persia Mission, those of Teherin and Hamadd,n the Eastern Persia Mission. The former mission has 37 churches, with 800 communicants, 150 schools with 3800 pupils, 2 hospitals and 4 dispensaries ; the latter 4 churches with 200 commvmicants, 10 schools with 580 pupils, 1 hospital and 4 dispensaries.

2. The Church Missionary Society, established in Persia since 1869. It has at Julfa (near Isfahan) a church with 146 com- municants, 3 schools with 478 pupils (258 boys, 220 girls), 2 hospitals and 3 dispensaries ; in Yezd a dispensary ; in Karmdn a school with 16 pupils. The establishment of the Church Missionary Society is under the care of a bishop, who resides at Julfa and is under the bishop of London.

3. The Anglican Mission, which was established by Br. Benson, archbishop of Canterbury, and has its work among the Nestorians in Azerbaijan.

4. The London Society for promoting Christianity among the Jews, which was established at Teheran in 1876, and at Isfdhin and Hamadan in 1889. It has in Teheran a church with 10 com- municants and a school with 20 pupils, at Isfdh^n a school with 95 pupils, and at Hamadto a small school (number of pupils not stated) .

5. The British and Foreign Bible Society, which was repre- sented at Isf^h^n since 1878, and is at present looked after by the Church Missionary Society.

The Jews in Persia number about 36,000, and are found in nearly all cities of the country, but communities with synagogues and priests exist

only in the larger cities like Teherdn, Isfdhfi,n, Yezd', Shiraz, Hamaddn, &o.

The Zoroastrians, commonly called "gabrs," numbering about 9000, reside principally in the cities and villages of Yezd and

Kermdn, and only three or four hundred live in Teherd,n, Kashdn, Isfahan, and Shiraz, some engaged in trade and commerce, but most of them employed in agricultural work and gardening. Their interests are attended to by a delegate who is appointed by the Bombay Parsis and resides at TeherAn.

The non-Mussulman Persian subjects, particularly those in the provinces, were formerly much persecuted, but since 1873, when the late Shah returned to Persia from his first journey to Europe, they have been treated more liberally, and the central authorities do their utmost to prevent their being persecuted or injustice being done to them. In cities where many non-Mussulman subjects reside, a special official is appointed to protect them ; and the Ministry of Justice has a special section, now directed by a gentleman who was educated in England, to look after them and see that they are protected against fanaticism and injustice.

Instruction.â€" Frimary schools, maktab (where Persian and a little Arabic, sufficient for reading the Koran, and sometimes also a little arithmetic, are taught to boys between the ages of seven and twelve), are very numerous, there being one in many villages which have a population of not more than forty or fifty families. These schools are private establishments, receive no aid from the State, and are not under any supervision whatever, and in consequence many teachers are inefficient, children are frequently improperly treated, and schoolrooms are often highly insanitary. The payment for tui- tion is very small, varying from fourpenoe or fivepence to tenpence a month for each child. Colleges, madrasah (where young men are instructed, fed, and frequently also lodged gratuitously), exist in nearly every town. Most of them are attached to mosques, and all are supported by religious endowments. The teachers are members of the clergy, and receive fixed salaries out of the college funds, and the education is

practically the same as it was in similar establish- ments many centuries ago. The students are instructed in Arabic and Persian literature, religion, interpretation of the Koran, Mussulman law, logic, rhetoric, philosophy, and other subjects necessary for admittance to ^the clergy, for doctors of law, &o., while modern sciences are neglected. Families who have means and do not desire their children to become members of the clergy, employ private tutors, and several have latterly obtained the services of English and French professors to educate their children, while others send their boys to schools in England, France, Ger- many, and Russia. At the beginning of the late Nassir-ed-din Shah's reign, a public school on the lines of a French lycee was opened in TeherS,n, principally with the object of educating officers for the army, but also of introducing a knowledge of Western science and languages, and a ministry of public instruction was created at the same time. Military and civilian teachers were obtained from Europe, and the State granted a large sum of money for the support of the establishment. The tuition is gratuitous, and the pupils are clothed and partly fed at Government expense. Some years later a similar school, but on a much smaller scale, was opened in Tabriz. After a time the annual gi-ant for the support of these two schools was reduced, and during the ten years 1890- 1900 amounted to only Â£5000. The average number of pupils was about 250, and until the beginning of 1899 these two schools were the only establishments under the supervision of the Minister of Public Instruction. Soon after his accession in 1896 the Shah expressed a desire that something more should be done for public instruction, and in the following year a number of Persian notables formed a committee, subscribed considerable sums of money, and opened some schools in Teherdn and other places in the beginning of 1898. A year later the new schools, until then private establishments, were placed under the Minister of Public Instruction. The new schools at Teheran have from 1000 to 1400 pupils. Much has been and is being done for education by the Armenians and the Protestant and Roman Catholic Missions in Persia, but Mussulmans only rarely attend their schools. The Alliance Israelite has also opened a school in Teheran. In 1899 the American Protestant Mission had 160 schools with 4380 pupils, the English Protestant Missions had ^^ schools with 670 pupils, the Roman Catholic Mission (Lazaristes) had 3 schools with 400 pupils,

and the Armenians had 4 schools and 646 pupils. All these schools are supported by voluntary subscriptions and donations, and instruct both boys and girls.

Finance.â€” -T\iQ fixed revenues of Persia are derived from (1) regular taxation (mdlidt) composed of taxes on lands, flocks, herds, shopkeepers, artisans, and trade ; (2) revenues from Crown lands ; (3) customs ; (4) rents and leases of State monopolies. There is also a kind of irregular revenue derived from public requisitions, presents, fines, confiscations, &c., nowadays not producing much. The land tax, which varies much according to localities, is paid in money and kind, and should amount on an average to about 25 per cent, of the yield of the soil. The

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taxation on flocks and herds exists either as- a siipple- menta,Tj method of land taxation, or as a contribution of a certain sum per animal, and the tax on shopkeepers, artisans, and trades sometimes takes the form of a poll- tax, sometimes that of an impost on the profits of the trades. The revenue from Crown lands consists of a cer- tain proportion of the produce, and also varies much ac- cording to localities. The customs are composed of a uniform ad valorem duty of 5 per cent, upon merchandise exported and imported by foreign subjects, as stipulated by the treaty concluded between Kussia and Persia at Turkmanchai in 1828, and of a duty varying from 1^ to 8 per cent, upon merchandise exported or imported by Persian subjects. Until March 1899 all the customs were farmed out, but since then an attempt has been made to organize them on European principles, with the help of Belgian ofl3.cials, beginning with the two provinces of Azerb^ij^n and Kermd^nsh^h, and, the attempt having been successful, other provinces have now been taken in hand, and it is hoped that the farm system, so far as con- cerns the customs, may be entirely done away with. It is also intended to introduce other reforms, either by estab-

lishing a uniform ad valorem duty of 5 per cent, upon the merchandise of both Persian and foreign subjects, or, with the assent of Russia, abolishing the 5 per cent, duty fixed by the Turkmanchai treaty and establishing an equitable tariff. The revenues from rents and leases of State monopolies are derived from the proceeds of various establishments, institutions, concessions, &c., leased out by the Government, as, for instance, posts, telegraphs, mines, mint, forests, banks, fisheries, factories, &c., and now amount to about Â£110,000 per annum.

The total revenue of Persia, from all sources, amounted in 1876 to 58,700,000 krans, in 1884 to 50,800,000, in 1890 to 60,000,000; it is now about 70,000,000 krans. This would seem to show a steady increase, but when we consider that the value of the kran in 1876 was nearly 8j^d., and has fallen in consequence of the great depre- ciation of silver to only 4-|d., the "total revenue really decreased from Â£1,950,000 in 1876 to Â£1,400,000 in 1900. Out of the actual total revenue Â£350,000 is represented by customs and Â£110,000 by rents and leases of State monopolies, leaving Â£940,000 for maliat and revenues of Crown lands. In 1876 the two latter items amounted to about Â£1,600,000, while the two former were only Â£350,000 instead of Â£460,000 in 1900. While the prices in krans of agricultural produce, and hence the profits of the landowners, and the wages and profits of artisans and tradesmen, were in 1900 more than double what they were in 1876, the maliat, the backbone of the revenue, has hardly increased at all, being 47,000,000 krans (Â£940,000) against 43,200,000 krans (Â£1,600,000) in 1876, and showing a decrease of over 40 per cent, in sterling money. A new assessment of the maliat, based upon the present value of the pro- duce of lands and actual profits of artisans and tradesmen, has frequently been spoken of, and Government, aided by a strong Minister of the Interior and an able Minister of Finance, ought to have no difficulty in raising the maliat to its proper level and the total revenues of the country to about two millions sterling. Until a few years ago the yearly expenditure was less than the yearly income, and every yekr a surplus found its way into the Shah's treasury, but lately, on account of the small maliat, the revenues have not been sufficient to cover the

expendi- ture, and many payments have fallen in arrear in spite of large disbursements out of the reserve in the Treasury.

In May 1892 the Persian Government concluded a contract with the Imperial Bank of Persia, established by British ifoyal charter in 1889, for a loan of Â£500,000 at 6 per cent., repayable in the course of forty years, and guaranteed by the customs of Pars and

the Persian Gulf ports. The produce of this loan served for the payment of an indemnity to the Imperial Tobacco Corporation, which began in 1890 and had to cease its operations in January 1892. In January 1900 the Persian Government, in order to pay the arrears and start afresh with a clear balance-sheet, contracted a new loan, this time through the Banque des PrÂ§ts de Perse, a Russian institution oomiected with the Russian State Banlc, and established in 1890. This loan was for 22J million roubles (Â£2,400,000) at 5 per cent, interest, guaranteed by all the Persian customs with the exception of those of Pars and the Persian Gulf ports, and repayable in the course of seventy-five years. In the contract, which was signed at St Petersburg at the end of January 1900, the Persian Government undertook to redeem all its former foreign obligations (the 1892 loan) out of the pro- ceeds of the new loan, and not to contract any other foreign loan before the redemption of the new loan without the consent of the Russian bank. The loan was at 86|, less If for commission and charges, the Persian Government thus receiving 85 per cent, of the nominal capital, or Â£2,040,000. The bonds enjoy the full guarantee of the Russian Government. The yearly charge for interest and amortization, about Â£124,000, is to be paid in two half-yearly instalments, and in the event of default the Russian bank will have the right to exercise effective control of the cus- toms with a maximum number of twenty-five European employ6s. When the contract for the new loan was concluded, the liabilities of the Persian Government for the balance of the 1892 loan (about Â£435,000), temporary loans from various banks, arrears of pays and salaries, and other debts, amounted to over Â£1,500,000, so that not much margin was left.

Defence. â€” Lord Curzon says that the Persian army, nominally 200,000 men strong, has an effective force of 30,000 men actually serving with the colours. Persia had no regular army until 1807, when some regiments of regular infantry {sarh&z) were embodied and drilled by the first French military mission to Persia under General Gardane. Since then seven other military missions (two British, two French, two Austrian, and one Russian) have come to Persia at the request of the Persian Government, and many officers and non-commissioned officers, and even civilians, of various nationalities, as Spanish, Italian, French, Bavarian, Aus- trian, Prussian, British, Danish, and Bulgarian, have been en- gaged as army instructors. The last serious attempt to reorganize the Persian army was made in 1879, when the second Austrian mission, composed of a colonel, a major, ten captains and lieuten- ants, and a bandmaster, formed the "Austrian Corps" of seven new battalions of 800 men each. A relic of the Austrian regime still survives in a number of Persians who were drilled by the Aus- trians as officers of the new battalions. These new battalions were in 1882 disbanded and resolved into the territorial elements from which they had sprung. The Russian mission of 1879 has been the most successful, and the so-called " Cossack Brigade " which it formed has always been and is now commanded by Russian officers. The strength of the brigade is now being raised to about 1500 men, and will cost Â£50,000 per annum. The total annual expenditure for the army amounts to about a third, or a litUe more, of the total revenues of the Government.

The Persian Government possesses three steamers, and no other vessels. These are the Persepolis, registered tonnage 600, 450 h.p., built at Bremerhaven in 1884, armed with one 8-5 and three 7 '5 centimetre steel Krupp guns, and stationed in the Persian Gulf; the Susa, tonnage .36, 30 h.p., built at Bremerhaven in 1884, and stationed on the river Karun ; the Nassir-ed-dln, a yacht of about 120 tons, presented by the emperor of Russia, and stationed at Enzeli, the port of Resht. The annual expenditure for the navy is about Â£3500.

Minerals and Mining. â€" Persia possesses considerable mineral riches, but the absence of cheap and easy means of transport, and the scarcity

of fuel and water which prevails almost everywhere, make any exploitation on a large and remunerative scale impos- sible, and the various attempts which have been made in Persia to work mines with European capital and under European superintendence have been . financially unsuccessful. Deposits of rich ores of copper, lead, iron, manganese, zinc, nickel, cobalt, &c., abound ; but either the distance from the deposits to the nearest shipping port is so great that the freight to the port exceeds the price of the ore on the European market, or the difficulty of obtaining fuel and water raises the cost of reducing the ore to more than the price of the metal impor^d from abroad. The result is that the Persian mining industry is very small. A few mines are worked by natives in a primitive, systemless manner, and without any great outlay of capitalâ€" the value of the plant in some mines the writer has visited not being more than twenty pounds. There are turquoise mines near Nish^piir (for description of mines, manner of working, &c., see A. Houtum-Sohindler, Beport on the Turquoise Mines in Ehor- as&n, E. 0. Reports 1884, and "Die Gegend zwischen Sabzwar und Meschhed," Jahrbuch, k. k. geol. S. A. Wien, vol. xxxvi. ;

also E. Tielze, Verhandl. k. Ic. geol. M. A., 1884, 93) ; several oo]iper mines in Khorasan, Semnan, Azerbaijan, and Kerman ; some of lead, two considerably argentiferous, in Khorasan, Tudarvar (near Semnan), Angiiran, Afshar (both west of Zenjan), and Kerman ; two of iron at Masiilah in Gilan and Kur in Mazandaran ; two of orpiment in Afshar and near Urmia ; one of cobalt at Kamsar (near Kashan) ; one of alum in Tarom (near Kazvin) ; and a number of coal in the Lar district, north-east of Teheran, and at Hiv and Abyek, north-west of Teheran. There are also many quarries of rock-salt, gypsum, lime, and some of marble, alabaster, soapstone, &c. The annual revenue of the Government from the leases, rents, and royalties of mines does not amount to more than Â£15,000, and about Â£6000 of this amount is derived from the turquoise mines near Nishapiir. As the rents and royalties, excepting those on the turquoise mines, amount to about one-

fifth of the net proceeds, it may be estimated that the value of the annual output does not exceed Â£50,000, while the intrinsic value of the ores, particularly those of lead, iron, cobalt, and nickel, which have not yet been touched, can bs estimated at millions. There are also some very rich coal seams in eastern Persia, far away on the fringe of the desert, and under existing conditions quite valueless. The richest deposits of nickel, cobalt, and antimony ores are also situated in localities where there is little water and the nearest useful fuel some hundred miles away. Auriferous alluvial strata have been dis- covered in various localities, but everywhere the scarcity of water has been a bar to their being exploited with profit. A rich naphtha-bearing zone stretches from the Luristan hills near Ker- manshah on the north down to the Persian Gulf in the south. Competent engineers and specialists have declared that borings in the Bakhtiari hills, west of Shushter, would give excellent results, but the difficult hilly country and the total absence of roads, as well as the antipathy of the inhabitants of the district, would make the transport and establishment of the necessary plant a most difficult matter.

Agriculture. â€" Wheat, barley, and rice are grown in all districts, the two former up to considerable altitudes (8000 feet), the'last wherever the water-supply is abundant, and in inner Persia generally along rivers ; and all three are largely exported. The most important rice-growing districts which produce more than they require for local consumption and supply other dis- tricts, or export great quantities, are Astrabad, Mazandaran, Gilan, Veramin (near Teheran), Lenjan (near Isfahan), and some localities in Fars and Azerbaijan. Peas, beans, lentils, gram, maize, millet, are also universally cultivated, and exported in not inconsiderable quantities from the Persian Gulf ports to India and the Arabian coast. The Persian fruit is excellent and abundant, and large quantities, principally dried and called khushkbdr (dry fruit), as quinces, peaches, apricots, plums (of several kinds), raisins, figs, almonds, pistachios, vfalnuts, and

dates (the last only from the south), as well as oranges (only from the Caspian provinces), are exported. Nothing is being done to improve the vine, and the Persian wines, until recently of world-wide reputation, are

yearly getting thinner and poorer. The phylloxera has done much damage. Cotton is largely grown, principally in the central districts and Khorasan, and tome qualities are excellent and command high prices in the European markets. 12,490 tons of raw cotton, valued at Â£384,013, were exported to Russia in 1897. Good hemp grows wild in Mazan-daran. Tobacco of two kinds, one the tumbakii, {Nieotiana persica, Lindl.), for water pipes, the other the tutun {Nieotiana rustica, – L.), for ordinary pipes and cigarettes, is much cultivated. The tumbaku for export is chiefly produced in the central districts round about Isfahan and near Kashan, while the tumbakti of Shiraz, Fessa, and Darab in Fars, considered the best in Persia, is not much appreciated abroad. Tutun is cultivated in Azer- baijan, near Urmia and other places near the Turkish frontier, in Kurdistan, and, since 1875, in the district of Eesht in Gilan. The cultivation of poppy for opium has greatly increased since 1880, and it is estimated that the annual produce of opium now amounts to over 1000 tons, of which about two-fifths is consumed and smoked in the country. The principal opium – producing districts are those of Shiraz, Isfahan, Yezd, Kerman, Khorasan, Burujird, and Kermanshah. The value of the silk produced in Persia in the ‘sixties was Â£1,000,000 per annum, and decreased in consequence of silk-worm disease to Â£30,000 in 1890. The quantity produced is now again increasing, and its yearly value is estimated at Â£350,000. Of oil-yielding plants the castor-oil plant, sesame, linseed, olive are cultivated, the last only in a small district south of and near Resht. Very little oil is exported. The potato, not yet a staple article of food, tomatoes, celery, cauliflower, artichokes, and other vegetables are now much more grown than formerly, chiefly in consequence of the great influx of Europeans, who are the principal consumers, during recent years. Horticulture lias much improved, the Shah and several princes and nobles retaining European gardeners, and some gardens at Teheran have shows of flowers vying with the prettiest in Europe. Horses, mules, and donkeys, formerly exported in great numbers, are at present not very abundant, and their prices have risen much since 1880. Some nomad tribes who owned many brood mares, and yearly sold hundreds of horses, now hardly possess sufficient animals for their own requirements. The scarcity of animals, as well as the dearness of fodder, is one of the causes of the dearness of transport, and freights

have risen on the most frequented roads from 3d. per ton-mile in 1880 to lOd., and even 13d. , per ton-mile now.

The following table shows the average prices of staple articles of food and necessaries at Teheran as they were in 1880 and in April 1900, and their apparent and real increases per cent, in local currency and sterling : â€”

Wheat, per kharvar (649 lb)

Barley ,,

Rice , ,

Charcoal ,,

Coal

Firewood , ,

Bread, per mann (6i lb)

Mutton ,,

Beef

Cheese ,,

Milk

Clarified butter ,,

Water melons ,,

Sweet melons ,,

Grapes ,,

Eggs (per 100) .

Average Price, 18S0.

Local currency.

krans.

30

20

75

30

16

12

â€¢40

1-60 1-20 2-00

â€¢50

3-00

â– 10

â€¢30

â€¢10 2^00

Sterling. lkran = 9d.

22

15 56 22 12

0 9 0

0 3f

1 2|

0 m

1 6

0 4J

2 3

0 2t% 0 A

Price in April 1900.

Local currency.

krans.

255 160 400 87-50 60 28 2 7 4 6 2 12

â€¢60

2 1-20

Sterling. lkran=4|d.

s. d.

102 0

64 0

160 0

35 0

20 0

11 2t

0 n

9f

4*

0 93

4 9^

0 2^

0 9f

0 5|

3 n

Increase per cent.

Apparent.

750 700 433 192 212 133 400 ‘337 233 200 300 300 500 666 1100 350

Real.

353 327

1S4

55

66

24 162 133

77

60 113 113 2221 255

639 J

140

season

1899.

At the lowest estimate it may be said for all Persia, that while wages since 1880 have risen in the proportion of 5 to 10, the prices of staple articles of fdod have gone up from 5 to 11.

Forests and Timber. â€” Timber from the forests of Mazandaran and Gilan has been a valuable article of export for many years, and since about 1870 large quantities of boxwood have also been exported thence ; in some years the value of the timber and box- wood exported has exceeded Â£50,000. This value represented about 200,000 box trees and quite as many others. Much timber is also used for charcoal-burning, and occasionally largo parts of forest are burned by the people in order to obtain clearings for the cultivation of rice. The destruction of the forests by timber- cutters and charcoal-burners has been allowed to go on unchecked,

no plantations have been laid out, and nothing has been done for forest conservation. Indiscrimina:te cutting has occasionally been confined within certain bounds, but such restrictions were generally either of short duration or made for tlie convenience and profit of local governors. The oak forests of Kurdistan, Luristan, and the Bakhtiari district are also being rapidly thinned, and the timi' is not far distant when there wi'U be no traces left unless the Government create a forest department with proper regula- tions and bye-laws. A small step in the right direction was made in 1900 by engaging tlie services of an oflieial of the Prussian forest department, but unfortunately, beyond sending him to inspect the Mazandardn forests belonging to the Crown, and employing him to lay out a small plantation in the Jajriid

valley, east of Teheran, nothing was done. The monopoly for cutting and exporting the timber of the Mazandaran forests is leased to a Greek firm established at Baku, and the rent has been paid in advance for some years. Boxwood has become scarce. There are many kinds of good timber-yielding trees, the best known being alder {Alnus glutinosa, Wild., A. barbata, A. cordi- folia, Ten.), ash {Fraxinus excelsior, L.), beech (Fagus sylvaiica), elm (Ulmus campestris, U. effusa, U. peduneulata), wych-elm {Ulmus montana), hornbeam [Carpinus betulus, L.), juniper {Juniperus excelsa, J. communis, J. sabiiia), maple {Acer insigne, Boiss., A. campestre, A. pseudo-platanus, L.), oak (Quercus ballota, Q. eastanecefolia, Q. sessifloria, Q. peduneulata), walnut, nettle tree (Ccltis australis, L.), Siberian elm (Zelkova crenata,, Spach.), and various kinds of poplar. Pipe-sticks, from the wild cherry tree, are exported to Turkey. Considerable quantities of gums, exudations of various plants, drugs, and dyes, some of them produced only in Persia, are gathered and exported.

Fisheries. â€” Along the shores of the Persian Gulf fish is a staple food, but the Crown derives no revenue from the fisheries there. Tlxe fisheries of the Caspian littoral were leased to a Kussian firm about 1870 at an annual rent of Â£16,000, and most of the fish goes to Russia. The fish principally caught are the ag-mdhi (dog-fish) ; sturgeon (Acipenser huso), which gives the caviare ; the summ (sheat-fish), or silure (Silurus glanis) ; and the Azdd- mdhi, a kind of salmon (Salmo sylvaticus). In inner Persia fish are scarce. There are a few carp and roach in the canals, and salmon -trout and mud -trout abound in some mountain streams.

Manufactures. â€” Of the articles mentioned under this head in the ninth edition (p. 625) only carpets, shawls, woollen and cotton fabrics, and silk stuff’s are of importance. Carpets may be divided into three categories : (1) Kdli, with – pile, and cut Hke plush ; (2) gillm, smooth ; (3) nimads, felts. Only the two first are ex- ported. . The Kali and its smaller sizes, called Kdllcheh (in Europe, rugs), are chiefly made in

Ferahan, Sultanabad (Irak), Khorasan, Yezd, Kerman, and among the nomad tribes of southern Persia. From the two first-mentioned localities, where two British firms have been established for many years, great quantities, valued in some years at Â£100,000, find their way to European and American markets, while rugs to the value of Â£30,000 per annum are ex- ported from the Persian Gulf ports. Of the second kind, gilim (used in Europe for curtains, hangings, and chair-covers), consider- able quantities are exported from Shushter and Kurdistan. Shawls are manufactured in Kerman and Meshed, and form an article of export, principally to Turkey ; and some of Kerman are quite equal to good Cashmere shawls. Woollen fabrics are manu- factured in many districts, but are not exported. Coarse cotton- stuff's, chiefly kerbds, are manufactured in nearly all districts, but not exported ; but cottons, called kalamkdr, which are Man- chester goods that have been block-printed in colours, -find their way from Isfahan and Komisheh to foreign markets. Of the great quantities of silk fabrics manufactured in Persia, principally in Khorasan, Kashan, and Yezd, only a small part is exported to Turkey and Afghanistan. In the environs of Kashan and in Ears, chiefly near Maimand, much rose-water is made, and a consider- able quantity of it is exported by way of Bushire to India and Java. Attempts have been made to start manufactures, sup- ported by foreign capital and conducted by foreigners, but nearly all have resulted in loss. In 1879 the Persian Government was induced to spend Â£30,000 on the erection of a gas factory in Teheran, but work was soon stopped for want of good coal. A few years later a Persian bought the factory and plant for Â£10,000, and made them over in 1891 to the Compagnie Gte&ale pour I'Eclairage et le Chauff'age en Perse, which, after bringing out much additional plant, and wasting much capital in trying for some years in vain to make good and cheap gad out of bad and dear coal, closed the factory. In 1891 another Belgian company, Societe anonyme des verreries nationales de Perse, opened a glass factory in Teheran, but the difficulty of obtaining the raw material cheaply and in large quantities was too great to make it a paying concern, and the factory had to be closed. A third Belgian company, Sooi^t^ anonyme pour la fabrication du sucre en Perse, with a large capital, then came to Persia, erected a magnificent factory with the best and most modern machinery

obtainable, and began making beetroot sugar in the winter of 1895. But, like the gas an.d glass companies, it found the cost of the raw material and the incidental expenses too great, and ceased its operations in 1899.

Commerce. â€” The total annual value of the exports and imports may safely be estimated at ten million pounds sterling. The estimated value of the imports and exports is arrived at by con- sidering the amounts received by the Government from the farmers of the customs as equivalent to 4 per cent, of the value of the imports and exports, and allowing 20 per cent, as profits of the farmers. The following table, compiled from the Statesman's Tear-Book, shows the farm-money received by the Government at intervals for the years 1879 to 1899, the estimated amounts paid

annually for customs, and the estimated value of the imports and exports, obtained by taking the average of the duty at 4 per cent. ad valorein.

1879-1880 1889-1890 1895-1896 1896-1897 1897-1898 1898-1899 1899-1900

Farm money received by Government.

Rate of

exchange

for the

year.

tomans.

606,400 800,000 1,250,000 1,250,000 1,500,000 1,500,000 1,750,000

242,724 250,000 250,000 300,000 300,000 350,000

Â£ :krs.=Â£l. 219,500 I 27|

33 50 50 50 50 50

Estimated totals of customs

Estimated value of im- ports and ex-

“TTl,, ports, average P^’*-!?f” duty taken at

money-f- SOpercent.

Â£

263,400 290,908 300,000 300,000 360,000 360,000 420,000

4 per cent. ad valorem.

Â£

6,586,000 7,272,700 7,500,000 7,500,000 9,000,000 9,000,000 10,500,000

As has been already stated (see “Finance,” supra), the customs department is being reorganized, the farm system has been ahol- ished in two provinces since March 1899, and the result has been highly satisfactory ; the new system is to be introduced into all the provinces. The new administration estimated the net receipts for 1900-01 at about Â£400,000 ; but in this amount were in- cluded the transit dues levied in the interior and the gate dues (octroi) levied in all principal towns, amounting to about Â£50,000 ; these should be deducted from the total receipts, and the re- mainder (Â£350,000) would then represent the amount of customs received on imports and exports. Calculating the customs at a little less than 3 J per cent., the total value of the imports and exports would amount to Â£9,500,000 or Â£10,000,000, which may safely be taken as within the mark, while the value of the imports and exports may be put down at not less than Â£7,500,000 to Â£8,000,000 for 1879 to 1892, and since then at not less than Â£8,500,000 to Â£9,000,000.

The export and import trade may be considered, in relation te the frontiers, under four heads : â€”

(a) Northern Frontier. â€” This extends for a length of about 1308 miles from near Maku in the west to the Afghan frontier in the east, and comprises the Perso-Transcaucasian frontier, with Julfe and Astara as principal stations, the southern Caspian shore, with the principal ports Enzeli (Resht), Meshhed-i-Sar (Barfunish), and Bander Gez (Astrabad), and the Perso-Transcaspian frontier, with a carriageable road crossing it north – west of Meshed between Kiichan and Askabad, and an easy road from Meshed eastwards, vid Serrekhs, to Turkistan. For the exports and im- ports on this frontier the Russian custom-house returns give trust- worthy figures, and show that their value exceeded Â£3,500,000 in

1897.

(J) Western Frontier. â€” For the trade on this frontier â€” a line of about 750 miles from Maku in the noith to Muhamrah in the south â€” the only returns trustworthy as to qiiantities, but frequently understating values, are those made at Trebizond for the mer- chandise which passes that port in transit to and from Persia. Of the great trade on the Kermanshah-Baghdad road and numerous other roads crossing the frontier there are no returns. The value of transit trade at Trebizond to and from Persia, in thousands of pounds sterling, is shown in the following table : â€”

Year.

Exports.

Imports.

Total.

1885

235

821

1056

, 1890

312

665

977

1895

212

683

895

1896

189

577

766

1897

216

555

771

1898

208

550

Allowing for the understatement of the values of the imports by the Trebizond route, and adding the value of the trade on the Kermanshah-Baghdad route, estimated in 1898 at a minimum value of Â£750,000, and that of the lively trade which is carried on between Persia and Asiatic Turkey by many other routes, which may be estimated at a minimum of Â£250,000, a total value not far short of Â£2,000,000 is arrived at for the exports and imports by way of the western frontier, and more than one-third of this is in British hands.

(c) Southern Frontier. â€” This is formed by a coast-line of about 1100 miles in length from Muhamrah in the west to British Baluchistan in the east. The export and import trade passes through Muhamrah, Bushire, Lingah, Bander Abbasi, and many smaller ports, but only the first four are mentioned in the con- sular reports. Many of the figures given in these reports are based on information which has been obtained from custom-house officials, and do not; give the true values of the exports and imports. The value of exports from and imports into Persia by way of Persian Gulf ports, according to British consular reports,

in thousands of pounds sterling is shown in the following table: â€”

Exports.

Imports.

“SS^

rear.

Muhamrah. Bushire.

1

3

1

3

Muhamrah. Bushire.

i

s

1

1

3-gS,

(0 ft

4206

1890

58 1 720

592

348

1718

146 J1268

665

409

2488

1895

98 ; 529

511

325

1463

138

1017

587

478

2220

3683

1896

67 (440

498

180

1185

144

788

425

364

1721

2906

1897

87 : 393

548

231

1259

121

1145

582

382

2230

3489

1898

89

427

571

187

1274

157

843

641

449

2090

3364

1899

59

529

552 ! 202

l.,42

202

916

612

546

2276

3618

1900

115

710

470 103

1398

282

1323

501

339

2445

3843

In order to’arrive at the value of the total trade on the southern frontier, there should be added to the values given in this table a certain percentage for understated values of exports and imports at the four ports and a considerable sum for the trade of the small ports which are not mentioned in the consular reports. The value of the total trade on the southern frontier will then no -doubt be found to exceed Â£4,000,000.

The trade at the four Gulf ports was distributed mainly as follows in 1900 :â€”

Countries.

Imports from.

Exports to.

Countries.

Imports from.

Exports to.

United Kingdom India . France Turkey China

Â£788,114

1,084,824

119,712

125,112

35,920

Â£163,716

745,142

7,604

192,172

818,611

Persian ports Arab coast . Muskat Bahrein Egypt.

Â£438,059

189,424

45,407

7,516

6,289

Â£340,449

207,061

28,780

19,830

37,975

(d) Eastern Frontier. â€” Of the trade on this frontier, which separates Persia from Afghanistan and British Baluchistan and has a length of about 900 miles, there are also no complete returns, and only since 1892 the British consular reports show the value of the trade between Meshed and Afghanistan as obtained from Persian officials, and quite recently that of the trade on the Quetta-Niishki-Sistan-Meshed road. The value of the exports and imports between Meshed and Afghanistan was Â£18,000 in 1892 ; Â£23,000 in 1893 and also in 1894 ; Â£24,000 in 1895 ; Â£21,000 in 1896 ; and Â£29,000 in 1897. The value of the exports and imports over the eastern frontier probably much exceeds Â£100,000 per annum.

From the figures given in the above tables the value of the exports and imports at the present time may be estimated as follows : â€”

Exports.

Imports.

j Propor-

Total exports tion ex-

and imports, j ports to

imports.

Northern frontier “Western ,, Southern ,, Eastern ,,

Total

Â£2,000,000

900,000

1,500,000

50,000

Â£1,800,000

1,100,000

2,500,000

50,000

Â£3,800,000

2,000,000

4,000,000

100,000

100:90 100 : 122 100 : 166 100 : 100

Â£4,450,000

Â£5,450,000 ,Â£9,900,000

According to this estimate, the proportion of exports to imports for all Persia would be 100 : 111, but Lorini {Persia Economica, &c., pp. 320-321) thinks that the balance of trade is in favour of Persia.

What are the chief imports and exports in the various districts will be seen from the table in the next column and the paragraph

which succeeds it. At the four Gulf ports the trade in 1900 was mainly in the following articles : â€”

Value in

Value in

Imports.

pounds

Exports.

pounds

sterling, 1900.

sterling, 1900.

Cottons

697,760

Opium

348,310

Pearls

244,274

Pearls

727,447

Tea .

196,191

Grain

89,982

Dates .

44,916

Fruits

85,651

“Woollens .

31,277

Mother of pearl .

25,388

Sugar .

207,997

Carpets, &c.

77,057

“Wheat and flour .

336,482

Timber

28,175

Copper, &c. Indigo

57,038

Dates .

27,916

49,997

Tobacco

28,175

Coffee .

37,742

Gums .

68,919

Specie

490,516

Specie

368,387

The prohibition against the importation of arms and ammuni- tion that has been in existence since 1881 is only spasmodically enforced, and in 1897 they found their way through the Gulf ports to the value of Â£132,018 ; the import in 1898 was nil.

From the Gulf ports, excluding Muhamrah, wheat to the value of Â£84,100 was exported in 1898. At Tabriz in the year 1898-99 the total imports were valued at Â£682,330, including Manchester shirtings and printed cottons, Â£376,000 ; sugar from Russia, Â£81,600 ; tea from India, Â£68,800 ; cloth and woollen goods from Europe, Â£57,200 ; silk stuffs and velvets from France and Ger- many, Â£55,400 ; and haberdashery from Germany and Austria, Â£28,000. The exports amounted to Â£219,930, including dried fruits (raisins and almonds), Â£72,000 ; carpets, Â£50,000 (but trust- worthy private information makes it Â£85,000) ; shawls, Â£20,000 ; and native silk, Â£14,000. In the Resht district in 1896 the im- ports vid Baku were valued at Â£842,655, and included sugar, Â£614,311 ; tissues, Â£81,400 ; silk-worm seed, Â£67,200 ; bar silver, Â£30,000 ; and petroleum, Â£15,000. The exports to Russia m& Baku amounted to Â£365,342, amongst them being rice, Â£177,220; fruits, Â£42,350 ; raw cotton, Â£40,740 ; and tea, Â£31,890. The ex- port of silk of all kinds from Resht, principally vid Kermanshahâ€” Baghdad, hardly any going to Russia,

was valued at Â£116,280 in 1898. From thie Caspian littoral the export of fish to Russia in 1897 was Â£8*1,427. Along the whole northern frontier the import of cotton goods from Russia in 1898 was Â£520,000 (in 1897, Â£420,452) ; of glassware in 1897, Â£32,061 ; of sailcloth, Â£26,043 : of china, Â£21,030 ; the export of rice in 1897 amounted to Â£336,489; of dried fruit, to Â£443,902 ; of cotton, to Â£360,114 ; and of live stock, to Â£58,930. The trade of Khorasan through Meshed in 1896-97 was : imports from India by Bombay and Bander Abbasi, Â£89,547 ; from Russian territory, Â£92,547 ; through Turkey, Â£19,740 ; from Afghanistan, Â£6206 : exports to India, Â£19,681 ; to Russian territory, Â£80,320 ; to Afghanistan, Â£15,073.

Shipping and Navigation. â€” Shipping under the Persian flag is restricted to vessels belonging to the Persian Gulf ports. Some of the larger craft, which are called baglah, and vary from 50 to 300 tons, carry merchandise to and from Bombay, the Malabar coast, Zanzibar, &o. ; while the smaller vessels, . called bagarah, and mostly under 20 tons, are employed in the coasting trade and the pearl-fisheries on the Arabian coast. No returns as to the number and tonnage of the native craft are available, but it is estimated that the four principal ports and the many smaller ones (as Mashiir, Hindian, Zaidin, Dilum, Rig, Kongiin, Taheri, Kishm, Hormuz, &c.) possess at least 100 baglahs and several hundred bagarahs, besides a large number of small boats. The following figures from British consular reports show the total and British shipping in thousands of tons (including both entrances and clearances) at the four principal Persian Gulf ports in 1891 and 1898 :â€”

Port.

1891.

1898. 1

Total Tonnage.

British Tonnage.

Total Tonnage.

British Tonnage.

Entered.

152 208

95

76

Cleared.

Entered.

Cleared.

Entered.

Cleared.

Entered.

Cleared.

85 58 79 74

Bushire . Lingah . Abbasi . Muhamrah

Total .

151

219

90

79

148

167

86

71

148

181

83

74

112

125

87

100

97 76 86 82

99

102

79

91

531

539

472

486

424

341

371

296

As most of the pearls obtained on the Arabian coast of the Gulf are brought to and exported from Lingah, that port has more native shipping than the others. It will be found from the figures in the last table that the British shipping amounted to 93-3 per

cent, of the whole shipping at Muhamrah, to 90 ‘2 per cent, at Bushire, to 78-9 per cent, at Lingah, and to 90-5 per cent, at Bander Abbasi, or to 88-2 per cent, of the total shipping at the four ports. The percentage of foreign shipping other than

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625

British is very small in the Persian Gulf. All the shipping on the Caspian is under the Russian flag’ and no returns of arrivals and departures of vessels at the Persian ports exist, but seeing that the value of the merchandise, most of it bulky, exported and imported from and into the Persian ports of Resht, Meshed-i-Sar, and Bander-i-Gez, and the Russian port of Astara, which supplies a great part of Azerbaijan, exceeds Â£2,000,000, the shipping must be very considerable. Russian statistics for 1897 give for Astara 77 vessels (76 steamers) with an aggregate of 43,101 tons entered, and 272 vessels (240 steamers) with 88,011 tons cleared. The British consul at Resht, in his report dated 3rd March 1893, reports 49 steamers with an aggre- gate tonnage of 16,702 as plying between the Russian and Persian ports of the Caspian ; but he omitted several steamers then already plying, and many more have been added since. Two or three flat-hottomed sailing vessels navigate

the lake of Urmia in north-western Persia, carrying merchandise, principally agricultural produce, from the western and south-western shores to the eastern for the supply of Tabriz. The navigation is a State monopoly, and leased out for Â£250 per annum.

Internal Communications. â€” 1. Moads. â€” Mr A. Hotz, head of a commercial firm long established in Persia, wrote in a paper communicated to the Society of Arts and published in the society's Journal of 10th March 1899 : "If we consider the present means of conveyance, it is indeed astounding that a country of about 636,000 square miles, without navigable rivers, but in- habited by 9,000,000 people who are remarkable for their intelli- gence and industry, should have to carry on its foreign trade and local traffic along, mule tracks, the like of which are hardly to be met with in any other part of the world, however backward. The passes between the Gulf ports and the Persian plateau are in the same conditidn as HerodTotus described them and as they were found by Marco Polo and his innumerable successors." With the exception of four short roads, having an aggregate length of less than 800 miles, all the roads of the country are as Nature has made them â€" in other words, mere mule tracks, carriageable in the plains and during the dry season, but totally unfit for continuous wheeled traffic during all seasons, and in the hilly districts often so difficult as to cause much dainage to goods and the animals carrying them." The four exceptions are : â€" (1) Resht-Kazvin- Teheran, 227 miles ; (2) Teheran-Kom-Sultanabad, 160 miles ; (3) Meshed-Kuchan-Askabad, 150 miles, 30 of which on Russian territory ; (4) Isfahan-Ahvaz, 280 miles. The first of these roads consists of two sections : Resht-Kazvin, 135 miles, and Kazvin-Teheran, 92 miles. The first section was constructed in 1897-99 by a Russian company, in virtue of a concession which the Persian Government granted in 1893 ; and the second section was con- structed in 1878-79 by the Persian Government at a cost of about Â£20,000, ceded to the concessionnaire of the first section in 1896, and repaired and partly reconstructed by the Russian company in 1898-99. Both sections were officially opened to traffic in August 1899. The capital of the company is 3,200,000 roubles (Â£341,330), of which 1,700,000 isi in shares taken by the public, and 1,500,000 in debentures taken by the

Russian Government, which also guarantees 5 per cent, on the shares. About two-thirds of the capital has been expended on construction. The company's income is derived from tolls levied on vehicles and animals using the road. These tolls are at present very high, but will be reduced by 15 per cent, in 1904, and by another 10 per cent, five years later. If all the trade between Russia and Teheran were to pass over this road, the tolls would no doubt pay a fair dividend on the capital, but quite 40 per cent, of it goes by way of the Teheran- Meshed-i-Sar route, which is much shorter and has no tolls.

The second road, Teheran-Kom-Sultanabad, 160 miles, also consists of two sections : the first, Teheran-Kom, 92 miles, the other, Kom-Sultanabad, 68 miles. The first section was con- structed by the Persian Government in 1883 at a cost of about Â£12,000, purchased by the Imperial Bank of Persia in 1890 for Â£10,000, and reconstructed at a cost of about Â£45,000. The second section formed part of the " Ahvaz road concession " which was obtained by the Imperial Bank of Persia in 1890 with the object of connecting Teheran with Ahvaz on the Karun by a direct cart-road vid Sultanabad, Burujird, Khorremabad (Luris-tan), Dizful, and Shushter.

' By article v. of the treaty of Gulistan of 1813, confirmed by article viii. of the treaty of Turkmanchii of 1828, it was declared that Russia alone should have the right of maintaining vessels of war on the Caspian, and that no other Power should fly the military flag on that sea ; and by a decision of the Council of the Russian empire, pub- lished on the 24th November 1869, the establishment of companies for the navigation of the Caspian, except by Russian subjects, and the purchase of shares of such companies by foreigners were prohibited. (fSlate Papers, vol. Ixiii. 925.)

2 There are a few miles of roads in the immediate neighbourhood of Teherin leading from the city to royal palaces, but not of any com-mercial importance.

The third cart-road, Meshed-Askabad, 120 miles to the Persian frontier, was constructed by the Persian Government in 1889-92 in accordance with article v. of the Khorasan Boundary Con- vention

between Russia and Persia of December 1881. The Persian section cost Â£13,000.

The fourth road, Isfahan-Ahvaz, 280 miles, is the old mule track provided with some bridges, and improved by freeing it of boulders and stones, &o., at a total cost of Â£5500. The concession for this road was obtained in 1897 by the Bakhtiari ehiefs, the necessary capital being advanced by an English firm at 6 per cent, interest, and revenues being derived from tolls levied on animals passing with loads.

2. Sailtoays. â€” Persia possesses only 8 miles of railway and 6i miles of tramway, both run by a Belgian company. The rail- way consists of a single line, one-metre gauge, from Teheran to Shah-abdulNAzim, south of Teheran, and of two branch lines which connect the main line with some limestone quarries in the liills south-east of the city. The tramway also is a single line of one-metre gauge, and runs through some of the principal streets of Teheran. 'The length of the main railway line is SJ miles, that of the branches 2^. The main line was opened in 1888, the branches were constructed in 1893, and the tramway started in 1889. The capital now invested in this enterprise, and largely subscribed for by Russian capitalists, amounts to Â£320, 000. There are also ordinary shares to the amount of Â£200,000 put down in the company's annual balance-sheets as of no value. The general opinion is that if Russian capitalists had not been interested in the enterprise the company would have liquidated long ago. (On railways in Persia, the many concessions granted by the Persian Government, and only one having a result, chapter xviii, of Lord Curzon's Persia [vol. i. pp. 613-639], and on the Belgian enter- prise, LoRiNi's La Persia Sconomica [pp. 157-158] may be read with great advantage.)

Posts. â€" Down to 1874 the postal system was in the hands, of an official called ehapdrchi bdskl, who was the head farmer- of the post, or chapdrs, and letters and small parcels were con- veyed by him and his agents at high and arbitrary rates and without any responsibility. The establishment of a regular post was one of the results of the late Shah's first visit to Europe (1873). Tw'o officials of the Austrian postal depart- ment having been engaged in 1874, an experiment of a post

office upon European lines was made in the following year with a postal delivery in the capital and some of the neighbouring villages where the European legations have their summer quarters. In the beginning of 1876 a regular weekly post was established between Teheran, Tabriz, and Julfa (Russo-Persian frontier), and Resht. Other lines, connecting all the principal cities with the capital, were opened shortly afterwards, and on 1st September 1877 Persia joined the International Postal Union with the rates of 2Jd. per i bz. for letters. Id. for post-cards, ^d. per 2 oz. for newspapers, &c., between Persia and any Union country. The inland rates were a little less. There are now between Persia and foreign countries a bi-weekly service viA Russia (Resht-Baku, Tabriz- Tiflis) and a weekly service md India (Bushire-Bombay). On the inland lines, with the exception of that between Teheran and Tabriz, the service is weekly. There are reported to be ninety -seven, post offices. Statistics as to the number of letters, post-cards, news- papers, &c., conveyed are kept but not published ; and since 1885, when a liberal-minded director communicated those for the year 1884-85 to the present writer, no others, although many times promised, have been obtained. In the year 1884-85 there were, conveyed 1,368,835 letters, 2050 post-cards, 7455 samples, and' 173,995 parcels, having a value of Â£304,720 ; and the receipts ex- ceeded the expenditure by Â£466. Since then the traffic has much increased, and the excess of receipts over expenditure in the year 1898-99 was reported to ha^e been Â£10,000, but is probably more than that, for the minister of posts has farmed the department, for Â£12,000 per annum. Under the most favourable conditions letters from London vid Russia are delivered at Tabriz in 14 days, at Teheran in 16, at Isfahan in 20, at Meshed in 25, and at Shiraz in 26 days ; and vid India, at Bushire in 26 days, at Shiraz in 31, at Isfahan in 36, and at Teheran in 40 days ; but during winter, when the roads are heavy or snowed up, or the mail steamers on the Caspian on account of bad weather cannot land the mails, the times of transmission are much increased, and sometimes letters between London and Teheran take forty days. In the interior the mails are conveyed on horseback, and, being packed in badly -made soft leather bags, are frequently damaged through careless packing and wet. The first Persian postage stamps were issued in 1875 and roughly printed in Persia. Since then there have been many issues, and

specimens of the early ones are much valued by stamp collectors. (For information on the postal system of Persia, see G. Ribderee, Aus Persien, Vienna, 1882 ; Fr. Schueller, Die Persische Post und die Postwerthzeichen von Persien, Vienna, 1893.)

Telegraphs. â€” The first line of telegraphs â€” from Teheran to Sultanieh, about 160 miles on the road to Tabrizâ€” was constructed

in 1859. In the following year it was continued to Tabriz, and in 1863 to Julfa on the Russiaa frontier. With the object of estab- lishing a direct telegraphic communiuation between England and India, by connecting the European and Indian systems by a land line through Persia from Baghdad â€” then the most easterly Turkish telegraphic station â€” to Bushire and by a cable from Bushire east- wards, a telegraphic convention was concluded in the same year between the British and Persian Governments, and a one-wire line on wooden posts from the Turkish frontier, near Baghdad, to Bushire vicL Kermanshah, Hamadan, Teheran, Isfahan, and Shiraz, was constructed at the cost and under the super- vision of the British Government. In 1865 a new convention, providing for a second wire, was concluded, and for some years messages between Europe and India were transmitted either vid Constantinople, Baghdad, Teheran, Bushire, or m(L Russia, Tiflis, Tabriz, Teheran, Bushire. An alternative line between Baghdad and India was created by the construction of aland line to Fao, at the head of the Persian Gulf, and the laying of a cable thence to Bushire. The service was very inefficient, and messages between England and India took several days and sometimes weeks to reach their destination, and besides, ” the staff in no case was competent, there was hopeless confusion of dates arising from the different calendars recognized, and the mutilation of messages consequent upon tlie frequent translations and retranslations by ignorant clerks into English, French, Dutch, German, Italian, Greek, Bulgarian, Wallaohian, Servian, Russian,

Turkish, and Armenian, reduced the patrons of the various lines to a state bordering upon frenzy ” (Curzon, Persia, ii. 610). In 1869 Messrs Siemens of Berlin, in virtue of concessions obtained in the year before and later disposed of to the Indo-European Telegraph Company, Limited â€” who also took over Renter’s cable from Lowestoft to Emdcn (274 knots) â€” cotistructed a two-wire line on iron posts through Germany and Rui-sia, and in Persia from Julfa to Teheran, This line was opened 31st January 1870. The British Government then handed the Baghdad-Teheran section, which had become unnecessary for international through traffic between Europe and India, over to the Persian Government, and changed its Teheran-Bushire line into one of two wires on iron posts. In 1873, according to a convention signed December 1872, and renewed concessions to the company, a third wire was added to the line, and there is now a three-wire line on iron posts (415 miles Indo-European Telegraph Company, 675 miles Indian Government) from Julfa to Bushire. It is worked throughout by an English staff, and may be considered one of the finest and most efficient lines in the world. From Bushire messages go by cable (laid in 1864) to Jask, and thence either by cable or by land to Kai’achi, Bombay, &o. The telegraphic convention between the British and Persian Governments has again been renewed, and is in force until 1925 ; and the concessions to the company were pro- longed to the same year by the Russian Government in March 1900. In addition to these lines, Persia possesses about 3700 miles of single – wire lines on wooden poles, belonging to the Persian Government and worked by a Persian staff ; the Teheran-Meshed line, however, is looked after by an English inspector, and since 1885 the Indian Government has allowed a sum not exceeding 20,000 rupees per annum for its maintenance. The minister of telegraphs has the Persian lines in farm for Â£6000 per annum, and no statistics are published. Statistics of the traffic on the Indo-European line are given in the adminis- tration reports of the Indo-European Telegraph Department, published by Government, and from them the figures in the following table have been obtained : â€”

Traffic over

Eamini^s in

Net Profits of tlie

Lines between

Government Dept.

London and Karachi.

-e^i . 6

S^

g= g-o

Number of

Â§1 Â§t

Total amount.

MS

50

Mes.sages

sa

Fl-Â°

Rupees.

Â§3

transmitted.

oÂ«

u

iQ

1887-88

83,031

74

100

198,381

1-75

1892-93

117,500

84

116

437,668

3-80

1895-96

140,401

102

138

8.^)2,631

7-42

1896-97

148,274

101

138

713,080

6-17

1897-98

146,988

106

145

758,172

6-57

1898-99

147,592

105

144

697,303

6 03

Banking. â€” It was only in 1888 that a European bank (the New Oriental Bank Corporation, Limited) established itself in Persia and modern ideas of banking were introduced into the country. Until then the banking was done by the native money-changers {sarrdfs) and some merchants â€” foreign and native â€” who did the banking

operations connected with their business, and occasion- ally undertook special outside transactions when they considered them sufficiently remunerative. In 1889 the Shah granted a con-

cession to Baron Julius de Renter for the formation of a State bank with the exclusive right of issuing bank-notes â€" not exceeding Â£800,000 without special assent of the Persian Govern- mentâ€" on the basis of the local currency, the silver kran. With the title of " The Imperial Bank of Persia " the bank was formed in the autumn of the same year, and incorporated by royal charter granted by Queen Victoria and dated 2nd September 1889. The authorized capital was four millions sterling, but the bank started with a capital of one million, and began its business in Persia in October 1889. In April 1890 it took over the Persian business of the New Oriental Bank Corporation, soon after- wards opened branches and agencies at the principal towns, and issued notes in the same year. During the first two years the bank remitted the greater part of its capital to Persia at the then prevailing exchange, and received for every pound sterling 32 to 34 krans ; but in consequence of the great fall in silver in 1893 and 1894, the exchange rose to 50 krans per pound sterling and more, and the bank's capital employed in Persia being reduced in value by more than one-third â€" 100 krans, which at the beginning repre- sented Â£3, then being worth only Â£2 or less â€" the original capital of one million sterling was reduced to Â£650,000 in December 1894. The bank has made steady progress in spite of innumer- able difficulties, and paid a fair dividend to its shareholders.'

In the same year, 1889, the Shah granted a concession to Jaques de Poliakov of St Petersburg for the establishment of a "Loan Bank," or, as the original concession said, "Mont de Piet^" with exclusive rights of holding public auctions. A com- pany was formed in the same year and started business at Teheran in 1890 as the " Banque des Prets de Perse." After confining its operations for some years to ordinary pawnbroking, without profits, it obtained the aid of the Russian State Bank, acquired large premises in Teheran, made advances to the Persian Government (since 1898), and in January 1900 financed the

loan of Â£2,400,000 to Persia (see “Finance,” supra). It has opened branches at Tabriz and Resht.

There is also established at Teheran a branch of the Russian “Banque de Commerce de Moscou,” and various Armenian firms, one with branches at many places in Persia and Russia, do bank- ing business, while various European firms at Tabriz, Teheran, Isfahan, Shiraz, and Bushire facilitate remittances between Europe and Persia.

The chief business of the native sarrdfs (money-changers, bankers, &c.) is to discount bills at high rates, hardly ever less than 12 per cent., and remit money from place to place in Persia for a commission amounting to from 1 to 5, or even 6 per cent, on each transaction ; and in spite of the European banks giving lower rates of discount and remitting money at par, the majority of the people and mercantile classes still deal with the natives. For advances with good security a native sarrdf charges at least 12 per cent, interest per annum ; as the security diminishes in value the rate of interest increases, and transactions at 10 per cent, a month, or more than 120],er cent, per annum, are not infrequerit. APersian who obtains an advance of money at less than 12 per cent, considers that he gets money “for nothing. ”

The monetary unit is the kran, a silver coin, formerly weighing 28 nakhods (88 grains), then reduced to 26 nakhods (77 grains), and now weighing only 24 nakhods (71 grains) or bomewhat less. Before the new coinage came into use (1S77) the proportion of pure silver was from 92 to 95 per cent. ; subsequently the pro- portion was for some time 90 per cent. ; now it is about 894 per cent. In consequence of this depreciation of the coinage and the fall in the price of silver, the value of the kran is now only about half what it was in 1S74. In that year it was worth a franc, the exchange being L5 to the pound sterling; in 1898-99 the average exchange for a Â£1 bill to London was 50 krans, which gives the value of 1 kran as 4|d. Taking this value of the kran, the values of the various niclcel and silver coins in circula- tion work out as â€”

Nicl^el Coins. Shahl = 2pul . . 0-24d. Two shahis = 4 pill . 0‘48d.

Silver Coins. Five shahis = Jkran Ten shahis=4 kran One kran =20 shahi

= 40 pdl Two krans

1 â€¢20d. 2-40d.

4 -sod. 9-60d.

In 1899 from 80 to 83 copper shahis (weighing about J lb) were being given for one silver kran. This was owing to the

In his paper on ” Banking in Persia ” (Journal of the Imtitiite of naiikcrs, 1891), Mr Joseph Rabino pointed out the great difficulties which make the easy distribution of fundsâ€” that is, the providing them wheu and where requiredâ€” a matter of impossibility in Persia, and gives this fact as the reason why the Iiiqierial Bank of Persia has local issues of notes, payable at the issumg branches only, ” for, in a country like Persia, where moveiiieuts of specie are so costly, slow, and difficult as to become impracticable except 011 a small scale, the danger of issuing notes payable at more than one place is obvious.”

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627

= 640 mi

>kals= 6-49 ft

= 720

, = 7-30 â€ž

= 1000

, = 10-14 â€ž

= 1280

= 12-98 â€ž

=2560

= 25-96 ,,

= 840

= 8-52 â€ž

720

= 116-80 â€ž

depreciation of the copper coinage from 1896 onwards, consequent ippn there being an excess of coinage due to tile excessive quan- tities formerly put in circulation from tlie mint. Accordingly tlie Government in 1900 replaced tlie copper by a nickel coinage. Gold coins are the J toman, 4 toman, 1 toman, 2, 6, and 10 tomans. The nominal value of the toman is 10 krans (4s.), but as there are very few gold pieces in circulation, its actual value is now about 16^ krans (6s. 7id.). Accounts are reckoned in dhiilrs, an imaginary coin, jniri; of a toman of 10 krans. 1000 dinars thus equal 1 krau, and 50 dinars 1 shS,hi.

The unit of weight is the miskal (71 grains), subdivided into 24 nakhods (2-96 grains), a nakhod being further subdivided into 4 gandum (-74 grains). Larger weights, again, are the sir (16 miskais) and the abbasi, wakkeh, or kervankeh (5 sir). Most articles are bought and sold by a weight called batman, or man, of which there are several kinds, the principal being â€”

Man-i-Tabriz=8 abbasis

Man-i-Noh abbasi = 9 abbasis

Man-i-Kohneh (the old man)

Man-i-Shah = 2 Tabriz mans

Man-i-Rey = 4 ,, ,,

Man-i-Bander abbisi

Man-i-Hashemi = 16 mans of

Corn, straw, coal, &c., are sold by kharvar=100 Tabriz mans = 649 ft.

The unit of measure is the zar or gez, of which, as in the ease of the man, there are several variants. 40 -95 inches is the most common length for the zar, but in Azerbaijan the length is 44-09 inches. Long distances are calculated in farsakhs, a farsakh being equal to 6000 zar. Probably the zar in tliis measure = 40-95 inches, which makes the farsakh 3 "87 miles, but the other length of the zar is sometimes used, when the farsakh becomes 4-17 miles. Areas are measured in jeribs of from 1000 to 1066 square zar of 40 -95 inches, the surface unit thus being from 1294 to 1379 square yards.

H. Eecent Histoey (1884-1901).

The history of Persia in the ninth edition of this Encyclo- paedia closed with the statement that in 1884 two steamers for the Persian Government were in course of construction, and that the Karun river was to be opened up to Ahy^z, and a carriageable road constructed connecting that place with Teheran. Already in 1865 the Shah had mooted the idea of a Persian naval flotilla in the Persian Gulf, to consist of two or three steamers manned by Arabs and commanded by English naval ofiicers ; but the idea was discountenanced by the British Government, to whom it was known that the project really concealed aggressive designs upon the independence of the islands and pearl fisheries of Bahrein (Curzon, Persia, ii. 294). Fifteen or sixteen years later it was repeatedly pointed out to the authorities that the revenues from the customs of the Persian Gulf would be much increased if control were exercised at all the ports, particularly the small ones where smuggling was being carried on on a large scale, and in 1883 the Shah decided upon the acquisition of four or five steamers, one to be purchased yearly, and instructed the late Ali Kuli Khan, Mukhber – ed – dowleh, minister of telegraphs, to obtain designs and estimates from

control British and German firms. The tender of a of the well-known German firm at Bremerhaven was Persian finally accepted, and one of the minister's sons " â– then residing in Berlin made the necessary con-

tracts for the first steamer. Sir Konald Thomson, the British representative in Persia, having at the same time induced the Shah to consider the advantages to Persia of opening the Karun river and connecting it with Teherdn by a carriageable road, a small river steamer for control- ling the shipping on the Karun was ordered as well, and the construction of the road was decided upon. The two steamers were completed in January 1885 at a cost of Â£32,000, and despatched with German officers and crew to the Persian Gulf (as has been already mentioned). One, the Persepolis, an iron schooner-rigged screw steamer, has a registered tonnage of 600, engines of 450 h.p., and a |

maximum speed of 10 knots ; the other, the Susa, now on the Karun above AhvAz, is a screw steam launch, with a tonnage of 36, engines of 30 h.p., and speed of 6 knots, and was sent out in sections on the Persepolis and put together at Muhamrah in 1885. The Persepolis has an armament of one 8^ and three 7^ centimetre Krupp steel guns, and forty old-system Mauser rifles. One of the 1^ centimetre guns was originally on the Susa, but transferred to the Persepolis in 1886. When the steamers were ready to do the work they had been intended for, the farmer, or farmers, of the Gulf customs raised difficulties and objected to pay the cost of maintaining the Persepolis ; the governor of Muhamrah would not allow any interference with what he considered his hereditary rights of the shipping monopoly on the Karun, and the objects for which the steamers had been brought were not attained. The Persepolis remained idle at Bushire, and the Susa was tied up in the Failieh creek, near Muhamrah. The annual cost of maintenance of the two vessels, merely for salaries and wages of officers and crew and expenses of necessary painting, oiling, and scrubbing, amounted to Â£3500, a large item in the small revenue of Persia, and the Shah wisely desisted from buying more steamers. The scheme of opening the

Karun and of constructing a carriageable road from AhvAz to Teherdn was also abandoned.

Frequent interruptions occurred on the telegraph line between Teheran and Meshed in 1885, at the time of the ” Panjdeh incident,” when the Russians were advancing towards Afghanis- tan and Sir Peter Lumsden was on the Afghan frontier ; and since (often for many days at a time) no news could be obtained. Sir Ronald Thomson concluded an agreement, still in force, with the Persian Government by which the line is kept in working order by an English inspector, the Indian Government paying a share not exceeding 20,000 rupees per annum of the cost of main- tenance, and an English signaller is stationed at Meshed. Shortly afterwards Sir Ronald Thomson left Persia (he died 15th November 1888), and Mr (afterwards Sir) Arthur Nicolson was appointed oharg^ d’affaires. During the latter’s tenure of office an agreement was concluded between the Persian and Britisli Governments regarding the British telegraph settlement at Jask, and the telegraph conventions of 1868 and 1872, relative to telegraphic communication between Europe and India through Persia, in force until 1st January 1895, were prolonged until 31st January 1905 by two conventions dated 3i-d July 1887. Since then these conventions have been prolonged to 1925. (See “Telegraphs,” supra.)

AyAb Khan, son of Shir Ali of Afghanistan, who had taken refuge in Persia in October 1881, and was kept interned in Teheran under an agreement, concluded 17th April 1884, between Great Britain and Persia, with a pension of Â£8000 per annum from the British Government, escaped on the 14th of August 1887. After a futile attempt to fenter, Afghan territory and raise a revolt against the Amir Ahdur Rahman, he ga,ve himself up to the British consul-general at Meshed in the beginning of November, and was sent under escort to the Turkish frontier and thence vid Baghdad to India. Yahya Khan, Mushir-ed-dowleh, the Persian minister for foreign aifairs (died 1892), Mho was supposed to have connived at Ayiib Khan’s escape in order to please his Russian friends, was dismissed from office.

In December 1887 Sir Henry Drummond WolfJ' was appointed minister to Persia. The appointment greatly plea,sed the Persian court, and the Shah lent a willing ear to his advocacy for the development of trade and commerce, construction of roads, aboli- tion of various restrictions hampering Persian merchants, &c. The Shah soon afterwards (26th May 1888) issued a proclamation assur- ing freedom of life and property to all his subjects,' and (30th October) declared the Karun river open to international naviga- tion up to Ahvaz. At about the same time he appointed Amin- es-Sultan, who had been prime minister since 1884, Grand "Vizir (Sadr Azam). In the same year (25th June) the first railway in Persia, a small line of 5| miles from Teheran to Shah-abdul-Azim, was opened under the auspices of a Belgian company in virtue of a concession granted two years before. A few months later (30th January 1889) Baron Julius de Reuter, in consideration of giving up the rights which he held by his concession obtained in 1873, became, as has been already stated, the owner of a concession for the formation of a Persian State Bank, with exclusive rights of issuing bank-notes and working the mines of iron, copper, lead, mercury, coal, petroleum, manganese, borax, and asbestos in Persia. Russia now insisted upon what she considered n, corresponding

advantage ; and Prince Dolgorouki, the Russian minister, obtained in February 1889 a document from the Shah which gave to Russia the refusal of any railway concession in Persia for a period of five years. The Persian State Bank was established by British royal charter, dated 2nd September 1889, and started business in Persia (23rd October) as the "Imperial Bank of Persia." The railway agreement with Russia was changed in November 1890 into one interdicting all railways whatsoever in Persia, and is still in force.

In April 1889 the Shah set out upon his third voyage to Europe. After a visit to the principal courts, inoli^ding a stay of a month in England, where he was accompanied by Sir Henry I It/ Drummond Wolff, he returijed to his ~~capital (20th Europe October). Sir Henry returned to~~

~~Persia soon after~~ 1889. ‘ wards, and in March of the following year the Persian Government granted another important concession, that of a tobacco monopoly, to British capitalists. In the autumn bad health obliged the British minister to leave Persia. It was during his stay in England that the Shah, for two or three days without his Grand Vizir, who was mourning for the death of his brother, listened to bad advice and granted a concession for the monopoly of lotteries in Persia to a Persian subject. The latter ceded the concession to a British syndicate for Â£40,000. Very soon afterwards the Shah was made aware of the evil results of this monopoly, and withdrew the concession, but the syndicate did not get the money paid for it returned. This unfortunate affair had the effect of greatly discrediting Persia on the London Stock Ex- change for a long time. The concession for the tobacco monopoly was taken up by the Imperial Tobacco Corporation (1891). The corporation encountered opposition fostered by the clergy, and after a serious riot at TeherAn (4th January 1892) the Persian Govern- ment withdrew the concession and agreed to pay an indemnity of Â£500,000 (5th April 1892). In order to pay this amount Persia contracted the 6 per cent, loan of Â£500,000 through the Imperial Bank of Persia, which was redeemed in 1900 out of the proceeds of the Russian 5 per cent, loan of that year. (For details of the tobacco concession and an account of the events which led to its withdrawal, see E. Lorini, La Persia Economica, Rome, 1900, pp. 164-169 ; and Dr Feuvrier, Trois ans a la Oour de Perse, Paris, 1899, chap, v., the latter ascribing the failure of the tobacco monopoly to Russian intrigue.)

In November 1889 Malcolm Khan, Nizam- el-Mulk, who fiad been Persian representative to the court of Great Britain since October 1872, was recalled, and Mirza Muhammad All Khan, consul-general at Tiflis, was appointed in his stead, arriving in London the following March, and later receiving the title Ala-es- Saltaneh. In 1890 the scheme of a carriageable road from Teheran to Ahvdz was taken up again ; the Imperial Bank of Persia obtained a concession, and work of construction was begun in the same year, and continued until 1893. In this year, too, the mining rights of the Imperial Bank of Persia were ceded to the Persian Bank Mining Rights Corporation, and a number of engineers were sent out to Persia. The total absence of easy means of

com- munication, the high rates of transport, and the scarcity of fuel and water in the mineral districts made profitable operations impossible, and the corporation liquidated in 1894, after having expended a large sum of money. The work of the corporation proved that without cheap means of transport no mining opera- tions on a large scale in Persia can be undertaken with profit.

Great excitement was caused in the summer of 1891 by the report that an English girl, Kate Greenfield, had been forcibly carried ‘ away from her mother’s house at Tabriz by a Kurd. g .... The British authorities demanded the girl’s restitu- ^gg” tion from the Persian Government. The Kurd, a

Turkish subject, refused to give up the girl, and took her to Sa6jbulagh, where he and a number of wild tribesmen en- trenched themselves, and threatened to resist any attempt on the part of the Persians to recover her. The Turkish authorities protected him, and serious complications were imminent ; but finally an interview between the girl and the British agent was arranged, and the matter was promptly settled by her declaring that she had left her mother’s house of her own accord, and was the wife of the Kurd. It also became known that she was the daughter of a British-protected Hungarian named Grtinfeld, who had died some years since, and an American lady of Tabriz,

Sir Frank Lascelles, who had been appointed minister to Persia in July, arrived at Teherto in the late autumn of 1891. In the following year Persia had a visitation of cholera. The epidemic entered Persia from the East, made many victims, and travelled as far as western Persia. In TeherAn the mortality rose for several days to over 1000 a day, and in the city and surrounding villages the number of fatal cases exceeded 28,000, or about 8 per cent, of the population. In 1893 the epidemic appeared again, but in a milder form. In June 1893, by a convention ratified a month later at Peterhof, Persia ceded to Russia the small but very fertile and strategically important district of Firiizeh and the adjacent lands between Baba Durmaz and Lutfdb^d on the northern

frontier of Khorasdn, and received in exchange the important village of Hissd,r and a strip of desert ground near Abbas^bdd on the frontier of

Azerb^i'jAn, which had become Russian territory in 1828, according to the treaty of Turkmanchai.

Sir Frank Lascelles left Persia in the early part of 1894, and was succeeded by Sir Mortimer Durand, who was appointed in July and arrived in Teheran in November. In the following year the Shah, by a firman dated 12th May, P"eoch gave the exclusive right of exploring ancient sites in Y"/?' Persia to the French Government, with the stipula^ con^sslon tion that one-half of the discovered antiquities, except- ing those of gold and silver and precious stones, should belong to the French Government, which also had the preferential right of acquiring by purchase the other half and any of the other antiquities which the Persian Government might wish to dispose of. The period for which this valuable concession is to remain in force is not mentioned in the firman, and is in consequence considered unlimited. In 1897 the French Government granted the necessary funds, and M. J. de Morgan, who had been on a scientific mission in Persia some years before and later distin- guished himself as head of the archaeological department in Egypt, was appointed chief of a mission to Persia, and, assisted by an efficient staff, began work at Susa in December. Opera- tions have been continued until now, and so far confined to Susa and southern Persia, but according to recent information the sphere of operations is to be greatly extended, and more than 400 ancient sites are to be explored.

On 1st May 1896 Ndssir-ed-dfn Shah was assassinated while paying his devotions at the holy shrine of Shah-abdul-Azlm, a few miles from TeherAn. Five days later he would have entered the fiftieth (lunar) year of his reign, ^,^g^lf"^' and great preparations for duly celebrating the jubilee g^aA* 1896 had been made throughout the country. The assassin '

was a small tradesman of Kermdn named Mirza Reza, who had resided a short time in Constantinople and there acquired i-evo- lutionary and anarchist ideas from Kemal-ed-dfn, the so-called Afghan sheikh, who, after having been very kindly treated by the Shah, preached revolution and anarchy at Teheran, fled to Europe, visited London, and finally

took up his residence in Constanti- nople. Kemal-ed-din was a native of Hamadan and a Persian subject, and as the assassin repeatedly stated that he was the sheikh's emissary and had acted by his orders, the Persian Gov- ernment demanded the extradition of Kemal from the Porte ; but during the protracted negotiations which followed he died. Mirza Reza was hanged 12th August 1896. There were few troubles in the country when the news of the Shah's death became known. The capital and most cities and districts were kept in order by the excellent measures taken by the Grand Vizir and the gov- ernors, and serious rioting arose only in Shir^z and Fars, where some persons lost their lives and a number of caravans were looted. European firms who had lost goods during these troubles were afterwards indemnified by the Persian Government. The new Shah, Muzaffar-ed-dfn (born 25th March 1853), then governor- general of Azerbdijin, residing at Tabriz, was enthroned there on the day of his father's death, and proceeded a few days later, accompanied by the British and Russian consuls, to Teheran, where he arrived 8th June. â€¢

An excessive copper coinage during the past three or four years had caused much distress among the lower classes since the beginning of the year, and the small trade was almost paralysed. Also the price of meat, particularly in JJJT"", the Teheran district, had been extraordinarily high ""â€¢<'â€¢""â– for some months, and was now quite prohibitive to the poorer classes. Immediately after his accession the Shah was made aware of these facts, and decreed that the coining of copper money should cease and the excess of the copper coinage be with- drawn from circulation. An arrangement was concluded with the Imperial Bank of Persia by which that institution advanced the required money and bought up the copper coinage at the rates current in the various cities until its circulating value became 26 shlhls equal to 1 kran. In order to reduce the price of meat, the meat tax, which had existed since ancient times, was abolished. The Imperial Bank of Persia, which had already advanced a large sum of money, and thereby greatly facilitated the Shah's early departure from Tabriz and enabled the Grand Vizir at Teherdn to carry on the government, cheer- fully accepted the arrangement, and stai-ted buying up the copper coinage at all its branches and agencies. The nominal value of the copper money

was 20 shahis equal to 1 kran, but in some places the copper money circulated at the rate of 80 shahis to the kran, less than its intrinsic value ; at other places the rates varied between 70 and 26 shahis, and the average cu-culating value in all Persia was over 40. If Government had been able to buy up the excess at 40 and reissue it gradually after a time at its nominal value when the people required it, the loss would have been small. But although the transport of

copper money from place to place had been strictly prohibited, dishonest officials found means to traffic in copper money on their own account, and by buying it where it was cheap and forwarding it to cities where it was dear, the bank bought it at high rates, thus rendering the arrangement for a speedy withdrawal of the excess at small cost to Government futile. It was only in 1899 that the distress caused by the excessive copper coinage ceased, and then only at very great loss to Government. The well- intentioned abolition of the tax on meat also had not the desired result, for by a system of “cornering” the price of meat rose to more than it was before.

In the autumn of 1896 Nizam-es-Saltaneh, governor of Arab- istan, and his brother Saad-el-Mulk, governor of Luristto, displayed much unfriendliness of attitude towards the British Government, and were removed from their posts at the instance of Sir Mortimer Durand, the Persian Government at the same time giving a promise that neither should be employed anywhere in Persia for a period of five years. In 1898 the British Govern- ment consented to the removal of the prohibition against the elder brother’s further employment, provided that a guarantee was given that he should never be employed in southern Persia or in any place where he might injure British trade. This was agreed to, and Nizam-es-Saltaneh became minister of justice and commerce in March, minister of finance In June, and chief administrator of Azerb3,ij&n in May of the following year (1899).

In the autumn of 1896 the Grand Vizir (Amin-es-Sultan) en- countered much hostility from some members of the Shah's entourage and various high personages. Amin-ed- Mlalsterlal dowleh was appointed chief administrator (vizir) of ^896-98′ Azerb&'j^n and sent to Tabriz. Shortly afterwards

the Grand Vizir found it impossible to carry on his work, resigned, and retired to Kom (24th November), and the Shah formed a cabinet composed for the greater part of the leading members of the opposition to the Grand Vizir. After three months of the new regime affairs of State fell into arrears, and the most important department, that of the Interior, was completely disorganized. The public treasury was empty. The ministers of the cabinet would not act together, and as all shirked responsibility, every matter, large and small, was brought before the Shah, who accordingly recalled Amin-ed-dowleh from Tabriz (February 1897), and appointed him minister president (Rals-i-Vuzara) and minister of the interior. In June Amin-ed- dowleh was made ,prime minister (Vizir 'Azam) and given more extended powers, and in August raised to the dignity of Grand Vizir {Sadr Azam) . Several reforms were now taken in hand, with a view of reducing expenditure and increasing the revenue ; but reducing expenditure meant the pensioning off or dismissal of crowds of functionaries, and this could not be done without paying arrears of salaries due to them. NSssir-el-Mulk was appointed minister of finance (February 1898), and made an attempt to introduce a simple system of accounts, establish a budget, reorganize the revenue department, make a new assessment of the land-tax, &c. ; but resistance on the part of the officials rendered it abortive. Other attempts at reform shared the same fate, and only resulted in making Amin-ed-dowleh very unpopular.

In the latter part of 1897 Mr E. Graves, the inspector of the English telegraph line from Jask eastwards, was brutally murdered by Baluchis, and the agents of the Persian Government sent to seize the murderers were resisted by the tribes. A con- siderable district breaking out into open revolt, troops under the com- mand of the governor-general of Kerm^n were despatched into Ba- luchistan. The

port of Fannoch was taken in March 1898, and order was restored. One of the murderers was hanged at Jask (31st May) .

Various attempts to obtain a foreign loan had been made during the previous year, but with the sole result of discredit- ing the Persian Government in Europe. In the be- Abortlve ginning of 1898 the Shah's mefiical advisers strongly oegotia- recommended a cure of mineral waters in Germany or British France, and as his departure from Persia without pay-

loaa In i'^S ^^^ arrears to the army and to thousands of funo-

1898. tionaries, or providing a sufficient sum for carrying on

the Government during his absence, would have created grave discontent, serious negotiations for a loan were entered npon. It was estimated that Â£1,000,000 would be required to pay all debts, including the balance of the 1892 loan, and leave a surplus sufficient for carrying on the Government until the Shah's return. Some time before this the Shah had asked Sir Mortimer Durand to assist, and the Persian Government, now applying to London, expected that the required money would be obtained quickly on easy terms, and thus enable the Shah to proceed on his journey to Europe in April. London capitalists offered to, float a loan for Â£1,250,000 at 5 per cent, and on the guarantee of the customs of Ears and the Persian Gulf ports, 'and to give Â£1,025,000, or 82 per cent, of the nominal capital to the Persian Government. They stipulated for a kind of control over the custom-houses by placing their

own agents as cashiers in them. This stipulation was agreed to in principle by the Grand Vizfr, Amin-ed-dowleh, who in March, in order to meet some pressing demands on the treasury, borrowed Â£50,000 on the customs receipts of KermS,nshah and Bushire, and agreed to the lenders, the Imperial Bank of Persia's agents, being placed as cashiers in the custom-houses of both cities. He encountered, however, much opposition from the other ministers. Objections were also taken to the low rate of 82, par- ticularly when it was ascertained that a rate of 86 could have been obtained if the claims of some members of the London

Stock Exchange, who had lost money over the lottery concession of 1889, had not had to be satisfied in order to obtain the necessary official recognition of the loan by the Stock Exchange. Further negotia- tions ensued, and the Shah's visit to Europe was abandoned. The assistance of the British Government not being forthcoming, the Grand Vizir's position became more and more difficult, and on 5th June he had to resign. Muhsin Khan, Mushir-ed-doWleh, minister for foreign affairs, then became president of the cabinet, and continued the negotiations, but could not bring them to a success- ful issue. Moreover, the Persian Government, finding that the previous estimate of the money required for paying its debts was about 50 per cent, below the mark, now asked for double the amount offered by the London capitalists, without, however, pro- portionately increasing the guarantee. This disorganized all previ- ous arrangements, and the negotiations for a London loan came to an end for a time at the end of July, leaving in tlie minds of the Persians the unfortunate impression that the British Government had done nothing to aid them.

On 9th July the former Grand Vizir, Amin-es-Sultan, was recalled from Kom, where he had resided since November 1896, arrived at Teher&n three days later, ^nd was reinstated as Grand Vizir on the 10th of August. His immense popularity, his friendly relations with the clergy, and some temporary advances from the banks, tided over difficulties for some time. The reform of the customs department was now (September 1898) taken up seriously, and the three Belgian custom-house officials who had been engaged by Amin-ed-dowleh in the beginning of the year were instructed to collect information and devise a scheme for the reorganization of the department and the aboli- tion of the farm system. In March 1899 the custom-houses of the provinces of AzerbMjS.n and Kerm6,nsh^h were given over to .the Belgians. The results of this step were so satisfactory that Government was induced to abolish the farm system and set up the new rggime in ttie other provinces in March 1900, and a number of other Belgian custom-house officials were engaged.

In March 1899 a small Persian force took Bander Lingah, one of the Persian Gulf ports, and expelled the Arab sheikh, whose family had

enjoyed a quasi-independence there for many generations. The loss of life was unimportant, and British gunboats were present to protect British subjects. The sheikh fled to the hills north of Lingah, obliging the Government to keep a garrison at the port.

In September, when renewed negotiations for a loan from London were not appearing to progress favourably, and the long-thought-of visit to Europe was considered to be absolutely necessary in the following year, the Shah Russian issued a firman authorizing the Russian Banque de tmut PrÂ§ts de Perse to float a loan. Shortly after this it was said that the London capitalists were willing to lend Â£1,250,000 without insisting upon the objectionable control clause ; but the proposal came too late, and on 30th January 1900, as we have already mentioned, an official announcement appeared at St Petersburg to the effect that the Russian Government had per- mitted the issue of a loan for 22 J million roubles (Â£2,400,000) at 5 per cent. , guaranteed by all the customs receipts of , Persia, excepting those for Pars and the Persian Gulf ports. Only in the event of any default of paying instalments and interests will the bank have the right of exercising control of the custom- houses. Persia received 85 per cent, of the nominal capital, and the Russian Government guarantees the bondholders. Without Government guarantee it is doubtful whether any financial insti- tution would have lent money on such advantageous terms. Money was immediately remitted to Tehera,n, and nearly all the arrears were paid, while the balance of the 1892 London 6 per cent, loan was paid off by direct remittance to London. The paying off the arrears, and the fact that a large quantity of cash was put into circulation in consequence, greatly revived trade, which had been languishing for a long time, and much distress and discontent disappeared.

Sir Mortimer Durand left Teher&n in the early spring, and proceeded to Europe on leave. On 12th April the Shah, accom- panied by the Grand Vizir and a numerous suite, started on his voyage to Europe, principally to undergo Shah's a cure at Contrexgville, but also with the intention of ^'" '" visiting the courts of Russia, France, Great Britain, igoo"igo2 Belgium, Netherlands, Germany, Italy, Austria, and '

Turkey. The affairs of State during his absence were entrusted

to a council of ministers, under the presidency of Ms second son, Malik Mansur Mirza, Shua-es-Sultaneh, who had made a long stay- on the Continent the year before.

After a residence of a month at Contrex^ville, the Shah pro- ceeded (14th July) to St Petersburg, and thence to Paris (29th July), intending to go to London on 8th August. But on account of the mourning in which several courts were thrown through the deaths of the king of Italy (29th July) and the duke of Saxe-Coburg-Gotha (30th July), the visits to England, Germany, and Italy were abandoned. On 2nd August an anarchist made an attempt upon the Shah's life in Paris, and a week later he went to Belgium. In the middle of June serious bread riots, in- stigated, it was said, by persons opposed to the Grand Vizir with the Shah in Europe, occurred in Teherd,n ; and to prevent a repetition of the disorders, some of the suspected ringleaders or instigators were expelled from the city. Sir Mortimer Durand having been given the post of ambassador to Spain, Sir Arthur Hardinge was appointed minister to Persia 12th August 1900.

In 1902 the Shah made another visit to Europe, and was wel- comed by King Edward in England during August.

Authorities. â€" The works treating of Persia and written by European writers, or in a European language, beginning with Herodotus, number thousands. The following bibliography has been restricted to works published during the 19th century which have not been quoted in the foregoing text, and, as giving useful information, may be consulted with advantage. The list excludes historical works and articles and papers, many of great value, which have appeared in the transactions, proceedings, and journals of learned societies, in magazines, reviews, newspapers, &c., and comprises only a selection, not a large one, of the works published as books. Au able summary of the voluminous

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Perth, or Pbethshiee, an inland county of Scotland, bounded on the N.W. and IST. by Inverness, on the K.E. by Aberdeen, on the E. by Eorfar, on the S.E. by the Eirth of Tay and Fife, Kinross, and Clackmannan, on the S. and S.W. by Stirling, and on the W. by Argyll.

Area and Population. â€” The area of the county is 1,617,808 acres, or 2528 square miles, with a population in 1881 of 129,007, in 1891 of 126,190, and in 1901 of 123,262, of whom 58,007 were males and 65,255 females, the number of persons per square mile being 48, and of acres to a person 13-01. Between 1881 and 1891 the percentage of decrease in the population was 2-17, and between 1891 and 1901, 2-3. The

following table gives the num- bers of marriages, births, and deaths, with the number and per- centage of illegitimate births, for 1880, 1890, and 1899 : â€”

Year.

Marriages.

BlrthB.

Deaths.

Illegitiniale Births,

No.

Per cent.

1880 1890 1899

743 695 730

3612

2869 2925

2372 2659 1945

357 252

227

9-2 8-8 8-4

In addition to Perth (32,872), the only town with over 5000 inhabitants is Crieff (5208). In 1891 there were in Perthshire

2465 natives of England, 68 natives of Wales, 1745 natives of Ireland, and 106 foreigners.

Administration. â€” For parliamentary purposes the county is divided into an Eastern and a Western division. The city of Perth also returns a member to Parliament.

Education. â€” The total grant to higher-class schools for the year ended 31st March 1900 was over Â£1651. The total accommodation in elementary schools for the year ended 30th September 1899 was 27,310, the average attendance 16,510, and the average cost per scholar Â£2, 17s. 11 Jd. The amount of rates received in 1898-99 was Â£31,219, and the average rate per Â£ on rateable value was at 6-87 in 1895-96, at 6-75 in 1896-97, and at 7-67 in 1897-98.

Agriculture. â€” Only a little more than one-fifth of the total area of the county is under cultivation, and of this nearly one-third is in permanent pasture, while in addition there are about 930,000 acres of hill pasturage, grazed partly by the native highland cattle, but mainly by sheep, in regard to the number of which Perthshire ranks, in Scotland, next to Argyll. Much of the old sheep pasturage is, however, now occupied by deer forests. Over 94,000 acres are under wood, and nearly 600 acres under orchards. Apples are grown chiefly in the Carse of Gowrie and the district of Menteith. Over 1000 acres are under small fruit. Since 1880 the acreage under corn crops has decreased by about one-sixth, the largest decrease being in the acreage under barley, which now occupies about one-sixth of the corn crop acreage, oats occupying nearly three-fourths, and wheat less than one-four- teenth. Nearly three-fourths of the green crop acreage is occupied by turnips, and less than one-third by potatoes. The following table gives the main divisions of the cultivated area at intervals from 1885 :â€”

Tear.

Total Area

under Cultivation.

Corn Crops.

(rreen Crops.

Clover.

Permanent Pasture.

Fallow.

1885 1890 1895 1899

345.136 349;818 337,227 338,737

99,902 94,826 89,474 87,514

47,963 45,865 44,294 43,394

103,533

118,683

98,265

99,918

91,623

87,735

103.284

105,745

2115

2130

1158

986

The following table gives particulars regarding the live stock for the same years : â€”

Tear.

. Total Horses.

Total Cattle.

Cows or Heifers

in Milk

or in Calf.

Sheep.

Pigs.

1885 1890 1895 1899

13,249 12,843 13,917 12,183

82,631 79,848 74,861 73,097

19,857 19,459 18,202 17,830

713,191 7.35,178 707,661 710,933

8902 9631 8886 7212

Industries and Trade. â€” The total number of persons employed in factories and workshops in 1897 was 12,198, as compared with 11,640 in 1896. Of these 4225 were employed in textile factories, flax, hemp, &c., chiefly coarse linens, in the several towns and villages, employing 2838. In non-textile factories 6258 persons were employed, 3402 of these in the print, bleach, and dye works for which the county town is famous. Of the 1715 persons em- ployed in workshops, 1170 were employed in clothing industries. Handloom weaving is still carried on in many of the villages. In 1899 among the minerals raised were 55,009 tons of "igneous rocks, 41,508 tons of sandstone, and, 9371 tons of slate.

See Robertson. General View of the Agriculture of the County of Perth. Perth, 1799.â€” Robertson. Comitatus de Atholice. Edin- burgh, 1800.â€” Guthrie. The Yale of Slrathmore. Edinburgh, 1875. â€” Drummonii. Perthshire in Bygone Days. London, 1879. â€” Marshall. Historic Scenes of Perthshire. Edinburgh, 1880.â€” Hunter. Woods, Forests, a)id Estates of Perthshire. Perth, 1883. â€” Beveridge. Perthshire-on-Forth, 2 vols. London, 1885.â€” Ford. The Harp of Perthshire. Paisley, 1893.â€” Clnninghame- Graham. Xotes on the District of Menteith. London, 1895.â€” Hutchison. The Lake of Menteith. Stirling, 1899. (w. Wa.)

Perth, an ancient city, a royal and parliamentary (one member) burgh, and the county town of Perthshire, Scotland, on the river Tay, at the junction of several lines of the Caledonian and North British railways, 48 miles north-north-west of Edinburgh by rail. Dyeing retains its importance, and there are. also glass, linen, wincey, and floorcloth manufactures, steam joinery works, and brick and tile works. There is an Episcopalian cathedral, to which in 1900 considerable additions were made in com- memoration of Bishop Wordsworth. The Perth Academy IS a higher-class school under the direction of the school

board;. and Sharp’s Institntion, besides satisfying the requirements of an organized science school, provides a course of instruction in classics, instrumental music, and gymnastics. In addition to the board schools other educational institutions are Ste^vart’s Free School, the industrial school for girls, and the Fechney industrial school. A scheme of city improvements has been to a large extent (1901) carried out. It includes a fine new- street from the North Inch to the South Inch ; the erection of anew bridge â€” a steel structure with handsome freestone piers â€” between the old bridge and the railway bridge, and connecting South Street with the Dundee Eoad. Jubilee corporation swimming baths, with bowling greens, were erected in 1887 by public subscription ; a handsome new post of&ce was opened in 1898, and in the same year the Saudeman Public Library, founded by a bequest of Â£32,000 from

the late Professor Sandeman of Owens College, Manchester. At the south end of the North Inch a granite column was erected in 1896 to commemorate the achievements of the 90th Light Infantry, now the second battalion Cameron Highlanders. Population (1881),

28,949 ; (1891), 29,899 ; (1901), 32,872.

Perth, the capital of West Australia, situated about 12 miles from the sea by rail, on the Swan river, which here widens out into a beautiful lake, one and a half miles long and one mile broad. The city has grown very rapidly since 1890. In 1891 the population was only 8447 ; in 1899 it was 35,000, of whom some 27,000 were within the .limits of the city proper (2660 acres). There is communication by bridge and steam ferry with South Perth, on the opposite side of the river; to the north-west lie the adjoining and rapidly growing munici- palities of Leederville and Subiaco. Outlying suburbs are Victoria Park, Burswood, Belmont, Claremont, Cottesloe, Peppermint Grove, and Bayswater. A Jubilee Victoria Public Library was opened in 1887, the Scots College in 1897, and the Mint, an imposing structure of con- siderable architectural merit, in 1899. An observatory is finely situated on a hill imm ediately west of the city, and there is a general museum. Chief among several reserves is the Perth Park Reserve, comprising over 1000 acres, now being cleared and laid out. The mean temperature is 64-9Â° F. ; the lowest that has been recorded is 37-5Â° ; and the maximum, an exceptional reading which was taken in 1878, 116-7Â°. The average rainfall is 33 inches.

The municipal council consists of a mayor, elected annually by the whole body of municipal electors, and 15 councillors, represent- ing 5 wards. In the Parliament of West Australia, for the meet- ings of which the city contains Legislative Council and Legislative Assembly chambers, Perth is represented by 3 members on the Council and 4 members in the Assembly. The total length of streets is 64 miles, of which in 1899 about 40 miles were properly formed and metalled. There are gas and electric lighting works, both as yet in the hands of companies. The water worlis, however, were acquired in 1896 by the central Government for Â£220,000 ; a further sum of Â£140,000 has

been expended on them, and the main reservoir, in the Darling range, is capable of holding 200,000,000 gallons. It is proposed to construct another with a capacity of 1,554,452,000 gallons, and a new service reservoir within the city boundaries is also contemplated. At present Perth has no proper sewerage system, but a scheme of surface drainage is being carried out as a temporary relief, and a permanent system of sewerage has also been approved, which will involve an expenditure of some Â£.350,000. There are three race-courses in the neighbourhood. Three daily papers are published.

Perth Amboy, a city and port of entry in Mid- dlesex county, New Jersey, U.S.A., at the head of Raritan Bay, in the eastern part of the state. Its site is low and level and the street plan regular. It has an excellent harbour and a large commerce, and three rail- ways, the Central of New Jersey, the Lehigh Valley, and the Pennsylvania, afford rail transportation. It contains terra-cotta works, machine works, ironf oundries, petroleum

refineries, and chemical works. Population (1880), 4808 ; (1890), 9512 ; (1900), 17,699, of whom 7978 were foreign- born and 89 negroes.

Peru, a country of South America, bounded on the W. by the Pacific Ocean, on the N. by Ecuador, on the E. by Brazil and Bolivia, and on the S. by Chile. The frontiers towards Ecuador and Bolivia are not yet defined, and the question as to the possession of the provinces of Tacna and Arica, which have been occupied by Chile since 1884, is still pending. According to the agreement between Peru and Chile, a popular vote should have decided in 1894 to which country these provinces should belong, but as a modus operandi acceptable to both parties could not be devised, the decision was deferred. On 16th April 1898 a convention for the purpose of carrying out the plebiscite was signed at Santiago, but two years later it was rejected by the Chilian Congress. According to Peruvian claims, the territory of the republic stretches from 1Â° 29- to 19Â° 13′ S., and from 61Â° 65′ to 81Â° 20′ 40″ W. Generally speaking, the climate is healthy, though a few endemic diseases are found. The climate in some places, as, for

instance, Piura and Jauja, has a curative effect on rheumatic, pulmonary, and other complaints.

The area of Peru, according to estimates published by the Geographical Society of Lima, covers 695,730 square miles. No census of the population has been taken since 1876, when the .^^ ^^^ number of inhabitants was returned at 2,657,853, ex- popuiatloa. elusive of uncivilized Indians, said to number about 350,000. In 1896 the Geographical Society of Lima estimated the population at 4,609,999. In tiie following table the areas of the 18 departments (including Tacna) and two provinces (Callao and Moquegua) and their population (census for 1876, and estimated for 1896) are set forth :â€”

Area

Population. j

Square Miles.

Census, 18T6.

Estimated, 1896.

Piura ....

16,824

135,502

213,909

Cajamarca

12,538

213,391

442,412

Amazonas

13,943

34,245

70,676

Loreto

288,456

61,125

100,596

Libertad .

10,206

147,541

250,931

Ancachs .

16,562

284,091

428,703

Lima

13,310

226,922

298,106

Callao

14

34,492

48,118

Huancavelica

9,251

104,155

223,796

Huanuco .

14,024

78,856

145,.309

Junin

23,347

209,871

394,393

lea .

8,718

60,111

90,962

Ayacucho .

18,185

142,205

302,469

Cuzco

156,270

238,445

438,646

Puno

41,198

256,594

537,345

Arequipa .

21,947

160,282

229,007

Moq.uegua .

5,549

28,786

42,694

Apurimac .

8,187

119,246

177,387

Lambayeque

4,614

85,984

124,091

Tacna ....

12,590

36,009

50,449

Tota

L

695,733

2,657,853

4,609,999

Of the total population in the republic, 57 per cent, are estimated to be aborigines ; 23 per cent, of mixed blood, white and Indian, or negro and Indian ; the remaining 20 per cent, are the descendr ants of Spaniards, some 6000 to 8000 Europeans, 15,000 Chinese, and 800 Japanese. No accurate data concerning the movement of population throughout the various departments are collected by the national authorities, but the prevalent opinion is that little change has taken

place in the number of inhabitants, any increase from births being counterbalanced by the heavy infantile mortality and the effects of alcoholism amongst adults. The immigration to Peru from Europe or elsewhere is on a very small scale, but no official statistics are kept. The number of Chinese is rapidly de- creasing, there being a high death-rate and no immigi'ation. The population of the city of Lima in 1897 was 100,144 (48,728 males and 51,416 females). In 1898 the number of marriages in the city was 405 ; births, 3885 (illegitimate, 2023) ; deaths, 4213. The population of the city of Callao, which in 1880 was 35,000, is now stated to be 48,118 ; that of Arequipa, 35,000 ; and of Cuzco,

30,000.

In Peru the Spanish spoken by the educated classes, though

National character.

Govern' ment.

they have a strain of Indian blood, is less corrupted than in most of the South American republics. The Peruvians are, as a rule, courteous and hospitable, proud in spite of their pov- erty, and patriotic in disputes with foreign powers. The Roman Catholic Church still holds great power amongst them, although its political iniluence is not so apparent as in former days. Amongst the Indians, the great bulk of the inhabitants, civilization has made comparatively little progress. They have, with the exception of a few remote tribes,, adopted Christianity, but in other respects they retain the habits of life practised by their Inoa forefathers. Away from the principal towns they live by cultivating small patches of ground, spinning by hand the cloth they need for their simple dress and household purposes, and tending flocks of alpacas and llamas ; they are content to acknowledge the authority of the locality. In many districts little Spanish is understood, in some none at all. The inhabitants of the higher valleys possess great power of endurance, and

travel long distances over mountainous country with only coca leaf and the barest modicum of food for sustenance. Unfortunately, drunkenness is a common vice in the interior, and is increasing.

The political constitution is that of 1860. The legislative power is vested in a Senate of 48 members and Chamber of Deputies of 108 members. Members of both houses are chosen for six years, by indirect popular election, in such manner that one-third of the number retire every two years. The executive power is vested in a President, elected by popular vote for four years ; with him are elected two Vice-Presidents. The retiring President cannot be elected for the next presidential term. There are six ministers of state â€” the heads of the depart- ments of foreign relations ; justice, worship, and public instruc- tion ; the interior and police ; war and navy ; finance and commerce ; public works, industry and internal development.

Local Government. â€” -The executive power is represented in each of the eighteen departments by a, prefect, in each province by a sub-prefect, in each district by a governor, and in each town by a lieutenant-governor. The prefects and sub-prefects are appointed by the President of the Republic, the governors by the prefects, and the lieutenant-governors by the sub-prefects. Each depart- ment is governed by a junta or council elected by the provincial councils, each consisting of twelve or sixteen members, according to its importance, and of forty members in the case of Lima. The smaller town districts are under district councils of three members, one chosen by the people and two by the provincial council.

By the constitution the Roman Catholic religion is the religion of the State, and the public exercise of any other is prohibited. Practically, however, there is a certain amount of tol- Rellglon eration, and there are Anglican churches and mission Vacation, schools in Callao and Lima. The marriage disabilities of non-Catholics were modified by an Act of 1897 and by a presidential decree published in May 1899.

Primary instruction is in charge of the municipal authorities, and though it is nominally compulsory between the ages of five and fifteen, little more than 10 per cent, of the children of school age are under

instruction. In 1898 there were 1456 primary schools, with 1618 teachers and an attendance of 60,732. Of the schools, 1152 were official and 304 were private. Of the teachers, 349 were men and 450 were women certificated, while 799 were as- sistants. Of the children, 39,547 were boys and 21,185 were girls. The expenditure on primary education in 1897 was 476,889 soles, equivalent to about Â£47,000, equal to 9 soles 78 centavos for each pupil attending the public schools. There is a normal school for the training of women teachers, founded in 1878, and upon which the Government expended 118,560 soles between 1878 and 1897. For secondary education there are twenty-three national colleges in different parts of the republic, twenty-two being for the instruc- tion of boys, and one at Cuzco for girls. In 1897 the number of students at these colleges was 1984, and the average attendance 1403, of whom 1186 passed satisfactory examinations. The number of their teachers was 163. The expenditure on the twenty-three colleges was 180,045 soles (Â£18,604), equal to 156 soles 86 centavos or about Â£15 for each student passing the examinations. For higher education there are four universities, at Lima, Arequipa, Cuzco, and Trujillo, granting degrees in theology, law, medicine, science, and literature. In 1897 there were 792 students, of whom 519 passed the requisite tests. The revenues of the four universi- ties in the same year amounted to Â£20,670, and their expenditure to Â£20,770. Lima has a school of mines and civil engineering, and there are also military and naval schools. There is a free library in the capital, in addition to one at the university and another at the school of mines. In several of the larger towns there are high schools under the direction of English and German teachers.

Justice is administered by the Supreme Court at Lima, and by superior and minor courts in nine judicial districts. Complaints aga,inst the administration of justice, both civil and Justice. criminal, are frequently made. On 1st July 1899 the police force consisted of 1162 officers and men of the civil guard, and 1266 olficers and men. of the mounted gendarmerie.

There are in Peru forty-eight charitable societies, formed chiefly for the support of thirty public hospitals within the republic. Their revenues

are derived chiefly from lotteries. There is but one national lunatic asylum. There are French, Italian, ^ ^’

and Chinese hospitals. Floating hospitals have been authorized at Callao.

The army, as fixed by the budget voted in 1899, consists of six battalions of infantry, with a strength of 1940 men ; two regiments of cavalry containing 250 men each ; four squadrons of 125 men to furnish the presidential escort ; and a regi- ‘ “”’*â– ment of mountain artillery of 510 men. Since 1896 a preparatory school has been established for the education of officers for the army and navy, and a military school has been founded at Chor- rillos for the instruction of officers and non-commissioned officers of the army. This institution is under the supervision of instruc- tors from the French army, sent out at the request of the Peruvian Government. The small-arm in use is the Mannlicher rifle. The Peruvian navy consists of the cruisers Lima and Constitution, and the transports Santa Rosa and Chalaco. There are also some smaller vessels, of little practical value for defence.

The revenue and expenditure,. which, before the outbreak of the war with Chile in 1891, amounted each to about 15,000,000 soles (or Â£1,500,000.) annually, have been f-‘oaace. as follows in recent years (the sole being taken at the uniform rate of 2 shillings) : â€”

Yeai-s. Eevenue. Expenditure.

1887 Â£525,380 Â£492,490

1897 1,053,990 1,114,570

1900 1,311,987 1,272,990

For 1900 the sources of revenue and the branches of expenditure were as follows (10 soles = Â£1): â€” Revenue. Customs . . Â£741,291 Taxes . . 471,982 Posts. . . 28,144 Telegraphs . 5,215 Various . . 65,355

Expenditure.

Finance

. Â£333,541

Army, navy

. 304,366

Government

378,969

Justice, &c.

. 115,429

Various

. 140,685

Total . Â£1,311,987 Total . Â£1,272,990

The revenue is derived mainly from customs and internal taxes on alcohol, tobacco, opium, and stamps. These taxes have been farmed out since 1896 ; and a new contract was made in 1900 with a syndicate specially formed for the purpose. Of the total amount collected, the syndicate retains Â£60,000 for the expenses of collec- tion ; of the balance, 94 per cent, goes to the Government and 6 per cent, to the syndicate. Other sources of revenue are a tax on real property and another on mining. The proceeds of the salt monop- oly are, by law of 1896, set apart for the redemption of Tacna. The foreign debt, contracted in 1870 and 1872, amounted to Â£31,580,000, but on this amount no interest was paid after 1876. In 1889 the arrears had accumulated to Â£23,000,000, and in January 1890 the Government entered into an agreement with the bondholders whereby it was released from all responsibility for the loans. To the bondholders were ceded the State railways for sixty-six years, the remaining guano deposits, and certain mines and lands. The Government agreed to pay them for thirty-three years an annual subsidy of Â£80,000, secured on

the Callao customs; while they undertook, among other responsibilities, the extension and im- provement of the railway system. For the purpose of carrying out the terms of this contract a company, called the Peruvian Corporation, was constituted in 1890, the bondholders becoming stockholders in the company on exchanging their bonds for shares. (See below.) The outstanding internal debt in 1899 consisted of : â€”

Description. Soles.

Interest-bearing funded debt . . . 26,606,645

Non-interest-bearing debt . . . 7,500,000

Floating debt 5,000,000

Miscellaneous claims on the treasury . . 9,500,000

Total

48,606,645

= Â£4,850,000

The rate of interest paid on the funded debt is 1 per cent, per annum, and the stock is quoted at 7 to 8 per cent, of the nominal value. The non-interest-bearing debt is amortized by tender by law at the rate of 20,000 soles monthly, but this provision has not been regularly attended to. This stock was quoted in 1890 at 3 to 4 per cent, of the nominal value.

Sugar-growing and manufacture have been important for many years, and a considerable extension of the industry took place during the period 1888 .to 1898, so that in 1899 the area planted with cane exceeded 160,000 acres. In ‘“dustrlal 1871 the sugar available for export was 4500 tons; in “Â«“Â«‘Â»?- 1881, 80,000 tons; in 1891, 41,400 tons; and in 1901, “”’“‘â€¢ 110,000 tons. The home consumption

of sugar is estimated at 20,000 tons annually. The climate is exceptionally favourable

for the sugar-planting industry, the labour difficulty being the great hindrance to a more rapid extension. The number of CJiinese coolies employed on the plantations is rapidly diminishing ; Japanese have been tried, but have proved deficient in strength, and they suffered severely from the climate. The sugar exports to Great Britain in three years were, in tons : 1898, 43,000 ; 1899, 21,200 ; 1900, 16,700 ; to the United States the quantities were : 1898, 14,200 ; 1899, 88,400 ; 1900, 57,800. The total value of sugar exported in 1899 was Â£1,010,351 ; in 1900, Â£1,455,842. Next in importance to sugar amongst agricultural products is cotton, both the fibre and seed being exported. The cotton grown in the department of Piura, where extensive works for irrigation are in progress, is of exceptionally good quality. The production was as follows during the specified years : â€”

Year.

Cotton Fibre.

Cotton Seed.

Quantity.

Value.

Quantity.

Value.

1891 1892 1898

Tons.

4765 9837 6712

Â£

105,800 322,520 247,000

Tons.

1,695 11,. 378

3,322

Â£

15,610

22,760 â€¢

9,970

In 1899 the exports of cotton fibre amounted to the value of Â£178,747; in 1900, Â£326,074. In 1898 the shipments of cotton- seed cake amounted to 1469 tons, valued at Â£2344. Four-fifths of the total cotton products exported are shipped to Great Britain. The production of ride shows a steady increase. In 1891, 1259 tons, valued at Â£15,000, were exported ; in 1898 it was 4295 tons, valued at Â£63,350. The shipments of coca^leaf were 128 tons in 1891, 818 tons in 1896, and 406 tons in 1898. Cocoina to the amount of 9590 lb, worth Â£65,200, was exported in 1898. In the same year cochineal to the value of Â£710 was exported, as com- pared with Â£3210 in 1896. For the cultivation of coffee many new plantations were formed a few years ago in the Chanchamayo, P6ren6, and Paucartambo districts of central Peru. For this pur- pose the Peruvian Corporation granted land on easy terms, and lent other assistance to settlers, the Government also offering facilities to European immigrants. The result was an increase in production from 191 tons in 1891 to 1215 tons in 1899. Unfortunately, owing to the heavy cost of transport, the scarcity of labour, and the fall in the price of coffee, these enterprises have proved unsuccessful, and the plantations

are being abandoned. The cultivation of cacao shows a marked increase. In 1891 the amount exported was 17 tons ; in 1898 it reached 618 tons, valued at Â£34,840. But this industry is hindered by difficulties similar to those which have checked the development of coffee cultivation. The rubber in- dustry promises an important development in the near future. The rubber trees are principally found near the affluents of the Amazon, extending from Iquitos southwards to the rivers Beni, Madre de Dios, and Madeira. Accurate information concerning the quantity collected cannot be obtained, as the greater portion of the product is conveyed to Brazilian ports and shipped as Brazilian. The export from Iquitos, by way of the Amazon, in 1884 was 540 tons ; in 1894, 1294 tons ; and in 1898, 1525 tons. Pastoral industry is confined to breeding cattle for home consumption, horses for local use, sheep and alpacas for food and wool, llamas for transport purposes, goats for skins and meat, and viouiias for the hair and hides. No official statistics have been compiled in regard to the number of cattle ; the supply is, however, barely sufficient to meet the local demand. The exportation of hides in 1898 was 2127 tons, valued at Â£83,110. In 1896 the shipments of wool were : â€” sheep wool, 2,698,000 lb ; alpaca, 2,888,000 tb ; vicufla, 9200 lb. In the same year 559,000 lb of vicuna skins and 677,000 lb of goat skins were exported. In 1898 the total amount of all wools ex- ported was 7,674,900 lb, valued at Â£308,260. The home consump- tion of native wools is considerable, the Indian population making the bulk of the cloth they need for the ponchos and other rough clothing for general use in the interior. The principal centres of the wool industry are: Arequipa and Ouzco. In the coast pro- vinces there are extensive areas of extremely fertile land, which might be made available for agriculture by irrigation. For instance, in the provinces of Tumbes, Nepena, and elsewhere vast networks of old irrigation canals, made before the Spanish conquest, prove that irrigation was extensively employed by the inhabitants in the time of the Incas. And at the present day the little valley of Chicama, to the north of Trujillo, in which irrigation is to some extent practised, is a standing illustration of the fertility of these coast-lands when properly watered ; there, 25,000 acres produce a crop of more than 40,000 tons of sugar annually.

Mining has made substantial progress, partly owing to com- parative freedom from revolutionary disturbances, and partly in consequence of the rise in the price of copper. The total mineral output of the republic in 1900 was 32,929 tons, valued at Â£1,695,055. The Cerro de Pasco copper mines, which have been developed only

since 1897, yielded in 1900, 5040 tons of bar copper and 11,700 tons of copper ore, the metal being carried a distance of 65 miles on llamas or donkeys to reach the nearest point of railway communi- cation with the seaboard. Silver is found in greatest abundance in the maritime Andes, especially in the valleys of the Rio Santa, near Carhuaz, Huaraz, and Recuay. CeiTO de Pasco is a great mining district, with over 360 silver mines open and at work. Farther south, at Yauli, there are 225 silver mines in operation. Still farther south, in the province of Huarochiri, there are 117 ; in Huanca^ velica and Castro Vireyna, 54 ; in Caylloma, 24 ; at Puno, over 50. The official returns of precious metals and mineral ores exported in 1898 and 1899 are :â€”

1898.

1899.

Description.

Value in Soles.

Value in Soles

Silver in bars and piiia and

mineral ores ...

9,481,213

10,667,010

Coined silver ...

482,365

.379,940

“Worked silver

439,807

11,160

Gold in coin and bars

41,500

6,460

Total .

10,444,885

11,064,570

= Â£1,044,490

= Â£1,106,450

The output of copper and copper ores in 1900 was valued at Â£619,260. Discoveries of rich quartz and placer mines in the Sahdia and Carabaya districts occurred in 1896, and attempts were made to work these fields. The natural obstacles of climate and difficulties of transport have as yet prevented any great develop- ment in this direction. Deposits of borax, discovered in 1892 about 45 miles south-east of Arequipa, are worked by a British company, which exported in 1897, 11,850 tons, valued at Â£94,800 ; and in 1898, 7177 tons, valued at Â£57,420. Recent explorations have demonstrated that extensive beds of anthracite and bitu- minous coal exist in the province of Hualgayoc. Coal is found also in the districts of Huamaohuco and Cerro de Pasco, where it is used for the mining establishments. Petroleum is found in considerable quantities in the department of Piura. The oil is extracted at Negritos, 6J miles south-east of Talara. Some of the wells have been sunk to a depth of 900 feet. The kerosene is

con- sumed in Peru, and a considerable quantity of crude oil is used as fuel by factories and other industrial undertakings.

Manufacturing industries are carried on on a small scale. “Panama” straw hats are made especially in the neighbourhood of Payta and Piura, but this industry is declining. In 1897 hats were exported to the value of Â£16,700; in 1898, of Â£10,600. About 2,000,000 gallons of spirits are produced annually from sugar-cane. Other manufactures (cotton, woollen, matches, soap, beer, cigars, &c.) have only local interest.

Commerce. â€” The foreign trade from 1891 to 1900 was as follows (10 soles = Â£1) :â€”

Tear. Imports. Exports.

1891 Â£1,700,133 Â£1,665,705

1894 1,174,470 1,495,860

1899 2,123,020 3,361,530

1900 2,317,000 4,498,000

In 1899 the chief imports and exports were : â€”

Imports.

Haberdashery

Â£798,860

Cottons

.377,030

Woollens .

145,140

Furniture, &c.

132,450

Provisions

238,100

Drugs, &c. .

92,770

“Wines, &o. .

36,590

Exports.

Minerals

Sugar

Wool

Cotton

Coffee

Borax

Hides

Cocaine

Â£1,066,700

1,010,350

311,810

178,750

48,410

61,100

78,340

67,510

Of the imports in 1900, 46 per cent, were from Great Britain, 16 per cent, from Germany, 13 per cent, from the United States, and 4 per cent, from Chile. Of the exports, 47 per cent, went to Great Britain, 21 per cent, to the United States, 13 per cent to Chile, and 11 per cent, to Germany.

The sea-borne trade passes mainly through the port of Callao. In 1901, 581 vessels of 755,461 tons entered and 537 of 758,334 tons cleared at that port. Of those entered, 232 of 893,483 tons, and of those cleared 233 of 393,858 tons SA/pp/n^. were British. There entered also 959 small vessels aggregating 12,697 tons, and cleared 952 aggregating 12,951 tons. The ports of Peru are visited regularly by the vessels of the Pacific Steam Navigation Company, and by those of the Chilian Compailia Sud Americana de Vapores. The German “Kosmos” Company, and the “Gulf Line,” a Glasgow company, also maintain communica- tion with the Peruvian ports, and another line connects Callao with New York ma Magellan Strait. In 1900 the merchant vessels belonging to Peru were 5 steamers of altogether 4253 tons, and 57 sailing vessels of 24,295 tons.

S. VII.â€” 8o

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P E E U

Koads are badly needed throughout the interior, although the Government is devoting some attention and money to the subject. Since

1896 communication has been opened up through Commani- jjg valley of Chanchamayo, by way of the river Pichis, " ‘”’^’ to Puerto Bermudez, and thence to Iquitos by steamer. But "as a matter of fact it is still easier to reach Iquitos viU New York and Para, or mS. the Strait of Magellan and Para, than by going across country." ^ A serviceable cart-road has also been made between Sicuani and Cuzco, through the productive provinces of Canchis and Quispicanchls. The total length of railways open to traffic in 1899 was 971 miles, the majority of the lines being held by the Peruvian Corporation. In 1899 there were within the repub- lic 3-39 post offices, and the postal movement comprised the trans- mission of 7,481,207 letters and post-cards in the internal service and 1,830,649 in the external. The post office receipts amounted to Â£80,625, and the expenses to Â£80,150. The telegraph system in 1899 extended 2037 miles, of which 1438 with 52 offices were under the administration of the Government, and 599 miles in the hands of the Peruvian Corporation. Peru is placed in communication with the outside world by the submarine cables of the Central and South American Company and the West Coast of America Company. The length of telephone wires erected was 3000 miles in 1900, offices being established in all the principal towns for telephonic service in the vicinity.

There are four commercial banks in Peru, with paid-up capital and reserve funds amounting in the aggregate to Â£568,560. A savings bank has also been established, with a paid-up and credit ‘^^Pi’^l Â°f 96,070 soles; the deposits on 31st December 1900 amounted to 1,504,422 soles. The customary rate of interest for loans is 8 per cent, per annum on sAund securities. Por several years the currency was based on the value of the silver sol, 25 grammes in weight, and -900 fine. By decree of 9th April 1897 the free coinage of silver was suspended, and the reimportation of Peruvian silver money was prohibited. On 11th December 1897 it was enacted that, pending the coinage of Peruvian gold, customs duties were payable in gold at the rate of 10 soles to Â£1 sterling in gold coin or in silver, with a surcharge to equal the difierence in value. On 29th December 1897 a decree was issued authorizing the coinage of Peruvian gold pieces of 10 soles of the same weight and fineness as the Â£ sterling. A decree on 10th January 1898

described the new gold coin as 22 millimetres in diameter, -916 fine, weighing 988 milligrammes, and containing 2 milligrammes of alloy. The name of libra is given to these pieces. The value of Peruvian gold coins minted, 1898-1901, was Â£218,726. In 1900-01 the rate of exchange was about 10 soles 20 cents, to the libra. The silver coins in circulation are the sol (actual value about 2s.) ; half-sol=50 cents. ; peseta=20 cents. ; real = 10 cents.; and half-real =5 cents. There are also current copper coins for values of less than 5 cents. The French metric system is the official standard of weights and measures, but is not in general use. The ounce, 1-104 oz. avoirdupois ; the libra, 1-014 R) avoirdupois ; the quintal, 101-44 lb avoirdupois ; the arroba, 25-36 R) avoirdupois, and of wine, 6-70 imperial gallons ; the gallon, -74 of an imperial gallon ; the vara, -927 yard ; and the square vara, -859 square yard, are aU commonly employed.

As a result of the Grace-Donoughmore contract with the Peruvian Government, the Peruvian Corporation was constituted in 1 890 with the following capital : â€" ordinary shares, l^f^'r^H' Â£9>000,000 ; 4 per cent, preference shares, Â£7,500,000, .â€žr. ^^^ power to issue Â£6,000,000 in 6 per cent, deben- tures : of the latter, a sum of Â£3,700,000 has been issued to provide working capital, to cover costs of railway exten- sion, and to settle certain outstanding claims. The Peruvian Government found that the national resources were unequal to the payment of the annual subsidy of Â£80,000, and in 1893 the amount was reduced to Â£00,000, and shortly afterwards the pay- ments ceased altogether. In consequence of the failure of the Government to meet its obligations, the Corporation was unable to build an additional 100 miles of railway agreed to in the original contract. The Government is also heavily indebted to the Corporation for the transport of troops and other expenses, and has no funds to discharge these liabilities. The revenues of the Corporation are derived from the earnings of the railways, the steamer traffic on Lake Titicaca, the transport of freight on the river Desaguadero, the sales of guano, and some other small in- cidental items. The net earnings in 1900-01 were Â£204,189. In 1896 the interest on the debentures was temporarily reduced to 3 per cent, per annum, higher rates of interest to be paid as the earnings of the Corporation permitted. The

Corporation has spent large sums of money in the endeavour to colonize the land con- ceded to it in the P^ren^ district, but without achieving satis- factory results. Considerable shipments of guano have been made of recent years, the net income in 1900-01 being Â£57,441, but the deposits in possession of the Corporation are rapidly becoming exhausted. The hope of the Corporation lies in the development

vian Cor= poratioa.

1 Brit. Cons. Beport for 1S99-1900, p. 20 (No. 2639).

of traffic in the mineral districts, and for this an extension of the existing railway system is necessary, especially in connexion with the Central railway. The Peruvian Government dispute the right of the Corporation to work the mineral deposits at Cerro de Pasco, on the ground that the privilege originally conceded has now lapsed.

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(w. w. B. ; I. P. A. E. ; c. E. A.)

Political History since 1880. â€” The victory of the Chilians over the combined forces of Peru and Bolivia at Taena on 7th June 1880 marked the close of the second stage of the war which had broken out in April of 1879. In November 1880 the Chilians began to make prepara- tions for the landing of an army to attack the Peruvian capital. A force of 25,000 men was concentrated at Tacna and Arica under the command of General Baquedano. These troops were embarked on transports and convoyed by Ohilian warships to a point a little to the south of Callao, there disembarking on 21st December 1880. The Peruvians, meanwhile, had not been idle. After the crushing defeat at Arica, every effort was made to put Lima in an effectual state of defence. Under the direction of Senor Nicolas de Pierola, who had assumed dictatorial powers after the departure of General Prado to Europe, all the remaining strength of Peru was organized for resistance. The military command was confided to General Andres Caeeres. Two lines of defence were planned to intercejot the advance of the enemy from the seaboard, trenches being dug, the mud walls dividing the various farms loopholed, artillery mounted on all com- manding positions, and large supplies of ammunition and stores collected to enable the defenders to sustain a lengthy siege. The Peruvian army at this juncture numbered 26,000 men of the line and 18,000 in the reserves. The defensive measures inspired great confidence, both Senor Pierola and General Caeeres considering the position of Lima practically impregnable. At daybreak on 13th January 1881 the Chilian attack began, and the action soon became general throughout the whole length of the Peruvian first line of defence. The (.‘hilian troops carried the trenches at the point of the bayonet after repeated charges, and at mid-day the defenders were forced to fall back upon the second line of fortifications. In this engagement, known as the battle of Chorrillos, the Chilian loss was 800 killed and 2500 wounded; the Peruvian 6000 killed, 4000 wounded, and 2000 prisoners. Ou the following day an attempt v.~~z.a made by the diplomatic rep~~ resentatives of foreign Governments in Lima to negotiate peace, but it proved abortive. On 15th January at 2 p.m. the final struggle of the war, known as the battle of Miraflores, comntenoed, and continued for some four hours. The Chilians were

again victorious, and carried the second line of defence, this success placing Lima completely at their mercy. When the fate of the day was no longer in doubt,

Senor Pierola, General CdÂ«eres, and such officers as could escape retired to the interior for the purpose of endeavouring to organize further resistance in the moun- tain districts. At the battle of Miraflores the Chilian losses were 500 killed and 1625 wounded, the Peruvian 3000, including killed and wounded. On 17th January a division of 4000 Chilian troops under command of General Saavedra entered Lima under instructions from the Chilian commander-in-chief to occupy the city and restore order within the municipal limits.

Desultory fighting was now maintained by the rem- nants of the Peruvian armjr in the interior, under direc- tion of General C^ceres, against Chilian authority. An attempt was made to constitute a Government with Senor Calderon as President of the Eepublic and Gen- eral C^ceres as first Vice-President. The negotiations between this nominal administration and the Chilian authorities for a treaty of peace proved futile, the Chilian occupation of Lima and the Peruvian seaboard continu- ing uninterruptedly until 1883. In that year Admiral Lynch, who had replaced General Baquedano in com- mand of the Chilian forces after the taking of Lima, sent an expedition against the Peruvians under General Caceres, and defeated the latter in the month of August. The Chilian authorities now began preparations for the evacuation of Lima, and to enable this measure to be effected a Peruvian administration was organized with the support of the Chilians. General Iglesias was nom- inated to the office of President of the Eepublic, and in October 1883 a treaty of peace, known as the treaty of Ancon, between Peru and Chile was signed. The army of occupation was withdrawn from Lima on 22nd October 1883, but a strong Chilian force was maintained at Chorrillos until July 1884, when the terms of the treaty were finally approved. The principal conditions imposed by Chile were the absolute cession by Peru of the

province of Tarapaca, and the occupation for a period of ten years of the territories of Tacna and Ariea, the ownership of these districts to be decided by a popu- lar vote of the inhabitants of Tacna and Arica at the ex- piration of the period named. A further condition was enacted that an indemnity of 10,000,000 soles was to be paid by the country finally remaining in possession â€" a sura equal to about Â£1,000,000 to-day. The Peruvians in the interior refused to recognize the validity of the nomination of President Iglesias, and at once began active operations to overthrow his authority on the final departure of the Chilian troops. A series of skirmishes now took place between the men in the country under Caceres and the supporters of the administration in Lima. Affairs continued in this unsettled state until the middle of 1885, Caceres meanwhile steadily gaining many ad- herents to his side of the quarrel. In the latter part of 1885 President Iglesias found his position, after some severe fighting in Lima, impossible, and he abdicated his office, leaving the field clear for Caceres and his friends to assume the administration of public affairs. Under the guidance of General Caceres a junta was then formed to carry on the government until an election for the Presidency should be held and the Senate and Chamber of Deputies constitT^ted. In the following year (1886) General Caceres was elected President of the Eepublic for the usual term of four years. The task assumed by the new President was no sinecure. The disasters suffered in the war with Chile had thrown the country into absolute confusion from a political and administrative point of view. Gradually, however, order in the official departments was restored, and peaceful conditions were reconstituted throughout the republic.

The four years of office for which General Caceres was elected passed in uneventful fashion, and in 1890 Senor

Morales Bermudez was nominated to the Presidency, with Senor Solar and Senor Borgono as first and second Vice-Presidents. Matters continued without alteration from the normal course until 1894, and in that year President Bermudez died suddenly A few months before the expiration of the period for which he had been chosen as President. General Caceres, who was the power behind the scenes, brought influence to bear to secure the nomination of Vice-President Borgono to

act as chief of the executive for the unexpired portion of the term of the late President Bermudez. This action in regard to the nomination of Senor Borgoflo was illegal and unconstitutional, and was bitterly resented by Vice- President Solar, who by right should have succeeded to the office. Armed resistance to the authority of Presi- dent Borgono was immediately organized in the south of Peru, the movement being supported by Senores Nicolas de Pierola, Billinghurst, Durand, and a number of influential Peruvians. In the month of August 1894 General Caceres was again elected to fill the office of President, but the revolutionary movement set afoot against President Borgono was continued against his successor, and rapidly gained ground. President Caceres adopted energetic measures to suppress the outbreak : his efforts, however, proved unavailing, the close of 1894 finding the country districts in the power of the rebels and the authority of the legal Government con- fined to Lima and other principal cities held by strong garrisons. A concentration of the revolutionary forces was now made upon the city of Lima, and early in March 1895 the insurgents encamped near the outskirts of the town. On 17th, 18th, and 19th March severe fighting took place, ending in the defeat of the troops under General Cd^ceres. A suspension of hostilities was then brought about by the efforts of H.B.M. consul, Mr St John. The loss on both sides to the struggle during these two days was 2800 between killed and wounded. President Caceres, finding his cause was lost, left the country, a provisional Government under Senor Candamo assuming the direction of public affairs. On 8th September 1895 Senor Pierola was declared to be duly elected as President of the Republic for the following four years. The Peruvians were now heartily tired of revolutionary disturbances, and the administration of President Pierola promised to be peaceful and advantageous to the country. In these circumstances it is not surprising that an insurrectionary outbreak in ‘the district of Iquitos met with small sym- pathy, and was speedily crushed. In 1896 a reform of the electoral law was sanctioned. By the provisions of this Act an electoral committee was constituted, composed of nine members, two of these nominated by the Senate, two by the Chamber of Depu:ties, four by the Supreme Court, and one by the President with the consent of his ministers. To this committee was entrusted the task of the examina- tion of all election returns, and of the

proclamation of the names’of successful candidates for seats in Congress. Another reform brought about by President Pierola was a measure introduced and sanctioned in 1897 for a modifica- tion of the marriage laws. Under the new Act marriages of non-Catholics solemnized by diplomatic or consular officers or by ministers of dissenting churches, if properly registered, are valid, and those solemnized before the pass- ing of this Act were to be valid if registered before the end of 1899. Eevolutionary troubles again disturbed the country in 1899, when the Presidency of Senor Pierola was drawing to a close. In consequence of dissensions amongst the members of the election committee constituted by the Act of 1896, the President ordered the suppression of this body. Seizing on this action as a pretext, a group of malcontents under the leadership of one Durand, a man who had been prominent in the revolution against General

Caceres in 1894-95, conspired against tlie authorities and raised several armed bands, known locally as montaneras. Some skirmishes occurred between these insurgents and the Government troops, the latter generally obtaining the advantage in these encounters. In 1899 several of these armed bands were still at large in the mountainous dis- tricts, but they were not regarded as formidable antag- onists by the authorities, nor was any great sympathy extended to them by the rural population. In September 1899 President Pierola vacated the Presidency in favour of Senor Komana, who had been elected to the office as a popular candidate and without the exercise of any undue official influence. President Eomaiia was educated at Stonyhurst, in England, and was a civil engineer by profession. He was credited with the desire to help on the development of Peru without any political ambi- tions to serve either on his own behalf or on that of his friends.

The principal political problem before the Government of Peru at the opening of the 20th century was the question with Chile of the ownership of the territories of Tacna and Arica. The period of ten years originally agreed upon for the Chilian occupation of these provinces

expired in 1894. At that date the peace of Peru was so seriously disturbed by internal troubles that the Gov- ernment was quite unable to take active steps to bring about any solution of the matter. Since 1894 negotia- tions between the two Governments have been attempted from time to time, but without any satisfactory results. The question hinges to a great extent on the qualification necessary for the inhabitants to vote, in the event of a plebiscite being called to decide whether Chilian owner- ship be finally established, or the provinces revert to Peruvian sovereignty. Peru has proposed that only Peru- vian residents shall be entitled to take part in a popular vote ; Chile rejects this proposition, on the ground that all residents in the territories in. question shall have a voice in the final decision. The agreement between Chile and Bolivia, by which the disputed provinces are to be handed over to the latter country if Chilian possession be recognized, is also a stumbling-block, a strong feeling existing among Peruvians against this proceeding. It is not so much the value of Tacna and Arica that makes the present difficulties in the way of a settlement as it is that the national pride of the Peruvians ill brooks the idea of permanently losing all claim to this section of country. The money, about Â£1,000,000, could probably be obtained to indemnify Chile if occasion for it arose.

The question of the delimitation of the frontier be- tween Peru and the neighbouring republics of Ecuador, Colombia, and Brazil has also cropped up at intervals. A treaty was signed with Brazil as far back as 1876, by which certain physical features were accepted by both countries as the basis for the boundary, but nothing has been accomplished towards definitely surveying the pro- posed line of limits. In the case of Ecuador and Colombia a dispute arose in 1894 concerning the ownership of large tracts of uninhabited country in the vicinity of the head- waters of the Amazon and its tributaries. An agreement was proposed between Peru and Ecuador in connexion with the limits of the respective republics, but difficulties were created to prevent this proposal from becoming an accomplished fact by the pretensions put forward by Colombia. The latter state claimed sovereignty over the Napo and Maranon rivers on the grounds of the ecclesi- astical jurisdiction exercised over this section of territory

during the period of Spanish dominion, the Government of Colombia pretending that these ecclesiastical rii^hts to which Colombia became entitled after her separation ^rom the Spanish Crown carried also the right of absolute ownership. In a treaty signed by the three interested

states in 1895 a compromise was effected by which Colombia withdrew a part of the claim advanced, and it was agreed that any further differences arising out of this frontier question should be submitted to the arbitra- tion of the Spanish Crown. The boundaries had in 1902 not yet been surveyed. (c. e. a.)

PerUy a city of Laselle county, Illinois, U.S.A., on the north bank of the Illinois river, and on the Chicago, Burlington, and Quincy and the Chicago, Rock Island, and Pacific railways, north of the centre of the state, at an altitude of 462 feet. It is built on the face and top of the river bluffs, with a regular plan, and is divided into five wards. It is in an agricultural and coal-mining region, and has large trade and varied manufactures. Population (1890), 6550; (1900), 6863, of whom 2095 were foreign-born.

Peru, a city of Indiana, U.S.A., capital of Miami county, on the Wabash river, the Wabash and Erie canal, and the Wabash and the Lake Erie and Western rail- ways, north of the centre of the state, at an altitude of 649 feet. It is in an agricultural region, has considerable trade, and contains varied manufactures. Population (1880), 5280 ; (1890), 7028 ; (1900), 8463, of whom 737 were foreign-born and 67 negroes.

Pesaro, a town, episcopal see, and capital of the province of Pesaro and Urbino, the Marches, Italy, on the Adriatic coast, 37 miles by rail north-west of Ancona. The house in which Eossini was born now contains col- lections of paintings, pottery, and furniture. The Pi.occa Costanza is now used as a prison. Pesaro possesses a technical institute, an agricultural school, a school of the industrial arts, and a meteorological observatory ; also a monument (1896) to the statesman and author, Mamiani delle Eovere (1799-1886), and a statue to Garibaldi (1891). The Foglia is crossed by an ancient Eoman bridge. Pesaro is famous for its figs. Population (1881),

13,943 ; (1901), 25,116.

Pescadores. â€” A group of islands (called by the Japanese Hdko td, or Hdko Guntd), lying 30 miles west- ward of Formosa, between 23Â° and 24Â° N. Flat and with unproductive soil, they are swept during one-half of the year by violent north-east winds, and also lie full in the path of the numerous typhoons that rush up the Gulf of Formosa. The anchorage is at Makyu (Japanese, MaJcnn). The islands number 48, have a coast-line of. 98-67 miles, a total area of 86-50 miles, and a populatifon of 61,719. Meterological observations taken by the Japanese during a period of three years show that the annual average of tempestuous days is 237.

Peshawar, a city of British India, giving its name to a district and division of the Punjab, the capital of the North-West Frontier Province. The city is 1165 feet above the sea, near the left bank of the river Bara, 11 miles from Janirud, at the entrance of the Khaibar Pass; the railway station is 1688 miles north-west of Calcutta. Population (1881), 79,982 ; (1891), 84,191 ; mu- nicipal income (1897-98), Es.1,97,609 ; death-rate (1897), 27 per thousand. The city proper is surrounded by a mud wall with sixteen gates. The suburbs contain gar- dens stocked with fine fruit-trees. Two miles west lie the cantonments, which accommodate a strong force of all arms, l^eshdwar is the depot for trade with Afghanistan and central Asia, and has manufactures of scarves and cutlery. The water-supply is derived from the river Bara. The station of the Church Mission is called after Sir Herbert Ed wardes. There are four high schools, nine printing-presses, and Hindu and Tilahommedan religious associations. In May 1898 there was a very destructive fire.

The district of PeshAwae has an area of 2444 square miles ; population (1881), 592,674; (1891), 703,768; (1901), 786,406; showing an increase of 19 per cent, between 1881 and 1891, and of 11-7 per cent, between 1891 and 1901, the increase having been con- tinuous since 1868 ; average density, 322 persons per square mile. The land revenue and

rates in 1897-98 were lis. 11, 43, 287, the incidence of assessment being Rs.0 : 13 : 3 per acre ; cultivated area, 697,020 acres, of which 405,290 were irrigated, including 155,066 from Government canals ; number of police, 1117 ; number of schools (1896-97), 297, attended by 7401 boys, being 9-3 per cent, of the boys of school-going age; death-rate (1897), 22-9 per thou- sand. The principal crops are wheat, barley, maize, millet, oil- seeds, with a little cotton and sugar-cane. In 1897-98 the Swat river canal irrigated 138,557 acres, and the net profits were Rs.1,41,184, being 3-5 per cent, on a capital outlay of just Rs.40, 00,000. The North-Western railway crosses the district from Attook, with its terminus at Peshawar city, 47 miles. The Indus is navigable for 146 miles.

The division of PeshAwar consists of the three frontier districts of Hazara, Peshd,war, and Kohat. Total area, 8206 square miles ; population (1891), 1,423,231; (1901), 1,715,248, showing an in- crease of 20”5 per cent. ; average density, 209 persons per square mile.

Pesth. See Budapest.

Petani. See Malay Peninsula.

Peterborough, an ancient city and parliamentary and municipal borough of iST orthamptonshire, on the river Nene, 76 miles north of London by rail. The choir of the cathedral was reopened in 1889 after being closed, for thorough restoration, for six years. During 1888-89 the lantern tower was rebuilt, the north and south transepts were underpinned, and three columns repaired in the choir. During 1889-90 the internal masonry of the nave, aisles, and western transepts was cleaned, and in 1896 the restoration of the west front and other parts was commenced. Great care has been exercised in preserving the many interesting discoveries made during the carry- ing out of this work â€” the most important being the site of the cruciform Saxon church, enclosed within a crypt under the south transept. A public library was estab- lished in 1893. The school of art, science, and technology in the minster precincts consists of nin^ class-rooms and two work-shops. Certain free studentships are offered annually by examination, and the students numbered in 1898 about 300. On the outskirts extensive brick-

works have grown up, their forest of stalks forming a remarkable feature in the landscape. The soke, or liberty, of Peter- borough was in 1888 declared a separate administrative county from the remainder of Northamptonshire. Except for parliamentary and militia purposes, it is entirely independent. Population (1881), 21,228 ; (1891), 25,171 ;

(1901), 30,870.

Peterborough, a town and port of entry of Ontario, Canada, and capital of the county of the same name, situated 70 miles north-east of Toronto, on the Otonabee river and the Grand Trunk and Canadian Pacific railways. The five falls of the Otonabee at this point, with a total descent of 60 feet, furnish power for a large number of manufacturing establishments, whilst its canalization as part of the Trent canal will give communication with Lake Ontario and Georgian Bay. The most important buildings are the post office, custom-house, hospital, and Young Men's Christian Association building. It has an electric railway, and contains manufactories of electrical machinery and supplies, iron and steel bridges, and agri- cultural implements, saw, flour, and woollen mills, and pork-packing establishments. Exports for 1898-99 were valued at $616,972, and imports, |697,467. Population

(1881), 6812; (1891), 9717; (1901), 11,239.

Peterhead, a seaport, market town, and parlia- mentary burgh (Elgin group) of Aberdeenshire, Scotland, 33 miles by road north-north-east of Aberdeen. The

harbour comprises three basins covering an area of 21 acres. In 1888, 690 vessels of 63,802 tons entered ; 640 vessels of 62,066 tons in 1898. Exports (mostly herrings) were valued at Â£259,040 in 1888 and Â£156,250 in 1898 (228,307 barrels). The value of the fish landed at the port in 1899 was Â£117,467. There are three trawling companies employing six trawlers, and a steam herring fishing company has been formed. The Arctic seal and whale fishing is extinct. The harbour of refuge has been under construction by convict labour since 1886. New police buildings have been erected. There is an academy with an elementary department. Population (1881),

10,922 ; (1891), 12,196 ; (1901), 11,763.

Petermann, August Heinrich (1822-78), Ger- man cartographer, was born at Bleicherode, near Nord- hausen, on 18th April 1822. At the age of seventeen he entered the Geographical School of Art in Potsdam, and in 1846 proceeded to Edinburgh to assist Dr Keith Johnston in the production of an English edition of the PhysicaT Atlas of Berghaus. In 1847 he came to London, and during the next seven je&vs published a large number of maps, including an atlas of physical geography (with Thomas Milner), and an account of Earth's expedition to Central Africa, 1866, besides contributing a number of geographical articles to the Encydopoedia Britannica which was then appearing. In 1864 he became director of the Geographical Institute of Julius Perthes in Gotha, and editor of its well-known Mitteilungen. His diligent research and careful delineation did much towards elucidating the geography of the interior of Africa and of the North Polar regions, and he drew up the plans, descriptions, and maps of all the German expeditions to Africa and to the Poles in his time. His merits as a scientific cartographer were universally recognized, and most of the geographical societies of the world numbered him among their honorary members. The University of Gottingen conferred an honorary degree upon him, and Queen Victoria, at the suggestion of Chevalier Bunsen, appointed him Physical Geographer-Eoyal. Dr Petermann died by his own hand at Gotha, 25th September 1878. (g. f. b.)

Peters, Karl (1866), German colonial admin- istrator, was born at Neuhaus on the Elbe on 27th September 1866, being the son of a Lutheran clergyman. He studied at Gottingen, Tubingen, and Berlin, and in 1879 was awarded a gold medal by the Berlin University for his "Erieden zu Venedig" ("Peace of Venice, 1178"). After visiting London to study English principles of colonization, he returned to Berlin, and promoted the German Colonization Society (Deutsche Kolonialverein). In the autumn of 1884 he proceeded to East Africa, and concluded in the name of his society treaties with the chiefs of Useguha, Nguru, Usagara, and Ukami. Eeturn- ing to Europe early in 1885, he undertook the manage- ment of the German East Africa Company,

which had obtained an imperial charter. In 1888 he undertook an expedition from the east coast of Africa for the relief of Emjn Pasha. He reached Victoria Nyanza in 1889 after great hardships, and learned of the departure of Emin with Stanley's expedition. Hearing of the hostilities between the Christians and Mahommedans in Uganda, he went to the assistance of King Mwanga, with whom he concluded treaties in favour of Germany. These treaties were, however, annulled by the Anglo-German Convention of July 1890. On his return to Germany Peters was received with great honours, and in 1891 published an account of his expedition entitled Die deutsche Emin-Pasha-Expedition, which was translated into English. In 1891 he went out to East Africa as Imperial High Commissioner, assisted in determining the Anglo-German

boundary, and founded a German station on Kilimanjaro. Eeturning to Germany in the following year, he was em- ployed in the Colonial Office from 1893 to 1895. In 1896 he removed to London, where he occupied himself in forming the Dr Karl Peters Estates and Exploration Company. The company, which was registered on 11th July 1898, was formed to prospect certain regions in Central and South-Eastern Africa, and to acquire the right to locate 500 mining shares in the British South Africa Company's territory, the same number in the Mozambique Company's territory, and also in the Zambezi Company's territory. In the interests of the company Peters ex- plored the Eura district and Macombe's country on the Zambezi, where in 1899 he discovered ruins of ancient cities and deserted gold mines. OrL his return in 1901 he brought out an account of his explorations, and set- tled in London as managing director of the company for South Africa. Besides the books already mentioned, and some smaller treatises, Peters has published a philo- sophic work entitled Willensivelt unci WeUicille (1883), and a disquisition on early gold production'entitled Das Goldene Ophir Salomos (1895), tra.nslated into English in 1898.

Petersburg, a city of Virginia, U.S.A., on the right bank of the Appomattox river, 12 miles from its mouth, at the head of navigation and at the foot of the falls. It was formerly in Chesterfield, Dinwiddle, and Prince George counties, but is now independent of county government. It is well laid out on the sloping river bank, is divided into six wards, and has an excellent water- supply by pumping. It is on the Atlantic Coast liue, the Seaboard Air line, and the Norfolk and Western railways. It has in the falls a fine water-power, which is largely utilized in manufactures. In 1890 the city contained 271 manufacturing establishments with a total capital of $3,911,240, employing 5625 hands, and with a total product of $7,167,004. The principal article of manufacture was tobacco, the value of which was $2,900,000; other prominent industries were canning and the making of cotton goods and flour-milling. Peters- burg is the seat of the Southern Eemale College, a non- sectarian institution, which had in 1899 twelve instructors and 100 students. Population (1890), 22,680; (1900), 21,810, of whom 269 were foreign-born and 10,751 negroes.

Petit-Quevilly, Le, town, arrondissement of Eouen, department of Seine-Inferieure, Erance, 2|- miles south-west of Eouen by rail, on the Seine. The chapel of St Bruyeres represents a leper hospital founded by Henry II. of England. The principal industries are cotton spinning and weaving, dyeing, and the manu- facture of cables, gear for machinery, gutta-percha goods, chemicals, soap, cartridges and safety matches for mines. Population (1881), 7181 ; (1901), 13,885. The commune of Le Grand-Quevilly had in 1901 a population of 1939.

Petofi, Alexander (1823-1849), the greatest lyric poet of Hungary, was born at Kis-Koroso, Pest county, on New Year's Day, 1823. The family received its diploma of nobility from the Emperor Leopold in 1688, but the ultra-patriotic Alexander early changed the old family name, Petrovics, which pointed to a Croatian origin, into the purely Magyar form of PetSfi. The lad's early days were spent at Eelegyhilz and Szabad- sz^lMs, the most Hungarian parts of Hungary, where he got most of his early education, including a good grounding in Latin. German he learnt subsequently at Pest, and Erench he taught himself.

He began writing verses in his twelfth year, while a student at the Aszdd gymnasium, where he also displayed a strong

predilection for the stage, to tjie disgust of his rigorous father, who formally disowned his son, early in 1839, for some trifling peccadillo, and whose tyrannical temper became downright furious when a series of misfortunes ruined him utterly in 1840. For the next three years Petofi led the wretched life of a strolling player, except for a brief interval when, to escape starvation, he enlisted as a common soldier in an infantry regiment. During the greater part of 1842 we find him a student at the Calvinist College at Papa, where he made the acquaint- ance of young Jdkai, and wrote the poem "Borozd," which the great critic Bajza at once inserted in the leading literary review, the Athenaeum,, 22nd May 1842. In November of the same year the restless poet quitted Papa to join another travelling troupe, playing on one occasion the Fool in King Lear, and after wandering all over Hungary and suffering incredible hardships, finally settled down at Pest (1844), where for a time he sup- ported himself by all sorts of literary hack- work. Never- theless, in the midst of his worst privations he had read voraciously, and was at this time profoundly influenced by the dominant Eomanticism of the day ; while, through Tieck, he learnt to know and value the works of Shake- speare. His first volume of original poems was pub- lished in 1844 by the Society Nemzeti Kor, through the influence of the poet Vorosmarty, w^hen every publisher had refused his MS., and the seventy-five florins which he got for it had become a matter of life or death to him. He now became a regular contributor to the lead- ing papers of Pest, and was reconciled to his parents, whom he practically supported for the rest of their lives out of his literary earnings. His position, if not exactly brilliant, was now at least secure. The little volume published by the Nemzeti Kor was followed by the parody, A Helyseg Kalapdcsa (1844) ; the romantic epic, Jdnos Vitiz (1844) ; Ciprislombok Eteike Slrjdrdl, a col- lection of passionate elegies over his lost love, Eteike Csap6 (1845) ; Uti Jegyzetele, an imitation of Heine's Reisebilder (1845) ; Szerelem Gyongyei (1845) ; FeUwJc (1846) ; Szerelme hs hdzassdga (1846), and many other vol- umes. The first edition of his collected poems appeared in 1847. Petofi was not yet twenty-five, and, despite the protests of the classicists, who

regarded him with some- thing of the cold dislike with which the Scottish reviewers regarded the Lake School, the best heads in Hungary, poets like Vorosmarty and critics like Szemere, already paid him the homage due to the prince of Magyar lyrical poets. The great public was enthusiastic on the same side, and posterity, too, has placed him among the im- mortals. Petofi is as simple and genuine a poet of nature as Wordsworth or Christian Winther, and his erotics, inspired throughout by a noble idealism, have all Byron's force and fervour, though it is perhaps in his martial songs that Petofi's essentially passionate and defiant genius asserts itself most triumphantly. On 8th Sep- tember 1847 PetSfi married Julia Szendrey, who bore him a son. "When the revolutionary war broke out, he espoused the tenets of the extreme democratic fac- tion with a heat and recklessness which estranged many' of his friends. He took an active part in the Transyl- vanian campaigns of the heroic Bern ; rose by sheer val- our to the rank of major; was slain at the battle of Segesvar (31st July 1849), and his body, which was never recovered, is supposed to have been buried in the common grave of the fallen honveds in the churchyard of Eeh^regyhaz. The first complete edition of PetSfi's poems appeared in 1874. The best critical edition is that of Haras, 1894. There are numerous indifferent German translations. SeeFEBENCzi. Petofi ^letrazja.â€"FisciiEn. Petofi' k Lehen tnid

(e. n. b.)

Werke.

P E T 0 S K E Y â€" P ETEOLEUM

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Petoskey, a city of Emmet county, Michigan, U.S.A. It is in the north- west part of the lower pen- insula on Lake Michigan. It is entered by the Fere Marquette and the Grand Rapids and Indiana railways. Population (1890), 2872 ; (1900), 5285, of whom 856 were foreign-born and 24 negroes.

Petra, a ruined site, in 30Â° 19′ K and 36Â° 31′ E., lying east of Wady-el-Arabah, the great valley running from the Dead Sea to the Gulf of Akabah. Access has been easy since the occupation of the plateau of Moab and Edom by Turkish troops, and a complete survey of the ruins and site of the ancient town has been made by Dr. Brlinnow. Petra was built in a basin in the "Nubian" sandstone through which the Wadi Miisd brook runs â€" entering it by a deep, narrow gorge, the Sik, and leaving it by another of somewhat similar character. The Eoman road running northwards from Petra, over the Edomite plateau, can be traced almost throughout, and the actual approach to the town is not nearly so difficult as travellers entering it by the Sik have sup- posed. Petra was occupied by Baldwin I. of Jerusalem, and formed the second fief of the barony of Krak, under the title Chateau de la Vallee de Moyse, or Sela â€" the territory being called Li Vaux Moyse. It remained in the hands of the Franks until 1189, and in 1217 there was still a small monastery on Mount Hor. There are several remains of the Prank occupation. The Nabataean inscriptions found in recent years have been edited for the Corpus of Semitic Inscriptions by Euting. At el-Beidha and el-Barid, near Petra, the rock excavations are almost of equal interest.

A few details noticed by recent travellers will be found in the Quarterly Statements of the Pal. Exp. Fund for 1898 and 1900, and in the Bevue Bihlique for 1897. There is a good general description of the site and ruins in Baedeker-Socin's HandhooH to Syria and Palestine.

Petrie, William Matthew Flinders (1853-

), English Egyptologist, was born at Charlton on

3rd June 1863, being the son of William Petrie, C.E. His mother was the daughter of Captain Matthew Flinders, the Australian explorer. He took an early interest in archaeological research, and between 1875 and 1880 was busily engaged in studying ancient British remains at Stonehenge and elsewhere; in 1880 he pub- lished his book on Stonehenge, with an account of his

theories on this subject. He was also much interested in ancient weights and measures, and in 1876 published a work on Inductive Metrology; his profound knowledge of the history of weights and measures was afterwards shown in his article in the ninth edition of this Encyclo- paedia. In 1881 he began the series of surveys and excavations in Egypt with which his name is so promi- nently connected, beginning with the pyramids at Ghizeh, and following up his work there by excavations at the great temple at Tanis (1884), and discovering and explor- ing the long-lost Greek city of Naukratis in the Delta (1885), and the towns of Am and Daphnae (1886), where he found important remains of the time when they were inhabited by the Pharaohs. Between 1888 and 1890 he was at work in the Fayum, opening up Hawara, Kahun, and Lachish; and in 1891 he discovered at Medum the earliest known temple. Much of this work was done in connexion with the Palestine Exploration Fund. By this time his reputation was established. He published in 1893 his Ten Years' Diggings in Egypt, was given the honorary degree of D.C.L. by Oxford, and was appointed Edwards Professor of Egyptology at University College, London. In this position he continued to do most valuable work, organizing collections and exhibitions, and lecturing in connexion with them, besides constantly adding by active research and excavation to a scientific knowledge of ancient Egypt. For an account of the results of his work, see Egyptology. Here it is only possible to mention his discovery of ancient sculpture at the temple of Koptos (1894), his remarkable find of evidences of an unknown race of prehistoric Egyptians at Nagada (1895), his exploration of the six temples at Thebes (1896), and his discovery of traces of Libyan foreigners in Egypt during the 12th dynasty (1898). Professor Flinders Petrie has published many volumes dealing with his work.

Petrolea, a town and port of entry in Lambton county, Ontario, Canada, situated 42 miles west of London on Bear creek, an afELuent of Sydenham river, and on the Grand Trunk and Michigan Central railways. It is in the midst of the oil region of Canada, and there are in the neighbourhood about 6000 producing wells, with an aggregate output of 20,000 barrels of crude oil per annum. Population (1881), 3465 ; (1891), 4367 ; (1901),

4135.

PETROLEUM.

I. Industry and Peodttction-.

DURING the period which has elapsed since the article Petboleum in the ninth edition of the Encyclo- pcedia Britannica was published (in 1885), the petroleum industry has undergone remarkable expansion. Fresh sources of supply have assumed importance, new uses have developed, and very considerable improvements, with resulting economics, have been effected in the work of production of the crude oil, and still more in the methods adopted in the refining, transport, and distribu- tion of the commerciarl products. The author of that article (a high authority) felt justified in devoting nearly the whole space allotted to his subject to a description of American petroleum, and did not consider it necessary to make more than a brief mention of the petroleum of Russia and other countries. Since that time the Russian petroleum industry has assumed an importance not inferior to that of the oil business of the United States ; while in Java, Sumatra, and Borneo, in Burma and Assam,

and' in Galicia, Rumania, and Alsace, highly productive oil-fields have been opened up. The rapid growth of the Russian petroleum trade has unquestionably been mainly due to the circumstance that the residuum, for which at first it was difficult to obtain a market, has long since been found to be an excellent fuel, and has become the principal product. This virtual conversion of the business into a fuel industry has admitted of the marketing of the immense quantities of oil produced in Russia without interference with the sale of American petroleum. The present tendency is towards the creation of a number of more or less local industries, with the result that the world's supplies of petroleum, which at one time were contributed almost entirely by the United States, and more recently by that country and Russia, are being obtained from a gradually increasing number of centres. That markets can be found for all the oil which can be produced in localities so situated geographically that the cost of transport is not prohibitive, is usually admitted, and indeed is scarcely open to doubt when the scope for

increased employment of the various products is con- sidered. So long as petroleum was chiefly of value as yielding an oil for burning in lamps, as a ofthe^’”” candle-making material, or as a lubricant for Industry, machinery, the fear of over-production was justifiable, for the growth of the trade in countries already using petroleum products for the pur- poses specified could not be very rapid, and new mar- kets had to be sought in less civilized countries, where inferior illuminating agents and lubricating materials were in use. With the recognition, however, of the value of petroleum as liquid fuel, and as a source of gas for illuminating purposes, the whole complexion of the case became altered, and the industry at once as- sumed an extensive character, which, notwithstanding its vast aggregate volume, it had not previously pos- sessed. The effect of this upon the Russian petroleum trade has already been mentioned, but it remains to be said that the substitution of petroleum for coal in gas- making has also bee^i a prominent feature of the develop- ment which the industry as a whole has undergone in recent years. A very large proportion of the gas used as a source of light in the United States is water-gas, to which light-giving power is furnished by oarburetting it with the gaseous products of petroleum, and already in Great Britain large quantities of petroleum distillate are similarly employed. ‘ Amongst other recent uses to which petroleum products are being put is that of furnishing power, through the agency of an internal-combustion motor similar to a gas engine, the most successful types of automobile vehicles for carrying light weights at high speed for long distances being furnished with petroleum- spirit motors. Oil engines, in which the ordinary petro- leum burning oil is similarly used, are also now largely employed in rural districts where gas is not obtainable, or is comparatively costly. Apart from these modern features of the industry, there has been a steady pro- gression in the world’s consumption of petroleum, and especially in the substitution of mineral oils for animal and vegetable oils in the

lubrication of machinery. To afford some idea of the present magnitude of the trade, it may be stated that a pipe 41 inches in diameter would be needed for the conveyance of the petroleum which the world is at present using, assuming a rate of flow of 3 feet a second ; and that for the storage of a year's supply, a tank 929 feet in length, breadth, and height would be required.

The technology of the business has been marked by several important advances. The system of drilling the wells in the United States, which closely re- sembles the ancient method practised by the Chinese, has been improved only in points of detail, and has remained practically unaltered for many years. In Russia a different system, in which the drill- ing instruments are attached to iron rods instead of to a manila cable, is usually employed. The wells in the latter country, though of less depth than the majority of those in the United States, are of far larger diameter and are much more costly to bore. The productiveness of a Rus- sian oil " fountain " is, however, enormously in excess of the average production of wells in America, though the flow is not, as a ride, long sustained. In the Russian and Rumanian oil-fields electric motors have been substituted to a considerable extent for steam engines, and in a few instances oil engines have been successfully introduced. From those wells in the Russian oil-fields which do not flow, it is customary to raise the oil by means of a cylindrical baler, the presence of sand in the oil inter- fering with the use of the ordinary lift-pump adopted in the United States. Recently a system of raising the oil by means of a stream of compressed air has

Recent advances*

been successfully tested in the Baku district, and seems likely to be largely employed. In the refining of petroleum the principal features of improvement have been, in Russia, the general introduction of the continuous system of distillation, which effects considerable economy in time, fuel, and labour; and in the United States, the successful treatment of crude oil containing sulphur compounds, whereby these impurities are practically eliminated, and a class of crude oil, which

could not previously be advantageously worked, is rendered com- mercially valuable.

Doubtless, however, the salient feature of advance has been the general adoption of the bulk system of transport and distribution. It is not many years since competent authorities expressed grave doubts as to the possibility of safely carrying petroleum in bulk across the At- lantic in stormy weather, and it must be admitted that the first experiments in this direction were not at- tended with hopeful results. The Russian petroleum trade was the first to benefit by the successful introduc- tion of a system of marine transport of petroleum, the credit for which belongs to the brothers Nobel. Subsequently British shipbuilders, and notably the firm of Armstrong, Mitchell and Company, directed their attention to the construction of steamships suitable for this traffic, and at the present time the fleet of petroleum tank steamers is a large and very valuable one. These vessels sail regularly at frequent inter- vals- from American and Russian ports, carrying car- goes of oil in bulk for the supply not only of the markets of Great Britain and the European continent, but also those of the East and elsewhere. Concurrently with this general introduction of marin3 transport in bulk, there has been a corresponding extension in the use of pipe lines, tank barges, tank railway waggons, and tank road waggons for distribution, so that much of the oil finds its way from the mouth of the well to the shop of the retailer, or even to the premises of the actual consumer, without having been put into any special package, such as the 40-gallon barrel or 4-gallon tin can in which it was formerly delivered ; and this, as vsdll be readily understood, results in a considerable saving of expense.

The closer study which has for some j-ears been devoted to the geological features of petroliferous territories has resulted in the acquisition of more exact know- ledge of the age and structure of the rock- Â°^‘Â°s”^’ formations concerned. This knowledge has been found of high practical value in enabling the expert to select favourable sites for boring operations, and it may be urged that no labour should be spared which may con- tribute to the completeness and accuracy of the available records. On all well-conducted petroleum properties it is now customary to note with care and precision the character of the

strata perforated by the drill, so that a complete section may be prepared from the recorded data. In sonie cases the depths are stated with reference to sea- level instead of being taken from the surface, and it is much to be desired that this practice should become universal, as the correlation of the rapidly-accumulating data is thus simplified. There is scarcely any part of the globe which does not afford some trace of bitumen, in the gaseous, liquid, or solid state, and it is a common fallacy that petroleum is a comparatively rare substance, in the sense of occurring in only a few localities. On the other hand, while the areas in which it occurs in sufficient concentration, or in such quantity as to be of commercial value, are both fairly numerous and extensive, the dis- covery of petroleum in a given locality is not necessarily of industrial importance. There are few substances more widely distributed in nature, but the conditions requisite

production]

for the creation of a valuable store of the material exist only in a limited number of places. No definite-connexion can be traced between the localities where it is known to occur and the present limits of sea and land, equally rich and equally scanty deposits being found in the hearts of continents and in the oceanic islands. Similarly, the tropics, the temperate and the polar circles are about equal in respect of their possession of bitumen, but it may be noted that the greater part of the known oil- bearing territory is north of the equator. Several writers have pointed out that the principal petroleum deposits of the world are intimately associated with the great mountain chains. It must not, however, be assumed that there is any necessary connexion between the origin of petroleum and the positions of the deposits in relation to the mountain ranges, the rational explanation of the intimate relation referred to being that it is usually in the neighbourhood of the mountains that the strata have, by the same changes as those which created the moun- tains and valleys, been thrown into a form suitable for the collection or concentration of the oil. The geo- graphical

distribution of petroleum affords most valuable evidence in relation to its origin. For a rare mineral special local conditions may be of paramount importance, but for a substance of almost world-wide occurrence, the theory of origin must harmonize with conditions that were either widespread simultaneously or of frequent recurrence in various places. We find that every one of the great divisions of .geological time has produced some form of bitumen, and in the following table Mr W. H. Dalton has attempted to classify on this basis the various localities in which petroleum has been found in large or small quantities : â€”

Geological Periods. Localities.

Quaternary . Lancashire, Schleswig-Holstein, Red Sea, Mexico.

Pliocene . . Italy, Sumatra, Borneo, New Zealand.

Miocene . . Auvergne, Italy, Algeria, Egypt, Zante, Ru- mania, Austria, Caucasus, Persia, Turke- stan, Assam, Burma, Eastern Archipelago (Java, Sumatra, Borneo, &o.), Japan, Alaska, California, Mexico, West Indies, New Zea- land.

Oligocene . Switzerland, Alsace, Galicia, Caucasus, Alaska,

, and other areas included under Eocene or Miocene by various authors.

Eocene . . Spain, Italy, Egypt, Turkey, Rumania, Austria, Caucasus, Baluchistan, Punjab, Assam, Burma, Eastern Archipelago, Utah, Texas, Mexico, New Zealand.

Cretaceous . Switzerland, Hanover, Greece, California, Wyo- ming, Colorado, Athabasca, New Zealand.

Neocomian Spain, East France, Switzerland, Hanover,

Austria, Rumania, Syria, Venezuela, West Indies, and other areas included under Cre- taceous by various authors.

Jurassic . ‘. England, Switzerland, Alsace, Hanover, Colorado, Mexico, Argentine Republic, and possibly other South American regions.

Triassic . Alsace, Hanover, Punjab, China.

Permian . . Autun, Saxony.

Carboniferous . Great Britain, South Russia, Central and Eastern United States, New Brunswick. Some of the deposits now assigned to the Carboni- ferous were formerly classified with the Devonian.

Devonian . England, North Russia, Ontario.

Silurian . . East Canada, Central and Eastern United States, Newfoundland.

Cambrian . British Columbia and Alberta (Kootenay Pass).

ArchEean Sweden (bituminous gneiss of NuUaberg), East

Canada (graphite).

It should be pointed out that the deposits which are of chief commercial importance occur in the older rocks (Carboniferous and Silurian) on the one hand, and in the comparatively new Teftiary formation on the other, the

intermediate periods yielding but little, or at any rate far less abundantly.

The anticlinal or terrace structure which characterizes the principal oil-fields of the world is a most important factor in the accumulation of oil and gas. The anticlines, which have been formed by the slow Porma- contractile m ovements of the earth, usually occur Deposits. as a series of broad low arches separated by syn- clines. They often extend for long distances, with great regularity, but are not infrequently crossed by subsidiary anticlines, which themselves play a not unimportant part in the aggregation of the oil. Owing to difference of density the oil and water present in the anticlines sepa- rate into two layers, the upper

consisting of oil which fills the anticlines, while the water remains in the synclines. Any gas which may be present rises to the summits of the anticlines. When the slow folding of the strata is accompanied by a gradual local descent, a modified or “arrested” anticlinal structure, known as a ”’ terrace,” is produced, the upheaving action at that part being sufficient only to arrest the descent which would otherwise occur. The terraces may thus be regarded as flat and extended anticlines. They need not be horizontal, and sometimes have a dip of a few feet per mile, as in the case of the Ohio and Indiana oil-fields, where the dip varies from 1 to 10 feet. These slight differences in level, however, are found to have a most powerful effect in the direction already mentioned. Generally, it may be said that the strata from which the main supplies of oil and gas have been obtained in the United States are unusually unbroken, nearly horizontal, and but little disturbed. The importance of the anticlinal structure has been equally observed in the oil-fields of the Caucasus, the Carpathians, and elsewhere.

The formation of large deposits of petroleum is, how- ever, dependent upon something more than we have yet considered. We may have the necessary deposit of organic matter, subjected to the requisite conditions to effect its conversion into petroleum, and we may have the anticlinal structure favouring the accumulation of the oil produced, but in addition we need a rock of sufficient porosity to serve as a reservoir for the oil, and above it an impervious stratum to preserve the oil from evaporation and oxidation, and from being displaced by water. The principal deposits which provide the necessary porosity for the storage of the oil are sandstones, conglomerates, and limestones. Shaly sandstones and slaty shales also serve as reservoir-rocks in a lesser degree. In the case of lime- stones, a natural porosity, such as is found in the coarsely crystalline varieties, or a certain amount of chemical change resulting in the formation of interspaces capable of receiving the oil, appears to be necessary for the forma- tion of a true reservoir-rock. Such change is usually dolomitic, consisting in the conversion of the calcium carbonate forming the limestone into the double car- bonate of calcium and magnesium known as ” dolomite,”’ which occupies less space than the unaltered limestone. It is therefore characterized by the production of such numerous spaces between the

dolomite crystals that the rock becomes capable of retaining a large volume of oil. This dolomitic change appears to be capable of occurring only in the purer limestones. The Trenton limestone, for instance, is thus modified only where almost free from silica, the changed parts showing about 54 per cent, of calcium carbonate and 44 per cent, of magnesium car- bonate. A large proportion of the Trenton limestone is too impure to permit of the change, and is destitute of oil and gas. Even in rich oil-fields the dolomite has only been formed in a small portion of the stratum. ^Vhen followed northwards into Ohio and Indiana, the Trenton limestone is found to have become dolomitic through a small thickness only of its upper beds. The changed and

unaltered portions occur at short intervals, but only the former contain the oil and gas. The change usually affects from 10 to 50, and in some cases 100 feet of the stratum, and has occurred along a line passing into Indiana through the principal oil and gas fields of Ohio. In addition to possessing a porous structure, the reservoir- rock must be entirely covered by an impervious layer, the commonest and most perfect cover being a fine- grained shale. The fractured character of the strata in central and eastern Pennsylvania may account for the absence of oil and gas in those districts. In oil- bearing territory the occurrence of a porous rock be- neath a cover-rock usually results in the formation of an oil-field.

Oil and gas are often met vrith in drilled wells under great pressure, which is highest as a rule in the deepest wells. The closed pressure in the Trenton limestone in Ohio and Indiana is about 200-300 lb per square inch, although a much higher pressure has been registered in many wells. The gas wells of Pennsylvania indi- cate about double the pressure of those drilled in the Trenton limestone, 600-800 lb not being

unusual, and even 1000 lb having been recorded. The extremely high pressure under which oil is met with in wells drilled in some parts of the Russian oil-fields is a matter of common knowledge, and a fountain or spout- ing well resulting therefrom is one of the ” sights ” of the country. A famous fountain in the Groznyi oil- field in the northern Caucasus, which began to flow in August 1895, was estimated to have thrown up during the first three days, 1,200,000 poods (over 4,500,000 gallons, or about 18,500 tons) of oil a day. It flowed continuously, though in gradually diminish- ing quantity, for fifteen months, quickly destroying the derrick which had been erected ; afterwards the flow became intermittent. In April 1897 there was still an occasional outburst of oil and gas.

The manner in which INature created and put away in her storehouses the petroleum which is being lavishly poured out to-day is a subject of more than academic interest, since it is closely connected with the question of the permanence of the supplies. The various theories of origin may be broadly classified into two groups, one con- sisting of those which assign to the product an inorganic origin, and the other those which account for its pro- duction from animal or vegetable matter, or both. The latter group of theories are the more generally accepted, and the researches of Engler have furnished strong sup- port to the view previously advanced by Hof er that the organic matter from which the petroleum was derived was, at any rate in many instances, animal rather than vegetable. To our knowledge of the chemical composi- tion of petroleum no very striking or commercially important addition has been made within recent years, although from time to time interesting results have been announced which have thrown light upon the subject, and afforded confirmation of views previously based largely upon deduction.

The ” production ” of petroleum by means of drilled wells in the United States was fully described in the article Peteolecjm in the ninth edition of the Pfodac- Encyclopuidia Britannica. The system remains petroleum. Substantially unchanged to-day, but in conse- quence of the increased depth of the wells, extending in some districts to upwards of 3000 feet, heavier tools are commonly employed. In the method

hitherto most largely adopted in drilling in the Russian oil-fields a percussion or “jumper” drill is also used, but the tools are suspended from the mechanism, which im- parts to them a vertical recii^rocating motion by means of screw-jointed iron rods instead of the manila cable which

fulfils a similar purpose in the American system. Cable drilling is’ also practised to some extent in the Baku dis- trict, and as it is admittedly far more expeditious than drilling with rods, it is probable that it will be increas- ingly adopted, on account of the greater depth at which the oil has to be sought. Although the Russian oil wells are of less depth than most of those in the United States, they are of much greater diameter, and are there- fore coraparatively expensive, some of them costing as much as Â£5000. Owing to the high price of screwed artesian casing of large diameter, and the difficulty of handling it, riveted casing of iron plate is generally used, although it is not easy with such casing effectively to exclude water from the bore-hole. Recently, on some properties in the Russian oil-fields, artesian casing has been employed advantageously. The character of the strata and mode of occurrence of the oil necessitate the drilling of wells of large diameter in these fields ; but even such wells frequently get choked when a fountain is struck, the soft sand and boulders of the oil-bearing formation being driven into the bore-hole by the im- mense pressure often exerted by the outflowing oil. The large diameter is also highly advantageous when the well has ceased to flow, for, owing to the great quantity of sand present in suspension, the oil cannot be raised with ordi- nary lift-pumps, as in the United States, and has to be brought to the surface by means of a baler (a long cylindrical vessel made of sheet iron, with a valve at the lower end) : it is therefore obvious that the quantity of oil thus obtained in the course of a day would be but small unless the size of the well were such as to admit of the use of a baler of considerable diameter.

Some success has attended the trial in the Baku district of a method of raising the oil from the well by the use of compressed air. In this system, which has been for some time past employed in raising water, the compressed air is forced down a pipe of small diameter, fixed centrally in the well, and issues at the bottom through an outlet fitted

with an inverted cone. The stream of air is thus made to impinge against the inner surface of the casing of the well, so as to fill the annular space, and in its upward rapid flow it carries the oil to the surface. It is found that oil can thus be raised far more rapidly than by baling, and as the air-lift system can be employed in a well of comparatively small diameter, it is possible that its general introduction may lead to a reduction in the diameter of the wells, especially in those parts of the territory in which fountains do not commonly occur. Electrical power has been substituted for steam power in both drilling and pumping by Messrs Iv^obel on their Russian petroleum properties, and by a Dutch company working in Rumania. This may prove to be one of the most important advances made in this branch of the industry. In Galicia, as in Russia, preference has, up to the present time, usually been given to the rod system of drilling, wooden rods, however, being in most instances employed. The rod system has also always been adopted m the Canadian oil-fields, and was, in fact, introduced into Galicia by Canadian drillers. Experts differ as to the relative merits of the cable and rod systems, and as very few drillers have had practical experience of both, it is difficult to get data for an effective comparison. It is asserted that the comparative rigidity of the rod is some- times highly advantageous, but, on the other hand, it is admitted that the cable system is far more expeditious, especially in drilling at considerable depth, the discon- necting and reconnecting of the rods for the frequently recurring operation of “dressing” the bit and removing the detritus from the well involving much loss of time In this connexion mention should be made of what is known as the water-flush system of drilling, which has

peoduction]

been usefully employed on the Pechelbronn (Alsace) pro- perty and elsewhere. In this system tubular rods attached to a bit with a hollow shank and apertures above the cutting edge are used. The rods are connected with a force-pump by means of flexible tubing, and water is

driven through them while the drilling is in progress. The water escapes through the orifices in the bit, and flows from the top of the casing, carrying away the detritus from the well. This method has been found successful where the strata are soft, and in such cases is inexpensive and rapid, but it is unsuitable for use in hard rock.

Attempts are being made to substitute a rotary ” crown ” borer for the percussion drill in sinking wells for petroleum. The instrument in question, which is known as the Calyx drUl, is furnished with a steel-toothed cutter of annular form, by means of which the bulk of the rock to be removed is obtained in the form of a solid core, instead of being broken up. It is thus simi- lar in action to the well-known diamond drill. With the Calyx drill good work has already been done in drilling for water ; and as the study of the nature of the strata perforated by the drill is greatly facilitated by the preservation of a core, it is to be hoped that this form of drill may in the future find employment in the oil- field.

The system of continuous distillation, to which brief reference has already been made as an important feature of the Russian petroleum refining business, was Refiaiag. g^.^^ adopted by Nobel Brothers. In the ordi- nary or intermittent system of distillation the crude oil is subjected in the still to gradually increased heat, with the object of separating or classifying the various hydro- carbons of which the crude oil is composed by taking advantage of their differences in volatility, and thus obtaining the desired commercial products. The crude oil, on being treated in this manner, first parts with the very volatile hydrocarbons forming the various descrip- tions of petroleum spirit (gasolene, benzene, &c.). As the temperature rises, the less volatile compounds, met with in commerce as kerosene, are removed, and at still higher temperatures lubricating oils and other products are obtained. The hydrocarbons, of course, leave the still in the form of vapour, but are brought back to the liquid state by being passed through a condenser. It will be evident that we have thus a means of effecting such division and sub-division of the crude oil as we may desire. In the continuous system of distillation, on the other hand, we have, instead of a single still with a progressive temperature, a series of

stills heated to successively higher temperatures, which are carefully maintained, and the crude oil is caused to flow slowly and continuously through the whole series, being thus subjected to a steadily increasing heat while the temper- ature of the contents of each still remains practically constant. In this manner each still yields continuously a product of given volatility, corresponding with the temperature at which it is maintained, and from the series of stills a range of products is continuously ob- tained corresponding with that yielded by the inter- mittent system within the same limits of temperature. In this system the loss of time, waste of fuel, and injury to plant involved in the cooling down and re-heating of the stills and furnaces in the intermittent system are avoided. The continuous system is now employed at all the principal refineries in Russia, and is in use in Burma, Galicia, Java, and elsewhere. In the United States, on the other hand, it has not found favour, although con- siderable sums of money have been spent in attempts to introduce it.

For a second important improvement in refining, viz., the desulphurizing of oils containing sulphur compounds.

the credit belongs to the Standard Oil Company. Two processes are employed, both based on the use of cupric oxide as a desulphurizer. In one of these the vapoiir passes from the still through a vessel containing cupric oxide, where the sulphur is separated as cuprous sulphide, and thence to the condenser. In this way the whole of the volatile constituents of the oil are subjected to the desulphurizing treatment. In the other method, which, in spite of its involving a double operation, is understood to be generally adopted, the petroleum spirit and kero- sene distillates, obtained by the ordinary process of dis- tillation, are redistilled with a large excess of finely divided cupric oxide in a still fitted with an agitator, by means of which the contents are kept actively stirred. From the cuprous sulphide the cupric oxide is recovered for further use by burning off the sulphur. The intro- duction of this process was of great commercial import- ance, since it rendered available, as a source of burning oil, the sulphuretted petroleum yielded by the prolific oil-fields of Ohio.

In view of the large extent to which pipe lines are employed in the United States for the conveyance of crude petroleum, it has been a matter of sur- prise that, notwithstanding the admittedly in- ^’““f^P^J^ adequate transport facilities afforded by tank tribution. waggons on the Transcaucasian railway, a pipe line has not been laid from Baku to Batum or some other port on the Black Sea. In the United States the refining business was many years ago largely transferred from the neighbourhood of the oil-fields to the Atlantic sear- board, the crude oil being pumped through pipe lines to the refineries in New York and Philadelphia, the guiding principle apparently being to refine the oil in a locality as near as possible to the point of shipment for export, or in a central position as regards consumption for the home trade. Two circumstances stood in the way of the adop- tion of a similar principle in Russia. One was that the revenue derived by the railway from the transport of petroleum products could not be spared, and the other that any considerable transference of the refining busi- ness from the shore of the Caspian Sea to that of the Black Sea would seriously diminish the value of the Baku refineries, many of which are establishments upon which very large sums of money have been expended. But now a pipe line for refined oil has been laid along a part of the 560 miles of railway from Baku to Batum, and this is to be extended so as to be available for the transport of re- fined oil from the Caspian to the Black Sea. The 8-inch pipe already completed extends from Michaelov to Batum, a distance of 140 miles, over the portion of the railway most subject to interruption of traffic by floods and snow- storms, and by employing it in conjunction with the rail- way tank waggons already in use, the carrying capacity of the railway will be largely increased.

The building of tank steamships for the marine trans- port of petroleum has steadily progressed, and every year sees important additions to a fleet of these vessels, which now number about 160, exclusive of the large number em- ployed in the local trade in America and Russia. Increase in number has been accompanied by increase in tonnage of the individual vessels, some having a carrying capacity of as much as 10,000 tons. Concurrently there has been a corresponding increase in the number of tank barges, tank railway waggons, and tank

road waggons employed in the distribution of the oil, as well as in the number and capacity of the tank storage installations.

Much difference of opinion exists as to what is a desir- able minimum flash-point for oil intended to be burned in household lamps of the usual construction. Atten- tion has been drawn to the number of deaths and cases of personal injury resulting from accidents with mineral oil

lamps, afld it has been contended that the remedy lies in a sufficient raising of the standard. Since the early days of the petroleum industry most civilized countries have prescribed by law a test of flashing-point or inflammability, designed in most cases primarily to afford a definition of oils for lighting pur- poses which may be safely stored without the adoption of special precautions. In the United Kingdom the limit has, for the purpose in question, been fixed by the legis- lature at 73Â° Fahr. by the present legal test (a form of ” close test,” devised by the late Sir Frederick Abel), which is the equivalent of the former standard of 100Â° Fahr. by the ” open test.” In Germany the law prescribes a close test of 21Â° C, equal to about 70Â° Fahr., whilst in Eussia the standard is 28Â° C, equal to 84 4Â° Fahr., by the close test. In the United States various methods of test- ing and various minimum standards have been adopted. In Pennsylvania the prescribed limit is a ” fire test ” of 110Â° Fahr., equivalent to about 70Â° Fahr. close test, while in the state of ISTew York it is 100Â° Fahr. close test. The subject of the testing of petroleum for legisla- tive purposes, with which in later inquiries that of acci- dents with mineral oil lamps has been associated, has been investigated in Great Britain by committees of both branches of the legislature, and voluminous evidence has been taken. It has been strongly contended that the raising of the standard from 73Â° to 100Â° Fahr. would put an end to lamp accidents, bat this view has been

equally forcibly combated ; and although the committee reported in 1898, by a narrow majority, in favour of such an alter- ation, no action has been taken upon the recommendation. The questions involved are in truth by no means simple. Obviously, the higher the flashing-point the ” safer ” the oil in one sense; but there are equally evident objections to a course which would to some extent reduce the avail- able supply; and thus might lead to an increase m price or a deterioration in quality. Moreover, since lamp acci- dents have occurred with oil of a- higher flash-point than 100Â° Fahr. Abel test, it cannot be held to be proved that the adoption of this standard would prevent such acci- dents. Apart from this, it does not appear to have been sufficiently borne in mind by the advocates of a high standard that the object of the Petroleum Acts passed in the United Kingdom has hitherto been to regulate stor- age. Petroleum spirit, “flashing” at zero Fahr., has always been obtainable for use as an illuminating agent, and, on the other hand, commercial enterprise has, with- out any legislative help, placed’ oils of high flashing-point at the disposal of those who prefer them. Moreover, if the legislature should, by putting difficulties in the way of the use in lamps of oil of the present legal test, lead to the creation of an impression that oil of, say, 100Â° Fahr. test can be safely used without the adoption of ordinary pre- cautions, accidents with lamps would probably increase in number. It has been said by advocates of a higher test that with a safe oil any lamp is safe, but it may with equal truth be asserted that in a properly-constructed lamp used with reasonable care the ordinary oil of com- merce is a safe illuminant.

The report of the United States Geological Survey on the production of petroleum in the United States during the year 1899, compiled by Mr F. H. Oliphant, indicates that the most conspicuous features of the industry for the period in question were : (1) The total production was considerably in excess of that of the previous year ; (2) there was a large increase in the number of wells completed in both the Appalachian and the Lima-Indiana oil-fields ; (3) in south-eastern Ohio and in Texas there was a largely increased production ; and (4) only about 7 per cent, of the total production was obtained outside the Appalachian and the Lima-Indiana

American supply.

fields. The Appalachian field embraces all the districts producing what is known as “Pennsylvania oil.” It extends from Wellsville in New York state on the north- east, through western Pennsylvania into West Virginia, and includes a large portion of south-eastern Ohio. Its extension through Kentucky and Tennessee into northern Alabama has not been attended with any noteworthy developments. The total production in the Appalachian field for 1899 was 33,050,076 barrels, as compared with 31,711,857 barrels in 1898. The greatest increase was in south-eastern Ohio, where the output was more than doubled, and the greatest falling off was in Pennsylvania. The Lima-Indiana field includes the whole of Indiana and that portion of north-western Ohio in which Lima petroleum, found in the Trenton limestone, is produced. The production decreased from 20,321,323 barrels in 1898 to 20,225,356 barrels in 1899. The total production of crude petroleum in the United States during 1899 was 57,070,850 barrels (of 42 American gallons or about 35 imperial gallons), as compared with 66,364,233 barrels in 1898 and 60,476,516 barrels in 1897. The following is a tabular statement of the production in the various states for the years 1897,1898, and 1899:â€”

Production.

.

state.

Barrels.

Barrels.

Barrels.

189T

1898

1S99

New York

1,279,155

1,205,250

1,320,909

Pennsylvania

17,982,911

14,743,214

13,053,603

West Virginia

13,090,045

1.3,615,101

13,910,630

Ohio .

21,560,515

18,738,708

21,142,108

Indiana

4,122,356

3,730,907

3,848,182

Kentucky-

322

5,568

18,280

Missouri

19

10

132

Colorado

884,934

444,383

390,278

California

1,903,411

2,257,207

2,642,095

Texas .

65,975

546,070

669,013

Indian Territory

625

0

0

Illinois .

500

360

360

Wyoming

3,650

5,475

5,560

Kansas .

81,098

71,980

69,700 57,070,850

60,475,516

55,364.233

Much attention has been attracted by the rapid devel- opment of the Beaumont oil-field in Texas and the large yield of the ” gushers ” or

spouting wells characteristic of what is known as the Spindle Top ai-ea. The oil, which will doubtless be used chiefly as fuel, is apparently obtainable in very large quantities at low cost, and hav- ing regard to the proximity of the field to the sea-board, the expense of transport is also small. The discovery of this new source of supply has led to renewed consider- ation of the advantages possessed by liquid fuel, and arrangements are being made on a large scale for the transport and distribution of the produce of the Beaumont field, principally with a view to its use as a substitute for coal. Oil-fields in various parts of the world which had been regarded as of minor importance have become more prominent, and much evidence has concurrently been furnished of the commercial value of other areas of petroliferous territory at present unworked.

The producing territory in the Baku district comprises the oil-fields of Balachani, Sabuntchi, Romany, Binagadi, and Bibi-Eibat, the aggregate area being under 10 square miles. The Balachani-Sabuntchi-Â«“Â«Â«‘Â«Â» Romany territory, and the adjacent district of *”””” Bmagadi, are situated on the Apsheron Peninsula from 8 to 12 miles north-east and north of the town of Baku, while the Bibi-Eibat field lies 2 to 3 miles south of Baku. The production of these fields from 1897 to 1899 is shown in the following table : â€”

LIQUID fuel]

PETROXEUM

645

District.

1897.

1898.

1899.

Balachanl Sabuntchi Romany . Binagadi . Bibi-Eibat

Poods.i

100,336,495

162,610,054

96,266,133

197,462

62,514,479

Poods.

108,836,439

179,828,697

100,523,699

227,730

96,526,783

Poods.

114,854,151

230,757,289

98,.581,782

213,386

80,840,807

421,924,623

485,943,348

525,247,415

In the year 1893 attention was directed to the prolific character of the oil-bearing lands of Grozny! in the Terek district, about 300 miles north-east of Baku, and recent developments in this field point to the conclusion that the Groznyi oil-field will be a formidable rival to those at Baku. The production in the G-roznyi district during the years 1897, 1898, and 1899 was as follows :â€”

1897 1898 1899

27,568,794 poods.

17,716,899 ,, 25,194,566 ,,

Petroleum also occurs in many other places in the Caucasus, in the Kuban district, in the Crimea, and at Petchora in the north of Russia, near the Ural Mountains. In Canada petroleum has been produced in large quan- tities for many years in the Enniskillen district in Lamb- ton county, Ontario. The production for the 'Juries ot yÂ®^^' ^^^^ '^^^ 758,391 barrels (of 35 imperial "ᵖ." gallons), and for 1899, 704,794. Petroleum is also reported to occur in the province of Quebec, near the extremity of the Gaspe Peninsula, and in the North-West Territories in the district of Athabasca.

On the European continent there is a considerable production of petroleum in Galicia (Austria-Hungary), Rumania, and Alsace. The Galieian oil-belt extends for a distance of about 220 miles along the northern slopes of the Carpathian Mountains, whilst the Rumanian deposits occupy the south-eastern and southern slopes of the southern Carpathians or Transylvanian Alps. The Galieian oil-fields have been worked by means of drilled wells for many years, but it is only recently that those of Rumania have been similarly developed, petroleum having until within the past few years been obtained in the latter country by means of hand-dug wells. Owing to its favourable geographical position and to the successful results of recent borings, Rumania appears destined to assume a position of importance among petroleum-pro- ducing countries. The production of petroleum in

Galicia during the year 1898 amounted to 330,451 metric tons, and in 1899 to 321,681 metric tons. In Rumania the production was about 240,000 tons in 1898 and about 300,000 tons in 1899. Much activity has been displayed in the drilling of wells in the Alsace oil-fields, and a profitable local industry has been created. In Italy the production of petroleum is small, but the oil, which is chiefly found in the Milan district, commands a high price. The Eastern Archipelago (Java, Sumatra, Borneo, &c.) bids fair to rank before long among the chief sources of the oil-supply of the world.- In Java there has been a large production for many years ; in Sumatra the results which have attended the drilling operations in the Moeara Enim field and elsewhere have demonstrated the existence of a rich oil-bearing formation ; and in Borneo the recent work of development, at Kotei, on the east coast of the island, on which much money has been expended, has already resulted in the discovery of abundant supplies of fuel oil, for the distribution of which arrangements are being made on a large scale. The petroleum industry of

1 1 pood=36‘1127 lb avoirdupois. In comparing the production of crude petroleum in Russia with the production of crude petroleum in the United States, 8 poods may be talien as the equivalent of the American ” barrel” unit.

Japan exhibits steady growth, and has already reached considerable proportions, the output of crude oil, which for the year 1899 was reported to be 800,000 barrels, having increased so much that, according to estimate, it has almost ‘doubled. Of this production the greater part was obtained in the province of Echigo. In Upper Burma British capital and energy have completely transformed the conditions which existed in the Yenangyaung oil-fields in the days of King Thibaw, when ” Rangoon oil” (named after the port of shipment) was an unimportant article of commerce. The primitive hand-dug shafts have long been superseded by drilled wells, the produce of which is treated in a refinery provided with the most modern appliances, and an important industry has been created. In Assam an English company has met with similar success in boring operations, and has obtained a considerable production, for the treatment of which a refinery is in

course of erection. Petroleum has been produced and refined in Peru in moderate quantities for many years, and has been found in Ecuador and Colombia. It also occurs in Algeria, on the Gold Coast, in Newfoundland, Alaska, the West Indies, New Zealand, and in other localities.

For further information see Bovertoi^ Redwood's Petroleum and its Products. London, 1896 (2nd ed.). (b. Â».)

II. Mineral Oil as Liquid Fuel.

The use of petroleum as fuel had long been recognized as a scientific possibility, and some attempts had been made to adopt it in practice upon a commercial scale, but the insufficiency, and still more the irregularity, of the supplies prevented it from coming into practical use to any important extent until recent discoveries of oil specially adapted by chemical composition for fuel pur- poses changed the aspect of the situation. These dis- coveries of special oil were made first in Borneo and later in Texas, and experience in treating the oils from both localities has shown that while not less adapted to produce kerosene or illuminating oil, they are better adapted to produce fuel oil than either the Russian or the Pennsylvanian products.

With regard to the chemical properties of petroleum, it is not necessary to say more in the present place than that the lighter and more volatile constituents, known com- mercially as naphtha and benzene, must be removed by distillation in order to leave a residue composed principally of hydrocarbons which, while containing the necessary carbon for combustion, shall be sufficiently free from volatile qualities to avoid premature ignition and con- sequent danger of explosion. Attempts have been made to use crude oil for fuel purposes, and these have had some success in the neighbourhood of the oil wells and under boilers of unusually good ventilation both as regards their chimneys and the surroundings of their stokeholds ; but for reasons both of commerce and of safety it is not desirable to use crude oil where some distillation is possible. The more complete the process of distillation, and the consequent removal of the volatile constituents, the higher the flash-point, and the more turgid and viscous is the fuel resulting ; and if the

process is carried to an extreme, the residue or fuel becomes difficult to ignite by the ordinary process of spraying or atomizing mechanically at the moment immediately preceding combustion. The pro- portions which have been found to work efficiently in practice are as follows : â€”

Carbon 88-00 per cent.

Hydrogen .... 10-75 â€ž Oxygen 1-25 â€ž

Total

100

[liquid fuel

The standards of safety for liquid fuel as determined by flash-point are not yet finally settled, and are chang- ing from time to time. The British Admiralty require a flash-point of 270Â° Pahr., and to this high standard, and the consequent viscosity of the fuel used by vessels in the British fleet, may partly be attributed the low rate of combustion that has been found possible in them. The German Admiralty have fixed a flash-point of 187Â° Fahr., and have used oil of this standard with perfect safety, and at the same time with much higher measure of evap- orative duty than has been attained in British war-ves- sels. In the British mercantile marine Lloyd's Register has permitted fuel with a flash-point as low as 160Â° Fahr. as a minimum, and no harm has resulted. The Board of Trade, the department of the Government which controls the safety of passenger vessels, has fixed a higher stand- ard upon the basis of a minimum of 185Â°. In the case of locomotives the flash-point as a standard of safety is of less importance than in the case of stationary or marine boilers, because the storage is more open, and the ventila^ tion, both of the storage tanks and the boilers during combustion, much more perfect than in any other class of steam boilers. ,

The process of refining by distillation is also necessary to reduce two impurities which greatly retard storage and combustion, i.e., water and sulphur. Water is found in all crude petroleum as it issues from the wells, and sulphur exists in important quantities in oil from the Texas wells. Its removal was at first found very expen- sive, but there no longer exists difficulty in this respect, and large quantities of petroleum fuel practically free from sulphur are now regularly exported from Tejas to New York and to Europe.

Water mixed with fuel is in intimate mechanical rela- tion, and frequently so remains in considerable quanti- ties even after the process

of distillation. It is in fact so thoroughly mixed as to form an emulsion. The effect of feeding such a mixture into a furnace is extremely injurious, because the water must be decomposed chemi- cally into its constituents, hydrogen and oxygen, thus absorbing a large quantity of heat which would other- wise be utilized for evaporation. Water also directly delays combustion by producing from the jet a long, dull, red flame instead of a short, bright, white flame, and the process of combustion, which should take place by vapor- ization of the oil near the furnace mouth, is postponed and transferred to the upper part of the combustion-box, the tubes, and even the base of the chimney, producing loss of heat and injury to the boiler structure. The most effective means of ridding the fuel of this dangerous im- purity is by heat and settlement. The coefl&cients of expansion of water and oil by heat are substantially different, and a moderate rise of temperature therefore separates the particles and precipitates the water, which is easily drawn off â€” leaving the oil available for use. The heating and precipitation are usually performed upon a patented system of settlingtanks and heating apparatus known as the Flannery-Boyd system, which has proved itself indispensable for the successful use at sea of petroleum fuel.

The laboratory and mechanical use of petroleum for fuel has already been referred to, but it was not until the year 1870 that petroleum was applied upon a ^iT^f^/rf wider and commercial scale. In the course of foe/. distillation of Russian crude petroleum for the

production of kerosene or lamp oil, large quan- tities of refuse vrere produced â€” known by the Russian name of astatki â€” and these were found an incumbrance, and useless for any commercial purpose. To a Russian oil-refiner gifted with mechanical instinct and the genius for invention occurred the idea of utilizing the waste

product as fuel by spraying or atomizing it with steam, so that, the thick and sluggish fluid being broken up into particles, the air necessary for combustion could have free access to it. The earliest apparatus for this purpose was a simple piece of gas-tube, into which the thick oil was fed; by another connexion steam at high pressure was

admitted to an inner and smaller tube, and, the end of the tube nearest to the furnace being open, the pressure of the steam blew the oil into the furnace, and by its velocity broke it up into spray. The apparatus worked with success from the first. Experience pointed out the proper proportionate sizes for the inlets of steam and oil, the proper pressure for the steam, and the propor- tionate sizes for the orifices of admission to the furnaces, as well as the sizes of air-openings and best arrangements of fire-bricks in the furnaces themselves ; and what had been a waste product now became a by-product of great value. Practically all the steam power in South Russia, both for factories and navigation of the inland seas and rivers, is now raised from astatki fuel.

In the Far East, including Burma and parts of China and Japan, the use of liquid fuel spread rapidly during the years 1899, 1900, and 1901, owing entirely to the develop- ment of the Borneo oil-fields by the enterprise of Sir Marcus Samuel and the large British corporation known as the Shell Transport and Trading Company, of which he is the head. In the United States of America liquid fuel is not only used for practically the whole of the manu- facturing and locomotive purposes of the state of Texas, but factories in ^NTew York, and a still larger number in California, are now discarding the use of coal and adopt- ing petroleum, because it is more economical in its con- sumption and also more easily handled in transit, and saves nearly all the labour of stoking. So far the supplies for China and Japan have been exported from Borneo, but the discoveries of new oil-fields in California, said to be of a character specially adapted for fuel, have encour- aged the belief that it may be possible to supply Chile and Peru and other South American countries where coal is extremely expensive, with Californian fuel ; and there are some who believe that it will ultimately find its way across the Pacific to Japan. There are believed to be large deposits in West Africa, but in the meantime the only sources of supply to those parts of Africa where manufacture is progressing, i.e., South Africa and Egypt, are the oil-fields of Borneo and Texas, from which the import has well begun, from Texas to Alexandria vid the Mediterranean, and from Borneo to Cape Town vid Singapore.

In England, notwithstanding the fact that there exist the finest coal-fields in the world, there has been a surpris- ing development of the use of petroleum as fuel. The Great Eastern railway have adapted 120 locomotive engines to its use, and these are running with regularity and success both on express passenger and goods trains. The London, Brighton, and South Coast railway are also commencing the adaptation of some of their locomotive engines, and they have recently entered into a contract for the delivery of a large quantity of Texas oil fuel. Several large firms of contractors and cement manufac- turers, chiefly on the banks of the Thames, have made large purchases f orfuture delivery, extending over as many as three years in some cases. The facts that the d(^p5t for the reception of Texas oil fuel is at Thames Haven, and that coal IS necessarily dearer in the south of England than in the coal-bearing parts of the country, suggest that the development of liquid fuel is more likelv to continue in the neighbourhood of London than elsewhere in England.

The chief factors of economy are the greater calorific value of oil than coal (about 16 ft of water per ft of oil fuel evaporated from a temperature of 212Â° Fahr.), not only

in laboratory practice, but in actual use on a large scale, and the saving of labour both in transit from the source

of supply to the place of use and in the act of ofl”gu?d stoking the furnaces. The use of cranes, hand fuel. labour with shovels, waggons and locomotives,

horses and carts, is unavoidable for the transit of coal ; and labour to trim the coal, to stoke it when under

combustion, and to handle the residual ashes, are all indis- pensable to steam-raising by coal. On the other hand, a system of pipes and pumps, and a limited quantity of skilled labour to manage them, is all that is necessary for the transit and combustion of petroleum fuel ; and it is certain that even in England petroleum will find places which, from topographical and other circumstances, will

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Fig. 1.â€” Holden Burner.

more economically use petroleum than coal as fuel for

manufacturing purposes.

The theoretical calorific value of oil fuel is more nearly

realized in practice than the theoretical calorific value of

coal, because the facilities for conlplete combustion, due

to the artificial admixture of the air by the atomizing

process, are greater in the case of

oil than coal, and for this reason,

among others, the practical evapor- ative results are proportionately

higher with liquid fuel. In some

cases the work done in a steam

engine by 2 tons of coal has been

performed by 1 ton of oil fuel,

but in others the proportions have

been as 3 to 2, and these latter

can be safely relied on in practice

as a minimum. This saving, com- bined with the savings of labour

and transit already explained, will

in the near future make the use

of liquid fuel compulsory, except â– ” in places so near to coal-fields that

the cost of coal becomes sufficiently

low to counterbalance the savings

in weight of fuel consumed and in

labour in handling it. In some vJocomotives on the Great Eastern

railway the consumption of oil

and coal for the same development

of horse-power has been as 17 tt>

oil is to 35 lib coal; all, however,

have not realized so high a result. The mechanical apparatus for

applying petroleum to steam-raising in loco- motives is very simple. The space in the tender usually occupied by coal is closed up by steel-plating closely riveted and tested, so as to form

a storage tank. From this tank a feed-pipe is led to

a burner of the combined steam-and-oil type already indicated, and this burner is so arranged as to enter a short distance inside the

furnace mouth. The ordinary fire-bars are covered with a thin layer of coal, which starts the ignition in the first place, and the whole apparatus is ready for work. The burner best adapted

Fig. 2. â€” Eusden and Eeles Burner.

Liquid fuel In loco- motives.

for locomotive practice is the Holden Burner shown in Fig. 1. The steam-pipe is connected at A, the oil-pipe at B, and the hand-wheels C and D are for the adjust- ment of the internal orifices according to the rate of combustion required. The nozzle E is directed towards

the furnace, and the external ring FF, supplied by the small pipe G and the bye-pass valve H, projects a series of steam jets intothefurnace,independentof the injections of atomized fuel, and so induces an artificial inrush of air

for the promotion of combustion. This type of burner has also been tried on stationary boilers and on board ship. It works well, although the great consumption of steam by the supplementary ring is a diÂ£B.culty at sea, where

WAirPipe

f'Jluicc l&lrc

Fig. 3.~8torage of Liquid Fuel on Oil-carrying Steamers (Flannery-Boyd system).

the water lost by the consumption of steam cannot easily be made up.

Although the application of the new fuel for land and locomotive boilers has already been large, the practice at sea has been far more extensive. The reason is chiefly to be found in the fact that although the sources of supply are at a distance from Great Britain, yet they are in countries to whose neigh- bourhood British steamships regu- larly trade, and in which British naval squadrons are regularly stationed, so that the advantages of adopting liquid fuel have been more im- mediate and the economy atTea/”” more direct. The certainty of continuous supply of the fuel and the wide distribution of storage stations have so altered the conditions that the general adoption of the new fuel for marine purposes becomes a matter of urgency for the statesman, the merchant, and the engineer. None of these can afford to neglect the new conditions, lest they be noted and acted upon by their competitors.

Saigon, Penang, Batavia, Surabaya, Amoy, Swatow, Fuchow, Shanghai, Hankow, Sydney, Melbourne, Adelaide, Zanzibar, Mombasa, Yokohama, Kobe, and Nagasaki ; storage arrangements are also projected in South African and South American ports.

Fig. 4.â€” Installation on bb. Trocnu.

Storage and supply now exist or will shortly be established in the following wide range of seaports : â€” London, Barrow, Southampton, Amsterdam, Copenhagen, New Orleans, Savannah, New York, Philadelphia, Singapore, Hong- Kong, Madras, Colombo, Suez, Hamburg, Port Arthur, Texas, Rangoon, Calcutta, Bombay, Alexandria, Bangkok,

Fig. 6.â€” Details of Furnace, (Meyer System).

The British Admiralty are proceeding with some vigour to experiment with liquid fuel at sea, and at the same time to investigate the possibility of supply from sources within the regions of the British Empire. There is an enormous supply of shale under the north- eastern counties of England, but no oil that can be pumped â€” still less oil with a pressure above it so as to ” gush ”’ like the wells in America â€” and the onlj- source of liquid supply under the British flag appears to be in Burma. The Borneo fields are, however, under British control, and

have been de- veloped entirely by British capital. The Italian Admiralty have fitted several large warships with boiler apparatus to burn petro- leum. The German Admiralty are regularly using liquid fuel on the China station. The Dutch navy have fitted coal fuel and liquid fuel furnaces in combination, so that the smaller powers required may be developed by coal alone, and the larger powers by supplementing coal fuel with oil fuel. The speeds of some vessels of the destroyer trpe have by this means been accelerated nearly two knots.

The questions which govern the use of fuel in war- ships are more largely those of strategy and fighting efficiency than economy of evaporation. Indeed, the cost of constructing and maintaining in fighting efficiency

a modern warship is so great that the utmost use strategically must be obtained from the vessel, and in

Fig, 6. â€” Details of Exterior Elongation of Furnace, Meyer System.

this comparison the cost of fuel is relatively so small an item that its increase or decrease may be considered almost a negligible quantity. The desideratum in a war- ship is to obtain the greatest

fighting efficiency ^dvan- based on the thickest wauib?ps. armour, the heaviest

and most numerous guns, the highest maximum speed, and, last and not least, the greatest range of effective action based upon the maxi- mum supplies of fuel, pro- visions, and other consumable stores that the ship can carry. Now, if by changing the type of fuel it be possible to reduce its weight by 30 per cent., and to abolish the stokers, who are usually more than half the ship’s company, the weight saved will be

represented not merely by the fuel, but by the consumable stores otherwise necessary for the stokers. Con- versely, the radius of effective

action of the ship will be doubled as regards consum- able stores if the crew be halved, and will be increased by 50 per cent, if the same weight of fuel be carried in the form of liquid instead of coal. In space the gain by using oil fuel is still greater, and 36 cubic feet of oil as stored are equal in practical calorific value to 67 cubic

feet of coal according to the allowance usual for ship's bunkering. On the other hand, coal has been relied upon, when placed in the side bunkers of unarmoured ships, as a protection against shot and shell, and this advantage, if it really exists, could not be claimed in regard to liquid fuel. Recent experiments in coaling warships at sea have not been very successful, as the least bad weather has pre- vented the safe transmission of coal bags from the collier to the ship. The same difficulty does not exist "for oil fuel, which could be pumped through flexible tubing from one ship to the other even in comparatively rough weather. Smokelessness, so important a feature of sea strategy, has not always been attained by liquid fuel, but where the combustion is complete, by reason of suitable furnace arrangements and careful management, there is no smoke. The great drawback, however, to the use of liquid fuel in fast small vessels is the confined space allotted to the boilers, such confinement being unavoidable in view of the high power concentrated in a small hull. The British Admiralty's experiments, however, are gradually

Fig. 7.â€" Furnace on ss. JferMnand Laeiss. A, it is proposed to do away with this ring of brickwork as being useless ; B, it is proposed to fill this space up, thus continuing lining of furnace to combustion chamber, and also to fit protection bricks in way of saddle plate.

solving the problem, and the quantity of oil which can be consumed by forced draught in confined boilers now more nearly equals the quantity of coal consumed under similar conditions.

In view of recent accusations of insufficiency of coal storage in foreign naval depots, by reason of the

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Fig. 8.â€” Fuel Tanks, &c., of i

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allegation that coal so stored quickly perishes, it is interesting to note that liquid fuel may be stored in tanks for an indefinite time without any deterioration whatever.

In the case of merchant steamers large progress has also been made. The Shell Transport and Trading Conapany have twenty-one vessels successfully navigating in all parts of the world and using liquid fuel. The Hamburg-

American Steam Navigation Co. have four large vessels similarly fitted for oil fuel, although differing in furnace arrangements, as will be hereafter ^^^gj,. described. One of the large American trans- tagesin atlantic lines is adopting liquid fuel, and mercbant French, German, Danish, and American mer- **”’*â– cantile vessels are also beginning to use it in considerable amounts.

S. VII. â€” 82

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PETROLEUM

[liquid fitei.

In the case of very large passenger steamers, such as those of 20 knots and upwards in the Atlantic trade, the saving in cost of fuel is trifling compared with the advantage arising from the greater weight and

space available for freight. Adopting a basis of 3 to 2 as between coal consumption and oil consumption, there is an increase of 1000 tons of dead weight cargo in a large Atlantic steamer, and a collateral gain of about 100,000 cubic feet of measurement cargo, by reason of the ordinary bunkers being left quite free, and the oil being stored in the double bottom spaces hitherto unutilized except for the purpose of water ballast. The cleanliness and saving of time from bunker- ing by the use of oil fuel is also an important factor in passenger ships, whilst considerable additional speed is obtainable. The cost of the installation, however,

is very considerable, as it includes not only burners and pipes for the furnaces, but also the construction of oil- tight tanks, with pumps and numerous valves and pipe connexions.'

Fig. 2 shows a iDumer of Rusden and Eeles' patent as generally used on board ships for the purpose of injecting the oil. A is a movable cap holding the packing B, which renders the annular spindle M oil and steam tight. E is the outer casing containing the steam jacket from which the steam, after being fed through the steam-supply pipe G, passes into the annular space surround- ing the spindle P. It will be seen that if the spindle P be travelled inwards by turning the handle N, the orifice at the nozzle RR will be opened so as to allow the steam to flow out radially. If at the same time the annular spindle M be drawn inwards by revolving the handle L, the oil which passes through the supply pipe F will also have emission at RR, and, coming in contact with the outfJowing steam, will be pulverized and sprayed into the furnace. Fig. 3 is a profile and plan of a steamer

Fig. 9. â€" Furnace Gear of ss. Mtirex.

adapted for carrying oil in bulk, and showing all the storage arrangements for handling liquid fuel. Fig. 4 shows the interior arrangement of the boiler furnace of the steamship Trocas. A is broken fire-brick resting on the ordinary fire-bars, B is a brick bridge, C a casing of fire-brick intended to protect the riveted seam immediately above it from the direct impact of the flame, and D is a lining of fire-brick at the back of the combustion- box, also intended to protect the

plating from the direct impact of the petroleum flame. The arrangement of the furnace on the Meyer system is shown in Fig. 5, where E is an annular projection built at the mouth of the furnace, and BB are spiral passages for heating the air before it passes into the furnace. Fig. 6 shows the rings CC and details of the casting which forms the projection or exterior elongation of the furnace. The brickwork arrangement adopted for the double-ended boilers on the Hamburg- America Steamship Company's Ferdinand Lac isz is represented in Fig. 7. The whole furnace is lined with fire-brick, and the burner is mounted upon a circular disc plate which covers the mouth of the furnace. The oil is injected not by steam pulverization, but by pressure due to a steam-pump. The oil is heated to about 60Â° C. before entering the pump, and further heated to 90Â° C. after leaving the pump. It is then filtered, and passes to the furnace injector C at about 30 pounds pressure ; and its passage through this injector and the spiral passages of which i(consists pulverizes the oil into spray, in which form it readily

ignites on reaching the interior of the furnace. The injector is on the Kbrting principle, that is, it atomizes by fracture of the liquid oil arising from its own momentum under pressure. The advan- tage of this system as compared with the steam-jet system is the saving of fresh water, the abstraction of which is so injurious to the boiler by the formation of scale.

The general arrange- ment of the fuel tanks and filling pipes on the Shell Transport Company's ss. Murcz is shown Fig. 8 ; and Fig.

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9 represents the fur- nace gear of the same vessel, A being the

steam-pipe, B the oil-pipe, C the injector, D tlie swivel upon which the injector is hung so that it may be swung clear of the

lighting]

furnace, E the fire-door, and F the handle for adjusting the in- jector. In Fig. 10, which represents a section of the furnace, H is a fire-briclt pier, and K a fire-brick baffling bridge.

It is found in practice that to leave out the fire-bars ordinarily used for coal produces a better result with liquid fuel than the alternative system of keeping them in place and protecting them by a layer of broken fire-brick.

Boilers fitted upon all the above systems have been run for thousands of miles without trouble. In new construction it is desirable to give larger combustion chambers and longer and narrower boiler tubes than in the case of boilers intended for the combustion of coal alone. (y. jr*.)

III. MiNBEAL Oil as an Illuminant.

As early as 1781 the idea was mooted of burning naphtha, obtained by the distillation of coal at low tem- peratures, for illuminating purposes, and in 1820, when coal gas was struggling into prominence, light oils ob- tained by the distillation of coal tar were employed in the Holliday lamp, which is still to be found flourishing as the chief factor in illuminating the street barrow of the costermonger. In this lamp the coal naphtha is con- tained in a conical reservoir, from the apex of

which it flows slowly down through a long metal capillary to a rose burner, which, heated up by the flame, vaporizes the naphtha, and thus feeds the ring of smalljets of flame escaping from its circumference.

It was in 1847 that James Young had his attention drawn to an exudation of petroleum that occurred in. the Biddings Colliery at Alfreton, in Derbyshire, petroleuln and found that he could by distillation obtain as an iiiw from it a lubricant of considerable value. The miaaai. commercial success of this material, however, was accompanied by a failure of the supply, and, rightly imagining that as the oil had apparently come from the Coal Measure, it might be obtained by distillation from material of the same character, he commenced investiga- tions in this direction, and in 1850 started, distilling oils from a shale known as the ” Bathgate mineral,” in this way founding the Scotch oil industry. At first but little attention was paid to the fitness of the oil for burning purposes, although in the early days at Alfreton Young attempted to burn some of the lighter distillates in an Argand lamp, and later in a form of lamp which had been made many years before for the consumption of turpentine. About 1853, however, it was noticed that the lighter distillates were readily bought, and were be- ing shipped to Hamburg and sent on to Germany, where lamps fitted for the consumption of the grades of oil now known as lamp oil were being made by Stohwasser of Berlin ; and some of these lamps being imported, were afterwards manufactured in Great Britain by Messrs Laidlaw in Edinburgh, undergoing several improvements during the ensuing years.

In Pennsylvania in 1859 Colonel Drake’s successful boring for petroleum caused the outbreak of oil fever in the States, which resulted in the flooding of the market with oil at prices never before deemed possible, and le^d to the introduction of lamps from Germany for its con- su.mption. Although the first American patent for a petroleum lamp is dated 1859, that year saw forty other applications, and for the next twenty years they averaged about eighty a year.

The English lamp-makers were not behind in their attempts to improve on the methods in use for producing The erfec- *^Â® highest results

from the various grades of tioa’oftbe oil, and in 1865 Messrs Hinks introduced the miaerah duplex burner, while later improvements made oil lamp, jjj various directions by Messrs Hinks, Silber, and Defries led to the high degree of perfection to be found in the lamps of to-day. Mineral oil for lamps as used in England at the present time may be defined as eoAsisting of those portions of the distillate from shale

oil or crude petroleum which have their flash-point above 73Â° F., and which are mobile enough to be fed by capil- larity in sufficient quantity to the flame. The oil placed in the lamp reservoir is drawn up by the capillarity of the wick to the flame, and being there volatilized, is con- verted by the heat of the burning flame into a gaseous mixture of hydrogen and hydrocarbons, which is ulti- mately consumed by the oxygen of the air and converted into carbon dioxide and water vapour, the’ products of complete combustion.

In order to secure high illuminating power, together with a smokeless flame and only products of complete combustion, it is necessary to pay strict attention to several important factors. ‘ In the first place, the wick must be so arranged as to supply the right quantity of oil for gasification at the burner-head â€” the flame must be neither starved nor overfed : if the former is the case great loss of light is occasioned, while an excess of oil, by providing more hydrocarbons than the air-supply to the flame can completely bum, gives rise to smoke and products of incomplete combustion. The action of the wick depending on the capillary action of the micro- scopic tubes forming the cotton fibre, nothing but long-staple cotton of good quality should be employed ; this should be spun into a coarse loose thread with as little twist in it as possible, ^nd from this the wick is built up. Having obtained a wick of soft texture and loose plait, it should be well dried before the fire, and when put in position in the lamp must fill the wick-holder without being compressed. It should be of sufficient length to reach to the bottom of the oil reservoir and leave an inch or two on the bottom. Such a wick will suck up the oil in a regular and uniform way, provided that the level of the oil is not allowed to fall too low in the lamp, but it must be remembered that the wick acts as a filter for the oil, and that if any sediment be present it will be retained by and choke

the capillaries upon which the action of the wick depends, so that a wick should not be used for too long a time. A good rule is that the wick should, when new, trail for 2 inches on the bottom of the oil vessel, and should be discarded when these 2 inches have been burnt off.

When the lamp is lighted the oil burns with a heavy, smoky flame, because it is not able to obtain sufficient oxygen to com- plete the combustion, and not only are soot flakes produced, but products of incomplete combustion, such as carbon monoxide and even petroleum vapour, escape into the air â€" the first-named liighly injurious to health, and the second of an offensive odour. In order to supply the necessary amount of air to the flame, an artificial draught has to be created which shall impinge upon the bottom of the flame and sweep upwards over its surface, giving it rigidity, and by completing the combustion in a shorter period of time than could be done otherwise, increasing the calorific inten- sity and thus raising the carbon particles in the flame to a far higher incandescence so as to secure a greater illuminating power. This in practice has been done in two ways, first by drawing in the air by the up-suok of the heated and expanded products of combustion in a chimney fitted over the flame, and secondly by creating a draught from a small clockwork fan in the base of the lamp. It is necessary to break the initial rush of the draught: this is mostly effected by discs of perforated metal in the base of the burner, called diffusers, while the metal dome which surrounds and rises slightly above the wick-holder serves to deflect the air on to the flame. These arrangements also act to a certain extent as regenerators, the air passing over the heated metal surfaces being warmed before reaching the flame, whilst other contriv- ances, such as discs, cones, buttons, perforated tubes, inner air- tubes, &c., have from time to time been introduced with the object of increasing the illuminating power and completing the combustion.

According to Dr Boverton Redwood, duplex burners which give a flame of 28 candle-power have an average oil consumption of 50 grains per candle per hour, while Argand flames of 38 candle-power consume about 45 .grains of oil per candle The Ulu- per hour. These must, hov^ever, be regarded as the "'Inatlag duties obtained from lamps of

the best types, and in ‘-‘c’eno’ order to obtain information as to the efficiency of the Â°J ’”<"'Â«'â– '' lamps most extensively used in daily practice, a num- mps.

ber of the most popular types were examined, using both Ameri- can and Russian oil.

The results obtained are embodied in the table on the next page. The first thing that strikes one in this table is the apparent superiority of the American over Russian oil in the majority of the lamps employed, and there is no doubt that the bulk of the lamps on the market are constructed with the view of burning American or shale oil. A second interesting point is that with the flat-flame lamps the Russian oil is as good as the American. We have the authority of Dr Redwood, moreover, for the fact

Type.

Name.

Grains of Oil per candle-power per hour.

Total Candle-power.

American.

Kusslan.

American.

Russian.

Veritas, 60-line

â€ž 30 â€ž . . .

â€ž 20 â€ž

64-5 42-5 43-76

112-5 50 58-5

122-5 60 40

78 60

35

Circular wick .

Ariel, 12-line centre draught .

Reading, 14-line

Kosmos, 10-line

Wizard, 16-line

52-8 97-9 63-9 56-9

70-9 85-4 97-2 51-3

18

12

9

18

18

12

9

19

Flat wick, single

Wanzer, no glass

Solid slip, gauze and cone

Old slip, fixed gauze ....

42-6

84-4 60-9

48-3 84-4 89-3

17 8

7

17 8

7

” duplex . <

Feeder wick ... . . Ordinary . ....

56-2 51-2

55-7 46-6

20 20

22 22

American oil â€” Sp

. gr. 0-7904 ; flash-point, 110Â° F. Kussi

an oil â€” Sp.

gr. 0-823 ; flash-point, 83Â° F.

that after prolonged burning the Russian oil, even in lamps least suited to it, gives highly improved results. Although the average consumption with these various forms of lamps is close upon 60 grains per candle with American oil, yet some of the turners are so manifestly wasteful that 50 grains per candle-power per hour is clearly the fairest basis to take for any calculation as to cost.

Candles, oil, and coal gas all emit the same pro- ducts of complete combustion, viz., carbon dioxide and water vapour. The quantities of these com- pounds emitted from the different illuminants for every caudle of light per hour will be seen from the following table : â€”

Cubic Feet per Candle. Carbon Dioxide. Water Vapour.

0-41 0-41

0-24 018

0-26 0-67

. â€¢ 0-17 0-45

0-07 0-19

0-03 0-08

Products ofcombuS' Hon ot oil and other llueala-' ants.

Illuminant.

Sperm candle .

Oil lamp .

Gas â€” Flat flame Argand . Regenerative Incandescent

From these data it appears that if the sanitary condition of the air of a dwelling-room be measured by the amount of carbon dioxide present, as is usually done, candles are the most pre- judicial to health and comfort, oil lamps less so, and gas least, an assumption which practical experience does not bear out, the discomfort and oppression felt being distinctly less in a room lighted by candles or oil than in one lighted by any of the older forms of gas-burner. The explanation of this is to be found in these facts : â€” First, where we illuminate a room with candles or oil we are contented with a less intense and more local light than when we are using gas, and in a room of ordinary size would be more likely to use a lamp or two candles placed near our book or plate than the far higher illumination we should demand if gas were employed. Secondly, the amount of water vapour given off during the combustion of gas is greater than in the case of the other illuminants, and water vapour absorbing radiant heat from the burning gas becomes heated, and, diffusing itself about the room, causes great oppression. Also the air, being highly charged with moisture, is unable to take up so rapidly the water vapour which is always evaporating from the surface of our skin, and in this way the functions of the body receive a slight check, resulting in a feeling of depression.

The amount of heat emitted by our illuminants is a matter of importance upon which little has been said, and which places a distinct limit upon the size and illuminating power of oil lamps. Taking the composition of lamp oil to be 86 per cent, carbon and 14 per cent, hydrogen, the relative amount of heat evolved from gas flames and oil lamps for every candle-power of illumination per hour will be â€”

British Thermal Units per Candle-power ^ per hour.

Oil lamp 336

Gas â€” Flat flame 310

Argand 207

Regenerative . . 88

Incandescent mantle . . 30

A very successful form of oil lamp for use in engineer- ing is that type of lamp represented by the ” Lucigen,”

“Doty,” and “Wells” lights, in which the oil is fJmps”^ forced from a reservoir by air-pressure through

a spiral heated by the flame of the lamp, and the heated oil being then ejected partly as vapour and

Heat emitted by oil flames.

partly as spray, burns with a large and highly luminous flame. The great drawback to these devices is that a certain proportion of the oil spray escapes combustion and is deposited in the vicinity of the light. This form of lamp is often used for heating as well as lighting, 9,nd any one who saw the wonderful engineering work at the Forth Bridge in progress will remember the effective way in which the rivets needed for that colossal undertaking were heated in trays by lamps of this type at the spot where they were required. The great advantage of these lamps was that oils of but very little value could be employed, and the light obtained approximated to 750 candles per gallon of oil consumed. They may to a certain extent be looked iipon as the forerunners of perhaps the most successful form of incandescent oil-burner.

As early as 1885 Mr Arthur Kitson attempted to make a burner for heating purposes on the foregoing principle, that is, by injecting oil under pressure from a o,|gâ€ž-y,gj fine tube into a chamber where it would be to incaa- heated by the waste heat escaping from the descent flame below, the vapour so produced being “Â«â– *””*â€¢ made to issue from a small jet under the pressure caused by the initial air-pressure and the expansion in the gasifying tube. This jet of gas was then led into what was practically an atmospheric burner, and drew in with it sufficient air to cause its combustion with a non- luminous blue flame of great heating power. At the time when this was first done the

Welsbach mantle had not yet reached the period of commercial utility, and attempts were made to use this flame for the generation of light by consuming it in a mantle of fine platinum gauze, which, although giving a very fine illuminating effect during the first few hours, very soon shared the fate of all platinum mantles â€" that is, carbonization of the platinum surface took place, and destroyed its power of light emissivity. It was not until 1897 that the per- fecting of the Welsbach mantle enabled this method of consuming the oil to be employed. The Kitson lamp has given results which certainly ought to ensure its future success, the only drawback to it being that it needs a certain amount of intelligent care to keep it in good work- ing order, but where this has been forthcoming the lamp has more than fulfilled the high expectations formed of it.

In this lamp as used for outside street lighting the oil reservoir is in the base of the pillar, and is made of steel in order to witli- stand very high pressures, so as to be absolutely safe under the conditions of ordinary use. In this reservoir tlie oil is by means of a small pump put under an air-pressure of 50 or 60 lb, which forces it up through a small capillary tube to the burner-head. Here it passes through a small cross-tube containing filtering material, for removing any small partitles in it, and is then ejected through a small aperture into a lower cross-tube placed immedi- ately above the top of the mantle, the heat from which passing upwards causes vaporization and partial gasification of the oil. The mixed gas and vapom- rush out under considerable pressure

from a small aperture in the under side of the tube down what is practically an inverted Bunsen tube, through the holes in the side oÂ£ which it draws in a sufficient amount of air to render the flame at the burner-head not only non-luminous but sufficiently oxidizing in its character as to prevent any deposition of carbon on the man- tle. By the time the burner-head is reached, the gas is practically down to atmospheric pressure again, so that the wear and tear to the mantle are not excessive. The performances of this lamp have been most carefully

studied, and experiments show that with a large single burner it is perfectly easy to obtain illuminating values of from 1000 to over 1200 candles, and that 1000 candle-power could with a large installation be readily obtained for Id. per hour, a figure which makes this method of illumination only one-third the cost of electric arc lighting. The cost, however, must vary with the number of lamps employed. Where the installation is large enough to keep a man constantly employed, the labour item becomes reduced to a very small figure, but rises to an excessive degree when the member of lamps decreases.

Oil gas and coil vaprturs differ from coal gas merely in the larger proportion and greater complexity of the hydro- carbon molecules present, and to render the oil lacaades- flame available for incandescent lighting it is

ceat table â– , , ii -i ,

lamps. o'lly necessary to cause the oil gas or vapour to become mixed with a sufficient proportion of air before it arrives at the point of combustion. A sim- ple statement of this kind, however, gives no idea of the great difficulties which exist in bringing about so simple an end, as with gases so rich in hydrocarbons as those developed from oil it is excessively difficult to get the necessary air intimately and evenly mixed with the gas in sufficient proportion to bring about the desired result. If even coal gas be taken and mixed with 2-27 volumes of air, its luminosity is destroyed, but such a flame would be useless with the incandescent mantle, as if the non- luminous flame be superheated a certain proportion bf its luminosity will reappear. When such a flame is used with a mantle the superheating effect of the mantle itself very quickly leads to the decomposition of the hydrocarbons and blackening of the mantle, which not only robs it of its light-giving powers, biit also rap- idly brings its life to a close. If, however, the pro- portion of air be increased, the appearance of the flame becomes considerably altered, and the hydrocarbon mole- cules being burnt up and so destroyed before impact with the heated surface of the mantle, all chance of blackening is avoided.

As soon as attempts began to be made to construct a satisfactory oil lamp which could be used with the incan- descent mantle, this trouble showed itself to be a most serious one, as although it was comparatively easy so to regulate a circular-wicked flame fed by an excess of air as to make it non-luminous, the moment the mantle was put upon this, blackening quickly appeared, while when methods for obtaining a further air supply were devised, the difficulty of producing a flame which would burn for a considerable time without constant necessity for regu- lation proved a serious drawback. This has been the trouble which has militated against most of the incandes- cent oil lamps placed upon the market.

It soon became evident that if a wick were employed the difficulty of getting it perfectly symmetrical was a serious matter, and that it could only be utilized in draw- ing the oil up to a heating chamber where it could be volatilized to produce the oil gas, which on then being mixed with air would give the non-luminous flame. In the earlier forms of incandescent oil lamps the general idea was to suck the oil up by the capillarity of a circular wick to a point a short distance below the opening of the burner at vi^hich the flame was formed, and here the oil was vaporized or gasified by the heat of the head of the burner. An air supply was then drawn up through a tube passing through the centre of the wick-tube, while a second air current was so arranged as to discharge itself almost

horizontally upon the burning gas below the cap, in this way giving a non-lumiuous and very hot flame, which if kept very carefully adjusted afforded excellent results with an incandescent mantle. It was an arrangement somewhat of this character that was introduced by the Welsbach Company. The lamps, however, required such careful attention, arid were moreover so irregular in their performance, that they have never proved very successful. Many other forms have been suggested and have reached a certain degree of perfection, but have not so far attained sufficient regularity of action to make them commercial successes. 1 One of the most successful was one devised by Herr Altmann, in which an ingenious arrangement caused the vaporization of oil and water by the heat of a little oil lamp in a lower and separate

chamber, and the mixture of oil gas and steam was then burnt in a burner- head with a special arrangement of air supply, heating a mantle suspended above the burner-head.

The perfect petroleum incandescent lamp on any of these systems, however, has not yet been made, but the results that have been obtained show that when the right system has been found a very great increase in the amount of light developed from the petroleum may be expected. In the case of one lamp which was experimented with for some time it was easy to obtain 3500 candle hours per gallon of oil, or three times the amount of light obtainable from the oil when burnt under ordinary conditions.

The cost of obtaining illuminating power of equal intensity from the various illuminating agents has been cal- culated, the basis of calculation in each case being Compara- the figure which practice shows to represent the aver- ”””* “>‘ <Â»' age duty obtained from each. The following table gives â€ž; " f” the results:- Wamlnaat.

Cost of 1000 Candles of Light per Hour. Electricity â€” 3^d. per unit s. d.

Incandescent lamp 1 2

Arc 0 3|

Coal Gas â€” 16 c. p. at 3s. per 1000 cubic feet.

Flat flames 16

Argand 10

Incandescent 0 2J

„ â€”pressure . . 0 IJ

Oilâ€” Duplex lamp â€” oil, 8d. per gallon . 0 7^

Oil gasâ€” oil, 4d. per gallon . . .06 Incandescent â€” lamp oil, 8d. per gallon . 0 2 J ,, air gas, gasolene, lOd. . 0 2

,, Kitson 0 1

(v. B. L.)

Petrovsk, a district town and seaport of Eussia, on the Caspian Sea, in the province of Daghestan, Trans- caucasia, 180 miles by rail east of Vladikavkaz, and 235 miles from Baku. The fort has been abandoned, but the town has become a considerable seaport, the imports reaching 400,000 tons annually, and the exports 50,000 tons. There are naphtha wells, and the hot sulphur baths at Ah-Gol and Taiga, close by, attract many visitors in summer. Population (1897), 9810.

Pettie, John (1839-1893), Scottish painter, was born at East Linton, Haddingtonshire, 17th March 1839, the son of Alexander and Alison Pettie. His first art work was done in the studio of E'obert Frier, and while there he made several drawings for book illustra- tion. At the age of seventeen he entered the Trustees' Academy in Edinburgh, working under Robert Scott Lauder with W. Q. Orchardson, J. MacWhirter, W. M'Taggart, Peter Graham, Tom Graham, and G. P. Chalmers. He first exhibited at the Royal Scottish Academy in 1858, the subject chosen being " The Prison Pet," following it in 1859 with a " Scene from the Fortunes of Mgel," and two portraits ; and at the Royal Academy with " The Armourers " in 1860. The success of this work and of its successor, " What d'ye Lack,

Madam ? " in the following year, encouraged him to settle in London (1862), where he joined Orchardson. In 1866 he was elected an Associateof theKoyal Academy, andin 1873 receivedfull Academicalhonoursin succession to Sir Edwin Landseer. His diploma picture was "Jacobites, 1745." Pettie was a hard and rapid worker, and, in his best days, a colourist of a high order and a brilliant executant. He

was a successful portrait-painter, if not quite in the front rank ; but he will always be better known for his subjects drawn from the romance of history, especially that of his native country. He was an accurate and charming draughtsman, with a capacity for the dramatic arrangement of a composition, and it is probable that his works of this class will always enjoy a very considerable popular vogue. In his early days he, along with many of his fellows, produced a certain amount of book illustration (see Illustration). His connexion with Oood Words began in 1861, and was continued during 1862 and 1863. In 1868 and 1869 wood-engravings after his drawings appeared in the Sunday Magazine. He also illustrated Tlie Postman' sBag (with J. MacWhirter), Wordsworth's Poetry for the Young (Strahan, 1863) ; as well as contributing to Pen and Pencil Pictures from the Poets (Nimmo, 1866) and to Touches of Nature by Eminent Artists (Strahan, 1866). His principal paintings, in addition to those already mentioned, are " One of Cromwell's Divines " (1862) ; " The Trio," " The Tonsure," and " George Eox refusing to take the Oath" (1863); " The Drumhead Court-Martial" (1866); "An Arrest for Witchcraft" (1866); " Sir Hugh and Ealph in the Stocks," " A Visit to the Necromancer," "The Eehearsal," "John MacWhirter, Esq." (1871) ; "Terms to the Besieged " (1872) ; "The Flag of Truce" (1873); " A Scene in Halo' the Wynd's Smithy" (1874); "The Sword and Dagger Eight" (1877, now be- longing to the city of Aberdeen) ; " A Death Warrant " (1879); "Before his Peers" (1881); "Monmouth and James II." (1882); "The Vigil" (1884, in the Chantrey Collection at the National Gallery of British Art ; see Plate); "Challenged" and "Sir Peter Teazle" (1886); "The Chieftain's Candlesticks" (1886); "The Traitor" (1889) ; and " The Ultimatum " (1892). Pettie died at Hastings on the 21st of February 1893, at the age of fifty -four, and was buried in Paddington Cemetery. In 1894-96 a selection of his work was included in the Winter Exhibition of the Eoyal Academy.

See Sir Walter Armsteong's article in the Dictionary of National Biography. â€" W. Matthews Gilbert in tlie Art Journal.

(e. f. S.)

Pezenas, town and railway station, arrondissement of Beziers, department of Hdrault, 26 miles in direct line west-south-west of Montpellier. The distilling of absinthe and other spirits, and the manufacture of distilling appa- ratus, casks, &c., are the principal industries. The com- merce in cognac, spirits, and wines is so important that the prices current for these at the weekly sales are regis- tered throughout the wine marts of France and Europe. A handsome monument of Molifere, who lived here for several years, was erected in 1896. Population (1881),

6602 ; (1901), 6951.

Pfaffers. See Eagatz.

Pfleiderer, Otto (1839-

), German Protestant theologian and philosopher, was born near Cannstadt in Wiirtemberg on 1st September 1839. From 1857 to 1861 he studied under Baur at Tilbingen, and after wards studied in England and Scotland. He then en- tered the Church, and for a short time held a pastorate at Heilbronn ; but in 1875 he was called to the chair of systematic theology at Berlin, having made his name by a series of articles on JSTew Testament criticism and Johan-

nine and Pauline theology, which appeared in Hilgen- f eld's Zeitschrift fiir wissenschaftliche Theologie, and by his Paulinismus, published in 1873. Das Urchristentum was published in 1887, and in 1890 The Development of Tlieo- logy since Kant, and its Progress iri Great Britain since 1825, which was written for publication in England. Kant's essay Was ist Aufkldrung i is taken as the pro- gramme of the task to which German philosophy has devoted itself since his day. "The Influence of the Apostle Paul on Christianity " was the title of a course of Hibbert Lectures given in London in 1885. In 1894 he delivered the Gifford Lectures at Edinburgh, the subject being " The Philosophy and Development of Eeligion." In New Testament criticism Pfleiderer belongs to the critical school which has grown out of the impulse given by Baur. But, like other modern German theologians, he shows a greater disposition to compromise, and has none of the dogmatic

narrowness that was at one time a character- istic of the German school. All his work shows a judicial tone of mind, and is remarkable for the charm of its style. Professor Pfleiderer's younger brother Edmund (1842- 1902) devoted himself to similar studies, and distinguished himself both in philosophy and theology. He too for a time held a post in the Church, and during the Franco- German war served as army chaplain, an experience de- scribed in his Erlehnisse eines Feldgeistlichen (1890). He was afterwards appointed professor of philosophy at Kiel, and in 1878 he was elected to the philosophical chair at Tubingen. He published works on Leibnitz, Empiricism and Scepticism in Hume's Philosophy, Modern Pessimism, Kantic Criticism, English Philosophy, Heraclitus of Ephesus, and many other subjects.

Pforzheim, a town of Germany, grand-duchy of Baden, on the outskirts of the Black Forest, 19 miles by rail south-east of Carlsruhe. It is a centre for the manu- facture of gold and silver ornaments and jewellery. Amongst its public institutions may be mentioned a technical school, a hydropathic, a lunatic asylum, and a museum. Population (1885), 27,201; (1896), 33,345;

(1900), 43,097.

Phaltan, a native state of India, in the Deccan divi- sion of Bombay, ranking as one of the Satara Jagirs. Area, 397 square miles ; population (1891), 66,383 ; gross revenue (1897-98), Es.2,29,425, of which Es.14,810 was expended on public works; tribute, Es.9600; number of police, 65 ; 33 schools, with 1365 pupils. The chief, whose title is desmukh, is a rajput by caste, tracing his descent to a grantee from a Delhi emperor in the 14th century. The town of Phaltan is 37 mile^ north-east of Satara. Population (1891), 10,564; municipal revenue (1897-98), Es.11,323.

Pharmacology. â€" Systematic writers on the sub- ject differ considerably in the exact meaning which they attach to the term pharmacology (<^dp/u.(iKov, a drug, X6yo^, adiscourse), somemakingitmuchmore comprehensive than others. Binz, for instance, defines it as treating of the origin, nature, chemical and

physical qualities, physiologi- cal actions, and therapeutical uses of drugs ; in France and in Italy it is restricted to the mere description of medicines and their preparations, the action and uses of which as reme- dies are included in the term therapeutics. In the English- speaking countries of the world, and by the majority of German writers also, the meaning is now restricted to the study of the action of chemical substances (as apart from foods) on all kinds of animals, from bacteria up to man ; it is, in fact, a comparative study of the action of chemical bodies on invertebrate and vertebrate animals, the ultimate aim being to obtain a wider and more accurate know- ledge of remedial substances in relation to their practical

^ i

application in the treatment of disease. This meaning of the word has now become fixed in the English language by use and wont. The term pharmaco-dynamics {a.pimKov, Svvafi.Lq, power), which is etymologically more correct, is often used as its equivalent, but it has never become widely adopted in the United Kingdom. Hitherto the study of pharmacological actions has been almost entirely confined to remedial agents, and especially to those in the different national pharmacopoeias, but in many cases it has now been extended to substances which are not used for curative purposes. Being a comparatively recent development of medical science, it found, when it came into the field, numerous remedies of undoubted activity in general use, and for many years it contented itself with attempts to investigate and explain the actions of these, but latterly the introduction into practical use of many medicines, such as paraldehyde, antipyrin, and strophanthus, has followed the study of their actions on animals, and this tends to be more and more the case. Pharmacology is a branch of biology just as physi- ology is. It is also closely connected with pathology and bacteriology, for certain drugs produce structural as well as functional changes in the tissues, and in germ diseases the peculiar symptoms are caused hy foreign substances (toxins) formed by

the infective organisms present in the body. The effects of many of these toxins bear a close resemblance to the action of certain well-known drugs, as in the case of tetanus toxin and strychnine, and are studied by the same methods of observation and research. It is impossible also to dissociate pharmacology from clinical therapeutics ; the former investigates the agents which are used in the treatment of disease, the latter is concerned with their remedial powers and the conditions under which they are to be used. Hence the word " pharmaco-therapy " has come largely into use, and most of the newer standard text-books combine together the consideration of pharmacology and therapeutics. Phar- macology is also related to toxicology, as many remedial and other agents are more or less poisonous when given in large doses, but it does not include the detection, tests, and the other strictly medico-legal aspects of poisoning.

Medical writers in ancient and mediaeval times had a very good idea of the general symptoms produced in man by certain important drugs, such as opium, belladonna, and alcohol, and of the effects of certain purgatives, emetics, and so on, but they were with- out any accurate conception of the why or wherefore of these 'effects, and of the special organs on which their ac- tions were exerted. Pharmacology necessarily had to wait on the development of chemistry, |5hysics, physiology, pathology, and medical diagnosis. Until physiological research had investigated and explained the structure, function, and mechanism of the tissues and organs of the body in their norma] conditions, it was hopeless to expect that the effect of drugs on them could be profit- ably studied. Pharmacology therefore took origin as the result of the application of strictly experimental methods to physiology. The discovery (early in the 19th century) that plants owe their remedial and poisonous qualities to small quantities of definite active principles, such as alkaloids and neutral bodies, which can be extracted in a chemically pure condition, had also a very important effect on its development. We meet first with some early experiments made by investigators who perceived that observations on man and animals might lead to a better understanding of the action of drugs. In 1676 Wepfer and Conrad Brunner demonstrated on dogs the tetanizing action of mix vomica,

and similar rough experiments were repeated from time to time with other substances by later investigators. In 1755 Menghini published an

elaborate study of the action of camphor on a great vari- ety of different kinds of animals. Albert von Haller (born 1708) sought to elucidate the action of remedies by obser- vations on healthy men, and in 1767 William Alexander made experiments on himself with drugs, which were, however, brought to an abrupt termination by his nearly killing himself. In 1776 Daries, by observations on him- self and on cats, established the mydriatic action of bella- donna and other atropaceous plants. Hitherto no attempt had been made to determine what particular parts of the body were especially aifected by drugs, but Fontana showed, in his great work (Florence, 1705) on the venom of the viper and on other poisons, that the general symp- toms were brought about by an action on particular organs. In the course of his researches he performed more than six thousand experiments, more than four thousand of which were on animals, and he determined the effects on the heart and other isolated parts. These analytical methods of research were well known to the second Monro in Edinburgh, and to his pupils, one of whom, William Alexander, wrote a thesis in 1790 entitled " De partibus corporis animalis quae viribus opii parent." His methods were doubtless known also to the French physiologist Magendie, who improved upon them, and who in 1809 published a research on the Upas Tieute and other strychnine-containing plants, in which he showed that their effects were due to an action on the spinal cord. The researches of his pupil, Claude Bernard, on curare, were equally exact and logical, and have served as the model for many subsequent investigations. In consequence, from the time of Magendie pharmacology may be said to have been put on a more exact basis. By the middle of the 19th century there were many workers on the subject, and the actions of such drugs as digitalis, morphine, alcohol, and many others had been frequently and minutely investigated. About this time Buchheim, professor of materia medica in Dorpat from 1846 to 1879, founded the first pharmacological laboratory on modern lines in Europe, and he performed a still greater service by introducing a more rational classification of drugs than had hitherto been in use, arranging them in groups according to their pharmacological actions. In the

herbals and older treatises on materia medica and therapeutics, no explanation is usually offered of the action of medicijies, and in such works as that of Cullen (1789) only a few of the more obvious actions are occasionally explained according to the current theories of physiology and pathology. In works such as Pareira's Elements of Materia Medica and TJiera- peutics (1842), the physiological effects of medicines are usually described, but very briefly as compared with the materia medica. At the present day most text-books dealing with medicinal agents and treatm ent devote a large part of their space to pharmacology, and a corresponding change has taken place in the teaching of the subject in our universities and medical schools. Since Magendie's time very numerous papers dealing with pharmacological subjects have appeared in such journals as the Journal of Anatomy and Physiology, the Journal of Physiology, Virchow's Archiv, and the principal medical periodicals of all countries. In 1873 the Archiv fiir experimentelle Patho- logie und Pharmakologie first appeared, and in 1895 the Archives Internationales de Pharmakodynamie, both chiefly or entirely devoted to pharmacology.

The methods of research are essentially those employed by physiologists, the action of substances being studied in the usual way on bacteria, leucocytes, frogs, rabbits, and other animals. Not only are the general symptoms investigated, but it is necessary to carry out experi- ments on the nerves, muscles, circulation, secretions, &c., so as to get a more exact knowledge of the reasons of the general action. It is true that many of these animals

react somewhat differently to drugs, both as regards each other and as regards man, but for the most part the differences are quantitative rather than qualitative. After carrying out a series of observations on animals, the drug can be assigned to its special group, and a good idea can be obtained of its possible practical value or the reverse ; hence

there is a saving of time and an avoidance of the necessity of testing its effects on man. The action of a drug may be called direct, when it acts on any part to which it is immediately applied, or which it may reach through the blood ; and indirect, when one organ is affected secondarily to another, as, for instance, in strychnine poisoning when the muscles are violently contracted as the result of the action of the alkaloid upon the spinal cord. In a few cases the action is merely physical, but most frequently it is chemical in its nature, and is exerted on the living cell, the activity of which is either stimulated or depressed. In some cases the sub- stances actually enter into a chemical combination with the protoplasm, which may be temporary or (much less frequently) permanent ; in other cases they seem simply to modify or disturb the usual chemical activity of the cells. Prolonged or excessive stimulation invariably leads to depression or paralysis, the tissues becoming, in fact, fatigued, and from this condition they may recover or they may not. When we come to consider more in detail the results of these actions, we find that the various secre- tions of the body, such as the sweat, gastric juice, bile, milk, urine, &c., may be increased or diminished; that the heart may have its muscular or nervous apparatus stimulated or depressed; that the nerve-centres in the brain, medulla, and spinal cord may be rendered more sensitive or the reverse; and that the general metabolism of the body may be altered in various ways. In addi- tion, the fluid constituents, such as the lymph and blood, may have their composition and bulk considerably altered,^ while the special senses, the temperature, and, in short, every function and tissue, may be more or less affected.

Some drugs given in excess are poisons to all forms of protoplasm, but when given in doses much short of the lethal they usually exhibit a distinct tendency to affect , specially, and at an early period, certain organs or tissues, and hence result differences in action ; others may act only on certain organs, leaving the others practically untouched. It is often possible by appropriate dosage to contrive that these special parts or organs may be affected and the rest of the body left practically intact, and it is by taking advantage of these selective actions that remedial or therapeutical effects are usually obtained. Some sub- stances have a very wide range of action, and involve a great variety of

structures, while others, such as purgatives, have a very limited sphere.^ The most important of these circumstances is age, but speaking broadly this is really a question of bulk, the child being affected as the adult, but by smaller doses. There are exceptions to this, however, as children are more affected in proportion by opium and some other substances, and less by mercury and arsenic. In old age also the nervous system and the tissues generally do not react so readily as in youth. Habit, race, personal temperament, emotional conditions, disease, the time and circumstances of adminis- tration, and other accidental causes may also modify the action in man. Some species of animals are much more susceptible to the action of certain drugs than others, a condition which depends on obvious or unknown structural or metabolic diiferences. In the same way some individuals show a special tendency to poisoning by doses of certain drugs which are harmless to the great majority of mankind,

1 The action of drugs is often modified by cironrastances peculiar to the individuals or animals to whom they are administered.

and hence we get unexpected or unusual results, these aris- ing from special susceptibility on the part of certain organs. These idiosyncrasies are not confined to drugs, but are seen with a few articles of food, such as eggs and shell-fish. It is well known that the habitual consumption of certain drugs, such as tobacco, Indian hemp, opium, arsenic, alcohol, and many others, gradually induces a condition of tolerance to their effects, so that large doses can be taken without causing symptoms of poisoning. In all cases, however, there is a limit, and after it is reached the ordinary effects of these substances are seen. Some in- dividuals, however, never become tolerant, and show poisonous effects on each repetition of the dose. The degree of tolerance often differs in individuals at different times and in different circumstances, and may become quite lost by breaking off the habit for a short time. The explanation generally given is that the nerve and other cells become accustomed to the drug, so that they cease to react, or that an antitoxin is formed which antagonizes the poison, or that the poison is rapidly destroyed in the body. Eecent researches on arsenic and atropine, however, point to the leucocytes as play- ing an important part in the

production of tolerance, as these gradually become capable of ingesting large amounts of the foreign substances, and thus render them more or less harmless to the tissues, until they are gradually excreted from the body. But in the case of arsenic an antitoxin also forms in the blood. When the amount is too large to be dealt with by the leucocytes, poisoning seems to occur even in the most habituated. Tolerance is therefore analogous to the immunity which takes place with the toxins of infectious diseases and snake poison. Certain substances, notably digitalis, lead, mer- cury, and strychnine, exhibit what is called a cumulative action â€" that is to say, when small quantities have been taken over a period of time, poisoning or an excessive action suddenly ensues. The explanation in these cases is that the drug is absorbed more rapidly than it is excreted, hence there is a tendency to its accumulation in the body until a point is reached when the amount becomes poisonous.

Bodies which have a close resemblance in their chemical constitution exhibit a similar resemblance in their phar- macological action, and as the constitution of the substance becomes modified chemically so does its action pharmaco- logically. Numerous researches have demonstrated these points with regard to individual groups of substances, but hitherto we have not been able to formulate any fixed laws regarding the relationship between chemical constitution and physiological action.

When drugs are s-^-allowed no absorption may take place from the alimentary canal ; but, as a rule, they pass from there into the blood, in which they circulate, and thus exert their action on different organs. Absorption may also take place from the skin, from the rectum, from the respiratory passages, or from wounds, and from direct in- jection into the subcutaneous tissue or into a blood-vessel. Very rarely, as in the case of silver salts, excretion does not take place ; but usually the drug is got rid of by the bowel, urine, bile, saliva, bronchial mucous membrane, or the (ither ordinary channels of elimination. Just as drugs act upon the tissues, so they themselves are in many cases reacted upon, and broken up or altered. While "in the alimentary canal they are subjected to the action of the digestive fluids and the varied

contents of the stomach and intestines, and after absorption they come under the influence of the constituents of the blood and lymph, and of the chemical action of the tissue cells. Inorganic bodies, such as metals, may enter into albuminous combinations which may greatly modify their effects, and organic substances may be split up into simpler compounds by

oxidation or reduction, or may be rendered more complex by synthesis.

The antagonism between certain drugs has been much studied in relation to their use as antidotes in poisoning, but what is aimed at in these cases is to counteract the effects rather than to obtain a direct physiological antago- nistic action. The substances which directly antagonize each other by acting on the same tissue are few in number, but there are numerous instances in which the effects or symptoms may be obviated by acting on another tissue. Thus curare may stop strychnine convulsions by parsr lysing the terminations of motor nerves, and chloroform may exercise the same effect by abolishing the irritability of the spinal cord. If two poisons act on the same tissue, one stimulating and the other paralysing it, the paralysing substance removes the action of the stimulant substance, not by bringing the tissue. back to its normal state, but by abolishing its excitability ; hence, although life may be saved by such an action, yet it can only be so within certain limits of dosage, because the antagonism is never complete at every point.

Speaking in the widest sense, every substance has an action on living protoplasm, but for convenience' sake pharmacological substances have come to be limited to those which are used as drugs, or which have a distinct action upon the animal organism, although they may not be put to any practical purpose. Such substances are derived from (1) the chemical elements and their com- pounds ; (2) plants ; and (3) animals. The first class includes such substances as iodine, mercury, iron, carbon, and their various compounds, and such bodies as alcohol,

chloroform, and chloral, all' of which are found in Nature or can be prepared by ordinary chemical processes of manufacture. From plants many substances are obtained which at the present time we are unable to make in the chemical laboratory, and of the constitution or composition of which we are in many cases ignorant. Some of these, such as resins, gums, essential oils and fats, are readily obtained as natural exudations or by very simple manipu- lations, while others, such as the alkaloids, glucosides, and vegetable acids, often require to be extracted by very complex processes. Substances obtained from animals include gland secretions, pepsin and other ferments, musk, cod-liver oil, &c., and to these may be added various

antitoxins. The classification of substances Classifies- â– i;^aying pharmacological actions presents so

many difflciilties that no satisfactory or uni- versally adopted method has yet been proposed. As a matter of fact, our knowledge presents so many gaps, and the mode of action of many remedies is so obscure and imperfectly understood, that any arrangement adopted must be more or less tentative in character. The close alliance between pharmacology, therapeutics, and clinical medicine has induced many authors to treat the subject from a clinical point of view, while, on the other hand, its relationships to chemistry and physiology have been utilized to elaborate a chemical and physiological classifi- cation respectively as the basis for systematic description. Certain writers in despair have adopted an alphabetical arrangement of the subject, while others have divided it up into inorganic, vegetable, and animal substances, following the botanical natural orders and the divisions of the animal kingdom. Tbese last-mentioned methods, however, are far behind our present state of knowledge, and need not be discussed here. The objection to a strictly chemical classification is, that while many sub- stances closely allied chemically have a somewhat similar action in certain respects, yet in others they differ very widely â€" a striking example of which is given in the case of sodium and potassium. A physiological classification according to an action on the brain, heart, kidney, or

other important organ becomes still more bewildering, as many substances produce the same effects by different agencies, as, for instance, the kidneys may be acted upon directly or through the circulation, while the heart may be affected either through its muscular substance or its nervous apparatus. A clinical or therapeutical classification into such divisions as anaesthetics, exjiectorants, bitters, and so on, according to their practical applications, also leads us into difficulties, as many drugs are employed for numerous purposes, and they cannot therefore be strictly classified in this way. The ideal method of grouping pharmacological substances would be in refer- ence to their chemical action on living protoplasm, but as yet our knowledge is too scanty for this. At the present time the method adopted by Buchheim, or some modification of it, is the most scientific. As the result of painstaking investigations he grouped together all those substances having similar actions, giving to each group the name of its best-known or most thoroughly investi- gated member. Once the groups were more or less fixed any new substance could, when its action was determined, be referred to its own group, and thus be placed or classi- fied. As few substances are absolutely identical in action, but only broadly similar, it is often difficult to divide sharply one group fronj. another. In a r6sumd it is mani- festly impossible to pass in review every pharmacological substance, and we shall therefore confine ourselves to those groups which are of practical importance. Many of the individual drugs have been already described, and detailed information regarding them may be obtained by reference to the particular headings in the earlier volumes (ninth edition) of this Encyclopaedia.

Group I. â€” Acids. â€” This includes sulphuric, hydro- chloric, nitric, phosphoric, tartaric, citric, acetic, and lactic acids, all of which owe their action to their acidity. Many of the other acids, such as carbolic and salicylic, have specific effects which have no relationship to their acid reaction. The concentrated acids have an intense local action, varying from complete destruction of the tissues to more or less irritation. When considerably diluted they lose this, and are only slightly irritating; externally applied and in the stomach they have an antiseptic action ; they increase the secretion of saliva, and thus assuage thirst. In the intestine they combine with ammonia and other alkalis

present, and are absorbed into the blood as neutral salts, being excreted chiefly in the urine. In small doses they somewhat increase general metabolism. Boric acid only belongs partially to this group, as it and its compound borax have certain specific actions in addition.

Group II. â€” Alkalis. â€” This includes caustic potash, caustic soda, solution of ammonia, their carbonates and bicarbonates, borax, soaps, lithium carbonate and citrate, quick lime, slaked lime, chalk, magnesia, and magnesium carbonate. All these substances, apart from any other actions, exert a similar effect upon the body in virtue of their alkalinity. When they are taken internally in small amounts they neutralize the acids in the stomach and other parts of the alimentary canal, and at the same time they increase the normal acid secretion of the stomach. After absorption into the blood, which they make somewhat more alkaline, they are excreted chiefly in the urine, to which they impart an alkaline reaction if given in sufficient quantity. Some of them by stimulating the kidney cells act as diuretics, but others apparently lack this action. Caustic potash and caustic soda are locally very irritating, and destroy the tissues, but lose tliis quality when combined with acids as in the case of their carbonates, bicarbonates, and borax. Quick lime is also caustic, but magnesia is bland and unirritating. Weak solutions applied locally saponify fats,

soften the epidermis, and thus act as slight stimulants and cleansers of the skin. Calcium salts form insoluble soaps with fats, and combine with albumen in a manner which makes them soothing and astringent rather than irritating locally. Apart from alkaline effects, these metals differ considerably pharmacologically. Potassium and lithium have a depressing action upon the nervous system, ammonium salts have a stimulating action, while sodium practically speaking is indifferent. Calcium and magnesium have actions somewhat similar to that of potassium. Most of these substances are normal con- stituents of the

body, and indispensable for healthy existence. They are contained in sufficient amount in our ordinary dietary to supply the needs of the organism.

Geoup III. â€” Easily absorbed Salts. â€” Sodium chloride may be taken as the type of those salts which diffuse readily, and which are therefore easily absorbed. Sodium nitrate, potassium nitrate, potassium chloride, ammonium chloride, the alkaline iodides and bromides, also belong partly to this group, although most of them have specific actions in addition. Locally they cause considerable irritation, and when swallowed in concentrated solution may cause vomiting. From the stomach and intestines they are rapidly absorbed, and rapidly excreted from the blood, increasing all secretions and the general meta^ holism. These effects are apparently due to their irritat- ing action upon individual cells.

Group IV. â€” Salts absorbed with difficulty. â€” This group includes the sulphates of sodium, potassium, and mag- nesium, the acetate and tartrate of potash, citrate of magnesium, sodium phosphate, sodium tartrate, and similar salts. Locally their action is slight, but when taken internally, dissolved in water, they are not absorbed from the alimentary canal except in very limited amount. They therefore remain for the most part in the intestine, and as they attract and retain large quantities of water, and at the same time slightly stimulate the mucous mem- brane, they come to have a purgative action and form the well-known group of saline cathartics. The small portion which is absorbed exerts a diuretic action.

Geoup V. â€” Heavy Metals. â€” These include iron, manga- nese, aluminium, chromium, zinc, copper, silver, gold, platinum, lead, mercury, and probably antimony, arsenic, and bismuth. Although some of these differ very greatly in their actions after absorption, still locally they have certain effects in common due chiefly to their chemical action on albumen. Their soluble salts precipitate albumen and preserve it, strong solutions being extremely irritant or caustic, while weaker ones are astringent simply, or even soothing. They are all antiseptics. Their insoluble compounds are much less active locally than the soluble, and

in many cases are only effective to the extent to which they are dissolved by the secretions. Some metals are only absorbed from the alimentary canal to such a very limited amount that they exert no general action, while others readily pass into the blood and give rise to more or less marked effects. All of them injected into the blood in large doses act as muscle and nerve poisons, and during their excretion by the kidney usually irritate" it severely, but only a few are absorbed in sufii- cient amount to produce similar effects when given by the mouth. When iron is injected directly into a vein it depresses the heart's action, the blood pressure, and the nervous system, and during its excretion greatly irritates the bowel and the kidneys. When taken by the mouth, however, no such actions are seen, owing to the fact that very minute quantities are absorbed, and that these become stored in the liver, where they are converted into organic compounds and ultimately go to form haemoglobin. Soluble salts of manganese, aluminium, zinc, copper.

gold, platinum, and bismuth have, when given by the mouth, little action beyond their local astringent or irritating effects ; but when injected into a blood-vessel they all exert much the same depressing effect upon the heart and nervous system. Silver resembles them closely, but differs by the circumstance that it is deposited per- manently in minute granules in the tissues, and, with- out affecting the general health, stains the skin of a bluish colour (argyria). Mercury and lead are absorbed from the bowel in considerable quantities, and a;:e capable of inducing acute irritant poisoning as well as chronic poisoning. In.the case of lead, the metal poisons the muscular and nervous systems, and gives rise to paralysis, wasting, colic, and other symptoms, while in the case of mercury, tremors, salivation, anaemia, and very marked cachexia are induced. Arsenic and antimony do not form combinations with albumen, but they both greatly depress the central nervous system and circula- tion ; and, if their action be long continued in large doses, they cause fatty degeneration of the viscera and dis- appearance of glycogen from the liver. Locally they are both very irritating, and antimony has a special ten- dency to cause vomiting.

Geoup VI. â€” Halogens. â€” This group includes iodine, bromine, and chlorine, in their free state or as compounds. Locally they are all three strongly irritant or caustic, owing to their chemical action on albumen. They are in addition powerful germicides, and by splitting up water may act as oxidizing agents. Owing to their strong affinity for the hydrogen of organic compounds, they often act as bleachers and deodorizers. Iodine has a special interest, from the fact that it is a necessary constituent of our food, and is present in the secretion of the thyroid gland. Apart from certain conditions of ill-health, the iodides, as such, have no very marked influence on the healthy body beyond their saline action. Alkaline bromides, in addition to their saline action, have in suf- ficient doses a depressing effect upon the central nervous system, and less markedly upon the heart. Chlorine compounds are not known to exercise any action of a similar kind.

Geoup VII. â€” Sulphur. â€” Sulphur itself has no action, but when brought into contact with the secretions it forms sulphides, sulphites, and sulphuretted hydrogen, and thereby becomes more or less irritant and antiseptic. In the bowel its conversion into sulphides causes it to act as a mild laxative. Baths containing sulphuretted hydrogen or alkaline sulphides have a slightly irritating effect upon the skin, and stimulate the general metabolism.

Group VIII. â€” Phosphorus. â€” This includes phosphides, and, according to some authorities, hypophosphites. Phos- phorus is present in all cells, in considerable quantity in the nervous tissue, and in the bones as phosphates. It is therefore, in some form or other, a necessary part of our dietary. When the element itself is taken by the mouth it is an irritant poison in large doses ; in small doses the only effects which are noticeable consist in an increased formation of bony and connective tissue, although it is also supposed to exert a gently stimulating effect upon the nervous system.

Group IX. â€” Oxygen. â€” When pure oxygen is inhaled the only effect is a slight increase of the amount of the gas in the blood, but this has no particular physiological effect. The pharmacological action of hydrogen peroxide (H2O2), potassium permanganate, powdered

charcoal, and some other oxidizing agents depends on the readiness with which they give up oxygen.

Group X. â€” Carbonic Acid. â€” Carbonic acid gasi, carbonic oxide (CO), and some other irrespirable gases produce their effects practically by asphyxiation. When dissolved in water, however, carbonic acid gas is a gentle stimulant

to the mouth, stomach, and bowel, the mixture being absorbed more rapidly than plain water; hence its greater value in assuaging thirst. Nitrous oxide (laugh- ing gas) was at one time believed to act simply by cutting off the supply of oxygen to the tissues, but in addition to that it has certainly a specific effect in producing paraly- sis of certain parts of the central nervous system, and hence its value as an anaesthetic ; when given in small amounts mixed with air it simply produces a condition of exhilaration.

Group XI. â€” Water. â€” Water acts directly as a diluent and solvent in the body. It therefore increases all the secretions, especially those of the skin and kidneys, while it also . stimulates the general metabolism of the body and the excretion of nitrogenous products. Mineral waters act in the same way, but their effects are very much modified by, and depend largely upon, other con- stituents, such as alkaline salts, iron, arsenic, sulphides, carbonic acid, &c.

Geoup XII. â€” Tannic Acid. â€” Tannic acid is present in small quantities in the great majority of plants, but in notable quantity in gall-nuts, oak bark, bearberry leaves, rhatany root, catechu, kino, red gum, bel fruit, logwood, and witch hazel, all of which are largely used as medi- cines. In these the variety of tannic acid is not exactly the same, but although there are slight chemical differ- ences, they all possess the power of tanning raw hides and of preserving albuminous tissues. The action of tannic acid is strictly local, and depends upon its power of pre- cipitating albumen and of destroying germs. It thus acts

as an astringent on all mucous membranes. After absorp- tion into the blood it loses this effect, as it is partly broken up into gallic acid and partly combined with alkalis, both of which changes nullify its action upon albumen.

Group XIII. â€” Local Irritants. â€” Although some of the drugs already considered have a local irritant action, they produce other effects which throw this into the background, but the substances which are here ranged under this heading depend entirely for their action on their local irritant effects.

(a) Those which act upon the alimentary canal : â€” Simple bitters such as quassia wood, columbo root, taraxacum, gentian, chiretta, and many others, irritate gently the mucous membrane of the stomach and bowels, and by increasing the secretions improve the appetite and digestion. The aromatic bitters such as camo- mile flowers, casoarilla bark, hops, absinthe, orange peel, and others, contain in addition small quantities of essential oils which increase their local action and give them a pleasanter flavour. The active principles in some of these bitters have been isolated pure, and have been found to be alkaloids or neutral compounds. Substances like pepper, cayenne pepper, mustard, horse-radish, and ginger irritate the stomach and bowel much in the same way, but are more pungent, and are consequently used as condi- ments. Some of these have a similar but less marked effect upon the skin. The large number of vegetable substances which are used as purgatives owe their action to an irritating eflect upon the mucous membrane and the neuro.muscular apparatus of the bowel, whereby the secretions and peristalsis are more or less increased, as the result of which diarrhoea ensues. Some of them cause so much irritation that the discharge is very watery (hydragogue cathartics), while others, for example aloes, by act- ing gently on the lower part of the bowel and on its muscular coat, produce simply a laxative effect. A few of them, such as aloin and colocynthin, are also purgative when injected subcutaneously or into the blood, probably owing to their being excreted into the intestinal canal.

(6) Those which act on the skin : â€” The best known of these is cautharides (Spanish fly), the active principle of which is a colour- less crystalline body â€” cantharidin â€” which is extremely irritating. On a mucous membrane or a delicate skin It exerts an irritant action, which occurs more quickly than on a thickened epidermis, such as the scalp, and according to the strength and period of application there may result redness, a blister, or an ulcer. Many other substances, such as chrysarobin, mustard, pepper, &c., are also capable of irritating the skin, the effect produced varying from mere dilatation of the cutaneous vessels to destruction of tissue.

Group XIY.â€” Male-fern. â€” This includes the male-fern, santonin, cusso, pomegranate bark, pumpkin seeds, and a very considerable number of other substances, all of which contain active principles which have a specific poisonous action on intestinal parasitic worms. Apart from this their actions vary considerably, but are of little practical importance.

Group XV. â€” Ethereal Oils. â€” This includes a very large number of substances which owe their action to the fact that they contain ethereal or essential oils. The best known of these are cloves, pimento (allspice), myrtle, eucalyptus, caraway, fennel, dill, coriander, rosemary, lavender, peppermint, spearmint, nutmeg, cinnamon, sandal-wood, turpentine, juniper berries, valerian, sum- bul, and many other substances. In this group may also be included the oleo-resins, such as copaiba, cubebs, and Canada balsam ; the gum-resins, such as asafcetida, myrrh, ammoniacum, and galbanum ; and the true balsams, such as benzoin, storax, balsam of Tolu, and balsam of Peru. The resins when taken internally have much the same action as essential oils, which are closely allied chemi- cally, while the benzoic and cinnamic acids present in the balsams modify their actions very slightly. Although individual essential oils may differ somewhat in action, yet chemically and pharmacologically they are funda- mentally similar. They all have a poisonous action on protoplasm, which makes them useful in medicine as antiseptics, disinfectants, germicides, anti-fermentatives, and parasiticides ; when locally applied they are more or less irritating, and, when very dilute, astringent. When swallowed in small doses they

slightly irritate the mouth and gastric mucous membrane, increasing the secretions and producing a feeling of warmth. At the same time they increase the movements of the stomach, and also in this way hasten digestion, an action which extends to the upper part of the bowel. They are readily absorbed into the blood, and they are excreted chiefly by the kidneys in a more or less altered form, and probably also by the different mucous membranes, and even by the skin. After absorption their action, speaking generally, is ex- erted on the brain and spinal cord, and is at first slightly stimulant and afterwards depressing, even to the causing of sleepiness and stupor. Locally applied they depress the terminations of sensory nerves, and may thereby lessen pain. On the heart and circulation the effects are stimu- lant unless large doses are given, when the pulse becomes slow and blood-pressure much lessened. During excre- tion they irritate the kidneys and the sweat glands, and thereby increase the excretion of urine and of sweat. They also have the effect of increasing the number of leucocytes in the blood, and the more irritating of them increase the flow of blood to the pelvic organs, and may thus stimulate the uterus, or in large doses cause abor- tion. The various camphors, such as laurel camphor, Borneo camphor, menthol, and cumarin, are oxidized derivatives of essential oils, and differ only superficially from them in their action.

Group XVI. â€” Phenol. â€” This includes a very large number of bodies chemically allied to benzol, such as carbolic acid, sulpho-carbolates, creosote, wood tar, coal tar, oil of cade, thymol, salicylic acid, benzoic acid, naph- thol, hydrochinon, cresol, guaiacol, ichthyol, saccharin, and many others. These all resemble carbolic acid more or less closely, and may be described as general proto- plasm poisons. Locally their destructive and irritating effects vary a good deal, but even when very dilute they all have a marked poisonous action on bacteria, white blood corpuscles, yeast, and similar organisms. After absorption most of them exercise a depressing effect upon the nervous system, and are capable of reducing high temperature. They are mostly excreted in the urine.

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G-Eoup XVII. â€” Alcohol. â€” This group also includes a very large number of chemical bodies, only a few of â– which are mentioned here. Ethylic alcohol is taken as a type of the action of methyl alcohol, amyl alcohol, propyl alcohol, ether, acetic ether, amyl ether, paraldehyde, sulphonal, chloroform, methyl chloride, ethyl chloride, chloral hydrate, butylchloral hydrate, and almost any number of derivatives from these. Some of them are so volatile that they produce their effects when inhaled, others when sprayed upon the skin cause intense cold and then aneesthesia; but taken in the broadest sense the action of all of them after absorption into the blood is very similar, and is exerted upon the central nervous system, more especially the cerebrum. Their effects are said to be brought about by a slight coagulating action on the substance of the grey nerve cells. In all cases there is a longer or shorter period of excitement, fol- lowed by intoxication or narcosis, and with large doses this passes into paralysis and death from depression of the respiratory centre or of the heart. Small doses of any of them dilate the blood-vessels from an action on the vaso-motor centre in the medulla oblongata, as a result of which the heart beats more rapidly and the blood circulates more freely in the body; but larger doses have a general depressing effect upon the circular tory system. Under their action more heat is lost from the body, the general metabolism is diminished, and the temperature falls. With some of them, such as chloral and chloroform, the stimulation period is short compared with the narcotic period, while with others, such as ether, the reverse is the case.

Geoup XVIII. â€” Nitrites. â€” This group contains amyl nitrite, ethyl nitrite, methyl nitrite, nitroglycerin, sodium and potassium nitrites, erythrol-tetranitrate, and many other compounds containing nitrous or nitric acid. The latter becomes reduced to nitrous in the body, and thereby exercises its characteristic effects. These consist chiefly in an action upon non-striped muscle, vaso-motor centres, blood-vessels, and the blood. When they are given by inhalation or by the mouth their first effect is to produce marked dilatation of the small arteries, with a fall of blood-pressure and a greatly increased rapidity of the heart's

action. At the same time the non-striped muscles slightly lose their tonicity, and when very large doses are given the haemoglobin of the blood becomes converted into the chocolate-coloured methaemoglobin. The volatile members of the group act much more rapidly and more transiently than the others.

Geoup XIX. â€” Alkaloids. â€” This embraces a very large number of important pharmacological substances, which differ a good deal in the details of their action, but which have this in common, that they all act upon muscle and nerve tissue. Some of them affect only certain portions of the nervous system, others have a much wider range of action ; they may act in either case as stimulants or as depressants, and hence the symptoms produced by them vary very greatly.

(1) Morphine and the other opium alkaloids (codeine, narootine, laudanine, &o.) have two prominent actions â€” a narcotic followed ty a tetanic action. In the case of morphine, on the higher ani- mals at least, the narcotic action is very mariced, the tetanizihg action slightly so ; while in the case of thebaine there is practically little narcotic effect, but a tetanizing action like that of strychnine. Morphine exercises its effects chiefly upon the cerebrum and the medulla oblongata in man. It has in addition a markedly depress- ing action upon the respiratory centre, it lessens all the secretions except the sweat, and diminishes bowel peristalsis and the size of the pupil. Men are much more affected by it than birds, rabbits, dogs, and most other animals. Cats, on the other hand, show marked symptoms of cerebral excitement and increase of the reflexes. Compared with morphine, codeine and the other alka- loids are only slightly narcotizing.

(2) Strychnine and brucine very closely resemble each other in

action, and under this heading curarine may also be included. These bodies stimulate the grey matter in the spinal cord, and cause tetanic convulsions. In the case of curare these are masked almost at once by paralysis of the terminations of the motor nerves.

(3) Caffeine is the active principle in tea, coffee, kola, mat6, and guarana ; while theobromine, a body closely allied to it, is found in

cocoa and chocolate. They both stimulate the grey nerve-cells in the brain and cord, this being the foundation of their dietetic value and their use as nervine stimulants. They also markedly increase the secretion of urine by stimulating the secreting cells of the kidneys.

(4) Cocaine is the active principle of the coca leaf, which is chewed as a stimulant-narcotic in Peru and Bolivia. Small doses have an exciting effect on the nervous system, while larger doses are depressing. The chief action of cocaine from a practical point of view is its power of paralysing the terminations of sensory nerves.

(5) Atropine, hyoscyamine, homatropine, duboisine, daturine, and some other bodies have a paralysing action upon the ends of the motor and secretory nerves. They therefore lessen all the secretions, and among other actions dilate the pupil and increase the rapidity of the heart by paralysing the vagus. Besides this they have a stimulating action on the central nervous system.

(6) Nicotine, piturine, and lobeline are the active principles of tobacco and other substances which are smoked as stimulant narcotics. In large doses they are powerful nerve poisons, but as usually taken they exercise a gently stimulant effect upon the nervous system. Pilocarpine has an action closely allied to that of nicotine, but as it is much less poisonous (the efiects produced by small doses being chiefly excessive sweating and salivation), it is capable of being utilized in medicine. Muscarine has a very close resemblance in action to pilocarpine.

(7) Physostigmine, the active principle of the Calabar bean, acts chiefly as a stimulant to voluntary and involuntary muscles, and at the same time exercises a depressing effect upon the spinal cord. It contracts the pupil.

(8) Conine, gelseminine, and sparteine all exert a paralysing effect on the terminations of the motor nerves, to the implication of which the weakened gait and other symptoms are due.

(9) Aconitine, delphinine, and many of their derivatives have a very widespread action on muscle and nerve, which are both de- pressed

from the beginning.

(10) Apomorphine is essentially a muscle poison, but owing to the fact that minute doses stimulate the vomiting centre and cause emesis before any other symptoms are observable, its emetic action is the most prominent effect in man.

(11) Emetine acts as a gradual depressant to the nervous system in animals. In man its chief effect is its emetic action, which seems to be due entirely to local irritation of the stomach.

(12) Quinine. Several of the other alkaloids found in cinchona bark act very much like quinine, while phenacetin, antipyrin, acetanilide, and many other artificially-made substances of the same nature resemble it and each other closely. They all depress the conducting power and the grey matter of the spinal cord, and to a much less extent that of the brain. They lessen the general metabolism and lower febrile temperature. The cinchona alka- loids have a specifically poisonous effect on the parasites of malaria when present in human blood, and are in addition poisonous to all low organisms.

Geoup XX. â€” Digitalis. â€” This group-name has been given to a large number of substances which have an action similar to that of the foxglove leaves, including the active principles of strophanthus, squill, Urechites suberecta, Gonvallaria majalis, Nerium Oleander, Helleborus niger, Antaris toxicaria (the upas tree), and several others. The active principles of these vary a good deal in chemi- cal composition, but they are all non-nitrogenous neutral bodies. Their action is exerted upon muscle, but chiefly upon the muscle of the heart and blood-vessels. The individual muscle-fibres contract and expand more per- fectly, and thus the diastole and systole of the heart ai-e rendered more complete, the pulse is slowed, and the blood-pressure is raised. The slowing of the heart is partly brought about by an action on the vagus centre.

. GrEOUP XXI.â€”Ficwtoxin.â€” In large doses the action of picrotoxin is exerted chiefly on the medullary nerve centres, whereby irregular tonic-clonic convulsions are produced ; in minute doses it stops the secretion of sweat.

Group XXII. â€” Saponin. â€” Saponin and allied bodies form an abundant soapy-looking froth when shaken up with water, and they are contained in a very large number

of plants, the chief of which are the Quillaia saponaria, Poly gala senega, sarsaparilla, and others, known collec- tively as soapworts. They all act as local irritants in the alimentary canal, and after absorption are more or less depressing to the muscular and nervous systems. They produce slight nausea and increased secretion of mucus.

Group XXIII. â€” Cyariogen. â€” This includes compounds of cyanogen such as hydrocyanic (prussic) acid, cyanides of potassium, sodium, &c., cherry ~~laurel water, amygdalin, bitter almonds, and other chemical and vegetable sub~~ stances which readily yield hydrocyanic acid. Hydro- cyanic acid is a general protoplasmic poison, all the lower organisms being very susceptible to its action, while in the higher animals it speedily depresses or paralyses all forms of nerve tissue. It enters into combination with haemoglobin, forming a bright scarlet compound and interfering with respiration. It kills by its paralysing effect on the motor ganglia of the heart and on the respiratory centre.

G-Roup XXIV. â€” Ferments. â€” These include such bodies as pepsin, diastase, the pancreatic ferments, papain, the pine-apple ferment, takardiastase, and others, and serve to convert starch into saccharine substances, or albumen into peptone and albumoses.

Group XXV. â€” Animal Glands and Secretions. â€” Of these the thyroid gland, the suprarenal bodies, the spleen, the bile, the bone marrow, the ovaries, and some others have been investigated fully. Speaking generally, when given in small doses their action on the healthy organism is slight or nil, but in disease some of them are capable of acting as substitutes for deficient secretions.

Group XXVI. â€” Antitoxins. â€” These are substances which antagonize the toxins formed in the body by pathogenic organisms, the toxins of snake venom and other animal poisons, and vegetable toxins such as abrin, riein, &e. A healthy person can be rendered insusceptible by gradually accustoming â– him to increasing doses of these poisons, and this immunity is due to antitoxins which are found in the blood serum and which are products of the body cells. The nature of these anti- toxic substances is not definitely known, but they are supposed to combine with and destroy the poisons. In specific geriii diseases a similar antitoxin forms, and in cases which recover it counteracts the toxin, while the germs are destroyed by the tissues. Antitoxins can be prepared by immunizing a large animal, such as a horse, by inject- ing gradually increasing doses of specific toxins into its subcutaneous tissue. In due time the horse is bled, the serum is filtered free of blood corpuscles, and then con- stitutes the antitoxic serum, which can be standardized to a certain potency. Such serums are injected subcutane- ously in diphtheria, tetanus, streptococcic infections, plague, snake-poisoning, cholera, and other similar diseases. They do not harm healthy men even in large quantities.

Group XXVII. â€” NeutralFats. â€” This includes cod-liver oil, almond oil, olive oil, lard, &c., all of which act as foods when taken internally, and have a merely physical emollient action when applied externally. Lanolin, linseed oil, wax, spermaceti, &c., also belong to this group. The paraffins, glycerin, and vaseline, although not fats, have much the same effect when applied externally, but they are not nutritive.

Group XXVIII. â€” Sugars, Starches, Gums, Gelatin, &c. â€” Although these and allied bodies are used in various ways, as drugs their action is for the most part purely mechanical or dietetic.

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Phelps, Samuel (1804-1878), English actor, was born at Devonport, 13th February 1804. His parents dying when he was a boy, he was early thrown upon his own resources, and, after a short experience of work in various newspaper offices, took to the stage as an occupation in 1826. About the same time he married Sarah Cooper, a girl of sixteen. She bore him three sons and three daughters, and died in 1867. After playing a diversity of parts with touring companies in the north of England and in Scotland, he appeared in some south of England towns in a round of prominent tragic characters, and attracted sufficient attention to be spoken of as a rival to Kean. After a short season under Webster at the Haymarket, he joined Macready's company at Covent Garden, where he first appeared in October 1837. He was with Macready for about six years at Covent Garden, the Haymarket, and Drury Lane successively, and during this period was seen in a number of important parts. In 1844, having by this time firmly established his reputa- tion, he became co-lessee of Sadler's Wells Theatre with Thomas Greenwood and Mrs Warner. Greenwood supplied the business capacity, Phelps was the theatrical manager, and Mrs Warner his leading lady. In this position Phelps remained for twenty years, during which time he raised the Sadler's Wells house to an important position, and himself appeared in a very extensive and varied repertory of characters. Thirty-four of Shake- speare's plays were presented there under his direction. In 1861 Greenwood retired from the partnership, and Phelps, finding himself unable to cope with the business responsibilities of the management, retired from it in the

following year. Eor the next fifteen or sixteen years he acted under various managements, his last appearance being in 1878 as Wolsey in Henry VIII., under Miss Litton at the Imperial Theatre. After this his health began to fail, and he died at Coopersale, near Ejjping, on 6th November 1878. He was essentially a sound and capable actor, rather than one of any marked genius ; and, in spite of his predilection for tragedy, was most successful in such characters of comedy as called for dry humour. Perhaps Sir Pertinax Macsycophant in Charles Macklin's Tlie Man of the World was his finest impersonation. He published an annotated edition of Shakespeare's plays, in 2 vols., 1852-64. (r. p. s.)

Philadelphia, the chief city of Pennsylvania and the third city in size in the United States, is situated on the west bank of the Delaware river, 96 miles from the Atlantic Ocean and 126 miles in a direct line north-north-east of Washington, D.C., and 85 miles south-west of the city of New York. It covers an area of 129-58 square miles, and the Schuylkill river, running north and south, divides the city. The length of river front on the Delaware is 18-8 miles, and the length of wharves 6-5 miles. On both sides of the Schuylkill the river front is 14-6 ihiles, and the length of wharves 3 miles. The channel of the Delaware river has been deepened to 26 feet below mean low water for the distance of 6-4 miles, giving a channel of this depth for 20 miles below the Philadelphia harbour, and it is bei^g further deepened

to 30 feet. The channel of the Schuylkill river has been deepened to 22 feet for a distance of 3 miles, and to 20 feet for a distance, above, of 17-1 miles. These improvements were begun in 1895 and completed in 1899. At the confluence of these two rivers is situated the United States ISTaval Station at League Island, covering an area of 997 acres and having a water front of 7 miles. This is the largest fresh-water naval station in America. Wind: mill or Smith's Island, in the Delaware river, lying between Philadelphia and Camden, New Jersey, which is on the east bank of the river, has been removed, giving clear navigation between the two cities by constantly- crossing ferry boats.

The city is divided into 42 wards, and there are plotted upon the city plans 955,165 separate town lots. There are laid down on these plans upwards of 3000 miles of streets, but only 1542 miles are at present opened. Of these, 413 miles are unpaved, 301 miles are laid with improved sheet asphalt pavements, 362 miles with granite blocks, 134 miles with vitrified brick, 226 miles with macadam, 61 miles with cobble or rubble stone, and 29 miles with blocks. Market or High Street and Broad or 14th Street are the most important thoroughfares. The former, running east and west, is 6 miles long, and Broad Street, running north and soutli, has a length of 13 miles, 10 of which are paved with sheet asphalt, making it the longest street so paved in the world. There are 1850 miles of pavement, 311 bridges, and 919 miles of sewers. There are 65 lines of electric street railway, covering 175,000 miles daily, and carrying an average of 1,000,000 passengers each day. The city has 9083 electric street lamps, at a cost of 30-17 cents per night, 20,373 gas lamps, and 14,355 gasoline lamps. There were, 31st December 1901, 5,045,977 feet of electric conduit, representing an aggregate of 26,288,119 feet of duct. At the same period there were 104 miles of telegraph and telephone cable, containing 4121 miles of wire ; 14,135 miles of overhead wire and 99,550 miles of underground wire. There are 1379 miles of water mains, through which in 1901 there were distributed 102,191,040,693 gallons of water, or 279,975,453 gallons a day, being 211 gallons per day for each man, woman, and child, figures which seem to show an enormous wastage. A system of slow sand filtration was being constructed in 1902 at a cost of nearly $20,000,000, and by the end of that year 300,000,000 gallons of filtered water will be furnished to the citizens daily. There are 19 reservoirs or water basins, with a capacity of 1,417,860,400 gallons, into which there were pumped, in 1901, 101,836,624,094 gal- lons, at a cost of $871,886. The receipts of the water department for the same period were $3,331,437, showing a profit to the city of $1,807,236.

The city has 47 small public parks or air spaces, aggre- gating 627 acres, besides Fairmount Park, the area of which has been increased to 3341-328 acres. The total cost of the latter, to 1st May 1902, was $6,430,000, and there had been expended on improvements $3,659,000. The Schuylkill river runs through the park for 4-2 miles, and

Wissahickon creek for 6-8 miles. The commissioners of Pairmount Park are the custodians of Willstack bequest of about $800,000 for a public art gallery which has been established in the park. A large number of statues and monuments have been placed in the park, the most important for size and cost being that erected by the Pennsylvania State Society of the Cincinnati to the memory of Washington.

Municipal Government. â€" By the governor's approval, 1st June 1885, of a legislative enactment known as " The Bullitt Bill," the government was radically changed. The Bill was drafted and passed in the interest of good govern-

ment and economy, but this Utopian purpose has sadly miscarried. The law went into effect 4th April 1887, and for the year prior thereto the cost of maintaining the city was $9,434,507. The first year of the new government cost the city $13,273,893, and from this it steadily rose until in 1901 the cost reached $24,522,804. By the Bullitt Bill extraordinary powers are conferred upon the mayor of the city as its chief executive officer, who holds office for four years, and serves until his successor is duly qualified, but is ineligibre for re-election for the next succeeding term. He appoints, with the plenary power of removal, the Directors of- the Departments of Public Works and of Public Safety, and the presidents and directors of the Department of Public Charities and Corrections, and of the Board of Health. The heads of departments form a cabinet, with whom the mayor must consult at least once a month ; and he is ex officio a member of all boards, with the right to vote. The salary of the mayor is $12,000 per annum, and of the two directors $10,000 each. Under the Department of Public Safety is the administration of police affairs, matters pertaining to the public health, and to the fire and police force, while under the Department of Public Works are the supply and distribution of water and gas, the care of the public highways, sewerage system, &c. The city hall or municipal building, at the intersection of Market and Broad Streets, beg^n in 1871, is now com- pleted, so far as construction is concerned, and the com- mission for its erection went out of existence 31st Decem- ber 1900. There was ex:pended on its construction to 30th June 1900, $17,868,067. In addition, there was spent on maintenance during

construction and fittings, upwards of $5,000,000. The building contains 634 rooms, with an area of 14-5 acres. The height of the main tower is 548 feet above the pavement.'

Fire and Police. â€" The records of the fire insurance patrol show that the year 1901 was Philadelphia's least disastrous year for fires in a decade. There were 3049. The loss was Â§2,657,099, of which $600,736 was on buildings and Â§2,056,363 on personal property. This loss was protected by insurance amounting to $37,071,305. To protect the city against fire there is a force of 844 men, 50 steam fire-engines, 44 combination waggons and chemical engines, 5 chemical engines, 11 hook and laMer trucks, 5 water towers, and 13,000 street fire-hydrants. The cost of the department for 1901 was $1,072,379.

The bureau of police deals with 34 districts, and the force in 1901 was 2890, of which 2427 were patrolmen. This is obviously a wholly inadequate force to protect properly an area of nearly 130 square miles and a population of over a million and â€¢ a quarter. There are 620 patrol boxes, with telephone connexion with station-houses, and in 1901 there were 61,189 arrests, of which 40 per cent, were for intoxication. There were 5135 com- mitments to the House of Correction, of which 956 were women and 1455 foreign-born.

Finances.â€" On 1st January 1902 the funded debt was $59,932,895, maturing at different periods extending over 30 yeara, and bearing rates of interest varying from 3 to 6 per cent. Additional loans have been authorized by a vote of the citizens to the extent of $7,800,000, at a rate of interest not exceeding 3J per cent. To provide for the payment of the debt at maturity there is a smkmg fund, which amounted at the above date to $13,642,714. There was also a floating indebtedness of Â§1,441,606. To meet its expenses the city has almost unlimited power of taxation of real estate, which is assessed at i?!i01,009,664 as subject to city tax for 1902. The tax rate for the last 15 years has been $1.85 per $100. In 1901 the receipts from all sources for municipal purposes were $36,922,333, of which Â§15,059,783 was from taxation of real estate. The city owns real estate assessed M. Â§02,313,924. There are 37 trust funds of the city under control of a>Board of City rrusts, which

amounted, 1st January 1902, to Â§17,880,651, of which $16,902,2:15 is the residuary estate of Stephen Girard for the maintenance of the college for orphan boys that bears his name.

There are -'IS national banlcs in Philadelphia, with an aggregate capital of $21,405,000, and for the week ending 30th April loiÂ« i^^n'Ll""" T"" $14(i,37S483, reserve $59,192,000, deposits $226,109,602, and circulation $9,606,737. In addition to the national banks there were, on 25th November 1901, 4 banks chartered by the state, with a capital of Â§250,434 and Â§727,578

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deposits ; 42 trust companies receiving deposits upon which inter- est is paid, subject to check, with a capital of 5531,757,661, a surplus of $21,810,867, and deposits of $139,192,677; and 8 mutual benefit saving funds, with assets of 199,095,813. On 1st January 1902 there were 16 joint-stocli fire insurance companies, with a capi- tal of $8,102,875, having in force policies to the amount of $2,237,158,865, of which $365,810,371 are perpetual risks; 4 joint- stock fire and marine insurance companies, with 64,202,875 capital and Â§5,252,027 marine risks ; and 11 mutual fire insurance com- panies, with outstanding risks of .'?106,233,582. There are also 6 life insurance companies, with 178,624 policies in force amounting to $446,206,264 ; 2 surety companies, with $750,000 capital and $79,778,875 risks ; 1 accident company, with a capital of $100,000 and $17,466,670 risks ; 5 land title insurance companies, and 1 plate-glass insurance company. \

Commerce. â€" Though the commerce is increasing, it has not kept pace â– witl^ the progress made in other branches of industry. The total imports at this port during the year ending 31st December 1901 were Â§47,787,361, and the total exports were $79,354,026, in which there were 50,530,408 bushels of cereals, 309,208,841 barrels of petroleum, 43,827 head of cattle, 687,274 tons of coal, 36;i76,536 pounds of glucose and grape sugar, and 100,936,062 pounds of linseed oil cake. In 1901, 159 American and 961 foreign vessels entered from

foreign ports, and 152 American and 976 foreign vessels cleared for foreign ports. In the same period 4403 coastwise vessels entered and 4426 cleared. Regular lines of steamers run as heretofore, and the railway lines in the city are unchanged, except in the passenger terminals of the Pennsylvania and the Philadelphia and Reading roads. By a system of elevated tracks these two lines have been brought, one to 15th and the other to 12th and Market Streets, where large and imposing stations have been erected which accommodate also the general business offices of the corporations. The gross receipts for 1901 of the Pennsylvania railway from all lines owned or operated by it, connecting directly with the city, were $101,329,795, and the gross expenses were $65,269,643. The total tonnage was 110,226,729 tons, an increase of 6-16 per cent, over 1900 ; and the number of passengers carried 43,136,611, an increase of 6-16 per cent. Its capital stock, 31st December 1901, was $203,272,100, and its funded debt $88,893,323. The gross receipts of the Pliiladelphia and Reading Company for the year ending 30th June 1901 were $62,143,470, and the gross expenses $46,621,006. It carried in the year 22,697,295 passengers. Its capital stock is $168,000,000, and its funded debt

$116,117,143.

Industries. â€” Philadelphia is one of the great manufacturing centres of America, with the largest locomotive works in the world and the largest shipyard in the country. Here, too, are made a greater number of yards of carpet and of oilcloth per annum than in any other place. According to the census of 1900,’ there were in this city 15,887 manufacturing establishments, employing 246,445 wage-earners and engaging $476,529,407 of capital. The Cramp shipyard, founded in 1830, has a worldwide reputation, as has also the Baldwin locomotive works, founded the next year. To 30th April 1902 the Baldwins had built 20,391 locomotives, of which 1275 were turned out in 1901 and 498 in the first four months of 1902, which is at the rate of 1494 for the year. The number of men employed is 11,500, the horse-power used is 7000, and the works cover an area of 16 acres. The immense works of the Cramp yard cannot be shown so satisfactorily by mere figures. It may be stated, however, that the Cramps employ 7000 men, and that

the weekly pay-roll reaches $84,000. The plant i-epresents an investment of $10,000,000, and covers more than 52-4 acres, with a water front on the Delaware river of 1229 feet. On 1st May 1902 they had 10 vessels in all stages of construction, the contract price of which was upwards of $24,000,000. These include one first-class battleship and two large armoured cruisers for the U.S. navy, and one protected cruiser for the Turkish navy. The Russian battleship Betvizaii was launched 23rd October 1900, and is the largest battleship ever built in America. During the last twelve years this yard has supplied the U.S.' navy with seventeen modern warships, beginning with the double-turreted monitor Terror, and including the first-class battleship Maine and

the great armoured cruisers Colorado a,nd Fennslyvania; to. the Japanese navy one first-class protected cruiser, and to the Russian navy one battleship and one protected cruiser. Philadelphia has always been noted for its shipbuilding, and has led America in this industry from colonial days. She is the birthplace of steam navigation in the United States. John Pitch in 1785, at Philadel- phia, made the first attempt, which two years later was successful. Up to the year 1902, 105 vessels had been built at Philadelphia for the U.S. navy, beginning in 1776 with the frigate Randolph and ending with the first-class battleship Maine, which was launched 27th July 1901. There were in 1902 five being built, including the armoured cruiser Pennsylvania, which was to be launched during the year.

According to the census of 1900, the following were the principal industries of the city, with the capital mve.sted and value of the product : â€"

Industries. Capital. Value of Product.

Foundry and machine-shop products ....

Sugar and molasses refining

Clothing

Carpets and rugs

Leather

Woollen goods .

Worsted goods .

Cotton goods

Hosiery

Liquors

Population. â€” Accord

$38,372,971 36,163,817 28,254,896 21,986,062 19,956,125 18,340,012 16,242,250 15,723,654 13,040,905 12,606,551

$45,935,567 23,992,552 11,526,030 16,866,764 9,932,990 12,874,265 14,079,859 12,541,083 10,024,606 27,636,289

ing to the census of 1900, Philadelphia had a population of 1,293,697, an increase of 246,733 over the census of 1890, a gain of 23‘6 per cent. By the census of 1890 the city had 511,112 males and 535,842 females, of which numbers 25-74 per cent, were foreign-bom, and 44-59 per cent, were engaged in gain- ful occupations. In 1900 the males numbered 634,485, the females 659,212, the native-born 998,367, and the foreign-born 295,340. There were 62,613 negroes. Out of 257,575 adult native-born males, 3695 were illiterate (unable to write) ; out of 129,378 adult foreign-bom males, 13,893 were illiterate ; and out of 20,096 adult negro males, 2190 were illiterate. In 1901 there were 9912 mar- riages, 28,215 births, and 24,137 deaths registered. In 1901 the death-rate was 18-26 per thousand. The immigration has materially decreased, only 13,304 immigrants having been landed in the year 1902, of whom 8056 were males, and 2195 came from Ireland, 2921 from Russia, 1594 from Hungary, 823 from Italy, and 1986 from Great Britain.

Domestic Life. â€” Philadelphia is emphatically the city of homes, a name which is now applied to it more frequently than that of Brotherly Love. According to the census of 1890, there were 187,0-52 dwelling-houses occupied by 205,135 families, which, taking the population as given by that census, 1,046,964, gave 5 -60 persons to each house ; at the same time New York had 18-52 persons to a house, and Chicago 8 60. There were in 1900 upwards of 245,000 dwelling-houses in the city, of which about 70 per cent, were owned by the occupants. This result is largely due to building societies, a form of investment which has had great influence in developing Philadelphia, where it had its origin in 1831. There were 467 of these societies in operation in Philadelphia at the beginning of 1900, with assets of $43,401,-384, loans to members of $36,603,702, and undivided profits of

$3,977,702.

Education. â€” There are 328 school-houses in Philadelphia, valued at $10,000,000, with 152,889 pupils and 3650 teachers, only 209 of whom are men. The cost of public education for 1901 was $4,223,278, or $23.15 for each child. On 10th September 1900 a new building for the Central High School for boys was opened, with 1400 pupils and 54 professors and instructors. The building was begun in 1894, and cost, with ground and equipment, $1,533,000. It has accommodation for 2000 pupils. A recent bequest to the city, by Dr Thomas W. Evans of Paris, of about $3,000,000 is for the endowment of a college and museum of dentistry in Philadel- phia. The University of Pennsylvania has within the last decade jumped from a merely local institution to a national one, taking an important part in university education. The list for 1901-02 gives the number of students at 2573, and the professors and tutors at 272. The property of the university amounts to upwards of $9,000,000, and the buildings, 29 in number, are situated on prop-erty covering an area of 56 acres.

Free Library. â€” In 1887 the state legislature ^enacted its first laws tending to the formation of free libraries, and on 18th February 1891 a private body was incorporated called The Free Library of Philadelphia. In October 1892 its first branch was started, and on 12th

March 1894 the main library was opened. At the close of 1894 the city councils created a public board of trustees for establishing a free library, superseding the private body, and in 1896 appropriated to it $60,000. The appropriation for 1902 is $125,000. There is a central library on Chestnut

Street, with a oWldren's department and one for the blind, and 14 branch libraries in remote sections of the city. ^ In 1901 it had 101 travelling libraries in active operation. The central and branch libraries on 31st December 1901 contained 239,103 books, and the circulation in 1901 was 1,915,687 books, against 632,536 in 1894. The library has already received many important gifts, among them a special collection of 500 volumes printed before 1501.

Changes and Improvements. â€" The business centre has moved from its original locality at the eastern end of the city to the vicinity of Broad and Market Streets, the centre of the original city. This change has been brought about by the removal of the courts of law and of all departments of the city government from the old State House or Independence Hall to the new City Hall, and the removal of the business offices of the Pennsylvania railroad to its passenger station at 15th and Market Streets. Large ofiice buildings have been erected in the immediate vicinity, and are occupied by banks, trust companies, corporations, lawyers, and other business people, leaving 3rd Street, the old Threadneedle Street of Philadelphia, deserted and dead. Some of the new buildings are " sky-scrapers," one of them being 20 storeys in height. To prevent the extension of this style of building, recent legislation gives power to the city to limit the height of such erections. A great change has taken place within the last few years in the conduct of retail business, and there are now five immense retail department stores, where every article for domestic or personal use can be purchased, excepting food and drink (which, however, may be obtained for consumption on the premises). Among noted improvements are the successful restoration of Independence Hall to its original state, thus

preserving this fine example of pure colonial archi- tecture as it was in historic days ; the widening of Delaware Avenue along the river front, for one mile between South and Vine Streets, from between 50 and 60 feet to a minimum width of 150 feet; the building of a subway under Pennsylvania Avenue for a distance of 11,000 feet, at a cost of $5,400,000, to do away with the passage of the Philadelphia and Beading railway trains along the street. This work was begun in November 1896, and was ready for use 20th May 1900. It required the excavation of 1,083,422 cubic yards of earth and rocks, and the laying of 183,114 cubic yards of masonry. The new United States Mint, in the northern section of the city, has a frontage of 316 feet and cost $2,000,000. Two new theatres have also been constructed on Chestnut Street, one opened in 1901 and the other in 1902. (c. H. H*.)

Philippeville, the fourth seaport of Algeria, 54 miles north by east of Constantino, on the Bay of Stora. It is connected by railway with Constantine, Batna, and Biskra. The surrounding country is laid out in vines, and its forests of cork tre^s yield valuable products. The town possesses an archaeological museum and a Roman theatre. The harbour works having been destroyed by a storm in 1878, a new and magnificent harbour was com- pleted in 1882. From Cape Stora on the east a mole or breakwater projects 4592 feet in a west-north-westerly direction, while from Chateau Vert on the west another mole runs out in a northern direction l.'!12 feet, leaving an entrance to the port about 656 feet wide. The protected area comprises an outer and an inner basin. The works begun in 1870 are not yet completed, but will ultimately provide a harbour of 1200 acres area. The tonnage, 195,000 in 1893, had grown to 400,000 in 1898. Population (1886), 17,653; (1896), 19,615;

(1900), 20,450.

Philippine Islands, The.â€" The boundary of the Philipjiine Islands, fixed by the Treaty of Paris, is

a line running from W. to E. along or near 20Â° N. and through the middle of the navigable channel of Bachi from 118Â° to 127Â° E., thence along 127Â° E. to 4Â° 46′ N., thence along 4Â° 45′ N. to its

intersection with 119Â° 35′ E., thence along 119Â° 35′ E. to 7Â° 40′ N., thence along 7Â° 40′ N. to its intersection with 116Â° E., thenceby a direct line to the intersection of 10Â° N. with 118Â° E., and thence along 118Â° E. to the point of beginning. In the description of the northern limits the line through the navigable channel of Bachi governs, as against the statement that it shall follow along or near 20Â° N. The cathedral in Manila is in 14Â° 35′ 31″ N. and in 120Â° 58′ 03″ E., or IC 27-” 55-6′ W. of Washington. Spanish maps, as a rule, reckon the longitude from the meridian of San Fernando, which is 6Â° 12′ 20″ W. of Greenwich. The date reckoning now conforms to European usage. Prior to 1845, however, there was a difference of one day. The change was made by suppressing the date following 30th December 1844, which would have been Tuesday, and calling it Wednes- day, 1st January 1845. A careful recount of the islands, made in 1889 by the United States Coast and Geodetic Survey, fixed the number at 1725 ; and a remeasurement of the land surface gave a total area of 119,542 square miles. The following islands have an area of more than 100 square miles: Luzon, 47,238; Mindanao. 36,237; Samar, 5040; Negros, 4854; Panay, 4708; Mindoro, 3972; Palawan, or Paragua, 3937;, Ley te (Leite), 2713; Cebii, 1742; Bohol, 1439; Masbate, 1290; Catanduanes, 680 ; Basilan, 350 ; Busuanga, 328 ; Marinduque, 287 ; Dinagat, 259 ; Tablas, 250 ; Sulu, or Jolo, 241 ; Polillo, 231 ; Tawi Tawi group, 183 ; Guimaras, 176 ; Burias, 163 ; Siargao, 134 ; Sibuyan, 131 ; Culion, 117 ; Samal, 105. The coast-line of the Philippines measures approximately 11,444 miles.

There are twenty-three volcanoes in the islands, of which the following are more or less active : in the Babuyanes Islands, Babuyan, Cami^uin (2415 feet), and Diplicia ; in w , Luzon, Mayon (8978 feet), Taal (1050 feet), Bacon Â°”””“‘Â°^^- (4592 feet) , and Bulusan ; in Negros, Canloon or Malaspina (4592 feet) ; in the island of Camiguin, Camiguin (10,824 feet); and in Mindanao, Apo (10,824 feet) and Macaturin. Those considered to be extinct are : Caua (3920 feet), Arayat (3506 feet),“Maquiling (3723 feet), Banajao (7315 feet), and Isarog (6448 feet), in Luzon ; Acudin- iug, in Leyte ; Magaso, in Negros ; Dinata, Calayo, Matutun, and Butulan, in Mindanao ; and Sarangani (3050 feet), -on Balut Grande Island, south-west of Davao. Mayon still

continues very -active. After its long-continued eruption in 1881 and 1882 there were minor disturbances in 1885, 1886, 1887, 1888, 1890, and 18!11, none of which occasioned more harm than the crushing in of roofs in neighbouring villages by falling ashes. In the eruption of 18112 the top of the volcano was lowered by about 100 metres. A similar eruption occurred in 1893, covering the ground thickly with ashes at a distance of 8J miles from the base of the volcano. There followed slight eruptions in 1895 and 1896. In 1897 occurred the most violent outbreak since the famous one of 1814 which destroyed 1200 lives. The eruption of 1897 began practically without warning on 23rd June, became alarming" ou the 24th, and destructive on the 25th, ending on the 30th. Streams of lava completely destroyed the villages of San Antonio, ,San Roque, Santa Misericordia, Santo Niiio, and San Isidro, and injured Bigaa, Libog, and the town of San Fernando. The lava flow extended more than 7 miles from the volcano to the east, one-fourth south-east. Highways were destroyed, and much valu- able agricultural land was ruined. Two hundred and twenty-.'iix dead were recovered. The total number of victims will never be known, as the village of San Antonio was completely buried. A rain of ashes extended 100 miles to the east and 75 to the west.

The Philippines are noted for the frequency and violence of their earthquakes. A seismic observatory has been established by the Jesuits at Manila, and the sytematic work carried on there and at other points in the archipelago ""T*" has greatly increased our knowledge of the seismic Â«"Â»*Â«â€¢ phenomena. Palawan and the Calamianes Islands seem to enjoy almost complete immunity from earthquakes, while on the other hand seismic foci, or centres of disturbance, have been shown to exist in the north-western mountains of Luzon ; in Nueva Vizcaya; in the Babuyanes Islands; in the vicinity of Taal

volcano ; in the vicinity of Mayon volcano ; in tlie vicinity of Canloon volcano ; in Surigao province, Mindanao ; in the vicinity of Mount Apo ; in the valley of the river Agusan ; in the vicinity of the volcano

Macaturin ; and in the neighbourhood of Camiguin. In March 1892 one of the severest earthquakes ever felt in Luzon wrought havoc in the provinces of Pangasinan, Union, and Benguet, ruining Binalenon, Mangaldan, San Jacinto, Pozorrubio, Santo Tomas, and Agoo, and more or less seriously damaging sixteen other towns. Other destructive earthquakes occurred on 10th February 1894 in the district of Davao in Min- danao ; on 21st June 1893 and 29th June 1894 in the valley of the Agusan river in Mindanao, ruining many toWns ; on the 11th of December 1895, the 8th of September 1896, and the 8th of April 1897, in the same region; and at Dapitan in 1885. In 1897 a very destructive series of shocks ruined the town of Zamboanga. Considerable loss of life was caused by falling buildings and by immense sear-waves, which swept away structures along the shore. Serious damage was done throughout the entire province of Zamboanga, the south-western ^coast of Mindanao in general, and the Sulia Archipelago. A new island appeared at this time oS the coast of Borneo, near Labuan.

Although there have been no recent additions to our knowledge

of a geological formation of the Philippines, much prospecting

has been done since the American occupation, and

“*â„¢ *â– extensive and rich deposits of copper and gold have been located.. The provinces of Benguet, Lepanto, Abra, and Bontoc, in Luzon, have been found to constitute a mineral district of exceptional richness. Present indications are that copper, coal, and gold will yield the largest returns, ranking in the order named.

The coals thus far discovered in the Philippines are highly car- bonized lignites. They burn with little smoke, leaving a clear, white ash, free from clinker. Recent analyses have resulted as follows : â€”

Place.

Fixed Carbon.

Volatile Matter.

1

Ash.

Caloric Volatile Matter.

Caloric Fixed Carbon.

Fuel.

Santa Rosa .

Caridad

Esperanza

57-94 54-56 51-96

31-75 34-53 37-56

9-23 9-60 7-80

1-08 1-31 2-68

674 1369 1632

5353 6643 5829

89-69 89-09 89-52

None of the deposits has as yet been worked to any considerable depth. Several of the coal-fields are very extensive. Valuable minerals are known to be distributed as follows : Luzon, coal, gold, copper, lead, iron, sulphur, marble, kaolin ; Catanduanes, gold ; Marinduque, lead,, silver ; Mindoro, coal, gold, copper ; Cararay, coal ; Batan, coal ; Raparapa, coal ; Masbate, copper ; Romblon, marble ; Samar, coal, gold ; Sibuyan, gold ; Semirara, coal ; Panay, coal, oil, gas, gold, copper, iron ; Biliran, sulphur ; Leyte, coal, oil, sulphur ; Cebi\, coal, oil, gas, gold, lead, silver, iron ; Negros, coal, copper ; Bohol, gold ;

Panaon, gold ; Mindanaq, coal, gold, copper, platinum. Cinnabar has been reported in Panay and Leyte, but its existence there is doubtful.

A meteorological observatory was established at Manila by the Jesuits in 1865. From small beginnings it has grown climate into a thoroughly equipped and admirably conducted institution. The following figures are taken from its records : â€”

1883-1898.

Jan.

Feb.

March.

April.

May.

June,

July.

August.

Sept.

Oct.

Nov.

Dec.

Annual.

Mean temperature . Absolute maximum temperature Absolute minimum temperature Mean relative humidity .

Mean rainfall (inches)

7f-0

93-0 651

77-7

1-193

77-7 95-7 610 74-1

0-413

80-4 95-9 63-3

71-7

0-736

82-9 99-0 66 0 70-9

1-42

83-3 100-0 ‘71-1

76-9

4-197

82-0 97-0 70-9 81-5

9-622

80Â°-8

94-8 70-0 84 ‘9

14-567

80-8 94-3 69-1 84-4

13-866

80Â°-4

93-7 70-5 85-6

14-925

80Â°-4

94-8 68-7 82-6

7-536

79Â°-0

92-1 64-9 81-6

5-126

77-4 91-9 60-3 80-7

2 134

80-2

79-4

75-457

Absolute maximum temperature for the sixteen years, 100-0. ,, minimum ,, ,, ,, ,, 60-3.

There are three seasons : the hot and dry, the hot and wet, and the cool and dry. At Manila the hot and dry includes March, April, May, and often the first half of June ; the hot and wet, the last half of June, July, August, September, and October ; and the cool and dry, November, December, January, and February. On the Pacific coasts of Luzon, Samar, Leyte, and Mindanao the seasons are reversed, the rains beginning with the north-east monsoon. While the observations as to temperature, humidity, and amount of rainfall obtained at Manila may be considered as fairly typical of conditions throughout the lowland regions of the archipelago, it should be remembered that there is great individual diiierence between the islands. Zamboanga is some 425 miles farther south than Manila, yet it has a cooler climate. The rain- fall in Mindoro is known to be much heavier than in Luzon. In the provinces of Benguet, Lepanto, Bontoc, and Abra there are extensive highlands with an elevation of 4000 to 5000 feet, having a maximum temperature of 77Â° Fahr. and a minimum of 45Â°. Observations at Baguio, Benguet, show a mean monthly tem- perature of 65-9Â° in August, 66-94Â° in September, and 67-4Â° in October. The mean daily variation for a period of ninety days was only 7-87Â°. The relative humidity and rainfall are somewhat less than at Manila. A highway affording connexion with this temperate highland region is in process of

construction, and the preliminary survey for a railway has been completed. The Philip- pines are often swept by the violent cyclonic storms known as typhoons, which not infrequently cause heavy loss of life and property. Since 1880 no less than 397 typhoons have been felt at the Manila observatory. \Twenty per cent, of these have occurred in September. During December, January, February, March, and April they are very rarely felt. In May, June, and July they become increasingly common. In August there is a falling off in the number, which reaches its maximum in September, gradually decrea.sing in October and November. In the famous typhoon of 1881, the vortex of which passed over Manila, an immense amount of damage was done in the city. Two thousand persons lost their lives in Samar and Leyte during the great storm of 1897. The typhoon warnings sent out from the Manila observatory annually save heavy loss of life and property.

Extensive additions to our knowledge of the Philip- pine fauna have been made by Everett, Platen, White- head, Keay, the Steere expedition (1887-88), and the Menage expedition (1890-93). The Philippines, politi-

cally speaking, and the Philippines, zoologically speaking, are not identical areas, Balabac, Palawan, and the Calamianes being characterized by the ^""""

occurrence of numerous Bornean forms which are con- spicuously absent from the remaining islands. While the Philippines are commonly held to form an eastern exten- sion of the Indo-Malayan sub-region, there is nevertheless a large amount of specialization in the fauna of the islands to the eastward of the Palawan group.

Mammals are scarce. No marsupials occur. The edentates are represented by the pangolin {Manis sp. ?) of the Palawan group. In the seas are found the dolphin, cachalot, and dugong. Wild hogs of at least two species occur, and in some of the islands are abundant enough to do considerable damage to growing crops. The beautiful axis deer of Sulu has apparently been brought there by man. Red or brown deer occur in Basilan, Mindanao, Leyte, Samar, and the Calamianes Islands. The number of species and their respective ranges have not been satisfactorily determined. In Masbate, Panay, Guimaras, and Negros

there is a dark-coloured species marked with bulf spots. Deer are absent in Palawan, Tawi Tawi, Tablas, Romblon, Sibuyan, and Siquijor. Domestic goats are abundant, and do well. Sheep do not thrive in the lowlands, but are said to flourish in the highlands of Benguet. Humped cattle are raised OQ most of the islands. They are killed for their flesh, hides, and horns, and little attention is paid to their milk-giving properties. The Philippine horses are small, but well formed and tough. The water-buffalo, or caraboa, is the most im- portant of the domesticated mammals. It occurs in a wild state in Luzon, Mindoro, the Calamianes group, Masbate, Negi-os, and Mindanao, but the wild herds are believed to have originated from domesticated animals. The domesticated water-buffalo is sluggish in its movements, and will not work through the heat of the day, but it is a wonderful swimmer, and makes its way through the worst quagmire with ease. It is universally used as a draught animal and beast of burden. The most interestino- of the ruminants is the timarau {Bubalus mindorensis, Heude)Â° peculiar to Mindoro. Unlike the water-buffalo, it does not bathe in water or wallow in mud. It is extremely wild, feeding by night and sleeping by day in the densest jungle. It sometimes charges the hunter without provocation, and is very dangerous

when wounded. It attacks and kills the much larger wild buffalo. All attempts to domesticate it have failed. A chev- rotain is found in Balabac. The house rat, which has been introduced by man, is a common nuisance, while mice occasion- ally become so numerous as seriously to damage sugar-cane and rice. Squirrels are confined to the eastern chain of islands from Basilan to Samar, and to the Palawan - Calamianes group. In the southern islands there is a tiny species the size of a mouse. Very large flying squirrels are found in Palawan and Mindanao. Squirrel-shrews occur in the Palawan-Calamianes group, and true shrews at Yarious points in the archipelago. Among the Carnivores may be mentioned the binturong and an otter, both found

in the Palawan-Calamianes group ; two civet cats, which range throughout the archipelago, and a wild cat of small size, which has been found in Palawan, Panay, Negros, and Luzon. Bats are very numerous, and a number of the species are peculiar to the Philippines. Galeopithecus and Tarsius range from Basilan to Samar, and the former occurs also in Bohol. In spite of all that has been said to the contrary, but one species of monkey {Macacus philippinensis, Geoff.) has been discovered in the Philippines. It occurs on every island of any importance., Its flesh is occasionally eaten by the natives. While albino specimens of this monkey are not uncommon, the pure white monkeys, not albinos, said to inhabit Mindanao, are mythical. The large fruit bats {Pteropus) occur in immense colonies, and are sometimes eaten by the natives. Especial importance attaches to the unexpected discovery by Whitehead of a new and peculiar mammalian fauna inhabiting a small plateau on the top of Monte Data in northern Luzon at an altitude of 7000 to 8000 feet. Specimens of 15 species were obtained, embracing 5 new genera (Calsemomys, Chrotomys, Rhynchomys, Batomys, and Carpomys). Eight of the species were new and strikingly peculiar. Their zoological relationships are probably with Celebes and with Australia. Other discoveries include a few new squirrels and bats, and the occurrence of a lemur {Nycticehus Tardigradus) in Tawi Tawi.

Birds. â€” The islands are as rich in birds as they are poor in mammals, the total number of species recorded up' to 1897 being 590, of which 325 are peculiar to the Philippines. A study of their geographical distribution has demonstrated that the islands may be divided into a number of fairly well-marked groups, in each of which the birds show a degree of specialization closely correlated with diversity of environment and completeness and probable duration of separation from adjacent groups. Balabac, Palawan, and the Calamianes show a very strong Bornean ele- ment. Mindoro stands by itself. Luzon and the small neigh- bouring islands have 61 peculiar forms. A close relationship exists between the birds of the entire eastern chain of islands. Numerous genera and some families which are absent from the central islands range from Luzon to Basilan. These genera usually have distinct representative species in Luzon, Samar and Leyte, Mindanao, and in some cases in Basilan also. The greatest difierences

occur between Luzon and Samar and Leyte. The latter islands have 22 peculiar species.

Sulu and Tawi Tawi belong zoologically to the Philippines, but have 12 well-marked peculiar species, and many of the characteristic Mindanao-Basilan forms are lacking. Panay, Guimaras, Negros, and Masbate constitute a, sharply-defined area, characterized not only by the occurrence of 30 peculiar species, but by the absence of important genera and even whole families represented in the eastern islands. Most of the mam- mals characteristic of the latter region are lacking. It is a curious fact that Cebii stands quite by itself, although the width of the deep channel separating it from' Negros narrows at one point to about four miles. Cebii possesses 9 striking species of birds not known to exist elsewhere, and lacks many of the character- istic forms of the central and eastern islands. The zoological position of Bohol has never been satisfactorily determined, but all existing evidence indicates that it must be grouned with Samar and Leyte.

Among the more interesting birds may be mentioned the "mound-builder" (Megapodius cumingi, Dillwyu), which buries its large eggs in the soft sand along the sea-beach, or under great mounds of earth and dead leaves, often at a depth of three or more feet below the surface. The young are forced to dig their way out and shift for themselves. The eggs are highly prized by the natives. The jungle-fowl abounds. There are 35 species of pigeons and doves, 'many of them most beautifully coloured and all edible. Snipe, plover, turnstones, and other shore birds are abundant during the cool season, and herons, bitterns, and ducks at all times. The birds of prey number 45 species, of which 22 are peculiar to the group. They vary in size from a tiny falcon, not larger than a sparrow (Microhierax), to an immense monkey-catching eagle (Fitheoophaga gefferiji, Grant), which is strong and active enough to seize monkeys in the air as they leap from tree to tree. But two specimens of this remark-

able eagle have thus far been secured. There are 21 species of kingfishers, 15 being peculiar. Of the 12 species of hombills, not one occurs outside of the Philippines. Erog-mouths, bee-birds, night-hawks,

and swifts are found in considerable variety. One of the last {Collocalia troglodytes, Gray) is of some commercial importance, constructing the edible nests so highly prized by the Chinese. The best nests are obtained on the precipitous sides of the Peiion de Coron, between Culion and Busuanga.

There may also be mentioned 21 cuckoos, 1 cockatoo, 19 parrots and parroquets, 19 woodpeckers, barbels, broadbills, starlings, orioles, weaver-finches, larks, nuthatches, 24 beautifully coloured sun-birds, and 23 flowerpeckers, titmice, shrikes, swallow-shrikes, tailor-birds, thrushes, fruit-thrushes, fairy bluebirds, fire-birds, 42 fly-catchers, 4 swallows, and 5 species of most beautifully coloured ant-thrushes, as well as a large number of birds for which English names cannot be readily supplied.

Reptiles and batraohians are abundant, but have been little studied. Pythons occur throughout the group, and sometimes attain enormot:is size. There are numerous venomous serpents, but the mortality from snake-bite is low. Geckoes may be seen on the walls and ceilings of any house. Elying lizards abound in the forests. Large iguanas are numerous. Their eggs are prized by the natives, and the flesh of one species, known as ibit or pelubid, is highly esteemed. Crocodiles are extremely numer- ous in many of the streams, and are occasionally found in the sea along the coasts. Specimens have been obtained measuring 18 feet in length. Land turtles of small size are common. Very large sea turtles are often captured by the fishermen, and their flesh is highly appreciated as an article of food. A con- siderable business is done in tortoise-shell. Frogs occur in great variety. One small species appears in immense numbers with the oncoming of the rainy season, and at night the noise of its outcry almost deadens other sounds.

Fishes. â€” Marine fishes constitute an important source of food supply. Some of the fresh-water species are also largely used by the natives, notably the ” dalag,” which is found in the paddy-fields during the wet season. Fishes are more numerous and more varied and less well known than are any others of the vertebrates.

Molluscs. â€” The Philippines are famous for the variety, beauty, and abundance of their land molluscs. Fresh-water and marine molluscs are also very numerous. While most of the species are of interest chiefly to the conchologist, there are a number of edible forms which help to supply the natives with food. The shells of Flacuna placenta, L., split into thin flat plates and cut into small squares, are almost universally used in place of window- glass.

The valves of the giant clam (Tridachna) sometimes attain a length of 5 feet and weigh hundreds of pounds. Pearl-oysters are abundant in the southern waters of the archipelago. Pearl- fishing is an important industry in the Sulu Islands. The shells of the pearly nautilus are commonly used by the Visayans for drinking-cups. From the great opercula of certain marine forms bracelets and other ornaments are carved, while the hard serrated edges of other species are sometimes employed in place of knives for harvesting rice. The land molluscs have been quite thoroughly classified, but much still remains to be done with the marine species.

Arthropoda are very abundant and as yet little known. Shrimps, crabs, and lobsters form an important source of food supply. Mosquitoes are numerous and troublesome in the wet lowlands. Bees are abundant, and wild honey and wax are gathered in considerable quantities. The number of species of ants is very large. Some of them infest dwelling-houses and swarm over the food. The termites, or so-called "white ants," inflict great damage on wooden buildings, often causing serious loss. Plagues of locusts occasionally ruin growing crops. An insect pest recently almost completely destroyed the coffee planta- tions of Batangas.

The remaining branches of the animal kingdom are abundantly represented in the Philippines, but have as yet been little studied. Land-leaohes swarm in the damp lowland forests, to the serious annoyance of foot passengers. The coral beds of Mindanao and the Sulu Archipelago are of unsurpassed beauty, and Guimaras, Cebii, and Siquijor are completely covered with a thick cap of coral limestone, proving the important part that coral polyps have played during bygone centuries.

There have been no important recent contributions to our knowledge of the Philippine ilora, and the epoch- making work of Father Blanco continues to be the standard authority. Some progress has Flora and been made in the study of the woods. The “e*”^’” number of species is known to exceed 450, of ”” ” ‘ which 385 have been classified. Included in this list are

numerous very valuable woods suitable for structural purposes, inside finishing, cabinet work, and carriage- making. The largest forests are in Mindoro, Palawan, and Mindanao, although there are immense tracts in many of the other islands. Timber forms one of the great natural sources of wealth in the archipelago, and the ex- ploitation of the forests bids fair to become an important industry. Tobacco continues to be one of the most im- portant products. Greater care in growing and curing would vastly improve the quality. Since the abolition of the Government monopoly in 1881, large companies have sprung up, which at present control the trade. Among these may be mentioned the Compania General de Tabacos, with a capital of $760,000. This concern has 100,000 hectares of land under cultivation, and handles annually 500,000 quintals of tobacco. Its Manila factory turns out 100,000,000 cigars annually, and employs 10,000 labourers. In 1900 a company called the Cagayana, with a capital of $500,000, was formed for the purpose of pur- chasing the product of the Cagayan valley. The output of abac^, or Manila hemp, increased steadily up to the outbreak of the insurrection in 1896. The coffee planta- tions have been ruined by a borer which attacked the canes. A small quantity of coffee is still produced in Benguet, where the borer has not appeared.

Exports of sugar also increased steadily up to 1896. Tliis in- dustry was in 1902 still in its infancy in the Philippines. The in- troduction of modern machinery and methods of cultivation will enormously increase production. Although there are a numher of small steam crushers in Negros and Luzon, much of the cane is still ground between wooden or stone rollers turned by draught animals. The methods of

obtaining sugar from the juice are often equally primitive. Only a small part of the good sugar land is yet under cultivation.

Rice and sweet potatoes are the staple foods of the natives, although Indian corn is now extensively raised in Negros, Cebii, and parts of Luzon. Cacao does admirably, and properly con- ducted plantations are profitable. There is a steadily growing trade in copra and cocoanut oil. Peanuts flourish, but are not raised to any considerable extent. The trade in indigo has been ruined by the Chinese, who adulterated the Philippine product so that it earned a bad name. A red dye obtained from sibucao (CcBsalpinia 8appan, L.) constitutes an important article of export to China and England. There are eleven other woods furnishing dyes of more or less value. Sago-palms grow* abundantly in some parts of the archipelago.

The distillation of alcohol from fewnented sap obtained from the nipa palm has become a flourishing industry. The' nutmeg grows naturally in Cebii and in Laguna province, but is not an article of commerce. Cinnamon, of rather poor quality, is abundant in the forests. The cultivation of pepper is diminishing. Valuable es- sential oils are obtained from the flowers of the ilangilang, sam- paguita, and champaca. There are eleven resins of domestic or commercial value. Extensive deposits of almaciga (damar) exist in Palawan, Sibuyan, and Mindanao. There are also eleven val- uable gum-resins, of which gutta-percha is the most important. At one time a considerable quantity of guttar-percha was exported from the southern islands, but adulteration by Chinese merchants has nearly destroyed the trade.

Cigars and cigarettes are the only manufactured articles ex-, ported in any quantity. Except for the cigar factories, cotton mills, rope walks, carriage and furniture factories, brick kilns, pottery ovens, and sugar refineries of Manila and vicinity, the Philippines have no manufactories of importance, although some articles are produced in considerable quantity by the natives at their homes. Among'manufactures of this class may be mentioned dyed cotton stuffs ; beautiful fabrics called " piSa " and " jusi," the former woven of pineapple-leaf fibre and the latter of this fibre mixed with silk ; mattings, bags, hats (those of

bamboo being extremely lightanddurable) ; patates orsleeping-mats ; shoes,leather, soap, and other small household articles. A consider- able amount of salt is also made from sea-water. There is much fine water-power in the islands, but none of it is at present in use.

The only railway extends from Manila to Dagupan, a distance of 122 miles. Elsewhere land transportation is by means of carts or sledges drawn by water-buffaloes or bullocks. High- Commanl- ^^yg are bad at the best, and in many of the islands cations. there are none. Water transportation is therefore employed when possible. There are 61 steamers, with a tonnage

Manu- factures.

of 21,300, 49 sailing vessels, with a tonnage of 5863, and numerous small native vessels engaged in the coasting trade.

There is cable communication with Europe by way of Hong Kong ; also with Panay, Negros, and Cebii. The line is in pro- cess of extension to Mindanao, Basilan, and Sulu. Military land lines extend throughout Luzon and connect the most important tovTns of Panay, Negros, Cebii, Samar, and Leyte.

Exports increased steadily up to the year 1897, as will appear from the following table :â€” Traae.

Year.

Abac^.

Copra.

Sugar.

Tobacco.

Piouls.

Piculs.

Piculs.

Quintals.

1890

1,012,310

74,447

2,360,422

179,054

1891

1,271,094

245,309

2,672,259

207,166

1892

1,581,106

259,539

3,955,263

253,850

1893

1,282,938

183,404

4,186,982

230,686-

1894

1,591,162

532,233

3,110,202

190,904

1895

1,664,590

593,671

3,697,.332

207,771

1896

1,551,786

607,529

3,671,024

219,729

1897

1,804,756

811,437

3,332,010

316,712

1898

1,585,212

263,402

2,859,661

176,170

1899

1,201,476

291,322

1,488,854

114,261

The total value of exports for 1894 was 13,237,760 ; for

1895, $3,333,095; for 1896, $3,440,800; for 1897, $3,721,460 ; for 1898, $3,409,605 ; for 1899, $3,161,284. The restrictive Spanish tariff on imports remained in force, with slight modifications, up to the close of 1900. Since the American occupation, the increase in imports, not including Government supplies, has been extraordi- nary, in view of the disturbed conditions which have prevailed. The largest annual collection of import duties at Manila under the Spanish regime was $4,055,696 in

1896. Collections fell to $3,536,788 in 1897. For the fiscal year ending 30th June 1900 there was collected $8,174,084. The total value of the imports for the year was $20,878,666. Of vessels engaged in the foreign trade there entered during this year 566, with a tonnage of 665,913, and

cleared 501, with a tonnage of 641,975. The entries of vessels engaged in the coasting trade were 3346, tonnage 469,076 ; clearances, 3666 vessels, tonnage 480,992. During the year ending 30th June 1901 the imports from the United States amounted to $4,014,180, and the exports, of which vegetable and manila fibres were valued at $4,264,416, to $4,420,289. The ports of entry are Manila, Iloilo, Cebu, Zamboanga, Sulu or Jol6, and Siassi.

The purely military government established shortly after American occupation was gradually replaced by a civil administration. The re-establishment of civil courts began on 29th May 1899, and the ""JJâ„¢" organization of civil municipal governments in July of the same year. There was no direct interven- tion in the affairs of the central government by civilians until 1st September 1900, when, by order of the Presi- dent of the United States, the legislative power and the power to appoint and remove civil ofiicers were taken from the military governor and vested in a civil commission of five members. This commission was further charged with the duty of completing the organ- ization of civil government, beginning with the pueblos, provinces, and departments, eventually recommending a suitable form of central civil government, and suggest- ing the time when it should go into effect. Benguet was the first province in which civil government was estab- lished by the commission.

The total number of inhabitants is not accurately known. It has been placed as low as 6,000,000, and as high as 12,000,000. The study of the Philippine tribes is in a far from satisfactory state. Blumentritt, Papula- whohas written moreaccurately concerningthem "" than has any other author, had never visited the islands. There are three distinct racesâ€" Negrito, Indonesian, and Malayan. The ISTegritos are almost universally conceded

to be the disappearing remnants of a people which once populated the entire archipelago. They are physical weaklings, of low stature, with

very dark skins, closely curling hair, flat noses, thick lips, and large, clumsy feet. In intelligence they stand near the bottom of the human species, and they are apparently incapable of any consider- able degree of civilization or advancement. As a rule, they are to be met with only on the forest-clad sides of the higher mountains of Luzon, Panay, ISTegros, and Min- danao, although in north-eastern Luzon they are found in the lowland forests near the coasts. They live a nomadic life, wandering almost naked through the forests, and subsisting on fruits, tubers, and such. game as they can kill. They are divided into twenty-one tribes, variously known as Negritos, Aetas, Buquiles, and Manguyanes. The Philippine representatives of the Indonesian race are confined to the island of Mindanao. They are physi- cally superior both to the Negritos and to the Malayan peoples, being tall and well developed, with high fore- heads and aquiline noses, and with wavy hair ; often, also, with abundant beards. The colour of their skin is quite light. Many of them are very intelligent. They are divided into sixteen tribes. All of these are pagan, and several are very warlike. The great majority of the inhabitants of the Philippines are of Malayan origin, although the Malayan race is not found pure in any of the islands, but is everywhere modified through inter- marriage with other peoples. The number of Malayan tribes is forty-seven. The individuals comprising them are of medium size, with straight black hair. As a rule the men are beardless. The skin is brown, and distinctly darker than that of the Indonesians, though much lighter than that of the Negritos. The nose is short and con- siderably flattened. The various tribes show every degree of social advancement, from abject savagery to a relatively high degree of civilization. Seven of them are Christianized, seven are Mahommedan, and the re- mainder pagan. Although there are far more pagan tribes in the Philippines, the seven Christian tribes with the Mahommedans include the bulk of the population, as will appear from the following table : â€”

Tribe.

Approximate Number of Individuals.

Territory occupied (square miles).

Visayans Tagalogs . Bicols Ilooanos . Pangasinans Pampangas Cagayans . Maliommedans .

2,601,600 1,663,900 518,111 441,780 365,500 337,900 166,300 268,000

28,100

15,380

â€¢ 6,900

6,170

1,950

1,950

11,050

12,860

6,.363,091

84,360

These figures are only approximate. The number of inhabitants composing the wild tribes is still more a matter of conjecture, but can hardly exceed 2,500,000. Of these latter peoples it may be said that, while many of them are pacific and harmless when well treated, not a few are vicious. Head-hunting is practised by several of the North Luzon tribes, some of which are even accused of occasionally indulging in cannibalism. Several of the tribes practise polygamy, and the taking and keeping of slaves is not uncommon. Human sacrifices are practised by at least two of the Indonesian tribes in Mindanao. The number of Americans in the islands was estimated at 66,700 in December 1900, including an army of 2219 officers and 60,480 men. The Chinese at this time were estimated at 70,000, Spanish at 3000, British at 250, Japanese at 175, Germans at 125, Swiss at 90, French at 60, Portuguese at 30, Belgians at 25, Italians at 20 ; other nationalities, 30. (d. c. w.)

History. â€” The history of the Philippine Islands shows that nearly the whole period of the 327 years of Spanish dominion (1571-1898) was one of continual strife and discord between the clergy, the mill- ^”’[ii-f. tary and civil power, and the natives. The perpetual struggle for supremacy between the Crown officers and the monastic orders, the immorality of the clergy, the feud between their respective communities, the constant inflow of penniless Spanish adventurers and the venality of the officials, brought both, laymen and ecclesiastics into lasting contempt among the natives. The government of the islands was inspired by the monks, and was based on the theory that the natives should for ever be regarded as minors. Education was entirely in the hands of the friars. In the course of time many natives acquired comparative wealth, the best education which the colony afforded, and a taste for European com- forts. The natural consequence was a desire to throw off the absolutely dominant tutelage of Spain, and participate in the administration. To this end there were frequent risings, suppressed by the Spaniards with a severity the remembrance of which was preserved from generation to generation. In 1812, during the enforced absence from Spain of King Ferdinand VII., the famous Cortes de Cadiz was established. This parliament, extremely democratic in its composition, resolved to impose a constitution on the king when he should return. The constitution was to include direct representation of the colonies â€” indeed, delegates from each dependency (including the Philip- pines) were invited to Cadiz and took part in the de- liberations. This ray of political sunshine for the Filipinos lasted, however, but a short while, for, on King Ferdinand’s return, reaction set in, and the pro- ceedings of the Cadiz parliament were annulled. But the desire for liberty lived on. On the other hand, the tyranny of the Spanish clergy increased as they found themselves face to face with an ever-growing body of enemies. Each parish had, in its friar incumbent, a secret G-overnment agent, through whom men were sud- denly wrested from their homes and deported to distant islands without trial.

The deposition of Queen Isabella II. in 1868 brought again into power the democratic political element in Madrid, and in 1869 it was decreed that a certain measure of participation in the civil government should

be accorded to the Filipinos, by the formation of a native council to co-operate with the governor-general. The councillors were indeed nominated ; but the hopes thus raised were once more thwarted by ultra-conservative influences, and the disappointment served only to fan the flame of dis- content. The Filipinos then conceived a new plan. According to those decrees of the Council of Trent which define the status of the regular clergy, the services of a monk in any colony were limited to mission work. His duty ended when there were no more converts to be made, and he could only temporarily act as incumbent when there was no secular clergyman available. In' 1871â€" three centuries after the conquestâ€" the only unconverted natives were the aboriginal mountain tribes and the Mussulman inhabitants of Mindanao. Therefore the natives, championed by a certain Father Burgos, agitated for the fulfilment of the Council of Trent decrees whereby the incumbencies in Christianized villages should be held by the secular clergy. Filipinos had for generations been ordamed in the priesthood, and parish curacies were actually held by them. The real aim of the natives was to dimmish the power of the regular clergy, whose com- munities were, in fact, strongly organized secret societies, each one extremely jealous of the other, but ever ready to join issue against any Filipino movement. In 1872 the friars took the initiative in bringing matters to a crisis.

Through their secret agents a pretended plot was con- cocted, and the native garrison at Cavite was induced to mutiny. The priests immediately presented a bill of indictment against the richest, best educated, and most influential Philippine-born families in Manila. The pro- scribed persons, accused of treason, were the leaders of that class which aspired to national manhood. It was the object of the friars to banish this class, and to secure to themselves the incumbencies in perpetuity. They succeeded temporarily, for the flower of the Philippine- born population was deported to the Ladrone Islands, whilst Pather Burgos and three other native priests were publicly

garrotted, and the native clergy were formally declared to be thenceforth incompetent to have the cure of souls.

Steamer and telegraphic communication, both opened about the same time, may be said to have marked a new era in the Philippines, by bringing them more into har- mony with the conditions of neighbouring colonies. The improved travelling facilities came at the time when intel- ligent natives were most anxious to flee from monastic tyranny. Some crossed over to Hong-Kong; others trav- elled to Spain, where, under the republic, they found sympathetic listeners. The tragedy of 1872 gave birth to revolutionary notions, and Philippine committees were founded at Madrid and Barcelona. Steamers' brought the Madrid newspapers to natives who hitherto had but a vague notion of European affairs. Filipinos, too, began to return with new ideas from Europe. The most dis- tinguished of these returned native scholars was the late Dr Eizal. Born in Calainha and educated in Manila, he was sent to Europe at an early age to complete his studies. After gaining the degrees of Doctor of Medicine and of Philosophy, he published, among other works, his Noli me tangere â€" a sarcastic exposition of the immorality of the friars, written in the form of a romance. He returned to the islands, and disputed the Dominican order's title to lands actually in their possession in Laguna province. He became the arch-foe of the friars and the idol of his own countrymen. To escape the monks' vengeance he returned to Europe ; but in 1892 he received assurances from Governor-General Despujols that he might enter the islands and remain there at liberty. On his arrival at Manila his enemies produced certain seditious leaflets, alleging that they were found in his luggage. He was therefore arrested on a charge of treason. The friars importuned the governor-general for his life, but the gen- eral persistently refused their demand, and met the case half-way by banishing Eizal to Dapitan in Mindanao. Incensed by the failure' of their plot, the friars' relations with the general became so strained that, in accordance with precedent, the procurators of the religious communi- ties in Madrid forthwith obtained the recall of Governor-General Despujols after only eight months' service. Meanwhile a reform party, initiated by Dr Eizal, was organized under the title of Liga Filipina. Its object was to procure, by pacific means, several

reforms in the govern- ment of the islands, the chief of which were (1) the expulsion of the friars, and (2) the withdrawal of the governor-general's arbitrary power to deport Pilipinos on his sole authority. The , new governor-general, Eamon Blanco, was, like Despujols and many of his other prede- cessors, a humane man at heart, but he could do no more for the Filipinos than hold in check the most tyrannical schemes of the clergy. The banishment of Eizal convinced the reform party that peaceful endeavour to procure re- forms was futile. A secret organization known as the Kati- punan was therefore started to secure reforms by force of arms. Each member enrolled was bound by the ancient "blood compact." An incision was made in the arm, and with the blood which flowed therefrom the roU of member-

Revolt of

1896.

ship was signed. In 1895 the friars suspected some move- ment, and consequently between the autumn of 1895 and August 1896 many hundreds of natives were banished.

The Katipunan leaders were completing their plans for open warfare, when the whole conspiracy came prematurely to light through a traitor. This man divulged the secret to his wife, who (in August 1896) went to Father Mariano Gil, parish priest of Tondo, and revealed the whole plot. The next day about 300 of the most prominent Filipinos were lodged in prison. The drawbridges of the walled city were put in working order, and troops were stationed along the approaches. News came shortly that the insurgents had attacked the civil guard about three miles outside the city. Native cavalry was sent there at once and the insurgents fled. A week later some hundreds of insurgents suddenly attacked the powder magazine at San Juan del Monte, about three miles from the city. Troops were quickly on the spot ; the insurgents, who were completely routed, left about eighty dead on the field, and fled in confusion towards the Pasig river. Many were shot dead in attempting to cross the river, whilst the rest were pursued for miles. Four chiefs were taken pris- oners, and subsequently executed in Manila. This was the first of the numerous executions which took place

all over the colony. Pandacan, Pasig, and several other parishes in the neighbourhood of the capital were unsuccessfully attacked by the insurgents during the following days. Ten days after the plot was discovered Manila and five other provinces were officially proclaimed in a state of siege. Insurgents were assembling in great numbers near Mariquina; Europeans, Chinese, and natives flocked into the city. News came that the whole province of Cavite was in revolt ; San Eoque was in insurgent hands. The in- surgents concentrated all their energies upon Cavite pro- vince. They dug a trench about a mile south of the neck of land on which Cavite arsenal is situated. To defend the arsenal the Spaniards established a camp at Dalahican, which was held by the 72nd Visaya (native) regiment and Spanish volunteers under General Eios. From this camp the Spanish forces made a sortie, but were driven back with great slaughter. There was a general call to arms, and volunteers were enrolled. Several villages were in the hands of the insurgents, and, emjjpldened by their success at Dalahican, they seized a convent in the centre of Cavite province, fortified and provisioned it, and for several weeks repulsed the attack of the Spanish troops, until at length artillery was brought into action, when most of the besieged effected their escape. It was now that Emilio Aguinaldo came to be known as the insurgent commander-in-chief.

The difiicult position of the Government was taken advantage of by the revolutionary chiefs. General Blanco had extremely few European troops at his disposal, and many of these were in Mindanao. Transports were at once despatched to bring them to the capital. It was doubtful how far native troops could be trusted against their own countrymen. Eeinforcements were soon on the way from Spain, but the demands of Cuba had already depleted the Peninsula of the best fighting material. Most of the troops sent out to Manila were of weak physique and without military training. By those who understood least the true position Blanco was blamed for his apparent lethargy. There was constant friction between him and Archbishop Nozaleda, who urged the immediate adoption of bloodthirsty measures; but as Blanco declined to be led by the archbishop, he was recalled, and in December 1896 General Polavieja ar- rived as his successor, with General Lachambre as chief of staff. Before General Blanco left he released Dr

Eizal and allowed him to go to Spain, but the friars caused a cablegram to be sent to arrest him. Eizal was

therefore sent back, a prisoner, to Manila, where he was executed by Polavieja's orders in December 1896.

The reinforcements now numbered about 16,000 men, and Lachambre took the field in Gavite with energy, whilst Polavieja held in check the insurgents north of Manila. After repeated encounters in Cavite province, with great slaughter to the insurgents and no incon- siderable losses on the part of the Spaniards, General Lachambre succeeded in practically quelling the rebellion in that province, whilst General Jaramillo rendered effective service in Bat^gas province. Lachambre was then despatched north, where the insurgents were in arms all over the provinces of Bulacan, Pampanga, and Nueva Ecija. Numerous small battles were fought, those of any importance being Aliaga and Cabanatuan. The insurgents, routed everywhere, quietly reappeared in other places. An attack was made on Bolinao, and the cable station was threatened, but troops arrived just in time. Aguinaldo personally operated in the province of Bulacan, making frequent raids on the Spaniards and then retiring to his mountain fastness. No definite progress towards a finish was being made by either party. Polavieja's demand for more troops having been refused, he tendered his resignation on the ground of ill- health, and was succeeded (spring of 1897) by General Primo de Eivera, who had been governor-general of the colony sixteen years previously. Kivera was already personally acquainted with- the leading Pilipinos. A rising in Cebu city had been quelled by a gunboat; hostilities continued elsewhere in an indecisive manner, and the wet season (middle of the year) had fully set in, making operations extremely difficult. A certain Paterno volunteered his services to Primo de Eivera to negotiate peace, with the result that Aguinaldo agreed to quit the islands with thirty-five of his chiefs on the understand- ing that the Spanish Government would pay them an indemnity of $1,200,000 and introduce certain reforms. Consequently,

on the 23rd December 1897, Aguinaldo and his colleagues left for Hong-Kong. The "Treaty of Biacnabato " in which it is said these conditions are set forth is of doubtful existence. However, according to agreement (verbal or written), a first instalment of $400,000 was paid to Aguinaldo. The Madrid Govern- ment having refused to confirm the terms of peace, further payment was suspended. As soon as Aguinaldo and his party were safely out of the colony, the peace rejoicings in Manila were followed by the persecution of all those who were known to have sympathized with the movement. The prospect of reform was as remote as ever, and other chiefs took the field in northern Luzon.

When hostilities between America and Spain broke out, on the 23rd April 1898, there was already an American fleet in Far Eastern waters, which, under the Spanish- command of Commodore (afterwards Admiral) Amer/can j)g.^^j^ arrived in the Bay of Manila on the 1st of May, and totally destroyed or disabled the Spanish fleet. Dewey demaaded the surrender of the city, which was refused. Cavite was at once occupied by the Americans, and Dewey awaited reinforcements of troops before attacking Manila. Shortly afterwards Aguinaldo and his party, at their request, were brought to Cavite in an American transport by Dewey's per- mission.

With the approval of Dewey, who allowed arms to be supplied to him, the rebel chief at once set to work to collect his forces, and with 30,000 men renewed the campaign against the Spaniards, harassing them on all sides, until practically all Luzon, excepting the city of Manila and the suburbs, was at his mercy. About 11,000 Spanish prisoners (soldiers and civilians) fell into the rebels' hands. At the same time rebel emissaries

were despatched to the southern islands of Panay, Negros, and Mindanao to raise rebellion against the Spanish forces commanded by General Kios. Many encounters took place, but the Spaniards held possession until the treaty of peace was signed in Paris. The American reinforcements had already arrived, and on the 13th August, after a show of resistance. General August! (the successor of Primo de Eivera)

surrendered the city of Manila. The capture of Manila coincided with the signing of the peace protocol at Washington.

Aguinaldo chafed at the refusal of the American commander. General Otis, to allow his troops to enter the city, and still more so when he was ordered to remove his camp farther away from the Manila suburbs. The fate of the islands was in suspense from August 1898 to February 1899, and during this period of abeyance the Filipino army remained quietly under arms, repudiated as a factor by the Americans. During this interval Aguinaldo went to Malolos, proclaimed the Philippine Eepublic, formed a ministry, presided over a parliament of deputies, and issued a new constitution. The American authorities were invited to attend, but did not do so.

The treaty of peace between America and Spain, by which the Philippine Islands passed into the hands of the Americans, had been signed in Paris on the 10th December 1898, but it was not until 6th February of the following year that the treaty was confirmed by the American Senate. On 4th February, however, hostilities had broken out between the American troops and the Filipino army. The next day the contending forces met at Paco, a Manila suburb, where the Filipinos were defeated with heavy loss. The American troops, following up the retreating enemy, drove them "Revolt out of Malolos and San Fernando into Nueva ^^"/icans. Ecija, and then withdrew to Manila. A call for troops brought the total American army of occupation up to about 60,000 men.

It is unnecessary to trace in detail the gradual eon- quest of the islands, or the hundreds of engagements, often small, between the rebels and the Americans, especially in the islands of Luzon, Panay, Leyte, Negros, Samar, and Mindanao. Owing to the nature of the country, the climate, the want of roads, and the fact that large parts of the islands had never really been subjected by the Spaniards, the war was prolonged for from two to three years. The Filipino forces were gradually disorganized and dispersed, and with the capture of Aguinaldo, 23rd of March 1901, and later of his successor as commander-in-chief, Malvar, the resistance became little more than that of guerilla bands, and by July 1902 these

bands seemed to have been largely captured or crushed. During all this time the islands were under military government, but civil gov- ernment was gradually introduced as fast as the different islands or provinces were conquered. During the first year of the war a civil commission, ”’*’” under the presidency of Dr Schurman, was meâ„¢â„¢’ despatched to Manila by President McKinley to inquire into and report on the state of affairs. In February 1900 a second commission for perfecting the civil government was appointed, consisting of Judge W. H. Taft, Professor D. C. Worcester, General L. E. Wright, Mr H. E. Ide, and Professor Bernard Moses. According to the instructions of the President, ” that part of the power of government in the Philippine Islands which is of a legislative nature is to be transferred from the military governor of the islands to this commission, to be there- after exercised by them in the place and stead of the military governor. Exercise of this legislative authority will include the making of rules and orders, having the effect of law, for the raising of revenue by taxes, customs

duties and imposts ; tlie appropriation and expenditure of public funds of the illands ;- the establishment of an educa- tional system throughout the islands ; the establishment of a system to secure an efficient civil service ; the organizar tion and establishment of courts; the organization and establishment of municipal and departmental govern- ments ; and all other matters of a civil nature for which the military governor is now competent to provide by rules or orders of a legislative character.” On the 1st of September the commission assumed its legislative powers.. Its first Act was to appropriate one million dollars for the construction and improvement of roads. Another early Act provided for the improvement of Manila harbour at an expense of three million dollars. It was hoped that the harbour work would be completed in two years. Other legislation enacted by the commission provided for the organization of bureaus and departments of the central Government; the creation of municipal and provincial

governments (of the latter, thirty-four were established between February and September 1901) ; the passage of a general school law, under which 1000 American teachers were brought to the Philippines, who, with the help of a much larger number of Filipino teachers, started schools in 600 different towns, attended by over 100,000 pupils ; the organization of a judiciary, with courts culminating in a Supreme Court of seven members, four Americans and three Filipinos; the establishment of a provincial constabulary of 5000 men, which led to the rapid disap- pearance of ladronism ; the adoption of a new tariff ; the extension of the postal system ; the enactment of a code of civil procedure; the establishment of a bureau of forestry, a health department, and an agricultural bureau ; and the enactment of what were known as treason and sedition laws.

On the 1st of July 1902 President Roosevelt signed a new and ii^portant Bill for the civil government of the Philippines. Under this Bill a census was to be taken at an early date, and two years thereafter, should peace prevail, a legislative congress or assembly was to be authorized. The upper house of this assembly was to consist of the present commission of five Americans, with three Filipino members added, large powers being given to it through its control over appointments and salaries. As the majority was composed of Americans, no legislation hostUe to the United States was possible. The lower house was to consist of members elected by property owners or persons who can speak English or Spanish. The Bill authorized the sale of the public domain in not larger lots than 2500 acres to any one person, and also the purchase of the land belonging to the hated friars. On the 4th of July President Roosevelt abolished the office of military governor, the military forces being largely recalled, and the part remaining being made henceforth subordinate to the civil authorities. He also granted a general amnesty to all rebels and political]n-isoners who would take the oath of allegiance to the United States. The most important question remaining was that connected with the ownershipof landby the friars. The four orders â€” ^the Dominicans, the Augustinians, the Eecoletos, and the Franciscans, none of which admit the natives to membership â€” were the owners of 400,000 acres of land, largely the best land in the islands, half of which are near Manila.

N o rents had been collected on these lands between 1896 and 1902. Through all the years of Spanish government the friars were the real rulers, and it was opposition to them that caused the rebellion of 1896. It was the object of the commission to buy out the friars as landowners, and to substitute for them as spiritual leaders American secular priests. With this object in view. Judge Taft proceeded to Eome in July 1902, and negotiations were in August 1902 progressing on the subject, the belief of the members of the American com-

mission, as well as that of all other authorities, being that the removal of the friars was of the utmost importance for the peace and progress of the islands. (j. f*.)

Philippopolis, the capital of eastern Eumelia, principality of Bulgaria, finely situated in the midst of picturesque granite eminences on the Maritza, 96 miles east-south-east of Sofia and 97 west-north-west of Adrian- ople. Having communication by rail both with the port of Sed^aghatch on the Mediterranean and that of Bourgas on the Black Sea, and being situated in a remarkably fertile country, it has now become the chief commercial centre of southern Bulgaria, and is the seat of both a Greek and a Bulgarian archbishopric. The residences of the richer Greeks and Bulgarians occupy the slopes of the largest eminence, the Djambaz-tepe, in the centre of the town ; between it and the Nobet-tepe, from the smnmit of which there is a magnificent view of the town, is the Armenian quarter ; near the bridge over the Maritza is the poorer Turkish quarter ; and south-west of the Dj ambaz-tepe there is a suburb of villas. On the Bounardji-t^pe a monument has been erected by the Russians in commemoration of the war of 1877, and near this is the new palace of the prince of Bulgaria. The Sahub-tepe is crowned by a clock- tower. ISTot far from it are the beautiful Exhibition Park laid out in 1892, and the fine Djournaia-djami Mosque. Near the Maritza are the remains of the ancient Konak of the Turkish pashas, the public park formed by the Russians in 1877, the gymnasium, and the new Greek cathedral. The town has a large commerce in rice, attar of roses, and cocoons ; other exports being corn, wine, tobacco, alcohol, and hides. Population (1892), 36,033, of whom the bulk were Bulgarians, Turks numbering about one-sixth and

Greeks about one-ninth, the remain- der being Armenians, Jews, Tziganes, and Bohemians;

(1900), 42,849.

Phillimore, Sir Robert Joseph (1810-1885), British judge, was the third son of the well-known eccle- siastical lawyer, Dr Joseph Phillimore, and was born at Whitehall, 6th November 1810. Educated at Westminster and Christ Church, Oxford, where a lifelong friendship with Mr Gladstone commenced, his first appointment was to a clerkship in the Board of Control, where he remained from 1832 to 1836. Admitted as an advocate at Doctors' Commons in 1839, he was called to the Bar at the Middle Temple in 1841, and rose very rapidly in his profession. He was engaged as counsel in almost every case of import- ance that came before the Admiralty, Probate, or Divorce Courts, and became successively Master of Faculties, Commissary of the Deans and Chapters of St Paul's and Westminster, Official of the archdeaconries of Middlesex and London, and Chancellor of the dioceses of Chichester and Salisbury. In 1853 he entered Parliament as member for Tavistock. A moderate in politics, his energies were devoted to non-party measures, and in 1854 he introduced the Bill for allowing vivd voce evidence in the Eccle- siastical Courts. He sat for Tavistock until 1857, when he offered himself as a candidate for Coventry, but was defeated. He was appointed Judge of the Cinque Ports in 1855, Q.C. in 1858, and Advocate-General in Admir- alty in 1862, succeeding Dr Lushington as Judge or Dean of the Court of Arches five years later. Here his care, patience, and courtesy, combined with unusual lucidity of expression, won general respect. In 1875, in accordance with the Public Worship Regulation Act, he resigned, and was succeeded by Lord Penzance as Dean of Arches. When the Judicature Act came into force, the powers of the Admiralty Court were transferred to the High Court of Justice, and Sir Robert Phillimore was therefore the last judge of the historic Court of the Lord High Admiral of England. He continued, however.

to sit as judge for the new Admiralty, Probate, and Divorce Division until 1883, when he resigned. In literature Sir Eobert will be remembered for his Ecclesiastical Law of the Church of England, a book which still holds its ground, for his Commentaries on International Law, and for his translation of Lessing's Laocoon. He married in 1844 Charlotte Anne, daughter of John Denison of Ossington Hall, Newark. He was knighted in 1862, and created a baronet in 1881. He died at Shiplake, near Henley-on- Thames, 4th February 1885. His eldest son, Sir Walter G. Â¥. Phillimore (b. 1845), also distinguished as an eccle- siastical and admiralty lawyer, became in 1897 a judge of the High Court.

PhillipoliS. See Okange Eivee Colony.

Phillips, Wendell (1811-1884), American orator and reformer, was born in Boston, 29th November 1811. His father, John Phillips, a man of wealth and influence, was a graduate of Harvard College in 1788, and became successively " town advocate and public prosecutor," and in 1822 first mayor of Boston, then recently made into a city. Wendell Phillips himself attended the public Latin school, entered Harvard College before he was sixteen, and graduated in 1831 in the same class with the historian Motley. Both of them belonged emphati- cally to the aristocracy of Boston, and it is recorded that Phillips was the only man for whom the family carriage was habitually sent out from Boston to Cambridge on Saturday morning that he might spend Sunday at home. He graduated at the Harvard Law School in 1834, and was admitted to the Bar in Boston. He soon came under the' influence of the anti-slavery movement, wit- nessing in 1836 the mobbing of Garrison. In 1837 a meeting was called at Faneuil Hall to express the senti- ments of the people on the murder of Elijah P. Lovejoy, at Alton, Illinois, for defending his press from a pro- slavery mob. In the course of the meeting a speech was made in opposition to its general current by James T. Austin, Attorney-General of the state, who said that Lovejoy had died "as the fool dieth," and compared his murderers to the men who threw the tea into Boston harbour during the American Eevolution. The speech seemed likely to divide the audience, when Wendell Phillips took the platform. " When I heard," he said, " the

gentleman lay down principles which placed the murderers of Alton side by side with Otis and Hancock, with Quincy and Adams, I thought these- pictured lips [pointing to their portraits] would have broken into voice to rebuke the recreant American, the slanderer of the dead." This appeal not merely determined the sen- timent of the meeting, but it gave Wendell Phillips his first fame and determined his career. Although loving his profession, and this especially for the opening it gave in the direction of public life, he practically stepped outside the sphere dearest to young Americans, and lived henceforth the life of an agitator, or, like his father, that of a " public prosecutor." Accepting unhesi- tatingly the leadership of Garrison, and becoming like him gradually a disunionist, he lived essentially a plat- form life, interested in a variety of subjects, but first and chiefly an abolitionist. He was not, however, like his great leader, a non-resistant, nor was he, on the other hand, like John Brown, borne on by irresistible necessity to overt action. Nor did he find, like his fellow-worker, Theodore Parker, the time to keep up his scholarship and lead in part the life of a student. Early study and travel had indeed furnished him with abundant material for rhetorical illustration ; and he was also a great reader of newspapers, but he used to say that he knew in his whole life but one thing thoroughly, namely, the history of the English Eevolution, and there were few occasions when he

could not draw from it the needful illustratioii. His style of eloquence was direct and brilliant, but eminently self- controlled. He often surprised his hearers by the quiet- ness of his beginnings, and these were very often the speeches which turned out most brilliant and most irresist- ible ere the close. He may be said to have introduced the direct and colloquial manner upon the American public platform, as distinct from the highly elaborated and often ornate style which had been established by Edward Everett ; nor has there ever been a reversion since his day to the more artificial method. He was capable at times, nevertheless, of highly sonorous periods with superb climaxes, yet his favourite style was the conversational. His logic, while never obtruded, was rarely at fault ; but he loved the flash of the rapier, and was never happier than when he had to face down a mob and utterly foil

Wendell Phillips. {From a phoiogi'aph'by Sarony, Neio Yorlc.)

it by sheer superiority in fencing. The two volumes of his speeches, as edited by Mr Eedpath, were fortunately made from verbatim reports, and they wisely enclose in parentheses those indications of favour or dissent from the audience which transformed so many of his speeches into exhibitions of gladiatorial skill. He was a tribune of the people, associated unflinchingly not merely with the un- popular, but â€" which is sometimes more difficult â€" with the unpolished ; always carrying about him not merely a certain Eoman look, but a patrician air. After slavery hadfallen Phillips associated himself freely with reformers occupied in other paths, herein separating himself from the other patrician of the movement, Edmund Quincy, who always frankly said that after slavery was abolished there was nothing else worth fighting for. Phillips was not always the best judge of character, and was sometimes allied in these movements with men who were little more than demagogues. But the proof he gave by his transfer of energies that the work of reform was never quite finished â€" this was something of peculiar value, and worth the risk of some indiscretions. The life of a reformer did not in

itself make him thoroughly happy; he chafed more and more under its fatigues, and he always felt that his natural place would have been among senators or ambassadors ; but he belonged essentially to the heroic type, and it may well have been of him that Emerson was thinking when he wrote those fine words : " What forests of laurel we bring and the tears of mankind, to him who stands firm against the opinion of his contemporaries." His domestic life was most happy, though his wife was a confirmed invalid, seldom quitting her room. She was a woman of heroic nature and very strong convictions. Her husband used to say that she first made him an abolitionist. They had no children, but adopted an orphaned daughter of a friend, Mrs Eliza Garnaut, and this young girl brought much light and joy into the household. Their worldly circumstances were easy, except that they

were always ready to impoverish themselves for the sake of others. Wendell Phillips died at Boston on the 2nd February 1884. (t. w. h.)

Phillipsburg, a city of Warren county, New Jersey, U.S.A., on the east side of the Delaware river, opposite the mouth of the Lehigh and the city of Easton, Penn- sylvania, in the western part of the state, at an altitude of 221 feet. Its site is hilly and the street plan irregu- lar. It is on five railways â€” the Central of New Jersey, the Lehigh Valley, the Delaware, Lackawanna, and Western, the Lehigh and Hudson River, and the Penn- sylvania, which afEord ample facilities for communication. The city has large manufactures of iron and steel goods. Population (1880), 7181; (1890), 8644; (1900), 10,052, of whom 990 were foreign-born.

Philo. â€” -Since the appearance of the article in the ninth edition of the Encydopcedia Britannica (vol. xviii. pp. 759-764; see especially p. 763) much valuable work has been done, the effect of which has been to establish, or at least to uphold, the genuineness of writings ascribed to Philo, but then held to be spurious. The works there impugned are the following: (1) Ilept jSi'ov Oemp-rjTiKov r} iKerSiv aperSiv {De Vita Oontemplativd). This is both the shortest and historically the most important of the impugned writings, since it contains the sole original account of an ascetic community known as the Therapeutae having their home on the shores of Lake Mareotis. These were held by Eusebius and many other Christian writers to be the earliest Christian monks, which of course could not be the case if it was a genuine work of Philo. On this account, amongst others, it was held to be spurious by Graetz and P. E. Lucius; and this view gradually received the assent of most modern scholars. Latterly, however, the tables have been turned. L. Massebieau has shown with great thoroughness that in language and thought alike it is essentially Philonic, and the genuineness of the book has also been affirmed by P. Wendland, and especially by F. C. Conybeare. Massebieau first conjectured that it was part of the 'ATroXoyta inrep 'louSaiojv of Philo men- tioned by Eusebius, and Conybeare has shown almost to demonstration that it formed the fourth part of his treatise in five books entitled Jlepl aperSiv, which was probably the work referred to by Eusebius. In any case, whether it

be held that the Therapeutae actually existed in Philo's day, or that they are a Utopian dream, it can no longer be doubted that the idea was Jewish, not Christian. (2) nept atjiOapa-iai Koapiov (De Incorruptibilitate Mundi), which has been declared unauthentic by Z. Frankel and J. Bernays. It has, however, been successfully defended by its latest editor, F. Cumont. (3) Hepl Koa-p-ov {De Mundo). It is generally agreed that, in L. Cohn's words, this is "nothing but a compilation from various portions of the Trept a.4>&ap(riai Korrpov and Other Philonic works." (4) Two discourses, De Sampsone and De lona, extant only

in Armenian, and certain other writings of the same kind. These appear only to have been imputed to Philo by chance, and certainly cannot claim to be his work. In addition to these, two other tracts have been attacked : (1) lltpl

Tov iravTa (Tirovhalov dvai iXev9epov (Quod Omnis Probus

Liber sit) has been questioned by Z. Frankel and R. Ansfeld; but their arguments would rather point to its being an early work of Philo, which P. Wendland believes to be the case. (2) Ilept â– n-povoM's (De ProiAdentia), which we possess as a whole only in an Armenian version : it consists of two books, the first of which appears to be in a Christian recension, but there is no reason for denying its Philonic origin. In a word, the effect of modern work upon the text has been to vindicate in a remarkable degree the genuineness of the works ascribed to Philo ; and these results are accepted by Dr Leopold Cohn and Dr Paul Wendland, the editors of the critical edition.

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Philology. â€” The history of philology since 1885 has been one of steady progress. In that period no dis- covery has been made equal to those that were made in the decade after 1870. As in previous periods of the history of the study of language, an era of discovery has been followed by an era of organization. The results of such discoveries as Vomer’s law have been far-reaching. It has taken time to grasp them in all their bearings and to tabulate the results. The working hypotheses which were furnished by the generalizations propounded in the ‘seventies have been justified by their successful applicar tion to the multitudes of facts relating to language which had been collected before, or which have in even greater numbers been collected since. This very success has led discussion back to those principles which, first definitely propounded by Leskien in 1876, by Osthoff and Brugmann in 1878, led to an animated controversy culminating in a war of pamphlets in 1885. This controversy had no definite termination. The older school led by Georg Curtius practically came to an end with his death in 1885. Curtius’s successor at Leipzig was Brugmann, the foremost exponent of the new principles. The school of Berlin represented by Johannes Schmidt, and that of Gottingen represented by Fick and by younger men like Bechtel and Collitz, though denying the originality of the new princi- ples, and though deviating to some extent in terminology, have nevertheless been equally active in the employment of these principles as an engine of discovery. These principles were : (1) phonetic change proceeds according to laws which admit of no exceptions ; (2) apparent ex- ceptions are produced by the cross-action of a psycho- logical influence-analogy. Besides the discussion of first principles attached to these two formulas, much has been done in investigating the effects of accent, though the results are still in too inchoate a condition to be treated here, while two practically new fields of investigation have been opened up. These are (a) Comparative Syn- tax, (6) the study of Semantics or the principles accord- ing to which the meanings of words develop and change.

In the study of phonetic laws several stages are traceable,

and the meaning attached, to the phrase plionetic law has varied at each of these stages. Moreover, the sweeping nature of the original generalizations has become so hedged in and contracted by limitations that a recent writer has been compelled once more to formulate the question whether phonetic laws actually exist. It must be admitted in the first place that the word law has been ill chosen for use in this connexion. In phonetic laws there is no element which can be identified as coming under the definition of a law as propounded by a jurist like John Austin. There is no authority which enun- ciates the law, there is no penalty for the breach of it. But the philologists who first used the term were not thinking of law in its strict signification, but of its use in such metaphorical expressions as scientific laws, for Schleicher and his followers in the middle of the 19th century had taken a keen interest in the development of the natural sciences, and had to some extent assimilated their terminology to that employed in those sciences. It was, however, soon recognized that the laws of language and those of natural science were not really alike or akin. A scientific “law” is only a brief method of expressing the fact that universal experience shows that certain causes universally produce certain effects. In chemistry two atoms of hydrogen and one of oxygen will make water, and they will make nothing else at any time or at any place the world over. Phonetic laws, however, do not hold true universally. They are often curiously limited in the area to which they apply. In ancient Greek, for example, the sound s between two vowels, which had been handed down from the original language whence Greek and the sister languages are derived, reg- ularly disappears ; in Latin, on the other hand, it changes into r ; thus an original genitive of a neuter substantive we find represented in Greek by yeVe-os, a form which com- parison with other languages shows to be traceable to an earlier *genes-os, preceding the separation of the languages, while the same original stem with a different vowel in

the ending apears in Latin as gener-is. Similarly an early *euso appears in Greek as cum, in Latin as uro. This disappearance of original intervocalic s pervades all Greek dialects â€” ^the apparent exceptions come under the heading of analogical change ; with a very few exceptions similarly explicable Latin intervocalic s has become r. But Latin was originally limited to a very small part even of Italy, and the next neighbours of the Latins on the east and south â€” the Sabines, Campanians, and Sam- nites â€” retained this intervocalic s without changing it into r. On the other hand, the neighbours to the north-eastâ€” the Umbrians in and beyond the Apennines â€” shared in this rhotacism. Yet the Kelts, who bordered on the Umbrians along the Po, and who spoke a language in many respects very closely akin to the dialects of Italy, in this regard agree rather with Greek than the Italic languages. In Latin, again, the period of action of the law which changed intervocalic s into r did not in all probability exceed the century from 460 B.C. to 350 e.g. So unlike, indeed, are phonetic laws to the laws of natu- ral science in universality that an opponent of the dogma which declares that phonetic laws have no exceptions has compared them with the laws of fashion. The compari- son is not so outrageous as it may seem at first sight. For in language there are two kinds of sound change, that which is unconscious, universal at a given time and within a given area, and, on the other hand, that which belongs only to a particular class or clique, deviates con- sciously from the pronunciation of the majority, is there- fore not universal, and exercises no permanent influence on the language. The second kind of sound change cor- responds exactly to the laws of fashion; it is in fact one of them. Such sound changes are the pronunciation of

the English ending -ing as ~~in', which was fashionable in the middle of the 19th century. This had, though pro~~ bably without the knowledge of those who used it, a his- torical justification in the earlier forms from which most of the English words now ending in -ing are descended, and which survive in numerous local dialects. A similar conventional mispronunciation was the lisp affected by some would-be artistic persons at a somewhat later period. Belonging to an entirely different social stratum, and now equally obsolete, was the London pronunciation of the first half of the 19th century typified in Tony and

Sam Weller's treatment of v and w in the Pickwick Papers. This, how- ever, made a much nearer approach to being a genuine dialect peculiarity. It undoubtedly pervaded the pronun- ciation of the lower classes in London at one time ; had it survived it might conceivably have spread over a wider and wider area until it einbraced the whole population of England. A later change, that of the diphthong ai into ei (so that day, daily are pronounced dy, dyly), has spread from Essex and the East End of London over a large part of London and of the adjacent counties, and is still widening its range both geographically and socially. The history of these sound changes has not yet been investigated in detail with the thoroughness which it deserves.

There is, then, a part of sound change which is a matter of fashion and which is conscious. This sound change appears frequently in the pronunciation of individuals who have migrated from one part of a country to another. In many parts of Scotland, for example, the prepositions with and of appear in dialect only in the forms ((‘(‘ and o’, which were originally the unaccented forms. In the conscious attempt to pronounce them as they appear in literary English, the educated Scotsman, if he remains in his native place, as a rule pronounces them as u'ith (with the final sound unvoiced as it appears in the Scottish legal preposition ontivith) and as off, the final sound here also being unvoiced. If he migrates to England or to Australia he will probably in course of time adopt the pronunciation with a voiced final sound. In the course of years habit â– will become second nature, and in this respect the speaker's pronunciation will become identical with that of his neighbours. It is clear, however, that changes of this nature cannot take place on a large scale. If a large number of persons migrate in a body and continue to live in close intercourse with one another and but little in contact with the outside world, changes such as take place in the pronunciation of the individual emigrant do not occur. There can be no imitation of alien sounds, for there are none ; no greater effort to be intelligible is re- quired, for the audience has not changed. Hence it has been often remarked that a population which history shows to have remained undisturbed for very long periods in the same geographical situation manifests but little change in its language. Thus in Arabia and Lithuania the population has remained practically unmixed in the same

habitat for thousands of years, with the result that the languages spoken there remain at the present day the most archaic members of the linguistic families to which they respectively belong.

From what has been said it will be obvious that a phonetic law is only an observed uniformity in the treat- ment of a sound or a combination of sounds ^^‘ithin a linguistic area at a given time. In the definition the term UiigniMic arcit is a very variable quantity. Thus it is a phouetic law that a sound of the original Aryan lan- guage, the precise pronunciation of which cannot be determined, but which was at any rate a palatal sound (&), appears in the Aryan group (Sanskrit, Zend, Old Persian, with their descendants), in Armenian, in Bal to- Slavonic and Albanian, in the form of a sibilant, while in

Greek, the Italic dialects, Germanic and Keltic, it appears as a ft- sound. Here the linguistic area is extremely wide, and it is clear that the difference between the two groups of languages must be dated back to a very early period. Again, it is a phonetic law of Greek that the original com- bination St- at the beginning of words is retained in Greek. How then are we to explain the existence side by side of o-reyos and Tâ,¬yos ? The former apparently complies with the law, the latter does not. The former has by its side the verb a-Teyio, while rt’yos is supported only by the rare Ttyrj. Yet the forms of the verb and substantive found in the Germanic languages leave no doubt that the forms without s- represent an extremely old form, for the Eng- lish thatch could not have changed its original t- into th- if it had been preceded by s-, the law being as strict for English as for Greek that initial st- remains unclianged. On the other hand, a phonetic law may be limited to a very small area. Thus in the dialect of Eretria, and nowhere else within the area of the Ionic dialect of Greek, do we find the change of the sound which appears elsewhere in Greek as σ- between vowels into p : a-LT- qpiv for aCTrjcnv (ace. sing.), TrapajSaCvwpiv for TrapapaLvoyaiv (3rd pi. sub- junctive). Why this change should take place here and nowhere else we do not know, although it may be con- jectured that the

cause was a mixture with immigrants speaking a different dialect, a mixture which ancient tradition supported. Undoubtedly such mixtures are the chief conditions of phonetic change, the effect of which is universal. The manner in which the change takes place is that the basis of articulation, the method in which the sound is produced, becomes changed. Thus along the ” Highland line ” in Scotland, where the English and Gaelic speaking populations had their linguistic frontier for centuries, the wh- of English, the Anglo-Saxon hio-, be- comes universally/-, wha ? becoming /a ? iuhite,fite, &c., / being the sound which it was most easy to substitute for the difficult hw-. The history of Spanish in the different communities of South America excellently illustrates this point. After the discovery of America there was a large influx of Spaniards into Chile, who ultimately, and chiefly by intermarriage, incorporated amongst them a consider- able element from amongst the native Araucanian Indians. The result has been that the language of Chile is Spanish, pronounced not with the genuine sounds of Spanish, but with the sounds of the Araucanian language substituted for them. Elsewhere in Spanish America the language of the conquerors remained comparatively pure, because the Spaniards were much fewer in number and had therefore to maintain themselves as a caste apart. For the same reason Latin has split up into the numerous branches which we know as the Romance languages. The particular line of development which, e.g., French followed as com- pared with Spanish or the language of the Rhaetian Alps was conditioned by the nature of the sounds in the language which preceded it in the same area, and which was spoken by the ancient Gauls who adopted Latin. The difficulty found in all of these cases is precisely of the same kind as that which an adult at the present day speaking one language finds in attempting to learn the pronunciation of another language. On the one hand, it is only with the greatest difficulty that muscles for many years accustomed to perform one set of movements can be forced into performing another set which are very similar but yet not identical; on the other hand, to an untrained ear the difference between the two sounds may remain unappreciated. The result is that the new language is pronounced with the sounds of the speaker’s original language. If the new language is adopted by a whole people to whom it was originally

foreign, the children naturally learn it from their parents with the sounds of the old language which has now become obsolete. Thus

the basis of articulation is changed, and if, as was the case with Latin, this process be frequently repeated among peoples speaking languages with articulation widely differing one from another, it is clear that a series of different dialects of the adopted language has been created. This kind of change is immediate and universal throughout the whole area where linguistic change has taken place.

While the syntax of individual languages was one of the first features which attracted the grammarians' attention, at any rate in so far as particular authors differed from a given standard, it is only in very recent times that syntax has received methodical treatment from the comparative point of view. It may indeed be said that almost the whole fabric of the comparative syntax of the Indo- European languages as it exists to-day has been reared by one man â€" Professor Berthold Delbrilck of Jena. In a series of brilliant studies beginning with a pamphlet on the Locative, Ablative, and Instrumental, published in 1867, and continued in his Syntactical Researches {SyiitaJctische Forschuw/eii) in five volumes, comprising a treatment of the conjunctive and optative moods in Sanskrit and Greek (1871), the theory of the Sanskrit tenses (1877), the order of words in early Sanskrit prose (Qatapatha Brahmana) (1878), the foundations of Greek syntax (1879), and the syntax of the oldest Sanskrit {Altindische Syntax) dealing exclusively with the literature of the Vedas and Brahmanas (1888), Professor Delbrilck laid the foundations for his treatment of comparative syntax in three volumes (1893, 1897, 1900), which has formed the completion of Brugmann's Orundriss der vergleichenden OrammatiJc der indogennanischen Sprachen. The only work by another hand (on a large department of the subject) which deserves to be mentioned by the side of Delbruck's studies is the small treatise by Hubschmann on the theory of the cases {Zur Casuslehre, 1875). For the comparative neglect of this field of investigation there are several reasons. The earlier philo- logists had so much to do in determining the languages which should be included within the Indo-European group, and in organizing the field of research as a whole,

that it is not to be wondered at if they were unable to devote much attention to syntax. In the ‘seventies, when attention began to be more directed towards comparative syntax, the remarkable discoveries made by Verner with regard to accentuation, and by Brugmann, Collitz, and others with regard to the phonology of the Indo-European languages, again distracted attention from the subject. Moreover, the research in itself is infinitely more difficult than that into sounds and forms ; for the latter may be carried on by the help of grammars and dictionaries with a compara- tively small knowledge of the literature of any individual language, while on the other hand the study of syntax is impossible without a thorough and intimate knowledge of the literature and modes of expression in each separate language. It is not, therefore, matter for wonder that Delbrilck has confined himself in the investigation of syntax to a part only of the languages whose sounds and forms are discussed by Brugmann in the earlier volumes of the Orundriss. To cover the whole ground is beyond the powers of a single man, and there is a great lack of preliminary studies on the syntax of many of the languages.

For the early history of the syntax of the verb Greek and Sanskrit are important above all other languages, because in them the original forms and the original usages are better preserved than they are elsewhere. And it is in the verb that the great difficulties of comparative syntax present themselves. The noun system is so well preserved in several languages that, when the number of the original cases had once been determined, the sifting of the

pro-ethnic usages attaching to each case was tolerably easy, for besides Sanskrit and (to a less extent) Latin, Lithuanian and Slavonic have kept the pro-ethnic case system almost complete. The ideas also which had to be expressed by the cases were on the whole of a very concrete character, so that here the problem was much simplified. On the other hand, the ideas expressed by the forms of the verb are of a much more subtle nature, while the verb system in all languages except Greek and

Sanskrit has broken down earlier and more completely than the noun. It is clear that the verb of the original Indo-European language possessed two voices, and forms corresponding to what we call the Indicative, Subjunctive, and Optative moods, and to the Present, Imperfect, Future, Aorist, and Perfect tenses. The imperative mood seems primitively to have been confined to the second person singular, just as the vocative, which, like the imperative, is a stem form without suffix, was con- fined to the singular. The infinitive, as is well known, is in all languages of this system not originally a verbal but a substantival form. The pluperfect, where it has developed, seems to be a mixed form arising from the application of aorist endings to a perfect stem. Thus far the history of the verb system is tolerably clear. But when we attempt to define the original meaning of the moods and of the tenses we pass into a region where, in spite of assiduous investigation in many quarters during recent years, the scanty amount of light thrown on the problem has only served to make the darkness visible. As regards the tenses at least, it has been shown that without doubt there is no difference in formation between present, future, and aorist stems, while the earliest meaning of the perfect was that of a special kind of present expressing either repeated or intensive action or a state. It has also been proved that the original meaning of the aorist is not past in time, and that in fact the only element whereby these languages could express remoteness in time was the augment. The augment seems to have been originally a pronominal deictic particle. Thus, as there was no original pluperfect, as neither perfect nor aorist originally referred to past time, and as the future, except in Lithuanian (with slight traces in Slavonic) and the Indo-Iranian group, cannot be clearly distinguished from the aorist, the system as a method of expressing time absolutely breaks down. The tenses in fact did not originally express the times when the action took place, but the type of action which took place. Thus the present system in the main expressed continued or durative action, the aorist only the fact that the action had taken place. The action indicated by the aorist might have been of considerable duration, or it might have been begun and ended in a moment ; its characteristics in this respect are not in any way indicated by the aorist form, which intimates only that the action is viewed as a completed whole and not as a continuous process. The present system,

however, is built up in a great variety of ways (thirty-two according to Brugmann's enumeration). It is a priori unlikely that such a multi-plicity of formations had not originally some reason for its existence, and Delbrilck thinks that he has discovered a difference in syntactical value between various forms. The reduplicated present forms of the type seen in Sanskrit jigati, Greek SiSuiyw, &c., he regards as expressing origin- ally an action which consisted of repeated acts of the same nature (iterative), though this iterative meaning frequently passed into an intensive meaning. Presents of the type seen in Sanskrit tf s? jati, " is thirsty," and Greek xa4""> " ‘ S^^^^ " i^^^ * X"-Pk'^)> where the i (if) of the suffix has modified the first syllable and disappeared, he regards as cursive â€" i.e., they express continuous action without reference to its beginning or end. Verbs which have regard to the beginning or end of the action he calls

terminative, and finds them represented (a) in verbs with m suffixes, Sanskrit rribti, opwa-i, " sets in motion," ayvvijn, " break to pieces " ; (b) in verbs with the suffix sJco, Sanskrit gdchati, " goes " (to a definite destination), Greek ySao-KO), &c. The roots he classifies as momentary (Punk- tuell) or non-momentary, according as they do or do not express an action which is begun and ended at once.

This method of classification was no dqubt suggested in the first instance by the characteristics of the Slavonic verb system. In this system a clear distinction is drawn in nearly all verbs between those which express a process (durative verbs) and those which express a completed action (perfective verbs). When perfective and durative verbs are formed from the same root, the perfective are distinguished from the durative forms (a) by having a preposition prefixed, or (b) by having a different stem formation. Thus in the Old Bulgarian (Old Ecclesiastical Slavonic) to strike (hit) and to strike dead are expressed by the same verb, but in the latter meaning a pre- position is found which does not appear in the former, hiti (infinitive), " to strike " ; u-biti, " to strike dead." To strike is durative ; to strike dead is]}erfective. As an example of difference of stem formation express- ing this difference of meaning, we may quote sesti, " to sit down" (perfective), sMet, "to sit " (durative). Verbs with a suffix in n have

often a perfective meaning: cp. the Sanskrit and Greek verbs quoted above. The perfective verbs correspond in meaning to the Greek aorist, and are to be carefully distinguished from perfect forms. The same distinction of meaning is often achieved in other languages also by means of prepositions, e.g., in Latin (Seneca, Epxi. xciii. 10), Quid autem ad rem pertinet, quamdiu vites, quod evitare non possis ? " What does it matter how long you go on avoiding [durative] what you cannot escape [perfective]." From this example, how- ever, it is clear that, though the means employed to make the distinction are different, there is no difference in meaning between such perfective verbs and those classified by Delbrlick as terminative. Here, as in many other parts of this study, the ideas are new, and grammatical terminology has not yet sufficiently crystallized, and still leaves something to be desired both in clearness and in precision.

As regards the moods, the difficulty has been to find any criterion whereby the functions of one mood should be differentiated from those of the others. It has long been recognized that the difference between indicative and sub- junctive is one of meaning and not one of formation ; that, e.g., in Sanskrit bharati (3rd sing. pres. indic), " bears," is morphologically identical with hanati, " may slay " (3rd sing. pres. subj.), and that the latter is described as a subj unctive only because of the meaning, and because there exists a dissyllabic form, hanti, which makes the indica- tive " slays." Similarly in Greek it is impossible to dis- tinguish morphologically between Travcno, " 1 shall check " (fut. indic.) and irawVu), " let me check" (1st aor. subj.). Moreover, m the earliest forms of the languages which preserve the moods best (Greek and Sanskrit), the con- nexion syntactically between the indicative and the sub- junctive forms is closest. Not only does the future express futurity, but also the determination of the subject to carry out the action expressed, which, in Delbruck's discussion of the moods, is precisely the point chosen as characteristic of the subjunctive. On the other baud, the present optative differs from the present (and future) indicative and present subjunctive in having a special mood suffix, and in having secondary while they have primary personal endings. Nevertheless its meaning overlaps that of the other forms, and some excellent authorities, like Professor W. W. Goodwin, see in future

indicative, subjunctive, and optative only different degrees of remoteness in the future,

the remoteness being least in the future and greatest in the optative. Delbrtick, however, abides, with slight modifications, by the distinction which he propounded in 1871, that the subjunctive expresses Will and the optative Wish. Here again the problem has not been solved, and it is doubtful how far any definite solution is likely to be arrived at, since there are so many gaps in our knowledge of mood forms. These gaps, owing to the break-up of the system at so early a period, it is hardly probable we shall ever be able to fill. It is possible, however, to do a great deal more than has yet been done even in the most familiar languages. In Latin, for instance, even now, the facts for the use of the moods within the two centuries of the classical period are very imperfectly known, and it is no exaggeration to say that more has been done in the last hundred years for Sanskrit than has been done in two thousand years of continuous study for Latin or Greek.

The second of the recent additions to the domain of Philology â€” the study of meaning â€” presents fewer diffi- culties, but until recent years has been equally neglected. The study is so recent that the literature of the subject is still extremely small. The only attempt to deal with it on a large scale is M. Breal's Essai de Simantique (1897), now translated into English under the title of Semantics (1900), with a valuable introduction and appendix by Dr Postgate. From the practical point of view many of the phenomena have been classified in works on rhetoric under the headings of Metaphor, Synecdoche, and Metonymy. The psychological principle behind this superficial classi- fication is that of association of ideas. Here, as else- where, changes proceed not by accident, but according to definite principles. Here, as elsewhere in language, in history, and the other moral sciences, the particular prin- ciple in operation can be ascertained only by beginning with the result and working back to the cause. In the development of meaning much more than in phonetics is this necessarily the case. In phonetics all

speakers of the same dialect start with approximately the same sound. But the same combination of sounds which we call a word does not recall the same idea to all persons who use that *word. The idea that the phrase railway station calls up in the mind of a Londoner is very different from that which occurs to the mind of a child acquainted only with a wayside station serving the wants of a country village of a few hundred inhabitants. The word herring suggests one idea or train of ideas to the fisherman who catches the fish, another to the merchant who purchases it from the fisherman, a third to the domestic who cooks it, and so on. To members of the same family the same word may often have widely different associations, and, if so, the meta- phors for which the word will be employed will differ in each case.

Por the history of meaning it is necessary to have regard to all the forms of association of ideas which psychology recognizes. These are contiguity in place or in time, resemblance and contrast. Contrast, however, as J. S. Mill and Bain have shown, is not a simple form of association,' but is evolved partly from contiguity, partly from resemblance. An artificial hollow generally implies also an artificial height made of the materials excavated from the hollow. Hence in most languages some words occur with the two contrasted meanings. Thus in Eng- lish we find dyke in use both for a ditch and for a mound fronted by a ditch, the word ditch being, in fact, but a dialectal form of dylce. In Scotland, on the other hand, where earthen mounds and stone walls form more frequent boundaries between fields than in England, the word dyke is now practically limited to elevated boundaries, while ditch is limited to excavated boundaries. Thus the proverb, "February fill dyke," which in England implies

that the February rains will fill the ditches, is often understood in Scotland to mean that in February the snow will be level with the tops of the stone or turf walls. Similarly in Latin Tacitus-can sajfossas proruere, which can only apply to levelling raised mounds ; while in Greek Xenophon also talks of the ditch (trench) thrown up (rat^pos ava fie pXri/xevrj). It is only natural, therefore, that other words with several meanings should be used similarly : moat, originally a mound of earth or peat, has come to mean a big ditch : while, conversely,

soldiers in trenches are not so much in ditches, as the word ought to signify, as behind breastworks. Sometimes when two actions opposed to one another are contiguous, a word seems to change to the exact opposite of its original meaning. Thus the English verb wean, which meant originally to accustom (to cooked food), has been transferred to the necessary preliminary, to disaccustom to the breast.

Resemblances may be (i.) genuine, and (a) of external appearance, or (6) of other characteristics, or (ii.) fanciful or analogical. From resemblance in the external appear- ance of the object, the word gem, which in Latin (gemma) usually means a bud, has come to mean first a pearl and then by extension of the meaning any precious stone. From the concentric coats which appear in both, the Latin word for a pearl (unio, ace. iinionem) appears in English as onion. Examples where the characteristics are not of external appearance are such as the German kaiser and the Russian tsar, which are descended from Julius Caesar, while the Lithuanian word for king â€” karSlius â€” is Carolus i.e., Charlemagne. So in modern Persian, Xusrev, ” Lord,” comes from the Zend proper name Husravah (Chosroes). The resemblances which have established a connexion between pert and impertinent (properly irrelevant) are in sound only. The same is true of the supposed relation of the verb cut to cutlass, cutler, and cutlet. While train oil really means oil in drops like tears (cp. German TJirdne), most, people connect it with railway trains. The re- semblance in some cases is merely in function. Thus, though the fir and the oak have no resemblance one to the other, the word Jir is now generally identified with the Latin quercus in etymology (cp. /owr and quattuor), in the same way as the Latin fagus, “beech,” is with the Greek 4’vyÂ°^> “oak,” the users of the word having, in the course of their migrations, passed from a land with oaks to a land with firs in the one case, and from a land of beeches to a land of oaks in the other. Resemblance as the basis of metaphor has a very widely extended influence on language.

The most numerous and most varied forms of change in meaning depend, however, upon the law of contiguity. Perhaps the commonest of all forms of contiguity is that where the word indicating some accompanying feature or condition replaces the word for the object

referred to. In the countries that border the Mediterranean the heat of mid-day is accompanied and intensified by the dying away of the wind, a characteristic remarked upon by Aeschylus (Agam. 565): “What time upon his noonday couch, windless and waveless sank the sea to rest.” From the Greek word xaS/xa, “burning heat,” arises through late Latin the English calm, where the absence of wind is the only idea present, that of heat having altogether dis- appeared. Again, in bugle, which is abbreviated for bugle- horn, the word which survives properly means wild ox, and the originally more important element is lost. In a combination like silver bugle the word has gone a stage farther; the original meaning of horn has also disappeared. There is no longer any thought of an animal’s horn ; the only idea that survives is that of a musical instrument. From the cope or cloak (capella) of St Martin, which was preserved as a sacred relic by the Prankish kings, comes

the word chapel. The word was first transferred from the cloak to the holy place wherein it was kept, and thence to similar shrines, and ultimately to any place, not being a church, where prayers were said. A jig was originally not the dance, but the fiddle which sup- plied the music for the dance. The names of liquors are often replaced by some accompaniment as of the place, port, slieri-y, champagne, or by a qualifying adjective as in brandy, properly ” burnt ” from the Dutch brande- wijn; or, again, only the less important element of the word is retained as in whisky, literally “water,” for the older nsquebaugh, a corruption of Gaelic words meaning the ” water of life ” (aqua vitce). Replacement of siib- stantives by their accompanying adjectives is common in most languages. One of the most common methods of coining a name for a new article is to give it the name of the place or people whence it comes. Thus we have arras, lawn (from Laon), cravat (Croat), coach from Kocs in Hungary, bilboes (both fetters and swords) from the iron mines of Bilboa in Spain. Equally common are the names of inventors â€” pinchbeck, tontine, silhouette, guillotine, derrick. In the word cash, which comes in- directly from Latin capsa, ” a box,” the

thing contained has taken its name from the container. Similarly mortar, “cement,” derives its name from the mortar in which it was mixed, while in box the material (boxwood, Lat. buxus, Greek irii^os) has usurped the place of the article made. In leper the disease (Lat. lepra, the rough disease, from Greek XtTrpa vdo-os) has been made into the ‘name of the sufferer, who was earlier called a leprous man. As a consequence, a new substantive leprosy has to be taken from the adjective to indicate the disease. The various changes in meaning, which are classed together as synecdoche, have their origin in contiguity. Thus we have the species for the genus ; the butcher, who properly kills goats only (Old French boo), has ousted the flesher. But we have also the genus for the species ; corn, as a rule, means in England wheat ; in Scotland, oats ; in America, maize. The individual becomes collective as in corps, navy, body (of men) ; the collective becomes individual when Latin racemus, ” bunch of grapes,” passes into Eng- lish “raisin.” Here would come the so-called meliorative and pejorative developments in word-meaning, whereby, e.g., steward, ” the sty-ward,” becomes the title of a great officer of the realm and the’ name of a line of kings ; or, on the other side, sou (Lat. solidus) passes from the name of a gold coin to that of one of proverbially insignificant value. Here, too, would come many euphemistic uses which are, for the most part, applications of more general terms to avoid the mention of some specific act or object which is unpleasant, as death, murder, bankruptcy, debt, &c., while metaphorical terms for the same things come under resemblance. These examples do not exhaust the forms of contiguity which appear in language, but they are enough to show how far-reaching the effect of this ty])e of association of ideas is upon language, and how extensive the field is which still calls for investigation before the study of meaning attains the same development as the investigation of the other branches of the history of language.

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Phoenix, a city of Arizona, U.S.A., capital of Mari- copa county and of the territory, situated on the Salt river, a main branch of the Gila, and on the Santa Ee, Prescott, and Phoenix and the Maricopa and Phoenix rail- ways, south-west of the centre of the territory. Population (1890), 3152; (1900), 5644, of whom 935 were foreign- born and 148 negroes.

Phoenix Islands. See Polynesia.

Phoenixville, borough of Chester county, Penn- sylvania, U.S.A., situated on the Schuylkill river at the intersection of branches of the

Pennsylvania and the Philadelphia and Reading railways, in the south-eastern part of the state, at an altitude of 131 feet. It contains extensive iron-works, blast furnaces, and rolling mills. It is widely known for its manufacture of bridges, girders, columns, &c. Population (1890), 8514 ; (1900), 9196, of whom 2221 were foreign-born and 278 negroes.

Phonograph. 7-The phonograph is an instrument by which the mechanical effect of vibrations of sound can be imprinted on a moving surface of tinfoil or wax. By mechanical arrangements the sound can be reproduced from these imprints. The phonograph was invented by Thomas Edison in 1876, and the first design was patented in January 1877. Many attempts had been made by earlier experimenters to obtain tracings of the vibrations of bodies emitting sound, such as tuning-forks, membranes, and glass or metallic discs. In 1807 Thomas Young (Lectures, vol. i. p. 191) described a method of recording the vibrations of a tuning-fork on the surface of a drum ; his method was fully carried out by Wertheim in 1842 (Recherches sur VilasticM, P- mim.). Recording the vibrations of a membrane was first accomplished by Leon Scott by the invention of the phonautograph, which may be regarded as the precursor of the phonograph (Comptes Rendus, t. liii. p. 108). This instrument consisted of a thin membrane to which a delicate lever was attached. The membrane was stretched over the narrow end of an irregularly shaped funnel or drum, while the end of the lever or marker was brought against the surface of a cylinder covered with paper on which soot had been deposited from a flame of turpentine or camphor. The cylinder was fixed on a fine screw moving horizontally when the cylinder was rotated. The marker “thus described a spiral line on the blackened surface. When sounds were transmitted to the membrane and the cylinder was rotated, the oscillations of the marker were recorded. Thus trac- ings of vibrations were obtained. This instrument was much improved by the well-known physicist, Konig, of Paris, who also made with it many valuable observations. (For a figure of the improved instrument, see Nature, 26th December 1901, p. 184.) The mechanism of the recording lever or marker was improved by Barlow, in 1874, in an

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instrument called by Mm the logograph (Trans. Boy. Soc, 1874^. The next step was Konig's invention of manometnc flames by -which the oscillations of a thin membrane under sound-pressures acted on a small reser- voir of gas connected with a flame, and the oscillations were viewed in a rotating rectangular mirror, according to a method devised by Wheatstone. Thus flame-pictures of the vibrations of sound were obtained {Pogg. Ann. cxxii. pp. 242, 660, 1864 ; see also Quelques Experiences d'AcousHque, Paris, 1882). Views of such flame-pictures may be seen in almost every text-book of physics. Clar- ence Blake in 1876 employed the drum-head of the huinan ear as a logograph, and thus obtained tracings similar to those made by artificial membranes and discs {Archiv fur Ophthalmol, vol. v. 1, 1876). In the same year Stein photographed the vibrations of tuning-forks, violin strings, &c. {Pogg. Ann., 1876, p. 142). Thus from Thomas Young downwards successful efforts had been made to record graphically on moving surfaces the vibra^ tions of sounds, but the sounds so recorded could not be reproduced. This was accomplished by Edison. In the first phonograph a spiral groove was cut on a brass drum fixed on a horizontal screw, so that when the drum was rotated it moved from right to left, as in the phonauto- graph. The recorder consisted of a membrane of parch- ment or gold-beater's skin stretched over the end of a short brass cylinder about 2 inches in diameter. In the centre of the membrane there was a stout steel needle having a chisel-shaped edge, and a stiff bit of steel spring was soldered to the needle near its point, while the other end of the spring was clamped to the edge of the brass cylinder over which the membrane was stretched. The recorder was then so placed beside the large cylinder that the sharp edge of the needle ran in the middle of the spiral groove when the cylinder was rotated. The cylinder was covered with a sheet of soft tinfoil. Dur- ing rotation of the cylinder and while the membrane was not vibrating, the sharp edge of the marker indented the tinfoil into the spiral groove ; and when the membrane was caused to vibrate by sounds being thrown into the short cylinder by a funnel-shaped opening, the variations of pressure corresponding to each vibration caused the marker to make indentations on the tinfoil in the bottom of the groove. These

indentations corresponded to the sound-waves. To reproduce the sounds the recorder was drawn away from the cylinder, and the cylinder was rotated backwards until the recorder was brought to the point at which it started. The cylinder was then rotated forwards so that the point of the recorder ran over the elevations and depressions in the bottom of the groove. These elevations and depressions, corresponding to the variations of pressure of each sound-wave, acted back- wards on the membrane through the medium of the marker. The membrane was thils caused to move in the same way as it did when it was made to vibrate by the sound-waves falling upon it, and consequently move- ments of the same general character but of smaller ampli- tude were produced, and these reproduced sound-waves. Consequently the sound first given to the phonograph was reproduced with considerable accuracy. Such was the first tinfoil phonograph. In 1878 Fleeming Jenkin and Ewing amplified the tracings made on this instru- ment by the sounds of vowels, and submitted the curves so obtained to harmonic analysis ; that is to say, by the application of Fourier's theorem they were enabled to analyse the complex curves corresponding to the vibra- tions of vowel-tones into the simpler curves, in a har- monic series, of which they were composed (Trans. Boy. Soc. Edin. vol. xxviii. p. 745). The marks on the tinfoil were also examined by Grtitzner, Mayer, Graham Bell, Preece, and Lahr (see Tlie Telephone, the Microphone,

and the Phonograph, by count du Moncel, Lond. 1884; also Tlie Speaking Telephone and Talking Phonograph, by G. B. Prescott, New York, 1878).

The tinfoil phonograph, however, was an imperfect instrument, both as regards the medium on which the imprints were taken (tinfoil) and the general mechanism of the instrument. Prom 1877 to 1888 Edison was en- gaged in working out the details of the wax-cylinder, phonograph as we now have it, one of the most beautiful of instruments (see Fig la and Fig. lb). The improve- ments consisted chiefly (1) in substituting for tinfoil cylinders made of a waxy substance on which permanent records are taken ; (2) in substituting a thin glass plate for the parchment membrane ; (3) in improving the mechanical action of the marker ; and

(4) in driving the drum carrying the wax cylinder at a uniform and rapid speed by an electric motor placed below the instrument. In the iirst place, permanent records can be taken on the wax cylinder. The waxy material is brittle, but it read- ily takes the imprints made by the marker, which is now a tiny bit of sapphire. The marker, when used for record- ing, is shod with a chisel-shaped edge of sapphire; but the sapphire is rounded when the marker is used for reproducing the sound. The marker also, instead of being a stiff needle coming from the centre of the mem- brane or glass plate, is now a lever, heavily weighted so as to keep it in contact with the surface of the wax cylin- der. A single vibration of a pure tone consists of an in- crease of pressure followed by a diminution of pressure. When the disc of glass is submitted to an increase of pressure, the action of the lever is such that, while the wax cylinder is rotating, the point of the marker is angled downwards, and thus cuts deeply into the wax ; and when there is diminu- tion of pressure, the point is angled upwards, so as to act less deeply. In reproducing the sound, the blunt end of the marker runs over all the elevations and depressions in the bottom of the groove cut on the wax cylinder. There it thus increased pressure transmitted upwards to the glass disc when the point runs over an elevation, and less pres- sure when the point runs over a depression on the wax cylinder. The glass disc is thus, as it were, pulled inwards and thrust outwards with each vibration, but these pulls and thrusts follow each other so rapidly that the ear takes no cognizance of the difference of phase of the vibrations of the glass plate in imprinting and in reproducing. The variations of pressure are communicated to the glass plate, and these, by the medium of the air, are transmitted to the drum- head of the ear, and the sound is reproduced with remarkable fidelity. It is necessary for accurate repro- duction that the point of the marker be in the centre of the groove. In the older phonographs this required accurate adjustment by a fine screw, but in newer forms a certain amount of lateral oscillation is allowed to the marker, by which it slips automatically into the groove. Recently two other improvements have been effected in the con- struction of the instrument. A powerful triple- spring motor has been substituted for the electric motor, and the circumference of the wax cylinder has been increased from 6|- inches to 15 inches. The cylinders make about two revolutions per second, so that

with the smaller cylinder the point of the marker runs over nearly 14 inches in one second, while with the larger it runs over about 30 inches. The marks corresponding to the individual vibrations of tones of high pitch are therefore less likely to be crowded together with the larger cylinder, and these higher tones, in particular, are more accurately reproduced. In a form of instrument called the 200-thread machine, motion of the drum bearing the cylinder was taken off a screw the thread of which was 50 to the inch, and by a system of gearing the grooves on the cylinder were 200 to the inch, or 2-^ of an inch apart. It was somewhat difficiilt to keep

the marker in the grooves when they were so close together ; and the movement is now taken directly off a screw the thread of which is 100 to the inch,

Fig. la. â€” Exterior of Edison Phonograph.

so that the grooves on the cylinder are -j-i-^- of an inch apart. Thus with the large cylinder a spiral groove of over 300 yards may be described by the recorder, and with a speed of about two revolutions per second this distance is covered by the marker in about 6 minutes. By diminishing the speed of revolution, which can be easily done, the time may be con- siderably lengthened. Other forms of phonographs, some termed gramophones, have been invented, in which the records are taken on a flat- tened disc rotating horizon- tally, and so arranged that the recorder describes a series of spirals diminishing from the circumference to the centre of the disc ; but they are all constructed on the general principal of the phonograph above described.

To understand how the phonograph records and re- produces musical tones, it is necessary to remember (1) that pitch or frequency de- pends on the number of vibra- tions executed by the vibrat- ing body in a given period of time, or on the duration of each vibration, say a tone

having a pitch or frequency of 200 vibrations per second, each vibration lasting ^^^ of a second ; (2) that intensity or loudness depends on the amplitude of the movement of the vibrating body; and (3) that quality,

timbre, or clang, first, depends on the form of the indi- vidual vibrations, or rather on the power the ear pos- sesses of appreciating a simple pendular vibration pro- ducing a pure tone, or of decomposing more or less completely a compound vibration into the simple pendular vibrations of which it is composed. If we apply this to the record of the phonograph on the wax cylinder, we find that, given a constant and sufiiciently rapid velocity of the cylinder, a note or tone of a certain pitch will be heard when the marker runs over a number of elevations and depressions corre- sjDonding to the frequency of that note. Thus if the note was produced by 200 vibrations per second, and suppose that it lasted in the music for J-j- of a second, 20 marks, each made in ^^^ of a second, would be imprinted on the wax. Consequently, in reproduction, the marker would run over the 20 marks in ^ of a second, and a tone of that frequency would be re- produced. The loudness would correspond to the depth of each individual mark on the cylinder. The greater the depth of a series of successive marks pro- duced by a loud tone, the greater, in reproduction, would be the amplitude of the excursions of the glass disc and the louder would be the tone reproduced. Lastly, the form of the marks corresponding to in- dividual vibrations would determine the quality of the tone or note reproduced, by which we can distinguish the tone of one instrument from another, or the sensation produced by a tone of pure and simple quality, like that from a well-bowed tuning-fork or an open organ pipe and that given by a trumpet or an orchestra, in whioh the sounds of many instruments are blended together. When the phonograph records the sound of an or- chestra, it does not record the tones of each instru- ment, but it imprints on the wax cylinder the form of impression corresponding to the very complex sound- wave formed by all the instruments combined. This particular form, infinitely varied, will reproduce back- wards, as has been explained, by acting on the glass plate, the particular form of sound-wave corresponding

Fio. lb.â€” Meclinnism of Edison Phonograph.

to the sound of the orchestra. This is one of the won- derful feats of tlie phonograph. Numerous instruments blend their tones to make one wave-form, and when one instrument predominates, or if a human voice is singing

to the accompaniment of the orchestra, another form of sound-wave, or rather a complex series of sound-waves, is imprinted on the wax cylinder. When reproduced, the

2 e i65 VD.

- 2m VD.

Fig. 2.

wave-forms again exist in the air as very complex varia- tions of pressure, these act on the drum-head of the human ear, there is transmission to the brain, and there an analysis of the complex sensation takes place, and we distinguish the trombone from the oboe, or the human voice from the violin obbligato. The phonograph reduces all to mechanical simplicity ; complexity arises when we have to deal with the effects on the human ear and brain. Many efforts have been made to obtain graphic tracings of wave-forms imprinted on the wax cylinder of the phonograph. Thus the writer has taken (1) celloidin casts of the surface, and (2) micro-photographs of a small portion of the cylinder (Journ. of Anat. and PJn/s., July 1895). He also devised a phonograph recorder by which the curves were much amplified {Trans. Roy. Soc. Edin. vol. xxxviii. ; Proc. Roy. Soc. Edin., 1896-97, Opening Address; Sound and Speech Waves as revealed by the Phonograph, Lond. 1897 ; and Schafer's Physiol, vol. ii., Vocal Sounds, p. 1229). As already mentioned, so long ago as 1878 Fleeming Jenkin and Ewing had examined the marks on the tinfoil phonograph. Professor Her-

mann, of Konigsberg, took up the subject about 1890, using the wax-cylinder phonograph. He obtained photo- graphs of the curves on the wax cylinder, a beam of light reflected from a small mirror attached to the vibrating disc of the phonograph being allowed to fall on a sensitive plate while the phonograph was slowly travelling. (For references to Hermann's important papers, see Schafer's Physiology, vol. ii. p. 1222.) Boeke, of Alkmaar, has devised an ingenious and accurate method of obtaining curves from the wax cylinder. He measures by means of a microscope the transverse diameter of the impressions on the surface of the cylinder, on diiferent (generally equidistant) parts of the period, and he infers from these measurements the depth of the impressions on the same

spot, or, in other words, he derives from these measure- ments the curve of the vibrations of the tone which produced the impression (Archiv. f. d. ges. Physiol. Bonn, Bd. 1, S. 297 ; also Proc. Roy. Soc. Edin., 1898).

From a communication to the Dutch Otorhinolaryngo- logical Society Dr Boeke has permitted the author to select the accompanying illustrations, which will give the reader a fair conception of the nature of the marks on the wax cylinder produced by various tones. Fig. 2 shows portions of the curves obtained by Hermann, and enlarged by Boeke one and a half times. The numbers 1 to 4 refer to periods of the vowel A (as in " hard "), sung by Hermann on the notes c e g c'. Numbers 5 to 8 show the curves of the vowel o (as in "go ") sung to the same notes. The number of vibrations is also noted. Boeke measured the marks for the same vowels by his method, from the same cylinder, and constructing the curves, found the relative lengths to be the same. In Fig. 3 we see the indentations produced by the same vowels, sung by Hermann on the notes c e g c', on the same phonograph cylinder, but delineated by Boeke after his method. The curves are also shown in linear fashion beside each group of indentations. From these measurements the curves were calculated and reproduced, as in Fig. 4. Thus the curves of the same vowel sounds on the same cylinder are shown by two methods, that of Hermann and that of Boeke. In Fig.

S 10

A

i52,7 YD. 169,^W.20iZ VD. 255,6VD.

5 we see the in- dentations on the vowel a, sung by Dr Boeke, aged 55, on the notes c d e f g a b c', and near the fre- quencies of 128,

144, 160, 170-6, 192, 213-3, 240,

and 256. The numbers 33 to 40 show the marks produced by the same vowel, sung by his son, aged 13. It will be seen that the boy sang the notes exactly an octave higher. Fig. 6 shows the marks produced by some musical sounds. Each shows on the right-hand side the curve deduced from the marks, and under it a graphical repre- sentation of the results of its har- monic analysis after the theorem of Fourier, in which the ordi- nates represent the amplitude of the subsequent har- monic constituents. No. 41 is the period of the sound of a pitch-pipe giving a' (425 double vibrations per second), No. 42 the period of a Dutch pitch-pipe, also sounding a' (424-64 double vibrations per second). No. 43 is a record of the period of a sound produced by blowing between two

S. VII. â€" 86

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strips of indiarubber to imitate the vocal cords, with a frequency of 453 double vibrations per second. No. 44 is that of a telephone pipe used by Hermann (603 double vibrations per second). ISTos. 45 and 46 show the marks

c 23 02 VD.

e 22 165 VD.

198 VD.

c’ 24^ 264^ VD.

rig. 4.

of a cornet sounding the notes a of Â± 400 double vibrations per second, and e of 300 double vibrations per second. In Fig. 7 are shown a number of vowel curves for the vowels o, ob, a, e, and i. Each curve has

on the right-hand side a graphical representation of its harmonic analysis. The curves are in five vertical columns, having on the left-hand side of each drawings, by Boeke’s method, of two periods of the marks of the

(Â£ e f Q a b c’ c’ d, e’ f a tt>’ b’ c”

rig. Â».

vowel. The marks are shown for the Dutch, German, English, and French languages. The sounds of the

vowels are o, like o in ” go ” ; oe, like oo in ” too ‘

like

the German u in ” Flihrer ” ; a like a in ” hard ” ; e like

a’s

427 YD. 453VD.4^jYj)

I’ig. 6.

a in ” take ” ; ij, not in English words, but somewhat like e in “bell”; and i like ee in “beer.” The first section contains only Dutch vowel sounds, either sung or spoken by Boeke or members of his family. The second

i3’A/^^ â€” V.’

Kg. T.

section contains curves from the voice of Professor Her- mann, the third from the voice of the author from a cylinder sent by him to Dr Boeke, and the fourth from the voice of Mons. H. Marichelle, professeur de I’Institut des Sourds-Muets, also forwarded by him to Dr Boeke. Thus curves and marks of the same vowel are shown from the voices of men of four nationalities.

Apart altogether from the use of the phonograph in business and for the reproduction of music, it will be seen that it is an instrument of great value in the investigation of problems in acoustics, and that it illustrates these as no other instrument can do (see ” Experimental Phonetics,” by the author. Nature, 26th December 1901).

(j. G. M.)

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PHOTOaRAPHY.

I. Scientific Advances.

Measurement of the Rapidity of a Plate. â€” Since the date of the article in the ninth edition of the Encydopoedia Britannica, photography has advanced in a direction which before the advent of gelatine plates was hardly to be ex- pected. It has now become a matter of everyday procedure among makers of a brand of photographic plates to gauge its sensitiveness by exact measurement, and express the result in terms of an empirical unit. This is effected by ascertain- ing the amount of silver-deposit to which a certain impact of light gives rise on the developed image. It is believed that the practicability of such determinations was first demonstrated iu 1874, when Sir William Abney {Phil. Mag., ” On the Opacity of the Developed Photographic Image “) established the connection between the intensity of light acting for a given time on a sensitive surface and the opacity produced

on development. He demonstrated that, within limits, the transparency of the deposit varies as the logarithm of the exposure. The method of meas- urement then adopted was comparatively crude, but ten years afterwards he showed how much greater exactitude could be ensured.

In 1888 Sir W. Abney pointed out that the speed of a plate could

be determined by the formula T = E-”‘Â°S”+’-‘)^’ where T is the transparency, E is the exposure (or time of exposure x intensity of light acting), and C a constant. If the abscissse (exposures) are plotted as logarithms, the curve takes the same form as that of the law of error, which has a singular point, a tangent through which lies closely along the curve and cuts the axis of Y at a point

which has a value of 2E~2- if the total transparency be unity, this ordinate has a value of 1-212, the singular point having a value 0‘606. The ordinate of the zero point of the curve will be where the tangent to the singular point cuts the line drawn at 1‘212. The diiierence between the measurements of this zero point for two kinds of plates {i.e., C in the formula) from the points in the abscissae marking the same exposure, will give the relative sensitiveness of the two plates in terms of log a;^. In 1890 Hurler and Driffield, in a paper read before the Society of Chemical Industry (see i7bÂ«TOnZ of that Society, 19th January 1891), worked out a far less empirical formula connecting the exposure

E with the density of deposit, which in an approximate shape had

â– p 1

the form D =7 log â€” , where D is the density of deposit (or log _) , i

the “inertia” of the plate, T the transparency of the deposit. In the customary way a small portion of a plate was exposed to a constant light at a fixed distance and for a fixed time, and another small portion to the same light for double the time, and so on. By measuring the densities of the various deposits and constructing a curve, a large part of which was approximately a straiglit line, it was found possible, by

the production of the straight portion to meet the axis of X, to give the relative sensitiveness of different plates by the distance of the intersection from the zero point L. (See also Exposure Meters, below, under II. Apparatus.)

It is believed that neither formula can be absolutely correct, though both are approximately true and are suffi- ciently near to be of practical value. This belief is based on the further researches described below. [Those applic- able for the correction of star magnitudes as determined by photography have been verified andconfirmed by Schwarz- child, Michalke, and others.]

Effect of Temperature on Sensitiveness. â€” In the year 1876 it was shown that heat apparently increased, while cold diminished, the sensitiveness of a plate, but the experiments were rather of the qualitative tlian the quanti- tative order. In 1893 fresh experiments were undertaken by Sir William Abney, and it was found that the effect of a difference in temperature of some 40Â° G. invariably caused a diminution in sensitiveness of the sensitive salt at the lower temperature, a plate often requiring more than

‘bo mo nzoSeconcfi

double the exposure at a temperature of about â€”18Â° C. than it did when the temperature was increased to -|-33Â° C. Fig. 1 shows the result of exposing a ””^

plate when at three different tempera- tures for the times shown in the scale of abscissae, the transparency of de- posit for the differ- ent exposures being shown as the ordi- nates. The general deduction was that increase in temper- ature involved in- crease in sensitive- ness so long as the

constituents of the Â£jcpasure

plate (gelatine, &c.) ^^r. 1.

were unaltered. Professor Dewar stated at the Royal Institution in 1896 that at a temperature of â€”180Â° C. certain sensitive films were reduced in sensitiveness to less than a quarter of that which they possess at ordinary temperatures. It appears also from his subsequent inquiry, that when the same films were subjected to the temperature of liquid hydrogen (â€”252Â° C.) the loss in sensitiveness becomes asymptotic as the absolute zero is approached. Presumably, therefore, some degree of sensitiveness would still be preserved even at the absolute zero.

Effect of Small Intensities of Light on a Sensitive Salt. â€” Another investigation by Sir William Abney was de- scribed in brief in the Proc. Roy. Soc, 1893, and in full in the Journal of the Camera Club, 1893. When a plate is exposed for a certain time to a light of given intensity, it is commonly said to have received so much exposure (E). If the time be altered, and the intensity of the light also, so that the exposure (time x intensity) is the same, it has usually been accepted that the energy expended in doing chemical work in the film is the same. A long series of experiments conducted under differing conditions has shown that such is not the case, and that the more intense the light (within certain limits) the greater is the chemical

foa

h”

^

L.

^y

%.

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Fig. 2.

o Scale N’*

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of light

action, as shown on the development of a plate. Pig. 2 illustrates the results obtained in three cases. The ex- posure E is the same in all cases. The curves are so drawn that the scale of abscissae is the intensity of

the light in powers of â€”2, and the ordinates show the percentages of chemical action produced. If the chemical action remained the same when the intensity of light was reduced, E

remaining the same, each of the curves would be shown as a straight line at the height of 100, which is the trans- parency of deposit with the unit of light. As it is, they show diminishing percentages as the light intensity is diminished. Thus when the intensity of the light is reduced to -^^ of the original, and the time of exposure is prolonged 64 times, the useful energy expended on a lantern plate is only 50 per cent, of that expended when the light and time of exposure are each unity. In the cases to which the diagram refers, the light used was a standard amyl-acetate lamp, and the unit of intensity taken was this light at a distance of 2 feet from the plate, and the unit of time was 10 seconds. The lamp being moved to 16 feet from the plate, gave an intensity of ^~~ij the unit, and the time of exposure had to be in~~ creased to 640 seconds, so that E was the same in both cases. Further, it was found that when the times of exposure on different parts of the plate were successively doubled, light at a fixed distance being used for one series, and altered for a second series, the slopes of the curves of transparency, as in rig. 1 (the gradar tion), were parallel to one another. Fig. 3 shows this in a graphic manner, the units of the scales of abscissae and ordinates being the same as before. This investigation is of

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Fig. 8.

use when camera images are in question, as the picture is formed by different intensities of light, not very different from those of the amyl-

acetate lamp, the time of exposure being the same for all intensities. The deductions made from the investigation are that with a slow plate the energy expended in chemical action is small as the intensity is diminished, while with a quick plate the variation is much less. As a practical deduction, we may say that , to obtain proper contrast in a badly lighted pic- ture it is advisable to use a slow plate. Effect of very In- tense Light on a Sensitive Salt. â€” An- other investigation was made as to the effect of very intense light on sensitive surfaces. , In this case a screen of step- by-step graduated opacities was made use of, and plates exposed through it to the action of lights markedly differing in intensity, one being

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Scale of Intensities in Powers of 2

Fig. 4.

that of the amyl-acetate lamp, another that of the arc

light, and a third the light emitted from the spark of a

‘ ‘ ” The exposures were so made that

Wimshurst machine.

one of the opacities produced on the plate from exposure to each source of light was approximately the same. Fig. 4 gives an example of the results obtained. The abscissae are derived from the graduated opacities of the screen used, and their units and that of the ordinates are the same as before. The unit of intensity of light is of course in each case widely different. It will be seen that the slope of the curve due to the spark light is less steep than that due to the arc light, and the latter, again, is much less steep than that due to the amyl-acetate lamp. A further investigation was made of the effect of increasing the time of exposure when the intense light was diminished, and it was found that with all plates the useful chemical energy acting on a plate was least with the most intense light, but in- creased as the intensity diminished, though the time was correspondingly increased. This is the reverse of what we have recorded as taking place when a com- paratively feeble light was employed. Further, it was proved that the variation was greatest in those plates which are ordinarily considered to be the most rapid. It follows, therefore, that there is some intensity of light when th^ useful chemical energy is at a maximum, and that this intensity varies for each kind of plate.

Intermittent Exposure of a Sensitive Salt. â€” Sir William Abney has also shown that, if a total exposure is made up of intermittent exposures, the chemical action on a sensitive salt is less than it is when the same ex- posure is not intermittent. It was also shown that the longer the time of rest between the intermittent exposures (within limits) the less was the chemical action. We may quote one case. Exposures were first made to a naked light, and afterwards to the same light for six times longer, as a rotating disc intervened which had 12 apertures of 6Â° cut in it at equal in- tervals apart, and 720 intermittent exposures per second were given. The plate was moved to different dis- tances from the light, so that the intensity was altered. The apparent loss of exposure by the intervention of the disc increases

as the intensity diminishes, the ratios of the chemical energy usefully employed of the naked light exposure to that of the intermitting exposures being â€”

For intensity 1 . . . l to -815

It). i . . . 1 „ -500

Â» n A â€¢ â€¢ . 1 â€ž -423

)Â»)Â» ^? â€¢ â– . 1 „ ‘370

These results appear to be explicable by the theoretical considerations regarding molecular motion.

Effect of Monochromatic Light of Varying Wave-Lengths on a Sensitive Salt. â€” It has been a subject of investigar tion as to whether the gradation on a plate is altered when exposures are made to lights of different colours ; that is to say, whether the shades of tone in a negative of a white object illuminated by, say, a red light, would be the same as those in the negative if illuminated by a blue light. Abney announced that the gradation was different; and, quite independently, Mr Chapman Jones undertook an investigation of the matter, and made a general deduction for isochromatic plates that, except with a certain developer, the gradation was steeper (that IS, the curve shown graphically would be steeper) the greater the wave-lengths of the light to which the sensitive salt was subjected. Investigation shows that with plates made with the ordinary haloid salts of silver Chapman Jones’s deduction requires modification. When monochromatic light from the spectrum is employed, it is found that the gradation increases with wave-lengths of light which are less, and also with those which are greater, than the light whose wave-length has a maximum effect on the sensitive salt experimented with. Thus with

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bromo-iodide of silver the maximum effect produced by the spectrum is close to the blue lithium line, and the gradation of the plate illuminated with that light is less steep than when the light is spectrum violet, green, yel- low, or red. From the red to the yellow the gradation is much the steepest. Whether these results have any practical bearing on ordinary photographic exposures is not settled, but that they must have some decided effect on the accuracy of three-colour work for the production of pictures in approximately natural colours is undoubted, and they may have a direct influence on the determination of star magnitudes by means of photography.

Correct Rendering of Colours in Monochrome. â€" As to the materials used for the correct rendering of colours in monochrome, isochromatic plates have been improved in character, and there is a simple means of ascertaining what light-filter should be used for each brand of plate. Perhaps the best isochromatic plate is, at the time of writing, the "Cadett Spectrum" plate, which is sensitive from the ultra violet to the red of the spectrum, and which shows hardly any of that lack of sensitiveness in the region of the spectrum green which plates dyed with eosin derivatives always betray. When the spec- trum is formed by light such as that of a paraffin lamp, the curve of sensitiveness is not far from the curve of luminosity of the spectrum of daylight; so that if a coloured object were illuminated solely by a parafB.n light, a print from the negative would give a fair repre- sentation of the object in monochrome â€" that is, the shades of grey in the print would represent the daylight lumi- nosity of the colours. As objects cannot usually be illu- minated by this light, it becomes necessary to filter daylight through a coloured screen, which can be put in front of the camera lens. By proper means the lumi- nosity of the light of day, coming through a red, a green, a blue, and an orange glass can be very accurately meas- ured ; if inch squares of these coloured glasses, together with a white glass of the same area, be placed in a row and cemented on white glass, we have a colour-screen which we can make available for finding the kind of light-filter to be employed. This is readily done by reducing the luminosity of the light coming through all the glasses to that of the luminosity of the light coming through the blue glass. If the luminosity of the blue be 5 and that

of the white light 100, then the luminosity of the former must be reduced to ^ of its original value, and so with the other glasses. The luminosity of the light coming through each small glass square can be made equal by rotating in front of them a disc in which apertures are cut corresponding to the reduction required. The blue glass, for instance, would not be covered by the disc at all, while opposite the white square the disc would have an aperture of an angle of 18Â°. When a plate is exposed behind the row of glass squares, with the light passing through the rotating disc, the negative obtained would, under ordinary conditions, show square patches of very different opacity. A light-filter of some transparent colour, if placed in the path of the light, will alter the opacities, and eventually one can be found which will only allow such coloured light to be trans- mitted as will cause all the opacities in the negative to be the same. As the luminosities of the white light passing through the glasses are made equal, and as the photographic deposits are also rendered equal, this light- filter, if used in front of the camera lens, will render all coloured objects in correct monochrome luminosity. An- other plan, based on the same principles, is to place seg- ments of annuluses of vermilion, chrome yellow, emerald green, French blue, and white on a disc, and to complete the annuluses ^ith black segments, the amount of black depending on the luminosity of the pigments, which can

be readily measured. When the disc is rotated, rings of colour, modified in brightness by black, are seen, and each ring will be of the same luminosity. As before, a screen (light-filter) to be used in front of the lens must be found which will cause the developed images of all the rings to appear of equal opacity. It must be remembered that the light in which the object is to be photographed must be the same as that in which the luminosity of the glasses or pigments is measured.

Photography in Natural Colours. â€” A method, devised by M. Lippmann, of Paris, by which the natural colours of objects are reproduced by means of interference, may be briefly described as follows : â€” A sensitive plate is placed in contact with a film of mercury, and the exposure to the spectrum, or to the image of coloured objects to be photographed, is made through the back of the plate. On

development, the image appears coloured when viewed at one particular angle, the colours being approximately those of the object. The necessary exposure to produce this result was very prolonged in the first experiments in which the spectrum was photographed, and a longer ex- posure had to be given to the red than was required for the blue. Lippmann at first employed collodion dry plates, prepared, it is believed, with albumen, and it required con- siderable manipulation to bring out the colours correctly. Lumi^re used gelatine plates dyed with appropriate dyes (orthochromatic plates) ; the exposure was much dimin- ished, and very excellent representations were produced of all natural colours. The main point to aim at in the preparation of the plate seems to be to obtain a very sensitive film without any, or, at all events, with the least possible, ” grain ” in the sensitive salt. A formula pub- lished by Lumiere seems to attain this object. Viewed directly, the developed images appear like ordinary negatives, but when held at an angle to the light the colours are vivid. They are not pure monochromatic colours, but have very much the quality of colours obtained by polarized light. It appears that they are produced by what may be termed ” nodes ” of different- coloured lights acting within the film. Thus in photo- graphing the spectrum rays penetrate to the reflecting mercury and are reflected back from it, and these, with the incident waves of light, form nodes where no motion exists, in a somewhat similar way to those obtained in a cord stretched between two points when plucked. In the negatives these nodal points are found in the thickness of the silver deposit. When white light is sent through the film after the image has been developed, theoretically only rays of the wave-lengths which formed these nodes are reflected to the eye, and thus we get an impression of colour. So far this process has been only of scientific value and of but small practical use.

Reproduction of Coloured Objects by means of TJiree Photographic Positives. â€” Ives’s Process. â€” A practical plan of producing images in approximately the true colours of nature has been devised by preparing three positives of the same object, one illuminated by a red, the other by a green, and the third by a blue light; the images from these three transparencies, when visually combined, will show the colours of the object. This plan was scientifically and practically

worked out by Ives of Philadelphia, though in France and elsewhere it had been formulated, especially by Hauron Du Cros. The following descrip- tion may be taken as that of Ives's process : â€" By the trichromatic theory of colour-vision every colour in nature can be accounted for by the mixture of two or three of the three-colour sensations, red, green, and blue, to which the eye is supposed to respond. Thus a mixture of a red and green sensation produces the sensation of yellow ; of a green and blue, that of a blue-green ; of red and blue, that of purple ; and of all three, that of white.

For the sensations we may substitute those colours which most nearly respond to the theoretical sensations with- out any material loss of purity in the resulting sensation. We must take the spectrum of white light as the only perfect scale of pure colours. From experiment it has been proved that the red sensation in the eye is excited by a large part of the visible spectrum, but with varying intensities. If, then, we can on a photographic plate produce a developed image of the spectrum which exactly corresponds in opacity and position to the amount of red stimulation excited in those regions, we shall, on illumi- nating a positive taken from such a negative with a pure red light, have a representation of the spectrum such as would be seen by an eye which was only endowed with the sensation of red. Similarly, if negatives could be taken to fulfil the like conditions for the green and for the blue sensation, we should obtain positives from them which, when illuminated by pure green and blue lights respectively, would show the spectrum as seen by an eye which was only endowed with a green or a blue sen- sation. Evideatly if by some artifice we can throw the coloured images of the three positives on a screen, superposing them one over the other in their proper relative positions, the spectrum will be reproduced, for the overlapping colours, by their variation in intensity, will form the colours intermediate between those used for the illumination of the positives. For the purpose of producing the three

suitable negatives of the spectrum, three light-filters, through which the image has to pass before reaching the photographic plate, have to be found. With all present plates these are compromises (see below). Roughly speaking, the screens used for taking the three negatives are an orange, a bluish green, and a blue. These transmit those parts of the spectrum which answer to the three sensations. When these are obtained, a coloured object can be reproduced.

Joly's Process. â€" Professor Joly, of Dublin, in 1897 in- troduced a colour process by which an image in approx- imately natural colours could be thrown upon a screen by an optical lantern, only one transparency being employed, instead of three, as in the Ives process. A "taking" screen was ruled with alternating orange, blue-green, and blue lines ~~j~~^ to 3-^ inches apart, touching one another and following one another in the above order. When such a screen was placed in front of a sensitive plate in the camera, and exposure made to the image of a coloured object, there were practically three negatives on the same plate, each being confined to the area occupied by lines of the same colour. The shades of colour and the depth of the colours used in ruling depended on the brand of plate. When a perfect triune negative was obtained, a transparency was made from it, and in contact with this was placed a screen ruled with lines the same distance apart, but of the colours corresponding to the three colour sensations, namely, red, green, and blue. The red lines were made to fall on the image taken through the orange lines, the green on that of the blue-green, and the blue or violet on that of the blue. On the screen there are practically three differently ~~coloured images shown by one transparency. The different colours blend to~~ gether and give a picture which shows approximately the correct colours of the original.

TJiree-Colom- Photographic Printing. â€" Three-colour print- ing has made rapid strides. The most suitable negatives are those which have been described for Ives's process. Instead of using the colours which correspond to the colour sensations, their complementaries are employed. for reasons which will be evident if the absorption of dyes when superposed is considered. Thus to produce a yellow patch by

Ives's process, that space must be almost bare in those positives through which red and

green lights are transmitted, since red and green com- bined make yellow. The negatives must therefore be opaque where these spaces occur. If we use the nega- tives for producing (say) collotype plates, which are sub- sequently " inked " with coloured " inks," the spaces in the print from the "red" and the "green" negatives will "take" no colour, whilst that in the "blue" negative will have a full colour. Evidently, then, to produce a yellow when the three printings are superposed, the blue negative must be printed in yellow, the complementary to the blue that is used by Ives in the triple projection process. Similarly, for inking in the plate printed from the red negative the colour used must be a green-blue, and from the green negative a purple. These last two colours must be transparent' colours if the first printing on a white surface is the yellow from the blue negative. If opaque, there would be a dirty image formed, of no particular colour. The colour next the white ground, however, may be opaque. We may expect that the difii- culty of obtaining the exact depth of colour necessary for each printing will be overcome before very long, and that three-colour printings will give uniform results (see Process).

Positives in Three Colours. â€" Ives was the first to show that a transparency displaying approximately all the colours in nature could be produced on the same principles that underlie the three-colour printing. This he effected by printing each of the three negatives, pro- duced for his triple projection process as already de- scribed, on gelatine films sensitized by bichromate of potash. Each of the three transparent films was dyed with a colour complementary to the colour of the light which he transmitted through the positives when used for projection. Thus the "red" positive he dyed with a blue-green dye, the " green " positive with a purple dye, and the "blue " positive with a yellow dye. These three films, when superposed, gave the colours of the original object. Sanger Shepherd has made the process a com- mercial success, and produces lantern slides of great beauty, in which all colours are correctly rendered. In- stead of using a dye for the "red"

transparency, he con- verts the silver im^ge of a positive image into an iron salt resembling Prussian blue in colour.

Sensitometers for Three-Oolour Work. â€” Sir W. Abney has devised sensitometers for determining the colours of the screens to be placed before the lens in order to secure the three-colour negatives. Their production depends upon the same principle as that he devised for the correct rendering in monochrome of a colour object. When the sensito- meter takes the form of glasses through which light is transmitted to the plate, the luminosities of the coloured lights transmitted are determined, and also the percentage composition of their colours in terms of the red, green, and blue lights used in the triple projection, and thence are deduced the luminosities in terms of red, green, and blue. For ascertaining what red screen should be used, the luminosity transmitted through each is so adjusted that the luminosity of the red components in each is made equal (see mite). This gives a sensitometer of equal red values. A coloured screen has to be found which, when placed in front of the lens, will cause the density of the deposit on the plate to be the same throughout. This is done by trial, the colour being altered till the proper result is obtained. In a similar way the "green" and "blue" screens are determined. Coloured pigments rotating on a disc can also be era- ployed, as indicated in the paragraph on the correct rendering of colour in monochrome (see ante).

Neiu Developers.â€" Some excellent developers have recently been brought out; formulee fcTr those most in vogue are appended : â€"

25 parts. 60 â€ž 50 â€ž

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Mikonogen Developer. Eikonogen Sodium sulphite Sodium carbonate Potassium bromide Water . . This is a one-solution developer, and acts energetically. Metol Developer.

Solution A. Metol .... 2 parts.

Sodium sulphite . . 18 â€ž Water . . . . 100 â€ž

Solution B. Sodium carbonate . . 6 parts.

Potassium bromide . 1 ,i

Water . . . . 100 â€ž For use, take one part of A to from 1 to 3 parts of B. Amidol Developer.

Amidol .... 3 parts.

Sodium sulphite . . 100 ,, Potassium bromide . 1 to 3 ,, Water .... 1000 ,, This developer requires no addition of alkali. Ortol Developer.

Solution A. Ortol .... 15 parts. Sodium metabisulphite . 7 ,,

Water .... 1000 â€ž

Solution B. Sodium carbonate . . 100 parts. Sodium sulphite . . 125 ,, Potassium bromide . 3 ,,

Water .... 1000 ^ â€ž A and B solutions are mixed together in equal proportions.

Besides these, there are several more, such as Adurol, Glycine, Pyro-catechin, vrhich have been used with more or less success. They all give a black in lieu of that dark olive-green deposit of silver which is so often found with pyrogallol developers. All are alkaline developers, and the image is built up from the sensitive salt within the film. They are applicable to gelatine or collodion plates, but for the latter rather more bromide of an alkali is added, to retard fogging.

Effect of Hydrogen Peroxide on Sensitive Plates.â€” Dt W. J. Russell instituted a series of experiments on the effect of exposure of sensitive plates to the action of vapours and gases for long periods. It has long been known that contact of plates with such substances as wood caused a sensitive surface to show ” fog ” on devel- opment. By a somewhat exhaustive series of experiments, Russell showed that the probable cause of this fog is per- oxide of hydrogen, since substances which

favoured its formation produced the same effect. This is somewhat remarkable, as this same substance will completely de- stroy the effect that light has had on a sensitive plate ; indeed, it affords one way of destroying a light image on a sensitive collodion plate. The experiments of Russell give a warning to photographers to take care how they store exposed plates for brief periods. It appears that negatives wrapped in paraffin paper are secure from this clanger. (w. de w. a.)

II. Appaeattjs.

Since the ninth edition of this work was published, great changes have been made in ordinary photographic apparatus, chiefly due to the extended use of small hand cameras suitable for taking instantaneous photographs upon the rapid gelatine dry plates or films now available. These small pictures can easily be enlarged four times or more, so that the photographic travelling equipment may be reduced to a hand package. The result of this is seen in the immense expansion that has taken place in the use of photography for all purposes of illustration. The tendency in all portable cameras and apparatus has been towards lightness and compactness in construction and material. Aluminium and its alloys are largely used, instead of brass, for fittings and mountings. Instead of

glass plates, flexible films of celluloid and other materials are available in single sheets like plates, or in rolls en- closed in opaque paper, which can be changed or replaced in daylight. The construction of lenses has also been improved, so as to obtain greater covering power, with flatness of field and freedom from astigmatism, with larger apertures than were available with aplanatic lenses. Greater rapidity of working is thus gained ; and with the increased sensitiveness of the dry plates in use, subjects in rapid motion can be photographed with a perfection which formerly was quite unattainable.

Cameras.

The general requirements of a good camera are: â€” Thoroughly well-seasoned material, simplicity and strength of construction, parallelism and squareness of front and back, smoothness and regularity of movement in focussing. A rising and falling front, by which the lens can be raised or lowered to take in more or less fore- ground, is almost a necessity, and may be supplemented by a swing back or swing front, to prevent distortion of the image when the camera has to be tilted, or to equalize definition of objects at different distances from the camera. A side swing is specially useful for the latter purpose. These movements should be round the central horizontal or vertical axis of the back or front, as the case may be. When the rising front is used, the lens must be stopped down, or another of longer focus fitted which will cover a larger plate than the camera is made for, in order to obtain good definition over the extended area of the picture. It is convenient to have the camera square and fitted with a reversible back, so that the greatest length of the plate may be horizontal or vertical, as desired. The increase of yreight and bulk is obviated in some French cameras by making the back part of the camera and bellows reversible, the former being placed upright or on its side, as required, while the small end of the bellows is made square or round, so as to fit in either position into the front of the camera behind the lens. The focussing screen may be ruled with parallel cross- lines for purposes of measurement, and as a check on the verticality of the camera when photographing buildings or

other objects with vertical lines. The distance from the lens of the focussing screen, and of the sensitive surface of the plate in the dark slide, must coincide exactly. This can be tested by measurement, or by carefully focussing some bright and well-defined object on the screen and then on a ground glass plate placed in each of the dark slides to be examined. The camera and the plate-carriers must be perfectly light-tight, and all their inner surfaces dead black, to prevent any reflection from bright spots from being thrown on the plate. The plate- carrier or dark slide must permit of the sensitive plate being placed in the camera and exposed without risk of any light reaching it except that passing through the lens. The corner joints, the hinges in the shutters, and the openings at the sides and top in the book form of double carrier are all weak points, and require careful examination from time to time. They should be protected by metal plates. The plate-carriers should fit readily into their places without jerking, and the shutters must run smoothly when withdrawn and replaced. Frames may be provided for smaller plates than the carriers are made for, care being taken that the surface of the plate is at the proper distance from the lens. It is convenient to have the plate-carriers numbered in sequence, and pro-vided with a small inlaid tablet for recording memoranda of plate, exposure, &c. A level or other means of show- ing that the camera is level and the plate vertical should be attached to the camera ; also a view meter or finder showing the exact extent of the picture.

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with two or more. One of the earliest forms of single-magazine cameras, and one still in use, is the “bag,” in which a supply of plates or films in sheaths is kept at the back ready for exposure, after which the exposed plate is raised with the fingers into a bag or expanding

chamber, above the magazine, and placed behind the rest of the plates at the back, â€” a fresh plate taking its place in front (Figs. 14 and 15). As a rule tney carry 12 plates or a larger

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Fig. 14. â€” Single-magazine Box Camera.

number of cut films. In some forms the magazines are removable and replaceable by others. The arrangement is simple and effec- tive ; but the bag, usually made of soft leather or cloth, is liable to

Fig. 15. â€” Single-magazine Box Camera.

wear and puncture, and may make dust. The arrangements with double magazines, in which unexposed plates are kept in one recess, exposed successively, and then transferred to a second recess, are much more complicated, and many ingenious devices have been invented for effecting the change (Fig. 16). Some of

Fig. 16. â€” Double-magazine Box Camera.

these cameras are very effective, and popular on account of their compactness and convenience, but there is always a certain risk of the mechanism failing, and great care has to be taken, in charging them, to lay the plates truly in their places. Most of the very handy binocular cameras or photo-jximelles, of which Richard’s ” Verasoope” (Figs. 17 and 18) is a type, are of this class, as are also hand cameras of the original ” Frena ” type (Fig. 19), specially constructed for using stiff celluloid films. In these the films are notched on two sides and packed in bundles of forty alternately with cards similarly notched. The paqik of films and cards is placed in a magazine at the back of the camera, and by the move- ment of a lever after exposure the exposed film and its following card are released, and, by turning the camera down, are

dropped into a second receptacle. The special advantage of this system is the large number of films that can be carried without increase of weight ; but the necessity of having specially cut films, which may

not be readily procurable, is an objection which has been avoided in other forms of magazine cameras for fUms. These cameras are

Figs. 17, IS. â€” ” Verascope ” Binocular Camera.

also constructed with extra magazines. In many ways the most convenient and compact hand cameras are those made specially for

Fig. 19.â€” ” Frena ” Film Camera.

use with the roll-film cartridges in many different sizes, both in the “box” and “folding” forms, some of the latter being easily

Fig. 20.â€” Interchangeable Hand Camera. Daylight-loading for films.

Fig. 21.â€” Folding Pocket Kodak.

carried in the pocket (Figs. 20 and 21). Those fitted with lenses of large aperture and rising and falling fronts are to be preferred.

Fig. 22.â€” Goerz-Anachiltz Camera ready for use. Front vii’w.

Fig. 23. â€” Goerz-Anschatz Camera. Closed,

There are several other forms of very portable collapsible hand cameras availableâ€” the ” Goerz-Anschiitz,” fitted with a focal plane

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shutter and a very quick-acting lens (Figs. 22, 23, and 24), also the ” Xit,” ” Nydia,” and the ” Natti,” may be mentioned as types.

In the cases which often, arise, when time-expoaures are neces- sary, it will be desirable to sup- port the hand camera on a tripod stand. The light aluminium stands previously noticed are specially suitable ; some of them are about the size and weight of a stout walking-stick, others about half the length, but all capable of extension to five feet. Details of the mechanism and construction of many hand cameras will be found in the photographic journals and year- books, and in some of the general and special treatises mentioned at the end.

Panoramic Cameras. â€” A large number of so-called “panoramic caineras have been brought forward from time to time, but none of them seem to have coma into general use till recently, when the use o: curved surfaces of celluloid film hits enableT thoroughly practical panoramic cS convenient size and weight to be put on the market. It is curious that these latest forms are on almost the same principle as the earliest one constructed by Martens, in 1845, to take curved Daguerreotype plates includ- ing an angle of 150Â°. In it the lens revolved on its centre and threw the image on to the cylindrical surface of the curved plate, through a slit which travelled with the lens. In 1861 Sutton devised a panoramic camera with a special spherical lens covering an angle of 120Â° for use with curved glass plates ; these, however, were difficult to work, and the in- strument never obtained a vogue. It was followed by Johnson’s ” pantascopio ” camera and others, in which a long flat plate was moved tangentially to the surface of rotation of the apparatus, so that it was always perpendicular to the axis of the lens. In 1889 Moessard greatly improved upon Mar- tens’s early apparatus in his ” Cylindro- graph,” utilizing the property of the nodal points of any lens to form the meeting- point of the two portions of each sec- ondary axis, one going towards the object,

back by the curved flexible carrier holding the sensitive film. The lens is fitted on a vertical axis, so that the nodal point of emergence remains motionless, and is revolved round it by means of a handle â– j^ked by hand and carrying a view meter. 1’he illumination of ^^ image is regulated by means of an adjustable slit in a tube attached to the lens inside the box, and by altering the rate at â– B’l’ t’le lens is revolved. The pictures taken embrace less than 18. The apparatus folds together and is quite

portable ; it is fully described in Moessard's Le Cylindrographe, Paris, 1889. The new " Al- vista " and the " Panoram Kodak " are apparently on the same principle as regards the rotation of the lens on the nodal poiiit, but they are arranged as roll-holder cameras holding film sufficient for several exposures. They work instantaneously, the lens swinging rapidly round by pressure on a button. The angle included in the views is about 120Â° (Figs. 25, 26, and 27). Other

Fig. 27 "Al- Vista" Panoramic Camera, open.

more elaborate instruments have been made for making a complete tour of the horizon, being actuated by clockwork. Among them may be mentioned Damoizeau's " Cyclographe," which can be used with lenses of different foci and takes the pictures upon roU films, the film being unrolled as the instrument revolves, and thus the image always remains sharp {Bull, de la Soc. Franc, de Photo- graphic, 1891, p. 183) ; Colonel Stewart's " Panoram " (1893) ; and the Bridges-Lee "Photo-theodolite," all of which, particularly the latter, are instruments suitable for photographic surveying.

Enlarging Cameras. â€" A gi-eat many forms of enlarging cameras are made, depending on the nature of the illumination. They ordinarfly consist of a double-extension arrangement for holding

Fig. 25.â€" " Al-Vista" Panoramic Camera, closed.

Fig. 26. â€" Section of "Al- Vista" Panoramic Camera.

the Other towards the image. A lens free from dis- tortion may thus revolve round its nodal point of emergence without the image being displaced on the sensitive surface ; in fact, its position only depends on this nodal point and on the direction of the secondary axis from the nodal point of incidence to the object, which is always invariable. The instrument consists of a semicircular camera, the front of which is formed of light-proof cloth, and the

FiQ. 28.â€" Enlarging Camera.

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the negative at one end and the sensitive plate at the other, the lens being placed on a fixed partition between the two (Fig. 28). Others are made on the principle of a magic lantern fpr projecting an enlarged image on to a sensitive paper or plate fixed on a

Enlarging Lantern.

screen (Fig. 29). A simple arrangement for daylight enlarging may be made by fixing a small quarter- or half-plate, camera on to a larger one by a sliding front, and mounting the two on a studio stand, which can be tilted so that the image may be illuminated by the open sky.

PJiotographic Objectives or Lenses.

The objective is the most important item of photographic apparatus, because the success of the pictures depends upon the perfection with which it will correctly and distinctly depict upon the plcme surface of the photographic plate actual images of objects in different planes, forming the field of view, which naturally would come to a focus on a series of curved surfaces. This image, besides being plane, must embrace a sufficiently wide angle and give fairly sharp definition all over the field of view it is in- tended to cover, even for objects at different distances from the lens. It must have suflBlcient luminous intensity to produce the required effect on the photographic plate with short exposures ; the chemical andvisual foci must coincide exactly ; and it must be free from all distortion of straight or parallel lines. The fulfilment of these varied and conflicting conditions is complicated by the presence of sundry focal displacements, or aberrations, to overcome which requires the greatest optical skill and scientific knowledge. The principal of these are: â€” (1) Spherical Aberration, or want of coincidence of the foci of the central and marginal pencils of rays passing through the lens. It is corrected by varying the curves of the

com- ponent lenses. (2) Coma, or blur, due to lateral spherical aberration of oblique rays, and mostly found in unsym- metrical combinations, such as portrait and single-view lenses. It is partly eliminated by the diaphragm. (3) Astigmatism, which always accompanies coma in single lens systems, and is usually present in objectives of the symmetrical aplanatic type, manifests itself by the forma- tion of two sets of images of points off the axis, which lie in two separate curved surfaces, one set focussing tangentially as more or less horizontal lines, and the other radially as more or less vertical lines. It increases with the obliquity of the rays, and causes want of definition and difference of focus between horizontal and vertical lines away from the centre. (4) Curvature of Field , which also increases with the obliquity of the rays. (5) Distortion, varying in effect according to the nature and construction of the objective and the position of the diaphragm. Thus with the single meniscus view lens, used in the ordinary way with its concave surface towards the object and the diaphragm in front, the distortion of the image of a square will make the sides appear convex or barrel-shaped, while if the

convex surface be turned to the object and the diaphragm placed behind, the sides of the square will appear concave. It can be overcome by using two such lenses, with their convex sides outwards and the diaphragm in the centre. (6) Chromatic Aberration, produced by the dispersion of the white light passing through a lens, and the different-coloured rays composing it coming to a focus at differei;it distances from the visual focus in the order of their wave- lengths. It is corrected by the use of glasses of different refractive powers, but, if present, may cause a want of coincidence in the position and size of the images formed at the visual focus about the yellow, and at the chemical or photographic focus of the blue and violet rays, which act most powerfully on the sensitive films in ordinary use.

The object of the optician in constructing photographic objectives is therefore to neutralize these aberrations and distortions as far as possible, by regulating the curves of their different components, and the refractive and dis- persive indices of the glasses from which they are made, so as to produce an image on the sensitive plate which shall

be well defined and free from distortion. In the older types of objectives in use before 1887 these correc- tions could never be fully carried out ; and although dis- tortion of straight and parallel lines could be overcome in the way mentioned, there was always more or less re- sidual curvature of field, spherical aberration, astigmatism, and, in some forms, coma, which had to be remedied as far as possible by the use of a diaphragm, which lengthened out the rays and caused them to define clearly over a larger surface, but at the expense of luminous intensity and rapidity of working. Few portrait lenses could be worked effectively with larger apertures than //8, or land- scape lenses with apertures larger than //16 or f/22, and so were slow in action. Although the introduction of rapid gelatine dry plates enabled photographs to be taken with much greater rapidity than with earlier methods, it only led to a further demand for more rapidity in lenses, in order to satisfy the requirements of the necessarily very rapid exposures made in hand cameras. For studio and copying work rapidity is also an important desideratum, especially in cloudy weather and in winter.

The rapidity of a lens with a light of given intensity depends upon the size of its aperture, or that of the diaphragm used, relatively to the focal length. In order, therefore, to obtain an increase of rapidity combined with perfect definition, some means had to be found of con- structing photographic objectives to work with larger effective apertures. This principle had been recognized by several of the best makers with regard to objectives of the single meniscus and aplanatic types, but with only partial success, because such objectives are dependent upon the use of the diaphragm for the further correction necessary to obtain good definition over an extended field. The great difficulty was to get rid of astigmatism and curvature of the field, which was impossible with the ordinary optical flint and crown glasses. In 1886 Messrs Abb & Schott, of Jena, introduced several new varieties of optical glasses, which rendered it possible to overcome these difficulties, and revolutionized the science and prac- tice of photographic optics by enabling objectives to be produced free from astigmatism, which can be effectively woiked at their nominal apertures, //2 to //l for portrait lenses, //6 to //8 for views, &c., with great flatness of field independently of the diaphragm, the principal use of which now is to extend the area

of definition or increase the angle of view, and also the so-called “depth of focus ” for objects m different planes. For full information regarding the theory and construction of photographic objectives, the reader may be referred to the works men- tioned at the end.

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Photograpliic objectives may be divided into the following classes : â€” â–

(1) Single achromatic combinations or “view lenses.” ^2) Unsymmetrioal doublets â€” old types.

(3) Symmetrical doublets â€” old types.

(4) Anastigmatic combinations, unsymmetrical and symmetrical.

(5) Triple combinations â€” old types.

(6) Telephotographio objectives.

(1) Single Achromatic Combinations. â€” In Its ordinary form the single landscape lens of the old type consists of an achromatic compound meniscus, formed of a biconvex positive crown cemented to p, biconcave negative flint, in order to secure achromatism and partially correct the spherical aberration. It may thus be looked upon as the type of the “old photographic achromat” (Fig. 30). 1 It is mounted with its concave surface towards the object, with the diaphragms in front of it, thus producing the convex distortion al- ready noticed, which is inherent in this type of objective. In order to obtain further partial correction for astigmatism, spherical aberration, and coma, as well as depth of definition and covering power, the full aperture of these objec- Fio. SO.â€” BiDgle tives has to be largely

reduced by a diaphragm ; Landscape Lens, consequently it is slow, though it has been much improved from its original form.

These lenses have always been popular for pure landscape work, on account of the equality of the illumination over the plate and the brilliancy of the images they give, owing to their comparative thinness and freedom from reflecting surfaces. In the older forms their use was limited on account of their tendency to show ” out- ward” distortion of the vertical lines of buildings, &c., but this is not very noticeable if they are worked well within their power and the camera is kept level. Objectives of this typQ are still largely used, and in some of their improved and “long-focus” forms are preferred by some portraitists for large heads, on account of the general softness of definition they give when used with large aper- tures. Ir(T. Grubb’s ” Aplanatic ” (1857) the positions of the crown and flint elements were reversed, the effective aperture increased and spherical aberration diminished (Fig. 31). J. H. Dallmeyer’s ” Wide- Angle Landscape Lens ” (1865), composed of three cemented glasses, a flint concave between two hard crown menisci, included an angle of 75Â°. In it distortion was reduced and better marginal definition obtained with an aperture of //15. The “Eapid (Long

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Fig. 81.â€” Grubb’s ” Aplanatic ” Lens.

Fig. 82. â€” Rapid Landscape Lens. Lung focus.

Focus) Landscape Lens,” of the same maker, brought out by his son (1884), is a modification of the former, with an extra light flint in place of the anterior crown (Fig. .32). Working at// 12 it is said to give good definition with great brilliancy over an angle of about 40Â°, and with large apertures up to //8 can be used for por- traiture of large heads. The same advantages were gained in Wray’s ” Landscape Lens” (1886),

a combination of two glasses working at//ll, the larger sizes working at//8 being useful for portraiture. Voigtlander's " Wide-Angle Landscape Lens" (1888), constructed of Jena glasses, worked at //15 over an angle of 90Â°, with great covering power and depth of fooui T. E. Dall- meyer's "Rectilinear Land- scape Lens" (1888) was composed of three glasses, and quite novel in con- struction (Fig. 33). It works at //14, is quite free from distortion, and has been recommended for

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Fig. 83.â€" Rectilinear Landscape Lens.

1 In the diagrams of lenses which follow, a uniform system of indi- cating the nature of the glass employed by means of the .shading has been adopted. ^m Flint glass is indicated thus : â€" ~~. Crown glass of low refractive power thus : â€" h\v3 Crown glass of high refractive power thus : â€" | 1

(These two are used indiscriminately in lenses made before the Introduction of the new Jena glass.)

Extra light flint glass thus :-

copying purposes on account of the clearness of the lines result- ing from the brilliant working of the single combination. Ross's " Wide-Angle Landscape Lens" (1890) is a triple cemented lens, made with Jena glasses, which works at//16. Many other excel- lent lenses of this type have been made by English and foreign makers, but they are not so well suited for general purposes as are the new fully-corrected anastigmats specially constructed to work singly, such as Rudolph's (Zeiss) four-lens anastigmat. Series VII. , or the single elements of many of the anastigmatic doublets, as will be noticed more fully later (Â§ 4).

(2) Unsymmetrical Doubletsâ€" Old Types. â€" In this class are in- cluded objectives formed of two dissimilar combinations, which in most cases correct each other, and may or may not be capable of being used independently as single lenses, the diaphragm being placed at the

optical centre between them. All the older “por- trait” lenses, some of the doublets and the ” orthoscopic ” lens, now disused, belong to this category. Even under the vastly im- proved conditions of the present day, the special requirements of the portraitist working in a studio demand a quick-acting objective of large effective aperture and comparatively short focus, giving a brilliant and fairly well defined image of near objects in different planes over a restricted field of view. Such was the original por- trait objective of the Petzval type, which is still largely used and preferred by many portraitists for their special purpose, though it has many defects which render it useless for any other purpose unless largely stopped-down and at the risk of “flare.” The in- troduction of more rapid dry plates caused it to be supplanted to some extent by lenses of the rapid aplanatic or rectilinear type, but the use of Jena optical glass has enabled several improved and well-corrected combinations, of specially large aperture and small angle, to be made for portraiture and the most rapid instan- taneous work. The Petzval portrait objective consists of two dis- similar achromatic combinations widely separated. In earlier forms the diaphragms were placed in front, but now they are usually between the combinations. The front element is a plano-convex, composed of a biconvex crown cemented to a plano-concave flint ; while the back element is a double convex, composed of a biconvex crown, separated by an air-space from a concavo-convex flint in front of it (Fig. 34). In 1866 J. H. Dallmeyer made some essential changes in the form and relative positions of the components of

Fig. 84.â€” Portrait Lens.

Fig. 35. â€” Dallmeyer’s Portrait ‘Lens,f/S.

the back element, and thus obtained a flatter field and freedom from “flare-spot” (Fig. 3-5). In this form the back element is a compound meniscus consisting of a meniscus crown in front, with its concave surface towards the diaphragm, and a meniscus flint behind, with its convex surface towards the plate. When the two components are in contact, sharp definition is obtained ; but by separating them, more or less spherical aberration can be intro- duced, so that the definition is

more diifused and the depth of focus increased. These objectives are made to cover an angle of 60Â° without distortion, and in three intensities, //3, //4, and//6. Dallmeyer also brought out an extra quick-acting portrait ob- jective for small portraits, with a working aperture of f/2. It differs from the preceding in the form of the back element, which is more like the original Petzval type, with a fixed air-space between the anterior flint-meniscus and the poste- rior biconvex crown (Fig. 36). In 1875 Dr Adolf Steinheil brought out an unsymmetrical aplanatic portrait combination of peculiar construction work- ing at//3-2 (Fig. 37). Though it was a masterpiece of calcula- tion and had many good qualities, it did not come into general use, and in 1881 was superseded by the ” Portrait Antiplanet,” which is also a distinct type, differing from the ordinary Steinheil

).â€” Dallmever’s Portrait Lens,//‘2-2.

antiplanets and more nearly approaching a triplet, there being six reflecting surfaces (Kg. 38). It worked at an aperture of //4 ; the

I’lO. 37.â€” A Steinheil’s Portrait Aplanate.

spherical correction was not so complete as in the last lens, but astigmatism was removed over an angle of 14Â°, and the curvature of field was but slight. Steinheil’s unsynimetrical ” Group Aplanats ” (1879), working at//6-4 over a field of about 70Â°, were an improve- ment upon the ordinary ” Aplanats,” but difficult to make, and were replaced in 1881 by the ” Group Antiplanets,” an unsymmetrical doublet of a distinct type (Fig. 39) . They were made of the old

Flo. 3S. â€” Portrait Antiplanet.

Fig. 89. â€” Group Antiplanet.

optical glasses, and were a still further advance on the “Aplanats,” working at larger apertures and giving better definition. They could be used at the full- dperture of //5 for instantaneous pictures and small groups. With smaller diaphragms they covered an angle of 70Â°, and were generally very useful lenses. According to Mr Dallmeyer, this lens is particularly interesting as being the first in which the principle was adopted of eliminating astigmatism by combining a “crown-shaped” lens of high refractive index with a “flint-shaped” of lower refractive index, though the Jena glasses were not available. All Dr A. Steinheil’s lenses are marked by their originality and diversity of design. The “Group Anti- planet” was modified and gi-eatly improved by Dr E. Steinheil (1893), as regards astigmatism and otherwise, by replacing the thick back combination by a triple long-focus negative element consisting of a crown between two flints, and by using a heavy barium crown in the front element instead of the flint. The new form has increased covering power, with a working aperture of about //6-5 (Fig. 40). Voigtlander, who was the original constructor of the Petzval portrait combination, improved it in 1878-79, and later in 1885, apparently on similar lines to Dallmeyer’s improved portrait lenses of 1860. More recently he has constructed a rapid combination of this kind, working with an intensity of //2-3, intended for astrophotography, cinematograph work, and other purposes for which the greatest intensity of illumination is required on small plates not exceeding 4 inches square. An entirely new portrait combination was con- m

struoted in 189-5 by Messrs Dallmeyer, for Mr Bergheim, to give a generally soft but well-defined and detailed image (Fig. 41). It is composed of a single uncor- rected meniscus front lens of positive focus, with a diaphragm in front of it, in com- bination with a single uncorrected back lens ^”’- “â– -Dallmeyer-Bergholm Lens,

of negative focus, and in the larger sizes it has great range nf focal length on the telephotographic principle. The amount of spherical and chromatic aberration produced by the uncor-

Fie. 40,â€” E. steinheil’s Im- proved Group Antiplanet.

Fig. 42.â€” 0. A. Steinlieirs ” Periskop.”

reeled single lenses gives the diffusion of focus which produces the peculiarly soft and delicate effect. It is most useful for large heads and life-size studies, the great depth of focus conducing to uni- formity of definition. It works perfectly free from distortion, and by stopping-down to about one-third perfect definition can be ob- tained. Owing to both elements being single glasses, the combina- tion gives great brilliancy. It is not achromatic.

(8) Symmetrical Doublets â€” Old Types. â€” This class includes ob- jectives formed of two similar combinations of lenses, usually of the convergent or positive meniscus form, with their concave sur- faces inwards, and a diaphragm between them ; consequently they are rectilinear and free from distortion of straight and parallel lines. Until the introduction of the anastigmatic doublets they were in universal use for almost all purposes. Even now they are very largely used, and have been greatly improved by the use of the Jena glasses in their construction.

Although Cundell (1844) described a symmetrical combination of two uncorrected meniscus lenses with a diaphragm between them, and several lenses of this type were brought out by various makers, it does not seem to have been recognized that this was the true cure for rectilinear distortion till C. A. Steinheil brought out his "Peri- skop" in 1865. This was a non-achromatized symmetrical doublet formed of two plain crowned glass men- isci with a central diaphragm (Fig. ^ | ^ 42). It included an angle of 90Â°, and gave a much larger field than objectives of the "globe " or spherical type, because the lenses were closer together. Being non- achromatic, it had to be adjusted for the chemical focus. It was, however, perfectly free from distortion, and constructed so that the field might be as flat as possible and both nodal points together. It is said to be the best possible combination of two plain lenses, and is still manufactured for use with some of the cheaper hand cameras with fixed focus, the difference of the visual and chemical foci being allowed for. Newer objectives of this kind are fitted with mounts adjustable for the chemical and visual foci. Rodenstock's " bistig- mats" are of this class. Zentmayer made a similar lens, but not symmetrical. In Adolf Steinheil's "Aplanat" (1866) the same principle

was carried out with achromatized lenses, and this was a great improvement. It consisted of two positive cemented flint menisci, the outside one having a negative focus and the inner a pos- itive one, glasses of different den- sities being used, but both having

their concave surfaces facing the centre (Fig. 43). This use of flint glass alone was peculiar, ‘ because former achromatic lenses hadbeenmadeof flint and crown. .

It was made to cover an angle ,. , â–¡Â» . v â€¢,. i.a , .â€ž c r^no ij-/oA I. i ij 1 ^ Fig. 48.â€” A. Steinheil s “Aplanat.”

of 90Â° at//30, but could also be *^

used with the larger aperture //8. It was afterwards made in three different rapidities : (a) “ordinary,” working with a relative aperture of //6or//7 over an angle of 60Â° ; (6) “landscape,” work- ing at //12 to //15over an angle of 90Â°, and used largely in convert- ible sets ; (c) “wide-angle,” working at //20 tof/25 over an angle of 104Â° for landscapes and interiors. In the aplanats of large aper- ture the components are from ^ to J the focal length apart, the largest diaphragm being nearly the full aperture of the lens. Spherical ab- erration is corrected at the expense of the angle of view. The inner curvature of the lenses is small, and consequently tliere is a good deal of astigmatism, and they are dependent on the diaphragm for good marginal definition. By the use of the newer and mtire transparent Jena glasses, as in the ” Universal Aplanat ” (1886), the component elements were brought closer together, the inten.sity of the com- bination increased, and the instrument made more portable. In the “Landscape Aplanats ” the diaphragms were relatively smaller, the separation of the elements less, the radius of inner curvature smaller, giving less astigmatism and better marginal definition. In the “Wide- angle Aplanats” the intensity was still less, smaller stops were required, and everything was arranged to secure the greatest sharpness over a wide angle of view. The component lenses had much greater curvature and were much nearer together. J. H. Dallmeyer had been working in the same direction simultaneously with Stein- heil, and in 1867 brought out his ” Wide- angle Rectilinear,” working at about //15 and having

the posterior element smaller than the front one (Fig. 44). This was also a great improvement on previous doublet combinations, and was succeeded, in 1868, by the well-known ” Rapid Rectilinear,” on the same principle, with the components made of menisciof flintand crown (Fig. 46). Itworksat//8, and islargely used for copying. Ross’s ” Rapid ” and “Portable Symmetrical ” lenses, Voigtlander’s ” Euryscopes,” and other similar lenses of

Fig. 44.â€” Wide-angle Rootilin*ar Lens.

apparatus]

English and foreign manufacture, are of the same type, and still largely in use. They are excellent lenses for general purposes, but more or less astig- matism is always pre- sent ; and although they can be used with niuoh larger apertures than the triplet lenses they displaced, they are de- pendent on the dia^ phragm for securing good marginal definition

Fig, 45, â€” Rapid Kectilinear Lens,

Fig. 46, â€” Concen- tric Lens,

over the size of plate they are said to cover. They are being superseded by the anastigmatic combinations.

(4) Anastigmatic Combinations, Unsymmetrical and Symmetrical. â€” As already stated, it was impossible to obtain flatness of field to- gether with freedom from astigmatism in objectives constructed with the old optical glasses. In the ” Antiplanets ” Steinheil endeav- oured to do so, but was only partially successful. The Jena glasses put a new power into the hands of opticians, by largely increasing their choice of glasses with different refractive and dispersive powers. Whereas the old glasses had high refractivity with higher dispersion, in the new ones high

refractivity with lower dispersion can be set against lower refractivity with higher dispersion.

The first lens made with the new glasses was Dr Schroeder's " Concentric," patented in 1888, though not brought out by Messrs Ross till 1892 {Phot. Journ. xvi, 276). It is a symmetrical doublet of quite novel construction (Fig. 46), consisting of two similar combinations, each composed of a plano- convex crown glass of high refractivity, cemented on the plane surface to a plano-convex lens of lower refractivity but about equal lower disper- sion. Both the unoemented surfaces are spherical and concentric, and in consequence of its shape it has considerable spherical aberration. At// 16 it gives equally sharp definition over a large and quite flat field of 75Â°. It is almost free from astigmatism, shows no distortion or " flare-spot," and gives great sharpness and depth of definition. Owing to the small working aperture it seems slow, but is not so for the definition and flatness of field obtained. It is an excellent copying lens. Both combinations can be used alone as single lenses of about double the focus. Dr Miethe calculated the data for two lenses brought out by Hartnack (1889), one of them a symmetrical anastigmatic aplanat, in which a crown of high refraction and low dispersion was combined with a flint of low refraction, thus diminishing astigmatism and giving perfect definition over a large field with a, maximum aperture of //7-7, Though astigmatism was removed, other defects remained, and the lenses did not come into use. Fritsch, of Vienna, in 1888, con- structed a wide-angle " Apochromat " of the symmetrical aplanatic type, composed of two similar combinations made of baryta flint and phosphate crown glasses, by which it was claimed that the secondary spectrum for the rays F, G, H was eliminated, and the dispersion of the chemical image reduced to a minimum, so that the definition was better and the image photographically more intense {Photo. Gorrespondem, xxvi, 14). Many of the early lenses made with the Jena glasses suffered from the want of stability of the glass, and it was not until the principle of sandwiching the soft glasses between two hard ones was adopted that this was over-come, Dr Paul Rudolph, of Messrs Carl Zeiss & Co., of Jena, was the first to work out (1890) a new and practically successful method of constructing a photographic objective in which astigmatism of the

oblique rays can be eliminated without loss of rapidity, and the want of marginal definition due to astigmatism removed, so that a comparatively extended field can be covered with a large aperture. This he effected by a combination of two dissimilar systems of single lenses cemented together, the positive element (converging lens) of each having in one case a higher and in the other a lower refractive index than that of the negative element (dispersing lens) with which it is associated. Both systems are approximately achromatic, the first, in which the glass of highest refraction has also the greatest relative dispersion, being what is termed a normal, or old, achromat, and the other, in which the highest refraction is accompanied by the lowest dispersion, an abnormal, or new, achromat. Both systems being spherically and chromar tically corrected for a large aperture, the field is flattened, the astigmatism of the one is corrected by the opposite astigmatism of the other without destroying the flatness of field over a large angle. [A full description of the principles on which these lenses are constructed will be found in Eder's Jahrbuch der Photographic, 1891 and 189-3 ; also in Prof. S. P, Thompson's translation of Lummer's Photographic Optics. 1 Several series of them have been made by Messrs Zeiss and their licensees since 1890, In England they are made by Messrs Ross. The first series were constructed

in two different types. The more rapid had five lenses (Fig. 47), two made of ordinary glasses in the front normal achromat, which effects the spherical correction of the whole, and three in the back abnormal achromat, two crowns of exceedingly high refractive power, with a negative flint of exceedingly low refractive power

Fig. 47.-

-Anaatigmat.

//6-8,

Series II,

Fig. 48. â€" Anastijnnat. Series Ilio. f/-i.

between them. This component efiects the anastigmatic flattening of the system. The fifth lens is useful in removing spherical aberrations of higher orders with large apertures. The second type (Fig. 48) has only two lenses in each component, the functions of which are as above. These combinations cannot be used separately as single lenses. Dr Rudolph also turned his attention in 1891 to the perfecting of the single landscape lens, and con- structed on the same principle a single combination of three lenses, of which the centre one had a refractive index between the indices of the two others, and one of its cemented surfaces was diverging, while the other was converging (Fig. 49). This lens gave an astigmatically flat image, with freedom from spherical aberration on or off the axis. It was, however, not brought out till 1893, as a convertible lens or "Satz-anastigmatio," Series Via (Fig. 50).

Fig, 49, â€" Anastigmat, Series VI, //14-6,

Fig. 50.â€" Satz Anastigmat, Series \la. f/VI.

In the meantime Dr E. von Hoegh had independently calculated for Messrs Goerz, of Berlin, a fully- corrected anastigmatic single lens on the above principle, consisting of a negative lens enclosed between two positive lenses, one of which has a higher and the other a lower refractive index than the negative (Fig. 51). Though

Fig. 51, â€" Koss-Goen,, Series III,

Eoss-Goerz, Series IV,

a lens of this kind could be used alone, Messrs Goerz preferred to put two of them together to form a symmetrical doublet of the "aplanat" type, and brought out the lens in 1893 under the name of " Double Anastlgmat," These lenses are also manufactured by Messrs Ross in two series â€" III,, a universal lens, working at //7-7, and IV., a wide-angle copying lens, working at f/W. Both these series of lenses, at full aperture, cover a field of 70Â° to 75Â°, and with smaller diaphragms, 90Â°. In 1893 Messrs Zeiss issued their Series VI. and Via of fully-corrected anastig- matic lenses with triple cemented components, which could be used either alone or as doublets, in combinations of two lenses

of the same or different focus. These lenses have practically been replaced by Series VII, and Vila, of “Convertible Anastigmats, ” now known as the convertible ” Protar,” consisting in the same way of single lenses formed of quadruple cemented components (Fig. 52). Each component comprises within itself a normal

Fig, 52,â€” Series VII, //12-5.

Series Vila. //6-E

achromat of two old glasses and an abnormal achromat of two new glasses. Mr Dallmeyer, in his presidential address to the Royal

Photographic Society in 1900, says that this is the most perfectly-corrected single lens that has yet been evolved ; for Dr Rudolph has not only succeeded in obtaining freedom from spherical aberration and astigmatism, but has also made a very successful attempt at the elimination of coma. The single “Protar” lenses of Series VII. have a relative rapidity of //12-5, embracing a field of 85Â°. With full aperture they have great anastigmatic flatness of field and only very slight marginal distortion â€” a condition not hitherto realized in a single lens. With the doublet combination, forming Series Vila, the relative rapidity varies from //6-3 tof/8, accord- ing to the lenses used. When lenses of unequal foci are used, the larger is placed in front, and with such a combination three object- ives of different focal length are available. Quadruple convertible single lenses have also been patented by Goerz and by Voigtiander, but do not seem to have come into use.

Under the names “Planar” and “Unar,” Messrs Zeiss, and in Great Britain Messrs Ross, have brought out two new anastigmatic lenses of large aperture which embody quite new features of con- struction. The first is a symmetrical doublet formed of two elements, each consisting

of three lenses, the two inner ones being a double concave and a double convex ce- mented together and separated by an air- space from the outer one, which is a convex meniscus (Fig. 6.S). Its special points are its freedom from chro- matic differences of the spherical aber- ration and the large relative aperture and intensity, varying from //3 to f/6, according to the size and application of the lens, with perfectly sharp definition and anastigmatic flatness of field over an angle of view varying from 62Â° to 72Â°. The single combinations cannot be used alone, except with very small stops. It is a very rapid wide-angle lens, useful for the most instantaneous kind of work with the cinematograph ; also for portraits and groups, photomicrography, and sharp reproduc- tion. It is based on the principle of the Gauss achromatic telescope objective, and is described in Eder's Jahrbuch, 1898, p. 79 ; also Thompson's edition of

Lummer's Photographic Optics, p. 81. The Unar (1899) consists of two uu- symmetrical combinations, each formed of two thin single lenses of very trans- parent glass, separated by positive and negative air- spaces (Fig. 54) . The halves cannot be used alone as sin- gle lenses, neither being fully corrected for colour.

Fig. 53.â€" Planar. Series la,

Fig. 54. â€" Unar Double Lens.

It works with an aperture varying from //4-5 in the small sizes to //5'6 in the largest, and gives sharp definition, with freedom from astigmatism, over a comparatively flat field of HoÂ° It is well adapted for portraiture, copying, and enlarging, and especially for hand-camera work, on account of its covering power combined with large relative aperture.

In 1899 Goerz brought out a double anastigmat with quintuple single lens components as a convertible lens, for which greater sharp- ness of definition and intensity, with perfect freedom from astigma^ tism and distortion in the single combination, were claimed ; but, like the earlier analogous quintuplet of Turner and Reich (1895), they do not seem to have been adopted in practice. The extra cost of the number of glasses

to be worked, and the difficulties of centring and construction, do not appear to be compensated by the additional advantages claimed. Several combinations of triple lenses, con- structed more or less on the principles enunciated by Dr Rudolph, have been brought out by several English and foreign makers, among them Steinheil's " Orthostigmats," made in England by Messrs R. & J. Beck ; Wray's " Platystigmats " ; Ross's " New Symmetrical Anastigmats " ; Voigtlander's " Collinears " ; Lacour's " Eury- graphes," may be noted. Suter, of Basel, has introduced an 8-lens doublet, composed of two quadruple lenses. An account, by E. Wallon, of the newest types of anastigmatic doublets of triple and quadruple lens systems made in France, of Mantois's new French glasses, is given in Eder's Jahrbuch, 1901, p. 225. The use of quartz is also noted.

A distinctly new type of anastigmatic objective, involving several new principles of construction, was invented by Mr. H. L. Aldis, who has fully described it in the Photographic Journal, 1896, xx. 117. It was brought out in three series by Messrs Dallmeyer, under the name of "Stigmatic." Series I. is a portrait combination.

Fig. 65. â€" Stigmatic Portrait Lens. Series I.

g DALLMEYER'S PATENT^-

|| STICMflTIC LENS 8-

workingat//4, and consisting (Fig. 55) of two compound elements, the front one a deep converging meniscus with strong positive spherical aberration, but approximately cor- rect for chromatic aber- ration, while the rear one is a diverging sys- tem with strong nega- tivesphericalaberration to correct the positive aberration of the front lens, and also approxir mately achromatic; the whole forming a converging system cor- rected for spherical and chromatic aberration, free from distortion and almost free from astigmatism. It gives equal definition over a flat field, and covers an angle of about 60Â° with great equality of illumina^ tion. By unscrewing the back cell a certain amount of spherical aber- ration can be introduced, giving more equal distribution of definition over different planes. It may be noted that all

the flint lenses have lower indices of refraction than the crowns. Series II. is on the same principle, but differs in construction (Fig. 56) . It works at f/6 over an angle of 85Â° as a universal and convertible lens. The front or back component can be used alone, giving the choice of two additional focal lengths, 1| and twice the focal length of the complete lens. Series III. (Fig. 57) works at //7-5, and at //16 will give sharp definition over a plate two sizes larger. The single components are not convertible. Another anastig- matic combination, also of English ori- gin, and containing some remarkable new features, was constructed in 1893 by Mr H. Dennis Taylor, of Messrs T. Cooke & Sons, and brought out by Messrs Taylor, Taylor, & Hobson under the name of the "Cooke Lens." It is also made by Messrs Voigtiander, under the name of "Triple Anastigmat." It is a triple combination consisting of three single lenses ; two of them are positive crossed lenses of crown glass, with their most convex sides outwards, and between them, in front of the dia- phragm, there is a single biconcave lens of light flint glass (Fig. 58). In Series III. , which is a universal or general- pur- pose lens, the relative aperture is //6-5 (Fig. 59), and in Series V. //8. These lenses are not convertible, but an ar- rangement has been made by which the focus can be lengthened by removing the back lens and replacing it by an "extension" lens of lower power. Series of them can

Fig. 56. â€" ^UaUmeyer'e Stigmatic Lens. Series II.

Fig. 57. â€" Ballmeyer's Stig- matic Lens. Serit-s III.

Fig. 5S.-

' Cooke " Portrait Lens. Aperture //4'5.

Cooke Lens. Series III.

be carried, either separately or mounted on a rotating wheel fitted inside the camera. A portrait lens, working at f/4'5 over an angle of 45Â°, is on the same principle. An adjustment is provided with it for the introduction at will of spherical aberration evenly over the plate. In the "Process" lens, Series V. //8, the combination is adjusted to secure

identical size and sharpness of each colour-image in three-colour process work, and it has a screw-fitting for the attachment of a reversing prism. It is highly spoken of for its good definition and covering power in copying work. (For a full description of the principles on which these lenses are constructed, see Photo. Journ. 1895, xix. 64.)

Dr Hartinghas recently discussed the correction of the secondary spectrum in photographic lenses, and described the method followed in constructing Messrs Voigtlander's " Apochromatio CoUinear Lens" {Photo. Journ., 1901, xxv. p. 323). It is claimed

that the colour correction of this lens is complete between C and G, and the images given by it of an object illuminated by any kind of monochromatic light fall in the same plane and are identical in size. This is of great importance in three-colour reproductions.

(5) Triple, Combinations â€" Old Types. â€" This class comprises objectives composed of three separate combinations or glasses widely separated from each other. An early form of this type was made by Andrew Ross (1841) for Fox Talbot, others by Goddard (1859) and by Sutton (I860), but they never came into general use. J. H. Dallmeyer's well-known "Triple Achromatic Lens" (I860), though now out of date, was an excellent lens, and very useful for copying (Fig. 60). As made by Dallmeyer,the inner surface of the front and back lenses (achromatic menisci) is slightly concave, but in similar lenses made by T. Eoss it was flat. The centre lens was an achromatic negative serving to flatten the field. They worked at //1 5, giving an

Pig.

-Triple Achromatic Lens.

image fairly flat and quite free from distortion of straight lines. (6) Telephotographic Objectives. â€” During the last few years special objectives, or attachments, have been constructed for photo- graphing near or distant objects on an enlarged scale with an ordi- nary camera, the extension required being very considerably less than would be needed to obtain an image of the same size by means of an ordinary long-focus lens without enlargement. They consist of a combination of a positive converging with a negative dispersing lens, by which the image is picked up and enlarged to varying degrees, according to the system of lenses used and the extension given to the camera, thus producing the same effect as a positive lens of very much longer focus. Enlarged images of this kind can also be made by a combination of two converging lenses, one of them forming an image of the object, which is received on the other of shorter focus and projected on the sensitive plate, being enlarged more or less according to the optical conditions and relative positions of the lenses and sensitive plate. The photo-heliographs at Greenwich and other solar observatories, designed by Dr de la Rue, are on this principle. A portable apparatus of the kind was made in 1869 by Borie and Tournemire, and later by Jarret, but this system requires much greater extension of the

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camera, entailing more loss of intensity of the image, and has never come into use.

The modern telephotographic combination is generally looked upon as an application of the principle of the ” Barlow ” lens, but it really goes back very much farther, and is oonteniporaneous with the telescope on the so-called Galilean system. J. B. Porta men- tions the combination of concave and convex lenses for giving enlarged and clearer images of near and distant objects {Magia Naturalis, lib. 17, cap. 10, 1589). Kepler showed that by a combination of a convex with a concave lens images of objects could be depicted on paper of a larger size than by the convex lens alone, but reversed (Dioptrice, Frob. cv. 1611). Scheiner made use of the same principle in his “Helioscope” for solar observations {Rosa XIrsina, cap. vii., 1630). If for the simple

uncorrected glasses then used we substitute a system of photo-graphically-corrected positive and negative lenses, suitably mounted, and put a sensitive plate in place of the paper, we have the modern telephotographic arrangement. Porro seems to have been the first to use a combination of this kind for photographing an eclipse in 1857, and later for terrestrial objects. It consisted of a small achromatic single lens combined with a concave lens. Many attempts were afterwards made in France, and also in England, to utilize the principle, but special lenses for the purpose were not available. Steinheil constructed one in 1889 for the Brussels Observatory, and another in 1890 for the Marine Department in Berlin. In 1891, curiously enough, three such combinations were worked out quite independently and patented, by T. R. Dallmeyer in London, A. Miethe in Berlin, and A. Duboscq in Paris. Since that time these combinations have been greatly Improved. They are exceedingly valuable for obtaining details of inaccessible objects at'a distance, whether architectural or topographical, and for photo- graphing animals without approaching them too closely. Large portraits can also be taken with much better perspective effects, and more conveniently, than by using long-focus lenses much nearer to the sitter. With the very perfect telephotographic objectives now available, the loss of intensity of illumination, which no doubt was the bar to early progress in this direction, has been over- come, and definition has also been improved, so that snap-shots can readily be made with combinations of high intensity, while with those of ordinary intensity the exposures are not unduly prolonged, and good definition y

can be obtained over an extended field. "^ "'

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The optical principle on which these combinations are based is very simple, and will be understood from Fig. 61. It depends mainly on the fact that in order that a real image may be thrown on the screen of an object AB, the rays proceeding from it, which pass through the positive system Li, must come to a focus at a point /within the secondary focus /” of the negative system La. Falling within this limit, they will be intercepted by La and made less convergent, so that instead of coming to a focus at /, they will continue to converge till they reach the screen at /”’, and will there form a proportionally larger image a’V of AB than the image ab given by the positive lens alone at/; just as stated in Kepler’s problem. Moreover, this image a’V will be of the same size as if it had been produced directly by a positive lens La with a focal length equal to If”, and this distance is the equivalent focal length of the entire sy.stem. It can be found from the formula

â– p /y2^ where /i and /a are the focal lengths of Li and L2 respect- ively, and dâ€”f--fiâ€”s, s being the distance between the lenses. In many instruments of the kind a scale showing the value of d is engraved on the mount. If the rays from AB come to a focus in front of L2, on it, or beyond/’, no real image can be projected on the screen. There is therefore a certain limit, which is greater in proportion to the length of focus of the negative system, within which the focus of the positive system Li may fall and produce a series of well-defined images on the screen, which can be varied in size by altering the amount of separation of the two systems of lenses within the above limit, and the distance of the screen from L2. Every change in the position of the screen will involve a corresponding adjustment of the lenses. The greater the exten- sion of the camera and the closer the lenses, the greater the size

of the image, and vice vers&. The camera extension for a given magnification can be found by multiplying the focal length of the negative system by the number of magnifications, less one. The magnification produced by a given camera extension is found by dividing the latter by the focal length of the negative system, and

adding one. In its usual form (Fig. 62) the telephotographic combination con-

FiG. 62. â€” Telephotographic Combination.

sists of a quick-acting portrait lens, or an anastigmatic doublet of large aperture and relative intensity, varying in focus from 6 to 10 inches, fitted at one end of a tube, in which slides a smaller tube carrying a properly-corrected negative system, which may vary in focus from 1 to 5 inches, but must be of shorter focus than the positive (usually about half) ; the shorter the focus the greater the magnifying power for a given extension of camera. The amount of separation of the lenses is limited on the one hand by the position of the focus of the positive system, and on the other by the focus of the negative system, as explained above, and can be adjusted within these limits by a rack and pinion. The tubes are adjusted so that when closed up the two foci may

coincide, or nearly so, and d=0, or its minimum value ; and when opened to their fullest extent the focus of the positive may fall upon the negative system, or so that d may not exceed the focal length of the negative system. Within these limits the focal length of the combination will be positive, and a real image formed on the screen. Mr T. R. Dallmeyer, to whom many of the im- provements in these lenses are due, has very fully discussed and explained the optical problems connected with their construction and use in his book on Telephotography. The other works noted at the end of this article may also be referred to.

Lens Diaphragms. â€” In order to regulate the intensity of the illumination by the lens, to enlarge its field, and, in the case of the older

forms of objectives, to extend the area of good marginal definition, diaphragms are used, usually with circular apertures. They are made in different ways : (1) as single metal plates, fitting into a slot in the lens tube (Waterhouse diaphragms) ; (2) Rota- tory : a single plate revolving on a central axis and pierced with apertures cut to fit centrically in the opening of the lens ; (3) Iris : a form of diaphragm now very generally used, and very convenient, because it can be easily adjusted as required for intermediate aper- tures.

In order to provide a uniform system of diaphragm apertures, the Royal Photographic Society in 1881 drew up some rules, which were revised in 1891, and again quite recentlv. The former

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standard unit-Vand the numerical notation used with it have been

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abolished. Intensity ratio is defined as dependent upon the effective aperture of a lens, and not upon the diameter of the diaphragm in relation to the focal length of a lens. The effective aperture of the lens is determined as follows : â€” The Imis must be focussed for parallel rays. An opaque screen is then placed in the principal focal plane, and a pinhole is made in the centre of the plate (in the axis of the lens) ; an illuminant is placed immediately behind the pinhole itself, when the diameter of the beam emerging from the front surface of the lens may be measured. (It will be found that, except in the case of the dia- phragm being placed in front of the lens, the diameter of the diaghragm itself is seldom that of the effective aperture.) Every diaphragm is to be marked with its true intensity ratio as above defined, but the present intensity ratios are retained in their order of sequence : â€”

rFI?FFFF!F F F T 14′ 2′ 2^’ 4′ 5^’ 8′ iTs’ 16′ 22^

F

45-2′

F

64′

In other cases apertures are to be made in uniformity with the scale, with the exception of the highest intensity. Standards for the screws of photographic lens flange fittings, and for the screws fitted to cameras, either for attachment to the stand or for fixing movable parts, have also been laid down {Photographic Journal, 1901, xxv. p. 322). Other systems of notation of diaphragm apertures have been adopted by the Paris Congress of 1889, by Messrs Carl Zeiss & Co., and by Messrs Dallmeyer. They are discussed in BoUrsault's Calcul du Temps de Pose en Fhotographie, p. 33, and Moessard's L^Objectif Photographique, p. 12.

Instantaneous Shutters.

The general use of very rapid dr^ plates and hand cameras rendered it necessary to have some mechanical means of regulating exposures in small fractions of a second, and the instantaneous shutter has become an essential part of modern photographic equipment in an immense variety of forms and patterns. Por quick studio v?ork, slow-acting shutters working to ~~jij~~ of a second are sufficient. Open-air exposures will usually range from tV tÂ° ihs' though legs than ~~J~~^ of a second is seldom necessary. For objects in quick motion the range may be from Y^ to ^-J-j, and for very rapidly moving objects from shf to ^ Ao of a second. In ordinary practice exposures of less than -^ of a second are not often required, and few of the shutters on the market in general use give higher speeds.

The rapidity required of a shutter in photographing moving objects is regulated by the minimum time necessary to produce a well exposed image upon the plate, with a loss of definition, or blurring, by displacement not exceeding j^-^, or preferably -j-J-^ to ^ of an inch, if enlargement is intended. The time required to produce a well-exposed

image depends on the state of the light and the illumination of the object, the relative intensity of

the lens as measured by its effective aperture and focal length, the sensitiveness of the plate, and the amount of effective light passing through the shutter during the exposure. The amount of displacement to be guarded against depends upon the rate of movement of the object, the direction in which it is moving with reference to the axis of the lens, its distance from the camera, and the focal length of the lens. It will be proportionately less as the distance of the object increases, and as the rate of its motion and the focal length of the lens for a given distance decrease, and vice versd. It will be greatest when the object is moving at right angles to the axis of the lens, aad least when the motion is directly towards it ; but in that case there will be some increase in the apparent size of the object as it approaches the camera. For example : â€" An object moving 1 mile an hour advances 17-6 inches per second. With a lens of 5-inch focus this would represent a displacement on the ground glass, for an object 50 feet away, amounting to ~~j~~-^ inch per second, and it would require exposures between ^ and Jy of a second to give maximum or minimum displacements of the image between ^hj ^^^ fhr Â°f ^^ inch. An object at the same distance moving ten times as fast would require yij- of the above exposures. If, however, the distance be increased, the possible exposure may also be increased in tile same proportion, so that the object moving 10 miles an hour at 600 feet distance would only require the original exposures of Jj- to ~~^ of a second. On the other hand, the limits of exposure for an object moving 1 mile an hour within 10 feet of the lens woitld be between yi, and Y^ of a second. This is entirely independent of th(sensitiveness of the plate, and only represents the maxi~~ mum duration of exposure permissible in order to reduce the blurring of the image between certain limits. The sensitiveness of the plate, and the intensity and amount of light acting upon it through the lens and shutter, must be adjusted so as to produce the desired photographic effect within that time. With a lens of 8 inches focal length the displacement would have increased in the first instance to ~~23 inch per second, and the maximum expo~~ sure permissible would be from -^ to -^V of a second. This shows that there is an advantage in using short-focus lenses for very rapid exposures. In practice, most

work of this kind is done upon quarter-plates (4i-x3i inches) with lenses of 4i to 5 inches focus. It may be noted that the displacement will be greatest for an object moving at a right angle across the axis of the lens, so that an expo- sure sufficient for this case will be sufficient for any other. Sir William Abney has discussed this question practi- cally in his Instantaneous Photography, and it is treated mathematically by MrW. B. Coventry in his Technics of the Hand Camera, in which will be found formulae and tables for ascertaining the distances and limiting expo- sures for moving objects, allowing for a blur of yctt of an inch. In foreign treatises the limit is usually calculated for a displacement of Jj of a millimetre, or about Tj-l-iy of an inch.

An e'fficient shutter should fulfil the following condi- tions :â€" It should be light and compact, simple in con- struction, but strongly made, and not liable to get out of order ; capable of being set without admitting light into the camera ; quite free from any tendency to shake the camera ; and easily released with a very slight pressure of the finger if a pneumatic release is not fitted. It should open and close quickly, allowingthe largest possible propor- tion of the exposure to be made with the full aperture, and It must not cut off any of the effective light passing through the lens, but should distribute it e^-enly all over the plate : though m landscape work it is an advantage to give the foreground more exposure thiin the sky. It should be adjustable for variable instantaneous and for prolonged or

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" time " exposures. With a good shutter there is less risk of shaking the camera in short " time " exposures, from \ to 1 second, than there is in taking off a cap. Shutters working between the lenses must permit of the use of diaphragms in the lenses. Above all, they must be constant in their action, giving short and variable exposures always correctly or relatively so, an imporaut condition which apparently is not often fulfilled, and the exposures marked on the indicator should be capable

of being always repeated with certainty. Shutters should also be capable of being used with different lenses. They are usually released by the pressure of the finger on the end of a lever holding the moving part in a state of tension ; or better, by Cadett's system of pneumatic pressure, applied by means of a compressible rubber bulb and tube, which drives a piston acting on the lever hold- ing the shutter, or which may inflate a collapsible bulb at the other end of the tube, and thus exert the necessary pressure on the lever. In many cases both methods can be used as desired, the pneumatic release being preferable on account of its convenience and freedom from liability to shake the camera. For hand cameras, however, the trigger pressure stud is more general, though in some forms a lever is drawn across from right to left, or vice ve7-S(i, being always set in both positions. Pressure is, however, better than a pull.

The following are the principal types of instantaneous shutter: â€" (1) Flap, (2) drop, (3) combined drop and flap, (4) rotary, (5) roller-blind, (6) focal plane, (7) lamellar, (8) moving disc or sector, (9) iris. They can be applied in four different positions : (a) in front of the lens ; (6) centrally, near the diaphragm ; (c) behind the lens ; (d) immediately in front of the sensitive plate. They all, however, come under two main classes. Lateral, including those in which the exposure commences and ends at the circumference of the lens aperture, and Central, those in which the exposure begins and ends at the centre of the aperture. Some of them are "lateral" in their single form and "central" when double. With the "focal plane" shutters, however, dif- ferent portions of the plate are exposed in succession, the lens working at its full aperture throughout the ex- posure. The form and position of the effective aperture of a shutter, relatively to the lens and plate, have strong influence, either favourable or unfavourable, on the amount of effective light passing through the lens, and its even distribution over the plate. This is especially the case d.uring the incomplete phases of opening and closing the apertiire. â– It seems to be agreed that the best position for shutters of the lateral type is behind the objective, and for those of the central type, between the component lenses. In this latter position the whole of the plate is illuminated during the full period of exposure, with a gradually increasing intensity during the first phase, until the

second phase of full opening is reached, and then the illumination gradually falls off again during the third phase until the shutter is closed again. The most effective shutter is one in which the first and third phases of incomplete illumination, during the opening and closing, are the shortest compared with the phase of full opening.

To secure successful results in using instantaneous shutters, the operator must make himself thoroughly acquainted with the working of his shutter in various circumstances of exposure with the lenses, plates, and developer he proposes to use ; he should also verify the value of the various exposures marked on the indicator, and, what is more important, determine how far they can be depended on for regularity. There are many simple ways in which the actual time of exposure from opening to closing can be ascertained sufficiently closely for

practical purposes. They depend upon the measurement of the trace left on a sensitive plate by the passage of a brightly illuminated object revolving at a known speed or falling vertically through a known distance, when photo- graphed with different speeds of the shutter against a dark background. These, and the more elaborate methods for obtaining more accurate determinations of the shutter- exposure periods and of the corresponding effective exposures â€” i.e., showing the actual effect of the shutter through its different phases from opening to closing â€” have been described by Sir William Abney in the work already mentioned, by Londe in La PhotograpJde Moderne and La Photographie Instantanie, and in other works mentioned at the end of this article.

(1) Flap Shutters. â€” The simple flap shutters consisting of a hinged flap opening upwards in front of the lens, though favourites in early days for landscape work, have been almost superseded by quicker and more compact forms. They are, however, still in use with single and double flaps for portraiture and studio work, for which purpose they are made to act noiselessly and not attract the attention of the sitters. Guerry's (Figs. 63 and 64) is a good example of the type.

Fig. 63. â€” Guerry's Single- Fig.' 64. â€” Guerry's

flap Shutter. Double-flap Shutter.

(2) Drop Shutters. â€” The old simple drop shutter, m which a plate having an opening in it falls in front of the lens aperture, has been superseded by the more compact and quicker-working roller- blind shutters, which act on much the same principle. It had a theoretical interest in connexion with the effect of diiferent forms of aperture â€” circular, square, or elongated â€” used with shutters of the lateral type, but it is now generally recognized that a more or less extended rectangular opening, of at least the full width of the lens aperture, is best for securing the even admission of light from all parts of the image with shutters of the rectilinear lateral type, to which this and similar shutters, in which a single opening passes across the lens aperture, belong.

(3) Combined Drop and Flap Shutters. â€” In early dry-plate days several forms of this kind of shutter were brought out, under the names of Phoenix, Phantom, &c., but they are now little used. In these shutters, in addition to the drop slide, there was also a lifting flap, which on release opened from below, and, having fully un- covered the aperture, released the drop slide, which fell and closed the shutter. They were useful and efiective in the smaller sizes, but heavy and cumbrous in the larger. The use of indiarubber bands for giving tension was also an objection.

(4) Jiotary Shutters. â€” These are of the lateral type, and consist of a circular metal disc revolving on an axis eccentric to the axis of the lens, and furnished with a radial sector-shaped or elongated opening with circular ends, which passes laterally in front of the lens aperture when the tension of a spring is released (Fig 65). They are largely used in various patterns in hand cameras, usually in front of the ob- jective, though they may be placed behind it or between the component lenses. So long as the opening is at least equal to the size of the lens aper- ture, the illumination is sufficiently even, but the openings are usually somewhat elongated so as to give a longer period of full opening.

(5) Boiler-Blind Shutters. â€” For gen- eral use the well-known roller-blind shutter of the single lateral type, as made by Thornton-Pickard

and others, is undoubtedly one of the most popular ^‘Â®- 65.-Eotary Shutter. and eificient. It possesses most of the qualities laid down as essential to a good shutter, gives good illumination, appears to be fairly regular in its action, and can be used for time or instantaneous exposures. It consists of a light mahogany or aluminium box, arranged so that it can be fitted in front of or behind the objective. It is made in difierent sizes, and each size can be adjusted to smaller objectives

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(Fig. 66). By pulling a cord an opaque black curtain witli an elongated rectangular aperture Is unrolled from the lower roller on

Fig. 67. â€” Mechanism of the Thornton- Pickard EoUer-Blind Shutter. â€” a, upper roller ; b, lower rol- ler ; 0. cord ; d, black curtain ; H, aperture in curtain ; K, rubber ring adapter.

Fig. 66.â€” Thornton-Pickard EoUer-Blind Shutter.

to the upper one, and held by a coiled spring on the lower roller

(Fig. 67). Pressure on a pneumatic bulb inflates a second smaller

bulb, raising a lever which releases the spring,

and thus brings the blind down with a rapidity

which can be adjusted by turning a handle

actuating the spring, the corresponding speed

being shown on the Indicator. For time

exposures, pressure on the bulb opens the

shutter, and another pressure closes it, but

an arrangement is now made by which time

exposures of ^, i, f, 1, 2, 3 seconds can be

given automatically (Fig. 68), the pressure of

the bulb opening the shutter, which closes of

itself at the expiration of the exposure required.

The theory of shutters of this type has been

very fully discussed by Mr Coventry (op. cit.

50), who shows that for any given tension of the spring the actual exposure decreases as the size of the lens aperture diminishes, while the effective exposure remains constant for all apertures. This is peculiar to the lateral shutter. He also shows that with plates of very different rapidities, though the exposure may be the same, the actual exposure effective is less with the rapid plate and a small stop, than with the slow plate and a large stop ; consequently the blur due to the movement of the object would be proportionately less on the rapid plate than on the slow one. He also shows that for any given lens the smaller the shutter the more rapid the exposure can be made, though with the same lens a larger shutter is capable of giv- ing a more efficient though less rapid exposure. It is better, therefore, for moderate exposures, to have a larger shutter than the size of the lens re- quires. Sir William Abney has given dia- grams of the action of

this shutter in his book referred to ; these show clearly that the centre of the plate gets more exposure than the margins ; but prac- tically this is not very noticeable, and the action is very regular.

(6) Focal-Plane Shutters.â€” These are also roller-blind shutters, with mechanism similarto the foregoing, but they are arranged so that an adjustable slit moves at a rapid speed a short distance in front of the

plate, exposing different portions of it in turn, the intensity of the exposure being regulated by the width of the slit, which is adjustable. In this way the lens can act on the plate with its full intensity. The construction of this shutter (Fig. 24) makes it capable of giving very rapid exposures with a narrow slit, and it has been used by Ansohiitz for his remarkable instantaneous studies of animals, &c., in rapid motion. It is made by Thornton- Pickard, Goerz, and others. The theory of it is discussed by Coventry (op. cit. p, 69). As the slit moves progressively over the plate, it may in certain circumstances cause distortion of the

Fio. 68.â€” Thornton-Pickard Roller-Blind Shutter â€”Automatic Exposure Appliance.

auicklv-moving images, especially if near the camera, or with a narrow slit and slow movement, but practically it is not often very

^“rn Lamellar Shutters.â€” These are a distinct type of lateral shutters, introduced abroad but not common in England. They act on the principle of a Venetian blind, with a series of parallel blades or plates, which turn through a semicircle on an axis during the exposure. They are said to have the advantage of giving a uniform very rapid exposure, but the blades cut off a great deal of light, whether placed before or behind the lens. ^

(8) Movina Disc Shutters.â€” These shutters, m which two thin metal plates with round or rectangular apertures, or m other oases two curved blades, pass very quickly over each other in opposite directions, are now very generally used m a variety of patterns. Formed of two single lateral shutters, they become in most oases central, opening and clos- ing in the centre of the lens aperture. The exposure takes place during the short period when the openings pass each other, or the curved blades open out and close again. The size of the openings generally corresponds with the diameter of the lens. If each plate moves as fast as a drop shutter, the combination gives double the speed, corresponding to half the exposure. High speeds of Tk or ^ of a second can therefore easily be attained, and rectangular apertures are the most

effective. The plate will be most evenly and strongly illuminated when the leaves of the shutter work inside the

lens near the diaphragm, as in Bausch & Lomb's (Fig. 70). This necessitates the shutter being made for the lens. Some forms are, however, suitable for use in front of the lens, such as the " Constant," Lancaster's

"See-Saw" (Fig. 69), the double roUer-blind, &c. In these the rectangular form of aperture is the best, circular apertures cutting off a good deal of the light, as in the case of drop shutters. Cov- entry has also discussed the action of the double roller- blind shutter as typical of the central class of shutters, and shows that while with the lateral shutter the effect- ive exposure is constant and the actual exposure variable, it is the reverse with the central shutters, and it will not be so easy to calculate ex- posures with difierent-sized

stops. A central shutter gives a more eflBcient exposure than a lateral shutter of the same dimensions as long as the opening is greater than the diameter of the lens. The greater rapidity of the double blind shutters is partly due to the spring being stronger.

(9) Iris Shutters. â€" These shutters are a further development of the double curved- blade central shutters, and are constructed on the principle of the "Iris" diaphragm, to open out from the centre of the lens and close again (Fig. 71). They are in all cases fitted between the components of double objectives, and can be made very lii;ht and compact. This central position of the shutter is theoretically the p,,, best, and the "Iris" is the best form. They I'equire very great care in construction and fitting to the lens, and consequently are expensive. They can, however, be used with convertible sets of lenses of different foci fitting the same mount. Sev- eral forms of them arc made by English

and foreign makers, but the principle is much the same in all, and ensures the most equal distribution of light over the plate.

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Fig. 70.â€” Bausch & Lomb's ' Shutter,

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Mochanisni of the "Iris" Sbuttcv.â€" d.a'.d", winding lever; b, speed bralte ; o, hand release ; (7, inde.x for iris ; Â«, index for exposures and also release ; B, brake ; M. in- stantaneous exposures ; 2, time exposures.

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PHOTOGEAPHY

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Exposure Meters.

When gelatine dry plates came into general use, and were made of many different degrees of sensitiveness, tlie want of a guide to the proper exposure for the various makes of plates under different conditions of lighting began to be felt, and several methods were devised for meeting the want. Some of them depend solely upon data derived from observations of the action of the principal factors affecting the result, namely : (1) The speed of the plate ; (2) the actinic power of solar light for the time of year in a given latitude ; (3) the time of day, with refer- ence to the position of the sun ; (4) the effective diaphragm aperture of the lens ; (5) the nature and illumination of the subject. With others these data are supplemented by, and practically based upon, actinometric observations of the action of the light upon sensitive paper exposed near the camera or the subject at the time. Both methods are in many cases of undoubted use, but the'information given by instruments of this kind can only be considered as approximate, and much is left to the judgment of the operator, whose surest guide will be an intelligent study of the principles on which these instruments are based, together with carefully-recorded observations of the combined working of his lenses, shutters, plates, and methods of development under the varying conditions of practical work. Before using any of these instruments, it is necessary to know approximately

the relative sensi- tiveness or ” speed ” of the plate in use. In the early days of gelatine dry plates, their rapidities were stated as so many times wet plates, or as ” ordinary,” ” instan- taneous,” ” rapid,” or ” extrarrapid,” terms which, though suitable for one make of plate, were of no value with reference to others. This was improved upon by the adoption of Warnerke’s ” Sensitometer,” which was in use as a standard for some years. It consisted of a transparent scale of 25 squares of different intensities, marked with opaque numbers and arranged so that each third number indicated a doubled rapidity. This was placed in a frame in front of the sensitive plate, and exposed for thirty seconds to the constant light emitted by a phosphorescent tablet, supplied with the instru- ment, which was previously excited by burning one inch of magnesium ribbon in front of it. The exposed plate was then developed and fixed, and the highest number visible indicated the rapidity of the plate. In 1890 Messrs Hurter & Drif&eld introduced an entirely new system of calculating the sensitiveness of plates of differ- ent rapidities. They make a series of exposures in seconds on different parts of the plate in geometrical pro- gression with a standard candle at one metre distance. After development for a certain fixed period with a standard developer, fixing, washing, and drying, the ” densities,” or logarithms of the opacities, of the differ- ent parts are measured by a special photometer and plotted on a skeleton diagram, producing a curve, one portion of which will practically be a straight line. The position of this line with reference to a scale of exposures given on the diagram decides the rapidity of the plate, while its length indicates the ” capacity ” of the plate for the truthful rendering of tone. The elaborate investiga- tions by which these results were obtained are of great interest, and were published in the Journal of the Society for Ghemical Industry, 1890, 1891, and later ones in the Photographic Journal, 1898. A paper read before the Photographic Convention in 1893 may also be noted. The sensitiveness given on the H. & D. scale is directly proportional to the number given. The method has been adopted by several dry-plate makers in denoting the sen- sitiveness of their different brands, and is more or less the basis on which the plate-speeds for the modern Eng-

lish dry-plate actinometers and exposure meters are cal- culated. Several systems of photometry and measurement of the speeds of dry plates were discussed at the meetings of the Congrfes International de Photographic, in Paris, 1889, and Brussels, 1891, but no definite standard was finally adopted. In Germany the use of Scheiner's sensitometer has been adopted, and appears to be extend- ing. It is based on a system of photographing the graduated tints given by rotating sectors. A full account of the instrument, and of a system of sensitometry based on its use, is given by Dr Eder in the Photographische Correspondenz, 1898, p. 469, and 1900, p. 244. 'Mr Chap- man Jones has recently brought out a convenient plate- tester on the same principle as the Warnerke sensitometer, but extended by the addition of a colour sensitometer, which is useful for the comparison of orthochroraatic dry plates, colour screens, light filters, &c. It consists of a screen plate, 4^x3;^ inches, containing a series of twenty-five tints of graduated densities ; a series of col- oured squaps, blue, green, yellow, and red, and a strip of neutral grey, all five being of approximately equal luminosity; a series of four squares of special pure colours, each representing a definite portion of the spec- trum ; also a space of line design, over which is super- posed a half-tone negative. To use the instrument, a quarter-plate of the brand to be tested is exposed behind the screen for a few seconds to the light of a standard candle placed at the distance of a foot, developed, fixed, and washed. An examination of the plate will show the sensitiveness, range of gradation, possible range of exposure, sensitiveness to colour, size of grain, amount of halation, and the most suitable light for development. It can be used for many other tests, and enables any brand of plates to be readily tested by the user and compared with any standard he may find convenient. In making these and similar tests, a standard devel- oper should be allowed to act for a fixed period and at a uniform temperature {Phot. Journ. 1901, xxv. p. 246).

The next important factor is the actinic power of the light. It depends normally on the height of the sun for the latitude of the place at the time when the photograph is taken, and exposures in bright sunlight are found to vary approximately as the cosecant of the sun's altitude above the horizon. The light of the sun itself is prac- tically the same at

any given time and place year after year, but is liable to more or less local and temporary diminution by the amount of cloud, haze, dust, &c., pres- ent in the atmosphere at the time. It is also affected by the time of day, increasing from sunrise to noon, and then decreasing to sunset. The remaining factor is the effective diaphragm aperture of the lens in relation to its focal length. In most cases of ordinary outdoor exposures this can be taken at its normal value, but becomes smaller and increases exposure if the focal lengtl^i is much increased for photographing near objects. Besides these principal factors, the nature and colour of the objects, their distance, and the amount of light received and reflected by them, have a very great influence on the result. Mr Coventry {op. dt. p. 75) shows how the ” light coefficient ” for full sunlight can be found, and gives a table for the latitude of London for every half-hour of the day in periods of ten days throughout the year ; also, roughly, the relative coefficients for “diffused light,” “cloudy,” “dull,” and ” very dull.” Convenient tables showing the normal ex- posures for each month in the year and at every hour of the day, together with others showing the influence of the different factors affecting exposure, have been published in some of the printed ” Exposure Note-books.” The reader may also be referred to H. Boursault’s Galcul du Temps de Pose en Photographic, and similar works by A. de la

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Baume-Pluvinel and Gr. de C. d’Espinassoux for a dis- cussion of the subject in all its aspects.

Based on the same principle as these exposure tables, various portable exposure meters have been brought out, in which scales representing the coefBoients for plate-speed, light, and diaphragm are arranged as in a slide rule, so that, when properly set, the normal exposure required can be found by inspection, and in- creased or diminished according to circumstances. In Hurter & Driffield’s ” Aotinograph,” the light

coeffioient is given by a printed card showing the curves for every day in the year and for every hour of the day, the unit being the ^hr P^i” of ^^^ brightest possible diffused daylight when the altitude of the sun is 90Â°. The ” lens ” scale shows the ratios of aperture to focal leugth in general use, and is calculated for single, double, and triple systems of lenses. The “speed” scale is based on the exposure in seconds which with one aotinograph degree of light will produce a perfect negative of an ordinary landscape. An additional scale is given for five different degrees of illumination â€” ^” very bright,” “bright,” “mean,” ” dull,” ” very dull.” A table of factors for “Views,” “Portraiture,” “Interiors,” “Copying,” is also given, and these regulate the figure to be taken for the exposure. The scales are engraved on boxwood, and there are two sliding pieces (Fig. 72) .

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SPEED OF PLATE

HURTER IDRIFFtElD’S ACTINOGRAPH PATENT NO 5545 IG88.

Fig. 72. â€” Hurter & Driffield’s Actino^aph.

It is specially adapted for use with plates of speed numbers agree- ing with the H. & D. scale, but can be used with any plate of which the relative speed number is known. Another convenient exposure meter is made by Watkins, of Hereford, in different forms. In the first the scales of ” light,” ” speed,” ” diaphragm,” and “exposures” are arranged round a cylinder, and in a later pattern on a dial, but the plate speeds are taken from a table, and the light coefficient is ascertained at the time by exposing a piece of sensitive paper under a blue glass for the number of seconds requisite to match a fixed tint, a pendulum being supplied with the instrument for counting seconds. In the “dial” instrument there are four apertures, marked “Plate,” “Stop,” “Act.” and “Exp.” above the corresponding scales. The numbers showing the speed of the plate in use, the diameter of the stop, and the actinometer exposure in seconds are brought into the respective apertures, and the exposure required is read off in the “Exp.” aperture (Eigs. 73 and 74) .

Other forms are made for hand cameras and indoor exposures. Wynne's exposure meter is also in dial

Fis. T.3.â€" Wilkin's Exposure Meter. Cylindrical form.

Pig. T4.â€" Dial Meter.

form, but the sensitive paper is exposed directly, no pendulum is used, and the scales are open on the dial. In use, the glass carrying the movable scale is turned until the actinometer time in seconds upon the exposure scale is opposite the diaphragm number of the plate ; the correct exposure will then be found against each stop given on the scale. There are practically only two scales : the scale of diaphragms representing the diaphragm apertures, the speed of plate and the variation of exposure due to subject ; and the time

scale, representing the actinometer time and the exposure. It is thus very simple. In another smaller form the scales are on the circumference of a locket and the actinometer at the back (Eigs. 75 and 76). A "Print meter" is also made for showing the ex- posures in contact-printing on sensitive papers, but it can also be used for testing speeds of plates and papers. Another form of exposure meter is Decoudun's, in which the exposure is estimated by the disappearance of a series of clear spots on a graduated scale

Fig. 7.5. â€" Wynne's Exposure Meter (ordinary form).

Fig. 76.â€" Wynne's Exposure Meter (locket form).

of densities^ laid on the most important parts of the image as seen on the ground glass. Its indications are not so definite as those given by the instruments noted above, and the scale is liable to change in density after a time. Other simple actinometers are in use for carbon and process printing, and usually consist of a gradu- ated scale of different thicknesses of tissue paper, or coloured gelatine in different densities. Papers are not suitable for making catinometer scales of this kind, on account of their tendency to turn yellow with age ; coloured gelatine is better.

Sensitive Plates and FUtrs.

The special feature of modern photography is the use of trustworthy ready-prepared sensitive dry plates and films in different grades of sensitiveness, sothatthereisnonecessity for the photographer to prepare his own plates, nor, indeed, could he do so with any advantage. The practice of out- door and studio photography has thus been very greatly simplified ; and although with wet collodion there was the advantage of seeing the results at once and retaking a pic- ture if necessary, the uncertainties connected with the use of the silver bath and collodion, and the amount of cum- brous apparatus necessary for preparing and developingthe plates, far outweighed any advantage. There is also an enormous saving of time, in using dry plates as compared with wet, by deferring development. On the other hand, the uncertainty of more or less random exposures on ready- prepared plates must not be overlooked. Besides their use in taking negatives, gelatine dry plates are also largely used for printing transparencies, lantern slides, enlargements, &c. For negative work the dry plates are prepared with an emulsion in gelatine of silver bromide, alone or with the addition of silver iodide or chloride, and are to be obtained in five or six degrees of rapidity : ” slow,” for photomechanical or ” process ” work; ” ordinary,” for general purposes when quick ex- posures are not required; “rapid,” for landscape and portraits; “extra rapid,” for instantaneous exposures; and ” double extra rapid,” for very quick snapshot work in dull weather or for special subjects. These latter kinds are exceedingly sensitive, and require great care in use to avoid fog. In order to prevent halation, or irregular action by reflection from the back surface of the glass, dry plates are coated with a non-actinic ” backing,” which can easily be removed before development.

The method of rendering photographic plates isochro- matic, or sensitive to all colours, by dyeing them with eosine or other suitable dyes, was noticed in the 9th edition of this work. Colour-sensitive plates of this kind are now largely manufactured and used for the reproduction of paintings, as well as for portraiture, landscapes, and all

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subjects presenting contrasts of colours which could not be satisfactorily reproduced in their relative luminosities on ordinary plates, which are insensitive to the most luminous, or yellow, rays, and still more so to the red. The manu- factured plates are of two kinds : the ordinary isochromatic, sensitive for yellow or yellow-green, and the panchromatic, which are more or less sensitive for red, orange, or yellow, as well as for the green, blue, and violet. To obtain the best results from these plates, it is necessary to use light- filters of yellow or orange glass, or glass cells containing solutions of suitable dyes or salts. For three-colour re- productions by the Sanger Shepherd, Ives, and other processes, special colour-sensitive plates and carefully selected red, green, and violet filters have to be used, and are on the market.

In order to avoid the weight of glass plates, which may become very burdensome on a tour, and also the risk of breakage of valuable records, thin films or sheets of celluloid or hardened gelatine coated with emul- sion may be used instead of glass plates, with a great saving in bulk and weight. There is, however, more liability to loss of sensitiveness in gelatino-bromide films coated on celluloid, so they should not be kept too long before exposure ; and if they have been kept, should be tested, if possible, before use, and should always be developed soon after exposure. They are generally placed in sheath, for exposure, in order to keep them flat. In other respects they are treated ex- actly in the same way as plates.

For some years past sensitive films have been prepared in long strips of different widths suitable for iTse in hand cameras, particularly of the Kodak type, and in roll- holders. In the early forms of roll-holders the films were used alone, and had to be changed in the dark room, but, as already stated, they are now supplied in cartridges, which can be changed in ordinary diffused light. Silvy, so long ago as 1870, seems to have been the first to employ this method. In these cartridges the film is attached to a much longer strip of black paper and rolled up with it, so that several turns of the paper have to be unrolled before the film is

ready for exposure, this point being marked on the outside paper and visible through a red glass at the back of the holder. The different lengths of film for the successive pictures are similarly indicated by numbers ; and when all have been exposed, the black paper is rolled on for several turns, and when taken out of the holder the loose end is fastened up till the film is developed. Paper coated with sensitive emulsions has also been used successfully in the same way as the flat or roll celluloid films, and is very much cheaper, but is more liable to change and become insensitive from the action of the air after exposure. Such films should be developed within a short time after exposure ; otherwise there is great risk of the impressed image fading and be- coming undevelopable. In order to overcome the granular appearance sometimes given by paper negatives, stripping films upon a paper support have been introduced by Messrs Wellington & Ward, in sheets or rolls. Such films have the advantage that they can be printed from either side without perceptible loss of definition, which is very useful in printing by the single transfer carbon pro- cess. Flexible films in sheets and rolls have also been prepared upon hardened gelatine, but with these it is difficult to retain the original dimensions of the film, owing to expansion of the gelatine.

Photographic Printing , Papers. â€” Pari passu with the supply of ready-prepared plates, facilities for obtaining all kinds of photographic printing papers ready for use have been made available, so that the photographer has now practically nothing to do with the preparation of his plates or papers. The most notable change in recent years is

the supersession of albuminized papers by papers coated by machinery with emulsions of silver haloids in gelatine, the chloride being used for most of the printing-out papers, which contain more or less free silver nitrate, while the bromide forms the basis of most of the developable papers used for enlarging and direct copying, which contain no free silver nitrate, and with which the image is brought out by development, much in the same way as with dry plates. Some of the printing-out papers are also made with emul- sions of silver salts in collodion. Considerable use is also made of ready-prepared platinotype paper, sensitized with salts of platinum and iron, which can be printed out

entirely or only partly printed and developed with potassic oxalate. These prints have the advantage of being per- manent, which is also shared by carbon or pigment prints (autotype, &c.), for which tissues, consisting of paper coated with pigmented gelatine, are now available in a great range of colours, as are also similar papers prepared with pigmented gum, instead of gelatine, for the practice of what is known as the ” gum bichromate ” process. For architects and engineers, cyanotype and f errogallic papers are prepared in rolls of considerable width for the direct reproduction of tracings and drawings, as blue or black prints by these methods. The manufacture of these different photographic papers has become an important industry in Europe and the United States, as well as in Great Britain.

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III. PiCTOEIAIi PhOTOGEAPHT.

Pictorial photography differs from other branches of photographic practice in the motive by which it is prompted. Employing the same methods and tools, it seeks to use photographic processes as a means of

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personal artistic expression. If a given subject or theme were rendered in the same medium by a Eobinson, a Davison, a Holland Day, and a Demachy, the results would differ as much as the respective authors' hand- writings. To trace the development during the last quarter of the 19th century of that particular phase or application of photography

which, in contradistinction to the scientific and technical, is termed pictorial, is to record in something approaching chronological order the influences which have gradually secured for it the position it now holds, rather than to notice improve- ments in methods of production, of which, indeed, its advancement is to a great extent independent. The growth of pictorial photography and the multiplication of amateur practitioners of photography generally, may be said to be synchronous. If the term ” amateur ” is taken to include those who devotedly practise for the satisfaction of their own desires rather than according to prescription and rule at the behests of another, then the two things are to be connected still more closely. At the present time, whether or not they fully understand the thing they are pursuing, by far the larger number of those in Great Britain who practise photography admit that their interest is in the pictorial side of the craft. To write the story of its progress is to show how each ad- vance has been made by those who, in the attempt to realize their own artistic ideals, have had the courage and independence to depart from the traditions and formulse laid down by those who have brought the mechanical process to a degree of perfection. The technician spends his best efforts on photography as a process, and the elimination of errors and defects is one of his chief aims ; the pictorial worker employs the process from choice, merely as a means to an end, and if he can make a ” picture ” which pleases him, he does not care whether or not, as an example of photographic work, it be of the highest modern or approved type. Thus in the early days of Fox Talbot’s calotype, about 1846, David Octavius Hill, a successful Scottish painter, took up this method of portrayal, and, guided by an artist’s knowledge and taste, and unfettered by photo- graphic convention, which indeed had then scarcely begun to grow, produced portraits which for genuine pictorial quality have perhaps never been surpassed, especially if some allowance be made for the necessary imperfections of the ” Talbotype ” (see Plate). Whether they were in their day typical examples of Talbotype with all the latest im- provements, Hill probably never cared. When, again, a few years later, Sir William J. Newton, the eminent minia- ture painter, read a paper before the newly-formed Photo- graphic Society of Great Britain (now the Royal Photographic Society), his recommendation to depart from the custom of defining everything with excessive sharp- ness caused his

address to be almost epoch-making. ” I do not conceive it to be necessary or desirable,” he said, ” for an artist to represent, or aim at, the attainment of every minute detail, but to endeavour at producing a broad and general effect. ... I do not consider that the whole of the subject should be what is called ‘ in focus ‘ ; on the contrary, I have found in many instances that the object is better obtained by the whole subject being a little out of focus.” The doctrine has been persistently repeated ever since, but only within the last decade of the 10th century was the suppression or diffusion of focus received by photographers generally with any thing better than ridicule or contempt, because it was unorthodox. 0. G. Rejlander, Mrs Julia Margaret Cameron, H. P. Robinson, and others, by precept or practice, strove against such photographic conventions as had arisen out of those technical exigencies to which pictorial qualities were so often sacrificed. As late as 1868, in the Manual of Photographic Manipulation,

by Lake Price, the old advice to arrange a group of per- sons in crescent form, so as to adapt the subject to the curve of the field of the lens, was repeated, with the addi- tional recommendation of plotting out on the ground beforehand the ” curve of the focus ” as a guide. As a defiance to this dictum, Rejlander, in 1869, produced a group of the members of the Solar Club in which some of the chief figures were set widely out of the ” curve of the focus.” The mere technical difficulties of this per- formance with wet collodion plates, and in an ordinary upper room, need not be touched upon here, but it is to be noted as one of those triumphant departures from con- vention which have marked the progressive stages of pictorial photography. At about the same period, Mrs Cameron, carrying the recommendation of ” a little out of focus” rather farther, regardless of how her lens was intended to be used by its maker, secui-ed the rendering dictated by her own taste and judgment, with the result that many of her p)ortraits, such as those of Tennyson, Carlyle, &c., are still in their way unsurpassed. Con- temporaneously, Adam Salomon, a talented sculptor, ” sunned ” down the too garish lights of his photographic prints, and strengthened the high lights by working on the back of the negative.

But, during the concluding quarter of the 19th century, probably the most powerful influence in pictorial photo- graphy was that of H. P. Robinson, who died in February 1901, and, but for a brief period about the year 1875, was one of the most prolific "picture makers." Inspired by Rejlander, of whom he was a contemporary, Robinson will perhaps be best remembered by his early advocacy of com- bination-printing. As early as 1856 Berwick and Annan exhibited a photograph which was the result of printing from more than one negative, a figure from one plate being cunningly introduced into a landscape print from another. Then came from Rejlander " The Two Ways of Life," in which, with wonderful ingenuity, thirty different negatives were combined. Robinson followed, and between 1858 and 1887 exhibited numerous examples of combination-print- ing, one of the most popular and fairly typical examples being " Carolling " (see Plate), which received a medal in the Exhibition of the Royal Photographic Society in 1887.

Though in this combination-printing one may perhaps perceive the germ of incentive towards the production of special effects not seen in the original, j-et the practice was not destined to become very popular, for even in the most capable hands there remains the difficulty, if not impossi- bility, of fitting a portion of one negative into a print from another and still preserving true relative tonality, and even true proportion. Skilfully produced, eminently popular in character though "Carolling" may be, such errors are not absent. Of this combination-printing Dr P. H. Emerson has said : " Cloud printing is the simplest form of combination-printing, and the only one admissible when we are considering artistic work. Rejlander, how- ever, in the early days of photography, tried to make pictures by combination-printing. This process is really what many of us practised in the nursery, that is, cutting out figures and pasting them into white spaces left for that purpose in the picture-book. With all the care in the world the very best artist living could not do this satisfactorily. Nature is so subtle that it is impossible to do this sort of patchwork and represent her. Even if the greater truths be registered, the lesser truths, still import- ant, cannot be obtained, and the softness of outline is easily lost. Tlie

relation of the figure to the landscape can never be truly represented in this manner, for all subtle modelling of the contour of the figure is lost."

Pictorial photography received a large accession of votaries in consequence of the greater facilities offered by the introduction of the gelatino-bromide, or dry-plate, pro-

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cess, which, although dating from 1880, did not notably affect photographic communities until some years after- wards ; and although impEovement in appliances and instruments has had little to do with the advance of the pictorial side of photography, yet, indirectly at least, the dry-plate and the platinotype printing process have had an undoubted effect. The former gave enormously in- creased facility, and dispensed with tedious manipula- tions and chemical knowledge, while its increased light- sensitiveness decreased the limitations as to subjects and effects. The platinotype process was discovered in 1874-80, by W. Willis, who employed his chemical skill and knowledge to give the world a printing process more likely than the hitherto prevalent silver papers to satisfy artistic requirements.

Up to 1882 but few outdoor photographers had ventured to run counter to the general dictum that photographs should only be taken during sunshine, or good bright light, and unquestioning consent would have been given everywhere to the proposition that it would be absurd to work when anything like fog or atmospheric haze was present. Isochromatic plates, introduced for the purpose of equalizing the actinic power of various colour luminosi- ties, and so rendering colours in correct relative value, were recommended by one writer, who applauded their supposed advantage of enabling the photographer to photograph distance without any suggestion of atmo- sphere. That evening or morning haze might enhance the beauty of a landscape, or that the mystery of half- concealment might itself be beautiful, does not seem to have occurred to the photographer, who had become in- fatuated by the exquisite clearness and sharpness which, with a minimum of labour, he was able to achieve. It is therefore interesting to note one of the first photographic successes which broke away from this convention, just as Eejlander’s Solar Club group defied the

formula of arrang- ing human figures like the tiers of an amphitheatre. William M'Leish, of Darlington, a Scottish gardener who had taken to photograpby, and who seems to have been less under the influence, or it may have been that he was ignorant, of the old dicta, sent to the Eoyal Photographic Society's Exhibition in 1882 a photograph entitled "Misty Morning on the Wear," a very beautiful view of Durham Cathedral as seen through the mist from across the river. The judges, although they that year awarded eleven medals, passed this by ; but appreciation came from out- side, for newspaper critics, and practically all those who were not blinded by prejudice and conventionality, de- clared it to be the photograph of the year. Thenceforward the landscape photographer cast aside the old doctrine, a.nd began to learn that there was such a thing as atmo- sphere, and that it was not undesirable even when envel- oping the chief features in the view. The exhibitions immediately succeeding revealed numerous imitators of M'Leish, and both figure and landscape work began to be shown in which there was evidence of greater freedom and originality.

Meanwhile the Photographic Society of Great Britain had drifted away from its artistic starting-point, and bad become chiefly absorbed in purely scientific and technical subjects. But the general apathy which existed in respect of the artistic aspirations of some workers was the forerunner of a period of renaissance which was to end in lifting the pictorial side of photography into a greatly improved position. In 1886 Dr P. H. Emerson read before the Camera Club a paper on "Naturalistic Photo- graphy," which served as an introduction to the publica- tion (1887) of his book under that title. Unquestionably this book struck a powerful blow at the many convention- alities which had grown up in the practice of photography, the chief doctrines set forth being the differentiation of

focus in different planes, a more complete recognition and truer rendering of " tone," a kind of truthful impression- ism derived from a close study and general acquaintance of nature, and a generally higher and more intellectual standard. After the. publication of a second edition in 1889, Dr Emerson publicly renounced the views he had published, by issuing in January of 1891 a bitterly- worded, black-

bordered pamphlet, entitled T7ie Death of Naturalistic Photography. But the thoughts which the book had stirred were not to be stilled by its withdrawal. Towards the end of the same year the conflict which within the Photographic Society had become apparent as between the pictorial enthusiasts and the older school, culminated in connexion with some matters respecting the hanging of certain photographs at the exhibition of that year, and a number of prominent members resigned their membership as a protest against the lack of sympa- thy and the insufficient manner in which pictorial work was represented and encouraged. This secession was to prove the most important event in the history of that branch of photography. The secessionists being among the most popular contributors to the annual exhibition, gathered round them numerous sympathizers. In the following year they formed themselves into a brother- hood called ” The Linked Ring,” and in 1893 held their first “Photographic Salon,” at the Dudley Gallery, Picca^ dilly. This has since been held annually, exclusively for the public exhibition of such photographs as in the opinion of the responsible committee give evidence of personal artistic feeling. The most noteworthy of the early adherents attracted to the new body was James Craig Annan, whose work was practically unknown until he exhibited it at the first Salon, and almost at once he, by general consent, took a ‘position amongst pictorial photographers second to none (see Plate).

Aroused into greater activity by these events, the Royal Photographic Society began to pay more attention to what had now become the more popular phase. At sub- sequent exhibitions the technical and scientific work was hung separately from the ” Art Section,” and a separate set of judges was elected for each section. It becEtme the custom to allot by far the greater amount of space to the “artistic”; and later, artists were elected as judges, by way of encouraging those who were devoted to the picto- rial side to send in for exhibition. In the autumn of 1900 the New Gallery was secured, and a comprehensive exhibition of all phases of photography was held ; and the experiment proving successful, it was repeated in the following year.

It is interesting to note that as a distinct movement pictorial photography is essentially of British origin, and this is shown by the very gratifying manner in which organized photographic bodies in Vienna, Brussels, Paris, St Petersburg, Florence, and other European cities, as well as in Philadelphia, Chicago, &c., following the ex- ample of London, have held exhibitions on exactly simi- lar lines to those of the London Photographic Salon, and have invited known British exhibitors to contribute. The international character of the "Linked Ring" encouraged an interchange of works between British and foreign exhibitors, with the result that the productions of certain French, Austrian, and American photogi-aphers are per- fectly familiar in Great Britain. This, in the year 1900, led to a very remarkable cult calling itself " The New American School," which has been very widely exploited in England. The prints have a certain generic similarity, but are the work of some forty or fifty photographers in the United States of America. In their total: disregard of the qualities which even the least conventional person is accustomed to expect in a photograph, the extreme seems to have been reached, and this, moreover, in the

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nature of the subjects chosen, as well as in the composition adopted. It is a question whether, in the suppression of detail, in the toning down of contrasts, and in the attempt to invest the photographic "picture" with amystery that may appeal to the spectator by mere suggestion rather than by representation, some of the American works contain sufficient to inspire imagination. Never- theless, the intense earnestness and serious purpose which pervade the whole as a class, command respect. Moreover, if the doctrine of the " artist-photographer " be true, there are present in the " New American School " the very conditions which should lead it to mark a period and an advance. Many of its members are trained painters and successful art students, who have taken up

photography not as an aid to art work, but as an independent means of possible artistic expression ; as a consequence, they have employed photographic means with entire indifference to the instructions of the chemist and the rules of the technical expert. That the ” New American School ” has had a powerful influ- ence on contemporaries in Great Britain there are already clear indications.

In this review of the principal successive influences which have been brought to bear upon and have built up the pictorial photography of to-day, we have now reached the close of the 19tli century, and it may be well to glance at such improvements of process or apparatus as have not been direct and essential means to pictorial advance, but rather modifications and improvements made in response to the requirements of the artistic aspirant. Such improvements are of two orders â€” those which are devised with the aim of securing greater accuracy of delineation, the correction of distortion and of apparent exaggeration of perspective, and the more truthful render- ing of relative values and tones ; and those which seek to give the operator greater personal control over the finished result. While during the past few years great advances have been made in photographic optics, it cannot be said that pictorial work has been thereby materially assisted, some of the most successful exponents preferring to use the simplest form of uncorrected objective, or even to dispense with the lens altogether, choosing rather to employ a minute aperture, technically called a “pinhole.” This is but one example of many which might be quoted to bear out the statement, that in photography the advance of anything in the nature of artistic qualities has not been correlative with mechanical improvements. The hand camera can only be said to have had an indirect influence : it has increased the photographer’s facilities, and by removing the encumbrance of heavy tools has widened his sphere of operations : but it is perhaps in connexion with the plates and printing processes that more direct advantages have been gained. The fact that the actinic power of colours is not proportional to their luminosity, was long regretted as an obstacle to correct representation, but by the introduction of orthochromatic or isochromatic plates in 1886 (when B. J. Edwards bought the Tailfer and Clayton patent, under which he shortly brought out his orthochromatic plates) this original disability

was removed, while with increased rapidity in the isochromatic plate colour values may still further be corrected by the use of coloured screens or light filters, without interfering with the practicability of making suflдciently rapid exposures for most subjects. Again, by a better knowledge of what is required in artistic representation, certain modifications in the formulated treatment of ordinary and uncorrected plates are found to do much towards removing the evil; hence, with an ordinary plate "backed" so as to counteract over-exy)osure of the higher lights, an exposure may, except in extreme cases, be given of length sufficient to secure the feeble rays of the less actinic colours, and by subsequent

suitable development a result hardly distinguishable from that of a colour-corrected plate may be secured. Chemical experiment has placed in the photographer's hands im- proved and easier means of entire, unequal, and local intensification and reduction, but utility of these is re- stricted. By the artistic worker it is claimed that the lens and camera are but the tools, and the negative the preliminary sketch or study, the final print standing to him in the same relation as the finished painting does to the artist. In the production of the print various means of personally controlling the formation of the image have been resorted to. Thus the local development of platino- type by means of glycerine has its champions, but it seems to have been little used, its resuscitation being chiefly due to^two or three prominent workers in New York. Here should also be mentioned the revival in 1898 of rough-surface printing papers, chiefly those sensitized with silver, the roughest texture drawing papers being employed to break up the excessive sharpness of the photo- graphicimage, and by the superficial inequalities introduc- ing the effect of luminousness to over-dark shadows and variety to blank whites. The almost forgotten process of Pouncy, and of Poitevin, now known as the gum bichro- mate process, was rehabilitated in 1894 by M. Eouille Ladeveze expressly to meet the needs of the pictorial worker. Perhaps the best results that have been achieved by it are those of M. Robert Demachy of Paris, though many English workers have used it with remarkable success. In it paper of any kind may be selected as the support. The power of the oijerator to modify the printed image to almost any extent, even to

introducing and eliminating lights and shadows, and in other ways to depart widely from the image given by the negative, depends upon the fact that the coating of gum and pigment (which, being bichromatized, becomes insoluble in proportion as it is acted upon by light) holds the pigment but imperfectly, and yields it up upon a vigorous application of water. According, therefore, to its application or retention, the operator can lighten or deepen in tone any portion. Numberless variations of other methods, such as brush development and local toning or stopping, have been suggested with the same object. Other workers have shown that by dexterously shutting off and admitting the light to various parts of the negative whilst printing, the disposition of the lights and shades in the print can be modified to so great an extent as to alter the general contour of the scene. Examples of an original unaltered print, and one which has been thus modified, are shown in the accompanying Plate. Portions are shaded in by allowing the light to have access to the print, either through the negative â€" in which case the image,with all its details, prints more deeply â€" or by removing the negative, when the action of the light is to flatten and suppress both detail and contrast. Such a course opens up innumerable possibilities whereby contrasts may be intensified, shadows made light, and light areas shaded down. Latterly some few have resorted to extensive working on the negative, both on the back and on the film ; drawing by hand is practised on the film to render too prominent features less obtrusive, and objects in the background are merged by an intricacy of lines and cross-hatching. Many of the results are very pleasing, although one hesitates to justify the means, however good the end. On the other hand, to exclaim for purity of method and the exclusion of extraneous aids is very like setting up an arbitrary standard no less unreasonable than those conventions against which pictorial photography has so long striven.

Adthorities.â€" P. H. Emeksox. Xainmlistic Photography. â€"H.P.Robinson. Picture-malting hy Photography; Art Photo- graphy; Pictorial Effect in Photography; Elements of a Pictorial Photograph.â€" A. H. Wall. Artistic Landscape Photography,

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1896. â€” H. HoRSLEY HiNTON. Practical Pictorial Photography, 1898, and subsequent editions. â€” C. Puyo. Notes sur la Photo- graphic Artistique, Paris. (*4* jj__jj \

Photogravure. See Process; also Engeaving (JNIezzotint).

Photometry, Stellar.â€” In the earlier volumes (ninth edition) of this Encyclopeedia was an article on Photometry, Celestial, which gives an adequate sketch of the history of stellar photometry down to about 1885. The three modern forms of instrument for measuring the visual brightnesses of the stars, there briefly described, may be called Zollner's photometer, Pickering's meridian photometer, and Pritchard's wedge photometer. It is mentioned in a footnote that extensive catalogues of stellar brightnesses or "magnitudes" had just been pub- lished by Professor E. C. Pickering of Harvard, using the second of the above instruments, and by Professor Pritchard of Oxford, using the third ; but as regards the first form it is stated in the text that " this ingenious form of photometer has enjoyed considerable reputation, but no astronomer has yet persevered in producing a complete ' uranometria ' by its aid." This omission has since been repaired by the labours of the late E. Lindemann of the Pulkowa Observatory (Photometrische Bestimmung der Grossenclassen der Bonner Durchmusterung. St Peters- burg, 1889), and by a more extended work at the Potsdam Observatory by Mtlller and Kempf (see Public. Potsdam Observ., vols. ix. and xiii.). No mention is made in the article of photographic photometry, for the reason that such work had at that time scarcely been begun, or at any rate had attracted very little attention. There is also a third method by which a star's radiance may be assessed, by measuring the amount of heat, or more properly, energy, which it conveys ; and though the delicate apparatus of Mr C. V. Boys (Proc. Boy. Soc. April 1890) has furnished \is so far with a negative result, even this is of consider- able importance. In the present supplementary article it is proposed to describe rather more fully the three visual photometers mentioned above, to summarize what has been done in photographic photometry and with the " radio-

micrometer," and to give a brief discussion of the effect of " colour" on all such determinations.

Pickering's meridian photometer (see Ann. Astron. Ohs. Harv., vols. xiv. and xxiii.) consists of two telescopes placed side by side pointing due east, the light from stars on the meridian Pickering's ijging reflected into them by two mirrors inclined at an merldlaa angle of 45Â° to this direction. If there were a star photo- exactly at the Pole, one of these mirrors would be

"" *'â– absolutely fixed and would constantly reflect the light

of this star down the axis of its telescope ; in practice a slight motion can be given to the mirror so as to keep in view the polar star selected, whether Polaris, with which the brighter stars were compared, or X Ursae Minoris, which was used for fainter stars. The second mirror (which projects a little beyond the first so as to get an unobstructed view of the meridian) can be rotated round the axis of the telescope by means of a toothed-wheel gearing, and can thus be made to reflect any star on the meridian down the second telescope ; it is also provided with a small motion in the perpendicular direction, so as to command a degree or two on each side of the meridian. Near the common eyepiece of the telescopes there is a double image prism which separates the light received from each into two pencils ; the pencil of ordinary rays from one object-glass is made to coincide with that of extraordi- nary rays from the other, and the two remaining pencils are excluded by a stop. The two coincident pencils then pass through a Niool prism to the eye of the observer, who by rotating the prism round its axis can equalize them at a definite reading depending on their relative intensities. This reading gives in fact the difference of magnitude between the two stars selected for comparison. It may be remarked that the position of the double image prism is important. It should be just within, not at, the common focus : this position prevents any noticeable colour in the imao'es, and gives the ordinary and extraordinary pencils a sufiicient separation at the eye-stop to permit the entire exclusion of one without the loss of any part of the other. If the prism were exactly at the focus, and any part of the superfluous images

were admitted, the resulting secondary images would coincide with the others and thus lead to errors in observing. But in the actual construction of the instrument the secondary images would appear, if at all, only as additional stars near those under observa- tion, and too faint to produce any inconvenience. It is worthy of note that Professor Pickering has extended his survey into the southern hemisphere, so that the Harvard photometry is the most complete of all. Each observation consists of four com- parisons ; after the first two the observer reverses the position of the star images in the field, and also reverses the double-image prism. The former precaution is necessary in order to eliminate a curious error depending on the relative position of the images, which may amount to several tenths of a magnitude. Errors of this kind affect all estimations of the relative brightness of two stars in the same field, as has been repeatedly shown ; a striking instance is given by Mr A. W. Roberta of Lovedale, South Africa (Mon. Not. B.A.S., April 1897), who found that his eye-estimations of the brightness of variable stars required a correction depending on the position-angle of the comparison star ranging over nearly two magnitudes.

In Zollner's instrument an artificial star is taken as the standard of comparison. There is only one telescope, and inside the tube near the eye end is a plate of glass placed at an angle ^

of 45Â° with the axis, so that the rays from a lamp which ^ollaer s enter the tube from the side are reflected down the tube Â° to the eyepiece, while the light from the star passes through the plate unobstructed. The lamplight passes through a Nicol prism and a plate of rock crystal, which give control over the colour ; through two Nicols which can be rotated round the axis of the beam to definite positions read off on a graduated circle ; and then through a convex lens which forms an image reflected by the glass plate to focus alongside the star. The whole of this apparatus is carried in a compact form on the eye end of the telescope, it being arranged that the lamp shall always stand upright. The measures are made by rotating the Nicols until the brightness of the artificial star is equal to that of the star viewed through the object-glass, and reading the graduated circle.

With regard to Pritchard's wedge photometer, the principle of which was sufiiciently described in the Ency. Srit., vol. xviii. p. 841, two material improvements suggested by Dr E. J. Spitta are worthy of notice. The first (^Proc. Roy. Soc, * Dec. 1889) corrects a slight defect in the form of the "^ f t instrument. If a pencil of rays passes through a thin ^eier. wedge of tinted glass, the rays do not all pass through the same thickness of glass. Dr Spitta proposes to substitute a pair of wedges with their thicknesses increasing in opposite directions. By sliding one over the other we obtain a parallel plate of glass of varying thickness, and a uniform beam of light of sensible dimensions can then be extinguished satisfactorily. He has also pointed out a source of error in the method of "evaluating" the wedge and shown how to correct it. The scale value was deter- mined by Professor Pritchard by the use of a doubly refracting prism of quartz and a Nicol prism. Using this method subsequently, Dr Spitta found that internal reflections within the Nicol prism interfered with the accuracy of the result, but that this error could be eliminated by using a suitable diaphragm (see Mon. Not. B.A. S. , March 1890 ; Abney, Ibid., June 1890).

Since 1885 systematic catalogues of stellar brightness have been constructed with all these instruments, and it has been of great interest to compare the results. . The comparison has in general shown a satis- Purkinje factory agreement, but there are small differ- pbeao- ences which are almost certainly systematic, 4ue '"enon. to the difference of method and instrument. One cause of such differences, the reality of which is undoubted, but the effects of which have as yet not been perhaps fully worked out, is the "Purkinje phenomenon" (PflUger's Archil', vol. Ixx. p. 297, and Psycliol. Rev., vols. v. and vi.). If a blue source of light and a red source appear equally bright to the eye, and if the intensity of each be diminished in the same ratio, they will no longer appear equally bright, the blue now appearing the brighter ; in more general terms, the equalizing of two differently coloured lights by the eye depends upon their intensity. It is clear that this phenomenon must affect all photo- metric work unless the stars are all exactly of the same colour, which we know they are not. Eor let us suppose that both the comparison star of the meridian photometer and the artificial star

of the Zollner photometer were equalized with a bright star A, and that they could be

also compared inter se and found equally bright. Then when a faint star B comes under observation and the intensities of the comparison stars are both reduced to equality with B, they will no longer appear equal to one another unless they are exactly the same in colour. In other words, the observed ratio of intensities of A and B will vary with the colour of the comparison star, and similarly it will also vary with the aperture of the tele- scope employed. To allow for this variation by direct observation would entail a large amount of work which is yet to be undertaken â€" the exact evaluation of the colours of stars (or at least of the comparison stars) and the effect on the eye with different intensities. It is not impossible to undertake such a detailed investigation, and so calculate the differences between the two methods, but it would be extremely laborious, and we rather look to observed differences between the results to indicate the magnitude of these effects, the general nature of which is well understood.

One complete set of numerical results has, however, been obtained by Sir W. Abney (Proc. Boy. Soc, May 1891, and Mo7i. Not. B.A.S., April 1892), viz., the limit- ing intensity at which each pure colour vanishes. If we start with lights C D E T G of the colours usually denoted by these letters in the spectrum, and each so bright that it appears to the eye as bright as an amyl-acetate lamp at 1 foot, and if then the intensity of each be gradually diminished, the C light will disappear when the original intensity has been reduced to 22,000 ten-millionths of the original value. The other colours will disappear at the following intensities, all expressed in ten-millionths of the original : D at 350, E at 35, E at 17, and G at 15. If then we had a mixture of two lights, one of C colour as bright as before, and the other of G colour 1000 times fainter (a combination in which the eye would be unable to distinguish the G light at all), and if we continually reduced the combined intensity, the luminosity of the C light would diminish so much more rapidly than

that of the G that the latter would begin to assert itself, and when the combined intensities were reduced to 22,000 ten-millionths of the original value, the C light would have all disappeared, while the G light would not. Hence the colour of the light would appear pure violet, though it was originally deep red. This extreme case shows that the ” last ray to disappear ” when a light is grad- ually extinguished may be very different in colour from that of the original light, and when more usual light- mixtures are considered, such as those of sunlight and starlight, which appear nearly white to the eye, the ” last ray to disappear ” is found to be in the green, very near E in the spectrum. This result has two important bearings on the use of the wedge photometer. In the first place, either the wedge itself should be of a green- ish hue, or green light should be used in finding the scale-value (the constant B in the formula m = A+ Bw). In the second, star magnitudes obtained by extinction with the wedge will agree better with those obtained by photo- graphy than those obtained with other visual photometers, since photographic action is chiefly produced by rays from E to G in the spectrum, and the E light of ultimate importance with the wedge photometer is nearer this light in character than the D light with which other photo- meters are chiefly concerned. It would also appear that results obtained with the wedge photometer are inde- pendent of the aperture of telescope employed, which is not the case with other photometers.

Passing now to the consideration of photographic methods, it is found that when a plate is exposed to the stars, the images of the brighter stars are larger and blacker than those of the fainter ones, and as the exposure is prolonged the increase in size and blackness

continues. Much of the light is brought to an accuratei focus, but, owing to the impossibility of perfect achro- matism in the case of refractors, and to uncor- rected aberration, diffraction, and possibly a graphic slight diffusion in both refractors and reflectors, photo- there are rays which do not come to accurate Â«‘eto’. focus, grouped in rings of intensity gradually diminishing outwards from the focus. As the brightness of the star increases, or as the time of exposure is prolonged, outer and fainter rings make their impression on the plate, while the

impression on the inner rings becomes deeper. Hence the increase in both diameter and blackness of the star discs. As these increase concurrently, we can estimate the magnitude of the star by noting either the increase in diameter or in blackness, or in both. There is conse- quently a variety in the methods proposed for determining star magnitudes by photography. But before considering these different methods, there is one point affecting them all which is of fundamental importance. In photography a new variable comes in which does not affect eye-observa- tions, viz., the time of exposure, and it is necessary to consider how to make due allowance for it. There is a simple law which is true in the case of bright lights and rapid plates, that by doubling the exposure the same photographic effect is produced as by increasing the inten- sity of a source of light twofold, and so far as this law holds it gives us a simple method of comparing magnitudes. Unfortunately this law breaks down for faint lights. Sir W. Abney, who had been a vigorous advocate for the com- plete accuracy of this law up till 1893, in that year read a paper to the Eoyal Society on the failure of the law, finding that it fails when exposures to an amyl-acetate lamp at 1 foot are reduced to 0?~~001, and " signally fails" for feeble intensities of light ; indeed, it seems possible that there is a limiting intensity beyond which no length of exposure would produce any sensible effect. This was bad news for astronomers who have to deal with faint lights, for a simple law of this kind would have been of great value in the complex department of photo~~ metry. It is satisfactory to know that the law holds in certain important cases. The Astronomer Royal found in 1892 {Mon. Not. R.A.S., January 1892) that it was sensibly correct for stars to the eleventh magnitude pho- tographed according to the methods adopted for the International Astrographic Chart, although Dr Scheiner of Potsdam had previously found a very serious deviation in a similar case. Just where it begins to fail seems to be dependent on a variety of circumstances. Sir W. Abney has remarked that it is important not to use bromide plates, for instance, and there is no doubt that caution must be exercised in applying the law to the faintest star images on a plate â€" those just discernible as discolorations of the film. But with plenty of light {i.e., a large telescope) and a rapid plate we should be able to compare the magnitudes of two stars by the ratio of the exposures required to give similar images both in size and blackness. If

the approximate ratio is known, we may obtain the exact ratio by varying the exposure of one star slightly, and noting which of the series most closely resembles the other star.

But there are many cases where it is inconvenient to give more than one exposure to a field of stars, and the question arises how to compare their magnitudes from their size or (and) blackness on a photo-Diameter graphic plate. The easiest quantity to measure magnuJde. is the diameter of the image, and when measure- ments of position are being made with a micrometer, it is a simple matter to record the diameter as well, in spite of the indefiniteness of the border. Accordingly we find that various laws have been proposed for representing the magnitude of a star by the diameter of its image, though

these have usually been expressed, as a preliminary, as relations between the diameter and time of exposure. Thus Bond found the diameter to increase as the square of the exposure. Turner as the cube, Pritchard as the fourth power, while Christie has found the law that the diameter varies as the square of the logarithm of the exposure within certain limits. There is clearly no universal law â€" it varies with the instrument and the plate â€" but for a given instrument and plate an empirical law may be deduced. Or, without deducing any law at all, a series of images may be produced of stars of known brightness and known exposures, and, using this as a scale of reference, the magnitudes of other images may be inferred by interpolation. A most im- portant piece of systematic work has been carried out by the measurement of diameters in the Cape Photo- graphic Durchmusterung (Ann. Cape Obser., vols. iii. and iv.) of stars to the tenth magnitude in the southern hemisphere. The measurements were made by Professor Kapteyn of Groningen, on photographs taken at the Cape of Good Hope Observatory ; he adopts as his purely empirical formula

B ‘^“diameter -|-C

where B and C are obtained independently for every plate, from comparison with visual magnitudes. C varies from 10 to 28, and B from 90 to 260. The part of the sky photographed was found to have an important bearing on the value of these constants, and it was in the course of this work that Kapteyn found a systematic difference between stars near the Milky Way and those far from it, which may be briefly expressed in the law, the stars of the Milky Way are in general bluer than the stars in other regions of the sky. It is intended, however, in the present article to discuss methods rather than results, and we cannot here further notice this most interesting discovery.

Of methods which choose the blackness of the image rather than the diameter for measurement, the most inter- esting is that initiated independently by Pioker- ‘toctts”” ing at Harvard and Schwarzschild at Vienna, which consists in taking star images considerably out of focus. The result is that these images no longer vary appreciably in size, but only in blackness or density ; and that this gradation of density is recognizable through a wide range of magnitudes. On a plate taken in good focus in the ordinary way there is a gradation of the same kind for the faintest stars ; the smallest images are all of approximately the same size, but vary in tone from grey to black. But once the image becomes black it increases in size, and the change in density is not easy to follow. The images-out-of-focus method seems very promising, to judge by the published results of Dr Schwarzschild, who used a prepared comparison scale of densities, and inter- polated for any given star from it. The most satisfactory photographic method would certainly be to take account of both size and blackness, i.e., to measure the total deposit in the film; as, for instance, by interposing the whole image in a given beam of light, and measuring the diminu- tion of the beam caused by the obstruction. But no con- siderable piece of work has as yet been attempted on these lines.

Although rather outside the domain of photometry, strictly so called, a word or two may be said here about the ” radio-micrometer ” of Mr C. V. Boys. No heat This is an extremely delicate instrument for stere. *

measuring radiant heat, which consists of a very light thermo-electric circuit (two tiny bars of antimony and bismuth soldered together at one edge, the outer edges being connected by a hoop of copper wire)

suspended by a quartz fibre (a torsion fibre of the very greatest sensitiveness) in a strong magnetic field. A minute quantity of radiant heat falling on one of the junctions of the circuit sets up a current in the circuit, which thus rotates in the magnetic field until brought to rest by the torsion of the fibre. For use on the heavenly bodies the radiant heat is collected to focus by a reflecting telescope (an object-glass would absorb it), and when the telescope is pointed to the moon the varying radiation from different parts of the disc is beautifully shown. No heat comes from the unlit portion, and of the illuminated portion the maximum is obtained from near the limb. But when pointed to the brightest stars no indications are obtained, although the instrument is sensitive enough to detect the heat from a candle more than a mile ofi'. It seems certain that indications of heat from the stars obtained by previous observers must be spurious. We may place alongside this result that obtained by Mr W. J. Dibdin (Proa. Boy. Soc, April 1892), who compared candle- light with twenty-one stars ranging to the sixth magnitude, and found the light of a second magnitude star equal to that of -0076 of a candle at 109 feet, or of a whole candle at 1260 feet.

The whole domain of stellar photometry has increased in importance and in activity so rapidly since 1885 that much has necessarily been omitted in this sketch. As an instance of new applications of its methods, we may quote the systematic observations of the eclipses of Jupiter's satellites by Pickering at Harvard. Instead of merely noting the instant of disappearance or reappear- ance of the satellite, he has organized a regular series of measurements of the diminution of its light, both by visual and photographic observations. The result has been to determine the moment of disappearance with greatly increased accuracy ; some of the observations were placed in the hands of Prof. Sampson of Durham, who is of opinion that they will afford suSicient material for forming new and improved tables of Jupiter's satellites. The photometric work done at the Harvard Observatory alone since 1885 probably far exceeds all that was done previously. As an instance

again of the novelty of results now being obtained, attention may be called to the fact, discovered also at Harvard, that in certain clusters there are numerous variable stars. In the cluster M5, for instance, Mr S. I. Bailey finds that about eighty-five stars are variable, and that their variations show a striking similarity (Astrophys. Jotirn., November 1899). Each goes through its cycle in about twelve hours ; each begins by a gradual diminution of light, remains at half bright- ness for a time, and then suddenly springs back to maximum again. We seem to be only beginning to under- stand the vast scope of photometric work.

(h. h. T.)

Phrenology. â€” Gall's great work on phrenology (see the earlier volumes of this Encyclopeedia, ninth ed.) contains a very considerable number of clinical and patho- logical observations that are of some value, though his deductive reasoning has failed to stand the test of time ; and an attempt has lately been made to bring phrenology back into good repute, and to show that Gall's doctrines are confirmed by the modern physiological and patho- logical facts concerning cerebral localization. This attempt to advance phrenology to the level of the natural sciences may be studied in the volume published in 1901 by Dr Bernard Hollander, entitled Tlie Mental Functions of the Brain, and bearing as a sub-title Tlie Revival of Phrenology. Two chief doctrines are involved in the acceptance of phrenology, in the ordinary sense of the word. They are : i. That the outer table of the skull is so finely and accurately modelled to the surface of

the brain that it is an exact copy of that surface, ii. That the grey matter on the surface of the brain is divided into thirty or more departmental regions, corresponding to certain universal habits, passions, propensities, and the like activities of consciousness. The first of these doctrines, the old belief in craniology and in " bumps," is lightly passed over by Dr Hollander. It stands in the â– wa,j of every attempt to make phrenology an exact science. The varying thicknesses

of different skulls, and of the same skull in its different parts, the existence of air- spaces in the frontal bone, and the mere features of tlie skull, which may fairly be called matters of chance, offer a fatal objection to popular phrenology ; and Dr Hol- lander's purpose is not, primarily, to uphold popular phrenology, but to bring Gall's clinical and pathological instances into line with more modern observations. He deprecates the craniology of Gall, and honours him, with justice, as an admirable and dexterous anatomist; he calls attention to many carefully recorded clinical and pathological facts that are scattered through Gall's writings and are worth saving out of the wreck of his system ; and he endeavours, by this method, to establish an unbroken connexion between phrenology, in the Greek sense, and our present knowledge of cerebral localization.

The substance of Hollander's work is of two kinds. The one kind is a tabulated statement of many hundred cases of different forms of mania, with injury or disease limited to one portion of the brain ; the otlier kind is a tabulated statement of cases of injury or disease of the brain, followed by perversion, or exaltation, or loss of some definite instinct or faculty of consciousness.

He divides the tabulated cases of mania into three groups : i. Melancholia; ii. Irascible Insanity, " Mania Furiosa"; iii. Mania with suspicion and delusions of persecution. For these three groups of cases he lays down the following rules ; i. Melancholia is especially associated with injury or disease of the parietal lobe of the brain, more particularly with injury or disease of the convolu- tions underlying the parietal eminences of the skull, i.e., the supramarginal and angular convolutions. ii. Mania Furiosa is especially associated with injury or disease of the central portion of the temporal lobe. iii. Mania with suspicion and delusions of persecution is especially associated with injury or disease of the posterior portion of the temporal lobe.

The second kind of cases, where injury or disease of the brain, strictly localized to one part or another of its grey matter, was followed by perversion, exaltation, or loss of some one instinct, habit, or faculty, includes cases of kleptomania, cases of voracious hunger and thirst,

cases of sexual desire exalted or lost, and cases of loss of certain special memories, as of words, tunes, numbers, and the like.

These two collections of recorded cases, taken from a vast mass of clinical and pathological literature acciimulated during the past century, have been arranged by Dr Hollander with great industry ; and they clearly express his purpose to ‘extend the limits of the study of cerebral localization, and to advance it from the observa- tion of the motor areas and the special sense centres to the observa^ tion of the higher acts and states of consciousness. This, we may be sure, is the tendency of all modern researches into the working of the central nervous system : to geek a higher level of inter- pretation, and a statement of the departmental life of the brain in terms of ever-increasing complexity. Physiology, from its objective point of view, is engaged over finer and finer issues of microscopic and experimental work ; and, from its subjective point of view, is becoming more and more psychological. The motor centres, governing the voluntary purposeful movements of the body, are not simply motor, but ” psycho-motor ” ; the speech-centres are not homogeneous, but are differentiated into sub-centres for the utter- ance of words, the recognition of words, and the understanding of words ; the visual centres are in like manner subdivided according to the consciousness involved in the complete act of vision. There is room, therefore, for a “higher phrenology,” if it can show clear evidence in favour of the localization, in determinate regions of the brain, of the physical changes accompanying certain states of consciousness.

Of the two kinds of cases that Dr Hollander has tabulated, it cannot be said that the cases of mania are convincing. Some of them are altogether beside the mark ; e.g., he quotes two oases of melancholia, after an injury over the left parietal bone, wliich were cured by an operation limited to the scalp (excision of a painful scar, removal of a small nerve-tumour of the scalp); in neither case was anything done to the skull or to the brain, but Iwth patients were cured of their melancholy. Again, the acceptance

of these rules as to the localization of these insane thoughts in- volves the localization of sane thoughts in the same areas of the brain, and this in turn involves assumptions that are wholly un- warranted by our present knowledge. Moreover, cases of mania are so common that it might be possible to find an equal number of cases to controvert his rules: we want consecutive, not picked cases. If 5000 consecutive fatal cases of these different kinds of mania, with the post-mortem record of each case, were tabulated, we should then begin to stand on surer ground. Again, though Dr Hollander seems to argue well, where he says that the facial and other movements, induced by direct electrical stimulation of certain convolutions, are such as express the mental states which he attributes to those convolutions, yet this argument is insecure, partly because Sherrington's recent work, on the motor area of the anthropoid apes, has rendered it necessary to reconsider the present localization of the motor area in man, and partly be- cause the interpretation of facial and muscular movements as repre- senting this or that state of the emotions is always in danger of fallacy. Altogether, these doctrines as to the cerebral areas in- volved in the chief forms of mania fail of their eSect. They sug- gest many subjects worthy of consideration and of future study, but they make no solid contribution to physiology.

The second kind of oases, where injury or disease limited to one portion of the brain is followed by perversion, exaltation, or loss of some special instinct or habit, is more valuable and more con- vincing ; especially the cases of voracious hunger and thirst, those of true kleptomania, and those of the loss of certain special memories. It is not so easy to believe that the cerebellum is in any primary way associated with sexual desire : its position, its structure, and its proved association with the co-ordination of muscular movements, seem clearly to indicate that its work is wholly subordinate and complementary to the work of the cerebral hemispheres ; and the evidence adduced in favour of its being the "seat" of the sexual impulses hardly amounts to more than a probability that it may transmit or co-ordinate the performance of the sexual act.

We come to this conclusion, that phrenology is seeking to re- habilitate itself by an alliance with physiology ; and that it is encouraged to take this step by the fact that physiology, in its interpretation of the central nervous system, is becoming more and more psychological. The old idea, that the brain ” moves as a whole,” has passed away ; and the principles of cerebral localiza^ tion are, after all, only a scientific statement of matters that are of general belief. We are all more or less phrenologists. Every time that a man apologizes for this or that defect in his mind, and for his ‘ ‘ curta supellex ‘ ‘ he appeals to a purely local weakness of his brain. ” I have no ear for music â€” I have no memory for dates “â– â€” these common excuses are direct appeals to the doctrine of the differentiation of the work of the brain. And, as though it were to justify these appeals, physiology is beginning to feel its way forward from the localization of muscular movements and sjiecial sense-centres to the localization of the simpler faculties and instincts : working, not as Gall worked, by deduction and guess, but by induction ; yet it may find a use for the clinical and patho- logical facts that are worth rescuing from the downfall of Gall’s phrenological system.

Phylloxera, a genus of insects belonging to the family of Aphidse, or Plant-lice, in the order Homopterous Hemiptera. It is chiefly known from the causal relation of one of its species to the most serious of vine-diseases. The name (Gr. fv\Xov irjpov) was first given in 1834 to a plant-louse which was observed to ” dry np the leaves ” of oaks in Provence. About twenty-seven species are now known, all characterized by length not exceeding -06 of an inch, flat wings, three articulations in the antenna?., one or two articulations in the tarses, with digitules, but without cornicles on the abdomen. A full description of the only species which attacks the vine, the Phylloxera vastatri.v, or grape-louse, will be found in the earlier volumes of this Encyclopaedia (ninth edition, vol. xxiv. p. 239).

The insect has a curious life-history, which may here be briefly repeated. It first appears as a minute louse (“about ^^ inch in diameter) which lives on the roots of the vine. These root>forms are all parthenogenetic femalo.s, and spend their short life in sucking the juices of the vine and laying eggs, which hatch into similar forms, each

~~of which attaches itself to the root in a suit~~ able spot and proceeds to lay eggs. They are so prolific that a single individual might have twenty-five million descendants in six months. As the summer advances, some of the eggs of the root-forms give birth to winged females, which are capable of transporting the disease by flight over distances of many miles.

These winged females â€” still parthenogenetic â€” lay eggs which produce wingless males and females. Their brief life is wholly devoted to sexual reproduction, whereby new vitality is given to a race that would gradually die out if confined to parthenogenesis. The female lays a single egg â€” the so-called “winter-egg” â€” which remains in the crevices of the vine-bark without development through the cold weather, and gives birth in spring to a ” stock- mother,” closely resembling the original root-form. This creature forms a gall in the young leaf, within which it produces a large number of eggs, some of which form new galls and multiply in the leaves, whilst others crawl down to the roots and become root- forms, with which the cycle recommences. Attacked both in its leaves and roots, and deprived thus of its fair nutrient, the vine which is once infested with these rapidly mtiltiplying pests slowly withers away, being stunted in its growth, discoloured in its leaves, and bearing imperfect grapes which do not ripen. In a year or two the vine dies.

The particular species of phylloxera which attacks the vine is a native of the United States, probably originating among the wild vines of the Colorado district. It was first observed in 1856 by Asa Titch, who had no suspicion of its evil nature, and called it Pemphigus vitifoKm. In 1863 it was independently discovered by Westwood in an English vinery at Hammersmith ; he was ignorant of Fitch’s observation, and called it Peritymbia vitisana. Prom 1858 to 1863 th^re were many importations of American vines for grafting purposes to Bordeaux, Eoquemaure, and other parts of France, England, Ireland, Germany, Portugal, i&c. It is practically certain that the deadly phylloxera was

imported on these plants. A year or two later certain vine-growers in the South of France began to complain of the new vine-disease. M. Delorme of Aries, in 1866, appears to have been the first who re-cognized its novelty and had a presentiment of disaster. The disease steadily spread outwards in concentric circles from its first place of lodgment near Eoquemaure. Within two or three years whole departments were infested. In 1866 a second centre of infection made its appearance near Bordeaux. The vine-growers were at their wits' end to account for this new plague, which threatened to be even more costly than the oidium. The completeness of the ruin which threatened them may be illustrated by the statistics for a single commune, that of Graveson, whose average annual production of wine in the years 1865-67 was about 220,000 gallons. In 1868 this fell to 121,000 gallons, in 1869 to 48,400 gallons, in 1870 to 8800 gallons, and by 1873 to 1100 gallons.

In 1868 Planchon proved that the disease was due to a new species of phylloxera which was invariably found on the roots of the affected vines, and to which he accordingly gave the prophetic name of Phylloxera vastatrix. During the next ten years a series of students, of whom only Kiley and Balbiani need be mentioned here, worked out the natural history of Phylloxera vastatrix, and proved its identity with the American grape-louse. Its devasta- tions rapidly assumed gigantic proportions. In France, where the disease was by far the most prevalent â€" owing in great part to the obstinacy with which the vine-growers at first refused to take any reasonable precautions against its spread â€" M. Lalande, President of the Chamber of Commerce at Bordeaux, in 1888 calculated the direct loss to the country by the phylloxera at 10 milliards (Â£400,000,000), or double the indemnity which had been paid to Germany in 1871 ! Nearly three million acres of vineyards had then been destroyed. In the Gironde, where the phylloxera first became serious about 1877, the mean annual production of wine in 1876-86 was reduced by more than twenty -six million gallons. In the Cote d'Or the phylloxera appeared in 1878, and the annual crop at once declined from thirty-four to eleven milliDn gallons. The effect of the phylloxera in France was to diminish the wine-crop by about one-half, while in

certain parts â€” as in the Gironde from 1881 to 1887 â€” the production of good

wine was practically stopped altogether by the phylloxera and other pests, such as mildew.

The phylloxera has made its appearance in almost every vine- growing country in the world. Thus it appeared in Austria- Hungary in 1888 ; in Italy, in spite of the frantic efforts made â€” as in other countries â€” to keep it out by strict legislation against the import of vines, in 1879 ; in Russia in 1880 ; in Germany, on the Rhine and Moselle, and in Switzerland in 1872 ; in Madeira, Spain, and Portugal about 1876. The pest even crossed the oceans, and appeared in Australia, at Geelong, about 1880 ; it has since twice broken out in Victoria, and has ravaged the vineyards of South Australia and New South Wales. At the Cape, in spite of a long endeavour to prohibit the import of the phylloxera, it appeared about 1884. In 1885 it crossed the Mediterranean to Algeria. There was only one country where its ravages were long unimportant ; that was its home in the United States, where the native vines had become, by the operation of natural selection, immune to its attacks. Yet no imported vine has ever lived there more than five years, and in 1890 the phylloxera crossed the Rocky Mountains, and seriously damaged the vineyards of California, where it had previously been unknown.

Three different methods of fighting the pest have been successfully adopted. One is to kill the phylloxera itself ; another, to destroy it along with the infected vines, and plant fresh and healthy plants ; the third, to adapt the secular therapeutics of nature, and to introduce American vines which a long acquaintance with the phylloxera has made immune to its ravages. Of the various plans adopted for killing the phylloxera, which included absurdities like burying live toads at the roots of the vines, or douching them with Lourdes water, few have survived. One con- sists in submerging the infected vineyard under water for at least forty days. This plan, introduced by M. Faucon of Graveson, is effective, but is clearly out of the question in the majority of vineyards, since, as Virgil said, Vitis' amat coUes. Yet large sums were spent in

France on canals intended for this purpose, and much good was done in low-lying districts like those of the Gironde. Insecticides, of which the bisulphide of carbon (CSj) and the sulpho- carbonate of potassium (KSGSj) remain in use, were in- jected into the earth to kill the phylloxera on the roots of the vine. These methods were chiefly advocated in vineyards of the first class, where it was worth while to spend a good deal of money and labour to preserve the old and famous vines : the Chateau Leoville Poyferre and CIos Vougeot are instances. Some good judges attribute the peculiar and not unpleasing flavour of certain clarets of 1888 to means thus adopted to kill the phylloxera. The second plan was largely adopted in Switzerland and on the Rhine, where measures resembling those taken with cattle suspected of anthrax were applied to all diseased vineyards. The third plan, which consists in replanting the affected vineyard with American vines â€" such as the Vitis lahrusca, V- riparia, V. rupestris, or V. monticola â€" has proved the most generally successful.

The department of the H^rault, which produces more wine than any equal area in any part of the world, in 1899 contained 45-3,000 acres of vineyards, of which 445,435 were grafted on American stocks, and the wine-crop was larger than was the case before the phylloxera appeared. The French Department of Agriculture now "looks upon the phylloxera scare as a thing of the past, it having been successfully combated and beaten " by the introduction of American stocks. Thus the total wine-crop of France, which had fallen in 1894 from 1300 to 650 million gallons, rose again in 1899 to more than 1480 millions.

A very good bibliography will be found in Les Inseetes de la Vigne, by Professor Majet of Montpellier (1890), which is the best book on the subject. Reference may also be made to the classic memoirs of Planchon, culminating in Les Meeiirs de la Phylloxera de la Vigne (1877) ; Dreyfds, Ueber Phylloxerinen (1889) ; LiCHTENSTEiN, Histoire du Phylloxera; the Bapports Annuels a la Commission Superieure du Phylloxera; and the excellent Report on Phylloxera drawn up by the Hon. J. W. Tavekner (Victoria, 1899, No. 68). (-^y. j;_ q.__j. n

PHYSIOLOaY.

I. General.

EVEE since men began to take a scientific interest in the problems of life, two distinct rival explanatory principles of vital phenomena have claimed attention : a natural and a mystical principle. The first outcome of the

scientific attempt to explain vital phenomena after Jem'of'^' the natural method and by a unitary principle ine. "was the doctrine of the Pneuma, held by the

followers of Hippocrates, which found its clear- est expression in Galen's system. According to this doc- trine, the origin of all vital phenomena was a very fine substance, the Pneuma, which was supposed to exist in atmospheric air, to be inhaled into the lungs of man, and thus through the blood to reach all the parts of the body, where it produced vital phenomena. This doctrine â€" an attempt to explain the phenomena of life which was not only altogether natural, but even material- isticâ€" was accepted by the Middle Ages together with Galen's system. With its translation into the Latin spiritus, however, the conception of the Pneuma lost its original force. The spiritus animales of the Middle Ages developed ere long into mystical powers, the result being the explanation of vital phenomena by a supernatural theory. Not until the scientific Kenaissance of the 16th and 17th centuries did views again undergo a change. After the establishment of a scientific method in physi- ology by Harvey, and the development of Descartes' mechanical system of regarding living bodies, the natural explanation of vital phenomena once more universally found favour. Two schools arose, which endeavoured by dissimilar methods to find a mechanical explanation of vital phenomena: the iatrophysical, originating with the gifted and versatile Borelli, and the iatrochemical, founded by the Dutchman, Delboe Sylvius. But when both chemical and physical methods of explanation failed at such problems as, for instance, irritability and evolu- tion,

another change in opinion took place. By degrees there emerged once more the tendency to explain vital phenomena by mystical means, finding expression in the Animism of Stahl, to quote an example ; and in the second half of the 18th century Vitalism, originating in Prance, began its victorious march throughout the whole scientific world. Again the opinion came to be enter- tained that the cause of vital phenomena was a mystical power (force hyper micaniqve) â€" that " vital force" which, neither physical nor chemical in its nature, was held to be active in living organisms only. Vitalism continued to be the ruling idea in physiology until about the middle of the 19th century, and its supremacy was only gradually overthrown by the great discoveries in natural science of that century. The chemical discoveries resulting from Wohler's synthesis of urea first showed that typical products of the animal body, the production of which had hitherto been supposed to be solely the result of the operation of vital force, could be obtained artificially by purely chemical methods. Then above all came the discovery of the law of the Conservation of Energy by Robert Mayer and Helmholtz, and its application to the living organism by Mayer, Helmholtz, Dulong, Erankland, Kubner, and others, to prove that the manifestations of energy by the organism are simply the result of the quantity of potential energy received into the body by means of food. Einally, the stu- pendous results arrived at by Darwin and the estab- lishment of the fundamental law of " biogenesis " by

Haeckel, prepared the way for a natural explanation of the enigma of evolution and structure of organisms. Thus by the second half of the 19th century the doctrine of vital force was definitely and finally over- vitalism thrown to make way for the triumph of the titansm. natural method of explaining vital phenomena, which down to the present time has continued to spread and flourish with an unparalleled fertility. It would, it is true, appear as if in our day, after the lapse of half a century, mystical tendencies were again disposed to crop up in the investigation of life. Here and there is heard once more the watchword of Vitalism. But all the so-called neo-vitalistic efforts (such as those of Bunge, Eindfleisch, Eeinke, and others) have nothing to do with the older vitalism. They originate solely in a widespread confusion with regard to the boundaries of natural science, their principal tendency

being to amalgamate psychological and speculative questions with problems of purely natural science. In the face of all these efforts, which by their unfortunate designations of Vitalism andNeo-vitalism give rise to entirely false conceptions, and which by their intermingling of psychological questions and questions of natural science have led to mere confusion in research, it is essential that natural philosophy should be called upon to realize its own limits, and above all clearly to under- stand that the sole concern of physical science is the investigation of the phenomena of the material world. Physiology, as the doctrine of life, must therefore confine itself to the material vital phenomena of organisms. It is self-evident, however, that only -such laws as govern the material world will be found governing material vital phenomena, â€” ^the laws, that is, which have hitherto been brought to their most exact and most logical development by physics and chemistry, or, more generally speaking, by mechanics. The explanatory principles of vital phenomena must therefore be identical with those of inorganic nature â€¢ â€” that is, with the principles of mechanics.

The investigation of vital phenomena in this sense requires, in the first place, an exact knowledge of the sub- stratum in which these phenomena are manifested, just as in chemistry and physics a thorough Ultimate knowledge of the composition of the material “ofuu!*^ world is a necessary premise to the investigation of the phenomena of inorganic nature. The knowledge of the composition and structure of organisms has in the course of the scientific development of anatomy attained to an ever-increasing minuteness of detail, without having as yet reached a definite limit. The last important step in this direction was the discovery by Schleiden and Schwann that all organisms are built up of elementary living structural components, namely, of cells. For the details of the anatomical construction of organisms, see Anatomy. We would here merely point out that a cell is the simplest particle of living substance which appears to be permanently capable of life. Different elements are essential, however, to the existence of the cell â€” two, at least, so far as has hitherto been discovered â€” the proto- plasm and the nucleus. It must at present be regarded as at least very doubtful whether the centrosome, which in recent times it has been

possible to demonstrate as existing in very many cells, and which appears sometimes in the protoplasm, sometimes in the nucleus, is a general and third independent cell-constituent. On the other hand, the number of special constituent parts which appear in various cell-forms is very large. A question which has long been discussed, and which has received special

general]

and animated attention, is that with regard to the finer structure of the cells â€” with regard, that is, to the protoplasm and the nucleus lying in it. Views on this subject have diverged very widely, and several totally diverse theories have been opposed to one another. One theory maintains that the living cell-substance has a reticular structure; another, that it is fibrillous. Ac- cording to a third theory, the essence of the construction of the cell-substance lies in the granules which it con- tains ; and according to a fourth, it lies in the ground- substance in which these granules are embedded. One view holds this ground- substance to be homogeneous, another regards it as possessing a fine foam-structure. It may at present be regarded as incontrovertible that living substance is more or less fluid, and that there does not exist any general structure for all cell-forms. But in some special cases all the theories which have been quoted are to a certain extent correct. In different cells there are reticular, fibrillous, and granular differ- entiations respectively, and differentiations in foam- structure ; in many cells, however, the protoplasm appears to be beyond doubt homogeneous and without a distinct structure, and only under certain conditions to assume changing structures. But the fact which is of most importance for the right understanding of vital phenomena is that the cell-substance is always more or less fluid, for only in a fluid substratum can such intense chemical processes be enacted as are to be found in every living cell.

Where the analytical powers of the microscope in anatomy can go no farther, chemical analysis of the composition of the cell steps in. By its means the dis- covery is made that there is no elementary difference between organic and inorganic nature, for only such chemical elements as are known to exist in the inorganic world are found in the organic. On the other hand, however, the living cell-substance possesses chemical compounds which find analogues nowhere in inorganic nature. The characteristic organic substances which are present in every cell are proteids and proteid-compounds. Besides these there occur, widely disseminated, carbohy- drates, fats, and other organic substances, which partly originate in the decomposition of proteids and their com- pounds, and are partly used for their construction. Lastly, there are in addition great quantities of water and some inorganic salts.

Such are the structure and composition of the sub- stratum in which vital phenomena play their part. When we consider vital phenomena themselves in the pheao- various living organisms â€" in protista, plants, menaot animals, man â€" there appears an incalculable ’"*â€¢ diversity of phenomena. Here, however, as in

the case of the structure of organisms, we have to analyse and to penetrate ever farther and deeper till we reach the fundamental phenomena. We then find that the great variety of vital manifestations may be traced back to a few fundamental general groups, which are precisely the same groups of phenomena as those to be observed in inorganic nature. All the processes that take place in the organic world may be regarded from the three different standpoints of their changes in substance, in energy, and in form ; for substance, energy, and form are all necessary to our conception of matter. Accordingly, the general elementary vital phenomena likewise fall into three groups â€" metabolism, the mechanism of energy, and the assumption of form. Every cell, so long as it is living, takes in certain substances from its environment, submits them to chemical transformation in its interior, and gives out other substances. This metabolism is manifested in several special functionsâ€" in nutrition and digestion, respiration and circulation, secretion and excre-

tion. The essence of the whole process is the fact that while out of these ingested stuffs living substance is always again being formed by the living substance which already exists, it is itself continually undergoing decom- position, and the products of this decomposition are what the cell gives off again to the outside. With metabolism, however, there is inseparably associated a transformation of energy. These substances taken in by the cell contain a large quantity of potential energy, which is transformed into kinetic energy. This has for its result the manifold activities of the organism, more especially motion, heat, electricity, and light. Finally, the chemical transforma- tions in living substance may also manifest themselves outwardly in changes of form, as is the case generally in the matter of growth, reproduction, and development. The three general elementary groups of vital phenomena are therefore in reality merely the expression of the vari- ous aspects of one and the same process â€" of the actual vital process itself. The ultimate object of all physi- ology is to discover what this vital process is, that is to say, what is the exact cause of these manifold vital phe- nomenaâ€" a goal from which it is at the present day still very remote.

As every physical and chemical phenomenon of in- organic nature occurs only under distinct conditions, so vital phenomena are also dependent upon cer- tain conditions of life. Every living body, flf""^ every living cell, requires food, water, oxygen, and, further, a certain temperature, and a certain press- ure in its environment. These are the general condi- tions of life. But the special conditions on which depends the continued existence of the individual forms of organ- ism are as numerous as the forms of organisms themselves. Now, just as the physicist or chemist varies those condi- tions under which a phenomenon occurs in order to get at its causes, so does the physiologist try to experiment with vital phenomena, altering the vital conditions and testing the changes which are thereby produced. The great importance of this method consists in the power it gives the experimenter of analysing vital phenomena systematically from definite points of view. Every change in its normal vital conditions which produces any effect whatsoever upon an organism is termed a stimulus. This is the only general definition we have for a concep- tion which is of such vast importance to physiology. According to it, experimental

physiology is entirely a physiology of stimuli. It further follows from this con- ception of stimulation that there must be an enormous multiplicity of stimuli, since each particular vital condi- tion may be subjected to some change capable of acting upon it as a stimulus. But, besides this, other factors may be brought to bear upon organisms which have abso- lutely no place among their vital conditions, for instance, many chemical reagents and electric currents. These influences come under the general definition of stimulus, because they likewise imply a change in the conditions under which the organism lives. Erom their qualitative nature stimuli are distinguished as chemical, thermal, photic, mechanical, and electrical. Each of these several varieties may, however, be applied quantitatively in vari- ous degrees of intensity, and may in consequence produce quite different results. This opens up to experimental physiology a vast field of research. But the physiology of stimulation is not only of the greatest value as a means of research : its importance is much increased by the fact that in nature itself stimuli are everywhere and con- stantly acting upon the organism and its parts. Hence the investigation of their action comes to be not merely a means, but a direct end of research.

Although it is not at present possible to define all the laws that govern stimulation, on the one hand because

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tlie number of stimulating effects known to us in the whole organic world is as yet too limited, and on the other

because those already known have not yet been Stimuli “* thoroughly analysed, yet it is within our power

to classify stimulating effects according to their various characteristics, and to ascertain a few facts con- cerning their general and fundamental conformity to law. The first fact, apparent from a glance at a great many of the various f6rms of stimulation, is that all their effects are manifested in either a quantitative or a qualitative alteration of the characteristic vital phenomena of each living object. The quantitative is the usual mode of action of stimuli. It is generally found that a stimulus either increases or diminishes the intensity of vital phenomena. In the first case the effect is one of excitation ; in the second, of depression. It is the more important to bear in mind this twofold operation of stimuli, owing to the fact that in former times physiologists were very apt to conceive of excitation and stimulation as identical. It is now, however, an undisputed fact that depression may also occur as atypical effect of stimulation. This is most apparent in cases where the same stimulus that produces excitation may, on being applied for a longer period and with greater intensity, produce de- pression. Thus narcotics (alcohol, ether, chloroform, morphia, &c.) on certain forms of living substance produce the phenomena of excitation when their action is weak, whereas when it is stronger they produce com- plete depression. Thus, likewise, temperature stimuli act differently upon vital phenomena according to the de- gree of temperature, very low temperatures depressing, medium temperatures exciting with increasing in- tensity, and higher temperatures from a certain height upwards again depressing. The effects of stimulation are not, however, always manifested in merely quantitative changes of the normal vital phenomena. Sometimes, especially in the case , of long uninterrupted and chronic stimuli, stimulation is found gradually to produce pheno- mena which are apparently quite “foreign to the normal vital phenomena of the cell in question. Such qualitative alterations of normal vital phenomena are perceptible chiefly in chronic maladies in the cells of different organs (the heart, liver, kidneys, spleen, &c.), in which the vital conditions become gradually more and more modified by the cause of the malady. To this category pertain all the so-called chronic processes of degeneration which in pathology are known as fatty degeneration, mucous degeneration, amyloid degeneration, and so forth. The characteristic element in all these processes is that the normal metabolism is diverted into a wrong channel by the altered vital

conditions of the cells of the organ affected, so that substances are formed and accumulated in the cell which are entirely foreign to its normal life. But this class of stimulation is still very obscure as re- gards causes and inner processes, and it is within the range of possibility that the ultimate cause of the quali- tative changes in the normal metabolism is to be found simply in the processes of excitation and depression which chronic stimulation produces in separate parts of the metabolism. Thus, at least with regard to fat-metar morphosis (fatty degeneration), it is highly probable that fat is deposited in the protoplasm simply because, owing to an inadequate supply of oxygen, it cannot, when it originates, be oxidized in the same proportion as it is formed, whereas in the normal cell all fat which origi- nates in metabolism is consumed as soon as it is produced. According to this conception, therefore, fatty degenera- tion is attributable primarily to a depression of the pro- cesses of oxidation in the cell. If we may accept this view as correct with regard to the other metamorphic processes also, the qualitative changes in vital phenomena

under the influence of stimuli would after all de- pend simply upon the excitation or depression of the constituent parts of the vital process, and, according to such a view, all stimuli would act primarily only as exciting or as depressing agents upon the normal process of life.

In accordance with the three groups into which general vital phenomena are divided, it follows as a matter of course that the excitation or depression produced by a stimulus can manifest itself in the cell's metabolism, assumption of form, and manifestation of energy. The effects of excitation upon the production of energy are the most striking, and were therefore in former times frequently thought to have a claim par excellence to rank as stimulating effects. These reactions attract most attention in cases where the production of energy is pro- portionately very great, as with muscle, for instance, which is made to twitch and perform work by a feeble stimulus. Processes of discharge (Auslosungsvorgange), however, lie at the bottom of cases like these. Potential chemical energy, which is stored up in a considerable quantity in living substance, is converted by the impulse of the stimulus into kinetic energy. Therefore the amount of the effect of stimulationâ€”

that is to say, the quantity of work performed â€” bears no proportion whatever to the amount of energy acting as a stimulus upon the muscle. The amount of energy thus acting may be very small as contrasted with an enormous production of energy on the part of the living substance. It will not do to make generalizations, however, with regard to this proportion, as was frequently done in former times. All processes of stimulation are not processes of discharge. The influence of many stimuli, as has been observed, consists far more in depression than in excitation, so that in certain cir- cumstances a stimulus actually diminishes the normal liberation of energy. There is therefore no general law as to the proportion which the amount of energy acting as a stimulus upon living substance bears to the amount of energy liberated.

Among special varieties of stimulation there is one class of stimuli which has attracted particular attention, namely, those which act unilaterally upon free-moving organisms. It is principally with f^â„¢^^^ the lowest forms of life that we have here to do uob. â€” unicellular protista and free-living cells in the bodies of higher organisms (sperm-cells, leucocytes, &c.). When from one direction a stimulus â€” ^be it chemical, ther- mal, photic, electrical, or of any other kin d â€” acts upon these organisms in their medium, they are impelled to move in a course bearing a definite relation to the source of the stimulus â€” either directly towards that source or directly away from it, more rarely in a course transverse to it. This directive action of stimulation is under such a fixed conformity to law, that it vividly recalls such purely physical processes as, for instance, the attraction and repulsion of iron particles by the poles of a magnet. For example, if light falls from one side upon a vessel full of water containing unicellular green algae, according to the intensity of the light these organisms swim either towards the illuminated side, where they form a compact mass on the edge of the vessel, or away from it, to cluster on the opposite edge. In the same way infusoria in water are observed to hasten towards or to flee from certain chemical substances, and leucocytes in our bodies act in the same manner towards the metabolic products of pus-forming bacteria which have penetrated into an open wound. The suppuration of wounds is always accompanied by an amazing conglomera- tion of leucocytes at the seat of the lesion.

Perhaps the most striking effects, however, are those of the constant electric current upon unicellular organisms, since in this case the motion follows the cause . with absolutely auto-

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matio regularity, certainty, and rapidity. Thus, for example, after the establishment of the current many Infusoria (Paramseeium) accumulate at the negative pole with great celerity and without deviation, and turn round again with equal celerity as soon as the direction of the current is altered. As such cases of directive stimulation may occur among all varieties of stimuli whenever stimuli act unilaterally, they have been designated, according to the direction in which they occur in relation to the source of the stimulus, as positive or negative Chemotaxis, Photo- taxis, Thermotaxis, Galvanotaxis, and so forth. The strange and perplexing element in these phenomena becomes clear to us as soon as we know the characteristic method of locomotibn for each form of organism, and whether the stimulus in question in the given intensity exercises an effect of excitation or of depression upon the special form. The direction of motion is the essential mechanical result of unilateral stimulation of the organs of locomotion. Seeing that these reactions are exceedingly widely distributed throughout the whole organic world, and possess a deep biological significance for the existence and continuance of life, the interest they have awakened is thoroughly justified.

One of the most important physiological discoveries of the 19th century was that of the ” Specific Energy of Sense-substances.” Johannes Muller was the ‘ene^’.” “^^ *o establish the fact that very different varieties of stimuli applied to one and the same organ of sense always produce one and the same variety of sensation, and tliat, conversely, the same stimulus applied to the different organs of sense produces a diiierent sensation in each organ â€” the one, in fact, which is its specific attribute. Thus, for example, mechanical, electrical, and photic

stimuli applied to the optic nerve produce no other sensation than that of light ; and, con- versely, any one variety of stimulus â€” take the electrical, for exampleâ€” produces sensations of light, hearing, taste, or smell, according as it affects the optic, auditory, gustatory, or olfactory nerves. This law of the ” Specific Energy of Sense-substances,” as Johannes Muller called it, has come to have a highly important bearing upon scientific criticism, since it proves experimentally that the things of the outer world are in themselves in no way discernible by us, but that from one and the same outward object â€” the electric current, or a mechanical pressure, for instance â€” we receive altogether different sensations and form altogether different conceptions according to the sense-organ affected. But this law does not possess significance for psychology alone; as regards physiology also it has a much more general and more comprehensive force than Muller ever anticipated. It holds good, as demonstrated by Hering and others, not of sense-substances only, but of living substance generally. Each cell has its specific energy in Johannes Mliller's sense, and in its extended form there is no more general law for all the operations of stimuli than this law of specific energy. To take examples, whether a muscle be stimulated by a chemical, mechanical, thermal, or electrical stimulus, the result is in each case the same, namely, a twitching of the muscle. Let a salivary gland be stimulated chemically, mechanically, electrically, or in any other way, there always follows the same specific action â€” a secretion of saliva; no matter what be the kind of stimulus acting upon it, the liver-cell always reacts by producing bile, and so on. On the other hand, one and the same stimulus â€” the electric current, for example â€” gives in each form of living substance a specific result: twitching in the muscle, secretion of saliva in the salivary gland, production of bile in the liver-cell, &c. That is, of course, with the proviso that the effect of the stimulus be exciting and not depressing. The

following general formulation,- however, of the law of specific energy brings the depressing stimuli also within its scope: “Different stimuli produce in each form of living substance an increase or a diminution of its specific activity.” As already observed, it will probably be found that those weak chronic forms of stimulation which pro- duce qualitative changes may also be comprised under this general law.

The knowledge thus far acquired from analysis of vital phenomena and their changes under the influence of stimuli affords but a very indefinite temporary basis for inecban- the theory of the actual vital process itself, of ism of which vital phenomena are the outward mani- “*â€¢ festation. The conceptions to which physiological re- search has hitherto attained in this matter are of a more or less doubtful nature. The facts contained in them still require to be linked together by hypotheses if we are to obtain even a vague outline of what lies hidden behind the great riddle of life. Such hypotheses, serv- ing as they do to link facts consistently together, are absolutely essential, however, to the further progress of research, and without their aid any systematic investiga- tion would be impracticable. But at the same time it must never be forgotten that these hypotheses are merely provisional, and that whenever they are found to be no longer in harmony with the widening range of new experiences and ideas, they must either be proved to be facts or be subjected to modification. This is the point of view from which we must deal with modern ideas concerning the nature of the actual vital process â€” the mechanism of life.

The fundamental fact of life is the metabolism of living substance which is continually and spontaneously under- goingdecomposition,and building itself up anew with the help of the food-substances it takes in. ^omm These processes of decomposition and of recon- struction may be briefly designated as Dissimilation (Cata- bolism) and Assimilation (Anabolism) respectively. Now the question arises : How are we to understand this process of dissimilation and assimilation from a mechanical stand- point ? It is quite evident that we have to do with some chemical occurrence ; but how are the chemical trans- formations brought about ? There are obviously two possibilities. It is conceivable

that the decomposition of foodstuffs and the formation of excretion-products in the cell-body are caused by the repeated casual encounter of a great series of chemical combinations and by their repeatedly reacting upon one another in the same manner, bringingabouttransformations and forming waste products which are excreted, while at the same time certain chemical affinities are always taking in from without new chemical combinations (foodstuffs) and uniting them. This theory was in fact occasionally advanced in former times, par- ticularly in its chemical aspect, and the belief was especially entertained that the enzymes in living substance might play an important part in these transformations. This assumption, however, leads to no clear and lucid image of what takes place, and moreover draws too largely upon auxiliary hypotheses. It has therefore met with but little acceptance. The other possible explanation of metabolism is, that its whole process is confined to one single class of chemical combinations whose tendency it is to be constantly undergoing spontaneous decomposition and regeneration. This latter theory was founded by Hermann, Pfluger, and others, and has met with universal recognition because of its naturalness, simplicity, and clearness.

Starting with this hypothesis, the path of further research lies clear and well-defined before us. In the first place, we are obviously met by the question : What con- ception are we to form of these combinations on which hinges the whole vital process? Among the organic

matters which compose living substance, proteids perform the most important part. Proteids and proteid-compounds

form the only organic matter which is never ab- Prote ds. ^^^^ from any cell. They form also the greater part of all the organic compounds of the cell, unless reserve-stuffs are accumulated to a considerable extent, and they are by far the most complicated of the com- pounds of

living substance. While animal life is impos- sible “without proteid food, there are on the other hand animals which can continue to subsist on proteid alone. This series of facts proves very conclusively that pro- teids and their compounds play by far the most im- portant part of all organic matter in the processes of life. The idea thus naturally presents itself that the required hypothetical compound forming the central point of metabolism will be found to bear a very close relation to proteids. But another point must be here considered. The proteids and their compounds known to us are, comparatively speaking, stable compounds, which never undergo spontaneous decomposition so long as they are protected from outward injury, whereas the hypothetical combination which lies at the centre of or- ganic metabolism is extraordinarily labile and continu- ally undergoing spontaneous decomposition. Therefore we have to think not of ordinary proteids in this case, but of still more complicated combinations, the atoms in the molecule of which have a strong tendency to group themselves in new arrangements. Owing to their fundar mental importance, these combinations have been termed ” biogens.” When we come to inquire how such labile biogen molecules are built up out of the proteids of food, we find our knowledge very much restricted. Doubtless the intramolecular addition of inspired oxygen has much to do with it, for living substance when deprived of oxy- gen loses its irritability, that is to say, its tendency to decomposition. The fact that the decomposition of living substance is always associated with the formation of car- bonic acid â€” a circumstance obviously necessitating the aid of oxygen â€” also points to the absolute indispensable- ness of oxygen in the matter. Pfluger has further sug- gested that the molecule of living substance owes its lability a,nd its tendency to form carbonic acid when joined by oxygen atoms principally to cyanogen groups which are contained in it. According to this view, the following is supposed to be the process of the formation of biogen molecules : It is assumed that the biogen mole- cules already present in living substance take out of the proteids of food certain groups of atoms, and dispose them so as to produce cyanogen- like compounds. The addition of oxygen atoms then brings the biogen molecule to the maximum of its power of decomposition, so that â€” partly spontaneously, but more especially when impelled by a stimulus â€” it breaks down somewhat explosively, causing the formation of

carbonic acid. In this proceeding, according to the hypothesis which is the most widely accepted and the most fruitful in results, would lie the very germ of the vital process.

If we accept these views as far as their general principle is concerned, assimilation is the re-formation of biogen

molecules by those already existing, aided by /^m oT' foodstuffs ; dissimilation, the decomposition of cell-life. biogen molecules. To this primary process,

however, is attached a whole series of secondary chemical processes, which serve partly to work upon the food so as to fit it for the building up of biogen molecules, and partly to form out of the direct decomposition-pro- ducts of the biogen molecules the characteristic secretion- products of living substance (excretions and secretions). The various workings of matter in the cell are rendered very much more complex by the circumstance that the living cell exhibits various morphological differentiations

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â€" above all, the differentiation in protoplasm and nucleus. Again, a transformation of energy is inseparably con- nected with metabolism. Along with food and oxygen potential chemical energy is continually being introduced into the cell, to be accumulated in the biogen molecules, and at their decomposition transformed into kinetic energy, which finds an outlet in the various manifesta/- tions of energy in the cell â€" motion, heat, and so forth. In the light of this hypothesis the operations of stimuli also become comprehensible. Seeing that there is an initial tendency to the occurrence of certain definite chemical processes, which are associated with the re- construction and decomposition of biogen molecules, various stimuli will either further or hinder the course of this metabolic series. A cell which is exposed to no outward disturbance, and which continues always in the unvarying medium provided by an exact suffi- ciency of food, will be in " metabolic equilibrium " ; that is to say, its assimilation and its dissimilation will be equal (A = D). When, however, the influence of

external stimuli is brought to bear upon them â€” that is to say, any change in their environing vital conditions â€” A and D will either be altered in similar proportion, or their mutual equilibrium will be disturbed. In the former case the vital processes will merely be intensified in their course ; in the latter and usual case the result will be determined according to the part of metabolism excited or depressed. When the effect of a stimulus is to excite D continuously in a high degree without correspondingly increasing A, the result is a dying off â€” an atrophy. In the contrary case, when A remains continuously greater than D, the result is growth, increase, and reproduction of the cell. Experience proves, however, that A and D stand JfietaboUc in a certain relation of mutual dependence to each other, with the result that when D has been increased iDy a stimulus, for example, A correspondingly increases during the stimulation, and continues to do so after its cessation, till the loss in living substanceproduced by the stimulation of D is eventually made good, and meta- bolic equilibrium is restored. The muscle may be taken as an example of this self-regulation of metabolism com- mon to all living substance (Bering's Selbststeuerung des Stoffwechsels) . When a muscle has been fatigued by some stimulation causing an enormous increase of D, there is a corresponding spontaneous increase in A. After some time the muscle is observed to have recovered. It has once more become capable of performing work ; its metabolism is again in equilibrium.

The vital phenomena of the cell may be derived me- chanically from metabolism and the changes it undergoes under the influence of stimuli. Our ability to do this will increase more rapidly as we become better acquainted with the details of the metabolism of the cell itself. The foregoing outline must be regarded, of course, as embody- ing only a fragmentary hypothesis, which can serve as a guide for further research only so long as it does not clash with facts, and which must be amplified, specialized, and developed with the widening of specific knowledge regarding the cell's metabolism. The relations already known are so exceedingly complex, that only by slow degrees can we pursue the investigation of separate fragments of the entire metabolic series. The differentiation of nucleus and protoplasm in the living substance of the cell alone gives rise to an extraordinary complication

in the metabolic process, for these two parts of the cell stand in -, ,, the mostcomplicated correlation with oueanother cesse^e as well as with the environing medium â€” a fact secret of of which the experiments made by vivisection ””^â€¢ in various free-living cell-forms have furnished abundant evidence. The farther such knowledge advances, the more rounded, clear, and free from hypotheses will be-

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come our conception of the cell's metabolism. But the cell is the elementary component part of. all organisms, and from the life of individual cells is constructed the life of the separate tissues and various organs, and thus of the entire organism. Hence the cell is the only vital element which the organism possesses, and therefore the investigation of the vital processes in its separate cells leads ultimately to a knowledge regarding the mechanism of life in the whole. (m. v.)

II. NUTEITION.

Living matter is living in virtue of the persistence of a constant cycle of dhemical changes, consisting in a con- tinual breaking down (Catabolism) on tlie one hand and a continual building up (Anabolism) on the other. By the breaking-down changes the energy is evolved which is required for the constructive processes by which the mass of living material is maintained or grows, and for the production of motion, of heat, and of all the various phenomena associated with vitality. Nutrition deals specially with the way in which these changes are carried on, with the manner in which the necessary energy-yield- ing material is supplied to and utilized by the pirotoplasm, and with the disposal of the waste material resulting from the catabolism. The present article deals with the nutrition of Vertebrates, and more especially with the nutrition of mammals.

A. Metabolism.

Protoplasm, or living matter, is not a substance but a vortex of substances, a vortex constantly sucking in

fresh material and as constantly throwing off changes *^Â® Â°^^- '^Â° attempt to analyse it is hopeless ;

but when its metabolism is stopped â€" when it is no longer protoplasm â€" it is found that the most abundant solid present belongs to the group of Proteids (see p. 724). Many speak of proteids as the essential constituent of protoplasm ; .but how, and in what form, they are present is unknown, owing to the important molecular changes which go on at death, as indicated by the liberation of carbon dioxide and lactic acid in con- siderable quantities. Whatever be the true relationship of proteid to protoplasm, the fact is clear that a supply of the former is necessary for the continuance of the latter. In green plants the proteid is built up from nitrates, water, and carbonic acid, but in animals it must be supplied ready made from plants or from other ani- mals. The proteids are complex substances with large molecules, which, when built into the protoplasm molecule, readily break down into simpler substances with the lib- eration of energy. Many organisms are capable of re- pairing the expenditure of matter and of energy, and of continuing to live on proteids, along with water and salts ; but the vast majority of animals have the power of using Fats and Carbohydrates as additional sources of energy, and many procure from these substances the greater amount of the energy they evolve. Thus man, on an ordinary diet, gets five times as much energy from these as from the proteids of the food. (For the energy-value of each of these materials, see Dietetics.) For the liber- ation of their energy these substances must be assimilated, drawn into the vortex, and built up to form an integral part of the protoplasm. Some plants, like the yeasts, have the power of evolving the energy of sugar through the action of one of their products, but all the evidence indicates that in animals assimilation is an essential step to utilization.

This is clearly indicated by the following considerations: â€" (1) Of the innumerable organic compounds which in their dis-

integration liberate energy, the animal body can use only a very limited number, belonging to the three groups of Proteids, Fats, and Carbohydrates; only a few substances outside these groups can be assimilated and used to a small extent as sources of energy, e.g., alcohol. (2)Proteids, Carbohydrates, and Fats, when in the blood undergo no such changes as they undergo when they become part of the living protoplasm. (3) Ammonium lactate, which undergoes no change in the blood, when introduced into the body of a living mammal is changed to urea, and in a living bird to uric acid ; while urea injected into the bird is in part changed into uric acid, and uric acid in the mammal may be changed into urea. In each case the substance must become part of the living protoplasm, and undergo profound alteration.

(4) A number of sub.stances, as benzyl alcohol, CcHsCHgOH,

and salicylic aldehyde, CeH^^.^, are not oxidized in the blood,

but when taken up by the protoplasm of the tissues are changed

into benzoic acid, C6H0CO2H, and salicylic acid, CeHi q|j .

In all probability the degree of assimilation which is necessary for the chemical changes in various substances acted on by living protoplasm varies greatly. Thus proteids must be carried into the inmost and most essen- tial vortex, while gelatine, carbohydrates, and fats must also take part in the more intimate chemical changes. On the other hand, the changes of lactate of ammonia, of urea, of uric acid, and the various chemical substances mentioned above, probably go on more towards the edge of the vortex, and without ever taking part in the funda- mental series of changes.

It was formerly supposed that the oxygen of the air directly oxidized the constituents of living matter, but the fact that the same changes go on in the living tissues of the frog for some time after they have been deprived of all free oxygen, shows this idea to be erroneous. The oxygen must be assimilated, must be part of the proto- plasm, must be what Pflilger calls intramolecular. Its presence in the complex molecule along with carbon, hydrogen, and nitrogen of course greatly increases the

molecular instability. Living matter has a great affinity for oxygen, and not only takes it greedily from the air, but can actually separate it out of various chemical com- pounds, such as oxyhaemoglobin, or even from more stable pigments, such as alizarin blue.

Protoplasm thus built up by the assimilation of Pro- teids, Pats, and Carbohydrates, with oxygen, undergoes changes by which it is broken down and the energy of these substances is liberated. These ^^f^Â°g'f changes are accompanied by an oxidation, the intramolecular oxygen of the protoplasm being distributed in simpler and more stable compounds. Proteids, Carbo- hydrates, and Fats, when burned outside the body, yield carbon dioxide and water, and in the body these are the chief products of the disintegration of living matter. But the proteids contain nitrogen and sulphur, which are also oxidized. In the animal body the sulphur is in great part converted to sulphuric acid, though some is got rid of in a less oxidized state. The nitrogen, on the other hand, is in fishes, amphibia, and mammals excreted chiefly as carbamide (urea), and to a smaller extent as ammonia and various diureides (see below, Chemistry of Animal Body). In birds and reptiles the diureides are the chief waste nitrogenous products. But while the waste nitrogen is thus got rid of in substances more complex than ammonia, the fact discovered by Minkowski, that in the goose exclusion of the liver from the circulation causes the appearance of lactate of ammonia in place of uric acid in the urine, tends to show that in all cases ammonia, or a closely allied substance, is actually formed, , and is built up into somewhat more complex substances, probably to facilitate excretion. The catabolism of the nuclein compounds (see p. 724) of the protoplasm is somewhat more complex. The proteid moiety is broken down in the manner just described, and the nucleic acid

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is split into phosphoric acid and a series of bodies which E. Fischer names the Purin Bases â€" ~~Hypoxanthin, Xan~~ thin, Uric Acid, Adenin,

&c. The amounts of these formed vary with the amount of nucleic acid which is broken down, but they are all capable of being further changed into urea.

The metabolic processes of protoplasm appear to be modified in response to various stimuli. For example, in carnivorous animals the result of administering acids is the formation of ammonia in sufficient quantities to com- bine with them. Free fatty acids determine the produc- tion of glycerin in the intestinal wall, and benzoic acid gives rise to amido-acetic acid, with which it links, to be excreted as hippuric acid.

In vertebrate animals muscle plays the most important part in the general metabolism. ISTot only is it the most constantly active and by far the most abundant Metaboi' pf ^;]2e tissues â€" in man it constitutes about 43 muscle. psr cent, of the total weight â€" but, since its two great functions are the production of heat and mechanical work, it is the great energy-liberating machine, the great expending tissue of the body. For its nourish- ment food is procured and digested, and the purpose of the various organs of excretion is to get rid of its waste products. The metabolism oi muscle is therefore the great governing factor in the nutrition of the body. The proportion between the amount of energy set free in mechanical work and in heat production has been studied by many investigators, but the niost trustworthy results have been obtained by Zuntz and his fellow-workers at the Veterinary School of Berlin. By investigation on men, horses, and dogs, they have shown that under the most favourable conditions about ^ of the energy liberated by the muscle may be used for mechanical work, while about |- is used in heat production; while in less favourable circumstances a much smaller proportion of the energy is available for mechanical work.

Muscle contains about 20 per cent, of proteids, some of which are soluble, others insoluble, in salt solution. The insoluble part consists of the collagen of the connective tissue, and of a phosphorus-containing proteid Myostromin, which makes up the framework of the fibres. The soluble proteids are of the nature of globulins, and two of these

(Myosinogeu and para-Myosinogen) tend to pass into an insoluble condition (Myosin). This occurs after death, and leads to the familiar stiffening of muscle. Another globulin, iiiyoglobulin, takes no part in the formation of the myo- sin. The remaining organic substances, amounting to 1 or 2 per cent. , consist of glycogen, glucose, and fats, and of waste matters, such as methyl-guanidin-acetic acid â€" creatin. The ash amounts to about 1 per cent., the most important base being potassium and the most abundant acid phosphoric acid.

When work is done, the disintegration of muscle substance is proportionately increased. Thus Zuntz found the excretion of carbon dioxide in a dog to vary as follows : â€"

CO2 per min. in cubic centimetres.

Besting, lying 124-7

,, standing ... â€¢ . . 170-2

Forward movement (unloaded) . . 525-0 ,, ,, (drawing weight) . 798-9

He further found that the more rapidly work is done, the greater is the disintegration. The simple oxidized compounds of the greater part of the carbon and hydrogen are given off from the muscle, and, with or without further modification, are excreted from the body as carbon dioxide and water. Nitrogen in simple com- binations also appears to be set free, for the proportion of nitro- genous substances soluble in alcohol is increased after contraction in excised muscle. But in muscle in the body, waste nitrogen is not given off proportionately to the work done ; indeed, increased excretion is not a necessary accompaniment of the performance of muscular work. Provided the work is moderate, and provided the supply of non-nitrogenous food is suiBcient for the energy required, and the supply of oxygen adequate for repair, there is no increased excretion of nitrogen. But when the work is excessive in relation to the amount of food absorbed and the amount of oxygen taken up, at once the waste nitrogen is thrown off in increased quantities. An increase in the excretion following muscular work is therefore correlated with deficiency of the

materials required for reconstruction. It thus seems that, except under special conditions, the nitrogen, instead of being thrown off, is used again, and, in combination with fresh carbon and hydrogen in fats and carbohydrates, and with oxygen, is rebuilt into the muscle protoplasm.

The course of metabolism and the rate of combustion of proteids and fats in the body may be studied with considerable accuracy in the human subject. It is necessary to ascertain the amount of nitrogen and of carbon excreted by the I^easure various channels â€" the kidneys, the lungs, the skin, holism and the bowel. By the two last almost negligible quantities are given off, so that it is usually suificient to confine the analysis to the urine and the expired air. In proteids there is 16 per cent, of nitrogen to 54 per cent, of carbon, and hence in the excreta every gram of nitrogen derived from proteids must be accompanied by 3-4 grms. of carbon. Any carbon above this amount must be derived from the fats of the body during fasting, or from the fats and carbohydrates of the food. The data for such studies are these : â€"

N excreted x 6-2 = proteids used.

C (a) an amount equal to N x 3-4 is from proteids.

(&) all above this is from fats and carbohydrates, and during fasting from fats. The amount of fats is obtained by multiplying by 1-3.

In fasting, the breaking-down changes by which energy is lib- erated continue, but since no energy from without is introduced, the animal's own tissues are used. The rate of wasting depends simply upon the amount of energy required for Metabol- muscular work and for heat production ; an individual f^tlnn kept warm and at rest will endure a fast for a much longer period than one exposed to cold and compelled to carry on strenuous labour. In the course of a fast the tissues do not waste equally : the more essential live on the less essential. The heart muscle hardly loses weight, and it must therefore subsist upon the proteids of the less essential skeletal muscles, which lose consider- ably, in turn deriving their supply of energy from the stored fat of the body. At the commencement of a fast the rate of wasting is rapid, but after a

time it diminishes and the animal lives more economically, more especially as regards its proteids. This is weU shown bytlie observations made in a case of prolonged voluntary fast undertaken by an Italian : â€”

Day of Fast.

1st 10th 20th 29th

Fat Waste.

Proteid Waste. 104 grms. â€”

51 ,, 170 grms.

. 33 â€ž 1-0 â€ž

. 31 â€ž 163 â€ž

So long as fats remain, they are used in preference to the proteids, and it is only when they have nearly disappeared that the proteids are called upon to supply the energy. Taking food increases the work of the muscles and glands of the alimentary canal, and hence when an animal which has been fasting is fed, there is a rise in the excretion of carbon dioxide and nitrogen. If the animal has been wasting 33 grms. of proteid and 170 grms. of fat per diem, and if a diet containing these quantities be given, on account of the in- creased demand for energy in digestion, the food is insufficient to maintain the weight.

Certain organs of the body produce substances which are carried to the muscles and other tissues, and exercise an important influence on the chemical ’”“”f’ changes going on therein. (For information as **”” ‘”’‘ to the structure of these organs, see Anatomy.)

Thyroid Gland. â€” The removal of this structure leads to a train of symptoms which varies somewhat in different animals, but is essentially the same in nearly all. The connective tissues tend to revert to the embryonic conditions, and the amount of mucin increases. The

temperature falls, muscular tremors appear, the functions of the higher nervous system become sluggish, and the animal usually dies. By administering the substance of the thyroid, or by giving extracts of it, most of these symptoms may be delayed or prevented. When thyroid gland or extract is given to healthy animals in moderate doses, it causes an increased metabolism of both fats and proteids, and thus may induce emaciation. It would ap- pear as if one function of the organ is to produce this internal secre- tion, in order to regulate the rate of the metabolic processes in the body by increasing them when such an increase is desirable.

Ovaries and Testes.â€” It is well known that the removal of these organs causes characteristic changes in the animal, a tendency to the deposition of fat being produced and the activity of the central nervous system being somewhat modified. Several years ago Brown-S^quard maintained that by the administration of testicular substance the general effects of atrophy of these organs might be obviated ; and more recently, as a result of clinical experience, the administration of extracts of the ovaries has been said to relieve certain of the nervous symptoms which supervene on their removal

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or atrophy. It has been found, too, that ovarian substance when given to dogs, whether male or female, causes a marked increase in the rate of proteid disintegration, but no similar action has been found with testicular substance. There is thus evidence that the ovaries, like the thyroid, form an internal secretion having an im- portant action in accelerating the metabolism ; and it is at least probable that the testes produce a similar substance.

Pancreas. â€” That the pancreas is the most important of the digestive glands, has for long been known, but in 1889 von Mering and Minkowski demonstrated a further function. They discovered that

excision of the pancreas produces a condition of diabetes â€” an increase of sugar in the blood, the appearance of sugar in the urine, an increased excretion of nitrogen, and a general emaciation. These symptoms do not occur when the duct is tied or occluded, but they are invariable when a sufficient amount of the gland is cut away. They are not prevented by the administration of pancreas, either fresh or as extracts. In this condition sugar seems to be formed from the proteids, because it appears after all the glycogen has been removed, and its amount is proportionate to the amount of nitrogen excreted. Normally, proteids are a source of carbohydrates in the body, and it would seem as if the pancreas in some way exercises a restraining influence in this splitting of proteids, and that the removal of the organ permits it to occur to an excessive extent. Since the only respect in which the pancreas differs in histological character from the parotid gland â€” removal of which has no effect on the metabolism â€” is in the presence of epithelial islets, one is inclined to ascribe this action to them.

Pituitary Body. â€” Removal of this causes in oats and dogs a fall of temperature, lassitude, muscular twitchings, dyspnoea, and ultimately death. Injection of extracts of the substance is said to diminish these symptoms, but so far no study has been made of the influence of such injection on the metabolism of healthy animals.

Suprarenal Body. â€” Long ago Brown-S^quard stated that removal of these bodies causes great muscular weakness, loss of tone of the vascular system, loss of appetite, and finally death in a short time. Addison had already pointed out that a similar set of symptoms, accompanied by pigmentation of the skin, is associated with diseased conditions of these organs in man. Within the last few years it has been demonstrated that injections of small quantities of the central portion of the bodies has a powerful effect on the muscular system generally, and especially on the muscles of the vascular system, an enormous rise in the blood-pressure being produced. So far the influence of the suprarenal on the general rate of metabolism has not been investigated.

B. Blood and Lymph.

The blood circulates in a system of closed tubes, the smallest of which â€” the capillaries â€” form a network in the tissues and have their walls composed of a single layer of flattened endothelial cells. From the capillaries fluid escapes into the spaces between the tissue elements, to form the lymph. The lymph from these spaces is con- ducted by a series of tubes â€” the lymphatics â€” which, after passing through lymphatic glands, join together and finally enter the blood-stream just as the blood is return- ing to the heart. The whole arrangement resembles an irrigation system, the blood being comparable to the water in the trenches, the lymph to the water as it percolates through the soil.

The blood is a red fluid, having a bright cinnabar colour when oxygenated, and a dark, more purple hue when deprived of oxygen. In man its specific gravity is about 1060. Its reaction is alkaline .â€”the alkalinity corresponding to about 0-3 per cent, of carbonate of soda. It is opaque, on account of the presence of numerous pigment-containing cells, which float in a more or less colourless fluid, the plasma. These cells constitute about 48 per cent., the plasma about 52 per cent., of the blood, which when dried is found to contain 20 per cent, of solids, with 10 per cent, of blood pigment â€” heemoglobin â€” and about 8 per cent, of other proteids. Theremain- ing 2 per cent, is made up of other organic bodies and inorganic salts. The cells are of three kinds â€” Red, White, and Platelets. When shed, the plasma forms a jelly enclosing the cells, and the blood is said to have clotted. This process of clotting takes place at different rates in different animals and under different conditions. In man, under ordinary conditions, it occurs in about three minutes. The clot contracts and squeezes out a fluid â€” the blood-serum. The process is due to a change in at least one of the proteids of the plasma, of which there are three, Serum Albumen, Serum Globulin, and Fibrinogen â€” a globulin. Under the influence of various factors, when blood is shed the fibrinogen becomes changed into a stringy tough insoluble substance â€” ^Fibrin â€” which forms the clot. It is possible that the chief cause of the clotting is the breaking down

of white cells, with the liberation of a substance which may be called Fibrin Zymin.

The Plasma contains, in addition to the above proteids : (1) A small quantity (about 0-15 per cent.) of glucose, partly free and partly in organic combination, probably as jecorin ; (2) a small quantity of fat, varying in amount with the character of the diet, but present even in starvation ; (.3) traces of various, more or less simple, com- binations of nitrogen, the result of the disintegration of the tissues ; and (4) various inorganic salts, of which the most abundant is chloride of sodium, but the most important are the phosphate and carbonate of soda. When carbonic acid is not being poured into the plasma from the tissues, the soda is all taken up by phosphoric acid to form Na2HP04 ; but when carbonic acid is in abundance, it takes up a certain quantity, and bicarbonate of soda is formed. The way in which the carbonic acid is carried from the tissues to the lungs is considered under Respiration. As to the source of the constituents of the plasma : (i.) The water is usually ingested ; but when it is withheld, it is derived by the plasma from the tissues in which it has been stored, (ii.) The proteids are primarily derived from the food ; but whether the peptone formed during digestion and taken up by the white cells is liberated as albumen or globulin, or as both, is not known, although various attempts have been made to show that in starvation it is the albumen which is diminished. But the blood proteids are also derived from the tissues, and in starvation proteid is carried in the blood from one tissue to another, e.g., from the skeletal muscle to the heart muscle, and (in the salmon) from the muscles to the growing ovaries and testes, (iii.) The glucose and fats are derived from the food, but they may also be derived from the tissues in which they have been stored, (iv.) The urea and other nitrogenous substances are derived from the tissues, (v.) The salts are primarily derived from the food, but it is also possible that they may be given off from tissues in which they have been stored ; e.g., the phosphates stored in the muscle of the salmon pass to the ovaries and testes. The proteids, carbohydrates, and fats are used in the nourishment of the tissues, while the nitrogenous waste products are excreted.

Cells. â€” The source of the various blood-cells is described under Anatomy (9th edit.), and the chemistry and functions of the red cells and their pigment below under Respiration. That the life of the white

cells is short, is shown by the rapid appearance and disappearance of digestive leucocytosis. After a meal of meat the leucocytes in the dog may increase 100 per cent., and in five or six hours again fall to their normal number. It is more difficult to determine the life-duration of the red cell. That they are con- stantly breaking down, is shown by the constant excretion of bile pigment and urinary pigment, which are both derived from hsemo- globin. From the small amount of these pigments daily produced, it is certain that the red cells continue in existence much longer than the white cells. Whether they break down in the general blood- stream or in special organs, is not fully investigated. The salts of the bile acids are powerful solvents of red cells, and since these salts are absorbed from the intestine, it is probable that the solution of old red cells goes on in the portal system. Evidence has been adduced that the spleen also plays an important part in the process.

It is through the lymph that the blood is brought into relation- ship with the cells of the body. Lymph is a colourless or yellow fluid, resembling closely the blood plasma in all its characters. Its reaction is alkaline. It contains about i^yfp â– 6 per cent, of solids, though the amount varies in different parts of the body. About 1 per cent, is inorganic and about 5 per cent, organic. It is the latter constituents which vary in amount. The chief organic substances are the proteids. In the lymph of the limbs these amount to about 2 to 3 per cent., in the lymph of the intestine to 4 to 6 per cent., and in the lymph from the liver to 6 to 8 per cent. They are serum albumen, seKum globulin, and fibrinogen. On account of the presence of the last, lymph clots like blood under the influence of the factors, causing the change of fibrinogen to fibrin. The lymph in the tissue-spaces is prac- tically devoid of formed elements, but after it has passed through lymph-tissue it contains leucocytes in greater or lesser numbers. These are chiefly of the small round nucleated variety â€” the lympho- cytes. When the animal is on a fatty diet, the lymph from the intestine â€” the chyle â€” is rendered milky by the presence of fat in a fine state of subdivision. Within the last few years the origin of lymph has been much studied, and it has been shown to have a double source â€” first from the blood, and secondly from the tissues. Heidenhain thus speaks of Blood-Lymph and Tissue- Lymph. The former has for long been recognized, and it

was formerly regarded as an exudation from the capillary blood-vessels. Ludwig believed that the amount produced depended on the intra- vascular pressure ; but the fact that in the limbs where the blood-pressure is high, lymph-formation goes on very slowly, while in the liver, where pressure is low, it is very rapid, shows that intravascular pressure alone is not a sufficient explanation. Heidenhain considered that this absence of relationship between blood-pressure and lymph-formation indicated that the blood- lymph is produced by a process of secretion by the endothelium of

the vessels, and, in his opinion, the increased lympli-formation caused by the injection of extract of the muscle of the crab, by proteoses, &c., is due to an increased activity of the endothelium. Starling, on the other hand, points out that this secretion theory is unnecessary, and considers that lymph-formation is governed, first, by the varying permeability of the capillary walls in different parts of the body, and, secondly, by the pressure within the vessels. More lymph is produced in the liver than in the limbs, because of the greater permeability of the capillaries. The permeability is in- creased by injuring the vitality of the endothelial cells, as by inject- ing hot water; and, according to Starling, Heidenhain's so-called lymphagogues â€" crab's muscle, proteoses, &o. â€" act by poisoning the vessel walls, and by thus diminishing their resistance to the passage outwards of the plasma constituents. That lymph is formed by the withdrawal of water from the tissues, is shown by the injection into the blood of substances of high osmotic equivalent, such as sugar, neutral salts, &o. This causes not only a dilution of the blood, from the passage of water into the vessels, but also an increased forma- tion of lymph, which must of course come from the tissues. Sub-stances which thus produce an increased lymph-flow Heidenhain has called Tissue Lymphagogues.

C. Supply of Matter and Energy required by the Tissues.

The supply and intake of oxygen are dealt with under Eespikation, and the sources from which the necessary supply of proteids, fats, carbohydrates, and salts are pro- cured in the various food-stuffs are considered in the article Dietetics. Before these food-stuffs are available they have to undergo certain preparatory processes, either outside the body by cooking, or in the alimentary canal by digestion, the processes of which are very fully dealt â– with in the 9th edition (see Nuteition, vol. xvii.).

One of the most striking results of recent vyork on digestion has been to emphasize the importance of the pancreatic secretion as the essential digestive fluid. The salivary glands may be cut out with- out causing any change in the health of the animal, and the stomach may be excised without the individual mani- festing any marked disturbance, but exclusion of the pancreatic secretion from the intestine causes great altera- tion in, the digestion of all classes of food-stuffs.

The other main advances have been in the elucidation of the influence of the nervous system on the gastric and pancreatic secretion, and the more complete working out of the stages of the chemical changes in the food-stuffs which constitute digestion, and of tlie course and dura- tion of digestion in various parts of the alimentary canal.

Nerves of Digestion. â€" Pawlow, by dividing the cesophagus in the dog and bringing both divided ends out in the neck, was able to allow the animal to feed without the food reaching the stomach. He showed that this "pseudo-feeding" leads to a free flow of gastric juice. This reflex flow is brought about by the vagi, since it occurs after section of the splanchnios, but is stopped by section of both vagi. Stimulation of the lower end of the cut vagus by slow induction shocks brings about a flow of gastric juice after a somewhat prolonged latent period. That the vagus is the secretory nerve of the pancreas, as was indicated by the investigations of older physiologists, has been also more clearly demonstrated by Pawlow by the method of stimulating some days after section. Stimulation of the central end of the cut vagus, or of the lingual, brings about a reflex secretion, but, as shown by Popielski, the

vagus also contains efferent inhibitory fibres, so that it has a double action in the pancreatic centre.

Conrsif of Onstric' Digestion. â€" Numerous studies of the course of

Digestion.

HRS

Diagram illustrating the course of Gastric Dit'estion in Man. A, Solids in stomach â€¢ BB opening of pylorus ; C, amylolytio digestion ; D, peptic digestion ; E, total HCl ; F, combmed Â±101.

gastric digestion in man have been made by removing the contents of the stomach at various periods after a meal by means of a soft rubber tube. The result of these studies may be tabulated in the foregoing diagram. The steps by which the complex proteid mole- cules taken in the food are in the stomach broken down into the simpler peptone molecules, have arrested the attention of several chemists, some of whom have increased rather than dispelled the obscurities surrounding the problem. Neumeister, however, shows that the process may be divided into the following stages: â€" Native Proteid. Syntonin (Acid Proteate). Proto-proteose. Hetero-proteose.

\ /

Deutero-proteose.

Peptone. That a splitting of a large into smaller and smaller molecules takes place in the process, is shown by the proportion of metallic salts combining with these various bodies. The molecular weight of such a native proteid as egg albumen is probably no less than 15,000, that of its proto-proteose 2400, and of peptone 400. Thus six pep- tone molecules will be yielded by one of proto-proteose. It appears that the hetero-proteose molecule is about five or six times the size of the molecule of proto-proteose.

Curdling of Milk. â€” The way in which milk is clotted by the gas- tric juice has been considerably elucidated. It has been showU' that the casein occurs in milk as a neutral lime salt, and that a mineral acid splits this, taking the lime and causing the casein to- be precipitated. But under the action of rennin, in neutral or even in faintly alkaline solution, a lime salt of para^casein is set free, with a small amount of "whey albumen." This salt of para-casein is insoluble, and hence it separates as the curd. If lime salts are- precipitated, the process cannot go on. The para-casein is acted on by pepsin and hydrochloric acid, and is changed into proteose and para^nuclein, which very slowly splits into proteose and para- nuoleic acid containing phosphorus. The rennin or milk-curdling zymin of the pancreatic juice has a somewhat peculiar action. It. forms a granular precipitate at the body-temperature, which changes to a coherent curd when the milk is cooled. The process- is not prevented by the precipitation of the lime salts with oxalate of potash. The true chemical nature of the precipitate has not been studied.

Pancreatic Splitting of Proteids. â€" It has for long been known that pancreatic juice has a more profound action on proteids than the gastric juice ; that it does not merely reduce thein to the simplest proteid molecule â€" peptones â€" but that it breaks these down into, yet simpler molecules. Por long only two of these combinations, leucin and tyrosin, were known, but it has now been ascertained that these bodies may be classified as follows : â€"

Amido-Acids of

the Fatty

Bases.

Aromatic Bodies.

Other Bodies,

Acid gives

Amido-caproic

Tryptophan.

acid (leucin)

Diamido cap-

Methyl – guani-

roic acid

din-propi-

(lysin)

onic acid (lysatinin).

A mid 0 ~~valeri~~

Ammonia.

Para – oxy-

anic acid

phenyl-amido-

Amido-succinic

propionic acid

acid

(tyrosin).

Amido-py.ro-

tartaric acid

The main interest of this decomposition is the light it throws upon the constitution of the proteid molecule, nearly all the derivatives being

amidogen compounds.

Intestinal (S’cc?-(;fjon.â€” Investigations have proved that the great chemical action of the intestinal secretion is to convert disacoharids mto monosacoharids. Thus maltose is changed to dextrose, cane sugar to dextrose and Isevulose. Apparently, however, lactose is not split, although it undoubtedly is split before it passes into the blood. The secretion has also a slight diastatic action ; but as this IS possessed by all secretions containing mucin, and by nearly all the tissues, it is of no special importance.

J?Â«e.â€” The flow of bile, which begins in intra-uterine life, persists throughout life, even during protracted starvation; and while the taking of food increases it, the increase does not reach Its maximum for many hours. In these respects it differe from the other secretions poured into the alimentary canal. In man the amount secreted per diem is probably about 800 c.c. with.

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about]5 grms. of solids. Although the secretion of bile is not immediately connected with the taking of food, it is influenced by the character of the food. The most marked increase in secretion follows a proteid diet, the next most marked a fatty diet, the least marked a carbohydrate diet. Bile may leave the liver as it is secreted, or it may accumulate in the bile passages and gall bladder, to be expelled afterwards. For this reason the flow is very irregular, and is influenced by such factors as the pressure of the viscera upon the liver and the reflex stimulation of the nerve passing to the muscular walls of the bfle passages. The slight increased flow of bile immediately after the ingestion of food is due to this expulsion of bile.

The older analyses were made on bile taken from the gall bladder, where it appears to be concentrated from the absorption of water.

Various observations have now been made on bile escaping from a flstula, and these show that the percentage of solids usually given is too high. In such bile the solids amount to between 1-5 to 2-0 per cent., the inorganic solids being about 0-6 to 0-8 per cent. The salts of the bile acids are about 0-4 to 0-8 per cent., and are by far the most important organic constituents. That the salts are formed in the liver cells is demonstrated by the fact that when the liver is excluded from the circulation and the bile duct ligatured, they do not appear in the blood. In man the chief salt is glycocholate of sodium ; the acid of this salt splits into amido-acetic acid and cholalic acid. In dogs, taurocholate of sodium is the chief salt, and the taurocholio acid yields amido-ethane-sulphurio acid and cholalio acid (p. 725). Both, therefore, are amidogen compounds. These salts must therefore be derived from the proteid constituents of the tissues or of the food.

The pigments of the bile are iron-free, and are derived from the hsematin moiety of the haemoglobin molecule. They are formed in the liver cells, exclusion of the liver from the circulation preventing their appearance. Not only can the liver cells form these pigments, but they can take them, as well as other pigments, from the blood and excrete them. Cholesterin, the important constituent of most gall-stones, is formed within the liver, and not merely excreted by it. The investigations of Naunyn have led him to the conclusion that it is derived from the breaking down of the cells in the bile passages, and not from the liver cells. The fat and lecithin are apparently derived from the fats and lecithin always present in the liver tissue.

The action of the bile in digestion is of small importance, and its exclusion from the intestine does not seem to have a prejudicial effect, either on men or on animals. Its main, if not its only, digestive function is to act as adjuvant to the pancreatic juice. It dissolves the fatty acids freed by the fat^splitting zymin, and thus assists their absorption. For this reason exclusion of bile from the intestine markedly diminishes the absorption of fats, about 30 per cent, escaping. Bile, indeed, is not so much a digestive secretion as an excretion. This view is confirmed by the following facts: â€” (1) The small importance of bile in digestion. (2) The presence of a pigment, the result of breaking down of

haemoglobin. (.S) The chemical nature of the acids, indicating their origin from the decomposition of proteids. (4) The secretion of bile before birth and during starvation. (5) The absence of any immediate relationship of bile secretion to the ingestion of food.

Synopsis of Digestive Processes.

Section of Alimentary Canal.

Chemical Change.

Active Agent.

I. Mouth ....

Starch to maltose.

Ptyalin.

II. Stomach (first

1. Starch to maltose.

Ptyalin.

Jhr.)

2. Maltose to lactic acid.

Bacteria.

(Reaching maxi-

3. Proteids to peptone.

Pepsin and

mum in 3 or 4

HCl.

hrs.)

III. Intestine.

(a) Pancreatic secre-

1. Proteids to peptone.

Trypsin.

tion

2. Starch to maltose and

Amylopsin.

dextrose.

3. Fat to glycerin and

Pialin.

free acids (soaps).

4. Peptone to tyrosin,

&c. Disaocharids to mono-

Trypsin.

(6) Succus entericus

Zymin.

saccharids.

(c) Micro-organisms

(1) Small intes-

Sugar to organic acids.

B. lactis, &c.

tine

(2) Large intes-

Proteids to indol, &o.

B. coli com-

tine

munis, &c.

Micro-organisms in Digestion. â€” The micro-organisms of the alimentary canal have been extensively studied. A very large number of bacteria are swallowed in the saliva and with the food. How far their passage downwards is checked by the leucocytes which are poured out into the saliva from the lymphoid tissue of the tonsils, has not been definitely settled, but it is highly probable that it is sc checked. When the stomach is reached, the organisms swallowed. with the food continue to act, and thus sugar is changed to lactic acid ; but when free hydrochloric acid appears, the growth of nearly all organisms is checked, while some â€” e.g., the comma bacillus of cholera â€” are destroyed. Most of the organisms pass on into the intestine ; and as the free hydrochloric acid becomes combined and neutralized, the acid-forming organisms again become active and proceed to split up sugar, setting free lactic, acetic, and other acids, and so, by keeping the contents of the small intestine acid prevent the growth of putrefactive organisms. Under normal conditions the alkalis formed in the intestine gradually neutralize the acids produced ; and by the time the large intestine is reached, the putrefactive organisms are able to grow, and to split up the pro- teid molecule to form various aromatic bodies, such as tyrosin, indol, soatol, &c. Of the organisms of the large intestine, the

bacillus coli communis is by far the most constant and most abundant. The theory has been advanced that these organisms play an important part in digestion ; but by procuring foetal guinea-pigs directly from the uterus with aseptic precautions, and feeding them on sterilized food, it has been shown that micro- organisms in the intestine are of secondary importance.

Absorption of Food. â€” The portions of the food which are to be used in the metabolism are absorbed from the alimentary canal. As a result of digestion, the three proximate principles of the diet are changed â€” the carbohydrates to monosaocharids, chiefly dextrose, the proteids to peptones, and the fats to soaps, fatty acids, and glycerin. Absorption does not occur uniformly through- out the canal. Thus, while sugar and peptones are absorbed from the stomach, water is absorbed only to a small extent. That absorption is not due merely to a process of ordinary diffusion or osmosis, is clearly indicated by many facts. Heidenhain has shown that absorption of water from the intestine takes place much more rapidly than diffusion through a dead membrane. The relative rate of absorption of different substances does not follow the law of diffusion. Grilbler's peptone passes more easily through the intestine than glucose, but glucose passes more readily through parchment paper, while sodium sulphate, which is more diffusible than glucose, is absorbed much less readily. Again, as shown by Reid, an animal can absorb its own serum under conditions in which filtration into blood capillaries or lacteals, osmosis and adsoi-ption, are excluded ; and this absorption is stopped or diminished when the epithelium is removed, injured, or poisoned, in spite of the fact that removal must increase the facilities for osmosis and filtration.

There are two channels of absorption from the alimentary canal : the veins which run together to form the portal vein of the liver, and the lymphatics which run in the mesentery, and, after passing through some lymph glands, enter a receptaculum chyli in front of the vertebral column. From this the great lymph vessel, the thoracic duct, leads up to the junction of the left subclavian and innominate vein, and pours its contents into the blood-stream.

“While peptones are formed from proteids by digestion, they undergo a change in the intestinal wall before passing to the tissues. It is probable that they are taken up by the leucocytes of the adenoid tissue of the wall of the alimentary canal, since under a proteid diet these increase in number and stream away in the blood, to produce a digestive leucocytosis. By breaking down in the blood- stream they probably set free the proteids for use in the tissues. When an excess of proteids is taken in the food, it is broken down in the lining membrane of the gut, its nitrogenous part forming ammonia compounds. Its non-nitrogenous part may yield carbo- hydrates, since a proteid diet leads to the accumulation of glycogen in the liver. The, ammonia compounds are carried to the liver and there changed to urea, and excTeted as such, and thus the entrance of an excess of nitrogen to the tissues is prevented. It has been pointed out that gastric juice does not dissolve the phospho-proteids, but that they are dissolved by the pancreatic juice. The phosphorus is undoubtedly absorbed in organic combination, but the mode of absorption and the channels by which the blood-stream is reached have not been investigated. Though the chief monosaccharid formed in digestion is dextrose, others are also produced â€” ^from cane sugar laevulose, and from milk sugar galactose as well as dextrose. All these are absorbed in solution, and are carried away in the blood by the portal vein. It was for long thought that the fats are absorbed as a fine emulsion,’ but the most recent investigations seem to indicate that, after being split up into the component acids and glycerin, they pass, as soluble soaps or as the fatty acids soluble in the bile, through the borders of the intestinal epithelium. Here they appear to be again con- verted to fats by a synthesis of the acid with glycerin, and as fine fatty particles they are passed on from the cells, through the lymph

Action of liver.

tissue of the villus, into the central lymph vessels, and thus on through the thoracic duct to the blood-stream. Unlike the pro- teids and carbohydrates, they are not carried directly to the liver. The food thus absorbed may be used immediately as a source of energy, either for the construction or reconstruction of tissues, or for the production of mechanical work or heat. Or, on fc' "h rf ^^Â® other hand, it may be stored for future use in the food hody. Such storage takes place chiefly in three situa-

tions: (1) Fatty tissue ; (2) Muscle ; (3) Liver.

1. Storage in Fatty Tissues. â€" In most mammals the chief storage of surplus food is in the fatty tissues. That the fat of the food can be stored in them is shown by the fact that the administration of fats different from those of the body leads to their appearance in those tissues. Fats are also formed from the carbohydrates of the food. Feeding experiments upon pigs and other animals have definitely proved that sugary foods are changed to fat in the body and stored in that form. In fact, the conversion of cheap carbo- hydrates into the moye expensive fats is the basis of the profits of the grazier. When it is remembered that as much energy is stored in a pound of fats as in two pounds of carbohydrates, the advantage of this conversion becomes manifest. There is good evidence that in excessive proteid feeding the non-nitrogenous part of the proteid molecule may be stored as fat. It has been maintained that the evidence in favour of the formation of fats directly from pro- teids is unsatisfactory ; but since proteids do yield carbohydrates, and since carbohydrates form fats, it must be admitted that proteids may be a source of fats.

2. Storage in Muscle. â€" Some animals, as the salmon, store fats within their muscular fibres, but in mammals such a storage is limited in amount. The salmon also stores surplus proteid material in the muscles, and mammals too appear to do the same. How far a passive storage may occur is not known, but feeding experiments on mammals indicate that only a small amount of proteid can be accumulated. On the other

hand, the experience of athletic train- ing shows that the muscles may be enormously increased by building

“up the proteid of tlie food into their protoplasm.

3. Storage in the Liver. â€” The liver is the chief storehouse of carbohydrates in all animals, and of fat in some â€” e.g,, the cod.

It is a matter of interest that the liver develops as a digestive gland â€” as a couple of diverticula from the embryonic gut. But early in fcetal life it comes to have important relation- ship with the blood going to nourish the body from the placenta. The vein bringing the blood breaks up into a series of capillaries in the young I’ver, and in these capillaries for a considerable time the development of the red cells of the blood goes on. Soon the liver begins to secrete bile, while animal starch and fat begin to accumulate in its cells. Gradually the formation of red cells stops, and the mass of liver cells becomes larger in pro- portion to the capillaries. As the foetal intestine develops, the vein bringing blood from it â€” the portal vein â€” opens into the capillary network of the liver, so that, when at birth the supply of nourish- ment from the placenta is stopped, the liver is still associated with the blood bringing nutrient material to the tissues.

Claude Bernard discovered that there is a constant formation of sugar in the liver. Even when an animal undergoes a prolonged fast, the amount of sugar in the blood on account of this constant supply does not diminish. In starvation there are only two possible sources of this glucoseâ€” the fats and the proteids of the tissues. That fats can be changed to sugar in the liver was maintained by Seegen as a result of experiments in vitro, but his results have been questioned by subsequent investigators. That proteids are a source of sugary substances is shown by the accumulation of a starch in the liver in animals fed upon proteids ; it is therefore probable that in starvation the proteids of the body are broken down and their non-nitrogenous part changed to sugar. Not only does the liver manufacture sugar for the tissues in starvation, but when the sup- ply of sugar is in excess of the demands of the tissues, it stores it as a form of glycogen, and gives it out as sugar as this substance is required. On a carbohydrate diet the

accumulation of glycogen in the liver is very great ; but even on a proteid diet, in dogs at least, a smaller accumulation takes place. The observation that various monosacoharids are stored as the same form of glycogen, shows that they must first be assimilated by the liver protoplasm and then converted into glycogen. The mode in whicfli glycogen is again changed to sugar is more doubtful. The fact that the liver after treatment with alcohol can change glycogen to glucose has induced some physiologists to believe that it is by a zymin 'that this conversion goes on during life. But there is considerable evidence against this view ; and it is possible that the conversion results from chemical changes in the liver protoplasm, which are controlled by the nerves of the liver. If too much sugar passes from the liver, or if the tissues do not use up the sugar "produced it appears in the urine, and glycosuria occurs.

Though the fats are not carried directly to the liver, like proteids and carbohydrates, they are stored in large amounts in the liver of some animals, e.g., the cod among fishes and the cat among mam-

mals. It appears that animals which have little power of storing fat generally throughout the muscles and other tissues, have a marked capacity for accumulating it in the liver. Even in starva- tion the fats do not disappear from the liver, and throughout all conditions of life a fairly constant amount of lecithinâ€" a phosphorus and nitrogen containing fat â€" is present in the liver cells. There is good evidence that the lecithin is a stepping-stone in the formation of the more complex nuclein bodies of living cells ; and it is possible that, in the formation of lecithin in the liver by the synthesis of glycerin, fatty acids, phosphoric acid and cholin, the first steps in the construction of the nuclein are carried out. If this is so, the fat of the liver may play an important part in retaining and fixing phosphorus in the body. There is some evidence, though not con- clusive, that the liver fats may be formed from carbohydrates.

Along with the intestinal wall, the liver regulates the supply of proteids to the body. Study of the chemical changes in muscle has shown that the waste of proteid is normally small in amount, and that a great part

of the nitrogen is capable of being used again if a supply of oxygen and carbonaceous material is forthcoming. Hence the demand for nitrogen in the muscles is small ; and for this reason, apparently, any excess of proteid in the food is decomposed to ammonia compounds in the intestinal wall, and these are built into urea in the liver, to be thus excreted. After the splitting of the nitrogenous portion, the liver has the further power of turning the jion-nitrogenous part into sugar, and either sending it to the tissues or storing it as glycogen. How far it is also able to perform the initial splitting of the proteid molecule has not been determined, but that it can manufacture urea from proteids without the co- operation of the digesting intestinal wall, is indicated by the con- stant production of urea in starvation. With one special proteid â€" haemoglobin â€" the liver has important relations. The haemoglobin breaks down, and the proteid part, which constitutes about 96 per cent, of its weight, is further decomposed, and its nitrogen excreted as urea, while the pigmented haematin portion is deprived of its iron and excreted as bilirubin.

The functions of the liver as regards the general metabolism may therefore be summarized thus : â€" (1) It regulates the supply of glucose to the body, (a) by manufacturing it from proteids when the supply of carbohydrates is cut off, and (6) by storing it as glycogen when the supply of carbohydrates is in excess, and after- wards giving it off as required. (2) It regulates the supply of proteids to the body, along with the intestinal wall, by decomposing any excess and giving off the nitrogen as urea, &c. (3) It regulates, in many animals at least, the supply of fat to the body by storing any excess. (4) It regulates the number of hsemocytes by getting rid of waste haemoglobin and retaining the iron for further use.

D. Excretion. Though our knowledge of the various stages of the catabolism of protoplasm is defective, the end products are fairly well known. These are excreted from the body, sometimes in the form in which they leave the tissue producing them, sometimes after further modification. The carbon dioxide and water formed in the tissues are excreted by the lungs (see RespiexVtion, below) and by the kidneys and skin without further change. The creatin of muscle is dehydrated to

creatinin in the kidney before being excreted in the urine. As already pointed out, the various ammonia compounds are in theliver built up into urea or into diureides. That ammonia is a source of these diureides in birds, is shown by the fact that exclusion of the^ liver from the circulation in these animals leads to their disappearance from the urine, and to the appear- ance of lactate of ammonia in their place. How far in mammals the diureide molecule is derived solely from the splitting of nuclfic acid, is not yet definitely known. The chief channel of the excretion of the nitrogenous waste products IS the kidneys (see Anatomy). In spite "of many in- vestigations, the difficulty of fully and satisfactorily explaming the way in which urine is produced in ‘'â€¢’""y- them has proved insurmountable. What is actually known may be briefly summarized :â€" (1) The watery part of the urine IS produced by a process of filtration from the glomerular tufts. (2) Solids are also excreted from the glomerular tufts, since the fluid in the capsules is alkaline, and since such a pigment as sulph-indigotate of soda has been found in the epithelium covering the glomeruli. (3) The specific constituents of the urine are secreted by the epithelium of the convoluted tubules. (4) The convoluted tubules can also secrete water to a very considerable extent. This has been demonstratoil by Munk's experiments of stopping the secretion of urine from the glomeruli by section of the cord, and then injecting caffeine, urea, &c., and producing a flow of

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urine from tlie tubules. But the old problem, whether any water or solids are reabsorbed in the tubules remains unsolved, though it must be admitted that nearly all the evidence which appears to support this view equally supports the other view, that the urine is changed in the tubules by the addition of solids. The very high osmotic equivalent of the urine as compared with that of the blood plasma is certainly opposed to the view that there is a passage of water from the urine to the plasma, for to bring about such an absorption the cells would have

to do an amount of work so enormous that it is impossible to conceive that they accomplish it. The acid reaction given to the urine in its passage through the tubules may equally well be explained by the absorption of its alkaline constituents, or by the addition of such acids as phosphoric and sulphuric acid. Perhaps the only experimental support for this idea of absorption is to be found in the observation of Ribbert, that removal of the medulla leads to the production of a more watery urine. But some experiments by Francis Boyd have yielded results which do not corroborate those of Kibbert.

In connexion with the action of the kidneys, a very curious observation has been made by Eose Bradford : that if, after one kidney has been removed from the dog, portions of the second are cut out, an increased flow of urine takes place ; while if only about one-sixth of the total kidney substance is left, not only polyuria but an increased excretion of nitrogen, resulting from a rapid dissolution of the proteids of the body, chiefly of the muscles, occurs, and the animal dies in a short time. In all probability this is due to the accumulation of some toxic substance in the blood, and not, as has been suggested, to the formation of ah internal secretion by the kidney.

The 8kin is a channel of excretion of secondary importance com- pared with the lungs or the kidneys. By it are excreted in the sweat : â€" (1) Water. (2) Sodium chloride. (8) Nitrogen. (4) Carbon dioxide. (5) Various other sub.stances in small quantities. The excretion of water varies with the temperature, from less than 500 to probably over per diem. Of the nitrogen excreted in the sweat, about 68 per cent, is in the form of urea, the rest being in the form of ammonia. The cutaneous excretion of nitrogen may amount to between 4 and 5 per cent, of the renal excretion. The carbon dioxide varies in amount ; it probably does not usually exceed 9 grms. per diem, but under the influence of high tempera- ture may rise to over 20 grms. One special modification of cutaneous excretion is the production of millc. In the 9th edition of this Encyclopaedia the mode of secretion and the composition of milk are dealt with. The mode of secretion has not recently been investigated, but our knowledge of the composition of milk has been considerably extended. The chief proteid, caseinogen, is a pseudo-nucleo-proteid of

marked acid character, occurring in a neutral lime combination which is not precipitated on boiling. But whenever the lime combination is split up by an acid, the free caseinogen becomes precipitated. When acted on by the rennet- zymiu, caseinogen is split up into whey albumen and into para- caseinogen, which latter combines with the soluble lime salts of the milk to form an insoluble casein. This, with the entangled fats, constitutes the curd. The amount of phosphorus in caseinogen is small â€” only about ~~8 per cent. After separation of the caseinogen, milk is found to contain traces of an albumen and of a globulin. Phosphorus occurs in milk in two organic combinations other than caseinogen : (1) Phosphocarnio acid, a substance which splits into phosphoric acid and carnic acid, which, according to Siegfried, is identical with antipeptone ; and (2) Lecithin. It also occurs as in~~ organic salts of potassium, sodium, and calcium. The proportions of phosphorus in these different combinations vary much in different animals. The subjoined table shows that in human milk the greater amount of the phosphorus is organically combined; â€”

Per Oentage of Phosphorus as P^Os.

Other organs of excretion^

3000 c.c.

Organic.

Inorganic.

Total.

Per Cent, of Organic.

Human .

Cow Goat

P^Oj.

0-04 0-076 0-13

0-b07

0-074 0-16

P2OB.

0-047 0-150 0-290

50 41

From the various mucous membranes, but chiefly from the mucous membrane of the bowel, a certain excretion of water, mucus, and various salts takes place. In some herbivora the ex- cretion of phosphates by this channel occurs, to the exclusion of their excretion by the kidneys. Certain salines given as drugs are also got rid of by the lining membrane of the bowel.

The Liver as a channel of excretion has been already considered.

(d. n. p.)

Chemistry of Animal Body.

The following is an account of the chemistry of some of the more important substances that occur in the animal body : â€”

A. Anastates. â€” Substances -which take part in the constructive (anabolic) processes in protoplasm : â€”

1. Carbohydrates. â€” These are aldehydes or ketones, and de- rivatives of these formed by polymerization and dehydration. They are for the most part derived from the members of the parafBn series, containing six carbon atoms (hexoses) ; but derivat- ives of the pentatomic alcohol (pentoses) have been derived from nucleins. The hexoses are derived from three hexacid alcohols isomeric with one another â€” mannitol, dulcit(fl, and sorbitol, CeHuOo. From the first the sugar mannose is formed ; from the second, galactose ; and from the third, dextrose. The ketone of mannite is IsBvulose. Dextrose, or a

body closely resembling it, has been prepared synthetically by the polymerization of formaldehyde.

The simplest carbohydrates constitute the group of mono- saccharids, of which dextrose, the sugar of the animal body, is the most important. They are crystalline substances, readily soluble in water and in hot alcohol, and are fermented by ordinary yeast, yielding alcohol and carbonic acid, and by various micro- organisms, e.g., the Bacillus lactis, giving lactic acids. They are readily oxidized in alkaline media ; when boiled with caustic potash, they take up oxygen from the air and become brown from the development of acids (Moore's test). If cuprio oxide is pres- ent, the oxygen is taken from this, and it is reduced to cuprous hydrate (Trommer's and Fehling's test). "With phenyl-hydrazin they each form a crystalline compound, an osazone, by which their presence is readily recognized.

Glycuronic acid, COH-(CH – 0H)4-C00H, is closely related to dextrose, and on oxidation yields the same acid, saccharic acid, and may be prepared from this by reduction. It does not occur free in the body, but is formed under the administration of various drugs, with which it combines, e.g., camphor, and a large number of aromatic bodies like benzoic acid. These compounds appear in the urine ; and since many of them are oxidized when boiled with caustic potash, they reduce Fehling's solution.

The monosaccharids polymerize with the loss of water, thus â€" C6Hi206-l-C6Hi206=Ci2H220ii-t-H20, aud disaccharids are pro- duced. The most important of these are cane sugar (dextrose and Icevulose), lactose (dextrose and galactose), and maltose (dextrose and dextrose). These rotate the plane of polarized light to the right, and break up into their component monosaccharids when boiled with an acid. Maltose and lactose are readily oxidized when boiled with an alkali, but cane sugar is not so oxidized.

By further polymerization and loss of water the group of poly-saooharids n (CsHioOs) is produced, which form a series of bodies commencing with substances of very slightly higher molecular weight than the disaccharids, and extending up to the various starches, &c.,

which have probably a very large molecule. 1’hese most complex molecules are readily broken down by the action of acids, &c., and the series of bodies intermediate between them and the sugars are the dextrins, formed from starch, and the laevulins, formed from inulin. In physiology the most important members of this group are animal starch or glycogen, and vegetable starches and cellulose.

2. Fats. â€” These are ethers, formed by replacing the H of the HO molecule, usually of the triatomic alcohol glycerin, by the radicals of the fatty acids, which are derived by the oxidation of the various alcohols of the paraffin series. The acid with 16 atoms of carbon (palmitic = Ci6H3202) and the acid with 18 atoms of carbon (stearic=Ci8H3602) enter into the formation of the fat of mammals. Oleic acid (= C18H34O2) , a member of the less saturated acid series, is the most abundant acid in the fat. The fats all give a peculiar “oily” sensation, and leave a characteristic stain on various textures. They are insoluble in water, soluble in ether, chloroform, benzene, &c., also in hot alcohol. “When dissolved in hot alcohol, palmitin and stearin crystallize out as the alcohol cools in the so-called margarin crystals. The melting-point varies according to the fatty acid which is present ; thus olein melts at 5Â° C, palmitin at 45Â° C, and stearin at about 60Â° C- The olein at the temperature of the human body holds the two other fats in solution. They are readily split into glycerin and the character- istic fatty acid, and these may be broken down into fatty acids lower in the series under the action of putrefactive organisms, thus : â€”

CaHsOa-fOg = Propionic acid.

C2H402-fC02-|-H20.

Acetic acid.

In the body of man and other animals certain fats occur which, are ethers of other alcohols than glycerin. Thus lanolin is the ether of the monatomic alcohol oholesterin (C26H43OH), which is soluble in ether and in hot alcohol, and crystallizes from the latter in characteristic rhombic plates. Lanolin, which occurs in the

secretion of the sebaceous glands, combines with water and resists putrefaction in a marlied manner. Spermaceti is the palmitate of cetyl alcohol, and beeswax the ether of oerotyl alcohol with cerotic acid. Lecithin is a fat in which one molecule of the radical of the fatty acid is replaced by phosphoric acid linked to trimethyl- oxyethyl-ammonium-hydroxide (cholin).

C3H5J0.C17H36O â€¢(O. fO.H

(CH3)3^N. HOj It is soluble in alcohol and ether, and swells up in water. It readily splits up intoÂ»glycero-phosphorio acid, fatty acids, and cholin.

3. Proteids. â€” These bodies are of unknown constitution, but ‘they contain the elements carbon, hydrogen, oxygen, nitrogen, and usually sulphur (sometimes also phosphorus in about the same percentage amounts), and give certain characteristic reactions. They constitute by far the greater part of the solids of all matter which has been living, and it is for this reason that they are named Proteids, or first substances. Drechsel gives the percentage com- position thus: â€”

C . . . 50-0to55‘0

The nature of

H

N O

s

the comi;

6-8 â€ž 7-3 15-4 â€ž 18-2

22-8 ,, 24-0 0-4 ,, 5-0

pounds formed with metals, and the difficulty with which they dialyse through animal membranes, indicate that the proteid molecule is very large. Drechsel studied the magnesia compound of one of the vegetable proteids, and puts the molecular weight at 2757, while another investigation of a similar compound of ordinary albumen indicated a molecular weight of 1496. All that is known of the empirical formula is that in albumen it is not smaller than CY2H112N18O22S, and very possibly the molecule is three times as large. What the constitution of the simplest possible proteid molecule may be has not been determined. We know that when the molecule is broken down, certain products are constantly formed. Among these are : Amido-aoids of the fatty acid series, e.g,, leucin (amido-caproic acid) ; amido acids of the benzene series, e.g,, tyrosin ; and certain ureides, having six carbon atoms, e.g. , lysatinin. According to Kossel, the simplest type of proteid is to be found in a series of bodies which are linked with nucleic acid in spermatozoa. These Protamins, when decom- posed, take up water and yield the bases above referred to. They do not, however, yield the amido acids which are derived from ordinary proteids, and Kossel regards these as existing in ” side chains” to the elementary protam in molecule. The proteids may be recognized by a number of tests, of which the most generally useful is the Xanthoproteic reaction. When boiled with nitric acid they decompose, with the formation of certain aromatic bodies, which give a brilliant orange colour with ammonia.

The proteids form a series of polymerization products of their simplest molecule, and the various members of the series differ from one another in their solubility and in their rate of diffusion.

Of the “simple proteids,” (ra) peptones are the lowest members in the series. They are very soluble, dialyse readily, are not coagu- lated by heat, and are not precipitated from their solution by saturation with ammonium sulphate. They polymerize, to form a series of (6) proteoses, which are not coagulated by heat and are precipitated in a saturated solution of ammonium sulphate. The lower members of the series, those

most near the peptones, which are not precipitated by sodium chloride, are called the deutero proteoses. The higher members, which are precipitated by that salt, are the protoproteoses. (c) Native proteids, on coagulation by heat, form coagulated proteids, and are precipitated by saturated ammonium sulphate. They do not readily dialyse through an animal membrane. When acted upon by acids or by digestive juices, they break down into proteoses, and finally into peptones. Two varieties are known : Albumens, which are soluble -in distilled water, and are not so readily precipitated by neutral salts as the second variety; and Globulins, insoluble in distilled water, soluble in weak solution of neutral salts, and readily precipitated by stronger solutions.

The members of these various groups of proteids tend to link to various other bodies, to form what may be called the “combined proteids.” According to the nature of the molecule with which they are linked, these may be classified into the following groups :â€” (o) Glycoproteidsâ€”a, number of proteids, on treatment with acid, yield various sugar-like bodies, and some investigators have thought that there is a carbohydrate element in the proteid molecule. But since from many of the proteids no sugary substance can be prepared, we must consider that the carbohydrate molecule is simply linked to the proteid, possibly forming what Kosael has

called a side chain.

the substance which gives viscosity to the saliva. (6) Ferro- proteids â€” proteids combined with an iron- containing molecule. The best-known of these is the colouring matter of the blood, haemoglobin, which consists of about 96 per cent, of a globulin linked with about 4 per cent, of hsematin. (For the chemistry of hemoglobin see Pigments, below.) (c) Phospho-proteids â€” pro- teids combining with a phosphoras-containing molecule â€” may be divided into two classes : Nucleins, where the proteid is linked to nucleic acid, which on decomposition yields phosphoric acid and the purin bases ; and Pseudo-nucleins, which on decomposing yield a proteid and a phosphorus-containing acid, the latter readily splitting, to yield phosphoric acid but no purin bases, (d) Phosplw- ferro-proteids, in which the proteid is linked to

both a phosphorus and an iron-containing molecule, are illustrated by the vitellin of the yolk of egg. (c) Sulpho-proteids are proteids to which a con- siderable amount of sulphur â€” 3 to 5 per cent. â€” in loose combina- tion is attached. Keratin, the substance composing horn and the outer layer of the skin, is of this nature. (/) Acid and Alkaline Proteids â€” Acids and alkalis form combinations with proteids, which are of importance in the process of digestion.

Two peculiar modifications of this proteid group do not find a definite place in this classification : â€” (a) Elastin, the substance composing elastic fibrous tissue, which has all the characters of an insoluble proteid, but is free from sulphur ; and (^) Collagen, the substance composing white fibrous tissue, which may be re- garded as a combination between a proteid and amido-acetic acid (glycocoU) . It yields this latter substance in large amount when heated with an acid. Collagen readily combines with water, to form the well-known gelatin, and with chondroitinsulphuric acid, to form chondrin, the substance of cartilage. This acid is a compound of sulphuric acid with chondroitin, C18H27NO14, which decomposes into acetic acid and chondrosin, and which yields, on further decomposition, glyouronic acid and glycosamin.

B. Catastates, the substances formed by catabolism of protoplasm in the body, and not further used by it as sources of energy.

I. Non-Nitrogenous Bodies of the Fatty Add Series.

1. Carbonic di-oxide (0 = C = 0), the substance in which the greater part of the carbon is excreted in the expired air.

2. Fatty acids. â€”

Oxalic acid, 0 O

II II (Hâ€” 0â€” Câ€” Câ€” 0â€” H) , is found in urine as the oxalate of lime. It is chiefly derived from the oxalates in the food, but there is some evidence that it is formed in proteid catabolism. Lactic acid is a hydroxy-propionic acid, H OH 0

Hâ€” Câ€” Câ€” Câ€” 0â€” H.

A

It occurs in the aniinal body in two isomeric forms. Ordinary lactic acid is obtained by the lactic acid fermentation of sugars, as in the souring of milk. It is a fluid of syrupy consistence, and is optically inactive. Sarcolaotic acid is the acid formed in muscle. It is a syrupy fluid, which rotates the plane of polarized light to the right. /3 Oxybutyric acid, H H HO

I I I 11 Hâ€” Câ€” Câ€” Câ€” Câ€” OH,

I I I H OHH is found in the urine in starvation, in diabetes, and in certain other pathological conditions. It is derived from the decomposition of proteids. Aceto-acetic acid, H 0 H 0

I ” I 11 Hâ€” Câ€” Câ€” Câ€” Câ€” OH,

i 1,

occurs in the urine in the same condition as oxybutyric acid. Aceton (the ketone of secondary propyl alcohol), H O H

H-(^-C-6-H,

Jl i

occurs m the urine along with the last two in the same circum- stances.

II. Nitrogenous Substances not of the Benzene Series. (1) Ammonia and the Amines. â€”

Ammonia (NH3) is formed in the tissues and in the intestine, probably as the lactate. It is constantly present in the urine in

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small quantities, and its amount is increased under various patbo-logical conditions of the metabolism.

Hydroxy-ethy 1-trimethy 1-ammonium-hydroxide (oholin) , OH
CHas,^ I

CHs-^Nâ€” C2H4.OH, CH3/

is formed in the disintegration of nerve tissues, being liberated from the lecithin molecule. It is a toxic substance. Neurine appears also to be formed.

OHH H

ch8\n-(!;=c(

CHs/ \h

(2) Amido Acids. â€” Amido-acetic acid (glycocoU or glycin), H 0

1 11

NH2â€” Câ€” Câ€” OH,

I

H occurs in combination with cholic acid, forming the glycocholic acid of the bile. Amido-ethyl-sulphonic acid (taurin), H H O

I I II NH2â€” Câ€” Câ€” Sâ€” OH,

I I 11

H H 0

occurs in combination vpith cholio acid, forming the taurocholic acid

of the bile. In the bile acids these are linked with cholic acid,

C24H40O6, a substance of tmknown constitution.

Disulphide of amido-propionio acid (cystin),

NH2

HsC

-i

-CO-OH

HsC

‘-L

CO-OH

NH,

occurs in traces in urine, and is increased in certain pathological conditions. It crystallizes in hexagonal plates. u. Amido-caproic acid (leucin),’

H H H H NH2O

I J. I J. J, II Hâ€” Câ€” Câ€” Câ€” Câ€” Câ€” OH,

I I I I I H H H H H is formed in the pancreatic digestion of proteids, and appears in the urine in certain conditions. It crystallizes in characteristic oily- looking spheres.

Di-amido-caproic acid (lysin) is a basic substance, also formed in the decomposition of proteids by pancreatic juice. (3) Amides. â€”

Carbamide (urea), 0

11

H2Nâ€” Câ€” NH2, is the chief substance in which nitrogen is excreted in all vertebrates except the sauropsida. It crystallizes in long prisms, and is very soluble in water and alcohol. “With nitric and oxalic acid it forms in- soluble salts. It readily takes up water, to form carbonate of ammonia. When heated dry it forms cyanic acid, CN.OH, which polymerizes to cyanuric acid, CsNsHsOs. In the process biuret is formed. OHO II I II H2Nâ€” Câ€” Nâ€” Câ€” NHo. “With caustic potash and sulphate of copper this strikes a pink colour. “With sodium hypboromite in excess of alkali, or under the action of nitrous acid, urea splits into nitrogen, carbonic acid, and water. By substituting NH for the 0 of urea, Ouanidin is formed.

NH

11

H2Nâ€” Câ€” NH2.

It does not occur in the body, but is the basis of various important

substances.

(4) Ureides are combinations of urea and guanidin with acids.

Oxaluric acid, 0 H 0 0

II I II II H2Nâ€” Câ€” Nâ€” Câ€” Câ€” OH, occurs in small traces in urine.

Methyl-guanidin-acetic acid (creatin, C4H3N3O2),

NHCHsH 0

II I I II H2Nâ€” Câ€” Nâ€” Câ€” Câ€” OH,

I H

is a constant constituent of muscle. Creatinin is creatin which has lost a molecule of water and assumed a ring structure â€” NHCHsH

II I I Câ€” Nâ€” Câ€” H

Hâ€” Nâ€” C=0 It is a normal constituent of the urine, and is crystalline and a powerful base.

Methyl -guanidin -propionic acid (lysatin) and lysatinin, CaHi3Na02, are homologues of creatin and creatinin, formed from proteids in pancreatic digestion.

(5) Diureides are formed of two molecules of urea linked through an acid chain. The most important are the Purin bases, derived from a double ring of five darbon and four nitrogen atoms, called by risoher the Purin Nucleus.

11

Nâ€” Câ€” Nâ€”

I I

C=Câ€” C =

I I

â€” N Nâ€”

\/

C

II The hypothetical bond here is acrylic acid â€” an unsaturated propionic acid,

H OH

oi>C-C=C-OH

0

I H

From the Purin Nucleus are derived, according to the degree of oxidation of the acid â€” Oxypurin (hypoxanthin),

H

I N=Câ€” Nâ€” H

0=0â€”0=0

I 1 N Nâ€” H

â€¢^/ Câ€” H

0

II Hâ€” Nâ€” Câ€” Nâ€” H

6=0â€” C=0

dioxypurin (xanthln).

and trioxypurin (uric acid),

N Nâ€” H

Câ€” H

0

H=Nâ€” Câ€” Nâ€” H

6=C~C=0

I 1 Hâ€” N Nâ€” H

\/

C

II

0

By the introduction of amidogen, amino-purin (adenin) is formed,

H

=Câ€” N

N

C=Câ€” Câ€” NH2

I I

N N ^H

Y-:

726

and amino-oxypurin (guanin),

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NH,

N=Câ€” N

i=câ€” c=o I i

N Nâ€” H

Vh

Hypoxanthin and xanthin occur in small quantitiesjn urine and in various organs. Uric acid, a dibasic acid (NaHU'~~H2U), is a soluble crystalline substance which occurs in small quantities, prob~~ ably as sodium quadrurates, iu the urine of mammals, and in large quantities in the urine of birds and reptiles. In birds, at least, it is in part formed in the liver from lactate of ammonia. In part it may be derived from the decomposites of nucleic acid. In mammals this is probably its chief source. Adenin was obtained by Kossel from the pancreas. Guanin is very widely distributed throughout the animal kingdom, occurring in the urine of birds, in the scales of fishes, and in many tissues, as the pancreas, liver, &o.

Allantoin is the diureide of glycoxylic acid.

0

II Hâ€" Nâ€" Câ€" NH2

Hâ€" C â€" 0 = 0

I i Hâ€" N Nâ€" H

\/

C

II

0

It is a characteristic constituent of the allantoic and amniotic fluids and of fatal urine, occurring also in the urine of the dog after the administration of uric acid and of nuclein. It crystallizes in small hexagonal prisms.

III. Benzene Derivatives.

Benzamido-acetic acid (hippuric acid), 0 H H O

. I I ~~Câ€” Nâ€” C~~

ICsHsl I

is formed by the union'of benzoic acid and amido-acetic acid in the body. The former is derived from the food, the latter is formed in the body from proteids.

Ortho-dioxy-benzene (pyrocatechin) .

Câ€” OH,

occurs as an ethereal compound with sulphate of potassium, OH.C6H4.0-S020K. Urine containing this, if exposed to air, especially if it be alkaline, becomes greenish brown or almost black. When boiled with an alkali, it reduces cupric hydrate.

Inosite is a substance which used to be called muscle sugar, but which has probably the constitution â€"

OH

OHâ€" I

OHâ€" I

Indol,

soatol (methyl indol),

and phenol.

/\J-

are substances formed by the action of putrefactive organisms upon proteids in the intestine. When absorbed, each is linked to sulphate of potassium, the two former after oxidation. Thus from indol, potassium indoxyl sulphate (indican) is formed â€" â–

0â€” SO2.OK From scatol the scatoxyl sulphate of potassium is similarly pro- duced ; and from phenol, potassium phenyl sulphate â€”

0â€” SO2.OK

These are excreted in the urine. Indican when oxidized yields indigo blue, while the scatoxyl sulphate yields a reddish pigment. Oxy-quinoline-carboxylic acid (kynurenio acid) has probably the formula â€”

H 0

I II

C = Câ€” Câ€” OH

C(,Hi I I

\Â° V-N=Câ€” OH

and is a derivative of phenyl propane,

H H H

.iJ-H I I I -H H H

It occurs in the urine of the dog, from which it may be crystal- lized in long white needles by evaporating and acidulating. a. Hydroxy-phenyl-amido-propionic acid (tyrosin), H0-/\ H^^HaO

\/ I I H H

is a product of the pancreatic digestion of proteids which crystallizes in sheaves of small acicular crystals, which are found in the urine in certain pathological conditions of the liver.

Pigments.

In this class are grouped, somewhat artificially, a number of substances, characterized by giving, even when present in very small quantities, to the tissue of fluid in which they occur a more or less marked colour. Their chemical nature is, generally speaking, little understood. They may be divided into lipo- ohromes, blood pigments, and the waste pigments of the urine, faeces, and bile.

Lipochromes form a large group of pigments, varying from yellow to red in colour, and very widely distributed in plants and animals. Their name is due to their frequent association with fat. Their chemistry has been most carefully investigated in the carotin of the carrot ; and, according to Khring, they are of the nature of oholesterin fats, but it is very probable that other members of the series have a different chemical nature. JIany of these pigments are readily bleached by light, and it is probable that the visual purple (rhodopsin) which occurs in the outer segments of the rods of the retina belongs to this class.

Blood Pigments. â€” The pigment of the blood, hsemoglobin, is a compound of about 96 per cent, of a globulin with about 4 per cent, of a brown pigment, Hsematin. The latter contains iron, and has the formula CiiHsENiFeOc. It gives a different spectrum in acid and in alkaline solutions, and in alkaline solution it can take up and give off oxygen. By mineral acids the iron may be removed, leaving a purplish pigment, Hfcmatoporphyrin, which has no power of taking up or giving off oxygen. This pigment is, under certain conditions, formed in the body and excreted in the urine. It is closely allied to the bile pigments. Htemoglobin, as pointed out in the section on Respiration, readily takes up oxygen, to form two compounds -, one â€” very unstableâ€” Oxy-hsemoglobin, of a bright red colour ; the other, very stable, of a brown colour, Methffiinoglobin. It also forms compounds with other gases, most notably with carbon monoxide.

Waste riiimei'ils.—j. Of BUe. â€"The bile contains n set of pig- ments closely allied to hajmatoporphyrin, of which the best known is Bilirubin, the probable formula of which is CioHisN-Os, but the constitution of which is unknown. It is an orange-brown sub- stance which crystallizes in rhombic plates, and is very readily oxidized,

forming a series of pigments. One of these, Biliverdin, Ci6Hi8No( )4, has a green colour and gives the characteristic hue to the bile of herbivora.

B. Of Urineâ€” OwT knowledge of the chemical affinities of most

of these pigments is veiy deficient. We know that normal yellow urine may undergo changes in colour on standing, and we know that in the fresh condition it does not give any definite bands in the spectrum. From this fresh urine a pigment, Urochrome, may be extracted, a brown hygroscopic substance which gives no definite spectral bands. By treating pure uroclirome with a mild reducing agent, such as aldehyde, another colouring matter is developed, which gives a very definite band near FraunhofSr's line 1? in the spectrum. This is Urobilin, a pigment which, either in the coloured form or as a colourless material capable of yielding the coloured form, is present in the urine in health in small quantities, and in certain pathological conditions in larger amounts. It is probably identical with the pigment of the ffeoes, and with the Hydrobili- rubin (probable formula C82H40N4O7) which Maly prepared from bilirubin. Uroerythrin is the pink pigment which gives the characteristic colour to deposits of urates. It is extremely unstable, and its chemical nature is unknown. Hsematoporphyrin is normally excreted in very small quantities in the urine, but in certain patho- logical conditions it is increased, and gives to the urine a dark brown colour. Its chemical afBnities have been already indicated. The following table of the pigments of the blood, bile, urine, and faeces, shows their relations: â€"

Methsemoglobin. Oxy-hsemoglobin. Carbon-monoxide-haemoglobin.

Globin

Alkaline â€” Hsematin â€” Acid.

Oxidized.

Reduced. . I . .

Iron-con- taining.

- Iron-free.

H^matoporphyrin. Bilirubin. Hydrobilirubin. Biliverdin. Urobilin. &c. Urochrome.

(d. n. p.)

III. Animal Heat.

Experience has long taught mankind that animals can be divided into two classes, the ” warm-blooded ” and the ” cold-blooded.” The first group, composed of the higher animals, mammals and birds, is characterized by the possession of a high bodily temperature; whereas the members of the second class, which consists of the lower animals, reptiles, amphibians, fishes, and invertebrate animals, have a temperature practically the same as that of their surroundings. This difference is one that can be recognized by our sensations of heat and cold, and we are conscious that we belong to the warm-blooded class. Our sensations, however, are not an exact guide ; we judge our own bodily temperature and that of other objects from the impression of heat or cold imparted to the nerves of our skin. The temperature of the skin may be low, owing to the presence of a smaller quantity of blood than usual ; and hence will arise the impression of cold. We feel cold although the general heat of our body may be perfectly normal. A patient in the shivering stage of a fever looks cold and feels cold, although his internal temperature is at fever heat ; on the other hand, in the sweating stage he perspires profusely and complains of feeling hot at a time when his internal temperature may be even below the normal point. In the former case the skin is cold and bloodless, owing

to the contracted blood-vessels ; in the latter the skin is very hot and red, with distended blood-vessels. We need therefore a much more exact measure of heat, and such we have in the thermometer (Thermometry). With that instrument we can compare accurately the temperatures of different animals and of man in health and disease, but it is necessary that care be taken in the selection of the part of the body in which the observation is to be made. The most suitable parts are those which afford a measure of the heat of the internal portions of the body, such as the bowel (rectum), the urine as it issues from the body, the arm-pit {axilla), the groin, and the mouth. The thermometer should be retained until the column of mercury becomes stationary. By numerous observations upon men and animals, John Hunter showed

that the essential difference between the so-called warm- blooded and cold-blooded animals lies in the constancy of the temperature of the former, and in the inconstancy of the temperature of the latter. He defined the two groups as ” animals of a permanent heat in all atmospheres ” and ” animals of a heat variable with every atmosphere.”

In the following table are compared the internal tempera- tures of man and some of the warm-blooded animals : â€”

Animal.

Mammals

‘Man .

Horse

Cow .

Sheep

Dog .

Cat .

Rabbit

Mouse

Monkey ‘Common Fowl

Pigeon Sparrow

Average Rectal Temperature.

Deg. 0. (Deg.

37-0 (98′ 37-9 ” 38-6 40-0 38-6 38-7 39-2 .37-4 38-4

(100 (101 (104 (101 (101 (102 (99 (101

41-6 (106 40-9 (105′ 42-1 (107′

F.1

60)

H’

5′ 0′ 5′

1

3) 1)

9) 6)

8)

Kange of Temperature in Healtli.

Deg. C, (Deg, Â¥.)

36-2-37-8 (97-1-100) 36-1-38-6 (97 -101-5) 37-7-39-6 (99-8-103-3)

38-5^1-8 (101-.3-107-2)

37-1-39-9 (98-8-103-8)

37-9-39-7 (100-2-103-4) 37-0-40-8 (98-6-105-4) 36-1-38-6 (97 -101-5) 36-9-39-7 (98-4-103-4)

40-6-43-0 (105-1-109-4) 40-0-425 (104-0-108-5)

Lower Animals. â€” Since the temperature of cold-blooded animals varies with and in the same direction as that of their surroundings, its determination would be incomplete without a simultaneous observation of the air or water in which they live.

Animal.

Temperature of Animal.

Temperature of Surroundings.

Deg. C. (Deg,, F.)

Deg, 0. (Deg. F.)

Python ....

24-4 (76-0)

15-6 (60-1)

Frog . . . . [

17-2 (63-0)

16-7 (62-0)

8-9 (48-0)

6-7 (44-0)

Trout ... 1

14-1 (58-0)

13-3 (55-9)

5-6 (42 0)

4-4 (39-9)

Shark ....

25-0 (77-0)

23-7 (74-6)

Crab

22-2 (72-0)

22-2 (72-0)

Leech ....

13-9 (5.7-0)

13-3 (55-9)

Locust ....

22-2 (72-0)

16-7 (62-0)

The data contained in this table show that there is no constant temperature for the cold-blooded animals, and that some members of the group often possess an internal heat considerably above that of their surroundings. The temperature of bees in their hives is often many degrees above that of the air outside ; a female python maintains

a high temperature when she is coiled round her eggs during the period of incubation. In fact, it is now known that there is no hard and fast line between the cold- blooded and warm-blooded animals. As the Darwinian theory of evolution would suggest, there has been a gradual development of the power of maintaining a constant tem- perature. The lowest mammals, such as the marsupials, possess a temperature much below that of the higher members of the group; thus the echidna has an internal temperature of 27-6Â° C. (81-5Â° F.), the duck-billed platypus (OrnitJiorhyncJius) one of 32-0Â° C. (89-6Â° F.). Hibernating mammals, such as the marmot, hedgehog, and dormouse, during their winter sleep resemble cold-blooded animals ; mammals born in a state of immaturity, naked, blind, and helpless â€" as are rats and rabbits â€" resemble cold-blooded animals in many respects, and on exposure to even moderate cold cannot maintain their temperature at the constant level characteristic of the adult. The chick, a warm- blooded animal, passes through a cold-blooded stage during its development within the egg.

Variations in the Temperature of Man. â€" A careful study of the internal temperature of man and of other warm- blooded animals shows that the heat of the human body is not absolutely constant even in health, but undergoes

slight changes. These fluctuations are caused by various conditions. There is a daily variation in temperature; during the day â€" the period of activity and work â€" the heat of the body rises ; during the night â€" the hours of inactivity and sleepâ€" the temperature falls. The range of this variation is about 1-2Â° C, (2-2Â° F.), the maximum being generally reached about five o'clock in the after- noon, the minimum about two or three o'clock in the early morning.

Curve of the Daily Variation in the Temperature of a Healthy

Breakfast between 8 a.m. and 9 a.m. Average mean, 37 ‘01Â°. Lunch â€ž 1 p.m. and 2 p.m. Highest mean, 37-54Â°.

Dinner ,, 7 p.m. and 8 p.m. Lowest mean, 36-25Â°.

Tea (about 5 p.m.) not regularly taken.

The causes of this daily variation are to be sought in the greater activity of the body during the day, for if the temperature be observed in men who constantly work

Hours of activity and work.

Hours of rest and sleep.

by night and sleep by day, a reversal of the fluctuation is found. This facit alone would suggest that muscular exercise is the important factor in increasing the heat of the body. This source of heat is generally recognized by mankind : in cold weather the body is kept warm by a more energetic walk, by more rapid and more forcible contraction of the muscles than obtain in summer. If this n^itural safeguard against cold be resisted by an effort of the will, the sensation of cold may become so great and imperative that involuntary contractions of the muscles begin, the teeth chatter, and the body shivers and shakes. This increased muscular activity is accom- panied by increased chemical changes and a greater production of heat in the muscles. Thus the injurious effect of cold is resisted. On the other hand, the athlete knows that prolonged and violent muscular effort would raise the temperature of the body so much as to cause great discomfort or actual injury, if he did not increase greatly the loss of heat from his body by discarding much of his ordinary clothing. Muscular exercise even under these conditions increases the internal heat of the body; the rectal temperature rises to 38Â° C. (100-4Â° F.) without causing any distress or discomfort. This in- creased heat from muscular work is most important, although often overlooked. It is responsible for much of the ” falling out ” and so-called ” sunstroke ” in soldiers marching in close order and unsuitable clothing on a hot day. The immediate effect of food is a slight rise in the internal temperature of the body. Mental

work is accom- panied by a slight fall in temperature, owing probably to the concomitant decrease in muscular activity. The temperature of the air has little or no effect upon the internal heat of the body ; in the height of summer and the depth of winter, in the tropics with a temperature of 40Â° C. (104Â° F.) in the shade, and in the Arctic regions

with the thermometer indicating fifty degrees of frost, the temperature of healthy men is practically the same.

Limits compatible ivith Life. â€” Although the tempera- ture of warm-blooded animals is so constant during health, in disease great variations above and below the normal occur. In men poisoned by “drink” and exposed to cold, the internal heat of the body may fall as low as 24Â° C. (76-2Â° F.), and yet recovery from this unconscious condition may follow careful treatment and nursing. In severe fever the temperature may rise to 46Â° C. (113Â° F.) without a fatal result, but above this point death almost invariably occurs. In cold-blooded animals, however, the limits of temperature compatible with life are wider. Fishes and frogs may be frozen and still live if they are carefully thawed. During Franklin’s explorations in the Arctic regions, it was observed that a carp, which had been frozen for thirty-six hours, was able after it was thawed to leap about with much vigour.

Regulation of Temperature. â€” The warm-blooded animals maintain so constant a temperature under such diverse conditions of external heat and cold, that they must possess some power of regulating the internal heat of their bodies. Two processes are comprised, regulation of the production and of the loss of heat. In cold weather the production of heat within the body is increased by greater muscular activity and the consumption of a larger quantity of food ; the loss of heat is diminished by a contraction of the cutaneous blood-vessels, the skin becomes pale, and thus less blood is exposed to the cold surroundings. On the other hand, in hot weather muscular activity is less marked, less food is taken, and the body is cooled by the evaporation of sweat and the exposure of more blood in the dilated blood-vessels of the skin. In man the loss of heat is regulated also by the

amount and nature of the clothes, and many animals develop special coats of fur for

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their protection against cold, and shed part of these coats on the approach of warm weather. The perfection of this regulation is shown by the fact already mentioned, that the temperature of man and of other warm-blooded animals is practically the same, whether they are living in the Arctic regions with such severe cold as 56Â° C. (-67Â° P.) below zero, or in the tropics with the temperature of the air 69Â° C. (138Â° F.). The experiments of Blagden and Fordyce show that even greater heat can be borne for a short time, if the air be dry : they remained fifteen minutes in a dry room heated to 116Â°-126Â° C. (239Â°-259Â° F.), in which beefsteaks were being cooked by the hot air ; they sweated profusely, but their temperature was not raised above the normal.

Nervous Control. â€” The regulation of temperature is controlled by the nervous system, apparently by the cortical portions of the brain. Drugs, such as alcohol, morphia, chloroform, and ether, which in large doses paralyse or depress the activity of the nervous and muscular systems, disturb the regulation of temperature so much that in some cases the warm-blooded man or animal is reduced to a cold-blooded condition, cannot maintain a constant temperature, and soon dies. The nervous system controls not only the production of heat by impulses carried down the motor nerves to the muscles, but also the loss of heat, regulating through the vaso-motor nerves the diameter of the small blood-vessels, and con- sequently the distribution of blood to the superficial and deep portions of the body. Further, it controls the dis- charge of sweat, the evaporation of which cools the body ; it adjusts the rapidity and depth of breathing â€” an important process in the regulation of the loss of heat, for the air driven out of the lungs has been raised almost to the temperature of the body, and is saturated

with moisture which has evaporated from the respiratory tract. In some animals this factor is the essential one. Dogs breathe very rapidly, with open mouth and lolling tongue, when they suffer from heat ; and if this natural means of cooling be prevented, as by a tight muzzle, their temperature rises much above the normal, and they suffer great discomfort and actual injury.

Sources of Animal Heat. â€” The real source of animal heat is now known to be a combustion or oxidation within the tissues of the body. The animal takes in food, which on combustion within the tissues of the body manifests its energy chiefly in two forms, heat and motion. Different foods have different values as producers of heat ; thus one gramme (15-4 grains) of dry meat produces in the body about 4000 calories, or suflftcient heat to raise 4000 cubic centimetres (7 pints) of water one degree; similar weights of dry sugar and fat yield on combustion about 4180 and 9400 calories respectively (see the section on Ebspieation and the article on Dietetics). A consideration of the law of conservation of energy would lead to the conclusion that the sole cause of animal heat is a chemical process, a combustion of food substances by the oxygen taken in hj the animal. Eubner has shown by prolonged and careful experiments that in animal heat this great law is true. The following values may be given for the heat value of the daily diet of an adult man : â€”

120 grammes proteid x4000 calories = 480,000

90 ,, fat X9423 â€ž = 848,070

330 â€ž carl)ohydratex4182 â€ž =1,380,060

2,708,130 calories.

Calculations and experiments show that an adult man produces in twenty-four hours nearly 3,000,000 calories, or enough heat to boil about five or six pints of water ; at the same time there is a continuous loss of heat, so care- fully regulated that the internal temperature of the body remains constant.

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IV. Vascular System.

A schematic representation is given of the circulatory system in the accompanying diagram. (For the detailed structure see Ency. Brit, 9th ed., vol. xxiv.) The venous blood flows into the right auricle principles (EA) from the superior vena cava and the otthecir- inferior vena cava.

The right ventricle (EV) “”’^t’””- drives through the lungs the blood received from the right auricle. The right auriculo-ventricular valve, or tri- cuspid, and the pulmonary semi-lunar valve are represented directing the flow of blood in this direction. From the pul- monary capillaries the blood returns by the pulmonary veins (PV) into the left auricle (LA), and so through the left auriculo-ventricular or mitral valve into the left ventricle (L V) . By the left ventricle the blood is driven through the aortic semi-lunar valve, and is distributed to the systemic arteries, and so to the capillaries of the various organs and back to the veins. The muscular wall of the auricles and that of the right ventricle are, as represented in the diagram, much thinner than that of the left ventricle. This is so, because the energy required of the left ventricle must exceed that of the right ventricle, inasmuch as the resistance in the systemic system exceeds that in the pulmonary circuit. The pulmonary vessels are of greater diameter, and the circulation through them is aided by the respiratory movements. The large arteries are of less capacity than the corresponding veins, and their walls are essentially extensile and elastic. The pulmonary arteries are especially extensile.

The elastic coefficients of the several layers of the coat of an artery increase from within out, and thus great strength is obtained with the use of a small amount of material. Over-expansion of the arteries is checked by an external coat of inextensileconnectivetissue. The elasticity of a healthy artery is almost perfect, while the breaking strain is very great and far above that exerted by the blood pressure. The small arteries and arterioles are essentially muscular tubes, and can, under the influence of the central nervous system, vary considerably in diameter. The “tone” of these vessels also directly depends on the quality and pressure

of the blood. The arterioles open into the capillaries, and these are so numerous that each organ may be regarded as a sponge full of blood. The skeletal muscles and the muscular walls of the viscera at each contraction express the blood within them, and materially influence the cir- cvdation. The whole muscular system, as well as the heart, must therefore be regarded as a pump to the vascular system. The capillary wall is composed of a single layer of flattened cells, separating the blood within from the tissues without. Through this layer, which is of extraor- dinary tenuity, there takes place an exchange of material between the blood and the tissues, an exchange which does not exactly follow any of the known laws of filtration, osmosis, or diffusion, but depends on the physico-chemical conditions which characterize the living state of the cells. These conditions still await elucidation. The capillaries, in spite of the extreme tenuity of their walls, can, owing to their small diameter (y^ mm.), with- stand more than double the blood-pressure produced by the systole of the heart. (The cir- cular tension equals the lateral pressure multiplied by the radius ; the longitudinal tension is equal to half this product.) The veins are of larger calibre than the corresponding arteries, and have tough and inextensile walls. Their walls are muscular, and contract on local stimula- tion. There is no clear evidence, except in the case of the portal vein, that the veins are directly controlled by the central nervous system. The veins are not, as a rule, distended with blood to their full potential capacity. The latter is so great that the whole blood of the body can collect within the veins.

The heart and lungs are placed within the thoracic cavity (T), the floor of which is formed by Scn'^'raopTnEoiEouLATioNOF the

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the muscular diaphragm (JD) ; The venous system is stippled, the heart is itself enclosed in a tough inextensile bag, the peri- cardium (P), the function of which is to check over-dilatation of the heart. The pericardium bears to the muscular wall of the heart the same relation as the leather case of a football does to the bag within. The abdominal organs and blood- vessels are encompassed by the muscular wall of the abdomen (A), and may be regarded as enclosed in a sphere of muscle.

Above is the dome of the diaphragm (T), and below the basin-like levator ani, closing the outlet of the pelvis ; in front are the recti muscles, behind the quadrati lumborum and the spine ; while the oblique and transverse muscles complete the wall at either side. The brain is enclosed in a rigid and unyielding box of bone â€” the cranium, while the limbs are encom- passed by the extensile and, in health, taut and elastic skin.

If the vascular system were formed of wide tubes, free from constrictions, each systolic pulse-wave would travel with so great a velocity that the whole system would reach the same pressure before the next systole of the

C, rigid cranial wall ; N", muscles and cutaneous wall of neck ; T, thoracic wall ; A, muscular and cutaneous wall of abdomen ;

D, diaphragm ; L, muscles and cutaneous wall of limbs ; P, pericardium; AO, aorta; S.V.C, l.V.O, venae cavae ; P.V, portal vein ; V, valves in veins of neck, or legs ; EA, LA, right and left auricles ; EV, LV, right and left ventricles.

heart occurred. This is not so, for the friction of the blood flowing through the arterioles prevents it from passing through with anything like the velocity of the pulse-wave. The pulse-wave travels, in fact, 8 metres per second, while the blood in the arteries travels \ metre. The resistance to flow is chiefly situated, not in the capillaries, but in the small arteries, where the velocity is high ; for " skin friction " â€" that is, the friction of the moving concentric layers of blood against one another and against the layer which wets the wall of these blood-vessels is proportional to the surface area and to the viscosity of the blood â€" is nearly proportional to the square of the velocity of flow, and is inversely proportional to the sectional area of the vessels. Owing to the re- sistance to the capillary outflow, the large arteries are expanded by each systolic output of the heart, and the elasticity of their walls comes into play, causing the outflow to continue during the succeeding diastole of the heart. The conditions are such that the inter- mittent flow from the heart is converted into a con- tinuous flow through the capillaries. If the arteries were rigid tubes, it would be

necessary for the heart to force on the whole column of blood at one and the same time ; but, owing to the elasticity of these vessels, the heart is saved from such a pro- longed and jarring strain, and can pass into diastolic rest, leaving the elasticity of the distended arteries to maintain the flow. As a result of disease, the elastic tissue may degenerate, and the arteries become rigid. It has been well said that "a man is as old as his arteries." Besides the saving of heart-strain, there are other advantages in the elasticity of the arteries. It has been found that an intermittently acting pump maintains a greater outflow through an elastic than through a rigid tube ; that is to say, if the tubes be of equal bore, ffidema and obstruction to the circulation quickly arise if the blood be delivered to an organ from a constant head of pressure in place of an intermittently acting pump. To maintain an efficient artificial circulation through a " surviving organ," the period of systole must be made, as in nature, half as short as the period of diastole, so delicately attuned are the finer vessels to this periodic wave motion.

Suppose, in an animal lying in the horizontal pos- ture, the heart be arrested, e.g,, by stimulation of the vagus nerve, then the arteries, owing to their elastic resilience and contractility, continue to drive the blood through the capillaries. The blood, under the influ- ence of gravity, collects in the venous system, fiUs the right side of the heart, and congests in the capil- laries in the most dependent parts of the body. So soon as the heart starts again to beat, the blood is taken from the venous system and piled up in the arteries, for at each systole of the heart a greater quantity of blood IS driven into the arteries than can escape through the capillaries. With each succeeding systole, therefore, the blood-pressure mounts in the arteries, while the venous pressure cannot sink below the atmospheric pressure, in spite of the continued abstraction of blood, for the flaccid walls of the veins collapse. After the first few strokes of the heart, a condition of equilibrium is established as the outflow through the capillaries, during the period of each cardiac cycle, becomes equal to the volume of blood expelled by the heart at each systole. The con- tinuous flow of blood thus established through the capil- laries is due to the difference between the blood-pressure m the arteries and that in the veins. The energy im- parted to

the mass of blood expelled at each systole IS spent m overcoming the resistance and is dissipated into heat. The potential energy of the blood is indicated by the lateral pressure ; the kinetic energy varies as the

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square of the velocity of flow. The lateral pressure is reduced from HO mm. of mercury in the arteries to 30-40 mm. in the capillaries, while the velocity of flow dimin- ishes from 300 mm. per second in the arteries to 1 mm. per second in the capillaries. The kinetic energy of the systolic output is thus reduced to (^^y of its value in the aorta. In the veins the lateral pressure continues to fall, while the velocity increases until in the venae cavee it reaches a value not less than half that in the aorta. The increase of kinetic energy in the veins is due partly to the change of potential into kinetic energy, but chiefly results from other sources of energy, such as the com pressive action of the skeletal muscles, the influence of gravity, and the action of the respiratory pump.

In each unit of time the same quantity of blood must, on the average, flow through the lesser and greater circuit, for otherwise the circulation would not continue. Likewise, the average velocity at any part of the vas- cular system must be inversely proportional to the total cross-section at that part. In other words, where the bed is wider, the stream is slower ; the total sectional area of the capillaries is roughly estimated to be 700 times greater than that of the aorta or vense cavee. Any general change in velocity at any section of this circuit tells both backwards and forwards on the velocity in all other sections, for the average velocity in the arteries, veins, and capillaries, these vessels being taken respect- ively as a whole, depends always on the relative areas of their total cross-sections.

The velocity of flow can be determined in any organ by inject- ing salt solution into an artery, and observing, with the aid of a Wheatstone's

bridge arrangement, the galvanometric change in electrical resistance which occurs in the corresponding vein when the salt solution reaches it. The moment of injection and that of the alteration in resistance are observed with a stop-watch (Stewart).

The venous side of the vascular system, owing to the great capacity of the veins, is not filled to distension, while many of the capillaries in each organ are empty and collapsed, except at those periods of vaso-dilatation and hypersemia which accompany extreme activity of function. The vascular system cannot be regarded as a closed system, for the blood-plasma, whenever the capil- lary pressure is increased, transudes through the capillary wall into the tissue-spaces and enters the lymphatics. Thus, if fluid be transfused into the circulatory system, it not only collects in the capacjous reservoirs of the veins and capillaries â€" especially in the lungs, liver, and abdom- inal organs â€" but leaks into the tissue-spaces. Hence the pressure in the vascular system cannot be raised abo-se the normal for any length of time by the injection of even enormous quantities of fluid. The lymphatics of tissue-spaces must be regarded as part of the vascular system. There is a constant give and take between the blood-plasma and the tissue lymph. If the fluid part of the blood be increased, then the capillary transudation becomes greater, and the excess of fluid is excreted from the kidneys and glands of the alimentary canal. If the fluid part of the blood diminish, then fluid passes from the tissue-spaces into the blood, and the sensation of thirst arises, and more drink is taken. The vascular system is especially con- structed so that considerable changes of pressure may be brought about in the arterial section, without any (or scarcely any) alteration of the pressures in the venous or pulmonary sections of the circulatory system. A high- pressure main (the arteries) runs to all the organs, and this is supplied with taps ; for by means of the vaso-motor nerves which control the diameter of the arterioles, the stream can be turned on here or there, and any part flushed with the blood, while the supply to the remaining parts is kept under control. Normally, the sum of the resist- ances which at any moment opposes the outflow through

the capillaries is maintained at the same value, for the vas- cular system is so co-ordinated by the nervous system that dilatation of the arterioles in any one organ is compensated for by constriction in another. Thus the arterial pressure remains constant, except at times of great activity.

The mean arterial pressure can be measured in man with con- siderable accuracy by means of the sphygmometer of Hill and Barnard. Fluid pressure is applied to the radial or brachial artery by an apparatus which indicates on a scale the size of the pulse- oscillations and the pressure employed to compress the artery. The pressure is read on the scale at the point where the pulse- oscillations appear to be maximal, for the wall of the artery oscillates most freely when the mean pressure within and without the artery are the same. The measurements are made with the arm on the same level as the heart, in order to avoid the iniluence which gravity exerts on the blood pressure. The normal mean arterial pressure is 100-110 mm. Hg. In a healthy man it is slightly higher in the erect than in the recumbent posture. The pressure rises to 120-150 mm. of mercury during bodily exertion or mental excite- ment, and falls to 95-100 mm. during rest in the recumbent posture or during sleep. By the same instrument the venous pressm'e can be ascertained. The instrument is applied to one of the veins at the back of the hand, the' vein emptied, and the pressure noted at' which the vein fills with blood.

The Circulation during Muscular Activity. â€" The great splanchnic area of arterioles acts as " the resistance box " of the arterial system. By the constriction of these arterioles during mental or muscular activity the blood- current is switched off the abdominal organs on to the brain and muscles, while by dilating during rest and digestion they produce the contrary effect. The constric- tion of the splanchnic vessels does not sensibly diminish the capacity of the total vascular system, for the veins possess little elasticity. Thus variations of arterial press- ure, brought about by constriction or dilatation of the arterial system, produce little or no effect on the pressure in the great veins or pulmonary circuit. Owing to this fact, the diastolic, or filling, pressure of the heart varies but slightly, while the arterial pressure is, at times of great effort, considerably raised, both by the increased energy of the

heart and by vaso-constriction. It is obvi- ously of the utmost importance that the heart should not be over-dilated by an increased filling pressure during the period of diastole.

When a man strains to lift a heavy weight he closes the glottis, and by contracting the muscles which are attached to the thorax, raises the intrathoracic pressure. ‘ The rise of intrathoracic pressure aids the pericardium in support- ing the heart, and prevents over-dilatation by resisting the increase in blood pressure. This increase results from the powerful and sustained contraction of the ab- domimal and other skeletal muscles. In the diagram it is clear that the contraction of T will counteract the con- traction of A. At the same time the rise of intrathoracic pressure supports the lungs, and prevents the blood, driven out from the veins, from congesting within the pulmonary vessels. Over-dilatation both of the heart and lungs being thus prevented, the blood expressed from the abdomen is driven through the lungs into the left ventricle, and so into the arteries. So long as the general and intense muscular spasms continue, there is increased resistance to the outflow of the blood through the capillaries both of the abdominal viscera and the limbs. The arterial pressure rises, therefore, and the flow of blood to the central nervous system is at first greatly increased. The rise of the intrathoracic and intra-abdominal press- ures, and the sustained contraction of the skeletal muscles, alike hinder the return of venous blood from the capil- laries to the heart, and, owing to this, the face and limbs become congested until the veins stand out as knotted cords. It is obvious that at this stage the total capacity of the vascular system is greatly diminished, and the pressure in all parts of the system is raised. It is

during sueli a muscular effort that a degenerated vessel in the brain is prone to rupture and occasion apoplexy. The venous obstruction quickly leads to diminished dias- tolic iilling of the heart, and to such a

decreased velocity of blood-flow that the effort is terminated by the lack of oxygen in the brain. During any violent exercise, such as running, the skeletal muscles alternately contract and expand, and the full blood of the circulation flows through the locomotor organs. The stroke of the heart is then both more energetic and more frequent, and the blood circulates with increased velocity. Under these conditions the filling of the heart is maintained by the pvimping action of the skeletal and respiratory muscles. The abdominal wall is tonically contracted, and the reserve of blood is driven from the splanchnic vessels to fill the dilated vessels of the locomotor organs. The thorax is tonically elevated and the thoracic cavity en- larged, so that the pulmonary vessels are dilated. At each respiration the pressure within the thoracic cavity ~~becomes less than that of the atmosphere, and the blood is aspirated from the veins into the right side of the heart and lungs ; conversely, at each expiration the tho~~ racic pressure increases, and the blood is expressed from the lungs into the left side of the heart. While the respiratory pump at all times renders important aid to the circulation of the blood, its action becomes of supreme importance during such an exercise as running. The runner pants for breath, and this not only increases the intake of oxygen, but maintains the diastolic filling of the heart. It is of the utmost importance that man should grasp the fact that the circulation of the blood depends not only on the heart, but on the vigour of the respiration and the activity of the skeletal muscles. Muscular exercise is for this reason a sine qud non for the maintenance of vigorous mental and bodily health. Under the influence of the muscular system comes not only the blood but the lymph. The lymphatics form a subsidiary system of small valved vessels, and drain the tissues of the excess of lymph, which transudes from the capillaries of the organs during functional activity, or in consequence of venous obstruction. The larger lym- phatics open into the veins at the root of the neck. It is chiefly by the compressive action of the skeletal and visceral muscles, and the aspirating action of the respira- tory pump, that the lymph is propelled onwards. It must be borne in mind that the descent of the diaphragm during inspiration compresses the abdominal organs, and thus aids the aspirating action of the thorax in furthering the return to the heart both of venous blood and of lymph.

Influence of Posture on the Circulation. â€” The circulation remains efficient not only in the horizontal but also in the erect position, and just as much so when a man, like a gymnast, is ceaselessly shifting the position of his body. Yet in a man standing six feet the hydrostatic pressure of a column of blood reaching from the vertex to the soles of the feet is equal to 14 cm. of mercury. The blood, owing to its weight, continually presses downwards, and under the influence of gravity would sink if the veins and capillaries of the lower parts were sufficiently exten- sile to contain it. Such is actually the case in the snake or eel, for the heart empties so soon as one of these ani- mals is immobilized in the vertical posture. This does not occur in an eel or snake immersed in water, for the hydrostatic pressure of the column of water outside balances that of the blood within. During the evolution of man there have been developed special mechanisms by which the determination of the blood to the lower parts is prevented, and the assumption of 4he erect posture rendered possible. The pericardium is suspended above by the deep cervical fascia, while below it is attached to

the central tendon of the diaphragm. Almost all dis- placement of the heart is thus prevented. The pericar- dium supports the right heart when the weight of a long column of venous blood suddenly bears upon it, as, for example, when a man stands on his head. The abdominal viscera are slung upwards to the spine, while below they are supported by the pelvic basin and the wall of the abdomen, the muscles of which are arranged so as to act as a natural waist-band. In tame hutch rabbits, with large patulous abdomens, death may result in from 15 to 30 minutes if the animals are suspended and immobilized in the erect posture, for the circulation through the brain ceases and the heart soon becomes emptied of blood. If, however, the capacious veins of the abdomen be conflned by an abdominal bandage, no such result occurs. Man is naturally provided with an efficient abdominal belt, although this in many is rendered toneless by neglect of exercise and gross or indolent living. The splanchnic arterioles are maintained in tonic contraction by the vaso- motor centre, and thus the flow of blood to the abdominal viscera is confined within due limits. The veins of the limbs are broken into short segments by valves, and these support the weight

of the blood in the erect posture. The brain is confined within the rigid wall of the skull, and by this wall are the cerebral vessels supported and con- fined when the pressure is increased by the head-down posture. Every contraction of the skeletal muscles com- presses the veins of the body and limbs, for these are confined beneath the taut and elastic skin. The pressure of the body against external objects has a like residt. Guided by the valves of the veins, the blood is by such means continually driven upwards into the venae cavae. If the reader hangs one arm motionless, until the veins at the back of the hand become congested, and then either elevates the limb or forcibly clenches the fist, he will recognize the enormous influence which muscular exer- cise, and continual change of posture, has on the return of blood to the heart. It becomes wearisome and soon impossible for a man to stand motionless. When a man is crucified â€" that is to say, immobilized in the erect pos- tureâ€" ^the blood slowly sinks to the most dependent parts, oedema and thirst result, and finally death from cerebral anaemia ensues. In man, standing erect, the heart is situated above its chief reservoir â€" the abdominal veins. The blood is raised by the action of the respiratory move- ments, which act both as a suction and as a force pump, for the blood is not only aspirated into the right ventricle by the expansion of the thoracic cavity, but is expressed from, the abdomen by the descent of the diaphragm. When a man faints from fear, his muscular system is relaxed and respiration inhibited. The blood in conse- quence sinks into the abdomen, the face blanches, and the heart fails to fill. He is resuscitated either by compres- sion of the abdomen, or by being placed in the head-down posture. To prevent faintness and drive the blood-stream to his brain and muscles, a soldier tightens his belt before entering into action. Similarly, men and women with lax abdominal wall and toneless muscles take refuge in the wearing of abdominal belts, and find comfort in pro- longed immersion in baths. It would be more rational if they practised rope-hauling, and, like fishermen, hardened their abdominal muscles.

The Heart-Beatâ€" The rhythmic systole and diastoles of the heart are the result of oscillations between processes of catabolism and anaholism, which take place in its chemical structure. The function of the heart is fundamentally an automatic one. The rhythmic beat is not

excited by stimulation from without, but is provoked by the chemical condition of the sarcoplasm of the cardiac muscle itself, and this in its turn ultimately, but not immediately, depends on the rate of flow and the quality of the blood which circulates through the coronary vessels. During diastole the production of synthetic compoundsâ€” the hypothetical

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“inogens” of Hermann â€” is, it is supposed, puslied to the maxi- mal limit of instability until there results, in the ensuing systole, an explosive liberation of energy. The autonomy of the heart is shown by the fact that the mammalian heart continues to beat for hours if fed through the coronary vessels with warm oxygenated defibrinated blood. If oxygen be supplied to the excised heart, at a tension of two atmospheres, a very small quantity of blood is sufficient to maintain activity (Porter). It is clear, therefore, that there is in the heart a large reserve supply of explosive material. Similarly, the excised and bloodless heart of the cold-blooded animal, if merely kept cool and moist, continues to beat for hours and even days. The beat of the heart does not, therefore, depend on excitations received from the central nervous system, and nei- ther does it emanate from a rhythmic activity of these ganglion cells which lie scattered in the cardiac muscle at the base of the heart. That this is so Is shown by the fact that every bit of the heart muscle, whether free of ganglion-cells or not, is capable, under suitable conditions, of rhythmic activity (Gaskell, Engel- mann. Porter). The inherent power of rhythmic contraction is most clearly seen in the embryonic heart, for the pulsation of the chick’s heart becomes visible by the twenty-fourth to the forty- eighth hour of incubation, while the migration of ganglion-cells into the heart from the sympathetic system does not take place until the sixth day (His, jun.). In an automatic organ, such as the heart, it is the accumulation of the explosive bioplasm which, in itself, unassisted by any external stimulus, provokes explosion. The anatomical elements of the heart are singly- or

doubly-nucleated, branched, and cross-striated muscle-cells. In contradistinction to cross-striated muscle, the structural unit of the heart is not also a functional unit, for the hearl^cells are, from the earliest stage of development, joined together by branches into networks and bands so as to form one functional whole, and hence excitation of any one part leads to the contraction of the whole. The first part to begin to functionate in the embryo is the venous end, and the waves of contraction passing thence spread over the developing ventricular /> segment. The muscle-cells of the ventricles are thicker, less sarco- plasmic, and more clearly striated than the auricular muscle, which is more embryonic in structure. The contraction lasts longer in the ventricular than in the auricular muscle, while the automatic rhythm not only persists longer in the auricles, but is of a greater frequency, as is clearly seen when the cavities of the heart are divided from each other. The venous orifices of the heart are least sensitive to injury, beat longest after death, and are the first to recover after arrest. Owing to the more powerful automatism of the venous extremity, the contraction normally proceeds thence, and, passing as a peristaltic wave over the auricles and ventricles, finally reaches the arterial orifices. This peristaltic form of con- traction is invariable in all periods of development and in all hearts both of invertebrate and vertebrate animals. The peristalsis may, with difficulty, be artificially reversed by the application of a pow- erful rhythmic stimulus to the ventricular end. Antiperistalsis does not, however, take place easily, because the comparatively slow excitation process in the ventricle has little effect on the auricular muscle. The latter, by initiating more rapid contrac- tion-waves, over-dominates the former. The frequency of the whole heart is accelerated by warming the auricles, while the period of systole is alone shortened on warming the ventricles. The segmentation of the cardiac contraction into auricular and ventricular systole depends upon certain muscle-cells, of embryonic type, which bridge the otherwise complete septum of connective tissue that divides the auricles from the ventricles (Kent, His). These fibres are endowed with a sluggish power of conductivity, and hence the peristaltic wave is at this point resisted and retarded. There is no convincing evidence in support of the view that the excitation is transmitted through the heart, and the contraction regulated in sequence, by the nerve ganglia of the heart.

The velocity of conduction of the excitation wave (5 metres per sec- ond) speaks against this hypothesis, for the rate is six times less rapid than in nerve (Engelmann). IBy the study of the electrical current â€" i.e., the current of action which accompanies the systole â€" with the aid of the capillary electrometer, it has been determined that the contraction of the heart is a simple twitch and not a tetanus (Sanderson and Page, "Waller and Eeid).

The heart during the period of systole is refractive to artificial excitation, but its susbeptibility returns with diastole. The force and amplitude of any cardiac contraction depend on the previous activity of the heart and on such physical conditions as the degree of diastolic filling, the resistance to systolic outflow, temperature, &o., but are independent of the strength of the artificial stimulus so long as the latter is efficient. Owing to the refractory period, the slow rate of contraction, and the independence of the ampli- tude of contraction on the strength of stimulus, the heart cannot be thrown, by rapidly-repeated excitation, into a complete state of tetanic spasm. The cardiac muscle is rich in sarcoplasm, and on this depends its power of slow, sustained contraction. The heart- muscle besides rhythmically contracting possesses "tone," and this tone varies with the conditions of metabolism, temperature, &c.

Chloroform, for example, produces a soft dilated, and strychnine or ammonia a tonically contracted, heart. The auricular muscle in some animals undergoes rhythmic oscillations of tone. The gan- glion-cells, which first wander into the embryonic heart several hours after it has started beating, can be removed without disturb- ing the cardiac rhythm. Extra-cardiac nerves from the vagus and from the sympathetic system end in these ganglia. From these ganglion-cells there pass non-meduUated, intracardiac nerve-flbres, which spin a fine-meshed network through all parts of the cardiac muscle. The study of development, and of comparative anatomy, alike show that the nervous system of the heart becomes more complicated with increasing complication of structure. A great many of the cardiac nerve-fibres are centripetal. These fibres pass in the vagus nerves up to the spinal bulb, and refiexly regulate the heart-frequency, the breathing, and the tonus

of the blood-vessels. For example, the stimulation of certain fibres, termed depressor, causes dilatation of the arterioles and a fall of arterial pressure by inhibiting the tonic action of the vaso-motor centre in the spinal bulb. The depressor fibres come into action when the systolic output is resisted by over-constriction of the arterioles. The cen- tripetal impulses which proceed from the normal heart do not enter into consciousness. The centrifugal cardiac nerves influence the frequency, the force of contraction, and the conductivity of the excitatory wave (chrono-, ino-, and dromo-tropism of Engelmann). The inhibitory fibres running in the vagi arise from a centre in the spinal bulb which is in tonic action and constantly curbs the heart. The function of the vagi is to decrease the frequency, force, and conductivity. The aoceleratory and augmentory fibres are likewise in tonic action and antagonize the action of the vagi. These fibres arise from the anterior spinal roots in the upper thoracic region, and form synapses with the ganglion-cells in the first thoracic sym- pathetic ganglia. The vagus nerve works directly on the cardiac muscle-fibre, and produces, it is supposed, a cliemical change whereby the conductivity, the excitability, and force are lowered. After a period of arrest, produced by vagal excitation, the heart beats more strongly, for the process of anabolism is increased thereby. The converse occurs after excitation of the sympathetic fibres. The function of the cardiac nerves is to co-ordinate the beat of the heart with the needs of the body and to co-ordinate the functions of other organs with the needs of the heart. For example, an undue rise or arterial pressure, induced, let us say, by compression of the abdomen, excites the centre of the vagus and produces slowing of the heart and a consequent lowering of arte- rial pressure. The heart of a mammal, however, continues to functionate after a section of all the branches of the cardiac plexus has been made, so that the nervous control and co-ordination of the heart are not absolutely essential to the continuance of life (Krehl).

The work of the heart, attained by multiplying the volume of the systolic output by the arterial pressure, i.e., the height of the lift, has hitherto been reckoned at too high a rate. The output is not greater than 60-100 c.c. (3 oz.) (Tigerstedt, Zuntz), and the mean arterial pressure in a healthy man, determined by the sphygmo- meter, is not

more than 110 mm. of mercury (L. Hill). The work of the right heart can be reckoned to be ^ that of the left, for the pressure in the pulmonary artery does not exceed 40 mm. The total work of the heart during the day may be taken as equal to 20,000 kilogrm. -metres, and this would be equivalent to 50 Calories out of the total 2500 Calories which a man takes in as food. The total work is increased two or three times over by very severe muscular labour. It has been estimated that the heart requires per diem, to maintain its energy, an amount of solid food (water-free) equal to the weight of solids in the heart itself, i.e., about 60 grms. of sugar or proteid (Stewart). 30 c.c. of blood must be circulated per minute through the coronary arteries of a dog to maintain the vigour of the heart.

Changes of Pressure in the Heart during the Cardiac Cycle. â€" Much labour has been spent in the contrivance of rapidly-acting spring pressure gauges, freed as far as possible from inertia, in order to investigate the changes of intracardiac pressure, which were first described by Chauveau and Marey (cf. Ency. Brit. vol. xxiv. Vascular Stbtem). As the intraventricular pressure may rise 150 mm. of mercury in ^^ of a second, it is no easy mat- ter to contrive an instrument which will respond as rapidly and yet yield an accurate result without overshooting the mark. The final result of a most careful inquiry is the confirmation in almost every point of Chauveau and Marey's pressure curves. Hiirthle's differential manometer has proved to be an instrument of great value and precision. A double-bored tube cannula is introduced so that one tube reaches the right auricle and the other the right ventricle. In observations on the left side of the heart, one tube is placed in the left ventricle and the other in the aorta, and each of these tubes is brought in connexion with a tambour. The two tambours are placed, one on either side of the fulcrum of a lever. This lever works against a light spring, which in its turn sets in motion a writing-style. The style records the pressure changes on a drum covered with smoked paper. By this means there can be

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recorded the exact moment at which the auricular pressure exceeds that in the ventricle, that is to say, the moment when the auriculo-ventrioular valves open ; likewise the moment when the ventricular pressure becomes greater than that in the auricles, and the auriculo-ventricular valves shut. Similarly, there can be recorded the moment when the intraventricular pressure exceeds that in the aorta and the semilunar valves open, and the moment at which the diastole of the ventricle begins, when the aortic pressure be- comes the greater, and the semilunar valves shut. The . smooth- ness with which the heart works is shown by the fact that neither the opening nOr the closing of the valves is marked by any peak or point on the pressure curves. The first part of the period of ven- tricular systole is spent in raising the tension of the blood up to and above that in the aorta. All the valves are closed during this period, and the contraction of the ventricular muscle is at this time isometric, for the volume of the ventricle does not alter. The period of rising tension lasts in the dog ~~02”~~ -04”, and varies very little when the output is resisted by a rise in arterial pressure. In other words, the heart can meet greater demands on its power without appreciable loss of time. The period of systolic output lasts from the moment when the semilunar valves open to the moment when they close. This period equals -178″ to ~~195”, and is but slightly altered by variations in arterial pressure or the fre~~ quency of the heart. The intraventricular pressure continues to rise during the period of output if the outflow be resisted ; on the other hand, it falls if the arterioles are dilated and the outflow un- impeded. When the heart becomes more frequent, as in fever, it is the diastolic or resting period which is especially shortened. A negative pressure (â€”10 to â€”30 mm.) appears in the auricles during the period of systolic output, and this is of no little importance, for it materially aids in the filling of the auricles. It is mainly pro- duced by the expulsion of the blood by the left ventricle into the arteries, and so out of the thorax. To take the place of the arterial blood which leaves the thoracic cavity, air passes into the lungs and blood into the auricles. The maximal and minimal pressures have been accurately recorded in the heart by a manometer fitted with a valve arranged so that either only a rise or a fall of

pressure is re- corded. In the right ventricle of the dog the maximal pressures recorded equalled 35-62 mm. of mercury, in the left ventricle 114- 135 mm., in the auricles 2-20 mm. (de Jager). A negative pressure, of considerable amount but of very fleeting duration, sometimes occurs in the ventricles at the beginning of diastole. This is pro- duced by the elastic rebound of the fleshy columns of the inner wall of the heart, which become pressed together as the blood is wrung out of the ventricular cavities. The entry of the flrst few drops of blood from the auricles abolishes this negative pressure, and it has no important influence on the flUing of the heart.

Valves and Papillary Muscles. â€" The muscular columns to be seen on the inner walls of the ventricles are attached by inexten- sile cords (the chordse tendinese) to the auriculo-ventricular valve flaps. It has experimentally been determined that the cords are pulled taut synchronously with the ventricular contraction, and so prevent the ballooning out of the valves into the auricles (Roy, Hay craft). The edges of these valves are thin and delicate mem- branes, and when in apposition are pressed together by the blopd in the ventricles. Regurgitation of blood is thus completely pre- vented. The outer parts of the valves bear the full strain of the intraventricular pressure, and are therefore tough and strong. These parts are supported by the chordae tendineae, just as an umbrella is supported by its ribs. A ring of muscle surrounds the auriculo-ventricular orifices, and confines the size of these openings during systole. The auriculo-ventricular valves are floated up and brought into apposition by eddies set up in the blood which streams into the ventricles during the auricular sys- tole. They close without noise or jar at the moment when the intraventricular pressure exceeds in the least degree that in the auricles. The semilunar valves are similarly brought into appo- sition by eddies, and close without noise or jar at the moment when the intraventricular pressure becomes less than that in the aorta. The arterial orifices are confined by the contraction of the muscle bands which surround them. During the period of systolic output the aortic valve-flaps assume a vertical position in mid- stream, and do not swing back against the orifices of the coronary arteries which lie at the root of the aorta. At the height of systole the flow through the coronary vessels is momentarily checked,

for the pressure of the ventricular muscle becomes greater than that in the aorta. The capillaries of the heart muscle become filled with blood during diastole, and this blood is partly expressed into the coronary veins during systole.

The Cardiac Impulse.â€” Th& impulse is synchronous with the period of rising tension in the ventricle. It occurs at the point where the ventricular wall touches the parietes of the chest, and is thus felt at a slightly different spot in each position of the body, for, owing to the influence of gravity, different parts of the heart come in contact with the chest-wall in different postures. The cause of the impulse is the sudden hardening of the ventricular muscle.

Where the heart touches the chest-wall the latter is driven out- wards ; at all other points it is sucked inwards, owing to the diminution in the size of the ventricles during the period of systolic output. To obtain a typical cardiogram, the cardiograph must be applied to the exact seat of the impulse. An excellent form of cardiograph has been contrived by Edgren (see Schafer's Physiology, vol. ii. p. 35). The cardiogram is partly a pressure and partly a volume curve. The form of the typical curve resembles that of in- traventricular pressure, but it can be endlessly varied by altering the position and pressure of the instrument, and the cardiograph is not therefore a sure or trustworthy guide to any facts concerning the force or extent of the cardiac contraction. By simultaneously recording the impulse curve, the heart sounds, and the pulse curve in the carotid artery, the time relations of the various acts which go to make up the cardiac cycle can be measured in man. The be- ginning of the impulse curve marks the beginning of the period of rising pressure in the ventricles. The beginning of the ascent of the pulse curve marks the beginning of the period of systolic out- put. The beginning of the dicrotic notch on the pulse curve marks the end of the period of output and the commencement of ventri- cular diastole. In making such calculations, a deduction must be made for the time spent in the transmission of the pulse-wave.

j[7ie Sounds of the Heart. â€” The sounds of the heart have been successfully recorded by means of the microphone. HUrthle inserted

the microphone in the primary circuit of a Du Bois Ray- mond induction coil, and placed the nerve of a frog-muscle pre- paration in the secondary circuit. The muscle, being attached to. a lever, recorded its contraction on a revolving drum at the moment when the sound of the heart reached the microphone and closed the primary circuit. A capillary electrometer can be inserted in place of the frog-muscle indicator, and the movements of the elec- trometer photographed on a sensitized plate moved by clockwork (Einthoven). Each sound gives rise to a succession of vibrations of the mercury meniscus of the capillary electrometer. The first sound is formed of many component tones derived from the sudden tension, and consequent vibration, of the ventricular muscle, and *Â» of the auricular-ventricular valves with their chordae tendineae. The first sound can be resolved by a trained musical ear into two tones, one deep and the other high. The deeper tone alone is heard on the contraction of the excised and bloodless heart, while the higher tone is produced by throwing the auriculo-ventricular valves into tension (ilayoraft). In the cold-blooded animal, such as the turtle, the heart muscle does not become tense rapidly enough to produce a sound (Allen). This sound is not produced by fluid friction as the blood rushes through the arterial orifices, for the velocity of outflow is too small to produce in this way any noise. Nor is it produced by sudden opening of the semilunar valves, for these open quietly and without jar at the moment when the intraventricular pressure rises above that in the aorta.

The second sound of the heart is produced by the tension of the semilunar valves in the aorta and pulmonary artery at the moment when the ventricles pass into diastole. These valves close without any jar or shock so soon as the arterial pressures rise to the slightest degree above that in the ventricles. In the next moment the ven- tricles dilate, and the valves, no longer supported on one side, be- come taut. The elastic vibrations of the walls of the distended arteries probably share in the production of this sound.

Vaso-motor System. â€” The tone of the arteries and veins, just as the permeability of the capillaries, depends on the chemical quality, the pressure, and the velocity of flow of the circulating blood. The tone of

the arterioles is secondarily controlled by the vaso- motor nerves, which are in their turn dominated by the vaso-motor centre in the medulla oblongata. The portal venous system is also controlled by vaso-motor nerves, while, as to the rest of the venous system, there is no definite evidence of the existence of any such control. The vaso-motor nerves are of two kinds, vaso-constrictor and vaso-dilator. The vaso-constrictor fibres issue in the anterior spinal roots, from the second thoracic to the second lumbar root, and pass to the sympathetic chain of ganglia. The fibres are of small diameter, and probably arise from cells situated in the lateral horn of the grey matter of the spinal cord. Nicotine paralyses ganglion cells, and by applying this test to the various ganglia, the cell stations of the vaso-constrictor fibres supplyiuc; each organ have been mapped out. The vaso-dilator fibres have not so re- stricted an origin, for they issue in the effel-ent roots in all parts of the neural axis. The two kinds of nerves, although antago-nistic in action, end in the same terminal plexus which" surrounds the vessels. The presence of vaso-dilator fibres in the common nei-ve trunks is masked, on excitation, by Uie overpowering action of the vaso-constrictor nerves. The latter are, however, more rapidly fatigued than the former, and by this and other means the presence of vaso-dilator fibres can be demonstrated in almost all parts of the body. The nervi-erigentes to the penis and the chorda tympani supplying the salivary glands are the most striking examples of vaso-dilator nerves. The vaso-motor centre exerts a tonic influence over the calibre of the arterial and portal

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venous systems, and, influenced as it is by afferent impulses received from all parts, reflexly regulates the supply of blood to the organs. Functional activity is accompanied by vaso-dilatation. Stimulation of the afferent nerves of any part excites reflexly vaso- dilatation in that part and constriction in other vascular areas. Paralytic dilatation

results on cutting off any part from the influence of the vaso-molipr centre, but after a few days local tone returns.

Authorities. â€” An exhaustive account of the literature on the circulation of the blood will be found in Tigerstedt's Lehrbuch der Physiologie des Kreislaufes, 1893. The following may also be consulted: â€" Porter's article on the "Circulation" in Howell's American Text-Book of Fhysioloyy, 1898 ; Gaskell's article on "Cardiac Muscle," and Leonard Hill's article on the "Vascular Mechanism," in Sohafer's Text-Book of Physiology, vol. ii. ; and the articles " Circulation," " Cceur," &o., in Richet's Dictionnaire de Physiologie. For a general account of the vascular system. Poster's Text-Book of Physiology, 6th ed., may be consulted.

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So far as is known, the intake of oxygen, either free or in combination, and the output of carbonic acid, are an essential part of the life of all organisms. The two processes are so closely associated with one another that they are always included together under the designation of Respiration, which may thus be defined as that part of organic activity which is concerned in the intake of oxygen and output of carbonic acid. According to the evidence at present available, it is only within living cells that the respiratory oxygen is consumed and the carbonic acid formed. The mere conveying of oxygen from the air to these cells, and of carbonic acid from them to the air, is, however, in itself a complex process in the higher animals ; and accordingly an account of animal respiration naturally falls into two divisions, the first of which (I.) is concerned with the manner in which oxygen and carbonic acid are conveyed to and from the living tissues, and the second (II.) with the consumption of oxygen and production of carbonic acid by the living tissues them- selves. Of these two divisions, the second is in reality the more important ; for the conveyance of oxygen and carbonic acid between the air and the tissues is essentially a subsidiary process, the rate of which, as will be shown below, is regulated in accordance with the requirements of the tissues.

I. In the higher vertebrates air is brought into the lungs by the respiratory movements. Oxygen from this air passes through the delicate lining membrane of the air-cells of the lungs into the blood, where it enters into loose chemical combination with the haemoglobin of the red corpuscles. In this form it is conveyed onwards to the heart, and thence through the arteries to the capillaries, where it again parts from the haemoglobin, and passes through the capillary walls to the tissues, where it is con- sumed. Carbonic acid passes out from the tissues into the blood in a corresponding manner, enters iiito loose combination as bicarbonate, and possibly in other ways, in the blood, and is conveyed by the veins to the lungs, whence it passes out in the expired air. A detailed account of this complex process, together with a sketch of the corresponding processes in lower animals, is given in the article on Respiration in the ninth edition of this work, which need only be supplemented here as regards points which have been further elucidated by recent research.

In certain circumstances the consumption of oxygen and production of carbonic acid by the body are tempo- rarily much increased. Thus during hard muscular work this increase may amount to ten times the normal, or more. It is evident that to meet this increase there must be (1) a large increase in the volume of air breathed, and (2) a similar increase in the rate of circulation of the blood.

As regards the first point, we know from analyses that the deficiency of oxygen and excess of carbonic acid in the expired air are nearly the same during muscular exer- cise as during rest ; so that the volume of air breathed is increased about proportionally to the increased respiratory exchange of oxygen and carbonic acid. The increased volume of air breathed is due partly to greater frequency, and partly to greater depth, of the respirations. It has been shown that this alteration in the breathing is brought about by an altered state of the blood reaching the respira^ tory centre ; and formerly it was believed that deficiency of oxygen in this blood is the cause. Deficiency of oxygen does undoubtedly stimulate the respiratory centre, but a study of the effects in man of deficiency of oxygen due to the breathing of air poor in oxygen is sufficient to negative the idea that this is the normal

stimulus to the respiratory centre. Simultaneously with the stimulation (which is, moreover, sometimes so feeble as to be scarcely noticeable) there is more or less of mental confusion, impairment of the senses, loss of muscular power, and other alarming symptoms, which certainly do not accompany the normal stimulation of the respiratory centre. Excess of carbonic acid in the air breathed acts far more powerfully and persistently on the respiratory centre than deficiency of oxygen. The phenomena experienced on breathing air containing a sufficient excess to cause panting are, more- over, identical with those observed during panting pro- duced by muscular exercise, so that it seems probable that excess of carbonic acid in the blood bathing the respira- tory centre is the real stimulus. It is only, however, free carbonic'acid that affects the centre. As only a small part of the carbonic acid in the blood is in the free state, the rest being combined with alkalies, the available proportion of which varies greatly at different times, mere determina- tions of the total jDroportion of carbonic acid in the arterial blood during rest and during exercise cannot decide the question whether it is the actual stimulus. Some physi- ologists maintain, on grounds which seem to the present writer insufficient, that the normal stimulus to the respira- tory centre is some unknown " product of metabolism." If, either voluntarily or by artificial means, the respiratory movements are increased for a short time, the condition known as apnoe.a follows, the action of the respiratory centre being temporarily suspended. During apnoea the arterial blood contains much less carbonic acid than before, an abnormal amount having been washed out in the lungs by the excessive breathing. The amount of oxygen is, however, practically the same, the arterial blood being saturated under normal conditions, so that with excessive breathing it can take up no more. The main, though not the only, factor in producing apncea seems to be the deficiency of carbonic acid in the blood. Although the respiratory centre tends to act in the normal rhythmic manner apart from all stimuli through nerves, yet researches have shown that afferent impulses conveyed from the lungs by the vagus nerve play a most important part in regulating the rhythm of the centre. Distension of the lungs arrests inspiration, while collapse of the lungs stimulates it, and this is brought about by stimuli con- veyed by the vagus fibres, and caused by the stretching and relaxation of the lungs. When the vagus nerves are severed, the effect is

absent, and the respirations are diminished in frequency and are deeper.

As regards the causes of the increased flow of blood which compensates for increased oxygen consumption in the muscles and other tissues, our knowledge is somewhat scanty. It appears that, along with the motor impulses which cause a muscle to contract, there proceed to the arterioles of the muscle vaso-motor impulses, leading to a greatly increased circulation through the muscle. The rush of blood through the working muscles must be compensated

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for by a corresponding increase in the work of the heart, as there is no fall in blood pressure ; but by what means the compensation is brought about is not yet clear.

Until recently it was assumed that practically the whole of the carhonio acid discharged in the breath is hrtjught to the lungs by the venous blood. Experiments made to test this question seem to show, however, that there is a very considerable produc- tion of carbonic acid and disappearance of oxygen in the lungs themselves, as much as a third or even half the total carbonic acid produced being under certain conditions formed there. On ac- count of the unpleasant effects produced by the air of crowded rooms, and for other reasons, it was believed that expired air con- tains, besides carbonic acid, some poisonous substance. A careful investigation of the question has shown that no such substance exists.

HcBmoglohin. â€” The law according to which the haemoglobin of the red blood corpuscles enters into combination with, or parts from, oxygen, has recently been more clearly determined. It has been shown that at a constant temperature the relative proportion of the haemoglobin present which will enter into combination, or remain in

combination, with oxygen, varies with the partial press- ure of the oxygen present. If blood or haemoglobin solution at a temperature of 37-4Â° C. (which is about that of the body) be shaken to saturation with pure oxygen at a pressure of 1-2 per cent, of an atmosphere (or at ordinary atmospheric pressure with nitrogen containing 1-2 per cent, of oxygen), half of the heemo- globin will combine with oxygen, the relative proportions of com- bined and uncombined haemoglobin being thus equal, or . At a pressure of 2-4 per cent, of an atmosphere the proportion of com- bined to uncombined haemoglobin will be f , so that the haemoglo- bin will be two-thirds saturated with oxygen, and so on. In dry air at normal atmospheric pressure the pressure of oxygen is 20-94 per cent, of an atmosphere, so that in blood saturated with

air the ratio of combined to uncombined haemoglobin will be â€” â€” ,

and the haemoglobin will thus be 94-6 per cent, saturated. It is evident from these data that, provided that the blood in passing through the lungs is saturated with oxygen at a pressure of 5 or 6 per cent, of an atmosphere of oxygen, the amount of oxygen taken up by the haemoglobin of the blood will vary but little either with variations of atmospheric pressure or with variations in the per- centage of oxygen in the air breathed. Haemoglobin not only combines with oxygen, but also forms an analogous compound with carbonic oxide. The af&nity of the latter gas for haemoglobin is, however, much more powerful than that of oxygen. When blood is saturated with air containing 0-07 per cent, of carbonic oxide, the haemoglobin is shared equally between the two gases, and in- crease of the percentage or partial pressure of either of the gases increases correspondingly its relative share of the haemoglobin. When carbonic oxide is breathed it passes into the blood, which continues to absorb it until the point is reached at which the pressure of oxygen in the blood passing through the lungs suffices to prevent further absorption. As, however, the haemoglobin com- bined with carbonic oxide is useless for the time as an oxygen- carrier, symptoms of lack of oxygen, or death from want of oxygen, may easily be caxised by carbonic oxide. When death occurs the blood is usually about 80 per cent, saturated with carbonic oxide, which is the poisonous constituent of lighting-gas, smoke, and the after-damp which

causes most of the deaths in colliery explosions. Besides the ordinary oxygen compound of haemoglobin, there is another oxygen compound known as Methcemoglohin, containing the same amount of oxygen, but combined in a different manner. Methaemoglobin has a brown colour, and does not yield its oxygen to a vacuum. It is readily formed by the action of various oxidiz- ing agents, such as ferricyanide of potassium, on haemoglobin. When the haemoglobin acted on is already combined in the ordinary way with oxygen or carbonic oxide, the whole of the gas thus combined is set free, and this reaction affords an easy and accurate means of determining the proportion of haemoglobin in a sample of blood. Methaemoglobin is formed in the living body by the action of vari- ous poisons, such as chlorate of potash, amylnitrite, or dinitroben- zol (the chief constituent of the explosive roburite). Since the methaemoglobin thus formed is useless as an oxygen-carrier, symp- toms similar to those of carbonic oxide poisoning are produced.

Between the air in the air-cells of the lungs and the blood of the lung-capillaries there intervenes nothing but a layer of very thin, flattened cells, and until recently it was very generally believed that it was by diffusion alone that oxygen passes inwards and carbonic acid outwards through this layer. Similar simple physical explanations of processes of secretion and absorption through living

cells have, however, turned out to be incorrect in the case of other organs. It is known, moreover, that in the case of the swimming-bladder of fishes oxygen is secreted into the interior against enormous pressure. Thus, in the case of a fish caught at a depth of 4500 feet, the partial pressure of the oxygen present in the swimming-bladder at this depth was 127 atmospheres, whereas the partial pressure of oxygen in sea water is only about 0-2 atmos- phere. Diffusion can therefore have nothing to do with the passage of gas inwards, which is known to be under the control of the nervous system. The cells lining the interior of the swimming-bladder are developed from the same part of the alimentary tract as those lining the air- cells of the lungs, so that it seems not unlikely that the lungs should possess the power of actively secreting or excreting gases. The question whether such a power ex- ists, and is normally exercised, has been investigated by more than one

method; and although it is not possible to go into the details of the experiments, there can be no doubt that the balance of the evidence at present avail- able is in favour of the view that diffusion alone is inca- pable of explaining either the absorption of oxygen or the excretion of carbonic acid through the living cells of the lungs. The partial pressure of oxygen appears to be always higher,- and of carbonic acid often lower, in the blood leaving the lungs than in the air of the air-cells ; and this result is inconsistent with the diffusion theory. As to the causes of the passage of oxygen and carbonic acid through the walls of the capillaries of the general circulation, we are at present in the dark. Possibly diffusion may explain this process.

II. Although we cannot trace the exact changes which occur when oxygen passes into living cells, and although, indeed, we have the clearest reasons for believing that it would be impossible to express these changes fully in chemical terms, yet it is possible to obtain a clear general view of both the ultimate destiny of the oxygen and the origin of the carbonic acid. The oxidizable material within the body consists, practically speaking, of proteids (albumen-like substances, with which the collagen of con- nective tissue may be included), fats, and carbohydrates (sugars and glycogen). All of these substances contain carbon, hydrogen, and oxygen in known, though different proportions, and the former also contains a known amount of nitrogen and a little sulphur. Nitrogen is constantly leaving the body as urea and other substances in the urine and faeces ; and a small but easily measurable proportion of carbon passes off in the same manner. The rest of the carbon passes out as carbonic acid in respiration. Now car- bohydrates and fats are oxidized completely in the body to carbonic acid and water. This follows from the fact that, practically speaking, no other products into which they might have been converted leave the body except carbonic acid and water. Moreover, a given weight of carbohydrate requires for its oxidation a definite weight of oxygen, and produces a definite weight of carbonic acid. There is thus a definite relation between the weight of oxygen used up and the weight of carbonic acid formed in this oxidation. The same is true for the oxidation of fat, and of proteid, allowing in the latter case for the fact that the nitrogen, together with part of the carbon and hydrogen, passes out as urea, &c.,

in an incompletely oxidized form. From all this it follows that if we measure over a given period (1) the discharge of nitrogen from the body, (2) the intake of oxygen, and (3) the output of carbonic acid, we can easily calculate exactly what the ultimate destiny of the oxygen has been, and at the ultimate expense of what material the carbonic acid has been formed. What the intermediate stages may have been we cannot say, but this in no way affects the validity of the calculation. If, during the period of measurement, food is taken, the basis

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of the calculation is still substantially the same, as the oxidizable material in food consists of practically nothing else except proteids, carbohydrates, and fats.

Liberation of Energy. â€” From experiments made outside the body, we know that in the oxidation of a given weight of proteid, carbohydrate, or fat, a definite amount of en- ergy is liberated. In the article on Dietetics it has been shown that precisely the same liberation of energy occurs in the living body, due allowance being made for the fact that the oxidation of proteid is not quite complete. The following table shows the respiratory quotients (see Ees- piBATioN, 9th edition) and energy expressed in units of heat (Calories) liberated per gramme of carbonic acid produced and oxygen consumed in the living body during the oxidation of proteid, fat, and a typical carbohydrate.

Substance oxidized.

Kespiratory Quotient.

Calories per

gramme of COa

produced.

Caloiies per gramme of â– oxygen consumed.

Proteid Fat . Cane-sugar

â– 78

â€¢71

1-00

2-78 3-.35 2-59

3-00 3-27 3-56

In the oxidation of non-living substances the rate varies, within wide limits, according to that at which oxygen is supplied. Thus a fire burns the faster the more air is supplied, and the higher the percentage of oxygen in the air. It was for long believed that in the living body also the rate of oxidation must vary according to the oxygen supply. It has been found, however, that this is not the case. Provided that a certain minimum of oxygen is present in the air breathed, or in the blood supplied to the tissues, it is, practically speaking, indifferent whether the oxygen supply be increased or diminished : only a certain amount is consumed. It might be supposed that the reason for this is that the available oxidizable material in the body is limited, and that if the food supply were increased there would be a corresponding increase in the rate of oxidation. This hypothesis is apparently supported by the fact that, when an increased supply of proteid is given as food, the amount of nitrogen discharged in the urine is almost exactly correspondingly increased, so that evidently the oxidation of proteid increases correspond- ingly with the supply. Similarly, when carbohydrate food is given, the alteration in the respiratory quotient shows that more carbohydrate than before is being oxidized. Closer investigation in recent times has, however, brought out the very striking fact that, if oxidation be measured in terms of energy liberated by it in the body, it makes but little difference whether the animal is fasting or not. If more

proteid or carbohydrate is oxidized at one time, cor- respondingly less fat is oxidized, but the total energy liberated as heat, &c., in the body is about the same, un- less the diet is very excessive, when there is a slight increase of oxidation. Even after many days of starva- tion, the rate of oxidation per unit of body weight has been found to remain sensibly the same in man. When more food is taken than is required, the excess is stored up, chiefly in the form of fat, into which carbohydrate and possibly also proteid are readily converted in the body. When less food is taken than is needed, the stock of fat is drawn upon, and supplies by far the greater pro- portion of the energy requirements of the body.

During the performance of muscular work oxidation is greatly increased, and may amount to ten times the normal or more. Even the slight exertion of walking increases oxidation to three times. When the energy represented by the external work done in muscular exertion is compared with the extra energy liberated by oxidation in the body, it Is found, as would be expected, that the latter value largely exceeds the former. In other words, much of the energy liberated is wasted as heat. Nevertheless the

muscles are capable of working with far less waste than any steam or gas engine. In the work of climbing, for instance, it has been found in the case of man that 35 per cent, of the energy liberated is represented in the work done in raising the body. Muscular work, if at all excessive, leads to fatigue, and consequent rest. On the other hand, unnatural abstinence from muscular activity leads to restlessness and consequent muscular work. Hence on an average of the 24 hours the expenditure of energy by diiierent individuals, with different modes of life, does not as a rule differ greatly.

The rate of oxidation per unit of body-weight varies consider- ably according to size and age. If we compare different warm- blooded animals, we find that the rate of oxidation is relatively to their weight far higher in the smaller ones. In a mouse or small bird, for instance, the rate is about twenty times as great as in a man. The difference is in part due to the fact that the smaller an animal is the greater is its surface relatively to its mass, and consequently the more heat does it

require to keep up its temperature. The smaller animal must therefore produce more heat. Even in cold-blooded animals, however, oxidation appears to be more rapid the smaller the animal. In the case of man oxi- dation is relatively more than twice as rapid in children as in adults, and the difference is greater than would be accounted for by the difference in the ratio of surface to mass. Allowing for differences in size, oxidation is about equally rapid in men and women.

It was for long believed that the special function of respiratory oxidation was (1) the production of heat, and (2) the destruction of the supposed ” waste products.” Further investigation has, however, tended to show more and more clearly that in reality respiratory oxidation is an essential and intimate accompaniment of all vital activity. To take one example, secretion and absorption, which were formerly explained as simple processes of fil- tration and diffusion, are now known to be accompanied, and necessarily so, by respiratory oxidation in the tissues concerned. The respiratory oxidation of an animal is thus a very direct index of the activity of its vital processes as a whole. Looking at what is known with regard to respiratory oxidation, we see that what is most striking and most characteristic in it is its tendency to persist â€” to remain on the whole at about a normal level for each animal, or each stage of development of an animal. The significance of this cannot be over-estimated. It indicates clearly that just as an organism differentiates itself from any non-living material system by the manner in which it actually asserts and maintains its specific anatomical structure, so. does it differentiate itself from any mere- mechanism by the manner in which it asserts and main- tains its specific physiological activities. This points to a fundamental difference in kind between the two aspects (and they are both of them only abstract aspects) of experience which are respectively represented in the Bio- logical and Physico-chemical sciences, and to the neces- sity for a clear recognition of the corresponding differences in what are the only practical aims which each of the two groups of sciences can set before itself.

Authorities. â€” The reader may be referred to the sections by Pembrey and by Gamgee in Schafer’s Handbook of Physiology, vol. i. 1898. The following references will give the additional clues requisite for a more

special study : â€” Production of carbonic acid in the lungs : Bohr and Henriques. Archives de la Physiol, norm., 1897, pp. 459, 590, and 819. Supposed poisonous organic matter in expired air: Haldane and Loekain Smith. Journ. of Pathology, vol. i. pp. 168 and 318, 1893. Properties of haemo- globin: HiJFifER. Arch, filr Anat. und Physiol., 1901, Suppl., p. 187. Cause of exchange of gases in the lungs and swimming- bladder : Summary by Haldane. Science Progress, 1898, pp. 120 and 237. Conservation of energy in the living organism : EnBNER. Zeitschrift filr Biologie, vol. xxx. p. 73, 1894. Con- ditions determining consumption of oxygen in the organism: PpLtroER. Archiv, vol. x. p. 251, 1875. Ecbnek. Zeitschrift filr Biologie, vol. xix. p. 312, 1883. Respiration and muscular work in man : Katzenstein. Ffluger^s Archiv, vol. 49, p. 330, 1891. Respiration and size, age, and sex : Magnus-Levt. Archiv filr Anat. und Physiol., 1899, p. 314. (j__g__jj \

S. VII. â€” 93

[muscle and nerve

VI. Muscle and Neeve.

Muscle. â€” Amongthe properties of living material there is one, widely though not ^miversally present in it, which

forms the pre-eminent characteristic of muscular bfilty’”—”^â– ‘s- This property is the liberation of some

of the energy contained in the chemical com- pounds of the cells in such a way as to give mechanical work. The mechanical work is obtained by movement resulting from a change in, it is supposed, the elastic tension of the living framework of the cell. In the fibrils existing in the cell a sudden alteration of elasticity occurs, resulting in an increased tension on the points of attach- ment of the cell to the neighbouring elements of the tissue in which the cell is placed. These yield under the strain, and

the cell shortens between those points of its attachment. This shortening is called contraction. But the volume of the cell is not appreciably altered, despite the change of its shape, for its one diameter increases in proportion as its other is diminished. The manifesta^ tions of contractility by muscle are various in mode. By toyiic contraction is meant a prolonged and equable state , of tension which yields under analysis no element of intermittent character. This is manifested by the mus- cular walls of the hollow viscera and of the heart, where it is the expression of a continuous liberation of energy in process in the muscular tissue, the outcome of the latter's own intrinsic life, and largely independent of any connexion with the nervous system. The muscular wall of the blood-vessels also exhibits tonic contraction, which, however, seems to be mainly traceable to a continual excitation of the muscle cells by nervous influence con— veyed to them along their nerves, and originating in the great vaso-motor centre in the bulb. In the ordinary striped muscle tissue of the skeletal musculature, e.g., gastrocnemius, tonic contraction obtains ; but this, like the last mentioned, is not of autochthonous origin in the muscles themselves; it is indirect and neural, and appears to be chiefly maintained reflexly. The sensi- facient organs of the muscular sense and of the semi-circular canals are to be regarded as the sites of origin of this 7-eJle.v tonus of the skeletal muscles. Striped muscles possessing an autochthonous tonus appear to be the various sphincter muscles.

Another mode of manifestation of contractility by muscles is the rhythmic. A tendency to rhythmic con- traction seems discoverable in almost all muscles. In some it is very marked, for example, in some viscera, the spleen, the bladder, the ureter, the uterus, the intes- tine, and especially in the heart. In several of these it appears proven that the recurrent explosive liberations of energy in the muscle tissue are not secondary to recur- rent explosions in nerve cells, but are attributable to decompositions arising sud sponte in the chemical sub- stances of the muscle cells themselves in the course of their living. Even small strips of the muscle of the heart, if taken immediately after the death of the animal, continue, when kept moist and warm and supplied with oxygen, to " beat " rhythmically for hours. Rhythmic contraction is also characteristic of certain groups of skeletal muscles, e.g., the

respiratory. In these the rhythmic activity is, however, clearly secondary to rhythmic discharges of the nerve cells constituting the respiratory centre in the bulb. Such discharges descend the nerve fibres of the spinal cord, and through the intermediation of various spinal nerve cells excite the respiratory muscles through their motor nerves. A form of contraction intermediate in character between the tonic and the rhythmic is met in the auricle of the heart of the toad. These slowly successive phases of increased and of diminished tonus regularly alternate, and upon

them are superposed the rhythmic ” beats ” of the pulsat- ing heart.

The ” beat,” i.e., the short-lasting explosive contraction, of the heart muscle can be elicited by a single, even momentary, application of a stimulus, e.g,, by an induc- tion shock. Similarly, such a single stimulus elicits from a skeletal muscle a single ” beat,” or, as it is termed, a “twitch.” In the heart muscle during a brief period after each beat, that is, after each single contraction of the rhythmic series, the muscle becomes ” inexcitahle.” It cannot then be excited to contract by any agent, though the inexcitable period is more brief for strong than for weak stimuli. But in the great group of the skeletal, voluntary, or striped muscles, a second stimulus succeeding a previous so quickly as to fall even during the continuance of the contraction excited by a first, elicits a second contraction. This second contraction starts from whatever phase of previous contraction the muscle may have reached at the time. A third stimulus excites a third additional contraction, a fourth a fourth, and so on. The increments of contraction become, how- ever, less and less, until the succeeding stimuli serve merely to maintain, not to augment, the existing degree of contraction. We arrive thus by analysis at a summa- tion of ” beats ” or of simple contractions in the com- pound, or ” tetanic,” or summed contraction of the skeletal muscles. The tetanic or summed contractions are more extensive than the simple, both in space and time, and liberate more energy, both as mechanical work and heat.- The tension developed by their means in the muscle is many times greater than that developed by a simple twitch.

Muscle cells respond by changes in their activity to changes in their environment, and thus are said to be ” excitable.” They are, however, less excitable than are the nerve cells which innervate them. The change which excites them is termed a stimulus. The least stimulus which suffices to excite is known as the stimulus of threshold value. In the case of the heart muscle this threshold stimulus evokes a beat as extensive as does the strongest stimulus; that is, the intensity of the stimulus, so long as it is above threshold value, is not a function of the amount of the muscular response. But in the ordinary skeletal muscles the amount of the muscular contraction is for a short range of quantities of stimulus (of above threshold value) pro- portioned to the intensity of the stimulus and increases with it. A value of stimulus is, however, soon reached which evokes a maximal contraction. Further increase of contraction does not follow further increase of the intensity of the stimulus above that point. Just as in a nerve fibre, when excited by a localized stimulus, the excited state spreads from the excited point to the adjacent unexcited ones, so in muscle the “contraction,” when excited at a point, spreads to the adjacent uncontracted parts. Both in muscle and in nerve this spread is termed ” conduction.”’ It is propaga,ted along the muscle fibres of the skeletal muscles at a rate of about 3 metres per second. In the heart muscle it travels much more slowly. The distu.rbance travels as a luaw of contraction, and the whole extent of the wave-like disturbance measures in ordinary muscles much more than the whole length of any single muscle fibre. That the excited state spreads onlv to previously unexcited portions of the muscle fibre, shows that even in the skeletal varietv of muscle there exists, though only for a very brief time, a period of inexcit- abihty. The duration of this period is about ^ of a second in skeletal muscle.

When muscle that has remained inactive for some time is excited by a series of single and equal stimuli succeed- ing at intervals too prolonged to cause summation, the

ExcitB” bllity.

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succeediBg contractions exhibit progressive increase up to a certain degree. The tenth contraction usually ex- hibits the culmination of this so-called ” staircase effect.” The explanation may lie in the production of CO2 in the muscle. That substance, in small doses, favours the contractile power of muscle. The muscle is a machine for utilizing the energy contained in its own chemical compounds. It is not surprising that the chemical substances produced in it by the decomposition of its living material should not be of a nature indifferent for muscular life. We find that if the series of excitations of the muscle be prolonged beyond the short stage of initial improvement, the contractions, after being well maintained for a time, later decline in force and speed, and ultimately dwindle even to vanishing point. This decline is said to be due to muscular fatigue. The muscle recovers on being allowed to rest unstimulated for a while, and more quickly on being washed with an in- nocuous but non-nutritious solution, such as ~~6 per cent. NaCl in water. The washing seems to remove excreta of the muscle’s own production, and the period of repose removes them perhaps by diffusion, perhaps by breaking them down into innocuous material. Since the muscle produces lactic acids during activity, it has been sug~~ gested that acids are among the “fatigue substances” with which muscle poisons itself when deprived of cir- culating blood. Muscles when active seem to pour into the circulation substances which, of unknown chemical composition, are physiologically recognizable by their stimulant action on the respiratory nervous centre. The effect of the fatigue substances upon the contraction of the tissue is manifest especially in the relaxation pro- cess. The contracted state, instead of rapidly subsiding after discontinuance of the stimulus, slowly and only partially wears off, the muscle remaining in a condition of physiological “contracture.” The alkaloid veratrin has a similar effect upon the contraction of muscle ; it enormously delays the return from the contracted state, as also does epinephrin, an alkaloid extracted from the suprarenal gland.

Nbkvous System. â€” The work of Golgi (Pavia, 1885 and onwards) on the minute structure of the nervous system has led to great alteration of doctrine in neural physiology. It had been held that the branches of the nerve cells, that is to say, the fine nerve fibres â€” since all nerve fibres

are nerve cell branches, and all nerve cell branches are nerve fibres â€” which form a close felt-work in the nervous centres, there combined into a network actually

continuous throughout. This continuum was aeory ^^^^ to render possible conduction in all

directions throughout the grey matter of the whole nervous system. The fact that conduction occurred preponderantly in certain directions, was explained by appeal to a hypothetical resistance to conduction which, for reasons imascertained, lay less in some directions than in others. The intricate felt-work has by Golgi been ascertained to be a mere interlacement, not an actual anastomosis network ; the branches springing from the various cells remain life-long unattached and unjoined to any other than their owii individual cell. Each neuron or nerve cell is a morphologically distinct and discrete unit connected functionally but not structurally with its neighbours, and with its own life and death independently of the destiny of its neighbours. Among the properties of the neuron is conductivity in all directions. But when neurons are linked together it is found that nerve impulses will only pass from neuron A to neuron B, and not from neuron B to neuron A ; that is, the transmission of the excited state or nervous impulse, although possible in each neuron both up and down its own cell branches, is only possible from one nerve cell to another in one direction.

That direction is the direction in which the nerve impulses flow under the conditions of natural life. The synapse, therefore, as the place of meeting of one neuron with the next is called, is said to valve the nerve circuits. This determinate sense of the spread is expressed as the law of forward direction. The synapse appears to be a weak spot in the chain of conduction, or rather to be a place which breaks down with comparative ease under stress, e.g., under effect of poisons. The axons of the motor neurons are, inasmuch as they are nerve fibres in nerve trunks, easily accessible to artificial stimuli. It can be demonstrated that they are practically indefatigable â€” re- peatedly stimulated by electrical currents, even through many hours, they, unlike muscle, continue to respond with unimpaired reaction. Yet when ^*^y*,*f" the muscular contraction is taken as index of the response of the nerve, it is found that unmistakable signs of fatigue appear even a very brief period after commence- ment of the excitation of the nerve, and the muscle soon ceases to give any contraction whatever in response to stimuli applied indirectly to it through its nerve. But the muscle will, when excited directly, e.g., by direct appli- cation of electric currents, contract vigorously after all response on its part to the stimuli (nerve impulses) applied to it indirectly through its nerve has failed. The inference is that the " fatigue substances " generated in the muscle fibres in the course of their prolonged contraction in- jure and paralyse the motor end plates, which are places of synapses between nerve cell and muscle cell, even earlier than they harm the contractility of the muscle fibres themselves. The alkaloid curarin causes motor paralysis by attacking in a selective way this junction of motor nerve cell and striped muscular fibre. It seems probable that the practical immunity of nerve fibres from fatigue is associated with their possession of a myelin sheath, for nerve fibres of the non-myelinate kind do not exhibit this immunity. Now, there is a difference between the axon in its course and at its termination, for at the latter it is naked and unsheathed in myelin. It may be that the rapidly fatigable character of the motor end

plate is due to the naked non-myelinate condition of the nerve fibre there. The myelin sheath probably prevents fatigue more by ensuing rapid renewal of nerve-conduct- ing material than by mechanical protection ; it may be looked on as a nutrient bath in which the core conductor lies immersed.

The neuron is described as having a cell body or perikaryon from which the cell branches â€” dendrites and axon â€” extend, and it is this perikaryon which, as its name implies, contains the nucleus. It “^’-‘^ forms the trophic centre of the cell, just as the nucleus-containing ‘part of every cell is the trophic centre of the whole cell. Any part of the cell cut off from the nucleus-containing part dies down: this is as true of nerve cells as of amoeba, and in regard to the neuron it constitutes what is known as the Wallerian degeneration. On the other hand, in some neurons, after severance of the axon from the rest of the cell (spinal motor cell), the whole nerve cell as well as the severed axon degenerates, and may eventually die and be removed. In the severed axon the degeneration is first evident in a breaking down of the naked nerve filaments of the motor end plate. A little later the breaking down of the whole axon, both axis cylinder and myelin sheath alike, seems to occur simultaneously throughout its entire length distal to the place of severance. The complex fat of the myelin be- comes altered chemically, while the other components of the sheath break down. This death of the sheath as well as of the axis cylinder shows that it, like the axis cylinder, is a part of the nerve cell itself.

In addition to the trophic influence exerted by each

part of the neuron on its other parts, notably by the perikaryon on the cell branches, one neiiron also in many instances influences the nutrition of other neurons. When, for instance, the axons of the ganglion cells of the retina are severed by section of the optic nerve,

and thus their iafluence upon the nerve cells of the visual cerebral centres is set aside, the nerve cells of those centres undergo secondary atrophy (Gadden's atrophy). They dwindle in size; they do not, however, die. Similarly, when the axons of the motor spinal cells are by severance of the nerve trunk of a muscle broken through, the muscle cells undergo" degeneration " â€" dwindle, become fatty, and alter almost beyond recognition. This trophic influence which one neuron exerts upon others, or upon the cells of an ex- trinsic tissue, such as muscle, is exerted in that Tonic ac- direction which is the one normally taken by the neuroas. natural nerve impulses. It seems, especially in the case of the nexus between certain neurons, that the influence, loss of which endangers nutrition, is associated with the occurrence of something more than merely the nervous impulses awakened from time to time in the leading nerve cell. The wave of change (nervous impulse) induced in a neuron by advent of a stimulus is after all only a sudden augmentation of an activity continuous within the neuron â€" a transient accentuation of one (the disintegrative) phase of the metabolism inherent in and inseparable from its life. The nervous impulse is, so to say, the sudden evanescent glow of an ember continuously black-hot. A continuous lesser " change " or stream of changes sets through the neuron, and is distributed by it to other neurons in the same direction and by the same synapses as are its nerve impulses. This gentle continuous activity of the neuron is called its tonus. In tracing the tonus of neurons to a source, one is always led link by link against the current of nerve force â€" so to say, "up stream" â€" to the first beginnings of the chain of neurons in the sensifacient surfaces of the body. Prom these, as in the eye, ear, and other sense organs, tonus is constantly initiated. Hence, when cut off from these sources, the nutrition of the neurons of various central mechanisms suffers. Thus the tonus of the motor neurons of the spinal cord is much lessened by rupture of the great afferent root cells which normally play upon them. A prominent and practically important illustration of neural tonus is given by the skeletal muscles. These muscles exhibit a certain con- stant condition of slight contraction, which disappears on severance of the nerve that innervates the muscle. It is a muscular tonus of central source consequent on the continual glow of excitement in the spinal motor neuron, whose outgoing end plays upon the muscle

cells, whose ingoing end is played upon by othei? neurons â€” spinal, cerebral, and cerebellar.

It is with the neural element of muscle tonus that tendon pheno- mena are intimately associated. The earliest-studied of these, the '^ knee-jerk,^ ^ may serve as example of the class. It is a brief ex- tension of the limb at the knee-joint, due to a simple contraction of the extensor muscle, elicited by a tap or other short mechanical stimulus applied to the muscle fibres through the tendon of the muscle. The jerk is obtainable only from muscle fibres possessed of neural tonus. If the sensory nerves of the extensor muscle be severed, the "jerk " is lost. The brevity of the interval between the tap on the knee and the beginning of the resultant contraction of the muscle excludes the possibility of reflex development. A little experience in observations on the knee-jerk imparts a notion of the average strength of the "jerk." Wide departures from the normal standard are met with and are symptomatic of certain nervous conditions. Stretching of the muscles antagonistic to the extensors â€" namely, of the flexor muscles â€" reduces the jerk by in- hibiting the extensor spinal nerve cells through the nervous impulses generated by the tense flexor muscles. Hence a favourable posture of the limb for eliciting the jerk is one ensuring relaxation of the hamstring muscles, as when the leg has been crossed upon the

other. In sleep the jerk is diminished, in deep sleep quite abolished. Extreme bodily fatigue diminishes it. Conversely, 'a cold bath increases it. The turning of attention towards the knee interferes with the jerk ; hence the device of directing the person to perform vigorously some movement, which does not involve the muscles of the lower limb, at the moment when the light blow is dealt upon the tendon. A slight degree of contraction of muscle seems the substratum of all attention. The direction of attention to the performance of some movement by the arm ensures that looseness and freedom from tension in the thigh muscles which is essential for the provocation of the jerk. The motor cells of the extensor muscles, when preoccupied by cerebral influence, appear refractory. Ziehen has noted exaltation of the jerk to follow ex- tirpation of a cortical centre.

Although the cell body or perikaryon of the neuron, with its contained nucleus, is essential for the maintenance of the life of the cell branches, it has become recognized that the actual process and function ^^""" of " conduction " in many neurons can, and does, neurons. go on without the cell body being directly con- cerned in the conduction. Wundt first showed, many years ago, that the nerve impulse travels through the spinal ganglion at the same speed as along the other parts of the nerve trunkâ€" that is, that it suffers no delay in transit through the perikarya of the afferent root- neurons. Bethe has succeeded in isolating their peri- karya from certain of the afferent neurons of the antenna of Carcinus. The conduction through the amputated cell branches continues unimpaired for many hours. This indicates that the conjunction between the conduct- ing substance of the dendrons and that of the axon can be effected without the intermediation of the cell body. But the proper nutrition of the conducting substance is indissolubly dependent on the cell branches being in continuity with the cell body .and nucleus it contains. Evidence illustrating this nexus is found in the visible changes produced in the perikaryon by prolonged activ- ity induced and maintained in the conducting branches of the cell. As a result, the fatigued cells appear shrunken, and their reaction to staining reagents alters, thus showing chemical alteration. Most marked is the decrease in the volume of the nucleus, amounting even to 44 per cent, of the initial volume. In the myelinated cell branches of the neuron, that is, in the ordinary nerve fibres, no visible change has ever been demonstrated as the result of any normal activity, however great â€" a striking contrast to the observations obtained on the perikarya. The chemical changes that accompany activ- ity in the nerve fibre must be very small, for no measur- able production of CO2 or of heat is observable as the result of the most forced tetanic activity.

The nerve cells of the higher vertebrata, unlike their blood cells, their connective tissue cells, and even their muscle cells, early, and indeed in embryonic life, lose power of multiplication. The number o^^*^ '" of them formed is definitely closed at an early Â°y7um. period of the individual life; they are like a committee given definite work to do and without power to add to their number. The nerve cells of a centenarian are themselves each individually a hundred years of age. Although,

unlike so many other cells, thuE'early sterile for reproduction of their kind, they retain for longer than most cells a high power of individual growth. They continue to grow, and to thrust out new branches and to lengthen existing branches, for many years far into adult life. They similarly possess power to repair and to re- generate their cell branches where these are injured or destroyed by trauma or disease. This is the explanation of the repair of nerve trunks that have been severed, with consequent degeneration of the peripheral nerve fibres. As a rule, a longer time is required to restore the motor than the sensory functions of a nerve trunk.

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PHYSIOLOGY

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Cerebral cortex.

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Whether examined by functional or by structural features, the conducting paths of the nervous system, traced from beginning to end, never terminate in the centres of that system, but pass through them. All ultimately emerge as efferent chan- nels. Every afferent channel, after entrance in the central nervous system, subdivides into several ; of these some pass to efferent channels soon, others pass farther and farther within the cord and brain before they finally reach channels of outlet. All the longest routes thus formed traverse late in their course the cortex of the cerebral hemisphere. It is this relatively huge development of cortex cerebri which is the pre-eminent structural charac- ter of man. This means that the number of " longest routes " in

man is, as compared with lower animals, disproportionately great. In the lower animal forms there is no such nervous structure at all as the cor- tex cerebri. In the frog, lizard, and even bird, it is a thin and poorly developed thing. In the marsupials it is more evident, and its excitation by electric currents evokes movements in the musculature of the crossed side of the body. Larger and thicker in the rabbit, when excited it gives rise in that animal to movements of the eyes and of the fore-limbs and neck ; but it is only in much higher types, such as the dog, that the cortex yields, under experimental excitation, de- finitely localized foci, whence can be evoked movements of the fore-limb, hind-limb, neck, eyes, ears, and face. In the monkey the proportions it assumes are vastly greater, and the number of foci, for distinct move- ments of this and that member, indeed for the individual joints of each limb, are much more numerous, and together occupy a more extensive surface, though relatively to the total surface of the brain a smaller one.

Experiment shows that in the manlike (anthropoid) apes the differentiation of the foci or ” centres ” of move- ment in the motor field of the cortex is more minute still. In them areas are found whence stimuli excite movements even of this or that finger alone, of the upper lip without the lower, of the tip only of the tongue, or of one upper eyelid by itself. The movement evoked from a point of cortex is not always the same; its character is determined by movements evoked from neighbouring points of cortex immediately antecedently. Thus a point A will, when excited soon subsequent to point B, which latter yields protrusion of lips, itself yield lip-protrusion, whereas if excited after C, which yields lip-retraction, it will itself yield lip-retraction. The movements obtained by point-to- point excitation of the cortex are often evidently imper- fect as compared with natural movements â€” that is, are only portions of complete normal movements. Thus among the tongue movements evoked by stigmatic stimu- lation of the cortex undeviated protrusion or retraction of the organ is not found. Again, from different points of the cortex the assumption of the requisite positions of the tongue, lips, cheeks, palate, and epiglottis, as components in the act of sucking, can be provoked singly. Earely can the whole action be provoked, and then only gradually, by prolonged and strong excitation of one of the requisite points, e.g., that for the

tongue, with which the other points are functionally connected. Again, no single point in the cortex evokes the act of ocular convergence and fixation. All this means that the execution of natural movements employs simultaneous co-operative activity of a number of points in the motor fields on both sides of the brain together.

The accompanying simple figure indicates better than any verbal description the topography of the main groups of foci in the motor field of a manlike ape (chimpanzee). It will be noted from it that there is no direct relation between the extent of a cortical area and the mass of muscles which it controls. The mass of muscles in the Anus ^vsglna,. Toes -â– Â»^J^*2*2n/' Abdomen**

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Diagram of the Topography of the Main Groups of Foci in the Motor Field of Chimpanzee.

trunk is greater than in the leg, and in the leg is greater than in the arm, and in the arm is many times greater than in the face and head ; yet for the last the cortical area is the most extensive of all, and for the first-named is the least extensive of all.

The motor field of the cortex is, taken altogether, rela- tively to the size of the lower parts of the brain, larger in the anthropoid than in the inferior monkey brains. But in the anthropoid brain still more increased even than the motor field are the great regions of the cortex outside that field, which yields in definite movements under electric excitation, and are for that reason known as “inexcitable.” The motor field, therefore, though absolutely larger, forms nevertheless a smaller fraction of the whole cortex of the brain than in the lower forms. The statement that in the anthropoid (orang-outan) brain the groups of foci in the motor fields of the cortex are themselves separated one from another by surrounding inexcitable cortex, has been made and was one of great interest, but has not been confirmed by subsequent observation. That in man the excitable foci of the motor field are islanded in inexcitable surface similarly and even more extensively, was a nat- ural inference, but it had its chief basis in the observa- tions on the orang, now known to be erroneous ; unless direct confirmatory evidence ~~is forthcoming from obser~~ vations on the human brain itself, the supposition must be abandoned.

In the diagram there is indicated the situation of the cortical centres for movement of the vocal cords. Their situation is at the lower end of the motor field. That they should lie there is interesting, because that place is close to one known in man to be associated with manage- ment of the movements concerned in speech. When that area in man is injured, the ability to utter words is im- paired. Not that there is paralysis of the muscles of speech, since these muscles can be used perfectly for all acts other than speech. The area in man is known as the motor centre for speech ; in most persons it exists only in the left half of the brain and not in the right. In a

similar wa,j damage of a certain small portion of the temporal lobe of the brain produces loss of intelligent apprehension of words spoken,

although there is no deaf- ness and although words seen are perfectly apprehended. Another region, "the angular region," is similarly related to intelligent apprehension of words seen, though words heard are apprehended perfectly.

When this differentiation of cortex, traceable by experi- ment to its highest expression in man, is collated with the facts of the detailed development of the cortex as studied in the successive phases of its growth and ripening in the human infant, a suggestive analogy is seen. The nervous paths in the brain and cord, as they attain completion, come to be furnished more and more with fibres that are fully myelinate. At the beginning of its history each is unprovided with myelinate nerve fibres. The excitable foci of the cerebral cortex are well myelinated long before the unexcitable are so. The regions of the cortex, whose conduction paths are early completed, may be arranged in groups by their connexions with sense-organs : eye- region, ear-region, skin and somaesthetic region, olfactory and taste region. The areas of intervening cortex, arriv- ing at structural completion later than the above sense- spheres, are called by some association-spheres, to indicate the view that they contain the neural mechanisms of reactions (some have said "ideas") associated with the sense perceptions elaborated in the several sense-spheres.

The name " motor area" is given to that region of cortex whence motor reactions of the facial and limb muscles are regularly and easily evoked, as Eerrier's investi- Sensori- gations showed. This region is often called the 'Mattes. sensori-motor cortex, and the term sommsthetic has also been used and seems very appropriate. It has been found that disturbance of sensation, as well as disturbance of movement, is often incurred by its injury. Patients in whom, for purposes of diagnosis, it has been electrically excited, describe, as the initial effect of the stimulation, tingling and obscure but locally-limited sensa- tions, referred to the part whose muscles a moment later are thrown into co-ordinate activity. The distinction, therefore, between the movement of the eyeballs, elicited from the occipital (visual) cortex, and that of the hand, elicited from the cortex in the region of the central sulcus (somsesthetic), is not a difference between motor and sensory,

for both are sensori-motor in the nature of their reactions ; the difference is only a difference between the kind of sense and sense-organ in the two cases, the muscular apparatus in each case being an appanage of the sensual.

That the lower types of vertebrate, such as fish, e.g., carp, possess practically no cortex cerebri, and neverthe- less execute "volitional " acts involving high co-ordination and suggesting the possession by them of associative mem- ory, shows that for the existence of these phenomena the cortex cerebri is in them not essential. In the dog it has been proved that after removal from the animal of every vestige of its cortex cerebri, it still executes habitual acts of great motor complexity requiring extraordinarily deli- cate adjustment of muscular contraction. It can walk, run, and feed ; such an animal, on wounding its foot, will run on three legs, as will a normal dog under similar mis-chance. But signs of associative memory are almost, if not entirely, wanting. Throughout three years such a dog failed to learn that the attendant's lifting it from the cage at a certain hour was the preliminary circumstance of the feeding-hour ; yet it did exhibit hunger, and would refuse further food when a sufficiency had been taken. In man, actually gross sensory defects follow even limited lesions of the cortex. Thus the rabbit and dog are not absolutely blinded by removal of the entire cortex, but in man destruction of the occipital cortex produces

Cere- bellum.

total blindness, even to the extent that the pupil of the eye does not respond when light is flashed into the eye.

Examination of the cerebellum by the method of Wallerian degeneration has shown that a large number of spinal and bulbar nerve cells send branches up into it. These seem to end, for the most part, in the grey cortex of the median lobe, some, though not the majority, of them decussating across the median line. The organ seems also to receive many fibres from the parietal region of the cerebral hemisphere. From the organ there emerge fibres which cross to the opposite red nucleus, and directly or indirectly reach the thalamic

region of the crossed hemisphere. The pons or middle peduncle, which was regarded, on the uncertain ground of naked-eye dissection of human anatomy, as commissural between the two lateral lobes of the cerebellum, is now known as constituting chiefly a cerebro-cerebellar decus- sating path. Certain cerebellar cells send processes down to the cell-groTjp m the bulb known as the nucleus of Deiters, which latter projects fibres down the spinal cord. Whether there is any other or direct emergent path from the cerebellum into the spinal cord is a matter on which opinion is divided.

Injuries of the cerebellum, if large, derange the power of executing movements, without producing any detectable derangement of sensation. The derangement gradually disappears, unless the damage to the organ be very wide. A reeling gait, oscillations of the body which impart a zig- zag direction to the walk, difficulty in standing, owing to unsteadiness of limb, are common in cerebellar disease. On the other hand, congenital defect amounting to absence of one cerebellar hemisphere has been found to occasion practically no symptoms whatsoever. Xot a hundredth part of the cerebellum has remained, and yet there has existed ability to stand, to walk, to handle and lift objects in a fairly normal way, without any trace of impairment of cutaneous or muscular sensitivity. The damage to the cerebellum must, it would seem, occur not very slowly in order to occasion marked derangement of function, and then the derangement falls on the execution of movements. One aspect of this derangement, named by Luciani astasia, is a tremor heightened by or only appearing when the muscles enter upon action â€” “intention tremor.” Vertigo is a frequent result of cerebellar injury : animals indicate it by their actions; patients describe it. To interpret this vertigo, appeal must be made to disturbances, other than cerebellar, which likewise occasion vertigo. These include, besides ocular squint, many spatial positions and movements unwonted to the body : the looking from a height, the gliding over ice, sea-travel, to some persons even travelling by train, or the covering of one eye. Common to all these conditions is the synchronous rise of perceptions of spatial relations between the self and the environment which have not, or have rarely, before arisen in synchronous combination. The tactual organs of the soles, and the muscular sense organs of limbs and

trunk, are originating perceptions that indicate that the self is standing on the solid earth, yet the eves are at the same time originating perceptions" that indicate that the solid earth is far away below the standing self. The com- bination is hard to harmonize at first; it is at least not given as innately harmonized. I'erceptions regarding the " me " are notoriously highly charged with " feeling," and the conflict occasions the feeling insufBciently described as " giddiness." The cerebellum receives paths from most, if not from all, the afferent roots. With certain of these it stands associated most closely, namely, with the vestibular, representing the sense-organs which furnish data for appre- ciation of positions and movements of the head, and with the channels, conveying centripetal impressions from the

apparatus of skeletal movement. Disorder of the cere- bellum sets at variance, brings discord into, the space- perceptions contributory to the movement. The body's movement becomes thus imperfectly adjusted to the spatial requirements of the act it would perform.

In the physiological basis of sense exist many impres- sions which, apart from and devoid of psychical accom- paniment, refiexly influence motor (muscular) innervation. It is with this sort of habitually apsychical reaction that the cerebellum is, it would seem, employed. That it is apparently devoid of psychical concomitant need not imply that the impressions concerned in it are crude and inelaborate. The seeming want of reaction of so much of the cerebellar structure under artificial stimulation, and the complex relay system revealed in the histology of the cerebellum, suggest that the impressions are elaborate. Its reaction preponderantly helps to secure co-ordinate innervation of the skeletal musculature, both for maintenance of attitude and for execution of movements. So far as the geotropism and stereo- tropism of the animal can be "centred" at any one limited field of the central nervous system, that field is cerebellar.

Sleep. â€” The more obvious of the characters of sleep are essentially nervous. In deep sleep the threshold-value of the stimuli for the various senses is very greatly raised, rising rapidly during the first hour and a half of sleep, and then declining with gradually decreasing decrements. The muscles become less tense than in their waking state : their tonus is diminished, the upper eyelid falls, and the knee-jerk is in abeyance. The respiratory rhythm is less frequent and the breathing less deep; the heart- beat is less frequent ; the secretions are less copious ; the pupil is narrow ; in the brain there exists arterial anaemia with venous congestion, so that the blood-flow there is less than in the waking state.

It has been suggested that the gradual cumulative result of the activity of the nerve cells during the waking day

is to load the brain tissue with "fatigue-sub- ^f^siÂ»sp. stances" which clog the action of the cells, and

thus periodically produce that loss of conscious- ness, &c., which is sleep. Such a drugging of tissue by its own excreta is known in muscular fatigue, but the fact that the depth of sleep progressively increases for an hour and more after its onset prevents complete explanation of sleep on similar lines. It has been urged that the neurons retract during sleep, and that thus at the synapses the gap between nerve cell and nerve cell becomes wider, or that the supporting cells expand between the nerve cells and tend to isolate the latter one from other. Certain it is that in the course of the waking day a great number of stimuli play on the sense organs, and through these produce disintegration of the living molecules of the central nervous system. Hence during the day the assimilatory processes of these cells are overbalanced by their wear and tear, and the end-result is that the cell attains an atomic condition less favourable to further disintegration than to reintegrar tion. That phase of cell life which we are accustomed to call "active" is accompanied always by disintegration. When in the cell the assimilative processes exceed dis- similative, the external manifestations of energy are liable to cease or diminish. Sleep is not exhaustion of the neuron in the sense that prolonged activity has reduced its excita- bility to zero. The nerve cell just prior to sleep is still

well capable of response to stimuli, although perhaps the threshold-value of the stimulus has become rather high, whereas after entrance upon sleep and continuance of sleep for several hours, and more, when all spur to the â– dissimilation process has been long withheld, the thres- hold-value of the sensory stimulus becomes enormously higher than before. The exciting cause of sleep is there-

fore no complete exhaustion of the available material of the cells, nor is it entirely any paralysing of them by their excreta. It is more probably abeyance of external function during a periodic internal assimilatory phase.

Two processes conjoin to initiate the assimilatory phase. There is close interconnexion between the two aspects of the double activity that in physiological theory constitute the chemical life of proto- plasm, between dissimilation and assimilation. Bering has long insisted on a self-regulative adjustment of the cell metabolism, so that action involves reaction, increased catabolism necessitates after-increase of anabolism. The long-continued incitement to catabolism of the waking day thus of itself predisposes the nerve cells towards rebound into the opposite phase ; the increased catabolism due to the day's stimuli induces increase of anabolism, and though recuperation goes on to a large extent during the day itself, the recuperative process is slower than, and lags behind, the disinte- grative. Hence there occurs a cumulative effect, progressively increasing from the opening till the closing hours. The second factor inducing the assimilative change is the withdrawal of the nervous system from sensual stimulation. The eyes are closed, the maintenance of posture by active contraction is replaced by the recumbent pose which can be maintained by static action and the mere mechanical consistence of the body, the ears are screened from noise in the quiet chamber, the skin from localized pressure by a soft, yielding couch. The effect of thus reducing the excitant action of the environment is to give consciousness over more to mere revivals by memory, and gradually consciousness lapses. A remarkable case is well authenticated, where, owing to disease, a young man had lost the use of all the senses save of one eye and of one ear. If these last channels were sealed, in two or three minutes' time he invariably fell asleep.

If natural sleep is the expression of ~~a. phase of decreased excit~~ ability due to the setting in of a tide of anabolism in the cells of the nervous system, what is the action of narcotics ? They lower the external activities of the cells, but do they not at the same time lower the internal, reparative, assimilative activity of the cell that in natural sleep goes vigorously forward preparing the system for the next day's drain on energy ? In most cases they seem to lower both the internal and the external activity of the nerve cells, to lessen the cell's entire metabolism, to reduce "srcotlcs, the speed of its whole chemical movement and life. Hence it is not surprising that often tjie refreshment, the recuperation, obtained from and felt after sleep induced by a drug amounts to nothing, or to worse than nothing. But very often refreshment is undoubtedly obtained from such narcotic sleep. It may be supposed that in the latter case the effect of the drug has been to ensure occurrence of that second predisposing factor mentioned above, of that withdrawal of sense impulses from the nerve centres that serves to usher in the state of sleep. In certain conditions it may be well worth while by means of narcotic drugs to close the portals of the senses for the sake of thus obtaining stillness in the chambers of the mind ; their enforced quietude may induce a period in which natural rest and repair continue long after the initial unnatural arrest of vitality due to the drug itself has passed away.

Hypnotism. â€" The physiology of this group of " states " is, as regards the real understanding of their production, eminently vague. The conditions which tend to induce them contain generally, as one element, constrained visual attention prolonged beyond ordinary duration. Symptom s attendant on the hypnotic state are closure of the eyelids by the hypnotizer without subsequent attempt to open them by the hypnotized subject; the pupils, instead of being constricted, as for near vision, dilate, and there ^ets in a condition superficially resembling sleep. But in natural sleep the action of all parts of the nervous system is subdued, whereas in the hypnotic the reactions of the lower, and some even of the higher, parts are exalted. More- over, the reactions seem to follow the sense impressions with such fatality, that, as an inference, absence of will- power to control them or suppress them is suggested. This reflex activity with "paralysis of will" is character- istic

of the somnambulistic state. The threshold-value of the stimuli adequate for the various senses may be ex- traordinarily lowered. Print of microscopic size may be read; a watch ticking in another room can be heard. Judgment of weight and texture of surface is exalted ; thus a card can in a dark room be felt and then re-selected from the re-shuffled pack. Akin to this condition is that in which the power of maintaining muscular effort is in-

creased; the individual may lie stiff with merely head and feet supported on two chairs ; the limbs can be held outstretched for, hours at a time. This is the cataleptic state, the phase of hypnotism which the phenomena of so-called " animal hypnotism " resemble most. A frog or fowl or guinea-pig held in some unnatural pose, and retained so forcibly for a time, becomes " set " in that pose, or rather in a posture of partial recovery of the normal posture. In this state it remains motionless for various periods. This condition is more than usually readily induced when the cerebral hemispheres have been removed. The decerebrate monkey exhibits " cata- leptoid " reflexes. Father Kircher's exjperimentum mirou- hile with the fowl and the chalk line succeeds best with the decerebrate hen. The attitude may be described as due to prolonged, not very intense, discharge from reflex centres that regulate posture and are probably intimately connected with the cerebellum. A sudden intense sense stimulus usually sufiices to end this tonic discharge. It completes the movement that has already set in but had been checked, as it were, half-way, though tonically main- tained. Coincidently with the persistence of the tonic contraction, the higher and volitional centres seem to lie under a spell of inhibition; their action, which would complete or cut short the posture-spasm, rests in abey- ance. Suspension of cerebral influence exists even more markedly, of course, when the cerebral hemispheres have been ablated.

But a potent â€” according to some, the most potent â€” factor in hypnotism, namely, suggestion, is unrepresented in the production of so-called animal hypnotism. We know that one idea suggests another, and that volitional movements are the outcome of ideation. If we assume that there is a material process at the basis of ideation, we may take the analogy of the concomitance between a spinal reflex movement and a skin sensation. The physi- cal ” touch” that initiates the psychical “touch” initiates, through the very same nerve channels, a reflex movement responsive to the physical “touch,” just as the psychical ” touch ” may be considered also a response to the same physical event. But in the decapitated animal we get, we have good arguments for belief, the reflex movement alone as response ; the psychical touch drops out. Could we assume that there is in the adult man reflex machinery which is of higher order than the merely spinal, which employs much more complex motor mechanisms than they, and is connected with a much wider range of sense organs ; and could we assume that this reflex machinery, although usually associated in its action with memorial and volitional processes, may in certain circumstances be sundered from these latter and unattendant on them â€” may in fact continue in work when the higher processes are at a standstill â€” then we might imagine a condition resembling that of the somnambulistic and cataleptic states of hypnotism.

Such assumptions are not wholly unjustified. Actions of great complexity and delicacy of adjustment are dally executed by each of us without what is ordinarily understood as volition, and without more than a mere shred of memory attached thereto. To take one’s watch from the pocket and look at it when from a familiar clock-tower a familiar bell strikes a familiar hour, is an instance of a habitual action initiated by a sense perception outside attentive consciousness. We may suddenly remember dimly afterwards that we have done so, and we quite fail to recall the difference between the watch time and the clock time. In many instances hypnotism seems to establish quickly reactions similar to such as usually result only from long and closely attentive practice. The sleeping mother rests undisturbed by the various noises of the house, and street, but wakes at a slight murmur from her child. The ship’s engineer, engaged in conversation with some visitor to the

engine-room, talks apparently undisturbed by all the multifold noise and rattle of the machinery, but let the noise alter in some item which, though unnotioeable to the visitor, betokens importance to the trained ear, and his passive attention is in a moment caught.

The warders at an asylum have been hypnotized to sleep by the bedside of dangerous patients, and ” suggested ” to awake the in- stant the patients attempt to get out of bed, sounds which had no import for them being inhibited by suggestion. Warders in this way worked all day and performed night duty also for months without showing fatigue. This is akin to the ” repetition ” which, read by the schoolboy last thing overnight, is on waking “known by heart. ‘ ‘ Most of us can wake somewhere about a desired although unusually early hour, if overnight we desire much to do so.

Two theories of a physiological nature have been pro- posed to account for the separation of the complex reac- tions of these conditions of hypnotism from volition and from memory. Heidenhain’s view is that the cortical centres of the hemisphere are inhibited by pecidiar con- ditions attaching to the initiatory sense stimuli. Preyer’s view is that the essential condition for initiation is fatigue of the will-power under a prolonged effort of undivided attention.

Hypnotic somnambulism and hypnotic catalepsy are not the only or the most profound changes- of nervous condition that hypnosis can induce. The physiological derangement which is the basis of the abeyance of volition may, if hypnotism be profound, pass into more widespread derangement, exhibiting itself as the hypnotic lethargy. This is associated not only with paralysis of will but with profound anaesthesia. Proposals have been made to employ hypnotism as a method of producing anaesthesia for surgical purposes, but there are two grave objections to such employment. In order to produce a suflB.cient degree of hypnotic lethargy the subject must be made extremely susceptible, and this can only be done by repeated hypnotization. It is necessary to hypnotize patients every day for several weeks before they can be got into a degree of stupor sufficient to allow of the safe execution of a surgical operation. But the state itself,

when reached, is at least as dangerous to life as is that produced by inhalation of ether, and it is more difficult to recover from. Moreover, by the processes the subject has gone through he has had those physiological activi- ties upon which his volitional power depends excessively deranged, and not improbably permanently enfeebled.

(c. s. s.)

VII. Special Senses.

Touch. â€” The sense of touch depends upon pressure. When we touch a body, a pressui-e is exerted. This pressure reacts on nerve-endings in the epidermis or skin, nervous impulses are generated, and when these react, the brain sensations of ” touch ” ai-e the result (see 9th edition, article Touch, vol. xxiii. p. 478). Eeseareh shows that the sensation may be referred to parts of the skin which do not contain the special end organs asso- ciated with this sense, and that fllaments in the Mal- pighian layer (the layer immediately above the papillje of the true skin) may form the anatomical basis of the sense. The skin may be regarded, also, as an extensive surface containing nervous arrangements by which we are brought into relation with the outer world. Accordingly, touch is not the only sensation referred to the skin, but we also refer sensations of temperature (heat and cold), and often those peculiar sensations which we call pain.

Sensations of heat and cold are chiefly referred to the skin, and only partially to some mucous membranes, such as those of the alimentary canal. Direct irrita- tion of a nerve does not give rise to these sensa- Tempera- tions. Thus, if we plunge the elbow into hot saâ„¢oâ€žT” water, or into ice-cold water, we may have feel- ings of heat or of cold referred to the parts immersed, but we do not experience heat or cold by irritating the ulnar nerve, which lies here just below the skin. A‘heu the change of temperature affects the nerve, there is a painful sensation referred to the extremities of the nerve on the

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ulnar side of the arm and hand. The exposed pulp of a diseased tooth, when irritated by hot or cold fluids, gives rise to pain, not to sensations of temperature. It has now- been ascertained that there are minute areas on the skin in which sensations of heat and cold may be more acutely felt than in adjoining areas; and, further, that there are points stimulated by addition of heat, hot spots, while others are stimulated by withdrawal of heat, cold spots.

A simple method of demonstrating this phenomenon is to use a solid cylinder of copper, eight inches in length by half an inch in thickness, and sharpened at one end to a fine pencil-like point. Dip the pointed end into very hot water, close the eyes, and touch parts of the skin. When a hot spot is touched, there is an acute sensation of burning. Such a spot is often near a hair. Again, in another set of experiments, dip the copper pencil into ice-cold water and search for cold spots. When one of these is touched, a sensa^ tion of cold, as if concentrated on a point, is experienced. Thus it may be demonstrated that in a given area of skin there may be hot spots, cold spots, and touch spots.

Cold spots are more abundant than hot spots. The spots are arranged in curved lines, but the curve uniting a number of cold spots does not coincide with the curve forming a chain of hot spots. By Weber's method (see Touch, 9th edition, vol. xxiii. p. 480) it will be found that we can discriminate cold spots at a shorter distance from each other than hot spots. Thus on the forehead cold spots have a minimum distance of 8 mm., and hot spots 4 mm. ; on the skin of the breast, cold spots 2 mm., and hot spots 5 mm. ; on the back, cold spots 1-5 mm., and hot spots 4 to 6 mm. ; on the back of the hand, cold spots 3 mm., and hot spots 4 mm. ; on the palm, cold spots 8 mm., and hot spots 2 mm. ; and on the thigh and leg, cold spots 3 mm., and hot spots 3-6 mm. Electrical and mechanical stimulation of the hot or cold spots call forth the corresponding sensation. No terminal organ for discrimination of temperature has yet been found. It will be observed that the sensation of heat or cold is excited by change of temperature, and that it is more acute and definite the more sudden the change. Thus discrimi- nation

of temperature is similar to discrimination of touch, which depends on more or less sudden change of pressure. The term cold means, physiologically, the sensation we experience when heat is abstracted, and the term heat, the sensation felt when heat is added to the part. Thus we are led to consider that the skin contains at least two kinds of specific terminal organs for sensations of touch and temperature, and two sets of nerve fibres which carry the nervous impulses to the brain. In all probability, also, these fibres have different central endings, and in their course to the brain run in different tracts in the spinal cord. This will explain cases of disease of the central nervous system in which, over certain areas of skin, sensar tions of touch have been lost while sensations of tempera- ture and pain remain, or vice versd. Tactile and thermal impressions may influence each other. Thus a leg sent to ” sleep ” by pressure on the sciatic nerve will be found to be less sensitive to heat, but distinctly sensitive to cold. In some cases of disease it has been noticed that the skin is sensitive to a temperature above that of the limb, but insensitive to cold. Again, a weight is always felt to be heavier when it is cold than when it is hot, and the minimum distance at which two compass points are felt is diminished when one point is warmer than the other. It is highly probable that, just as we found in the case of touch (pressure), the terminal organs connected with the sense of temperature are the fine nerve filaments that have been detected in the deeper strata of the Malpighian region of the epidermis, immediately above the true skin, and it is also probable that certain epidermic (epithelial) cells in that region play their part in the mechanism.

Sensations of touch (pressure) and of temperature are

not, however, the only sensations referred to the skin. We may also experience in that organ the peculiar class of sensations called pain. Sensations of a painful ^^^^

character may also, in certain circumstances, be referred to the viscera, and to mucous and serous surfaces. Pain is not a sensation excited by irritating the end organs either of touch or of temperature, nor even by irritating directly the filaments of a sensory nerve. Even if sensory

nerves are cut or bruised, as in surgical operations, there may be no sensations of pain; and it has been found that muscles, vessels, and even the vis- cera, such as the heart, stomach, liver, or kidneys, may be freely handled without giving rise to any feeling of pain, or indeed to any kind of sensation. These parts, in ordinary circumstances, appear to be insensitive, and yet they contain afferent nerves. If the sensibility of these nerves is heightened, or possibly if the sensitive- ness of the central terminations of the nerves is raised, then we may have sensations to which we give the name of pain. In like manner the skin is endowed with affe- rent nerves, distinct from these ministering to touch and to temperature, along which nervous impulses are con- stantly flowing. When these nervous impulses reach the central nervous system, in ordinary circumstances they do not give rise to changes that reach the level of con- sciousness, but they form, as it were, the warp and woof of our mental life, and they also afl:ect metabolisms, that is to say, nutritive changes in many parts of the body. They may also, as is well known, affect unconsciously such mechanisms as those of the action of the heart, the calibre of the blood-vessels, and the movements of res- piration. If, however, their plane of activity is raised, as by intermittent pressure, or by inflammatory action, or by sudden changes of temperature, as in burning, scalding, &c., such nervous impulses give rise to pain. Sometimes pain is distinctly located, and in other cases it may be irradiated in the nerve centres, and referred to areas of skin or to regions of the body which are not really the seat of the irritation. Thus irritation of the liver may cause pain in the shoulder; disease of the hip-joint often gives rise to pain in the knee ; and renal colic, due to the passage of a calculus down the ureter, to severe pain even in the abdominal walls. It is also noticeable that a sen- sation of pain gives us no information as to its cause ; we simply have an agonizing sensatiion in a part to which,, hitherto, we probably referred no sensations. The acute- ness or intensity of pain depends partly on the intensity of the irritation, and partly on the degree of excitability of the sensory nerves at the time. Sometimes, for example, the excitability of sensory nerves may be so high that a whiff of air may cause acute distress. If only a few nerves are affected, the pain is acute and piercing; but if many nerves are involved, it may be more massive and diffuse in character. The quality of pain, whether it is gnawing, dull,

boring, piercing, shooting, depends on the nature of the irritation, and on whether the irritation is constant or intermittent (see Touch, vol. xxiii. p. 482).

Smell. â€” It has not yet been decided whether the sense of smell depends, in the first instance, on a chemical or on a physical process. All that can be said is that sensory impulses are excited when odoriferous particles come into contact with the free ends of peculiar rod-like cells found in the olfactory mucous membrane (see Anatomy, vol. L p. 885 ; also Smell, vol. xxii. p. 167). The free olfactory surface is always covered with a thin layer of fluid, and it is clear that all odoriferous matters must be dissolved in this fluid so as to reach the rod-cells. There is here an analogy with the conditions found in the sense of taste, where sapid substances must be soluble in the fluid of the mouth. The intensity of the sensation of smell depends on the size of the area of the olfactory membrane affected : the greater

the area the more intense the sensation. On this principle an olfactometer may be constructed by which the inten- sities of different odours may be compared. Thus the odoriferous value of a substance may be expressed by the smallest superficial area, impregnated with the odoriferous matter, over which the air must pass to give rise to a distinct sensation. The minimal quantity of material, as in the case of musk, is extremely small.

No progress has been made in establishing any con- nexion between the chemical nature of a substance and the odour it may excite. There is a relation between the molecular weight of a gas and the presence or absence of odour. Gases of less than a certain molecular weight are odourless, and it is significant that to some persons hydrocyanic acid,

which has a low molecular weight, gives rise to no sensation of smell. It has also been pointed out that chemical compounds of elements belong- ing to the same group, according to the well-known periodic law, have sometimes odours of a similar charac- ter (Foster's Physiology, part iv. p. 1605).

As a rule, we experience odours by the simultaneous use of both nostrils. Stimulation of either nostril would give rise to the sensation, while there is a fusion of sen- sations when both are affected. If, by means of a tube, an odour is conveyed into one nostril, while an odour of a different kind is directed into the other, there may be either a compound sensational effect, a sort of double- odour, or one odour may so predominate as entirely to destroy the other. The fusion of odours is not complete, and it is similar to the effect of combining, say blue and red, in stereoscopic vision. When one odour destroys the other, the obliteration must take place in the cerebral centre. It is not unlikely that when one odour pre- dominates among many, this may be due not to any chemical action of one substance over anoth'Br, but that the missing sensations may be accounted for by their failure to excite the olfactory region of the cerebrum in the presence of a stronger stimulus.

Taste. â€" The structure of the terminal organ of taste has already been fully described (see Taste, 9th ed. vol. xxiii. p. 79). Evidence is accumulating that taste depends on nervous impulses excited by chemical change. Sub- stances that have taste must be soluble, and they are brought into contact with delicate hair-like processes in the taste goblets (taste-buds), or with filaments ending on the free mucous surface between epithelial cells. Chemi- cal changes are in all probability set up in these taste cells, or in the processes connected with them. Some progress has been made in the attempt to establish a connexion between the chemical composition of sapid substances and the different kinds of taste to which they may give rise. Thus acids are usually sour ; alkaloids have a peculiar soapy taste; salts may be sweet, like sugar of lead, or bitter, like sulphate of magnesia; soluble alkaloids, such as quinine or strychnine, are usually bitter ; and the higher alcohols are more or less sweet. Substances which taste sweet or bitter often con- tain definite groups in the molecule, especially the hydroxyl

(HO) and amido (NHj) groups. By alter- ing the chemical composition of a substance having a characteristic taste (changing the position or relations of the radicles), the substance may become tasteless or intensely bitter. The sensation of taste may also be excited mechanically, as by smartly tapping the tongue, or by the stimulus of a continuous current (see art. Taste, p. 80). In the latter case electrolytic change may be the exciting cause ; but that the sense organs may be stimulated electrically is proved by the fact that very rapidly-interrupted induced currents, which produce little or no electrolysis, may also excite taste. Sensa- tions of taste are heightened by increasing the area of

the tongue affected, and by mechanical stimulation, as when the tongue is pressed against the lips, cheeks, or palate. A temperature of about 40Â° C. is most favour- able, either extreme heat or cold apparently benumbing the sense for a time. Gustatory sensations affect each other: that is to say, a strong taste will affect the taste of another body taken immediately after it. Thus sweetness will modify bitterness, and sourness will modify both. Moreover, the application of a sapid sub-stance to the tongue will affect taste in other parts. If the same taste is excited on each side of the tongue, although there are two sets of gustatory nerves, one for each lateral half, the sensations are blended into one; while if two different substances, say one sweet and the other bitter, are simultaneously applied, one to each side, there is not a blending of the sensation, but the observer can distinctly differentiate the one from the other.

As a general rule, bitter tastes are most acute at the back of the tongue, near the circumvallate papillae, and sweet tastes at the lip, but there are considerable in- dividual variations. Some persons taste both bitter and sweet substances best at the back, while others taste bitter things at the lip. Many experience salt tastes best at the tip, and acid tastes at the sides of the tongue. When we consider that there are three kinds of papillae on the surface of the tongue, filiform, fungiform, and circum-vallate (see Anatomy), one would almost expect to meet with different degrees of sensitiveness to different tastes, even while we admit that the papillae may also have to do with sensations of touch and of

temperature. By experimenting with fine capillary tubes containing sapid substances, observations have been made with individual papillae. Some are found to be sensitive to many tastes, others to two or three, others to only one, while others are insensitive to taste altogether. Again, it has been found that a mixture of sapid substances, say of quinine and sugar, may taste sweet when applied to one papilla and bitter when applied to another. The inference must be that there are special terminal organs for different tastes. This is supported by some interesting experi- ments made by Shore {Journal of Physiology, 1891). Assuming that there are different kinds of taste cells, it might be possible to paralyse some without affecting others, and thus different sensations of taste might be discriminated. This has been done by the use of the leaves of a common Indian plant, Oymnema sylvestre. If some of these be chewed, it has been found that bitters and sweets are paralysed (neither quinine nor sugar giving rise to sensation), while acids and salines are unaffected. Again, certain strengths of decoctions of the leaves appear to paralyse sweets sooner than bitters. These observa- tions show the existence of different taste cells for sweets, bitters, acids, and salines ; and it is clear that the region of the tongue most richly supplied with taste cells sensi- tive to sweets will respond best to sweet substances, while another region, supplied by taste cells sensitive to bitters, will respond best to bitter substances. In like manner the argument may be applied to other tastes. Suppose, again, a set of taste cells sensitive to bitter substances : it is conceivable that in whatever way these were irritated, a bitter taste would result. If so, a substance which, applied to one part of the tongue, would cause a sweet sensation, might cause a bitter if applied to a part of the tongue richly supplied with taste cells sensitive to bitters. This may explain why sulphate of magnesia excites at the root of the tongue a bitter taste, while applied to the lip it causes a sweet or an acid taste. Saccharine, a peculiar bromine derivative, in like manner is sweet to the lip and bitter to the back of the tongue. It has also been found that if the sweet and bitter taste cells are paralysed

by Oyvinema, electrical irritation of the lip by a weak interrupted current does not give rise to an acid taste mixed with sweet, as it usually does, but to sensations somewhat different, and which may be described as metallic or salt or acid. This experiment indicates that the action of the interrupted current on the terminal organ is analogous to the action of sweet or bitter sub- stances. No direct observations of importance have yet been made on single circumvallate papillse. Further experiments with capillary tubes show that fungiform papillae destitute of taste buds, and areas of the surface of the tongue having neither papillae nor taste buds, may still, when stimulated by sapid substances, give rise to tastes.

The distribution of nerves to the tongue is very com- plicated. The motor nerve, that is, the nerve that excites and governs the movement of the tongue, is the ninth cranial, known as the hypoglossal. The sensory nerves

are usually described as two in number, the tt'e MDffue. 8'ii'terior two-thirds of the tongue being supplied

by the gustatory or lingual branches of the fifth cranial nerve, and the posterior third (the situation of the circumvallate papillse) by the glosso-pharyngeal nerves. The lingual branch of the fifth nerve contains both ordinary sensory and gustatory filaments, and the glosso-â– pharyngeal supplies the circumvallate papillae and taste buds. Another nerve, however, has to be considered, namely, the chorda tympani, a branch given off by the facial]ierve during the passage of the latter through a canal in the petrous portion of the temporal bone known as the aqueduct of Fallopius. Loss of taste on one side of the tongue has been observed in cases of disease of the ear involving the chorda nerve. This, however, is not conclusive evidence that the chorda contains gustatory filaments, as the loss of taste following its injury may be due to the removal of its influence over the nutrition of the mucous membrane of the organ. If the mucous membrane deteriorated from faulty nutrition, then loss of taste might be due to that cause. On the other hand, there are good grounds for the view that the gustatory

filaments, both of the lingual branch of the fifth and of the glosso-pharyngeal itself, come primarily from the roots of the fifth nerve. It is true that there is no direct evidence that irritation of the proximal end of the fifth nerve, after it had been divided, gives rise to sensations of taste. Clinical evidence, however, shows that disease of this nerve within the cranial cavity causes loss of taste in one lateral half of the tongue, both lip and back, but no case has been recorded of dis- ease of the glosso-pharyngeal being followed by this result (M'Kendrick and Snodgrass, Physiology of the Senses, p. 78).

Vision. â€" The mechanism of vision has been described in the article Eye, 9th ed., vol. viii. p. 816. The mechan- ism by which the anterior surface of the lens becomes more convex when we look at objects within a range of

say 70 yards to 10 inches, is usually described as Mechanism consisting of a Contraction of the fibres of the "' "d'7i'"a "i^i^.ry muscle by which the ciliary processes of

the choroid are pulled forwards, thus releasing the tension of the anterior layer of the capsule of the lens (the layer in front of the lens), and allowing the lens to bulge forwards by its elasticity. Thus rays of light from an object within the range above indicated, becoming more and more divergent as the object approaches the eye, are brought to a focus on the retina, and distinct vision is secured. By this mechanism the radius of cur- vature of the anterior surface of the lens, as the eye accommodates from the far to the near point, may shorten from 10 mm. to 6 mm., as determined by Helmholtz. The ciliary muscle, however, contains two sets of fibres, the

longitudinal or meridional, which run from before back- wards, and the circular or equatorial (Milller's muscle), which run, as their name indicates, around the band of longitudinal fibres forming the muscle. Direct observa- tion on the eye of an animal immediately after death shows that stimulation of the ciliary nerves actually causes a forward movement of the ciliary processes, and there can be little doubt that the explanation above given applies to man, probably most mammals, and to birds and most reptiles. In birds, which are remarkable for acute-

ness of vision, the mechanism is somewhat peculiar. In them the fibres of the ciliary muscle have a strong attach- ment posteriorly, and when these contract they pull ‘back the inner posterior layers of the cornea, and thus relax that part of the ciliary zone called the ligamentum pec- tinatum. In a state of rest this structure in the bird’s eye is tense, but in accommodation it becomes relaxed. Thus by a somewhat different mechanism in the bird, accommodation consists in allowing the anterior surface of the lens to become more and more convex. In reptiles generally the mechanism resembles that of the bird ; but it is said that in snakes and amphibia there is a move- ment forwards of the lens as a whole, so as to catch rays at a less divergent angle. When the eye is directed to a distant object, such as a star, the mechanism of accom- modation is at rest in mammals, birds, reptiles, and am- phibia, but in fishes and cephalopods the eye at rest is normally adjusted for near vision. Consequently accom- modation in the latter is brought about by a mechanism that carries the lens as a whole backwards. There is still some difficulty in explaining the action of the equatorial (circular) fibres. Some have found that the increased convexity of the anterior surface of the lens takes place only in the central portions of the lens, and that the cir- cumferential part of the lens is actually flattened, presum- ably by the contraction of the equatorial fibres. Seeing, however, that the central part of the lens is the portion used in vision, as the pupil contracts during accommoda- tion, a flattening of the margins of the lens can have no optical effect. Further, another explanation can be offered of the flattening. As just stated, during accom- modation the pupil contracts, and the pupillary edge of the iris, thinned out, spreads over the anterior surface of the capsule of the lens, which it actually touches, and this part of the iris, along with the more convex central part of the lens, bulges into the anterior chamber, and must thus displace some of the aqueous humour. To make room for this, however, the circumferential part of the iris, related to the ligamentum pectinatum, moves backwards very slightly, while the flattening of the cir- cumferential part of the lens facilitates this movement. JSTor must we suppose that the longitudinal and equato- rial fibres of the iris always act independently. It is more probable that the muscle acts as a whole. Thus, for man and the higher animals, the

explanation of the mechanism of accommodation as propounded by Helm- holtz is correct.

Under Eye, 9th ed., vol. viii. p. 824, a short account is given of one theory by which an attempt is made to explain the perception of colour. This theory, originally proposed by Thomas Young and advocated by Helmholtz and Clerk Maxwell, is not, however, the only theory of colour vision. Another, enunciated â– SensaWons by Hering, has received large support, more especially from physiologists. We shall here give a brief statement upon this important question. Colour, on the most likely hypothesis as to the physical nature of light, depends on the rate of vibration of the lumini- ferous ether, and white light is a compound of all the colours in definite proportion. When a surface reflects solar light into the eye without affecting this proportion,

it is white, but- if it absorbs all the light so as to reflect uothing, it appears to be black. If a body held between, the eye and the sun transmits light unchanged, and is transparent, it is colourless, but if translucent it is white. If the medium transmits or reflects some rays and absorbs others, it is coloured. Thus, if a body absorbs all the rays of the spectrum but those which cause the sensa- tion of green, we say the body is green in colour ; but this green can only be perceived if the rays of light fall- ing on the body contain rays having the special rate of vibration required for this special colour. For if the sur- face be illuminated by any other pure ray of the spectrum, say red, these red rays will be absorbed and the body will appear to be black. As a white surface reflects all the rays, in. red light it will be seen to be red, and in a green light, green. Colour depends on the nature of the body and on the nature of the light falling on it, and a sensation of colour arises when the body reflects or transmits the special rays to the eye. If two rays of different rates of vibration, that is to say, of different colours, affect a sur- face of the retina at the same moment, the effects are fused

together and we have the sensation of a third colour different from its cause. Thus, if red be removed from the solar spectrum, all the other colours combined cause a sensation of greenish yellow. Under the article Eye, vol. viii. p. 823, a table is given showing the result of mix- ing the pure colours of the spectrum. Thus red and violet give purple, and yellow and blue, white. Yellow and blue, however, only give white when pure spectral colours are mixed. It is well known that a mixture of yellow and blue pigments do not produce white, but green; but, as was explained by Helmholtz, this is because the blue pigment absorbs all the rays at the red end of the spec- trum up to the green, while the yellow pigment absorbs all the rays at the violet end down to the green, and as the only rays reflected into the eye are the green rays, the substance appears green. Finally, if colours are painted on a disc in due proportions and in a proper order, the disc will, when quickly rotated, appear white, from, the rapid fusion of colour effects.

When two colours produce a sensation of white, they are said to be complementary to each other. Thus red with blue-green will give white, but the whiteness so produced is not so intense as the white caused by the simultaneous action of all the spectral colours. The following list shows characteristic complementary colours, with their wave-lengths (A) in millionths of a millimetre : â€” :

Eed, \ 666. Orange, A. 608. Gold-yellow, X 574. Yellow, X 667. Greenish yellow, X 564.

Blue-green, X 492. Blue, X 490. Blue, X 482. Indigo-blue, X 464. Violet, X 433.

By combining colours at opposite ends of the spectrum, the effect of the intermediate colours may be produced ; but the lowest and the highest, red and violet, cannot thus be formed. These are therefore fundamental or primary colours, colours that carinot be produced by the fusion of other colours. If now to red and violet we add green, which has a rate of vibration about midway between red and violet, we obtain a sensation of white. Bed, green, and violet are therefore the three fundamental colours.

Colour physiologically is a sensation, and it therefore does not depend only on the physical stimulus of light, but also on the part of the retina affected. The power of distinguishing colours is greatest when they fall on, or immediately around, the yellow spot, where the number of cones is greatest. In these regions more than two hundred different tints of colour may be distinguished. Outside of this area lies a middle zone, where fewer tints

are perceived, mostly confined to shades of yellow and blue. If intense coloured stimuli are employed, colours may be perceived even to the margin of the periphery of the retina, but with weak stimuli coloured objects may seem to be black, or dark like shadows. In passing a colour from the periijhery to the centre of the yellow spot, remarkable changes in hue may be observed. Orange is first grey, then yellow, and it only appears as orange when it enters the zone sensitive to red. Purple and bluish green are blue at the periphery, and only show the true tint in the central region. Four tints have been found which do not thus change: a red obtained by adding to the red of the spectrum a little blue (a purple), a yellow of 574-5 X, a green of 495 X, and a blue of 471 X.

Every colour has three qualities : (1) hue, or tint, such as red, green, violet ; (2) degree of saturation, or purity, according to the amount of white mixed with the tint, as when we recognize a red or green as pale or deep ; and (3) intensity, or luminosity, or brightness, as when we designate the tint of a red rose as dark or bright. Two colours are identical when they agree as to these three qualities. Observation shows, however, that out of one hundred men ninety-six agree in identifying or in discriminating colours, while the remaining four show defective appreciation. These latter are called colour- blind. This defect is about ten times less frequent in women. Colour-blindness is congenital and incurable, and it is due to an unknown condition of the retina or nerve centres, or both, and must be distinguished from transient colour-blindness, sometimes caused by the excessive use of tobacco and by disease. When caused by tobacco, the sensation of blue is the last to disappear. Absolute inability to distinguish colour is rare, if it really exists ; in some rare cases there is only one colour sensa- tion

; and in a few cases the colour-blind fails to distin- guish blue from green, or there is insensibility to violet. Daltonism, or red-green blindness, of which there are two varieties, the red-blind and the green-blind, is the more common defect. Bed appears to a red-blind person as a dark green or greenish yellow, yellow and orange as dirty green, and green is green and brighter than the green of the yellow and orange. To a green-blind person red appears as dark yellow, yellow is yellow, except a little lighter in shade than the red he calls dark yellow, and green is pale yellow.

” Seeing that green lights imply safety, and red lights danger, on our railways, and that in navigation a green or red light on the port or starboard side shows the course a vessel is taking, it is evident that no one who is red- or green-blind should be employed in the services, and accordingly various tests are now in use for the detection of such defects. The most efficient is the wool-test of Holmgren, which consists of three skeins of wool dyed with standard test colours, namely, a light green, a pale purple or pink, and a bright red. Other skeins of reds, oranges, yellows, yellowish greens, pure greens, blue greens, violets, purples, pinks, browns, and greys, all called confusion colours, are provided, and the examinee is requested to select one and match it with one of the test colours. Suppose the light green skein is shown first. If the exammee matches greys, brownish greys, yellows, orange, or faint pmk with this, he is colour-blind. Then he is shown the purple skein. If he matches with this blue or violet he is red-blind, but if he selects only grey or green, he is green-blind. Finally, he may be shown the red skein, having a bright red colour, like the red flag used on railways. A red-blind peraon will then match with this, green or shades of brown, which to a normal eye seem darker than red ; while, if he be green-blind, he will select shades ot these colours which look lighter than red. Violet blindness is recognized by the examinee confusing red and orange with purple ” {Physiology of the Senses, by M’Kendrick and Snodgrass, 1893, p. 100). Â° ‘ ‘

The question now arises, How can we perceive differ- ences m colour ? AVo might suppose a molecular vibration to be set up in the nerve-endings synchronous with the

undulations of the luminif erous ether, without any change in the chemical constitution of the sensory surface, and we might suppose that where various series of waves in the ether corresponding to different colours act together, these may be fused together, or to interfere so as to give rise to a vibration of modified form or rate that corre- sponded in some way to the sensation. Or, to adopt another line of thought, we might suppose that the effect of different rays (rays differing in frequency of vibration and in physiological effect) is to promote or retard chemical changes in the sensory surface, "which again so affect the sensory nerves as to give rise to differing states in the nerves and the nerve centres, with different concomitant sensations." The former of these thoughts is the founda- tion of the Young-Helmholtz theory (see Eye, vol. viii. p. 824), while the latter is applicable to the theory of Hering.

According to the Young-Helmholtz theory, there are three funda- mental colour sensations, red, green, and violet, by the comhination of which all other colours may be formed, and it is assumed that there exist in the retina three kinds of nerve elements, each of which is specially responsive to the stimulus of waves of a certain frequency corresponding to one colour, and much less so to waves of other frequencies and other colours. If waves corresponding to pure red alone act on the retina, only the corresponding nerve element for red would be excited, and so with green and violet. But if waves of different frequencies are mixed (corresponding to a mixture of colours), then the nerve elements will be set in action in proportion to the amount and intensity of the constituent excitant rays in the colour. Thus if all the nerve elements were simultane- ously set in action, the sensation is that of white light ; if that corre- sponding to red and green, the resultant sensation will be orange or yellow ; if mainly the green and violet, the sensation will be blue and indigo. Then red-blindness may be explained by supposing that the elements corresponding to tlie sensation of red

are absent ; andgreen- blindness, to the absence of the elements sensitive to green. If to a red-blind person the green and violet are equal, and when to a green-blind person the red and violet are equal, they may have sensations which to them constitute white, while to the normal eye the sensation is not white, but bluish green in the one case and green in the other. In eacli case, to the normal eye, the sensation of green has been added to the sensations of red and blue. It will be evident, also, that whiteness to the colour-blind eye cannot be the same as whiteness to the normal eye. No doubt this theory ex- plains certain phenomena of colour-blindness, of after-coloured images, and of contrast of colour, but it is open to various objections. It has no anatomical basis, as it has been found to be impossible to demonstrate the existence of three kinds of nerve elements, or retinal elements, corresponding to the three fundamental colour sensations. Why should red to a colour-blind person give rise to a sensation of something like green, or why should it give rise to a sensation at all ? Again, and as already stated,' in cases of colour- blindness due to tobacco or to disease, only blue may be seen, while it is said that the rest of the spectrum seems to be white. It is difficult to understand how white can be the sensation if the sensations of red and green are lost. On the other hand, it may be argued that such colour-blind eyes do not really see white as seen by a normal person, and that they only have a sensation which they have been accustomed to call White. According to this theory, we never actually experience the primary sensations. Thus we never see primary red, as the sensation is more or less mixed with primary green, and even with primary blue (violet). So with regard to primary green and primary violet. Helmholtz, in his last work on the subject, adopted as "the three primary colours a red bluer than spectral red, (a) a green lying between 540 \ and 560 X (6, like the green of vegetation), and a blue at about 470 X (c, like ultramarine), all, however, much more highly saturated than any colours existing in the spectrum" (Foster's Physiology, part iv. p. 1345).

In Sandbuch der Physiologischen Optik (Hamburg and Leipzig, 1896) Helmholtz pointed out that luminosity or brightness plays a more important part in colour perception than has been supposed. Bach spectral colour is composed of certain proportions of these

fundamental colours, or, to put it in another way, a combination of two of them (a and 6) added to a certain amount of white (c). Thus 100 parts of green are composed of 15 of a, 51 of &, and 34 of c ; or, to take other examples, spectral red will contain, per cent. , 42 of a, 7 of 6, and 51 of white ; yellow, 11 of a, 14 of &, and 75 of white ; and blue, 2 of a, 11 of c, and 87 of white. The white gives bright- ness. ” According to this view, it is not necessary to suppose that in the red-blind the red-perceiving elements are awanting, or that in the green-blind the green-perceiving elements are absent, but

that these elements may be stimulated with intensities different from those affecting the normal eye. Suppose that in the eye of a colour-blind person the curves of intensity representing the red and green coincided, or, in other words, that the elements responsive to red and green in the abnormal eye were stimulated Intensities equal to that of red in a normal eye, the sensation would be yellow, as we find to be the case in so-called green-blindness. Again, if in a similar way the red curve coincided as regards intensity with the green, the general effect would be that of a red-blind person, the red end of the spectrum would appear to be green and no red would be visible” (M’Kendrick and Snodgrass, op. cit. p. 169).

Hering’s theory proceeds on the assumption of chemical changes in the retina under the influence of light. It also assumes that certain fundamental sensations are excited by light or occur during the absence of light. These fundamental sensations are white, black, red, yellow, green, and blue. They are arranged in pairs, the one colour in each pair being, in a sense, complementary to the other, as white to black, red to green, and yellow to blue. Hering also supposes that when rays of a certain wave-length fall on visual substances assumed to exist in the retina, destructive or, as it is termed, catabolic changes occur, while rays having other wave-lengths cause con- structive or anabolic changes. Suppose that in a red- green substance catabolic and anabolic changes occur in equal amount, there may be no sensation, but when waves of a certain wave-length or frequency cause catabolic changes in excess, there will be a sensation of red, while shorter waves and of greater frequency, by exciting ana- bolic changes, will cause a sensation

of green. In like manner, catabolism of a yellow-blue visual substance gives rise to a sensation we call yellow, while anabolism, by shorter waves acting on the same substance, causes the sensation of blue. Again, catabolism of a white-black visual substance gives white, while anabolism, in the dark, gives rise to the sensation of blackness. Thus black- ness is a sensation as well as whiteness, and the members of each pair are antagonistic as well as complementary. In the red end of the spectrum the rays cause catabolism of the red-green substance, while they have no effect on the yellow-blue substance. Here the sensation is red. The shorter waves of the spectral yellow cause catabolism of the yellow-blue material, while catabolism and ana- bolism of the red-green substance are here equal. Here the sensation is yellow. Still shorter waves, corresjjond- ing to green, novy cause anabolism of the red-green substance, while their influence on the yellow-blue sub- stance, being equal in amount as regards catabolism and anabolism, is neutral. Here the sensation is green. Short waves of the blue of the spectrum cause anabolism of the yellow-blue material, and as their action on the red-green matter is neutral, the sensation is blue. The very short waves at the blue end of the spectrum excite cata- bolism of the red-green substance, and thus give violet by adding red to blue. The sensation orange is experi- enced when there is excess of catabolism, and greenish blue when there is excess of anabolism in both substances. Again, when all the rays of the spectrum fall on the retina, catabolism and anabolism in the red-green and yellow-blue matters are equal and neutralize each other, but catabolism is great in the white-black substance, and we call the sensation white. Lastly, when no light falls on the retina, anabolic changes are going on and there is the sensation of black.

Hering's theory accounts satisfactorily for the forma- tion of coloured after-images. Thus, if we suppose the retina to be stimulated by red light, catabolism takes place, and if the effect continues after withdrawal of the red stimulus, we have a positive after-image. Then anabolic changes occur under the influence of nutrition, and the effect is assisted by the anabolic effect of shorter

wave-lengths, with the result that the negative after- image, green, is perceived. Perhaps the distinctive feature of Hering's theory is that white is an independent sensation, and not the secondary result of a mixture of primary sensations, as held by the Young-Helmholtz view. The greatest difficulty in the way of the accept- ance of Hering's theory is with reference to the sensation of black. Black is held to be due to anabolic changes occurring in the white-black substance. Suppose that anabolism and catabolism of the white-black substance are in equilibrium, unaccompanied by stimulation of either the red-green or yellow-blue substance, we find that we have a sensation of darkness, but not one of intense blackness. This "darkness" has still a certain amount of luminosity, and it has been termed the "intrinsic light " of the retina. Sensations of black differing from this darkness may be readily experienced, as when we expose the retina to bright sunshine for a few moments and then close the eye. We then have a sensation of intense blackness, which soon, however, is succeeded by the darkness of the " intrinsic light. " The various degrees of blackness, if it is truly a sensation, are small compared with the degrees in the intensity of white- ness. Another difficulty is thus stated by Ladd: "A light composed of red and green may be made to seem to the eye the same as a light composed of yellow and blue. If, then, the eye is fatigued to red, instead of the red-green mixture appearing greenish, and so dis- tinguishable from the yeliow-blue mixture, they both appear the same to the fatigued eye " (Ladd, Outlines of Physiological Psychology, p. 268). The application of both theories to the phenomena of colour- blindness is fully discussed in Foster's Physiology, part iv., 1900, p. 1352.

The movements of the eye are described in the article Eye, 9th ed. vol. viii. p. 825, but one or two points require further elucidation. It has been shown that the eye may rotate round three possible axes, a vertical, hori- .zontal, and antero-posterior. These movements The move- g^jg effected by four straight muscles and two tbTeyes. oblique.

The four straight muscles arise from the back of the orbit, and pass forward to be inserted into the front part of the eyeball, or its equator, if we regard the anterior and posterior ends of the globe as the poles. The two obliques (one originating at the back of the orbit) come, as it were, from the nasal side â€" the one goes above the eyeball, the other below, while both are inserted into the eyeball on the temporal side, the superior oblique above, and the inferior oblique below. The six muscles work in pairs. The internal and external recti turn the eye round the vertical axis, so that the line of vision is directed to the right or left. The superior and inferior recti rotate the eye round the horizontal axis, and thus the line of vision is raised or lowered. The oblique muscles turn the eye round an axis passing through the centre of the eye to the back of the head, so that the superior oblique muscle lowers, while the inferior oblique raises, the visual line. It was also shown by Helmholtz that the oblique muscles sometimes cause a slight rotation of the eyeball round the visual axis itself. These move- ments are under the control of the will up to a certain point, but there are slighter movements that are altogether involuntary. Helmholtz studied these slighter movements by a method first suggested by Bonders. By this method the apparent position of after-images produced by ex- hausting the retina, say with a red or green object, was compared with that of a line or fixed point gazed at with a new position of the eyeball. The ocular spectra soon vanish, but a quick observer can determine the coincidence of lines with the spectra. After producing an after-image with the head in the erect position, the head may be

placed into any inclined position, and if the attention is then fixed on a diagram having vertical lines ruled upon it, it can easily be seen whether the after-image coincides with these lines. As the after-image must remain in the same position on the retina, it will be evident that if it coincides with the vertical lines there must have been a slight rotation of the eyeball. Such a coincidence always takes place, and thus it is proved that there is an involuntary rotation. This minute rotation enables us to judge more accurately of the position of external objects.

The horopter is the locus of those points of space which are projected on retinal points. While geometrically it may be conceived as simple, as

a matter of fact it is generally a line of double curvature produced by the inter- section of two hyperboloids, or, in other words, it is a twisted cubic curve formed by the intersection of two hyperboloids which have a common generator. The curves pass through the nodal ‘point of both eyes. An infinite number of lines may be drawn from any point of the horopter, so that the point may be seen as a single point, and these lines lie on a cone of the second order, whose vertex is the point. When we gaze at the horizon, the horopter is really a horizontal plane pass- ing through our feet. The horopter in this instance is the ground on which we stand. Experiments show “that the forms and the distances of these objects which are situated in, or very nearly in, the horopter, are perceived with a greater degree of accuracy than the same forms and distances would be when not situated in the horopter ” (M ‘Kendrick, Life of Helmholtz, 1899, p. 172 et seq.).

Hearing. â€” The mechanism of hearing has been described in the article Ear, vol. vii. p. 591. (Details will be found in the article ” Ear ” by M’Kendrick in Schaf er’s Text-Book of Physiology, vol. ii.)

The special form of the drum-head attains a maximum of efficiency for tones of the feeblest intensity. When the effect of a sound-wave is transmitted from the j.^ drum-head to the internal ear, there is a change mechanism in the amount of force expended, and also of trans- a change in the amplitude of the movement. ”’**’<'"â€¢ The mechanism of the chain of bones, malleus, incus, and stapes, serves the pin-pose of convej-ing periodical variations of pressure, occurring in the air, into a minute space or cavity full of fluid, in which we find the terminal structures connected with hearing, and this result is attained with a minimum loss of energy by the chain of bones. The chain is a lever in which the handle of the malleus forms the long arm, the fulcrum is where the short pro- cess of the incus abuts against the wall of the tympa- num, while the long process of the incus, carrying the stapes, forms the short arm. The mechanism is a lever of the second order. Measurements show that the ratio of the lengths of the two arms is as 1-5: 1; the ratio of the resulting force at the stapes is therefore as 1:1-6; while the amplitudes of the movements at the tip of the handle of the malleus and the stapes is as 1-5 : 1. Hence, while there is a

diminution in amplitude there is a gain in power, and thus the pressures are conveved with great efficiency from the membrana tympani to the labyrinth, while the amplitude of the oscillation is diminished so as to be adapted to the small capacity of the labyrinth. As the drum-head is nearly twenty times greater in area than the membrane covering the oval window, with which the base of the stapes is connected, the energy of the move- ments of the membrana tympani is concentrated on an area twenty times smaller ; hence the pressure is increased thirty-fold (1-5 x 20) when it acts at the base of the stapes. Experiments on the human ear have shown that the move- ment of greatest amplitude was at the tip of the handle of

the malleus, 0-76 mm. ; the movement of the tip of the long arm process of the incus was 0-21 mm. ; while the greatest amplitude at the base of the stapes was only â€¢0714 mm. Other observations have shown the movements at the stapes to have a still smaller amplitude, varying from 0-001 to 0‘032 mm. With tones of feeble intensity the movements must be almost infinitesimal.

The sacs of the internal ear, known as the utricle and saccule, receive the impulses of the base of the stapes. Considerable doubt still exists as to their func- J** “‘â– ”’* tions. The simplest form of internal ear is a saccule. sac Containing fluid in which an otolithic mass (ear-stones) is usually immersed, and having on the wall hair-like processes related to the terminations of a nerve. Such internal ears exist in some of the lower invertebrates. In the lower vertebrates (fish) there is a single sac, into which the semicircular canals open ; still higher (amphibia), we find the beginning of the cochlear duet; and lastly (birds and mammals), a division of the sac into two, with a much greater development of the cochlear portion. These facts seem to point to the sacs being organs connected with the perception of sounds as sound, without reference to pitch or quality. Tor the analysis of tone a cochlea

seems to be necessary. Even in mammals all the parts of the ear may be destroyed or affected by disease, except these sacs, without causing complete deafness. The evidence, however, is by no means satisfactory.

It has been suggested by Lee (Amer. Jour, of Physiol. vol. i. No. 1, p. 128) that in fishes the sac has nothing to do with hearing, but serves for the perception of movements, such as those of rotation and translation through space, movements much coarser than those that form the physical basis of sound. He considers, also, that as fishes, with few exceptions, are dumb, they are also deaf. In the fish there are peculiar organs along the lateral line which are known to be connected with the perception of movements of the body as a whole, and Beard {Zool. Anz. Leipzig, 1884, Bd. vii. S. 140) has attempted to trace a phylogenetic connexion between the sacs of the internal ear and the organs in the lateral line. According to this view, when animals became air-breathers, a part of the ear (the papilla acustica hasilaris) was gradually evolved for the perception of delicate vibrations of sound. It may be assumed, however, that even in the higher vertebrates the nerve-endings in the saccule and utricle may still have to do with the perception of the grosser mass movements.

It is by means of the part of the internal ear known as the cochlea that we discriminate pitch, hear beats, and are affected by quality of tone.

(a) Pitch and Beats. â€” The range of pitch appreciated by the human ear is from 30 to 40,000 vibrations per second. When two tones are in unison, they are heard as one sound ; but if one is made a little flatter than the other, then a peculiar sensation is experienced, to which we give the name of a beat. The number of beats per second increases in proportion to the difference in frequencies of the two tones, so that beats may be heard so slow as to be only a waxing and waning of tiie auditory sensation, or they may be so rapid as to be individually indistinguishable, while they still give a feeling of harshness or roughness to the sound. If the number of beats per second is equal to the difference of the frequencies of the tones, and if, as is the case, an interval depends on the ratio of frequencies, it is evident that the number of beats given by two tones nearly in unison will be doubled if

the two tones are sounded an octave higher. It is possible by means of beats to measure the sensitive- ness of the ear by determining the smallest difference in pitch that may give rise to a beat. In no part of the scale can a difference smaller than 0‘2 vibration per second be distinguished. The sensi- tiveness varies with pitch. Thus at 120 vibs. per second 0 -4 vib. per second, at 500 about 0-3 vib. per second, and at 1000, 0-6 vib. per second can be distinguished. This is a remarkable illustration of the great sensitiveness of the ear. When tones of low pitch are

The cochlea.

produced that do not rapidly die away, as by sounding heavy tuning-forks, not only may the beats be perceived corresponding to the difference between the frequencies of the forks, but also other sets of beats. Thus, if the two tones have frequencies of 40 and 74, a two-order beat may be heard, one having a frequency of 34 and the other of 6, as 74 ═ 40 = 1 Ł a positive remainder of 34, and 74 ⊽ 40 = 2 â€” 6, or 80 â€” 74, a negative remainder of 6. The lower beat is heard most distinctly when the number is less than half the frequency of the lower primary, and the upper when the number is greater. The beats we have been considering are pro- duced when two notes are sounded slightly differing in frequency, or at all events their frequencies are not so great as those of two notes separated by a musical interval, such as an octave or a fifth. But Lord Kelvin has shown that beats may also be produced on slightly inharmonious musical intervals {Proc. Boy. Soc. Ed. 1878, vol. ix. p. 602). Thus, take two tuning-forks, utn = 256 and uts â€” 512 ; slightly flatten uta so as to make its frequency 510, and we hear, not a roughness corresponding to 254 beats, but a slow beat of 2 per second. The sensation also passes through a cycle, the beats now sounding loudly and fading away in intensity, again sounding loudly, and so on. One might suppose that the beat occurred between 510 (the frequency of uts flattened) and 512, the first partial of uti, namely wfe, but this is not so, as the beat is most audible when afe is sounded feebly. In a similar way, beats may be produced on the approximate harmonies 2:3, 3:4, 4:5, 5:6, 6 : 7, 7 : 8, 1 : 3, 3 : 5, and beats may even be produced on the major chord 4:5:6 by sounding uts, miz, soh, with soh or miz

slightly flattened, “when a peculiar beat will be heard as if a wheel were being turned against a surface, one small part of which was rougher than the rest” (article by author on the “Ear,” in Schafer’s Text-Book of Physiology, vol. ii., 1900). These beats on imperfect harmonies appear to indicate that the ear does distinguish between an increase of pressure on the drum-head and a diminution, or between a push and a pull, or, in other words, that it is affected by phase.

(6) Beat Tones. â€” Considerable difference of opinion exists as to whether beats can blend so as to give a sensation of tone ; but Konig, by using very pure tones of high pitch, appears to have settled the question. These tones were produced by large tuning- forks. Thus uti = 2048 and ret, = 2304. Tlien the beat tone is uts â€” 256 (2304 â€” 2048). If we strike the two forks, ut?, sounds as a grave or lower beat tone. Again, ut^ = 2048 and si^ = 3840. Then (2048)2 â€” 3840 = 256, a negative remainder, uti, as before, and when both forks are sounded uts will be heard. Again, ?(Â«c = 2048 and soli = 3072, and 3072 – 2048 = 1024, or ut^, wliich will be distinctly heard when ut^ and sols are sounded (Kbnig, Quelques experiences d” acoustique, Paris, 1882, p. 87).

(c) Analytical Power of the Ea,r. â€” When we listen to a compound tone, we have the power of picking out these partials from the general mass of sound. It is known that the frequencies of the partials as compared with that of the fundamental tone are simple multiples of the frequency of the fundamental, and also that physi- cally the waves of the partials so blend with each other as to produce waves of very complicated forms. Yet the ear, or the ear and the brain together, can resolve this complicated wave-form into its constituents, and this is done more easily if we listen to the sound with resonators, the pitch of which corresponds, or nearly corre- sponds, to the frequencies of the partials (see article Eak, Ency. Brit. vol. vii. p. 593). Much discussion has taken place as to how the ear accomplishes this analysis. All are agreed that there is a complicated apparatus in the cochlea which presumably may serve this purpose ; but while some are of opinion that this structure is probably quite sufficient, others hold that the analysis ultimately takes place in the brain. When a complicated wave falls on

the drum-head, it must move out and in in a way corresponding to the variations of pressure, and these variations will, in a single vibration, depend on the greater or less degree of complexity of the wave. Thus a single tone will cause a movement like that of a pendulum, a simple pendular vibration, while a complex tone, although occur- ring in the same duration of time, will cause the drum-head to move out and in in a much more complicated manner. The complex movement will be conveyed to the base of the stapes, thence to the vestibule, and thence to the cochlea, in which we find the ductus coohlearis containing the organ of Corti, a, highly complicated structure composed of epithelium and the neive-endings of the coch- lear nerve. It is to be noted also that the parts in t)ie cochlea are so small as to constitute only a fraction of the wave-length of most tones audible to the human ear. Now it is evident that the cochlea must act either as a whole, all the nerve fibres being affected by any variations of pressure, or the nerve fibres may have a selective action, each fibre being excited by a wave of a definite period, or there may exist small vibratile bodies between the nerve filaments and the pressures sent into the organ. The last hypothesis gives the most rational explanation of the phenomena, and on it is founded a theory generally accepted and associated with the names of Thomas Young and Hermann Helmholtz. It may be shortly stated as follows :

‘â€¢ (1) In the cochlea there are vibrators, tuned to frequencies within the limits of hearing, say from 30 to 40,000 or 50,000 vibs. per second. (2) Each vibrator is capable of exciting its appropriate nerve filament or filaments, so that a nervous impulse, correspond- ing to the frequency of the vibrator, is transmitted to the brain- not corresponding necessarily, as regards the number of nervous impulses, but in such a vfay that when the impulses along a par- ticular nerve filament reach the brain, a state of consciousness is aroused which does correspond with the number of the physical stimuli and with the period

of the auditory vibrator. (3) The mass of each vibrator is such that it will be easily set in motion, and after the stimulus has ceased it will readily come to rest. (4) Damping arrangements exist in the ear, so as quickly to extinguish move- ments of the vibrators. (5) If a simple tone falls on the ear, there is a pendular movement of the base of the stapes, which will affect all the parts, causing them to move ; but any part whose natural period is nearly the same as that of the sound will respond on the principle of sympathetic resonance, a particular nerve filament or nerve filaments will be affected, and a sensation of a tone of definite pitch will be experienced, thus accounting for discrimination in pitch. (6) Intensity or loudness will depend on the amplitude of movement of the vibrating body, and consequently on the intensity of nerve stimulation. (7) If a compound wave of pressure be com- municated by the base of the stapes, it will be resolved into its constituents by the vibrators corresponding to tones existing in it, each picking out its appropriate portion of the wave, and thus irritating corresponding nerve filaments, so that nervous impulses are transmitted to the brain, where they are fused in such a way as to give rise to a sensation of a particular quality or character, but still so imperfectly fused that each constituent, by a strong effort of attention, may be specially recognized ‘ ‘ (article ‘ ‘ Ear, ” by author, Schafer’s Text-Book, loc. cit.).

The structure of the ductus cochlearis meets the demands of this theory. It is highly differentiated, and it can be shown that in it there are a suflScient number of elements to account for the delicate appreciation of pitch possessed by the human ear, and on the basis that the highly trained ear of a violinist can detect a diSerence of â– gfjthof a semitone (M’Kendrick, Trans. Roy. Soc. Ed., 1896, vol. xxxviii. p. 780 ; also Schafer’s Text-Book, loc. cit.). Measurements of the cochlea have also shown such differentiation as to make It difficult to imagine that it can act as a whole. A much less complex organ might have served this purpose (M’Kendrick, op. cit.). The following table, given by Retzius {Das Gehbrorgan der Wirbelihiere, Bd. ii. S. 356), shows differentiations in the cochlea of man, the oat, and the rabbit, all of which no doubt hear tones, although in all probability they have very different powers of discrimination : â€”

Man. Cat. Eabbit.

Ear-teeth . . . 2490 2430 1550

Holes in habenula for nerves . 3985 2780 1650 Inner rods of Corti's organ . 5590 4700 2800 Outer rods of Corti's organ . 3848 3300 1900 Inner hair cells (one row) . 3487 2600 1600

Outer hair cells (several rows) . 11,750 9900 6100 Fibres in basilar membrane . 23,750 15,700 10,500 (d) Dissonance. â€" The theory can also be used to explain dissonance. When two tones suificiently near in pitch are simultaneously sounded, beats are produced. If the beats are few in number they can be counted, because they give rise to separate and distinct sensations ; but if they are very numerous they blend so as to give roughness or dissonance to the interval. The rough- ness or dissonance is most disagreeable with about 33 beats falling on the ear per second. When two compound tones are sounded, say a minor third on a harmonium in the lower part of the key- board, then we have beats not only between the primaries, but also between the upper partials of each of the primaries. The beating distance may, for tones of medium pitch, be fixed at about a minor third, but this interval will expand for intervals on low tones and contract for intervals on high ones. This explains why the same interval in the lower part of the scale may give slow beats that are not disagreeable, while in the higher part it may cause harsh and unpleasant dissonance. The partials up to the seventh are beyond beating distance, but above this they come close together. Conse- quently instruments (such as tongues, or reeds) that abound in upper partials cause an intolerable dissonance if one of the primaries is slightly out of tune (Sedley Taylor, Sound and Music, London, 1873, p. 166 et seq.). Some intervals are pleasant and satisfying when produced on instruments having few partials in their tones. These are concords. Others are less so, and they may give rise to an uncomfortable sensation. These are discords. In this way unision, 1, minor third f, major third |, fourth |, fifth |, minor sixth f , major sixth |, and octave f , are all concords ; while a second |, minor seventh J^, and major seventh ^, are discords. There is no difficulty, on the theory above enunciated, in explaining these facts, because it must respond to

the prime tones and partials of both the notes forming the interval ; but it is not easy to see why the sensation should be disagreeable when two portions of the basilar

membrane sufiBciently near are thrown into vibration. Still, simi- lar, phenomena occurring in the other senses show that, for some unexplained reason, if two nerves sufficiently ne^r in their central terminations are stimulated, or if they are stimulated intermittently, the sensation is disagreeable. Helmholtz compares the sensation of dissonance to that of a flickering light on the eye. “Something similar I have found to be produced by simultaneously stimulating the skin, or margin of the lips, by bristles attached to tuning forks giving forth beats. If the frequency of the forks is great, the sensation is that of a most disagreeable tickling. It may be that the instinctive effort at analysis of tones close in pitch causes the disagreeable sensation ” (Schafer’s Text-Book, op. cit. p 1187).

(e) GomUnation Tones.â€” Frequently, when two tones are sounded, not only do we hear the compound sound, from which we can pick out the constituent tones, but we may hear other tones, one of which is lower in pitch than the lowest primary, and the other is higher in pitch than the higher primary. These, known as combination tones, are of two classes : differential tones in which the frequency is the difference of the frequencies of the generating tones, and summational tones having a frequency which is the sum of the frequencies of the tones producing them. Differential tones, first noticed by Sorge about 1740, are easily heard (Sorge, Vorcjemach musikalischer Composition, 1740). Thus an interval of a fifth, 2 : 3, gives a differential tone 1, that is, an octave below 2 ; a fourth, 3 : 4, gives 1, a twelfth below 3 ; a major third, 4 : 5, gives 1, two octaves below 4 ; a minor third, 5:6, gives 1, two octaves and a major third below 5 ; a major sixth, 3 : 5, gives 2, that is, a fifth below 3 ; and a minor sixth, 5 : 8, gives 3, that is, a major sixth below 5. Summational tones, first noticed by Helmholtz, are so difficult to hear, that much controversy has taken place as to their very existence. Some have contended that they are produced by beats. It appears to be proved physically that they may exist in the air outside of the ear (Forsyth and Sowter, Proe. Boy. Soc. vol. Ixiii. p. 396 ; and

Riicker and Edser, Phil. Mag., April 1895). Further, differential tones may be gen- erated in the middle ear (Preyer, Wiedemann's Annal. xxxviii. S. 131). Helmholtz also demonstrated their independent existence, and he states that ' ' whenever the vibrations of the air or of other elastic bodies, which are set in motion at the same time by two gen- erating simple tones, are so powerful that they can no longer be considered infinitely small, mathematical theory shows that vibra- tions of the air must arise which have the same vibrational num- bers as the combination tones " (Helmholtz, Sensations of Tone, p. 235). The importance of these combinational tones in the theory of hearing is obvious. If the ear can only analyse compound waves into simple pendular vibrations of a certain order (simple multiples of the prime tone) , how can it detect combinational tones, which do not belong to that order ? Again, if such tones are purely subjective and only exist in the mind of the listener, the fact would be fatal to the resonance theory. There can be no doubt, however, that the ear, in dealing with them, vibrates in some part of its mechanism with each generator, while it also is affected by the combinational tone itself, according to its frequency. (For a discussion of this question, see Sedley Taylor, op. Ci't. p. 181).

(/) Other Theories. â€" In 1865 Rennie objected to the analysis theory, and urged that the cochlea acted as a whole (Ztschr. f. rat. Med. Dritte. Beihe, Bd. xxiv. Heft 1, S. 12-64). This view was revived by Voltolini (Virchow's Archiv, Bd. c. S. 27) some years later, and in 1886 it was strongly urged by Rutherford {Bep. Brit. Assoc. Ad. Sc, 1886), who compared the action of the cochlea to that of a telephone plate. According to this theory, all the hairs of the auditory cells vibrate to every note, and the hair cells transform sound vibrations into nerve vibrations or impulses, similar in frequency, amplitude, and character to the sound vibrations. There is no analysis in the peripheral organ. Waller, in 1891 (Proc. Physiol. Soc, Jan. 20, 1891) suggested that the basilar membrane as a whole vibrates to every note, thus repeating the vibrations of the membrana tympani ; and since the hair cells move with the basilar membrane, they produce what may be called pressure patterns against the tectorial membranes, and filaments of the auditory nerve are stimulated by these pressures. Waller admits a certain degree

of peripheral analysis, but he relegates ultimate analysis to the brain. These theories, dispensing with peripheral analysis, leave out of account the highly complex structure of the cochlea, or, in other words, they assign to that structure a compara- tively simple function, which could be performed by a simple mem- brane capable of vibrating. We find that the cochlea becomes more elaborate as we ascend the scale of animals, until in man, who possesses greater powers of analysis than any other being, the number of hair cells, fibres of the basilar membrane, and arches of Corti, are all much increased in number (see Retzius' s table, supra). The principle of sympathetic resonance appears, therefore, to offer the most likely solution of the problem. Theories dispensing with this principle have also been advanced. Hurst's view is that with each movement of the stapes a wave is generated which travels up the scala vestibuli, through the helicotrema into the

scala tympani, and down the latter to the fenestra rotunda. The wave, however, is not merely a movement of the basilar membrane, but an actual movement of fluid or a transmission of pressure. As the one wave ascends while the other descends, a pressure of the basilar membrane occurs at the point where they meet ; this causes the basilar membrane to move towards the tectorial membrane, forcing this membrane suddenly against the apices of the hair cells, thus irritating the nerves. The point at which the waves meet will depend on the time interval between the waves (Hurst, " A New Theory of Hearing," Trans. Biol. Soe. Liverpool, 1895, vol. ix. p. 321). More recently Max Mayer has advanced a theory some- what similar. He supposes that with each movement of the stapes corresponding to a vibration, a wave travels up the scala vestibuli, pressing the basilar membrane downwards. As it meets with resistance in passing upwards, its amplitude therefore diminishes, and in this way the distance up the scala through which the wavp progresses will be determined by its

amplitude. The wave in its pro- gress irritates a certain number of nerve terminations, consequently feeble tones will irritate only those nerve fibres that are near the fenestra ovalis, while stronger tones will pass farther up and irritate a larger number of nerve fibres the same number of times per unit of time. Pitch, according to this view, depends on the number of stimuli per second, while loudness depends on the number of nerve fibres irritated. Mayer also applies the theory to the explanation of the powers of the cochlea as an analyser, by supposing that with a compound tone these are at maxima and minima of stimulation. As the compound wave travels up the scala, portions of the wave corresponding to maxima and minima die away in consecutive series, until only a maximum and minimum are left ; and, finally, as the wave travels farther, these also disappear. With each maximum and minimum different parts of the basilar membrane are affected, and affected a different number of times per second, according to the frequencies of the partials existing in the com- pound tone. Thus with a fifth, 2 : 3, there are three maxima and three minima ; but the compound tone is resolved into three tones having vibration frequencies in the ratio of 3:2:1. According to Mayer, we actually hear when a fifth is sounded tones of the relationship of 3:2:1, the last (1) being the differential tone (vide supra). He holds, also, that combinational tones are entirely subjective (Max Mayer, Ztschr. f. Psycho, und Phys. d. Sinnes- organe, Leipzig, Bd. xvi. and xvii. ; also Verhandl. d. physiolog. Gesellsch. zu Berlin, Feb. 18, 1898, S. 49). Two fatal objections can be urged to these theories, namely, first, it is impossible to conceive of minute waves following each other in rapid succession in the minute tubes forming the scalm â€” the length of the scala being only a very small part of the wave-length of the sound ; and, secondly, neither theory takes into account the differentiation of structure found, in the epithelium of the organ of Corti. Each push in and out of the base of the stapes must cause a movement of the fluid, or a pressure, In the scalse as a whole.

There are difficulties in the way of applying the resonance theory to the perception of noises. Noises have pitch, and also each noise has a special character ; if so, if the noise is analysed into its con- stituents, why is it that it seems impossible to analyse a noise, or to perceive any

musical element in it ? Helmholtz assumed that a sound is noisy when the wave is irregular in rhythm, and he sug- gested that the crista and macula acustica, structures that exist not in the cochlea but in the vestibule, have to do with the percep- tion of noise. These structures, however, are concerned rather in the sense of the perception of equilibrium than of sound (see Semi- circular Canals'). Gray is also of opinion that evidence supports the view that the ear detects difference of phase, which was denied by Helmholtz. Comparing the perception of sound with that of touch, he advances a modification of the resonance theory which appears to meet some of the objections that may be urged against it as it was enunciated by Helmholtz.

Various physicists have attempted to measure the sen- sitiveness of the ear by estimating the amplitude of the Sensitive- moleoular movements necessary to call forth nessofthe the feeblest audible sound. Thus Topler and ear- Boltzmann, on data founded on experiments

with organ, pipes, state that the ear is affected by vi- brations of molecules of the air not more in amplitude than -0004 mm. at the ear, or 0-1 of the wave-length of green light, and that the energy of such a vibration on the drum-head is not more than -^^ billionth kilog,, or J^-th of that produced upon an equal surface of the retina by a single candle at the same distance (Aim. d. Phys. u. Ohem., Leipzig, 1870, Bd. cxli. S. 321). Lord Eayleigh, by two other methods, arrived at the conclu- sion " that the streams of energy required to influence the eye and ear are of the same order of Inag-nitude."

He estimated the amplitude of the movement of the aerial particles, with a sound just audible, as less than the ten-millionth of a centimetre, and the energy emitted when the sound was first becoming audible, at 42-1 ergs per second. He also states that in considering the am- plitude or condensation in progressive aerial waves, at a distance of 27-4 metres from a tuning-fork, the maximum condensation was =6-0×10"' cm., a result showing "that the ear is able to recognize the addition or subtraction of densities far less than those to be found in our highest vacua" (Proc. Roy. Soc, 1877, vol. xxvi. p. 248; Land. Edin,. and Bub. Phil. Mag,, 1894, vol. xxxviii. p. 366).

Hearing with two ears does not aflrect the quality of sounds, but it must to some extent affect the intensity with which sounds are perceived. We hear a sound louder with two ears than with one, and audMoa. there can be no doubt that by having two ears we are enabled to judge of the direction of sound with more accuracy than if we used only one ear. Our judg- ment as to the direction of sounds is formed mainly from the different degrees of intensity with which they are heard by two ears. Lord Eayleigh states that diffraction of the sound-waves will occur as they pass round the head to the ear farthest from the source of sound ; thus partial tones will reach the two ears with different intensities, and thus quality of tone may be affected {Trans. Music. Soc, London, 1876). Silvanus P. Thompson advocates a similar view, and he shows that the direction of a com- plex tone can be more accurately determined than the direction of a simple tone, especially if it be of low pitch. (Phil. Mag., 1882).

The Sense of Equilibrium. â€” By this term is meant the sense, or series of sensations, by which we have a feeling of security in standing, walking, and indeed in all the movements by which the body is carried through space. Such a feeling of security is necessary both for maintain- ing any posture, such as standing, or for performing any movement. If this feeling is absent or uncertain, or if there are contradictory sensations, then definite muscular movements are inefficiently or irregularly performed, and the body may stagger or fall. When we stand erect on a firm surface, like a floor, there is a feeling of resistance, due to nervous impulses reaching the brain from the soles of the feet and from the muscles of the limbs and trunk. In walking or running, these feelings of resistance seem to precede and guide the muscular movements necessary for the next step. If these are absent or perverted or deficient, as is the case in the disease known as locomotor ataxia, then, although there is no loss of the power of voluntary movement, the patient staggers in walking, especially if he is not allowed to look at his feet, or if he is blindfolded. He misses the guiding sensations that come from the limbs ; and with perhaps the feeling that he is walking on a soft substance, offering little or no resistance, he cannot avoid staggering, and his muscular movements become fitful and irregular. Such a condition may be artificially brought about by

washing the soles of the feet with chlo- roform or ether. And it has been observed to exist par- tially after extensive destruction of the skin of the soles of the feet by burns or scalds. This shows that tactile impulses from the skin take a share in generating the guiding sensation. In the disease above mentioned, how- ever, tactile impressions may be nearly normal, but the guiding sensation is weak and inefficient, owing to the absence of impulses from the muscles. The disease is known to depend on morbid changes in the posterior columns of the spinal cord, by which impulses are not freely transmitted upwards to the brain. These facts point to the existence of impulses coming from the muscles and tendons. It is now known that there exist in both end- organs in the shape of peculiar spindles, in the substance

of muscle, and of little rosettes or coils or loops of nerve fibres in close proximity to tendons. The transmission of such impulses gives rise to what is termed the muscular sense, and the guiding sensation which precedes co-ordi- nated muscular movements largely depends on these impulses. Thus from the limbs streams of nervous impulses pass to the sensorium from the skin and from muscles and tendons ; these may or may not arouse con- sciousness, but they guide or evoke muscular movements of a co-ordinated character, more especially of the limbs.

In animals whose limbs are not adapted for delicate touch nor for the performance of complicated movements, such as some mammals and birds and fishes, the guiding sensations seem to depend largely on the sense of vision. This sense in man, instead of assisting, sometimes disturbs the guiding sensation. It is true that in locomotor ataxia visual sensations may take the place of the tactile and muscular sensations that are absent, and the man can walk without staggering if he is allowed to look at the floor, and especially if he is guided by either

longitudi- nal or transverse straight lines. On the other hand, the acrobat on the wire-rope dare not trust his visual sensa- tions in the maintenance of his equilibrium. He usually keeps his eyes fixed on one point instead of allowing them to wander to objects below him, and his muscular move- ments are regulated by the impulses that come from the skin and muscles of his limbs. The feeling of insecurity probably arises from a conception of height, and also from a knowledge, the result of experience, that by no muscu- lar movements can a man avoid a catastrophe if he should fall. A bird, on the other hand, depends largely on visual impressions, and it knows by experience that if launched into the air from a height it can fly. Here, probably, is an explanation of the large size of the eyes of birds. Cover the head, as in hooding a falcon, and the bird seems to be deprived of the power of voluntary movement. Little effect will be produced if we attempt to restrain the movements of a cat by covering its eyes. A fish also is readily deprived of the power of motion if its eyes are covered! But both in the bird and in the fish tactile and muscular impressions, especially the lat- ter, come into play in the mechanism of equilibrium. In flight the large-winged birds, especially in soaring, can feel the most delicate wind-pressures, both as regards direction and force, and they adapt the position of their body so as to catch the pressure at the most efficient angle. The same is true of the fish, especially of the flat-fishes. In these animals, and in mammals generally, the sense of equilibrium depends, then, on streams of tactile, muscular, and visual impressions pouring in on the sensorium, and calling forth appropriate muscular movements. It has also been suggested that nervous im- pulses coming from the abdominal viscera may take part in the mechanism. The presence in the mesentery of felines (eats, &c.) of large numbers of Pacinian corpuscles, which are believed to be modified tactile bodies, favours this supposition. Such animals are remarkable for the delicacy of all these muscular movements, especially those of balancing and leaping.

There is still another channel by which nervous impulses may reach the sensorium and play their part in the sense of equilibrium, namely, from the semicircular canals, a portion of the internal ear. We have already Semi- learned (under Hearing) that the appreciation caaaiB. of sound is

in reality an appreciation of varia- tions of pressure. We have also seen that the labyrinth consists of the vestibule, the cochlea, and the semicircular canals. There can be no doubt that the cochlea has to do with the reception of sound-waves (variations of pressure) that constitute musical tones. This it accomplishes by the structures in the ductus

cochlearis. In the vestibule we find two sacs, the saccule next to and communicating with the ductus cochlearis, and the utricle communicating with the semicircular canals. The base of the stapes communicates pressures to the utricle. The membranous portion of the semi- circular canals consists of a tube, dilated at one end into a swelling or pouch, termed the ampulla, and each end com- municates freely with the utricle. It is important to note that on the posterior wall of both the saccule and of the utricle there is a ridge or crest, termed in each case the macula acustica, bearing a highly specialized epithelium, and that a similar structure exists in each ampulla. This would suggest that all three structures have to do with hearing; but, on the other hand, there is experimental evidence that the utricle and the canals may transmit impressions that have to do with equilibrium. Pressure of the base of the stapes is exerted on the utricle. This will compress the fluid in that cavity, and tend to drive the fluid into the semicircular canals that communicate with that cavity by five openings. Each canal is surrounded by a thin layer of perilymph, so that it may yield a little to this pressure, and exert a certain pu.ll or pressure on the nerve-endings in each ampulla. Thus nervous impulses may be generated in the ampullae which are primarily excited at the base of the stapes.

The three semicircular canals lie in the three directions in space, and it has been suggested that they have to do with our appreciation of the direction of sound. But our appreciation of sound is very inaccurate : we look with the eyes for the source of the sound, and instinctively direct the ears or the head, or both, in the direction from which the sound appears to proceed. But the relationship of the canals on the two sides must have some physiologi- cal significance. Thus (1) the six canals are sensibly parallel, two and two ; or (2) the two horizontal canals are in the same plane, while the superior canal on one side is

nearly parallel with the posterior canal of the other. These facts point to the two sets of canals and ampullae acting as one organ, in a manner analogous to the action of two retinse for single vision (Crum-Brown, Nature, London, 1878, p. 449; also il'Kendrick's Physi- ology, vol. ii. p. 694).

We have next to consider how the canals may possibly act in connexion with the sense of equilibrium. So long ago as 1820, Purkinje (Med. Juhrb., Wien, 1820, Bd. vi.) studied the well-known vertigo that follows rapid rotation of the body in the erect position on a vertical axis. On stopping the rotation there is a sense of rotation in the opposite direction, and this may occur even when the eyes are closed. Purkinje noticed that the position of the imaginary axis of rotation depends on the axis around which the head revolves (M'Kendrick, op. eit. vol. ii. p. 701). In 1828 Flourens discovered that injury to the canals causes disturbance of equilibrium and loss of co- ordination, and that sections of the canals produce a rotatory movement of a kind corresponding to the canal that had been divided. Thus division of a membranous canal causes rotatory movements round an axis at right angles to the plane of the divided canal. The body of the animal always moves in the direction of the cut canal (Flourens, Comptes Ilendus, 11th August 1828, p. 5). Many other observers have corroborated these experiments. Goltz was the first who clearly formulated the conditions necessary for equilibration. He put the matter thus :â€" (1) A central co-ordinating organ â€" in the brain ; (2) centripetal fibres, with their peripheral ter- minationsâ€"in the ampullae ; and (3) centrifugal fibres, with their terminal organsâ€" in the muscular mechanisms. A lesion of any one of these portions of the mechanism causes loss or impairment of balancing (Goltz, Archiv f. d. ges. Physiol, Bonn, Bd. iii. S. 172). Cyon also investigalted

the subject, and arrived at the following conclusions : â€" (1) To maintain equilibrium, we must have an accurate notion of the position of the head in space ; (2) the function of the semicircular canals is to

communicate impressions that give an accurate representation of this position â€” each canal having a relation to one of the dimensions of space ; (3) disturbance of equilibrium follows section; (4) in- voluntary movements following section are due to ab- normal excitations; (5) abnormal movements occurring a few days after the operation are caused by irritation of the cerebellum (Cyon, Eecherches eoepMmentales sur les fonctions des canaux semi-circulaires, Th6se, 1878).

On theoretical considerations of a physical character, Mach, Crum-Brown, and Breuer have advanced theories based on the idea of the canals being organs for sensations of acceleration of movement, or for the sense of rotation (Mach, Qrundlinien der Lehre von den Bewegungsempfend- ungen, Leipzig, 1875; Crum-Brown, Journ. of Physiol. Land. vol. viii. ; Breuer, Jalirb. d. GesellscJi. d. Ante, Wien, 1874-75). Mach first pointed out that Purkinje's pheno- mena, already alluded to, were in all probability related to the semicircular canals. " He showed that when the body is moved in space, in a straight line, we are not conscious of the velocity of motion, but of variations in this velocity. Similarly, if a body is rotated round a vertical axis, we perceive only angular acceleration and not angular velocity. The sensations produced by angular acceleration last longer than the acceleration itself, and the position of the head during the movements enables us to determine direction." (Schafer's Text-Book of Physiology ; article Hearing, by author, vol. ii. p. 1200). Both Mach and Goltz state that varying pressures of the fluid in the canals produced by angular rotation produce sensations of movement (always in a direction opposite to the rotation of the body), and that these, in turn, cause the vertigo of Purkinje and the phenomena of Iflourens. Mach, Crum-Brown, and Breuer advance hydrodynamical theories â€" that is to say, they assume that the fluids move in the canals â€" and the two latter differ from Mach only in details. Goltz, on the other hand, supports a hy drostatical theory â€" that is to say, he assumes that the phenomena can be accounted for by varying pressures. Crum-Brown differs from Mach and Breuer as follows: â€" (1) In attributing movement or varia^ tion of pressure not merely to the endolymph, but alsp to the walls of the membranous canals and to the surrounding perilymph ; and (2) in

regarding the two labyrinths as one organ, all the six canals being required to form a true conception or the rotating motion of the head. He sums up the matter thus: “We have two ways in which a relative motion can occur between the endolymph and the walls of the cavity containing it â€” (1) Wlien the head begins to move, here the walls leave the fluid behind; (2) when the head stops, here the fluid flows on. In both cases the sensation of rotation is felt. In the first this sensation corresponds to a real rotation, in the second it does not, but in both it corresponds to a real accelera- tion (positive or negative) of rotation, using the word acceleration in its technical kinematical sense” (Crum-Brown, Nature, London, 1878 ; review of Cyon’s Thesis, loc. cit.).

Cyon states that the semicircular canals only indirectly assist in giving a notion of spatial relations. ” He holds that knowledge of the position of bodies in space depends on nervous impullses coming from the contracting ocular muscles ; that the oculomotor centres are in intimate phy- siological relationship with the centres receiving impulses from the nerves of the semicircular canals ; and that the oculomotor centres, thus excited, produce the movements of the eyeballs, which then determine our notions of spatial relations ” (Sehafer’s Text-Book, loc. cit. vol. ii. p. 1203). These views are supported by experiments of Lee on dog-

fish. When the fish is passively rotated round different axes there are compensating movements of the eyes and fins. ” It was observed that if the fish were rotated in the plane of one of the canals, exactly the same movements of the eyes and fins occurred as were produced by experi- mental operation and stimulation of the ampulla of tha,t canal ” (Lee, Journ. Physiol, Camb. and London, vol. xvii. p. 192). Sewall, in 1883, carried out experiments on young sharks and skates, and concluded that there was not sufficient evidence to connect the canals, and indeed the labyrinth, with the sense of equilibrium (Sewall, Journ. Physiol., Camb. and Lond., vol. iv. p. 339). Lee returned to the subject in 1894, and, after numerous experiments on dog-fish, in which the canals or the audi- tory nerves were divided, obtained strong evidence that the ampullae contain sense-organs connected with the sense of equilibrium (Lee, Journ. Physiol., Camb. and London, 1894, vol. xv.).

It has been found by physicians and aurists that disease or injury of the canals, occurring rapidly, produces giddi- ness, staggering, nystagmus (a peculiar twitching move- ment of the muscles of the eyeballs), vomiting, noises in the ear, and more or less deafness. It is said, however, that if pathological changes come on slowly, so that the canals and vestibule are converted into a solid mass, none of these symptoms may occur. On the whole, the evidence is in favour of the view that from the semicircular canals nervous impulses are transmitted, which, co-ordinated with impulses coming from the visual organs, from the muscles, andfromthe skin, form the bases of these guiding sensations on which the sense of equilibrium depends. These im- pulses may not reach the level of consciousness, but they call into action co-ordinated mechanisms by which com- plicated muscular movements are effected. (j. g. m.)

Physiology of Development. See Embry- ology.

Physiology of Plants. â€” The great development of research into the vital phenomena of living organ- isms, which was a conspicuous feature of the scien- tific work of the last three decades of the 19th century, has tended to establish and develop the view that physi- ology should not be divided into two distinct sections, animal and vegetable, but that it exhibits an essential unity, and comprehends the study of all living proto- plasm, whether the organisms under observation are simple or complex, and whatever is the nature of the differentiation exhiljited by them. The so-called vegetable physiology, at the beginning of that period, was in arrear of animal, and particularly of human, physiology, the study of the latter being followed by many more observers, and from its relative degree of advancement being the more capable of rapid development. It was fully recognized by its followers that the dominating influence in the structure and working of the body was the protoplasm, and the division of labour which it exhibited, with the accompany- ing or resulting differentiation into various tissues, was the special subject of investigation. Many who followed the study of vegetable structure did not at that time give an equal prominence to this view. The early histological researches of botanists led them to the recognition of the vegetable cell, and the leading writers in the middle

of the 19th century pointed out the probable identity of Von Mohl's " protoplasm " with the " sarcode " of zoologists. They laid great stress on the nitrogenous nature of protoplasm, and noted that it preceded the formation of the cell-membrane. But by the ordinary student of thirty years later their work was to some extent overlooked, and the cell-iuall assumed a prominence to which it was not entitled. The study of the differentiation of protoplasm was at that time seldom undertaken, and

no particular attention was paid either to fixing it, to enable staining methods to be accurately applied to it, or to studying the action of chemical reagents upon it. It is only comparatively recently that the methods of histological investigation used by animal physiologists have been carefully and systematically applied to the study of the vegetable organisms. They have, however, been attended with wonderful results, and have revolu- tionized the whole study of vegetable structure. They have emphasized the statements of Von Mohl, Cohn, and other writers alluded to, that the protoplasm is here also the dominant factor of the body, and that all the pecu- liarities of the cell-wall can only be interpreted in the light of the needs of the living substance.

The Nature of the Organization of the Plant, and the Relations of the Cell-Membrane and the Protoplasm. â€" This view of the structure of the plant and tliis method of investigation lead us to a greatly modified conception of its organization, and afford more completely an explana- tion of the peculiarities of form found in the vegetable kingdom.

The study of simple organisms, many of which consist of nothing but a little mass of protoplasm, exhibiting a very rudimentary degree of differentiation, so far as our methods enable us to determine any at all, shows that the duties of existence can be discharged in the absence of any cell-wall. Those organisms which possess the latter are a little higher in the scale of life than those which remain unclothed by it, but a comparison of the behaviour of the two qiiickly enables us to say that the membrane is of but secondary importance, and that for those which

possess it, it is nothing more than a protec- tive covering for the living substance. Its physical properties, permeability by water, extensibility and elas- ticity, receive their interpretation in the needs of the latter. We come, accordingly, to regard it as practically an exoskeleton, and its functions as distinctly subordi- nate to those of the protoplasm which it clothes. If we pass a little higher up the scale of life, we meet with forms consisting of two or more cells, each of which con- tains a similar minute mass of living substance. A study of them shows that each is practically independent of the others ; in fact, the connexion between them is so slight that they can separate and each become free with- out the slightest disadvantage to another. So long as they are connected together mechanically, they have apparently the power of influencing one another in vari- ous ways, and of passing liquid or gaseous materials from one to another. The conjoined organism is, in fact, a colony or association of the protoplasmic units, though each unit retains its independence. When we pass, again, from these to examine more bulky, and conse- quently more complex, plants, we find that the differ- ences which can be observed between them and the simple lowly forms are capable of being referred to the increased number of the protoplasmic units and the con- sequent enlarged bulk of the mass or colony. Every plant is thus found to be composed of a number of th^se protoplasmic units, or, as they may preferably be termed, protoplasts, all of which are at first exactly alike in appearance and in properties. This is evident in the case of such plants as have a body consisting of filaments or plates of cells, and is little less conspicuous in those whose mass is but small, though the cells are evidently capable of computation in three dimensions. It does not at first appear to be the same with the bulkier plants, such as the ordinary green herbs, shrubs, or trees, but a study of their early development indicates that they do not at the outset differ in any way from the simple un- differentiated forms. Each commences its existence as a simple naked protoplast, in the embryo-sac or the arche-

gonium, as the case may be. After the curious fusion with another similar protoplast, which constitutes what we call fertilization, the next stage in complexity already noted may be observed, the protoplasm becoming clothed by a cell-membrane. Very soon the single cell gives

rise to a chain of cells, and this in turn to a cell mass, the individual units of which are at first quite uniform. With increase of number, however, and consequently enlargement of bulk in the colony, differentiation be- comes compulsory. The requirements of the several protoplasts must be met by supplies from without, and, as many of them are deep seated, varieties of need arise, so that various members of the colony are set apart for special duties, masses of them being devoted to the discharge of one function, others to that of another, and so on. Such limitations of the powers and proper- ties of the individuals have for their object the well- being of the community of which those individuals are constituents.

Physiological and Morphological Differentiation. â€” The first indication of this differentiation in the vegetative body of the plant can be seen not only in the terrestrial green plants which have been particularly referred to, but also in the bulkier searweeds. It is an extension of the first differentiation which was observable in the simple protoplasts first discussed, the formation, that is, of a protective covering. Fucus and its allies, which form conspicuous members of the larger Algee, have their external cells much smaller, more closely put together, and generally much denser, than the rest of their tissue. In the lowly as well as the higher green plants we have evidence of specialization of the external protoplasts for the same purpose, which takes various shapes and shows different degrees of completeness, culminating in the elaborate barks which clothe our forest trees.

The second prominent differentiation which presents itself takes the form of a provision to supply the living substance with water. This is a primal necessity of the protoplast, and every cell gives evidence of its need by adopting one of the various ways in which such need is supplied. What little differentiation can be found to exist in the protoplasm of the simple unicellular organism shows the importance of an adequate water supply, and, indeed, the dependence of life upon it. The naked cells which have been alluded to live in water, and call there- fore for no differentiation in connexion with this neces- sity; but those which are surrounded by a cell-wall always develop within themselves a vacuole or cavity which occupies the greater part of their interior, and

the hydrostatic pressure of whose contents keeps the proto- plasm in contact with the membrane, setting up a condition of turgidity.

The need for a constant supply of water is partly based upon the constitution of protoplasm, so far as we know it. The apparently structureless substance is saturated with it ; and if once a cell is completely dried, even at a low temperature, in the enormous majority of eases its life IS gone, and restoration of water fails to enable it to recover. Besides this intimate relationship, however, we can point to other features of the necessity for a con- stantly renewed water supply. The protoplasm derives its food from substances in solution in the water ; the various waste products which are incident to its life are excreted into it, and so removed from the sphere of its activity. The raw materials from which the food is constructed are absorbed from the exterior in solution in water, and the latter is the medium through which the gaseous constituents necessary for life reach the proto- plasm. Moreover, growth is essentially dependent upon water supply. There is little wonder, then, that in a colony of protoplasts such as constitute a large plant, a

considerable degree of differentiation is evident, bearing upon the question of water supply. Certain cells of the exterior are set* apart for absorption of water from thesoil, this being the source from which supplies are derived. Others are devoted to the work of carrying it to the protoplasts situated in ~~the interior and at the ex~~ tremities of the plant, a conducting system of considerable complexity being the result.

Other collections of cells are in many cases set apart for giving rigidity and strength to the mass of the plant. It is evident that as the latter increases in bulk, more and more attention must be paid to the dangers of uprooting by winds and storms. Various mechanisms have been adopted in different cases, some connected with the sub- terranean and others with the sub-aerial portions of the plant. Another kind of differentiation in such a cell-mass as we are dealing with is the setting

apart of particular groups of cells for various metabolic purposes. We have the formation of numerous mechanisms which have arisen in connexion with the question of food supply, which may not only involve particular cells, but also lead to differentiation in the protoplasm of those cells, as in the development of the chloroplastids of the leaves and other green parts.

The inter-relations of the members of a large colony of protoplasts such as constitute a tree, demand much adjustment. Relations with the exterior are continually changing, and the needs of different regions of the in- terior are continually varying, from time to time. Two features which are essentially protoplasmic assume a great importance when we consider these relations. They are the power of receiving impressions or stimuli from the exterior, and of communicating with each other, with the view of co-ordinating a suitable response. We have nothing structural which corresponds to the former of these. In this matter, differentiation has proceeded very differently in animals and plants respectively, no nerves or sense organs being structurally recognizable. Communication between the various protoplasts of the colony is, however, carried on by means of fine protoplasmic threads, which are continuous through the cell-walls.

All the peculiarities of structure which we encounter consequently support the view with which we started, that the protoplasm of the plant is the dominant factor in vegetable structure, and that there need be but one subject of physiology, which must embrace the behaviour of proto- plasm wherever found. There can be no doubt that there is no fundamental difference between the living substance of animals and plants, for many forms exist which cannot be referred with certainty to either kingdom. Free- swimming organisms without cell-membranes exist in both, and from them series of forms can be traced in both directions. Cellulose, the material of which vegetable cell-walls are almost universally composed, at any rate in their early condition, is known to occur, though only seldom, among animal organisms. Such forms as Volvox and the group of the Myxomycetes have been continually referred to both kingdoms, and their true systematic

position is still a subject of controversy. All physiology, consequently, must be based upon the identity of the protoplasm of all living beings.

This method of study has to a large extent modified our ideas of the relative importance of the parts of such an organism as a large tree. The interest with which we regard the latter no longer turns upon the details of the structure of its trunk, limbs, and roots, to which the living substance of the more superficial parts was subordinated. Instead of regarding these as only ministering to the construction of the bulky portions, the living protoplasts take the first place as the essential portion of the tree,

and all the other features are important mainly as ministering to their individual well-being and to their multiplication. The latter feature is the growth of the tree, the well-being of the protoplasts is its life and health. The interest passes from the bulky dense interior, with the elaborate features of its cell-walls, to the superficial parts, where its life is in evidence. We see herein the reason for the great subdivision of the body, with its finely cut twigs and their ultimate expansions, the leaves, and we recognize that this subdivision is only an expres- sion of the need to place the living substance in direct relationship with the environment. The formation and gradually increasing thickness of its bark are explained by the continually increasing need of adequate protec- tion to the living cortex, under the strain of the increas- ing framework which the enormous multiplication of its living protoplasts demands, and the development of which leads to continual rupture of the exterior. The increasing development of the wood as the tree grows older is largely due to the demands for the conduction of water and mineral matters dissolved in it, which are made by the increased number of leaves which from year to year it bears, and which must each be put into communication with the central mass by the forma- tion of new vascular bundles. Similar considerations apply to the peculiar features of the root-system. All these points of structure can only be correctly inter- preted after a consideration of the needs of the indi- vidual protoplasts, and of the large colony of which they are members.

Gaseous Interchanges and their Mechanism. â€” Another feature of the construction of the plant has in recent years come into greater prominence than was formerly the case. The organism is largely dependent for its vital processes upon gaseous interchanges. It must receive a large constituent of what ultimately becomes its food from the ‘ air which surrounds it, and it must also take in from the same source the oxygen of its respiratory processes. On the other hand, the aerial environment presents consider- able danger to the young and tender parts, where the protoplasts are most exposed to extremes of heat, cold, wet, &c. These must in some way be harmonized. No doubt the primary object of the cell-wall of even the humblest protoplast is protection, and this too is the meaning of the coarser tegumentary structures of a bulkier plant. These vary considerably in completeness with its age; in its younger parts the outer cell-wall undergoes the change known as cuticularization, the material being changed both in chemical composition and in physical properties. The corky layers which take so prominent a share in the formation of the bark are similarly modified and subserve the same purpose. But these protective layers are in the main impermeable by gases and by either liquid or vapour, and prevent the access of either to the protoplasts which need them. Investigations carried out by Blackman, and by Brown and Escombe, have shown clearly that the view put forward by Boussingault, that such absorption of gases takes place through the cuticular covering of the younger parts of the plant, is erroneous and can no longer be supported. The difficulty is solved by the provision of a complete system of minute intercellular spaces which form a continuous series of delicate canals between the cells, extending throughout the whole substance of the plant. Every protoplast, except in the very young regions, has part of its surface abutting on these, so that its wall is accessible to the gases necessary for its vital processes. There is no need for cuticularization here, as the external dangerous influences do not reach the interior, and the processes of absorption which Boussingault attributed to the external cuticularized cells can take place freely through

the delicate cell-walls of tlie interior, saturated as these are with water. This system of channels is in com- munication with the outer atmosphere through numerous small apertures, known as stomata, which are abundant upon the leaves and young twigs, and gaseous inter- change between the plant and the air is by their assistance rendered constant and safe. This system of intercellular spaces, extending throughout the plant, constitutes a reservoir, charged with an atmosphere which differs some- what in its composition from the external air, its gaseous constituents varying from time to time and from place to place, in consequence of the interchanges between itself and the protoplasts. It constitutes practically the exterior environment of the protoplasts, though it is ramifying through the interior of the plant.

The importance of this provision in the case of aquatic vascular plants of sturdy bulk is even greater than in that of terrestrial organisms, as their environment offers considerable obstacles to the renewal of the air in their interior. They are without stomata on their submerged portions, and the entry of gases can only take place by diffusion from the water through their external cells, which are not cutieularized. Those which are only par- tially submerged bear stomata on their exposed portions, so that their environment approximates towards that of a terrestrial plant, but the communication even in their case is much less easy and complete, so that they need a much larger reservoir of air in their interior. This is secured by the development of much larger intercellular spaces, amounting to lacunae or passages of very consider- able size, which are found ramifying in different ways in their interior.

Transpiration. â€” In the case of terrestrial plants, the continual renewal of the water contained in the vacuoles of the protoplasts demands a copious and continuous evaporation. This serves a double purpose, bringing up from the soil continually a supply of the soluble mineral matters necessary for their metabolic processes, which only enter the plant in solutions of extreme dilution, and at the same time keeping the plant cool by the pro- cess of evaporation. The latter

function has been found to be of extreme importance in the case of plants exposed to the direct access of the sun's rays, the heat of which would rapidly cause the death of the protoplasts were it not employed in the evaporation of the water. Brown and Escombe have shown that the amount of solar energy taken up by a green leaf may often be fifty times as much as it can utilize in the constructive processes of which it is the seat. If the heat were allowed to accumulate in the leaf unchecked, they have computed that its tem- perature would rise during bright sunshine at the rate of more than 12Â° C. per minute, with of course very rapidly fatal results. What is not used in the construc- tive processes is employed in the evaporation of the water, the leaf being thus kept cool. Whether the leaf is brightly or only moderately illuminated, the same relative proportions of the total energy absorbed are devoted to the purposes of composition and construction respectively. This large evaporation, which constitutes the so-called transpiration of plants, takes place not into the external air but into this same intercellular space system, being possible only through the delicate cell- walls upon which it abuts, as the external coating, whether bark, cork, or cuticle, is impermeable by watery vapour. The latter ultimately reaches the external air by diffusion through the stomata, whose dimensions vary in proportion as the amount of water in the epidermal cells becomes greater or less.

Mechanism and Function of Stomata. â€" It is not quite exact to speak of either the gaseous interchanges or the transpiration as taking place through the stomata. The

entry of gases into, and exit from, the cells, as well as the actual exhalation of watery vapour ^om the latter, tal^e place in the intercellular space system of which the sto- mata are the outlets. The' opening and closing of the stomata is the result of variation in the turgidity of their guard cells, which is immediately affected by the condi- tion of turgidity of the cells of the epidermis contiguous to them. The amount of watery vapour in the air pass- ing through a stoma has no effect upon it, as the surfaces of the guard cells abutting on the air chamber are strongly cutieularized, and therefore impermeable. The only way in which their turgidity is modified is by the entry of water

into them from the contiguous cells of the general epidermis and its subsequent withdrawal through the same channel. This opening and closing of the stomata must be looked upon as having a direct bearing only on the emis- sion of watery vapour. There is a distinct advantage in the regulation of this escape, and the mechanism is directly connected with the greater or smaller quantity of water in the plant, and especially in its epidermal cells. This power of varying the area of the apertures by which gases enter the internal reservoirs is not advantageous to the gaseous interchanges â€" indeed, it may be directly the reverse. It may lead to an incipient asphyxiation, as the supply of oxygen may be greatly interfered with and the escape of carbon dioxide may be almost stopped. It may at other times lead to great difficulties in the supply of the gaseous constituents which are used in the manu- facture of food. The importance of transpiration is, however, so great, that these risks must be run.

Nature of the Food of Plants. â€" The recognition of the fundamental identity of the living substance in animals and plants has directed attention to the manner in which plants are nourished, and especially to the exact nature of their food. The idea was till recently currently accepted, that anything which plants absorbed from without, and which went to build up their organic substance, or to supply them with energy, or to exert some beneficial influence upon their metabolism, constituted their food.]S"ow, as the materials which plants absorb are carbon dioxide from the air, and various inorganic compounds from the soil, together with water, it is clear that if this view is correct, vegetable protoplasm must be fed in a very different way from animal, and on very different materials. A study of the whole vegetable kingdom, however, throws considerable doubt upon the theory that the compounds absorbed are in the strict sense to be called food. Fungal and phanerogamic parasites can make no use of such sub- stances as carbon dioxide, but draw elaborated products from the bodies of their hosts. Those Fungi which are saprophytic can only live when supplied with organic compounds of some complexity, which they derive from decomposing animal or vegetable matter. Even in the higher flowering plants, in which the processes of the absorption of substances from the environment has been most fully studied, their is a stage in their life in

which the nutritive processes approximate very closely to those of the group last mentioned. When the young sporophyte first begins its independent life â€” when, that is, it exists in the form of the embryo in the seed â€” its living substance has no power of utilizing the simple inorganic compounds spoken of. Its nutritive pabulum is supplied to it in the shape of certain complex organic substances which have been stored in some part or other of the seed, sometimes even in its own tissues, by the parent plant from which it springs. When the tuber of a potato begins to germinate, the shoots which it puts out derive their food from the accumulated store of nutritive material which has been laid up in the cells of the tuber. If we examine the seat of active growth in a young root or i^\g, we find that the cells in which the organic substance.

the protoplasm, of the plant is being formed and increased, are not supplied with carbon dioxide and mineral matter, but with such elaborated material as sugar and proteid substances, or others closely allied to them.

Identity of the Food of Animals and Plants. â€” It is evi- dently to the actual seats of consumption of food, and of consequent nutrition and increase of living substance, that we should turn when we wish to inquire what are the nutritive materials of plants. If we go back to the first instance cited, the embryo in the seed and its develop- ment during germination, we can ascertain what is neces- sary for its life by inquiring what are the materials which are deposited in the seed, and which become exhausted by consumption as growth and development proceed. We find them to consist of representatives of the great classes of food-stuffs on which animal protoplasm is nourished, and whose presence renders seeds such valu- able material for animal consumption. They are mainly carbohydrates such as starch and sugar, proteids in the form of globulins or albumoses, and in many cases fats and oils, while certain other bodies of similar nutritive value are less widely distributed.

The differences between the nutritive processes of the animal and the plant are not therefore fundamental, as they were formerly held to be. The general vegetable protoplasm has not the capacity of being nourished by inorganic substances which are denied to the living substance of the animal world. Differences connected with the mode of supply of nutritive material do exist, but they are mainly correlated with the structure of the organisms, which makes the method of absorption different. The cell-walls of plants render the entry of solid material into the organism impossible. The food must enter in solution in order to pass the walls. More- over, the stationary habit of plants, and the almost total absence of locomotion, makes it impossible for them to seek their food.

The Special Apparatus of Plants for constructing Food. â€" The explanation of the apparent difference of food supply is very simple. Plants are furnished with a constructive mechanism by which they are enabled to fabricate the food on which they live from the inorganic, gaseous, and liquid matters which they absorb. The fact of such absorption does not render these substances food ; they are taken in not as food, but as raw materials to be subjected to the action of this constructive mechanism, and by it to be converted into substances that can nourish protoplasm, both vegetable and animal. It is sometimes forgotten, when discussing questions of animal nutrition, that all the food materials of all living organisms are prepared originally from inorganic substances in exactly the same way, in exactly the same place, anH by the same machinery, which is the chlorophyll apparatus of the vegetable kingdom. A consideration of these facts emphasizes still more fully the view with which we set out, that all living substance is fundamentally the same, though diiferentiated both anatomically and physiologi- cally in many directions and in different degrees. All is nourished alike on materials originally prepared by a mechanism attached to the higher vegetable organism, and capable of being dissociated, in theory at least, from its own special means of nutrition, if by the latter term we understand the appropriation by the protoplasm of the materials so constructed.

The possession of this mechanism, which we have al- luded to as the chlorophyll apparatus, is limited to those plants which are green, or which have green portions, the colour, of course, being the inherent colour of the mechan- ism itself. The latter is especially charged with the duty of manufacturing carbohydrates, its action in the formar tion of proteids being not completely understood. The

construction of the latter apparently depends upon a supply of carbohydrate material, together with other constituents, so that indirectly, at least, the chlorophyll apparatus is concerned in their preparation. The forma- tion of fats is still less understood. It appears to be a function of protoplasm itself under certain conditions of nutrition, and therefore removed a little farther from the influence of the chlorophyll machinery.

The story of the construction processes is not, how- ever, complete until we have considered also the groups of plants which contain no chlorophyll apparatus. We have evidence in the case of many of these that the power of construction is not entirely absent from them. Eungi can live, thrive, and grow in nutritive media which contain carbohydrates, together with certain salts of ammonia, but which are free from proteids. As we have seen strong reasons to believe that their protoplasm is like that of animals, and therefore incapable of being nourished by inorganic compounds of nitrogen, we must surmise their possession of a mechanism which can construct proteids if supplied with these nitrogen compounds, together with sugar. We have no apparent differentiation of such a mechanism, and its existence must remain for the present only as a probability, although a strong one. It must exist in the green plant side by side with the chlorophyll apparatus ; indeed, this is probable from the fact that a good deal of evidence points to the leaves as the seat of proteid consti-uction. It may be that this power is a particular differentiation of a physiological kind in alf vegetable protoplasm, or in that of certain cells. The idea of an identity of protoplasm does not involve a denial of special powers developed in it in different situations, and the possession of such a power by the vegetable cell is not more striking than the location of

powers of co-ordination and thought in the protoplasm of cells of the human brain.

The normal green plant is seen thus to be in possession of a complete machinery for the manufacture of its own food. The process of manufacture of carbohydrates, in which are primarily concerned the carbon dioxide of the air and the water of the soil, has been generally spoken of as the assimilation of carbon dioxide, a term which the more recent work on the true nature of the food shows to be misleading, and which has already been abandoned by many writers. The carbon dioxide is not assimilated by the protoplasm, but is built up into carbohydrates by the chlorophyll apparatus. As the latter is only active under the influence of the radiant energy of light, the term photosynthesis has been suggested, to replace the older one.

Photosynthesis. â€" Though the actual details of this pro- cess have been studied by many observers of late years, little substantial progress has been made in ascertaining what they are. The general position has been slightly changed, the appearance of starch in the chlorophyll apparatus bearing now a slightly different interpretation from that formerly in vogue. Its very prompt appearance as soon as the apparatus became active led to the opinion that the work of the latter was only complete when the starch was formed. It appears more likely that the ultimate product is not starch but sugar, though what particular sugar is still a matter of controversy. The appearance of the starch is interpreted as the sign of a surplus manufacture : what is produced beyond the immediate requirements of the cell being converted into the insoluble form of starch by the plastids of the chloro- phyll apparatus, and so withdrawn from the sphere of action, thereby enabling the construction of further quan- tities of sugar to take place. Starch, indeed, wherever it appears in the plant, seems to be a reserve store of

carbohydrate material deposited where it is found for longer or shorter periods till it is needed for consumption. The readiness with which it is converted into sugar fits it especially for that duty.

Very little progress has been made in the investigation of the stages by which sugar is constructed. The view brought forward originally by Baeyer, that the first step is the decomposition of carbon dioxide into carbon monoxide and oxygen, while water is simultaneously split up into hydrogen and oxygen, and that this is at once followed by the union of the carbon monoxide and hydrogen to form formaldehyde, has only been slightly modified. There is no evidence that carbon monoxide is ever produced ; indeed, there are strong reasons for disbelieving that it is. Tormaldehyde has been said to be present in leaves during photosynthesis, and certain Algse have been found capable of forming nutritive substances and storing starch in their cells when supplied with a compound of this body and sodium-hydrogen-sulphite. The evidence for its formation in the ordinary course of photosynthesis is not, however, very strong. The course of photosyn- thesis has been with tolerable certainty found to lead to the construction of sugar, and the general opinion has been that the sugar is a simple hexose such as glucose, CgHijOe. Brown and Morris in 1892 advanced strong reasons for thinking that cane sugar, CijHjaOu, is the first carbohydrate synthesized, and that the hexoses found in the plant result from the decompositions of this. The whole story of the different sugars existing in the plant â€” their relations, and their several functions â€” requires renewed investigation.

Symbiosis. â€” Though green plants thus possess a very complete mechanism for the manufacture of their differ- ent food-stuffs, it is not always exercised to the fullest extent. Many of them are known to supplement it, and some almost entirely to replace it, by absorbing the food they need in a fully prepared condition from their envi- ronment. It may be that they procure it from decompos- ing organic matter in the soil, or they may get it by absorption from other plants to which they attach them- selves, or they may in rare cases obtain it by preying upon insect life. The power of green plants, not even specialized in any of these directions, to absorb certain carbohydrates, particularly

sugars, from the soil was de- monstrated by Acton in 1889. Similar observations have been made in the case of various compounds of nitrogen, though these have not been so complex as the proteids. It was formerly the custom to regard as parasites all those plants which inserted roots or root-like organs into the tissues of other plants and absorbed the contents of the latter. The most conspicuous case, perhaps, of all these is the mistletoe, which flourishes luxuriantly upon the apple, the poplar, and other trees. Bonnier has drawn attention to the fact that the mistletoe in its turn, remain- ing green in the winter, contributes food material to its host when the latter has lost its leaves. ‘ The relation- ship thus existing he showed to be mutually beneficial, each at one time or another supplying the necessities of the other. Such a relationship is known as symbiosis, and the large majority of the cases of so-called parasitism among green plants can be referred to it. Bonnier showed that the same relationship could be proved in the cases of such plants as the rattle (Rhinanthus), the eye- bright (Euphrasia), and other members of the Natural Orders Scrophidariaceos and Santalacece, which effect a union between their roots and the roots of other plants growing near them. The union taking place underground, while the bulk of both partners in the symbiosis rises into the air, renders the association a little difficult to see, but there is no doubt that the plants in question do afford each other assistance, forming, as it were, a kind

of partnership. The most pronounced ease of parasitism, that of Cuscuta, the dodder, which infests particularly clover fields, appears to differ only in degree from those mentioned, for the plant, bare of leaves as it is, yet con- tains a little chlorophyll. The advantages it can offer to its host are, however, infinitesimal when compared with the injury it does it. Many other cases of symbiosis have been investigated with some completeness, espe- cially those in which lower plants than the Phanerogams are concerned. The relations of the Alga and the Fun- gus, which have formed a close association ship in the structure known as the Lichen, were established many years ago. Since about 1880 our knowledge of the species which can enter into such relationships has been materially extended, and the fungal constituents of the Lichens are known to include Basidiomycetes as well as Ascomycetes.

Mycorhizas. â€” The most interesting cases, however, in which Fungi form symbiotic relationships with green plants have been discovered in connexion with forest trees. The' roots of many of the latter, while growing freely in the soil, are found to be surrounded with a dense f eltwork of fungal mycelium, which sometimes forms a mass of considerable size. The plants showing it are not all forest trees, but include also some Pteridophytes and some of the prothallia of the Ferns, Club-mosses, Liver- worts, and Horsetails. The true nature of the relation- ship was first recognized by Pfeffer in 1877, but few cases were known till recent years. Very complete examina- tion, however, has now been made of many instances, and the name mycorhiza has been given to the symbiotic union. Two classes are recognized. In the first, which are called ectotropic, the fungal filaments form a thick felt or sheath round the root, either completely enclosing it or leaving the apex free. They seldom penetrate the living cells, though they do so in a few cases. The root- hairs penetrate between masses of the hyphse of the Fungus. This type of mycorhiza is found among the Poplars, Oaks, and Fir trees. The other type is called endotropic. The fungal filaments either penetrate the epidermis of the root, or enter it from the stem and ramify in the interior. Some make their way through the cells of the outer part of the cortex towards the root- tip, and form a mycelium or feltwork of hyphse, which generally occupies two or three layers of cells. From this branches pass into the middle region of the cortex and ramify through the interior half of its cells. They often cause a considerable hypertrophy of the tissue. From the outer cortical mycelium, again, branches pass through the epidermis and " grow out in the soil. In such cases the roots of the plants are usually found spreading in soils which contain a large amount of humus, or decaying vegetable matter. The organic compounds of the latter are absorbed by the protruding fungal fila- ments, which take the place of root-hairs, the tree ceas- ing to develop the latter. The food so absorbed passes to the outer cortical mycelium, and from this to the inner hyphse, which appear to be the organs of the interchange of substance, for they are attracted to the neighbourhood of the nuclei of the cells, which they enter, and in which they form agglomerations of interwoven filaments. The prothalli of the Pteridophytes, which form similar sym- bioses,

show a somewhat different mode of arrangement, the Fungi occupying the external or the lower layers of the thalloid body.

The discovery of the widespread occurrence of this mycorhizal symbiosis must be held to be one of the most important results of research upon the nutritive processes of plants during the closing decade of the 19th century. Among green plants the symbionts include Conifers, Orchids, Heaths, Oaks, Poplars, and Beeches, though

all do not derive equal advantages from the association. Monotropaa afford an extreme case of it, having lost their chlorophyll almost entirely, and come to depend upon the Fungi for their nutriment. The fungal constituents vary considerably. Each species of green plant may form a mycorhiza ~~with two or three different Fungi, and a single species of Fungus may enter into symbiosis with several green plants. The Fungi that have been discovered tak~~ ing part in the union include Eurotium, Pythium, Boletus, Agaricus, Lactarius, Penidllium, and many others of less frequent occurrence. All the known species belong to the Oomycetes, the Pyrenomycetes, the Hymenomycetes, or the Oasteromycetes. The habit of forming mycorhizas is found more frequently in warm climates than cold ; in- deed, the percentage of the flora exhibiting this peculiarity seems to increase with a certain regularity from the Arctic Circle to the Equator.

Fixation of Nitrogen. â€” Another, and perhaps an even more important, instance of symbiotic association has come to the front during the same period. It is an alli- ance between the plants of the Natural Order Leguminosce and certain bacterixim-like forms which find a home within the tissues of their roots. The importance of the sym- biosis can only be understood by considering the rela- tionship in which plants stand with regard to the free nitrogen of the air. Long ago the view that this gas might be the source of the combined nitrogen found in different forms within the plant, was critically examined, particularly by Boussingault, and later by Lawes and Gilbert and by

Pugh, and it was ascertained to be erro- neous, the plants only taking nitrogen into their substance when it is presented to their roots in the form of nitrates of various metals, or compounds of ammonia. Many writers in recent years, among whom may be named especially Hellriegel and Wilfarth, Lawes and Gilbert, and Schloesing and Laurent, have shown that the Legu- minosEe as a group form conspicuous exceptions to this rule. While they are quite capable of taking up nitrates from the soil where and so long as these are present, they can grow and thrive in soil which contains no com- bined nitrogen at all, deriving their supplies of this element in these cases from the air. The phenomena have been the subject of very careful and critical exam- ination for many years, and may be regarded as satisfac- torily established. The power of fixing atmospheric nitrogen by the higher plants seems to be confined to this solitary group, though it has been stated by various observers with more or less emphasis that it is shared by others. Frank has claimed to have found oats, buck- beans, spurry, turnips, mustard, potatoes, and Norway maples exercising it ; Nobbe and others have imputed its possession to Eloeagnus. There is little direct evidence pointing to this extension of the power, and many exper- imenters directly contradict the statements of Frank.

The power exercised by the Leguminosse is associated with the presence of curious tubercular swellings upon their roots, which are developed at a very early age, as they are cultivated in ordinary soil. If experimental plants are grown in sterilized soil, these swellings do not appear, and the plant can then use no atmospheric nitrogen. The swellings have been found to be due to a curious hypertrophy of the tissue of the part, the cells being filled with an immense number of minute bacterium- like organisms of V, X, or Y shape. The development of these structures has been studied by many observers, both in England and on the continent of Europe. They ap- pear to be present in large numbers in the soil, and to infect the Leguminous plant by attacking its root-hairs. One of these hairs can be seen to be penetrated at a par- ticular spot, and the entering body is then found to grow along the length of the hair till it reaches the cortex of

the root. It has the appearance of a delicate tube which has. granular contents, and is provided with an apex that appears to be open. The wall of the tube is very thin and delicate, and does not seem to be composed of cel- lulose or any modification of it. Careful staining shows that the granular substance of the interior really consists of a large number of delicate rod-like bodies. As the tube grows down the hair it maintains its own inde- pendence, and does not fuse with the contents of the root-hair, whose protoplasm remains quite distinct and separate. Af|;er making its way into the interior, the intruder sets up a considerable hypertrophy of the tissue, causing the formation of a tubercle, which soon shows a certain differentiation, branches of the vascular bundles of the root being supplied to it. The rod-like bodies from the interior of the tube, which has considerable resemblance to the zooglcea of many Bacteria, are liber- ated into the interior of the cells of the tubercle and fill it, increasing by a process of branching and fission. When this stage is reached, the invading tubes and their ramifications frequently disappear, leaving the cells full of the bacterioids, as they have been called. When the root dies later, such of these as remain are discharged into the soil, and are then ready to infect new plants. In some cases the zoogloea thread or tube has not been seen, the organism consisting entirely of the bacterioids.

This peculiar relationship suggests at once a symbi- osis, the Fungus gaining its nutriment mainly or entirely from the green plant, while the latter in some way or other is able to utilize the free nitrogen of the air. The exact way in which the utilization or fixation of the nitrogen is effected remains undecided. Two views are still receiving certain support, though the second of them appears the more probable. These are : (1) That the green plant is so stimulated by the symbiotic associa- tion which leads to the hypertrophy, that it is able to fix the nitrogen or cause it to enter into combination. (2) That the fixatioiT of the gas is carried out by the fungal organism either in the soil or in the plant, and the nitrogenous substance so produced is absorbed by the organism, which is in turn consumed by the green plant. Certain evidence which supports this view will be re- ferred to later.

Whichever opinion is held on this point, there seems no room for doubt that the fixation of the nitrogen is concerned only with the root, and that the green leaves take no part in it. The nodules, in particular, appear to play the important part in the process. Marshall Ward has directed attention to several points of their structure which bear out this view. They are supplied with a regular system of conducting vascular bundles commu- nicating with those of the roots. Their cells during the period of incubation of the symbiotic organism are abundantly supplied with starch. The cells in which the fungoid organism is vigorously flourishing are exceed- ingly active, showing large size, brilliant nuclei, proto- plasm, and vacuole, all of which give signs of intense metabolic activity. The sap in these active tissues is alkaline, which has been interpreted as being in accord- ance with Loew's suggestion that the living protoplasm in presence of an alkali and free nitrogen can build irp ammonium nitrate, or some similar body. It is, however, at present entirely unknown what substances are formed at the expense of the atmospheric nitrogen.

The idea that the atmospheric nitrogen is gradually being made use of by plants, although it is clearly not easily or commonly utilized, has been growing steadily. Besides the phenomena of the symbiosis just discussed, certain experiments tend to show that we have a con- stant fixation of this gas in the soil by various Bacteria. Kesearches which have been carried out since 1885 by

Berthelot, Andr^e, Laurent, and Schloesing, and more recently by Kossowitsch, seem to establish the fact, though the details of the process remain undiscovered. Berthelot imputes it to the action of several species of soil Bacteria and Fungi, including the Bacterium of the Leguminosse, when the latter is cultivated free from its ordinary host. Laurent and Schloesing affirm that the free nitrogen of the air can be fixed by a nvimber of humble green plants, principally lowly green

Algae. They must be exposed freely to light and air during the process, or they fail to effect it. Frank has stated that Penicillium dadiosporioides can flourish in a medium to which no nitrogen but that of the atmosphere has access. Kosso- witsch claims to have proved that fixation of nitrogen takes place under the influence of a symbiosis of certain Algae and soil Bacteria, the process being much facilitated by the presence of sugar. The Algae include Nostoc, Cystococcus, Oylindrospermum, and a few other forms. In the symbiosis the Algae are supplied with nitrogen by the bacteria, and in turn they construct carbohydrate material, part of which goes to the microbes. This is supported by the fact that if the mixed culture is placed in the light there is a greater fixation than when it is left in darkness. If there is a plentiful supply of carbon dioxide, more nitrogen is fixed.

Nitrification and Denitrification in the Soil. â€" Another aspect of the nitrogen question has been the subject of much investigation and controversy since 1877. The round of changes which nitrogenous organic matter under- goes in the soil, and how it is ultimately made use of again by plants, presents some curious features. We have seen that when nitrogenous matter is present in the condition of humus, some plants can absorb it by their roots or by the aid of mycorhizas. But the changes in it in the usual course of nature are much more profound than these. It becomes in the soil the prey of various microbes. Ammonia appears immediately as a product of the disruption of the nitrogen-containing organic mole- cule. Later, oxidation processes take place, and the ammonia gives rise to nitrates, which are absorbed by plants. These two processes go on siiccessively rather than simultaneously, so that it is only towards the end of the decomposition of the organic matter that nitri- fication of the ammonia which is formed is set up. In this process of nitrification we can distinguish two phases, first the formation of nitrites, and secondly their oxida- tion to nitrates. The researches of Warington in England and Winogradsky on the Continent have satisfactorily shown that two distinct organisms are concerned in it, and that probably more than one species of each exists. One of them, comprising the genera Nitrosomonas and Nitrosococcus, has the power of oxidizing salts of ammo- nium to the condition of compounds of nitrous acid. When in a

pure culture this stage has been reached, no further oxidation takes place. The oxidation of the nitrites into nitrates is effected by another organism, much smaller than the first. The name Nitrobacter has been given to this genus, most of our knowledge of which is due to the researches of Winogradsky.

The two kinds of organism are usually both present in the same soil, those of the second type immediately oxidizing the nitrites which those of the first form from ammonium salts. The Nitrobacter forms not only cannot oxidize the latter bodies, but they are very injuriously affected by the presence of free ammonia. When culti- vated upon a suitable nutritive material in the laboratory, the organism was killed by the presence of -016 per cent, of this gas, and seriously inconvenienced by one-third as much. Except in this respect, however, the two classes show great similarity. ^ A very interesting peculiarity attaching to them is their distaste for organic nutriment.

They can be cultivated most readily on masses of gela- tinous silica impregnated with . the appropriate com- pounds of nitrogen, and their growth takes place most copiously in the absence of light. They need a little carbonate in the nutrient material, and the source of the carbon which is found in the increased bulk of the plant is partly that and partly the carbon dioxide of the air.

We have in these plants a power which appears special to them, in the possession of some mechanism for the construction of organic substance which differs essentially from the chlorophyll apparatus of green plants, and yet brings about substantially similar results. The steps by which this carbon dioxide is built up into a compound capable of being assimilated by the protoplasm of the cells, are not known. The energy for the purpose appears to be supplied by the oxidation of the molecules containing nitrogen, so that it is dependent upon such oxidation taking place. Winogradsky has investigated this point with great care, and he has come to the conclusion that about 35 milligrammes of nitrogen are oxidized for each milligramme of carbon absorbed and fixed.

Deposition and Digestion of Reserve Materials in Plants , and Animals. â€” As we have seen, the tendency of recent research is to prove the identity of the mode of nutrition of vegetable and animal organisms. The material on which they feed is of the same description, and its treat- ment in the body is precisely similar. In both groups we find the presence of nutritive material in two forms, one specially fitted for transport, the other for storage. In the plant the intermittent processes of its manufacture from the raw materials absorbed lead to the accumulation of a constantly increasing surplus, which is continuously being removed from the seats of its construction and deposited for longer or shorter periods in other parts of the structure, usually near the regions at which its ultirtate consumption will take place. We have the deposition of starch, aleurone grains, amorphous proteids, fats, &c. &c., in the neighbourhood of growing points, cambium rings, and phellogens ; also the more prolonged storage in tubers, seeds, and other reproductive bodies. Turning to the animal, we meet with similar provisions in the storage of glycogen in the liver and other parts, of fat in various internal regions, and so on. In both we find the reserve of food, so far as it is in excess of immediate need, existing in two conditions, the one suit- able for transport, the other for storage, and we see con- tinually the transformation of the one into the other. The formation of the storage form at the expense of the travelling stream is due to the activity of some proto- plasmic structure â€” it may be a plastid or the general protoplasm of the cell â€” and is a process of secretion. The converse process is one of a true digestion, which deserves the name no less because it is intracellular. We find processes of digestion strictly comparable to those of the alimentary canal of an animal in the case of the insectivorous Xejxnthes, Drosera, and other similar plants, and in the saprophytic Fungi. Those which now concern us recall the utilization of the glycogen of the liver, the stored fats and proteids of other parts of the animal body, being like them intracellular.

Enzymes. â€” The agents which effect the digestive changes in plants have been studied with much care. They have been found to be mainly enzymes, which are in many cases identical with those of animal origin. A vast number of them have been discovered and investigated, and the majority call for a brief notice. Their number, indeed, renders it

necessary to classify them, and rather to look at groups of them than to examine them one by one. They are usually classified

according to the materials on whicli they work, and we may here notice especially four principal groups, the members of which take part in the digestion of reserve materials as well as in the processes of external diges- tion. These decompose respectively carbohydrates, glu- cosides, proteids, and fats or oils. The action of the enzyme in nearly every case is one of hydration, the body acted on being made to take up water and to undergo a subsequent decomposition.

Among those which act on carbohydrates the most important are : the two varieties of diastase, which con- vert starch into maltose or malt sugar; inulase, which forms fructose from inulin ; inveHase, which converts cane sugar into glucose (grape sugar) and fructose ; glu- case or maltase, which produces grape sugar from maltose ; and cytase, which hydrolyses cellulose. Another enzyme which does not appear to be concerned with digestion so directly as the others is pectase, which forms vegetable jelly from pectic substances occurring in the cell-wall.

The enzymes which act upon glucosides are many ; the best known are emulsin and myrosin, which split up respectively amygdalin, the special glucoside of certain plants of the Hosacece ; and sinigrin, which has a wide distribution among those of the Cruciferce. Others of less frequent occurrence are erythrozym, rhamnase, and gaultherase.

The proteolytic enzymes, or those which digest pro- teids, are usually divided into two groups, which are represented by the pepsin of the stomach of the higher animals and the trypsin of their pancreatic juice. The differences between them have recently been shown to be of degree rather than of kind. It is not quite certain whether a pepsin exists in plants, but many trypsins have been discovered. Among them we have the papain of the Papaw fruit (Carica Papaya), the hromelin of the Pine-apple, and the enzymes present in many germinat- ing seeds, in

the seedlings of several plants, and in other parts. Another enzyme, rennet, which in the animal body is proteolytic, is frequently met with in plants, but its function has not been ascertained.

The digestion of fat or oil has not been adequately investigated, but its decomposition in germinating seeds has been found to be due to an enzyme, which has been called lipase. It splits it into a fatty acid and glycerine, but seems to have no further action. The details of the further transformations have not yet been completely followed.

Oxidases. â€" Another class of enzymes has been discov- ered in both animals and plants, but they do not appar- ently take any part in digestion. They set up a process of oxidation in the substances which they attack, and have consequently been named oxidases. Very little is known about them.

In many cases the digestion of reserve food materials is effected by the direct action of the protoplasm, without the intervention of enzymes. This property of living sub- stance can be proved in the case of the cells of the higher plants, but it is especially prominent in many of the more lowly organisms, such as the Bacteria. The processes of putrefaction may be alluded to as affording an instance' of such a power in the vegetable organisms. At the same time, it must be remembered that the secretion of enzymes by Bacteria is of widespread occurrence.

Supply and Distribution of Energy in Plants. â€" Since about 1880 considerable attention has been directed to the question of the supply, distribution, and expenditure of energy in the vegetable kingdom. This is an ex- tremely important question, since the supply of energy to the animal world has been found to depend entirely upon the vegetable one. The supply of energy to the several protoplasts which make up the body of a plant is

as necessary as is the transport to them of the food they need ; indeed, the two things are inseparably connected. The source of energy which is the only one accessible to the ordinary plant as a whole is the radiant energy of the rays of the sun, and its absorption is mainly due to the properties of chlorophyll. This colouring matter, as shown by its

absorption spectrum, picks out of the ordi- nary beam of light a large proportion of its red and blue rays, together with some of the green and yellow. This energy is obtained especially by the chloroplastids, and part of it is at once devoted to the construction of car- bohydrate material, being thus turned from the kinetic to the potential condition. The other constructive pro- cesses, which are dependent partly upon the oxidation of the carbohydrates so formed, and therefore upon an expenditure of part of such energy, also mark the storage of energy in the potential form. Indeed, the construction of protoplasm itself indicates the same thing. Thus even in these constructive processes there occurs a constant passage of energy backwards and for- wards from the kinetic to the potential condition, and vice versd. The outcome of the whole round of changes, however, is the fixation of a certain part of the radiant energy absorbed by the chlorophyll. The rays of the visible spectrum do not supply all the energy which the plant obtains; It has been suggested by several botan- ists, with considerable plausibility, that the ultra-violet or chemical rays can be absorbed and utilized by the protoplasm without the intervention of any pigment such as chlorophyll. There is some evidence pointing to the existence of this power in the cells of the higher plants. Again, we have evidence of the power of plants to avail themselves of the heat rays. There is no doubt a direct interchange of heat between the plant and the air, which in many cases results in a gain of heat by the plant. Indeed, the tendency to absorb heat in this way, either from the air or directly from the sunlight, has already been pointed out as a danger which needs to be averted by transpiration.

There is probably but little transformation of one form of kinetic energy into another in the plant. It has been suggested that the red pigment anthocyan, which is found very commonly in young developing shoots, petioles, and midribs, effects a conversion of light rays into heating ones, so facilitating the metabolic processes of the plant. This is, however, rather a matter of speculation. The various electrical phenomena of plants also are obscure.

Certain plants possess another source of energy which is common to them and the animal world. This is the absorption of elaborated

compounds from their environ- ment, by whose decomposition the potential energy expended in their construction can foe liberated. Such a source is commonly met with among the Eungi, the insectivorous plants, and such of the higher plants as have a saprophytic habit. This source is not, however, anything new, for the elaborated compounds so absorbed have been primarily constructed by other plants through the mechanism which has just been described.

The question of the distribution of this stored energy to the separate protoplasts of the plant can be seen to be the same problem as the distribution of the food. The material and the energy go together, the decomposition of the one in the cell setting free the other, which is used at once in the vital processes of the cell, being in fact largely employed in constructing protoplasm or storing various products. The actual liberation in any cell is only very gradual, and generally takes the form of heat. The metabolic changes in the cells, however, concern other * decompositions side by side with those which involve the building up of protoplasm from the products on which it feeds. So long as food is supplied, the living substance

is the seat of transformations wliich are continually proceeding, being partially decomposed, and again con- structed, the new food being incorporated into it. The changes involve a continual liberation of energy, which in most cases is caused by the respiration of the proto- plasm and the oxidation of the substances it contains. The need of the protoplasm for oxygen has already been spoken of: in its absence death soon supervenes, respi- ration being stopped. Kespiration, indeed, is the ex- pression of the liberation of the potential energy of the protoplasm itself. It is not certain how far substances in the protoplasm are directly oxidized without enter- ing into the composition of the living substance, though this appears to take place. Even their oxidation, how- ever, is effected by the protoplasm acting as an oxygen carrier.

The supply of oxygen to a plant is thus seen to be as directly connected with the utilization of the energy of a cell as is that of food concerned in its nutrition. If the access of oxygen to a protoplast is interfered with, its normal respiration soon ceases, but frequently other changes supervene. The partial asphyxiation or suffoca- tion stimulates the protoplasm to set up a new and perhaps supplementary series of decompositions, which result in the liberation of energy just as do those of the respiratory process. One of the constant features of respiration, the exhalation of carbon dioxide, can still be observed. This comes in almost all such cases from the decomposition of sugar, which is split up by the protoplasm into alcohol and carbon dioxide. Such decompositions are now generally spoken of as anaerobic respiration. The decomposition of the complex molecule of the sugar liberates a certain amount of energy, as can be seen from the study of the fermentation set up by yeast, which is a process of this kind, in that it is inten- sified by the absence of oxygen. The liberated energy takes the form of heat, which raises the temperature of the fermenting wort. It has been ascertained that in many cases this decomposition is effected by the secretion of an enzyme, which has been termed zymase. This body has been prepared from active yeast, and from fruits and other parts which have been kept for some time in the absence of oxygen. The protoplasm appears to be able also to bring about the change without secreting any enzyme.

The Ascent of Water in Trees. â€” Little advance has been made in the solution of the problem of the ascent of water in tall trees. About 1880 two views were held by different botanists : one was that the water travels in the woody cell-walls of the vascular bundles, mainly under the action of the forces of root-pressure and transpiration, and that the cavities of the vessels contain only air. The other was that the vessels are not empty, but that the water travels in their cavities, which contain columns of water in the course of which are large bubbles of air. On this view the water flows upwards under the influence of variations of pressure and tension in the vessels. Neither hypothesis is satisfactory, and others have been advanced to supplement them, which have more or less weight. Westermaier and Godlewski put forward the view that the living cells of the medullary rays of the wood, by a species of

osmosis, act as a kind of pumping apparatus, by the aid of which the water is lifted to the top of the tree, a series of pumping-stations being formed. Though this at first met with some acceptance, Strasburger showed that the action goes on in long lengths of stem the cells of which had been killed by poison or by the action of heat. More recently, Dixon and Joly in Dublin and Askenasy in Germany have suggested the action of another force. They have shown that columns of water of very small diameter can so resist tensile strain

that they can be lifted bodily instead of flowing along the channel. They suggest that the forces causing the movement are complex, and draw particular attention to the pull upwards in consequence of disturbances in the leaves. In these we have (1) the evaporation from the damp delicate cell-walls into the intercellular spaces; (2) the imbibition by the cell-wall of water from the vacuole ; (3) osmotic action, consequent upon the sub- sequent increased concentration of the cell sap, drawing water from the wood cells or vessels which abut upon the leaf parenchyma. They do not, of course, deny the co- operation of the other forces which have been suggested, except so far as these are inconsistent with the motion of the water in the form of separate columns rather than a flowing stream. This view requires the existence of cer- tain anatomical arrangements to secure the isolation of the separate columns, and cannot be said to be fully established.

Nervous System of Plants. â€” Kesearches made upon the relationship of plants to their environment have been marked by definite results. In this direction, also, there has been a closer approximation of the plant to the animal. The indications of definite sense organs by which particular stimulations were appreciated, or which were said to be the seats of particular irritabilities, had been suggested by 1880, and a few cases were established. It had been shown that the root-tip is sensitive to watery vapour, and turns towards it as growth goes on. This fact has been confirmed and our knowledge of such phenomena extended. The root^tip has been shown to be sensitive to many forms of stimulation. The growing apex of some stems has been shown to have the power of appreeiating light, and many parts have been proved to be capable of receiving impressions of contact, or of responding to chemical

stimulation. The effect of these various forms of stimulation has been found to be the production of a purposeful response, generally taking the form of a movement of some part of the plant, which is usually situated at some distance from the sen- sitive part. We have evidence, indeed, of a rudimentary nervous system in which such parts play the r&le of or- gans of special sense, which are clearly differentiated physiologically though not anatomically. The conduc- tion of such stimulation to parts removed some distance from the, sense organ suggests paths of transmission comparable to those which transmit nervous impulses in animals. Again, the degree of differentiation is very slight anatomically, but delicate protoplasmic threads have been shown to extend through all cell-walls, con- necting together all the protoplasts of a plant. These may well serve as conductors of nervous impulses. The nervous mechanism thus formed is very rudimentary, but in an organism the conditions of whose life render locomotion impossible great elaboration would seem su- perfluous. There is, however, very great delicacy of perception or appreciation on the part of the sense organ, stimuli being responded to which are quite incapable of impressing themselves upon the most highly differen- tiated animal.

The power of response is seen most easily in the case of young growing organs, and the parts which show the motor mechanism are mainly the young growing cells. We do not find their behaviour like that of the motor mechanism of an animal. The active contraction of inuscular tissue has no counterpart in the plant. The peculiarity of the protoplasm in almost every cell is that it is especially active in the regulation of its permeability by water. Under different conditions it can retain it more strongly or allow it to escape more freely. This regulation of turgor is as characteristic of vegetable protoplasm as contraction is of muscle. The response to

the stimulus takes the form of increasing the perme- ability of particular cells of the growing structures, and so modifying the degree of the turgidity that is the pre- cursor of growth in them. The extent of

the area affected and of the variation in the turgor depends upon many circumstances, but we have no doubt that in the process of modifying its own permeability by some molecular change we have the counterpart of muscular contractibility.

Organic Rhythm. â€” It is a remarkable fact that during the process of growth we meet with rhythmic variation of such turgidity. The existence of rhythm of this kind has been observed and studied with some completeness. It is the immediate cause of the phenomena of circum- nutation, each cell of the circumnutating organ showing a rhythmic enlargement and decrease in its dimensions, due to the admission of more and less water into its interior. The restraint of the protoplasm changes gradu- ally and rhythmically. The sequence of the phases of the rhythm of the various cells are co-ordinated to produce the movement. Nor is it only in growing organs that the rhythm can be observed, for many plants exhibit it during a much longer period than that of growth. It is easy to realize how such a rhythm can be modified by the reception of stimuli, and can consequently serve as the basis for the movement of the stimulated organ. This rhythmic affection of vegetable protoplasm can be observed in very many of its functions. What have been described as ” periodicities,” such as the daily variations of root-pressure, afford familiar instances of it. It reminds us of a similar property of animal protoplasm which finds its expression in the rhythmic beat of the heart and other phenomena.

AuTHOKiTiES. â€” Sachs. Lectures on the Physiology of Plants, translated by Marshall Ward. â€” Vines. Lectures on the Physiology of Plants. â€” Pfeffek. The Physiology of Plants, translated by Ewart. â€” Reynolds Green. Introduction to Vegetable Physiology : The Soluble Ferments and Fermentation. â€” Detmer. Practical Plant Physiology, translated by Moor. â€” Darwin and Acton. Practical Physiology of Plants. â€” Davenport, C.B. Experimental Morphology, vols. i. and ii. â€” Verworn. General Physiology, translated by Lee. â€” Butschli. Investigation on Microscopic Forms and on Protoplasm, translated by Minchin. (j. e. gr.)

Piacenza (in French Plaisance), a fortified town, bishop's see, and capital of the province of Piacenza, Emilia, Italy, on the right bank of the Po, just below the confluence of the Trebbia, 91 miles north-west of Bologna by rail. The public library contains 120,000 volumes, valuable MSS., and numismatic and other collections, amongst them the " finds " of the ancient Velleia, 6 miles to the east, which was overthrown by a landslip in 370. Piacenza has an arsenal, a technical school, an arts school, and various industries â€" iron and brass works, foundries, silk-throwing, manufactures of cardboard boxes, casks and tubs, and hosiery, flour-mills, and printing. It is also an important administrative and military station. Popu- lation (1881), 34,987 ; (1900), 36,064.

Piano. â€" Since 1885, when the article Pianofoetb in vol. xix. of this work was published, and the Inventions

and Music Exhibition at South Kensington took structural place, there are few; changes of piano structure

to record, such as were conspicuous in the inter- val which had followed the Paris Exhibition of 1867, with the exception of one in metal framing which will be described later. Since 1885 the American system of a metal plate in one casting, and cross- or over-stringing by which the spun bass strings cross the longer steel dia- gonally, has become general in Europe with the exception of France, where musical taste has remained constant to the older wooden structure and parallel stringing through- out. The greater tenacity of the modern cast-steel wire

favours a very much higher tension, and consequent easier production of the higher partials of the notes, permitting a sostenuto unknown to Beethoven, Schumann, or Chopin. While in 1862 the highest tension of a concert grand piano worked out at sixteen tons, since 1885 thirty tons has been recorded. Generally speaking, the rise in tension may be expressed musically by the interval of a minor third, to the great advantage of the standing in tune. First shown by the late Henry Steinway in the London Exhibition of 1862, this altered construction attracted extraordinary attention at Paris in 1867, and determined the German direction of manufacture and a few years later the English. What is now particularly noticeable wherever pianos are made, is the

higher average of excel- lence attained in making, as well as in piano-playing. Naturally the artistic quality, the personal note, charac- terizes all first-class instruments, and permits that liberty of choice which appertains to a true conception of art.

Much attention has been given of late years to the touch of pianos, to make it less tiring for the modern manipulator, especially since, in 1885-86, Anton Rubin- stein went through the herculean feat of seven his- torical recitals, played consecutively in the capital cities and principal musical centres of Europe. For even this stupendous player a light touch was indispensable. In the competition for power, piano-makers had been gradu- ally increasing the weight of touch to be overcome by the finger, until, to obtain the faintest pianissimo from middle C, at the front edge of the key, from three to four ounces was a not uncommon weight. The Broadwood grand piano which Chopin used for his recitals in London and Manchester in 1848 an instrument that has never been repaired or altered, shows the resistance he required : the middle C sounds at two ounces and a half, and to that weight piano-makers have returned, regarding two ounces and three-quarters as a possible maximum. Owing to the greater substance of the hammers in the bass, the touch will always be heavier in that department, and lighter in the treble from the lesser weight. The shorter leverage of the black keys has of course to be adjusted in balancing to the longer white, the so-called natural, keys. When the player touches the keys farther back, the leverage is proportionately shortened and the weight increased, and there is also an ascending scale in the weight of the player's blow up to the fortissimo sought for. The sum of the aggregate force expended by a pianist in a recital of an hour and a half's duration, if calculated, would be astonishing.

The one important structural change in pianos referred to has been the rejection of support given by metal bars or struts between the metal plate to which the strings are hitched and the wrestplank wherein the tuning-pins are inserted. These bars (see Pianofoete, vol. xix.) formed part of William Allen's invention, brought forward by Stodart in 1820, and were first employed for rigidity in place of compensation by the Paris jErards two years later, Broadwood in London introducing about

that time the fixed metal plate. The patent, No. 1231, for the barless or open-scale piano, taken out in London in 1888 by'H. J. Tschudi Broadwood, is remarkable for simplification of design as weU as other qualities.

The problem of resonance â€" with stringed keyboard instruments, the reinforcement or amplification of sound â€" has, from the days of the lute- and spinet-makers, been empirical. With lute, guitar, and viol or â„¢* '"â€¢ violin the sound-box comes in, combining in the re^nance. instrument the distinct properties of string and enclosed air or wind. With the spinet, harpsichord, and piano we have to do chiefly with the plate of elastic wood, to amplify the initial sound of the strings ; and the old plan of a thin plate of spruce, put in slightly convex and

with an under-barring of wood for tension, has absorbed the attention of piano-makers. The violin belly, with its bass bar and sound post, has relation to it ; but the recent invention of the Stroh violin has shown us that the ini- tial string vibrations may be passed through a bridge, be concentrated, and adequately transferred to an aluminium disc not much larger than half a crown. The piano, with its numerous strings, cannot be so reduced, but the rein- forcement problem is open to another solution, tentative it is true, but a possible rival. The " Gladiator " sound- board is the invention of Albert Schulz, late director of the piano manufactory of Eitmiiller und Sohn of Gottin- gen. Dr Moser's name has been associated with the

Fig. 1. â€" Broadwood Barless Grand.

inventor's in the English patent. In the "Gladiator" two slabs of wood, with grain of opposed direction to give the necessary tension, are glued together, and the whole system of belly bars is done away with. There is a thinning round the edge, to facilitate promptness of speech. As we are still feeling our way towards an accurate and comprehensive statement

of resonance, this invention is one claiming scientijBc interest, as well as being of possible practical importance.

To return to the touch. The desirability of what is called repetition â€” that the jack or sticker, which from

eÂ«H(,n *^Â® depression of the key delivers the blow that raises the hammer to the strings, should never be far away from the notch or nose which receives the impulse â€” is as much an object of consideration with piano-makers now as it has been since Sebastian ;^rard began those experiments in 1808 which ended in his

famous “double escapement” action. The principle of this grand action, like that of Wornum patented for upright pianos in 1826, has become general. But Joseph Henry Cary in 1853 (patent No. 2283) invented a simple contrivance for repetition in all pianos, neglected at the time, and subsequently repatented and disputed over by others, which has only been preserved in the records of the Patent Office, while the inventor has left no other mark. But the utility of ohe invention has come to light. It is increasingly used in the actions of upright pianos, and, in combination with the old Eng- lish grand action (vol. xix. p. 74, Eig. 24), is success- fully competing with the Â£rard action proper, and the simplified Herz- ifirard, of late years so very generally employed.

There has been a great change in the freer technique of piano – playing, partly favoured by the development of piano-making, but reacting and oblig- ing the piano- makers to keep their attention in- cessantly alive to the aim and re- quirements of the players. It is true that the genius of Beethoven domi- nates a technique that has become obsolete, and so completely that the adequate perform- ance of his piano works still gives to the sense as well as the intellect the highest pleasure, but his annotations to Cramer’s Studies, as preserved by Schindler, betray the close touch of the clavichord- player and the Pig. a.-Cary’s Eepeating Action. I, the butt in student of 0 P E 1*”’,Â°” “^^ hammer Is glued. E, a spring attached buuuuuu Ui i^. jr. Jh. to the butt by a link of silk cord passed through a Xiacn S ii.s.sro/ on wire guide. The object being that though the key (llnmnhnrrJ Vlnulnn “‘‘7 ‘”’ ^”” Pressed down,

the hammer returns but K..iaviCllOI a – l-iaymg, a short distance to ensure a quick response to the as well as the weak- ^‘Â°”’ if repeated.

ness as a musical instrument of the early piano. The in- ventor of a technique so original, and at the time (c. 1830) so extraordinary, as Chopin’s, sat at the ^Â«‘Â«“9”e. piano with his elbows immovable, usint,’, for flexibility neither wrist nor arm. With Chopin, to play loud was anathema. The modern free style of playing comes from Czernyâ€” whom Beethoven despised as having no legato (a7c?wnqr),â€” through Liszt to the Eubinsteins, and to the splendidly equipped performers of our time, to whom the pedal has become indispensable for cantabile and effect.

These great performers are, however, rivalled tecliiii- cally by the recent extraordinary invasion of the American

aiitomatic piano-players â€” the Angelus, Pianola, pi^ytng!^’ Apollo, Cecilian, and other varieties of the same

idea. The use of the perforated roll acts by means of the ingenious and indeed faultless application of pneumatic leverage to the ordinary piano, doing duty for the pianist’s fingers ; and it is made possible to play louder or softer, faster or slower, by mechan- ical arrangement. Such an instrument lacks the player’s touch, which is as personal and indispensable for sympathy as the singer’s voice or violinist’s bow. Still, to a violinist, it is a benefit to have a correct coadjutor in a Beethoven or Brahms sonata with one of these handy companions, just as it is to a singer to have always at command the accompaniments to his or her repertory. The Apollo has the addition of a useful transposing apparatus â€” an aid, however, that, though often tried, has never yet been adopted ; it is possibly too disturbing to the musician’s ear. The mechanical tuning-pin is an analogous experiment which comes regularly under notice as the years go by, to be as persistently rejected. The most prac- tical of these tuning inventions was the Alibert, shown

in the Inventions Exhibition, 1885. Here, pressure upon the strings above the wrestplank bridge modified their tension after a first rough adjustment to pitch had been effected.

The perforated music-sheet, a mechanism common to piano-playing attachments as well as self-playing pianos, first appears in a French patent, 1842. A United States patent for a keyboard piano-player was issued to E. D. Bootraan, 18th December 1860, and the first pneumatic keyboard piano-player was patented in France in 186.3 by M. Fourneaux. Between 1879 and 1902 a total of 55 patents had been issued in the States. The first complete auto- matic piano-player ready for performance was the Angelus (No. 24799, 1897). The specification is from a communication to the British Patent Office by Edward HoUingworth White, of Meriden, New Haven, Connecticut, U.S.A. There is a pneumatic chest, fulcrum bar, finger levers, bellows, and pedals. The whole apparatus is contained in a portable cabinet mounted upon castors, so as to be conveniently moved about a, room. The finger levers or key strikers correspond with a considerable portion of the manual keys or clavier of a piano. Thus the automatic piano-player comprises a port- able cabinet provided with bellows and operating pedals, a pneumatic actuating mechanism, a tracker adjusted for the nse of a perforated music-sheet, a pneumatic motor and winding-roll mechanism to propel the music-sheet, and a series of finger levers operated by the pneumatic mechanism, so project- ing as to overhang the piano keyboard and play upon it, with rockers or levers for depressing the piano pedals. Subsequently the apparatus was made capable of accelerating or retarding the tempo at the will of the operator. A roll of music, twelve inches wide and varying in length according to the composition, can be placed in position promptly, and when exhausted can be returned upon its orig- inal roll by a simple stop, altogether a triumph of mechanical adjustment. The Pianola followed in 1898, the Apollo 1900. The difference of all these clever contrivances is not conspicuous to the amateur.

While these allied inventions have had to do with a substitute for touch and the necessity for the persever- ing acquii-ement of a difiBcult technique, another, the Virgil Practice Clavier, so called after the

inventor, Mr Almon Kin- caid Virgil, an American music teacher, is intended to shorten

the period of study by doing away with tone, so that the finger technique is acquired mechanically and unmusically, while value of tone, reading, expression, whatever we understand by musical production exciting our receptivity through the ear, is delayed until the player's hand is formed and considerably developed. The opinion of some of the very greatest pianists is

Fig. 3. â€" Sectional plan of Pianola. MM is the perforated paper, carried on a roll N, and wound upon another roll 0 by the action of a pneumatic motor. When a perforation comes opposite the orifice of A, the suction bellows in the base of the machine, worked from a treadle by the player's feet, draw in a puff of air which passes along A to the mushroom valve C. The chamber V^, being in connexion with the suction bellows, is at less than atmospheric pressure, and the result of the an: arriving along A is that 0 rises from its seat. Thereupon communication is opened from the chamber P^, which is at atmospheric pressure, along the channel D to a second valve E, the chamber above which, V^, is also under suction. Hence E also rises and opens a way from Vj by the passage F to the collapsing bellows G ; the air-pressure in these being thus reduced, the back H moves to the left, communicating its motion through the lever I. to the finger K, which strikes the key of the piano. Similar mechanism, including a mushroom-valve, a secondary pneumattc-valve (of which another may be seen at Ej in connexion with the passage Fj), and collapsing bellows, , as at Gj, G2, Gj, are provided corresponding to each note of the piano. The time is altered by regulating the suction on the pneumatic motor which unwinds the perforated roll, so that it runs more quickly or slowly as desired. Changes in loudness are attained by means of a handle, P, operating on valves, which increase or diminish the suction in the bellows G, Gi, &c., and therefore the force with which they collapse.

brought forward as approving of the system ; in the work, for instance, of Vladimir de Pachmann, whose technique was formed long before the

Virgil Clavier came to Europe. Bear- ing in mind that the minimum weight of the touch of a

concert piano is not likely to exceed three and a half ounces, it is hardly likely that these skilled performers use this dumb keyboard with the graduated weight advised for ad- The dumb yanoing pupils, namely, from five to eight ounces. keyboard, jj. jg allowed that the lightest possible touch may be used at first. One high recommendation certain4y remains after all that may be said regarding Mr Virgil's invention : that it is practically silent, almost noiseless, the up and down clicks that mark the duration of finger attachment being alone audible, a boon to the unwilling hearers of ordinary piano practice, scales, and five-finger exercises. Mr Virgil's invention was produced in its elementary form in 1872, when it bore the name of Techniphone ; the more satisfactory Practice Clavier dates from the completion of the invention, about 1890. It was brought to England in 1895 by Mr Virgil, who, assisted by an American jjupil of great talent, Miss Julie Geyer, made his theory extensively known by a widely conducted series of lecture-recitals.

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The article on the Pianoforte in vol. xix., published in

1885, having been based, wherever practicable, upon

personal examination, few corrections are now

Corrigenda required to bring the information in it up to

date. Some are, however, due to the record

having been less complete then than now.

and addenda

Earlier Article.

Vol. xix. p. 65Â°. A keyboard of balanced keys may have been first introduced in the little portable organ known as the Begal.

P. Q&>. The oldest clavichords extant have no more than two tangents to a note, formed by a pair of strings.

P. 68”. The oldest spinet we can point out (is dated) 1523.

P. 68”. S p i n e 1 1 a Tavola. Fig. 9.

P. 68”. Earliest date for an English spinet,

1668.

P. 69”. From the tuning of Handel’s clavi- chord we are led to infer that the nearer halves of the two cut sharps were the chromatic semi- tones.

P. 69^ Thomas Hitch- cock, for whom we have a date 1703.

P. 69”. There is an existing example, dating as early as 1526, with the bass keys carried out in long measure.

P. 69”. Cristofori . . . the single keyboard.

Corrections.

Vitruvius, de Architectura, lib. x. cap. xi., translated by Newton, describes a balanced keyboard ; but the key apparatus is more particularly shown in The Pneumatics of Hero of Alexandria, translated by Bennett Woodoroft (London, 1851). In con- firmation of this has been the recent remarkable discovery at Carthage of a terra-cotta model of a Hydraulikon or water organ, dating from the 2nd century a.d., in which a presumably balanced keyboard, if not two, of eighteen or nineteen keys, is shown. It seems likely the balanced keyboard was lost, and afterwards reinvented.

There are now instances of small clavichords having three keys and tangents to one pair of strings.

One was shown at Bologna in 1888 dated 1480.

This is now one of the treasures belonging to the Victoria and Albert Museum, S. Kensington, London.

Bead 1664.

“We now know they were the further halves ; the nearer being employed for the major thirds below, i.e., the dominant fourths to the next natural keys.

We have also an early date for him,

1664.

This date should be 1626 â€” unfor- tunately this interesting keyboard has been altered by a restorer.

In the harpsichord Cristofori made for Prince Ferdinand dei Medici in 1702, recently acquired by Mr Stearns, of Detroit, and presented by him to the University of Michigan, U.S.A., there are three keyboards, thus arranged : 1st, highest keyboard, octave string only ; 2nd, middle, octave and first unison ; 3rd, lowest, both unisons. A harpsichord similarly designed with three keyboards, in- scribed Vinoentius Sodi Florentinus, Anno Domini 1779, has been pre-

P. 70”. Hans Ruckers . . . we may not with- hold from him the credit of introducing the octaVe string.

P. 70”. Handel had a Buokers harpsichord.

P. 70”. Two pedals were also used, the left- hand one a combination of a unison and lute.

sented by Mrs John Crosby Brown to the Metropolitan Museum, New York.

The octave string was already in use when Hans Ruckers began his work. The harpsichord as known through- out the 18th century, with piano upper and forte lower keyboard, was the invention of Hans Ruckers' grand- son, Jean Buckers' nephew, Jan Couchet, about 1640. Before that time the double keyboards in Flemish harpsichords were merely a transposing expedient, to change the pitch a fourth, from plagal to authentic and vice versct, while using the same groups of keys. Fortunately there is a harpsichord existing with double keyboards un- altered, date 1638, belonging to Sir Bernhard Samuelson, formerly in the possession of the late Mr Spence, of Florence, made by Jean Buckers, the keyboards being in their original position. It was not so much inven- tion as beauty of tone which made the Buckers' harpsichords famous.

It is now in Buckingham Palace.

P. 71". Cristofori pianoforte of 1720.

P. 72". Frederici up- right piano, dated 1745.

P. 72". Zumpe's square piano, 1766.

P. 73". Americus Backers, the inventor of the English action.

This pedal, with the " machine " stop, reduced the upper keyboard to the lute register, the plectra of which acted upon the strings near the wrest- plank bridge only ; the lower key- board to the second unison. Beleasing the machine stop and quitting the pedal restores the first imison on both keyboards and the octave on the lower. Is now in the Metropolitan Museum, New York, the gift of Mrs John Crosby Brown.

An earlier upright grand piano has been discovered by Signer Ponsicchi, of Florence, made by Domenico del Mela, in 1739. The action is an adaptation of Cristofori' s.

F^tis narrates that he began the study of the piano on a square piano made by Zumpe in 1762,

Backers' " Original Forte Piano "

was played at the Thatched House

in St James's Street, London, in

1773. Ponsicchi has found a Backers

grand piano at Pistoia, dated that

year.

The invention of the piano by Cristofori, and he alone, is now

past discussion. What is still required to satisfy curiosity would

be the discovery of a Fort Bien, or Frederici square piano, said to

antedate by a year or two Zumpe's invention of the instrument in

London. Also the " old movement " for the long or grand pianos,

sometimes quoted in the Broadwood day-books of the last quarter

of the 18th century with reference to replacement by the Backers

English action. The store or lumber rooms of old country houses

in England have produced many interesting and valuable examples

of old keyboard instruments. The particular interest of the " old

movement " is to see if it was Cristofori's, like the three Silbermann

**pianos at Potsdam. (j^__j g **

Piatra, a town in Rumania (Moldavia), on the left bank of the river Bistritza, chief town of the district of Neamtz. It is the seat of a court of first instance, con- tains seven Orthodox churches, one Roman Catholic

church, one Armenian church, and two synagogues. The town is connected with the railway system by a branch line from Bacau. The chief trade is timber and wine, and three fairs are held annually. There are several monasteries in the neighbourhood, namely, those of Bistritza, Eiss cani, Pangaratzi, Bulhalmitza, Vinetori, and Aln Population (1895), 18,000 ; (1901), 17,391.

Piatti, Carlo Alfredo, Italian violoncellist (1822- 1901), born at Bergamo, 8th January 1822, was the son of a violinist and became a pupil at the Con- servatorio of Milan. At the age of twelve he appeared

ssen- Almas.

at a school concert, and from 1838 onwards he journeyed over Europe, playing with extraordinary success in all the important cities of the Continent. In 1844 he appeared before the London public at a Philharmonic Concert ; and in 1869, on the foundation of the Popular Concerts, he took up the work with which he was most intimately connected for thirty-nine seasons, retaining until 1897 the post of first violoncello at these famous chamber concerts, during the latter half of each series. His purely classical style of interpreting the music of the great composers, his wide musical sympathies, and his general culture and charm would have ensured him a high position even without the marvellously finished technical skill, which was kept so wonderfully under control that difficulties seemed not to exist for him. In 1894 tlie fiftieth anniversary of his first appearance in London was celebrated by a reception given in honour of him and his lifelong friend Joachim, whose first appearance in England was made in the same year as his own. He retired from public life, owing to a severe illness, in 1897, and from that time till his death, which occurred at Bergamo on 19th July 1901, he divided his time between his native town and Cadenabbia. As a composer he attained a wide popularity with his songs, in a popular and graceful style ; he did excellent work as an editor ; and he was, moreover, an enthusiastic collector and musical antiquary. (j. a. f. m.)

Piauhy, a state of Brazil, situated between 2Â° 45′ and 11Â° 40′ S. and 40Â° 5′ and 48Â° 40′ W., bounded on the N. by the Atlantic, on the W. by Maranhao, on the S. by Bahia, and on the E. by Ceara and Pernambuco. Area, 116,218 square miles. Population (1890), 267,610. The capital is Therezina; and other towns are Amarante (12,000), Parnahyba (10,000), Barras, and Uniao. The foreign trade is carried on through Tutoyo, the port of Parnahyba. The exports, valued at about Â£100,000 a year, consist of hides, cotton, and rubber.

Pickering, Edward Charles (1846-

~~), Ameri~~

can physicist and astronomer, was born in Boston on 19th July 1846. He graduated in 1865 at the Lawrence School of Harvard University, where for the next two years he was a teacher of mathematics. Subsequently he became professor of physics at the Massachusetts Institute of Technology, and in 1876 he was appointed professor of astronomy and director of the Harvard College Observatory. Under his direction the operations of this observatory, founded in 1840, have been enormously extended. In 1877 he decided to devote one of the telescopes of the observatory to stellar photometry, a field of research at that time very little explored, and after an exhaustive trial of various forms of photometers, he devised one, the meridian photometer (see Photometkt, Stellar), which seemed to be free from most of the sources of error to which previous methods had been liable. With the first instrument of this kind, having objectives of 1-5 inch aperture, he measured the brightness of 4260 stars, including all stars down to the 6th magnitude between the North Pole and â€”30Â° declination. Encouraged by this success, and with the object of reaching fainter stars. Professor Pickering constructed another instrument of the same pattern, but of larger dimensions, and with this more than a million observations have been made. The first important work undertaken with it was a revision of the magnitudes given in the Bonn Durchmusterung. On the completion of this. Professor Pickering decided to under- take the survey of the southern hemisphere. An

expedi- tion, under the direction of Professor S. I. Bailey, was accordingly despatched, and the meridian photometer

erected successively in three different elevated positions on the slopes of the Andes. The third of these was Arequipa, at which a permanent branch of the Harvard Observatory is now located. The magnitudes of nearly 8000 southern stars were determined, including 1428 stars of the 6th magnitude and brighter, and the Harvard Photometry thus extended to , the whole visible heavens. The instrument was then returned to Cambridge (U.S.A.), where the former work was revised and the survey extended so as to include all stars of magnitude 7-5 down to â€”40Â° declination, after which it was once more sent back to Arequipa for further observations of the southern stars. In 1886 the widow of the late Professor Henry Draper, one of the pioneers of stellar spectroscopy, made a liberal provision for carrying on spectroscopic investigations at Harvard College in memory of her husband. With Pro- fessor Pickering's usual comprehensiveness, the inquiry was so arranged as to cover the whole sky ; and with four telescopes, â€" two at Cambridge for the northern hemi- sphere, and two at Arequipa in Peru for the southern, â€" to which a fine 24-inch photographic telescope has more recently been added, no less than 76,000 photographs had been obtained up to the beginning of 1901. These investigations have yielded many important discoveries, not only of new stars, and of large numbers of variable stars, but also of a wholly new class of double stars which are so close together that no telescope in existence is capable of dividing the components, but whose binary character is revealed by peculiarities in their spectra. The important conclusion has been already derived that the majority of the stars in the Milky Way belong to one special type ; and, in Professor Pickering's opinion, the fact that the spectra of the stars may be arranged in a sequence merging by insensible degrees one into the other, is evidence of a unity of plan governing the construction of all parts of the visible universe.

PictOU, seaport, port of entry, and capital of Pictou county, Nova Scotia, 90 miles north-east by north of Halifax. It has a good harbour and railway facilities, churches, an excellent academy, and several

valuable industries. It is the shipping port for the adjacent coal mines. For 1901 the exports were $187,214, and imports $249,748. Population (1891), 2998; (1901),

3235.

Piedmont, a territorial division of northern Italy. It embraces the four provinces of Alessandria, Cuneo, Novara, and Turin, and has an area of 11,340 sq. miles, with a population of 3,070,250 (1881), and 3,326,311 (1901). The people are chiefly engaged in agriculture, growing wheat, maize, and rice, chestnuts, wine, and hemp, and in the reeling and throwing of silk, and in the manufacture of cottons, woollens, and clothing. The Piedmontese dialect has been rather strongly influenced by Erench. The more important towns are Turin, Pinerolo, Car- magnola, Novara, Vercelli, Biella, Alessandria, Asti, Casale Monferrato, Cuneo, Mondovi, Savigliano, and Bra. There are numerous summer resorts in the Alpine valleys, e.g., Baveno, Valdieri, Varallo, Ceresole, Pallanza, and several others in the vicinity of Biella.

Pierson, Henry Hugo (properly Henbt Hugh Pearson), English composer (1815-1873), son of the Eev. Dr Pearson of St John's College, Qxford, where he was born in 1816 ; his father afterwards became dean of Salis- bury. Pierson was educated at Harrow and Trinity College, Cambridge, and was at first intended for tiie career of medicine. His musical powers were too strong to be re- pressed, and after receiving instruction from Attwood and

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770 PIETERMAEITZBUR Gâ€" P IGEON POST

A. T. Corfe, lie went in 183& to Germany to study under C. H. Hink, Tomaschek, and Eeissiger. He was elected Eeid Professor of Music in Edinburgh in 1844; but, owing to a disagreement witb the authorities concerning the original intentions of the founder of the chair, he resigned in the following year, and definitely adopted Germany as his country about the same time, making the change in his names noted above. His two operas, Leila (Hamburg, 1848) and Contarini

(Hamburg, 1872), have not retained their hold upon the German public as his music to Faust has done, a work which, until quite recently, was frequently associated with Goethe's drama. He was never recognized in England as he was in Ger- many, for the most important part of his career fell in the period of the Mendelssohn fashion, when not to imitate that master was to court disaster, and not to admire his methods and mannerisms was to ensure neglect. His most important work was the oratorio Jerusalem, pro- duced at the Norwich Festival of 1852, and subsequently given in London (Sacred Harmonic Society, 1863) and Wiirzburg (1862). For the Norwich Festival (at one of the meetings a selection from his Faust music was given with success) he began an oratorio, Hezekiah, in 1869 ; it was not finished, but was given in a fragmentary condi- tion at the festival of that year. These two large works and a number of Pierson's songs, as well as the three over- tures played at the Crystal Palace, reveal undeniable orig- inality and a wealth of melodic ideas. His critics were right in pronouncing him weak in contrapuntal skill, and his music no doubt was sadly wanting in outline and co- herence; but in a more favourable atmosphere and in more fortunate conditions his great natural gifts might have been turned to better artistic account, and have made a more lasting mark upon the art of his time. He died at Leipzig, 28th January 1873, and was buried at Sonning, Berks, of which parish his brother. Canon Pearson, was rector. (j. a. f. m.)

Pietermaritrburg, capital of Natal, South Africa, situated about 40 miles north by west of Durban by rail, at an elevation of 2200 feet above the level of the sea. The town was laid out by the Boers in 1839, and takes its name from their leaders, Pieter Eetief and Gert Maritz. In 1898 the population was 24,635, comprising 14,016 Europeans, 6967 natives, and 3563 Indians. The town compares favourably, as regards health and climate, with any other in South Africa. The mean temperature for the year is 64-9Â°, for February 71-8Â°, for July 56-7Â°. Its town hall, destroyed by fire in 1898, has been rebuilt, and there are handsome Government and Parliament buildings. The town is well lit by electricity. An ex- tensive park, botanical gardens, and good swimming-baths are attractive features.

Pigeon Post. â€” Ever since the time of King Solomon, historical examples can be found of the use of i:)igeons to carry messages, but their extendeduse in modern times dates from the siege of Paris in the Franco-Prussian war of 1870-71. For a trustworthy system of communica- tion by means of these birds, it is generally recognized that careful organization and preliminary training must first be established ; but, in spiteof the absence of all such arrange- ments, it was found possible to send a hundred and fifty thousand official messages, and a million private ones, into Paris duringthe siege. Soon afterwards numerous private societies were established for keeping pigeons of this class in all important European countries ; and, in time, various governments recognized the importance of the subject, and established systems of commuuicationfor military purposes by pigeon post. When the possibility of using the birds between military fortresses had been thoroughly tested,

attention was turned to their use for naval purposes, to send messages between coast stations and ships at sea ; and at the present date most great Powers propose to employ them both for naval and military purposes. They are also found of great use by news agencies and private individuals. Governments have in several countries established lofts of their own. Laws have been passed making the destruction of such pigeons a serious offence ; premiums to stimulate efficiency have been offered to private societies, and rewards given for destruction of Ijirds of prey. It has also been found of great importance to establish registration of all birds. In order to hinder the efficiency of the systems of foreign countries, difficulties have been placed in the way of the importation of their birds for training, and in a few oases falcons have been specially trained to interrupt the service in war time.

Results of experiments differ very much, according to the con- ditions under which they were undertaken, and it is therefore impossible to lay down any rigid rules as to what pigeons can or cannot do, but it is possible to arrive at a general idea of what may be expected in average cases. Birds employed for such work in Great Britain are usually known as homing pigeons. The best are bred in Belgium, where private societies and owners are very numerous, much encouragement is given,

and many races are organized. The Belgian homers are crossed with local breeds in various countries, with successful results. The best sort of bird to suit climatic conditions is soon arrived at, the pigeons best adapted for rough weather being somewhat heavier and slower than those employed in countries where atmospheric conditions are more favourable. A homing pigeon is trained to take a message to the loft where he was bred, or to which he was moved before he had seen the outside of any other loft. Old birds that have been brought up elsewhere are sometimes kept in lofts for breed- ing purposes, but these are not allowed outside, or they will probably find their way to their original home, if within a reason- able distance. Various methods have been adopted for carrying the messages. One of the most usual is to place the paper inside a quill, which is then sealed at both ends and attached to a tail feather by means of wire, one of the firmest feathers being selected if during the moulting season. Another way is to wrap the paper round the bird's leg and fix it with an elastic band, or it may be fixed to a strong wing feather. In order to reduce the weight carried, the assistance of photography may be resorted to. Mes- sages sent to Paris in the 1870 war were photographed on films, each of which took over 2000, and in this way as many as 40,000 messages were in one case carried by a single bird. On receipt of the films in Paris they were enlarged on a magic lantern screen, copied out, and sent to their destinations. Opinions differ very widely as to the distance which birds can be relied upon to cover, and all estimates must necessarily depend upon local and tem- porary conditions. For lofts or land communication, perhaps 150 miles apart may be taken as a distance that should not be exceeded, although with specially picked birds messages could no doubt be sent for double this distance with but a small percentage of loss in favourable weather, and with special training even this can be considerably exceeded. For communication between ships and the coast the results of experiments difler very widely indeed. For absolutely safe work perhaps 50 miles may be taken, though suc- cessful results have been obtained up to 300. In cases where the home of the pigeon moves about, as with the headquartera of a field army or of a ship at sea, success cannot be expected excepting at ranges not exceeding a few milesâ€" certainly not over 20. Atmo- spheric conditions must be studied on all occasions, as they very materially

affect the results. A large proportion of the birds will be lost in foggy weather, and they fly only during the period of daylight. Should the distance to be covered be considerable, they should not be sent off in the evening, but at a time that will enable them to reach their home by daylight at their average speed. Stormy weather interferes very seriously with their flight. For these reasons, also, it is very difficult to lay down any rule about the average speed at which the messages will be carried. Whilst speeds of about 60 miles an hour are sometimes attained, the average could not be placed at over 30 miles an hour under fairly favourable conditions.

The training of young birds is commenced during the first year by takmg them out in closed receptacles and releasing them at gradually increasing distances from their loft, allowing intervals of rest for several days between each flight. About 100 miles may be expected of them during the first season, and this distance increased m subsequent years. The best results are obtained by training a bird always to fly in the same general direction for the season. If intended to be kept away from their loft for a long

time, they should be placed in a dark room with no looli-out, and the cocks and hens should be separated. When the young are being brought up, only one of the parent birds is taken out at a time. Each brood consists of two eggs, on which both parents sit in turn, the cock only for a few hours in the middle of the day. A loft for homing pigeons should be on a commanding site. It is best made in the shape of a large room, which should be protected from vermin, suitably subdivided, and provided with drinking troughs, rock salt, and crushed mortar for the bird's use. It should also be fitted with a sufficient number of nests about 2 feet long, 20 inches in breadth and height. Arrangements should be made for allowing the pigeons to fly out daily for exercise ; and they should be trained to re-enter the loft through bolting wires which open inwards only into a small chamber, to which an electric arrangement may be fitted so as to sound a bell and warn the owner of

the arrival of a bird. This chamber can be shut off from the loft, if required, to facilitate the capture of birds return- ing with messages. Marks showing to what club and to what loft each bird belongs are usually stamped on wing feathers, and when quite young a metal ring showing the date of hatching is usually placed on the leg by passing it over the foot. The food of birds in training consists of vetch, beans, maize, peas, broken rice, and millet, in various proportions, according to the country, climate, and season of the year, the daily allowance for each bird being alsout 40 grammes weight. Young birds may be fed on rice in the husk and bread.

The question of the homing Instinct, which enables pigeons of certain classes to find their way home over such great distances, is a study of much interest, and their method of determining the true direction is still a matter of surmise. At all times their culture provides an interesting recreation, and numerous societies exist for the organization of races, and for encouraging their further development. (g. g. a.)

Pigments. â€" It is convenient to distinguish between pigments and paints, tTie latter being prepared from the former by the addition of a vehicle or medium. Nor are pigments and dyes identical, although there are cases in which the same colouring matter which yields a dye or stain may give rise to a pigment. A pigment is, in fact, a substance which is insoluble in the vehicle with which it is mixed to make a paint, while a dye is soluble. Pig- ments exhibit various degrees of transparency and opacity, and ought to possess such qualities as these : ease in working, chemical indifference to each other and, gener- ally, to the vehicles employed, also stability under expos- ure to light and air. As a rule, it is desirable that pigments should not be seriously affected in hue by the vehicle ; at all events, whatever change does occur ought to admit of calculation. In the case of oil colours it should be remembered that a thorough drying of the paint is preferable to the formation of a surface-skin, and that a few pigments, notably white lead, possess properties conducing to this desirable result. It is scarcely neces- sary to add to these general observations concerning pig- ments that their artistic value depends primarily upon the nature and amount of the optical sensation which they are competent to produce.

Although the number of available pigments is great, the number of chemical elements which enter into their composition is not large. Very many richly- Sources. coloured compounds cannot be employed because they lack the properties of insolubility, inertness, and stability. Pigments are drawn from various sources. Some are natural, some artificial; some are inorganic, some organic ; some are elements, some mixtures, some compounds. It is not unusual to arrange them into two groups, substantive and adjective. Amongst the members of the former group such a pigment as vermilion, where each particle is homogeneous, may be cited as an example. Amongst the adjective pigments rose-madder may be named, for each particle consists of a colourless base on which a colouring matter (alizarin) has been thrown. Most of the inorganic pigments, whether natural or arti- ficial, belong to the substantive group ; while there are many organic pigments, notably those of artificial origin,

which are of adjective character. The following table

presents a summary classification of pigments according

to their source or origin : â€”

â– Â»â€ž . 1 . , (Natural ; as terre verte.

Mineral pigments . ^ a ¯ â– i t

^ Â° (Artificial ; as aureolm.

(Animal ; as carmine.

Organic pigments . -l Vegetable ; as madder-lake. (Artificial ; as alizarin-orange.

A variety of processes are in use in order to fit natural coloured substances for employment as pigments. The first step is, in many cases, to select or ” pick over” the raw material, rejecting whatever im- yf^’“‘â„¢’ purities may weaken or injure the characteristic hue of the product. It is occasionally necessary to treat the finely-ground

substance with water by the method of elutriation or washing-over ; the wash-waters will then deposit, on standing, various grades of the coloured body required. With rare exceptions native pigments need careful grinding, either by means of a muller on a slab or by edge rollers, or horizontal mill-stones, or special machines. The substance is usually ground in spirits of turpentine, or alcohol, or water; oil-paints are of course finally ground in a drying-oil, such as linseed oil or poppy oil ; water-colours require gum-water, or gum-water and glycerin if they are to be ” moist ” paints. In the case of all pigments, whether mineral or organic, whether natural or artificial, it is of the highest importance to make sure that they are free from saline matters soluble in water. Such salts are removed by thorough washing with distUled water. A treatment of this kind is essential in the case of a large number of pigments formed by chemical reactions in the ” wet way.” Characteristic examples are furnished by Prussian blue, viridian, and lakes. Sometimes it is necessary to remove dangerous impurities by solvents other than water, such as carbon bisulphide, which is used to extract free sulphur from cadmium yellow. Mention may h^re be made of another kind of preparative treatment which is adopted with some pigments : they are subjected to the action of heat â€” moderate in some cases, strong in others. Thus a few substances, such as ivory black and yellow ochre, which in ordinary circumstances contain much non-essential moisture, before they are ground in oil may with advantage be gently dried at a temperature not above that of boiling water. Again, there are pigments, such as Prussian brown, light red,“lnd burnt sienna, which owe their hues to a process of actual calcination, the first of these being thus made from Prussian blue, the second from yellow ochre, and the third from raw sienna. The pigments known as burnt carmine and burnt madder are prepared at a much lower temperature, and ought to be described as roasted rather than as burnt.

The substitution of one pigment for another is rarely practised, but it is not so unusual to find that a costly substance has received an admixture of some- thing cheaper, and that an inferior grade of a ^”’”*”’- genuine pigment has had its hue exalted or enhanced by some unlawful or dangerous addition. In fact, these two kinds of sophistication are often associated. Thus vermilion is adulterated with red lead, with red

antimony sulphide, or with baryta white andlead sulphate, and then the hue of the mixture is restored to the proper pitch by the introduction of one of the powerful but fugitive colouring matters from coal-tar known as eosiii. Amongst other adulterations which may be named here are the addition of chrome-yellow (leadchromate) to yellow ochre, of green ultramarine to terre verte, and of indigo to ivory black ; this last mixture being a substitute for vine-black, the natural blue-black. The detection of the above-named sophistications is by no means difficult even in the hands of persons unacquainted with chemical mani- pulation, but it needs a trained analyst when quantitative

results are required. If we are dealing with an oil-colour, the first step is to remove the oil by means of a solvent, such, for example, as ether. The residual pigment is then allowed to dry, and the dry powder submitted to the appropriate physical and chemical tests. Thus a suspected vermilion, having been freed from oil, is heated in a small hard glass bulb-tube : it should prove practically volatile, leaving a mere trace of residue. In this particular case the presence of a red hue in the ether-extract affords evidence of adulteration with an organic colouring matter, such as eosin. Then, again, we may detect the presence in yellow ochre of lead chromate by pouring a little sul- phuretted hydrogen water and dilute hydrochloric acid upon one portion of the dry pigment, and boiling another portion with dilute sulphuric acid and some alcohol : in the former experiment blackening will occur, in the latter the liquid part of the mixture will acquire a greenish tint. So also green ultramarine may be recognized in adulterated terie verte by the addition of dilute hydrochloric acid, which de- stroys the colour of the adulterant and causes an abundant evolution of the evil-smelling hydrosulphuric acid gas. Moreover, nothing is easier than the recognition of indigo in vine or charcoal-black, for the dry powder, heated in a glass tube, gives off purple vapours of indigo, which con- dense in the coolerpart of the tubeintoablackish sublimate. A word must be said here as to the adulteration of white lead, and the

examination of this most important pigment. The best variety of white lead or flake white contains two molecules of lead carbonate to one of lead hydrate, and is wholly soluble in dilute nitric acid, while barium sulphate, its most frequent adulterant, is wholly insoluble. China- clay and lead sulphate will also remain undissolved ; but whitening or chalk cannot be detected in this way â€” indeed, the thorough examination of white lead, not only for sophistications but also for correspondence with the best type in composition, cannot be carried out save by a skilled analyst.

One of the most instructive ways of arranging pigments is based on their chemical composition. With the ordinary pigments nine groups may be constituted, seven of these being fairly well defined, but the eighth and ninth having a somewhat miscellaneous character. The groups of Elements, Oxides, Sulphides, Hydrates, Carbonates, and Silicates present this character- istic, namely, that each" member of any one group is with- out action upon the other members of the group ; any two or more may therefore be mixed together without fear of mutual injury. The same statement may be made with reference to the various inorganic salts of Group VIII. and to the organic compounds of Groiip IX., although in this large final group there are two pigments containing copper (verdigris and emerald green) which must be regarded with suspicion. The inertness of the members of the same group towards each other may be explained in the majority of cases by the following consideration. An oxide does not act upon an oxide, nor does a sulphide affect a sul- phide, because all the pigment oxides have taken up their full complement of oxygen, and can neither give nor lose this element to similar oxides ; so also with sulphur in the sulphides. A few details regarding the several members of the nine groups are now offered : â€"

Group I. â€" Elements. â€" All the black pigments in ordinary use â€"

ivory blacli, lamp black, charcoal black, Indian ink, and graphite

consist of or contain carbon, an element not liable to change ; the last-named pigment, which is less correctly termed black lead and plumbago, is a special form of carbon of peculiarly unalterable

character. The metallic pigments, gold, silver, aluminium, and platinum, belong here ; of these, silver alone is easily susceptible of change, tarnishing by absorption of sulphur.

Group II. â€” Oxides. â€” The oxides have generally been formed at a high temperature and are not easily amenable to physical or chemical change ; they are, moreover, not liable to affect other

Classltl- catlon.

pigments, being practically inert, red lead only being an exception. The oxides, include zinc white, green oxide of chromium, burnt umber (oxides of Te and Mn), cobalt green (CoO,reZnO), cobalt blue (CoO,reAl203), cceruleum (CoO,raSn02), Venetian red, light red, Indian red, and burnt sienna (all chiefly composed of Fe203), and red lead (PbgOi).

Group III. â€” Sulphides. â€” Some of the members of this group are liable to contain free sulphur, and some may give up this element to the metallic bases of other pigments. Thus cadmium yellow blackens emerald green, producing copper sulphide. Another pigment of this group, vermilion, is prone to a molecular change whereby the red form passes, without chemical alteration, into the black variety. This change, frequent in water-colour drawings, is scarcely observable in works painted in oil. The sulphides comprise cadmium yellow (CdS), king's yellow (AS2S2), realgar (AS2S3), antimony red (Sb2Ss), and vermilion (HgS). It is convenient to give places in the same group to the various kinds of ultramarine, blue, green, red, violet, and native, for in all of them a part of the sulphur present occurs in the form of a sulphide. It may be stated that the sulphides of arsenic and antimony just named are dangerous and changeable pigments not suited for artistic painting.

Group IV. â€” Hydrates or Hydroxides. â€” Several native earths belong here, notably yellow ochre, raw umber, raw sienna, and Cappagh brown. These substances owe their colours mainly to hydrates and oxides of iron and of manganese, but the presence of a colourless body such as white clay or barium sulphate is usual with the paler pigments. A false yellow ochre from Cyprus is really a basic ferric

sulphate, and does not properly belong to this group. Besides the yellow and brown pigments, there is a ma^gnifi- cent deep green pigment in this group, known as emerald oxide of chromium or virldian. The blue copper preparation which goes under the name of bleu lumiere and mountain blue, a very unstable pigment, is also essentially a hydrate, though by no means pure. It should be stated that all the earthy or native hydrates belonging to this group contain water in two states, namely, hygroscopic or loosely-attached, and constitutional. Before grinding them in oil, the reduction in the amount of the hygroscopic moisture by means of a current of dry air or a gentle warmth often improves the hue and working quality of these pigments.

Group V. â€” Carbonates.- â€” There is but one really important member of this group, namely, the old and typical variety of white lead (2PbC03, PbHaOs). Like green verditer (2CUCO3, CUH2O2), and blue verditer (CuCOs, CUH2O2), it is not a simple carbonate, but contains a hydrate or hydroxide as well. Purified chalk or whitening (CaCOs) belongs here also.

Group VI. â€” Silicates. â€” Terre verte, which is a natural green ochre containing a silicate of iron, potassium, and magnesium, and one other silicate, smalt, an artificial glass containing a silicate of cobalt and potassium, constitute this small group. However, some of the ochreous earths contain silicates of iron, manganese, and aluminium, as well as hydrates of the two former metals, and so have some claim to be ranked with the silicates.

Group VII. â€” Chromates. â€” These salts are rich in oxygen. When in contact with some of the more alterable organic pigments belonging to Group IX. , the chromates may lose oxygen, acquiring a somewhat greenish or greyish hue, owing to the formation of the lower or green oxide of chromium. The chromates cannot be trusted as pigments. The yellow chromates, those of barium, strontium, zinc, and lead, are represented by the general formula M”Cr04 ; chrome red is basic, and is PbnCrOs.

Group VIII. â€” Various Inorganic Salts. â€” This group is intended to receive a number of pigments which are solitary, or almost solitary,

examples of various classes of salts. There is one cobalti- nitrite, aureolin (Kc,Co2l2N02, associated with one or more mole- cules of water), called sometimes cobalt yellow ; one antimonate, that of lead, the true Naples yellow ; one tungstate, that of chromium, known as tungsten green; a metaphosphate of man- ganese, which goes under the name of Nurnberg or manganese violet ; and several mixed cobalt compounds containing arsenates and phosphates of that metal, and represented by cobalt violet and Th^nard's blue. Two sulphates also belong here, namely, baryta white (BaSOi) and lead sulphate (PbSO.,) ; also Sohweinfurt green, a basic copper arsenite. It is obvious that of the membere of so miscellaneous a group of pigments no general characteristics can be predicated. But it may be stated that the two sulphates, the tungstate, and the cobalt compounds are practically inert and unalterable, while the copper arsenite and the lead antimonate are sensitive to the action of sulphur and of sulphides. The cobaltinitrite, aureolin, cannot be safely mixed with some of the organic pigments belonging to the next and last group.

Group IX.â€" Organic Compounds. â€" Most of the members of this large and unwieldy group of pigments possess this character in common, proneness to oxidation and consequent deterioration in the presence of light, moisture, and air. Such oxidation is accelerated by the action of some of the highly oxidized pigments

belonging to other groups, such as the chromates of Group VII. and aureolin of Group VIII. , this action being particularly marked in the case of the yellow lakes, the cochineal lakes, and indigo. There are two pigments consisting of copper salts in this group. They are verdigris â€" both the blue-green and the green varietes being basic copper acetates â€" ^and the pigment known in England as emerald-green, which is a basic cupric aceto-arsenite. These copper pigments present the usual sensitiveness to the attack of sulphur which distinguishes compounds of this metal, and cannot therefore be safely mixed with the members of Group III., and more particularly with the cadmium

colours. About nine mem- bers of Group IX. may be regarded as substantive pigments. These include Indian yellow (mainly magnesium and calcium euxanthates), gamboge, sap green, indigo, Prussian blue, bitumen or asphalt, bistre, sepia, and the bituminous variety of Vandyck brown. The adjective pigments include a great variety of lakes where different kinds of colouring matters of more or less acid character have been thrown upon a base, generally of colourless aluminium hydrate, aluminium phosphate, stannous hydrate, stannic oxide, baryta, or lime ; sometimes coloured bases contain- ing such metals as copper, chromium, manganese, or iron are introduced in small quantities. The colouring matters used are both natural and artificial. Amongst the former may be named Indian lake, from the resinous exudation produced in certain trees by the attacks of Coccus lacca ; carmine, crimson, and purple lake, from the colouring matter obtained from the cochineal insect. Coccus cacti ; rose-madder and the madder-lakes, from the alizarin and allied bodies derived from the root of the ordinary madder plant Buhia tinctorum; and yellow lakes, from quercitron bark {Quercus tinctoria), and from Persian and Avignon berries (species of Mhamnus or Buckthorn). The lakes derived from alkanet root, archil, Brazil wood, and red sanders wood are of very small interest and value. The same judgment may be pronounced upon the large number of artificial lakes which owe their colours to coal-tar derivatives, with the single exception of the important class of pigments obtained from artificial alizarin and from its congeners and derivatives. Of these, alizarin itself (Ci4H602(OH)2), in its purest state and associated with alumina and a little lime, yields those pigments which possess a pink or rosy hue. When purpurin (Ci4H502(OH)3) and its isomers, anthrapurpurin and flavopur- purin, are present, the red hue is more pronounced, and may even tend towards a golden colour, or, when some copper or iron or manganese is introduced, may become decidedly brown. Many of the alizarin crimsons sold as paints are not made from alizarin itself, but from the sulphonic acids of alizarin. These lakes present a wide range of hues. Another derivative of alizarin, known as /3-nitro-alizarin, yields a rich orange lake, to which such names as pure orange, orange madder, and marigold have been applied.

Stability. â€” Some notion of the relative stability of pig- ments will have been derived from the remarks already made under " Classification." But as permanence is of no less importance than chromatic quality in the case of pig- ments used in the fine art of painting, to which the present article is mainly devoted, further particulars concerning certain selected pigments may profitably be givfin here. The judgments formed have been derived from direct ex- periments and from the study of old paintings and draw- ings. It will be convenient, for the practical purpose in view, to revert to the familiar arrangement according to hue. Beginning, then, with white pigments, these three may be named as useful : white lead. Freeman's white, zinc white. As an oil-colour, white lead of the old type is generally the best to use, but among water-colours its place must be taken by zinc white in the condensed form known as Chinese white. Zinc white, in spite of the qualities which recommend its use in oil, namely, the fact of its being not only unaffected by sulphur, but odourless and non-poisonous, lacks toughness as an oil-paint, and has a tendency to scale. Freeman's white, which consists essen- tially of lead sulphate, is the best substitute for white lead yet devised. The small percentages of zinc white and baryta white which it contains are not to be regarded as adulterations, for they greatly increase its body, and though of less specific gravity than lead sulphate, actually raise the weight per cubic foot of the dry pigment. Out of a dozen or more familiar yellow paints, a selection may be made of these six : yellow ochre, raw sienna, mars orange, cadmium yellow, aureolin, and baryta yellow. Concerning two of these, cadmium yellow and aureolin, the following

recent observations may be set down. There is but one sulphide of cadmium, CdS, but this compound exists in two forms, which in some measure correspond to the two modifications of mercuric and antimonious sulphides. One of these forms is yellow and the other reddish orange. When sulphuretted hydrogen is sent into a weak, cold, and neutral solution of a cadmium salt, the sulphide which separates is pale and yellow â€" the orange variety is obtained from a strong, hot, and acid solution. The pale variety is more prone to change than the darker one ; but as oil-colours both forms are sufficiently stable for use, provided they are pure. The value of aureolin as a pig- ment

depends much upon its mode of preparation. A new variety of bright yellow hue was described by Adie and Wood in 1900, and is represented by the formula K2NaCo(]Sr02)e,H20 ; it seems likely to prove an excellent and permanent pigment. Of red pigments, six claim special mention. These are vermilion, light redy Vene- tian red, Indian red, red ochre, and the red lakes derived from madder or alizarin. Vermilion is stable in oils, but as a water-colour paint is prone to change, under exposure to strong light, into the black modification of mercuric sulphide. The iron-reds named above, whether natural or artificial, are quite permanent, but so much cannot be said of the various madder-paints. They are of far greater stability under exposure to light than any other red or- ganic pigments, and are absolutely necessary to the artist. It must be noted that those madder and alizarin lakes which contain an element of yellow and brown are less stable than those of a crimson hue. Five green pigments may be recommended, namely, viridian, or the emerald oxide of chromium, the ordinary green oxide, cobalt green, green ultramarine, and terre verte. Except for minor decorative work, where permanence is of secondary mo- ment, one is obliged to exclude from the palette emerald green, green verditer, verdigris, sap-green, and the numer- ous preparations which owe their colour to mixtures of Prussian blue and chrome yellow, and are sold under the names of green vermilion, chrome green, Brunswick green, and so on. All these pigments usually contain much barium sulphate. Similarly, amongst blue pigments, ultramarine, cobalt blue, and coeruleum may be retained, while smalt, indigo, and all the copper blues should be rejected. Prussian blue, or the mixture of this pigment with a white base which is usually called Antwerp blue, can scarcely be spared, but care should be taken to choose a sample containing no potassium compounds. Coeruleum, which may be described as cobalt stannate, presents the peculiarity of appearing a greenish blue in artificial light, not a purplish blue like that of ordinary cobalt blue. Cobalt violet is a sound pigment, while manganese meta- phosphate or Nilrnberg violet is said not to be safe in oil. Mars violet, an artificially prepared ferric oxide, is dull in hue but permanent. Passing on to brown pigments, it is matter for regret that there are no permanent colours possessing the artistic capacities of asphalt, madder brown, and the old bituminous Vandyke brown. Cappagh brown, burnt sienna, and

raw and burnt umber may be employed safely. Little need be said as to the selection of black pigments, for all are permanent. The soot from burning acetylene, which has recently been introduced, forms a black pigment of remarkable intensity.

Uses. â€” Hitherto pigments have been considered chiefly in relation to the requirements of the painter of pictures, whose aim it is to translate ideas of colour and of light and shade into a concrete and permanent form. In many merely decorative arts, such as the manufacture of wall-papers and the painting of woodwork and of iron, the pigments available are in one direction, that of cost, more restricted, but, on the other hand, many alterable or weak pigments are commonly employed. In paints in-

tended for the protection of ironwork, the nature of the pigment introduced is a matter of great moment, for red lead, zinc white, and white lead are found to exert a strong protective influence, which is not observed in the case of the vast majority of pigments. There are a number of other uses besides those just named for which special pigments, or, more precisely, special paints, are employed. Amongst such preparations may be named luminous paints, anti-fouling paints, metallic paints, damp-proof paints, and asbestos and other fi.re-proof paints.

Authorities. â€” Bersch, J. Manufacture of Pigments. Trans- lated from the 2nd German edition by A. C. Wriglit. London, 1900. â€” Cennini, Cennino. The Book of the Art. Translated by Mrs Herringham. London, 1899. â€” CnnKCH, A. H. Chemistry of Paints and Painting. London, 1901. â€” Hurst, G. H. Painters^ Colours, Oils, and Varnishes. London, 1901. â€” Mierzinski, S. Handbuch der Farhen-Fabrikation. Vienna, 1898. â€” Eiffault (and others). Fabricant de Couleurs. Paris, 1884. (a. H. c.)

Pilibhit, a town and district of British India, in the Rohilkhand division of the North- West Provinces. The town is situated on the left bank of the Deoha river ; railway station, 34 miles north-east of Bareilly. Population (1881), 29,721 ; (1891), 33,799. The munici- pal incomeinl897-98 was Es.42,535,morethanhalf derived from octroi ; incidence of taxation, 11 annas per head ; registered death-rate (1897), 89-7 per thousand. It was made the headquarters of a district in 1879, and has con- siderable trade in country produce, manufactures of sugar, a high school, and a printing-press. The district of Pilibhit has an area of 1372 square miles ; population (1881), 461,601 ; (1891), 485,366 ; (1901), 470,689, show- ing an increase of 7 per cent, between 1881 and 1891, as compared with a decrease of 8 per cent, in the previous nine years, and a decrease of 3 per cent, between 1891 and 1901 ; average density, 342 persons per square mile. The land revenue and rates were E.s.8,12,749, the inci- dence of assessment being E.s.2 per acre ; cultivated area (1896-97), 375,640 acres, of which 73,805 were irrigated from wells, &c., including 15,595 from Government canals ; number of police, 1419 ; vernacular schools, 78, with 3170 pupils ; registered death-rate (1897), 45-3 per thousand. The principal crops are rice, pulses, wheat, and sugar-cane. The Lucknow-Bareilly section of the Oudh and E-ohilkhand railway runs through the district, a portion of which is watered by the Rohilkhand canals.

Pillau, a seaport town of Prussia, province of East Prussia, on the spit of sand (nehrung) which separates the Prisches Haff from the Baltic, on the north side of the entrance channel, and 29 miles by rail west by south of Konigsberg. It is fortified and has a harbour, which serves as the outer port of Konigsberg, and to some ex- tent also of Elbing and Braunsberg. A new navigable channel was in 1900-01 constructed across the Prisches Haff from Pillau to Konigsberg. Shipbuilding, sail-making, fishing, and the working of amber are carried on. Population (1895), 3192 ; (1900), 2993.

Pilots. â€” The name of pilot is applied either to a par- ticular officer serving on board a ship during the course of a voyage and having the charge of the helm and the ship’s route, or to a person taken on board at a particular place for the purpose of conducting a ship through a

river, road, or channel, or from or into a port. The lat- ter kind is the only one to which the term is now applied either in British or foreign countries. In England, form- erly, pilots were subject to the jurisdiction of the Lord High Admiral ; and in the 16th century there are many in- stances of the Admiralty Court dealing with pilots discip- linarily as well as civilly holding them liable in damages to owners of ships lost or damaged by their negligence.

For some considerable time throughout the United Kingdom the appointment and control of pilots have been in the hands of numerous societies or corporations estab- lished at the various ports by charter or Act of Parliament, such as the Trinity Houses of Deptford Strond (London), Kingston-upon-Hull, Newcastle-on-Tyne, and Leith, and the Society of Cinque Ports Pilots and Court of Lode- manage (now extinct). These societies had juris- diction over the pilots exercising their employ- 2Â«. ment within the limits of suchports, and in many cases made it compulsory for ships resorting thither to employ them. By degrees the London Trinity House acquired a leading position, which was confirmed and extended by the general Pilotage Acts passed in the 18th and 19th centuries, with the object of introducing a uni- form system throughout the realm. At the present day the United Kingdom is divided into districts for the purpose of pilotage jurisdiction. The (London) Trinity House has jurisdiction over the London district, which extends from Orfordness to Dungeness, and comprises the Thames andMedway up to London and Rochester bridges ; the English Channel district, comprising the sea between Dungeness and the Isle of Wight ; and the Triuity out- port districts, which include any pilotage districts for the appointment of pilots within which no particular provision is made by Act of Parliament or charter, and the number of which, according to a parliamentary return of 1899, is 40, all English and Welsh. There are 66 other districts, within which other pilotage authorities have jurisdiction.

The present general pilotage law is contained in the Merchant Shipping Act of 1894. Pilotage authorities are defined as bodies or persons authorized to appoint or license pilots, or to fix and alter rates of pilotage, or to exercise any jurisdiction in respect of pilotage. They are

subject to the control of the Board of Trade as the supreme mercantile marine authority. Those bodies, however, which existed at the time of the passing of the Act retain their powers and jurisdiction, so far as is consistent with it. The Board has power to appoint anew pilotage authority in any area where there is none, and to include a new area where there is none vnthin an already existing one (but in either case pilotage cannot be made compulsory), or to transfer pilotage jiu'isdiction over a port other than that where the pilotage authority for that port resides, from that pilotage authority to the harbour or other local authority for that port, or to the Trinity House, or to a new authority; and the Board has all powers necessary to effectuate such transfer and consti- tute the new authority. The Board may also, by provi- sional order (which requires parliamentary confirmation), provide for the representation of pilots or shipowners on the pilotage authority of any district, and the exemption of ships from compulsory pilotage in any district. Where pilotage is not compulsory, and the power of obtaining pilotage licences unrestricted, the Board can in the same way give the pilotage authority powers with respect to licences, amount of pilotage rates, and the like. Pilotage authorities may, by by-laws under the Act (which require confirmation by Order in Council), exempt wholly or partly any ships or classes of ships from compulsory pilotage, and regulate the means of obtaining licences, and the amount of pilotage rates, subject to a maximum limit. They must make yearly returns to the Board of Trade of their by-laws, the names, ages, and services of their licensed pilots, the rates of pilotage, the amounts received for pilotage and their receipts and expenditure ; and if they fail to do so, the Board may suspend their authority, which is then exercised by the Triuity House.

The statute also provides generally for the qualifica- tions of pilots. A "qualified" pilot is one duly licensed by a pilotage authority to conduct ships to which he does not

belong. On his appointment he receives a licence, which is registered with the chief officer of customs at the nearest place to the pilot's residence, and must be deliv- ered up by the pilot whenever required by the licensing pilotage authority. On his death this licence must be returned to that authority. Pilotage dues are recoverable

summarily from the owner, master, or consignees 'tions!"' Â° ^^^ ^^^P' ^fter a written demand for them has

been made. A pilot may not be taken beyond the limits of his district without his consent, and if so taken he is entitled to a fixed daily sum in addition to the dues; if he cannot board the ship, and leads her from his boat, he is entitled to the same dues as if he were on board; and he must be truly informed of the ship's draught of water. An unqualified pilot may in any pilot- age district take charge of a ship without subjecting him- self or his employer to any penalty, where no qualified pilot has offered himself, or where a ship is in distress, or in circumstances where the master must take the best assistance he can, or for the purpose of changing the moorings of any ship in port on docking or undocking her ; but after a qualified pilot has offered himself any unqualified pilot continuing in charge, or any master con- tinuing him in charge of the ship, is liable to a penalty. A qualified pilot may not be directly or indirectly inter- ested in licensed premises or in the selling of dutiable goods, or in the unnecessary supply of gear or stores to a ship for his personal gain or for the gain of any other person. He can be punished for quitting a ship before the completion of his duty without the consent of the master, refusing or delaying to perform his duty without reasonable cause when required by lawful authority, lending his licence, acting as pilot when suspended or when intoxicated, and any pilot who through wilful breach of or neglect of duty, or by reason of his drunk- enness, endangers ship, life, or limb, is guilty of a misde- meanour and liable to suspension or dismissal ; but the pilot has an appeal in cases of fines over Â£2, of suspen- sion or dismissal, suspension or revocation of his licence, or the application of a pilotage fund to which he has con- tributed. This appeal lies in England to a county court judge having jurisdiction over the port where he is licensed, or a metropolitan police magistrate or stipen- diary

magistrate with the like power ; in Scotland to a sheriff ; in Ireland to a county court judge, chairman of quarter sessions, recorder, or magistrate. Pilotage certi- ficates may also be granted by pilotage authorities, avail- able within their districts, to masters and mates of ships ; and the holder of such a certificate may pilot any ship in respect of which it is available without incurring any penalty for not employing a qualified pilot.

The statute further makes special regulation for Trinity House pilots. Every such pilot, on his appointment, must execute a bond for Â£100 conditioned for due observ- ance of the Trinity House regulations and by-laws, and thereupon he is not liable for neglect or want of skill to anybody beyond the penalty of the bond and the amount payable to him for pilotage on the voyage on which he was engaged at the time of his so becoming liable. The licence may be revoked or suspended by the Trinity House when it thinks fit ; it only continues in force for a year, and the Trinity House has absolute discretion whether it shall be renewed or not.

A pilot boat is approved and licensed by the district pilotage authority who appoints or removes the master

thereof. In order to be easily recognized, she Pilot has printed on her stern in legible white letters

si^naf”” *^Â® name of her owner and her port, and on her

bows the number of her licence ; the remainder of the boat is usually black. The pilot flag is a red and white horizontal flag of a comparatively large size, and is

flown from a conspicuous position. When the flag is flown from a merchant vessel, it indicates that a licensed pilot is on board, or that the master or mate holds a certificate entitling him to pilot the ship. By Order in Council of 1900, on and after the 1st day of January 1901 the signals for a pilot displayed together or separ- ately are to be : â€” In daytime, there is (1) hoisted at the fore the Union Jack having round it a white border, one- fifth of the breadth of the flag ; (2) the

international code pilotage signal indicated by P.T. ; (3) the international code flag S., with or without the code pennant; (4) the distant signal consisting of a cone pointing upwards, having above it two balls or shapes rese}nbling balls. By night, (1) the pyrotechnic light commonly known as a blue light, every fifteen seconds; (2) a bright white light, flashed or shown at short or frequent intervals just above the bulwarks for about a minute or two.

Pilotage in British waters may be either compulsory or free for all or certain classes of ships. From the parlia- mentary pilotage return of 1899, it appears that it is compulsory in 64 districts of the United Kingdom (of which two-thirds are the Trinity House districts), free in 32, free and compulsory in 8, while in 3 cases (Berwick, Dingwall, and Coleraine) no particulars are given. British warships in British waters are not compelled to employ a pilot, the navigating officer becoming Cb'np"'- the pilot under the direction of the captain. If gg^ " Â° " a pilot be employed, the captain and navigating officer are not relieved from responsibility. They super- vise the pilot, and should, if necessary, remove him from the ship. In the majority of foreign ports British war- ships are exempted from employing pilots, but the Suez Canal and the ports of Prance are exceptions. The Merchant Shipping Act continues the compulsory em- ployment of pilots in all districts where it was already compulsory, and also the already existing exemptions ; and there is no power in any pUotage authority or the Board of Trade to increase the area of compulsory pilot- age, though there is to diminish it. Compulsion is enforced by a provision in the Act, that within a district where compulsory pilotage exists, the master of an unex- empted ship who pilots her himself without holding the necessary certificate, after a qualified pUot has offered or signalled to take charge of the ship, shall be liable for each offence to a fine of double the amount of the pilot- age dues demandable for the conduct of the ship. The exemptions from compulsory pilotage still existing in British territorial waters are as follows : â€" Ships or vessels with British registers trading to Norway or the Cattegat or the- Baltic (except vessels on voyages between any port in Sweden or Norway and tie port of London), or round the North Cape, or into the White Sea on their inward or outward voyages whether coming up by North or South

Channels; any constant British traders in- wards from ports between Boulogne inclusive and the Baltic coming up by North Channel, and any British ships or vessels trading to ports between the same limits on their outward passages and when coming up by the South Channels; Irish traders using the navigation of the Thames and Med way; ships engaged in the regular coasting trade of the kingdom ; ships or vessels wholly laden with stone produced in the Channel Islands and Isle of Man and brought thence; ships or vessels not exceeding 60 tons, whether British or belonging to a foreign country specified by Order in Council; ships within the limits of the port or place to which they be- long, if this is not a place particularly provided for by Act of Parliament or charter as regards the appointment of pilots ; ships passing through the limits of any pilotage district in their voyages from one port to another port, and not being bound to any port or place within such

limits or anchoring therein, but not including ships load- ing or discharging at any place situate within the district, or at any place situate above the district on the same river or its tributaries. Ships whose masters or mates are owners or part-owners of them, and living at Dover, Deal, or the Isle of Thanet, may be piloted by them from any of these places up and down the Thames or Medway, or into or out of any place or port within the jurisdiction of the Cinque Ports. The following ships in the London district and Trinity outport districts are also exempt when not carrying passengers, namely: ships employed in the coasting trade of the United Kingdom ; ships of not more than 60 tons burden ; ships trading to or from any port in Great Britain within the above districts to or from the port of Brest in France, and any port in Europe (which does not include the United Kingdom) north and east of Brest, or to the Channel Islands or Isle of Man ; and ships navigating within the limits of the port to which they belong. The port to or from which the ship must be “trading” in this provision has been interpreted by the decisions to mean the port where the cargo is sub- stantially

discharged or loaded respectively ; and the word “coaster” similarly has been held to apply only to a vessel carrying to one port of the United Kingdom a cargo which has been taken in at another. Every ship carrying passengers between any place in the British Islands and any other place so situate must carry a com- pulsory pilot, unless her master or mate have a pilotage certificate. The effect in law of the ship (British or foreign) being in charge of a compulsory pilot under the Act is that her owner and master are not answerable to any person whatever for any loss or damage occasioned by the fault or incapacity of any qualified pilot acting in charge of such ship within any district where the employ- ment of such pilot is compulsory by law. In order to take advantage of this privilege, the shipowner must show (1) that a properly qualified pilot was acting in charge of the ship; there are, however, various kinds of quali- fied pilots â€” ~~the ‘qualified pilot who is always capable of acting, and the qualified pilot who is liable to be super~~ seded if a better can be obtained; (2) that that charge was compulsory ; the pilot, however, need not be com- pulsorily employed at the place where the accident hap- pened, so long as he is compulsorily employed within the district where it happens ; (3) that it was solely the pilot’s fault or incapacity which caused the damage. Similarly, under the Harbours, Piers, and Docks Clauses Act, the owner of a vessel is not liable for damage done thereby to docks or piers when she is in charge of a duly licensed pilot. ,

This statutory exemption of a ship in charge of a com- pulsory pilot from any liability for her negligent naviga- tion by that pilot, is only declaratory of the common law of England, and is based on the principle that the pilot is a State official put in charge of a ship, and is not the servant of the shipowner so as to make him liable for his negligence; and a British court gives the same effect to any foreign or colonial law which makes it compulsory on shipowners to put a pilot in charge of their ship when within their jufisdiction. Most foreign codes, however, while agreeing with English law in making the presence of a pilot on board compulsory, differ from it in not putting him in charge of the ship ; and in this case the defence of com- pulsory pilotage cannot be pleaded successfully in British courts. Judicial decisions have established that French, Suez Canal, Danube, and Dutch pilots are not

compulsory l^ilots in the British sense of the word, being only advisers of the master, or ” living charts.” But if the pilot is put in charge by the foreign or colonial law, although that law expressly provides that in spite of the owner surrender- ing the charge of the ship to him the owner shall still

remain liable, a British court will hold the owner free from liability, on the ground that to make any person liable for a tort committed abroad, the act complained of must be wrongful not only according to the foreign law but also by English law. This consequence which Eng- lish law attaches to the employment of a compulsory pilot has been much criticized in recent times, and it would seem that the foreign view is much more satisfac- tory, in regarding the pilot merely as the advisor and not the superior of the master. Moreover, the adoption of the foreign law on this point would restore the old general maritime law. The policy of the law was at one time inclined to extend this principle of compulsory pilotage, on the ground that it was for the benefit of commerce and the safety of seamen’s lives, but it now restricts it within as narrow limits as possible, e.g., the presence of a compulsory pilot on board a tow who is directing the navigation of a tug does not protect the tug-owner from liability for negligent navigation. As already pointed out, pilotage authorities have no power to extend its scope.

A pilot who is compulsorily in charge of a ship under English law has supreme control over her navigation, superseding the master for the time being ; and if she is a tow he has also control of the navigation of her tug. The judicial decisions establish that it is within his province to decide whether the ship shall get under way, the proper time and place for her to anchor, the way of carrying her anchor, the proper orders for the helm, her rate of speed, and whether the statutory rules of navigation shall be com- plied with ; and the master and crew must not interfere with his control, and only remain liable for the proper execution of the pilot’s orders and the trim and general efftciency as to lookout, &c., of the ship. The master, however, is bound to supersede the pilot in case of his intoxication or manifest incapacity, and to interfere if there is a clear and plain prospect of danger to the ship in following the pilot’s directions, e.g., getting under way in a thick fog. A

pilot taken voluntarily, and not by compulsion of law, is considered as the servant of the shipowner, and as such renders him liable for his acts of negligence towards third parties. He does not, it seems, supersede the master in the control of the ship, but only advises him. The Admiralty and the Board of Trade and the Trinity House all take the view that the captain or master is bound to keep a vigilant eye on the navi- gation of the vessel by the pilot, and insist on all proper precautions being taken. For the purposes of a policy of marine insurance a ship is not seaworthy with- out a pilot in compulsory pilotage waters; and where there is no legal compulsion to have one, but the locality requires navigation by a person having local knowledge, it has been said that a ship must take a pilot, certainly when leaving a port, and probably on entering a port if a pilot is available.

A pilot can sue for his pilotage fee at common law or in Admiralty (q.v.), in the latter case provided that the contract was made and the work done not within the body of a. county; but he has a summary remedy by statute which is of easier application. He cannot be sued in Admiralty for damage done by a collision caused by his negligence (e.g., on the Admiralty side of a county court having Admiralty jurisdiction) ; but he can be made liable at common law or in the Admiralty Division of the High Court, although in the case of a Trinity House pilot his liability is limited to the amount of his bond and pilotage fee then being earned (see above) ; but the court has refused to join him as a defendant to an action in rem brought against the ship of which he had the charge. A pilotage authority cannot be made liable for the negligent navigation of a ship by a pilot which it has licensed, for

he is not its servant, though it has been held liable for the negligence of a person not licensed by it as a pilot, but employed by it for wages to pilot ships into a har- bour under its jurisdiction, itself taking the pilotage dues and applying them for harbour purposes. A pilot is not in common employment with the master and crew of a ship, and can

recover for any injury done him by their negligence. He may be entitled to claim salvage from a ship of which he has charge, if the services he renders are beyond the scope of his pilotage contract, either from the outset or owing to supervening circumstances; but not otherwise, whether he is on board her or leading her from his boat. (See Salvage.)

United States pilotage laws are regulated by the respective states according to Congress. If the waters are the boundary between two states, a duly licensed pilot of either state may be employed, but no discrimination can be made in the rates of pilotage between vessels of different states. In the German Empire the pilotage laws are very complicated. In the majority of the maritime states each one has its own regulations and laws. ‘ In Prussia there are Government pilots who enter the service as apprentices, and are placed under a department of state. In France the general organization of pilots is regulated by the Statute on Pilots of the 12th December 1806, and the pilotage regulations for each port are made by the Minister of Marine at the request of his local repre- sentative and the Chamber of Commerce. French pilots are exempt from military service.

See Abbott. Shipping. London, 1802. â€” Maude and Pollock. Shipping. London, 1881. â€” Maksden. Collisions at Sea. Lon- don, 1896. â€” Select Fleas of the Admiralty. Selden Society, London, 1892 and 1897. â€” ^Twiss. Black Book of Admiralty. London, 1871. (g. g. p*. ; j. w. D.)

Piloty, Karl von (1826-1886), German painter, was born at Munich, 1st October 1826. Under the guidance of his father, Ferdinand Piloty (d. 1844), who enjoyed a great reputation as a lithographer in that city, young Piloty acquired in early life an insight into the princi- ples of art. In 1840 he was admitted as a student of the Munich Academy, where he became a zealous pupil of the artists Schorn and Schnorr. After a journey to Belgium, France, and England, undertaken for the purpose of visiting the galleries in those countries, he commenced work as a painter of genre pictures, and in 1863 produced a work, ” Die Amme ” (The Wet Nurse), which, on account of its originality of style, caused a considerable sensation in Germany at the time. But he soon forsook this branch of painting in favoiir of historical subjects, and produced in

1854 for King Maximilian II. an historical painting representing ” The Adhesion of Maximilian I. to the Cath- olic League in 1609.” This picture has been variously criticized, but on the whole opinion inclines to regard it as being somewhat superficial and theatrical in tone, whilst it strongly betrayed the influence of the Belgian school of colourists. It was succeeded by ” Seni at the Dead Body of Wallenstein ” (1855), which gained for the young painter the membership of the Munich Academy, where he succeeded Schorn (his brother-in-law) as pro- fessor. Among other well-known works by Piloty are the ” Battle of the White Mountain near Prague,” ” Nero Dancing upon the Kuins of Rome ” (1861), ” Godfrey of Bouillon on a Pilgrimage to the Holy Land ” (1861), Â« Galileo in Prison” (1864), and Â« The Death of Alexander the Great ” (unfinished), his last great work. He also executed a number of mural paintings for the royal palace in Munich. For Baron von Schach he painted the justly celebrated “Discovery of America.” In 1874 he was ap- pointed keeper of the Munich Academy, being afterwards ennobled by the king of Bavaria. Piloty was the foremost representative of the realistic school in Germ any : he strove to represent nature to the minutest details. He was a most successful teacher, and among his more famous pupils may be mentioned Makart, Lenbach, Defregger, Max, and Griltzner. He died at Munich on the 21st of July 1886.

Pilsen (Czech, Plzen), the second town of Bohemia, Austria, at the confluence of the Mies and Radbusa, 52 miles west-south-west of Prague. Population (1890), of the town proper, 9778, including suburbs 50,221 ; (1900), 68,292, including the garrison of 2259 men. In 1880 the Czech and German elements were nearly equal, but it is now estimated that about 84 per cent, are Czech, 16 per cent. German ; 94 per cent. Catholic, 5 per cent. Jewish, and 1 per cent. Protestant. Of all Bohemian tovms, with the exception of the four suburbs of Prague, Pilsen shows the largest increase of population since 1857, when it had 14,269 inhabitants. As in Prague, there are separ rate educational establishments for the two nationalities, including gymnasia, real schools, commercial and trade academies, training colleges, &c. A joint-stock company was formed in 1893 for the manufacture of the staple product of the town, the celebrated Pilsen beer. In that year the

two largest breweries produced 808,600 hecto- litres of beer, over four times the entire quantity pro- duced in the ‘eighties. Other branches of industry com- prise manufactures of malt, of iron and metal wares (including bell-founding and wire-drawing), of carts and waggons, and explosives, and the preparation of marble, granite, mill-stones, &c., together with steam corn and saw mills.

Pinardel Rio, capital of Pinar del Rio, the east- ernmost province of Cuba, 97 miles south-west by west of Havana. The town has rail connexion with Havana, and is the centre of the tobacco industry of the Vuelta Abajo region. Population (1899), 8880.

Pind Dadan Khan, a town of British India, in the Jhelum district of the Punjab, situated in 32Â° 36′ N”. and 73Â° 5′ E., near the right bank of the river Jhelum, and a station on the salt mine branch of the North-West- ern railway. Population (1881), 16,724 ; (1891), 16,065 ; municipal income (1897-98), Rs.30,381. It is an im- portant centre of trade, and its manufactures include boats, brass-ware, pottery, embroidered scarves, and riding-whips. There is a municipal school.

Pine Bluff, a city of Arkansas, U.S.A., capital of Jefferson county, on the Arkansas, at an altitude of 216 feet. It is in one of the richest cotton regions of the country, and is on the St Louis, Iron Mountain, and Southern, the St Louis South- Western, and the Pine Bluff and Arkansas River railways. It has a large trade in cotton, and has cotton compresses, cotton-seed oil mills, planing mills, flour mills, and car works. Population (1880), 3203 ; (1890), 9952 ; (1900), 11,496, of whom 359 were foreign-born and 5771 negroes.

Piotrkow, a province in the west of Russian Poland, with an area of 4729 square miles. Geologically it repre- sents a continuation of Upper Silesia, and is built up of Upper Carboniferous deposits, containing near Bendzin a layer of coal, 265 square miles in extent, of which only one-fifth is worked. Permian and Jurassic deposits, con- taining zinc ores, as also lignite and limonite iron ores, overlie the Carboniferous. The surface forms a series of heights, from 1000 to 1580 above sea-level, intersected by ravines, and stretching from south-west to north-east. The province is watered by the Warta and the Pilica, and was

formerly covered by thick forests. It was colonized by Mazurs and Poles (Veliko- and Malo-Polyans). The domiciled population numbered 1,409,044 in 1897, of whom 707,272 were women, and 509,699 lived in towns. Most of the inhabitants are Poles, the rest being Jews (189,000) and Germans (162,500). The province is divided into eight districts, of which the chief towns are Piotrkdw (see below), Bendzin (21,190), Brzeziny (7669), Czens- tochowo (45,130), task (4238), ‘iiddi (315,209), Nowo

Eadom (12,407), and Eawa (6471). Pabianice has 26,900 inhabitants, Zgerz 19,124, and Tomaszew 21,041. Edu- cational institutions are comparatively numerous and effi- cient. Although the soil is not fertile, agriculture is the main occupation of the people, and nearly 1,440,000 quarters of various cereals and 2,165,000 quarters of potatoes are grown annually, the latter chiefly for the distilleries. The average crops of 1895-99 were : wheat, 668,000 cwt. ; rye, 3,154,000 ; oats, 1,254,000 ; all cereals, 5,941,000 ; and potatoes, 11,724,000 cwt. Cattle-breeding is extensively carried on, and in 1897 there were 123,130 horses, 251,050 horned cattle, and 220,000 sheep. Weaving as a domestic industry gave employment in 1897 to 8920 workers, and yielded a return of Â£460,000. Small furni- ture works and forges are widely scattered amongst the vil- lages. Coal-mining gives occupation to 13,500 workers, and 3,230,000 tons are extracted annually. Iron ore was extracted in 1898 from 44 mines (1630 workers), and there were 9 iron works (6250 workers), employing 79 steam engines, and showing a return of 125,000 tons of pig iron and 100,000 tons of iron rails and iron-ware. Textile industries have rapidly developed, the towns of Jiddi Pabianice, Zgrez, and Bendzin all being important manu- facturing centres. The chief industries are cotton-spinning, cotton-printing, dyeing, and the manufacture of woollen cloth, silks, and jute. They employ 150,000 workers, and the value of their yearly output reaches Â£15,000,000. Granica and Sosnowice are two of the chief custom-houses in Russia,

and the annual trade of the province is estimated at Â£12,000,000. (p. a. k.)

Piotrkow, capital of the above government, situated 90 miles by rail south-west of Warsaw, on the railway to Vienna. It is a well-kept town, with numerous gardens. Its factories (agricultural machinery works, flour-mills, saw-mills, tanneries) are unimportant. Population (1882),

23,050 ; (1897), 30,372.

Piqua, a city of Miami county, Ohio, U.S.A., on the Miama river, the Miami and Erie Canal, and the Cincin- nati, Hamilton and Dayton, and the Pittsburg, Cincinnati, Chicago, and St Louis railways, at an altitude of 866 feet. It contains varied manufactures, especially of agricultural implements, furniture, waggons, tin-plate, and woollen goods. Population (1890), 9090 ; (1900), 12,172, of whom 901 were foreign-born and 487 negroes.

Pirano, a seaport town in the crownland of Istria, Austria, situated at the point of a small peninsula, a few miles south of Trieste. In addition to viticulture and the cultivation of the olive, its principal resources are ship- building, fishing, the manufacture of chemicals, and the evaporation of sea-salt, of which some 60,000 tons are annually produced. Its port is entered and cleared by an aggregate of about 7600 vessels of 442,000 tons annually, mostly coasting vessels. Pirano is celebrated for the victory of the Venetians over the fleet of the Emperor Frederick I., in 1177. Population (1900), 13,339.

Pirna, a town of Germany, on the Elbe, 11 miles by rail south-east of the town, and in the circle of Dresden, kingdom of Saxony. It has several educational institu- tions, amongst them a girls' higher-grade school, a girls' industrial school, a commercial school, and a seminary for teachers. Population (1890), 13,852 ; (1900), 18,296.

Pi rot, during the Turkish rule known as Shehr-Koey, a Servian town, 12^ miles from the Bulgarian frontier at Tsaribrod, on the railway line between Nish and Sofia. It has a mediaeval fortress, believed to have been built on the site of the Roman fortress QiimPiJawt, on the

military road leading from Old Naissus to Philippopolis. The town is of great strategical importance, for which reason the

Russian plenipotentiaries at the Berlin Congress (1878) stubbornly tried to include it within the Bulgarian frontier, while Austria and some other Powers insisted that it should be given to Servia. In the war between Servia and Bul- garia in 1885 the Bulgarians occupied and held it until the conclusion of peace. It is the seat of the prefecture for the whole district, with a tribunal, several schools, and a custom-house. A regiment of infantry, with several batteries, is stationed permanently in Pirot, the neighbour- hood of which has since 1886 been strengthened by mod- ern fortifications. It is the only really industrial town in Servia, having numerous small factories for the manu- facture of thin cloth (shayak), woollen braid (gaytan), and â– especially carpets. Its carpets have a great reputation in the Balkan Peninsula for their quaint designs, durability, and freshness of colour. Population (1900), 10,421.

Pisa, a town, archiepiscopal see, and capital of the province.of Pisa, Tuscany, Italy, on the Arno, 7 miles from the sea and 49 miles west of Florence by rail. It still retains its ancient walls, 6^ miles in circuit, and is de- fended by a citadel on the south-west. The principal streets run alongside the river, and are lined with fine buildings. Besides the cathedral, the baptistery, and the leaning tower, the city possesses several notable churches, as the Renaissance church of the Tuscan order of St Stephen, built in 1662 from plans by Vasari ; San Niccolo, with a four-storeyed tower (1230), built by Niccola Pisano, and the tomb of John of Swabia, the parricide ; Santa Caterina (1262) ; Santa Maria della Spina, in the Italo-Gothic style, built in 1230 and restored in 1872 ; San Sepolchro, erected in 1150 by Diotisalvi ; San Francesco, with frescoes by Taddeo Gaddi ; and the basilica of San Michele (1018). Amongst the secular buildings may be mentioned the royal palace; the archiepiscopal palace; the palace of the order of St Stephen, built by Niccola Pisano and re- constructed by Vasari ; the Upezzinghi (formerly Lanf re- ducci) palace, built of Carrara marble in 1590 ; the Lanfranchi, Agostini, and other palaces ; the university (1472) ; a large hospital (1258) ; and fine market halls. There are statues to Cosimo I.

(by Francavilla), Archduke Leopold, and Ferdinand I. The city possesses also an academy of the fine arts, with a gallery of paintings ; and the university a library of 120,000 volumes, a natural his- tory museum, botanical garden, and agricultural schools. The university, founded in 1338, has faculties of law, medicine, mathematics, and philosophy- and literature. In 1898 it -was attended by 1087 students and had 56 professors. There are also numerous other educational institutions, including the school of the Chamber of Commerce and a technical school. The most important industry is the manufacture of cottons. In the vicinity of the city are the royal stud-farm (horses and dromedaries) of Cascine di San Rossore, and the mineral baths of San Giuliano, alkaline-ferruginous, with temperature 91-4Â° to 105-8Â° Fahr. Population (1881), 42,779 ; (1900), 61,279.

Pisciculture (^Marine).â€” The extent and efficiency of sea-fishing operations in British waters greatly increased during the last decade of the 19th century, but the quantity of fish lauded by no nutans increased in equal proportion, and in the case of certain kinds actually decreased. The average price of fish, especially of soles and turbot, advanced considerably, and it can be proved that the supply at any rate of ground fish on the more accessible grounds, which have been exploited for the longest time, has materially diminished. In the drift-net fisheries the development of the industry and the diminu- tion in the supply have not hitherto been so conspicuous. The fecundity of fish being so great, it is often sup- posed that adequate protection of the young would be

sufficient to maintain the supply of adults. But in cases where the capture of the commercially valuable adult fish is very extensive and persistent, the number of mature individuals surviving to breed may diminish every season, in spite of the protection of the young, and thus in every season there may be fewer young to be protected.

We may especially consider, in reference to this point, the trawl fishery in the North Sea, where the steam trawler, with the large otter trawl,

extending 90 or 100 feet at the mouth, is so enormously more efficient than the old sailing trawler with the beam trawl of 40 or 50 feet. The most definite evidence on this question is supplied by Dr Fulton's account of the results of experiments made by the Scottish Fishery Board {Fourteenth Annual Report, p. 128). That authority prohibited trawling for ten years in the Firth of Forth and St Andrews Bay, and throughout that time took careful observations of the abundance of fish both in the closed areas and the open areas adjacent to them. Dr Fulton, after careful discussion of the results, shows that in spite of the closure a decrease took place, both in the closed and the open areas, in some of the most important flat-flshes, namely, plaice and lemon soles. Dr Fulton points out that the plaice and lemon sole spawn in the open ofi-shore areas and not in the closed, and concludes that the diminution was due to the capture of so many adult mature fish in the open areas by the trawlers. Exception was taken to Dr Fulton's evidence by Professor M'Intosh ; but Mr Garstang, after re-examining it, finds that, though Dr Fulton's discussion of the statistics was open to certain objections, his conclusions are nevertheless correct. Dr Ful- ton thinks that protection of the off-shore spawning-grounds is the method most likely to increase the supply of fish. But the question arises whether it is practicable to close off-shore areas to trawling or other kinds of fishing. The Scottish Fishery Board has now for some years closed the whole of the Moray Firth, which includes spawning-grounds as well as inshore grounds ; but this closure applies only to British subjects, and is not therefore complete, as foreign vessels can and do trawl there, a state of things which it is difficult to justify.

Artificial Propagation. â€" The conclusion that the chief cause of the diminution in the supply of fish is the exces- sive destruction of the mature adults, is a strong argu- ment in favour of the necessity of artificial propagation. But in spite of the efforts which have been made since 1890, it is by no means certain that a practically successful system of artificial propagation has yet been devised. The practice hitherto followed is to obtain a large number of fertilized eggs, to keep them in appropriate apparatus until they are hatched, and then to liberate the fry in the sea. The number of eggs produced by a single female fish is

very large, as will be . seen from the following list of average numbers : â€”

Plaice

. 300,000

Haddock .

500,000

Lemon dab

. 500,000

Whiting .

100,000

Sole .

. 500,000

Cod .

. 3,000,000

Turbot

. 8,000,000

Ling .

. 20,000,000

The number varies according to the size of the individual fish, as well as according to the species ; but a very large number of eggs can be obtained from a small number of mature fish, and if the number of valuable fish produced bore any considerable proportion to the number

of eggs which can be obtained, the results of artificial propagation would be very important. The fertilization of the spawn is very easily effected. The eggs are collected either by stripping them from the mature adult immediately after capture, or by keeping the adults alive until they are ready to spawn, and then stripping them, or by keeping them in reservoirs of sea water and allowing them to spawn of their own accord. In the two former cases a little milt is allowed to fall from a male fish into a vessel con- taining sea water, and the eggs are pressed from the female fish into the same vessel. With few exceptions, the eggs of commercially valuable marine fishes are buoyant in sea water and free ; those of the herring and of the American winter flounder, however, are heavy and adhesive.

The United States Fish Commission possesses two marine hatcheries, one at Gloucester and one at Wood's Hole, both in Massachusetts. In the winter of 1897-98 the following results were obtained : â€”

Gloucester . . 160 million eggs yielded 96 millions of cod fry.

7 â€ž â€ž 4 â€ž poUackfry.

Wood's Hole . 153 ,, â€ž 105 â€ž cod fry.

â€ž 57 â€ž â€ž 39 â€ž winter-floun-

der fry. The Government of Newfoundland possesses a hatchery at Dildo Island, in Trinity Bay. This establishment is under the direction of Mr Adolf Nielsen, Superintendent of Fisheries, and is devoted entirely to the propagation of cod. The total output of fry since the commencement of operations has been as follows : â€”

17 millions.

1894 1895 1896

221 millions. 188 â€ž 186 â€ž

1890 .

1891 .

1892 . . 165

1893 . . 201

The annual average, therefore, has been over 145 millions. In 1896 the number of cod eggs placed in the hatching apparatus was 233 millions, so that the proportion lost in the process of development was 20 per cent. In 1890, we are informed, the loss was 49-4 per cent., and therefore a great improvement has been effected.

The first important marine hatchery established in Europe was that of Captain Daunevig at Flodevig, near Arendal, on the south coast of Norway. This also deals almost exclusively with cod eggs. The total numbers hatched annually have been as follows : â€”

1891 .

. 193J millions.

1894 .

. 100 millions.

1892 .

. 208 â€ž

1895 .

â– 85 â€ž

1893 .

. 240

1897 .

Of these fry about 15 millions have been liberated on the average every year in Christiania Fjord ; the rest have been put into the sea near Arendal.

In Britain the Scottish Fishery Board has maintained a marine fish hatchery since the year 1894. Until 1899 this establishment was situated at Dunbar ; it has since been removed to the Bay of Nigg, near Aberdeen. Its resources have been devoted principally to plaice, the fry of which have been hatched in numbers varying from 11 millions to 38 millions per annum. In the years 1895 and 1896 a few million fry of cod, lemon dabs {PI. microcephalus), and turbot were hatched. In the earlier years the fry were all liberated in the sea near Dunbar, but in recent years all the plaice fry were put into upper Loch ^ne, in order that more definite evidence might be obtained concerning the effect of the introduction of artificially hatched fry on the subsequent supply of adult fish. The efficiency of the arrangements in the Dunbar hatchery, which has been under the management of Mr Harald Dannevig, a son of Captain Dannevig, is proved by the fact that the loss of eggs during hatching operations was only 10-7 per cent, for a whole season.

A small hatchery has peen established by the Lancashire Sea Fisheries Committee at Piel, on the shore of Morecambe Bay. In the year 1899 over 3 million fry were produced and liberated. These consisted principally of cod fry ; of plaice there were 364,000, of haddock 340,000, and of flounder a few thousands.

Hatching Apparatus. â€” In the United States and in Newfound- land the apparatus generally used for hatching buoyant ova is the M’Donald automatic tidal box. This apparatus is made of wood, and consists of water-tight compartments each 2^ feet by IJ foot in area, and 18 inches deep. In each compartment flts an egg-box, the bottom of which consists of linen scrim. The outflow pipe is in the form of a siphon, so that the outflow is intermittent, and the level of the water in the box rises and falls alternately. Water is admitted through the side of the egg-box. These arrange- ments are supposed to keep the eggs in constant motion. In the Dannevig apparatus, which is used in England

and Norway, the egg-boxes are only 1 foot square, and are hinged by one side to the sides of the water-tight compartments. The apparatus is fixed in a slanting position and water flows from one compartment into the egg-box below, the overflow being continuous, not inter- mittent. Usually the egg-boxes are moved at intervals by a mechanical arrangement, to keep the eggs in motion. This appa- ratus has proved very successful.

Results of Artificial Propagation. â€” Very little satis- factory evidence, of a statistical kind, of the results of artificial propagation has been published. The following figures, given by Captain Dannevig for Christiania Fjord, are probably the most important yet produced : â€”

Tear

Number of

Millions of

Cod caught.

Fry planted.

1892

44,013

10

1893

50,322

20

1894

65,212

â€”

1895

65,753

12

1896

70,414

18

1897

70,898

15

1898

81,367

15

1899

78,760

15

780

PISE K â€” P ITCAIRN ISLAND

During the period covered by the above figures the great cod fisheries of the north of Norway showed considerable fluctuations, but no general increase.

As there seems no reason at all to suppose that artifici- ally-hatched fry are in any way inferior to those produced naturally, a certain proportion of the millions of fry planted must develop into fish of marketable size. The only questions, therefore, to be considered are : (1) What is the magnitude of the results produced by operations of the method and extent indicated above ? (2) Does the value of possible result exceed the cost of the operations ? (3) What improvements can be suggested in the mode of operation ?

If the fry placed in a certain area, such as Christiania Fjord, were the only fry of the species in that area, there would be no doubt that the fish caught were the result of artificial propagation. But in order to be convinced that an increase in the fish caught is due to artificial operations, we ought to be able to compare the number of fry intro- duced with the number naturally produced. We may do this either by comparing parent fish in the two cases, or the eggs and fry in the two cases. Supposing every egg hatched into living fry, the fifteen millions of fry placed by Dannevig in Christiania Fjord would be the produce of only about five mature female cod. Supposing that only one-tenth of the eggs are hatched in the sea, the same number of fry would be the produce of fifty female cod. The question therefore arises whether the addition of fifty mature female cod, with a suitable number of males, each year would double the cod supply in Christiania Fjord. It is at any rate evident that artificial propagation on the scale on which it has hitherto been carried on cannot possibly check to any considerable extent the diminution of great sea fisheries. For example, it has been calculated that four million mature female plaice were landed in a year at Grimsby alone. The greatest number of plaice fry produced by the Scottish hatchery was thirty-eight millions. Taking the number of eggs produced by one plaice at only 200,000, and supposing only one-tenth to hatch in the sea, the produce of the hatchery represents 1900 female plaice in the sea; so that the work of the hatchery is equivalent to returning to the sea one female plaice out of every 2000 killed at Grimsby, leaving the plaice landed at other ports out of consideration.

As an instance of the comparison of artificially and naturally produced fry, the following may be given. Mr Williamson {Report of Scottish

Fishery Board for 1898) estimated, from a number of tow-net collections made at definite intervals, that 483 millions of plaice eggs were naturally produced in Loch Fyne in one spawning season. The number of artificially-hatched fry added was 19 millions. As the plaice eggs in the loch were in all stages of development, the loss before hatching could not be very high. Supposing only 100 million fry were naturally hatched in the loch, the increase in the supply of plaice due to artificial hatching would be only 19 per cent. However, even a small percentage added to the produce of a valuable fishery may be worth a good deal of money, and it is interesting to consider whether it is possible to compare the cost of hatcheries with the value of results.

The working of the hatchery at Dildo, Newfoundland, in 1896, is stated to have cost Â£200 a year. Captain Dannevig states that his hatchery has produced 2163 millions of fry in ten years, at a cost of Â£485 a year, but he does not say whether the value of the fishery has been increased by that amount. With regard to shad-hatching in the United States, it is stated (U.S. Fish Commission Beport for 1898, published 1899) that the value to the fishermen of the shad caught in 1880 was $995,790, in 18110 fl,656,711, an increase of $660,921, while the total expenditure in the year 1896-97, for shad- hatching alone, was only $15,726. The total appropriation for the Commission from the U.S. Treasury in 1898 was |462,076=Â£92,416 â€¢ for propagation alone, $1.32,500, or Â£26,500. ‘ ‘

Bearing of Fry. â€” The development of the fish in the egg up to the moment of hatching takes but a short time, namely, from three or four days up to about three weeks, according to temperature and the kind of fish. The development of the hatched fry up to the perfect con- dition in which it resembles its parents takes from six weeks to three months. There can be no doubt that most destruction occurs during this stage, both because it is longer than the egg stage and because the young fish have to seek their own food. The fry also have more enemies than the eggs or older fish. It would therefore be advan- tageous to rear the fry through the larval stage before putting them into the sea. Such rearing has generally been found very difficult, but experience indicates that the two chief conditions of success are: (1) to feed the larvae before the

yolk has all been absorbed; (2) to move the larvae artificially in the water. Fish larvae and other pelagic creatures seem to require the stimulus of considerable agitation in the water to keep them in vigour. In 1886 Dannevig turned out 500,000 cod larvae into a closed reservoir 43 yards long by 20 yards in breadth and 6 yards in greatest depth. Some of these lived for two years ; but his object was merely to prove that they would develop into perfect cod, not to rear them before they were put into the sea. In 1896 Harald Dannevig reared plaice larvae at Dunbar in a large glass carboy, changing the water twice a day : when six weeks old they had nearly completed their transformation and had taken to lying on the bottom. If the fry are not reared to the fully-developed condition, it is open to question whether it would not be equally beneficial to put the fertilized eggs directly into the sea, instead of hatching them. The process of hatching absorbs a large proportion of the cost of artificial propagation, and it is not certain that the protection of the eggs alone is worth the expense.

AuTHOEiTiES. â€” Cunningham. Natural Sistory of the Marketable Marine Fishes of the British Islands. London, 1896. A Manual of Fish Culture. Washington, 1897. â€” Roche. La Culture des Mers. Paris, 1868. â€” M'Intosh. Resources of the Sea. London, 1899. Reports of the U.S. Fish Commission. Annual Reports of Scottish Fishery Board. Twelfth Annual Report of Inspectors of Sea Fisheries (England and Wales). Reports of the Newfoundland Department of Fisheries. (j. x. c.)

Pisek, the chief town of a government district in Bohemia, Austria, on the Woltawa, 24 miles west by south of Tabor. Population (1890), including suburbs, 10,950 ; (1900), 13,574, including gai-rison of 935 ; mostly Czech and Catholic. Feldspar, quartz, and granite are quarried in the environs.

Pistoja, a town and episcopal see of the province of Florence, Tuscany, Italy, 21 miles north-west of Florence on the railway to Bologna. It is surrounded by a wall pierced by five gates and further defended by a citadel. Its institutions embrace a medical institute, a natural history museum, an academy of sciences, and two small libraries. Its varied industries include iron and steel works, manufactures of glass, silk,

macaroni, woollens, olive oil, ropes, paper, and vehicles. Population (1881),

30,051 ; (1899), 32,000.

Pitcairn Island, the most southerly island of the Low Archipelago, in the eastern Pacific Ocean, in 25Â° 3′ S. and 130Â° 6′ W. It became known as the home of the mutineers of the Bounty, of whom the present inhabitants are for the most part descendants by Tahitian wives. Described in past travels as the denizens of an earthly Paradise, they seem to have fallen sadly from their high estate. There has been a gradual disappearance of trees, which has affected the climate and caused droughts, and though there is still much fertile soil left in the valleys and on the hills in the interior, the energy to make use

of it is lacking. Recent accounts describe the people as ” lax in morals ” and ” weak in intellect ” ; as ” degener- ating ” ; ” unless something is speedily done to alter their condition they will probably drift into hopeless imbe- cility.” Intermarrying has brought about its natural results, and the want of intellect among the young is reported to be appalling. There would appear, however, to be some reason to believe that these accounts have been unduly pessimistic, for later report is of a much more favourable character. Nevertheless the population is diminishing. In 1901 it was 126. Meat, except goat’s flesh and chicken, is unknown. The island is overrun by chickens, which unfortunately the islanders do not appreciate. Tea, coffee, tobacco, and spirituous liquors are never tasted. There is an annual election of a gov- erning body of seven, who elect their chairman. The island has now been placed under the jurisdiction of the High Commissioner of the Western Pacific. It has been proposed to remove the people en masse to Fiji, Tahiti, or Norfolk Island, but the mischief may be remedied by the opening up of a frequent communication with Tahiti.

The Parliamentary Papers C. 9148, Correspondence relating to the Condition of the Pitcairn Islanders, 1899, and Cd. 764, Further Correspondence, &c., 1901, should be consulted. (h. E. eg.)

Pitch, Musical. â€” The pitch of a musical sound is aurally defined by its absolute position in the scale and by its relative position with regard to other musical sounds. It is precisely defined by a vibration number recording the frequency of the pulsations of a tense string, a column of air, or other vibrator, in a second of time. In Great Britain and America the complete vibration to and fro (swing both ways of a pendulum) is taken as the unit ; elsewhere the vibration in one direc- tion only (swing one way of the pendulum). The only oificial standard is the French, dating from 1859, pre- served by a tuning-fork vibrating 870-9 (double vib. 435-46) at a temperature of 15Â° Centigrade (59Â° Fahr.) in a second. The vibration number stated in the edict establishing the Diapason Normal is 870 (435), which for comparison will be here adhered to. The natural basis for a standard musical pitch is the voice, particularly the male voice, which has been of greater importance historically. There is no reason to suppose the human voice has varied, dur- ing the period of which we have evidence, more than other physical attributes. The only difference to be reckoned with may be in recent tendencies of solo vocal- ists to sing for effect, and so to extend the compass of the voice upwards. Otherwise we may assume no disturbing alteration has taken place for more than 2000 years in its position and extent. Vibrations increase in rapidity as a note rises, and decrease as it falls. Any note may be a pitch note ; for orchestras custom ha^ settled upon a?- in the treble clef, for organs and pianos in Great Britain (?, and for modern brass instruments b flat\

We are not without a clue to the pitch usual in the classic Greek and Alexandrian ages : the vocal octave to which the lyre was adapted was noted as from e to e’. As in choruses baritone and low tenor singers always prevail, d-(^, at French or at medium pitch, would really be the Greek singing octave ; we may therefore regard it as a tone lower than that to which we are accustomed. But to sing the lower Greek modes in or near the vocal octave it was necessary to transpose {i>.â,¬Tafio\rj) a fourth upwards, which is effected in modern notation by a flat placed

upon the h line of the staff ; thus modulating from our major key of C to that of F. This transposition has had, as we shall see, much to do with the history of our subject, ultimately influencing the ecclesiastical chant and lasting until the 17th century of our era. It does not appear from any evidence that the keyboards â€”

when there were more than one â€” of the early organs were arranged for transposition, but it is certain that the Flemish harpsichords to 1650 were made with double keyboards to accommodate it, as the writer has proved elsewhere {History of the Pianoforte, Novello, London, 1897). But a positive identity of pitch cannot be claimed for any period of time, and certainly not for the early organs ; the foot-rule of the organ-builder, which had to do with the lengths of the pipes, and which varied in every country and province, could easily cause a differ- ence of a semitone. Scale and wind-pressure are also important factors. But with all these often opposed con- ditions, Ve find less variation than might be expected, the main and really important divergence being due to the necessity of transposition, which added a very high pitch to the primarily convenient low one.

The first to attempt to define pitch would seem to have been Arnold Schlick (Musica ausgeteutscht und ausgezogen, Heidelberg, 1511), who gives a measure, a line of 4|- Ehenish inches, which, he says, multiplied sixteen times, should be the lowest F of a small organ. He gives no diameter or wind-pressure. The late Dr A. J. Ellis used this indication to have an organ pipe made which, with one-sixteenth diameter and a wind-pressure of 3\ inches, at one-fourth Schlick's length, gave/^ 301-6, from which he derived a just major third of a' 377, which would compare very well with an old Greek a}. Schlick goes on to say the organ is to be suited to the choir and properly tuned for singing, that the singer may not be forced to sing too high or too low and the organist have to play chromatics, which is not handy for every one. Further, he says pitch cannot be exactly defined, because voices vary ; he nevertheless gives the measure above mentioned for the low F, but if a larger organ is built to include the still lower C, then this C must be of the same measui'emejit, the reason being that a greater part of Church music ends in " grambus," a word under- stood by Schlick's

editor to mean the transposition of a fourth. The larger high-pitch organ will therefore be at a^ 502-6. The Halberstadt organ, about which so much has been written, was, according to Praetorius (Syntagma Musicum, Wolffenbuttel, 1618), built in 1361, and repaired or rebuilt 1495. He gives the longest pipe of this organ, B natural, as 31 Brunswick feet, and the circumference 3^ feet. He further tells us this pitch was a tone, nearly a tone and a half, higher than a suitable church pitch {Ghorton), for which he gives a diagram. Dr Ellis had pipes (now preserved in the Koyal Institution, London) made to reproduce both these pitches at 3\ inches wind-pressure. The Halber- stadt pitch was found to be a^ 505-8 ; the Chorion, 424-2. Ellis used mean-tone temperament in calculating this lower pitch; but as he used just intonation for the Hal- berstadt, it seems preferable to substitute it for the Chorton, thus reducing it to a^ 422-8. Praetorius's Cam- merton, or chamber pitch, formulated in his diagrams for voices and instruments, is, he says, a whole tone higher; equivalent, therefore, to a^ 475-66. Nearly all the German organs in his time were tuned to this higher pitch. Ellis offered the suggestion of a much higher pitch for this Cammerton in his lecture " On the History of Musical Pitch," read before the Society of Arts, London (Journ. Soc. Arts, 6th March 1880), but the writer is unable to accept it. The lower vibration number is justified by due consideration of the three divisions of the male voice, bass, tenor, and alto, as given by Praeto- rius, whose Cammerton very closely corresponds with Bernardt Schmidt's Durham organ, 1663-68, the original pitch of which has been proved by Professor Armes to have been a^ 474-1. The Halberstadt pitch is nearly a semitone higher, which again agrees with the statement of

Praetorius, and also Schlick's high C organ. Yet it ~~would seem there had been a still higher pitch used in the old ecclesiastical music. Upon this interesting question Praetorius is confused and difficult to understand, but he never wavers about the transposition of a fourth. In one passage he distinctly says the old organ high pitch had been a~~

~~whole tone above his Cammerton, with which we shall find his Tertia minore combines to make the re~~ quired interval. The term ” Tertia minore,” or ” infe- riore” is used by Praetorius to describe a low pitch, often preferred in England and the Netherlands, in Italy, and in some parts of Germany. An organist, instead of transposing a whole tone down from the Cammerton, would for the Tertia minore have to transpose a minor third. A corroboration of this pitch is found in A. Sil- bermann’s great organ in Strasburg minster (1713-16), the pitch of which, taken in 1880 and reduced to 59Â° Pahr. (as are all pitches in this article), is a^ 393-2. An old organ at Versailles (1789) was very near this exam- ple, d^ 395-8. Sir Frederick Gore Ouseley (vide Ellis’s lecture) regarded the Erench ton de cliapelle as being about a minor third below the Diapason Normal, a^ 435, and said that most of the untouched organs in the Erench cathedrals were at this low pitch. Strasburg was Erench territory in 1713, but Silbermann’s organ is not quite a whole tone below. Ellis quotes an organ at Lille, a}- 374-2, but no other instance of the very low Schlick pitch is recorded, although trial of the Erench cathedral organs might perhaps result in the finding of examples. Ellis gives Dom Bedos {L’Art du Facture d’orgues, Paris, 1766) as authority for a mean tone a^ 376-6. To return to the Tertia minore. Dr R. Smith, of Cambridge, in 1759, had the organ of Trinity College, built by Bernhardt Schmidt, lowered a whole tone, to reduce it to certain Roman pitch pipes made about 1720. His determinations of pitch by a weighted wire are not trustworthy ; Ellis thinks they are not safe within four or five vibrations per second, but gives a mean pitch for this organ, when altered, of a^ 395-2. St Michael’s Church at Hamburg, built as late as 1762 and unaltered in 1880, had a 17th-century pitch, a^ 407-9. This is about a semitone below the Diapason Normal, and a just minor third lower than the St Jacobi organ in the same city (1688), measured by Herr Schmahl, a)- 489-2. What was remarkable in this organ was that it had one stop which was an equal minor third lower, a^ 411-4^. The difference of a minor third, or, as we shall see later, a whole tone, had replaced the earlier fourth. Sir Frederick Gore Ouseley’s com- parison of the church and chamber pitches of Orlando Gibbons {vide Ellis’s lecture) clearly shows the minor third in Great Britain in the first half of the 17th century. But the narrowing continued. Bernhardt Schmidt, better known in England

as Eather Smith, was invited about 1660 to build the organ for the Chapel Eoyal, Whitehall. Two years later he built the organ in Durham Cathedral, a} 474-1, difference a whole tone, and practically agreeing with the Cammerton of Praetorius. The Hampton Court organ of 1690 shows that Schmidt had further lowered his pitch a semitone, to a^ 441-7. What happened at Durham was that at some subsequent date the pipes were shifted up a semitone to bring the organ into conformity with this lower pitch, with which it is probable Schmidt's organs in St Paul's and the Temple, and also Trinity College, Cambridge, agreed. This lowering tendency towards the low church pitch, and the final adoption of the latter as a general mean pitch throughout the 18th century, was no doubt influenced by the intro- duction of the violin, which would not bear the high tension to which the lutes and viols had been strained. Harpsichords had long been preferred at the Tertia

minore. The Chorton of Praetorius, a^ 422-8, is practi- cally the same pitch as that of the fork the possession of which has been attributed to Handel, a^ 422-5. It is a very fair mean between G. Silbermann's 18th-century Dresden pitch, a^ 415, and the organs of Renatus Harris, a^ 428-7. Stein tuned Mozart's piano to a fork a^ 421-6, and the Broadwood pianos used at the London Phil- harmonic Society in its first concerts (1813) were tuned to a fork (? 606-8, which gives a mean tone a'

423-7.

According to Schindler (Niederrheinische Musik-Zeitung, 1865, Nos. 8 and 9) and the report of the Erench Com- mission, 1859, the rise in pitch began at the Congress of Vienna in 1816, the military bands being the cause. With the improvements in wind instruments this continued, as a more brilliant effect was gained. In 1823 Weber's Euryanthe is recorded as having been played in Vienna at a^ 437-5, and in 1834 Krentzer's NacMlager at a)- 440. The measurements are doubtful, but the upward tendency is clear. Scheibler, who was nothing less than trustworthy, owing to his simple and accurate Tonometer, has recorded pitches in Vienna about 1834 from a^ 433-9 to 440-2. About that time, or it may be a few years earlier. Sir George Smart established a fork

for the Philharmonic Society, a^ 433-2. Forks intended for this vibration number, stamped "Philharmonic," were sold as late as 1846. But about that year the performing pitch of the Society had reached 452-6. Sir Michael Costa was the conductor 1846-54, and from his acceptance of that high pitch the fork became known as Costa's, and its inception was attributed to him, though on insufficient grounds. In 1874 a further rise in the fork to a^ 454 was instigated by Sir Charles Halle. The British army is bound by His Majesty's Rules and Regulations to play at the Philhar- monic pitch, and a fork tuned to a' 452-5 in 1890 is pre- served as the standard for the Military Training School at Kneller Hall. But the Philharmonic Society adopted the Diapason Normal in 1896, and the military bands have not gone with it. In point of fact, they are gradually going higher, and the brass bands, which are so important in the North of England and in Wales, are not behind them.

It was the irrepressible upward tendency that caused the French Government in 1859, acting with the advice of Hal^vy, Meyerbeer, Auber, Ambroise Thomas, and Rossini, to establish by law the Diapason Normal. Other countries have gradually followed, and, with few exceptions, the low pitch derived from the Diapason Normal may be said to prevail throughout the musical world. Great Britain has been the last to fall in, but the predominance of the low pitch, introduced at Covent Garden Opera since 1880, is assured. The proprietors of Queen's Hall, London, did much for it when they undertook the alteration, at great expense of their large concert organ, which had only just been erected. In 1896 the Philharmonic Society decided upon a performing pitch, ostensibly at 68Â° F., of a^ 439 ; and in 1899 Messrs Broadwood made a success- ful effort to get this vibration number accepted by their competitors in Great Britain. The high pitch remains only where there are large concert organs not yet lowered, and with the military and brass bands.

The consideration of temperature as affecting the use of a standard pitch was not attended to when the Erench Government issued its ordonnance. The 15Â° Centigrade attached to the description of the standard fork in Paris was intended for^the definition and verification

of the fork only. The alteration of the fork due to heat is scarcely perceptible, but wind instruments, and particularly the organ, rise almost proportionately to the increase in’ tem- perature of the surrounding air, because sound travels at an enhanced rate as the temperature rises. The co- efficient of this rise is equivalent to half a vibration (0-6)

PITESCI â€” PITHIVIEES

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per degree Fahr. per second. Mr D. J. Blaikley (Essay on Musical Pitch, Catalogue of the Royal Military Exhibi- tion, Chelsea, 1890) and Mr Victor Mahillon (Catalogue descriptif et analytique du Musie, Bruxelles, troisifeme volume, appendice, 1900) have recorded their experience of wind instruments under changes of temperature. The French Commission, in establishing the Diapason Normal, should have chosen a temperature of 20Â° C. There would then have been less disturbance owing to the breath of the players and heat of the theatres or concert rooms. It would be a great advantage to get this higher grade generally adopted. It was proposed in the Stimm-Con- ferenz at Vienna in 1885, but not carried. Table III., showing orchestral pitches obtained in 1899, for the measurements of which the writer is responsible, prove how chimerical it is to hope for greater accuracy than is found between 435 and 440 vibrations a second for a}, inasmuch as temperature must always be reckoned with.

TaMe I.

1495 to 1690. Pitch descending.

Authority.

V. at59oF.

Halberstadt organ . . . 1495 Arnold Schlick, Heidelberg 1511 St Jacobi, Hamburg . 1688-93 St Catharinen, Hamburg . 1643 Praetorius. Cammerton . 1618 Durham organ .... 1683 Great Franciscan organ,

Vienna c. 1640

Hampton Court organ . . 1690

Ellis ....

Ellis

Sohmahl .... Degenhardt . . . Hipkins .... Armes and Ellis

Ullmann .... Ellis

a’ 505-8

502-6 489-2 480-8 475-65 474-1

457-6 441-7

Table II.

1511 to 1900. Pitch ascending.

Arnold Schlick, Heidelberg 1511 Strasburg Minster. A. Sil-

bermann .... 1713-16 Trinity College, Cambridge 1759 Versailles organ .... 1789 Praetorius “Tertiaminore” 1618 St Michael’s, Hamburg . 1762 Pascal Taskin’s tuning- fork, Paris 1783

St Jacobi, Hamburg,

“Tertiaminore “stop 1688-93 Hofcapelle, Dresden . . 1754 St Sophie, Dresden. G. Sil-

bermann 1722

Freiberg. G. Silbermann . 1714 Seville Cathedral . . 1785-90 Old English tuning-fork c. 1716 Imperial Russian Court

Church Band .... 1860 Stein's tuning-fork, Vienna 1780 Handel's tuning-fork . . 1751 Praetorius. Chorton . . 1618 Peppercorn's tuning-fork

(Broadwood) . . . .1813 Eenatus Harris, St An- drew's tJndershaft . . 1696 Renatus Harris, New-

castle-on-Tyne . . . 1670 C. Meerens, proposed standard derived from c? 512, and favoured by Boito and other Italian

musicians 1876

Sir George Smart, Philhar- monic 1826-34

Scheibler No. I., Vienna

orchestra 1834

Mental's tuning-fork, Paris

opera 1829

Scheibler No. II., Paris

opera 1834

Reissiger's tuning-fork, Dresden 1826

Authority.

Ellis ....

Stockhausen . . Smith and Ellis . M'Leod and Ellis Hipkins Sohmahl

Lissajous

Sohmahl Nake .

Nake Nake Ellis Ellis

Nake and Ellis . Nake and Ellis . Ellis .... Ellis and Hipkins

Ellis .... Ellis .... Ions and Ellis .

Meerens ....

Ellis

Scheibler .... Cagnard de la Tour Scheibler .... Nake

V. at59or.

fli 377-0

393-2 395-2 395-8 396-4 407-9

409-0

411-4 415-0

415-5 419-5 419-6 419-9

421-2 421-6 422-5 422-8

423-5

427-7 428-7

432-0 433-2 433-9 434-0 434-0 435-0

Table Il^continued.

1611 to 1900. Pitch ascending.

Paris Diapason Noi-mal.

Ordonnance .... 1859 ^Scheibler No. III., Paris

Conservatoire .... 1834 Paris Diapason Normal. Standard fork 1859

Paris opera 1836

Scheibler, Stuttgart, pro- posed standard (440 at

69Â° r.) 1834

Scheibler No. IV., Vienna

opera 1834

HuUah's tuning-fork . . 1842 Naples opera. San Carlo . 1857 Society of Arts intended for 444. (Since 1886 the Society of Arts has ad- vocated the Diapason

Normal) 1860

Broadwood's medium . . 1850 Paris grand opera . . . 1858 Lazarus's clarinet . . . 1843 Gewandhaus, Leipzig . . 1869

Berlin opera 1857

Milan opera, La Soala . . 1856 Philharmonic, London . 1846-54 KnellerHall 1890

Philharmonic, London . . 1874 Streicher's tuning-fork,

Vienna 1859

Strauss's Band, Imperial Institute, London, open air 1897

Authority.

Fr. Comm. . . .

Scheibler ....

Koenig

Cagnard de la Tour

Scheibler ....

Scheibler .... Ellis ... Lissajous . .

V. at 59Â° F.

Ellis .... Ellis .... Lissajous . . . Ellis and Hipkins Ellis .... Lissajous . . . Lissajous ... . EUis and Hipkins Hipkins . .

Hipkins . . .

Ellis

Hipkins

43rr0

435-2

435-45 437-0

440-2

440-3 441-3 444-9

445-7 445-9 448-0 448-0 448-2 448-4 450-3 452-5 452-5 454-0

456-1

457-5

Table

///.

Orchestral Pitch. 1899.

Authority.

v. at 68Â° F.

Leipzig

Berlin

New York

Boston . .

Bliithner

Bechstein .... Steinway .... Chickering . . . Broadwood . . .

Becker

Muhlfeld's clarinet A. Schiedmayer . Bosendorfer . . . Hipkins .... Erard ....

fli 435-0

438-0 438-6 438-8 439-0 439-4 439-5 440-0 440-0 440-0 442-4

London

St Petersburg

Meiningen (and Bayreuth) . . Stuttgart

London. Covent Garden opera . Paris

Verified by A. J. Hipkins. But for Leipzig a comparison with the Gewandhaus Band may be sought. (a. j. h.)

Pitesci, or PiTESTi, a small town in Rumania (Wallachia), situated on the right bank of the river Arges, and capital of the district of the same name. The branch railway to Curtea d' Arges leaves the main line at this point. Population ^900), 15,570.

Pithiviers, chief town of arrondissement, depart- ment of Loiret, 26 miles north-east of Orleans, on the railway to Malesherbes. The church of St Solomon is partly of the 12th century, and there are some remains of the ancient ramparts. Statues have been erected of the mathematician Poisson (d. 1840), and of the physician and agriculturist Duhamel de Monceau (1700-82), who in- troduced into his park at Monceau several hundred species of trees and shrubs previously unknown in Prance. The town is an important centre for saffron, the cultivation of which, originally introduced by the Jews of Avignon, was fostered by Louis XIV. Lark pies and almond cakes are noted comestibles. The shrine of St Solomon in the 9th, and that of St Gregory, an Armenian bishop, in the 10th century formed the nuclei of the town ; and the donjon built at the end of the 10th century for Heloise, lady of Pithiviers, from the design of Lanfroy, was one of

the finest of the period. Population (1881), 4745;

(1891), 5115 ; (1901), 6226.

Pitlochry, a village of Perthshire, Scotland, iu the midst of charming Highland scenery, at the south end of the Pass of Killiecrankie and on the banks of the Tummel, 7-^ miles south of Blair Athole and 28-|- north-north-west by rail from Perth. It is a favourite summer resort and excursion centre for the Scottish Highlands. Amongst its immediate attractions may be mentioned the Loch and Palls of Tummel, Killiecrankie Pass, and a couple of hydropathics. The village is well sheltered, although standing 300 feet above sea-level. Population (1901), 1541.

Pitman, Sir Isaac (1813-1897), English phono- grapher, was born at Trowbridge, Wiltshire, 4th January 1813, and educated at the local grammar school. He started in life as a clerk in a cloth factory, a business with which his father also was connected ; but in 1831 it was decided that he should become a schoolmaster, and for this purpose he was sent for training to the ISTormal College of the British and Poreign School Society in London. Between 1832 and 1839 he held masterships at Barton-on-Humber and Wotton-under-Edge, and from 1839 to 1843 he conducted a private school of his own at Bath. In 1829 he took up Taylor's system of short- hand, and from that time he became an enthusiast in developing the art of phonography. A detailed account of his own system (which he first expounded in 1837) is given under the article Shobthand (Ency. Brit. xxi. 838 et seq.). Pitman devoted himself to perfecting phono- graphy and propagating its use, and established at Bath a Phonetic Institute and a Phonetic Journal for his purpose ; he printed in shorthand a number of standard works, and his new book on phonography (1st ed., 1840) went through many editions. He was also an enthusiastic spelling reformer, and adopted a phonetic system which he tried to bring into general use. He was twice married, his first vsrife dying in 1857, and his second, whom he married in 1861, surviving him. In 1894 he was knighted, and on 22nd January 1897 he died at Bath. Sir Isaac Pitman's memory will live as the popularizer of short-hand at a time when the advance of the newspaper press and modern business methods were making it a matter of great commercial importance. His system adapted itself readily to the needs of journalism, and its use revolutionized the work of reporting. He was a non- smoker, a vegetarian, and a great advocate of temperance principles.

Pitt- Rivers, Augustus Henry Lane- Fox

(1827-1900), English soldier and archEeologist, son of W. A. Lane-Fox, was born 14th April 1827. It was not till 1880 that he assumed the name of Pitt-Kivers, on inheriting the Dorsetshire and Wiltshire estates of his great-uncle, the second Lord Elvers. Educated at Sand- hurst, he received a commission in the Grenadier Guards in 1845, being captain 1860, lieut.-colonel 1867, colonel 1867, major-general 1877, and lieut. -

general 1882. He served in the Crimean War, and was at the Alma and the siege of Sebastopol. His talent for experimental research was utilized in investigation into improvements of the army rifle, and he was largely responsible for starting the Hythe School of Mtisketry. It is not, however, for his military career, but for his work as an anthropologist and archseologist, that General Pitt-Rivers will be remembered. His interest in the evolution of the rifle early extended itself to other weapons and instruments in the history of man, and he became a collector of articles illustrating the development of human invention. His collection became famous, and, after being exhibited in 1874-76 at the Bethnal Green Museum, was presented in 1883 to the

University of Oxford. When, in 1880, General Pitt- Rivers obtained possession of his great-uncle's estates â€" practically untouched by the excavator since they had been the battleground of the West Saxons, the Romans, the Britons â€" he devoted himself to exploring the rich field of research which they offered. His excavations round Rushmore discovered a mine of materials of the utmost interest and value ; he founded a local museum to exhibit the results, and published several illustrated volumes recording them. As a scientific archseologist he was recognized as taking rank among the first. Oxford gave him the degree of D.C.L. in 1886 ; he was president of the Anthropological Institute, and F.R.S. He married, in 1853, Alice Margaret, daughter of the second Lord Stanley of Alderley, and had a numerous family; his second daughter became, in 1884, the wife of Sir John Lubbock (Lord Avebury). General Pitt-Rivers died at Rushmore, 4th May 1900.

Pittsburg, a city of Crawford county, Kansas, U.S.A., at the intersection of five trunk lines of railway, at an altitude of 934 feet. It has a level site and a regular plan, and is divided into four wards. It is in the lead and zinc region of south-eastern Kansas and south- western Missouri, and contains zinc smelting works. Popu- lation (1880), 624; (1890), 6697; (1900), 10,112, of whom 860 were foreign-bom and 365 negroes.

Pittsburg. â€" ^Pittsburg, the second city in Pennsyl- vania and chief iron and steel manufacturing centre in the United States, situated at the junction of the Alle- gheny and Monongahela rivers, where they unite

to form the Ohio river. The closing decades of the 19th century brought exceptional municipal and industrial growth. In 1880 the population within the city limits was 166,389, in 1890 it was 238,617, and in 1900 it was 321,616. The largest growth during the last decade of the century was in the manufacturing and residential suburbs outside the city limits. The total population for the entire industrial com- munity of city and suburbs, estimated in 1885 at 325,000 was 460,000 in 1890, and in 1900 was estimated at 650,000. For several years the city enjoyed in natural gas a smokeless and extraordinarily cheap fuel. About 1890 the supply began to be inadequate to the demand, and the price rose to a level which confined its main use to household purposes, and manufacturers returned to the coal of western Pennsylvania. The cheques passing through the clearing-house in 1883 aggregated $497,663,962. In 1901 they aggregated $2,047,605,967, or more than four times as much. In the same period the production of iron and steel in the city and its neighbourhood increased sixfold. In 1901 there were 34 blast furnaces, prodiic- ing 3,690,011 tons of pig iron, and (1899) 63 rolling mills and steel works, producing 4,134,917 tons of finished iron and steel. Of the entire production of the United States, the Pittsburg district in 1899 produced 24 per cent, of the pig iron, 34 per cent, of the Bessemer steel, 50 per cent, of the open-hearth steel, and 64 per cent, of the structural iron. Not only have existing works, such as the Carnegie Steel Company, the Westinghouse works, expanded until they are the largest in their respective lines in the world, but districts previously rural, such as Ford City, East Pittsburg, Glassport, Charleroi, and Davis Island City, have become manufacturing towns, so that the manufacturing district of Pittsburg has been extended 2r> to 30 miles up the Allegheny and Monongahela, and 10 miles down the Ohio. Within this manufacturing dis- trict in 1900 there were 3300 manufacturing establish- ments of all kinds, employing 250,000 men, and having aggregate assets of $2,000,000,000. The total freight tonnage of the district for 1899 was 58,666,697, of which

5,683,120 tons were shipped by river. In 1901 Pittsburg received a new charter under the state law for the govern- ment of second-class cities. The government consists of two branches of councils, and a Recorder as executive, directing departments of public works, public safety, and public charities. Under it about $30,000,000 have been expended for city improvements of all kinds. Prior to 1890 Pittsburg had no parks, but it now contains Schenley Park, of 422 acres, the greater part of which was the gift of Mrs Mary E. Schenley ; Highland Park, of 366 acres ; and seven smaller parks aggregating 132 acres ; and over a million dollars has been authorized for further park acquisitions. The County Court House of Allegheny county, which was completed in 1888, and cost about $2,500,000, is a splendid structure in the Roman- esque style, designed by H. H. Richardson. Another very prominent municipal building is the Carnegie Insti- tute, at the Schenley Park entrance, founded by Andrew Carnegie in 1894, and combining within one building a free library â€" which has branches throughout the city â€" an art gallery, a music hall, and a museum. On this foundation Andrew Carnegie has expended nearly $8,000,000, while his similar gifts to the suburban muni- cipalities amount to $2,000,000 more. Schenley Park also contains a fine conservatory, the gift of Henry Phipps ; and Highland Park contains zoological build- ings, the gift of C. L. Magee. The total assessed valua- tion of real and personal property in the city in 1900 was $352,682,792; the net debt was $19,600,569. The income for the fiscal year, not including loans of $7,137,410, was $9,251,065 ; and the total expenditures, not includ- ing loans repaid, were $10,838,360. The amount of cash on hand at the end of the fiscal year was $7,449,761. Of the total population in 1900, 84,878 were foreign-born and 17,040 were negroes. Out oJf 96,563 adult males, 7933 were illiterate (unable to write), of whom 6419 were foreign-born and 1116 were negroes. The death-rate in 1890 was 20-1 ; in 1900 it was 20. (See Allegheny.)

Pittsfield, a city of Massachusetts, U.S.A., capital of Berkshire county, on the Housatonic river, at an alti- tude of 1013 feet. It has a large area, 43 square miles, situated mainly in the broad, level valley between the Hoosac and Taconic mountains. The densely-built por- tion is regularly laid out, has a water supply derived from Lake Ashley by gravity, and

is divided into seven wards. It is on the main line of the Boston and Albany railway, and on a branch of the New York, ISTew Haven, and Hart- ford railroad. The city has extensive manufactures of cotton and woollen goods, boots and shoes, and paper. Population (1890), 17,281 ; (1895), 20,461 ; (1900), 21,766, of whom 4344 were foreign-born and 277 negroes.

PittStOn, a city of Luzerne county, Pennsylvania, U.S.A., on the north branch of the Susquehanna river, near the mouth of the Lackawanna, at an altitude of 571 feet. Its site is uneven, the street plan is irregular, and it is divided into eleven wards. It is on five railways, the Central of New Jersey, the Delaware and Hudson, the Delaware, Lackawanna, and Western, the Erie and AVyoming Valley, and the Lehigh Valley. It is in the anthracite coal region, and has a large coal trafiic. Its manufactures are varied. Formerly a borough, it re- ceived a city charter in 1894. Population (1890), 10,302 ; (1900), 12,656, of whom 3394 were foreign-born.

Pi Lira, the most northerly department of Peru ; area, 13,931 square miles. Popiilation (1896), 213,000. The principal towns of the department are Tumbez (3000), the most northerly port of Peru ; Paita (5000), the port of Piura ; and Piura, capital of the department (12,000) â€” all in provinces of the same names ; Catacaos, in the pro-

vince of Ayabaca ; Sechura (8500) ; and Sullana (7000), in Huancabamba. In the eastern mountain district are the towns of Morropon (5000), Tambo Grande (8000), and Chulucanas (6000).

Pizzo, a seaport town of the province of Catanzaro, Calabria, Italy, 72 miles north-east of Reggio on the west coast railway from Naples, and 27 miles south-west of Catanzaro, on a steep cliff overlooking the Gulf of Santa Eufemia. It has an old castle, in which Joachim Murat, ex-king of Naples, was shot on 13th October 1816. The people engage in tunny- and coral-fishing, and carry on an active coasting trade. In 1897 the port was cleared by 350 vessels of 66,542 tons. In 1783 the town was almost destroyed by an earthquake. Population (1899), about

8500.

Plague. â€” The exhaustive article by Dr J. E. Payne in the ninth edition of this work brings the history of plague down to about 1880. Since then much has happened to enlarge our knowledge of the disease from every point of view. The most striking feature of the previous history, summarized by Dr Payne, is the gradual retrocession of plague from the West, after a series of exceedingly destructive outbreaks extending over several centuries, and its eventual disappearance from Europe. It appears to have come to a sudden end in one country after another, and to have been seen there no more. Those lying most to the west were the first to be freed from its presence, namely, England, Portugal, and Spain. From all these it finally disappeared about 1680, at the close of a period of pandemic prevalence. Northern and central Europe became free about 1714, and the south of France in 1722. The last outbreak in northern Russia occurred in 1770. After this, plague only appeared in the south-east of Europe, where in turn it gradually died away during the first half of the 19th century. In 1841 its long reign on this continent came to an end with an isolated outbreak in Turkey. From that time until quite recently it has been extinct, except in the East. The province of Astrakhan, where a very small and limited outbreak occurred in 1878, is politically in Europe, but geographically it belongs rather to Asia. And even in the East plague was confined to more or less clearly localized epidemics ; it showed no power of pandemic diffusion. In short, if we regard the history of this disease as a whole, it appears to have lost such power from the time of the Great Plague of London in 1665, which was part of a pandemic wave, until the present day. There was not merely a gradual with- drawal Eastwards lasting nearly two hundred years, but the outbreaks which occurred during that period, violent as some of them were, showed a constantly diminishing power of diffusion and an increasing tendency to localiza- tion. The sudden reversal of that long process is there- fore a very remarkable occurrence. Emerging from the remote endemic centres to which it had retreated, plague has once more taken its place among the zymotic diseases with which Western communities have to reckon, and that which has for more than a century been little more than a name and a tradition has become the familiar object of investigation, carried on with all the ardour and all the resources of modern science. In what follows an attempt will be made to summarize

the facts and indicate the conclusions to be drawn from recent ex- perience.

Diffusion. â€” At the outset it is characteristic of this subtle disorder that the present pandemic diffusion cannot be traced with certainty to a definite time or place of origin. Herein it differs notably from other exotic diseases liable to similar diffusion. For instance, the last visitation

of cholera could be traced clearly and definitely to a point of origin in northern India in the spring of 1892, and could be followed thence step by step in its march Westwards. (See Cholera.) Similarly, though not with equal precision, the last wave of influenza was shown to have started from central Asia in the spring of 1889, to have travelled through Europe from east to west, to have been carried thence across the sea to America and the Antipodes, until it eventually invaded every inhab- ited part of the globe. (See Influenza.) In both cases no doubt remains that the all-important means of dis- semination is human intercourse. The ‘ movements of plague cannot be followed in the same way. With re- gard to origin, several endemic centres are now recognized in Asia and Africa, namely, (1) the district of Assyr in Arabia, on the eastern shore of the Red Sea; (2) parts of Mesopotamia and Persia; (3) the district of Garwhal and Kumaon in the North- West Provinces of India ; (4) Yunnan in China; (6) East and Central Africa. All these are mentioned by Dr Payne, with the exception of the last, which was recently discovered by Dr Koch. It includes the district of Kisiba in German East Africa, and extends into Uganda. In applying the term “en- demic centres ” to these localities, no very precise mean- ing can be attached to the word. They are for the most part so remote, and the information about them so scanty, that our knowledge is largely guesswork. What we mean is that there is evidence to show that under various names a disease identical with plague has been more or

less continuously prevalent for a number of years, but how long and how continuously is not known. Whether any of them are permanent homes of plague the evidence does not enable us to say. They seem, at any rate, to have harboured it since its disappearance from Europe, and probably further investigation would disclose a still wider prevalence. Eor instance, there are good reasons for believing that the island of Reunion has been subject, since 1840 or thereabouts, to outbreaks under the name of ” lymphangite infectieuse,” an elegant euphemism characteristically French. In all the coun- tries named, plague appears to behave very much as it used to do in Europe from the time of the Black Death onwards. That is to say, there are periods of quies- cence, with epidemic outbreaks which attract notice at irregular intervals. Taking up the story at the point where Dr Payne leaves off, we get the following list of countries in which plague is known to have been present in each year (Local Government Board’s Reports, 1898-99-1900) :â€” 1880, Mesopotamia; 1881, Mesopotamia, Per- sia, and China ; 1882, Persia and China ; 1883, China ; 1884, China and India (as mahamari) ; 1885, Persia ; 1886, 1887, 1888, India (as inahamari) ; 1889, Arabia, Persia, and China; 1890, Arabia, Persia, and China; 1891, Arabia, China, and India (as mahamari); 1892, Meso- potamia, Persia, China, Russia (in central Asia) ; 1893, Arabia, China, Russia, and India (as inahamari) ; 1894, Arabia, China, and India (as mahamari) ; 1895; Arabia and China; 1896, Arabia, Asia Minor, China, Japan, Russia, and India (Bombay) ; 1897, Arabia, China, Japan, India, Russia, and East Africa; 1898, Arabia, Persia, China, Japan, Russia, East Africa, Madagascar, and Vienna ; 1899, Arabia, Persia, China, Japan, Mes- opotamia, East Africa, West Africa, Philippine Islands, Straits Settlements, Madagascar, Mauritius, Reunion, Egypt, European Russia, Portugal, Sandwich Islands, New Caledonia, Paraguay, Argentine, Brazil; 1900, to the foregoing should be added Turkey, Australia, California, Mexico, and Glasgow ; and in 1901, South Africa.

This list is probably by no means exhaustive, but it sufficiently indicates in a summary fashion the extent

of that wave of diffusion which set in during the closing years of the 19th century and is still in progress. It did not fully gather way till 1896, when plague appeared in Bombay, but our modern knowledge of the disease dates from 1894, when it attacked Hong-Kong and first presented itself to accurate observation. From this point a more detailed account may be given. Plague was recognized at Hong-Kong in May 1894, and there can be little doubt that it was imported from Canton, where a violent outbreak â€" said to have caused 100,000 deaths â€" was in progress a few months earlier, being part of an extensive wave of infection which is believed to have come originally out of the province of Yunnan, one of the recognized endemic centres, and to have in- vaded a large number of places in that part of China, including Pakhoi and other seaports. Hong-Kong was severely affected, and has never since been entirely free from plague. In two intermediate years â€" 1896 and 1897 â€" very few cases were recorded, but more recently the epidemic has gathered force again. The following table gives the cases and deaths in each of the six years 1894-99 :â€"

Tear.

Oases.

Deaths.

Case Mortality.

1894

2833

2550

90 per cent.

1895

45

36

80

1896

1204

1078

89

1897

21

18

85

1898

1320

1175

89

1899

Total .

1486

1415

95

6909

6272

90-7 per cent.

The excessively high rate of mortality is probably due in part to under- statement of the number of cases. Con- cealment is practised by the Chinese, who are chiefly attacked, and it is easier to conceal sickness than death. Plague appears to have been equally persistent and destructive on the mainland in southern China during the period indicated, but no accurate details are avail- able. In 1897 the Portuguese settlements of Lappa and Macao were invaded. In addition to the provinces of Yunnan, Kwang-si, and Kwang-tung in Southern China, plague is reported to have been present for several years in a district in Mongolia to the north of Peking, and dis- tant about "twelve days' ride." More recently several localities in Mongolia and Manchuria have been affected. Formosa was attacked in 1896, and has suffered consid- erably in subsequent years ; in 1899 the Japanese Gov- ernment ofiicially reported 2633 cases, with 1974 deaths. Japan itself has had a certain amount of imported plague, but not on a large scale. Speaking generally, the disease has persisted and spread in the Far East since 1894, but precise information is lacking, except with regard to Hong-Kong.

In 1896 plague appeared in the city cf Bombay. It was certainly present in August, but was not recognized until 23rd September, and the diagnosis was not bacterio- logically confirmed until 13th October. This fact should be remembered when failure to recognize the disease on its first appearance occurs elsewhere. The origin of the Bombay invasion is shrouded in obscurity. It is not even known when or in what part of the city it began (Condon, Tlie Bombay Plague). Several theories have been put forward, but it seems useless to discuss con- jectures as to matters of fact in the absence of evidence. Importation by sea from China is the theory which has met with most acceptance. The native form of plague, known as mahamari, is confined to the southern slopes of the Himalaya. It is described by Dr Payne, whose account of plague in India begins with the epidemic of

1812-21, and may here be supplemented by some earlier references unearthed by the Bombay Gazetteer (vol. iv.). Ibn Batesta notices two destructive pestilences in the 14th century, and Ferishta one in 1443, which he calls ta'un, and describes as very unusual in India. At the end of the 16th century there was a pesti- lence following a prolonged famine, and in the 17th century two violent epidemics are recorded under the names ta'un and wdba. In the second of these, which occurred in the Ahmedabad district of the Bombay Presidency in 1683-89, buboes are distinctly described. In the 18th century several pestilences are recorded without description. It is at least probable from these notes that even before the undoubted outbreak, which began in Cutch in 1812, India was no stranger to epidemic plague. To return to Bombay and 1896 : the infection spread gradually and slowly at first, but during the first three months of 1897 not only was the town of Bombay severely affected, but district after district in the presidency was attacked, notably Poona, Karachi, Cutch Mandvi, Bhiwandi, and Daman. The number of cases and deaths reported in the. presidency, exclusive of the city, in each year down to the end of 1899, was as follows : â€"

Tear,

1896 1897 1898 1899

Total

Cases.

367

49,125

90,506

131,794

271,792

Deaths.

273

36,797

68,061

101,485

206,616

Case Mortality.

74-3 per cent. 74-7 â€ž 75-2 â€ž 77-0 â€ž

75 ‘S per cent.

The

corresponding figures for Bombay c

ity are : â€”

Year.

Cases.

Deaths.

Case Mortahty,

1896 1897 1898 1899

Total

2,530 11,963 19,863 19,484

1,801 10,232 18,160 15,830

71-1 per cent. 85-7 â€ž 91-2 â€ž 81-3 â€ž

53,840

46,023

85-4 per cent.

The total for the presidency, including the city, in four years was 326,632 cases with 252,549 deaths in a popular tion of 26,960,421 (census of 1891). The population of the city is 821,764, but during the earlier plague period large numbers fled, so that the foregoing figures do not give the true plague incidence according to popu- lation. Moreover, concealment was extensively practised, and there can be little doubt that the number of victims was really much greater than the official returns indicate. The most striking fact brought out by the tables given above is the large and steady increase year by year in the presidency, in spite of all efforts to arrest the spread of infection. It has gone on since 1899, and it has not been confined to Bombay, but has extended over the whole of India. In 1897 it had already penetrated to Eajputana, the Punjab, the ifTorth West Provinces, and the Central Provinces. In the following year Bengal, Madras, Haidarabad, and Mysore were invaded. Not all these provinces suffered alike, but on the whole plague steadily strengthened its hold on India generally, and hardly relaxed it in any part. The most noteworthy details available are as follows : â€” Calcutta, mortality, 192 in 1898, 2745 in 1899, 7449 in first half of 1900; Patna district, mortality in first half of 1900, 17,674 ; Punjab, mortality in 1898, 2049; Madras Presidency, mortality August 1898 to June 1900, 2892 ; Haidarabad, mortality in 1899, 4242 ; Mysore, mortality 1898-99, 15,597.

Out of China and India plague has caused no great mortality in any of the countries, enumerated above, in

which it has appeared, vnth the exception perhaps of Arabia, about which very little is known. But some of the outbreaks are interesting for other reasons, and require notice. The first case is the singular occurrence of three deaths at Vienna in October 1898, undoubtedly

occasioned by a laboratory accident. The earliest victim was an attendant named Barisch, employed in the patho- logical laboratory of the Vienna General Hospital, and told off to look after the animals and bacteriological apparatus devoted to the investigation of plague, cul- tures of which had been brought from India by the medi- cal commissioners sent by the Eoyal Academy of Science in 1897. Barisch was drunk and out all night on 8th October; on 14th October he fell ill. Plague was sus- pected, but Dr Miiller, who attended the man and had studied the disease in India, would not admit the diagno- sis on clinical grounds, nor was it bacteriologically estab- lished until 19th October. Barisch died on 18th October. On the 20th one of the nurses, and on the 21st Dr Miiller, fell ill. Both died of pneumonic plague, from which also Barisch had undoubtedly suffered. A second nurse and a sister of mercy had feverish attacks, but no further case occurred. Barisch was shown to have been careless in the performance of his duties, and to have disregarded instructions ; and the inference is that he conveyed the infection to his mouth, and so to the lungs, from the bacteriological specimens or inoculated animals. The melancholy incident illustrates several points of interest :

(1) the correctness of the bacterial theory of causation, and the identity of the bacillus pestis as the cause;

(2) the infectious character of the pneumonic type of disease ; (3) its high fatality ; (4) the difiiculty of diag- nosis. The next occurrence of special interest is the appearance of plague in Portugal in 1899, after an ab- sence of more than 200 years. Its origin is shrouded in obscurity. Oporto, the seat of the outbreak, had no connexion by sea with any place known to be infected, and all attempts to trace introduction ended in specula- tion or assumption. The most probable theory was that soldiers returning home from infected Portuguese posses- sions in the East brought it with them, but this does not explain the selection of Oporto and the escape of other places. The earliest cases, according to retrospective inquiry, occurred in June 1899 ; suspicions were aroused in July, but the diagnosis was not established until August. It was contended by some medical men that the disease had really been present long before ; but this view was supported by no better evidence

than the opinion held in the same quarters, but quite untenable, that it was not plague at all. The conclusion reached, after careful investigation by Dr Jorge, the medical officer of health, that the comm.encement really dated from June, is confirmed by the fact that about that time the riverside labourers, who were first affected, began to notice an illness among themselves sufficiently novel to attract their attention and that of an English shipowner, who from their description suspected plague. Through him the suspicion was conveyed to the Medical Times and Gazette, in which the suggestion of plague at Oporto was made before any public mention of it in the town itself. The outbreak never assumed large proportions. It gained ground by degrees until October, after which it declined, and eventually ceased in February 1900. No recru- descence has been officially announced. The number of cases recorded in a population of 150,000 was 310, with 114 deaths, representing a case mortality of 36-7 per cent. They were widely scattered about the town and outlying suburbs ; but no further extension occurred, except some isolated cases at Braga, a town 35 miles distant, and one at Lisbon, in the person of the distinguished bacteriologist, Professor Camara Pestana, who contracted the disease in

making a post-mortem at Oporto, and died in Lisbon. The only other appearance of plague in Europe in 1899 was on the Volga. Three places were affected, namely, Kolobovka and Krasnoyarsk, in the province of Astrar khan, and Samara, higher up the river. All three out- breaks were small and limited, and no further extension took place. A commission appointed by the Russian Government pronounced the disease to be undoubtedly plague, and it appears to have been very fatal. The origin was not ascertained.

The most interesting extensions of plague in 1900 were those in Australia and Glasgow. The following towns were affected in Australia: â€” Sydney, in New South Wales; Adelaide, in South Australia; Melbourne, in Victoria ; Brisbane, Eockhampton, Townsville, Cairns,

and Ipswich, in Queensland ; Fremantle, Perth, and Coolgardie, in West Australia. In none of these, with the exception of Sydney, did plague obtain a serious hold. The total number of cases reported in Queensland was only 123, with 63 deaths. In Sydney there were 303 cases, with 103 deaths, a case mortality of 34 per cent. The infection is supposed to have been brought from Noumea, in New Caledonia, where it was present at the end of 1899 ; and the medical authorities believe that the first case, which occurred on 19th January, was recognized. The outbreak, which hardly reached epidemic proportions, lasted about six months. That in Glasgow was on a still smaller scale. It began, so far as could be ascertained, in Aiigust 1900, and during the two months it lasted there were 34 cases and 15 deaths. Once more the disease was not at first recognized, and its origin could not be traced. In 1901 plague invaded South Africa, and obtained a distinct footing both at Cape Town and Port Elizabeth. The total number of cases down to July was 760, with 362 deaths ; the number of Europeans attacked was 196, with 68 deaths, the rest being natives, Malays, Indians, Chinese, and negroes. With regard to Great Britain, a few ship-borne cases have been dealt with at different ports from time to time since 1896, but except at Glasgow the disease has nowhere obtained a footing on land.

Causation. â€” Plague is a specific infectious fever, caused by the bacillus pestis, which was indentified in 1894 by Kitasato, and subsequently, but independently, by Yersin. An account of the organism will be found under the head- ing of Pathology {Parasitic diseases). It is found in the buboes in ordinary cases, in the blood in the so-called ” septicsemic ” cases, and in the sputum of pneumonic cases. It may also be present in the urine. Post mortem it is found in great abundance in the spleen and liver. Nothing is known of its natural history outside the body, but on cultivation it is apt to undergo numerous involu- tion forms. Its presence in a patient is regarded as posi- tive diagnostic proof of plague ; biit failure to find or to identify it does not possess an equal negative value, and should not be too readily accepted, for many instances are recorded in which expert observers have only succeeded in demonstrating its presence after repeated attempts.

It is clear, from the extreme variations in the severity of the illness, that the resisting power of individuals varies greatly. According to the Plague Research Committee of Bombay, the predisposing causes are " those leading to a lower state of vitality," of which insufBcient food is probably the most important. There is no evidence that age, sex, or race exercises a distinct predisposing influence. The largest incidence in Bombay was on young adults ; but then they are more numerous and more exposed to infection, because they go about more, than the younger and the older. Similarly, the comparative immunity of Europeans in the East may be explained by their different conditions of life. It is doubtful whether the distinction

drawn between pestis minor and pestis Tnajor (see Dr Payne's article) has a real aetiological basis. Very mild cases occurring in the course of an outbreak of typical plague may be explained by greater power of resistance in individuals, but the epidemic prevalence of a mild illness preceding the appearance of undoubted plague suggests some difference or modification of the exciting cause. " It is impossible," writes Sir Richard Thorne (Local Government Board Report, 1898-99), "to read the medical history of this disease in almost every part ol the world without being impresssed with the frequency with which recognized plague has been preceded by ail- ments of such slight severity, involvihg some bubonic enlargement of glands and some rise in body ~~temperature, as to mask the real nature of the malady." Considering the great importance of arresting the spread of infection at the outset, and the implicit reliance placed upon bacteriological criteria, the aetiology of such antecedent ailments deserves more attention than has hitherto been paid to it. Of course plague does not stand alone in this respect. Epidemic outbreaks of other diseases â€" for in~~ stance, cholera, diphtheria, and typhoid fever â€" are often preceded and followed by the prevalence of mild illness of an allied type ; and the true significance of this fact is one of the most important problems in epidemiology. In plague, however, it is of special importance, on account of the peculiarly insidious manner in which this disease fastens itself upon a locality.

The path by which the bacillus enters the body has not been satisfactorily determined. In pneumonic cases it is presumed to enter by the air-passages, and in bubonic cases by the skin, through some abrasion or crack. The Bombay Plague Research Committee, whose experience is unequalled, say : "In a number of instances points of inoculation were found on the extremities of patients, from which plague cultures were obtained, and in these cases buboes were found above the point of inoculation. In the majority of instances, however, no local indication could be found marking the point at which the microbe was implanted." Prom the fact that bacilli are hardly ever found in the blood of bubonic cases, it may be inferred that they are arrested by the lymphatic glands next above the seat of inoculation, and that the fight â€" which is the illness â€" takes place largely in the bubo ; in non-bubonic cases they are not so arrested, and the fight takes place in the general circulatory system, or in the lungs. As might be expected from these considerations, the bubonic type is very little infectious, while pneumonic cases are highly so, the patients no doubt charging the surround- ing atmosphere by coughing. Whether infection can be introduced through the digestive tract by infected food is doubtful. The bacillus is non-resistant and easily killed by heat and germicide substances, particu- larly acids. Little is known of its toxic action ; only a weak toxin has been obtained from cultures. Of the lower animals, mice, rats, guinea-pigs, rabbits, squirrels, and mon- keys are susceptible to the bacillus ; horses, cattle, sheep, goats, pigs, dogs, and cats are more or less resistant, but cats and dogs have been known to die of plague (Oporto, Daman, Cutch, and Poona). In the Great Plague of London they were believed to carry the infection, and were killed in vast numbers. The bacillus has been de- monstrated in the bodies of fleas, flies, bugs, and ants.

Clinical Characters.â€" One of the results of recent ob- servation is the classification of plague cases under three heads, which have already been mentioned several times: (1) bubonic, (2) pneumonic, (3) septicajmic. (The word "pesti-cremic " is also used instead of "septi-caemic," and though etymologically objectionable, it is otherwise better, as " septiciemic " already has a specific

and quite different meaning.) It should be understood that this classification is a clinical one, and that the second and third varieties are just as much plague as the first. It is necessary to say this, because a misleading use of the word ” bubonic ” has given rise to the erroneous idea that true plague is necessarily bubonic, and that non- bubonic types are a different disease altogether. The word ” plague ” â€” or ” pest,” which is the name used in other languages â€” had originally a general meaning, and may have required qualifications when applied to this particular fever ; but it has now become a specific label, and the prefix “bubonic” should be dropped. The illness varies within the widest limits, and exhibits all gradations of severity, from a mere indisposition, which may pass almost unnoticed, to an extreme violence, only equalled by the most violent forms of cholera. The mild cases are always bubonic; the other varieties are invariably severe, and almost always fatal. Incubation is generally from four to six days, but it has been observed as short as thirty-six hours and as long as ten days (Bombay Eesearch Committee). Incubation, however, is so difficult a thing to determine that it is unwise to lay down any positive limit. As a rule the onset is sudden and well marked. The symptoms may be described under the headings given above. (1) Bubonic cases constitute fully three-fourths of the whole, and the symptoms may there- fore be called typical. In a well-marked ease there is usually an initial rigor â€” in children convulsions â€” followed by a rise of temperature, with vomiting, headache, giddi- ness, intolerance to light ; pain in epigastrium, back, and limbs ; sleeplessness, apathy, or delirium. The headache is described as splitting; delirium is of the busy type, like delirium tremens. The temperature varies greatly ; it is not usually high on the first day â€” from 101Â° to 103Â° â€” and may even be normal, but sometimes it rises rapidly to 104Â° or 105Â° or even 107Â° Â¥. ; a fall of two or three degrees on the second or third day has frequently been observed. The eyes are red and injected ; the tongue is somewhat swollen, and at first covered with a thin white fur, except at the tip and edges, but later it is dry, and the fur yellow or brownish.

Prostration is marked. Constipation is the rule at first, but diarrhoea may be present, and is a bad sign. A characteristic symptom in severe cases is that the patient appears dazed and stupid, is thick in speech, and staggers. The condition has often been mistaken for intoxication. There is nothing, however, in all these symptoms positively distinctive of plague, unless it is already prevalent. The really pathognomonic sign is the appearance of buboes or infiamed glands, which happens early in the illness, usually on the second day ; sometimes they are present from the outset, sometimes they cannot be detected before the third day, or even later. The commonest seat is the groin, and next to that the axilla; the cervical, submaxillary, and femoral glands are less frequently affected. Sometimes the buboes are multiple and on both sides, but more commonly they are unilateral. The pain is described as lancinating. If left, they usually suppurate and open outwards by sloughing of the skin, but they may subside spontaneously, or remain hard and indurated. Petechise occur over buboes or on the abdomen, but they are not very common, except in fatal cases, when they appear shortly before death. Boils and carbuncles are rare. (2) Pneumonic plague was observed and described in many of the old epidemics, and particularly by two medical men, Dr Gilder and Dr Whyte, in the outbreak in Kathiawar in 1816 ; but its precise significance was first recognized by Childe in Bombay. He demonstrated the presence of the bacilli in the sputa, and showed that the inflammation in the lungs was set up by primary plague infection. The

pneumonia is usually lobular, the onset marked by rigors, with difficult and hurried breathing, cough, and expectoration. The prostration is great and the course of the illness rapid. The breathing becomes very hurried â€” forty to sixty respirations in the minute â€” and the face dusky. The expectoration soon becomes watery and profuse, with little whitish specks, which contain great quantities of bacilli. The temperature is high and irregular. The physical signs are those of broncho- pneumonia; oedema of the lungs soon supervenes, and death occurs in three or four days. (3) In septicaemic cases the symptoms are those of the bubonic type, but more severe and without buboes. Prostration and cere- bral symptoms are particularly marked; the tempera- ture rises rapidly and very high. The patient may die

comatose within twenty-four hours, but more commonly death occurs on the second or third day. Recovery is very rare.

There is no reason for doubting that the disease described above is identical with the European plagues of the 14th and subsequent centuries. It does not differ from them in its clinical features more than epidemics of other diseases are apt to vary at different times, or more than can be accounted for by difference of handling. The swellings and discolorations of the skin which play so large a part in old descriptions would probably be equally striking now but for the surgical treatment of buboes. Similarly, the comparatively small destructiveness of modern plague, even in India, may be explained by the improved sanitary conditions and energetic measures dictated by modern knowledge. The case mortality still remains exceedingly high. The lowest recorded is 34 per cent, in Sydney, and the highest 95 per cent, at Hong Kong in 1899. During the first few weeks in Bombay it was calculated by Dr Viegas to be as high as 99 per cent. It is very much higher among Orientals than among Europeans. In the Bombay hospi- tals it was about 70 per cent, among the former, and between 30 and 40 per cent, among the latter, which was much the same as in Oporto, Sydney, and Cape Town. It appears, therefore, that plague is less fatal to Europeans than cholera. The average duration of fatal cases is five or six days; in the House of Cor- rection at Byculla, where the exact period could be well observed, it was five and a half days. Patients who survive the tenth or twelfth day have a good chance of recovery. Convalescence is usually prolonged. Second attacks are rare, but have been known to occur.

Diagnosis. â€" When plague is prevalent in a locality, the diagnosis is easy in fairly well marked oases of the bubonic type, but less so in the other varieties. When it is not prevalent the diagnosis is never easy, and in pneumonic and septicaemic cases it is impossible without bacteriological assistance. The earliest cases have hardly ever been even suspected at the time in any outbreak in a fresh locality. As the doctor who was called to the first cases in Glasgow said afterwards, "It never occurred to me that I was dealing with plague." It very seldom does occur to medical men in similar circum- stances, and not

infrequently they continue to believe the disease is something else after full proof of its nature has been furnished. This will show the difficulty of diagnosis when plague is a novelty. In these circum- stances it may be taken at first for almost any fever, particularly typhoid, or for venereal disease or lymph- angitis. In plague countries the diseases with which it is most liable to be confounded are malaria, relapsing fever, and typhus, or broncho-pneumonia in pneumonic cases.

Treatment.â€” The treatment of plague is still symptom-

atic. The points requiring most attention are the cere- bral symptoms â€” headache, sleeplessness, delirium, &c. â€” and the state of the heart. Alcohol and cardiac stimu- lants may be required to prevent heart failure. Speaking generally, it is important to preserve strength and guard against collapse. Buboes should be treated on ordinary surgical principles. An antitoxic serum has been pre- pared from horses by the Institut Pasteur in France, but has not met with success. The results in India obtained by British and various foreign observers were uniformly unfavourable, and the verdict of the Research Committee (1900) was that the serum had ” failed to influence fav- ourably the mortality among those attacked.” Success was somewhat noisily claimed for an improved method tried in Oporto, but the evidence is of little or no value. Of 142 cases treated, 21 died ; while of 72 cases not treated, 46 died; but the former were all hospital patients, and included several convalescents and many cases of extreme mildness, whereas the non-serum cases were treated at home or not at all, some being only dis- covered when death had made further concealment im- possible. Moreover, it is not known how many non-serum eases ~~there really were to furnish the 46 deaths; 72 was the number notified, but an unknown number was con~~ cealed, which might entirely alter the proportions. Some light is thrown upon these curious statistics by the singu- lar fact that the mortality was nearly twice as great among those serum cases which had the advantage of the treatment from the beginning, as it was among those treated at a later stage of their illness and there- fore

under less favourable conditions. There were 7 deaths in 31 full-serum cases, and only 14 deaths in 111 part-serum cases. The only possible conclu- sion is either that the serum had an injurious effect, or that the statistics are valueless. Another se- rum, prepared by Lustig and Galeotti, has not been successful.

Morbid Anatomy. â€” (1) Bubonic cases. A bubo is found to consist of a chain of enlarged glands, surrounded by a mass of engorged connective tissue, coagulated blood, and serum. Nearly all the lymphatic glands in the body are a little swollen, but the lymphatic vessels show little or no change. The spleen and liver are always enlarged, the former sometimes to twice or thrice its natural size. The lungs are engorged and cedematous, and often show haemorrhages. The kidneys are enlarged and congested. The serous membranes show petechise and haemorrhages. The right side of the heart is frequently dilated, with clots in the cavities. The heart muscle is normal, or soft and friable. The substance of the brain, spinal cord, and nerve trunks is normal, but the membranes are engorged. (2) Pneumonic cases. The lymphatic glands are hardly affected. There is general engorgement and oedema of the lungs, with pneumonic patches varying in size and irregularly distributed. (3) Septicagmic cases. Nearly all the lymphatic glands in the body are involved, and have a characteristic appearance. They are enlarged to the size of an almond, rounded, firm, and pink ; there is some engorgement and oedema on section ; the substance is rather soft, and can be scraped off with a knife. The surrounding tissue is not engorged or cedematous. The description of the other organs given under (1) applies also to (2) and (3).

Dissemination. â€” Given the bacillus, the questions arise. How is it disseminated? and What are the conditions that favour its propagation? Only a very imperfect answer can be given. The perpetual failure to trace introduction, even with approximate precision, shows how obscure and secret the movements of this poison are. Perhaps it is unscientific to assume introduction as a matter of course in all cases, but its appearance in places

where it has been unknown for centuries, and in others where it has never been known at all, combined with the fact that seaports are the points of attack, is suffi- cient evidence to justify the assumption in general. That it is conveyed from person to person is an un- doubted fact, proved by innumerable cases, and tacitly implied by the word ” infectious,” which is universally allowed. The sick are a source of danger and one means of dissemination, and, since the illness may be so slight as to pass unrecognized, an obviously insidious one. The ambulatory plague patient goes far to explain the spread of the disease without leaving any track. But there is evidence that persons may carry the infection and give it to others without being ill at all themselves. One such case occurred at Glasgow, and another at Oporto. In the Glasgow case the wife of a laundryman employed in handling plague linen contracted the dis- ease. She was brought into connexion with it in no other way, and there can be no doubt that she took it from her husband, though he was not ill at all himself. The Oporto instance is still more conclusive. Two little girls had plague at Argoncilhe, a suburb some miles from Oporto, and were the only cases which occurred in that place. Their father was a riverside labourer, who lodged during the week in Oporto, but went home for Sunday. He was not ill, but several cases of plague occurred in the house in which he lodged. How the poison passes from one person to another is less clear. In pneumonic cases patients no doubt spread it around them by coughing, and others may take it up through the air-passages or the skin ; but even then the range of infection is small, and such cases are comparatively rare. In the vast majority of cases the bacilli are in the lymphatic or the circulatory system, and aerial con- vection, even for a short distance, seems highly improb- able. This view is borne out by the experience in hospitals and with ” contacts,” which goes to show that with reasonable care and under fair conditions the risk of infection from ordinary plague patients is very small. When persons live crowded together in close contact, and when they are careless with regard to discharges of all kinds from patients, the risk is obviously much increased. Discharges â€” vomited matters, sputa, urine, and faeces â€” are probably the media by which plague is chiefly spread from person to person. They also contaminate clothing, which thus becomes another means of dissemination cap- able of acting at a

distance. This is the most probable explanation of the two cases of indirect infection related above. Failure to catch or induce plague from clothing that has been worn by plague patients proves nothing. Such clothing is not necessarily infectious ; indeed, the probability is that it is not, unless contaminated by dis- charges. There is no evidence that merchandise and food- stuffs are means of dissemination, and a great deal of evidence against such a theory, but suspicion has some- times fallen on bakers' shops. Then we come to the lower animals. Attention has been concentrated on rats, and some observers seem disposed to lay upon them the whole blame for the propagation and spread of plague, which is held to be essentially a rat-borne disease. This hypo- thesis is in advance of the evidence, and not consistent with some of the facts. The susceptibility of rats has been noted from remote times and in many countries, part\c:i- larly in China, but it has never attracted so much attention as (^uring the recent prevalence of plague. From one place after another a great mortality among rats was reported, and the broad fact that they do die of plague is incontestable. It is therefore easily intelligible that they may play an important part in multiplying and fixing the poison on a locality. How they convey it to man is less clear, for they seldom come in contact 'with human

beings. They may conceivably infect articles of food, but the weight of the evidence is all against the convey- ance of plague by ingestion. Fleas have been suggested ; and that again is possible, for it has been shovra that rat fleas will bite man, but it can hardly happen often enough to account for the incidence of plague. Equally doubtful is the part played by them in disseminating the disease to a distance. Mortality among rats is said to precede the appearance of human plague, but the evidence of this is always retrospective and of a very loose character. The proof that rats migrate in large numbers to great distances is still more unsatisfactory. We are told that " armies of rats " were seen migrating on sundry occasions; but we are not told who saw them, or what an " army of rats " is. Such rhetorical lan- guage condemns itself.

The strongest evidence in favour of rat-borne plague yet produced is the experi- ence at Sydney, where a careful investigation was made. The conclusion reached by Dr Tidswell is that "there was no ground for even a suspicion that our epidemic was being maintained by any process of direct conta- gion between man and man," but that rats were the carriers. This seems to prove too much. The inference is that infected rats are more dangerous to human beings than infected persons, although the latter manufac- ture the poison on a much larger scale and come into far closer contact. In Glasgow the experience was just the contrary. Personal connexion was traced in every case, and rats excluded; there was no mortality among them, and of 300 caught and examined none had plague (Chalmers). Similarly, at Oporto personal connexion was traced in all the earlier cases ; there was no mortality among rats, and no evidence to con- nect them with the outbreak (Jorge). Again, a com- parison between rat-infested and rat-free districts in Bombay showed a much higher incidence of plague in the latter. A campaign against rats in Bombay, by which 50,000 or 60,000 were killed in a short time, had no effect in checking the disease. Plague-rats have rarely been found in ships sailing from infected ports ; and though millions of these animals must have been carried backwards and forwards from quay to quay between Hong-Kong, Bombay, and the great European ports, they have not brought the disease ashore. The evidence, therefore, is conflicting on the subject. Per- haps a fair conclusion is that rats are one of the means of disseminating plague ; but it can exist without them, and be spread by other agencies. According to the official history of plague in India (Nathan), rats are " certainly not so common a cause of infection as the sick person and his surroundings." Very little light has been thrown on the conditions which favour the prevalence of plague. We do not know why it has developed a diffusive activity of late years, nor why it has attacked some places and consistently passed by others, such as Singapore. The words "dirt" and " insanitary conditions " are much used, but such general terms explain nothing. Singapore, where plague has several times been introduced, but never taken hold, is probably quite as dirty and insanitary as Hong-Kong, and it is pertinently remarked by the Bombay Research Committee that filth per se has but little influence, inas- much as " there occurred in the House of

Correction at BycuUa, where cleanliness is brought as near to perfection as is attainable, an outbreak which exceeded in severity that in any of the filthy chawls and tenements around." Again, in Oporto there is an area which combines every possible sanitary defect â€" dense overcrowding, great pov- erty, no light, no air, no drainage, no scavenging, water brought in buckets. Plague got into this quarter, but did not spread there ; on the other hand, it appeared in

other and vastly superior parts of the town. Yet in at least one case neither the patient nor the " contacts " were removed, but were all shut up in one room with a sentry at the door and another in the street. The sea- sonal variations have been well marked and extremely regular in Bombay. The disease begins to be active in late autumn or the commencement of winter, and reaches its height in February or March, dying down in the summer. Mr Baldwin Latham has made an elaborate examination of the meteorological conditions, and more particularly of the vapour tension, from which he draws the conclusion that the seasonal variations are due to ex- halation from the ground. His observations are original and worth attention. A simpler explanation is that the people live more indoors, and are so more exposed to infection during the plague season. The curve shows two rises, one at the beginning of winter, and the other at the commencement of the monsoon, and at both these times the people are driven indoors. A broad survey of the epidemiological facts suggests some general conclu- sions. The outbreaks fall into two well-defined groups :

(1) those in which the disease is destructive and persis- tent, (2) those in which its effects are slight and transient. In the former the poison clearly fastens on the locality, and gradually increases its hold. The place is infected, not merely the people in it ; for if they evacuate it, the disease soon ceases among them, and if they return in a short time, they are again attacked. ISTow the poison is contained, as we have already seen, in the discharges from patients, and in such infected localities the standing conditions and the habits of the people combine to retain the discharges on the premises. The floors, mostly of mud covered with dung, are fouled with spittle, vomit, and urine, and, being seldom or never cleaned out, foster a gradual accumulation of poison, to which

infected rats and the concealment of illness contribute. These are just the conditions which prevailed in Europe in the old plague days. They do not prevail now in those ” white countries ” which have been invaded but have repelled the attack with comparative ease and little loss. It may be concluded, with some confidence, from experience and theory alike, that localities where they do not prevail may fail to keep plague out, but haye very little to fear from it, except the disturbance of trade caused by the traditional terrors that still cling to the name.

Prevention. â€” The principles are the same as those which govern the prevention of other infectious diseases. ” Sanitary cordons ” and the like are obsolete. Inter- national procedure is supposed to be regulated by the Venice Convention of 1897, but that instrument has never been ratified, and it contains an optional clause, which allows countries to do as they please with their own frontiers. Except Great Britain and Germany, they all retain quarantine in a more or lest stringent form at sea- ports. It is generally used as a system of local extortion imposed upon travellers and shipping. According to the Venice Convention, ships are divided into (1) healthy,

(2) suspected, (3) infected. (1) Healthy are those free from plague throughout the voyage ; (2) suspected, those in which plague has occurred, but no fresh case within twelve days ; (3) infected, those in which plague has occurred within twelve days. Great Britain relies on medical inspection, removal of sick or suspected cases, and supervision of the healthy arriving on an infected ship ; infected clothing is burnt and infected ships disinfected. The procedure is the same as for cholera, and it has been equally successful. Ships passing through the Suez Canal are subject to similar inspection ; sick persons are landed at Moses Wells, and suspected ones detained. The risk of importing plague from India has been materially lessened

by medical inspection of outward-bound ships at the principal ports. This has been very thoroughly carried out at Bombay with good

results. In 1897 pilgrimages from India to the Hedjaz were prohibited. By the Venice Convention a number of articles of merchandise are classed as susceptible and liable to be refused admission, but the only ones which there is any reason to consider dangerous are used clothing and rags. A watch should be kept on rats at ports of arrival and on board ships from infected countries.

When plague is present in a place, the measures to be taken are the usual ones for dealing with infectious dis- ease, with some additions. The sick and suspected should be removed in special ambulances to an isolation hospital, their soiled linen, &c., should be burnt, and the premises disinfected. Corrosive sublimate in an acid solution is the best disinfectant, but sulphuric acid, 1 in 250, is efficient and cheaper. Suspected cases should be bestowed in a special isolated building until the diagnosis is fully determined. ” Contacts ” should be kept under observa- tion. Rats should be exterminated as far as possible. The greatest care should be taken in dealing with the hospital linen and discharges from patients. Hospital staffs should be kept apart. Inoculation with Haffkine’s prophylactic fluid should be offered to all persons willing to avail themselves of it. It is especially desirable for hospital and ambulance staffs to be inoculated. This drug is prepared from sterilized culturesof plague bacillus. Inoculation is harmless, and the results obtained in India justify a favourable opinion of its protective efficacy. At Hubli, where nearly thÂ£ whole population was inoculated between 11th May and 27th September 1898, the mean mortality among the inoculated was 1-3 percent. ; among the uninoculated 13-2 per cent. At Daman the mortal- ity was â€” inoculated 1-6 per cent., uninoculated 24-6 per cent. ; at Dharwar â€” inoculated 1-2 per cent., uninoculated 6-2 per cent. In all these cases the numbers dealt with were large and the test fair. For further statistics and details the reader is referred to The Bombay Plague, by Captain Condon (official, 1900). Inoculation protects against attack, and greatly modifies the illness when it fails to protect. How long the protection lasts has not been determined, but it appears to be several months at least. Evacuation of streets and whole villages has been adopted in India with marked success, but in Western countries so drastic a measure is hardly feasible and not likely to be required.

Recent experience goes to show that plague is an ex- ceedingly difficult disease to keep out altogether, but a very easy one to control under fairly good local conditions, and even under bad ones provided that it is not allowed to implant itself firmly in a locality. When that happens, it is most difficult to eradicate or confine. Vigilance, therefore, on the part of medical men, and promptness on the part of the administrative authorities, are of the utmost importance. Backed by them, the foregoing measures may be relied upon with perfect confidence to dispose of plague quickly and effectually. Without them it is likely, in a favourable soil, to defy all measures.

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Plainfleld, a city of Union county, New Jersey, U.S.A., 24 miles from New York, of which it is in great measure a residential suburb, and with which it is connected by the Central of New Jersey railroad. It is regularly and beautifully laid out on a level site commanded by hills on the north-west and south-east, is divided into four wards, and has all municipal improvements. Population (1890), 11,267; (1895), 13,629; (1900), 15,369, of whom 2733 were foreign-born and 1450 negroes.

Planarians. â€” In reviewing the work done by natu- ralists on this group of animals since the publication in 1885 of the article on them in

the earlier volumes (ninth edition) of this Encyclopaedia, it will be necessary not only to notice the discovery of new forms and the progress towards a fuller anatomical knowledge of the different phases of life, but also to inquire how far later investigation of this class (Turbellaria) has contributed to a solution of the pressing modern problems of comparative physiology. Lastly, the views which are held as to the affinities of the group will be discussed.

Anatomical Discovery. â€” Although there has been a steady stream of publications dealing with the descrip- tions of new forms of Polyclads, Triclads, and Rhabdoccels, the advance in taxonomic and morphological knowledge has been most marked in the case of two groups, the "Turbellaria Acoela" and the "Land Planarians." In the former the advance is a morphological one. Com- paratively little is known of the specific variety of the Acoela, and no doubt there still exists a wealth of unde- scribed forms, as is shown by the discovery of such pecu- liar genera as Polychoenis (Mark, Festschrift f. Lenckart, p. 298), and the pelagic Haplodiscus. At present about a dozen species of Acoela are adequately known, and they have furnished the material for a monograph by von Graff {Turbellaria Acoela, Leipzig, 1891) which has shed a new light on many vexed questions, such as the nature of the " digestive parenchyma," the nervous system, and the relations of the Acoela to other Turbellaria.

Von Graff has shown that the parenchyma assumes a simple, an intermediate, and a complex grade of struc- ture. The simple parenchyma is seen in Monoporios. It consists of a nucleated vacuolated syncytium, and con- tains active amoebocytes, which are probably the chief agents in digesting the food and in supplying it to the surrouiiding tissues. In Amphiccerus the walls of the vacu- oles assume a firmer consistency and give more stability to the parenchyma, while in Con valuta jxtradoxa the syncytium is divisible into a central finely granular- pro- toplasm and a peripheral cellular parenchyma. The for- mer is presumably the digestive tract, while the latter is skeleto-trophic in nature, and, in addition to many un- specialized cells, contains the symbiotic brown struc- tures, which are apparently unicellular algae. In fact, the absence of a gut is more apparent than real, and the

anatomical study of known Acoela leads to the conclusion that from a common central syncytial mass those tracts have been developed to whicli in higher Turbellaria we give the names endodermal gut and mesodermal paren- chyma. The embryological study of the Aca4a has thrown no clear light on this subject (see Georgovitch, Arch. Zool. E.ip. ser. iii. vol. vii. p.' 343).

Another great advance in the morphology of this inter- esting group has been the discovery of the nervous system. This was first made in a convincing manner by Delage {Arch. Zool. Exp. ser. ii. vol. iv. p. 199) in 1886, and the details of the system are pretty fully described by von Graff in his monograph. The "brain" is always placed anteriorly, and is composed of two pairs of ganglia. One of these supplies .the otooyst and other sensory struc- tures, and gives off the outer pair of longitudinal nerve

tracts whicli course down the margin of the body. The other pair of cerebral ganglia gives off an ad-median and a lateral pair of tracts, and these form a small meshed plexus in the body-wall.

The appendix to von Graff's work on the Acoela con- tains Haberlandt's account of the nature of the green cells in Convoluta roscoffensis. This animal when just hatched contains no green cells, and it is said to die unless it comes into contact with a green unicellular alga (Georgo- vitch, loc. cit.). These algee form a definite assimilating tissue, and the Gonvohitce adopt a plant-like mode of life. The nature of the brown, yellow, and purple structures in many other (holozoic) Acoela is at present unknown. A peculiarity of this group which still holds good is the entire absence of any excretory system of " flame-cells," and of canaliculi in connexion with them.

It is to von Graff, again, that we owe the magnificent work (Monographie d. Turbellaria, 1899), dealing with the Land Planarians in a monographic and elaborately illustrated manner, the outcome of

twenty-five years' un- wearied devotion to the subject. The sections dealing with the nervous system, sense-organs, and reproduction are perhaps the most noteworthy. But the chapter and tables of distribution have the greatest general interest, since they form the first attempt on a sufficiently large scale seriously to consider the distribution of Land Plana- rians, and the manner in whicli it has come to pass. One of the most salient facts is the division of the family Geoplanidse into two closely related sections. Of these, one, the more primitive, inhabits South America; the other, Australia and New Zealand. Another striking conclusion is the contrast between Japan and the rest of the Palsearctic regions, and the almost complete re- striction of the family Bipaliidae to Madagascar, Ceylon, and Indo-Malaya (including Celebes).

Physiology. â€" The most noteworthy advance in recent zoology has been the broadening of its aims. Zoological science is no longer content merely to describe the ana- tomical facts of a group, to discriminate its members, and to determine its distribution and development. Such a collection of facts forms the basis for further investigation into the nature and influence of the factors which deter- mine the developmentâ€" sexual and asexual â€" of the indi- vidual; into the influence of the environment, organic and inorganic, intrinsic and extrinsic, in modifying metabol- ism and reproduction ; into comparative physiology and phylogeny. At present it must be admitted that although Planarians are very promising subjects for research on these questions, they have not been utilized by workers on the first two problems. We must therefore inquire what light research has thrown upon the organs of Planarians considered as structures for carrying out the functions of life. What indications have we as to the manner in which, e.g,, the muscles, nerves, secretory organs^as we know them in their highly differentiated character in Arthropoda, Annelida, and MoUusca â€" have arisen from the simple and yet multi-functional corre- sponding tissues of the lower Invertebrates ? The evidence of Planarians on this question may be expected to be especially valuable, since there is reason for believing that they form a basal group, intermediate in a physio- logical sense between the Ccelenterates (including Cteno- phores) and the segmented Chaetopoda.

As an indication of the intermediate character of Planarians, reference may "be made to tlie nervous system. In Ccelenterates this is composed of stellate ganglion-cells specially developed in relation to the musculature, whether ecto- or endodermic. These cells give off processes which serve partly to connect them inter se and with the muscles and skin. But these processes are equivalent. There are no distinct nerve-fibres. In the ganglion-cells and their processes there is no known differentiation of neurofibrillse (Apathy,

Mitt. Zool. Stat. Neap. vol. xii. pt. iv., 1897). Even in Cteno- phores the grade of structure remains as we find it in medusse or sea-anemones â€" simply a diffused plexus. In Chsetopods, on the other hand, the nervous system never exhibits anastomosing gang- lion-cells. There is a marked distinction between the central and the peripheral parts. The ganglion-cells are largely confined to the central nervous system, and their processes are of two kinds : nerve-fibres, which form the peripheral system, and branching out- growths (neuropile) confined to the core of the brain or cord. Neurofibrillse are found both in the body of the cell and in its processes. A neuropile is established which seems to be the real seat of reflex action, the ganglion-cells becoming centres of trophic actions. The question now is, Does the nervous system of Plana- rians show how the differentiation of these elements of the nervous system in the higher invertebrate has taken place from the Coelen- terate ganglionic plexus ? To some extent it may be said to do so, although we are not sufficiently acquainted with the minute struc- ture of the ganglion-cells of Planarians to be able to state the ori- gin of neuropile and neurofibrillae. The planarian nervous system possesses scattered ganglion-cells along the course of the chief paired tracts â€" dorsal, lateral, and ventral â€" and large multi- and bi-polar cells occur peripherally in relation to the muscles and sensory organs (Monti, Boll. Sci. Ann. Favia, vol. xviii. No. 24, 1897). In Triclads and Polyclads the brain is little more than a thickening due to the fusion of these tracts at the anterior end and on the ventral surface. There is no clear separation between central and peripheral portions. The gradual formation of neuropilar centres is seen in its inception. What is perhaps still more significant of the undifferentiated con- dition of the nervous system is its mode of reparation. A fresh- water Planarian can be

divided into a few or a great number of small pieces, and each of these will regenerate the organs of the entire animal, apparently so long as a small group of ganglion-cells is included in the severed part (Morgan, Arch. f. Entwicklung , vol. vii. p. 364, 1898). But the growth of the new ganglion-cells, as of some of the other tissues, is not due to a multiplication of pre-existing differentiated cells, but to certain elements of the "parenchyma" which have remained at an embryonic phase, and which in the severed portion give rise to new ganglion-cells. In sonje forms of Planarians asexual reproduction in this way is a normal physiological process.

This marked absence of " division of labour " in the planarian economy, as contrasted with the more complex and efficient mechanism of higher Invertebrates, is mani- fested by the other tissues, and in none more clearly than in the endoderm. In the Acoela the first indication of a separation and transference of the many functions of this tissue becomes apparent. But even in Triclads the gut still plays many parts. It digests, absorbs, and circulates the food. It is partially a respiratory organ. It contains excretory products either in the form of granules or in " flame-cells " embedded in its walls (Gunda) . There is some evidence (which requires confirmation) that the endoderm furnishes the ovaries and testes. Viewed from such a physiological standpoint, the Planarians ex- hibit little advance on the Ccelenterates, except in the presence of ducts (often of great complexity) belonging to the reproductive organs.

Afflnities. â€" There remains for discussion the chief problem with reference to this group that morphology sets itself to solve : What are the affinities of Planarians ? To this question there are at present two separate and irreconcilable answers. It is universally conceded that Planarians form a natural and homogeneous subdivision of the phylum Platyelmia. This being allowed, attempts have been made to solve the problem of the origin of this phylum in different ways, which may for convenience be distinguished as (1) the Trochophore hypothesis, (2) the Gastraea hypothesis. The view that this phylum is a de- generate outcome of more highly organized, segmented Annelids is not here discussed.

The Trochophore hypothesis is the oldest and most widely supported of these, but in its latest and most detailed form it is due to Hatschek (Lehrbuch d. Zoologie, 1891). Hatschek emphasizes the occurrence of the trocho- phore larva in many Invertebrate phyla (for example, Mollusca, Chaetopoda, Polyzoa, and Eotifera), and believes it to represent, not the larva of a common ancestor, but

the common ancestor itself of all invertebrates above the Planarians, the Echinoderms alone excepted ; and a mod- ification of this â€” the pro-trochula â€” is, Hatschek holds, to be considered as the point of meeting of flat-worms and all higher invertebrates. If we go farther, and in- quire what this pro-trochula may be and how it arose, Hatschek's reply would be that it is a hypothetical organ- ism represented by the stage in the development of the troehophore before the formation of the anus. How it arose is not clear. Kleinenberg (ZeitscJi. f. wiss. Zool. vol. xliv. p. 1, 1887) held that the Troehophore was a modified form of Medusa, while Hatschek compared it to a hypo- thetical Ctenophore in which the gonads and excretory vessels had become separated from the stomach. And he considered that the apical sensory plate, the mesenchy- matous musculature and ectodermic stomodseum were com- parable structures in both Troehophore and Ctenophore. Hatschek- concludes that Ctenophores, Platyelmia, and other Invertebrates (except Echinoderms) have a com- mon ancestor which resembled a Troehophore larva. The ingenuity of zoologists has devised several variants of the Troehophore hypothesis. The Ctenophore hypothesis of Lang (1884), which has been extended by Willey (1896), reaches much the same conclusion, though with differences of detail (see Bourne in Lankester's Treatise on Zoology, vol. ii., 1900). In both cases the Polyclad Turbellaria are assumed to be ancestral to the remaining Pianarians ; but from von G-raff' s work on the Acoela there appears to be strong grounds for doubting the validity of such an assumption. Both hypotheses are suggestive specula- tions,

and will remain so until we have some principles of embryology by which their real value may be gauged.

The Gastraea hypothesis has been propounded by von Graff on the basis of his study of the Turbellaria Acoela. ” I find,” he says (Turbellaria Acoela, p. 61), ” that the remarkable creature discovered by P. E. Schultze, ^nd described by hipi as Trichoplax adhwrens, represents a precursor of the Acoela leading straight to the Gas- trseadse.” Trichoplax has hitherto only been found in the marine aquarium at Graz. It is a flattened amoebi- form animal from 1‘6 to 3 mm. in greatest length. Dor- sally it is covered with a squamous epithelium, ventrally with ciliated columnar cells. Beneath this epidermis is a thin layer of circular muscle fibre. The central part of the body is composed of a jelly, secreted by mesenchy- matous cells, and contains both dorso-ventral muscle elements and peculiar refringent corpuscles. Fission is the only mode of reproduction as yet known. No ner- vous system nor otolith has been found. The Gastraeadss from which von Graff derives this Triclioplax, and through it the Acoela, is an obscure group of heterogeneous and problematical members, and there is much doubt as to its validity. The parasitic Dicyemids and Orthonectids form the greater part of it; some writers add Hali- physema and Physemaria, which others consider to be aberrant sponges. The only character which these Gas- traeadge have in common is a central core of nucleated tissue covered with an outer ciliated one. They may, in fact, be compared to planulae.

A more intelligible conclusion on the view that the Acoela are the basal group of Planarians would be to con- sider them, as Sedgwick has done {Text-Book of Zoology, p. 212, 1898), as “connecting forms between large In- fusoria and the higher animals, in which the endodermal protoplasm, though without a continuous cavity, is partly differentiated into a number of important organs.” It seems to the present writer that this conception of the intimate relation of the endederm to the parenchyma, and especially to the reproductive and nephridial organs, is a very promising one, and capable of considerable extension. The separation of the parenchyma from the

endoderm may take place “early in development, in the form of mesoblast-cells capable of secreting vast masses of a gelatinous or semi-fluid matrix forming the soft parenchyma analogous to the mesogloea of Coelenterates ; and just as in Anthozoa and Ctenophora the reproductive function and the function of excretion are largely the work of the endoderm cells, so in Turbellaria the endoderm appears to give rise to the gonads (in Polyclads, Triclads, and Ehabdocosls), and to excrete in the form of granules the greater part of the solid waste products, while the fluid ones are swept out by the nephridial canals. Yet even these canals are often closely related to the endoderm cells, and Lang has shown in Ounda that the flame-cells may lie in, and form part of, the endoderm. If we further consider the gradual differentiation of the parenchyma in the Acoela, the conclusion seems probable that the endoderm in Turbellaria has by no means lost, or lost connexion with, the functions of reproduction and excre- tion ; and that while it performs its characteristic work of digestion, it is still closely associated with the sexual and uropoietic properties which we connect with it in Coelenterates. Prom the fact that the parenchyma (and its contained organs) may remain in connexion with the endoderm throughout life (Acoela), or separate at a late period (larva of Styloclius pilidiurri) or early in develop- ment (many Polyclads), we should expect to find, on a more extended basis of observation, that this cell-layer exhibits in the Turbellaria that gradual differentiation into a number of different organs to which Mr Sedgwick has alluded. If that proves to be the case, the attempt by Hatschek {loc. cit.), followed by Lankester (Treatise on Zoology, vol. ii., 1900), to claim the so-called ” gen- erative sacs ” of Planarians as ” coelomic ” in nature, and to include the Platyelmia among the Coelomata (Ccelo- mocoela), must be given up. There are at present no facts to support it ; and what facts there are as to the origin of reproductive and nephridial tissues seem to show that there is actually no coelom at all, but that if it be desired to force the Platyelmia into the- ” Coelomata,” the branches of the gut itself will have to be considered as a virtual coelom. For this there is no more justification than in the case of many Coelenterates.

ADTH0RITIE8. â€” The literature on Planarians is conveniently summarized in the article “Flat- Worms” (Cambridge Natural History.

Macmillan. 1896) ; and in A Treatise on Zoology (editedbyE. Rat Lankester, P. K.S. Black. 1901). Partly., “Platyhelmia and Mesogoa.“â€” To these lists the following im- portant papers should be added:â€” Hesse (Zeit. Wiss. Zool. vol. Ixii. 1897. “On the Eyes of Planarians”).â€” Dorler (Ibid. vol. Ixviii. 1900. “On Certain Parasitic Rhabdocoels”).â€” And LoEB (Comparative Physiology of the Brain. Murray. 1901. “On the Nervous System and Response to Stimulation”).

(f. W. GA.)

Planquette, Robert (1850), French musi- cal composer, was born in Paris, 31st July 1850, and was educated at the Conservatoire. While little more than a boy he wrote numerous songs and operettas for cafe concerts, and sprang into fame as the composer of Les Cloches de Gorneville (Paris, 1877; London, 1878). In this popular work he showed a fertile if somewhat commonplace vein of melody, which won instant recogni- tion. There is besides in his music a touch of romantic feeling, which, had he cared to cultivate it, would have placed him far above contemporary writers of opera bouffe. Unfortunately, he did little but repeat the formula which originally brought him reputation. Le Chemlier Gaston, his next work, was produced in 1879 with little success. In 1880 came Les Voltigenrs dtt 32me, which had a long run in London in 1887 as Tlie Old Guard, and La Cmi- tinih-e, which was translated into English as Nectarine, though never produced. In 1882 Planquette’s Bip ran

Winkle was produced in London, being subsequently given in Paris as Bip, in both cases with remarkable success. The libretto, an adaptation by H. B. Farnie of Washington Irving’s famous tale, brought out what was best in Plan- quette’s talent. In Rip van Winkle there is a note of tenderness and even of pathos such as is rarely heard in works of this kind. In 1884 the phenomenon of an opera by a French composer being produced in London previously to being heard in Paris was repeated in Mil Gfwynne. In this work Planquette reached the highest point of his

achievement. His score was carefully written, and some of the concerted music was excellent. It suffered from being allied to a libretto of more than ordinary in- anity and inconsequence. Nell Owynne was tolerably successful in London, though it failed completely when produced in Paris as La Princesse Colombine. Nell Gwynne was followed by La Cr&maiMre (Paris, 1885), Snrconf (Paris, 1887 ; London, as Paul Jones, 1889), and Captain TJiir&se (London, 1887). A change in popular taste banished French opSra bouffe from the London stage during the last decade of the 19th century, its place being taken by so-called musical comedy of home manufacture, and none of Planquette's later works found their way across the Channel. The most successful of his more recent productions have been La Cocarde Tri-colore (Paris, 1892), Le Talisman (Paris, 1892), Panurge (Paris, 1896), and Mam'zelle Quat'sous (Paris, 1897). Planquette is more gifted naturally than any writer of op4ra bouffe of his time. His melodies are always fluent, and often original, but the workmanship of many of his operas suffers from the fact that he appears to aim at nothing but popularity of the most transient description.

Plasencia, a town of Spain, province of Caceres, on the right bank of the river Jerte. It has some trade in agricultural products and live stock, and the local industries are unimportant. It is still interesting on account of its churches and convents, and as the highroad to the monastery of Yuste (St Just), where Charles V. retired and died. Population (1877), 7090 ; (1897), 8361.

Plate River, or Eio de la Plata, a funnel-shaped estuary, on the east side of South America, extending west-north-west from the sea about 170 miles. Its ex- treme breadth at its mouth is 138 miles. It narrows quickly to 57 miles at Montevideo, and at its head, where it receives the united Parani and Uruguay rivers, its width is about 25 miles. Its northern or Uruguayan shore is somewhat elevated and rocky, while the southern or Buenos Airean shore is very low, and much of it has a tosca rock cap which gently dips under the river-bed. The whole estuary is very shallow, and in no place above Montevideo exceeds 36 feet in depth when the river is low. The bottom generally consists of enormous banks of sand covered with from 10 to 20 feet of water, and

there is a continuous and intricate channel, of about 22 feet depth only, to within 14 miles of the port of Buenos Aires. The remaining distance has a depth of 18 feet in the uncertain channel. At times, however, the river is so low that for three or four days together carts can drive out a distance of three miles or more from the shore. Azara says that ” in 1796 the water fell so much in a calm day, that for three leagues out the shore was exposed, remaining so a whole day.” The Plata is simply the estuarine receptacle of two mighty streams, the Uruguay and Par and, -yrhich drain the Plata basin. This has an area of 1,198,000 square miles, or over two and one-half times that of the Pacific slope of the Andes, and comprises the most fertile, healthiest, and best part of Brazil, a large portion of the Argentine Republic, the

whole of Paraguay and south-eastern Bolivia, and most of Uruguay.

The Uruguay river has a length of about 1000 miles. Many- small streams from the western slope of the Brazilian Serra do Mar unite, in about 27Â° 45′ S., to form this river, which then, in imposing volume, flows west-north- Tj’^ westwards, serving as the boundary between the states aÂ«d*â„¢*^ of Santa Catharina and Rio Grande do Sul, as far as a/fluents. 52Â° W., near which it receives a considerable tributary from the north, called the Pepiri-guazu. Throughout this section it is enriched by many minor streams, mostly from the highlands which cross the state of Eio Grande do Sul. Between 27Â° 58′ and 33Â° 34′ S. three important tributaries join it from the east â€” the Ipui-guazu, the Ibiciti, and the Negro, the last being its main affluent. A few unimportant streams enter it from the Argentine provinces of Misiones, Corrientes, and Entre Eios, the GualeguaychU being the largest.

The Pepiri-guazli was one of the limits between the possessions of Portugal and Spain. Its lower course is about 250 feet wide, but higher up it narrows to about 30 feet, and runs with great violence between high wooded banks. It is navigable for canoes for about 70 miles above its mouth, as far as its first fall. The Rio Negro has a delta of several large islands at its confluence with the Uruguay. Its head-waters are in the southern part of Rio Grande do Sul, but the main river belongs entirely to the state of Uruguay, which it cuts midway in its course from

north-east to south-west. En route it receives a great number of copious afflu- ents and waters a most inviting region. Its lower reaches are navigable for craft of moderate draught.

From the time the Uruguay leaves the coast range of Brazil, it runs for a long distance through a beautiful, open, hilly country, but afterwards enters a forest belt of high lands. At the river Pepiri-guazli it turns suddenly to the south- Course west, and continues this course to its junction with the "J Parani and Plata. Near Pray Bentos, 61 miles before /""suay. reaching the Plata, it forms a great lake, about 56 miles long and from 4 to 6 miles wide. At Punta Gorda, where it debouches into the Plata, it is only 1 mile to 1| mile wide, but is 90 feet deep. From the Pepiri-guazd junction its banks are high and covered with forest as far down as 27Â° 30′ S., where the river is 2300 feet wide and from 10 to 40 feet deep. Thence its course is through a smooth and generally open, but occasionally broken, country ; but along the lower 100 miles of its eastern side there are picturesque hills, from 100 to 500 feet high, divided by many rivulets, which fertilize rich valleys beyond, while the Entre Rios margin is low, monotonous, and wooded. The Uruguay is much obstructed by rocky barriers. Four miles below its confluence with the Pepiri-guazu it has a cataract, about 8 miles long, with a total fall of 26 feet at low water. 'The river near the Pepiri- guazii is 1550 feet wide, but about 1| mile before reaching the cataract its width is reduced to 600 feet. Along the cataract it is closed in between high precipitous walls of black rock only 70 feet apart. Above Punta Gorda, 212 miles, is the Salto Grande, which has a length of 15 miles of rapids, the greatest single fall being 12 feet, and the difference of level for the entire length of the reefs 25 feet. These cross the river diagonally, and during floods all, excepting a length of IJ mile of them, are submerged. Nine miles below the Salto Grande is the Salto Chico, which bars navigation during six months of the year, but in flood-time may be passed in craft drawing five feet of water. The Uruguay can be navigated at all seasons by vessels of 4| feet draught as far up as the Salto Chico, and of 14 feet up to Paysandti for a greater part of the year. Fray Bentos may be reached all the year round by any vessel that can ascend the Parana. Above the navigable lower river there is launch and canoe naviga^ tion for many hundreds of miles upon the main

artery and its branches, between the rapids which are met with from time to time. The Uruguay has its annual floods, due to the rains in its upper basin. They commence at the end of July and continue to November, attaining their maximum during September and Octo- ber. At the narrow places the river rises as iiigh as 30 feet, but its average rise is 16 feet. It flows almost for its entire course over a rocky bed, generally of red sandstone, at times very coarse and then again of extremely fine composition. Except in floods, it is a clear-water stream, and even at its highest level carries comparatively little silt.

The Parana (the "Mother of the Sea" in Guarani) drains a vast area of southern Brazil. It is formed by the union of the Bio Grande and Faranahyha, and is about 1600 miles long from its extreme source in Goyaz to its junction ^^^ with the Paraguay, and thence 600 more to the Plata '"^ff estuary. Its average width for the latter length is fff/ e fa from 1 to 3 miles. Its Rio Grande branch descends " " '

from the slope of the Serra da Mantiqueira, in the region where the orographic system of Brazil culminates near the peak of Itatiaia-assii, almost in sight of Rio de Janeiro. It is about 680

miles long, but only navigable in the stretches between the many- reefs, falls, and rapids which interrupt its regular flow. Among its numerous affluents, the principal one is the Bio das Mortes, rising in the Serra Mantiqueira. It is 180 miles long, with two sections, of a total of 120 miles, which are navigable for launches. The main branch of the Parana, the Paranahyba, rises in about 15Â° 30′ S., on the southern slopes of the Pyreneos mountains, and receives numerous tributaries before its confluence with the Rio Grande, near which it is barred by two cataracts. It drains a little-linown region of Goyaz and western Minas Geraes, lying upon the immediate southern watershed of Brazil.

Besides these rivers, the Parana has many long and powerful affluents from the Brazilian states of Sao Paulo and Parana ; but its western

ones, limited by the Serra Cayapo and the highlands which border north-eastern Paraguay, are not of equal importance. Most of them, although obstructed by rapids, are navigable for launches and canoes. Among the eastern tributaries are the Tiete, the ParanA-panema, formerly known as the Anemby, and the Iguazu.

The Tiete, over 700 miles long, rises in the Serra Parandpioaba and flows in a north-west direction. “With the river Pardo, it was the favourite route of the ” Sertanistas ” â€” explorers and raiders of Matto Grosso â€” although its course is broken by fifty-four rapids, and the lower river by two falls, the Avanhandava, 44 feet drop, and the Itapura, 65 feet.

The ParanA-panema is about 600 miles long, and rises in a ram- ification of the Serra Parandpicaba which overlooks the Atlantic Ocean. Its general course is north-west. From the south it re- ceives many important tributaries, and from the north about a score of affluents, all of small volume. It is navigable for a distance of only about SO miles above its mouth, and for its whole course it has so many obstructions that it is useless for commercial purposes.

The Iguazu, also called the Rio Grande de Curutiba, has its sources on the slopes of the Serra do Mar of Brazil, and flows nearly west, through thick forests, along the line of 26Â° S. Its nav- igation is difficult even for small craft, as it is full of reefs, rapids, and cataracts. Sixteen miles above its mouth is the magnificent Salto del Iguazu, sometimes called the Victoria Fall, round which canoes have to be transported 37 miles before quiet water is reached again. Its mouth is about 800 feet wide, and tlie depth in mid-river 40 feet. The volume of water which the Iguazd receives from its four principal branches and numberless small streams is large ; and as the great river tumbles 197 feet over the Iguazii fall into a wild gorge, the scene is of imposing grandeur. The width of the falls, measured along their crest or edge, is 21 miles ; part of the river takes two leaps of about 100 feet each, but a portion of it plunges down the whole depth in unbroken mass.

The Parana, at a point 28 miles above the mouth of the Ti6t6, is interrupted by the falls of Urubuponga, but below these it has

unobstructed navigation for about 400 miles, as far Course ot ^^^^ s the falls of Guaira, in 24Â° 3′ S., where the p . river forms a lake 4J miles long and 2J miles wide, pre- arana. paratory to breaching the Serra de Mbaraoayii, which there disputes its right of way. It has torn a deep gorge through the mountains for a length of about 2 miles, where it is divided into several channels, filled with rapids and cataracts. It finally gathers its waters into a single volume, to plunge with frightful velocity through a long caJion only about 200 feet wide. From these so-called falls of Guaira, or ” Sete Quedas,” as far as its confluence with the Paraguay river, the Parana has carved a narrow bed through an immense cap of red sandstone, along which it sometimes flows with great rapidity, occasionally being interrupted by dangerous narrows and rapids, where the banks in some places close in to a width of 450 to 600 feet, although the average is from 1200 to 1600 feet. At the south-east angle of Paraguay the Parang is prevented from continuing its natural southern course to the river Uruguay by the highlands which cross the Argentine province of Misiones, and connect those of Rio Grande do Sul with the Caa-guazii range of Paraguay. Here, therefore, it is turned westwards ; but before escaping from its great sandstone bed, it is obstructed by several reefs, notably at the rapids of Apip, which are the last before it joins the placid Paraguay, 130 miles farther on. From the Apip6 rapids there is a vast triangular space at the south-western corner of Paraguay but little above sea-level, consisting of low, sandy ground and morasses, at times flooded by the Paraguay river. This district, united to the equally enormous area occupied by the Yberd, lagoon and its surrounding morasses, in the northern part of the Argentine province of Corrientes, was probably the delta of the Parand, river when it emptied into the ancient Pampean Sea. The Parana is charged with but little silt in comparison with its much smaller affluent, the Paraguay, although in flood it carries a volume of water estimated to be ten times that of the latter stream, and its width along the northern sandstone border of the province of Corrientes is from 3 to 9 miles.

The river Paraguay, the main affluent of the Parang, rises in

Matto Grosso, in the vicinity of the town of Diamantino, about 14Â° 24′ S. It flows south-westwards, as far as “Villa Maria, ^^^ along the foot of the high plateau which divides it from Paraguay. the Cuyaba river to the east, and then, turning south- wards, soon reaches the morass expansion of Xarayas, which it traverses for about 100 miles. A few

miles below Villa Maria it receives an afliuent from the north-west, the JaurA, which has its source nearly in contact with the head-waters of the Guapor^ branch of the river Madeira. The Cuyabd, which is known as the Sao Lourengo for 90 miles above its confluence with the Paraguay, has its sources in l:iÂ° 45′ S., almost in touch with those of the Tapajos branch of the Amazon. The Cuyabd, flows past them at a right angle, from north-east to south-west, for a distance of 160 miles, and is only separated from them by the plateau-ridge of Trombador, which in places is not 3 miles wide. As it flows onwards it is enlarged by a great number of minor streams, es- pecially from the north-west, until it reaches the spur of the , great sandstone plateau, at the south-eastern point of which the town of Cuyaba is situated ; thence it enters the upper margin of the vast, swampy, and inundated region between the rivers Paraguay and Sao Lourengo. Just below the point where it takes this latter name it is 700 feet wide. Above the town of Cuyabd it is from 150 to 400 feet wide, and may be navigated up stream by canoes for 150 miles ; but there are many rapids. The town may be reached from the Paraguay river, at low water, by craft drawing 18 inches. According to the observations of Clauss, Cuyaba is only 660 feet above sea-level. From the junction of the Sao Lourengo (or Cuyaba) with the river Paraguay, the latter, now a great stream, moves sluggishly southwards, spreading its waters, in the rainy season, for hundreds of miles to the right and left, as far south as 20Â°, turning vast swamps into great lakes â€" in fact, temporarily restoring the region, for thousands of square miles, to its ancient lacustrine condition.

On the west side of the upper Paraguay, between about 17Â° 30′ and 19Â° S., are several large, shallow lagunas or lakes which receive the drainage 6f the southern slopes of the Chiqultos sierras, but represent mainly the south-west ^^Â°Â°"^ overflow of the vast morass of Xarayas. The principal Paraguay. of these lakes, naming them from north to south, are the Oberaba, the Gaiba, Mandior^, and the "Bahia" de Casares. The Oberaba is the largest ; its margins are completely inundated at high water, and the surrounding lands, as far as the eye can see, are tree-covered swamps and creeks choked with aquatic plants. The Gaiba is connected with the river Paraguay by a

short cano or canal, said to offer 7 feet depth of water in the channel. The total length of the lake, which is in two unequal divisions, is

11 miles ; its greatest width is 5 miles, and its maximum depth

12 feet â€” all at low water. It has long shelving shores which prevent access to its margins, except with craft of extremely light draught of water. The northern division of the lake belongs entirely to Brazil, but the southern division, about two-thirds of its area, is bisected from north to south by the boundary-line between Brazil and Bolivia, according to the treaty of 1867. It is in great part surrounded by high ground and hills, but its southern coast is swampy and flooded during the rainy season. The west shore is historic. Here, in 1543, the conquistador, Martinez de Irala, founded the ” Puerto de los Reyes,” with the hope that it might become the port for Peru ; and from Lake Gaiba several expeditions, in Spanish Colonial days, penetrated 500 miles across the Chaco to the frontier of the empire of the Incas. At the Puerto de los Reyes Bolivia laid out a town in December 1900, in the forlorn hope that the “Port” may serve as an outlet for that commercially suffocated country, there being no other equally good accessible point for Bolivia on the Paraguay river. “West of, and almost in contact with, the Gaiba is the smaller laguna Gaiba-Merim. A little to the south of the Gaiba is the shallow and useless Mandior6 lake, and it is probably con- nected with it by a caTio choked with weeds. Still farther south is the lake called the “Bahia” de Casares (Puerto Suarez), 19Â° S. It is too shallow to navigate, except by craft drawing less than 3 feet of water. “Bahia” Negra, 20Â° 10′ S., is an irregular flooded region forming a group of large connected lakes on the west side of the Paraguay river. They take the drainage of the river Otuquis, through the sandy district in which it is lost in its unsuccessful effort to reach the Paraguay. As an outlet for the country to the west and north of it the Bahia Negra is valueless.

South of the Sao Louren90, the first river of importance which enters the Paraguay from the east is the Taquary, about 19Â° S. It rises in the Serra Cayap6, on the southern extension of the Matto Grosso tableland. It is a river famous â– ”“Â«”< in the history of the slave-

raiders from Sao Paulo in Â»'"â– * the 16th century. South of this stream, about 50 Â«"'*'"Â«>'â€¢ miles, a considerable river, the Mondego, with many branches, drainhig a great area of extreme southern Matto Grosso, also flows into the Paraguay ; and still farther south, near 21Â°, is the Api'i tributary, which forms the boundary between Paraguay and

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The Pll- comayo

Brazilian Matto Grosso. From northern to southern Paraguay the western drainage slope sends numerous short streams to swell the Paraguay. Prom the west it has but few and very short tribu- taries until the river Pilcomayo is reached, the country being too flat and the soil too sandy and thirsty to allow any large amount of water to flow to the great river.

The Pilcomayo is of more importance from its length than from its volume. It rises among the Bolivian Andes north of Potosi and north-west of Sucre, races down the mountains to their base, crosses the Chaco plains, and pours into the river Paraguay near Asuncion. Nor does it receive any branch of importance until it reaches about 21Â° S., where it is joined from the south-west by the river Pelaya, upon which Tupiza, the most southerly city of Bolivia, is situated. The Pelaya rises upon the lofty inter-Andean plateau, and, taking an easterly course, saws its way across the inland Andean range, turns northwards and then eastwards to unite with the Pilcomayo, which it is said at least to equal in volume. Just below the junction is the fall of Guarapetendi, 23 feet high. Prom this point to the mouth of the Pilcomayo the distance in a straight line is 480 miles, although by the curves of the river, which is extremely tortuous, it is about double that distance. According to Storm, who quotes Captain Baldrich, the river bifurcates at 21Â° 51′ S., but again becomes a single stream at 23Â°<43', the right channel being the greater in vol- ume. It is probable that between 23Â° and 24Â° S. it throws east- south-eastwards three great arms to the river

Paraguay, the upper portions of which have yet to be explored, but the lower parts have been examined for 100 to 200 miles up from the Paraguay. Enumerating from north to south, they are called the Esperanza, the Montelindo, and the Mac^. From 180 to 200 miles above its mouth the Pilcomayo filters through a vast swamp about 100 miles in diameter, through which there is no principal channel. This swamp, or perhaps shallow lagoon, is probably partly drained by the river Confuso, which reaches the Paraguay between the Pil- comayo and Maoa. A northern branch of the Pilcomayo, the Fontana, the junction being at 24Â° 56′ S., is probably also a drainage outlet of the same great swamp.

For the first 100 miles below the fall of Guarapetendi the Pilco- mayo is from 600 to 1000 feet wide, but it so distributes its waters through its many bifurcations, and loses so much from infiltration and in swamps, and by evaporation from the numerous lagoons it forms on either side of its course, that its channel is greatly con- tracted before it reaches the Paraguay. It is possible that its Montelindo outlet may be the main river. From Sucre to the Andean margin of the Chaco, a distance of about 350 miles by the river, the fall is at least 8000 feet â€” a sufficient indication that its upper course is useless for purposes of navigation. The statements made by explorers regarding the Pilcomayo are very confused. This is probably due to the wandering propensities of the river and the immense areas of country it overflows in flood-time.

The missionaries in 1556 first reported the existence of the Pilco- mayo, which for a long period of time was known as the Araguay. The first definite information regarding its course was given by the expedition of Armenta y Zarate, which descended its valley by land for a considerable distance in 1672. In 1721 Patifio and Rodriguez partially explored it, and since then numerous attempts have been made to test its navigability, all of which have been failures ; and several of them have ended in disaster and loss of life, so that the Pilcomayo now has a sinister reputation.

The Bekmejo river flows parallel to the Pilcomayo, and enters the Paraguay a few miles above the junction of this with the Parana. Its

numerous sources are on the eastern f ront- â„¢Â® , age of the inland Andes, between the Bolivian town of ermejo. xarija and the Argentine city of Jujuy. Its most north- erly tributary is the San Lorenzo, which, after being augmented by several small streams, takes the name of Bio de Tarija. This, running east, is in turn swollen by several aflfiuents, and then taking a general south-easterly course, joins the Bermejo in 22Â° 50′ S. at a point called the Juntas de San Antonio. Thence, flowing southwards, the Bermejo is enriched by many tributaries from the Andean gorges, and finally, in 23Â° 50′ S., receives its main affluent, the San Francisco, from the south-west. The latter has its source in about 22Â° 30′ S., and, under the name of Rio Grande runs directly southwards, in a deep, mountain valley, as far as Jujuy. It then turns eastwards for 50 miles, and is then joined by the Lavayen from the south-west. These two streams form the San Francisco, which from their junction runs north- eastwards to the Bermejo. The average width of the San Fran- cisco is about 400 feet ; it is seldom over 2 feet deep, and has many shoals and sandbanks. From its junction with the latter stream the Bermejo flows south-eastwards to the Paraguay, with an average width in its main channel of about 650 feet, although narrowing at times to 160 and even 100. In its course, however, it bifurcates and ramifies into many channels, forming enormous islands, and frequently leaves old beds for new ones. During floods it inundates immense areas of the flat Chaco country, filling

vast lagoons and swamps on both sides of the river, which at such times becomes of indefinable width.

Since the exploration of the Bermejo byPatiSio in 1721, it has often been examined from its sources to its mouth, with a view to ascertain its navigability. Captain Page in 1854 and 1859 found it impracticable to ascend it over 135 niiles, in the dry season, with a little steamer drawing 23 inches of water ; but in flood-time, in December 1871, he succeeded, in 60 days, in reaching a point 720 miles from its mouth, in the steamer Alpha, 53 feet long and 30 inches draught. He afterwards penetrated another 100 miles up stream. The round voyage took a year, owing to the swift cur- rents, slioals, quicksands, snags, and fallen trees.

The Salado, about 250 miles south-west of and approximately parallel to the Bermejo, is the only great tributary which the Parang receives from the west below its confluence with the Paraguay. Its extreme head-waters are in safado the Argentine provmce of Salta, and they drain a much broken Andean region lying between 24″ and 26Â° 30′ S. The most westerly sources are the rivers Santa Maria and Calchaqui, which unite near the town of San Carlos and form the river GuAchipas, which flows north-eastwards until it meets the Rio Arias, which has collected in a single artery various small affluents from the north and west. Having received the Arias, the Gud,chipas runs north-eastwards about 50 miles, and then it changes its name to the Juramento, which is retained until the river reaches the Chaco plains at the base of the foot-hills of the Andes. Here it becomes the Salado, a name it preserves for the remainder of its course. It joins the Parand, near Santa F6, in 31Â° 39′ S. and 60Â° 40′ W. From the time the Salado leaves the foot-hills it lazily rambles across the plains in a south-easterly course, now in a single channel, then dividing into several branches and forming long islands, and again overflowing to the right and left into great lagoons and swamps, sometimes to a width of 60 miles. In the dry season it is a nar- row, tortuous ^stream, full of shoals and snags. At all times it carries an immense quantity of floating vegetation and trunks of trees, which constantly fall from its crumbling banks. Explorers of the river, inclusive of Captain Page in 1855, claim that its lower half is navigable, but the many efforts which have been made to utilize it as a commercial route have all resulted in failure. The Salado occupies the south-western side of a very level depression 300 miles across from south-west to north-east, and only 240 feet above the sea. Along the north-east side of this depression runs the Rio Bermejo.

As the Pilcomayo, the Bermejo, and the Salado wander about the country, ever in search of new channels, they erode and tear away great,quantities of the Pampean material, dissolve it into silt, and pour it into the Paraguay and Parana rivers. The engineer Pelleschi estimates that “the soil annually subtracted from the territory of the Chaco by the Bermejo alone equals 6,400,000 cubic yards.”

South of the Salado, the rivers Saladillo, Primero, and Segundo provide the water for the evaporation from the great inland lake Porongos. The Tercero and Quarto streams unite and empty into the Parang near Rosario, with a considerable volume of water. The Quinto, with other small rivers, draining the southern spurs of the Cordoba range, are absorbed by the thirsty Pampean morass La Amarga.

South of its confluence with the river Paraguay, the Parana washes the western foot of a series of sandstone blufis for 30 miles. Thence for 240 miles the bordering hills are about 80 feet high, but at Goya the country is almost on a level South- with the river. Near the boundary-line between Cor- easterly rientes and Entre Rios the banks are very low on both ‘parank sides of the river, and continue so for nearly 100 miles ; but farther down, for 150 miles, the left bank is margined, as far as Diamante, by a range of hills from 125 to 160 feet high, at times boldly escarped. At Diamante they trend inland, south- eastwards, for about 50 miles, and probably once bordered an ancient channel of the river. From 31Â° 30′ S. to the head of the Plata estuary the western bank of the Parand is a precipitous bluff of reddish clay, varying from 25 to 75 feet above mean river level. It is being gradually undermined, and tumbles into the water in great blocks, adding to the immense volume of silt which the river carries. According to Ramon Lista, ” the lowest level of the Parana is in October and November, and, save an occasional freshet, it remains stationary until the beginning of summer, when its waters commence to rise, reaching their maximum about the mid- dle of February in the lower part of their course.” The difference between low and high river is generally about 12 feet, depending upon the varying quantity of rains in Brazil and the melting of the Andean snows. Below its junction with the Paraguay the Parana has an average current of 2^ miles an hour, and the river varies in width from 1 to 3 miles at low water ; but in floods it seems almost a continuous lake, broadening to 10 and 30 miles and burying many of its numerous islands and marginal swamps imder a vast sheet of water, and obliterating its many parallel lateral channels and intricate systems of connecting canals.

PLATTSBUR G â€” P L A Y F A I R

In the middle Parang, from the mouth of the Iguazii to the mouth of the Paraguay river, there are many islands, some of them large, rocky, and high above the river. From Paraguay S~ , to the city of Rosario, islands are numerous, many of

–‘ them of great area ; and again below Rosario they soon increase in number and size until the Plata estuary is reached. In the lower Parana they are mostly covered with dense and beautiful vegetation, sometimes mingled with the bright crimson foliage of the Seibo tree. In flood-time the upper portion of the trees being out of water, they have the appearance of floating forests. Then the river often makes wild work with its banks, and builds up or sweeps away entire islands, leaving deep channels instead. Mouchez in 1857, searching for two islands, the position of which he had fixed in the previous year, found in their place 25 and 32 feet of water. The lower delta of the ParanA does not share in these phenomena ; its islands and main channels appear more fixed. This probably is due to the less elevation attained by the waters in flood-time, and the numerous branches which distribute them into the Plata estuary. This must have extended, in a very recent geological period, inland from its present head to at least 32Â° S. ; but the enormous quantity of silt which the Parand receives from its Paraguay affluent, and from the tributaries which reach it from the Andes, has filled this length of about 220 miles with these muddy islands, which rest upon a sandy bed of great depth.

The frontage of the Parani delta is 40 miles across, almost in a straight Une from north to south. Through this the river finds , its way to the Plata by eleven outlets, large and small, del^^ the two principal ones being the Parana-guazii and the Parana de las Palmas. The frontage is a line of marked regularity, due probably to the current of the Uruguay river, which cuts across its face and carries the silt to the south-west until it meets the outflow of the Parang de las Palmas, which sweeps it south-east along the Buenos Aires shore.

The mean flow of the Mississippi river at New Orleans is 675,000 cubic feet per second, and its flood maximum about 1,000,000 feet. The

minimum of the Plata past Buenos Aires is 534,000, the maxi- mum 2, 145,000. It may therefore be fairly assumed that the yearly discharge of the great North American river is not superior, and may be inferior, to that of the Plata.

The Parang is navigable at all times as far up as the Sao Lourengo river by craft drawing 3 feet of water, and to within a few miles of Asuncion, the capital of Paraguay, by vessels drawing 9 feet. The city of Parana may always be reached with a draught of 12, and Rosario with 15, feet of water.

The commercial development of the Plata basin may be con- veniently illustrated by statistics for the year 1822, which marks , the beginning of independent rule in its republics ;

iMmmerce. ^^^ 1854, when the steamboat and the railway first began to play a part in this quarter of the world ; and in 1898 and 1899, as indicating approximately the state of affairs at the end of the 19th century. In Buenos Aires, for example, the foreign trade (entered and cleared) in 1822 aggregated 107,170 tons; in 1854, 342,463 tons ; and in 1899, 5,046,847 tons. The coasting and river trade of the same port increased from 150,741 tons in 1854 to 3,695,088 tons in 1899. But, taking into account all the Argentine ports, except those which lie to the south of the Plata, there was for the six years ending with 1899 an annual average of 14,000,000 for the overseas commerce and 11,000,000 tons for the river and coasting trade. On the other, or northern, bank of the stream the chief port is Montevideo ; and its foreign commerce increased from an aggregate of 50,000 in 1822 to 150,000 tons in 1854 and to 4,069,870 tons in 1898, the river and coasting trade having increased from 50,000 tons in 1822 to 150,000 tons in 1854 and to 3,915,421 tons in 1898. The total foreign trade of the Plata valley thus increased from over 157,000 tons in 1822 to nearly 18,100,000 tons m 1898-99. (g. b. C.)

Plattsburg, a village of New York, U.S.A., capital of Clinton county, on tlie west shore of Lake Ghamplain, at the mouth of the Saranac river, at an altitude of 120 feet. It is on the Delaware and Hudson railroad, and is the terminus of the Chateaugay railroad. Its site is level and its

plan regular. Its manufacturing establishments include saw-mills, pulp-mills, foundries, and machine shops. Population (1890), 7010 ; (1900), 8434, of whom 1053 were foreign-born.

Plattsmouth, a city of Nebraska, U.S.A., capital of Cass county, at the junction of the Platte and the Missouri rivers, at an altitude of 968 feet. The city has an irregular plan, with good water supply and sewer systems. It is upon the Burlington and Missouri River

and the Missouri Pacific railways, has a large trade in grain and cattle, and has the works of the Burlington and Missouri Eiver railroad. Population (1880), 4175 ; (1890), 8392 ; (1900), 4964, of whom 979 were foreign- born.

Plauen, a tovm of Germany, on the Weisse Elster, 21 miles south-west of the town and in the circle of Zwickau, kingdom of Saxony ; stations on the Leipzig- Hof, Reichenijach-Eger, and Gera-Weischlitz railways. The seat of a commercial and industrial chamber, Plauen has 3 churches, a Methodist chapel, a gymnasium, a builders', an industrial, a commercial school, and other schools, and a seminary for teachers. Its industries include cotton, carded woollen, paper, twisting, embroidery, and other mills, many dye and bleaching works, leather, piano, iron safe, and other factories. Population (1880),

35,082; (1890), 47,007 ; (1900), 73,891.

Playfair, Lyon, 1st Baeon (1818-1898), was born at Chunar, Bengal province, on 21st May 1818. He was sent to Europe by his father at an early age, and received his first education at St Andrews. Subsequently he studied medicine at Glasgow and Edinburgh. A short visit to India (in 1837-38) was followed by his return to Europe to study chemistry, which had always attracted him. This he did at University College, London, and afterwards under Liebig at Giessen, where he took his doctor's degree. At Liebig's request, Playfair translated into English the former's work on the Chemistry of Agriculture, and represented Liebig at a meeting of the British Associa- tion at Glasgow. The outcome of his studies was his engagement in 1841 as chemical manager of the Primrose print works at Clitheroe, a post which he held

for rather more than a year. In 1843 he was elected hon. professor of chemistry to the Royal Institution of Manchester, and soon afterwards was appointed a member of the Royal Commission on the Health of Towns, a body whose investigations may be said to have laid the foundations of modern sanitation. In 1846 he was appointed chemist to the Geological Survey, and thenceforward was constantly employed by the public departments in matters of sanitary and chemical inspection. He had previously been offered, and had accepted, a professorship of chemistry at Toronto; but the representations of his friends, who had interested Sir Robert Peel in his favour, induced him to withdraw his acceptance and rely on the certainty of a career in England. The opportunity of his life came with the 1851 Exhibition, ~~of which he was one of the Special Commis~~ sioners. For his services in this connexion he was made C.B., and his work had the additional advantage of bring-ing him into close personal connexion with the Prince Consort, who appointed him Gentleman Usher in his household. He was selected to appoint the jurors for the Exhibition of 1862, and was one of the English commis- sioners at the Paris Exhibition of 1855, and again in 1878. From 1856 to 1869 he was professor of chemistry at Edinburgh University, numbering among his pupils the present King and the late Duke of Edinburgh. In 1868 he was elected to represent the Universities of Edinburgh and St Andrews in Parliament, and retained his seat till 1886, from which date until 1892 he sat as member for Leeds. In 1873 he was made Postmaster-General, and in the following year, after the dissolution of Parliament, was applied to by the incoming Tory Government to preside over a Commission to inquire into th’e working of the Civil Service. Its report established a completely new system, which has ever since been officially known as the ” Playfair scheme.” The return of Mr Gladstone to power in 1880 afforded opportunity for Playfair to resume his interrupted parliamentary career, and from that time until 1883 he acted as Chairman of Committees during a period when the

obstructive tactics of the Irish party were at their height. On his retirement from the post he was made K.C.B. As illustrative of the many interests which now divided his time, may be mentioned his strong advocacy of the Vaccination Acts ; his efforts on behalf of the Tercente- nary Commemoration of Edinburgh University in 1884 ; his presidency of the British Association in 1885; his appointment by Mr Grladstone in 1886 to the office of Vice-President of the Council ; his advocacy of medical reform ; and his work (as deputy-chairman of the Com- missioners of the Great Exhibition) in connexion with Queen Victoria's Jubilee in 1887. In 1892 he was created Baron Playfair of St Andrews, and a little later was ap- pointed Lord-in-Waiting to the Queen. In 1895 he was given the G.C.B. In spite of failing health, the last years of his life were full of activity, one of his latest public acts being his suggestion that Queen Victoria's Diamond Jubilee of 1897 should be commemorated by the comple- tion of the South Kensington Museum. He died in Lon- don, after a short illness, on 29th May 1898, and was buried at St Andrews. He was three times married. He was the author of a number of papers on scientific and social topics, a selection from which he published in 1889 under the title of S^ibjects of Social Welfare. A memoir of him by Sir Wemyss Reid appeared in 1899. (e. f. s.)

Plevna, or Pleven, the chief town of a district in the principality of Bulgaria, situated 85 miles north-east of Sofia, on the Toutchinitza, an afl3.uent of the Danube, and on the Sofia^Varna railway (opened in 1899), where a branch line passes north, 25 miles to Sdmavit on the Danube, where a new port has been formed. After the capture of the town by th'e Russians in 1877, it was forsaken almost entirely by the Turks, and most of the mosques have gone to ruin ; but, peopled now mainly by Bulgarians, it has quite recovered its prosperity, and has a large commerce in cattle and wine. A recently intro- duced manufactory is that of safes. The ancient Turkish kanak is now used as the prefecture of the department. Numerous monuments have been erected by the Russians and Bulgarians to the memory of those killed during the struggles for its possession. Population (1900), 18,709.

Plimsoll, Samuel (1824-1898), British politician and social reformer, was born at Bristol on 10th February 1824. Leaving school at an early age, he became a clerk, and rose to be manager of a brewery in Yorkshire. In 1853 he endeavoured to set up a business of his own in London as a coal merchant. The venture proved a fail- ure, and Plimsoll was reduced to destitution. He has himself related how for a time he lived in a common lodging-house on 7s. 9^d. a week. This experience had a profound influence on his career. He learnt to sympathize with the struggles of the poor ; and when the success of his enterprise placed him in possession of a competence, he resolved to devote his leisure to the amelioration of their lot. His efforts were directed more especially against what were known as "coffin-ships" â€" unseaworthy and overloaded vessels, often heavily insured, in which an un- scrupulous owner was allowed by the law of that time to risk the lives of his crew. Plimsoll entered Parliament as Liberal member for Derby in 1868, and endeavoured in vain to pass a Bill dealing with the subject. In 1872 he published a work entitled Our Seamen, the sincerity and deep feeling of which made a great impression throughout the country. Though many of its statements were shown to be exaggerated or unfounded, enough remained to prove the crying need for reform. Accordingly, on Plim soil's motion in 1873, a Royal Commission was appointed, and in 1875 a Government Bill was introduced, which Plimsoll, though regarding it as inadequate, resolved to accept. On

22nd July, the Premier, Disraeli, announced that the Bill would be dropped. Plimsoll lost his self-control, applied the term " villains " to members of the House, and shook his fist in the Speaker's face. Disraeli moved that he be reprimanded, but on the suggestion of Lord Hartington agreed to adjourn the matter for a week to allow Plimsoll time for reflection. Eventually Plimsoll made an apology. The country, however, shared his view that the Bill had been stifled by the pressure of the shipowners, and the popular agitation forced the Government to pass a Bill, which in the following year was amended into the Merchant Shipping Act. This gave stringent powers of inspection to the Board of Trade, and made the old abuses impossi- ble. The mark that indicates the limit to which a ship may be loaded is generally known as PlimsoU's mark. With the passage of this Act PlimsoU's work reached

its climax. He was re-elected for Derby at the general election of 1880 by a great majority, but gave up his seat to Sir W. Harcourt, in the belief that the latter, as Home Secretary, could advance the sailors' interests more effectively than any private member. Though offered a seat by some thirty constituencies, he did not re-enter the House, and subse- quently became estrangedfrom the Liberal leaders by what he regarded as their breach of faith in neglecting the question of shipping reform. He held for some years the presidency of the Sailors' and Firemen's Union, raised a further agitation, marred by obvious exaggeration, about the horrors of the cattle ships, and visited the United States with the object, in which he proved successful, of securing the adoption of a less bitter tone towards England in the historical text-books used in American schools. He died at Folkestone on 3rd June 1898. (h. st.)

Ptock, a government of Russian Poland, bordering on Prussia, with an area of 4200 square miles, and in 1897 a population of 666,819, of whom 278,104 were women, and 99,821 lived in towns. It is divided into seven districts, of which the chief towns are Pltock {q.v.), Ciechanow (10,664), Lipno (6753), M3awa (13,449), Pras- nysz (9136), Rypin (6040), and Sierpiec (8560). The standard of education is very low, and in 1896 the 443 schools were attended by only 13,749 boys and 5386 girls. Agriculture is the main occupation, the average annual yield of the crops from 1895 to 1899 being 1,141,000 cwt. of wheat, 3,252,000 cwt. of rye, 852,000 cwt. of oats, 406,000 cwt. of barley, 6,048,000 cwt. of all cereals, and 9,541,000 of potatoes ; considerable quantities of grain are exported. Beetroot is also cultivated for the manu- facture of sugar, and gardening and bee-keeping are extensively engaged in for industrial purposes. The live stock included in 1897, 90,000 horses, 213,000 horned cattle, and 393,000 sheep, chiefly of improved breeds. The aggregate output of the factories â€" chiefly sugar works â€" was valued at only Â£335,000.

Ph>ck, the capital of the above government, situated on the right bank of the Vistula, 172 feet above its level, 32 miles from the Kutno railway station. There is con- siderable navigation on the Vistula, grain, flour,

wool, and beetroot being the chief items of export. Coal, naphtha, salt, and flsh are imported. Population (1897), 27,073.

Ploesci, chief town of the district of Prahova, Rumania, situated 38 miles from Bucharest, at the en- trance of the valley of the Prahova, in a region which is sufficiently indicated by its name Ploesci (jpluviena, rainy). It is the headquarters of a military division and seat of a court of first instance, and has a lycee, a school of arts and crafts, and a commercial school, and is besides an import- ant commercial centre, with numerous markets and fairs. It is likely to develop still further, as occupying one of the

richest petroleum-bearing districts in Rumania. There is a large number of commercial and banking co-operative societies. It contains nineteen churches, comprising one Roman Catholic church and three synagogues, besides the Church of Our Lady, constructed in 1740 by Matthew Bassaraba. In the neighbourhood are the monasteries of Pargasoru, Crangulu, Peinlui, and Maigineni. Population

(1900), 42,687.

Plumptre, Edward Hayes (1821-1891), English theologian and scholar, was born in London on 6th August 1821. Becoming scholar of University College, Oxford, he graduated with a double first-class in 1844, and in the same year was elected fellow of Brasenose College. He was ordained in 1847, and was shortly after- wards elected to the Chair of Pastoral Theology at King's College, London. In 1863 he was given a prebendal stall at St Paul's, and for the period from 1869 to 1874 was a member of the committee appointed by Convocation to revise the authorized version of the Old Testament. After successively holding the livings of Pluckley and Brickley in Kent, he was installed in 1881 as Dean of Wells. Dean Plumptre was a man of great versatility ; he is known as the translator of the plays of Sophocles and jEschylus, and of the Divina Gommedia of Dante. Among his contributions to theological

literature may be mentioned Exposition of the Epistles to the Seven Churches of Asia (1877), The Spirits in Prison (1884), Tlie Booh of Proverbs (which he annotated in the Speaker's Gommentary), the First Tliree Gospels, the Acts, and the Second of Gorinthians, in Bishop Ellicott's New Testament Gommentary, and Lfe of Bishop Ken (1886). He died on 1st February

1891.

Plymouth, a municipal, county (1888, extended 1896), and parliamentary borough, and seaport of Devon- shire, England, 231 miles by rail west-south-west of Lon- don, on Plymouth Sound, which consists of the confluence of the estuary of the Tamar on the west with the estuary of the Plym on the east. With the township of Stonehouse and the borough of Devonport, Plymouth constitutes the aggregate "Three Towns." The municipal borough is distributed into 14 wards, under a mayor, 14 aldermen, 42 councillors, a recorder, town clerk, &c. Bounded on the S. by a line connecting Penlee and Wembury Point, the Sound is 3 miles long from north to south and 2-1- to 3 miles broad, covering at high water 4600 acres. Its inlets into the land on the north are, from the east end westwards : (1) Catwater, 200 acres, with accommodation for 1000 vessels, anchorage chiefly for timber vessels and coal-hulks ; it was in 1888 provided with anew wharf and hydraulic cranes, and a small breakwater is laid across its entrance. The depth varies from 18 to 24 feet, and in 1902 was increased throughout to the greater depth. (2) Sutton Pool, 90 feet wide at its entrance, with an area of 27 acres, a substantial jetty, and a graving beach 400 feet long. The Pool has been connected with the Great Western and South-Western railways. (3) Mill Bay. Outside its floating dock, 17 feet neaps, is the tidal basin of 35 acres ; on its western side is an extension jetty. At low water it accommodates ships of 24 feet draught, free to arrive and discharge at any time. The graving dock, entered from the inner basin (13 acres), is 464 feet long by 92 feet wide, 80 feet width of entrance, and 22 feet depth of water at ordinary spring tides, as in the floating basin. (4) Stonehouse Pool, the anchorage more particularly of ships in the timber trade, and with 22 to 24 feet at low water. New quays have been constructed, and there are two discharging

berths. (5) Hamoaze, 4 miles long from Mount Edgcumbe to Saltash,the thoroughly protected harbourage of his Majesty's ships " in ordinary." Eor 14 miles above

Devonport the Tamar is navigable for small vessels. Till 1841 the Sound was exposed to the brunt of the south- western gales. In that year was completed, at a cost of 11 million sterling, the Great Breakwater. It stretches, an isolated mole of stones, 2\ miles south of the Hoe, 360 feet wide at the base, sloping to 45 feet at the top, 1700 yards long, across the middle of the Sound, its two ends or cants bent inwards at an angle of 120 degrees ; an outlying barrier which has since secured to the entire Sound the safety of a harbour. The open channels between breakwater and shore are on the west 4300 feet and on the east 2200 feet broad. A lighthouse stands at the west end of the breakwater, a pyramidal beacon at the east end. The school board has 13 ordinary schools, 3 cooking centres, 2 woodwork centres, &c. ; and the municipal, science, art, and technical schools (1892) are attended by 800 students. Other new buildings are an Established church, the Marine Biological Laboratory (1888), the Armada Memorial (1888), a new Corn Ex- change, the market, rebuilt, a new fish market, an ear and throat hospital, a new wing to the Devon and Cornwall Hospital, an endowed convalescent home, and the Mill Bay station of the Great Western railway.

A highly important Government station, Plymouth is strongly fortified. On the north the chain of forts around the three towns, stretching in horse-shoe line from the river Tamar to the river Plym, is 14 miles long. The citadel at the east end of the Hoe commands the Catwater. Strong fortifications on Mount Wise command the entrance to Hamoaze. Just inside the breakwater is one of the strongest forts in the world. The channel to the east of the breakwater is further protected by a granite battery at Bovisaud, north of which is' a strong fort on Staddon Heights, and still farther north the forts of Bellevue and St Ann. The channel to the west of the breakwater is protected from the land by Cawsand Battery. Farther north, on the west side of the Sound, are Picklecombe Fort and Earl's Battery, Western King Fort and Eastern King Battery â€" the two latter on Stonehouse coast. White- sand Bay,

again, is guarded from the coast by Pollawny Battery and Tregantle Fort. Drake's Island is strongly fortified and garrisoned. The industries of Plymouth include large engineering and shipbuilding works ; large exporting starch, blue, and black-lead factories ; two soap factories, tanneries, distilleries, &c. There are three daily newspapers. The registered shipping at the port in 1900 was 323 vessels of 55,637 tons, against 345 of 28,087 tons in 1888. In 1900, 2903 vessels of 884,918 tons entered, as compared with 1231 of 480,525 tons in 1888. Clearances numbered 2902 vessels of 833,222 tons in 1900, as compared with 1116 of 433,983 tons in 1888. The total foreign and colonial imports in 1900 were valued at Â£1,573,049, against Â£1,416,282 in 1888. The total exports of merchandise of the United Kingdom in 1900 were Â£154,993, against Â£162,227 in 1888. Area, 2370 acres. Population (1891), 88,926 ; (1901), 107,509.

The township of Stonehouse, governed by an urban district council of 16 members, is a western continuation of Plymouth, separated by Stonehouse Pool from Devonport, in the parliamentary borough of which it is included. A bridge across the Pool connects Stonehouse with Devon- port ; higher up, Mill Bridge connects Stonehouse with Stoke Damerel. A naval and military dep6t, Stonehouse contains the Royal William Victualling Yard (14 acres), the western part of which is appropriated to the naval ordnance department, with repairing shops, armoury, &c. ; marine barracks, with accommodation for 1500 men ; a naval hospital (24 acres) ; a town hall ; and a theatre (1889), seating over 2000 persons. Area, 190 acres. Population (1881), 16,041 ; (1901), 15,108.

(o. N.)

PLYMOUTH â€" PNEUMATIC DESPATCH 801

Plymouth, a town of Massachusetts, U.S.A., capi- tal of Plymouth county, comprising 116 square miles of rolling country, dotted with ponds. The principal village bears the same name as the town, and is situated in the northern part, on Plymouth Harbour and on a branch of the New York, New Haven, and Hartford rail- road. It has an irregular plan, a good water supply and sewer systems, and varied manufactures.

Population of the town (1890), 7314 ; (1895), 7967 ; (1900), 9592, of whom 2274 were foreign-born and 146 negroes.

Plymouth, a borough of Luzerne county, Pennsyl- vania, U.S.A., on the Susquehanna river, and on the Delaware, Lackawanna, and Western railroad, at an altitude of 535 feet. It is in> the anthracite coal region, and its industries are related to the mining and handling of coal. Population (1890), 9344; (1900), 13,649, of whom 4804 were foreign-born.

Pneumatic Despatch. â€" The system of pneu- matic despatch tubes (for telegrams only) in use in the English Postal Department had in 1902 a total length of over 60 miles, laid underground, of which length 40 miles were in use in the London district. There are also short tubes, known as " house tubes," in use in most large offices ; such tubes, which are worked either by power (in the case of the head offices) or by hand pumps, are from 1-J- to 2Jf inches in diameter, and are used for the purpose of conveying messages from one part of a telegraph instru- ment-room to another, or from the instrument-room to the public counter. The underground, or " street," tubes in London are chiefly 2^ inches in diameter, but there are also a number of 3-inch tubes in use ; those in the large provincial towns (Birmingham, Bradford, Cardiff, Glas- gow, Grimsby, Liverpool, Manchester, Leeds, and New- castle) are 2\ inches in diameter, but in Dublin l^inch tubes are employed. There are 50 street tubes in Lon- don, varying in length from 100 to 2000 yards (Central Ofl&ce to the Houses of Parliament), and also 50 house tubes ; the pumps for the whole system are worked by four 50-horse power steam-engines. At Cardiff and Leeds the pumps are driven by electric motors.

The "carriers" in all cases have gutta-percha bodies and are covered with felt, the front of the carrier being provided with a buffer or piston formed of Carriers, several discs of felt which exactly fit the tube ; the messages are prevented from getting out of the carrier by the end being closed by an elastic band, which can be stretched sufELciently to allow the message forms to be put in. The 3-inch carriers will hold 75 ordinary message forms, the 2^inch carriers 25 forms, and the l|-inch

carriers 20 forms. The tubes are in all cases of lead, the Tubes. 2^inch tubes weighing 8 lb per foot run and being made in lengths of 28 feet ; they are enclosed in 3-inch cast-iron pipes made in lengths of 9 feet.

Great care is exercised in making tiie joints in the lead pipes. Before the tube is placed in its trench a strong chain is passed through it, and a polished steel mandrel, 6 inches long and slightly less in diameter than the diameter of the tube, is heated and attached to the chain, and pushed half its length into the end of the tube already laid ; the new length of tube is then forced over the projecting end of the mandrel until the tube ends (which have been previously cut flat) butt perfectly together ; an ordinary plumber's joint is then made. By this means the tube is made perfectly air-tight, and the mandrel keeps the surface of the tube under the joint as smooth as at any other part of its length. After the joint is completed, the mandrel is drawn out by the chain attached to it, the next length is drawn on, and the above process repeated. The tubes are laid about 2 feet below the surface of the ground.

The tubes radiate from the central to the branch offices, the principal offices having two tubes, one for " inward " and the other for " outward " traffic. At the smaller offices both

the inward and outward traffic is carried on through one tube. The carriers are propelled in one direction (from the central office) by " pressure," and drawn in the opposite direction by " vacuum," the standard "' "*^' pressure and vacuum being 10 lb and 6^ ft per sq. in. re- spectively, which values give approximately the same speed.

The time of transit of a carrier through a tube when the air pressure does not exceed 20 lb per square inch is given very ap- proximately by the empirical formula :

Â«=-00872^/Z;

t=-

where i=length of tube in yards, d=diameter of tube in inches, P=effective air-pressure in pounds per square inch, Â«=transit time in seconds. For vacuum the formula is :

â– 00825 te.

l—234v'l5-5-Pi^5" where Pi = effective vacuum in pounds per square inch.

The horse-power required to propel a carrier is approximately, for pressure â€"

H.P. = (-674+ â– 0OnF)JP!^ ;

for vacuum â€"

H.P. = (5-187-l-214-\/l5-5-Pi)Pi-^y-

For a given transit time the actual horse-power required is much less in the case of vacuum than in the case of pressure working, owing to the density of the air column moved being much less : thus, for example, the transit time for 10 lb pressure is the same as for 6J lb vacuum, but the horse-power required in the two oases is as 1'83 to 1. A tube 1 mile long, 2^ inches in diameter, and worked at 10 lb per square inch pressure, will have a transit time of 2 J minutes, and will theoretically require 3-35 horse-power to be expended in working it, although actually 50 per cent, more horse-power than this must be allowed for, owing to losses through varioiis causes. Tlie transit time for a 2J-inch tube is 16 per cent, more than for a .3-inch tube of the same length, when both are worked at the same pressure, but the horse-power required is 50 per cent, less ; it is not advisable, therefore, to use a tube larger than is absolutely necessary to carry the volume of traffic required.

The somewhat complicated pattern of " double sluice valve " originally used at the central stations has been superseded by a simpler form, known as the " D " box â€" so named from the shape of its ing"aad ' cross section. This box is of cast iron, and is receiving provided with a

close-fitting, brass-framed, ‘pp^”^^”^- sliding lid with a glass panel. This lid fits air-tight, and closes the box after a carrier has been inserted into the mouth of the tube ; the latter enters at one end of the box and is there bell-mouthed. A supply pipe, to which is connected a “3- way ” cock, is joined on to the box and allows communication at will with either the ” pressure ” or ” vacuum ” mains, so that the apparatus becomes available for either sending (by pressure) or receiving (by vacuum) a carrier.

On the long tubes (over about 1000 yards) a modification of the “D” box in its simplest form is necessary; this modification consists in the addition of a ” sluice ” valve placed at a distance of about 9 inches (i.e., rather more than the length of a carrier) from the mouth of the tube. This sluice valve, by means of an inter- locking arrangement, is so connected with the sliding lid of the box that the lid cannot be moved to the open position unless the sluice valve has closed the tube, nor can the sluice valve be opened unless the sliding lid is closed. The object of this sluice valve is to pre- vent the back rush of air which would take place into the tube when the sliding lid is opened to take out a carrier immediately on the arrival of the latter ; for although the vacuum may be turned off by the 3-way cock, yet, owing to the great length of the tube, equilibrium does not immediately take place in the latter, and the back rush of air into the vacuum when the lid is opened to extract the carrier will cause the latter to be driven back into the tube. The sluice also prevents a similar, but reverse, action from taking place when pressure working is being carried on. As a rule, only one carrier is despatched at a time, and no second carrier is inserted in the tube until the arrival of the first one at the farther end is automatically signalled (by an electric apparatus) to the despatch- ing ofiice. On some of the long tubes a carrier, when it passes the midway point on the tube, strikes a trigger and sends back an electrical signal indicating its passage ; on the receipt of this signal a

second carrier may be despatched. Recently a signalling apparatus â– whioh by a clock movement actuates an indicating hand and moves the latter to “tube clear” a certain definite time (30 to 40 seconds) after a carrier has been inserted in the tube, has been intro- duced. By this arrangement carriers can be despatched one after the other at comparatively short intervals of time, so that several carriers (separated by distinct intervals) may be travelling through the tube simultaneously. It is necessary that the carriers be separated by a definite interval, otherwise they tend to overtake one another and become jammed in the tube. Although the stoppage of a carrier in a tube is of exceedingly rare occurrence, it does occasionally take place, through picks being driven into the tube by Stoppages vrorkmen executing repairs to gas or water pipes, but ff A the locality of such a stoppage is easily determined by

” ” **â– a simple inspection along the route of the tube. In no case is any special means of testing for the locality from the central office found necessary.

In America, tubes (of brass) up to 8 inches in diameter are in use for the despatch of letters. The system is that of Batcheller, and a total lenth of several miles is worked.

Keferenoes. â€” G-eneral Post Office Technical Instructions, ‘K., ” Pneumatic Tubes “; Kempe’s Engineers^ Tear-Book, 1902 edition.

(h. e. k.)

Pneumatic Tools. â€” The term pneumatic tool is applied to a class of macMne-shop appliances of recent origin, whicli have been developed chiefly in America, and, in the initial stages, in the railway repair and maintenance works of that country. This development was due to the prior existence in these works of means for compressing air. The air-brake is almost universally used on Ameri- can railways, and in consequence numbers of the air- pumps whioh are fitted on the locomotives are always to be found in such works, either awaiting or having under- gone repair. In these circumstances, when an apparently useful application of compressed air was devised, it be- came a simple

matter to lay the necessary pipes and con- nect one of the pumps for trial. In many cases these pumps, in spite of their well-known low efficiency, were retained for a considerable time, several being corubined in a battery ; but when the economy of the new methods had been fully demonstrated, well-designed air compres- sors of a suitable and economical type were substituted, and are now considered a necessary part of the equipment of a well-organized Am.erican railway repair work. Prom such works the use of the tools has extended to other works, and especially to shipyards.

The machines may be roughly classified into small portable tools, guided largely by the hand, in which the effort exerted is small but fairly continuous, and larger stationary tools, in which a considerable effort is exerted, but intermittently only. All are alike in one particular â€" the aggregate of power consumed per hour is small. The work done by both classes is chiefly such as has hitherto been done directly by hand, although occasionally they displace other machines, which, however, are in most cases hand-driven. Sometimes, when only a small amount of work is to be done, pneumatic tools are brought to heavy pieces of material which were previously taken to fixed machines. The main sources of economy in the use of pneumatic tools are thus the substitution of mechanical for manual power, and the moving of a small portable machine to a heavy piece of work, instead of moving the work to a fixed machine. As is the fact with most applications of compressed air, the mechanical efficiency, considered as the ratio between input and output, is low, but, as in many other instances connected with applications of power, the commercial efficiency, measured by the cost of the work, is nevertheless high. The increase of output of a workman and his pneumatic tool over that of a workman using the old hand tools is so much greater than the increased cost due to the added expense of maintaining and operating the pneumatic plant, that the work is done at far less cost per unit. Moreover the output of a given plant or workshop is largely

increased, and the owners thereby secure the well-re- cognized economical advantages of production on a larger scale.

Perhaps the most important of these tools is the hammer (Fig. 1), which was the first to become of commercial import- ance. It is some- what similar to the rock-drill, the chief difference, next to that of size, being the free-flying pis- ton. In the rock- drill the piston car- Fig. l.- Pneumatio Hammer.

ries the drilling-tool with it in its reciprocations, but in the hammer it does not. The shank of the tool â€” chisel, caulking-tool, or whatever it may be â€” projects slightly through the cylinder head, so that the free piston strikes it at each stroke, the action being precisely like that of a hand hammer. The motion is very rapid, 3600 blows per minute being delivered in the smaller sizes. Originally these tools were of small size only, suitable for holding in the hand, but larger ones are now made, with suitable frames and supports, intended chiefly for driving rivets. For some pur- poses a heavy blow is needed â€” a large number of light blows not being the equiv- alent of a smaller number of heavy blows. For these purposes a new type of hammer, to be held in the workman's hand, and called the long-stroke hammer, is an important development. The piston is heavier and the stroke is much longer than in the older type. This type is especially adapted to riveting, and it is in large use for that purpose on steam boilers, the hulls of ships, and the erection- work of bridges and steel-frame buildings. It can be used in many places in which the application of machines held in yokes or frames would be impossible. The range of application of pneumatic hammers is almost as wide as that of a hand hammer ; they have even been used under water by divers working on wrecks. A recent appli- cation of the same principle is to be seen in the sand-rammers employed in making foundry moulds (Fig. 2).

A second tool of similar importance is the rotary drill (Fig. 3). Originally this consisted of a small rotary engiue with feeding mechanism for tools suitable for drilling or boring in iron or wood, but the wastefulness of such an arrangement led to the design of small reciprocating engines for the same purpose. For distinction these are called piston air drills, though, as the original construction drops out of use, the distinction in name will naturally be dropped also, the term rotary being probably retained. They are chiefly used !'Â«'â€¢ 2.â€"

Pneumatic where formerly the hand racliet brace sand-Eammer. ^as relied upon. In all heavy machine work cases are of frequent occurrence in which holes are required in inaccessible places. In these the hand rachet was formerly employed, as well as in those in which small holes, so located as to be easily accessible, were needed in large pieces. The operation of the hand rachet is slow, laborious, and expensive, while the mere moving and fix ing of heavy pieces in position under a stationary drilling machine may cost far more than the actual performance

P 0

803

of the -work. In both these cases the rotary air drill gives marked economy.

These motors are applied to a great variety of opera- tions besides drilling. Beaming, tapping, expanding boiler tubes, grinding steam joints, sand- papering -woodwork, and cleaning castings by their aid, are very common ; and a recent application is to the driving of a special tool for the removal of flues from old boilers, an operation that was previously very tedious and ex pensive. The motors are also employed to drive portable boring- bars, crank pin and car journal turners,

and, in emergency pig. s.-Pneumatio Eotary Dnii.

-work, at night or on

Sundays, to drive the standard machine tools of the machine shop.

Classed among pneumatic tools, perhaps not quite correctly, is the pneumatic hoist, -which has come into very extensive use. A long cylinder of bored pipe hangs from the ceiling or from a trolley running on a tram rail attached to the ceiling. Within it is a piston, from -which a long piston-rod depends. A simple hook for attaching a chain by -which the load is slung, and a valve for admitting and discharging air to and from the lo-wer end of the cylinder, complete the mechanism

~~which has largely dis~~ placed the chain hoist. Where head-room is restricted, these hoists are often arranged to lie horizontally under the ceiling, and they are frequently applied to light s-wing- cranes for yard use. A modification of the device is the pneumatic jack, -which is placed belo-w the piece to be lifted, and operates directly. The jack is frequently mounted on -wheels, for transporting the load.

Other pneumatic tools are of more restricted and special application. Of these are the stay-bolt cutter, ~~which is simply a powerful pair of nippers, designed to remove by a single movement the surplus ends of locomotive stay~~ bolts â€" an operation which, when done by cold chisel and hand hammer, is laborious, and, moreover, tends to loosen the bolts in their holes. The painting machine for paint- ing large surfaces simply atomizes the paint by a jet of air ; it was first used on the buildings at the Chicago World's Fair of 1893. The mud-ring riveter is a special device for riveting the seam around the bottom of locomotive fire- boxes, and another special machine cuts the stay-bolts of old locomotive fire-boxes prior to removal. Among other appliances more or less related to the preceding are small presses for forcing work together ; small forging and bend- ing presses â€" commonly known as " bull-dozers " ; furnaces for heating and expanding driving-wheel tyres; paint burners for the removal of old paint; cleaning machines for the renovation of the seats and cushions of railway carriages, the efficiency of which is remarkable ; bell ringers for the bells universally used as warning signals on American locomotives ; track-sanders for blowing sand under locomotive driving-wheels ; fire-kindlers for the use of oil fuel in place of wood in starting fires on locomo- tives; and sheep-shearers, which are widely adopted in Australia.

Very few trustworthy data of the comparative cost of work done in the old and new way have been published, and, indeed, exactness in such data is scarcely to be

expected. The following are given on the authority of Mr Edward C. Schmidt, of the University of Illinois, U.S.A. :â€"

Saving

Tool.

General Character of Work.

per cent, of Cost.

Pneumatic hammer .

General foundry work â€” chipping

67 to 75

n ^1

Kiveting on mud ring and fire-

box

67

11)?

Chipping flue sheet .

84

1} })

Beading flues . . . .

75

))))

General boiler-shop work .

60

)Â»))

Cutting out broken fire-box

stays

70

1) n

Cutting off stay-bolt heads

58

Riveter .

Boiler riveting . . . .

66

Drill

Drilling saddles

70

)) â€¢

In general machine-shop work .

75

Drilling for stays

50

)Â»

In general boiler-work shop

75

>) â–

Facing steam pipes .

75

)?

Tapping for stays

65

5J â€¢

Reaming crown sheet

70

Breast drill

General work . . . .

90

Stay-bolt nippers

Cutting off stays

73 to 90

Driving-box press .

Pressing brasses

68

Paint sprayer .

Painting box cars

67

5) 51 â€¢ â€¢

Painting car trucks .

87

„ burner .

Cleaning of passenger cars

67

Sand blast

Cleaning tanks . . . .

90

Air jet .

Cleaning cushions

50

These figures relate to the saving at the tool, and do not include the fixed charges and cost of operating the air-compressor. In one work, from which many of these figures were taken, the decrease in the percentage of saving due to the cost of compressing the air was found to amount to about 15 per cent, at the most. Generalization in this respect is scarcely possible.

It is too early to speak with confidence of the ultimate place and importance of these appliances. Compared with the main equipment of a workshop, they are small and apparently insignificant, but it is quite possible that they may eventually be looked upon as the greatest contribution to the methods of machining iron and steel made during the closing decade of the 19th century. The mechanical talent embodied in

many of them is of the first order. The hammers and rotary drills especi- ally, whether considered from the standpoint of design or of execution and workmanship, are worthy of high praise. (f. a. h.)

Po, a river of North Italy, draining Piedmont, Lom- bardy, and the greater part of Emilia, also parts of Venetia.

In the first 21 miles of its course, down to Revello (west of Saluzzo), the Po descends no less than 5250 feet, or a fall of 47 -3 : 1000, forming a very remarkable contrast to its fall lower down. From the confluence of the Ticino its fall is about 0 -3 : 1000 ; from the beginning of the delta below Perrara, 0-08 : 1000. At Turin it has an average width of 400 to 415 feet, a mean depth of 3^ to 5J feet, and a velocity of 1 to 3 feet in a second. The mean depth from the confluence of the Ticino (altitude 217 feet) downwards is 6 to 15 feet. The river is embanked from Piaoenza, and continuously from Cremona, the total length of the embankments exceeding 600 miles. Owing to its confinement between these high banks, and to the great amount of sedimentary matter which the river brings down with it, its bed has been gradually raised, so that in its lower course it is in many places above the level of the surrounding country. A result of confining the stream between its containing banks is the rapid growth of the delta. Lombardini calculated that the annual increase in the area of the Po delta during the period 1300 to 1600 amounted to 127 acres ; but during the period 1600 to 1830 it rose to 824 acres. Dr Marinelli estimates that between the years 1823 and 1893 the annual increase has been at the average rate of 173 to 175 acres, and the total accretion at about 20 square miles ; and the total area of inundated land north and south of the delta at nearly 60 square miles. He further estimates that the Po della Maestra advances 282 feet annually, the Po delle ToUe,

262 feet, the Po della Gnocca, 111 J feet, and the Po di Goro, 259 feet. All along its course from Chivasso (below Turin) down to the delta the river is connected with several of its tributaries by canals, and at the

same time other canals connect the tributaries and carry off their waters and the waters of the Po for purely irrigation purposes. The river is navigable as far as Casale, above the junction of the Sesia, but navigation is attended with great risks, owing to the prevalence of shallows and sandbanks.

See G. Marinelli, in Atti Inst. Veneio Sci., series 8, vol. viii. (1896-97); and ” L’Aocrescimento del Delta del Po nel Secolo XIX.,” in Biv. Geog. Ital, vol. v. (1898).

Pobedonostsef, Constant! ne Petrovitch

(1827), Russian jurist, state official, and writer

,on philosopMcal and literary subjects. Born in Moscow in 1827, he studied at the, School of Law in St Peters- burg, and entered the public service as an official in one of the Moscow departments of the Senate. From 1860 to 1866 he was professor of Russian civil law in the Moscow University, and was entrusted with the task of giving instruction in the theory of law and administra- tion to the sons of Alexander II. In 1868 he became a Senator in St Petersburg, in 1872 a member of the Coun- cil of the Empire, and in 1880 Chief Procurator of the Holy Synod, an important post which forms the connect- ing link between the Russian Church and the Tsar. In all his professorial, administrative, and literary activity he always showed himself a consistent, uncompromising Conservative, and, unlike the majority of Russian Con- servatives, he never shrank from expressing boldly his opinions. Consequently, in the so-called Liberal camp he was always denounced as an “obscurantist” and an enemy of progress. In the early years of the reign of Alexander II. (1855-81), when the great majority of his educated countrymen assumed that the duty of Russia was to replace her antiquated and barbarous institutions by the most liberal institutions of Western Europe, M. Pob8donostsef maintained, though keeping aloof from the Slavophils, that these Occidental institutions were radically bad in themselves and totally inapplicable to Russia. Parliamentary methods of administration, mod- ern judicial organization and procedure, trial by jury, freedom of the press, secular education, â€” these were among the principal objects of his aversion.

Parliamen- tarism he considered the great curse of the time, because it handed over the mass of the population to the tender mercies of narrow-minded, egotistical, unscrupulous men who have learned the dangerous arts of sophistry and eloquence. In his opinion the modern courts of law were equally objectionable. Barristers were simply adepts in sophistry and logomachy, and juries were a motley, mixed herd, chosen at random and incapable of analysing facts or comprehending the duties of a judge. Still worse, if possible, was the periodical press, for it enabled any ignorant, worthless babbler to pose as a great authority on any conceivable subject. Fortunately these dangerous products of the spirit of Occidental rationalism find a counterpoise in popular vis inertice, and in the respect of the unsophisticated masses for the old respectable institutions which have developed slowly and automatically during the past centuries of the na- tional life. Among the practical deductions drawn from these premisses is the necessity of preserving in the admin- istration the autocratic power, and of fostering among the people the traditional veneration for the ritual of the National Church. These strange ideas and deductions may be regarded as the natural outcome of the peculiar intellectual condition of the Russian educated classes in the reign of Alexander II. Exaggerations naturally engender exaggerations in an opposite direction: as the ultra-Liberal ideas of that time found their extreme ex- pression in Nihilism, so the ultra-Conservative tendencies culminated in the wildly reactionary doctrines of M.

Pobedonostsef. In the sphere of practical politics he exercised considerable influence by inspiring and encourag- ing the Russification policy of Alexander III. (1881-94), which found expression in an administrative Nationalist propaganda and led to a good deal of religious persecu- tion. (See also Russia, History.)

Podiebrad (Czech, Podebrad), chief town of a gov- ernment district in Bohemia, Austria, on the right bank of the Elbe, between Kolin and Nimburg. It was the birthplace of George of Podiebrad, the Calixtine or Utra- quistic king of Bohemia. It contains the ruins of Podie- brad castle and a church of the 14th century. It has also a mineral spring (iron) and bathing establishment. There is an important trade in corn,

and the manufactures comprise sugar, flour, and glass works and breweries. Popu- lation (1890), 4807 ; (1900), 5512.

Podolia, a frontier province of south-west Russia, bordering on Austria, with an area of 16,224 square miles, and a population of 2,242,650 in 1881, and 3,031,513 in 1897, when there were 1,614,753 women and the urban population numbered 220,596. In 1896 there were 2,162,629 Greek Orthodox, 17,648 Nonconformists, 241,742 Catholics, 4137 Lutherans, and 388,437 Jews. It is, after Moscow, the most densely inhabited govern- ment of Russia outside Poland. It is divided into twelve districts, the chief towns of which are Kamenets-Podolsk (34,483), the capital of the government, Balta (23,393), Bratslaff (4796), Gaysin (9393), Leticheff (8731), Litin (9428), Moghileff-on-Dniester (43,106), Novaya Ushitsa (5099), Olgopol (8098), Proskuroff (22,916), Vinnitsa (28,996), and Yampol (6709). Tulchin (11,217), Bar (10,614), and Khmelnik (11,216) are also worthy of notice. The sanitary service is fairly well organized by the zemstvo (provincial council), and in 1896 there were 1762 schools (exclusive of the Jewish liedars), attended by 74,283 boys and 14,500 girls. The chief occupations of the people are agriculture and gardening, both maintained at a high level. Only 12 per cent, of the surface is under forests, and less than 5 per cent, is uncultivable. The annual average yield from 1895 to 1899 of wheat was 10,019,000 cwt., of rye 6,279,000 cwt., of oats 1,963,000 cwt., of barley 3,117,000 cwt. ; of all cereals, 29,180,000 cwt. ; of potatoes, 6,950,000 cwt. ; of beetroot and tobacco, 6250 cwt. Nearly 67,000 gallons of wine are obtained annually. Owing to the green crops, cattle-breeding is flourishing ; in 1897 there were 501,860 horses, 665,500 horned cattle, and 829,000 sheep. Bee-keeping is an important industry (annual production about 6000 cwt. of honey). Factoriesâ€” sugar factories, distilleries, flour mills, woollen mills, tanneries, potteries â€” give employ- ment to nearly 29,000 persons, and have an annual output valued at about Â£4,000,000. There is consider- able trade in grain, flour, sugar, spirits, leather, and wool, all of which are exported. Grain, timber, firewood, spirits, and fruit are shipped in great quantities down the Dniester, the annual movement of 28 river ports being over 100,000 tons loaded and unloaded. Large fairs are held at Yaronolintsy and Balta. (p. a. k.)

Poissy, a town, arrondissement of Versailles, depart- ment of Seine-et-Oise, France, 12 miles north-north-west of Versailles, on the railway from Paristo Havre. Thechurch, supposed to have been built between 1125 and 1130, and restored in modern times under the direction of Viollet le Due, is of special architectural interest, as affording one of the earliest and best, examples of transition from the Roman to the ogival style. The bridge of Poissy, a very ancient foundation, has been widened and modernized, but of the mills, known as Queen Blanche's, which formerly bordered it, only one remains. A statue of the painted-

Meissonier was erected in 1894. His house, on the site of an ancient monastery, is now occupied as an asylum for children. Poissy during six centuries supplied butchers' meat to Paris, but in 1867 the market was removed to the metropolis. A handsome fountain stands in the old market-place. Various branches of engineering and im- portant iron foundries are the leading industries, and rag- stone is quarried. Population (1881), 3990 ; (1901), 7406.

Poissy, the ancient Pinciacum, was the capital of the country of the Carnutes. In the time of Charlemagne it had a royal palace, where during the 9th century four national assemblies were held. Later it became a favourite residence of Blanche of Castille, and here her son, afterwards St Louis, was born in 1215. Philip the Fair gave the castle to the Dominicans, by whom it was completely transformed, and it was in the refectory of the abbey that the famous conference of Poissy between the Roman Catholics and Protestants tooli place in 1561.

Poitiers, capital of the department of Vienne, Prance, 206 miles south-west of Paris, on the railway from Paris to Bordeaux. The Palais des Pacultds was enlarged in 1892-94. Near the Pont Joubert has been erected a colossal statue of Notre Dame des Dames. Population

(1881), 29,304 ; (1901), 39,665.

Poker, a card game played by any number of players. It is usual to play with a full pack of fifty-two cards, but occasionally an ecart^ pack is used. Five cards are dealt to each player, whose object it is to obtain certain com- binations of cards, the value of which depends on their infrequency. Each player has the option of exchanging any number of the cards dealt to him for an equal number from the undealt portion of the pack. The pool is started by the player on the dealer's left (called the age) deposit- ing a fixed amount (called the ante). Every player who, after looking at his cards, decides to enter the game, must in his turn, beginning with the player to the left of the age, deposit an amount equal to twice the ante, except the a^e, who again deposits the same amount as the ante. An essential part of the game is that each player, at the time he makes any contribution to the pool, or signifies his intention to remain in, can make a raise, which obliges all the players to make an equal contribution to the pool, or to retire from the game. There is not, however, uni- formity of custom ; sometimes players are only allowed to make a raise after cards have been exchanged. After the draw the raising is started by the player on the left of the age. When all the players who remain in have seen the last raise, none of them making a further raise, the hands are shown, and the best hand takes the pool. The hands are valued in the following order : â€" 1. Straight flush (all the five cards being of the same suit and in sequence). 2. Pours (four cards of the same rank and one other). 3. Pull hands (three cards of one rank and two of another rank). 4. Plushes (the five cards being of the same suit, but not in sequence). 5. Straights (the five cards being in sequence, but not of the same suit). 6. Triplets (three cards of one rank and two of different ranks). 7. Two pairs. 8. One pair. 9. All other hands. When there are hands in the same class, the best is de- termined in the case of fours by the rank of the quartet ; in the case of a full hand or a triplet, by the rank of the triplet ; in case of two pairs, by the rank of the higher pair ; in the case of a pair, iDy the rank of the pair ; in other cases, by the rank of the highest card in the hand, and, if these are equal, by the rank of the second best card.

Advice to Players. â€" A scientific analysis of the rules of play is to some extent out of place, since scientific play is often one of the last

things desired by the votaries of the game. Poker is indulged in for the sake of excitement. The opportunities of showing reck- lessness with regard to money have made it a favourite pastime with those who are proud of having money to lose, and consequently also with those who are desirous of winning it. In some circles it

would be considered bad form to foUow the correct methods of play.

The following table gives the probability of a player havmg dealt to him the various combinations : â€”

T\ * ^ J i* J> TT .1

Number of Times in

Number of Times in

Description of Hand.

2,598,960 Deals.

1,000,000 Deals.

Straight flushes.

40

15

Tours

624

240

Full hands

3,744

1,441

Mushes

5,108

1,965

Straights .

10,200

3,925

Triplets .

54,912

21,129

Two pairs .

123,552

47,539

One pair .

1,098,240

422,569

Inferior hands

1,302,540

501,177

This table, it should be noted, gives only the probabilities before the draw. The probabilities after the cards have been exchanged are

dependent on the character of the play, which, in its turn, rightly depends on the number of players. It can, however, be approximately obtained by the use of the following proposition : â€” If the player exclusively aims at obtaining a given combination, he is equally likely to obtain it in any specified manner ; or the probability that he will have dealt to him a particular part of the combination and then fill it, is the same as the probability that the whole of the combination will be dealt to him. For instance, take the case of a straight flush to the ace in hearts. The chance that the player will have ace, king, queen, knave, ten of hearts dealt to him, is the same as the chance that he will have a given four, ace, king, queen, knave (say) dealt to him, and obtain the ten in exchange for his fifth card, or that he will have aoe, king, queen, dealt to him, and obtain the knave and ten in exchange. This Is on the assumption that the player is striving exclusively for the given combination. If the player's rule is to keep any four in the hope of filling a straight flush, since there are five combinations of four cards, he would be five times as likely to obtain the combination after having had four of the cards dealt to him as to have the whole of the five cards dealt to him at once. In a similar manner, a player is four times as likely to obtain four of a kind by taking in the fourth card to a triplet, as by having the four dealt to him originally ,- and six times as likely by taking in two cards to a pair. A disturbing element in the case is that there is a chance that the cards outside the combination may induce him to try for a different combination ; still, the rule is sufficiently near the truth for practical use.

Whilst the game is one especially susceptible of mathematical treatment, most attempts to treat of it from a mathematical stand-point have been failures. The fault has been in ignoring the possibility of the other players modifying their play in order to oppose any fixed rule. A fixed rule, to be successful, must be such as to leave the other players frequently in doubt as to their play ; whilst advantage must be taken of the possibility of their being frightened and led to abandon hands which would have won. Thus every rule of play must be tested as much by its effect on the other players as by its own apparent chance of.succeeding. The following advice may be given with regard to the decision to play a hand. When a player has six players following him,

he should stand on nothing less than a pair of aces ; when he is followed by only one player, he can stand on a pair of fives ; the gradations are fairly regular between these extremes. To oppose a player who has declared to stand, a second player should hold a rather better hand than would justify the first ; except the age, who may stand on an equal or even an inferior hand.

The two objects of raising are to choke off better hands, and to win more by making the pool larger. With a moderately strong hand it is a mistake to raise, because only opposing hands, that would be beaten, will be choked off ; and the hands that see the raise will generally be stronger hands, that will take the pool thus increased. With a strong hand, rather more than twice as rare as what he would expect to find against him, the player should raise the pool ; and about half as frequently with a hand too weak to be shown. The most advantageous amount by which to raise is the amount which is already in the pool (if less than the limit). If it is worth raising the pool at all, it is worth raising as much as this. Making any distinction between the amount of raises will only give an observant adversary a hint as to the character of the hand.

The number of times that a player bluffs, i.e., raises with a weak hand, should bear such a proportion to the number of times that he raises with a strong hand as to give a fair inducement to the opponent or opponents to see the raise. By seeing the raise, the opponent virtually bets the amount of the raise to the amount in the pool that the player is bluffing. The number of bluffs to the

number of genuine raises ought to bear this same proportion. If the proportion of bluffs is greater, the opponent knows that it is worth seeing the raise, and blufBng will fail ; if the proportion is less, he will not see the raise, and the pool will be less. In a similar way, the rule as to seeing the raise is connected with bluff- ing. If the player seldom sees a raise, the opponent will know that he can bluff successfully. If he sees

a raise too often, the opponent will avoid blufEng, profiting by the increased value of the pool. By bluffing, a player virtually bets the amount of the raise to the amount in the pool that the opponent will not see the raise. This ought to represent the proportion of the number of tim^s that the hands are abandoned to the times that the raises are seen.

By following correct rules, of play, the player can with average luck avoid loss. Nearly the whole of the gain will be made by noticing where the other players follow wrong methods, and modi- fying one's own play in accordance.

Pola, the principal naval harbour and arsenal of the Austro-Hungarian Monarchy, situated near the southern extremity of the peninsula of Istria, on the Gulf of Venice. The extensive system of fortifications com- prises forts and batteries at the adjoining coast village of Fasana, overlooking the channel of the same name, and on the Brionian Islands. Pola is, next to Trieste and Fiume, the most important mercantile harbour of the monarchy. It is an Episcopal see. Population (1890), 38,937 ; (1900), 46,052, including a garrison of 7657.

Poland, Russian, a territory consisting of ten governments which formerly constituted the kingdom of Poland (Tsaritvo Polskoye), but now ofiB.cially de- scribed as "governments on the Nistvlsi," {PrivislyansMs Giibernii), or occasionally as "territory on the Vistula" {Privislyanskiy Krai). It has a total area of 49,159 square miles, and its population, which was 7,319,980 in 1881, numbered 9,455,943 (4,764,007 men and 4,691,936 women) in January 1897, counting the domiciled popula- tion only, to which about 1,000,000 must be added if the total is to include the inhabitants (foreigners and natives) not living at their regular domicile at the date of the census. Omitting this last class, Poland, with 193 inhabitants per square mile, has a denser popu- lation than any other portion of the empire, the next to it being Moscow, with 189 inhabitants per square mile. Poland has thus a more considerable urban popu- lation than any other part of the Russian Empire. Twelve per cent, of the aggregate population is gathered in 117 towns, of which 32 have populations of over 10,000, the three largest

being Warsaw (638,000), -iiddz (315,000), and Lublin (60,000). Nearly one-half of the urban population are Jews, the great bulk of whom are artisans. The distribution of the population is shown in the following table : â€”

Governments.

Area,

Square Miles.

Domiciled

Population,

1S9T.

Urban Population.

Density per Square'Mile.

Kalisz . Kielce . Lomza . Lublin . Piotrkdw Mock . Eadom . Siedloe . Suwatki . Warsaw .

Total .

4392 3897 4667 6501 4729 4200 4769 5535 4848 5623

846,719

763,746

585,781

1,159,463

1,409,044

556,877

820,.363

775,316

604,945

1,933,689

113,609 57,814 69,834

148,196

509,699 89,821 94,318

110,995 73,308

791,746

194 196 144 177 297 153 171 140 127 286

49,159

9,455,943

2,059,340

193

Classified according to nationality and religion it is estimated that there are about 6,630,000 Poles, 1 225 000 Jews, 1,060,000 Great and Little Russians, 'SOOJOOO Lithuanians and Zhmudes, and 250,000 Germans- and

that some 75-2 per cent, are Eoman Catholics, 14-1 per cent. Jews, 6-8 per cent. Protestants, and 4-9 per cent, of the Greek Orthodox Church. Of the non-domiciled population, nearly 100,000 are estimated to be foreigners, chiefly Germans.

Education. â€” There were in 1896, under the Ministry of Public Instruction, 3026 schools, with 3729 teachers and 206,973 pupils, while other schools and colleges numbered nearly 4000. The principal among these latter are the University of Warsaw, with 1114 students in 1899, at which instruction is now given in the Russian language ; the Agricultural Institute at ISTowa Alexandrya ; and the Veterinary Institute and the Musical Conservatory at Warsaw. For secondary education there are 31 lyceums for boys and 19 for girls, 9 normal schools for teachers, 5 realschulen, 6 Catholic seminaries, and 1 polytechnic at ~L6dz. There are also a considerable number of smaller technical schools and private schools in the industrial regions. Nearly 70 newspapers were published in 1899, but the censorship is very rigorous.

Land Tenure and Agriculture. â€” In 1901 the village communities owned 40-9 per cent, of the total area; pri- vate owners, 50-3 per cent, (the bulk of which is owned by the nobles) ; the Crown and the Imperial Family, 6 per cent. ; various institutions, 2-8 per cent. The holdings of the peasant families vary, generally speaking, from 13 to 30 acres. By a law of 1891 further subdivision is prohibited when the holding is less than 8-3 acres. Forests cover over 23 per cent, of the surface, or 7,357,000 acres, of which 2,130,400 acres belong to the Crown. Agriculture continues to stand at a higher level than in other Russian provinces. No less than 70 per cent, of the peasants' holdings, and 62 per cent, of the land owned by the landlords, is under crops, while 11 per cent, of the former and 8 per cent, of the latter is meadow land. In 1899, 12,638,000 acres were under crops, yielding 76,548,000 qrs. of rye, 56,392,000 qrs. of oats, 25,838,000 qrs. of wheat, 19,274,000 qrs. of barley, 264,826 qrs. of potatoes, and 1,956,350 tons of hay. After all local wants are supplied, there remains every year a surplus of about 3,'500,000 qrs. of grain. Beetroot is largely grown for the manufacture of refined sugar, of which Poland produces more than the rest of Russia put together. The crop in 1898-99 was 838,000 tons, and the production of sugar 68,196 tons. Potatoes are largely grown for use in the distilleries.

Mining and Industries. â€” Mining and the iron industry have considerably developed in the governments of Piotrkdw and Radom. The output of coal was 4,026,000 tons in 1898 ; and in 1899 the output of pig-iron from the 36 private and 4 Crown ironworks was 310,400 tons, of steel 227,500 tons, of iron 71,800 tons, and of zinc 5650 tons. Some salt is extracted from springs in the government of Warsaw. Other industries are steadily progressing. In 1898 there were nearly 30,000 factories and workshops, employing some 250,000 workers of both sexes, the annual output being valued at about Â£25,000,000, while the total annual output of all indus- tries, including mining and distilleries, was valued at Â£42,500,000. The districts of -iddz, Rawa, and -task, in the government of Piotrkdw, and the provinces of Warsaw and Kalisz, are the main centres of industry. The yearly returns of the different brandies of textile industries are: cottons, estimated at Â£6,000,000; woollens, Â£4,000,000; and linen and hemp goods, Â£1,700,000.

Track'.â€" Viith. the extension of railways (1293 miles), the fairs have lost much of their importance, but their aggregate yearly returns are still estimated at Â£3,000,000. The chief fairs are held at Warsaw (wool and hemp), "Lenczica, Skaryszew, Ciechanoviec, andtowicz.

(p. A. K.)

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POLAR REGIOIN^S.

I. Arctic Explokation.

APTEE the synchronous observations during the years 1882-83, the next important Arctic work was the crossing of the great glacier forming the interior of Greenland by Nansen and Peary. Dr Hansen, with six companions, after overcoming great difficulties in traversing the ice-floes, succeeded in landing on the east coast of Greenland in August 1888, and reached a height of 7000 feet on the glacier, in 64Â° 60′ IST., on the 27th. Here there is an extensive flat plateau resembling a frozen ocean, rising to 8000 and 9000 feet. The cold was intense, and

for more than two weeks they travelled over these regions, each man dragging a small sledge, while the two leaders, IsTansen and Sverdrup, drew a some- what larger sledge between them. As they approached the western side their progress was checked by dangerous crevasses, but on the 26th of September Nansen and his gallant little party arrived at the inner end of the Ameralik-fjord, in 64Â° 12′ N., having traversed 260 miles of glacier. He discovered that in this latitude the inland ice of Greenland has the shape of a shield, rising rather rapidly, but regularly, from the east coast to 9000 feet, ” flat and even in the middle, and falling again regularly towards the western side.

In 1892 Mr Peary, accompanied by Eivind Astrup, made his great journey across the inland ice to ascertain the northern limit of Greenland. The party consisted of four men and sixteen dogs. Starting in April from Whale Sound, on the west coast, in 77Â° N., they took a north- easterly course. The highest part of the glacier was 6000 feet above the sea, gradiially sloping down on either side. At last they sighted land, indicating the termination of the glacier in 82Â° 12′ N., on the 26th of June. Soon after- wards they obtained a view of a bold line of cliffs, forming part of the east side of Greenland, in 81Â° 37′ N. It was discovered that land masses extended to the north where the great glacier terminated, thus establishing the northern limit of the inland ice-cap. Peary’s subsequent journey in 1896 did not add much to the information gained in

1892.

The year 1893 saw the departure of Dr Nansen on his famous expedition to cross the polar ocean by trusting to the drift from east to west. This was in several respects the most remarkable northern voyage that ever was under- taken. Dr Nansen had studied the Arctic problem ex- haustively and with great care ; his conclusions were sound, and he planned the expedition with ability, and with a close attention to details which ensured success. He knew exactly what he intended to do, and he adapted his means to a well-defined end. His ship, the Fram, was designed to sustain and rise to great ice pressure, and, in its interior arrangements, to ensure the health and comfort of

his people ; while minute attention was given to provisions and equipment. In the autumn of 1893 the Fram was forced into the ice to the north-west of New Siberia Island, and its memorable drift was com- menced, and continued during three winters. Eventually the Fram came out of the pack to the north of Spitsbergen. Hansen's chief discovery is that there is a very deep ocean to the north of the Eranz Josef group, continuous with that to the north of Spitsbergen, and that this deep sea has a relatively warm temperature in its depths. This ice-bearing ocean extends at least as far as the pole, and the time occupied by the ice in drifting across it from the Siberian side to Spitsbergen is about three years. The existing evidence points to the conclusion that there is a continuous drift from the eastern to the

western hemisphere, across an ice-covered ocean uninter- rupted by land of any magnitude. The light thrown upon the polar question by Nansen has not only extended our knowledge positively, but has had the effect of piecing together what appeared before to be fragmentary, and of making the detached pieces fit into their proper place and form a consistent whole.

After the second winter Dr Nansen, with a single com- panion, Johansen, left the ship to examine the nature of the ice to the northward on 14th March 1895. On 8th April, after travelling over very heavy ice for several days, he reached his farthest north in 86Â° 13′ N. He then returned southwards, and eventually reached an island of the Eranz Josef group, where he wintered in a stone hut. In the spring of 1896 the journey was recommenced, and on 17th June Hansen and Johansen met Mr Jackson, and their troubles were at an end.

Mr Jackson was in command of an expedition to explore Eranz Josef Land, fitted out at the expense of Mr A. C. Harmsworth. It consisted of Mr Armitage as second in command, and six scientific civilians, who were landed at Cape Elora, where log houses were erected. The vessel which took them out, the Windward, had to winter in 1894-96. In the spring of 1895 Mr Jackson made a jour- ney northwards as far as 81Â° 19′ 30″ H., and discovered a channel leading between groups of islands,

to the west of the Austria Sound of Payer. Later in the season he made an exploring boat voyage to the westward along the coast of Eranz Josef Land. In June 1896, after the second winter, Mr Jackson's party welcomed Dr Hansen and his companion to their house at Cape Flora. The explorers returned to Horway on board the Windward, the Fram arriving a few days afterwards. In 1897 Mr Jackson, accompanied by Mr Armitage, made a remarkable journey, during which he discovered the western portion of Eranz Josef Land and explored the glaciers of the most western island. The Jackson-Harmsworth expedition returned to England in the autumn of 1897. Mr Jackson had dis- covered a wide channel opening on a sea to the north, and numerous islands forming the western portion of the Eranz Josef group. Careful series of meteorological and magnetic observations were taken during these years, and the geological collections indicated that the Eranz Josef group and Spitsbergen were portions or fragments of one extensive land existing in the late Tertiary period.

Since the return of Mr Jackson, a party led by Sir Martin Conway has explored the interior of Spitsbergen, and the Swedish savant, Hathorst, has examined its eastern coast and the off-lying islands on that side. The Danes have established a new colony on the east side of Greenland, and a party under Lieut. Ryder has done some good exploring work along the east coast. A small party of Americans and Horwegians, led by Mr Wellman, was landed on Eranz Josef Land in 1898 and wintered there. They returned in the autumn of 1899, and one of the party, Mr Baldwin, completed the discovery of the east- ernmost islands of the group.

In 1899 Captain Sverdrup, on board the Fram, led an expedition up Smith Sound, with the object of discovering the northern coast of Greenland. Lieut. Peary, trusting to the help of the northern Eskimo, pressed northwards by the same route. H.Pv,.H. the duke of Abruzzi, on board the Horwegian whaler Jason, which was renamed the Stella Polare, proceeded to Eranz Josef Land in the summer of 1899. The ship was put into Teplitz Bay in Eudolf Land, where the expedition wintered. The side of the ship was crushed by the ice-pressure. Three

sledge expeditions were sent north in the spring of 1900, and one of these,

under Captain Cagni, reached 84Â° 33′ N. at about 66Â° E., being about 20 miles farther north than Nansen's farthest. It was found that the Petermann Land of Payer does not exist, and the same is believed to be the case with King Oscar Land. The Stella Polare was patched up, and in her the expedition reached Norway in the begin- ning of September. Three members of the expedition, returning from Captain Cagni's party, were never heard of. Lastly, Baron Toll in 1900 led an expedition to dis- cover islands supposed to exist to the north of the New Siberia group. (c. e. m.)

II. The Arctic Ocean.

According to its geographical position, the Arctic Ocean may be described as the sea situated north of the Arctic Circle; but, according to its natural configuration, we may more adequately say that it is the gulf ~~like northern termination of the long and relatively narrow Atlantic arm of the ocean which extends north between Europe on one side and America on the other ; for by this situa~~ tion as the northern bottom of such a long arm of the ocean its physical conditions are to a very great extent determined. This Arctic gulf is bounded by the northern coasts of Europe, Siberia, North America, the North American Arctic Archipelago, Greenland, and Iceland. The entrance to this typical gulf, the largest in the world, is the opening between Europe and Labrador divided by Iceland, Greenland, and the American Arctic Islands ; and its natural southern boundary would be the submarine ridge extending from Scotland and the Shetland Islands over the Faroe Islands and Iceland to Greenland, and con- tinuing on the other side of Greenland across Davis Strait to Baffin Land. This ridge separates the depressions of the Arctic Ocean, filled with cold polar water at the bot- tom, from the deep depression of the North Atlantic. The Arctic Ocean communicates with the Pacific Ocean

through Bering Strait, which is, however, only 49 miles broad and 27 fathoms deep. The area of the Arctic Ocean may be estimated to be about 3,600,000 square miles, of which nearly two-thirds (or 2,300,000 square miles) is continuously covered by floating ice.

The Arctic Ocean may be divided into the following parts: â€” (1) The North Polar Basin (including the Siberian Sea), bounded by the northern coasts of Siberia (from Bering Strait to the western Taimyr Peninsula), Eranz Josef Land, Spitsbergen, Greenland, Grinnell Land, the Parry Islands, and Alaska ; (2) the Kara Sea, between Novaya Zemlya and the Siberian coast, south of a line from the north point of the former to Lonely Island (Ensomheden) and Nordenskiold Island ; (3) the Barents and Murman Sea, bounded by Novaya Zemlya, Eranz Josef Land, Spitsbergen, Bear Island, and the northern coasts of Norway and Eussia ; (4) the Norwegian Sea, between Norway, Spitsbergen, Jan Mayen, Iceland, and the Faroes ; (6) the Greenland Sea, between Spitsbergen, Jan Mayen, Iceland, and Greenland ; (6) Baffin Bay and Davis Strait, between Greenland, Ellesmere Land, North Devon, and Baffin Land.

Depths. â€” The Arctic Ocean forms an extended depres- sion separating the two largest continental masses of the world â€” the European-Asiatic (Eurasia) and America. Along its centre this depression is deep, but along its whole margin, on both sides, it is unusually shallowâ€” a shallow submarine plateau or drowned plain extending northward from both continents, forming the largest known continental shelf. North of Europe this shelf may be considered as reaching Spitsbergen and Franz Josef Land, extending over more than 10 degrees of lati- tude, although there is a somewhat deeper depression in between. North of Spitsbergen it reaches north of 81Â°

N., and north of Franz Josef Land probably somewhat north of 82Â° N. North of Siberia the shelf is 350 miles broad, or more, with depths of 60 to 80 fathoms, or less. In longitude 135Â° E. it reaches nearly 79Â° N., where the bottom suddenly sinks to form a deep sea with depths of 2000 fathoms or more. Farther east it probably has a similar northward extension. North of America and Greenland the shelf

extends into the unknown north. This shelf, or drowned plain, evidently marks an old extension of the continents, and its northern edge must be considered as the real margin of their masses, the coasts of which have probably been overflowed by the sea at some comparatively recent geological period. On this submarine plateau the Arctic lands are situated â€” Spits- bergen (with Seven Islands to the north. Bear Island and Hope Island to the south), Franz Josef Land, Novaya Zemlya, Lonely Island, the New Siberia Islands, Wrangel Island, the American Arctic Archipelago. The depth of the shelf is, especially north of Siberia, very uniform, and usually not more than 60 to 80 fathoms. North of Europe it is intersected by a submarine fjord-like depression, or broad channel, extending eastward from the Norwegian Sea. Between Norway and Bear Island this depression is about 240 fathoms deep, and between Novaya Zemlya and Franz Josef Land 100 to 150 fathoms deep. It gives off several submerged fjords or channels towards the south- east into the shallow Murman Sea, e.g., one channel, more than 100 fathoms deep, along the Murman coast towards the entrance of the White Sea ; another narrow channel, partly 100 fathoms deep, along the south-west coast of Novaya Zemlya through the Kara Strait. It also extends into the Kara Sea, rounding the north point of Novaya Zemlya and forming a narrow channel along its eastern coast. Just east of Vaigatch Island there are sounded depths of nearly 400 fathoms. On the American side similar but much narrower submarine depressions, or we might here call them submarine fjords, extend from Baffin Bay into the continental shelf, northward through Smith Sound, Kane Basin, and Kennedy Channel, and westward through Lancaster Sound, &c.

The greatest depths in the Arctic Ocean have been found in the North Polar Basin, where depths of 2100 fathoms, in about 81Â° N. and 130Â° E., have been measured with certainty. It is deeper than 1650 fathoms along the whole route of the Fram, from about 79Â° N. and 138Â° E. to near Spitsbergen. In 84|Â° N. and about 75Â° E. the depth is 2020 fathoms, and in 83Â° N. and 13Â° E. it is 1860 fathoms. The northern and eastern extension of this deep basin is not known. It was formerly believed that still greater depths existed west of Spitsbergen, the so-called Swedish deep, where 2600 fathoms had been sounded, but the

Nathorst expedition in 1898 found no greater depths there than about 1700 fathoms. The Norwegian Sea, farther south, is 2000 fathoms deep mid- way between Iceland and Norway, in about 68Â° N. This so-called Norwegian deep is, as before stated, separated from the North Atlantic basin by the shallow Wyville Thomson ridge and the Shetland-Faroe-Iceland ridge. Farther north there is a low transverse ridge extending eastward from Jan Mayen, in about 72Â° N., which is about 1300 fathoms deep. North of this the sea is again deeperâ€" 1986 fathoms in 76Â° N. From the north-west corner of Spitsbergen a submarine ridge extends in a nort^i-westerly direction, with depths of about 430 fath- oms m 81Â° N. and about 4Â° E. How far this ridge extends is unknown, and there is a possibility that It reaches Greenland, and thus separates the Swedish and the Norwegian deep from the deep depression of the North Polar Basin. Baffin Bay forms, probably, a relatively deep basin of about 1000 or 1200 fathoms, which IS separated from the West Atlantic Basin by the

shallow submarine ridge from Greenland to Baffin Land in about 65Â° or 66Â° N.

The deposit composing the bottom of the Arctic Ocean contains in its northern part, in the North Polar Basin, extremely little matter (shells) of organic origin. It is formed by mineral material, sandy clay of very fine grain, to an extent which is hardly found in any other part of the sea with similar depths. It contains only from 1 to 4 per cent, of carbonate of lime. Farther south, in the sea between Spitsbergen and Greenland, the amount of

carbonate of lime gradually increases owing to the shells of foraminif era (especially biloculinee) ; west of Spitsbergen we may already find the proportion above 20 or even 30 per cent., while more towards Greenland it is considerably lower.

The circulation of the Arctic Ocean may be explained firstly by the vertical and horizontal distribution of temperature and salinity (i.e., density) ; secondly, by the influence of the winds, especially on the ice-covered surface. The currents in this sea may to a, very great

Sketch Map

of the

ARCTIC REGIONS.

20″ Longitude East 40″ of Greenwich 60*^

extent be considered as convection currents. The water near the surface is cooled down by radiation of heat ; it becomes heavier, sinks to the bottom, along which it creeps slowly southward, while it must be replaced on the surface by warmer water coming from the south. To replace the northward-flowing surface water, the cold, heavy bottom water must again rise towards the surface in more southern latitudes. On account of the rotation of the earth the northward-running water on the surface, as well as the sinking water, will be driven in a north-easterly or easterly direction, while the southward-flowing water along the bottom, as well as the rising water, is driven south-west or westward. This very simple circula-

tion is, however, to a great extent complicated on one side by the irregular configuration of the sea-bottom, especially the transverse submarine ridges â€” e.g., the Spits- bergen ridge, the Jan Mayen ridge, and the Shetland- Paroe-Iceland ridge ; and on the other side by the circumstance that the upper water strata of the sea are comparatively light in spite of their low temperature. These strata, about 100 or 120 fathoms thick, are diluted by addition of fresh water from the North European, Siberian, Canadian, and Alaskan rivers, as well as by precipitation, while at the same time the evaporation from the surface of the mostly ice-covered sea is insignificant. The light surface strata will have a tendency to spread over

the heavier water farther south, and thus the polar surface currents running southward along the east coasts of Green- land, Baffin Land, and Labrador are formed, owing their westerly course to the rotation of the earth. These cur- rents are certainly to a great extent helped and increased by the prevailing winds of these regions. The winds have a firm hold in the rough surface of the floating ice, which, with its deep hummocks and ridges, acts as a good stirrer of the water, transferring the movement of the surface immediately down to at least 5 or 10 fathoms.

The chief currents running into the Arctic Ocean are the following : â€”

1. The Chdf Stream, or Atlantic drift, passing north- eastward over the Shetland-Faroe-Iceland ridge, along the west coast of Norway, with one arm branching oif east- ward round North Cape into the Barents Sea, and another branch running northward along the margin of the shelf between Norway, Bear Island, and Spits- bergen, passing as a very narrow current along the west coast of the latter, over the Spitsbergen ridge (at its north-west corner), and into the North Polar Basin, where it flows gradually northward and eastward (on account of the rotation of the earth) below the cold but lighter layer, 100 fathoms thick, of polar water, and fills the whole basin below 100 or 120 fathoms to the bottom with Atlantic water.

2. The Irminger current, running north along the west coast of Iceland. One part branches off westward and southward again in Denmark Strait, following the Green- land polar current, whilst another part evidently dives linder the polar current and runs as an under-current northward into the Greenland Sea, and partly also east- ward and south-eastward to the north and east of Ice- land.

3. An Atlantic current runs northward along the west coast of Greenland, passes the ridge across Davis Strait, and flows into Baffin

Bay, forming its deeper strata below the polar water in a similar way to the Gulf Stream m the North Polar Basin. There is a possibility that some slight portion of this current even reaches the latter along the bottom of the deep channel through Smith Sound.

4. A small current running northward .into the North Polar Basin through Bering Strait.

The Arctic Ocean receives also a contribution of fresh water from the rivers of northern Europe, Siberia, and America, as well as from the glaciers of Greenland and the precipitation over the whole area of the sea itself.

The chief currents running out of the Arctic Ocean are these : â€” 1. The Greenland polar current, running south- ward along the east coast of Greenland, and dividing into two branches north of Iceland â€” (a) the east Green- land branch, passing south through Denmark Strait and rounding Cape Farewell ; (6) the east Icelandic branch, running south-eastward between Iceland and Jan Mayen, towards the Paroes. It seems as if only a small portion of this current actually passes the Faroe-Icelandic ridge and reaches the Atlantic Ocean. The greater part is partly mixed with the water of the Gulf Stream and is turned by the latter in a north-easterly direction, forming a kind of eddy in the Norwegian Sea. 2. The Labrador polar current, formed by the water running south through Smith Sound, Lancaster Sound, and Jones Sound, as well as water from Baffin Bay, and also from the east Greenland current rounding Cape Farewell and crossing Davis Strait. 3, Along the south-east coast of Spits- bergen a polar current is also passing in a south-westerly or westerly direction past South Cape, where it meets the Gulf Stream. 4. A very small current probably also runs out along the western side of Bering Strait.

Temperature and Salinity. â€” While the temperature is comparatively uniform, with small variations, the differ-

ence in salinity between the upper and lower strata is greater than in most other parts of the sea. In the North Polar Basin the vertical distribution of temperature as well as salinity is very much the same in

all places ex- amined. Near the surface, from 0 down to 100 fathoms, the water is below freezing-point â€” with a minimum of between 28-75Â° (-1-8Â° C.) and 28-57Â° (-1-9Â° C.) at a depth of about 30 fathoms â€” and is much diluted with fresh water (see above), the salinity gradually increas- ing downward from about 29 or 30 per mille near the surface to nearly 35 per mille in 100 fathoms. Below 100 fathoms the temperature as well as the salinity gradually increases until they approach their maximum in about 160 or 200 fathoms, where the temperature varies between 32-5Â° (0-3Â° C), north of the New Siberia Islands, and about 33-8Â° (1Â° C), north of Franz Josef Land ; and the salinity is about 35-2 and 36-3 per mille. From this depth the temperature gradually sinks downwaj.-d; 32Â° (0Â° C.) is found at about 490 fathoms in the western part of the basin â€” e.g., between about 84Â° N. 15Â° E. and 85-1^Â° N. 58Â° E.â€” while it is found in about 400 fathoms farther eastâ€” e.^., in 81^Â° N. and 123Â° E. In depths between 1400 and 1600 fathoms the temperature has a second minimum between 30-6Â° (-0-8Â° C.) and 30-4Â° (-0-9Â° C), below which depth the temperature again rises slowly, a few tenths of a degree towards the bottom. In all depths below 200 fathoms the salinity of the water remains very much the same, between 35-2 and 35-3 per mille, with very slight variations. This comparatively warm and saline water evidently originates from the branch of the Gulf Stream passing north across the submarine ridge from north-west Spitsbergen (see above). The vertical distribution of temperature and salinity is very much the same, summer and winter, throughout the North Polar Basin, except near the surface, which in summer is covered by a layer of fresh water arising from the melting of the snow-covered surface of the floe-ice. This fresh-water layer may attain a thickness of 5 or 6 feet between the floes. North of the Siberian coast the sea is, during summer, covered with a layer of warm water from the Siberian rivers, and the temperature of the surface may rise to several degrees above freezing-point.

In the Norwegian and Greenland Sea there are greater variations of temperature. Below a certain limit, which in the northern part (on the eastern side) is about 550 fathoms deep, and in the southern part between 300 and 400 fathoms deep, the whole basin of this sea is filled

with water which has an unusually imiform salinity of about 35-05 per mille, and the temperature of which is below zero centigrade, gradually sinking downward from the above-mentioned limit, where it is 32Â° (0Â° C.) ; and down to 29-85Â° (-1-2Â° C.) or 29-65Â° (-1-3Â° C.) near the bottom in 1400 or 1600 fathoms. In the northern part of this sea the bottom temperature seems even to be about 29-5Â° (-1-4Â° C.) or 29-3Â° (-1-5Â° C). The origin of this cold underlying water of such a remarkably uniform and comparatively low salinity is not quite clear. On one side, the salinity of this water is considerably higher than that of the equally cold water of the east Grt?enland polar current (see later) ; but on the other side it seems to be distinctly different from the hitherto known water filling the deep of the North Polar Basin, as it has a lower salinity and lower temperature; the known bottom temperature of the North Polar Basin being between 30-7Â° (-0-7Â° C.) and 30-4Â° (-0-9Â° C), and the salinity about 35-2 or 35-3 per mille. This fact seems to indi- cate that there can be no direct communication between the deep depression of the North Polar Basin and the Norwegian-Greenland Sea, which are probably separated by a submarine ridge from the north-west corner of

Spitsbergen to Greenland. The cold bottom water of the Norwegian-Greenland Sea may to some extent arise from the cooling down of the Atlantic water of the surface during the winter ; to some extent also by mixing with the cold but less saline water of the polar current. There is, however, also another possibility: that the bottom water of the North Polar Basin is colder and less saline in its more northern and western parts, which are still unknown, and that this water has communication with the bottom water of the Norwegian-Greenland Sea through a deep channel along the western side of the sea between Spitsbergen and Greenland.

The above-mentioned underlying layer of uniform cold water of the Norwegian-Greenland Sea is, along its eastern side, covered by the warm and saline water of the Gulf Stream flowing northward along the

west coast of Norway, Bear Island, and Spitsbergen, and forming the iipper strata of the sea about 300 to 500 fathoms deep. The maximum temperature of this water is on the surface about 46Â° (8Â° C.) to 50Â° (10Â° C.) west of northern Norway, and about 37Â° (3Â° C.) to 39Â° (4Â° C.) west of Spitsbergen. The salinity is generally about 35-2 or 35-3 per mille, varying between 35-1 and 35-5 per mille.

Along the western side of this sea, towards the east coast of Greenland, the underlying cold water is covered by the less saline water of the polar current, which in the upper strata of the sea, from the surface down to about 100 fathoms, has very much the same tempera- ture and salinity as in the upper cold and less saline strata of the North Polar Basin. Near the east coast of Greenland, as far north as 74Â° 46′ N., a layer of comparatively warm and saline water, with a tempera- ture of 32-7Â° (0‘4Â° C.) and a salinity of 35-2 per mille, has been found (by the Eyder Expedition in 1891) below the cold and lighter polar water in a depth of 70 to 90 fathoms. This warmer undercurrent probably runs northward, being a continuation of the warm Irminger current passing north along the west coast of Iceland.

In Barents Sea the temperature and salinity are highest in the western part near Norway or between Norway and Bear Island, where the eastern branch of the Gulf Stream enters and where in summer the salinity generally is about or a little above 35 per mille from the surface down to the bottom, and the surface temperature generally is about 41Â° or 43Â° (6Â° C. or 6Â° C), and the bottom temperature is above zero centigrade. The eastern part of Barents Sea is filled with water of a little lower salinity, often below 35 per mille â€” the deeper strata of which are very cold, with temperature even as low as 28-9Â° (â€”1-7Â° C). The bottom temperature is everywhere in the eastern part below zero centigrade and generally below â€”1Â° C.

The Kara Sea is, near the surface, covered with a layer of cold water much diluted by the fresh water from the Siberian rivers, especially the Obi and the Yenisei. The salinity varies between 29 and 34 per mille ; near the mouth of the rivers it is naturally much lower. The deeper western parts of Kara Sea are filled with unusu- ally cold and more

saline water, with a temperature of about 28-4Â° (â€”2Â° C.) and a salinity of about 34-9 per mille. This water is colder and more saline than the water at similar depths in the North Polar Basin, which indicates that there is no direct communication between the deeps of the two basins.

The vertical distribution of temperature and salinity in Baffin Bay seems to be very similar to that of the North Polar Basin, with a cold but less saline upper stratum of water â€” with a minimum temperature of about 28-9Â° (â€”1-7Â° C.) â€” and a warmer and more saline deeper

stratum from 100 or 200 fathoms downward, with a maximum temperature of 33-6Â° (0-9Â° C.) in about 200 fathoms, and the temperature slowly decreasing towards the bottom.

The Ice. â€” As before mentioned, at least two-thirds of the Arctic Ocean is constantly covered by drifting ice. This ice is mostly formed on the surface of the sea itself by freezing, the so-called floe-ice or sea-ice. A small part is also river-ice, formed on the rivers, especially the Siberian, and carried into the sea during the spring or summer. Another comparatively small part of the ice originates from the glaciers of the Arctic lands. These pieces of glacier-ice, or icebergs, are, as a rule, easily distinguished from the floe-ice by their size and structure. They occur almost exclusively in the seas round Green- land, where they originate from the glaciers descending into the sea from the inland ice of Greenland. Some small icebergs are also formed in Franz Josef Land, Spits- bergen, Novaya Zemlya, Grinnell Land, &c., but they are comparatively insignificant, and are not as a rule carried far from the coasts. Sea-ice or floe-ice is formed during the autumn, winter, and spring, especially in the North Polar Basin, but also in Kara Sea, a greater part of Barents Sea, the northernmost part of the Norwegian Sea (near Bear Island and towards Jan May en), Green- land Sea and Baffin Bay. The floe-ice does not, as a rule, grow thicker than 7 or 8 feet in one year, but when it floats in the water for some years it may attain a thick- ness of 16 feet or inore directly by freezing. By the constant upheaval from pressure much greater thick- nesses are attained in the

piled-up hummocks and rubble, which may be 20 to 30 feet high above the water when floating. During the summer the floe-ice decreases again by melting, partly on the surface owing to the direct radiation of heat from the sun, partly on the under side owing to the higher temperature of the water in which it floats. The first kind of melting is the prevailing one in the North Polar Basin, while the latter kind occurs in more southern latitudes. The floe-ice is con- stantly more or less in movement, carried by winds and currents. The changing wind, or also to a great extent the changing tide current, causes diverging movements in the ice by breaking it into larger or smaller floes. When these separate, lanes and channels are formed ; when they meet, ice-pressures arise, and the floes are piled up to form hummocks or ridges, and thus the uneven polar ice arises. In the North Polar Basin the floe-ice is slowly carried by the prevailing winds and the currents in an average direction from Bering Strait and the New Siberia Islands, north of Franz Josef Land and Spitsbergen, more or less near the North Pole, towards the Greenland Sea and southward along the east coast of Greenland. Such a drift of an ice-floe from the sea north of Bering Strait to the east coast of Greenland probably takes, as a rule, four or flve years, and the floes found in this part of the sea are not, therefore, generally older. How the drift of the ice is on the American side of the North Polar Basin is little known. But here it is probably more or less blocked up in its southward drift by the islands of the American Arctic Archipelago, and the ice-floes may thus grow very old and thick. The southward distribution of the drifting floe-ice (the pack ice) in Barents Sea, Norwegian-Greenland Sea, and Davis Strait, may differ much from one year to another, and these variations are evidently due to more or less periodical variations in the currents and also the directions of the prevailing winds. In most places the ice has its most southerly distribution during the late winter and spring, while the late summer and autumn (end of August and September) is the most open season.

Biological Conditions. â€” The development of organic life is comparatively poor in those parts of the Arctic Ocean which are continuously covered by ice. This is, amongst other things, proved by the bottom deposits, -which contain exceptionally little carbonate of lime of organic origin. The reason is evidently that the thick ice prevents to a great extent the development of plant life on the surface of the sea by absorbing the light ; and as the plant life forms the base for the development of animal life, this has also very unfavourable conditions. The result is that â€” e.g., in the interior of the North Polar Basin â€” there is quite exceptionally little plant life in the sea under the ice-covering, and the animal life both near the surface and in deeper strata is very poor in indi- viduals, whilst it is comparatively rich in species. Near the outskirts of the Arctic Ocean, where the sea is more or less open during a greater part of the year, the pelagic plant life as well as animal life is unusually rich, and, especially during the early summer, there is often here such a development of plankton (i.e., pelagic life) in the sea- surface as is hardly found in any other parts of the ocean. It seems as if the polar water has specially favourable conditions for the development of the pelagic plant life, which makes the flora, and consequently also the fauna, flourish as soon as the ice-covering disappears and the water surface is exposed to full sunlight. At the same time the temperature of the water also rises, and thus the conditions for the chemical changes of matter and the nutritive assimilation are much improved. The Arctic Ocean, or more especially the North Polar Basin, might thus be considered as a lung or reservoir in the circulation of the ocean where the water produces very little life, and thus, as it were, gets time to rest and accumulate those substances necessary for organic life, which are every- where present only in quite minimal quantities. It is also a remarkable fact of interest in this connexion, that the greatest fisheries of the world seem to be limited to places where water from the Arctic Ocean and from more southern seas meet â€” e.g'., Newfoundland, Iceland, Lofoten and Finmarken in Norway.

The mammal life is also exceptionally rich in indi- viduals along the outskirts of the Arctic Ocean. We meet there, especially along the margin of the drifting ice, the enormous quantities of seals of various

kinds, as well as whales, which live on the plankton and the fishes in the water. A similar development of mammal life is not met with anywhere else in the ocean, except perhaps in the Antarctic Ocean and Bering Sea, where, however, similar conditions are present. In the interior of the Arctic Sea or the North Polar Basin the mammal life is very poor, and consists mostly of some straggling polar bears, probably occasionally wandering everywhere over the whole expanse of ice ; some seals, especially Phoca foetida, which has been seen as far north as between 84Â° and 85Â° N. ; and a few whales, especially the narwhal, which has been seen in about 85Â° N.

The bird life is also exceptionally rich in the outskirts of the Arctic Ocean, and the coasts of most Arctic lands are every summer inhabited by thousands and millions of sea-birds, forming great colonies almost on every rock. These birds are also dependent for their living on the rich plankton on the surface of the sea. In the interior of the Arctic Ocean the bird life is very poor, but straggling sea- birds may probably be met with occasionally everywhere during summer-time, even over the whole North Polar Basin.

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III. Antarctic Regions.

Strictly speaking, the Antarctic Regions are the portion of the Earth’s surface lying south of the Antarctic circle, but it IS usual to extend the term so as to include that part of the surrounding ocean which is influenced by Antarctic drift ice. The limits cannot be exactly defined. The long-cher- ished belief in a great Antarctic continent which extended into temperate and even tropical latitudes was disproved by CaptaiQ Cook in his second voyage of circumnavigation, and the fact was clearly established before 1839 that any southern land which may exist only extends appreciably beyond the Antarctic circle in one placeâ€” to the south of South America. The voyage of Weddell in 1824 to 74Â° 15′ in 34Â° 17′ W., and that of Ross in 1841-12 to

78Â° 10′ in 161Â° 27′ E., proved that navigable water ex- tended into high latitudes on opposite sides of the polar circle.

Recent Exploration. â€” The first steamer to cross the Antarctic circle was H.M.S. Challenger on 16th February 1874: she only penetrated to 66Â° 40′ S., in 78Â° 30′ E., south of Kerguelen Island ; but she continued her course to Australia for some distance in a high latitude, passing within 15 miles of the position assigned to Wilkes's Termination Land without seeing any sign of land. Her dredgings and soundings yielded indirect evidence as to the nature of the unknown region farther south. Sir John Murray believed that the soundings showed a general shoaling of the ocean towards the Antarctic ice, indicating the approach to a continent. By collecting and analysing all samples of deep-sea deposits which had been secured from the far south, he discovered a remarkable symmetry in the arrangement of the deposits. The globigerina ooze, or in deeper waters the red clay, carpet- ing the northern part of the Southern Ocean, merges on the southward into a great ring of diatom ooze, which gives place in turn, towards the ice, to a terrigenous blue

mud. The fine rock particles of which the blue mud is composed are such as do not occur on oceanic islands, and the discovery of large blocks of sandstone dropped by ice- bergs proved the existence of sedimentary rocks within the Antarctic circle. The marine fauna discovered by the Challenger contained many species very similar to those common in the Arctic regions, if not identical with them. The suggestion of identical forms occurring in the two polar areas, and absent from the intervening seas, has given rise to a lively discussion amongst biologists.

During the southern summer in which the Challenger visited Antarctic waters, a German whale-ship, the Qrbnland, under Captain Dallmaim, visited the western coast of the Antarctic land south of Tierra del Fuego, and rectified the chart in several particulars. The chief dis- covery was a channel, named Bismarck Strait, in 65Â° S., which seemed to run between Palmer Land and Graham Land.

When the International Circumpolar observations were set on foot in 1882, two scientific stations were maintained for a year in the southern

hemisphere in order to obtain data for comparison with the observations at twelve

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Sketch Map of the Antakotic Regions, showing Tracks of Recent Expeditions.

stations round the North Pole. One of these was occupied by French observers in Tierra del FuegO in 55Â° S., the other by German observers at Royal Bay on South Georgia in 54Â° 30′ S. The magnetic and meteorological observations were of considerable importance.

In 1892 four steamers of the Dundee whaling fleet â€” the Balmna, Active, Diana, and Polar Star â€” went out to test Ross’s statement that the ” right whale ” inhabited Antarctic waters. The surgeons of two of the vessels â€” on the Balmna Mr W. S. Bruce, on the Active Dr C. W. Donald â€” were selected at the instance of Mr Leigh Smith and the Council of the Royal Geographical Society for their scientific tastes, and equipped with all requisite instruments for observations and collecting. The result of the experiment was disappointing. No whales were obtained, and all the ships devoted their attention to sealing on the east of Joinville Island and Louis Philippe Land, not going farther south than 65Â° S., although the floes were found fairly open, with numerous water chan- nels. Some small changes were made on the chart, and the few opportunities which were permitted for scientific work were taken advantage of by the sur- geons {Geographical Journal, vii., 1896, pp. 502-521, 625-643). The experiment has not been repeated by British ships.

During the summer of 1892-93 a Norwegian sealer, the Jason, Captain Larsen, also visited those seas, but did not go farther than about 66Â° S. The captain landed

and collected fossils at several points. In 1893-94 the Jason, accompanied by two other Norwegian vessels, the Hertha and the

Castor, returned to the Antarctic and entered the ice-laden waters in November at the very beginning of summer. Captain Larsen in the Jason made his way as far south as 68Â° 10′ in 60Â° W. on the eastern side of Graham Land, but several miles from the coast, which was bordered by a high ice-barrier. The most prominent headland, in 66Â° S., was named Cape Framnes. Returning northwards, two small islands, Lin- denberg and Christensen, were discovered and found to be active volcanoes. Meanwhile the Hertha, Captain Evensen, had reached the South Shetlands on 1st Novem- ber 1893, and worked her way southward along the west side of Palmer Land and past the Biscoe Islands, reach- ing the Antarctic circle on 9th November without meet- ing ice. This was the first time the Antarctic circle had been crossed since the Challenger did so twenty years before. Captain Evensen sighted Alexander Land, but did not follow the coast to find whether it is continuous with Graham Land; and without experiencing any trouble from ice-floes he reached his farthest south, 69Â° 10′ S. in 76Â° 12′ W. (Mittheilungen cler Geographischen Gesellschaft, Hamburg, 1896, pp. 245-304.) After visit- ing Tierra del Fuego, both the Jason and the Hertha returned to Antarctic waters towards the end of January, but went no farther than Joinville Island, and then sailed for Europe.

In 1894 the -well-known Norwegian whaler, Svend Foyn, sent out one of his vessels, the Antarctic, Captain Christensen, to try his hick off the coast of Victoria Land. The Antarctic sailed from Melbourne in Septem- ber, having on board C. E. Borchgrevink, a young Nor- wegian resident in Australia, who, being determined to take part in a voyage he could join in no other way, shipped as an ordinary seaman. He made notes of the voyage, and published an account of it on his return to Europe (Report of Sixth International Geographical Con- gress, London, 1895, pp. 169-175). The Antarctic, after being compelled to put back for repairs, left Stewart Island, New Zealand, on 28th November 1894, and en- tered the pack in 62Â° 45′ S., 171Â° 30′ E., on 8th December. The Balleny Islands were sighted on 14th December, and

Cape Adare on Victoria Land two days later. On 22nd January 1895 the farthest point was reached at Coulman Island in 74Â° S. ; the sea was then easily navi- gable to the south. On 23rd January a small party, in- cluding the captain and Mr Borchgrevink, landed on the mainland near Cape Adare, the first people to set foot on what is probably the Antarctic continent. On the return voyage the ship was only six days in working through the pack.

Efforts had been made from time to time, by Pro- fessor Georg von Neumayer in Germany and by Sir John Murray and others in Great Britain, to induce learned societies to inaugurate a new era of scientific Antarctic research under Government, or at least under national auspices. In 1895 Sir Clements Markham, as president of the Eoyal Geographical Society and of the International Geographical Congress, which met that year in London, also took the matter up, and interest in the Antarctic regions began to be aroused in every civilized country. M. Adrien de Gerlache organized a Belgian expedition, for which he raised the funds with difficulty, and only secured a grant of public money at the last moment when the enterprise appeared almost hopeless. He purchased the Norwegian whaler Patria, had her refitted and re-named Belgica, and brought to- gether a scientific staff and crew â€" half Belgian and half foreign. M. de Gerlache, commanding the expedition, M. Georges Lecointe, captain of the ship, and Lieutenant Danco, magnetic observer, were Belgians ; Mr Amund- sen, the mate, a Norwegian ; M. Argtowski, the geolo- gist and physicist, a Pole ; M. Eacovitza, the biologist, a Rumanian ; and Dr F. A. Cook, the surgeon, an Ameri- can. The Belgica sailed from Antwerp on 16th August 1897, but it was 14th January 1898, already long past midsummer, before she left Staten Island for Antarctic waters. She sighted the South Shetlands on the 21st, and proceeded to Hughes Gulf, from which a channel was explored leading south-westward between continuous land, named Danco Land, on the east (possibly the northern extension of Graham Land), and Palmer Land on the west. Palmer Land was found to be a group of large islands. Both coasts of Belgica Strait, as the new channel was named, were surveyed and twenty landings made, so much time being occupied that it was 12th February when the Belgica re-entered the open sea to the west at Cape Tuxen in 65Â° 16′ S. A large bay

opening eastward was so encumbered with ice that it was impossible to find whether or not it led to Bismarck Strait. Much fog was experienced, but on the 16th Alexander Land was sighted in the distance. Continuing on a westerly course, the Belgica made every effort to enter the pack, which was successfully accomplished after a heavy storm on the 28th. By taking advantage of the leads, the expedition advanced to 71Â° 30′ S. in 85Â° 15′ W. by 2nd March, but the ship was blocked next day by the growth of young ice soldering the pack into one continuous mass. For more than a

year further independent movement was impossible ; but the ship drifted with the ice between the limits of 80Â° 30′ W. and 102Â° 10′ W., and of 69Â° 40′ and 71Â° 35′ S., which was the highest latitude attained (31st May 1898). The sun did not rise for seventy days, and all on board suffered severely from depression of spirits and disorders of the circulation, which Dr Cook attributes to the dark- ness and to improper food. Lieutenant Danco died dur- ing the period of darkness. On 13th March 1899, when a second winter in the ice began to seem probable, the Belgica was released in 69Â° 50′ S. and 102Â° 10′ W. (Bulletin de la Sociite Royale Beige de Oeographie, 1900, passim). The geographical results of this expedition were insignificant so far as the discovery of land or penetration to a high latitude is concerned. The ship passed several times to the south and west of Peter I. Island, proving that the land seen by Bellingshausen at that point is of very limited extent. During the drift in the ice the soundings were usually between 200 and 300 fathoms, which, com- pared with the great depths to the north, clearly indicated a continental shelf of considerable breadth, probably connected with land in the south (Geographical Jouriml, xiv., 1899, pp. 77-82). A line of soundings was carried from Staten Island to the South Shetlands, and a maximum depth of 2210 fathoms found in that con- stricted part of the Southern Ocean to which the name of Drake Strait has been applied, although the officers of the Belgica termed it, less appropriately, Antarctic Strait.

The Hamburg America Company's steamer Valdivia, chartered by the German Government for a scientific voyage under the leadership of Professor Carl Chun of Leipzig, left Cape Town on 13th November

1898, and on the 25th was fortunate in rediscovering Bouvet Island (54Â° 26′ S., 3Â° 24′ E.), which had been searched for in vain by Cook and Eoss. Steering south, the Valdivia found the edge of the drift ice in 56Â° 45′ S., andj although an unprotected iron vessel, she followed the edge of the pack from 8Â° E. to 58Â° E., reaching 64Â° 15′ S. in 64Â° 20′ E. on 16th December. At this point a depth of 2641 fathoms was found, so that if Enderby Land really occupies its assigned position, 102 nautical miles farther south, the sub-oceanic slope must be of quite unusual steepness. The rocks dredged up contained specimens of gneiss, granite, and schist, and one great block of red sandstone weighing 5 cwt..was secured, con- firming the theory of the continental nature of the land to the south. From her farthest point the Valdivia returned northward vid Kerguelen Island. Although only an incident in a vogage from the Cape to Kerguelen, this trip allowed of twenty-nine deep-sea soundings being made south of 50Â° S., where only fifteen had been recorded before. The general depth of the Southern Ocean proved to be much greater than had been formerlv supposed, the greatest depth being 3155 fathoms in 58Â° S. No con- clusion as to the existence of an Antarctic continent could be drawn from the soundings south of 55Â° S. between 0Â° and 50Â° E. (For abstract of observations, see Geo- graphical Journal, xv., 1900, pp. 518-r)28 ; and for fuller report Zeitschrift der Gesellschaft fiir Erdkunde zu Berlin, xxxiv., 1899, pp. 75-192.) The physical and biological conditions of the water and the nature of the ice were very carefully investigated.

On his return to England in 1895 IMr C. E. Borchgrevink made strenuous efforts to organize an Antarctic expedition under his own leadership, and in August 1898 he left the Thames on the Southern Cross, a Norwegian Avhaler for- merly known as the PoUk.i; in charge of a private expe- dition equipped by Sir George Newnes. His scientific staff included Lieutenant Colbeck, R.N.R. ; Mr Louis Bernacchi, a trained magnetic observer ; Mr N. Hanson

and Mr H. Evans, biologists ; and Dr Klovstad. About fifty dogs were taken out, the intention being to land at Cape Adare and advance towards tbe magnetic, and per- haps also towards the geographical, pole by sledge. The Southern Gross reached the edge of the ice in 52Â° S. and 164Â° E. on 30th December 1898; one of the BalleAy Islands were sighted on 14th January 1899, and after in vain attempting to get south about the meridian of 164Â° E., the ship forced her way eastward and emerged from the pack (after having been beset for forty-eight days) in 70Â° S., 174Â° E. She reached Cape Adare, and anchored in Robertson Bay on 17th February. The land party, consisting of ten men, was established in a house built on the strip of beach at the base of the steep ascent to the mountains, and the ship left on 2nd March. Mr Borch- grevink found it impossible to scale the slopes to the snow-fields, which he believed to occupy the surface of a great plateau in the interior, and the party, except for short trips along the shore or on the sea-ice, spent the year of their sojourn â€" the first year ever passed by man on Antarctic land â€" in making natural history collections and keeping up meteorological and magnetic observations. The Southern Cross returned to Cape Adare on 28th January 1900, and after taking the winter party on board â€" diminished by the death of Mr Hanson â€" set out for the south on 2nd February. Landings were made on Posses- sion Island, Coulman Island, on the mainland at the base of Mount Melbourne, Franklin Island, and on 10th February at the base of Mount Terror, near Cape Crozier. From this point the ship steamed eastward along the great ioe-barrier to a point in 164Â° 10′ W., where an inlet in the ice was found, and the ship reached her highest latitude, 78Â° 34′ S., on 17th February. The edge of the ice was found to be farther south than it had been when Eoss visited it in 1842. About 5000 square miles of open water are shown on Borchgrevink's map, where Eoss's showed the solid ice-barrier. Mr Borohgrevink was able to land on the ice with sledges and dogs, and advanced southward about 16 miles, reaching in 78Â° 50′ the farthest south yet attained. On the 19th the Southern Gross started on her return, and, without encounter- ing any pack ice, reached Stewart Island, New Zea- land, on 30th March {Qeographical Journal, xvi., 1900, pp. 381-414).

In the autumn of 1901 three well-equipped expeditions left Europe for Antarctic exploration. The British National Antarctic expedition was organized by a joint committee of the Eoyal Society and the Eoyal Geo- graphical Society, and equipped under the superinten- dence of Sir Clements Markham. One-half of the cost was borne by the Government, the rest mainly by Mr LI. W. Longstaif, who provided Â£30,000, the Eoyal Geo- graphical Society, and Mr A. C. Harmsworth. A strong wooden ship of about 700 tons register (1700 tons dis- placement) was built at Dundee, and named the Discovery. She was barque-rigged, with auxiliary engines, and amid- ships entirely non-magnetic, so that magnetic observations might be carried on without interference from local attraction. The vessel was equipped with all necessary scientific apparatus, and the expedition sailed under the command of Commander E. F. Scott, E.N., with Lieu- tenant Armitage, E.N.E., as second in command. Lieu- tenants Eoyds and Barne, E.N., Lieutenant Shackleton, E.N.E., and Mr Skelton, E.N. The crew of forty men were almost entirely sailors of the Eoyal Navy. The scientific staff included Dr Koettlitz, who had shared with Mr Armitage in the Jackson-Harms worth Arctic expedi- tion ; Mr Louis Bernacchi, who had sailed with Mr Borohgrevink in the Southern Gross; Dr Wilson, Mr Hodgson, and Mr Ferrar. The scientific director, Mr George Murray, accompanied the vessel to Cape Town, and

Dr H. E. Mill also went part of the way as instructor in oceanography. The Discovery left Cowes on 6th August 1901 and Simon's Bay on 14th October, and on the voyage to New Zealand entered the ice-pack and reached 62Â° 50′ S., 139Â° 40′ E., where a sounding of 2300 fathoms was obtained. She reached Lyttelton on 28th November, and finally, having embarked a number of dogs, she sailed from Port Chalmers for Victoria Land on 24th December.

The German expedition sailed from Kiel on 11th August 1901 in the Gauss, a vessel similar in size to the Discovery, and similarly equipped for scientific work, though of a different model and sail plan. The com- mander of the expedition was Professor Erich von Dry- galski, of the University of Berlin, and he was supported by an able scientific staff of four specialists. The sailing- master. Captain Euser, and crew were of

the merchant service, although the vessel, unlike the Discovery, carried the naval flag. The Gauss reached Cape Town on 23rd November, and sailed for Kerguelen a few days later, taking in stores at that island, and departing southwards at the end of January 1902, with the object of pene- trating the absolutely unknown part of the Antarctic area in the neighbourhood of Enderby Land. Simulta- neous meteorological and magnetic observations were arranged to be carried out on both vessels and at a land station which has been established at Kerguelen Island, and the two expeditions, although entirely distinct, acted in perfect harmony. Magnetic and meteorological obser- vations were also arranged for comparison at Lyttelton in New Zealand, and at Staten Island in Argentina.

Dr Otto Nordenskjold organized a Swedish expedition on board the whaler Antarctic, Captain Larsen, and sailed from Falmouth on 26th October 1901 for Buenos Aires ; he left on 24th December, bound for the coast of Graham Land, where he was landed with a wintering party in order to carry out explorations and scientific observations simultaneously with the British and German expeditions.

Arrangements were completed for two additional expe- ditions to sail in 1902, each employing an old Norwegian whaling vessel purchased for the purpose. The Eoyal Geographical Society sent out the Morning under Lieu- tenant Colbeck, E.N.E., as a relief ship to the Discovery; she sailed from the Thames on 9th July. Mr W. S. Bruce, who had experience of both Antarctic and Arctic exploration, completed the plans of a Scottish expedi- tion under his command in the Hecla, which was greatly strengthened and refitted at Troon and renamed the Scotia. Captain Thomas Eobertson went as master of the ship. Mr Bruce proposed to turn his attention to Weddell Sea.

The full results of the work of the Belgica, Valdivia, and Southern Cross were not available at the time of writing ; but the preliminary observations convey much new information, especially with regard to climate.

Land. â€” No new land has been discovered south of the Antarctic circle, if we except the southern prolongation of what is probably the

east coast of Graham Land, reported by Larsen. The observa- tions of the Belgica increase the probability that the land known to exist in the south of South America is an archipelago, the islands being perhaps locked together by ice in the south. The relatively shallow water in w^ich the Belgica drifted when fast in the floe indicates an extensive land or numerous islands of a continental character to the south on that side, while the very deep water found by the Valdivia to the north of Enderby Land appears to justify the supposition that the sea penetrates far to the south in that region. Active volcanoes have been seen both in the Graham Land and Victoria Land areas, and there is some proba- bility that violent earthquakes are occasionally experienced. It has been suggested that the great increase in the amount of drift- ice from the Antarctic, and in the size of the bergs, observed in the period of 1891-96, was due to the disruption by earthquakes of vast masses from the seaward ends of the Antarctic ice-sheet. Borchgrevink's observation of the apparent retreat of the southern ioe-barrier is in accordance with this view. The hypothesis of a great Antarctic continent or continental archipelago continuously

covered by an ice-sheet is confirmed by the observations of recent expeditions, but the evidence is not yet direct or conclusive.

Land^Ice. â€" The ice-barriers which have been seen extending for hundreds of miles along the coast of Antarctic lands, and reaching the height of from 100 to 200 feet, have hitherto been viewed as the seaward face of a vast ice-sheet or confluent glacier, the only analogous phenomena in the north being the great glaciers of northern Alaska. Mr Bernacchi, however, suggests that they may be the sides of great spurs of ice projecting at right angles from the land. The ice wall at the place of its greatest exten- sion in Victoria Land is evidently afloat, for deep soundings have been obtained near the edge, but it is probably in continuous contact with the land. Borchgrevink advanced about 16 miles on it, and found a rising gradient all the way ; but he does not report a crevassed zone, which analogy with Greenland would lead us

to expect. East of Mounts Erebus and Terror, Ross reported that the ice-barrier was from 180 to 200 feet high ; but Borchgrevink assigns to it only a height of 60 or 70 feet, and at the place where he landed the ice was only 3 feet above the sea. The fact that flat-topped icebergs of enormous dimensions, such as could only be produced by ice faces similar to that of Victoria Land, are found in large numbers wherever the Antarctic region has been approached, makes it probable that an ice-barrier girdles the Earth some short distance within the Antarctic circle. M. Argtowski points out, with regard to the land bordering Belgica or Gerlache Strait, that small icebergs are formed from the ice-foot produced by the regelation of ice which has fallen from the glaciers on the upper part of the steep slopes.

Sea-Ice. â€” The pack formed of sea^ice and fragments of bergs appears to surround the Antarctic circle as a floating breakwater, and open water sometimes occurs to the south of it. So far as already known, this is the case only off the east coasts of land projecting northward from the unknown region ; at least, it is only in such positions that latitudes beyond 72Â° S. have been reached, and farther to the east sea-ice has prohibited the advance of ships both in Ross Sea and Weddell Sea. The Antarctic pack differs from that of the Arctic region chiefly in the large number of bergs and fragments of hard land-ice frozen up in it, this unequal structure increasing the dangers of ice navigation. The northern edge of the pack appears to lie nearly along the parallel of 60Â° S. in summer ; its position in winter is unknown. Drift-ice, consist- ing mainly of large, flat^topped bergs, is usually met with in the Southern Ocean at all times of the year south of 50Â° S. , but most abundantly in the months of November and December (the southern summer), and least frequently between April and July. The drift-ice comes farthest north on the Atlantic side ; an occasional berg may be sighted off the Cape of Good Hope, and the extreme limit at which ice has been seen was 26Â° 30′ S. in the very centre of the Atlantic in April 1894.

Magnetism and Aurora. â€” Mr Borchgrevink was led by the magnetic observations taken by Lieutenant Colbeck and Mr Bernacchi to assign to the magnetic pole the position of 73Â° 20′ S. and 146Â° E. The

observations at Cape Adare, however, were rendered unsatisfactory by the local attraction exercised by the masses of volcanic rocks in the neighbourhood, and by frequent magnetic storms, the difference between the maximum and minimum declination in a single day sometimes amounting to 3Â°. Magnetic observations were made from the Belgica on the ice-floe, but the want of stability of the ice made the work difficult. During the drift of the Belgica the aurora was observed with great attention during the period 11th March to 10th September, when theije was no daylight or strong twilight, although the cloudiness of the sky only allowed it to be seen on sixty ~~two occasions. A diurnal period was observed, the maximum intensity occurring between 9 and 10 p.m. The brilliance and variety of the display were less marked in July than in the other months. The commonest form was a luminous arch, the culminating point of which almost always bore S.S.W. ; the arch did not attain so great an altitude at the solstice as at the equinoxes, the auroral phenomena appear~~ ing to retire towards the magnetic pole in midwinter. (H. Ar9towski, Gengraphical Journal, xvi., 1900, pp. 92-94.) At Cape Adare the aurora was observed "nearly every night," the prevailing form being a luminous arch, the centre of which always lay to the north, never to the south. This would appear to indicate an unsymmetrical distribution of the aurora with regard to the pole. The period of diurnal maximum was between 8 and 9 P.M., and here also the annual minimum seemed to occur at midwinter.

Climate. â€" ^The summer climate of the Antarctic region has long been known to be extremely cold and ungenial. Bruce on the Balmna found the average temperature during the three summer months of 1892-93 to be rather Under 31Â° F. for latitude 62Â° S. The actual figures were December 31-1Â°, January 31 '1Â°, February 29-6Â°. The following table shows the monthly mean temperatures observed on the Belgica west of Graham Land in the pack about latitude 70Â° S. (H. Ar^towski, Geographical Journal, xiv., 1900, p. 417), and of Borchgrevink's expedition at Cape Adare in

latitude 71Â° S. (C. E. Borchgrevink, Geographical Journal, xvi., 1900, p. 405) :â€"

Average Temperature in

the Antarctic Begions.

W. of Graham Land,

Cape Adare, 1899-1900.

â€¢

1898-1899.

March 1898 to February 1899. Means of hourly

February 1899 to January 1900. Means of daily maximum and minimum.

observations.

Mean.

Max.

Min.

Mean.

Max.

Min.

January . .

29-8

17-4

33-0

48-9

22-5

February . .

30-2

14-7

(26-4)

March . . .

15-6

- 4-5

17-7

31-1

-“2-5

April . . .

10-8

-15‘7

10-3

30-0

-10-0

May . . .

20-3

-13-4

- 4-6

23-2

-31-1

June . .

4-1

-22-0

-11-8

14-1

-.36-0

July . . .

-10-3

-34-8

- 8-6

23-8

-39-9

August . . .

11-7

-21-3

-13-4

18-9

-43-1

September

- 1-3

-45-6

-11-9

11-5

-36-1

October . .

17-8

-15-3

- 1-8

19-6

-35-5

November . .

19-6

- 6-5

17-8

45-7

- 40

December . . Year . .

28-0

5-9

31-8

42-2

20-4

14-7

-45-6

7-0

48-9

-43-1

The temperatures in the pack were, as might be expected, less extreme than those on the land, and subject to great variations as the wind blew from the ice on the south or from the open ocean on the north. The temperature found by the Belgica for August is remarkably high, so high that it is advisable to say that it is -)-ll-7Â°F., not a slip for â€”11-7Â°. The summers are remarkably cold, the winters by no means extraordinarily so. Indeed, the severity of the climate at Cape Adare seems to be due to the fact that the mean temperature remained below zero Fahrenheit for sis consecutive months ; the minima were not lower than occur every year in lower latitudes in central Canada and Siberia. At the southern ice-barrier a minimum of â€” 12Â° was found by Borchgrevink in February, during the height of summer. A rise of temperature was found to be a sure indication of an approaching storm ; at Cape Adare the thermometer was more sensitive than the barometer in prognosticating gales.

Pressure and Wind. â€” The barometric observations at Cape Adare are not available for discussion, but the maximum observed was 30-182 inches and the minimum 27-860 inches. On the Belgica the mean

pressure for the year was 29-319 inches. The maximum pressure observed was 30-400 and the minimum 28-022. The isobario charts compiled from all previously existing data show the isobar of 29-30 running slightly to the north of 60Â° S. ; and as the same pressure occurs again in 70Â° S., it seems fair to infer that the belt of minimum mean pressure lies somewhere about 65Â° S., and that higher pressures will be found farther south. A belt of comparative calm appears to lie between the "roaring forties " and the tempestuous margin of the Antarctic continent. This was particularly noticed by the Valdivia. The record kept on the Belgica showed that the number of hours when the wind blew from southerly or easterly directions was slightly less than from northerly or westerly directions ; in other words, the probability appeared to be slightly greater that the pressure was, on the whole, lower to the south than to the north. However, the vessel was drifting over a considerable area during the time of observation, and there was also a well-marked seasonal range. Westerly winds predominated in winter (June to August), and easterly winds in summer (December to February) ; the northerly and southerly components show no clear seasonal range, and are nearly equal in frequency. The weather as a whole was due to a succession of cyclones. At Cape Adare winds from southerly direc- tions predominated, and especially heavy gales from E.S.E., afford- ing some evidence of a permanent south polar anticyclone. As the latitude differs but slightly from that of the mean position of the Belgica, it would seem that the anticyclone lay towards the Victoria Land side ; and this in turns suggests that the main body of tlie land lies in that direction, an inference supported by the temperature observations also. But the records of a single year do not allow of any definite conclusions being arrived at ; they furnish at most a legitimate basis for tentative hypotheses. At both posi- tions terrific storms of wind were very frequent, making the cold unbearable while they lasted. These are probably due to the proximity of the relatively warm sea to the cold ice or land, and it is probable that farther in the interior there will be a region of relative calm, although of lower temperature.

Precipitation. â€" Frequent mists and snow squalls have been reported by all voyagers in the Antarctic seas, even in the height of summer. The

immense thickness of snow necessary to form the Antarctic icebergs presents a problem of great difficulty. If the prevailing winds were northerly, a heavy precipitation would be a natural consequence ; but if there is an anticyclone over the

land, giving rise to prevailing southerly winds, the source of moist- ure is a mystery. A ring of high pressure near the Antarctic circle, surrounding a lovr pressure area lying over an open polar sea, might account for observed facts ; but there are no observational data for or against this fancy.

Flora and Fauna. â€” Terrestrial flora and fauna have been dis- covered on Victoria Land and in the Palmer Archipelago, but both are very limited. Borohgrevink reports five species of lichens, including the ordinary reindeer moss. Lichens were found as far south as 78Â° S. Insects of three species were discovered, all very minute, but capable of being detected by the naked eye as they moved about on the lichen. The Belgica found a more extensive flora on the shores of Belgica Strait, mosses and a single species of grass being observed as well as lichens. The insects found there included a species of dlptera with rudimentary wings, poduridse, and minute acarides. Marine life was very abundant even in the highest latitudes. It included a great number of species repre- senting plankton, littoral forms, and fishes, as well as benthos. The seals and sea-birds have for the most part been described before. The right whale seems to be absent. There is no walrus nor narwhal, and no trace of land mammals has been found.

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Pole, William (1814-1900), English engineer, was born at Birmingham on 22nd April 1814. He was a man of many accomplishments. Having spent his earlier years in various engineering occupations in Eng- land, he went out to India in 1844 as first professor of en- gineering at Elphinstone College, Bombay, where he had to organize the course of instruction for native students, but his health obliged him to return to England in 1848. Eor the next ten years h.e worked in London under James Simpson and J. M. Eendel, and the high reputation he achieved

as a scientific engineer gained his appointment in 1859 to the chair of civil engineering in University College, London. He obtained a considerable amount of official work from the Government. He served on the committees which considered the application of armour to ships and fortifications (1861-64), and the comparative advantages of Whitworth and Armstrong guns (1863-65). He was secretary to the Eoyal Commission on Railways (1865-67), the duke of Richmond's Commission on London Water (1867-69), also taking part in the subse- quent proceedings for establishing a constant supply, the Eoyal Commission on the Disposal of London Sewage

(1882-84), and the Departmental Committee on the Science Museums at South Kensington in 1886. In 1871 he was employed by the War Office to report on the Martini-Henry rifle, and in the same year was appointed consulting engineer in London to the Japanese Govern- meut, a position through which he exercised considerable influence on the development of the Japanese railway system. He was elected a fellow of the Eoyal Society in 1861, in recognition of some investigations on colour- blindness. Music was also one of his chief interests. At the age of twenty-two he was appointed organist of St Mark's, North Audley Street, in open competition, the next selected candidate being Dr E. J. Hopkins (1818-1901), who subsequently was for fifty years organist of the Temple Church. He took the degree of Bachelor of Music at Oxford in 1860, proceeding to his doctor's degree in 1867, and in 1879 published his Philosophy of Music. He was largely concerned in the institution of musical degrees by the University of London in 1877, and for many years acted as one of the examiners. His mathematical tastes found congenial occupation in the study of whist, and as an exponent of the scientific prin- ciples of that game he was even earlier in the field than "Cavendish." His literary work included treatises on the steam engine and on iron construction, biograph- ical studies of famous engineers, including Robert Stephenson and I. K. Brunei, Sir William Eairbairn and Sir C. W. Siemens, several books on musical sub- jects and on whist, and many papers for reviews and scientific periodicals. He died on 30th December 1900. His son, William Pole (b. 1852), is known, under the stage-name of William Poel, for his studies

in Shake- spearian drama and his work m connexion with the Elizabethan Stage Society.

Police. â€” The powers and duties of the police in England and Wales with respect to the detection and prevention of crime have not been materially altered since 1884, but in each session of Parliament new offences are created, and an enormous amount of subordinate legisla- tion in the form of bye-laws has added to the duties of the force. The summary remedy given by the Prevention of Crimes Act, 1871, Â§ 12, for assaults on the police in the execution of their duty was in 1885 extended to cases of resistance or wilful obstruction. The usefulness of con- stables in cases of serious accident has been much increased by systematic instruction in the modes of giving first aid to injured persons ; and they are now authorized to destroy at once animals seriously injured in the streets (57 and 58 Vict. c. 22). It is now usual, in order to ensure the proper treatment of women on arrest, to employ police matrons at the police stations, and to arrange for the presence of female attendants or searchers when required. Under the Sheriffs Act, 1887, courts of quarter sessions may direct the attendance of constables at the assizes to keep order, and when such direction is given the sheriff is relieved of his common-law duty to provide javelin men for the purpose. Under the Police Act, 1890, Â§ 25, provision is made for sending constables of one force to the assistance of those of another authority at the request of the latter, and at the expense of the police area to which they are sent.

Inl897 was established auniform systemfordealing with property coming into the hands of the police in connexion with a criminal charge or in execution of certain of their duties. Courts of summary jurisdiction are empowered to make orders forthe restitution of the propertyto the owner. If not claimed, it is dealt with under regulations made by the Home Secretary on 14th February 1898, which include a power of sale at the end of a year after the police got possession of the property (see 60 and 61 Vict. c. 30). The constables of a borough police force may now be em- ployed as firemen, and constables of any force who under

general or special directions act as firemen, or assist in ex- tinguishing fires, or in saving life or property, are entitled, in the event of injury, to pensions, &c., as for injury in the execution of their duty (66 and 57 Vict. c. 10). In 1887 policemen “were allowed to vote at parliamentary elections, and in 1893 at municipal elections and the like.

Management. â€” On the establishment of county councils in 1888 the police of each administrative county (except London) were put under the control of a standing joint committee composed of an equal number of justices, appointed by the court of quarter sessions, and of mem- bers of the county council, appointed by the council, subject to the power of the Home Secretary to fix the number of each if the council and the quarter sessions cannot agree. The joint committee appoints the chief constable, divides the county into police districts, and generally controls the police of the county, subject to the rights of the justices as conservators of the peace, and to the rights of quarter sessions or of the county council to impose additional duties on the force under the Police Act, 1856. It is also the duty of the standing joint committee in a county, and of the watch committee in a borough, to transmit as soon as possible after the end of each calendar year an annual return of offences reported to the police, of persons arrested by the police, the charges against them, the result of the proceedings there, and such other par- ticulars as to the state of crime in their district as they think material (55 and 66 Vict. c. 38). By the Act of 1888 the police forces of liberties or of boroughs with less than 10,000 inhabitants in 1881 and lying within an adminis- trative county were merged in the county force.

The cost of the police in England and “Wales for the year 1900,^ including salaries and pay allowances, contri- butions of deficiency in the pension account, clothing and accoutrements, the cost of buildings,

and the other expenses incidental to the maintenance of the force, was Â£4,822,886.

Separate Forces.

No. of each Force: aver- age Daily Strength.

Population

Policed; by

Census of 1891.

Gross Cost.

Counties and boroughs

(185) . . .

Metropolitan police City of London .

26,.376

13,588

1001

23,384,932

5,595,638

37,7052

Â£2,802,212

1,871,363

149,311

The cost of maintenance of the force is now defrayed in the following manner : â€” From the local taxation grant from the Imperial Exchequer to each county there is trans- ferred to the police account of the county fund half the cost of the pay and clothing of the county police, and there is paid over to the council of each borough within the county which has a separate police force half the cost of the pay and clothing of the borough force, including the cost, &c., of any extra police temporarily added from another force and paid for under agreement under the Police Act, 1890. The balance of the expense of the force is defrayed from the county or borough fund. The Gov- ernment inspection of local police is unaffected by the Act of 1888, but if the Home Secretary withholds his certifi- cate of efficiency in point of numbers and discipline, the authority in default forfeits the amount applicable for police out of the local taxation grant, and must pay the whole cost of the force out of its own funds. The county council of any county within the Metropolitan Police District has to transfer to the receiver of police a sum bearing such proportion to the police rate levied in

1 See Pari. Paper, 1901 (200).

2 Sleeping population. The day population is over 300,000.

the parts of the county lying within that district as the Home Secretary certifies would have been proper under the arrangements in force from 1875 to 1899.

In 1890 a complete system of superannuation and pensions was established for every force in England except that of the City of London. The pensions are awarded in accordance with a prescribed scale, and under certain conditions : (a) On retirement after 25 years' service ; (6) on retirement after 16 years' service or certificate of inca- pacity for duty ; (c) at any time in the event of certified incapacity for duty in consequence of mental or bodily infirmity diie to injuries in service as a constable or at a fire. Gratuities may be granted on retirement with less than 16 years' service on a medical certificate of incapa- city for duty, and pensions and allowances may be given to the widows or children of deceased constables.

Elaborate machinery is created for settling the amount of pension and the mode of calculating service and to pre- vent fraud. The cost of the pension is defrayed from the pension fund of each force, to the account of which are carried certain deductions from the pay of the force and certain classes of fines imposed by courts of summary jurisdiction. But the chief item is the Exchequer con- tribution of Â£300,000 a year made to the pension funds of authorities outside the Metropolitan Police District from the proceeds of the local taxation customs and excise duties (56 and 57 Vict. c. 45, Â§ 17 ; 56 and 57 Vict. c. 60). The contribution is forfeited where a force is certified not to be efficient. Any deficiency in the pension fund is made good from the police fund.

United States. â€" The organization of police forces in the United States differs more or less in the different states of the Union. As a rule the force in cities is under municipal control, but to this rule there are numerous exceptions. In Boston, for instance, the three com- missioners at the head of the force are appointed by the Governor of Massachusetts. The force in New York City, alike from the standpoint of numbers and of the size and character of the city, is the most important in the United States, and in its general composition may be taken as typical. It includes a commissioner appointed by the mayor for a term of years and exercising a wide range of authority; a chief of police, who has immediate charge of the force and through whom all orders are issued ; he is assisted by four deputies ; inspectors, who are in charge of different sections of the city, and who carry out the orders of the chief ; captains, each of whom is in direct charge of a precinct; sergeants; roundsmen; and last of all, the ordinary policemen, or patrol men as they are often called from the character of their duties. There is a separate branch, the detective bureau, composed of picked men, charged with the investigation and, still more, the prevention of crime. The total number is about 4000. Appointments are for life, with pensions in case of disability and after a given number of years of service. The cost of the police department in New York m the year 1900 approximated $12,000,000, and in Chi- cago $3,800,000.

As regards the prevention of ordinary crime, the pre- servation of the peace, the protection of life and property, the American police is

probably about as effective as that m English or Continental cities. But in certain cities there have been serious scandals. Under the Tammany govern- ment m New York City a system of almost organized blackmail came into existence, by which the keeper of the saloon and the house of ill-fame paid regularly and liberally to the police captains for impunity in breaking the law ; and It was repeatedly shown that candidates for the position of captain paid large sums to their superiors for appointment to that post. The demoralizing effect of such a system needs no demonstration. (w. f. o.)

POLLOKSHAWS â€” POLO

Pollokshaws, a burgh, of barony and police burgh of Renfrewshire, Scotland, now, by the extension of the city and itself, virtually a suburb of Glasgow, with which it IS connected by rail and tram. A great many houses have been built in recent years for the accommodation of the working classes and Glasgow business people. A public hall has been presented to the town by Sir John Stirling-Maxwell, Bart. , the feudal superior. The academy is a secondary school with an elementary department. Population (1891), 10,228 ; (1901), 11,169.

Polna, a town inlihe government district of Deutsch- brod, in Bohemia, Austria, on the frontier of Moravia, north-east of Iglau, and just beyond the bounds of the German-speaking enclave. It has manufactures of starch and syrup, glass-cutting and brewing. On the 29th of March 1899 Polna was the scene of a sensational murder of a young girl (Agnes Hruza), which led to a revival of the accusation of ” Ritual Murder ” against the Jews, and was made the starting-point of an anti-Semitic agitation. The trial of the accused, a Jew named Hilsner, which took place at Kuttenberg on the 12th-16th September, ended in his conviction on purely circumstantial evidence. The ‘ sentence was subsequently commuted to a term of im- prisonment. Population (1890), 4923; (1900), 5013.

Polo. â€” Since the article on polo was written for the earlier volumes of the Encycloposdia Britannica (ninth edition), the game has altered in

character and increased in popularity. There were over sixty clubs in the United Kingdom in 1902, besides many others in British colonies and dependencies. In Prance and Russia, and in Spain, as well as all over America and the Argentine Republic, polo has taken root and flourishes greatly, games, matches, and tournaments being played throughout the season. As the game differs slightly In the United Kingdom and its colonies from that played in America and India, it will be convenient to consider its present conditions under these three heads.

Tlie United Kingdom and Colonies. â€" The game of polo is ruled by the code of laws and by-laws laid down by the committee of the Hurlingham Club, which, with some few inconsiderable exceptions, are everywhere in force. The height of the ponies played is in England 14 hands 2 inches. Every pony is measured by an official measurer, and registered in a book kept for that purpose at Hur- lingham. No ponies above that height are permitted in any circumstances to play in matches or tourna- ments. A polo ground should be a parallelogram 300 yards in length by 200 yards in breadth. The longer sides are boarded with planks from 9 to 11 inches in height. Pull-sized grounds, however, are not entirely satisfactory in practice, and it is probable that 300 yards by 150 or 170 will become the standard size in England. So large a ground as 300 by 200 is found to keep the ball in play too long, and to be tiring to the players and hard on the ponies. It must be remembered that good polo is played at full gallop. At each end of the ground are two goal-posts, which are placed 8 clear yards apart in the centre of the back line, which is marked with lime-wash. At a distance of 30 yards from the back line a second line is marked parallel to the back one. Then, taking the point midway between the goal-posts, a half circle of 26 yards should be described in white lime-wash. A scoring board, a clock to mark the time, a bell to sound the close of the periods of play, and a pavilion or dressing tent, are also necessaries of a well-appointed polo ground.

The game is played by eight players, four arside. Each of the four players has his appointed place in the game and his particular duties, which may consist either in for- warding the progress of the ball

towards the adversaries' goal or impeding its course towards his own. Taking the

players in order of importance, number 4 is the back ; and his ultimate duty is to guard his own goal in defence, and in attack to prevent the ball from coming back, and, having stopped it, to pass it forward to the man in front of him, who should be number 3. This player, whose position is one of great responsibility, should either help the back in defence, or support his own forwards when they are attack- ing. Number 2, who should ride a fast pony and be a brilliant and hard hitter with control of the ball, generally leads the attack on the enemies' goal. Number 1 is sup- posed to hamper the movements of the opposing number 4, and by " riding him off " to clear the way for number 2 on his own side. It will thus be seen that the players are in pairs, whose duty in attack is to press the ball forward, and in defence to impede the corresponding man. Thus, let A and B be two sides : number lA will impede number 4B ; number 2A will try to carry the ball on, be impeded by number 3B ; number 3A will endeavour to place the ball so that number 2A can- obtain possession, or, if the game is against him, hinder number 2B, while number 4A will be impeded by number IB doing the like. Both backs will use every endeavour to place the opposing number 1 off side, while both numbers 1 wUl endeavour to ride off the backs.

The rules as to off side and riding off are given here : â€"

Off side (Rule 18). â€" No player who is off side shall hit the ball, or shall in any way prevent the opposite side from reaching or hitting the ball.

Definition of off side. â€" A player is off side when at the time of the ball being hit he has no one of the opposite side nearer the adversaries' goal line, or that line produced, or behind that line, and he is neither in possession of the ball nor behind one of his own side who is in possession of the ball. The goal line means the 8 yards line between the goal-posts. A player, if off side, remains off side until the ball is hit or hit at again.

Biding out an antagonist.- â€” A player may ride out an antagonist, or interpose his pony before his antagonist so as to prevent the latter reaching the ball, but he may not cross another player in possession of the ball, except at such distance that the said player shall not be compelled to check his pony to avoid a collision.

It is thus evident that polo is a game in which combina- tion and tactics count for much. In order to prevent the game from becoming a mere rough-and-tumble, there are always on the ground, besides the players, two experienced and well-mounted men who have the rules of polo at their finger-ends, and whose duty it is to check all unfair play and enforce the penalties on the offending side. The position of umpires is one of great resppnsibility and importance, and the whole welfare of the game of polo depends on their duties being thoroughly and efficiently carried out. In addition to the umpires there should be a referee, to whom appeal may be made if the two umpires differ.

Penalties (Rule 22). â€” Any infringement of the rules constitutes a foul. In case of an infringement of Rules 16, 17, 19, 20, and 21, the umpire shall stop the game ; and in case of an infringement of Rule 18, the umpire shall stop the game on an appeal by any one of the side which has been fouled. On the game being stopped as above, the side which has been fouled may claim either of the following penalties : â€” (a) A free hit from where the ball was when the foul took place, none of the opposing side to be within 10 yards of the ball. (6) That the side which caused the foul take the ball back and hit it off from behind their own goal line. The side injured by the foul may claim either penalty. There is also the extreme penalty of disqualification of the whole team for disregarding the umpire's decisions. There is also a minor penalty (New Rule, May 1898) inflicted on a side which, when being hard pressed, hits the ball behind their own goal line, thus putting the ball out of play and of course depriving the adversary of the chance of making a goal. Rule 14. If the ball be hit behind the back line by one of the opposite side, it shaU be hit ofi by one of the side whose line it Is, from a spot as near as possible to where it crossed the line. None of the attacking side shall be within 30 yards of the back line until the ball is

hit off. If, however, the ball be hit behind the back line by one of the players whose line it is, they shall hit

it off from behmd the goal line between the posts, and all the defending side shall, until the ball is hit off, remain behind their back line, and between two lines which shall be drawn at right angles to the goal line produced, from points 10 yards distant from the centre of the goal on either side, the attacking side being free to place themselves where they choose, but not within 25 yards of the centre of the goal-posts. The penalty shall not be exacted should the ball glance off a player or pony.

The game is played with a ball made of ~~willow root, about 3 inches in diameter and painted white. No ball should be over 6 ounces in weight. The sticks used are made of cane and wood, white Malacca cane being the best. There is no rule as to the length or weight of the stick ; each player is left to suit himself. Whippy canes, however, are dangerous ; those too stiff are apt to strain the wrists of the players. The stick is most important, and good players spare no pains to obtain suitable ones. The heads are usually square in England and cigar~~ shaped in India, these forms being found better for soft and hard ground respectively.

The full match time in England is one hour. This is divided into six periods of ten minutes each. As the players do not leave the ground until the ball is actually out of play by having been hit over the boundary boards or back line, a period of actual play may, and sometimes does, exceed ten minutes ; but in this case the excess is deducted from the following period, so that if, for example, a period of play lasted twelve minutes, the next one would only last eight. At the close of each period of ten minutes two minutes are allowed for changing ponies, and after each twenty minutes there is an interval of five minutes. In the event of the scores being equal at the close of the hour of actual play, the rules provide that the period shall be prolonged till the ball goes out of play. Then, if it is still a tie, after an interval of

five minu:tes the ball shall be started from where it went out of play, and the game continued as before, until one side obtain a goal which shall determine the match. In the earlier matches of tournaments the whole period of play is often reduced to forty minutes.

The polo pony is any small horse of 14-2. There are animals from America, Canada, Argentina, Africa, India, and Australia playing, as well as a considerable but diminishing number of Arabs. The polo pony must be fast, docile, and well-mannered, and thoroughly trained to the game. The best ponies are those obtained by cross- ing a thoroughbred sire with a mare having some Arab, or Welsh, or Exmoor pony blood. There are a few dwarf thoroughbred horses playing, but these are accidents, though it will be noted that the best-known are all descendants of Kewminster. A considerable trade exists in polo ponies, and there is a stud book under the super- vision of the Polo Pony Society. The qualities of a firs1> rate pony are so many and so rare, that high prices are often paid for really high-class specimens.

The principal tournaments of the year in England are the Inter-Regimental and Championship played at Hur- lingham, the Hunt Cup and Subalterns' Cup played at Eanelagh, the Eugby Tournament and the County Cup ; the All Ireland, Dublin Inter-Kegimental and Phoenix Park are also important fixtures. The ties of the County Cup tournament are played off at different centres under the control of the County Polo Association, the final only being played on the grounds of the Hurlingham Club at Eulham.

America. â€" The game of polo, which is very popular in America, differs a good deal from that in England. Whereas in the latter country the whole conception of cor- rect play is based on combination, in America individual brilliance counts for more. The American Association thus promotes games of two and three a-side, which are never attempted inEngland. Each player has his handicap.

as at golf, which is based on the number of goals he is supposed to be worth to his side. When two sides meet for a match, the handicaps of the players on either side are added together and the less subtracted from the greater; thus, A side with a handicap of twelve meets B side

with a handicap of ten. Then A would have to make two goals to start on even terms with B. Polo was introduced into America by Mr James Gordon Bennett in 1876, and has gradually grown in popularity. The American regulation ground is 250 by 166 yards. They have no off side, and it is not permitted to crook the stick of an adversary. America has produced some fine individual players, but no team, so far, equal to the English Rugby, Freebooter, or Hurlingham teams.

India.â€” Volo in India is under the control of the Indian Polo Association, which is responsible to the military authorities that the game is played in such a way as to make the danger as little as possible and to avoid needless expense to players. The Indian game is in the main the same as that in England, with the follow- ing exceptions :â€” The height of ponies is 14-1. The rules as to riding off are much stricter, or it would perhaps be true to say more strictly enforced by the umpires. The time allowed for a match is forty min- utes. In order to avoid a tie, the subsidiary goal is scored. The following is a definition of a subsidiary goal : ” A subsidiary goal is obtained in the same way as a true goal, except that to score a subsidiary goal â€” 11 feet from outside of each goal post â€” the ball must pass between the subsidiary goal mark and the goal post which is nearest to it.” {Riding and Polo, p. 377 (ed. 1899), Rule 37.) Left-handed players are forbidden altogether. The Indian grounds are usually 300 by 200, and there are no boards. In India polo is a much less expensive game than in England, and is almost uni- versally played by officers of the British army stationed in that country, and to a less extent by civilians. There are 120 clubs in India affiliated to the Indian Polo Asso- ciation. In addition to these there are many small asso- ciations for polo which are not registered. There are about 600 ponies holding the Indian Polo Association certificate of age and height, without which no pony can play in a tournament.

Authorities. â€” J. Moray Brown. Siding and Polo. Bad- minton Library. Revised and brought up to date by T. F. Dale. Longmans, 1899. â€” Captain YonNOHOSBAND. Polo in India. (N.d.).â€” J. Moray Brown. Polo. Vinton, 1896.â€” E. D. Miller. Modern Polo. Thaoker, 1896.â€” T. F. Dale. The Game of Polo. A. Constable and Co.,

1897. â€” Captain TonNGHUSBAND. Tourna- ment Polo. 1897. â€” Captain de Lisle, Durham Light Infantry. Hints to Polo Players in India. 1897. â€” T. B. Drybrough. Polo. Vinton, 1898. (t. p. B.)

Poltava, a government of south-west Russia, to the north of Kherson, has an area of 19,265 square miles. The population was 2,418,870 in 1881 and 2,794,727 in 1897, of whom 1,406,736 were women, and 271,459 lived in towns. The government is thus the fourth in Russia in respect of density of population outside Poland, although considerable numbers of people have emigrated to Siberia. The land is chiefly owned by the peasants, who possess 52 per cent, of the cultivable land ; 42 per cent, belongs to private persons, and the remainder to the Crown, the clergy, and the municipalities. In 1896, 283 private owners held over 2700 acres each, 380 held from 1350 to 2700 acres, 2092 from 270 to 1350 acres, 1966 from 135 to 270 acres, and 22,570 persons owned less than 135 acres each. Twenty per cent, of the peasants hold no field-land, and 26 per cent, hold less than 8 acres per family. Land is sold and rented at very high rates. The average yield per annum from 1895 to 1899 was of wheat 9,361,000 cwt., of rye 9,679,000 cwt., of oats

3,882,000 cwt.â€” of all cereal crops 29,664,000 cwt. ; of potatoes 9,010,000 cwt. Nearly 670,000 cwt. of beet- root are grown annually, while tobacco plantations cover 2310 acres and yield some 302,600 cwt. annually. Garden- ing for commercial purposes (melons, sunflower, &c.) is extensively carried on, as also is bee-keeping. There were in the province in 1898, 289,400 horses, 793,600 horned cattle, 1,530,960 sheep, and 390,000 swine. Domestic industries are but slightly developed, and the factories (flour mills, tobacco and sugar works, and distilleries) afford employment to only 9200 persons, and have an output valued at only 23,000,000 roubles a year. The Dnieper is the chief artery for the exports â€” grain, live stock, hides â€” and imports â€” timber. The chief river ports are Kremenchug and Poltava. Steamers ply between Kieff and Ekaterinoslav.

Owing to the efforts of the zemstvo (provincial council), there were in 1896, 721 primary schools, attended by 62,242 boys and 7164 girls f the total number of schools of all kinds in the government iu 1898 was 2142 (87,227 boys and 17,960 girls). Poltava is divided into fifteen districts, of which the chief towns are Poltava, Gadyach (7714 in- habitants), Khorol (8390), Kobelyaki (11,936), Konstan- tinograd (6456), Kremenchug (68,648), Lokhvitsa (8917), Lubny (10,108), Mirgorod (10,023), Pereyaslav (14,609), Piryatin (8545), Priluki (19,055), Eomny (22,539), Zenkoff (10,542), and Zolotonosha (9900). Several villages have from 7000 to 9000 inhabitants each.

Poltava, capital of the above government, is situ- ated on the Vorskla river, 88 miles by rail west-south- west of Kharkoff. Its population was 53,060 in 1897, as compared with 41,050 in 1881. The great fair is gradu- ally losing its importance since Kharkoff has become the centre of the wool trade. The stock at the fair was valued at only Â£142,880 in 1896, as compared with Â£2,800,000 in 1865; and the sales amounted to Â£110,700. Industrial establishments (flour mills and tobacco works and tanneries) give employment to 1000 persons. The town is well built, and has beautiful public and private gardens.

Polynesia. â€” Under this general expression are comprised three great oceanic divisions: Melanesia (q.v.), Micronesia {q.v.), and Eastern Polynesia, but it is to the third that, according to present usage, the term Polynesia (Polynesia proper) is commonly restricted. Between this eastern section and the two western divisions the parting line runs from New Zealand somewhat obliquely between Piji and Tonga north-eastwards to Hawaii, but north of Fiji is deflected considerably westwards, so as to bring the Ellice and Phoenix groups within the eastern area. Polynesia proper thus lies roughly between the two tropics, dipping southwards below 30Â° S. to include Kermadec, and extending from about 180Â° to a little beyond 110Â° W., so as to take in the outlying Easter Island, about 400 miles from South America. A certain ethnical unity is imparted to this fragmentary oceanic world by its inhabitants, who are all without exception members of the large brown Polynesian race, and speak closely related dialects of the Polynesian stock language. But of political unity there can be no

question, since the whole region has been partitioned between Prance, Great Britain, Germany, the United States, and the Republic of Chile. The partition began in 1841, when the Mar- quesas were occupied by the French, and was completed in November 1899, when Samoa was divided between Germany and the United States.

Before 1893 Hawaii (the Sandwich Islands) had been recognized as an independent kingdom by Great Britain, France, the United States, and other governments.

But in that year the reigning Queen, Liliuokalani, was deposed, and after the proclamation of a republic in 1894 the archipelago was formally annexed to the United States in August 1898, and constituted the Territory of Hawaii. All whites, people of colour,, and Hawaiian natives who were free citizens prior to the annexation, became citizens of the United States ; and all who could speak, read, or write either Hawaiian (a pure Polynesian dialect) or English have the right to vote. For details, see Hawaii.

In the subjoined table is shown the distribu- tion of all the Polynesian archipelagoes and Partition islands among the five above-mentioned ^, Powers : â€”

Great Britain : Kermadec . Tonga

Cook (Hervey) Savage (Nlug) Tokelau (Union) Ellice (Lagoon) , Phoenix Gilbert Ducie . Pitcairn Manahiki (Humphry) “| Tongarewa (Penrhyn) [â– Caroline (Voslok, Flint)) Suvarof Dudoza Maiden Christmas Fanning

Polynesia,

Squtrfmles. Por>^tion.

Total

France : Tahiti Moorea Tuamotu . Marquesas Gamhier Tuhuai

Tetiaroa Baiatea Wallis

Total

Germany :

Marshall Group .

Total

United States : Hawaii Tutuila (Samoa)

15 374 142

24 7

14

16 166

12

2 2

35 234

15

1,060

410

50

600

500

“20

‘iio

50 1,740

150

f600

1250

1,000

6,640

180

10

17,500

8,400

5,000

1,050

2,400

60

35,200

“126

1,000

170 100 150

71,166

10,300 1,600 6,000 6,500

300 1,000

200

2,300 3,500

31,700

10,000 12,000 20,000

42,000

109,000 4,000

Total

Chile:

Easter Island

Total Polynesia

Subjoined are particulars of those Polynesian islands belonging to Great Britain which are not described in separate articles :

Kermadec, a small group of hilly islands 500 miles north of New Zealand, named from D'Entrecasteaux's able captain, Huon Ker- madec, in 1791. The largest is 12 miles round, 1600 feet high, and thickly wooded. The flora and fauna belong for the most part to those of New Zealand, on which colony the islands are also politi- cally dependant.

Mue, or Savage, a raised mass of coral rock 9 miles long, mid- way between the Tonga and Samoa groups, is very fertile, and inhabited by a mixed Polynesian and Melanesian people of Samoan speech ; an intelligent Christian community, said to be increasing.

Tokelau, or Union, a group of three islets about 350 miles north- east of Samoa, produces little but copra ; the natives are all Christians, akin to the Samoans in type and speech.

Manahiki, a scattered group, sometimes also called Penrhyn, lying north of Samoa about the equator, and comprising Manahiki, Penrhyn, or Tongarewa, Caroline or Thornton, Suvarof, Flint, Vostok, Starbuck, Maiden, Funafuti, and a few other typical lagoon islets, sparsely peopled and producing a little copra and guano. There are pearl and pearl-shell fisheries at Suvarof and Penrhyn, and the natives, of Polynesian stock, are all nominal Christians.

Christmas is the largest lagoon island in the Pacific, a little north of the equator, 154Â° W.

Fanning and Falmyra are lagoon islets lying north-west of Christmas.

These last three are commonly known as the America Islands, because chiefly frequented by traders from the United States. There is a settlement at English Point on Panning, where good drinking water is procurable.

Phcenix is a small scattered cluster a little south of the equator and north of Samoa, between 170Â° and 180Â° W. The rich guano deposits formerly worked by the Phoenix Guano Company have been exhausted, and all the buildings, wharves, &o., abandoned. The group appears to be now uninhabited.

That tlae Polynesian race has been continuously, and in some places rapidly, decreasing since their first contact D ca ‘with Europeans, is the unanimous opinion of

of the all observers. But doubts have been thrown Polynesian on the current statements regarding the rate race. qÂ£ decrease, which some

good authorities be-

lieve to be not so great as is commonly represented. They hold that former estimates of the number of in- habitants in the various insular groups were mere guess- work, and often far in excess of the real facts. Thus it is pointed out that Cook's estimate of 240,000 for the Society Archipelago (Tahiti) was at the time reduced by his associate, Forster, to 160,000, so that the 300,000 credited by him to the Sandwich Islands should also be heavily discounted. That is probably true, and it may be admitted that, as a rule, the early calculations erred on the side of excess. But when full allowance is made for all such exaggerations, the following considerations will show that, except in a few small areas subject to special conditions â€" Lukunor in Mortlock (Carolines), Futuna in Wallis, Niue or Savage â€" the falling off has been excessive both in Polynesia proper and in Micronesia. For the last- mentioned division some 60,000 must be added to the 267,966 given in the preceding table, besides 40,000 for the Maori of New Zealand, all true Polynesians, but excluded from the table as belonging to the Australian area. We should thus get a present total of 350,000, from which, how- ever, have to be deducted some 80,000 of the inhabitants of Hawaii, where the Polynesian aborigines now number only about 30,000, all the rest being Chinese (22,000), Japanese (25,000), Portuguese (16,000), Europeans, Americans, and half-castes (20,000). Thus is reached an absolute total of 270,000 as the probable number of pure and mixed (Micronesian) Polynesians in 1900. But the careful observers George and J. R. Eorster gave as a moderate estimate 650,000 at the time of Cook's last voyage (1774), showing an absolute decrease of 380,000, or about three-fourths. This conclusion is fully borne out by a detailed study of all the larger insular groups, where more accurate figures are available since the occupation of the islands by the European Powers. Thus in the Marianas the Chamorro aborigines had fallen from 60,000 or 60,000 in 1700 to less than 2000 in 1760, and the group had to be repeopled from the Philippines. Even now the whole population scarcely exceeds 10,000, mostly centred in Guam. The neighbouring Pelew Islanders, numbering 60,000 in 1800, had been reduced to 12,000 in 1880 and about 10,Q00 in 1900. The Tahitians, 150,000 in 1774, fell from 17,000 in 1880 to 10,300 in 1899; and in this group, while the pure

stock appears to be dying out, there is a small in- crease amongst the half-breeds. When New Zealand was occupied (1840) the Maori were said to number 120,000,

and were doubtfully stated to be still 66,000 in 1867; since then the returns of the 1881 and 1891 censuses gave 44,000 and 40,000 respectively. During the last two decades of the 19th century the decrease has been from 30,000 to 17,500 in Tonga ; from 11,600 to 8400 in the Cook group ; from 8000 to 3600 in Wallis ; from 1600 to 1000 in Manahiki ; from 1400 to 1000 in Tubuai ; and from 600 to 100 in Easter Island. A general decline seems thus to be placed beyond doubt, though it may be questioned whether it is to be attributed to a decayed vitality, as some hold, or to external causes, as is the more general opinion. The prevalence of elephantiasis and the occurrence of leprosy, for instance, in Hawaii, would seem to point at least in some places to a racial taint, due perhaps to the unbridled licentiousness of past generations. On the other hand, the rapid disappearance of whole communities, as in the Marianas, and the reduction of others to one-half or even one-fourth of their former numbers, as in Tahiti and Tonga, can be accounted for only by an accumulation of outward causes, such as wars, massacres, and raidings for the Australian and South American labour markets before this traffic was suppressed or regulated. Other destructive agencies were epidemics, such especially as measles and small-pox, which swept away 30,000 Eijians in 1875; the introduction of strong drinks, including, besides vile spirits, a most pernicious concoction brewed in Tahiti from oranges ; the too sudden adoption of European clothing, rendering the body supersensitive to changes of temperar ture; lastly, the action of over-zealous missionaries in suppressing the dances, merry-making, and free joyous life of pagan times, and the preaching of a sombre type of Christianity, with deadening effects on the buoyant tem- perament of these blithesome children of nature. Most of these abuses have been checked or removed, and the results may perhaps be detected in a less accelerated rate of decline, which no longer proceeds in geometric proportion, and seems even almost arrested in some places, as in Samoa and New Zealand. If such be indeed the case, perhaps the noblest of all primitive races may yet be saved from what at one time seemed inevitable extinction ; and the

Maori, the Samoans, and Tahitians may, like the Hawaiians, take their place beside the Europeans as free citizens of the various states of which they are now subjects. For the original home and dispersion of the Polynesian race over the Pacific Ocean, see Samoa.

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Polytechnics â€" The word "Polytechnic" (ttoXu'? many, and tâ,¬xv?; an art) may be held to designate any insti- tution formed with a view to encourage or to illus- trate various arts and sciences. It has, however, â„¢e *Â«"" been used with different applications in several l^fJuoZ European countries. In France the first icole pohjtechnique was founded by the National Convention at the end of the 18th century, as a practical protest against the almost exclusive devotion to literary and abstract studies in the places of higher learning. The institution is described as one "oil Ton instruit les jeunes gens, destines a entrer dans les ecoles sp^ciales d'artillerie, du g^nie, des mines, des ponts et chauss^es, cree en 1794 sous le nom d'^cole centrale des travaux publiques, et en 1795 sous celui qu'elle porte aujourd'hui " (Littrd). In

Germany there are nine teclinical colleges ~~whicli, in like manner, have a special and industrial rather than a general educational purpose. In Switzerland, as will be found explained in the article Education, the priacipal edu~~ cational institution, which is not maintained or adminis- tered by the communal authorities, but is non-local and provided by the Federal Government, is the Polytechnikum at Zurich. In all the important towns of the Federation there are trade and technical schools

of a more or less special character, adapted to the local industries ; e.g., schools for silk-weaving, wood-carving, watchmaking, or agriculture. But the Zurich Polytechnikum has a wider and more comprehensive range of work. It is a college designed to give instruction and practical training in those sciences which stand in the closest relation to manufac- tures and commerce and to skilled industry in general.

To the English public the word polytechnic has only recently become familiar, ia connexion with some London The first iiistitutions 6f an exceptional character. In the poiytecb- reign of William IV. there was an institution in ales la London called after the name of his consort â€” Eagisad. Â« rpj^g Adelaide Gallery “â€”and devoted rather to the display of new scientific inventions and curiosities than to research or to the teaching of science. It enjoyed an ephemeral popularity, and was soon imitated by an institution called the Polytechnic in Eegent Street, with a somewhat more pretentious programme, a diving-bell, electrical and mechanical apparatus, besides occasional illustrated lectures of a popular and more or less recreative character. Both of these institutions, after a few years of success, failed financially; and in 1880, Mr Quintin Hogg, an active and generous philanthropist, purchased the disused building in Eegent Street, and reopened it on an altered basis, though still retaining the name of Poly- technic, to which, however, he gave a new significance. He had during sixteen years been singularly successful in gathering together young shopmen and artisans in London in the evenings and on Sunday for religious and social intercourse, and in acquiring their confidence. But by rapid degrees his enterprise, which began as an evan- gelistic effort, developed into an educational institution of a novel and comprehensive character, with classes for the serious study of science, art, and literature, a gym- nasium, library, reading circles, laboratories for physics and chemistry, conversation and debating clubs, organized country excursions, swimming, rowing, and natural his- tory societies, a savings bank, and choral singing, besides religious services, open to all the members, though not obligatory for any. The founder, who from the first took the closest personal interest in the students, well describes his own aims : ” What we wanted to develop our institute into was a place which should recognize that God had given man more than one side to his char-

acter, and where we could gratify any reasonable taste, whether athletic, intellectual, spiritual, or social." The success of this effort was remarkable. In the first win- ter 6800 members joined, paying fees of 3s. per term, or 10s. 6d. per year ; and the members steadily in- creased, until in 1900 they reached a total of 15,000. The average daily attendance is 4000; six hundred classes in different grades and subjects are held weekly ; and upwards of forty clubs and societies have been formed in connexion with the recreative and social departments.

The precedent thus established by private initiative has since been followed in the formation of the Later la- Public institutions which, under the name of stitatioas "Polytechnics," have become so prominent of this and have exercised such beneficent influence class. among the working population of London.

It has been shown in the article on Education that

the principal resources for the foundation and main- tenance of these institutions have been derived from two funds â€" that administered under the City Parochial Charities Act of 1883, and that furnished to the London County Council under the terms of the Local Taxation (Customs and Excise) Act of 1890. More detailed refer- ence to these two Acts seems to be necessary in this place.

The Eoyal Commission of Inquiry into the Parochial Charities of London was appointed in 1878, mainly at the instance of Mr James Bryce, and under the xhecity presidency of the Duke of Northumberland. Parochial Its report appeared in 1880, giving particulars charities of the income of the parishes, and revealing the fact that the funds had largely outgrown the orig- inal purposes of the endowments, and were ill adapted to the modern needs of the class for whose benefit they were intended. The Act of Parliament of 1883 was designed to give effect to the recommendations of the Commissioners. It provided that while five of the larg- est parishes were to retain the management of their own charitable funds, the endowments of the remaining 107 parishes in the City should be administered by a cor- porate body, to be entitled " the Trustees of the London Parochial Charities," this body to include five nominees of the Crown and four of the Corporation of London. The remaining members were to be chosen under a subsequent scheme of the Charity Commission, which added four nominees of the London County Council, two of the Ecclesiastical Commissioners, and one each by the University of London, University College, King's College, the City and Guilds Institute, and the governing body of the Bishopsgate and the Cripplegate foundations. For the purpose of framing the scheme, a special commis- sioner, Mr James Anstie, Q.C., was temporarily attached to the Charity

Commission, and it thus became the duty of the Commission to prepare a statement of the income possessed by the 107 parishes, distinguishing between the secular and the ecclesiastical parts of the endowments. The value of the estates and stocks rendered available for the purposes of the scheme amounted to Â£1,690,442; the annual income derived from the ecclesiastical fund was Â£35,000, and that from the secular portion of the fund Â£50,000. The scheme assigned capital grants amounting to Â£155,000 to the provision of open spaces, and Â£149,500 to various institutions, including free libraries in Bishopsgate and Cripplegate, the People's Palace, the Eegent Street and Northampton Institutes, and the Victoria Hall. A capital sum of Â£49,355 out of the ecclesiastical fund was devoted to the repair of City churches ; and the balance of this fund, after allowances for certain vested interests, was directed to be paid annu- ally to the ecclesiastical Commissioners. This balance has varied by slight increases from year to year, and amounted in 1899 to Â£11,545. The remaining fund thus set free for secular purposes was by the scheme largely devoted to the erection and maintenance of poly-technic institutions, or "industrial institutes," as they were at first called. It was the opinion of Mr Anstie and his fellow-commissioners that in this way it would be possible to meet one of the most urgent of the intellectual needs of the metropolis, and to render service nearly akin to the original purposes of the obsolete charitable endowments.

The general scope and aims of the institutions thus contemplated by the Commissioners are defined , ^^. in the scheme for the Borough Eoad (Southwark) scbeale Polytechnic, which may be taken as a fairly uadertbe typical example of the rest: â€" '*'*â–

The object of this institution is the promotion of the industrial skill, general knowledge^ health, and well-being of young men and women belonging to the poorer classes by the following means :â€"

I. Instruction in â€"

(a) The general rules and principles of tiie arts and sciences

applicable to any handicraft, trade, or business. (6) The practical application of such general rules and

principles in any handicraft, trade, or business, (c) Branches or details of any handicraft, trade, or business, facilities for acquiring the knowledge of which cannot usually be obtained in the workshop or other place of business. The classes and lectures shall not be designed or arranged so as to be in substitution for the practical experience of the workshop or place of business, but so as to be supplementary thereto.

II. Instruction suitable for persons intending to emigrate.

III. Instruction in such other branches and subjects of art, science, language, literature, and general knowledge as may be approved by the governing body.

IV. Public lectures or courses of lectures, musical and other entertainments, and exhibitions.

v. Instruction and practice in gymnastics, drill, swimming, and other bodily exercises.

VI. Facilities for the formation and meeting of clubs and societies.

VII. A library, museum, and reading room or rooms. Within the limits prescribed, the governing body may from time to time, out of the funds at their disposal, provide and maintain buildings and grounds, including workshops and laboratories suitable for all the purposes herein specified, and the necessary furniture, fittings, apparatus, models, and books, and may provide or receive by gift or on loan works of art or scientific construction, or objects of interest and curiosity, for the purpose of the institute, and for the purpose of temporary exhibition.

Other provisions in the scheme require : fl) that the educational benefits of the institute shall be available for both sexes equally, but that common rooms, refreshment rooms, gymnasia, and swimming-baths may be established separately, under such suitable arrangements as may be approved by the governing body ; (2) that the fees and subscriptions shall be so fixed as to place the benefits of the institute within the reach of the poorer classes ; (3) that no intoxicating liquors, smoking, or gambling shall be allowed in any part of the building ; (4) that the buildings, ground, and premises shall not be used for any political, denominational, or sectarian purpose, although this rule shall not be deemed to prohibit the discussion of political subjects in any debating society approved by the governing body ; (5) that no person under the age of sixteen or above twenty-five shall be admitted to membership except on special grounds, and that the number thus specially admitted shall not exceed 5 per cent, of the total number of members.

These and tlie like provisions have formed the common basis for all the metropolitan polytechnics. When in

1890 a large sum was placed hf the Local aicai Board Taxation Act (Customs and Excise) at the oftbeLoa- disposal of the county and county borough amncn”^^ councils for the general purposes of technical

and secondary education, the London County Council determined to devote a considerable portion of this revenue to the further development and sustentation of polytechnics. While the funds granted by the City Parochial Trustees may be employed in aid of the social and recreative as well as the educational purposes of the various institutes, it was decided by the County Council that the sums contributed by its Technical Board should be applied to educational work only.

Dr Garnett, the secretary and educational adviser of the Technical Board of the London County Council, has, in a published lecture delivered before the International Congress on Technical Education in June 1897, thus described the conditions under which that Board offers financial help to the London polytechnics : â€”

The objects which the Technical Education Board has had in view in its dealings with the polytechnics have been : â€”

1. To allow to the several governing bodies the greatest possible freedom in the conduct of social, recreative, and even religious work within the provisions of the schemes of the Charity Com- missioners.

2. To secure to each polytechnic the services of an educational principal, who should be responsible to his governing body for the organization and conduct of the whole of the work of the institution.

3. To provide in each polytechnic a permanent staff of teachers.

who should be heads of their respective departments and give their whole time to the work of the institution, and thus to establish a corporate or collegiate lite in the polytechnic.

4. To ensure that all branches of experimental science are taught experimentally, and that the students have the opportunity of carrying out practical laboratory work, at an inclusive fee not exceeding ten shillings for any one subject.

5. To provide efHcient workshop instruction in all practical trade subjects.

6. To secure that the number of students under the charge of any one teacher in laboratory or workshop classes, or in other classes in which personal supervision is of paramount importance, shall not exceed a stated limit (fifteen in the workshop, or twenty in the laboratory).

7. To exclude from classes students who, for want of preliminary training, are incapable of profiting by the instruction provided; and to this end to restrict the attendance at workshop classes to those who are actually engaged in the trades concerned, and have thus opportunities of acquiring the necessary manual dexterity in the performance of their daily duties.

8. To furnish an adequate fixed stipend for all teachers, in place of a contingent interest in fees and grants.

9. To encourage private subscriptions and donations.

10. To establish an efficient system of inspection.

11. To facilitate the advertisement of polytechnic classes, u,nd especially to invite the co-operation of trade societies in supporting their respective classes.

12. To encourage the higher development of some special branch of study in each polytechnic.

13. To utilize the polytechnic buildings as far as possible in the day time by the establishment of technical day schools, or otherwise.

14. To secure uniformity in the keeping of accounts.

In furtherance of these objects, the Technical Education Board has offered to each polytechnic â€”

(o) Such equipment grants as may from time to time be made by the Board for specific purposes on the application of the governing body. 5) A fixed contribution of Â£1000 a year, c) Three-fourths (not exceeding Â£500 a year) of the stipend

of the educational principal. (d) Ten per cent, on the fixed salaries of the teachers, (e; One penny for each hour's attendance of each student. (/) Fifteen per cent, on all voluntary subscriptions and dona^ tions from private sources. Provide(^ that the total payment to any polytechnic in any one year under (6), (c), (d), and (e) does not exceed Â£3000, and under (/) does not exceed Â£2000.

With a view to a due division of labour, and also to the co-operation of the public bodies concerned, the " London Polytechnic Council " was created in 1894. It is composed of representatives of the City Paro-p^fyf chial Trustees, the Technical Education Board fccAnfc of the

London County CouncU, and the City ‘“Â«’“- and Guilds of London Institute, and its duty is to consult together as to the appropriation of funds, the organization of teaching, the holding of needful examinations, and the supervision of the work generally. The statement on the following page shows the number and names of the several institutions, and the extent to which they have been severally aided by the trustees of the two funds.

The ” People’s Palace ” owes its origin in part to the popularity of a novel by Sir Walter Besant, entitled All Sorts and Conditions of Men, in which the writer pointed out the sore need of the inhabi- ^ , tants of East London for social improvement PaiaJ.^ and healthy recreation, and set forth an imagi- nary picture of a “Palace of Delight,” wherein this need might be partly satisfied. Much public interest was awakened, large subscriptions were given, and the trustees of the Parochial Charities Fund aided the project ; but the munificence of the Drapers’ Company in setting aside Â£7000 a year for its permanent maintenance has released the London County Council from any obligation to make a grant out of its technical fund. Apart from the social and recreative side of this popular institution, the educational section, under the name of the East London Technical College, has steadily increased in numbers and

influence since it has enjoyed the fostering care of the Drapers’ Company.

Grants from City Parochial Charities.

Grants from London County Council.

For Building.

For Annual Mainten- ance.

For Building

and Equip- ment.

For Annual Mainten- ance.

1. The City Polytechnic, including â€” *(a) Northampton Institute (6) The Birkbeck

Institute (c) City College, Moorfields *2. East London Technical Institute (People's Palace) *3. Regent Street Poly- technic *4. Battersea Polytechnic * 5. Borough Polytechnic . *6. Northern Polytechnic, HoUoway . 7. Victoria Hall (Morley College) . *8. Woolwich Polytechnic *9. South – Western Poly- technic, Chelsea * 10. Sir John Cass's Poly- technic, Aldgate *11. Goldsmiths' Institute, New Cross

Â£

45,000

6,750 11,750

6,000

Â£

4700 1250 1500

3650

5350 3750 3750

3000

1500 1500

2750

1500

Â£

2240 600

150

250

76b

6050

1000

600 1800

Â£

2000 2195 1245

545

4659 3488 5269

3482

2797 4966

The institutions marked thus * are fully equipped, and are the best examples of polytechnics in the stricter sense of the term.

The Birkbeck Institute and the City College are older institutions, which have been long very successful rather with educational than - with social work. By the scheme of the Commissioners they have been federated with the Northampton Institute, a large and fully equipped establishment of the best modern type, with unusual provision for recreation and for workshop training. The three institutions together form the City Polytechnic.

The Goldsmiths' Institute in like manner owes it exist- ence and its annual maintenance to the generous initiative of the ancient City Guild whose name it bears. It is therefore entirely independent of pecuniary subsidy from any other public body. In the year 1900 the number of class entries to the institute at New Cross was 7574. The Clothworkers' Company has also contributed Â£18,000 to the Northern Polytechnic at Holloway.

In all these institutions the general aims have been practically the same, although special features have been differentiated in order to meet the local needs m"hods" ^^^ *^Â® wishes of the inhabitants. In all there are laboratories and lecture rooms, trade classes, art studios, gymnasia, provision for manual training and domestic economy, and applied science. In nearly all, at first, mechanical and manual instruction were the promi- nent objects in view, partly owing to the conditions under which grants were made by the Science and Art Depart- ment of the Board of Education. But of late increased attention has been paid year by year to literary and humaner studies, and to general mental cultivation, pur- sued pari passu with technical and scientific training. The aid of the London organization for University Ex- tension has been especially serviceable in providing courses of lectures and classes in literary subjects at nearly all of the polytechnics. As subsidiary to their main work, each of them has established a junior continuation school, with a view to provide suitable instruction for scholars who have left the public elementary schools and are not yet prepared to enter the technical and trade classes. Although the workshops and the classes for arti- sans are used chiefly in the evenings, there is an increasing

number of day students : e.g., in the Birkbeck Institute, classes in natural science, mathematics, and languages ; at Chelsea, a domestic economy school and an arts school ; at the East London Technical College and at Eegent Street, engineering departments ; at the Goldsmiths' In- stitute, a "Commercial and Civil Service" department, largely attended by young women ; at Battersea, regular day classes for mathematics, building and machine con- struction, wood work, and metal work. In short, the schemes of the several institutions are so elastic that the governing bodies are at liberty to open any classes or to

try any educational or recreative experiment for which they can find a genuine local demand.

It is computed by Dr Garnett that the sites, buildings, and equipment of the London polytechnics represent a total capital outlay of Â£500,000, and that the annual revenue required for their sustentation is about Â£120,000. Of this sum about one-fourth is contributed by the City Parochial Charities, one-fourth by the Technical Education Board, one-fourth by the fees of students and members, and the remaining fourth by the subscriptions of the City Guilds and the grants received from the Science and Art Department of the Board of Education. The total number of scholars in the polytechnics and their branch institutions is variously estimated at from 40,000 to 60,000, and the total number of regular scholars in the evening schools of the London School Board does not exceed 100,000. These figures may be usefully compared with the census returns, which show that within the Metropolitan area there are 704,414 young persons be- tween the ages of thirteen and twenty-one. It is a note- worthy fact, that whereas in the population statistics for the whole of England and Wales the number at each year of age is regularly diminished by death from eight years onwards, there is a steady increase in London, year by year, from fourteen up to the age of thirty. This fact is owing to the constant immigration of young men and women from the provinces to the metropolis. The Census Commissioners in their report for 1901 (p. 15) compute that more than one-third of the population of London are not natives. They show also that, if all England and Wales be taken together, the number of persons between twenty and twenty-one is less by 12-8 per cent, than the number between thirteen and fourteen ; but that, taking London alone, the number of persons between twenty and twenty-one is greater by 14-4 per cent, than the number between thirteen and fourteen. Hence the proportion of the inhabitants who are of an age to benefit by poly- technics and continuation schools is in London ex- ceptionally large. It would not be right for Londoners to complain that there is thus cast upon them the duty of providing suitable instruction for so many immigrants, for if the great city drains the rural districts of some of their best brain and muscle, she gains much from their industry and productive power.

But it follows from the particulars thus given that at present neither the supply of suitable provision for mental improvement and rational recreation for the wage-earning classes, nor the demand for such provision on the part of the workers themselves, is commensurate with the moral and intellectual needs of a community of nearly seven millions of people. The provision in evening schools, institutes, classes, and polytechnics is still ^ar inferior to that which is to be found in most German and Swiss towns, and needs to be greatly in- creased. In matters relating to the higher life, de- mand does not always precede supply; it is supply which is needed not only to satisfy the public de- mand, but to create it. As new and well-devised op- portunities for mental culture are placed within reach, they will be more and more appreciated, new and

healthier appetites will be stimulated, the art of employing leisure wisely and happily will be more systematically studied, and the polytechnics will become still more im- portant centres of civilizing and educating influence than they have already become.

In particular, the reconstituted University of London will probably be placed in new and most helpful relation to the best of the polytechnics. By the statutes which have recently come into force, the Senate of the Univer- sity is empowered to include in the list of ” schools of the University ” all institutions which are duly equipped and able to furnish suitable instruction of an advanced and scholarly type ; and also to recognize all thoroughly qualified professors in their several faculties and subjects as ” teachers of the University,” although some of their classes may meet in the evening only. There is thus a way open for the due admission of the best polytechnics to the University, and for the recognition of the best students as undergraduates, with all the rights of internal students. At present the great possibilities of the metro- politan University under its new conditions are hardly revealed or

accurately foreseen. But it is probable that while the greater and older colleges of the University â€” such as University and King's â€” will devote their efforts largely to such post-graduate lectures and intellectual and scientific research as are the special province of the higher order of professors, most of the aid required by the ordinary undergraduate will be provided in institutions of minor rank, officered by experienced and well-accredited teachers, who are fully able to give the needful instruction and preparation for a degree in arts and science. The best of the polytechnics are already competent, both as regards their staff and their equipment, to perform this task ade- quately, and thus to become integral parts of the London University of the future. There is no reason to fear that the recreative, social, manual, and industrial training, to which at first the special attention of the founder was directed, will suffer from a fuller expansion of the academic and literary side of " polytechnic " life. Eather it may be hoped that the due co-ordination of the practical with the purely intellectual purposes of these institutions will serve to give to all the students, whatever their future destination may be, a truer and broader conception of the value of mental culture for its own sake.

**See also a paper by Mr Sidney Webb, The London Poly- technic Institutes, in the second volume of special reports on educational subjects (1898) issued by the Education Department ; the Beport of the Central Governing Body (1900) of the London Parochial Charities; the Annual Beports and the Monthly Gazette of the Technical Board of the London County Council ; the Poly- technic Magazine, published from time to time at the institute in Regent Street ; and various memoirs and papers contained in the Proceedings of the International Congress on Technical Education (1897), especially two â€" that by Mr Quintin Hogg, detailing his own early experience in founding the first polytechnic, and that of Dr William Garnett, the secretary of the Technical Education Board. (j_q_p **

Polyzoa. â€" The researches of the last few years have gone far to show that the classification adopted in the earlier volumes (9th edition) of this Encydopcedia can no longer be accepted. Cephalodiscus and Rhabdojoleura, then regarded as constituting the Section

Pteeobeanchia, have been proved to possess unexpected resemblances to Balano- glossus. Phoronis, the solitary member of the Section Vermiformia, appears to have aflB.nities in the same direc- tion. By the removal of these two Sections to another group (see Hbmichorda), the remaining Section, Eupoly- zoa, acquires the same limits as the Class Polyzoa, and the term Eupolyzoa hence becomes unnecessary. The Class Polyzoa as thus restricted includes only the Sub- classes ENTOPROGTA and EGTOPROGTA. The re-

cent Ectoprocta are divided into A. GYMNOLAEMATA, with the Sub-orders Cyclostomata, Cheilostomata, and Ctenostomata ; and B. PHYLACTOLAEMATA.

The association of the Polyzoa with the Sipunculoidea and the Brachiopoda in a^phylum Podaxonia rested mainly on the belief that Phoronis is an annectant form between the three groups. Delage and Herouard introduce the term Vermidia as the name of a group including the Gephyrea in the widest sense, with the Polyzoa, Ptero-branchia, Eotifera, Gastrotricha, Kinorhyncha, Chaeto- gnatha, and Brachiopoda. The Polyzoa here occupy a central position, leading through Phoronis and the Sipun- culoidea to the remaining Gephyrea, and in other direc- tions to the Brachiopoda, the Pterobranchia, and the Eotifera respectively ; the last being believed to lead to the Gastrotricha, Kinorhyncha, and Chaetognatha. Cori, basing his views principally on the excretory organs of fresh- water Polyzoa (Phylactolaemata), supports the asso- ciation of Phoronis with the Polyzoa; but it may be noted that the Phylactolaemata are in certain respects highly specialized forms, whose peculiarities are not likely to have an ancestral significance. Hatschek separates the Entoprocta from the Ectoprocta as a division of his group Scolecida, characterized by the possession of a primary body-cavity and of protonephridia, the Ectoprocta being placed in a group Tentaculata, which nearly corresponds with the Molluscoidea after the removal of the Tunicata. Against this view may be urged the essential similarity between the processes of budding in Entoprocta and Ecto- procta (cf. Seeliger, Zeitschr. wiss. Zool. xlix. 168 ; 1. 560), and the resemblances in the development of the two groups. These instances will show the wide

discrepancies which exist between current views. Without disputing the possibility that the Polyzoa are distantly related to other animals, it will be best to regard them as an isolated Class which is not proved to have close affinities to any other group.

Adidt Structure and Vital Phenomena. â€” The general account of the adult structure, habits, &c., of the Eupolyzoa given in the earlier volumes is still valid, though certain points, which were then imperfectly un- derstood, have since been investigated more thoroughly The problematical ” intertentacular or- gan” (Eig. 1, int.) of Earre has been considerably eluci- dated by Prouho {Arch. Zool. Exp. (2) X. 557). In Alcy- onidium duplex a male ” polypide ” (=alimentary canal, tentacles, &c.) occurs in a ” zooecium ” (= body- wall) and produces sperma- tozoa, though it has no intertentacular organ. It then de- generates to the con- dition of a “brown body,” its place be- ing taken by a new polypide, produced as a bud, which de- velops ova. The female polypide is provided with an intei^ tentacular organ, a tubular passage from the body-cavity to the exterior, situated between the bases of the tentacles on the anal side ; and through this passage the eggs pass into the tentacle-sheath. The structure plays the part of an

Fio. 1.â€” Part of a polypide otAlei/onidium gela- tl1wsium,sho^vins the intertentaculai”Organ(iÂ«^) {From Farre.)

oviduct in three species investigated by Prouho, although there is evidence that spermatozoa and fragments of brown bodies may also be evacuated by the same passage. The ex- ternal opening of the excretory organs described in some Phylactolaemata may be a homologous structure. These organs (see Verworn, Zeitschr. wiss. Zool. xlvi. p. 114; Braem, Bibl. Zool. ii. Heft 6, p. 51 ; Cori, Zeitschr. wiss. Zool. Iv. p. 626 ; Oka, J. Coll. Japan, iv. p. 108 ; viii. p. 339^ are specially ciliated portions of the lophophore- cavity (a space vrhich is incompletely separated from the principal body-cavity), at the regions where its two halves unite on the distal side of the cavity of the epis- tome, at the base

of the anal tentacles. The “oral glands” of certain Cheilostomata, developed in con- nexion with the distal end of the teatacle-sheath, are believed by Waters to be excretory in their nature; but they cannot be regarded as coraesponding in any way with the organs just mentioned. The body-cavity of Gymnolaemata is not lined by a ciliated epithelium ; and it is, indeed, seldom possible to distinguish a ccelomic epithelium of any kind in the adult zooecium. The structure of the Phylactolaemata has been further elucidated by the researches of Kraepelin (Abh. Ver. Hamburg, x. No. ix. ; xii. No. ii.), Braem (toe. cit.), Cori {loc. cit), and Davenport (Bull. Mus. Harvard, xx. p. 101). Wesenberg-Lund {Vidensk. Meddel. Copenhagen, 1896, p. 253) gives interesting information regarding their biol- ogy. The form of Plumatella known as Alcyonella fun- gosa is usually the result of the simultaneous germination of numerous sessile statoblasts, whereby a composite colony results and the crowded tubes take on their char- acteristic parallel arrangement. Colonies which persist through several years may show distinct annual rings of growth. The statoblasts are said to be derived partly from an ectodermic core of the funiculus, and partly from its external mesoderm (Braem, toe. cit), the former giving rise to the chitinous envelope and to a nucleated layer (Fig. 2, ect) imme- diately inside the chitin, which later invaginates to form the inner vesicle of the polypide – bud. The mesodermic por- tion becomes charged with a yolk-like mar terial (y), and, on the germination of the statoblast, gives rise to the outer layer (mes.) of the bud. The produc-

Fi&. 2 â€” Section of a germinating statoblast of Cristatella mucedo : â€” ann,, cliitlnous annulus, containing air-cavities, which enable the stato- blast to float; ect.f thickened part of the ecto- derm, which will give rise to the inner layer of the polypide-bud ; ttiss,, mesoderm, forming the outer layer of the bud ; sp., anchoring spines of the statoblast ; y, the yolk-like mesodermic mass of

... ey the statoblast. {Afier Â£ra6m.)

tion of a polypide by the statoblast thus differs in no essential respect from the formation of a polypide in an ordinary zooecium. The statoblasts require a period of rest before germination, and Braem has

shown that their property of floating at the surface may be bene- licial to them, by exposing them to the action of frost, which in some cases improves the germinating power. The occurrence of Phylactolaemata in the tropics (see Meissner, Zool. Am. xx. 173) would show, however, with- out further evidence, that frost is by no means a factor essential for germination. Important memoirs have been published on the structure of the Entoprocta, of which those by Foettinger {Arch. Biol. vii. 299), Ehlers {Abh. Ges. Obttingen, xxxvi.), Davenport (Bull. Mus. Harvard, xxiv. p. 1), and Prouho (Arch. Zool. Exp. (2) ix. p. 91) may be specially mentioned. There is no confirmation of the view that the lophophore of Pedicellina has the structure indicated in Fig. 15 c of the article in Ency. Brit vol. xix. p. 438. The budding of Polyzoa has been

studied by Seeliger (loc. cit), who finds, with most others who have investigated this subject, that the polypide- bud is derived from ectoderm and mesoderm only (see, however, Calvet, C. B. cxxvii. pp. 79, 194). Ladewig (Zeitschr. wiss. Zool. Ixvii. p. 323) controverts Calvet's ^ statements. The ectoderm forms the inner layer of the two-layered vesicle, and gives rise to the lining of the tentacle-sheath (" kamptoderm," Kraepelin), the ganglion, and the whole of the epithelium of the alimentary canal. The mesoderm constitutes the outer layer, and forms the muscles, the reproductive organs, and other structures. The periodical histolysis of the polypide, leading to the formation of a " brown body," may partly be due to the accumulation of excretory substances in the cells of the alimentary canal (Harmer, Quart. J. Micr. Sci. xxxiii. p. 123) ; but the effects of artificially introduced pigments (indigo-carmine, &c.) suggest that the excretory function is in part performed by some of the mesodermic tissues.

Development. â€" The eggs are rarely laid (Cyphonautes type), but in the great majority of cases undergo their early development in some part of the parent. The vestibule of the adult may be employed as a brood- chamber (Entoprocta, Alcyonidium duplex) ; the eggs may pass into the tentacle-sheath of a degenerated poly- pide, or even develop in the body-cavity (Prouho, Arch. Zool. Exp. (2) X. p. 625) ; but in a large proportion of the marine forms they develop in ovicells. The ovicell of the Cheilostomata is a derivative of a zooecium, and is usually situated

just above the orifice, while that of the Cyclostomata is a modified zooecium. The egg may be without yolk, but it commonly possesses a moderate quantity of yolk, which, however, does not interfere with the regularity of the segmentation. Two polar bodies have been observed in some cases. Some of the details of fertilization have been made out in Phylactolaemata (Kraepelin, toe. cit^. The segmentation of the egg of marine Ectoprocta is remarkably regular, and leads to the formation of a hollow blastula. The endoderm is formed by invagination; and in Cyphonautes (Prouho, loc. cit) it gives rise to the mid-gut; the stomodaeum being represented by the large vestibule, and the anus being formed as a proctodaeum. The origin and complete history of the mesoderm have not been satisfactorily made out in Ectoprocta. There is hence no embryological evidence that the large body-cavity which characterizes these forms is to be regarded as a space which precisely corresponds with that of other ” Coelomata ” ; and it is not impossible that it may have been evolved by the enlargement of the space between the alimentary canal and the skin in the Entoprocta, in order to permit of the complete retraction of the part of the body which bears the tentacles. The stages which succeed the completion of segmentation are much obscured in most Ectoprocta. This depends on the facts that no functional alimentary canal is developed by the larva, and that the larval organs are merely of a temporary nature, destined to be pro- foundly modified by the complicated metamorphosis which follows fixation. The larva of Pedicellina (the epistome of which must be regarded as ventral) fixes itself by its oral surface (Barrels, Ann. Sci. Nat (7), i. No. 1 ; Harmer, Quart. J. Micr. Sci. xxvii. p. 239), and the mouth and anus are carried away from the plane of fixation by a rotation of the entire alimentary canal about an axis cutting the middle of the two sides through an angle of 180Â°. This movement is permitted by the histolysis of most of the larval vestibule ; part of this passes to the side remote from the object on which fixation has taken place, and there forms the adult vestibule, by acquiring a new open- ing to the exterior. The ” ciliated disc ” and the cephalic ganglion atrophy during the metamorphosis. This is the

only case in which the larval digestive apparatus is known to become that of the primary individual of the colony.

The Cyphonautes larva, distinguished by the possession of a functional alimentary canal, was formerly supposed to be peculiar to the Cheilostome genus Membranipora, but has been shown by Prouho (loc. cit.) to occur in Alcyonidium and Hypophorella among the Ctenostomata. The marked similarity between the Cyphonautes larvae of these three genera, which have no special connexion with one another, may indicate that the larva itself has a phylogenetic significance ; it may, in fact, be regarded as a modification of the Entoproot larva. Fixation takes place, as in the Entoprocta, by the oral surface, and is effected by the eversion of a special organ (“sucker” or “internal sac “) which opens to the exterior between the mouth and the anus. The alimentary canal undergoes histolysis (Ostroumoff, Arch. Slaves Biol. ii. p. 333). In larvae of the type shown in Ency. Brit. vol. xix. p. 440, fig. 20, the alimentary canal may still be recognizable (Harmer, Arch. Zool. Exp. (2) v. p. 443), though it is no longer functional ; st is the internal sac, and m? is a problematical larval structure known as the ‘ ‘ pyrif orm organ ” (x in fig. 21). The vestigial mouth is situated between St and m f. The metamorphosed larva of the Ectoproota becomes the primary zocecium of the colony. Its definitive alimentary canal is developed in the same way as that of any of the secondary zooecia formed by budding ; that is to say, by the formation of a polypide-bud, which appears on the aboral surface, and there- fore in the position finally acquired by part of the larval vestibule, with the alimentary canal, of the fixed larva of Pedicellina.

The spermatogenesis, oogenesis, and development of Phylacto- laemata are described by Kraepelin (^loc. cit.) and Braem (^Bibl. Zool. Bd. X. Heft 23). The ovum is taken up by a special polypide-bud which grows into a protecting envelope for the embryo, the early development of which somewhat resembles that of the Cyclostomata. Larval organs are hardly represented, and the embryo, before birth, becomes a zocecium, with one, two, three, or more polypides, produced as buds from its two-

layered body-wall. After a short period, during which it swims by means of its uniformly ciliated ectoderm, it fixes, and forms a new colony. This type of development may be regarded as a further modifica- tion of that found in Gymnolaemata. The Cyclostomata are char- acteriz;ed by the occurrence of a remarkable process of embryonic fission (Harmer, Quart. J. Micr. Sci. xxxiv. p. 199 ; xxxix. p. 71 ; xli. p. 73) , which is most nearly paralleled in certain Hymenopterous insects (Marchal, 1898), and by the fact that eggs which actually develop are restricted to a few individuals of the colony. A zocecium in which the egg develops becomes an ovicell ; it differs to a conspicuous extent from the other individuals of the colony, and often acquires a complicated form. Its orifice (" ooeciostome ") is valuable for the discrimination of the species.

Classification. â€" The existing classifications of the Cheilostomata, the largest division of recent Polyzoa, will probably be much modified when the details of their anatomy are more fully worked out. It may be expected that the arrangements in connexion with the protrusion and re- traction of the polypide will prove to give important indications of affinities. The view that the characters of the front wall (that on which the operculum is situated) of the Cheilostomata is of primary importance in the classification of this group, has already been maintained by Jullien. The retracted polypide of the Ectoprocta (Fig. 3) lies in a cavity which contains a considerable quantity of fluid and is bounded by the body-wall. The protrusion of the tentacles and other parts of the polypide implies the temporary removal of some of the organs in the body-cavity. It is possible to imagine two methods by which this movement can be permitted without producing a partial vacuum in the body -cavity. The body -wall must either be flexible, so that the volume of the zocEcium may diminish when the polypide is protruded ; or, in cases in which the body-wall is rigid, there must be some arrangement by which the amount of fluid it contains can be altered from time to time, in order to permit of the free movements of the polypide. In the Phylacto- laemata the body-wall is muscular, and can thus exert a

pressure on the fluid of the body-cavity sufficient to cause protrusion. In the Gymnolaemata the body-wall is not muscular, and protrusion of the polypide is effected by the contraction of the parietal mu scles(p.m.), which pass freely across the body-cavity from one part of the body-wall to another. In the more delicate branching Ctenostomes (Vesicularina) the entire body-wall is flexible, so that the contraction of a parietal muscle acts equally on the two points of the body ~~wall with which it is connected. In encrusting Ctenostomes (Alcyonellea) and in the Mem~~ braniporaAike Cheilostomes (Figs. 3, 4, a) the zooecia are attached by their basal wall and united to one another by their vertical walls, so that the free surface or front wall is the only one in which any considerable amount of move- ment can take place. The parietal muscles (p.m.), which pass from the vertical walls to the front wall, thus act by depressing the latter and so exerting a pressure on the fluid of the body-cavity, as shown to be the case by Nitsche in 1871. This explanation of the movement will obviously not apply to Cheilostomata in which the front wall is rigid; and in 1888 Jullien showed that the protrusion and retraction were rendered possible by the existence of a ” compensation-sac,” lying inside the body-cavity and in communication with the external water (Bull. Soc. Zool. France, xiii. p. 67).

A renewed investigation of this subject proves that this sac is present in a considerable number of the Cheilostomata. In its most fully developed condition (Figs. 3, 4, c, c.s.) it is a large cavity, with delicate walls of great tenuity, which lies beneath the calcified front wall of the zocecium, and opens to’ the exterior at the proximal border of the chitinous operculum (Fig. 5, c). This structure is not hinged to the calcareous wall which is adjacent to its base-line, but it is continuous with the floor of the compensation-sac, a passage by which water can pass in and out of the sac existing between its base and the calcareous body-wall. The sac is joined to the rigid body-wall by numerous muscle-fibres, the contraction of which must therefore exert a pressure on the fluid of the body- cavity in which the sac lies. The comparison of various genera of Cheilostomes with regard to the method in which the polypide is protruded, leads to the following conclusions. The most primitive condition is that shown in the Membraniporidae, Flustridae, &c., in which the front wall is entirely or partially membranous or

flexible, the membranous part constituting the ” aperture ” (Fig. 5, A, ap.), so called from the fact that its disappearance in fossil forms leaves a wide opening into the body-cavity. The parietal muscles

3.â€” DlagrnmrnnMc lonKitudiiml sections of Chellostomatous zooecia : â€”a. Jfemiranipora (after mtso/ie) ; 11, a-ihrihna ; o, some of the Leiiralioid forms ; d, Mlcrapoi-dlld ; c.s.. compensation- sac ; mp., median pore (in d) ; o, orifice, through which the tentacles are protruded ; op., operculum;^.â„¢., parietal muscles. (See also the note to Fig. 4.)

are inserted in groups, along the two sides of the zocecium into the membrane of the aperture (Figs. 3, 4, a). In certain species of Membranipora the membrane is protected by a series of calcareous spines, which start from its periphery and arch over the delicate opercular wall. A special modification of this arrangement is found in the genera Scrupocellaria, Mniipea, and Caberea, in which a single much-expanded spine, known as the “scutum”or “fornix,” protects the aperture ; this spine is absent or vestigial in some species of all the three genera. Forms provided with a scutum are probably related to one another, and they are usually characterized

by the high development of avicularia or vibraoula. Cheilostomata first become common in Cretaceous strata, in which a large proper-

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Fig. 4. â€” Diagrammatic transverse sections :â€” a, of M&mbranipora ; b, of an im- mature zooecium of Crihrilkia; o, of a Lepraliold form^; c.fl., compensation- sac ; p.m., parietal muscles.

tion of the genera belong either to the Membraniporidae or to a family known as the Cribrilinidae, which is represented at the pres- ent time by the genera Membraniporella and Cribrilina. In these a series of calcareous spines are formed, in the young zooecium (Fig. 4, b), round the membranous aperture, as in the species of

..op-..

C D

Fig. 5.â€" Zocecia of a, Membranipora ; e, Cribrilma ; o, Lepralia ; d, Mic/to- porella. The arrow shows the entrance to the compensation-sac in b, o, and D ; in D passing through the "median pore ; ap., aperture," or membra- nous front wall (in a) â€¢ d., the " denticles," forming the hinge of o (seen after the removal of the operculum) ; op., operculum.

Membranipora referred to above. While in these latter the spines remain free from one another, they unite to a greater or less extent in the Cribrilinidae (Fig. 5, b), thereby forming a secondary front wall piei-ced by slits or rows of pores, corresponding with the inter- vals between the original spines. The operculum retains its con- nexion with the membranous aperture (Fig. 3, b), into which the parietal muscles are still inserted. The condition found in a certain proportion of existing Cheilostomes is probably a further develop- ment of the Cribrilinidan arrangement. The original spines are no longer distinct in ontogeny, but are represented by the calcareous wall, which is usually pierced by irregular pores (Fig. 5, c), now filled with living protoplasmic structures, instead of by the regu- larly arranged slits or pores of most Cribrilinidae. This conclusion is arrived at by the study of the compensation-sac (Figs. 3, 4), the floor of which is seen to correspond with the aperture of Mem- braniporidae by its relations to the parietal muscles and to the operculum. The compensation-sac may develop by the formation of a calcareous lamina which overarches the membranous aperture {Umbonula (Fig. 6, a)), differing from the condition found in Cribrilinidae only in the fact that the original spines are not dis- tinct from one another ; or the calcareous front wall is formed first and the sac is developed as an invagination (Fig. 6, o) from the

1 It appears probable that in most Lepralioid forms the calcareous front wall (upper in figures) is not arranged as in Fig. 3 (c, D ?) and in Fig. 4 (c) ; but that it may (in some cases) correspond with the inner layer of the Cribrilina spines (Figs. 3. 4, b), the outer layer of which is then represented by a membranous layer known as the ” epitheca.”

region of the base of the operculum (^Lepralia, Schizoporella, Euthyris, Calwellia, &c.). This may be regarded as a modifica- tion in ontogeny of the phylogenetio history of the organ.

In certain Lepralioid forms (Microporella, Calwellia, &c.) the operculum becomes separated from the floor of the compensation- sac by a portion of the calcareous front wall (Figs. 3, 5, 6, d). The sac now opens to the exterior by the so-called “median pore ” (m.j).), which has probably been formed by the closure of the “sinus,” which receives a small, median, tongue-like projection of the proximal side of the operculum in such genera as Schizoporella (Fig. 6, b). It remains to be seen whether all forms which possess this arrangement are really related, or whether the median pore has been evolved independently in several cases.

The development of the compensation-sac can be studied in the young zooBcia which are formed at the margins of a growing colony. The primary individual (” ancestmla,” JuUien), formed by the metamorphosis of the larva, commonly shows characters different to those of the other zocecia, and confirming the views above suggested.

...op.

-m.p

Fio. 6.â€” A, Umbonida verrucosa, at an early stage of its calcification ; a calcare- ous wall is overarching a Membranipora-like aperture (cf Kg. 5), into which the parietal muscles are inserted; b, Schieoporella, showing the “sinuate” operculum (op.) ; the compensation-sac opens at the sinus, and is attached to the wall of the zocecium by parietal muscles ; c, a voung zooecium of Lepralia pallasiana ; the front wall (not shown) is completely calcified ; the compen- sation-sac, from

which the parietal muscles radiate, is still small ; n. Cal- wellia siticlairii, showing the compensation-sac opening by the median pore im.p.).

It results from an examination of the compensation-sac that many of the existing divisions of the Cheilostomata are unnatural. This applies particularly to the so-called Cellularina, an assemblage of erect and branching forms, of delicate habit. Some of these, such as the Bicellariidae, are quite MemhranipororVikQ in the character of their front wall and in the arrangement of their parietal muscles. Others, such as the genera Catenicella, Calwellia, Ich- thyaria, Urceolipora, &c., are Lepralioid forms with a completely calcareous front wall and a typical compen- sation-sac.

In the Microporidae and Steganoporellidae, and perhaps in many of the Lepralioid Cheilostomata, the body-cavity is partially subdivided by a calcareous lamina (" cryptocyst," JuUien) which grows from the proximal side, parallel

to the opercular wall, which remains membranous. The parietal muscles are here reduced to a single distal pair, which may pass through foramina (" opesiules," Jullien) to reach their insertion into the aperture.

The determination of the recent marine Polyzoahas been greatly facilitated by the publication of Miss Jelly's Synonymic Catalogue. Bibliographies of recent and fossil Polyzoa have been published by Vine {Brit. Assoc. Beps., 1880-85, 1890, 1892), and by Niokles and Bassler {Bull. U.S. Geol. Survey, No. 173, 1900). Important work on recent marine Polyzoa has been done by Hinks, Waters, MacGillivray, Levinsen, and others. The most complete classifica- tion of recent marine forms is that given by MacGillivray {Proc. Soc. Victoria, xxiii. p. 187), but the works of Vine and of Delage and H^rouard {Traite de Zoologie Concrete, vol. v. Paris, 1897) will also be found specially

helpful. The fossil forms have been studied by Gregory, Pergens, Waters, Neviani, and others. The English edition of Zittel's Palaeontology contains an elaborate account of them by E. O. Ulrich, who accepts the sub-orders Trepostomata (Ulrich, J. Cincinnati Soc. v. p. 151) and Cktp- TOSTOMATA (Shrubsolc and Vine, J. Geol. Soc. xxxviii., Proceed- ings, p. 245) in addition to the three sub-orders under which the recent forms are classified. In addition to the references already given, the reader may consult Gregory. Catalogue of the Pnssil Bryozoa in the British Museum. "Jurassic Bryozoa," 189B ; "Cretaceous Bryozoa," i. 1899. â€" Harmeh. Cambridge Nat. History, \i. "Polyzoa," London, 1896. â€" Simpson. "Handbookof the Genera of the North American Palaeozoic Bryozoa," Beport State Geologist New York, for 1894.

[An important memoir by Calvet on the structure, budding, and development of marine Ectoprocta wUl be found in 'Trav. Inst. Zool. Montpellier, No. 8.] (s. f. h.)

Pomerania, a northern province of Prussia, with an area of 11^628 square miles and population of 1,634,832 (1900). In 1897, 3600 acres were planted with tobacco, and the yield was valued at Â£85,600. In 1900 the live stock embraced 1,296,832 sheep, 936,043 pigs, 685,609 cattle, and 213,637 horses. The iron foundries produced 9724 tons of materials, valued at Â£87,300 in 1897 ; and in 1899-1900 the sugar factories produced 89,192 tons of sugar ; the breweries, 18,766,000 gallons of beer ; and the distilleries, 9,123,400 gallons of pure alcohol. In 1899 the mercantile marine of the province numbered 366 sea-going vessels of 82,623 tons, of which 124 of 66,979 tons were steamboats. The principal ports are Stettin, Swinemilnde, Stralsund, Stolpmilnde, and Sassnitz. The province possesses a length of 1128 miles of railway,

Pomona, a city of Los Angeles county, California, U.S.A., east of Los Angeles, on the Southern California (Atchison, Topeka, and Santa Fe) and the Southern Pacific railways, in the southern part of the state. The surrounding country is devoted to the culture of sub- tropical fruits, for which Pomona serves as a shipping point. Population (1900), 6626.

Ponce, town on the south coast of Porto Kico, 60 miles south-west of San Juan. It is the largest com- mercial place in the island, and was founded in 1752, and is second to San Juan in population, having in 1899 27,952 inhabitants. It consists of two parts. Ponce and Ponce Playa. Ponce, the residence and business portion, is situated at the interior margin of a beautiful plain, where the latter meets the foot-hills. It has a handsome plaza, hospitals, municipal hall, barracks, and other public buildings. There are medicinal springs and baths. Ponce Playa is the seaport. It is two miles from Ponce, and Lies on a spacious bay. The custom-house, shipping offices, and wholesale stores are situated at Playa. An electric railway connects the city and port. A short line of railway runs from Ponce to Yauco to the west, and good highways extend to San Juan, 80 miles, and to Guayama, about 44 miles.

Ponchielli, Amilcare (1834-1886), Italian musical composer, was born near Cremona on 1st Sep-

tember 1834. He studied at the Milan Conservatoire. His first dramatic work written in collaboration with two other composers, was II Sindaco Babbeo (1861). After completing his studies at Milan he returned to Cremona, where his opera I Promessi Sposi was produced in 1856. This was followed by La Savojarda (1861, produced in a revised version as Lma in 1877), Roderigo, R& dei Goti (1864), and La Stella del Monte (1867). A revised version of I Promessi Sposi, which was produced at Milan in 1872, was his first genuine success. After this came a ballet, Le due Qemelle (1873), and an opera, I Lituani (1874, produced in a revised version as Alduna in 1884). Pon- chielli reached the zenith of his fame with La Oioconda (1876), written to a libretto founded by Arrigo Boito upon Victor Hugo's tragedy, Angela, Tyran de Padoue. La Gioconda was followed by 11 Figliuol Prodigo (1880) and Marion Delorme (1885). Among his less important works are II Parlatore Eterno, a musical farce (1873), and a ballet, Clarina (1873). In 1881 Ponchielli was made maestro di cappella of Piacenza Cathedral. His music shows the influence of Verdi, but at its best it has a distinct value of its own, and an inexhaustible flow of typically Italian melody. His fondness for fanciful figures in his accompaniments has

been slavishly imitated by Mascagni, Leoncavallo, and many of their contem- poraries. Ponchielli died at Milan on 17th January 1886.

Pondicherry, the capital of the French posses- sions in India, is situated on the Coromandel or western coast, about 100 miles south of Madras. The territory, which is entirely surrounded by the British district of South Arcot, has an area of 115 square miles, with a population of 182,000. The chief crops are dry grains, rice, earth-nuts, and a little indigo. It is traversed by a branch of the South Indian railway from VHlupuram (24 miles). The town has a population of about 50,000. It has an open roadstead, with a small iron pier. In 1900-01 the total seaborne trade was valued at 13,257,116 francs, of which 8,329,013 francs consisted of exports, chiefly cotton manufacliures, earth-nuts, cleaned rice, and hides. The principal imports were betel-nuts, cotton manufactures, wines and liqueurs, and oils. Of the export trade more than half was with Prance, but of the import trade only one-fourth. During 1900 the number of British vessels that called was 204, with an aggregate tonnage of 312,488 tons. A cotton mill has recently been opened by a company with a capital of Â£200,000. In 1900 there were altogether 4 mills, with 1144 looms and 71,432 spindles, employing 2628 persons.

Pondoland. See Cape Colony.

Pont-a-Mousson, town, arrondissement of Nancy, department of Meurthe-et-jMoselle, on the river Moselle, 17 miles north-north-west of Nancy by rail. It is of considerable antiquarian interest, and has a library, three hospitals, engineering workshops, blast furnaces, and manufactures of lacquered ware, paper, cardboard, calDles, and electrical apparatus. Population (1901), 12,847.

Pontarlier, a fortified town and chief town of arrondissement, department of Doubs, France, 37 miles south-east of Besan^on, on the railway from Dijon to Berne. It forms a very important strategic point at the mouth of the Cluse, one of the principal passes across the Jura. It was here that the French army of the east made its last stand against the Prussians in 1871, in order to cover the retreat of the main army into Switzerland. The distilla- tion of herbs, extensively cultivated for

absinthe, gentian, kirsch, and liqueurs, occupies several establishments. The town has considerable commerce with Switzerlandiu spirits and agricultural produce, &c. Population (1901), 8031.

PONT AFDEME E â€” P 0 N” T 0 0 N

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Pont Audemer, chief town of arrondissement, de- partment of Eure, France, 43 miles north-west of Evreux, on the Risle, a left-bank affluent of the Seine, and on the railway from Evreux to Honfleur. The churches of St Ouen and St Germain date in part respectively from the 11th and the 12th centuries. Local institutions are a hospital, chamber and tribunal of commerce, and small public library. Manufacturing industry is very active, and includes the founding of malleable metal, a large spur factory, and various important branches of leather manu- facture. There is considerable trade in flax, wool, grain, cattle, cider, paper, iron, wood, and coal. The port has a length of about half a mile on the Risle, navigable to this point. It is bordered by quays for 450 yards, and vessels drawing 6^ to 9^ feet of water are towed up by horses from Koque, 17 miles below. Population (1901), 5908.

Pontefract, a municipal and parliamentary borough (since 1885 returning only one member) and market- town of Yorkshire, England, 13 miles south-east of Leeds by rail. An isolation hospital was erected in 1900, costing Â£9000. ISTew waterworks have been con- structed by the corporation at a distance of 8 miles from the town at a cost of Â£30,000. Population (1881), 8798 ;

(1901), 13,422.

Pontevedra, an Atlantic province of Spain; area, 1739 square miles; population (1897), 447,612; death- rate 2-38 per cent. ; birth-rate 2-66 per cent. Ifis divided into 11 districts and 66 parishes.

Much “business is done at the great fairs held at several towns, where the country folk bring in live stock, poaltry, and dairy pro- duce. The foreign trade is considerahle. The exports are cattle to England and

Portugal, hams, salt meat and fish, eggs, bread- stuffs, leather, wine. Vigo, Carril, Marin, Villagarcia, Bayona are the principal ports. In 1898 wheat was grown on 5865 acres ; rye, oats, barley, and maize on 249,527 acres ; pod fruit and beans on 88,635 ; vines on 13,022 ; live stock included 3928 horses, 1282 mules, 623 asses, 73,531 cattle, 42,201 sheep, 14,840 goats, and 32,581 pigs. The mines are not important.

Pontevedra, capital of the above province, near the coast, on the river Lerez, here spanned by a bridge of twelve arches. The country around produces wheat, wine, and fruit. It is a station on the Monforte-Vigo railway. The institute and primary schools are well attended. The town contains many convents, some of which have been turned into public buildings, refuges, hospitals, schools. Some of the modern provincial and municipal buildings are very handsome. Population (1897), 19,986.

Pontiac, a city of Michigan, U.S.A., capital of Oak- land county, on the Clinton river, and the Grand Trunk and the Pontiac, Oxford, and Northern railways, in the south-eastern part of the state, at an altitude of 932 feet. It is surrounded by many small lakes and ponds, which have become well-known resorts for sportsmen. The city is the site of the Eastern Michigan insane asylum. Popu- lation (1880), 4609 ; (1890), 6200 ; (1900), 9769, of whom 2020 were foreign-born and 161 negroes.

Pontivy, formerly I^apolbonvillb, chief town of arrondissement, department of Morbihan, Erance, 32 miles north-north-west of Vannes, on the Blavet. 'The town comprises two distinct parts : that built by order of Napoleon I., who desired to make it the military head-quarters for Bretagne, and consisting chiefly of barracks, subsequently gave name to the whole town, but in 1871 the former name was resumed. The ancient castle of the dukes of Eohan, built in 1486, is now occupied by the Musee Le Brigant of art and archaeology. A monument to commemorate the Breton-Angevin Union was erected in 1894, and there are statues of Dr Guepin, a Democrat, and General de Lourmel (d. 1854). Population (1881),

5720 ; (1901), 9369.

Pontoon. â€” The pontoon equipments of European armies have undergone few changes in recent years. In the British army Colonel Blood's equipment has been modified by the introduction of a bipartite pontoon de- signed in 1889 by Lieut. Clauson, R.E.

Each pontoon is carried on one waggon with a bay of super- straoture, and consists of two sections, a bow-piece and a stern- piece, connected together by easily manipulated couplings of phosphor bronze. Decks and "coamings" are dispensed with, and the rowlock holes are sunk in a strong gunwale. The detach- able saddle-beam, which receives the load on the centre of the thwarts, is made in sections, so as to form a continuous saddle of any length required. The baulks (or road-bearers) and chesses (or planlis) remain unaltered, but chess-holders and chess-bearers are added for use in constructing light bridges for infantry in file. In this kind of bridge each pontoon section is used separately, with a roadway of chesses placed longitudinally four abreast. In the normal or medium bridge two sections, and in heavy bridge three sections, are joined together. The chief advantages of the equipment are (1) the buoyancy of the piers can be proportioned to the weight of traffic and to the roughness of the water ; (2) owing to the special design of the bows, boats and rafts are easy to row, while the pontoons in bridge oppose little resistance to the current, and so require less anchor power ; (3) transport rafts, pier-heads, and flying bridges can be constructed with great ease, owing to the flush gunwales on which baulks can rest if necessary ; (4) the pontoon sections are convenient to handle, easy to ship or to transport by rail, and can readily be replaced singly if damaged in bridge. A canoe pontoon and superstructure adapted for pack transport has also been adopted from designs by Colonel Elliott Wood, C.B., R.E. The pontoon consists of four sections laced together, each section being a framework of wood covered with waterproof-sheeting. Three pontoons and eight composite planks form a "unit," from which can be constructed 48 feet of bridge for infantry in file, 84 feet for infantry in single file, or a raft to carry 15 men or an empty waggon. The Indian demi-pontoon is of the same length (22 feet) as the Blood pontoon, but is sheathed with copper. It has a square stem, to enable it to be used in pairs. The Chitral Belief Expedition, 1895, brought to light some defects in this pontoon. The shape of the bows

proved unsuited to rapid currents, the balance was unsatisfactory, and cracks developed in the copper sheathing. Experiments have been made with bipartite pontoons.

The Erench pontoon is a somewhat cumbrous wooden boat. The German army is equipped with a galvan- ized iron pontoon in one piece, handy as a boat, but of insuflcient buoyancy to form a satisfactory bridge sup- port, as the spans have to be unduly diminished for heavy- traffic, and the waterway is consequently obstructed. The Bavarian equipment has been improved ; it approximates to the Austrian type. Aluminium pontoons have been tried in Germany, but have not been adopted. Eor the German cavalry the Berthon folding-boat equipment has been introduced. Each regiment has a waggon carrying suffi- cient equipment to form a road-bridge 26 feet long, a foot-bridge 65 feet long, or a raft capable of ferrying a field gun and limber, 46 sets of saddlery and kits, or 26 equipped infantrymen. In Austria, repea.ted but unsuc- cessful efforts have been made to reduce the weight of the Birago pontoon sections stiU in use, by the substitution of steel for iron. The Russian pontoon, of Birago type, with sheer sides, and the heavy wooden boat of the Italian equipment, have not been modified.

The methods of constructing pontoon bridges have been simpli- fied of late years in most armies, and are usually restricted to (1) adding pontoons one by one to the head of the bridge ; (2) con- necting rafts of two or more pontoons into bridge by intermediate bays of superstructure ; and (3) swinging across the river a bridge previously prepared alongside the shore. The formation of a bridge from rafts touching one another consumes an excessive amount of equipment, and opposes unnecessary resistance to the stream ; it is therefore being discarded in most armies. “Booming out” the bridge bay by bay from the shore untU the head reaches the opposite bank is unsuited for rapid currents, and is almost obsolete except for light infantry bridges.

The organization of bridging personnel in difierent armies shows as much divergence of opinion as the design of pontoon equipment. In the British army a pontoon troop, R.E., is included in the corps engineers

of each army corps, with a war establishment of 5 officers, 81 dismounted men, 132 mounted men, and 186 horses.

In peace the pontoon troops constitute an administrative unit called the bridging battalion, with an establishment of 197 all ranks and 70 horses. A pontoon troop can make 185 yards of light bridge, 105 yards of normal, or 75 yards of heavy bridge. Each of the four field companies R.E. in an army corps can make 25 yards of light, 15 yards of normal, or 10 yards of heavy bridge, the equipment being of the same pattern as that of the pontoon troop. In France an important change was made in 1894, when the two pontoon regiments were transferred from the artillery to the engineers. In war these regiments furnish five army bridge trains, forming 280 yards of bridge each, besides supplying to each army corps a pontoon company with 140 yards of bridge. The requirements of divisions are met by an advanced guard bridge train (33 yards of bridge) carried on two waggons with each divisional company of sappers and miners. In the German army the pioneer company attached to each division can throw 47 yards of bridge. The corps pontoon train carries 133 yards of bridge, which is constructed by one of the pioneer companies of the army corps. The cavalry equipment has already been described. In Austria the pioneers are in charge of the pontoon equipment. Forty-five normal bridge trains, each carrying 58 yards of bridge, are at the disposal of army headquarters, and a light bridge train carrying the same length of bridge would usually be allotted to each army corps. In Russia half a pontoon battalion, carrying about 140 yards of bridge, is detailed to each army corps, and in addition the divisional sapper company has a light bridge train carrying 22 yards of bridge on six waggons. In Italy the pontoon companies provide eight army bridge trains (219 yards of bridge each), and the sapper company attached to each division carries 43 yards of bridge on six waggons.

See VoN Ripper, Europdischen Kriegsbriicken-Systeme, Vienna, 1896 ; and Instruction in Military Engineering, part iii.. Bridging, 1894. (j. E.

c.)

Pontremoll, a town and bishop's see of the province of Massa and Carrara, Tuscany, Italy, in the upper valley of the Magra, 20 miles north by east of Spezia. It has a 17th-century cathedral, a citadel, and an episcopal library. There are also mineral springs ; and the people quarry marble and polish it, as well as make lime and bricks. The town was an independent republic in the 12th and 13th centuries, and in 1495 was sacked by the troops of Charles. VIII. of France. Population (1899), 11,000.

Pontypool, a town in the northern parliamentary division of Monmouthshire, England, 8 miles north of Newport by rail. An electric lighting power company was formed in 1893 to supply the district with electric light. The market-house was opened in 1894, after a reconstruc- tion which cost Â£22,280, and a new cattle market was formed in 1899. A new recreation ground was opened in 1893. Population (1901), 6126.

Pontypridd, market-town, urban district, and par- ish in the eastern parliamentary division of Glamorgan- shire, Wales, on the Taff river, 12 miles south of Merthyr Tydfil by rail. A new town hall has been built over the market, and a free library erected. New gas works have been established, and a water reservoir to store 200,000,000 gallons was completed in 1900. Population (1891), 24,763 ;

(1901), 32,319.

Poole, a municipal borough, county in itself, seaport, and market-town in the eastern parliamentary division of Dorsetshire, England, 20 miles east of Dorchester on the South-Western railway. Modern erections are the free library and school of art; and the Cornelia Hospital. Poole Park, containing 40 acres of land and 62 acres of water, was acquired in 1887 and 1889, and Brankstone Park of 40 acres in 1896. Since 1885 the Poole corpora- tion has had power to regulate the oyster fisheries in the harbour, and 200 acres in the Wareham (Channel have been granted to a local company, under whose manage- ment the oyster beds are again productive. The harbour, which has a depth of only 8^ feet, is beset by shifting

sand-banks, through which there are only narrow channels. In 1888 the registered shipping totalled 42 vessels of 2257 tons; in 1900, 45 vessels of 2834 tons. In 1888, 1002

vessels of 87,299 tons entered and 984 of 83,567 tons cleared; in 1900, 1353 vessels of 156,399 tons entered and 1366 of 168,414 tons cleared. The total trade is valued at Â£130,000 annually. Area, 6333 acres. Popula- tion (1881), 12,310 ; (1891), 15,438 ; (1901), 19,461.

Poole, Reginald Stuart (1832-1895), English archaeologist and orientalist, was born in London, 27th January 1832. On his mother's side he was a nephew of E. W. Lane, the Arabic scholar, with whom he lived in Cairo from 1842 to 1849, thus imbibing an early taste for Egyptian antiquities. In 1852 he became an assistant in the British Museum, and was assigned to the department of coins and medals, of which in 1870 he became keeper. His work in that capacity was of the highest value, alike as a writer, teacher, and administrator. In 1882 he was largely responsible for founding the Egypt Exploration Fund, and in 1884 for starting the Society of English Medallists. He retired in 1893, and died on 8th Febru- ary 1895. Some of Poole's best work may be found in his articles for the Ency. Brit, (ninth ed.) on Egypt, Hieroglyphics, and Numismatics ; he also wrote for Smith's Dictionary of the Bible, and published several volumes dealing with his special subjects. He was for some time professor of archaeology at University College, London, and also lecturer at the Eoyal Academy.

Poona, or Puna, a city and .district of British India, in the Deccan division of Bombay. The city is on the right bank of the Muta river, 1850 feet above the sea; railway station, 119 miles from Bombay. Municipal area, about four square miles ; population (1881), 129,761 ; (1891), 161,390 ; (1901), 111,386, showing an increase of 24 per cent, between 1881 and 1891, but a decrease of 31 per cent, between 1891 and 1901. From its healthy situation, Poona has been chosen not only as the head- quarters of the Bombay army, but also as the residence of the Governor of Bombay during the rainy season, from July to November. The native town, along the river bank, is somewhat poorly built. The European quarter extends to the north-west as far as the cantonment of

Kirkee. The modern waterworks have been constructed mainly by the munificence of the late Sir Jamsetjee Jeejeebhoy. Poona was never a great centre of trade or manufacture. Two cot- ton mills, with 1250 looms and 33,000 spindles, employing 1000 hands ; a paper mill, employing 340 hands, with an out-turn valued at Rs.3,09,000 ; a brewery (at Dapuri) pro- ducing 800,000 gallons of beer ; two flour mills, with an out-turn valued at Rs.42,000 ; factories of ice and mineral waters; four dairy farms, furnish the chief industries. Educational institutions are numerous, but their statistics since 1896 have been vitiated by the prevalence of the plague. They include the Government Deccan College, ~~with a law class ; the aided Fergusson College ; the un~~ aided Maharashtra College ; the Government college of science, with agricultural and forest classes ; seven high schools; training schools for masters and mistresses; medical school ; municipal technical school ; and several schools for European boys and girls. There are altogether forty-three printing-presses, including those belonging to Government departments, which issue two English and a large number of vernacular newspapers. Since 1896 the history of Poona has been painfully associated with the plague. Down to July 1898 the total number of cases of plague reported in I'oona city was 9362, and the number of deaths was 6967. During 1897 the death-rate rose to 93 per thousand in Poona city, 71 per thousand in the cantonment, and 93 per thousand in Kirkee.

The district of Poona has an area of 5369 square miles; population (1881), 901,828; (1891), 1,007,800; (1901), 996,074, showing an increase of 18 per cent, after the disastrous famine

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of 1876-77, but a decrease of nearly 7 per cent, between 1891 and 1901 ; average density, 185 persons per square mile. Land revenue and rates, Rs. 19,32,44,3, the incidence of assessment being R.0-10-3 per acre ; cultivated area (1897-98), 1,860,195 acres, of which 142,948 were irrigated, including 54,492 from Government canals ; number of police, 1210 ; children at school (1897-98), 20,699, being 2 per cent, of the total

population. The principal crops are millet, pulse, oilseeds, and wheat. The two most important irrigation works in the Deccan are the Mutha canal, vfith which the Poona waterworks are connected, and the Nira canal. The total capital outlay on the former has been Es.66,00,979 ; in 1897-98 the gross receipts were Rs.2,34,211 and the expenditure Rs.79,818, showing a profit of 2-34 per cent. The capital outlay on the latter has been Rs.56,71,000 ; in 1897-98 the gross receipts were Rs. 1,35,705 and the expenditure Es.61,694, showing a profit of 1-30 per cent. There are manufactures of cotton, silk, and blankets. The district is traversed for 106 miles by the Great Indian Peninsula railway, and also by the Southern Mahratta line, which starts from Poona city towards Satara. It is liable to drought, from which it suffered severely in 1866-67, 1876-77, and again in 1896-97. (j. s. Co.)

Poor Laws. â€" The chief difficulty in iinderstanding the English poor law arises from the fact that there are three authorities, each of them able to alter its administra- tion fundamentally. Few statutes relating to the poor law have been repealed, and the need of consolidation is very generally admitted. The poor law, however, is not only the creation of statutes passed by Parliament ; it is also controlled by the subordinate jurisdiction of the Local Government Board, which in virtue of various Acts has the power to issue Orders. The Board possesses great facility for consolidating its Orders, and probably all that is here possible has been done. A third source of authority is the local board of guardians, which,' within the discre- tion allowed to it by Statutes and Orders, can so variously administer the law that it is difficult to understand how procedure so fundamentally different can be based on one and the same law. This elasticity, admirable or mischievous, as we choose to regard it, is the most charac- teristic feature of the English poor-law system, and a supplementary note in illustration of its working during the closing years of the 19th century will give a better idea of the public policy in this respect than an elaborate analysis of statutes.

I. Legislation. â€" The burden of pauperism was in 1834 so heavy that England hardened its heart to perform a very drastic act of social surgery. The Poor Law Amendment Act, 1834, checked the growth of pauper- ism. Relatively to the wealth and population of the country,

pauperism has never since that date been an overwhelming burden. Apprehension was allayed, and a certain humanitarian reaction against the strict theory which underlies the Act of 1834 set in almost at once. Up to 1869 the local administrative bodies, with few exceptions, although in self-defence they applied the provisions of the Act, never embraced its principles with enthusiasm. About 1869, owing to a variety of causes (e.g,, the influence and example of men like Ed- ward Denison, followed as a result by Mr Goschen's cir- cular of 20th November 1869 and Mr Eaweett's book on Pauperism, published in 1871), a deeper theoretical interest was aroused, and several boards of guardians adopted (as recommended in these and other treatises) a stricter administration of outdoor relief. The burden, it wais argued, might no longer be intolerable to the rate- payer, but the dependence of the pauper was a cruelty to himself, and a firm policy, tending to infuse a spirit of independence into the pauper population, was the truest philanthropy. Thoroughgoing support to this policy has been confined to a few unions, but some advance in this direction has been well-nigh universal. A reduction of pauperism from 47-1 per 1000 of population in 1871 to 21-9 in 1900 (see Monthly Statement of Pauperism, March 1900) is a solid achievement. The improvement, how-

ever (so at least advocates of the principles of 1834 argue), is much less marked than it might have been had the policy of 1834 been frankly adopted. This belief in the emancipating effect of a stricter policy has not had much weight with the legislature, and effort has chiefly been directed to secure the comfort rather than the emancipation of the pauper. Legislative changes, indeed, with regard to the actual administration of the law, have not during the period under review been numerous or important.

The first Act to be noticed in this connexion is the Medical Relief Disqualification Removal Act, 1885, passed by Lord Salis- bury's Government. This Act relieves voters from disqualification which would otherwise attach in consequence of the receipt by them or their families of medical or surgical assistance, or of medicine, at the expense of the poor rate. This does not apply to guardian elections, and it does not include persons who, in addition to medical relief, receive

nourishment or other relief from the poor rate. The provisions which require the removal of the names of paupers from the electoral roll are, it is understood, very perfunctorily carried out. The Outdoor Relief Friendly Societies Act, 1894, authorizes guardians, in calculating the proper allowance to be made, to disregard an income derived from a friendly society, and to give relief as if the applicant in receipt of such an allowance was wholly destitute. This Act is a curious illustration of the English poor-law system. In earlier years, notably in what is known as Paget's letter (22 Rep. Poor Law Board, p. 108), the Central Board had, in answer to inquiry, pointed out that such preferential treatment given to men receiving benefit, in- sufficient to maintain them, from a friendly society, could not in equity be withheld from persons in receipt of an adequate benefit, or from those whose savings took the form of a deposit in a bank, of a share in a co-operative society, or of cottage property ; and further, that an engagement on the part of guardians to supple- ment insufficient allowance from a friendly society was a bounty on inadequate and insolvent friendly society finance. The Central Board went so far as to say that relief given in such dis- regard of the pauper's income was illegal. They had, however, issued no peremptory order on the subject, nor had guardians been surcharged for neglect of the rule. The local authorities followed their own discretion, and a very general practice was to reckon friendly society allowances at half their value. The above Act sets aside the Central Board's earlier interpretation of the law. It makes, however, no attempt to enforce its procedure on the numerous boards of guardians who regard the course thereby authorized as contrary to public policy.

The period under review has also seen the passage of several Acts designed to secure a more effective treatment of lunatics and children. The Lunacy Act of 1890 is a consolidation of the Acts affecting lunatics. It is further amended by the Lunacy Act, 1891. An explanatory letter issued by the Local Government Board will' be found in the 20th Annual Report, p. 33. The tendency of this and of all recent legislation for an afflicted class is to increase the care and the safeguards for their proper treatment. The same desire to improve administrative methods for the rescue of the helpless is shown in the Poor Law Act, 1889, and in the Custody of Children Act, 1891 , sect. 8. The evil of allowing

children who have been reputably brought up in poor-law schools to relapse into vicious habits on return to the custody of unworthy parents, has been the subject of frequent remark. By the Act of 1889, guardians are authorized to detain children who are under their charge, as having been deserted by their parents, up to the age of 16 if boys and of 18 if girls. By the Poor Law Act, 1899, the principle is extended to orphans and the children of bad parents chargeable to the rates. The Act of 1891 goes farther, and enacts that where a parent has (a) abandoned or deserted his child, or (6) allowed his child to be brought up by another person at that person's expense, or by the guardians of a poor-law union for such a length of time and in such circumstances as to satisfy the Court that the parent was unmindful of his parental duties, the Court shall not make an order for the delivery of the child to the parent unless the parent has satisfied the Court that, having regard to the welfare of the child, he is a fit person to have the custody of the child.

Some important readjustments of the burden of local expendi- ture have next to be noticed. The system of making grants from the national taxes in aid of local rates has proceeded to consider- able lengths. The article in the ninth edition of the Ency. Brit. notices the institution of the Metropolitan Common Poor Fund, a device for giving metropolitan grants assessed on the whole of London in aid of the London local poor-law authorities. The same principle, mutatis mutandis, is also followed in the relations which now obtain between the national and the local exchequers.

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At the time of the repeal of the Corn Laws, Sir R. Peel expressed an opinion that this fiscal change necessitated some readjustment of local rates. In that year, 1846, a beginning of grants from the national exchequer in aid of local expenditure was made. The salaries of poor-law teachers, medical officers, and auditors were provided from the

larger area of taxation, and in 1867 the salaries of public vaccinators were added to the list. In 1874 a grant of 4s. per head per week was made for each pauper lunatic passcc' 'cy the guardians to the care of a lunatic asylum. By the Local Government Act, 1888, supplemented by the Local Taxation (Customs and Excise) Act, 1890, this principle was more widely extended. The various grants in aid were abolished, and in substitution the proceeds of certain specified taxes (i.e., additional beer and spirit duties, (a) customs and (&) excise ; excise licences, share of the probate, now termed the estate duty) were set aside for local purposes. From this source, the gross amount of which of course varies, there are now distributed to local poor-law author- ities 4s. a week for lunatics in asylums, and allowances based on their average expenditure in previous years in salaries of offi- cials and other specified charges. In London, in order not to con- flict with the operation of the Common Poor Fund, which had already spread these charges over a wide area, the grant takes the form of a sura equivalent to 4d. per diem for each indoor pauper. The number on which this calculation is based is not, however, to be the actual number, but the average of the last five years previous to the passing of the Act. By this legislation something like one- quarter of the total expenditure on poor-law relief is obtained from national taxes as opposed to local rates. By the Agricultural Rates Act, 1896, enacted for a period of five years, the occupier of agricultural land is excused one-half of certain rates, including the poor rate. The deficiency is supplied by a contribution from the National Exchequer. Meanwhile, the spending authority con- tinues to be elected by the local ratepayers. In this connexion two further anomalies deserve notice. By the Poor Rate Assess- ment and Collection Act, 1869, owners who compound to pay the rates in respect of tenement property are entitled to certain de- ductions by way of commission. Such payments by the owner are constructively payments by the occupier, who thereby is to be deemed duly rated for any qualification or franchise. Under these arrangements a large number of electors do not contribute directly to the rate. A converse process is also going on, whereby the ownership of an important and increasing body of property is prac- tically unrepresented. This is due to the great growth of property in the hands of railway companies, docks, and limited liability companies generally. The railways alone are said to pay 13 per

cent, of the local taxation of the country, and they have no local representation. There is, in fact, in local administration a divorce between representation and taxation to a greater extent than is generally supposed, and it is impossible not to connect the fact with the rapid growth of local expenditure and indebtedness.

The Local Government Act, 1894, did away with ex officio and nominated guardians. The plural vote (which gave to the votes of the larger ratepayers a higher value) was also abolished ; and in place of the old property quahfication for the office of guardian, a ratepaying or residential qualification was substituted. In urban districts the Act in other respects left the board of guardians untouched, but in rural districts it inaugurated a policy of con- solidating local authorities which is capable of further extension . In the rural districts the district council is practically amalgamated with the guardians, for, though each body retains a separate cor- porate existence, the district councillors are the guardians, and guardians as such are no longer elected. These electoral changes, extremely democratic in their character, have not brought about any marked general change in poor-law administration. Here and there abrupt changes of policy have been made, but the difficulty of bringing general principles to bear on the administration of the law remains much as before. Two statutes important to the official staff of the guardians may be mentioned â€" the Poor Law Officers' Superannuation Act, 1896, and the Poor Law Officers' Superannuation Act Amendment Act, 1897. The Poor Law Act, 1897, is a consolidating and amending Act on the important question of the repayment of loans. This Act, together with the Poor Law Act, 1889, which it partially repeals, are the principal statutes governing the question. With the sanction of the Local Govern- ment Board, guardians may borrow, and repay in a period not to exceed sixty years ; such loans are not to exceed one-fourth of the total annual rateable value of the union.

II. Passing to the svbordinate jurisdiction of the Local Government Board, we may notice that in the year ending 31st March 1899 over eighteen hundred Orders were issued by the Board, over one thousand

of them having special reference to the poor law. It is not possible, therefore even to summarize this mass of subordinate legislation!

The Orders and circulars (these last are hardly less im- portant) quoted below are mentioned merely as illustrar tions.

Several circulars and Orders with reference to the detention of casual paupers have been issued since 1885. These are summed up in the General Order, 11th June 1892. Its general purpose is to mitigate the severity which might seem authorized by the pro- visions of the Pauper Inmate Discharge Act of 1871 and the Casual Poor Act, 1882. By this order the guardians are called on to use a reasonable latitude in allowing the departure of the casual pauper who professes to be in search of work. Against this we have to set a circular letter of 25th February 1896, calling atten- tion to the increase of vagrancy, and stating that ” there appeared to be reason for considering that this increase was to a considerable extent not unconnected with a failure on the part of boards of guardians to enforce the provisions of the Pauper Inmate Discharge and Regulation Act, 1871, as amended by the Casual Poor Act, 1882 ; and of the regulations of the Board.” On inquiry, the Board found that ” in a large proportion of unions ” the deterrent regular tions authorized by these Acts had been neglected.

The earlier years of the period were years of commercial de- pression, and the boards of guardians throughout England were much exercised as to the best means of dealing with the “unem- ployed.” On the 15th March 1886 an important circular was issued from the Local Government Board. It states that while ‘ ‘ the Board have no doubt that the powers which the guardians possess are fully sufficient to enable them to deal with ordinary pauperism, and to meet the demand for relief from the classes who usually seek it,” yet “these provisions do not in all cases meet the emergency. What is required to relieve artisans and others who have hitherto avoided poor-law assistance, and who are temporarily deprived of employment, isâ€” (1) Work which will not involve the stigma of pauperism ; (2) work which all can perform, whatever may have been their previous occupations ; (3) work which does not compete with that of other labourers at present in employ-

ment ; and lastly, work which is not likely to interfere with the resumption of regular employment in their own trades by those who seek it."

The circular goes on to recommend that guardians should confer with the local authorities, "and endeavour to arrange with the lat- ter for the execution of works on which unskilled labour may be immediately employed. " The conditions of such work were (1) the men to be employed must be recommended by the guardians ; (2) the wages must be less than the wages ordinarily paid for such work.

The circular was widely distributed. Many boards that were inclined in that direction regarded it as an encouragement to open or to promote the opening of relief works. Others, again, looked closely at the conditions, and declared roundly that it was impos- sible to fulfil them. A poor-law authority, they said, cannot give relief which will not subject the recipients to the legal (if any) and economic disabilities attaching to the receipt of poor-law relief. Work which all can perform can only be found in the shape of task- work under adequate supervision. If the work is of a useful and necessary character, it must compete with the labour of others be- longing to the trades affected. If the relief works are opened by authorities other than the poor-law guardians, the conditions that the men were only to be employed when recommended by the guardians, and then paid less than the current rate of wages, were calculated, it was urged, to secure bad work, discontent, and all the " stigma of pauperism." The ambiguity of the circular indeed is such, that both action and inaction, as presently to be described, seem amply justified by it.

Two important Orders on the subject of the boarding out of poor- law children were issued in 1889. By the Boarding of Children in Unions Order, orphan and deserted children can be boarded out with suitable foster-parents in the union by all boards of guardians except those in the metropolis. This can be done either through a voluntary committee or directly. By the Boarding Out Order, orphan and deserted children may be boarded out by all boards of guardians without the limits of their own unions, but in all cases this must be done through the offices

of properly constituted local Boarding-Out Committees. The sum payable to the foster-parents is not to exceed 4s. per week for each child. The local committee require to be approved by the Local Government Board.

The question of the education of poor-law children has been ranch discussed of late years. During the early years of the Central Authority, it was the object of the Commissioners to mduoe boards of guardians to unite in Districts for educational purposes. This was advocated on grounds of efficiency and economy. It was very unpopular with the local authorities, and the number of such districts has never exceeded a dozen. In London, where this aggregation was certainly less desirable than m rural unions, several districts were formed and large dis- trict schools were built. Adverse criticism, by Mrs Nassau Senior

in 1874, and by a departmental committee appointed twenty years later, has been directed against these large, or, as they are in- vidiously called, barrack schools. The justice of this condemnation has been disputed, but it seems probable that some of these schools had grown too large. One of the districts was dissolved by order of the Local Government Board on the application of the unions concerned, and others were in 1900 in course of dissolution. This condemnation of some schools has in certain quarters been extended to all schools, and is construed by others as an unqualified recom- mendation of boarding out, a method of bringing up poor-law children obviously requiring even more careful supervision than is needed in the publicity of a school.

The classification of children apart from adult paupers is per- emptory. Even in those unions where what is called a Workhouse School is maintained, the children are kept in detached parts of the building, and do not associate with the adult paupers. The Separate School is built on a separate and often distant site. Some- times the separate school is one building, sometimes Detached ” Blocks,” and sometimes a group of

Cottage Homes. There still re- main ten District Schools. In Sheffield and other places an experi- ment which is called the Scattered Homes system has been adopted. This consists in lodging-homes for the children placed in different parts of the town, from which the children attend the local public elementary schools. In the rural districts and in less populous unions the children generally attend the local public elementary school. To these expedients Boarding-out must be added. The above refers of course only to those children who as inmates are under the charge of the guardians. Outdoor paupers are respon- sible for the education of their children, but guardians cannot legally continue outdoor relief if the children are not sent regularly to school.

Summary, for year ending Lady Day 1898, of the number of unions in which the children attend the different classes of schools : â€”

Class of School.

Poor-law schools â€” District schools Separate schools Workhouse schools . Schools of other unions

Public elementary schools Total .

Attended by the Children belong- ing to

28 unions

38

63

155 493

658

Average daily Number of Children.

6,811

10,230

3,531

20,572

A later return with regard to boarding out gives the number â€¢boarded out within the Union on 1st January 1899 as 5191, the number boarded out beyond the Union as 1896.

III. Local Administration. â€” The above recorded varia^ tions of the educational policy must to a certain extent be regarded as the result of differences of local administration, but as each system is supervised in considerable detail by the Local Government Board, they have been noticed in connexion with theOrders issued by the Central Authority. The administration of relief to the adult population affords a better instance of the strangely divergent methods in which the poor law is normally carried out in con- tiguous and similar areas. These differences of policy largely turn on the attitude taken by guardians towards outdoor relief. Both in town and country, since 1875, a few boards have practically discontinued to give outdoor relief â€” that is, relief to paupers at their own homes. Other boards have continued to give it lavishly. Between the two extremes almost every variety is to be found. The following table will illustrate the position. The figures are taken from the summer returns (a period less affected by weather conditions), at a date previous to the change of policy which arose from the above-mentioned discussions of 1869, and from returns for 1899.

For this comparison unions in proximity have been chosen. More striking contrast could be obtained by a wider selection (see Guardians' Guide, by an Official, p. 27). The motives which underlie these two entirely divergent methods of administration require careful consideration, if the current operation of the law is to be understood.

The strict or indoor policy is based on the belief that the more eligible the endowment of pauperism, the easier will

Two Town Unions.

S

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Name of Union.

Date.

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Total.

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Pauper

to ever}

**Whitechapel (East f London) **

July 1, 1870

974

3236

4210

18

July 1, 1899

1162

26

1188

62

**St Olave's (South f London) **

July 1, 1870

1320

3548

4868

20

July 1, 1899

2278

4120

6398

21

Two Country Unions

CO

S

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Name of Union.

Date.

Â§2

III

Total.

If

i^g

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t^

(k

Pm

One

Pauper

to ever)

Bradfield (Berks)

July 1, 1870

152

807

959

16

Do.

July 1, 1899

104

17

121

140

Hungerford (Berks) .

July 1, 1870

109

1049

1158

17

Hungerford and

Ramsbury (Berks)

July 1, 1899

61

395

456

39

be the descent into pauperism and the greater the reluct- ance to undergo the effort necessary for emancipation. The supporters of this policy also point with confidence to the expansive nature of the English industrial system, and they complain that the progress of the poorer population from the servile conditions of feudalism and pauperism (influences both historically and essentially closely related) is retarded and arrested by alavish poor-law administration. The offer of indoor maintenance, if strict and repressive, is also, they contend, adequate and humane. If hard cases arise, they should not be strained to make bad law, but should be dealt with by private charity or by voluntary agencies, a method of relief which has a less disturbing effect on the calculation and conduct of the poor. The opponents of this stricter system have had the great advantage of being the party in possession. They appear to believe less firmly in the possibility of a complete emancipation of the poorer class. Their principal desire is to relieve the

sufferer in the manner most agreeable to him. They persuade themselves that the general effect of this policy will not be detrimental to the general welfare. Or, if they admit a danger, they argue that progress is too dearly purchased by curtailment of a system of relief to which the poorer population has become habituated.

Two instances may be added to show how on abnormal occasions the widest variety of policy can be introduced, with the sanction apparently of one and the same set of statutes and orders. During the decade beginning in 1885 there was much complaint made on behalf of the unemployed. A large number of unions passed through the crisis without any relaxation of their procedure. Whitechapel, which may be again taken as typical, offered ” the house” to the able-bodied, as directed by the law. They obtained, but we believe made no use of, a special Order from the Local Government Board authorizing them to receive the able-bodied male head of a family into their workhouse and to relieve the family at their home ; after a short detention they were author- ized to let the man go out to look for work during the day, and to continue for a limited period the outdoor relief to the family.

They opened no labour-yard, and the crisis passed without any apparent pressure on the relief authorities. No large additional class found it necessary to become dependent, and no exceptional hardship, it is alleged, was imposed on the class which un- doubtedly would have availed itself of relief offered under more eligible conditions. Separated only by the Thames is the union of St Olave’s, containing a population industrially superior rather than inferior to the Whiteohapel population. London, it should be premissed, is administered under the Outdoor Relief Regulation Order, 1852, which permits the local board to open a labour-yard. Unions under the Prohibition Order, 1844, require the sanction of the Local Government Board. The St Olave’s board availed itself of this privilege, and, accepting with more enthusiasm than discrimination the recommendations of the circular of 15th March 1886, opened a labour-yard, gave relief at trade union

wages, and speedily attracted an enormous and unmanageable crowd. This policy reached a climax in the winter of 1894-95. The labour-yard was opened 7th January 1895, and remained open till the end of March. The guardians spent Â£18,000 in employing all applicants at stone-breaking, paying trade union wages. Each ton cost Â£7, as against 4s., which was said to be the market price. The labour-yard was largely monopolized by the worst characters, and the conditions of relief were thus rendered extremely distaste^ f ul to any respectable workman who was obliged to apply. Super- vision was so lax, that the men absented themselves till the hour of payment arrived. On the day before the yard was closed, presumably because the guardians thought it was no longer neces- sary, there were over 1000 men in attendance. No evil conse- quences are said to have followed the closing of this source of relief. The facts as above stated are derived from the evidence of the chairman of the board, given to the Committee on Distress from Want of Employment.

One other instance of the large discretion placed in the hands of the local administrator may be cited. In April of the year 1898 a strike affecting some 100,000 colliers took place in South Wales. The union of Merthyr found its workhouse full, and opened a labour-yard. The representatives of the employers, who were the principal ratepayers, objected to relief being given to workmen on strike ; being in a minority, they appear to have withdrawn from attendance at the board. The stone-yards were failures in two respects â€" they did not serve as tests of destitution, and each ton of stone broken involved a dead loss and seriously added to the cost of relief. The guardians accordingly closed the labour-yards, and gave relief on the plea of "sudden and urgent necessity," without calling on the able-bodied head of the family to enter the workhouse, and without subjecting him to the task of work. (See L. G. JB., 2Sth Annual Beport, p. 174.) One of the leading colliery companies took the matter into court, asking for an injunction to stop further relief to the colliers, and for a declaration as to the legality of relief given in such circumstances. On appeal, it was affirmed by the Master of the Rolls " that the payment by the defendants out of the poor rates of any money for setting to work or for the relief of able-bodied men, who were at the time able to obtain and perform work at

wages sufficient to support themselves and their wives and families (if any) , was unlawful. . . . But this declaration does not include relief given to or for the wives and children of such men." This judgment may be of less importance than at first sight appears. It leaves an enormous discretion in the hands of the local authority. A board of guardians favourably disposed to the employers, or determined to be neutral, would, as has frequently been done in similar cases, have exerted themselves to provide temporary work- house accommodation, a course of procedure which, all previous experience seems to show, would have enabled them to surmount the difficulty. Very few would have accepted the condition. On the other hand, even with the declaration of law as above quoted, a board of guardians determined to favour a strike can still do so by relieving the wives and families on terms which it is known will be readily accepted. Happily, such questions do not often arise, bat the incident and the declaration of the law which it called forth are both very characteristic of the elastic, not to say arbitrary, nature of local administration.

Authorities. â€" Sir G. Nicholls, K.C.B. A History of the English Poor Law, 2 vols. 1854. New edition with a supplemental volume, ISQd.^Eeporl, and Evidence ofBoyal Commission on Aged Foor, 1895 ; Do. of Select Committee of House of Commons on Distress from Want of Employment, 1895. â€" A valuable series of yearly reports from the Whitechapel Union. â€" Aschrott. Das Englische Armenwesen, 1886. Translated under title, Hie English Poor Law System, 1888. â€" Emile Chevallier. La Loides Pauvres p.t la Societe Anglaise, 1895. â€" W. Chance. The Better Administra- tion of the Poor Law, 1895 ; and Children under the Poor Law, 1897. â€" The publications of the Charity Organization Society : Reports of Poor-Law Conferences. For list of subjects discussed, see index to Beport of Central Conferences, 1896.â€" T. Mackat. Methods of Social Beform, ISdd.â€" The Organization of Charities. Report of

Congress at Chicago, 1894. â€" Miss G. Lubbock. Some Poor-Law Belief Questions. A compilation of arguments on controverted points of poor-law administration, 1895. â€" Guardians" Guide, by an Official, 1899 (a very valuable handbook). (t. m*.)

Pope, John (1822-1892), American soldier, was born at Louisville, Ky., 16th March 1822, and. graduated at the United States Military Academy in 1842. Brevetted for gallantry at Monterey and Buena Vista, he next made surveys over the Mexican frontier, and was commissioned a captain of engineers, 1st July 1856. In the political campaign of 1860 he earnestly espoused Lincoln's can- didacy, and was nearly court-martialled for his remarks. As brigadier-general of volunteers, 17th May 1861, he was placed in command of the Missouri military districts. He co-operated in 1862 with Admiral Foote's flotilla in the capture of New Madrid and Island No. 10, taking over 6000 prisoners. Promoted major-general of volun- teers, March 1862, he next united with General Halleck's combined armies in the capture of Corinth, 30th May. He was now summoned to the east and assigned to com- mand of the army of Virginia, while McClellan was at the Peninsula. Upon the latter's want of success the army of the Potomac was recalled to aid Pope's operations close to Washington ; but the new campaign was unfortunate, and culminated in the disastrous second battle of Bull Eun, 29th and 30th August ; and a few days later Pope resigned his command, and never again actively engaged at the seat of war. Controversy arose over the failure of these operations, which Pope himself imputed to the personal hostility of Generals McClellan and Pitz-John Porter, though not himself free from blame. He subse- quently commanded departments at the North-West and the Pacific ; was made major-general United States army, 26th October 1882 ; retired, 16th March 1886 ; and died at Sandusky, Ohio, 23rd September 1892.

Poperinghe, a town of Belgium, in the province of West Planders, 40 miles south-west of Bruges, with a station on the line from Ypres to Hazebrouck (Prance). The district around is covered with hop-gardens. Among the industries are the manufacture of woollen goods, tobacco, and tanning. Population (communal) (1880),

11,007; (1900), 11,124.

Population. ^The total population of the world continues to be very largely a matter of rough approxi- mation, though every decade brings

a certain diminution of the field of conjecture, as some form of civilized ad- ministration is extended over the more backward tracts. In the following table the results of the most recent cen- sus and estimates are compared with those given in 1882, the proportion of guesswork being indicated against both population and area.

Table I.

Population, In Thousands.

Square Miles, in Thousands.

Oc

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ISS'2.

1900.

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1900.

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la la

Europe

327,748

898,022

1-6

8,765

8,788

8-8

104

Asia .

795,591

874,2^2

68-0

17,208

15,806

44-4

65

Afi-Ica

206,828

164,819

37-9

11,618

11,300

98-4

14

America

100,416

146,661

7-2

14,851

15,477

20-1

9

Oceania . Totali

4,282

5,652

16-6

8,456

8,446

9-9

1-6

1,483,804

1,588,686

45‘0

50,788

49,828

42-4

82

‘ Excluding the Polar regions.

Next to Africa, China and its neighbourhood, with Turkey, Persia, the large islands of the south-eastern oceans and the wilder tracts of Central and South America, furnish the greater part of the field still open to inquiry (see Census).

POPULATION

837

Sex. â€” Investigations into the subject of the normal distribution of the sexes have added comparatively little directly to our knowledge of the question, though much valuable information in this respect has been obtained from the wider study of factors which tend to disturb that proportion. Among the undeveloped communities brought under observation, the relatively low value set upon female life results possibly in a real, certainly in a recorded, paucity of that sex. Again, in a far more advanced stage of civilization, convention entails a similar inaccuracy of the record. In most Oriental and orien- talized countries, for instance, the strict seclusion of the women of the household and consequent reticence re- garding them, is habitual among the upper classes, and naturally tends to spread downwards throughout the community. Even in the higher and more progressive civilization of Western Europe and its offshoots in other continents, where neither of the above-mentioned dis- turbing considerations are operative, other causes, such as the greater dangers to -which men are exposed in war and industry, together with the wider prevalence of migration among that sex, tend to counteract what appears to be the better vitality of women and a possibly growing proportion of female births. All that can be said on the subject with certainty, therefore, is that in long-settled and prospering communities, where accuracy of data may be fairly

assumed, there will be found a greater or less excess of females, whilst in their colonies the influence of immi- gration throws the weight into the opposite scale. Elsewhere, on the other hand, the general preponderance iu the returns of males may be attributed both to neglect of female life and to the concealment of those in existence, according to circumstances. In illustration of these gen- eral propositions, the following table, giving the number of females per 1000 males, is subdivided into groups showing Western European countries. Oriental countries, and European colonies respectively, with, in some cases, the variation in the proportion that has been returned at different periods.

Table II.

Country.

Tear.

Females per 1000 Males.

Country.

Tear.

Females per 1000 Males.

England and j Wales . 1

Scotland .

Ireland . â€¢!

Sweden . â– Norway . | Finland . i. Denmark . | Germany . \ Austria . -j Holland . | Belgium . I Switzerland â–

France

1851 1871 1901 1851 1871 1901 1841 1871 1901 1870 1900 1865 1890 1886 1897 1870 1900 1875 1900 1869 1890 1849 1899 1866 1900 1870

1900 1851 1876 1896

1042 1054 1069 1100 1096 1058 1034 1050 1028 1067 1049 1036 1090 1038 1022 1026 1053 1036 1032 1041 1044 1040 1025 995 1005 1046 1035 1010 1008 1024

Portugal . – Spain . . – Italy . . 1 Greece â€¢<

1878 1900 1877 1897 1871 1881 1879 1896

1091

1090

1029

1062

989

995

934

921

Hungary . |

Russia (Europe) Servia Bulgaria Bosnia (and 1 Herzegovina) j Egypt .

Ceylon . |

India . Russia (Asia)

1869 1890 1897 1895 1900

1895

1897 1861 1891 1901 1897

1002

1015

986

949

959

893

967 941 887 963 893

United States |

Canada . – Cape Colony Australasia -j Argentina .

1860 1900 1871 1891 1891 1861 1901 1895

955 953 939 967 990 715 864 893

Age. â€” The general distribution of the population by age is ascertained in the first instance at the census, but the return, when based upon the untested statement of the individual, is apt to err, owing to the ignorance or deliberate intent of those furnishing the information. Of the latter class of error examples are given in the census reports for England and Wales. The possibilities of the former may be judged by the preference shown by the enumerated for the even multiples of ten in the following selected figures.

Table III.

Age.

Number at each Age per 10,000 of Population. ^

United States, 1890.

Germany,

1890.

India, 1891. Females.

White.

Coloured.

fl9 .

160

195

196

64

â– ^ 20 .

183

202

225

505

21 .

177

200

187

54

r29 .

138

148

101

42

â– ^ 30 .

149

214

238

624

Ul . ,

143

123

69

30

r49 .

86

70

50

12

\ 50

101

119

156

386

(51

87

56

35

12

(“59

59

41

20

10

â€¢ 60

69

77

103

281

(.61

56

35

17

11

In order to neutralize such irregularity, the return is sub- divided into aggregates of five to ten years, from which the annual detail can be obtained by graduation. Shown in some such form, it will be found that the distribution by age varies not only in the different countries, but also from decade to decade in the same country. To facilitate comparison in this respect, the table given below contains

Table IV.

Proportion in 1000 Persons.

Country.

Tear.

Under

15.

15-40.

M-60.

60 and over.

Sweden

{

Normal

1890

336 333

389 360

192 192

83 115

Denmark .

1890

348

368

182

102

Holland .

,

1889

352

372

184

92

Belgium .

1890

328

389

186

97

Germany .

/

I

1871 1890

345 351

389

387

190 182

76 80

Austria

1890

342

388

191

79

Hungary .

1890

387

379

178

56

Bulgaria .

1888

414

322

172

92

France

{

1851

273

399

227

101

1896

260

392

223

125

Italy

1881

322

388

201

89

England and Wales

{

1841 1891

360 351

408 405

161 170

71

74

Scotland .

1891

356

398

167

79

Ireland

{

1841 1891

382 325

396 387

157 183

65 105

United States .

{

1860 1890

405 356

418 423

134 159

43 62

United States (colour

ed)

1890

421

404

129

46

Canada

1891

365

411

153

71

Cape Colony

1891

432

390

130

48

Australia .

1891

374

427

149

50

India

1891

392

399

157

52

the number per thousand of the population of each of the selected countries, returned at the different periods corre- sponding with early

youth, prime, middle age, and decline of life. Most of the more recent figures are borrowed from the report on the German census of 1890, whilst

the earlier are compiled from the original returns. At the head of the list stands the distribution of a standard West European population established by Dr Sundbarg, of Stockholm, from the unrivalled series of data available in Sweden, with which the figures for countries more subject to abnormal disturbance may be compared. Amongst the prominent features of the return may be mentioned the highproportionof thoseunderforty in the British Colonies, England, and Germany ; the low proportion of the young in France, Ireland, and Italy, with a corresponding weight of the aged ; and the generally close approach of Austria to the standard.

General Rate of Increase. â€” The variation in the total population of a country and in its distribution by sex and age at different times, as reflected in the preceding table, is mainly due, apart from the effects of war, pesti- lence, or famine, to the ordinary relation between births and deaths on the one hand, and the interchange of population with other countries on the other. The former, or natural, variation usually manifests itself in a greater or less excess of births over deaths, while the tide of migration sets, on the whole, steadily from the old world to the new, and from the north of Europe to the north of Asia. The resultant of these two factors is shown in Table V. below, which gives the annual rate of increase per cent, during the 19th century of some of the principal countries of the civilized world. It should be noted, how- ever, that the returns for the earlier years dealt with are by no means as accurate as those for the years since 1840 (see the BevolJcerungslehre und Bevolkerungspolitik of A. E. von Eircks, p. 197). The rate, again, is in geometrical, not arithmetical, progression ; and is lower, accordingly, than that shown in some current publications. The total for Europe includes the figures for Ireland, the population of which has been decreasing since about 1846, as well as those for countries in the east of

Europe, of which the population is at present, or was until recently, a matter of conj ecture. Taking only the western countries, the returns for which are more trustworthy, the percentage for the century is something over -68 instead of ~~76. France, Spain, and Italy fall far below this average, while Eng~~ land and Scandinavia considerably surpass it. The rate in ” new ” countries is given by way of contrast.

Table V.

Count

Annual Eate of Increase per

Cent.

ry.

1800-99.*

1800-60.

1850-99.*

By latest Census.

England and ^

Vales . 1-35

1‘41

1-21

1-15

Sweden .

0-78

0-79

0-78

0-71

Norway .

0-93

0-94

0-92

1-10

Denmark

0-98

0-84

I’ll

1-09

Finland .

0-91

0-91

0-92

1-01

Germany-

0-98

0‘96

0-99

1-50

Austria .

0-67

0‘58

0-79

0-89

Hungary

0-65

0-57

0-75

0-95

Holland .

0-87

0-78

1-01

1-24

Belgium .

0-81

0-76

0-88

1‘06

France .

0-36

0-52

0-20

0-13

Spain

0-49

0-48

0-51

0‘54

Italy .

All Euroi United States

0-57

0-56

0-58

0-69

)e . 0-76

0-67

0-79

0-86

2-69

3-00

2-39

1 -no

Australia

3-05

1-87

Argentina

...

3-22

Canada .

2-15

1-00

Brazil

...

2-00

British India

0‘93t

- **Or later.**

t 1891.

Migration. â€” The want of full information as to emigra- tion from the different countries precludes any accurate demarcation by statistics of the respective influence upon the rates of increase given above of migration and natural growth. It has been calculated by the author quoted just now, Dr Eircks, that during the period 1825-1900 over 23 millions of people left western Europe in excess of those received from abroad. To this sum Ireland con- tributed 8-7 millions ; Germany, 5-6 ; Great Britain, 2-3 ; Italy, chiefly during recent years, 1-6 ; and Scandinavia, about a million. The loss to Germany during the twenty-four years ending with 1895 is stated to have amounted to about 18 per cent, of the natural increase. In the United States the census of 1890 gives nearly 15 per cent, of the population as foreign-born, as compared with 9-68 per cent, in 1850. The census of Canada, too, in 1891 gave a proportion of about 14 per cent. In Australia in 1891 the corresponding figure was nearly one-third, and the census of Argentina in 1895 showed over one-fourth to be of foreign birth.

Natural Increase. â€” The general rate of increase given above may be compared with the average annual excess per cent, of births over deaths shown in Table VI. The only general tendency to be noted in the figures is that while both birth- and death-rates appear to diminish, the former does so far more slowly than the latter. There are important exceptions, however, amongst which are France, England, and Ireland.

Table VI.

-Annual Bates of Birth, Death, and Natural Increase per 100 of Population.

Birth-Eate.

Death-Eate.

Excess of Births.

Country.

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England and Wales .

8-46

3-T6

3-05

2-37

2-40

1-92

1-09

1-86

1-24

Ireland

2-(>2

‘1-m

1-(it>

1-B.T

0-9ti

11-74

Sweden

8-11

8-14

Si-74

2-of;

2-02

vm

1-06

1-12

1-12

Norway .

3-07

3-09

3-04

1-82

1-80

1-63

1-25

1-29

1-41

Denmark .

.S-IB

8-10

8-(m

‘i-nf,

1-99

1-74

1-00

1-11

I -.82

Finland .

8-.W

8-47

3-1, “)

2-S.5

3-26

2-16

1-20

0-21

0-99

Germany .

8-61

8-72

8-59

2-68

2-69

2-1. 5

0-98

1-ns

1-40

Austria .

.â€¢i-HT

S-(Â«

8-71

8-38

S-06

2-72

n-.54

0-79

0-99

Hungary .

.

4-35

4-16

S-40

S‘18

0-9,’)

1-03

Holland ,

3-8()

8-.NS

8-2B

2-(i2

2-,’>4

1-S4

0-fiS

0-99

1-44

Belgium .

8-05

s-ie

2-92

2-44

2-88

2-02

0-61

0-7S

0-90

France .

‘2-78

1-(t

2”W

2-.S2

2-8B

2-10

0-41

0-27

0-07

Italy.

S-75

3-43

810

2-81

0-65

1-12

- **Or later.**

In comparing the conditions of different countries as judged by their vital statistics, the question arises : WTiat standard should be applied ? By some authorities civil- ization is judged by the death-rate. Others, however, regard as of equal importance the gradual extension of that rate over a wider field, and take the birth-rate also into account. In order to avoid giving the latter undue preponderance in the equation, Herr Rubin, Director of Statistics for Denmark, has suggested as the most re- presentative measure of civilization the quotient of the birth-rate into the square of the death-rate (Jovrnal of Royal Statist. Sac, London, 1S07, p. 154). The serial order of the twelve principal countries of Europe for which figures are available is shovm in Table Yll. according to all three methods. In the two first sections the order is that of the death- and birth-rates respectivel)', beginning in each case with the lowest, that is, Norway as to the former and France in respect to births. The last section of the table combines in like order these two factors in the ratio proposed by Herr Rubin. In two of the three divisions Scandinavia and England occupy the first place, but the high

birtli-rate of England places it below France and Belgium. The decreasing natality of France takes

that country far down the list in the combined figure ; but Austria and Hungary, with high rates of both natality and mortality, occupy the lowest places. The position of Finland is obviously due to the abnormal death-rate in the decade 1861-70, otherwise its place would fall between Holland and Belgium.

Table VII. â€” Countries in Serial Order according to the Birth and Death-Bate.

(d) Death-Eate.

(b) Birth-Eate.

d’:i.

Country.

i

i

1

o i-r

1

00

2

i

1-1

CO

7

CD

00

at

J, i

Norway . Sweden . Denmark rinland . England and 1 Germany
Holland . Belgium . France . Italy Austria . Hungary

iVales

1

3

2

11

4

8

7

6

5

10

9

12

2

1

3

7

4

9

6

5

8

10

11

12

2

1

3

8

5

7

4

6

9

10

11

12

2

4

3

6

7

9

8

5

1

10

11

12

4 2 5 8 6

10 7 3 1

11 9

12

4

2

5

6

7

10

8

3

1

9

11

12

1

3

2

12

4

7

6

5

8

10

9

11

1

2

3

5

4

8

6

7

10

9

11

12

1

2 3 8 5 6 4 7

11

9

10

12

Nuptiality and Fecundity. â€” In connexion with the sub- ject of natural increase may be mentioned the tendency of a people towards marriage, and the average fertility of each union, so far as these facts can be tested statistically. In Table VIII., based on German authority of some years ago, the yearly rate of marriages per 1000 of population is shown for three periods, together with the average number of children per marriage and the births per thousand married women of between fifteen and forty-five years old.

Table VIII. â€” Marriage Bates, &c.

Average

Average

Number

Annual Marriages per 1000

Number

of Births

of Population.

of Chil-

per 1000

dren per

Wives,

Country.

Marriage.

aged 15-4S.

1841-50.

1861-70.

1891-95.

1871-80.

1871-80.

Sweden

14-54

13-08

11-45

4-0

302

Norway

15-56

13-28

1292

3-9

322

Denmark .

15-74

14-90

13-84

4-3

286

Finland

16-30

15-50

12-98

4-1

309

England and

Wales

16-10

16-69

15-16

4-2

302

Ireland

10-50

9-48

5-5

France

15-88

15-62

14-90

2-9

201

Germany .

16-10

17-04

15-88

4-2

332

Holland

14-82

16-44

14-48

4-3

367

Belgium

13-58

15-04

15-24

4-1

342

Italy .

15-20

14-96

4-5

291

Austria

17-25

17-36

15-76

4-0

Hungary .

18-60

17-92

The general tendency shown in this table is for the marriage rate to decline. It is apparently the same with the number of births compared with that of married women of the productive ages, for in England that rate, which was in 1871, 292 per thousand wives, fell in 1891 to 264. In Prussia the corresponding figures were 409 and 383. The Swedish returns, which go back to 1811, show considerable fluctuations, but seem to indicate a decline dating from the middle of the 19th century.

The average age at marriage is another factor not with- out its importance in connexion with this subject. Without

entering into details, it may be said that in Switzerland and Austria the husband's age tends to a little above 31, and in Scandinavia and Belgium to a little below that figure. It is about a year less in France, Italy, and Hol- land. England, with 28-4, stands lowest. As to the average age of the wife at marriage, there seems a con- siderable tendency towards 27 years, Scandinavia, Hol- land, and Belgium exceeding, and England and France falling short of it. Italy returns the lowest figure, namely, 24J. Most of Europe, excluding Eussia and the east, shows a difference in age between husband and wife of from two to three years. In Italy the interval is nearly 6 years, in Ireland and Austria, about 4, in France, 3\, and in England and Holland, 2\ years.

Mortality. â€" The influence on the constitution of a popu- lation of the distribution by age and sex of the annual death-rate can only be given in outline here. The most prominent feature in the returns of mortality is the heavy proportion borne to the total by the deaths of children of under five years old. This ratio varies according to the birth-rate, from a little over a quarter, in France, to over 40 per cent, in the greater part of central Europe, and even higher in Eussia and the east. The predominant factor is the rate during the first year of life, which tends to be twice, thrice, and even four times that which prevails in the succeeding year. The two first columns of Table IX. give the rate of this infantile mortality at two decen- nial intervals computed by Dr Bodio. In the rest of the table the sexes are distinguished, as the rates of the two differ materially. Thus the predominating numerical superiority of

women in most civilized countries is shown by the third column to be not attributable to the fact that more of them come into the world, since boys are born in far greater numbers than girls, though the dis-proportion seems, from the English returns, to tend to diminish. But, except between the ages of 10 and 20, the vitality of the female sex exceeds that of males throughout life, the advantage in the first year, according to the theoretical constitution of a life-table, being as great as is shown below : â€”

Table IX. â€” Infantile Mortality, &c.

From Keturns.

From Life-Tables.

Boys

Annual Beaths per

In 1000 Births,

1000 at each Age.

Mean

Country.

Deaths in Tirst Tear.

AUve

per 1000

Girls.

After-life- time, in Tears.

Under 1

Under 5

Tear.

Tears.

1874-83.

1884-98.

1894.

Boys.

Girls.

Boys.

Girls.

M.

P.

Sweden

128

107

1050

141

119

50

44

45-3

48-6

Norway

104

96

1058

113

96

43

39

47-4

49-9

Denmark .

141

136

1048

147

124

47

42

45-6

47-4

England

144

146

1039

161

131

55

48

43-7

47-2

Holland

204

174

1055

197

165

64

56

42-5

45-0

France

165

168

1046

198

167

64

57

40-8

43-4

Italy .

208

190

1058

213

193

89

85

35-1

35-4

Prussia

216

207

1052

221

189

73

65

39-0

42-2

Saxony

284

282

1050

303

258

96

84

34-6

38-5

A considerable difference will be noted between Scan- dinavia and England and the rest of the countries men- tioned. In the former not only is infantile mortality lower, but the difference between the sexes in this respect is less. It is true that Italy |)recedes them in regard to this last point ; but there the conformity of the two rates is apparently the result of a high female rather than of a low male mortality. The general results tend to confirm the indications afforded in the last portion of Table VII..

840

PORBANDAR â€” POET AETHUE

Comparison between the countries is carried a little farther by the addition of the mean after-lifetime from birth, cal- culated from the life-tables. It must be understood that where, as in England, there is a large natural increase, the mean age at death is necessarily much lower than the figures here given, which are those derived solely from a stationary community.

The normal course of a generation in the different countries is as follows : â€”

Table X. â€” Survivals at Various Ages of 100,000 Births of each Sex. {Herr Fircks.)

Country.

Males.

Females.

5

15

46

70

5

1.5

45

TO

Tears.

Tears.

Tears.

Tears.

Tears.

Tears.

Tears.

Tears.

Sweden .

775

727

574

294

798

749

610

356

Xorway .

803

754

590

325

820

769

616

372

l^enmark

785

737

587

285

808

753

588

334

England and

Wales .

751

726

564

239

783

759

604

299

Holland .

717

684

543

269

748

712

560

314

France .

716

680

512

245

744

703

539

291

Italy

629

579

442

198

643

588

438

200^

Prussia .

684

651

505

210

715

677

542

263

Saxony .

602

573

443

169

645

614

483

239

(j. A. B.)

Porbandar, a native state of India, in the Gujarat division of Bombay, extending along the south-west coast of the peninsula of Kathiawar. Area, 636 square miles ; population (1881), 71,072;' (1891), 85,786 ; estimated gross revenue, E.s.6,60,000, of which E.s.2,62,560 was expended on public works in 1897-98; tribute, Es.48,504. The chief, whose title is Eana, is a Jethwa Rajput. At present the state is under British administration. Limestone is largely exported to Bombay. The town of Poebandae is on the seacoast, and the maritime terminus of the Kathiawar railway system. Population (1881), 14,569 ; (1891), 18,805. A large trade is conducted in native boats as far as the west coast of

Africa. There are an oil mill and a state printing-press, issuing a gazette.

Pordenone, a town of the province of Udine, Venetia, Italy, 30 miles west by south of Udine on the railway to Treviso. It was the birthplace of the painter II Pordenone (1483-1639). Paintings from his brush adorn the Renaissance cathedral, and others are preserved in the gallery of the town hall. Cotton industries are active, and silk and pottery are manufactured. There is an industrial school (1872). Population (1881), 6996;

(1899), 7500.

Portadown, an inland town and urban sanitary district in the county of Armagh, Ireland, on the river Bann and the Great Northern railway, 25 miles west-south- west of Belfast. There are frequent markets for the sale of agricultural produce, and a large number of persons are engaged in the manufacture of linen and cotton goods. The town, which belongs to the Duke of Manchester, has been much improved. Population (1881), 7850 ; (1891),

8430 ; (1901), 10,046.

Portaels, Jean Francois (1818-1895), was bom at Vilvorde (Brabant), in Belgium, 30th April 1818. His father, a rich brewer, sent him to study in the Brussels Academy, and the director, Pranqois Navez, ere long received him as a pupil in his own studio. About the year 1841, Portaels, wishing to make further progress, went to Paris, where he was kindly received by Paul Delaroche. Having returned to Belgium, he carried off the Grand Prix de Rome in 1842. He then travelled through

Italy, Greece, Morocco, Algeria, Egypt, the Lebanon,* JudÂ«a, Spain, Hungary, and Norway. On his return to Belgium in 1847, Portaels succeeded H. Vanderhaert as director of the Academy at Ghent. In 1849 he married the daughter of his first master, Navez, and in 1860 settled at Brussels ; but as he failed in obtaining the post of director of the Academy there, and wished, nevertheless, to carry on the educational work begun by his father-in-law, he opened a private

studio-school, which became of great importance in the development of Belgian art. He again made several journeys, spending some time in Morocco ; he came back to Brussels in 1874, and in 1878 at last obtained the directorship of the Academy which had so long been the object of his ambition. Portaels executed a vast number of works. Decorative paintings in the church of St Jacques-sur-Caudenberg; Biblical scenes, such as "The Daughter of Sion reviled" (in the Brussels Gallery, see Plate), "The Death of Judas," "The Magi travelling to Bethlehem," " Judith's Prayer," and " The Drought in Judsea"; genre pictures, amongst which are " A Box in the Theatre at Budapest " (Brussels Gallery), portraits of officials and of the fashionable world. Oriental scenes, and, above all, pictures of fancy female figures and of exotic life. " His works are in general full of a facile grace, of which he is perhaps too lavish," wrote Theophile Gautier. Yet his pleasing and abundant pro- ductions as a painter do not constitute Portael's crowning merit. The high place his name will fill in the history of contemporary Belgian art is due to his influence as a learned and clear-sighted instructor, who formed, among many others, the painters E. Wauters and E. Agneesens, the sculptor Ch. van der Stappen, and the architect Licot. He died at Brussels on 8th February 1895.

See E. L. de Taete, Peintres Beiges contemporains ; J. du Jardin, L'Art Flamand. (p. k*.)

Portage, a city of Wisconsin, U.S.A., capital of Columbia county, on the Wisconsin river and the Chicago, Milwaukee, and St Paul and the Wisconsin Central railways, south of the centre of the state, at an altitude of 813 feet. It is in a farming and lumber region, has con- siderable trade and important manufactures of lumber. Population (1880), 4346; (1890), 5143; (1900), 5459, of whom 1184 were foreign-born.

Portage la Prairie, a port of entry and the chief town of Macdonald county, Manitoba, Canada, situ- ated 50 miles west of Winnipeg, on the Canadian Pacific and Canadian Northern railways, at an altitude of 854 feet above the sea. It is in the midst of a fine agricul- tural district,

and a large export trade in grain and other farm produce is carried on. Population (1891), 3363; (1901), 3901. (j. w.)

Portalegre, a city and episcopal see of Portugal, capital of district of Portalegre, 103 miles north-east of Lisbon. Population (1890), 10,354. The district of PoETALBGEE, with an area of 2482 square miles, and population (1890), 112,834, and (1900), 124,697, giving 50 inhabitants to the square mile, produces corn, olive oil (annual average, 325,400 gallons, valued at Â£40,000), and wine (246,578 gallons in 1892) ; but the chief occupation is the breeding of pigs. Woollens and corks are manu- factured.

Port Arthur, or, as it is called by the Chinese, Lu- SHUN-Kou, a fortress situated at the extreme south of .the peninsula of Liaotung, which stretches down between the Gulf of Pechili and the Yellow Sea in the Chinese province of Manchuria. It was formerly a Chinese naval arsenal and fortress, but was captured by the Japanese in 1894, who destroyed most of the defensive works. In 1898

it was leased to Russia along with the neighbouring port of Talienwan, and was gradually converted into a Russian stronghold. The port or harbour is a natural one, entirely landlocked except to the south, where the entrance is very narrow, being less than a quarter of a mile wide. The basin inside is of limited exteht, but is being improved by dredging. Barren and rocky hills rise from the water’s edge all round. Extensive barracks have been constructed for the accommodation of troops. A railway connects the port with the Eussian lines in Manchuria. The harbour is ice-free all the year round, a feature in which it con- trasts favourably with Vladivostok.

The Liao-tung peninsula, separated from Korea by the Bay of Korea, from the Chinese mainland by the Gulf of Liao-tung, runs in a south-

westerly direction from the mainland of Man- churia, and is continued by a group of small islands which reach another peninsula projecting from the mainland of China in a north-easterly direction, and having at its north-eastern extremity the port of Wei-hai-wei. The Liao-tung peninsula is indented by several bays, two of which nearly meet, malting an isthmus less than 2 miles wide, beyond which the peninsula slightly widens again, this part of it having the name of Kan-tun (Regent's Sword). Two wide bays open on the eastern shore of the latter : Lu-shun-kou (now Port Arthur) and Talienwan. Both have been leased to Russia. The bay is nearly 4 miles long and 1| mile wide, the entrance being only 350 yards wide. The Chinese deepened the bay artificially and erected quays, and- the popula- tion of the village at its extremity reached 6000, Chinese and Japanese. The roadstead is exposed to south-easterly winds, and in this respect the wider bay of Talienwan is better. Port Arthur is well connected by roads with Peking, Korea, and Manchuria, and lies 270 miles from Mukden, 500 miles from Kirin, and 800 miles from the Nikolsk station of the South Usuri railway. Coal is found near to the port. The climate is very mild, and similar to that of south Crimea, only with more moisture. The small peninsula above mentioned has received in Russia the official name of Kwang-tung province. Since its occu- pation by the Russians, Port Arthur has become Europeanized. The Russian military port, Dalny, is a few miles to the north.

Port Augusta, a town of South Australia, in the country of Frome, the northernmost port of the colony, on the east shore of Spencer Gulf, 259 miles by rail north- west of Adelaide. There is a fine natural harbour. The Government wharf has berthing for large vessels. The town is the starting-point of a railway, which j oins the main line from Adelaide to the north. Valuable gold reefs were discovered in 1900 at Tarcoola. A water reservoir (200,000,000 gallons) has been formed at Nectar Brook, 22 miles distant. The town hall is the finest in the colony, that of Adelaide excepted. Population (including Port Augusta West, 369), 1370.

Port-au-Prince. SeeHAVTi.

Port Chester, a village of Westchester county, New York, U.S.A., on the shore of Long Island Sound, and the New York, New Haven, and Hartford railroad, 26 miles north-east of New York. Its site is hilly and its plan irregular. It has varied manufactures, consisting in part of woollen goods, carriages, and iron and steel goods. Population (1880), 3264; (1890), 6274; (1900), 7440, of whom 2110 were foreign-born and 97 negroes.

Port Darwin, or Palmekston, the chief town of the Northern Territory of South Australia, on the eastern shore of Port Darwin inlet, in the county of Palmerston, about 2000 miles north-north-west of Adelaide. It pos- sesses a magnificent harbour, and a jetty connecting it with the railway, which runs for a distance of 146 miles to Pine Creek. There are a Government House, town hall, and other public buildings, and a Government experi- mental nursery garden has been laid out in the vicinity. The mean yearly rainfall (13 years) is 63-21 inches. Popu- lation, about 2600.

Port Elizabeth, a town and seaport of Cape Colony. The population increased from 13,000 in 1876

to 23,266 in 1891, while the foreign exchanges have in some years exceeded Â£10,000,000. The imports, chiefly textile fabrics, machinery, and hardware of all kinds, apparel and haberdashery, spirits and provisions, rose from Â£2,800,000 in 1891 to Â£8,670,000 in 1896, Â£7,877,000 in 1897, and Â£6,246,000 in 1898 ; for the same years the exports (gold, diamonds, wool, ostrich feathers, hides) were Â£2,000,000, Â£1,921,000, Â£1,950,000 and Â£2,103,000. The commercial importance of Port Elizabeth is largely due to its position nearly midway between Cape Town and Durban, about 800 miles from both places, and a little over half that distance from Kimberley. The opening of several important railways, by which it com- municates with Port Alfred, Graaff Eeinet, the Orange River Colony, and Rhodesia, has also helped to make it the most convenient outlet for the whole of South Africa. Lying on the west side of Algoa Bay, under the shelter- ing headland of Cape Recife, it is protected from the west winds, but is

still exposed to the more violent easterly gales pending the completion of extensive harbour works.

Porter, David Dixon (1813-1891), American admiral, was born in Chester, Pennsylvania, 8th June 1813. Three generations of his family before him had commanded vessels upon the high seas. It was under his father. Admiral David Porter of the war of 1812, that he took his first lessons in naval service, when at the age of eleven he accompanied an expedition to the West Indies. He studied for a time at Columbian College, Washington ; but the sea soon claimed him, and at the age of fourteen he was a midshipman in the Mexican navy (of which his father was then commander-in-chief). In 1829 he entered the U.S. navy as midshipman, in 1841 was made lieu- tenant, and in the war with Mexico was in comma,nd of the naval rendezvous at New Orleans. At the outbreak of the Civil War he was given command of the steam-frigate PowKatan, and joined the expedition for the relief of Port Pickens. On 22nd April 1861 he was appointed to the rank of commander. In the battle of New Orleans he was in charge of the auxiliary fleet of mortar-boats which made the preliminary five days' bombardment upon Forts Jackson and St Philip. It was he, also, to whom the forts surrendered after the capitulation of New Orleans to Farragut. In October 1862 he took command of the Mississippi Squadron, and the following January had an important part in the capture of Arkansas Post. He next formed the original and daring plan of cutting the levee of the Mississippi at the old Yazoo Pass, and sending a fleet of vessels through the gap into the Cold Water, and thus down the Tallahatchie and the Yazoo rivers to the rear of Yazoo city ; but the almost insuperable physical difficulties involved gavetheConfederates time to block the advance. In March 1863 another expedition noless daring, and, as it proved, still more perilous, attempted under Porter's personal command topenetrate through connecting streams and bayous to the Yazoo river, and thus reach the rear of Vioksburg ; but even greater obstacles thwarted its success. These two expeditions illustrate how diflicult and dangerous were the enterprises undertaken by Porter and other naval commanders in their river operations far inland, largely with miscellaneous and improvised vessels, often under conditions hitherto unknown in the history of naval warfare, and yet

not infrequently with brilliant success. When Grant decided to approach the rear of Vicksburg from the south, Porter ran his fleet successfully down past the Vicksburg batteries and co-operated with him in the undertaking, and also with General Banks in an ex- pedition up the Red river against Alexandria. On 4th July 1863 he was appointed rear-admiral. In September 1864 he was transferred to the command of the North Atlantic

Blockading Squadron, and in December, with the largest fleet that was assembled at one point during the war, bombarded Fort Fisher, N.C., and silenced the enemy's guns. After a second bombardment (16th January 1865) a land force stormed the fort, and with the aid of the guns of the fleet captured it. After the war he was super- intendent of the U.S. Naval Academy (1865-69), and was then assigned to departmental duty at Washington. He was made vice-admiral 25th July 1866, and admiral 15th August 1870, being the only person except his pre- decessor, Admiral Farragut, who had ever reached that rank. He died at Washington, 13th February 1891. Among his writings are Tlie Life of Commodore David Porter, Incidents and Anecdotes of the Civil War, and The Naval History of the Civil War. His reputation, although somewhat overshadowed by that of his foster-brother, Farragut, was deservedly great. Marked ability and skill as an officer, readiness to take hazardous risks when needed, and an order of originality and resourcefulness quite invaluable in the work that he had to do, were his characteristic qualities as a naval commander, (g. b. l.)

Porter, Fitz-John (1822-1901), American soldier, was born at Portsmouth, N.H., 31st August 1822, the son of Captain John Porter, U.S.lSr., and graduated at the United States Military Academy in 1845. He served with honour in the Mexican War, was instructor at West Point, 1849-55, and in 1856 became assistant adjutant- general, with the rank of captain, serving in the Utah expedition of 1857-60. In 1860

he was assistant inspector- general, with headquarters in New York City ; and he superintended, in 1861, the protection of the railway be- tween Baltimore and Harrisburg during the Baltimore riot, and also organized volunteers in Pennsylvania. He became colonel of a new regiment of regulars, 14th May 1861, and, 17th May, was made brigadier-general of volunteers. In 1862 he took part in the Virginia Penin- sular campaign ; he was at the siege of Yorktown ; and upon the evacuation of that place took command of the 5th Corps, and fought splendidly in Jrme in the battles of Mechanicsville and Gaines's Mill ; taking a leading part, besides, at Malvern Hill, 1st July, when McClellan changed his base to the James river. Promoted major- general of vohmteers 4th July 1862, and temporarily attached to the army of Virginia, he fought under Pope in the second battle of Bull Eun, 29th and 30th August 1862 ; his corps was unable to move forward the first day, when ordered to advance, but in the afternoon of the second day fought well to save the army from utter rout. Porter, as a warm friend of McClellan, had shown dislike of Pope, and charges were preferred against him ; he was tried by court-martial, November 1862, and sentenced to be cashiered, 21st January 1863, " and for ever disqualified from holding any office or trust under the Government of the United States." Thejusticeof thissentencewasmuch discussed after the Civil War, and upon a re-examination made in 1882 Porter was acquitted of the main charge, and President Hayes remitted the disqualifying penalty. General Grant had now taken Porter's part. Against much opposition, partly political, 1879-86, and a veto from President Arthur, a relief Bill finally passed Congress, and Porter was, 7th August 1886, restored to the United States army as colonel, and placed on the retired list. He was commissioner of public works. New York City, 1875- 76 ; police commissioner, 1884-88 ; and fire commissioner, 1888-89. He died 21st May 1901, at Morristown, New Jersey. (j. sch.)

Porter, Noah (1811-1892), American educationist and philosophical writer, was born in Farmington, Con- necticut, 14th December 1811. He graduated at Yale

College, 1831, an'd laboured as a Congregational minister in Connecticut and Massachusetts, 1836-46. He was elected professor of moral philosophy and metaphysics at Yale in 1846. From 1871 to 1886, when he resigned, he was president of the same college. He edited several editions of Noah Webster's English dictionary, and wrote on education, books and reading, moral science, and the ethics of Kant ; but his best-known work is The Human Intellect, with an Introduction upon Psychology and the Human Soul (1868), comprehending a general history of philo- sophy, and following in part the "common-sense" philo- sophy of the Scottish school, while accepting the Kantian doctrine of intuition, and declaring the notion of design to be a priori. He died in New Haven, 4th March 1892.

Port-Glasgow, a seaport, burgh of barony, and parliamentary burgh (Kilmarnock group) of Eenf rewshire, Scotland, on the Clyde about 20 miles below Glasgow by rail. The output from the shipbuilding yards, 71,325 tons in 1889, was only 48,123 tons in 1899. There are two graving docks, and a considerable amount of repair work is done. The manufacture of tents and trawling gear has been introduced. The port has an area of 16 acres and nearly 6000 feet of quayage. In 1900, 23 vessels of 15,494 tons were on the register of the port. Modern erections are a library, orphan homes, and public baths. The Birkmyre Park was opened in 1894. Popular tion (1881), 13,294 ; (1891), 14,685 ; (1901), 16,840.

Port Hope, the chief town of Durham county, Ontario, Canada, situated 58 miles east-north-east of Toronto, on the north shore of Lake Ontario and on the Grand Trunk railway. File and machine shops, tanneries, breweries, canneries, carpet and carriage factories, are the principal industries. Population (1901), 4188.

Port Huron, a city of Michigan, U.S.A., capital of St Clair county, on the St Clair river, at the foot of Lake Huron, and the Grand Trunk and the Pere Mai'- quette railways, in the eastern part of the state, at an altitude of 586 feet. The site is level, the street plan regular, and it is divided into ten wards. It has the Holly system of waterworks, the supply being pumped from Lake Huron, and the city is well paved. It is

an important railway centre, and has a large trade in grain and lumber. It has the works of the Grand Trunk railway, many grain elevators, and manufactures of varied character. It is connected with Sarnia, Canada, on the opposite side of the river, by ferries and by a railway tunnel. Population (1890), 13,543; (1900), 19,158, of whom 7142 were foreign-born and 69 negroes.

Port Jervis, a village of Orange county. New York, U.S.A., on the Delaware river, at the mouth of the Never- sink, near the junction of the three states of New York, New Jersey, and Pennsylvania. It is on the Erie rail- way, and at an altitude of 442 feet. It contains works of the Erie railway, andhas varied maniif actures. Population (1890), 0327; (1900), 9385, of whom 895 were foreign- born and 119 negroes.

Portland, a town of Middlesex county, Con- necticut, U.S.A., on the east side of the Connecticut river, 40 miles from Long Island Sound and the New York, New Haven, and Hartford railroad. It com- prises an area of 26 square miles of hilly country, con- taining rural population, and a village of the same name as the town. It contains quarries of brown sandstone. Population of the town (1890), 4687; (1900), 3856, of whom 1316 were foreign-born.

Portland, a city and seaport of Maine, U.S.A., capital of Cumberland county, in the south-western part

of the state, the largest and most important city in the state. It has an uneven, hilly site, broad, well-shaded streets, is divided into nine wards, and derives an ex- cellent water-supply from Sebago Lake to the north by gravity, the works being owned privately. It is well sewered, and the business streets are paved. It is situated on a neck or promontory, rising, in Munjoy Hill, to an altitude of 161 feet, and lying between the harbour and Back Bay. The deep and capacious harbour has made Portland mainly a commercial city. Its exports for the year ending 30th June 1901 amounted to $12,416,793, and its imports to $633,114. The

Grand Trunk, the Maine Central, and the Boston and Maine railways meet here. The manufactures are large and varied; in 1900 it contained 639 establishments, with a total capital of $6,991,251, employing 5699 hands, and with a product valued at $11,440,201. One of the largest industries was carpentering, the products of which were valued at $1,094,788. Other items of importance were foundry and machine-shop products, lumber, and cloth- ing. The assessed valuation in 1900 was $45,128,305, the net debt was $1,287,533, and the rate of taxa- tion was $21 per flOOO. Population (1890), 36,425; (1900), 50,145, of whom 10,435 were foreign-born and 291 negroes. There were 12,645 persons of school age (5 to 20 years). Of 16,433 males 21 years of age and over, 597 were illiterate (unable to write). In 1899 the city of Deering was included within the charter limits of Portland.

Portland, a city of Oregon, U.S.A., capital of Multnomah county, on both banks of the Willamette river, 12 miles above its junction with the Columbia, in the north-western part of the state. The city is built mainly on the west side of the river, the portion on the east side consisting of recent inclusions within the charter limits, which were formerly known as East Portand and Albina, and which were annexed in 1891. The business portion lies mainly on low ground near the river on the west side, whence the residential quarter extends up the slope to the hills, now being dotted with villas. The water supply is drawn from streams and lakes in the Cascade range by gravity, the sewer system is excellent, and the city is divided into eleven wards. It derives its power for manufactures, for trolley cars, and for lighting, from the falls of the Willamette at Oregon city by electric cable. Portland is the chief city and seaport of the state. Although situated more than 100 miles from the mouth of the Columbia, the largest vessels can reach its wharves, and its foreign commerce is considerable. For the year ending 30th June 1901, its exports, consisting almost entirely of wheat and wheat flour, had a value of $10,381,884. It is the meeting-point of four railways, the Southern Pacific from California, the Northern Pacific from Seattle and the north, the Astoria and Columbia river from the west, and the Oregon Eailroad and Navi- gation Company from East Washington and Oregon. The latter line brings to Portland for shipment the enormous wheat crop of southern Washington and north-

eastern Oregon. It has regular steamship lines to San Francisco, to Puget Sound, Alaska, China, and Japan. The volume of business may be summarized by the state- ment that in 1898 the exchanges at its clearing-house aggregated $94,572,454. The number of manufacturing establishments in 1900 was 1064, with a total capital of $13,331,500. They employed 8572 hands, and the pro- duct was valued at $23,451,132. The chief industries, with the value of their products, were lumber and timber, $3,539,268 ; flouring and grist mill products, $1,759,262 ; and slaughtering andmeat-packing (wholesale), $1,306,996. Among the many fine buildings may be mentioned the

magnificent new Union dep5t, the Portland Hotel, the Oregonian Building, the Chamber of Commerce, and the City Hall. Among the institutions of the city is the Pm-t- land Oregonian, one of the best-known newspapers of the West. The assessed valuation of real and personal prop- erty in 1900, on a basis of about one-fourth of the full value, was $29,554,209. The net debt was $5,631,548, and the rate of taxation $36 per $1000. Population (1890), including that of Albina and East Portland, since annexed, 62,046; (1900), 90,426, of whom 25,876 were foreign-born and 9812 coloured, including 775 negroes. There were 23,211 persons of school age (5 to 20 years). Of 38,353 males 21 years of age and over, 3251 were illiterate (could not write).

Portland Canal, a typical fjord on the north-west coast of America, leading from Dixon's Entrance in 54Â° 40′ N. north-eastwards and northwards for a distance of some 80 mUes, with an average width of a mile and a half north of lat. 55Â°. The lower portion, commonly known as Portland Inlet, is divided by islands on the northern side, receives from the eastward the estuary of the Nasse river, and sends out an arm called Observatory Inlet, 40 miles long, to the north-east, which is divided from Portland Canal by a peninsula terminating at Point Eamsden. These inlets were discovered and named by Vancouver in 1793, and surveyed again by Staff Com- mander Pender in 1868. The water is deep, and the shores are for the most part precipitous and bordered by mountains from 3000 to 6000 feet in height. There are no settlements on the canal except those of the Nasse river Indians. The canal derives its interest from the fact that its mid-channel line,

according to the treaty of 1825 between Great Britain and Eussia, forms the boun- dary between Alaska and British Columbia.

Portland, Isle of, a peninsula and town of England, projects from the south coast of Dorsetshire, 4 miles south of Weymouth and 50 miles by rail south- west from Southampton. The harbour of refuge, and the gigantic moles by which it is enclosed, are described under Dockyards. Population (1891), 9443 ; (1901), 15,262.

Port Louis. See Mauritius.

Port Mahon, or Mahon, a seaport and the capital of the island of Minorca. Its population in 1897 was 17,790. Mahon is still the principal quarantine station of Spain, with a large lazaret. The bay and splendid roadstead cause it to be frequently visited by Spanish and foreign fleets. The modern buildings are a town hall, military and civil hospitals, the Coliseum Theatre, the institute and primary schools, the public library, the museum, a few parish churches that have been restored, and the Government House. The trade is important. The imports in 1898 amounted to Â£133,596, and were mainly cement, coal (chiefly from England), flour, iron, raw cotton, hides, and machinery. The exports, princi- pally live stock, bread-stuffs, agricultural products, shoes, and cotton stuffs, were valued at Â£127,772. The shipping returns showed that 165 vessels entered and 136 cleared, mostly Spanish.

Porto Alegre, a city of Brazil and capital of the state of Eio Grande do Sul, at the head of the Bay of Patos and the mouth of the Pardo river. Owing to the shallowness of the bar at the mouth of the lagoon and the temporary closing of the custom-house (re-opened in 1900), the trade of the port is not in a flourishing condition. The bar, too, is rapidly increasing in height, for whereas in 1898 the average depth of water was 16i feet, in 1900 it was only 15^ feet. Important works are contemplated to improve the port. The exports, chiefly lard, jerked beef,

salt pork, liides and leather, and manioc flour, vary be- tween Â£560,000 and Â£630,000 annually. The greater part of the trade is with other Brazilian ports, and with Hamburg, New York, and Great Britain. Amongst its public institutions counts a school of engineering and an efficient fire brigade. A successful exhibition of industrial and other products was held here in 1901. Population (1890), 62,-421; (1900, estimate, probably too high) 100,000, including 10,000 Germans.

Porto Empedocle, formerly Mold di Giegbnti, a seaport town of the province of Girgenti, Sicily, Italy, 6 miles by rail south-west of Girgenti. It exports large quantities of sulphur, the total export increasing from Â£371,800 in 1888 to Â£792,400 in 1898. The other ex- ports are chiefly almonds (Â£60,000 in 1897 and Â£42,000 in 1898). The total exports rose from Â£387,000 in 1888 to Â£774,600 in 1898. The imports increased in the aggregate from Â£10,350 in 1888 to Â£60,000 in 1898. The port is protected by two breakwaters, and affords a depth of 17^ to 12\ feet. Vessels load and unload from and into lighters. It was cleared by 1322 vessels of 323,120 tons in 1898. The inhabitants carry on fishing and fish-curing, especially of anchovies and sardines, and there are quarries of calcareous tufa. Population, about

7500.

Port of Spain. See Trinidad.

Porto Maurizio, capital of the province of the same name, Liguria, Italy, on the north shore of the Gulf of Genoa, 71 miles by rail south-west of Genoa. It is visited for sea-bathing, and possesses a school of navi- gation and a meteorological observatory. It has trade in olive oil. In 1897 the port was cleared by 198 vessels of 68,096 tons. Population (1881), 6591 ; (1901), 7207.

Porto Rico, or Puerto Eico (“Eich Harbour”), the most easterly and fourth in size of the Antilles, situated between 17Â° 50′ and 18Â° 30′ JST. and 65Â° 35′ and 67Â° 10′ W., roughly rectangular in shape, being 108 miles long and 37 broad, and with an area of 3560 square miles.

Population. â€” In 1900, the people, almost entirely natives, numbered 953,243. They are divided into a better class of whites of Spanish descent, which constitutes the com- mercial, professional, and planter element, and a lower class of peasants, known as gibaros, which includes whites, people of mixed blood (coloured), and blacks, and consti- tutes the labouring and agricultural element. Among the gibaros there were many traces of the aboriginal Borin- quens or Boricuans, who were absorbed into the Spanish cult by the application of the Encomienda in 1512. Of the total population, 589,426 are white and 363,817 black and coloured. N"early all the people are Roman Catholic in religion and Spanish in language, customs, and dress. The density of population is about 226 to the square mile, and the island presents a continuous series of farms and small villages. The lower classes generally are indolent and thriftless. The question of education was neglected under the Spanish dominion, and the proportion of persons unable to read or write (75 per cent, of these over 10 years of age) is unusually large. The scattered character of the population accounts to some extent for the absence in the past of any effective educational system for the lower classes. The clergy have from time to time attempted to cope with these difficulties, but without any marked degree of success. The United States Government since its occupation has initiated a comprehensive and thorough system of public schools directed by duly qualified teachers, and attendance is compulsory. The cost of these schools is defrayed by the State.

Imhistries. â€" One of the principal industries is the j)ro-

duction of coffee. There are approximately some 110,000 acres under cultivation, and the area is increasing. It is of high quality, and the prices realized are much greater than for the Brazilian article. The coffee plantations are as a rule situated on the higher lands in the interior of the island, where the climate is temperate and healthy. The amount available for export in average years is 26,000 to 27,000 tons. Excessive rain or unusually dry weather seriously affects the yield. Little attention is paid r.o scientific methods of cultivation. The preparation of the bean for the market is also carried out in a slovenly manner. Labourers on the plantations earn an average wage of 50 cents

a day in Porto Rican money, equal to a little less than two shillings. Some foreign capital is invested in the industry besides that belonging to Span- iards, who own, however, most of the larger estates not in the hands of natives. A few plantations are owned by British subjects.

The swgar industry showed fairly good prospects in 1902, chiefly owing to the small intrinsic value of the wage rate and the advantage the producer gains from the removal of the American duties. The majority of the plantations are on the lower lands near the seaboard, where the ground allows of easy ploughing. The great central – factories common in Cuba are nowhere found. The sugar available for export amounts to some 60,000 tons an- nually, the greater part being sent to the United States. Pv,um of excellent quality is largely manufactured, and finds a ready sale in European markets. A considerable amount of foreign capital, some of it British, is invested in the sugar industry. Several properties changed hands after the island became a colony of the United States, the buyers being Americans.

Cacao is also cultivated to some extent. The bean is exported in its natural state, and also as manufactured chocolate. There is room for a great extension of this industry, lands suitable for plantation being abundant and reasonable in price, and the demand for the product showing a steady increase in the United States. The principal plantations are situated in the valleys, at no great height above sea-level, where the climate is moist and warm, and the trees are sheltered from the prevailing winds.

Tobacco is largely grown, both for local consumption and for export. The quality is, however, inferior, although seed is annually brought from Cuba. Cigar and cigarette manufactories are established in all the larger towns. It has been stated by experts that with more attention to the curing of the leaf the quality could be much improved.

Cattle-farming is an important source of wealth, the number of animals in the island being estimated to exceed 400,000. Cuba was a purchaser of the surplus stock, and a market was also found in Barbados and other West Indian islands. In 1896 the value of the live cattle exported was $139,000, and this has since increased con- siderably. Hides are

shipped to the United States and Spain, and have constituted a regular article of trade with these countries for many years. Little attempt has been made to improve the breed of cattle.

Commuiuaiflons. â€” Porto Rico requires both railways and roads for the proper development of its resources. In all there were l.'>7 miles of railway open to traffic in 1902, and other lines were under construction. San Juan is connected with Arecibo by rail, and Ponce with Mayaguez. The railway system was built by a French company under a concessionfrom the Spanish Government, by which interest on the capital invested was guaranteed. An excellent road with easy gradients runs from San Juan across the island to Ponce, passing through the towns of Caguar, Cayey, Aybonito, and Coamo. The distance from San Juan to Ponce is 90 miles, the journey in a carriage usually occupy- ing 12 hours. This road was built by the Spanish author-

ities for military purposes, and similar works in other sections of the island were in progress when the war broke out. In 1898 there were 470 miles of telegraph open to public service. A submarine cable connects San Juan with St Thomas and Jamaica, and thence with the outside world.

Finance and Commerce. â€” There is no public debt, the revenue obtained under Spanish administration having been sufficient to balance expenditure. In the year from 1st July 1894 to 30th June 1895 the receipts and ex- penses were returned as : â€”

Kevende.

Expenditure.

Property taxed $1,045,417

General expenses

1715,297

Customs duties . 2,904,138

Justice and worship

368,953

Stamps . . 318,747

War

1,142,906

National properties 17,887

Marine

255,555

Miscellaneous . 168,771

Finance .

160,479

Interior .

702,014

Public works . Total

558,667

Total . . #4,464,960

13,903,871

The currency was the silver dollar coined specially for use in Porto Eico, and exchange in 1898 averaged $11 to one sovereign. The United States authorities have brought the currency to a gold basis. The foreign trade in 1896 amounted to $33,246,000, the value of the imports being $17,446,000, and of the exports $15,799,000. In 1896 the amount was $37,953,000, distributed as follows : â€”

Countries.

Imports,

Exports.

Spain .

. 16,188,000

15,480,000

Great Britain

. 2,350,000

144,000

Prance .

299,000

2,701,000

Germany

. 1,344,000

1,954,000

TJnited States

. 4,118,000

2,645,000

Cuba .

718,000

4,014,000

Britisii Colonies .

. 2,734,000

298,000

Other countries

. 1,195,000

1,771,000

118,946,000

$19,007,000

The principal articles exported in 1896 were coffee to the value of $13,864,000, sugar to the amount of $4,242,000, and tobacco worth $423,000. The principal imports are textiles, rice, flour, provisions, oils, hardware, machinery, and wines. In 1896 the number of vessels calling at Porto Eico was 1142, with a tonnage of 1,407,240. The number sailing from the island was 1116. Oranges, bananas, pine-apples, and many other tropical fruits grow to perfection, and can be delivered in the United States in four days, the distance from San Juan to New York being only 1420 miles. The demand for fruit in that market, especially during the winter months, is practically unlimited.

Towns and Cities. â€” The Americans found seventy-one municipalities in Porto Eico, including many cities and villages. These were all either

agricultural centres or ship- ping places, which had little commerce with one another, owing to the difl&culties of inland communication. All were built upon the Spanish plan, with public edifices massively constructed of mamposteria, and had paved streets, central plazas, and gardens. Some of them dated back to 1511. San Juan (27,000), on the north side, was the political capital ; Ponce (42,389), on the south side, the largest commercial city ; and Mayaguez, on the west side, the abode of wealthy planters and an important seaport. Arecibo (26,000), Aguadilla, Guayama (the seaport of which is Arroyo), and Humacao (12,000) were capitals of departments which bear their names, and Naguabo and Fajardo, in Humacao, smaller maritime cities of the second class, of from 6000 to 15,000 population. Each transacted considerable foreign commerce by means of steamers and

sailing ships. Sabana Grande, Yauco, JuanarDias, and Salinas, on the south side, are small commercial towns of less than 10,000 peojjle each, situated near the foot of the mountains a few miles from the south coast. Adjuntas, Aguas Buenas, Aybonito, Caguas, Cidra, Cayey, Juncos, Las Marias, Lares, Moca, San Sebastian, and Utuado are neat country towns of 6000 people each, more or less, situ- ated in the coffee districts of the central mountains. They are essentially agricultural towns, Cayey and Caguas being chiefly dependent upon the surrounding tobacco farms. Many of the villages, like Lares, were handsome and well improved. Each had an imposing church and ayunta- miento. With the exception of Caguas, Aybonito, and Cayey, which are situated upon the macadamized high- ways, they were almost inaccessible except by pack trains. History. â€” During the great Spanish-American uprising at the beginning of the 19th century, and the various Cuban insurrections, Porto Eico exhibited slight sympa- thetic signs of unrest ; but Spain was always kinder to this island than to Cuba, and met these disturbances by enact- ing conciliatory legislation. Between 1815 and 1820 a Junta was formed of Eepublicans, who later declared inde- pendence. Governor de la Torre took prompt action, and restored tranquillity in 1823. Many of the leaders were executed. During the ten years' war in Cuba the Porto Eico Eepublicans again attempted an uprising. In 1868 there were insurrections at Ponce, Bayamon, and Arecibo, but these were quickly

suppressed. A result of the last outbreak was the passage of a measure by the Spanish Cortes, in 1860, which took away the colonial character of the island and made it a political province and organic part of Spain. The province was divided into seven departments for convenience of central administration, while the old municipalities continued to constitute the units of local government. The island was given repre- sentation in the Spanish Cortes by five regular Deputies and two Senators, elected upon the same suffrage as those in Spain. With the outbreak of the last Cuban revolution in 1896 the insurrectionary spirit again became noticeable. The Spanish garrisons were increased and the island vol- unteers strengthened. Many arrests were made, and suspects fled to the United States and Mexico. An insur- rectionary Junta was maintained in New York. In 1897 the Spanish Prime Minister, Canovas, instituted a system of reform called provincial autonomy, which was, however, merely a matter of form, the island being governed, as of old, by the representatives of the Crown at San Juan. When, in April 1898, war was declared between Spain and the United States, the Spanish naturally expected that Porto Eico would be assaulted, and the island was strongly gar- risoned. In July 1898 the American army reached the island, and was received with a patriotic outburst of welcome by the Porto Eicans that surprised Americans and Spaniards alike. The people, it seems, like those of all other Spanish-American countries, looked upon the American flag as the symbol of democracy and Eepublican government, and expected that it would bring to them, as General Miles at the time told them it would, all the privileges of other citizens of the United States. When war broke out. General Macias was the Spanish captain- general. He was without adequate means of defending the colony in the event of any serious attack . on the part of the United States. In the har- spanish- bour of San Juan were a few antiquated cruisers American and one first-class torpedo boat, the Terror. ”’^’” The latter properly belonged to the squadron under Admiral Cervera. The fortifications, especially at San Juan, were of old-fashioned massive stone construction, and most of the artillery was of an obsolete type. A few earthworks were thrown up for the defence of the capital, and orders were given to the troops in the various coast

towns to report immediately any indication of the appear- ance of the enemy. General Macias then waited quietly for developments. On 12th May an American squadron, under the command of Admiral Sampson, appeared off San Juan and bombarded the forts. Having satisfied himself that the squadron under Admiral Cervera was not in the harbour, the American commander withdrew. No great damage was effected by the shells from the American ships, but the fire of the Spanish guns was silenced and a panic was created in the city. On 22nd June the United States converted cruiser St Paid appeared off San Juan, having been detailed to watch the seas in that direction. The Spanish gunboat Isabella II. and the torpedo boat Terror were ordered by General Macias to put to sea and attack the American vessel. The St Paid was armed with ten 6-inch quick-firing guns, and a secondary battery of three- and six-pounder Hotchkiss and Gatling guns. The Isabella II. soon retired, but the Terror approached within 1600 yards of the St Paul. The American vessel had been holding her fire while the Spaniard was attempting to reach her, but suddenly opened with a broadside, and continued firing rapidly. The Terror was struck by a shell, which exploded on board; but she managed to steam back into the harbour, the St Paul not attempting to pursue. The residents of San Juan fled in large numbers from the town, and did not return until after the protocol of peace was signed in August. All communica^ tion was cut off between Porto Kico and the outer world ; but the food supplies were fairly abundant, and little real distress prevailed. No change occurred in the situation until 26th July, when a United States fleet appeared off the southern coast, San Juan being also threatened by a small squadron. A bombardment of the Playa, the port of Ponce, then took place. While this was in progress, an expedition of United States troops was landed at Guanica, fifteen miles to the eastward, the small Spanish garrison of which surrendered. A movement of the American troops was then made towards Ponce, which capitulated without resistance on 28th July. General Miles, the commander-in-chief of the United States army, was in command of the forces, and was assisted by Generals Brooke, Ernst, Schwan, Henry, and Wilson. The first expedition disembarked consisted of 3415 officers and men, but

reinforcements arrived immediately after the first landing and brought the number up to 10,000 in round figures.

The Spanish forces in the southern section of the country were ordered to fall back towards the ridge of mountains intersecting the island from east to west, and a little to the north of the town of Coamo. This was a strong position, and her-e General Macias deter- mined to endeavour to check the American advance. Eeinforcements were brought up from San Juan, and all preparations made to resist an attack. General Miles advanced towards the Spanish position, and occu- pied Coamo after a sharp skirmish. Other movements were in progress, when the peace protocol was signed on 12th August, and orders were at once issued to sus- pend hostilities. The section of the island occupied by the Americans remained under the jurisdiction of the United States military authorities, while to the north the Spaniards remained in possession. This condition of affairs continued during the arrangements for the evacuation of the island by Spain. The total loss on the American side in the campaign was three killed and forty wounded. The Spanish casualties were somewhat greater, but were not heavy.

The commissioners appointed to arrange the evacuation of the island were Admiral Schley, General Brooke, and General W. Gordon for the United States ; and Admiral Villarino, General Ortega, and SenorDellagiulia for Spain.

The meetings of the Commission began early in Septem- ber, and continued regularly for six weeks. It was arranged that the Spanish troops should be concentrated at San Juan for embarkation. As the Spaniards with- drew from the positions occupied, American troops were detailed to garrison the different towns. While the evacuation was taking place, disturbances occurred at various points, owing to certain natives having insti- gated their neighbours to revenge themselves on Span- ish civilians. The United States military authorities were prompt in quelling these outbreaks ; and when it was understood that the first person found implicated in these attacks would be shot or hanged, the trouble practically ceased. By the beginning of October the greater portion of the island had been evacuated by the Spaniards ; and on

16th October 1898 Captain- General Macias embarked for Spain, leaving General Ortega to make the final delivery of the island to the American authorities. On 1st January 1899 the sover- eignty of Spain, which had dominated the island for four hundred years, was formally transferred to the United States.

Pending the action of Congress, the island was tem- porarily placed under a military government, presided over by the commanding officer of the military de- partment of Porto Eico, General Guy V. Henry, '^^Â° to whom any one treated unjustly had the right Ameri^ of appeal. The four Spanish insular bureaus depend- of administrationâ€" State, Justice, Treasury, and ^'"^â– Interior, each under a prominent citizen â€" were continued. The old municipal local governments and Spanish laws remained as before and were not interfered with, except in cases of notorious corruption or injustice. In August 1899 a tropical hurricane of unusual severity devastated the island. Towns, estates, and habitations were destroyed in a day, and thousands of people were reduced to de- pendence. In Arecibo alone 640 persons were killed by falling houses or masonry thrown down by the wind. The total loss of life was reported to be nearly 6000 persons. The administration of General George B. Davis, who succeeded General Henry shortly after this event, was largely devoted to alleviating the suffering. Over $6,000,000 was expended by the Government of the United States.

Meanwhile the people of Porto Eico awaited patiently the action of the American Congress, which alone had power under the Constitution to devise for them a territorial form of government. The old 'l*'^,' Spanish tariff laws were still in force, and the and cMi island suffered a heavy loss of trade, due to the govern- fact that the customs laws of both Spain and the "'' United States were operative against it. The commercial conditions during this interval were well described by the President in his annual Message of 1899, in which he said : " Since the cession, Porto Eico has been denied the principal markets she had long enjoyed, and our tariffs have been continued against her products, as when she was under Spanish sovereignty. The markets of Spain are closed to her products except upon terms to which the commerce of all nations is subjected. She has therefore lost her free intercourse with

Spain and Cuba, without any conipensating benefit in this market. The markets of the United States should be opened up to her products. Our plain duty is to abolish all customs tariffs between the United States and Porto Eico, and give her products free access to our markets." 'When the American Conoress assembled in December 1899, the problem of a govern- ment for the Porto Eicans quickly came to the front, and unexpectedly resulted in legislation divergent from all traditions and precedents of the American people. A revenue Bill, reported to the House of Eepresentatives

by the Ways and Means Committee, provided for a con- tinuance of a tariff between Porto Rico and the United States. This measure was considered unconstitutional by many, and was so directly in opposition to the President's recommendation, that " it was our plain duty " to give the island free trade, that it resulted in a violent storm of opposing public opinion, which bade fair to wreck the organization of the dominant political party. But in spite of the great sentiment against this proviso, the discipline of the party leaders was so perfect that the measure was forced through the House by a small majority. The Bill made no provision for the government of the island. In President McKinley's Message of 5thDecember 1899 to the fifty-sixth Congress, first session, he stated that it was desirable that the military government should be superseded by an administration entirely civil in its nature, and recommended that Congress pass a law for the organization of a temporary government, which should provide for the appointment by the President (subject to confirmation by the Senate) of a governor and such other officers as the general administration of the island might require ; and that for legislative purposes upon subjects of a local nature a legislative council, composed partly of Porto Eicans and partly of citizens of the United States, should be nominated. In the municipalities and other local subdivisions he recommended that the principle of local self-government be applied at once, so as to enable " the intelligent citizens of the island to participate in their own

government, and to learn by practical experience the duties and requirements of a self-contained and self- governing people." When the House Bill, providing revenues for Porto Pico, reached the Senate, an amend- ment providing for a government of Porto Rico was appended thereto. The Bill as amended then passed and became a law. Under this Act the government of Porto Rico is vested in the hands of a governor, to be appointed by the President of the United States. The governor has absolute power to veto all Acts of the legislature. A legislative assembly, also provided, consists of an Execu- tive Council and a House of Delegates. The Executive Council comprises the Island Secretary, Attorney-General, Treasurer, Auditor, and Commissioners of the Interior and Education, none of whom need be citizens of the island, and five other persons to be appointed by the President, who shall be native inhabitants. The House of Delegates is to consist of five members from each of the seven districts of the island. This legislature is given no authority which the governor has not the power to veto ; and all power whatsoever over the local questions of franchises, rights, provisions, or con- cessions is left solely in the hands of the non-resident Executive Council and governor. The ultimate judicial power is vested in the Supreme Court, to be composed of a Chief Justice, Associate Justices, and a Marshal, to be appointed by the President, who need not be residents of the island. Minor judicial matters remain vested in the courts and tribunals already established. The island is elevated into a judicial district, to be called the District of Porto Rico. The pleadings of the court must be conducted in the English language, and appeals may be taken to the Supreme Court of the United States. A Commission was also constituted to revise the laws of Porto Rico, to consist of three members, one of whom shall be a native citizen. Each commissioner is to receive $5000 per annum, to be paid out of the treasury of Porto Rico, together with an allowance for necessary clerks and other assistance. The Act did not give Porto Rico a territorial delegate to Congress, as has heretofore been provided in the case of new territorial organizations ; but the island is allowed a resident commissioner at Washington, who is to receive $5000 per annum. The Act leaves no substantive author-

ity whatever in the hands of tlie people of the island, and does not give them American citizenship. Under the law, furthermore, all administration officials may be Americans, with the exception of the five native members of the Council and the thirty-five members of the House of Delegates. The form of government greatly resembles that of the British Crown Colony of Jamaica.

On 1st May 1900, Mr Charles A. Allen, who had been appointed the first American civil governor of Porto Rico, was installed in office at San Juan. Under his adminis- tration the island became peaceful, and prosperity was attained through the removal of duties by executive pro- clamation of President McKinley.

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Portovenere, a town and summer resort of the province of Genoa, Liguria, Italy, at the southern ex- tremity of the peninsula which protects the Gulf of Spezia on the west, 7 miles south of Spezia. It still retains portions of the fortress and walls with which it was provided by the Genoese in 1113; also of the church of St Peter (1118, destroyed by the Aragonese in 1494), which is reputed to occupy the site of a temple of Venus (whence Partus Veneris). The parish church dates from 1139. Here is the cave in which Lord Byron was in- spired to write The Corsair. To the north of the towns is the Varignano lazaretto, where Garibaldi was impris- oned in 1860 and 1867. Marble and building-stone are quarried, and oysters are caught. Population, about

4000.

Portraiture. â€” The earliest attempts at individual portraiture are found in the eidolon and mummy-cases of the ancient Egyptians; but their painting never went beyond conventional representation â€” mere outlines filled in with a fiat tint of colour. In Greece portraiture prob- ably had its origin in skiagraphy or shadow-painting. The story of the Greek maiden tracing the shadow of her departing lover on the wall points to this. The art developed rapidly. In 463 e.g,, Polygnotus, one of the first Greek painters of distinction, introduced individual por- traiture in the decoration of public buildings, and Apelles nearly a century later showed so much genius in rendering character and expression, that Alexander the Great ap- pointed him ” portrait painter in ordinary,” and issued an edict forbidding any one else to produce pictorial repre- sentations of his majesty. Similar edicts were issued in favour of the sculptor Lysippus and Pyrgoteles the gem engraver. No works of the Greek painters survive, but the fate of two portraits by Apelles, which were in the possession of the Emperor Claudius (a.d. 41-54), is known,

the heads having been painted out to make room for the features of the divine Augustus !

After the time of Alexander (300 b.o.) Greek art rapidly deteriorated. There is, perhaps, nothing in the history of human intelligence to compare with the dazzling swiftness of its development or the rapidity of its decline. War vs^as followed by pillage and devasta- tion, and victorious Roman generals, mere depredators and plunderers, crowded Eome with the stolen treasures of Greece, with the result that Greek art and Greek influence soon made themselves felt in the imperial city, and for generations its artists were almost exclusively Greeks, chiefly portrait painters and decorators. The Romans possessed no innate aptitude for art, and rather despised it as a pursuit little becoming the dignity of a citizen. Although lacking in appreciation of the higher conditions of art, they had from early times decorated their atria with efiigies â€" originally wax moulds â€" of the countenances of their ancestors. These primitive " wax- works " ultimately developed into portrait busts, often vivid and faithful, the only branch of art in which Rome achieved excellence.

With the invasion of the Northern barbarians and the fall of the empire Graeco-Roman art ended. In the follow- ing centuries Christianity gradually became the dominant religion, but its ascetic temper could not find expression in the old artistic forms. Instead of joy in the ideals of bodily perfection, came a loathing of the body and its beauty, and artists were classed among "persons of iniquitous occupations." Before the 5th century these prejudices had relaxed, and images and pictures again came into general favour for religious uses. In the 8th and 9th centuries the iconoclasts commenced their systematic destruction, and it was not till the Renaissance in the 13th century that art began again to live. The great revival brought with it a closer observation of the facts of nature and a growing sense of beauty, and the works of Cimabue and Giotto prepared the way for those of Benozzo Gozzoli, Ghirlandaio, and the long line of masters who raised Italian art to such a height in the 15th and 16th centuries. Although the works of the early painters of the Renaissance were mostly devoted to the expression of the dogmas of the Church, the growing love and study of nature led them, as opportunity afforded, to introduce portraits of living contemporaries into their sacred pictures. Gozzoli (1420-1498) and Ghirlandaio (1449-1494) began the practice, followed by nearly all the

old and great painters, of introducing portraiture into their works ; Ghirlandaio especially filling some of his great fresco compositions with the forms and features of the living men and women of Florence, members of the Tornabuoni, Medici, and other great families. Acuteness of observation was innate in the race. By degrees it manifested itself in a marvellous subtlety in the render- ing of individual character, in the portrayal of individual men and women, and a school of portraiture was developed of which Titian became the crowning glory. This great Venetian painter, by universal consent reckoned one of the masters of portraiture, has handed down to us the features of many of the greatest historical and literary personages of his timeâ€" Emperor, Pope, King, Dogeâ€" all sat by turn to him and loaded him with honours. The names of Bellini, Raff aelle,Tintoret, Veronese, and Moroni of Bergamo occur among those of the great Italian portrait painters of the 16th and 16th centuries. The last named some of whose finest works are now in England was highly praised by Titian.

A love of ugliness characterizes the artists of the early German and Flemish schools, and most of the portraits produced by them previous to Holbein's time suffei' from this cause. Schongauer, Dlirei', and Lucas Cranacli are

never agreeable or pleasant, however interesting in other respects. Dtlrer, the typical German artist, the dreamer of dreams, the theorist, the thinker, the writer, was less fitted by nature for a portrait painter than Holbein, who, with a keen sense of nature's subtle beauty, was a far greater painter although a less powerful personality. He produced many fine works in other branches, but it is as a portrait painter that Holbein is chiefly known, and his highest claims to fame will rest on his marvellous achieve- ments in that branch of art. He first came to England in 1526, bringing with him letters of introduction from Erasmus. Sir Thomas More received him as his guest, and during his stay he painted More's and Archbishop Warham's portraits. In 1532 he was again in London, where till his death in 1643 he spent much of his time. He was largely employed by the German merchants of the Steelyard and many Englishmen of note, and afterwards by Henry VIII., by whom he was taken into permanent service with a pension. As

a portrait painter Holbein is remarkable not only for his keen insight into the character of his sitters, but for the beauty and delicacy of his drawing. As colourist he may be judged by an admirable example of his work, " The Ambassadors," in the National Gallery in London. Many of his drawings appear to have been made as preliminary studies for his portraits.

In Flanders, Jan van Eyek (1390-1440), his brother Hubert, Quintin Matsys, Memlinc, and other artists of the 15th century, occasionally practised portraiture. The picture of Jean Arnolfini and his wife, in the National Gallery, London, is a remarkable sample of the first-named artist, and the small half-length of young Martin van Nieumenhoven, in the Hospital of St John at Bruges, of the last-named. Nearly a century later the names of Antony Mor (or Moro), Rubens, and van Dyck appear. Rubens, although not primarily a painter of portraits, achieved no small distinction in that way, being much employed by royalty (Maria de Medici, Philip IV., and the English Charles I. among the number). His services were also in request as ambassador or diplomatist, and thrice at least he was sent on missions of that nature. His personal energy and industry were enormous, but a large proportion of the work attributed to him was painted by pupils, of whom van Dyck was one of the most celebrated. Van Dyck (1599-1641) early acquired a high reputation as a portrait painter. In 1632 he was invited to England by Charles I.,~~'and settled there for the remainder of his life. He was knighted by Charles, and granted a pension of Â£200 a year, with the title of painter to his majesty. Many of van Dyck's portraits, especially those of his early and middle periods, are un~~ surpassed in their freshness, force, and vigour of handling. He is a master among masters. England possesses many of his works, especially of his later period. To van Dyck we owe much of our knowledge of what Charles I. and those about him were like. A routine practice, luxurious living, failing health, and the employment of assistants, told upon his work, which latterly lost much of its early charm.

In Holland, in the 17th century, portraiture reached a high standard. A reaction had set in against Italian influence, and extreme faithfulness

and literal resemblance beeamethepreva ilingfashiou. The large portrait pictures of the members of guilds and corporations, so frequently met with in Holland, are characteristically Dutch. The earliest works of the kind are generally rows of portraits ranged in double or single lines, without much attempt at grouping or composition. Later, in the hands of painters like Rembrandt, Frans Hals, and van der Heist, tliesc pictures of civic guards, hospital regents, and masters of guilds assumed a very different character, and

are among the very finest works produced by the Dutch portrait painters of the 17th century. They may be termed “subscription portraits,“â€” each member of the guild who desired a place on the canvas agreeing, before the commission was given, to pay, according to a gradu- ated scale, his share of the cost. Among the most famous examples of this class of portraits are ” The Anatomy Lesson,” Â« The March-out of Captain Banning Kock and his Company” (erroneously called “The Night Watch “), and ” The Five Syndics of the Cloth-Workers’ Guild,” by Kembrandt. The magnificent portrait groups at Haarlem by Halsâ€” the next greatest portrait painter of Holland after Rembrandt â€” and the ” Schuttersmaaltyd ” by van der Heist, in the Amsterdam Museum, which Reynolds considered ” perhaps the first picture of portraits in the world,” must also be mentioned.

Of the pictorial art of Spain previous to the 16th century, little, if any, survives. Flemish example was long paramount, and Flemish painters were patronized in high places. In the 16th century the names of native Spanish artists begin to appearâ€” Morales, Ribera, Zur- baran, a great though not a professed portrait painter ; and in the last year of

the century Velazquez was born, the greatest of Spain's artists, and one of the great portrait painters of the world. ISTone, perhaps, has ever equalled him in keen insight into character, or in the swift magic of his brush. Philip IV., Olivarez, and Innocent X. live for us on his canvases. His constantly varying, though generally extremely simple, methods, explain to some extent the interest and charm his works possess for artists. Depth of feeling and poetic imagina- tion were, however, lacking, as may be seen in his prosaic treatment of such subjects as the "Coronation of the Virgin," the " Mars," and other kindred works in the Madrid Gallery. Velazquez must be classed with those whose career has been prematurely cut short. His works often show signs of haste and of the scanty leisure which the duties of his office of "Aposentador Mayor" left him â€" duties which ended in the fatal journey to the Isle of Rhe.

In France the most distinguished portrait painters of the 16th and 17th centuries were the Clouets, Cousin, Vouet, Philippe de Champaigne, Rigaud, and Vanloo. French portraiture, long inflated and artificial, reached the height of pomposity in the reigns of Louis XIV. and XV., the epoch of which the towering wig is the symbol. In the 18th and early part of the 19th centuries occur the names of Boucher, Greuze, David, Gerard, and Ingres ; but somehow the portraits of the French masters seldom attract and captivate in the same way as those of the Dutch and Italian painters.

Foreign artists were engaged for almost every important work in painting in England down to the days of Sir Joshua Reynolds and Gainsborough. Henry VIII. em- ployed Holbein ; Queen Mary, Sir Antonio Moro ; Elizar beth, Zuechero and Lucas de Heere; James I., van Somer, Cornelius Janssens, and Daniel Mytens ; Charles I , Rubens, van Dyck, Mytens, Petitot, Honthorst, and others ; and Charles II., Lely and Kneller, although there were native artists of merit, among them Dobson, Walker, and Jamesone, a Scottish painter. Puritan England and Presbyterian Scotland did little to encourage the portrait painter. The attitude of the latter towards it may be inferred from an entry in the diary of Sir Thomas Hope, the Scottish Lord Advocate in 1638. " This day, Friday, William Jamesone, painter (at the

earnest desyr of my sone Mr Alexander) was sufferit to draw my pictur." He does not even give the painter's name correctly, although Jamesone at the time was a man of some note in Scotland. At the commencement of the reign of George I., art in England had sunk to about the lowest ebb. With the

appearance of William Hogarth (1697-1764) the English school of painting may be said to have commenced, and in Reynolds and Gainsborough it produced two portrait painters whose works hold their own with those of the masters of the 16th and 17th centuries. Both Sir Joshua and Gainsborough are seen at their best in portraits of women and children.

George Romney (1734-1802) shared with Reynolds and Gainsborough the patronage of the wealthy and fashion- able of his day. Many of his female portraits are of great beauty. For some unknown reason he never exhibited his works in the Royal Academy.

Sir Henry Raeburn (1756-1823) was a native of Edin- burgh, and spent most of his life there. His portraits are broad and effective in treatment, masterly and swift in execution, and often fine in colour. He painted nearly all the distinguished Scotsmen of his time â€" Walter Scott, Adam Smith, Braxfield, Robertson the historian, Dugald Stewart, Boswell, Jeffrey, Professor Wilson, and many of the leading noblemen, lairds, clergy, and their wives and daughters. For a considerable period his por- traits were little known out of Scotland, but they are now much sought after, and fine examples appearing in London salerooms bring remarkable prices. Raeburn's immediate successor in Scotland, J. Watson Gordon (1788-1864), also painted many excellent portraits, chiefly of men. A very characteristic example of his art at its best may be seen in his "Provost of Peterhead" in the Scottish National Gallery.

Sir Thomas Lawrence (1769-1830) was the favourite English portrait painter of his time, and had an almost unrivalled career. He had an immense practice, and between the years 1787 and 1830 exhibited upwards of three hundred portraits in the Royal Academy alone. The Waterloo Gallery at Windsor contains some of his best work, chiefly painted in 1818-19, including his portraits of the Emperor Francis,

Pope Pius VII., and Cardinal Gonsalvi. He was loaded with honours, and died President of the Royal Academy.

Sir J. E. Millais (1829-1896), although most widely known as a painter of figure suljjects, achieved some of his greatest successes in portraiture, and no artist in recent tiines has approached him as a painter of children. His portraits of Mr Gladstone, Sir James Paget, Sir Gilbert Greenall, Simon Eraser, J. C. Hook, and Mrs Bischoffsheim, to name only a few, are alone sufficient to give him a high place among British portrait painters.

Frank Holl (1845-1888) first came into note as a portrait painter in 1878, and during the subsequent nine years of his life he painted upwards of one hundred and ninety-eight portraits, an average of over twenty-two a year. The strain, however, proved too great for a naturally delicate constitution, and he died at the age of forty-three â€” another instance of a brilliant career prema- turely cut short.

It is always a matter of considerable difficulty to estimate the work of contemporary artists, for, owing to its nearness, it is apt to assume an importance which with the lapse of time it loses, but the names of a few of the best portrait painters living in 1902 may be men- tioned, including those of G. F. Watts (b. 1820), to whom we are indebted for admirable portraits of many of the leading men of the Victorian era in politics, science, literature, theology, and art ; Orchardson (b. 1836), like Millais more widely known as a painter of figure subjects, but also admirable as a portrait painter ; Sargent (6. 1866), whose brilliant and vigorous characterization of his sitters leaves him without a rival ; as well as Ouless, Shannon, Fildes, Herkomer, and others, who have worthily carried on the best traditions of the art.

In France contemporary portraiture is ably represented

in the works of Carolus-Duran, Bonnat, and Benjamin- Constant, and in Germany by Lenbach, who has handed down to posterity with uncompromising faithfulness the form and features of Prince Bismarck.

Of portraiture in its other developments little need be said. Miniature painting, which grew out of the work of the illuminator, appears to have been always successfully practised in England. The works of Hilliard, Isaac and Peter Oliver, Samuel Cooper, Hoskins, Engleheart, Plimer, and Cosway hold their own with the best of the kind ; but this beautiful art, like that of the engraver, has been largely superseded by photography and the ” processes ” nowin use. It is unnecessary to refer to the many uses of portraiture, but one of its chief est has been to transmit to posterity the form and features of those who have played a part, worthy or otherwise, in the past history of our race. Of its value to the biographer and historian, Carlyle, in a letter written in 1854, says, ” In all my poor historical investigations it is one of the most primary wants to procure a bodily likeness of the personage inquired after ; a good portrait, if such exists ; failing that, even an indifferent, if sincere one; in short, any representation, made by a faithful human creature, of that face and figure which he saw with his eyes and which I can never see with mine. Often I have found the portrait superior in real instruction to half-a-dozen written biographies, or rather, I have found the portrait was as a small lighted candle, by which the biographies could for the first time be read, and some human interpretation be made of them.” (g. be.)

Port Richmond, formerly a village of Eichmond county, E”ew York, U.S.A., and since 1st January 1898 a part of Kiehmond borough, one of the five boroughs constituting New York city. It is situated on the northerjj. shore of Staten Island, in the south-east part of the state. Population (1890), 6290.

Portrush, a seaport town in the extreme north of Co. Antrim, Ireland. It is very picturesquely situated, and is on the Belfast and Northern Counties rail- way. A fine new hotel and an excellent golf-course are the chief new features, and the place is much frequented both for golf and

sea-bathing. It is also the centre for visitors to the Giant's Causeway, with which it is con- nected by an electric railway (see Electricity Supply, III., vol. xxviii.). There is a thriving trade in salmon. Population, about 2600.

Port Said, a seaport town of Egypt, at the Medi- terranean end of the Suez Canal. Its prosperity is bound up with the traffic going through the Canal ; for statistics, &c., see Egypt. In 1893 it was connected with Ismailia by railway. Population, 37,000.

Portsea. See Portsmouth.

Portsmouth, a municipal, county (1888), and parliamentary borough, seaport, naval station, and arsenal of England, an aggregate of four towns, namely, Ports- mouth, Portsea, Landport, and Southsea, in the south-west of the island of Portsea, Hampshire, opposite the Isle of Wight, from which it is separated by Spithead, 75 miles by rail south-west of London. It is a terminal station of the London and South-Western and of the London, Brighton, and South Coast railways. There are about 20 churches. The new church of St Mary's, or Kingston Church, with a tower 165 feet high, was erected in 1889, at a cost of nearly Â£50,000. Twenty-six board schools include 2 of higher grade, one of them (1896) equipped with chemical and physical laboratories. There are also schools for engineer- ing students and dockyard apprentices. Public build-

ings of modern erection are the town hall (1890), costing Â£140,000, and the Eoyal Hospital (1899). Close to the town hall is Victoria Park (15 acres), with a monu- ment to Admiral Napier; on the north side of it is the still unfinished Eoman Catholic cathedral. Whale Is- land, in Portsmouth harbour, has, by the continuous accretion of excavated mud, grown to nearly 90 acres in area, and is now covered with naval and military buildings. It is proposed to connect the island by a' causeway with the mainland. Between Portsmouth and Portsea is the gunwharf of 14 acres reclaimed from the harbour; the grand depot for ordnance and ammunition, both 'for land and sea service, with an aggregate of about 40,000 stand of arms. A floating bridge (1892), 100 feet in length of hull by 62 feet wide, with capacity for 1400 passengers,

connects Portsmouth with Gosport. There are now only seven barracks, in- cluding the Marine Artillery Infantry barracks at Eastney, beyond Southsea, the Anglesea barracks having been absorbed by the extending dockyard. On the Gosport side of the harbour (see Gospoet) are two barracks â€” making in all nine barracks. An extention of 62 acres beyond the Eoyal Dockyard was determined on by the Admiralty in 1897 for the erection of naval barracks to accommodate about 3000 men. Portsmouth Dockyard covered an area of 294 acres â€” the total area planned out when the extension works were commenced in 1864 â€” by 1890. Since then it has been further enlarged, and is now said to be the greatest dockyard in the world. Down to August 1900 the extension works cost about 2\ millions sterling. Altogether the dockyard comprises 16 dry docks, 2 building slips, 60 acres of enclosed basins, 18,400 feet of wharfage, and about 10 miles of railway, with iron foundry, gun-mounting and boiler-making stores, joinery, mast-house, pump-house, block-making machines, naval college, observatory. Admiralty house, official resi- dences ; sheer, boat-house, south, and troopship jetties, &c. The men employed in the dockyard number about 9800. (See'also Dockyards.)

On the north defensive works stretch nearly 7 miles along Portsdown Hill, with a total barrack accommodation for 3000 men. On the south there are various forts. On the sea face of Gosport, again, the line oÂ£ defence is continued for two miles westwards along Stokes Bay to Browndowu. Thence a line of 5 forts stretches across the marshy ground between the Solent and Portsmouth harbour. On the east side of the harbour other forts take up the defence works of Portsdown Hill and continue the defence south- wards to Hilsea lines, 2800 yards long. The south face of Portsea island is defended by 4 works. There are also forts on the Isle of Wight and a line of forts on shoals between St Helens (Isle of "Wight) and Portsmouth. The shipping registered at the port in 1888 amounted to 262 vessels, of 15,520 tons; in 1900, to 253 vessels, of 13,539 tons. 14,601 vessels, of 1,524,939 tons, entered m 1888; in 1900, 16,743, of 1,851,593 tons. In 1888, 14,130 vessels, of 1,490,163 tons, cleared ; in 1900, 16,552, of 1,800,507 tons. The total foreign and colonial imports tn 1888 were valued at Â£221,797; in 1900, Â£222,174. The total exports amounted to Â£121,022 in 1900. Two daily

newspapers are issued. Area of the municipal and parliamentary boroughs, which are coextensive, 4320 acres. Population ri881V 127.989 â€¢ ClRon i.f;Q9r,i- r^am\

189,122.

Population (1881), 127,989 ; (1891), 159,251 ; (1901),

Portsmouth, a city of New Hampshire, U.S.A., capital of Eockmgham county, on a peninsula at the niouth of the Piscataqua river, in the south-eastern part of the state. The city is irregularly laid out, divided into five wards, and supplied with water from springs by gravity. Though a seaport and the only one in the state, Portsmouth has practically no foreign commerce. It has manufactures, largely of cotton goods and boots and shoes. In 1900 there were 176 manufacturing estab- lishments, having a capital of f4,167,645, employing I. o.if.^^Â®”^^^’Â®’”‘ ^^”^ turning out products valued at *4,813,138. Population (1890), 9827; (1900), 10,637, of whom 2033 were foreign-born and 101 negroes.

POETSMOUT H â€” P 0 R T U G A L

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Portsmouth, a city of Ohio, U.S.A., capital of Scioto county, on the Ohio river, at the mouth of the Scioto, in the southern part of the state, at an altitude of 625 feet. It has a level site on the flood plain of the river, partly enclosed by terraces, is divided into seven “wards, and derives its water supply from the river by pumping. It has three railways, the Norfolk and Western, the Cincinnati, Portsmouth, and Virginia, and the Balti- more and Ohio South- Western, which, with boats on the river, give the city a large trade. It has also extensive manufactures, consisting in great part of iron and steel goods, boots and shoes, lumber, and flour. In 1900 its 284 manufacturing establishments had a total capital of $4,113,700, and employed 4586 hands. Their products were valued at $7,532,976. Population (1890), 12,394 ; (1900), 17,870, of whom 1064 were foreign-born and 947 negroes.

Portsmouth, a city and seaport of Virginia, U.S.A. Though within the limits of Norfolk county, it is not subject to county government. It is situated at the mouth of the. Elizabeth river, opposite Norfolk, in the south-eastern part of the state. It is irregularly laid out on a level site, and is divided into five wards. It shares Norfolk harbour with the city of Norfolk, and has

some commerce by sea. It is traversed by five railways, the Atlantic and Danville, the Atlantic Coast Line, the Chesapeake and Ohio, the New York, Philadelphia, and Norfolk, and the Seaboard Air Line. It contains the works of the last-named line. In 1900 'there were 103 manufacturing establishments, employing 1154 hands. Population (1890), 13,268; (1900), 17,427, of whom 710 were foreign-born and 6625 negroes.

Port Townsend, a city and seaport of Wash- ington, U.S.A., capital of Jefferson county, at the north- eastern point of the Olympic peninsula, in the north- western part of the state. It is at the entrance to Puget Sound, and, as a commanding point, has been fortified by the United States, which has also established there a quarantine station and a marine hospital. The city is well laid out, with a water supply by gravity from Little Quilcene river. It has regular lines of steamers to Sound ports and to Victoria, and is the terminus of the Port Townsend Southern railroad. It is in a lumber region, and its industries consist largely in the sawing and manufacture of lumber. Population (1880), 917 ; (1890), 4658 ; (1900), 3443, of whom 1042 were foreign-born and 218 coloured.

PORTUGAL.

I. Geogeapht and Statistics.

PORTUGAL, one of the two constituent kingdoms of the Iberian Peninsula, lies to the west of Spain, and is washed by the Atlantic for a distance of 473 miles out of a total frontier line of 1076 miles. It is the most westerly country of the continent of Europe.

Orogra/phy. â€” Portugal embraces three mountain sys- tems : (1) the Transmontane, embracing the ranges which lie north of the Douro and stretch through the provinces of Minho, Traz-os-Montes, and a small part of Douro ; (2) the Beirene, comprising the ranges of the two provinces Beira and the province of Douro, lying between the rivers Douro and Tagus ; (3) the Trans-Tagine, or the ranges which lie south of the Tagus. To the Transmontane sys- tem belong the following ranges : Peneda (4728 feet), forming the watershed between the rivers Minho and Lima; Gerez (4817 feet), which rises like a gigantic wall between the Lima and the Homem, and sends off a spur known as the Amarella, Oural, and Nora, parting the Homem from the Cavado; and Cabreira (4196 feet), which gives birth to the Ave, and separates the basin of the Cavado from that of the Tamega. These three main ranges belong to the province of Minho. In the province of Traz-os-Montes these ranges occur : Larouco (5184 feet), which continues the Serra do Gerez, and gives birth to the river Cavado ; Padrella (3776 feet), Villarelho (3668 feet), and Marao (4666 feet), forming an enormous massi/between the rivers Tamega, Tua, and Douro ; and Nogueira (4331 feet) and Bornes (3944 feet), separating the basins of the Tua and the Sabor. To the Beirene system belong the following chains : Montemuro (4557 feet), between the Douro and its left-hand tributary the Paiva ; Gralheira (3681 feet), separating the Paiva from the Vouga, and continued south by the Serra do Caramullo (3511 feet), parting the basins of the Vouga and Dao ; and Lapa (3330 feet), lying to the north-east of the last-named, and giving rise to the Tavora and Paiva (tributaries of the Douro), the Vouga, and the Dao. All these lie north of the Mondego ; south of this river come the loftiest ranges in the kingdom, still belong- ing to the same system, namely, the Serra da Estrella (6539 feet), and Louza (3944 feet), between the Mondego

and the Zezere ; Mesas (3465 feet), the watershed between the Coa and the Zezere ; and Guardunha (4016 feet) and Moradal (3647 feet), separating the Zezere from the Ponsul and Ocreza, right-hand tributaries of the Tagus. The constituent ranges of the Trans-Tagine system are the Serra da Arrabida (1637 feet), between Cape Espichel and SetubaJ ; Sao Mamede (3363 feet), in Portalegre ; Ossa (2129 feet, Monfurado (1378 feet), and Mendro (1332 feet), forming the high

ground between the Sorraia, Sado, and Guadiana. Finally, in the province of Algarve, in the south, a series ~~of low ranges â€" Alcaria do Cume (1716 feet), Malhao (1887 feet), Mesquita, Monchique (with the summit of Eoya, 2993 feet), and Espinhaqo de Cao â€" stretch from east to west, and terminate in Cape St Vin~~ cent. Plains and level expanses are comparatively few, the most notable being the veigas of Chaves and Valenqa^ in the north, the campos of the valley of the Tagus, the haixas of the coast in Alemtejo, the campos of Beja, the baixas of the Sorraia, and the campos of Aviz. To these may be added the high plains known as the cimas of Mogadouro, in Traz-os-Montes, and the cimas of Ourem, east of the Tagus.

Geology. â€" ^Nearly every geological formation is repre- sented in the structure of Portugal. The district of Minho, in the extremenorth, is almost entirely built up of granites, amongst them being granite with white mica and granite with black mica in the valley of the Cavado, and porphy- ritic granite extending from the Minho to the Serra do Marao, and thence passing over into the district of Traz-os- Montes. Between the granites, on the north and south, lie embedded strata of crystalline and Silurian schists, in the middle. The Serra de Padrella is formed of ramifica- tions of the Transmontane granites. In Beira Baixa (pro- vince) granites, irregularly intermingled with schists, compose the great mass of the Serra da Estrella. Jurassic formations predominate in the province of Estremadura, constituting the bulk of the Serra do Bouro, the Serra de Penella, the Serra de Sicd, and the south face of the Serra de Cintra, as well as the peninsula of Peniche. South of Torres Vedras, between the Tagus and the coast. Cretaceous rocks prevail, and along a line drawn from Leiria to Aveiro they are overlain by a Tertiary deposit. In Alemtejo,

although the granite reappears, the greater part of the province consists of schists accompanied by crystalline limestones. In the

southernmost province of Algarve, Cretaceous, Jurassic, and Triassic rocks are all repre- sented. Basalt is encountered near Lisbon, and betv^een that city and Alhandra, Tertiary formations.

Climate. â€” Meteorological observations are taken at eleven stations. Those with the lowest mean temperature are on the Serra da Estrella (44-7Â° F.), atMontalegre (48-3Â°), and at Guarda (50-3Â°) ; those with the highest mean are Lagos (63-5Â°), Campo Maior (60‘9Â°), Evora (61-9Â°), and Lisbon (‘60-5Â°). The greatest daily variations have been registered at Campo Maior (22-8Â°) and Evora (18-5Â°) ; and the least at Lisbon (12-5Â°) and on the Serra da Estrella (11-3Â°). The greatest humidity is at Guarda, the smallest at Campo Maior ; and the heaviest rainfall occurs on the Serra da Estrella, and at Vizeu, Oporto, and Montalegre ; and the smallest at Lagos, Campo Maior, and Moncorvo.

Area and Population. â€” Particulars of the area and population in 1890 and 1900, together with the density in the latter year, are given in the following table : â€”

District.

Area

in

Square

Miles.

Popula- tion,

1890.

Population, 1900.

Density per

Square Mile,

1900.

Males.

Females.

Total.

Aveiro

Beja .

Braga

Braganja .

Castello Branco

Coimbra

Evora

Faro .

Guarda

Leiria

Lisbon

Oporto

Portalegre

Santarem .

Vianna do Cas-

ttUo Villa Real Vizeu

1213 4196 1067 2574 2556 1499 2736 1872 2145 1848 2718 886 2482 2649

866 1717 1920

287,437 157,571 888,808 179,678 205,211 316,624 118,408 228,686 250,154 217,278 611,168 546,262 112,834 254,844

207,866 237,802 .391,015

187,257

81,283 161,727

91,924 105,752 158,545

64,779 127,221 126,618 117,169 360,806 280,370

68,052 189,661

98,766 116,949 186,149

164,924

80,369 195,092

98,662 110,877 179,960

62,458 127,680 186,674 122,998 847,944 321,318

61,645 144,015

120,883 126,635 216,650

302,181 161,602 856,819 185,586 216,629 333,505 127,282 264,851 268,292 240,167 708,760 601,688 124,697 288,676

214,599 248,584 402,799

249 38 888 73 85 222 45 136 122 178 260 680 50 107

248 142 209

Portugal

84,428

4,660,095

2,407,978

2,613,679

5,021,667

146

Angra do Hero-

ismo Horta Ponta Delgada

281 804 387

72,151 58,685 124,758

83,361 24,461 59,208

40,091 30,995 68,858

73,452 56,456 127,566

264

182

878

Azores

922

255,594

117,030

139,444

256,474

278

Madeira (Fun- ohal)

Slo

184,040

72,362

78,266

160,528

477

Grand Total

85,665

5,049,729

2,597,270

2,831,389

6,428,669

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During the period 1878 to 1890 the increase per cent, was -85, and between 1890 and 1900, 7-5 per cent. In 1890 there were 41,339 subjects of foreign countries in Portugal ; and at the same date 3,067,408 of the population (1,507,269 males and 1,560,139 females) were unmarried and 1,669,874 were married, and there were 94,198 widowers and 218,249 widows. The following table shows the movement of the population in continental Portugal and the Azores and Madeira in 1890 and 1896 : â€”

1890.

1896.

Total.

Per Thou- sand.

Con- tinent.

Islands.

Total.

Per Thou- sand.

Births . Deaths Marriages .

164,627

127,237

35,769

32‘60

2519

7-08

144,530

110,970

30,585

13,335 8,761 2,433

157,865

119,731

33,018

31-24

23-71

0-54

Thus the natural increase in 1896 was 38,134, or at the rate of 7-53 per thousand of the 1890 population. Emigration is still rela- tively heavy. In 1890 there were 29,421 emigrants ; in 1895 (an exceptional year), 44,746; in 1898, 23,510. Of the last number, 21,422, or more than 91 per cent., went to America, Brazil being the destination of practically all ; 1854, or nearly 8 per cent., were bound for Africa. From 15 to 20 per cent, of the emigrants are from the Azores and Madeira. Only about one-fifth are females. Government. â€" Various modifications have been made in the con- stitution of the two Houses of Parliament since 1885. Until that year certain members sat in the House of Peers by hereditary

right. It was then decided, however, that such rights should cease, except in the case of princes of the royal blood, with those of the members who then held them, and that when all the hereditary peerages had thus lapsed, the House should be composed of the princes of the royal blood, the twelve bishops of the continental dioceses, a hundred legislative peers appointed by the king for lite, and fifty elected every new Parliament by the deputies of the Lower House. A

further modification was decided on in 1895, when the number of life peers was reduced to ninety and the elec- tive branch was abolished. The House of Deputies was reconsti- tuted in 1899, when all citizens 21 years of age who could read and write, or who paid taxes to the value of 500 reis (except non-com- missioned soldiers, Government workmen, domestic servants, &c.), were declared qualified electors. The House is composed of 145 deputiesâ€" six from Lisbon, three from Oporto, one from each of 129 *>ther electoral districts into which the mainland, the Azores, and Madeira are divided, and seven from the colonies. Both life peers and deputies must possess certain qualifications. Besides the courts of appeal at Lisbon and Oporto, there is a third at Ponta Delgada (Azores). About 17,500 persons, of whom some 20 per cent, are women, are, on an average, annually convicted of crime, the proportion of convictions thus being about 1 in 300 inhabitants.

Beligion. â€" Not only is Roman Catholicism the State religion of Portugal, but it is professed by nearly all the inhabitants ; Pro- testants do not number more than 500. The total income of the upper hierarchy of the Church is estimated to be about Â£70,000.1

Education. â€" The law making primary education compulsory pro- vided there be a school within a mile, is not stringently enforced, and in 1890, nearly 50 years after the passing of the Act, 79-2 per cent, of the total population could not read. In the same year the children attending primary schools formed less than 1 in 20 of the population ; there were 5339 primary schools (3864 public), with 237,783 scholars (152,707 boys and 85,076 girls). In 1357 communes there were no primary schools. By 1899, however, 619 additional public primary schools had been established. The system of second- ary education was improved and set upon a sound basis in 1894. New state lyceums have been established since 1885 at Amarante, Guimaraes, and Lamego, and these, with the district lyceums, were attended in 1898 by 3976 pupils. Private secondary schools afiord- ing a general education are numerous, and there are 18 theological seminaries, with (1897) 2262 pupils. Technical and commercial schools number about 30 and educate over 4000 scholars, while special mention may be made of a college for those who intend to go into the army. Under the head of

secondary education, also, notice may be taken of the increase in the number of training colleges for primary school teachers, and of the pilot schools established at Lis- bon, Oporto, Faro, and Ponta Delgada (Azores). In addition to the institutions for higher education mentioned in the ninth edition of this work, there are military and naval colleges, a high school of letters, a second school of fine arts (at Oporto), and a conservatorio at Lisbon for music and dramatic art. At the University of Coim- bra there were 1429 students in 1900. According to the Budget of 1898-99, the total Government expenditure on education in that year was over Â£282,200, of which about Â£20,260 was expended through the "War and Marine ministries.

In 1891 the financial condition of the kingdom had become so serious that the public debt had to be reorganized. A marked improvement was subsequently observed. While the â€ž revenue increased very considerably, the expenditure r nance. had not up to 1901 grown to any appreciable extent, and though it always exceeded the revenue, the deficits were much smaller than was formerly the case. In 1891-92 the revenue was Â£8,587,380 and the expenditure Â£12,210,460. Between then and 1901 the worst financial year was 1896-97, when the revenue had increased to Â£11,287,955 and the expenditure stood at Â£12,946,820. The Budget estimates for 1900-01 were as follows : â€"

Kevenue.

Expenditure.

Direct taxes . . Â£2,722,080 Indirect taxes . 5,398,680 Additional taxes . 244,155 Registration and

stamps . . 1,223,555 Receipts d'ordre . 974,016 National property

and sundries . 77'.V"!20

Consolidated debt Â£4,434,243

Loss on exchange 111,111

Sums voted for the several ministries 4,986,296

Civil list, Cortes and various . 2,172,212

Deposit and Con- signment Office . 16,408

Total ordinary Â£11,341,805 Extraordinary . 255,555

Total ordinary Â£11,719,270 Extraordinary . 469,384

Total . Â£12,188,654

Total Â£11,697,360

1 Throughout this article 4i milreis (thousand reis) has been taken as the equivalent of one pound sterling.

JEOGEAPHY AND STATISTICS]

PORTUGAL

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Thus the deficit on the Budget of 1900-01 was only a little over half a million sterling, compared with more than 3J millions in 1891-92 and more than li million in 1896-97. The outstanding debt in 1899 was estimated to be â€”

Total external Â£62,901,275

Internal, 3 per cent, (quoted in London) 58,951,812

Total . . . Â£121,853,087

Also outstanding â€”

Internal, at 4 and 4 J per cent. . . . Â£6,143,426

Â£2,318,819 of the external debt and Â£27,579,446 of the in- ternal debt â€” total, Â£29,898,265 â€” was stated to be in the hands of Government. The floating debt in 1899 amounted to Â£9,738,350.

The IPortuguese army is maintained at its normal strength partly by conscription, the chief law regulating it being that of 1887 as , variously modified in subsequent years. The Cortex

ence. g^^g ^j^g number of conscripts to be enrolled in each year (in 1899, 16,500 for the army, 200 for the navy), and with certain exceptions all men over 21 years of age are liable for service â€” 3 years in the regular army, 5 years in the first reserve, and 7 years in the second reserve. In time of peace the effective force of the reg- ular army is 1723 officers, 29,703 men, 5404 horses and mules, and 144 guns ; that of the reserve troops is 81 officers and 297 men, making the total number of officers 1804 and of men 30,000. In time of war the regular army has an effective force of 2029 officers, 82,843 men, 10,736 horses and mules, and 216 guns ; while the reserve forces can muster 1447 officers, 62,796 men, 5113 horses and mules, and 96 guns, making a total effective force of 3476 officers, 145,639 men, 15,849 horses and mules, and 312 guns. In time of war, also, the municipal guards, numbering 80 officers and 2176 men, and the fiscal guards, numbering 136 officers and 5619 men, may be incorporated in the army. The Portuguese navy is being gradually increased, and in 1901 consisted of 1 armoured vessel, 5 protected cruisers, 3 third-class cruisers, 21 gunboats, 2 destroyers, 4 torpedo boats, 21 river gunboats, 5 steamers, and 4 training ships. The whole fleet was manned by about 5000 men.

Minerals. â€” Coal is scarce, and, owing to that fact and to the lack

of cheap transport, the mines still remain to a large extent un-

worked. In 1899 the principal products were copper ore

Production (ggg^ggo tons, value Â£212,698) ; anthracite and lignite

(10,942 tons, value Â£10,178) ; lead ore (1866 tons, value

Â£8411) ; and iron ore (11,169 tons, value Â£7066). The

market value of the total output was Â£285,887.

Agriculture. â€" In spite of the great improvement in roads and in agricultural training and agricultural machinery during the last quarter of the 19th century, it is estimated that from 5 millions to 10 millions of acres of land are still uncultivated, notably large tracts in Alemtejo and Traz-os-Montes, and in the higher parts of the mountains. Owing to this fact, the very large proportion of 45-8 per cent, of the country is classed as "waste " in the returns. Notwithstanding this, more than 65 per cent, of the population are agricultural, and agricultural products constitute more than 60 per cent, of the exports. But Portuguese agriculture is not in a flourishing condition. Wages have nominally increased, but the effects, so far as the workers are concerned, have been neutralized by the high protective duties. Other retarding influences are the lack of education, ignorance of modern methods of agriculture, and a slowness to adopt modem maohineiy ; these are all in addition to the hampering conditions of heavy landed mortgages and scarce and dear capital. The branches of agriculture in which there is the greatest amount of energy and enterprise are wine- growing, the production of fruit and vegetables (especially in the south) , and cattle-breeding. Olive trees abound, and large quan- tities of oil are manufactured, though in an unscientific way. The country may be divided into four agricultural divisions : (i.) the north, producing millet and other cereals and cattle ; (ii.) the centre, producing millet, wheat, and rice ; (iii.) the south, pro- ducing wheat and pigs; and (iv.) the mountainous regions, in which rye is the chief crop and the breeding of live stock the chief occupation. In divisions (i.) and (iii.) large estates are the rule ; small estates in divisions (ii.) and (iv.). Of the whole area of the country, 26-7 per cent, is pasture and fallow ; 12-5 per cent, under Cereals ; 7-2 per cent, under fruit trees ; 2-9 per cent, under forests; 2-7 per cent, under pulse and other crops; and 2-2 per cent, under vineyards, all these areas forming the 54-2 per cent, of the country not returned as waste. The average annual yield of cereals is estimated as follows : wheat, 5,670,900 bushels ; millet, 11,729,550 bushels; rye, 4,678,850 bushels;

barley, 2,693,800 bushels; and oats, 797,500 bushels. The yield of potatoes aver- ages 120,108 tons annually, and of beans, 18,103 tons. Wine, however, though vineyards cover a relatively small area, is still the most important product. Attempts have been made to find foreign markets for the great quantity of light cheap wine which has always been made in Portugal, for since 1886 greater care has

aad In- dustry,

been given to the manufacture, so as to produce good sound wine of the nature of claret and hock. In 1900, while 6,057,000 gallons of port wine and 576,450 gallons of Madeira were ex- ported, the export of the lighter Portuguese wines amounted to 11,597,200 gallons. In 1892 the produce amounted to 79,336,360 gallons, valued at Â£3,495,150 ; by 1898 the figures had in- creased to 93,399,537 gallons and the value to Â£4,169,692. All live stock numbered 5,786,610 in 1898, and was valued at Â£9,456,100.

Fisheries. â€” In 1898 the fisheries yielded fish estimated to be worth Â£826,250, the most important being the sardine fishery, valued at Â£386,650 ; the tunny fishery, the next most important, was far below, being of the estimated value of Â£62,650. Both these fisheries have developed greatly along the south coast of Portugal. About 4000 vessels of all kinds are engaged in the fisheries.

Manufactures. â€” Since the institution of protective duties in 1892, Portuguese industries, stimulated also by the growing de- mands of the Portuguese colonies on the south-west coast of Africa, have made considerable progress. The most advanced are the manufactures Of cottons and woollens, the chief centres of which are Lisbon, Oporto, and Covilha. Other branches which have been thus artificially fostered are the manufacture of linen fabrics, china, earthenware, and metal goods.

The following table shows the value of the imports and of the exports (including coin and bullion) in four several years j^^^^,^ since 1880: â€”

1885.

1890.

1895.

1900.

Imports Exports

Â£8,261,177

6,017,639

Â£12,385,161

7,255,317

Â£9,107,555

6,504,245

Â£13,272,088

10,451,333

These figures fairly illustrate the fluctuations in the respective values, but special reference should be made to the exports in 1891, when they reached the quite exceptional value of Â£11,373,944. The figures for 1900 show the highest point reached by the imports and exports in the years quoted. Of the imports in 1898 (Â£11,293,946) the most, valuable were wheat, Â£812,925 ; cotton, Â£784,905 ; and cottons and yarn, Â£636,900 ; while sugar, cod-fish, coal, iron, cattle, leather and hides, wool, and woollens and yam, ranged in value from Â£453,900 for the first to Â£227,900 for the last. The only exports higher in value than this last item of the imports were wine, Â£2,551,327, which it will thus be seen provided more than one-third of the total value of all exports (Â£7,379,370) ; cork, Â£734,000; cottons, Â£521,770; and sardines, Â£.338,600. Of the imports, 32 per cent, came from Great Britain, 14

per cent, each from Germany and the United States, 10 per cent, from Prance, and 9 per cent, from Spain. Great Britain received 28 per cent, of the exports (with Brazil, Great Britain received most of the wine export, Portuguese vintages being valued at more than one-fifth of the total wine import of the United Kingdom) , Brazil received 20 per cent., the Portuguese colonies 16 per cent., and Spain 13 per cent.

In 1890, 6110 foreign vessels (including those merely calling at different ports), of 5,288,000 tons, entered, and 6381, of 5,276,000 tons, cleared ; in 1900, 5744, of 9,464,386 tons, entered, and 6733, of 9,425,758 tons, cleared. In the coasting ^"'PP'og- trade, 5438 vessels, of 1,006,000 tons, entered in 1890, and 5244, of 977,000 tons, cleared ; in 1900, 4294 vessels, of 1,452,335 tons, entered, and 4219, of 1,416,017 tons, cleared.

There are 8700 miles of public roads. In 1898, 1464 miles of railway were open for traffic, the State owning 507 miles. There were 1304 post offices, and lie total number of pieces of all kinds carried during the year was : internal, liternal 55,201,810 ; international and colonial, 10,202,493. """J"""""" The number of telegraph offices was 426, controlling "* '"'*â– 4584 miles of line and 9475 miles of wire, and dealing with 1,272,042 internal and 1,065,309 international telegrams, includ- ing those in transit.

In 1896 there were in all 35 banks (including savings banks). Only the Bank of Portugal can circulate notes in the country, though the Ultramarine Bank may issue them in the colonies. No gold has been coined since 1891, and in Banking the present condition of the monetary system paper and Â°"" credit silver are the chief media of circulation. The amount of the State Bank notes in circulation in February 1900 was Â£14,404,400. At the beginning of 1899 the deposits in savings banks amounted to Â£3,084,000, of which rather less than Â£700,000 was in the State Savings Bank.

The table on next page shows the area and population of the several Portuguese colonies as nearly as possible ; in the case of the African continental possessions and the Coâ„¢"â„¢*- Indian Archipelago, only estimates are possible. The figures in parentheses indicate the year of the last census.

Colonial Pos-

Area in

Popula-

Coloiiial Pos-

Area in

Popula-

sessions.

Sq. Mis.

tion.

sessions.

Sq. Mis.

tion.

T-n Africa :

In Asia :

Cape Verde Is-

Goa (1887)

1,890

494,836

lands (1896) .

1,480

114,130

Indian^ D a m a o

Guinea .

4,440

820,000

Diu (1887)

168

77,454

Indian AroUpel- ago (Timor, &c.)

Thomas's Is-

7,458

800,000

lands .

360

24,660

China : Macao, &c.

Angola .

484,800

4,119,000

(1896) .

4

78,627

301,000

3,120,000

Total Africa

Total Asia Total Colonies

9,020

950,917

T92,080

8,19T,T90

801,100

9,145,707

Few of the colouies are self-supporting, and between 1870 and 1899 Portugal expended about 15 millions sterling on them. Between 1897 and 1900 there was a noteworthy increase in the trade between Portugal and her colonies, especially her African colonies. During the six years ending 1897 the aggregate of this commerce was under 2 millions sterling ; but only two years later it had jumped up to over 12J millions sterling. The total inclusive commerce (imports and exports) of the several colonies in the year 1899 amounted to the following sums : â€” Cape Verde, Â£392,830 ; Guinea, Â£223,190; St Thomas,

Â£1,188,220; Angola, Â£3,346,8-30; Mozam- bique, Â£1,890,510; India, Â£572,400; Macao, Â£4,992,100; and Timor, Â£86,600,â€” total, Â£12,692,680. The total trade between Portugal and her colonies in 1900 was Â£4,194,950, as follows : â€” Cape Verde, Â£224,040; Guinea, Â£51,650; St Thomas, Â£1,281,710; Angola, Â£2,223,500 ; Mozambique, Â£403,000 ; India, Â£7670 ; Macao and Timor, Â£3380.

Authorities. â€” Baedeker. Spain and Portugal. London, 1898. â€” Annuario Estatistico de Portugal, Anno 1892. Lisbon, 1899. â€” Censo da Populagao do Beino de Portugal, 1890 y 1900. Lisbon, 1896, 1900, and 1902. â€” Movimento da Populaqao, Anno 1883. Lisbon, 1899.^ â€” Estatistica de Portugal: Commercio . . â– Extraneiro e Ultramar, 1883 onwards. Lisbon. â€” Belatorio do llinistro da Fazenda, 1899. Lisbon, 1899. â€” Vasconcellos. As Colonias Portuguezas. Lisbon, 1897. (b. de v.)

II. HlSTOKY.

The closing years of the reign of King Luis of Portugal (b. 1838, succeeded 1861, died 1889) were comparatively uneventful. The policy of reform begun by his first Ministers was steadily continued, and in many cases re- ceived his active co-operation. Progress and material prosperity had advanced, the army and navy had been reorganized on a modern basis, the system of railway communications largely developed, new ports made at Lisbon and Oporto, the constitutional charters modified in a liberal sense, and compulsory education more stringently enforced. On the whole there had been a great increase in commerce and a marked improvement in the national credit. The de Mello Ministry, which came into office in October 1883 and resigned in February 1886, was succeeded by that of Jose de Castro, the leader of the Progressives. The marriage of the king’s sou and heir, Dom Carlos, to the daughter of the Comte de Paris in 1886, attracted considerable attention, and the attitude of the French Government raised it even to international import- ance. Then colonial affairs almost exclusively occupied public attention. The Congo Convention of 1885, by which a considerable portion of the Lower Congo territory was ceded to the king of the Belgians, had produced in Portugal a feeling akin to

national humiliation, and, accordingly, the first care of the new Ministry was devoted to strengthening the ties between the mother country and its other colonies. In 1886, Germany and Portugal defined by treaty their respective spheres of influence in Africa. In the following year a native military force was organized in Angola, and the country opened up by a line of railway. Macao, hitherto leased to Portugal, was formally ceded by China on the 26th of March 1887, and steps were taken to revive the trade of this island, which had long languished. A resolution was unanimously adopted in 1889 by both Chambers, calling upon the Government to assert with all energy the legal claims of Portugal to the territories in

East and Central Africa. This action was due to appre- hension of attempts by Great Britain to extend her sphere of influence in those regions at the expense of Portugal.

On the 19th of October 1889 Luis died of typhoid fever, and was succeeded by his son Carlos (q.v.), who ex- pressly declared his intention of walking in his father's footsteps. Shortly after his accession, '^^f^'"" , colonial affairs took a threatening turn. Major chartfs. Serpa Pinto having invaded British territory on the Shire river, the British Government had demanded satisfaction of Barros Gomes, the Portuguese Minister for Foreign Affairs. The dilatory tactics of Portugal were met by the despatch of a British fleet to Portuguese waters, and an ultimatum of the 11th of January 1890, peremp- torily requiring the withdrawal of all the Portuguese forces, civilians, and agents on the Shire, under threat of breaking off diplomatic relations. Barros Gomes, declaring that Portugal yielded to superior force, gave way under protest on the following day. Disturbances at once broke out in Lisbon and Oporto. In the face of the popular indignation, de Castro's Ministry resigned office, -'^^^^^ and made way on 14th January following for Britain"" a Coalition (Liberal-Conservative) Government under Serpa Pimental, with Hintze-Pibeiro as Foreign Minister. The Republicans, stimulated by the success of the revolution in Brazil in the previous year, fomented the spirit of disaffection, and were so far successful that in many cities demonstrations, ostensibly directed against Great Britain, assumed an anti-dynastic character.

The king, yielding to public opinion, openly espoused the patriotic attitude of the demonstrants, and in a letter to Queen Victoria declined for the time being the Order of the Garter which had just been offered him. On the 6th of February the Government addressed a circular to the Great Powers proposing to submit the Anglo-Portu- guese differences to the arbitrament of a European Con- ference, and suspended its naval and military preparations. Meanwhile an attempted Eepublican pronunciamiento in Lisbon was suppressed, sixty-three arrests were made, and many officers who were under suspicion degraded. The elections resulted in an overwhelming majority for the Government, only three Republicans being returned. On the 20th of August an Anglo-Portiiguese agreement respect- ing Africa was settled in London ; but its terms were regarded in Portugal as greatly to that country's disad- vantage, and their publication was a signal for a fresh outburst of disturbances in the larger cities, and even ia the Cortes itself, which refused to ratify the treaty. The Ministry resigned, making way on the 14th of October for Abreu e Sousa, who formed an administration of a decidedly constitutional character. The new Cabinet approached the British Government with proposals for a revision of the agreement of 20th August ; and, pend- ing the result of the negotiations, a modus vivendi for six months was agreed to.

Great Britain showed herself conciliatory and ready to make concessions, with a view to relieving the tension in Portugal. Yet, in spite of the utmost vigilance, more than one collision took place between the Portuguese and the forces of the British South Africa Company in Manica, on territory which by the Convention of August was acknowledged to be under the influence of Portugal. The Portuguese forces were defeated, and the repetition of occurrences of this kind for a time threatened the very existence of the monarchy. But the Government pro- ceeded warily, and was successful in suppressing a military revolt which broke out in Lisbon on 30th January 1891. It followed up this action by repressive measures against the Republican press. The enhanced prestige of the Cabi- net prevailed with the Chambers, which forthwith by an increased majority approved the Convention with Great

Britain in its original form ; and the ratification of the treaty followed on 28th May following. The next step of the Government in colonial matters was the granting of a charter to a limited company to exploit and admin- ister the African colony of Mozambique, saving the paramount sovereignty of the Crown and the surveillance of the State.

A new crisis was brought about by the unfortunate financial position of the country. The careless and ex- travagant management of the railways guaranteed by the State had entailed such heavy deficits that the payment of the coupon of the Railway State Loan, due on 2nd January 1892, had to be suspended. Consequently the dim”””^’ Minister of Finance, Marianino de Carvalho, cutties. resigned ; and his example was followed on the

15th of January by the other members of Abreu e Sousa’s Cabinet, which a few days later was replaced by a Ministry with Diaz Ferreira as Premier and Oliveira Martins as Minister of Finance. The new financial Minister reported a great deficiency in the revenue and a heavy increase of debt, and as a remedy proposed largely to curtail the expenditure and to increase taxation. Un- able, however, to obtain the sanction of the Minister to certain arrangements proposed by the Paris Syndicate of Foreign Bondholders with a view to rehabilitating the financial position, he resigned in the May following. Thereupon the Portuguese Government committed a formal act of bankruptcy by issuing a decree reducing the pay- ments to foreign bondholders then due to one-third the amount. The committees of bondholders at once ener- getically protested against this illegal action, and were supported in their remonstrances by several of the oflS.oial representatives of their countries. The elections to the Cortes, which took place at the end of October 1892, gave the Conservatives (Regeneradores) a substantial majority, and the Ministry was reconstructed by introducing con- servative elements. But Ferreira was unable to cope with the situation ; and on disagreement with the king as to the proposals for improving the financial situation, his Minis- try resigned office in February 1893,

and Senhor Hiutze- Ribeiro undertook the formation of a Liberal Ministry. The new council promised only slightly better terms to the foreign bondholders, but on the whole it improved the position of the State finances, and by coming to an under- standing with Germany in East and with Great Britain in South Africa as to the delimitation of frontiers, minimized the risks of a conflict with either country. The elections of the 15th of April 1894 resulted in a large majority for the Government, but the reform of taxation proposed by the Minister of Finance met with great opposition. Hintze- Ribeiro, however, held to his scheme and, the better to carry it, relinquished the office of Premier for that of Finance, Lobo d'Avila taking his place. But Ribeiro's proposals were nevertheless rejected by the Cortes, which were forthwith adjourned and then dissolved, the new elections again resulting in a majority for the Govern- ment. In the same year diplomatic relations with Brazil were suspended for a time, because Portugal had offered an asylum to insurgents who had fled from that country. Parliamentary reform had long been in the air, and the year 1895 saw the accomplishment of far-reaching reforms in the constitution of the Chambers and the qualifications of electors. By an electoral law of 28th March, the number of deputies to the Lower Chamber was reduced

from 170 to 145. Every responsible male Pariia- citizen of twenty-one years of age who can read

and write, or pays at least 500 reis in taxes, has

the right of suffrage, which is denied to domestic servants. Government servants, and soldiers. By a subse- quent law of 25th September of the same year, the reform of the Upper Chamber was also effected. The elective

meatary reform.

members were abolished, and the house now consists of 90 members chosen by the king, 12 bishops, and the princes of the blood royal. Thus professional politicians, who had been the source of much mischief in Portugal, were restricted both in numbers and influence, whilst greater

political influence was assured to the commercial, indus- trial, and agricultural classes.

In the autumn of 1895, the king, after undertaking a journey through France and Germany, paid a long-deferred visit to England, where he was warmly received. The Order of the Garter was now conferred upon him, and his visit did much to remove the last traces of the misunder- standing between the ancient allies.

The Hintze-Ribeiro Ministry resigned in February 1897. The chief reproach against it was its inability to remove the economic difficulties under which Portugal had suffered in consequence of bad harvests and colonial troubles. The State was forced in March of the year 1898 to come to an arrangement with its external creditors. In view of the British attitude, all attempts â€” notably that of the Gov- ernor of Mozambique, Major d' Albuquerque â€" to improve the frontier of the Portuguese colonies failed (see Africa, and East Afkica), and this and the ensuing year closed gloomily, with a deficit in the public revenue.

Portugal observed neutrality on the outbreak of the South African war, but the permission it conceded to the British Consul at Lourenqo Marques to search for contra- band of war among goods imported there, and the free passage accorded to an armed force under General Carring- ton from Beira through Portuguese territory to Rhodesia, were vehemently attacked in the press and at .

public meetings. The Ministry resigned, and oeiagoa ' gave place to a Conservative Government under Bay Hintze-Ribeiro. The award of the Swiss arbi- "'"'â€¢ trators in the matter of the Delagoa Bay railway was given in 1900 ; it was in favour of Portugal in regard to the seizure of the railway, but the country was condemned Â» to pay lo,.314,000 francs compensation ; and this sum (less than was expected) was immediately raised by loan from the Portuguese Tobacco Company. The new elec- tions resulted in a majority for Government ; and the century closed in the midst of signs that the period of gloom which had oppressed the country was passing away, and that its relations with Great Britain rested on a more friendly basis.

Posen, an eastern province of Prussia, with an area of 11,184 square miles, and population of 1,887,275 (1900). In 1900 the live stock embraced 867,795 cattle, 609,816 sheep, 772,402 pigs, and 263,284 horses. The iron foundries produced 6288 tons of iron, valued at Â£66,930, in 1897 ; and in 1899-1900 the sugar factories produced 193,243 tons of sugar ; the breweries, 13,530,000 gallons of beer ; and the distilleries, 13,582,360 gallons of pure alcohol. For further particulars, see under Prussia.

Posen, in Polish Poznan, a fortified town and archi- episcopal see of Prussia, capital of the province of Posen, 103 miles by rail north from Breslau, on the river Warthe, a first-class fortress and the headquarters of the 5th German Army Corps. In 1902 the Prussian Government voted a first instalment of Â£200,000 for the demolition of the old fortifications, which greatly cramped the town. The modern fortifications embrace a dozen inner forts and nearly twenty outer forts. The cathedral was restored in 1898. Of the public institutions and newer buildings may be mentioned several churches, the provincial archseo- logical museum and library (1894), the (Renaissance) town-house (1895), the Mielzynski Museum, the royal palace with state archives, the archbishop's palace, the Emperor William library, a couple of handsome fountains, zoological gardens, art and other collections of the Society (Polish)

of Frieuds of Science, a monument to the Polish poet Mickiewicz, a monument (1870) to the soldiers who fell at Nachod in 1866, a monument of the war of 1870-71, three theatres, a theological college, a building and, trades school (1892), with over 1000 pupils, a trade and domestic economy school for girls, a Jewish teachers' seminary, and a (female) normal school. The industries are of a miscel- laneous character â€" machinery, furniture, vehicles, cigars, beer, chemicals, &c. Population (1885), 68,315 ; (1895), 73,239; (1900), 117,014, of whom about one-half are Germans and one -tenth Jews. The rural communes of Jersitz, Wilda, and St Lazarus were incorporated in 1900.

POSSneck, a town of Germany, duchy of Saxe- Meiningen, 21 miles by rail south of Jena, with a Gothic church (1390) and a Gothic town hall (1443), an agricul- tural school, and manufactures of porcelain and flannel, besides tanning, dyeing, brewing, and gardening. The town dates from the 11th century or earlier. Popula- tion (1885), 7653; (1900), 12,268.

Posters (see also Advertisement). â€" The earliest examples of pictorial posters were adorned with rough woodcuts. When lithography became a common commercial process, wood-blocks ceased to be employed. The modern artistic poster made a definite beginning in France about 1836, with a design by Lalance to advertise a book entitled Comment Meurent les Femmes. His example was followed by C. Nanteuil, Kaffet, Gavarni, Bertrand, Grandville, Tony Johannot, Â£. de Beaumont, T. H. Frere, Edouard Manet, and other artists of high repute. Most of these early designs were printed in black on white or tinted paper. Between 1860 and 1866 crude attempts at printing posters in colours were made in both France and England. In 1866, Jules Cheret began what was destined to be the most noticeable series of pictorial placards in existence, a series containing over a thousand items. Cheret was the first artist rightly to appreciate the possibilities of the poster and to raise it to high consideration in the opinion of the art world. Brilliant colour in acute contrast characterized his work, which rapidly achieved, and still retains, immense popularity. He may be fairly described as the father of the modern pictorial placard. Cheret was originally employed in a lithographic establishment in England before he began to work for himself, and he used his knowledge there acquired to adapt all three primary colours, economically used, to astonishingly brilliant ends. For a considerable time he remained without a rival, though he had hosts of imitators. Eugfene Grasset, a decorative designer of great versatility, pro- duced the first of a small number of placards which, though inferior as advertisements to those of Cheret, were learned and beautiful decorations. Somewhat later a sen- sation was caused in Paris by the mordantly grotesque posters of Henri de Toulouse-Lautrec, in which the artist reduced detail to a minimum and obtained bold effects by the employment of large masses of flat colour. Important work, similar in character to Lautrec's, was

produced by Ibels, Bonnard, Steinlen, and others. A now and contrary direction was given to poster design by Mucha, a Hungarian resident in Paris, whose placards are mai'ked by delicate colour and richness of detail. The following are amongst ' French artists who have designed posters of conspicuous merit : Forain, Willette, Paleologue, Sinet, Jossot, Roedel, Mayet, Cazals, Biais, De Feure, Guillaume, Ranft, Rdalier- Dumas, Valloton, and Metivet. Occasionally eminent French painters, such as Carriere, Boutet de Monvel, Aman-Jean, Schwabe, have made essays in poster-designing.

In England the first artists of repute to attempt the pictorial placard were Godfrey Durand and Walter Crane ; but the first bill to attract widespread attention was one

by Fred Walker to advertise a dramatized version of The Woman in White (1871). This was engraved on wood by W. H. Hooper. Shortly after this time pictures by Pi,oyal Academicians and others began to be reproduced as adver- tisements (the best known case being that of Sir John Millais's " Bubbles "), but these have nothing directly to do with poster-designing. Mr Stacy Marks, Hubert von Her- komer (the great poster for the Magazine of Art), Sir Edward Poynter, and Sir James Linton are among popular painters who have made special drawings for reproduction as posters.

About 1894 the English poster began to improve. De- signs by Aubrey Beardsley for the Avenue Theatre, by Dudley Hardy for various plays, and by Maurice Greiflfen- hagen for The Pall Mall Budget, were widely noticed by reason of their originality, simplicity, and effectiveness. Simplicity was carried even farther by "the Beggarstaff Brothers " (James Pryde and William Nicholson), whose posters are perhaps the most original yet produced by Englishmen. Among other British designers the following have executed artistic and interesting placards : Frank Bran^wyn, K. Anning BeU, John HassaU, CecU Aldin, Phil May, Raven-Hill, Henry Harland, Robert Fowler, Wilson Steer, Charles R. MacMntosh, MacNair and MacDonald, Edgar Wilson, Charles I. Foulkes, Mabel Dearmer, Albert Morrow, and C. Wilhelm.

Poster design on the continent of Europe has been largely influenced by French work, but designs of much originality have been made in Germany, Belgium, Italy, and Spain. In Germany, among the most typical posters are those of Sattler, Otto Fischer, Gysis, T. T. Heine, Speyer, Max Klinger, Dasio, Hofmann, and L. ZumbruscL The principal Belgian designers include Privat Livemont, Rassenfosse, Berchmans, Meunier, Duyck and Crespin, V. Mignot, Donnay, Evenepoel, Cassiers, and Toussaint. Of Italian designers those whose work is most characteristic are Mataloni and Hohenstein ; while the best Spanish posters â€" those to advertise bull-fights and fairs â€" are mostly anonymous. The Spanish artists UtrLUo and Casas have signed posters of more than ordinary merit. Curious if not very artistic bills are being produced in Russia; and in Austria good work is being done by Orlik, Schliess- mann, Oliva, and Hynais.

In the United States of America, however, with the excep- tion of some designs by Matt Morgan, few posters of artistic interest were produced before 1889, in which year Louis J. Rhead commenced a notable series of decorative placards. Will H. Bradley began to produce his curious decorative grotesque posters a little later. If American artists are behind Europeans in the artistic designing of large posters, they have no rivals in the production of small illustrated placards for publishers of books and magazines. Chief among those who have devoted themselves to this branch of poster design is Edward Penfield. Others who have achieved success in it include]\Iaxfield Parrish, Ethel Reed, Will Carqueville, J. J. Gould, J. C. Leydendecker, Frank Hazenplug, Charles Dana Gibson, Will Denslore, Florence Lundbourg, and Henry Mayer.

Exhibitions of artistic posters have been held in the chief cities of Europe and Americ-a, and the illustrated placard has already a literature of its own. In England a monthly magazine {The Poster) was for a time specially devoted to its interests, and collectors are numerous and enthusiastic.

The following are the most important books of reference on the subject:â€" Eknbst Maindhon'. L,-s Afiches IllvMries. Paris, 1895. Les

Maitrcs de I’Afficlit. Paris. Les Affiches X’trangires lUustries (Belgium, Austria, Great Britain, United States, Germany, and Japan). Paris, 1897.â€” Charles Hiatt. Pktnre Posters. Londoi;, 1895.â€” J. L. Spottsel. Das Modenie Plakat. Dresden, 1897.â€” Arsexe Alexandre, M. H. Spielmann, H. C. Buxn-er, and A. Jaccacci. The Modem Poster. Scribners, New York ^^^^- (C. Hl)

POST OFFICE.

I. United Kingdom.

SINCE 1884 the business of the British Post Office has continued to grow at a more rapid rate than the population of the United Kingdom. Some of the causes of this development must be sought within the Post Office department, e.g,, improved facilities, lower charges, and the assumption of new functions ; but others are to be found in the higher level of popular education, the increase of wealth, industry, and commerce, and the rapid expansion of Greater Britain.

On the death of Mr Fawcett (7th November 1884), the Eight Hon. G. J. Shaw Lefevre was appointed Postmaster-

General. His successors have been Lord John Manners, afterwards Duke of Rutland, who had already been Post- master-General from 1874 to 1880, and again held the office from 1885 to 1886 ; Lord Wolverton, 1886 ; the Eight Hon. H. G. Eaikes, 1886 to 1891 ; Sir J. Fergusson, 1891 to 1892; the Eight Hon. Arnold Morley, 1892 to 1895; the Duke of Norfolk, 1895 to 1900; and the Marquess of Londonderry, 1900. The Secretary to the Post Office, Sir A. Blackwood, died in 1893, and was succeeded by Mr (after- wards Sir) S. Walpole, on whose retirement inl899 Sir G. H. Murray was appointed permanent head of the Post Office. The following table shows the increase in the number of letters delivered : â€”

Letters Delivered.

Estimated number of letters delivered in the United Kingdom, and the increase per cent, per annum.

number to each person. 00,000's omittea

Also the average

Delivered

in England and Wales.

%

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Financial Year ending 3l8t March.

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111

1884-85 .

757,2

2-7

391,1

4-1

1,148,3

3-2

42

122,9

2-6

32

89,1

1-6

18

1,360,3

2-9

38

1885-86 .

778,0

2-8

409,4

4-7

1,187,4

3 ‘4

43

126,4

2 ‘8

32

89,7

â– 7

18

1,403,5

3-2

39

1886-87 .

800,8

2-9

439,1

7-3

1,239,9

4-4

44

129,1

21

33

90,9

1-3

19

1,459,9

4-0

40

1887-88 .

838,0

4-6

448,9

2-2

1,286,9

3-8

46

132,1

2-3

33

93,2

2-5

20

1,512,2

3-6

41

1888-89 .

846,0

1-0

480,5

7-0

1,326,5

31

46

136,0

S’O

34

95,5

2‘5

20

1,558,0

3-0

42

1889-90 .

895,0

5-8

518,1

7-8

1,413,1

6 ‘5

48

140,3

3-2

34

96,8

1-4

21

1,650,2

5-9

43

1890-91 .

924,4

3-3

538,4

4-0

1,462,8

3-5

50

143,2

21

36

99,8

31

21

1,709,0

3-4

45

1891-92 .

965,0

4-4

551,0

2-4

1,516,0

3-7

52

146,4

21

36

105,0

5-2

23

1,773,4

3-6

46

1S92-93 .

965,8

0-1

566,5

2-8

1,532,3

11

52

152,3

4‘0

37

105,9

â€¢9

23

1,790,5

1-3

47

1893-94 .

973,8

0-8

575,6

1-6

dee.

1,549,4

11

dec.

52

153,9

11

38

108,5

2-5

23

1,811,8

1-2

dec.

47

1894-951.

993,3

2-0

508,8

11-6

inc.

1,502,1

31

inc.

50

156,0

1-4

38

112,8

4-0

dec.

24

1,770,9

2-3

inc.

46

1895-96 .

1,021,3

2-8

537,5

5-6

1,558,8

3-8

51

162,9

4-4

39

112,5

0-3

25

1,834,2

3-6

47

1896-97 .

1,049,3

2-7

557,2

3-7

1,606,5

31

52

168,5

3-4

40

118,0

4-9

26

1,893,0

3-2

48

1897-982.

1,120,3

6-8

590,9

6-0

1,711,2

6-5

55

177,4

5-3

42

123,7

4-8

27

2,012,3

6-3

50

1898-99 .

1,242,0

10-8

617,7

4-5

1,859,7

8-7

59

190,6

7-4

45

136,5

10-3

30

2,186,8

8-6

54

1899-1900

1,276,3

2-7

632,6

2-4

1,908,9

2-6

60

196,8

3-3

46

141,1

3-4

31

2,246,8

2-7

55

1900-01 .

1,312,7

2-9

664,3

5-0

1,977,0

3-6

61

202,4

2-8

47

144,2

2-2

32

2,323,6

3-4

57

1 It was discovered in the course of this year that the estimated figures for previous years had been swollen by an imperfect method of reckoning the liOndon letters, &c. In 1883 as many as 2,770,000 valentmes were sent through the post. The numbers gradually decreased until in 1890 only 320,000 were observed. Christmas cards have, however, considerably increased.

2 Since 22nd June 1897, all packets over 2 oz., formerly counted as book packets, arc reckoned as letters.

Inland Letter Bates. â€” The rates of inland letter postage have been altered as follows : â€”

From 5th October 1871 to 1st July 1885 the charges were : â€”

s. d. Not exceeding 1 oz. . Over 1 oz. and not exceeding 2 oz.

10 12 13

and Id,

10 â€ž

12 â€ž

13 â€ž

,. 14 â€ž for each succeeding ounce.

1

li

2

24

34 4 1 2

On 1st July 1885 the postage on letters over 12 oz. was reduced, and the gradation of charge beyond 2 oz. was made uniform, at the rate of |d. for each additional ounce. Thus a letter weighing over 12 and not exceeding 14 oz. was charged 4^d., 14 to 16 oz. 5d., and ^o on. Notwith-standing this change, it was found as late as 1895 that 95 per cent, of the letters sent through the post weighed not more than 1 oz. each.

Not exceeding 4 oz. .

Over 4 oz. and not exceeding 6 oz.

In his Budget speech of 29th April 1897, the Chan- cellor of the Exchequer, Sir M. Hicks-Beach, announced that a number of postal and telegraphic concessions would be made to the public on Jubilee Day, the 22nd June 1897, the sixtieth anniversary of Queen Victoria's accession to the throne. The new rates for letters were : â€"

d.

. 1

. . H

>7 6 j> „ !, 8 „ . . .2

with id. for each succeeding 2 oz.

This change, while it saves both the Post Office and the public the trouble of testing the weight of a large number of letters, has also the advantage of simplicity of calcula- tionâ€" one halfpenny is charged for each 2 oz., with a minimum charge of Id.

Arrangements were at the same time made to ensure a delivery of letters by postmen at every house in the United Kingdom. It was estimated that 16 millions of letters, whose owners had previously to fetch them from the post office or from some point on a postman's walk, would thus

be added to the official delivery. The estimate proved, however, to be much under the mark. Fifty-five millions of letters are already brought annually into the official delivery under this arrangement, which still awaits com- pletion in a few remote districts of Scotland and Ireland. In May 1892 the House of Commons, on the motion of Sir E. Birkbeck, had passed a resolution in favour of a more liberal extension of the free

delivery in rural districts. Under the relaxed Treasury regulations, 155,000 letters a week were brought into the delivery in 1892, but a large number stUl remained outside. Financial considerations have now been entirely disregarded for the benefit of these letters, and the cost of their delivery alone, excluding sorting, carriage, cost of post office buildings, &c., greatly exceeds the whole revenue derived from them.

In studying the statistics of letters delivered, it should be remembered that the figures for any particular year are affected by circumstances hke a general election or a boom in trade, as well as by changes in the rates or condition of the Post Office services. The letters from foreign countries have been stimulated by lower charges, and those from the colonies by the Imperial Penny Post, to which reference is made below.

Letter Cards. â€" On the 12th February 1892 letter cards bearing an imprinted penny stamp, and made to be fastened against inspection, were issued to the pubHc at a charge of Is. for 10 cards. The charge was reduced almost at once to 9d. for 8 cards. Similar cards have long been in use on the Continent, but they do not enjoy much popularity in Great Britain either with the Post Office, which finds them inconvenient to handle in sorting and stamping, or with the public. The number issued annu- ally is about 10 miUions, not counting those of private manufacturers.

Post Cards. â€" The following table gives the number of post cards ; â€"

Estimated

Number

of Post Cards delivered in

the United Kingdom,

and the Increase per Cent, per Annum.

England and Wales.

Scotland.

Ireland.

United Kingdom.

jj .

.t! .

-tf .

43 .

Tear.

fl a

l^M

S

o 1

ii

o 3

O 2

a

0 g

II

.a

al

.a

SO

1

^3

K

a 5,

!5

|l

K

^

1884-85.

134,100,000

4-3

18,400,000

5-6

7,900,000

3-1

160,400,000

4-4

1889-90 .

184,400,000

8 -4

22,900,000

6-0

9,800,00C

6-4

217,100,000

7-8

1893-94 .

209,100,000

1-4

27,400,000

a -2

12,000,O0C

6-2

248,500,000

1-6

1894-951

271,600,000

dec.

1-2

28,700,000

4-7

12,500,000

4-2

312,800,000

25-9

1895-96 .

268,300,000

32,200,000

12-2

14,000,000

12-0

314,600,000

0-6

1900-01 . ;369,400,000

[

4-9

41,600,000

2-0

18,000,000

6-5

419,000,000

4-7

1 Private cards with adhesive stamps first allowed in this year.

Post cards were first introduced in Austria on the 1st October 1869, and were first issued in Great Britain on 1st October 1870. Only one kind of card was employed, and this was sold for one halfpenny ; but on the complaints of the stationers, a charge of ^d. a dozen for the material of the card was made in 1872, and permission was given for private persons to have their own cards stamped at Somerset House. In 1875 a stouter card was put on sale, and the charges were raised to 7d. per dozen for thin cards and 8d. per dozen for stout cards. In 1889 the charges were reduced to 5|d. for 10 and 6d. for 10 re- spectively. On 1st September 1894 private post cards with an adhesive halfpenny stamp were allowed to pass by post, and the result has been greatly to diminish the number of cards purchased through the Post Office. It is estimated that 232 out of the 400 millions of cards de-

Kvered in 1899-1900 were private cards. The sizes of the official cards were again altered in January 1895 and November 1899. Reply post cards were issued on 1st October 1883. The regulations forbidding a,ny thing but the address to be written on the address side of a post card were made less stringent on 1st February 1897 ; and in 1898 unpaid post cards, which were previously charged as unpaid letters, were allowed to be delivered on payment of double the post card rate. These various changes, especially the use of the private card and the popularity of illustrated post cards, have contributed to the rapid increase in the number of post cards sent by post. Reply post cards were first issued on 1st October 1893. Their use has not been very extensive. Only about IJ miUion are issued yearly.

Book Packets and Samples. â€” The following table shows the estimated number of book packets, circulars, and samples delivered in the United Kingdom, and the increase per cent, per annum : â€”

Tear.

England and Wales.

Scotland.

Ireland.

United Kingdom.

1

n

.a

1

1^

1

â€¢i

3

II

12!

0 ii

^

!zi

a

oS

c a

a a

18-9

c a

1884-86 .

269,400,000

8-1

34,500,000

10-0

16,600,000

320,400,000

8-8

1889-90 .

378,200,000

7-5

42,100,000

S-7

21,600,000

9-6

441,900,000

7-3

1894-95 .

622,600,000

6-7

dec.

60,800,000

8-2

dec.

31,300,000

10-2

dec.

614,600,000

7-0

dec.

1898-991

590,900,000

3-6

inc.

75,100,000

2-3

inu.

35,600,000

5-3

inc.

701,600,000

3-5

inc.

1900-01 .

619,800,000

4-0

77,800,000

3-7

36,300,000

8-6

732,400,000

4-2

1 Book packets over 2 oz. transferred to the letter post as a result of the Jubilee changes.

The rate of ^d. for 2 oz. for the book post has re- mained unaltered since 1st October 1870. Changes have from time to time been made in the regulations defining the articles which may be sent by book post, and prescrib- ing the mode of packing them so as to admit of easy examination for the purpose of detecting letters, &c., sent by the halfpenny post. The book post received a great impetus in 1892 (28th May) by the permission to enclose book packets in unsealed envelopes. Complaint is, how- ever, made that such envelopes form a dangerous trap for small letters, which are liable to sUp inside the flaps of open envelopes, and so suffer delay and loss. On the other hand, as the rate of postage for articles weighing over 2 oz. is now the same for letters and for book packets, articles over that weight derive no advantage from being sent in open covers.

Sample Post. â€” The sample or pattern post, which was confined to bond fide trade patterns and samples on 1st October 1870, was then assimilated to the book post (Jd. for 2 oz.) ; but the restriction was found to be both difficult to enforce and irritating to the public, and the sample post was abolished on 6th October 1871, when the rates of letter postage were lowered. It was re-established on 1st October 1887 (Id. for 4 oz. or under, and ^d. for each succeeding 2 oz.) ; but when the Jubilee letter rates were introduced (22nd June 1897) it lost its raison d'etre, and ceased to exist for inland pm-poses.

Newspapers. â€" The first table on next page shows the estimated number of newspapers delivered in the United Kingdom, and the increase per cent, per annum.

The carriage of newspapers by the Post Office does not show the same elasticity as other post-office business. The Postmaster-Qeneral's Report of 1896 states that this is " due to increased energy and improved system on the part of the great newsagents." It is also, no doubt, in part due to improvements in provincial journalism,

and especially to the extension of the halfpenny press. The practice of posting a newspaper after reading it, under a co-operative arrangement, has practically ceased to exist. The carriage of newspapers by post is con- ducted at a loss by the Post Office, which can thus regard with satisfaction the comparatively slow increase in the numbers sent.

Year.

1884-8B ,

1889-90 ,

1894-951

1899-1900 1900-01 .

England and Wales.

110,700,000 126,600,000

117,600,000

126,000,000 127,800,000

P.<

Scotland.

16,900,000 16,700,000

17,300,000

19,300,000 19,300,000

S 0-

Ireland.

16,100,000 16,000,000

17,000,000

19,100,000 20,700,000

United Kingdom.

143,700,000 159,800,000

163,400,000 167,800,000

â€¢7

4-9

dec.

7-9

inc.

6-0 2-7

1 See note to table of Letters Delivered.

Halfpenny Post Finance. â€" It has been frequently stated on behalf of the Post Office that the halfpenny post is unremunerative. Representations are, however, made from time to time in favour of lower postage for literature of all kinds. It may therefore be of interest to mention that the Postmaster-General of the United States has, in successive annual reports, deplored the effect on the Post Office service of the cheap rates for "second-class matter." The cost of carriage over so large a territory is heavier than in the United Kingdom ; but the Postmaster- General states that the low rates of postage "involve a sheer wanton waste of $20,000,000 or upwards a year." Facilities like the extension of free delivery are stifled, and the efficiency of the whole service is cramped, by the loss thus sustained.

Inland Parcels. â€” The following table shows the number of parcels delivered in the United Kingdom : â€”

Year ending 31st March.

Number of Parcels.

Year ending 3l8t March.

Number of Parcels.

1884 1885 1886 1887 1888 1889 1890 1891 1892

14,000,000 22,910,040 26,417,397 32,860,154 36,731,786 39,589,313 42,852,600 46,287,956 49,378,365

1893 1894 1895 1896 1897 1898 1899 1900 1901

52,370,326 54,034,000 57,136,000 60,527,000 63,715,000 67,823,000 71,913,000 75,448,000 81,017,000

The inland parcel post commenced on 1st August 1883. No parcel might exceed 7 B) in weight, 3J feet in length, or 6 feet in length and girth combined. The rates were : â€”

s. d.

Not exceeding 1 lb , ... 0 3

Exceeding 1 lb, but not exceeding 3 lb . 0 6

>, 3 â€ž ,, â€ž 5 â€ž . 0 9

5 ,. â€ž â€ž 7â€ž . 10

Arrangements were made with the railway companies, under which they receive 55 per cent, of the postage on each parcel sent by train. This arrangement, which was to hold good for 21 years, proved, however, an onerous one, and on 1st June 1887 the Post Office started a

parcel coach between London and Brighton. The coach, which travels by night, arrives at Brighton in time for the first delivery, and there is thus no loss of time to the public. The experynent proving successful, other coach services were started at different dates between

London and Chelmsford, Colchester and Ipswich, London to Oxford vid Eeading, London to Chatham, Tunbridge Wells, Bedford, Guildford, Brighton, Watford, and Windsor respectively, Birmingham and Coventry, Liverpool and Manchester, with branch coach services to Cambridge, Hitchin, &c. Motor-cars have also been employed. Nearly 11^ miUions of parcels were conveyed by the Post Office in 1900-01 without passing over a rail- way.

On 1st May 1896 the maximum weight was increased to 1 1 3b, and the postage rates were reduced : â€”

s. d.

Not exceeding 1 lb 0 3

For each succeeding pound . . . . 0 IJ The charge for a parcel of 11 lb was thus . 1 6

On 22nd June introduced ; â€”

1897 the present (Jubilee) rates were

this

Not exceeding IB. For each succeeding pound up to 10 lb The charge for a parcel of 10 lb is thus is also the charge for a parcel of the

s. d.

0 3

0 1

1 0, and maximum weight

(11 ft).

Eegistered Letters. â€” The number of letters registered by the public in the United Kingdom in 1884-85 amounted to 11,365,151. In the next ten years the numbers oscil- lated between 10,779,555 (1886-87) and 12,132,144 (1892-93); but since 1894-95, when 11,958,264 letters were registered, the number has steadily increased, until it stood at 17,729,869 for 1900-01. It has been sur- mised i that the introduction of postal Orders checked the growth of registered letters for some years after 1880. In' 1886 a system of insurance for registered letters was adopted. The ordinary registration fee entitled the owner, in case of loss, to recover compensation from the Post Office up to a limit of Â£2. For an additional insurance fee of Id. the limit was raised to Â£5, and for 2d. to Â£10. Various changes have since been made, and the separate insurance system has been abolished. At present a re- gistration fee of 2d. entitles to compensation up to Â£5, 3d. Â£10, and each additional penny to a further Â£10, up to a maximum of Â£120. The system of registration has also been extended to parcels.

Railway Letters.â€" On 1st February 1891 the railway letter service came into operation. At passenger stations on the principal railways a letter not exceeding 4 oz. in weight may be handed in at the booking office for convey- ance by the next train. A fee of 2d. is payable to the railway company as well as the ordinary postage of Id. The letter may be addressed to a railway station to be called for. If it bears any other address it is posted on arrival at its proper station. The number of packets so sent is about 200,000 a year.

Express Letters. â€" The express delivery service dates from 25th March 1891. A private company formed for the purpose of supplying the public on demand with an express messenger to execute errands, was found to be infringing the Postmaster-General's monopoly both as re- gards the conveyance of letters and the transmission of communications by electricity. The services of the com- pany were, however, so much appreciated by the public, that the suppression of the company would have seemed both harsh to its shareholders and inconvenient to its customers, who could not obtain similar facilities

from the Post Office itself. The Government accordingly authorized the Post Office to license the existing company to continue its business, on the payment of royalties, till 1903,2 and to start an express service of its own. Messengers can be

‘ Thirty-second Eeport of Postmaster-General. 2 Afterwards extended to 31st March 1922.

summoned from the post office by telephone, and arrange- ments can be made with the Post Office for the special delivery of all packets arriving by particular mails in advance of the ordinary postman. The sender of a packet may have it conveyed by express messenger all the way, or may direct that, after conveyance by ordinary post to the terminal post office, it shall then be delivered by special messenger. The fees, in addition to ordinary postage, were originally fixed at 2d. for the first mile, 3d. for the second mile, and Is. a mile additional when the distance exceeded 2 miles and there was no public conveyance. Further changes of rates were made in 1892, 1893, 1895, 1897 (Jubilee revision), and 1900. Under the present regula- tions the fee is 3d. for each mile covered by special messenger before delivery. No charge is made for postage in respect of the special service, but if the packet is very weighty or the distance considerable, and no public con- veyance is available, the sender must pay for a cab or other special conveyance.

Letters and parcels to or from a number of foreign countries and colonies may also be marked for express delivery after transmission by post; and residents in London, not having a delivery of ordinary letters on Sunday, may receive on that day express letters from home or abroad which have come to hand too late for express delivery on Saturday nights. The total number of express services in 1900-01 was 804,447. In many cases one of these services included the delivery of batches of letters, so that in London alone 819,959 articles were delivered by express messenger â€” 307,051 being letters sent out for delivery in advance of the postman.

Returned Letters. â€” There are 16 dep6ts for dealing with " dead " or returned letters. The principal office is in London. Others are at Manchester, Liverpool, Birming- ham, Leeds, Bristol, Newcastle-on-Tyne, Nottingham, Plymouth, Edinburgh, Glasgow, Aberdeen, Inverness, Dublin, Belfast, and Cork. In the year 1900-01, 7,470,288 letters were received at the various returned letter offices, of which 6,226,805 were returned to the senders, while 377,261 were returned unopened to foreign countries to be dealt with by the post offices of the country of origin, leaving only 832,421 undisposed of. Such of these as contain nothing of value are at once destroyed, and no record of them is kept. The others are recorded, and (if not previously claimed by the owners) their contents are sold by auction at intervals. If the owner applies after the sale, the proceeds are handed over to him. In addition to these 7|- millions of letters, there were 2,316,582 disposed of at head post offices, whence they were returned direct and unopened to the senders, whose names and addresses appeared on the outside of the letters. The total number of post cards received in the various offices as undelivered was 1,619,391; book packets, 11,911,614; newspapers, 627,642; and parcels, 227,252. 174,193 of these last were re-issued. Articles sent by the halfpenny post are destroyed at the head offices if they cannot be delivered; but the sender may have such articles returned if he writes a request to that effect on the outside of the packet, together with, his name and address, and pays a second postage on the return of the packet.

No fewer than 85,640 articles were found loose in the post {i.e., without envelopes or wrappers) in 1901-2. In 1900-1, 345,690 packets were posted unaddressed,' contammg Â£251 m cash and bank notes, and Â£7203 in bills, cheques, postal orders, stamps, &c. The coin found loose m the post amounted to Â£902. The total value of property found in undelivered letters opened in the returned letter office was Â£681,335.

Foreign Mails.â€" The following table shows the estimated

weight of the mails (excluding parcels) exchanged with the British colonies and foreign countries in 1900-01. The number of letters and

post cards may be roughly taken at 40 to the B) :â€”

go’s omitted.

Despatched from the

Destined for the 1

Country or Colony.

United Kingdom.

United

Kingdom.

Letters

Circulars, Book

Letters

OircularB, Book

and

Packets,

and

Packets,

Post

Patterns,

Post

Patterns,

Cards.

News- papers.

Cards.

News- papers.

EUKOPE.

m

B)

lb

ft

Austria-Hungary

27,0

233,0

26,0

66,0

Belgium and Luxemburg .

65,0

360,0

58,0

131,0

Denmark

17,0

73,0

16,0

32,0

France (including Algeria

and Tunis) .

271,0

1,715,0

243,0

719,0

Germany

259,0

1,479,0

252,0

807,0

Gibraltar (including Tan-

gier), Malta, and Cyprus

32,0

319,0

40,0

32,0

Greece ....

5,0

50,0

3,5

9,0

Holland ....

56,0

249,0

53,0

126,0

Italy ....

64,0

676,0

50,0

137,0

Norway ....

18,0

89,0

12,0

25,0

Portugal and Azores

10,0

124,0

10,0

15,0

Eumania and Balkan

States ....

4,5

51,0

3,5

8,0

Russia ....

39,5

310,0

24,0

62,0

Spain ....

28,0

251,0

24,0

45,0

Sweden ....

15,5

86,0

15,0

26,0

Switzerland .

45,0

436,0

40,0

110,0

Turkey (European) . Totals Asia.

8,0

120,0

7,0

10,0

964,5

6,621,0

877,0

2,359,0

Asiatic Turkey and Persia

4,5

65,0

3,0

6,0

India (including Aden) .

147,0

2,187,0

112,0

313,0

Ceylon, Straits .Settle-

ments, and East Indies

30,0

467,0

27,0

62,0

China and Japan Totals Africa.

30,0

462,0

27,0

50,0

211,5

3,181,0

169,0

431,0

South African Colonies ‘ .

298,0

2,270,0

243,0

473,0

EastCoastofAfrica(Britisli

and Portuguese Posses-

sions), Mauritius, &c. .

8,5

119,0

6,5

11,0

West Coast of Africa, &c.

12,0

170,0

8,5

XJ., V

7,0

Madeira, Canary Islands,

25,0

350,0

20,0

40,0

Cape Verde, St Helena, and Ascension

Totals

America.

5,5

56,0

5,5

3,0

349,0

2,965,0

283,5

534,0

United States .

Canada and Newfoundland

Mexico and Central Ameri-

307,0 83,5

2,290,0 1,068,0

290,0

70,0

2,100,0 375,0

can States . Bri^zil, Argentine Repub-

7,0

96,0

5,0

11,0

lic, Uruguay, and Para-

guay ....

27,0

473,0

23,0

47,0

Chile, Peru, and Bolivia .

8,0

126,0

7,0

13,0

Ecuador, Colombia, and

Venezuela . British West Indies (in-

2,0

60,0

1.5

2,0

ohiding British Guiana,

British Honduras, Ba-

hamas, and Bermuda),

and Falkland Islands . Foreign West Indies

Totals

21,0 5,5

350,0 50,0

20,5 2,5

35,0 2,0

461,0

4,503,0

419,5

2,585,0

1 Including correspondence to and from the army.

POST OFFICE

861

OO’s omitted.

Despatched from the

Destined tor the

Country or Colonj

United Kingdom.

United Kingdom.

Letters

Circulars, Book

Letters

Circulars, Book

and

Packets,

and

Packets,

Poat

Patterns,

Post

Patterns,

Cards.

News- papers.

Cards.

News- papers.

Atjstealasia.

lb

lb

lb

lb

West Australia

10,0

188,0

8,5

42,0

South Australia

8,5

145,0

6,5

45,0

Victoria .

27,0

463,0

22,0

217,0

New Soutli Wales

28,5

438,0

23,0

200,0

Queensland

12,0

270,0

8,5

78,0

Tasmania

3,5

76,0

3,0

19,0

New Zealand .

26,0

567,0

18,5

183,0

Fiji, &c. .

Totals Grand tota

1,5

27,0

1,0

3,0

. 117,0

2,174,0

91,0

787,0

la . 2,103,0

19,444,0

1,840,0

6,696,0

During the same year 2,005,506 parcels were despatched out of the United Kingdom, and 1,118,788 were received from the British colonies and other countries. Excluding Cape Colony, where the statistics are inflated by the parcels for the British army, Germany, with 281,145, received the largest number of any one country, and easily heads the list of countries from which parcels were imported into the United Kingdom, with 392,426, France coming next with 212,032.

It will be noticed that while the totals of letters and post cards sent abroad exceed those receive^ by only one- ninth, the printed matter exported was nearly three times as great as that received. This is due in great measure to the large numbers of books and newspapers sent to the British colonies, and especially to the army in Egypt, India, and South Africa.

Foreign and Colonial Letter Bates. â€” On 1st January 1889 a weekly all-sea service to the Australasian colonies was opened. The rates were 4d. per ^ oz. for letters, and 2d. for post cards, as compared with 6d. and 3d. by the quicker route. In his Budget of April 1890, Mr Goschen provided for a lower and uniform rate of postage from the United Kingdom to India and the British colonies generally. The rates, which had hitherto varied from 2 Jd. to 4d., 5d., or 6d. per ^ oz., were fixed at 2|^d. per ^ oz. The change took effect on 1st January 1891, and resulted at the outset in a loss of Â£100,000 a year. The fourth Postal Union Congress, which met at Vienna in May and June 1891 (third congress at Lisbon, February and March 1885), took a further step in the direction of uniformity, and on 1st October 1891 the 2id. rate was extended to foreign as well as colonial letters from the United Kingdom. The Australasian colonies gave their adhesion to the Union at this congress, leaving the Cape Colony, British Bechuanaland, and St Helena the only important parts of the British Empire still outside. St Helena and Ascension joined the Union in 1896, and the Cape signified its adhesion at the next congress (Washington, May and June 1897), while British Bechuanaland and Khodesia entered in 1900, and

practically the whole of the British Empire is now included in the International Union. Abyssinia, Afghanistan, Arabia, China, and Morocco are the chief countries which remain outside.

Imperial Penny Post. â€” Advantage was taken of the presence in England of special representatives of India and the principal British colonies, to hold an Imperial Postal Conference in London in June and July 1897, under the presidency of the Duke of Norfolk, Postmaster-General.

The duke was authorized by the Government to announce that on and from Christmas Day, 1898, an imperial penny post would be established with such of the British colonies as were prepared to reciprocate. The new rates (Id. per \ oz.), which had long been advocated by Mr Henniker Heaton, came into effect in most cases on the appointed day, and with the other colonies and protectorates shortly afterwards, with the exceptions of Australasia and the Cape, where the 2\A. rate remained unaltered. The Cape came afterwards into the scheme, which has also been extended to Bhodesia, British Bechuanaland, Orange River Colony, Transvaal, and New Zealand. The Australian colonies are now the only important exception. At the same conference it was proposed that the parcel rates with British possessions should be lowered and simplified by the adoption of a triple scale for parcels exchanged by sea, namely, Is. up to 3 B), 2s. from 3 to 7 BE), and 3s. from 7 to 1 1 tt. This scale has been adopted by many of the British colonies. The parcel post has been gradually extended to nearly the whole civihzed world, with the exception of the United States, while the rates have in many cases been considerably reduced.

On 1st January 1885 the post office at Malta was transferred from the control of H.M. Postmaster-General to that of the local administration, and a similar change was made as regards Gibraltar on 1st June 1896.

Foreign Mail Service. â€” Remarkable improvements have been effected in the speed and frequency of the mails sent abroad, and contracts are entered into from time to time with the mail steamship companies, of which the Peninsular and Oriental, the Orient, the Cunard, the Oceanic or White Star, the Pacific, and the Royal Mail are

the prin- cipal lines. The approximate time occupied in course of post between London and the foUovnng places is : Cairo, 6 days ; New York, 8 days ; Bombay, 14 days 16 hours ; Cape Town, 19 days; Hong Kong, 29 days; Adelaide, 30 days 1 6 hours. The transit charges for special trains conveying mails through France and Italy for Egypt, India, Australia, and the Far East have been successively reduced until they now stand at the ordinary Postal Union transit rates.

Army Post Office Corps. â€” Mention should be made of the Army Post Office, which is now an essential accompani- ment of military operations. On the outbreak of hostilities in South Africa in 1899, the British Post Office supplied a force of 10 officers and 392 men for the purpose of sorting and delivering the mails of the forces, despatching their re- plies, selling postage stamps, dealing in postal orders, &c. Contingents were also sent by the Canadian, Australian, and Indian Post Offices. During the first eight months of the campaign the letters despatched to the seat of war num- bered over 5J millions, while about half that number were sent home. Including telegraphists, and men of the army reserve, 3400 post office servants were sent to the front.

Money Order Pates. â€” The decrease in the number of inland money orders till 1890-91 was due to the competi- tion of postal orders (introduced on 1st January 1881), alid to the reduction (on 1st January 1878) of the charge for registering a letter from 4d. to 2d.i Between 1878 and 1886 the commission on money orders under 10s. was 2d., but on the 1st September in the latter year the rates were altered as follows : â€”

Orders not exceeding Â£1

â€ž â€ž â€ž 7

â€ž â€ž â€ž 10

2d. 3d. 4d. 5d. 6d.

On 1st February 1897 new rates were introduced : on orders not exceeding Â£3 â€” 3d. ; over Â£3 and not exceeding

1 The total sums remitted did not fall off to the same extent, show- ing that the small orders alone were affected. The average amount for ordinary inland orders is now Â£2, 19s. 5d.

Â£10 4d. The cost of a money order transaction (at least

3d.) is very Kttle affected by the amount of the remittance, and it was thought undesirable to continue the unre- munerative business of sending small sums by money order at less than cost price at the expense of the senders of larger orders. The needs of smaller remitters appeared to be sufficiently met by postal orders and the registered

letter post. It appeared, however, that the new charges fell vpith great severity upon mutual benefit societies, like the Hearts of Oak, which send large numbers of small money orders every week, and on 1st May 1897 the 2d. rate was restored for orders not exceeding Â£1.

Money Orders. â€” The following table shows the move- ment of money-order business since 1883 : â€”

Tear.

Inland Orders.

Colonial Orders.

Foreign Orders.

Grand Total.

1 1

.g

-P.g

1

Iz;

1

“P.g

Sgg “*g

I

i

S

“*g

“4

1

4i

.4i

ill

o

Â£

1,263,690

Â£

dec.

Â£

dec.

dec.

1884-a5

11,968 127

Â£

23,636,699

dec.

13-3

6-9

337,420

7-7

67

569,189

1,430,387

1-7

â– 2 inc.

12,864,736

26,230,676

12-3

5-

inc.

1889-90

9,027,760

23,333,417

2-1

1-6

453,102

1,631,616

6-6

7-2

893,292

2,200,872

4-6

dec.

3-

dec.

10,374,144

27,165,905

1-2

inc.

2-

1894-96

9,190,304

24,953,632

1-7

1-6

518,662

1,711,818

â€¢5

31

976,340

2,257,777

â€¢6 inc.

5-

inc.

10,685,206

28,923,127

1-6

â€¢7

1899-1900

10,292,890

30,606,361

5-8

6-6

617,340

1,876,411

4-0

â– 9

1,177,229

2,819,600

1-4

â€¢1

12,087,469

36,201,262

6-3

6-7

1900-01

11,376,618

34,454,869

10-5

12-9

680,370

2,074,495

10-2

10-5

1,207,679

2,846,311

2-5

â€¢9

13,263,667

39,374,665

9-7

11-8

Foreign and Colonial Money Orders. â€” The rates brought into force on 1st January 1883 were as follows : â€”

s. d.

Not exceeding Â£2 0 6

5 10

7 ... 1 6

” 10 20

On 1st February 1897 these rates were reduced to the

present scale : â€”

s. d.

Not exceeding Â£2 0 6

6 10

10 16

Money orders may be sent to almost any country in the world. Russia, Spain, Greece, and some of the states of Central and Southern America are the principal excep- tions.

The money order system is largely used by the British Government departments for the payment of pensions, separation allowances, remittance of bankruptcy dividends, &c. ; and free orders may be obtained by the public, under certain conditions, for the purpose of remitting their taxes. The cost of management of the Money Order Office was

reduced by the substitution, since 1898, of a number of women clerks for men and boys.

Telegraph Money Orders. â€” On 2nd September 1889 the issue of telegraphic money orders between London and seventeen large towns was commenced as an experiment, and on 1st March 1890 the system was extended to all head post offices and branch offices in the United Kingdom. Two years later it was extended to every office which transacts both money order and telegraph business. The rates

Not exceeding Â£1 0

2 0

t 0

7 0

10 1

d.

4 6 8

10 0

in addition to a minimum charge of 9d. for the official telegram of advice. The rate was lowered on 1st February 1897 to 4d. for sums not exceeding Â£Z, and 6d. for sums from Â£3 to Â£10, and the minimum charge for the telegram was reduced to 6d. The sender of a telegraph money order may give instructions that, instead of being left at the post office to be called for, it should be delivered at

Talle showing the Nmriher and Value of Postal Orders issued to the Public from the commencemeiit on the 1st January 1881 to

the 31st March 1900, with those of typical years.

Number of each Class of Postal Orders issued (OOO's omitted).

Total.

s. d.

1 0

8. d.

1 6

8. d.

2 0

s. d.

2 6

8. d.

3 0

8. d.

3 6

s. d.

4 0

8. d.

4 6

B. d.

6 0

s. d.

7 6

s. d.

10 0

8. d.

10 6

s. d.

12 6

8. d.

16 0

s. d.

17 6

8. d.

20 0

No.

Value.

1885-86 . 1889-90 . 1894-95 . 1899-1900 . 1900-01

Totals .

1,624 8,266 4,838 8,906 8,229

1,169 2,338 3,639 5,088 5,358

1,631 2,951 4,301 6,262 6,646

1,581 2,699 3,930 6,419 6,716

1,843 2,418 3,866 4,698 6,024

708 1,391 1,997 2,676 2,954

1,497 2,837 3,894 5,419 5,651

566 1,126 1,673 2,237 2,361

8,987 6,637 8,924 11,686 12,363

1,146 2,008 2,841 3,737 3,936

8,874 6,027 7,684 9,461 9,977

694 1,389 1,978 2,568 2,766

1,127 1,796 2,304 2,863 2,982

4,943 7,839 9,416 11,214 11,622

26,790 44,712 60,681 82,116 86,390

10,788 17,737 22,759 28,633 29,881

367,044

81,401

66,462

64,334

61,900

60,366

29,639

68,449

24,449

139,226

48,678

120,972

28,938

628

36,139

339

160,071

945,896

Eateb of POtraDASE.

To 31st May 1884.

Poundage.

Jd.

Id.

Id.

2d.

2d.

Amount of Order .

s. d.

1 0

8. d.

1 6

8. d.

2 0

s. d.

2 6

s. d

8 0

8. d.

3 6

s. d.

4 0

B. d.

4 6

s. d.

6 0

a d.

7 6

8. d.

10 0

8. d.

10 6

8. d.

12 6

8. d.

16 0

8. d.

17 6

s. d.

20 0

From iBt June 1884.

Poundage.

Jd.

Id.

lid.

l}d.

Postal orderB for the sums o(128. 6d. and 178. 6d. were abolished on the Slst May 1884. Postal orders for the sums of 2s., 33., 3s. Od., 48., 48. 6d., and 10s. 6d. were established on the 1st June 1884.

the payee's residence, and that it should be crossed for payment through a bank. He may also, on paying for the extra words, send a short private message to his correspondent in the telegram of advice.

Telegraph money orders may also be sent to Austria, Belgium, Egypt, France, Germany, Holland, Hungary, Italy, Luxemburg, Norway, Kumania, Sweden, and Switzerland. A fee of 2d. is required in addition to the usual money order commission and the cost of the telegram. The system is being rapidly extended to other countries.

The telegraph inland money orders in 1899-1900 amounted to 311,943, and the sums so remitted to Â£999,086, an average of Â£3 4s. 1591

were sent abroad for a total of Â£7213, while 2183 for Â£12,576 were received from foreign countries.

Postal Orders. â€” The table at foot of preceding page relates to postal orders.

It will be observed that in 1884 six new denominations of postal orders were introduced, while those for 12s. 6d. and 17s. 6d., which were comparatively little used, were discontinued. At the same time permission was given to make up broken amounts by affixing postage stamps for sums not exceeding 5d. to the order. The stamps so affixed now amount to Â£100,000 a year. The postal orders for Is. have recently greatly increased, owing to the number of sporting competitions, for which a fee of Is. is required. British postal orders may also be obtained at Constantin- ople, Malta, Gibraltar, India, Straits Settlements, Hong Kong, and Newfoundland, and by sailors on H.M. ships.

Savings Banks.

A succinct account of the history of the Post Office Savings Bank, ” so far as depositors and the general public are concerned,” wiU be found in an Appendix to the Forty-third Report of the Postmaster-General (1897). The growth of business is shown in the following table : â€”

Year ending 31st December.

Average Number of Accounts.

Averagfe

Amount of

Deposits.

Average

Balance in

each Account.

Average Number of Offices.

1863-68 . 1869-74 . 1875-80 . 1881-85 . 1886-90 . 1891-95 . 1896-99 .

663,000 1,373,000 1,889,000 3,088,000 4,248,000 5,776,000 7,444,744

7,000,000 18,000,000 29,000,000 42,000,000 69,000,000 83,000,000 119,000,000

Â£ s. d.

11 3 6 13 1 5 3

15 12 5 13 11 3

13 16 10

14 7 0

16 0 4

3,390 4,498 5,742 7,348 9,025 10,888 12,404

“It is no slight testimony,” says the report referred to, “to the skill of the able men who drew the original regulations of 1861, that these regulations remained unchanged, in spite of the vast expansion of the Bank, until a new code was prepared under the Act of 1887″ (50 & 51 Vict. c. 40). The code of 1st November 1888, issued under this Act, did not enlarge the limits of deposits or make any great and conspicuous change in the general system, but the Postmaster-General obtained power to offer certain facilities for the transfer of money from one account to another, for the easier dis- posal of the funds of deceased depositors by means of nominations, and in various ways for the convenience of the customers of the bank. Arrangements were made for reducing to Is. the cost of certificates of births, deaths, and marriages required for savings bank purposes. In July 1889 Local

Loans 3 per cent, stock was made available for purchase through the Post Office Savings Bank.

“In July 1891,” continues the report, ” another Act of Parliament was passed by which the maximium amount

which might be deposited was raised from Â£150 to Â£200, inclusive of interest. The annual limit remained at Â£30, but it was provided that, irrespective of that limit, depositors might replace in the bank the amount of any one withdrawal made in the same year. The object of this provision was to avoid curtailing the saving power of a person who might be driven by emergency to make an inroad upon his store, but who might nevertheless, when the emergency had passed, find himself none the poorer and able to replace the money withdrawn.

” The Act provided also that where on any account the principal and interest together exceeded Â£200, interest should cease only on the amount in excess of Â£200, whereas previously interest ceased altogether when it had brought the balance of an account up to Â£200.

” The next striking development of the Savings Bank arose out of the Free Education Act, passed in September 1891. The Government of the day desired that advantage should be taken of the opportunity to inculcate upon parents and children alike a lesson of thrift â€” that they should save the school pence which they were no longer bound to pay. The Education Department and the Post- master-General worked in concert to realize this end. School managers were urged to press the matter upon all concerned, special stamp slips were prepared and issued, managers were supplied on credit with stocks of stamps to be sold to the children, and clerks from the nearest post offices attended at schools to open accounts and receive deposits. The arrangement began in January 1892 ; about 1400 schools adopted the scheme at once, and three years later this number had risen to 3000. A sum of nearly Â£14,000 was estimated to have been deposited in schools in 5 months, and about Â£40,000 in the first year. ‘

” Concurrently with the spread of the stamp-slip system in the schools, the extension of School Penny Banks, con- nected intimately with the

Savings Bank, was a conspicu- ous result of the effort to turn into profitable channels the pence which no longer paid school fees.

"In December 1893 another Act of Parliament ex- tended the annual Hmits of deposits from Â£30 to Â£50. The maximum of Â£200 remained unchanged, but it was provided that any accumulations accruing after that amount had been reached should be invested in Govern- ment stock unless the depositor gave instructions to the contrary.

" In December 1893 arrangements were made for the use of the telegraph for the withdrawal of money from the Savings Bank. Postmasters-General had hesitated long before sanctioning this new departure. It was known that the system was in force abroad, and it was recognized that there might be, and doubtless were, cases in the United Kingdom where the possibility of vpithdrawing money without delay might be all-important, and might save a depositor from debt and distress. But, on the other hand, it was strongly held that the cause of thrift was sometimes served by interposing a delay between a sudden desire to spend and its realization ; and it was also held to be essential to maintain a marked distinction between a bank of deposit for savings and a bank for keeping current accounts."

On the whole, the balance of opinion was in favour of the change, and two new methods of withdrawal were provided A depositor might telegraph for his money and have his warrant sent to him by return of post, or he might tele- graph for his money and have it paid to him in an hour or two on the authority of a telegram from the Savings Bank to the Postmaster. The first method cost the depositor about 9d., the second cost him about Is. 3d. for the trans- action. In 1899, 161,190 applications were received for

withdrawal by telegraph, and 11,405 telegrams were received requesting payment by return of post.

By an Act which came into force on 1st January 1895, building societies, duly incorporated, were enabled to deposit at any one time a sum not exceeding Â£300, and to buy Government stock up to Â£500 through the Savings Bank.

Savings Bank Finance.â€” The increase in the deposits lodged in the Post Office Savings Bank must be ascribed to a variety of causes. Numbers of trustee banks have been closed, and have ttansferred their accounts to the Post OfiBce Bank ; greater facilities have been offered by the bank ; the limits of deposit in one year, and of total deposit, have been raised ; and, since October 1892, deposits may be made by cheque ; while the long-continued fall in the rate of interest made the assured 24 per cent, of the Post Office Savings Bank an increasing temptation to a class of investors previously accustomed to look elsewhere. The high price of Consols, due in part to the magnitude of purchases on Savings Bank account, proved a serious embarrassment to the profitable working of the bank, which had shown a balance of earnings on each year's working until 1896, after paying its expenses and 2i per cent, interest to its depositors. Economical working minimized, but did not remove, the difficulty. The average cost of each transaction, originally nearly 7d., has been brought down to Sjd. Down to the year 1896, Â£1,598,767 was paid into the Exchequer under sec. 14 of the Act 40 Vict. c. 13, being the excess of interest which had accrued year by year. But since 1895 there have been deiicits amounting to Â£6162 in 1896, Â£9232 in 1897, Â£7018 in 1898, and Â£11,711 in 1899â€” in all, Â£34,123.

The Central Savings Bank having outgrown its accommodation in Queen Victoria Street, London, a new site was purchased in 1898 for Â£45,000 at West Kensington, and the foundation-stone of a new building, to cost Â£300,000, was laid by the Prince of Wales on behalf of Queen Victoria on 24th June 1899.

Under the Workmen's Compensation Act of 1897, sums awarded as compensation may be invested in the Post Office Savings Bank. This arrangement proved so convenient, that an Act of 1900 authorized a similar investment of money paid into an English county court in

ordinary actions at common law, and ordered to be invested for the benetit of an infant or lunatic.

Inducements to Thrift. â€” By arrangement with the War Office in July 1893, the deferred pay of soldiers leaving the army was invested on their behalf in the Post Office Savings Bank, but it was found that the majority of the soldiers draw out practically the whole amount at once, and the experiment was discontinued in 1901. At the request of large employers of labour, an officer of the Savings Bank attends at industrial establishments on days when wages are paid, and large numbers of workmen have thus been induced to become depositors. The advantages of the Savings Bank are brought prominently before the public by notices and leaflets, and appear to be now thoroughly appreciated throughout the United Kingdom, as shown by the following table : â€”

On 31st December 1900.

ill

til

England and Wales Scotland Ireland .

Totals .

7,685,317 372,801 381,865

Â£

122,365,193 5,126,299 8,058,153

Â£ 8. d.

15 18 5 13 15 0 21 2 1

1 in 4 1 in 12 linl2

8,439,983

135,549,645

16 1 3

lin 5

Between the foundation of the bank and the end of 1899, upwards of Â£648,000,000, inclusive of interest, was credited to depositors, of which Â£474,000,000 was withdrawn. There were 232,634,596 deposits, 81,804,509 withdrawals, 27,071,556 accounts opened, and 18,631,573 accounts closed. The cross-entries, or instances where the account is operated uj)on at a different office from that at which it was opened, amounted to 33 per cent. It is chiefly in respect of this facility that the Post Office Savings Bank enjoys its advantage over the trustee savings bank. In 1900, 14,969,849 deposits were made, amounting to Â£40,516,436. In the same year the withdrawals numbered 5,406,347, the total sum withdrawn being Â£38,231,372. The interest credited to depositors was Â£3,145,978, and the total sum standing to their credit on 31st December 1900 was Â£135,549,645.

A classification of accomits opened for 3 months in 1896, and assumed to be fairly typical, showed the following results : â€”

Occupation as stated by Depositors in opening Account.

Professional

Official

Educational

Commercial ..... Agricultural and fishing

Industrial

Railway, shipping, and transport Tradesmen and their assistants , Domestic service ....

Miscellaneous

Married women, spinsters, and children

to

Total.

1-55

2-81

1-01

3-88

1-83

18-43

2-96

8-14

8-61

0-37

50-41

100-00

Women and children of all ranks are believed to be 60-59 of the total number of depositors.

The accounts open at the end of 1895 showed the following division of deposits .- â€”

Per Cent.

Balances not exceeding . . Â£50 . . 36-1

Exceeding Â£50 and not exceeding 100 . . 24-5

100 ,, â€ž ,, 150 . . 17-3

150 â€ž â€ž â€ž 200 . . 14-8

200 7-3

100-0

The division according to number of accounts, in the same groups, was 90-8, 5-3, 2-2, 1-3, and 0-4 respectively.

Investments in Government Stock. â€” In September 1888 the minimum amount of Government stock which might be purchased or sold through the Post Office Savings Bank was reduced from Â£10 to Is., and it was also provided that any person who had purchased stock through the Savings Bank could, if he so desired, have it transferred to his own name in the books of the Bank of England. The Act of 1893 raised the limit of stock to Â£200 in one year, and Â£500 in all ; but any depositor might purchase stock, to replace stock previously sold, in one entire sum during that year. If a depositor exceeds the authorized limits of deposit in the Post Office Savings Bank, the excess is invested in stock by the Post Office on his behalf.

During the year 1900 the investments of depositors in Govern- ment stock were 41,030, amounting to Â£2,830,513. The sales were 12,028, amounting to Â£678,510. On the 31st December there were 93,965 depositors, whose total holding of stock amounted to Â£10,468,290.

Annuities aiid Life Insurances. â€” The Act of 1882, which came into operation on the 3rd June 1884, utilized the machinery of the Post Office Sayings Bank for annuities and life insurances, which had been effected through the Post Office at selected towns in England and Wales since 17th April 1865. Under the Act of 1882 all payments were to be made by means of money deposited in the Savings Bank, and an order could be given by a depositor that any sum â€” even to Id. a week â€” should be devoted to the purchase of an annuity or insurance so long as he retained a balance in the Savings Bank. In February 1896 new life insurance tables came into operation, with reduced annual

rates, and with provision for payment of sums insured at various ages as desired. In 1900 contracts were entered into for 2268 immediate annuities for Â£49,893, 137 deferred for Â£2722, and 677 life insurances for Â£32,512. The receipts for the year were Â£728,142 immediate and Â£19,852 deferred annuities, and Â£22,185 for life insurances. The payments amounted to Â£503,297 in respect of immediate annuities, to 31,409 persons; Â£12,921 deferred annuities, to 1020 persons; and 364 persons had claims amounting to Â£15,422 on account of life insurances, on death and surrender.

Telegraphs and Telephones.

On the 5th of February 1870 the monopoly conferred upon the Postmaster-General by the Telegraph Act of the previous year took effect. The Post Office assumed control of telegraphic communication within the'^*'**'"""*' United Kingdom, and it became possible to send telegrams throughout the country at a uniform charge irrespective of locality or distance. The purchase money paid to the telegraph companies, the compensation to railway companies for their interest in telegraph business, and the expense of new lines, amounted to upwards of ten millions sterling. On the day of the transfer a thousand

post offices and 1900 railway stations were opened as telegraph offices. The public at once showed their appreciation of the change. In 1869 but seven millions of telegrams passed on the companies' wires. In 1870 the Postmaster-General transmitted ten millions.

In 1885 sixpenny telegrams were introduced. The charge for a written telegram which came into force in 1870 was one shilling for the first twenty words, and threepence for every additional five words, the addresses of sender and receiver being sent free. In 1885 the charge was reduced to a halfpenny a word throughout, including addresses (a system of abbreviated addresses, which could be registered on payment

of a guinea a year, being introduced), with a minimum charge of sixpence. The effect of this reduction was to raise the number of telegrams in two years from 33,000,000 to 50,000,000. . During the first six months the number of telegrams increased by 48 per cent., while the gross telegraph revenue fell oflf to the extent of Â£40,233, though Â£18,124 had been received in respect of abbreviated addresses. In April 1886 the telegrams exceeded those for April 1885 by 40 per cent. ; the revenue was Â£11,800 less. In May the increase in telegrams was 51 per cent., and the revenue Â£4100 less than in the previous May. In June the increase was 61 per cent. ; the revenue Â£2800 less. The working expenses were thus increased, while the receipts were diminished. In London alone the receipts from local messages fell off by as much as 74 per cent.

The following table shows the total number of telegrams forwarded from telegraph offices in England and Wales, Scotland, and Ireland, in each year since 1883 : â€”

Year.

Number of Telegrame. OOO's omitted

England and Wales.

Scotland.

Ireland.

Total.

Provinces.

London.

Total.

1884-85 .

15,195

12,930

28,125

3,257

1,894

33,278

1885-86 .

18,029

15,081

33,110

3,812

2,223

39,146

1886-87 .

24,044

18,276

42,320

5,106

2,816

50,243

1887-88 .

26,052

18,872

44,924

5,430

3,047

53,403

1888-89 .

28,269

20,263

48,532

5,991

3,241

57,765

1889-90 .

30,873

21,562

52,435

6,545

3,420

62,403

1890-91 .

32,827

22,831

55,658

7,077

3,673

66,409

1891-92 .

84,854

23,911

58,765

7,155

3,674

69,685

1892-93 .

35,382

23,554

58,936

7,100

3,871

69,907

1893-94 .

36,129

23,501

59,630

7,279

3,987

70,899

189J-95 .

36,098

24,117

60,215

7,334

4,038

71,589

1895-96 .

39,411

27,025

66,436

8,095

4,307

78,839

1896-97 .

40,305

26,645

66,950

8,094

4,378

79,423

1897-98 .

42,542

27,419

69,961

8,463

4,605

83,029

1898-99 .

44,781

28,468

73,249

9,064

4,729

87,043

1899-1900

46,144

29,971

76,115

9,387

4,910

90,415

1900-01 .

46,029

29,355

75,384

9,289

4,903

89,576

In 1891 the terms under which a new telegraph oiBce was opened, on the request of a person or persons who undertook to guarantee the Post Office against loss, were reduced. In 1892 rural sanitary authorities were empowered to give such guarantees out of the rates. In 1897, as part of the Jubilee concessions, the Govern- ment undertook to pay

one-half of any deficiency under guarantees. During the six years ended in 1891 the average number of tele- graph offices guaranteed each year was 77. From 1892 to 1897 the average rose to 167. In 1898 and 1899 it amounted to 290. The number of telegraph offices opened without guarantee has increased apace, and there are now 11,512 telegraph offices in all. As part of the Jubilee scheme the charges for porterage â€” formerly 6d. per mile beyoml the free postal delivery of a town, or beyond one mile from an office, and Is. per mile from the office door when the dis- tance exoeedeil 3 miles and a mounted messenger was sent â€” were reduced as follows : Up to 3 miles, free ; beyond 3 miles, 3d. per mile, reckoned from the post office ; and arrangements were made for the free delivery at all hours of the day or night of any tele- gram within the metropolitan postal district. The cost of free delivery up to 3 miles was estimated at Â£52,000 a year.

On the 26th April 1892 the House of Commons passed a resolu-

tion, moved by Sir E. Birkbeok, in favour of providing telegraphic or telephonic communication between coastguard stations, for the better prevention of loss of life and property by shipwreck. Â£20,000 a year was voted for 1892-93 and for each year in succes- sion till 1900-01 (Â£30,000 ; 1901-02, Â£15,000), and a Eoyal Com- mission was appointed to consider the best means of connecting lightships and lighthouses with the telegraph system of the country. The Post Office Cruide contains a list of- 48 points at sea from which casualties can be reported by telegraph or telephone. A new line from London to Nevin, on tlje coast of Wales, and thence to Ireland, was laid in 1887, at a cost of Â£40,700. In June 1899 an additional cable was laid from Nevin to Newcastle, Co. Wioklow.

In order to obviate the damage and interruption resulting from storms, large numbers of wires have been laid underground ; and a system of underground wires between London and Birming- ham has been completed, to secure the storm-swept centre from the Wash to the Bristol Channel.

Foreign Telegrams. â€” The Sixth International Telegraph Conference, held at Berlin in 1884, effected a reduction in the charges to many

countries. U.g., the rate per word was reduced for Kussia from 9d. to 6Jd., Spain 6d. to 4|^d., Italy 5d. to 4Jd., and India 4s. 7d. to 4s. The cost of repeating a message was reduced from one-half to one- fourth of the original charge for transmission. The next Conference (1890) was held at Paris. Further consider- able reductions were effected. The rates to Austria- Hungary and Italy were reduced from 4^d. to 3d., Eussia 6^d. to 5^d., Portugal 5^d. to 4^d., Sweden 5d. to 4d., Spain 4^d. to 4d., Canary Islands Is. 7^d. to Is., &c. The minimum charge for any foreign (European) telegram was fixed at lOd. The Eighth Conference (Budapest, 1896) succeeded in making the following reductions, among others, from the United Kingdom : China 7s. to 5s. 6d., Java 6s. to 5s., Japan 8s. to 6s. 2d., Mauritius 8s. 9d. to 5s., Persia 2s. 5d. to Is. 9d. At this Conference it was made incumbent upon every State adhering to the Union to fix in its currency an equivalent approaching as nearly as possible the standard rate in gold, and to correct and declare the equivalent in case of any important fluctuation. The limit of letters in one word of plain language was raised from 10 to 15, and the number of figures from 3 to 5. The International Telegraph Bureau was also ordered to compile an enlarged official vocabulary of code words, which it is proposed to recognize as the sole authority for words which may be used in cypher telegrams sent by the public. . (See Appendix to Postmaster-General's Report, 1897.)

In the meantime progress had been made in the transfer of international cables from private companies to the State. The concession held by the Submarine Telegraph Com- pany, for cables between the United Kingdom and the continent of Europe, expired in January 1889, but was extended to the 31st of March in that year. From that date the undertaking was purchased by the Governments concerned. France and Great Britain jointly acquired the cables between Calais and Dover, Boulogne and Folke- stone, Dieppe and Beachy Head, Havre and Beachy Head, Piron, near Coutances, and Vieux Chateaux (St Heliers, Jersey). Belgium and Great Britain became joint-pro- prietors of the cables between Ramsgate and Ostend and Dover and De la Panne (near Fumes). The two cables to Holland and one of the cables to Germany werfe already the property of Great Britain, and the German Union Company's cable to Germany was

purchased by the German Government. The offices of the Submarine Company in London, Dover, Ramsgate, East Dean, and Jersey were purchased by the Post Office, as well as the cable ship ; and the staff, 370 in number, was taken over by the Govern- ment. The capital amount laid out by Great Britain was Â£67,163, and on 1st April the new business was com- menced with a uniform rate to France, Germany, HoUand, and Belgium of 2d. a word, with a minimum of lOd.

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POST OFFICE

In 1890 Liverpool was placed in direct telegraphic communica- tion with Hamburg and Havre, and London with Rome. The following year an additional cable was laid from Bacton, in Norfolk, to Borkum, in Germany, at the joint expense of the British and German Governments. Direct telegraphic communication was thus afforded between London and Vienna. In 1893 a contract was made with the Eastern and South Africa Telegraph Company for the construction, laying, and maintenance of a cable from Zanzibar to the Seychelles and Mauritius, a distance of 2210 miles, for a subsidy of Â£28, 000 a year for twenty years, to be made up as follows : Great Britain 10 millions, India 10 millions, Seychelles 1 million, Mauritius 7 millions. The cable has been worked since November 1893. In 1894 the Eastern Extension Telegraph Company laid a cable from Singapore to Labuan and Hong Kong, thus duplicating the route and making it an all- British line. The following year the rates to and from East and South Africa were reduced, by negotiation, from charges varying from 7s. 9d. to 8s. lid. a word to 5s. 2d. or 5s. Government messages were accorded a rate of 2s. 6d. and press telegrams from Is. 6d. to Is. TJd. a word. In 1896 it was arranged to lay two new cables to France and one (for duplex working) to Germany. On 1st February 1898 a new cable was laid between Bermuda and Jamaica (yid Turks Islands), giving an all-British line to

the West Indies, with reduced charges. In 1900 direct telegraph working was established between London and Genoa, and a third cable was laid to South Africa vid, St Helena and Ascension.

Experiments by Sir W. Preece in electrical communication with- out wires have been reported from time to time by the Postmaster-General, and the method has been employed by the Post Office in practical working across the Severn Channel, and in instances where an inland telegraph has been interrupted.

Ten years of State administration of the telegraphs had not passed before the Postmaster-General was threatened with a formidable rival in the form of the tele- obones P^one, which assumed a practical shape about the year 1878, the first exchange in the United Kingdom being established in the City of London in that year. It was claimed by those in possession of the tele- phone patents that they could supply the means of tele- phonic communication to the public without the licence of the Postmaster-General, and could thus, in effect, compete with the State in the transmission of messages by means of electricity. The Postmaster-General resisted this view, and in 1880 it was judicially determined (Attorney-General v. The Edison Telephone Company, 6 Q. B. D. 244) that the telephone was a telegraph, and that telephone exchange business could not legally be carried on except by the Postmaster-General or with his sanction. Licences were then granted to the United Telephone Company, the owners of the master-patents, and to a number of sub- sidiary companies, to establish exchanges in specified places, on condition that a royalty of 10 per cent, on the gross receipts of each enterprise was paid to the Post Oflfice. The business grew rapidly, and in 1884 the local licences (which were found to hamper business) were superseded by licences applicable to the whole country. At the same time a few Post Office exchanges were estab- lished, and the Postmaster-General undertook the business of supplying private telephone wires.

Between 1884 and 1889 the three principal telephone companies (the United, the National, and the Lancashire and Cheshire) greatly extended their business, and on 1st May 1889 they became merged in

the National Telephone Company Limited. On 1st May 1890 the company reduced its rates in the North of England from Â£20 to Â£15 per annum, and on 1st January 1891 a general reduction of rates outside the metropolis took place from Â£15 and Â£12 per annum to Â£10 per annum. The remaining companies were shortly afterwards amalga- mated with the National Telephone Company. In July 1891 the last of the patents expired, and in March 1892 Sir C. Cameron moved a resolution in the House of Commons in favour of nationalizing the telephone service. The Government therefore announced its intention of purchasing the trunk lines {i.e., lines connecting town

and town), leaving to the companies the local exchange business. A Treasury Minute of 23rd May 1892, printed in full in the Postmaster-General's Thirtieth Report (1892), sets out the objects of the Government's policy. It points out that the telegraph revenue was being checked by the telephones, and that at the same time the pubUc was dissatisfied w'ith the practical monopoly of the company, which by buying up its rivals had destroyed competition, whUe the system still lacked its necessary development. The charges for trunk conversations were to be fixed at 3d. for 3 minutes for any distance not exceeding 20 miles, 6d. for over 20 and not exceeding 40 miles, and 6d. for every additional 40 miles.

A Select Committee of the House of Commons in 1892, under Mr Goschen, recommended that the companies' licences should not be extended, but that the Government should on its own responsibility settle the details of an* agreement to be laid before Parliament. The New Tele- phone Company had arisen in Manchester after the patents had expired, but by arrangement with its more powerful rival it went into liquidation, leaving the National Tele- phone Company alone in the field. The Telegraph Act, 1892 (55

25 miles or under

s.

0

d.

3 for 3 minutes.

Over 25 miles and not exceeding 50

0

6

â€ž 50 â€ž â€ž 75

0

9

â€ž 75 â€ž â€ž 100

1

0

For each 40 miles beyond

0

6

The heads of the agreement with the company were initialled on the 11th August 1892 ; but the complication and magnitude of the details to be arranged for the transfer of the lines occupied a period of nearly four years, and the final agreement was not signed until 25th March 1896. Nearly 30,000 miles of vdres were taken over, at a cost of Â£459,114, and new areas were allotted to the company for the prosecution of its exchange busi- ness. All communication between one exchange area and another now involves the use of the trunk wires. A large number of the operatives employed by the company on the trunk wires passed into the service of the Post Office at the time of the transfer.

Meanwhile the draft agreement with the National Telephone Company, laid on the table of the House of Commons on 7th August 1894, had been followed by much pubhc discussion. The principle of competition in exchange business again found favour with a section of the public, and the corporation of Glasgow, in particular, pressed its appHcation for the grant of a licence to carry on telephone business. Local authorities objected in some instances (notably in London and Glasgow) to permit the company to take up the streets for the purpose of laying underground wires; while overhead wires, apart from aesthetic objections, were liable to interruptions from fire, storms, and accidents. Accordingly in 1895, a Select Committee of the House of Commons was appointed, with Mr Arnold Morley, Postmaster-General, as chairman, ” to consider and report whether the provision now made for the telephone service in local areas is adequate, and whether it is expedient to supplement or improve this provision, either by the granting of licences to local authorities or otherwise.” As the dissolution of Parlia-

ment was imminent and the Committee was not unanim- ous, it failed to do more than report the evidence to the House.

The corporation of Glasgow persevered in its efforts to obtain a licence, and in 1897 the Treasury appointed Sheriff Andrew Jameson a Special Commissioner to hold a local inquiry in Glasgow whether the telephone service in that city was adequate and efficient ; whether the price charged was reasonable ; whether any inefficiency or inade- quacy was due to the refusal of facilities on the part of the municipal authorities and others, and how far such refusal was reasonable or justifiable; and ffiially, whether it was expedient to grant the corporation a licence to carry on a telephone service. After taking evidence for a fort- night, the Commissioner reported that the service was inefficient, but adequate â€” i.e., no undue conditions were imposed upon applicants. The price was reported to be reasonable. The corporation was held responsible for unreasonably withholding facilities, and so rendering the service

inefficient; while it was held inexpedient to give the corporation a licence, on the grounds that (i.) the funds of a city ought not to be applied for the benefit of a limited class of citizens only, (ii.) that delay and waste result from two systems in one area, (iii.) that the acquisition of all telephones by the Government in 1911 would become more difficult and expensive, and that (iv.) the corporation had not proved that they could work the licence without throwing a new and serious burden on the rates.

On 1st April 1898 a further debate was opened in the House of Commons by Mr Caldwell, in the course of which Mr Hanbury, Financial Secretary to the Treasury and representative of the Post Office in the House, stated on behalf of the Government the objections to purchasing a company whose capital stock had been largely watered, whose plant was in many cases old-fashioned, consisting of single overhead wires, and whose term of existence was approaching its end. A Select Committee was appointed, with Mr Hanbury as chairman, to consider ” whether the telephone service is, or is calculated to become, of such general benefit as to justify its being undertaken by municipal and other local authorities, regard being had to local finance ” ; and if so, under what conditions. The Committee reported (9th August) to the effect that the telephone service of the country was not likely to become of general benefit ” so long as the present practical monopoly in the hands of a private company shall continue.” The trunk service in the hands of the Government and worked on the toll system (i.e., a separate payment for each service) was the most expensive in Europe. The ex-change service, chiefly confined to annual subscribers to the National Telephone Company, was much behind what it should be as judged by Continental standards. The company’s capital of Â£3,105,000 at the time of amalga- mation included Â£1,292,000 of “water.” Â£300,000 had been spent on patents which expired in 1891. And the service, practically limited to the wealthy classes or large users who could afford to become annual subscribers, was rendered precarious by the difficulty of obtaining way- leaves, which, even when secured, were held upon short notice. Out of 143,000 miles of vrire, 120,000 were liable to be removed at 6 or 12 months’ notice. The company’s rates were unregulated, and it claimed the right to give preferences, or even

to refuse its services altogether. The Committee found that the Post Office was ” not prevented, either by legal agreement or by good faith, from limiting or ending the monopoly of the company ” ; and that ” competition appears to be both expedient and necessary, in order, first, to extend and popularize the service, and, next, to avoid a danger, which is by no means remote if no

alternative service is in operation, that a purchase of the company’s undertaking at an inflated price may be forced upon the Government of the day.” They therefore recom- mend that ” general immediate and effective competition ” should be at once undertaken either by the Post Office or by local authorities, while considering that ” a really efficient Post Office service affords the ‘ best means for securing such competition.” The Post Office should either start services of its own, or grant licences to local author- ities, subject to proper regulations. Equal terms should be aimed at where the local authorities came into com- petition with the company ; and proposals were made with a view to the purchase by the Post Office in 1911, at the then value, without any compensation for goodwill or future profits, of any suitable plant or buildings held by a competing and expiring licensee.

In addition to the Â£1,000,000 raised for trunk line purposes by the Act of 1892, further sums of Â£300,000 and Â£1,000,000 had been authorized by ~~the Telegraph Acts of 1896 (59 & 60 Vict. c. 40) and 1898 (61 & 62 Vict. c. 33). Following upon the report of the Select Committee of 1898, the Telegraph Act, 1899 (62 & 63 Vict. c. 38), was passed for the purpose of enabling the Post Office to develop its exchange business, for which a loan of two millions was authorized, and to empower local authorities under certain conditions to carry on telephone exchange business under licence from the Post~~ master-General. The position of the National Telephone Company was also defined in case of competition by local authorities, and its licence was extended to be coextensive with that of a new licensee in any locality on condition of its affording intercommunication and coming under the control of the Post Office as regards rates.

The Post Office opened its exchange telephone service in London in 1902. It has granted Ucences to the States of Guernsey (1898), Glasgow, Huddersfield, Tunbridge Wells, Brighton, and other centres.

The principal reasons alleged for the unfavourable financial results of the working of the telegraphs are : (i.) The large price (Â£10,130,000) expended as pjâ€žgâ€žciai purchase-money â€" an argument of little weight results ot so long as working expenses are not paid, (ii.) state tele- The right accorded to railway companies at the ^"^P^y- time of the transfer, of sending postal telegrams free of charge. The number of these telegrams, at first insignifi- cant, reached a total of 1,600,000 in 1891, with an average length of 25 words, representing a value of over Â£80,000 a year. Arrangements were afterwards made under which the companies surrender this privilege in return for per- mission to send a fixed number of free telegrams in the course of each year, (iii.) The loss on press telegrams. To quote the Forty-first Report of the Postmaster-General ; " A still more serious burden is caused by the loss on press telegrams. The charge specified in the Telegraph Act of 1868 for press telegrams is Is. for 75 words during the day, or for 100 words at night. But a proviso was added that for copies the charge was to be only 2d. per 75 or 100 words, and no condition was laid down as to the copy being for the same town as the original. The news- papers accordingly combined to receive from the News Associations messages in identical terms, and by dividing the cost they are enabled to get the benefit of a rate which comes nearer 2d. than Is., the average charge being in fact about 4^d. per 100 words. Notwithstanding the economical arrangements which have been made for the transmission of the telegrams (5,400,000 in number, con- taining 650,000,000 words), the loss incurred by the Post Office in dealing with them is estimated to amount to Â£300,000 per annum." (iv.) The reductions in the tariff (especially in 1885 and 1897). (v.) The competition of

the telephone (upwards of 450,000,000 messages a year transmitted by the National Telephone Company alone), though it must be

remembered that the royalties of the company, exceeding Â£100,000 per annum, figure among the receipts of the Post Office telegraph service, (vi.) The increased wages paid to telegraphists : in 1880-81 the wages and salaries represented 44 per cent, of the total revenue ; they now exceed 66 per cent.

The real success of the State administration of the telegraph lies not in any contribution to the revenue, but

in cheap telegrams and a large use of the service. The average price paid for the ordinary inland telegram is 7|d.; and there are far more telegrams sent in the United Kingdom, both positively and relatively to population, than in any other country, with the possible exception of the United States. For every 100 persons there are sent, in the United Kingdom, 184 telegrams, while in France there are but 108, and in Germany but 66. The accom- panying table shows the revenue and expenditure of the telegraph service : â€”

Year.

Revenue.

Expenditure.

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Sites and Buildings.

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Other Expenditure.

1

Pur- chase.

Erec- tion.

Under Tele- graph Vote.

Under other Votes.

1884-85 . 1889-90 . 1894-95 . 1899-1900 1900-01

Â£

1,739,586 2,307,444 2,698,986 3,389,746 3,380,689

Â£

17,731 20,326

Â£

27,097 36,329 47,429 70,746 78,764

Â£

1,784,414 2,364,099 2,646,414 3,460,492 3,459,363

Â£

10,160 18,908 8,915 18,029 32,297

Â£

40,450 42,112 52,854 69,629 48,199

Â£

260,021 149,131 74,819 277,193 260,740

Â£

21,666 26,776 39,791 81,031 86,834

Â£

939,364 1,382,414 1,833,684 2,279,722 2,342,896

Â£

876,661 445,566 500,833 705,819 696,826

Â£

124,188 162,126 212,803 288,610 248,718

Â£

49,274 66,953 69,353 89,151 97,569

Â£

1,820,764 2,278,986 2,788,062 3,749,084 3,812,669

Â£

36,8601 86,113 141,6381 288,6921 363,2161

Â£

326,417 306,076 298 888 298,888 298,888

1 Deficits.

Fast Office Staff. The stafif of the Post Office on 31st March 1901 amounted to 173,184, or 1 in 236 of the whole population of the United Kingdom. Of these, 35,377 were women, a proportion of over one-fifth of the staff. The postmasters numbered 909 (including 11 employed abroad), and the sub-postmasters 21,027. The total number of offices (including branch offices) was 22,189. The unestablished staff, not entitled to pension, made up chiefly of telegraph boys, and of persons who are employed for only part of the day on Post Office business, included 79,052 out of the grand total, and almost the whole of the sub-postmasters. The pay and prospects of almost all classes have been greatly improved since 1884, when the number stood at 91,184. The principal schemes of general revision of pay have been :â€" 1881, Mr Fawcett's scheme for sorting-clerks, sorters, and telegraphists (additional cost Â£210,000 a year), and for postmen, 1882, Â£110,000: Mr Kaikes's various revisions, 1888, chief clerks and supervising officers, Â£6230; 1890, sorting-clerks, sorters, and tele- graphists, Â£179,600; 1890, supervising force, Â£65,000; 1890, London sorters,

Â£20,700; 1891, London overseers,’ Â£9400; 1891, postmen, Â£125,650: Mr Arnold Morley, 1884, London overseers, Â£1400, and rural auxiliaries. Â£20,000.

On June 10th 1895 a committee was appointed, with Lord Tweedmouth as chairman, to consider the pay and position of the whole Post Office staff, excluding the clerical force and those employed at headquarters. After ex- haustive inquiry, the committee reported its recommenda- tions on 15th December 1896, and these were adopted in their entirety by the Government at an immediate increased expense of Â£139,000 a year, which has since risen to Â£500,000. In 1897 a conference of members of the House of Commons, under the presidency of the Duke of Norfolk and Mr Hanbury, considered further representa- tions of grievances on the part of the staff, and in the result additional concessions were made at a cost of Â£100,000 a year.

In Jtily 1890 a number of postmen in London went out on strike. Over 450 were dismissed in one morning, and the work of the Post Office was carried on without inter- ruption. The men received no sympathy from the public

and most of them were ultimately successful in their plea to be reinstated. A quasi-political agitation was carried on during the general election of 1892 by some of the London sorters, who, under the plea of civU rights, claimed the right to influence candidates for Parliament by exacting pledges for the promise of parliamentary support. The leaders were dismissed, and the Post Office has upheld the principle that its officers are to hold themselves free to serve either party in the State without putting themselves prominently forward as political partisans. Parliament has been repeatedly asked to sanction a parliamentary inquiry to reopen the settlement of the Tweedmouth Committee, and the telegraphists have been especially active in pressing for a further committee. The rates of pay now, and at various dates since 1881, are set out with great fulness in two Parliamentary papers {Postman, No. 237 of 1897, and Sorters, Telegraphists,

The pay of a sorter or telegraphist in London rises to ilbO a year, with prospects of promotion to higher classes ihe maximum pay of a

postman in London is 34s. a week but he may receive as much as 6s. a week extra for good- conduct stripes. The Parliamentary returns above referred to show the perquisites in the form of overtime, allow- ances, double increments, uniform, free medical attendance, hohdays, and pensions, &c., enjoyed in addition to the bare wages "The mere scales of pay given to the staff only imperfectly represent the full advantages arising from their position; and the growing disinclination of the staff to leave the service, and the increasing desire of outsiders to enter it, afford a fair presumption that the position and prospects of the employes in the Post Office are at least equal, if not superior, to those of persons employed on similar duties outside the service." i f ^ ^

The estimated expenditure of the Post Office on account ot salaries and wages in 1900-01 amounted to Â£8 620 171 representing 49-38 of the total revenue and 62-11 of the total expenditure. These percentages were respectively 36 72 and 50-32 m 1884-85, and have been steadily in- creasing, notwithstanding the considerable extension of and!tr .r'Â°f"^"l experiment of employing women and girls in the clerical work of certain branches of the

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' Forty-first Report of the Postmaster-Geueral, 1895, p. 11.

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In November 1891 an important change was made in the method of recruiting the staff of postmen, with the object of encouraging military service, and of providing "situations for those who after serving their country in the army or navy are sometimes left without employment at a comparatively early age. In making appointments to the situation of postman, preference was given to army, navy, and royal marine pensioners, and men of the army reserve. Due regard was paid to the legitimate claims of telegraph messengers or other persons who had prospects of succeed-

ing to these situations, but on March 31st, 1892, no fewer than 1379 old soldiers and sailors were serving as postmen. Since that time the number has considerably increased. In August 1897 the Government decided to reserve one- half of all suitable vacancies for ex-soldiers and sailors, as postmen, porters, and labourers, and preference has been shown to them for employment as hft-attendants, care- takers, &c.

Finance. â€” The following table shows the financial work- ing of the Post Office : â€”

Year.

Kevenue.

Expenditure.

Net Revenue.

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Sites and Buildings.

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other Expenditure.

1

Pur- chase.

Erec- tion.

Under P.O.

Votes.

Under other Votes.

1884-85 . 1889-90 . 1894-95 . 1899-1900 . 1900-01 .

Â£

7,808,911

9,467,165

10,748,014

13,192,020

13,776,886

Â£

382,002

36,279

Â£

198,336 218,037

202,315 218,584

Â£

8,389,249

9,721,481

11,025,460

13,394,335

13,996,470

Â£

72,464 70,900 12,697 116,294 81,949

Â£

80,234 79,840 176,390 169,098 176,000

Â£

150,742 153,921 188,919 269,092 286,238

& 2,829,210 3,369,663 4,597,355 6,963,399 6,277,276

Â£

1,164,211 1,249,821 1,396,282 1,474,118 1,616,859

Â£

728,413 664,342 729,813 769,807 764,804

Â£

616,892 553,910 677,524 719,944 726,101

Â£

136,999 142,788 178,464 213,747 236,677

Â£

6,668,166 6,276,086 7,966,344 9,688,999 10,064,903

Â£

2,721,084 3,446,396 3,070,116 3,710,336 3,930,667

Postage Stamps.

The pamphlet of Mr (afterwards Sir) Eowland HiU, Post Office Reform : Its Importance and Practicability/, 1837, led to the appointment of a committee of the House of Commons on 22nd November 1837, “to inquire into the rates and modes of charging postage, with a view to such a reduction thereof as may be made without injury to the revenue.” This committee reported in favour of Hill’s proposals ; and an Act, 2 & 3 Vict. c. 52, was passed in 1839, authorizing the Treasury to fix the rates of post- age, and regulate the mode of their collection, whether by prepayment or otherwise. By Treasury Minute of 23rd August 1839, published in the press, it was announced that “My Lords . . . feel it will be useful that artists, men of science, and the public in general may have an opportunity of offering any suggestions or proposals as to the manner in which the stamp may be best brought into use.” A premium of Â£200 was offered for the best, and Â£100 for the next best, proposal. The points to be con- sidered were : ” (1) the convenience as regards the public use ; (2) the security against forgery ; (3) the facility of being checked and distinguished at the post office, which must of necessity be rapid; and (4) the expense of the production and circulation of the stamps.” To this invita- tion 2600 replies were received, but no improvement was made upon Eowland Hill’s suggestions. A further Minute, of 26th December 1839, announced that the Treasury had decided to require that, as far as practicable, the postage of letters should be prepaid, and such prepayment effected by means of stamps. Stamped covers or wrappers,

stamped envelopes, and adhesive stamps were to be issued by Government. The stamps were engraved by Messrs Perkins, Bacon, & Petch, of Fleet Street, from Hill's designs, and the Mulready envelopes and covers by Messrs Clowes & Son, of Blackfriars. The stamps were appointed to be brought into use on 6th May 1840, but they appear to have been issued to the public as early as lst May. The penny stamp bearing a profile of Queen Victoria was coloured black, and the twopenny stamp blue, with check-letters in the lower angles (in all four angles from April 1858). Up to 28th January 1854 the stamps were not officially perforated, except in the session of 1851, when stamps, perforated by a Mr Archer, were issued at the House of Commons post office. In 1853 the

Government purchased Archer's patent for Â£4000. The stamps were first water-marked in April 1840.

(i.) Line-engraved Stamps.

Balfpenny Stamp. â€" First issue, 1st October 1870 : size 18 mm. by 14 mm. ; lake red varying to rose-red.

One Penny Stamp. â€" First issue, 1st (for 6tb) May 1840 : the head executed by Mr Frederick Heath, from a drawing by Mr Henry Corbould of Mr Wm. Wyon's medal struck to commemorate her Majesty's visit to the City of London on 9th November 1837 : size 224 mm. by 18f mm.; black, watermarked with a small crown ; a few sheets in 1841 struck in red, two essays were made in April and October 1840 in blue and blue-back. Imperforate. The second issue, 20tli January 1841, differed only from the first issue as to colour â€" red instead of black. It is stated ' that the colour, ' ' though always officially referred to as ' red, ' was really a red-brown, and this may be regarded as the normal colour ; but considerable variations in tone and shade (brick-red, orange-red, lake-red) occurred from time to time, often accentuated by the blueing of the paper, though primarily due to a want of uniformity in the method employed for preparing the ink." The change of colour from black was made in order to render the obliteration (now in black instead of red ink) more distinct. Imperforate. Third issue, February 1854 : small crown watermark,

perforated 16 (i.e., 16 holes to 2 centimetres). The fourth issue, January 1855, differed only from the third issue in btiing perforated 14. Fifth issue, February 1855 : from a new die, with minute varia- tions of engraving. In the second die the eyelid is more distinctly shaded, the nostril more curved, and the band round the hair has a thick dark line foraiing its lower edge. Small crown watermark. Perforated 16 and 14. Sixth issue, July 1855 : large crown water- mark. Perforated 14 ; a oertfiin numVer 16. Seventh issue, January' 1858 : carmine-rose varying from pale to very deep. Large crovm watermark. Perforated, chiefly 14. Eighth issue, 1st April 1864 : check-letters in all four corners instead of two only ; large crown watermark. Perforated 14.

In 1880 the line-engraved one penny stamps were superseded by the surface-printed one of similar value in Venetian red, designed and printed by Messrs De la Rue & Co.

Three-halfpenny Stamp. â€" 1st October 1870 : large crown water-mark ; lake-red ; perforated 14. Superseded in October 1880 by De la Rue's surface-printed stamp.

Twopenny Stamp. â€" First issue, 1st (for 6th) May 1840 : small crown watermark ; light blue, dark blue ; imperforate. Second issue, March 1841 ; small crown watermark ; white line below "Postage" and above "Twopence"; dull to dark blue; imper- forate. Third issue, February (?) 1854 : small crown watermark ; blue, dark blue ; perforated 16. Fourth issue, March 1855 : small crown watermark ; blue, dark blue ; perforated 14. Fifth issue, July 1855 : large crown watermark ; blue ; perforated 16 ; blue, dark blue ; perforated 14. Sixth issue, May (?) 1857 â– – large crown

' Wright and Creeke, History of the Adhesive Stamp of the British Isles available for Postal and Telegraph Purposes. London, 1899.

watermark ; white lines thinner, blue, dark blue ; perforated 14 ; dark blue ; perforated 16. Seventh issue, July 1858 : large crown watermark ; white lines as in fifth issue ; deep to very deep blue ; perforated 16. Eighth issue, April (?) 1869 : large crown water- mark ; white lines thinner ; dull blue, deep to very deep blue, violet blue ; perforated 14. Superseded in December 1880 by De la Hue's surface-printed stamp.

(ii.) Embossed Stamps.

Produced by Dryden Brothers, of Lambeth, from designs sub- mitted by Mr Ormond Hill of Somerset House, engraved after Wyon's medal.

Sixpence. â€" 1st March 1854 : violet, reddish lilac, dark violet ; imperforate. Superseded in October 1856 by De la Rue's surface-printed stamp.

Tenpence. â€" 6th November 1848 : pale to very deep chestnut- brown ; imperforate. Superseded by De la Rue's surface-printed stamp in 1867.

One Shilling. â€" 11th September 1847 ; emerald green, pure deep green, yellow green ; imperforate. Superseded in November 1856 by De la Rue's surface-printed stamp.

(iii.) Surface-printed Stamps before 1880.

Twopence Halfpenny. â€" First issue, 1st July 1875 : small anchor watermark ; lilac-rose ; perforated 14. Second issue, May 1876 : orb watermark ; lilac-rose ; perforated 14. Third issue, 5th Feb- ruary 1880 : orb watermark ; cobalt, and some ultramarine ; per- forated 14. Fourth issue, 23rd March 1881 ; large crown water- mark ; bright blue ; perforated 14.

Threepence. â€" All perforated 14. First issue, 1st May 1862 : heraldic emblems watermark ; carmine (pale to deep). Second issue, 1st March 1865 : same watermark as above ; carmine-pink. Third issM^, July 1867 : watermarked with a spray of rose ; carmine-pink, carmine-rose. Fourth issue, July 1873 : watermark as third issue ; carmine-rose. Fifth issue, 1st January 1881 ; watermark large crown ; carmine-rose. Sixth

issue, 1st January 1883 ; watermark as fifth issue ; purple shades overprinted with value in deep pink.

Fourpence. â€” All perforated 14. First issue, 31st July 1855 ; watermark small garter ; deep and dull carmine. Second issue, February 1856 : watermark medium garter ; pale carmine. Third issue, 1st November 1856 ; watermark medium garter ; dull rose. Fourth issue, January 1857 ; watermark large garter ; dull and pale to deep rose, pink. Fifth issue, 15th January 1862 : water- mark large garter ; carmine-vermilion, vermilion=red. Sixth issue, July 1865 ; watermark large garter ; pale to dark vermilion. Seventh issue, 1st March 1876 : watermark large garter ; pale vermilion. Eighth issue, 27th February 1877 : watermark large garter ; pale sage-green. Ninth issue, July 1880 : watermark large garter ; mouse-brown. Tenth issue, 1st January 1881 : wateiinark large crown ; mouse-brown.

Sixpence. â€” All perforated 14. i^‘irei isswe, 21st October 1856 : no letters in angles ; watermark heraldic emblems ; dull lilac. Second issrn, 1st December 1862 : small white letters iu angles ; otherwise as first issue. Third issue, 1st April 1865 : large white letters in angles ; otherwise as first issue. Fourth issue, June 1867 : water- mark spray of rose ; otherwise as third issue ; some in bright lilac. Fifth issue, March 1869 : as fourth issue ; lilac, deep lilac, purple- lilac. Sixth issue, 1st April 1872 : as fourth issue ; bright chest- nut-brown. Seventh issue, October 1872 : as fourth issue â€¢ buff. Eighth issue, April 1873 : as fourth issue ; greenish grey. ‘Ninth issue, 1st April 1874 : watermarked as fourth i-ssue ; large coloured letters in angles ; greenish grey. Tenth issue, 1st January 1881 : large crown watermark ; otherwise as ninth issue. Eleventh issue, 1st January 1883 : as tenth issue ; purple, overprinted with value in deep pink.

Eightpence.â€”Uth September 1876 : watermark large garter â– chrome -yellow, pale yellow ; perforated 14. . ‘

Ninepence.â€”A\ perforated 14. First issue, 15th January 1862 â– watermark heraldic emblems ; ochre -brown, bright bistre. Second issue, 1st December 1865 : watermark as above ; bistre-brown straw Third issue, October 1867 : watermark spray of rose ; straw

Tenpence.â€” \s,t3n\j 1867 : watermark spray of rose’: red-brown â€¢ perforated 14. ‘

One ShiUing.—A.\ perforated 14. First issue, 1st November 1856 : watermark heraldic emblems ; no letters in angles â€¢ dull green, pale to dark green. Second issue, 1st December 1862 â– as above ; small white letters in angles ; pale to dark green. Third tssÂ«e, February 1865; as above; larae white letters in angles- pale to dark gi-een, bluish green. Fourth issue, August 1867 â€¢’ watermark spray of rose ; otherwise as third issue ; pale to dark green, blmsh green. Fifth issue, September 1873: large coloured etters m angles ; otherwise as fourth issue ; light to dark green, bluish green. Sixth issue, 14th October 1880 : as fifth issue â€¢ pale red-brown.^ Seventh issue, 15th June 1881 : watermark large’ crown ; otherwise as sixth issue ; pale ^ed-bro^vn

Two Shillings.â€” WateTUxnTk spray of rose ; perforated 14. Mrst

issue, 1st July 1867 ; pale to full blue, very deep blue. Second issue, February 1880 : light brown.

Five Shillings. â€” First issue, 1st July 1867 : watermarked with a cross pat^ ; pink, pale rose ; perforated 15 J by 15. Second, issue, November 1882 : watermark large anchor ; carmine-pink ; perforated 14.

Ten Shillings. â€” First issue, 26th September 1878 : watermark cross paid; green-grey; perforated 15^ by 15. Second issue, Februaryl883 : watermark large anchor ; green-grey; perforated 14.

One Found. â€” First issue, 26th September 1878 : watermark cross patd; brown- violet ; perforated 15^ by 15. Second issue, December 1882 : watermark large anchor ; brown-violet ; perforated 14.

(iv.) After 1880.

In 1880-81 the halfpenny, penny, three halfpenny, and twopenny surface-printed stamps superseded the line-engraved stamps of the same value, and a new surface-printed stamp of fivepence was introduced. These stamps are di.stingiiished from the stamps already

described by the absence of plate-numbers and (except in the penny stamp) of check-letters in the corners ; also by the coarser style of engraving necessary for printing by machines driven by steam-power.

One Halfpenny. â€” First issue, 14th October 1880 : large crown watermark ; pale green, bluish gi'een, dark green ; perforated 14. Second issue, 1st April 1884 : slate-blue.

One Penny. â€” 1st January 1880 : large crown watermark; Vene- tian red ; perforated 14.

Three Halfpence. â€” 14th October 1880 : large crown watermark; Venetian red ; perforated 14.

Twopence. â€” 8th December 1880: large crown watermark; pale to very deep carmine red ; perforated 14.

Fivepence. â€” 15th March 1881: large crown watermark; dark dull indigo, indigo-black ; perforated 14.

The Customs and Inland Revenue Act which came into force on 1st June 1881 made it unnecessary to provide separate penny stamps for postal and fiscal purposes. By an Act of 1882 (45 & 46 Vict. c. 72) it became unnecessary to provide separate stamps for postal and fiscal purposes up to and including stamps of the value of 2s. 6d. A new series was therefore issued : â€"

One Penny. â€" All perforated 14. First issue, 12th July 1881 : large crown watermark ; 14 pearls in each angle ; purple-lilac, purple. Second issue, 12th December 1881 : as first issue ; 16 pearls in each angle ; purple.

Three Halfpence. â€" 1st April 1884 : large crown watermark ; purple ; perforated 14.

Twopence. â€" Ditto-

Twopence Halfpenny. â€" Ditto.

Threepence. â€” Ditto.

Fourpence. â€” Ditto, except in colour (sea-green).

Fivepence. â€” As fourpence.

Sixpence. â€” Ditto.

Ninepence. â€” Ditto.

One Shilling. â€” Ditto.

Two Shillings and Sixpence. â€” 22nd July 1883 : watermark large anchor ; purple, dull lilac, dark purple ; perforated 14.

Five Shillings. â€” 1st April 1884: ditto; pale to very deep carmine.

Ten Shillings. â€” Ditto ; pale blue, cobalt, light to dull blue.

One Pound. â€” First issue, 1st April 1884 ; large crown watermark, 3 appearing in each stamp ; bro^'n-violet ; perforated 14. Second issue, 27th January 1891 : same watermark ; bright green ; per- forated 14.

Five Pounds. â€” 21st March 1882 : large anchor watermark ; orange-vermilion, vermilion, bright vermilion ; perforated 14.

Following upon the Report of a Committee of Officials of the General Post Office and Somerset House, a series of new stamps, commonly known as the “Jubilee” issue, was introduced on 1st .Tanuary 1887, all of which between one halfpenny and onii shilling exclusive were printed either in two colours or on a coloured paper, so that each stamp was printed iu part in one or other of the doubly-fugitive inksâ€” gi-ecn and purple.

One Half pen ny.â€”\st January 1887: large crown watermark; orange vermilion to bright vermilion ; perforated 14.

- Three Halfpence. â€” 1st January 1887 : as the halfpenny ; green and purple.

Tnwpcnce. â€” Ditto : green and scarlet to carmine.

Twopence Halfpenny.â€” 1st January 1887: blue paper; water- mark large crown ; dark purple ; perforated 14.

Thr^eepetice.â€” 1st January 1887: yellow paper; watermarked with a large crown ; purple ; perforated 14.

Fourpence.â€” 1st January 1887 : watermark and perforation as in threepence ; green and brown.

Fourpence Halfpenny.â€” 15t\ September 1892 : as the fourpence ; gri'i'u and carmine.

Firppence.â€” 1st January 1887 : as the fourpence ; purjile and blue.

S ii-pen ce.â€” 1st January 1887:]iale red paper; watermarked with a large crown ; purple ; perforated 14.

POST OFFICE

871

Mnepence. â€” Ist January 1887 : large crown watermark ; purple and blue ; perforated 14.

Tenpence.â€”2ith February 1890 : as the ninepeuce ; purple and carmine-red.

One Shilling. â€” 1st January 1887 : as the ninepence ; green. The various fiscal stamps admitted to postage uses, the over- printed official stamps for use by Government dejiartments, and the stamps specially surcharged for use in the Ottoman Empire, do not call for detailed notice in this article.

The distinctive telegraph stamps are as follows : â€"

One Halfpenny.â€" 1st April 1880 : shamrock watermark ; orange-vermilion ; perforated 14.

One Peimy. â€” 1st February 1876: as the halfpenny; reddish brown.

Threepence. â€” Perforated 14. First issue, 1st February 1876 : watermark spray of rose ; cai-mine. Second issue, August 1881 : watermark large crown ; carmine.

Fourpence. â€” 1st March 1877 ^ watermark large garter; pale sage-green ; perforated 14.

Sixpence. â€” Perforated 14. First issue, 1st March 1877 : water- mark spray of rose ; greenish grey. Second issue, July 1881 : as first issue ; watermark large crown.

One Shilling. â€” Perforated 14. First issue, 1st February 1876 : watermark spray of rose ; green. Second issue, October 1880 : watermark spray of rose ; pale red-brown. Third issue, February 1881 : watermark large crown ; pale red brown.

Three Shillings. â€” Perforated 14. Slate blue. First issue, 1st March 1877 â– – watermark spray of rose. Second issue, August 1881 : watermark large crown.

Five Shillings. â€” First issue, 1st February 1876 : watermark cross pate ; dark to light rose ; perforated 15 by 15^. Second issue, August 1881 : watermark large anchor ; carmine-rose ; perforated 14.

Ten Shillings. â€” 1st March 1877 : watermark cross yaW; green- gi-ey ; perforated 15 by 15^.

One Pound. â€” 1st March 1877 : watermark shamrock ; brown-purple ; perforated 14.

Mve Pounds. â€” 1st March 1877: watermark shamrock; orange-vermilion ; perforated 15^ by 15.

In addition to these, there were stamps specially prepared for the army telegraphs.

II. Foreign Counteibs.

Postal statistics for different countries will be found under the separate headings for each. But the following tables show comparatively the business done in the principal

countries : â€”

Postal Statistics, 1900.

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Austria

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102

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Belgium .

402

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25

14

-1-11

Canada

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22

26

- 4

France

2106

46

62-2

11

46

41

276

208

-1-68

Including Algeria.

Germany .

32fi.S

171

61-6

46

121

141

669

537

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Holland

26a

4

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3

20

16

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Hungary .

265

9

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47

34

4-13

India . . .

604

1

1-8

13

34

13

31

28

+ 3

Br. India only.

Italy .

716

7

26-1

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13

61

69

4- 2

New South Wales

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96-2

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18

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New Zealand

63

â– 2

84-3

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â€¢2

â€¢2

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+ -2

Bussia

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2

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18

10

20b

143

-1-62

Switzerland

17S

16

67-7

4

6

6

36

33

+ 3

United States .

7130

96 -6

78

16

32

630

666

-2b

Victoria

99

â€¢2

97-1

2

2

â– 1

16

13

+ 2

United Kingdom

3642

78

88-9

22

114

97

368

254

-f99

In column 1 the figures for Canada and the United Kingdom include the

foreign letters. „ „ 2 the figures for Canada and the United Kingdom include the

foreign parcels. „ 6 the figures for Austria, France, Germany, Hungary, New

South Wales, Russia, and the United Kingdota include

telegraph employes. â€ž . , 6 the figures for France, New South Wales, and the United

Kingdom include postal orders (5 millions in France, 85

millions in the United Kingdom). â€ž 7, 8, and 9 the figures for Austria, France, Germany, Hungary,

New South Wales, and Victoria include telegraphs.

Telegraph Statistics, 1900.

â€”

Length of

Country.

No. of

Telegrams

(in Millions).

Telegraph

OflSces (in

Thousands).

“VA ires (in Thousands of Kilo- metres).

Remarks.

Austria .

16

5

106

Belgium .

7

1

84

France .

63

14

648

Including Algeria.

Germany

46

24

473

Holland .

6

1

28

Hungary

8

3

115

India

7

5

291

Br. India only.

Italy .

12

6

132

Russia .

20

6

498

Switzerland .

4

2

22

United Kingdom .

93

12

666

**These fig^ures in some cases include, and in others exclude, the telegraph lines of railway companies, &o. /^ h* **

III. United States.

The financial statements of the United States Post Office for a series of years show the following figures : â€”

Year ended 30th June.

Revenue.

Expenditure.

Deficit.

1893 .

$75,896,933

$81,074,104

$5,177,171

1894

75,080,479

84,324,414

9,243,935

1895

76,983,128

86,790,172

9,807,044

1896

82,499,208

90,626,296

8,127,088

1897

82,665,462

94,077,242

11,411,780

1898

89,012,618

98,033,523

9,020,905

1899

95,021,384

101,632,160

6,610,776

1900

102,354,579

107,740,267

5,385,688

1901 .

111,631,193

115,554,920

3,923,727

The revenue quoted does not include any allowance for the large quantity of official matter carried for other public departments, &c.; nor does the expenditure include the amounts certified to the Treasury for the transportation of mails over aided Pacific railways, or any allowance for the use of such buildings as are provided by the Government. Contrary to expectations repeatedly expressed, each year since 1883 has shown a deficit. This is partly explained by reductions in charges. The rate of postage on first- class matter was reduced from three cents to two cents on 1st October 1883, and the unit of weight was increased from half an ounce to one ounce on 1st July 1885. On the latter date, also, the postage on second-class matter was reduced from two cents to one cent per pound. This low rate has led to wholesale violation of the purpose of the law. In his report for 1899 Mr Emory Smith, Post- master-General, estimated that "fully one-half of all the matter mailed as second-class, and paid for at the pound rate, is not properly second-class within the intent of the law"; and that the co.st of mere transportation of this wrongly-classed matter exceeded the revenue derived from it by more than $12,000,000 for the year.

Recent Developments. â€" The free delivery service has grown rapidly during recent years. On 1st July 1901, 866 cities and towns were included in the scheme, and 16,389 letter-carriers were serving a population of 32,000,000. An extension to rural districts was started in 1896, and by December 1901, 4,000,000 of the rural population were within the scope of free delivery. Since 1st October 1885 a system has been in force for the immediate delivery by special messengers of letters, parcels, &c., for addresses within certain areas. A special ten-cent stamp is required in addition to the ordinary postage. Under this arrangement, 7,133,263 articles were trans- mitted during the year ended 30th June 1901, resulting in a net profit of $167,727. A step towards the popu- larization of the registry system was authorized in December

P 0 S T Y E N â€” P 0 T G I E T E E

1899 : letter-carriers in many city districts now accept and register letters at the door of the householder. Sea post offices for sorting mails during the Atlantic transit were established in December 1890 on the steamers of the North German Lloyd and Hamburg-American lines, and later on the vessels of the International Navigation Company. This plan effects a saving of from two to fourteen hours in the delivery of mails from Europe. The issue of ” postal notes,” commenced in 1883, was abandoned in 1894. The introduction of ” postal checks ” for small fixed amounts is now being advocated. A new postal convention with Canada, removing the former restriction against sending merchandise, came into force on 1st March 1888. Uniformity of postage rates having been previously established, the United States and Canada became virtually one postal territory.

The limit of weight for domestic parcels in the United States is four pounds. A convention for an exchange of parcels with Jamaica, admitting articles not exceeding eleven pounds, was, however, agreed to in 188T ; and since then conventions on similar lines have been con- cluded with a number of other colonies and countries in America. The first arrangement of the kind with any European country was made with Germany, and came into operation on 1st October 1899. During the year to 30th June 1901, 76,148 parcels of a total weight of 252,791 pounds were despatched to foreign countries, &c., and 42,522 foreign parcels of a total weight of 281,813 pounds were received.

Considerable progress has been made in the organiza- tion of the postal service in the ne*ly-acquired posses- sions and Cuba. The postal laws, regulations, and domestic conditions of the United States have been extended, by Act of Congress, to Porto Rico and Ha- waii. The ” island possessions ” (Guam, the Philippine Archipelago, and Tutuila) have also been brought within the scope of the domestic conditions, including the rates of postage. The service introduced into Cuba, though modelled on the American plan, is practically autonomous.

The following statistics are taken from the report of the Post Office Department for the fiscal year ended 30th June 1901. On that date the

number of post offices was 76,945. The sales of stamps for the year amounted to $102,023,473, and the collec- tions from publishers and newsagents for second-class postage to Â§4,294,445. The total estimated number of letters was 3,604,322,767, of post cards 659,614,800, of pieces of second-class matter (news- papers and periodicals) 2,206,791,539, of pieces of third-class and fourth-class matter (books, circulars, parcels of merchandise, &c.) 953,661,223. The registered letters and parcels numbered 20,814,501, and the Irrecoverable losses are given as 466, or one in every 44,666 articles registered. It is estimated that there were sent to foreign countries 76,536,229 letters, 4,324,709 post cards, and 90,153,343 packets containing printed matter, commercial papers, or samples of merchandise ; and that there were received from foreign countries 62,698,084 letters, 3,584,208 post cards, and 58,12.3,993 packets of printed matter, &c. A total of 8,507,257 articles of undelivered mail was received at the dead-letter office ; 23,362 magazines, illustrated papers, &o., which could not be returned, were distributed among the inmates of various charitable institutions. The total number of domestic mail routes of all classes was 35,316, their aggregate length 511,808 miles, and the annual transportation 466,146,059 miles. Of these, the “star” routes had a total length of 267,357 miles and an annual trans- portation of 134,404,541 miles, the railway routes a total length of 183,358 miles and an annual transportation of 302,013,325 miles, and the steamboat routes a total length of 33,970 miles and an annual transportation of 4,652,257 miles. The “railway mail service” maintained 1306 lines of travelling po.st offices (on rail- way trains, steamboats, and electric and cable cars), covering a total length of 182,154 miles. It employed 9182 clerks, who dur- ing the year travelled “in crews” a total distance of 210,221,670 miles. Their manipulations of pieces of ordinary mail matter numbered 14,181,224,420, and of packages and pouches of reg- istered matter 21,284,833. The number of domestic money orders issued was 35,586,379, representing |274,546,067. The inter- national orders issued numbered 1,247,888 and amounted to

$20,072,613, while those paid numbered 492,408 and amounted

to 17,972,453.

Telegraphs. â€” The formation of a postal telegraph system has continued to be a subject of discussion by the Postmasters-General. In his report for the year 1888, Mr Dickinson proposed the appointment of an expert commission authorized to erect short experimental lines. His successor, Mr Wanamaker, for four years vigorously advocated a limited postal telegraph service. Under this proposal, contracting telegraph companies were to furnish lines, instruments, and operators, and to transmit mes- sages at rates fixed by the Government ; the department was to receive a small sum per message, to cover its expenses in collection and delivery. In 1894 Mr Bissell expressed the opinion that a Government system would be unprofitable and inexpedient.

Savings Banks. â€” The establishment of postal savings banks was also recommended by Mr Wanamaker in his reports for the years 1889 to 1892, and by Mr Gary in 1897. What is regarded as a step in this direction was taken in 1898, when the postal regulations were modified to allow money orders to be made payable at the office of issue. This change is described by Mr Emory Smith as ” establishing a mild and very convenient adaptation of the European savings bank system, without the payment of interest.” ‘ (b. j. h*.)

Authorities. â€” Postmaster-General’s Annual Reports. â€” Joyce. History of the British Post Office, 1893.â€” J. Wilson Hyde. The Post in Grant and Farm, 1894. â€” A. H. Norway. History of the Packet Service, 1895. â€” F. E. Baines. Forty Years at the Post Office, 1895.â€” Raikes. Life of Bt. Hon. H. C. Bailees, 1898.â€” i’ Union Fostale XJniverselle, sa fondation et son developpement, m^moire public par le bureau international k I’occasion de la c616bration du xxv^^ anniversaire de I’Union 2-5 juillet 1900. Lausanne, 1900. â€” Statistique generate du service postal. Bern, 1902. â€” Statistique generate de la telegraphie. Bern, 1902.

The various postal and telegraph rates and regulations are set out in the quarterly Post Office Guide (price 6d.) and the Post Office Handbook (price Id.), which may be purchased at any post office. The

penny handbook was first issued in 1886, and has a circulation of over half a million.

Pdstyen (Pistyan), a market town of Hungary, in the county of Nyitra, situated near the Vag, with 5661 inhabitants in 1901. It is famous for its sulphur and mud baths, which in 1900 attracted 6600 patients. There are separate bathing-houses for poor people.

Potenza, a town, bishop's see, and capital of the province of the same name, Basilicata, Italy, 93 miles by rail west by north of Taranto. It stands 2712 feet above sea-level, its mean temperature being 53Â° Eahr. ; Jan., 37-8Â° ; July, 70-9Â°. It has a school of the industrial arts and sciences, grows good wine, and makes bricks. Pop- ulation (1881), 17,978 ; (1901), 16,620.

Potgieter, Everhard.es Johannes (1808- 1875), Dutch prose writer and poet, was born at Zwolle, in Overyssel, 17th June ISOS. As a young man Potgieter went to Antwerp, where he started a commercial career at the office of a local merchant. In 1831 he made a journey to Sweden, subsequently described in two volumes, which appeared at Amsterdam in 1836-40. Soon after his return from the North, he settled in Amsterdam, still engaged in commercial pursuits, on his own account, but with more and more inclination towards literature. With Heije, the popular poet of Holland in those days, and Bakliuizen van den Brink, the rising historian (see also Groen vax Peinsteree), Potgieter founded De Jruzen (" The Muses," lS34-;'iG), a literary review, which was, however, soon superseded by De Gids (" The Guide "), a monthly whieli became the leading magazine of Holland. In it he wrote, mostly under the

initials of " W. D g," a great number of articles and

poems, collected and published both before and after his death. The first collected edition of his poems (1832- 1868) appeared in 2 vols. (Haarlem, 1868-75), preceded by some of his contributions to De Gids, in 2 vols, also (Haarlem, 1864), and followed by 3 vols, of his Studien en

Schetsen (" Studies and Sketches," Haarlem, 1879). Soon after his death (3rd February 1875) a more compre- hensive edition of Potgieter's Verspreide en Nagelaten Werken ("Miscellaneous and Posthumous Works") was published in 8 vols, by his friend and literary executor, Johan C. Zimmerman (Haarlem, 1876-77), who likewise supervised a yet more complete edition of Potgieter's writings which appeared at Haarlem in 1885-90 in 19 vols. Of Potgieter's Het Noorden in Omtrekken en Tafreelen (" The North in Outlines and Pictures ") the third edition was issued in 1882, and an Mition de luxe of his poems followed at Haarlem in 1893. Under the title of Personen en Onderwerpen (" Persons and Subjects ") many of Potgieter's criticisms had collectively appeared in 3 vols, at Haarlem in 1885, with an introduction by his lifelong friend and collaborator, Busken-Huet, the famous critic, to whom we owe the best biographical notice and the truest appreciation of Potgieter. The latter's great influence upon Dutch language and literature in the second half of the 19th century is undisputed. It was largely enhanced by his Gids circle in Amsterdam, all the more prominent litterateurs, poets, and artists of his day frequenting it at his house in Amsterdam. Potgieter, with all his learning and accomplishments, was a very modest man. His favourite master among the Dutch classics was Hooft, whose peculiarities in style and language he ad- mired and imitated. The same vein of altruistic, if often exaggerated and biassed, abhorrence of the wonted con- ventionalities of literary life runs through all his writings, even through his private correspondence with Huet, parts of which have been published. Potgieter remained to his death the irreconcilable enemy of the Dutch " Jan Salie," as the Dutchman is nicknamed who does not believe in the regeneration of the Dutch people. Potgieter held up the Netherlanders of the golden age of the 16th and 17tli centuries as models to be emulated. In these views he essentially differed from Huet. Yet the two friends worked harmoniously together ; and when Potgieter re- luctantly gave up De Gids in 1865, it was Huet whom he chose as his successor. Both then proceeded to Italy, and were present at the Dante festivities at Florence, which in Potgieter's case resulted in a poem in twenty stanzas, Florence (Haarlem, 1868), which certainly proved, if nothing else, that he could appreciate and glorify greatness in a Southern people, as well as in a Northern. In Holland Potgieter's

influence has been very marked and beneficial ; but his own style, that of an ultra-purist, was at times somewhat forced, stilted, and not always easily understood. (h. ti.)

Potosi, a department of Bolivia, bounded on the N. by the departments of Oruro and Cochabamba, on the S. by Chile and the Argentine Republic, on the E. by Chuquisaca and Tarija, and on the W. by Tarapaca and Chile. Area, 52,100 square miles. Population (1893), 360,400. The capital, Potosi, situated 13,350 feet above sea-level, has 40,000 inhabitants. The department is divided into 9 provinces, and in 1898 had 63 schools and 2900 pupils.

Potsdam, a town of Prussia, 16 miles by rail south- west of Berlin, beautifully situated at the centre of the network of Havel lakes. The town has been greatly embellished, and the gardens and parks with which it is surrounded have been laid out with care. There is an

excellent railway service with Berlin, with which it is connected by a third suburban line of railway running by way of Wannsee. Among modern buildings must be mentioned the new stone bridge, ornamented by statues, which connects the Altstadt with the suburb of Teltow. To the Friedenskirahe is attached a mausoleum built after the model of a chapel at Innchen in Tirol, in which lie the Emperor Frederick, his consort. Princess Royal of Great Britain, and two of their children who died in infancy. The Marble Palace on the ” Leiliger See ” was the residence of Kaiser Wilhelm II. until his accession. To Potsdam has been removed the Geodetic Institute, which occupies extensive premises. Population (1880),

48,447 ; (1900), 69,814.

Pott, August Fried rich (1802-1887), German philologist, was born at Nettelrede, Hanover, 14th November 1802. He studied in Gottingen, and in 1826 became schoolmaster at Celle, Hanover; but after two years removed to Berlin, where he heoajae privat docevt at the university. He applied himself to the study of com- parative philology, and in 1883 was made professor at Halle, where he lived till his death on 6th July 1887. His magnum opus was his Etymologisclie Forschung

(1834- 36), which entitled him to rank as Bopp's foremost disci- ple in the Indo-Germanic science of language. See the article Philology (vol. xviii.). Pott also devoted much attention to the origins of the gipsies (q.v.).

Potter, Henry Codman (1836-^ â€" -), American bishop of the Protestant Episcopal Church, born in Schenectady, N^ew York, 25th May 1835, is a son of Bishop Alonzo Potter of Pennsylvania. He was a graduate of the Theological Seminary of Virginia in 1857, and was ordained in 1858. After serving churches at Greensburgh, Pa., Troy, N.Y., and Boston, Mass., he became rector of Grace Church, New York City, from 1868 to 1884. In 1883 he was chosen assistant bishop of New York ; and on the death in 1887 of the bishop, his uncle, he became bishop of the diocese. He published Sisterhoods and Deaconesses (1872), TJie Gates of the East (1876), and other ecclesiastical and religious works ; and he received the degrees of D.D. and LL.D. from Union College (New York), and D.D. from Trinity College (Connecticut), Harvard, Oxford, and Cambridge Universities.

Pottery and Porcelain. â€" Recent advances in the potter's art, as practised in Europe, have sprung fundamentally from the growth of real scientific know- ledge of the potter's materials and methods. Until well within the 19th century the potter's knowledge was purely empirical, built up on traditional methods of working with the materials of a particular district, and failing when the conditions changed. Since 1850, however, the founda- tions at least of sounder knowledge have been laid by the labours of men of an eminently scientific turn of mind, of whom Brongniart, Salvetat, and Seger must be regarded as the chief." These men and their disciples have examined not only all modern materials and methods, but those of the past as well ; and as their researches have iDeen published, they have had the most direct influence on the work of the practical potters of every country. The bodies (clay mixtures), glazes, and colours of the older forms of pottery, Persian and Rhodian faience, Italian majolica, Hispano-Moresque ware, Chinese porcelain, are no longer forgotten secrets or " lost arts " ; they are, or may be, as well known as the bodies, colours, and glazes of the most everyday pottery produced in

Staffordshire or Delft. Neither is the potter any longer dependent on the materials or the technical methods found in his own particular district : he has the materials and the know-

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ledge of a continent at his disposal ; and the science of his craft has been so far reduced to system, that he can readily produce a hundred varieties of ware, running through all the range of earthenware, stoneware, and porcelain, with a higher degree of technical accomplish- ment in each than his fellow of a previous century would have attained in one kind alone.

This remarkable growth and concentration of accurate knowledge regarding the chemical laws underlying the composition of the different materials used by potters, as well as their behaviour, singly and in combination, when exposed to varying temperatures and conditions of the kiln, have been accompanied by changes almost as important in the mechanical methods of mixing and purifying the materials, forming the clay articles into shape, and supporting them during the firing, so that even the commonest wares are now produced with a degree of certainty, accuracy, and finish formerly un- dreamt of. The extended modern use of articles made from clay for the construction and decoration of build- ings, for lavatories and other sanitary appliances, and for the technical work of the chemist, the distiller, and the electrician, has only become possible because of this advance in precise knowledge. Admirable and entirely useful as this development of the technical side of pottery has been, the fear has often been expressed by persons qualified to judge, that progress in this direc- tion would inevitably destroy the artistic qualities which have in the past been such a precious possession of the potter’s productions. The first results of the changed conditions were undoubtedly depressing from the artistic point of view. Certainty of result, precision and finish of manufacture, together with mechanical imitation of well-known effects, seemed to

result in the production only of wares the merits of which were in the sharpest contrast with all that made the old pottery artistically admirable.

The development of scientific and mechanical know- ledge and skill has brought with it a much juster appreci- ation of the familiar qualities and possibilities of different substances and processes. The success achieved by Deck and De Morgan in adapting the principles of the Persian, Cantigalli those of the Italian Cinque-cento, and Copen- hagen those of the Japanese pot painter, compared with Wedgwood's reproduction of classic pottery or Dresden imitation of Chinese porcelain, proves that vital progress has been made. The present position is one of develop- ment and change, even more so than at any previous period in the history of the art. Pottery is now being made in all the leading European states, and in some states of the American Union, possessing a high degree of technical excellence, and in such a variety of forms as all the previous centuries combined have not produced. The great bulk of this production is frankly utilitarian, either making no pretence of art, or manifesting such debased and mechanical ideas of it as to be infinitely more objectionable. In every country, however, there is a general endeavour to infuse a spirit of art into modern production, manifesting itself in two distinct ways â€" first, in the efforts of the large commercial firms to make some portion of their productions as artistic as may be under their methods of working ; and, secondly, by the labours of a number of individual artist potters, caring for the artistic side of their work above everything, and by their example influencing the large manufacturers. As an actual result, the potter's art is full of vitality; more alive and more energetic, indeed, than at any time since the rise of the china factories of the 18th century, while the variety of uses to which pottery is being put shows that, through all the changes of fashion and of taste, pottery holds its own in popular favour and appreciation.

Among modern wares of considerable technical interest, mention must be made of the iine semi-porcelains pro- duced in Staffordshire, in which the ordinary English earthenware body has been pushed to its utmost limits. The ware is thin, light, beautifully potted, and of the

utmost durability. Sanitary appliances, electric fittings, door furniture, and wall tiles are also produced with almost the same high degree of technical excellence. The tendency to use some finer form of pottery than ordinary brickwork for the construction or embellishment of build- ings, has brought about a great extension of the manu- facture of architectural terra-cotta, faience, and stonewares. For all such purposes the hard-fired varieties are undoubt- edly best fitted; and while the colours obtainable in terra-cotta or in faience are the more brilliant, the once-fired stonewares have greater durability. In Ger- many and France this use of pottery has made even greater advances than in the United Kingdom. On the Continent the material has been considered more sympathetically; in England it is too often appar- ent that a design originally intended for stone con- struction has been executed unaltered in the plastic material.

Turning to the decorative side of pottery work, we have in slip-painting a method as old as primitive pottery itself, the practice of which persists in a variety of forms and on wares of every class. The work produced in. Germany under the influence of Professor Lailger merits notice. It is simple and direct, almost brutal, in method ; splashes of red, blue, or green clay, touched into shape by a brush or a modelling tool, on a ground of white, buff, or red; making no pretence but of directness and simplicity, and interesting only from the frankness of the work and the brightness and richness of the colour. At the opposite extreme in this method is the pdte-sur-pdte, first produced at Sevres, but best known in connexion with M. L. Solon of Mintons'. Here material and method have been refined to their utmost. The clays used are of translucent china, white or delicately tinted for the raised ornament, and strongly tinted in brown, dark green, or celadon for the grounds. The ornament, largely figure work, is got by laying on successive layers of slip with a brush, with modelling when required to soften or define, as the^case may be, much as an artist would work in gesso. When the work is finished and glazed with a rich glaze, the effect is like cameo work of the finest kind, but with a breadth and softness peculiarly its own.]\I. Taxil Doat, of Sevres, has also done much excellent work by this method ; and by superposing clays of different

col- ours on the ground, he has obtained richly broken colour in an effective manner.

Apart from the production of stonewares for archi- tectural and technical purposes, there has been a notable development of stonewares for jars, vases, and ornamental objects generally. Doultons undoubtedly led the way in this revival, and, under the direction of Mr John C. Sparkes, produced the Lambeth stonewares, which in their low key of greys and blues were admirably decorative, and formed a distinct advance on the stonewares of Ger- many and Flanders. It is on the Continent, and particu- larly in France, however, that one finds gri^ turned to the best account. A number of men, like Delaherche, Lachenal, Dalpayrat, as well as Taxil Doat and Chaplet, inspired obviously by the hard-fired unglazed wares of the Japanese, but showing an intimate knowledge and appreciation of their material, which stamps them at once as potters and as artists, are now working on stone- wares. In the hands of one of these men the material IS neither hidden out of sight nor exalted to vulgarity, but shows its qualities of texture, surface, colour, and plasticity perfectly yet quietly. Fine work has also been

produced by such firms as Â£mile ^Nluller, Bigot & Co., but in their case the results are often disfigured by unnecessary coarseness of execution.

Among the new departures that are being turned to artistic account, one of the most interesting is that of crystalline glazes. The first of these in point of time was the so-called “cat’s-eye” or “tiger-eye” glazes pro- duced by the Rookwood pottery in America. In this case the glaze is full of small metallic-looking spangles, which give it an appearance like the mineral known as ” aventurine.” The glazes produced at Kookwood are all very deep in colour, and are only obtained on a red body. In England, Pilkingtons have produced a series of glazes, yellow, brown, and green, all possess- ing the same appearance “of gold-coloured

spangles in the glaze ; but, unlike Eookwood, they can produce the effect on any earthenware or china body. Totally differ- ent are the crystalline glazes produced by the Eoyal Copenhagen Works, and now also made at Sevres, Ber- lin, Meissen, Eorstrand, and elsewhere. Here the crys- tallization generally occurs in radiating or star-like masses, apparently on the surface of the glaze, some- times beautifully coloured blue, grey, yellow, or brown, but otherwise resembling the patterns formed by frost on a window-pane. These effects are always quasi-accidental, and only partially under the control of the potter. Occasionally they take the form of blobs and patches on the glaze which are positively unpleasant; but when the star-like forms are well developed and fairly disposed over the surface of the piece, the effect is magical.

About 1870, William De Morgan in England, and Can- tigalli of Florence, rediscovered the method of producing iridescent lustres from copper and silver fired on the glaze in a reducing atmosphere, which had been so largely prac- tised during the Middle Ages by the Persian potters, the Moors in Spain, and the Italian majolica potters. Since that time the production of this reflet m&talUque has been greatly extended. In the hands of Clement Massier in France most vivid effects of iridescence have been pro- duced, apparently in many cases by acting on the glaze itself with reducing gases at high temperature. Zsoliiay, of Etlnfkirchen in Hungary, has produced a pottery decoration in which minute patterning of silver lustre is produced on a ground of dark copper or other metallic lustre. The patterns, which are often of the most intri- cate character, are evidently inspired by every phase of Oriental design, from ancient Assyrian downwards ; but the effect is novel, rich, and in the best pieces subdued. The best lustre work, however, has been done, and already the vulgarization of the process has set in by the develop- ment of the cruder shades of colour from which the earlier work was free.

From time to time European potters receive fresh inspiration from the East. Keference has already been made to the influence of the Japanese potters on the production of gr^s in France. This influence is equally felt in the modern painted porcelains of the Royal Copen- hagen

Works, and in the somewhat similar effects obtained at Rorstrand and by the Rookwood Company. In the last case a Japanese artist was brought to the works for that speciflc purpose. Though the delicate underglaze paint- ing on hard-fired porcelain of Copenhagen and Rorstrand owes its inception to this foreign influence, it proceeds on its own lines, and is far from being a slavish imitation. The temperature of firing having fixed a palette in which blue and some greyish or drabbish tones predominate, the artists have wisely adapted their painting to this, and have made the utmost of their available colour' scheme. The rich glazes of the Oriental potter have also formed a point of departure for another set of potters. Deck in

France, and afterwards Minton, Maw, De Morgan, and Moore in England, produced brilliant turquoise blue and violet glazes rivalling the Persian and Chinese. Even the long-sought secret of the Chinese sang de bceuf and rouge flambe glazes has been worked out in Europe. Salvetat in France and Seger in Germany analysed speci- mens of Chinese glazes, and synthesized the glaze from its elements. Chaplet in France and Bernard Moore in England produced pieces independently ; and flaiiiM glazes are now being produced by many potters in Europe on every kind of pottery ware, and with every variety of surface, from the driest and most opaqae to the brightest and most transparent.

Within the last ten years of the 19th century, a certain reaction set in against the brilliant glazes in ordinary use, and potters began to produce glazes with a dull or egg-shell surface. In some cases this effect was apparently obtained by dulling the surface of an ordinary glaze by vapours of hydrofluoric acid or by the sand-blast, but in the best of them the effect was actually due to the nature of the glaze, which fired only to a dull vitreous surface. (For Japanese Keramics, see Japan.)

(w. B*.)

Pottstown, a borough of Montgomery county, Pennsylvania, U.S.A., on the Schuylkill river, at the intersection of branches of the Pennsylvania and the Philadelphia and Reading railways, in the south-eastern part of the state, at an altitude of 138 feet. Its indus- tries consist chiefly in iron and steel manufacture, for which there are blast furnaces, rolling mills,

bridge works, nail mills, and boiler works. Population (1890), 13,285; (1900), 13,696, of whom 802 were foreign-born and 292 negroes.

Pottsville, a borough of Pennsylvania, U.S.A., capital of Schuylkill county, on the Schuylkill river, in the eastern part of the state, at an altitude of 611 feet. The street plan is irregular, it is divided into seven wards, has a steam heating plant, and its water supply, obtained by gravity, is owned by private parties. It is on four railways, the Lehigh Valley, the Pennsylvania, the People's, and the Philadelphia and Reading. It is situated within the anthracite coal region, and is one of the principal coal-shipping points. Population (1890), 14,117 ; (1900), 15,710, of whom 1662 were foreign-born and 168 negroes.

Poughkeepsie, a city of ISTew York, U.S.A., capital of Dutchess county, on the eastern bank of the Hudson river, 73 miles north of ISTew York, in the south-eastern part of the state, at an altitude of 42 feet. Its street plan is irregular, it is divided into seven wards, and its water supply, derived from the Hudson, is pumped and filtered. It has four railways, the New York Central and Hudson River, the Poughkeepsie and Eastern, the West Shore (by ferry), and the Central New England. The latter road crosses the Hudson here by a fine cantilever bridge. The city is of importance in manufactures. In 1900 it contained 377 manufacturing establishments, with a total capital of $5,688,058; the hands numbered 3432, and the products were valued at $6,826,769. Among the principal articles of manufac- ture were clothing and iron and steel goods. Vassar College for women, situated 2 miles east of the city, had in 1900 a faculty of 64, and was attended by 700 students. In 1899 its property was valued at nearly $2,268,805, and its income was |319,957. Population (1890), 22,206- (1900), 24,029, of whom 3998 were foreign-born and 623 negroes.

Poulton-le-Sands. See Mobecambe.

Poultry and Poultry-farming. â€” The later years of the 19th century witnessed a very great develop- ment in poultry-breeding, which could scarcely have been foreseen, and which in some of its aspects has contra- dicted opinions that had been more or less generally expressed during a period of less experience and know- ledge. The broad result is that poultry-culture in one form or another has become a really important industry both in Europe and America, one in which much capital is invested, and the returns from which form a consider- able item in national food and wealth.

Poultry Shows and Prize Poultry. â€” During the last ten year.? of the 19th century especially, the number of poultry exhibitions multiplied to such an extent that as many as twenty shows have been criticised in print in one vfeek in Great Britain during the height of the season. Such a ceaseless round of competition has increased the money value of prize fowls, and created a large class â€” almost a profession â€” who have considerable pecuniary in- terests embarked in breeding and exhibiting such birds. This professionalism, and the interests at stake, have in turn natur- ally given rise to many proceedings of doubtful character, which it has been found needful to keep in check by an organization known as the Poultry Club. An enormous multiplication of varieties is another phase of this development, nearly all breeds having had their older subdivisions supplemented by new colours, produced through crossing and skilful selection, amidst which buff or orange, now bred in nearly all fowls, has had a curious popularity. There may also be mentioned the fact that whilst formerly the diminutive Bantams were confined to a few well-marked varieties, all the large breeds of poultry have now been dwarfed into Bantam size by the skill of breeders. To enter farther into this branch of the subject is beyond the scope of the present article, but it may be interesting to state that at a public auction in 1901 one prize fowl was knocked down to a honci-fide purchaser at the sum of Â£150.

Breeds. â€” Not only have many additions been made, either by discovery or manufacture, to the breeds known in 1880, but considerable changes have taken place in their relative importance, in some of which a principle of substitution can be traced. The

unfortunate exaggeration of fluff and leg-feather has removed all Cochins â€” it is to be feared permanently â€” from amongst popular and useful breeds, and in only less degree the Brahma, once the most popular breed of the day. On the other hand, new sub- breeds, based upon a cross from one or the other of the Asiatic races, have been multiplied and largely bred, these being all of smooth-legged type, and somewhat less in size. To the original cuckoo-coloured Plymouth Rock have been added buff and white varieties; and by crossing Cochins and Brahmas with other fowls, American breeders produced another useful race of compact form with smooth yellow legs, and white feathers laced with black round the edges, called the silver-laced Wyandotte, to which were speedily added other colours and patterns of plumage. The feathered Langshan has given rise to the Black Orpington with smooth legs ; and a local cross of Cochin and Dorking prevalent in Lincolnshire, to a buff breed with smooth white legs, now called the Buff Orpington, though quite unrelated to the former. All these are useful for table, and good layers. Among non-sitting breeds the white-faced Black Spanish, once the most widely kept, has almost disappeared ; but the allied red- faced Minorca and the blue Andalusian have achieved great popularity as free layers of large white eggs ; and the yellow-legged Leghorns of similar type, though rather smaller, have spread on all sides with much multiplication of varieties, the latest of which, with mottled black and white plumage, is termed the Aneona. Hamburghs have been depressed by the complicated system of breeding separate strains for each sex; but' there has been intro- duced from the Continent the hardy Campine or Braekel, resembling the pencilled Hamburgh in plumage, but larger and with a single comb, and laying a large egg in great numbers. The older French breeds are less kept than formerly; but a race originated in France by crossing

Houdans with Dorkings and Light Brahmas, and known as the Faverolles, is taking a strong position as a tender and quick-growing table fowl, and even in the Houdan district itself is displacing the Houdan, one of its an- cestors. The Faverolles have single upright combs, beards and whiskers, slightly feathered legs, and five toes on each foot ; and the general colour of the hen is salmon or fawn, with an

almost white breast. This list might be extended, but must close with the supersession of the stilty exhibition Game fowl by the old and genuine type of English Game.

Most of these changes, broadly speaking, have been in the direction of replacing poultry with chiefly fancy points by really useful fowls, yet it is noteworthy that they have been carried out by fanciers, or breeders for exhibition, proving that there has not been that practical antagonism between the aims of these breeders and the production of food which some have alleged. But there has further been, since 1890 especially, a remarkable development of what has been termed ” utility ” poultry- breeding. It had always been taught by a few, but was only grasped later by the many, that a fowl could be bred with as much certainty for tender and juicy flesh, or great number of eggs laid in a year, as for some colour of feather, and without losing any real features of its race. Many varieties are now bred, and advertised and sold as being bred, for these objects; and thus the stock kept up by the fancy breeders is gradually becoming spread amongst farmers, to their marked advantage where prop- erly used.

Feeding and Egg-Production. â€” These aspects of poultry- culture are closely connected, and in both, such advances have been made as almost amount to a revolution. As will appear natural if the enormous poultry interest in America is considered, in these matters the breeders of the United States have led the way, and, though it had first been taught in England, were the first to practice generally the systematic breeding, year after year, from the best layers only. It had always been known that some hens would lay from 150 to 200 eggs in a year, whilst many did not exceed 100, and some laid much less. This was tested (on a better stock than the average) at the Maine Experimental Station in 1898-99, 260 pullets being selected, of which 6 died and 19 were stolen. Of the remainder, 39 laid 160 eggs each or more, and 22 less than 100, the rest coming between these figures ; the five best laid 200, 201, 204, 206, and 208 eggs in twelve months, and the three worst only 36, 37, and 38 in the same time. From such figures the money value of selective breeding is apparent. In England, those who practise it usually secure the better layers by selecting those which lay early in the season, or

early in the day, or are first down from the perch in the morning ; in America trap- nests have been used, which automatically confine the laying hen till she is released and her number or mark registered. As a proof of what may be done by sys- tematic breeding, one American breeder obtained an average of 196 eggs per annum from as many as 600 White Leghorns, and another 194 eggs from 140 Plym- outh Rocks : greater numbers have been obtained from single birds or small pens of fowls, but these are results from considerable flocks.

It has been proved, howcA-er, that such averages as these cannot be obtained unless they are fed for as well as bred for. Such an enormous production of albuminoids can only come from adequate supplies ; while, on the other hand, such supplies as would be profitably turned into eggs by a prolific layer would only produce fat, or hyper- trophy, or disease in a poor layer. The most successful esK-farmers now feed their poultry on definite ” rations,” compounded so as to give what is termed a proper

“nutritive ratio,” or proportion of albuminoids to car- bonaceous material. The basis of such feeding is analysis of food-stuffs, in some form which shows simply their percentages of albuminoids, fats or hydro-carbons, carbo- hydrates (starch, sugar, &c.), salts, crude husk or fibre’, and water. Fats being relatively much richer in carbon than the starch compounds, are generally multiplied by 2-25, and this product added instead to the carbo- hydrates ; then the ratio of albuminoids or nitrogenous matter to this total of carbonaceous compounds is the “nutritive ratio.” The following is a useful table of analyses made out in this way, taken from Tlie Book of Poultry : â€”

Analyses of Poultry Foods.

Articles of Food.

1g

o

S a

1

1

^“1

o

i

1

^

^fc.

O

o

u

Grains and Meals.

Linseed Meal .

32-9

7-n = 17-8

36-4

5-7

8-9

9-2

Beans and Peas

24-0

1-5= 3-4

48-0

2-5

10-0

14-0

Malt Sprouts .

23-2

1-7= 3-8

48-5

5-7

10-7

10-2

Oatmeal .

18-0

6-0 = 13-5

63-5

2-0

1-5

9-0

Middlings or Fine

Sharps .

16-0

4-0= 9-0

57-0

4-5

4-5

14-0

Sunflower Seed

16-0

21 -5 =48 -4

21-4

2-6

29-0

9-5

Bran

15-5

4-0= 9-0

44-0

6-0

16-5

14-0

Oats and Ground

Oats .

15-0

5-5=12 -4

48-0

2-5

19-0

10-0

Wheat .

12 ‘0

1-8= 4-0

70-1

1-8

2-3

12-0

Barley (and Meal) .

12-0

1-4= 3-2

56-0

3-6

14-0

13-0

Millet Seed .

11-3

4-0= 90

60-0

3-0

9-4

12-3

Maize

10-5

8-0 = 18-0

66-5

1-5

2-5

11-0

Rye

10-5

1-8= 4-0

72-5

1-9

1-7

11-6

Buckwheat

10-0

2-2= 5-0

62-2

2-0

110

12-6

Hempseed

lO-O

21-0=47-2

45-0

2-0

14-0

8-0

Dari

9-5

4-5=10-1

68-7

1-5

3-3

12-5

White Bread .

8 ‘8

1-8= 4-0

56-4

0-5

0-0

32-5

Rice

6-6

0-4= 0-9

80-0

00

0-0

13-0

Brewers' Grains

5-4

1-6= 3-6

12-5

1-0

3-8

75-7

Vegetables.

Potatoes .

6-5

0-0= 0-0

41-0

2-0

0-0

50-5

Red Clover

5-0

0-8= 1-8

13-3

2-4

6-5

72-0

Meadow Grass .

3-5

1-0= 2-2

13-5

2-0

4-7

75-3

Hay. . .

8-4

2-6= 5-8

41-0

6-2

27-2

14-6

Cabbage .

2-4

0-4= 0-9

3-8

1-4

1-5

90-5

Onions

1-5

0-2= 0-5

4-8

0-5

2-0

91-0

Turnips .

0-5

0-1= 0-2

4-0

1-0

1-4

93-0

Animal Foods.

Dry Meat Meal

71-2

13-7=30-8

0-3

4-1

0 0

10-7

Plesh of Fowls

210

3-8= 8-5

0-0

1-2

0-0

74-0

Horse-flesh

21-7

2-6= 5-8

0 0

1-4

0-0

74-3

Lean of Beef .

20-5

3-5= 7-9

0-0

1-6

0-0

74-4

Fresh-out Bone

20-2

26-1=58-7

0-0

24-0

0-0

29-7

Dried Fish

48-4

11-6 = 26-1

0-0

29-2

0-0

10-8

Milk

4-0

3-5= 7-9

4-8

0-7

0-0

87-0

Skim Milk (separa-

tor)

3-1

0-3= 0-7

5-3

0-7

0-0

90-6

Eggs (yolk only) .

16-0

30-0=67-5

0-0

1-0

0-0

53 0

„ (white only) .

12-0

2-0= 4-5

0-0

1-2

0-0

84-8

A glance will show how greatly various foods differ in their nutritive ratio, what variety of composition is therefore possible, and that if we wish for cheapness to use some food of low ratio, it must be "balanced" by some other whose ratio is high.

Many writers have introduced unnecessary complication into a very simple matter. Some elaborately compute the amount of " dry matter," which is needless if our analyses show the propor- tion of water, as above. Others have calculated "digestibility," on the theory that food not rejected as excrement is "retained in the body." This theory has a basis in the case of animals which consume a large amount of hard indigestible fibre, excreted in such

a form as horse manure ; but fowls macerate all they eat in the crop, and grind it in the gizzard, and in their case the excreta represent very little undigested food, but mainly the final result of the vital processes, and of food usefully employed in carrying these on. We may be sure that we more than allow for any factor of indigesti- bility if we merely leave out any crude husk or fibre, giving that to the fowl for whatever it is worth, and calculate our ratio direct from the figures of the table.

Two extremely simple cases will suffice as examples of the modern method. Potatoes are often cheap, but on account of their starchy composition require a ” balance,” and the same may be said of maize : one method of balancing each will show what is meant, and the sim- plicity of the calculation. We will take potatoes and bran first : â€”

Batio of Potatoes and Bran.

AlbuminoidB.

Fat X 2i.

â€¢

Carbo- hydrates.

Salts.

1 lb Potatoes . 1 lb Bran .

6-5 15-5

0-0 9-0

410 44-0

2-0 6-0

22-0

9-0

86-0 + 9-0

8-0

94-0

Adding here the fats x 2^ to the carbohydrates, we get the ratio of the mixture as 22 : 94, or about 1 : 4J, which is very good. Coming next to the maize, let us suppose that it is desired to feed this as grain in the evening, and to “balance ” it by an equal weight of “mash” or soft mixture in the morning. One way would be as follows :â€”

A Diet containing Maize.

Albuminoids.

Fatx2i.

Carbo- hydrates,

Salts.

3 lb Maize (x 3) .

1 lb Horse-flesh

2 lb Ground Oats (x 2)

31-5 21-7 30-0

54-0

5-8

24-8

199-5

0-0

96-0

4-5 1-0

5-0

83-2

84-6

295-5 + 84-6

10-5

380-1

This ration explains how in such a case we must multiply the figures for maize by 3, and those for oats by 2, being the proportions we are taking to one portion of horse-flesh. The ratio of this dietary comes out slightly lower than 1 : 4|-.

The proper ratio for feeding fowls has received much discussion. ” Dietetic authorities mostly agree that about 1 : 5 is the best for maintenance of animal life generally, and more specifically that there should be of albuminoids about 18 parts in 100, of fats 7, and carbohydrates 75. That should suffice for growing chickens ; but it is fairly obvious that fowls fattening may require more fat, while the constant production of eggs, whose high ratio is shown in the analyses, must require a larger amount of albuminoids. This fact is indicated by the hen herself, which when laying devours large earthworms, usually rejected with disgust at other times. She shows by this appetite how specially she needs albumen ; and fowls on a wide range, though only fed with corn, may thus in summer “balance” a dietary for themselves by the worms and insects which they procure. When they

cannot do this, more albumen must be supplied, and tbe general opinion of practical egg-farmers lias tended to- wards a ratio of 1 : 4 or 1 : 4i for hens in full lay. One successful American breeder feeds as high as 1 : 3, and states that his results have been best at that figure.

Passing from theory, the greatest practical advance in poultry-feeding has probably been the discovery of the benefit to be derived from dividing the extra supply of albumen between fresh bones cut up small in a mill (known amongst breeders as ” cut bone”) and such green food as clover or cabbage. The bones, it will be seen, contain a good proportion of fat, and of mineral salts also, which careful experiments have shown to be of great importance both in egg-production and for grow- ing stock. Green food had until recently been looked upon chiefly as a corrective, or necessity for health, though it was known that fowls on a pasture grazed largely. But the nutritive ratio of clover is as high as 1:3, and American poultry-farmers now use it largely as really albuminous food, to promote laying. Its use in this way also allows more animal food to be used without ill effect; and to this free use of clover and cut bone in conjunction the improved results upon American egg-farms are largely due. So beneficial is this combination found, that for winter use clover- hay is cut up small, or ground into ” clover-meal,” to be used in the same way, being generally mixed with boiling water in the other soft food at night, and kept covered to cook or soak until the morning. The follow- ing is the ” mash ” ration on a successful American egg- farm, and represents a high forcing diet : middlings or sharps lOOlb, maize-meal 7511b, gluten-meal (a highly nitrogenous bye-product of American flour-milling) 25 tb, clover-meal 801b, meat meal 351b ; all weighed dry, mixed with boiling water in the evening, and kept covered all night.

This introduces another practical question. The majority of poultry-farmers give their stock each day one feed of grain, and one of soft meal-food or “mash,” but by no means agree as to the times for these meals. In England, morning mash and evening grain are almost universal, the latter giving more support dur- ing the long fast at night, and the former more rapid recuperation on cold mornings. But in America and Canada, where the climate compels confinement of the

fowls for months together in enclosed sheds, health and eggs can only be secured by constant ” scratch- ing,” to promote which the grain is scattered amongst loose litter spread several inches deep. Many, there- fore, prefer to scatter the grain in the morning and feed the mash at night, alleging that a good breakfast of mash makes the fowls lazy, with bad results. Others state that this is avoided by a rather scantier morning feed of mash, with a slight sprinkle of grain in the litter afterwards. In 1890 a careful experiment was made by the Massachusetts Agricultural College, two similar lots of pullets being fed upon similar food, on the two plans, for two periods of several months each, in summer and winter seasons, and each lot receiving, besides the morning and evening feeds, a slight sprinkle of millet in the litter, to promote exercise. In egg- production there was scarcely any difference, what little there was being in favour of the morning mash; and the birds thus fed became also somewhat the heaviest. The most remarkable result was that the weight of manure voided in the night was nearly double in the case of the evening-mash birds, showing the rapid digestion of mash food. This might have been expected â€¢ and in some cases the transference of so much weight of manure from day to night deposit might be found convenient.

Artificial Incubation and Rearing. â€” In this depart- ment immense progress has been made, which has created practically new industries. None of the incu- bators in use about 1875 has survived ; but it is known now that while some of them failed from insufficient regulation of temperature, and others from want of a proper balance between ventilation and moisture, the cause of failure in most cases was lack of practical knowledge, and that some of them would give very good results in the hands of present operators. The incubators now used are of two distinct types, and it is noteworthy that British practice so far has mainly adopted one, while the best recent American practice prefers the other.

In what may be called the ” tank ” system, the heat from a lamp is led through flues traversing a tank of water which forms the upper side of the egg-chamber. Most usually the lamp has a vertical chimney, closed at the top by a valve rising or falling at one end of a lever, while the

tank flue issues from one side of this chimney : then if the valve be raised, more heat passes directly into the outer air, and less through the tank, and so the tem- perature is lowered ; while conversely, if the valve sinks, more heat is diverted through the tank, and its tempera- ture is raised. The valve-lever is in Europe generally actuated by a thermostat invented by Mr C. Hearson, and known as the ” capsule ” regulator, which consists of two flat plates of thin brass soldered together round their edges. Between them is introduced a drop or two of ether, so diluted as to boil at a suitable temperature, after which the capsule is sealed. “When the given temperature is exceeded, the ether vaporizes, and the bulging of the plates is easily made to work the valve- lever. Boiling-point being affected by pressure, it is only necessary to apply an adjustable weight to the rod resting on the capsule to alter the point at which the valve shall open, and thus all is easily controlled. This form of regulator, and all others which depend upon vaporization of a liquid, have, however, the serious defect that the boiling-point differs also with atmospheric pressure, to the extent in this case of about 2Â° E. for every inch of barometer; hence in England, where the barometer often varies as much as 1\ inch and sometimes 2 inches, this kind of thermostat may vary the heat as much as 3Â° or 4Â° E., quite independently of the real necessities of temperature in the egg-chamber. Machines of this kind, therefore, require constant adjustment for rise or fall in the barometer.

In most British machines of this class, the eggs are laid in a drawer with perforated bottom, and the air enters below this, passing on the way either over an open tray of cold water or through cloths dipping in such a trav ; it then passes through the perforated bottom of the drawer and between the eggs, escaping through holes round the upper part of the chamber, which is thus ventilated and supplied with fresh moist air. The chief point in regard to success, next to a proper uniform temperature and regular turning of the eggs, is a proper balance of ventilation and moisture. The chick ought at the end of the period to occupy about four-fifths of the shell, the other fifth being vacant. If too much moisture be supplied, the egg is too full and the chick perishes ; while, on the other hand, if the egg is too much dried out by too great air-current without enough moisture, the fatal result equally follows in

another way. Eggs are always tested at the end of five or six days, and unfertile ones withdrawn : as are any which perish later. ^ ^

The other class of incubators, more general in America, is known as the hot-air or atmospheric tvpe. In snoh machines there is no water-tank, but air ‘heated by the lamp passes more or less directly into the egg-chamber, in

different ways which cannot be described in detail here. This mode of heating is found more economical in oil, which in large establishments becomes of importance ; and it is also more sensitive to outer changes of tempera- ture, and responds more quickly to any regulation ; but for that very reason it requires more efficient thermostats, and especially such as are not affected by the state of the barometer. The hot-air incubators of America are almost universally regulated by compound thermostatic bars of metal, which operate subject to temperature alone, and the best of which will keep the heat uniform within about half a degree.

Even in England the eggs hatched in incubators now probably equal, or nearly equal, those hatched under hens : in America the wide practice of artificial incubation is difficult to realize. Of small-sized machines one Illinois maker sold 14,800 in the year 1899; and in regard to large sizes, in 1900 at least seven names and ad- dresses were known of operators who each used from 65 to as many as 85 machines, every machine holding 300 or more eggs : somewhat smaller plants were of course far more numerous. Experience on such a vast scale has led to a practical advance of consider- able importance. While in England it is still usual to effect empirical adjustment of ventilation and moisture as above indicated, the better American incubators now dispense with direct moisture altogether. It was remembered that the hen hatches without moisture, and equally so the egg-ovens of Egypt; the absence of direct air-current, and consequently of any rapid evaporation, being the obvious explanation. The manufacturers therefore set themselves to slow the move- ment of the air ; and when this object was effectually accomplished, it was found that there was no need for moisture, and

that the chicks also hatched out stronger and in higher proportion. The general opinion in the United States, where many farmers tested both hens and machines on a large scale, whilst still undecided between them, is that the proceeds of artificial incubation are superior by about 10 per cent., and this is based upon hatches of thousands annually.

Artificial hatching necessitates artificial brooding, and in this also great changes have taken place, any real success in rearing having been for some years far behind that in hatching. The method universally attempted at first might be called the “coverlet” system, nestling material such as strips of flannel or wool, warmed from above, being provided for the chicks to nestle under, as they do under the feathers of the hen. Many were reared in this way, but failures were also terribly general, and these were ultimately traced to confinement and pollution and heating and rebreathing of the air, caused by the iiestling material. That system is now abandoned, warmed but open chambers being provided, which the chicks use at pleasure, but which have no coverlet to rest upon their bodies. In some, heated pipes traverse the upper part of the chamber, some inches above the chicks ; in others a warm iron plate radiates heat in the same way ; in others warmed air is brought in by flues or openings; in some small ones the lamp itself burns in the chamber of the brooder : but the principle is common to all of a warmed shelter, open above, and generally with an outer chamber also, sheltered but not heated, which breaks the transition to the open air outside. In America a very large proportion of the chickens reared are brought up till hardy in the large brooder-houses mentioned below.

Poultry-farming.â€” The advances here described have brought poultry into greater prominence as an industry, and poultry-farming in a practical sense is now carried on somewhat extensively in various ways, understanding

that term to include any case where poultry-culture is carried on for substantial profit, or as an important interest of the holding, beyond the mere breeding of prize birds for exhibition. The difficulty never had been, as some have stated, in ground getting tainted or rent costing too much. It is now well understood that in the English climate 100

birds per acre must not be exceeded, though it is far better to confine them to one-half or one-third of the space, while some crop is got off the remainder when they go yearly to absolutely fresh ground. The mere rent of an acre is not much for 100 fowls, but the real difficulty was and is that a fowl is such a small unit, entailing constant liability to small losses and wastes, and necessity for labour and oversight out of proportion. Hence at a time when 100 eggs per annum was thought a fair return for each bird, and there was but a poor and uncertain market for them, this difficulty was insuperable. A very different average production would now be worked for; while, on the other hand, the greater crowding into cities, and growing appre- ciation of eggs as an article of diet, have caused a market for ” new-laid ” eggs at good prices, which previously did not exist. It is these changes which have altered the conditions.

The chief development in England at the beginning of the 20th century was a veiy large increase in the poultry kept upon farms. Formerly very few were kept, looked after casually by the mistress or a boy, and only expected to provide for the household and occasionally a few shillings in cash, while any food expressly fed to them was grudged. It has now been taught all over the country, by lecturers under the County Council Technical Instruction Committees, that poultry pay best of any branch upon a farm. It has become generally known that, provided they can be run over the farm by using detached houses, and not huddled together, a dozen hens per acre can be kept upon a holding without interfering with any other stock ; indeed, the curious fact is observed that horses and cattle prefer to ‘graze over grass that might be thought soiled by the fowls. Where the statement was once derided, it is now a commonplace of County Council lecturers, that the additional manure thus made is really worth to the farm from sixpence per bird per annum for small breeds to as much as one shilling for very large ones. Out of a large number of similar instances collected in 1900, two specimens may be given. In Worcestershire 210 fowls had the run of 100 acres, lots of 20 to 30 being kept in detached houses. Erom 20,000 to 25,000 eggs per annum were marketed, and 150 to 200 chickens, the food averaging about Â£40, and the cash return Â£90 to Â£100. In Leicestershire, on part of a. holding of 500 acres, 372 hens

had in 1898 produced a profit of Â£100; the following year, owing to illness and consequent lack of oversight, 440 only paid a profit of Â£92. The almost universal opinion is that the manure pays for the labour, and that the annual profit averages from 4s. to 5s. 6d. per head. It has been estimated by many different observers that the number of poultry kept in Great Britain on farms is now probably five times as large as it was in 1875 : in some districts “ten times as many” have been reported, but such are exceptional.

Poultry-farming on a larger scale than this is also carried on in connexion with the Sussex fattening industry, presently described. That was until recently a separate business, chickens being bought from neighbouring small rearers, or imported from Irelan d, to go directly into fatten- ing cages ; and it has often been stated that rearing and fattening together were incompatible. This was so far true that the manure made by numbers of fattening poultry was

very considerable, and had to be used upon a small holding kept in order to use it ; such a holding, therefore, received as much as it could possibly bear, and was thereby ” sickened ” for live poultry running at large. But with an extra holding or larger holding this is not the case, and increasing competition and the desire for the two profits have led to a large amount of rearing and fattening combined. In 1894 one of the officers of the Agricultural Commission found 8000 chickens being reared and fattened annually on one farm of 200 acres, and this proved only a pioneer : in 1900 he found (amongst many such in- stances) 4000 reared upon 80 acres, 1500 upon 22 acres, and 6000 upon an extra holding (taken for the p)arpose) of 40 acres. In most cases the main cereal crop was oats, to be fed to the fowls ; and some cows were kept, the skim milk from which was used in the same way ; but the poultry was the controlling interest of the whole.

On any such scale as this the manure becomes of great importance, and the manner in which the compulsory use of large quantities has taught

Sussex farmers its value is interesting. Of course there is no uncertainty about the value of manures, and about 1880 the late Dr Augustus Voelcker, chemist to the Royal Agricultural Society, made the following analysis of two samples, one moist or fresh dropped, the other freed from much moisture by storing under cover for four weeks : â€”

Moisture

Organic matter and ammonia salts Tribasic phosphate of lime Magnesia, alkaline salts, &o. Insoluble silioious matter (sand)

Containing nitrogen Equal to ammonia

Fresh Partially Dried Manure. Manure.

61-63

20-19

2-97

2-63

12-58

41-06

38-19

5-13

3-13

12-49

100-00

100-00

1-71 2-09

3-78 4-59

Valued in the usual way, Dr Voelcker found that the moist manure was worth Â£2 per ton, and the drier stored manure Â£4 4s. per ton ; but though the figures were indisputable, for many years such manure was practically unsaleable. Gradually in Sussex it became saleable at 64. per bushel, and in 1900 some of the smaller fatters were selling it at prices varying from 4s. to 15s. per load ; the larger men either used it themselves or obtained higher prices. In one district this manure was to be found in railway trucks, purchased for the growing of grapes and tomatoes under glass; and one fatter in a fairly large way, who once sold his at Â£2 10s. per ton for this purpose, having lost his market to some competitor, had put up a number of glass-houses and was using it himself for tomato culture. Others utilize it mainly for hay, the effect upon scrubby land being remarkable. Off one holding of 123 acres, some portion of which was wood and coppice, and the whole worn out when entered upon, the owner had sold nothing for several years but poultry products and hay ; of the former, 8700 chickens had been marketed in one season, and of hay 90 tons had been cut, worth about Â£3 5s. per ton.

Really large poultry-farms are few in England,- and it is difficult to state any recent facts without some risk that they may prove ephemeral; but a few existed at the end of 1900 which had by no means failed after two years, as some allege to be invariably the case. Two in Berkshire were selling eggs from over 2000 and 3000 laying hens; and there was one farm in the West of England, occupying 300 acres with the poultry (besides a shorthorn herd and some other branches), which had

a stock of 6000 pullets for laying, and had been in existence four years, a large capital amounting to thousands of pounds having been sunk in it. The owner explained that two years was the critical period, simply because for about that time there were practically no returns, and that in his case he had only “turned the corner ” after three years. Though a practical man already, he had begun in a small way with one incubator

and training one man; gradually extending, building up his own market, organizing his own selling agency, and building a mill to grind his own grain. Only such gradual extension by practical men can ever lead to success : what people term ” embarking ” in poultry -farming can only end in ruinous failure. One reason is the error of supposing that buyers are waiting at a certain price for any new supply : the new-comer has to creep in, and find out for himself how to bring his supply and a profit- able demand together. Unless this is done gradually, there is heavy loss, and while it is being done there is little return. The egg-farmer, again, has to breed up his own laying stock, as above indicated. And, finally, the business is tdrribly exacting: there is no rest, no holiday, no relief; intermission of labour and care for a few hours means loss or disaster, and paid oversight that will avoid this is both expensive and difficult to find.

Besides the breeding of prize poultry, which need not be discussed here, but which is remunerative enough to a certain number of persons who possess the necessary peculiar qualifications, the changes mentioned in the early portion of this article have led to another class of breeding directed to the supply of pure races from good stock, but bred mainly for purposes of utility. The demand for such stock, at fair prices, though far below those for prize stock, is a good index of the development of the poultry industry. The estab- lishments which supply it furnish eggs for hatching, or stock birds, or newly-hatched chickens, which are now hatched in incubators and sold by thousands when only one day old, at which age they travel without needing food. Some of such establishments are quite large. One in Yorkshire occupies 43 acres solely de- voted to this business. In 1900 there were on the farm about 100 breeding-pens of poultry, confined by 6^ miles of wire-fencing. The few waste eggs sold for market realized about Â£100; over 4000 sittings of eggs for hatching were sold, and about 1500 stock birds. This farm had then been carried on for ten years, and was purchased out of the proceeds of an- other held previously; but the business qualifications which could build up such an establishment must always be rare.

Poultry-farming has reached its fullest development in the United States, owing no doubt to the apparently mexhaustible market;

butcher's meat being far less eaten than in England, and poultry and eggs to a large extent replacing it as national food. More especially is there an enormous demand for small chickens, known as "broilers," weighing from 14- ft to 2 lb only, destined to be split m half and broiled on a gridiron. These birds being unfattened, and ready at ten or twelve weeks, give a quick turnover with less expense and risk than older fatted birds; and this peculiar demand has largely dominated American poultry-farming, a great deal of which runs in the direction of great "broiler-plants" solely devoted to the hatching and rearing of these broilers, while large brooder-houses," similar to those used in that business, are prevalent on more miscellaneous farms. The broiler icIn^Q^r Started at Hammonton in New Jersey about I88O-80, when plant after plant was rapidly erected, some of which have since shut down ; but many others

have taken their place, and some of the originals are still running. The chicks are all hatched in incubators (many plants running from 20 to 40 machines), and then transferred to long " brooder-houses," built with a corridor all along one side, the rest being divided into successive pens for the chickens. These latter are moved along every few days to the next of the pens, which are arranged so as to give rather more space as the birds grow larger. Each pen has next the corridor a "hover" or brooding-shelter. These have no nestling material, but only a roof or cover somewhat to retain the heat, closed by a curtain cut into strips in front; and are warmed by hot-water pipes running along the building. Generally these pipes run some inches above the chicks reposing on the floor, and are set rather on a slant, so as to be higher for the bigger chicks in the larger pens ; but in some cases they run under the floor, and warm the air which enters under the hovers. Every hover, with its inmates, can be reached from the corridor at the back of all. In many cases the chickens are confined in these small pens until large enough, the floors being littered and regularly cleaned ; but some raisers have also small out- side yards which they use in fine weather. The mortality in nearly all plants is great, as might be supposed. There are said to be some at Hammonton which only market 30 per cent, of the eggs

incubated, yet pay a modest profit at that, which is allowed for. On the one hand, a broiler realizes about four times the cost of its own hatching and food ; on the other hand, the labour is very heavy and the loss considerable : these factors obviously give a very wide margin of possibilities as regards success or failure.

The most remarkable establishment of this kind, em- bodying some novel features, was erected in Ohio at the end of 1896 by Mr J. Loughlin, and was still running in 1901, though many believe its permanent success doubtful. The plant cost over 60,000 dollars, and was designed to market 260 to 300 broilers per day regularly, weighing 1|- lb each, which are sold alive to one large dealer at three dollars per dozen. Each day an average of 450 eggs are started, the chicks from which go into one pen. Eor the chicks, while small, there are thirty small pens, each with 6 by 10 feet of floor space, or at the rate of six chickens per square foot ; and there are sixty larger pens each 8 by 12 feet, with outer runs to each of 8 by 20 feet. Every day the chickens are marketed from the ninetieth pen, and all the rest moved one pen for- ward, leaving the first small pen vacant for the day's hatch: thus fully 22,000 birds are in the plant at one time. The crowding appears very great â€" we should say far too great â€" yet the plant had run four years, and was stated to make a profit of 14,000 dollars an- nually.

In more general American poultry-farms the sam'e system of brooder- houses largely prevails, and from many great numbers of broilers are sent to market ; but as both heart and liver are perceptibly affected by such rearing, birds intended for stock are either taken out of doors early, or reared in detached brooders, as in England. Some establishments are mainly egg-farms, high averages being obtained by the system before described. Many breeders have a high reputation for their stock as layers, and derive large profit from selling stock or eggs to other farms. There are many immense duck-farms or "ranches," as mentioned below, which sell nothing except stock ducks or market ducklings. A great many combine the breeding and sale of exhibition poultry with some or all of these objects, fancy points being on the whole less distinct from useful qualities than in Eng- land, and the farmer and exhibitor far more commonly combined.

As a rule, American poultry-farmers employ long ranges of buildings divided into pens or houses, with enclosed yards in front; and the most remarkable fact is that interest can be paid upon the capital sunk in such buildings. The explanation in some cases is that much is put up by personal labour and energy of which British farmers have no idea, while the cheapness of land and feed are also favourable. But the climatic conditions also differ. During the winter months the birds have to be confined in what are called " scratching-sheds," and American farmers have successfully reduced to a system the keeping of them healthy and in profit by scratching amongst litter in a small space. During this period the outer runs sweeten and recuperate ; smaller runs there- fore suffice, and the stock is kept closer and more com- pact. Another system is pursued, more especially about Rhode Island, called the " colony " plan ; detached rough houses, holding forty or fifty hens each, being scattered over the farm ; there may be a hundred houses, but there is no fencing. This is very economical in buildings, but expensive in the labour of feeding and collecting eggs, and the system is only possible near the sea or where there is little snow. In several cases it has been aban- doned for the system of houses and scratching-sheds..

There are a few very large establishments indeed in the United States, combining almost every branch ; but some which did well on a rather smaller scale, when enlarged by companies have been less successful, and had either to contract again or shut down. The largest single establishment at the end of 1901 was probably the Meadow Brook Farm, in Pennsylvania, occupying 80 acres, the buildings of which totalled 112,000 square feet under cover. There were half a dozen brooder- houses ; one hen-house is 1000 feet long : and the farm sent to market in one year 26,000 chickens and 20,000 ducklings, besides selling many stock birds, and an enor- mous number of eggs for hatching at an average price of $40 per thousand. But an even larger business has been built up in Ohio by the former minister of a church, whose health had broken down. The chief and centre establishment, known as Crescent Earm, is itself pretty large, and carries many buildings ; but, by a system of contracts, there is also secured the absolute control of a number of other establishments, some of considerable size. A special business has been developed here of "

stocking-up ” new egg-farms and broiler-plants with laying stock in September, birds ” bred to lay ” being supplied in lots of one hundred at a dollar each. Ten thousand such birds are raised : there is also a reputation for exhibition stock ; and the demand for eggs for incu- bation sometimes reaches nearly 3000 per day : one order for 20,000 eggs was received on 18th March 1901. Chickens and ducklings are also marketed, about 60,000 ducklings being the expected product of the year just named. Of course businesses like these are very excep- tional ; but farms on a more moderate scale are numerous, and intelligent American farmers reckon to make a profit of a dollar per annum for each head of their laying or breeding stock.

Table Poultry. â€” ^National taste governs the market for table poultry to a large extent. In England white meat, skin, and legs are preferred, and at one time black legs or yellow skin were heavily discounted. More knowledge has largely removed that prejudice, but white has a market value still. In France exceedingly white and smooth skin is preferred, but buyers are indifferent to black legs. In America yellow skin and legs are actually preferred, such fowls being thought more juicy ; but there has been some tendency towards white meat of late. Belgian feeders think the best result follows from crossing a yellow-skinned race upon a white-fleshed one. It is

some confirmation of this idea that one of the best English table fowls is the produce of a cross between Dorkings and the yellow-skinned Indian Game, while other similar instances might be cited. For some years past the quality of British table poultry has been shown by displays of plucked birds in connexion with the Christmas Smithfield Cattle Show. For many years France had a reputation for greatly surpassing British production ; and as the best French fowls readily sell for Â£1 each and more in the Paris market, it would not be surprising if they were superior to such as have to be sold for 15s. per couple. French fatters

appear to seek and obtain a smooth white- ness of fat under the skin, almost like that of a bladder of lard, which does not find favour in the British market ; but the best judges have considered that the finest English specimens staged were equal to all comers, and some realized high prices. Foreign experts, equally with English, admitted in 1899 and 1900 that England had now little to learn from any foreign feeders.

The chief supply of the best fowls for the London market has long come from the Sussex district whose centre is Heathfield : these are termed ” Surrey ” fowls, though Surrey now sends few in comparison.* This local in(Jiistry has been founded in a curious way upon the ” ground oats ” of the district, the whole grain being ground up, husk and all, nearly as fine as flour. This is done by a peculiar local dressing of the stones, which are ” stitched ” into little pits by a pointed pick, instead of being dressed into narrow grooves, as for flour-milling ; and this meal is found specially suitable for feeding and fattening poultry. In early times cottagers crammed a few fowls with pellets of meal dipped in milk, but this method is now quite superseded by machine-cramming, a rubber tube from the machine being introduced into the crop of each fowl, and a stroke of the foot on a pedal squeezing out a ration of thin, almost creamy, paste, composed of the ground oats, fat, and sour skim- milk, a food which puts on flesh fast and makes it white and delicate. Great experience is required in this business. When killed and plucked, the fowls are placed in a trough whilst still warm, close side by side, and their backs and breasts pressed closer together by a board loaded with heavy weights. This combination of fattening and subsequent shaping constitutes the Sussex system.

The trade in these fatted and shaped fowls is still increasing, so that in 1900 more than 2.300 tons of poultry went up from Heathfield station alone to London. There are a few very large establishments ; many small men fatten a few ; and a fair number send up about four to six dozen fowls three times a week. This growth is in spite of the fact that increased competition and that of cheap foreign poultry have somewhat reduced profits, so that a large portion of the trade now consists of a lower class of birds, at a narrow margin. They are all carried up and the packages brought back empty at the inclusive charge of one penny

per bird. The Sussex system is extending in some other parts of England, and many excellent fowls, well fed, but unfattened, are also supplied from Lincolnshire (known as ” Bostons “) and other districts. The largest provincial towns have similar supplies in less degree.

In America larger fowls are called ” roasters,” to dis- tinguish them from the broilers above described; and quite recently there has grown up in the Eastern states a system of rearing these also in confinement. Hatching them begins in September, and the birds are at first reared in brooder-houses; but when large enough are placed about fifty together in small houses, with 6 by 8 feet of floor, in small yards about 20 feet square. One very successful raiser puts 200 birds into one pen 10 by 17

feet, in a warmed house, where they remain till killed at 7 lb or 8 lb weight. One firm had raised in this way, for seven years in succession, 2000 birds per annum upon half an acre of ground ; but occasionally there is serious mortality in this kind of business, and as a rule only 60 per cent, are reared of those hatched, the loss of the rest being averaged and allowed for.

In western Europe there has grown up some demand for chickens fattened quite young, weighing only 8 oz. to 12 oz. each, and known as petits poussins, or “milk chickens.” In Belgium somewhat older ones, weighing up to 1-|- lb, are sold as poulets de grains. The demand for such birds in England is small, and confined to the West End of London, the flesh being too excessively tender for average English palates. Birds of similar sizes have lately been finding a market in the United States as ” squab broilers,” but are split and broiled, and not fattened, the difference being that a whole bird is served for one portion.

Ducks, Oeese, and Turkeys. â€” Little need be added under these heads. During the last fifteen years of the 19th century the Indian Eunner Duck, formerly known as the Penguin Duck, became very popular as a hardy forager and good layer, many birds laying 150 to 180 eggs in a year. It is small in body but good in flavour, and is a great favourite in many districts. Formerly the greater number of ducklings came to the London market from the Vale of Aylesbury, the birds being

carried and empties returned for one penny per head, as in Sussex. This trade still continues, but the adherence of the Aylesbury duckers to old-fashioned methods, and the increasing demand, has led to great competition in other districts, such as Norfolk, Lancashire, Kent, &c. Some of the new duck-farmers market 10,000 to 15,000 annually, mostly hatched in incubators, and never allowed in the water or out of the small rearing-pens. In America, however, this kind of rearing has found its fullest development, the number who raise 10,000 ducklings or more being considerable, and a few sending to market, as above indi- cated, very large numbers indeed, requiring 40 to 80 incubators to keep up the supply. It is remarkable that while in England the Aylesbury is generally preferred, in America the Peking duck is universally used, and has been made by selection both larger and a better layer. Some duck-farmers in England have, however, also adopted the Peking.

Geese in England are declining in relative popularity. In Germany they are consumed to an enormous extent, and the British Consul-General at Berlin reports that even the large domestic supplies have to be supplemented by considerable imports from Russia, a special ” goose-train” of fifteen to forty cars arriving daily from the Eussian frontier at that city. In America there has been increased interest in goose-breeding, and in the Chinese Goose especially, which has been largely bred (with some trifling peculiarities) under the name of the African Goose, and crossed with the Embden and Toulouse. The produce of this African cross is considered very fertile and profitable to rear.

Turkey-breeding has been largely dominated by the magnificent American Bronze breed, derived from wild blood, and distinguished for size and weight. There is some question whether it does not require more space and fresher ground than the older English strains, and may not be more delicate on small holdings. French birds come largely to the Christinas market in London, but, as compared with English, are small.

National Interests and Commerce. â€” The foreign importa- tions of eggs into Great Britain have increased rapidly, and are now very

considerable. Taking only alternate years for brevity's sake, the following table' shows the

POULTRY AND POULTR Y-F ARMING

883

amount, value, and average price per 120 since the year 1870 :â€"

Number, Value, and Price of Imported Eggs.

Tear.

Number of Eggs.

Value.

Average Price.

1870

430,842,240

1,102,080

6/H

1872 .

531,591,720

1,762,000

7/lli

1874 .

680,552,280

2,433,134

8/7

1876

753,026,040

2,620,396

8/4

1878 .

783,714,720

2,511,096

7/8i

1880 .

747,408,600

2,235,451

7/2

1882 .

811,922,400

2,385,268

7/1

1884 .

993,608,760

2,910,493

7/0

1886 .

1,035,171,000

2,884,063

6/8

1888

1,126,793,000

3,083,167

6/6

1890 .

1,234,950,000

3,428,806

6/8

1892 .

1,336,730,000

3,794,718

6/10

1894 .

1,425,236,000

3,786,329

6/6

1896 .

1,589,401,000

4,184,656

6/4

1898 .

1,730,952,000

4,467,117

6/2

1900 .

2,025,820,560

5,406,141

6/5i

From such figures the conclusion has been drawn, and at first sight is natural, that foreign eggs have been ” ousting ” British to a formidable extent ; but such a conclusion is dispelled when we take into consideration questions of price and nationality. The following are the values imported from the chief foreign sources during the last ten years of the 19th century, taken every alternate year until the last : â€”

Value of Imports of Foreign Eggs.

Year.

France.

Russia.

Denmark.

Germany.

Belgium.

Â£

Â£

Â£

Â£

Â£

1889

1,181,335

165,740

286,917

893,902

565,057

1891

1,269,099

383,791

395,963

781,903

539,666

1893

1,611,495

426,106

376,793

618,631

682,636

1895

1,069,580

601,460

447,709

916,821

713,458

1897

1,022,869

812,297

546,282

813,022

768,077

1899

867,865

1,183,031

808,543

966,641

759,250

1900

868,133

1,109,553

923,551

1,106,719

733,453

These eggs are of very different qualities and prices, France averaging for the year 1900, 7s. 7^d. per 120, Denmark 7s. 6|d., Belgium 6s. 2d., Germany 5s. 9-^-d., and Eussia 5s. 6d., many of the latter being almost putrid when sold iu England, and chiefly used in manufactures, for which, at a low price, they answer perfectly. Many eggs are sent from Russia to Germany, Belgium, and even Denmark, so that some of these also come from her, at an original price with which no British producer could compete. The steady decline in imports of the higher-priced French eggs, and enormous increase of low-priced eggs, explain the drop in average price from 8s. 7d. per 120 in 1874 to 6s. 5\A. in 1900 ; and were this all, the inference would be simply that the selling price of eggs had fallen. But this is not so. While the higher-priced foreign eggs have thus been largely displaced from the market, there has grown up a very large demand for British ” new-laid ” eggs, at prices much higher than any of the above. Every observer must have noticed the many packages of such eggs now exposed for sale in all towns; and what is still more significant, there is now a wholesale market for such eggs in London, the lowest price (in May) for 1900 being 7s. 6d. to 8s. 6d., and the highest (in December) 19s. to 20s. per 120. This market is steadily increasing, the greatest difficulty being to ensure really genuine

freshness from producers. The quantity of reputed ” new-laid ” British eggs now sold is simply enormous, and has grown up in

the face of foreign imports, the native producer selling in spite of them, and at far better prices, many times more than he did, say, in 1876.

The following are the British imports of dead poultry and game for the last three years of the 19th century : â€” â–

Value of British Imports of Poultry and Game.

1898 1899 1900

Â£

217,703 296,555 333,148

Eussia.

Â£

164,498 139,834 199,282

Belgium.

Â£

127,923 166,803 213,603

Other Countries.

Â£

127,368 183,102 264,327

The total for 1900 thus amounted to Â£1,010,360. The imports from France and Belgium are largely for the Christmas market. Those from Eussia are chiefly very small fowls, wrapped in paper and packed in cases of a hundred each, which come over frozen, to be sold at Is. 2d. or

Is. 3d. each. Other sources include America, Canada, and Australia, which have been sending smaller but increasing quantities of larger birds, packed in smaller numbers, and which realize 2s. 6d. to 3s. 6d. each, a few of the largest as much as 4s. each. Such supplies have somewhat affected the Sussex fattening industry, necessitating (as already hinted) the production erf a lower class of bird at a lower price and narrower margin; but they look rough and inferior in colour, and chiefly supply restaurant and hotel demand. The foreign birds being cold-storage goods, which must be consumed quickly when taken out, a fresh Sussex fowl of the same weight will always sell for considerably more.

There are no statistics of British poultry ; in Ireland they are collected. The year 1851 closed a decade in which the number of holdings under ten acres had de- creased enormously, and the number of poultry in Ireland was then returned as 7,470,694. In 1889 this number had doubled to 14,856,517, and in 1899 there were 18,233,520, an increase in ten years of almost 25 per cent. The Irish Agricultural Organization Society is doing much to improve breeds and management, and the pack- ing of eggs, of which Ireland is a considerable exporter to Great Britain. There is also now a considerable export of lean chickens for fattening to Sussex and other parts of England, and a smaller number have also been fattened in Ireland. Eeally great progress is manifest in the size and quality of the poultry in many districts, and in the freshness and packing of eggs for the English market.

The poultry industry is developing in Australia, and some export to England has arisen, but too recently for much definite information. Most of the federated States have a Produce Export Department, which re- ceives eggs and dead poultry into cold storage and ships to London, managing, if desired, the whole business. That of South Australia shipped a good many eggs to England in 1895, but the temperature was found too low for eggs, and this trade has so far not developed. Dead poultry come in a similar way from West Australia and Victoria to London. In New South Wales such arrangements have inaugurated a small export business which seems the most active of any, and more seems known about the poultry industry in this state than in others.

The Government statistician estimates the number kept in 1900 at 3,180,000 fowls, 320,000 ducks, 234,000 turkeys, and 97,000 geese, the annual consumption being about three-fourths of this, and of eggs about 97,000,000. Around Sydney there are many poultry and duck farms of one to a dozen acres, and one large duck-farm produces ten to twelve thousand

ducklings annually. These farms supply the best export fowls for London, the Government depot having to refuse many others sent in, as too small and poor to pay for export. From Tasmania there is no export as yet, but the colonial Government has started a poultry farm, in order to improve the stock kept and afford instruction in poultry - breeding.

In Canada the Government makes considerable effort to encourage poultry. It has established several stations where systematic fattening of chickens in the English manner is taught, and official experiments are also made on the results of various feeding-rations and other matters. From these stations shipments of fatted chickens were first made to Liverpool and London, commencing an ex- port trade which shows signs of growth. In 1900 the eggs exported to England were valued at Â£288,945 in London ; and the dead poultry shipped realized in Canada for 1898, 100,739 dollars; for 1899, 140,142 dollars; and in 1900, 211,181 dollars. These have improved in quality, and the largest have realized 3s. 6d. and 4s. each. There are no statistics of home production.

The poultry industry in the United States is the most gigantic in the world, and probably the greatest pecuniary interest the country possesses. By the census of 1900, which tabulates returns from 5,096,252 out of the 5,739,657 farms in the States, the number of fowls over three months old on 1st June 1900 was returned as 233,598,085, with 6,599,367 turkeys, 5,676,863 geese, and 4,807,358 ducks, or 250,681,673 birds in all, valued at 85,794,996 dollars. This, however,

would include very few of the chickens raised that year, which would not have reached the age stated, and mainly represents breed- ing and laying stock, which thus averages about 49 birds to every holding ; it also of necessity omits many of the smaller city-lot raisers. The value of the poultry raised during the whole year 1899 is given as 136,891,877 dollars, and of the eggs produced (1,293,819,186 dozen) at 144,286,186 dollars ; a total year's product of over Â£56,000,000. Adding only a very moderate amount for city ~~lot and other small producers not making return, it will be seen that the poultry industry in America exceeds in value either the wheat crop, or swine crop, or cotton crop, which probably comes next in value. Reasons for this enormous production have been indicated, and much is done to foster it by the state governments, which carry out numerous experiments that are reported all over the country. The last development here also, dating only from 1899, is a commencement of export to England of some of the larger fowls produced in the establishments above de~~ scribed. The best are selected, the greater portion so far being sent by one firm in Chicago ; and the birds vary in price from Is. 6d. for the smallest to 3s. 6d. and 4s. for the largest, being sold chiefly to London hotels.

The importance of poultry in France has long been recognized, being due mainly to the prevalence of moder- ately small holdings and the national disposition to small rural industries. There are no very recent statistics available, but whereas in 1862 the poul-fe^ry in France were reported as 43,000,000 head, these had increased in 1892 to 54,000,000 head, besides 9,000,000 ducks, geese, and turkeys. The eggs exported are collected from the farmers by such a well-organized system that eggs col- lected on Wednesday are in the London market the following Tuesday. The home consumption of eggs is also enormous, so that when prices for foreign eggs decreased in England, the Paris market paid better. In 1899 the Paris Municipal Council reported the consump- tion of eggs in that city alone in the previous year as 212 per head, and the taste for omelettes must make the number used in France very great. Eggs are imported from Italy to some extent.

The conditions in Belgium are somewhat similar to those in France. No domestic statistics are available. Some eggs are imported from Italy,

and much of the home production is from imported Italian hens, kept laying for a year and then killed : eggs are exported chiefly to France, Great Britain, and Germany. There is a fattening industry somewhat similar to that in Sussex, lean chickens beingbought for fattening in certain markets. The chief export of these is to Germany, but there is some to the London market, especially in December.

The Netherlands statistics for 1898 show that the number of poultry had increased considerably during the previous ten years, excepting turkeys, which had diminished. There were in that year 4,083,312 fowls, 430,022 ducks, 36,307 geese, and 13,130 turkeys; and there were about 70 special establishments for poultry- rearing, which were rather on the increase, chiefly for local requirements. Of eggs there were exported to Belgium 656,898, England 370,418, and Germany 3,212, 845 kilos; but the imports were in excess of this by 2,916,269 kilos, and came chiefly from Eussia. Dead fowls and ducks also go to the countries above named.

In Denmark there were in 1900 about 9,000,000 fowls, mostly local and Italian. The eggs exported numbered 332,000,000, practically all to England ; there were im- ported 35,600,000, practically all Russiap, re-exported to England. The flourishing export trade is due to a good co-operative system, to which the Government contributes Â£555 annually towards poultry-breeding and the holding of exhibitions.

The customs returns of Germany must truly represent her imports, but obviously give little idea of her exports, since eggs are only given as exported in 1899 to the value of Â£23,900 (reckoning 1 mark = 1 shilling), whilst English imports from her are above given as amounting to Â£1,106,719. Her enormous imports of geese have already been alluded to; these come alive from Eussia, and in

1899 numbered 6,875,810, of the value of Â£978,350, all for home consumption. Other poultry and eggs are tabulated in quantities of 100 kilos, and were valued as follows : live fowls Â£508,350, other live poultry (than geese) Â£171,650, dead poultry Â£290,150, eggs Â£4,815,450, not far from the imports of England. It is clear, as was incidentally apparent before, that Ger- many is a large consumer

rather than a producer of poultry products, and chiefly a carrier of her nominal exports. She imports eggs from Italy and Austria- Hungary as well as from Eussia. These large imports may probably be profoundly affected by the new tariff legislation.

There are no domestic statistics for Austria-Hungary, but her trade in poultry and eggs is considerable. In

1900 the dual monarchy imported poultry to the value of Â£268,240 and eggs to the value of Â£1,2.30,655. But the exports of poultry amounted to Â£977,0.”’)1. and of eggs to no less than Â£.S,750,078. This country is therefore a very large producer, most of the eggs going to Germany, and some of them through her on to England.

Italy sends live fowls, for laying, to northern Europe, and some eggs to Belgium and France ; but no definite figures are accessible.

In Eussia the growth of the poultry industry has been very great since 1890. In that year her British trade was small : in 1900 we have seen that she bulked largest of all countries in eggs sent to England direct, and that some nominally from others really came from her. Her exports of eggs (reckoned as Â£1 = 10 roubles) were valued in 1898 at Â£3,113,386, and of live poultry (chiefly geese) at Â£637,000 ; but this latter sum is now exceeded by geese alone sent to Germany; as above noticed. Her vast southern provinces are, of course, the origin of this

produce, ~~which is collected by dealers from the farmers, the price realized by the latter for eggs being in summer sometimes less than a rouble per hundred. The Govern~~ ment has shown considerable interest in this growing industry in several ways, and produce is carried at almost incredibly low rates on the State railways ; but the vast distances involved must always confine Russian produce to the supply of the cheaper class of demand in western Europe.

For these details we are mainly indebted to the consuls-general of Germany and the Netherlands in London, to the British consuls

in Copenhagen, Antwerp, Vienna, and Berlin, and to varioas miscellaneous tables and returns, including those obtainable from the agents-general of the principal British colonies.

(l. wr.)

Povoa de Varzim, a seaport and bathing resort of Portugal, district of Oporto, 17 miles north of Oporto, on a small and ill-sheltered bay. The people, who are good seamen, are mostly engaged in fishing, 2644 persons and 649 boats being so employed in 1898, the value of the fish caught being Â£22,000. Population (1890),

12,067; (1900), 12,623.

POWER TRA^SMISSIOK

I. El/ECTBIC.

THE electric transmission of power may be briefly de- fined as the art of delivering electric energy at any desired point and there transforming it into mechanical energy. It therefore involves not only the design and con- struction of the delivery circuits and the generators which feed them, but the properties and the use of the electric motors which accomplish the transformation. As the former considerations are somewhat contingent upon the latter, it will be convenient first to discuss the properties of the electric motor in its various forms, and later the transmission systems as such.

Motors.

Fundamentally, electric motors are electric generators reversed in function: they convert into mechanical energy the continued stresses between two electro-mag- netic fields relatively movable, just as generators convert into electromagnetic stresses the mechanical energy applied to them. Since no transformation of energy is ever absolutely quantitative, the conversions just con- sidered are not accomplished without loss of energy to about the same extent in both cases. The sources of this loss are ohmic loss in the conductors, hysteresis, friction

of bearings and brushes, air friction, and eddy currents ; the sum of these losses in large modern machines does not exceed 6 or 6 per cent. The torque of the motor is the dynamical result of the electromagnetic stresses between the magnetic field of the motor and that due to the armature currents, the latter field being proportional to the strength of the current sheet due to the numerical strength of the current and the number of its effective convolutions. This applies to all types of motors, if one remembers that whenever either of these two factors is a periodic variable, as in the case of alternating motors, the torque is proportional to their geometrical co-directed product and not merely to their numerical product. At this point it will be convenient to distinguish between the various types of motors. The first broad distinction is between continuous-current and alternating-current motors, a distinction rather of convenience than of neces- sity, for in point of fact the two depend upon the same broad principles and ca;i be considered on precisely the same lines. Each class is composed of numerous possible types, of which comparatively few are in considerable use for the purpose of powertransmission, and of thesefew twoorthree go to make up the vast maj ority of those generally employed. Motors may be conveniently divided as follows : â€”

(A) Continuous Current.

1. Separately excited.

2. Series-wound constant current.

3. Series-wound constant potential.

4. Series-wound interdependent current and

potential.

5. Shunt-wound constant potential.

(B) Alternating Current.

1. Synchronous constant potential.

2. Induction-polyphase constant potential.

3. Induction-monophase constant potential.

Of these, the series-wound constant potential, shunt-wound constant potential, and polyphase induction motors do a very large proportion of the active work of power transmission : the first-mentioned furnish power for electric railways ; the second, power distribution from public electric supply stations ; while the third are mainly relied upon in long-distance transmission systems.

In class (A) in general, for a certain value of the torque current must be forced through the armature against the motor electromotive force which results from the rotation of the armature in a given field. This demands a certain greater applied electromotive force to produce the current required, which is determined by the effective electro- motive force, equal to the geometrical difference between the applied and motor electromotive forces, and by the im- pedence of the armature. For steady currents this is of course the same as the ohmic resistance, just as for steady electromotive force the geometrical and the numerical dif- ference of the applied and motor electromotive forces are coincident. The torque depends, as heretofore noted, on the field strength and the strength of the current sheet due to the current thus determined. For small values of the torque the speed practically depends upou the applied electromotive force and the field, so that if the former and the latter be constant the speed is also sensibly constant. This is likewise the case if the armature resistance be very small, and in general the variations of speed at constant potential are determined by the product of this resistance and the torque, while the absolute speed depends essentially upon the field strength. Motors for low speed or high electromotive force must have both a strong field and many turns upon the armature, so that both the fundamental stresses may be large. As the field is generally strong â€” to secure economy of iron â€” low-voltage and high-voltage machines differ principally in the num- ber of armature turns. For variable speed, this latter factor being fixed, field strength and applied electromotive force are the factors easily altered, and most of the speed variation is accomplished by changing one or

both of them. Torque is at a maximum when the current is the greatest possible at the given voltage â€” that is, when the motor is at rest. With a small armature resistance, this current is generally far too great for convenience; hence the motors are usually started with a rheostat in series with the winding if the current is not limited by the generator itself. The torque then depends on the sum of the resistances in circuit, and can be made just sufficient to start the motor under the required load. By the same device, the motor can run at reduced speed, although with a considerable loss of energy in the rheostat ; it is indeed, as a rule, diflcult to get effective speed variation in motors

of any kind without serious loss of energy. The field can be changed witliin wide limits only by a considerable increase of the iron in tlie magnetic circuit, the applied electromotive force cannot usually be varied except by increasing the re- sistances in circuit, and the number of armature turns cannot be varied without complication, although the effec- tive number can be modified by shifting the brushes, probably at the expense of sparking. Altogether, if the speed variation demanded be more than 16 or 20 per cent., it causes, in one way or another, considerable expense and trouble, particularly if each speed must be closely held irrespective of load. No large change in absolute speed can readily be made without considerable change in the percentage variation of speeds at various loads. Practically the best results are obtained from motors of very low armature resistance, in which the field or the applied electromotive force, or both, are varied. The whole problem is nearly identical with the production of constant potential or constant current from generators driven at constant speed, and is solved by similar means. For any one absolute speed a generator can be made to give constant potential, nearly irrespective of load, by compound winding. Similarly, a motor may give a very nearly constant speed at constant potential by a differen- tial winding in series with the armature, weakening the field as the armature current rises. This

device, how- ever, obviously increases the energy required for magneti- zation, and decreases the effective torque at starting. Practically the best continuous-current motors can be made to hold their speed to within 1 or 2 per cent, from no load to full load. Commercial machines, however, generally vary from 5 to 10 per cent, in speed. With respect to the direction of rotation of a motor, the torque changes sign with a change of sign in either field or arma- ture current, but not with a change of sign in both. The input of the motor is numerically equal to the product of the current and the applied electromotive force, while the output is determined by the product of the current and motor electromotive force ; hence the efficiency of the motor, as a transformer of energy, is the ratio between these two quantities. The output is a maximum when the applied electromotive force is double the motor electromotive force, and the efficiency is a maximum when the motor and applied electromotive forces are substantially equal. At the point of maximum output, the speed is that sufficient to reduce the current to one- half its static value. ISTo motor is worked at or near this point, except momentarily, on account of the low effi- ciency and severe heating in the armature. These theoretical values are slightly modified in practical ma- chines by the small miscellaneous losses subject to inde- pendent variations.

(A) 1. Separately excited Motors are seldom used in power- transmission work, but they are interesting prin- cipally on account of the very efficient method of speed regulation possible by their use. In this method the field of the motor is excited from the supply mains, and the armature current is furnished by a motor-generator run- ning at constant speed. A rheostat in the shunt field of the latter element enables the applied electromotive force to be varied to any desired extent, and hence the working motor can be given full torque at any speed up to that assigned by the ;naximum value of the electromotive force which can be applied to the armature. Moreover, if the armature resistance be small, the motor is fairly self- regulating at all speeds. The effect is rather startling, since the motor may be giving a very great torque when it is merely turning over at a few revolutions per minute ; and although the process is complicated, it leads to excellent results.

(A) 2. Series-wound Constant-current Motors were early

worked to a considerable extent on arc-light circuits, but have now passed out of use save in a small number of con- stant-current power-transmission systems on the continent of Europe. In these motors the motor electromotive force is directly proportional to the output, the torque being constant. They will not start with more than a certain definite load, but once started, the speed will increase until added work (internal or external) balances the torque. The type is intrinsically bad in speed regulation, and must be treated by the same methods as are adopted to secure constant current in arc machines. The most successful device in most cases is to vary the field strength by shunt- ing the field coils, or to vary the number of effective arma- ture conductors by shifting the brushes. Both methods are carried out mechanically rather than by purely elec- trical means â€" in the first case by an automatic rheostat, and in the second by an automatic brush shifter â€" but neither is wholly satisfactory.

(A) 3. Series-ivound Constant-potential Motors comprise nearly all motors used for electric traction â€" aggregating not lesfe, probably, than one million horse-power ; hence they are of great practical importance. These traction motors are usually highly specialized machines with very powerful armatures, and fields strongly saturated at all working values of the current. The brushes ha^e an in- variable position. Such motors behave much like sepa- rately excited motors having a rather large armature resist- ance. Speed regulation has to be obtained by varying the applied electromotive force. In early traction motors this variation depended upon inserting a rheostat ; in modern practice it is customary to employ two or ev^n four identical motors on each car, operated in series for low speeds and in parallel for full speed. In practice, however, resistances are inserted when necessary to prevent too sudden changes of speed, and to secure intermediate steps between those obtained by the series-parallel connexions. In rare instances a still further variation is secured by the use of a field only partially saturated at ordinary loads.

(A) 4. Series-u-ound Motors with Interdependent Current and Potential are used only in connexion with generators of similar design, motor and generator forming a dynamical unit. This system is occasionally used with good results in power transmission. Assuming the motor field to be saturated, if the speed is to be constant the applied electromotive force must rise with the load to an amount depending on the resistances in circuit. If the correspond- ing generator has a field less fully saturated, the increase in current demanded by the increment of torque in the motor can be made not only to raise the applied electromotive force enough to compensate for armature resistance, but for the total resistances in circuit, including the line. With this difference in saturation, the motor will auto- matically maintain constant speed. The fields of the ma- chines need not be designed for a given saturation, since shunting them with a suitable resistance will give the same result.

(A) f). Shunt-wound Jfotors at Constant Poteutial are the mainstay of continuous-current distributions for industrial purposes. At constant potential the field remains sensibly constant, and the torque is directly pro- portional to the current. The motor then behaves much like a separately excited motor, and the armature resist- ance being generally very small, the speed is very nearly constant, varying less than 5 per cent, from no load to full load in the best commercial machines. Operating on a compound-wound generator a single motor of this type can be made to regulate with great precision, as in the pre- vious case. If the motor field be only moderately satu- rated, its strength, and hence the motor electromotivi? force, rises and falls with the applied electromotive force ; and therefore at constant load these motors run at very nearly

constant speed, in spite of small variations of voltage. If speed variation be required, it can be obtained to a moderate extent by a rheostat in the

field circuit. At starting, a rheostat is necessary in the armatu’re circuit. The differentially wound modification is now seldom used.

(B) 1. Synchronous Alternating-current Motors. â€” The simplest starting-point in the consideration of this class is the continuous-current generator. This machine actually generates within the armature alternating cur- rents ; and if the commutator be replaced by two or more slip-rings connected symmetrically to two or more points on the armature winding, alternating currents, monophase or polyphase, according to the number of connexions and the points touched, can be withdrawn therefrom. The simplest case involves only two slip-rings, joined to the winding at diametrically opposite points. Consider two such modified machines as motor and generator. The condition of complete reversibility is that the instantar neous values of the currents, and the instantaneous values of the angular displacements between poles and armature coils, shall be equal throughout. This evidently requires that the rotation of the motor should be synchronous, pole for pole, with that of the generator. Here, as be- fore, the torque depends on the two fundamental stresses, but the torque has no determinate sign in the absence of an initial rotation. The instantaneous value of the torque depends on the instantaneous value of the current and on its angular displacement. The speed of the motor being invariable, its motor electromotive force depends only on the effective excitation, including the armature reactions, and it may or may not, according to the condi- tions of load, be in phase with the impressed electromo- tive force. In the case of the continuous-current motor, the motor output is numerically equal to the product of current and motor electromotive force ; and since, in the alternating circuit, these quantities are usually not in phase, in alternating motors the activity is determined by the co-directed part of their product. The current in the alternating motor depends, not on the ohmic resist- ance, but upon the impedance, and upon the geometrical difference between the applied and motor electromotive forces. At a given applied electromotive force and an armature impedance assumed constant, the fundamental variables in the motor are the output, motor electromo- tive force, and motor current. The two last factors are interdependent, so that the current may have a wide range of values, according to the

excitation, while the output remains constant, or itself remaining constant, may cover a variety of values of the power correspond- ing to different excitations. These changes involve changes in the phase angle between the motor electro- motive force and the current, so that, at given output, the power-factor of the motor â€” that is, the ratio between the numerical and geometrical products of current and electromotive force â€” may be given various values at will by changing the field excitation of the motor, a most unique and valuable property. If the motor electromo- tive force be fixed and the output varied, the phase angle between current and motor electromotive force varies by reason of the armature taking up a new angular position with respect to the field, backward for increasing load, forward for decreasing load. The minimum value of the current for a given load is reached when the excitation is such that the applied electromotive force and current are in phase, at which point the real and the apparent energy in the circuit coincide. The input can then be accurately measured by voltmeter and ammeter readings, and the motor is working at its best efficiency for the given load. Por greater values of the motor electroniotive force, the current leads in phase with respect to the applied electromotive

force ; for less values it lags. Theformer conditionis accom- panied by the rising of the eleptromotive force at the motor terminals, the latter by its fall. It therefore becomes pos- sible to use a synchronous motor, if the necessary current due to the load be not too great, as a voltage and phase regulator upon an alternating circuit, a function very valu- able in power-transmission work. If the excitation be set to produce leading phase at small loads, the phase angle will gradually diminish as the load rises, and then, passing through zero, increase again with the lagging current, thus holding the power-factor near to unity at all working loads. In a well-designed synchronous motoT, by proper initial adjustment of the field, the power-factor can easily be kept between 0-95 and 1 from quarter load to full load, and very close to unity within the ordinary working range. Save for its inability to start, the synchronous motor is a highly desirable addition to a transmission system. Starting is generally accomplished by the help of an induction motor or other auxiliary power, and the motor is treated exactly like an alternator to be thrown in parallel with the supply circuit. A

synchronous motor will pull itself up to synchronism if brought near to its synchronous speed, but this requires a very large amount of current. Operating from a generator of its own, it can be brought to speed by giving it a small initial rotation and raising the generator speed very carefully and gradually, when the two machines will accelerate in synchronism. Polyphase synchronous motors obey these same general laws ; they can, however, be started as quasi-induction motors with an open field circuit, the pole faces serving as secondary conductors, but require so large currents in thus starting themselves that it is better practice to bring them to speed by extraneous means.

Synchronous motors sometimes cause serious trouble by ” pumping,” a phenomenon closely allied to the surging of current between alternators in parallel, and due to similar causes. If not due to defective governing of the prime mover, it usually starts with a change of load or of phase, producing fluctuations in the electromotive force in the system great enough to interfere seriously with incandes- cent lighting, and continuing with uniform amplitude and frequency for hours if unchecked. The amplitude varies with the conditions, but in the same machine the frequency is nearly constant. The fluctuation affects both the armature and the field circuits, but it can as a rule be controlled by varying the excitation until aneutral point is found, usually when the phase angle is near to zero. Motors with solid pole pieces give little trouble of this sort, the oscillations being rapidly counteracted by the eddy currents. In motors with laminated fields, the most effective remedy is chamfering away the edges of the pole pieces so as to admit heavy copper shoes running along and under the edges, and even bridging the spaces between the pole pieces. The eddy currents in these shoes com- pletely check the ” pumping.”

Rotary Conveners. â€” These are, in effect, synchronous motors, and have the same general properties so far as their motor functions are concerned. When practicable, it is desirable to start them from the continuous-current side ; otherwise, through auxiliary motors.- They often show an inclination towards “pumping,” and, as in all parallel working of alternators and in synchronous motor practice, they work

best when all the machines involved have similar characteristics, and, as nearly as may be, the same form of electromotive wave.

(B) 2. Polyphase Induction Motors. â€” Speaking broadly, an induction motor is one in which the armature current is introduced into the armature windings by electromagnetic induction instead of by brushes. It is at once an alter- nating current transformer and an alternating current motor, operating in the latter function by virtue of the

current received from the former. In the commonest form the alternating currents are of two or more phases interacting in carrying on these duplicate functions. Induction motors consist of two concentric masses of laminated iron taking the form of short hollow cylinders, of which the outer is fixed and the inner fitted to re- volve. The outer surface of the inner drum and the inner surface of the outer drum are slotted or perforated, to receive the primary and secondary windings of the apparatus. The outer winding is usually the primary, and the inner (or armature) winding the secondary. The primary winding is almost universally a multipolar drum in character ; the secondary is, in the most highly developed motors, of the same character, but very often consists merely of numerous insulated armature bars united at each end of the drum by a common end-plate or end-ring, forming the structure usually known as a “squirrel-cage” winding. In polyphase motors of the usual type the primary drum winding is in duplicate or triplicate, resembling very closely the armature winding in a two- or three-phase generator. The actions which go on in these motors have been the subject of much debate ; most of the theoretical discussions of the matter have been based upon the concept of a rotary magnetization produced by two simple sinusoidal mag- netisms superimposed in quadrature upon the same core, or in the case of a three-phase motor, three superimposed in a similar symmetrical manner. This hypothesis is often most convenient, being merely an application of the general

physical thesis that two equal simple harmonic motions in quadrature produce circular motion, as in the case of the conical pendulum. All the results of this hypothesis follow, however, from the introduction of two alternating magnetizations, acting in quadrature in time but independently ; and one or the other view of the matter is convenient according as, in the structure considered, the effective magnetizations do or do not produce a definite physical resultant. There is no discrepancy between the two hypotheses ; they are merely two points of view of the same phenomena. In the general case, one need make no supposition as to the existence or non-existence of the physical resultant rotary magnetization ; it is merely necessary to note that if one phase-winding predominately produce a magnetic field, and the other a current in the rotary member fitted to react with that field, torque will result, whether the two phase-wind- ings act upon the same magnetic structure, or upon two en- tirely separate magnetic structures merely connected by the leads which deliver current from one to the other.

Induction motors having both these forms of structure are in successful use. If one considers the latter case, the two phase-windings have exchanged functions every 90 degrees in the two-phase structure, each phase-wind- ing serving to produce a magnetic field and to deliver, almost as if it were merely a pair of brushes, current to react with this field alternately, and the two halves of the motor structure exchange functions every 90 degrees. Considering the motor in which the two phase- windings are superimposed on the same core, there is a virtual magnetic resultant rotating at a speed deter- mined by the frequency of the current and the number of poles, and setting up induced currents in the secondary member, which currents are so disposed as to react with the field to produce rotary motion. At rest, the second- ary electromotive force produced by the machine as a transformer is a maximum ; when the motor is running at speed, unloaded, it is a minimum, and an increment of load causes the secondary member merely to slip behind synchronous speed far enough to receive an increment of transformed energy sufficient to carry the new load. If the secondary member is of very low resistance, the |

slip behind synchronism is very small even at full load, less than 2 per cent, in motors developed for this particular property. An increase of secondary resistance produces increased falling behind from synchronous speed; and if resistance be added to the secondary member by interpolating rheostats in its circuits, the motor can be made to produce uniform torque over a very wide range of speed, as is the case with continuous current motors. The percentage of slip is the percentage of energy lost in the secondary member, as likewise in continuous-current motors if one regards their synchronous speed as that at which tdie motor electromotive force would equal that impressed. Polyphase induction motors start, when properly designed, with a very powerful torque, even up to three or four times the full load running torque of the same motor. With a very low-resistance secondary member, this torque demands an immensely large current, the structure acting almost like a short-circuited trans- former, and the lag in the secondary circuit is considerable. In motors in which this large starting current is objection- able, it may be reduced very greatly by interpolating resistances in the secondary circuits at starting, the effect of these being to diminish the lag in the secondary circuit and to decrease the demand for primary current. A certain critical value of this resistance gives a maximum torque per ampere in the primary circuit. Where a small primary current in starting is of considerable importance, this extra resistance is frequently introduced at starting and cut out afterwards, particularly in cases where large torque is necessary. If great starting torque is not neces- sary, the primary electromotive force is often diminished by inductive resistances, or a change in the connexions of the transformer from which the motor isfed. Bothmethods of starting are in commercial use on a very large scale.

In efficiency and closeness of speed regulation and good general running properties, polyphase induction motors approximate very closely to the best continuous-current practice. They produce, however, a certain amount of lag between primary electromotive force and current, which causes the apparent input to be larger than the real input, as often happens in alternating current work. The ratio between the real and the apparent watts input is the power- factor of the motor.

In well-designed modern machines this is usually from 85 to 90 per cent, at rated load; it should seldom fall below the former figure, and rarely rises more than 1 or 2 per cent, above the latter, though in rare instances power-factors as high as 94 or 95 per cent, have been obtained. Condensers have sometimes been employed in connexion with such motors to increase the power-factor, and with considerable success, particularly in maintaining the power-factor at low and moderate loads, but their use is generally unnecessary. The weakest point in these polyphase induction motors is the impor- tance of. employing a very small clearance between arma- ture and field, in order to increase the power-factor by making the structure more efficient, considered merely as a transformer. The clearances in ordinary use are seldom greater than one-sixteenth of an inch even in motors as large as one hundred horse-power, and in smaller machines are frequently not more than one thirty-second of an inch. Induction motors, however, possess many valuable properties, and are the mainstay of long-distance power- transmission work at the present time.

(I!) ,'!. Monophase Induction Motors closely resemble the polyphase motor in construction, but have only a single- phase winding in the primary. T'he theories of their action are very similar to those of polyphase motors. The essential point of difference is that the stable angular dis- placement between the field magnetization and the armature currents which co-act ^^ith it is obtained in the polyphase motor by the time-displacements in the several phase

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windings, while in the single-phase motor it is obtained by the angular space-displacement of the armature, which has to be set up by an initial rotation. Single-phase motors therefore are not inherently self-starting, and run in either direction equally well when once started. The torque is always in the direction of the initial rotation. This rotation is

sometimes given by hand and sometimes by auxiliary phase-windings supplied by derived current from the main circuit, or merely short-circuited on them- selves and receiving induced currents from the main winding. Both these devices give a small initial torque in a definite direction. Once up to speed, the single- phase motors act much like the polyphase. They are conspicuously weak in the matter of power-factor, how- ever, as well as in that of starting-torque, and have as yet not come into very extensive commercial use, although under special conditions they have been and are success- fully employed. A theoretically interesting form of induc- tion motor is a modification which runs at absolutely synchronous speed, receiving the necessary energy in the secondary not in virtue of slip behind synchronous speed, but from great difference in wave form between the pri- mary and secondary circuits, so that energy is periodically received by the armature in spite of synchronism in speed. Such motors are not employed commercially, but some- times find a field for usefulness in the laboratory.

General Methods of Power Transmission.

The largest single department of power transmission â€" that is, transmission for traction purposes â€" is at present almost wholly carried on, as has already been indicated, by continuous currents. The usual voltage is 500 to 600, and the motors are almost universally series-wound constant-potential machines. The total amount of such transmission in daily use reaches almost to a million horse-power. In power transmission proper continuous currents are not used to any considerable extent, owing mainly to the difficulty of generating continuous currents at sufB.cient pressure to be available for long-distance work, and the difficulty of reducing such pressure, even if it could be conveniently obtained, far enough to render it available for convenient distribution at the receiving end of the line. Single continuous-current machines have seldom been built successfully for more than about 2000 volts, if at the same time they were required to deliver any considerable amount of current. About 200 kilowatts per machine at this voltage appears to be the present limit. For distances at which more than this very moderate voltage is desirable, one must

either depend on alternating currents or use machines in series. In American practice the former alternative' is universally taken. On the continent of Europe a very creditable degree of success has been achieved by adopting the latter, and plants upon this system, aggregating some- thing like 20,000 horse-power, are in use, mostly in Switzerland. In these, generators are worked at constant current, a sufficient number in series being employed to give the necessary electromotive force. They have usu- ally had a total voltage of less than 10,000, although in one instance the plans call for about double this figure. These systems are, however, characterized by the fact that the full working pressure is only carried at extreme load, and under ordinary conditions of working this is greatly reduced. They are subject, however, to a very grave inconvenience in the utilization of the power trans- nnitted ; and in the present state of the art of insulation, both in machines and lines, the advantages of the system are not generally conspicuous, although in particular cases it may be of material service.

The great bulk of power transmission all over the world is at the present time carried on by the use of polyphase

alternating currents. The alternating current, as such, possesses for this purpose conspicuous advantages. In the first place, whatever the voltage of transmission, the voltage of generation and that of distribution can be brought within moderate limits at a very high degree of efficiency by the use of transformers ; and, in the second place, it is possible to build alternating-current generators of any required capacity, and for voltages high enough to permit the abolition of raising trans- formers except in unusual circumstances. At present such generators, giving 10,000 to 12,000 volts directly from the armature windings, are in common and highly successful use in America and elsewhere ; and while the use of raising transformers is preferred by some en- gineers, experience shows that they cannot be consid- ered essential, and are probably not desirable for the voltages in question, which are as great as at the present time seem necessary for the vast majority of transmission plants. But for very large transmission work to consid- erable distances where still higher

voltages are requisite, such transformers cannot be dispensed with. Alternat- ing currents are practically employed in the polyphase form, on account both of increased generator output in this type of apparatus, and of the extremely valuable properties of the polyphase induction motors, which fur- nish a ready means for the distribution of power at the receiving end of the line. As between two- and three-phase apparatus, the present practice is about equally divided ; the transmission lines themselves, however, are, with rare exceptions, worked three-phase, on account of the saving of 26 per cent, in copper secured by the use of this system. Inasmuch as transformers can be freely combined vectorially to give resultant electromotive forces having any desired magnitudes and phase relations, the passage from two-phase to three-phase, and back again, is made with the utmost ease, and the character of the generating and receiving apjjaratus thus becomes almost a matter" of indifference. As regards such apparatus, it is safe to say that honours are about even : sometimes one system proves more convenient, sometimes the other. The difficulty of obtaining proper single-phase motors for the purpose of general distribution has so far prevented any material use of single-phase transmission systems.

Generators for Power Transmission.

The generators are usually large two- or three-phase machines, and in the majority of instances they are driven by water-wheels. Power transmission on a large scale from steam plant has, up to the present, made no substan- tial progress. The size of these generators varies from 100 to 200 kilowatts in small plant up to several thousand in the larger ones. The voltage of the generators varies greatly. When rising transformers are used, it is usually from 600 to 2000 volts ; without them, the generators are usually wound for 10,000 or 12,000 volts. Intermediate voltages have sometimes been employed, but are rather passing out of use, as they seem to fulfil no particularly useful purpose. The tendency at the present time, what- ever the voltage, is towards the use of machines with sta- tionary armatures and revolving field magnets, or towards a pure inductor type having all its windings stationary. At moderate voltages such an arrangement is merely a

matter of convenience, but in high-voltage generators it is practically a necessity. Low-voltage machines are usually provided with polyodontal windings, these windings having several separate armature teeth per pole per phase, while the high-voltage machines are generally monodontal ; in both classes the edges of the pole pieces are usually chamfered away in such form as to produce at least a close approxi- mation to the sinusoidal form for the electromotive force. For this purpose, and to obtain a better inherent regulation

under variations of load, the field magnets are, or should be, particularly powerful. In the best modern generators the variation of electromotive force from no load to full load, non-inductive, is less than 10 per cent, at constant field excitation. Closeness of inherent regulation is an important matter in generators for transmission work, inasmuch as there is as yet no entirely successful method of automatic voltage regulation on very large units ; and the less hand regulation the better. Moreover, the design which secures this result also tends to secure stability of wave form in the electromotive force, a mat- ter of even greater importance. There has been much discussion as to the best wave form for use on alternat- ing circuits, it having been conclusively shown that the siniisoidal wave does not give the most economical use of iron in the transformers. For transmission work, however, particularly over long lines, this is a matter of inconceivably small importance compared with the stability and the freedom from troubles from higher har- monics that result from the use of a wave as nearly sinus- oidal as can possibly be obtained. In every alternating circuit the odd harmonics are considerably in evidence in the electromotive force, either produced by the structure of the generator or introduced by the transformers and other apparatus. These are of no particular moment in work upon a small scale, but in transmission on a large scale to long

distances they are, as will be seen in the consideration of the transmission line itself, a serious menace, the gravity of which is just coming to be fully realized. Inasmuch as the periodicity of an alternating circuit must be maintained sensibly constant for success- ful operation, great care is usually exercised to secure such governing of the prime movers as will give constant speed at the generators. This can now be obtained, in all ordinary circumstances, by several forms of sensitive hydraulic governors which are now in use. The matter of absolute periodicity has not yet settled itself into any final form. American practice is based largely upon 60 cycles per second, which is probably as high a frequency as can be advantageously employed. Indeed, even this leads to some embarrassment in securing good motors of moderate rotative speed, and the tendency of the frequency is rather downward than upward. An inferior limit is set by the general desirability of operating incandescent lamps off the transmission circuits. For this purpose the fre- quency should be held above 30 cycles per second ; below this point, flickering of the lamps becomes very serious â€"so serious, indeed, as practically to prohibit their suc- cessful use â€" and plant installed for such low frequencies is generally confined to motor practice, or to the use of rotary converters, which are somewhat easier to build in large units at low than at high periodicities. Nearly all the work of power transmission, however, is carried on between 30 and 60 cycles per second. The inferior limit at which it is possible to operate alternating arc lamps is about 40 cycles ; and if these are to be and to remain an important feature in transmission systems, the indications are that practice will tend towards a periodicity of between 40 and 50 cycles per second, at which all the accessory apparatus can be successfully operated.

Transmission Lines.

Power transmission lines differ from those used for gen- eral electric distribution principally in the use of higher voltage and in the precautions entailed thereby. The' economic principles of design are precisely the same here as elsewhere, save that the conductors vary less in diame- ter and far more in length. Inasmuch as transmission systems are frequently installed prior to the existence of a well-developed

distribution system, the conditions of load and the market for the power transmitted can sel-

dom be predicted accurately ; consequently, the cases are very rare in which Kelvin's law can be applied with any advantage ; and as it is at best confined to determining the most economical conditions at a particular epoch, this law is probably of less use in power transmission than in any other branch of electric distribution. A superior limit is set to the permissible loss of energy in the line by the difficulty attending regulation for constant poten- tial in case the line loss is considerable. The inferior limit is usually set by the undesirability of too large an investment in copper, and lines are usually laid out from the standpoint of regulation rather than from any other. In ordinary practice, it seldom proves advantageous to allow more than 15 per cent, loss in the line even under extreme conditions, and the cases are few in which less than 5 per cent, loss is advisable. These few cases comprise those in which the demand for power notably overruns the supply as limited by the maximum power available at the generating station, and also the few cases in which a loss greater than 5 per cent, would indicate the use of a line wire too small from a mechanical stand- point. It is not advisable to attempt to construct long lines of wire smaller than jSTo. 4 American wire-gauge (â€¢204 inch diameter), although occasionally wire as small as No. 6 (-162 inch diameter) may safely be employed. The vast majority of transmission lines are composed of overhead conductors. In rare instances undergroundcables are used. In single-phase work these are preferably of concentric form, which, however, gets too complicated in the three-phase lines, generally employed to secure economy in copper ; for the latter, triplicate cables lead sheathed, laid in glazed earthenware ducts, seem to give the best results. â€¢ On account of the cost and the difficulty of repair of such lines, they are not extensively used, and cables have not yet been produced for the extremely high voltages desirable in some very long circuits. As to the material of the conductors, copper is almost universally used. For very long spans, however, bronze wire of high tensile strength is occasionally employed as a substitute for cop- per wire, and more rarely steel wire ; aluminium too is beginning to come into use for general line work. Bronze of high tensile strength (say

80,000 to 100,000 fib per square inch) has unfortunately less than half the conduct- ivity of copper ; and unless spans of several hundred feet are to be attempted, it is better to use hard-drawn copper, whii^h gives a tensile strength of from 60,000 to 65,000 lb to the square inch, with a reduction in con- ductivity of only from 3 to 4 per cent. As to aluminium, this metal has a tensile strength slightly less than that of annealed copper, a conductivity about 60 per cent, that of copper, and for equal conductivity is almost exactly one- half the weight. Mechanically, aluminium is somewhat inferior to copper, as its coefficient of expansion with tem- perature is 50 per cent, greater ; and its elastic limit is very low, the metal tending to take a permanent set under com- paratively light tension, and being seriously affected at about half its ultimate tensile strength. Joints in alumi- nium wire are difficult to make, since the methods of solder- ing amount to little more than cementing the metal with the flux; in practice the joints are purely mechanical, being usually made by means of tight-fitting sleeves forced into contact with the wire. “Willi great caution in stringing, aluminium lines can be successfully used, and are likely to serve as a useful defence against increase in the price of copper. Overhead lines are most commonly strung upon wooden poles, set generally fifty to the mile ; a pole forty feet long set seven feet in the “earth is a far vourite size in American practice. The conductors are sys- tematically transposed, to suppress inductive disturbances; or if, as usually, they are worked three-phase, the three- wire system is often disposed at the vertices of an equi-

electric]

lateral triangle, and the transposition is effected by spi- raling the lines in cyclic order. The distance between wire and wire is usually from 18 to 24 inches â€” at extreme voltages, more. The insulators are of a rather large triple-petticoat design, of porcelain or glass ; the former material, when thoroughly vitrified, has the greater mechanical strength, and is less likely to weather on the surface from protracted

use, but glass insulators are more uniform in quality, less subject to inherent electric and mechanical defects, and moreover are materi- ally cheaper.

Voltage. â€” The most important factor in the economy of the conducting system is the actual voltage used for the transmission. This varies within very wide limits. For transmissions only a few miles in length, the press- ures employed are generally from 2000 to 6000 volts, but for the serious work of power transmission less than 10,000 volts are now seldom used. This pressure, under all ordinary conditions and in all ordinary climates, can be and is used with complete success, and apparently with- out any greater difficulty than would be encountered at much lower voltage. It is regarded as the standard transmission voltage in American practice for distances up to 20 or 25 miles. Beyond this, and sometimes even on shorter lines, it is greatly increased; up to 20,000 volts there seems to be no material difficulty whatever in effecting and maintaining a sufficient insulation of the line. Forty thousand volts is in successful use on two or three American transmission systems without any serious difficulty having been encountered. The longest transmission yet attempted commercially â€” that of 1000 kilowatts from Colgate, California, to Stockton, Cali- fornia, 218 miles (via Mission San Jose) â€” is at 40,000 volts, the line being three-phase at 60 cycles per second ; and on this system there has been no more trouble in maintaining the insulation of the line than would be met in ordinary working at one-tenth the voltage in question. Above 40,000 volts the situation is complicated by a tendency towards breaking down of the air as a dielectric, and the establishment of serious leakage or even actual arcs between wire and wire. With a wave form very closely sinusoidal, transmission at 60,000 volts may be successfully accomplished ; but small variations from a sinusoidal wave make themselves felt seriously, in an increase of the tendency to leakipg and arcing. The lines become self-luminous at a little above 20,000 volts, and at 40,000 or 50,000 volts the phenomenon, which is often closely connected with resonance, becomes of a striking, not to say startling, character.

Resonance, in substance, is due to synchronism of tlie periodic electromotive force, or a harmonic thereof, with the electro- magnetic time-constant of the system. The frequency of the currents actually employed in transmission work is so low that resonance with the fundamental frequency must be extremely rare ; resonance with the harmonics is, however, common â€" much com- moner than is generally supposed. In every electromotive force wave the odd harmonics are more or less in evidence, particularly the 'third, fifth, and seventh. If the electromotive force wave departs notably from a sinusoidal form, traces of harmonics up to at least the 15th may generally be found; the third, seventh, and the alternate higher harmonics are manifest in flattening the crest of the wave. Supposing, what is seldom quite true, that the harmonics are symmetrically disposed in phase with the funda^ mental, all the harmonics tend somewhat to elevate the shoulders of the wave ; a wave, therefore, with peaked shoulders and a depression in the centre is certain to be affected by harmonics, while if it has a high central crest, there is evidence of great predominance of the fifth and higher harmonics. Generally the harmonics are slightly out of phase with the fundamental, so that the wave is both deformed and unsymmetrical. As to the ampli- tude of these harmonics, , the third is usually the largest, and may sometimes in commercial machines amount to as much as 20 per cent, of the amplitude of the fundamental, and frequently 10 per cent. In machines giving nearly sinusoidal waves, it is of course much less, but it is not difficult to find even the seventh

and higher harmc)fiics producing variations as great as 5 per cent. Since, other things being equal, the rise in electromotive force due to resonance is directly proportional to the magnitude of the harmonics, and the chance of getting it mcreases rapidly with the presence of those of the higher orders, the desirability of using the closest possible approximation to a sinusoidal wave is self- evident. The greater the inductance and capacity of the system and the less its ohmic resistance, the greater the chance of ^ getting serious resonance. As regards the distributed capacity and inductance due to the line alone, the ordinary conditions are not at all formidable; the general effect of such distributed capacity and inductance is to produce in the system a series

of static waves, their length varying inversely with the frequency. At commercial frequencies the wave length is very great, so great that even in the longest lines at present employed, only a small fraction of a single wave length appears ; the total length of the Ime is generally less than one quarter the complete wave length, and the only notable effect is a rise of potential along the line. The time constant of the alternating circuit is

T= ~~00629 VLC where L is the inductance in henrys and C the capacity in micro~~ farads ; and if the frequency, or a marked harmonic thereof, coincide with this time-period, resonance may safely be looked for, and resonance of the harmonics may appear conspicuously in lines of ordinary lengths. The following table gives the values, both L and C, per mile of line, of the sizes (American wire-gauge) ordinarily employed for transmission circuits, the wires being assumed to be strung 18 inches apart and about the height already indicated : â€" Size No. Diameter (inch). L. C.

0000 -460 1-48 -0102

000 -410 1-52 -0099

00 -365 1-56 -0097

0 -325 1-59 -0095

1 -289 1-63 -0093

2 -258 1-67 -0090

3 -229 1-71 -0088

4 -204 1-74 -0088

5 -182 1-78 -0084

6 -162 1-82 -0083

In cases where underground cables form a part of the system, the above values are likely to be very largely increased, and the prob- ability of resonance is in proportion enhanced. A still further complication is introduced by the capacity and inductance of the apparatus used upon the system, which may often be far greater than that due to the entire line, even if the latter be of consider- able length. In point of fact, it is altogether probable that resonance due to the distributed capacity and inductance of the overhead line alone is of rare occurrence and generally of trivial amount, while it is equally probable that resonance due to capacity and inductance other than that of the line conductors may, and often does, cause very serious disturbances upon the system. The subject has never been adequately investigated, but the tendency towards formidable sparking and arcing at various points on long- distance transmission systems is generally far greater than can be accounted for by consideration of the nominal voltages alone. The conditions may be still further complicated by the effect of earths or open circuits, which sometimes may produce, temporarily, appalling resonance phenomena, through bringing into action the capacity and inductance of the apparatus. In ordinary working the resonance of the harmonics is not very conspicuous, and the fact that it occurs not systematically, but only in special ways and under special conditions, indicates more strongly than anything else that the vital point is not the time-constant of the line alone, but those of the apparatus connected thereto. A definite and persistent tendency towards resonance may sometimes be effectively checked by the introduction of suitable inductance in the parts of the system most seriously affected, but the best general policy is to avoid as far as possible the presence of the higher harmonics which are the chief sources of danger.

Maintenance. â€” Generally speaking, a transmission line is rather less than more difficult to maintain than an equal amount of distribution system, for it generally encounters fewer sources of trouble. Transmission lines are, when practicable, laid out through open country, and along roads which furnish easy access for inspection and repairs. The chief sources of danger in temperate cli- mates are mechanical injury from the falling of branches of trees across the

circuits, sleet and wind storms, and lightning. The first-mentioned difficulty may be avoided by keeping clear, so far as possible, of wooded country, and it should be remembered that, at the voltages custom- arily used for transmission, a twig the size of a lead-pencil,

falling across the wires, may set up arcing, and it will end by burning the wires completely off â€” not directly by fusion, but by persistent arcing. A properly con- structed overhead line is practically safe against all storms, save those of most extraordinary violence, and with care may be made secure even against these. As a matter of practice, interruptions of service upon trans- mission systems are very rarely due to trouble upon the main line itself, but are far more likely to occur in some part of the distributing system. The most dangerous combination of circumstances is a sleet storm sufficient to coat the wires with ice, followed by heavy winds ; if the line, however, is constructed with proper factors of safety, bearing this particular danger in mind, there need be very little fear of serious results. Lightning is a much more formidable enemy. The lightning dis- charges observed upon electric circuits are of two general descriptions : â€” first, a direct discharge of lightning upon the line, more or less severe, and always to be dreaded ; and secondly, induced discharges due to lightning flashes which do not hit the line, or to static disturbances which may or may not produce actual lightning. Discharges of the former class are vastly more severe than those of the latter, and, fortunately, are somewhat rare. They may actually shatter the line, or may distribute them- selves along it for a considerable distance, leaping from wire to pole, and thence to earth, without actually damaging the line to any marked degree. The induced discharges are felt principally in the apparatus, caus- ing many of the burn-outs observed in transformers and generators. There is no complete protection against the effects of lightning upon the apparatus. The best lightning arresters are palliatives rather than preven- tives. If, however, a number of

arresters are put in parallel, with reactance coils between them on the way towards the apparatus, the vast majority of lightning discharges, to whatever cause they may be due, will be deflected harmlessly to earth. Moreover, the appara^ tus itself has a considerable power of resistance, due to its high insulation. The ends of the line should be very thoroughly protected by such lightning arresters, and other points, such as prominent elevations along the line, should receive similar additional protection. In some cases a strand of barbed wire, stretched along the tops of the poles, and well grounded at frequent intervals, has been found very advantageous. With the best protection at present available, lightning is not a serious menace to continuity of service, and the apparatus of the distribut- ing system is far more difficult to protect than the main line and its apparatus.

Sub-stations. â€” In most long-distance transmission work, the transmission line itself terminates in a sub-station, which bears to the general distribution system precisely the same relations which are borne by a central electric supply station to its distributing lines. Such a sub-station should be treated, in fact, as a central station, receiving its electric energy from a distance instead of employing local generators driven by prime movers. The design of the sub-station, however, is somewhat different from that of the ordinary central station. The transmission lines terminate generally in a bank of reducing transformers, bringing the voltage from the 10,000 or L‘0,000 employed upon the line to the 1000 or 2000 used in the distribu- tion. These transformers are usually large, and their magnitude should be determined by the same considera- tions which apply to determining the size of the units to be employed in a generating station. The general rule to be followed is that the separate units shall be of such size that one of them may be dispensed with without serious inconvenience. In the case of transformers, the unit in two- or three-phase working is the bank of trans-

formers which must be used together. In Continental practice three-phase reducing transformers are frequently made to include all three phases in a single structure; this practice is not followed in American plant, separate transformers being used in each phase. In this case, two

or three transformers, according as the two- or three- phase system is used, constitute a single transformer unit in the sense just mentioned. If a change is to be made from three-phase line to two-phase distribution, the change is made by the appropriate vector connexion of the transformers. In any case, the sub-station is furnished with voltage regulating appliances, to enable the voltage upon the distribution lines to be held con- stant and uniform, just as in the case of central-station distribution. These regulators are, in practice, trans- formers with a variable transformation ratio. This is obtained in divers ways â€" sometimes by changing the inductive relations of the primary and secondary coils, sometimes by changing the relative number of' effective turns in primary and secondary. Sets of these induc- tive regulators enable the voltage to be controlled over a sufficiently wide range to secure uniform poten- tial on the system, and with a degree of delicacy that obviates any undesirable changes in voltage. The regu- lation is usually manual, no automatic regulator yet having proved entirely satisfactory. In very large sys- tems, it is worth noting that the so-called " skin effect " in alternating current conductors may become conspicuous. In the transmission circuits themselves the wires are, in practice, never large enough to produce any sensible difference in conductivity for continuous and for alter- nating currents. In the heavy omnibus-bars of a large sub-station this immunity may not be continued, but in such cases flat strips are frequently employed. If these are not more than, say, a centimetre in thickness, the "skin effect" is practically insignificant for all frequencies used commercially. Not infrequently the sub-station also contains devices for the changing of alternating to con- tinuous current, usually rotary converters feeding either traction systems or electric lighting mains. Beyond these rotary converters the system becomes an ordinary continu- ous-current system, and is treated as such. When very close regulation is necessary, motor-generators are often preferred to rotary converters. Arc lighting from trans- mission circuits is a much more serious problem. At the present time two methods are in vogue : â€" first, the operation of continuous-current series-arc machines by synchronous or induction motors driven from the trans- mission system ; and, secondly, series alternating appara- tus for feeding alternating arcs. This apparatus consists either of constant-current transformers with automatically

moving secondaries, or of inductive regulators, also auto- matic in their action, supplemented by transformers to supply them with the necessarily rather high voltage employed for arc distribution. As between these two systems practice is at present divided: electrically, the alternating apparatus gives a rather higher real effi- ciency, but involves the use of alternating arcs, which are somewhat less efficient, watt for watt, as '^ light producers than the continuous-current arcs. The apparatus, how- ever, requires practically no care, while the arc machines, driven by motors, require the same amount of care as if they were driven by other power. Arc light trans- formers, however, are likely to have low power factors, hardly above ~~8 at full load, and rapidly falling off at lower loads. Rectifiers changing the alternating current into a unidirectional current, suitable for use 'with arc lights, have been employed with some measure of success, but not to any considerable extent. They are, of course, satisfactory in avoiding the use of alternating currents in the arc, and consume but little energy in "the trans~~

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formation from one form of current to the other, but involve the use of static transformers automatically giv- ing constant current, which are somewhat objectionable on the score of low power-factor.

Distances of Transmission. â€" Obviously the ultimate determining factor in the distance to which power can be commercially transmitted is the economic side of the transmission, the maximum distance being the maximum distance at which the transmission will pay. As a mere engineering feat, the transmission of power to a distance of several hundred miles is perfectly feasible, and, judg- ing from the somewhat extensive data now available, the phenomena encountered in increasing the length of lines have not been of such character as to cause any hesita- tion in going still farther, provided the increase is com- mercially feasible. In American practice, it is within the truth to say

that nearly all transmissions of reason- able size (say a few hundred kilowatts) to distances of twenty miles, or less, are pretty certain to pay. At distances up to fifty miles, in a large proportion of cases power can be delivered at prices which will enable it to compete with power locally generated by steam. From fifty to one hundred miles (on a large scale â€” several thousand kilowatts) the chances for commercial success are reasonably good. The larger the amount of power transmitted, the better on the whole is the commercial outlook. In rare instances transmissions of still greater length will prove feasible. The longest one yet operated (218 miles) has already been noted, and may be regarded as a commercial success. In attempting transmissions over far greater distances, one fact (sometimes forgotten) must be borne in mind â€” that the conditions which indi- cate profit may not persist. In certain localities where the cost of fuel is extremely high, transmissions of several hundred miles may prove successful from a com- mercial as well as an engineering standpoint, but the growth of industry, which indicates the necessity for such a transmission, may go on until, through improved facilities of transport, the cost of fuel may be greatly lowered and the economic conditions entirely changed. Such a modification of the conditions sometimes takes place much more quickly than would be anticipated at first sight, so that when very long distance transmissions, involving the locking up of large amounts of capital in apparatus and lines, are under consideration, the perma- nence of the conditions which will render them profitable should be a very serious subject of consideration. Cases may arise of transmissions over' very long distances on an enormous scale to regions in which the fuel condi- tions may have already reached stability, and in these there may be assurance of a continued profitable market for power, but it is necessary to say that at the present time such instances seem to be extremely rare. As the World's coal supply is diminished, and industrial growth goes on, colossal transmissions of power from fuel beds and natural or artificial hydraulic sources, including the tides, may become an important factor in the world's work ; but this state of things belongs to the future rather than to the present. (l. bl.)

II. Hydkaulic.

The first proposal for a general transmission of hydrau- lic power was made by Bramah in 1802. In 1846, Lord Armstrong's hydraulic crane was erected at Newcastle, and was worked from the town water mains, but the pressure in such mains was too low and uncertain to se- cure satisfactory results. The invention of the accumu- lator in 1850 enabled much higher pressures to be used ; since then 700 lb per square inch has been adopted in most private hydraulic power transmission plant. An attempt to give a public supply of hydraulic power was

made in 1859, when a company was formed for laying mains in London along the river Thames between the Tower and Blackfriars, the engineer being Sir George Bruce ; but though an Act of Parliament was obtained, the works were not carried out. The first public hydrau- lic supply station was established at Hull in 1877. In 1883 the General Hydraulic Power "Works, Messrs Elling- ton and Woodall being the engineers, were started' in London, and they now form the largest system of hy- draulic power transmission in existence. Works of a similar character have since been established in several other towns. The general features of hydraulic power transmission are : â€" (1) a central station where the hy- draulic pressure is created, usually by means of steam pumping engines; (2) a system of distribution mains; (3) machines for utilizing the pressure. In cases of pub- lic STipplies there is the further important matter of registration. The theoretical principles involved belong to the subject of Hydromechanics, and this article has reference only to their practical application.

When dealing with any practical problem of hydraulic power transmission, it is of the first importance to de- termine the maximum demand for power, its duration and frequency. If the duration of the fSJ/on' maximum demand is limited and the frequency restricted â€" for instance, when a swing bridge has to be opened and closed only a few times in the course of a day â€" a small pumping plant and a large accumulator (see Ency. Brit., 9th ed., vol. xii. p. 522) will be desira- ble. If the maximum demand is more or less continuous, as when hydraulic pressure is used for working a pump in a mine or a hydraulic engine in a workshop, the cen- tral station pumping engine must be capable of supplying the maximum demand without the aid of an accumulator,

which may or may not, according to circumstances, be provided to serve as a regulator. The aim should be to employ a pumping engine of such capacity that it can be worked as nearly as possible continuously at its maxi- mum output; the same consideration should, in the main, determine the size of the pumping units in a station where more than a single unit is employed. In most hydraulic power transmission plants the demand is of a very intermittent character, the periods of approximate maxima rarely exceeding in the aggregate two or three hours a day (cp. Pig. 2). With a number of units, each can be worked, when in use, at or near the most eco- nomical speed. Moreover, reserve plant is necessary if the supply of power is to be constant, and where the units are many the actual reserve required is less than where the units are few.

An effect of the multiplication of power units is to increase the capital outlay ; indeed, it may be stated quite generally that economy in working and maintenance cannot be obtained without a larger capital outlay than would be required for a simpler and less economical plant. A high degree of economy estimated on financial data â€” the ultimate base on which these practical ques- tions rest â€” can only be obtained in large installations where the averaging effect of the combination of a large number of com- paratively small intermittent demands for power is greatest. The term load-factor, since it was first coined by Mr E. E. Crompton in 1891, has come into common use as an expression of the relation between the average and the maximum output from any central source of supply. No argument is required to show that a given central station plant working continuously at its maxi- mum speed day and night all the year round, say for 8760 hours in a year, should produce the power more cheaply per unit, not only as to the actual running cost, but also as to the capital or interest charges, than the same plant running on the average at the same speed for, say, one-third the time, or 2920 hours. In this case the load-factor 2920/8760= -333, or 33-370 per cent. The sav- ing on the whole expenditure per unit is not in direct proportion to an increase in the load-factor, and its effect on the various items of expenditure is extremely variable. The influence is greatest on the capital charges, and it has no influence at all, or may even have a detrimental efiect, on some items ; for instance, the

cost of repairs per unit of output may be increased by a high load-factor. Its effect on the coal consumption depends very much on the kind and capacity of the boilers in use ; on whether the engines are condensing or non-condensing ; on the hours of â– work of the engine staff, &c. The economic value of the load-factor is of great importance in every installation, but its influence on the cost of supply varies at each central station, and must be separately determined. There is a load-factor peculiar to each use for whicli the power is supplied, and the whole load-factor can only be improved by the combination of different classes of demands, which differ in regard to the time of day or season at which they attain their maximum. It is in this respect that the great economy of a public distribution of power is most apparent, though there is also, of course, a direct economy due simply to the presumably large size of the central stations of a public supply. Demands for power of every kind have unfortunately a tendency to arise at the same time, so that in the absence of storage of power there seems no prospect of the load-factors for general supply of power in towns exceeding, in the most favourable con- ditions, 40 per cent. The load-factor of most public hydraulic power supplies is considerably under 30 per cent. It is questional ble, however, whether a very high load-factor conduces to economy of working expenses as a whole in any general supply of energy. The more continuous the supply during the twenty-four hours of the day, the greater is the difSculty of executing repairs, and the greater the amount of the reserve plant required.

In all central station work where fluctuating loads have to be dealt with, it is most important that there should be ample boiler power. In a comprehensive system of power supply, demand arises in a very sudden and erratic manner, and to meet this by forcing the boilers involves greater waste of coal than keeping steam up in sufficient reserve boilers. For this purpose, boilers with large water capacity, such as the Lancashire, are preferable to the tubular type, if sufficient space is

available. Peed water heaters or economizers should always be used, all steam and feed pipes should be carefully protected from radiation, and the pipe flanges should be covered ; in short, to secure good results in coal consumption, every care must be taken to minimize the stand-by losses which are such serious items in central station economy when the load-factor is low. Though hydraulic power has the peculiar advantage, as regards coal consumption, that it is the speed of the engines which varies with an intermittent demand, nevertheless at the London stations it has been found that during a year's working only from 60 to 75 per cent, of the coal efficiency of trial runs of the engines can be obtainedâ€" i.e., at least 25 per cent, of the coal is wasted through the stand-by losses and

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Fig. 1.

through the pumping engines having to run at less than full power. The use of superheated steam, which is now being intro- duced, will certainly lead to further economy.

To determine the scale on which a central station plant should

be designed is frequently a difficult matter. The rate of growth of the expected demand for the power is an important factor, but it has been clearly established that the reduction of working expenses resulting from the increase of size of an undertaking proceeds in a diminishing ratio. The diagram (Fig. 1) of the costs of the London undertaking and the amount of power supplied shows this very clearly. The curve on the diagram gives the cost per 1000 gallons. The straight line A B has been drawn approxi- mately as a mean through the points marking the total expenses of each year in relation to the output of power. This line cuts the boundary above the origin 0 at A, and indicates by the amount of the running expenses the initial size of the central station adopted in this case. Whether it is more economical to have several smaller stations, in any particular system of power transmission, or a single centre of supply, is mainly governed by the cost of the mains and the facilities for laying them in the area served. No general rule can,

however, be formulated, for, as in many engineering problems, it is a question of balance of advantages, and the solution must be obtained by consideration of the special circumstances of each case as it arises.

There were in 1900 four central stations at work in connexion with the public supply of hydraulic power in London, having an aggregate of 4600 i.h.p. ; a fifth station which had been begun at Kotherhithe would raise the horse-power to 6200. All the stations and mains are connected together and worked as one system. There are nine accumulators with a total capacity of 2600 gallons, most of them having rams 20 inches diameter by 23 feet stroke. The pumping engines are able together to deliver 7000 gallons

Fig. 2.

per minute, and the accumulators are principally of use in regu- lating the pressure and facilitating the control of the work of the stations. Details of the London supply are given in Fig. 2 and in the following table : â€”

Tear.

Gallons pumped.

Annual Load-Factors.

Max. 24 hours Load-Factors.

Cost of Fuel per 1000 gallons.

Price of Fuel per ton in bunkers.

Mo. of Machines at work.

Miles of Mains.

1889 1891

1894 1896 1897 1898 1899

163,883,000 267,671,000 400,316,000 472,507,000 600,974,000 620,662,000 718,028,000

0-328 0-339 0-338 0-347 0-379 0-340 0-332

0-524 0-462 0-553 0-481 0-518 0-483 0-466

d.

3-11 3-21 1-96 1-91 1-88 1-98 2-11

s. d.

10 9 12 9 10 0 10 0 ‘ 10 6 118 12 9

1022 1503 2204 2796 3141 3515 3964

38 53

73 89 98

109.

118

The load-factors are calculated on the actual recorded maximum output, and not on the estimated capacity of the plant i-unning or installed. The daily periods of maximum output are shown in Fig. 1. The very high load-factor in 1897 was due to special

oiicumstances. The table shows that the load-factors have not been affected either by the increase of the area of supply or by the increased consumption of power. The coal used has been prin- cipally Durham small. The capital cost of the London undertaking

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has been about Â£650,000. In the central station at Wapping, erected in 1891, there are six sets of triple-expansion, surface-condensing vertical pumping engines of 200 i.h.p. each ; six boilers with a working pressure of 150 lb per square inch, and two accumulators with rams 20 inches diameter by 23 feet stroke loaded up to 800 lb per square inch. The engines run at a maximum piston speed of 2.”)0 feet per minute, and the pumps are single-acting, driven directly from the piston rods. The supply given from this station in 1899 was approximately 6,000,000 gallons per week, and the cost for fuel, wages, superintendence, lighting, repairs, and sundry station expenses, SJd. per 1000 gallons, the value of the coal used being 12s. 6d. per ton in bunkers. The capital cost of the station, including the land, was Â£70,000. The load-factor at this station for 1899 was -39, and the supply was maintained for 163 hours per week. The conditions are exceptionally favourable, and the figures represent the best result that has hitherto been obtained in hydraulic power central station work.

The installation in Hull differs little from the numerous private plants at work on the docks and railways of the United Kingdom. The value of the experiment was chiefly commercial, and the large public hydraulic power works established since are to be directly attributed to the Hull undertaking. In Birmingham gas engines are employed to drive the pumps, but though the plant has recently been extended, the whole power available is only 250 li.p. In Liverpool the central station has five engines of 200 i.h.p. each, and a second station which is being erected is laid out for a further 1600 i.h.p. The working pressure in Liverpool is 850 lb per square inch. There are 2-3 miles of mains, and between 700 and 800 machines at work. In Manchester and Glasgow the pressure adopted is 1100 lb per square inch. In Manchester this pressure was selected principally in view of the large number of hydraulic packing presses used in the city, and the result has been altogether satisfactory. The works were established by the corporation in 1894, the central station being designed for 1200 i.h.p. Another station has since been built of equal capacity, and 3 to 4 million gallons per week are being supplied to work about 1400 machines. About 17 miles of mains are

laid. In Geneva there is a distribu- tion of haudraulic power at the moderate pressure of 200 ib per square inch, the pumps being driven by turbines which are worked by the water of the Rh6ne. 3000 h.p. is supplied to work 268 machines, principally turbines, at a cost of Â£3 per brake h.p. per annum for 3000 hours' work, and about half the total is used for creating electric current for lighting and traction. Public supplies of hydraulic power exist also in Melbourne and Sydney.

In Antwerp a regular system of high-pressure hydraulic power transmission was established in 1894, specially to provide electric light for the city. The scheme was due to the late Professor von Ryssleburgh, an electrical engineer of Ghent, who came to the con- clusion that the most economical way of installing the electric light was to have a central hydraulic station, and from it transmit the power through pipes to various sub-stations in the town, where it could be converted by means of turbines and dynamos into electric energy. The coal cost of the electricity supplied â€" 0'88d. per kw. hour â€" compares favourably with most central elec- tric supply stations, although the eiEciency of the turbines and dynamos used for the conversion does not exceed 40 per cent. Von Ryssleburgh argued that hydraulic pumping engines would be more economical than steam engines and dynamos, and that the loss in transmission from the central station to the consumer would be less with hydraulic converters than if the current were distributed directly. The loss in conversion, however, proved to be twice as great as had been anticipated, owing largely to defective apparatus and to under-estimation of the expense of maintaining the converting stations ; and the net result was com- mercially unsatisfactory. The system, therefore, is not likely to be extended, but the facts regarding the coal consumption are a striking testimony to the great economy of hydraulic power transmission.

At Buenos Aires hydraulic mains are laid in the streets, not for a general power supply, but solely for drainage purposes. Each of the sumps, which are provided at intervals, contains two hydraulic pumps which automatically pump the sewage from a small section of the town into an outfall sewer at a higher level. The districts where this system is at work lie below the general drainage level of Buenos Aires. The

average efficiency (pump h.p. to i.h.p.) is 41 per cent., which is high, having regard to the low heads against which the pumps work. In this application all the conditions are favourable to hydraulic power transmission. The work is intermittent, there is direct action of the hydraulic press- ure in the machines, and the load at each stroke of the pumps is constant. The same system has been adopted for the drainage of Woking and district, and a somewhat similar installation is in use at Margate.

The minimum cost at which hydraulic power is sup- plied from the hydraulic mains in London at present

is Is. 6d. per 1000 gallons, made up approximately as follows : â€”

Coal, wages, repairs, &c., at central station

Distribution and general charges

Kates and interest on capital at 0 per cent.

The average cost is much higher (cp. Fig. 2). In 1000 gallons at 760 lb per square inch there is an energy of

.’ ~~â€ž~~ â€” ;;7- =8-74 horse power hours : thus Is. 6d. per 1000 33,000 X 60 -^ ‘ ^

gallons = 2d. per h.p. hour nearly. It is evident that the capital charge is the dominating factor, and that the influence of the load-factor on this ^‘ ”’ charge is far more important than it is on the station cost. The capital employed in building and equipping the central stations bears a nearly fixed ratio to the supply, but the relative cost of mains may be expected to decrease as the supply is augmented. It does not, however, appear probable that hydraulic power at 760 R) per square inch can be supplied from central stations in towns on a commercial basis over any con- siderable areas at less than Is. per 1000 gallons. Allow- ing 75 per cent, as the efficiency of the motor through which the power is utilized, this rate would give l-83d. per brake or effective h.p. hour. This cost seems high, and it is difficult to believe that it is the best hydraulic

power transmission can accomplish, having regard to the well-established fact that the mechanical efficiency of a steam pumping engine is greater than any other appli- cation of a steam engine, and that the power can be conveyed through mains without any material loss for considerable distances. Still no other system of power transmission except gas seems to be better off, and there is no method of transmission by which power could, at the present time, be supplied in towns with commercial success at such an average rate when steam is employed as the prime mover. The average- rate t^2s. 6d. to 3s. per 1000 gallons) charged for hydraulic power in London and other towns agrees, in fact, very closely with the average rate charged for the supply of electrical energy. Gas is undoubtedly cheaper, but in a large number of cases is mechanically inconvenient in its application. Hydraulic pressure, electrical energy, and compressed air (with reheating) can all be transmitted through- out towns with approximately the same losses and at the same cost, because the power is obtained in each system from coal, boilers, and steam engines, and the actual loss in transmission can be kept down to a small percentage. The use of any particular system of power does not, however, primarily depend upon the cost of running the central station and distributing the power, but mainly upon the mechanical convenience of the system for the purpose to which it is applied. One form of energy is, in practice, found most useful for one purpose, another form for another, and no one can command the whole field.

When water is employed as the fluid in hydraulic transmission, the effects of frost must usually be provided against. In London and other towns, the water, before being pumped into the mains, is passed ^Â°tioâ€žs through the surface condensers of the engines, against so as to raise its temperature. The mains ‘â„¢**- are laid 3 feet below the surface of the ground. Exposed pipes and cylinders are clothed, and means provided for draining them when out of use. When these simple precautions are adopted, damage from frost is very rare. In special cases oil having a low freezing point is used, and in small plants good results have been obtained by mixing glycerine and methylated spirit with the water.

POWEE TEANSMISSION

[hydeaulic

A few gas jets judiciously distributed are of value where there is a difBculty in properly protecting the machinery by clothing.

From the central station the hydraulic power must be transmitted through a system of mains to the various points at which it is to be used. In laying out Disiribu- ^ ^^^ work of mains, it is first necessary to de- termine what velocity of flow can be allowed. Owing to the weight of water, the medium usually em- ployed for hydraulic transmission, a low velocity is neces- sary in order to avoid shocks. The loss of pressure due to the velocity is independent of the actual pressure employed, and at moderate velocities of 3 to 4 feet per second the loss per 1000 yards is almost a negligible quantity at a pressure of 700 lb per square inch. For practical purposes Box's formula is sufficiently accurate â€"

^ , , gallons 2 X length in yards â€ž,

Loss of head=^-j, ^-A ^. â€" ; ^rr â€¢ There is a

(diameter 01 pipes lu inches x3)Â» ,

further loss due to obstruction caused by valves and bends, but it has been found in London that a pressure of 750 ft at the central accumulators is sufficient to ensure a pressure of 700 ft throughout the system. The greatest distance the power is conveyed from the central stations in London is about 4 miles. The higher the initial velocity, the more variable the pressure ; and in order to avoid this variation in any large system of mains, it is usual to place additional accumulators at a distance from the central station. These have an important effect in main- taining regularity of pressure, as local demands are, in the first instance, supplied from them; and they act in the same way as air-vessels, giving the whole system an elasticity which would hardly be

expected with such an inelastic substance as water. The largest pipes used in London are 7 inches internal diameter. In one or two places el sewhere 8-inch pipes have been used, and in Antwerp the pipes are nearly 12-inoh bore. In the last case they are of steel, but as a rule the large pipes are of cast-iron, flanged, and provided with spigots and faucets. The joint (Fig. 3) is

JJ’tTnffituuiiTiai. S^d^^jn^

Fig. 3.

made with a gutta-percha ring, though sometimes asbestos and leather packing rings are used. The mains should be laid in circuit, and valves placed at intervals, so that any section can be isolated for repairs or for making connexions without affecting the supply at other points. The main valves adopted in London’ are shawn in Fig. 4. Valves are also fixed to control all branch pipes, while relief valves, washouts, and air valves are fixed as required.

Inpublicsuppliesthepowerused is in all cases registered by meters, and since 1887 automatic instruments have been used at the central stations to record the amount Son!”’‘ supplied at each instant during the day and night. The ratio between the power registered at the consumers’ machines and the power sent into the mains is the commercial efficiency of the whole system. The loss may be due to leakage from the mains or to defects in the meters ; or if, as is often the case, the exhaust from the machines is registered, to waste on the consumers’ premises. The automatic recorders give the maximum

and minimum â™¦supplies during 24 hours every day, the maximum record showing the power required for a given

Fig. 4.

number and capacity of machines, and the minimum giving an indication of the leakage. It has been found practicable to obtain an efficiency of 95 per cent, in most public power transmission plants over a series of years, but great care and watchfulness are required to

produce so good a result. In some years 98 per cent, has been registered. Up to a few years ago no meter was available for registering so high a pressure as 700 ft per square inch, and hence all that could be done was to register the water after it had passed through the machines and lost its pressure. This method is still largely adopted ; but seeing tliat high- pressure meters have lately been perfected to give excellent results, it will doubtless be superseded to a considerable extent by the more satisfactory arrangement of registering the power on its entry into the consumers' premises, as is done with gas, water, and electricity. In IManchester Kent's high-pressure meters are now used exclusively. The water, after the pressure has been eliminated by passage through the machines, may run to a drain or be led back to the central station in return mains ; the method adopted is a question of relative cost and con- venience.

The subject of the transmission of hydraulic power cannot be regarded as in any way complete without refer- ence to the machines which are actuated by it, for it is only by a comparison of the useful work ^'Â«''Â°'y- done by them with the work done by the engines and boilers at the central station that the mechanical efficiency of the system as a whole can be gauged. At the central station and in the distribution there is no great difficulty in determining the efficiency within narrow limits; it should be 80 per cent, at the point of entry to the machine in which the pressure is used. But there a great uncer- tainty arises ; the character of the machines and the nature of the conditions are so variable, that a really accurate general statement is impossible. In most cases the losses in the machine are constant for a given size and speed of working ; consequently, the efficiency of a given machine may vary within very wide limits, according to the work it has to do. For instance, a hydraulic pump of a given

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capacity, delivering the water to an elevation of 100 feet, will have an efficiency of 80 per cent. ; but if the elevation of discharge is reduced r

to 15 feet, even though the hydraulic-pressure rams may be propor-tioned to the reduced head, the eflB^ciency falls below 50 per cent. The ultimate efficiency of ,.,.,.pump h. p.

the system, or ^ }^ p >

in the one case is 64 per cent., and in the other under 40 percent. In crane or lift work the efficiency varies with

the size of the apparatus, with the load, and with the speed. Efficiency in this sense is a most uncertain guide. Some of the most useful and successful applications of hydraulic power â€" as, for instance, hydraulic capstans for hauling waggons in railway goods yards â€" have a very low efficiency expressed on the ratio of work done to power expended. Hydraulic cranes for coal or grain hoisting have a high efficiency when well designed, but it is now very usual to employ grabs to save the labour of filling the buckets, and their use lowers the efficiency, expressed in tons of coal or grain raised, by 33 per cent, or even 50 per cent. When hydraulic machines are fully loaded, 50 per cent, to 60 per cent, of the indicated power of the central station engine is often utilized in useful work done within a radius of two or three miles from the station. In very favourable circumstances the efficiency may rise to over 70 per cent., ami in a great many cases in practice it no doubt falls below 25 per cent. If, however, energy in any form can be obtained ready for use at a moderate rate, the actual efficiency of the machines (i.e., the ratio of the useful work done to the energy absorbed in the process) is not of very great importance where the use is intermittent. i

Hydraulic pressure is more particularly advantageous in cases where the incompressibility of the fluid employed can be utilized, as in hydraulic lifts, cranes, and presses. Hydraulic machines for these

purposes have the peculiar and distinct advantage of direct action of the pressure on the moving rams, resulting in simplicity of construction, slow and steady movement of the working parts, absence of mechanical brakes, and greatest safety in action. When the valve regulating the admission of the pressure to the hydraulic cylinder is closed, the wateris shut in, and, as it is incompressible, the machine is locked. Thus all hydraulic machines possess an inherent brake ; indeed, many of them are used solely as brakes, so important is this property of fluids. The buffer-stop to be seen in terminal railway stations, and the hydraulic brakes of quick-firing guns, are examples. Mr F. W. Webb's buffer-stop is shown in Fig. 5.

Sometimes a much higher pressure than 700 lb or 1000 lb per square inch is desirable, more particularly for heavy presses and for machine tools such as are used for riveting and for punching, shearing, bending, drawing, and stamping metal. The development of these applications of hydraulic pressure has been largely due to the very complete machinery invented and perfected by the late Mr R. H. Tweddell. One of the principal installations of this kind was erected in 1876 at Toulon dockyard, where the machines are all connected with a system of mains of 2|-inch bore and about 1700 yards long, laid throughout the yard, and kept charged at a pressure of 1500 lb per square inch by engines of 100 h.p. with two large accumu- lators. M. Marc Berrier-Fontaine, the superintending

engineer of the dockyard, has stated that the economy of the system over the separately-driven geared machines

Fig. 5.

formerly used is very great. But while pressures so high as 3 tons per square inch (as in the 12,000-ton Armstrong- Whitworth press) have been used for forging and other presses, it is not desirable, in the distribution of hydraulic power for general purposes, that 1000 lb per square inch should be much exceeded ; otherwise the rams, which form the principal feature in nearly all hydraulic machines, if pro- portioned to the work required, will often become inconveniently small, and other mechanical difficulties will arise. The cost of the machinery also tends

to become greater. In particular cases the working pressure can be increased to any desired extent by means of an intensifier (Fig. 6). ,

An important application of hy- draulic power transmission is for ship work, the system being largely adopted both in H.M. navy and for merchant vessels. Hydraulic coal- discharging machinery was fitted by Armstrong as early as 1864 on board a small steamer, and in 1868 some hopper barges on the Tyne were sup- plied with hydraulic cranes. Mr A. Betts Brown of Edinburgh applied hydraulic power to ship work in 1873, and in the same year the first use of this power for gunnery work was effected by Mr G. M. Eendel on H.M.S. Thunderer. In 1883 the P. and 0. steamer Massilia was fitted with hydraulic cranes, and since then all the large P. and 0. boats have been supplied with hydraulic power (Fig. 7). The pressure usually employed in H.M. navy is 1000 lb per square inch. Accumulators are not used, and the engines have to be fully equal to supply directly the whole demand. The distance through which the power has to be transmitted is of course very short, and the high velocity of 20 feet per second is allowed in the main pipes. The maximum engine-power required under these conditions on the larger ships is very consider- able. In the case of H.M.S. Royal Sovereign the pump- ing engines are capable of delivering 1340 gallons per minute.

In hydraulic transmission of power it is usually the pressure which is employed, but there are one or two important cases in which the velocity of flow due to the pressure is utilized in the machine. Reference has already been made to the use of turbines working at 760 lb per square inch at Antwerp. The Pelton wheel has also been found to be admirably adapted for use with such high

pressures ; in converting hydraulic power into electric by means of this device and a dynamo, the losses vary from

Fig. 8.

Fig. 7.

33 per cent.- to 60 per cent., depending mainly on the sizes of the machines. Another very useful application of the velocity due to the head in hydraulic transmission is in an adaptation of the -well-known jet pump to iire hydrants devised by the late Mr J. H. Greathead (Eig. 8). One of these injector hydrants will do the work of a single steam fire engine, and, with 30 to 40 gallons of water from the hy- draulic mains, will deliver a jet of 150 gallons of water through a 1-inch nozzle to a height of 100 feet or more through 200 feet of hose, the bulk of the water being drawn from the low-pressure domestic supply or from a tank. The apparatus has only a low effi- ciency, seldom exceeding 25 per cent. At the present time there are about 120 of these hydrants at work from the mains in London.

Improvements in hydraulic machinery since 1876 have been mainly in the direction of the perfecting of details, and in the adaptation of older and well-known apparatus to new requirements ; but though many of these improve- ments have been of a highly interesting and important character, it would be outside the scope of this article to make further reference to them.

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(e. b. e.)

III. Pneumatic.

Probably the earliest recorded air-compressor is that found on the walls of a tomb in Egypt, in which two

men standing on leather bags of air alternately press them down with their feet, to produce a blast for a furnace. The ancients employed compressed air in various ways, as in the "wind-guns of Ctesibus" (blow- * "'â– guns), in forming continuous jets for their fountains, in blasts for forges, &c. Two hundred years ago, in France, Denis Papin first suggested the use of compressed air for transmitting packages in tubes. In later times it was used in diving-bells and caisson work, Brunei employing it in tunnelling under the Thames in 1825. William Mann in 1829 took out a patent in England for a com- pound air-compressor. In his application he states : " The condensing-pumps used in compressing I make of differ- ent capacities, according to the densities of the fluid to be compressed. Those used to compress the higher den- sities being proportionally smaller than those previously used to compress it at the first or lower densities," &c. This is a very exact description of the best methods of compressing air to-day, omitting the important intercool- ing. Baron Van Eathen in 1849 proposed compressing air in stages, and using intercoolers between each stage to get 750 lb pressure, for use in locomotives. For the next forty years inventors and engineers tried -without success all manner of devices and complicated mechanism for cooling air during compression by the use of water, either injected into the cylinder or circulated around it, and finally, with few exceptions, settled down to direct compression with no cooling worthy of mention. Only in the last ten years of the 19th century were the fundar mental principles of economical air-compression put into general practice, though all of them are contained in the patent of William Mann and the suggestion of Van Eathen.

The first successful application of compressed air to the transmission of power as we know it, was at the Mont Cenis Tunnel in 1861. The form of compressor used was a system of water-rams â€" several of them in succession â€" in which the water was the piston, compressing the air

upwards in the cylinder and forcing it out. Although the air came in contact with the water, it was not cooled, except slightly at the surface of the water and around the walls of the cylinders. Eotary drills for penetrating the rock were tried first, but were soon replaced by a percus- sion drill adapted from drawings in the United States Patent Office, copied by a Prench and Italian Commission from the patent of Powle of Philadelphia. Drinker states positively that the first percussion drill ever made to work successfully was patented by J. J. Couch of Philadelphia in 1849. Shortly afterwards Powle patented his drill, in which the direct-acting and self-rotating principle was used as we use it now. The first successful drill in the Hoosac Tunnel was patented 6th IMarch 1866, by Brooks, Gates, and Burleigh, but after a few months was replaced by one made by Burleigh, who had bought Fowle's patent and improved it. The successful work in the Mont Cenis and Hoosac Tunnels with the percussion drilling machine caused the use of compressed air tb spread rapidly, and it was soon found that there were many other purposes for which it could be employed with advantage, especially after economical compression was adopted. About 1870 there was started in Paris a pneumatic clock system, by which public and private clocks were run by compressed air from a central station. This soon developed into an immense system for distributing compressed air for power purposes, until Paris now has two great compressor plants and more than fifty miles of distributing pipes, furnishing air at 75 ft pressure to thousands of customers, who use it for every im aginable purpose, from cooling beer or dusting furniture to running electric light dynamos. The smaller motors are often of t;he rotary type and are not very efficient, though each has its little stove in which is a

pneumatic]

common kerosene lamp to heat the air before use. Com- pressed air is being largely and successfully introduced on tramways, in competition with electric and wire-rope traction systems. It was first tried in 1875

by Scott- Moncrieff, but failed owing to financial difficulties. Hardie, who was an assistant under him, made a suc- cess of it, and his system is now working on a very large scale in New York. The reheating is done with a tank of hot water. Mekarksi uses hot water and steam. In his system, which was tried on tramways in the north of London, and is largely used in Prance, the air, under a high pressure, is passed over water at a temperature of 330Â° F., forming a combination of air and steam for use in the motor. For underground traction compressed air has been introduced in the coal mines of the Eastern states of America, and also to some extent in the metal mines of the West, but the difficulty of heat- ing underground has not been overcome, though it might be, partially, by using compound engines and warming the air between the cylinders by the mine water, as in compound pumps.

Dr Pohle of Arizona, U.S.A., has patented and intro- duced extensively since 1890 the use of compressed air for lifting water directly, bj' admitting it into the water column. His plan is principally adopted in artesian wells, and is so arranged that the air-supply has a back pressure of water equal to half the lift. In the case of the artesian well, if it is desired to lift the water 30 feet, the air is admitted to the water column at least 30 feet below the water surface. The air admitted being so much lighter than the water it displaces, the column 60 feet high becomes lighter than that 30 feet high, and is constantly raised and flows out at the top. The efficiency of this method is only from 20 to 60 per cent., according to the height, but its adaptation to artesian wells renders it very valuable in some localities.

A remarkable compressed-air system was installed in 1890 by Priestly in the Snake Eiver Desert, Idaho, U.S.A. On the north side of the river is a cliff, nearly perpendicular, about 300 feet high. One hundred and ninety feet above the river, for a considerable distance along the. cliff, streams of water gush out from between the bottom of the great lava bed and the hardened clay of the old lake bottom. Priestly, without knowledge of Pohle's system, built a pipe line down the cliff, and trained the water into it in such a way that it carried a very considerable quantity of air in the form of bubbles along with it down the pipe, and compressed it on the way. The air was collected at the

bottom in a covered reservoir, and taken up the cliff again to the lower part of an inverted siphon pipe, one side of which reached down from the water-supply about 60 feet, and the other side reached up and over the cliff. Allowing the water to fill both sides of the pipe to the level of the water- supply, he admitted his compressed air at about 75 lb pressure into the long side of the pipe near the bottom, and soon had the water flowing upwards over the cliff and irrigating a large tract of rich lava land. Here, then, was a power transmission and motor plant, without a moving part. A similar compressor was installed near Montreal, Canada, in 1896 (and patented), and another larger one at Ainsworth, British Columbia, Canada, in 1898, by the Taylor Hydraulic Air Compressing Co. of Montreal. Tests on the first compressor showed an efficiency of from 60 to 62 per cent., and it is thought that a few obvious improvements would bring the second one up to 75 per cent.

Saunders defines compressed air as ” air under press- ure.” “It is usual,” he continues, “to define com- pressed air as air increased in density by pressure, but we may produce compressed air by heat alone, as illus-

trated by the discharge of the cork from a bottle of air when heated.” The laws of compression and expansion of gases may be found under Pneumatics {Ency. Brit., 9th edition, vol. xix.), but it may “Â°’^’

be stated here that air develops heat on compression and is cooled on expansion, and that it expands with heat and contracts with cold. For the purpose of illus- tration, suppose a cylinder 10 feet long containing 10 cubic feet of air at 60Â° F., with a frictionless piston at one end. If this piston be moved 7-^ feet into the cylinder, so that the air is compressed to one-quarter of its volume, and none of the heat developed by com- pression allowed to escape, the air will be under a press- ure of 90 lb per square inch and at a temperature of 460Â° F. If this air be cooled down to 60Â° F., the press- ure will be reduced to 45 lb per square inch, showing that the heat produced in the air itself during compres- sion gives it an additional expansive force of 45 lb per square inch. The average force or pressure in compressing this air

without loss of heat is 21 lb per square inch, whereas if all the heat developed during compression had been removed as rapidly as developed, the average pressure on the piston would have been only 11 lb per square inch, showing that the heat developed in the air during compression, when not removed as fast as Seveloped, caused in this case an extra force of 10 lb per square inch to be used on the piston. If this heated air could be transmitted and used without any loss of heat, the extra force used in compressing it could be utilized ; but in practice this is impossible, as the heat is lost in transmission. If the piston holding the 2\ cubic feet of air at 45 lb pressure per square inch and at 60Â° F. be released, the air expanding without receiv- ing any heat would move it back to within 3^ feet of the end only, and the temperature of the air would be lowered 170Â° F., or 110Â° F. below zero. If the air were then warmed to 60Â° F. again, it would move the piston back the remaining 3^ feet to its starting-point, thus showing that air in expansion becomes cooled in the same manner as in compression it develops heat.

From the foregoing it may be seen that the ideal air- compressing machine in one which will take all heat from the air as rapidly as it is developed during compression. This is called Isothermal Compression, and is never reached in practice, the best work yet done lacking 10 per cent, of it. It follows that the most inefficient compressing machine is one which takes away no heat during compression. This is called Adiabatic Compression, and in practice has been much more nearly approached than the ideal. It also follows that the ideal motor for using compressed air is one which will supply heat to the air as it is required in expanding. This is called Isothermal Expansion, and is often attained, and some- times exceeded, in practice by supplying heat artificially. Finally, the most inefficient motor for using compressed air is one which supplies no heat to the air during its expansion. This is called Adiabatic Expansion, and has been very closely approached by most air motors until recent years. In practice isothermal compression is approached by compressing the air slightly, then cooling it, compressing it slightly again and again cooling it, until the desired compression is completed. This is called compression in stages, or compound compression. Iso- thermal expansion is approximately

accomplished by allowing the air to do a part of its work (as expanding slightly in a cylinder) and then warming it, then allowing it to do a little more and then warming it again, and so continuing until expansion is complete.

A description of the actual performance may make the matter clearer. At the North Star Mines, in California,

Practice.

air is compressed by an ordinary pressure blower to about 5 lib pressure per square inch, its temperature rising from 60Â° to 100Â° P. It is then cooled again to 60Â° F. by a system of cooling-pipes placed in the tail-race of the water-wheel that runs the blower ; then it is taken to the first cylinders of the compressor and compressed to 26 lb, its tempera- ture being thus raised to nearly 200Â° F. ; then it is passed through a system of cooling-pipes placed in the tail-race of the water-wheel that runs the compressor, and its temperature again reduced to 60Â° F. ; thence it is passed to the second cylinders and compressed to 90 lb, and delivered to the transmission pipes convey- ing it to the mines. On reaching the motors at the mines, in some eases nearly 2 miles distant, the tempera- ture, which had been raised by the last compression to over 200Â° F., has been reduced to about 70Â° F. Here, for the principal motors, the air, by being passed through a system of pipes heated by burning crude oil, has its temperature raised to 350Â° F., and is then taken by the first cylinder of the motor, where it is expanded down to 25 lb pressure per square inch and reduced to 75Â° temperature. It is then taken to the heater again, and after its temperature has been raised to 250Â° F., it is used in the second cylinders and exhausted at a temperature somewhat above that of the surrounding air.

It will be seen that the air is carefully cooled during compression to prevent the heat it develops from working against compression, and

even more carefully heated during expansion to prevent loss from the cold developed during expansion. More stages of compression, of course, give a higher eflB.ciency, but the cost of machinery and friction losses have to be considered in . practice. The reheating of the air is often considered a serious dis- advantage, especially in mining, where there are great objections to having any kind of combustion underground. In the foregoing instance only one gallon of crude oil per hour is required to heat to 350Â° F. the air for a 300 horse-power hoisting engine. As Professor Unwin says : ” For the amount of heat supplied the economy realized in the weight of air used is surprising. The reason for this is, the heat supplied to the air is used nearly five times as efficiently as an equal amount of heat employed in generating steam.” Practically there is a hot-air engine, using a medium much more effective than common air, in addition to a compressed-air engine, making the efficiency of the whole system extremely high, probably over 90 per cent.

For underground work Eix has employed compound or triple expansion motors on pumps, using the pump- water in the tank as a reheater. The air enters the first cylinder at the normal temperature of the mine, the exhaust passes from that cylinder into a system of circulating pipes placed in the pump-tank, which warms the chilled air up to the temperature of the water ; thence the air passes to the second cylinder, does its work there, and is again sent into a second system of circulating pipes in the tank, \vhere it is again warmed to the temperature of the water ; then it is used in the third cylinder, and exhausted. In this manner the heat that is lost in com- pressing the air is recovered without expense. This method has proved very successful, and as the heat costs absolutely nothing, it makes the system very economical. On account of the very considerable amount of heat taken from the water, the efficiency is high. A similar arrange- ment might be employed wherever there is cheap circu- lating water on the surface, to avoid any difficulty or complications arising from the use of fuel.

The use of compressed air without reheating should never be considered practical except in temporary emer-

gencies, or where the cold exhausted air is of value, as is sometimes the case in sinking pumps or rock drills. An efficiency of less than 25 per cent, may be expected in such cases, where the motors are what might be called piston-displacement machines ; that is, the compressed air is admitted at one end of the cylinder and moves the piston the length of the stroke at full pressure, and dis- charges without getting anything of the expansive force of the air. There are a great many of this class of motors in use.

The transmission of air from the compressor to the motor is much more simple and efi'ective than is usually supposed. The air admits of a velocity of 15 to 20 feet per second through pipes, with very slight loss of friction, and therefore there is no necessity for an expensive pipe system in proportion to the power transmitted. It is found in practice that, allowing a velocity as given above, there is no noticeable difference in pressure between the compressor and the motor several miles away. Common oil well-tubing is largely used for the pipes, and if it is properly put in there is very slight loss from leakage, which, moreover, can be easily detected and stopped. In practice, a sponge with soap-suds, passed around a joint, furnishes a detective agency, the escaping air blowing soap-bubbles. In good practice there need not be more than 1 per cent, loss through leakage, and 1 per cent, possibly through friction, in the transmission of air. (See also Pneumatic Tools.) (a. De w. f.)

Poynter, Sir Edward John, Baet. (1836- -), President of the Royal Academy and Director of

the National Gallery, son of Ambrose Poynter, architect, was born in Paris on 20th March 1836. He pursued his art studies in England and in Paris (under Gleyre, 1856-59), and exhibited his first picture at the Eoyal Academy in 1861. In 1869, after the exhibition of " Israel in Egypt " and " The Catapult," he was elected an Associate of the Eoyal Academy, and in 1876, the year of " Atalanta's Eace," full Academician. From the beginning of his career Sir Edward Poynter was academi- cal in his art â€" that is to say, he sought to base it on a profound and reverent study of the old masiters, more particularly

those of Italy. It has been objected, with much truth, that with all their learning and evidence of power, the greater number of his more important pictures display violent action which is not real so much as arrested movement. The true answer is not, as some have held, that this is the price paid for conscientious and deeply- studied drawing and complex composition laboriously overcome. It is that the artist's aim has been essentially decorative, and that by concession to the laws of decoration some sacrifice of realism and spontaneity is required. On the death of Sir John Millais in 1896, Sir Edward was elected to the Presidency of the Eoyal Academyâ€" and to all the semi-official posts and duties, professional and social, it carries with it â€" and on that occasion he received his knighthood. He was made a baronet in 1902.

When the art teaching centre of South Kensington was assuming the importance it has since attained, Mr Poynter was appointed Director for Art in the Science and Art Department, and Principal of the National Art Training Schools (now the Royal College of Art), and by virtue of his vigorous and successful administration he invested his office with a distinction which, after his resignation in 1881, it soon notoriously lacked.

In the decorative arts Sir Edward practised freely as a designer ni fresco, mosaic, stained glass, pottery, tile-work, and the like. While still quite a young man, he was encouraged by the architect William Burges, A.I^.A.,to design panels for his quaint Gothic cabinets ; Messrs Powell obtained from him cartoons of designs for stained glass ; for the decoration of AValtham Abbey church he was employed on a series of thirty important designs. Attracted by these, Dalziel Brothers commissioned a number of full-page drawings on wood for the illustration of their celebrated "Bible

"Idle 1<'ears."];y Sir E. J. Poykter, P.R.A.

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P02AEEVATZ â€" PEAGUE

Gallery." The cartoons lor "St George" and "St David," the mosaic panels now embellishing the Outer Lobby of the Palace of Westminster, were produced in 1870, and they were followed by the " Apelles " and " Phidias," in the same method of reproduction, in the Victoria and Albert Museum ; by the important series of frescoes in St Stephen's, Dulwich â€" scenes from the life of the saint ; by the decoration of the Grill Boom at the Museum at South Kensington, with the tiles en camaieu â€" an achievement strikingly successful and pregnant with results. Sir Edward Poynter, always a lover of water-colour drawing and of the art of landscape painting, was elected to the Royal Society of Painters in Water Colours in 1883. In 1874 Sir Edward designed the Ashantee medal ; and in 1892, for the coinage of that year, the reverse of the shilling and florin, to the obverse of Mr Thomas Brock, E.A.

The Directorship of the National Gallery became vacant in 1894, and Sir Edward, profoundly versed in the works of the Old Masters, especially of the Italian schools, was appointed to the post. From that date to the end of 1901 the collection largely increased in numbers, while in general arrangements, in hanging, &c., great improvements were introduced. Under Sir Edward's rule the National Gallery of British Art, at Millbank, presented by the late Sir Henry Tate, became a department of the National Gallery, and thither were removed many pictures formerly in the British rooms at Trafalgar Square, as well as the Chantrey Collection from South Kensington, &c. One of the most important services by the Director was the editing of the great Illustrated Catalogue of the National Gallery (1889-1900), in which every picture in the collection is reproduced â€" an unprecedented achievement in the annals of art-publishing.

Paintings. â€" Sir Edward Poynter's most notable pictures have been the following: "Israel in Egypt" (186T); "The Catapult" (1868) ;" Perseus and Andromeda" (1872); "Atalanta's Race" (1876); "The Fortune-Teller " (1877); "Nausioaa and Her Maidens" (1879); "Visit to jEsculapius" (1880), now in the Ohantrey Collection, in the Tate Gallery; "The Ides of March" (1888); " DiadumenS" (1885), now destroyed ; " On the Terrace " (1889) ; " The Meeting of Bolomou and

the Queen of Sheba ” (1891) ; ” Hors Serense ” and ” Idle Fears ” (1894; see Plate), and numerous portraits and water-colour drawings.

Lbotubbs. â€” The presidential discourses of Sir Edward Poynter have been of a purely academic character, dwelling on the necessity of conscientious labour and the study of tradition, in opposition to the modern tendency to avoid such study and to trust to genius. In his series of Slade Lectures, delivered from 1875 to 1879, and first published in 1879 (republished, with additions, in 1897), Sir Edward Poynter deals more fully with the whole subject of art education, considering in turn Decorative Art, Old and !New Art, Systems of Art Education, Hints on the Formation of a Style, Training of Art Students, The Study of Nature, The Value of Things, Objects of Study, Professor Kuskin on Michelaugelo (hotly controversial in tone). Influence of Art in Social Life, and Ancient Decorative Art.

See also Cosmo Monkhouse. ” Sir E. J. Poynter, P.K.A. : His Life and Work,” Art Annual, 1897. â€” M. H. Spielmans. “Sir E. J. Poynter P.R.A., and his Studies,” The Magazine of Art,

1897.

Pozarevatz, a town in Servia, situated in the Morava valley, 4 miles to the east of the Morava river and 8 miles south of the Danube. The station for steamers, Dubravitza, with its custom-house, standing on the banks of the latter river, forms practically the harbour of Pozarevatz. The town has no special industry, but is the principal market of a very extensive and fruitful plain between the rivers Morava, Mlava, and Danube. It is the seat of the district perfecture, a tribunal of justice, a college, and several national or normal schools. It has a large modern penitentiary, with a department for political offenders and a prison for women. Two miles to the west, towards Morava, is situated Lubichevo, a model farm and stud belonging to the Government. The shady park and flower gardens are a popular resort of the people of Pozarevatz. It is known in the history of international treaties as the place at which the famous ” Pozarevatz Peace” between Austria and Turkey was concluded in 1718. Population (1900)/ 12,957.

Pozoblanco, a town of Spain, province of Cordoba, to the south-west of Pedroehe, with a little stream, De los Alamos, running through it. Its population was 11,522 in 1887, and 11,682 in 1897. It has clean, regular streets and some fine public buildingsâ€" the parish church, the town hall, the hospital, and numerous schools. The fairs are famed for their exhibit of live stock and agricul- tural products. There are argentiferous lead mines in the neighbourhood, and manufactures of cloth and leather in the town itself.

Pozsony (German, Pressburg), a municipal town, Hungary, the capital of the county of the same name, on the left bank of the Danube, 35 miles east of Vienna. Its dynamite factory produces yearly above one million kilograms of explosive material, and there is, besides, a well-known industry of fine brushes. The Danube here is spanned by a beautiful iron bridge, serving both for the railway and as a public road. In 1897 an equestrian statue in white marble of Queen Maria Theresa was erected, the work of the Hungarian sculptor Fadrusz. Population (1891), 56,048 ; (1901), 65,867.

Pozzuoli, a town and bishop's see of the province of Naples, Campania, Italy, on the north shore of the Bay of Naples, 6 miles west of Naples. A branch of the firm of Armstrong & Co. of Newcastle-upon-Tyne has been established here for, amongst other things, the making of guns for the Italian navy. A cement made from the volcanic earth of the neighbourhood (pozzuolana) is extensively used in building. The mineral baths attract numerous visitors in the summer. The Serapeum is by some authorities considered to have been a market, and â€" contrary to the common theory â€" they explain the holes made in the pillars by molluscs as due to the fact that the pillars formed part of a large tank for marine animals. In 1899 the Italian Government voted Â£32,000 for building a breakwater and improving the harbour. Population (1881), 14,703 ; (1899), 16,000.

Prachatitz, a town in Bohemia, Austria, at the foot of the Libin, on a tributary of the Blanitz river. It has a Gothic church of the 14th century, and remains of its old fortifications, together with a town hall and numerous castellated houses with mural decorations in colour. The

manufactures produce hosiery, starch, matches, and electrical plant, beer and spirits. It is a favourite summer resort. Population (1890), 4141 ; (1900), 4338, mostly German.

Prague (German, Pragj Czech, Praha), the capital of Bohemia. The adjoining suburbs of Weinberge, Zizkoff, Karolinenthal, and Smichoff now practically form part of the town. Population (1880) 162,323, or including suburbs, about 250,000 ; (1890) with the garrison, 182,530 (of whom 27,125 were German), or with suburbs, 323,663 ; all Eoman Catholic, with the exception of 17,635 Jews and 3288 Pro- testants, both religions showing a slight decline. In 1900 the population was 204,478, including the garrison of 7120 men, or with suburbs, 385,238 (estimated at 87 per cent. Czech, 13 per cent. Gentian, 91 per cent. Eoman Catholic, 7 per cent. Jews, and 2 per cent. Protestants). The rela^ tive diminution of the German element continues at an accelerated pace, mainly owing to the attraction of higher wages to the Czech rural population, but fostered by political causes. A token of the change that has converted Prague from a town in which German influence was para- mount into a Czech stronghold, is the reduction in the decade 1880-90 of 3150 in the number of the German- speaking inhabitants^ and an increase of the Czechs by 24,400. This progressive change is not exclusively due to the Czech immigration, however. In Prague, as else- where in the Czech provinces, the adoption of one or the other language is frequently apolitical confession of faith, so that a part of the Czech increase must be attributed to the conversion of former Germans. Another visible sign of the change is the removal of the German street names in the Hapsburg black and yellow, which have been re- placed by the Bohemian language and colours. There are now two universities, one German and the other Czech (the latter a recent concession to Bohemian national senti- ment), two polytechnics, a theological seminary, three upper and ten ordinary gymnasia, two commercial academies,

an academy of arts, and a conservatory of music, together with, five other special high schools, twelve intermediate and thirty-four elementary schools. Education is in an advanced state, being promoted not merely by the indus- trial progress and prosperity of the town and province, but by the rivalry of the two races. The boast of the Germans that they represent not merely the capital but also the culture of the city, is being steadily deprived of its justification, not through German decline but through Czech progress. In 1894 the German university was attended by 1287 and the Czech university by 2410 ; in 1901 the figures were 1314 and 3188 respectively. In 1894 the German polytechnic was attended by 244 students and the Czech by 417, the corresponding totals for 1901 being 685 and 1262. Twelve of the intermediate schools are Czech and six German, and of the elementary schools 39 are Czech and 18 German. Of the other educational insti- tutions, the Czechs maintain 16 and the Germans 12. The same rivalry and separation are maintained in all grades and forms of instruction, even down to cookery, for which there are special German and Czech schools. In this struggle the Czechs have a decided advantage in their control of the municipal and provincial funds. The creation and the recognition by the State of a Czech Academy of Science are regarded as an important achieve- ment by the dominant nationality. The addition (1878) of a new bridge, named after Palacky, the Bohemian historian, raised the number crossing the Moldau within the city to eight, and since then a ninth has been built. The Karls bridge, partially destroyed by floods in 1890, was restored in 1892. Prague now possesses fifty-seven Eoman Catholic and four Protestant churches and one Russian church, together with ten synagogues. Among the public collections should be mentioned the Nostitz Picture Gallery, the Eudolphinum, and the Bohemian National Museum, in a building erected in 1889-93. In April 1901 the Emperor Erancis Joseph founded, and endowed out of his privy purse, a gallery of modern painting, sculpture, and architecture, intended to contain representative works of Bohemian artists of both nation- alities. There is a large and increasing number of scientific, literary, artistic, social, and benevolent institu- tions. The new towers of the cathedral, and the cam- panile, the Straha Kitter Academy, the new central market, and the Nostitz Palace constitute

fresh archi- tectural features. A second Czech national theatre was begun in 1900.

Prague has more than maintained its position as the leading centre of Bohemian industry and trade, and indeed as one of the most important places in the monarchy. Its progress has been greatly promoted hy the development of communications. It is now the junction of seven railway lines, as well as of the extensive roads of the crown-land. It has also benefited by the growth of the sugar industry, of which it is the chief Austrian market, and by the efforts that have been made to promote inland navigation. In 1895 the shipping service on the Moldau numbered 56 steamers and 163 barges. The principal industries are milling, brewing, the production of oast iron, the manufacture of all kinds of metal wares and chemicals, cotton-spinning, calico-printing, tanning, and glove-making. Among the new industries is the construction of railway waggons and carriages. In Prague the struggle between the two races has of late years been marked by many vicissitudes, by ostentatious disaffection, rioting, plunder, incendiarism, bloodshed, revolutionary plots, and even murder, followed by the suspension of constitutional rights and severe measures of military repression. The upshot, thus far, has been the practical triumph of Czech aspirations in the Bohemian capital. (See Bohemia.)

(m. o'n.)

Prato, a town and episcopal see of the province of Elorence, Tuscany, Italy, 11 miles by rail north-west of Elorence, dominated by a mediaeval castle and sur- rounded by walls. It has a picture gallery (in the town hall), a scientific, and a musical academy. Its varied

industries embrace the manufacture of woollens (the most important), straw-plaiting, biscuits, hats, macaroni, can- dles, silk, olive oil, clothing, and furniture, also copper and iron works, and printing. Population (1881), 26,156 ;

(1899), 27,000.

Prayers for the Dead. â€” Wherever there is a belief in the continued existence of man's personality through and after death, religion naturally concerns itself with the relations between the living and the dead; indeed, some philosophers have attributed the origin of all religion to the cultus of ghosts. Be that as it may, the existing conceptions of our relations to the dead vary widely. Sometimes they are worshipped, as in China. Sometimes they are consulted, as by necro- mancers. Sometimes the living think to furnish them with the means of enjoyment in the other world by slay- ing horses, &c., at their graves. Sometimes the dead are dreaded and propitiated. And, lastly, where the idea of a future judgment obtains, prayers are often of- fered on their behalf to the Higher Powers. Prayers for the dead are mentioned in 2 Maccabees xii. 43-45, where the writer is uncertain whether to regard the sac- rifice offered by Judas as a propitiatory sin-offering or as a memorial thank-offering, a distinction of great im-portance in the later history of the practice. Prayers for the dead form part of the authorized Jewish services. The form in use in England contains the following pas- sage : " Have mercy upon him ; pardon all his transgres- sions . . . Shelter his soul in the shadow of Thy wings. Make known to him the path of life." The only passage in the New Testament which is held to bear directly on the subject is 2 Tim. i. 18, where, however, it is not cer- tain that Onesiphorus, for whom St Paul prayed, was dead. Outside the Bible the proof of the early use of prayers for the dead has been carried a step further by Professor Ramsay's discoveries, for it is now impossible to doubt the genuineness of the copy (contained in the spurious acts of the saint) of the inscription on the tomb of Abercius of Hieropolis in Phrygia (see Light-foot, Apostolic Fathers, part ii. vol. i. p. 492 ff.). The 19th line of the inscription runs thus : " Let every friend who observeth this pray for me," i.e., Abercius, who throughout speaks in the first person: he died in the latter part of the 2nd century. The inscriptions in the Roman catacombs bear similar witness to the practice, by the occurrence of such phrases as " Mayst thou live among the saints " (3rd century) ; " May God refresh the soul of . . . " ; " Peace be with them." Among Church writers Tertullian is the first to mention prayers for the dead, and that not as a concession to natural sentiment, but as a duty : " The widow who does not pray for her dead husband has as good as divorced

him." This passage occurs in one of his later Montanistic writings, dating from the beginning of the 3rd century. Sub- sequent writers similarly make incidental mention of the practice as prevalent, but not as unlawful or even dis- puted (until Aerius challenged it towards the end of the 4th century). The most famous instance is St Augus- tine's prayer for his mother, Monica, at the end of the 9th book of his Confessions.

An important element in the liturgies of the various Churches consisted of the diptychs or lists of names of living and dead who were to be commemorated at the Eucharist. To be inserted in these lists was an honour, and out of the practice grew the canonization of saints; on the other hand, to be excluded was a condemnation. In^ the middle of the 3rd century we find Cyprian enjoining that there should be no oblation or public prayer made for a deceased layman who had broken a Church rule by appointing a cleric trustee under his will : " He

ought not to be named in ttie priests' prayer who has done his best to detain the clergy from the altar." Although it is not possible, as a rule, to name dates for the exact words used in the ancient liturgies, yet the universal occurrence of these diptychs and of definite prayers for the dead in all parts of the Church in the 4th and 6th centuries tends to show how primitive such prayers were. The underlying principles of these recitations of names seem to have been, first, that the Eucharistic offering was the act of the whole Church, of those absent as much as of those present : " We offer on behalf of A and B " ; and, secondly, that those who are asleep in Christ are as truly members of the Church as those who are alive. Hence there is in the earliest forms no sharp distinction, such as grew up later, between those who are commemorated with thanksgiving and those for whom prayers are made. The offering and the petitions embrace all alike, from the Blessed Virgin and the Twelve Apostles down to the sick and sorrowful on earth. God is further asked to hear the intercessions of the holy dead on behalf of the living. The language used in the prayers for the

departed is very reserved, and contains no suggestion of a place or state of pain. We may cite the following from the so-called liturgy of St James : â€”

” Remember, O Lord, the God of Spirits and of all Flesh, those whom we have remembered and those whom we have not remem- bered, men of the true faith, from righteous Abel unto to-day ; do Thou Thyself give them rest there in the land of the living, in Thy kingdom, in the delight of Paradise, in the bosom of Abraham, Isaac, and Jacob, our holy fathers, from whence pain and sorrow and sighing have fled away, where the light of Thy countenance visitetli them and always shineth upon them.”

Public prayers were only offered for those who were believed to have died as faithful members of Christ. But Perpetua, who was martyred in 202; believed herself to have been encouraged by a vision to pray for her brother, who had died in his eighth year, almost certainly unbaptized ; and a later vision assured her that her prayer had been answered and he translated from punishment. St Augustine thought it needful to point out that the narrative was not canonical Scripture, and contended that the child had perhaps been baptized. Similarly, a mediseval legend relates that Gregory the Great was so struck with the justice of the Emperor Trajan, that he prayed for him, and in consequence he was admitted to Paradise (cf. Dante, Furg. x.. Farad, xx.).

As time went on, further developments took place. Petitions to Grod that He would hear the intercessions of the departed became direct requests to them to pray (Orapro nobis) ; and finally, the saints were asked them- selves to grant grace and help. Again, men felt difficulty in supposing that one who repented at the close of a wicked life could at once enjoy the fellowship of the saints in Paradise (St Luke xxiii. 43), and it seemed unfair that they should be made equal with those who had borne the burden and heat of the day (St Matt. xx. 12). And so the simple severance between good and bad indi- cated in St Luke xvi. 26, became the threefold division made familiar by Dante. First there were the saints in Paradise, awaiting their final glory, but already above the

need of human prayers, and able to help men. Next came the forgiven sinners, who would ultimately pass on to Paradise, and were being prepared for it in Purgatory, and might be helped forward by the prayers of their friends on earth. And lastly, the impenitent wicked, whose destiny was Hell. These speculations were further fixed by the growth of the theory of satisfaction and of Indulgences : each forgiven soul was supposed to have to endure an amount of suffering in proportion to the guilt of its sins, and the prayers and pious acts of the living availed to shorten this penance time in Purgatory (see Ency. Brit, 9th ed., art. Indulgences). It thus came about that prayers for the dead were regarded only as aiming at the deliverance of souls from purgatorial fires ; and that application of the Eucharist seems to have over-

shadowed all others. The Council of Trent attempted certain reforms in the matter, with more or less success ; but, broadly speaking, the system still remains in the Eoman Church, and masses for the dead are a very important part of its acts of worship.

The Eeformation took its rise in a righteous protest against the sale of Indulgences ; and by a natural reaction the Protestants, in rejecting the Eomish doctrine of Purgatory, were inclined to disuse all prayers for the dead. They tended to divide men sharply into two classes, the good and the bad ; to speak as if judgment followed immediately on death, and as if the soul passed at once to Heaven. Prayers for the dead therefore seemed useless, if not presumptuous ; though if the fact that a man's fate is already decided makes it vain to pray for him, it is difficult to see ho'wj a strict Calvinist could permit intercession even for the living. The formularies of the English Church speak plainly of an intermediate state, where disembodied spirits await their " perfect con- summation and bliss," resting in Christ until " the general resurrection at the last day " (Burial Service) ; but they as clearly condemn the Romish doctrine of Purgatory. Important changes have been made, in the successive revisions of the Prayer-Book, in the commemorations of the dead at the Eucharist and in the Burial Service.

In the Communion Service of 1549, after praise and thanks were offered for all the saints, chiefly the Blessed Virgin, came the following : ” We commend unto Thy mercy all other Thy servants, which are departed hence from us with the sign of faith and now do rest in the sleep of peace : grant unto them, we beseech Thee, Thy mercy and everlasting peace.” The Burial Service of the same date contained explicit prayers for the deceased, and Introit, Collect, Epistle, and Gospel were provided for “the Celebration of the Holy Communion when there is a Burial of the Dead. ‘ ‘ In 1552, under the influence of Bucer, all mention of the dead, whether commemorative or intercessory, was cut out of the Eucharist ; the preyers in the Burial Service were brought into their present form ; and the provision for Holy Communion at a Burial was omitted. The thankful commemoration of the dead in the Eucharist was restored in 1661 , but prayers for them remained, if they remained at all, veiled in ambiguous phrases.

The Church of England has never forbidden prayers for the dead, however little she has used them in her public services. It was proposed in 1552 to condemn the scholastic doctrine de precatione pro defunctis in what is now the 22nd of the Thirty-nine Articles, but the proposal was rejected. And these intercessions have been used in private by a long list of English divines, among whom Andrewes, Cosin, Ken, Wesley, and Keble form an almost complete chain down to the present day. On the tomb of Bishop Barrow (1680) stands a request to passers-by to pray for their fellow-servant. And in a suit (1838) as to the lawfulness of an inscription, “Pray for the soul of . . .,” the Court decided that ” no authority or canon has been pointed out by which the practice of praying for the dead has been expressly prohibited.” As Jeremy Taylor put it (Dissuasive from Popery, I. i. iv.), ” General prayers for the dead the Church of England never did condemn by any express articles, but left it in the middle.”

In conclusion, we may quote the views of a writer who represents Eastern Christendom : ” We pray ... for the dead that they may become worthy of the vision of God’s face. We know nothing of an intermediate state of souls which have neither been received into the kingdom of

God, nor condemned to torture ; for of such a state we have received no teaching, either from the apostles or from Christ. We do not acknowledge Purgatory â€” that is, the purification of souls by sufferings from which they may be redeemed by their own works or those of others ; for the Church knows nothing of salvation by outward means, nor any sufferings, whatever they may be, except those of Christ ; nor of bargaining with God, as in the case of a

man buying himself off by good works ” (Khomiakoff’s ” Essay on the Church,” in W. J. Birkbeck, Russia and the English Church, p. 217. London, 1896).

LucKOCK. After Death. London, 1879, &o.â€” Plumptee. The Spirits in Prison. (w. 0. B.)

Prenzlau, a town of Prussia,..on the tjcker river and at the north end of the Lower TJeker lake, 30 miles west-south-west of Stettin by rail. There are 4 Evangelical churches, a Reformed church, a Catholic church, a syna- gogue, a gymnasium, a boys’ and 2 higher grade girls’ schools, a seminary for teachers, and a dairy school. Population (1880), 16,933; (1900), 20,228.

Prerau (Czech, Prerov), an important railway junction and commercial centre in Moravia, Austria, 13 miles south- east of Olmiitz. Population (1890), 12,955; (1900)16,738, chiefly Czech and Catholic (estimated to have 9 per cent. G’erman, 6 per cent. Jewish). It has an important cloth industry, in addition to the staple manufactures of sugar, ropes, machinery, agricultural implements, &c. It was, at one time the chief seat of the Moravian Brethren.

Presbyterianism. â€” The extent to which the Presbyterian form of Church polity prevails throughout the world has been made manifest in recent years by the formation of a Pan-Presbyterian Alliance. At a repre- sentative conference in London in 1875, the constitution of the

Alliance was agreed upon, and arrangements were made for holding, every three or four years, a Presbyterian CEcumenical Council. This ” General Council of the Alliance of Reformed Churches holding the Presbyterian System ” met in Edinburgh in 1877, in Philadelphia in 1880, in Belfast in 1884, in London in 1888, in Toronto in 1892, in Glasgow in 1896, and in Washington in 1899. Churches which are organized on Presbyterian principles, and hold doctrines in harmony with the Reformed Confessions, are eligible for admission to the Alliance. Its object is not to form one great Presbyterian organization, but to promote unity and fellowship among the numerous branches of Presbyterianism throughout the world. On the roll of the General Council held at Washington there were 64 Churches. The statistics of these and of 16 others not formally in the Alliance were as follows : Congregations 29,476, ministers 26,521, elders 126,607, communicants 4,862,096. The approximate amount raised during the previous year (1898) for home and foreign work was Â£6,999,021. Of these 80 Churches, 12 were in the United Kingdom, 20 on the continent of Europe, 16 in North America, 3 in South America, 10 in Asia, 9 in Africa, 6 in Australia, 2 in New Zealand, 1 in Jamaica, and 1 in Melanesia. The desire for union which led to the formation of the Alliance has since 1875 borne remarkable fruit. In England in 1876 two Churches united to form the Presbyterian Church of England ; in the Netherlands two Churches became one in 1892 ; in South Africa a union of the different branches of the Presbyterian Church took place in 1897 ; in Scotland the “Eree Church” and the “United Presbyterian” became one in 1900, under the designation of the United Free Church ; in Australia and Tasmania six Churches united in 1901 to form the ” Presbyterian Church of Australia ” ; and a few months later the two Churches in New Zea- land which represented respectively the North and South Islands united to form the ” Presbyterian Church of New Zealand.” ” In no portion of the Empire,” it has been said, ” does the British flag now fly over a divided Pres- byterianism except in the British Isles themselves.”

The United Kingdom. The development of Presbyterianism in the United Kingdom has been marked since 1875 by some features

common to all the Churches. The first of these has been a restatement of doctrinal belief. No Church has proposed to set aside the Westminster Confession of Faith, but the United Presbyterian Church (which led ^^^”” the way in this matter), the Free Church of Scotland, and the Presbyterian Church of England, have taken steps to define more accurately their relation to the Confession. This has been done by a Declaratory State- ment, or by an alteration of the formula by which min- isters and other office-bearers express their adherence to the standards, or, as in the case of the Presbyterian Church of England, by the adoption of more briefly expressed “Articles of the Faith.” No change, it is alleged, has been made in regard to the substance of the Westminster doctrine, but there has been a desirable alteration of emphasis and proportion. The Church of Scotland, in onsequence of her relation to the State, has not found it so easy to move in this direction ; and the Presbyterian Church of Ireland, in consequence of her conservatism in matters of doctrine, has not felt the need of change.

Another feature of development common to Presby- terianism in the United Kingdom is the great attention devoted to the improvement of public worship. The service as distinguished from the sermon ^”*“L has been the subject of much thought and care. Instead of one or two long prayers, there is a tendency to have a greater number of brief prayers, definitely apportioned into acts of confession, thanksgiving, sup- plication, and intercession. The repetition of a creed is also provided for. All the larger churches in Great Britain have produced books of the nature of a Directory of Worship, in which the right order of service and suitable topics for prayer are indicated. This help has in most cases been rendered by a Church Service Society not directly connected with the Courts of the Church. The Synod of the Presbyterian Church of England took the matter into its own hands and prepared a “Directory for the Public Worship of God on the Basis of that agreed upon by the Assem- bly of Divines at Westminster, a.d. 1644.” The Ser- vice of Praise, too, has received special attention in all the Churches. The adoption of the new ” Church Hym- nary ” by the Churches in Scotland and Ireland will do much to unify Presbyterian worship, as did the exclu- sive use of “Psalms and Paraphrases” before

hymn- books were introduced. The ” Church Hymnary ” was the work of a joint committee representing the three Churches in Scotland and the Church in Ireland. Since 1875 the use of instrumental music has become much more general.

A third feature characteristic of British Presbyterianism during the period under review is a strenuous endeavour to provide for the higher instruction of youth, not only in the Sunday-school, but also in lastmc- the Bible-class and in the home. Conspicuous “outft’ service in this respect has been rendered by the production of handbooks covering the whole field of biblical and doctrinal education. Written examinations are held yearly, and honours and prizes are awarded. In this way much has been done to prolong the religious instruction of young people after they have ceased to be children, and it is hoped that a fruit of the movement will be a larger supply of well-equipped teachers for Sunday-schools.

One other feature common to the development of Presbyterianism in several of the Churches in Great Britain concerns the tenure of the pastorate. In all Presbyterian Churches of the United Kingdom it has been the invariable rule and practice that a minister holds office ad vitam aut cidpam, i.e., for life or until

otthe pastorate.

found guilty of an offence which merits suspension or deposition. In the United Pree Church of Scotland and the Presbyterian Church of England efforts have Tenure been made to formulate a quasi-judicial method of removing a minister from his charge on the ground of apparent inefSciency or want of suc- cess. This marks a new departure in British Presbyterian polity. The following deliverance of one of the Churches indicates the line along which the new movement tends to advance: â€”

If the Presbytery, after exhausting all ordinary means, shall find that the ends of the ministry are still not being served ; that there is pn'mS /ocie ground to believe that the responsibility for this state of things rests mainly with the minister ; and that there is no reasonable hope that these ends will be served by a continuance of his ministry in that congregation ; they shall prepare a full and explicit statement of tÂ£e facts and grounds upon which they have come to this conclusion, and shall hear the minister and other parties thereupon. If, after due hearing of parties, the judgment of the Presbytery shall be that there is no hope of the ends of the Christian ministry being served in that particular congregation under the existing pastorate, they may, on such pecuniary provision being made for the minister as in the circumstances of each case the Presbytery shall deem equitable, dissolve the pastoral tie ; but without prejudice to his ministerial standing, and subject to complaint and appeal in the ordinary form.

There has been little time and less practical experience to test the effect of this departure from the immemorial law and practice of the Presbyterian Church, which went far to secure, even in unendowed churches, the in- dependence of her ministers. But it seems likely to affect unfavourably the supply of high-class candidates for a sacred ofB.ce, the independence of which, even when hedged about by constitutional safeguards, is often men- aced by the unscrupulous exercise of money power.

Other features in the development of Presbyterianism in the United Kingdom are more specifically associated with individual Churches.

Scotland.

In the Church of Scotland by far the most import- ant change was the abolition of patronage in 1874. It exercised a powerful influence upon the Scottish people, for it was the uprooting of the main cause of alL the alienations and secessions from the National Church. The Act of 1874 gave back to the people the right to elect and call the minister to a vacant parish. What- ever effect it may have had in other respects, there is no doubt that it restored the affections of many of the peo- ple to the mother Church and caused them to return to her fold. Prom that

time the increase in her member- ship has been rapid and continuous. The number of her communicants in 1874 was 460,464 ; in 1890 they had increased to 593,393 ; in 1901 the number was 661,629, and in 1902 it was reported as 668,336. The increase from 1874 to 1902 was 207,871, a yearly average of 7424. Contemporaneous with this movement of the people back to the Church, there has been within the Church a grow- ing earnestness in promoting deeper spiritual life and in fostering organized Christian effort. Much work has been done among the young by the formation of guilds. The work of women has been recognized and encouraged. The ancient order of deaconess has been revived, and institutions founded in which women are trained for missionary work at home and abroad. The liberality of the Church has shown decided improvement, home and foreign missions have been better supported, large sums have been raised for the endowment of new parishes and for the better endowment of poor ones, the care of the toiling masses has come close to the Church's heart, and successful efforts have been made to minister to the large migratory population which follows the fishing every

season round the coasts of the British Isles. The volun- tary offerings of the people for 1901, as reported to the General Assembly of 1902, amounted to Â£545,786. This included a munificent gift of Â£62,000 from Lord Mount Stephen for increasing the stipends of certain parishes in his native district. Since 1876 the Church of Scot- land has had on several occasions to meet the crusade of the Dissenting churches for Disestablishment by organi- zation for Church defence. Coupled with this, a fine spirit was manifested towards the Churches outside the Establishment, and suggestions emanated from the Church of Scotland for the inclusion of them all within the Establishment, even at the expense of sharing with them her own privileges and endowments. The statis- tical return to the General Assembly of 1902 gave the number of parishes as 1391, of non-parochial churches as 217, of preaching stations and missions as 207, a total of 1815. Since 1875 the church accommodation has been increased by 184,870 sittings. Since the Disruption 420 new parishes have been endowed, at a cost to the Church of Â£1,547,000.

The outstanding feature in the history of the Pkbe Chukch and the United Presbyterian Church after 1875 was the desire, expressed in repeated efforts, to accomplish the incorporating union which was at length effected in October 1900. The Eree Church left the Establishment in 1843 strongly holding and frequently asserting what was called the Establishment principle. In the minds of her younger ministers this principle was gradually obscured by the splendid success of her practical voluntaryism, until at last, most of the "Dis- ruption fathers " having passed away, it became possible to subordinate it to the expediency of uniting with a Church which was voluntary not only in practice but also in principle. Under the influence of a brilliant leader, successive General Assemblies by increasing majorities declared in favour of regarding the "Estab- lishment principle " as a non-essential doctrine of the Eree Church. Eventually the union of the Free Church and the United Presbyterian Church was "brought about on the understanding that the question as to the lawfulness of State endowments should be an open one." It is impossible to predict the effect of this union upon the Churches themselves, or upon the general ecclesiastical history of Scotland. The two Chiirches, differing widely in historical origin, traditions, and ad- ministrative methods, may for a time have to expend their energy on consolidation, internal adjustment, and assimilation. Agitation in favour of Disestablishment may henceforward be less emphatic, hampered as it will be by the presence of many in the united Church who conscientiously hold the " Establishment principle " and long for a reconstruction of Scottish Presbyterianism within the National Church. The heroic self-sacrifice of the Eree Church ministers in 1843, the splendid liberality of her people, her marvellous power of organi- zation, and the fervour of her evangelical teaching, won the admiration of all the Churches and gave a powerful impulse to the religious life of the country. The con- spicuous missionary achievements of the United Pres- byterian Church and her fearless advocacy of religious equality and freedom gained for her also a place of honour among sister Churches. The union of 1900 was therefore regarded with special interest, and took place amid almost universal congratulations and benedictions. Great things are expected from it, and its spiritual fruits will be hailed with joy.

The following statistics of the United Free Church were presented to the General Assembly of 1902 : Congregations 1630, preaching stations 72, communicants 495,259 ; raised for home missions Â£20,051, for foreign missions Â£123,‘055, for all purposes Â£1,056,-347.

S. VII.â€” 114

906

PEESBYTEKIANISM

Two small todies of Presbyterians in Scotland continue to main- tain a separate existence. One is a remnant of the Reformed Pkesbyterian Chdrcii, which united with the Free Church in 1876. It consisted in 1899 of 9 congregations, 8 ministers, and 1040 communicants. The other claims to represent the United Okigikal Secession Church, and consists of 29 congregations, 24 ministers, and 3769 communicants.

England.

The union of the Presbyterian Church in England with the English congregations of the United Presbyterian Church of Scotland, which took place in 1876, gathered all English Presbyterians (with a few exceptions) into one Church, the Presbyterian Church of England. ” What kept these bodies apart was their separate historic origin and development, but especially the alienation caused by the ‘ Voluntary controversy,’ which had its roots in the difficult problems of State law in its relation to religion, and the stumbling-block of the civil magistrate’s authority in relation to the Christian conscience.” ^ Since the union the growth of the Church is indicated by the following figures : â€”

1876. 1901.

Congregations . . . 259 326

Communicants 51,013 78,024

Sittings provided . . . 134,146 167,945

Value of church buildings . Â£973,485 Â£1,378,525

Presbyterianism is comparatively strong in three districts of England, namely, Northumberland, Lancashire, and London. Elsewhere it is either weak or non-existent. As yet it is largely an exotic. The membership is mainly Scottish, and the ministers have been imported principally from Scotland. Hence a distinctly Scottish accent and a Scottish type of theological thought in the pulpit ; Scottish methods in church arrangements, and Scottish manners in religious worship. To the English people, therefore, the Presbyterian Church is ” the Scottish Church,” and they are slow to connect themselves with it. Though they see much in it to admire and approve, they look upon it as meant for the Scots rather than for themselves. Here and there a different state of things prevails, but this is the attitude of the English people as a whole. Earnest efforts have been made to counteract this feeling by making the Church more distinctively English. Hymns and organs were introduced earlier than elsewhere. The technical nomenclature of Presbyterian procedure is being modernized so as to be better understood in England. Eor a similar reason, Presbyterian procedure itself is some- times modified. This readiness to make changes in her polity is regarded by some as a dangerous symptom ; by others it is hailed as the indication of an open mind and a desire to make progress by adaptation to environment. Eollowing the lead of the Independents, who set up Mans- field College at Oxford, the Presbyterian Church has founded Westminster College at Cambridge. It was opened in 1899. It is hoped that it will do much to ensure a home-bred and home-trained ministry more con- versant with English academic life and thought.

The most notable feature of the Church’s work is her foreign missions. The field is mainly China, and the results attained are remarkable, as the following statistics will show : â€”

Ordained European missionaries . Medical missionaries .... Lady missionaries (including two

medical)

Native pastors supported by their own

congregations . Native Evangelists Organized congregations Preaching stations Communicants There are also in England 14 congregations in connexion with

1 Drysdale's History of the Presbyterians in England, p. 625.

1876.

IflOl.

12

21

3

13

...

27

34

49

260

14

87

52

123

1974

the Church of Scotland, namely, 5 in Berwick and Northumberland, 1 in Carlisle, 2 in Liverpool, and 6 in London. The number of communicants in 1900 was 3799.

Many Unitarians in England call themselves Presbyterians. This is a misnomer, for though descended from the old English Presbyterians, they retain nothing of their distinctive doctrine or polity â€" nothing of Presbyterianism, indeed, but the name. This is retained on account of ancient Presbyterian endowments which they continue to hold.

Ireland.

The Presbyterian Church in Ireland, most con- servative of the great Presbyterian Churches in the United Kingdom, has during recent years passed through some phases of development which the others reached consid- erably earlier. After heated discussions in her General Assembly for many years, she has come abreast of the sister Churches in regard to the use of hymns and organs in public worship. Her attitude is one of sturdy adherence to the old paths of Evangelical doctrine and Presbyterian polity. She zealously supports the Irish system of national education, which may be briefly defined as "united secular and separate religious instruction," and she declines to be bribed by the offer of a Presbyterian university in Belfast to consent to the formation of a Roman Catholic university in Dublin. The Church Act of Mr Gladstone which disestablished the Episcopal Church took away the Presbyterian Regium Donum. Her ministers, with all but entire unanimity, decided "to commute in the interests of the Church." The Com- mutation Eund thus formed is a permanent memorial of a generous and disinterested act on the part of her min- istry. It amounted in 1902 to Â£588,028. The interest accruing from it is added to the yearly Sustenation Fund contributions to form a strong central fund for ministerial support. Since the State endowment ceased, the average income of her ministers has increased by about Â£30 a year.

Statistics show that whilst Ireland lost about a quarter of a mil- lion of its people during the decade 1890-1900, the Presbyterian Church is

numerically almost the same as in 1891. Returns presented to the General Assembly in 1902 give the following particulars: Congregations 574, ministers and missionaries 655, communicants 106,121, amount raised in congregations and Sunday schools Â£229,307, collections for missions Â£18,892, Out- side Ulster the number of strong, self-supporting congregations is small, but hearty support is given to weak congregations and mission stations in the south and west of Ireland. The Presby- terian Orphan Society was founded for the purpose of undertaking the support of every poor orphan child throughout the Church. No Presbyterian orphan now needs to seek workhouse relief. The orphans are boarded in the homes of respectable poor people, who thus also benefit by the Society. A training home for girls forms part of the scheme.

Three small bodies of Presbyterians maintain a separate existence, namely, the Reformed Presbyterian Church, with 36 congre- gations and 4040 communicants ; the Eastern Reformed, with 6 congregations and 700 communicants ; and the Secession Church, with 10 congregations and 123U communicants.

Wales.

The Presbyterian Church op Wales, formerly better known as ” The Calvinistie Methodists,” had its origin in the great Evangelical revival of the 18th century. Its polity has been of gradual growth. In 1811 its preachers were first Presbyterially ordained and authorized to ad- minister the sacraments. In 1823 a ” Confession of Faith ” was adopted. In 1864 the two Associations (or Synods) of North and South Wales were united in a “General Assembly.” The progress and present strength of the Church are indicated by the following figures :â€”

Ministers Communicants Churches and stations

preaching

1850.

1^82,

1901.

172

616

834

58,678

122,167

160,333

848

1372

1679

P R E S C 0 T â€” P R E S T 0 N

907

In 1901 the Church raised for all purposes Â£305,745. Of this sum, Â£14,407 went to missions, Â£9041 to Sunday- schools, Â£2899 to the poor, and Â£67,494 to reduce the debt on church buildings. (w. y.)

United States.

Although Presbyterians are closely united in America, twelve distinct organizations exist. The total number of Presbyterians at the beginning of the 20th century was 1,945,106. The Sunday-school teachers and scholars numbered 1,829,336. The largest body, known as The Presbyterian Church in the United States of America, had a membership in 1900 of 1,007,689. In 1880 the whole number of members reported was 678,671. The Presbyterian Church in the United States, commonly called the Church South, which separated from the main body during the Civil War in 1861, reported in 1900, 226,890

members. These two bodies differ only regarding civil relations, and the separation is simply an expression of disagreement concerning relations to the Government. When the happy reunion of the Old School and New School Churches was accomplished in 1869, it was the hope of many that the spirit of union would bring to- gether again those who had been separated by the bitter- ness of war. Conferences have been proposed by the Northern Church frequently since the division, but up to 1902 these had not led to union. There is, however, a growing desire for fraternal federation, and it is the conviction of very many that the near future will bring to Presbyterianism the power of such federation. This federation, it is believed, will include all the organiza- tions known as Presbyterian. Tlie United Presbyterian Church, the result of the union of the Associate and Associate Reformed Churches, accomplished in 1868, numbered 128,836. This Church represents a fine type of Presbyterians, the descendants of the Scottish and Irish loyalists who did not count their lives dear when truth was to be defended. The United Presbyterians are much closer to other bodies bearing the Presby- terian name than they were in 1876. New versions of the Psalms, instrumental music, and less vigorous pro- test against secret societies, together with a frequent exchange of ministers and members, are all significant signs of closer fellowship in work, if not actually signs of organic union. Hie Cumberland Presbyterian Church reported a membership in 1900 of 180,192. This organi- zation flourishes chiefly in the South. It is not strictly Calvinistic in doctrine, but is Presbyterian in polity. Whether the revision movement in the Presbyterian Church may win the Cumberland Presbyterians into closer union, remains to be seen. But it is not likely that there will be any such modification of the Calvinis- tic faith as could satisfy the more liberal belief of this body of Presbyterians. There were thirteen thousand Welsh Presbyterians, and nearly thirty thousand other Presbyterians divided into half a dozen smaller organi- zations. There were also more than three hundred and sixty thousand Church members belonging to the Re- formed Churches, which are closely associated with Presbyterians in faith and in government. They stand together in the defence of a common system of doctrine, and the government of the Churches is very similar. These organizations, Presbyterian and Reformed, comprise the Alliance of the Reformed

Churches, which was formed in 1875, and has since held several general councils. Two of these councils have been held in the United States, four in Great Britain, and one in Canada. Ninety separate Churches or denominations comprised this great Reformed Presbyterian Alliance. These Churches re- presented five continents and twenty-five millions of adherents.

The Presbyterian Church in the United States of America has since 1880 enjoyed signal prosperity. In 1880 it included 177 presbyteries-; In 1900, 232. There were 600 candidates for the ministry in 1880 ; in 1900, 973. There were 6044 ministers in 1880 ; in 1900, 7467. In 1880 there were 5489 churches ; in 1900, 7750. Over 57,000 members were added to the Church in 1900 by examination and 40,000 by church letters. The whole member- ship in 1900 was 1,007,689, whereas in 1880 the number was 578,671. The Sunday-school membership in 1880 was 631,952 ; in 1900, 1,058,051. $429,769 was given for home missions in 1880, and $1,088,367 in 1900; $420,427 for foreign missions in 1880, and in 1900, $822,811. $6,098,150 was con- tributed for congregational purposes in 1880, and in 1900, $11,372,383. The total contributions of the Church in 1880 were $8,361,028, as compared with $15,054,301 in 1900. These contri- butions do not include the personal gifts of members of the Church to charitable and educational institutions. 1371 missionaries were employed in the home field during 1900, and 728 missionaries, with over 2000 native helpers, in foreign countries. The Board of Church Erection has secured church property valued at $14,500,000. The Board of Relief has under its care 363 ministers and 483 widows of ministers. The Board of Missions for Freedmen, which was organized in 1865, is represented by 340 churches and 20,000 members. 10,000 scholars are instructed in 80 day schools. This Board has also under its care 18 boarding schools, and supports 231 teachers. The Biddle University in Charlotte, North Carolina, is intended for coloured students, and eleven of its twelve pro- fessors are coloured men. Lincoln University, near Oxford, Pa., which is independent of the Board but connected Vfith the Presby- terian Church, has an able faculty, is liberally endowed, and is concerned specially with the education and elevation of the coloured race. Through the Board of Aid for Colleges and Academies, old colleges have been strengthened, and

new colleges and academies have been planted, particularly in the newer parts of the country, and the work of higher education has been fostered. Nearly $200,000 was so distributed in 1900 by this Board. There are 14 theological seminaries in connexion with the Presbyterian Church. Three large and prosperous hospitals have been estab- lished by the Church â€” one in New York, one in Philadelphia, and one in Chicago. There is a disposition in other cities to provide Church hospitals for the benefit of the poor. The charity of the Church is expressed also by homes and asylums of various kinds, and by many forms of mission work. The Presbyterian Church resolved to mark the advent of the 20th century by a great forward movement. While the synods are giving special attention to the increased endowment of colleges and theological seminaries, the Presbyteries are encouraging the churches to pay ofi their debts and to contribute money for the organization of new churches. Already gifts amounting to several millions of dollars have been received. This forward movement is both the cause and the result of a spirit of unity in the Church. Twenty years of discus- sion have ended in a harmonious and hopeful determination to find a satisfactory solution of the question that has so long disturbed the Church. Three-fourths of the Presbyteries having indicated a desire that there should be some revision, the General Assembly of 1901, by a vote of three to one â€” and finally by a unanimous vote â€” determined to have prepared (1) a Short Statement of doctrine for popular use and information, and (2) a Declaratory Statement, which might remove misapprehension regarding a few confessional statements ; or, if necessary, revision by a change of text. These statements, however, could not be adopted without the prior approval of the General Assembly, and, this being given, the adhesion afterwards of two-thirds of the Presbyteries â€” that is, by more than 150 Presbyteries. (c. A. D.)

Prescot, a, market-town in the Ormskirk parlia- mentary division of Lancashire, England, 8 miles east of Liverpool by rail. The streets are lighted both by electric light and gas, and the town has been connected by tramway with St Helens. A large factory has been built for the complete making of watches. There is also a manufacture of electric cables. Population (1891),

6746; (1901), 7855.

Preserved Fruits. See Canning.

Pressburg. See Pozsont.

Preston, a municipal, county, and parliamentary borough, seaport and market-town of Lancashire, England, on the Ribble, 209 miles north-west of London by rail. Since 1880 the municipal borough has been successively extended. In 1894 the townships and parts of townships within the limits of the county borough were consolidated into one civil parish. The parliamentary borough returns

two members. St Stephen's church was erected in 1888, and St Jude's in 1893. A new Harris Free Public Library and Museum was opened in 1893, and to this building was transferred in 1894 the free library of 1879. Â£40,000 has been given by the Harris trustees towards establishing a technical school, and part of this sum has been spent on a Victoria Jubilee Technical School (1897). A school for the education of the deaf and dumb was opened in 1894. There is one daily newspaper. The construction of spacious docks, in conjunction with the deepening of the river from the quays of Preston to its outfall in the Irish Sea, a distance of 16 miles, begun in 1884, has been carried out at a cost of over one million sterling. The main wet dock, opened in 1892, is 3240 feet long and 600 feet wide. The total quayage is over 8500 lineal feet. The channel of the river has been made straighter, and from docks to sea deepened, so that the dock is now accessible for vessels of 17 feet draught on 'ordinary spring tides. The waterworks are now the town property. Vessels entering port in 1888 numbered 198 of 15,362 tons ; clearances, 198 of 16,462 tons. In 1900 entrances numbered 1223 vessels of 153,903 tons ; clearances, 1183 of 161,298 tons. Imports of foreign and colonial produce in 1888 were valued at Â£7211; in 1900, Â£446,934; exports in 1888 at Â£207; in 1900, Â£14,812. Area, 4089 acres. Population (1881),

96,637 ; (1891), 107,573 ; (1901), 112,982.

Preston pans, a police burgh and coast village of Haddington, Scotland, on the shore of the Firth of Forth, nine miles east of Edinburgh, with a station on the North British railway. If was formerly the principal seat of the salt trade in Scotland, but has now only one salt work. There are a fire-brick and tile work, a brewery, a soap work, and a pottery. There is also an extensive coalfield in the vicinity. An oyster bed, once famous for its Pandore oysters (an esteemed variety), is now scarcely as productive. The cross of the Barony of Preston dates from 1617. The churches are Established and United Free. The pub- lic school had an average attendance of 640 in 1898-99. Prince Charles inflicted a severe defeat here upon the Hanoverian forces, under Sir John Cope, on the 21st of September 1745. An obelisk was erected to the memory of Colonel Gardiner, who fell in the battle. Population

(1881), 2265 ; (1891), 2224 ; (1901), 1721.

Prestwich, Sir Joseph (1812-1896), English geologist, was born at Clapham on 12th March 1812, and was educated at Beading and at University College, London, where, under Dr Lardner, he paid special atten- tion to scientific studies, particularly mineralogy and geology. Up to the age of 60 he was actively engaged in his business, which was that of a wine merchant, and therefore was only able to devote his leisure time to his favourite scientific pursuits. But the journeys he was obliged to make to various parts of Great Britain and the Continent afforded him opportunities of becoming ac- quainted with the geological conditions of many localities, and he was thus able to combine business and science so effectively that he won for himself a high place among the geologists of the 19th century. He began original work early in his career, publishing in 1836 a remark- able memoir on the structure of the Coalbrookdale coal- field, which embodied the results of observations made during visits there in 1831 and 1832. His name is especially known in connexion with his studies on the Tertiary deposits of the London Basin, which he system- atically classified and correlated with similar deposits in other parts of the world. He was further led to investigate their water-bearing characteristics, and his extensive know-

ledge in that respect procured him a seat on the Metro- politan Water Commission in 1867. From about 1868

the question of the antiquity of man specially engaged his attention. On various occasions statements had been made as to the association of flint implements formed by man with the bones of extinct mammals which belonged to more remote periods than those generally assigned for the appear- ance of the human race on this earth, but the evidence adduced had usually been disregarded by geologists as not affording sufficient proof of the point. Prestwich, however, saw the desirability of a closer examination of the facts, particularly in regard to the implements discovered by Boucher de Perthes in the gravels of the Somme valley, and his investigation yielded evidence which was generally regarded as proving that man existed contemporaneously with the Pleistocene mammoth. In 1866 Prestwich became a member of the Coal Commission, the report of which in 1871 contained a paper by him suggesting the probability that a range of coalfields extended from Somer- set to south-eastern England. He was inclined, however, to consider that the coal-trough would be found to lie in Essex and Hertfordshire, rather than on the more southerly line favoured by Godwin- Austen and actually verified by sub- sequent borings. After retiring from business in 1872, he was elected to the chair of geology at Oxford, and retained it till 1888. His two volumes on Geology: Chemical, Physical, and Stratigraphical, were the product of this period. He was knighted in 1896, and died on 23rd June of the same year at Shoreham, Kent.

Pretoria, city of the Transvaal Colony, British South Africa. It was the capital of the South African Republic since 1855, the seat of government being trans- ferred from Potchefstroom after the death of Pretorius, in whose memory Pretoria was founded and named. It is pleasantly situated about 4500 feet above sea-level, near the southern slope of the Magaliesberg Range, which is here pierced by the Aapies headstream of the Limpopo. Like most of the Boer settlements, it was laid out on a regular and somewhat ambitious plan, with broad streets and boulevards disposed at right angles to each other, and ample enough to accommodate some 100,000 inhabitants. But Pretoria, which

suffers from the rivalry of the neigh- bouring Johannesburg, has remained a small place, with a population estimated in 1899 at not more than 10,000 whites and perhaps half that number of natives. As a railway centre it is the converging point of the main lines from Delagoa Bay, Natal, and Orange River Colony, with extensions running north to Pietersburg and south- west to Potchefstroom and the Klerksdorp goldfields. In Church Street, the chief thoroughfare, stand several fine blocks, notably the former Raadzaal (Parliament House), an imposing structure, the ” architectural glory” of Pretoria, crowned by the statue of Liberty, rising 120 feet above the pavement. In the northern outskirts is the perennial spring, where still flourishes the Wonderboom (” Wonder Tree “) which first attracted the voortrekkers to the spot ; and a little farther north is the Waterval station on the Pietersburg railway, where were laagered the British prisoners captured during the war. All were released soon after 31st May 1900, when the capital surrendered to General Roberts without resistance, despite the formidable-looking encircling forts, now dismantled, â€” Wonderboom, Daspoort, Schanzkop, and Klapperkop, â€” which, however, were so elaborately designed that they were never effectively armed.

Prevesa, the capital of a sanjak, in the vilayet of Janina, European Turkey, at the entrance to the Gulf of Arta. The houses are for the most part embosomed in gardens, and magnificent olive plantations surround the town. The chief exports are wool, butter, cheese (to the yearly value of about Â£14,000), olive oil and olives, valonea,

skins, and coal. The total value of the exports in 1900 was Â£35,243, as compared with Â£31,100 in 1898; the value of the imports in the same years being Â£45,567 and Â£46,600 respectively. A hindrance to the commercial prosperity of the port is the impossibility of large steamers entering the harbour owing to a bar of sand, which reduces

the depth of the gtilf to 10 feet. The number of vessels that entered the port in 1900 was 1374 of 100,296 tons, as compared with 1785 of 98,761

tons in 1898. The population is estimated at 11,000, of whom about one-fifth are Moslems, the remainder being Greeks and Chris- tian Albanians.

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PREFATORY ESSAY.

THE FUNCTION OF SCIENCE IN THE MODERN STATE.^

By Karl Pearson.

I. Science and the Structure of the Modern State.

BEFORE the second half of the 19th century a true theory of the state was impossible. A sound idea of mankind as but one among many types of life, even if the highest type, had hardly entered men's minds ??? they were accustomed to contrast "nature " and "man." But had it entered, they knew so little about the laws governing any form of life, that they would not have gained much by extending the little known to man. Not till the publication of Darwin's epoch-making works was a real theory of appreciation of man's position in the evolution of living forms possible, and with this apprecia-tion all the old theories of the state became practically idle ??? landmarks only in the study, e vet-interesting to man, of the history of human thoughts and theories. A complete revolution was wrought in the ideas of those who read and understood Darwin, both as to the nature of the state and as to its functions. The theory of the state could no longer be treated from either the philosophical or the purely logistic standpoint. The state was the product of an historical evolution ; the nation was a unity evolved by the struggle of one living type under the same laws as applied to other phases of life. The theory of the state became biological: one of the most complex and difficult branches of biology no doubt; but still it was a great step to remove this theory from philosophy ??? or even from metaphysics, as in the case ???of Hegel ??? and transfer it to its true class.

It is little wonder, perhaps, that the first investigators in this new field went widely astray. They extended without due thought fascinating biological hypotheses to the case of man. They found the struggle of individual against individual in many vital fields, and they extended the survival of the fitter as a governing principle to all individual life within human communities ; they did not stay to inquire why and how communities had themselves

come into existence; they neglected the suggestions of the hive and the herd, and reached (as in the cases of both Spencer and Huxley) fallacious conclusions as to the functions of the state and the sources of social conduct. In short, they over-emphasized the intra-racial struggle, and under-emphasized the inter-racial contest, as factors producing and developing the political and moral characteristics in man. Other state theorists, again, accepted without qualification some doctrine like that of panmixia, unproven or even disproven for the lower types of life, and heedlessly applied it to civilized man. Nor were these over-hasty conclusions to be entirely condemned: by the discovery of the doctrine of evolution by natural selection, an absolutely new country had been thrown open, with endless possibilities for thought and action. What wonder if publicists, with no

1 It must be understood that this is the briefest sketch of a vast and all-important subject, where the writer has not been able at every turn to develop detailed plans, but only to outline suggestion and criticism.

sound biological training, indeed no scientific training whatever, rushed in with jubilation to be among the early settlers ? What wonder that biologists, with smaU historical knowledge, even without intimate acquaintance with the exact social history of any human community for the briefest of periods, extended at once great vital principles beyond their legitimate limits ?

We can scarcely be surprised that some false views as to man and the state were propounded under the new impetus, or that some mistakes were made even in social legislation. Eeaction was certain to come, and the cycle was completed, as usual, by a German professor demonstrating all Darwinian theory to be snare and delusion.

Let us then at the present moment take stock and see where we actually stand. The main

principle of evolution by natural selection is based upon four factors :
??? (a) That characters are variable.

(h) That characters are inherited, (o) That there is a selective death-rate, i.e., that individuals

Darwinian ^ ⬛⬛⬛’ ^ ^ j r i,

theory and possessing characters or combinations of characters in a higher or less degree than other “^”’ individuals die, on the whole, sooner or later than the latter, (c?) That those individuals who

die early leave fewer offspring than those who die late. How far are these factors demonstrable truths in the case of civilized man ?

(a) This is beyond question for both physique and intelligence in man.

(by This is absolutely certain for both the mental and physical characters in man. Both these are sensibly inherited at the same rate and, further, with such a degree of intensity that three, or at most four, generations of selection will suffice to establish a race in man which will breed true to itself under a stable environment.

(e) By observations on the death-rate of relatives ⬛⬛⬛ i.e., of groups of individuals possessing like characters or combinations of characters ⬛⬛⬛ it has been demonstrated that 50 to 80 per cent, of the deaths among mankind are selective.

{d} This has been statistically demonstrated for both sexes in Great Britain, America, and Australia.

We are forced, then, to the conclusion that the Darwinian theory in the case of mankind is a law and not a, “plausible hypothesis.” It is a different problem to measure the rate at which evolution works. What sensible modifications can be made within 200, or even 8000, years in a human race by evolution? Recent craniological investigations seem to show that, even within the shorter of these periods, such changes can occur in the shape of the skull of a single race that 50,000 years or less would suffice to have modified the cranium from a type which any modern anatomist would hesitate to call human. The argument is not that the human skull has always gone forward at this rate, but that it could do so under apparently quite

ordinary conditions. In other words, the biologist’s demand for time must not be looked upon as indefinitely exceeding what the geologist is prepared to grant.

Such is our modern stock-taking ††† a possibility of the work done between 1890 and 1902 ††† of the relation of the Darwinian theory to man.

But if we only apply the principle that all life progresses by the struggle of individual against individual to the history of man, we find half the facts of both social and political history wholly unintelligible. We have missed the great point, that man has largely progressed because latioaar ^†† ^†† grcgarious ; we cannot describe on such a basis the evolution of morality, the origins straggle of tribal customs, tribal worship, national institutions, national religions, and, ultimately, of existence, the modern state. We might as well attempt, on the basis of the survival of the fitter individual, a satisfactory explanation of why Sir Harry Johnston’s African ant gave forth, when trodden on, a most appalling stench, so skunk-like that the destroyer fled from the spot. The welfare of the whole has controlled in this case, as in others, the development of the individual. The community in its entirety is struggling against its vital and physical environments. As soon as we interpret the facts of history in the light of progress by inter-racial struggle, and only in a secondary manner by intra-racial competition, those facts become deeply suggestive and significant for our guidance. We see both Roman and Hebrew nations arising from very small beginnings by successful variations in tribal custom and belief. We no longer mourn over the apparent waste of power in the continuous wars of the small Greek communities : we see in that strife the probable source of their rapid progress

in intelligence and physique. Nay, modern Europe itself at once becomes the stage whereon the drama of evolution is being played out amid the hum of factories, the clash of armaments, and the buzz of youth in the playing-field and the lecture-room. History has painted for us the ever-present strife of nations : in the lower stages we see the victory of brute-force and of

cunning ; in somewhat higher stages we find the dominance of strength, valour, and discipline ; at the present the factors of mastery are possession of material sources and the skill to turn them to account, ??? the copious store of knowledge, the power to increase it at will, and the intelligence to apply it for the national profit. The struggle of nations is the commonplace of history ; but the realization that this struggle is a factor in human develop- ment,??? ^that big battalions or an armada are not sufficient insurance for success in it, but that organization and intelligence in every function of national life are requisite for victory, ??? this is the special truth that dawned upon us at the end of the 19th century. Formerly territory was blindly seized, trade routes and commercial markets blindly opened or controlled, manufacturing processes and means of transit developed or not, according as they might seem profitable or not to individuals. The bearing of these things and a multitude of others ??? such as the physique of the nation, the skill of its craftsmen, the intelligence of its trade-leaders, the activity of its educators, the organization and preservation of its material resources ??? was unrecognized in their relation to national fitness for the international struggle. The politician could tell the nation that it must have more ships or more rifles for the national safety, or he could emphasize the importance of the ” open door ” for national welfare, but he did not provide for the intelligent building of the ships, the intelligent sighting of the rifles, the intelligent training of the merchants who were to enter the open door amid the great international crush to get inside. He did not. see that ultimately the training of even the apparently most insignificant workers in the community, the fitness for its purpose of the simplest manufacturing or agricultural process, may be vital to a nation in the evenly balanced contest of modern civilization. To stand still ??? for a moment to depend only on the possession of material resources, of the existing trade routes, or of means of transit ??? is to lose points in the game. Where all are pressing forward, not to advance is to fall behind.

Let us consider for a moment some of the factors of national welfare. First, the physical powers

of the nation ??? vital: its numbers and effective fertility, its health and sanitation, the energy, vigour, and

absolute strength of individuals ; material: mineral wealth, sources of mechanical energy, coal.

Factors ot n ###, ### i i i- j .

national oil. Water power, water and rail transit, docks, coaling stations; equipment: power to seize saccess. ^^^ power to hold. Secondly, the mental powers of a nation ### power to carry out mechanical work quickly and effectively; power to discover and power to imagine, to incite and to stimulate: ### morale and patriotism ; power to resist long strain, to avoid epochs of national hysteria, to follow for years definite policies with only future profit in view, to govern effectively, or ultimately assimilate divergent racial groups. On examination, each one of these and other factors of national efficiency will be found to require intelligent handling : they demand training and knowledge ### science in its broadest sense ### if ‘the stability of the state is to be maintained and increased, if the nation is to contribute its full share to the total progress of human activity.

The future is to the nations which not only realize the international struggle in all fields of activity,

but consciously develop all the factors of national efficiency with this end in view. This is the theory

of national life which presents itself at the beginning of the 20th century. It connotes

Trained la- an immense development of the functions of science in both legislature and executive. It

teiiigeace gj^Quld lead to new conceptions of, and new scope for, patriotism, and a revised attitude

ot national ^ -r, j!

fitness. towards state action and state service. Brute force, strength and bravery, material wealth, have in turn been dominant in the state ; to-morrow will be marked by the dominance of intelligence. The most

intelligent nations will be victorious in the struggle ; and it befits each state that would be great to-morrow as well as to-day to educate and organize itself, from the statesmen at the top to the ploughboys and factory hands at the basis. In the future it will not be possible either to organize and lead a nation or to make a cheese effectively without training ††† without a knowledge of what science has to say about men or milk.

S. VIIL ††† &

X PEEFATORY ESSAY

The education of the nation, from statesman to dairymaid, is a task of great magnitude ††† more especially in old countries, where the institutions have developed historically, and often preserved features

of earlier periods, when other factors than intelligence were dominant in national life. On canee of the Other hand, the older nations possess traditions and divisions which are not without service raste^”’’ ^†† rough results of experience. Caste and class may be exaggerated so much that they do far

more harm than good, but to a certain extent they may serve for differentiating workers within the community. The nation stands equally in need of its ploughmen, its craftsmen, its traders, its brain-workers, and its leaders; and it is desirable to have some preliminary classification of what work an individual is best suited for. While, on the one hand, it is most important that all capacity which will be of special social service in performing a particular function shall find that function within its reach, it is, on the other iiand, not only undesirable, but impossible, to subject every individual in the nation to a test of fitness for every possible calling. With rough practical efficiency a man’s work in life is settled by his caste or class. This is not so undesirable as it might at first sight appear; it is a largely unconscious differentiation of the nation into workers of different types, who marry within their caste, and ††† if we remember how few generations are needful for a special human group to breed true ††† thus preserve to a large extent their special usefuLaess. We need a net which will be widely cast to drag upwards, and a similar net to drag

downwards, but the meshes of neither of these nets should be too small. It is cruel to the individual, it serves no social purpose, to drag a man of only moderate intel- lectual power from the hand-working to the brain- working group ; yet this seems too often the result of the present system. If there be a moderately capable worker, the state should strive, in the first place, that he should be trained to better craftsmanship. Do not let it assume that he will turn out a Faraday because he shows some relative capacity. In at least nine cases out of ten disappointment will be in store for the state if it does. Let there be a ladder from class to class, and occupation to occupation, but let it not be a very easy ladder to climb ; great ability will get up, and that is all that is socially advan- tageous. We have to remember, for example, that the middle class in England, which stands there for intellectual culture and brain-work, is the product of generations of selection from other classes and of in-marriage. A hundred men of this class, quite apart from training and tradition, will provide a greater percentage of men capable of doing brain-work, than a hundred men from the farming class, or a hundred craftsmen. 1 These in their turn (if we do not regard training and tradition, though there is no reason why we should not) will produce a larger proportion of men suited for colonists or for the workshop than the former, and for precisely the same reasons ??? long selection and in-marriage. Again, we assert, the gradation of the body social is not a mere historical anomaly ; it is largely the result of long-continued selection, economically differentiating the community into classes roughly fitted to certain types of work. And here we reach the first fundamental principle in the education of a community : the education must be specialized for each individual class of workers^all intelligence must not be driven through the same miU. The system under which local colleges ape universities, polytechnics ape local colleges, night-schools ape polytechnics, and all think it the highest merit to get their students stamped with a degree of one kind or another, is an utterly fallacious one ; it is educational chaos, and has not the slightest approach to that harmonious system of education differentiated to class-function and class-intelligence, which must be at the basis of national fitness, i.e., the readiness of each group in the community to do its specialized work efficiently. Let there be a ladder then, that indisputable capacity may climb to the place where it is most wanted, but the nation needs that the great bulk of its members shall work at the same tasks as their forefathers, only with increased intelligence and more highly developed craftsmanship.

1 The cry for ” an easy ladder ” is a most mistaken one, especially as long as any false feeling of gentility attaches to one or another class of workers. During the last few years the writer has come largely in contact with a number of young men and women whom the county councils up and down the country are educating at the national expense. These county council scholars are on the average not up to the mean middle-class intelligence. It is very rarely that one could not pick out for any given post better, often many better middle-class candidates. In this case the meshes of the net are far too small : ten per cent, of the scholarships would have sufficed to procure the really capable men and women whom it was of social value to educate for intellectual pursuits. The rest want either the originality, the power of self-assertion, or the physique which would enable them to force their way forward in a new sphere. The bitterness of failure is upon those, who, scholarships ended, sink to usherdom in small private schools, or to second-rate draughtsmen in engineering works. Taught in true craft^schools, they might well have been leaders in their own class, instead of failures in another.

PREFATORY ESSAY XI

Make it easy for the Michael Faradays to climb, but only for such as he was ; the increase of the intel- lectual proletariat is a sign not of efficiency but of chaos in national education.

If national education at the present day be a sine qud non of national fitness for success in the

world-struggle, it must none the less be a specialized education suited to develop the intelligence of each

caste and class. Training is essential to a nation, but it must be specialized to each social

Need of ××× . . .

speciaiiza- activity, if it is to perform its function. How is this truth to be brought home to the states- *educatioa ××××××^^’ ^^×× permanent officials, or the politicians, who alone can bring order into educational

chaos ? The statesmen of the old school, blamelessly ignorant of the laws of national develop- ment, were inclined to look upon race-progress as due to mighty forces beyond human control, and thus to believe that executive and legislature could do little to make or mar national welfare. But as we learn to understand better the laws ruling living organisms, our appreciation of the factors in human history changes : man cannot modify the law of gravitation, but he can make its effects subserve his own ends ; and this is equally true of the laws which rule organic and inorganic material.

Unfortunately the training of the statesman himself is often sadly defective ; he rarely stands at the summit of the knowledge of his day, or has the instinct to select his subordinates for real organiziug

power. In a democratic state the process by which the statesman is chosen is at best a risky of the one. His requirements are, first, ample private resources ; secondly, power to impress a possibly

weU-meaning but largely ignorant democratic electorate ; and lastly, ready debating power and personal influence on the somewhat narrow group, chiefly of his own type, which is to be found in the average representative assembly. There is no security in these requisites for a training in statecraft. The race-leaders and potential empire-builders rarely find their way into representative assemblies. The men who could organize a great national department, or even organize the nation itself, devote their energies to the building up of world-wide commercial enterprises to their own profit, or to the profit of a narrow circle. And when such men have convinced the world of their business capacity, of the shrewdness with which they can appreciate new ideas and forestall the future, they are already beyond their prime. They have no longer the inclination to learn the complex routine of parliamentary life, or the power to stand its physical strain. One of the most difficult problems for the democratic state is to make state service in its highest branches a career for such men in their youth, and thus allow the nation to exploit at once and directly their power of initiation and organization. Still more difficult, perhaps, is the selection of statesmen in the case of an oligarchy. The nation which bred and trained a specialized class of men solely for statesmanship would undoubtedly be best governed under such a true aristocracy. But in practice the existing false aristocracies

fall far short of serving any such state function. There is no security that the dominant caste represents either the intelligence or the organiz- ing power of the community. Even if the caste be based on wealth-accumulating power or state- service of ancestry, there is no security for the brain-power indicated in past success being preserved by inheritance, unless the maintenance of family ability becomes a far more conscious guide in the arrange- ment of matrimonial alliances than it appears to be in any aristocracy of the present day. Further, little, if any, specialized training has hitherto been provided for such a class beyond the educative experience of men and manners ††† which may legitimately be considered a trifle narrow ††† to be gained in a parlia- mentary career and the earlier stages of executive life. Without proper selection or fitting training the statesmen of the oligarchy may forget inter-racial competition under the bias of class interest, and the intra-racial dominance of a caste become the chief object of a false statecraft..

A secure autocracy hardly affords a like foothold for intra-racial struggle weakening the effective response of a nation to its environment. But its success depends so entirely on a single throw of the ^Iqq ††† the discovery of a man with unique powers of selecting intelligence and organizing ability in his immediate subordinates ††† that it need hardly be considered as a practical form of government. The discovery of the ideal dictator is a problem which finds not even an approximate solution in elected presidents, still less in hereditary autocrats. It is true that revolutionary processes by which the really strong man comes to the top may occasionally aid a nation at a time of crisis, but they are too expensive in other ways to be aught but a counsel of despair. Historical evolution has left most civilized nations,

after a rough and tumble experience, with a democratic government more or less tempered by oligarchic and autocratic institutions. This may be the best practical solution of the problem in the present stage of national development, but such a system is terribly cumbersome in its processes for ensuring that the keenest brains and the best organizing power of individuals shall be secured as the brains and the organizing power of the

nation at large. If the best trained, the most intelligent community, is destined to be the surviving type of the present century, then the cry must not only be : Educate your democracy ! but also : Select and train your aristocracy for statecraft !

If we may assume, and there is small doubt that we safely may assume, that all qualities in man are inherited, and inherited at such a rate that very few ××× ^two to four ××× generations suffice for selection to produce a class breeding true to itself, then the selection of an aristocracy even by the rough process of ennobling great ability or great wealth (acquired by the owner) is intelligible. But the continuous support by the nation of members of an oligarchic class who have ceased to be of service for aristocratic purposes is futile. In the fourth generation at latest such members should drop put, unless the stock has again proved its capacity by effective national service. The absence of such service will be a sure sign that the original ability was sporadic, that the stock has not bred true, has wasted its intellectual patrimony, or has neglected to train itself for its special functions. The net ××× meshes not too small, let us remember ××× must drag downwards as well as upwards.

The training of an oligarchic class in statecraft is the first and perhaps hardest task of the modern state.

Much, very much no doubt, can be learnt from municipal, parliamentary, and minor executive experience

by the man who from youth upwards has resources and leisure. But such a training alone

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school of is very narrow ; it may be supplemented by leisurely travel, and the somewhat superficial knowledge thus gained of the men of other races, their institutions, aims, and modes of thought. As a preliminary, however, to both travel and political experience, a specialized academic training is really needed. There is a demand for a school of statecraft. The idea is not so absurd as it may at first sight appear ; nor, on the other hand, are the chances of its success so great that every university, local college, and night

school should rush to establish a lectureship in statecraft ! Special schools are best localized at one or at most two centres ; they should grow up naturally by the development in a definite direction of an existing educational centre, which to some extent already attracts the class of men to be catered for. We want a specialization and a modernization, in the light of current biological science, of some existing History School. There should be one school at least, where the political institutions of Germany and France are as well known as those of Greece and Rome ; where the chief phases of Indian religious development are as closely appreciated as the theological currents of 16th-century Europe ; where the 19th-century ” discovery of Africa ” would be discussed and interpreted in its relation to modern European politics, like Columbus’s discovery of America has been dealt with as marking the end of the Middle Ages and the collapse of the mediceval system. There should be one school at least where colonial institutions, aml)itions, and developments are studied and appreciated ; where national customs, racial prejudices, the foreign press, its powers and limitations, are calmly, and apart from political intrigue, investigated and weighed in the balance ; where the students’ own nation, its comparative power and influence, its morale, and its policy are all dealt with in an atmosphere comparatively free from party strife, and at an age A^ hen the mental judgment has not had its roadway worn into ruts by the continual traffic of men and affairs. Sketchy as such a scheme must seem, its realization could only be a growth, yet the absence of such a school of statecraft is a partial, if not complete, excuse for ignorance on the part of the leisured and ruling class of more than one modern nation. A class of great ability and organizing power has not only to be gathered together by the drag-net cast over the other classes of the community, but once formed it must have a high tradition in its choice of mates, and a really effective training provided for its members.

The form of government, the right selection of statesmen, is far more important in its bearing upon the true function of science in the state than might at first sight appear. Unless we have the statesman of insight, who recognizes that every function of the state, every phase of national life, has a theory of its own ; that there is a right and a wrong way of conducting all state business, whether it be con- cerned with the wealth, the physique, the intellectual efficiency, or the morale of a nation ; we cannot

place knowledge ••• science in its broadest and truest sense ••• in its rightful position of consultant alongside the executive. We must have stored knowledge, science theoretical or empirical, at the service of the state Statesman- ^^^ *^•• Ordinary routine of every department of national activity ; we must also have thinkers ship and and discoverers ready to meet new needs and sudden emergencies; there must be in reserve

trained brains and deft organizers both of material resources and of living workers, not only for the constant drain of progressive national development, but, above all, to give the community confidence and reasoned guidance in times of national crisis. The universal rivalry of nations at all points of the globe, the rapidity and ease of modern communications, do not give any nation time to wait for the right man for a particular task to turn up. He must be there fully trained and equipped, so that the executive, the commerce, or the commonality of the nation can seize and exploit him at once. If he is not immediately forthcoming, the fruit will drop into the mouth of the nation that had the luck or the foresight to have its man ready for the occasion. Readiness for pioneer-work is one of the best tests for efficiency in the modern state. The mineral wealth, the climate, the agricultural resources of a new territory are to be reported upon with a view to its incorporation or development : the men to do this effectively must be ready trained and at hand. A troublesome native tribe is to be tutored by the touch of the masterhand : the man who can guide them with experience, with knowledge of their language, of their religion and their customs, cannot be reared ••• he must be forthcoming on the spot. The trade-rivals of a nation discover a chemical process which threatens some national industry of a second : the chemical or agricultural experts of the latter must be immediately prepared with a process for cheaper manufacture or more intensive production. Another nation invents a smokeless powder or a submarine boat : no neigh- bouring state can afford to start de novo with years of experimental inquiry ; its experts ••• if they have failed, as it is not creditable to have failed, to be first in the field ••• must be ready with an immediate and effective reply. No nation can nowadays risk being a single step behindhand in its offensive or defensive services, in its methods of production, of trade or of transit, or in the general

education of its citizens, ††† their craftsmanship and their ingenuity, ††† or, again, in their average physique and reproductive power.

In the days of old the battle of life was won by the nation with physique, and intelligence enough to guide that physique. To-day victory is to the nation with intelligence, and physique enough to keep

that intelligence in healthy activity. In past times the chief store of national power was the'^os't"' manual labour : to-day it is the machine that does the work, and not the man ; the important iateiiigent things are the brain which organizes and the intelligence which creates and guides the

machine. Mineralogical, chemical, engineering knowledge achieve to-day what muscle and

brain did a thousand years ago ; the chief function of physique is now to maintain the brain in order,

and not to act as a machine at the bidding of brain. The old order has changed ; from statesman at the

helm to craftsman in the shop, modern conditions demand special training, not haphazard selection. Here

is the wide function of science in the state. How under existing conditions can science serve the state ?

How provide guidance in executive, reserves of knowledge, of discovering power, and quick response for

emergencies ; how train the craftsman, the agriculturalist, the engineer, to be one and all efficient

for the international contest ? To touch upon these things will be the object of the second section of this

paper.

II. Science as Educator.

The subject of primary education is not one on which much can be profitably said here. Its

thorny character- arises partly from theological difficulties, and partly from the widespread delusion in the

minds of those who have received a primary, or even a more advanced education, that this fact

Primary alonc Constitutes them educational experts. Neither aspect of the case is satisfactory from the

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crucial standpoint of national efficiency : both involve immense waste in time, energy, andpersonnel. Sooner or later the primary schools must fall absolutely into the hands of the state, and, free frpm direct local control, be managed by a single council of education and a minister responsible to the national assembly. Every other system is merely tinkering at best ; there are not sufficient real educational experts in the country to provide the capacity which is needful on innumerable school boards, to say nothing of parish

committees and district councils. Local vigilance committees may well be organized to see that the national system is effectively carried out locally, but local bodies are not in the intellectual position to draft an efficient system ; nor, if they could do so, are they able either to put it into practice economically, or to avoid the friction of local sectarian feeling. If intelligence be the keynote to national fitness for the inter- national struggle, the organization of even the primary stages of the nation’s training is as much a national affair as the equipment of the nation’s forces for offence and defence : it cannot be left to local management, but must be removed to a higher plane of both criticism and executive organization.

But state control of primary schools is not only essential from this aspect, but also from the importance which must be attached to the nation having a complete and uniform record of the physical

condition of its children. Is the stamina of the nation being not only maintained but recotTot strengthened? This is a question to which the statesman ought to be able to give at once a nation's satisfactory answer. He ought to be in a position to tell us whether fifteen to twenty years

hence we shall be as strong and active a nation as we have been in the past. We are too apt to forget the changes that have taken place not only in the nature of the food supplies, but in the very atmosphere our citizens are breathing. What are the eff-ects of urban or suburban dwellings on increasing numbers of the population ; of a frozen meat supply kept for months and possibly years ; of foreign ground flour ; and of innumerable articles of food and medicine prepared in factories, here or abroad, by processes not wholly scientific, and now sold over the whole country ? Possibly but little knowledge of the direct effects of such new factors could be obtained by straightforward inquiry, but a systematic anthropometric record of the schools would tell us whether our children progress or not from generation to generation, and what is the nature of the special precautions, if any, to be taken with regard not only to individuals but to whole localities. Very little extension of the system of observation and measurement would teach the state the effec,t of particular trades on parentage ; the districts where special diseases have to be combated ; the localities where special physical or mental aptitudes are to be found ; and where it is most desirable to establish secondary and craft-schools of a specialized character. In Great Britain Vfe have not only many local races, but many mixtures in diverse proportions of these races. How far are such groups particularly suited to specialized activities ? It does not follow that because certain industries have sprung up in the neighbourhood of material resources or of means of transit, that the local population is best fitted to carry on these industries ; the sorting and sifting of population, the creation of a local sub- race, suitable to a developing local industry, is by no means so rapid as it ought to be.^ An effective record, made on a common system, of the physique and intelligence of the children of the nation would immensely assist the quest for suitable types of manual labour or of special intelligence.

Or, again, at a time of national stress it may be important to answer a definite question, which could be at once answered from primary school

records. We may be struck by some defect in our training, we

may attribute want of intelligence in our officers or soldiers to the over-emphasis given in our athletics ” school systcm to athletic sports. We may be stirred by ringing phrases like ” the flannelled to Intern- IqqI ^^ ^jjg wicket ” and “the muddied oaf at the goal,” not to change the bat for the rifle, nor

the pad for the pigskin, but to condemn sports in the school as lessening the training required for intellectual development. We may attempt to remedy wrongly an admitted national failure through ignorance as to its true source. Here, again, the schools can aid with a proper record. What are the characteristics with which we find the athletic tendency associated in the schoolboy ? Science is now ready with an answer,^ which would be far more definite and complete if we could draw our statistics from the wide material of a national record. Association between qualities is measured scientifically by the so-called coefficient of correlation, which is really a measure of the averao-e relation- ship between two qualities ??? it can take every value between zero and unity. When it is zero, we say the qualities have no relation to each other ; when it is unity, we consider the relationship perfect or

1 The ibaii who wants horses for a particular type of work, to go at a definite speed, or with a definite load, or on a particular type of metal, will generally be able to find a part of the country where horses suitable for his purpose are bred.

2 The results given below are based upon measurements and observations of between 5000 to 6000 school children which have been taken for the writer during the last five or six years by the help of school teachers. The inquiry has been aided by a grant from the Royal Society Government Grant Committee.

causal.i When it is positive, the two qualities increase together; when it is negative, the one quality increases as the other decreases, and vice versd. Premising so much, let us inquire in what degree our school record shows

the athletic character to be increasingly related to admittedly desirable charac- teristics. We find, if we define the athletic group to consist of boys not only keen on games but pro- ficient at them, that the relationship between the characters is expressed as follows : ???

Athletics and good health -46

Athletics and intelligence -21

Athletics and quick temper -22

Athletics and noise ... . . . -35

Athletics and popularity -33

Athletics and self-consciousness -08

Thus we see that the athletic lad has associated with this character in a very sensible degree : good health, quick temper, and intelligence. His ability in games makes him slightly self-conscious, comparatively noisy, and, as we might expect, popular. He is also rarely sullen. Nor is this character substantially the result of his having good health ; for we find that the healthy, as distinct from the athletic, have less than half (‘09) the association with intelligence, and a scarcely sensible correlation (“03) instead of a fairly high correlation with quick temper. Nor is it a matter of race ; for soundness of health is very slightly related to dark eye (“07) and dark hair (-01) colours, but the fair are just sensibly the more athletic (‘04). The athletic schoolboy who rejoices in cricket and football is distinctly neither ” fool ” nor ” oaf,” but the healthy, intelligent, rather quick-tempered lad who should make a good soldier. Clearly games and aptitude for games ought to be encouraged in the primary school. When and for what they should be laid aside as we approach the real work of life, with its national and industrial demands on the citizen, cannot be profitably studied untU we have ample data of the above kind for youth both in the factory and at the university.

To the observer of childhood playing and questioning are its natural functions, and the teacher in

the primary school has to develop nascent intelligence on these lines. Playing skilfully means intelligent

use of eye and hand, ??? it is the basis of efficient craftsmanship in the future. Questioning

Aims of

primary profitably as to the meaning of what is seen, is the basis of discovery by observation ??? it provides e uca oa. ^^^ principia of scientific training. To turn the ceaseless movements of the healthy child into the co-operative work of eye, hand, and leg, and its too often meaningless ” why ” into reasoned inquiry, is the first and most difficult task of the primary-school teacher. Organized games developing into the elements of craftsmanship, inquiry into things observed expanding as time goes on into a conception of the methods of science : these must be the essential features of the state primary schools of the future. Facts are to be secondary, methods of the first importance ; the intelligent man knows where and how to find his facts, but he retains no more in his head than he finds economical for everyday practice.^ His brain is an instrument for work, not a lumber-room. Hence when once the barest essentials of elementary know- le(jge ??? the power to read, to write, and to do simple calculations ??? have been attained,^ let us adopt largely heuristic methods ??? collect facts only as aids to intelligent observation and inquiry, and use biology or mechanics, or history or physiography, according to the aptitude of the teacher and the environment of the school, as a means of training intelligence, and not as a store of facts worth remembering for their own sakes. Let the child come out of the primary school able to formulate its questions intelligibly ; able to put eye, hand, and leg into co-operative action ; ^ble to read, write, and count ; ??? and the first stage in the training of its intelligence to national ends has been attained.

1 The following series indicates the closeness of correlation in various qualities for purposes of comparison : ???

/ligh Correlation, 1 to ‘75.

Ei^lit and left femurs in man .... . ‘96

Bone length, right and left Httle fingers in man ‘90

Stature and femur in man … ‘80

Left middle finger and foot in man ... . . . “76

Considerable CorrelaUon, ‘75 to ‘5.

Stature and foot length in man *74

‘W’eight and length of new-born infants . , . . ‘63

Vaccination and recovery in cases of smallpox . . ‘60

Statures of father and son , ‘51

Moderate Correlation, ‘5 to ‘25.

Out-relief rates and pauperism . . . *48

Degree of foTeation and severity of smallpox attack in vaccinated

persons . . . . ‘40

Coat colours of horse and grandsire .... ‘30

“Winter barometric heights in Lisbon and Valentia ... ‘25

Low Correlation, ‘25 to ‘00.

Strength of pull and stature in women ‘22

Lengths of lives of mother and adult daughter . . ‘15

Sizes of family for mother and daughter -11

Size of head and ability in man . . . -06

2 Not to know the capital of Servia, the tributaries of the Don, or the constituents of the atmosphere, is no sign of defective educa- tion. ‘ ‘ Facts

‘ ‘ change from generation to generation ; but skill in manipulating facts is the fundamental sign of a trained intelligence, of a true education, which survives all modifications of its material.

8 From the standpoint of economy a certain amount of rote teaching must be admitted in the case of the three E’s. It is loss of time to apply the heuristic method to English spelling, or to every stage in the multiplication table. Nature-study??? physical or biological- offers far more profitable material than adding nines to nines up to 108 1

But let it realize in the simplest way that this development of intelligence is not for selfish ends. Bring before it from the earliest day the habits of the herd and the hive as illustrations of united work to a common end; let it see that man is lord of all life because he is the most intelligent gregarious animal; teach the child by practice and example the effect of combination, the struggle of the social group against its environment, and the progress man has made in effective resistance by co- Sociai operation. Let the child verv srraduallv become conscious of the fact that man is fittest not as

action as ^ j ia j

a product individual, but as society. In the broadest outline let it see evolution at work on man, and Hon. why the social is “right” and the anti-social “wrong.” Let it realize that the strong nation is

the intelligent nation ; and let it early grasp school-teaching as the first stage to good citizenship, and that only the intelligent man can successfully perform the duties which society and the nation demand from each of their members. Here is a broad enough basis for primary schools in teaching the fundamentals of morality, which each sect may supplement in its own special manner. The state, as unsectarian, has first to inculcate the social duties : to emphasise the need of developing the physiqxie, the intelligence, and the spirit of co-operative action as essentials of true patriotism.

From primary we may pass to secondary education, wherein we shall find that far greater changes will be needed in the future than seem at all to be

anticipated to-day. For while the subject matter of primary education may well be the same for all classes in the nation, modern requirements urgently education demand specialization in secondary education, and to a large extent a differentiation of groups, according to the nature of the work they are to undertake in life. This does not necessarily mean a differentiation of method, nor perhaps of location, but certainly of the subject and of the apparatus used to illustrate method. The great bulk of the population are already at fourteen employed in work or in seeking employment. For this portion, at any rate, there ought to be the elements of a secondary education specialized to their calling in life. Besides the state primary schools, there ought to be craft-scliools, possibly separate for the two sexes, thickly strewn over the country. These schools, while largely craft. under state control, ought to be subject to a much greater local influence than the primary sc oos. sciiools, partly because theological problems will have been for the most part settled at an earlier stage, partly because the needs of local industries are often best appreciated in their immediate neighbourhood. In these craft-schools we do not want university graduates lecturing upon mechanics or chemistry as they have learnt those subjects in academic text-books or laboratories. We do not want the higher theory of agriculture or engineering such as may be given to the directors and leaders of labour in technical colleges. What is needed is an extension of the object-lesson method of the primary school to the basal forms of labour on which the social fabric ultimately rests. We want to give a system of secondary education to the great bulk of workers, which will make the individual worker an intelligent instrument for his allotted task ; we do not require, in the first place, a system which leaves the majority un- touched, but raises an artisan here and there to a higher caste. We need a system of education for the bulk of men, who follow, entirely independent of the system requisite for the minority, who organize and lead. The craft-school, in the few years in which it can handle its material, must achieve two things, both tending to strengthen the national fitness for survival, namely, it must lay the basis (1) of good crafts- manship and (2) of good citizenship. Under the first heading no form of labour is to be con-

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craft- sidered beneath educational treatment. Taking first the rural craft-schools, no agricultural or

sc 00 s. horticultural iwocess is or ought to be without a basis of scientific theory ; hedging and ditch- ing, ploughing, hay-making, harvesting, care and handling of horses, cattle, sheep, and pigs, all that falls to the lot of farm-labourer, shepherd, hind, and groom, can be treated intelligently. They can all be dealt with by the object-lesson method, ??? observation, and deduction from what is observed. On the girls' side, milk, butter, cheese, poultry, household work of every description, can be used in the same way as material for showing how to do things intelligently. Education is in no case to leave the feeling that it is finer to follow one trade than another, but is to develop the consciousness that it is a disgrace to follow any craft without intelligent appreciation of the why of its processes. The victory is to the intelligent nation; that nation is intelligent in which each member performs his allotted task with appreciation of how and why it is done.

The pure scientist still occasionally speaks with contempt of the technical side of education. If technical education be merely a knowledge of the facts and formulae used in special industries, he is entirely in the right ; if, on the other hand, technical education means the illustration of scientific method on the material and appliances used in a particular trade or craft, he is hopelessly wrong. It is as possible to give scientific instruction on the apparatus of a craft as upon the delicate toys technical of the acadcmic physical laboratory. The horse and the pig, the growing crop and the vegetable science. garden, are as replete with lessons in scientific method as zoological or botanical laboratories with their microtomes and microscopes. The science of elasticity may be as effectively studied with the 60-ton testing machine on the materials of construction as with pound-weights on the rods and wires of the physical laboratory ; thermodynamics is, perhaps, as instructive a science when illustrated on the steam- or gas-engine as when a diagrammatic air-engine appears on the lecture-room table ; and there is a reality about the inertia of machinery in motion which illustrates momentum and energy in a somewhat more con- vincing way than the falling weights and the rolling balls of the academic mechanical laboratory.

We have diverged here far beyond the humble limits of our craft-school, but it seemed necessary to insist once and for all on the great principle : that technical instruction can be scientific in the best and highest sense ; scientific method can be inculcated and illustrated on the material and apparatus of any special craft or employment as well as with the costly buildings and delicate apparatus now demanded for academic purposes. If it be said that apprenticeship is the true craft-school, the argument is ticesh”p valid, so far as many facts and empirical rules have still to be learnt in the shop, on the farm, and craft- qj, jjt the bench. But our secondary craft-school is to be preliminary to work in field and

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factory, it is to inculcate what the master or fellow-workman has not the time, nor usually the power, to do, namely, to emphasize the importance of intelligently following out each craft-process. The secondary craft-school must inspire its pupils with a desire to know the reason for the rote which apprenticeship is sure to thrust upon them. The secondary craft-school is not to be too specialized ⁂ at least not in rural districts ; its pupils must spend much of their time on the farm, in the local factory, in the carpenter’s shop, and at the smithy. They should not be required to learn the elements of mechanics out of examination text-books ; nor be pushed on to the extraction of cube roots, as if that were the crown- ing feat of mathematical instruction. Let the pupils measure a plot of garden ground intelligently, the capacity of a barn with reference to the size of crop it will hold, or the cubic feet of air in a stable or stall , with reference to the air-space necessary for healthiness of cattle ; the approximate amount of half ~~inch planking to be obtained from an unfelled tree (to be tested after it has passed through the local sawmill) ⁂ these and many other exercises will occur to the intelligent teacher. Let his or her work be supple~~ mented, too, by occasional lessons from the highly-trained artisan, the carpenter or millwright, the head- gardener, the shepherd or the dairymaid, or from the workers in any other crafts which are locally available and offer craft-workers of experience. The intelligent craftsmen may be scarce at present, but as the secondary> craft-schools pass more and more of their pupils into local activities, and possibly keep touch with them through the higher craft-schools, through continuation and night-schools, the material to draw upon

for occasional lessons, and possibly for permanent teachers, will become more extensive and better. In the town districts the secondary craft-schools ought to be more specialized ; some of their work is already being done by so-called technical schools and polytechnics. But these places and their courses are largely chaotic at present. They have not settled whether it is their function vrhan to give Secondary craft-education to boys and girls, to give higher craft-education to the schools: non-commissioned officers of industry, to train the commissioned officers themselves ××× the ch^aos”^ proper work of the higher technical colleges, ××× or to provide cheaply a one-sided and, in nine cases out of ten, inferior academic education fqr young men and women who believe their success and standing in life will be assured if they are hall-marked with a university degree. It cannot be too emphatically asserted that absolute differentiation in function is essential for success in technical education, especially in urban districts. There must be secondary craft-schools which will supplement primary education, by illustration of scientific method on the elementary processes of most forms of labour. Boys and girls will leave these schools not later than thirteen to fifteen, roughly pre-

pared to follow intelligently the lower grades of industry. There must be higher craft-schools, with much more specialized instruction, for the non-commissioned officers of industry. There must be technical colleges for the leaders of industry, and universities or uniYersity-coUeges for pure science, literature, and other types of brain-work ; these again must be supplemented by professional schools for medicine, law, actuarial training, &c. &c. There must be for the most capable pupils a possible passage from secondary to higher craft-school, and from the latter to the technical college, or in special cases, where pure scientific capacity is noted, a transition to the university. But the nation which fondly imagines that one class of teacher and one building will serve for all these diverse purposes, and calls it a polytechnic or a university-college, is only excelled in folly by the nation which clubs a dozen such hybrid institutions together and supposes that they form a working university ! Such a nation has not learnt the principia of

educational theory, and the sooner it learns from the nations that have, the better for its welfare if that depends upon industrial efficiency. The secondary craft-school, the higher craft-school, the technical college, and the university serve quite diverse functions, educate for different careers and occupations in life; if economy or convenience bring any two under one roof, then there should be a differentiation of teachers ; if even this be not possible, there should be at the very least a differentiation of material and of plan of instruction, i Otherwise, there is the greatest danger that instead of intelligent workers in the ranks, the secondary schools turn out a superfluity of incompetent non-commissioned officers ; the polytechnics provide non-commissioned officers who know only the duties of the subaltern, and the colleges subalterns with the making of pure scientists, but not of technical leaders.

In urban districts, from the higher grade or continuation board-schools, and from one side of the

polytechnic teaching, must arise the perfectly distinct secondary craft-school, educating boys and girls

to be intelligent workers in the ranks of specialized industry. It must go no further than

s^ndaiy ^hc attempt to show that all forms of manual labour can be performed intelligently : its

’’’’’*” aim is the real, or at any rate the idealized, craftsman of the Middle Ages, the man who

schools. ’’’’ *=”

loved his work, because he realized the why of it, and its relation to a greater whole. There is no doubt that the highly-differentiated character of some branches of modern factory labour ’’’ by no means all ’’’ tells against intelligent craftsmanship. For tliis reason the secondary craft-school must not be too specialized, even in urban districts. The demand of the state for intelligent citizens is equally important with its demand for intelligent craftsmen. Hence it should be a sine qud non of every craft-

school, whether secondary or higher, that each pupil should study one branch of pure science, or one literature, or one historical period, apart from his technical studies, as a field for rational enjoyment in adult life. Let it be done as recreation, not as task ; but let its effectiveness be a condition of any state or municipal support to a craft-school. It has been in the past such a noteworthy characteristic of the British race to produce amateurs, following professions, trades, or even handicrafts, who have done first-class historical or scientific work, that we may hope that the absolute need for differentiation in education and the specialization of the smallest branches of knowledge will not finally check this production. The encouragement in the craft-schools of a special recreative study miglit be of most material importance in this direction. If care be taken that not facts and formulae, but the scientific method and spirit, are illustrated on the subject and appliances peculiar to the craft, very little time or energy will be expended in merely applying the notions of scientific observation and reasoning thus obtained to the recreative study. In the higher craft-schools and technical colleges, lecturers of the university-extension type would find a most useful field for their energy and enthusiasm in teaching recreative branches of literature or science, and above all in showing the pleasures of a library, apart from its value as a store for facts and formulae, its most important function on the technical side. In the secondary craft-schools, also, the ” citizenship ” teaching should certainly be carried a stage further : both boys and girls should learn a little, if only a little be possible, of the reason for and history of the institutions[illegible] ^national, municipal, and social [illegible] which, as citizens, they will have to work under and develop.

1 To give a man control of a higher oraft-sohool because he has taken a brilliant university degree in pure science is a common illustration of the present chaos in technical education in England. It is hardly excelled by the offers of teaching posts which the hio-h wrangler receives the day after the appearance of the class lists.

Lastly, in no secondary craft-school ought the need for athletic exercises to be disregarded. The anthropometric record of the primary schools should be continued, that it may serve as a control for

comparative physical progress. But a certain portion of the time devoted to athletic exercises j❓❓❓ should now be applied to developing qualities which may hereafter be of service for national

secondary offence or defence. The rural lads should be taught the elements of drill, rough road-making,

the ready use of pick and shovel, and the fun of scouting games ; where possible, rifle practice should be introduced, and swimming and even riding be taught. For the lads of urban secondary schools some of these matters are diflBcult enough ; but the plan of holiday camps in the summer may be widely extended,! rough map-making and scouting can often be practised on suburban heaths, and opportunities for drill and swimming, rough carpenter's, saddler's, or shoemaker's work can nearly always be found. In all these cases let it be recognized by the lads themselves that these things are not cra;^-training, but are taught to fit them for duties which a strong nation demands of all its citizens in one form or another. In the case of the girls the horizon must appear somewhat narrower, and it is, perhaps, only their teachers and elders who can realize the national importance of those forms of physical training which may aid them to be the healthy mothers of a strong race. Still it is highly important that they should realize that they belong to a larger whole : that they have a function in the state as well as a relation to individuals. Bandaging, first-aid, the elements of nursing, the care of infants ❓❓❓ and of the aged ❓❓❓ may all be taught as extensions of household economy, and the social value of such work inculcated. But they are not essentially outdoor physical exercises, and the latter, whatever be their real import, must bear for the girls the aspect of mere games, not of sports obviously directed to national ends.

To sum up, then, our conclusions as to the functions of the secondary craft-school : it is intended for the rank-and-file workers in all the industries and crafts of the country. It should provide : (i.) Training

for the intelligence, by illustrating scientific method upon the material and appliances of Qenerai every craft. As the elements only of the craft will be considered, many crafts will be com-

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ot second- bined in one school, but greater specialization may be possible in urban than in rural districts. “schools. ‘ (^^0 Recreative Studies, (iii.) Citizenship Course, and (iv.) Athletic Exercises. The bulk of the

instruction will fall to the lot of the permanent teachers under (i.) ; subjects (ii.) and (iii.) may well be undertaken by a specially trained class of peripatetic teachers; while (iv.) might largely be aided by volunteer workers, whose labours should be guided and systematized by district advisers, who wotdd travel from school to school, suggesting and organizing the service with a keen eye for local possibilities. If from the secondary education of the rank-and-file workers we turn to that of the leaders, we have at once the differentiation into the two classes of non-commissioned officers or foremen, and of the

commissioned officers, or the leaders of industry, the brain- workers, thinkers, and educators of edaauion ^^^ nation. Probably the first class will be largely drawn from those who have shown marked of middle capacity in the secondary craft-schools ; these should be passed on to the higher craft-schools,

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the work of which will be dealt with later. When we consider, however, the provision hitherto made for the nation’s intellectual leaders in the matter of secondary education, one is surprised, not that the nation has gone relatively backward, but that it has survived at all in the keen competition of modern times. A nation needs organizers, leaders, thinkers, not only in commerce, but in manufactures, the technical arts, transit, colonization and exploitation, pure science, professional and literary pursuits. Up to the immediate present hardly any secondary education at all has been provided suitable in the least degree for a college training in any one of these matters except the last. Our commercial and technical leaders have rarely had any scientific training at all ; they have grown up without it, and held their own owing to the political and economic conditions of their country relative to its rivals. Such will be an absolute impossibility in the future, now that the equal or superior sources of power of our rivals are being worked, and the plant is created and the labour trained which is requisite for production.

Granted that resources and machinery are alike, ??? they are now far from being in our favour, ??? it is “only

1 The camp-holiday system, which has flourished a good deal under voluatary effort during the last few years, ought not only to be developed and widely extended, but supplemented, if possible, by short summer cruises on training brigs, where the lads would receive a different kind of drill and learn a little, if the veriest little, of what the sea means.

XX PEEFATOEY ESSAY

the most highly trained intelligence which can turn the balance to our side, or even equalize it. Yet what ~ has happened ? The movement for technical education has’led to the establishment of a number of technical colleges, where a more or less efficient technical higher education can be obtained, but it has not provided the essential stepping-stones to this education : namely, secondary schools up and down the country special- izing in commercial, technical, and scientific instruction. Occasionally the modern side of a large school may be found doing good work, but its existence at all is an exception, and it is an exception among exceptions if it gives a training useful for technical purposes. A Cambridge wrangler, who teaches to an occasional student an arid text-book on the calculus, with a view of his getting a scholarship ; academic laboratory work of a physical or biological character, boiled down and sterilized to suit the youthful digestion ; formulae from algebra, facts from mechanics : all these exist. But in nine cases out of ten no direct and conscious training in scientific method, no teaching to observe, classify, and reason on facts collected by the lads themselves.^ No specialization by trained teachers for commercial, technical, and scientific pursuits is in the majority of cases thought of ; and since it would largely have to be provided by men not educated in the ruts of the older academic methods, there is small doubt that both teachers and taught would be looked down upon as of a lower caste. Desirable as it is to associate lads who are about to follow very diverse callings in life, there is small hope of efficient secondary education, specialized for commercial, technical, and scientific pursuits, being provided in the majority of our great public schools, ., J. with their traditions and systems centuries old. These modern schools will have to be founded

Need for ^

modern de novo, or developed out of the large day-schools of urban districts, or the decadent rural

grammar schools, which up and down the country may be found, atrophied under a system which was, perhaps, a vigorous reform in the second half of the 16th century, but supplies no urgent national need of to-day. Let there be no doubt, however, about the nature even of the commercial education we are now considering ; it is not intended to turn out commercial travellers and clerks, who fall into the class we have termed non-commissioned officers. For these the secondary and higher craft schools should provide. The scheme is intended for the leaders of industry, for the men who will be manufacturers, merchants, shippers, engineers, the organizers and thinkers. These are the men who will pass on to the technical colleges and the commercial universities of the future. ‘ As the German technical universities ^ draw their students from the Realschulen and not the G-ymnasien, so our technical colleges need an effective technical and scientific secondary education antecedent to their work. We have the German experience to draw from and to learn from, and we ought to be able to create schools which will turn out a lad with all the healthy traditions of English public-school life, but who has replaced its classical education by an effective training in the methods, not the results, of scientific inquiry.

To the general outline of these schools much that we have said of the secondary craft-schools will apply. The teaching will have to a considerable extent to be specialized ??? commercial, technical, and purely scientific departments being provided with different teachers and methods. In each o” modern casc the primary object will not be to give the lad information useful to him in his future secondary calling, but to dcvclop his intelligence by the application of scientific method to the material and processes with which he will later be concerned. ^ Again, to prevent narrowness we must have the recreative study ; and to strengthen social stability, the citizenship lessons. Athletic exercises, culminating in some knowledge useful for purposes of national offence or defence, must not of course be omitted. But as the secondary education of the classes we are considering will last at

least two or three years longer, the extent of these secondary studies can be considerably increased. Thus the ground-

1 Every teacher in a technical college knows well the average public-school lad : personally delightful, athletic, popular he cannot draw, his geometry is a rapidly disappearing acquaintance with Euclid I. to II., his algebra a formula for quadratics, and his arith- methical accuracy sadly inferior to that of a shilling slide-rule. His secondary education has to be undertaken over again, and even then he will probably end iu the South African Constabulary.

2 The German Polytechnikum, technische Hochschule, is not for the moment to be confused with our polytechnic which ou^ht to be a higher craft-school and is a hotch-potch of a dozen stages of education. It corresponds more to our technical college, but is ten times as complete. It usually represents the complete technical university, and by government decree its teachers and students are placed on an academic footing.

‘ One man may learn how to use his reasoning powers from a teacher who adopts Greek grammar as his medium, another from a teacher whose material is provided by the hedgerow, and the powers gained in either way may be turned from one to another subject ††† but there are obvious advantages in selecting for the object-lesson material at least akin to what the reason is ultimately to deal with. ‘

work of a true culture ††† the superstructure of which must always be self-culture ††† can be laid in the technical college or science school. An important addition, however, should be made to the teaching of such modern secondary schools, not as part of the recreative but as part of the bread studies, ††† a reading knowledge of one, and a speaking knowledge of a second language should be insisted upon. The doorway into another race’s scientific laboratory, its methods of work and of expression, is as important an opening for the mind as the doorway provided by a knowledge of its language into its institutions, literature, and folk-feelings. To grasp how a great investigator works needs presence at his lectures or in his laboratory, or at least the study of his papers, ††† it is an education

which can never be obtained from text-books. In any specialized branch of science there are rarely at any given epoch more than two or three master-minds, and these are diverse in country and in tongue. To follow these personally or in the written word is an impossibility without linguistic knowledge, and science-abstracts and text-books are a deadening and nigh worthless substitute for direct contact with a master-mind. We shall insist later on the national importance of the Wanderjahre, but to profit by such years the young apprentice must have received in his secondary school the groundwork of at least one language, and maintained and developed that knowledge at college. The pure scientist or the professional engineer who cannot directly study the work of contemporary foreign investigators is most heavily handicapped, and in many cases a tenth of the time and energy he will spend in finding out how to do things already done would have given him a reading knowledge of foreign literature. The speaking knowledge of a language serves a different purpose : it is essential to the pioneer in commerce, exploitation, and transit. ^ Started in the secondary school, it may be completed in the Wanderjahre ; it is a practical instrument of a man's calling ••• ^like the multiplica- tion table, he requires to be sure of it, but he will not, like the philologist, make it a means, in the first place, of intellectual training.

It would be out of place here to give even outline curricula for the secondary modern schools we have in view. If the curriculum of the secondary classical school has only been crystallized out in the Nature ot course of many generations, no new scheme for science schools will in itself be wholly satis- teacbers. factory, or work without initial difficulties and friction. In the first place, the teachers, to do the work effectively, have largely to be made. In the next place, parents have to be convinced that the secondary modern school is not going to provide knowledge useful in professional life. It is going, like the classical school, to develop the intellectual powers, but it will take as its material not the dead languages, but the living sciences which bear most closely on commercial or professional work. There will be, undoubtedly, specialization and differentiation. The biologist and the physicist receive their intellectual education in observing and reasoning on a certain class of facts ••• they need mathematics as an instrument of investigation. The mathematician who insists that they shaU have it as an intellectual

education only is going beyond his legitimate sphere. In the same way, the engineer receives his intellectual training in a field very unfamiliar to most physicists and mathematicians, and the teachers of mathematics and physics who insist upon these subjects being taught to him as intellectual exercises from the pure-science standpoint are the bane of technical education. Secondary schools, like the higher craft-schools, will do little to improve technical instruction if this point be not kept in view : the teachers of pure science required for the technical side must be men trained in a technical college, and having touch with the needs of practical life. Such men ought to be distinct from the teachers of pure science on the science side, who ought to be men who have been through research schools and laboratories, and whose first aim will be pure science as an education, not as an instrument.

Lastly, if we consider the secondary education given in the public and large day-schools as they at

present exist, in many ways well fitted, perhaps, for professional and literary careers, we can only hope

that the opening up of large secondary modern schools, turning out pupils of equal intelligence

classical and better fitted for modern commercial, mercantile, and technical pursuits, will serve as a

schools. stimulus to quicken and, above all, humanize their activities. They will certainly decrease in

1 While Trench and German for the English-speaking races are the more valuable languages for the storehouses of method and knowledge they throw open, Spanish and Dutch are perhaps at present most useful for pioneering. But it is nationally important to have a great range of choice in the spoken languages among workers in both the commercial and technical fields.

number, but this does not necessarily mean in efficiency ; and where the endowment allows of a complete duplication of staff and educational apparatus, the running of modern and classical schools side by side would have all the advantage which the admixture of men of different callings, modes of thought, and social standpoint provides in after-life. Before the renascence, teachers of the old monastic learning would have denied that it was possible to improve their methods, or to change with advantage the subjects taught. Yet within fifty years the Humanists reconstructed the school-education of all Europe. They achieved it by raising an enthusiasm in youth, which demanded that instruction should be for both teachers and taught a vitalizing process and not a drudgery. A small minority of teachers with the new ideas, and a wide- spread rebellion of the taught, swept the old system and its professors swiftly and forever away. The abuses of to-day do not perhaps justify, nor the tutelage under which young people now stand ^ permit, of quite such a drastic reformation. Yet the pressure of competing modern schools ought assuredly to modernize classical and philological studies. We want to train the intelligence of each future citizen to observe and reason about facts, and this power can never be fully developed when the material dealt with is isolated from all relationship with present experience or living modes of thought. The scholar has to realize that he is merely a unit in a living nation, which is one among many nations, each with a history of its own. The study of a special literature or language may be very harmful if it is not seen in perspective. It leads to the spirit which supposes that philosophy was summed up in Aristotle, that style culminated in Cicero, that there is only one great religious work, and that Euclid provided once and for all what is needful for geometrical instruction. Comparative history, folk-lore, and custom, ??? the discrimination of what is peculiar and what is universal in the institutions of the special people studied, ??? are all needed if the scholar is to be saved from narrowness. The Odyssey is not only a great epic, it is intensely exciting as an object-lesson in the early stages of civilization, in the growth of mankind from boyhood to adolescence. The institutions of early Rome are unintelligible without comparison with Teutonic, Slavonic, and even African folk-customs and religious practices. Style and taste are never to be despised; but what we want the cultured lad of to-day to understand is what man now is and how he has come to be what he is. The over-emphasis of one period, one literature, one art or language, may be dangerous if it tends

to obscure the fundamental principle that man is the product of an evolution, under vital forces of which science knows something and is daily learning more. No nation was ever without rivals, moulding and modifying its development ; no literature without a growth ; no art or craft without an historic evolution ; no human product, judged from either the artistic or intellectual standpoint, final. The schoolmaster who forgets these things is not truly preparing lads to be thinkers and leaders for the nation ; the academic teacher who does not make them the thread of liis exegesis will aid little towards the much-needed humanization of the older forms of study. Neither religious thought nor educational theories can stand aloof from the growth of scientific knowledge. One and all react upon each other. We cannot stand now where Virchow did in 1877: the pressure of foreign commercial competition has been a conclusive object-lesson in the survival of the fitter. We must base national education on the need for national reaction against a changing environment ; we must consciously prepare for the struggle, and by an intelligent study of human evolution arouse the patriotism and race pride of the young to assist directly in developing their intelligence for national ends.

Before we pass to the specialized college education, a word ought to be said of the higher craft- schools, which should supplement secondary craft-schools in the preparation of the non-commissioned officers of industry. Hitherto these schools have either been wholly wanting or supplied by private HI her enterprise bent on personal profit. The keynote to such a school should be intelligent craft- instruction in a craft suitable to lads of fourteen to seventeen who hope to be foremen workers.

It should lay more stress on technical knowledge than the secondary craft-school, wliere the development of the intelligence is the first requisite ; but it must, like aU true education, appeal to the reason as a guide. It must also be far more specialized. We need higher craft-schools in plumbing,

1 In mediaeval times the lad of fourteen to seventeen might wander across Europe seeking for the school reputed for its methods or attracted by the vigorous teacher. The Wanderjahre for the schoolboy are, perhaps, wisely abolished ; they will, let us hope, be reinstituted for the undergraduate.

farriery, cabinet-making, textile industries, metal-plate work, and a dozen other different things. As usual, we began with the wrong end ††† establishing examinations in these subjects, rather than model schools. Nor have the so-called polytechnics and technical schools of the county councils ††† good although the work has been in some cases ††† wholly made up the leeway. The technical school or polytechnic, instead of throwing itself body and soul into a special branch of craft or industry, has aped the university. It prided itself on getting a few students labelled B.Sc, or on producing a small piece of pure-science research having no bearing whatever on the national industries. It aimed at turning out second-rate engineers, rather than first-rate machinists. The result has not been, and cannot be, that great increase of craft efficiency which we might expect from the amount of money expended on technical education. The polytechnic may become a centre for a mild form of general instruction and amusement, or it may become a specialized higher craft-school. It cannot effectively fulfil both functions. In the first case it wiU probably fail, as the mechanics' institutes of last century have failed ; in the second case it will become not only of local but of national importance. Let one technical school devote itself to smith's work, another to the print- ing and lithographic arts, a third to the glass industries, a fourth to bookbinding, and so on,i not duplicating their work and teaching many things superficially.

Some large towns may maintain a considerable variety of specialized schools, but it is the student who ought to wander; repetition of staff and teaching material at a dozen centres means waste and inefficiency. If Birmingham founds a higher craft-school for electroplating work, Wolverhampton may reply with a metal-plate-work school ; if the Whitechapel higher craft- j^^j ""^ school specializes in cabinet-making, Clerkenwell may find a wide enough sphere in the glass ^p^ciaii^' trades. The bane of technical, indeed of all education of an advanced kind in England, is the unreasonable overlapping of institutions, teachers, spheres, and methods. The higher craft-school has nothing to do with academic training, therefore we appoint academic scientists to teach in it, and place them on university faculties ; the technical college has a separate but coequal function with the university, therefore we mix them up, thinking one method of teaching and one teacher will serve for both. We send peripatetic teachers out to fulfil the all-important function of raising the

general culture of the people : we fancy it academic extension, and demand that it shall lead to a university degree. Nay, a degree having come to be looked upon as a mark of caste or gentility, the branding-iron is, in the true democratic state, to be brought to every man's chamber. At the basis of every science are real philosophical and intellectual difficulties ; in its structure, endless lessons in observation and in method ; at its summit, the prospect into still untrodden lands. Not one of these things can be indicated by an examination schedule; they are scarcely touched by any text-book which follows such a schedule. They are appreciated only when the student comes into personal contact with the creator of knowledge, and sees how he observes and reasons. Here is the field of true academic work ; no branding-iron brought to a man's chamber can testify that he has been in contact with this vivifying atmosphere. Nor can we bring science and learning in their highest expression to each student's door. He must go out on his Wanderjahre in pursuit of the master-teacher, or of the school which has specialized in his chosen study. What is true of the university is equally true of the higher craft-school : the student must seek the specialized teacher and the specialized school, and not trust a local polytechnic to be an effective educational omnium gatherum.

Besides schools for the more mechanical crafts, we need higher schools for the lower ranks of head- workers, for the lower branches of civil and municipal employ, for shorthand and clerks' work, for postal, telegraph, and railway service. Some of these employments ??? where students will pay to be got through an examination ??? are at present provided for by private enterprise. But such commercial schools want organizing as a comprehensive system, and should not be based on the question of immediate profits derivable from some small section of the work. To such schools the government, the municipality, companies, and private employers would very soon learn to turn for a specially-trained class of employee, and we might hope that in the first instance they would ultimately replace the Chinese system of selecting by examination.

1 To some extent this has been begun with the textile schools in the North of England, and the photographic and optical instru- ment schools in London, but these are the merest beginnings only.

XXIV PEEFATORY ESSAY

We now turn to the highest forms of education, which, whatever we may hope for in a distant future, can at present only be organized for the brain-workers of the community ††† for its thinkers and leaders. Here we find much the same educational chaos as we have had to note lower down in the Higher scale. With as great, if not greater, need for it, there is even less organization and specializa- tion. As a first classification, we may consider our subject under four headings : (i.) the university proper ; (ii.) the technical college ; (iii.) professional schools; (iv.) the commercial university. How far these four phases of advanced education can be advantageously united into a single university system is not easily determined. In Great Britain the advantages of union are : first, that as education becomes more specialized, the larger funds accumulated during many generations for the university proper may be shared by the younger branches of study ; ^ secondly, it is of immense gain that both students and teachers of specialized studies should mingle together, and share traditions common to all. This is what must take place in later life, and the joint university provides, from student to professor, an excellent training in toleration, ††† a characteristic as important in science as in theology. On the other hand, the union of the four schools in one locality and institution is likely to disguise the absolute need for entirely independent staffs, and for completely specialized methods of study. The doctor and the engineer require mechanics and chemistry, but to teach medical and engineering students in the pure-science laboratories of these subjects is an evil only sanctioned by absolute want of funds, and solely due to the haphazard growth of British systems of education. Look at the specialized staff of one of the great German poly- technics,††† a dozen professors and double as many more lecturers and assistants, ††† and then compare such staff with the roll presented by any university or technical college in Great Britain ! Nine out of ten of these colleges think it sufficient to provide a so-called professor of engineering, and send their students to pick up what mathematics, what physics, what chemistry they can under teachers who have had no special technioal training, who have never studied the special needs of engineering students, nor published a single memoir dealing with technical problems. The result of such a system is manifest : we have no research in the sciences preliminary to engineering ;

not even first-class text-books, for the preliminary science teachers in the engineering schools are, if not overdone with teaching, workers in pure science. It is very little better in the matter of engineering research pure and simple. The professors are not able to specialize, partly because they have to teach too many subjects, owing to want of colleagues and of the fitting secondary and preliminary scientific training in their students, and partly because they have not been themselves educated in an atmosphere of research. We do not think there is exaggeration in this statement of the case; we have not overlooked certain text-books on the strength of materials, machine-design, or the steam-engine. Rather these illustrate our text : they show that want of know- ledge of the modern theory of elasticity, of kinematics, or even of foreign contemporary work, which indicates how pressing the need of an effective research training may be in even the highest places under our present system.

We are undoubtedly far better off now than we were a generation ago ; the technical schools up and down the country are doing good work, but they are not in any case comparable with a German polytechnic, nor with the technical university which we must hope to see ultimately established here. The Technical University of London, for example, comprises three or four engineering schools, each duplicating niuch preliminary work ; combine their staffs, specialize their individual teachers, give them leisure and laboratories suitable for research, and there would be only the foundations of one real technical university. Yet no other university or technical college in the country could produce as much. We have started again on the wrong system ??? multiplication of little centres, doing their individual best no doubt, but not what is best for the nation. Three or four technical universities would suffice for the whole nation, but we have established fifteen or twenty technical colleges, on the theory that knowledge, like milk, must be delivered at each man’s door. The result is that all the schools are, broadly speaking, doing the same elementary work, and there is no specialization. No one school devotes itself entirely to civil engineering, naval engineering, hydraulics, municipal work, gas, electric lighting, or haulage, &c. &c. The elements of many

1 Thus it is satisfactory to hear of College fellowships at Cambridge being given to engineering students for technical dissertations.

things are touched on, but the higher teaching and the atmosphere of research are largely absent. What then is needed ?

The development of three or four only of the technical colleges of the country into technical uni- versities, with specialized departments of mechanical, civil, electrical, &c. engineering and of chemical industry. The remaining schools should disappear or be converted into higher craft-schools. technical Use their staff or buildings, where possible, for special departments of the university, but un vers . pg^Qg^^ge once and for all that under the stress of modern competition these are matters of national importance ; and that to bring our technical intelligence up to the level of that of our neigh- bours, we do not want local engineering professors, or local colleges, but national technical, universities, each with ten or more complete laboratories, a score of special technical professors, and with equipment and funds comparable only with those of the whole of the pure-science faculty of a first-class modern university. Such universities would train not only the nation’s industrial leaders, but the teachers for the secondary and higher craft-schools ; and by bringing both classes into touch with actual knowledge- making, indicate on the one hand how the problems of practical life, on the other the problems of craft education, may be met and solved.

If we pass from the technical university to the university proper, by which we are to understand the

corporation of teachers which deals with training in pure science or scholarship, without regard to the

needs of special industries or professions, its work in the future seems likely to become more

The

university Specialized. There will always be minds for which the best intellectual training, independent of and Its future calling, will be an end in itself. Senior Wranglers may make good judges ; senior classics, excellent

doctors; and double-firsts, capable statesmen. But in the case of modern nations specialization of the individual appears to be a progressive feature, and as soon as it becomes a recognized principle that the intelligence can be trained and developed by observation, and reasoning on observation, applied to technical or professional subjects, much of the monopoly value of pure academic studies will disappear. The study of yeasts may be as good an intellectual training as that of the gases of the atmosphere ; bacteria are as mentally exciting as snails ; the vibrations of a bridge lead to more aspects of physical science than those of the tuning-fork, and examples may be multiplied to show that technical or professional education is not one-sided or intellectually inadequate. It seems likely, therefore, that academic studies, whether purely scientific, literary, linguistic, historical, or philosophical, will tend to be recognized more and more as a training for specialized careers, namely, for statesmen, scientists, historians, literary men, educators, and makers of all forms of knowledge, ××× in short, for the intellectual leaders of the nation. With this recognition, academic studies will become more intense and definite in character. Above all, the research training will more and more supplant the examination training. In actual life it is the problem which comes to us ; stores of facts are accessible ××× we want the training which enables us to apply these facts and solve the problem.

The recognition of this fundamental fact is the reformation which must take place in academic studies. Examination is by no means the best process for testing the power to observe, classify, and reason on observation. The known itself may be made the subject of a formally new inquiry, and a tiottof'' monograph may be written showing data, classification, and deduction ; ××× the method is equally academic applicable in physics, biology, or history. It forms the basis on which the capable instructor can point out the sources of information, the proper method of arranging it, the logical results which flow from it. Scientific method, the true spirit of inquiry, is better learnt by criticism and suggestion applied to two or three such monographs by the master-investigator, than by months of labour devoted to learning the known for examination purposes. We cannot too often repeat that for the purposes of education what we need is a training in method, and not, in the first place, a mere knowledge of facts, nor even of the laws under which these facts may be classified. It is so easy to provide

facts and formulae, so difficult to give insight into method, that text-books, degree schedules, and examination papers invariably turn to the former ; and the latter, to be learnt only from direct touch with the investigator or from the classical memoir of the master, is thrust ruthlessly aside. Treat the known as unknown, to be rediscovered, or bring the student rapidly to the real unknown on the confines of the

discovered, then true training in method becomes a possibility. Every nation is daily being confronted with new problems ; they may be material, or they may be social, or they may be intellectual. Admit progressive evolution, and this statement is an obvious truth. The nation's brain-workers, whether their role be great or small, have to be prepared to meet and answer these new problems. Training for examina- tion is but feeble equipment, certificate of examination success very one-sided evidence of competence for this essential function in a nation's thinkers. Nor is the reader to suppose these remarks apply only to the training of master- investigators in any branch of human knowledge ; the academic training is that upon which the great majority of secondary educators depends, and their present failure to apply, or rightly -apply, heuristic methods is largely due to the examination system not having brought them into close touch with the methods of research. Nay, our professional and commercial classes suffer in international competition from much the same want ??? definite training in observing and reasoning upon facts. The university of the future will bring its undergraduates, not into touch with an army of tutors and "coaches," nor with their impedimenta of examination schedules and text-books, but directly into the field, the library, the laboratory, where the material of knowledge is accumulated and classified, and into personal touch with the men who make it.

The problem of the professional college or school of academic rank and its relation to the university is one of considerable complexity, and can hardly be dealt with at length here. Specialization is the most emphatic note of modern national development ; it has to be met, not by protest, but by fessioaai providing for training in method, even when a special or

somewhat narrow class of facts is dealt ege. -^^rith. The establishment of technical colleges for engineering,metallurgy, chemical industries,

navigation, agriculture, and forestry ^ indicates to some extent the direction in which the older academic faculties of law, theology, and medicine must develop. It is fundamental that the preliminary linguistic or scientific studies should be, as in the case of the technical colleges, in the hands of a special staff, distinct from that of the pure academic studies.^

It is difficult to understand why great law schools do not thrive in this country. No other nation can present such living object-lessons in comparative law : it rules in different parts of the world under nearly every present or past legal system, and by innumerable forms of folk-custom, which school. exhibit legal institutions in almost each stage of progressive evolution. Yet comparative and

historical knowledge is very largely lacking in our practical lawyers ; but few of them are acquainted with the French, Dutch, or German codes, or have gained insight by a study of the develop- ment of the early Teutonic and mediaeval systems. The result is a want of imagination in our own domestic legislation, and too little sympathy in dealing with the legal institutions of subject or assimi- lated races. The law schools have thus partially failed to create the class of men needed by the nation for its legal work in all corners of the globe. The broad idea of satisfying a national want has not been a primary consideration, and to this extent they urgently require that humanization which is demanded in the history school, if it is to become a school of statecraft.

Perhaps in the case of the professional schools the most complete chaos in educational matters

is to be found on the medical side. In the first place, it cannot be doubted that the hospital system

itself must soon suffer a profound modification. It is impossible that the present svstem

The *’

medical of Support by fluctuating charity can permanently continue. Alongside the public charities

*” ►►►► ►►► have arisen infirmaries, fever hospitals, and asylums supported by public funds, and in

iln the last three oases the colleges should be for the scientific experts, not for mariners, farmers, and foresters, who require, in the first place, higher craft-colleges. What might be achieved in the science of navigation at present by an expert school can be well realized by a study of the first fifty years of Gresham College, London. The merchants and traders of London, in the first fiush of new- world discovery, turned to Sir Thomas Gresham’s professors for their instruments of, and treatises on, navigation.

‘ It is not to be inferred that mechanics or biology is to be taught by medical men waiting for a chance to get on to the clinical staff of a hospital school. On the contrary, we want a specialized class of teachers, who devote their leisure to research in biophysics and kindred subjects. The mechanism of the jaw is quite as good an object-lesson in the fundamental principles of mechanics as the screw and the systems of pullies, while the principle of energy and the laws of elasticity are subject to variations in living forms which are apt to be overlooked by the pure physicist. The range of linguistic studies required for canon and mediaeval law, for Wcisthumer and folk-custom, are scarcely those of the academic classical scholar or the Teutonic philologist. Nor does the university philosopher find any- thing profitable between Aristotle and Descartes, ►►► although it was the age of fathers and schoolmen, who directly or indirectly gave rise to all modem European philosophico-theological systems.

many cases but little used for clinical instriiction. The medical schools thrive or not according to the success of their hospitals in attracting charitable subscriptions, and this again depends indirectly on skilful advertisement. The result is overlapping, rivalry, want of specialization, and the predominance of pecuniary instead of purely scientific interests. General municipal control of the whole hospital system must sooner or later be the rule, and with the wider clinical material thus placed at the disposal

of medical instruction must come a diminution in the dominance of individual medical schools over individual hospital management. The overlapping of the preliminary teaching, and of much of the more theoretical and scientific branches of medicine and surgery, must be avoided. The direct and sufficient payment of all forms of medical teaching must attach men to academic work and experimental medical research as a profession, and such teaching not be undertaken as a step to a consulting practice. The competition of the medical faculties of different universities, and of the medical schools of the same university, would be perfectly healthy if it depended solely upon the reputation of the teachers ; but it depends largely on the flow of public subscriptions to individual hospitals, the success with which the school may be used as a step towards a professional reputation, and the skill of one or two men in effective advertisement of the special wants of their individual hospital, or its special fitness to deal with a disease for the time looming large in the popular mind. The municipal control of the hospitals, the utilization of all clinical material, the wider separation of the academic teaching of medicine from its purely professional pursuit ××× these are the points which arise in the mind of one who views the present chaos from an outside standpoint. But if the observer be an outsider, he is a sympathetic one, who believes largely in the academic future of experimental and scientific medicine. Yet here the very instruments of knowledge (such as vivisection) and of experiment (like inoculation) demand the most careful and diplomatic procedure. The storms of the past in these matters are as nothing compared with what we may experience in the near future ; and if sure progress is to be made, there must be no hasty adoption of tentative treatments, when no strong scientific anguments in their favour are adducible ; there must be no ” fishing ” inquiries on living forms ; in other words, each experiment sanctioned must be directed to answering a definite question, which in the opinion of scientifically trained minds there is reasonable hope might be answered by the investigation proposed, and, if answered, would be of substantial service to medical or surgical treatment. Lastly, a greater knowledge of the nature of scientifio method and of scientific proof must in’ some manner be provided for by academic medical training. ^ Medicine, and even surgery, must to a large extent be, and remain, empirical ; but it is just the empirical scieatnic scicnces in which, for example, an accurate theory of statistics is of most importance. It ’”*^’”” is not too much to say that medical statistics

are at present in a most rudimentary condition ; definite conclusions are over and over again drawn from short series of cases, where the trained statistician realizes that the emphasized differences are well within the limits of random sampling; or, again, A and C are found statistically to be associated with B, and it is argued that A and C must be themselves associated. The recent vaccination legislation has produced most instructive object-lessons in this direction. It has very unfortunately created a large class of men with pecuniary interests in the maintenance of vaccination. These men have had, in the press and at public meetings, to face a strong opposition, partly sceptical, largely fanatic. It is not too much to say that from the stand- point of science the medical defendants' handling of statistics has been excelled in inadequacy only by that of their opponents'. Much of the strength of proof in medical science depends entirely on statistics ; copious raw material can be obtained from hospital practice, but this is rather too largely drawn from special classes of the community. The bulk of data from all classes either escapes written record, or remains " unstandardized " in case-books ; here it is monopolized as " experience," when by co-operative action it might be statistically generalized into proof. The quantitative value of the correlation between environment, age, or physical characters and the special features or virulence of any disease is probably unknoAvn at the present day in a single instance ; and yet it is hard to conceive that clinical prognosis

1 In the course of the past twenty years the writer has received a scarcely intermitted flow of papers and letters from pseudo- scientists, circle-squarers, perpetual-motion mongers, heredity-theorists, neo-Darwinists, and others. The common feature of all these productions is the failure to grasp the elements of a real scientific proof. If the authors were classified by profession, the general medical practitioner would lead in numbers, the engineer being second, and the theologian a comparatively poor third.

would not be greatly advanced, especially among the younger members of the profession, by a quanti- tative_ knowledge of this kind. An authoritative body standardizing records, collecting individual experi- ence and reducing it by adequate statistical theory, seems almost a necessity for medical

progress at the present day. An elementary training in the handling of statistics and an insistence on the nature of scientific reasoning and statistical proof seems an urgent need, which ought to be, but is not, provided for in the preliminary scientific education of the medical profession.

Passing from professional schools ^ to the commercial university, we see at the present moment a great experiment being made in this direction. Birmingham has wisely entered on an unoccupied field.

It may be desirable that one or, at most, two large centres should follow its lead, but it is most merciai siucerely to be hoped that every university and university-college in the kingdom will not now

appoint a professor of commerce and advertise a commercial department because they think it will pay. They have neither the funds nor the experience requisite for success. What is needed, from the national standpoint, is at most two or three perfectly efiicient, fully manned, and fully equipped commercial universities, attracting students from the whole area of the empire. There are plenty of unoccupied fields for other institutions and colleges to specialize in, to the national profit, without the creation of innumerable small rivals in a new sphere. This is, of course, on the supposition that those who have first taken the work in hand will do it thoroughly, even if their progress be gradual and tentative at stages. Let it be remembered that it is not a mere professor of commerce that is required, but ultimately a staff of ten or a dozen such, with a large auxiliary force of lecturers and assistants. The man who can effectively deal with preferential tariffs and the general fiscal policy of the empire is not neces- sarily the man who has special knowledge of commercial interests and transit possibilities in China. A fundamental rule of the commercial university ought to be the ” third free year ” of the Russian academic system, and this means that only two-thirds of the senior staff will at any given time be actually engaged in teaching. The ” third free year ” is only free from teaching work ; the lecturer is expected to travel for the purposes of research. ^ Especially, owing to the rapidly altering, ever contracting and developing, processes of commerce, will it be needful for the teacher to keep in touch with current progress and methods. Nor can a man rear men

to be pioneers unless he has done pioneering work himself. It is a big task which the commercial university sets before itself, full of difficulties and, possibly, pitfalls, but one of essential national importance to-day, when our commercial leadership has been more than threatened. We have to rear a new type of worker, who will see in trade not only a source of individual profit, but a patriotic duty. Developing commerce on the Yangtse, or struggling against fever in West Africa, or starting new industrial enterprises in the Argentine, the trader must realize the relation of his eiforts and those of his colleagues to thousands of handworkers at home, whose bread must come from over the sea by exchange. He must recognize that on his intelligence, on his linguistic and local knowledge, on his readiness to adapt goods and transit to environment, depends, to a far larger extent than has been dreamt of in the past, the national fitness to survive. The leeway of the nation has to be made up by increased intelligence, first in production and then both in distribution and exchange ; the former need has to be met by higher craft-schools and improved technical colleges ; the latter, by the creation of commercial universities. Can any training help the nation to the skilful merchant and the fully-equipped pioneer ? Those who believe in education and modern scientific methods can only reply : Yes, if you train the intelligence by the heuristic method, and exercise it on the materials of its future work. It is a great task which Birmingham has set itself ; let us hope that it realizes its magnitude and difficulty ??? above all, that it understands that failure, from want of efficient staff or of equipment, or from lack of internal or external enthusiasm, would be little short of a national disaster. It would discredit for years, if not indefinitely, the systematic training of intelligence in one of the most important fields of national activity.

1 The range of professional schools wants considerable widening. One profession certainly ripe for a great professional science school is that of the actuaries, and a little study of ofBcial reports will show that a school for government statists is a necessity of a not distant future.

2 Started in the commercial university, we might hope that this wise custom would extend to the pure-science, medicine, and engineering faculties, where it is as important to seek new material, test foreign methods, and critically examine current practice as in commerce.

PEEFATOKY ESSAY XXIX

Commercial universities, again, suggest the great importance of further extending the Wandety'ahre custom. We have already discussed the need for local colleges, schools, and universities to specialize, and the advantage of the student wandering in search of his subject and the master-teacher. To j-^^ ^a<illegible>. the commercial university a relatively considerable number of studentships should be attached,

III. Science in the Direct Service of the State.

A slender sketch like the present does not permit of our dealing at length with another class of science school of vital importance to the state, namely, Q-overnment Schools training directly for special branches of state service. Here the maximum efficiency possible both in staff and equipment is absolutely essential for national safety, and yet the routine, almost a necessity, of official in- meat stitutions is excessively apt to check just the very variations of individuality and the genius on which discovery in science and progress in its practical applications almost invariably depend. For this reason it is very desirable that the government schools should be limited to those branches of instruction which are needed only for the national service. For example, schools of offence and defence ??? naval colleges, staff colleges, artillery and military engineering colleges ; to these ought probably to be added, schools for home and imperial civil service ??? for consuls, native state residents, and the lower branches of the diplomatic service. It seems, but for the historic evolution,^ a curiously anomalous process to select for many of the latter services men who have obtained examination distinction in classics and pure science, often taught by crammers, and with no special relation to the future work of the taught. It would probably be a great advantage to place these colleges, where feasible, near to one or other university. Thus while specialization in training and study should be insisted upon, both teachers and taught would have the widening influence of contact with other forms of work and play. The want of this ” touch ” undoubtedly tells on the efficiency of certain service colleges: their professors are too isolated; and necessary as is specialization, and valuable as is esprit de corps., the creation of a caste among the students, with caste habits and amusements, is far from an unmixed good. Without rivalry, and free from comparison with

^ Comparatively few of these scholarships appear now to be given for essentially technical research, ??? which was possibly the original intention.

2 The origin of the all-pervading state-examination system in the United Kingdom was the desire to check nepotism in government appointments ; to

hinder one type of inefficient is not equivalent to selecting the fittest and training them effectively for their specialized work. Even the examination system has probably been adapted, by artificial “adjustment of marks,” to pass into the service not individuals, but types of men who appear best suited for the work in the eyes of certain commissioners. In other words, we are trusting very considerably to personal judgment as to a fit type ; and this fact, be it good or bad, is screened behind a complex system of examination-marking.

any but foreign schools, the government service school is liable to run in grooves ; in many cases the staff does not appear to be numerous enough or sufficiently specialized to have leisure or inclination to study new problems or foreign methods. The pay of a government professor and the honour of the position should be such as to attract the highest teaching and organizing talent to the state service, and the leisure at present sometimes devoted to external teaching and examination work should be mono- polized for specialized research work in the national service.

Lastly, the government schools should be confined to those branches of the service where the specialized training required by government servants is not already being provided on an adequate scale by other educational bodies. A government civil engineering college, for example, may be govera- perfectly efficient in its own line, but the men it turns out see only one group of teachers and Schools to oils form of instruction. The whole service may thus run far too much in one groove, which technical would be impossible if its members were the picked students of the various technical schools

colleges. ‘- ^

and universities. The same criticism applies, if to a less extent, to naval engineering and architecture. The Admiralty, which occasionally does draw on external supplies, rarely gets the best students of the technical colleges, because it draws by an examination schedule which none of the more efficient engineering schools would be likely to adopt for its curriculum ; and if they did, it would be, under present arrangements, devoting their

energies to a small and very uncertain class of student. It would be an interesting experiment ??? ^and we believe a successful one ??? if the government gave for a trial number of years a limited number of engineering appointments to the pick of the technical college students, and compared their work with that of the men reared in their own schools. We believe that the wider field of selection would lead to a greater variety in capacity, talent, and training being made avail- able for the government service.

From government schools we naturally pass to government research institutions, and the position of science as consultant in the modern state. The position accorded to science in the past in this respect

has been a very defective one. The state needs quite as much scientific as legal advisers ; ment ”’ indeed, under present circumstances, they are perhaps even more essential. Not only problems research j^j^ offence and defence, but in development, transit, industry, disease, sanitation, reproduction,

and medico-legal matters arise daily, and the government wants not only to know where to turn for immediate advice, but to be sure that it will get what for the great bulk of cases is sound advice. Beyond this, the progressive state ought always to be on the look-out for and seeking to encourage dis- coveries or inventions which will increase national efficiency either for war or in peace. Something of this latter function may be fulfilled by permanent government research institutions and consultative scientists. But not only is the incentive to discovery greatest in the young man with his future to make, but the power to discover great things rapidly diminishes with age. There is the born scientist, who

researches for the keen intellectual pleasure of the work, and would go on, whatever his income

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scientific or post ; and there is the man for whom research or science is a means to a living and a position. types. yiq pursues it to a competency and his D.Sc, to his F.R.S. or to his K.C.B., as the desire impels.

He retires on his laurels, spending his life on committees, emphasizing the needs of pure science, the im- portance of technical education, and scaring us with the German bogie. i It would be unreasonable to condemn this man ; for he belongs to the type which forms the bulk of humanity, whether occupied with science or any other pursuit. He has probably done good work, and his experience is of value for con- sultative, if no longer for research, purposes. We have only to remember that science has and can have no high priests, for it is always progressive and advancing. It is hardly too much to say that the moment a scientist reaches celebrity as a man, he has ceased to be a discoverer. For he can hardly attain fame before middle life, and already the younger man is on his shoulders reaching higher, for he starts with his elder's knowledge and with the unspent energy of youth. One of the greatest dangers of science, and especially science in the consultative service of the state, is the possible creation of a scientific

1 All honour to Germany's scientific work 1 Her specialist has organized his science and made research a trade, yet his product lacks too often the real insight, the lucidity, the touch of genius characteristic of the best French work ; rarely, too, does- the German break entirely novel ground, as was done by the three great scientists of the English type ??? Newton, Faraday, and Darwin.

hierarchy, resting on past achievement and believing itself at the summit of scientific knowledge. As soon as a man ceases to research, he has fallen behindhand ; his tools grow rusty, and he ceases to grasp new methods and new possibilities. Hence one of the greatest problems of the state is how to draw into its service not only those who have achieved as consultants, but those who are achieving as discoverers. Possibly an extension to our country of the French system of substantial pecuni- ary prizes, with not too-closely defined limitations, would turn more of the research work of the f'^^^^ country to national ends. A prize every two or three years of four or five thousand pounds for a markedly iiseful contribution to the country's means of naval defence ; a like sum for the inost valuable work tending to develop the chemical industries of the country, or to improve its sea or land transit ; or, again, equally substantial prizes for medical or sanitary

discoveries ××× these would drawthe energy of many youthful scientists into channels of national value. A yearly government offer, not necessarily an expenditure, of ××10,000 to ××20,000 in such prizes would be no extravagant sum, and might well have enabled this country to lead in at least some of the recent fields of discovery, such as smokeless powders, submarine boats, motor cars, wireless telegraphy, &c. &c. Such prizes and research should be independ- ent of national laboratories and government consultants, to whom more specialized problems and routine difficulties should be submitted for solution or advice. In the one case the appeal is made to the energy of the youthful scientist, in the other to the experience of the consultant, to the store of current knowledge.

Considering more closely science institutions in the direct service of the state, will be found that the ideas of men on this point are at present somewhat chaotic. Such institutions as exist have arisen partly from the immediate exigencies of executive, and partly from the outside pressure of pure scientists, asking for governraent assistance, or for public support on the ground of a private science institution fulfilling a crying national need. This haphazard origin accounts for the want of organization and specialization ; private institutions are partially doing national work, and national insti- tutions which should be doing specialized industrial work have fallen to some extent into the hands of pure scientists. Here, as in other fields, a differentiation of pure and applied science is necessary. It is perfectly true that none can tell how soon a result of pure science will be applicable to industry ; but the type of mind that can apply such results is rare, and the bulk of applied science problems are first formulated, and afterwards the extension of pure science which leads to their solution worked out.^ In the first place, there- fore, a nation needs laboratories for its industries ××× for standardizing the implements, testing the materials, and distributing knowledge with regard to the processes of its manufactures. There must be institutions which, free of every bias, will test and compare the products of all manufacturers seeking government con- tracts, or will advise Boards of Trade and state or municipal authorities as to regulations for factories, transit, food, and sanitation. These needs stretch far beyond any existing institution, and cannot be satisfactorily dealt with except by technical specialists having control of independent laboratories.

Thus the nation’s wants comprise : (i.) National Engineering Laboratory. ??? This must be subdivided into mechanical, civil, and naval departments. The first would test materials and machinery for government use, or apply standard tests in the case of corporations or private individuals. It should keep a hold on the industries of the country by reports on the quality of materials of construction engln^r- bought in the open market, and their quality relative to foreign productions. It should under- ‘“g’abora- take engine and other tests for manufacturers, and report to them on the relative efficiency of British and foreign machinery. In fact, in every way within its sphere it should apply and circulate current knowledge. The second, or civil engineering department should deal in a like manner with docks, railways and general transit, water and sewerage, &c. It should be prepared to advise the government or municipalities on the conditions to be satisfied in bridge structure, to criticize development plans from the national and from local standpoints, to provide tests for dam efficiency, data for the flow of fluids, and a multitude of other matters which come daily before civil and municipal engineers. The naval depart-

1 Of course this rule is not universal, but it is strikingly illustrated in pure and applied mathematics. Developments of pure analysis are now and then of occasional use, but pure mathematics has over and over again been enriched by analysis directly invented for the solution of special physical or even technical problems.

ment should lay down the conditions for testing the machinery of ships, the strength of their plating and riveting, and keep shipbuilders in constant touch with foreign developments, as well as help to maintain a high standard of efficiency in home work. It should assist indirectly or directly in the registration or classifica- tion of ships. Of course much of all this is done at present by various government inspectors or depart- ments, by private corporations like the two Institutions of Engineers and Lloyd’s. But it is not done in a systematic manner. When a pressing need arises, a commission is appointed, which investigates or experiments for a time on iron, boilers, or bridges. It has to do this in a more or less haphazard sort of way, with a temporary staff, and without a properly equipped centre, or

even without direct experiment by comparing the conflicting evidence of too often iiiterested witnesses. These defects of existing procedure result in grave delays, much expense, and general inefficiency. A trained staff accustomed to experiment, with apparatus and locus provided, ought to be at the constant service of such commissions ; in many cases such a staff would be already prepared with the unbiassed information necessary for a judgment, and would be the centre from which government and private individuals could at once ascertain what was known here or abroad on the problems ever arising in progressive construction.

(ii.) In close touch with the Engineering Laboratory should be a Laboratory for Electro- Technical Industries. This is especially needful in the case of electric transit. But electro-technology opens up such

an immense field of activity in transit, lighting, telegraphy, telephony, power, and the smaller arts,

technical that the laboratory ought to be differentiated from that for engineering proper. Here there is

ory. ^^ present such a wide amount of work necessary in standardization, testing, regulation, and

control for public safety, that the early establishment of such a laboratory is almost more urgent than that

of any other.

(iii.) It seems almost unnecessary to discuss the importance of a National Chemical Laboratory. This is to some extent already provided for in separate government departments. What is needed is

centralization, departmental differentiation, and complete and efficient equipment. It must be chemical in no scnse an institute for research in pure science, but it has to answer the innumerable

chemical problems of the state, both on the organic and inorganic sides. It must do for the chemical industries what the engineering laboratory does in

its own field ??? standardize, test purity, report, and watch foreign rivals ; deal with colonial produce, poisons, adulteration of food, and an infinity of other prob- lems, which suggest many sub-departments, and ultimately differentiation into separate national institutes, (iv.) There must be at least one institute to deal with those smaller industries which demand a high standard of scientific efficiency. The work done in the old Kew Laboratory was excellent of its kind, and

kept fairly in view the industrial factor ; the testing of watches, chronometers, barometers, and National thermometers must be supplemented by work on microscopes, theodolites, telescopes, and a for the multitude of optical instruments used in pure or applied scientific work. The Admiralty or

industries. War Office should know at once where to turn for a report on telescopes or telemeters, and upon

the reliability of instrument makers, here or abroad. Nor does the above list by any means com- plete the round of important smaller industries where scientific control, standardizing, testing, or advice is desirable. As the scientific training of the nation, from the handworkers to the organizing leaders of each specialized industry goes on, the need for national institutes, as centres for collecting information, for maintaining high standards of production and controlling the relations of industry to the state, will grow more and more pressing, and the differentiation of the above institutes and the foundation of new ones must be taken in hand. It will be clear that it is not possible to deal satisfactorily, from the industrial side, with such consultant bodies as we have sketched when they are merely sub - departments of a National Physical Laboratory. They must be placed in the hands of leading and independent technical authorities.

(v.) National Astronomical Observatory. (vi.) National Meteorological Office.

(vii.) National Q-eographical and G-eological Survey Office.

The institutes comprised under (v.), (vi.), and (vii.) have been for years in effective existence, but perhaps have hardly been developed on a

sufficiently wide or imperial basis. The link between the central

home observatories and those in the colonies and dependencies has hardly been strong enough, nor the whole

chain of institutes systematized ; and this is particularly the case in the meteorological service. There is

no central authority for collecting and storing the meteorological data of the empire. In some

cases records are taken at scientifically important stations, but no returns are made, still less ^”^oali

printed. Often months or years of record will be omitted. In other cases returns are made institutes

by the naval authorities, by the army medical service, by colonial botanical superintendents, &c.

&c., and returns have to be sought for at the Admiralty, Netley, Kew, or vainly at the Colonial Office.

Colonial data, unless printed, rarely reach this country, which from the imperial standpoint is far behind

Portugal in the system atization of its meteorological service. It must never be forgotten that

. Meteoro-

the meteorological condition of the world at any given time is a complex unity, and the state of logical the atmosphere in Northern Norway is correlated with the contemporary conditions even of St ”””^ **’ Helena and the Cape. The world-wide extent of the British Empire presents opportunities in this direction which are far from utilized at the present

time, and the extension and ” imperialization ” of all three of the institutes just referred to must be an important task for the immediate future.

Thus far we have dealt chiefly with the inorganic or physical sciences applied to the service of the state. In several of these sciences there have been, and undoubtedly will in future be, demands for state institutions for research in pure science. Now although the boundaries of pure and applied

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science are in some cases ill-defined, yet we believe a working distinction can be made, especially and pure- if we remember tnat the first, if not, however, the whole function of a national institute is to s’:ience

Institutes.

collect data and apply existing knowledge. It is to the academic bodies that we should look for real advance in pure science, and this will become the more feasible the sooner it is recognized that it is the function of these bodies to teach by research, and that the members of their staff who merely teach and do not research are not teaching in the proper manner. Hence any cry for national laboratories for pure science must weaken the legitimate demand of the universities for effective municipal and state support for their laboratories. The university laboratories for research and post-graduate students are, and ought to be, the true national laboratories for pure science. Of course they want, especially on the biological side, wide extension and development.

Turning now to the organic side, we see at once the fundamental importance of : (viii.) National Institute for Preventive Medicine and (ix.) National Institute for Sanitary Science. ??? Here again there are innumerable questions to which municipalities, or home and colonial governments, need answers, and definite and prompt answers. It is little good, after an army has been decimated by enteric, to appoint a commission to inquire into the causes of it : advice and control on the point should ^^ ‘^ have been provided before the army started. Pollution of rivers, provision of vaccine and anti- sanitary toxin, the treatment of malarial districts, are not topics to be left on one side until public atten- tion forces the government to action ;

they and many other matters are not effectively dealt with by private corporations, individual research, or hurriedly constituted commissions ; the staff of government institutes should have been steadily pegging away at them, collecting data and experimenting, so as to be ripe with information when the state demands aid, or popular interest, tardily excited, calls for expert opinion.

(x.) National Institute for Anthropology. ××× With possibly more races under the British flag than under any other imperial symbol since the days of the Roman eagle, we have yet entirely failed to systematize and nationalize our study of those races. There is no national museum or institute where one may learn the cranial, anthropometric, and physical characters of the various races lasutute under our sway, still less something of their languages, folk-customs, industries, and religions, forantbro- An institute carrying out a complete anthropological survey of the empire is as necessary from the imperial standpoint as those dealing with the geographical or geological surveys. The Americans have recognized this, and their anthropological reports and museums under state supervision will soon be a model for such work everywhere.

(xi.) National Institute for Botany. ××× The importance of this has been long recognized, and Kew with its associated botanical gardens in the colonies and dependencies forms a great organization which

justifies further support and wider extension. A special department, or even a separate institute, ought to be devoted to agricultural economy, while a further institute or sub-department must be devoted to forestry.

The reforesting of large tracts in Great Britain ××× for example, miles and miles of grouse moor. Institute where, as in the Schwarzwald, the deer and capercailzie might still serve to train the sight of otany. j^gg j^ ·^ walk as wcU as stand ××× is a matter of growing importance ; while the economic usage, not ‘ use-up-age,’ of colonial and African forests is a matter which demands trained intelligence and wise control. As Professor F.

O. Oliver has suggested, the outdoor life involved in planting, tending, felling great national forests ††† and, we may add, the training in sight and scouting involved in game- preservation ††† would be excellent work for army-reserve men. The foresters would be a great body of fit men who could, like the coastguard, be at once drawn upon in time of need, without upsetting great national industries or important systems of transit. The organization of a forest service, which should ultimately be imperial rather than local, would provide excellent material for the experts of a Forestry Institute ; while at the present rate of consumption the exhaustion of existing supplies will render even pine forests self-supporting by the middle of the century.

(xii.) National Biological Institutes. ††† Here again great differentiation and much extension are requisite. If we preserve, as seems fitting, the principle that the national institutes are in the first place

for applied science, and that the state directly undertakes pure scientific work only when it biological cannot do it indirectly through support to academic laboratories, then we may perhaps see

some light through a rather complex situation. We need first an Institute for Marine and Riverine Fisheries, solely devoted to the study of these matters from the industrial standpoint. The existing marine biological laboratories have principally, although not entirely, opened opportunities for research in pure science, and they are likely to become still more closely associated with one or other academic body or group of universities. The Institute for Fisheries should be the head-centre of the government fishery inspectors, the store for statistics of home and deep-sea fisheries, and the place for the experimental development of all industries relating to fish, ††† catching, curing, and transit, ††† as well as for the control of these industries. Such investigations only hamper the development of pure science, which requires marine laboratories for its own purposes. Turning to land fauna, we need in the first place a National Zoological Institute, which would, like the Geological and Anthropological Surveys, report on living forms within the limits of the empire, with special reference to the preservation and spread of such as are of industrial

importance or agricultural fitness for special climates or tasks. This institute sliould be in

National r b i

zoological close touch with government studs, and with the custodians of zoological reservations in the colonies and dependencies. The Royal studs should be developed into national studs, where secular experiments might be carried on with horses and cattle, and interchanges made with the like studs in the outlying parts of the empire, ??? in the same manner as interchanges are now carried on between Kew and its allied botanical gardens. Such an institute should be able to report at once on the best type of animals for a given district or climate, and on the fodder and animal or insect foes there to be met with. Here again we are behind the Americans, who are already starting ” state farms ” for the experimental investigation of the laws of heredity and their application to animals used in agricultural industries. Naturally a special study of the smaller wild animals, birds, and insects, from the standpoint of their importance to husbandman, fruit-grower, and farmer, would be undertaken as a special department of the Zoological Institute. It would be the consultative faculty of the Board of Agriculture, and of many county councils in rural districts. This institute should deal with close seasons, game laws, wild- bird protection, and insect destruction on a firm scientific basis, and seek the transfer and acclimatization of new and useful species of both wild and domestic animals.

Corresponding to such an institute, with its associated group of national breeding establishments and zoological reserves, we must hope in the near future to see the establishment, in the interests of pure science, of one if not more fully-equipped Biological Farms. The Biological Farm or Garden has biological a perfectly definite scientific mission alongside the Biological Laboratory. There is a great range ’”^”’ of problems bearing on the evolution of living forms, their variation by natural selection, their

laws of inheritance, the origin of species, and the differentiation of local races, which can be solved only by

PEEFATOEY ESSAY XXXV

experiment on “populations,” carried on under nearly natural conditions, or on a large scale, from genera- tion to generation. Such statistical and secular experiments cannot be satisfactorily undertaken in existing biological laboratories : they need a considerable range and variety of land, water, wood, and open field, free from intrusion and under the management of skilled keepers ; there must be sheds for the breeding of, at any rate, the smaller mammals, houses for insects and birds, and ample space of all kinds for all sorts of extensive experiments on heredity and variation. There must be, in addition, workrooms, microscope rooms, dissecting laboratories, and instrument departments for the use of measurers, computers, and researchers. Such a biological farm could in the present state of affairs do epoch-making work within the space of a very few years. There are all-important questions in variation and heredity which cannot be settled by individual experiment, owing to the labour, the time, and the freedom from bias required. There must be trained servants ††† ^keepers or gardeners ††† to tend, in the absence of the directing researchers ; there must be facility for inspection at any time, so that there can be no question of how characteristics are measured, or of personal equation in the interpretation of results. It ought to be perfectly possible in a few years to determine, to the satisfaction of all parties concerned, the limits of truth in the laws propounded by Galton, or Mendel, or any other ; and only by such unbiassed experiments, not by controversial publications, can the actual facts be reached. It is admitted on all sides that we stand here, in the matter of variation and heredity, on the eve of wide-reaching discoveries, and only an institute such as we have here sketched can really conduct the extensive and secular experiments which are needed for truly authoritative answers.

Such answers, when found, will not only be of vast importance to pure science, but of wide practical usefulness in stock-rearing, horticulture, and agriculture. Nor is their value limited to the lower forms of life. The crowning study of man is man ; the highest science is that which deals with human races, and sees the causes which lead to their progression and relative dominance. This importance science, applied to national life, is statecraft, ††† the art of seeing what makes for national health ††^^” ^ and for national fitness. Every nation, however, is an agglomeration of classes and castes, of heredity, the mentally and phys’ically healthy, and of the mentally and physically unsound. Man, if the highest of living forms, is

still one of them ; and it is easy to test whether the general laws of heredity and relative fertility proved for the lower forms hold, with or without modification, for him. Problems as to the reproductive dominance of the better stocks, as to effective national fertility, as to progressive physical and mental development in man, will be vital problems for the statesmen of the near future ; their solution is closely bound up with a knowledge of the laws of heredity, fertility, and variation in other living forms, which only such an institute as we have just described can effectively study.

With the Biological Farm we must conclude our too brief account of some of the institutes which

are essentially necessary for increasing and circulating the knowledge which is the life-blood of the

modern state.

IV. Records of Scientific Discovery.

Passing for a moment to the conditions under which newly discovered knowledge is published, we find, both from the national and international standpoints, considerable confusion and overlapping of functions. Placing on one side book publication, ??? in which form, perhaps, less and less original work sees the light, ??? we have two chief methods of issue, the scientific journal and the proceedings or ofpubiica- transactions of learned societies. The national work done by both journal and society is often deserving of far greater recognition than it receives ; in many cases the publication funds depend solely on the range of either subscribers or members, and editors and councils are occasionally compelled to keep up their numbers -by the issue of memoirs which do not reach the high-water mark of scientific research. Permanent endowment of journals and societies is a more or less urgent need, and we could wish that the millionaire with patriotic instinct would occasionally realize that to set one scientific society or journal firmly on its legs may do more real good than the establishment of an additional free library. The further endow- ment of University Presses with trust funds for the publication of non-paying scientific and scholarly works is also a form of public benefaction which should be heartily

commended. The reputation of a great university, the width of knowledge at the service of its press committee, may in some respects afford

better security for the publication of first-class work than can be provided even by a strong editorial committee in a specialized branch of science.

If we demand for scientific journals and societies permanent endowment, we must also demand from

them increased specialization, and in many cases a higher standard of publication. At present memoirs of

a given class may appear in perhaps a dozen different journals or proceedings. We may hope

Need tor i^ ^he future that national journals may assume a more international character, and then special-

speclallza-

tioa In ization would become more and more feasible.^ Such specialization is needful, not only for the

%urnais. efficiency of editorial committees, and for the facility of reference, but would ultimately extend

circulation. A specialist will take in one or two journals devoted to his own branch of science, but he cannot afford a round of publications which partially and intermittently touch his special field. He trusts to the library rather than to the study shelves, and thus the total number of subscribers to scientific literature is permanently reduced.

The progressive specialization and differentiation of learned societies are of course familiar to every student of the formal history of science, and it becomes a grave question how long national academies and royal societies can maintain their old lines of publication or constitution. Under the present arrangement the most highly specialized and, perhaps, the best work does

not reach these societies at all ; and the leading specialists may be far more interested in the work and executive of special societies or journals for astronomy, biology, or geology, than in those of the academy or society which is supposed to be the repre- sentative of national science. It weakens the reputation of the leading society to publish special memoirs distinctly inferior to those issued by a specialized society or journal ; ^ it is undesirable, on the other hand, that the leading society should skim the cream of special journals and transactions, if indeed it lie in its power to do so. The co-ordination of learned societies and the organization to a common end of their publications is a matter of some difficulty, but of a pressing character. It may be doubted whether a central society discussing and publishing communications bearing on almost every field of knowledge, is fitted to survive in the highly specialized science of the future. Rather such a central society needs differentiation

into astronomical, mathematical, physical, biological, geological, physiological, and other sections, co-ordina- each of which is now more or less effectively provided for by one or more special societies. existing In our own case we might render the whole work of science much more effective if the societies. publications of these societies ??? proceedings and transactions ??? were rendered uniform in format,

and the first stage to publication ^ by the Royal Society, or to its membership, were through these specialized or co-ordinated societies. In this way a much higher standard of publication and of mem- bership might be reached, especially if the executive of the central society were a body fully representative of the executives of the co-ordinated societies. Thus the Royal Society's Transactions and Proceedings, off- printed from the sectional publications, would embody the best and most representative scientific work of the nation ; this selection, embracing most of originality and progress in the year's scientific work, would be offered as an incentive in style and matter to individual workers, and as a resume of the best in national work for international criticism and exchange. Whatever direction reform of the Royal Society and co-ordination of existing scientific bodies may take, it is hardly possible that by the middle of this century the Royal Society can remain with its present olla podrida in publication and membership, and yet maintain its reputation or influence.

V. State Recognition of Science.

We have already referred to a more or less fundamental distinction that exists between the two types of scientific workers, ††† those who adopt science and research as a profession, and those who are impelled to

1 There are, for example, perhaps a dozen journals of mathematical research, of which at least five or six are of the first class. But each one covers the enormous range of pure and applied mathematics, and a mathematical paper may have to be hunted for not only in these, but in twice as many more proceedings or transactions. Both pure and applied sides require to-day in publication (as in teach- ing) wide-reaching differentiation, and a specialization of mathematical journals on international lines would be a great gain.

2 The mixed character of the papers communicated, even at a single sitting, to anational academy or society makes a really valuable discussion, such as may well arise in a specialized society, rarely possible.

8 It vfould be needful to maintain a general publication, co-ordinate with those of the specialized societies, for work in new fields††† often the most important type of work ††† not yet recognized as a part of any difierentiated section.

investigate by an uncontrollable curiosity, to which in our higher flights we are tempted to give grandilo- quent names. As in other callings, so in science the bulk of men, from forces of external circumstance and of internal character, must belong to the first class, and the usual incentives of endowment and state recognition are needful as spurs. The state of the future, the welfare of which will so largely depend on science, must provide such rewards of this kind as seem necessary. In this respect the institution of a particular grade, say that of State Science Counsel, with a patent like that of the existing King’s Counsel, might serve to mark the field in which distinction had been gained, and so differentiate science scientists as a class from provincial mayors and successful financiers. The whole body of State Science Counsellors might form the State Science Council. This would

consist of the directors of the national institutes, of the most distinguished pure science professors in the universities, of the leading teachers in the principal technical and government schools, and of any other persons of great scientific achievement. It would form the chief scientific consultant body to which government or any public authorities could appeal in cases of difficulty. Out of the members of such a council, investigating and advising commissions might be nominated by ministers of state. It would probably be undesirable to summon such a Science Council as a whole, or give it officers or corporate existence. Many of its members at any given time might be beyond active scientific work, but, as in the case of other state councils, selected members only might be summoned for special committees and special types of work. It would provide a body from which men far better able to advise the state could be drawn, than the council of any existing society. For it would involve specialists in all branches of pure and applied science, having the instruments of research at their disposal, and would be essentially practical and national in its character. But in the selection of the right type of man to aid the state in a particular function, we come back to the point from which we started ××× to a knowledge wholly different from and scientific knowledge. Science in the end, if it is to be of the highest national service, must be subject to a different type of knowledge ××× to that experience of men, that power of selecting the fit man for the fitting task, which is summed up in statecraft. We need men in every department of state who have insight into character, who can judge the man who is capable of achieving, without having studied his creative work or knowing the ” ropes ” of his special science. Herein the position of science in both Germany and France is better than in Great Britain, for there is a closer association of the scientific and governing castes ; we do not want an increase in the number of parliamentary scientists, for in deserting science they have not become statesmen. It is a matter where closer personal knowledge and a more intimate contact of men of diverse pursuits have to be brought about. Such considerations lead us again to the training of statesmen ; it seems far easier to develop the scientific knowledge of a nation than to increase its store of statecraft. Educate intelligently the craftsmen who form the basis of social life and the bulk of the electorate ; then, perhaps, the politician who appeals to them will need to reach a higher standard ; he, in his turn, will demand graver qualities and more weighty capacity in his leaders than at present: power of organization, insight into

character, true executive ability, will weigh more than ready repartee, mere force in verbal criticism, or the other special aptitudes developed by a parliamentary training. But it is a long way up from nature-study in the village schools, and the heuristic method in craft-schools, to this ; it may sound paradoxical to some, and a counsel of perfection to many. Yet the nation, from the bottom to the top, has yet to learn that trained intelligence in all functions is the factor which makes for victory in the modern international struggle. It may be a lesson taught by the wisdom of statesmen, or bitterly by the stress of defeat and famine. We have by one or other process to learn the national importance of science : to realise that science in the broadest sense, as educator and discoverer, is the mainspring of modern national life ; that the future is to the scientifically trained nation which reproduces itself, maintains its health, develops its institutions, controls its production, organizes its distribution, extends its territory, governs its subject races, and prepares its offensive and defensive services with scientific foresight and insight ###

In the reproof of chance Lies the true proof of men ###

and, we may add, the true proof of nations.

ENCYCLOPEDIA BEITANNICA.

]^E## YOLUMES.

PEIBILOFF ISLANDS-PEIEGO DE COEDOBA

PribilofF Islands, often called the Fur Seal Islands, a part of the U.S. territory of Alaska, lying in Bering Sea in about 56## 50′ N. and 170## W. They were first sighted in 1767 by Synde, but visited by Gerasim Pribiloff in 1786, who discovered the fur seal rookeries for which they became famous. Between 1786 and 1890 it is estimated that 6,500,000 seal-skins were taken on the islands ; and during the period of the first lease by the Government of the United States (1870-90) the lessees paid to the Treasury $5,956,565. There are two principal islands, St Paul and St George, about 30 miles apart, and Otter and Wahus islets near St Paul. The Aleuts employed in the fishery number about 400, and only agents of the United States or employes of the lessees are permitted on the islands. The

islands are hiUy and volcanic, vsdthout harbours, with abundant herbage, a mean annual temperature of 35 ‘7►► F., and a rainfall of about 35 inches. The total area of the group is about 50 square miles.

PFibraiYl, town and capital of a district of the same name, Bohemia, Austria, 29 miles east by south of Pilsen. It is the most important silver-mining town in Austria, the rich Adalbert vein having been worked continuously since 1778 and now reaching a depth of over 3300 feet, becoming richer with the depth. Population (1890), 13,412, or, including the adjoining township of Birken- berk, 18,536; (1900), 19,119, almost exclusively Catholic and Czech.

Price, Bartholomew (1818-1898), English

mathematician and educationist, was born at Coin St Denis, Gloucestershire, in 1818. After a private early education he matriculated at Pembroke College, Oxford, of which college (after taking a first class in mathematics in 1840 and gaining the University mathematical scholar- ship in 1842) he became fellow in 1844 and tutor and mathematical lecturer in 1845. He at once took a leading position in the mathematical teaching of the University, and published treatises on the Differential Calculus (in

1848) and the Infinitesimal Calculus (4 vols., 1852-60), which for long were the recognized text-books there. In 1853 he was appointed Sedleian professor of natural philosophy, a post which he filled for forty-five years, resigning it in June 1898. His chief public activity at Oxford was in connexion with the Hebdomadal Council, in which he was very prominent, and the Clarendon Press, of which he was for many years secretary. He was a man of remarkable business ability as well as great diligence, the result of this being that he became largely responsible for the conduct of the affairs of the University in various directions. He was also a curator of the Bodleian Library, an honorary fellow of Queen’s College, a governor of Win- chester College, and a visitor of Greenwich Observatory. In 1891 he was elected Master of Pembroke College, which dignity carried with it a canonry of Gloucester Cathedral He died on 29th December 1898. (e. r. s.)

Price, Bonamy (1807-1888), political economist, was born at St Peter’s Port, Guernsey, on 22nd May 1807. He was educated privately, and then

entered at Worcester College, Oxford, in 1825, where he took a double first in 1829. From 1830 to 1832 he was mathematical master, and from 1832 to 1850 a classical master, at Eugby. After resigning his position there, he lived for some years in London, and was appointed, both then and later, to serve on various Royal Commissions. He married in 1864. In 1868 he was elected Drummond professor of political economy at Oxford, and, proving himself an excellent lecturer, was thrice re-elected to the post, which he held till his death. In 1883 he was elected an honorary feUow of his college. He died in London on 8th January 1888. His principal economic pubhcations, exclusive of pamph- lets, were : The Principles of Currency (1869), Currency and Banking (1876), Chapters on Practical Political Economy (1878).

PriegfO de Cordoba, a town of Spain, in the province of Cordoba, in a plain bounded on the south by the sierra of the same name and by Eute. The surrounding

districts send to the market large droves of cattle and mules, and agricultural products, especially wine and oil. The local industries, tanning and manufactures of esparto grass, rugs, and cotton goods, are on the increase. The streets and squares are well built and mostly modern. The parish church was built in the 13th century and subsequently restored; it has a fine chapel. There are several other churches and convents. The town-hall, theatre, and public promenades are modern. There are ruins of an old castle ††† Priego having been a fortified city of the Moors, and twice retaken by the Christians in 1226 and 1407. Population (1897), 14,434.

Priluki, a district town of Kussia, in the government and 145 miles north-west of the town of Poltava. It is an old town, and is mentioned in the will of Vladimir Monomakh. It belonged for some time to the Poles, but was definitively annexed to Russia in 1781. It has an agricultural society and

two steam flour-mills, and carries on trade in grain and flour. Population (1897), 19,055.

Primrose Leag^ue, The, an organization for spreading Conservative principles amongst the British democracy. The primrose is associated with the name of the late Lord Beaconsfield {q.v.), as being preferred by him to other flowers. In a letter to his private secretary, Mr Montague Corry, afterwards Lord Rowton, he once viTote : “Primroses are beginning to show themselves at Hugh- enden, ‘sweet harbingers of Spring.’” On a card affixed to the wreath of primroses plucked in the Isle of Wight, and sent by Queen Victoria to be placed upon his coffin by Prince Leopold, there were written in Her Majesty’s own handwriting the following words : ” His favourite flowers : from Osborne : a tribute of affectionate regard from Queen Victoria.” On the day of the unveiling of Lord Beacons- field’s statue, Sir Henry Drummond Wolfi”, coming late, found all the members of the Conservative party in the House of Commons decorated with the primrose. A small group had for some time discussed the means for obtaining for Conservative principles the support of the people. He therefore said to Lord Randolph Churchill, ” Let us found a primrose league.” The idea was accepted by several gentlemen in the habit of working together, and a meeting was held at the Carlton Club shortly afterwards, consisting of Lord Randolph Churchill, Sir H. Drummond Wolff, Mr (afterwards Sir John) Gorst, Mr Percy Mitford, Col. Fred Burnaby, and some others, to whom were subsequently added Mr Satchell Hopkins, Mr J. B. Stone, Mr Rowlands, and some Birmingham supporters of Col. Fred Burnaby, who also wished to return Lord Randolph ChurchiU as a Conservative member for that city. These gentlemen were of great service in remodelling the original statutes first drawn up by Sir H. Drummond Wolff. The latter had for some years perceived the influence exercised in benefit societies by badges and titular appella- tions, and he further endeavoured to devise some quaint phraseology which would be attractive to the working classes. The title of Knight Harbinger was taken from an ofiice no longer existing in the Royal Household, and a regular gradation was instituted for the honorific titles and decorations assigned to members. This idea, though at first ridiculed, has been greatly developed since the foundation of the Order; and new distinctions and decorations have been founded, also contributing to the attractions of the League. The

League was partially copied from the organization of the Orange Society in Ireland, which does not include either Roman Catholics or Jews, who had then recently proclaimed their support of the Conservative party. Thus it was considered that the Primrose League, embracing all creeds and classes, would have much influence in organizing public opinion.

In lieu of calling the different subsidiary associations by the ordinary term “Lodges,” the name was given of ” Habitations,” which could be constituted with thirteen members. These were intended as a substitute for the paid canvassers, about to be abolished by Mr Gladstone’s Reform Bill. It was thought that thirteen in the habit of work- ing together would be sufficient to undertake the registra- tion and canvassing of a district. The principles of the League are best explained in the declaration which every member is asked to sign : ” I declare on my honour and faith that I will devote my best ability to the main- tenance of religion, of the estates of the realm, and of the imperial ascendancy of the British Empire ; and that, consistently with my allegiance to the Sovereign of these realms, I will promote with discretion and fidelity the above objects, being those of the Primrose League.” The motto was ” Imperium et libertas ” ; the seal, three prim- roses; and the badge, a monogram containing the letters PL, surrounded by primroses. Many other badges and various articles of jewellery have since been designed, with this flower as an emblem.

A small office was first taken on a second floor in Essex Street, Strand; but this had soon to be abandoned, as the dimensions of the League rapidly increased. Ladies were generally included in the first organization of the League, but subsequently a separate Ladies’ Branch and Grand Council were ~~formed. ‘The founder of the Ladies’ Grand Council was Lady Borthwick (afterwards Lady Glenesk), and the first meeting of the committee took place at her house in Piccadilly, on the 2nd March 1885. The ladies who formed the first committee were : Lady Borth~~ wick, the Dowager-Duchess of Marlborough (first lady president). Lady Wimborne, Lady Randolph Churchill, Lady Charles Beresford, the Dowager-Marchioness of Waterford, Julia Marchioness of Tweeddale, Julia Countess of Jersey, Mrs (subsequently Lady) Hardman, Lady Dorothy NeviU, the Honourable Lady Campbell (later Lady Blythswood), the Honourable Mrs Armitage, Mrs Bischofisheim, Miss Meresia Nevill (the fiarst secretary of

the Ladies’ Council). Miss Nevill soon achieved a consider- able reputation by her activity and her oratorical gifts. The work of the ladies’ branch consists principally in the distribution of literature, the organization of social enter- tainments with an admixture of politics, and in constant assistance as district visitors both in registration and in canvassing during elections.

When the League had become a success, it was joined by Lord Salisbury and Sir Stafford Northcote, who were elected Grand Masters. Since the first formation the numbers have increased to a marvellous extent, and the following table shows the annual progress : ???

Year.

Knights.

Dames.

Associates.

Total.

Habita- tions.

1884 .

747

153

57

957

46

1885

8,071

1,381

1,914

11,366

169

1886

32,645

23,381

181,257

237,283

1200

1887

50,258

39,215

476,388

565,861

1724

1888

54,580

42,791

575,235

672,606

1877

1889

68,180

46,216

705,832

810,228

1986

1890

60,795

48,796

801,261

910,852

2081

1801

63,251

50,973

887,068

1,001,292

2143

1892

65,149

52,914

957,180

1,075,243

2188

1893

66,570

54,623

1,010,628

1,131,821

2233

1894

67,896

56,147

1,074,388

1,198,431

2275

1895

69,167

57,632

1,133,009

1,259,808

2296

1896

70,475

59,117

1,185,536

1,315,128

2326

1897

71,563

60,484

1,244,381

1,376,428

2346

1898

72,590

61,817

1,295,612

1,430,019

2360

1899

73,566

62,942

1,338,844

1,475,352

2371

1900

74,461

64,003

1,380,097

1,518,561

2380

1901 .

75,260

64,906

1,416,473

1,556,639

2392

The Primrose League has undoubtedly exercised consider- able influence on elections. Much information may be found in an article in a review called The Albemarle of January 1892, written by Miss Meresia Nevill; and in the Primrose League Manual, published at the offices at West- minster. The latter publication shows that the League wishes for the dissemination of its three great principles, in- dependently of party politics, and it contains at length the statutes and general instructions, with the gradation of honours and the financial arrangements. It is interesting as a history of the organization. (h. d. w.)

Prince Edward Island, a province of the

Dominion of Canada, lies between 45•• 58′ and 47•• 5′ N. and 62•• and 64•• 27′ W. The rocks consist of soft red micaceous sandstone and shales, with interstratified but irregular beds of brownish-red conglomerates containing pebbles of white quartz and other rocks. There are also beds of hard dark-red sandstone with the shales. Bands of moderately hard reddish-brown conglomerate, the pebbles being of red shale and containing white calcite, are seen at many points ; and then greenish-grey irregular patches occur in the red beds, due to the bleaching out of the red colours by the action of the organic matter of plants. Fossil plants are abundant at many places. These characteristics are persistent over the whole island, and the rocks have been assigned to the Permian age, but it is probable that outliers of Triassic rocks also occur. North of Summerside the land nowhere rises more than 175 feet above sea-level; but a considerable area l5dng between Summerside and Charlottetown, especi- ally near North Wiltshire, is hilly, rising in places nearly 400 feet and containing the highest land on the island. From Charlottetown eastwards the land is comparatively low and level. The average mean temperature for 1899 was 43•• F., the lowest being 10•• and the highest 86•• ; the average rainfall for twenty-seven years (1874-1902) was 31 ‘7 inches, and the snowfall for the same time .was 92‘7 inches. The area of the island is 2184 square miles. The population in 1871 was 94,021 ; in 1881, 108,891 ; in 1891, 109,078 ; and in 1901, 103,259, giving a density of 47 ‘2 inhabitants to the square mile. In 1901 there were 18,746 families, vpith an

average number of 5”5 persons per family. There were 51,959 males and 51,300 females. In 1901 the origin of the people was ††† ††† Scots, 41,753; English, 24,043; Irish, 21,992; French, 13,867; all other nationalities, 1604. Of the whole population 103,126 were either born in Canada or became naturalized citizens.

Constitution and Government. ††† In 1892 the Legislative Council was abolished. The present Legislative Assembly consists of 30 members, who sit and vote together, though divided into 15 coun- cillors and 15 assemblymen. The latter are elected by manhood suffrage, and the former by voters who own real estate valued at $325 or over. The province is represented in the Dominion House of Commons by 5 members instead of 6, as formerly.

Eeligion. ††† The principal religious denominations and the number of their adherents were as follows (1901) : ††† Church of England, 6976 ; Church of Rome, 46,796 ; Presbyterians, 30,750 ; Methodists, 13,402; Baptists, 5905.

Education. ††† In 1901 there were 475 schools conducted by 589 teachers ; pupils enrolled, 20,779 ; percentage of attendance, 59-34. The total amount expended for education was |164, 935, the cost per pupil enrolled being $7.93.

Finance.††† The. ordinary revenue in 1901 was $284,431, and the ordinary expenditure $315,326. In 1901 the gross debt was 1642,178, and the assets $181,953.

Defence. ††† The active militia consists of one regiment of garrison artillery, one company of engineers, one battalion of infantry, and a squadfron of Canadian mounted rifles ††† a total of 58 officers and 713 non-commissioned officers and men, and No. 8 Field Hospital Medical Corps.

Agriculture. ††† Within the last ten years of the 19th century a great impetus was given to the manufacture of butter and cheese by the introduction of the co-operative plan. In 1899 there were

34 cheese factories and 30 creameries, which produced 3,746,168 lb of chei-se valued at $376,000, and 722,014 lo of butter valued at $139,056. The rapid development of this industry wfll be seen from the fact that in 1892 there was only oue factory, pro- ducing 63,018 lb of cheese valued at S7872 ; and in 18y4 only 2 creameries, producing 44,512 lb of butter, vaiued at ►►7872. The island is famous for the excellent quality of its dairy products. In 1891 the crops raised were wheat, 613,364 bushels; barley, 147,880 ; oats, 2,922,562 ; rye, 221 ; peas and beans, 7180 ; buck-wheat, 84,460 ; corn, 2651 ; potatoes, 7,071,308; turnips, 2,005,453 ; grass and clover seed, 12,417 ; and hay, 132,9.59 tons. The total numberofoecupiersofland was 15,137; of these, 14,295 were owners, 813tenants, and 29 employfe. Therewerel, 214,248 acres occupied, 718,092 improved, 536,175 under crop, 178,072 in pasture, 496,156 in woodland and forest, and 3845 in gardens and orchards. In the same year there were animals and their products : horses, 37,392 ; milch cows, 45,849; other horned cattle, 45,730; sheep, 147,372; swine, 42,629 ; domestic fowls, 534,962 ; cheese, 123,708 lb ; butter, 1,969,213 lb ; wool, 528,273 lb.

Fisheries. ►►► The Dominion Government distributes annually $160,000 among the fishermen and fishing vessels of Canada ; of this amount Prince Edward Island received $10,589 in 1900, distri- buted among 29 vessels of 737 tons and 1140 boats with 2198 men. In the same year the total number of vessels employed in the fisheries was 29 of 750 tons and 2330 boats manned by 4895 men. The value of vessels, boats, nets, lobster canneries, &c., used in the whole province was $442,120. The total value of the fisheries was ►►►SI, 059,194, of which lobsters amounted to $445,417, herring to $147,347, oy.sters to $71,300, and cod to $155,038.

Manufactures. ►►► Factories have been established for the manu-facture of tobacco, boots and shoes, cream cheese, condensed mUk, and pork-packing. In 1891 there were 2679 industrial establish- ments : capital invested, $2,911,963 ; hands employed, 7910 ; wages paid, $1,101,620; value of raw material, $2,092,067; value of articles produced, $4,345,910. The volume of trade during the last quarter of the 19th century is shown in the following table : ►►►

Year.

Exports.

Imports.

Entered for Consumption.

Duty.

1875 . 1885 . 1895 .

1900 .

1901 .

S

1,308,461 1,494,469 1,039,493 1,349,529 681,403

1,960,997 780,141 524,133 502,565 626,617

S

1,983,419 778,444 530,713 506,374 643,130

S

317,163 187,642 136,136 143,402 148,258

Shipping. ††† The registry books of the Dominion for 1900 showed that Prince Edward Island owned 176 sailing ships and steamers, net tonnage, 14,251 ; of these 21 were steamers, gross tonnage, 3966. During the same year there were 3 vessels built, net tonnj,ge, 106.

Communication. ††† Two specially constructed boats ply between Georgetown and Pietou, and, with slight interruptions in extremely cold weather, make regular trips. The mail is now carried in this way instead of by ice-boats, as formerly. During the winter of 1901-02 experiments with one of these steamers were carried on between Cape Tormentine, N.B., and Prince Edward Island ports. These experiments showed that communication

can be kept up the whole winter. A com plete telephone system extends over the island, connecting all the towns, villages, and the more populous country districts. In 1901 there were 209 miles of railway in operation.

Boads and Bailways. ††† Good waggon roads intersect each other everywhere, and the Prince Edward Island branch of the Inter- colonial Railway runs the whole length of the island, with branches to Georgetown, Charlottetown, and Cape Traverse. The Murray Harbour Branch Railway, under construction, will connect Charlottetown with Murray Harbour.

The chief towns are Charlottetown, the capital (12,080 in 1901), Summerside (2875), Georgetown (about 1060), Montague, Souris, Alberton, Kensington, and Tignish.

Atithokities. ††† SiK J. “W. Dawson. Acadian Geoloqy. ††† J. W. Dawson, LL.D., F.R.S., and B. J. Haekington, Ph.D. Geolo- gical Structure and Mineral Resources of Frince Edward Island. Report of Dr R. W. Ells, Geological Survey, 1882-83-84 ; Report of R. Chalmers, Geological Survey, 1894 ; Public Documents. ††† Rev. G. Sutherland. Manual of History of Prince Edward Island, 1861. ††† D. Campbell. History of Prince Edward Island, 1875. (w. J. w.)

Prince of Wales Island, the ofEciai name of

the island commonly called Penang by Europeans, and Piilau Pinang (i.e., Areca Nut Island) by the Malays, situated in 5†† 24′ N. and 100†† 21′ E., and distant about 2|- miles from the west coast of the Malay Peninsula. The island is about 15| miles long by lOJ^

miles wide at its broadest point. Its area is something over 107 square miles. The town, which is built on a promontory at a point nearest to the mainland, is by- no means imposing. It is largely occupied by Chinese and Tamils, though the Malays are also well represented. Behind the town, Penang Hill rises to a height of some 2700 feet, and upon it are built several Government and private bungalows, which are much used both as health and pleasure resorts. The town possesses a fine European club, a

racecourse, and good golf-links. Cocoanuts are grown in considerable quantities along the seashore, and rice is cultivated at Balek Pulau and in parts of the interior of the island, but for the rest the jungle still spreads over wide areas. Penang forms, after Singapore, the most important settlement in the Crown colony of the Straits. It has an excellent harbour, and is much used by shipping ; but in this respect it has suffered from its proximity to the more important port of Singapore. There are a Church of England and a Eomau Catholic church in the town, and a training college under the Roman Catholic missionaries of thei Soci^t^ des Missions ^trangeres at Pulau Tlkus, a few miles outside the town.

History. ??? Penang was founded on 17th July 1786, having been ceded to the East India Company by the Sultan of Kedah in 1785 by virtue of an agreement entered into by him with Captain Light, in consideration of the payment of a sum of $10,000 for a period of eight years. In 1791 the subsidy was changed to $6000, to be paid annually ia perpetuity ; but some years later this was raised to $10,000, which amount is stiU annually paid to the Sultan of Kedah. This final addition was made when the strip of mainland now called Province Wellesley was purchased by the East India Company for $2000 in 1798. At the time of the cession Penang was almost uninhabited. In 1796 it was made a penal settle- ment, and 700 convicts were transferred thither from the Andaman Islands. In 1805 Penang was made a separate presidency, rank- ing with Bombay and Madras ; and when in 1826 Singapore and Malacca were incorporated with it, Penang continued to be the seat of Government. In 1829 Penang was reduced from the rank of a – presidency, and eight years later the town of Singapore was made the capital of the Settlements. In 1867 the Straits Settlements were created a Crown colony, in which Penang was included. Since then it has been under the administrative control of a resident councillor, who is responsible to the Governor of the Straits. He is aided in his duties by officers of the Straits Civil Service.

Population. ??? The estimated population of Penang in 1898, ex- clusive of Province Wellesley, amounted to 154,850 souls. The population is divided into the following nationalities: Europeans, 1173 ; Eurasians, 1814 ; Chinese, 80,511 ; Malays, 44,790 ; Indians, 24,893; other nationalities, 1669. The number of births registered in Penang in 1898

numbered 1178 males and 1058 females, a total of 2236, giving a ratio of 14‘44 per thousand of the population of the island. The number of deaths registered was 3364 males, 1142 females, a total of 4506, being a ratio of 29 ‘10 per thousand of the population. From this it will be seen that in Penang, as in other parts of the Straits Settlements, the deaths annually far exceed the Ijirths, this being due to the disproportionate smallness of the female as compared with the male population. None the less the population of Penang yearly increases, owing to immigration from China and the mainland of India.

Shipping. ††† The number of ships which entered and left the port of Penang during 1898 was 5114, with an aggregate tonnage of 3,761,094. Of these, 4412 were British, with an aggregate tonnage of 2,847,301.

Finance and Trade. ††† The revenue of Penang, including that of Province Wellesley, amounted in 1898 to $1,653,767, of which $1,084,839 was derived from the revenue farms for the collection of import duties on opium, spirits, &c. ; .’}il02,909 from land revenue, $120,987 from stamps, and .$65,000 from postal revenue. The expenditure for 1898 amounted to ,$1,211,267, of which $844,719 was spent on the administrative establishments, $103,028 on the upkeep of existing public works, $69,604 on the construction of works and buildings, and $87,780 on the construction of roads, streets, &c. The revenue in 1900 amounted to $1,736,130.

The imports in 1899 were valued at $tl9,078,371, the exports at $61,424,108, making the total value of the trade of the year up to $130, 502, 479. Of the imports in 1898 the value of |6, 339, 203 came from Great Britain, and $25,075,737 from British possessions. The exports to the United Kingdom were valued at $10,299,968, and those to British possessions at $10,920,735. The principal exports were pepper, tin, rice, and sugar ; but all these things were brought

from the mainland, none being produced on the island itself in any quantities.

See Straits Settlements Blue Book containing Annual Meports for 189S, Singapore, 1898. Straits Directory for 1900, Singapore.

Princes’ Islands, the ancient Demoned; Byzan- tine, Papadonisia ; Turk, Kizil Adalar, or ” Eed Islands,” from the ruddy colour of the rocks, a cluster of nine islands in the Sea of Marmora, which forms a kaza of the prefecture of Constantinople. Four of the islands are inhabited, and noted for the mildness and salubrity of their climate ??? Prinkipo (Pityusa), altitude 655 feet; Khalki (Ghalcitis ; Turk, Heibeli), altitude 445 feet; Prote (Turk, Kinali), altitude 375 feet; and Antigone {Panm-mus ; Turk, Burgaz Adasi), altitude 500 feet. The others are Oxeia, a marble rock 300 feet high ; Plate, Pyti, Antirobitho, and Neandro. The buildings on all the islands were injured by the earthquake of 1894, especially the naval college, and monastery of St George on Khalki, and the monastery of Christ on Prinkipo. Population about 10,000, of whom more than half are Greeks. On Prote were the monasteries to which Bardanes, Michael I. Eangabe, Eomanus I. Lecapenus, and Eomanus IV. Diogenes were banished.

Princeton, a city of Indiana, U.S.A., capital of Gibson county. It is at the intersection of the Evansville and Terre Haute and the Louisville, Evansville, and St Louis (Southern) Eailways, in the south-western part of the state. Population (1890), 3076 ; (1900), 6041, of whom 198 were foreign-born and 628 negroes.

Princeton, a borough of Mercer comity, New Jersey, U.S.A., on high ground between the Millstone river and Stony brook, at an altitude of 209 feet. It is on the Delaware and Earitan canal, and on a short branch from the main line of the Pennsylvania Eailroad, between Philadelphia and New York. It is chiefly known as the seat of Princeton University (which see). Population (1890), 3422; (1900), 3899, of whom 508 were foreign- born and 899 negroes.

Princeton University, situated in Princeton, New Jersey, U.S.A., originally named The CoUege of New Jersey. It was founded in 1746, in Elizabeth-town, N.J., but was removed to Newark, N.J., and finally, in 1754-55, the first college building, Nassau Hall, was erected at Princeton. During the period before the American Eevolution it graduated many men of distinction, among them Richard Stockton and Dr Benjamin Eush, who, with John Witherspoon, president of the College, were signers of the

Declaration of Inde- pendence ; James ^Madison, fourth president of the LTnited States ; twenty-two members of the Continental Congress, and nine members of the Convention which framed the United States Constitution. It has since maintained its place among the leading American colleges. In 1896, responding to the general movement towards advanced instruction and special research, it was incorporated as a university, although, unlike many American universities, it has no law school and no medical school. It is governed by a president and a self-perpetuating board of twenty-six trustees, and five other trustees elected by the alumni, and is independent of state or denominational control. There were, in 1901, 760 undergraduates in the academic or classical department, pursuing courses leading to the degree of Bachelor of Arts, and 477 undergraduates in the John C. Green School of Science, divided among the departments of electrical engineering, civil engineering, and general science. The graduate students, who con- stitute the university element proper, numbered 138. The higher degrees conferred are Master of Arts, Master of

Science, Doctor of PMlosopliy, Doctor of Science, and Bachelor of Divinity. Tliere were 46 professors, 19 assist- ant professors, 40 instructors, assistants, and lecturers, and 16 fellows.

Pringrsheim, Nathanael (1823-1894), Ger- man botanist, was born at Wziesko in Silesia, on 30th November 1823. He studied at tbe universities of Breslau, Leipzig, and Berlin successively. Though at one time intended for the medical profession, his tastes were always for pure science, and it was as doctor of philosophy that he graduated in 1848, with the thesis De formd et incre-mento stratorum crassiorum in plantarum celluld. From that time onwards his life was devoted to botanical research, and he rapidly became a leader in the great botanical renaissance of the 19th century. Until Prings- heim was over fifty his work was entirely on the morpho- logical side of the science, and in this direction his great triumphs were won ; during the last twenty years of his life he turned his attention to physiological questions, but with less marked success. His contributions to scientific algology were of striking interest. Pringsheim was among the very first to demonstrate the occurrence of a sexual process in this class of

plants, and he drew from his observations weighty conclusions as to the nature of sexuality. Together with the French investigators Thuret and Bornet, Pringsheim ranks as the founder of our scientific knowledge of the Algae. Among his researches in this field may be mentioned those on Vaucheria, 1855, the (Edogoniacese, 1855-58, the Coleochaeteae, 1860, Hydrodictyon, 1861, and Pandorina, 1869 ; the last- mentioned memoir bore the title Beobachtungen iiber die Paarung der Zoosporen. This was a discovery of fun- damental importance ; the conjugation of zoospores was regarded by Pringsheim, with good reason, as the primi- tive form of sexual reproduction. A work on the course of morphological differentiation in the SphacelariaceaB (1873), a family of marine Algae, is of great interest, inasmuch as it treats of evolutionary questions; the author's point of view is that of NaegeU rather than Darwin. Closely connected vrith Pringsheim's algological work was his long-continued investigation of the Sapro-legniaceae, a family of algoid Fungi, some of which have become notorious as the causes of disease in fish. Prings- heim's work was by no means hmited to Thallophytes ; among his contributions to our knowledge of the higher plants, his exhaustive monograph on the curious genus of Water-Ferns, Savinia, deserves special mention. His career as a morphologist culminated in 1876 vrith the publication of a memoir on the alternation of generations in Thallophytes and Mosses ; his theory will always hold its own as a brilKant attempt to solve the greatest problem of morphological botany. From 1874 to the close of his life Pringsheim's activity was chiefly directed to physio- logical questions : he published, in a long series of memoirs, a theory of the carbon-assimilation of green plants, the central point of which is the conception of the chlorophyll-pigment as a screen, vrith the main function of protecting the protoplasm from light-rays which would neutralize its assimilative activity by stimulating too active respiration. This view, though it no doubt contains an element of truth, has not been accepted as offering an adequate explanation of the phenomena. Pringsheim founded in 1858, and edited till his death, the classical Jahrbuch fiir wissenschaftliche Botanih, which still bears his name. He was also founder, in 1882, and first pre- sident, of the German Botanical Society. His work was for the most part carried on in his private laboratory in Berlin; he had little taste for professorial duties, and only held a teaching post of importance for four years.

1864-68, when he was professor at Jena. In early life he was a keen politician on the Liberal side, and even took part in the street fighting in Berlin during the “Annus Alirabilis.” That adventure, however, appears to have finally extinguished his active interest in politics. He died in Berlin on the 6th of October 1894.

A fuller account of Pringsheim’s career will be found in Nature, vol. 11., 1895, and in the Bericlite der detdschen iotanischen Gesell- schaft, vol. xiii., 1895. The latter is by his friend and colleague, Ferdinand Cohn. (d. h. S.)

Printings, Book: See Book Printing.

Printing’ Presses. ??? Improvements in newspaper printing machinery are now sought in the direction of greater compactness and simplicity. The Goss Eotary of Chicago, also known as the straight-line machine, from that peculiarity in its construction, is an illustration of this tendency. The larger part of this machine is in four sections, apparently exactly alike, each section at times independent of other sections. Four webs of paper, four impression and four plate cylinders are in a vertical line. In the process of printing from four rolls, the sheets from each roU. move in a horizontal line untU they near the end of the machine, in which position they are folded, conjoined, and thrown out ready for delivery. As each section is independent, one section only, which prints 4 pages, can be used, and the other sections thrown out of gear. When combined, two sections wiU print 8 pages, three sections 12, and four sections 16 pages.

As rotary machines for the rapid printing of news- papers in two or more colours always require for each colour a separate ink-fountain and rollers, and usually a separate plate cylinder and impression cylinder, their production is not so great as the machine of same size made for black ink only. A successful form of colour machine, made by Marinoni, of Paris, is used for printing in six colours more than 1,000,000 copies on each edition of the weekly illustrated supplement of Le Petit Journal. Colour machines of American design are used by a few papers of New York for their Sunday and holiday editions. A machine recently made in that city is intended to pro- duce 48,000 papers, cut and folded, with an inset sheet, and a cover in fotu- colours. All the colour presses now made register with perfect

accuracy, but much has yet to be learned about the making and management of the paper and the inks adapted to colour work. Kotary machines printing from a continuous roU have their hmita- tions. They are constructed usually so that they can print one size only of paper, and that size must be in length the exact circumference of the impression cylinder.

Machines for printing books and jobs are of simpler construction and of slower speed. The drum cylinder, so called from the large size of the cyUnder, makes one revolution for each impression; but as the width of the bed containing the type is about one-third the circum- ference of the cylinder, the actual printing of the sheet takes up but one-third of the time the cylinder is rotating. During two-thirds of its rotation no printing can be done. On the smaller sizes of drum cylinder, 1800 impressions an hour can be had ; on the larger, about 1000. The two-revolution cylinder, which makes two revolutions to each impression, and can be made to produce 1500 or more impressions on a large sheet in one hour, is preferred for its compactness and its somewhat greater speed. The stop-cylinder (invented by Dutartre, of France, in 1852) is a little inferior to the two-revolution cylinder in performance, but it has marked merit in greater strength and accuracy of movement, and is largely used for the printing of woodcuts and the best colour work. In this machine the cylinder stops after every impression and allows the feeder to place properly the sheet to be

printed. The bed containing the type is moved to and from impression by steady wheel motion. The ink is distributed ujjon a table as well as by vibrating rollers. The Perfecting Press of two cylinders prints from a flat type bed the outer and inner side of the same sheet by the same operation. It is a form of cylinder machine

once largely used abroad, but Ls not approved in the United Wtates, and Ls declining in favour in France. Its product is greater than that of the simple cylinder, but not more than that of two single cylinders, nor is it so easily managed. The Rotary Art Press (fu-st made by E. Hoe & Co. for the printing of the illustrated formes

Quadruple Perfecting Printing Machine and Folder.

of the Century Magazine) is simpler and more manage- able. Sixty-four electrotyped plates, curved and attached to a cylinder about 30 inches in diameter, are inked by 16 rollers. Impression is made against a cylinder of similar size which revolves at the same rate of speed. The sheets are fed by hand. Unlike all other hand-fed cylinders, this machine has no lost motion, for printing is continuous. Although it does four times the work of the stop-cylinder, the rotation of the cylinder is no faster, and the quality of the press work is really superior. For printing the plain t3rpe pages and adver- tising pages of this magazine a simpler form of web press is used, which is not so rapid as the web press of newspapers ; but it performs more operations and does more accurate work. At every revolution it puts on the delivery-table 64 pages in exact register, truly cut, folded, and ready for the binder. SmaU cylinder machines are also made for printing cards, numbered railway tickets, pamphlets, stock and market reports, proofs for proof- readers, matrixes for stereotype plates, and for aluminium plates to be printed by lithographic process. Improve- ments in cylinders for book work have been made by several European mechanicians. At the Paris Exposi- tion of 1900 Marinoni exhibited a perfecting cylinder which printed at one revolution at a rapid rate two colours on either side of the sheet. Alauzet and Voirin, of Paris, Koohstrop and Schneider-Nachf, of Dresden, Kbnig and Bauer, of Oberzell, and Schelter and Giesecke are makers of approved book and job printing machines.

Methods of printing have been as greatly changed as the styles of presses. Before 1870 nearly all the books and newspapers made in the United States were printed on damped paper. For the printing of types, damping was of advantage in aiding the quicker production of bold and black impressions, but for the printing of the finest engravings, dry paper of smooth surface was needed to show the delicacy of the finer lines. To attain this desired smoothness, paper-makers extended the application of calendering rollers for the quality now known as super-

calendered paper, which is still largely used for the printing of ordinary illustrations. It is not possible, however, to give by calendering to the fibres of paper the smoothness of surface needed for the finest engravings. To produce perfect smoothness, the web of paper must be covered with a thin coat of whiting, which closes up aU the pits in the fibre, and after

calendering leaves it with a surface as smooth as polished metaL Paper so coated, when properly printed, will show a velvety black in the shadows of a cut and a paleness of grey in sky tints unattainable on pure paper fibre. The development in 1875 of photo-engraving by the Meisenbach process brought with it finer engraving with very shallow counters, and compelled a greater use of coated paper, which had to be printed dry. In 1880 the new process was so greatly improved that the so-called half-tone engravings began to supplant woodcuts in the magazines. As some of these half-tones were made behind screens of two hundred or more lines to the inch, the counters were unavoidably shallow, and printable only on the smoothest coated paper. Damping of paper was generally abandoned, not only for coated but for ordinary paper. This, in turn, compelled new methods of press- work. “Woollen blankets and indiarubber impressions- resists were supplanted by hard cardboard, which, as it pressed upon the face only of the cut, did not thicken its hair-lines, iluch more time had to be given by the pressman to overlays and the exact graduation of impres- sion for diflferent tints on every illustration. Although the new method of hard-surface impression improved the appearance of the illustrations, it was wearing to the types, making them relatively deficient in boldness and blackness. The old-time boldness and blackness of type- printing have been appreciably sacrificed for the preserva- tion of the higher delicacy of engraving.

All the old processes of stereotyping in plaster, or in clay, or in paper, were ineffective in book – printing, in that they could not fairly reproduce the fine work of a woodcut or an actinic plate. The more recently developed art of electrotyping is now used by all book printers for

types as well as for cuts, and even daily newspapers have to use it for issues containing illustrations of high merit. As first practised, the battery required about twelve hours for the making of the shell for an electrotype plate, but now, by the aid of the dynamo-electric machine, a fair jjhell can be produced in one or two hours. (See also Type-Settino Machines, Engeaving, Electeo-Metal- XUEGT, Xewspapees, BpoK Peintixg.) (t. l. de v.)

Prishtina, Peichtina, or Peistina, the chief town of a sanjak in the vilayet of Kossovo, European Turkey, situated on the Sitnitza, an affluent of the Ibar,

3 miles east of the station on the Salonica- Metrovitza Kailway, 60 miles north-east of Prizren. It is the seat of a governor-general and of a general of division, and possesses seventeen mosques, a military hospital, and a higher class school. The trade is con- siderable, the imports including sugar, coffee, hardware, iron and steel, &c., and the exports chrome, wheat, maize, barley, skins, and wine. The Prishtina valley was the .scene of the final combat between the Turks and Servians, which led to the establishment of the Ottoman Empire in the Balkan Peninsula. Population, 21,000.

Prison Discipline. ††† Great changes were intro- duced into the methods of enforcing penal discijjline during the latter decades of the 19th century, and there has been a steady progress towards milder and more enlightened methods of prison treatment. Some new and remarkable experiments have been tried, especially beyond the Atlantic, and everywhere much attention has been paid to penal problems. This has shown itself abroad by the almost universal adoption ††† at least in theory ††† of principles hitherto accepted as paramount in Great Britain. The prison cell, which in effect typifies the modern system, has been long an established British institution. The separation, more or less strict and pro- longed, of prison inmates has been esteemed an essential part of penal treatment, and of late years all civilized nations without exception have built or started building new prisons to carry out this form of treatment. France has bhown much progress in this direction. Great addi- tions have been made to La Sant6 in Paris, and an entitely new building on the very latest plan has been constructed at Fresnes-les-Eungis to replace the once famous but somewhat obsolete gaol of Mazas and other prisons of the Seine. Germany has taken up the question of penitentiary reform, and new establishments on the cellular system have been erected ; while Austria, Kussia, Spain, Portugal, Hol- land, Denmark, Norway and Sweden, Switzerland, even Japan, all have been busy in providing separate cells for their prisoners. In Italy a comprehensive scheme has been drawn up, so that cellular imprisonment may become a general rule. In Belgium, where penal administration has received the closest attention for a number of years, the regirne of cellular imprisonment has been long carried to its farthest limits, and solitary confinement ranging over ten years, and in some cases much more, has been .strictly enforced. Of late years, however, a new school ias arisen in Belgium which dissents from the hitherto accepted principle, and

expresses strong doubts of the wisdom or efficacy of prolonged cellular confinement. In England, moreover, which if not the first to adopt separation in principle, certainly gave the largest effect to it in practice, continuous cellular confinement for short terms is ceasing to be the universal inevitable rule. A growing dislike to it has been manifested by both experts and philanthropists ; the terms for which it could be inflicted have been constantly diminished ; and although it is still retained in cases of penal servitude for the first six months, it was in 1899 practically abandoned

for lesser sentences, and all prisoners after the first month work together in association under surveillance. This is neither more nor less than the adoption of the old- fashioned Auburn system, which in old days held the ground against the solitary system of Pennsylvania. The bias of modern practice, in short, is towards milder methods, not only in prison treatment, but in those anticipatory processes which if successful may render imprisonment unnecessary.

It has been well said that criminals are such by acci- dent or inclination, and that under a perfect system of government they should be spared the one and cured of the other. Consistent attempts have been made to follow out this principle. When prevention ends reformation begins. The first includes child rescue, the general raising of the moral standard by education ; the second, pains- taking efforts to improve the character of all subjected to the chastening influences of imprisonment. Very bene- ficial results have been obtained by the care devoted to juveniles, who from inherited disposition, the neglect of parents, vicious surroundings, evil advice and example, might lapse into misconduct. The recruitment of the vast army of crime is cut off at its source. Great for- bearance is shown to the less hardened offenders for whom there is reasonable hope of recovery. The law is loth to appeal at once to repressive measures, and does not necessarily apply the ultima ratio of the gaol. Several important Acts have been passed, having for their object the more merciful treatment of first or venial offenders. The punishment of such as are charged with anything less than the most heinous crimes may be held over pending good behaviour. The Probation of First Offenders Act discharges provisionally and practically pardons those who have not committed any previous offence, and some 5000 of these have

annually escaped imprisonment since 1893. Moreover, the Summary Jurisdiction Act, 1879, by affording time for the payment of fines, keeps numbers of offenders out of gaol. Quite 46,000 were thus suffered to remain at large and seek funds for the discharge of their fines during 1899. A careful examination of the sentences now inflicted wiU show that they have steadily decreased in severity ; for those who are still condemned to pass the gaol gates considerable modifications in penal treat- ment have been devised. Continuous cellular seclusion is no longer the rule. The older harsher forms of penal labour have been abolished ; the crank which ground only air has all but disappeared, and if the treadwheel is still retained, it is made to fulfil the useful purpose of water- raising or grinding wheat. The 39 treadwheels and 29 cranks still in operation in 1895 had dwindled down in 1901 to 13 and 5 respectively, and they also will shortly be abolished. Attention is as far as possible concentrated on industrial labour, and great pains are employed to instruct prisoners in handicrafts and the manufacture of useful articles, which can be carried on as wage-earning trades in freedom. In deference to popular demand, great additions were made to prison dietaries, and these, if not actually excessive, compare favourably with the food issued in workhouses and with the general allowance of the poorer classes. The privilege of correspondence with friends outside and of receiving visits has been enlarged; additions have been made to prison libraries, which now contain works of fiction and other entertaining literature ; the rule of silence during hours of association is relaxed for certain classes of prisoners. The use of tobacco, which is permitted in many prisons on the Continent and in the United States, but has been pro- hibited in the United Kingdom, is recommended by some reformers, who have also urged that lectures and other entertainments should be provided, and that, following

the example of some American prisons, the forbidding character of the gaol as a place of durance and punish- ment should largely be made to disappear.

So far these more extravagant views have not been generally accepted. But the pendulum has alvpays oscil- lated between severity and mildness, and

the recent move- ment has been in the latter direction. The new departure dates from a report of a dejjartmental committee in 1895, which had been appointed by Mr Asquith to review the existing system of treatment of prisoners, and suggest changes in prison administration. The inquiry admitted that the centralization of authority in 1878 had been a complete success, as shown by increased economy in working and by the enforcement of uniformity in prison discipline. The committee was, however, dissatisfied with the moral results achieved, and thought that more atten- tion should be paid to reformatory processes. They be- lieved that “few inmates left prison better than they came in.” Eecommittals were frequent, and “recidivism ” ××× or repeated reconviction of the same individual ××× was increasing. To make imprisonment more deterrent on the one hand to the habitual criminal class, and on the other hand more improving to the hopeful and less hard- ened offenders, was the aim of any good system, and the committee’s recommendations dealt mainly with the latter aspect. They were accepted by Mr Asquith, then Home Secretary, as indicating the line which reform should take. The more academic and somewhat visionary theories of increasing the staff of chaplains and schoolmasters, and the calling in of outside exhortation, whereby each individual might be dealt with personally, have not borne much fruit. But the more minute classification of prisoners has worked well. Not only are the convicted and unconvicted kept apart, but the juvenile and first offenders are strictly separated from habitual criminals. The principle of the ” star class,” so successfully tried since 1879 in the con- vict prisons, has been extended to the local prisons ; a prisoner never previously convicted is designated as a ” star,” and absolutely segregated from his fellows at chapel, labour, exercise, and quarters occupied. The salutary results of this system have been proved by prison statistics. Between 1879 and 1899, 2435 convicts were placed in the ” star ” class, of whom no more than 1 “2 per cent, have been sent back to penal servitude under fresh sentences, and only 1 ‘3 per cent, have forfeited their tickets of leave. The same results are shown in a lesser degree in the local prisons ; in the four years 1897-1900, out of 29,195 males and 5823 females placed in the “star” class, 7”1 per cent, only of the former and 11 ‘7 of the latter have been relegated to prison. Great emphasis was laid by the committee upon the development of agencies for the assistance and rehabilitation of the released, and the excellent work already done by private societies for the aid of discharged

prisoners has been systematized and their functions enlarged. The help thus given is of the most useful kind, and tends to encourage good resolutions formed in gaol by keeping the weak or friendless, on their first reappearance in public, away from the evil influences of former associates. Reformatory institutions have also been opened to others than juveniles. One rule which restricted admission to youths below 16 has been modified to take in adults at 16 and retain them till they were 21, and the creation of a large penal reformatory for all such was mooted by the committee of 1895 and adopted in 1901, when a “juvenile-adult reformatory ” was opened at Borstal, near Rochester, by the conversion of a part of the existing ermvict prison. It has been shown by undoubted figures that there is a ” criminal age,” a period ranging between 16 and 30, when more than 50 per cent, of the total indictable offences are committed ; and it is held by expert

authority that much might be done in this way to prevent lapses into crime at the most susceptible period. The principle has found practical illustration in the United States, where the reformatory system, as applied to adults and to full grown men (not children and juveniles), has reached an extraordinary development. Elmira, in the state of New York, and Concord, in Massachusetts, are typical establishments, whose methods deserve to be detailed. Their principal aim is to substitute complete moral regeneration for punishment. There is supposed to be nothing vindictive in the treatment. They are prisons in reality, but not in name, and those committed to them are called inmates, not prisoners. The offender is to be pitied, not punished, and it is held to be the duty of the public as well as its best safeguard to make another man of him. With this object in view he is handed over to be dealt with under an elaborate system of physical, intel- lectual, and industrial training, with no specific sentence, but for such period, with certain limits, as may be found necessary by the agent who is to carry out the desired change. These processes depend upon gymnastic and military exercises, upon a vnde curriculum of instruction, and upon apprenticeship in some handicraft or technical trade. Jluch importance is attached to physical agencies ; the Turkish bath is in constant use, and the frame is strengthened and its normal healthful functions highly developed. At Elmira there is a newspaper, written, edited, and printed by the inmates, and prison journalism of this kind is not at all uncommon in the States. The in- mates are also formed into battalions of infantry, carefully drilled to manoeuvre

and march to the strains of an excel- lent band. Admission to these state reformatories is by the order of a high tribunal, the ages of offenders selected ranging between 15 and 35. The crimes com- mitted are such as robberies, forgeries, manslaughter, embezzlement, receiving, and others of lighter character. The course of treatment is carefully prescribed, and each inmate passes through progressive stages, promotion from grade to grade being dependent upon application and good conduct. The discipline is more severe than the system would imply, and is enforced by ingenious penalties and the use of the ” paddle ” or stick. Considerable results are claimed for the treatment, but they are based upon presumption rather than upon positive fact, for the super^ vision that follows “parole” or conditional discharge covers no more than one year, and is chiefly exercised through relations and employers. According to the reports received, the Elmira pupils who do well amount to 78 per cent, of the total. No doubt they have much encourage- ment, not only in the acquisition gratis of a high-class education ??? which is denied to those who have never offended ??? but in the care bestowed upon them on release. No inmate leaves Elmira until a situation has been found for him, adapted to his abilities and recent training. It is not easy to strike the balance between excessive care bestowed on unworthy objects and the value to the com- munity in the reclamation of delinquents by such extra- vagant means. More positive and more tangible results are hoped for from the less ambitious methods to be pur- sued at Borstal. Reliance will be placed upon a strict discipline and useful instruction in wage-earning trades, while all cases will be carefully watched on discharge by an association of kindly workers, ever ready to give advice and assistance to the well-intentioned. The character and scale of these may in a measure be judged by the following particulars concerning the former : ???

The Elmira Reformatory, the buildings of which are large and thoroughly equipped, was opened in 1876. Only male felons who have not hitherto been convicted of felony are sentenced to the reformatory. They are com-

mitted there for a period not to exceed the maximum term provided by law for their particular offence had they been sentenced to a state prison instead. This indeter- minate sentence, as well as the process of training and reformation in place of the ordinary jjunishment, distin- guishes the reformatory from , an ordinary prison. (Besides those sentenced to an indefinite term, there are a few ††† about one-tenth of the total number ††† sentenced to a definite period, but the board of managers has strongly recommended that these “definites” should no longer be received.)

On admission a man is assigned to the intermediate of the three grades in the institution, and from this grade he is promoted or degraded according to his conduct. He is at once set to learn a trade, if he does not already possess one, and he works at this half the day, the other half being spent in work connected with the institution. Three evenings each week every inmate attends school. After six perfect months in the medium grade he is eligible for promotion to the highest grade, and after six perfect months in this grade he may be paroled, at the discretion of the management, on condition that he has employment awaiting him and that he report to the management every month for six months. At the end of this third six months he may receive an absolute discharge. Certain privileges, especially in regard to food, dress, and letters, depend on the grade of the inmate. The men receive definite wages, 55 cents per day in the highest grade and 45 cents in the others. Out of their wages they must pay for their board, clothes (apart from the outfit given them on entrance), and also pay the fines imposed upon them for offences in demeanour and failures in trade or school. A monthly account is kept with each man, and he cannot be promoted unless he has a credit balance, nor paroled until he has saved enough to take him to his future place of employment. The dis- cipline and daily life of the institution are largely of a military character. The men are organized into a regiment, are thoroughly drilled, and dress parade is held daily. Flogging has been abolished.

The number in the institution on the 30th September 1901 was 1276, the average number during the preceding twelve months being 1338. The total net cost of main- tenance for the year was $205,021, or an average cost of 42 cents per inmate per day. Although no persons are sentenced to the reformatory who have previously been convicted of a felony, still a large

proportion have been previously imprisoned for less serious offences. Of the 1276 inmates above mentioned, 559 had previously been confined in gaols, reformatory schools, penitentiaries,

The total number of inmates received from the opening of the institution to the end of September 1901 was 11,046, of whom 10,540 had been sentenced for indefinite terms. The average age of inmates has been 21 years. Of the 10,540 “indefinites” received, 7010 have been released on parole. Of this number 508 were returned to the institution, of whom 257 were ultimately re-paroled, 209 were otherwise discharged (through ex- piration of maximum sentence, transfer to other prisons, &c.) or died, and 42 were still at the reformatory. Of the remaining 3530 “indefinites” not paroled the following statistics are given : absolutely released without parole, 27 ; maximum sentences expired, 935 ; pardoned, 33 ; escaped, 29 ; died, 1 99 ; transferred to other prisons, state hospitals, (fee, 1137; now remaining in the institu- tion, 1170.

It has been often debated whether or not prison dis- cipline reacts upon the criminality of a country ; whether, in other words, severity of treatment deters, while milder methods encourage the wrong-doers to despise the penalties

imposed by the law. Evidence for and against the theory is drawn from the whole civilized world. In France crime increases by leaps and bounds (especially in the most serious forms ××× murder, parricide, poisoning), yet in French prisons of late years the rule of strict cellular confinement has obtained, while banishment to the uttermost ends of the earth is in force as a grievous punishment for a people so attached to the soil. There is the same very marked increase in the United States, in spite of the reformatory systems described. On the other hand, in Belgium a steady diminution is to be noted in the numbers committed to prisons in which that most irksome of all restraints, un- broken solitude for years, is inflicted. In Great Britain the whole tendency of legislation and administration has been towards leniency, and a steady decrease in crime has been long in progress ××× a fact combated by some critics, but based upon indisputable official figures. Taking England and Wales for illustration, although the same results are still more marked in Scotland and Ireland during the period 1860-1900, the

total number of penal servitude sentences per annum has decreased from 2589 in 1859 to 728 in 1900, in spite of the growth of the population. The readiest method of contrast is by comparing the number of persons sentenced per 100,000 of the general population, and this works out at 13‘4 in 1859, with successive reduc- tions to 9-1 in 1869, 6-6 in 1879, 3-3 in 1889, and 2-3 in 1900. It has been urged that this diminution means no more than a reluctance in the various jurisdictions to im- pose the heaviest penalties, even for serious offences, but in that case a proportionate increase would be shown in the population of local prisons, in which sentences less than penal servitude are carried out. Yet taking these ” local ” prisons from 1878, the year in which they were brought under direct Government control, the same strongly marked decrease is (with some few fluctuations) to be ob- served. Thus at the date of the change in administration the total number of convicted prisoners in custody in the gaols was 20,833 ; this fell by 1000 within a year, and the move has since been generally downwards. In 1888 the total had sunk to 14,536, in 1892 to 12,663 ; in 1899 it had risen slightly to 14,957, and in 1901 it had again decreased to 14,739.’ The decrease may be better appreciated by taking the figures relatively vidth popula- tion. Thus for the quinquennial period ending 31st March 1885 the yearly average imprisoned for indictable offences was 37‘8 per 100,000 of the population in England and Wales ; for the next five years it was 327 ; the next, 28‘0; for the five years ending 1900 it had fallen to 25‘0, and for 1901 it was no more than 22. Consideration must be had to the character of the offences for which imprisonment was meted out. The more serious of those dealt with by indictment has continuously decreased ; the increase has followed summary convictions for minor offences, many of which are no more than infractions of police rules, such as the order to muzzle dogs, or to prevent annoyance by the improper use of bicycles or motor-cars.

Satisfactory as the facts on the whole appear with regard to the decrease of the numbers incarcerated in England, it cannot be concluded that crime is distinctly on the wane. There may be fewer heinous offences compared to population, but they are more persistently repeated by the same persons. The gravest feature in modern penology is the vitality of “recidivism” ??? to adopt the term of French origin which expresses ^*;’” the persistent, reiterated lapses of the same individual into wrong-doing. Kather more than half the whole number of serious crimes are the work of the

“habituals.” A few figures will show this most clearly. In the official year ending 31st March 1899 there were in

all 113,182 males and 45,288 females committed to prison on conviction of crimes. Kather more than half the males and nearly two-thirds of the females had been previously convicted, not merely once, but tv^ice, thrice, up to twenty times and more. Some of the figures are most extraordinary. There were 19,313 males and 6062 females with one previous conviction ; with four previous convictions the numbers were 3891 males and 2013 feifiales; from six to ten times, 8558 males and 5269 females ; from eleven to twenty times, 6079 and 5393 ; above twenty times, 4182 and 6639. It will be noted that by far the largest proportion of recidivists were females, but men and women alike offered themselves per- petually for reimprisonment. We have thus a grand army constantly on the march through prison, subjected all of them to the various processes known to and tried by penal administration, and yet undeterred by the treatment. Nothing has availed to check or cure them ††† neither the most irksome restraints on the one hand, nor the most philanthropic efforts of moral and educational persuasion on the other. It is the criminal residuum, the essence of the criminality of a country, a contingent ever at war with society, persistently defying the law and refusing to abide by the rules of conduct accepted by others. The State retaliates as best it can ; it takes the criminal red- handed, punishes him, secludes him, exhorts, cautions, assists him when he is once more free, but it still largely faUs to transform him into an honest, law-abiding citizen. Call them what we will ††† born criminals in the phrase- ology of the Lombroso school, the product of an imperfect social .system, criminals by predestination, uncontrollable tendency, mere accident or neglect ††† criminals a large pro- portion will continue to be to the end of the chapter. Their path is chosen and will be trodden while they live ; they are a terror and a danger to society while at large, incorrigible while in custody, intractable ††† at least to any methods

hitherto applied. This failure to cope with habitual crime has led to the invention of the “indefinite sentence,” adopted beyond the Atlantic”. It means a system of indeterminate imprisonment, under which the hardened offender would be kept from doing more harm until there was reasonable hope that he was weaned from his evil ways. But the scheme bristles with difficulties. The reluctance of judges to sentence even the most abandoned offenders to nearly interminable periods of detention has to be overcome.

The progress made in prison treatment will be best realized by a brief survey of penal institutions in the principal countries of the world. It will be convenient to take them alphabetically.

1. Auntria-Hungary. ††† The rigime of cellular confinement has not been universally adopted ; only six prisons are built on that principle, and no more than 15 per cent, of the whole number of prisoners can be subjected to the system. Cellular separation is not inflicted for long periods, the minimum being six months and the maximum three years. The bulk of the prisoners live and labour in common. A great feature has been the execution of public works by prisoners in a state of semi-liberty beyond prison walls ††† the practical adoption of the so-called “Irish” or inter-mediate prison ††† and good results are seen in road-making and the improvement of river-beds. The reformatory at Aszod was built by convict labour, and also the fine prison of Marburg on the Drave. New prisons have been constructed at Pilsen, Prague, Stanislau, Budapest, Streu, and Wiener Neudorf, all on the best lines and with liberal expenditure, bnt older establishments are still to be found ††† ^convents, monasteries, and castles ††† being appropriated to service. A number of societies (35) exist to aid discharged prisoners. Recidivism is very constant, and the existing discipline does not sufficiently restrain the habitual criminals, as is shown by a serious imeute in the prison of Garsten in 1890. In the new prison at Eozsahegy, in Hungary, the inmates are chiefly en!]!aged in agriculture.

2. Belgium. ††† This country has spared no pains and no money in carrying out penal processes, and the Belgian prisons are examples of the cellular system prolonged to the utmost limits of human endurance. There is a minimum of ten years, but the individual

may elect to continue in separation, or be transferred to partial association. Many, it is said, still prefer the living death of the cell, and cases are known of prisoners who have passed fifteen, twenty, even twenty-three years in unbroken solitude. Great results are claimed for the system, and judged by the test of dmiinishing crime it appears to have succeeded, though it fails^ to prepare those who endure it for the struggles of everyday life. The treatment is especially recommended for recidivists, whom no doubt it removes moie or less entirely irom the theatre of crime. A new school of Belgian criminologists has been headed by M. Prins, the chief of the department, who has protested that any hope that the vicious, hardened offender after a long detention, ‘ ‘ surrounded with every attention, soaked with good counsel, will leave his cell regenerated,” is a Utopian dream. Some of the Belgian prisons are magnificent edifices ; that of St Gilles in Brussels is of imposing architecture, and was built regardless of cost ; modern establisliments, such as those of Louvain, Merxplas, and the new quarter at Ghent, are built on an excellent plan, and all of them are cellular.

3. British Empire. ??? The principle of cellular separation was accepted as far back as 1836, and the model prison of Peutonville, opened in 1842, has since been copied throughout the civilized world. The cellular system has been adopted in all British colonies with various modifications, and prisons built on modern principles are to be found in Canada, Australia, New Zealand, and the Cape of Good Hope. India retains association as the system most suitable for its criminal classes, with other methods generally abandoned by Great Britain, such as the employment of well- conducted prisoners as auxiliaries in prison discipline and service. Deportation is still the penalty for the worst offences, and is carried out on a large scale and with satisfactory results in the Andaman Islands. In Egypt since the establishment of British control a very marked change has been introduced in prison affairs under the active and enlightened initiative of Dr Crookshank Pasha. The great public works prison of Tourah, near Cairo, employs a large number of convicts in the neighbouring quarries ; parties of them accompanied the Anglo-Egyptian advance into the Sudan, and assisted greatly in railway extension, in loading and unloading stores, and other ” fatigue” duties. Although the cellular system has made no great progress, the new and improved prisons at Alex- andria, Gizeh, Assiut, and elsewhere are well and carefully managed.

4. Denmark. ††† In Denmark all convicted prisoners pass through several stages, from cellular treatment to the intermediate prison and conditional liberty. Two new prisons on the latest model have been erected at Copenhagen, one for males and the other for females. The smaller gaols lor short times are mostly on the cellular plan.

5. France. ††† France has devoted very considerable attention ta prison matters, and is now practising the two extremes of treat- ment, the strict cellular isolation of the Belgian system, and the penal exile or transportation which was long the English rule. The conversion of her numerous provincial prisons into cellular has not yet been possible, but a splendid prison for Paris, replacing the obsolete Mazas, St P^lagie, and La Roquette, has been built in the suburbs at Fresnes-les-Rungis, near Bercy, on the Seine. It contains 1780 cells, and embodies all the latest ideas and appliances in prison construction, douche baths, electric light, iron bedsteads. The cells have varnished walls, perfect ventilation, and the best hygienic services. There is also a. quarter for 400 prisoners in association, so that the total prison population will exceed 2000. The old prison of La Sante in Paris has also been transformed into a cellular prison, with the same liberal provision of modern improvements, and contains now 1150 cells. Much is hoped from these new methods both in deterrence, and reformation, but recidivism is steadily on the increase in France, and has resisted all treatment. The law of “relegation,” which prescribed that all habitual offenders should be sent back to the penal colonies, has not worked well. The results of deporta- tion generally have been most unsatisfactory. In Cayenne, in French Guiana, which has a climate deadly alike to convicts and their guardians, the hoped-for colonial development has proved disappointing. Even in New Caledonia, to which upwards of 30,000 convicts have been sent, and where the conditions are far more favourable to colonization, since it possesses a fruitful soil, a. splendid climate, and unlimited mineral wealth, little substantial advance has been made. Some miles of road open for wheel traffic, a few thousand acres brought under cultivation, and one or two mediocre public buildings in the capital, Noumea, sum up the achievements of this vast amount of labour provided gratis for the improvement of the colony. France is encountering all the ob- jections that led to the abandonment of deportation by Great Britain. It has been inordinately costly, unequal in incidence, and barren of substantial

results in the rehabilitation of the criminal exiles, who, as free immigration has increased, have become more and more distasteful to their fellow-colonists. The climax will come when the free settlers outnumber tha liberated, and the colony refuses to be further contaminated.

6. Germany. ??? The unified German empire has not as yet adopted one system of prison treatment, and its various component kingdoms still retain independence in views and practice.

Baden has a well-known cellular prison at Bruchsal, but separa- tion is not imposed lor more than four years, and associated labour is carried out in another quarter of the prison.

Bavaria has four cellular prisons, the chief being at Munich and Nuremberg, but the collective system also obtains.

I'russta having declared for the cellular system and constructed the ???well-known Jloabit prison in Berlin, those of Ratibor in Silesia, of Herford in Westphalia, and of Graudenz, Breslau, Werdeu, and Cologne have been ailded since. Frankfort has a good prison on the Pentouville (London) plan ; so has Hamburg ; and new buildings have been erected at Wohlau, Siegburg, Bieslau, and Miiuster. Separate cells in Prussia had increased in 1896 from 3247 to 6573. The cellular regime is applicable to prisoners between 18 and 80, and to first offenders of 60 years of age, the term being fixed by the governor of the gaol, but never exceeding three years.

Saxony established a penitentiary at Zwickau in 1850, and in its earlier management exhibited exaggerated kindness to its inmates. Both the cellular and the associated systems obtain.

Wiirte-iiiberg has accepted the cellular system. There are prisons for females at Heilbronn, and for males at Ludwigsburg and Stuttgart ; in Wurtemberg itself the regime is collective.

7. HoUand has followed her nearest neighbour Belgium, and has now at command ••• separate cells sufficient to receive the whole number of her prison population. The system of unbroken seclusion, prolonged to' five years, is maintained with strictness. The prisons of Alkmaar and Breda have been enlarged, and the new buildings exhibit all the most recent improvements : the cells are lighted with electricity, perfectly ventilated and warmed, and furnished with every convenience. Prison labour embraces all kinds of handicrafts, and the prisoners' earnings are divided into three portions ••• one of which goes to the State, a second is at the disposal of the prisoner while incarcerated, or of his family outside, a third is paid him on discharge. This system obtains throughout the Dutch prisons at The Hague, Rotterdam, and elsewhere.

8. Italy. ••• Although accepting the principle of cellular imprison- ment, Italy has not adopted it largely, partly from want of funds, and not a little because the current of thought has set against it, one leading criminologist, Enrico Ferri, having stigmatized the separate cell as "the greatest crime of the 19th century." In the 188 central prisons appropriated to accused persons and those sentenced to quite short teims there are only 13 on the cellular plan, and three others have a cellular quarter. The same applies in the smaller local prisons known as i mandamentali. The really penal establishments are 77 in number, the great ergastolo of San Stefano being one. Agricultural labour for convicts has been tried in colonies of coaiti (or those pro- visionally released) planted out in the islands of the Italian archipelago. There are three of some importance upon Pianosa, Gorgona, and Capraja, one also on Monte Cristo and in Sardinia, several at Castiadas near Cagliari, at Bitti and Tre Fontane. These colonies are said to have been largely self-supporting, to have raised wine, cereals, and stock, and to have added to the develop- ment of the country by road-making, land reclamation, the build- ing of breakwaters and river dams. Another view is that these colonies of coatti are a curse to the country, that their denizens live for the most part in idleness, that they set discipline at defiance, and terrorize their neighbourhoods. A marked feature in Italian criminality is the steaily increase of recidivism, traceable by some to the faulty and demoralizing prison system of the country ; others blame the practice of imposing sentences too short to be deterrent or to admit of the improvement of the offenders. A later experiment in the coercion of the recidivist,

whereby the most determined were exiled as coatti to Assab in Abyssinia, where they were subjected to a very rigorous rigime, lasted only eight months, as the whole number within that time had died or were invalided. Many Italian prisons, especially those of Naples, Venice, Parma, Mantua, Cagliari, and other large towns, are .►►aid to be of a most unsatisfactory character, and the peni- tentiary of Civita Vecchia is still more strongly condemned as a hotbed of vice.

9. Norway and Sweden. ►►► Prince Oscar of Sweden was one of the earliest adherents of cellular imprisonment, and at his urgent representation penitentiary reform was warmly espoused in 1841. His influence is still felt, and the system in force in Norway and Sweden is progressive from strict separation to work outside the cell. There is a good prison at Christiania, another at Bodsfaengslet, and a fortress prison on the associated principle at Akershus for life-prisoners and recidivists. Serious crime in Norway tends to diminish, but the lesser offences have increased considerably, while reconvictions are very numerous, and the percentage of recidivists is for thefts alone from 34 to 35. Sweden, which adopted the cellular system in 1842, has now cells sufficient for prisoners sentenced to two years and less. There are three principal central

prisons, one at Langholm near Stocicholm, a, second at Malmo, and the third at Nya Varfec near Gothenburg. In these as well as in the departmental and local prisons the system is one of com- plete isolation by day and night, but for sentences of more than four years the rule is associated work in the open air, with night separation. The cellular system is being extended to the prisons of Norrkoping and Gothenburg. In no case does the rule of cellular separation last beyond tliree years. It is claimed that the number of convictions is on the decrease in Sweden, but recidivism is frequent, amounting to 30 per cent, of the whole. A veiy substantial growth of juvenile crime is officially recorded in Sweden. One excellent agricultural colony lor youthful oflenders exists at Hall.

10. Portugal. ►►► There are three or more cellular prisons at Lisbon, Coimbra, and Santarem, and the system of strict separa- tion when first adopted in 1884 was expected both to amend and deter. These hopes have proved illusory, although the imprison- ment has been piolonged to eight

years for most serious otfences. Deportation is a penalty always included in the Portuguese code, and it is still practised under the plea that it will regenerate the individual and develop colonization, but the results are unsatis- factory. There are now three penal colonies on the west coast of Africa ??? Mossico, Nana Gandongo, and Caznengo in the province of Angola ; and liberated convicts there are granted concessions of land. Depots of exiled convicts exist also at Loanda and Benguela. Transportation has been decreed for recidivists, the releguis of the French law, but no very sanguine hopes are held of the success of the system.

11. Russia. ??? The subject of penal discipline in Russia covers a wide area, owing to the inclusion of political with purely criminal offences, the enormous number for whom prisons are needed under existing laws, and the severe character of the penalty most largely inflicted. The total prison population for whom accommodation is required amounts to 100,000 males and 13, 000 females, a total which does not include children who accommpany their parents. For these vast numbers 883 prisons exist, nearly all of them till quite lately disgracefully bad and terribly overcrowded. Drastic reform was imperative, and between 1885 and 1891 eleven millions of roubles were spent on new buildings and the improvement of the old. The new cellular prison, “the Central,” of St Petersburg, is a model of construction, with all the latest appliances ; but the Belgian cellular rigime is enforced with uncompromising severity. For some 300 years Russia has employed Siberian exile as almost the only method of secondary punishment, but at last sentiment has declared against a system which has inflicted countless sufferings upon hundreds of thousands, and by transporting some 30,000 souls annually has added 50 per cent, of the criminal class to the population of Siberia. But the Government would not surrender the principle of deportation, and as a later experiment has directed the stream of exiles by sea upon the semi-arctic island of Saghalien, with the object of creating a new great penal colony upon its inhospitable shores. The attempt appears to have been a failure. The island has proved quite unsuitable, owing to the rigours of the climate, the poverty of the soil, and the scarcity of food. Great administrative errors were made, the wrong sites for settlement chosen, the wrong persons ??? the aged and weakly ??? too largely selected as colonists. The moral and social condition of the con- vict population is reported to be abominable ??? drink,

gambling, and the worst vices being everywhere prevalent. A high Russian official has thus summarized the situation: “The life led by the convict exiles at Saghalien is a frightful nightmare. It is a medley of debauchery, insolence, and impudence, coexistent with true suffering and indescribable privations.” The general con- clusion arrived at by competent authorities is that Saghalien is ” a ghastly failure.” The day cannot be far distant when a more intelligent system will replace all these costly and fruitless experi- ments.

12. Spain. ••• After many abortive attempts and long years of neglect, Spain took up penitentiary reform seriously in 1876, in which year a new cellular prison to accommodate 1000 souls was decreed for Madrid. Since then eiphteen cellular prisons have been built and others designed. Presidios, or prisons for long terms, akin to the British convict establishments, exist throughout Spain. In them a harsh, merciless system prevailed, and prisoners’ labour was leased out to contractors. Presidios beyond the confines of the kingdom have been maintained for long years, as at Melilla and notably at Ceuta. The system varies between great severity and excessive leniency. At Ceuta there is an average of 2500 inmates sentenced for life or long terms {cadena perpetual or mdena temporal). At first they are kept in close confinement, and then granted liberty, at first conditional, but afterwards complete, except for having to remain in Ceuta.

13< Switzerland. ••• The cantonal constitution of Switzerland has produced great variety in penal methods. Some are quite abreast of the best modern ideas. Cellular imprisonment is very generally the rule. There are excellent prisons at Geneva, Ziirich, Neu- chatel, Basel, Lausanne, and Lensburg, In the canton of Bern

the progressive system is the rule, with strict separation in the first stage, followed by labour at large and intermediate prisons. In the canton of Ticino there is a good cellular prison at Bellinzona, and the longest term of strict separation is for three years.

14. United States. ••• The penal system of the United States is perhaps the most advanced and also the most backward in the world. At one end are the numerous bad county gaols, and the horrors of the convict lease system in the Southern states, now nearly extinct ; at the other the modern and well-equipped reformatories such as Elmira and Concord. The worst feature is the indiscriminate association sometimes seen of all inmates, bond and free, the convicted and accused ; even witnesses against whom there is no shadow of a charge are sometimes imprisoned among felons. Nor is it only in distant corners of the great continent that this criticism applies. The local gaol in the city of New York, “the Tombs,” a house of detention for prisoners awaiting trial, was described only a few years ago in an official report to the state Legislature as “a disgrace. . . . It is defective In every modern appliance. It is dark, damp, and ill-ventilated .... worst of all is the hideous system of keeping two or three men in a cell .... a means of indescribable torture to a decent man, and ••••••••••• prolific source of vice and crime to a criminal. Such treatment of dogs would be gross cruelty.” This building has since been pulled down, a new and better one taking its place, and at least the worse features referred to in the official report have been done away with. The administration of prisons rests mainly with the state authorities, and there is no federal or general system which would introduce uniformity of treatment. Some of the state prisons are models of cleanliness and good order, built on the best and most imposing lines, with large, comfortable cells and an abundance of light and air. The earnest desire of most prison administrations is to develop industrial training and trade profits side by side with mildness of treatment. The latter sometimes lapses into methods which are not usually thought compatible with prison discipline, such as the permission to play on musical instruments, the holding of concerts, the privilege of smoking and chewing tobacco, of receiving baskets of provisions, novels, and newspapers from friends outside. The actual effect of prison treatment upon crime is doubtful. (a. g.)

Pritchard, Charles (1808-1893), British

astronomer, was born at Brixton on 28tli February 1808. At the age of 16 he was taken away from school and left practically to his own resources. Two years later he was enrolled as a sizar at St John’s College, Cambridge,

where he graduated in 1830 as fourth Wrangler. In 1832 he was elected fellow of his college, and in the following year he was ordained, and became headmaster of a private school at Stockwell, a post which he resigned in 1834 to undertake the headmastership of Clapham Grammar School, which he held tiU 1862, when he retired to Fresh- water, in the Isle of Wight. For the next seven years he took an active interest in the affairs of the Eoyal Astro- nomical Society, of which he became honorary secretary in 1862 and president in 1866. His career as a professional astronomer began in 1870, when he was elected SaviUan professor of astronomy at Oxford. At an age when most persons would have been looking forward to relief from the labours of an active life, he not only embarked with enthusiasm upon his professorial duties, but set himself vigorously to the task of original investigation. At his request the University determined to erect a fine equatorial telescope for the instruction of his class and for the purpose of original research, a scheme which, in consequence of Warren de la Eue's munificent gift of several valuable instruments from his private observatory at Cranford, ex- panded into the establishment of the new University Observatory. At de la Kue's suggestion the first research undertaken by Pritchard was a determination of the physical libration of the moon, or the nutation of its axis, an investigation in which the photographic method seemed to offer conspicuous advantages. Some thousands of photographs were taken and measured ; but although im- portant conclusions bearing on the applicability of photo- graphy to accurate astronomical measurements were deduced in the course of the work, the final results with regard to the moon's libration were never published. In 1S82 Pritchard commenced a systematic study of stellar photo-

metry, a branch of astronomy in which up to that time very little had been done (see Pickering). For this pur- pose he employed an instrument known as the wedge photometer (see Photometey, Stellae, and Mem. B.A.S. voL xlvii. p. 353). In his Uranometria Nova Oxoniensis, pubhshed in 1885 at the Clarendon Press, this work was extended so as to include the stars of Argelander's Urano- metria Nova from the North Pole to about – 10►► declina- tion. It is thus confined to stars not fainter than the sixth magnitude, and includes in all 2784 different objects. In recognition of this important contribution to stellar photometry he was awarded the gold medal of the Eoyal Astronomical Society in 1886, conjointly with Professor

Pickering. On the completion of this research he deter- mined, for the first time in the history of astronomy, to apply the photographic method to the determination of stellar parallax. With the object of testing the capabilities of the method, he took for his first essay the well-known star 61 Cygni, whose parallax had already been attacked by several investigators employing other methods ; and although the accuracy of his results was afterwards seriously called in question, they agreed so well with those of previous investigators that he was encouraged to undertake the systematic determination of the parallaxes of stars of the second magnitude, the results of which are contained in the third and fourth volumes of the Publications of the Oxford University Observatory. Apart altogether from the value of the actual parallaxes obtained, this work must be considered an important contribution to astronomy, as showing the possibility of employing ^jhotography in such delicate investigations. When the great scheme of an international survey of the heavens was projected, he tmder- took a share in it. The zone between 25►► and 31►► north dechnation was allotted to him, and at the time of his death some progress in the work had been made. Pritchard became a fellow of New College, Oxford, in 1883, and an honorary fellow of St John's College, Cambridge, in 1886. He was elected a fellow of the Eoyal Society in 1840, and in 1892 was awarded one of the Eoyal IMedals for his work on photometry and stellar parallax. His death took place on 28th May 1893. (a. a. e*.)

Prittiewell, a parish in the South-Eastern parlia- mentary division of Essex, England ; the village is 1 J mile north-north-west of Southend. The railway station is on the Great Eastern Eailway. Population (1881),

7979; (1891), 12,333; (1901), 27,181.

PrivaS, chief town of department Ardfeche, France, 378 miles south-south-east of Paris, with terminal station on branch line from Le Pouzin on the railway from Lyons to Nimes. It is situated near the Orwfeze, here joined by the Mezayon and Chazalon. A college, normal schools, library of 5000 volumes, mineralogical museum, hospital, and lunatic asylum for the departments of Ardfeche and Drome are the principal local institutions. INIanufac- turing establishments include several silk-mills, forges, and foundries. The rearing of silk-worms and the cultivation of the mulberry are

widespread industries. The important mining concession of Lac yields some of the finest iron ore in France. There is much commerce in silk, tanned leather, game, chestnuts, and fruit preserves. Population (1881), 4203; (1891), 4012; (1901), 7561.

Privas, one of the strongholds of the Reformed faith, suffered terribly during the wars of religion. Ineffectually besieged by Montpensier in 1574, it passed in 1619 into the possession of a Roman Catholic noble. A general rising followed, and in 1629 it was besieged and taken by Louis XIII. and Richelieu. In revenge for its resistance the captors reduced it to ruins, and the king decreed that it should not be again inhabited. A few years later, however, some of the townspeople crept back, and it was again repeopled. Some ancient Gothic-fronted houses, which escaped the general destruction, are still standing.

P R I Z R E N ❓❓❓ P R 0 C E S S

13

Prizren, Peizbendi, Peezdea, or Peezeein, chief town of a sanjak in the vilayet of Kossovo, European Turkey, situated on the Bistritza, near its junction with the White Drin, 60 miles east of Scutari. Among the mosques is the ancient Servian cathedral of Sveta-Petka. The old royal castle has been restored. Besides a manu- factory of firearms, the town has an active general trade. Population, about 35,000, almost entirely Albanian, and chiefly Mussulman.

Prjevalsk (Pezewaisk), formerly Kaeakol, a dis- trict town of Russian Turkestan, in the province Semi- ryechensk, 8 miles from the southern coast of Lake Issyk-kul. Prjevalsky, the Eussian explorer in Central Asia, died here, and a monument’ has been erected to his memory. It is a growing town, and had in 1897 a population of 7987.

Prjevalsky, Nikolai Mikhailovich

(1839-1888), Eussian traveller, bom at Eambory, in the government of Smolensk, on 31st JIarch 1839, was de- scended from a noble Cossack family. He was educated at the Smolensk gymnasium, and in 1855 entered

an infantry regiment as a subaltern. In November 1856 he became an officer, and four years later he entered the academy of the general staff. From 1864 to 1866 he taught geography at the military school at Warsaw, and in 1867 he was admitted to the general staff and sent to Irkutsk, where he started to explore the highlands on the banks of the Usuri, the great southern tributary of the Amur. This occupied him until 1869, when he published a book on the Usuri region, partly ethnographical in char- acter. Between November 1870 and September 1873, accompanied by only three men and with ridiculously small pecuniary resources, he crossed the Gobi, reached Peking, and, pushing westwards and south-westwards, explored the Ordos and the Ala-shan, as well as the upper part of the Yang-tse-kiang. By this remarkable journey he proved that, for resolute and enduring men, travelling in the Central Asian plateaux was easier than had been supposed. The Eussian Geographical Society presented him with the great Constantine medal, and from all parts of Europe he received medals and honorary diplomas. The work in which he embodied his researches was immediately trans- lated into all civilized languages, the English version, Mongolia, the Tangut Country, and the Solitvdes of Northern Tibet (1876), being edited by Sir Henry Yule. On his second journey in 1877, while endeavouring to reach Lhasa through east Turkestan, he discovered the great lake Lob-nor {q.v.), which had not been visited by any European since Marco Polo. On his third expedition in 1879-80 he penetrated, by Hami, the Tsa-i-dam, and the great valley of the Tibetan river Kara-usu, to the vicinity of Lhasa, when he was turned back by order of the Dalai-lama. In 1883-85 he undertook a fourth journey of exploration in the wild mountain regions between Mongolia and Tibet. On these four expeditions he made collections of plants and animals of inestimable value, including nearly twenty thousand zoological and sixteen thousand botanical specimens. Among other remarkable discoveries were those of the wild camel, ancestor of the domesticated species, and of the ancestor of the modern horse (Equus prjewalskii), which some two hundred years ago inhabited Eussia and Poland. Prjevalsky’s account of his second journey. From Kulja, across the Tian-Shan, to Loh-ncyr, was translated, into English in 1879. In September 1888 he started on a fifth expedition, intending to reach Lhasa, but on 20th October he died at Karakol, on Lake Issyk-kul. A monument was erected to his memory on the shores of the lake, and the Eussian

Government changed the name of the town of Karakol to Prjevalsk in his honour. (e. i. c.)

Process. ??? Until the last quarter of the 19th century reproductive processes, save as regards line reproduction, can hardly be said to have had an existence. Paintings, drawings, and engravings which it was desired to put into a form which by means of the printing-press could be multiplied indefinitely, had to go through a process of interpretation by an engraver or draughtsman, who on a metal plate, a block of wood or stone, gave a rendering of the original subject to the best of his power. The means at his disposal were lines and dots, which, vary- ing in their thickness and proximity, expressed dark or light passages in the scheme of light and shade of the original It will readily be understood how such inter- pretations would vary. An engraver with fine art instincts would produce a result as distinct in character as an engraving as was the original as a painting or drawing, and engravings were sought after as works of art, and treasured for their artistic qualities. But engraving of this kind took time. Years were devoted to the produc- tion of one steel or copper plate, while wood engravers who were artists could only work on a block when in the mood ; and for that mood the pubhsher had to wait, and he grew impatient and was wilhng to accept rapid interpretation of originals by men who could produce them under other than artistic conditions. But the pain of the artist at the bad rendering of his original was often great, so that he, not less than the pubhsher, though for another reason, hailed the attempts that were being made to reproduce his work mechanically without the intervention of the translator or interpreter. The ideal of an artist would naturally be a reproduction of his work in faxjsimile, which retained all, or as many as possible of, the mdividual characteristics of his work ; and to give him this was the aim of the school of wood engravers which originated in the United States and made a last stand to maintain the position of their art in the field of book illustration. By a system of extremely fine work the American wood engravers were able to keep much closer to the tones of an original than had previously been possible ; but the result was obtained at the sacrifice of the artistic rendering of the best old engravings, and was so mechanical in its character that when it came in contact with a real mechanical process the engraving could not hold its ground, the enormous differ- ence in the cost of production being a factor of sufficient importance

in itself to make it impossible for the engraving to retain the field. A similar development had been going on in the other branches of engraving. The steel-plate en- graver and the etcher, to whom had been entrusted the interpreting of works of art first produced in other forms, found themselves faced by mechanical reproductions in plate form which, while preserving more of the character of the original work, were produced in much less time and at a greatly reduced cost. It has thus come about that the last quarter of the 19th century witnessed the dispossession of the hand engraver from the field of interpretative en- graving, and the occupation of his position by the chemist and the mechanician. (See Engeaving.)

The term ” process,” which has come to be applied to all mechanical reproductions, is a somewhat unfortunate one, inasmuch as it is descriptive of nothing. From time to time various names have been given to its varying forms, indicative either of the name of the inventor or of some peculiarity of method. Zinco- graphy, GiUotype, Photogravure, Heliogravure, Heliotype, Phototype, Albertype, are illustrations of the kind of name given often to very slightly varying applications of the same principle, but usage has come to apply the term

” process ” to any printing surface that is produced by chemical and mechanical means.

The whole of these processes may be arranged under three heads ××× 1. Belief- 2. Intaglio; 3. Planographic.

1. Relief Processes. ××× An engraving in relief is one in ×××which the printing surface stands up above the surround- ing ground. Its typical form is presented by the mov- able letter of the letterpress printer. The history of its development is really the history of photography ; for vchilst attempts were made to obtain results without the aid of photography, by drawing upon plates with prepared chalk or ink, “rolling them up” with printer’s ink and etching away the ground with acid, as in the case of Zincography, the real progress of all process has been upon the lines of

photography; and to the two Frenchmen, Niepce and Daguerre, the first a mechanician and the second a photo- grapher, may be attributed the origin of the modern mechanical and chemical processes. These two men were both born towards the end of the 18th century.

Speaking broadly, all the modern ” processes ” are the outcome of a discovery that a preparation of albumen and bichromate of potash could be hardened by exposure to light, and that as a photographic negative permitted the passage through it of light in varying degrees of intensity, so a film of the preparation placed under a negative was liable to be hardened in varying degrees according as the light affecting it was intense or otherwise. This discovery governs the production of process blocks or plates of all kinds. By its application relief blocks may be made from drawings or engravings executed in line purely, or from drawings, or engravings, or photographs which are rendered in graduated tones.

The methods of reproduction of pure line work differ greatly from those for the reproduction of originals in tone, and they must be described separately. As the first necessity in securing a good result is the suitability of the original to be reproduced, it is desirable to make clear the character of a good original. This should be of one tone or degree of colour all through. It may be all grey ; it is better that it be all black. It may not be black in parts only and grey in others. The lines of an original may be of any variety of thickness, but in colour they must be uniform. It is necessary, therefore, for the draughtsman to see that he works with a good black ink, or ink which will tell as black when it is exposed to the photographic plate. Inks of a warm tone ††† ^that is, inclining to red or orange ††† yield better results than cold inks which incline to blue.

It is found in practice that most prepai-ed liquid inks have a tendency to lose their blackness by exposure to the atmosphere on the removal of the cork from the bottle. The ideal ink is one freshly ground from a dry cake of colour when beginning work each day. Indian ink is good if well ground and kept sufficiently thick to assure the necessary blackness. It has the advantage of not washing up when colour in washes is passed over it, but it must be used freshly ground. The addition of a little Indian yellow, burnt sienna or sepia, gives a warmth of tone to it and renders it photographically

more active. Bourgeois ink, prepared by M. Bourgeois of Paris, appears to be prepared with the admixture of some warm colour with the black base. It is a good ink for the purpose, and is prepared both in solid and liquid form. Lamp- black gives good black lines ; so does ivory black, which is warmer in tone than lamp. Higgins's Indian Ink or American drawing ink is an American ink made in liquid form which has the reputation of not fading by exposure, as most others do. Stephens's Ebony Stain is a fine black medium which does not clog the pen ; if it thickens and dries, it cracks otf and does not corrode the pen. The pen is not the only medium by which originals may be prepared for reproduction by line process. A brush brought to a fine point is much preferred by some artists, as it yields a line less monotonous than that given by a pen, though the brush cannot be used so freely. The paper used should be smooth and as white as possible. A paper is made with a surface coating of white chalk, which admits of the use of a scraper to remove lines or to break them up. It is not possible to lay down a

rule for the amount of reduction to be made when photographing for the reproduction ; the finer the drawing the less should be the reduction made. Usually a reduction to three-quarters or two- thirds the size of the original is sufficient, but experience is the only guide. Sometimes, where the lines are very fine and the dravying minute in character, an enlargement is desirable. Where drawings are reduced too much, there is ►►. tendency for the spaces between the lines to fill up, and to give a coarse, heavy result. Faulty drawing is not lessened by reduction. On the contrary, the fault becomes more evident, so it is desirable to make all necessary corrections in the drawing.

The original drawing which has to be reproduced is photographed to the size of the required block. The nega- tive taken is absolutely dense except where the lines of the drawing have affected it, and these are absolutely clear, admitting the unrestricted passage of light through them. A piece of planished copper or zinc is prepared or made sensitive to light by a preparation of albumen or gelatine and bichromate of potash spread upon its surface. The negative is laid upon the sensitized metal and placed in the light in the way an ordinary photograph is printed. The light passes through

the transparent lines of the negative and hardens the bichromate of potash beneath it. Both negative and plate are then taken into a dark room, where the metal plate is rolled with an inked roller, placed in a bath, and allowed to soak until the albumen and bichromate become so softened everywhere, except where the light has hardened them, that they all wash away, and nothing is left but the hardened lines. The lines are dusted with asphalt, which by heat is melted on to them, and makes a ground which resists the action of acid. A coat of varnish is put over the back and edges of the plate, to protect them from the acid also, and only the spaces between the lines on the surface are left free to its action. The plate is then placed in an acid bath, which eats away the metal wherever it is exposed ; but it leaves the lines of the drawing, which are protected by the hardened film standing up above the eaten or etched surface; and these lines, which correspond to those of a wood engraving, are the printing surface of the plate. The plate is mounted on a wood or metal block, the whole is made type-high, and it can then be used along with type in the printing-press.

Various devices have been resorted to that effects of tone may be obtained by means of the simple line process. Grained papers with a surface of chalk, upon which are printed close-ruled lines crossing at right angles, or rows of dots ; these give the papers a heavy, flat “tone,” upon which a drawing can be made in pencil, chalk, or ink, and gradations of tone introduced by means of scrapers prepared for the purpose, which remove partially or entirely the black ruled lines or dots, leaving, if desired, high lights of pure white. A drawing on such paper consists of lines or dots, a combination of the original lines or dots of the paper and those of the drawing itself, the scraper splitting up lines into dots or removing them altogether. The result is quite easily re- produced by the line process.

Another method of obtaining a combination of tone and line by the line process is by the use of what are known as Day’s “shades,” or shading mediums. They are transparent films of gelatine which have upon them lines or dots in varying combina- tion in relief, so that they can be inked up by a roller. When placed over a drawing, their transparency enables the operator to see exactly what passage he is dealing with, and he can by means of a burnisher impress the lines or dots of the shade upon any

passage of the ilrawing ; thi’Se lines or dots then become part of the drawing, and are reproduced in the usual way.

Pencil or chalk drawings upon simple white-grained paper, where the pencil or chalk passing over the ruts or hollows in the paper makes a mark on the top of the grain only, are also reproducible by the line process, but such drawings are apt to be unequal in colour and difficult to deal with.

This difficulty led ††† to the invention of a process by Mr Henry Matheson, who, not having the capital to work it, joined the late Mr Dawson, sen., whose

sons continued to work the process with Mr Matheson under the namo of the Swelled Gelatine Process. It is

based upon the discovery that gelatine, sensitized ^7latln ^^^*^ bichromate of potash, swells Avhen placed process. ‘^^ water, and swells in proportion to the

amount of light to which it has been exposed. A negative taken from a drawing which varies in tone, not being thoroughly black all through, varies in the quahty of its transparent lines and dots ; and when a piece of paper or glass coated with sensitized gelatine is exposed to the action of such a negative, it is affected according to the amount of light the negative allows to pass. After making a print on such paper or glass, it is placed in a dish of water and the surface allowed to swell, which it does in varying degrees, the portion unaffected by the light absorbing most water and swelling most, the lines of the drawing not swelling at all. This swelled print is then placed in a frame, and a preparation of plaster is poured upon it to make a mould of its surface. When this has set and the gelatine has been removed, this mould is filled with a pre- paration of wax, which sets in a few minutes sufficiently for it to be released from its plaster mould. Additional wax is built up when necessary upon the ” whites,” as they are technically called ††† that is, the passages which represent what will be the hollows in the block †††

so that these may be as deep as possible ; and the wax mould is then handed over to the electrotyper, who deposits a layer of copper upon it. The lines and dots of this copper block, which when finished is backed up with metal and mounted, vary slightly in height, the result being that the sHghtly lower dots do not come so closely in contact with the inking roller or with the paper, and so produce a grey impression corresponding to the greyness of the original drawing.

The drawback to the use of the process is that it is about three times as costly as the ordinary process. It is a method much used for the reproduction of line and stipple engravings, where fine dots and lines are apt to be printed in delicate tones. The finest results by this method are producible, however, by omitting the plaster mould and wax-oast stages, and by coating the sensitized gelatine with plumbago or other impalpable metal preparation which will enable it to receive a copper deposit to qualify it to take its place in the electrotyper's bath, and so to get the needed thin coating of copper from the surface of the gelatine itself ; but this needs to be done with the greatest of care, and is still more costly..

The invention of line processes only stimulated the efforts to find out means whereby tones might be repro- duced on blocks or plates that could be printed Half-tone g^jgjjg ~~^^^{j ^ype in the ordinary rapid printing~~ press. It is only possible to approximate to the printing of a flat or graduated tone by producing a surface that is broken up into some sort of granulated surface which shall present a series of lines or dots that, when inked and impressed upon paper, shall by the variations of proximity and size give the impression of an unbroken tone. This necessitates the lines or dots being so small that the eye shall not at a glance appreciate the broken-up character of the surface of the block. Many efforts resulted in the production of what is known as the screen, which itself was only made possible by the invention of ruling machines of a delicacy previously unknown. A screen is made by coating a sheet of glass ??? which must be flawless both as to body and surface ??? with a composition analogous to the ground used by an etcher to coat his plate before drawing upon it with his needle. The glass so coated is placed in an automatic ruling machine, of which the ruling point is a diamond, and which can be adjusted so flnely as to produce between 200 and 300 lines to the inch. The lines are ruled diagonally on the glass, and at

mathematically equal distances from each other. The sheet of glass, after ruling, is treated with acid, like the plate of an etcher, and the lines where the ground is

cleared away by the diamond point are etched or bitten into it. The plate is cleaned up and an opaque dark pigment rubbed into the lines. Two such ruled sheets of glass are placed face to face, with the diagonally ruled lines crossing each other at right angles, the result being a medium or screen containing innumerable little squares of clear glass through which the light can pass, which it cannot do through the ruled lines, which are fiUed by the opaque pigment. To produce a half-tone block from a picture, a black and white drawing in tone, or a photograph, a negative is exposed in the camera in the usual way, with this screen quite close to it but not in contact ; and the subject is photographed on to the negative through the screen, and what is termed a screen negative is the result. It is a photograph of so much of the original as could affect the negative through the little clear squares of the screen, and represents the tones of it by innumerable dots and lines, the size and proximity of which are regulated by the fineness or coarseness of the screen used. In the early days zinc was the metal used for these half-tone blocks ; but experience showed that though more difficult to etch to the necessary depth, the closer, denser texture of copper rendered plates of this metal much more suitable for the production of the best blocks, and zinc now is used only for inferior blocks. Whichever metal may be used, a sheet of it, most carefully planished, is sensitized with a coating of gelatine or fish-glue and bichromate of potash, and exposed under the screen negative to the action of Ught, as in the ordinary method of photographic printing. The action of the light, as previously explained, hardens the gelatine film, the portion not so hardened being removable by water. The plate with the hardened lines and dots is exposed to heat and they are burnt in upon it, to enable the means of resistance to be set up to the action of acid. The plate is placed in an acid bath, which is rocked to and fro to prevent the air-bubbles produced by the acid action from settling upon the surface of the plate and interfering with the regular action of the acid. Wherever the surface of the plate is free from the lines and dots, it is bitten away by the acid, and the lines and dots are left in relief. This first biting in the bath produces a rather rough general impression of the original, and is termed ” rough etching.” To produce finer results, and to bring out the contrasts of black and white so

necessary to a good reproduction, the block has to go through processes of stopping out and rebiting similar to those of etching an intaglio plate. This ” fine etching ” calls for the artistic taste and judg- ment of the craftsman; and with a good photograph to work from, the final quality of a block wiU turn almost entirely upon its treatment by the fine etcher.

One risk that has to be most carefully guarded against is the underbiting of the lines and dots which form the printing surface. As soon as the acid has eaten its way downwards past the protecting surface film, it will attack the sides of the upstanding dots as well as the ground that supports them, with the result that they become weakened and rendered liable to break off in the process of printing, as well as to make the obtaining of electrotypes from the blocks a matter of extreme difficulty, the underbitten. points breaking or tearing away in the mould. To avoid this underbiting in the course of etching and re-etching, a fatty ground is laid over the surface of the block each time it is etched ; by exposure to heat this ground is sufficiently melted to permit of its running down the sides of the upstanding points, and so giving them the required protec- tion. When completed, the copper plates are mounted on wood or metal blocks, type-high, for use with type in the printing-press.

The name by which this process of making tone relief blocks is most generally known is the Meisenbaoh process, from Herr

Meisenbach, of Munich, who first brought it prominently forward in Europe. It was greatly improved upon by Messrs Angerer and Gbschl, of Vienna ; but the great advance was due to the improvements made in the manufacture of the screens by Mr Max Levy, of Philadelphia, who made it possible, by his improvements in the ruling machines, to produce screens of a fineness not previously practicable.

The chief objection to this process is its inability to reproduce the extremes of expression employed by the artist in black and white : actual white is impossible, and delicate tones, such as are characteristic of skies, are

destroyed by the cross-bar lines of the screen, which cover down all light passages and rob the repro- duction of that brilliancy which characterized wood engraving. It is true that the addition of hand engraving can be resorted to in the case of the process block, and lights and other varieties of tone and form introduced, but this can only be done on blocks of very tine texture, and the cost of reproduction is greatly increased by the introduction of such handwork by the engraver.

The most important development of the half-tone process is in the direction of the reproduction of works

in colour rendered possible by the researches of Three- artists and scientists. It -will be sufficient here 6/0C&5. ^ explain the general principles upon which

the three-colour process is based. It has long been an accepted theory that all combinations of pigmental colour exhibited in pictures, ~~flowers,~~ or any other form resulted from a combination in varying quantities of what are known as the three primary colours, red, blue, and yellow, and that if it were possible to get at the exact amount of each colour necessary to its formation, any possible tone of colour might be produced by blending the primary colours in the necessary proportions. But the human eye has not been able to analyse tones of colour with sufficient accuracy to settle what proportion of each primary colour goes to the making up of a given tone. Such analysis, however, has been rendered practically possible by photography. The white light of daylight is the result of a combination of rays of coloured light, which for our purpose we may describe as being rays of blue, red, and yellow. It is interesting to note that the com- bination of these three colours, in varying proportions in the form of rays of colour, combine to produce white light ; but the combination of the same three colours in the form of pigment results in black, i The prism which breaks up the combination of coloured rays shows that when the light rays do not contain the necessary combination of the rays of the three primary colours, white light no longer results, but that separated they give “all the colours of the rainbow.” The various colours of objects are the result of the fact that surfaces have the power of absorb- ing and reflecting certain of the coloured rays only which strike them, and that they are unaffected by the

others. Thus the green leaf absorbs and reflects the blue and yellow of white light, leaving the red unaccounted for.

The photographer has utilized these facts and theories by inventing j? ^S►►rs of various substances, which, owing to their nature, absorb and refuse passage to certain coloured rays, while permitting the passage of others, just as a charcoal filter will keep back certain substances in water, but allow the water itself to pass through it. So a photographic filter of a certain colour will absorb and stop the passage of red and blue rays, while permitting the passage through it of the yellow. Another filter will similarly absorb and stop the yellow and red rays, while permitting the passage through it of the blue. It will then be readily perceived how, when a picture or other coloured object is placed before a camera, with one of

‘ As a matter of scientific analysis, the primaries of white light are red, green, and purple, but the pigmental primaries are red, yellow, and blue ; and as we are in this paper dealing -with pigmental results only, it will simpUfy the theory, and render it more intelligible, if WB treat it from the pigmental point of view, and speak of the primary colours of the artist rather than those of the scientist.

these filters between it and the exposed negative, the rays of light of the colour which can pass through the* filter to the negative will be the only ones which can afi’ect it, and that it is possible in this way to secure on three separate negatives a record of the blue, red, and yellow rays which are reflected from its coloured surface by any object placed before the camera. These three negatives may then be used in the ordinary way, and, by means of the ruled screen already described, three half-tone blocks produced, which, when printed one over another with coloured inks corresponding with the three primary colours, give approxi- mately a reproduction of the original in its true colours.

It was as far back as 1861 that the suggestion was made, at the Royal Institution by Mr J. Clerk-Maxwell, to reproduce objects in their natural colours by superimposing the three primary colours. Later Baron Bansomut, of Vienna, Mr Colleu, a gentleman who taught drawing to Queen Victoria, and two Frenchmen, Messieurs Chas. Cros and Duco du Nauron, carried on the idea and made experiments witb the aid of photography, which were

still further developed in Germany by Professor Husnik, of Prague, Dr Vogel, of Berlin, and others ; but it was in America that the first three-colou blocks for letterpress printing were made, Mr Ives, at Philadelphia, being their maker in 1881.

This three-colour relief process is yet in its infancy, but already its develojDment is such that no doubt remains as to its ultimate success. The first great practical difficulty which had to be overcome was to produce three screen blocks which could be printed one over the other. Were the screens of each block used at the same angle, the lines and dots would print on the top of one another; but a great deal of the colour result depends upon a considerable proportion of each colour being on the white paper. Artists and people who work with colours know well that much purer and more brilliant results are produced by placing touches of colour side by side than one over another : small patches of red and blue placed side by side yield to the eye a purple of much greater purity and beauty than the same touches of colour worked one over the other. Consequently it was found necessary to turn the screen at a different angle for each block, so that the lines should not fall on each other but should cross each other ; but the risk of this is that, used at certain angles, the crossing of the screen lines will produce what is known as the moire antique result. Dr Yogel took out a patent in Great Britain for the process, and he therein stated that the screens should be used at certain stated angles. He also proposed to use single-line screens, similar to those used by Mr Ives at Philadelphia, instead of cross-line ; but it has since been found that the cross- or double-line screens can be used with better results than single-line ; and that the angle at which they can be used may vary, but it is well that the Hues should cross each other at an angle of some- where about 30►►.

Filters are made in a dry or wet form. The dry filter is made by spreading a film of gelatine or collodion, tinted by an aniline colour, upon a piece of glass. The wet filter is a cell or trough made of two sheets of glass, sealed Colour- all round and filled with water tinted with an ””►►”►►► aniline dye or colour. The accuracy of the tint of the colour- filter may be tested by the spectroscope, or by an instrument invented by Sir William Abney, and known as the Abney Colour Sensitometer. This is a theoretical test. The practical test is by photographing through them patches of blue,

red, nnd yellow. If, for example, the filter for blue records the full strength of blue with the full strength of the colour of the nesative, while giving no record at all of the red and yellow, it is practically a true filter. It is possible to treat the negatives themselves so as to render them more sensitive to the special colour they are intended to record. Indeed, it is necessary to see that the filters and the negatives are in working harmony. Different makes of plates demand different colour-filters. For full information as to screen-making the reader may be referred to a paper by Mr Ives in the Photographic Jouriicd, vol. XX. No. 11. The efforts of the ink manufacturers have had to be directed to the production of what are termed “neutral” primaries ××× that is to say, a blue pigment absolutely free from any

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taint of red or yellow, and, similarly, a red and yellow free from admixture with their complementary colours. The preparation of these colour-filters calls for great perfection of qualiiy in the materials employed, and great accuracy in the using of them. The glass, whether for the dry or wet filter, must he absolutely Hat as to its surface, without waves or irregularities of any description, aud its two sides must be absolutely parallel ; in other words, it must be absolutely uniform in thickness through- out. In the wet filter the glasses forming the sides of the cell or trough must be parallel to each other.

Coloured glass is sometimes used in combination with the tinted collodion, but there is no particular advantage in this, because two glasses are always used in the making of a filter, aud each one may, if desired, be coated with different dyes and after- wards cemented together with Canada balsam.

The following dyes or their equivalents form a basis for nearly all three-colour filters : ???

For the red printing negative {Sntfl?^.

vn f Cochineal red.

” ??’”?? ” ” \Brmiant yellow.

??????ii (Methyl violet.

??? yeuow ??? „ \Naphthol green.

The first dye named is the base colour in each case, the second is employed in small proportions to produce the required modifica- tion of tint.

The theory of this three-colour process is that the same three colours shall be used for the printing of every subject ; and there is no doubt that if the filtration were perfect and the printing inks absolutely pure, the theory- would work out fairly correctly in practice ; but at present there is room for improvement in both these matters, and it is therefore often found desirable to print special subjects with special pigments, which makes it difiicult to print several subjects together. Special care is called for on the

part of the printer. There must be the most Need of perfect register of the three subjects, otherwise a “^”^1′ blurred effect results; there must be constant

watchfulness to see that there is no excess of ink of any one colour, or the whole scheme of colour wiU be destroyed. An ” eye for colour ” is

perhaps hardly to be looked for as one of the qualifications of a machine-minder, and yet without the oversight of some one with such an eye colour-printing cannot be successful. This three-colour process has been a rather long time in taking the place it deserves, and nothing has so tended to retard it as bad printing. For some time past good blocks have been obtain- able, but in the hands of ordinary printers they have yielded but indifferent results. There is great need for the technical training of the men who have to oversee such work. It is hardly to be expected that the untrained eye of the ordinary printer should be successful where the work requires the cultivated judgment of an artist. There is one other necessity for success in all tone relief work, whether block or colour, and that is the use of the right quality of paper and ink. The blocks are so delicate they soon fill up if an excess of ink is used. Ink of a good quality can be used in much less quantity than common kinds, but it must be impressed upon paper that is sympathetic and will ” bear out” the ink.

The best results can be obtained only with the use of what is known as ‘ ‘ coated ” paper. It is paper which, after manufacture, is passed through a bath of a preparation of china clay, which by means of brushes is rubbed into the surface of the paper. When dry the surface takes a high polish, and is sensitive to the smallest amount of ink. The polish of this coated paper is objectionable to many readers of illustrated books, and the clay adds considerably to its weight.

2. Intaglio Processes. ??? An intaglio engraving is one in which the printing surface is sunk below the surrounding portions of the block or plate ; the lines or dots ??? pressed, cut, or bitten into the surface ??? holding the ink, which is to be impressed upon the paper when the original surface of the plate is wiped clean. The old-fashioned steel engrav- ing may be taken as the type of an intaglio plate, in which the lines which printed were cut into the surface of the

plate, instead of being left standing up in relief, as in the case of a wood engraving.

Photogravure is the name by which the many processes are generally known by means of which intaglio engravings are made mechanically, heliogravure being another name for the process, or special application of it. Photogravure reproduces the tones of photographs or drawings, and gives the nearest approach to a facsimile reproduction that has yet been arrived at. Gelatine bichromatized, as in the case of relief blocks, is the medium by means of which the photogravure plate is produced ; but as the screen is not used in ordinary work, it is necessary to produce an ink-holding grain in some way upon the plate. This is done by allowing a cloud of bitumen dust, raised inside a box, to settle upon the surface of the plate; it is fixed by heat, which, though insufficient to melt it, is enough to attach the fine grains to the plate. Over this prepared surface is laid the film of bichromatized gelatine, upon which is printed the subject through a glass positive; the usual hardening process takes place by the action of light, followed by a washing out of the unhardened portions of the gelatine. The plate is exposed to the action of perchloride of iron, which attacks it most strongly in the least exposed parts, but which cannot eat it away in broad flat masses of dark, even in the non- exposed portions, owing to the existence of the bitumea granulation, which ensures the keeping of a grained sur- face even in the darkest passages.

Photogravnre is a costly process to employ for illustration. The plates have to be printed slowly, with much hand work, as in the case of etchings. It is the printing that makes its use expensive, rather than the making of the plates ; and as each plate must be printed sepaiately and on special paper, it cannot be eujployed with type, Kke relief blocks.

It will he readily understood that there is much uncertainty about the production of plates by the photogravure method ; and although great improvements have been made in the process, it- is often necessary to produce several plates before a satisfactory” one is obtained ; and even then a good deal has to be left to the retoucher, who with his roulette, burnisher, and graver must give qualities of transparency and brilliancy and intensity that are. missed by the mere mechanical operation. In all these repro- ductive processes the more artistic the workman, the better the result ; this is especially true of photogravure,

in which the aim is to come very much nearer to the original work of the artist designer than in the less perfect processes.

The method of M. Eouisillon, which was adopted by Goupil in the production of photograrvure plates in the early days of the process, was to prepare the surface of the plate with a secret preparation of certain salts, which crystallized under the action of light, so that when exposed under the negative the surface was broken up by this crystallization more or less, according to the amount of light the negative permitted to reach it. The plate with its crystallized surface was then electrotyped, and the electro- type was the plate used for printing. It was a deposit process, as opposed to an etching process.

Photogravure plates are made also by the use of the grain screen, in which the reticulations of the screen take the place of the bitumen powder in producing a grain; it is the inversion of the method by means of which, points and lines are produced in the rehef block. It has not, however, come much into favour, probably owing to the greater coarseness of the grain and the consequent loss of softness in the tones. An application of this method has, however, been made in the most recent development of the use of screen plates in what is known as the Eembrandt Intaglio Process. It is the property of a firm at Lancaster, and is a secret process ; but the Rembrandt secret lies more in the press by which the plates ’”*****”” are printed than in the plates themselves, which are intaglio plates made with a very fine screen and bent to a cylinder. The attempt to print photogravure plates, by machinery was made many years ago, but it was given up because the plates were so shallow they would not stand the wear and tear, and their life was too short and**

the results too indifferent; but the use of the grain screen renders possible stronger, deeper plates, that will stand harder wear. While we

are unable here to describe actually the machine in use in Lancaster, there is little doubt it is some form of the machine used to print wall papers, in which there is a central cylinder engraved with the design, inked by rollers with which it comes in contact. The ink not only fills up the intaglio or sunk portion which has to print the design, but covers as well the whole surface of the plate. To clean this surface, leaving ink only in the sunk dots and lines, another metal cylinder is employed, ground and grooved somewhat like the shaft of the common steel of the dinner table used to sharpen knives, the grooved surface of which, passing over the engraved cylinder, scrapes clean its inked surface, leaving ink only in the sunk portions, which wiU, as the cylinder comes in contact with the paper, deposit itself and print the picture. The results produced by the Reriibrandt intaglio process are softer and smoother than those given by photogravure, and they are free from the gritty qualities which occasionally characterize photo- gravure; but they lack the brilliancy and depth of the latter. The process on the whole is less costly to use, mainly because the printing is so much more rapid, and is turned out by a machine instead of by hand.

The monotype is not a new, but a revival of a somewhat old, method of reproducing on paper a painting by an artist. The Monotvoe ^^^^S^ ^^ executed on a plate by means of brushes, ??? fingers, or other tools, with paint or printer's ink. On the completion of the painting, paper is laid upon it, and plate and paper are together passed through a press, when ihe ink or colour is transferred to the paper. One impression only is possible, hence the name of the process. A method has been devised by Professor von Herkomer, R.A., for dusting the painting while still wet with a fine metallic powder, which renders the surface sympathetic to a copper deposit when it is placed in the galvanic bath, by which means an electrotype of the painting, with its varying relief surfaces, is obtained, and forms a plate from which numerous impressions can be taken.

The very large number of impressions it is often required to get from the etched surface of a block has made it necessary to Electro- ^^'^^^ means for preserving the original block, and to tvoes ' pi'spare and

work from duplicates, which can be renewed ‘ when necessary. For this process the original is

coated with =-??? film of the finest plumbago (blacklead) powder before being placed face to face with a bed of soft fine wax, into which it is pressed. The plumbago prevents adhesion and facilitates the withdrawal of the block after contact with the wax. The wax mould which is thus obtained is suspended in a galvanic or electric bath in which sulphate of copper has been dissolved. The copper at once begins to deposit itself in metallic form over the face of the wax mould, and in a short time the deposit becomes thick enough, either by itself or when backed up with other metal, to be used as a block in the place of the original. The very fine nature of process blocks, and the necessity of obtaining perfect impressions from them, has led to the intro- duction of gutta-percha instead of wax as the medium for making a mould. It is melted and poured in a liquid state upon the block, and when cold can be removed without the risk attending the use of wax, which is apt to give way with the slightest lateral move- ment in the course of the separation of the block from the mould. Gutta-percha is much more tenacious, and being somewhat flexible, does not break and tear, as wax is liable to do. The whole process requires the greatest care in its manipulation, and on its success depends the tinal apjiearance of the artist’s work in the printed page.

3. Planogeaphio Processes, which include Photo- lithography, Woodbury-type, and other processes of print- ing from a flat surface, are described in vol. xxiii. p. 704.

Steel-facing is resorted to where long numbers have to be printed from photogravure plates. The finest film of steel is depo-sited by Steel- ^” electric battery over the whole fice of the plate,

tacinz which it hardens and protects. This steel face in time *??? begins to wear, through the constant pressure and rubbing incidental to the process of printing, and the copper begins to show through it. As soon as this happens, the plate is placed in an acid bath, in which the steel film disajipears like dew from the grass before the lie.it of the sun. The plate itself being still intact, can be resteeled for further work.

The changes which have taken place in the form of illustrations have necessarily been accompanied by changes in the machinery by which they are jirinted. Almost all the changes and imjirovements have macA/nerv been initiated in the United States of America, which country has taken the lead in all developments of printing machinery and processes. The vital change made in the interest of process block-printing is what is techni- cally known as ” hard packing.” Before the introduction of process blocks, tlis blanket played an important part in all printing machines. It was a soft woollen sheet, which came between the plate or cylinder and the type and blocks, and modified the force of the contact between them. Owing to the increased fineness of the texture of the process block as compared with the wood engrav- ing, it was found that the blanket was too coarse and soft a material, and that it interfered with the clearness and fineness of the printed result. Blankets of finer material were tried, with improved results ; but at last the blanket was entirely discarded, the machinery was more accurately constructed, and the hard, finely polished steel cylinder, without any intervening substance save the sheet of paper to be printed, was brought in immediate contact with the type and blocks. The old soft blanket kept the cylinder or the flat press in contact with the type, in spite of the weak construction of much printing machinery. The new method of work made no allowances for such construction; and the new machinery, to meet the new conditions, had to be very perfect in manufacture. About the old machines there was a lack of solidity, which allowed vibration. Modern work demands abso- lute rigidity in the machine; and a chief characteristic of the best modern printing machinery is strength and solidity, admitting of precision of impression. Another change has been in the nature and treatment of the print- ing paper. Most elaborate methods were adopted in all large printing establishments for the moistening of the substance of paper before use. Most paper was printed on whilst damp ; but damp paper had to disappear with the soft blanket, and a clay-surfaced paper was introduced with a highly glazed face in harmony with the polished steel cylinder which pressed it against the type and blocks. It is essential to this paper that it be dry when used; to ensure the best results with it, the paper should be kept some weeks or months before use, so that it may be absolutely dry, or seasoned. If printed on too soon, its surface

tears away when in contact with the ” tacky ” ink ; and instead of the ink being deposited on the paper, bits of the paper surface are left on the forms, and white spots appear in the impression. The bits of paper surface so deposited on the forms get inked as they pass under the rollers, and impress black spots on the sheets that come after. jSTew and unseasoned paper accounts for much bad printing, and this form of badness is due to the change in material due to the necessities of modern process work.

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PROCTOR

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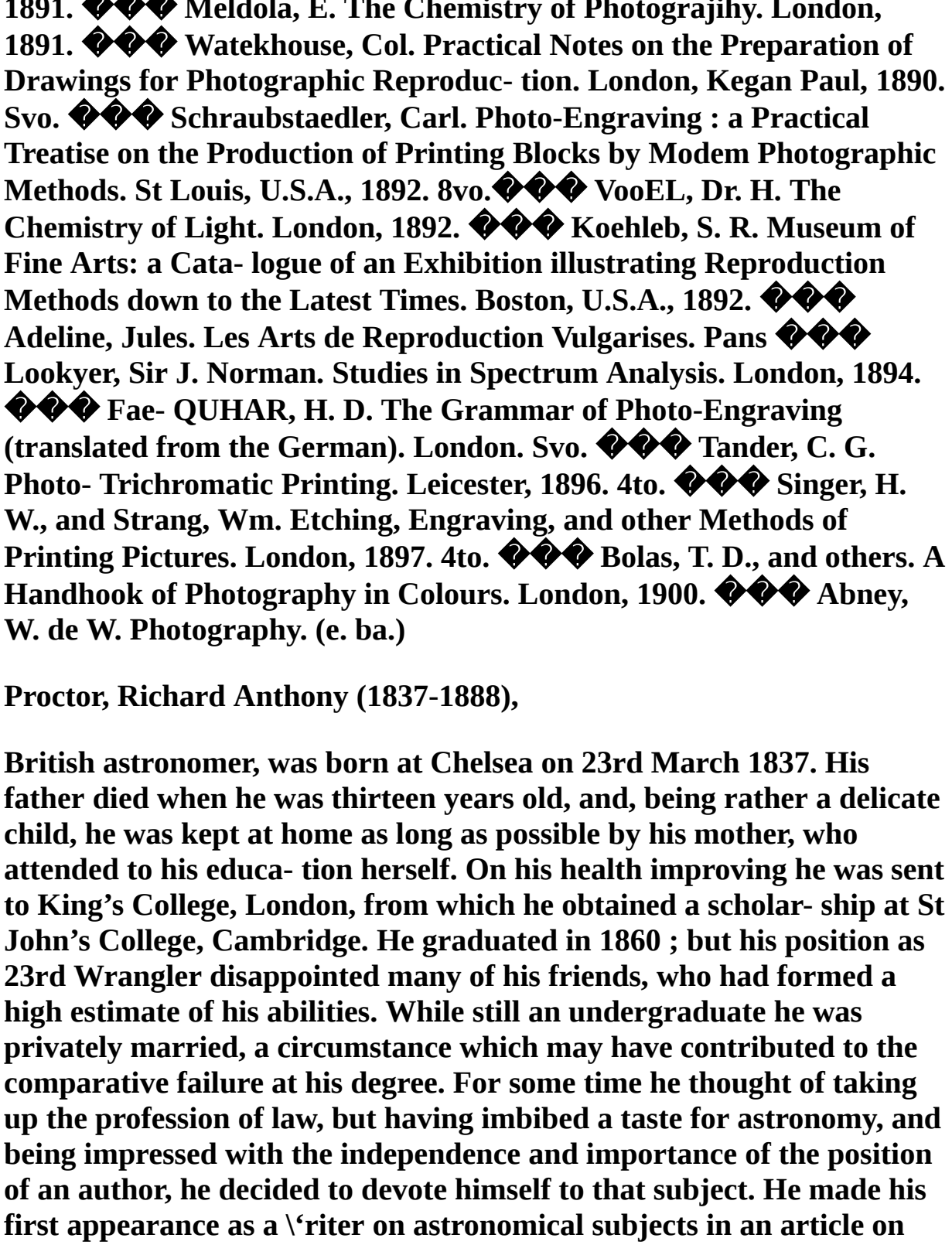
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Proctor, Richard Anthony (1837-1888),

British astronomer, was born at Chelsea on 23rd March 1837. His father died when he was thirteen years old, and, being rather a delicate child, he was kept at home as long as possible by his mother, who attended to his educa- tion herself. On his health improving he was sent to King’s College, London, from which he obtained a scholar- ship at St John’s College, Cambridge. He graduated in 1860 ; but his position as 23rd Wrangler disappointed many of his friends, who had formed a high estimate of his abilities. While still an undergraduate he was privately married, a circumstance which may have contributed to the comparative failure at his degree. For some time he thought of taking up the profession of law, but having imbibed a taste for astronomy, and being impressed with the independence and importance of the position of an author, he decided to devote himself to that subject. He made his first appearance as a \‘riter on astronomical subjects in an article on the ” Colours of Double Stars,” published in the Cornhill Magazine

(1865). His first book ??? Saturn and his System ??? was published in the same year, at his own expense. This work contains an elaborate account of the phenomena presented by the planet, his satellites, and rings, a discussion of the various motions of the planet, and the possibility of life upon its globe. It was favour- ably received by astronomers ; but although marked by a lucidity of exposition and enthusiasm for his subject which distinguish his later works, and although it possesses elements of permanent value as a contribution to astro- nomical literature, it had no great sale. He has left it on record that he intended to follow it up with similar treatises on Mars, Jupiter, Sun, Moon, Comets and Meteors, Stars, and Nebulae, and had in fact commenced a mono- graph on Mars, when the failure of a New Zealand bank, in which he was a considerable shareholder, deprived him of an independence which would have enabled him to carry out his scheme without anxiety as to its commercial success or failure. Being thus obliged to depend upon his writings for the support of his family, and having learned by the fate of his Saturn that the general public are not attracted by works requiring prolonged attention and arduous study, he cultivated with success a more popular style. He wrote for a number of periodicals ; and although he has stated that he would at this time willingly have ” turned to stone-breaking on the roads, or any other form of hard and honest but unscientific labour, if a modest competence had been offered ” him in any such direction, he attained a high degree of popularity as an exponent of

astronomy, and his numerous works have had a wide in- fluence in familiarizing the public with the main facts of astronomy, and have doubtless had far-reaching effects in stimulating an interest in astronomical subjects. His earlier efforts were, however, not always successful. His Handbook of the Stars (1866) was refused by Messrs Longmans and Messrs Macmillan, but being privately printed, it sold fairly well and paid expenses. For his Half-JIours with the Telescope (1868), which eventually reached a 20th edition, he received originally ??25 from Messrs Hardwick. Although the work of teaching was uncongenial to him, he took pupils in mathematics, and held for a time the position of mathematical coach for Woolwich and Sandhurst. His position as a writer was, however, improving, and he became a regular

contributor to The Intellectual Observer, Chambers's Journal, and the Popular Science Review. In 1870 appeared his Other Worlds than Ours, in which he discussed the question of the plurality of worlds in the light of new facts ascertained since the time of Whewell and Brewster. This was followed by a long series of popular treatises in rapid succession, amongst the more important of which are Light Science for Leisure Hours and The Sun (1871) ; The Orbs around Us and Essays on Astronomy (1872); The Expanse of Heaven, The Moon, and The Borderland of Science (1873) ; The Universe and the Coming Transits and Transits of Venus {19>1 4:) ; Our Place among Infinities {\81h) ; Myths and Marvels of Astronomy (1877); The Universe of Stars (1878) ; Flowers of the Sky (1879) ; The Poetry of Astro- nomy (1880); Easy Star Lessons and Familiar Science Studies (1882); Mysteries of Time and Space and The Great Pyramid (1883); The Universe of Suns (1884); Tlie Seasons (1885); Other Suns than Ours and Half- Hoairs with the Stars (1887). In 1881 he founded Know- ledge, a popular weekly magazine of science (converted into a monthly in 1885), which had a considerable circula- tion. In it he wrote on a great variety of subjects, including chess and whist. He was also the author of the articles on astronomy in the American Cyclopaedia and the ninth edition of the Encyclopcedia Britannica, and was well known as a popular lecturer on astronomy in England, America, and Australia. Elected a fellow of the Boyal Astronomical Society in 1866, he became honorary secretary in 1872, and took an active part in its proceed- ings, contributing no less than eighty-three separate papers to its Monthly Notices. Amongst the more important of these are papers dealing with the distribution of stars, star-clusters, and nebulae, and the construction of the sidereal universe. He made frequent use of accurately drawn charts to support and illustrate his arguments, was an expert in all that related to map-drawing, and published two excellent star-atlases. A chart on an isographic projection, exhibiting all the stars contained in the Bonn Durchmusterung, may be specially mentioned, in which, within a circle 11 inches in diameter, are 324,198 minute dots, each representing a star in size and position, designed to show the laws according to which the stars down to the 9- 10th magnitude are distributed over the northern heavens. Two papers entitled "Theoretical Considerations respecting the Corona " {Monthly

Notices of E.A.S. vol. xxxi. pp. 184 and 254) are worthy of note, as are also his early papers on the rotation of Mars, in which, from a discussion of observations from 12th March 1666 to 4th February 1889, including 72,232 rotations of the planet, he deduced the period of its rotation with a prob- able error of 0”-005. He also contributed several papers dealing with the transits of Venus of 1874 and 1882, in which he vigorously criticized the official arrangements for observing them. His largest and most ambitious work, Old and New Astronomy, to which he had devoted his

best energies for several years, was unfortunately left un- finished at Ms death, but was completed by a friend ??? A. Cowper Ranyard ??? and published by Messrs Longmans, Green and Co. in 1892. He died at New York, on his way to England, on 12th September 1888. (a, a. e*.)

Prohibition. ??? See Liquoe Laws.

Pro me, a district in the Pegu division of Lower Burma, with an area of 2914 square miles and a popula- tion of 368,466 (1891) ; 365,860 (1901). There were 1848 villages in the district in 1898-99, paying Rs.755,672. The population was made up as follows in 1 89 1 : ??? Buddhists and Jains, 354,650 ; aborigines, mostly Karens, 8521 ; Hindus, 2384; Mahommedans, 2283; Christians, 628, of whom 381 were natives.

Of the 1,864,960 acres in the district, 306,149 acres were culti- vated in 1898-99, and the rest was made up of forests, 316,697 acres; unoultivable land, 942,604 acres; cultivable land, 278,765 acres; and current fallow, 20,745 acres. The total rainfall, taken at Prome in 1898-99, was 37-83 inches. The highest thermo- meter reading in May was 104►►, and the lowest in December was 63►► F. The chief towns in the district are Prome, with a popula- tion of 30,022 in 1891 ; Shwedaung, 12,424 ; and Paungdii, 10,233. Prome is the terminus of the railway from Rangoon. There is a reformatory school for the province at Paungde, but it is being converted into a district gaol, and the reformatory is moved to Insein. There were 88 boys at the school in 1898-99. In addi- tion to agricultural work, the boys are taught trades, such as those of tinsmith and carpenter.

Proof-Rea.ding'. ►►► Proof-reading as a distinct de- partment in the work of a printing office does not date from the very earliest days of " the art preservative of all arts." The first products of the printing – press show abundant evidences of the non-existence of any one specially charged vdth the duty of correcting the com- positors' mistakes. How much conjectural emendation and consequent controversy would have been avoided if the First Folio Shakespeare had been more tjrpographicaUy correct ! Sir Theodore Martin said that the typographical errors alone of that work had been computed to number nearly 20,000, which amounts to 2'25 per cent, of the total number of words in the volume. It was a usual practice in the 17th and 18th centuries for authors to send the proofs of their works round amongst their per- sonal friends for correction ; and in the universities and colleges sheets of works passing through the press were frequently hung up in the quadrangles for public inspection and correction. With the growth of printing gradually came a demand for systematic proof-reading, and the lead- ing printers engaged scholars and men of letters to read proofs for them. Among these may be mentioned Cruden, of Concordance fame (" Alexander the Corrector "), and William .Julius Mickle, poet, and translator of Camoens's Lusiads, who was a reader at the Clarendon Press. Gold- smith and Dr .Johnson also are credited with having wielded the proof-reader's pen. Times, however, have

changed since, as the elder D'Israeli ⬛⬛⬛i\Tote, " it became the glory of the learned to be correctors of the press to eminent printers," and to-day in every printing office the proof-reader is found ⬛⬛⬛ an unobtrusive functionary, known to publishers, authors, editors, and journalists, but for the most part unknown to the general reading public ; a functionary who yet does useful, often valuable, and always indispensable work. The influence of good proof- reading ujion the character of book, newspaper, and general printing is too often underrated. The celebrated old printing offices and the foremost of the modern ones owe their reputation for good workmanship largely to the excellence and thoroughness of the work done in their reading-rooms, for no perfection of paper, ink, machining, or binding can atone for bad or slipshod typography.

The nature of the proof-reader's work, frequently mono-

tonous and uninteresting, wiU be made clear by_ what follows. After the compositor (see Typogeaphy, in the earlier volumes of this Encyclopaedia) has set up by hand or type-setting machine (q.v.) the " copy " supphed to him, a slip or page proof is " pulled " and sent with the manuscript to the proof-reader. The manuscript is then read aloud by a reading-boy or copyholder, while the proof-reader care- fully follows the text before him letter by letter, marking on the margin of the proof all the misspellings, turned letters, " wrong fonts " (letters differing in size or style of face from those in the immediate context), and other errors, and seeing that the punctuation clearly defines the author's meaning. The reading-boy reads rapidly ⬛⬛⬛ indeed, an ordinary listener would imagine it to be impossible for the reader to understand him ⬛⬛⬛ and as the reader is obliged to keep pace, he goes through the proof again, without the aid of the boy, in order to mark any errors that may have escaped him in the first rapid reading. The proof, called the "first proof," is then sent to the compositor to be corrected. When this has been done, a further proof is submitted to the reader, who, upon satisfying himself by careful revision that it is free from typographical mistakes, passes it as "clean." If the reader, when dealing with the first proof, notices any slips in grammar or errors of fact on the part of the vn-iter, or is in doubt whether any particular

word in the manuscript has been correctly de- ciphered, he underlines the word or passage, and places ” Qy-” (qisry) in the margin. The proof is then despatched to the author or editor. On the return of the proof, after the writer’s corrections and alterations have been carried out the type is made up into pages and sheets, and another proof puUed. This passes into the hands of the press reader (as distinguished from the “first-proof reader”), who checks the headlines, page numbers, and sequence of chapters or sections, and observes that the pages are of uniform length and that a sufficient amount of margin is allowed, before finally reading through the text. When the press reader’s corrections have been eflfected, the work is ready for the printing machine or the stereotyping foundry.

The cost of proof-reading may be said to range from about 7|- to 20 per cent, of the cost of composition, vary- ing, of course, with the nature of the work.

Many prominent authors have expressed in warm terms their gratitude to the proof-reader for valuable assistance rendered by apt queries and pertinent suggestions. Two of these expressions of opinion may be given as typical, one from a novelist and one from a poet. Charles Dickens said : ” I know from some slight practical experience what the duties of correctors of the press are, and how these duties are usually discharged. And I can testify, and do testify here, that they are not mechanical ××× that they are not mere matters of manipulation and routine ; but that they require from those who perform tliera nuich natural intelligence, much super- added cultivation, considerable readiness of reference, quickness of resource, an excellent memory, and a clear understanding. And I most gratefully acknowledge that I have never gone through the sheets of any book I have written without having had presented to me by the corrector of the press something I had overlooked ××× some slight inconsistency into which I had fallen ××× some little lapse I had made ××× in short, without having set down in black and white some unquestionable indication that I had been closely followed in my work by a patient and trained mind, and not merely by a skil- ful eye. In this declaration I have not the slightest doubt that the great body of my brother and sister wi-itcrs

would, as a plain act of justice, heartily concur." Robert Browning thus corroborated Dickens : "I have had every opportunity of becoming acquainted with, and gratefully acknowledging, the extreme service rendered to me ; and, if mine be no exceptional case, the qualifications of readers and correctors are important indeed." P. Larousse spoke of French proof-readers as his "coUaborateurs lesplus chers," and Hugo referred to them as those "modestes snvants " so well able "lustrer les plumes du genie"; while the Acad(Smie Fran^aise consulted them on points arising in the revision of the Academy's dictionary.

Though much good work is done by readers who have

not been practical printers, yet the technical knowledge gained by working as a compositor is essential to the best proof-reading. The reader must possess a quick eye, alert to note every error or mechanical imperfection in the type, and must scrutinize closely every letter of every word, clause, and sentence, while keeping a grasp of the sense of the matter he is dealing with. The more varied his information and the wider his knowledge, the better. Though his strict duty is merely to see that the author's copy is properly reproduced, he is always glad to give the author the benefit of the experience and knowledge he has acquired, and, as a consequence, he is constantly crossing the line which separates proof-reading from sub-editorial duties. From this last consideration has arisen the plea for the reader, on the daily press especially, being placed under the control of, and made responsible to, the editorial department rather than the head of the composing-room.

Proof-readers, as such, have no trade unions, though many of them in Great Britain retain membership of the unions to which they belonged when working as compositors ; and in some states of the American Union the compositors insist upon readers being also members of their society. The oldest organization devoted entirely to the interests of proof-readers is the London Association of Correctors of the Press,

founded m 1854. For many years it was restricted to a membership of 150, but since the abolition of this limit the membership has steadily increased, and stood in January 1902 at 500. The chief aim of the association is to give its members information as to vacant situations, so as to keep them in full employment ; but it also assists members in distress from its benevolent fund, and provides pensions, as well as a sum of money at death. At the end of 1894, when the association had existed forty years, the total funds amounted only to ►►65 ; at the close of 1901 they stood at ►►811. There is in France the Societe des Correcteurs des Imprimeries de Paris. There are also proof-readers' societies in several American cities, many of whose members are ►►►women, for in the United States women bulk largely in the rank of proof-readers. There are very few women proof-readers in London. In Edinburgh, however, women form a considerable proportion of the proof-readers. (j. a. Bl. ; J. E*.)

Propel la.ntS. ►►► ~~Explosives are those substances, either solid or liquid, which, upon the application of heat or other cause setting up chemical action in them, are capable of instantaneous or extremely rapid conversion into gases occupying a very great volume as compared with that of the original substance, the gases in addition being highly expanded by the enormous heat resulting from the chemical action accompanying the change of state. Those explosives which are used for the purpose of im~~ parting motion to projectiles of all kinds, whereby they are enabled to travel at great velocity through the air, are termed propellants. Any gas subjected to great pres- sure can by the sudden removal of that pressure be made to act as a propellant. Compressed air has been used in this way as a propellant in the Zalinski dynamite gun. (See AiE-GuN, vol. xxv.) The article on Gunpowdee in the ninth edition of this work may be consulted for the history of its manufacture.

Smokeless Propellants.

History. ►►► The proportions of the ingredients of the British ser- vice gunpowder remained for a very long period unaltered. But the introduction of heavy breech -loading guns necessitated the

employment of a very slow-burning explosive ; and the manufacture of prismatic powders, consisting of seventy-nine parts saltpetre, eighteen parts charcoal, and three parts sulphur, was begim in England in 1884. Smokeless explosives have now very generally superseded gunpowder for all propulsive purposes. As a result of the new processes, described under the article Gun-Cotton in the ninth edition of this work, it became possible to use gun-cotton as a military explosive ; the regulation of its rate of combustion suffi- ciently to enable it to be employed as a propellant in ordnance and small arms had, however, not been effected. It was not until 1885, when the introduction of small – calibre magazine rifles, rendering absolutely necessary the use of a smokeless powder, was occupying the attention of the principal European Powers, that the problem of using gun-cotton or other forms of nitro-cellulose as a propellant was solved by converting it into a

substance devoid of all porosity. This result was attained by subjecting the nitro-cellulose to the action of a suitable solvent, by which it was gelatinized, and alter evaporation left as a compact homogeneous non-porous njaterial, capable only of burning from the exterior surface toward.^ tlie centre. Tlie gelatinized material before the evaporation of the solvent can, wljile still plastic, be rolled out or piessed into sheets, cords, or otljer desired form, and when dry be cut up into discs, tablets, cylinders, &o. On these lines many smokeless powders have been produced, and are in general use. They ditter in details of manufacture, and fre- quently contain, besides nitro-cellulose, other explosive or non-explosive ingredients. The iirst country to adopt a smokeless powder for her magazine rifle was France. The Vieille powder was invented in 1885, and contained probably picric acid as well as gelatinized nitro-cellulose. This powder appears soon to have been replaced by what is known as Poudre B, a gelatinized mixture of two varieties of nitro-cellulose. A further development in the production of smokeless powders for propulsive purposes lias been the employment of nitro-glycerine as an essential con- stituent. This substance had been discovered in the year 1847 by the Italian chemist A. Sobrero at Turin. For many years it re- mained a laboratory curiosity, and it was not until about the year 1863 that Mr Alfred Nobel, a Swedish engineer, commenced its manufacture on a large scale on the Continent, with a

view to using it as a blasting agent. In 1875 Mr Nobel made the discovery that the less highly nitrated form of nitro-cellulose known as soluble nitro-cellulose or collodion cotton had the property, when kneaded with nitro-glycerine under the influence of heat, of absorbing the nitro-glycerine. At the same time it lost its fibrous character and became a stiff gelatinous product, in which the nitro- glycerine largely predominated. This product was patented by Mr Nobel as an explosive under the name of blasting gelatine. In 1886 he made the further discover)' that if the proportion of soluble nitro-cellulose were increased until it about equalled the nitro-glycerine, and the materials were incorporated by malaxation, or rolling between hot rollers, a horn-like product suitable for use as a propellant resulted. To this product the name of " Ballistite " was given, and it soon became the Italian service smokeless powder. Although a vast number of explosive substances have been proposed as constituents of smokeless powders, the only ones which are now employed for service propellants and for the most generally used sporting powders are varieties of nitro-cellulose and nitro-glycerine (see ninth edition, Gun-Cotton and Nitko-Gltobrine).

Classifimtion. ??? Smokeless propellants, whether for warlike or for sporting purposes, may be broadly classed under two heads as follows : ??? (1) those which are composed of nitro-cellulose, either soluble or insoluble, or a mixture of the two varieties, with the addition sometimes of small quantities of other explosive and non-explosive substances ; (2) those which contain nitro-glycerine in addition to the above ingredients. It would be impossible to give a complete list of the very large number of such explosives proposed, patented, and introduced, and it would be equally im- possible to give their exact compositions with certainty, as, in the case of the service powders particularly, the ingredients and their proportions are more or less secret. Belonging to class 1 are the service powders of Austria (small arms), Belgium, Denmark, France (small arms), Germany (small arms), Holland, Norway, Russia, Spain, Sweden, Switzerland, Turkey, and the United States. Belonging to class 2 are the service powders of Austria (ordnance), France (ordnance), Germany (ordnance). Great Britain (small arms and ordnance), Italy (small arms and ordnance),

and the United States. The most important varieties of sporting powders are as follows; ??? Class 1. Amberite, Cannonite, E.G., Kynochs, Normal, Plastomenite, Rifleite, Schultze, Troisdorf, Von Fbrster, Walsrode, and Wetteren. Class 2. Amberite, Cordite, and Sporting Ballistite.

Qualities. ??? The principal qualities which all smokeless powders should as far as possible combine are as follows : ??? (1) Smokelessness. Smoke is due to the presence of solid products of combustion in a very fine state of division. Substances which on explosion could pro- duce nothing but non-oondensible gases would be perfectly smoke- less ; as, however, the explosion of practically all modern powders gives rise to vapour of water which condenses, they all show ji slight amount of smoky vapour varying according to the degree of moisture in the air. This is slightly increased by the products of combustion of the small proportions of organic and inorganic matter, in most cases added as moderants. As a rule the smoke is small and dissipates quickly. (2) Freedom from objectionable products of combustion. The gases given off should not be such as will injuriously affect the firer. Carbonic oxide, a poisonous gas, is produced in considerable quantity by the combustion of most smokeless powders ; but as it is a combustible gas, and at the moment of its production highly heated, it takes fire on issu- ing from the barrel and burns away. Other objectionable gases which it was thought nitro-powders might evolve are nitrogen oxides, but these under the ordinary conditions of firing are not

produced, or if produced are instantly destroyed again by the combined action of the large volume of reducing gases, carbonic oxide and hydrogen, and the high temperature. The tendency of rifle- and gun-barrels to become rusty after firing nitro-povvders was at one time ascribed to the presence of nitrogen oxide iu the explosive gases, and special oils containing alkali were recom- mended for cleaning the

barrels. It is now understood that this tendency is due to another cause, i.e., to the fact that the very high temperature of the explosive gases aifects the surface of the bore and renders it more susceptible to the corroding action of air and moisture. Oiling the barrel after firing with a more viscous lubricant than the oil ordinarily used gets over the difficulty. In the case of heavy guns the quantity of heat evolved has an important bearing on the amount of erosion or wearing away which takes place in the bore. It is greater with smokeless powders than with the old black powders, and greatest in the case of those containing nitro-glycerine. Although these nitro- glycerine powders possess the undoubted advantage that a lesser weight of charge is required for the production of the same velocities with lower chamber pressures, owing to the increased expansion of the gases due to the extra heat, this extra heat appears to increase the amount of erosion, and this has to a certain extent restricted their more general adoption. (3) Stability both chemical and ballistic, under all conditions of climate, storage, and use, is undoubtedly one of the most important properties of any explosive. With black powders there was no question of want of stability so long as they were kept dry. Now that the manu- facture and proper purification of nitro bodies are well understood, there is also no difficulty in making those used for smokeless powders very stable, and the experience of some years has proved that these powders can stand severe climatic conditions without showing signs of deterioration, and without their ballistic qualities being impaired. (4) High velocities with moderate pressures. The introduction of magazine rifles and quick-firing guns necessi- tated not only the employment of a powder producing little if any smoke, but also, to enable them to develop their full efieot, one giving much higher velocities than those obtainable with the old black powder, without exceeding the permissible limits of pressure in the bore. These improved ballistics became possible with the new powders owing to a great extent to their colloidal or structureless form. Ignition having taken place on the surface of the flake, cube, or cord, combustion can only proceed by suc- cessive layers ; with the result that although a much larger total volume of gas, with consequent greater velocity of the projectile, is now developed than formerly, this development of gas takes place gradually during the whole time of the passage of the projectile down the bore, with

correspondingly more uniform distribution of pressure. The total propelling force is naturally greater, but as it is more sustained, the maximum pressure is not correspondingly increased. It follows, therefore, that for equal velocities much smaller charges are required than when black powder was used, and the chamber pressures are lower ; also that for the same or even lower chamber pressures, higher velocities are obtained. In the old powders complete combustion of the explosive took place before the projectile had time to move far down the bore of the gun ; high pressures were in consequence set up in the chamber, necessitating a massive breech. As the development of the gas and therefore of the pressure fell off rapidly, the gun thinned down considerably towards the muzzle, and was comparatively short. For smokeless powders the guns are more uniform in out- line, to suit the more uniform distribution of pressure, and they are longer, to enable the full effects to be obtained from the com- paratively slow-burning explosive. It is obvious that the property of burning in successive layers affords a ready means of adapting the new explosives to the various calibres of small arms and ordnance for which they are used. By increasing the thickness of the flakes or cubes, or the diameters of the cords or cylinders, the surface of ignition for a given weight is decreased with a corre- sponding decrease of initial development of gas, and consequfntly of initial pressure, whereas the time of total combustion is in- creased. The thicker the flake, cube, or cord, the slower-burning the powder and the larger the gun in which it can be advantage- ously used. (5) Ease and safety of manufacture. The manu- facture of smokeless powders consists in, firstly, the production of the nitro-conipounds, and secondly, their treatment with suitable solvents to give them the required colloidal condition. As regards nitro-cellulose, the operations ai-e simple and free from all risks, as throughout the operations the nitro-cellulose is always being dealt with in large volumes of water, in which condition it is quite harmless. The manufacture of nitro-glycerine is one of more difficulty and danger. It is a liquid, very sensitive to friction and percussion, and when acid it has a great tendency to decompose spontaneously if adequate means are not adopted of controlling the temperature while the material is in contact with acids. The precautions to be observed in its manufacture are based on these considerations. In most processes for the production

of smokeless powders, the nitro-cellulose has to be dried before further treat-

ment. This operation must be conducted with great care, as dry nitro-celluloses, particularly gun-cotton, are very sensitive to slioek of all kinds. When once the solvent is added to the nitro-cellu- lose, or to the mixture of nitro-cellulose and nitro-glycerine, the danger of accidents is much lessened, and the manufacture of smokeless powders from this point is much safer than that of the old gunpowders. In the latter case there was always present a. more or less considerable amount of gunpowder dust which formed a highly explosive mixture with the air, ignitable by the smallest spark, and in its turn exploding the dusty gunpowder in process of manufacture. In the case of smokeless powders there is practi- cally no dust ; and the explosives themselves, wetted with the solvent, and more or less gelatinized, would, if ignited, burn away very fiercely but without explosion unless confined ; and even if confined, as in the press cylinders, an ignition or explosion would be entirely local, and would not spread to the bulk of the material under treatment.

Most naval and military smokeless powders are in the form of flakes, cubes, cords, ribbons, or cylinders either solid or with one or more perforations ; sporting powders are required to be quicker- burning, and are often granular like the old gunpowders, or in the' form of very thin flakes. Some cord powders have one or more axial perforations. Flat strips with and without perforations are also made. The colours vary considerably, and depend to a great- extent on the added non-explosive ingredients. Pure nitro- cellulose powders are, as a rule, greyish or yellow ; those in which nitro-glycerine is present vary iu colour from light yellow to deep^ brown. Sporting powders sometimes contain colouring matters, and are frequently coated with gra^jhite, which gives them a. silvery grey appearance. The surface of the flake, cube, and cord powders is usually smooth rnd hard, and in texture they are horn- like if made from nitro-cellulose, but softer and more of the con- sistency of india-rubber if containing nitro-glycerine. Their density varies according to the ingredients and method of manu-facture. Unless they contain ingredients soluble in water such as-

metallic 7iitrates, they are unaffected by damp, and they do not absorb any appreciable amount of moisture. They are more- difficult to ignite than black powders, and in the case of small-arm powders require a stronger cap ; cannon cartridges require a- priming of fine-grain gunpowder or of gun-cotton. Experiments carried out wilih cordite on several occasions have shown that when packed in the service stout wood boxes with screwed down lids, the boxes may be subjected to a fierce fire which only ignites- the cordite without explosion when the flames reach it ; and that the cordite in a box may be ignited and burnt away without ex- ploding or even setting fire to boxes packed round it. As far as. experiments have hitherto shown, most smokeless powders are fairly insensitive to shock, and are not exploded by the impact or passage through them of rifle bullets even when made up iu small- arm cartridges packed in boxes.

Manufacture. ??? The process of manufacture of both classes of smokeless powders referred to above is similar in all essential particulars, and onsists of the three following main operations : ???

1. Incorporating and gelatinizing the ingredients either by means- of a solvent or by heat.

2. Forming the gelatinized material into the desired shape.

3. Drying or expelling the solvent and anj' moisture.

The nitro-cellulose, in a very fine state of division, and free from small lumps and knots which would delay the action of the solvent, is thoroughly dried. The gelatinization and the incorporation of the other ingredients are effected almost universally in the kneading machines of Messrs Werner, Pfleiderer and Perkins. This machine- is described below under the manufacture of cordite. The usual procedure is to pour in the solvent and start the machine, and then add the nitro-cellulose, or it may be roughly mixed with the solvent before charging into the machine. The other ingredients may be- added separately in a fine state of division if solid, usually after incorporation has been proceeding for some little time, or if they are soluble in the solvent they may be added immediately. AVhen nitro-glycerine is an ingredient it is

either mixed roughly with the nitro-cellulose by hand before being charged into the machine, or it is mixed with a portion of the solvent and then added. The- solvents most generally used are acetic ether or acetone, but when soluble nitro-celluloses only have to be dealt with, an ether-alcohol mixture may be employed. Less used solvents are ether, and the- methyl, ethyl, and amyl acetates. The gelatinizing action of the- solvent is much assisted by the kneading and squeezing action, and the constant agitation the materials receive in the machine. The- time of incorporation varies from about four to eight hours but it depends on the amount of solvent and to a certain extent on the- nature of the other added ingredients. On completion of the gelatinization the mass is of a pasty consistency due to the presence- of the solvent, and is in a very suitable condition for rolling out into sheets or pressing through dies to form cords. To form it into- shects, the paste is passed backwards and forwards through hollow chilled cast-iron rollers usually steam heated, their distance apart being capable of adjustment so as to produce any required thickness-

of sheet. The sheets are next placed in drying stoves, where the solvent is driven off ; and as the drying generally produces blisters and unevennesses in the sheets, they are again passed through hot rollers. The sheets are rolled out very thin in the first instance ; to form thicker flakes or cubes they are folded over and over and passed through the rolls between each successive folding until tlie desired thickness is obtained. This treatment dispels all traces of the solvent, and welds the sheets thoroughly together. The sheets are then cut first of all into strips, and the strips divided into flakes or cubes, for which purposes various machines are in use ; or the sheets may be converted into grains much in the style of gunpowder. For the manufacture of cord powders such as cordite, screw or hydraulic presses are employed. They consist of a cylinder for containing the paste, closed at the bottom by a plug having one or more orifices of the required shape. A piston slowly descending into the cylinder forces the paste out through the

holes in a continuous cord or cords. The cord is delivered either on a revolving reel or on an endless band on which it can be cut to any desired length. The construction and use of the presses are more fully described below, under the manufacture of cordite. The cords, either on reels or cut to lengths and packed on trays, are dried ir stoves at a temperature of about 100►► F. (37-5►► C). The drying is effected either by hot air blown into the stove, or by radiation from steam or hot-air pipes. In some drying processes, where the recovery of the solvent is aimed at, the drying chambers are in connexion with vacuum- producing and condensing arrangements. All natures of smokeless powders when thoroughly dry are blended and packed. Another method of granulating powders for sporting guns is, when gelatin- ization is completed, to add hot water to the mass in the machine and to blow in steam ; this treatment has the effect of quickly reducing the paste to a granular condition. The solvent is next evaporated and the water got rid of by pressing, centrifugalling, and drying. The grains are finally sifted to the required sizes.

COEDITE.

Cordite is the smokeless powderwhich has been used by the British service since 1891. It was introduced on the recommendation of a committee presided over by Sir Frederick Abel, who came to the conclusion that an explosive containing a considerable amount of nitro-glycerine offered many advantages over any of the purely nitro-ceilulose powders then in existence. Experiments by the committee eventually led to the production of a smokeless powder made from nitro-glycerine and gun-cotton gelatinized by means of a solvent, to which a small proportion of a mineral hydrocarbon was added as a moderant. This explosive is known as "Cordite Mark I," and consists of nitro-glycerine, 68 % ; gun-cotton, 37 % ; mineral jelly, 5 %.

The mineral jelly is a hydrocarbon having the formula CuH^, and is obtained by the fractional distillation of crude petroleum oil at a temperature of over 200►► C. The variety used for cordite must have a flash point not below 204"4►► C. (400►► F.), and a melting point not below 30►► C. (86►► F.). It must also be free from acidity and

foreign mineral matters. The solvent used is acetone, C3H5O. Acetone is obtained by the destructive distUlatioa of acetates,- generally acetate of lime ; the principal source of the acetic acid being the destructive distillation of wood. The acetic acid as it distils over from the wood is at once neutralized by lime (or other base) and converted into acetate. The crude acetone as obtained from the acetate, is purified by rectification. It is a colourless aromatic liquid, and as used for the manufacture of cordite it must have a specific gravity of not more than 0‘80, must leave no residue on evaporation at 100►► C. (212►► F.), and must not contain more than 0‘005 per cent, of acidity; further, when it is mixed with a O’l per cent, solution of potassium permanganate the mixture must retain its pink colour for not less than 30 minutes. The composition of cordite is the same for all descriptions of small arms and ordnance, the required rate of combustion being obtained by varying the diameter of the cords. The density is constant (specific gravity 1 ‘66) ; it contains practically no moisture, nor is it affected in any way by water. It is poisonous. An ex- haustive series of experiments carried out in England, in India, in Canada, and in the Arctic regions, extending over a lengthened period, with the view of testing its keeping qualities, proved that it remained stable in its composition and uniform in its ballistic properties. Experiments also demonstrated its absolute non-sensi- tiveness to detonation in the form and under the conditions in which it is employed. The different sizes of cordite are designated by a fraction ; the numerator gives in hundredths of an inch the nominal diameter of the die through which the cordite is pressed, the denominator, the nominal length of the sticks in inches.

To diminish the erosion produced by cordite of the above com- position, especially when firing the heavy charges necessary to produce the high velocities now required from modern ordnance, a modified cordite, known as “Cordite M.D.,” is being intro- duced. Its composition is ►►► nitro-glycerine, 30 % ; gun-cotton, 65 % ; mineral jelly, 5 %. With Cordite M.D., slightly heavier

charges than of Cordite Mark I are required to give the same velocities, but the corresponding pressures are lower, so that by a further increase

in the charge, higher velocities can be obtained without exceeding the permissible pressures, and without undue erosion. The manulacture of Cordite M. D. is similar to that of Cordite Mark I.

Manufacture. ††† The various processes in the manufacture of cordite are as follows : ††† 1. Drying the gun-cotton. 2. Mixing the gun-cotton and nitro-glycerine. 3. Incorporating. 4. Pressing, and reeling or cutting. 0. Drying. 6. Blending and packing.

1. Drying the gun-cotton. ††† The gun-cotton after pulping, is compressed into cylinders 3 inches in diameter and 4^ inches high, of suf&cient consistency to enable them to be handled with care. It contains from 40 to 45 per cent, of water. In this form it is placed on trays with copper wire gauze bottoms, arranged on racks in the drying stoves. The drying is ettected by means of warm air blown into the stove, the temperature in the stove being kept as nearly as possible at 104†† F. (40″ C.). The gun-cotton is dried down to under 1 per cent, of moisture.

2. Mixing the gun-cotton and nitro-glycerine. ††† When dry the gun-cotton is weighed out into brass-lined wooden boxes and taken over to the nitro-glycerme final-washing house. The con'esponding quantity of nitro-glycerine is- weighed out a-s it comes from the filter tank, and poured over the gun-cotton. The boxes are taken to the mixing house, and the gun-cotton and nitro-glycerine thoroughly

Plan oftrovghs.

Fig. 1.

mixed by hand so as to break up the gun-cotton and make it ahsorb the nitro-glycerine. This mixture of gun-cotton and nitroglycerine is not nearly so sensitive or dangerous to handle and transport as either the dry gun-cotton or the nitro-glycerine alone. The gun- cotton and nitro-glycerine in this roughly mixed condition are known as cordite paste.

3. Incorporating.††† The cordite paste is next taken to the incorporating machines. This machine (Fig. 1) is an iron box, on suitable

supports, open at the top, and with a bottom shaped to form two semicircular troughs, in each of which a spindle -with screw -shaped blades revolves. The spindles turn in opposite directions, one moving at about twice the rate of the other. They are driven by cog-wheels on a third spindle running underneath the machine. This driving spindle has two pulleys on it, either of which can be put into gear by means of a friction cone. Both pulleys are driven from an overhead shaft, and as one has an open and the other a crossed belt, the blades can be made to revolve in- wards or outwards as desired. At the back of the machine is a screw arrangement for tilting it to facilitate the removal of its contents. The low-er or trough portion has an iron jacket, through which cold water circulates to keep down the temperature during incorporation. When at work the blades revolve in close proximity to the bottom of the machine, and the paste is continually being squeezed between the blades and the bottom and between the blades themselves as they meet along the centre line. The action is in fact a kneading one, and the machine is very similar to those used for making biscuit dough and for many other like purposes.

The details of the process are shortly as follows : ??? A portion of the charge of acetone having been poured into the machine, the

blades are started to revolve inwards, that is, towards one another, and the cordite paste ladled in with a wooden scoop, the remainder of the acetone being poured in as the paste is being added. The opera- tion of charging only takes a few minutes, and as soon as it is com- pleted the top of the machine is closed with a wooden cover to prevent the loss of acetone by evaporation, and the machine allowed to run for 2| hours. At the end of this time the weighed quantity of mineral jelly is added, and the machine set to work for another 2i hours. For about the last quarter of an hour the motion of the blades is reversed ??? that is, they are made to revolve away from one another ; this has the effect of breaking up the ” cordite dough,” as it is now termed, in which condition it is more easily filled into the press cylinders. At the end of

the iive liours the gelatiuiza- tion of the gun-cotton, and its admixture with the nitro-glycerine by the aid of the common solvent, acetone, is complete, and the mineral jelly is also uniformly distributed throughout the mass. The blades aie now stopped, and the cordite dough removed from the machine and placed in barrels for conveyance to the press house.

4. Pressing. ??? There are three kinds of presses in use at Waltham Abbey for pressing cordite, viz. , screw, screw and hydraulic com- bined, and hydraulic. The screw presses are used for the manu- facture of small-arm cordite, and are combined with an automatic reeling arrangement for winding the cordite on reels as it issues from the die. The screw and hydraulic combined, and the hydraulic presses, are for produc- ing the large natures of cordite, and are pro- vided with cutting gear for cutting the cordite to the required lengths as it is pressed. The general construction of the screw press for small – arm cordite is shown in Fig. 2. The plunger, the upper portion of which is screwed, passes up through the centre of a worm wheel worked by a worm on a horizontal shaft, to which the driving pulleys are at- tached. By means of automatic striking gear the motion of the worm is reversed when the plunger comes to the bottom of its stroke, and stopped when the return stroke is completed.

The reeling gear is shown in Fig. 3. The reel, the body of which is of sheet brass, with skeleton brass ends, is mounted in front of the press on a horizontal spindle with a cone pulley fixed to one end, and is driven by another cone pulley on the worm shaft ; this latter pulley is made to revolve by means of a friction cone worked by a lever on the right side of the machine. The object of the cone pulleys is to enable the speed of the reel to be adjusted to suit the rate at which the cordite is issuing from the die. The cordite is traversed automatically from side to side of the reel as it is wound upon it. The press cylinders are closed at the bottom by a plug, in the centre of which is the die. Resting on the plug is a steel plate with a number of holes in it. This plate supports a fine wire gauze disc, which acts as a sieve to prevent small particles of foreign substances from getting into and blocking up the die. The cylinder is shown in section in Fig. 2. The press cylinders are filled by

hand ramming. The full cylinder is placed in the press under the phinger, and the machine started and worked as aljove described. On completion of the up-stroko, the empty cylinder is removed from the press and another full one inserted. Each cylinder con- tains a little over one pound of cordite dough. A fresh reel is used for each cylinder, and the reels as filled are taken to the drying- stove.

The screw and hydraulic presses for the largo natures of cordite are, as far as the actual pressing is concerned, on practically the same principle as the screw press just described. The press cylinders, however, are an integral part of the machine, and are not removed for filling, the filling being done from a hopper attarhed to the cylinder, which latter is deep enough to contain the whole charge in an uncompressed condition.

In one pattern of press the plunger screw is attached to and revolves in a ram working in a small hydraulic cylinder. When the press cylinder is charged the valve leading to the hydraulic cylinder is opened, and the pressure, acting on the ram and plunger.

Fig. 2.

forces it down, and it compresses the material into the actual press cylinder. The screw gear is then started and the material pressed out through the die. The arrangement of perforated plate and wire gauze strainer is the same as in the small press cylinder. The number of dies in the plug, that is the number of cords that can be pressed at one time, depends on the diameter of the press cyl- inder and on the size of the cordite which is being

Fig. 3.

The smaller sizes of cord- ite, sizes T^Tf, ???VsS and -V^, are reeled by hand as they issue from the die, on reels of similar materials to those

used for small-arm cordite.

As soon as a pressing is completed, the reels are taken to a cutting machine, consisting of two horizontal steel blades mounted on a stand opposite one another and in the same plane. The reel is supported in the stand so that the cordite lies at right angles to and between the two blades, which are then brought together, cutting through the cordite and dividing it into a number of strands of equal or nearly equal length, this length being that of the semi-circumference of the reel. The cordite is then laid out flat on shallow wooden trays, the bottoms of which are formed of narrow battens with open spaces between them.

The larger sizes of cordite, viz., \^ and above, are led as they issue from the die on an endless leather band travelling at the same rate as the issuing cordite. This band has steel blades on its surface, fixed at right angles to the direction of its motion. The band passes under a roller, adjusted so as to press the cordite on to the knives, and in this way it is cut to length, the length being regulated by the distance apart of the blades on the belt. As they are cut, the strands are picked off the belt by hand, and arranged on trays, as described above in the case of the smaller sizes.

The hydraulic press is on the usual principle of such presses. The plunger is fixed, and the cylinder is supported on a table which is secured to the ram. As the ram ascends, the cordite is pressed out, and reeled or cut on the endless band, as already described.

5. DryiTig. ××× All cordite, after pressing, is dried in stoves, heated by means of steam pipes or hot-air blast to a temperature not exceeding 38×× C. (100×× F.). The reels or trays are arranged on open racks in the centre of the stove. Small-arm cordite takes about three days, the larger sizes about six days, and the largest nearly three weeks to dry. The object of the stoving is to remove the acetone and any moisture from the cordite.

6. Blending and Packing. ××× After drying, small-arm cordite is blended as follows : ××× Ten single-strand reels are mounted on a frame and wound oif simultaneously on a larger reel. The winding is done by a small machine in which the single large reel is made to

revolve and draw the cords from the 10 single-strand reels ; a lever actuated by cam, through which the ten strands pass, guides them from side to side of the larger reel as thej' are wound on it. Six of the full 10-strand reels are next taken, mounted on a stand, and the 60 strands wound off on a drum in the same way as the 10 single strands were wound on the 10-strand reel. When the reel- ing is completed, the ends are all secured by a band of stout tape wound round the drum, and the drum is packed in a box or barrel for transport. Larger sizes of cordite, which have been cut into lengths, are blended as follows : ??? As the trays come from the stove, their contents are packed into boxes, each containing about 100 lb of cordite, until a sufficient number of boxes to form a lot have been filled. This number is subdivided into batches, the number of boxes in a batch varying with the size of cordite, and the cordite in each batch of boxes is blended, by taking a few sticks from each box of the batch and packing them into another set of boxes, filling one box at a time until the whole of the original boxes have been emptied. A box of the blended material is then taken from each batch, and the contents of these boxes are again blended, as above described, so as to form when completed a uniform lot, the number of boxes forming a lot varying with the nature of the cordite. Cordite is packed in wooden boxes holding from 50 to 115 lb, according to the size of the box and the nature of the cordite.

Cordite for Uank ammunition and for Webley pistol cartridges. ??? Cordite for blank ammunition is prepared from size 20. After the cordite has been dried it is wound on reels. These reels are mounted on a stand in front of a machine which automatically feeds about 40 strands at a time through rows of holes in a fixed plate, in front of which, and close up against it, a disc revolves at a very high rate of speed. Attached to this disc are four knives, set at right angles to one another, which take thin slices off the strands as they are fed through the plate, the principle of the machine much

resembling that of a chaff-cutter. The flakes should vary in thick- ness between 0”-008 and 0”-003. It is designated -^.

Cordite for the Weblcy pistol is prepared by’ slicing size 1 cordite in a machine similar in principle to the one used for making ??? . It is designated —i^.

Tests. ??? The tests for finished cordite are as follows : ???

1. Analysis.- -To ascertain that the percentage composition is correct.

2. Moisture test. ??? To ascertain that it does not contain more than a certain percentage of volatile matter varying with the size of the cordite.

3. Heai test for stability.???This test is briefly as follows :??? 20 grains of finely ground cordite arc placed in a test tube provided with a stopper, through which passes a glass rod terminating in a hook. A piece of filter paper saturated with a solution of starch and potassium iodide, and dried, is attached to the hook, and the upper half of the paper moistened, when about to be used, with a solution of glycerine in water. The paper is inserted in the test tube, and the test tube placed in a water bath heated to 180?? F. The test is completed when the faint brown line, which after a time makes its appearance at the margin between the wet and dry

Sortions of the test paper, equals in depth of tint the brown line rawn on a standard test paper. This test with slight modifica- tions is the one in general use for testing the purity of all nitro- explosives.

4. Ballistic proof. ??? Each size of cordite is fired in the small arm or piece of ordnance with which it is intended to be used, under certain fixed conditions as to weight of charge and projectile, &c. , and must give velocities and pressures within certain defined limits.

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(f. L. N.)

PrOSSnitz (Czech, Prostejov), chief town of a government district in the fertile plain of Hanna, in Moravia, Austria. It has important textile, malt, and sugar industries, distilling, brewing, and milling, manu- factures of agricultural implements and lucifer matches. Geese are bred in large numbers, and there is a brisk trade in corn. Population (1890), 19,512; (1900), 24,054.

Prostitution. ??? Prostitution may be defined as promiscuous unchastity for gain. In German law it is described as Oewerbsmassige TJmueht. It has always been distinguished in law and custom from concubinage, which is an inferior state of marriage, and from adultery and other irregular sexual relations, in which the motive is passion. Prostitution has existed in all civilized countries from the earliest times, and has always been subject to regulation by law or by custom. In Christian countries attempts have repeatedly been made to suppress it, but without success. Its ultimate basis lies in the two most

elementary attributes of living things, namely, the will to live and the instinct of reproduction. The one represents the interest of the individual, the other that of the race ; and the essential character of prostitution is that it utilizes the latter to satisfy the former, whereas in true sexual passion, as Schopenhauer has pointed out, the advantage of the individual is subordinated to the needs of the race. In practical language, prostitution ofi'ers, through abuse of the sexual instinct, a means of livelihood which a certain proportion of women prefer to other means. It is often assumed by philanthroxjic moralists that no other means are open to them. That may be so in cases in which deception or constraint has been used, and adverse circum- stances???such as lack of friends and a harsh social code ??? close the door to other occupations ; but to suppose that such cases account for prostitution is to misapprehend the problem. The detailed investigations of various observers and the experience of rescue societies prove that the great majority of prostitutes prefer that means of livelihood to others entailing regular work, discipline, and self- control. When they really cease to prefer the life, they leave it voluntarily. 1 Otherwise there is extreme difficulty in re- claiming even the few who will consent to try, and permanent success is only attained with a small proportion of them. The earliest attempt at reclamation met with the same result. It was carried out by the Koman Empress Theo- dora, wife of Justinian, herself a prostitute in early life. She established a home for 500 women on the Bosphorus, but after a time they could not bear the restraint ; some threw themselves into the sea, and event- ually the scheme was abandoned. The preference is due to several causes, of which indolence is the chief. Pros- titutes are drawn

mainly from the lower classes : the life offers them an escape from the toil which would otherwise be their lot. Women who present themselves to the police for inscription on the Continent frequently give as their reason for embracing the life, that they do not intend to work any more. Other causes are love of excitement and dislike of restraint. The same quahties make the criminal and the wastrel. In addition, a large proportion have the sexual appetite developed in an abnormal degree. Of 3505 women interrogated by M. Buls in Brussels, 1118 admitted le goutpcmr Vhomme. The foregoing are primary causes. External conditions which foster any of these tendencies, or destroy the self-respect and sense of modesty which are their natural antidotes, are secondary causes of prostitution. The more important are : (1) difficulty of finding employment ; (2) excessively laborious and ill-paid work ; (3) harsh treatment of girls at home ; (4) promis- cuous and indecent mode of living among the overcrowded poor ; (5) the aggregation of people together in large com- munities and factories, whereby the young are brought into constant contact with demoralized companions; (6) the example of luxury, self-indulgence, and loose manners set by the wealthier classes ; (7) demoralizing literature and amusements ; (8) the arts of profligate men and their agents. Alcohol is often an aid to prostitution, but it can hardly be called a cause, for the practice flourishes even more in the most abstemious than in the most drunken countries. These observations apply to the West. In Oriental countries girls are commonly bom into or brought up to the trade, and in that case have no choice.

Among the ancient nations of the East, with the excep- tion of the Jews, prostitution appears to have been con- nected with religious worship, and to have been not merely

****** The number of those who do so is considerable. In Copenhagen from 1871 to 1896 33 per cent, of the registered prostitutes were re- moved from the register by marriage and by returning to their friends. Many women resort to prostitution occasionally, in alternation with work.**

tolerated but encouraged. From the Mosaic ordinances

and the narrative of the Old Testament it is clear that the

separation of the Jews as the chosen people, and

- ‘”” the maintenance of their faith, were always felt ty Moses and by the later prophets to be chiefly endangered by the vicious attractions of the religious rites practised around them. The code of sexual morality laid down in the Book of Leviticus is prefaced by the injunction not to do after the doings of the land of Egypt, nor after the doings of the land of Canaan, where all the abominations forbidden to the Jews were practised ; and whenever the Israelites lapsed from their faith and ” went a-whoring after strange gods,” the transgression was always associated with hcentious conduct. In Egypt, Phoenicia, Assyria, Chaldea, Canaan, and Persia, the worship of Isis, Moloch, Baal, Astarte, Mylitta, and other deities consisted of the most extravagant sensual orgies, and the temples were merely centres of vice. In Babylon some degree of pros- titution appears to have been even compulsory and imposed upon all women in honour of the goddess Mylitta. In India the ancient connexion between religion and prosti- tution stiU survives ; but that is not the case in China, a most licentious country, and, considering the antiquity of its civilization, and its conservatism, we may perhaps conclude that it formed an exception in this respect among the ancient nations. Among the Jews, who stood apart from the surrounding peoples, the object of the Mosaic law was clearly to preserve the purity of the race and the religion. Prostitution in itself was not forbidden, but it was to be confined to foreign women. Jewish fathers were forbidden to turn their daughters into prostitutes (Lev. xix. 29), and the daughters of Israel were forbidden to become prostitutes (Deut. xxiii. 17), but no penalty was attached to disobedience, except in the case of a priest’s daughter, who was to be burnt (Lev. xxi. 9). This

distinction is significant of the attitude of Moses, because the heathen "priestesses" were nothing but pros- titutes. Similarly, he forbade groves, a common adjunct of heathen temples and a convenient cover for debauchery. Again, his purpose is shown by the severe penalties imposed on adultery (death) and on unchastity in a betrothed damsel (death by stoning), as contrasted with the mild prohibition of prostitution. So long as it did not touch the race or the religion, he tolerated it; and even this degree of disapproval was not maintained, for Jephthah was the son of a harlot (Judg. xi. 1). There is abundant evidence in the Old Testament that prostitution prevailed extensively in Palestine, even in the earlier and more puritan days. The women were forbidden Jerusalem and places of worship ; they infested the waysides, and there is some evidence of a distinctive dress or bearing, which was a marked feature of the trade among the Greeks and Romans. In the later period of aggrandizement that increase of licentious indulgence which Moses had foreseen took place, associated with infidelity. The people plunged into debauchery, the invariable sign of national decadence, which has always accompanied over-prosperity and security, and has always heralded national destruction. Before leaving the Jews, it may be noted as an interesting fact that the remarkable series of ordinances laid down by Moses in the interest of public health contains unmistak- able recognition of venereal disease and its contagious character (Lev. xv.).

Passing on to the ancient Greeks, we find prostitution treated at Athens on a new principle. The regulations of Solon were designed to preserve public order and decency. He established houses of prostitution (dicteria), which were a State monopoly and confined to certain quarters. The dicteriades were forbidden the superior parts of the town, and were placed under various disabilities. They

were compelled to wear a distinctive dress, and, so far from being connected with religion, they were not allowed to take part in religious services. These laws do not seem to have been carried out at all effectually, and were presently relaxed. After the Persian wars more

stringent regulations were again introduced. The dicteriades were placed under police control, and were liable to prosecution for various offences, such as ruining youths, committing sacrilege, and treason against the State. It is clear, how- ever, that as time went on the Athenian authorities experienced the difficulties encountered by modern adminis- trations in carrying out State regulation. There were grades of prostitution, socially though not legally recog- nized, and women of a superior order were too powerful for the law, which failed to maintain the ban against them. The Greek hetterw, who were prostitutes, not ” mis- tresses,” and the most gifted and most brilliant members of their class known to history, wielded great and open influence. The test case of Phryne, in which the stern attitude previously maintained by the Areopagus broke down, estabUshed their triumph over the law, deprived virtuous women of their sole advantage, and opened the door to general laxity. In later times any one could set up a dicterion on payment of the tax. In other Greek cities extreme licence prevailed. At Corinth, which was famous for sensual practices, a temple, with a huge staff of common prostitutes for attendants, was established in honour of Aphrodite and for the accommodation of the sailors frequenting the port. The worship of this goddess became generally debased into an excuse for sexual excesses.

The Romans united the Jewish pride of race with the Greek regard for pubhc decency, and in addition upheld a standard of austerity all their own. In early days female virtue was highly honoured and strenuously main- tained among them,’ of which the institution of the vestal virgins was a visible sign. Their attitude towards prosti- tution differed, accordingly, from that of other ancient nations. Among them, alone, it was considered disgraceful to a man to frequent the company of prostitutes ; and this traditional standard of social conduct, which markedly distinguished them from the Greeks, retained sufficient force down to the later days of the Republic to furnish Cicero with a weapon of rhetorical attack against his political opponents, whom he denounced as scortatores. Prostitution was more severely regulated by them than by any other ancient race. They introduced the system of police registration, which is the leading feature of Con- tinental administration to-day. From the earliest days of the Republic

prostitutes were required to register at the rediles' office, where licences were issued to them on pay- ment of a tax. They were placed under stringent control, had to wear a distinctive dress, dye their hair or wear yellow wigs, and were subject to various civil disabilities ; but the severest feature of the system was that, once registered, their names were never erased, and consequently remained for ever under an indelible stain. As in our times, registration became ineffective, and neither law nor tradition could check the demoraUzing influence of ease and luxury when once external conquest left the Romans free to devote their energies to the pursuit of pleasure. An attempt was made, by the enactment of severer laws against prostitution, to stem the rising tide of immorality, which threatened to taint the best blood in Rome with the basest elements in the later days of the Republic. Citizens were prohibited from marrying the descendants or relatives of prostitutes, daughters of equestrians were forbidden to become prostitutes, and married women who did so were liable to penalties. More stringent regulations were also imposed on prostitutes themselves, in addition to the old disabilities and police system, which remained in force. If

these laws had any effect at all, it was to promote the general prevalence of immorahty ; they certainly did not diminish prostitution. The profligacy of imperial Rome has never been surpassed for gross and obscene sensuality. The greatest change introduced by Christianity with re- gard to prostitution was the adoption of a more charitable attitude towards these social and legal outcasts. The Roman state tax, which had descended to the emperors and had been further regulated under Caligula, was partly given up in the 4th century by Theodosius, on the repre- sentations of Florentius, a wealthy patrician, who offered to make good the loss of revenue out of his own pocket. It was fully and finally abolished by Anastasius I. in the next century, and the old registers were destroyed. Then some of the civil disabilities of prostitutes were removed by Justinian in the 6th century. Gibbon, who never gave credit for a good motive when a base one could l)e found,

attributes Justinian's action solely to his desire to marry Theodora, whose life had been notorious ; and no ???doubt she influenced him in the matter, but it is per- missible to assume a good motive. Even Gibbon is con- .strained to admit her virtue after marriage, and to give her credit for " the most benevolent institution " of Jus- tinian's reign, the rescue home for fallen women in Constantinople, which was at any rate disinterested. Though it did not succeed, it marks a turning-point in the treatment of a class which had never met with pubhc .sympathy before. At the same time procuration and con- nivance were severely punished, which is in keeping with the Christian attitude. The early Christian Church laid great stress on chastity, which probably suggested to its Roman persecutors the horrible punishment of forcibly prostituting Christian maidens. Such malignity enhanced the glory of martyrdom without shaking the constancy of its victims; and the triumph of purity in an age of un- iDounded licence was conspicuously recognized by Alaric, the Gothic conqueror, who gave strict orders in the sack of Rome that the virtue of Christian women was to be respected. The Church, however, was not severe upon prostitutes, to whom the altar was open upon repentance, and some of the fathers expKcitly recognized their trade as a necessary evil. Among them was St Augustine, a man of the world, who saw that its suppression would stimulate more destructive forms of immorality. Gradually charity degenerated into patronage. Rome, conquered spiritually by Christianity and materially by the Northern barbarians, sapped the virtue of both. Before the Middle Ages the institutions and ministers of the Church became a by-word for vice. Charlemagne made an effort to .suppress the prevailing disorder, but his private life was licentious, and his capitularies, which ordained the scourg- ing of prostitutes and panders, were not inspired by any regard for morality. A period of reform followed. The jise of chivalry, with its lofty idealization of women, and the wave of Christian fervour connected with the Crusades, inspired a vigorous and high-minded campaign against an all-prevalent evil. The Church became exceedingly active in prevention and rescue work, and was assisted by a devout and zealous laity. Rescue missions were organized, III. (1198- 1216) pronounced it a praiseworthy act to marry a prostitute ; and Gregory IX., a few years later, wrote to Germany that brothel-keepers were not to prevent pros-

t;itutes from attending missions, and that clergy and laity who drew profit from prostitution were banned. ” Urge bachelors,” he wrote, “to marry repentant girls, or induce

the latter to enter the cloister.” In spite of such efforts, and of occasional spasms of severity by individual rulers, prostitution flourished everywhere throughout the Middle Ages. It was not merely tolerated, but Kcensed and regulated by law. In London there was a row of “bordells” (brothels) or “stews” in the Borough near London Bridge. They were originally licensed by the Bishops of Winchester, according to John Noorthouck, and subsequently sanctioned by Parliament. Stow quotes the regulations enacted in the year 1161, during the reign of Henry II. These were rather protective than repressive, as they settled the rent which women had to pay for the rooms, and forbade their compulsory detention. The Act was afterwards confirmed in the reigns of Edward III. and Richard II. In 1383 the bordells belonged to William Walworth, Lord Mayor of London, who farmed them out, probably on behalf of the Corporation, according to Con- tinental analogy. They were closed in 1506, but reopened until 1546, when they were abolished by Henry VIII. In London we get the earliest known regulations directed against the spread of venereal disease. The Act of 1161 forbade the bordell-keepers to have women suffering from the “perilous infirmity of burning”; and by an Order of 1430 they were forbidden to admit men suffering from an infirmitas nefanda. Probably it was by virtue of this Order that in 1439 two keepers were condemned to eleven days’ imprisonment and banishment from the city. In 1473, again, it is recorded that bawds and strumpets were severely handled by Lord Mayor Hampton. On the Con- tinent much the same state of things prevailed during the same period. Prostitution was both protected and regulated, and in many places it constituted a source of public revenue. In France prostitutes were distinguished by a badge, and forbidden to wear jewels and fine stuffs and to frequent certain parts of the town. Public brothels on a large scale were estabhshed at Toulouse, Avignon, and Montpellier. At Toulouse the profits were shared between the city and the university ; at MontpeUier and Avignon the trade was a municipal monopoly, and farmed out to individuals ; at Avignon, where the establishment was

kept up during the whole period of the popes' residence, the inmates were subjected to a weekly examination. In 1254 Louis IX. issued an edict exHing prostitutes and brothel-keepers ; but it was repealed two years later, though in this and the succeeding century procuration was punished with extreme severity. In some parts of France prostitutes paid a tax to the seigneur. In Germany, according to Fiducin, the public protection of Lust-Dirnen was a regular thing in all the large towns during the Middle Ages. " Frauenhauser," similar to those in London and in France, existed in many places. They are mentioned in Hamburg in 1292 ; and from later records it appears that they were built by the corporation, which farmed them. So also in Ulm, where special regulations were issued in 1430. We find them existing at Regensburg in 1306, at Ziirich in 1314, at Basel in 1356, and Vienna in 1384. According to Henne-am-Rhyn, admission to these houses was forbidden to married men, clergy, and Jews, and on Sundays and saints' days they were closed. The laws of the Emperor Frederick II. in the 13th century contain some curious provisions. Any one convicted of a criminal assault on a prostitute against her will was liable to be beheaded ; if she made a false accusation, she was subject to the same penalty. Any one not going to the assistance of a woman calUng for help was liable to a heavy fine. In these ordinances the influence of chivalry may be detected. At the same time prostitutes were forbidden to live among re- spectable women or go to the baths with them. Hospitality to important guests included placing the public Frauenhauser at their disposal So King (afterwards Emperor) Sigismund

???was treated at Bern in 1414 and at Ulm in 1434, so nmch to his satisfaction tliat he publicly complimented his hosts on it. Besides the municipal Frauenhauser, there were " Winkeihauser," which were regarded as irregular com- petitors. In 1492 the hcensed women of Nuremberg complained to the mayor of this unfair competition, and in 1 508 they received his permission to storm the obnoxious Winkelhaus,

which they actually did. In Italy and Spain the system appears to have been very much the same. At Bologna prostitutes had to wear a distinctive dress, in Venice they were forbidden to frequent the wine-shop, and in Ravenna they were compelled to leave a neighbour- hood on the complaint of other residents. At Naples a Court of Prostitutes was established, having jurisdiction over everything connected with prostitution. It led to great abuses, was reformed in 1589, and abohshed about a century later.

Such was the state of things in the Middle Ages. In the 15th and 16th centuries a great change took place. It was due to two very different causes : (1) fear of disease; (2) the Reformation. With regard to the first, there can be httle doubt that both the slighter and graver forms of venereal disease existed in very remote times, but until the 15th century they attracted com- paratively little attention. The constitutional character of syphilis was certainly not understood, ??? which is by no means surprising, since its pathology has only been eluci- dated during the last half century and is still extremely obscure, ??? but one would still have expected to find more notice taken of it by historical, moral, and medical writers in classical and mediagval times. Nor is it possible to explain their reticence by prudery, in view of the unbounded literary licence permitted in those ages. One can only conclude that the evil was less widely spread or less viru- lent than it afterwards became. At the end of the 15th century it attracted so much notice that it was supposed to have originated then de novo, or to have been brought from the West Indies by Columbus ??? both untenable hypotheses ; and, as usual, each country accused some other of bringing the contagion within its borders. To speculate on the causes of this increased prevalence wordd be idle ; it is enough to note the fact and its con- sequences. It was immediately followed by the Reforma- tion, and the two together led to a general campaign against the system of licensed prostitution. The last Frauenhaus was closed in Ulm in 1531, in Basel in 1534, and in Nuremberg in 1562. In London, as already noted, the bordeUs were abolished in 1546. In Paris an ordinance was issued in 1560 prohibiting these estabhshments, and later all prostitutes were required to leave the city within twenty-four hours. These instances will suffice to show the general character of the movement.

Nor were muni- cipal brothels ever tolerated again. It is observed by Henne-am-Rhyn ??? no friend of toleration ??? that their suppression was followed by the appearance of the crime of infanticide, by the estabhshment of hospitals for found- lings and for syphihs. This suggests an indictment against humanity which is hardly justified by the facts. Infanti- cide was no new thing, and foundling hospitals date from the beginning of the 13th century. Their marked in- crease and the establishment of syphilitic hospitals came a century later than the Reformation campaign against the Frauenhauser. The suppression of the latter did not affect the prevalence of prostitution. In the 17th century another spasm of severity occurred. In 1635 an edict was issued in Paris condemning men concerned in the traffic to the galleys for life ; women and girls to be whipped, shaved, and banished for life, without formal trial. These ordinances were modified by Louis XIV. in 1684. The Puritan enactments in England were equally

savage. Fornication was punishable by three months' imprisonment, followed by bail for good behaviour. Bawds were condemned to be whipped, pilloried, branded, and imprisoned for three years ; the punishment for a second offence was death. In Hamburg all brothels were pulled down and the women expelled from the town. If these measures had any effect, it was speedily lost in a greater reaction; but they have some historical interest, as the present system was gradually evolved from them.

It would be tedious and unprofitable to follow all the steps, the shifts and turns of policy, adopted in different countries during the 18th century for the suppres- sion or control of an incurable evil. They involve no new principle, and merely represent phases in the evolution of the more settled and more systematic procedure in force at the present time. Its chief feature, as compared with the past, is the establishment of an organized police force, to which the control of prostitution is entrusted, coupled with a general determination to put the subject out of sight and ignore it as far as possible. The procedure on the continent of Europe is virtually a return to the old Roman system of registration and supervision, except that there is no State tax, and names can be removed from the register. The objects are the same,

namely, public order and decency, with one important addition, which has given' rise to much controversy. This is the protection of health. From what has gone before, the reader will have gathered that it is not, as frequently supposed, a new tiling. Already in the Middle Ages the question occupied the attention of Parliament in England, and a weekly examination of pubhc women by the barber (the surgeon of that time) was instituted at Avignon. The practice was adopted in Spain from about 1500, and later in many other places. But the abolition of hcensed brothels, and the consequent growth of private prostitution, rendered it a dead letter. To meet the difficulty, registra- tion was devised. It was first suggested in France in 1765, but was not adopted untU 1778. The present regulations in France are based on the ordinances of that year and of 1780, which in their turn were borrowed from those of the 16th and 17th centuries, previously mentioned. The theory of the modern attitude to- wards prostitution is clearly laid down by successive ordinances issued in Berlin. Those of 1700 stated that "this traffic is not permitted, but merely tolerated"; the more precise ones of 1792 pronounced the toleration of prostitution a necessary evil, "to avoid greater disorders which are not to be restrained by any law or authority, and which take their rise from an inextinguishable natural appetite"; and the regulations of 1850 and 1876 are headed " Polizeiliche Vorschriften zur Sicherung der Gesundheit, der offentlichen Ordnung und des offentlichen Ansta7ides." This embraces the whole theory of present administration, and if Gesundheit be omitted, is not less applicable to the United Kingdom than to the Continent. The last attempt to suppress prostitution in Germany is worth noting, as it occurred so late as 1845. Regis- tration was stopped and the tolerated houses were closed in Berlin, Halle, and Cologne. The attempt was a com- plete failure, and it was abandoned in 1851 in favour of the previous system.

We proceed to state the present condition of the law in France, Germany, Austria, and the LTnited Kingdom.

France. ??? The French criminal law takes no cognizance of prostitution. The subject was omitted from the penal code drawn up by

the first Republic, and was never restored, although many attempts were P???sen< made to introduce legislation, on account of the "'*'

great disorder which arose. Procuration is to a certain extent a criminal offence. Paragraph 334 of the code for-

bids the exciting, favouring, or facilitating habitually the debauch of girls or boys under twenty-one years of age ; the penalty is imprisonment for six months to two years, and a fine of 50 to 500 francs. If the offence is committed by parents, guardians, or other persons in a tutelary posi- tion, imprisonment is from .two to five years, and the fine 300 to 1000 francs. The regulation of prostitution rests on the law of 1790, which entrusted the preservation of public tranquillity to the administrative authorities; these are in Paris the prefect of police, and in other communes the mayor. The Parisian regulations have been built up by the decrees of successive prefects. They are based on those of 1778, which fell into abeyance at the Eevolution, were reintroduced in 1816, amended in 1823, and made more complete in 1830 and 1841. Those adopted in other towns do not differ in any essential particular. The more important points are: (1) registra- tion of prostitutes, which is either voluntary, or compulsory after repeated arrest; (2) recognized brothels, which are of two classes ??? maisons de tolerance (residential) and maisons de passe (houses of call) ; (3) medical examina- tion, which is weekly at the maisons de toldrance, while other registered prostitutes must present themselves fort- nightly at the dispensary ; (4) hospital treatment of those found diseased ; (5) rules wdth regard to solicitation, the frequenting of public places, &c. A small fee is paid for examination. The penalty for infraction of regulations is imprisonment ; offences are divided into two classes : (1) slight, (2) grave, and the term of imprisonment varies accordingly from fourteen days to one year. Names may be erased from the register on the following grounds : (1) marriage, (2) organic disease such as to render the calling impossible, (3) return to relations and proof of good behaviour. The whole procedure appears to rest on grounds of doubtful

legality. Prostitution never comes before the courts which alone can try offences and pro- nounce sentence. The police have no power to do so, yet they both try and sentence these women. That is to say, the whole system depends on their doing, by some verbal quibble, what they have no power to do. The question came before the court of Kheims in 1876, in the case of two women who refused to submit to medical examination, and the judge decided in their favour. He was dismissed in consequence, which does not make the situation more satisfactory.

Germany. ??? The German law is more explicit and more logical. Prostitution is not forbidden, but by paragraph 361 of the Imperial Code women are liable to arrest for prac- tising prostitution vidthout being under police control, and for contravening regulations after they have been placed under such control. This brings the traffic completely under the police, and gives legal sanction to their regulations. These vary to some extent in different places, but their general tenor is the same. They include compulsory registration and weekly or semi-weekly medical examina- tion, together with rules, for the most part extremely strict, with regard to public demeanour and conditions of life. In Hamburg, for instance, prostitutes are confined to certain streets or houses, forbidden to share lodgings with persons not registered, to have female servants under twenty-five years of age, to keep children after school age, to admit young men under twenty, to make a noise or quarrel, to attract attention in any way, to go out between two and five in summer, to frequent certain parts of the town, or public balls, or superior seats in the theatre, to remain out after 11 p.m. (Kegulations of 1886). On proved reclamation, supervision may be relaxed or names struck off the register. Generally, the women are com- pelled to contribute a fixed sum to a sick fund, for defray- ing the cost of medical examination ; and in some places

also to a journey fund, which is apphed to sending strangers to their homes. Brothels are absolutely illegal throughout Germany. Paragraph 180 of the Imperial Code (1876) makes Kuppelei a penal offence. Kuppelei is defined as promoting prostitution, either by procuration or by pro- viding facilities of any kind. There is (1) ordinary Kuppelei, or simply assisting prostitution for gain, and (2) aggravated Kuppelei,

which includes false pretences and procuration by parents, guardians, teachers,

Austria. ??? The Austrian law goes further than the Ger- man, and is still more inconsistent with the existing practice. By paragraph 5 of the Criminal Act of 1885 prostitution is actually forbidden, but permission is given to the police to tolerate it under conditions, and to pre- scribe regulations according to circumstances. Power to punish is also given to the police. Only certain cases of prostitution are liable to criminal prosecution, namely, when continued after police punishment, with disregard of regulations, when practised by persons suffering from venereal disease, and when accompanied by public scandaL Seduction of the young is punishable by imprisonment, eight days to six months ; living on the prostitution of others, by eight days to three months. Kuppelei is a penal offence. Simple Kuppelei includes (1) harbouring prostitutes for the purpose of pursuing their trade, (2) procuration, (3) having any connexion with the traffic – ??? penalty, three to six months' imprisonment; quahfied Kuppelei is (1) procuration of innocent persons (equivalent to use of false pretences), (2) procuration by parents, guardians,

Great Britain. ??? The English law differs markedly from the foregoing. It regards prostitution solely as a public nuisance, and dates from the middle of the 18th century. The principal Act (25 Geo. II.) was passed in 1755, making perpetual a previous Act of 1752. It is entitled "An Act for encouraging prosecutions against persons keeping bawdy ~~houses," and provides that two ratepayers, on giving notice to a constable, may go vdth him before a justice and obtain an order for proceeding against the persons in question. A further Act was passed in 1763, fixing the penalties; and a third in 1818 (58 Geo. III.), enabling the overseers of the parish to take the requisite proceedings. Thus machinery was provided for dealing with brothels, but it was left to the public to put it in motion. The Vagrancy Act of 1824 enables the police to proceed against " common prostitutes for behaving in a riotous or indecent manner," and also for~~ bids indecent literature. This was strengthened by a special Act (2 and 3 Vict.), applying to London only, for the prevention of "loitering for the purpose of prosti- tution or

solicitation, to the annoyance of passengers or inhabitants.” Other large towns have since obtained private Acts for the same purpose. The penalties are fines and short terms of imprisonment. In 1847 an Act was passed making it an offence for publicans to allow “common prostitutes to assemble and continue ” in licensed premises. The Licensing Act of 1872 contains a provision to the same

effect. Tlie previous law for dealing with brothels by indictment was strengthened by the Criminal Law Amend- ment Act of 1885 (48 and 49 Vict. c. 69), which renders ” any person who keeps, manages or acts or assists in the management of a brothel,” and any owner or occupier who knowingly permits the same, liable to summary con- viction under the Summary Jurisdiction Act ; penalties for first offence, a fine up to ––20, or imprisonment up to three months, increased for second offence to ––40 and four months respectively. The same Act also strengthened the law, which had previously been very weak, for the protection of the young and the prevention of procuration. It makes the procuration or attempted procuration of any girl or woman “to become a common prostitute” a mis- demeanour punishable by two years’ imprisonment, and places the following offences on the same footing : procuring defilement by threats, fraud, or drugs ; compulsory deten- tion for defilement or in a brothel ; procuring the defile- ment of girls under twenty-one ; inducing them to leave the kingdom or to leave home and go to a brothel, with intent. The defilement of girls under sixteen and over thirteen years of age is also a misdemeanour, and subject to the same penalty ; the defilement of girls under thirteen is felony, punishable by penal servitude from five years up to a life- sentence. Owners or occupiers of premises conniving at these offences are equally liable.

No account of the law iii the United Kingdom would be complete without some reference to the partial adoption of the Continental system in 1864-83. In 1864 a Con- tagious Diseases Prevention Act was passed, providing for the compulsory medical examination of

prostitutes, and detention in hospital of those found diseased, in the following garrison towns : ??? Portsmouth, Plymouth, Wool- wich, Chatham, Sheerness, Aldershot, Colchester, Shorn- cliffe, the Curragh, Cork, and Queenstown. The legal machinery was a justices' order granted on sworn informa- tion that the woman named was a common prostitute. " The Act having proved very inefficacious " (Judge Advo- cate-General in House of Commons, April 1883), it was amended in 1866 and extended to Windsor. Two years later an important memorial was drawn up by the Eoyal Colleges of Physicians and Surgeons in favour of the Acts and their extended application, and in 1869 they were further amended and applied to Canterbury, Dover, Graves- end, Maidstone, Southampton, and Winchester ??? eighteen places in all. A popular agitation, based on humanitarian and moral grounds, and continuously carried on against the measure, led to the appointment of a Eoyal Com- mission in 1871 and a Select Committee in 1879. The direct evidence was strongly in favour of the Acts, alike with regard to the diminution of disease among the troops in the protected towns, the nbsenoe of complaints, and the good effect on public order, to which clergymen and other residents testified. The majority of the Committee reported accordingly after three years' inquiry; but in 1883 the House of Commons passed a resolution, by 182 to 110 votes, condemning the compulsory examination of women. As this would have entailed refusal to vote the money required to carry on the system, it was immediately dropped, and the officers of the metropolitan police to whom its execution had been entrusted were recalled. In 1886 the Acts were repealed.

In India the system was introduced for military can- tonments in 1865, partially suspended at the end of 1884, and stopped in 1888 on account of the action of the House of Commons. A new Cantonment Act was applied in 1889, and an amending Act in 1893, by which the compulsory or periodical examination of women was pro- hibited. In consequence of the enormous increase of syphilis which followed, a new Order was made in 1897,

which gave power (1) to call on persons suffering fromi a contagious disease to attend the dispensary, (2) to remove brothels, (3) to prevent

the residence or loitering of prostitutes near cantonments.

The foregoing summary of existing laws and regulations sufficiently indicates the present methods of dealing with prostitution. All Western nations broadly follow one or other of the systems described, though the local regulations may vary somewhat in minor details.

The French system of recognized houses, with registra- tion, police des moeurs, (fee, obtains in Belgium, Kussia, Hungary, Spain, and Portugal ; Italy adopted it in 1855, but abandoned it in 1888 for a modi- º^^'^^"* fied system ; in the Dutch towns maisons de existing. toUrance are permitted with or without a service des moeurs; Norway has abandoned registration, except in Bergen and Trondhjem, but otherwise Scandinavia rather follows the German principle of non-recognition, I with more or less vigorous policing ; of the Swiss cantons, some have the French, others the German system ; whUe the United States and the British self-governing colonies incline more to the English model of comparative freedom, without a moral police or one possessing arbitrary executive powers independent of the courts of justice. All the systems have their defects ; all fail to fulfil their purpose in the great cities. The most modest aim is to preserve public order and propriety. This object is better secured on the Continent than elsewhere, but at the cost of submitting to an arbitrary police rule, intolerable to a free people. There appears to be less prostitution, both visible and actual, in Italy than in other countries. Under the English system the streets can be, and sometimes are, kept orderly in provincial towns by an energetic police; but in London the mass of prostitution is so great that the police seem totally unable to cope with it. Important thoroughfares and centres are frequented by large numbers of prostitutes in broad daylight, and choked by them at night. The law with regard to loitering is a dead letter, for these women do nothing but loiter. Flagrant solicita- tion is to some extent repressed, but for the most part the police content themselves vrith preventing positive tumults, and do not always succeed in that. On the other hand, the less ob^aous but more pernicious nuisance of the brothel prevails to a far greater extent on the Continent.^ Under the French system it is, of course, encouraged, in preference to " surreptitious " prostitution ; but

under the German it is forbidden. The facts here afford a proof of the impotence of the law no less striking than the condi- tion of the London streets. By the German and Austrian criminal law, quoted above, brothels are prohibited, yet they abound in both countries. In Austria they are recognized, and perhaps the logic of the law is saved by permissive police clauses. In Germany it is not so. Paragraph 180 absolutely disposes of the question, and in Berlin it is acted on. Elsewhere brothels not only existed, but were recognized by authority for years after the passing of the law against Kuppelei. It was not until 1886 and 1889 that they were nominally abolished in Hamburg and Saxony respectively. Yet they still exist in most or all of the large towns, with the knowledge and consent, if not with the permission, of the police. In some they are even authorized. Berlin, which is more severely policed than any town outside Eussia, is an exception. There brothels are not openly winked at, but the police have to deal annually with 16,000 or 17,000 charges of Kiqipelei, and the number remains very con-

^ Dublin furnishes an exception to the usual practice in the United Kingdom. In that city the police permit open brothels, confined to one street, but carried on more publicly than even in the south of Europe or in Algeria.

stant, from which it may be inferred that the law, even when logically and energetically carried out, is quite ineffective. The Continental system of registration is still more delusive. In Russia, where the authorities have the means of knowing the movements and habits of every individual, it may be possible to compel the registration of the majority of prostitutes, but in other countries it is impossible. The police everywhere complain of the amount of ” clandestine ” prostitution, which they cannot control, and which tends always to increase, under the system, while the roll of inscribed women dvsdndles. The numbers alone are sufficient to prove the failure of the procedure; for instance, 311 and 270 in Dresden and Munich

respectively (Zehnder, 1891), both capital towns and cities of pleasure containing over 300,000 inhabitants. Cologne, with only half the population, had double the number on the register at the same time. In Paris, which may be called the headquarters of Western vice, the dis- proportion between registered and clandestine prostitution has reduced the whole system to an absurdity. The number of women on the roll is not a tenth of the esti- mated number of prostitutes; nor is Berlin, with about 3000 on the register, any better off. In Bordeaux, Brest, Lille, Lyons, and Marseilles the same process is going on (Eeuss). It follows that the protection of health, which is the object aimed at by registration, is delusive in an equal degree. There are no means of ascertaining the amount of venereal disease existing in any town or country, except in Norway, and consequently no data for comparing one period or one place with another ; but we know that all forms of such disease are stUl very prevalent in all large Continental tovms, in spite of the system. The only exact figures available are the military returns, which are of some value. It is in garrison towns of moderate size that com- pulsory registration is likely to be most efficiently carried out and to produce the most decided results, because the women with whom soldiers consort are by their character and habits least able to elude the vigilance of the police. The following table gives the proportion of admissions to hospital from all forms of venereal disease in the German, French, Austrian, and British forces since 1876. It may be added that the proportion in the Eussian army is almost identical with the French, while the Italian figures are slightly higher than the Austrian. It is therefore unnecessary to give them : ???

Admissions per 1000 in European Armies.

following, which gives the average admissions per 1000 for the three years 1890-92 :???

Year.

German.

French.

Austrian.

British (Home).

British (India).

1876 .

28-8

57-0

65-8

146-5

203-5

1877

30-0

57-8

66-9

153-2

224-4

1878

36-0

59-7

75-4

175-5

291-6

1879

38-5

637

81-4

179-5

253-3

1880

34-9

65-8

75-7

245-9

249-0

1881

39-2

60-6

79 0

245-5

259-6

1882

41-0

62-0

73-7

246-0

265-5

1883

38 ‘2

58-9

73-3

260-0

271-3

1884

34 ‘5

52-1

73-5

270-7

293-5

1885

32-6

50-7

69 0

275-4

342-6

1886

29-7

49-6

65-8

267-1

385-8

1887

28-6

51-6

64-4

252-9

361-4

1888

26-3

46-7

65-4

224-5

372-2

1889

26-7

45-8

65-3

212-1

481-5

1890

26-7

43 ‘8

65-4

212-4

503-6

1891

27-2

43-7

63-7

197-4

400-7

1892

27-9

44-0

61-6

201-2

409-9

1893

42-8

64-5

194-6

466-0

1894

40-9

64-8

182-4

511-4

1895

173-8

522-3

German.

French.

Rus sian.

Aus- trian.

Italian.

U.S.A.

British (Home).

British (India).

Dutch (Indies).

27-2

43-6

43-0

63-5

71-3

77-4

203-6

438-0

45

The most striking thing in this table is the enormous difference between the Continental and the British figures. To make the comparison more complete, we will add the

It is clear at once that troops in the East stand upon an entirely different footing from those in the West, the- Dutch figures being even higher than the British; we may therefore put them aside for the

moment. Compar- ing the rest, we notice that not only are the British figures enormously higher than the Continental, but the latter also show very large discrepancies ; and since all the foreign troops are under the same protective system, we- may conclude that other factors must be taken into account. The disciphne maintained, the character of the soldiers themselves, and the procedure with regard to admission into hospital, no doubt all affect the returns. Further, a sort of epidemic rise and fall is to be noted. AH the returns given in the first table show a simultaneous'- rise for several years, beginning with 1876; and having reached a maximum, each shows a progressive fall, likevsdse lasting over several years. This points to another dis- turbing factor. It is convincingly shown by the figures- for the protected districts in the United Kingdom before, during, and after the period of protection. In 1864 ??? that, is, just before the first Contagious Diseases Act came into- operation ??? the proportional figure was 260 ; ten years later it had fallen to 126; but in 1883 it had risen again tO' 234, in spite of the protection. Then, protection being removed, it rose to 276, but afterwards feU again pro- gressively to 191 in 1895, without any protection. It is therefore evident that in interpreting the statistics allow- ance must be made for large fluctuations due to causes, quite independent of the protective system. The margin of difference, however, between the British and Con- tinental returns is so large that, when all allowances have- been made, it is impossible to doubt that a considerable degree of real protection is afforded to soldiers by th* system. This conclusion is confirmed by the comparatively high returns for the somewhat exotic army of the United States, and still more by the Indian statistics. They rose- gradually, it is true, during the cantonment system, but, when that was dropped disease increased with shocking rapidity. Between 1887 and 1895 the admissions for primary syphihs rose from 75-5 to 174-1 per 1000, and. those for secondary S3rphiHs from 29-4 to 84-9.

The broad conclusion is that under special conditions, and when rigidly enforced, registration and medical exam- ination do to a considerable extent fulfil the purpose of protecting health. Their failure to do so among the popu- lation at large and under the ordinary conditions of hfe is not surprising when we regard the amount of venereal disease

which still occurs even among soldiers protected by the most rigorous measures and under the most favourable- conditions.

A general view of the whole subject suggests no pleasant or hopeful conclusions. Prostitution appears to be- inseparable from human society in large communities. In different countries and ages it has in turn been patronized and prohibited, ignored and recognized, tolerated and con- demned, regulated and let alone, flaunted and concealed. Christianity, the greatest moral force in the history of mankind, has repeatedly and systematically attacked it vsdth a scourge in one hand and balm in the other ; but the effect has been trifling or transient. Nor have all the social and administrative resources of modern civilization, availed to exercise an effective control. The elementary

laws on which prostitution rests are stronger than the artificial codes imposed by moral teaching, conventional standards, or legislatures; and attempts at repression only lead to a change of form, not of substance. It survives all treatment; and though it may coexist with national vigour, its extravagant development is one of the signs of a rotten and decaying civilization. In Western communities the traffic is not carried on so openly as in the East, nor is it exploited for purposes of pubhc revenue, as among the ancients and in the Middle Ages ; a veil of reticence and secrecy, for the most part of a transparently flimsy character, is thrown over it ; but whatever is gained in public decency is counterbalanced by other attendant evils. Two, in particular, are fostered by the pohcing of prostitution. One is the system of blackmail levied by the executive. The scandal has been most notorious in the United States, but it exists everywhere, and is a con- stant source of profound corruption. The other is the growth of the most degraded class that ever disgraced the name of man ??? the creatures who live upon the earnings of individual prostitutes, with whom they cohabit. They are called souterieurs in France, louis in Germany, cadets in New York, and by various slang names in Great Britain. They are all criminals. They flourish chiefly on the Continent, where they

exist in large and ever-increasing numbers ; but they find their way everywhere, and are a dangerous menace to society. They are not altogether new. The Elizabethan drama is full of references to men who took toll of prostitutes in return fof protective services in the old days of persecution ; but they have been greatly fostered by the modern system, under which women find it necessary or convenient to have the cover of a man, who can pass for a husband and baffle the police. Thus the law is evaded on the one hand by the corruption of those who administer it, and on the other by the appear- ance of a class of criminal idlers more degraded than any other ??? both greater evils than the traffic which the law is intended, but fails, to control. There are no data for comparing the extent of profligacy at present existing in Western communities with that in other countries or in former times, but the unmentionable facts which come constantly to the knowledge of the police des ???moeurs, and less frequently to the ear of doctors and lawyers, leave no doubt that in intensity of vice the great centres of modern civilization have nothing whatever to learn from Corinth, imperial Eome, ancient Egypt, or modern China. The classical obscenities dug up and relegated to museums are far surpassed by the photographic abominations pre- pared to-day in Paris or in Amsterdam. The gross per- version and abuse of the sexual instinct imphed by these excesses may be a passing phase, but it is a phase which has always marked the decadence of great nations. It is undoubtedly accompanied by a general tendency towards increase of the volume of prostitution. Improvement in the conditions of hfe among the poor ought to tend in the opposite direction, by removing one of the most potent causes of the traffic, but it is more than counterbalanced by the rising standard of luxury and comfort which accompanies it, by the aggregation of the people more and more into great cities, and by their craving for amusement. The growth of prostitution has already left its marks on the marriage- and birth-rates of the most highly civilized Western communities.

In 1900 the Prussian Government made an attempt, with the co-opemtion of the medical corporations, to ascci-t;iin the amount of venereal disease prevalent in the kingdom. Circular questions were addressed to all members of the medical profession requestinw them to

report the number of patients sufferinf; from those dis” orders in their practice at the date of Ist April. Answers were sent in by 63 per cent., and the agKreijate number of patients was 40,902. From this datum it is calculated tliat the number of

persons attacked in the course of a year is at the very least 500,000 in Prussia alone (vide Rygienische Rundschau, April 1902).

AuTHOKiTiKs. ??? Amos. State Regulation of Vice. ??? Committee OF Fifteen (New York). The Social Evil. ??? ConfiSbence Inter- nationale (Brussels, 1899). Comptes Sendus. ??? FiAUX. La Pro- stitution en Belgique. ??? Gibbon. Decline and Fall of the Roman Eminre. ??? Henne-am-Rhyn. Die Gehrechen der Sitten-polizei. Parent-Duchatelbt. De la Prostitution dans la ville de Paris. ??? Reuss. La Prostitution. ??? Von Eaitmek. Geschichte der Hohenstaufen. ??? Sanger. History of Prostitution. ??? Sohlegei. Sistoire de la Prostitution en Chine. ??? Schbank. Die Prostitu- tion in Wien. ??? Sturmer. Die Prostitution in Pussland. ??? Tar- NowsKT. La Prostitution. ??? Zehnder. Die Gefahren der Prostitution. (a. Si.)

Protection. ??? Protectionism includes a system of commercial policy and a body of economic doctrine, which in their modern forms are the outgrowth of the commercial and industrial develojiment of the noUcy past century. The common definition of pro- tection as a policy is the attempt to develop a manufac- turing industry by a system of discriminating duties upon manufactured goods imported from foreign countries. But this is far too narrow a definition to suit the modem use of the term, though the notion of discriminating tariffs is common and, we may say, basal to aU definitions. Pro- tection as a policy includes not only discriminating tariffs, but also a large number of other features supplementary to this fundamental one and designed to emphasize its purpose. Thus a scheme of bounties and premiums, of rebates and drawbacks, is everywhere considered an essential element of the protective system. Nor is it any longer limited to the encouragement of manufactures, but includes as well the protection of agriculture, forestry, mining, fishing, shipping, &c. In short, one cannot give a

comprehensive and satisfactory definition of protection to-day without giving it a much wider scope than that of a system of protective duties upon manufacturing industry.

Many of its advocates claim, and with some show of reason, that the term protection, as now used to describe the commercial policy of a nation, should be so defined as to include all the means by which a country undertakes to secure through the positive efforts of the Government the complete industrial and commercial development of all its resources and of aU its parts. As its object is thus comprehensive, its justification is to be found in a series of arguments based upon political, economic, and social considerations. From this point of view the protective policy embraces not merely the system of discriminating import duties in favour of home products ??? industrial, agricultural, and mining, with which the policy began in the United States, for example ??? but also the system of bounties offered for the introduction and establishment of new industries; the policy of restricted immigration of the less desirable classes of labourers, combined with the positive inducements to the skilled labour of other countries to transfer itself to the one in question; the system of discriminating or prohibitive tonnage duties, known as Navigation Acts; the system of developing foreign mar- kets by an active policy directed towards securing advan- tages for home products in foreign countries. In a word, all those pecuniary or other sacrifices which a country may niake in order to develop its material resources and estab- lish, develop, and foster industry and commerce. In this wide sense the comprehensive policy adopted by the United States, for example, includes the making of a careful geological and botanical survey of the whole country in order to discover and open up the vast natural wealth of its domain in its mines, forests, and fields ; the establishment of experiment stations to test the usefulness of new crops or means of making old crops more valuable ; the stocking of its rivers with fish and the afforesting of its mountains ; the introduction of new or more valuable

breeds of live stock ; the building of railways and canals, and the offering of inducements to private parties to undertake similar enterprises ; the deepening of its rivers and harbours, &c. ; and, finally, the development, at public expense, of a scheme of technical and commercial education ??? lower and higher ??? adapted to discover and train all the talent in the community available for developing the industry and commerce of the country.

If such an account of the features of a protective policy is objected to on the ground that free trade countries hke Great Britain have also adopted some of them, it may be replied, that in so far as they have done so, they have adopted the principle of protection, namely, that Government shall adopt a positive policy looking towards the development, by Government aid if necessary, of new branches of commerce and industry and the firmer establishment of old branches. It may further be pointed out that the .countries which have adopted the protective policy most fully ??? the United States, France, Germany, and Eussia ??? have most consistently followed out the poUoy here indi- cated, and in all these countries it has been the so-called protectionist party which has identified itself most fuUy “with the comprehensive policy here suggested.

As a doctrine, protection is the set of principles by which this policy of Government aid to industry is justified, and these principles have been elaborated hand in hand with the development of the so-called protective policy, sometimes outrunning its actual application and advocating its further extension, more often lagging behind and seeking for means of explaining and defending what had already been done. The present development of the system and theory of protection is a result of the growing predominance of capitalism in modern society, combined with the tendency of modern politics towards the organization and development of great national :states, with the resulting desire to secure their industrial ,as well as their political

independence. It has been further favoured in certain ways by the fact that the financial needs of modern states require a resort to indirect taxation, thus making it easier for the capitalistic forces to exploit the tax system for their own benefit ; while the wars of the 19th century have favoured in many ways the tendency towards the adoption of special means, like high discriminating duties, to accomplish this end. Hand in hand with this has gone a steady tendency to see in the state a powerful means of promoting the development of trade and industry, and a growing disbelief in the more extreme forms of the free trade doctrine, such as the type inown as Manchesterism, the theory of the laissez faire, Jaissez passer school of economics and politics.

Protection, both as a doctrine and policy, can be best understood by examining the course of its development in those countries adopting it most consistently. Germany -and the United States offer the two most striking examples ???of great modern nations adopting a system of protection and developing under its influence. They may in a certain sense serve as types of the kind of state which in the 19th century has accepted and defended, in its politics at any rate, the so-called protective system. In both cases the high protective system was associated with the development of nationality, of industry, of capitalism, and of a financial system which favoured the growth of <:ertain elements of the protective policy.

The protective system in the United States began with the adoption of the Constitution in 1789, and found its first formal defence in the celebrated report of Alexander Hamilton on manufactures. The argument and the movement were largely academic. As there was no strong manufacturing interest in existence, so there was no organized capitalistic efibrt to secure

United States.

manipulation of the tariff duties in the interest of special industries. There was general agreement, however, that it would be desirable to develop a manufacturing industry in the colonies if it were practicable. A high degree of natural protection was already afforded by the cost of transportation. It was felt, therefore, that a small duty on manufactures

would probably serve the purpose, since the development of the manufactures would favour the pro- duction of raw material, which would therefore need no special encouragement. It was also felt that a small duty, continued for a few years, would result in the establishment of the industry on such a firm basis that all duties might be abohshed. The introduction of this form of protection, i.e., discriminating duties upon imported goods, was greatly assisted, if not originally caused, by the fact that the new Government needed money, which could most easily be obtained by customs duties. Thus all those parties which were opposed to direct taxes joined their efforts with those interested in securing protective duties, in order to commit the Government to the policy of basing its revenue system on a tariff on imports. To these considerations must be added the further one, that the country had just thrown off political dependence on Europe, and felt that it must now become industrially independent also, if it were to be a great nation. These influences, then, namely, firstly, the desire of the statesmen of the time to create a revenue system for the Federal Government which would make it absolutely independent of the states ; secondly, the wish to develop an industry which would serve the needs of the new country while it promoted its com- plete independence of the Old World, conspired to commit the Federal Government from the beginning to a policy of protection based upon a system of discriminating duties. At the same time a system of discriminating tonnage dues and prohibitory regulations relating to foreign shipping in the coasting trade was adopted to promote and foster the shipping interest.

Industry and commerce began to thrive as never before, largely because of the absolute free trade which the consti- tution had secured among the states of the Union. The long struggle between France and Great Britain, extending from 1806 to 1812, for the possession of the commerce and the trade of the world, combined with the retaliatory measures of the American Government itself, practically destroyed American commerce for a time, and finally led to the British- American war of 1812, which closed in 1815. The financial system of the Federal Government during this war was based on getting the largest possible returns from the customs, so that the duties were screwed up still higher. The ten years period of non-intercourse, while it had seriously

injured American commerce, had fostered the growth of American manufacturing ; and when the close of the war of 1812 brought with it an enormous influx of foreign goods, particularly from the plethoric warehouses and factories of England, it looked for a time as though the new American industries were destined to vanish as rapidly as they had grown up. And now for the first time appeared a strong, well-developed, capitalistic party, which was, in spite of some drawbacks, destined to grow until it became one of the most characteristic features of the politics of the republic.

The manufacturers of the country determined the tariff policy of the country, and with few reverses pursued a steadily advancing course of victory down to the close of the 19th century. They secured the maintenance of high duties at the close of the war of 1812, and managed to in- crease them steadily until the reaction of 1830-33, when they were forced to content themselves with a lower rate, which continued, with a slight interruption in 1842-46, until the outbreak of the Civil War in 1861. This was an

opportunity which they knew how to utilize to the greatest advantage. During the war, when the Government was forced to exploit every possible source of revenue, the pro- tectionist party knew how to turn the necessities of the Government to its advantage. The rate of duties was pressed ever higher ; and when the war closed, and the taxes could again be lowered, the protectionist managers knew how to lower or remit altogether the non-protective duties, and thus keep high, and even advance to a still higher point, the duties which protected them from foreign competition.

In the meantime the country was turning from agri- culture to manufactures at an unprecedented rate. The manufacturing party was becoming ever stronger and more aggressive. As it had also been the

national party, it profited by the enormous development of the nationalist sentiment during and after the war. It now became patriotic to favour the development of a national industry. It was treason to advocate free trade ??? that had been the policy of the slave-holders' party, and the Slave-Holders' Eebellion, as the Civil War was called, had drawn its strength largely from the free trade sentiment. The policy of the protectionist party had expanded with the growth of the country and the necessity of coming to terms with the antagonistic elements. Thus at first the platform of the protectionists had been one of reasonably low duties on manufactured commodities, low duties on half -manufactured, and no duties at all on raw material. But as the country advanced, and it was seen how the interests of manufacturing had been quickened by the policy of discrimination, those engaged in producing raw materials and half-manufactured commodities demanded that they too should be considered. As this concession had to be made by the manufacturers, they were compelled to justify it by other arguments than those used at first. The infant-industry argument gave place to the proposition, that as long as the prices of raw materials and labour were higher in America than abroad, it would be necessary to maintain countervailing duties at least equal to this differ- ence, in order to protect American industry. One branch after another of manufacturing or agriculture was included and given the benefit of protection. In order to have a satisfactory theoretical basis for such a policy, the theory was advanced that foreign trade was a necessary evil, to be diminished as much as possible. The ideas were ad- vanced and spread throughout the country : that the home market should be reserved for home products ; that the labourers should be protected against the influx of foreign cheap labour (Chinese Exclusion Acts ; restrictive immi- gration laws) ; that prices should be kept high, so as to enable employers to pay high wages ; that shipping should be encouraged by subsidies, the sugar industries by bounties ; that the nation should become ever more inde- pendent of foreign nations for all its industrial products, and capable of holding its own against the world in industry as well as in arms.

The protective party has been the national party during a time when the greatest question before the American people was whether it was to

be one nation, or two, or twenty, and it naturally profited by the inevitaljle victory of nationalism ; it has always stood for honest payment of national and state debts, if not in the standard according to which they were contracted, in a still bettor one, and it has profited naturally by this attitude in a country where the development of trade and industry was rapidly and steadily towards a cajjitalistic state of society in which such policy is favoured ; it has stood for a vigorous and active independence in the field of world politics, and it has naturally profited by this fact in a country which was rapidly forging ahead to take its place among the greatest

of existing nations, and with an ever-increasing seK-con- sciousness was ready to assert itself among the nations, of the world ; it has stood for free labour against slave labour, and consequently profited here again in a country whose greatest conflict turned upon the question whether the system of slave labour should be extended or not ; it has. stood for high wages for American labourers, and in words at any rate has advocated a policy directed to protecting them against competition with the "pauper labour" of the Old World. It has stood for Government activity in the direction of developing railways and canals ; of establishing education upon national lines, making it free, in all grades from the kindergarten to the university, to aU citizens of the republic, and it has profited by this association in a country where all influences were telling in favour of this tendency. In short, whatever one may think of the wisdom or folly of trying to develop national industry by a system of discriminating duties, the protective party as. such in the United States has been on the progressive side of so many of the deep questions of national importance that it has obtained and kept the allegiance of thousands of men who would have been glad to see a change, or in- deed a reversal, in the tariff policy of the party.

The history of the tariff policy in Germany has been very similar to that of the United States. Beginning with the establishment of absolute free trade among the various German states in the earlier customs union, it extended this policy, by the establish- ment of the ISTorth German Confederation and the new German Empire, to aU the states now included in the federation. The long-wished-for political union

meant political independence, and when political independence was once achieved, industrial and commercial independ- ence were . next desired. Within the empire itself it was necessary, if the new organization were to be strong and vigorous, that the central government should become inde- pendent of the individual states ; and this could be best effected by giving it a revenue system based upon import duties, which in the long run has enabled the central govern- ment to subsidize the state governments, and thus bring them still further under its influence. To develop this sys- tem the political support of some strong party was needed. This party was found in the protectionist elements, which have thus again become the national jjarty in a state which was being rapidly nationalized ; the industrial party in a society which was rapidly passing from the agricultural to the industrial condition ; the capitalistic party in a society which was rapidly becoming capitaUstic in all its tend- encies. It stood for industrial and commercial, as well as political, independence of other countries, and thus satis- fied the longing for national unity and independence of a people which had suffered for centuries from disunion and dependence.

These two examples may serve to explain how the two most powerful industrial nations next to Great Britain have become and remained highly protectionist in sentiment and in action for the last generation, and how they both opened the 20th century with a more openly declared and a more fully developed system of protection than ever before.

Protection as a theory or doctrine is to a certain extent an outgrowth or modification of the old doctrines of mercantilism. In its modern form, however, it moiem dates really from the celebrated TJeport on advocates l^Ianufactures made by Alexander Hamilton ►►”” when Secretary of the U.S. Treasury in the year “►►►“‘t’”^- 1791. The views there advanced have been further devel- oped by Friedrich List and Henry C. Carey, and have of late years been carried along somewliat different lines to their logical conclusions by Simon N. Patten and George-

Gunton. Starting from an argument in favour of tem- porary duties on manufactured goods imported from abroad until such, time as the infant industry might take firm root, the development proceeded through List, who favoured the maintenance of such duties until the country had passed into the manufacturing stage as a whole, and then through Carey to Patten and Gunton, who maintain that a protective policy, extended to cover agriculture, trade, and mining, should be preserved as the permanent policy of the country until the entire world is one nation, or all nations have reached the same level of political, economic, and social efficiency. The protective policy, which a century ago was to be, in the view of its advocates, temporary and partial, has become to-day, in the argu- ments of its apologists, permanent and comprehensive. We must content ourselves here with a brief statement of the arguments of the leading and most successful defenders of modern protectionism.

Alexander Hamilton, at that time Secretary of the Trea- sury, submitted his celebrated Keport on Manufactures to . the Congress of the United States on the 5th of December 1791. It is in a certain sense the first formulation of the modern doctrine of protection, and all later developments start from it as a basis. It is a positive argument directed to proving that the existence of manufacturing is necessary to the highest development of a nation, and that it may be wisely promoted by various means, of which the most important is a system of dis- criminating duties upon foreign imports. Among the objects to be attained by the development of a flourishing manufacturing industry are mentioned : ??? (1) Independence of foreign nations for military and other essential supplies. (2) A jjositive augmentation of the produce and revenue of society growing out of (a) division of labour, (b) exten- sive use of machinery, (c) additional employment to classes of the community not ordinarily engaged in busi- ness. (3) An increase in the immigration of skilled labourers from foreign countries. (4) A greater scope for the diversity of talents and dispositions which discriminate

men from each other. (5) A more ample and various field for enterprise. (6) In many cases a new, and in all a more certain and steady, demand for the surplus pro- duce of the soil. (7) A more lucrative and prosperous trade than if the country were solely agricultural.

Among the feasible means of promoting the development of such an industry he mentions the following : ??? (1) Protect- ive duties, or duties on foreign articles which are the rivals of the domestic ones, to be encouraged. (2) Prohibition of rival articles or duties equivalent to prohibition. (3) Prohibi- tion of the exportation of the materials of manufactures. (4) Pecuniary bounties. (5) Premiums. (6) Exemption of the materials of manufactures from duty. (7) Draw- backs of the duties which are imposed on the materials of manufactures. (8) The encouragement of new inventions and discoveries at home, and the introduction into the United States of such as may have been made in other countries ; particularly those which relate to machinery. (9) Judicious regulations for the inspection of manufac- tured commodities. (10) The facilitating of the pecuniary remittances from place to place.

The above suggestions contain the outline of a com- prehensive scheme for developing the manufacturing resources of the country, and the United States has sub- sequently adopted, in one form or another, almost all of these propositions. Hamilton considered that the duties, (fee, would not have to be very high nor very long con- tinued in order to accomplish their legitimate ends, after which they would become unnecessary, and would natur- ally be abolished. He conceded that, generally speaking, import duties were taxes on the consumer, and therefore

List.

burdens ??? but burdens which might well be temporarily borne for the sake of the ultimate advantage arising from cheaper goods and diversified industries. He emphasized also the advantage of a home market for agricultural pro- ducts, and seemed to think that the United States had to pay the cost of transportation both on the agricultural products it exported and the manufactured goods it im- ported. This

report remained the armoury from which the protectionists drew their weapons of offence and defence for two generations, and it has not yet ceased to be the centre around which the theoretical contest is waged even to-day in Germany and France as well as in the United States.

The next great theorist in this field was the German, Friedrich List, who, while an exile in the United States, became imbued with protectionist ideas, and after doing substantial service for them in the country of his adoption, returned to Germany to do battle for them there. He published his National System of Political Economy in Germany in the year 1841. It had great and immediate success, and has exercised a wide influence in Europe on theoretical discussion as well as on practical politics. List, like Hamilton, looked on protec- tion as a temporary system designed to facilitate the passage of a country from an agricultural to a manufactur- ing state. He accepted free trade as generally and per- manently true, but suited for actual adoption only in that cosmopolitan era towards which the world is progressing. But in order to prepare for this cosmopolitan jjeriod it is first necessary for each nation to develop its own resources in a complete and harmonious manner. A comprehensive group of national economies is the fundamental condition of a desirable world economy ; otherwise there would be a predominance of one or of a few nations, which would of itself constitute an imperfect civilization. Protection is a means of educating a nation, of advancing it from a lower to a higher state. He admits that it may involve a loss, but only in the sense that money expended for an educa- tion or an educational system is a loss, or that money spent for seed corn is a loss. To the cosmopolitan system of Adam Smith, List opposes the national system as a preliminary and necessary stage. He favours the imposi- tion of duties as the most eflacient means of effecting the protection which he has in mind. Agriculture wUl be sufficiently protected by the constant demand for its pro- ducts. The essence of his larger work is contained in a pamphlet published in Philadelphia in 1827, entitled Outlines of American Political Economy. It is, in fact, a series of letters advocating the further development of the protective system already adopted in the United States.

The third great name in the history of protection is that of Henry C. Carey, an American, in some ways the most distinguished and most influential of the followers of Hamilton and List. He was at first a strong free trader, then a protectionist who believed in protection as a preparation for free trade, and finally an p'^"*'"' unconpromising advocate of protection in all circumstances and for all nations. In him and in Simon N. Patten, the last, and in many respects the ablest, of the apologists for protection, we have the theoretical develop- ment corresponding to the practical outcome of protection as a comprehensive all-embracing scheme extending pro- tection to all branches of industry alike ??? agriculture, manufacturing, and mining ??? and aiming to be permanent in its form and policy. As Patten expresses it : "Protec- tion now changes from a temporary expedient to gaia specific ends (such as the establishment of manufactures), to a consistent endeavour to keep society dynamic and progressive. Protection has become part of a fixed**

national policy to increase the value of labour with the increase of productive power, and to aid in the spread of knowledge and skill, and in the adjustment of a people to its environment." The object of protection has now become, in the view of the theoretical American protec- tionist, not an approximation to European industrial con- ditions, but as great a differentiation from them as possible. Carey's works were translated into the leading European languages, and contributed doubtless to the spread of protectionist ideas, though the extreme form in which his views were expressed, and the rambling illogical method of exposition, repelled many who might otherwise have been attracted by the course of his thought.

Economists of other schools, with the exception of the British, have allowed a relative validity to the doctrines of List; and even among British economists, Mill and some of his disciples have conceded the logical possibility of quickening the development of an industry by import duties in such a way as to result in more good than harm,

though they have hardly been willing to acknowledge that it is practically possible. The historical school of political economists have generally admitted the reasonableness of protective poUcies at certain times and places, though usually finding the justification in political and social considerations rather than in economic.

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Protectorates. ††† "Protectorate," which was a few years ago rarely named in books on international law, is now a common term to describe the relation between two states, one of which exercises control,

great or small, direct or indirect, over the other. It is significant of the rare use of the term until recent times, that the word does not occur in Sir G. C. Lewis's book on T/ie Government of Dependencies. Yet the relation is very ancient. There have always been states which dominated their neighbours, but which did not think fit to annex them formally. It has always been politic for powerful states to facilitate and hide schemes of aggrandizement under euphemistic expressions ; to cloak subjection or dependence by de- scribing it in words inoffensive or strictly applicable to other relations. A common problem has been how to reduce a state to submission or subordination while ostensibly preserving its independence or existence ; to obtain power while escaping responsibility and the expenditure attend- ing the establishment of a regular administration. Engel- hardt {Les Protectorats Anciens et Modernes) and other writers on the subject have collected a large number

of instances in antiquity in which a true protectorate existed, even though the name was not nsed. Thus the Hegemony of Athens as it existed about 467 B.C. was a form of protectorate; though the subject states were termed allies, the so-called "allies" must in all important legal matters resort to Athens (Meyer, Geschichte der Alterthums, iii. s. 274).

In dealing with dependent nations Eome used terms which veiled subjection (Gairal, Les Protectorats Lnter- nationaux, 26). Thus the relationship of subject or dependent cities to the dominant Power was described as that of clientes to the patronus (Marquardt, Romische Staatsverwaltung, 2nd ed., i. 80). Such cities might also be described as civitates feeder atce or civitates liber ae. Another expression of the same fact was that certain communities had come under the power of the Eoman people ; in deditionem or in fidem p>opuli Bomani venire (Marquardt, Romische Staatsverwaltung, i. 73, 81). The kingdoms of Numidia, Macedonia, Syria, and Pergamum were examples of protected states, their rulers being termed inservientes. The Romans drew a distinction between foedera aequa and faedera iniqua. The latter created a form of protectorate. But the protected state remained free. This is explained in a passage of the Digest, 49. 15. 7 : " Liber

autem populus est is, qui nullius alterius populi potestati est subjectus, sive is fcederatus est ; item sive aequo f cedere in amicitiam venit, sive f oedere comprehensum est, ut is populus alterius popuh majestatem comiter conservaret. Hoc enim adjicitur, ut intelligatur alterum populum superiorem esse : non ut intelligatur alterum non esse liberum ” (Marquardt, Romische Staats- verwaltung, 2nd ed., i. p. 46, and the instances collected by Puffendorf, 8. c. 9. 4).

In mediaeval times this relation existed, and the term protection was in use. But the relation of subordination of one state to another was generally expressed in terms of feudal law. One state was deemed the vassal of another ; the ruler of one did homage to the ruler of another. In his book De la Ripuhlique Bodin treats of Ceux qui sont en protection (L c. 7), or, as the Latin text has it, de patrocinio et clientela. In Bodin’s view such states retain their sovereignty (1. c. 8). Discussing the question whether a prince who becomes a cliens of another loses his majestas, he concludes that, unlike the true vassal, the cliens is not deprived of sovereignty : ” Nihilominus in foederibus et pacis aotionibus, quae inter principes aut populos societate et amioitia conjunctissimos sancientur ; eam vim habet, ut nee alter alteri pareat, nee imperet : sed ut alter alterius majestatem observare, sine ulla majestatis minutione tenea tur. Itaque jus illud clientelare sen protectionis omnium maximum ac pulcherrimum inter principes censetur ” (1. c. 7). Elsewhere Bodin remarks, ” le mot de protection est special et n’emporte aucune subjection de celuy qui est en protection.” He distinguishes the relation of seigneur and vassal from that of protecteur and adherent. As to whether the protected state or prince is sovereign, he remarks, “je tiens qu’il demeure soverain, et n’est point’ subject.” He makes clear his conception of protection by adding, ” I’advou^ on adherant doit estre exempte de la puissance du protecteur s’il contrevient aux traictes de protection. Voila done la plus grande seuret^ de la protection, c’est* ompescher s’il est possible que les protecteurs ne soyent saisis dos fortresses,” &c. (p. 549, ed. 1580). Sometimes letters of protection were granted by a prince to a weak state ; thus Louis XIII. granted in 1641 such letters to the Prince of Monaco (Gairal, 81).

Reverting to the distinction in Roman law, Grotius and Puffendorf, in common with many other writers, treat protection as an instance of unequal treaties ; that is, ” when either the promises are unequal, or when either of

the parties is obliged to harder conditions ” {De Jure Belli et Pads, 1. c. 13. 21 ; Z)e Jwre Naturae, d>. c. 9).

The following are some definitions of ” protectorate ” : ??? ” Principis privilegium, quo ne alicui vis inferatur, cavetur, eumque in profectionem suscipit.” Ducange : ot”ro.’??”^ ” ^^ situation d’un etat a I’egard d’un autre moins “tectorate. puissant auquel il a promis son appui d’une maniere permanent ” (M. Gairal, 52) ; a definition applicable only to certain simple forms of this relation. ” Pour le proteg^, une condition de mi-souverainet6 sub- stitute a la pleine independence que comporte le regime de simple protection ” (p. 58). ” La situation respective de deux dtats de puissance in^gale, dont Fun contracte I’obligation permanente de defendre I’autre, et en outre de le diriger” (p. 62). “Unter einem Protektorat versteht man ein Schutzverhaltniss zwischen zwei Staaten des Inhalts, das der eine Staat, der Oberstaat oder schutz- herrliche Staat, zum dauernde Schutze des anderen Staates ??? des Sohutzstaates oder Understaates ??? verpflich- test ist ; wofiir ihm ‘ein mehr oder weitgehender Einfiuss auf die auswartigen Angelegenheiten desselben und theilweise auch dessen innere Verhaltnisse eingeraiimt ist ” (von Stengel, Bie deutschen Schutzgebiete, 11). ” The mark of a protected state or people, whether civilized or un- civilized, is that it cannot maintain political intercourse with foreign powers except through or by permission of the protecting state ” (Hall, Foreign Jurisdiction of the British Grown, 218). ” A British protectorate is a country which is not within British dominions, but as regards its foreign relations is under the exclusive control of the King, so that its Government cannot hold direct com- munication with

any other foreign Power, nor a foreign Power with that Government" (Jenkyns, British Rule and Jurisdiction beyond the Seas, 165).

The term is used very loosely. Often it designates a relation which it is deemed politic to leave indefinite : a state desires to obtain the reality of conquest without the responsibilities attaching thereto. It may mean no more than what it says, " One state agrees to protect or guarantee the safety of another." The term is also employed to describe any relation of a political superior to an inferior state. It is also used as the equivalent of suzerainty. As appears from the article Suzerainty, the terms are distinguishable. But both imply a desire to carry out changes without friction and not to break up ancient forms ; both proceed on the plan of securing the substance of power while allowing the weaker state a semblance of its old constitution.

Certain protectorates originate in treaties ; others have been imposed by force. Some are accompanied by occupa- tion, in which case it is difficult to distinguish them from annexation. Thus the treaty of May 1881, Article 21, between France and Tunis, provides for the occupation of strategical points by the army of the protecting state. The establishment of a protectorate may be akin to a guarantee. Generally, however, the former implies a closer relation than a guarantee ; and the two relations may be widely different, as may be seen by comparing treaties of guarantee vsdth the treaty establishing the protectorate of Tunis.

Strictly speaking, a protectorate cannot exist over a domain uninhabited or ruled by no organized state ; in such cases the elements of the true protectorates are wanting. But the distinction is not adhered to. The difficulty of defining the relations between the protected and protecting states is greater, because a protectorate may imply a condition of transition : a contractual or limited relation of state to state, more or less rapidly changing into true union.

It has been the policy of the British Government in

India to establish on the frontiers, as elsewhere, pro- tectorates. The political advantages of the system are pointed out in Sir A. Lyali's Rise

aiid Expan- sion of the British Dominion in India. It J'^'Waa is a system " whereby the great conquering or ^^^ ' commercial peoples masked, so to speak, their irresistible advance " ; it was much practised by the Romans in Africa and Asia \ it has been chiefly applied in modern times in India (p. 326). The Indian states are some- times described as "Feudatory States," sometimes " Independent and Protected States " (Twiss), sometimes " Mediatized States " (Chesney), sometimes " Half- Sovereign," sometimes as in a position of "subordinate alliance" (Lord Salisbury, Parliamentary Papers, 1897 [c. 8700], p. 27). The Interpretation Act, 1889 (52 and 53 Vict. c. 63, c. 18), refers to the Indian native princes as under the " suzerainty " of the British Crown. These states are really sui generis, and their precise position can be understood only by a private examination of the treaties affecting them. The following are the chief points as to which Indian states are subject to English law : ??? (1) the Governor-General is empowered to make laws for servants of the British Government and European and native Indian subjects of his Majesty ; (2) British laws are in force in certain parts of the native states, e.g., in cantonments ; (3) native princes have adopted certain British laws, e.g., the Indian Penal Code ; (4) they have no external relations with foreign states ; (5) the king is the donor of honours ; (6) Acts of Parliament affect them indirectly by directly affecting the British agent; (7) they receive advice, which may be akin to commands. (See also Ilbert's Government of India, 142.)

Among the chief British protectorates are : the African group, consisting of British Central Africa, East Africa, Uganda and Zanzibar, Basutoland, and British Bechuanaland ; the Indian group, consisting of Existing the protected chiefs near Aden, and the island of ^^g^" '"" Socotra and Somali ; the Malay group, consisting of the Malay States in the Borneo peninsula and in Borneo, the protectorates of North Borneo, Brunei, and Sarawak; the Pacific group, consisting of a few islands, includnig Harvey Islands protectorate and Gilbert Islands. France possesses several protectorates, of which the chief are Tunis, Annam, and Tongking. Her policy appears to be to transform them into French territory. Such change has taken place as to Tahiti and Madagascar, and such in effect is the position of the Indo-China

protectorates. The chief German protectorates are South-West Africa, Togoland and Cameroon, German East Africa, Kaiser Wilhelm Island, and Kiaochow.

There are two principal divisions of protectorates; the first being those exercised generally by treaty over civilized countries. Of the first, the chief are : (a) that of Cracow, which was recognized by the Treaty of Vienna as a free and independent state, and placed under the protection of Eussia. It was incorporated with Austria in 1846. (Calvo, 1. 2. s. 42.) (b) Andorra, protected by Spain and France as successor of the Counts de Foix (Freeman's Historical Geography, 1.343, 537). (c) The Ionian Islands, placed under the protection of Great Britain by the Treaty of Paris of 1815. (d) Montenegro, as regulated by the Treaty of Berlin of 1878. (2) The second class of protectorates consists of those exercised by one civilized State over an uncivilized people, sometimes called a " Colonial Protectorate " or "pseudo-protectorate," and usually the preparatory step to annexation. Such protectorates have become common, especially in Africa, since 1878. The second class may be subdivided into two groups : (a) protectorates exercised over countries with organized governments and under recognized sovereigns,

such as the Malay States ; and (b) those exercised over countries possessing no stable or definite governments and rulers. The territories of chartered companies, when not within the dominion of the protecting state, may also for some purposes be regarded as protectorates.

Attempts have been made to define the reciprocal rights and duties of protecting and protected states. Sometimes

the treaty creating the relation defines the obliga- dutiesot ^ioiis- Thus in the treaty with respect to Sarawak protecting the latter is described

as an ” independent state and pro- under the protection of Great Britain.” “Such tected protection shall confer no right on his Majesty’s

Government to interfere with the internal ad- ministration of that state further than is herein pro- vided.” The British consular officers are to receive exequaturs in the name of the Government of Sarawak. Foreign relations are to be conducted by that Government, and the raja cannot cede or alienate any part of the terri- tory without the consent of the British Government (Herts- let, 18. 227). In the treaty creating a protectorate over the territories of the king and chief of Opopo (Hertslet, 17. 130) the sovereign undertakes to extend to them, and to the territory under their authority and jurisdiction, his favour and protection. They promise not to enter into ” any correspondence, agreement, or treaty with any foreign nation or Power, except with the knowledge and sanction of his Majesty’s Government.” Some treaties establishing protectorates provide for direct interference with internal affairs; for example, the treaty of 1847 creating a French protectorate over Tahiti, and that of 1883 as to Tunis. Sometimes the Oberstaat ??? to use a convenient expression ??? is content to insist upon the presence of a resident, who guides the policy of the native ruler. In the case of protectorates over uncivilized countries it is usual to stipulate against ahenation of territory without consent of the Oberstaat.

The position of protectorates according to municipal and international law is still undetermined, and there p , , _ are an old view and also a new view of ates and ”^^i’” nature. The relation may be one of Inter- international law,, two states having entered into national obligations by treaty. Or the relation may

be one of public law; one of two states has become subordinate to, and incorporated with, the other. No doubt the general rule is that the protected state does not cease to be a sovereign state, if such was its previous status. Its head is still entitled to all the im- munities and dignity of a sovereign ruler. Further, the establishment of a protectorate does not necessarily rescind treaties made between the protected state and other states, at all events when the protectorate is

not in reality conquest or cession, or when any modification would be to the injury of third parties {Parliamentary Papers, Madagascar, 1897 [c. 8700]; Trione, 187). Nor does the new relation make any change as to the nationality of the subjects of the two states, though by the legislation of some countries facilities are afforded to the subjects of the Unterstaat to transfer their allegiance. Nor, speaking generally, does the territory of the pro- tected state become part of the territory of the Oberstaat ; in this respect it is unKke a colony, which may be regarded as an extension or outlying province of the country. At the same time, the question whether a particular pro- tectorate forms part of the ” dominion ” or ” territory ” of the Crown for any purposes or within the meaning of any statute cannot be regarded as wholly free from doubt. In charging the jury in JRer/. v. Jameson, Lord Chief Justice Russell of Killowen directed the jury, with reference to the question whether Pitsani-Pitlogo, situated in the Bechuana Protectorate, formed part of the territory of the

Crown, that the circumstance that the latter was described as a “protectorate” was not conclusive that it was not “territory” of the Crown within the meaning of the Foreign Enlistment Act (12 Titnes L.R. 594), and put to the jury the question whether the Queen in fact exercised dominion and sovereignty at Pitsani-Pitlogo ;??? a ruling which has not been generally approved, and which is incon- sistent with the practice as to determining such questions. Several writers propose this distinction ??? the protected country is to be considered a part of the territory as to matters to which sovereignty extends, and as to other matters not. In one view, for the purpose of municipal law, the territory of a protectorate is not, but for the pur- poses of international law is, within the territory of the protecting state. In another view, such territory is foreign only in the sense that it is not within the purview of the majority of statutes (see Hall’s International Law, 131, 135, Heilborn, 535; Tupper’s Indian Protectorates, 336; Laband, 2. s. 70). The older view of the position of a protectorate according to international law is contained in the decision of Dr Lushington in the case of “the Leucade” (8 S.T., N.S. 432), to the effect that, the declaration of war by Great Britain against Russia not- withstanding, the Ionian islands, which were then under the protectorate of Great

Britain, remained neutral. The king of Great Britain', had the right of declaring peace and war. " Such a right is inseparable from protection." But the Ionian states did not become necessarily enemies of the state with which Great Britain was at war. According to one view, the protected state is implicated ' in the wars to which the protecting state is a party only when thff latter has acquired a right of military occupation over the territory of the former. "Cette solution a t reconnue par la France en 1870, k propos de la guerre contre I'Allemagne pour les iles Taiti alors soumises a notre protectorat ; elle s'imposerait pour la Tunisie, I'Annam et Tonkin, et pour le Cambodge, ou les trait^s nous conf erent le droit d'occupation militaire " (jM. Despagnet). In the event of hostilities between the protecting and protected states, such hostilities would be regarded not as of the nature of an insurrection, but as a regular war (Trione, 149). By the General Act of the Berlin Conference it was agreed that the acquisition of a protectorate should be notified to the signatories to the agreement (Article 34), and it has been the practice to give such notice. It was proposed by some of the Powers represented at the Conference that effective occupation should be a condition to the creation of a protectorate on the coast of Africa. But this was opposed by England, and was not adopted (Laband, ii. 680).

Many writers adhere to the doctrine that there is no impairment of sovereignty of the weaker state by the establishment of a protectorate. They also allege that it is res inter alios acta. But the trend of recent policy and purport of much recent legislation are against this view. On the whole, the distinct tendency in recent times, especially as to protectorates over uncivilized countries, is to treat the territory of a protectorate as if it belonged to the protecting state. If France, for example, permitted in Tunis or other protectorates operations which were of an unfriendly character to any Power, say Italy or Germany, the injured Power would no doubt look to France for redress. This view would probably be strongly pressed in the case of protectorates over countries having no well-defined or stable government. The probability IS that in such cases governments and courts applying

international law would be guided not by technical facts

such, to take the case of British possessions, as the fact that an Order in Council permitted appeals to the Judicial Committee ??? but would look to the facts of the case.

PROTESTANT EPISCOPAL CHURCH

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The tendency is for protecting states to assert jurisdiction over foreigners within the territories of the protected states (Westlake, 187; Ilbert, 43-4). Mr Hall remarks {International Law, p. 131 n.) that "all the states repre- sented at the Berlin Conference of 1884-85, with the exception of Great Britain, maintained that the normal jurisdiction of a protectorate includes the right of adminis- tering justice over the subjects of other civUized states." The General Act contemplated measures which are scarcely compatible with the exemption of European traders and adventurers from the local civilized jurisdiction. He points out that Great Britain ??? which until lately took the view that a protected state possesses only delegated powers, and that an Eastern state cannot grant jurisdic- tion over persons who are neither its own subjects nor subjects of the country to which the powers are delegated ??? had by the Pacific Order in Council of 1893 and the South African Orders in Council of 1891-94 asserted jurisdiction over natives and foreign subjects. It may be added that "the Orders show a gradual increase of the assumption of internal sovereignty" (Jenkyns, 193).

The fact is that in the case of protectorates over un- civilized or semi-civilized countries a development, more or less rapid, is inevitable : control quickly hardens into conquest, and international law more and more takes note of this fact. The probability is that, in deciding the questions here mooted, regard will be had mainly to the facts of the particular case, and to attribute responsibility to the state which possesses the power of control.

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und Vdlkerrechtlichestellung der Deutschen Colonien, 1886. ††† Heimbukgeb. Der Erwerb der Oebietshoheit, 1888. ††† D'Orgeval. Les Frotectorats AUemands, Annates de I'Ecole des Sciences Politiques, 1890. ††† ~~Wilhelm. Thdorie Juridique des Frotectorats, 1890. ††† Despagnbt. Essai sur les Frotectorats, 1896. ††† Heilbokn. Das Volkerrechtliche Frotectorat, 1891. ††† Hall. The Foreign Juris~~ diction of the British Crown, 1894. ††† Lee "Wabnee. Protected Princes of India, 1894. ††† Stengel. Die deutschen Schutzgebiete, 1895. ††† Gaibal. Zes Frotectorats Intemationaux. ††† I:fiZE. Avde Thiorique, &e., sur V Occupation, &c., 1896.^ ††† Tbione. Gli Stati Givili Nei Loro Bapporti Gfiuridici coi Popoli Barbari e Semi- barbari, 1889. ††† Ilbebt. The Government of India, 1898. ††† Jenkyns. British Rule and Jurisdiction beyond the Seas, 1902. ††† Laeand. Das Staatsrecht des deutschen Peiches (1876-82) ††† Revue de Droit International, Oivilis& et Barbares, xvii. p. 1, xviii. 188. ††† Stengel. Die Pechtsverhdltnisse der deutschen Schutzgebiete, 1901.

(j. Mf.)

Protestant Episcopal Church.††† This is

the official title of the religious body which represents in the United States the Anglican Communion (q.v.). The numer- ical strength of this Church has never borne any due pro- portion to its historic claims. It never has been the official Church of the American people, though of late it has made great strides both in numbers and in the respect and con- fidence of all sorts and conditions of men. Even in colonial days it numbered among its adherents only a very small minority of the population, while for many years after the American Revolution even its friends hardly dared to hope that it could survive the shock it had received. From the first settlement a large part of the population of the thirteen colonies had been either indifferent to, or openly hostile to, the Anglican Church. The Dutch in New York, the Swedes in Delaware, the Scots and Irish in ISTew Jersey, the Germans in Pennsylvania, and the Huguenots in New York and the Carolinas, felt little interest in what was to them the national Church of a foreign people ; while the

Quakers in Pennsylvania and the Puritans in New England both feared and hated it. Even in Virginia, where the Church of England was recognized by law as the established Church, and where for a while it had full sway, there soon sprang up an active and rapidly growing minority bitterly opposed to it. The troublous times in England during

and after the Puritan Commonwealth drove large numbers of religious dissenters to the shores of Virginia, and they were soon reinforced by men like minded from the other colonies. In Pennsylvania provision had been made by charter that ” on the petition of twenty persons a preacher might be sent out by the Bishop of London”; but the attempt to do this in 1694 aroused a violent opposition, and it was some time before the Quakers raid aside their distrust. In New York the regular services of the Church of England were unknown until after the capture of the colony by the British, and for some years they were confined to the little chapel within the fort, where the English chaplain and the Dutch dominie took turns in officiating. It was 1697 before Trinity Church, the first Episcojpal parish in New York, was organized. The first rector was William Vesey, a communicant of King’s Chapel, Boston, and a recent graduate of Harvard College. He crossed the sea to obtain orders after his election, and was ordained by the Bishop of London in 1697. He continued as rector until his death in 1746. At the beginning of the Eevolu- tion, besides Trinity Church, with its two stately chapels, St Paul’s and St George’s, the Church had gained a strong foothold in Westchester county and on Long Island, and had established a line of churches up the Hudson as far as Albany and Schenectady. In New England the Church met with the most bitter resistance. King’s Chapel, Boston, was the first Episcopal church in New England, and was erected in 1688 through the influence of Sir Edmund Andros and by the exercise of- his authority as royal governor; but the building was closed for a time almost immediately, and the first rector driven from the country, on the news of the accession of Wilham and Mary. In Connecticut, as in Massachusetts, ” the Standing Order,” i.e., Congregationalism, was the established religion, and every citizen was compelled to pay taxes for its support. In 1707 the first Episcopal church was begun at Stratford. This was followed in 1722 by an event which, Quincy in his history of Harvard

College says, “shook Congrega- tionalism throughout New England like an earthquake, and filled all its friends with terror and apprehension.” This was the public announcement that Cutler, “the rector,” or president, of Yale College, with the two tutors. Brown and Johnson, had decided to take orders in the English Church. Dr Cutler became the first rector of Christ Church, Boston, and Dr Johnson, after many years of faithful labour in Stratford, became the first president of King’s (afterwards Columbia) College, New York. The greatest obstacle, however, to the healthy growth of the Church was the fact that for the first 200 years it was left without a bishop, and dependent for aU episcopal service on the bishop of London. No such makeshift as the sending out of commissaries to investigate and enforce discipline could make amends for this vital defect. The American Church owes much to Dr Bray, and stOl more to the Society for the Propagation of the Gospel, which for nearly a century gave liberally men and money for the work ; but had missionary bishops been sent out to enforce discipline, to give wise direction, and, above all, to raise up and commission a native ministry, history would have had a very different story to record. As it was, at the beginning of the American Revolution there are said to have been in the colonies only about 300 churches and 250 clergy of the Church of England.

The Revolution was a terrible blow to this little body of faithful men. Naturally many among them, especially in New York and New England, were opposed to the popular movement ; and after the war was over, the bitter prejudices against everything English were arrayed against the Church, which had been known as the English Church. Keen observers like John Adams in Massachusetts and

Chief Justice Marshall in Virginia did not hesitate to describe it as “an exotic” and “too far gone ever to be revived.” The first quickening of its life began in Con- necticut, where at a meeting of the clergy, held at Wood- bury on the feast of the Annunciation 1783, Samuel Seabury was elected first bishop of Connecticut. After trying in vain to obtain

orders in England, he was con- secrated at AbA-deen, in Scotland, on 14th November 1784. Meanwhile, in the preceding October, a meeting had been held in New York, at which representatives from seven states were present. Among them were the courtly Parker of Massachusetts, the stately Provoost and the gentle INIoore from New York, the scholarly Smith from Mary- land, and the saintly White from Pennsylvania. The first General Convention was held in Philadelphia in 1785. On 4th February 1787, at Lambeth, William White was consecrated first bishop of Pennsylvania and Samuel Provoost first bishop of New York, by the archbishops of Canterbury and York; and in 1790 James Madison was consecrated in the same place as first bishop of Virginia. The "succession" having been thus secured, two years later Thomas John Claggett was consecrated first bishop of Maryland by bishops Provoost, Seabury, White, and Madison. Through him ??? in whom the Scottish and Eng- lish lines are thus united ??? every American bishop to-day can trace his succession.

For nearly a generation after the Eevolu'tion the Church dragged on a feeble and a starveling life. Then came a new race of bishops. The Church ceased to apologize for her existence, and began to assert openly her claims as a true branch of the Cathohc Church. Hobart, bishop of New York, 1811-30, was the pioneer in this movement, and to him more than to any other man were due the hopefulness and the vigour of the new life. In 1835 the General Convention declared that the Church was the missionary society, elected Kemper as the first missionary bishop to the North- West, and sent out the first missionaries to foreign lands. To-day the Church, notwithstanding her marvellous growth since 1850, holds a position and an influence immeasurably greater than her ??? numerical strength. This is due largely to the fact that she stands for these five things : historic continuity, litur- gical worship, equal rights for clergy and laity, absolute separation of Church and State, and the carrying of religion into the daily life of the people. The hturgy is substantially that of the Church of England, with additions from the liturgy of the Church of Scotland, or changes suggested by the test of experience. From 1880 to 1892 a work of liturgical revision was carried on by the General Convention with two objects in view, "liturgical enrich- ment and

increased flexibility of use." The American Church, both in its diocesan and in its general conventions, has recognized fully the right of both clergy and laity not only to legislate about temporal matters, but also to settle questions touching the faith and worship of the Church. Her early experience in colonial days helped the Church to realize the advantage of a separation from the State ; yet it was long before the older traditions were laid aside. It was not until 1838 that permission was given to divide a state so as to provide for an additional diocese ??? and it was not until 1898 that the General Convention abandoned civil lines in arranging and distributing its missionary jurisdictions. It had already refused to accept Government aid for its work among the Indians. Since 1850 the growth of this Church has been especially marked in the older states and the larger cities ; but throughout the whole country she has more than kept pace with the increase in the population, so that while in 1850 she had one communicant in every 300 of the population, she had in 1900, roughly speaking, one in every 100.

Population.

Communicants,

1850 .

23,347,884

79,987

1860 .

31,442,960

146,600

1870 .

38,555,983

220,000

1880 .

50,152,866

344,789

1890 .

62,480,540

509,149

1900 .

76,295,220

700,458

This numerical increase represents very inadequately the real change in her position. The years since 1880 have been marked also by great changes vdthin the Church, in her methods of work, and in the multiplication and enrichment of her services; but the greatest of all has been the dying out of the old party spirit, the broadening and deepening of every school of thought, and the coming together of men of many minds to work for great common ends. Side by side with this, and partly as a result of it, has been the upbuilding of the great city parish. Instead of an unwise multiplication of new parishes, there has been seen a judicious strengthening of the old. Nowhere has this been more marked than in New York City. In 1875 there were only five parishes in the old city of New York claiming each over 600 communicants; now there are nearly a score, reporting each over 1000 communicants, while old Trinity has over 7000, and St George's nearly 5000. The organization of the Church covers now every state and territory within the United States, while her missionary work extends to Africa, China, and Japan, and she is lending a helping hand in Porto Rico, Cuba, the Philippines, Mexico, and Brazil. In every organized

diocese there is an annual convention or council, presided over by the bishop and composed of the clergy and lay delegates from the various parishes, and having power to legislate on all local matters. Once in three years the General Convention meets as the supreme legis- lative body. This is composed of two houses, the House of Bishops, in which each bishop has a seat, and the House of Clerical and Lay Deputies, in which each diocese is represented by four clerical and four lay deputies.

The following table wiU give some idea of the present condition of the Church and its growth since 1880 : ??? ???

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11,188,697

1900

80

84

4878

6519

69,998

43,UM

700,4SS

13,878,380

(h. c. p.)

Protoplasm. ??? The importance of protoplasm, as the physical and material basis of life, has caused it to be the subject in recent years of much minute and laborious research. Mysterious indeed are the powers and activities manifested by the minute speck of matter which circulates within a plant-cell or creeps freely about as an Amoeba, or the " microcosmic subtlety " wherebj' the tiny sper- matozoon transmits to the next generation the qualities and peculiarities which go to make up a human personality. It seems obvious that matter so peculiarly endowed must possess a complexity of structure and organization far exceeding that which at first sight meets the eye. Some biologists have attacked the problem of the ultimate con- stitution of protoplasm from a purely theoretical standpoint, and have framed hypotheses of an ultramicroscopic consti- tution sufficient, in their opinion, to explain, or at least to throw light upon, the vital activities of the living sub- stance. Others, proceeding by more empirical methods,

lave attempted to lay bare the structure of protoplasm by means of the refinements of modern microscopical tech- nique, or to solve the question

of its constitution by means of chemical and physiological investigation. Hence a con- venient distinction, not always easy, however, to maintain in practice, is drawn between speculative and empirical theories of protoplasm.

(1) Speculative theories have come with the greatest frequency from those who have attempted to find a material explanation for the phenomena of heredity {q.v.). As instances may be mentioned more particularly the " gemmules " of Darwin, the " pangenes " of de Vries, the " plastidules " of Haeckel, and the "biophores" of Weismann. These theories have been ably brought to- gether and discussed by Delage, who has included them all under the term " mioromerism," since they agree in the assumption that the living substance contains, or consists of, a vast number of excessively minute particles ??? i.e., aggregates or combinations of molecules, which give to the protoplasm its specific properties and tendencies (" idio- plasm " of Nageli). In other cases the assumption of invisible protoplasmic units has been inspired by a desire either to explain the general vital and assimilative powers of protoplasm, as, for example, the "micellse" of Nageli and the " plasomes " of Wiesner, or to elucidate the mechanism of some one function, such as the " inotagmas " of Engelmann, assumed to be the agents of contractility. In general, it may be said of all these speculations, either that they can only be extended to all vital phenomena by the help of so many subordinate hypotheses and assump- tions that they become unworkable and unintelligible, or that they only carry the difficulties a step farther back, and really explain nothing. Thus it is postulated for Wiesner's hypothetical plasomes that they possess the power of assimilation, growth, and reproduction by division ; in other words, that they are endowed with just those properties which constitute the unexplained mystery of living matter.

(2) Empirical theories of protoplasm differ according as their authors seek to find one universal type of structure or constitution common to all conditions or differentiations of the hving substance, or, on the contrary, are of opinion that it may vary fundamentally in different places or at different times. From these two points of view protoplasm may be regarded either as monomorphic or polymorphic (Fischer). The microscopical investigation of protoplasm reveals at the first glance a

viscid, slimy, or mucilaginous substance, in which is embedded an immense number of granules, for the most part very tiny. Very rarely are these granules absent, and then only from a portion of the protoplasm, and only temporarily. Hence many authorities have regarded the minute granules ◆◆◆ the " microsomes " of Hanstein ◆◆◆ as themselves the ultimate living units of pro- toplasm, in opposition to those who would regard them merely as "metaplastic" substances, i.e., as the hetero- geneous by-products of metabolism and vital activity. The granular theory, as this conception of the living substance is called, has received its extreme elaboration at the hands of Altmann, whose standpoint may be taken as typical of this class of theories. After demonstrating the universal occurrence of granules in protoplasm, Altmann has com- pared each individual granule to a free-living bacterium, and thus regards a cell as a colony of minute organisms, namely, the granules or biohlasts, as he has termed them, living embedded in a common matrix, like a zooglcea colony of bacteria. Of this theory it may be remarked, firstly, that it brings us no nearer to an explanation of vital phenomena than do the plasomes of Wiesner; secondly, that to consider bacteria as equivalent, not to cells, but to cell granules, is to assume for this class of organisms a position with regard to the cell theory which is, to say

the least, doubtful; and, thirdly, that the observations of the vast majority of competent microscopists furnish abundant support for the statement that granules of proto- plasm do not lie free in a structureless matrix, but are embedded in the substance of a minute and delicate frame- work or vnorphoplasm, which in its turn is bathed by a watery fluid or enchylema permeating the whole substance. The upholders of the granular theory deny the existence of the framework, or explain it as due to an arrangement of the granules, or as an optical effect produced by the matrix between the granules. Amongst those, on the other hand, who assert the existence of a framework dis- tinct from granules and enchylema, the utmost diversity of opinion prevails with regard to the true structural relations of these three parts and the r61e played by each in the exercise of vital functions. Some have regarded the framework as made up of a tangle of separate fibrillse {filar theory) ◆◆◆ a view more especially connected with the name of Flemming ◆◆◆ but most are agreed that it represents the appearance of a reticulum or network with

excessively fine meshes, usually from ^ to 1 /i in diameter. The reticulum carries the granules at its nodal points, and is bathed everywhere by the enchylema. Even with so much in common, however, opinions are still greatly at variance. In the first place, the majority of observers interpret the reticulum as the expression of an actual spongy framework, a network of minute fibrillse ramifying in all planes. While, however, Heitzmann, following the speculations of Briicke, considered the framework itself to be actively contractile, and the seat of all protoplasmic movement, an opposite point of view is represented by the writings of Leydig, Schafer, and others, who regard the reticulum merely as a kind of supporting framework or spongioplasm, in which is lodged the enchylema or hyaloplasm, considered to be itself the primary motile and living substance. Biitschli, on the other hand, has pointed out the grave difficulties that attend the interpretation of the reticulum as a fibrillar framework, in view of the distinctly fluid consistence of, at any rate, most samples of protoplasm. For if the substance of the framework be assumed to be of a firm, solid nature, then the protoplasm as a whole could not behave as a fluid, any more than could a sponge soaked in water. On the other hand, the hypothesis of a fluid fibrillar framework leads to a physical impossibility, since one liquid cannot be permanently suspended in another in the form of a network. Biitschli therefore interprets the universally present reticulum as a meshwork of minute lamellae, forming a honeycombed or alveolar structure, similar to the arrangement of fluid lamellae in a fine foam or lather, in which the interstices are fiUed not with air but with another fluid ; in other words, the struc- ture of protoplasm is that of an exceedingly fine emulsion of two liquids not miscible with one another.

It may be claimed for the alveolar theory of Biitschli that it throws light upon many known facts relating to protoplasm. It interprets the reticulum as the optical section of a minute foam-like structure, and permits the formation of protoplasmic striations and of apparent fibrillse as the result of linear or radiating dispositions of the alveolar framework ; it reconciles with the laws of physics the combination of a framework with a fluid or semifluid aggregate condition, while variations in the fluidity of the framework are compatible with a stiffening of the protoplasm almost to the pitch of rigidity, as seen, for example, in nervous tissue ; and, finally,

it explains many characteristic structural peculiarities of protoplasm, such as the superficial layer of radiately arranged alveoli, the spher- ical form of vacuoles, the continuous wall or pellicle which limits both the vacuoles and the protoplasm as a whole, and many other points not intelligible on the theory of a sponge-like structure. Biitschli has succeeded, moreover, in producing artificial foams of minute structure, which not only mimic the appearance of proto- plasm, but can be made to exhibit streaming and amoeboid move- ments very similar to those of simple protoplasmic organisms. Incidentally these experiments have shown that many of the

apparent granulations and "microsomes" are an optical effect pro- duced by the nodes of the minute framework. In his most recent works Btitschli has extended his theory of alveolar structure to many other substances, and has tried to prove that it is a universal characteristic of colloid bodies, a view strongly combated, however, by Fischer. While it cannot be claimed that Biitschli's theory furnishes in any way a complete explanation of life, leaving un- touched, as it does, the fundamental question of assimilation and metabolism, he at least draws attention to a very important class of facts, which, if demonstrated to be of universal occurrence, must be reckoned with in future treatment of the protoplasm question, and would form an indispensable preliminary to all speculations upon the mechanism of the living substance.

In opposition to the above-mentioned monomorphic theories of protoplasm, all of which agree in assuming the existence of some fundamental type of structure in all living substance, attempts have been made at various times to show that the structural appearances seen in protoplasm are in reality artiiicial products, due to precipitation or coagulation caused by reagents used in the study or preparation of living objects. These views have been developed by Fischer, who by experimenting upon various proteids with histological fixatives, has

shovim that it is possible to produce in them a granular, reticular, or alve- olar structure, according to treatment, and, further, that granules so produced may be differentially stained according to their size and absorptive powers. Fischer therefore suggests that many structural appearances seen in proto- plasm may be purely artificial, but does not extend this view to all such structures, which would indeed be im- possible, in view of the frequency with which reticular or alveolar structures have been observed during life. He suggests, however, that such structures may be temporary results of vital precipitation of proteids within the organism, and that protoplasm may have at different times a granular, reticular, or alveolar structure, or may be homogeneous. Fischer's conception of living protoplasm is therefore that of a polymorphic substance, and a similar view is held at the present time by Flemming, Wilson, and others. Strassburger also regards protoplasm aa composed of two portions : a motile kinoplasTn which is fibrillar, and a nutritive trophoplasm which is alveolar, in structure.

The chemical investigation of protoplasm labours at the outset under the disadvantage that it cannot deal with the living substance as a whole, since no analysis can be performed upon it without destroying the life. Protoplasm consists, to the extent of about 60 per cent, of its total mass, of a mixture of various nucleo-proteids ??? that is to say, of those substances which, in molecular structure and chemical composition, are the most complex bodies known. In association with them are always found varying amounts of fats, carbohydrates, and other bodies, and such com- pounds are always present in the living substance to a greater or less degree as products of both upward and downward metabolism. Protoplasm also contains a large but variable percentage of water, the amount of which present in any given case affects largely its fluid or viscid aggregate condition. Especial interest attaches to the remarkable class of bodies known as ferments or enzymes, which when prepared and isolated from the living body are capable of effecting in other substances chemical changes of a kind regarded as specifically vital. It is from their study, and from that of the complex proteids found in the living body, that the greatest advances towards an explanation of the properties of living matter may be expected at the present time. (See article Physio- logy; also Buohner, "Alcoholic Fermentation without Yeast Cells," Ber. d. deutsch.

c/iem. Ges. vol. xxx., xxxi., and xxxii. ; Verworn, General Physiology, London, 1891, p. 304 ; Keynolds Green, The Sol-uble Ferments and Fermentation, Cambridge, 1899.)

The question may be raised how far it is probable that there is

one universal living substance, which could conceivably be isolated or prepared in a pure state, and which would then exhibit the phenomena characteristic of vital activity. It is sufficiently obvious, in the first place, that protoplasm, as we know it, exhibits infinite diversity of character, and that no two samples of protoplasm are absolutely similar in all respects. Chemical differences must be assumed to exist not only between the vital fabrics of allied species of organisms, but even between those of individuals of the same species. Kassowitz regards this variability as compatible with the assumption of a gigantic protoplasmic molecule in which endless variations arise by changes in the combinations of a vast number of atoms and atom complexes. It is difficult to conceive, however, of any single substance, however complex in its chemical constitu- tion, which could perform all the functions of life. To postulate a universal living substance is to proceed along a path which leads inevitably to the assumption of biophores, plastidules, or other similar units, since the ultimate living particles must then be imagined as endowed at the outset with many, if not all, of the fundamental properties and characteristic actions of living bodies. Such a conception has as its logical result a vitalistic standpoint, which may or may not embody the correct mental attitude with regard to the study of life, but which at any rate tends to check any further advance towards an explanation or analysis of elementary vital phenomena. We may rather, with Kbiliker, Verworn, and others, ascribe the activities of protoplasm to the mutual interaction of many substances, no single one of which can be considered as living in itself, but only in so far as it forms an indispensable constituent of a living body. From this point of view life is to be regarded, not as the property of a single and definite substance, but as the expression of the ever-changing relations existing between the many substances which make up the complex and variable congeries known to us as protoplasm.

Authorities. ⁂ For exhaustive historical summaries of the proto- plasm question, with full bibliographical references, the reader may be referred to the following works, especially the first five : ⁂ BiJTSOHLi. Investigations on Microscopic Foams and Protoplasm. London, 1894 ; Untersuchungen ilber StruMuren. Leipzig, 1898 ; "Meine Ansicht iiber die Struktur des Protoplasmas und einige ihrer kritiken," Arch, f, Entmclcelungsmechanik. d. Org. xi. pp. 499-584, pi. XX. (1901). ⁂ Delagb. La Strudtire du Proto- plasme et les Thiories sur I'Hdr^iti. Paris, 1895. ⁂ Wilson. The Cell. 2nd ed. London, 1900. ⁂ FiscHEE. MxiruTig, Fdriung, und ⁂au des Protoplasmas. Leipzig, 1899. ⁂ Kassowitz. Allge- meine Biologic. Vienna, 1899. (e. A. M.)

Provengal Literature (Modem: 1350-I900).i

Literature in the South of France never died out entirely. Indeed, we have a link which, though too much import- ance may easily be attached to it, yet undoubtedly connects the products of the troubadours with the Pro- vengal poetry of the present day. The Academy of Toulouse, founded in 1324, was flourishing in the 14th century, and, after many vicissitudes, is flourishing stUL [The poets crowned by this body between 1324 and 1498 stand in the same relation to the troubadours as the Meistersinger do to the Minnesanger ⁂ academic correctness takes the place of inspiration. The institution flourished, even to the extent of establishing branches in Catalonia and Majorca; and in 1484, when its prosperity was threatened, a semi-fabulous person, CMmence Isaure, is said to have brought about a revival by instituting fresh prizes. The town of Toulouse never ceased to supply funds of some kind. In 1513 French poems were first admitted in the competitions, and under Louis XIV. (from 1679) these were alone held eligible. This unfair arrange- ment, by which some of the leading poets of northern France profited, held good till 1893, when the town very properly transferred its patronage to a new Escolo Mcmn- dino,^ but very soon restored its support to the older institution, on learning that Provencal poetry was again to be encouraged.] In the two centuries that followed the glorious medifeval period we have a succession of works, chiefly of a didactic and edifying character, which scarcely belong to the realm of literature proper, but at

1 In accordance mth general usage, we are emplojang the term Provencal for the whole of the South of France, save where special reservation is made.

" Moundino, i.e., of Toulouse ; a common designation, derived from Raymond, the famihar name of the Counts of Toulouse.

least served to keep alive some kind of literary tradition. This dreary interval was relieved by a number of religious mystery plays, which, though duU to us, probably gave keen enjoyment to the people, and represent a more popular f/enre ; the latest that have come down to us may be placed between the years 1450-1515. Not only did the literature deteriorate during this period, but dialects took the place of the uniform literary language employed by the troubadours, while the spoken tongue yielded more and more to French. In 1539 Frangois I. forbade the use of Provengal in official documents ??? a fact that is worthy of note only as being significant in itself, not as an important factor in the decadence of Provencal letters.

On the contrary, just aboat this time there are signs of a revival. In 1565 the Gascon, Pey de Garros, translated tho Psalms into his dialect, and two years later published a volume of poems. His love for his native tongue is genuine, and his command over it considerable ; he deplores its neglect, and urges others to follow his example. Auger Gaillard (c. 1530-1595) does infinitely less credit to his province : the popularity of his light pieces was probably due to their obscenity. More in the spirit of Garros is tho charming trilingual Salut composed by the famous du Bartas in honour of a visit of Marguerite de Valois to N^rac (1579) : three ijymphs dispute as to whether she should be welcomed in Latin, French, or Gascon, and the last, of course, wins the day. Provence proper gave birth to a poet of considerable importance in Louis Bellaud de la Bellaudiere (1532-1588), of Grasse, who, after studying at Aix, enlisted in the royal armies, and was made a prisoner at Moulins in 1572. During his captivity he wrote poems inspired by real love of liberty and of his native country {Don-Don infernal, 1584 or 1585). At Aix Bellaud subsequently became the centre of a literary circle which included most of the local celebrities ; all of these

paid their tribute to the poet's memory in the edition of his works published by his uncle, Pierre Paul, himself the author of pieces of small value, included in the same volume {Lous Passatens, Obros et rimos, &c., Marseilles, 1595). Even when Bellaud is wholly frivolous, and intent on worldly pleasures only, his work has interest as reflect- ing the merry, careless life of the time.

A writer very popular in Provence for the light-hearted productions of his youth was Claude Brueys (1570-1650), remarkable chiefly for comedies that deal largely with duped husbands {Jardin deys Musos provensalos, not pub- lished till 1628). There is a certain charm, too, in the comedies of Claude's disciple, Gaspard Zerbin {La Perlo deys musos et coumedies prouvensalos, 1655); and those critics who have read the plays of Jean de Cabanes (1653- 1712) and of Seguin (of Tarascon, c. 1640), still in MS., speak highly of them. The most consistently popular form of poetry in the South of France was always the noel. There has been no limit to the production of these ; but very rarely does the author deserve special mention. An exception must be made in the case of Nicholas Saboly (1614-1675), who produced the best pieces of this class, both as regards beauty of language and the devotion they breathe. They have deservedly maintained their popularity to the present day. In Languedoc four poets have been cited as the best of the age ???Goudelin, Michel, Sage, and Bonnet. This is certainly so in the case of Pierre Goudelin (province Goudouli, 1579-1649), of Toulouse, the most distinguished name in South French literature between the period of the troubadours and that of Jasmin. He had a good classical education, traces of which appear in all his poetry, his language and his manner being always admirable, even where his matter is lacking in depth. He is often called "the Malherbe of the South," but resembles that writer only in form : his poetry, taken

as a whole, has far more sap. Goudelin essayed and was successful in almost every short genre {Lou Bamelet Moawli, 1617, republished with additions till 1678), the piece of his which is most generally admired being the stanzas to Henri IV., though others will prefer him in his gayer moods. He enjoyed enormous popularity (extending to Spain and Italy),

but never prostituted his art to cheap effects. His influence, especially but not exclusively in Provence, has been deep and lasting. The fame of Jean Michel, of Nlmes, rests on the Einbarras de lafoire de Beavcaire, a poem of astonishing vigour, but deficient in taste. Daniel Sage, of Montpellier {Las Foulies, 1650), was a man of loose morals, which are reflected in nearly all his works : his moments of genuine inspiration from other causes are rare. More worthy of being bracketed with Goudelin is the avocat Bonnet, author of the best among the open-air plays that were annually performed at B^ziers on Ascension Day : a number of these (dated 1616-1657) were subsequently collected, but none can compare with the opening one. Bonnet's Jugement de Pdris. Another very charming poet is Nicolas Fizes, of Frontignan, whose vaudeville, the Opira de Frontignan (1670), dealing with a shght love intrigue, and an idyllic poem on the fountain of Fron- tignan, show a real poetic gift. A number of Toulouse poets, mostly lauriats of the Academy, may be termed followers of Goudelin : of these, Frangois Boudet deserves mention, who composed an ode, Le trinfe del Moundi (1678), in honour of his native dialect. The classical revival that may be noted about this time is also generally ascribed to Goudelin's influence. Its most distinguished representative was Jean de Vales, of Montech, who made excellent translations from Virgil and Persius, and wrote a brilliant burlesque of the former in the manner of Scarron {Virgile deguisat, 1648; only four books published). He also composed a pastoral idyU, which, though too long and inclined to obscenity, contains much tender description. The greatest of the pastoral poets was Frangois de Cortete (1571-1655), of Prades, whose comedies, Ramounet and Miramoundo (published, unfortunately with alterations, by his son in 1684), are written with such true feeling and in so pure a style that they can be read with real pleasure. A comedy of his dealing with Sancho Panza in the palace of the Duke is being edited. It is difficult to understand the enormous popularity of Daubasse (1664-1727), of Quercy, who belonged to the working classes ; he was patronized by the nobility in exchange for panegyrics. Gascony produced two typical works in the 17th cen- tury: Ader's Gentilhomme gascoun (1610) and Dastros's Trinfe de la langv►► gascoune (1642). The former depicts a regular boasting Gascon, who distinguishes himself in everything; while the latter is a plea in favour of the Gascon tongue, inspired by a genuine love of country. Gabriel Bedout {Parterre gascoun,

1642) is chiefly noted for his amorous solitari, called forth Isy the sufierings he endured from a hard-hearted mistress. Louis Baron (b. 1612), living peacefully in his native village of Pouyloubrin, celebrated it with great tenderness.

In the 18th century the number of authors is much larger, but the bulk of good work produced is not equally great in proportion. The priests are mainly re- sponsible for the literary output of Languedoc. Claude Peyrot (1709-1795), one of them, celebrates his county with true rural spirit in the Printemps rouergat and Quatre Sosous. But the chief of the band is the Abb6 Favre (1727-1783), the prior of Celleneuve, whose Sermoun de Moussu Sistre, delivered by a drunken priest against intemperance, is a masterpiece. He also wrote a success- ful mock-heroic poem {Siege de Caderousse), travesties of Homer and Virgil, a prose novel depicting the country

manners of the time (Histoire de Jean I'ont pris), and two comedies, whicli likewise give a vivid picture of the village life he knew so well. Two genuine poets are the brothers Eigaud, of Montpellier : Auguste's (1760-1835) descrip- tion of a vintage is deservedly famous; and Cyrille (1750-1824) produced an equally delightful poem in the Amours de Mounpei^. Pierre Hellies, of Toulouse (d. 1724), a poet of the people, whose vicious life ~~finds an echo in his works, has a certain rude charm, at times distantly recall~~ ing Villon. In the Provence Toussaint Gros (1698-1748), of Lyons, holds undisputed sway. His style and language are admirable, but unfortunately he wasted his gifts largely on trivial pieces d' occasion. Coye's (1711-1777) comedy, the Fiance pari, is bright and still popular, while Germain's description of a visit paid by the ancient gods to Marseilles (La Bourrido dei Dious, 1760) has con- siderable humour. la Gascony the greatest poet is Cyrien Despourrins (1698-1755), whose pastoral idylls and mournful chansons, which he himself set to music, are imbued with tenderness and charm (most of them were collected at Pau, in 1828).

The Revolution produced a large body of literature, but nothing of lasting interest. However, it gave an impetus to thought in the South of France, as elsewhere; and there, as elsewhere, it called forth a spirit of independence that was all in favour of a literary revival. Scholars of the stamp of Eaynouard (1761-1863), of Aix, occupied them- selves with the brilliant literary traditions of the Middle Ages ; newspapers sprang up (the Provengal Bouil-Abaisso, started by Desanat, and the bilingual Lou Tambourin et le Menestrel, edited by Bellot, both in 1841) ; poets banded together and collected their pieces in volume form (thus, the nine troubaire who published Lou Bouquet prouvengaou in 1823). Much has been written about the precurseurs du Filihrige, and critics are sorely at variance as to the writers that most deserve this appellation. We shall not go far wrong if we include in the list Hyacinthe Morel (1756- 1829), of Avignon, whose collection of poems, Imu Saboulet, has been republished by Mistral; Louis Aubanel (1758- 1842), of Nimes, the successful translator of Anacreon's Odes; Auguate Tandon, "the troubadour of Montpellier," who wrote Fables, contes et autres pieces en vers (1800); Tabre d'Olivet (1767-1825), the versatile litterateur who in 1803 published Le Troubadour: Poisies occitaniques, which, in order to secure their success, he gave out as the work of some mediaeval poet; Diouloufet (1771-1840), who wrote a didactic poem, in the manner of Virgil, relat- ing to silkworm-breeding (Leis magrmns) ; Jacques Azais (1778-1856), author of satires, fables, &c.; D'Astros(1780- 1863), a writer of fables in Lafontaine's manner; Castil- Blaze (1784-1807), who found time, amidst his musical pursuits, to compose Provencal poems, intended to be set to music; the Marquis de Fare-Alais (1791-1846), author of some light satirical tales {Las Castagnados). While these writers were all more or less academic, and appealed to the cultured few, four poets of the people addressed a far wider public: Verdi^ (1779-1820), of Bordeaux, who wrote comic and satirical pieces; Jean Reboul (1796- 1864), the baker of Nimes, who never surpassed his first effort, L'ange et Venfimt (1828)1; Victor Gelu (1806- 1885), relentless and lirutal, but undeniably powerful of his kind {Fenian et Grouman ; Dix chansons provenralcs, 1840); and, greatest of them all, the true and acknow- ledged forerunner of the fdibres, Jacques Jasmin (1798- 1864), the hairdresser of Agen, whoso pnems, buth lyrical

‘ One of lii.s chief titles to fame is that, together with Aljjhonse Dumas, he drew the attention of Lamartine to Mistral’s Mireio. Eoumanille and Mistral showed their gratitude by republishing the best pieces of these two prlcursmra, together with those of Castil- Blaze and others, in Un Liame de Rasin, 1865.

and narrative, continue to find favour with men of the highest culture and literary attainments, as with the villagers for whom they were primarily intended.

While much of this literature was still in the making, an event took place which was destined to eclipse in im- portance any that had gone before. In , 1845 Joseph Eoumanille (1818-1891), a gardener’s son, of Saint-Eemy (Bouches-du-Eh6ne), became usher in a small school at Avignon, which was attended by Frederic Mistral {q.v.), a native of the same district, then fifteen years of age. The former, feeling the germs of poetry within him, had composed some pieces in French ; but, finding that his old mother could not understand them, he was greatly distressed, and determined thenceforth to write in his native dialect only. These poems revealed a new world to young]Mistral, and spurred him on to the resolve that became the one purpose of his life ‘de remettre en lumiere et conscience de sa gloire cette noble race qu’en plein ‘89 ifirabeau nomme encore la nation Provenpale. There is no doubt that Mistral’s is the more puissant personality, and that his finest work towers above that of his fellows ; but in studying the Provencal renaissance, Roumanille’s great claims should not be overlooked, and they have never been put forward with more force than by Mistral himself (in the preface to his IscIqs d’oro). Eoumanille’s secular verse cannot fail to appeal to every lover of pure and sincere poetry (Li Margaritedo, 1836-1847; Li Sounjarello, 1852 ; Li Flour de Sauvi, 1850-1859, (fee), his noels are second only to those of Saboly, his prose works (such as Lou mege de Cv/^ugnan, 1863) sparkling with delightful humour. He it was who in 1852 collected and published Li Prouvencalo, an anthology in which all the names yet to become famous, and most of those famous already (such as Jasmin), are represented. In 1853 he was one of the enthusiastic circle that had gathered round J. B. Gaut at Aix, and whose literary output is contained in the Roumavagi dei Troubaire and in the shortlived journal Loii, gay

saber (1854). At the same time the first attempt at regulating the orthography of Provengal was made by him (in the introduction to his play, La Part dou bon Dieii, 1853). And in 1854 he was one of the seven poets who, on May 21st, forgathered at the castle of Fonts^gugne, near Avignon, and founded the Fdlibrige. [The etymology of this word has given rise to much specula- tion : the one thing certain about the word is that Mistral came across it in an old Provencal poem, which tells how the Virgin meets Jesus in the temple, among the sevenfelibres of i;he law. The outlines of the constitution, as finally settled in 1876, are as follows : The region of the Fdibrige is divided into four mantenengo (Provence, Languedoc, Aquitaine, and Catalonia). At the head of all is a con- sistori of fifty (called majourau), presided over by the Capouli, who is chief of the entire Fi'librige. The head of each mantenenro is called sendi (who is at the same time a majourau); and at the head of each "school" (as the subdivisions of the ???;?KX??^t'n(???fo are called) is a cabis- con. The ordinary members, unlimited in number, are mantencire. Annual meetings and fetes are organized. The most widely read of the Fi'lihrige publications is the Armana Prouvenraw, which has appeared annually since 1855, maintaining all the while its original scope and purpose ; and though unpretentious in form, it con- tains much of the best work of the school.] The other*

' One of the most pleasing features of the movement is the spirit of fraternity maintained by the felihres with the poets and literary men of northern Prance, Spain, Italy, Rumania, Germany, and other countries.

- *In common with so many other productions of the FtUbriiye, this Almanac is published by the firm J. Eoumanille, Libraire-Editour, Avignon.*

six were Mistral, Aubanel, A. Mathieu (a schoolfellow of Mistral's at Avignon), E. Garcin, A. Tavan, and P. Giera (owner of the castle). Of these, Theodore Aubanel (1829-1886, of Avignon, son of a printer and following the same calling) has alone proved himself worthy to rank with

Mistral and Roumanille. “Zani,” the girl of his youthful and passionate love, took the veil ; and this event cast a shadow over his whole life, and determined the character of all his poetry {Lou midugrano entre-duherto, 1860; Li fiho d’Avignoun, 1883). His is, without a doubt, the deepest nature and temperament among the fMibres, and his lyrics are the most poignant. He has a keen sense of physical beauty in woman, and his verse is replete with suppressed passion, but he never sinks to sensuality. His powerful love drama Lou pau dou peccat was received with enthusiasm at Montpellier in 1878, and successfully produced (some years later in Arene’s version) by Antoine at his Theatre Libre ??? no mean criterion. It is the only play of real consequence that the school has yet produced.

*We need not do more than glance at the work of the fourth of the group of poets who alone, amidst the numerous writers of lyrics and other works that attain a high level of excellence, appear to us to have so far secured permanent fame by the magnitude of their achievement. F^lix” Gras (1844-1891) settled at Avignon in his youth. His rustic epic, Li Carbmini^ (1876) is full of elemental passion and abounds in fine descriptions of scenery, but it lacks proportion. The heroic geste of Tolom (1882), in which Simon de Montfort’s invasion of the South is depicted with unbounded vigour and intensity, shows a great advance in art. Li Roumancero provengal (1887) is a collection of poems instinct with Provengal lore, and in Li Papalino (1891) we have some charming prose tales that bring to life again the Avignon of the popes. Finally, the poet gave us three tales dealing with the period of the Revolution (Zi Rouge dou Miejour, &c.) ; their realism and literary art called forth general admiration.^*

A few lines must suffice for some of the general aspects of the movement. It goes without saying that all is not perfect harmony ; but, on the whole, the differences are differences of detail only, not of principle. While Mistral and many of the best f4libres employ the dialect of the Bouches-du-Rh6ne, others, who have since seceded as the Filihrige latin (headed by Eoque-Ferrier), prefer to use the dialect of Montpellier, owing to its central position. A third class favour the dialect of Limousin, as having been the literary vehicle of the troubadours ; but their claim is of the

slenderest, for the filihres are in no sense of the word the direct successors of the troubadours. Nearly all the leaders of the Felibrige are Legitimists and Catholics, their faith being the simple faith of the people, undisturbed by philasophic doubts. There are exceptions, however, chief among them the Protestant Gras, whose Toloza clearly reflects his sympathy with the Albigenses. Yet this did not stand in the way of his election as Gapoulie ??? a proof, if proof were needed, that literary merit outweighs all other considerations in this artistic body of men. Finally, it may be noted that the fdlibres have often been accused of lack of patriotism towards northern France, of schemes of decentralization, and other heresies ; but none of these charges holds good. The spirit of the movement, as represented by its leaders, has never been expressed with greater terseness, force, and

^ Gras was Oapoulie from 1891 till 1901, succeeding his brother-in- law, Roumanille, who held the ofHce from 1888 till 1891. The first GapowlU was, of course, Mistral (1876-1888). Gras's successor was Pierre Devoluy, of Die (appointed in April 1901), who has done good work, but has yet to prove himself worthy of the supreme distinction conferred on him by his feUow-poets.

truth than in the three verses set by F^lix Gras at the head of his Garbounii: “I love my village more than thy village ; I love my Provence more than thy province ; I love France more than all”

Authorities. ►►► Las Jmjas del gay saber, edited by Noulet (vol. iv. of Gatien-Arnoult’s Monum^ns de la UtUruture romane, dx., Tou- louse, 1849). ►►► NouLBT. Essai swr I’histoire litUraire dts patois du midi do la France aux xvi” et xvii’ siecles (Paris, 1859) and . . . au xviiP siicle (Paris, 1877). ►►► Gaut. ” ^tude sur la litt^ra ture et la po6sie proven^ales ” (M&moires de VAcadiviie des Sciences, (t-c, d’Aix, tome ix. pp. 247-344, Aix, 1867). ►►► Maey – Lafon. Histoire litUraire du Midi de la France. Paris, 1882. ►►► Eestoei. Leiteratura provenzale. Milano, 1891 (pp. 200-214). ►►► MamSton’s articles on Provengal and Filbirige in the Grande Encyclcypidie. ►►► DoNNADiEU. Les Pricurseurs des Filihres (1800-1855). Paris, 1888. ►►► JoUKDANNB. Jlistoire dn Fdibrige {185i-lS9e). Avignon, 1897. ►►► Hennion. Les Fleursfdliiresques. Paris, 1883. ►►► Portal. La leiteratura provenzale modema. Palermo, 1893. ►►► KosoHWlTZ. Ueicr die provenzalischen Feliber wnd ihre Vorgdnger. Berlin, 1894. ►►► Maki^ton. La Terre prooencale. Paris, 1894.

(H. O.)

Providence, a city of the United States, capital of the state of Rhode Island, is situated at the head of Narragansett Bay, in 41►►49' 22" N. and 71►►24' 48”_W. Its area is 18‘29 square miles. Its surface is hilly, rising to the height of 204 feet on the ” East Side.” The park area is 542 acres. Roger Williams Park (102 acres) is the largest. Its population in 1900 was 175,597, of whom 55,855 were foreign-born and 4817 were negroes. Among 53,131 adult males 3830 were illiterate (unable to write), of whom 3384 were foreign-born. The death- rate in 1900 was 19-9; in 1890 it was 2M. Brown University, seventh in age of the colleges of the United States, is the chief educational institution. Other institu- tions are the Rhode Island School of Design, the Rhode Island Normal School, four high schools, the Friends’ Boarding School, and the Roman Catholic Academy of the Sacred Heart. The University Library and the

Providence Public Library number about 125,000 volumes each. The Providence Athenaeum contains 70,000 volumes. Most noteworthy is the library of Americana, now the pro- perty of BrovsTi University, begun by John Carter Brown ??? the most complete collection in the world of books relating to early American history. Of benevolent institutions the most noted are the Dexter asylum for the poor, the Butler hospital for the insane, and the Rhode Island hospital. The oldest edifice for religious purposes is the First Baptist Meeting House, erected in 1775 "for the public worship of Almighty God, and also to hold Com- mencements in." The largest is the Roman Catholic Cathedral. There are in all 129 places of worship. Of these, 21 are Baptist, 10 Congregational, 14 Episcopal, 18 Methodist, 16 Roman Catholic, 4 Unitarian, 3 Universalist, and 4 Presbjrterian. Of public buildings there are the City Hall, the Providence County Court House, and the Rhode Island Normal School. The old State House (1762) is a fair specimen of colonial architecture. The finest building in the city is the State Capitol. With its ap- proaches it cost about $3,500,000. Seven railways, all controlled by one corporation, enter the city. Besides steamboats plying upon Narragansett Bay and to New York, steamships sail regularly to Philadelphia, Baltimore, Norfolk, Savannah, and Kingston, Jamaica. The city is a great distributing centre for central New England.

Providence is one of the great manufacturing centres of the Union. It is the leading city in the manufacture of jewellery, the total product of which in 1900 was valued at $12,719,124. In all industries in 1900 there were 1933 manufacturing establishments, having a capital of $83,513,679, and employing an average num- ber of 42,693 wage-earners, who received wages amounting to $19,998,362. The total products were valued at $88,168,897. Among these products the most important, apart from jewellery, were : worsted goods ($16,603,252), silver ware ($3,834,408), foundry and machine-shop products, rubber and elastic goods.

cotton and woollen goods, and oleomargarine. It is the growth of manufacturing which accounts for the fact that the population, once almost wholly native-born, has received an element of foreigners amounting to almost one-third. In 1899 the valuation placed upon real estate was $146,701,900. Upon personal property the valuation was $41,799,880. The revenue of the municipality was $3,878,439. The net debt 1st April 1900 was $14,008,484. It is a banking centre for "[illegible] *region of mammoth factories. There are nineteen national banks, with a total capital of $15,113,523 and deposits of $14,609,832 ; two state banks, with a capital of $320,000 and deposits of $446,743; five trust companies, with a capital of $4,150,000 and deposits of $27,745,108, make a total capital for all banking and trust companies of $19,583,523 and total deposits of $12,801,684. There are five savings banks, with deposits of $38 855,589. The clearings for the year ending 30th June 1900 were $338,132,500. (W. H. Mu.)*

PrOVO, a city of Utah, U.S.A., capital of Utah county, at the west base of the Wasatch mountains, on the Provo river, and on the Oregon Short Line and the Rio Grande Western railways, near the east shore of Utah Lake, north of the centre of the state, at an altitude of 4532 feet. It has a level site and a regular plan, and is divided into five wards. It contains the insane asylum of Utah. Population (1880), 3432; (1890), 5159; (1900), 6185, of whom 1176 were foreign-born.

Prussia^ the principal state of Germany, ranking first in both area and population, though only twentieth in respect of density of population. More than 5 per cent, of the entire surface of Prussia consists of moorland, some of it high (heathy) moors, some of it (the smaller portion) low boggy moors. Hanover [illegible] *more particularly the districts of Osnabriick, Stade, Liinebarg, and Aurich (East Friesland)* [illegible] *and Schleswig-Holstein possess between them nearly 3000 square miles of this variety of surface. Another 1 100 square miles are in East Prussia ; and the rest, about 1500 square miles in all, occur chiefly in the provinces of Pomerania, Brandenburg, Posen, and Saxony. Since 1870 the Prussian Government, as well as the authorities of the province of Hanover, and various private persons, have started several more or less successful*

schemes for the reclamation of these waste tracts. The region to which the Prussian Government has principally directed its

*attention is the great Bourtanger Moor, between the Ems and the Dutch frontier, in the north-west of the province of Hanover. There colonies were established as long ago as the first half of the 17th century ??? Papenburg, for example (1630) ??? chiefly for the purpose of cutting turf for fuel ; and in East Friesland, in the first place at the instigation of Frederick the Great, over eighty similar colonies, aggregating in all 20,000 persons, were planted between 1765 and 1800, but nothing effective was done for the real reclamation of the moorland. But in 1870 the Prussian Government turned its attention to the matter, and proceeded to cut navigable canals through the moor- land, and appointed a special commission to deal with its reclamation generally. These efforts received a further impulse from the founding of an experimental station near Bremen in 1877. In consequence of the work done in the laboratory attached to this station, as well as of experiments conducted on the moors themselves, the province of Hanover organized a new system of colonization in 1887. Having bought some 1100 acres beside the main canal which traverses the Bourtanger !Moor from north to south, they drained the land and divided it into 25-acre plots, which they granted to occupiers free, with the option of purchase, the principal condition being that the grantees should first reclaim 5 acres. This project proving successful, induced the Prussian Government in 1899 to embark in similar enterprises on the Wiseder Moor (Marcardsmoor) along the line of the Ems-Jade canal, between Aurich and Jade Bay. In 1902 Prussian estimates embraced an item of over ??131,000 for these and similar improvements. Other private ventures of some importance have been made at Friedrich-Wilhelms- dorf near Loxstedt, a few miles south-east of Bremerhafen, on the Kehdinger Moor, on the west side of the estuary of the Elbe, in Schleswig-Holstein, and in East Prussia. In 1883 a national society was founded for the reclamation and cultivation of the moorlands of Germany.^*

Population. ??? The following table gives particulars of the area and population of the several provinces of the kingdom in the years 1890, 1895, and 1900, as well as the chief religious statistics for 1895 : ???

Provinces.

Area in sq. miles.

Population,

1890.

Population,

1895.

Population,

1900.

Density per

sq. mile,

1900.

Protestants,

1895.

Roman

Catholics,

1895.

Jews, 1S95.

East Prussia

West Prussia .

Berlin (city)

Brandenburg

Pomerania

Posen

Silesia . . . .

Saxony . . . .

Schleswig-Holstein .

Hanover ....

Westphalia

Hesse-Nassau .

Rhine Province .

Hohenzollern .

Total . . . .

14,278

9,852

25

15,376

11,625

11,181

15,561

9,747

7,335

14,865

7,801

6,058

10,420

441

1,958,663 1,433,681 1,578,794 2,541,783 1,520,889 1,751,642 4,224,458 2,580,010 1,219,523 2,278,361 2,428,661 1,664,426 4,710,391 66,085

2,006,689 1,494,360 1,677,304 2,821,695 1,574,147 1,828,658 4,415,309 2,698,549 1,286,416 2,422,020 2,701,420 1,756,802 5,106,002 65,752

1,996,626 1,563,658 1,888,848 3,108,554 1,634,832 1,887,275 4,668,857 2,832,616 1,387,968 2,590,939 3,187,777 1,897,981 5,759,798 66,780

139 159 75,554 202 140 168 300 290 189 174 409 313 552 151

1,724,374

715,581

1,426,591

2,681,637

1,530,003

561,201

1,980,552

2,498,748

1,257,454

2,094,604

1,298,852

1,224,021

1,434,715

2,566

266,641

758,168

155,363

118,265

31,739

1,227,197

2,384,754

187,559

24,184

311,457

1,378,676

482,752

3,610,142

62,608

14,364

20,238

86,152

18,394

11,661

40,019

47,593

7,850

3,702

15,065

19,359

45,725

49,018

576

134,565

29,957,367

31,855,123

34,472,509

256

20,430,899

10,999,505

379,716

Between 1880, when the total population numbered 27,279,111, and 1900 there was an increase of 7,193,398 persons, or at the rate of 26-4 per cent, per annum. For

the period 1890-99 the marriage-rate averaged 8‘2 per 1000 inhabitants, the birth-rate 38-1 per 1000, and the death-rate 23-3 per 1000. In respect of illegitimacy, while for the same period the percentage of illegitimate births to total births was as much as 14-25 in the city of Berlin, and between 10 and 11 per cent, in each of the pro- vinces of Pomerania, Brandenburg, and Saxony, the average for the whole kingdom was only 7 -76. The densely-peopled manufacturing and mining provinces of Westphalia and

the Rhineland have by far the best record in this respect, their averages being 2-61 and 3-87. The present popula- tion is concentrated most densely (300 to 552 inhabitants per square mile) in the manufacturing districts of Rhenish Prussia, Westphalia, the adjacent Hesse -Nassau, and in the extreme south-east of the kingdom, the coal and zinc and iron region of Silesia. The average density in the

‘^ See the nnnual MifteUungm of this society (published at Berlin) ; Fleischer, Die Besiedehmrj der nordwestdeutschen Hochmoore (Berlin’ 1894) ; Rimpan, Die Bemrthschaftung des Rittergutes Cunrau (Berlin, 1887) ; and F. P. Koenip;, AgriciUture in Germany (Brit Cons. Report, Misc. Series, No. 452, 1898).

agricultural provinces of East and West Prussia, Posen, Pomerania, Brandenburg, Saxony, Hanover, and Schleswig- Holstein varies between 139 and 290 inhabitants per square mile, or, roughly, one-half of the density in the manu- facturing provinces. According to the census returns

of 1900, there were 1031 females for every 1000 males, as com- pared with 1037 females in 1880. In 1900 there were in Prussia one city with a population exceeding one million inhabitants, seven towns between 200,000 and 500,000 ; fourteen between 100,000 and 200,000 ; twenty-four be- tween 50,000 and 100,000; and eighty-nine between 20,000 and 50,000. The emigration decreased from 145,679 in 1881 to 50,461 in 1886; then, after going up to 76,196 in 1892, it rapidly declined to 12,471 in 1900. The number of suicides varies from 5000 to 6500 annually, the average being 19 for every 100,000 inhabitants, or one less than the average for all Germany. In 1890 the island of Heli- goland was ceded by Great Britain to Germany, and in the following year it was administratively attached to the Prussian province of Schleswig-Holstein.

Of the total population in 1900, 55‘6 per cent, were classed as urban and 44‘4 as rural, i.e., as living in places of less than 2000 inhabitants each. In 1895 the foreign residents embraced 63,289 natives of Austria-Hungary, 47,715 natives of Holland, 18,998 of Eussia, 24,389 of Denmark, 10,062 of Switzerland, 8120 of Great Britain, 7327 Armenians, 6564 of Belgium, 6301 of Norway and Sweden, and 2127 of France. Adverting to the religious statistics, it will be seen that 64‘14 per cent, of the entire population belonged (1895) to the Protestant State Church, 34‘53 per cent, to the Roman Catholic Church; and 1‘19 were Jews. Of races other than Teutonic the population of Prussia embraced 2,922,475 Slavs (Masurians, Cassu- bians), 117,637 Lithuanians, 64,254 Wends, and 74,069 Bohemians and Moravians. In 1895, 11,113,794 persons, or 34‘9 per cent, of the population, were engaged in agriculture, cattle and sheep breeding, &c. ; 12,196,352, or 38‘3 per cent.j in mining and industry; 3,585,430, or 11‘3 per cent., in commerce and trade; 1,671,827, or 5”2 per cent., in the learned professions ; 658,896 in domestic service; 261,302 in forestry, fishing, &c. ; and 2,002,714, or 6‘3 per cent., had no profession.

Agriculture. ❓❓❓Out of the total area of cultivable land in the German empire, fully 66 per cent, belongs to Prussia, namely, 53,002,600 acres (1895). Of this total less than 5 percent, was divided into farms of less than 5 acres each, 32 ‘14 per cent, amongst farms ranging from 5 to 50 acres, 32 ‘Ol per cent, amongst farms ranging from 50 to 250 acres,

*and the rest amongst farms exceeding 250 acres. The provinces in which large estates (up to 2500 acres and more) are the rule, are Pomerania, Posen, Silesia, East Prussia, Brandenburg, West Prussia, and Saxony, in the order named. The estates of the old landed gentry {Ritterguter) of Prussia, taking the estates above 500 acres each, aggregate in all some 13,428,000 acres. Small estates (peasant holdings) prevail principally in the Rhine province, Hesse-Nassau, and Westphalia, And to some extent also in Hanover, Silesia, and Saxony ; but large peasant holdings (50 to 250 acres) exist only in Schileswig- Holstein, Hanover, East Prussia, Westphalia, Saxony, and Branden- burg. Notwithstanding the continuous decline in prices, and other
॥drawbacks from which agriculture suffered in all the older countries of Europe during the last quarter of the 19th century, the Prussian farmers have on the whole fairly well maintained their position, owing mainly to the fact that they have been both eager and skilful in availing themselves of the opportunities offered by the progress of agricultural knowledge. One of the latest de- partures in this field has been the establishment of central stations for the distribution of electric power to the estates in its neighbour- hood, the power to be used for driving both fixed and movable machinery (mills, chaff-cutters, threshing machines, ploughs, &c.), for lighting buildings and houses, for cooking and heating, and on large estates for giving signals and conveying orders. The culti- vation of the beetroot for sugar has had a far-reaching effect upon Prussian agriculture, especially in the provinces of Saxony, Silesia, Posen, Hanover, West Prussia, Pomerania, Brandenburg, the Rhine Province, and other parts of the kingdom, where the beetroot is extensively cultivated. Owing to the deep cultivation of the soil*

and the incessant hoeing which the beet crop requires, the three or four crops which follow it are invariably good, and the liability to failure of the immediately succeeding crop is reduced to a minimum. Moreover, the fiscal policy of the Prussian Government has been of first-riite assistance to the Prussian farmer. And hand in hand with the cultivation of the beetroot has gone the cultivation of barley and chicory, crops of scarcely inferior value from the culti- vator's point of view. Barley is grown on more than llj million acres. The Prussian province of Saxony produces one-half of the total quantity of chicory yielded every year throughout the

empire ; the principal centres for its manufacture in Prussia are llagdeburg, Berlin, and Breslau.

The Prussian Government, in conjunction with the provincial authorities, also gives encouragement to the breeding of live stock, which it endeavours to improve by subsidizing and maintaining stud-farms. It is, however, the breeding of horses to which it especially devotes itself, supporting about two dozen stud-farms for this end, of which the most famous are at Trakehnen in East Prussia, at Graditz near Torgau in the province of Saxony, and at Beberbeck between Oassel and Hoxter. The only stud, however, where thoroughbred stallions are kept is at Graditz. The most noticeable features in connexion with the lire stock of Prussia are the altogether unusual diminution in the number of sheep (caused in large part by the fall in the price of wool), the even greater relative increase in the number of pigs, and the increase, though at a much smaller rate, in the numbers of the cattle and horses. For instance, sheep in 1873 numbered 19,660,800, but in 1900 not more than 6,989,400. Pigs, however, increased from 4,294,900 in the former year to 10,954,000 in the latter ; cattle from 8,639,500 to 10,865,300 ; and horses from 2,282,400 to 2,913,000.

In the matter of freights also the Government renders material assistance to the Prussian farmer. The State owns the railways, and carries agricultural produce, especially such as is destined for export, at lower preferential rates. See further under Com,- municalions below.

The crops chiefly grown are potatoes (5,477,095 acres in 1900), hay (8,025,230 acres), beetroot, rye (11,277,340 acres), oats (6,710,930 acres), wheat (2,999,860 acres), and barley (2,205,625 acres). In 1900 some 11,500 acres were planted with tobacco, the yield of which'(about 10,000 tons) was valued at ??420,000 ; about 5500 acres were planted with hops. In 1899-1900 there were 308 sugar factories at work, their total production being 1,339,270 tons of sugar; 6103 breweries produced 690,250,000 gallons of beer, and 6331 distilleries produced 67,598,900 gallons of pure alcohol. Wlieat is grown more especially in Silesia, Saxony, tlje Rhine Province, East Prussia, and Hanover ; barley in Silesia and Saxony ; oats in Silesia, East Prussia, Hanover, the Rhine Province,

and the northern provinces generally ; potatoes in Silesia, Branden- burg, and Posen ; and rye commonly in every province of the king- dom. Brandenburg produces about one-half of the tobacco ; the hops are chiefly grown in Posen. Of the entire area about 23 per cent, is covered with forests.

Viticulture. ❓❓❓ The principal wine-growing districts of Prussia are the Rheingau and the Rhine Province, though wine is also pro- duced in Silesia, Westphalia, and a few other districts. The valleys of the Nahe, Saar, Moselle, and Ahr all produce excellent wine. The total area planted with vines in 1900 was 45,400 acres, and on this the yield was 6,752,000 gallons, valued at ❓❓767,235, as compared with an average of 60,000 acres planted and a yield of 5,500,000 gallons during the period 1880-90. The Prussian State owns several vineyards in the Rhine district, including 240 acres of the choicest vineyards in the Rheingau ❓❓❓ Rauenthal, Eltville, Marcobninn, Steinberg, Erbach, Rudesheim, and Assmannshausen; and it has also bought several acres of vineyards along the Moselle. During the last two or three years of the 19th century the German vine-growers suffered, in common with vine-growers in other coun- tries of Europe, from the attacks of diseases and insect pests^e.g'. , Peronospora viticola, Oldium Tuclceri, and Phylloxera vastatrix. The last named alone has already cost the Imperial Government ❓❓400,000 in efforts to stamp it out. This industry, being so near the great mining and manufacturing districts of western Prussia, naturally suffers from the increasing scarcity and dearness of manual labour. These hindrances the vintagers counteract to some extent by forming associations for the co-operative manufacture, storage, sale, and advertising of their wine. The principal school of viti- culture in Prussia is at Geisenheim in the Rheingau. The best wines of the Rhine and Moselle region which come into commerce are largely sold by public auction.

Mining and Metal Industries. ❓❓❓ Prussia still retains her pre-eminence as the largest producer of coal, zino, salt, lead, and copper amongst the states of the German empire, though in respect of iron she comes second to Alsace-Lorraine. Of the aggregate German output of coal Prussia now supplies over 93 per cent., namely, the huge total of 101,966,158 tons, valued at ❓❓43,912,600 in 1900, as compared with

some 47,000,000 tons in 1882, representing an increase of about 117 per cent. Westphalia produces the largest quantity, namely, 42,657,146 tons, valued at ––17,958,000,

in 1900 ; next comes the Rhine Province, that is, the Saar, Aachen, Diisseldort', and Roer coal-helds, with 29,010,089 tons, of the value of ––14,149,500 ; and then the Milesian coal-tield, with 29,596,738 tons, valued at ––11,420,500. Since the high prices of 1900 the Prussian Government has spent ––1,250,000 in the purchase of coal-fields so as to be independent of market fluctuations, temporary scarcity, and the manipulations of middlemen. The Prussian State is a large owner of mines and salines ; these in 1902 were estimated to yield a revenue of 9^ millions sterling. An extremely important r6le is played in the coal industry of Prussia by the Rhenish-Westphalian Goal Syndicate, which has its headquarters at Essen, and which from the bulk of its output (about 40 per cent, of the total German output) has succeeded in regulating the production and price of the coal-fields generally. Out of a total output of lignite for the entire German empire of 40,498,019 tons in 1900, Prussia yielded no less than 84 per cent., or a total of 34,007,512 tons, valued at ––4,012,900, showing an annual increase of over 24 million tons and of 3^ millions sterling since 1882. Almost the whole of the zinc produced in Germany comes out of the Silesian mines, the amount being 636,068 tons in 1900, valued at ––1,279,600, or nearly six times the amount mined in 1882. The iron production of Prussia amounted in 1900 to only 33 per cent, of the aggregate production of Germany, or a total of 4,268,069 tons, valued at ––1,884,300, the increase over the output in 1882 being little more than a quarter of a million tons. The chief iron-producing regions are the Rhine Province, Westphalia, Hesse-Nassau, and Silesia. But in the production of lead Prussia enjoys almost an unchallenged monopoly, in that in 1900 she produced 147,042 tons out of 148,257, the value being ––890,000 ; in 1882 the output amounted to 88,300 tons. And the Prussian output of manganese occupies an exactly analogous position, amounting to 58,016

tons, valued at ⁇33,000, out of 59,204 tons. In the same year 169,447 tons of pyrites, valued at ⁇60,750, and some cobalt were mined. Salt, one of the most valuable of the mineral products of the country, was in its various forms, but principally in the form of rock-salt, obtained to the extent of 2,476,867 tons, valued at ⁇1,410,650, in 1900, as compared with some 550,000 tons in 1882. Ordinary salt is mined prin- cipally in the province of Saxony (Stassfurt, Aschersleben, Erfurt, Halle, Merseburg, Sangerhausen), the kali salts near Magdeburg, and Glauber salts in the Rhine Province and Hesse-Nassau. The furnaces, forges, salt-works, and similar establishments for the conversion of the raw ores into manufactured or semi-manufactured products yielded in 1900 5,781,892 tons of pig iron, valued at ⁇19,113,400, as compared with a yield of 2,467,500 tons, valued at ⁇7,490,000, in 1882 ; 155,760 tons of zinc, valued at ⁇3,102,600 ; 112,170 tons of lead, of the value of ⁇1,880,300 ; copper to the extent of 27,157 tons and the value of ⁇2,069,700 ; silver to the extent of 6,920,150 oz., valued at ⁇1,084,350, approximately equivalent iu value to the output twenty years earlier ; and 566,368 tons of sulphuric acid, valued at ⁇727,350. The iron was worked principally in the districts of Arnsberg, Dusseldorf, Oppeln in Silesia, Treves, and Ooblenz, and gave employment to 25,686 hands ; the zinc, for the most part near Oppeln in Silesia, the number of hands employed being 10,779 ; the lead and the silver near Aachen, Oppeln, and Wiesbaden, the hands em- ployed numbering 2716 ; and the sulphuric acid in all the mining districts, as well as near Potsdam, Breslau, Magdeburg, and Merseburg, and the number of hands 2969. Further, a total of 203,700 persons were employed in some 1000 foundries, puddling-mills, rolling-mills, and so forth, and they produced iron and steel materials to the weight of 1,612,000 tons and a combined value of ⁇13,383,150. Petroleum (27,731 tons in 1900) is extracted to a limited extent at a couple of places in the province gf Hanover. Down to 1899, in which year the monopoly was bought out by the Prussian Government, 150 to 250 tons of amber were mined in East Prussia. A little is also collected on the coast near Pillau.

Other Manufacturing Industries, Commerce. ⁇⁇⁇ During the last quarter of the 19 th century Prussia developed into a great manu- facturing country. Between 1882 and 1895 it was estimated that the

number of persons employed in manufacturing and kindred pursuits increased in the aggregate at the rate of 34J per cent., but the number employed in trade and commerce increased at a vastly greater rate, namely, 60^ per cent., or from 771,323 in the first-mentioned year to 1,237,882 in 1895. Amongst the causes which have been mainly instrumental in fostering the industrial development in Prussia are those which have also contributed to the progress of Prussian agriculture, such as the fostering cire of the Government (at once energetic, comprehensive, and watchful), co-operation and organization, which has been immensely facili- tated by the habits of prompt obedience and order learnt in the course of the military training ; the generally high intellectual level and technical and artistic skill of the workmen, due in part to the enforcement of sound elementary education and in part to the fostering care of the excellent technical high schools, trades "con- tinuation schools," and hosts of special schools in which the arts and crafts are thoroughly and systematically taught ; the use made

of scientific discoveries and the power of taking advantage of scientific progress generally ; the national aptitude for giving conscientious attention to minutise, and for thoroughness and mastery of detail ; the extensive emidoyment of commercial travellers, having command of languages, in all parts of the world ; and an earnest desire to find out and meet the wants and tastes of customers. Moreover, the social and economic condi- tions of the people have been in their favour. Wages have on the whole been lower than, for example, in England, though since 1896 they have shown a strong upward tendency, and the standard of comfort, and even in many cases the standard of living, has been lower. Litigation, too, is more expeditious and less costly. But the Prussian manufacturer has derived no small measure of advantage from the fact that he has come into the field somewhat later than his foreign rivals. He has been enabled to utilize their experience, to profit from their drawbacks, faults, and deficiencies, and to make a clean start in the light of this extremely valuable acquired knowledge. And his interests have also been materially- promoted by the commercial and fiscal policies of his Government.

The chief industrial districts are, of course, those which yield coal, with, in addition, the great cities ⁂ Berlin, Magdeburg, Hanover, Breslau, Gbrlitz, Stettin. Essen, Dortmund, Elberfeld- Barmen, Diisseldorf, Cologne, Aix-la-Chapelle, Crefeld, Halle, Hanover, Frankfort-on-the-Main, Saarbriicken, Hijchst, Solingen, Remscheid, Hagen, Konigsberg, Danzig, and many others. The iron and metal industries, especially the making of machinery, electrical plant, tramway plant, and the production of articles in wrought copper and brass, rank in the very forefront, not only in virtue of their magnitude, but also because of the remarkable rate at which they have increased and grown. In these branches Berlin, and more lately its suburbs, as well as Magdeburg and Cologne, have played an active rule, though the old centres of the metallurgical and iron and steel industries in the Rhine Pro- vince and Westphalia have also expanded in an extraordinary- degree. The growth of the chemical industries, which are essen- tially a German speciality, must also be mentioned in the front rank. The genius of men like Liebig, Wbhler, Bunsen, Runge, Hofmann, Bottiger, KekuM, Fischer, and their pupils has made the German chemical manufacturer pre-eminent in his own special lines throughout the world. The branches in which his supremacy stands unrivalled are those which produce aniline dyes, artificial indigo, illuminants (acetylene gas, "VVelsbach mantles, &c.), ex- plosives, various chemical salts, pharmaceutical preparations, cellulose, glycerine, artificial (chemical) manures, and perfumes.^ A third branch of industry in which German genius has won triumphs of the very liigliest kind is shipbuilding. Here the advance has been materially assisted by the admission free of duty of materials needed for the building of ships, preferential low railway rates for the carriage of materials of native German origin, and by an indirect bounty on shipments made to the Levant, East Africa, and elsewhere, in German-built, or at least German-owned, vessels.

Oommunicalions. ⁂ Between 1880 and 1886 the Stete-owned lines of railway increased by 9240 miles, the increase being principally due to the policy of buying up private lines ; and since 1886 there has been a further increase of 6000 miles. By law the Prussian State enjoys the right to buy up lines privately constructed after an interval of 30 years, though in many cases the interval has been shortened to 15 or even 10 years. In

1900 the State lines amounted to a total of IS, 859 miles, with about 950 in process of construction ; and the private lines to 1872 miles. The former total includes 590 miles in Hesse ~~Darmstadt, the~~ railways of this grand-duchy having been incorporated with the Prussian railways in 1896. The building of the railways in Prussia has in almost every case been determined, or at any rate influenced, by militarv requirements ; and this applies also to the making of private lines. The most important trunk line of' Prussia is that which enters the western frontier at Herbesthal, and runs through Cologne, Diisseldorf, Hanover, Berlin, Dirschau, and Konigsberg, and leaves the eastern boundary at Eydtkuhnen for St Petersburg. Generally speaking, the principal lines of the, country either radiate from Berlin or run alongside the frontiers, and boundaries. To the former category belong the lines which connect the capital with Hamburg and Kiel, with Stettin with Danzig and Konigsberg, with Posen and Breslau (dividing at Frankfort-on-Oder), with Dresden, with Leipzig and Bavaria, with Frankfort-on-the-Main vid Halle and Erfurt, with Coblenz vid Cassel, and with Cologne vid Magdeburg and Brunswick. The second category embraces lines from Hamburg to Stettin from Stettin to Posen and Breslau, and from Breslau to Halle ; the rinir is aaain taken up at Frankfort-on-the-Main, and continues up the Rhine (on both banks) to Cologne, and thence through Miinster and Bremen to Hamburg. Besides these there are two other-

See Dr Frederick Rose, "Chemical Instruction and Chemical Industries in Germany, 1901-02," being Nos. 561 and 573 of the- Miscellaneous Series of British Diplomatic and Consular Reports

important lines, one connecting Hamburg with Frankfort-on-the- Main vid Hanover and Cassel, the other linking Hanover with Halle. The capital invested in the State railways of Prussia increased from ►►7,2il,150 in 1854 to ►►311,878,540 in 1889, and to ►►390,550,100 in 1899 (including ►►12,369,800 for the Hessian railways). In the last-mentioned year the expenditure amounted to

\u\u38,816,820 and the revenue to \u\u66,987,740, showing a net profit of \u\u28,170,920, or sufficient to pay interest at the rate of 7i per cent., as compared with 2 J per cent, in 1854 and 6 J per ceut. in 1889. The estimated revenue from the State railways for the year 1902-03 was put at \u\u70,602,000, against which there were expected to rank an ordinary expenditure of \u\u44,188,000, and an extraordinary expenditure of \u\u4,582,000. Besides these, \u\u\u'light railways" have been built in increasingly greater numbers since 1892. In this year they totalled 643 miles, but in 1900 reached a length of about 4350 miles, the capital invested in tliem amounting to nearly 30J millions sterling. Prussia possesses also an extensive and admirably arranged system of natural and artificial waterways, and the latter are being con- stantly extended and improved. For instance, in the period 1880-93 the Prussian Government spent no less than \u\u11,677,760 upon the maintenance and construction of locks, canals, canal buildings, bridges, roadways, &o. Besides this there was a special vote of \u\u6,197,600 for the construction of the Dortmund-Ems Canal and the improvement of the navigation of the Oder, Vistula, Spree, and other waterways in Brandenburg. The most important of the canals recently constructed, or still under construction, are the North Sea and Baltic Canal (officially the Emperor William Canal), the Trave-Elbe Canal (to give Liibeck access to the Elbe), the Dortmund-Ems Canal, and its continuation, the Dortmund-Khine Canal, both intended to serve the coal and iron districts of West- phalia and the Rhinelaud ; and there are also projects, which have not yet taken definite shape, for constructing a canal between Stettin and Berlin, another between Kiel and the Elbe vid the Plon lakes, and a gigantic scheme known as the Midland Canal for connecting the rivers Rhine, Elbe, Weser, and Oder. The object of this last is avowedly to facilitate the transmission of the corn and other agri- cultural food products of the east of the kingdom to the populous manufacturing districts of the west. The mercantile marine of Prussia amounted in 1900 to 2074 vessels of an aggregate of 406,657 register tonnage. The largest ship-owning ports are Flensburg, Stettin, Kiel, Rostock, and Danzig ; and Geestemunde owns the largest deep-sea fishing fleet. (Compare also Hambtjeg.) The harbours of the kingdom were in 1898 entered by 64, 329 sea-going vessels of 7,310,013 tons. The bulk of this traffic belonged to the pofts of Danzig, Konigsberg, Stettin, Rostock, Kiel, Altona, and Geestemunde.

Sassnitz, Norddeich, Heligoland, Norderney, and Warnemiinde all have heavy passenger traffic.

Education. ??? All fees are now entirely abolished in the element- ary schools. The subjoined table gives statistics of the schools and universities of the kingdom in the years named : ???

Institution.

No.

Teaching Staff.

No. of

Students or

Pupils.

Universities (1900) .

11

1,503

17,407

Classical and pro-classical

schools (1897-98)

327

4,994

95,196

Mixed classical and modern

schools, and higher modern

schools (1897-98)

145

2,170

46,214

Modern schools (1897-98)

106

1,139

27,820

Elementary schools (1896)

36,138

82,182

5,236,826

Private elementary schools

(1896)

404

17,876

Middle schools (1896)

1,703

5,645^

225,497

Normal schools (1897) .

126

929

11,782

The total number of children of school age (six to fourteen years) in 1896 was returned as 5,654,918. The number of public elementary schools increased from 32,613 in 1878 to 36,138 in 1896. The steady progress of education is attested by the decrease in the percentage of illiterates amongst the military and naval recruits in the annual levy, the decrease going from 2 '33 per cent, in 1880 to 0-1 per cent, in 1900.

Finances. ❓❓❓ As in all civilized countries, the national accounts of Prussia expand by leaps and bounds, and they do this in spite of the advantage which the State derives from the possession of valuable revenue-yielding properties. Of these the most important are the railways. Next in point of revenue come the mines and salines, with an estimated yield in 1902-03 of 9^ millions sterling. Then follow the State forests, yielding over 4 millions sterling in the same year, and the landed domains, yielding about ❓❓1,300,000, though the income from this source is rapidly decreasing as agri-

' In the public middle schools only.

culture declines. For 1902-03 the public revenue was estimated at ❓❓130,708,360 and the expenditure at the same, as compared with a revenue and expenditure of ❓❓86,981,000 in 1890, equivalent to an increase of 66)^ per cent. inl2years. Theprincipal sources of revenueare the railways, ❓❓70,816,400 (1902) ; domains and forests, ❓❓5,354,000 ; State lottery, ❓❓4,413,200; mines, ❓❓9,529,700 ; direct taxes (principally income-tax), ❓❓10,705,000; indirect taxes, ❓❓4,360,850; administrative receipts, ❓❓6,995,350 ; and from the general financial control, ❓❓18,806,500. The chief items of the expenditure consist of

payments for religion and education, ––9,529,700 ; for justice, ––6,061,700 ; expenses of administration, including ––44,188,000 for working the State railways, ––67,050,900 ; interest, &c., on public debt, ––13,923,170 ; the matricular contribution to the imperial exchequer, ––17,395,600; the ministry of finance, ––5,771,750; and the ministry of the interior, ––3,880,300. The minimum of income upon which income-tax is levied was raised from ––21 to ––45 in 1883, and the sum total of incomes liable for income-tax increased from ––286,200,000 in 1892-93 to ––338,750,000 in 1898- 1899, and the number of income-tax payers from 2,435,858 in the former year to 2,907,000 in the latter. The public debt grew from ––64,363,000 iu 1872 to ––329,584,000 in 1900. The greater part of this debt has been incurred in the purchase of the State railways. In 1898-99 there were in all 8,024,928 savings bank books, the number having doubled since 1883 ; and the deposits standing to their credit amounted to ––16,757,000, or an average of ––1 19s. 3d. per head.

Authorities.' ––– In addition to the sources already quoted, see Landeskunde Preussens, Berlin, 1901, edited by Beueemakn. ––– Various volumes of Forschungen zur Deutschen Landes- und Volks-Kunde, edited by KiECHHOFF. ––– British Diplmnatic and Consular Reports, especially Nos. 452, 454, 490, 559, 561, 573, and 574 of the Miscellaneous Series ; and James Bakee, Report on Technical and Commercial Education in East Prussia, &c. London, 1900.

(j. T. BE.)

Prussia, Rhenish, a province of Prussia, witii an area of 10,423 square miles and a population of 5,759,798 (1900), ranking seventh in point of area, but first in point of population, amongst the provinces of the kingdom. The density vforks out at 552 inhabitants to the square mile. Like Westphalia, it is a great producer of coal and other minerals. The chief seats of the coal-mining are the vicinity of Diisseldorf, Saarbriicken and the valley of the Saar, and Aix-la-Chapelle. The total number of hands employed is 111,444 (1900). The statistics of the mines production in 1900 were as follows : ––– 29,010,100 tons of coal, valued at ––14,149,500; 5,162,400 tons of lignite, valued at ––590,500 ;

1,158,120 tons of iron ore, valued at ⬜⬜659,050; 62,470tonsof zinc, valued at⬜⬜275,150; 41,740 tons of lead, valued at ⬜⬜303,400; 51,330 tons of man- ganese, valued at ⬜⬜26,400 ; and 3660 tons of copper, valued at ⬜⬜6650 : or, in all, 35,489,820 tons of minerals, valued at ⬜⬜16,010,650. The salt-works and smelting fur- naces yielded 5131 tons of salt, valued at ⬜⬜3850 ; 24,660 tons of Glauber salts, valued at ⬜⬜29,850 ; 2,915,614 tons of iron, valued at ⬜⬜955,060 ; 38,709 tons of zinc, valued at ⬜⬜810,400 ; about 47,484 tons of lead, valued at ⬜⬜799,000; l,986,730ouncesof silver, valued at ⬜⬜312,850; and 136,426 tons of sulphuric acid, valued at ⬜⬜168,050 ; and the forges, foundries, &c., turned out iron bars, ingots, pig-iron, &c., to the value of ⬜⬜25,222,100. Vines are extensively cultivated, approximately 300,000 acres being planted ⬜⬜⬜with vineyards, and the produce amounts annually to 5 or 6 million gallons of wine. The live stock in the same year numbered 1,156,388 cattle, 892,522 pigs, 174,201 sheep, and 190,294 horses. The sugar factories and refin- eries produced 53,504 tons of sugar, and the breweries, 1 27, 182, 000 gallons of beer. Co-operation is made extensive use of by the cultivators of the soil in this province, there being in 1898 some 65 farmers' associations, besides nearly 200 special associations for horse-breeding, gardening, bee- keeping, viticulture, &c. There are also nearly 120 co- operative farming societies, and 700 " co-operative casinos " for supplying their members with feeding stuffs, artificial manures, machinery, and seeds. (See further under Petissia.) See Brit. Cons. Reps., Nos. 452 and 454

(1898).

S. VIII. ⬜⬜⬜7

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PRUSSIA, EAST ⬜⬜⬜PSYCHICAL RESEARCH

Prussia, East, the most north-easterly province of Prussia, with an area of 14,282 square miles, and popula- tion (1900), 1,996,626, giving 139 inhabitants to the square mile. (See further under Prussia.) The live stock in 1900 numbered 1,061,221 cattle, 839,934 pigs, 622,236 sheep, and

458,063 horses. The sugar factories in the same year produced 10,440 tons of sugar; the iron foundries, goods to the value of ??29,000 ; the breweries, 26,884,000 gallons of beer ; and the distilleries (including those of West Prussia), 8,971,200 gallons of pure alcohol. The mercantile marine consisted in 1900 of 33 sea-going vessels of 15,135 tons.

Prussia, West, a north-easterly province of Prussia, vsith an area of 9854 square miles, and population (1900), 1,563,658. In 1899-1900 the sugar factories pro- duced 102,670 tons of sugar; the breweries, 17,644,000 gallons of beer. (For the distilleries, see Prussia, East.) The Uve stock in 1900 numbered 618,423 sheep, 637,667 cattle, 626,828 pigs, and 243,118 horses. The mercantile marine of the province in 1900 consisted of 57 vessels of 29,045 tons. (For further particulars, see under Prussia, above.)

Przemy^l, a strongly fortified town in Galicia, Austria. There is a strong garrison of 8514 men, com- posed of all arms, including 4 regiments of artillery. The industries comprise the manufacture of machinery, liqueurs, and spodium or tutty, the refining of naphtha, corn-milHng, and the sawing of timber. The trade is chiefly in timber, corn, leather, and linen. Population

(1890), 35,209 ; (1900), 46,349.

PsilOff", a government of north-west Eussia, lying to the south of St Petersburg. It has an area of 17,069 square miles, and a population of 895,710 in 1881andof 1,136,540 in 1897, when there were 584,931 women in the province, and the urban population numbered- only 72,623. With the exception of some 10,000 Esthonians, the inhabitants are almost entirely Great Russians. They mainly belong to the Greek Orthodox Church, but Nonconformity is widely spread, the official number of Nonconformists, 32,066, being far below the mark. There are also about 12,000 Lutherans and 4000 Catholics. The government is divided into eight districts, the chief towns of which are Pskoff (see below), Kholm (5899 inhabitants), Novorzheff (2847), Opochka (5658), Ostroff (6252), Porkhoff (5573), Toropets (7489), and Velikiya Luki (8481). There were in 1896 only 518 schools, attended by 22,601 boys and 6236 girls. In 1887 the peasantry owned 4,114,400 acres ???of land, and 5,312,000 acres belonged to private owners, 366,100 acres to the Crown, 108,200 acres to

the clergy, and 78,000 to various institutions. Since that time the conditions have considerably changed ; between 1875 and 1896 the peasantry increased their possessions by 91 per cent., and the merchants bought considerable areas from the nobles, who altogether sold 43 per cent, of their estates. Although the soil is far from fertile, no less than 3,670,600 acres were under crops in 1900, and 1,359,600 acres were under meadows ; the average annual yield from 1895 to 1899 was 97,000 cwt. of wheat, 4,003,000 cwt. of rye, 1,963,000 cwt. of oats, 756,000 cwt. of barley, and 4,160,000 cwt. of potatoes. Grain has to be imported, but oats are exported. Owing to the efforts of the zemsfvos, there has been a notable improvement in agriculture, especially as regards dairy-farming. Flax is an important crop, producing on an average 86,200 quarters of linseed and about 48,000 tons of flax annually. Live stock in 1897 included 190,090 horses, 412,220 horned cattle, and 328,700 sheep. Fishing in Lake Pskov and the smaller lakes is a source of income, yielding about ££40,000 annually. The manufacture of wooden goods for local

needs, shipbuilding, the timber trade, and the weaving of linen and woollens for local requirements are additional sources of income ; but factories are f ev, giving employ- ment to less than 10,000 persons, and having an annual output valued at about ££1,000,000.

PsICOff, the capital of the above government, situated on Velikaya river, 171 miles by rail south-west of St Peters- burg. It has a lyceum for boys and another for girls, a cadets' school, a normal school for teachers, and a few lower technical schools, attended in 1896 by 2344 boys and 1138 girls, as also a few scientific societies. Its industries are insignificant, and its chief trade is in flax. In 1897 it had a population of 30,424.

Psychical Research. £££ "Psychical research" may be defined, partially, as an examination into the amount of truth contained in world-wide superstitions. Thus when Saul disguised himself, before his seance with the Witch of Endor, and when Croesus scientifically tested the oracles of Greece (finding clairvoyance or lueidiU in the Delphic Pythoness), Saul and Croesus were psychical researchers. A more systematic student was the Neo- platonist philosopher Porphyry. In his

letter to Anebo, answered by lamblichus, we find Porphyry concerned with the usual alleged phenomena ❓❓❓prophecy; the power of walking through fire unharmed ; the movements of inanimate objects, untouched; the "levitation" of "mediums"; apparitions of spirits, their replies to questions, the false- hood of those replies ; and so forth. Similar phenomena fill the lives of the saints, and the records of witch trials. Apparitions, especially of the dying or the dead; the stereotyped ❓❓❓ disturbances in haunted houses ; and the miraculous healing of diseases, are current in classical and medieval records. The exhibition of remote or even future events, to gazers in mirrors, crystals, vessels full of water, or drops of ink or blood, are equally notorious in classical. Oriental, mediaeval, and modern literature, while the whole range of these phenomena is found in Chinese, Japanese, Hindu, ancient American, Red Indian, and savage belief.

At various periods, and in proportion to the scientific methods of the ages, attempts have been made to examine these things scientifically. St Augustine wrote on the whole topic with remarkable acuteness and considerable scepticism ; his treatment of miracles of healing is especially noteworthy. After Thyraeus, S. J. Wierus, Lavater, and other authors of the 16th century, came the labours of Glanvil, Henry ^lore, Richard Baxter, Boyle, Cotton JIather, and others in England and America, during and after the Restoration. Attempts were made to get first-hand evidence, and Glanvil investigated the Knocking Drummer of Tedworth in situ, (1663). The disturbances in the house of the Wesleys at Epworth (1716 and later) were famous, and have copious contem- porary record. David Hume believed himself to have settled questions which, when revived by the case of Swedenborg and the experiments of Mesmer and his jiupils, puzzled and interested Kant. The influence of Mesmer has never died out ; the fact of " animal magnetism " (with such examples as the " divining-rod," and the phenomena in general) was accepted, in his manner, and explained, by Hegel. The researches of Braid {circa 1840-50) gave a now name, "hypnotism," to what had been called "mesmerism" or "animal magnet- ism," a name conveying no theory of " magnetic " or other " fluids." " ^Icsmerism " implies a theory of " emanations " from the operator to the patient ; " hypnotism " implies no such hypothesis. In the middle of the 19th century Dr Gregory and Dr

Mayo published their entertaining but unsystematic works on Animal Magnetism and Tlie

Truths in Popular Superstitions. Esdaile and Elliotson ???were practical pioneers. The epidemic of " spiritualism " and of "turning tables" then invaded Europe from America, and was discussed by Dr Carpenter, Faraday, Gasparin, De Morgan, and many others. The adventures of Daniel Dunglas Home excited all Europe, and his effects were studied by Sir William Crookes with especial attention. Home disappeared after a law-suit; his arts seemed to have induced a wealthy widow to endow him with funds which a jury obliged him to restore. His successes remain an unsolved enigma. Believers explained them by the agency of the spirits of the dead, the old savage theory. He had many followers, most of whom, if not all, were detected in vulgar impostures. Of the books of this period those of Mr Eichard Dale Owen are the most curious, but exact method was still to seek.

In 1882 the Society for Psychical Research, under the presidency of the late Mr Henry Sidgwick, professor of moral philosophy in the University of Cambridge, was founded, expressly for the purpose of introducing scientific method into the study of the "debatable phenomena." Other early members were the late Mr Edmund Gurney, the late Mr E. W. H. Myers, Professor Barrett, Mrs Sidg- wick, Mr Podmore, Lord Tennyson, Lord Eayleigh, and Professor Adams, while among presidents were Professor Balfour Stewart, Mr A. J. Balfour, Professor William James of Harvard, and Sir William Crookes. The society has published many volumes of Proceedings; it has an American branch ; in France is L'Institut Psychologique ; and in Germany and Italy many men of distinguished scientific position have examined the Italian " medium " Eusapia, and have contributed experiments, chiefly in the field of hypnotism and "telepathy." That study has been introduced into official experimental psychology and medicine with some success.

It is plain that the range of psychical research is almost unlimited. It impinges on anthropology (with its study of the savage theory of spirits ❓❓❓ animism ❓❓❓ and of diabolical possession), and on the usual province of psychology, in the problems of the hallucinations both of morbid patients and of people in normal mental health. The whole topic of the unconscious or subconscious self is made matter not of mere metaphysical speculation (as by Kant and Hamil- ton), but of exact observation, and, by aid of hypnotism and automatism, of direct experiment. The six original committees of the society undertook the following themes : ❓❓❓

1. An examination of the nature and extent of any

influence which may be exerted by one mind upon another, apart from any generally recognized mode of perception.

2. The study of hypnotism and the forms of so-called

mesmeric trance, clairvoyance, and other allied phenomena.

3. A critical revision of Reichenbach's researches into

certain organizations called "sensitive."

4. A careful investigation of any reports, resting on

strong testimony, regarding apparitions at the moment of death or otherwise, or regarding dis- turbances in houses reputed to be haunted.

5. An inquiry into the various physical phenomena

commonly called spiritualistic, with an attempt to discover their causes and general laws.

6. The collection and collation of existing materials

bearing on the history of these subjects. To these themes we might now add the study of "crystal-gazing," and of the hallucinatory visions which a fair percentage of people observe when staring into any clear deep,

usually a glass ball ; but ink (with some ex- perimenters) does as well, or a glass water-jug. Of these

themes, the third has practically led to nothing. The experiments of Reichenbach on the perception of flames issuing from magnets have not been verified, though quite recently a hopeful case is reported. The collection of historical examples, again (6), has not been much pursued by the society, except in Mr Gurney's studies of witchcraft in Phantasms of the Living, by himself, Mr Podmore, and Mr Myers. On the other hand, a vast number of experi- ments were made in "thought transference." (1) Dia- grams drawn by A were reproduced by B ; cards thought of, numbers, and so forth, were also reproduced in conditions that appeared to make the normal transference of the idea by sound, sight, or touch impossible, and to put chance coincidence out of court. In one or two instances coUusion was detected ingeniously. In others two ex- planatory theories have been broached. People may accidentally coincide in their choice of diagrams, or the " unconscious whispering " of a person fixing his mind hard on a number, card, or what not may be heard or seen. But coincidence in diagrams does not apply when a ship, dumb-bells, a candlestick, or a cat is drawn by both experimenters; nor can "unconscious whispering" be heard or seen when the experimenters are in different rooms. On the whole, the inquirers convinced them- selves that one mind or brain may influence another mind or brain through no recognized channel of sense. This is, of course, an old idea (see Walton's Life of Donne, and his theory of the appearance of Mrs Donne, with a dead baby, to Dr Donne in Paris). The method of communication remains a problem. Are there "brain waves," analogous to the X-rays, from brain to recipient brain, or does mind touch mind in some unheard-of way'? The former appears to be the hypothesis preferred by Sir William Crookes and Professor Flournoy {Des Lndes a la Planete Mars, pp. 363-365). On this showing there is nothing " supranormal " in "telepathy," as it is called. The latter theory of " a purely spiritual communication " is argued for by Mr Myers (Proceedings of the Society for Psychical Research, vol. xv. pp. 407 ? ? ? 410). If we accept telepathy as experimentally demonstrated, and regard it as a physical process, we reduce (4), " apparitions at the moment of death or otherwise," to a normal though not very usual fact. Every one would admit this in the case of mere empty

hallucinations. A, in Paisley, sees P, in London, present in his room. P is neither dying nor in any other crisis, and A is, as both continue to be, in his normal health. Such experiences are by no means very uncommon, when there is nothing to suggest that P has exercised any telepathic influence on A. On the other hand, in Phantasms of the Living, and in the Report on the Census of Hallucinations {Proceedings, vol. x.), the society has published large numbers of " coincidental " hallucina- tions, the appearance of P to A coinciding with the death or other crisis of the distant P. That such " wraiths " do occur is the popular and savage belief. But, it may be urged, many hallucinations occur and many deaths. People only remember the hallucinations which happened, or were made by erroneous reckoning to seem to hapipen, coincidentally with the decease of the person seen. This is not quite true, for a hallucination so vivid as to be taken for a real person, and addressed as such, is not easily forgotten by a sober citizen, even if "nothing happened" afterwards. None the less, the coincidental hallucinations have certainly a better chance of being remembered, while fancy is apt to exaggerate the closeness of the coincidence. Nothing can demonstrate that coincidences between death and hallucination occur more frequently than by the doctrine of chance they ought to do, except a census of the whole population. In the present indifference of Government to psychical science

no party is likely to institute such a census, and even if it were done, the frivolity of mankind vpould throw doubt on the statistics. It would be necessary to cross-examine each "percipient," and to ask for documentary or other corroborative evidence in each case.

The Society for Psychical Eesearch collected statistics in proportion to its resources. More than 17,000 answers were received to questions rather widely circulated. The affirmative respondents were examined closely, their mental and physical health and circumstances were inquired into, and collectors of evidence were especially enjoined to avoid selecting persons likely to return affirmative replies. There were eighty cases at first hand in which the death of the person seen coincided, within twelve

hours, with the visual hallucination of his or her presence, out of 352 instances of such hallucinations. By way of arriving at the true proportions, the hallucinations which coincided with nothing were multiplied by four. In this way allowance was made for obliviousness of non-coincidental hallucina- tions. The verdict of the committee was that, on the evidence before them, hallucinations coincided with deaths in a ratio of 440 times more than was to be expected by the law of probabilities. The committee came to the conclusion that a relation of cause and effect does exist between the death of A and the vision of A beheld by P. The hallucination is apparently caused from without by some unexplained action of the mind or brain of A on the brain or mind of P. This effect is also traced, where death does not occur, for example, in the many instances of false " arrivals." A is on his way to X, or is dreaming that he is on his way, and is seen at X by P, or by P, Q, and R, as may happen. These cases are common, and were explained, in Celtic philosophy, by the theory of the " Co- Walker," a kind of " astral body." The facts are accounted for in the same way by Scandinavian popular philosophy. Doubtless in many instances such hallucinations are the result of expectancy in the beholder. Where the arrival is not expected, this explanation fails. In "second sight," even among savages, these occurrences are not infrequent, and doubtless admit of an explanation by telepathy. In two instances, known at first hand to the present writer, persons dreamed, at a distance, that they entered their own homes. In one the person was seen, in the other distinctly heard, by the inmates of his or her house. In several of these examples knocks are heard, as in spiritualist seances. In fact, if we accept the evidence, living but remote persons may, unconsciously, produce effects of sound and of phantasms exactly like those which popular belief ascribes to the spirits of the dead.

If we admit the evidence, of which a great body exists, and if we attribute the phenomena to telepathy, curious inferences may be drawn. Thus if the phenomena are such as only the spirits of the dead could be credited with producing ??? if the dead were frequently recognized by various good witnesses ??? it would follow (on the hypothesis of telepathy) that telepathy is not a pliyncal process caused by material waves or rays from hving brain to brain, the dead having no brains in working order. On the other hand, if living brains may thus affect each other, the subjective

hallucination of the living A may conceivably be ” wired on ” to the living P. Thus A, in a given house, may have a mere subjective hallucination of the presence of the dead P, and may, unconsciously, infect with that hallucination other persons who come to the house. Thus once admit that any living brain may infect any other, and it becomes practically impossible for a spirit of the dead to prove his identity. Any information which he may give in any way must either be known to living people, however remote, or unknown. If known to a living person, he may, unconsciously, ” wire it on ” to the seer. If wholly un-

known to everybody, the veracity of the information can- not be demonstrated, except later, when it refers to the unknown future. Thus the theory of telepathy, with a little goodwill, puts the existence and activity of the souls of the dead beyond possibility of proof.

These remarks ajjply to the researches of the society into alleged isolated phantasms of the dead, and into ” haunted houses.” As to the former cases, it is admitted on all hands that sane and sober people may have subjective hallucinations of the presence of living friends, not dying or in any other crisis. Obviously, then, the appearance of a dead person may equally be an empty- hallucination. Thus, a member of the House of Commons,, standing at the entrance of a certain committee-room, saw another member, of peculiar aspect and gait, pass him and enter the room, his favourite haunt. Several hours passed before the percipient suddenly recollected that the other member had been dead for some months. Even super- stition cannot argue that this appearance was a ghost. In the same way Hawthorne, the celebrated novelist, frequently saw a dead club-man in his club. But suppose, for the sake of argument, that at intervals members of the House kept seeing these appearances of dead Members of Parliament, and suppose that they had never seen the prototypes in their lifetime, but yet correctly described them : then it might be said that their hallucinations had merely been ” wired on ” from the brain of some living Member of Parliament who knew the deceased.

Thus telepathy cuts two ways. It is, if accepted, a singular discovery, but it throws an enormous burden of proof on a ” ghost ” who wants to establish his identity. In the same way telepathy cuts at the root of

“clairvoyance,”’ or lucid view of events remote in space or distant in time. The vision may have been “wired on” tele- pathically by a living person who knew the remote event. The ” supranormal ” can only be proved if the information conveyed by the hallucination is verified in the future, or is proved by the finding of documents not known to exist at the time of the hallucination, but after- wards discovered. A curious possible instance was the discovery, in 1856, of a MS. inventory of the jewels of Mary Stuart (1566), verifying in some degree a clairvoyant vision about the jewels published some years earlier (see “Queen Mary’s Jewels” in the writer’s Book of Dreams and Ghosts). For the same reasons, the informa- tion nominally given by “spirits” of the dead through the mouth or by the automatic writing of Mrs Piper (Boston, U.S.) and other mediums may be explained by telepathy from the living who know the facts. This theory is rejected, for example in the case of Mrs Piper, by Mr Myers and Dr Hodgson, who have devoted much time to the examination of the lady (see Proceedings, vols, vi., viii., xiii., xiv., with criticisms by }tlrs Sidgwick and the present writer in vol. xv. part xxxvi.). In Dr Hodgson’s present opinion, the dead do communicate through the automatic writing or speaking of JIrs Piper. The published evidence (much is unpublished) does not seem to justify the conclusion, which is not accepted by iirs Piper herself !

This leads us to the chief field of research in ” auto- matisms,” or actions of the subconscious or “subliminal” self. The prototype of such things is found in the per- formances of natural somnambulists, who in all ages have seemed to exhibit faculties beyond their power when in a normal condition. The experiments of]\Icsmer, and of those who followed in his track, down to the psychologists of to-day, proved (what had long been known to savages, and conjurers) that a state of somnambulism could be induced from without. Moreover, it is jn-oved that certain persons can, as it were, hypnotize themselves and pass into-

trance. In these secondary conditions of trance, such persons are not only amenable to "suggestion," but occasionally evolve what are called secondary personalities : they speak in voices not their own, and exhibit traits of character not theirs, but in harmony with the impersona- tion. The popular, savage, and ancient theory of these phenomena was that the people thus aifeoted were inspired by a god or spirit, or " possessed " by a demon or a dead man. Science now regards the gods or demons or spirits as mere exhibitions of the secondary personality, which wakens when the normal personality slumbers. The knowledge and faculties of the secondary personality, far exceeding those exhibited in the normal state, are explained to a ^eat extent by the patient's command, when in the .secondary state, of resources latent in the memory. The same explanation is offered for other phenomena, like those of automatic writing, knocking out answers by tilting tables, or discovering objects by aid of the " divining- rod." The muscular actions that tilt the table, or wag the Tod, or direct the pencil or planchette, are unconsciously made, and reveal the latent stores of subconscious know- ledge, so that a man writes or knocks out information which he possessed, but did not suspect himself of possessing. These processes were familiar to the Neoplatonists, and in one form or other are practised by Chinese, Tibetans, Negroes, Malayans, and Melanesians. A similar kind of automatism is revealed in the inspirations of genius, which often astonish the author or artist himself. An interesting example has been studied by Mr Myers in the feats of arithmetic recorded about " calculating boys," who are usually unconscious of their methods. The whole of this vast field of the unconscious, or subconscious, or subliminal self has been especially examined by Mr Myers, and by such psychologists as Eibot, Janet Eichet, and many others. The general result is a normal explanation, not yet complete, of the phenomena hitherto attributed to witch- craft, inspiration, possession, and so forth. Probably the devils, saints, angels, and spirits who have communicated with witches, living saints, demoniacs, and visionaries are mere hallucinatory reflections from the subconscious self, endowed with its store of latent memories and strangely acute percipient faculties. Thus a curious chapter of human history is at last within possible reach of explana- tion. Men regard phenomena as " supranormal" or " super- natural," or reject them altogether, tUl their

modus is explained. But it would not be candid to say that the explanation is complete, or nearly complete. The nature of the hypnotic trance itself remains matter of dispute. The knowledge automatically revealed can by no means always be accounted for, either by latent memory or by the sharpening of the normal faculties of perception, while the limits of telepathy (if it be accepted) are vaguely conjectured. Even the results of simple experiments in " crystal-gazing " are often very perplexing. In all ages and countries it has been believed that certain persons can see visions in water, glass, ink, and polished surfaces generally. Experiment has proved, beyond the possibility of doubt, that this is actually the case. But when the visions are not mere fancy pictures, but correctly represent remote persons and events, unknown to the gazer, and perhaps unknown to all present, but later (in the case of the events) verified, the explanation is 'rather to seek. Eurther experiment may reveal some normal explanation, while scepticism (which seldom takes the trouble to examine the alleged facts with any care) can always repose on a theory of malobservation and imposture. These, of course, are verm causae, while in this, as in all provinces of human evidence, bad memories and unconscious errors distort the testimony. Psychical research encourages, or ought to encourage, the cool impartiality in examining.

collecting, and recording facts, which is usually absent, in greater or less degree, from the work even of eminent historians. Men of equal honesty and acuteness may believe or disbelieve in the innocence of Mary Queen of Scots, or in the " spirits " which control Mrs Piper. As to alleged "physical phenomena" of unknown nature, one, the power of passing without lesion with naked feet over fire, has recently been attested by numerous competent observers and experimenters in the ritual of Fijians and other South Sea Islanders, Japanese, Bulgarians, natives of southern India, and other races. (The evidence has been collected by the present writer in Proceedings S.P.R. vol. XV. part xxxvi. pp. 2-15. Compare a case examined and explained, more or less, by Mr S. P. Langley, Nature, August 22, 1901.) The much more famous tales of move- ments of objects untouched have been carefully examined, and perhaps in no instance have professional performers proved innocent of fraud. Yet the best known living medium, Eusapia Paladino, though exposed at Cambridge, has been rehabilitated, after later experiments, in the opinion of many

distinguished Continental observers, who entirely disbelieve in the old theory, the action of " spirits," and venture no other hypothesis.

The results of psychical research, after several years of work, are not really less than could be expected from toil in a field so difficult. The theory of alternating, or secondary, personalities is the key, as we have said, to a strange chapter in "The History of Human Error." The provisional hypothesis of telepathy puts a meaning into the innumerable tales of "wraiths" and of "second sight." It is never waste of time to investigate the area of human faculty ; and practical results, in the medical treatment of abnormal intellectual conditions, have already been obtained. The conduct of our witch-burning ancestors now becomes intelligible, a step on the way to being pardonable. With their methods and inherited prejudices, they could scarcely have reasoned otherwise than they did in certain cases of hysteria and autohypnotization. Many "miracles" of healing, and of "stigmatization," become credible when verified in modern experience and explained by " suggestion " ; though to " explain the explanation " is a task for the future. Such as it is, the theory was accepted by St Francis de Sales in the case of St Theresa. Kesults of wider range and of more momentous interest may yet be obtained. The science of electrical phenomena was not developed in a quarter of a century, and it would be premature to ask more from psychical research than it has achieved in a shorter period. The subject is not readily capable of exact experiment, human faculty being, as it were, capricious, when compared with ordinary physical processes. Imposture, conscious or un- conscious, is also an element of difficulty. But already phenomena which are copiously reported throughout the whole course of history have been proved to possess an actual basis in fact, have been classified, and to some extent have been explained. Even if no light is ever to be cast on spiritual problems, at least the field of psychology has been extended.

The literature of psychical research is already consider- able, and a complete bibliography would occupy much space. Readers who care to pursue the study will find their best guide in the Proceedings of the Society for Psychical Research, which contain a catalogue of the society's collection, including the Gurney Library (Hypnotism), with reviews of

modern books in many languages ⁂ French, German, Italian, Russian ⁂ as they appear. Among modern English books may be recommended Phantasms of the Living, by Messrs Gurney, Podmore, and Myers; Studies in Psychical Research, by Mr Podmore, with his Apparitions and Thought-Transference ; and Principles

of Psychology, by Professor William James, of Harvard. The historical side of the subject, especially as regards the beliefs of savages and of classical antiquity, may be studied in Mr E. B. Tyler's Primitive Culture (under "Animism"), in Mr Myers's Classical Essays (under " Greek Oracles "), and in the present writer's Cock Lane and Common Sense, and Making of Beligion. Mr Myers's work, Hwman Personality, contains collections of facts.

with a provisional theory. M. Th. Flournoy's Des Indes a la Planete Mars is a penetrating study of pseudo- spiritual "messages." A criticism making against the notion of telepathy may be found in Herr Parish's- Hallminations and Illusions (English translation). Some errors and confusions in this work (due in part to the expansion of the original text) are noted in the author's Making of Religion, Appendix A. (a. l.)

PSYCHOLOGY.

THE science of Psychology has made unwonted strides since 1885. First of aU, it has entered upon an experimental stage, and a well-equipped laboratory is now an adjunct of almost every important psychological school. A bewildering mass of detail has been accumulated relating to such processes as sensation, perception, memory, associa- tion, and attention (see Physiology, Special Senses). But there must be a thorough scrutiny of methods and a careful elimination of such results as have really only a physiological import, before we can decide how much of this material can be safely or systematically incor- porated into the science itself. In the next place ⁂ and largely through the influence of Darwin ⁂ we have now the beginning of a new Comparative

Psychology to replace the old repertories of anecdote collected by uncritical admirers of animal instinct and intelhgence. Further, important additions to our psychological knowledge have resulted from the observations of the mental physician, particularly in cases of aphasia and cognate diseases, and in hypnotic and other abnormal states.

So impressive altogether are these extensions of psycho- logy by objective methods of experiment and observation, that the older and more fundamental method of introspective reflection is nowadays often scouted not merely as more difficult ––– this has always been acknowledged ––– but as now at length altogether obsolete and superfluous. Thus, whereas the old psychology was closely related to the philosophical or moral sciences and sharply contrasted with the natural sciences, the new assumes very much the posi- tion long ago assigned to psychology by Comte : it becomes ” mental physiology ” or ” physiological psychology.” The distinction of natural and moral science only serves, on this view, to mark different stages of evolutional com- plexity : it ceases to be a distinction of kind.

But meanwhile, and from another side, the old psycho- logy stDl shows signs of life. Here, too, great progress has been made, and several new lines of advance may be distinguished. The relation of psychology to episte- mology, for example, has been very much under dis- cussion of late. A generation ago it was common ––– except in Germany ––– to lump psychology and philosophy together under the common title of Mental Philosophy or Metaphysics.! Since then the growth of physiological psychology on the one hand, and the increasing influence of the Kantian philosophy on the other, have led to the undue severance of the two subjects, which is now in course of correction. But the psychologist no longer essays to solve the problem of objective knowledge by looking ––– ~~after Locke’s fashion ––– into the individual mind. Nowadays it is the epistemologist endeavouring to analyse and connect the forms, categories, and ideas (to use the Kantian phrases) by means of which objective knowledge is organized, who is led to demand, or perhaps himself to provide, a genetic psychology of Kant’s Bewusstsein iiber~~

1 Cf., e.g., Hamilton's Lectures on Metaphysics, or the article " Metaphysics," by Mansel, in the 8th edition of this EncyolopjEdia.

haupt ??? i.e., of the general or collective mind, to which the universal and necessary syntheses of experience are referred.

To Kant at the close of the 18th century it seemed obvious that the so-called pure forms of knowledge and practice were original and ultimate faculties of the human mind, and therefore quite beyond elucidation by psychological methods, whether genetic or analytic. The hard and fast distinctions which he drew between & priori and d posteriori, between matter and form, cut off psycho- logy from any part or lot in the deliberations of philosophy. But to Kant's followers at the opening of the 20th century it seems equally obvious, (1) that if the human mind is the result not of a special creation but of a continuous development, it cannot be, as he maintained, ' ' perfectly futile labour " to investigate how those epistemologioally d priori or transcendental forms were acquired ; and (2) that, if acquired, those forms cannot be, as ho supposed, elementary and ultimate in such wise as to render any analysis of them impossible. For the perceptual forms of space and time such analysis has been in the main accomplished already, and the result seems to entail important changes in the Kantian epistemology, especially in relation to mathematics." As regards the categories, Kant's derivation of them from the forms of judg- ment is allowed to be little better than wasted ingenuity ; while ma admission of an acquisitio originaria, if not meaningless, brings them within the range of a genetic psychology dealing with objective experience, as our latter – day Kantians for the most part acknowledge.'

Again, two problems, that have vexed most philosophic thinkers since Descartes, are now brought into conjunction in a way that makes psychological revision inevitable : they are the question concerning the perception of an external world and the question as to the relation of body and mind. The solutions in vogue maybe summarized as follows: ??? (1) "The face to face acquaintance with the real world which Common Sense assumes is illusory : the coloured, tangible, sonorous world is not the external world at all, not even a copy of it. Our sensations are but

symbols or indications of external reality ; the most we can say is that there is correspondence between the" two." (2) "States of mind and states of brain run parallel, but do not interact : brain-ehanges, both as to the causes that produce them and the effects that they produce, belong entirely to the physical world of matter and motion." The deadlock here becomes palpable and evident on a very slight examination. On the physical side it cannot be kno^vn that psychical changes shadow neural changes, for there can be no physical evidence that psychical change occurs at all. And on the psychical side, though one sensation may serve as index to another sensation, it is as impossible that sensory experience should give any clue to what is, ex hypothesi, wholly beyond it, as that sounds, for example, should apprise a blind man of colours or colours a deaf man of sounds. In fact, according to these theories th& physical and the psychical standpoints are comparable to the positions of the blind and deaf relatively to each other. A way out of the difficulty is sought in a surreptitious use of the notion of causality. Sensations, it is assumed, are not merely indications, but effects, of the external world in the one case ; and mental states generally are not merely concomitants, but "collateral," non-physical, products of neural states in the other. The justi- fication of these assumptions must, in part at all events, be referred to psychology.

In this supplementary article the attempt will be made to discuss the various new topics just described, on the old lines as far as possible and as fully as the limits allow.

" Cf. B. Erdmaun, Die Aodome der Geometric, 1877, and Eussell, An Essay on tlie Foundations of Geometry, 1897.

" On this whole topic, cf. Stumpf, Psychologie mid Erkenntnisstehre, 1891 ; 0. Schneider, Die psychologisclie JEntwickeluiig dcs ApHsri,

1883,

standpoint]

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Standpoint; Relation to Epistemology ; General Analysis.

In defining psychology the propriety of avoiding the term Mind, on account of its implication of the disastrous dualism of mind and matter, is widely acknowledged. But the term Consciousness, which is the most frequent substitute, is liable to an opposite objection, that of laying undue stress on the subjective as opposed to the objective. Experience is, it is maintained, a more fundamental and ‘ less ambiguous conception. We must start, of course, from individual human experience ; and we must endeavour from this standpoint to determine the ” irreducible minimum ” involved, so that our conception may apply to all lower forms of experience as well. Etymologically experience connotes practical acquaintance, efficiency, and skill as the result of trial ??? usually repeated trial ??? and effort. !Many recent writers on comparative psychology propose to make evidence of experience in this sense the criterion of psychical life or ” mentality.” The ox knoweth his owner and the ass his master’s crib, and so would pass muster ; but the ant and the bee, who are said to learn nothing, would, in spite of their marvellous instinctive skill, be re- garded as mere automata in Descartes’ sense. That this criterion is decisive on the positive side will hardly be denied ; the question how far it is available negatively we must examine later on. But it will be well first briefly to note some of the implications of this positive criterion : Experience is the process of becoming expert by experiment. The chief implication, no doubt, is that which in psycho- logical language we express as the duality of subject and object, already strenuously insisted on in the article in the earlier volumes of this Encyclopaedia. Looking at this relation as the comparative psychologist has to do, we find that it tallies in the main with the bio- logical relation of organism and environment. The individuality of the organism corresponds to, though it is not necessarily identical with, the psychological subject, while to the environment and its changes corre- sponds the objective continuum or totum objectivum already described (p. 45).-‘ This correspondence further helps us to see still more clearly the error of regarding individual experience as wholly subjective, and at the same time helps us to find some measure of truth in the naive realism of Common Sense. As these points have an important bearing on the connexion of psychology and epistemology, we may attempt to elucidate them more fully. Though it

would be unwarrantable to resolve a thing, as some have done, into a mere meeting-point of relations, yet it is perhaps as great a mistake to assume that it can be any- thing determinate in itself apart from all relations to other things. By the physicist this mistake can hardly be made : for him action and reaction are strictly correlative : a material system can do no work on itself. For the biologist, again, organism and environment are invariably complementary. But in psychology, when presentations are regarded as subjective modifications, we have this mistake in a glaring form, and all the hopeless difficulties of what is called "subjective idealism" are the result. Subjective modifications no doubt are always one con- stituent of individual experience, but always as correlative to objective modifications or change in the objective con- tinuum. If experience were throughout subjective, not merely would the term subjective itself be meaningless, not merely would the conception of the objective never arise, but the entirely impersonal and intransitive process that remained, though it might be described as absolute

' Eeferenoes to pages iu the text without further qualification are to pages of the earKer article in this Encyclopaedia, vol. xx. (ninth edition).

becoming, could not be called even solipsism, least of aU real experience. Common Sense, then, is right in positing, wherever experience is inferred, (1) a factor answering to what we know as self, and (2) another factor answering to what each of us knows as the world. It is further right in regarding the world which each one immediately knows as a coloured, sounding, tangible world, more exactly as a world of sensible qualities. The assumption of naive realism, that the world as each one knows it exists in- dependently of him, is questionable. But this assumption goes beyond individual experience, and does not, indeed could not, arise at this standpoint.

There is one further characteristic of individual ex- perience involved in the preceding that is worth noting here. Answering to the individuality and unity of the subjective factor, there is a corresponding unity and in- dividuality of the objective. Every Ego has its correlative Non-Ego, whence in the end such familiar sayings as Tot mentes qiiot sententice, and the like. The doctrine of Leibnitz, that "each monad is a living mirror

. . . repre- sentative of the universe according to its point of view," will, with obvious reservations, occur to many as illustrative here. In particular, Leibnitz emphasized one point on which psychology will do well to insist. " Since the world is a plenum," he begins, " all things are connected together, and every body acts upon every other, more or less, according to their distance, and is affected by their reaction ; hence each monad is a living mirror," &c.^ Subject and Object, or (as it will be clearer in this connexion to say) Ego and Non-Ego, are then not merely logically a universe, but actually the universe, so that, as Leibnitz put it, " He who sees all could read in each that which passes everywhere else" {Monadology, ►►61). Though every individual ex- perience is unique, yet the more EgOj is similar to EgOj. the more their complementaries Non-EgOj, Non-EgOj are likewise similar ; much as two perspective projections are more similar the more adjacent their points of sight, and more similar as regards a given position the greater its distance from both points. No doubt we must also make a very extensive use of the hypothesis of subconsciousness, just as Leibnitz did, before we can say that the universe is the objective factor in each and everyindividual's experience. But we have in any case to allow that, besides the strictly limited " content " rising above the threshold of conscious- ness, there is an indefinite extension of the presentational continumm beyond it. And the Leibnitzian Monadology helps us also to clear up a certain confusion that besets terms such as " content of consciousness," or " finite centre of experience " ►►►a barbarous but intelligible phrase that has recently appeared ►►►the confusion, that is, with a mosaic of mutually exclusive areas, or with a scheme of mutually exclusive logical compartments. Consciousnesses, though in one respect mutually exclusive, do not limit each other in this fashion. For there is a sense in which all individual experiences are absolutely the same, though relatively different as to their point of view, i.e., as to the manner in which for each the same absolute whole is sundered into subjective and objective factors.

This way of looking at the facts of mind helps, again, to dispel the obscurity infecting such terms as subjective, intersubjective, transsubjective, and objective, as these occur in psychological or epistemological discussions. For the psychologist must maintain that no experience is merely subjective : it is only epistemologists, and notably

Kant, who so describe individual experience, because for them objects experienced in their concrete particularity pertain, like so many idiosyncrasies, to the individual alone. In contrast with this, epistemologists then describe universal

^ Prirwiples of Sature and Grace, ►►3.

[sensation

experience, the objects in which are the same for every experient, as objective experience par excellence. And so has arisen the time-honoured opposition of Sense-know- ledge and Thought-knowledge : so too has arisen the dualism of Empiricism and Eationalism, which Kant sought to surmount by logical analysis. It is in the endeavour to supplement this analysis by a psychological genesis that the terms intersubjeotive and transsubjective prove useful. The problem for psychology is to ascertain the successive stages in the advance from the one form of experience or knowledge to the other. " When ten men look at the sun or the moon," said Reid, " they all see the same individual object." But according to Hamilton this statement is not " philosophically correct, . . . the truth is that each of these persons sees a different object. ... It is not by perception but by a process of reasoning that we connect the objects of sense with existences beyond the sphere of immediate knowledge." i Now it is to this " beyond " that the term transsubjective is applied, and the question before us is : How do individual subjects thus get beyond the immanence or immediacy with which all experience begins 1 By a "process of reasoning," it is said. But it is at least true in fact, whether necessarily true or not, that such reasoning is the result of social intercourse. Further, it will be generally allowed that Kant's Analytih, before referred to, has made plain the insufficiency of merely formal reasoning to yield the categories of Substance, Cause, and End, by which we pass from mere perceptual experience to that wider experience which transcends it. And psy- chology, again, may claim to have shown that in fact these categories are the result of that reflective self-consciousness to which social

intercourse first gives rise (cf. pp. 75 n^, 84). But such intercourse, it has been urged, presupposes the common ground between subject and subject which it is meant to explain. How, it is asked, if every subject is confined to his own unique experience, does this intersubjeotive intercourse ever arise ? This objection ❓❓❓ ^formidable though it seems when the discrete alter- natives, "either. . . or," are alone considered as in logical analysis ^ ❓❓❓ disappears in the region of continuous development with which genetic psychology deals. If no progress towards intellective synthesis were possible before intersubjeotive intercourse began, such intercourse, as presupposing something more than immediate sense ~~*knowledge, obviously never could begin.^ Let us illustrate by an analogy which Leibnitz's association of experience with a "point of view" at once suggests. If it were possible for the terrestrial astronomer to obtain observations of the heavens from astronomers in the neighbouring stars, he would be able to map in three dimensions constellations which now he can only represent in two. But unless he had ascertained unaided the heli entrio parallax of those neighbouring stars, he would have no means of distinguishing them as near from the distant myriads besides, or of understanding the data he might receive ; and unless he had first of all determined the still humbler geocentric parallax of our sun, those heliocentric parallaxes would have been un*~~ *attainable. So in like manner we may say "intersubjeotive parallax" presupposes what we may call "subjective parallax," and even this the psychological duality of object and subject. But such subjective parallax or acquaintance with other like selves is the direct outcome of the extended range in time which memory proper secures ; and when in this way self has become an ohjeet, resembling objects become other selves or "ejects," to adopt with slight modification a term originated by Professor W. K. Olilford. We may be quite sure that his faithful dog is as little of a solipsist as the noble savage whom he ac- companies. Indeed, the rudiments of the social factor are, if wo may judge by biological evidence, to be found very early. Sexual union in the physiological sense occurs in all but the lowest Metazoa, pairing and courtship are frequent among insects, while "among the cold-blooded fishes the liattle of the stickleback with his rivals, his captivating manoeuvres to lead the female to the nest which he has built, his mad dance of passion around her, and his*

‘ Lectures on Metaphysics, ii. p. 153.

^ It is amazing how often this type of argument has occurred since Zeuo’s famous paradoxes about motion, where it first appears.

‘ And it is precisely for want of this mediation that Kant’s “two stems of human knowledge, which perhaps may spring from a common but to us unknown root, ” leave epistemology still more or less hampered with the old dualism of sense and understanding.

subsequent jealous guarding of the nest, have often been observed and admired.”^ Among birds and mammals we find not merely that these psychological aspects of sexual life are greatly extended, but we find also prolonged education of oHspring by parents and imitation of the parents by ott’spring. Even language, or at any rate “the linguistic impulse,” is not wholly absent among brutes.’ Thus as the sensorimotor adjustments of the organism to its environment generally advance in complexity and range, there is a concomitant advance in the variety and intimacy of its relations specially with individuals of its kind. It is therefore reasonable to assume no discontinuity between phases of experience that for the individual are merely objective and phases that are also ejeotive as well ; and once the ejective level is attained, some interchange of experience is possible. So disappears the great gulf fixed betwixt subjective or individual and intersubjeotive or universal experience by rival systems in philosophy.

One other implication of the psychological conception of experience calls for brief mention, for it is one that of late years has gained many adherents. Experience as the psychologist deals with it, living experience, is primarily and pre-eminently practical. Obvious as this must appear to those who look at the facts of life in the light of the theory of evolution, yet it is a truth that was for the most part overlooked so long as psychology was studied mainly by philosophers, and studied therefore mainly in its bearing on philosophical problems. But the notion of an inde- pendent realm of truth existing sub specie wternitatis has literally no place within the purview of a psychology that knows its business. Here we find no such thing as mere cognition : the uninteresting is not known but ignored, and the interesting leads at once to response, and sooner or

*later to adjustment ⬛⬛⬛ in the race, at all events. Success is then completed experience or expertness, and in general prepares the way for a new advance. So far the true is the useful, and the criterion is not theoretical but practical. Looking broadly at the progress of life, as it ascends through the animal kingdom and onwards through the history of man, it seems safe to say that knowledge is always a means to ends, is never an end by itself ⬛⬛⬛ till at length it becomes interesting and satisfying in itself. Psychologically, then, the sole function of perception and intellection is to guide action and subserve volition ⬛⬛⬛ more generally, to promote self-conservation and betterment. Knowledge, from this point of view, may even be regarded as the joint product of natural selection and subjective selection : it emerges tainted, as some may think, at aU events permeated, by a teleological colouring.^*

Sensation, Movement, and the External World.

On the view of experience just described, we are led to challenge the physiological method of describing sensations as due to physical stimuli, which is still widely current. The following definition, given by Dr Bain, may be taken as a type: ⬛⬛⬛ "By sensations, in the strict meaning, we understand the mental impressions, feelings, or states of consciousness following on the action of external things on some part of the body, called on that account, sensitive." ' It is true, no doubt, that what the psychologist calls sensibility has as its invariable concomitant what physiolo- gists call sensibility, or what the more careful of them call irritability; and, true again, that this irritability is invariably jDreceded by a physical process called stimulation. But the converse utatemonts are not true : there may be stimu-

⬛⬛⬛⬛⬛⬛ Ernlntlon of Sex, by Geddes and Tliomson, 1st ed., p. 265.

" Cf. Darwin, Descent of Man, i. p. 56.

⬛⬛ Cf. especially Simmel, "Ueber eine Beziehungder Selectionstheorie zur Erkenutnisstheorie," .1 (⬛⬛⬛< ⬛⬛⬛/!,. /. syst. Philosophic, 1895, pp. 34-4ri ; W. James, Philosophical Conceptions and Practical Results, 1898 ; J. Ward, Naliimlism and Af/nostieism, 1899, vol. ii. pp. 133 f., 235

f., 253 f., &o. The view above described, which doubtless is substantially an iudirect result of the philosophy of Schopenhauer, has been called Voluntarism (Paulsen, Wundt), and again Pragmatism (James).

‘ Senses and Intellect, 4th ed., 1894, p. 101.

lation and no consequent irritation, irritation and no concomitant sensation. It is then certain that the three processes are distinct, and it is equally certain that the last alone enters into immediate experience. Nevertheless, it is urged, why not recognize a connexion that actually obtains, since otherwise sensation must remain unexplained % Well, in the first place, such ” psychophysical ” connexion is not a psychological exislanation : it cannot be turned directly to account in psychology, either analytic or genetic. Next, the psychological fact called sensation always is, and at bottom always must be, independently ascertained ; for, as said, the physiological ” neurosis ” or irritation has not necessarily a concomitant ” psychosis ” or sensation and, strictly dealt with, affords no hint of such. Finally, this inexplicability of sensation is a psychological fact of the utmost moment : it answers to what we call reality in the primary sense of the term. The psychophysicist, in setting out to explain sensation, has ??? unawares to himself ??? left this fundamental reahty behind him. For it belongs essentially to individual experience, and this ??? in assuming the physical standpoint ??? he has of course transcended. Nevertheless the mistake of method that here reveals itself was perhaps inevitable, for the facts of another’s sense- organs and their physical excitants must have obtruded themselves on observation long before the reflective attitude was advanced enough to make strictly psychological analysis possible. The psychophysical standpoint, that is to say, was attained before the purely psychological; and the consequent bias is only now in process of correction. A series of physical processes, first without and then within the organism ??? ethereal or aerial vibrations, neural and cerebral excitations ??? was the starting-point.

What comes first, immediately, and alone, in the individual's experience, and is there simply and positively real, was then mis- interpreted as subjective modification, mental impression, species sensibilis, or the like. For from the days of Democritus down to our own the same crude metaphor has prevailed without essential variation. And here the saying holds : Nulla vestigia retrorsum. Into the man's head the whole world goes, including the head itself. Such thoroughgoing " introjection " afibrds no ground for sub- sequent "projection." Thus the endeavour to explain sensation overreaches itself : the external object or thing that was supposed to cause sensations, and to be therefore distinct from them, was in the end wholly resolved into these and regarded as built out of them by association (MUl) or by apperceptive synthesis (Kant). But no "mental chemistry," no initial alchemy of "forms," can generate objective reality from feelings or sense-impressions as psychophysical^ defined. ^ A's experience as it is for B is not real but inferential ; and if the grounds of the infer- ence, which are realities only for B, are to be regarded as the causes of which A's experiences are merely the effects, then the two experiences are on a wholly different footing. When A treats B in the same fashion we get the world in duplicate : (1) as original and outside, i.e., as cause, and (2) as copied within each percipient's head, i.e., as effect. But when B interprets his own experience as he had interpreted A's, we seem to have lost the real world altogether. In presence of this dilemma, the philosophers of our time, as already said, are feeling it needful to revise their psychology. The question of method is vital. If the psychophysical standpoint were the right one, psychology would be based on physiology, and the old conception of sensation might stand. If, on the other hand, it is the exclusive business of psychology to analyse and trace the development of individual experience as it is for

' Nothing shows this more plainly than the newly-coined term epiphenmnenon now applied in this connexion. As to this, see helow, p. 68.

the experiencing individual, then ??? however much neuro- logical evidence may be employed as a means of ascertain- ing psychological facts ??? the facts themselves must be scrupulously divested of all

physical implications, the psychophysical method takes a secondary place, and the objective reality of "sensory" presentations stands unim- peached.

Motor presentations have been constantly under discus- sion since 1875, and at length it may perhaps be said that clearer views begin to prevail. AuxiKo-motor presentations (now called kinsesthetic), by means of which bodily equi- librium and locomotor taxis are regulated, were commonly allowed to be purely sensory, the concomitants of centri- petal excitations: hence the older name of "muscular or sixth sense " applied to them by Sir Charles Bell, Weber, Sir William Hamilton, and others. But concerning motor presentations proper (more commonly called feelings of innervation or feelings of efibrt), the view first tentatively advanced by the great physiologist Johannes MiiUer, and adopted by Helmholtz, Wundt, and especially by Professor Bain, is now generally discredited, if not completely over- thrown.2 According to this view, " the characteristic feel- ing of exerted force " must be regarded, Dr Bain maintains, " not as arising from an inward transmission .... but as the concomitant of the outgoing current by which the muscles are stimulated to act" {op. cit, p. 79).

The necessity for this assumption has certainly not been established on physiological grounds, nor apparently does Dr Bain rely primarily on these, for at the very outset of his discussion we find him saying " that action is a more intimate and inseparable property of our constitution than any of our sensations, and enters as a component part into every one of our senses " {pp. cit., p. 59). But this im- portant psychological truth is affirmed as strenuously by some at any rate {e.g.. Prof. James) of Dr Bain's opponents as it is by Dr Bain himself. Unhappily many, under the same psychophysical bias and so induced, like the up- holders of this innervation theory, to look for evidence of subjective activity in the wrong place, have been led to 'doubt or to deny the reality of this activity altogether. In fact, this theory, while it lasted, tended to sustain an undue separation of so-called " sensory " from so-caUed " motor " presentations, as if living experience were literally an alternation of two independent states, one wholly passive and the other wholly active, corresponding to the anatomical distinction of organs of sense and organs of movement. The subject of experience or Ego does not pass to

and fro between a sensorium commune or intelli- gence department and a motorium, commune or executive, is not in successive intervals receptive and active, still less always passive, but rather always actively en rapport with an active Non-Ego, commonly called the External World.

*Experience at this level ??? experience, that is to say, con- fined to sensation and movement ??? may be described as perceptual, and as consisting of the difierentiation and redintegration of a presentational continuum (cf. pp. 51 f.). Space and time, as ” forms ” of this perceptual experience, have, it is important to note, certain concrete character- istics not pertaining to the ideal conceptions of pure space and pure time afterwards elaborated from them. Both psychology and epistemology gain by the recognition of these differences, which, owing to the influence of Kant, have till recently been quite ignored. Only the barest reference to these characteristic differences is here possible.^*

2 Cf. Bastian, The Brain as an Organ of Mind, 1880, pp. 691 ff.; Ferrier, The Functions of the Brain, 2iid ed., 1886, pp. 382 ??F.; James, Principles of Psychology, 1890, ch. xxvi.

‘ Cf. Ward, Xaturalism and Agnosticism, 1899, vol. ii. pp. 136-149, for fuller treatment.

S. VIII. ??? 8

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[ideation

(1) ” Here ” and ” now ” are for the individual percipient absolute positions, and have no counterpart in the thorough- going relativity of abstract space and time. (2) Again, they refer not to a mathematical “point” and “instant,” but imply a certain ” restricted ubiquity.” This, in the case of space, answers to the primitive extensity of what may be called the body-sense, the fundamental importance of which for the further elaboration of spatial experience is now at length widely recognized. ^ In

the case of time, such ” ubiquity ” answers to that ” sensible present ” or “enduring now,” within which change is directly appre- hended : the reduction of this to an instant would render experience impossible. ^ (3) In this perceptual experience of the temporal and spatial in the concrete there is nothing of that homogeneity which science attributes to space and time in the abstract. The “body-sense,” in contrast with what may be called ” the projecting senses,” ^ yields the vital distinction of internal and external, marking off the bodily self from its environment. The environing space, again, varies in character, intimacy, and even in dimensions as we recede from the foreground towards the background, from objects to which we can adjust by changes of posture to objects only to be reached by locomotion. A similar perspective is characteristic of temporal perceptions, but is confined almost entirely to the “psychical present” till experience advances to the ideational stage. To this stage we may now turn.

Growth aistd Development op Ideation.

We find ourselves sometimes engrossed in present per- ceptions, as when tracing, for example, the meanderings of an ant; at other times we may be equally absorbed in reminiscences ; or, again, in pure reverie and ” castle-build- ing,” Here are three well-marked forms of conscious life : the first being concerned with what is, the second with what has been, and the third vidth the merely possible. Again, the first involves definite spatial and temporal order, though the temporal order, as just said, is in the main restricted to the ” sensible present ” ; the second involves only definite time-order; and the last neither in a definite way. Thus analytically regarded, perception, memory, imagination, show a steady advance. In infancy the first predominates, while senility lapses tack to the second ; in the third, where similarities suggest themselves and the contrast of actual and possible is explicit, we have at length the groundwork of logical comparison. Nevertheless, since imagination plays a con- spicuous part in child-life before much personal reminis- cence appears, it would seem probable that ideas do not first arise as definite memory-images or reminiscences. On the other hand, in the so-called homing instincts of the lower animals we have evidence of isolated ” memories ” of a simpler form than ours. Altogether it will be best, therefore, to lay aside the

analytical distinction of a memory continuum or “thread,” and of an ideational continuum or ” texture ” ‘^ (supposed to be formed by re-duplication of the thread upon itself), in here taking up anew the question of the genesis of ideas, very inadequately dealt with in the earlier article (p. 60).

The subject is as difficult as it is interesting and important, and we can hardly hope at present for a final solution. One chief obstacle, as is so often the case in psychology, lies in the unsettled connotation of such leading terms as memory, asuocialion, and idea. Even what is most fundamental of all, that ” plasticity ” which

‘ Cf. especially James, Principles of Psychology, 1890, ch. xx.

2 Cf. James, op. cit, vol. i. pp. 608 ff.; L. W. Stern, “Psychisohe Prasenzzeit,” Zeitsrhrift f. Psycholoijieu.s.m., 1897, Bd. xiii. pp. 325 tf.

‘ For the suggestion of these terms see Flechsig, Gehim und Seele, 1896, p. 21.

* 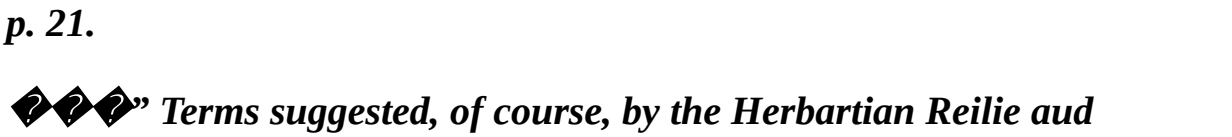 ” Terms suggested, of course, by the Herbartian Reilie aud Oewebe ; cf. vol. XX. pp. 58 and 61.*

we have analysed into retentiveness, differentiation, and integra- tion, is sometimes described as if it already involved memory- ideas and their association. Ideas, that is to say, are idcntiued with mere “residua” of former “impressions,” and yet at the same time are spoken of as “copies” of these : which is much like saying the evening twilight is a replica of the noonday glare as well as its parting gleam. Again, the continuous differentiation and redintegration of the presentational continuum which mark the progress of perceptual experience are resolved into an original multiplicity of presentational atoms which are associated by ‘ ‘ adhesion ” of the contiguous. Yet before the differentiation there was no plurality, and after the integration there is only a complex unity, comparable perhaps with a group of segregated cells or other organic whole, but certainly not with a mosaic stuck together with cement. This mistaken identification by the Associationist psycho- logy of later processes with simpler and earlier ones, by which they are only partially explained, has

not only obscured the science with inappropriate conceptions but has prevented the question on which we are entering ??? that concerning the genesis and develop- ment of ideas ??? from being ever effectually raised. The discussion of this question will incidentally yield the best refutation of those views.

Experience, we say (cf. above, p. 56), is the acquisition of practical acquaintance and efficiency as the result of repeated opportunity and effort. This means that strange- ness on the cognitive side gives place to familiarity, and that on the active side clumsiness is superseded by skill. But though analytically distinct, the two sides are, as we have already insisted, actually inseparable : to the uninteresting we are indifferent, and what does not call for active response is ignored. If the original presenta- tions, whether sensory or motor, be A, B, C, we find then that they gradually acquire a new character, become, let us say, A", B", C", y representing the eventual familiar- ity or facility, as the case may be. We find, again, a certain sameness in this character, however various the presentations to which it pertains, a sameness which points to the presence of subjective constituents, and to these we may assign the "feelings" that enter into accommodation and adjustment. This factor is important as evidence of a subjective co-operation which may enable us to dispense with the mutual " adhesions " and " attractions " among presentations, on which the Associationists rely. But it is obvious that there must be an objective factor as well; and it is this objective factor in the process giving rise to y that now primarily concerns us. We have described that process as assimilation or immediate recognition : the older psychology described it as association of the completely similar, or as automatic association. That the two views have something in common is shown by the juxtaposition of " automatic " and " immediate," " similar- ity " and " assimilation." To prepare the way for further discussion, let us first ascertain these points of agreement. " When I look at the full moon," says Dr Bain, " I am instantly impressed with the state arising from all my former impressions of her disc added together." This

we may symbolize in the usual fashion as A H- a???

+ a^ + a.^ + ay Now, it will be granted (1) that the present occurrence (full moon) has been preceded by a series of like occurrences, enumerable as 1, 2, 3, ??? ??? ???n; (2) that the present experience (A^) is what it is in conse- quence of the preceding experiences of these occurrences ; and (3) that it " arises instantly " as the joint result of such preceding experiences. But it is denied (1) that this present experience is the mere sum, or even the mere "fusion," of the experiences preceding it; or (2) that they were qualitatively identical ; or (3) that they persist severally unaltered, in such wise that experience " drags at each remove a lengthening chain" of them. In the case of dexterities, where y answers to facility, it is obvious that there is no such series of identicals (a,, a???, ??? ??? ???an) at all. From the first rude beginning ??? say the schoolboy's pothooks ???up to the finished performance of the adept there is continuous approximation : awkward

ideation]

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and bungling attempts, passing gradually into the bold atrokea of mastery. Nor is the case essentially different in cognition where y answers to familiarity, if we attend, as it is plain we ought, not to the physical fact but to the individual's percept. This too is an acquisition, has en- tailed activity, and is marked by gradual approximation towards clearness and distinctness. The successive ex- perience of n identical occurrences does not then result in an accumulation of n identical residua. The ineptness 'of the atomistic psychology with its " physical " and " chemical " analysis is nowhere more apparent than here. Considering the intimate relation of lite and mind, and the strong physiological bias shown by the Associationists from Hartley onwards, it is surely extraordinary how com- pletely they have failed to appreciate the light-bearing ???significance of the conceptions of function and develop- ment. Facility and faculty (or function) are much the same, both etymologically and actually. As the perfected structure is not so many rudimentary structures " added together," but something that supersedes them completely, must we not

say the same of the perfected function % The less fit is not embodied in the fittest that finally survives. Development implies change of form in a continuous whole : every growth into means an equal growth owt cf : thus one cannot find the caterpillar in the butterfly. Between organic development and mental development there is then more than an analogy.

But though assimilation cannot be analysed into a series of identical ideas (a^, a^, ??? ??? ???an), either " added together " ???or "instantaneously fused," yet it does result in an a which may provisionally be called an idea. Such idea is, however, neither a memory-idea in the proper sense nor an idea within the meaning of the term implied in imagina- tion or ideation. For it is devoid of the temporal-signs indicated by the subscript numerals in a^, a^ ??? ??? ???, and it does not yet admit of reproduction as part of an ideational continuum, one, that is, divested of the characteristics belonging to the actual and sensibly present. It is, so to say, embryonic, something additional to the mere sensation assimilated, and yet something less than a " free or independent idea." It is, as it has been happily called, i a tied (ffebundene) or implicit idea. We have clear evidence of the sense-bound stage of this immature " idea " in the so-called "memory after-image" already described (pp. 59 f.). There is, however, nothing in this of memory, save as the term is loosely used for mere retentiveness ; and after-percept would therefore be a less objectionable name for it. This after-percept is entirely sense-sustained and admits of no ideal recall, though ???in minds sufficiently advanced ???it may persist for a few moments, and so form the basis of such comparison with a second sensation as we find in the experiments of Weber, Fechner, and others. ^ At a still lower level, or in actual perception, we cannot assume even this amount of partial independence, though continuity clearly points to something beyond the bare sensation, which is a pure abstraction, as we may presently see.

It is saying too little to maintain, as some do, that this "some- thing " is subconscious, on the ground that it is not discoverable hy direct analysis. Yet it is saying too much, regardless of this

‘ Cf. Hbffdiug, ” Ueber ‘Wiederkeuneu, Association und psyohische ActivitSt,” in Vierteljahrsschr. /. wissenscha/tl. PhilosopMe, Bd. xiii. and xiv. To Hoffding we are also indebted for the term Bekannfheits- qiuditdt, which has suggested the 7 character used above. Cf. also Ward, “Assimilation and Association,” Mind, 1894-95.

^ Eecent experiments, however, seem to prove that the after-percept is not the sole factor, and often is not a facto/ at all in such successive comparison (so-called) ; but that what is now termed ” the absolute impression ” may supplement it or even replace it altogether. As to -what is meant by absolute impression, cf. earlier article, vol. xx. p. 50, col. a, fin.

defect, to describe a percept as a presentative – representative complex, if representation is to imply the presence of a free or independent idea. To call this “soujetliing” a tied or nascent idea on the ground of its possible later development into an in- dependent representation seems, then, nearest the truth. The same meaning is sometimes expressed in a wholly diilerent, and desinnedly paradoxical, way, by saying that all cognition (perception) is recogni- tion. This statement has been met by elaborate expositions of the difference between knowing and knowing again, the irrelevance of which any lexicon would show ; and, further, by the demand : How on such a view is & first cognition possible, or how is an indefinite regress of assimilation to be avoided ? We may confidently reply that it cannot be avoided : an absolute beginning of experience, whether phylogenetically or ontogenetically, is beyond us. Assimila- tion means further assimilation ; in this sense all cognition is further cogidtion, and a bare sensation is, as said, an abstraction represent- ing a limit to which we can never regress.

We find evidence, again, of ideas in the making in what Lewes called preperception. Of this instances in plenty are furnished by everyday illusions, as when a scarecrow is hailed by the traveller who mistakes it for a husband- man, or when what is taken for an orange proves to be but an imitation in wax. In reality all complex percepts involve preperception ; and so far, it must be allowed that such percepts are directly analysable into presentative- representative complexes. Nevertheless the

representative element is not yet, and may never become, an idea proper. The sight of ice yields a forefeel of its coldness, the smeU of baked meats a foretaste of their savour. Such pre- percepts differ from free ideas just as after-percepts do : they are still sense-bound and sense-sustained (cf. p. 57). Nor can this complication be with any propriety identified either with the association pertaining to memory or with that specially pertaining to ideation ; though, no doubt, the two processes ??? complication and association ??? are genetically continuous, as are their respective constituents, nascent and free ideas.' The whole course of perceptual integration being determined and sustained by subjective interest, involves from the outset, as we have seen, con- current conative impulses ; and thus the same assimilation that results in familiarity and preperception on the subjective side results in facility and purpose on the conative. Knovidng immediately what to do is here the best evidence of knowing wliat there is to do with ; the moth that flies into the candle has assuredly no pre- perception of it, and does not act with purpose. Bearing this in mind, we may now see one way, and probably the earliest, in which tied ideas become free.

The contrast between the actual and the possible con- stitutes, as we have seen, the main difl'erence between experience at the perceptual and experience at the idea- tional stage. A subject confined to the former level knows not yet this difference. Such knowledge is attained not through any quasi-mechanical interaction of presentations, but usually through bitter experience. The chapter of accidents is the Bible of fools, it has been said ; but we are all novices at first, and get wisdom chiefly by the method of trial and failure. Things are not always different in what to us are their essential properties, but they so differ from time to time. Kesemblances are frequent enough to give us familiarity and confidence; yet uniformity is flecked by diversity, and thwarted intentions disclose possibilities for which we were not prepared. What was taken for sugar turns out to be salt ; what was seized as booty proves to be bait. We catch many Tartars,

?? Hence the earlier process has been named " impressional associa- tion" (Stout, Analytic Psychology, 1896, ii. pp. 27-29), and again " animal association " (Thomdike, Animal Intelligence, an Experi- mental Study of the Associative Processes in Animals, 1898, pp. 71, 87, and passim). But it

seems preferable to confine the term ” associa- tion ” to the later process, in which alone the component presentations have that amount of distinctness and individuality which the term properly connotes.

and so learn wariness in a rough sciool. In such wise preperceptions displaced by the actual fact yield the “what” severed from the “that,” the “ideal” freed at length from the exclusive hold of the real. In a new situation after such adventures the attitude assumed ❓❓❓ if, for brevity, we describe it in terms of our own stiU more advanced experience ❓❓❓ is of this sort : ❓❓❓ ” It is possibly sugar, in which case I eat ; possibly salt, and then I don’t. It may be a weasel, if so, I back ; it may be a rabbit, if it is, I spring.” Instead of unquestioned preperception that “makes the mouth water,” we have the alternative possibilities present as “free ideas,” and action is in suspense, the alternative courses, that is to say, again present only in idea. It is easy to see how in such situations one free idea, a “what” sundered from its ” that,” will tend to loosen the sensory ties of alternative, still implicit ideas. On the cognitive side, from immediate assimilation an advance is made towards mediate cognition, towards comparison ; on the active side there is advance from impulsive action towards deliberate action. ^

We conclude, then, that implicit ideas ❓❓❓ the products of assimilation, and integrated as such in complex percepts and the motor co-ordinations to which they lead ❓❓❓ are more likely to emerge as free ideas the more this perceptual complexity increases. Perception in the lower animals, who give no signs of either memory or ideation, has apparently no such complexity. A fish, for example, can feel, smell, taste, see, and even hear, but we cannot assume solely on that account that it has any percepts to which its five senses contribute, as they do to our percept, say, of an orange or a peppermint. Taking voluntary movements as the index of psychical life, it would seem that the fish’s movements are instigated and guided by its senses not collectively but separately. Thus a

dog-fish, according to Steiner, seeks its food exclusively by scent ; so that when its olfactory bulbs are severed, or the fore-brain, in which they end, is destroyed, it ceases to feed spontaneously. The carp, on the other hand, appears to search for its food wholly under the guidance of sight, and continues to do so just as well when the fore-brain is removed, the mid-brain, whence the optic nerves spring, seeming to be the chief seat of what intelligence it has.^ Again, Bateson observes : " There can be no doubt that soles also perceive objects approaching them, for they bury themselves if a stroke at them is made with a landing-net ; yet they have no recognition of a worm hanging by a thread immediately over their heads, and will not take it even if it touch them, but continue to feel for it aimlessly on the bottom of the tank, being aware of its presence by the sense of smell." ^ To this inability to combine simple percepts into one complex percept of a single object or situation we may reasonably attribute the fish's lack of true ideas, and con- sequent lack of sagacity. The sagacity even of the higher animals does not amount to "general intelligence," such as enables a child " to put two and two together," as we say, whatever " two and two " may stand for. ??? So far as life consists of a series of definite situations and definite acts, so far the things done or dealt with together, the contents of the several /oci or concentrations of attention, form so many integrated and comparatively isolated wholes. Kound the more complicated of these, and closely connected with them, free ideas arise as sjioradio groups, making possible those "lucid intervals," those fitful gleams of

1 Some light is perhaps here thro-wii on the reciprocal relation of " association hy contrast " and " nKsociatiou hy similarity " as severally the differentiation of partial similars and the integration of partial dissimilars.

2 J. Steiner, Die Functionen drs Oentralnervensytems u.s.n'., 2te Ahth. Die Fische, 1888, pp. 50, 126, 19 f., 101.

^ W. Bateson, "The Seuse-Organs and Perceptions of Fishes," Journ. of the Marine Biol. Assoc, 1890, p. 239.

intelligence in the very heat of action, which occasionally interrupt the prevailing irrationality of the brutes. And as we cannot credit even the

*higher animals with general trains of ideas, just as little can we credit them with a- continuous memory : indeed, it is questionable how far memory of the past, as past, belongs to them at all. For they live entirely in an up-stream, expectant attitude, and it is in this aspect that "free ideas" arise when they arise at all. We cannot imagine a dog regretting, like one of Punch's heroes, that he " did not have another slice of that mutton." **

The free idea (a) then at its first emergence has neither an assignable position in a memory-record, as a^ or o.^, nor has it a definite relation as a "generic idea" to possible specializations such as a or a". These further develop- ments have been dealt with in the earlier article (cf. pp. 60-63), the former as " contiguous association " deter- mined by the successive movements of attention, the latter as so-called "association of similars," the joint result of assimilation and contiguity.

Two or three supplementary remarks seem, however, called for. First, the exclusively sucoessional character of contiguous associa- tion has recently been denied, and its exclusively simultaneoua character maintained instead. It is at once obvious that this opposition of succession and simultaneity cannot be pressed so as to exclude duration and reduce the whole process to an instan- taneous event. Nor is there any ground for saying that there is a fixed and even distribution of attention to whatever is simultaneously presented : facts all point the other way. Still, though we cannot exclude the notion of process from consciousness, we may say that presentations attended to together become pro taiito a new whole, are synthesized or complicated. Such primary synthesis leads not to an association of ideas, but rather to the formation of one percept, which may become eventually a free idea. The disconcerted preperception which sets this free may likewise liberate a similar or contrasting idea, but it will not resolve either complex into the several "ideas" of its sensory or motor con- stituents, with which only the psychologist is familiar. The actual recurrence of some of these constituents may again reinstate the rest, not, however, as memories or as "thoughts," but only as tied ideas in a renewed perception.

Secondly, it has become usual to distinguish the association of contiguous experiences and the so-called association of similars or opposites as respectively external and internal /ornis of association. The new terminology is illuminating : the substitution of forms for laws marks the abandonment of the old notion that association was by "adhesion" of the contiguous and "attraction" of the similar. We ai-e thus left to find the cause of association in interested attention ; and that, we may safely say, is an adequate, and apparently the sole adequate, cause for the two commonly recognized forms of external association, the so-called simultaneous and the successive. But these two are certainly not co-ordinate ; and if our analysis be sound, the former ??? for which we would retain the Herbartian term complication ??? yields us not members of an association but a member for association. So far, then, we should have hut one form of association, that of the successive contents of focalized attention; and but one result, wliioh in the earlier article was called the representation or memory continuum," in contrast to the primary or presentation continuum, whence its constitiients arise (cf.]i. 60). Turning now to the distinction of external and internal, it at once strikes the unprejudiced mind that " internal association" is something of an anomalj', since the very notion of association implies externality. Also, on closer inspection wliat we find is not an association of similars or opposites as such, but ??? something quite distinct ??? a similarity or contrast of associates ; of ideas, that is to say, which are contiguous members of the memory (or experience) continuum, or of ideas which have- become contiguous through its reduplication.

ExrEEIMENTAL INVESTIGATIONS OONCEENING jMeMOEY AND iVsSOCIATION.

Of the vast mass of experimental work undertaken in- recent 3'ears, that relating to memory and association is

- *Cf. Stout, Manual of Psydwloiiii. ISOSl, vol, ii. ch. i. : also F. H. Bradley, "Memory and' hifereuee," Mind, ISM, pp. 115 ff. ; and especially Thorndike, Animal Intelligence, cited above, a most original' and important contribution to comparative psyehology.*

*^ Experience-continuum would, perhap,s be a better name, since it is, only a preliminary to a true memory-record, as we shall presently sec^*

probably the most important. A brief account of some of it is therefore oftered at this point, by way of illustrating the character of the "new psychology."

The learning and retaining of a stanza of poetry, say, is obviously a function of many variables, such as the mode of presentation (whether the words are heard only, or heard and seen, or both heard, seen, and spoken aloud), the length, familiarity with the words and ideas used, the number of repetitions, the attention given, &c. Familiarity of course implies previous learning and retaining; the first essential, therefore, in any attempt to study these processes from the beginning, is the exclusion of this factor. Accordingly Ebbinghaus, the pioneer in experi- ments of this kind,i devised the new material, which is now regularly employed, namely, closed monosyllables, not themselves words, and strung together promiscuously into lines of fixed length so as never to form words : ban, rit, por, sig, nef, gvd, &c., is an instance of such " sense- less verses." With very slight attention most persons would be able to reproduce three or four such syllables on a single reading or hearing ; and by greater concentration six or seven might be so reproduced. This maximum, called sometimes the "span of prehension," has been repeatedly made the subject of special inquiry. In idiots it is found, as might be expected, remarkably low; in school children it increases rapidly between the ages of eight and fourteen, and then remains almost stationary, individual differences being small compared with the striking differences that appear when longer lines make repetitions necessary.^ This comparatively constant span of prehension is doubtless closely connected with certain other psychical constants, such as the duration of the psychical present and of the primary memory-image, the tempo of movements of attention (p. 65), &c. There are isolated investigations of

these several conditions, but the subject as a whole still awaits systematic treatment.^ That it is not wanting in interest is evident when we consider that if our span of prehension were enlarged, a corresponding increase in the variety and range of metre and rhyme in poetry, of ” phrase ” in music, and of evolution in the dance would be possible. The limits at present imposed on these and like complexities find their ultimate explanation in the constants just mentioned.

With lines of greater length than seven syllables some repetition is requisite before they can be said correctly : the number of such repetitions was found by Ebbinghaus to increase very rapidly with the number of syllables to be learnt. In his own case, for lines of 12, 16, 24, 36 syllables the repetitions necessary were on the average 16 “6, 30, 44, 55 respectively. Thus for a line exceed- ing in length that of the span of prehension only about five times, he required fifty-five times as many repetitions, if we may call the single presentation of the syllables a “repetition.” Substituting poetry for gibberish of equal amount, Ebbinghaus found that one-tenth the number of repetitions sufficed ; the enormous saving thus effected showing how numerous and intimate are the ready-made associations that ” rhyme and reason ” involve. But at one and the same time to memorize five verses even of sense requires more than five times as many repetitions as the memorizing of one. Two or three lines of inquiry

‘ H. Ebbinghaus, ‘ ‘ Ueber das Gedaehtniss : TJntersuchungen zur experimentellen Psychologie,” 1885.

‘ Cf. J. Jacobs and F. Galton on the ” Span of Prehension,” Mind, 1887, pp. 75 ff.; Bourdon, “Influence de I’jge sur la m^morie imme- diate,” Rev. Phil, xxxviii., 1894, pp. 148 ff.

‘ Cf. Dietze, ” Untersuchungen iiber den TJmfang des Bewusstseins n.s.w.,” PhU. Studien, 1885, pp. 362 ff.; L. W. Stem, “Psychische Prasenzzeit,” Ztschr. f. Psychologie, xiii. 1897, pp. 325 ff. ; Daniels, ” Memory Afterimage and Attention,” Am. J. of Psychology, vi., 1893, pp. 558 ff.

here present themselves, e.g., (i.) as to the comparative value of successive repetitions when several are taken together; (ii.) as to retention after an interval, as (a) a function of the number of repetitions previously made, and as (h) a function of the time ; (iii.) as to the respective effects of more or less cumulating, or more or less distributing, the repetitions, on the number of these required.

(i.) It is at once obvious that beyond a certain point exhaustion of attention renders further repetition for a time futile ; thus Ebbinghaus found 64 repetitions at one sitting of six 16-syllable nonsense verses, a task lasting some three-quarters of an hour, "was apt to bsftig on asthenia, a sort of epileptic aura, and the like " ! But keeping well within this heroic limit, a certain "law of diminishing return," to use an economic analogy, discloses itself. Thus taking a line of 10 syllables, the number of syllables reproduced correctly and in their proper order, after 1, 3, 6, 9, and 12 "repetitions," were 2-2, 2-5, 2-8, 3 "4, 3 '9 respectively, as the averages of a series of experi- ments with each of eight persons. " The first repetition is undoubtedly the best," assuming, of course, that the subjects start with their attention fully concentrated. Some persons naturally do this, many do not ; the experi- menter has therefore to take special precautions to secure uniformity in this respect.*

(ii.) {a) On relearning a line after an interval of twenty-four hours there was in Ebbinghaus's case an average saving of one repetition for every three made the day before. A line of 16 syllables, for example, required some 30 repetitions, and could then be said off correctly. If only 8 repetitions were taken at first, the line being " underlearnt," it probably appeared quite strange the next day, yet the proportional saving was no less ; on the other hand, if an additional 30 repetitions followed immediately on the first, the line being " doubly learnt," in spite of the familiarity next day apparent, the proportional saving was no greater. The absolute saving would, of course, be less. We are so far led to infer that the stronger associations effected by many repetitions at one time fall off more rapidly than weaker associations effected by fewer repetitions in the same way. Herbart in his " psychical dynamics " ??? influenced probably by physical analogies ??? conjectured that the " sinking " or " inhibition " of presentations generally was proportional to their in-

*tensity : the less there was to sink, the slower the sinking became. Kecent experiments certainly point in this direc- tion. (5) As to retention as a function of the time
 ص we all know that memories fade with time, but not at what precise rate. Ebbinghaus, by a series of prolonged experiments, ascertained the rate to be proportional to the logarithm of the time ص a result already implied in that connecting retention and intensity ; albeit in inquiries of this kind independent confirmation is always of value.*

(iii.) Had the proportional saving just described held good indefinitely, some 100 repetitions of the 16 syllables at one time should have dispensed with any further repetition twenty-four hours afterwards ; whereas, in fact, this result seemed never attainable. Beyond a certain degree of accumulation, an ever-diminishing return was manifest, and that apparently short of the stage at which exhaustion of attention began to be felt. But, contrariwise,

- *"W. G. Smith, " The Place of Repetition in Memory," Psychological Rev., 1896, pp. 20 ff. The figures given are unquestionably low, partly, as the writer points out, in consequence of the method employed, but partly, as his detailed tables show, iu consequence of the lax atten- tion of three out of his eight subjects. Objections have been taken to the plan of this investigation, but it is doubtful if they invalidate the result here mentioned. Cf. Jost, " Die Assooiations-festiglteit in ihrer Abhangigkeit von der Vertheilung der Wiederholungen," Ztschr. f. Psychologie, xiv. pp. 455 ff.*

when the repetitions were distributed over several days, an ever-increasing efficiency was tlien the result. Thus, for Ebbinghaus, 38 repetitions spread over three days were as effective as 68 taken together. The results of careful experiments by Jost with two different subjects, using G. E. Miiller's "method of telling" (to be described later on), are

still more conclusive. Comparing 8 repe- titions on three successive days with 4 repetitions on six, and 2 on twelve, the efficiencies, tested twenty-four hours later, were respectively as 11 ‘5, 35, and S-i ; and probably, as Jost surmises, the effect of the maximum distribution ❓❓❓ single “repetition” on twenty-four successive days ❓❓❓ would have been more advantageous still, securing in fact the superiority of a first impression (cf. i. above) on every occasion. This result, again, is in part explained by the law of sinking already found. For if the sinking were simply proportional to the time, or were independent of the intensity, there would so far be no reason why one mode of distributing a given number of repetitions should be more economical than another. There is, however, another reason for this superiority, less clearly implied, to which we shall come presently.

Invariably, and almost of necessity, a more or less complex rhythmical articulation becomes apparent as the syllables are repeated, even when ❓❓❓ as in the improved methods of G. E. MuUer and his collahorateurs ❓❓❓ they are presented singly and at regular intervals. A series of twelve syllables, for example, would be connected into six trochees, with a caesura in the middle of the verse ; while in each half of it the first and last accented syllables would be specially emphasized ; thus :

ham, fls I lup tol | yen ker || duh n3,f | ifec. In trying to suppress this tendency and to repeat the syllables in a monotonous, staccato fashion, just as they were presented, the tempo, though really unchanged, seemed to be distinctly quickened, a consequence, doubtless, of the greater effort involved. Moreover, the attempt, which was seldom successful, about doubled the number of repetitions required for learning off, thereby showing how much is gained by this psychical organization of disconnected material. But the gain thus ensured was manifest in other ways. Each foot, whether dissyllabic or trisyllabic, became a new complex unit, the elements to be connected by successive association being thereby reduced to a half or a third, and the Avhole line seemingly shortened. The varied intonation, again, helped to fix the place of each foot in the verse, thus further facilitating the mind’s survey of the whole. Such a

transformation can hardly be accounted for so long as retention and association are regarded as merely mechanical and i)assive processes.

Psychical rhythm, upon which we here touch, has also been experimentally investigated at great length, alil

we may assume that physiological processes fix the limits within which psychical rhytlim is possible, but yet may be as little an. adequate cause of it or its developments as Ungers are of arithmetic, or legs of an Irish jig. In motor rhythms, such as the last, the initiative is obviously psychical, and the respiratory and other peri- odic organic processes simply follow suit. And even sensory rhythms' can often be varied at the subject's own choice, or on the suggestion of another ; and then again the breathing is altered in consequence. Familiar instances of such procedure are to be found in the "tunes" so readily attributed to the puff of a locomotive, to the churning of a steamer's screw, and the like. Psychical rhythm, then, we may conclude, is due to attention or apperception, but the conditions determining it are many, and their relations very complex. If the presentations to be "rhythmized" (the rhyth- mizom^non, as the Germans say) succeed each other slowly, the' length (or shall we say the breadth ?) of the " psychical present " tells one way : the first impression is below the threshold when the third appears. If they arrive rapidly, their intensity and duratioa and the span of prehension tell another way ; for it is essential that they retain their individual distinctness, and only so many can be grasped at once. But if tlie series continue long enough or be frequently experienced, sub-groups may be treated as indi- viduals ; and indeed till some facility is acquired, the subject attending is aware of no rhytlim. In the act of attention itself there are phases, in so far as expectation involves preadjustment to what is coming : usually the first members of a tact are pre- dominant, and the rhythm tends to "fall" ; several alternations, of accent within a complex rhythmic whole are of course still compatible with this. But it is important to note that, whether simple or complex, the rhythm is an intuited unity as truly as- a geometrical figure may be. Unlike a geometrical figure, how- ever, it rarely or never has symmetry. We cannot reverse a tune and obtain an effect comparable with that obtained by reprinting, the score backwards

*in line with the original. We now pass to a question in which the psychological bearing of this fact becomes- apparent.^*

But first a new method of dealing with memory- problems must be mentioned, in which the connexion between rhythmizing and memorizing has been turned to account by the Gbttingen psycholo- gists. The method of Ebbinghaus consisted in ascertaining the repetitions saved in consequence of previous repetitions, when the verse was relearnt some fixed time later. Hence this method is called the learning method or the method of saving. When, a given time after a certain number of repetitions (say) in trochaic measure, the subject is confronted with one of the accented syllables and asked to name the unaccented syllable that belongs to it, he will answer sometimes rightly, sometimes wrongly, and sometimes be unable to answer at all. This, the new, method is therefore named Treffer-methode, the method of "shots," or, let us say, the telling method. It enables the experimenter to obtain far more insight into details than was possible before, for the "misses" as well as the "hits" are instructive. Moreover, by measuring the time of each answer [Trcfferzcit) and comparing these times together, much can be learnt ; in stronger or recent associations, for example, the answers being quicker than in weaker or older ones.

Does association work forwards only or backwards also, as the middle link of a chain, when lifted, raises the- contiguous links on either side of it? This is certainly not the case when the forward direction makes sense, but with nonsense verses, if the mechanical analogy is a sound one, such reversal is to be expected. For here there are none of the obstructing associations which "rhyme and reason" imply. In learning a verse back- wards Ebbinghaus found a saving of 12'4 per cent, of the time originally taken up in learning it forwards. A saving almost as great (10'4 per cent.) was effected by relearning a like verse forwards, but skipping one syllable : the order of syllables, that is to say, being 1, 3, 5, ??? ??? ??? 1."), 2, 4 ??? ??? ??? ???16. Even when learning backwards and skipping one syllable, Ebbinghaus found a saving of 5 per cent. But the number of his experiments (four) was -too few to give this result much value, as he fully admits. These experiments as a whole, then, might incline us to suppose

‘ The following are among the more important papers on rhythm : ❓❓❓ J. L. Bolton, “Rhythm,” Am. J. of Psych olorin, 1894, pp. 145 ff.; E. E. Meumaun, ” Untersuchungen z. Psychologie u. Aesthetik des Rhythmus,” Phil. Studien, x., 1894, pp. 249 ff., 393 ff. ; M. K. Smith, ” TMiythmus mid Arbeit,” Phil. Stitdkn, xvi., 1900, pp. 71 ff., 197 ff. ; Arbeit und Hhijthmus, 1S99, by K. Bncher, a well-known economist, bringing out the teleological aspects of rhythm.

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that association does work in both’ directions, though the connexions backwards are considerably weaker. But if so the associations both ways should be alike at least in form ❓❓❓ continuous, that is to say, backwards, d c b a, sm well as forwards, abed. The facts at present available are, however, against this. In two or three hundred experi- ments by Miiller and Pilzecker, verses of twelve syllables were repeated a set number of times in anapaestic measure ❓❓❓ accented, that is to say, on the 3rd, 6th, 9th, and 12th. After a fixed interval the subject, confronted with one of the accented syllables, mentioned any of the other syllables which it called to mind. Now the cases in which the syllable immediateli/ preceding was revived were only about half as frequent as those in which the syllable Tiext but one preceding was revived ; the time of telling {Trefferzeit) for the latter was also dvorter. This result is incompatible with the theory of continuous back- ward association, but it is readily explained by the fact that the group of three syllables had become one complex whole, and it shows that the tendency to reinstate the initial member of the group is stronger than that to reinstate the middle. The saving effected in Ebbing- haus’s experiment is also thus explained. ^

A somewhat paradoxical situation is brought to light when the method of saving and the method of telling are used together. In the experiments by Jost, mentioned above, two series of verses were repeated thirty times ; after an interval of twenty-four hours one series was tested by the first

method and the other by the second. Two new series were then taken : the first repeated four times, and after an interval of a minute tested by the first method ; the other was then repeated in like manner, and tested after the same interval by the second method. The old series was found (by the method of saving) to require on an average 5 '85 repetitions for relearning, and the new 9 '6; yet on the method of telling, the new series yielded 2 '7 "hits,',' with an average time of about 1| second for each, while the old yielded only '9 "hits," with an average time of 4^ seconds for each. Thus one may be able to reproduce relatively little of a given subject-matter, and yet require only a few repetitions in order to learn it off anew ; on the other hand, one may know relatively much, and still find many more repetitions requisite for such complete learning. The " age " of the associations is then important. Other things being equal, we may conclude that each fresh repetition efl"ects more for old associations than for recent ones. It might be supposed that the strength of the old associations was more uniform and on the average greater than the strength of the new ; so that while none of the old were far below the threshold, few, if any, were above it ; whereas more of the new might be above the threshold though the majority had lapsed entirely. And the latter would certainly be the case if the subject of experiment tried to make sure of a few " hits," and paid no attention to the rest of the series. Due care was, however, taken that the ends of experiment should not in this way be defeated. Also, there is ample evidence to show that the supposed greater uniformity in strength of old associations is not, in fact, the rule. We seem left, then, to conjecture that the difference is the effect of the process of assimi- lation working subconsciously, that psychical aspect of nervous growth which Professor James has somewhere aptly characterized by saying that " we learn to skate in summer and to swim in winter." It continually happens that we can recognize connexions that we are quite unable to reproduce. To the diminished " strength " of an associa-

^ There are still other forms of what seems at first sight to be regressive association, but none that do not admit of explanation without this assumption.

tion, as tested by the method of telling, there may then quite well be an equivalent set-off in more developed assimi- lation. As a seed germinates it has less latent energy, but this is replaced by growth in root and stem : similar rela- tions may obtain when an old association is said merely to lose "strength." On the other hand ⁂ within the range of the primary memory-image ⁂ we can often reproduce what after a longer interval we should fail to recognize. We seem warranted, then, in concluding that this concep- tion of "association-strength," so freely used by G. E. !M filler and his co-workers, requires more analysis than it has yet received. The two factors which their methods disclose in it appear to confirm the distinction we have already made between imjiressions and free ideas. They help us also to understand, fiirther, the superiority of dis- tributed over cumulated repetition, of " inwardly digest- ing" over " cram."

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By transposing a tune from one key to another we may obtain two entirely diverse aggregates of notes, and yet the melody may remain unchanged. On the other hand, by varying the order of the notes two distinct tunes may result from the same collection of tones. Sense furnishes merely the parts : whence, then, this identity of the whole in spite of their diversity, this diversity of the whole in spite of their identity \ From the sameness or difference of the several "intervals," it is replied. But the answer is in- sufiicient ; for the tune is a unity, not a mere series, and, further, with every interval the same problem recurs. For the interval, too, is a whole, though a simp>le one : it does not necessarily change with a change of its constituents, nor remain the same as long as their distance is unaltered. Feelings and " associations," again, cannot account for the result, inasmuch as such accompaniments are not invari- ably present : moreover, they obviously presuppose the melody instead of producing it. Of such complex wholes or combinations ⁂ as distinct from mere aggregates or collections ⁂ there are many forms ; as, for example, geo- metrical figures and patterns, motions and other changes, numbers, logical connexions, &c. In view of this variety it seems to strike the unprejudiced as wild to expect that " the progress of psychophysics " may disclose an explanation of such combinations conforming to the old

scholastic maxim, Nihil est in intellectu quod nonfuerit prius in sensu. Yet hopes of such a generatio cequivoca are entertained ! ^ ^Meanwhile the " old psychology," at any rate, is content tO' regard such complex wholes as we have already done (pp. 79, 80) ❓❓❓ as new presentations, that is to say : the products, not of a quasi-mechanical interaction of their constituents, but of intellectual synthesis.

What is here said of the combinations whereby the items of an aggregate are construed as parts of a whole holds equally of the comparisons whereby such items are related, as like or unlike, compatible or incompatible. Before either combination or comparison is possible, such items or particulars must be "given." But it is con- ceivable that they should be given and no intellectual synthesis ensue ; such a consciousness has been happily named anoeticfi Whether or no it actually exists is another matter : it is a conceivable limit, and has the theoretical usefulness of limiting conceptions generally. But relative anoesis suffices here. Suppose, then, we have :. (a) item, a sound ; item, ditto ; item, ditto ; or (6) item,. blue ; item, green. The sensationalist, from Hume onwards, has complained that he does not find in the one case a

^ Of. t.g., F. Schumann, " Zur Psychologie der Zeitanschanung," Ztsohr. f. Psychologie, rvii. pp. 130, 136.

^ G. F. Stout, Analytic Psychology, i. pp. 50 f.

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further item : total three ; nor in the other a further item : unlikeness. After vainly seeking the living whole among the dead particulars, he next surmises that they generate it by their conjoint action ! But whence this notion of " action " ; and how, if such disjecta memhra suffice, do they so often fail of their effect, so that we cannot " see the wood for the trees " 1 Combinations and comparisons then, we conclude, are not given, but " grounded " on what is given, and is thus their fundamentuTn. Hence

Meinong, who has studied the psychology of intellection with especial care, has called the new presentations, due to this process of "grounding" (Fundiren), "objects of a higher order," or ideal objects.^ They have validity in respect of the particulars on which they are grounded, but not reality as data existing for perception alongside of such particulars.

The reader will here be reminded of Hume's distinction between knowledge and probability. His four philosophical relations, "which, depending solely upon ideas, can be the objects of know- ledge and certainty ??? resemblance, contiuuity, degrees in quality, and proportions in quantity or number " ??? are objects of higher order, and ideal. "The other three, which depend not upon the idea, and may be absent or present even while that remains the same " ??? namely, identity, the situations iu time and place, and causation ??? are thus obviously not the result of grounding or Tioesis merely, are not ideal but empirical, and have, that is to say, existential import. In fact, the second of these, the situations, though they imply synthesis in the wider sense in which all complex perception does, do not involve intellectual synthesis at all : are neither ideal combinations nor ideal relations. And since such temporal and spatial situations enter into both the other two ??? numerical identity and causation ??? the mixed, Ajmsteriori character of these is obvious. Whatever be the defects of Hume's psychology, his classification of relations is so far sound, and its epistemologieal importance can hardly be overrated. It is accordingly to be regretted that the one vague terra "relation" does not allow us to make these dis- tinctions more precise. The German language, with the two terms Verhaltniss and jSeziehung, can do more.

When we say that two "contents" are similar, and when too they admit of analysis, we can, if need be, enumerate certain elements as the ground of their partial likeness, and certain others as maintaining their partial diversity. We may further say that, abstracting from these last, we can regard the points of resemblance as constituting a general class to which the two contents belong as specific instances. But how is either comparison or abstraction possible when the two resembling contents appear as simple, and so far unanalysable 1 Instances, of course, are familiar to every one : thus we call red and orange colours, and say they

resemble each other more than do red and blue. In presence of this question logicians and psychologists are apt to be at loggerheads. The logician maintains that abstraction and resemblance (as distinct from qualitative identity) imply complexity ; and surely here he cannot be gainsaid. Yet there are the facts : reds and blues of sorts and a whole scale of degrees of likeness and unlikeness ; but no constituent parts, no assignable marks of identity or diversity, are forthcoming, such as we find when we class sugar and salt together as solid or soluble, and pronounce them like in colour and unlike in taste. Here the logician's symbols a + b,+ c, a + b+d, have their counterparts : there ??? for the per- cipient's consciousness at all events ??? they have not. We cannot " consider and attend to either the sameness or the differences in " red and blue, as we can to the like or the unlike properties in salt and sugar. None the less it would be hasty to conclude that colours or any given sensations are simple. In the first place, musical notes,

'A. Meinong, "Ueber Gegenstande hoherer Ordnung u.s.w.," Ztsch/r. f. Psychologie, xxi., 1899, pp. 182 ff. Special mention must be made of an earlier paper by C. v. Ehrenfels ("Ueber Gestaltquali- taten," Yierteljah/rsschr. f. wissensch. Philosophic, 1890, pp. 249 ff.), round which the whole subsequent discussion of this topic centres. Cf., too. Stout, op. cit, bk. i. ch. iii.

which were long taken to be so, can with due practice be perceived as a complex of ground-tone and over-tones; and there is indirect evidence of still greater complexity in the case of many so-called tastes. Further, we are often struck by the likeness of complex wholes ??? two faces, say long before we can discern the exact points of resem- blance. StiU, so long as there is no perceptible complexity in the individual presentations there can be no analysis of them and, therefore, neither abstraction nor comparison based upon it. Can we find elsewhere the complexity that generalization and comparison invariably imply? This question has been already in the main anticipated (cf. pp. 77, 80), but perhaps with undue brevity. A word or two by way of further exposition seems therefore desirable.

Though colour may be regarded as a general term appKcable alike to red, green, and blue, just as animal is a general term applicable alike to bird, beast, and fish, it is a mistake to infer that the processes are the same because of this similarity in their products. We seem bound to dis- tinguish between consciously logical or " noetic " processes and processes that are unconsciously logical or "hyponoetic," as we may perhaps call them. In the former the sub- jective aspect is left aside; in the latter it cannot be. The only common mark we can psychologically assign to colours is that they are all seen, and to tones ??? as the element of notes and noises ??? that they are all heard. So often as we talk of tasting tastes, smelling smells, feeling touches, language leads us to bear witness to this fact. When the sunset red changes to the twilight grey, I still see ; but when the thunder follows the lightning there is a double change, though not an absolute one : from seeing I pass to hearing, but I am sentient still. And if pro- gressive differentiation be the order of experience (cf. p. 42), then the " universal " sentience precedes the differentiations seeing, hearing, &c., and, again, the "universal" colour the differentiations, red, green, blue, &c. Such "first uni- versals," then, are not reached by abstraction, but are given in the fundamental continuity of experience, and their subsequent differentiation admits neither of definition nor the classification applicable to discrete complexes, which are the material of logical comparison only. Allien red is pronounced liker or nearer to yellow than it is to green, this is because a smaller change is experienced in the transition from red to yellow than in that from red to green, and because in the latter yellow is reached and passed before green appears. ^ Proximity and resemblance are, then, so far one and the same ; also both are equally relative, admit of the same indefinite gradation, and have the same limit in zero, regarded either as coincidence or identity. The conception of " distance between " answers, then, to what we have called a hyponoetic relation, and this is plainly distinct from the analysis of discrete complexes, with which, as said, noetic comparison is alone concerned : the one implies and the other excludes the notion of con- tinuity and change ??? a fact which helps still further to distinguish the two.

Emotion and Emotional Expression.

The nature of emotion and its relation to the various organic changes and bodily movements, commonly described as its expression or manifestation, have been continually under discussion since the appearance in 1884 of the notorious article, ” What is an Emotion t ” in which Pro- fessor W. James ^ turned the views of Common Sense upside

^ Assuming, of course, that the change is the simplest or directest possible, i.e., a change of ” colour proper ” without change of saturation.

‘ Mind, ix. pp. 188 ff., and, again, Principles of Psychology, oh. xxv. Very similar views were advanced independently, and almost at the same time, by the Danish physiologist, C. Lange : hence the name,

down. ” Common Sense says : we lose our fortune, are sorry and weep ; we meet a bear, are frightened and run ; we are insulted by a rival, are angry and strike.” But, Professor James continues, “the hypothesis here to be defended says that this order of sequence is incorrect : that the one mental state is not immediately induced by the other, that the bodily manifestations must first be inter- posed between, and that the more rational statement is that we feel sorry because we cry, angry because we strike, afraid because we tremble, and not that we cry, strike, or tremble because we are sorry, angry, or fearful, as the case may be.” In a word, whereas it is commonly supposed that the emotion precedes and produces the expression, it seems here to be maintained that the expression precedes and produces the emotion. But the sequence denied in the first case is a psychological sequence, the sequence maintained in the second is a physiological sequence. The subject’s experiences of the bodily expressions is here the emotion, and these are physically, not psychically, deter- mined. ” They are sensational processes,” says Professor James ; ” processes due to inward currents set up by physical happenings.”

The new theory is, then, in part psychological, in part psychophysical. As to the first part, which the author calls “the vital point of the whole theory,” it consists mainly in exposing the ambiguity of the phrase ” bodily expression of an emotion ” ??? a phrase which is liable to mis- lead us into fancying that emotion, like thought, may be antecedent to, or independent of, any expression or utter- ance. My fear or anger may chance to be expressive to another, but they are of necessity impressive to me. “A disembodied human emotion is a sheer nonentity.” In so far as I have a certain emotion, in so far I have ” the feelings of its bodily symptoms.” This is true, not to say trite ; but how do these symptoms arise t With this ques- tion we pass to the psychophysical side of the theory, and here it becomes perplexing, and is itself perplexed ; for to this question it is driven to return two distinct and divergent answers. First, we are told that it is not the emotion that gives rise to the bodily expression, but that, on the contrary, “the bodily changes follow directly the perception of the existing fact,” it being beyond doubt “that objects do excite bodily changes by a pre- organized mechanism.” Again: “Each emotion is,” for Professor James, ” a resultant of a sum of elements, and each element is caused by a physiological process of a sort already well known. The elements are all organic changes, and each of them is the reflex effect of the existing object.” The old attempts at classification and description being contemptuously dismissed as belonging only to ” the lowest stage of science,” we are informed that now we step from a superficial to a deep order of inquiry. ” The ques- tions now are causal : ‘ Just what changes does this object and what changes does that object excite?’ and ‘ How come they to excite these particular changes, and not others ‘! ‘ ” But we have not had to wait for the James-Lange theory to raise these questions, and surely there are none that bring out its defects more glaringly. ” Objects ” that determine bodily changes by means of preorganized mechanism and without psychical . inter- position might fairly be taken to be physical objects ; and indeed the whole process is expressly described as reflex. But only very slovenly physiologists talk of ” objects ” exciting reflexes : it is inexact even to say that sensations do so. All that reflex action requires is a stimulus. ” The essence of a reflex action,” says Foster, ” consists in the transmutation, by means of the irritable protoplasm of

James-Lange theory, by which their views are now commonly known. Of Lange's work, a German translation, Ueber Gemiithsbewegungen : eine psychophysiologiscke Stvdie, viaa published in 1887.

a nerve-cell, of afferent into efferent impulses." Let Pro- fessor James be confronted first by a chained bear and next by a bear at large : to the one object he presents a bun, and to the other a clean pair of heels ; or let him first be thrilled by a Beethoven symphony and then by a Eaphael Madonna. Will he now undertake to account, in terms of stimuU and their reflex efi'ects, for the very different results of the similar " causes " in the one case, or for the similar results of the very different " causes " in the other ? Such a challenge would certainly be declined, and Professor James would remind us that in his nomenclature " it is the total situation on which the reaction of the subject is made." ^ But there is just a world of difference between "object" = stimulus transformed bypreorganized mechanism into an efferent discharge, and " object " = total situation to which the subject reacts. The attempt to explain emotion causally on the lines of the former meaning lands us in the conscious automaton theory, with which we must deal presently : this Professor James rejects. The latter mean- ing, on the other hand, involves the recognition of the subject's attitude as essential to the reaction, and of this as determined by pleasure, pain, or by some " interest " resting ultimately on these. Such, with scarcely an ex- ception, has always been, and still remains, the analysis of emotion in vogue among psychologists. It brings to the fore a new category, that of worth or value, one wholly extraneous to the physiologist's domain, and rejiugnant to the mechanical analogies which are there in place. No doubt such a conception is attained only by reflection, but the experiences from which it is drawn, the affective states, the conative tendencies of the subject experiencing, must first precede. From this central standpoint alone the objective situation has a worth which explains the sub- ject's attitude, and here alone can we find the clue which will enable us to answer the questions of cause that Pro- fessor James propounds.

The experimental investigations of Mosso, F^r^, Lehmann, and others have shown that the vasomotor and such like bodily changes as are prominent in emotional excitement are present also to some extent in all

forms of conscious activity. The more un- wonted and interesting the situation, the more diffused movements predominate over movements that are purposive ; the further assimilation, both on the cognitive and the reactive side, has ad- vanced, the more diffusion is replaced by restriction and adapta- tion. But we are not warranted in separating these factors of voluntary activity into distinct processes, as the physiologist, for example, separates the functions of striped and unstriped muscle. Unless we are prepared to treat all activity as reflex ??? a's the physiologist may quite well do, if he keep strictly to his own point of view ??? it does not seem possible to regard emotional expression as so much organic sensation with which purposive movement has nothing to do. No doubt this connexion of vegetal and animal functions remains one of the obscurest in all psycho-biology, though its teleological iitness is obvious enough.

Nevertheless, Professor James's main position is that an emotion is but a sum of organic sensations ; and in order to establish this he is led to the second and very different statement which we have now to examine. Here, so far from suggesting inquiries as to the " objects " that excite emotion, his point is to maintain that in so far as the bodily cause is set up, be the means what they may, in so far the emotion is present. ^ And here, at length, the con- tention is explicit : Emotions are a certain complex of organic sensations, and such complexes are emotions : the two are not merely coexistent, they are identical. The exciting object is thus, after all, physiological ; that is to say, it is whatever stimulus sets up the sensations. It cannot be psychological, "the total situation for the

' " Physical Basis of Emotion," Psychological Review, 1894, p. 518. In this reply to criticisms Professor James is supposed to have modified his views : it would be nearer the truth to say that he has made admissions incompatible with them.

2 Text-Book of Psychology, 1890, p. 383.

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reacting subject," for in this sense the emotion, it is maintained, may be "objectless." In support of his position Professor James first of all cites pathological cases of such objectless emotion. He next follows up these with accounts of other cases in which emotional apathy seemed to keep pace with sensory anaesthesia, arguing that, according to his theory, a subject absolutely anaesthetic should also be incapable of emotion, although " emotion-inspiring objects might evoke the usual bodily expression from him." Whether any testimony from lunatics, hypnotics, and other minds diseased could suffice to establish this novel doctrine is questionable : that the evidence so far adduced is insufficient. Pro- fessor James seems himself to allow. There are some four or five of the apathetic cases altogether : three of them are regarded by the mental pathologists who describe them as adverse to Professor James's theory. ^ Of the fourth case, reported by a pathologist on Professor James's side, the latter himself candidly observes, " We must remember that the patient's inemotivity may have been a co-ordinate result with the ansesthesia of his neural lesions, and not the anesthesia's mere effect." This missing link in the argument is supplied by the experi- ments of Professor Sherrington, ^ and these show conclu- sively that normal emotional states are possible along with complete visceral anaesthesia. As to emotional excitement induced by intoxication or disease, and so far groundless, the most that can safely be said is that the object may be vague, ill-defined, and shifting, but not that it is absent altogether. States of physical exaltation, de- pression, or irritability readily arouse by association appropriate troupes of imagery; only when they fail of this are we entitled to say that there is no object, and then we must add that there is also no emotion.

Relation op Body and Mind : Psychophysical

Paeallelism.

Of disembodied mind as a res completa we can form no conception. It might even be said that such a conception is a contradiction in terms, since living experience refuses to be sundered into the unmediated

dualism of res cogitans and res extensa, as in Descartes' Philosophy; and since, again, the subject of experience is invariably related to the objective environment by means of its organism. It is this connexion of mind and organism that we have now to consider. In development and efficiency, in the intensity and complexity of their processes, mind and brain keep invariably and exactly in line together. Striking and impressive instances of this correspondence are to be found in comparative psychology, and especially in mental patho- logy ; but it is needless here to enlarge on a point which in the main is beyond dispute. In this correspondence lay the plausibihty of the old materialism. But a closer scrutiny discloses an impressive disparity ❓❓❓ that of quality may suffice as an example. We reject materialism, accord- ingly, while still maintaining this Psychoneural Parallelism to be a well-established fact. From this we must dis- tinguish a second sense of parallelism founded on the disparity just mentioned as also pertaining to the psychical and neural correlates. We may call this Physiologico- psychological, or, more briefly. Methodological, Parallelism. It rejects, as illogical, the attempt to penetrate to psychical facts from the standpoint of physiology, so persistently and confidently pursued by the old materialists. It also

' G. H. J. Berkley, "Two Cases of General Cutaneous and Sensory Anaesthesia without Marked Psychical Implications," Brain, 1891, vol. xiv. pp. 441 ❓❓f.

^ " Experiments on the Value of Vascular and Visceral Factors for the Genesis of Emotion," Proc. Roy. Soc, 1900, Ixvi. pp. 390 if.; and Mature, vol. Ixii. pp. 328 S.

forbids the psychologist to piece out his own shortcomings with tags borrowed from the physiologist. The conceptions of the two sciences are to be kept distinct, as the facts themselves to which they relate are distinct (cf. above, p. 57). Confusion is inevitable if the psychologist, for example, talks of his volition as the cause of his arm moving, when by arm movement he means the process described by the physiologist in terms of efferent excita- tions, muscular flexions, and so forth ; or if the physiologist speaks of a sensation of red as produced by retinal stimulation due to light-waves of a certain length, when by sensation he

means what he immediately experiences on looking at a field-poppy. This methodological con- vention, as we may call it, implies a more stringent interpretation of causation than that expounded by J. S. Mill and his contemporaries. It does not, however, forbid psychological inferences on the basis of physiological facts, nor vice versd. But in spite of this distinctness of the facts, and of the standpoints from which they are respectively studied, their causal relation cannot be simply ignored : it is, however, a problem that pertains strictly to the higher standpoint of philosophy. There have been in all four different theories of this relation vpithin modern times : (1) that of mutual interaction ??? th& Common-sense view??? very inconsistently maintained by Descartes ; (2) the " Occasionalism " substituted for this by Geulincx and the later Cartesians ; (3) the Pre-established Harmony of Leibnitz; and (4) the Monism of Spinoza, which reduced matter and mind to parallel attributes of the One Substance.^ The last of these ??? severed, however, from Spinoza's metaphysics ??? is now the prevailing theory, and to it the term Psychophysical Parallelism most properly applies. For whereas the parallelism first men- tioned states a real correspondence between psychi- cal processes and neural processes, but leaves open the question of a possible interaction between matter and mind, psychophysical parallelism is a pure hypothesis con- cerning the relation of psychical facts to physical theories, on the ground of which ??? as we shall presently see ??? any interaction between matter and mind is expressly denied.

But in the exposition of this hypothesis these two meanings of parallelism are frequently confused or interchanged. The same term " body " is applied both to an aggregate of matter and to the: living organism. Now life must be regarded as either inherent in matter, or as the result simply of a particular material configuration, or as physically inexplicable. But, for the present at all events, it cannot be explained physically ; nor are we even within measurable distance of such an explanation : so much is beyond cavil. Yet the hypothesis of psychophysical parallelism confines us to one or other of the former alternatives : at the same time its unwarrantable identification with psychoneural parallelism ??? where we find a real correspondence between mind and organism ??? tends to conceal the! gravity of such assumptions. The standpoint of physiology, there^ fore, must be described not as identical with that of

physics, but as intermediate between it and the standpoint of psychology. If the fact of life could be reduced to physical terms, physiology then, no doubt, would have to fall into line with physics, much as chemistry, for example, may have had to do. On the other hand, till a physical explanation of life is forthcoming, physiology belongs, with psychology, to the biological group of sciences, and cannot divest itself completely of the teleological conceptions essential to them, not a vestige of which belongs to. bare physics. It is just because of this community in their con- ceptions that there actually is a certain "point to point" corre- spondence or parallelism between the psychical and the neural : as an organ a neuron is a unit ; physically regarded, it ceases to be one. Yet this illicit identification of organism and material body is. thought to be legitimate, inasmuch as physiological processes are- found to rest invariably on a physical basis ; and inasmuch as, though methodological parallelism forbids the physiologist to identify psychosis with iieurosis, no limits can be imposed on his efforts to ascertain the mechanism of the neurosis itself. But if this be granted, is not psychophysical parallelism justified, in prin- ciple at all events ? By no means : as little, for example, as an.

' Particulars of these theories will be found in the articles dealing: mth the authors of them.

explanation of the mechanism of a locomotive would justify us in ascribing its origin, its maintenance, or its guidance to the machine itself. When life and mind are explained by their mechanism, the physicist may summon the biologist, as Mephistopheles did Faust, ^' Her zu mir" : then, but not before.

A favourite mode of stating psychophysical parallelism is that known as the Double Aspect Theory. In this, besides the unjustified identification of the first and third meanings, we find also an equally unjustified interpreta- tion of parallelism in the second sense. All that method- ology

prescribes is that psychologists and neurologists ◆◆◆ and, we may add, that physicists too ◆◆◆ shall severally, as " specialists," mind their own business. Again, all that the first two jointly ascertain is simply the fact of cor- respondence : the explanation of it is still to seek. Two propositions are now advanced which are held to meet this need. First ◆◆◆ and negatively ◆◆◆ the connexion, it is said, is not causal : mind does not act on body, nor body on mind : the changes on each side form two independent series, each " going along by itself." In other words, the series them- selves are said to exemplify what methodology enjoins on the sciences that investigate them ◆◆◆ they mind their own business and never intrude into each other's domains. Nevertheless their interaction is not primd facie contra- dictory or absurd, and ordinary thought, as we have seen, assumes that it exists. What evidence, then, is there for denying it absolutely? Empirical evidence for such a universal negative there can hardly be ; it must be estab- lished therefore ◆◆◆ if established at all ◆◆◆ on h priori grounds. Meanwhile two facts already noticed make seriously against it. On the psychical side sensations point to an intrusion of some sort, and are not psychically explicable (cf. above, p. 57) ; and the like ◆◆◆ for the present at aU events ◆◆◆ must be said of the fact of life on the physical side. Apart from all this, it seems plain that methodological parallelism, so far from justif3dng the denial of interaction, simply precludes its discussion on the dualistic level to which that parallelism is confined. The gulf implied is indeed not absolute ◆◆◆ of so much, parallelism in the first sense assures us ◆◆◆ but those who are forced to keep to their ovra side of it obviously are not the people to settle how it is crossed. We are aware that the dualism is not absolute, it is re- plied : it is only phenomenal, and the two series of phenomena are conditioned by an underlying unity of substance. Such is the second, and positive, proposition of the Double Aspect Theory. Again asking for evidence, we learn that this underlying unity is unknown ◆◆◆ in fact, unknowable. This unknowable substance is assumed, then, simply because ◆◆◆ the impossibility of causal connexion being taken as established ◆◆◆ no other alternative remains. The negative proposition is thus the foundation of the theory, and without it this agnostic monism becomes en- tirely arbitrary. We have therefore to continue our search for the grounds on which the possibility

of interaction is denied. But it will be worth while first to examine certain ambiguities besetting the positive statement of the Double Aspect Theory.

Difference of aspect may result solely from difference of standpoint, or it may be due to difference in the reality itself. The circle, seen as concave from vrithin and as convex from without, is an ancient instance of the first still in great favour ; the pillar, that was cloud and dark- ness to the Egjrptians but light to the children of Israel, may serve to exemplify the second. The former we may call the phenomenal, and the latter the ontal, meaning of "aspect." With these two very different meanings our theory plays fast and loose as suits its own convenience. To do this is easy ??? in so far as the reality is unknown and unknowable ; and necessary ??? since in the end, the reality, however unknowable, must somehow include both the

phenomenal aspects and all that pertains to them, and so far therefore be known. In dealing with " aspect " in the first sense, the one question to be raised concerns the nature and relation of the respective standpoints. To the one belongs what we know as individual experience, and this is essentially concrete, immediate, and qualitatively diverse ; to the other belongs an abstract, conceptual scheme, whoDy quantitative, familiarly known as the mechanical theory. Between these there is plainly no such co-ordination as the inept comparison vidth the inside and the outside of a circle implies.^ Neither is there, on the other hand, the same complete opposition; for the entire mechanical theory is based upon individual experience as enlarged and de- veloped by intersubjective intercourse (cf. above, p. 56). Both the sense-knowledge of the one and the thought-knowledge of the other relate to the one objective factor involved in both. So far, then, there is fundamentally only one standpoint ??? that of the subjective factor to the objective factor, which is immediately perceived in the one and mediately conceived in the other. The question here raised is then primarily epistemological, but it is a question, aa we have seen, in which psychology is intimately concerned. "Aspect " in the second sense is independent of standpoints. We have here to deal with attributes of the one reality, more or less in Spinoza's sense ; this reality itself is so far dual. But in this case the question of causal connexion between these attributes is not escaped. For to know that a thing has

invariably two attributes does not enable us to determine straightway how the changes or ” modas ” of the one are connected with those of the other. (1) The same attribute might be always the initiating or inde- pendent variant, and then would come the question of finding out which of the two it was ; or (2) it might be that now one, now the other, took the lead, the grounds of this alternation being then the matter for inquiry; or, finally, (3) it might be, as our theory assumes, that there was but a single series of double changes. The questions here raised are phOosophical questions, but again they are questions in which psychology is intimately concerned. Our examination thus yields two results : first, there is fundamentaiUy only a single standpoint ??? that of experience, now at the perceptual, now at the conceptual, level ; and, secondly, the distinction of aspects is not merely pheno- menal, but pertains ” somehow ” to reahty. The question is how ; and this leads us to resume our inquiry into the grounds on which interaction is denied.

They are neither psychological nor physiological, but ??? in spite of the outstanding difficulties connected with sensa- tion and life which these sciences severally raise ??? such denial is upheld mainly on the strength of an interpretation of the principle known as the conservation of energy ??? an interpretation of it, however, which many of the ablest physicists disallow. The energy of the physical world, it is maintained, is a strictly invariable amount ; matter, therefore, cannot act on mind, for such action would entail a decrease, nor can mind act on matter, since that would entail an increase, of this energy. In other words, the material world is held to be a ” closed system ” ; and as aU the changes within it are mass-motions, there can be none which are not the effect and equivalent of antecedent mass-motions. But now this statement must be estabhshed

‘ In fact, if there were, since it is only as we contemplate finite portions of the circle that the distinction of concave and convex is present, the nearer we approximated to its elements the more this difference of aspect would disappear. If on the physical side we called these elements atoms, there would be an answering element of ” mind- stuff” on the psychical ; and there would be no more unity and no other diversity in a given man’s mind than in his brain regarded as a complex of atoms. Wild as all this

seems, yet views of the kind have been seriously put forward more than once as the logical outcome of psychophysical parallelism.

on physical grounds : to assume it otherwise would be openly to beg the very question at issue. For if mind does act on matter, the physical mechanism is subject to changes from without, and so often its motions are not due to antecedent motions ; and this ??? the Common-sense view ??? cannot, of course, be summarily dismissed as impossible or absurd. Xow energy is essentially a metrical notion, and its conservation in finite and isolated material systems has been ascertained by careful quantitative experiments. To say that the energy of the material universe is constant is only a way of expressing the generalization of this result ??? is tantamount, in other words, to saying that it holds of aU finite isolated systems. The tv/iole universe may perhaps be called isolated, but we do not know that it is finite. We cannot, therefore, apply metrical conceptions to it, and consequently cannot interpret the conservation of energy as meaning that the physical part of it is a closed system. Bat if not a closed system, then the energy of a given group of bodies may be increased or decreased without interaction between that group and other bodies ??? may be increased or decreased by psychophysical interaction, that is to say. And, moreover, such psychophysical interaction would not invalidate the conservation of energy, rightly understood ; for that merely means that the energy of a group of bodies can be altered only from without, and this might happen whenever such interaction occurred. ^ We seem, therefore, justified for the present in rejecting psycho-physical parallelism as one of the three possible modes of relating mind and matter regarded as attributes of the real. N'ot only are there psychological as weU as bio- logical objections which it has not yet overcome, but there are so far no physical grounds in its favour.

At this point we may again for a moment turn aside to consider a modified form of the doctrine ??? the so-called Conscious Automaton

Theory, an attempt to blend the old Cartesian views concerning the minds of man and brute. According to Professor Huxley, the best known modern exponent of this theory, "our mental con- ditions are simply the symbols in consciousness of the changes that take place automatically in the organism." This consciousness is supposed "to be related to the mechanism of the body simply as a collateral product of its working, and to be as completely without any power of modifying that working as the steam-whistle ... is without influence upon the locomotive's machinery " : thus " the feeling we call volition is not the cause of a voluntary act, but the symbol of that state of the brain which is the immediate cause of that act." In other words, physical changes are held to be independent of psychical, whereas psychical changes are declared to be their "collateral products." They are called collateral products, or "epi- phenomena " to obviate the charge of materialism, and to conform to the interpretation of the conservation of energy that we have just discussed. Such a theory is, strictly speaking, one of parallelism no longer : rather it adopts, instead, the first of the two possibilities we have noted above as opposed to parallelism. According to it, matter is the initiating or independent variant, on whose changes mind simply follows suit. It is open to two fatal objec- tions. First, it is methodologically unsound : its psycho- logy is physiological in the bad sense. It regards all states of consciousness as passive, i.e., as ultimately either "feelings" or "reflexes." Volitional activity is declared illusory ; and if this be true, intellectual activity must be illusory too. But to detect illusion requires experience of reality[illegible] *we only know the sham by knowing the genuine*

' The possibility is enough : we caimot tt-Il what actually happens, and do not, therefore, know how far the direotiou of matter by mind calls for a modification or limitation of physical hypotheses. Cf. Ward, Natv/ralism and Agnosticism, 1899, vol. ii. pp. 73-86.

first; and even passive states could not be experienced as such save by contrast with states that are active. To the physical side, then, we naturally turn for this know- ledge which we are told is not to be found on the psychical ; and we do so the more readily as, according to the present theory, the physical holds the primary place. But we turn in vain; for matter is inert, and its energy only "works" by taking the fine of least

resistance, like water running down hill. Moreover, such activity as we are in search of could only be found here in case the physical mechanism showed signs of being intelligently directed, and that would also be evidence that psychical activity is not illusory. Is, then, the physical side after all primary 1 No, we reply : the assumption is epistemologically unsound. This is our second objection. The order implied in the distinction of physical phenomena and psychical epi'phenomena is contrary to all experience and indefensible. A physical phenomenon is either actually perceived or possibly perceptible ; other- wise it is devoid of empirical reaHty altogether. But objects of perception are so far psychical; that is, they belong to immediate or individual experience. Therefore we cannot regard them as independent of this experience, nor this as their collateral product, i.e., as epiphenomenal. Again, the phenomencdity supposed to be common to both involves, as we have already seen, a fundamental identity in the standpoint of each : they belong to the same con- tinuous experience at different levels. And lastly, their abstract, merely quantitative, character shows that it is the conceptions of physics, and not the fact of immediate experience, that are S3rmbohc, and so to say epithetic. The attempt ??? either empirically or speculatively ??? to out- flank mind by way of matter is an absurdity on a par with getting into a basket in the hope of being able to carry oneself.

These epistemological considerations may help us to deal with the prime and ultimate argument for strict parallelism. When all is said and done, it is urged, stiU the interaction of mind and matter remains inconceivable :

Tangere enim et tangi nisi corpus nulla potest res.

But this is hardly a suflScient reason for denying what is prima facie a fact. Occasionalists, from Geulincx to Lotze, have acknowledged the same obscurity in all cases of transitive action. Yet they did not venture to deny that sensations were interruptions in the psychical series, the " occasions " for which were only to be found in the physical; nor that purposive movements were interrup- tions in the physical series, the " occasions " or which were only to be found ia the psychical. And surely such a position is more in harmony with experience than that of the parallelists, who maintain that each series " goes along of itself"

* a statement which, as we have repeatedly urged, contradicts psychology and assumes the physical " explanation " of life. Whereas occasionalism leaves the question of ultimate means to be dealt with by meta- physics, parallelism forecloses it on the basis of a ready-made metaphysics modern naturalism, that is to say in which psychology as an independent science is entirely ignored. Starting with a dualism as absolute as that of Descartes but replacing his two substances by one, enjoying the otium cum, digvitate of the Unknowable starting, too, from the physical side, no wonder such a philosophy finds that what is for us the most familiar and of the supremest interest, the concrete world of sense and striving, is for it the altogether inconceivable, the supreme "world riddle." And yet if the naturalist could deign to listen to the plainest teachings of psychology and of epi- stemology, the riddle would seem no longer insoluble, for*

^ Cf. Lotze, Metaphysik, sec. 61 Jim.

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his phenomenal dualism and Ms agnostic monism would alike disappear. The material mechanism which he calls Nature would rank not as the profoundest reality there is to know : it would rather become what indeed " machine " primarily connotes an instrumentality subservient to the " occasions " of the living world of ends ; and so regarded, it would cease to be merely calculable, and would be found intelligible as well. Psychophysical parallelism, then, we conclude, is not a philosophically tenable position ; and pending the metaphysical discussion as to the ultimate nature of interaction generally we have to rest content with the second of the three possible modes of connexion above defined, as occasionalism formulates it. According to this, the two series, the psychical and the physical, are not independent and " closed " against each other ; but in certain circumstances e.g., in perception physical changes are the occasion of psychical, and in certain circumstances e.fj., in purposive movements

* psychical changes are the occasion of physical : the one change not being explicable from its psychical antecedents, nor the other from its physical.*

Into the metaphysical discussion we cannot, of course, enter here. It must suffice to say that it wiU not be conducted on the lines of our present inquiry : it will not start from a dualism of matter and mind, either regarded as substances or as phenomena. Its problem will rather be the interaction of subject and object a duality in the unity of experience, which by no means coincides with the dualism of matter and mind, neurosis and psychosis, and the like.

COMPAEATIVE PSYCHOLOGY.

Psychoneural parallelism is no doubt a well-established generalization ; nevertheless, concerning its exact range and its precise meaning there are differences of opinion. It is applicable, every one will allow, so soon as there is evidence of experiences individually acquired (cf. p. 55 above) ; and from such point onwards, in ascending any biological phylum, we find that the psychical and neural aspects differentiate and develop together. But how when we descend % Interpreting the neural correlate phj'siologically, and not morphologically, as referring primarily to function and not to structure, we find it still present as irritability and conductivity (leading to contraction, secretion,

But though every psychosis have its concomitant neurosis, it is uncertain how far the converse holds good. The action of the heart, for example, depends upon neuroses of which we have now no direct consciousness. Facts of this kind have led to three hypotheses concerning

' Plasticity the psychological "d priori" or groimd of the possi-bility of experience 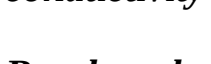 is a convenient term to express what is implied in retentiveness and differentiation.

the lowest forms of life, differing more or less from that just proposed, (i.) Perfectibility and instinct are found, it is said, to be in inverse ratio. Hence in the lowest forms of life there is no " learning by experience," because a stationary state of complete adjustment to environment has

been already attained, and all reactions have therefore become ” secondarily automatic ” : consciousness having served its purpose, has disappeared. To such a very Buddhistic psychology it may be objected : (1) that even organic reflexes tell upon the so-called vital sense or ccencBsthesis, and so far ??? the irreducible minimum being still intact ??? do not preclude all possibility of learning, should occasion arise ; and (2) that the psychical life even of a Protozoan does not, according to the best evidence, show any such mechanical finality as is here supposed, (ii.) According to the second view, which is advocated by Mr Herbert Spencer, the behaviour of the lower organisms is wholly made up of such reflexes, supposed to be devoid of aU psychical concomitants; but consciousness ??? so far from having disappeared ??? first comes upon the scene at the opportune moment when the increasing complexity of the mechanism calls for its guidance. Psychologically this hypothesis is less defensible than the last, and it has already been dealt with at some length (cf. pp. 42 fin., 43). It not only assumes, as that does, far more uniformity in the interaction of organism and environment than the facts warrant, but in regarding life as prior to mind, and as the means of its evolution, it burdens science with two insoluble problems instead of one. For even if it were possible chemically to build up protoplasm, we should stiU be as far from organisms as a heap of bricks are from putting them- selves together as a house, (iii.) The last view we have to notice is essentially an extension of the preceding, and is chiefly interesting as a rediictio ad absurdum of that. The physics of colloidal substances ??? at present wanting, but confidently expected ” in the near future ” by certain biologists ??? is the key which is to unlock the mysteries of protoplasm. Certain organisms, regarded as varieties of this substance, react positively to a given physical property of the environment, and others negatively : thus a moth flies towards the light, and a centipede runs from it ??? the one is positively, the other negatively, ” helio tropic ” ; the radicle of a seed, grovring downwards, is positively, the plumule, growing upwards, is negatively, “geotropic.” Instincts are but complexes of such tropisms, and owe their character entirely to the symmetrical form and definite structure of the colloidal substance. Now if it f acihtate the work of the biologist to say that when what we ordinarily regard as a hungry caterpillar climbs to the tip of a branch, it is forced so to do by positive hehotropism ; that then positive chemiotropism sets up

mastication of the young buds ; and that, lastly, ” we can imagine this process lead- ing to the destruction of the substances in the skin of the animal that are sensitive to light, and upon which the heliotropism depended,” so leaving it free to crawl down- wards and come in contact with the new buds which have in the meantime unfolded^ ??? if such language serve any useful purpose, all well and good ; only it must be applied to the hungry man too : in short, all behaviour must be described in the same terms. For the champion of coUoids to betake himself to consciousness as he approaches the higher forms of hfe, is as much a breach of methodological paralleUsm as it is for the psychologist to fall back upon protoplasm as he approaches the lower. But to suppose that psychical processes first appear in the complicated form of association of ideas ??? which learning by experience is taken to imply ??? and at the same time to assume that

‘ Cf. Loeb, Comparative Psychology, 1901, pp. 188 ff. ??? an interesting hook, full of psychological crudities.

such, experience, even when it appears, is ” ultimately due to the motions of colloidal substances,” these are incon- gruous absurdities which only the grossest ignorance would be bold enough to maintain.

Concluding, as we have done, that mind and matter ??? as we may provisionally call them ??? do really interact, we naturally infer that organic structures are not the result solely of material processes, but involve the co-operation of mental direction and selection : in other words, we are led to regard structure as partly shaped and perfected by function, rather than function as solely determined by structure, itself mechanically evolved. And such a view is justified by the fact that mechanical evolution is primarily a process of ” degradation ” rather than develop- ment, a case of facilis descensus contrasting with the upward struggle of life per aspera ad astra. StiU, the notion of life or mind as formative and directive has its difficulties. In the first place, we

have no experience of mind organizing matter ⬛⬛⬛ no experience of the actual process, that is to say ⬛⬛⬛ however sure we may feel of the fact. Hence the occasionalism to which here, at any rate, science is confined. Bat even so, the difficulty is not wholly removed. In the handicrafts whence we derive the conception of organs the artificer handles, but does not literally order, his tools ⬛⬛⬛ as if they too were intelligent. The conscious direction of such movements is doubtless facilitated by the fact that many of the complex co-ordina- tions actually involved in them are carried out automatic- ally, thanks to structural modifications, either inherited or acquired. And, regarding life phylogeneticaUy, we can imagine this process carried back indefinitely. Indeed, if it be illogical to talk of mechanisms evolving themselves and giving rise to the beings whose ends they serve, we have no choice but to accept this dualism of mind-shaping and matter inert. No choice, that is, unless we can establish the primacy of the psychological standpoint. Here we have duality but not dualism, arid the object is not inert. But still there remain two (difficulties, ⬛⬛⬛ possibly resolvable into one, ⬛⬛⬛ the plasticity a^^eady referred to as involved in all biological development and hereditary transmission ; as to these, psychology is almost wholly in the dark.i

AiTTHOKiTiES. ⬛⬛⬛ Historical. ⬛⬛⬛ The Hstor/'of psychology is still strangely neglected. Max Dessoir has commenced a Oeschichte der neueren deutschen Psychologic, comprising three volumes : one section of the first, dealing with the 17th century writers prior to Kant, has appeared (2nd ed., 1897) ; it contains a useful collection of material. From Les origines de la Psychologie contemporaine (1897), by the neo-Thomist scholar, Msgr. D. Mercier, much may be learnt, though its purpose is not primarily historical.

Positive. ⬛⬛⬛ The output of systematic works on psychology within the last twenty-five years is quite unprecedented. One of the most important of these ⬛⬛⬛ for the English reader the most important ⬛⬛⬛ is the Principles of Psychology, 2 vols., 1890, by W. James. Other works in English calling for special mention are G. F. Stout, Analytic Psychology, 2 vols., 1896 ; A Manual of Psychology, 2nd ed., 1901 ; Hoffding, Outlines of Psychology, 1891 (translated from Danish) ; G. T. Ladd,

Psychology, De- scriptive and Explanatory, 1894 ; W. Wundt, G-rumlriss der Psychologic, 4th ed., 1901 (translated). Dealing mainly with experimental psychology are KUlpe, Orundriss der Psychologie atif experimenteller Orundlage dargtstdlL, 1893 (translated) ; Ebbinghaus, Grundzilge der Psychologie, 1902, still in course of publication ; and E. B. Titohener, Experimental Psychology : a Mlanual of Laboratory Practice, 2 vols., 1901.

Specially interesting as treating psychological problems on new lines are La Psychologie des Idies-forcen, by A. FouilMe, 2 vols., 1893 ??? perhaps the best French contribution to recent psychology ; its cardinal point is the fundamentally dynamical character of the psychical. R. Avenarius, Kritik der reinen Erfahrung, 2 vols., 1888-90, an attempt, on the model of Kirchhoff and Mach's treat- ment of physics, to describe experience, taking the relation of the

1 On the subject of comparative psychology generally, see Animal Behaviour, 1900, by Prof. C. Lloyd Morgan ; L. T. Hobhouse, Mind in Evolution, 1901.

central nervous system to the environment as starting-point. Its strange and forbidding terminology prevented the timely recognition of its merits ; but since the author's death in 1896 ??? from overwork and disappointment ??? quite a literature has grown up, partly expository, partly controversial, devoted to this latest critique. H. Cornelius, Psychologie als Erfahrungswissenschaft, 1897, rather epistemological than psychological, and claiming affinity with the critiques of Kant and Avenarius. In J. Eehmke's Lehrbuch der allgemeinen Psychologie, 1894 ??? a psychology loith a soul, and claiming to be philosophy as well ??? the problems of perception and of psycho-neural interaction are discussed at length. F. Brentano, Psychologie vom empirischen Standpunkte, Bd. i., 1874, and still unfortunately incomplete : Brentano treats presentations and judgments as fundamentally distinct, feeling and willing, on the other hand, as fundamentally one. His influence on Austrian psychologists has been considerable, and is more or less apparent in the following : ??? K. Twardowski, Zur Lehre vom Inhalt und Gegenstand der Vorstellungen, 1894 ; A. Meinong, Psychologisch –

ethische Untersuehungen zur JVcrth- theorie, 1894 ; v. Ehrenfels, System der Werththeorie, 2 vols., 1897-98 ; A. Hofler, Psychologie, 1897.

Important as treating of particular topics are C. Stumpf, Tonpsychologie, 2 vols, 1883-90 ; A. Lehmann, Die Hauptgesetze des menschlichen Gefuhlsleben (translated from the Danish), 1892 ; various monographs by T. Kibot on diseases of memory, wUl, personality, on the psychology of attention, of the emotions, of general ideas, &c. ??? all translated into English ; J. M. Baldwin, Social and Ethical Interpretations in Menial Development, 1897 ; "W. Wundt, Volkerpsychologie, 1900, 3 vols., in course of pub- lication.

Later editions have appeared of many of the works mentioned in the earlier article, Sully's Outlines being replaced by a much fuller work. The Human Mind, 2 vols., 1892.

There are now several periodicals devoted exclusively to psychology, the chief being the Avwrican Journal of Psycho- logy ; the Psychological Review ; Zeitschrift fur Psychologie und Physiologie der Sinnesorgane ; and V Annie Psychologique.

(j. W.)*

Pteridophyta,! ??? The Pteridophyta, or, as they are frequently called, the Vascular Cryptogams, were treated of in the ninth edition of this work under the title Feens, since the majority of the existing plants of this great subdivision of tjae vegetable kingdom belong to that group. The importance and interest of the other Pteridoph5rtes, of which the Club-mosses and Horsetails are the most familiar examples, depend largely on the fact that they are the surviving representatives of large groups of plants which flourished in earlier geological periods. In order to understand the relationship of those now living, the extinct forms must be taken into consideration, and so far as is possible must be included in the general ^eme of classification. For a fuller description of the extinct Vascular Cryptogams than can be given here the articles on the Palceozoic and]Mesozoic floras should be consulted, and with regard to the living forms, the article on Ferns already mentioned. The investigations since 1879 have resulted in an increase of our knowledge

of the details of morphology and natural history of these plants, which has placed many of the problems presented by them in a new light. Thus, though points treated fully in the ninth edition of the Encyclopaedia Britannica will only be referred to here, it is necessary to review the^vhole subject. For fuller information regarding the anatomy of the sporoph3rte and explanation of anatomical terms, the article on Anatomy of Plants should be consulted.

The relation which exists between the two alternating stages or generations, which together constitute the complete life-cycle of all plants higher than the Thallophyta, is perhaps the most natural ^”” characteristic of the Pteridophyta. From the * *”” germinated spore of a fern-plant a small, flat, green organism is developed; this is the prothallus (gameto- phyte, sexual generation). As the result of fertilization of the ovum produced by this, the fern-plant (sporophyte, asexual generation) originates; from it spores are*

ultimately set free, with the germination of which the life- history again commences. The point common to all Pteridophyta is that from the first the gametophyte is an independent organism, while the sporophyte, though in the first stages of its development it obtains nutriment from the prothallus, becomes physiologically independent -when its root develops. This independence of the two generations for the greater part of their lives distinguishes

Fio. 1. *Diagrammatic sltetohes of prothalli of* *a, Equisetum ; 6, Lyoopodium cemuum ; c, L. Phlegmaria ; d, L. clavatum ; e, Selaginella ; /, Botry- ohium Virginianum ; g, Helminthostachys ; h, a Pern ; i, Salvinla.*

this group on the one hand from the Bryophyta (in which the sporophyte is throughout its life attached to the gametophyte), and on the other hand from the Gymnosperms and Angiosperms (in which the more or less reduced gametophyte remains enclosed within the tissues of the

sporophyte). The gametophjrte, which is usually dorsiventral, though in some cases radially symmetrical, is a small thallus attached to the soil .by rhizoids. In structure it is equally simple, being composed of parenchymatous tissue without' any clearly marked conducting system. Usually it grows exposed to the light and contains chlorophyll, but subterranean sapr6ph)rtic prothaUi also occur. In the heterosporous forms the gametophyte is more or less reduced. The reproductive organs ultimately produced on the same or on different individuals are of two kinds, the antheridia and archegonia ; the origin of both is from single superficial cells of the prothallus. The antheridium at maturity consists of a layer of cells forming the wall which encloses a group of small cells ; from each of the latter a single motile spermatozoid originates. The archegonium consists of a more or less projecting neck, and the venter, which is usually enclosed by the tissue of the prothallus. A central series of cells can be distinguished in it, the lowest of which is the ovum ; above this come the ventral canal cell and one or more canal cells. When the archegonium has opened by the separation of the terminal cells of the neck, the disintegration of the canal cells leaves a tubular passage, at the base of which is the ovum. Down this canal the spermatozoid, which in the Ferns has been shown to be attracted by reason of its positive irritability to malic acid, passes and fuses with the ovum. After fertilization

the latter surrounds itself with a cell- wall and develops into the sporophyte. The early segmentation of the embryo

Fig. 2. ??? Diagrammatic sketches of spore-producing members of??? a, Equisetum ; &, Lycopodium ; c, Psilotum ; d, Ophioglossum ; e, Kaulfussia ; /, Angi- opteris ; g, Nepiirodium ; A, Salvima. (All except d represent vertical seccions of sporangiophore or sorus.)

differs in the several groups, but usually the first leaf or leaves, the apex of the stem, and the first root are differentiated early, while a special absorbent organ (the foot) maintains for some time the physiological connexion between the sporophyte and the prothallus. The sporophyte is always highly organized both as regards form and structure. Root, stem, and leaf can be dis- tinguished even in the simplest forms, and the plant

ia traversed by a well-developed vascular system. The re- productive organs of the sporophyte are the sporangia, within which the spores are produced ; these are often borne on or in relation to leaves, which may be more or less distinct from the foliage leaves in form and structure. The cells of the wall of the sporangium are usually so constructed as to determine the dehiscence of the sporan- gium and the liberation of its spores. The spores pro- duced in each sporangium vary from very many to a single one in the caise of some heterosporous forms. These latter bear spores of two kinds, microspores and megaspores, in separate sporangia. From the microspore an extremely reduced male prothallus, and from the megaspore the female prothallus, develops. The spores of the homo- sporous Vascular Cryptogams are usually of small size ; the prothalli produced from them usually bear both antheridia and archegonia, though under special conditions an imperfect sexual differentiation may result. The com- plete life-history, with its regular alternation of gameto- phyte and sporophyte, is now known in aU except a few rare genera of recent Pteridophyta, and will be described in connexion with the several groups.

The Pteridophyta as known at present comprise four main subdivisions, the Equisetales, Sphenophyllales, Lyco- podiales, and Filicales. The Sphenophyllales are only known in a fossil state, while the other three j∧∧''''∧' include both fossil and recent representatives. The systematic arrangement of the Vascular Cryptogams for the purposes of identification and description necessarily remains unchanged, while the comparative morphology ia being more fully worked out. But modifications in the order of placing the natural groups are of importance in*

expressing the results of sucli investigations. Such, a scheme may be placed here in a tabular form before enter- ing on the consideration of the life-history, natural history, morphology, and classification of the several groups : ???

Pteridophyta. I. Equisetalbs

(Eqzdsetacece. ??? \Calamariace(B.

II. Sph.koph???.les {SS^—

III. Lycopodiales

i ??? –

Psilotacece. -(Selaginellacece.

Lepidodendracece. \Isoctacece.

Ophioglossacece.

IV. FiLICAlES

.???{

Filicacece,

Hydnpteridece.

Marattiaceos.

Osinundaceos.

ScMzceacem.

Glcicheniacece.

Matoniacece.

Loxsomacetc.

Hyinenophyllacece.

Cyatheacece.

Polypodiacece. (Salviniacece. \Marsileacece.

I. Equisetales. ??? The plants of the single living genus Equisetum, which vary in height from a few inches to forty feet, have subterranean rhizomes, from which the erect shoots arise. The general appearance and construc- tion of the shoot, with its elongated hollow internodes and whorls of united leaves inserted at the nodes, have been described in the article on Ferns. The leaves of successive whorls alternate vsdth one another, and this applies also to the branches which arise in the axil of the leaf sheath. In most species many of these buds, which alternate with the leaves, remain dormant, but in others the aerial shoots are copiously and repeatedly branched. In some species branches of the rhizome with tuberous internodes are formed, which serve as a means of vegetative repro- duction. The roots which arise from the base of the lateral buds remain undeveloped on the aerial stem. The general course of the vascular bundles in the stem of Equisetum is figured and described in the article on Feens. The young stems, and the older stems of certain species, are clearly monostelic, but in other species an inner and outer endodermis may be present, or an endodermal layer surrounds each bundle. The vascular bundles themselves are collateral, the xylem consisting of the protoxylem, towards the centre of the stem, and two groups of xylem, between which the phloem is situated ; the protoxylem elements soon break down, giving rise to the carinal canal. There is no secondary thickening except at the node in E. maximum, where some short tracheides, arranged in radial rows, arise from a cambium. The stems, the surface of which exhibits a number of ridges with intervening furrows, perform the greater part of the work of assimila- tion. The chlorophyll-containing tissue reaches the surface at the sides and base of the furrows, where stomata of peculiar form occur in the epidermis, while subepidermal strands of sclerenchyma occupy the ridges. In the cortical

tissue beneath each furrow a wide intercellular space is present running the length of the internode, and called the vaUecular canal. The central cylinder of the root, in which there are several xylem and phloem strands, has around it a two-layered endodermis, the inner layer of which appears to take the place of a j'ericyclo. The sporangia are borne upon lateral outgrowths of the axis (the sporangiophores), which arise in whorls and are associated in definite strobili or cones ; at the base of the cone an outgrowth of the axis like a rudimentary leaf sheath (the annulus) is j)resent. Each sporangiophore consists of a stalk expanding into a peltate disc of hexa-

gonal outline ; from the inner surface of the latter six to nine sporangia hang parallel with the stalk. The single vascular bundle suppUes a branch to the base of each sporangium. The latter arises from a number of super- ficial cells, the cells destined to form the spores being derived from a single one of these. A tapetal layer is derived from the cells surrounding the sporogenous group, and the arrest of a number of the spore mother-cells further contributes to the nourishment of the remainder, each of which gives rise to four spores. The outermost layer of the ceU-waU of the ripe spore splits along spiral lines, giving rise to the elaters ; these two long strips of wall, attached by their middle points to the spore, tend to straighten out in dry and close round the spore in damp air. They thus assist in the opening of the sporangium, which takes place by a slit on its inner face. Further, several spores will be likely to germinate together owing to their elaters becoming entangled; a fact of some im- portance, since the antheridia and archegonia, though occurring sometimes on the same prothallus, are more often borne on separate individuals. The prothaU con- tain abundant chlorophyll, and are dorsiventral. Those that bear the antheridia are the smaller, and are either filamentous, or flattened, with the margin irregularly lobed. The antheridia are deeply sunk in the tissue ; the spermatozoids consist of a spiral of two or three coils, the numerous cilia being attached to the pointed anterior end. The female prothalli, which are sometimes branched, con- sist of a thick cushion bearing thin, erect, lateral lobes, at the base of which the archegonia are situated. The necks of the latter are short, the central series of cells consisting of ovum, ventral canal cell, and one or two canal cells. The half of the embryo directed towards the

archegonial neck gives rise to the apex of the stem and a sheath of three leaves, the other half to the small foot and the primary root. The first shoots are of hmited growth, being replaced by lateral branches, which gradually acquire the number of leaf teeth characteristic of the species.

Fossil species, some of which attained a great size, are known, to which the name Equisetites is given, since they appear to be closely allied to the existing forms. Two other extinct genera, Phyllotheca and Schizonenra, may be mentioned here. Abnormal specimens of Equisetum in which the strobilus is interrupted by whorls of leaves are of interest for comparison with the fructification of Phyllo- theca. The most important and best known of the extinct Equisetales are, however, the Calamites, for a detailed account of which the article Paleobotany : Palceo:oic, must be consulted. In the primary structure of the stem the Calamites present many points of resemblance to Equisetum, but secondary thickening went on in both stem and root. These plants, which appear to have grown in swampy soil, thus attained the dimensions of consider- able trees. The leaves, which were of simple form (except in Archceocalamites, where they forked), were inserted in whorls at the nodes ; they were either free from one another or cohered by their bases into a sheath. The branches alternated in position with the leaves, and sprang from just above the insertion of the latter. Some of the branches terminated in cones, which present a general similarity to those of Equisetum. This similarity is closest in Ai-chceocalamite.% an ancient type found in Upper Devonian rocks ; in this the strobilus consists of peltate sporangiophores inserted in whorls on the axis. In the other Calamarian strobili known the whorls of sporangiophores are separated by whorls of bracts. In some the sporangiophores stood midway between the sterile whorls, Avhile in others they approached the whorl above or below. There is a close resemblance between these sporangiophores and those of Equisetum., but as a

rule only four sporangia were borne on each. Some Calamites were heterosporous, sporangia with, microspores and megaspores being found

in the same cone.

Our knowledge of the extinct Equisetales, full as it is with respect to certain types, does not suffice for a strictly phylogenetic classification of the group. The usual sub- division is into Equisetaceos, including Equisetum and Equiaetites (with which Phyllotheca and Schizoneura may be provisionally associated), and Calamariacece, including Calamites and ArchcBocalamites.

II. Sphbnophyllales. ❓❓❓ The two very distinct genera Sphenophyllum and Cheirostrobus, included in this group, are known only from the Palaeozoic rocks. Though the high specialization of this ancient group of plants renders the determination of their natural affinities difficult, indi- cations are afforded by anatomy and the morphology of the strobilus. In general appearance the species of Spheiw- phylluTn (the remains of Cheirostrobus known do not allow of any idea of its habit being formed) present some re- semblances to the Equisetales. The long, sparingly branched stem bore at the somewhat swollen nodes whorls of six to eighteen wedge-shaped or hnear leaves, which did not alternate in successive whorls. Both the broader and narrower leaves may be more or less deeply divided, and both forms may occur on the same shoot. From the relation of the thickness of the stem to its length it may be inferred that the shoots of Sphenophyllum derived support from adjoining plants. Without entering into detail regarding the anatomy, it may be stated that secondary thickening took place in both genera. The single stele in the stem consisted of the phloem surrounding a solid central strand of xylem, the groups of protoxylem being situated at the projecting angles. In Sphenophyllum, in which the transverse section of the xylem is triangular, there were three or six protoxylem groups; in Cheiro- strobus they were more numerous. The anatomy of the stem is thus very unlike that characteristic of the Equiset- ales, and presents essential points of resemblance to the Lycopodiales, especially the Psilotaceae. The general morphology of the cones, on the other hand, points to an affinity with the Equisetales. The cone of Sphenophyllvmi consisted of an axis bearing at the nodes whorls of bracts, united below into a sheath. The overlapping bracts affi)rded protection to the sporangia, which were borne on sporangiophores springing from the upper surface of the coherent bracts

near their origin from the axis ; two spor- angiophores usually arose from each bract, and sometimes adhered to its upper surface for some distance. Each bent round at the upper end, and bore one or two sporangia on the side turned towards the axis. The mature sporangium had a wall of a single layer of cells, which were larger towards the base, where- they continued into the epidermis of the sporangiophore. In other species of Sphenophyllum, which are known only as impressions, single sporangia, or groups of four, appear to have been inserted directly on the upper surface of the bracts. In Cheirostrobus a similar relation of sporangiophores to bracts existed, but here each bract was divided into three segments. From each segment, near its base, a stalked peltate sporangiophore arose ; this bore four sporangia, which hung parallel to the stalk. That these three sterile segments, with their sporangiophores, are together comparable to one of the bracts of Sphenophyllum, with its sporangiophores, is shown by the vascular supply in each case being derived from a single leaf-trace. So far as is at present known, the Sphenophyllales were homosporous. The differences between the two genera described above are sufficiently marked to justify the division of the Sphenophyllales into the two orders Sphenophyllaceae and Cheirostrobaceae. A consideration of the characters of both shows that

resemblances suggesting actual relationship exist between this group and the Equisetales and Lycopodiales, between which they are here placed. It has been suggested that the Sphenophyllales may have sprung from a very Oid stock which existed prior to the divergence of the latter groups. So long, however, as our knowledge of these three phyla is confined, as at present, to specialized forms, the nature of the relationship between them must remain hypothetical.

III. Lycopodiaies. ??? The. living representatives of this group, for a general description of which the article Feens should be referred to, are of small size compared with the related plants which lived in Palaeozoic times. A large proportion of the hving species are tropical, though others have a wide distribution. As general characteristics of the Lycopodiales, the simple form of the leaves, which are generally of small size, and the situation of the sporangia on the upper surface of the sporophylls, which are often associated in cones, close to their insertion on the axis, may be

mentioned ; there are both homosporous and heterosporous forms, the prothalh exhibiting corresponding differences. Before considering the characteristics of the several orders of this phylum, it is of interest to recognize in many of the surviving forms peculiarities in mode of life, to which we may reasonably ascribe their success in the struggle for existence or their escape from severe com- petition. Thus Tmesipteris and many species of Lyco- podium, are epiphjrtic, Psilotum, is a partial saprophyte, and many species of Lsoetes are aquatic. Vegetative repro- duction is effected in various ways : by the separation of the branches of a creeping stem in some Lycopodia, the persistence through the winter of the apex of the shoot in L. inundatum, the formation of leafy bulbils on the aerial stem of L. Selago and others, and of small gemmae on the rhizome of Psilotum,. A highly speciahzed means of vegetative reproduction is seen in the tubers of Phyllo- glossum, and the embryos of some Lycopods. The modifi- cations shown by the gametophyte of Lycopodium vdll be described below. All such special relations of the plant to its environment, which might be expected in the few forms of a large group which had persisted beyond the others, are less marked in the genus Selaginella. It would appear as if the latter was more suited to the conditions of the existing flora, and many of the specific forms within it may rather be regarded as recently evolved than as simply persistent.

LycopodiacecB. ❓❓❓ This order contains the two genera Phylloglossum and Lycopodium ; the former has a single species, while nearly one hundred species of Lycopodium are known. Erect and creeping terrestrial plants and pendulous epiphytes occur in the latter genus. The simple leaves, which are of small size and do not possess a ligule, are arranged spirally around the branched stem in the majority of the species. The roots of the erect forms often grow downwards in the cortex of the stem to reach the soil. The anatomy of Lycopodium presents considerable variety in detail, but the stem is always monostelic and the development of the xylem centripetal, the protoxylems being situated at the periphery of the stele ; pericycle and endodermis surround the stele, and the wide cortex may be more or less sclerenchymatous. The central cylinder of the root often shows a striking resemblance to that of the stem. The Lycopodiaceae are homosporous. The spores are formed in sporangia of considerable size, situated on the upper surface and near the base of

the sporophylls. The latter may differs from the foliage leaves and be arranged in definite cones, or the two may be similar and occupy alternate zones of a shoot with continued growth ; sometimes rudiments of sporangia are found at the bases of the leaves. In the development of the sporangium the sporogenous tissue is derived from a number of superficial cells by divisions parallel to the surface. The tapetum is derived from the layer of cells surrounding the sporogenous group. Short trabecule of sterile tissue have been found to project into the cavity of the sporangium of some species. The spores, when liberated by the dehiscence of the sporangium, give rise to the prothallus, which is now, owing mainly to the investigations of Treub and Bnichmann, known in a number of tropical and temperate species. In habit

and mode of life of the prothallus these present striking differences, which may be correlated with the situations inhabited by the sporophyte, and are perhaps to be regarded as adaptations which have enabled the species to survive. Thus in L. cernuum and others the 'prothallus is green and grows on the surface of the soil ; in the species living on the moors it is subterranean and sapro- phytic, though capable of developing chlorophyll when exposed to light ; while in L. Phlegmaria and other epiphytic forms the pro- thallus consists of fine branches growing saprophytically in rotting wood. A comparison of these various types would appear to in- dicate that the primitive form of prothallus in the genus was radially symmetrical and contained chorophyll. The prothalli of L. cernuum come nearest to this ; in them the meristem forms a zone slightly below the summit, which may bear a number of green lobes. The different forms of the prothallus found in L. Selago give an idea of how the more extremely modified types could be derived from such a prothallus as that of L. cernuum. All the saprophytic prothalli contain an endophytic fungus in definite layers of their tissue. The antheridia and archegonia are produced above the meristematic zone, and are more or less sunk in the tissues of the prothallus. The most important difference in

the sexual organs concerns the length of the archegonial neck ; this is shortest and has only a single canal cell in L. cernuum, while in i. compla- ncUum it is longer than in any other Vascular Cryptogam, and con- tains a number of canal cells. The spermatozoids are biciliate. The embryo in L. cernuum and other forms with superficial green prothalli is attached to the prothallus by a small foot, and develops at first as a tuberous body (the protocorm) bearing rhizoids ; this forms a number of simple leaves, and upon it the apex of the shoot arises later. In the saprophytic forms the protocorm is absent, and in some of them the foot is of large size. When new in- dividuals of species which possess a protocorm arise vegetatively from the leaves or roots of young plants, the protocorm appears in the young sporophyte. This fact leads to the consideration oiPhyllo- glossum, which resembles the embryo of Lycopodium cernuum in so many respects that it has been spoken of as a permanently embryonic form of Lycopod : it is in some respects the simplest existing Pteridophyte. Its prothallus resembles that of L. cernuum, but wants the crown of assimilating lobes. The plant is reproduced by tubers, which resemble the protocorm in bearing first a number of protophylls and later the upright shoot with its single terminal strobUus. The sporangia agree with those of Lycopodium in structure and position.

Fsiiotacece. ??? The two genera included in this order are somewhat isolated among the Lycopodiales. In both Psilotum and Tmesipteris the functions of the root-system, which is completely absent, are performed by leafless rhizomes bearing absorbent hairs and inhabited by an endophytic fungus. Psilotum lives epiphytically or in soil rich in humus, while Tmesipteris is epiphytic (and, it has been suggested, partially parasitic) upon stems of tree ferns : the former has small scale-like leaves ; those of the latter are of considerable size. The stem is monostelic, the protoxylem groups being to- wards the periphery of the xylem, the development of which is thus centripetal ; the centre of the stele is occupied by sclerenchy- matous tissue. The leaves, which bear the sporangia, are bilobed and do not form definite cones, but alternate in irregular zones with the foliage leaves. The sporangia of the PsilotacecB are associated in synangia, which occupy the same position relatively to the sporo- phyll as the single sporangium of Lycopodi^i,m. The careful study of the

development of the synangium of Tmesipteris, which consists of two loculi, and of Psilotum, which consists of three, has shown that their structure can be adequately explained as originating by the septation of a single sporangium resembling that oi Lycopodium. Other views of the nature of the Psilotaceous synangium are, how- ever, possible ??? one, which regards the sporophyll and synangium as corresponding to the bract and sporangiophores in Sphenophyllum, being of special interest, on account of the resemblance in anatomy between the Psilotacece and the Sphenophyllales. There is some reason to believe that the prothallus of Psilotum resembles some Lycopodium prothalli, but conclusive evidence is wanting ; that of Tmesipteris is unknown.

Selaginellacece. ??? The single genus of this order (Selaginella) contains between three and four hundred species. There is con- siderable diversity among them as regards external form, the majority having dorsiventral aerial shoots with dimorphic leaves, while in others the shoots are radially symmetrical and the leaves alike. The stem contains one, two, 'or several steles ; in one species the stele is tubular. The phloem completely surrounds the xylem, which usually develops from two protoxylem gi-oups. In the aerial stem of the British species {S. spinosa) the radial stele has a number of protoxylem groups arranged round the periphery, much as in Lcpidodendron. The cells of the endodermis are de- veloped as trabecule, which traverse the continuous air-space surrounding each stele. The simple, uni-nerved leaves have a ligulo near the base ; the base of the ligule is somewhat sharply marked off from the other tissues of the leaf. In some species a depression of the leaf-surface encloses the ligule, regardinc the

function of which little is known. The roots, the stele of which is monarch, may arise directly from the stem, or are borne on rhizo- phores, which spring from the shoot at the point of branching, and root on reaching the soU. In structure they resemble the roots, but their morphological nature is uncertain. The sporophyUs are arranged radially in the cones, which are terminal on the branches, A single sporangium is borne on the axis just above the insertion of each sporophyll. Selaginella is heterosporous, the megasporangia being often found towards the base of the cone. The development of the micro- and mega-sporangia is the

same up to the stage of isolation of the spore mother-cells. The sporogenous tissue, which is referable to several archesporial cells, is surrounded by a tapetum, mostly derived from the sporogenous group. In the micro- sporangium all the mother-cells undergo the tetrad division, giving rise to the numerous microspores. In the megasporangium, on the other hand, the four megaspores, which arise from a single mother-cell, are nourished at the expense of the other sporogenous cells and of the tapetum. On germination the microspores give rise to a reduced prothallus, consisting of the small cell first cut off and a wall of cells enclosing two to four central ones ; from these latter the biciliate spermatozoids originate. The megaspore be- comes filled with the female prothallus, the formation of cell-walls commencing at the pointed end of the spore, where from the first the nuclei are more lUumerous, and later extending to the base. The surface of the prothallus which is exposed when the thick wall of the spore is ruptured may produce a few rhizoids ; upon it the archegonia, consisting of a short neck and the central series of ovum, ventral canal cell, and canal cell, arise. After fertilization the embryo forms a short suspensor ; the apex of the stem, with a leaf on each side of it, is first distinguishable ; at the base of this is the foot ; while the root arises on the farther side of the latter. Thus the position of the foot in Selaginella is different from what obtains in the other Vascular Cryptogams. A point of interest in this heterosporous genus is that the formation of the prothallus may commence before the megaspore is liberated from the sporangiimi.

Lepidodendracece. ??? This order includes only extinct forms, the best known of which are the plants placed in the genera Lcpido- dendron and Sigillaria. These plants, a fuller description of which must be sought in the article PALiEOBOTAXY : Palaeozoic, underwent secondary increase in thickness and attained the size of large trees ; the aerial stem was more or less branched dichotomously. The leaves, which were of simple form and provided with a ligule, were, as the leaf-scars on the stem show, variously arranged. In Sigillaria the latter form vertical rows, while in Lcpidodendron the arrangement is a complicated spiral. The stem had a single stele, the primary xylem of which was polyarch and centripetally developed. The upright stems were attached to the soil by a number of dichotomously branched members (Stigmaria), which, whatever their

morphological nature may be, appear to have per- formed the function of roots : they have numerous cylindrical appendages, which penetrated the soil on 'all sides. The cones, which in some instances at least were heterosporous, presented a general resemblance to those of Lycopodium and Selagiii^lla, a single sporangium being situated on the upper surface of each sporophyll. The cavities of the large sporangia were sometimes traversed by trabecule of sterile tissue resembling those found in Isoetes. In some of the heterosporous forms {Lepidocarpon) the sporangia were sometimes surrounded by an integument ; and since only a single megaspore attained maturity, the structure of the megasporangium suggests a comparison with an ovule.

Isoetotce(E. ❓❓❓ The single genus (Isoetes) contains about fifty, mostly aquatic, species, though a few are amphibious or terrestrial. The plants present considerable uniformity in general habit, consisting of a short, unbranched stem, bearing the closely crowded awl- shaped leaves, which in the larger species attain the length of a foot. Each leaf bears a ligule resembling that of Selaginella in structure and position. The stem is monostelic, the centre of the stele being occupied by a mass of short tracheides ; but little can be said as to the primary structure of the central cylinder, which appears to be reduced. A meristematic zone forms, a short distance outside the xylem, from which secondary tissue is developed both internally and externally ; that to the inside contains iDoth xylem and phloem elements. By the unequal development of" the secondary cortex the stem becomes two- or three-lobed ; the roots, which branch dichotomously, spring from the furrows between the lobes. The leaves have a single main bundle, and in the mesophyll are four longitudinal series of large intercellular spaces separatedby transverse diaphragms. The sporangia, which are situated singly on the adaxial surface of the leaves, between their insertion on the stem and the ligule, arise from a considerable number of epidermal cells. The cells composing the young spor- angium are at first similar, but ultimately become differentiated into sterile trabeculfe, which may stretch from the inner to the outer wall, and the mother-cells of the spores. The latter are more numerous in the microsporangium than in the mega- sporangium. The tapetal layer is partly formed from the spor- angium wall and partly as a layer covering the trabecula;. The

spores, which are set free by the rotting of the sporaiigial wall, germinate much as in the case of Selaginella, though the similarity luay be o, case of independent resemblance. Important points of dillerence are found in the multioiliate spermatozoids, and in the embryo, which has no suspensor.

*The several orders of Lycopodiales described above,
 ॐ ॐ while presenting a number of features in common, are dis- tinctly isolated from one another. A natural classification of such specialized plants can only be obtained when the extinct forms are more fuUy known. What is known at present, while it does not indicate the phylogeny of the Lycopodiales, at least shows that such living orders as Lycopodiacex and Selac/inellacete cannot be regarded as forming a linear series. The difficulty is increased when it is borne in mind that the small surviving forms probably have a long geological history, and may have coexisted with the Lepidodeitdraceae. For these reasons no attempt has been made to arrange the orders in larger divisions, since such a division as that of the ligulate and ehgulate forms, while convenient for practical purposes, may not express the phylogeny of the group. The resemblances between the outstanding order Psilotacece and the Spheno- phyllales have been noted above, and it remains to be mentioned that the Isoetaceae have been regarded as more nearly allied to the Filiccdes than to the forms near which they are here placed.*

IV. FiLiOALES. ॐ ॐ ॐ The article on Feens dealt so much more fully with the Ferns than with the other Vascular Cryptogams that it is sufficient to refer to it for a general account of their life-history, structure, and habit, and the principles on which they are classified. The classification in that article was that of the Synopsis Filicum, the standard systematic work on these plants; the modifica- tions in general arrangement adopted below are the ex- pression of the progress which has been made in tracing the phylogeny of the group. One main departure must be specially noted here. The OpMoglossacece and Maratti- acem, united in the article on Fbens as Stipulates, though possessing some characters in common, do not appear to constitute a natural group, and

have been separated ; the former are placed by themselves, but, pending further evidence as to their true relationship, are still included in the Filicales, while the latter are grouped with the rest of the homosporous ferns as Filicacem. The heterosporous forms are treated by themselves as Hydropteridece, though further research will probably indicate more precisely their relationship to the Filicacece.

Ophioglossacece. ❓❓❓ The peculiarities of this small order of Pteridophyta render their systematic position a matter of some doubt, especially in the absence of evidence as to their geological history. In the three genera, Ophioglossum, Botrychium, and Helmintkostachys, there is an under- ground rhizome, from which one leaf or a few leaves with sheathing bases are produced annually ; the roots arise in more or less definite relation to the insertion of the leaves. The latter are simple, or irregularly lobed in Ophioglossmn, more or less compoundly pinnate in Botrychium, and palmately pinnate in Helmintkostachys. The fertile branch or branches are situated on the adaxial surface of the leaves, and may be simple, as in Ophioglossum, or more or less compound, the degree of branching in the sterile and fertile segments exhibiting a general parallehsm. The stem is monostelic, the arrangement of the xylem and phloem being collateral. The endodermis and pericycle surround the whole stele in Botrychium and Helmintho- stachys; in Ophioglossum each bundle has a separate sheath. Well-marked secondary thickening occurs in Botrychium. In the roots of Ophioglossum and Botry- chium and in the first formed roots of Helmintkostachys an endophytic fungus is present, forming a mycorhiza ❓❓❓

the stele in the larger roots has the usual radial arrange- ment of xylem and phloem. The morphology of the fertUe spike is a disputed question, upon the answer to which the systematic position of the Ophioglossacece largely rests. The spike is most simple in Ophioglossumi, where it bears on each side a row of large sporangia, which hardly project from the surface, the vascular bundles occupjdng a central position. In the young spike, which arises when the leaf is still very small, a band of tissue derived from superficial cells is distinguish- able along either side ; this sporangiogenic band gives rise to the sporogenous groups, the sterile septa between them, and the outer walls of the sporangia. The spike of

Helmintkostachys corresponds to that of Ophioglossum, but in it the sporangia are borne on two lateral rows of branched sporangiophores. The sporangia resemble those of Botrychiwm, which project from the ultimate sub- divisions of the branched spike ; each is developed from a number of cells, the sporogenous tissue arising from a single cell. Two diverse views of the morphology of the fertile spike in these plants have been entertained which must be mentioned. The older view was that it was a fertile segment of the leaf ; and though its ventral position presents a difficulty, this must be regarded as a possible explanation when the analogous case of the Marsileacece is taken into consideration ; the occasional occurrence of sporangia on the lamina in Botrychium has also been regarded as supporting it. On the other hand, the spike has been explained as due to the elaboration of a single sporangium occupying a similar position with regard to the leaf as in the Lycopodiales, and evidence of consider- able weight has been brought forward in support of this interpretation. The important bearing of this question on the relationship of the Ophioglossacece to the phyla of the Filicales and Lycopodiales will be obvious. The Ophio- glossacecB are homosporous, and the prothaUi, which are known in two species of Ophioglossum and Botrychium, and in Helmintkostachys, are subterranean and sapro- phytic. The prothallus of 0. pedunculosum, as observed by Mettenius, subsequently reached the surface and produced green lobes ; those of the other species known are wholly saprophjrtic, and contain an endophytic fungus. They thus present a general, but probably homoplastic, resem- blance to the prothalh of certain Lycopodia. Important points of diflference exist, however, in the apical position of the meristem of the Ophioglossaceous prothalU, in the presence of a basal cell to the archegonium, and in the multiciUate spermatozoids. In these respects, and in the absence of a suspensor from the embryo, the OpMo- glossacece, approach the Filicacece. The position of the OpkioglossacecB can at present only be regarded as an open question, in considering which the possible antiquity of the group must be borne in mind.

Filicacece. ??? This order of Pteridophyta differs from the others in being well represented in our present flora by forms, many of which can be regarded, not as archaic types which have persisted to the present day, but as having been evolved in comparatively recent periods. The external

form of the Ferns having been fully dealt with in the article already mentioned, it will suffice to refer to the more striking adaptive modifications in the gametophyte and sporoph3rte, and to certain efiects of altered external conditions which have been ascertained experimentally. The dorsiventrality of the prothallus has been shown to depend mainly on the illumination, the filamentous form being retained in feeble light ; a similar result is obtained when the prothaUi are cultivated in water. These facts may have a bearing on the filamentous prothaUi of some Hymeno- pkyllaceas. The reproduction of the prothallus by gemms in species of Trichomanes, Vittaria, and Monogramm^e

is anotlier interesting adaptation ; the perennial prothallus of Gymnogramme leptophylla is described in the article on Feens. The phenomena of apogamy and apospory, which have now been observed in a number of Ferns, may be mentioned here. In the former the prothaUus produces one or more fern-plants vegetatively, the projection which develops into the sporophyte in many cases occupjdng the position of an archegonium. In some apogamous Ferns sporangia may occur on the prothaUus, and the vegetative organs of the sporophyte may also occur singly. In apospory the converse phenomenon is seen, the gametophyte springing vegetatively from the sporangium, receptacle of the sorus, or leaf margin of the fern-plant. In a number of cases, though not in aU, apospory appears to be corre- lated with a failure of the sporangia to develoj), and a similar correlation between apogamy and the prevention of sexual reproduction appears probable. The adaistations in the vegetative organs of the sporophyte are similar to those in the Flowering Plants. Thus there are a few Ferns which climb, others are water plants, while many, especially those which live as epiphytes, are more or less xerophytic. Some of the epijjhytic forms {Polypodium quercifolium, Platycerium) have strongly dimorphic leaves, the sterile leaves serving in some cases to catch falling debris, and thus to provide the plant with soil. Lastly, the symbiotic relation between the plant and ants is found in

Ferns, the rhizome of Polypodium carnosum containing cavities inhabited by these insects. The existence of these myrmecophilous Ferns suggests a possible explanation of the nectaries on the leaves of some other species, such as the common Bracken.

The main existing groups of the Filicacece may now be briefly described, vnth special reference to the characters of gametophyte and sporophyte, which have been found of value in determining affinities.

Marattiacew. ??? These are ferns of considerable size, the large leaves of which are borne on a short, erect, swollen stem {Angiopteris, Marattia), or arise from a more or less horizontal rhizome {Danosa, Kaulfussia). The leaves, at the base of which are two large stipule- like outgrowths, have a thick leaf-stalk, and are simple or simply pinnate in Dancsa, pinnate in Archangiopteris, bi- to tri-pinnate m Marattia and Angiopteris, and digitately lobed in Kaulfussia. The stem, from the ground tissue of which sclerenchyma is absent, has a complicated system of steles arranged in concentric circles ; the thick roots, the central cylinders of which have several alter- nating groups of xylem and phloem, arise in relation to these. The pinnae, except in a few filmy forms, are thick ; in Kaulfussia large pores derived from stomata occur in the epidei'mis. The sori are borne on the under surface of the pinnse, usually in a single row on either side of the midrib, but in Kaulfussia dotted over the ex- panded lamina. The large sporangia, each of which originates from a number of superficial cells, are here incompletely separated from one another and arranged in a single circle forming a synangium. The association is closest in Danma, where the individual sporangia of the elongated sorus, which is sunk in a depression of the leaf, open by pores ; in Marattia and Kaulfussia they dehisce by slits on the inner face ; while in Angiopteris they are almost free from one another. The spores produce a green prothaUus of large size, the sexual organs of which hardly project from the surface. The cotyledon and stem grow up vertically through the prothaUus, the root turning downwards into the soil.

Osmu7idacece. ??? The two genera of this group, Osmunda and Todea, have thick erect stems, covered with the closely crowded leaf bases. The stem is monostelic, the vascular tissues being separated into curved

groups comparable with collateral vascular bundles, which surround the pith. The somewhat thick roots are diarch. The leaves are large and pinnate ; their lamina is usually thick, though fUmy species of Todea occur. The leaf-base shows indica- tions of stipular outgrowths. In Todfn the sori, each of which consists of a single circle of bulky sporangia, are borne on the under surface of the pinnte. In Osmunda the '???egion of the leaf which bears the sporangia has its lamina little developed ; the leaf thus bears sterUe and fertile pinnaB, or, as in 0. cinnamomea, sterile and fertile leaves may bo present. The sporangia originate from single cells, though surrounding cells may contribute to the formation of the stalk. The latter is thick and short, and the wall of the sporangium, which opens by a median slit, has a group of thick- walled cells at the summit, forming the annulus. The prothalli are

simUar to those of the other Filicacece, but more massive ; the same may be said of the archegonia and antheridia, which, however, project more than in the preceding group.

Schizceacece. ??? The anatomy of the stem differs in the four recent genera of this order, and presents a series possibly Ulustrating the origin of a number of concentric steles from a sohd stele, the inter- mediate step being represented by those forms in which the central cylinder is tubular. The sporangia are borne singly or in sori of two or three on the margin or under surface of leaves, the fertUe pinnse of which differ more or less from the sterile segments. The sporangium is of considerable size, and dehisces by a median slit, the annulus being a more or less definitely limited horizontal ring of cells near the apex. The prothaUus and sexual organs may resemble those of the Polypodiacece ; in Aneimia and Mohria the prothaUus, though flattened, is not bUaterally symmetrical, the growing point being on one side ; a filamentous type of prothaUus is known in S&Mzaa.

Gleidheniaceos. ??? These forms have a horizontal rhizome, from which simply pinnate leaves arise in Platyzoma, while Gleichenia bears compound pinnate leaves with continued apical growth. The rhizome usually has a solid central cylinder in Gleichenia, whOe that of Platyzoma is tubular. The sporangia arise simultaneously in the sorus,

which is borne on the under surface of the ordinary pinna ; in those species with large sporangia the latter form a single circle, in others sporangia may also arise from the central part of the receptacle. The annulus is horizontal and the dehiscence median. The prothaUi, while resembling those of the Polypodiaccm, have points of similarity with those of the preceding groups.

Matoniacece. ??? This contains the single gamis Matonia, two species of which are known from the Eastern Tropics. They are of special interest, since they have been shown to be the surviving forms of a group species of which have been identified from Jurassic and Cretaceous rocks. The living species have a long rhizome, from the upper surface of which the large leaves arise ; these are branched in a pedate manner, each branch being pinnate. The structiire of the rhizome is complicated, a transverse section showing that the centre may be occupied by a solid stele, outside of which are two tubular steles. The sori are borne on the under surface of the pinnae, each consisting of a single series of large sporangia covered by a coriaceous indusium, which is attached to the central part of the receptacle. The sporangium, which corresponds on the whole to that of the Gleicheniacece, has a somewhat oblique annulus ; the dehiscence also is not truly median. The gametophyte is unknoMm.

Loxsomacem. ??? The single genus Loxsoma has a tubular stele in its rhizome, which bears leaves resembling those of some Davallias. The elongated receptacle of the marginal sori is surrounded by a basal cup-shaped indusium. The sporangia, which arise in basipetal succession on the receptacle, dehisce by a median sUt, though the annulus is somewhat oblique ; they have resemblances to the Gleich- eniacecB. When mature, the sporangia are raised above the margin of the indusium by the elongation of the receptacle, thus facUitating the dispersion of the spores. The gametophyte is unknown.

HyinenophyUace(B. ??? This group, which contains the two genera Hymenophyllum and Trichomanes, is characterized by the pre- valent "filmy " texture of the leaves. Many of the species inhabit situations in which the air is constantly moist, especially in the tropics ; some are terrestrial ; others epiphytic on tree stems, or, in the case of the smaller

species, some of which are very minute, on the leaves of other plants. A single solid central cylinder is found in the rhizome. The sori, which are marginal, have a long re- ceptacle, bearing the sporangia in basipetal succession, and are surrounded by a cup-shaped indusium. The sporangia present a considerable range in size, the largest being found in species of Hymenopliyllum, the smallest in Trichomanes. Each has an almost horizontal annulus resembling that of Gleichenia, but the dehiscence is lateral. The gametophyte m Hyinenophyllum is flat and variously lobed ; that of TrichomaTies may be similar, but in other species is filamentous. The archegonia and antheridia present points of similarity to those of the Gleicheniacea:

Cyatheacea-. ❓❓❓ This order includes the majority of existing tree-ferns, as well as some of smaller size. The anatomy of the stem, with its ring of flattened steles, is figured in the article on Feuns, The sorus has a somewhat elongated receptacle, on which the sporangia arise basipctally ; the indusium may be cup-shaped, bivalve, or wanting. The dehiscence of the sporangium is almost transverse, as in the Polypodiacea; but the annulus is slightly oblique. The prothalli correspond to those of the next group.

Pohfjiodiacea: ❓❓❓ This group, which contains the remaining Ferns, will doubtless require subdivision as our knowledge of the morpho- logy of the genera classed in it becomes extended. The stem rarely has a tubular stele ; for the most part two to many steles, arranged in a ring or in two concentric circles. In a number of genera, which there is reason to regard as relatively primitive, the sporangia show the same regular basipetal succession as in some of the preceding groups ; in the great majority, however, the succession is not regular, but those of various ages are intermixed in the sorus. The sporangia dehisce by a transverse slit, the annulus being traly

Tertical or, in some of the genera in which they are regularly arranged, very slightly oblic^ue. The prothallus and sexual organs are of the type

described in the article on Feens; some of the more interesting modifications have been referred to above.

A consideration of the Filicaceae as arranged above vrill shov? that the several suborders may in general terms be said to form a series between those in ~~which the sorus consists of a single circle of bulky sporangia and those Polypodiobceae in which the numerous small sporangia appear to be grouped without order in the sorus. When the survey is extended to the extinct Ferns of which the fructification is known, those from the more ancient rocks are found to group themselves with the existing suborders with large sporangia, such as the Marattiacece, Gleicheni~~ acece, and SchizoeacecB ; the Polypodicbceoe, on the other hand, do not appear until much later. The extinct forms cannot be dealt with in detail here ; but it may be pointed out that their order of appearance affords a certain amount of direct evidence that the existing Ferns with a single circle of large sporangia in the sorus are relatively primitive. The series which can be constructed from a study of the sorus is in general supported by the anatomy of the sporophjrte, and by the structure and sexual organs of the gametophyte. A more detailed investigation of all the characters of the Ferns wiU be needed before the course of evolution thus broadly indicated can be traced, but the results obtained by Bower afford a deeper insight into the general method of progression and the selective factors in the process. On the ground mainly of an examination of the sorus and sporangium. Bower has shown that the FilicacecB may be divided into three groups ??? the Simplices, Gradatae, and Mixtce ??? in which the sporangia arise simul- taneously, in basipetal succession, or irregularly in the sorus respectively. The first includes the MarattiacecB, OsmundaceoB, 8chucBObceoe, Oleicheniobceae, and Matoniacece ; the second the LoxsomacecB, Hymenophyllacem, Gyatheaceae, and the Dennstcedtinem (a group including species placed in the Synopsis Filicwm, in Dichsonia and Davallia) ; while the remaining Polypodiaceae constitute the Mixtce. The change from the one type of sorus to the other may have taken place in several different lines of descent, some of which have been traced. A consideration of the biology of the sorus gives an insight into the advantages obtained by the one type over the preceding, as regards protection, spore production, and the dispersal of the spores, and thus indicates the way in which natural selection may have acted. The

differences in the form and mode of dehiscence of the sporangia (those of the Simplices having median dehiscence and a horizontal annulus, those of the GradatcB a more or less oblique position of the annulus and of the plane of dehiscence, while in the Mixtce the annulus is vertical and the dehiscence transverse) stand in relation to the position of the sporangia in the sorus relatively to one another. The application of the important criteria, which Bower has thus pointed out, to the construction of a strictly phylogenetic classification of the Filicaceae cannot be made until the anatomy, the sexual genera- tion, and the palseobotanical evidence have been further examined from this point of view. Though on this account and because, as Dr Bower himself points out, the subdivisions Simplices, Gradatae, and Mixtce do not correspond to definite phylogenetic groups, they have not been used in classifying the Ferns above, their importance as an advance towards a natural classification should be fully recognized. It may be added that in the large number of existing forms and the numerous fossil remains of those that have become extinct the Filicacem offer an opportunity such as is perhaps afforded by no other group for the study of the history of descent.

Hydropterideae. ??? The uncertainty which exists as to the

exact affinity of the two orders of Pteridophyta placed in this group must be aissociated wii '\ the more or less com- plete aquatic habit of the plants b> longing to them. This general characteristic is expressed > a the name Hydropter- ideae, while that of RhizocarpcB, Ui'der which they were described in the article Feens, rests on an early miscon- ception of their morphology. For a gimeral account of the group the article named should be consulted. Since it was written, repeated detailed investigations have re- sulted in a very complete knowledge of the structure and development of the four genera of this group : space wiU not allow of a full account being given here, and for this some of the works cited below must be referred to. Mention must, however, be made of the anatomy and the reproduc- tive structures of the sporophyte to indicate the difficulty of deciding the affinity of these orders. The latter are associated by the well-marked heterospory they exhibit ; but such a character does not necessarily indicate a natural group, and there is some reason to believe that the nearest relations of the Salviniacece and Marsileacece are to be

found at different points in the series of Homosporous Ferns. In the Salviniacece, which contain two genera of small floating plants, Salvinia and Azolla, the sporangia are associated in sori surrounded by an indusium springing from the base of the receptacle. The sori consist either of microsporangia or megasporangia, which are arranged, except when only one is present, in basipetal succession on the receptacle ; this suggests that an affinity may be found with some of the groups placed in the Grradatoe by Bower. The complete absence of an annulus from the sporangia prevents the comparison from being carried farther ; and the vascular system is so reduced, probably in relation to the aquatic habit, that the anatomy affords no safe guide. The same holds good to some extent for the Marsileacece ; but here the presence of a tubular stele in the forms, with thicker rhizomes, affords an indication, at least, that their affinity is also with the Gradatae. In structure and de- velopment the sporocarp is, however, essentially different from the indusiate sorus of the Salviniacece, and, though its position on the ventral surface of the leaf-stalk presents a difficulty, must probably be regarded as corresponding to a modified leaf-lobe. In the absence of direct evidence from Palaeobotany, and bearing in mind the modifications associated with adaptation to an aquatic life in other plants, the recognition of any more definite affinity for these heterosporous Ferns appears to be inadvisable. Further evidence is necessary before they can be removed from such a position of convenience as is assigned to them here, and placed in relation to the series of FilicacecB.

The several phyla of Pteridophyta having now been briefly described, their relationship to one another remains for consideration. The available evidence does not suffice to solve this question, although certain ^ ogeay. indications exist. In the earliest land vegetations of which we have any sufficient record specialized forms of Equisetales, Lycopodiales, Sphenophyllales, and Filicales existed, so that we are reduced to hypotheses founded on the careful comparison of the recent and extinct members of these groups. In this connexion it may be pointed out that the fuller study of the extinct forms has as yet been of most use in emphasizing the difficulty of the questions at issue. It has thus led to a condition of uncertainty as regards the relationship of the great groups of Vascular Cryptogams, in which, however, Ues the hope of an ultimate

approach to a satisfactory solution. The study of the Sphenophyllales, however, as has been pointed out above, appears to indicate that the Equisetales and Lycopodiales may be traced back to a common ancestry. As to the relationship of the Filicales to the other phyla, evidence from extinct plants appears to be wanting. If, as has been

suggested by Bower, the strobiloid types are relatively primitive, the large-leaved Pteridophyta must be supposed to have arisen early from such forms. The question cannot be discussed fully here, but enough has been said above to show that in the Ught of our present knowledge the main phyla of the Vascular Cryptogams cannot be placed in any serial relationship to one another.

It may even be regarded as an open question whether some of them may not have arisen independently and represent parallel lines of evolution from Bryophytic or Algal forms. This leads us to consider the question whether any indications exist as to the manner in which the Pteridophyta arose. It will be evident that no direct record of this evolution can be expected, and recourse must be had to hypotheses founded on the indirect evidence available. There appears to be no reason to doubt that the sexual generation is homologous with the thallus of a Liverwort, or of such an Alga as Coleochaete. It is with regard to the origin of the spore-bearing generation of the Pteridophyta that differences of opinion exist. This, though at first dependent on the prothallus, soon becomes independent. It may be regarded as derived from a wholly dependent sporogonium not unlike that of some of the simpler Bryophyta ; the latter are assumed to have arisen from primitive Algal forms, in which, as the first step in the interpolation of the second generation in the life cycle, the fertilized ovum gave rise to a group of swarm-spores, each of which developed into a new sexual plant. On this view the origin of the sporophyte is looked for in the gradual development of sterile tissue in the generation arising from the fertilized ovum, and a con- sequent delay in spore-formation. Certain green Algae {e.g., (Edogonium, Coleochmte), the Bryophyta, and the simpler Pteridophyta, such as Phylloglossum, are regarded as illustrating

the method of progression, though the existing forms may not constitute an actual series. For a discussion of this view, which regards the alternation of generations in Pteridophytes as antithetic and the two generations as not homologous with one another, reference may be made to the works of Celakovsky and Bower. Although the antithetic theory is supported by many facts regarding the life-history and structure of the group of plants under consideration, it must be remembered that it is at least possible that a stage in which the sporophyte was whoUy dependent on the gametophyte may not have been passed through in their evolution. The spore-bearing generation may throughout its phylogenetic history have been inde- pendent at one part of its life, and have been derived by modification of individuals homologous with those of the sexual generation, not by the progressive sterilization of a structure the whole of which was originally devoted to asexual reproduction. A number of facts regarding the Algae, and also those relating to such deviations from the normal life cycle as apogamy or apospory, may be regarded as lending support to this view, which, in contrast to the theory of antithetic alternation, has been called that of homologous alternation. Without entering farther into the discussion of these alternative theories, for which the literature of the subject must be consulted, it may be pointed out that on the latter view the strobiloid forms of Pteridophyta would not necessarily be regarded as primitive relatively to the large-leaved forms, and also that the early stages of the origin of the sporophyte in the two cases may have proceeded on different lines.

Another question of great interest, which can only be touched upon here and may fitly close the consideration of this division of the Vegetable Kingdom, concerns the evidence as to the derivation of higher groups from the Pteridophyta. The most important positive evidence on this point appears to indicate that the most ancient

Gymnosperms were derived from the Filicales rather than from any other phylum of the Vascular Cryptogams. A number of extinct forms are known intermediate between the Ferns and the Cycads, and classed as Cycadofilices, some of which, when their reproduction is more fully known, may have to be classed vidth the Filicales rather than with the Gjnnnosperms. These forms wiU, however, be found discussed in the

articles treating of extinct plants and the Gymnosperms, but their recognition wiU serve to emphasize, in conclusion, the important position the Pteridophyta hold with regard to the existing flora.

*Authorities. ◆◆◆ Soott. Structural Botany : Flowerless Plants. London, 1896 ; Studies m Fossil Botany. Edinburgh, 1900. ◆◆◆ *Campebll. Mosses and Ferns. London, 1895. ◆◆◆ *Englee and Peantl. Die Natilrlichen Pfianzenfamilien. Theil i. Abth. 4. Leipzig, 1898-1902. ◆◆◆ BowEE. "Studies in the Morphology of Spore-Producing Members," Phil. Trans. B. 1894, 1896, 1897, and 1899. ◆◆◆ Hookee. and Baker. Synopsis Filicum. London, 1874. ◆◆◆ Bakee. Fern Allies. London, 1887. ◆◆◆ Christ. Die Fankriiuter der Erde. Jena, 1897. ◆◆◆ Sbwaed. Fossil Botany. Vol. i. Cambridge, 1898.' ◆◆◆ In those works marked with an asterisk copious references to the recent Hterature of the snbject will be found. (w. H. L.)*

Public HeSLlth. ◆◆◆ Few branches of law have ex- panded more rapidly than the law of public health. Pre- mising that the Local Government Act, 1894, transferred to urban and rural district councils, elected by ballot by the parochial electors, the powers of the existing urban and rural sanitary authorities, and also conferred on such councils certain powers related to public health {e.g., the execution of the Acts as to petroleum and infant life protection), we may commence with the Public Health Acts Amend- ment Act, 1890, and the Public Health Act, 1896. The first of these statutes confers enlarged powers on such local authorities as choose to adopt it ◆◆◆ the right of adoption being general in the case of urban authorities, and in that of rural authorities limited to certain specified provisions unless it is extended by the Local Government Board. The adoption is effected by a resolution passed at a meeting of the local authority convened by special notice for the purpose, and a copy of the resolution is required to be sent to the Local Government Board, and ◆◆◆ where certain parts of the Acts are adopted ◆◆◆ to the Board of Trade and the Home Office. After some general provisions, the Act deals successively with (i.) danger or obstruction caused by telegraph, telephone, lighting, railway signalling, and other wires ; (ii.) sewers, sanitary conveniences, and similar matters ; and (iii.) music and dancing licences. A word may be said in regard to

each of these sections in turn, (i.) Urban authorities are em- powered to make by-laws for the prevention of danger or obstruction to the public from wires of the class in- dicated, and any apparatus connected vsith their erection. Provision may be made for the inspection of such wires, and offenders against by-laws are liable to penalties on con- viction by a court of summary jurisdiction, subject to an appeal to quarter sessions ; and the court may also order the removal of any wire or apparatus so placed as to con- stitute a contravention. The by-laws before taking effect must have been submitted to, and confirmed by, the Board of Trade. The Board of Trade may exempt from the operation of such by-laws for a maximum period of five years from their confirmation any wires, ifec, already erected. But any danger arising from an exempted wire may be dealt with on application to a court of summary jurisdiction. None of the above provisions applies to wires belonging to the Postmaster-General, or undertakings under the Electric Lighting Acts, or is to interfere with the working of mines lying under or adjacent to any street along or across which wires have been stretched, (ii.) Injurious matters, chemical refuse, waste steam, &c.,

PUBLIC HEALTH

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are not to be turned, or allowed to pass into drains ; the local authority is enabled to make communications with, or repair drains at the owner's or occupier's expense, and also to make by-laws regulating the provision and main- tenance of sanitary conveniences in manufactories and elsewhere ; common courts and passages are to be kept clean ; medical officers and inspectors of nuisances are empowered to seize, and justices to condemn all unsound " articles intended for the food of man " which are sold, or exposed or being prepared for sale within the district of any local authority, and the licence of the occupier of any slaughter-house who is convicted of the sale of any meat unfit for food may be revoked ; hoardings are to be set up during the progress of buildings ; cellars under streets are to be kept in good repair, and safe means of ingress to and egress from places of public resort, such as churches, chapels, or theatres, are to be provided. Similar provision is made for the safety of platforms

on public occasions, and of whirligigs, swings, and shootings galleries. Urban authorities are enabled to provide refuges in streets, cabmen's shelters, and public clocks, (iii.) Places to be used for public dancing, music, &c., are to be licensed by the licensing authority of the district in which they are carried on. The licences are granted annually in October, except in Middlesex, where, under the Music and Dancing Licences (Middlesex) Act, 1894, they may be granted at any time. The Public Health Act, 1896, abolishes the old system of quarantine, and empowers the Local Government Board Notltica- to make regulations as to the landing of in- Won of fected persons from ships. Elaborate pro- Intectlous vision has been made for the notification of seases. infectious diseases by the Infectious Diseases (Notification) Acts, 1889 and 1899. The former statute was originally adoptive only, but it has now been ex- tended by the latter to every district in England or Wales ❓❓❓ in London notification has been compulsory since 1891. For the purposes of these Acts " infectious disease " means smallpox, cholera, diphtheria, membranous croup, erysipelas, scarlatina or scarlet fever, typhus, typhoid, enteric, relapsing, continued or puerperal fevers, as well as any other infectious disease which, by a resolution duly passed by the local authority, and sanctioned by the Local Government Board, is declared to be included within the definition. When any such disease occurs in any building used for human habitation, or in any ship, boat, tent, van, shed or similar structure (other than Crown buildings, or ships, vessels, or boats belonging to any foreign Govern- ment), the fact must be notified to the medical officer of health of the district. The duty of giving this notifica- tion is imposed, first on the head of the house to which the patient belongs, failing whom, on the nearest relative present, and on his default on the person in charge of, or in attendance on, the patient, and on his default on the occupier of the building. Any medical practitioner visit- ing the patient is also bound to give notice. Reference should also be made to the following statutes : the In- fectious Disease (Prevention) Act, 1890, provides for the inspection of dairies, and the cleansing and disinfecting of premises, and under the Public Health (Ports) Act, 1896, the Local Government Board may by order assign to any port sanitary authority powers or duties arising under this statute. The Isolation Hospitals Act, 1893, enables county councils to promote the establishment of hospitals for the reception of patients suffering from infectious diseases; the

Cleansing of Persons Act, 1897, enables local authorities to permit persons who apply to them, on the ground that they are infested with vermin, to have the gratuitous use of cleansing apparatus ; and the Vaccination Act, 1898, profoundly modified the law as to vaccination.

In addition to these statutes, account has to be taken of a large body of legislation which relates indirectly to the law of public health, or at least comes well within its range of operation. It deals with a very great variety of subjects, and only a comparatively slight sketch of its results need be given here. The Factories and Workshops Act, 1895, extended the Factory Acts to laundries and docks, and enlarged the powers of courts of summary jurisdiction to provide for the safety of these establish- ments, especially as regards protection from fire. The Coal Mines Regulation Act, 1896, aims at the prevention of accidents due to inflammable gas and coal-dust in coal mines. The Merchant Shipping Act, 1894, enabled local authorities to make by-laws providing inter alia for the licensing, inspection, and sanitary condition of seamen's lodgings. The Rivers Pollution Prevention (Borders Councils) Act, 1898, enables joint committees of English and Scottish county councUs of counties on both sides of the Border (viz., Northumberland and Cumberland in England, and Dumfries, Roxburgh, and Berwick in Scotland) to exercise the powers of the Rivers Pollution Prevention Act, 1876, in relation to any river or tributary which is partly in England and partly in Scotland ◆◆◆an expression including the Tweed. The Dangerous Per- formances Act, 1897, extends the earlier Act, 1879, which prohibited the emplojrment in dangerous perform- ances of children under 14 years of age, to boys under 16 and girls under 18, and also provides that, except where an accident causing actual bodUy harm occurs, no prosecution may be instituted under either of the statutes without the consent in writing of the chief officer of police of the police area in which the offence is committed. The Infant Life Protection Act, 1897, which requires persons retaining for reward more than one infant under five, for nursing or maintenance for more than forty-eight hours, to notify the fact to the local authority, imposes upon local authorities the duty of instituting inquiries whether there are any persons residing within their districts who come within the Act, and empowers them to appoint male or female inspectors for the purpose of enforcing its pro- visions. Lastly,

reference may be made to the Contagious Diseases (Animals) Act, 1894, which consolidated the law on this subject.

London. ❓❓❓ Down to the year 1891 London was governed, in matters of public health, by a series of special statutes and by provisions in the general statutes, the scope of which is explained in the article on Public Health in vol. xx. of this Encyclopaedia. The law as to the metropolis was, however, consolidated, and is now regulated by the Public Health (London) Act, 1891. The authorities for the execution of the Act were, for the City of London, the Corporation, the vestries of the larger and the district boards of some of the smaller parishes, and certain boards of guardians. Under the Local Government Act, 1899, the powers of each existing vestry and district board are transferred to the council of the borough comprising the area within the jurisdiction of such vestry and district board ; and the borough councUs take over certain of the powers of the county council {e.g., as to street obstruction and the registration of dairy- men) and exercise concurrent jurisdiction with it in other matters. Provision is made for the appointment of medical officers of health and sanitary inspectors. The medical officer is for some purposes placed on the footing of a district poor-law medical officer, and he cannot be removed without the consent of the Local Government Board. In its structure and substance the Public Health (London) Act, 1891, which consists of 144 sections, closely resembles the general Acts. The principal matters with which it deals are : (i.) nuisances, general and

particular ; (ii.) worksliops, baketouses, and dairies ; (iii.) removal of refuse; (iv.) water-closets, &c. ; (v.) food and water ; (vi.) infectious diseases and epidemics ; (vii.) hospitals and ambulances ; (viii.) niortuaries ; (is.) lodging-tents and underground rooms; (x.) legal pro-ceedings, appeals, and inquiries. On some of these subjects a few notes may be added, (i.) Nuisances. ❓❓❓ It is the duty of every sanitary authority to inspect its district for nuisances. Certain nuisances, chiefly relating to the insanitary condition of premises, cisterns, closets,

summarily. Underground rooms are not to be let or occupied as dwellings unless they satisfy certain stringent requirements prescribed by the Act as to height, drainage, ventilation, &c. Provision is made for the enforcement of this prohibition, and, in case of two convictions within three months, the court may order the room to be closed, (x.) Legal proceedings, appeals, inquiries. ??? A general power of entry on premises for the purposes of the Act is given to the sanitary authority. The county council has power to prosecute offenders on default by the sanitary authority ; and the Local Government Board, on complaint by the county council, may also interfere. There is a. general appeal under the Act from magistrates to quarter sessions, and from notices by or acts of the sanitary authority to the county council. Inquiries by the Local Government Board are to be held under the provisions of the Public Health Act, 1875.

Besides the Public Health (London) Act, 1891, it is necessary to note that the law of public health in London is also affected by a number of later statutes relating tO' the metropolis alone. Thus the Baths and Wash-houses Act, 1896, allows closed swimming-baths to be used gratuitously for music and dancing in London with the licence of the London County Council. The Canals Protection (London) Act, 1898, empowers the county council to require a canal company to protect dangerous places on its canal.

Scotland. ??? The various statutes relating to public health in Scotland are now consolidated and amended by the Public Health (Scotland) Act, 1897, which, together with the Infectious Diseases Notification Act, 1889 (v. sup.), and the Burgh Police (Scotland) Act, 1892, constitutes the statutory law of Scottish sanitary adminis- tration. The central authority is the Local Government Board for Scotland. The local authorities are ??? (i.) in burghs under the Burgh Police (Scotland) Act, 1892, the town council or burgh commissioners ; (ii.) in other burghs, the town council or board of police ; (iii.) in districts where the county is divided into districts, the district committee ;, (iv.) in counties not so divided, the county council. The sub- stantive provisions are similar to those of the English Acts.

Ireland. ⬛⬛⬛ Most of the English Acts apply to Ireland with modifications and adaptations. See the following' statutes: Infectious Diseases (Notification) Acts, 1889 and 1890 ; Cleansing of Persons Act, 1897. The collective title, "Public Health (Ireland) Acts, 1878 to 1896," was. by the Short Titles Act, 1896 (59 and 60 Vict. c. 14) given to the consolidating Act of 1878, the Act of 1890, and the Act of 1896. See also the Local Government Act, 1898, ⬛⬛⬛⬛ 32, 105, schedule 5. The most important of these statutes is the Public Health (Ireland) Act, 1896, 59 and 60 "\^ict. c. 54, which invested rural sanitary authorities ^^'ith the powers and duties of urban authorities. The Public Health (Ireland) Act, 1900; gives power to the Local Government Board for Ireland to determine the- area of charge in respect of certain special expenses.

United States. ⬛⬛⬛ It is within the police power of each. state to legislate on such subjects as adulteration, con- tagious diseases, quarantine, vaccination.

AuTHORrriES. ⬛⬛⬛ English : Glen. Publie Hmlth Ads. London, 12th edition, 1899. ⬛⬛⬛ Lumlby. Public Health Acts. London, 5tb edition, 1896. ⬛⬛⬛ Fitzgerald. PiMic Health Acts. London, 7thi edition, 1895. ⬛⬛⬛ Huntek. Open Spaces. London, 1896. ⬛⬛⬛ Hunt. London Local Government. London, 1897. ⬛⬛⬛ Ht;NT. London Govern- ment Act, 1S99. London, 1899. ⬛⬛⬛ Macmorran, Lushington, and' Naldrett. London Government Act, 1S99. London, 1899. ⬛⬛⬛ Shaw's Vaccination Manual. London, 1899. Scottish : Mac- dougall and Murray. Handbook of Public Health. Edinburgh. Irish : Vanston. Public Health in Inland. Dublin, 1892. ⬛⬛⬛ Vasston's Public Health Supplement. Dublin, 1897. Americans BouviEE. Law Diet., ed. Rawle. London and Boston, 1897.

(a. W. E.)

PUBLISHING

Publishing^. ⁂ Under the description of Book- selling, the earlier volumes of the EncT/clopcedia Britannica (ninth ed., vol. iv. pp. 39, 40) dealt summarilywith the early history of what is novp known as publishing. It is, however, not quite correct in modern times to ot'sy^em speak of publishing and bookselling as identical. The publisher now confines his energies entirely to the production and publication of books, while the bookseller retails them to the public. By this division a larger constituency is reached, as the bookseller's counter is considered the best medium through which a book can be seen and advertised.

Before dealing with the present system of publishing, it will be best, if only for comparison, to' sketch briefly some of the methods of publishing which were in vogue during the later part of the 18th and the early part of the 19th century, before the severance of the seller from the producer of books. Formerly, by a system of association, the principal booksellers produced for themselves most of the books they sold, and in many cases they employed the authors to write them. Dr Johnson and Oliver Goldsmith, as well as many other well-known authors, were so engaged. By this system of co-operative publishing, prices were fixed, discounts regulated, and all trade questions easily adjusted. The cost of producing a book was borne by this circle of publisher-booksellers, who were called partners, and the books thus produced were usually of a popular character, such as dictionaries, natural histories, encyclopaedias, and general educational literature. The interests in these works were frequently divided and sub- divided into lots or shares, which, in the case of an expensive book, or of one for which a large circulation was anticipated, were sometimes very numerous and often formed a complex arithmetical problem. These divisions or shares in a book sometimes consisted of as many as 300 different lots. On the title-page of the first edition of Johnson's Lives of the Poets there were the names of thirty-six of these associated booksellers, and on the second edition of the same work, forty-two. The following extract from a trade catalogue sale which was held at the London Coffee House, Ludgate Hill, in 1805, will illustrate this curious custom : ⁂

One 160th Johnson's Dictionary sold for ⁂23 5 0 16 7/8 books in 3000 Pope's Works ⁂6 6 0

*15 books in 1000 Sterne's Works ***11 0 0***

*And in a division by the partners of Cruden's Concord- ance the fractions of shares into which this once very popular book was divided were as follows : ***

527

*3^*

52

214 1 L

1600 18 60

338

936

1000

This partnership in the cop5Tight of a book led to fre- quent meetings on the part of the proprietors to discuss new issues and divide profits. These transactions were usually accompanied by a dinner, which in later years developed into a trade usage, every publisher of importance during the last half of the 19th century giving at least one dinner in each year to his customers. This custom was continued until 1897, Messrs E. Bentley & Son being the last publishers to give a trade dinner, a year previous to their incorporation vrith Messrs MacmiUan & Co. in 1898. Mr John Murray's trade sale dinner was discontinued in 1887, and Messrs Longman & Co.'s in 1872. On those occasions books were offered at a considerable reduction from the ordinary cost prices. The invitation to these dinners was always by a sale catalogue, which was sent out to "a select number of booksellers of London and West- minster," and which in its shape and character, for nearly 200 years, showed little change, the earliest known being dated 1 704. They were always on thick woven folio paper,

with broad margins for figures, with some such formulary as the following printed on the first page : ❓❓❓ " Beginning at nine in the morning, when the whole company shall be entertained with a breakfast, and at noon with a good dinner and a glass of wine, and then proceed with the sale, to finish that evening."

From this early period down to the middle of the 19th century the stock sold at these sales consisted largely of miscellaneous books, besides those which the publisher- bookseUer himself partly controlled. After that date the shares of most of these partnership books were either bought up by one partner or through the lapse of time became worthless, the old methods gradually died out, and the publisher, as we know him, became the sole producer of the works which the booksellers sold.

There were, however, during the first half of the 19th century several great publishing houses, some of whom stUl exist, who, with foresight and discretion, issued many of their publications on their own responsibility, notably the house of Longmans, who speculated large sums in the works of Wordsworth, Moore, Macaulay, and also in the issue of the Edinbwrgh Review. This was true also of John Murray, who paid immense sums to Lord Byron, Scott, Crabbe, Irving, Hallam, Southey, and to the writers in the Quarterly Review. The same business methods existed in the houses of Blackwood, Colburn, Constable, Eivingtons, A. & C. Black, and others, who displayed great knowledge of the requirements of that age, many of them making large fortunes.

This complete centralization of the publisher's responsi- bility developed many changes, some of them considerably influencing the relation of the author to the publisher asi well as the position of the publisher to the bookseller. There also grew up conditions in these trades which, eventually led to the formation of protection societies for the author, the publisher, and the bookseller.

The old-established publishers, being in many instances men of culture and education, gathered round them authors of position and renown, with whom they became on intimate terms. A personal relationship was thus fostered, which frequently resulted in business suggestions beneficial to both author and publisher. This is further illustrated in the published

lives of the Murrays, the Blackwoods, of Daniel MacmiUan, and Adam Black, as well as in the- biographies of authors themselves. The great commercial prosperity which was associated with this and a later period induced many men of enterprise and capital to enter the publishing trade, with the result that through the multi- plicity of publishers a competition arose for the successful writer, which, although enriching the author, has occasion- ally severed many pleasant social relationships. There are, however, still many exceptions to this condition of affairs.

The changes which have affected the publishing trade from time to time are well illustrated by the difference in the position of the publishers' readers ❓❓❓ those men of letters who assist and advise the '"^ers'- publisher in the literary side of his business. In the time of Dr Johnson, when the publisher was practically no more than a bookseller, and publishing- mainly consisted in combinations of booksellers to share expenses, there was very little room for independence in the position of their literary advisers. Indeed, at that time the publisher's reader, so far as he existed, was practically the publisher's "hack," engaged in odds and ends of literary work at a very insufficient stipend, and subject at times to actual indignities at the hand of his employer. In some such position Johnson himself served Cave at St John's Gate, ClerkenweU.; and most of the booksellers could claim the assistance of a ready man of this description, though rarely, of course, of equal distinction.

Gradually, however, as the business of publishing assumed a dififerent complexion, there was a tendency for each bookseller to act for himself, and little Uterary cliques were gathered around the different houses, ready to advise and assist. In this way the Quarterlies sprang into existence, and rivalry became more direct and more lively between the different houses. Then each house sought to become the exclusive publisher to the best writers of the day, and the duties of the publisher's adviser became more extensive. He was often something of a go-between from publisher to author, and himself a writer of distinction and high reputation. Scott's relation to the Ballantynes and Gifford's to Murray are

almost inseparable from many of the associations of the publisher's reader : they read manuscripts and advised upon proposals, consulted with writers, and represented the literary conscience and judg- ment of the firms, to whom they stood as friendly sponsors. But the development did not stop there. " The mob of gentlemen who write with ease " increased so rapidly in number and pertinacity that it soon became necessary for ??very house to keep in constant employ at least one, and often several advisers, who should read the manuscripts and report upon their quality. By the beginning of the 'thirties this custom was universal; and the reader was also expected to suggest schemes and help to carry them through. Charles Whitehead, for example, a Bohemian of the old school, was responsible to the firm he served for the suggestion that Charles Dickens should be asked to write The Pickwick Papers to accompany a series of projected illustrations by Seymour. In this way the position of " reader " often became a very responsible one, and gave many meritorious but undistinguished men of letters a chance of affording their first opportunity to writers who were soon to outstrip them alike in commercial value and in literary reputation. Thus it was Mr Smith Williams, the reader, who induced Mr George Smith (Smith, Elder & Co.) to publish Jane Eyre. Then, as the competition among publishers became more acute, and the business gave wider opportunities for taste and culture, the status of the " reader " naturally advanced pari passu. A man of judgment and executive skill was able to indicate to a promising writer faults which might easily be remedied and qualities which should be culti- vated ; courtesies of this kind made for business, and so there grew up a new rivalry between house and house, who vied with one another in securing the best advice available.

These were the golden days in the history of the publisher's reader, and they were perhaps at their zenith in the middle 'seventies. Then Mr John Morley, for example, advised Messrs Macmillan, and Mr George Meredith Messrs Chapman & Hall ; and several of the most distin- guished vwiters of our day bear testimony to the invaluable advice which they received from these gentlemen at the outset of their own careers, advice extending to a detailed examination of their manuscripts, and elaborate suggestions for their improvement and alteration. The recent increase, however, in the number of publishers, and the purely mercantile

nature of certain developments in the business, seem not unlikely in the future to undermine the position of the "reader," and to render him once more a mere appanage of the office. This change of front is, no doubt, chiefly attributable to the growing tendency to neglect the old and intimate personal relations between publisher and author, and to entrust the whole of the business arrangements to a literary agent or middleman, who under- takes the entire conduct of a manuscript from the time it leaves the author's hand until the day of its publication, arranges the author's contract, and collects his dues. The result of this innovation, however effectually it may relieve

the writer of business anxieties, has undoubtedly been to separate author from publisher, and very often to deprive the author of the advantage of the publisher's experience in the way of advice and direction. In this way the " reader " has lost the better part of his occupation. Instead of being a cultured expert, prompting the writer with suggestions, he tends to become a sharp man of business, acquainted with the " sales " of every successful author, and the sums which it is safe to adventure in advance of publication, and the young and inexperienced writer seems likely to find less and less literary assistance within the walls of a publishing house.

There are naturally several branches of publishing into which this rather illiberal competition cannot enter, and here the more humane functions of the literary adviser are still unimpaired. The fields of belles lettres, criticism, bibliography, scientific and (perhaps) educational literature are exempt from the present stress of the market, and it is here that we must look for the preservation of the calmer and more dignified spirit of business. Here the " reader" has still his place and his opportunity. But in the wider field of general pubhshing his position has almost certainly passed its meridian, and only a complete change in the nature of business methods can restore it to the privileges and satisfactions which it once enjoyed.

Competition among publishers for the successful author assisted in the establishment about 1880 of the Uterary agent. The business of these literary agencies, of which there are about ten, is to dispose of an T^"

author's MS. to the highest purchaser, to arrange agent. for the serial issue of the work, to negotiate and settle the American and foreign editions, to keep the author's accounts, and to act as the intermediary between him and the publisher, for which he charges a commission. Some publishers resent this interference, and will not consider a MS. coming through these sources; but the demand for the work of a popular writer is always great, and through the prices obtained by means of the literary agent an author is stimulated to give quantity rather than excellence of work, thereby frequently enriching himself at the expense of his reputation.

Growing up about the same time and covering some- what the same ground as the Hterary agent is the Society of Authors. This society, which owed its in- ception mainly to the initiative of Sir Walter T^"^,"' Besant, was established in 1883, and from its society. commencement met with a considerable amount of support from the workers in literature. Lord Tennyson became its first president, and Lord Lytton, Matthew Arnold, Huxley, Tyndall, and Dr Martineau were among its 36 vice-presidents. The registered office of the society is 39 Old Queen Street, Storey's Gate, S.W. Its accredited organ. The Author, was established in May 1890, and has a circulation of over 2000 copies; the subscription to the society is ►►1, Is. per annum, or 10 guineas for a life membership. In the first year of its existence it had only 68 paying members; it now has over 1300. The main principles of the society are : (1) the main- tenance, definition, and defence of literary and musical property; (2) the consolidation and amendment of the law of domestic copyright ; (3) the promotion of inter- national copyright. The society has grown with its requirements, and now not only aims at defining and establishing the principles and methods of publishing, but examines agreements and advises authors as to the best publishers for their purpose. It looks through and caiefully examines publishers' accounts and estimates for printing and production ; it takes action on behalf of its members for the recovery of MSS. ; and will for a small fee give a critical report upon the work of young

authors submitted to it. Although not antagonistic to the literary agent, it warns the author who is starting on his career not to enter into contracts or dispose of his MS. before consulting the society, as in his preliminary efforts the advice of the Authors' Society would be found useful. The great work of the society has been its con- tinual insistence on the value of Uterary propertyNand the right of the author to his share of profit. It has therefore laid down what it considers the heads under which the various methods of publishing should fall ; these are as follows: (1) sale outright; (2) limited sale; (3) the half-profits system; (4) the royalty system ; (5) publication by commission.

In discussing these proposals of tlie Authors' Society separately, it must be understood that variations may take place by agree- ment between author and publisher in any of the several depart- ments, and the various arrangements are here explained rather than suggested as a system to be adopted for publishing. With regard to sale outright much might be urged, both for and against. It is not an infrequent occurrence for an author, who has probably put his most original work into his first book, to be unable to find a publisher. Cases might be mentioned where, after many unsuccessful attempts, an author has disposed of the copy- right of his book for a nominal sum, and the work has after- wards turned out a surprising success. To the credit of the publishers, this success has generally been recognized by further payments, but legally the author has no further claim. It is therefore suggested that if an author considers his work to be one of merit, he should not dispose of his rights in the book. If, however, the author cannot afibrd to wait the verdict of the public, he is sometimes compelled to accept the best price offered for his MS. On the other hand, by sale outright the author dispenses with all future trouble, and the loss, if any, falls upon the pub- lisher, who, in order to make his investment a satisfactory one, must do his best to make the book a success by reviews, advertise- ment, and through trade mediums. These advantages should be a considerable help to a young author.

The method of limited sales is not often adopted. It is an arrangement by which an author sells to a publisher the right of producing his book for a limited period for a stated sum, or sells a limited number of copies at an

agreed price. Neither of these methods is considered desirable, and should never be undertaken without an agreement.

The half-profits system is less objectionable. According to this plan, the publisher produces the book at his own risk, and the net profits are divided in half or on an agreed ratio between author and publisher. Under this system the cost of production and advertising is met before any profit can accrue. This method should not, however, be undertaken unless the author knows well the integrity of the publisher with whom he is dealing, as under this arrangement it is possible for the publisher to take discounts in which the author does not share.

By far the most satisfactory system and the one most generally adopted is the royalty leystem, by which the publisher produces the book at his own cost and pays the author a royalty upon each copy sold. These royalties vary from 10 per cent, to 25 per cent., and in very exceptional oases to 30 per cent., according to the reputation of the author and the anticipated sale of the book. Sometimes by arrangement a royalty is paid upon all copies sold over and above a certain number, or after the cost of production has been covered, but none of these methods should be undertaken without an agreement legally drawn up and duly signed. Most of the leading novelists now publish on the royalty system, as by this they receive a larger return for their literary property. Fre- quently it is arranged that an author shall receive a large sum on depositing the MS. with the publisher, or on publication, on account of royalties, which in the case of a popular novelist will amount to thousands of pounds.

The method of publishing on commission is generally adopted when an author has opportunities for producing his book himself. By this method the work is issued at the expense and risk of the author, and the publisher or agent is paid by a commission on all copies sold, and also on the cost of production, should this be undertaken by the publisher or agent. Provided the book is a successful one, this method is, from a financial point of view, the most satisfactory to an author ; for should he have time and oppor- tunity to see the book through the press, he takes all the inter- mediate profits, and also the commission on production ; but it has the objection that a publisher may not throw his energies into the sale of a

commission book to the same extent that he would if it were issued upon the royalty system, or if he had him- self bought the copyright.

In all these methods of publishing, care should be taken in

drawing up agreements, and also, where possible, the copjrright should remain in the possession of the author. The success of a book can frequently be traced not only to the effective way a publisher produces it, but also to the w^y he advertises it, and to the channels through which he causes his advertisements to pass ; so that the selection of a publisher is an important matter. It is a fact that the name of a particular publisher on the title-page of a book is a guarantee that the book has been well considered before being issued ; this has a great effect with the bookseller who stocks it, and also with the public who buy.

Undoubtedly one of the great factors in publishing, besides an exact knowledge of what to pubhsh, is to bring before the book-buyer the particular character of book that he can use, without undue waste of either money or energy ; and this can be done best by judicious advertising, and through the intelligent bookseller.

To the author as well as the pubhsher one of the principal difficulties is the disposal of the books that do not sell, that is, to use the usual trade term, of " Eemainders." With the consent of the ^^^/"" author these are generally either sold by public auction or privately to a trader known as a remainder- buyer. Books so sold fetch a purely nominal sum, some- times not amounting to the cost of the paper upon which they are printed. Some publishers prefer sending their unsaleable stock back to the paper miUs to be repulped, rather than that they should be sold in this unsatisfactory manner. It has sometimes happened that a book sold out in this way has found its real place in a cheaper market, and a fresh and quite unexpected demand for the book has been created. In no case, however, should a book be remaindered until two years after its pubKcation.

Although established after both the Authors' and Book- sellers' Association, still, as the predominant partner in the trades coming between the author and the public, it would be right to treat here of the origin and work of the Publishers' Association of Great Britain and

Ireland. This association was established in 1896, and had as its first president Mr C. J. Longman. It has a membership of about 70, consisting of aU the principal London and provincial publishers. The objects of the association are to promote and protect by aU lawful means the interests of the pubHshers of Great Britain and Ireland. The work undertaken and accomphshed has been varied and useful, and in its results has affected the Publishers' publishers themselves as well as the book trade ".” generally. Amongst the most important ques- tions discussed have been the stopping of colonial piracies, copyright, bibliography, trade terms, and publication agree- ments. The foUovidng are the principal clauses from a draft agreement between author and publisher drawn up by the association, which has received legal sanction and upon which agreements may be founded for publishing upon the royalty system :
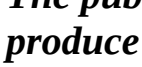

The publisher shall at his own risk and experfee, and with due diligence, produce and publish the work, and use his best endeav- ours to sell the same.

The author guarantees to the publisher that the said work is in no way whatever a violation of any existing copyright, and that it contains nothing of a libellous or scandalous character, and that he will indemnify the publisher from all suits, claims, and pro- ceedings, damages, and costs which may be made, taken, or in- curred by or against him on the ground that the work is an infringement of copyright, or contains anything libellous or scandalous.

The publisher shall, during the legal term of copyright, have the exclusive right of producing and publishing the work in the English language throughout the world. The publisher shall have the entire control of the publication and sale and terms of sale of the book, and the author shall not, during the con- tinuance of this agreement (without the consent of the pub- lisher), publish any abridgment, translation, or dramatized version of the work.

The publisher agrees to pay the author the following royalties on the published price [these by arrangement].

No royalties shall be paid on any copies given away for review or other purposes.

The author agrees to revise the first and, if necessary, to edit and revise every subsequent edition of the work, and from time to time to supply any new matter that may be needful to keep the work up tu date.

The author agrees that all costs of corrections and alterations in the proof sheets exceeding 25 per cent, of the cost of composition shall be deducted from the royalties payable to him.

In the event of the author neglecting to revise an edition after due notice shall have been given to him, or in the event of the author being unable to do so by reason of death or otherwise, the expense of revising and preparing each such future edition for press shall be borne by the author, and shall be deducted from the royalties payable to him.

During the continuance of this agreement the copyright of the work shall be vested in the author [or publisher], who may be registered as the proprietor thereof accordingly.

The publisher shall make up the account annually.

If the publisher shall at the end of three years from the date of publication, or at any time thereafter, give notice to the author that in his opinion the demand for the work has ceased, or if the publisher shall for six months after the work is out of print decline or, after due notice, neglect to publish a new edition, then and in either of such cases this agreement shall terminate ; and on the determination of this agreement in the above or any other manner, the right to print and publish the work shall revert to the author, and the author, if not then registered, shall be entitled to be registered as the proprietor thereof, and to purchase from the publisher forthwith the plates or moulds and engravings (if any) produced specially for the work, at half cost of production, and whatever

copies the publisher may have on hand at cost of production ; and if the author does not within three months pur- chase and pay for the said plates or moulds, engravings, and copies, the publisher may at any time thereafter dispose of such plates or moulds, engravings, and copies, or melt the plates, paying to the author in lieu of royalties a percentage of the net proceeds of such sale.

If any difference shall arise between the author and the pub- lisher touching the meaning of this agreement, or the rights or liabilities of the parties thereunder, the same shall be referred to the arbitration of two persons (one to be named by each party) or their umpire, in accordance with the provisions of the Arbitration Act, 1889.

Much business of an international character haa also been undertaken by the association, especially in the im- portant work of organizing the International Congresses of Publishers. The aim of these has been to promote and establish a true international friendship, so that if trade or other differences should arise in any country, they may be settled by the interventioh of the publishers in the particular country; and also to extend the advantages of the Bern Convention by securing the adherence of those countries which have not yet joined (see Copyeight). The first of these Congresses was held at Paris in 1896, the second at Brussels in 1897, the third at London in 1899, and the fourth at Leipzig in 1901. At all these Congresses questions were discussed, and in many oases settled, in a spirit which beneficially affected the trade of Great Britain and other countries, and which may go far to remove possible causes of future friction.

One of the most important actions of the publishers, and one which has had a material bearing upon the book- selling trade of the United Kingdom, was the system. a-doption and enforcement of what is known as the Net System, which means that no bookseller may give a discount to the public off the price at which a book is published when issued under this system. This arrangement was the subject of much discussion between authors, publishers, and booksellers, but eventually a modus operandi was arrived at, which was deemed satisfactory to the various interests in question, and on 1st January 1900 the system came into

operation : puljlishers undertaking to discontinue supplying any bookseller who gave a dis- count off the selling price of net books, and the booksellers, through their association, signing an agreement to fall in with the publishers' proposals and to charge the published price, giving no discount. At the outset some of the

discount booksellers took exception to the coercive policy thus introduced, but their opposition gradually died out, owing to the firm stand taken by the publishers; and although some objections are still raised against the system, it is in the main accepted as the best solution of the discount difficulty yet proposed. The publishers have at present refused to take action as to discounts in regard to books published in any other way than on the net system.

Many previous attempts had been made to grapple with the discount difficulty. In July 1850 twelve hundred book- sellers within 1 2 miles of the London General Post . Office signed a stringent agreement not to sell below a certain price. This agreement was broken almost immediately. Another attempt was made in 1852 ; but at a meeting of distinguished men of letters resolutions were adopted declaring that the principles of the Booksellers' Association of that period were opposed to free trade, and were tyrannical and vexatious in their operation. The question was eventually referred to a commission, consist- ing of Lord Campbell, Dean Milman, and George Grote, which decided that the regulations were unreasonable and inexpedient, and contrary to the freedom which ought to prevail in commercial transactions. An attempt was also made in 1869 to impose restrictions upon the retail book- seller; but these also failed, mainly through the want of decided action on the part of the publishers. Later success was undoubtedly due to the unity of purpose which animated all parties, and was made possible through the existence of both a publishers' and booksellers' association, the members of which worked in harmony and towards a definite and settled end.

*Besides the discount question, there have been many disturbing elements in the publishing and bookseUing trade. Perhaps no greater change ever took place than that which was brought about by the ^** ^*' Education Act of 1870; which caused a revolu- tion in educational literature,*

rendering most of the then existing school-books practically useless, new educational methods taking the place of the old-fashioned system of questions and answers. Another change was brought about by the abohtion of the three-volume novel. It had always been the custom to issue works of fiction in several volumes. Eichardson's Clarissa Harlowe was in 8 volumes, Fielding's Tom Jones in 6 volumes, and Sterne's Tristram Shandy in 9 volumes; but during nearly the whole of the 19th centui-y, until 1897, three volumes were considered the regulation number for all novels. In 1894 Mudie's and Smith's circulating libraries sent to the publishers a circular suggesting drastic changes in the prices of this mode of issue, which had the efi'ect of gradually reducing the number of novels in this form ; and in the last year of their existence, 1897, only four novels were thus published. Up to this time the 6s. volume was reserved for the cheap edition of a work first published in three volumes, but the abolition of the latter opened the flood-gates for the publication of original fiction in one-volume form. The result has been a yearly growth in this department of literature, which now forms the principal stock of the general bookseller. To the popular novelist this change has been beneficial, as he at once appeals to the large majority of readers before the critics have had time to express their opinion, in one sense or another, which was hardly the case in the days of the three-volume novel. As illustrat- ing the large demand created by this form of issue, it may be mentioned that of Miss CorelK's The ^faster Chris- tian, published in 1900, nearly 260,000 copies have been sold ; and of Mr Hall Caine's The Eternal City, published in September 1901, over 120,000 copies were 'disposed of in six months in Great Britain alone. Other examples

of large sales might easily be cited. By this one-volume form of issuing novels the colonial bookselling trade has been greatly benefited, as it is now usual to publish simul- taneously with the English editions another edition entirely for sale in India and the Colonies. This trade is a very

increasing one, and is considered an important factor in the sale of a book.

The increase in the publication of very cheap editions has been a feature of recent years. Enormous numbers of

low-priced (even sixpenny) editions of standard boo^ works have been issued, and this is notably the

case with cheap reprints of books of which the copyright has just expired. New novels of good standing have also been first published in a sixpenny edition. Akin to this is the practice of pubhshing novels serially in the cheap monthly magazines, such as those which Messrs Harmsworth, Newnes, and Pearson have popularized.

The number of books published in the United Kingdom somewhat declined between 1897 and 1902, the South African War and the death of Queen Victoria naturally affecting the book-market. In 1897 there were issued 6244 new books; in 1898, 6008; in 1899, 5971; in 1900, 5760; and in 1901, 4955. About 1500 in each year were fiction.

Coming between the publisher and the retail bookseller is the important distributing agency of the wholesale bookseller. It is to him that the retailer looks for his miscellaneous supplies, as it is simply impossible for him to stock one-half of the books published. In Paternoster Row, which has for over a hundred years been the centre of this indus- try, may be seen the collectors from the shops of the retail book- sellers, busily engaged in obtaining the books ordered by the book-buying public. It is also through these agencies that the country bookseller obtains his miscellaneous supplies. At the lead- ing house in this department of bookselling almost any book can be found, or information obtained concerning it. At one of these estab- lishments over 1,000,000 books are constantly kept in stock. It ia here that the publisher calls first on showing or " subscribing " a new book, a critical process, for by the number thus subscribed the fate of a book is sometimes determined.

What may bo termed the third partner in publishing and its ramification is the retail ioolcseller ; and to protect his interests there was established

in 1890 a London Booksellers' Society, which had for its object the restriction of discounts to 25 per cent., and also to arrange prices generally and control all details connected with the trade. The society a few years afterwards widened its field of operation so as to include the whole of the United King- dom, and its designatioii then became "The Associated Book- sellers of Great Britain and Ireland." This association, with the aid of the publishers, established the net system before mentioned, and by unity of action aims at stopping further underselling and the giving of ruinous discounts. Mr H. W. Keay is the president of the association, and the registered offices are 1 Bathurst Street, London, W.

From the beginning of the 20th century there has been a large influx into England of American literature, especi- ally fiction. Not only has there been a growing St % appreciation of many American writers, but the

attractive " get-up " of American books has made its influence felt upon the British market. Some of the American methods of distribution have also been attempted in Great Britain, but with only partial success. The most successful effort has been the sale of important expensive works through the medium of newspapers. Canvassing, which is a common method of distributing books in the United States, meets with little support in the United Kingdom, although about the middle of the 19th century a large trade was done throughout England and Scotland by canvassers, who sold in numbers and parts such works as Family Bibles, Daily Devotions, Lives of Christ, and Foxe's Book of Martyrs. It is, however, an acknowledged fact among publishers that there is still a large British public not reached through the ordinary channels of trade, and how this book-buying public can be touched is a question which is continually exercising the minds of the enter-

prising producer. The methods of publishing in America are similar to those adopted in Great Britain, but the discount to the booksellers is generally given pro raid according to the number purchased. It is, however, in respect of the means of distribution that the systems of the two countries differ most. In America the general stores to a considerable extent take the place of the English bookseller, and by their energy and extensive advertising a wider public is sei-ved. In the distribution of

fiction the American plan of ” booming ” a book by copious advertising, although expensive, is often the means of in- ducing a large sale, and of bringing an author’s name before the public, but it does not always establish a permanent reputation for him. In 1901 the net system, as adopted in Great Britain, was partially introduced into America.

The Continental methods of publishing and distribution, especially in Germany, differ, in many respects very materi- ally, from those of Great Britain. In even the

*smallest German towns there is a bookseller who �t, �с. �с^ , . T 1 IT” Continent**

receives on sale, immediately upon publication,

a supply of such new books as he or the publisher may think suitable to his class of book-buyers. The bookseller submits these books to his customers, and by this method most books issued are at once placed at the disposal of any buyer interested in the particular subject. The large sums spent in other countries upon advertisement are thus saved. At the book fairs held in Leipzig at Easter and Michaelmas the accounts for books sent on sale are made up and paid. In France all books have to be licensed before publication, but the methods of publication differ little from those of other Continental countries.

See also S. S. Spkiggb, The Various Methods of Publication.

(j. SH.; A. WA.)*

British Publishing Houses.

The following firms, whose names are well knovm from the books they published, have ceased to exist : �

Bbntley, R., & SoK, founded by Richard Bentley in 1832. He started business with H. Colburu in 1829. In 1837 he commenced the issue of Bentley’ s Miscellany, in which Dickens’s Oliver Twist and Ainsworth’s^ Qhiy Fawkes, illustrated by G. Cruikshank, appeared. At his

establishment in New Burlington Street, Richard Bentley and his son George gathered round them a famous band of men of letters ; among them was the Rev. R. H. Barham, the celebrated author of The Ingoldsby Legends, which was first published in 1840. This firm also published the "Library of Standard Novels" and the "Favourite Novel Library." In the latter Mrs Henry Wood's East Lynne appeared. In 1866 the firm took over the publication of Temple Bar, founded by G. A. Sala and Edmund Yates ; Bentley' s Miscellany was afterwards incorporated with this magazine. Mr Richard Bentley was the last member of this firm, and he, with his father, Mr George Bentley (1828-95), worthily maintained its historical reputation until its incorporation by Messrs Macmillan & Co. in 1898.

BoHN. ❓❓❓ Henry George Bohn, born of German parents in London in 1796, was a man of great hterary and business activity. His father was a bookseller, and young Bohn in 1831 started as a dealer in rare books, besides buying up the surplus stock of publishers and selling them at a cheap rate to the retail booksellers. In 1841 he issued his celebrated Guinea Catalogue, a monumental work containing 23,208 diff'erent items. Bohn was also noted for his book auction sales ; one held in 1848 lasted four days, the catalogue comprising twenty folio pages. Printed on this cata- logue was the following information: "Dinner at 2 o'clock, dessert at 4, tea at 5, and supper at 10." The name of Bohn is principally remembered by the important "libraries" which he inaugurated ; these were commenced in 1846, and comprised such subjects as history, science, classics, theology, archseology, &c., consisting in aU of 766 volumes. 'The libraries were bought in 1864 by Messrs G. Bell & Sons. Bohn died in 1884.

CoLBUEN. ❓❓❓ Henry Colburn obtained his earliest experience of bookselling at the establishment of W. Earle, Albemarle Street, and afterwards as an assistant at Mr Morgan's Library, Conduit Street, of which in 1816 he became proprietor. He afterwards removed to New Burlington Street, where he established himself as a publisher, resigning the Conduit Street Library to Messrs Saunders & Otley. In 1814 he originated the New Monthly Magazine, of which at various times Thomas Campbell, Bulwer

Lytton, Theodore Hook, and Harrison Ainsworth were editors. Colburn published in 1818 Evelyn's Diary, and in 1825 the Diary of Pepys, edited by Lord Braybrooke, paying ––2200 for the copy- right. He also issued Disraeli's first novel, Vivian Grey, and a large number of other works by Theodore Hook, G. P. R. James, Marryat, and Bulwer Lytton. In 1830 Mr R. Bentley was taken into partnership ; and in 1832 Colburn retired, but set up again soon afterwards independently in Great Marlborough Street ; his business was taken over in 1841 by Messrs Hurst & Blackett. Henry Colburn died on 16th August 1855, leaving property to the value of ––35,000.

Constable, Archibald, was born on the 24th of February 1776 at Carnbee, in Fifeshire. In 1788 he was apprenticed to Peter Hill, bookseller, of Edinburgh, but started in business for himself in November 1795 as a dealer in rare and curious books, the (Scois Magazine, was acquired by him in 1801, and Leyden, the poet, antiquarian, and Orientalist (d. 1811), became its editor. He introduced Constable to literary circles. In 1802 Constable commenced the Farmers^ Magazine, and in the same year the Edinburgh Review burst upon an astonished world. The first number was issued in November 1802, under the nominal editorship of Sydney Smith ; Lord Jeffrey was, however, the guiding spirit of the review, having as his associates Lord Brougham, Sir Walter Scott, Hallam, Playfair, and afterwards that brilliant essayist Lord Macaulay. Constable was also publisher of the Encyclopaidia Brilannica, then in its sixth edition, which passed in 1827 into the hands of Adam Black on Constable's failure. In 1804 A. G. Hunter joined Constable as partner, bringing considerable capital into the firm. In 1805, jointly with Longman & Co., Constable published Scott's Lay of the Last Minstrel, the demand for which exceeded anything previously known in the annals of British poetry ; he also published, subsequently, Marmion. In 1808 a split took place between Constable and Sir Walter Scott, the latter transferring his business to the firm of Ballantyne & Co. In 1811, however, a reconciliation took place between Constable and Scott. Constable again

became Scott's publisher ; but the Ballantynes maintained their printing establishment, in which Scott was largely interested. In 1814 Constable purchased for ––700 the copyright of Waverley. This was issued anonymously ; but in a short time 12,000 copies were disposed of, Scott's other works following in quick succession. Through over-speculation, complications in Constable's business arose, and in 1826 a crash came. Constable's London agents stopped payment, and he failed for half a million of money, while Ballantyne also went bankrupt for ––90,000. Constable began business afresh, but died on the 21st July 1827. After Constable's bankruptcy, Robert Cadell (who had been his partner), in conjunction with Sir Walter Scott, bought from the various publishers in whose hands they were all the novels which had been issued up to that time, and began the issue of the famous forty-eight volume edition, which was published in monthly volumes between 1829 and 1833. It was annotated by the author, who called it his Magnum Opus. The result of its publication was that the debt on Abbotsford was redeemed, and that Cadell bought the estate of Ratho, near Edinburgh, which he owned till his death in 1847. From Cadell's executors the entire copyrights of Scott's works were acquired by Adam and Charles Black in 1851.

MoxoN. ––– Edward Moxon, poet and publisher, published in 1826 his first volume, entitled The Prospect, and other Poems, which was received with much favour as containing the germ of better things. In 1830 Moxon was started by Samuel Rogers as a pub- lisher at 34 New Bond Street. The first volume he issued was Charles Lamb's Album Verses. In the following year he took over the publication of the Englishman's Magazine, which was contributed to by Charles Lamb (whose adopted daughter Moxon afterwards married), Arthur H. Hallam, and Alfred Tennyson.' Removing to Dover Street, Piccadilly, Moxon published an illus- trated edition of Rogers's Italy, ––10,000 being spent upon the illustrations. In 1839 he issued the first complete edition of Shelley's poems. Some passages in Queen Mab were the cause of a charge of blasphemy being made against Moxon in 1841. The case was tried before Lord Denman. Serjeant Talfourd defended Moxon, but the jury returned a verdict of "Guilty," and the offensive passages were for a time eliminated. In 1840 Browning's Bordello was published ; and in succeeding years works by Lord Houghton, Tom Hood, Barry Cornwall,

Lord Lytton, Browning, and ‘fennyson appeared. Edward Moxon died on the 3rd of June 1858, his business being continued by Mr J. B. Payne and Mr Arthur Moxon, who in 1865 published Swinburne’s Atalanta in Oalydon ; but in 1871 it was taken over by Messrs Ward, Lock & Tyler.

Knight, Chakles, born at Windsor on 15tli March 1791, was ap- prenticed to his father, a bookseller in the royal borough. Upon the completion of his indentures he practised journalism and interested himself in several newspaper speculations. He, W. & R. Chambers, and John Cassell were the forerunners of “literature for the people.” In 1832, in conjunction with some Eton friends, he started Knight’s Quarterly Magazine, to which Praed, Derwent Coleridge, and

Macaulav contributed, many of the last-named’s early poems appear- ing in its pages. In 1828 he started the British Almanac and the Companion to the Almanac, and also the “Library of Entertaining Knowledge.” In 1832 there appeared the celebrated Penny Maga- zine, which reached a sale of 200,000 in weekly and monthly parts. This was followed by the Penny Encyclopmdia, which was also a great success. Knight was the publisher of the works issued under the direction of the Society for the Diffusion of Useful Knowledge, with which Lord Brougham, Lord John RusseU, and William Tooke were associated. The Illustrated Bible, edited by the Rev. Dr Kitto, the National Encyclopaidia, The Land We Live In, Popular History of Engla-nd, English Encyclopcedia, and Half- Eours with the Best Authors were among the many works insti- tuted and carried through by this earnest worker in popularizing good literature. He died at Addlestone, Surrey, 9th March 1873.

Of existing publishing houses, some date back iato the early part of the 18th century. Their long and honour- able record as leaders in the publishing world is insepar- able from that of the literature of their time.

MuKKAT, John. ??? The founder of this firm was John M ‘Murray, born at Edinburgh in 1745. In 1762 he was a lieutenant in the navy, but retired in 1768, and was soon engaged in the active business life of London. In 1766 he took over the old-established business of W. Sandby, Fleet Street ; and after this period M ‘Murray found it convenient to drop the Scottish prefix, and called himself plain John Murray (1). In 1780 he

issued the London Mercury, a volume of annual intelligence ; and in 1783 he started the English Review. Among his earlier publications were Mitford's Greece, Langhorne's Plutarch's Lives, and, in 1791, D'Israeli's Curiosities of Literature. He died on the 6th November 1793, bequeathing to his only son his copyrights and business. John Murray (2), born in 1778, was only fifteen years of age when his father died. After a year or two, during which the widow nominally managed the business, Mr Highley was admitted a partner, and the firm became "Murray k Highley," the latter to conduct the business until young Murray came of age. In 1803 the partnership was dissolved, Highley taking all the medical publica- tions. Afterwards, in 1812, Murray migrated to Albemarle Street, where, with uncommon gifts and a speculative spirit, he earned for himself the name, given to him by Lord Byron, of "The Anak of Publishers." In 1806 Murray married Miss Elliot, of Edinburgh, shortly afterwards publishing Mrs Rundell's Domestic Coolccry Book, and in 1807 he took a share with Constable in publishing Marmion. Thus began a couDCxion with Sir Walter Scott, who, through differences arising on political questions with the viritera in the Edinburgh Review, assisted Murray in launching a Tory periodical, the Quarterly Review, with Gifford as its editor, the first number being issued on 1st of February 1809 ; among the contributors being Scott, Canning, Southey, Barrow, and Hookham Frere. The Quarterly at once brought Murray into prominence with the Conservative leaders as well as with literary men. Murray was, jointly with Constable, the publisher of some of Scott's early poems and novels, but, greatly to his distress, he was compelled to break this association on account of the methods which, as he foresaw, ultimately led to disaster. In the spring of 1812 Childe Harold was published. This was brought to Murray by Dallas, to whom ByioTi had presented it, Murray paying ??600 for the copyright. In the same year he bought the business and stock- in-trade of Mr Miller, 50 Albemarle Street, and transferred himself there. Literary London flocked to his house, and John Murray became the centre of the publishing world. In his drawing-room, at four o'clock daily, was collected together most of tho talent, literature, and art of that time. It was in this room in 1824, after the death of Lord Byron, that the MS. of his autobiography, which he had given to Moore, was destroyed, it being considered by Gifford to be unfit for publi- cation. A lifelong friendship existed between Lord Byron

and his publisher, he having paid him nearly ––20,000 for his various poems. Murray paid 'Thomas Moore ––4200 for writing the life of Byron, toCrabbe ––3000 for his Talcs of the Hall, all his trans- actions being of the most generous character. In 1824, however, he lost ––27,000 on the failure of his shortlived Conservative daily paper, the Representative. Murray was as celebrated for his books of travel as for belles lettrcs. He died on the 29th June 1S43, leaving also an only son. John Murray (3), born in 1808, inherited much of his father's business tact and judgment. In early life he took especial pleasure in foreign travel ; the famous handbooks for travellers were issued under his personal editorship, some of them being written by himself. In the first year of his accession he issued the " Home and Colonial Library," and in his selection of authors he successfully maintained the reputation of the old firm. One of his most successful books was Campbell's Lives of the Chancellors. He also issued books by Hallam, W. E. Gladstone, Lyell, Layard, Dean Stanley, Murchison, Darwin, Livingstone, and Samuel Smiles. Ho died 2nd April 1892, and was succeeded by

his son. John Murray (4) was born in London in 1851, was the seuoud president of the Publishers' Association, and is an active worker in everything connected with the publishing and book- selling trade. He is associated in his business with his brother A. H. Uallam Murray.

Longmans, Gkeen & Co. ––– This firm dates back farther than any other English publishing house. Its founder, Thomas Long- mau (1), born in 1699, was the sou of Ezekiel Longman, described as a gentleman of Bristol, who died in the year 1708. Thomas was apprenticed in June 1716 to John Osborne, bookseller, of Lombard Street, London. At the expiration of his apprenticeship he married Osborne's daughter, and in August 1724 purchased the stock and household goods of William Taylor (the first publisher of liobinson Crusoe) for the sum of ––2282, 9s. 6d. Taylor's two shops were known as the Black Swan and the Ship, and occupied the same ground in Paternoster Kow upon which this famous

publishing house now stands. Osborne, who afterwards entered into a partnership with his son-in-law, issued upon the share system, in conjunction with other booksellers, various educational books, and also Ephraim Chambers's Cydopcedia. In 1754, having no son, Thomas Longman took his nephew, who was born in 1731, into partnership, the title of this firm becoming T. & T. Longman. Upon the death of his uncle in 1755, Thomas Longman (2) became the proprietor of all the partnership stock. He maintained the old traditions of the firm, and greatly extended his colonial trade. He married Miss Harris, and by her had three sons. Of these, Thomas Norton Longman (3), bom in 1771, followed in 1797 his father in his publishing business. In 1794 Owen Eees became a partner in the firm, and Thomas Brown, who was for many years after 1811 a partner, entered the house as an apprentice. Mr Brown died in 1869 at the age of 92. In 1799 Longman purchased the copyright of Lindley Murray's English Grammar, which had an annual sale of about 50,000 copies ; he also purchased about 1800 the copyright, from Joseph Cottle, of Bristol, of Southey's Joan of Arc and Wordsworth's Lyrical Ballads. He also published the works of Wordsworth, Coleridge, Soiithey, and Scott, and acted as London agent for the Edinburgh Review, which was started in 1802. From this period the firm greatly enlarged its business, issuing many works of an important character. In 1804 Mr Hurst and Mr Orme became partners ; and in 1824 the title of the firm was changed to Longman, Hurst, Eees, Orme, Brown & Green. In 1814 arrangements were made with Thomas Moore for the puplication of Lalla RooTch, for which he received ►►3000 ; and when the house of Constable, Edinburgh, fell in 1826, Longmans became the proprietors of the Edinburgh Review, while the advent of Thomas Babington Macaulay powerfully contributed to the fortune and reputation of the firm. They also issued in 1829 Lardner's Cabinet Encyclopcedia, which was contributed to by many of the most conspicuous workers in literature of the day ; and in 1832 M'Culloch's Commercial Dictionary. Thomas Korton Longman (3) died on 29th August 1842, leaving his two sons, Thomas (4) and William Longman, in control of the gigantic business in Paternoster Row. Their first success was the pub- lication of Macaulay's Lays of Ancient Rome, which was fpllowed in 1849 by the issue of the first two volumes of his History of England, which in a few years realized a sale of 40,000 copies ; the subsequent volumes reaped a still greater*

success ; and a cheque for ►►20,000, on account of profits, given to Lord Macaulay is a record in payment for authorship. The two brothers were well known for their literary talent ; Mr Thomas Longman edited a beautifully illustrated edition of the New Testament, and Mr William Long- man was the author of several important books, among them being a History of the Three Cathedrals dedicated to St Paul, in which he took a great interest, and a work on the History of the Life and Tvnes ^Edward III. In 1863 the firm took over the business of Mr J. W. Parker, and with it Eraser's Magazine, and the publication of the works of John Stuart Mill and the historian J. A. Froude ; while in 1890 they incorporated with their own all the publications of the old firm of Rivingtons, established in 1711, and with it the important works formerly issued by Hatchards, Piccadilly, whose publishing business had previously been bought by Rivingtons. The head of the present firm is Mr Thomas (5) Norton Longman, his brother Mr G. H. Longman, sons of Mr Thomas Longman ; Mr C. J. Longman and Mr H. H. Longman, sons of Mr William ; and Mr W. E. Green, being also members of the firm.

Black, Adam & Chaeles. ►►► The founder of this firm, Adam Black, was born in Edinburgh on 20th February 1784 ; he was the son of a builder of that town. After serving his apprenticeship to the bookselling trade, and a few years in London with Lackington, Allen & Co., he began business at 57 South Bridge, Edinburgh, in 1807. In 1826, at the time of Constable's {q.v.) failure, he was recognized as one of the principal booksellers in Edinburgh : he was joined in business a few years later by his nephew Charles. The two most important events connected with the firm were the publication of the 7th edition of the Encyclopcedia Britannica and the purchase of the stock and copyright of the Waverley Novels. The original

proprietors of the Encyclopaedia were Andrew Bell and Colin Maofarquhar ; in 1827 the copyright passed into the hands of Adam Black and a few friends, the 7th edition being published by him under the editorship of Proiessor Macvey Napier ; its issue was com- menced in monthly parts in March 1830, and finished in 1842. It was in twenty-one quarto volumes, and cost in production ►►108, 766, the number sold being 4500 copies. An 8th and 9th edition were published by Messrs

Black. In 1851 A. & C. Black bought the copyright of the Waverley Novels, at a cost of ––27,000 ; and in 1861 they became the proprietors of De Quincey's works.

Adam Black was for some years M.P. for Edinburgh ; he retired from business in 1865, and died on 24th January 1874. He was succeeded by his sons, who, finding that London would be more central lor publishing, relinquished in 1895 their establishment at Edinburgh, and removed to 4, 5, and 6 Soho Square, London.

Macmillan & Co. Limited. ––– The founders of this firm were Daniel and Alexander Macmillan. The former was born in the Isle of Arran in 1813, while his younger brother was born at Irvine on 3rd October 1818. Coming to London, they entered the house of Seeleys in 1839 ; but Alexander in 1843 commenced business in Aldersgate Street, and in the same year the two brothers purchased the business of Newby, in Cambridge. In 1845 they became the proprietors of the more important business of Stevenson, in Cam- bridge, when Mr Barclay became a, partner, the firm being styled Macmillan, Barclay & Macmillan. In 1850 Barclay's name dis- appeared from the title-pages of their publications, and the firm became settled in Cambridge. Mr Daniel Macmillan died in 1857, and in the same year an impetus was given to their business by the publication of Kingsley's Two Years Ago. A branch office was opened in 1858 at Henrietta Street, London, which led to a large extension of their trade. These premises were surrendered for larger ones in Bedford Street, and in 1897 their magnificent premises in St Martin's Street were opened. Mr Alexander Macmillan died in January 1 896. By his great energy and literary associations, and with the aid of his partners, there had been built up in little over half a century one of the most important publishing houses in the world. Besides the issue of many important series of educational and scientific works, they published the works of Kingsley, Huxley, Maurice, Tennyson, Lightfoot, Westcott, J. E. Green, Lord. Roberts, Lewis Carroll, with many other authors whose names are well known in literature. In 1898 they took over the old-estab- lished publishing house of R. Bentley & Son, and with it the popular works of Mrs Henry Wood, Miss Ehoda Broughton, The Jngold––by Legends, and also Temple Bar and The Argosy. In 1893 the firm was converted into

a limited liability company, with Mr Frederick Macmillan as chairman and Mr G. Macmillan, Mr G. L. Craik, and Mr Mamrice Macmillan as directors. There is probably no English house which has such a large connexion in America as Macmillans. Although distinct in its trading, the Macmillan Company of New York has in Mr F. Macmillan one of its most important and experienced members.

*EiviNGTON & Co. ***Charles Rivington, the originator of this firm in 1711, was a Derbyshire man, who took over the business of Richard Chiswell, and at the sign of the Bible and the Crown carried on a business almost entirely connected with theological and educational literature. Charles Rivington was born at Chester- field, and at an early age evinced a taste for religious books. He came to London, and was apprenticed to a Mr Matthews ; and in 1718, in conjunction with other firms, he published Mason's Vindi- cation of the Church of England. He also published one of Whit- field's earliest works, and brought out an edition of the Imitation- of Christ. In 1736 he became one of the company of booksellers who called themselves the " New Conger." In 1741 he published the first volume of Richardson's Pamela, which went through five editions in its first year of publication. Charles Rivington died on 22nd February 1742, and was succeeded by his two sons, John and James. The latter turned to other pursuits, but John pursued his father's policy, and was known as the great Church of England publisher of the day. In 1760 he was appointed publisher to the Society for Promoting Christian Knowledge, retaining the agency for over seventy years. Having admitted his sons Francis and Charles into partnership, they commenced the issue of a standard edition of the works of Shakespeare, Milton, Locke, and other British classics ; also Cmden's Concordance. John Rivington died on the 16th January 1792. Francis and Charles started in January 1793 the British Critic, in two-shilling numbers, which attained a circula- tion of over 3000 copies. In 1810 John, the eldest son of Francis, was admitted a partner ; and in 1819 they took alease of 3 Waterloo Place, where they remained until the business was sold, in 1890, to Messrs Longmans & Co. In 1827 George and Francis, brothers of John, joined the firm ; and by the publication (1833) of Tracts for the Times, to which Newman, Pusey, and Keble contributed, the house of Rivingtons was strengthened in its position as High Church publishi-rs.*

John Rivington died 21st November 1841, his son being admitted a partner in 1836. George Rivington also died in 1842 ; and in 1859 Francis Rivington retired, leaving the business in the hands of John Rivington and Francis Hansard Rivington.

As before stated, in 1890 the business and the right to trade were bought by Longmans & Co. A business of the same character was, however, carried on from 1889 to 1893 by Mr Septimus Kivington and Mr J. G. Percival, as Percival & Co., 34 King Street, Covent Garden. This was changed in 1893 to Riviugton, Percival & Co. ; and in 1897 the firm was enabled to revive its previous title of Rivington & Co., maintaining large educational and theological connexions with the Moderate and High Church party.

Smith, Elder & Co. *George Smith (1), the founder of this firm, was born in Scotland in 1789, and died 1846. From Scotland lie migrated to London, where he found employment first with Rivingtous, St Paul's Churchyard, and afterwards with J. Murray. In 1816, together with a fellow Scotsman, Alexander Elder, he commenced business at 158 Fenchurch Street as booksellers and stationers ; and in 1819 they added publishing to their business. It was here that George Smith (2) was born, on 19th March 1824 ; and in the same year the business was removed to 65 Cornhill, a house which was afterwards justly celebrated in literary and business circles. At the age of fourteen George Smith (2) came into the business, and shortly afterwards took over the control of the publish- ing department. His father dying in 1846, the responsibility of the business devolved principally upon his son, and under his manage- ment increased by leaps and bounds, multiplying thirteen times in twenty years. A large portion of the business was connected with foreign agencies and banking, especially with India. This was re- linquished in 1868 in favour of Messrs H. S. King & Co. Mr Smith removed the publishing business to Waterloo Place. Here the literary side of his career was extended and developed ; he exerted considerable influence upon men and letters, encouraging young writers and laying the foundation of lasting*

friendships. For over thirty years Mr G. Smith (2) was the friend and publisher of John Euskin, and it was with him that Jane Eyre, found a publisher in 1847. In 1855 was started the Omrla/nd Mail and the Hovieward Mail, journals which still have a large circulation. By this firm were issued works by W. M. Thackeray, Mr and Mrs Browning, "Wilkie Collins, Matthew Arnold, Miss Martineau, James Payn, and Mrs Humphry Ward. In 1866 was published Anthony Trollope's Last Chronicles of Barset, for which ►►3000 was paid. In January 1860 the first of the three great ventures connected with Mr Smith was commenced, the Oornhill Magazine being issued in that month, under the editorship of W. M. Thackeray, with whom was associated many of the brilliant writers of the period. The second venture was the founding of the Pall Mall Gazette, the first number appearing on 7th February 1865, price 2d. The third and most important venture in Mr Smith's career was the publication of The Dictionary of National Biography, the first volume being issued in 1882 ; it was completed in 1901, consisting in all of 66 volumes ; and this monumental work was the crowning effort of a successful career. Mr George Smith died on 6th April 1901. In 1894 Mr George Smith's son-in-law, Mr Reginald J. Smith, entered the firm, and afterwards became sole acting partner.

Blackwood, W., & Soxs. ►►► The house of Blackwood owes its origin to William Blackwood, who was born of humble parents at Edinburgh on the 20th November 1776. At the age of fourteen he was apprenticed to BeU & Bradfute. In 1797 he entered the employment of Mundell & Co., Glasgow. In 1800 he joined Mr Ross, a bookseller and book auctioneer ; but finding the old-book trade more to his liking, he left Edinburgh for London, where he remained three years. Returning to Edinburgh in 1804, he opened an old-book shop in Princes Street, selling old, rare, and curious books. He undertook the Scotch agency for John Murray and other London publishers, and gradually drifted into publishing on his own account. On 1st April 1817 was issued the first number of the Edinburgh Monthly Magazine, which on its seventh number bore the name of Blackwood's as the leading part of its title, by which it has ever since been known. ' ' Maga, " as this magazine soon came to be called, was the organ of the Scottish Tory party, and round it gathered John Wilson ("Christopher North "), Maginn, Lookhart, Lord Weaves, Carlyle,

Moir, Lord Lytton, Gait, Aytoun, and Mrs Oliphant. William Blackwood died on the 10th September 1834, and was succeeded by his two sons, Alexander and Robert. In 1829 they removed to the premises they now occupy in George Street ; and in 1845 Alexander Blackwood died, and was shortly afterwards followed by his brother Robert. A younger brother, John, who was born in 1818, succeeded to the business ; four years later he was joined by Major William Blackwood, who continued in the firm until his death in 1861. In 1862 John Blackwood took into partnership the Major's elder son, William, who, with his uncle, largely developed the business until John's death in 1879. John Blackwood was a man of strong personality and great business discernment ; it was he who introduced George Eliot to the world of letters. He also inaugurated the "Ancient Classics for English Readers " and other important series, while the many great writers who had their works issued from this house are too numerous to catalogue. The present head of the firm is Mr William Blackwood, assisted by his two nephews, Mr George W. Blackwood and Mr J. H. Blackwood. Oassell & Co. Limited. ??? *John Cassell, the founder of this firm.*

was born at Manchester on 23rd January 1817, and died on 1st AprU 1865. Starting in humble life, he educated himself, and early gained a considerable knowledge of English literature, and also attained a proficiency in French. In 1836 his energies became centred in the temperance movement, in which he laboured with eloquence and zeal. He started a temperance publishing office in the Strand, and at the same time did a large trade in tea and coffee. A few years after he developed a more influential business in La Belle Sauvage Yard, Ludgate Hill. Messrs Petter and Galpia became partners, and added greatly to the business by the issue of good literature for the working classes, one of the most useful being the Popular Educator, which was followed by the Technical Educator. The firm also published the History of Juli^is Caesar, by Napoleon III., and the English edition of the illustrated works of Gustave Dor^. The business is now under the control of a limited company, who produce all their own serial and other pub- lications.

Chambers, W. & R. ??? *The elder of the two pioneers of popiJar literature, William Chambers, was born at Peebles on 16th April 1800, his*

brother Robert two years later. From the village school they obtained the foundation of an education by which, with industry and perseverance, they were enabled to gain for themselves a knowledge which was almost encyclopsedio. Each brother started separately a small shop, with a capital of a few shillings, selling some of their old school-books, doing printing, and producing some of the books they sold. Robert early developed a literary taste, writing in all seventy volumes, besides innumerable articles, among the former being the Vestiges of the Natural History of Creation, the authorship of which was not, however, acknowledged until after his death. On the 4th February 1832 appeared the first number of Chambers's Edinburgh Journal, which met with immediate success, reaching a circulation of 50,000 copies of its weekly issue. This brought the two brothers together as partners, Robert supervising the literary part of the concern, William being business manager. In 1844 appeared the Cyclopcedia of English Literature, from 1860 to 1868 the famous Chambers's Encyclopcedia, and in 1864 that remarkable work, fbe Boole of Days. Robert Chambers died at St Andrews on 17th March 1871. His brother William had accepted the offer of a baronetcy, but died on 20th May 1883, before it could be bestowed. The business is now a limited company, and beside educational and general literature, it publishes a large number of books for juveniles.

Chapman & Hall Limited. ??? This firm commenced business in 1834 at 186 Strand, removing in 1850 to 193 Piccadilly, and in 1881 settled in Henrietta Street, Covent Garden, where it has continued to carry on the business of publishing. Charles Dickens wrote The Pickwick Papers for them. They afterwards published many of Dickens's works ; but in 1844 they quarrelled, and Dickens transferred his publishing to Bradbury & Evans. This breach was healed in 1859 ; and at the death of Dickens, Frederick Chapman bought the entire copyright of Dickens's works. This firm also published works by Mr and Mrs Browning, Anthony Trollope, Carlyle, and George Meredith ; and in 1865 they started ftie Fortnightly Review, of which G. H. Lewes was the first editor. This magazine was originally issued twice a month, but in 1867 it was changed to a monthly periodical. In 1880 the firm became a limited company under the managership of Mr Frederick Chapman (1823-95), and the business is now continued as general publishers.

Gardner (Wells), Darton & Co. ❖❖❖ *The head of this firm, Mr Joseph W. Darton, is the successor in a long line of ancestry, all of whom have maintained a high position in the issue of books for children. The first, William Darton (Darton & Harvey, Grace- church Street), was born in 1755 and died in 1816. He, his son William Darton (2) (1781-1854), and grandson, John Maw Darton (1810-81), were members of the Society of Friends. For over half a century this firm almost monopolized the trade in children's books. Amongst their early publications was the Original Poems by Jane and Ann Taylor. They also issued works by Priscilla Wake-field, Maria Hack, Peter Parley, Mrs Sherwood, and William and Mary Howitt. In 1857 Mr J. W. Darton joined the firm of Wells Gardner & Co., who publish Chatterbox, Sunday, and works in juvenile and devotional literature.*

Heinemann, William. ❖❖❖ *Mr William Heinemann was born at Surbiton on 18th May 1863, and after some years of experience with the late Nicholas Triibner, he established himself as a publisher on 1st January 1890. In 1893 Mr Sydney S. Pawding, a nephew of the late C. E. Mudie, the librarian, joined him in partnership. Mr Heinemann married, in 1899, Magda Stuart-Sindici ("Kassandra Vivaria "). He is himself the author of several plays, and, besides issuing the later works by Mr Hall Caine and other popular novel- ists, he has introduced into England translations of many import- ant and artistic works from the Continent.*

Low (Sampson), Mahston & Co. Limited. ❖❖❖ *Sampson Low, the founder of this firm, was born in London in November 1797. He was the son of Sampson Low, printer and bookseller, Soho Square, was apprenticed at a circulating library in Bond Street, and afterwards entered the employ of Longmans & Co. In 1819 he*

commenced business at 42 Lamb's Conduit Street as a bookseller and stationer. In connexion with Mr William Longman and other publishers, he started in 1837 The Publishers' Circular, which became Low's property in 1867. In this journal a list of new books is printed, and from

these lists the Annual Catalogue of books is issued, the first volume appearing in 1839. From these volumes the British Catalogue was compiled, followed by the English Catalogue of Books, the only bibliographical work of reference for new books. In 1848 Low opened a publishing office in Eed Lion Court, which in 1852 was removed to Ludgate Hill, where he greatly developed his publishing business, and also added to it a depot for the sale of American books. He died on 5th March 1871. In 1856 Mr Edward Marston became a partner ; in 1867 the firm removed to Fleet Street, and finally to St Dunstan's House, Fetter Lane, in 1887. This firm has a large American and continental agency ; they are the publishers of the Nineteenth Century and After, and books in various branches of literature.

RonTLEDGE, Geobgb, & SoNS LIMITED. ❓❓❓George Eoutledge, a native of Cumberland, was apprenticed at Carlisle, came to London, and found employment at the house of Baldwin, Cradock k Joy. He afterwards obtained a subordinate position under the Govern- ment, and opened a small shop in Ryder's Court, Leicester Square. In 1845 Routledge moved to Soho Square ; and in 1848 he was joined in partnership by his brother-in-law, Mr William Wame, and after- wards by Mr F. Wame. The firm then removed to Farringdon Street, where they successfully developed a business in issuing cheap literature, giving Lord Lytton ❓❓20, 000 for the right to issue a cheaj) edition of his works for a term of ten years. They also issued the works of G. P. R. James, Harrison Ainsworth, Mayne Reid, and James Grant. Among the various "libraries" they started were the "Railway" and the "Popular."' In 1865 Mr F. Wame terminated his partnership and established a fresh business in Bedford Street. Mr Routledge's business was removed to the Broadway, where his two sons, Robert and Edmund, were associated with him. Mr George Routledge died 13th December 1888, Mr Robert Routledge 23rd July 1899, and Mr Edmund Routledge on 25th August 1899. '

Bell, Georqe, & Sons. ❓❓❓This business was foimded by George Bell in 1840, as a publisher of works in educational, classical, and general literature. Upon the retirement of Mr H. G. Bohn they purchased from him his various "libraries" of standard, classical, and other branches of literature, numbering in all 766 volumes. During recent years great

attention has been given by this firm to fine art publications and to the production of artist- ically illustrated works.

Allen, George. ??? When John Ruskin decided to sever his con- nexion with Messrs Smith, Elder & Co., he selected his lifelong friend, Mr George Allen, of Orpington, Kent, to sell his books to those who wanted them. It was a strange campaign against the publisher and bookseller, but by this action Ruskin added one more to the long list of publishers. It was in 1873 that this country publishing business was inaugurated ; and from that time a gradual development took place, until it was found desirable to remove Mr Allen's establishment to London. Here the business has greatly increased ; and besides the works of Ruskin, books in all departments of literature have been issued.

Blaokib & Son Limited. ??? This firm, which was founded in 1809 by John Blackie, has been largely engaged in the canvassing trade, but during recent years has developed an important publish- ing business in books for boys and girls, issuing annually a large number of books by G. A. Henty and others.

Virtue, H., & Co. Limited. ??? George Virtue, one of the leaders in the book-canvassing business, was bom at Coldstream, Ber- wickshire, in 1793, but early in life came to London, and in 1820 was established as a religious book-remainder buyer near the Houses of Parliament. He frequently reissued these books in parts for canvassers, who made calls upon people at their houses who sub- scribed for the books thus issued. On the 15th July 1821 he was given an interest in Pierce Egan's Life in London, or the Adventures of Tom and Jerry, Olustrated by I. R. and G. Cruikshank. This work caused great excitement, and was freely bought and imitated. In 1831 he moved to Paternoster Row, where he issued for can- vassers Fletcher's Guide to Family Devotion, of which 30,000 copies were sold. Virtue also arranged with W. H. Bartlett to produce a series of fine art works descriptive of various countries of the world. The first issued was Switzerland, of which 20,000 copies were sold. He also produced Scotland, at a cost of ??40,000. In 1849 the Art Union passed into his hands ; the title of this magazine he changed to The Art Journal, which to this day maintains a high reputation for artistic merit. George

Virtue died on the 8th December 1868 ; but some years before his death the business had been transferred to his son, Mr J. S. Virtue. The firm is now a limited company, under the chairmanship of Mr Herbert Virtue, and has important and extensive printing and binding premises in the City Road, London.

Cambridge University Press. ??? The London business of this press was established at 17 Paternoster Row in 1873. Previous to

that period it had confined its energies to producing books which were sold through the various bookselling agencies. One of their most important undertakings was the issue, in connexion with the Oxford University Press, ot the Revised Version of the New Testa- ment in 1881, and the Old Testament in 1885. They also issue an important collection of classical works in the " Pitt Press Series." This term was given to the series from the building at Cambridge erected by money subscribed to perpetuate the memory of William Pitt. The business was formerly under the management of Mr C. J. Clay, and is now conducted by his tivo sons, Messrs J. & C. F. Clay.

Chatto & WiNDUS. ??? John Camden Hotten, the originator of this firm, was born in 1832. He was a man of considerable literary ability, compiling a Slang Dictionary and various works on topo- graphy and family history. In 1854 he commenced business in Piccadilly as a publisher and seller of rare and curious books. Hotten died in 1873, and was succeeded by Mr Andrew Chatto. He, %vith his partners, have developed an important publishing business, especially in fiction and helles lettres,

Oxford University Press.- ??? This press trades under three different imprints, namely : 1. Oxford, printed at the University, for Bibles, prayer-books, &o ; 2. Henry Frowde, Oxford University Press Warehouse, for miscellaneous works not issued under the authority of the delegates ; 3. The Clarendon Press, for classical and especially erudite works. The Clarendon Press publications were formerly issued through the agency of Macmillan & Co. , but in 1874 a, London business was opened under the management of Mr Henry Frowde. Besides a large and important trade in

the United Kingdom and in America in Bibles, prayer and other books in handsome and rare bindibgs, they publish a large number of educational and classical works. The Clarendon Press holds the perpetual copyright of Clarendon's History of the Bebellion; the profits from this book were the means by which a part of the Clarendon Press buildings at Oxford wi- re erected.

Hurst & Blaokett Limited succeeded, about 1840, to the business established by Henry Colbum in 1807. The principal trade of this firm has been the issue of fiction in three-volume form. These works were formerly sold to fiction distributors, who bound them and sold them to the libraries. Upon the establish- ment of Mudie's Library in 1842 this system broke down, since Mr C. E. Mudie arranged to buy the sheets himself and bind them up according to the demand. Publishers then adopted the method of issuing novels bound up in cloth. The firm is now known for its cheap and well-selected fiction.

Nelson, Thomas, & Sons. ??? Thomas Nelson was born at Throsk, in Scotland, in 1780 ; he received his business training in London, but returned to Edinburgh, where he opened a shop, selling such works as Baxter's Saints' Best, Booth's Beign of Grace ; and in connexion vrith Peter Brown published the works of Paley, Romaine, and Newton. The business was greatly increased by the exertions of his two sons, W^illiam and Thomas, who were admitted as partners. Among their successes were the issue of popular juvenile literature, especially by A. L. 0. E. and R. M. Ballantyne. Thomas Nelson died on 23rd March 1861. Messrs Nelson & Sons have a large and important printiiig and binding establishment in Edin- burgh, but the publishing business is mainly carried on in Pater- noster Row. Mr G. M. Brown, M.P., who married the daughter of Thomas Nelson (2), is now the acting partner.

NiSBET, Jambs, & Co. Limited. ??? James Nisbet, the son of a Scottish farmer, was born on 3rd February 1785. Early in his career he came to London, and commenced business in Castle Street in 1809, where he was interested in the issue of many religious works, by Edward Irving, Dr Hamilton, and Dr MacDuff. He died on 8th November 1854. Mr James Murray succeeded to the manage- ment of the business, and he

was followed by Mr Watson. The business is now a limited company, publishing works in all branches of literature.

Si.MPKiN, Marshall, Hamilton, Kent & Co. Limited. ??? The founder of this large publishing and distributing agency was Benjamin Crosby. He relinquished business in 1814 in favour of his two assistants, W. Simpkin and R. Marshall. In 1828 Simpkin retired, and Mr John Miles took the financial management of the concern. This firm were the London agents for Tennyson's first poems, publishing in 1827 Poems hy Two Brothers. Marshall died on 17th November 1863, and the business remained entirely in the hands of Mr Miles's sons, under whose management it greatly developed. The firm published, among other works, O'Meara's Napoleon at St Helena, and Dame Buropa's School ; but their busi- ness is principally as distributing agents for the supply of mis- cellaneous books to the booksellers of town and country. In 1889 an amalgamation was effected between Simpkin, Marshall & Co., Hamilton, Adams & Co., and Kent & Co., being converted into a limited company, to which in 1891 was added a large wholesale newspaper distributing agency.

Dent, J. M., & Co. ??? As a pioneer of cheap but tastefully produced reprints in all classes of literature this finn is pre-eminent. Mr Dent was born at Darlington, and at eighteen came to London,

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where he commenced business as a bookbinder. "With the instincts of a true book-lover, he felt the want of cheap but well-edited books, and this induced him to commence the publishing business which ha has carried on with such marked success. The "Temple' Bible, Shakespeare, and classics have had immense sales. The business was started at Great Eastern Street, but is now carried on at 29 Bedford Street, "W.C, the premises once occupied by Macmillan & Co. With Mr J. M. Dent is associated his son Mr Hugh Dent. , ^

Lane, John (The Bodley Head, Vigo Street). Mr John Lane originally started publishing with Mr Elkin Mathews during the ‘eighties, and by degrees their devotion to hdles Idtres, and particularly their successful discernment in encouraging the young poets of the day, made their establishment famous. The ‘ ‘ Bodley Head ” became identified with this new generation of literature, and with such writers as Mr William Watson, Mr Richard Le Gallienne, and Mr John Davidson. In 1898 the partnership was ❖❖❖dissolved, and Mr Lane continued to carry out the same publishing policy on his own account.

Clark, T. & T. (38 George Street, Edinburgh), originally founded by Thomas Clark in 1821, publishers of works in theology, philosophy, and general literature.❖❖❖ Hoddek & Stoughton (27 Paternoster Row), publishers of theological, devotional, and general literature ; also The Bookman, The British WeeUy, Expositor, &o.❖❖❖ Hutchinson & Co. (34 Paternoster Row), with a large export and colonial trade. Publish principally fiction, biography, and travel.❖❖❖ Methubn & Co. (36 Essex Street, Strand), founded 1889 ; principal publications, fiction, poetry, and bio- graphy.❖❖❖Nutt, David (57-59 Long Acre), founded 1829, dealer ill foreign, classical, and general literature ; publishes works in philology, folk-lore, &c.❖❖❖ Paul (Kegan), Teenoh, TkObnee & Co. Limited (20 and 22 Charing Cross Road), exporters and dealers in scientific and general literature, and publishers of ~~works in various branches of science. This firm succeeded to the business of Nicholas Triibner and Kegan Paul, Trench & Co. ❖❖❖ Richakds, GliANT (Leicester Sc[uare), founded 1897, pub~~ lisher of fiction, juvenile, and most departments of literature. ❖❖❖ Sonnenschein (Swan) & Co. Limited (6 White Hart Street, Paternoster Square), founded 1878, educational, scientific, and general publishers. ❖❖❖ Stanford, Edwakd (12, 13, and 14 Long Acre), founded 1852, military and geographical publishers, agents for the Geological Survey maps. ❖❖❖ Unwin, T. Fishek (11 Pater- noster Buildings), founded 1883, publisher of “The Story of the Nations,” and works in fiction and general literature. Wakd, Look & Co. Limited (Salisbury Square), founded 1861, publishers of cheap and miscellaneous literature. With this firm is incor- porated Moxon & Co., S. 0. Beeton, and A. D. Innes & Co. ❖❖❖ Arnold, Edward (37 Bedford Street, Strand), publisher of fiction and general

educational literature. ❖❖❖ Bradbury, Agnew & Co. Limited (Bouverie Street, Fleet Street), publishers of sporting and general literature ; also proprietors and publishers of Punch. ❖❖❖ Constable (Archibald) & Co. Limited (2 Whitehall Gardens), publishers of the Victorian County Histories, fiction, and other works in general literature. ❖❖❖ Waknb (Frederick) & Co. (Bedford Street, Strand), founded 1865, publishers of fiction, poetry, and cheap reprints. ❖❖❖ Churchill, J. & A. (7 Great Marl- borough Street, W.), the oldest publishing house which deals ex- clusively with medical books ; it was established in 1825 by John Churchill.

American Publishers.

Appleton, D., & Co., was founded in 1825 by Daniel Appleton, who opened a small store in Exchange Place, New York, for the importation of foreign publications. His son, William H. Apple- ton, became a partner in 1838. In 1831 they published their first book, entitled Daily Orv/mbsfrom the Master's Table, of which they sold 2000 copies. In 1835 Mr William H. Appleton went abroad as the representative of the firm. He was entertained in England by John Murray, of whom, he became a lifelong friend, and by Thomas Norton Longman. In Germany he met Baron Tauchnitz. In 1838 the firm assumed the familiar title of "D. Appleton & Co.," which it has borne ever since. In 1848 Daniel Appleton retired, dying the following year. The firm was reorganized by his sons, with William H. Appleton at its head. Under his direction several important enterprises were undertaken : the pub- lication of the Jfew American Cyclopiedia, under the editorship of George Ripley and Charles A. Dana ; and the publication of scientific and educational books, which has since been a feature of the house. William H. Appleton died in 1899, being the last of the second generation. The business, a large one, is now conducted by his son, William W., and the sons of his brothers, John A. and Daniel Sydney. Their growing business caused many removals, until they entered their present quarters in Fifth Avenue in 1902. Their most noted publication of recent times has been David Harum, which has been through nearly 100 editions, reaching the

enormous total of over 650,000 copies. A branch house is main- tained in London.

Century Co., The. *In 1870 Mr Roswell Smith and Dr J. G. Holland united with Charles Scribner & Co. to found Scribner's Monthly, Dr Holland being the editor. In 1873 St Nicholas, an illustrated magazine for children, was started, with Mrs Mary Mapes Dodge as editor. In 1881 the Scribner interest was bought out, a new company (The Century Co.) formed, and the name of Scribner's Monthly changed to The Century Magazine. The most notable series of articles that have appeared in the magazine are*: the " Civil War Series," contributions by the surviving officers of the war, including several by General Grant ; Mr Kennan's articles on "Siberia and the Exile System"; and the "Life of Abraham Lincoln," by his private secretaries Nioolay and Ha,y. The business of the Century Co. has steadily grown since its founding. Its best known publications are : The Century Dictionary (1888-91), the cost of which was nearly 81,000,000 ; The Century Cyclopaedia of Names, The Century Atlas, and the series of hymn- books prepared by Dr Robinson. In 1892 the first president of the company, Mr Roswell Smith, died. His successor, Mr Frank H. Scott, is still president.*

DoDD, Mead & Co. was established in New York in 1839 by M. W. Dodd and John S. Taylor, in the old Brick Church Chapel, a building then standing on what is now the site of the New York Times, and in that year published Cruden's Concordance,. Various changes have occurred in the personnel of the firm, which, when it assumed its present title in 1876, included Frank H. Dodd, Edward S. Mead, and Bleecker van Wagoner. Mr Mead died in 1894. Notable publications of the house are E. P. Roe's books. The Inter- national Cyclopaedia (1885), and The Bookman, started in 1895.

Harper & Brothers was established in New York in 1817 by John and James Harper, under the name of J. & J. Harper. In 1825 their two younger brothers, John Wesley and Fletcher Harper, were admitted to partnership, and in 1833 the firm name was changed to Harper & Brothers. In 1840 their mechanical establishment occupied several buildings on both sides of Cliff Street, just behind their present quarters

on Franklin Square ; and in 1850 they erected in Franklin Square a large and commodious structure, which was connected with the Cliff Street buildings. In 1853 the enth'e establishment was destroyed by fire. It was at once rebuilt, with increased facilities, on the same site, and is still occupied. For many years the business was carried on as a partnership, the members of the firm being the sons and grand- sons of the original founders. Their best known publications are : Earper's Magazine, Harper's Bazaar, and Harper's Weekly. In 1893 the firm was incorporated as a stock company, and so con- tinued until its reorganization in 1901, when the control and the presidency was turned over to Colonel George Harvey, editor and proprietor of the North American Review. The house has a London branch.

Houghton, Mifflin & Co. ❓❓❓ The publishing firm of Hurd & Houghton was established in 1864, consisting of Melanchthon M. Hurd of New York and Henry Oscar Houghton of Boston. Mr Houghton already owned the "Riverside Press" in Cambridge, Mass., which he had established in 1849, and in which the manu- facture of books published by the firm has since been carried on. In 1866 Albert G. Houghton, elder brother of the founder, was admitted to the firm ; and in 1872 Horace E. Scudder and George H. Mifflin became members, the former retiring after three years. In 1873 the house bought The Atlantic Mordhly. In 1878 Albert G. Houghton and Mr Hurd retired, and the firm was consolidated with James R. Osgood & Co., successors to Ticknor & Fields, and the name changed to Houghton, Osgood & Co. Two years later Mr Osgood retired, and the firm became Houghton, MifSin & Co. In 1895 H'. O. Houghton, the founder, died. As now constituted, Mr Mifflin is senior partner, and has associated with him sons of Henry 0. and Albert G. Houghton, James Murray Kay, and L. H. 'Valentine. The manufacturing business at the "Riverside Press " is carried on under the name of H. 0. Houghton & Co. , although identical with the publishing firm. Among the publi- cations of the firm are the works of Emereon, Lowell, Holmes, Longfellow, Whittier, Hawthorne, and Fiske. "They also published the Narrative and Critical History of America.

Lee & Shepakd. ❓❓❓ A partnership between William Lee and Charles A. B. Shepard was formed in Boston in 1861. Beginning as booksellers,

they developed into a publishing business. Mr Shepard died in 1889, and Mr Lee continued as sole partner until 1897, when he sold his entire business, including the firm name, to E. Fleming & Co., bookbinders. Mr Lee continued with the firm until 1898.

Lippincott Co., J. B. ◆◆◆ In 1794 Jacob Johnson opened a small book-store in Market Street, Philadelphia. Later, as Johnson & Warner, Warner & Grigg, and Grigg, Elliot & Co., the business was successively and successfully carried on until 1850, when it was purchased by Joshua B. Lippincott and became known as Lippincott, Grambo & Co. A large building was erected at Market and Filbert Streets during the Civil War. In 1885 a

joint-stock company, capitalized at 551,000,000, was formed and given the present name. In January of the following year Mr Lippincott died. In 1899 a fire destroyed not only tlie Market Street building, but also a large stock of books and plates. In 1901 the company built and equipped a new live-storey building at Locust and Sixth Streets. Chambers's ◆◆ncyclo}>cbdia, and Lijiyin- cott's Magazine are two of their important publications.

Little, Brown & Co. was founded in 1784 in Boston by E. Batelle. He was succeeded by Benjamin Guild, Samuel Cabot, William T. and Samuel Blake. In 1806 William Andrews suc- ceeded to the business, and later, Jacob A. Cummings and William Hilliard. In 1821 the firm became Carter, Hidiard & Co. In 1827 a new firm was formed, under the title of Hilliard, Gray & Co., the company being Charles C. Little. The name for a time was Hilliard, Gray, Little & Wilkins. In 1837 Mr Little and James Brown became the proprietors, under the name of Charles C. Little & James Brown. In 1847 Augustus Flagg was admitted to the firm. Mr Little died in 1869, and Mr Brown in 1855. Mr Flagg continued as managing partner until his retirement in 1884. The present firm consists of John Murray Brown, Charles W. Allen, Hulings C. Brown, and James

W. M'Intyre. Besides law-books, the firm has published several standard works both of American and of foreign authors.

Putnam's Sons, G. P. ??? In 1836 George Palmer Putnam became a partner in the firm of Wiley & Long, which a year later became Wiley & Putnam. In 1849 he established the first American bookselling house in London. In 1848 he separated from Mr Wiley and instituted the firm of G. P. Putnam k Co. In 1853 Putnam's Monthly was established, which in 1872, after the death of Mr Putnam, was transferred to Scribner's, and was an important factor in the foundation of the first Scribner's Monthly (now The Century Magazine). In 1866 the firm became G. P. Putnam & Son. In 1841 Mr George Haven Putnam organized the first of the committees charged with the work of securing an American international copyright law. In 1872 the firm became G. P. Putnam's Sons, the additional partners being John Bishop Putnam and Irving Putnam. In 1 879 they reinstituted a branch in London, and their publications have since borne the imprint "New York and London." In 1893 they established, at New Kochelle, New York, the " Knickerbocker Press." In 1896 they assumed the publication of the literary monthly The Critic. The present head of the house is George Haven Putnam.

Sohibner's Sons, Chaelbs, was established in New York City in 1846 by Charles Scribner, sen., and Isaac D. Baker, as Baker & Soribner. Mr Baker retired after a few years, and Charles Scribner continued the business until 1857, when he united with Charles Welford. This partnership, under the name of Scribner & Welford, was separate from the main house, and was organized for the purpose only of importing books. On the death of Mr Welford in 1885 the two departments were combined. In 1864 Mr Soribner admitted to partnership Andrew C. Armstrong, and in 1869 Edward Seymour. Mr Scribner died in 1871, and was suc- ceeded by his eldest son, John Blair Scribner, and the firm now became Scribner, Armstrong & Co., and that of the importing house Scribner, Welford & Armstrong. Mr Seymour died in 1877, and a year later John Blair Scribner and Charles Scribner, his younger brother, purchased the interest of Mr Armstrong, and the present firm name was adopted. The death of John Blair in the next year left Charles the only partner until 1884, when his brother Arthur H. joined him. In 1894 the

firm erected a handsome edifice in Fifth Avenue, which it now occupies. In 1881 they sold their interest in Scribner's Monthly, the name of which was changed to The Century Magazine, the Scribners agree- ing to abstain for five years from the publication of a similar magazine. In 1887 the present Scribner's Magazine was started. Among the notable achievements of the house was the importation and sale of the EncycloiJaidia Sritannica (9th edition).

Other important American publishing houses are : Lothhop Publishing Co., which succeeded D. Lothrop & Co., founded by Daniel Lothrop in 1850. ❓❓❓Dol'bleday, Page & Co. succeeded Doubleday, M'Clure & Co. The firm consists of F. N. Doubleday, Walter H. Page (formerly editor of The Atlantic Monthly), Henry W. Lanier, J. Leslie Thompson, and S. A. Everitt. Their publi- cations include books by Kipling, Crockett, Anthony Hope, and others, and two monthly magazines ❓❓❓The World's Work and Country Life in America. ❓❓❓E. P. Dutton & Co., established in Boston in 1852, but removed to New York in 1869. Their publi- cations are largely of a religious nature. ❓❓❓A. 0. M'Cltjkg & Co., a Chicago firm, establisheci in 1848 by S. C. Griggs, which developed, after several changes, into the present firm. 'The guiding spirit for nearly forty years was General A. C. M'Clurg, who died in 1899. Tho firm suffered from three great fires, the last in 1899, after which the present corporation %vas formed. They are the largest publishers in the West. ❓❓❓At the head of educational publishers stand The Amekiean Book Co., incorporated under the laws of the state of New Jersey in 1890, with a capital of $5,000,000. It purchased the school and college text-books previously owned by

Ivison, Blakeman & Co., A. S. Barnes & Co., Van Antwerp, Bragg, & Co., D. Appleton & Co., and the common school-books owned by Harper & Brothers. Two of these firms closed their business, and the new corporation started with stockholders, directors, and officers largely made up from the partners in the former houses. They now publish various series of school-books, which are most widely used throughout the United States, and have issued many new books that have met with wonderful success. Their annual output approximates ten million volumes. The main offices of the company are at New York, Chicago, and Cincinnati,

with distributing centres at other important points. ❖❖❖ D. C. Heath & Co., Boston, established in 1886, publish a considerable number of educational works. ❖❖❖ Maynaud, Mekkill & Co. are publishers of school and college text-books.

FOEEIGN FlEMS.

Tatjohnitz, Beenhaed (Leipzig). ❖❖❖ The founder of this famous house. Baron Christian Bemhard von Tauchnitz, was born in 1816, the nephew of the noted German printer and bookseller, Karl C. T. Tauchnitz. His establishment at Leipzig was founded by him in 1837, and his name is associated with the Library of British Authors, now numbering between 2000 and 3000 volumes. In 1860 he was ennobled, and in 1877 was made a life member of the Saxon Upper Chamber. He held for many years (1866-95) the ofiice of British Consul-General for the kingdom and duchies of Saxony. He died on the 13th of August 1895, and the publishing business is carried on by his son. Baron Christian Karl von Tauch- nitz, Dr. Juris., who is likewise British Consul-General.

Beookhaus, F. a. (Leipzig). ❖❖❖ The iounder, Friedrich Arnold Brockhaus, was bom in 1772 and died in 1823. This business was first stai'ted at Altenburg in 1811, but removed to Leipzig in 1818. It is now under the management of Messrs Albert (president of the Publishers' Association, 1901) and Piudolf Brockhaus, who carry on an immense publishing and manufacturing business. They issue Ersch and Gruber's Encyclojycedia, the important Kon- versations-Zezikon, and many historical and bibliographical works.

Other important German houses are : ❖❖❖ Teuenee, Babdekbe, Meybe, Teubnee, and Beeitkopf & Haetel.

DiDOT (Paris). ❖❖❖ This house was founded by Francois Didot, who was born in 1689 and died 1757, being succeeded by his sons F. A. and P. F. Didot, who greatly distingmshed themselves by the improvement they made in printing. The house has a long and distinguished history, and is associated with bookselling, paper- making, and bookbinding in all its branches.

*Haohette & Co. (79 Boulevard St Gemjain, Paris, and 18 King William Street, W.C.).**** *Established in 1826 by Louis Hachette, born 5th May 1800 and died 31st July 1864. He founded several series of works, including the notable " Bibliotheque Populaire," the " Bibliothfeque Variee," and many others. M. Een6 Fouret is the present (1902) head of this firm.*

The following are also important French houses : *** *A. Colin & CiB (Paris), Ch. Dblageave (Paris), Calmann L^vy (Paris), G. Masson (Paris), Hetzel & Cie (Paris), DBSCLiiE be Bkouwee et CiE (Paris, Lille, Brussels, and Tournai), A. Maine & FiLS (Tours).*

PudSey, a municipal borougli of Yorkshire, Eng- land, in the Pudsey parliamentary division of the West Riding, 6 miles south-west of Leeds, on the Great Northern Railway. Since 1894 it has been controlled by an urban district council. Recent buildings include Baptist, Free, and Primitive Methodist chapels. A small public park was opened in 1889. Part of the parish, Tyersall, is in the borough of Bradford. Population (1881), 12,314;

(1891), 13,444; (1901), 14,907.

Pudukota.| a state of southern India, in sub- ordination to Madras, lying between the British districts of Tanjore and Madura. Area, 1101 square miles. Popu- lation (1881), 302,127; (1891), 373,096, showing an increase of 23 per cent. ; average density, 339 persons per square mile. In 1901 the population was 380,582, showing an increase of 2 per cent.

*The chief, whose title is Tondaman, is of the Kallar or robber caste. His ancestor received a grant of territory for loyal sei-vices during the wars in the Carnatic at the end of the 18th century. The present raja, aged twenty-three, has been educated by an English tutor, and visited England in 1898. Estimated gross revenne, Rs. 10,00, 000, exclusive of land revenue granted to junior branches of the family, to Brahmans, and to temples ; no tribute. In 1897-98 the expenditure on public works was Rs.l, 18,000 ; number of schools, 368. The town of Pudtjkota is situated in 10** 23' N. and 78** 52' E. Population (1891), 16,885.*

Puebla., a town of Spain, island of Majorca, on the north coast, with a railway station. The population was 5681 in 1887, and 5877 in 1897. It is a clean, well built town. In the neighbourhood there are marshes, lagoons, and flat alluvial plains that afford excellent grazing ground for live stock. Puebla has a parish church and several convents.

Puebla., a state of Mexico, bounded on the N. and E. by Vera Cruz, on the S. by Oaxaca and Guerrero, on the W. by Morelos, Mexico, and Hidalgo. Area, 12,207 square miles. Population (1879), 784,466; (1900), 1,024,446. Agriculture is the principal industry; the chief products are cereals, sugar-cane, cofl^ee, vanilla, and a variety of fruits. The value of the cereals produced in 1897 is given as $8,746,999 (Mexican currency), and of sugar-cane, $786,307. The state is divided into twenty- one districts. The capital, Puebla, or Puebla de los Angeles, with a population of 88,684, is one of the oldest and most important cities of Mexico, possessing many handsome buildings, among others the cathedral, and the state college with a large library, the palace of justice, school of medicine with the Palafoxiana Library of over 100,000 volumes. It is an important commercial and industrial centre, with numerous cotton and woollen mills, glass factories, foundries, and other establishments. The Mexican Kailway and the Inter-Oceanic Ptailway pass through it. Among the chief towns are : Teziutlan (9776), Tlatlauquitepec (8754), Athxco (7698), Tehuacan (7275), Matamoros (7184), Zautla (7053), Cholula (7031), Chalchicomula (6913), Ixtamaxtitlan (6699), Zacatlan (6226), Acatlan (5883), San Juan de los Llanos (5742), Cuetzalan (5176).

Pueblo, a city of Colorado, U.S.A., capital of Pueblo county, on both sides of the Arkansas river, at the mouth of Fountain creek, south-east of the centre of the state, at an altitude of 4656 feet. It is regularly laid out, mainly in the level bottom land of the river, is divided into eight wards, has Holly system waterworks, owned by the city, and is sewered. It is, next to Denver, the largest city in the state, and is an important railway centre, being entered by the Atchison, Topeka, and Santa P4 the Chicago, Rock Island, and Pacific, the Denver and Rio Grande, the Colorado and

Southern, and the Missouri Pacific. In 1900 it contained 241 manufacturing establishments, with a total capital of $12,374,248. They employed on an average 4911 wage-earners, and the product was valued at $30,795,481. Pueblo is the largest smelting point west of Missouri river, and besides smelters and blast furnaces, contains roUing and other mills for the manufacture of iron and brass. The assessed valuation of real estate was, in 1898, $7,980,327, and the net debt was $1,108,052. Population (1880), 3217; (1890), 24,558; (1900), 28,157, of whom 4705 were foreign-born and 1213 negroes.

Pueblo Nuevo del Mar, a seaport of Spain, in the province of Valencia, on the Mediterranean coast to the north of the mouth of the river Guadalaviar, near the Valencia and Tarragona Railway. It has straight, regular, well-built streets, divided in two by the little river Rinet. There is a lighthouse installed in a tower of the church of Los Angeles. The theatre and casino are only used in summer, when the Valencians come down. Population (1887), 11,291; (1897), 13,100, but these figures are much increased from June to September.

Puenteareas, a town of Spain, province of Pontevedra, south-east of Vigo, on the river Tea, in a hilly country abounding in vines, hemp, wheat, rye, oats, orange ftnd fruit, where live stock is extensively reared.*

The industries are porcelain manufactures, tanning, and distilling. The town has a large, handsome square, weU- built streets, good shops, and an old parish church. Close by are the ruins of the castle of Sobroso, that played an important part in mediseval civil wars. Population (1887),

13,286; (1897), 13,342.

Puente Genii, a town of Spain, in the province of Cordoba, on the banks of the Genii. It is on the Cordoba-Malaga line, and is the starting-point of the line to Linares. A bridge joins the lower part of Puente Genii with the higher, built on rising ground extending to the olive groves above. The principal industry is the manufacture of olive oil in eighty mills. There are also flour-mills and hnen factories. The alhoTidiga or permanent market is always well stocked with grain, vegetables, and live stock. The streets and squares are all regular and well built. The suburbs extend far

into the country. There are two large parish churches and several convents, schools for primary and higher education, hospitals, a municipal library, and a theatre. Population

(1887), 11,406; (1897), 11,645.

Puerto CabellO, a town of Venezuela, the third port of the republic, situated on the Caribbean Sea, about 45 miles from Valencia by rail and 65 miles from La Guaira. Population, over 15,000. There are some handsome buildings, among others the custom-house, the city hall, the theatre, the hospital, the railway station, and two churches. In 1900 the port was visited by 267 ships, of 218,788 tons burden. The value of the imports' for the same year was ??340,693, and the exports were : coffee, 12,994 tons; cacao, 455 tons; hides and skins, 1276 tons ; and lumber, 274 tons.

Puerto de Santa Maria, a seaport and town

of Spain, in the province of Cadiz, on the right bank of the river Guadalete, with a station on the railway from Cadiz to Seville. The most important industry is the wine trade, and there are modern glass, liqueur, alcohol, starch, and soap manufactures. There is a bull-ring accommodating 12,000 persons, large markets, town-hall, an iron bridge across the river, and several hospitals. The primary and higher schools are in the hands of the Jesuits. The parish church, begun in the 13th century, was completed in the 17th. It resembles the Seville Cathedral. Population (1877), 22,125; (1897), 20,630.

Puerto Principe, the chief interior town of the province of Camaguey, in Cuba. It was founded by Velasquez, lieutenant of Diego Columbus, governor of Hispaniola, in 1515, and claims to be the most Creole of Cuban towns. It stands upon a plain about midway between two coasts, and is connected by rail with Xuevitas to the north-east. Population (1899), 25,102.

Puerto Real, a town of Spain, province of Cadiz, to the north of San Fernando, at the end of the Bay of Cadiz, with a station on the line from Seville to Cadiz. It is a bathing resort in summer. The port has good quays, a dry dock of the Spanish Transatlantic Company, connected with

their important works, and safe anchorage close to the wharves for the largest steamers. The town has fine squares, and broad, well-built streets, a noble town-hall, many schools, a bull-ring, fine promenades, several convents, and a parish church that is a good specimen of architecture of the 16th century, with three naves and a remarkable atrium. The industries are important, and there is an active trade in wine and oils. Puerto Real was founded in 1488 by Ferdinand and Isabella. Population

(1897), 9772.

Puket, known to the Chinese as Tongka, the capital town of the island of Junkseylon and the chief Siamese

port on the west coast of the Malay Peninsula. It is situated on the eastern side of the island, in 7❖❖54′ N. and 98❖❖24′ E. It is the residence of the chief commissioner of the west coast, and has a population, chiefly Chinese, of about 20,000. The town may be briefly described as a gigantic tin-mine. The output declined, owing to a variety of causes, during the ‘nineties, and may be stated at from 2000 to 3000 tons annually. The improvement in the price of tin and the lowering of the royalty demanded by the Siamese Government, assisted by the establishment of a branch office of the Mining Department in the place, should all tend to restore the former prosperity of the port.

PulkOVO (Pulkowa), a village of Russia, in the province and 10 miles from the city of St Petersburg. It contains the Pulkovo Observatory, on a hill 248 feet Mgh, consisting of a main building, with several towers for various instruments, and a special small observatory for the officers of the Qeodetical Section of the General Staff Academy. (See Obseevatoey in the ninth edition of this work for an account of the instruments.) Attached to the university there is a library of 15,000 volumes and 20,000 pamphlets. Sixteen volumes of ” Observations ” and about 600 separate works have been published by the Observatory since its foundation.

Pulley BlOCki ⁇⁇⁇ Pulley blocks are now very generally made of metal, the block being built up of light steel or wrought iron stampings bolted together, and the sheaves being of cast iron or steel, or of bronze in the smaller sizes.

In order that the sheaves may turn freely on the pin and not heoome set hard by corrosion, they should, if made of iron or steel, have an inner bearing surface or "bush" of bronze. Although hempen rope may he and is used with metal pulley blocks, steel wire rope frequently takes its place, and tliis conduces to a farther reduction in the weight of the block. Hempen ropes are, however, generally used when hand power is applied directly to the rope, as wire rope is not suitable for handling. A very effective pulley tackle is known as the differential pulley or "Weston's pulley." It depends for its efficiency on the mechanical principle inrolved in the old Chinese windlass. Chains are necessarily used with this tackle in place of rope, both for the sake of handling' and to prevent the chain from slipping and the load from falling. The sheaves of the upper and lower blocks are recessed to suit the links of the chain. The two sheaves of the upper block are fixed together and turn as one ; these sheaves slightly differ in diameter, so that one sheave may have one more recess for a link thah the other. The chain, passing over the larger sheave of the upper block, is led through the sheave of the lower block, returned in the opposite direction over the smaller sheave of the upper block, and the free ends connected together. From this arrangement it results, that if by means of the free end of the chain the sheaves of the upper blocks are revolved once, the chain is wound on the large sheave a,nd off the small sheave, the load at the same time being lifted an amount equal to half the difference. This pulley block is largely nsed in factories and workshops, and generally for lifting loads of a few tons. Its chief defect lies in the tendency of the chains to kink and jam the pulleys, and this has led to the introduction of other devices for weight lifting. Conspicuous among these is an arrangement of tackle in which the upper sheave is rotated by a worm and worm wheel, the lifting chain passing from an upper sheave to the pulley block below, from which it is returned and made fast to the upper block. The worm of the worm wheel is turned by a hanging chain which passes loosely over a wheel in the worm shaft. Tackle of this kind sometimes has the upper sheaves actuated by an epicyclic train of toothed

wheels. All the above devices possess the great advantage of holding the load in suspension, but in consequence they necessarily work with much frictional loss. (g. H. Ba.)

Puiitna,n, formerly a town of Cook county, Illinois, U.S.A., now a part of Chicago. It was built entirely by the Pullman Car Company, and was composed of the car-shops and homes of the employes. The company owns all the property, and formerly exer- cised jurisdiction over it. In many respects it was a

model town, with excellent municipal institutions. The population has never been separately returned by the census.

PulSZky, Franz Aurel (1814-1897), Hun- garian politician and author, was born on the 17th of September 1814, at Eperjes. After studying law and philosophy at the high schools of his native town and J\liskolcz, he travelled abroad. England particularly at- tracted him, and his fascinating book, Aus dem Tagebach eines in Grossbritannien reisenden Ungarns (Pesth, 1837) gained for him the membership of the Hungarian Academy. Elected to the Eeichstag of 1840, he was in 1848 appointed to a financial post in the Hungarian Government, and was transferred in like capacity to Vienna under Esterhazy. Suspected of intriguing with the revolutionists, Pulszky fled to Budapest to avoid arrest. Here he became an active member of the Committee of National Defence, and when obliged to fly the country he joined Kossuth in England and with him made a tour in the United States of America. He was condemned to death (1852) in con- tumaciam by a council of war. In 1860 he went to Italy, took part in Garibaldi's expedition to Aspromonte (1862), and was interned as a prisoner of war in Naples. Amnestied by the Emperor of Austria in 1866, he returned home and re-entered public life ; was from 1867-76, and again in 1884, a member of the Hungarian Eeichstag, joining the D^ak party. In addition to his political activity, he was president of the literary section of the Hungarian Academy, and director of the National Museum at Budapest, where he became distinguished for his archeeological researches. He employed his great influence to promote both art and science and Liberal views in his native country. He died on the 9th of September 1897. Among his literary works must be

mentioned Die Jacobirier in Ungarn (1887), Ideen zwr Philosophic der Geschichte Ungarns and Eletem es Levrom (4 vols.,

1882).

Pu4tusk, a town of Russian Poland, in the govern- ment of Warsaw, 56 miles south-west of iomza and 36 miles from Ostrolenka railway station, on the right bank of the Narew. It is well built, and has woollen, linen, and hosiery mills, copper works, and potteries. Population (1897), 15,878.

Punjab, The (^a'?y-a6 = " five rivers"), a province of British India, under the administration of a lieutenant- governor. It includes three classes of native states : (1) a number of old rajput principalities in the Himalaya, some of which are very small ; (2) a collection of scattered states in the eastern plains, mostly under Sikh rulers ; and (3) the Mahommedan state of Bahawalpur, running along between the river Sutlej and Eajputana. Kashmir is ex- cluded from the Punjab, as being in direct political relations with the Governor-General. Total area (including native states), 148,966 square miles. Total population (1891), 25,130,127; (1901), 26,888,300. The capital is Lahore. In November 1901 the area of the Punjab was reduced by the creation of the North- West Frontier province.

Populatimi. ??? The table on next page gives the area and popula- tion of the Punjab, according to the census of 1891 and that of 1901. Between 1881 and 1891 the rate of increase was 10-71 per cent, for British districts and 10-42 for native states, and between 1891 and 1901, 7-6 per cent, for British districts ami 4-1 per cent, for the native states. In both cases the highest rate of increase was to be found in the western plains and in the submontane tracts, where irrigation has been most extended. In the eastern plains, where population is already dense, the increase has been less. The average density in British districts is 173 persons per square mile, ranging from 633 in Jullundur and 620 in Amritsar to only 74 in the Derajat. Classified according to re- ligion, in British districts only, Jlahommedans in 1891 numbered 11,634,192, or 55-8 per cent, of the population, being proportion-

PUNJAB

Area ami Population of the Punjab, 1891 atid 1901.

British Territory. |

1

Area in Square Miles.

Number of

Towns and

Villages

(1891).

Population,

1891.

Population, 1901.

Density of

Population to

Square Mile

(1891).

Divisions.

Districts.

Total.

Males.

Females.

Total

Delhi . . -!

Jullundur

Lahore .

L

Rawalpindi . –

Derajat . Peshawar

Delhi

Gurgaon

Karnal

Hissar

Rohtak

Umballa

Simla

1,290 1,984 2,440 5,163 1,797 2,754 102

702 1,167 938 967 483 2,114 160

638,689 668,929 683,718 776,006 590,475 1,033,427 44,642

371,529 390,219 479,157 418,029 333,590 451,768 26,210

317,450 355,658 404,300 363,546 297,121 364,342 14,143

688,979 745,877 883,457 781,575 630,711 816,110 40,353

495 337 280 150 329 375 437

Jullundur Hoshiarpur . Kangra . Ludhiana Ferozepore

Lahore .

Amritsar

Gurdaspur

Multan .

Jhang

Montgomery

Lyallpur .

Rawalpindi Jhelum . Gujrat . Shahpur . Gujranwala Sialkot .

Dera Ismail Khan . Dera Ghazi Khan . Bannu . Miizaffargarh .

Peshawar Hazara . Kohat .

15,530

6,531

4,435,886

2,470,502

2,116,560

4,587,062

286

1,433 2,244 9,574 1,453 4,302

1,223

2,097

778

858

1,527

907,583 1,011,659 763,030 648,722 886,676

497,018 525,502 399,282 369,546 524,519

420,878 463,674 369,020 303,956 433,699

917,896 989,176 768,302 673,502 958,218

633 451 80 446 206

19,006

6,483

4,217,670

2,315,867

1,991,227

4,307,094

222

3,678 1,601 1,889 6,079 5,871 5,754

1,522 1,036 2,242 1,397 800 1,867

1,075,379 992,697 943,922 631,434 436,841 499,521

635,768 560,186 510,155 388,569 200,470 248,903 454,278

520,780 463,716 430,440 321.979 178,330 214,682 338,388

1,156,548 1,023,902 940,595 710,548 378,800 463,585 792,666

292 620 500 104 74 87

24,872

8,864

4,579,794

2,998,329

2,468,315

5,466,644

184

4,844 3,995 2,051 4,840 3,017 1,991

1,688 971

1,338 705

1,188

2,202

887,194 609,056 760,875 493,588 690,169 1,119,847

415,151 300,276 390,161 273,530 409,898 574,010

364,929 293,742 361,877 251,042 346,851 510,505

780,080 594,018 752,038 624,572 756,749 1,084,515

183 152 371 102 229 562

20,738

8,092

4,560,729

2,363,026

2,128,946

4,491,972

220

9,440 5,606 3,847 3,422

766 655 472 699

486,201 404,031 372,276 381,095

283,342 242,800 212,882 220,263

244.363 202,363 190,190 185,480

527,705 445,163 403,072 405,743

52

72

97

111

22,315

2,592

1,643,603

959,287

822,396

1,781, 6S3

74

2,444 2,991 2,771

690

1,288

297

703,768 516,288 203,175

427,518 379,826 122,378

358,888

330,842

95,796

786,406 710,668 218,174

288

173

73

8,206

2,275

1,423,231

929,722

785,526

1,715,248

173

Baluoh Trans-frontier .

Total British Territory Native States

5

5,934

58,978

40,803

99,781

110,667

34,842

20,866,847

12,095,711

10,353,773

22,449,484

188

38,299

20,115

4,263,280

2,417,932

2,020,884

4,438,816

111

G

rand total

???

148,966

54,957

25,130,127

14,513,643

12,374,657

26,888,300

173

ately more numerous than in any other part of India except Sind and Kashmir. They are found chiefly along the valley of the Indus, where they represent immigration from Afghanistan. In the neighbourhood of the old Moghul capital of Delhi they form only 23 per cent. Hindus numbered 7,743,477, or 37 per cent., being most numerous in the hills and along the Jumna. In the native states the proportion rises to 58 per cent. Sikhs numbered 1,389,934, or 6 '6 per cent., being most numerous in the neighbour- hood of Amritsar and Ferozepore, but they nowhere form as much as one-third of the inhabitants. Since 1881 they have increased more rapidly than the general population, except in the native states, where they show an actual decrease. But the distinction between a Sikh and a Hindu Jat is not very easy to determine. Buddhist and Jains numbered 45,245, or '2 per cent., of whom the Buddhists are to be found almost entirely in Kangra, and the Jains in the eastern plains. Christians

numbered 63,587, or ‘3 per cent., of whom 30,839 were Europeans and 3111 Eurasians, leaving 19,637

for native converts, chiefly in the districts of Sialkot, Gujranwala, and Gurdaspur. “Others” numbered only 412, aborigines not being distinguished in the Punjab census.

Afiricullui-i’. ❓❓❓ Out of a total area of 70,718,720 acres, the area assessed to land revenue is 49,598,193 acres, at the average rate of a little more than 8 annas (say 8d.) per acre. In 1897-98 the total cultivated area was 18,515,957 acres, of which 8,720,408 acres were irrigated from canals and wells in almost equal pro- portions. The principal crops are wheat, millet, pulse, barley, maize, oil-seeds, rice, cotton, and sugar-cane. In 1897-98 the area uniler indigo was 94,615 acres, chiclly in Multan and Muzaffargarh ; the area under tea was 10,064 acres, almost entirely in Kangra. Irrigation has been greatly extended. Perhaps the most im- portant work of this kind in India is the Chenab canal, which has altogether changed the face of the Rechna Doab, a thirsty upland tract between the Ghonab and the Ravi. An elaborate system of colonization has been successfully introduced, and rail-

way extension has proceeded at the same time. During the five years between 1893 and 1898 the area irrigated from the Chenab canal rose from 157,197 to 810,000 acres. A new district has thus been created, with its headquarters at Lyallpur, called after a late lieutenant-governor. The entire canal system of the Punjab consists of 3323 miles of main channels and 8089 miles of dis- tributuries, upon which Es.8,90,93,ay0 has been expended, yield- ing a net revenue of Rs.95,29,130, or 10‘7 per cent, on the capital outlay.

Iiiduslries. ❓❓❓ The Punjab possesses no great industries, like the cotton of Bombay or the jute of Bengal. There are four cotton mills, at Dellii and Lahore, with 406 looms and 46,932 spindles, employing 2014 persons, of whom 1656 are adult males. The out-turn in 1897-98 was

more than 6 million Xb of yarn, chietly of counts between Nos. 11 and 17, and 1 million lb of woven goods, chiefly dhutis, T- cloths, and grey goods. There is also one woollen mill at Dhariwal, with 128 looms and 4320 spindles, employing 834 persons, and producing 700,000 lb of goods, valued at Es.8i3,550. There are seven breweries, mostly at hill stations, the oldest of which dates from 1852, witli a total out-turn of about 24 million gallons of beer. Coal is mined for railway purposes at two places in the salt range in Jhelum district. In 1898 the total output was 85,862 tons, valued at Es.7, 18,950, and the number of persons employed was 1803. The development of both collieries is hindered by the difficulty of procuring labour. Factories for cleaning and pressing cotton are numerous. There are flour-mills at Delhi, carpet factories at Amritsar, and a sugar factory at Gurdaspur. The Punjab is well supplied with railways, which have their central terminus at Delhi. One main line of the North-Western runs from Umballa through Lahore and Rawal- pindi to Peshawar, on the extreme frontier ; another main line runs from Lahore to Multan, and thence to the sea at Karachi ; while a third will run along the left bank of the Indus, from Attock southwards. From Delhi to Umballa there are two lines, one of tlie North- Western through Meerut and Saharanpur in the North- West Provinces, and a more direct one of a company, which is continued to Kalka, at the foot of the hQls, whence a further continuation to Simla is under eonstraction. The south- east of the province is served by two branches of the Rajputana system, which have their termini at Delhi and Ferozepore ; and also by the Southern Punjab, which runs from Delhi to Bhawalpnr. The total length of railways in British districts is about 2000 miles.

The foreign trade is registered with six countries ??? Tirah, Kabul, Bajaor, Kashmir, Ladakh, and Chinese Tibet. The total value of both imports and exports is about Es.2,50, 00,000, of which more than half belongs to Kashmir. The chief imports are ghi (clarified butter), timber, wool, charas (an intoxicating preparation of hemp), fruits, rice, and skins. The chief exports are cotton piece-goods, cotton twist and yam, sugar, tea, salt, indigo, brass, and copper. The internal trade with other provinces of India is valued at about Es. 12,00, 00, 000 for imports and Es.8,00,00,000 for exports. Almost the whole of this is oondnoted by rail, the river-borne trade on the Indus having dwindled to only Rs.l 0,00, 000 for imports and

Es. 40,00,000 for exports. The wheat trade is almost entirely conducted by rail with Karachi, and depends upon the demand in Europe. It is liable to great fluctuations, the quantity exported in 1897-98 being more than double that in the preceding year.

The administration is conducted by a lieutenant-governor, who is appointed by the governor-general, subject to the approval of the Crown. The secretariat consists of a secretary, a junior secretary, and two under secretaries. Two financial commis- sioners take the place of the board of revenue in most other provinces. A survival of the " non-regulation " system is to be found in the title of deputy-commissioner for the district ofiicer elsewhere called collector. The highest judicial authority is styled the chief court, now consisting of six members, which corresponds to the high court elsewhere. A legislative council of nine nominated members, of whom four are natives of India, was created in 1897 ; but the privileges of interpellation and of discussing the financial statement have not yet been extended to the council. The province is distributed into six divisions or commissionerships and thirty-one districts. Most of the com- missioners also exercise political functions over the native states within their jurisdiction. In 1897 the total number of police of all kinds was 19,506, of whom just half were provided with fire- arms. The number employed on police duty proper was 7938, being one policeman to every 13 '9 square miles of area and to every 2628 of population.

In 1897-98 the total revenue of the province amounted to Ex.3, 916, 031, of which Ex. 2, 438,671 was derived from land. The total civil expenditure amounted to Ex.2,023,821, the whole of which was covered by profits from railways and irrigation. Since the reorgRnization of the Indian army in 1894 the Punjab has formed an independent command, under a lieutenant-general, with headquarters at Murree, a hill sanitarium not far from the

great military station of Eawalpindi. The command consists of three first-class districts (including the Punjab frontier force) and two second-class districts. Tlie Punjab frontier force is composed of five batteries of artillery, four legimentsof cavalry, and nine regiments of infantry ??? ail natives. The remaining native regiments letaiu their former numbers

in the Bengal army. In 1898 the Punjab command consisted of 20,337 British and 46,232 native troops; total, 66,569. In addition, there were three battalions of volunteer rifles, with an enrolled strength of

2020.

The total number of municipalities is 148, with an aggregate population of 2,120,372 (1891). In the majority of these at least two-thirds of the municipal committee are elected by the ratepayers, who take considerable interest in the privilege. At the contested elections iu 1897 more than half the ratepayers voted. The total number of members is 1671, of whom 1546 are Indians, and 816 are elected. In 1897-98 the aggregate; municipal income was Es.44,22,324, of which Es.31,41,078 was derived from taxation, chiefly octroi, the average incidence of taxation being E.1.7.6 per head. The aggregate expenditure was Es.43,96,972, of which Es.l8, 76,462 was devoted to public health and convenience, Es.6,71,420 to public safety, and Es. 5, 98, 4 99 to education. The aggregate amount of debt out- standing was Es. 37,14,738, chiefly raised by the four municipalities of Lahore, Delhi, Simla, and Dera Ghazi Khan. In every district except Simla there is a district board, and in most of the districts there are also subordinate local boards ; out of a. total of 2494 members, 1153 are elected. The district boards, on the whole, work satisfactorily ; but the local boards are of little use. In 1897-98 the total local fund income was Es.31, 23,315, ??f which Es. 24, 09, 900 was derived from provincial rates. The total expenditure was Es.31, 12,528, of which Es.8,57,438 was devoted to public works, Es.6,64,651 to education, and Es.4,03,418 to medical and sanitary charges.

JSducation. ??? The following table gives the chief statistics of education for the two years 1886-87 and 1896-97 :???

Class of Institution.

1886-87.

1896-97.

Schools.

Pupils.

Schools.

Pupils.

Colleges

Secondary schools . Primary schools Special schools Private institutions

Total .

5

245

1,934

19

16,527

509 44,808 89,702

995 145,145

10

346

2770

18 5363

1,409

61,128

119,046

2,155 82,184

18,730

281,159

8507

265,922

The totals in this table are misleading, for they include private: institutions, such as Koran schools attached to mosques, which are specially numerous, but cannot be said to give any valuable instruction. As a matter of fact, schools under the Education Department, and particularly those which teach English, have progressed more rapidly than in any other province. The pupUs. in them have increased during the flve years ending 1897 by no less than 31 per cent. , while students in arts colleges have nearly doubled. Including private institutions, the proportion of male pupils to the estimated male population of school-going age (IS' per cent, of the total male population) is 14 '5 per cent., compared with 22 '3 per cent, for India generally. The proportion of female pupils is 1'5 per cent., compared with 2 '3 per cent, for India generally.

The following table gives the expenditure on education according to sources for the same two years : ???

Source of Eevenue.

1886-87.

1896-97.

Provincial revenues ....

Local funds

Municipal funds

Fees

Other sources

Total .

Es.

7,47,746 4,89,269 3,06,270 2,48,951 4,64,927

Es.

7,27,394 6,41,001 3,37,203 7,98,590 5,68,526

22,57,163 30,72,714

The increase in expenditure has fairly kept pace with the increase in pupils ; but during the last few years almost the whole of the increase has been borne by fees, which now con- tribute no less than 26 per cent, of the total. In secondary schools alone the proportion ri.ses to 60 per cent., and in colleges to 43 per cent. This is another indication of the extent to which English education has been accepted by the people. The Punjab University, which was founded in 1882, differs from other Indian

universities in being more than ⬛⬛⬛⬛⬛ merely examining body. It is Tesponoible fur the management of the Oriental College at Lahore, and it takes a part in the improvement of vernacular literature. It also coiiducts Oriental examinations side by side with those in English, and has been the first to introduce a series of examina- tions in science from matriculation to the degree, as well ^ as a, final school examination in clerical and commercial subjects. During the five years ending 1897 the total number of students who matriculated was 4397 ; 437 graduated B.A. and 51 M.A., while 34 passed examinations in law and 181 in medicine.

The Punjab has not altogether escaped recent visitations of plague and famine. Plague, fortunately, never spreads in an epidemic form, being

almost entirely confined to a few villages in Jullundur district, where it persisted for more than a year. The total number of deaths from plague throughout the province from October 1897 to April 1899 was 1920. In the winter of 1901-02 a severe outbreak of plague occurred, causing as many as 2000 deaths in a week. The famine of 1896-97 was most severely felt in the Delhi division, and especially in Hissar district adjom- ing the desert of Rajputana, where at one time 15 per cent, of the inhabitants were in receipt of relief. For the provmce generally the maximum number on relief was 127,758 in the middle of March 1897. The total expenditure was Rs.22,34,004. The famine of 1899-1900 was more mdely spread, but was again most severe in Hissar, where the cattle died in hundreds through scarcity of fodder. The maximum number on relief in May 1900 was 180,000 in British districts and 50,000 in native states.

(j. S. CO.)

Punta, Arenas, a town of Chile, capital of the territory of Magallanes, situated in 53 10′ S. and 70 54′ "W. Population (1895), 3227. The estimated population in 1900 was 6419. It is the only free port in Chile. It has grown with phenomenal rapidity ; a few years ago a poor village, it has now fine buildings, broad streets, is lighted by electricity, and bids fan? to become a large city. Its principal commerce is in wool, skins, beef (salted and dried), lard, and tallow. Numerous steamers belonging to European hnes touch there monthly. A highroad 170 kilometres in length joins the town to the Argentine colonies of Gallegos and Santa Cruz.

Puri, or Jagannath, a town and district of British India, in the Orissa division of Bengal. The town is on the seacoast, and has a railway station. Population (1881), 22,095 ; (1891), 28,794. As containing the world-famous shrine of Jagannath, Puri is perhaps the most holy and most frequented of all Hindu places of pilgrimage. Sanitation is effected by the Puri Lodging-House Act, which provides for the appointment of a special health officer, and for the licensing of lodging-houses both in the town and along the pUgrims' route. It has a high school, with 159 pupils, a literary club, and a students' association.

The district of Pitki has an area of 2473 square miles ; popula- tion (1881), 888,592; (1891), 944,998; (1901), 1,017,286, showing an increase of 6 per cent, between 1881 and 1891, and of 7 ‘6 between 1891 and 1901 ; average density, 411 persons per square mile. Classified according to religion, Hindus in 1891 numbered 927,514 ; Mahommedans, 15,597 ; Christians, 841, of whom 41 were Euro- peans ; ” others,” 1046. Land revenue and rates (1897-98) were Ks.6, 58,825; number of police, 388; boys at school (1896-97), 22,310, being 31 ‘3 per cent, of the male population of school- going age ; registered death-rate (1897), 39 per thousand. In the Orissa famine of 1866 more than one-third of the population of Puri is said to have perished. The district suffered from drought in 1897, but it is now protected by the East Coast Railway, which was opened throughout from Calcutta to Madras in 1891, with a branch to Puri town.

Purnea., a town and district of British India, in the Bhagalpur division of Bengal. The town is on the left bank of the little river Saura, with a railway station. Population (1881), 15,016 ; (1891), 14,555. It has a bad reputation for fever. The high school had 249 pupils in 1896-97, and there is a technical school with 15 pupils.

The district of Pitrnea has an area of 4993 square miles. Popu- lation (1881), 1,849,073; (1891), 1,944,658; (1901), 1,877,072, showing an increase of 5 per cent, between 1881 and 1891, but a decrease of 3‘5 per cent, between 1891 and 1901 ; average density, 376 persons per square mile. Classified according to religion, Hindus in 1891 numbered 1,138,738; Mahommedans, 805,267;

Christians, 387, of whom 114 were Europeans; “others,” 266. Land revenue and rates (1897-98) were Rs.12,80,230 ; number of police, 570; boys at school (1896-97), 20,035, being 13-4 per cent, of the male population of school-going age, compared with 28 ‘3 per cent, for Bengal generally ; registered death-rate (1897), 32 per thousand. Jute is grown to some extent, but the principal industry is indigo. There are 7 indigo concerns and 14 factories, with a capital of Rs. 13, 45, 000, employing 8000 persons, with an out-turn of 5000 maunds, valued at Rs.9,00,000. The district is traversed by two branches of the Eastern Bengal Railway,

running out north, and a third branch, parallel to the Ganges, is under construction.

Puruiia., a town of British India, headquarters of Manbhum district in Bengal, situated in 23 19' N. and 86 24' E., with a station on the Bengal-Nagpur Kailway. Population (1881), 9805; (1891), 12,128. It is a grow- ing centre of trade, with large imports of rice during the scarcity of 1896-97, and has a high school, with 339 pupils in 1896-97.

PuruS. See Amazon.

Putnam, a town and included city of Windham county, Connecticut, U.S.A It has an area of 27 square miles of hiUy country, situated in the north-eastern part of the state. The city of Putnam is on the Quinebaug river, at the intersection of two branches of the New York, New Haven, and Hartford Kailway, and at an altitude of 287 feet. In 1900 it contained 93 manu- facturing establishments, with a capital of .$2,019,685, 1631 employes, and products valued at .$1,928,803. Popu- lation of the town (1880), -5827; (1890), 6512; (1900), 7348 : of the city in 1900, 6667, of whom 2012 were foreign-born and 81 negroes.

Putney, a district in the county of London, in the borough of Wandsworth (to which parliamentary division it has since 1885 belonged), on the right bank of the Thames about 8 miles above London Bridge by river, with a station on the South- Western EaUway. In 1890 a new cemetery was opened to meet the needs of the district. Population (1881), 13,221,; (1891), 17,771;

(1901), 24,139.

PutumayO. See Amazon.

Puvis de Chavannes, Pierre C^cile

(1824-1898), French painter, was born at Lyons, 14th December 1824. His father was a mining engineer, the descendant of an old family of Burgundy. Pierre Puvis was educated at the Lyons College and at the Lyc6e Henri IV. in Paris, and was intending to follow his father's

profession when a serious illness interrupted his studies. A journey to Italy opened his mind to fresh ideas, and on his return to France he announced his intention of becoming a painter, and went to study first under Henri Scheffer, and then under Couture. On leaving this master in 1852, he established himself in a studio in the Place Pigalle (which he did not give up till 1897), and there organized a sort of academy for a group of fellow-students who wished to work from the living model. Puvis first exhibited in the Salon of 1850 a "Pieta," and in the same year he painted " Mademoiselle de Sombrenil drink- ing a glass of blood to save her father," and " Jean Cavalier by his Mother's Deathbed," besides an " Ecce I Homo," now in the church of Champagnat (Sa6ne-et- Loire). In 1852 and in the two following years Puvis's pictures were rejected by the Salon, and were sent to a private exhibition in the Galeries Bonne-Nouvelle. The public laughed at his work as loudly as at that of Courbet, but the young painter was none the less warmly defended by Th^ophile Gautier, and Banville. For nine years Puvis was excluded from the Salons. In 1857 he had painted a " Martyrdom of St Sebastian," " Meditation," "Village Firemen," "JuUe," " Herodias," and "Saint

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P U Y, L E

97

Camilla " ??? compositions showing a great variety of impulse, still undecided in style and reflecting the influence of the Italian masters as well as of Delacroix and Couture. In 1859 Puvis reappeared in the Salon with the " Eeturn from Hunting " (now in the Marseilles Gallery). But not till he produced "Peace" and "War" did he really impress his critics, inaugurating a vast series of decorative paintings. For these two works a second-class medal was awarded to him, and the State ofiered to purchase the " Peace." Puvis, not choosing to part the pair, made a gift of " War " to the State. He then set to work again, and in 1864 exhibited "Autumn" and " Sleep," but found no purchasers. One of these pictures is now in the Lyons Museum, and the other at Lille. " Peace " and " War " were placed in the great gallery of the Museum at Amiens, where Puvis completed their effl'ect by painting four panels : a " Standard-Bearer," "

Woman Weeping over the Ruins of her Home," a " Reaper," and a "Woman Spinning." These works were so much admired that further decorations were ordered for the same build- ing, and the artist presented to the city of Amiens " Labour " and " Repose," for which the municipality could not afford to pay. At their request Puvis undertook another work, intended for the upper landing of the stair- case, and in 1865 a composition entitled " Ave Picardia Xutrix," allegorical of the fertility of the province, was added to the collection. In 1879 the city wished to complete the decoration of the building, and the painter, again at his own expense, executed the cartoon of " Ludus pro Patria," exhibited in the Salon of 1881 and purchased by the State, which at the same time gave him a commis- sion for the finished work, which gained for the artist in the following year the first-class medal of the Society of French Artists. While toiling at these large works, Puvis de Chavannes rested himself by painting easel pictures. To the Salon of 1870 he had sent a picture called " Harvest," a work introductory to his paintings in the Picardy Gallery ; the " Beheading of John the Baptist " figured in the Great Exhibition of 1889; a "Magdalen" is in the collection of M. CMramy (Paris). Then followed " Hope" (1872), the "Family of Fisher-Folk" (1875), and "Women on the Seashore " (1879). StiU, these canvases, however interesting, are not to be named by the side of his grand decorative works. Among these must be noted those in the Palais Longchamp at Marseilles. These two paintings, ordered in 1867, represent "Marseilles as a Greek Colony " and " Marseilles, the Emporium of the East." After these, Puvis executed for the town-hall of Poitiers two decorative paintings of historical subjects : " Radegund, in seclusion at the convent of Sainte-Croix, afibrds a refuge to poets," and " Charles Martel, in the year 732, saves Christendom by defeating the Saracens at Poitiers." The Pantheon in Paris also possesses a decor- ative work of great interest by this painter : " The Life of Saint Genevieve," treated in three panels. In the first we lee the saint's childhood, and in the second and third her life as a shepherdess, the two being surmounted by a frieze, also divided into two subjects. In 1876 the Department of Fine Arts in Paris gave the artist a commission to paint " Saint Genevieve giving Food to Paris " and " Saint Genevieve watching over Sleeping Paris " (see Plate), in which he gave to the saint the features of Princess Canta-cuzene, his wife, who died not long before he did. At the time of his death

* After completing the first paintings in the Pantheon, which occupied him for three years and eight months, Puvis de Chavannes undertook to paint the stair- case leading to the gallery of fine arts in the Lyons Museum, and took for his subjects the " Vision of the Antique," a procession of youths on horseback, which a female figure*

standing on a knoll points out to Pheidias; the "Sacred Grove " ; and two allegorical figures of " The llh6ne " and " The Sa6ne." It was in the same mood of inspiration by the antique that he painted the hemicycle at the Sorbonne, an allegory of " Science, Art, and Letters," a work of great extent, for which he was paid 35,000 francs (= 1400). In this he has symbolized Eloquence, Philosophy, History, Geology, Mineralogy, and Physics with wonderful artistic feeling and sense of decorative treatment. At the Hotel de Ville in Paris, again, Puvis decorated the grand staircase and the first reception-room. These works employed him from 1889 till 1893. In the reception-room he painted two panels: "Winter " and " Summer," the mural paintings on the staircase, which had previously been placed in the hands of Baudry and of Delaunay, are devoted to the glory of the attributes of the city of Paris ; " Patriotism," " Charity," "Artistic Gifts," " Learning," "Wit," "Fancy," "Beauty," "Courage," "The Worship of the Past," " Industry," " Urbanity," and " Poetry." On the ceiling we see Victor Hugo offering his lyre to the city of Paris. The pictures in the Rouen iluseum (1890-92) show a different vein, and the artist's power of conceiving and setting forth a plastic scheme enabling him to decorate a public building with beautiful human figures and the finest Hues of landscape. He took for his theme the three sections of the museum : " Antiquities," " Ceramics," and " The Fine Arts," entitling his allegory " Inter Artes et Naturam." We see here toilers raising a colossal mono- lith, part of some ancient monument, to add it to other architectural pieces ; then the busy scene of a pottery ; and finally artists painting in the open air. Puvis, as a rule, adhered to the presentment of the nude or of the lightest drapery; here, however, in response to some critical remarks, he has clad his figures exclusively in modern dress. The importance given to the landscape in this work is also worthy of note ; it is broadly treated, and in a purely decorative manner. Nor was it for France alone that Puvis de Chavannes executed decorative works. After

prolonged negotiations, begun so early as in 1891, -n-ith the trustees of the Boston Library, U.S.A., he accepted a commission to paint nine large panels for that building, to be inserted in separate compartments, three facing the door, three to the right, and three to the left. These pictures, begun in 1895, were finished in 1898. For the centre panel, to which the others are subsidiary, he chose as the title ” The Inspiring Muses hailing the Herald Genius of Light.” In the eight others we find ” Bucolic Poetry,” “Dramatic Poetry,” “Epic Poetry,” “History,” “Astron- omy,” ” Physics,” and ” Chemistry.” In these works of his latest period Puvis de Chavannes soars boldly above realistic vision. In the figures which people the walls with poetic images he endeavours to achieve originality of the embod)dng forms, and at the same time a plastic expression of ideas born of a mind whose conceptions grew ever loftier, while yet the artist would not abandon the severe study of nature. Such works as the great paintings at Amiens, Rouen, Marseilles, the Pantheon, the Sorbonne, and the Hotel de Ville are among the most important productions of French art in the 19th century. Puvis de Chavannes was president of the National Society of Fine Arts (the New Salon). His principal pupils and followers are Ary Renan (died 1900), Baudouin, J. F. Auburtin, and Cottet.

See also A. Michel. “Exposition de M. Puvis de Chavannes,” Gazette des Beaux Arts. Paris, 1888. ◆◆◆ Marius Vachox. Puxis de ChavanTies. Paris, 1900. ◆◆◆ J. BuissoN. ” Puvis de Chavannes, Souvenirs Intimes,” Gazette des Beaux Arts. Paris, July 1899.

(h. Fk.)

Puy, Le, or Puy-en-Velay, chief town of department Haute-Loire, France, 313 miles south-south-east of Paris,

on the railway to St Etienne. It contains the Montredon asylum for the departments of Loire and Haute-Loire, an institution for deaf mutes,

municipal industrial schools of drawing, architecture, and mathematics applied to arts and industries, and schools of lace -making for poor children. About ninety establishments are engaged in the manufacture of lace and guijrare, and there is a noted distillery. Electric tramways connect the town with Brives – Charensac and Espalay – St – Mareil. Population

(1881), 15,459; (1891), 16,640; (1901), 20,570.

Puy-de-Dotne, a department of central France, traversed by the mountains Dore, D6me, and Du Forez, and watered by the Allier.

Area, 3090 square miles. The population, 566,064 in 1881, had decreased to 529,181 in 1901. Births in 1899, 9821, of which 396 were illegitimate; deaths, 10,785; marriages, 3872. There were, in 1896, 1371 primary schools, with 79,000 pupils, there being 4 per cent, of the population illiterate. Out of 1,672,190 acres of land cultivated in 1896, 834,860 acres were plough-land and 106,210 acres vineyards. Of the rest two-sevenths were wood land and five-sevenths grassland. The department in 1899 produced wheat valued at ––780,000 ; rye, ––520,000 ; barley, ––166,000 ; oats, ––278,000 ; potatoes, ––544,000 ; mangold-wurzel, ––96,000 ; beetroot, ––72,000 ; vines, ––304,000. Its live stock included 15,910 horses, 265,110 head of cattle, 352,040 sheep, 132,100 pigs, and 18,580 goats. Mining in 1898 turned out 384,000 metric tons of coal, valued at ––160,000 ; 750 tons of peat, 1324 tons of lead and copper, and 10,000 tons of alum and bitumen. The metallurgic industry is, however, in a backward state. The well-known cutlery of Thiers employs (1896) 12,000 workmen. Much is done in sugar- refining at Billom, and there is a busy industry in caoutchouc around Clermont-Ferrand, the capital (52,017 in 1901).

Pwllheli, municiiJal and contributory parliamentary borough (Carnarvon district), seaport, and market -town of Carnarvonshire, AVales, 20 miles south of Carnarvon, on the shore of Tremadoo Bay, with a terminal station on the Cambrian Kailway. It has a sandy beach 4 miles in extent. There is a promenade near the sea, and the scenery around is very

picturesque. Stone obtained from Gimlet Rock is worked into setts and shipped to various ports. Population (1891), 3231; (1901), 3675.

Pyrenees, a range of mountains in south-west Europe, separating the Iberian peninsula from France. The more careful examination of the chain by members of the English and French Alpine Clubs has considerably modified our views with respect to its general character, the southern versant having been shown to be the more important of the two. It has been recognized, as shown in the maps of Mil. Schrader, de St Sand, and Wallon, that, taken as a whole, the range must be regarded, not as formed on the analogy of a fern-frond or fish-bone, ???n-ith the lateral ridges running down to the two opposite plains, but rather as a swelling of the earth's crust, the culminating portion of which is composed of a series of primitive chains, which do not coincide with the line of partition of the water, but cross it obliquely, as if the ground had experi- enced a sidewise thrust at the time when the earth's crust was ridged up into the long chain under the influence of contraction. Both the orderly arrangement of these diagonal chains and the agreement which exists between the tectonic and geological phenomena are well shown in the geological and hypsometrical maps published in the Annuaire du Club Alpiii fran^ais for 1891 and 1892 by it.M. Schrader and de Margerie. The primitive forma- tions of the range, of which little beyond the French portions had previously boon studied, are shovm to be almost all continued diagonally on the Spanish side, and the central ridge thus presents the appearance of a series of wrinkles with an inclination (from north-west to south- east) greater than that of the chain as a whole. Other less pronounced wrinkles run from south-west to north-east and intersect the former series at certain points, so that it

is by alternate digressions from one to the other series that the irregular crest of the PjTenees acquires its general direction. Far from having impressed its own direction on the orientation of the chain at large, this crest is merely the resultant of secondary agencies by which the primitive mass has been eroded and lessened in bulk; and though its importance from a hydrographic point of view is still considerable, its geological significance is practically nil.

In their primitive state the Pyrenees were composed of syn- clinal and anticlinal folds, slightly inclined, as a rule, to the general direction of the range, and to be distinguished even at the present day in a long series of valleys which follow each other in a longitudinal direction. But the waters, in their descent from the higher ground in a north and south direction to the plains of France and Spain, have attacked these folds successively, forming, in course of time, transverse watercourses which, broadly speaking, follow the line of greatest inclination in their descent. These watercourses, which must originally have been formed of a chain of lakes and swamps at varying altitudes, united by cascades, have gradually worn down the sills which obstructed their passage, and made their way to the plains by valleys which have become more and more deep and regular. This is how, at least on the French side, the mountains eventually acquired the character of transverse chains running down from a central dividing crest. In Spain, where the lesser humidity of the atmosphere has allowed the primitive folds to retain more of their original foi-m, these may be traced, in spite of the fluvial erosion, to right and left of the principal valleys, which have been merely cut by running water, as by a saw, across the mass of the range.

This mass of ancient formations, with the associated Silurian rocks, constitutes almost the whole of the slopes on the side of France, where the ridges pushed farthest into the plain have lost all importance, or in certain cases have entirely disappeared under the action of erosion. The case is quite different in Spain. On this southern slope the central mass is separated from the plains by two very distinct lines of high ground, which are a char- acteristic feature of the Pyrenean structure. These are the zone of plateaux and that of the sierras which separate the central mass of the range from the plains at . its foot. The zone of plateaux forms a sort of basement, which fringes and supports the more elevated portions. Its maximum elevation scarcely exceeds 1000 metres (3280 feet), and it presents a succession of broad syn- clinal depressions, in which Tertiary (Miocene and Oligocene) formations, the most recent of the whole range, occupy the surface. This zone does not sink directly towards the plains. It is bordered on the outer side by high chains of sierras with anticlinal strata, which rise at certain points to a height of over 6500 feet, and which enclose the whole Pyrenean region with no further break than the

narrow clefts which give passage to the running waters. The plateaux region ??? completely unfaiown but a few years ago ??? thus presents the appearance of a great longitudinal lake, whose waters have been drained off by a series of breaches in the outer wall.

In the zone of the sierras denudation has continued to act until it has exposed on the summits the most ancient rocks, which have been shorn of their Tertiary covering. They have, however, re- tained their character of longitudinal folds, parallel to the direction of the central mountains. Those which extend farthest towards the plain have been tilted up so that they rise above the latter in a steep escarpment. Originally the French side had also its plateaux and sierras, but the only traces which remain are in the region of the Corbi^res and the Lesser Pyrenees of the Ariege, the more active denudation nearer the ocean having removed them entirely down to the level of the plains, from before the western Pyrenees.

The arrangement of the Pyrenees in chains, gently inclined near the centre but longitudinal everywhere else, is brought out better still by observing the courses of the streams which flow down towards Spain. On the French side most of the longitudinal valleys have disappeared ; and this is why the range has so long been described as sending out transverse spurs, the more important slope remaining unknoOTi. It is, however, still possible to distinguish some traces of this formation towards the east, where atmospheric denudation has been less active. On the south the principal streams, after cutting their wny through the highest zone at right angles to the general direction of the range, become involved half-way to the plains in great longitudinal folds, from which they make their escape only after traversing long distances without finding an outlet.

The unexpected importance shown by recent investigations to attach to the Spanish versant has greatly modifled the values assigned only a few years back to the area and mean elevation of the Pyrenees. Instead of the 13,440 square miles formerly put down for the former, M. Schrader has obtained a value of 21,044 square miles in the light of our later knowledge. Of this total

6390 square miles fall to the northern slope and 14,654 square miles ??? i.e., more than double ??? to the southern, the difference being mainly due to the zone of plateaux and sierras. The mean elevation, estimated by Elie de Beaumont at 1500 metres (4900 feet), has been sensibly diminished by the addition of that zone to the system, and we must now put it at only 1200 metres (3930 feet) for the range as a whole. We thus see the important part played by the above-mentioned plateaux of small elevation in a chain whose highest summit reaches 11,167 feet, while the passes show a greater altitude than those of the Alps. (y. son.)

PyreneeS-BclSSeS, a department in the extreme south-west of France, traversed by the Pyrenees, which separate it from Spain, and washed by the Atlantic.

Area, 2978 square miles. The population, 434,366 in 1881, had decreased to 423,164 in 1901, a decrease due to emigration. In 1899 the births numbered 9542, of which 590 were illegitimate ; deaths, 7988 ; marriages, 2738. There were in 1896, 1168 schools, with 59,000 pupils, as many as 9 per cent, of the population being illiterate. The area under cultivation in 1896 comprised 1,113,970 acres, of which only 380,380 acres were laid out in plough-land and 49,400 in vines. The wheat grown in 1899 was valued at ??536,000 ; maize, ??600,000; potatoes, ??56,000 ; natural pastures, ??444,000 ; vines, ??372,000 ; chestnuts, ??78,000. The live stock numbered in 1899, 25,240 horses, 14,530 asses, 155,800 head of cattle, 410,960 sheep, 130,700 pigs, and 14,300 goats. The department in 1898 raised 720 metric tons of peat, 1920 tons of copper and iron, and 16,750 tons of rock-salt. The alimentary industries are especially developed, Pau, the capital, had in 1901, 34,692 inhabitants ; Bayonne, 27,601.

Pyrenees – Hautes, a department of south- western France, traversed by the Pyrenees, which divide it from Spain, and watered by the Adour and the Gave de Pau.

Area, 1750 square miles. The population, 236,474 in 1881, had declined to 212,173 in 1901. Births in 1899, 3969, of which 290 were illegitimate ;

deaths, 4342 ; marriages, 1406. There were in 1896, 856 primary schools, with 30,000 pupils, 3 per cent, of the population being illiterate. Out of a total of 674,310 acres culti- vated in 1896, 271,700 acres were plough-land and 34,580 acres vineyards. The wheat grown in 1899 was valued at ––308,000 ; meslin, ––64,000; oats, ––56,000; maize, ––144,000; potatoes, ––88,000; natural pastures, ––440,000; vines, ––106,000; walnuts, ––24,000. The live stock included (1899) 17,400 horses, 13,000 asses, 121,770 cattle, 364,800 sheep, and 81,000 pigs. Peat is cut, and there are marble quarries. Industry is in a backward state. Tarbes, the capital, had in 1901, 26,055 inhabitants.

Pyrenees-Orienta.les, a department of the

south of France, resting on the chain of the Pyrenees, and washed by the Mediterranean.

Area, 1599 square miles. The population, 208,585 in 1881, was 209,447 in 1901. Births in 1899, 4864, of which 211 were ille- gitimate ; deaths, 4195 ; marriages, 1670. There were in 1896, 479 schools, with 33,000 pupils, 4 per cent, of the population being illiterate. Tlie area under cultivation in 1896 amounted to 537,405 acres, of which 154,552 acres were arable and 131,594 acres were in vines. The department in 1899 raised wheat valued at ––64,000 ; rye, ––108,000; oats, ––56,000 ; maize, ––48,000 ; potatoes, ––164,000. The vintage of 1899 was valued at ––2,250,000. The department also raised in 1898, 489 cwts. of silkworm cocoons. Its live stock (1899) included 11,270 horses, 23,020 cattle, 364,800 sheep, 81,000 pigs, and 7000 goats. The mining of 1898 turned out 1750 tons of lignite and 32,000 tons of iron. The industries in metals produced 125 metric tons of cast-iron and 208 tons of iron, totalling the value of ––4000. Perpignan, the capital, had in 1901, 36,157 inhabitants.

PyrgfOS, a town of Greece, in the province of Elis and Achaia, 43 miles south-south-west of Patras. It is the second town in importance in the Peloponnesus, and is connected with its harbour, Katakolon, 7^ miles distant, and also with Patras and Olympia, by rail. It has frequently been injured by earthquakes. Population

(1896), 12,705.

Pyrites. ❓❓❓ MineralogicaUy this word is used to denote either a group of metallic sulphides or else cubic iron pyrites ; miners use the term rather loosely to indicate mineral matter the bulk of which consists of sulphide of iron, which may be either true iron pyrites, FeSj, or

magnetic pyrites, Fe^Sg, or both. Iron pyrites is one of the most widely distributed of metallic minerals, and occurs in deposits of all kinds ; it is sometimes, e.g., in coal seams, an injurious impurity, whUst in other cases it may be the main object of exploitation. Pyrites is largely worked for the sake of the sulphur it contains, and is used in sulphuric acid manufacture. The material thus employed may be a pure iron pyrites in the sense of containing no other metal except iron, its value then depending wholly on the pro- portion of sulphur it contains. Pyrites low in sulphur is incapable of sustaining its ovm combustion without the aid of an external source of heat, and 45 per cent, of sulphur is, for economic reasons, usually looked upon as the lowest admissible for sulphuric acid manufacture. It is also important fpr this purpose that the ore should be as free as possible from arsenic.

The world's annual production of iron pjrrites (that is, of pyrites valuable mainly as a source of sulphur) is about 1,000,000 tons. The largest producer is France, with over 300,000 tons ; the greater part of this (about 250,000 tons) comes from the Sain Bel mines in the department of the Khone, not far from the historic copper mines of Chessy, where the deposits are in the form of large veins and of beds of mica schist highly impregnated with pyrites. Spain produces annually about 200,000 tons of iron pjrrites, used merely as a source of sulphur, whUe the mines in the famous Huelva district produce chiefly copper pyrites ❓❓❓ i.e., iron P5T:ites containing a small amount of copper, the latter probably existing as disseminated chalcopyrite. Pyritic ore free from copper is also exported from the same region ; for example, the Aguas Tenidas pyrites is practi- cally free from copper, and is especially valuable on account of its freedom also from arsenic. Germany produces about 135,000 tons of iron pyrites, by far the greater part of which is derived from mines near Meggen on the river Lenne, where the ore occurs in lenticular veins

intercalated between Upper Devonian shales. In many of the deposits of cupriferous pyrites in various parts of the world, certain portions which are found to be too poor to be worth treating for copper are sold as ordinary pyrites, in spite of their containing small amounts of copper. Great Britain produces about 12,000 tons of pyrites annually.

A most important group of deposits widely distributed throughout the world is that of cupriferous iron pyrites, usually spoken of commercially as copper pyrites ; these are characterized by consisting mainly of iron pyrites with notable amounts of copper, sometimes silver and gold, and frequently the sulphides of lead and zinc in small pro- portions. The form of the deposits is generally lenticular, and they usually occur in or near the contacts of various eruptive rocks with schists or slates : there is much reason for supposing that the presence of the eruptive rocks is in some way connected genetically with the existence of these deposits. Among the best known are those already men- tioned in the Huelva district of the south-west of Spain, extending also into Portugal, of which the Eio Tinto mines are the most famous, including also Tharsis, Catania, Santo Domingo (in Portugal), &c.; the Eammelsberg mines in the Harz Mountains ; Agordo and Montecatini in Italy ; Szomolnok in Hungary ; Eoros, Vigsnas, and Sulitjehna in Norway; Falun.in Sweden; Betts Cove, TUt Cove, 'and Little Bay in Newfoundland; Ducktown in Tennessee; Sudbury in Canada, where the deposit is remarkable for containing a large proportion of magnetic pyrites and for its richness in nickel ; and Mount Lyell in Tasmania. The products of these deposits are treated for the most part as ores of copper, no attempt being made in many cases to utilize their sulphur contents. At Eio Tinto the ore is divided into three classes : ??? (1) The poorest, containing 2 per cent.

of copper, averaging, say, 1| per cent., is treated locally by leaching \vitli water and liquor containing ferric sulphate ; by this means the copper is gradually dissolved, and is precipitated by means of pig iron ; the residue is exported and sold as ordinary iron pjrrites. (2) Export ore, containing between 2 and 5 per cent, of copper, in which the sulphur, copper,

precious metals, and iron are aU utilized, the residual oxide of iron after extraction of the other ingredients being sold under the name of ” purple ore.” (3) Smelting ore, which averages about 6 per cent, of copper, and is smelted after partial calcination, pro- ducing a matte with 30 to 35 per cent, of copper.

In some places the modern process of pyritic smelting is being introduced; it consists of smelting p3rrites in a shaft furnace by means of a heated air blast, little or no carbonaceous fuel being used. The heat evolved by the oxidation of the greater portion of the iron and sulphur is sufficient to smelt the remaining iron, sulphur, and copper to a matte, whilst the oxide of iron formed combines vrith

sUica to form a slag. (For the further treatment of the matte so formed see Copper.)

AuTHOEiTiES. ◆◆◆ VoGT. ‘ ‘ Ueber die Kieslagerstatten vom Typus Roros,” &c. Zeitsch. f. prakt. Oeol., 1894; “Das Huelva-Kiesfeld,” &c. Zeitsch. f. prakt. Geol., 1899. ◆◆◆ GoNZALO Y Takin. Descripcion fisica, geologica y minera de la Provincia de Huelva. Madrid, 1888. ◆◆◆ De Launat. ” Memoire sur Findustrie du ouivre dans la region d’Huelva.” Annales des Mines, 1889. ◆◆◆ Phillips and Louis. A Treatise on Ore Deposits. London, 1896. (h. l.)*

Pyriti, a tovrai of Prussia, province of Pomerania, 16 miles south -south ~~west of Stargard by the railway to Kiistrin. It is still surrounded by a mediaeval wall with towers, and has two parish churches. Close by is the fountain (1824) in which Otto, bishop of Bamberg, baptized the iirst Pomeranian converts to Christianity in 1124. Excellent wheat is grown in the vicinity. Popu~~ lation (1900), 8188.

Pyrometry. See Thermometby.

Quain, Sir Richard, 1st Baronet (1816-1898),

Irish physician, was born at Mallow-on-the-Blackwater, Co. Cork, on 30th October 1816. He received his early education at Cloyne, and was then apprenticed to a doctor in Limerick. In 1837 he entered University

College, London, where he graduated with high honours as M.B. in 1840, and as M.D. (gold medal) in 1842. Six years later he was chosen an assistant physician to the Brompton Hospital for Diseases of the Chest, and with that institu- tion he retained his connexion until his death, first as fuU physician (1855) and subsequently as consultant. He became a fellow of the Koyal College of Physicians in 1851, and filled almost every post of honour it could offer except the presidency, in the contest for which he was beaten by Sir Andrew Clark in 1888. He became physician-extraordinary to Queen Victoria in 1890, and was created a baronet in the following year. He died in London on 13th March 1898. Quain, who was elected a fellow of the Koyal Society in 1871, was the author of several memoirs, dealing for the most part with disorders of the heart, but his name will be best remembered by the Dictionary of Medicine, the preparation of which occupied him from 1875 to 1882 (2nd edition, 1894; 3rd, 1902). He sat on the Royal Commission on Rinderpest (cattle plague) in 1865. He was a cousin of Jones Quain (1796-1865), the author of Quain's Elements of Anatomy, and of Richard Quain, F.R.S. (1800-1887), who was president of the Royal College of Surgeons in 1868, and left ►►75,000 to University College, London, with which the Quain professorships of botany, English language and literature, law, and physics were endowed. A half- brother of the two last, the Hon. Sir John Richard Quain (1816-1876), was appointed a judge of the Queen's Bench in 1871.

Quakers.►►► Since 1886 the Society of Friends has increased in numbers and has shown many signs of vigorous life. In constitution there has been Kttle change, save in the position of women, who are now accorded an equal rank with men at all deliberative meetings. The society has been actively interested in questions of peace, slavery, and temperance, and has been ready to express its interest by financial help, as in the case of the Douk- hobors. Foreign missionary work has grown apace, and the Home Mission Committee (established 1882, and now consisting of 96 members) is actively engaged in evan- gelistic labour in England. The Quakers' interest in

careful religious education is as strong as ever, and the secular training in their schools is well abreast of modern requirements. In 1895 a

conference was held at Man- chester, for the discussion of Biblical criticism and kindred topics, and has been followed by ” Summer Schools ” in theology. On the whole, this period has been one of growing interest in evangelization and in the conditions of modern life and culture.

In 1900 there were in Great Britain 17,153 members and 7921 ad- herents ; in Ireland, 2609 members ; in U.S.A., 93,000 “Friends “; in Australasia, about 500 ; in Europe, about 200.

There are 79 missionaries (men and women) in India, Syria, China, Ceylon, Madagascar ; memhers, 3149 ; adherents, 14,377 ; children in schools, 21,145 ; medical patients tteatesi, 24,299. Mada- gascar had in 1898 about 400 churches and stations, while India came next with about 23. (a. e. N.)

Quarantine. ❓❓❓ The last vestige of the British quar- antine law was removed by the Public Health Act, 1896, which repealed the Quarantine Act, 1825 (with dependent clauses of other Acts), and transferred from the Privy Council to the Local Government Board the powers to deal with ships arriving infected with yellow fever or plague, the powers to deal with cholera ships having been already transferred by the Act of 1875. The last incident under the old law was in June 1889, when the s.s. Xeva arrived at Southampton from Brazil, having had two deaths from yellow fever on the voyage : the ship, crew, and numerous passengers were detained at the Motherbank for six days. There had been no case of a plague ship for many years ; but, by a singular coincidence, two or more cases of plague arrived in the Thames (and died in hospital near the docks) in the very weeks of 1896 in which the change to the new system was impending. The great endemic centre of plague in Bombay, which has arisen since 1896, has brought that disease once more to the front as the principal object of quarantine measures. The exist- ing regulations are those of 9th November 1896, issued by the Local Government Board under ❓❓ 130 of the Public Health Act of 1875 (extended and amended) ; they apply to yellow fever, plague, and cholera. Officers of the Customs, as well as of Coast Guard and Board of Trade (for signalling), are empowered under Acts of 1889 and 1896 to take the initial steps. They certify in writing the master of a supposed infected ship, and detain the vessel provisionally for

not more than twelve hours, giving notice meanwhile to the port sanitary authority. The medical officer of the port boards the ship and examines every person in it. Every person found infected is certified of

the fact, removed to a hospital provided (if his condition allow), and kept under the orders of the medical officer. If the sick cannot be removed, the vessel remains under his orders. Every person suspected (owing to his or her immediate attendance on the sick) may be detained on board forty-eight hours, or removed to the hospital for a like period. All others are free to land on giving the addresses of their destinations to be sent to the respective local authorities, so that the dispersed passengers and crew may be kept individually under observation for a few days. The ship is disinfected, dead bodies buried at sea, infected clothing, bedding, &c., destroyed or disinfected, and bilge- water and water-ballast (subject to exceptions) pumped out at a suitable distance before the ship enters a dock or basin. Mails are subject to no detention. A stricken ship within 3 miles of the shore must fly at the main a yellow and black flag borne quarterly from sunrise to sun- set. In 1895 thirty-one vessels arrived infected with cholera at three British ports, from none of which did disease spread ashore. In 1897 a troopship with plague on board arrived at Portsmouth, and landed her 1200 troops accord- ing to the above rules without any infection being con- veyed by their dispersal.

International Conventions. ❓❓❓ Since 1852 eight conferences have been held between delegates of the Powers (see Hygiene), with a view to uniform action in keeping out infection from the East and preventing its spread within Europe ; all but the last of these (1897) were occupied with cholera. No result came of the four earlier (Paris 1852, Constantinople 1866, Vienna 1874, and Eome 1885), but each of the subsequent four has been followed by an international convention on the part of nearly one-half of the Powers represented. The general effect has been an abandonment of the high quarantine doctrine of ” constructive infection ” of a ship as coming from a scheduled port, and an approximation to the principles advocated by Great Britain for many years. The principal

States which retain the old system are Spain, Portugal, Turkey, Greece, and Russia (the British posses- sions Gibraltar, Malta, and Cyprus being under the same influence). The aim of each international sanitary con- vention has been to bind the Powers to a uniform minimum of preventive action, vnth further restrictions permissible to isdividual States. The minimum is now very nearly the same as the British practice, which has been in turn adapted to Continental opinion in the matter of the importation of rags. The Venice convention of 1892 is on cholera by the Suez Canal route ; that of Dresden,

1893, on cholera within European countries ; that of Paris,

1894, on cholera by the pilgrim traffic ; and that of Venice, 1897, on plague from the East, both by the ordinary traffic and by the pilgrim traffic.

The international agreement as it now stands may be summarized as follows : ???

General Traffic from the East. ??? Ships arriving at Suez are classified indemnes, suspects, or infeelis, according as they have had no cases (cholera or plague) on the voyage, or have had such cases, or have such on arriTal. All arrivals from an infected port are detained for an examination to be made within forty-eight hours. In practice the difference between indemne and suspect is not clearly drawn. Ships which have had cases on the voyage enter the Canal "in quarantine," i.e., with guards on board to prevent com- munication with the shore, and under restrictions as to piloting and coaling ; they remain in the state of " quarantine " ten days from the last case (being the incubation period of plague, that of cholera being five days), and may be detained in actual quarantine at Brindisi, Naples, Marseilles, Plymouth, &c., if the ten days have not run out on the voyage thither. Ships with actual cases on board at Suez are treated like suspect ships, after landing their sick and those who had been in immediate attendance on them, the period " in quarantine " counting from the time the sick were put ashore. The crew and passengers of a ship in any of these classes are subject further to a "quarantine of observation" at the port of arrival ; but instead of this the British practice of

taking the addresses of dispersing passengers and crews is admis- sible as a minimum, and has been adopted at Marseilles in the case of clean ships from in fected ports.

Pilgrim Traffic. ??? There is now an inspection at the port of departure. Under the convention this should be done among the pilgrims on shore, but it is not usually practicable until they are on board. The cubic space for each pilgrim on the main covered deck is increased to 16 square feet. The ship is to report the state of health on arrival at Aden, where the British Government has provided for the landing of sick pilgrims. Turkey has reduced the period of detention for all pilgrim ships at Camaran to three days, whether infected or not, and has improved the buildings for the reception of parties of pilgrims that must be landed as infected or suspected.

MerchaTtdise. ??? The return of plague has revived the old doctrine of susceptible articles. Under the Venice convention of 1897 it is forbidden to send from an infected country articles of clothing by parcel post. All other postal matter passes unhindered. There is a schedule of articles which may or may not be prohibited from entering, including old and worn clothing and used bedding (but not if they are the passengers' effects), rags, carpets, sacks, human hair, untanned skins and hides, unmanufactured hair and bristles, wools, claws, hoofs, &c. Most of the signatories have used their option to exclude some or all of these articles. The question arose with Great Britain of excluding wool (a large annual shipment) from Bombay and Kuraohee, but it was answered in the negative by the Local Government Board. Where goods are not shut out absolutely they may be subjected to disinfection according to modern methods, which are much more expeditious than the ex- posures and airings for days or weeks under the old quarantine laws. Much that passes under the name of disinfection is mere formality.

Land Quarantine. ??? This is abolished for Europe under the convention of 1897. The practice in India since the outbreak of plague in 1896 has been tentative and various as regards railway and other land traflSo.

In the United States and the Australian states there has been no recent change. The committee of the U.S. Senate on Public Health and National Quarantine, 1898, while approving the system of the marine hospital service by the several states, considers that infection would be kept out more certainly if the exclusive ultimate control were given to one authority, namely, a federal department. Towards the end of the 19th century a project was dis- cussed of federal quarantine for the Australian continent, with suggested stations at Thursday Island, Albany, Adelaide, and Palmerston.

Literature. ??? The arguments in support of the British practice were ably restated by the late Sir R. Thornb Thorne in Report (Medical) of Local Government Board, xxiv. 1892-93. The same writer reports on the Dresden conference in App. 20 of the Report, 1893-94, p. 449. (c. c.)

Quaregrnon, a town of Belgium, in the province of Hainaut, 4 miles west of Mons by rail. There are important coal-mines in the vicinity, and foundries, forges, and tobacco factories in the town. Population (1890),

14,361 ; (1900), 16,033.

Quarryingf. ??? Quarrying is the art of winning or obtaining from the earth's crust the various kinds of stone used in construction, the operation being in most cases conducted in open workings. The term in its primary significance implies the production of material with quadrilateral or rectangular faces, as usually is necessary with building stone, and it is for the extraction of this material that quarrying operations are exclusively conducted. The art was necessarily developed at a remote period of human history ; and the immense blocks of stone which may be seen in the early monuments- of Egypt show that, in results, the ancient inhabitants of that country achieved great success, though their methods were slow and involved much manual labour. In modern times, and especially in countries where manual labour is costly, machinery has been devised to minimize expense.

According to their composition, building stones are broadly classed as granites, sandstones, limestones, and slates. Under the first of these heads is included a num- ber of crystalline rock species, such as granite, syenite,

gneiss,

The methods of quarrying vary with the composition and hardness of the rocks, their structure, cleavage, and other physical properties ; also with the position and char- acter of the deposits or rock-masses. The general purpose

of the work is to separate the material from its bed in masses of form and size adapted to the intended use. The work of cutting the stone to accurate dimensions, dressing, rubbing, and pohshing are g^ ig Ij subsequent operations not involved in quarry- ing. The practice of quarrying consists in uncovering a sufficient surface of the rock by removing superficial soU, sand, or clay, or by sinking a shaft or stope, and then with proper tools and, when necessary, with explosives, detaching blocks of form and size adapted to the purpose in view. Frequently the outer surface of the rock has been afiected by the action of the weather and other atmospheric agencies, so that it has become discoloured or softened by decay. The weathered outcrop of a rock is usually a good index of its future behaviour when used as a building stone ; for one which yields quickly to the action of the sun, rain, and frost in its original mass, cannot be expected to endure when used in construction, unless it is employed solely for interior work. A quarry should, if possible, be opened on a hillside, for in this case it is usually much easier to dispose of the water which necessarily collects in any deep excavation, and which, if drainage by gravity is not afforded, must be removed by pumping, at considerable expense. As it is generally most convenient to operate on a vertical face of rock, the preliminary work of opening a quarry is usually directed toward the production of this result; but ila accomplishment involves the waste of a certain amount of stone, which must be broken into irregular and useless pieces. The separation of blocks of building stone is eiTected ordinarily by drilling holes along the outlines of the block to be removed, and then, by exploding blasting-powder in the holes, or by driving wedges into them, exert- ing suflicient force to overcome the cohesion of the rock and rend it asunder. In many

quarries it is found most con- venient to separate a large mass and afterwards divide it into blocks of the required size. When the rock is stratified, or has an easily determined “rift,” the holes are drilled at right angles to the plane of separation. “When there is no stratification or “rift,” or these natural planes of separation are too far apart, or when the position of the joints is not advantageous, a row of horizontal holes must be drilled into the face or ” breast ” of the quarry, along which separation is efi’ected by the use of wedges. Again, in thinly-bedded sandstones, where vertical joints are frequent, it is often possible to separate the desired slabs and fiagstones with crowbars and wedges, without drilling or the use of explosives. When blasting is neces- sary, some form of gunpowder is generally used, rather than a violent explosive like dynamite, in order to avoid shattering the rock. This, however, applies only to dimen- sion stone. When the production of broken stone for road-making, concrete, or similar purposes is the sole end in view, violent explosives are preferred. In limestones and marbles and in the softer sandstones, channeUing machines, driven by steam, are employed, by which vertical or oblique grooves can be cut with great rapidity to a depth of several feet. A level bed of rock is cleared, and on this are laid rails, along which the machine moves. After the channels are cut, a row of holes is bored per- pendicular to the former at the desired distance below the surface of the bed, and by driving wedges into these the required blocks are separated. When the beds of stone to be quarried are thin, and when to remove the whole of the overlying mass of earth or rock would be too expensive, it is found convenient to treat the quarry as if it were a mine, and to rely upon methods similar to those practised in mining. A horizontal bed of rock is usually opened at its outcrop on some hillside. If this is impracticable, a shaft or stope is excavated to reach it j and if dimension

stone is required, a deep horizontal groove is cut near the top or the bottom of the bed. The quarry face is then divided into blocks by saw-cuts, channels, or rows of drill- noles, and the blocks are separated by wedging or blasting. As the excavation progresses, portions of the rock are left in place as pillars to support the roof. In many localities in Europe where

roofing slate is quarried, it is found in beds dipping more or less from the horizontal. These deposits are worked by stopes which follow the inclination of the bed, from which, at convenient intervals, levels are driven across, to take advantage of the cleavage of the slate. As in other subterranean quarries, pillars of rock are left to support the roof, since artificial supports would be more expensive. At some of the marble quarries in Vermont, U.S.A., where the strata are very nearly vertical, the beds are worked to a great depth with a comparatively small surface opening.

For details concerning English building stones see Ency. Brit. vol. iv. p. 448 and p. 512. For classification of rocks in general see ibid. vol. x. p. 229 et seg. For methods of underground work see Mining, ibid. vol. xvi. See also G. P. Merrill. StoTies for Building and Decwaiion. New York, 1898. ???C. Lb N. Foster. A Text-Book of Ore and Stone Mining. London and Philadelphia, 1894. ???0. Herrman. Steinbruehindustrie und Steinbrnchcjeoloqie. Berlin, 1899. (p. j. h. m.)

Quatrefages de Br6au, Jean Louis

Armand de (1810-1892), an eminent French natur- alist, whose work ranges over the whole field of zoology from the annelids and other low organisms to the anthro- poids and man. Son of a Protestant farmer who had settled in HoUand before the Revolution, but returned to France on the outbreak of the war between the two countries, he was born at Berthezene, near VaUe- rangue (Gard), on 10th February 1810, and died at Paris on 12th January 1892; studied medicine at Strasbm-g, where he took the double degree of M.D. and D.Sc, one of his theses being a TMorie d'un Coup de Canon (November 1829) ; next year he published a book, Sur leg A^rolit/ies, and in 1832 a treatise on L'extraversion de la Vessie. Removing to Toulouse, he practised medicine for a short time, without neglecting the natural sciences, and there con- tributed various memoirs to the local Journal de MMecine and to the Annales des Sciences Naturelles (1834???36). But being unable to continue his researches in the pro- vinces, he resigned the chair of zoology, to which he had been appointed by the minister, d' Salvandy, and in 1839 settled in Paris, where he found in Milne-Edwards a patron and a friencL Elected

professor of natural history at the Lycde NapoMon in 1850, he became a member of the Academy of Sciences in 1852, and in 1855 was called to the chair of anthropology and ethnography at the Mus^e d'Histoire Naturelle. Other distinctions followed rapidly, and continued to the end of his otherwise uneventful career, the more important being honorary member of the Royal Society of London (June 1879), member of the Institute and of the Acad^mie de M^decine, and com- mander of the Legion of Honour (1881).

De Quatrefages was an indefatigable worker in all branches of his favourite studies, and amid his professional duties and extensive original research he found time to contribute numerous essays to several scientific periodicals, besides some bulky volumes on various branches of zoology and anthropology, between the years 1840 and 1889. Of these, the more important were : Considerations sur les caracteres zoologiques des rongeurs (1840) ; " De I'Organisa- tion des animaux sans vertebres des C6tes de la Manche " {Annales des So. Nat., 1844) ; "Recherches sur le Systeme nerveux, I'Embryog^nie, les Organs des Sens, et la Circula- tion des Ann^lides " {ibid., 1844-50) ; " Sur les Affinites et les Analogies des Lombries et des Sangsues " {ibid.) ; " Sur I'Histoire Naturelle des Tarets" {ibid., 1848-49). Then

there is the vast series issued under the general title of " Etudes sur les Types Inferieurs de I'Embranchement des Annelds," and the results of several scientific expeditions to the Atlantic and Mediterranean coastlands, Italy, and Sicily, forming a series of articles in the Jievue des Deux Mondes, or embodied in the Souvevirs d'un Naturaliste, 2 vols. (1854). These were followed in quick succession by the Physiologie Compar^e, Metamorphose de V Homme et des Animaux (1862); Les Polyiidsiens et lewrs Migrations (1866); Histoire Naturelle des Annelds Marins et de I'eau douce, 2 vols. (1866); La RocJielle et ses Environs (1866) ; Rapport sv/r les Progres de I' Anthropologic (1867) ; Gh. Da-)~win et ses Pr^curseurs frMir.ais (1870), a study of evolution in which the writer takes somewhat the same attitude as A. R. Wallace, combating the Darwinian doctrine in its application to man ; La Race

Prusienne (1871); Crania Ethnica, jointly with Dr Hamy, 2 vols., with 100 plates (1875-82), a classical work based on French and foreign anthropological data, analogous to the Crania Britannica of Thurnam and Davis, and to Morton's Crania Americana and Crania jEgyptiaca ; UEspece Humaine (1877); Nouvelles Etudes sur la Dis- tribution Geographique des Nigritos (1882); Hommes Fossiles et Hommes Sauvages (1884); Histoire Oinirale des Races Humaines, 2 vols. (1886-89), the first volume being introductory, while the second attempts a complete classification of manldnd.

De Quatrefages was an accurate observer and unwearied collector of zoological materials, gifted with remarkable descriptive power, and possessed of a clear, vigorous style, but somewhat deficient in deep philosophic insight. Hence his serious studies on the anatomical characters of the lower and higher organisms, man included, will retain their value, while many of his theories and generalizations, especially in the department of ethnology, are already forgotten. Even his fellow-worker, Dr Hamy, has given up the view that the cradle of mankind is to be sought in the Arctic regions ; and the astonishing expansion given to the primitive Negrito peoples and to the Norse element in North America are no longer taken seriously. Indeed, his whole scheme of classification must be regarded as a failure, and has not been accepted by any leading systematist.

(a. h. k.)

Quebec, a province of Canada, bounded on the E. by Labrador and the Gulf of St Lavsrence ; on the S. by Chaleur Bay, New Brunswick, and the United States; on the S.W. and W. by the Ottawa river and Ontario ; and on the N. by Ungava district.

Rivers. ??? The principal river is the St Lawrence, which flows through the entire length of the province. Its largest tributary ??? the Ottawa ??? 730 miles long, forms the boundary between Ontario and Quebec from the head of Lake Temiskaniing to Point Fortune, and receives several large branches from the Quebec side. There are many affluents of the St Lawrence from the right bank. The Cape Chat, Ste

Anne (de Monts), Magdalen, and York fall into the Gulf of St Lawrence ; the Bonaventure, Cascapedia, Mata- pedia, and Patapedia, into Chaleur Bay ; and the Peribonka, 280 miles, Mistassini, 225 miles, Ashwapmuchuan, Ouiatchuan, and Metabetchouan, into Lake St John. North of the Height-of-Land, the Harricanaw, Nottaway, 450 miles long, with its tributaries the Megiskun, Waswanipi, and Broadback, the Rupert, 260 miles, and East Main, 420 miles, discharge their waters into James Bay, and the Hamilton, 630 miles long, with its southern affluents the Ashuanipi, Attikonak, and Kenamou, into Hamilton inlet.

Lakes. ??? The principal lakes south of the St Lawrence are Cham- plain, Memphremagog, Megantie, Temiscouata, and Matapedia ; between the St Lawrence and the Height-of-Land, Temiskaming, Des Quinze, Expanse, Victoria, Dumoine, Kippewa, Kakabonga, Thirtyone-miles,' Whitefish, Piscatong, Simon, Nomining, Nemi- kachi, Kempt, St John, Pipmaukin, Manuan, Pletipi, Ishimani- l^uagan ; north of the Height-of-Land, Mistassini, 98 miles long and 10 wide and at an elevation of 1350 feet above the sea, Abitibi, Mattagami, Waswanipi, Chibougamau, Obatagamau, Ashuanipi, Attikonak, Menihek, Dyke, and Ossokmanuan.

Olimate. ??? The climate varies from the cold but bracing winters and the long warm summers of the St Lawrence and Ottawa valleys, to the long cold winters and short cool summers of the portion to the north of the Height-of-Land. The following table gives the average temperature and precipitation at a number of places in the southern portion of the province : ???

1

!

Mean Temperature.

a o

‘a

1

Anticosti, “W. pt. Bird Rocks Chicoutirai Quebec Cranbourne Montreal .

49 52′ 47 51′ 48 25′ 46 48′ 46 20′ 45 30′

64 32′

61 08′ 71 05′ 71 13′ 70 43′ 73 35′

ft.

15 106 159 315

187

55‘4 57-2 58-0 61-6 58-2 64-8

12-9

18-4 9-8 14-6 12-6 17-1

36-9

36 -5 38-7

42-3

in.

41-32 27-51 30-33 42-96 46-77 40-20

The normal percentage of bright sunshine at Montreal is 46, a higher average than northern Europe.

Area and Population. The original area included within the limits of the province 228, 900 square miles has been increased

to 339,360 square miles by the extension of the northern boundary. By Order in Council of 8th July 1896 the boundary-line is traced from the intersection of the then western boundary ❓❓❓ produced due north ❓❓❓ with the shores of James Bay, along the shores of the bay to the mouth of the East Main river, thence by this river to its source in Patamisk Lake in approximate 52❓❓ 55' N. and 70❓❓ 42' W., thence by a due east line to the Ashuanipi river, and thence by the Ashuanipi and Hamilton rivers and the undefined western boundary of Labrador to the point of intersection of a meridian line from Anse an Sablou with the 52Qd parallel. The population (1881) was 1,359,027 ; (1891), 1,488,535; (1901), 1,648,898 (824,454 males and 824,444 females), or 4-9 per square mile. The urban population increased from 19-5 per cent, in 1871 to 22-8 per cent, in 1881 ; to 29-2 per cent, in 1891 ; and to 39-8 per cent, in 1901. In 1891 there were 212, 094 engaged in agricultural pursuits ; mining, 1534 ; fishermen, 3433 ; trade and transportation, 50,688 ; manufac- turing and mechanical pursuits, 93,206 ; domestic and personal services, 73,307 ; professional avocations, 16,342 ; and in the non-productive class, 26,396. The chief towns are : Quebec, the capital, population, 68,840 in 1901 ; Montreal, the commercial metropolis of Canada, 267,730 (1901); St Henri, 21,192; Hull, 13,993 (1901); Sherbrooke, 11,765 (1901); St Hyaointhe, 9210; Three Rivers, 9981 ; Valleyfield, 11,055 ; St Louis de Mile End, 10,933 ; St Cunegonde, 10,912 ; Westmount, 8856 ; Sorel, 7057 ; Levis, 7783 ; Lachine, 5561 ; St Johns, 4030 ; St Jerome, 4132 ; Fraserville, 4569 ; Joliette, 4220 ; Lauzon, 3416 ; and Maisonneuve, 3958.

The following table shows the birth-places of the inhabitants of the province in 1901 : ❓❓❓ Canada, 1,560,190 ; England, 20,726 ; Ireland, 14,275 ; Scotland, 7338 ; other British possessions, 2907 : total, 1,605,436. United States, 28,405 ; France, 3181 ; Germany, 1543 ; Russia and Poland, 2670 ; other foreign countries, 7663 : total foreign countries, 43,462. There were 9123 Indians in the province in 1901, as compared with 11,649 in 1892.

Vital Statistics. ❓❓❓ The table below gives vital statistics of the province for the pei-iod 1871-1900 : ❓❓❓

1871.

1881.

-.301.

1900.

Births Deaths Marriages . Still-born, number . ,, ,, percentage

46,286 20,873

Statisti

))

53,013

25,930

cs not coll

>)

3)

55,811 28,164

ected.

53,815

32,778

10,103

1,606

4-9%

Administration. ◆◆◆ The affairs of the province are administered by a lieutenant-governor and an executive council of seven members, with portfolios, the latter being responsible to the Legislative Assembly, which consists of seventy-four members, and to the Legislative Council of twenty-four councillors.

Religion, ◆◆◆ The Roman Catholic Church, the adherents of which form 80-7 per cent, of the population, has nine dioceses, namely, the archbishoprics of Quebec and Montreal, and the bishoprics of St Hyaointhe, Sherbrooke, Valleyfield, Chicoutimi, Nioolet, Rimouski, and Three Rivers. The Church of England has two dioceses, namely, Montreal and Quebec. In 1891 the religious denomina- tions were as follows: ◆◆◆ Roman Catholics, 1,429,260; Church of England, 81,563 ; Presbyterians, 58,013 ; Methodists, 42,014; Baptists, 8480 ; Congregationalists, 5173 ; Adventists, 3079 ; Jews, 7498; other denominations, 11,692; not specified, 2126.

Education. ◆◆◆ In lUOl the Roman Catholic committee controlled

4322 elementary schools, 511 model schools, 139 academies, 2 normal schools, 19 classical colleges, 1 university ◆◆◆ Laval, in Quebec, with a teaching branch at Montreal ◆◆◆ and 3 schools for deaf-nmtes and the blind. The Protestant committee controlled 876 elementary schools, 46 model schools, 29 academies, 1 normal school, 3 colleges, 2 universities ◆◆◆ McGill, in Montreal, and Bishops College, Lenuox-

ville and a school for deaf-mutes and the blind. In addition,

there were 7 schools of arts and manufactures and 4 of agriculture and dairy-farming. The number of pupils in the Roman Catholic elementary schools was 174,613, and average attendance 119,884 ; in Protestant elementary schools, 26,511 pupils and average attend- ance, 18,903 ; pupils in school^ of all kinds, 326,507. There were 1344 school municipalities ; 5595 schoolhouses ; 7087 lay teachers (791 men and 6296 women) ; 4285 teachers in religious orders (1535 males and 2748 nuns). The local contributions amounted to $2,999,804, supplemented by a Government grant of ◆◆241,948; total, $3,241,752.

Finance ❖❖❖ The principal sources of revenue are the subsidy from the Dominion Government and moneys received from the sale of timber limits, fees for liquor licences, &e. The principal items of revenue and expenditure for the year ending 30th June 1901 were as follows : ❖❖❖

Revenue. Dominion subsidies . Woods and forests . Liquor licences Succession duties Law stamps Miscellaneous .

$1,278,987 1,471,004 661,968 163,511 187,721 800,238

Total revenue . ❖❖4,563,432

Expenditure Interest on debt .81,436,510 Justice, administration 531,648 Charities and asylums 389,571 Education . . 451,590 Civil government . 278,307 Miscellaneous . . 1,428,632

Total expenditure 84,516,258

The gross debt in 1901 was ❖❖36,146,873, of which 82,549,214 has been assumed by the Dominion ; other assets, not including public buildings, aggi-egate ❖❖11,364,132, leaving a net debt of

122,233,527.

Minerals and Mining. ❖❖❖ Gold- washing has been carried on in a desultory manner on the Chaudiere river and its tributaries for upwards of sixty years, but the total product only amounts to about $2,000,000. Copper is obtained as a by-product from the pyrites mined in the Capelton district for the production of sulphuric acid. Copper ore has been mined at a number of places in the south-eastern portion of the province, notably at the Harvey Hill and Acton mines. Iron was mined as far back as the latter part of the 17th century. Magnetite and haematite, bog and titanic iron ores are found at many points throughout the province. The production of apatite (phosphate), which in 1891 amounted to 26,591 tons, has dwindled to a few tons. Asbestos of excellent quality is mined in the Thetford, Coleraine, and Danville districts. The total value of the mineral production for 1901 was S3, 640, 000, copper and asbestos being the most important.

Agriculture. ◆◆◆ General agi-icnltnral instruction is given at agri-cultural schools at Oka, Notre Dame du Lao, Compton, and Ste Anne de la Pocatiere ; and there is also a housekeeping school for farmers' daughters at Roberval. Two veterinary schools, attached to McGill and Laval universities respectively, and eleven societies for the improvement of horticulture, receive grants. Subventions are given to the dairy association for the inspection of butter and cheese factories, and to the St Hyaointhe dairy school. There were 452 creameries and 1841 cheese factories in the province in 1901. In 1891 the total acreage occupied was 15,961,763 acres ; improved, 8,670,946 acres; under crop, 5,542,780; in pasture, 3,054,539; gardens and orchards, 73,627 ; and woodland and forest, 7,290,817. There were 174,996 occupiers of lands, of whom 154,227 were pro- prietors, 19,479 tenants, and 1290 employes. In 1899 the total acres^e assessed was 17,110,770 ; value of taxable real estate, $274,719,408 ; value of non-taxable real estate, 837,390,957.

The following are statistics of live stock in the province in 1891 : ◆◆◆ Horses, 345,789 ; working oxen, 49,608 ; milch cows, 546,986; sheep. 722,025 ; swine, 348,397.

Fisheries. ◆◆◆ The fisheries yielded in 1S81 a product valued at .82,751,962 ; 1891, $2,008,679 ; 1900, 81,989,279 ; and in the latter year gave employment to 13,097 men, in 29 vessels and 1483 boats ; capital invested in boats, nets, &c., $830,869 ; fish exported, $515,427. The value of the lobster catch in 1900 was $204,821.

Manufactures. ◆◆◆ The following table gives statistics of the prin-cipal manufacturing industries of the province for the year 1891 : ◆◆◆

Number of

Number of

Value of

Factories.

Employes.

Product.

Saw-mills

1815

13,241

??10,082,891

Leather manufactures

2270

11,863

12,533,531

Flour and grist mills

871

1,628

8,697,483

Tanneries .

354

1,956

5,815,532

Foundries

161

4,107

5,755,124

C’^’-ton mills .

6

3,792

3,656,170

Q U E B E C ⁇⁇⁇ Q U E E N’S COUNTY

105

There were 23,037 industrial establishments, with a total fixed capital of $58,449,404; working capital, S59,841,711 ; hands employed, 117,389 ; wages per annum, 130,699,115 ; raw material used, $85,630,496 ; and a total product valued at $153,255,583.

Exports and Imports. ⁇⁇⁇ The following table gives statistics of exports and imports for the period 1879-99 : ⁇⁇⁇

Exports.

Imports.

Duty.

1879 1889 1899

129,740,512 37,223,605 70,311,571

$30,924,842 49,272,475 72,230,739

$4,733,249 10,408,008 10,002,839

On 1st January 1902 there were 1265 vessels, with a tonnage of 142,664 tons, on the registry books of the province.

Railways. ❓❓❓ In 1901 the total length of the steam railways in the province was 3544 miles, 19 ‘4 percent, of the railway mileage of the Dominion. The principal railway systems in Quebec are the Canadian Pacific, 1017 miles ; Grand Trunk, 446 ; Intercolonial, 452 ; and Quebec and Lake St John, 241. There are 206 miles of electric railways in the province, principally in Montreal and Quebec. (j. WH.)*

QuebeCi the capital of the province of the same name and the third city of Canada, situated on the north bank of the river St Lawrence, in 71❓❓ 12' 19“‘5 W. and 46❓❓ 48' 17" ‘3 N. It is the terminus of the Great Northern, Quebec and Lake St John, Quebec, Mont- morency, and Charlevoix, and Canadian Pacific railways ; and the projected bridge to L^vis, on the south shore, will also admit the Intercolonial, Grand Trunk, and Quebec Central railways. The harbour is spacious and capable of accommodating ships of the largest tonnage, and, with the Louise basin and Lome graving-dock ❓❓❓ the latter on the opposite shore at L^vis ❓❓❓ forms one of the best harbours in America. The Louise basin consists of twin wet-docks and tidal harbours, with areas of 40 and 20 acres respectively, and a minimum depth of 26 feet. The Parliament and departmental building, completed in 1887 at a cost of nearly $2,000,000, is one of the finest build- ings in Canada. It forms a perfect square, each side of which is 300 feet in length, with towers at each angle : statues of Wolfe, Montcalm, Frontenac, de Salaberry, de L^vis, Lord Elgin, and other prominent actors in Quebec history occupy recesses in the front fagade.” It contains an excellent library, and in its vaults are nearly all the original archives of New France prior to the conquest in 1760. The new city hall is a fine building in the Norman style of architecture, and accommodates, in addition to the mayor and civic officials, the recorder’s court and central fire and police station. An electric railway afibrds rapid communication with all parts of the city and vicinity. The total tonnage of shipping entered inwards during the year 1900-01 was 1,326,987 tons; exports, $5,055,336; imports, $6,324,991. Population (1891), 63,090 ; (1901), 68,840. (j. wh.)*

Quedlinburg’, a town of Prussia, province of Saxony, at the north foot of the Harz Mountains, 12 miles by rail south-east of Halberstadt. The municipal museum contains collections of bronze and iron objects, urns,

arms, &c. Here is a monument of the war of 1870-71 (1895), also an allegorical group of peace (1898). Eitter, the geographer (1779-1859), was born in Quedlin- burg. The abbey church was in part rebuilt in 1882. The town is famous for its nurseries and seed farms. Population (1885), 19,323 ; (1900), 23,378.

Queen borOUg'h, a municipal borough and parish in the Faversham parliamentary division of Kent, England, on the Isle of Sheppey, 2 miles south of Sheerness. On the site of the present town stood a town-castle and free borough which Edward III. named Queenborough in honour of his consort, Philippa of Hainault. Before the

Reform Act (1832) the town returned two members to Parliament for a population of 786. By that Act it was disfranchised. In 1890 Portland cement works were built, and there is a large trade in timber. The South-Eastern and Chatham Railway Company have laid down a branch line for their Continental traffic vid Flushing. Continental mails leave twice daily. Population of muni- cipal borough (1901), 1546.

Queen Charlotte Islands. ??? This compact

group lies off the northern part of the coast of British Columbia, and forms part of that province of Canada. It occupies a position similar to that held by Vancouver Island, farther to the south, in regard to the mainland coast and its immediately adjacent islands, but is separated by a somewhat wider sea from that coast. Although the islands promise to become important in the future, because of their excellent harbours, the discovery of good seams of bitu- minous coal (besides the anthracite already known), their abundant timber of certain kinds, and their prolific fisheries, but little settlement or occupation has as yet taken place. The wonderfully productive halibut fisheries of Hecate Strait, separating these islands from the mainland and its adjacent islands, have attracted the attention of fishing companies, and great quantities of this fish are being taken regularly and shipped across the continent in cold storage. The natives, the Haida people, constituted with little doubt the finest race, and that most advanced in the arts, of the entir west coast of North America. They had developed in its highest degree the peculiar conventional art of the north-west coast Indians, which is found in decreasing importance

among the Tshimpsians on the west, the Thlinkeets to the north, and the Kwakiools and other tribes farther south on the Pacific seaboard. The carved totem-posts of the Haida, standing in front of the heavily- framed houses, or at a little distance from them, and constituting mortuary posts upon which the dead were placed, generally exhibited designs treated in a bold and original manner, highly conventionalized, but always recognizable in their purport by any one famUiar with the distinctive marks of the animal forms portrayed. These primitive monuments are now, however, rapidly falling to decay, and the people who erected them are becoming reduced in number and spirit. Native popula- tion of the islands, less than 700.

Queen's County, an inland county of Ireland, province of Leinster.

Pojmlaiion. ??? The area of the administrative county in 1900 was 424,690 acres, of which 127,305 were tillage, 228,397 pasture, 147 fallow, 10,685 plantation, 18,914 turf bog, 4338 marsh, 17,009 barren mountain, and 17,895 water, roads, fenceS) &c. The new administrative county under the Local Government (Ireland) Act, 1898, does not include the portion of the town of Carlow formerly situated in Queen's County. The population in 1881 was 73,124, in 1891, 64,883, and in 1901, 57,226, of whom 29,523 were males and 27,703 females, divided as follows among the different religions: ??? Eoman Catholics, 50,461; Protestant Episcopalians, 5946 ; Presbyterians, 274 ; Methodists, 411 ; and other denomina- tions, 134. The decrease of population between 1881 and 1891 was 11 '27 per cent., and between 1891 and 1901 10 '4 per cent. In 1891 the average number of persons to an acre was -15, and of the total population, 57,142 persons inhabited the rural districts, being an average of 104 persons to each square mile under crops and pasture. The following table gives the degree of education in 1891 : ???

Males.

Females.

Total.

Percentage.

E.C.

Pr.Ep.

Pres.

Meth.

Read and write Read only Illiterate

22,463 3,193 4,552

21,775 3,409 3,755

44,238 6,602 8,307

72-5 12-1 15-4

91-1 4-6 4-3

92-0 2-3 5-7

94-3 2-2 3-5

S. VIII.

14

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QUEENSLAND

[physical chaeacteeistics

The percentage of illiterates among Roman Catholics in 1881 was 22-4. In 1891 there were 10 superior schools, with 360 pupils (Roman Catholics 259 and Protestants 101), and 135 primary schools, with 8811 pupils (Roman Catholics 7648 and Protestants 1163). The number of pupils on the rolls of the National schools on 31st December 1900 was 8825, of

whom 7817 were Roman CathoUcs and 1008 Protestants. The following table gives the number of births, deaths, and man-iages in the years specified : ???

Births.

Deaths.

Marriages.

1881 . 1891 . 1900 .

1327 1311 1119

966 1024 1077

219 232 221

In 1900 the birth-rate per 1000 was 9‘6, and the death-rate 8‘8 ; the rate of illegitimacy was 1‘9 per cent, of the total births. The total number of emigrants who left the county between 1st May 1887 and 31st December 1900 was 56,641, of whom 28,380 were males and 28,261 females. The chief towns in the county, with their populations in 1901, are Maryborough, 2953 ; Mount- mellick, 2751 ; Mountrath, 1304.

Administration. ??? The county is divided into two parliamentary divisions, Leix and Ossory, the number of registered electors in 1901 being respectively 6553 and 6613. The rateable value in 1900 was ??257,111. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises 2 urban and 5 rural sanitary districts.

Agriculture. ??? The following tables show the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900. The figures for 1900 are for the new administrative county.

Wheat.

Oats.

Barley,

Bye,

Beans,

Pota- toes.

Tur- nips.

Other Green Crops.

Meadow

and Clover.

Total.

1881 1891 1895

1900

4419

618

23

206

23,614 21,566 22,670

21,487

21,402 22,592 20,525

19,708

16,656 15,162 14,033

13,189

11,746 12,412 12,496

12,016

8497 8267 3188

3634

68,498 55,941 61,102

67,066

139,831 131,648 134,037

127,306

Inl900 the total value of the cereal and other crops was estimated at ??728,912. The number of acres under pasture in 1881 was 212,281 ; in 1891, 222,241 ; and in 1900, 227,305.

Horses & Mules.

Asses.

Cattle.

Sheep.

Pigs.

Goats.

Poultry.

1881 . 1891 . 1895 .

1900 .

14,824 15,624 17,151

14,400

5533 6318 5961

5913

74,277 86,184 79,590

84,420

74,344 95,095 69,685

74,182

28,021 34,350 31,320

30,053

5162 6250 5014

4577

256,324 288,369 287,893

325,444

The number of milch cows in 1891 was 21,156, and in 1900, 19,888. It was estimated that the total value of cattle, sheep, and pigs for 1900 was ►►1,266,949. In 1900 the number of holdings not exceed- ing 1 acre was 1695 ; between 1 and 5, 1600 ; between 5 and 15, 2238 ; between 15 and 30, 2004 ; between 30 and 50, 1322 ; be- tween 50 and 100, 1213 ; between 100 and 200, 600 ; between 200 and 500, 257 ; and above 500, 36 : total, 10,965. The number of loans issued (the number being the same as

that of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901, was 1126, amounting to ––526,031. The number of loans for agricultural improvements sanctioned under section 31 of the Land Act, 1881, between 1882 and 1901, was 188, and the amount issued was ––14,193. The total amount issued on loan for all classes of works under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1901, was ––164,473.

QUEENSLAND.

I. Physicai, Chaeacteeistics and Statistics.

QUEENSLAND, originally a British colony, and now a state of the Australian Commonwealth, occupies the whole of the north-eastern portion of the Australian continent, and comprises also the islands in Torres Strait. It lies between 10–– and 29–– S., and is bounded on the N. by Torres Strait, on the N.W. by the Gulf of Carpentaria, on the W. by the Northern Territory of South Australia, on the S. by New South Wales, and on the E. by the Pacific Ocean and Coral Sea. It has an area of 668,497 square miles, a coast-line of 2500 miles, is 1250 miles long, and 950 miles i^ide at its widest part.

Glimate. ––– The rainfall varies greatly in different parts, Geraldton on the Johnstone river standing first with an average of 150 inches for the year, Brisbane totalling 51 inches. The smallest occurs in the extreme west, with an average at Winton of 18 inches and at Birdsville of 6 inches. Rain usually falls from December to March, the monsoons producing a wet season during these months with great regularity in the north, and irregularly throughout the rest of the year, according to locality. The central, say from south of Mackay to north of Bundabcrg, is drier than the north, whilst from Bundaberg southwards the rainfall is precipitated at more regular intervals throughout the year. West of the coast rango the rainfall diminishes rapidly and droughts are frequent ; the absence of dew in the western country allows the sun's heat to convert the native grasses into hay, their nutritive qualities being preserved long after all sign of moisture has left. Sheep and cattle live and keep their condition on such food, provided they get abundance of water. The fertility of the soil is

such that two or three good thunder-storms will provide abundance of green grass in a few days. The heaviest losses in stock occur after bush fires have swept off the dry grass. The summer heat is not greater in North Queensland than in the south, but is more constant and lasts longer. West of the coast range the air is dry and hot, and the thermometer rises to 106 ; east of that it rarely exceeds 96 in the shade. The monsoons play an important part in cooling the atmosphere near the coast, and are very regular m the north. The winter climate is perfection, especially in the north, but frosts are

frequent and regular west of the coast range. Ice is cammonly seen at Herberton, 17 S., during winter, and the surrounding highlands are looked upon as the sanatorium of the north. On the Darling Downs frosts are of nightly occurrence. The heat is oppressive during the rains of summer, but manual labour is carried on by miners, timber-getters, stockmen, and labourers of all classes in every part throughout the whole day. Adelaide, Melbourne, and Sydney often show higher temperatures than even the north, and frequently suft'er from hot winds, which are almost unkno^vn in Queensland. The diseases which cause the greatest number of deaths are miasmatic, constitutional, digestive, and respiratory, in the order named, the death-rate for the state for 1900 being 1172 per 1000 inhabitants. The deaths from phthisis are steadily decreasing, and a large sanatorium has been erected at Dalby for the treatment of consumptives, the air there being peculiarly beneficial to such patients. The following are the death-rates per 1000 inhabitants of the principal cities of Aus- tralia : Brisbane, 12-00 ; Sydney, 1274 ; Adelaide, 15-20 ; Perth, 16-36 ; Hobart, 14-03 ; Melbourne, 15-39.

Geology. Queensland may be divided geologically into two great portions, occupying nearly equal areas, and possessing very different physical features. The one extends along the eastern coast from the New South Wales border northwards to the 12th parallel of latitude, with an average width of about 200 miles from east to west. This division also comprises a large area in the north-west portion of the state. In this district occiur the loftiest mountain ranges, the remnants of what was once a high tableland. The rainfall is comparatively large, and the country is well watered and timbered, and in places where the soil is good

it is covered mth dense scrubs. The drainage is eastwards into the Pacific Ocean. This region contains stratified rocks of different ages from the oldest Paheozoio, the exact relation of the older of which has not yet been determined, up to those of recent origin. There are also gi-anites, porphyries, and syenites, partly of plutonic and partly of metamorpliic origin, as well as other inti-usive and interbedded igneous rocks. It is in this division that most of the mineral wealth exists. The other large area is what is known as the Western Interior, consisting almost entirely of the Lower Cretaceous rocks, known as the Rolling Downs formation, overlaid unconformably in places by the Desert Sandstone. This presents a vast area of almost treeless plains, though here and there dense Gidia scrubs exist. The rainfall over this area, more especially in the south-western districts, is very smaU, and consequently the

river beds are generally dry. The want of water renders it im- possible to stock to anything like its full extent some of the very best pastoral land in the state. But this difficulty has been largely overcome in recent years by the tapping of the vast supplies of artesian water contained in these beds. The rivers north of the high open downs about 21►►60′ S. flow north into the Gulf of Carpentaria, while to the south they flow southwards towards the Great Australian Bight.

In the Palceozoic rooks many of the most important gold, silver, tin, and copper fields are situated, amongst which may be mentioned the Croydon, Etheridge, Eidsvold, Charters Towers, and Cape River goldhelds ; Kangaroo Hills and Running Creek sUver and tin fields ; the Herberton, Annan, and Bloomfield tin fields ; and the Chillagoc, Mount Perry, and Peak Downs cojjper fields.

‚SUurian rocks extend westwards from Gloncui'ry to the western border, southwards to below Boulia, and right away to the extreme north-west, with the exception of a mass of strata north and east of Gamooweal

mapped as Devonian (?). In this area are situated the Clonourry, M'Kinlay, and Leichhardt goldfields ; the Clon- curry and Lawn Hill copper fields ; and the rich ironstone deposits of Mount Leviathan and other hills in the neighbourhood of Cloncurry.

The principal area of Middle Devoniam, is in the Upper Burdekin, including the Fanning river, Burdekin Downs, and Broken river. Eocks of this age also occur at Chillagoe ; Eeid's Gap on the Towns- ville-Charters Towers Railway ; south of Clermont ; and at Raglan, and in the neighbourhood of Olsen's Caves, north of Rockhampton. The argentine silver field occurs in a series of slates and schists, &c. , supposed to belong to this formation.

The Fermo – Oarboniferous system includes five formations, namely, the Gympie, Star, and the Lower, Middle, and Upper Bowen formations. The Gympie formation occupies large areas in the south-eastern and north-eastern portions of the state, and consists of sandstones, grits, conglomerates, shales, and slates, which in parts have undergone considerable alteration, together with bedded volcanic rocks. Interbedded volcanic rocks are especially numerous in the type district. The rocks generally dip at a high angle of inclination. They contain a very scant flora represented by Oalamites, Lopidodendron, and fossil wood ; but they have produced the largest fauna of any Queensland rocks. Numerous gold and mineral fields occur in this formation, amongst which may be mentioned : ❓❓❓Goldfields, Gympie, Cania, Raglan, and Calliope, and other smaller fields in the Gladstone district, the Rockhampton fields, the Warwick fields. Mount Shamrock, and Mount Biggenden, Eidsvold, Paradise, the Hodgkinson, Mulgrave, Palmer, and Nebo. Silver, Montalbion, Chillagoe, Dry river, and Sellheim fields. Copper, the Mount Coora mine, Gigoomgan, and Tebar copper mines. Mercury, the Kilkivan mines. Bismuth, Mount Biggenden and Mount Shamrock. Antimony, the North- cote, Mitchell mines. Tin, the Cannibal Creek tin mines. Oohcdt, Mount Coora mine.

There is but little Palaeontologioal evidence for separating the Star beds from the Gympie series. They contain nineteen species

Eeculiar to themselves, and twelve species common to the Gympie eds. They are, however, generally less highly inclined than the latter, and have not been so much disturbed and altered. They are best developed at the follomng places : ??? Near the junction of the Great and Little Star rivers, from which they take their name ; near Dotswood, Keelbottom Creek ; in the neighbourhood of Harvest Home, Lornesleigh, and Mount M'Connell stations, on the latter of which the nearly complete remains of a fish of the

fenus PaliEoniscus was found ; and lastly, a large area of these eds exists in the neighbourhood of Drummond's range on the Central Railway, where numerous remains of the teeth and scales of fish have been discovered. The Lower Bowen formation con- sists of a series of white and yellow sandstones, with beds of conglomerate containing pebbles of quartzite porphyry, the latter being derived from the metamorphic rocks in the vicinity. The lowest beds of this formation consists of volcanic agglomerate seen near the heads of Pelican Creek, south-west of Bowen. This series dips under the bedded trappean rocks of Mount Toussaist. Another area of these rocks occurs north of Mackay. They have here undergone considerable alteration. So far no fossiliferous remains have been found in this formation. The Middle Bowen consists chiefly of alternate white and yellow sandstones, blue and gi-ey shales, and impure arenaceous ironstones. Two seams of coal, known as the Kennedy and Garrick seams, have been met with near Pelican Creek in this series. The Middle Bowen series is mainly marine, although it contains in parts a land flora. Seams of coal occur on the Dawson river both north and south of the railway line, and quite recently a seam of very good coal, 9 feet thick, perhaps the best in Queensland, has been discovered on the Dawson river, about 30 miles south of the Central Railway. The Upper Bowen beds are chiefly fresh-water, and possess but a small flora and fauna. They contain numerous seams of coal, including the Macarthur, Daintree, and HavUah seams, but most of the seams have been destroyed through being burnt by intrusive

sheets of dolerite. Beds of this formation occur west of Laura, the terminus of the Cooktown RaQway, on the Little river coal- field ; at Hamilton, about 20 miles west of Cooktown ; at Stewart's Creek, near

Townsville ; also farther south near Mackay ; on the Isaac and Dawson rivers at Dinner Creek near Stanwell, on the Central Railway ; and at Blair Athol, about 10 miles north-west of Clermont. Blair Athol is the only place where coal seams in this formation are being actually worked. The coal is one of the best steam coals worked in the state.

The Burrum coal-field is the lowest member of the Mesosoio rocks (Lower Trias-Jura), and it extends along the coast from north of Bundaberg down to south of Noosa Heads, occupying an area of about 3000 square mUes. The Coal Measures over a large portion of this area are covered with thin sandstones and con- glomerates of more recent origin, and to this fact the flat and barren nature of the country is due. The formation consists of white and brown sandstones and grey and black shales. Seams of coal are known to occur from Littabella Creek in the north to near Noosa in the southern portion of the field. The seams have been worked chiefly in the neighbourhood of the Burrum river, near the townships of Howard and Torbanlea, about 28 and 15 miles respectively north-north-west of Maryborough. In the Burrum river above the railway bridge at least five seams of workable thickness can be seen cropping out in the bank within half a mile, and having a regular dip to the north-east at about 12 degrees. The two principal collieries are the Queensland Coal Company's and the Torbanlea. The Burrum is the second largest coal-producing field in the state. The Ipswich coal-field (Upper Trias-Jura) covers an area of about 12,000 square miles in the south-east. In the neighbourhood of Brisbane the base of the Measures is an ash or ashy sandstone, consisting of>a felspathic matrix with blebs of quartz and pebbles of schist and quartz, &c. The formation consists of the usual alternating sandstones, shales, and conglom- erates. The Coal Measures to the west of this area at Jimbour and Clifton, &o. , are on a higher horizon than those in the Ipswich district, from which they are separated by a thick layer of basalt. The Ipswich coal-field has the largest output of any. Several coal seams occur in the Albert and Logan district, and thin coal has been met with in the Brisbane district. The seams that are being worked occur in the Ipswich basin and near Clifton. In the Ipswich area at least sixteen distinct seams either have been or are being worked.

In 1894 Mr R. L. Jack and Mr Gibb Maitland made a survey of the eastern edge of the Lower Cretaceous (Rolling Downs) formation, which was followed along on the western side of the Main Dividing Range, with the result that ►►. porous sandstone, which has been named the Blythesdale Braystone, the chief intake rock of the series, was traced near the base from the neighbourhood of Texas on the southern border to Normanton in the north. The amount of water yielded by the numerous bores is almost infin- itesimal when compared with the amount of water taken in by this rock and other porous beds, and the only conclusion to be arrived at is that the water finds its way into the sea at the Great Australian Bight and in the Gulf of Carpentaria. The total number of bores knoAxm to the end of June 1899 is 715, and the total continuous yield from 440 of these is 266,377,056 gallons per day. The Rolling Downs formation has been classified under the general term of Cretaceous, but it contains amongst its numerous fauna forms allied to Oolitic.

The Upper Cretaceous (Desert Sandstone) formation at one time covered the greater portion of Queensland, but the work of de- nudation has left only isolated patches or outliers, which in the western districts overlie unconformably the Rolling Downs beds. Some of these areas are of large extent, especially those in the centre, where they hide the outcrop of the Blythesdale Braystone. The base of the Desert Sandstone is from 1000 to 1800 feet above sea-level in the southern and central portions of the state, but in the Cape York Peninsula it is nearly at sea-level. The Desert Sandstone consists of coarse and horizontal sandstones, shales, magnesite shales, and conglomerates, &c. The conglomerates contain pebbles of quartz, and others derived from the rooks in the vicinity. A series of rooks in the neighbourhood of Maryborough, which overlie the Burrum Coal Measures, against which they are faulted, have been provisionally included in this fonnation. They have produced a large number of fossils, some of which are allied to those from the Desert Sandstone at Croydon.

The Tertianj deposits are very poorly represented ; in fact, with the exception of a few old alluvial drifts, no sedimentary Tertiary deposits have been described. There was undoubtedly great vol- canic activity in Tertiary times, as is evidenced in numerous parts of the state by the

outflows of basalt capping rocks of Desert Sandstone age. The Post-Tertiary and Recent period is repre- sented by bone drifts on the Darling Downs and Peak Downs, at Maryvale Creek, and along the Burdekin river. They have fur- nished numerous remains of living and extinct marsupials, such as Diprotodon australis, Macropus 'titan Thylacoleo, Phascolomys, Notafheriwm, &c. ; a Struthious bird {DroTnornis australis), and

remains of reptiles and fishes. The deposits of the beautiful ChUlagoe caves in the north have also furnished a few bones, and may be expected to be a rich source of interesting organic remains when they come to be thoroughly explored.

Queensland is famous for its rich tin and copper deposits, and with such districts as Ghillagoe, Herberton, and Gloncurry she will doubtless take the lead amongst the states in the production of these metals. It is true that the output of both in 1900 was smaller than it was in 1894 ??? when the figures stood at 2871 tons of tin, valued at ??102,277, and 415 tons of copper, valued at ??9582 ??? but with the advance in prices, which has led to a brisk deniaud for properties known to contain these metals, the old productivity will doubtless be restored, if indeed it is not exceeded. The follow- ing table shows the output of gold and other minerals for 1900 : ???

Total Output.

Total Value.

Chief Sources.

Ounces.

Tons.

Place.

Ounces.

Tons.

Value.

Charters Towers

464,679

1,203,166

Gold .

063,130

2,871,709 1

Croydon . Gympie, &c. Mount Morgan .

97,740 93,622 206,681

204,092 824,154 819,762

f Herberton.

789

49,199

Tin .

1,123

74,041 j

Kangaroo Hills

61

4,565

Stanthorpe

64

^’^*it*

r

Charters Towers

4,283

482

Herberton

6,249

690

Silver

112,990

12,712-^

Kavenswood and Star

Stanthorpe

Burketown

7,234 68,914

“69

812 7,753 1,003

Lead .

205

*3,369-^*

Herberton . Stanthorpe Clermont .

47

63

6,774

799

945

6,126

Coal .

497,132

*173,705^*

Ipswich and Dar- \ ling Downs . / Wide Bay . Cloncurry . Herberton

379,504

110,849 13 21

126,425

41,148

780

1,260

Copper

884

23,040-j

Mount Perry .

Stanthorpe

Cunnamulla

40 48

2,400 2,880 1,000

Opal

7,500 j

Fermoy Inndah Thargomindah .

* *

1,600 2,600 2,500

Wolfram .

189i

6,605

Hodgkinson

188

6,560

Manganese .

76

205 J

Gladstone . Rockhampton .

56 20

175 30

BiBmuth

8

1,865 J

Hodgkinson Paradise .

6 3

1,366

600

Lime .

3,664

*3,862 *

Charters Towers Etheridge .

3,594 70

8,705 157

Tip to the end of 1900 there had been won of gold 14,837,049 ounces, valued at ►►50,101,486 ; and silver, tin, lead, coal, copper, wolfram, manganese, bismuth, antimony, and opal to the value of ►►10,176,045.

Mora. ►►► There are no mountain ranges of suflicient altitude to make any appreciable change in the plant-life. Bellenden Ker, the highest mountain in tropical Australia, has a height of only 5200 feet, and the plants growing upon its summit, as well as on the highest parts of the neighbouring mountains, are for the most part similar to those on the low lands in the southern parts of the state, and the plants which may be considered as peculiar to these heights are few in number of species. They consist of a Leptospermum and a (?) Myrtus, which attain a height of about 30 or 40 feet, and have wide-spreading, densely-leaved heads. The most attractive of the tall shrubs are Dracophyllum Sayeri, of which there are two forms, Bhododendron Lochs, and Orites fragrans. A few orchids of small growth are met with, but the only large species known to inhabit these localities is the normal form o{ DeTidrobium specii/sum. These high spots have a few ferns peculiar to them, and of others it is the only known Australian habitat ; for instance, the pretty white-fronded Java Bristle-fern (Trichovianes pallid a. Ill) has only so far in Australia been met on the south peak of Bellenden Ker ; here also Tudca Frnsrri may be seen with trunks 2 to 3 feet high. The sides of these mountains are clothed by a dense forest scrub growth, some of the trees being very tall, but diminishing in height towards the summits. Pahns and fern-trees are plentiful, but the greatest variety are met with at about 4000 feet altitude. So far this is the only known habitat of that beautiful fern-tree Alsophila Rebecca} var. commutata, peculiar for the wig-like growth at the summit of its stem, which is formed by the metamorphosed lower piunfe and pinnules.

The Myrtaoeous genus Eucalyptus, of which si.xty species are found, furnishes the greater part of what is designated ‘ ‘ Hard- woods, ” the kinds beiug variously termed ‘ ‘ Box, ” ” Gum, ” ‘ ‘ Iron- bark,” “Bloodwood,” “Tallow- wood,” ” Stringy bark, ” &o. These are mostly trees of large size. Other large trees of the order which supply hard, durable timber are the broad-leaved Tea-tree (Mela- leuca Uucademlriin, and others), “Swamp Mahogany” (Tristania suaveolens), “Brisbane Box”

{T. conferta), “Turpentine” {Syn- carpia Inirn’folia), “Peobeen” (iV. Ilillii), ” Fenda ” {Xanthostcmon oppositifolius). These are most generally cut at saw-mHla. Other

orders, however, furnish equally serviceable, large-sized timber, particularly the following: ??? “Sour Plum” (Owenia verwsa, ihli-ace(s), “Rod Gedax ” {C’edrela Toona), “Crow’s Ash” (Mindersia australis, Meliacece), ‘ ‘ Burdekin Plum ” (Pleiogynium Solandri, Anacardiacece), “Bean-Tree” (Castanospermum australe, Legumi-nosae), “Johnstone River Teak” [Afzelia aiistralis, Leguminosm), “Ringy Rosewood” {Acacia glaucescens, Leguminosai), “Black Walnut” {Cryptocarya Palmerstoni, Laurinece), “Hill’s Teak” (Dissiliaria baloghioides). Many trees yield wood particularly adapted for carving and engraving, such as the ‘ ‘ Native Pomegran- ate” {Oapparis nobilis), the “Native Orange” (Citrus a-ustralis), “Sour Plum” (Owenia acidula), “Ivoijwood” {SiplwTwdon aus- trale). Coachbuilders and wheelwrights use the wood of many myr- taoeous trees and several others, with Flindersias {il/eliacece), whilst tool-handles are also formed from these and other trees. There is also a large variety of woods, some very beautifully marked, admirably suited for the requirements of the cabinetmaker, and the list of trees furnishing wood for building materials is a long one. Besides the wood value of the trees and shrubs, a large number furnish tannin barks, gums, &c. The tannin barks are mostly derived from various kinds of Acacia, but the barks of the Queens- land varieties, of which there are about 120, are not so rich in tannin as those of species belonging to. the more southern parts of Australia. Three spice barks, locally known as Sassafras, are employed for flavouring ??? in the northern parts, Daphnandra aromatica, a Monimiaceous tree, and Oinnamomum Tamala ; and in the southern parts Oinnamomum Oliveri. Mary indigenous plants are used in dom- estic medicines, and several are recognized in the Pharmaccpaeia, such as Eucalypts, Cmnamomums, Sideroxylons, Alstonias, Duboisias, and Pipers.

“With regard to fodder-plants, no country is better furnished ; the species of grasses are numerous, and the greater part of them highly nutritions, besides which there are many herbs and a large number of salt bushes and other shrubs, which form excellent auxiliaries to the food supply for

stock. It is, how- ever, to the grasses that the excellence of the pastures is mainly due. On the extensive plains where the best species abound may be seen a large number of the genus Panicum, of which the following are looked upon with the greatest favour : ??? ??? " Vandyke grass, a form of P. flavi- dum; "Cockatoo grass" (P. semialatum), on the roots of which a species of cockatoo, in some parts of North Queensland, feeds; "Barley grass" (P. decompositum and P. distachyum) ; "Blue grass" (Andropogon sericeus, A. pertusus, A. refractus, and A. erianthoides) ; "Russell River grass" (Paspalum galmarra, nearly allied to the South American species P. paniculatum, P. minutiflorum, and P. brcvifolium, Agropyrum, scabrum); "Tall Oat grass " (Anthistiria arenacea) ; " Landsborough grass " (Anthis- tiria itiemhranacea) ; Danthonia racemosa, D. jiilosa, D. pallida, and D. semiannularis ; Sporobohis Benthami, an excellent species found near the Diamantina and Georgina rivers, a.nd S. actinocla- dus; Stipa aristiglumis, Leptochloa chinensis, Microlcena stipoides; "Early spring grass" (Eriochloa panctata), with the following "Love grasses": ??? Eragrostis Prou-nii, E. chmtopliylla, E. pilosa, and E. tenella. The "Mitchell gi-asses" (Aslrebla pectinata) and its varieties, viz., the Wheat (triticoides), the weeping (elymoides), and the curly (airvi/olia), are those that have the most extra- ordinary vitality, but some stockholders consider that the "Sugar grass" or "Brown Top" {Po/linla fulva) surpasses them in its quickness of bursting into leaf with the first showers of rain.

Amongst the fruits are Antiflcsma Bvnius, A. Dallachyanum, A. erostre, A. GluescTribilla, and A. parvifolium, called cherries or currants according to the size of the fruit they bear, the jelly made from the fruit of some species being in nowise inferior to that made from the European red currant. The Kumquat or lime of Southern Downs country (Alalantia glauca) makes a peculiarly nice-flavoured preserve. Of the allied genus Citrus two species are met with in the south, C. australis, which has a round fruit 1 to 2 inches in diameter ; the other, 0. australasica, with long finger-like fruits 3 or more inches long and about 1 inch in diameter ; of this a red variety (C. inodora), which is only met with in the tropics, bears a fruit often 2J inches long by IJ in diameter. All these fruits are juicy, and of an agree- ably sharp, acid flavour. ' ' Davidson's Plum " [Da vidson iajiruricns) is a fruit with a sharply acid, rich, plum-coloured

juice, sometimes attaining the size of a goose's egg. Of the genus Eugenia, over thirty are indigenous, and fully one-third produce more or less useful fruits. One Fig (Ficiis gracilipes) produces a fruit used for jam and jelly. Two Garcinias are recorded as indigenous, but of one only [G. Mestoni) is the fruit known. It is of a depressed globular form, sometimes 3 inches in diameter, very juicy, and of

a pleasant flavour. Leptomeria adda, one of the very early fruits used by Australian colonists, is met with in some localities. The "Finger Berry" or "Native Loquat" (Rhodomyrtus mctcrocarpa) makes a good jam, but is in bad repute for use in the raw state, perhaps owing to a peculiar fungus at times found to infest the berries. The Queensland Raspberry {Rubus roscefolius) is widely spread and commonly used, but the fniit is rather insipid. The representatives of the genus Vitis all belong to the sub-genus Cissus ; several of them, although somewhat acrid, are usefxd for jam and jelly : probably the best for the purpose is one met with near the Walsh river, V. Gardineri, which is said to bear bunches from 1 16 to 2 lb in weight, the berries being large and of pleasant flavour. A large number of nut-like fruits are used by the aborigines for food, but the only one used by the white population is the fruit of Macadamia temifolia, the Queensland nut.

The foliage of many plants yields by distillation essential oils, particularly Euoalypts, Backhousias, and other Myrtaoeous plants, as well as some belonging to Rutacese and Labiatae, especially the genus Mentha. Apart from plants of economic value, there is a profusion of ornamental plants, shrubs, trees, and parasites. Of ferns, one-half of the kinds met with in Australia are found in Queensland as well as in the other states, one-fourth in Queens- land alone, the remaining fourth belonging to the other states, but not to Queensland. The indigenous ferns equal in number those of New Zealand, and are three times the number of those of Great Britain.

Fawna. ❓❓❓ The land fauna of Queensland is essentially one with that of the entire continent. It presents the same old-fashioned aspect, with its antique transition-forms mingled with a vast num- ber of animals arrested in their development through untold ages. Biit the geographical position of the state, which exposes it to the climatic and transporting influences of the intertropical Pacific, has to a notable extent impressed on its fauna characters of its own. It has thus been made the headquarters of Australian bird- life on land and fish-life at sea, the moisture of its coastal regions and the warmth of its tidal waters being eminently favourable to that wealth of insect and other low types of life which determines the multiplication of the higher. The barrier reefs are thickets of corals of the most varied forms, in life glowing with colour, in death shrubs of snowy purity. Among the shell-fish conspicuous for beauty or rarity are the exquisitely delicate Paper Nautilus and Venus Comb {Murex tenuispina), the orange and other valuable cowries, and the gigantic Clam-shell, which may require a ship's tackle to lift it from its bed. On the land surface, among its lowly organized products, interest centres in the multitudinous forms of insect life, of which, excepting the Butterflies and Moths (Lepi- doptera) and Beetles (Coleoptera), comparatively little is known at present. Insects inimical to man, with the exception, in some localities, of ants, flies, and mosquitoes, are inconsiderable in number, and possess few hurtful properties. Centipedes, scorpions, and leeches are less troublesome than in most other tropical regions. Spiders present themselves in astonishing variety, but only one kind, a small black spider with red spots {Lathrodectus), is malignant. Among the larger insects proper, the great-winged Phasmas, the Skeleton or Stick -insects, the Leaf-insects, and the splendid Swallow-tailed Butterflies, are especially notable. Many of the Beetles are remarkable for size or brilliancy of colour. Turning to the Vertebrate classes, that of the Fishes is extra- ordinarily profuse in diversified forms, the coral reels being the grazing- and hunting-grounds of hosts of gorgeously decorated fish, chiefly of the Wrasse family ; these, however, are almost equalled in beauty by the Chaetodons, Gurnards, &c., of other habitats. Among the Perches are the enormous Groper, which may attain the weight of 4 cwt., the Murray Cod, and the Giant Perch, both excellent food-fish of about 70 lb in weight. Sharks of many species abound, but there is no evidence that the Port Jackson Shark (Cestracion), which has been claimed for

Queensland, extends its range into her waters. The fish which continues to excite the keenest interest in scientific circles, as a survival from the mediaeval period of geological time, is the Ceratodus or Burnett Salmon, which, formerly inhabiting the headwaters of the Murray, still perpetuates its kind in two of the smaller rivers north of the Bunya range. Batrachians are limited to the frogs and their nearest allies ??? that is, to the tailless division of the order, the tailed batrachians (newts, &o.) being, as far as is known at present, entirely absent. The greater part of the frogs are arboreal in habit, the most familiar being the large Green Tree Frog. The exuberance and diversity of their food have doubtless been the cause of their ditferentiation into many distinct species, which enables them to play a very useful part in checking the undue increase of noxious insects. Snakes, on the other hand, are in too great variety for human interests, as they live very largely on insect-feeders. The great majority belong to the venomous Colubridse, but for- tunately the kinds of which the bite is more or less deadly are not numerous, and snake-bite is one of the rarest causes of death. Those with the worst reputation are the Black Snake and the Orange-bellied Black Snake {Pseudechis), the Brown Snake {Die-

Toansia), the Keeled Snake {Tropidechis), and the Death Adder {Acanthopis), The principal non-venomous species are the Pythons or constricting snakes, e.g., the common Carpet Snake (Morelia), the long lithe Tree Snake (DendropMs), and the Fresh- water Snake {Tropidonotus). The Black-headed Rock Snake (Aspidiotes), one of the Pythons, is said to reach the length of from 20 to 25 feet, but to be perfectly inoffensive. Several kinds of marine snakes occur on the coasts, and all are to be accounted dangerous. Of reptiles, the most numerous group by far is that of the lizards, which have among them representatives of each of the leading families of the class except the Chameleons. AU of them are harmless so far as their bite is concerned, and the great majority of them are useful to man, but the largest, the Monitors, or as they are locally called Iguanas, are decided pests in country poultry-yards ; these lizards in ancient times grew to the formidable length of 15 feet or more. The common Sleeping Lizard (Cyclodus) is a rare example of a plant-eating lizard, and the western border of the country is crossed by the demoniacal-looking but quite inno- cent Moloch horridus of the far west.

Tortoises are exemplified by many forms in the fresh- waters ; on the coasts by the Leather-back, the Edible Turtle, and the Tortoise-sheU Turtle. Queensland waters are not at present infested by any species of Alligator, though in times past one of large size was a scourge on the borders of the then inland sea. The crocodilian of its coasts is the crocodile of the Indian Seas, which ranges over the whole of the western tropical Pacific, and wanders south into Queensland waters as far as Keppel Bay. In the fresh-water pools of the northern tableland is found a small and harmless crocodile (PhUas) of a very uncommon form. The avifauna is to the naturalist exceedingly attractive, for it is fuU of sxrrprises and interesting lines of research, while to the artist it is a storehouse of form and colour. Where flowering and honey -yielding trees prevail, a profusion of birds seek their food either on the insects attracted by the honey, or, if so fitted, on the honey itself. Accordingly, the most striking feature of the bird-life, amid the forests of Euoalypts and Acacias, is its richness in honey-eaters and insect destroyers. The former, however, taken as a whole, are not a natural group, but include a famUy of perching birds and a portion of the Parroquet family, both furnished with brush-tongues adapted to the extraction of honey. A second characteristic is the great development of that quaint company, the Bower Birds, among them the Regent Bird, Satin Bird, Cat Birds, &c., constructors of the elaborate playgrounds which have excited so much attention. A third is the presence in one small part of the territory of a Cassowary, and on its seaboard of three kinds of Rifle Birds, both extensions southwards of the tropical families of Cassowaries and Paradise Birds. In the same region of prolific vegetation the handsome fruit-pigeons are also outliers of a large family of such pigeons spread through the Papuan jungles. On the other hand, one species of that eccentricity in bird-life, the Lyre-bird, repre- sents m the southern highlands its kinsfolk farther south. The Scrub-turkey [Catheturus] heaps its mound of rotting debris to ferment in the shade of the jungles and give warmth to its eggs ; the Scrub-hen (Megapodius) piles up sand on the beach for the sun to furnish the necessary temperature. The Giant Kingfisher, other- wise the Laughing Jaokass, salutes the rising and setting sun with its discordant cackle, secure in its ill-deserved reputation for benefits bestowed and in oversight of mischief done by it. The comparative paucity of birds of prey .(Falamidce), and the almost total

absence of rasorial game- and poultry- birds, may be noted. Birds pursued for spoi-t or profit, however, are not wanting. The Emu and the Bustard or Plain Turkey afford sport in the open country. Quail and Snipe in or near the timber, while rivers and lakes still unvisited by the gun are covered with Ducks and Geese, Swans and Pelicans. It has been said that Australia has no migratory birds : this is an error, founded upon an undue restriction of the term migratory. Several species could be mentioned which are truly migratory in Queensland, as the Drongo-shrike, Bee-eater, Dollar-bird, &c. On the whole, it may be remarked of the Queensland avifauna, as of its fish resources also, that, owing to life-conditions in both cases, its constituents have but little disposition to associate ??? in the one case in flocks, in the other in schools. One may meet with mobs of White Cockatoos or Kites, but as a general rule a visitor from Europe misses the frequent flights of small birds to which he has been accustomed. As to quadrupeds, the prevalence of Marsupials haa led many to suppose that Australia has bred nothing but these. This is quite a mistake. It is true that Queensland has no indigenous cattle, and only one native carnivorous beast, the Dingo, though the Seals of the southern coasts range almost, if not quite, within her boundary. Two classes of the superior- mammals, however, are fairly represented, the Bats {Cheiroptera) and the Rodents. Of these latter. Rats and Mice of native origin are in considerable variety ; among them are the Jumping Rats. {Sapolotis), Jerboa-like little animals, which are seldom seen. The Bats are of several species ; the most notorious of them are the great Fruit-Bats, or Flying-Foxes, which the fruit-grower could well enough spare. The Sirenian Mammal, the Dugong, haunts.

nearly the whole of its coast-line. Queensland, in common with the rest of Australia, has those two strange egg-laying beasts, the Echidna, or Porcupine Ant-eater, and the Ornithorhynchus, or Platypus, two most remarkable milk-yielding mammals with- out mammse that have not been able to divest themselves of the mode of generation and much of the

struotm-e of their reptilian forefathers. With regard to the intermediate and predominant class, the Marsupials, one of the most interesting forms is the Tree-Kangaroo {Deiulrolagus), as, apart from the habit of climb- ing trees, which is shared to some extent by the Rock- Wallabies, they afford a proof of the one-time continuity of the fauna with that of the islands to the north, when land communication still existed between the two areas. Of these curious animals, two species at least are known. As to the rest of the Marsupials, there is of course a general resemblance to those of the continent as a whole, but this is accompanied by much evolution of forms, especially among the smaller sorts, recognized by differences which are occasionally sufficient to mark off distinct generic, or even more differentiated groups. The larger Kangaroos are pretty conserva- tive in character everywhere, while the common Wallabies, the Rock- Wallabies, and the Kangaroo-Rats exhibit a greater tendency to differ from their southern and western kindred. The Koala, or native Bear, is almost absolutely invariable, a sign of the antiquity of the race. The Opossums and the so-called Flying-Opossums are not many in species, and are dwarfed descendants from a more flourishing ancestry. The Bandicoot family {Peramelidm) is fairly represented ; it in- cludes the Rabbit- Bandicoot, which crosses in its eastern range the western border of the country. Carnivorous Marsupials of destructive powers are few; the largest of them, the spotted-tailed Native Cat (Dasyurus maculatus), is the most troublesome. Superior in size to the domestic cat, this pretender to the rank of cat is able to devastate a whole hen-roost in a single night, and is even said by the aboriginals to attack their infants. With the exception of a smaller species of the same kind, and a brush-tailed ally very much smaller, but yet able to Idll a, fowl with a single bite, the rest (Marsupial mice) are but partly carnivorous, chiefly insectiv- orous, and therefore useful. This fauna is now fortunately deprived of the Thylacinus (Native Tiger) and Sarcophilus (Native Devil), which have been driven by physical changes southwards to Tasmania, and, it was thought until lately, of the Wombats, but a new species of these inoffensive burrowers has recently been discovered within the southern borders of the state. One other peculiarity in the form of a marsupial mammal is the little Musk-Rat {Hypsiprymnus), inhabiting those northern scrubs which are so prolific in other animal forms foreign to the rest of Australia, and seem to have received some of their denizens from the Indian Archipelago and

some from the Papuan Islands. The remarkable deposits of fossil bones, extending in patches through- out the length of the country, are sufficient proof that in former times a much larger number of animals were supported by it than are now to be found within its borders. That their diminution was not due to a permanent decrease in the fertility of the land is obvious, since this is now depastured by vast numbers of stock of all kinds. Nor is there any reason to suppose, as has been done, that it ensued from the advent of aboriginal man with his supposed attendant the dog, for these are not exterminating agents, as Africa and America prove. The fact is sufficiently explained by that law of organic life which gives to each individual, species, family, and class, its period (long or short according to its organization) of development, maturity, decay, and death. In the age when these deposits were formed, marsupial life was probably at its best ; since then it has, independently more or less of physical conditions, gradually declined. No amount of sustenance can rejuvenate or even uphold a being which age is rendering incapable of sustentation. It is sad to see in this re- sourceful country a moribund fauna, brute and human, but the obsolete and refractory must pass away, that the coimtry they occupy may be put to better uses.

Fisheries. ❓❓❓ Numerous varieties of well-known and undesoribed species of fish frequent the coast, which extends from 28❓❓ S. for 2000 miles along the Tasman and Coral Seas and the Inner Route to the tropical waters of Torres Strait up to 10❓❓ S. One of the best known variety is the sea mullet (MuqiUdcc), large shoals of which strike the Australian coast 100 miles south of Sydney, and travel northwards, arriving on the southern coast-line of Queenslaiid in the months of April and May, crossing bars and ascending rivers on the appearance of south-easterly weather. These magnificent fish often attain a weight of from 10 lb to 12 lb, and are the great annual harvest of the fishermen, who forward them to cooling and freezing chambers at the principal ports, and, packed in ice, to up-country towns. Small schools of bream succeed the mullet, and are followed in September and 'October by the poombah or taylor fish, a fish of exceptional flavour,

and much esteemed by epicures. These are succeeded by jewfish, specimens of which caught in southern waters have been known to exceed

a weight of 50 lb, whiting, garfish, and flatheads, while flomiders, black and tongue soles are occasionally caught by seine or hauling nets. White and black trevally, groper and rock cod, and a variety of bonito identical with the tunny of the Mediterranean Sea, are also frequently met with. Several species of the tassel fish (Polynemus ???macrocolwir), from which isinglass is pro- cured, have been taken by fishermen. The celebrated lung fish or Geratodtis forsteri, also known as the Burnett or Dawson river salmon, remarkable for possessing a rudimentary lung in addition to ordinary gUls, perhaps enabling it to Uve independently of a viti- ated water supply, attains a length of 6 feet, and is valuable as an article of food, its pink flesh bearing a resemblance to that of the English salmon. Kingfish, batfish, gurnards, and eels of many varieties are also common. Although seine or hauling nets are commonly used for taking fish, fish-traps are largely utilized on the northern seaboard. Schnapper, bream, rock codf, parrot-fish, and groper are caught by hook and line in from 10 to 30 fathoms of water off the rooky headlands of the southern coast, and brought in well-boats alive to market. Sardines, whitebait, and sprats make their appearance in large shoals on the coast at intervals. The barramundi (Osteoglossum leichardti), which occurs in the Dawson and western waters, is found also on the east coast,

Fia. 1.??? The Dugong.

and is one of the most esteemed fresh-water fish in Queensland. Dugong, which are found in herds along the northern coast and as far south as Moreton Bay, are caught in set nets of 36-ineh mesh, 100 fathoms in length. A full-grown dugong (Fig. 1) will measure 11 feet, and weigh from 11 to 13 cwt.: they suckle their young, and then- food consists of marine grasses ; their flesh when cured like bacon is highly valued, and the oil forms a substitute for cod-liver oil ; tusks and rib-bones are utilized for handles in cutlery, and the hides when tanned make excellent mill-belts. Different varieties of turtle are plentiful, the green edible turtle being caught by large set nets, and preserved and tinned for export. In Torres Strait and the northern coast the hawksbill turtle, yielding the valuable tortoise-shell of commerce, is said to be captured in a peculiar manner, the sucking-fish or remora {Echeneis 'naucrcUes) being utilized by the islanders for that purpose. The remora is carried alive in the

bottom of the canoe, a long thin line being attached to the fish's tan and another usually to the gill. On a turtle being sighted and approached to within the length of the line, the sucking-fish is thrown towards it, and immediately it swims to and attaches itself by its singular head sucker to the under surface of the turtle, which if of moderate size is easily pulled into the canoe. Amongst the Crustacea may be enumerated the gigantic clams which are found on the reefs of the Inner Route. Occasionally some are met with weighing nearly half a ton, embedded in coral,

Fia. 2. *The Squat Lobster.*

and it has been reported that while natives have been wading at half-tide over the reefs, they have stepped into the open shells, which have immediately closed on their feet, from which position they have been rescued with difficulty by their companions cutting the shell open with tomahawks. Fresh-water clams are found in

statistics]

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the rivers in the northern districts. The edible oyster {Ostrea graminifora) has for nearly twenty years been largely cultivated in southern Queensland, the exports to the southern states in 1892 rising as high as 18,000 bags, valued at ??22,000, producing n revenue tor that year of ??6200 ; but this successful return received a severe check in the following, years when a small red wonn made its appearance amongst the oysters, causing hea-vy loss (Figs. 3 and 4). Amongst other Crustacea, the squat lob- ster {Themis orientalis), is, with giant prawns and quampi, or small golden-lipped pearl shell, obtained by trawling in the southern waters (Fig. 2). Many, varieties of crabs are also found on reefs and foreshores at low tide ; prawns and shrimps are. caught, dried, and form an article for export to China ; mussels, pinna or razor -shell, cockles, and eugaries (a species of small shell-fish) are also abundant. The pearl shell fishery, located in ToiTes Strait, has for over twenty-five years given magnificent returns on the capital invested. Pearls of great value are

occasionally obtained, and the shells realize from ►►100 to ►►150 per ton in London. As an instance of the value of this industry, it may be stated that ►►► 1898, ►►100,000 worth of

from 43-07 per 1000 for the period 1861-66, 36-37 per 1000 for 1881-85, and 35-15for 1891-95. The illegitimates in 1881 were 4-2 per cent., in 1891 4-7 per cent., in 1900 6-40 percent. Inl900 there were bom 7599 boys and 7202 girls (14,801 in all). The death-rate is 11-72 per 1000, showing a remarkable diminution, for in 1861-65 it averaged 21-06 per 1000 ; in 1871-75, 17-94 ; in 1881-85, 19-10 ;

Fio. 3.►►► Cultivated Oyster Bank, Moreton Bay.

shell was exported to London, bringing in a revenue of ►►1100 to the Government, the shell having been to a great extent collected off the shallow reefs ; diving is now prosecuted in deep water of 25 fathoms and upwards, causing frequent and fatal accidents to divers engaged. Beche-de-mer, or holothuria, or trepang, has been col- lected, cured, and exported from the reefs and adjacent seas for over thirty years, the yearly value of the exports occasionally exceeding ►►30,000, though of late years the industi-y has not been so remun- erative. Schools of whales are occasionally sighted on the coast, but the old fishing grounds at the Bamptons, 450 miles distant across the Coral Sea, are seldom visited. Amongst the dangerous and voracious classes of fish fre- quenting the warm waters of Queensland, which are com- mon to both temperate and tropical seas, may be enum- erated sharks of all var- ieties, gigantic sword – fish and saw-fish, and immense stinging rays.

Population. ►►► The popula- tion has increased from 326,916 in 1885 to 502,892 (census preliminary count) on 1st April 1901►►►280,504 males and 222,388 females. Included in these are col- oured aliens, estimated to be Polynesians, 8826 ; Chin- ese, 10,076; Japanese, 3063; Javanese, 298 ; other Asi- atics, 2357 ; total, 24,620 persons, or about 5 per cent, of the total population. The density of population in 1901 was 0-75 per square mile, compared with 0-32 in 1881 and 0-59 in 1891. Persons engaged on sheep and cattle runs numbered 17,500 ; in

agriculture, 40,700 males and 7500 females; in mining, 14,000; in industries and manufactures, 20,000 males and 6400 females ; in building, road-making, and the like, 13,000. Trade and commerce utilize 19,200 males and 2400 females ; transit and transport, 15,800 ; domestic occupations, 18,000 females and 7200 males ; professions, 9100 men and 3700 women. Of the rest, some 20,000 manual labourers are not constantly in any one branch of work, and about 1000 men and 250 women live on their means. The birth-rate is now 30-19 per 1000, showing a gradual decline

and in 1891-95, 12-82. The deaths in 1900 numbered 5747 (males, 3678 ; females, 2069). The marriage-rate in 1900 was 6-88 per 1000, being a decrease on the figures for 1885, owing to the age- condition of the population ha-idng reached a more normal leveL In 1890 the poll tax on Chinese was abolished, but their arrival was restricted to one person for every 500 tons of the ship's register. The aborigines have diminished in numbers very fast in the south, and they are no longer wild and ferocious, except in a

Kg. 4. ??? Mangrove Oysters, Moreton Bay.

few remote parts of the north. Protection is afforded to them in their dealings with whites, and several missions at Bellenden Ker, Bloomfield, Cape Bedford, Deebing Creek, Maria Yaamba, Mackay, Mapoon, and "Weipa have done good work amongst the children. Their numbers are now estimated to be 10,000 persons. Agriculture. ??? Agriculture is a thriving industry, employing a considerable percentage of the population. It has largely taken the place of sheep-raising on the Darling Downs and cattle-raising on much of the coast country in the south, whilst farther north

sugar and other tropical products have led to the cultivation of the rich scrub land at the mouths of coastal creeks and rivers, the total area of land under cultivation for 1900 being 479,716 acres, against 209,130

acres for 1885. Sugar produced in Queensland in 1885 equalled 55,796 tons, and in 1899, 123,300 tons. It is principally grown at Logan, Maryborough, Bundaberg, Eock- hampton, Mackay, Bowen, Burdekin, Ingham, Johnstone river, Mossman, and Cairns. There are now two refineries and fifty- eight sugar-making mills in active work. It has long been re- cognized that only well-equipped mills are able to manufacture sugar at a profit at the low price to which the competition of bounty-fed sugar has now reduced this article, and, whilst many mills are still owned with the plantations, a different system has sprung up by which farmers cultivate comparatively small areas of cane, and either sell to owners of mills or combine and erect a mill themselves (in which they are liberally assisted by the Government), and after receiving a price per ton for their cane, divide whatever profits there are over working expenses, interest, &o., at the close of the season. The central mill system, by ex- tending the growth of cane by small farmers, will, it is believed, solve the troublesome question of black labour in connexion with this industry, besides having the effect of settling a large number of persons on farms of their own. The production in 1900 reached 92,554 tons. Another large agricultural product is wheat, and of this there was produced, in 1897, 1,009,293 bushels, the yield for 1900 being 1,194,088 bushels from 79,304 acres, against 51,598 bushels for 1885. The centres of wheat production are the Warwick and Toowoomba districts. Indeed, the Darling Downs produce nineteen-twentieths of the whole of the wheat grown. Barley, ordinary and malting, is also grown in the same district, and two malting-houses exist for con- verting it into malt. Maize is grown extensively, but owing to drought in 1900 did not suffice for local requirements. The pro- duce for 1900 was 2,456,647 bushels, against 1,574,294 bushel for 1885. Rice is an industry of comparatively recent introduction, and although small areas are grown at many places, Caims is the centre of the industry. There were 271 acres, yielding 6870 bushels of paddy grown in 1900. Potatoes are reared principally in the south ; there were 20,014 tons grown in 1900, against 8326 tons in 1885. Sweet potatoes are also grown extensively. Arrow- root is grown almost entirely in the south, where, besides supplying local requirements, 463,617 lb of manufactured arrowroot were exported in 1900. The production for 1900 was 3978 tons of tubers, and in 1885 it was about 3855 tons. Coffee is attracting attention, its cultivation being principally in the north. Bananas grow along the whole seaboard,

and form an important industry ; thousands of bunches are exported weekly from the northern ports to the southern states. The production for 1900 was 2,313,108 bunches, against 1,660,180 dozens for 1885. Tobacco yielded 4032 cwt. of cured leaf in 1900, against 1330 in 1885 ; pine-apples, 424,835 dozens in 1900, against 122,263 in 1885 ; oranges, 2,356,068 dozens in 1900, against 658,549 in 1885 ; mangoes, 277,444 dozens in 1900 ; and strawberries yielded 401,105 quarts. Though grape-vines grow throughout Queensland, they are best suited for wine- making in the south of the state.

Stock-Raising. ❓❓❓Although farming has advanced rapidly and displaced pastoralists near the centres of settlement, the pastoral industry still retains the premier place. The number of sheep in- creased from 8,994,322 in 1885 to 17,552,608, but has fallen through the severe and protracted drought to 10,339,185 in 1900. Cattle have decreased from 4,162,652 to 4,078,191, whilst the value of wool exported rose from ❓❓1,779,682 to ❓❓2,199,370. The more thorough opening up of the country, better means of communication, lower rents, and longer tenure have all combined to induce pastoralists (both sheep and cattle) to occupy the more remote districts, leaving the more accessible parts to settlement. The discovery of artesian water has enabled them profitably to stock and use country which, though rich, is devoid of natural water. There are now more than 439 artesian bores in operation, the outflow from which is calculated to exceed 268 million gallons daily. In addition to this creeks are dammed and excavations made in suitable localities, and large sums freely spent in the endeavour to retain a permanent supply of the precious fl!uid. The character of sheep-farming, too, has altogether changed. Instead of the sheep being lierded by a man who accompanied them through the day and yarded them at night, they are allowed to go at large in paddocks many miles in extent and surrounded by wire fences, and only mustered when required. Men are em- ployed to keep the fences in good order and poison the dingoes. This system and the artesian bores together are changing the char- acter of squatting, and good land, where water can be obtained, is now largely sought after in blocks of 20,000 acres. In future smaller holdings of 10,000 sheep will take the place of the larger holdings of 300,000 sheep, the former plan also giving employ- ment to a larger number of persons. Shearing by machinery, too, is

having a good effect on the values of wool. Cattle, which a few years ago sank to an almost nominal price, have again risen

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in value, and promise to increase. A market for frozen meat having been found in England, meat works were established which are able to send fresh meat to any port in the world in a perfect state of preservation. Preserved meat in tins and in extract, and a large variety of subsidiary products are also exported, and no portion of the animal killed is wasted. Fourteen freezing works and eleven preserving and boiling-down works are now running, most of them fitted with the latest appliances for economically reducing cattle to marketable products. The value of frozen meat exported in 1900 was ––982,125, whilst preserved and salt meats were ––490,811, and extract of beef ––89,011, hides and skins ––551,752, tallow ––397,439, miscellaneous products of the industry ^––628, 277, making altogether ––3,049,415, and, including wool, a sum of ––5,248,785 as the value of the pastoral produce in excess of the requirements of the state. A small insect pest call the "tick" has caused much loss in the north, and has gradually spread southwards. It is believed that inoculation will render cattle immune, and that the losses sustained in the north will not be repeated in the south. Dairy- farming has latterly received much attention, and promises to attain considerable dimensions. This also depends on the cheapness of cold storage, since the local consumption of butter has been overtaken, and the exportation of that article is largely on the increase. The best breeds of milking cattle have been extensively imported, and feeding and treatment have been assimilated to British methods, whilst co-operation amongst dairy-farmers has led to the establishment of creameries and butter factories in many parts of South Queensland. There were 1,389,250 lb of butter exported in 1900, of the value of ––51,729. Horse-raising has become an im-portant industry, the number of horses now approximating half a million. There has also been a large increase in pigs, namely, from 55,843 in 1885 to 122,187 in 1900. Within the last few years bacon-curing factories have come into existence, mth the result that whilst bacon and ham were imported to the value of ––29, 969 in 1885, they formed in 1900 exports to the value of ––46,866. These factories purchase pigs from the farmer

and convert them into bacon, ham, lard, &c. They are all fitted with refrigerating machinery, and carry on their operations throughout the year.

ComTmrce. ►►► Since 1885 the coastal towns have grown steadily in size and importance, and the trade passing through them has increased. The total exports for 1900 were ►►9,581,562, or ►►20 per head (1882 = ►►3,534,452), of which wool represented ►►2,199,370 (1882 = ►►1,329,019) ; gold, ►►2,819,495 (1882 = ►►829,655) ; tin, ►►79,958 (►►269,904); live stock, ►►597,474 (►►280,466); green fruit, ►►104,387 ; sugar, ►►669,389 (►►153,188) ; tallow, ►►307,439 (►►129,549) ; preserved meats and extracts, ►►1,562,197 (►►119,343) ; pearl-shell, ►►128,524 (►►105,869); hides and skins, ►►551,752; beche-de-mer, ►►4376 (►►25,032). The principal articles of export for 1900 may be grouped as follows : pastoral products, ►►5,248,785 ; mineral, ►►2,984,689; and agricultural, ►►904,171. The imports for 1890 were ►►7,184,112, or ►►14 13s. Od. per head (1882= ►►6,318,463), and it is noticeable that in 1892, the time of financial troubles, imports fell to less than five millions. The imports for the years instanced show for manufactured cotton, sUk, and woollen goods, 1900, ►►819,118 (1882=►►839,352) ; unmanufac- tured, ►►486,299 (1882 = ►►194,489) ; metal goods and hardware, ►►1,221,145 (►►910,029); flour and grain, ►►390,967 (►►453,307); oilman's stores, ►►77,806 ; spirits, wines, and beer, ►►282,460 (►►320,925); books and stationery, ►►184,987 (►►113,798^; tea, ►►135,637 (►►109,286). During 1900 there entered 713 sea-going vessels with a tonnage of 835,355, and cleared 716 with a tonnage of 819,662. A dry dock with all conveniences exists at Bris- bane, and slips for smaller vessels at the larger ports. Dredgers are largely employed in improving and deepening the rivers and harbours, of which the principal are Brisbane, Maryborough, Bundaberg, Gladstone, Rockhampton, Mackay, Bowen, Towns- ville, Dungeness, Geraldton, Cairns, Port Douglas, Cooktown, and Thursday Island, all on the eastern coast, and Normanton and Burketo%vn in the Gulf of Carpentaria. The project of opening a port at Point Parker has been abandoned.

Manufactures. ❓❓❓ The abundance of raw materials, and the free entry of articles imported for manufacture, have tended to develop industries of all kinds, and whilst the number and description in 1885 were few, great progress has taken place in later years. Large foundries and engineering shops exist in all the principal to:vns, and there are, besides, flour, sugar, and saw mills ; breweries ; ice, butter, cheese, tobacco, jam, pickle, clothing, and boot factories ; meat preserving, boiling down, and soap works ; tanneries ; distilleries ; wine making ; and a woollen manufactory. The total number of establishments is 2610, and for 1899 they employ 28,883 hands, and utilize 27,580 horse-power. The value of the output in 1899 was ❓❓8,883,231. Electric light is largely employed, and all the principal towns are lighted ^vith gas.

Railways. ❓❓❓ Since 1885 good progress has been made, not only in extending the main trunk lines, but in constructing branch and other lines to meet local requirements, the total length of railways- open to traffic having increased from 1434 to 2801 miles, at a total cost up to the 30th June 1900 of ❓❓19,803,239. The Southern

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line, which in 1885 stopped at Stanthorpe, has now been extended to Wallangarra, where it connects with the New South Wales system, alibrdiug rail communication from Brisbane with Sydney, Melbourne, and Adelaide. Branch lines exist to KiUarney, Allora, and Pittsworth. The Western line passing through Darling Downs has been extended from 416 miles, or 97 miles west of Roma, through the rich pastoral country of the Warrego to Cunnamulla (604 miles), and about 64 miles distant from the New South Wales boundary. Besides branch lines completed to Dugandan, Esk, and Crow's Nest, a line has been built from Brisbane to Southport, 50 miles, with branches to Beaudesert and Nerang, as well as a line to Cleveland. The North Coast line has been built connecting Brisbane with the Gympie-Maryborough Railway, and continuing on to Bundaberg and Gladstone, 328 mUes, whence it will shortly be extended

to Rockhampton. At present a steamer conYeys mails and passengers for Rockhampton and the west from Gladstone to Broadmount, through the smooth water of the Narrows, thence by rail to Rockhampton. Branches exist on the North Coast line to Enoggera, Penkeuba, Sandgate (on Moretou Bay), Kilkivan, Degilbo, Cordalba, Pialba, and Mount Perry. The Central line, which in 1885 extended from Rock- hampton to the Alice river, now reaches Longreach on the Thomson river, 427 miles, and in addition to the Clermont branch, other branch lines have been built to Springsure, Emu Park, Broadmount, and Mount Morgan. Passing north, a railway line has been built from Maokay, 23 miles, through the sugar countiy. The Northern line commencing at TownsvUle has been extended from Torrens Creek, through Hughendon to Win ton, 367 miles, and has a branch to Ravenswood. The respective termini of the Central and Northern lines are now about 110 miles apart, and give railway communication to a vast extent of magnificent open downs of the richest soil, and comprising some of the finest sheep country in Queensland. Since 1885 lines have also been constructed from Bowen to Wangaratta, 48 mUes, from Cairns, past the celebrated Barron Falls to Mareeba, from Cooktown, an additional 36 mUes, towards the Palmer goldfields, and from Normanton to Croydon goldfield. In addition to the 2801 miles of Government railways open to traflio, the Clullagoe Railway, starting at Mareeba, and several steam tram lines have been built by private enterprise, whilst others are under construction, and proposals have been made for several additional lines. In 1899-1900 the railway earnings amounted to ––1,464,399, and the working expenses to ––948,691, the net balance being equal to 2‘67 per cent, on the invested capital.

Administration. ––– At the head of affairs is the governor, who is appointed by the Crown. In the conduct of his office he acts through and with an executive council. Parliament consists of two Houses ––– the Legislative Council of forty-one members (though the number i? not fixed), nominated by the governor for life, and the Legislative Assembly of seventy- two members, elected by ballot on practically manhood suffrage from sixty-one electoral districts. Their period of office is three years, and they receive a fee of ––300 a year, besides travelling expenses. In these Houses is vested the power of making laws and imposing taxes. For purposes of local self-government the state is divided into thirty

municipalities, six shire councils, 117 divisional boards, and 100 petty sessions or police districts. The boroughs and shires control 430 square miles, and in 1900 their revenue was ££369,322 and their expenditure ££391,578. The divisional board controls 667,823 square miles, and in 1900 their receipts amounted to ££271,301, and their outlay to ££261,609. Revenue is mainly derived from rates levied on the capital value of assessed properties, which amounted for the state to ££41,500,000, representing an annual value of ££2,770,000. All improvements are exempt from assessment, and much of the revenue is expended in road-making and the building of bridges. Rates are supplemented by an endowment from the central Government.

Finance. ††† Revenue is made up to the 30th June each year. In 1900 it was ££4,588,207 (in 1884=££2,566,358), being customs ££1,461,690 (££866,475), excise ££148,423 (££34,442), land sales, &c., ££202,281 (££365,536), pastoral rents ££323,622 (££254,424), railways ££1,422,852 (££582,642), post and telegraph ££309,470 (££155,996). The expenditure was ££4,540,418 (££2,511,651). In the settled dis- tricts pastoralists had so far been replaced by the agriculturists that there were only eleven runs containing 506†† sqnare miles under lease, the rent being ††737 12s. 2d., against 304 runs, containing 11,162 square miles, paying ††21,419 rent in 1883. In the un- settled districts the number of runs had fallen to 2261, containing 351,359 square miles, but paying ††290,308 4s. lid. rent, against 8939 runs, containing 475,601 square miles, paying ††216,638 in 1883. Grazing farms numbered 1904, containing 20,375 square miles, paying ††83,754 12s. lOd. annual rent, whilst the settled and unsettled portions of runs held under occupation licence numbered 1534, with an area of 54,530J square miles, paying ††32,292 7s. 3d. annual rent. The absolute public debt in 1900 was ††35,898,414 (1884 = ††16,419,850). Of that amount the indebtedness for rail- ways was over 20 millions (1884 = 9J millions), for immigration

2i millions (1884 = 2 millions), and for harbours 2 mUlions (1884 = 1 million).

Education. ❓❓❓ PubUo education is free, unsectarian, and com- pulsory. State or provisional schools are foi-med wherever an average attendance of twelve children can be got. Theoretically the school age is from six to twelve years, but in practice com- pulsory attendance is seldom if ever enforced in certain parts, owing mainly to the difficulty of providing suitable schools within reasonable access. In 1900 there were 932 schools in the state, 2217 teachers, and 108,070 scholars. Of private schools the number in 1900 was 173, with 664 teachers and 14,653 pupils. Exclusive of coloured aliens, almost the whole adult population can read and %mte. In 1900 the sum spent on education was ❓❓289,509 13s. 2d. In primary schools the annual cost per scholar, calculated on the net enrolment, was ❓❓2 14s. 4Jd. Masters and mistresses of state schools are paid by the Government according to their educational status, the number of chOdren, and the pro- ficiency of instruction. Ten grammar schools are endowed by the state. By a system of competitive scholarships the Government gives free education in grammar schools to scholars in state schools, and also three-yearly exhibitions to universities to students who pass an examination of a high standard. State aid is also rendered to schools of art, schools of design, free libraries, and technical schools. The foundation of n university at Brisbane is now con- templated.

Religion. ❓❓❓ There is no state church. Amongst the different denominations the Church of England at the date of the last census numbered 36 "21 per cent, of the population, the Roman Catholics 23-56, the Presbyterians 11-59, the Methodists 7-93, the Lutherans 4 '43, the Baptists 2-60, the Jews 0-21, and other Christian bodies 13'31. Pagans and Mahommedans 4-43.

Justice^ ❓❓❓ The law courts comprise a supreme court, with a chief justice and fonr puisne judges, district courts, and petty sessions courts. In 1899 the number of persons convicted of serious off'ences was 252, and petty sessions convictions amounted to- 18,534. The state police force, including native troopers, exceeds 900 men, and the number of prisons is eighteen.

Defence. ❓❓❓ The land force of 6535 men (of whom 321 were fully paid regulars, 4131 militia paid for each day's drill, and 2083 volunteers)

costs the state ►►70,000 a year. Naval defence is provided for by three armed tenders, two gunboats, five naval brigades, and a picket boat. Thursday Island in the Torres Strait has been strongly fortified at the cost of all the states, and is maintained at their expense, the Imperial Government con- tributing the armament. Queensland's share of the annual charge- for the support of the imperial auxiliary squadron in Australian, waters came to ►►14,031 in 1899.

Post and Telegraphs. ►►► Postal communication is well developed. Every vessel is obliged to give notice of intended departure, in order that mails may be shipped. Mail matter is forwarded coastwise by all suitable steamers, whether subsidized or not, and carried on all railways, travelling post offices existing on the main lines to expedite delivery. Coaches carrying mails and passengers connect with all terminal and many other stations, whilst horse mails run wherever the mails to be carried do not warrant coaches. In this manner nearly all pastoral stations are on or near a mail route of one or other kind, whilst the amount of mail matter carried is very great, and continually increasing. In 1898 there were 19,723,905 letters (1885 = 9,776,407) and 16,778,555 news- papers and packets carried (1885 = 9,949,650) by mail. The number of post offices is 1166, against 623 for 1885. The revenue of the postal department, exclusive of telegraph and telephone, for 1898 was ►►182,206 (1885 = ►►97, 651), whilst the expenses, including telegraph and telephone, amounted to ►►313,771. Postal notes are largely used, the number of notes issued and paid for 1898 being 481,069, having a value of ►►183,360. The number of money orders issued and paid was 217,910 (1885 = 137,479), valued at ►►835,981 (1885=►►514,593). Counting all routes once only, the, land distance over which mails are carried is stated to be 32, 127 miles. A parcel post was established by the post oflSce in 1892, and has grown to considerable proportions, carrying 238,240' parcels in 1898. Branches of the Government savings bank are opened at each staff post office, besides other places, there being 147 branches now open. Telegraph offices exist in every town, and there are offices in the bush. In most towns they are com- bined with the post offices. There are 422 offices open (1885 = 259), there being now 10,088 mUes of line open (1885 = 7533), and 18,565 miles of wire (1885=12,290). The total cost of construction of telegraph

lines is ►►912,175, the revenue for 1898 being ►►79,831. the number of messages despatched and received being 1,334,846. Telephones are now very largely used in all the principal towns, there being 1516 subscribers. Receipts from telephones amounted to ►►8896 in 1898. There are eight exchanges, and 1334 miles of wire.

Banks. ►►► Eleven banks have been established. In 1900 treasury notes issued through the banks amounted to ►►388,833, deposits to ►►13,653 775, total liabiHties to ►►14,190,560, coin and buUion to

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►►1,879,326 ; advances to ►►12,599,306, total assets to ►►16,257,443. There were 84,796 depositors in tlie Government savings bank, with ►►3,624,740 to their credit.

The writer desires to acknowledge his indebtedness to Mr "William H. Eands, the Government Geologist, for notes on the geology ; to Mr F. Manson Bailey, F.L.S., for notes on the ilora ; and to Mr C. W. De Vis, M.A., for notes on the fisheries and on the fauna. (j. v. c.)

II. Histoey.

Queensland was separated from New South Wales by an Order in Council of 13th May 1859. The constitution, which was based upon the New South Wales Act of 1853, provided for 16 electoral districts, with a representation of 26 members. A Legislative Council was also formed, to which the governor of New South Wales, Sir William Denison, appointed 5 members, to hold office for four years, and Sir George Ferguson Bowen, the first governor of the new colony, 8 life members. Mr Robert George Wyndham Herbert was the first premier and colonial secretary, and held oifice until 1866. Amongst Mr Herbert's colleagues were Mr

(afterwards Sir) Maurice Charles O'ConneU, president of the Legislative CouncU and afterwards lieutenant-governor, i, representative of the pastoralist interest and a commanding personality ; Mr St George Richard Gore ; Mr Arthur Macalister ; Mr Robert Ramsay Mackenzie, a squatter, and leader of the Brisbane party in the House ; the late Mr (afterwards Sir) Charles Lilley, who established free education in 1870; Mr (afterwards Sir John) Bramston ; Mr Joshua Peter Bell, treasurer, a prominent squatter and a man of sterling character ; Mr T. L. Murray Prior, the father- of Mrs Campbell Praed, the novelist ; and Mr George Raff, who represented Brisbane trade, and was long an important figure in the financial and commercial life of the colony. There were thirteen appointments in the first administration, and Mr Herbert alone held oflSce uninterruptedly. Of the 39 representatives in the first Parliament, 20 were pastoral- ists ; the others may be roughly classed as barristers, solicitors, and merchants. The pastoralista were the pioneers of settlement in the colony ; those best known were the Archers of Gracemere, the Bells of Jimboor, the Gores of Yaudilla, the Bigges of Mount Brisbane, Mr (afterwards Sir) Arthur Hodgson, Mr Robert Eamsay, Mr Gordon Sandeman, and Messrs Kent and Wienholt. The white population at the end of 1859 was 25,788, and the exports were valued at ►►500,000.

Mr Herbert's Administration, 1859-186S. ►►► The first Parliament was opened on 29th May 1860. The providing of revenue and the establishment of immigration were the chief matters for considera- tion. The treasury was practically empty, but Sir Saul Samuel, treasurer of New South Wales, took a broad and generous view of the situation, and rendered financial aid, whilst in 1861 the first Government loan of ►►123,800 was authorized, the money being appropriated to public worlcs and European immigration. Labour was so scarce that as early as 1851 the squatters had imported Chinese ; various schemes for the introduction of coolies on a large scale were now mooted, but public opinion was decidedly against any increase in the number of coloured aliens then in the colony. Other matters requiring the attention of Parliament were the en- couragement of settlement throughout the colony's gigantic terri- tory, the discovery and exploitation of her natural resources, the establishment of connexions with the outside world, the construc- tion of railways and telegraphs, education, State aid to new in-

dustries, and exploration of the unknown country in the north and west. In 1859 the educational system was a mixed national and denominational one ; there were 10 schools of the latter class, 1 of the former, and 30 private schools. In 1860 a Board of General Education was established, which extinguished the denominational system and placed the schools under State control. In the same year State aid to religion was abolished. At this time there were 18 places of worship existing, and 3523 persons were returned as attending divine service. The governor, in opening Parliament in 1863, pronounced decisively against the reintroduction of con- victs. In that year Queensland boldly grappled with the extension of colonizing, and a settlement was established at the northerly point of Cape York peninsula by Mr Jardine. During the follow- ing two years ports were opened along the coast, and pastoral occu- pation spread far into the northern and western interiors. The first sod of the first railway, from Ipswich to the Darling Downs, was turned on 15th February 1864. On 1st February 1866 Mr Herbert retired, and Mr Macalister became premier and Mr Mac- kenzie colonial secretary. In the following July the failure of the Overend and Gurney and Agra banks, in the latter of which the Government had public moneys, caused the collapse of a loan which was being negotiated in London. A panic followed : the Govern- ment could not pay the railway contractors, and the navvies em- ployed by them started for Brisbane, threatening to hang the ministers and loot the town. On arrival, however, they were easily headed off to a reserve. By this time the treasury was empty, general insolvency prevailed, and the community appeared to be wrecked. Treasury bills to the amount of ??300,000 were

issued, and the governor in council was authorized to legalize Trea- sury notes, when necessary, as currency, payable in gold on de- mand, to tide over the crisis. Prior to this, however, the treasurer took preliminary steps to issue ??300,000 "Legal Tender Notes " ??? inconvertible "greenbacks" ??? but Sir George Bowen informed the premier that he should veto such a scheme, and suggested the issue of Treasury bills. Mr Macalister thereupon resigned, and Mr Herbert, who had made arrangements to proceed to England (where subsequently he became permanent secretary of the Colonial Office), took office again to help the colony through the difficulty. His second ministry lasted for eighteen

days, and, having passed the Treasury Bills Act, he retired from the public life of Queens- land. The only determined opposition the Herbert ministry met with was from the townspeople's representatives, whose contention was that the squatters dipped too deeply into the public purse for public works expenditure ; but an important factor in the early parliamentary days was the opposition between the Brisbane and Ipswich parties in the House, the latter town aspiring to be the capital of the colony.

*The Discovery of the Goldfields, 1866-1879.**U.v Macalister re-**turned to power in August 1866, and dealt so vigorously -ndth the after-effecfis of the financial crisis that by the end of 1867 affairs had approached their normal condition. A new era was now opened for Queensland by the discovery of gold. The Gympie field was discovered by Nash in 1867, and a big "rush" resulted. In 1872 Mr Hugh Mosman discovered Charters Towers, the premier goldfield of the colony ; and Hann, the rich Palmer diggings. Other important discoveries were also made, and Queensland has ever since been a gold-producing colony. Miaiiig is the founda- tion upon which much of the progress of the colony has been built, and the legislation and records show continuous traces of the influ- ence of the gold-getter. In 1873 Mr John Murtagh Macrossan, a digger, was returned to Parliament expressly as a mining repre-sentative ; and other men of a different stamp from the representa- tives of the squatters and townspeople, who had hitherto composed the House, now began to enter public life. From 1870 to 1879 progress was satisfactory, trade interests were prosperous, and in this decade the foundations of the public and social structure of Queens- land were laid. Agriculture was extended, and sugar growing took the place of cotton cultivation. (The first crop of sugar was grown by the Hon. Louis Hope at Cleveland, about 1862.) Hitherto politics had been non-partisan, and legislation was chiefly of a domestic character. From the time of Mr Herbert's departure until the appearance of Mr Thomas Mcllwraith and Mr Samuel Walker Griffith, the two master spirits of Queensland parliamentary life, the political history of the colony was composed of shortlived administrations, with Messrs Macalister, Mackenzie, Palmer, Lilley, George Thorn, and John Douglas (afterwards Government Resident at Thursday Island) as premiers. Mr Arthur Hunter Palmer (whose administration, from 1870 to 1874, had the longest life), a New*

South Wales squatter, entered the Queensland Parliament in 1866. He was one of the most popular of Queensland's parlia- meni;ary leaders, and has left the impress of his labours on the public works, and educational and defence force systems of the colony. In 1870 Queensland was disappointed in her ambition of becoming the connecting point for Australia -n-ith the European and Eastern cable systems. A company ??? the British Australian Telegraph Company ??? was formed in London to connect Australia by cable with Singapore. The plan provided for a land line from the Queensland telegraphs at Burketown to Port Darwin, in the Northern Territory of South Australia, where the cable was to be landed. Writing on 25th January 1870, the Telegraph Construc- tion and Maintenance Company oHicially informed the governor of Queensland that it had received a contract from the British Aus- tralian Telegraph Company to construct "cables and land lines, to be laid between Singapore and Burketown, in North Australia." The Construction Company deputed Commander Noel Oshorn to negotiate with the Governments of South Australia and Queens- land in reference to the land line ; but on arrival in Adelaide he accepted the offer of the South Australian Government to construct and maintain a telegraph line right across the continent from Port Darmn to Adelaide, and Queensland was informed that the origmal plan had been abandoned. Although the company was thus saved the expense of making and maintaining the Port Dar- win-Burketown line, it was regarded as ha--ing broken faith with Queensland, which had specially pushed on her telegraph system to connect with the proposed line. Owing to this feeling Queens- landers have not always had the facilities for cheap cabling to Europe enjoyed by the other colonies, though the subsequent owners of the cable, the Eastern Companies, were in no way responsible for the act of their predecessors.

A resolution in favour of the payment of members was carried in 1871. In 1872 the first Agent-General in London, Mr Richard Damtrco, was appointed. The same year the Railways Act Amend- ment Act was passed, authorizing the construction of railways by private enterprise, land being offered as compensation for the outlay. Meotoral representation was increased to 42 members. In January

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1874 Mr Palmer resigned, and Mr Macalister came into power for two years, the most important measure of his Government being the State Education Act of 1875, on which the present educational sys- tem is based. Both Messrs Mollwraith and Griffith were members of the Macalister ministry, but the former resigned in October 1874, owing to a ditference of opinion as to a proposed land-grant railway from Dalby to Normanton. In 1878 Mr (afterwards Sir) James Francis Garriok first became a cabinet minister, joining the Douglas ministry as secretary for public works and mines.

The governors of Queensland from separation to 1901 were : ❖❖❖ Sir George Bowen (d. 1899) [1859-68] ; Colonel Samuel Wensley BlackaU (d. 1871) [1868-71] ; the Marquis of Normanby (d. 1890) [1871-74] ; Mr (afterwards Sir) William Wellington Cairns (d. 1888) [1875-77] ; Sir Arthur Kennedy (d. 1883) [1877-83] ; Sir Anthony Musgrave (d. 1888) [1883-88] ; Sir Henry Wylie Norman [1889-95] ; Lord Lamington [1896-1900] ; Sir Herbert Charles Chermside [appointed 1901],

Active PolUics,^ 1879 to 1890. ❖❖❖ On 21st January 1879 the first Mcllwraith administration came into power, and an important extension of local government was one of the early measures passed, divisional boards being formed to take charge of public works in districts not included in mimicipalities. In the following session, 1880, the Opposition, led by Mr Griffith, bitterly opposed the Government proposals on Kanaka labour, land-grant rail- ways, and a European mail service vid ToiTes Straits. The Government, however, concluded an agreement with the British India Steam Navigation Company for a monthly mail service between Brisbane and London for an annual subsidy of ❖❖55,000. The Railway Companies Preliminary Act, giving the governor in council power to ti'eat with persons willing to construct railways in return for grants of 8000 acres of land for each mile of rails laid, was also passed. This measure was generally unpopular, and no railways were built under

its provisions. During the session Mr Griffith impeached the premier in connexion with contracts for the purchase of 15,000 tons of steel railway metals, and their carriage to the colony, made in London whilst Mr Mcllwraith was there in January 1880. A select committee in the colony, and afterwards a Eoyal Commission in London, sub- sequently reported in the premier s favour. The discovery of the celebrated Mount Morgan gold mine, and the initiation of artesian well-boring by Mr E. L. Jack, Government geologist, took place in 1881. In 1883 a great drought prevailed,' and the compulsory stoppage of public works demoralized the labour market. Early in the year information reached the oolonjr that Germany proposed to annex a portion of New Guinea, which, together with other islands in the Papuan Gulf, was becoming of great strategic value to Australia ; and the premier, fearing that it would thus be lost to the empire, instructed Mr H. M. Chester, police magistrate at Thursday Island, to proceed to Port Moresby and take possession of the unappropriated portion of the island in the name of the Crown. This act was afterwards ??? to the indignation of Australia ??? repudiated by Lord Derby ; and, eventually, under the Berlin Treaty of 1886, England and Germany entered into joint possession of that part of New Guinea lying east of 141?? E. In July Sir Thomas Mcllwraith (created K.C.M.G. in 1882) was defeated by 27 votes to 16 on a proposal to arrange for the con- struction of a land-grant railway from Charleville to the Gulf of Carpentaria. The general elections which followed were fought mainly on the questions of coloured labour for the sugar planta- tions and land-grant railways. The Government was defeated, and Mr Griffith formed his first administration. Later in the year the premier drafted the Federal Council Act at Sydney, and through his efforts Queensland eventually joined the Federal Council of Australasia. In 1884 a 10 million Loan Act was passed, intended to secure continuity in borrowing for railway construction, but many of the lines specified were unsurveyed. According to the view now generally held in Queensland, this loan seriously hampered the colony in after years. In 1887 the number of seats iu the Assembly was increased to 72 (the present number), and several reforms were effected in the public service, notably the establishment of the department of agriculture. At the general elections in 1888 Sir Thomas Mcllwraith was returned for North Brisbane, defeating Sir Samuel Griffith (who had been created K.C.M.G. in 1886) by a large

majority, and resumed office as premier and leader of the ” National Party.” Ill-health, however, soon compelled him to leave the colony, and he was succeeded by Mr Boyd Dunlop Morehead. Sir Thomas Mcllwraith’s inflex- ible nature was evidenced all through his public life. On the death of Sir Anthony Musgrave ia Brisbane in 1888, he maintained that the Government should be consulted as to the appointment of the new governor. Lord Knutsford declined to accept this view, and appointed Sir Henry Blake. The premier formally protested, and a deadlock ensued, which was only removed by the resignation of the governor-designate. In 1889 payment of members at the rate of ––300 a year, plus Is. 6d. per mile travelling expenses, was established. In 1890 a financial crisis arose. Sir Thomas Mcllwraith had returned to the colony and dissociated himself

from the ministry. He conferred on the situation with Sir Samuel Griffith, and a want-of-confidence motion was nearly carried. Mr llorehead resigned, and a coalition ministry, with Sir Samuel Griffith as premier, chief secretary, and attorney-general, and Sir Thomas Mcllwraith as treasurer, was formed. An agitation for the separation of Queensland into two or three separate colonies ––– mentioned as early as 1866 ––– was very marked during this period. It took formidable shape at Towns- ville in 1882, the chief argument in its favour being that the north and central districts did not get a fair share of the public expenditure. Delegates were sent to London on several occasions to interview the Colonial Secretary, but success did not attend these direct appeals. Sir Samuel Griffith’s Decentralization Bill of 1890, which proposed to erect separate legislatures in the three divisions with powers of local government, was a blow to separa- tionists, and the agitation gradually disappeared.

The Ldbour Party in Politics, 1890 to 1900. ––– The decade from 1890 to 1900 was chiefly notable, apart from the accomplishment of Federation, for the rise of the Labour party as a power in politics and the gradual disappearance of the squatter as a dominant factor. In 1890 the old opponents. Sir Samuel Griffith and Sir Thomas Mcllwraith, were still working side by side. The revenue for the year fell short of the estimates by half a million sterling, and a heavy accumulated deficit had to be

grappled with by Parliament. Sir Thomas Mcllwraith, the treasurer, proposed a dividend tax and other imposts, which were agreed to, and a Treasury Bills Act authorizing an issue of ??500, 000 was also passed. A Constitution Act establishing triennial Parliaments, in place of quinquennial, which had hitherto existed, also went through. In August the great maritime strike spread to Brisbane, and crippled trade and commerce for several months. In 1891 a loan for ??2,500,000, which was issued in London under the auspices of the Bank of England, failed. Sir Thomas Mcllwraith reflected strongly in Parliament on the conduct of the Bank of England, and the governor of the Bank wrote to Sir James Garrick, the agent-general, protesting against Sir Thomas Mcllwraith's state- ments, and breaking off relations with the colony ; but mutual explanations afterwards healed the breach.

Litigation was initiated by the London board of the Queensland Investment and Land Mortgage Company against the Queensland directors, on the ground that they had made advances without taking adequate security. The case was tried by the chief justice. Sir Charles Lilley, in 1891 and 1892, the defendants being Sir Thomas Mcllwraith, Sir Arthur Palmer, then president of the Legislative Council, and Messrs F. H. Hart and E. R. Drury. The judge submitted 143 questions to the jury, and though these were answered generally in favour of the defendants, judgment was entered largely for the plaintiff's. On appeal, heard before a specially constituted court, presided over by the late Sir William Windeyer of New South Wales, this judgment was reversed, with costs. Lack of employment and a disastrous strike of bush workers paralysed the colony in this year. The strike began in January at Logan Downs station, where 200 shearers refused to sign the Pastoralists' Convention agreement. This strike was remarkable for the determined and aggressive attitude of the men, and the firm, though conciliatory, manner in which it was handled by Mr (afterwards Sir) Horace Tozer, the colonial secretary, who had to provide military forces and artillery to hold the strikers in check. The trouble lasted many months ; and after it was over a farcically planned plot to seize the central district and proclaim a republic was revealed in the Brisbane Courier. As an outcome of this strike, "New Australia" ???a settlement on communistic lines ???was founded in Paraguay. About 500 bush workers, largely

recruited from Queensland, joined the scheme, and sailed from Sydney in the barque Royal Tar in 1893, under the leadership of William Lane. The experi- ment failed disastrously, and in later years the Queensland Government paid the passages of many of the men back to the colony. The year 1892 was one of gloom and depression : want of money interfered mth public works, and the impending stoppage of Kanaka labour and the low price of sugar almost ruined the planters. Sir Samuel Griffith then announced his conversion to the policy of continuing Kanaka labour for the sugar plantations, and also of land-grant railways. An Act was passed authorizing agreements with companies for the extension of the tnmk lines on this principle ; but the measure was unpopular, and no trans- actions under the Act are recorded. Financial depression reached its height in 1893 : the salaries of ministers and civil servants were reduced, and drastic retrenchments were made in every depart- ment. In February 107 inches of rain fell at the head of the Brisbane river, and enormous losses were caused by the resulting floods ; several vessels, including the Queensland Government gunboat Paluma, were washed into the Brisbane Botanic Gardens, and left high and dry when the waters subsided. A second flood followed hard on the heels of the first and caused further losses. Rockhampton, Bowen, Townsville, and other places also suffered severely from floods. On 13th March Sir Samuel Griffith was*

gazetted chief justice, and on the 27th Mr (afterwards Sir) Hugh Si. Nelson became premier and treasurer, and Sir Thomas Mcllwraith chief secretary and secretary for railways. Parliament was dissolved on 3rd AprU, and after the general elections the ministry returned with 38 supporters, against Labour, 16, and Opposition and Independent, 18. During the month several financial institutions suspended payment, and on 15th May the Queensland National Bank closed its doors. Parliament was hurriedly summoned to deal with the financial crisis and the question of the Government funds held by the Queensland National Bank.

Treasury notes, issued against coin held by the treasurer, were made legal tender throughout the colony ; an issue of ►►1,000,000 Treasury bills to retire the Treasury notes was authorized, and a series of Acts dealing with the suspended banks were passed. To assist the unemployed, labour and co-opera- tive communities were started, but proved failures. An impetus was given to the sugar industry by the Sugar "Works Guarantee Act, which authorized the treasurer to guarantee debentures issued by companies for the erection of sugar mills and plant. In 1894 little legislation was achieved, the policy of the Government being directed towards national rehabilitation. In 1895 Sir Thomas Mcllwraith left the colony for London, where he died on 17th July 1900. Sir James Garrick, agent-general, retired in 1895, and Mr Charles Shortt Dioken, who had acted as secretary to the agency since 1880, was gazetted acting agent-general, and held the position until the appointment of Sir Henry Norman as agent – general in November 1896. Mr Dioken was also acting agent – general during the interregnum which existed between the resignation of Sir Henry Norman and the appoint- ment 0' ^ir Horace Tozer in 1898. At the general election of 1896 the Labour party slightly improved its position. In that year a committee of investigation reported a heavy deficit in the aflFairs of the Queensland National Bank, and made certain recom- mendations. In 1897 the bank was reconstructed a second time upon terms very favourable to the institution. An Act was passed granting powers to a company to construct a railway from the rich raining district of GhHlagoe to the terminus of the Cairns railway at Mareeba ; at the end of fifty years the State will have the right to acquire the line. In April 1898 the Queensland-born statesman, Mr T. J. Byrnes, whose early death iu the following September was lainented throughout Australia, succeeded Sir Hugh Nelson as premier. The late Mr (afterwards Sir) J. R. Dickson, Mr Robert Philp, and the late Mr J. Vincent Chataway, the latter an authority on the sugar industry, were members of this administration. On 24th October the trial of the three ex-directors of the Queensland National Bank, Messrs F. H. Hart, B. D. Morehead, and A. B. Webster, was commenced. The prosecution was instituted by the Government, on the advice of three barristers to whom the report of the committee of investiga- tion iuto the affairs of the bank, which sat in 1897, was submitted. After a trial lasting 12 days, a verdict of "Not guilty" was returned. Proposals for the acquisition of 250,000 acres of land in New

Guinea, made by a syndicate of London capitalists, were provi- sionally agreed to, but were eventually rejected, owing to a popular outcry raised in the colony and in New South Wales' and Victoria.

Federation was a burning question in the neighbouring colonies during the year, but Queenslanders generally took little interest in the movement, and the colony was not represented at the Federal Convention at Melbourne when the Commonwealth BUI In 1899 Mr Dickson, who had succeeded Mr

Byrnes as premier, was enlisted on the side of the " Billites," and in June of that year an Enabling Bill was passed. In September the Referendum supported the Act by the narrow majority of 7492 votes on a poll of 69,484. Towards the end of the second session the ministry narrowly escaped defeat on the Railway Standing Committees Bill, and resigned. Mr Dawson, leader of the Labour Opposition, then formed a ministry, and held office from 1st December to 7th December 1899. He was then defeated on a motion by Mr R. Philp, and resigned, and Mr Philp became premier, and was in power when Queensland joined the Common- wealth. The year was shadowed by the continuance of a terrible drought, which towards the end of 1900 became so aggravated that the revenue began to fall off, owing to decreased receipts from railways and land. In that year Mr Philp's chief policy was the passing of legislation to permit of the construction of railways by private enterprise. The Labour party offered vigorous opijosition ; but notwithstanding this ►► certain amount of progress was made. The Government appointed Dr Maxwell, an American sugar expert, to superintend the sugar industry in the colony ; a State school of mines was established at Charters Towers ; and the compulsory clauses of the Education Act were put in force for the first time. Another Act of importance was the establish- ment of a Government land bank. A powerful agitation for the extension or renewal of the leases of pastoral lands was raised, but no legislation resulted. A suggestion that Sir Samuel Griffith should retire from the chief justiceship, on a pension of ►►1750

a year (to be reduced by any emoluments received), to enable him to enter Federal politics, fell through. Some important discoveries of coal were

made during the year, and dredging the northern rivers for gold became an established industry. Mr J. R. Dickson represented the colony in London at the conference of Federal delegates in 1900, when the final details of the Common- wealth were settled. Early in 1901 he was created K.C.M.G., but died somewhat suddenly, at Sydney, on 9th January of that year, shortly after he had been made a member of the first Federal ministry.

Alien Immigration. ??? The geographical position of Queensland, with almost half her territory lying within the tropics, has been fruitful in public questions bearing upon the immigration of Asiatics and South Sea Islanders. The lands lying along the northern coast are well suited for the cultivation of sugar, eoflfee, and other tropical produce, to grow which, profitably, cheap labour is required. The working classes of Queensland have always objected to the presence of coloured aliens, and successive Govern- ments have legislated against indiscriminate immigration into the colony. In 1876 Governor Cairns resei-ved an Act imposing certain disabilities upon Chinese working on gold-fields. In that year a poll tax of ??10 was imposed upon Chinese arriving. In 1884 another principle was adopted : masters of ships were only allowed to carry to Queensland ports one Chinese for every 50 registered tons, and the poll tax was increased to ??30. In 1888 Queensland took the lead in summoning an intercolonial conference on Chinese immigi'ation, the outcome of which was the adoption of uniform legislation : in the Queensland Act passed that year the main provision was that only one Chinese for every 500 registered tons should be permitted to be carried to the colony from Chinese ports. The poll tax was then abolished. This Act was also reserved, but received the Royal Assent on 5th February 1890, after slight modification had been made.

Treaty arrangements with Japan had been carried through by the Imperial Government, at the initiation of Queensland, under which the Japanese Government undertook to prevent the emigration of coolies to the colony ; and a Pearl Shell Fisheries Act was passed in 1895 placing restrictions upon the acquisition of vested interests in the industry by Japanese and other aliens. At Federation eight Acts ??? two Imperial and six local ??? regulated the importation of Kanakas from the

South Seas : that of 1880 was the basis of the system under which Kanakas were recruited in the islands, brought to the colony in schooners, employed there, and returned to their homes at the end of their three years' engagements. The 1884 Act confined Kanakas to field work. In December 1884 a Royal Commission was appointed, consisting of Messrs W. Kinnaird Rose, J. F. Buckland, and Hugh M. MUman, to report upon the system of recruiting Kanakas. Followiog the report sf the Commission, which was in effect that many islanders had been recruited "by force and fraud," Sir Samuel Griffith, then premier, introduced the important Pacific Island Labourers Amendment Act of 1885, which stopped the importation of Kanakas after 1890. It was ??? and is ??? an article of faith with the working classes that white labour could be utilized for sugar cultivation. Yet from the passing of the Act the sugar industry began to decay, no fresh capital was put into it, plantations dwindled down in value 50 to 75 per cent. , mills were closed, and the magnificent iudustry threatened to die out. Sir Samuel Griffith, being converted by these signs of the times from his position that sugar could fiourish in the colony without coloured labour, issued on 12th February 1892 his "Manifesto to the People of Queensland, " in which he acknowledged that to prevent the collapse of sugar-growing it was necessary to resume the immigration of Polynesians. This manifesto was the forerunner of the 1892 Act, which reintroduced Kanaka labour. After 1892 no further legislation on this subject was passed, and the recruiting of South Sea Islanders took place on a reduced scale. The Kanakas iu the colony in 1900 numbered 8795, and the Chinese 10,000 ; the whole of the coloured aliens represented only between 4 and 5 per cent, of the population.

Land Legislation. ??? In Queensland's early daj's, with the pre-dominance of the squatting class, the lands were freely leased in large blocks for sheep and cattle gi-azing. It was the squatter who furnished 50 per cent, of the public revenue with his rents, and who opened up the great interior by his pioneering enterprise. As, however, population increased, the necessity for the agricul- turist arose, and it became requisite to legislate in the interests of the small holder. Successive Queensland Governments have had some of their hardest work in adapting their land legislation to the needs of the community, recent

policy being to reduce large estates and place the cultivator on the soil. At separation from New South Wales the holding of land was regulated by Orders in Council, under an Imperial Act of 1846 : untransferable leases of "runs" for fourteen years were issued, the minimum size of the run was measured in sheep-carrying capacity ❖❖❖ 4000 sheep being the least number, and ❖❖ 10 the minimum rent. The lessee was able to buy up his holding in blocks of 160 acres at a time, ❖❖ 1 per acre being

the minimum price, and was entitled to a renewal of his lease at its expiry. The minimum lease principle shut out the small agriculturist. The first leading Acts passed by Queensland were the Crown Lands Alienation Act of 1868, dealing with the settled districts, and the Pastoral Leases Act of 1869, dealing with the unsettled districts ❖❖❖ these divisions were fixed by the first-named measure. The "resumption" principle was introduced by the 1868 Act: lands in the settled districts were resumed after twelve months from the passing of the measure, and lessees were granted leases of half of their holdings for ten years ; the other moiety was thrown open for settlement. The 1869 Act granted new leases for twenty-one years at practically the same low rentals, but 10 per cent, was added to the rent after each period of seven years ; the area of a run was fixed at from 25 to 100 square miles. This Act greatly

pleased the squatters. In 1884 the Button Act was passed. Its importance lies in its dealings with the 1869 Act leases : on their expiry the State resumed from one-quarter to one-half of the area as Crown lands, which were thrown open to selectors, and new leases from ten to fifteen years were granted for the balance. Grazing farms (20,000 acres) and agricultural farms (1280 acres) were established. This measure was- very unpopular with the squatters. With the Act of 1897 it forms the basis of the existing land regulations of Queensland. Under the 1897 Act the passing of the land into the hands of agriculturists was further marked by the creation of agricultural homesteads (160, 320, or 640 acres), grazing homesteads (20,000 acres), scrub selections (10,000 acres), and unconditional selections (1280 acres). Some of these classes of selections could be purchased right out, and all were leased at extremely moderate rates. Sales of country lands were established. Two measures were passed in 1894 and 1897 ??? the Agricultural Lands Purchases Acts ??? under which the State was authorized to purchase suitable estates of specially fertile land already alienated, to be cut up and thrown open as agricultural farms. These measures confirmed Queensland's determination to

encourage agriculture. Owing to the expiration of pastoral leases and the faet that no legislation existed for their renewal for a term long enough to encourage the investment of capital, a formidable agitation prevailed in the colony, the lessees bitterly complaining of the uncertainty of their tenure. The British Australasian Society was formed in Great Britain, to protect the interests of British capital invested in the pastoral industiy in Queensland. In 1900, out of the total Queensland area of 427,838,080 acres, no less than 411,793,786 acres remained in the hands of the State unalienated. /j. t. CE.)

QueenstOWn, a seaport, urban sanitary district, and important naval station, in tte county of Cork, Ireland, on the south side of the Great Island in Cork harbour, 13 miles east-south-east of Cork by rail. Of late years the local authorities have expended large sums of money in widening the streets, providing public baths, and improving the water supply. The harbour contains three islands ??? Spike, the Rocky Island, and Haulbowline, where extensive docks have been erected by the Govern- ment. Population, about 9000.

QueenstOWn, a town of Cape Colony, in the upper valley of the Great Kei river, about midway between East London and Aliwal North, with both of which places it is connected by raO. It is well situated in the abundantly watered and fertile district between the Great Winterterg and Stormberg ranges, which was formerly inhabited by the Tambuki branch of the Ama-Xosa Kaffres. Queenstown is a prosperous agricultural centre, with a population which rose from about 2500 in 1887 to over 3000 in 1900.

Quelima,ne, Kilimane, or sio Maetinho de

QtJELiMANE, a town of Portuguese East Africa, capital of the district of Zambezia, 14 miles above the mouth of the river Bons Signaes, with anchorage in the stream in over 30 feet of water. It has a trade in copra, almonds, sesamum, indiarubber, coffee, wax, ivory, and skins, and produces rice, millet, and beans. The trade aggregates barely ►►200,000 per annum. Soap and oil are manufac- tured here. Population, 3000.

Quelpa.rt (Chai-ju), an island used by Korea as a penal settlement, situated in 126►►10' to 126►►57' E., and 33►►11' to 33►►35' N. It is 40 miles from east to west and 17 from north to south. It rises gradually from the sea-board, is heavily wooded, and is cleared for cultiva-

tion to a height of 2000 feet. There are several crateriform hills, and Hali San (Mount Auckland) has an altitude of 6558 feet. The island is entirely volcanic, and the soil is finely disintegrated lava. Broken black lava forms the beach, and blocks of it are the universal building material There is no good drinking water. There are no good harbours, and the only anchorage for large vessels is Tai-chong, or Yung-su, at the east end, with from 9 to 1 3 fathoms of water.

Population and Industries. ►►►The officially estimated population is 100,000, Korean by race, language, and costume. There are 3 magistracies and 90 villages. The valleys and slopes are carefully cultivated in fields divided by stone walls, and produce beans, peas, sweet potatoes, ” Russian turnip radish,” barley, a little rice, and miUet, the last being the staple article of diet. Nuts, oranges, limes, and plums are grown. Small but strong ponies are bred for export, and small cattle and pigs for home use. Apart from agriculture, the industries consist in the manufacture of fine bamboo hats and mats, and wooden combs for export and local use. For fishing the islanders use double-decked raft boats, similar to those of southern Formosa. Their lucrative pearl fisheries have been practically monopolized by the Japanese, who use proper diving apparatus. A valuable product is a species of clam, the shell of which furnishes a specially iridescent mother-o’-pearl, which the natives barter with the’ Japanese for inlaying lacquer. European goods are not

imported, but Japanese articles find ready barter. There are no markets, and only a very few poor shops.

Capital. ❓❓❓ Chu-song, the capital and seat of Government, a few miles from Port Pelto, has a black lava wall 25 feet high, with three gates and towers ; an imposing audience- hall in Chinese style ; and a great bell tower, with a fine bronze bell, sounded to drive off "evU dragons." Its population is estimated at 16,000. The governor has a hereditary army for coercive purposes. The uniform is a complete suit of mail, with a helmet, from which leather curtains fall over the shoulders. The weapons are equally antique. Pelto has ancient breakwaters for the protection of small boats, erected, many believe, by the Mongol conqueror, Khublai Khan, who in 1273 built on Quelpart 100 ships for the invasion of Japan.

Flora and Fauna. ❓❓❓ These are scarcely yet investigated. Pines of three species, junipers, larches, oaks, maples, vrillows, and the Thuja Orientalis, have been identified. The known fauna comprise boars, bears, deer, swans, geese, pheasants, and quail. The roads are scarcely passable bridle tracks. Quelpart was introduced to European notice by the Dutchman, Hendrik Hamil, who was shipwrecked there in 1653. (i. l. b.)

Quental, Anthero de (1842-1891), Portu- guese poet, was born on the island of St Michael, in the Azores, 18th April 1842. He studied at the University of Coimbra, and soon distinguished himself by unusual talent, as well as turbulence and eccentricity. He began to write poetry at an early age, chiefly, though nqt entirely, devoting himself to the sonnet. After the publication of one volume of verse, he entered with great warmth into the revolt of the young men which dethroned CastUho, the chief living poet of the elder generation, from his place as dictator over modem Portuguese hterature. He then travelled, engaged on his return in political and socialistic agitations, and found his way through a series of dis- appointments to the mild pessimism, a kind of Western Buddhism, which animates his latest poetical productions. His melancholy was increased by a hopeless spinal dis- ease, which after several years of retirement from the world, eventually drove him to suicide in his native island,

*QUERET ARO- ARTE AGA***QU ETTA**

11 til September 1891. Antliero stands unquestionably at tbe head of modern Portuguese poetry after the unrivalled Joao de Deus. His principal defect, in a strictly poetical point of view, is monotony his own self is his solitary theme, and he seldom attempts any other form of composi- tion than the sonnet. On the other hand, few poets who have chiefly devoted themselves to this form have produced so large a proportion of really exquisite work. The com- paratively few pieces in which he either forgets his doubts and inward conflicts, or succeeds in giving them an objective form, are among the most beautiful in any litera- ture. The purely introspective sonnets are less attractive, but equally finely wrought, interesting as psychological studies, and impressive from their evident sincerity. His mental attitude is well described by himself as " the effect of Germanism on the unprepared mind of a Southerner." He had learned much, and half-learned more, which he was unable to assimilate, and his mind became a chaos of conflicting ideas, settling down into a condition of gloomy negation, save for the one conviction of the vanity of existence, which ultimately destroyed him.. He will live not more by the beauty of his style and diction than by the truth of self- portraiture. As a prose writer he dis- played almost equal ability, but the same want of balance and sound judgment. A healthy participation in public affairs might have saved him, but he seemed incapable of entering upon any course that did not lead to delusion and disappointment. The great popularity acquired, notwith- standing, by poetry so metaphysical and egotistic is a striking testimony to the artistic instinct of the Portuguese people. Much of the charm necessarily evaporates in translation, yet Quental has been ably rendered by Mr Edgar Prestage in English and by Dr Storch in German.

(e. g.)

Querdtaro-Arteagfaja state of Mexico, bounded on the N. by San Luis Potosi, on the E. and N.E. by Hidalgo, on the S.E. by Mexico, on the S? by Michoacan, and on the W. by Guanajuato. Area, 3.558 square miles. Population (1879), 203,250; (1900), 228,489. The trade of the state may be estimated at about $10,000,000 (Mexican currency) a year, and

consists principally of cereals, fruits, jerked meat, and mineral products. The Mexican Central Kailway traverses the state, and there are numerous tramway lines. The capital, Quer^taro, or Dis- trito del Centro, with a population of 34,576 (1895), is situated some 134 miles from the city of Mexico. Besides its commercial importance, this city is interesting histor- ically as the birthplace of Mexican independence, and the last refuge and place of execution of the emperor Maxi- milian. It has fine public buildings, among which the Federal Palace and the Government Palace (both built of basalt), the Municipal Palace, the Cathedral, and the historic Iturbide Theatre should bo mentioned. An excel- lent aqueduct, 5 miles long, suppHes the city with water. Amongst other important towns are San Juan del Eio (9040 inhabitants), Landa (6324), Ahuacatlan (5929), Jalpan (5131), and Toliman, noted for its opals.

Quesada y Matheus, Jenaro de (1818-

1889), 1st Maequis of Mieavalles, Spanish soldier, was born at Santander, 6th February 1818. He was a son of General Vicente Quesada, a Conservative officer who was murdered and atrociously mutilated in the streets of Madrid by a revolutionary mob in the early days of Queen Isabella's reign. As Quesada belonged to an ancient family con- nected with the dukes of Fernan Nunez, he was made a cornet when only six years old, was educated at the seminary for nobles, and in 1833 was promoted lieutenant in the 1st Foot Guards. He served from 1833 to 1836 against the Carlists. When his father was assassinated in

1836 he resigned, went to France, got employment in a merchant's office, and was only induced to return to the army in 1837 by his relatives, who got him a company in the guards. He distinguished himself often in the Carlist war, but his promotion was slow, and he declined to have anything to do with politics. He confined himself to his duties as a soldier, always fighting on the side of Govern- ments against Carlist, Republican, and Progressist risings. He only became a general of division in 1853, and at the head of the Madrid garrison he fought hard in 1854 to avert the triumph of Espartero, O'Donnell, and Dulce, who publicly recognized his gallant conduct. When the war in Morocco broke out. Marshal O'Donnell gave Quesada the command of a division, which played so conspicuous a

part in that campaign and at the battle of Wad el Eas that its commander was made lieutenant- general and grand cross of Charles III. He was director- general of the Civil Guard when the military rebellion of 22nd June 1866 broke out in Madrid, and after he had been wounded in the leg he remained at the head of the loyal troops until the insurgents were crushed. He did not accept any military post during the revolution until Marshal Serrano in 1874 offered him the direction of the staff, and he only accepted it after clearly stating that he was a royalist and partisan of Alphonso XII. In his long and brilliant career he never swerved from his steadfast resolve never to be mixed up in any political or military intrigues or pronunciamientos ❓❓❓ to use his own words, " not even to restore my king." As soon as the king was re- stored, the Government of Senor Canovas made Quesada first general-in-chief of the army of Central Spain, and in February 1875 general-in-chief of the army of the North. With the assistance of another officer who also had never dabbled in pronunciamientos, General O'Eyan, Quesada restored discipline in the armies confronting Don Carlos, and for twelve months concerted and conducted the operations that forced the pretender to retire into France and his followers to lay down their arms. The Govern- ment confided t the marquis of MiravaUes the difficult task of ruling the northern provinces for several years after the war, and he succeeded in conciliating the sym- pathies of the Basques and Navarrese, though the penalty of their last rising had been the loss of most of their ancient liberties or "fueros." Quesada was made marquis of MiravaUes, grandee after the war, minister of war in 1883, and senator. Though he was a strict, stern dis- ciplinarian of the old school and an unflinching Con- servative, Catholic, and royalist, even his political and military opponents respected him, and were proud of him as an unblemished type of the Castilian soldier and gentleman. He died at Madrid, 19th January 1889, and was given full military honours. i (a. e. h.)

Quetta, a district and town of Baluchistan, rose to prominence in 1876, when Sir Eobert Sandeman founded a residency there, and first represented the Government of India as the practical ruler of Baluchistan. The name is a variation of the word hrat-kot, signifying a fortress, and the place was locally known as Shdl Kot till adopted officially as Quetta. The name is doubtless derived from tlie_ fortified "

Miri ” or mound, which is the dominant position on the plain whereon the present fort now stands, and beneath which the old town clustered formerly. This prominence is doubtless one of those dead mud volcanres with which Baluchistan abounds. There are some on the Baluch coast still in active operation. The cantonment and civil station of Quetta, which now cover an area of many square miles, and are ever extending their borders, stand in the open plain at a height of about 5500 feet above sea-level, within a ring of gigantic mountain heads (such

as Takatu, Murdar, and CliLltd,n) which overlook it from a height of over 11,000 feet. To the north-west the view is open across the base of the Peshin valley to the Khojak and Kandahar. Southwards is the open valley leading to the Bolan Pass, traversed by the railway. North of Quetta is the open plain leading to Peshin and the Harnai, also traversed by the Sibi-Peshin line of railway, which passes through the fortifications. These defensive works, stretch- ing from the base of Takatu to the foot of the Mashelak hills on the west, bar the way to advance from the Khojak. The actual line of valley which contains Quetta and the Bolan was originally rented from the Kian of KaUt on terms which were changed in 1882 to a quit-rent of 25,000 rupees per annum, and a further compensation of 30,000 in lieu of transit duties in the BoUn. This perpetual leasehold was afterwards extended so as to include Nushki and give the Government of India the command of the trade route to Sistan. The Quetta district is now administered, together with the assigned districts of Peshin, Tal Chotrall, and Sibi (assigned by the treaty of Gandamak as being nomin- ally Afghan territory) by a regular staff of civU officials. During the last quarter of the 19th century Quetta grew from a dilapidated group of mud buildings, with an in- ferior bazaar and a few scattered remnants of neglected orchard cultivation, into one of the most popular stations of the Indian service. A residency was followed by a club- house, and by public buildings of all descriptions, schools, hospitals, and a first-class market-place in the civil station. Drainage, irrigation by artesian wells, and railways followed the extension of military occupation. The Yorktown

quarter, the high, level end of Quetta, sprang into exist- ence, taking its name from its first occupants, the Yorkshire Light Infantry. This rapid evolution has been chiefly due to the energy and foresight of Sir Eobert Sandeman, with whose name the history of Quetta must be ever associated. Quetta is already the trade mart for western Afghanistan, eastern Persia, and much of central Asia.

Indian Survey Reports, 1878 to 1898. Calcutta. ◆◆◆ Thoknton. Life of Sir Robert SaTideman. Loudon, 1896. (t. H. h.)*

QueZciltenang'O, capital of a department of Guatemala, Central America, and the second town of the republic, is situated on the northern slope of the Cerro Quemado volcano, on a high plateau (7700 feet), watered by the Samala, 75 miles west-north-west of Guatemala, and 35 north-east of its port, Champej:ico. A railway is projected to connect it with San Felipe, the actual terminus of the line which runs inward from Champerico. The town is the centre of the trade (in coffee, sugar, and cereals) of western Guatemala, and it has also cotton and woollen manufactures. There are several important educa- tional establishments, including schools of law and of medicine, a school of art, and higher-class schools for boys and girls. Under the name of Xenahu or Xelaluh it was an Indian town before the conquest. From 1838 to 1840 it was the capital of the three departments of the plateau ◆◆◆ Quezaltenango, Solola, and Totonicapum ◆◆◆ which during those years combined to form an independent repubhc. Population, about 27,000, a large proportion being Indians.

Qui Ion, a seaport town of India, on the Malabar coast, in the state of Travancore; situated in 8◆◆53' N. and 76◆◆36' E. Population (1891), 15,375. Formerly a British cantonment ; now the headquarters of the Tra- vancore army, with a subsidiary battalion. There is a cotton mill, with 25,000 spindles, employing 600 hands. It is proposed to construct a railway across the hiUs from Tinneveliy.

Quincy, a city of Ilhnois, U.S.A., capital of Adams county. It is situated in 39◆◆55' N., and 91◆◆25' W., on the east bank of the Mississijjpi river, in the western part of the state, at an altitude of 481 feet. It is buUt

largely on the river bluffs, is regularly laid out, is divided into seven wards, has a water-supply 'pumped from the river, is well sewered, and its business streets are paved with brick. Three railways enter the city, the Chicago, Burlington, and Quincy, the Omaha, Kansas City, and Eastern, and the Wabash ; and these, with boats on the river, give it a large trade. It has prominence as a manufacturing place. In 1890 there were 394 manufacturing establishments, employing 5110 hands, and having a total capital of $6,554,810. The product was valued at $10,395,102. The principal items were flour, foundry and machine – shop products, carriages and waggons, and packed meats. In 1899 the assessed valuation of real and personal property was $4,620,353, indicating a very low rate of assessment. The net debt of the city was $1,148,415, and the rate of taxation was $77.20 per $1000. Population (1890), 31,494; (1900), 36,252, of whom 4961 were foreign -born and 2029 negroes. There were 11,543 persons of school age (5 to 20 years). Of 10,276 males 21 years of age and over, 391 were illiterate (could not write).

Quincy, a city of Norfolk county, Massachusetts, U.S A. It is on the south shore of Boston bay, a few miles south-east of Boston, in the eastern part of the state. It was incorporated as a city in 1888. It is in great measure a residential suburb of Boston, but is noted also for its quarries of Quincy marble, which is widely used as a building stone, and for its manufacture of boots and shoes. It is on a branch of the New York, New Haven, and Hartford Kailroad. Population (1890), 16,723; (1895), 20,712; (1900), 23,899, of whom 7662 were foreign-bom.

Quito, the capital of Ecuador, Central America, situated on the Andine plain, 9300 feet above sea-level, 165 miles north-east of Guayaquil, to which a rail- way is under construction. At present trade is still hampered ty the diflaculties of communication. The ex- ports are chiefly hides and indiarubber. The native manu- factures include saddles, tanned leather, shoes, ponchos, woollen and cotton cloth, sandals, common sacking, blankets, wood-carvings, coarse matting, coarse woollen carpets, and also superior hand-made carpets. Electric lighting was introduced in 1898. The population is about 80,000.

Rabah Zobeir (-

-1900), the conqueror of Bornu (an ancient sultanate on the western shores of Lake Chad, included since 1890 in British Nigeria), was a half - Arab, half-Negro chieftain. He was originally a slave of Zobeir Pasha (q.v.). In 1879, Zobeir being in Egypt, his son Suleiman and Rabah were in command of Zobeir's forces in the Bahr-el-Ghazal. They persisted in slave-raiding, and denied the Khedive's authority, and

Colonel C. G. Gordon sent against them Romulous Gessi Pasha. Gessi captured Suleiman and routed Eabah, who in July 1879 fled westward with some seven hundred Bazingirs (black slave soldiers). During the next fourteen years Eabah overran various states of Central Africa, defeating the sultan of Wadai and establishing himself in Bagirmi, a state south-east of Lake Chad. In 1893 Eabah overthrew the sultan of Bornu. He could not have been

successful in this campaign but for the very strong dis- content against the reigning family that had existed for some years in Bornu. To the British, represented by the Eoyal Niger Company, Eabah gave comparatively little trouble. During 189J:~~95 he continually (but unavail~~ ingly) asked the Company's representatives at Yola and Ibi to supply him with gunpowder. Kabah then tried threats, and in 1896 all communication between him and the Company ceased. Early in 1897 he began an advance in the direction of Kano, the most important city in the Fulani Empire. The news of the crushing defeat by Sir George Goldie of the Fulahs at Bida, and of the capture of Ilorin, induced Kabah to return to Bornu. He gave the British no further trouble, but turned his attention to the French. M. Gentil had in this same year (1897) reached Lake Chad, vid the Congo and Bagirmi, and had installed a French resident with the sultan of Bagirmi. Years before (in 1891) Rabah had killed M. Paul Cramp- bel, who had led an expedition towards Lake Chad, and now, as soon as M. Gentil had withdrawn, Rabah again fell upon Bagirmi, and forced sultan and resident to flee. In 1899 the French sent an expedition to reconquer the country, but at first they were unsuccessful. In the summer of 1899 Rabah attacked and routed the French advanced post,

held by Naval-Lieutenant Bretonnet, and the latter was killed. In October following another battle was fought, in which the French, under Captain Robillot, completely defeated Rabah, who retreated north-east towards Wadai. Gathering a fresh army, he returned to Bagirmi and joined issue with the French a third time. In a battle fought in April 1900 Rabah was slain and his host defeated. The chieftain's head was cut off and taken to the French camp. In this engagement Major Lamy, the French commandant, also lost his life.

The French continued the campaign against Rabah's sons, two of whom were killed. Rabah had left instructions that if his army was finally defeated by the French, his successor should return to Bornu and make friends with the British. Rabah's third son, Fader-Allah, accordingly threw himself entirely upon British protection. He made a favourable impression, and it was contemplated to recognize him as sultan of Bornu. However, in the later part of 1901 Fader-Allah, who had 2500 riflemen, again made aggressive movements against the French. In retaliation, Captain Dangeville pursued him into British terri- tory. A battle was fought at Gujiba, Fader- Allah being defeated. He fled mortally wounded, and died the same night, being buried in the bed of a small river, the course of which had been diverted for the purpose. In consequence of these occurrences General Lugard, High Commissioner of Northern Nigeria, despatched to Bornu, in January, 1902, a force under Colonel Morland, the result being the efi'ective establishment of British rule in that country. The French force which had remained in Bornu retired as Colonel Morland approached Lake Chad. (p. e. o.)

Ra.b□□lt {Rthdt el Fateh) is only of importance in these days as one of the Moorish ports open to foreigners, which is not the case with its older vis-a-vis, Salli. A few merchants, some of whom hold consular appointments, and missionaries, form a small foreign colony ; but the growth of trade is slow, as the bar in the river hampers the shipping. Exports: 1896, □□31,819; 1897, □□42,877; 1898, □□42,.5.36; 1889, □□22,457; 1900, □□20,071. Imports: 1896, □□140,064; 1897, □□110,488 ; 1898, □□111,861 ; 1899, □□110,384; 1900, □□95,440. Shipping: 1897, 58,349 tons; 1898, 541,526 tons; 1899, 65,324 tons; 1900, 37,758 tons. Population, probably 30,000.

Racine, a city of Wisconsin, U.S.A., capital of Racine county. It is situated in 42 43' N., and 87 47' W., on the shore of Lake Michigan, 62 miles north of Chicago and 23 miles south of Milwaukee, on the Chicago, Milwaukee, and St Paul and the Chicago and North-Western railways, at an altitude of 627 feet.

It is regularly laid out on a level site, divided into seven wards, and has a water-supply from the lake. It has a good harbour, and a share of the lake commerce. Its manufactures in 1900 were carried on by 252 estab- hshments, with a total capital of $16,753,215. They employed 6785 hands, and the product was valued at $12,502,796. The principal articles of manufacture are agricultural implements, carriages and waggons, for which Racine is widely known. These articles form not far from one-half the value of all the manufactured goods. Popula- tion (1890), 21,014; (1895), 24,889; (1900), 29,102, of whom 9242 were foreign-born.

Ra.Cingf. See Hoeseeacing.

Ra.ClautZ, a town in the Austrian duchy of Bukovina. Population (1890), 12,895; (1900), 14,343 (estimated, 68 per cent. Germans, 25 per cent. Rumanians, 4 per cent. Poles, and 3 per cent. Ruthenians. There is a German upper gymnasium and a Protestant church. The Govern- ment stud contains over 1400 horses.

RsldclifFe, a town, urban district (1894), and parish, in the Radcliffe-cum-Farnworth parliamentary division of Lancashire, England, 7 miles north-west of Manchester by rail. Technical schools were erected in 1896, and a public swimming bath was opened in 1899. Dyeing, paper-making, iron founding, and machine-making have become important industries. Population of urban district (1881), 16,267; of extended area (1891), 24,972 ; (1901), 25,368: of the parliamentary division (1881), 63,086;

(1891), 72,931 ; (1901), 78,298.

Rcldeberg', a town of Germany, on the Grosse Roder, 8 miles by rail north-east by east of the town and in the circle of Dresden, kingdom of Saxony There are important glass-works. Near by is a dairy and cheese institute. Population (1890), 8740; (1900), 12,918.

Radiation, Theory of. ◆◆◆ 1. The foundation

of this subject is the principle, arrived at independently by Balfour Stewart and Kirchhoff about the year 1858, that the constitution (◆◆ 6) of the radiation which pervades an en- closure, surrounded by bodies in a steady thermal state, must be a function of the temperature of those bodies, and of nothing else (see Radiation, Ency. Brit. vol. xx.). It was subsequently jiointed out by Stewart {Brit. Assoc. Iie]iort, 1871) that if the enclosure contains a radiating and absorbing body which is put in motion, all being at the same temperature, the constituents of the radiation in front of it and behind it will differ in period on account of the Doppler effect, so that there will be an opportunity of gaining mechanical work in its restoration to a uniform state ; there must thus be some kind of thermodynamic compensation, which might arise (see Radiation, Eucj/. Brit. vol. XX.) either from ethereal friction, or from work required to produce the motion of the body against pressure exerted on it by the surrounding radiation. The hypothesis of friction is now excluded in ultimate molecular physics, while the thermodynamic bearing of a pressure exerted by radiation has been more recently developed by Bartoli and Boltzmann (1884), and combined with that of the Doppler effect by W. Wien (1893).

The original reasoning of Stewart and Kirchhoff rests on the dynamical principle, that by no process of ordinary reflexion or transmission can the period, and therefore the wave-length, of any harmonic constituent of the radiation be changed ; each coristituent remains of the same wave- length from the time it is emitted until the time it is again absorbed. If we imagine a field of radiation to be enclosed within perfectly reflecting ^Yalls, then, provided there is no material substance in the field which can

radiate and absorb, the constitution of the radiation in it may be any whatever, and it will remain permanent. It is only the presence of material bodies that by continued emission and absorption can transform it

towards the unique constitution which corresponds to their temperature. We can define the temperature of a uniform field of radiation, of this special constitution and travelling in all directions indifferently, as the temperature of the material bodies with which it would thus be in equilibrium. Further, the mutual independence of the various constituents of any enclosed field of radiation allows us to assign a temperature to each constituent, such as the part involving wave-lengths lying between A, and X -h 8A ; that will be the temperature of a material system with which this constituent by itself is in equiUbrium of emission and absorption. But to. reason about the temperature of radiation in this way we must be sure thg,t it completely pervades the space, and has no special direction ; the question of the temperature of a directed wave-train, such as a beam of light, will come up later. The temperature of each constituent in a region of undirected radiation is thus a function of its waverlength and its intensity alone. It is the fundamental principle of thermodjniamics, that temperatures tend to become uniform. In the present case of a field of radiation this equalization cannot take place directly between the various constituents of the radiation that occupy the same space, but only through the intervention of the emission and absorption of material bodies; the constituent radiations are virtually partitioned off adiabaticaUy from direct equilibrium. Thus in discussing the transformations of temperatures of the constituents of radiation we are really reasoning about the activity of material bodies that are in thermal equilibrium with those constituents; and the theoretical basis of the idea of temperature, as depending on the fortuitous element in molecular motions, is preserved.

2. Mechanical Pressure of Undulatory Motions. ❓❓❓Con- sider a wave-train of any kind, in which the displacement is ^ = a cos m{x--ct) so that it is propagated in the direc- tion in which x decreases ; let it be directly incident on a perfect reflector travelling towards it Tvith velocity v, whose position is therefore given at time thy x = vt. There will be a reflected train given by i' = a cos m (x – ct), the velocity of propagation c being of course the same for both. The disturbance does not travel into the reflector, and must therefore be annulled at its surface ; thus when a; = v< we must have ^ 1 ^' = 0 identically. This gives a = -a, and m'(c -❓❓❓❓❓) = m{c + v). The amplitude of the reflected disturbance is

therefore equal to that of the incident one; while the wave-length is altered on the

ratio ^^^, which is approximately 1 ◆◆◆ 2u/c when v/c is

c + v small, and is thus in agreement with the usual statement of the Doppler effect. The energy in the wave-train being half potential and half kinetic, it is given by the integra- tion of p{dildty along the train, where p represents density. In the reflected train it is therefore augmented,

◆◆◆ 1 ◆◆◆ /c-l-u\2

when equal lengths are compared, m the ratio \^◆◆◆^) ;

but the length of the train is diminished by the reflexion

(J y

in the ratio ; hence on the whole the energy trans-

c + v

mitted per unit time is increased by the reflexion in the

of the energy in a length c + v oi the incident wave-train ;

ratio

c + v

This increase per unit time can arise only

from work done by the advancing reflector against pres- sure exerted by the radiation. That pressure, per unit

2

surface, must therefore be equal to the fraction j◆◆◆ ^

c ⁇⁇⁇v' thug it is the fraction g , .j of the total density of energy

in front of the reflector, belonging to both the incident and reflected trains. When v is small compared with c, this makes the pressure equal to the density of vibrational energy, in accordance with Maxwell's electrodynamic formula.

The argument may be illustrated by the transverse vibrations of a tense cord, the reflector being then a lamina through a small aperture in which the cord passes ; the lamina can thus slide along the cord and sweep the vibratory motion in front of it. In this case the force acting on the lamina is the resultant of the tensions T of the cord on the two sides of the aperture ; this resultant is $^{Td\{}$*+i'yjdx\ which, when v/c is small, is an oscilla- tory force of amount 2p(dijdty, whose time-average agrees with the value above obtained.*

When it is a case of transverse waves in an elastic medium, reflected by an advancing obstacle, the origin of the working pressure is not so obvious, because we cannot easily formulate a mechanism for the advancing reflector like that of the lamina above employed. In the case of light-waves we can, however, imagine an ideal material body, with very small molecules, that would reflect them with the same perfection as a metalhc mirror reflects the longer Hertzian waves. The pressure will then be repre- sented, as in the case of the latter waves, by the me- chanical forces acting on the screening oscillatory electric current-sheet which is induced on the surface of the re- flector. The displacement represented above by f, which is annulled at the reflector, may then be taken to be either the tangential electric force or the normal component of the vector whose velocity is the magnetic force. The latter interpretation is theoretically interesting, because that vector, which is the dynamical displacement in electron-theory, usually occurs only through its velocity. The general case of oblique incidence can be treated on similar lines.

The usual formula for the pressure of electric radiation is derived from a theory, namely, that of the ordinary electrodynamic equations, which considers the velocity of the matter, or rather of the electrons associated with it, to be so small compared with that of radiation that the square of

the ratio of these velocities can be neglected. The formula above obtained is of general application, and shows that for high values of v the pressure must fall off. It has been urged as an objection to the thermodynamic reversibility of a ray (►►8) that the work of the radiant pressure exerted at its front is lost, as there is no obstacle to sustain it ; but on an obstacle moving with the velocity of the wave-front the pressure would vanish, so that this objection does not hold.

In every such case of an advancing perfect reflector the aggregate amphtude of the superposed incident and reflected wave-trains, of different wave-lengths and periods, will be represented by

f + 1 = 2a sin (x – -t) sm (x – vt) ;

c►►►v V c►►►v

thus the appearance presented wiU be that of a train of waves each of length lirjm- (l►►►vjc), and travelling with the velocity v of the reflector, which is at one of the nodes of the train. This slowly travelling wave-train corresponds to the stationary train which would be produced by a stationary perfect reflector ; but the amplitude is now a varjdng quantity which, once uniform vibration has been fully established along any path, may itself be described as running on after the manner of a superposed wave- train of very great wave-length 2ir/m- (cjv ►►►l) and of

S. Vin. ►►►i6

very great velocity c-/v: A somewhat similar state of things arises when a wave-train is incident on a stationary reflector very nearly normally, as may sometimes be seen with incoming roUers along a shelving beach ; the visible disturbance at a reflecting ridge, arising from a single wave-crest, then rushes along the ridge at a speed at first sight surprising, as it

is enormously in excess of the speed possible for any simple train of waves.

3. Wien's Law. ◆◆◆ Let us consider a spherical enclosure filled with radiation, and having walls of ideal perfectly reflecting quahty so that none of the radiation can escape. If there is no material body inside it, any arbitrarily assigned constitution of this radiation will be permanent. Let us suppose that the radius a of the enclosure is shrink- ing with extremely small velocity v. A ray inside it, incident at angle t, will always be incident on the walls after the successive reflexions at the same angle, except as regards a negligible change due to the motion of the reflector (◆◆2) ; and the length of its path between succes- sive reflexions is 2a cos i. Each undulation on this ray will thus undergo reflexion at intervals of time equal to 2ac~i cos I, where c is the velocity of light, and it is easily verifled that on each reflexion it is shortened by the fraction 2vc~^ cos t of itself : thus in the very long time T required to complete the shrinkage it is shortened by the fraction via, which is So/a where 8a is the total shrinkage in radius, and is independent of the value of t. The wave- length of each undulation in the radiation inside the enclosure is therefore reduced in the same ratio as the radius. Now suppose that the constitution of the en- closed radiation corresponded initially to a deflnite tempera- ture. During the shrinkage thermal equilibrium must be maintained among its constituents ; otherwise there would be a running down of thermal energy if material radiating bodies are present, which would be superposed on the mechanical operations belonging to the shrinkage, and the]process would not be reversible. Such a state of affairs is not possible, for it would land us in processes of the following type. Expand the enclosure, gaining the mechanical work of the radiant pressure against its walls, whatever that may be. Then equalize the intensities of the constituent radiations to those corresponding to a common temperature, by taking advantage of the absorp- tions of material bodies at the actual temperatures of these radiations ; when this is done, as it may actually be to some extent by aid of the sifting produced by partitions which transmit some kinds of radiation more rapidly than others, a further gain of work can be obtained at the expense of the radiant energy. Then contract the re- maining radiant energy to its previous volume, which requires an expenditure of less work on the walls

of the enclosure than the expansion of the greater amount of radiation originally aff'orded ; and, finally, gain still more work by again equalizing the temperatures of its con- stituents. The energy now remaining, being of smaller amount and under similar conditions, must have a tempera- ture lower than the initial one. This process might be repeated indefinitely, and would violate Carnot's principle by deriving an unlimited supply of mechanical work from thermal sources at a uniform temperature.

Thus, independently of any knowledge of the intensity of the mechanical pressure of radiation, or indeed of whether such a pressure exists at all, it is established that the shrinkage of the enclosure must directly transform the contained radiation to the constitution which corresponds to some definite new temperature. Now we have seen that the wave-lengths of its constituents are all reduced in the same ratio by this process. If, then, we can prove that the intensities of these constituents are also all changed in a common ratio by the reflexions at the shrinking

envelope, it will follow that the distributions of the radia- tion among the various wave-lengths are, at these two temperatures, and therefore at any two temperatures, homologous, so that the intensity curves, after the wave- lengths in one of them have been reduced in a ratio depending definitely on the two temperatures, differ only in the absolute scale of magnitude of the ordinates.

This procedure modifies Wien's argument by employing a uniformly shrinking spherical enclosure. If the en- closure is not spherical, the angles of incidence at successive reflexions of the same ray will differ by finite amounts ; we must then estimate the average effect of the shrinkage. In the form of enclosure here employed all rays are affected alike, while by the principle of Stewart and Kirchhoff what is established for any one form is of general vahdity.

4. Pressure of Natural Radiation. ??? The question reserved above has now to be settled. At first sight it might have appeared that the reflexion is perfect ; but, as has been seen in ?? 2, the advancing perfect reflector does work against the pressure of the radiation, and this work must be changed into radiant energy and thus go to increase the

intensity of the reflected ray. Considering electric radiation incident at angle t, the tangential electric force is annulled at the reflector ; hence the amplitude of the vibration is conserved on reflexion, though its phase is reversed when the electric vibration is in the plane of incidence. As already seen, the wave-length is shortened approximately by the fraction 2vc"icosi in each reflexion ; thus, as in ►►2, the energy transmitted per unit time is increased in the same ratio, and allowing for the factor cos I of foreshortening, there is therefore a radiant pressure equal to the total density of radiant energy in front of the reflector multiplied by cos^t. This argument, being independent of the wave-length, applies to each constituent of the radiation separately ; thus their energies are all increased in the same ratio by the reflexion, as was to be proved. When we are dealing -pith the natural radiation in an enclosure, which is distributed equally in all directions, this factor cos^i must be averaged ; and we thus attain Boltzmann's result that the radiant pressure is one-third of the density of radiant energy, this statement holding good as regards each constituent of the natural radiation taken separately.

5. Adiahatic Relations. ►►►Consider the enclosure filled with radiation of energy-density E at volume V, of any given constitution but devoid of special direction, and let it be shrunk to volume V – 8V against its own pressure ; if the density thereby become E ►►►SE, the conservation of the energy requires

EV + pSV = (E – 8E)(V – 8V), so that |ESV-|-V8E = 0, or E varies as '-t.

Again ►►► but now with a restriction to radiation of one wave-length or else of uniform temperature ►►► the perform- ance of this mechanical work JESV has changed the energy of radiation EV from the state that is in equilibrium of absorption and emission with a thermal source at temperature T to the state in equilibrium with an absorber of some other temperature T – 8T, and that in a reversible manner ; thus by Carnot's principle

^E8V/EV=-8T/T, so that T varies as Y'l, or inversely as the linear dimen- sions when the enclosure is shrunk uniformly.

Combining these results, it appears that E varies as T^ ; this is Stefan's empirical law for the complete radiation corresponding to the temperature, established on these lines by Boltzmann. Starting from the principle that this radiation must be a function of the temperature alone, this adiabatic process has in fact given us the form of the function. These results cannot, however, be extended without modification to each separate constituent of the

complete radiation, because the shrinkage of the enclosure alters its wave-length and so transforms it into a different constituent.

6. Law of Distribution of Energy. ??? The effect of com- pressing the complete radiation is thus to change it to the constitution belonging to a certain higher temperature, by shortening all the wave-lengths by the proportion of one- third of the compression by volume, the temperature being in fact raised by the same proportion ; at the same time increasing in a uniform ratio the amounts corresponding to each interval 8X, so as to get the correct total amount of energy for the new temperature. In the compression each constituent alters so that TA. remains constant, and the energy E^SA in the range 8X in other respects changes as a function of T alone. Hence generally Ea8X must be

of form F(T)/(TX)8A.. But for each temperature f\hX

is equal to E and so varies as T, by Stefan's law ; that is,*

*T-iF(T)/'7(TX)d(TX)ocT^*

so that T-iF(T)ocT^. ??Thus, finally, E;,8X is of form ATB/(TX)8X or AX-5

7. Transformation of a Single Constituent. ??? It is of interest to follow out this adiabatic process for each separate constituent of the radiation, as a verification, and also in order to ascertain whether

anything new is thereby gained. To this end let now E(X,T)8X represent the intensity of the radiation between X and X-l-SX which corresponds to the temperature T. The pressure of this radiation, when it is without special direction, is in in- tensity one-third of this ; thus the application of Carnot's principle shows, as before, that in adiabatic compression TocV~i, so that a small linear shrinkage in the ratio 1 ??? x raises T in the ratio \+x. We have still to express the equation of energy. The vibratory energy E(X,T)8X.V in volume V, together with the mechanical work ^E(X,T)8X.3a;V, yields the vibratory energy

E{X(l-a:), T(l-t-a^}8X(l-a;).V(l-3;c); thus, writing E for E;^ or E(X, T) we have, neglecting x^,

E(l f a;) = (E – xXj^ + T)(l – ix),

so that

0,

a partial differential equation of which the integral is

E = AX-5,^(TX), the same formula as was before obtained.

This method, treating each constituent of the radiation separately, has in one respect some advantage, in that it is necessary only to postulate an enclosure which totally reflects that constituent, this being a more restricted hypothesis than an absolutely complete reflector.

To determine theoretically the form of the function <^ we must have some means of transforming one type of radiation into another, different in essence from the adiabatic compression already utilized. The condition that the entropy of the independent radiations in an enclosure is a minimum when they are all transformed to the same temperature with total energy unaltered, is already implicitly fulfilled ; it would thus appear that any further advance must involve (??11) the dynamics of the radiation and absorption of material bodies.

8. Temperature of an Isolated Bay. ❓❓❓ The temperature of each independent constituent of a radiation has here been taken to be a functipn of the intensity E?,, where E;i8X is the energy per unit volume in the range between wave-lengths X and X ƒ 8X ; the condition is, however, imposed that this radiation is indifferent as to direction.

When a beam of radiation travels without loss in a definite direction across a medium, its form varies as it progresses ; but it is reversible inasmuch as it can be turned back at any stage, or concentrated without loss, by perfect re- flectors. If the energy of the beam has a temperature, its value must therefore remain constant throughout the progress of the beam, by the principle of Carnot. Now by virtue of a relation in geometrical optics, which on a corpuscular theory would be one aspect of the fundamental dynamical principle of Action, the cross-section 8S at any place on the beam, and the conical angle 8(0 within which the directions of its rays are there included, are such that the value of V'SSSu is conserved along the beam, V being the velocity of propagation of the undulations. If we represent the amount of radiant energy transmitted per unit time across the section 8S of the beam by I8S8(o, it will follow that in passing along the beam its intensity of illumination I varies as V~, or as the square of the index of refraction, provided there is no loss of energy in transmission. This condition requires that changes of index shall be gradual, otherwise there would be loss of energy by partial reflexions ; in free sether I is constant along the beam. The volume-density of the energy in any part of the directed beam is V^^ISco ; it is thus inversely as the angular concentration of the rays and directly as the cube of the index of refraction. Now we may consider this beam, of aggregate intensity ISSScu, to form an elementary filament of the radiation issuing in the direction of the normal from a perfect radiator. As such a body absorbs completely and therefore radiates equally in all directions in front of it, the total intensity of radiation from its

element of surface 8s is 8s/l cos 6dw, or 8s.irl, while the volume-density of the total advancing and receding radia- tion in front of it is 2,Y~^/ldw, and therefore 4-7rV~'I. If

we take ISX to represent the intensity between wave- lengths X and X + 8X, this density is the quantity Ex of which the temperature of the

radiator is a function. Thus the quantity I, which optically is a measure of the bright- ness of the beam, and is conserved along it to the extent that jLi^I is the same from whichever of its cross-sections the beam is supposed to be emitted, also determines its temperature, the latter being that of an enclosure filled with undirected radiation of the same range 8X and of density E^SX given by Ex = 4irV”iI, where V is the velocity of radiation in the enclosure. When a beam of radiation travels without suffering absorption, its tempera- ture thus continues to be that of its source multiplied by the coefiicient of emission of the source for that kind of radiation, this coefficient being less than unity except in the case of a perfect radiator; but when its intensity I falls by 81 in any part of its path owing to absorption or other irreversible process, this involves a further fall of temperature of the energy of the beam and a rise of entropy which can be completely determined when the relation connecting /u-^^Ex with T and X is kno-mi. Any directed quality in radiation increases its effective temperature. Splitting a beam into two at a refracting surface diminishes the temperature of each part. The direct solar radiation falling on the Earth is almost completely convertible into mechanical effect on account of its very high temperature ; there seems ground for believing that certain constituents of it can actually be almost wholly turned to account by the green leaves of plants. But the same solar radiation, when broken up into diffused sky light, which has no definite direction, has fallen into equilibrium with a much lower temperature, through loss of its reversibility. It has been remarked that the temperatures of the planets can be roughly compared by means of this principle, if

their coeflBcients of absorption of the solar radiation are assumed; that of Neptune comes out below – 200 ° C, if we suppose that it has no internal heat.

To obtain dynamical precision in this discussion an exact definition of the narrow beam such as is usually called a ray is essential. It can be specified as a narrow filament of radiation, which may be isolated within an infinitely .thin, impermeable, bounding tube without thereby

producing any disturbance of the motion. If either the tube or the surrounding radiation were not present to keep the beam in shape, it would spread sideways, as in optical difiraction. But the function of the tube is one of pure constraint ; thus by Poynting's law of energy-flux the change of energy-content of a given length of the tube is represented by energy flowing into it at the end where the radiation enters, and leaving it at the other end, but with no leakage at the sides.

9. Temperature of the Sun. ❓❓❓ The mean temperature of the radiating layers of the Sun may be estimated from Stefan's law, by computing the intensity of the radiation at his surface from that terrestrially observed, on the basis of the law of inverse squares ; the result is about 6500❓❓ C. The application of Wien's law, which makes the wave- length of maximum energy vary inversely as the tempera- ture, for the case of a perfectly radiating source, gives a result 5500❓❓ C. These numbers will naturally difier because (i.) the Sun is not a perfect radiator, the constitu- tion of his radiation in fact not following the law of that of a black body, (ii.) the various radiating layers have different temperatures, (iii.) the radiation may be in part due to chemical and electrical causes, and in so far would not be determined by the temperature alone. The fair agreement of these two estimates indicates, however, that the radiation is largely regulated by the temperature, that the layers from whicli the main part of it comes are at temperatures not very different, and that not very much of the complete radiation established in these layers and emitted from them is absorbed by the overlying layers.

10. Fluorescence. ❓❓❓ ~~When radiation of certain wave~~ lengths falls on a fluorescent body, it is largely absorbed, but in such manner as directly to excite other radiation of different type which is emitted in addition to the true tem- perature-radiation of the body. The distinction involved is that the latter radiation is spontaneously convertible with the heat of the absorbing body at its own temperature, without any external stimulus or compensation : it is, in fact, on the basis of this convertibility that the thermo- dynamic relations of the temperature-radiation have been established. According to the experimental law of Stokes, the wave-lengths of the fluorescent radiation are longer than those of the radiation

which excites it. If the latter were directly transformed, in undiminished amount, into the fluorescent kind, this is what would be expected. For such a spontaneous change must involve loss of avail- ability ; and, beyond the wave-length of maximum energy in the spectrum, the temperature of a given density of radiation is greater the shorter its wave-length, as it is a function of that density and the wave-length alone, such that greater density always corresponds to higher tempera- ture. But it would appear that the opposite should be the case for radiation of long wave-lengths on the other side of the maximum, in which the tendency would thus be for spontaneous change into shorter waves ; this may perhaps be related to the fact that at lower temperatures the lines of longer wave-lengths in spectra often come out brighter. The principle does not, however, have free play in the present case, even when the incident radiation is diffused and so has not the abnormally high temperature associated with a directed beam (□□8), since part of it might be degraded into low-temperature heat, or there might be

other compensation of chemical type for any abnormally high availability that might exist in the fluorescent radia- tion. It has been found that fluorescent radiation, showing a continuous or banded spectrum, can be excited in many gases and vapours. A milky phosphorescence of consider- able duration is produced in vacuum tubes, containing oxygen or other complexly constituted gases, by the electric discharge.

11. Entropy of a Ray. □□□ If each definitely constituted beam of radiation has its ovm temperature and every- thing is reversible as above, a question arises as to the location of the process of averaging which enters into the idea of temperature. The answer can depend only on the fact, that although the beam is definite as to wave-length and intensity, yet it is far from being a simple wave-train, in that it is constituted of trains of limited lengths and various phases and polarizations, coming from the separate radiating molecules. When such a beam has once emerged, it travels without change, and can be reflected back intact to its source, and is in so far reversible ; but when it has arrived there, the molecules of the source will have changed their positions, and it cannot be wholly reabsorbed in the same manner as it was emitted. There must thus be some feature in the ultimate averaged constitution of the beam, emitted

from a body in the definite steady state of internal motion determined by its temperature, which adapts it for spontaneous uncompensated reabsorption into a body at its own (or a lower) temperature, but not at a higher one.

The question of the determination of the form of the function (^ in ❓❓6 would thus appear to be closely connected with the other hitherto imperfectly fathomed problems relating to the statistics of kinetic molecular theory. A very interesting attack on the problem from this point of view has recently been made by Planck. It of course suffices to examine some simple type of radiating system, and the results wiU be of general validity. He considers an enclosure filled with radiation involving an entirely arbitrary succession of phases and polarizations along each ray, and also containing a system of fixed linear electric oscillators of the Hertzian type, which are taken to represent the transforming action of radiating and absorb- ing matter. The radiation contained in the enclosure wiU be passed through these oscillators over and over again, now absorbed, now radiated, and each constituent will thus settle down in a unilateral or irreversible manner towards some definite intensity and composition. But it does not appear that a system of vibrators of this kind, each with its own period, can perform one of the main functions of a material absorber, namely, the transforma- tion of the relative intensities of the various types of radiation in the enclosure to those corresponding to a common temperature. There would be equilibrium established only between the mean internal vibratory energy in the vibrators of each period and the density of radiation of that period ; there is needed also some means of interchanging energy between vibrators of different periods, which probably involves doing away with their fixity. In the absence of any method of introducing this temperature equilibrium directly, Planck sought, in the case of each independent constituent, for a function of its intensity of energy and its wave-length, restricted as to form by a certain assumed molecular relation, which has the property of continually increasing after the manner of entropy, during the progress of that constituent of the radiation in such a system towards its steady state. If the actual entropy S per unit volume were thus determined, the relation of Clausius 8S = 8E/T would supply the connexion between the

temperature and the density of radiant energy E. The procedure of Planck led him, in an indirect and tentative manner, to a relation

d'^S,/(IE? = a/E, so that S = aE log ;8E, where a, (B are functions of A ; this expression conducts through Clausius's

relation to E = ◆◆◆ e"^^"". The previous argument then

gives the formula 'E{\,T)B\ = c-^-^e-">-'^d\, which was originally suggested by Wien on the basis of the analogy that it assigns the same distribution for the radiant energy, among the various frequencies of vibration, as for the energy of the molecules in a gas among their various velocities of translation.

Processes may be theoretically assigned for the direct continuous transformation of radiant into mechanical energy. Thus we can imagine a radiating body at the centre of a wheel, carrying oblique vanes along its circumference, which reflect the radiation on to a ring of parallel fixed vanes, which finally reverse its path and return it to the centre. The pressure of the radiation will drive the wheel, and in case its motion is not resisted, a very great velocity may be theoretically obtained. The thermodynamic compensation in such cases lies in the reduction of the effective temperature of the portion of the radiation not thus used up. We might even do away with the radiating body at the centre of the wheel, and consider a beam of definite radiation reflected backwards and forwards across a diameter. It is easy to see that its path will remain diametral ; the work done by it in driving the wheel will be concomitant with increase of the wave-length, and therefore with expansion of the length occupied by the beam. The thermodynamic features are thus analogous to those of the more familiar case of an envelope filled with gas, which can change its thermal energy into mechanical energy by expansion of the envelope against mechanical resistances. In the case of the expanding ga,spv=%E ◆◆◆, where E,, is the total translatory energy of the molecules, while in adiabatic expansion ^=fcir ◆◆. Thus,

the work gained in unlimited expansion, fpdv, is |E ◆◆◆/(7 – 1). The final temperature being absolute zero, this should by Carnot's principle be equal to the total initial energy of the gas that is in connexion with temperature, constitutive energy of the molecules being excluded ; when 7 – 1 is less than f there is thus internal thermal energy in the molecules in addition to the translatory energy. In the case of the beam of radiation, of length I, between n and n + Sn reflexions, where dn is an integer, its total energy E is by ◆◆ 2

reduced according to the law -7^= ~~; to~~ ^^Iso ◆◆◆ = ; thus

SE Ic SI ^ "+'" ^ " + "

=- . When V is small compared with c, this gives

E = kZ~^; and ^ is then 2E/Z, so thsit /pdl=E, the temperature of the beam being ultimately reduced to absolute zero by the unlimited expansion. This is in accord with Carnot's principle, in that the whole energy of the beam travelling in a vacuum is mechanically available when reduction to absolute zero of temperature is in our power.

12. Experimental Knowledge. ◆◆◆ Under the stimulus of Wien's investigation, the general character of the curve con- necting energy and wave-length in the complete radiation at a given temperature has been experimentally ascertained over a wide range. At each temperature there is a wave- length \m of maximum radiation, which travels towards the ultra-violet as the temperature rises, and Wien's law of homology (◆◆ 6) shows that Am,T should be constant. This deduction, and the law of homology itself, as also the law of Stefan and Boltzmann that the total radiation varies as T have been closely verified by the experiments of Lummer and Pringsheim, and of Paschen and others ; they established a steady field of radiation inside a material enclosure by raising the walls to a definite temperature, and measured the radiant intensity emitted from it through an opening in the walls, by means of a bolometer or thermopile, this being the radiation of the so-called perfectly black body. It has been remarked by Planck and by Thiesen that the coefficient of T* in Stefan's law, and the value of AmT, are two absolute physical constants*

independent of any particular kind of matter, which in conjunction with the constant of gravita- tion would determine an entirely absolute system of physical units. The form of the function <^(TX) adopted by Wien and Planck, namely, c-^e~^l^'^, has been found to agree fairly with experiment over the range from 100 C. to 1300 C when Ci= 1-24 x 10"= and c= 1-4435 in c.g.s. measure, but not so well when the range is

further extended : it appears that a larger value of c is needed to represent the radiation for high values of TA, that is, for high temperature or for very long wave-lengths. Thiesen proposed the somewhat more general form Cj(TX)"e~ "\ and suggests with good reason that the value ^ = i agrees better with the experimental numbers than Wien's value k = Q. Lord Kayleigh has been led {Phil. Mag., June 1900) towards this form with k equal to unity from entirely different theoretical considerations, on the assumption of the Maxwell-Boltzmann distribution of the energy of the molecule among its free periods of vibration, infinite in number ; in some cases this form appeared to give as good results as Wien's, but it has been shown that it is not adapted to short wave-lengths, and that it is infected with systematic errors.

Acting on a suggestion advanced by Lord Rayleigh, Eubens and Kahlbaum have recently widely extended the test of the formulse by means of the so-called "Eest- strahlen." A substance which exhibits selective absorp- tion of any group of rays also powerfully reflects those rays ; and Rubens has been able thus to isolate in con- siderable purity the rays belonging to absorption bands very far down in the ultra-red, of wave-length of order 60 X 10"^ cm., in the case of substances such as sylvin, by means of five or six successive reflexions of the beam of radiation. By experiments ranging between temperatures – 200 C. and ∓ 1500 C. it has now been found that the intensity of this definite radiation tends to vary simply as T, with close approximation, thus increasing indefinitely with the temperature, whereas Wien's formula would make it tend to a definite limit. The only existing formula (except the one suggested by Lord Eayleigh) that proved to be in accord with this result was a new one advanced shortly before on theoretical grounds by Planck, namely, E^ 8X = CA."SA./(e"^- 1), which for small values of A.'T

agrees with Wien's original form, known to be there satisfactory, while for larger values it tends towards C/c.X"!; it is, in fact, the simplest and most likely form that satisfies these two conditions. But it should be noticed that the point of Lord Rayleigh's argument was that, at any rate at low frequencies, there should be an equable partition of the energy between the temperature heat and the radiant vibrations, and that therefore the energy of the latter should ultimately vary as T ; this prediction, which has thus been verified, may be grafted on either to Wien's form or to a new one after the manner of Planck. Recognizing that his previous hypothesis restricting the nature of the entropy, in addition to its property of continually increasing, had to be abandoned, as leading to results not in accord with experiment, Planck had in fact made a fresh start on the basis of a train of ideas which was introduced by Boltzmann in 1877, in order to obtain a precise physical definition of entropy. According to the latter, for an indefinitely numerous system of molecules with known properties and under given conditions there is a definite probability of the occurrence of each statistical distribution of velocities or " complexion " of the system that is formally possible, when all velocities consistent with given total energy are considered to be equally likely as regards each molecule; the distribution of greatest probability is the state of thermal equilibrium of the system, and the probability of any other state is a function of the entropy of that state. This conception can be developed only in very simple cases ; the case of an ideal monatomic gas-system led Boltzmann to take the entropy proportional to the logarithm of the prob- ability. This logarithmic law is in fact required by the principle that the entropy of a system should be the sum of the entropies of its parts. By means of a priori considerations of this nature, referring to the distribution*

of internal vibratory energy among a system of linear electric vibrators of given period, and its equilibrium with the density of the surrounding radiant energy, Planck has been guided to an expression for the law of depend- ence of the entropy of that system on the temperature, which

corresponds to the form of the law of radiation above stated : whatever may be thought of the cogency of his argument, especially in view of the circumstance that Ms vibrators cannot change the types of the radiation, ^ the result gains support from the fact that it involves determinations of the absolute physical constants of molecular theory that prove to be of the correct order of magnitude. By an argument based on the theory of dimensions, Lorentz has recently been led to the con- clusion that consistency between temperatures as measured molecularly and as measured by the laws of radiation requires that the ultimate indivisible electric charges or electrons must be the same in all kinds of matter.

13. Modification by a Magnetic Field. ??? The theory of exchanges of radiation, which makes the equilibrium of radiating bodies depend on temperature alone, requires that, when an element of surface of one body is radiating to an element of surface of another body at the same temperature, the amounts of energy interchanged (when reflexion is counted in along with radiation) should be equal. This proposition is a general dynamical consequence ??? on the basis of the analytical method developed in this connexion mainly by Helmholtz, Kirchhoff, and Eayleigh ??? of the form of the equations of propagation of vibra- tions in the medium. But in a material medium under the influence of a strong magnetic field these equations are altered by the addition of extraneous terms involving differential coefficients of the third order, and the dynamical consistency of the cardinal principle of the theory of exchanges is no longer thus directly verified. A system of this kind has in fact been imagined by Wien in which the principle is imperfectly fulfilled. A beam coming from a body A, and polarized by passage through a nicol, may have its plane of vibration rotated through half a right angle by crossing a magnetically active plate, and may then pass through another nicol, properly orientated for transmission, so as finally to fall on another body B. On the other hand, the radiation from B which gets through this adjacent nicol will have its plane of vibration rotated through half a right angle by the magnetically active plate, and so will not get through the first nicol to the body A. Such possibilities of unequal exchange of radiation between A and B are the result of the want of reversibility of the radiation in a magnetic field, which might have been expected to lead to pro- portionate inequalities of concentration ; in this example, however,

though the defect of reversibility is itself slight, its results appear at first sight to affect the whole radia- tion. But a closer examination removes this discrepancy. In order to make the system self-contained, reflectors must be added to it, so as to send back into the sources the polarized constituents that are turned aside out of the direct line by the nicols. Then, as Brillouin has pointed out, and as in fact Lord Eayleigh had remarked some years before, the radiation from B does ultimately get across to A after passage backward and forward to the reflectors and between the nicols : this, it is true, increases the length of its path, and therefore diminishes the concentration of a single narrow beam, but any large change of path would make the beam too wide for the nicols, and thus require other corrections which may be supposed to compensate. The explanation of the slight difi'erence

^ The argument has been recast recently by Larmor, ao as to avoid the introduction of vibrators.

that is to be anticipated on theoretical grounds might conceivably be that in such a case the magnetic influence, being operative on the phases, alters the statistical con- stitution of the radiation of given wave-length from the special type that is in equilibrium vrith a definite tempera- ture, so that after passage through the magnetic medium it is not in a condition to be entirely absorbed at that temperature; there would then be some other element, in addition to temperature, involved in equilibrium in a magnetic field. If this is not so, there must be some thermodynamic compensation involving reaction, extremely small, however, on the magnetizing system.

14. Origin of Spectra. ??? In addition to the thermal radiations of material substances, those, namely, which establish temperature-equilibrium of the enclosure in which they are confined, there are the fluorescent and other radiations excited by extraneous causes, radiant or electric or chemical. Such radiations are an indication, by the presence of higher wave-lengths than belong in any sen- sible degree to the temperature, that the steady state has not arrived ; they thus fade away, either immediately on the cessation of the exciting cause, or after an interval. The radiations, consisting of definite narrow bright lines in the

spectrum, that are characteristic of the gaseous state in which each molecule can vibrate freely by itself, are usually excited by electric or chemical agency; thus there is no ground for assuming that they always consti- tute true temperature radiation. The absorption of these radiations by strata of the same gases at low temperatures proves that the unaltered molecules themselves possess these free periods, which do not therefore belong specially to dissociated ions. Although very difficult to excite directly, these free vibrations are then excited under the influence of resonance, which naturally becomes extremely powerful when the tuning is exact ; this indicates, more- over, that the true absorption bands in a gas must be extremely narrow. There is direct evidence that many of the more permanent gases do not sensibly emit light on being subjected to high temperature alone, when chemical action is excluded, whUe others give under these cir- cumstances feeble continuous spectra; in fact, the more permanent gases are very transparent to most kinds of radiation, and therefore must be very bad radiators as regards those kinds. The dark radiation of flames has been identified with that belonging to the specific radiation of their gaseous products of combustion. There is thus ground for the view that the impacts of the colhding molecules in a gas, or rather their mutual actions as they swing sharply round each other in their orbits during an encounter, may not be sufficiently violent to excite sensibly the free vibrations of the definite periods belonging to the molecules. But they may produce radiation in other ways. While the velocity of an electron or other electric charge is being altered, it necessarily sends out a stream of radia- tion. Now the orbital motions of the electrons in an actual molecule must be so adjusted, as appears to be theoretically possible, that it does not emit radiation when in a steady state, and therefore when it is moving with constant velocity. But in the violent changes of velocity that occur during an encounter this equipoise will be dis- turbed, and a stream of radiation, without definite periods, but such as might constitute the equilibrium thermal radiation of the substance, may be expected while the encounter lasts. At very high temperatures the energy of this thermal radiation in an enclosure entirely over- powers the kinetic energy of the molecules present, for the former varies as T, while the latter measures T itself when the number of molecules remains the same. The selective emission of gases, confined as*

it is to extremely narrow bands in the spectrum, may indeed be expected to possess

such, intensity as to be thermally in equilibrium with extremely high temperatures. That the same gases absorb such radiations when comparatively cold and dark does not of course affect the case, because emissive and absorp- tive powers are proportional only for incident radiations of the intensity and type corresponding to the tem- perature of the body. Thus if our adiabatic enclosure of ⁇ 3 is prolonged into a tube of unlimited length which is filled with the gas, then when the temperature has become uniform that gas must send back out of the tube as much radiation as has passed down the tube and been absorbed by it ; but if the tube is maintained at a lower temperature, it may return much less. The fact that it is now possible by great optical dispersion to make the line-spectra of prominences in the middle of the Sun's disc stand out bright against the background of the con- tinuous solar spectrum, shows that the intensities of the radiations of these prominences correspond to a much higher temperature than that of the general radiating layer underneath them ; their luminosity would thus seem to be due to some cause (electric or chemical) other than mere temperature. On the other hand, the general revers- ing gaseous layer which originates the dark Fraunhofer lines is at a lower temperature than the radiating layer, and is probably in the same relatively steady thermal state as its surroundings. When the radiation in a spectrum is constituted of broad bands it may on these principles be expected to be in equihbrium with a lower temperature than when it is constituted of narrow lines, if the total intensity is the same in the cases compared ; this is in keeping with the easier excitation of band spectra (cf. the banded absorption spectra), and with the fact that various gases and vapours do appear to emit band spectra in equilibrium with the temperature.

15. Constitution of Spectra. ⁇ In the problem of the unravelling of the constitutions of the very complex systems of spectral lines belonging to the various kinds of matter considerable progress has been made in

recent years. The beginning of definite knowledge was the dis- covery of Balmer in 1885, that the frequencies of vibration {n) of the hydrogen Unes could be represented, very closely and within the limits of error of observation, by the for- mula nocl ◆◆◆4ni~^, when for m, is substituted the series of natural numbers 3, 4, 5, ◆◆◆ ◆◆◆ ◆◆◆ ◆◆◆15. Soon afterwards series of related lines were picked out from the spectra of other elements by Liveing and Dewar. Eydberg conducted a systematic investigation on the basis of a modification of Balmer's law for hydrogen, namely, m = w◆◆◆– N/(m. + /i)2. He found that in the group of alka- line metals three series of lines exist, the so-called principal and two subordinate series, whose frequencies fit approxi- mately into this formula, and that similar statements apply to other natural groups of elements ; that the con- stant X is sensibly the same for all series and all substances, while Wo 3'iid /"◆◆◆have different values for each; and that other approximate numerical relations exist. In each series the lines of high frequency crowd together towards a definite limit on the more refrangible side; near this limit they would, if visible, constitute a band. In most series there are, however, not more than six lines visible : helium and hydrogen are exceptions, no less than thirty lines of the principal series of the latter having been identi- fied, the higher ones in stellar spectra only. The principal or strongest series of lines shows reversal very readily. The lines of the first subordinate series are usually nebular, while those of the second subordinate or weakest series are sharp, but with a tendency to broaden towards the less refrangible side. Simultaneously with Eydberg, the problem was attacked by Kayser and Eunge, who used the formula n = A. + 'S>jn~'^ + Cm''^, higher terms in

this descending series being presumed to be negligible. This cannot be reconcOed with Eydberg's form, which gives on expansion terms involving m~^ ; but for the higher values of m the discrepancies rapidly diminish, and do not prevent the picking out of the lines, the frequency- differences between successive lines then varying roughly as the inverse squares of the series of natural numbers. For low values of m neither mode of expression is api>lic- able, as was to be expected ; and it remains a problem for the future to ascertain if possible the rational formula to which they are approximations. Considered dynamically, the c[uestion is

that of the determination of the formula for the free simple harmonic periods of the vibrating system which constitutes the molecule. Although we are still far from any definite line of attack, there are various indications that the quest is a practicable one. The lines of each series, sorted out by aid of the formulse above given, have properties in common : they are usually mul- tiple lines, either all doublets in the case of monad elements, or generally triplets in the case of those of higher chemical valency ; in very few cases are the series constituted of single lines. It is found also that the components of all the double or triple lines of a sub- ordinate series are equidistant as regards frequency. In the case of a related group of elements, for example the alkaline metals, it appears that corresponding series are displaced continually towards the less refrangible end as the atomic weight rises ; it is found also that the interval in frequency between the double lines of a series diminishes with the atomic weight, and is proportional to its square. These relations suggest that the atomic weight might here act in part after the manner of a load attached to a fundamental vibrating system, which might conceivably be formed on the same plan for all the metals of the group ; such a load would depress all the periods, and at the same time it would split them up in the manner above described, if it introduced dissymmetry into the vibrator. The discovery of Zeeman that a magnetic field triples each spectral line, and produces definite polarizations of the three components, in many cases further subdividing each component, is explained, and was in part predicted, by Lorentz on the basis of the electron theory which finds the origin of radiation in a system of unitary electric charges describing orbits or executing vibrations in the molecule. Although these facts form substantial sign- posts, it has not yet been found possible to assign any likely structure to a vibrating system which would lead to a frequency formula for its free periods of the types given above. Indeed, the view is open that the group of lines constituting a series form a harmonic analysis of a single fundamental vibration not itself harmonic. If that be so, the intensities and other properties of the lines of a series ought all to vary together ; it has in fact been found by Preston that the lines are multiphed into the same number of constituents in a magnetic field, with intervals in frequency that are the same for all of them. When the series consists of double or triple Unes the separate com- ponents of the same compound line are not affected similarly, which

shows that they are differently constituted. The view has also found support that the different be- haviours of the various groups of hues in a spectrum show that they belong to independent vibrators.

According to Eydberg, there is ground for the view that a natural group of chemical elements have all the same type of series spectrum, and that the various constants associated with this spectrum change rapidly in the same directions in passing from the elements of one group to the corresponding ones of the following groups, after the manner illustrated in graphical representations of Mendeleeff's law by means of a continuous wavy curve in

???which each group of elements lies along this same ascending or descending branch ; the chemical elements thus being built up in a series of types or groups, so that the in- dividuals in successive groups correspond one to one in a regular progression, which may be put in evidence by connecting them by transverse curves.

The frequencies of the series of very close lines which constitute a single band in a banded spectrum are con- nected by a law of quite different type, namely, in the simpler cases ii? = K-'S>m?. It may be remarked that this is the kind of relation that would apply to a row of independent similar vibrators in which the neighbours exert slight mutual influence of elastic type. If ^ denote displacement and x distance along the row, the equation git git

-j^-l-Ff = -g-r^i would represent the general features of

their vibration, the right-hand side arising from the mutual elastic influences. If the ends of the line of vibrators, of length I, are fixed, or if the vibrators form a ring, the appropriate type of solution is ^ oc sin (xm sin pt, where /iZ = OTir and m is integral; further -p'^ + B=giJ?,

hence p'^ = W— ^-j^m^, which is of the type above stated.

Dynamical systems of this kind are illustrated by the Lagrangean linear system of connected bodies, such as, for example, a row of masses fixed along a tense cord, and each subject to a restoring elastic force of its own in addition to the tension of the cord. A single spectral line might thus be transformed into a band of this type as the effect of disturbance arising from slight elastic connexions established in the molecule between a system of similar vibrators. But the series in line-spectra arw-of entirely different constitution ; thus for the series expressed by the formula p'^ =Po' – B►►i~^ the corresponding period-equation may be expressed in the form sin h{p'^ -p(,^)~ = constant, which belongs to no type of vibrator hitherto analysed.*

The original memoirs by the writers above mentioned are mostly in Wiedemann's Armalen der Physik ; references are given by P. Drude, Zehrbuch der Optik, Leipzig, 1900. There are important reports by the same writers in the collection issued by the In- ternational Congress of Physios, Paris, 1900. See also Lord Eayleigh's Scientific Papers ; and Larmor, in Brit. Assoc. Seports, 1900, 1902. In spectrum analysis Kayser's elaborate treatise is the standard authority. Winckelmann's Handbuch der Physik, vol. ii. (by Kayser, Drude, &c.), may also be consulted. (j. l.)*

Radio meter. ►►► it has been remarked at various times, amongst others by Fresnel, that bodies delicately suspended within a partial vacuum are subject to apparent repulsion by radiation. The question was definitely investigated by Sir W. Crookes, who had found that some delicate weighings in vacuo were vitiated by this cause. It appeared that a surface blackened so as to absorb the radiant energy directed on it was repelled relatively to a polished surface. He constructed an apparatus in illustra- tion, which he called a radiometer or light-mill, by pivot- ing a vertical axle carrying equidistant vertical vanes inside an exhausted glass bulb, one side of each vane being blackened and the other side bright, the blackened sides all pointing the same way round the axle. When the rays ' of the sun or a candle, or dark radiation from a warm body, are incident on the vanes, the dark side of each vane is repelled more than the bright side, and thus the vanes are set into rotation with accelerated speed, which becomes uniform when the forces produced by the radiation are

balanced by the friction of the pivot and of the residual air in the globe. The name radiometer arose from an idea that the final steady speed of rotation might be utilized as a rough measure of the intensity of the exciting radiation.

The problem of the cause of these striking and novel phenomena at first produced considerable perplexity. A

preliminary question was whether the mechanical impulsion was a direct effect of the light, or whether the radiation only set up internal stresses, acting in and through the residual air, between the vanes and the walls of the enclosure. The answer to this was found experimentally by Schuster, who suspended the whole instrument in delicate equihbrium, and observed the effect of turning on the radiation. If the light exerted direct impulsion on the vanes, their motion would gradually drag the case round after them, by reason of the friction of the residual air in the bulb and of the pivot. On the other hand, if the effects arose from balanced stresses set up inside the globe by the radiation, the effects on the vanes and on the case would be of the nature of action and reaction, so that the establishment of motion of the vanes in one direction would involve impul- sion of the case in the opposite direction ; but when the motion became steady there would no longer be any torque either on the vanes or on the case, and the latter would therefore come back to its previous position of equilibrium ; finally, when the light was turned off, the decay of the motion of the vanes would involve impulsion of the case in the direction of their motion until the moment of the restoring torque arising from the suspension of the case had absorbed the angular momentum in the system. Experiment showed that this was what happened. The important part played by the residual air in the globe had also been deduced by Osborne Reynolds from observing that on turning off the light, the vanes came to rest very much sooner than the friction of the pivot alone would account for ; in fact, the rapid subsidence is an illustration of Maxwell's great theoretical discovery that viscosity in a gas (as also diffusion both of heat and of the gas itself) is sensibly independent of the density.

The origin of these phenomena was recognized, among the first by O. Reynolds, and by Tait and Dewar, as a consequence of the kinetic theory of the constitution of gaseous media. The temperature of a gas is measured by the mean energy of translation of its molecules, which are independent of each other except during the brief intervals of collision ; and collision of the separate molecules with the blackened surface of a vane, warmed by the radiation, imparts heat to them, so that they rebound from it with greater velocity than .they approached. This increase of velocity implies an increase of the reaction on the surface, the black side of a vane being thus pressed vsdth greater force than the bright side. In air of considerable density the mean free path of a molecule, between its collisions with other molecules, is exceedingly small, and any such increase of gaseous pressure in front of the black surface would be immediately neutralized by flow of the gas from places of high to places of low pressure. But at high exhaustions the free path becomes comparable with the dimensions of the glass bulb, and this equalization is only partial. The general nature of the phenomena is thus easily understood ; but the problem of the stresses in gaseous media arising from inequalities of temperature, which is thereby opened out, involves some of the most delicate considerations in molecular physics. It remains practically as it was left in 1879 by two memoirs communicated to the Philosophical Transa/:tions by Osborne Reynolds and by Clerk Maxwell. The method of the latter investigator was purely d, priori. He assumed that the distribution of molecules and of their velocities, at each point, was slightly modified, from the exponential law belonging to a uniform condition, by the gradient of temperature in the gas (see Dippusion op Gases). The hypothesis that the state was steady, so that interchanges arising from convection and collisions of the molecules produced no aggregate result, enabled him to interpret the new con- stants involved in this law of distribution, in terms of the

temperature and its spacial differential coefficients, and thence to express the components of the stress at each point in the medium in terms of these

quantities. As far as the order to which he carried the approximations, the result was that the equations of motion of the gas, con- sidered as subject to viscous and thermal stresses, could be satisfied by a state of equilibrium under a modified internal pressure equal in all directions. If, therefore, the walls of the enclosure held the gas that is directly in contact with them, this equilibrium would be the actual state of affairs ; and it would follow from the principle of Archimedes that, when extraneous forces such as gravity are not considered, the gas would exert no resultant force on any body immersed in it. On this ground Maxwell inferred that the forces acting in the radiometer are con- nected with gliding of the gas along the unequally heated boundaries ; and as the laws of this slipping, as well as the constitution of the adjacent layer, are uncertain, the problem becomes very intricate. Keynolds, introducing no new form of law of distribution of velocities, uses a linear quantity, proportional to the mean free path of the gaseous molecules, which he takes to represent (somewhat roughly) the average distance from which molecules directly affect, by their convection, the state of the medium ; the gas not being uniform on account of the gradient of temperature, the change going on at each point is calculated from the elements contributed by the parts at this particular distance in all directions. He lays stress on the dimen- sional relations of the problem, pointing lut that the phenomena which occur with large vanes in highly rarefied gas could also occur with proportionally smaller vanes in gas at higher pressure. The results coincide with Maxwell's so far as above stated, though the numerical co- eflScients do not agree. According to Maxwell, priority in showing the necessity for slipping over the boundary rests with Eeynolds, who also discovered the cognate fact of thermal transpiration, meaning thereby that gas travels up the gradient of temperature in a capillary tube, owing to surface-actions, until it establishes such a gradient of pressure (extremely minute) as will prevent further flow. In later memoirs Eeynolds followed up this subject by proceeding to establish definitions of the velocity and the momentum and the energy at an element of volume of the molecular medium, with the precision necessary in order that the dynamical equations of the medium in bulk, based in the usual manner on these quantities alone, vdthout directly considering thermal stresses, shall be strictly valid, ??? a discussion in which the relation of ordinary mechanics to a complete molecular theory is involved. (j. l.)*

Radnor, an inland county of South Wales, bounded on the N. by Montgomery, on the N.E. by Shropshire, on the E. by Hereford, on the S. and S.W. by Brecknock, and on the W. by Cardigan.

Area and Population. ??? The area of the ancient and administrative county is 301,164 acres, or 471 square miles, with a population in 1881 of 23,628, in 1891 of 21,791, and in 1901 of 23,263, the number of persons per square mile being 49, and of acres to a person 12 ???8. The area of the re^stration county is 238,715 acres, with a population in 1891 of 17,119. Between 1881 and 1891 the population decreased at the rate of 7”58 per cent., but between 1891 and 1901 there was a recovery, although the total at the latter date was still a fraction less than in 1881. The following table gives the numbers of marriages, births, and deaths, with the number and percentage of illegitimate births, for 1880, 1890, and 1898 : ???

Tear.

Marriages.

Births.

Deaths.

Illegitimate Births. |

No.

Per cent.

1880 1890 1898

130 103 173

554 462 691

319 299 309

74 58 35

13-3

12-6

6-0

The percentage of illegitimacy has greatly diminished. In 1891 there were in the county 62 natives of Scotland, 32 natives of

Ireland, and 22 foreigners, while 16,270 persons could English, 76 Welsh only, and 924 English and Welsh.

Constitution and Government. ??? The county returns one member to Parliament. It has neither a parliamentary nor a municipal borough, but the ancient town of Radnor (406) is governed by the provisions of an old charter. The urban districts are Knighton (2139), Llandrindod Wells (1827), and Presteigne (1237). Radnor is in the South Wales and Chester circuit, and assizes are held at Presteigne. The ancient county, which is partly in the diocese of Hereford and partly in that of St Davids, contains 41 eutire ecclesiastical parishes and districts and parts of 5 others.

Education. ??? The total number of elementary schools in the county on 31st August 1899 was 61, of which 10 were board and 41 voluntary schools, the latter including 36 National Church of England schools, and 5 " British and other." The average attend- ance at board schools was 439, and at voluntary schools 2483. The total school board receipts for the year ended 29th March 1899 were over ??1663. The income under the Agricultural Rates Act was over ??325.

Agriculture and Industry. ??? More than half the total area of the county is under cultivation, but of this nearly three-fourths is in permanent pasture, in addition to which about 117,000 acres of hill pasturage are grazed, chiefly by sheep, which are largely kept. About 700 acres are under orchards, and about 11,000 acres under woods. Oats are the principal corn crop, occupying more than three- fifths of that area, while wheat and barley, each having about the same acreage, occupy together less than two-fifths. Turnips occupy five-sixths of the area under green crops, the acreage under potatoes being insignificant. The

following table gives the larger main divisions of the cultivated area at intervals from 1880 : ???

Tear.

Total Area under Cultiva- tion.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1880 1885 1890 1895 1900

156,896 157,483 163,442 162,660 163,240

23,070 21,129 20,407' 18,858 18,937

7334 7129 7305 7035 6752

16,961 14,065 13,933 14,270 16,173

107,370 113,652 120,433 121,619 120,718

2160

1518

1369

764

654

The following table gives particulars regarding the principal live stock for the same years : ???

Tear.

Total Horses.

Total Cattle.

Cows or Heifers

in Milk or in

Calf.

Sheep.

Pigs.

1880 1886 1890 1896 1900

8,879 9,398 9,604 10,266 9,677

29,855 32,297 31,493 32,633 34,638

9,482 10,706 10,712 10,266 11,048

245,559 267,965 272,325 270,761 283,590

5131 6371 6630 6692 4909

In 1898, 65,814 tons of sandstone were raised, 35,372 tons of limestone, and 36, 560 tons of igneous rocks.

Attthoritibs. ??? Ince. Views Illustrating the County of Radnor. London, 1832. ??? Williams. The History of Radnorshire (reprinted from the Archceologia Camlrensis). Tenby, 1858. ??? Guide-books to South Wales.

Radotn, a southern frontier government of Russian Poland, bordering on Galicia. It has an area of 4765 square mUes, and a population which numbered 820,363 in 1897, when there were 409,624 women, and the urban population numbered 94,318. Poles formed 80 per cent, of the population, and Jews 17 per cent. The province is divided into 7 districts, the chief towns of which are Eadom (see below). Ilia (4168), Konsk (8235), Kozenice (5327), Opatdw (6942), Opoczno (6022), and S►►domierz (6534). In 1899 there were 4 gymnasia for boys and girls and 154 primary schools ►►► altogether, 440 schools, including the Jewish hedars, with about 20,000 pupils. The soil is mostly fertile, and agriculture, the main occupation of the people, is in good condition ; out of 2,461,700 acres of land in 1896, 1,383,600 were under cultivation and 874,000 under woods. The crops in 1900 were: wheat, 805,000 cwt. ; rye, 2,548,000 cwt. ; barley, 896,000 cwt.; oats, 1,540,000 cwt.; and potatoes, 11,724,000 cwt., chiefly cultivated for distilleries. Grain is exported. Live stock is kept in large numbers, there being, in 1897, 116,000 horses, 241,000 horned cattle, 175,000 sheep, and 120,000 swine. Manufactures have

considerably developed of late years, the province being rich in iron ore. The iron industry occupies more than 60,000 workmen, and in 1898, 2,013,873 cwt. of pig iron, 501,117 cwt. of iron, and 1,058,296 cwt. of steel were produced. There are also several sugar works. The total return from all industries in 1898 was 19,899,000 roubles.

Radom, the capital of the above province, situated 65 miles south of Warsaw, on the railway from Minsk to Vienna. It has several iron and agricultural machinery works and tanneries. Population (1897), 28,749.

Radomysl (formerly Mychek), a district town of Kussia, in the government and 64 miles north-west of the town of KieflF, on the Tetereff river. It is a very old town, and was mentioned in the annals in 1 1 50 ; in the 18th

century it was the residence of the metropolitans of the United Church. It has several tanneries and flour mills, and exports timber, corn, and mushrooms. Popu- lation (1897), 18,154.

Ra.e Bareli, a town and district of British India, in the Lucknow division of Oudh. The town is on the river Sai, 48 miles south-east of Lucknow, and has a railway station. Population (1881), 11,781 ; (1891), 18,798 ; muni- cipal income (1897-98), Ks.27,133, two-thirds derived from octroi; registered death-rate (1897), 75‘65 per thousand. The DISTRICT of Eae Bareli has an area of 1751 square miles. Population (1881), 951,905; (1891), 1,036,521, shovsdng an increase of 9 per cent., compared with a decrease of 4 per cent, in the preceding twelve years ; average density, 592 persons per square mile. In 1901 the population was 1,033,948, showing a slight decrease. The land revenue and rates are Es. 15,58,430, the incidence of assessment being K. 1.5.7 per acre; cultivated area (1896-97), 459,608 acres, of which 285,998 were irrigated from wells, ifec. ; number of police, 2850 ; vernacular schools, 136, with 5724 pupils; registered death-rate (1897), 50 per thousand. The principal crops are rice, pulse, wheat, barley, millet, and opium. Eae BareK town is connected with Lucknow by a branch of the Oudh and Eohilkhand Eailway, which in 1898 was extended to Benares. There are no Government canals.

Ra.gfa.tz, a watering-place in the Swiss canton of St Gall, 12|- miles by rail north of Coire. In 1900 the popu- lation was 1861. From Eagatz a funicular railway runs up in ten minutes to the Wartenstein Hotel, above the ruins of the 14th-century ruined castle of that name. A short distance beyond the hotel are the buildings of the ancient abbey of Pfaffers, now turned into a lunatic asylum and hospital. Pfaffers is 2697 feet above the sea.

RagfUSa, a city of the province of Syracuse, Sicily, Italy. It embraces two separate communes, Eagtjsa SuPEEioRE, 76 miles west by south of Syracuse on the railway to Licata, and Eagusa Infeeioee, 3 miles by rail farther to the east. There are several old churches and rock caves, and various industries, such as asphalt and limestone quarries, cotton, macaroni, and cheese factories. Population of Eagusa Superiore (1881),

24,236 ; (1899), about 23,000; of Eagusa Inferiore (1889), 6260; (1899), about 8000.

Ragrusa, a city on the east coast of the Adriatic, in the Austrian province of Dalmatia. Population (1890) of city, 7143, and of commune, 11,177; in 1900, 13,174, in- cluding a garrison of 1122 men. Of these, it is estimated that 93 per cent, are Serbo-Croatians, 4 per cent. Italians, and 3 per cent. Germans; and that 92 per cent, are Catholic, 5 per cent. Protestant, and 3 per cent. Jewish. The industries include the manufacture of oil, silks, leather, and liqueurs. There is some transit trade with Herzegovina. The city is now connected with its hinter-

land by an extension of the Bosnian railway system to Gravosa, the harbour of Eagusa.

RagfUSavecchia, a market-place in the govern- ment district of Eagusa, in Dalmatia, about 6 mUes south- east of the latter city. It occupies the site of the ancient Epidaurum, destroyed by the Slavs in the 7th century, and contains the ruins of a bath and aqueduct of the Eoman period. Population (1890) of village, 723, and of commune, 9949; (1900) 10,690, Serbo-Croatians.

Rah way, a city of Union county. New Jersey, U.S.A. It is situated in 40 37′ N. and 74 17′ W., on the Eahway river and on the Pennsylvania EaUroad, in the north-eastern part of the state. Its site is level, and the street plan regular. To some extent it serves as a resi- dential suburb of New York, which is distant but 19 miles. It has carriage factories, publishing houses, wooUen mills, and other manufactures. Population (1895), 7915 ; (1900), 7935, of whom 1345 were foreign-born and 349 negroes.

Raid. A raid, in the language of international law, is an invasion by armed forces, unauthorised and unrecog- nized by any State, of the territory of a State which is at peace. Piracy is the attack on the high sea of any vessel by an armed vessel, not authorized or recognized by any State, for the purpose of robbery. A raid for the purpose of carrying off movable property and converting it to the use of the captors would still be distinguishable from pioacy, because it was committed on territory subject

to an exclusive territorial jurisdiction. Where the attack or invasion by an armed ship not authorized or recognized by any State is not for the purpose of capturing property, it is properly speaking a raid and not piracy. An attack though in time of peace, by armed forces authorized or recognized by a regular Government is not a raid but an act of war, there being a Government responsible for the act committed. The fact of any act being authorized, not by the supreme Government, but by a chartered company, or by its governing officer, makes no difference in international law, the directorate of a chartered company exercising its powers by delegation of the State under which it holds its charter. The acts of its armed forces cannot in reason be distinguished from the acts of the armed forces of the State Government. Thus compensation is just as much due for them as for the deliberate acts of the State itself, and any claim of an injured State can only be preferred against the State to which the company belongs. Invasion by the regular forces of a State, or by the regular forces of its delegated authority, being an act of war, the laws of war apply to it, and, on capture, such forces, or any members or part of such forces, are prisoners of war. On the other hand, the State whose subordinate authorities commit acts of war against a friendly State has the option of following them up as a commencement of hostilities, or of giving satisfactory compensation to the invaded State. Where the invasion is not by forces subject to the orders of a State, the invaded State has the right to apply its own laws for the repression of disturbances in its territory. Thus, in the so-called Jameson Eaid, the Transvaal Government had no right to treat Dr Jameson, an officer holding his powers under the British Government, and his sub- ordinates, as outlaws, and it was probably so advised, and the British Government owed proper compensation for an act for the consequences of which, under international law, it was responsible.

British domestic law punishes raiding under the Foreign Enlistment Act, 1870 (33 & 34 Vict. c. 90). Section 11 of this Act provides as follows : ”If any person within the limits of His Majesty’s dominions, and without the licence of His Majesty, prepares or fits out any naval or military

KAIGARH RAILWAYS

expedition to proceed against the dominions of any friendly State, the following consequences shaU ensue : (1) Every person engaged in such preparation or fitting out, or assists ing therein, or employed in any capacity in such expedition, shall be guilty of an offence against this Act, and shall be punishable by fine and imprisonment or either of such punishments, at the discretion of the Court before which the offender is convicted ; and imprisonment, if awarded, may be either with or without hard labour. (2) All ships and their equipments, and all arms and munitions of war, used in or forming part of such expedition, shall be forfeited to His Majesty." Section 12 provides for the punishment of accessories as principal offenders, and section 13 limits the term of imprisonment for any offence under the Act to two years. In the Sandoval case (1886), in which Colonel Sandoval, who was not a British subject, bought guns and ammunition and shipped them to Ant- werp, where they were put on board a vessel, which after- wards made an attack on Venezuela, it was held that the offence of fitting out and preparing an expedition within British territory against a friendly State, under this section, is suflBciently constituted by the purchase of guns and ammunition in the British Empire, and their shipment for the purpose of being put on board a ship in a foreign port, with knowledge of the purchaser and shipper that they are

to be used in a hostile demonstration against such State, though the shipper takes no part in any overt act of war, and the ship is not f uUy equipped for the expedition vtdthin any British port. Under the same section, Dr Jameson, administrator of the British South Africa Company, and his confederates were tried before the Central Criminal Court and sentenced to different terms of imprisonment. The offence committed under a British Act is, of course, that of preparing and fitting out an expedition on British territory. Any acts subsequently committed by any British expedition on foreign soil are beyond the operation of domestic legislation, and fall to be dealt with by the domestic legislation of the State within which they occur, or by diplomacy, as the case may be. (t. ba.)

Ra,ig►►irh, a feudatory state of India, in the Chhat- tisgarh division of the Central Provinces. Area, 1486 square miles. Population (1891), 168,525; (1901), 174,911, showing an increase of 4 per cent., compared with an increase of 31 per cent, in the previous decade. Estimated revenue, Ks. 1,27,870; tribute, Rs.4000. The chief belongs to the old Gond royal family. The state is traversed by the Bengal-Nagpur Railway, with a station at Raigarh town, 338 miles east of Nagpur. Iron ore is said to aboimd.

RAILWAYS.

Statistics.

FOR the early history of railways, a sketch of their development, statistics of the earlier stages of that development, and a picture of the state of the art of carriage by rail as it was in 1883 to 1885, the reader may consult the ETwydopcedia Britannica, voL xx. The present article wiU deal with railways as they were in the year 1900, showing something of their place in modern society, of their relations to each other and to the citizen, of the work they do, and of the present development in building, equipping, and working them. Part of this subject, however, wiU be covered by articles that are placed alphabetically in other volumes. Thus train brakes are treated in the article Brakes.

At the end of 1885 there were in the world 302,887 miles of railway; by the end of 1898 the length was 466,524 miles. (In reading and using these figures, and some other general figures which will appear in this article, the fact must be recognized that it is impossible that they should be strictly accurate. They must be in error by some scores or even hundreds; but they are accurate enough for most purposes.) The increase in thirteen years was 54 per cent. ; and absolutely it was more than all the railways built in the world from the beginning, in 1828, up to 1872. The increase in the United Kingdom was at less than one-fourth the average rate of the world, namely, 12f per cent., for the very good reason that the territory had been well occupied early in the history of railway building. By Table I. it will be seen that, relatively to area, the United Kingdom has more miles of railway than any other country except Belgium. The rate of increase in the United States was considerably below the average, namely,

44^ per cent., that country having also been very enterprising in the early years, and having more railways relatively to population than any other great nation. But the length of railway there had become so great by 1885 that an addition of 44 J per cent, made 35 per cent, of aU the increase in the world in the thirteen years. In all Europe the increase was 38 per cent., while in European Russia it was 60 per cent., but that was

*from a small mileage. The greatest relative growths were : Austraha, 80 per cent. ; British India, 83^ per cent. ; Japan, 750 per cent. ; and all Asia, 141 per cent. But in all these cases the mileage in 1885 was but small : in Japan it was only 348 mUes. By Table I. it wiU be seen that in those countries now fairly well supphed vrith rail- ways the rate of increase is stiU falling, as one would expect ; and the decline in the United States is a fact of tremendous importance to the whole world. For years railway building was one of the chief industries of that country, and absorbed a great part of all the capital avail- able for investment. Probably the railways buUt in the United States in the four years ending 1883 cost at least $1,000,000,000 more than those built in the four years ending 1898. The release of this vast capital for other uses must affect profoundly the industries and commerce of the civilized world. The student of statistics of rail- ways may consult the yearly census of railways of the *orld which appears in the May-June issue of the Archiv fur Eisenhahnwesen, a periodical pubhcation of the Prussian Ministry of PubUc Works. That census is brought up to two years before the year of its publication, and now covers many years. This publication also gives regularly, throughout each year, special studies of the railways of every nation, which are of great value.*

It has been said that nothing is so cheap as the carriage of goods. It is not worth while to try to prove this ❓❓❓ perhaps it is not absolutely true ; but it is quite true that the transportation of goods is very cheap. The most in- structive examples of the charges for carriage by rail may be found in the United States, for several reasons. The length of railway there is 11 per cent, more than the railways of all Europe, including the United Kingdom. The tons of freight carried are 112 per cent, more than in the United Kingdom, and the average haul is miich longer than in any other great country. Furthermore, the statistics of the railways of Great Britain

do not give the traffic units, tons-one-mile and passengers-one-mile, i so that it

^ The North-Bastem Railway has decided to compile and publish these particulars, which it is believed have been prepared by the London and North-Western for the use of its own officials for some

[statistics

is impossible to get the average cost of service there. We find, then, in the United States examples of trans- portation on a great scale, covering a variety of con- ditions; and because the United States is the most important food – producing country, it is perhaps true that the cost of transportation in the United States more closely affects the rest of the world than the cost of carriage in any other country.

In the United States in 1899 the average charge for carrjdng one ton one mile was 0”724 cent. In 1888 the charge was I’OOl cent. This difference of twenty-eight hundredths of a cent on each ton carried one mile made a prodigious sum in the aggregate. If the freight rates in 1899 had been as high as they were in 1888, shippers and consumers would have paid to the railways of the United States $342,000,000 more than they did pay in fact. We cannot get the average for all of the lines for any year much further back, but the figures of two representative systems of railway, one in the East and one in the West, will illustrate the fall in freight rates for the whole country. In 1 870 the Pennsylvania Eailroad received 1 ‘55 cents for one ton one mile, and in 1899, 0‘469 cent. In 1870 the Chicago and North- Western received 3 ‘09 cents, and in 1899, 0-878 cent. The rates of 1870 corrected for the premium on gold would have been about 1‘35 and 2‘69 cents respectively in the money of 1899. This apparent decrease of about two-thirds is partly due to the greater relative growth of low-class traffic, but stiU it is a rough measure of the benefit which the people of the United States have enjoyed from the fall in freight rates, ??? a

benefit which has been shared by aU the world, more particularly because the United States is the great food- producing country.

We may better understand the social meaning of very cheap freight rates if we consider a few commodities of prime necessity to mankind. In 1899 a barrel of flour was carried by rail from the mills at Minneapohs to the warehouse in New York for about 52 cents on the average. The distance is 1332 miles by one of the shortest rail routes. This means that the transportation charge on an ordinary loaf of bread for 1332 miles of carriage is about one-third of a cent. The charge for carrying a barrel of flour from Minneapolis to Liverpool was about 70 cents in 1899. Kates and~wages vary somewhat year by year, but in general terms we may say that the supply of bread and meat for one man one year is carried from Chicago to Liverpool for a mechanic's wages for one day. In 1899 the charge for one ton of bituminous coal from the mines of West Virginia to deep water at Newport News was $1'00 for a haul of 400 miles. Anthracite coal was carried from the mines in Pennsylvania to tide-water, 200 miles, for $1 '00 a ton. In the same year a quart of milk was carried into New York from gathering grounds 260 miles away for y^^ths of a cent. Such examples might be multiplied indefinitely, and might bo found in different degrees in all countries which have railways. For railways have im- measurably enlarged the market in which a man may sell his products, and they have equally broadened the field from which he may draw his sustenance. They have made modern society possible. All this is true, to a less degree, of the cost of passenger movement. That has fallen, but not so fast or so far as the charges for goods, nor are low passenger rates so necessary to society as low goods rates. Low passenger rates are important within what may be called suburban zones, that is, in the areas in which people may Uve and go daily to and from a city.

time. Among English railway managers, however, there ia a wide- spread opinion that, in the conditions which exist in the United Kingdom, such particulars are not of great practical value, or at least are not essential for the proper conduct of a railway's traffic.

In ideal conditions the homes of the people, and especially of the poor, must be in the country. Air, light, low rent, ground to till, and wholesome

recreation for children can only be had by scattering the working population of a city into the surrounding country to sleep ; and the lower the passenger rates and the faster and more frequent the trains, the broader is the zone over which the popula- tion of any given city may be scattered. In the United States from ^ to ~~^^ cent a mile are the common suburban rates, good for aU trains and all hours. In England the ordinary rate for working men's suburban tickets is prob~~ ably not far from ^ cent a mUe. The use of these tickets is, however, restricted to certain trains and hours. Season ticket rates in England work out considerably higher than suburban rates in the United States.

Enough has been said to suggest the place of railways in civilization : the relative supply and use of railways are one measure of the relative civilization of two countries. In order to indicate the basis for such a comparison, certain statistics are collected in the following tables. The figures, however, change from year to year, and those who wish to make comparative studies should look for information in the annual statistical publications of the various countries. The tables are intended to suggest methods, rather than to serve as material for actual study.

Table I. shows miles of railway, absolute and relative, for several countries for the year 1898. It is obvious that such figures must be subject to some correction, for the reasons (among others) that statistical years and calendar years do not always coincide, and that censuses are not made every year. The table is, however, accurate enough for practical purposes. The countries in this table have been selected (1) to show the relative situa- tion in the great nations, and (2) to compare some of the most important of the British possessions. This table also shows the rate of increase in the various countries from 1894 to 1898. It is not safe to try to reason from this increase in the past to the increase in the future, as accidental conditions may have affected the growth abnor- mally in any one of these countries : in the United States, for instance, the rate of increase in these four years was perhaps abnormally small, owing to the great business depression which followed the panic of 1893.

Table I. ❓❓❓ Miles of Railway in Several Countries at the end of 1898.

Country.

Miles of Railway.

Per Cent.

of

Increase,

1894 to

1898.

Miles

of Railway

per 100

Square

Miles.

Population

per Mile of

Hallway.

United Kingdom .

United States (not in- cluding Alaska)

Germany

Belgium

France

Russia in Europe (in- cluding Finland)

Austria- Hungary .

British North America

British India

New South Wales

21,659

186,396

30,771

3,781

25,898

26,414 21,805 16,870 21,475 2,691

3-0

3-9

9-0 9-8 4-3

19-6 16-9

7-0 17-1

3-0

17-83

6-26 14-74 33-20 12-68

1-26 8-33 0-51 1-35 0-86

1,856

399 1,699 1,764 1,488

4,020 2,059

308 14,340

490

Table II. compares the work done by the railways of a few of the great nations ; from this the United Kingdom must be omitted, since the figures

of passenger-miles and ton-miles are not obtainable. Table II. gives results for 1898 in the United States and Germany, and for 1897 in the other countries. Further, the miles of Hne doing the work in the United States and Germany are not exactly the same as the miles in Table L, for

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complete traffic returns were not gathered from all of the railways. The returns of Belgium are from the State railways only, or about seventy per cent, of the whole Belgian mileage. The columns of passenger-miles and ton-miles in Table II. show millions, six ciphers being omitted. These columns give a notion of the prodigious amount of work done by the railways, but the column of daily movement each way (3 and 4) shows the relative density of the work. These give the passengers and the tons that must be moved each way, every day, over the whole mileage in each country, to make up the totals in columns 1 and 2. Here we discover that the density of passenger traffic is least in the United States and greatest in Belgium, which is precisely what one would expect from the relative density of population of the various countries. Columns 5 and 6 show the work done relatively to the population.

Table II. ???pfork done hy the Railways of Several Countries- Absolute and Relative. {United States and Germmvy, 1898 ; oth^r countries, 1897.)

MUlion Passenger- Miles

(000,000

omitted).

(1)

Million Ton-Miles

(000,000

omitted.)

(2)

Moved each

Way every Day

over the whole

Mileage.

Yearly Move- ment per Inhabitant.

Passen- gers.

(3)

Tons.

(4)

Passen- ger- Miles

(6)

Ton- Milas.

(6)

United St

Germany

France

Austria

Hungary

Belgium

3,tes .

13,380 10,934 7,228 2,506 1,320 1,240

101,855 17,958 8,482 5,830 2,423 1,711

99 500 386 318 181 849

748 820 454 740 332 1,170

180 209 188 98 70 190

1,376 343 221 228 129 262

Table III. gives the rolling stock of a few countries, showing not only the absolute number of locomotives and cars, but the number for each 100 miles of railway. It is not seriously misleading to compare the equipment per mile in the European countries and New South Wales, for the capacity of each unit of roUing stock is about t|ie same. It would be misleading, however, to make such a comparison with British India, because of the large pro- portion of narrow gauge stock; and it would be very misleading to make a comparison between the United States and other countries. As will be shown in the section on KoUing Stock, the average freight car of the United States probably carries three times as much as the average freight car of Europe. On that assumption the freight equipment of the United States is much more per mile than that of Prance or Germany, but only

Table III.

Rolling Stock in Several Countries Absolute and

per 100 Miles of Railway.

Year .

1898.

1897.

1897.

1897-98.

1900.

United States.

United Kingdom.

France.

Germany.

India.

New South Wales.

Locomotives .

36,234

19,479

10,611

16,884

4,637

489

Locomotives

per

100 miles .

20

91

42

67

19

17

Passenger cars

33,696

44,063

27,179

33,664

13,263

1,026

Passenger cars

per

100 miles

18

206

107

114

55

37

Freight cars .

1,292,679

664,883

279,634

361,606

89,108

10,929

Freight cars

per

100 miles

700

3,044

1,096

1,230

375

390

about two-thirds that of the United Kingdom. German statistics often give not only the number of cars but also the number of axles. Even that does

not give an exact basis of comparison, for the load on one axle is considerably greater in the United States than in any other country.

The same is true, though in a less degree, of comparisons between locomotives. By combining Table II. and Table III. a notion may be obtained of the work done by a unit of equipment in various countries.

Table IV. shows the capital of the railways of several countries, absolute and per mile, giving the latest figures available at the time of writing, which will, however, suffice for the purposes for which it is inserted here, namely, to give a comparison at a particular period.

Table IV. ???Capital of the Railways of Certain Countries.

(Great Britain from Board of Trade Returns ; United States from Interstate Commerce Commission ; other countries from the Archiv filr Eisenbahnwesen.)

Country.

Year.

Total

Per Mile.

Germany

1897-98

??580,225,000

??19,927

Austria ....

1897

230,053,000

21,260

Hungary ; State roads .

1897

84,970,000

17,900

France ; Main lines

1897

640,186,000

24,790

United Kingdom .

1898

1,134,468,462

52,400

United States

1898

2,221,470,000

12,390

British North America .

1898

193,343,000

11,470

New South Wales .

1898

38,424,000

14,280

Trans-Continental Railways. ***K railway line across North America was first completed in 1869, when the Union Pacific, building from the Missouri river at Omaha (1400 miles west of New York), met the Central Pacific, which built from San Francisco eastwards, making a line 1848 miles long through a country then for the most part uninhabited. This was followed by the Southern Pacific in 1881, from San Francisco to New Orleans, 2489 miles; the Northern Pacific, from St Paul to Portland, Or., in 1883 ; the Atchison, Topeka, and Santa Fe, from Kansas City to San Diego ; and the Great Northern, from St Paul to Seattle and New Westminster in 1893. Meanwhile the Canadian Pacific, a true trans-continental line, was built from Montreal, on Atlantic tide-water, to the Pacific at Vancouver, 2906 miles. But these hues have been dwarfed since 1891 by the Siberian Kailway, built by the Eussian Government entirely across the continent of Asia from Cheliabinsk (1769 miles by rail east of St Petersburg) to Vladivostok, a distance of 4073 miles, with a branch about 500 miles long to the Chinese ports Dalny and Port Arthur. The part of this railway in China had construc- tion trains running over its fuU length early in 1902, but was not to be ready for public traffic until much later ; and there remains to be built about 170 miles in very difficult country around the south end of Lake Baikal, communica- tion being now maintained by ferry-boats, which convey all the carriages of a train across the lake, more than 40 miles, when the ice permits. Besides its connexion with the Chinese Eastern Railway, the Siberian Railway reaches a navigable branch of the Amur at Sryetensk, from which a large fleet of hght-draught steamboats maintain communi- cation with Vladivostok by means of a railway from that place north-east 478 miles to the Amur at Khabarovsk. The extent of country made accessible by the Siberian Railway is greatly increased by the thousands of miles of*

navigable rivers which it crosses ❓❓❓ the Ob, the Tom, the Irtysh, and the Yenisei west of Lake Baikal, and the Sungari in Manchuria. Down to 1902 the new railway had brought about a million Russian immigrants into Siberia, and a beginning had been made towards exploiting the coal, copper, and other mines of the country. Mr. Rhodes's project of the Cape-to-Cairo Railway, if ever reahzed, is likely to serve almost exclusively for local and not for trans-continental traffic, because the sea affords a very much cheaper and, for nearly all purposes, a much better route. A trans-continental hne was long ago

undertaken across South America from Buenos Aires to the Chilian coast. The continent here is only about 900 miles wide. A short section remains to be built, but that is over and through the Andes, and will be very costly. (h. a. p.)

Kailway Economics and Legislation.

It was at one time an axiom of law and of poUtical economy that prices should be determined by free com- petition. But in the development of the railway business it soon became evident that no such dependence on free competition was possible, either in practice or in theory. This difficulty is not pecuhar to railways ; but it was in the history of railway economy and railway control that certain characteristics which are now manifesting them- selves in all directions where large investments of fixed capital are involved were first brought prominently to public notice.

For a large number of those who use a railway, com- petition in its more obvious forms does not and cannot exist. Independent carriers cannot run trains over the same line and underbid one another in offering trans-portation services. It would be practically impossible for a line thus used by different carriers to be operated either with safety, or with economy, or with the advantage to the public which a centralized management affords. It is equally impossible for the majority of shippers to enjoy the competition of parallel lines. Such duphcation of railways involves a

waste of capital. If parallel hues compete at all points, they cause ruin to the investors. If they compete at some points and not at others, they produce a discrimination or preference vnth regard to rates and facilities, which builds up the competitive points at the expense of the non-competitive ones. Such partial competition, with the discrimination it involves, is apt to be worse for the public than no competition at all. It increases the tendency, already too strong, towards concen- tration of industrial life in large towns. It produces an uncertainty with regard to rates which prevents stability of prices, and is apt to promote the interests of the un- scrupulous speculator at the expense of those whose business methods are more conservative. So marked are these evils that such partial competition is avoided by agreements between the competing lines with regard to rates, and by divisions of traffic, or pools, which shall take away the temptation to violate such rate agreements. The common law has been somewhat unfavourable to the enforcement of such agreements, and statutes in the United States, both local and national, have attempted to prohibit them ; but the public advantage from their existence has been so great as to render their legal disabilities inoperative. In those parts of the continent of Europe where railways are owned and administered by State authority, the necessity for such agreements is frankly admitted.

But if rates are to be fixed by agreement, and not by competition, what principle can be recognized as a legiti- mate basis of railway rate-making^ The first efforts at railway legislation were governed by the equal mileage principle; that is, the attempjt was made to make rates proportionate to the distance. It was, however, soon seen that this was inadmissible. So much of the expense of the handHng, both of freight and of passengers, was inde- pendent of the length of the journey that a mileage rate sufficiently large for short distances was unnecessarily burdensome for long ones, and was bound to destroy long- distance traffic, if the theory were consistently appUed. The system has been retained in large measure in passenger business, but only because of the conflict which inevitably occurs between the authorities and the passengers with regard to the privilege of breaking and resuming a journey

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In

when passenger rates are arranged on any other plan, freight schedules it has been completely abandoned.

A somewhat better theory of rate regulation was then framed, which divided railway expenditures into movement expense, connected with the line in general, and terminal expense, which connected itself with the stations and station service. Under this system each consignment of freight is compelled to pay its share of the terminal expense, independently of distance, plus a mileage charge proportionate to the length of the journey or haul. There has been also a further attempt in England to divide terminal charges into station and service terminals, accord- ing to the nature of the work for which compensation is sought. But none of these classifications of expense reaches the root of the matter. A system of charges which com- pels each piece of traffic to pay its share of the charges for track and for stations overlooks the fundamental fact- that a very large part of the expenses of a railway ??? more than half ??? is not connected either vpith the cost of moving traffic or of handling traffic at stations, but with the cost of maintaining the property as a whole. Of this character are the expenditures necessary for maintenance of way, for general administration, and for interest on capital bor- rowed, which are almost independent of the total amount of business done, and quite independent of any individual piece of business. To say that all traffic must bear its share of these interest and maintenance charges is to impose upon the railways a rate which would cut off much of the long-distance traffic, and much of the traffic in cheap articles, which is of great value to the pubhc, and which, from its very magnitude, is a thing that railways could not afford to lose. It is also a fact that with each recurring decade these general expenses (also called indirect, undistributed, or fixed charges) have an increased importance as compared with the particular (direct, distributed, or operating) expense attaching natur- ally to the particular portions of the traffic. For with increased density of population it becomes profitable to make improvements on the original location, even though this may involve increased charges for interest and for some parts of its maintenance, for

the sake of securing that economy of operation, through larger train-loads, which such an improved location makes possible.

Whatever the ostensible form of a railway tariff, the contribution of the different shipments of freight to these general expenses is determined on the principle of charging what the traffic will bear. Under this principle, rates are reduced where the increase of business which follows such reduction makes the change a profitable one. They are kept relatively high in those cases where the expansion of business which follows a reduction is small, and where such a change is therefore unprofitable. This theory of charging what the traffic vsill bear is^ an unpopular one, because it has been misapplied by railway managers and made an excuse for charging what the traffic wiU not bear. Eightly applied, however, it is the only sound economic principle. It means taxation according to abihty ??? that ability being determined by actual experiment.

In the practical carrying out of this principle, railways divide all articles of freight into classes, the highest of which are charged two or three, or even four, times the rates of the lowest. This classification is based partly upon special conditions of service, which make some articles more economical to carry than others (with par- ticular reference to the question whether the goods are offered to the companies in car-loads or in small parcels), but chiefly with regard to the commercial value of the article, and its consequent ability to bear a high charge or a low one. For each of these classes a rate-sheet gives the actual rate-charge per unit of weight between the various

stations covered by the tariff. This rate increases as the distance increases, but not in equal proportion ; while the rates from large trade centres to other trade centres at a great distance are not higher than those to intermediate points somewhat less remote ; if the law permits, there is a tendency to make them actually a little lower. Besides the system of

charges thus prescribed in the classification and rate sheet, each tariff provides for a certain number of special rates or charges made for particular lines of trade in certain locahties, independently of their relation to the general system. If these special rates are published in the tariff, and are offered to all persons alike, provided they can fulfil the conditions imposed by the company, they are known as commodity rates, and are apparently a necessity in any scheme of railway charges. If, however, they are not published, and are given to certain persons as individual favours, they become a prolific source of abuse, and are quite indefensible from the standpoint of political economy.

While the superficial appearance of the railway tariff is different for different countries, and sometimes for different parts of the same country, the general principles laid down are followed in rate-making by aU well-managed lines, whether State or private. It is a mistake to suppose that the question of public or private ownership wiU make any considerable difference in the system of rate-making adopted by a good railway. A State system will be com- pelled, by the exigencies of the pubhc treasury, to arrange its rates to pay interest on its securities ; a private company will generally be prevented, by the indirect competition of railways in other parts of the country which it serves, from doing very much more than this. The relative merit of the two systems depends upon the question how we can secure the best efficiency and equity in the apphcation of the principles thus far laid down. There are three different systems of control : ???

1. Private operation, subject only to judicial regulation, was exemplified most fully in the early railway history of the United States. Until 1870 railway companies were almost free from special Acts of control ; and, in general, any company that could raise or borrow the capital was allowed to build a railway wherever it saw fit. In the United Kingdom there was almost as much immunity from legislative interference with charges, but the com- panies were compelled to secure special charters, and to conform to regulations made by the Board of Trade in the interests of pubhc safety. The advantage of this relatively free system of railway building and manage- ment is that it secures efficient and progressive methods. Most of the improvements in operation and in traffic

management have had their origin in one of these two countries. The disadvantage attendant upon this system is that the courts are reluctant to exercise the right of regulation, except on old and traditional lines, and that in the face of new business methods the public may be inadequately protected. There is also this further disadvantage, that in the gradual progress of consolidation railway companies take upon themselves the aspect of large monopoUes, of whose apparently unrestricted power the pubhc is jealous. As a result of these difficulties there has been, both in the United Kingdom and in the United States, a progressive increase of legislative interference with railways. In the former the Kailway and Canal Traffic Act of 1854 specially prohibited preferences, either in facihties or in rates. The Regulation of Railways Act of 1873 provided for a Railway Commission, which should be so constituted as to take cognizance of cases on the investigation of which the courts were reluctant to enter. Finally, the legislation of 1888 put into the hands of a reorganized Railway Commission and of the Board of

Trade powers none the less important in principle because their action has been less in its practical effect than the advocates of active control demanded. In the United States the years from 1870 to 1875 witnessed sweeping and generally iU-considered legislation ("Granger" Acts) concerning railway charges throughout the Mississippi valley; while the years from 1884 to 1887 were marked by more conservative, and for that reason more enforceable. Acts, which culminated in the Interstate Commerce Act, prohibiting personal discrimination and gradually restrict- ing discrimination between places, and providing for a National Commission of very considerable power ??? not to speak of the pooling clause, which was extraneous to the general purpose of the Act, and has tended to defeat rather than strengthen its operation. An increased amount of attention has also been paid, both by the states and the government, to laws in the interests of public safety.

2. Operation by private companies, imder specific pro- visions of the Government authorities with regard to tlie method of its exercise, has been the pohcy consistently carried out in France, and less systematically and con- sistently in other countries under the domination of the Latin race. It was believed by its advocates that this system of prescribing the

conditions of construction and operation of hnes could promote public safety, prevent waste of capital, and secure passengers and shippers against extortionate rates. These expectations have been only partially fulfilled. Well trained as was the civil service of France, the effect of this supervision in deadening activity was sometimes more marked than in its effect in preventing abuse. Moreover, such a system of regulation almost necessarily carries with it a guarantee of monopoly to the various companies concerned, and not infrequently large gifts in the form of subsidies, for without such aid private capital wUl not submit to the special biirdens involved. These rights, whether of monopoly or of sub- sidy, form a means of abuse in many directions. Where the Government is bad, they are a fruitful source of corrup- tion; even where it is good, they enable the companies to drive hard bargains vidth the public, and prevent the expected benefits of official control from being reahzed.

3. State operation and ownership is a system which originated in Belgium at the beginning of railway enter- prise, and has been consistently carried out by the Scandinavian countries and by Hungary. Since 1860 it has been the poUcy of Australia. It has generally come to be that of Germany and, so far as the finances of the countries allow, of Austria and Russia ; British India also affords not a few examples of the same method. The theory of State ownership is excellent. So large a part of the railway charge is of the nature of a tax, that there seem to be a priori reasons for leaving the taxing powers in the hands of the agents of the Government. In practice its operation is far more uncertain. Whether the intelligence and efficiency of the officials charged by the State with the handUng of its railway system will be sufficient to make them act in the interest of the pubhc as fully as do the managers of private corporations, is a question whose answer can only be determined by actual experience in each case. If they fail to have these qualities, the com- plete monopoly which a Government enjoys, and the powers of borrowing which are furnished by the use of the public credit, increase instead of diminishing the danger of arbitrary action, unprogressiveness, and waste of capital. Even in matters like pubhc safety it is by no means certain that Government authorities wiU do so well as private ones. The question is one which practical railway men have long since ceased to argue on general principles : they

recognize that the answer depends upon the respective degree of talent and integrity which characterize the busi-

ness community on the one hand and the Government officials on the other.

AuTHOKlTiES. ◆◆◆ On economics of construction and of operation, see Wellington, The Economic Theory of Railway Location, 5th edition, New York, 1896. On principles governing railway rates in general, and specifically in England, see Acworth, The Rail- ways and the Traders, London, 1891. On comparative railway legislation and the principles governing it, see Hadlby, Railroad Transportation; Its History and Its Laws, New York, 1885. On the history of railway legislation in England, see Cohn, Unter- suchungen fiber die Englische Eisenbahnpolitik, Leipzig, 1874-83. On practice concerning rates in continental Europe, see Ulkioh, Das Eisenlahntarifwesen, Berlin, 1886. (Since this was published, Continental passenger rates have fallen. The French translation- Paris, 1898 ◆◆◆ gives Russian tariffs.) (a. T. H.)

Bkitish Railway Legislation.

The first thing a railway company in Great Britain has to do is

to obtain a special or private Act of Parliament authorizing the

construction of the line. Not that the mere laying or

Construe- ^y^j-i^i^g ^f ^ railway requires parliamentary sanction, so

“◆◆◆ long as the work does not interfere with other people’s

rights and interests. An example of a railway built without any legislative authority is the little mountain railway from Llanberis to the summit of

Snowdon, which was made by the owner of the land through which it passes. Such a railway has no statutory rights and no special obligations, and the owner of it is liable to be sued for creating a nuisance if the working of the line interferes with the comfort of those residing iu the neighbourhood. When, how- ever, a company desires to construct a line on a commercial scale, to acquire land compulsorily, to divert rivers and streams, to cross roads either on the level or by means of bridges, to pass near houses, to build tunnels or viaducts, and to execute all the other works incidental to a railway, and to work the line when com- pleted without interference, it is essential that the authority of Parliament should be obtained. The company therefore promotes a Bill, which is considered first by select committees of the two Houses of Parliament, and afterwards by the two Houses them- selves, during which period it faces the opposition, if any, of rival concerns, of local authorities, and of hostile landowners. If this is successfully overcome, and the proposals meet with the approval of Parliament, the Bill is passed, and after securing the Royal Assent, becomes an Act of Parliament. The company is then free to pro- ceed with the work of construction, and at once becomes subject to various general Acts, such as the Companies Clauses Act, which affects all joint-stock companies incorporated by any Special Act ; the Land Clauses Act, which has reference to all companies having powers to acquire land compulsorily ; the Railway Clauses Act, which imposes certain conditions on all railways alike (except light railways) ; the various Regulation of Railways Acts ; the Carriers Protection Act ; Acts for the conveyance of mails, parcels, troops ; Acts relating to telegraphs to the conveyance of workmen, and to the housing of the labouring classes ; and several others which it is unnecessary to specify. From the early days of railways Parliament has also been careful to provide for the safety of the public by inserting in the general or special Acts definite conditions, and by laying upon the Board of Trade the diity of protecting the public using a railway.

The first Act which has reference to the safety of passengers is the Regulation of Railways Act of 1842, which obliges every rail- way company to give notice to the Board of Trade of tfoaf' ^^^ intention to open the railway for passenger traffic, and places upon that public department the duty of inspecting the line before the opening of it takes

place. If the officer appointed by the Board of Trade should, after inspection of the railway, report to the department that in Ms opinion "the opening of the same would be attended with danger to the public using the same, by reason of the incompleteness of the works or permanent way, or the insufficiency of the establishment for work- ing such railway," it is lawful for the department to direct the company to postpone the opening of the line for any period not exceeding one month at a time, the process being repeated from month to month as often as may be necessary. The company is liable to a fine of twenty pounds ►► day if it should open the line in contravention of such order or direction. The inspections made by the officers of the Board of Trade under this Act are very complete : the permanent way, bridges, viaducts, tunnels, and other works are carefully examined ; all iron or steel girders are tested ; stations, including platfoi- ms, stairways, waiting-rooms, etc., are inspected; and the signalling and "interlocking" are thoroughly overhauled. A code of requirements in regard to the opening of new railways has been drawn up by the department for the guidance of railway companies, and as the special circum- stances of each line are considered on their merits, it rarely happens that the department finds it necessary to prohibit the

opening of a new railway. The Regulation of Railways Act of 1871 extends the provisions of the above Act to the opening of "any additional line of railway, deviation line, station, junction, or crossing on the level " which forms a portion of or is connected with a passenger railway, and which has been constructed sub- sequently to the inspection of it. This Act further defines the duties and powers of the inspectors of the Board of Trade, and also authorizes the Board to dispense with the notice which the previous Act requires to be given prior to the opening of any railway or part of it.

It may be remarked that neither of these Acts confers on the Board of Trade any power to inspect a railway after it has once been opened, unless aud until some addition or alteration, such as defined in the last-named Act, has been made. When a line has once been inspected and passed, it lies with the company to main- tain it in accordance with the standard of efficiency it originally possessed, but no express statutory obligation to do

so is imposed upon the company, and whether it does so or not the Board of Trade cannot interfere.

The Act of 1871 further renders it obligatory upon every railway company to send notice to the Board of Trade in the case of (1) any accident attended with loss of life or personal injury to any person whatsoever ; (2) any collision i"?" ' where one of the trains is ******passenger train ; (3) any ^^^jjg^f^ passenger train or part of such train leaving the rails ; (4) any other accident likely to have caused loss of life or personal injury, and specified on that ground by any order made from time to time by the Board of Trade. The department is authorized, on receipt of such report, to direct an inquiry to be made into the cause of any accident so reported, and the inspector appointed to make the inquiry is given power to enter any railway premises for the purposes of his inquiry, and to summon any person engaged upon the railway to attend the inquiry as a witness, and to require the production of all books, papers, and documents which he considers important for the purpose. The inspector, after making his investigation, is required to make a report to the Board of Trade as to the causes of the accident and the circumstances attending the same, with any observations on the subject which he deems right, and the Board ' ' shall cause every such report to be made public in such manner as they think expedient." The usual mode of publishing such reports is to forward them to railway companies concerned, as well as to the press, and on application to any one else who is in- terested. The reports are subsequently included in a Blue- book and presented to Parliament. It should be noted that although the inspecting officer may in his report make any recom- mendations that he may think fit with a view to guarding against any similar accident occurring in the future, no power is given to the Board of Trade, or to any other authority, to compel any rail- way company to adopt such recommendations. This omission is sometimes held to be an error, but as a fact it is an advantage. The moral effect of the report, with the criticisms of the company's methods and recommendations appended thereto, is great, and it rarely happens that a company refuses to adopt, or at any rate to test, the recommendations so made. If on the other hand the company is of opinion that the suggestions of the inspecting oiEcer are not likely to prove beneficial, or are for any reason unadvis- able, it ia at liberty to reject them, the responsibility of*

doing so resting entirely upon itself The effect of this latitude is to give the company ample discretion in the matter, and to enable the Act of Parliament to be administered and the object of it to be attained without undue interference.

In 1889 a very important Act was passed placing upon the Board of Trade the obligation to call upon railway companies throughout the United Kingdom (1) to adopt upon all passenger lines the “block” system of working; “<"''''???? (2) to "interlock" their points and signals: (3) to fit all trains carrying passengers with some form of automatic continuous brake. Prior to this some companies had, to a certain extent, done these things, but few, if any, were completely equipped in these respects. A reasonable period was afforded them, according to circumstances, to comply with these requirements, and at the present time the work is practically complete. In this respect the lines of the United Kingdom are far ahead of those of any other country, and a diminution of accidents, particularly of collisions, has resulted therefrom. America is now following the lead thus set, and all the most important lines in the United States have adopted block working and interlocking, but a great deal still remains to be done. In certain respects, on the other hand, America has gone further than the United Kingdom, especially iu the matter of automatic signalling, and in the operating of points and signals by electrical power or air-pressure instead of manual labour. In America, also, it is the custom to fit freight trains with an automatic continuous brake, whereas in the United Kingdom this appliance is required by law only in the case of passenger trains, and in fact is not fitted to goods and mineral trains except in one or two isolated instances.*

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Hoars ot labour.

The above-named Acts enable the Board of Trade to take all the necessary steps to ensure that the safety of passenger trains is sufficiently guarded.

More recently legislation has been passed to safeguard the lives and interests of railway servants. In 1893 an Act was passed by Parliament giving the Board power to interfere if or when representations are made to them by or on behalf of any servant or class of servants of a railway company that the hours of work are unduly long, or do not provide sufficient intervals of uninterrupted rest between the periods of duty, or sufficient relief in respect of Sunday duty. In such oases the company concerned may, after inquiry, be called upon to submit such a schedule of the hours during which the man or men are employed as will bring those hours within limits which appear to the department reasonable. In the event of the company failing to comply with the demands of the depart- ment, the latter is empowered to refer the case to the Railway and Canal Commissioners, who form a special Court constituted by the Eailway and Canal Traffic Act of 1888, for deciding, among other things, questions relating to rates and charges, for protecting traders from undue charges and undue prefer- ence, for regulating questions of traffic, and for deciding certain disputes between railway companies and the public. The Commis- sioners are then empowered to deal with the matter, and if " a railway company fail to comply with any order made by the Eailway and Canal Commissioners, or to enforce the provisions of any schedule " approved by them, it is liable to a fine of a hundred pounds for every day during which the default continues. This Act has been the means of effecting a considerable reduction in the hours worked by railway men on certain railways, and no case has yet arisen in which a reference to the Commissioners has been necessary. Such modifications of the hours of work have not only been beneficial to the men, but have improved the discipline of the staff and the punctuality and regularity of the train service, particularly in respect of the goods trains.

The Notice of Accidents Act of 1884, which obliges employers of labour to report to the Board of Trade, when ' ' there occurs in any employment " as defined by the schedule of the Act, "any accident which causes to any person employed therein, either loss of life or such bodily injury as to prevent him on any one of the three working days next after the occurrence of the accident from being employed for five hours on his ordinary work," affects railways in course of construction, but not, as a rule, otherwise.

*Although the administration of the above-mentioned Acts of Parliament has had a beneficial effect upon the safety of the public, Saletv ot ^^^ * enabled an enormous volume of traffic to be serv^ts ^*’”l‘i “““itli celerity, punctuality, and absence of risk, it has during recent yeara come to notice that the number of casualties among railway servants is still unduly great, and in 1899 a Eoyal Commission was appointed to investigate the causes of the numerous accidents, fatal and non-fatal, to railway men. As a consequence of the report of this Commission the Eail- way Employment (Prevention of Accidents) Act of 1900 was passed, putting upon the Board of Trade the duty of making ” such rules as they think fit with respect to any of the subjects mentioned in the schedule to this Act, with the object of reducing or removing the dangers and risks incidental to railway service.” Eules may also be made in respect to other matters besides those mentioned in the schedule, and companies may be called upon to adopt or reject, as the case may be, any appliance, the use or disuse of which may be considered desirable in the interest of the men. Before, however, the rules so made become binding upon the com- panies, the latter have the right of appealing against them to the Eailway Commissioners. Failure to comply with any of the rules renders a company “liable for each offence, on conviction under the Summary Jurisdiction Acts, to a fine not exceeding fifty pounds, or in the case of a continuing offence to a fine not exceeding ten pounds for every day during which the offence continues after conviction.” Eules drafted by the Board of Trade under this Act came into force on the 8th of August 1902, the subjects referred to being (1) labelling of waggons ; (2) movements of waggons by propping and tow-roping ; (3) power-brakes on engines ; (4) lighting of stations and sidings ; (5) protection of points, rods, &c. ; (6) construction and protection of gauge-glasses ; (7) arrangement of tool-boxes, &c. , on engines ; (8) provision of brake-vans for trains upon running lines beyond the limits of stations ; (9) protection to permanent-way men when relaying or repairing permanent way. The final settlement of a rule requiring brake-levers to be fitted on both sides of goods-waggons was, however, deferred, owing to objections raised by certain of the railway companies.*

Other Acts which are of importance in connexion with accidents are the Accidents Compensation Act of 1846 ; the Employers’ Liability Act of

1880, and the Workmen's Compensation Act of

1897.

The public Acts of Parliament referring to British railways are collected in Bigo's General Bailway Ads. /ft A Y ">

Statistics of Accidents.

The railway companies of Great Britain are, as stated above, obliged by the Act of 1871 to give the Board of Trade notice of certain kinds of accidents occurring on their lines. Some of these kinds are explicitly mentioned in the Act, but with regard to requiring notice of others, the Board of Trade has a discretionary power. This it has exercised from time to time, and its general orders now in force specify, as requiring notice, accidents (1) as regards the locomotive power and rolling-stock, such as the bursting of engine-boilers and failures of axles, wheels, tyres, and other parts of locomotive engines, tenders, or vehicles ; (2) as regards the permanent way and works, such as the failure of rails, bridges, tunnels, viaducts, &c. ; and (3) miscellaneous accidents to rolling-stock and permanent way, such as trains coming into collision with the gates of level-crossings and other obstructions on the lines, &c.

Accidents to trains, such as collisions and derailments, may be divided into two classes, namely, those caused by defective con- struction or maintenance of the permanent way, works, ... and rolling-stock, and those caused by mistakes or """"'^ negligence on the part of the employes of the railway trains. companies ; to these must be added a few cases that arise from unavoidable causes, such as obbtacles falling on the raOs, or the expansion of rails through excessive heat. The improvements in safety appliances on the railways have much reduced the number of serious accidents to trains, and the following summary (Table V.) of the cases into which it was found necessary to order inquiries by the inspecting officers of the Board of Trade, divided into periods of five years, shows to what extent such reduction has taken place since 1871 : ???

Table V.

Number of inquiries held by inspecting officers of the Board of Trade into accidents to trains during successive periods of five years, and total number of miles open for traffic at end of each period of five years.

Period.

Number of Inquiries.

Miles open at End of Period.

1871 to 1875 1876 ??? 1880 1881 ??? 1885 1886 ??? 1890 1891 ??? 1895 1896 ??? 1900

996 621 488 303 266 290

16,658 17,933 19,169 20,073 21,174 21,855

These accidents may be divided into the classes shown in Table VI. :???

Table VI.

Class of Accident.

1871- 1875,

A. From engines or vehicles meeting with ohstructions, or leaving the rails in consequence of obstructions, or from defects in connexion with the per- manent way or works ....

B. From boiler explosions, failures of axles, wheels, or tyres, or from other defects in the rolling-stock .

C. From trains entering stations at too great speed

D. From collisions between engines and trains following one another on the same line of rails, excepting at junc- tions, stations, or sidings

E. From collisions at junctions

F. From collisions within fixed signals at stations or sidings

G. From collisions between engines or trains meeting in opposite directions .

H. From collisions at level-crossings of two railways

I. From engines or trains being wrongly run or turned into sidings^r otherwise, through facing-points ....

J On inclines (trains) ....

K. Miscellaneous

1876- 1880,

25

1881-

1885.

1886- 1890.

1891- 1896- 1895 1900,

The principal improvements which have tended to the reduction of most of the classes of accidents shown in the preceding table

S. VIII. ???1 8

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are the adoption of the block system, of interlocking points and signals, and of continuous automatic brakes, all of which the Board of Trade was

empowered to order by the Regulation of Railways Act of 1889.

The circumstances which contributed to the accidents inquired into are shown in the following summary (Table VII.) ; but it must be borne in mind that as a large number of the accidents arose from more than one of the circumstances enumerated, this summary shows an excess over the actual number of accidents : ???

Table VII.

Circumstances contributing to the Accidents.

Defective rolling-stock or failures of

apparatus of rolling-stock . Defective road or works signalling and

safety apparatus, &c

Insufficient or defective accommodation

for the requirements of the traffic Insufficient establishment, long hours,

inexperienced servants, or want of

proper supervision ....

Defective systems for securing intervals

between trains

Negligence, wantof care, and mistakes of

officers and servants Foggy or stormy weather .

1871- 1875.

174 412 120

187

212

740 82

1876- 1880.

1881- 1886.

1886- 1890.

1891- 1896,

1896- 1900.

In the accidents that occurred to trains, the loss of life and personal injury to passengers was as shown in Table VIII : ???

Table

VIII.

Number of Pas-

sengers Killed

Number of Passenger Journeys (ex-

Proportion of Killed and Injured

to Number carried.

Tear.

to Trains.

clusive of

Journeys by

Season-Ticket

Holders).

Killed.

Injured.

Killed.

Injured.

1874

86

1613

477,840,411

1 in 5,556,284

1 in 296,243

1875

17

1212

506,975,234

1 ??? 29,882,073

, 418,296

1876

38

1279

538,287,295

1 ??? 14,165,455

, 420,865

i8yv

11

664

551,593,654

1 ,, 50,144,876

, 830,713

1878

24

1173

565,024,455

1 ,, 23,542,685

, 481,692

1879

75

602

562,732,890

1 ??? 7,503,105

, 934,772

1880

29

904

603,885,025

1 ??? 20,823,586

, 668,013

1881

28

987

622,160,000

1 ,, 27,050,435

, 630,354

1882

18

803

654,838,295

1 ??? 36,379 905

, 815,489

1883

11

662

683,718,137

1 ◆◆◆62,156,194

, 1,032,806

1884

31

864

694,991,860

1 ◆◆◆22,419,092

, 804,388

1885

6

436

697,213,031

1 ◆◆◆116,202,171

, 1,599,112

1886

8

615

725,584,390

1 ◆◆◆ 90,698,049

, 1,179,812

1887

25

538

733,670,000

1 ◆◆◆ 29,346,800

, 1,363,699

1888

11

594

742,499,164

1 ,, 67,530,000

, 1,250,555

1889

88

1016

775,183,073

1 ◆◆◆ 8,808,875

, 762,975

1890

18

496

817,744,046

1 ◆◆◆ 45,430,224

, 1,648,677

1891

5

875

845,463,668

1 ◆◆◆ 169,092,733

, 966,244

1892

21

601

864,435,388

1 ◆◆◆ 41,163,589

, 1,438,328

1893

lY

484

873,177,052

1 ◆◆◆51,363,356

, 1,804,084

1894

16

347

911,412,926

1 ,, 56,963,307

, 2,626,550

1895

5

399

929,770,909

1 ◆◆◆185,954,182

, 2,330,253

1896

5

388

980,339,433

1 ??? 196,067,887

, 2,526,648

1897

18

324

1,030,420,201

1 ,, 57,245,567

, 3,180,309

1898

25

632

1,062,911,116

1 ◆◆◆ 42,516,445

, 1,681,821

1899

14

693

1,106,691,991

1 ◆◆◆ 79,049,428

, 1,596,958

1900

16

863

1,142,276,686

1 ◆◆◆ 71,392,293

, 1,323,611

1901

0

476

1,172,395,900

, 2,463,017

From this table it will be seen that no deaths occurred to passengers from collisions, derailments, &o., on the railways of the United Kingdom in the year 1901. The two accidents involving the greatest loss of life in the period covered by the table were (1) the Tay Bridge disaster, which occurred in 1879, when, owing to the failure of the bridge while a train was passing over it during a gale, the train was thrown into the water and 73 passengers lost their lives ; and (2) the terrible accident at Armagh in 1889, when the rear portion of a passenger train ran back down an incline and came into collision with a following passenger train, causing the death of 80 passengers and injury to 262 others.

Accidents to passengers from causes other thsm Accidents accidents to the trains in which they were travelling to for the years 1875, 1880, 1885, and 1890-1901 a,Te passengers. shown in Table IX : ???

Table IX.

From Accidents

From Accidents

1

Year.

in connexion with

the Movement of

Trains, Railway

Carriages, &c.

Premises not in

connexion with

the Movement of

Trains, &o.

Total.

Killed.

Injured.

Killed.

Injured.

KUled.

Injured.

1875 .

117

594

1880

114

709

4

204

118

913

1885

96

693

5

223

101

916

1890

100

865

3

359

103

1224

1891

98

737

8

266

106

1003

1892

108

747

12

336

120

1083

1893

89

737

7

312

96

1049

1894

101

821

4

323

105

1144

1895

78

710

4

297

82

1007

18961

88

11981

5

5151

93

17131

1897

115

1315

2

586

117

1901

1898

128

1238

9

489

137

1727

1899

141

1457

10

617

151

2074

1900 .

119

1563

7

624

126

2187

1901

135

1669

23

680

168

2349

1 Note. *la the year 1896 an Order of the Board of Trade under the Regulation of Railways Act 1871, laying down more stringent regulations for reporting non- fatal accidents, came into force. By this Order companies are required to report all cases of injury to passengers. The principal causes of accidents to passengers in this class are from falling between trains and platforms or on the ballast when entering or alighting from trains in motion, from falling off platforms or out of trains, from being run over when crossing the lines at stations, and from falling when ascending or descending steps at stations.*

Taking the figures for 1901, the total risk to passengers from the time they entered the premises of the railway company until their departure therefrom was

Total Fatal accidents . . . 1 in 7,420,227 risk to

Non-fatal accidents . . . 1 ❓❓❓ 415,007 passengers.

This calculation, like those previously given in the above tables, does not take into account the journeys made by holders of season- tickets, of which 1,879,136 were issued in 1901, as the number of journeys made by the holders cannot be estimated. It is obvious that if an accurate estimate of these journeys could be made, a large increase in the number of passenger journeys would be shown, with a corresponding benefit to the passenger when calculating his risk of accident.

Notwithstanding the measures taken by the railway companies for the protection of their servants when on duty, and the efforts of the Government to reduce the risks incurred by the men, the number of accidents of this class continue ‘”””‘” to be high. The effects of the Rules issued by the , ,

Board of Trade under the Railway Employment ‘““P”^^*- (Prevention of Accidents) Act of 1900 will, it is hoped, however, tend to the reduction of these accidents. The principal risks incurred by the men are those entailed by shunting operations, and by the work of repairing or inspecting the permanent way while the traffic is in progress. The Rules issued by the Board of Trade are intended to minimize these risks. Table X. shows the number of accidents occurring to servants of the cornpanies in traffic operations, but a large number of slight accidents occur from causes in which the movement of the traffic is not concerned, and these are not included in the two following tables (Tables X. and XI.)

The number of persons employed by the railway companies is known accurately for certain years only, namely, 1874, 1884, 1889, 1895, 1898, and 1901, but for the purposes of these tables it has been estimated for the other years taken (estimated figures being prmted in italics).

The apparent sudden rise of the injuries in 1896 is due to the effect of the Board of Trade Order of October 1895, referred to in the note to Table IX. From the commencement of 1896 the companies were required to report non-fatal accidents to their servants whenever they were such as to

prevent the servant injured, on any one of the three working days next after the accident, from being employed for five hours on his ordinary work. ???'

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Table X.

Year.

By Train Accidents.

By Accidents on Railways, exclusive of

Train Accidents.

Proportion of Acci- dents occurring to Servants of Com- panies by Train and otiier Accidents to the whole Number employed.

Total Numbers employed

by the ??? Railway Companies.

Killed.

injured.

Killed.

Injured.

KUled.

Injured.

1874 . 1876 .

1876 .

1877 .

1878 .

1879 .

1880 .

1881 .

1882 .

1883 .

1884 .

1885 .

1886 .

1887 .

1888 .

1889 .

1890 .

1891 .

1892 .

1893 .

1894 . 1896 .

1896 .

1897 .

1898 .

1899 .

1900 .

1901 .

46

21

28

22

15

8

23

19

21

11

23

13

4

8

7

4

12

12

9

10

6

12

3

9

16

19

24

8

271

239

236

154

158

118

118

168

158

87

116

81

81

109

93

117

147

154

92

73

62

88

163

140

110

196

180

156

742 744 646 620 629 444 623 602 532 643 623 438 421 414 889 431 487 637 626 450 473 430 444 501 488 612 669 603

2644 3379 2364 2009 1847 1836 1962 2278 2423 2373 2204 2086 1929 1966 2100 2652 2975 3007 2823 2568 2649 2666 3833 3989 4089 4437 4405 4087

lin 320 1 ◆◆◆35U 1 ◆◆◆386 1 ◆◆◆Uk 1 ◆◆◆600 1 ◆◆◆619 1 ◆◆◆631 1 ◆◆◆676 1 ◆◆◆670 1 ◆◆◆696 1 ◆◆◆634 1 ◆◆◆768 1 ◆◆◆816 1 ◆◆◆821 1 ., S7U 1 ◆◆◆877 1 ◆◆◆765 1 ◆◆◆696 1 ◆◆◆71h 1 ◆◆◆829 1 ◆◆◆796 1 ◆◆◆1062

1 ◆◆◆low

1 ◆◆◆912 1 ◆◆◆1060 I ◆◆◆1006 1 ◆◆◆916 1 ◆◆◆1127

lin 80 1 ◆◆◆70 1 ◆◆◆100

1 ◆◆◆m

1 ◆◆◆136 1 ◆◆◆US 1 ◆◆◆ISO 1 ◆◆◆123

1 ◆◆◆m

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1 ◆◆◆m

1 ◆◆◆167 1 ◆◆◆167 1 ◆◆◆138 1 ◆◆◆122 1 ◆◆◆121 1 ◆◆◆130 1 ◆◆◆lk6

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1 ⬛⬛⬛176 1 ⬛⬛⬛117

1 ⬛⬛⬛lis

1 ⬛⬛⬛129 1 ⬛⬛⬛116 1 ⬛⬛⬛116 1 ⬛⬛⬛186

250,000 266,000 260,000 266,000 270,000 280,000 290,000 300,000 316,000 330,000 346,426

3U>,M

Sie,/a6

Sie,i26

sis.m

881,626 381,626 381,626 381,626 381,626 381,626 466,112 1,66,112 1,65,112 634,141

6St,,lil 6SU,1U

676,834

Table XI. shows, for the year 1901, the risks incurred in the more important classes of railway service : ⬛⬛⬛

Table XI.

Number of Ser-

Class of Servants.

Number

Employed

in 1901.

vants of Railway Companies Killed and Injured dur- ing the Year 1901

Proportion to the Number Employed.

Killed.

Injured.

Killed.

Injured.

Stationmasters

8,103

2

23

lin 4051

1 in 352

Brakesmen and

goods-guards .

15,708

42

845

1 ??? 374

1 ??? 18

Permanent-way

men .

66,621

121

149

1 ◆◆◆ 651

1 ◆◆◆ 447

Gatekeepers . Engine-drivers

3,507

◆◆◆ 3

6

1,, 1169

1 ◆◆◆ 584

25,556

26

342

1 ◆◆◆ 983

1 ◆◆◆ 75

Porters

55,276

45

572

1 ◆◆◆ 1228

1 ◆◆◆ 97

Shunters

10,841

41

650

1 ◆◆◆ 264

1 ◆◆◆ 17

Firemen

24,083

24

496

1 ◆◆◆ 1003

1 ◆◆◆ 49

Inspectors .

6,772

7

19

1 ◆◆◆ 967

1 ◆◆◆ 356

Guards (passenger)

7,291

8

122

1 ◆◆◆ 911

1 ◆◆◆ 60

Pointsmen and sig-

nalmen

28,496

12

70

1 ◆◆◆ 2377

1 ◆◆◆ 407

Labourers

53,282

33

153

1 ,, 1615

1 ◆◆◆ 348

Ticket collectors

and examiners .

3,642

1

17

1 ??? 3642

1 ,, 214

Mechanics .

81,440

18

26

1 ??? 4524

1 ,, 140

Other classes Total .

185,216

108

724

1 ??? 1715

1 ??? 256

575,834

491

4214

1 in 1173

1 in 137

Table XII.

Year.

Number of Persona ‘ EUled at

Level- Crossings.

Number of

Persons Injured at

Level- Crossings.

Year.

Number of Persons Killed at

Level- Crossings.

Number of

Persons Injured at

Level- Crossings.

1875

66

41

1895

65

33

1880

74

30

1896

51

27

1885

58

21

1897

80

25

1890

83

35

1898

64

27

1891

66

31

1899

60

22

1892

77

21

1900

63

35

1893

55

30

1901

55

26

1894

The number of accidents to persons making use of level-crossings over the railways does not show any appreciable diminution in the 25 years from 1875 to 1901, although improvements have been made by the provision of foot-bridges or ” subways at many busy places where the level-crossings ”’=”’””’**** were previously the only means of crossing the line, and in other oases by the provision of signals interlocked with the gates. The numbers of persons killed and injured while passing over level- crossings in certain years are shown in Table XII.*

The remaining classes of accidents on railways are those which occur to trespassers on the railways, of whom 282 were killed and 154 injured in 1901 ; those which occur to persons transacting business at railway stations and sidings (principally traders’ ser- vants engaged in obtaining or delivering goods), 17 of whom were killed and 122 injured in 1901 ; and those that occur to persons who can neither be described as being on business or trespassing, of whom 24 were killed and 28 injured in 1901. In addition, 144 persons committed suicide by placing themselves in front of trains in 1901, and 17 persons were injured while apparently attempting to commit suicide in the same manner. The number of suicides is slightly in excess of the average number for preceding years.

*In the United States of America the figures of accidents are now reported under an Act ot Congress, approved on the 3rd March 1901, which requires that “common carriers engaged . ,j ^ in interstate commerce make fuU reports of all j^lf^f^t accidents to the Interstate Commerce Commission by c< * s a monthly report under oath, of all collisions of trains, or where any train or part of a train leaves the track, and of all accidents which may occur to its passengers or employes while in the service of such common carrier and actually on duty." The reports rendered in accordance with this Act are apparently more complete than those hitherto furnished, but the requirements of the Act do not include accidents at level – crossings. For the second six months of 1901 it appears that 108 passengers were killed and 1999 injured in accidents to*

trains, and 87 were killed and 1510 injured in other accidents. The number of employes killed was 1343, and 17,213 were injured. Compared with the accidents in the United Kingdom for the same period of six mouths the relative figures are given in Table XIII. : ???

Table XIII.

United States of America.

United Kingdom.

KiUed.

Injured.

KUled.

Injured.

Passengers Servants .

195 1343

3,509 17,213

80 286

1299 2178

The latest proportions given for the United States are for the year ending 30th June 1900, as shown in the Report of the Inter- state Commerce Commission ; these are compared with the British figures for the year ending 31st December 1900 in Table XIV : ???

Table XIV.

United States.

United Ifingdom.

Killed.

Injured.

Killed.

Injured.

Passengers : Proportion of killed and in- jured from accidents in connexion with the move- ment of trains to number of passenger journe3's Servants : Proportion of killed and in- jured to numbers employed

1 lin j 2,316,648

1 1 in 399

lin

139,740

lin 26

lin

8,461,309

lin 916

lin

470,848

1 in 116

The differences between the mileage of the railways, the numbers of passengers carried, and the numbers of employes in the two countries in the vear 1900 are shown in Table XV. It will

Table XV.

United States.

Year ending 30th

June 1900.

United Kingdom. Year ending 31st December 1900.

Mileage of railways

Number of passengers carried

in 12 months Number of employes

193,345

576,865,230 1,017,653

22,078

1,142,276,686 575,834

140

be noticed that while the mileage and number of employes is higher in the United States than in the United Kingdom, the number of passengers carried is higher in the United Kingdom.

The number of persons killed and injured at level-crossings (not including those described as employes and trespassers) was 558 killed and 1090 injured in the year ending 30th June 1900, as against 59 killed and 29 injured in the same period in the United Kingdom.

(h. a. y.)

Financial Organization.

Before considering the general method of financial organization of railway companies, it is important to note the attitude taken up by the State toward their construc- tion. In the United States public policy encourages the free building of lines by providing, under general laws, that any body of citizens may become incorporated in order to locate a railway, expropriate the necessary land, and pro- ceed with construction and operation, the sole preliminary being that evidence must be shown of bona fides by a most modest subscription of capital. The effect of this legislation has been to make the railway a highly com- petitive business, subject from the investor's point of view to the extra hazards which must necessarily attend on capital engaged in fierce competition. From the point of view of the public, the policy mentioned has resulted in the multiplication of lines, and consequent cheap rates of service, together with wide development of territory. In the other countries of the world, where Government sanc- tion has to be obtained for each undertaking, after proof not only of the ability of promoters to further the enter- prise, but also of its present necessity and probable profit- able conduct, the result is to surround capital with greater safeguards, but at some sacrifice of pubHc benefit.

Some economic and g'ltasi-political questions of import- ance may arise as the pressure of continuous high rates threatens to handicap a given region in the commercial race. For instance, in the United States the so-called " Granger " movement by the farmers was an important political force for some years. As the product of the farm depended largely on export values, it followed that the producers in the far interior found the cost of transporta- tion to the sea a heavy burden, and largely disproportionate to the charge upon their competitors nearer to the shore. The progress of competition between rival carriers finally afforded a natural solution of this difficulty, by the reduc- tion brought about in the rates of freight until a point was reached where it bore small proportion to the value of the article transported. But in cases where the same difficulty presents itself with a governmental concession practically precluding

competition in rates, the aggrieved citizen naturally turns to the State for redress. This situation is beginning to assert itself in the Argentine Eepublic, in the British colonies, and to some extent in England itself.

The financial organization of railways began in various countries on substantially identical lines where it was proposed to build under private corporations. The shares of the corporation, after being paid for, carried no further liabiHty, and the capital thus raised by subscription was augmented by borrowing under powers conferred by legisla- tion or charter. Financial developments, however, soon assumed different forms in the different countries. In Great Britain and on the Continent borrowing powers were granted in very limited degree, generally for only one-fourth of the capital, and the debenture, or other obligation repre- senting the authorized debt, became esteemed as a security of the highest character for investment. In the United States, on the other hand, borrowing powers were exercised for the most part under general laws and without limitation, so that often all the actual capital for building a railway was raised by forms of debt, while the share capital was

issued solely for contractors' profit, and afforded no guaran- tee or margin for protection of indebtedness. The latter, therefore, became necessarily a much more precarious form of security for the investor, and large losses ensued to the public, both in the United States and in Europe, by reason of a confused belief that bonds or debentures indi- cated in each community an identical security, whereas the case was quite otherwise. In the former country, as has been above pointed out, the existing conditions of free competition call for the same examination on the part of an investor into individual conditions and environment as would be needful in respect to any other competitive industry. As rates have fallen, it has come to pass, particularly in the United States, that a complete re- habilitation of the plant has been gradually forced upon all the railways of the country. As the cost of hauling a large train-load is proportionately much less than of hauling a small one, the efforts of managers have been directed to increasing the carrying capacity of their trains. Herein is the explanation of the demands for new capital on a great scale by the older railway companies, which otherwise would presumably have reached the approximate limit of capital requirements.

Hence, also, arose the policy now general in the United States of devoting a greater or less proportion of net revenues to payment for permanent im- provements, instead of dividing them amongst the share- holders, a policy which has excited much criticism among British holders of American shares, but which American opinion has accepted as being for the best interest of shareholders, inasmuch as it gives assurance of greater stability under the stress of commercial fluctuations.

The tendency to amalgamate connecting systems of railway has had a marked stimulus in late years, by reason of the economies in operation and the advantages in con- duct of traffic accruing from the extension of lines under one control. A certain jealousy is exhibited in some public quarters lest a centralized power thus vested over a great number of employes should lead to pohtical abuses in a country where manhood suffrage prevails, but it is to the credit of those controlling such great executive powers that they seem to have been exercised, on the whole, wisely and in the public interest.

The peculiar status of the railway in modern life makes it of equal interest to the investor, the employ^, and the political economist. It wiU be found that the best end is subserved for each of these by all development which tends to secure the maximum of service at the minimum of cost. By such influences will be created that volume and diversity of human industry which affords the best guarantee for the welfare of the individual and of the State. To this end the modern railway has proved itself an instrument of greater efficiency than any other, or perhaps than all others combined, as witness in the United States the growth in tonnage from 72,500,000 tons in 1870 to 975,000,000 tons in 1899, an increase of more than 1300 per cent. (j. gh.)

Railway Consteuction.

The principles of railway construction described in the ninth edition of this Encyclopaedia remain true, and most of the essential facts there told need no modification. The changes are in detail.

The tendency of time is to unify the gauge in each country and, generally speaking, in the world, though pro- gress in that direction is not without

interrup- tion. In France, for example, at the end of <^"'??^- 1898 there were 26,0-44 miles of railway, and of this amount 2490 miles were of narrow gauge, viz., 1 metre, 0-80 metre, and 0-60 metre, while 870 miles of narrow gauge were in course of construction. In British India about

construction]

RAILWAYS

141

42 per cent, of the total mileage is built to metre gauge or less, while the standard is 5 feet 6 inches, and the metre gauge lines are added to year by year. In the British colonies generally the gauge of 3 feet 6 inches may be called standard ; but throughout the world the gauge of 4 feet 8^ inches is much more used than any other, and is increasing in far greater ratio. In North America 4 feet 8 1 inches has become almost universal, except for small industrial railways and some short lines for local traffic, chiefly in mountainous country. The long lines ,of 3 feet, gauge have generally been converted, or a third rail has! been laid, permitting interchange of vehicles. The gauges of 5 feet and more have disappeared. A considerable number of lines use 4 feet 9 inches ; but cars run freely from this gauge to the lines of 4 feet 8^ inches gauge, and back again. The commercial importance of this free interchange of cars is now the controlling fact in deciding on the gauge of a new railway, unless that railway is isolated by its geographical position. In Great Britain, also, the standard gauge is 4 feet 8-| inches, and there railways are now built to other gauges only under excep- tional conditions ; the " broad gauge " of 7 feet disappeared when the Great Western main hne from London to Penzance was converted to standard gauge throughout its length on 20th-23rd May, 1892. In Ireland, however, the standard gauge is 5 feet 3 inches; and perhaps it would have been better for aU the countries of Europe and America had 5 feet 6 inches, or even 6 feet, been made the standard, since the physical hmits of the power of locomotives and the ultimate carrying capacity of cars would not have been reached so soon.

On the continent of Europe the standard gauge is generally 4 feet 8i inches, but in Kussia it is 5 feet, and in Spain 5 feet 5f inches. In France, as in the United States, there are many miles of track of 4 feet 9 inches gauge ; but for traffic purposes this is not a break from the standard of 4 feet 8^ inches. The narrow-gauge railways of France have already been mentioned. In other Conti- nental countries there is also an important mileage of metre gauge, and even narrower, on lines of local or secondary importance. India had, in March 1900, 13,670 miles of railway of 5 feet 6 inches gauge, 9496 miles of metre gauge, and 598 miles of special gauges ; hence that country will supply valuable comparative data for the study of the efficiency and cost of working of broad and narrow gauge lines, and for such data the reader may be referred to the elaborate yearly reports of the Government of India. In Australia the disadvantages of a break of gauge are already felt. In New South Wales the standard is 4 feet 8^ inches; but in Victoria, on the south, it is 5 feet 3 inches ; and in Queensland, on the north, it is 3 feet 6 inches. Obviously, as commerce between the states increases, the tax of a break of gauge at the frontier vsdll become more serious, and for some years various commissioners of those states have urged the importance of one gauge. In New Zealand, Tasmania, and South Africa the gauge is 3 feet 6 inches. In Lower Egypt the standard is 4 feet 8-| inches, but the line into the Egyptian Sudan is 3 feet 6 inches. The reasons for building the Sudan line to this gauge were weighty and sufficient; but the time wiU come when a struggling commerce will be taxed with the perpetual costs of a break of gauge. On the other hand, the South African railways are built to 3 feet 6 inches ; and if the so-caUed Cape-to-Cairo railway is ever completed, there wiU be one gauge from Upper Egypt to Cape Town.

For sleepers (called cross-ties or ties in the United States) wood is the material stiU generally used. Metal is em- ployed for the purpose in a few countries where timber is scarce, or Uable to destruction by white ants, and, also somewhat experimentally, on a considerable mileage on the

*continent of Europe ; but its use there is not increasing, and in the United States it is exceedingly hmited. In England, Germany, and France at least 90 per cent, of the wooden sleepers are treated before they are laid, to preserve them from decay, and the same ??*P??”- practice is*

followed to some extent in other European countries. A great number of preservative processes have been tried (many of them patented), but the one now most largely used is that known as ” creosoting.” Dead oil of coal tar is forced into the wood under pressure, or sucked in under vacuum, both the timber and the oil being heated. In the United States only a very small percentage of the cross-ties are treated in any way beyond seasoning in the open air, timber being still too cheap in nearly all parts of that country to justify preservative treatment ??? at least so the officials of the railways think. A few lines, however, which have a long mileage in timberless regions do treat their sleepers. Probably the large majority of railway engineers in nearly all countries believe that timber sleepers, preserved in some way, and protected from direct wear by plates or chairs under the rail, wiU be standard practice for many years. Steel is the only material that can be substituted for wood in the present stage of invention, and generally it is still too costly for this use.

One of the most important events in the whole history of the railway was the substitution of steel for iron rails. That made possible . the wheel weights and the speeds of to-day, and diminished the cost of maintenance of track to such a point as made possible the rates of to-day. The continued improvement of the steel rail in stiffness of section and in toughness and hardness of material is an element of progressive economy almost as important as the substitution of steel for iron. The weight of rail has increased, particularly in the United States, and in Great Britain raUs weighing 95 and 100 B) per yard are now largely laid on main lines. Harder steel is also employed. The important element in controUing this quality is carbon, and in their notions of desirable carbon contents the rail makers and users of Great Britain differ from those of the United States. Generally speaking the rail steel of the United States is higher in carbon, hence harder, than that made and used in England. In the United States the best and most widely accepted practice is from 0‘43 per cent, of carbon as the minimum limit for light rails up to 0‘70 per cent, for the top limit for heavy rails. Nevertheless, it is true that even there some rail-makers and railways still specify the minimum carbon as low as 0‘35 per cent. In Great Britain the hmits of carbon adopted range from 0‘25 up to 0‘50 per cent., but in the greater number of cases 04 is specified as the lower limit. It will be seen, therefore, that there is practical agreement in

the two countries as to the minimum of carbon, but a wide difference as to the maximum. The tendency on the Continent is towards harder steel than prevails in England. In recent years there has been a real advance in the art of making rails. This has not consisted so much in the acquisition of new knowledge as in the spread of knowledge from a few men to many. It has come to be widely known that the treatment of the steel from the time of melting to the last passage through the roUs is quite as important as the chemistry of the stock. Especially has it become known to many, as it has long been known to a few, that the last work on steel must be done at a comparatively low temperature if the product is to be fine-grained, homo- geneous, and tougk The spread of this knowledge has already affected the outline of the cross-section of the rail, in the United States at least, and it will soon begin to affect rolling-mill practice.

To understand how a more correct knowledge of mill treatment lias affected the rail section we must look at the typical sections used. In the United Kingdom the

?r-

I”

Fio. 1.

-A, section of English bull-head rail, 90 ft to the yard, showing also chair and fastenings ; B, plan of chair.

standard rail section is the bull-head, which is shown in

Figs. 1 and 2. This is used also to a comparatively small

extent in France and in India. The

rail section much more generally used,

always in the United States and

nearly always on the continent of

Europe, is frequently called the Vig-

noles section, or in the United States

the T rail (Figs. 3 and 4). It is also

often spoken of as a flange rail. An

inspection of the figures will show

that in the buU-head rail the weight

of metal in the top and bottom

members is not very different, and that the neck (or web)

is comparatively thick. Similarly, it will be seen that

if 1

Fig. 2. ??? English rail and raU joint.

L si'-

FiG. 3. ??? American rail, 90 lb to the yard, showing rail Joint.

in the Vignoles section the flange or foot is broad and thin, and that there is considerably leas metal in the flange than in the head. It will be understood, then, that one part of the bull-head rail cools about as fast as another, but that the flange of the Vignoles rail cools much faster than the head. The result of this is that the finishing passes must be made while the head is at a temperature too high to give good results ???

otherwise, the flange would be too cool to be rolled. This fact resulted in the develop- ment in the United States of what are there caUed balanced

sections ??? that is, sections in which the metal is divided approximately equally between the head and the flange ??? and, furthermore, the head is made comparatively broad and thin. The final development of this section was reached in 1893, when the American Society of Civil Engineers recommended a set of standard sections, one

Fia. i.

-French rail, 90J lb to the yard, showing also rail joint and seat in the sleeper.

of which is seen in Fig. 3. By comparing this with the French rail (Fig. 4) the reader may see the difierence in the distribution of the metal These balanced sections are now standard on many railways, their use is increas- ing, and, so far as we can now foresee, they are destined to prevail, except that the flange will probably be made thicker. The bull-head section is a better section to roll, but track made with it is more costly, and changes are less convenient ; it now seems likely that its use will be continued indefinitely in the British ??? Islands, but that it will not supersede the flange rail elsewhere. The spread of knowledge of the mill treatment of rails is likely to bring about still another change in mill practice, namely, such an arrangement of rolls as will retard the progress of the rails just before they reach the finishing roUs, and permit their temperature to fall, thus making the finishing passes cooler than is now ordinary practice. This wiU probably be brought about by introducing a table over which the rails wiU move slowly but continuously, fed up to the finishing rolls at a uniform rate, but having time to cool while on this table. Obviously rail-makers will not permit any change in practice to be made which would diminish the speed and regularity of the output, and it is not for the interest of anybody that such a thing should be done. The plan now developing, as briefly outlined above, will not lessen the speed or quantity of output ; it will merely require additional machinery and additional room.

A few types of rail joints and fastenings are shown in the figures, and little need be added to what the cuts teU. In the United States the joint shown is weU-nigh universal. It consists of two symmetrical angle "j"^^" bars, and the variations are in length (from 20 inches to 48 inches), in weight, and in the number of bolts, which may be four or six for each joint. The best length of joint is still much debated. Other joints than the type shown (almost invariably patented) are used, and some of them largely, but far the greater number are of the angle splice type seen in Fig. 3.*

Eails in the United States are usually laid directly on the sleepers and spiked with hook-headed spikes driven with a maul. The whole arrangement is simple, and lends itself admirably to fast track-laying, and to repairs and i.'hanges of line. Further, it is cheap in first cost, but obviously it is not so durable or so stable as the British and Continental methods. Of late years tie plates have come into considerable use, and their use is increasing. These plates, in the United States, are always made of rolled steel and punched with rectangular holes, through

which the spikes are driven. All the accepted forms now have two or more flanges on the bottom of the plate, running lengthwise of the plate and crosswise of the rail ; these are necessary to give the plate proper stiffness, and further, as they are driven into the tie by the weight of passing traffic, they help to fix the plate securely in its place. The plates are laid between the rail and the cross tie and serve two principal purposes ; they diminish the wear of the tie under the rail, and they help to support the spike and so to keep the gauge. In Great Britain the simple fish-plate joint, as shown in Fig. 2, is used, often provided with flanges depending vertically below the bottom of the raU, to give additional stiffness to the joint. The rail is laid in a cast-iron chair and held there by a key driven in alongside the rail; this key, which is usually of oak, though sometimes of metal, is now generally placed outside the rails,

though the inside position is still to be seen occasionally. The chair is held to the sleeper by screwed spikes and by round drift bolts, which are entered in holes already bored in the sleeper. On some railways, e.g., the Great Western and the Taff Vale, fang bolts are employed. With what has been said of practice in the United States and Great Britain, the figures of Continental joints and fastenings will explain themselves. Wherever the bull-head rail is used, it must be laid in chairs; but the usual Continental practice is to use the Vignoles rail, with plates or strips of felt beneath it, all very carefully fastened to sleepers by screwed spikes. The diagram (Fig. 4) of the French rail and joint shows also the rail seat in the sleeper. The practice of notching the sleeper in this way, and giving the rail a slight cant inwards, is very common on the Continent. The same result is reached in England by canting the rail in its chair. This is never done in the United States, where the rails stand upright; and little pains are taken to prepare seats for them on the ties, on which they soon seat themselves. On the Great Western Railway the practice is to prepare a serrated surface on the sleeper for the chair, which is forced into its seat by hydraulic pressure. On the London and North- Western a strip of felt is interposed between the chair and the sleeper. There is a tendency in Great Britain to increase the weight and bearing-surface of the chairs, also the number of sleepers per mile.

A section of road-bed typical in the United States is shown in Fig. 5. In Great Britain and the Continent

*the sleepers are frequently covered with the ^^^’”’’ ballast up to the level of the top of the rail *

a practice which adds to stability, but makes inspection and maintenance somewhat more difficult. In

Fig. 5. 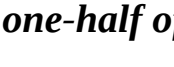 ^Typical American road-bed one-half of a double track.

general, the reader vrill be struck by one broad distinction between American and European practice in railway track, namely, the greater expenditure in Europe to get security and permanence. Space does not permit analysis of the causes of this interesting phase of the subject ; but

under- neath it lie the facts that in the United States money and labour were dear, vast and thinly-peopled areas had to be crossed and developed, and the citizen was left to work out his enterprises with the least possible official control With the gradual equalizing of conditions in the civilized countries of the earth there is a slow but steady movement in the direction of uniformity in railway con-

struction. Various proposals, however, have been brought forward from time to time for constructing railways on prin- ciples radically different from those generally followed. In the Lartigue system, for instance, the train is straddled over a single central rail, elevated a suitable distance above the ground. Several small Hues have been constructed on this plan, including one, worked by steam, between Ballybunnion and Listowel in Ireland; and in 1901 a Bill was passed by Parliament authorizing a more ambitious railway on the same principle, from designs by Mr F. C. Behr, to connect Liverpool and Manchester. The motive-power is to be electricity, and it is proposed to run frequent trains with- out a stop between the two places at a speed exceeding 100 miles an hour. In the Langen monorail the car is hung from a single overhead rail ; a line on this system is worked between Barmen and Elberfeld, a distance of about 9 miles, the cars for a part of the way being suspended over the river Wupper.

The important subjects of tunnels and bridges as related to railway construction are not taken up here, because they are treated in the special articles on those subjects.

(h. g. p.)

Signalling.

In railway phraseology the term ” signal ” is applied to a variety of hand motions and indications by lamps and other symbols, as well as to fixed signals ; but only the last-named class ??? discs and semaphores, with Hghts, per- manently fixed (on posts) at the side of the track ??? will be considered here. These may be divided into (1) inter- locking signals, used at junctions and yards, and (2) block signals, for maintaining an interval of space between trains following one another. In either class the

function of a signal is to inform the engine-driver whether or not he may proceed beyond the signal, or on what conditions he may proceed, and it is essential to give him the in- formation some seconds before it need be acted upon.

So early as 1846 it became a common practice in Eng- land to concentrate the levers for working the points and signals of a station in one or more cabins, and the neces- sity of interlocking soon became evident to pre- vent simultaneous signals being given over con- /Vi' flicting routes, or for a route not yet prepared to receive the train. In large terminals concentration and interlocking are essential to rapid movement of trains and economical use of ground. The form of signal now ap- proved practically everywhere is the semaphore (Fig. 7), an arm or blade about 5 feet long extending out horizon- tally, at right angles to the line of the track, from the top of a post (wood or iron) 15 to 30 feet high, and sometimes higher. This arm, turning on a spindle, is pulled down ("off") to indicate that a train may pass it. The horizontal (or " on ") position indicates "stop." A lamp is fixed to the side of the post about on a level with the blade, and by the movement of the blade is made to show at night red for " stop " and green for go-ahead or "all clear." The earlier practice, white for "all clear," stUI prevails largely in America. The signal is worked from a cabin by rods or wires.

In the early days of railway signalling three positions of the semaphore arm were recognized : ??? (1) Horizontal, or at right angles to the post, denoting danger ; (2) at a downward angle of 45 degrees, denoting caution ; (3) hanging vertically downwards or parallel to the post, denoting all right. Corresponding to the position of the arm, three different lights were employed at night ??? red for danger, green for caution, and white for aU right. But of late years, in consequence of the introduction of block- working, British railways make use of only two positions of the arm and two lights ??? the arm at right angles to the post and a red light,

both signifying danger or stop ; and the arm at about 60 degrees and a green light, both meaning all right or proceed. Some com- panies, while adopting the two positions of the arm or semaphore, still adhere to the use of the three lights ❓❓❓ red, green, and white. But the more modern practice of using only red and gi'een lights for signals is far preferable. The reason is obvious. There are many lights and lamps on the platforms, in signal-boxes, and in the streets and houses adjacent to a railway ; and if white lights were recognized as signals, a driver might mistake a light of this nature as a signal to proceed : in fact, accidents have been caused in this manner. It is therefore better to abolish the use of white lights for signalling purposes. A white light is not to be regarded as a danger signal, as is sometimes erroneously stated, but rather as no signal at all ; and as there is a well-known rule to the effect that " the absence of a signal at a place where a signal is ordinarily shown must be treated as a danger signal, "it follows that a white light, when seen at a place where a red or green light ought to be visible, is to be treated as a danger signal, not because a white light per se means danger, but because in such a case it denotes the absence of the proper signal. Some companies have adopted a purple light as a "danger" signal for shunting purposes in sidings and yards ; but this practice is not to be commended, since red should be the universal danger signal. On the other hand, a few companies have adopted the purple light as an "all-right" signal for shunting purposes, to which there is no objection.

Distant signals are used to make it unnecessary for an engine-driver to slacken Hs speed in case the stop {home) signal is obscured by fog or smoke, or is beyond a curve, or for any reason is not visible sufficiently far away. Encountering the distant signal at a point 400 to 800 yards before reaching the home signal, he is informed by its position that he may expect to find the latter in the same position. The arm of a distant signal usually has a fish-tail end. In America its night colour-indication is made different from that of the home signal. Thus, where white is used to indicate all clear (in both home and – distant) the distant arm, when horizontal, shows a green light ; where green is the all-clear colour a horizontal distant shows either a yellow light or (on one road) a red and a

green light side by side. Two lights for a single arm, giving their indication by position as well as colour, have been used to a limited extent for both home and distant signals. Dwarf signals are used for very slow movements, such as those to or from a siding. In cases where room must be economized, signals are usually placed on narrow over- head bridges or " gantries " spanning a number of tracks.

Fig. 6 shows a typical arrangement of interlocked signals, the principle being the same whether a yard has

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Fig. 6. ??? Interlocked signals (American practice, signals at right of 1 and arms at right of post).

one set of points or a hundred. The signals (at a, b, and c) are of the semaphore pattern (Fig. 7). For the four signals and one pair of points there are, in the second storey of the cabin 0, five levers. Each signal arm stands nor- mally in the horizontal position, indicating stop. To permit a train to pass from A to B the signalman moves the arm of signal b to an inclined position (60 degrees to 75 degrees downwards) ; and the interlocking of the levers prevents this movement unless it can safely be made. If a has been changed to permit a movement from S to B, or if the points x have been set for such a movement, or if either signal on post c has been lowered, the lever for b is immovable. In like manner, to incline the arm of signal a for a. movement from S to B it is first necessary to have the points set for track S, and to have the levers of all the other signals in the normal (stop) position. A sixth lever, suitably interlocked, works a lock bar, which engages with the head rod of the points ; it is connected

to the lock through bar d (called in America the detector bar). This bar, about 45 feet long, lying alongside of and close to the rail, must move upwards when the points lock is being moved either to lock or to unlock ; and as it is held down by the wheels of any car or engine standing or moving over it, the signalman is prevented from inadvertently changing

the points when a train is passing. At r is a throw-off or derailing switch (" catch-points "). When X is set for the passage of trains on the main line, r, connected to the same lever, is open ; so that if a car, left on the side track unattended, should be accidentally moved from its position, it could not run foul of the main track. The dwarf signal a being for slow movements, has a blade about 1 foot long, and the post is about 4 feet high ; the lower arm on post c being for slow movements, is also frequently made shorter than the upper one. Where more than two full-sized arms are used on a post, the custom in America is to have the upper arm indicate for the track at the extreme right, and the others in the order in which the tracks lie ; in Great Britain the opposite rule prevails, the upper arm indicating for the extreme left.

*AH the switches and locks are connected with the signal cabin by iron rods (channel-iron or gas-pipe) supported (usually near the ground and often covered by boxing) on small grooved wheels set at suitable distances apart. The foundations of these supports are of wood, cast iron, or concrete. Concrete founda- tions are comparatively recent, but are cheap and durable. For signals (but not for points) wire con- nexions are universal in England, and are usual in America, being cheaper than rods. In changing the direction of a line of rodding (pipe) a bell -crank is used, but with a wire a piece of chain is -.^ inserted and run round a grooved -L> puUey. Wire connexions are shown fiq. 7.**Semaphore signaL at a and b, Fig. 7, the main or ^^^"^ ^^^' ^' '"" "front" wire being attached at a.*

By this the signalman moves the arm down to the inclined

or go-ahead position, to do which he has to

lift the counter-weight c. If the wire should

1^ break, the counter- weight would restore the

arm to the horizontal (stop) position, and

thus prevent the unauthorized passage of a

train ; and in case of failure of the rod I,

* 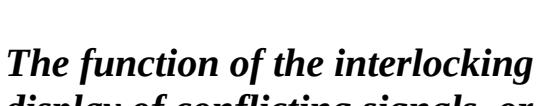 * *the iron spectacle s would act as u safety*

counter-weight. The back-wire b is added

to ensure quick movement of the arm, but is not

common in England. Long lines of rigid connexions are

” compensated ” for expansion and contraction due to

changes in temperature by the introduction of bell-cranks

or rocker-arms. With wire connexions compensation is

difficult, and many plans have been tried. The most

satisfactory devices are those in which the connexion, in

the cabin, between the wire and the lever is broken when

the signal is in the horizontal position. The wire is kept

taut by a weight or spring, and at each new movement

the lever (if the wire has lengthened or shortened) grips

it at a new place.

The function of the interlocking machine is to prevent the simultaneous display of conflicting signals, or the dis- play of a signal over points that are not set accordingly. The most common forms of interlocking have the locking bars arranged in a horizontal plane ; but for ease of de- scription we may take one having them arranged vertically,

:B’

signalling]

the principle being the same. The diagram (Fig. 8) shows a section with a side view of one lever. A machine consists of as many- levers, placed side by side, as there are points and signals to be moved, though in some cases two pairs of points are moved simultaneously by a single lever," and two or more separate arms on the same post may be so ar- ranged that either one of them will be moved by the same lever, the position of the point con- nexions being made iQ to govern the selec- tion of the arm to be moved. A switch rod would be con- nected to this lever at H ; the lever K is for use where a signal is connected by two wires, as be- fore described. The lever is held in each of its two positions by the catch rod V,

Fig. 8. ❓❓❓ Signal lever, with mechanical interlocking.

which engages with notches in the segment B. When the signalman, preparatory to lowering a signal, grasps the lever at its upper end, he moves this rod upwards, and in so doing actuates the interlocking, through the tappet N, attached at T. Lifting the tappet locks all levers which need to be locked to make it safe to move this one. In puUing over the lever the rocker R is also pulled ; but the slot in it is radial to the centre on which the lever turns, so that during the stroke N remains motionless. On the completion of the stroke and the dropping of V, N is raised still farther, and this unlocks such levers as should be unlocked after this lever is pulled (" cleared " or " reversed "). It will be seen that whenever the tappet N of any lever is locked in the position shown in the figure, it is impossible to raise V, and therefore impossible to move the lever.

The action of tappet N may be understood by reference to Fig. 9. A tappet, say 3, slides vertically in a planed recess in the locking plate, being held in place by strips G and K. Transverse grooves N, O, P, carry dogs, such as J. Two dogs may be connected together by bars, E. The dogs are held in place by straps Y (Fig. 8). Locking is effected by sliding the dogs horizontally ; for example, dog J has been pushed into the notch in tappet 1, holding it in the normal position. If tappet 2 were raised, its notch

would come opposite dog J ; and then the lifting of 1 would lock 2 by pushing J to the left. By means of horizontal rod R, the lifting of 1 also locks 4. If 4 were already up, it would be impossible to lift 1.

“Power interlocking” is the term used to describe switch and signal machines worked by compressed air, or electric or hydraulic power. The use of power makes it possible to move points at a distance from the cabin. The most widely used apparatus is the electro-pneumatic, which has been installed at over seventy plants in America and to some extent in other countries. One of these, at the South Station, Boston, is probably the

most elaborate interlocking plant in the world. In this system points and signals are moved by compressed air at 70 B) per square inch, a cylinder with piston being fixed at each signal or switch. From a compressor near the cabin air is conveyed in iron pipes buried in the ground. The valves admitting air to a cyhnder are controlled by electromagnets, the wires of which are laid from the cabin underground. Each switch or signal, on completing a. movement, sends an electric impulse to the cabin, and the interlocking is controlled by this “return.” In the machine the ” levers ” are very small and Hght, their essential function being to open and close electric circuits. This is performed through the medium of a long shaft, placed horizontally with its end towards the operator, which is revolved on its axis through 60 degrees of a. circle. This shaft actuates the interlocking, which is in principle the same as that abeady described ; and it opens and closes the electric circuits, governing the admission, of air to cylinders, by means of simple metal contact strips rubbing on sections of its surface. The high-

Fi&. 9. ❓❓❓ Interlocking frame.

pressure machine has been used with hydraulic power instead of pneumatic, and with electrical interlocking, instead of mechanical.

Interlocking apparatus worked by compressed air at low pressure (15 BE) per square inch), and with no electrical features, is in use on some lines in America and has been, introduced into England. In place of an electromagnet for admitting compressed air to the cylinders, a rubber

diaphragm 8 inches in diameter is used. This is Ufted by air at 7 Si pressure, this pressure being conveyed from a cabin, 500 feet or more, in one or two seconds. As in the electro-pneumatic machine, the lever of a switch cannot complete its stroke until the switch has actually moved, home and conveyed a "return indication" to the cabin. Pneumatic apparatus of other designs is in use to a. limited extent.

Pneumatic interlockings are costly to instal, and, de- pending on an unfailing source of power, have not been much used at isolated places, except on railways where an air-pipe is installed for block signals ; but at large yards the pneumatic machines have been made a means of

economy, because one attendant can manage as many levers as can two or three in a manual power machine. Moreover, a single lever wiU work two or more switches, locks, &c., simultaneously, where desirable. The absence of outdoor connexions above ground is also an advantage.

Since about 1900 electric power has come into use for working both points and signals ; although, as men- tioned below, motors have been used since about 1897 for isolated automatic signals. At interlocking a motor, with gearing and cranks, is fixed to the sleepers at each pair of points. The power is conveyed from the cabin by underground wires, the locking is of common mechanical types, and, in general, the system is similar to pneumatic systems except in the source of power. By using accumulators, charged by dynamos run by gasoline engines, or by a travelling power-car, the cost of power is reduced to a very low figure, so that power-interlocking becomes economical at small as well as large stations. Electric interlocking is extensively used at Crewe, on the London and North-Western, and at Chicago, Ilhnois.

The essence of block signalling is a simple regulation forbidding a train to start from station. A until the last preceding train has passed station B. As the ^/”’’^Uln introduction of the telegraph was almost or quite ‘ contemporaneous with the advent of the railway, the possibihty of a block system was early recognized; but its introduction was retarded by the great cost of employing attendants at every block station. But as traffic increased, the time-interval system, dependent, in the case of irregularities, on the efficiency of a flagman, proved inadequate ; and in the United Kingdom the block system is now practically universal, while in America it is in use on many thousand miles of line. The Continent is far behind Great Britain.

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FiQ. 10. ***Block signals. (English practice, trains run on left-hand track, track, arms on left of post.)***

The manual ” block” system in use at the present day in no way differs from that devised by Cooke in 1842, except so far as the details and designs of the telegraphic instruments are con- cerned. Cooke used a single-needle instrument giving two indi- cations the needle to the left signifying “line clear,” to the right, ” line blocked ” ; the instrument being also available for speaking purposes. The instruments employed in Great Britain consist of two dials one for the up line and one for the down and a bell. They may be divided into two main classes, those requiring one wire, and those requiring three wires for each double

line of rails. The dials of the one-wire instruments give only two indications, namely, “line clear ” and ‘ ‘ train on line ” or “line blocked,” the latter being the normal indication, even when there is no train in the section. The three-wire instrument has the advantage of giving three indications on the dial, namely, ” line clear,” ” line closed,” and ” train on line,” the normal indi- cation being “line closed.” The one- wire instrument differs from the three-wire in that the indicator is moved over to the different positions by a momentary current, and is then helil there by induced magnetism, the wire being then free for any suc- ceeding signals. In the three-wire apparatus there is a separate wire, with an instrument at each end for the up line ; the same for the down line ; and a wire for the bell, which is common to both lines. When no current is flowing, the indicator is vertical, meaning ” line blocked or closed.” When a current is sent along one of the wires, the deflections to the right or left, according to the polarity of the current, mean “line clear” or “train on line” respectively. Some dial instruments are made with needles, some with small discs, some with miniature semaphores to give the necessary indications, but the effect is the same. The block instruments and bells should not, as a rule, be used for speaking purposes ; but on ►► few subsidiary railways, block working is

effected by means of ordinary single-needle telegraphic instruments, or by telephone, the drawback to such an arrangerpent being that the signalman has no indication before him to remind him of the condition of the line.

Fig. 10 shows the signals at a typical English station, which may be called B. Notice having been received over the block telegraph that a train is coming from A (on the up track), the signalman in the cabin, h, lowers the home signal h ; and (if the block section from B to C is clear of trains) he lowers the starting signal, ►►, also. The function of a distant signal d has already been described ; it cannot be lowered unless A has been lowered. The relation of the signals to the ” crossover road ” xx is the same in principle as is shown in Fig. 6. Dwarf signals are omitted from the sketch. Where the sections are very short, the starting signal of one section is often placed on the same post as the distant signal of the next. Thus, supposing B and C to be very close to each other, B’s starting signal

would be on the same post as C's distant signal, the latter being below the former, and the two would be so interconnected by "slotting" apparatus that- C could not lower his distant signal unless B's starting signal was " off," whUe B by the act of raising his starting arm would necessarily throw C's distant arm to "danger." In America many block stations have only the home signal, even at stations where there are points and sidings, and on double-track lines the block telegraphing for both is done on a single Morse circuit. In the United Kingdom the practice is to have separate apparatus and separate wires for each track. In the simple block system it is clearly possible for a signalman, through carelessness, forgetfulness, or other cause, so to lower his signals as to admit a second train into the block section before the first has left it, and that without the driver of either train being aware of the fact. To eliminate as far

as possible the chance of such an occurrence,

which is directly opposed to the essence of

l1 jac the block system and may obviously lead

^^ to a collision, the locking of the mechanical

wrt signals with the electrical block instruments

I ^1 I was introduced in England by Mr W. R.

Sykes about 1876, the apparatus being so signals at left of arranged that a signalman at one end of

a section is physically unable to lower his

, Lock-aad- block.

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signals to let a train enter that section untU they have been released electrically from the cabin at the other end. The starting signal at a block section A cannot be lowered until the signalman at the next station B, by means of an electric circuit, unlocks the lever in connexion with it. In so

doing he breaks the unlocking circuit at his own station, and this break is restored only on the arrival of the train for which the unlocking was performed, the wheels of the train acting through a lever or by a short rail circuit. Valuable improvements have been made in this machine by Patenall, Coleman, and others, and these are in use in America. The passage of a train is also made to set a signal at ” stop ” automatically, by discon- necting the rod between the signal and its lever. The connexion cannot be restored by the signalman ; it must be done by an electromagnet brought into action by the train as it passes the next block station.

” Lock-and-block ” has been used to a limited extent on a good many lines in England and a half-dozen in America, but of extensive installations there were in 1901 only four : two in America ??? the New York, New Haven, and Hartford, 229 miles, and the New York Central and Hudson River, 457 miles, and two in England ??? the South-Eastern and Chatham and the London and South- western.

In “permissive blocking,” an objectionable practice

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Siatt system.

which is occasionally resorted to on many lines, especially in America, a second train is permitted to enter a section before the preceding one has cleared it, the engineman being required so to control his speed that if the preced- ing train be unexpectedly stopped he can himself stop before colliding with it. With this practice “lock-and- block ” would be useless.

The block system is used on single as well as on double lines. In the United Kingdom and in Australia the means for preventing collisions between trains running towards each other is the ” staif system.” The staff, suitably inscribed, is delivered to the engine-driver at station A, and

constitutes his authority to occupy the main track between that station and station B. On reaching B he surrenders the staff, and receives another one which gives him the right to the road between B and C. If there are two or more trains to be moved, all except the last one receive tickets, which belong to that particular staff. The staff system requires no telegraph ; but to obviate the inconvenience of sometimes finding the staff at the wrong end of the road, electric staff apparatus has been devised. Staffs (or tablets) in any desired number are kept at each of the two stations, and are locked in a cabinet automatically controlled, through electromagnets, by apparatus in the cabinet at the other station ; and a staff (or tablet) being taken out at one station, a second one cannot be taken out at either station until this first one is returned to the magazine at one station or the other. Thus we have a complete block system. By simple " catching apparatus " on the engine, staffs or tablets may be delivered to trains moving at a good speed. The electric staff is used in Great Britain, in Australia, and on half a dozen roads in America.

In America automatic rail-circuit block signals are ex- tensively used, and the Pennsylvania Eaikoad has substi- tuted them for non-automatic on its main line. s"xaSs " '^^^y li3,ve been introduced in England and France (1901), but only on a very few lines. The apparatus is costly, and so is inspection ; but at block stations where there are no points the wages of a signal- man are saved. The block sections are made shorter, usually less than a mile long. There are three styles in general use, the Hall (introduced in 1871), the Union clock-work (1880), and the Westinghouse electro-pneumatic (1884). Within the past few years all manufacturers have made signals worked by individual electric motors, and these have been introduced extensively in America. Energy is derived from a non-freezing battery at each post, or from accumulators fed by wires from dynamos situated, say, every 10 miles along the line. Another recent device is the gas-motor signal. A tank of carbonic acid gas, at the foot of the post, furnishes power for several thousand movements. Line- wire circuits have been about abandoned everywhere, and the rail circuit is universal.

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Fie. 11. Automatic electric block signal, with rail circuit.

Fig. 11 shows the arrangement of a rail circuit. The disc is fixed to a vertical spindle (Fig. 12), and the clock-work revolves the spindle on its axis, one-quarter turn at each operation. The current from the main battery b flows through the rails of one side of the track to the signal s, through an electromagnet which controls th^ clock-work, and back to the battery through the other rail. The presence on any part of this block section of a train, or any vehicle with metal wheels connected by metal axles, short-circuits the current from the battery, so that the relay (placed vertically) drops

PlO. 12. Signal moved by clock- work (Union).

its armature. This releases the clock-work and causes the signal disc to turn so as to indicate “stop.” On the restoration of the current the signal makes another quarter turn and then shows only its edge to the approaching train, indicating “all clear.” At each rail joint a wire is used to ensure electrical continuity, and at the ends of each block section there are insulating joints. The current for a rail circuit must be of low tension because of the imperfect in- sulation. As a rule the ballast must not be allowed to touch the rails, and it must be free from iron or other conducting material Block sections more than about 1 mile long are usually divided into two or more circuits, connected to- gether by relays. At points the rail circuit is run through a circuit breaker, so that the “opening” of the points will set the signal for that section. The circuit is also run through the rails of the side track as far as it fouls the main track. An indicator at each switch gives audible or visual warning of the approach of a train

The enclosed disc signal, commonly called a “banjo” (Fig. 13), is a circular box about 4 feet in diameter, with a glass- covered opening, behind which a red disc is shown to indicate stop. The disc, very hght, made of cloth stretched over a wire, or of alu- minium, is supported on a

*spindle, which is delicately balanced on a pivot so that the closing of an electromagnet lifts the disc away from the window and thus in- dicates "all clear." On the with- drawal or failure of the current the disc falls by gravity to the " stop " position. A local battery is used, with a relay, the rail circuit not being strong enough to lift the disc. ^'**??**' ^^'*

In the electro-pneumatic system a full-size semaphore is used. Compressed air, from pumps situated at intervals of 10 to 20 miles, is conveyed along the hue in an iron pipe, and is supplied to a cylinder at each signal, exactly as in pneumatic interlocking, before described. The rail circuit, when complete, maintains pressure in a cylinder, holding the signal " off." On the entrance of a train or the failure of the current, the air is hberated and the signal arm is carried by gravity to the " stop " position.

Automatic signals are sometimes made to stand normally (when no train is in the section) in the " stop " position. The local circuit is connected with the rail circuit so that it is closed only when a train is approaching within, say, one mile. With the rail circuit, distant signals are con- trolled, without a line wire, by means of a polarized relay. Each signal, when cleared, changes the polarity of the rail circuit for the next section in its rear, and this, by the polarized relay, closes the local circuit of the distant signal, without affecting the home signal for that section.

???*Enclosed disc signal (Hall).*

[SIGNALLINO

Automatic signals are used in America on a few single lines. The signal at A for the line AB is arranged as before described ; and the signal at B, for movements in the opposite direction, is worked by means of a line wire from A, strung on poles. When a section is occupied, signals are set two sections away, so as to provide against the simultaneous entry of two trains.

The length of railway in the United States equipped with automatic block signals was in 1902 about 4000 miles.

One of the chief causes of anxiety and difficulty in the working of railway traffic is fog, which practically blots out the whole P system of visible signals, so that while the block tele-

sl^alUttit g’~~”?’^ remains, the means of communicating the neces~~ *” ****sary instructions to the driver are no longer effective. Delay and confusion immediately arise ; and in order to secure safety, speed has to be lessened, trains have to be reduced in number, and a system of ‘ ‘fog-signalling ” introduced. In England, especially around London, elaborate arrangements have to be made. “Fog-signalling” consists in the employment of audible signals, or detonators, to convey to drivers the information ordinarily imparted by the visible or semaphore signals. As soon as possible after a fog comes on, a man is stationed at the foot of each distant signal, and generally of each home signal also, who by means of detonators, red and green flags, and a hand-lamp conveys information to the driver of every train as to the position of the semaphore arm. A detonator is a small flat metal ease about 2 inches in diameter and ^ inch deep, furnished with two leaden ears or clips which can be easily bent down to grip the head of the rail. The case contains some detonating composition, which readily explodes with a loud report when a wheel passes over it. As soon as a signal arm is raised to ” danger,” the fogman places upon one of the rails of the track to which the signal applies two detonators, or in the case of a new and improved class of detonator which contains two separate charges in one case, one detonator, and at the same time exhibits a red flag or light to the driver of an approaching train. The engine of a train passing over the detonators explodes them, the noise so made being sufficient to apprise the driver that the signal, though invisible to him, is at danger, and he then should act in the same way as if he had seen the signal. If, however, the signal arm should be lowered to the “all-right” position before a train reaches it, the fogman should immediately remove the detonators and exhibit a green flag or lamp, replacing the detonators as soon as the signal is again raised to danger. As a rule the fogmen are drawn from the ranks of the permanent-way men, who otherwise would be idle. But if, as sometimes happens, a fog*

continues for several days, great diffi- culty is experienced in obtaining sufficient men to carry on this important duty without undue prolongation of their hours of work. When this liappens, signalmen, shunters, porters, yardsmen, and even clerks may have to be called on to take a turn at "fogging." Some companies have adopted mechanical appliances, whereby a man can place a detonator upon a line of rails or remove it while standing at a distance away from tlxe track, thus enabling him to attend to more than one line without danger to himself. The cost of detonators often amounts to a considerable sum ; and an apparatus called an economizer has been introduced, whereby the explosion of one detonator removes the second from the rails before the- wheels reach it. As it is only necessary for one de- tonator to explode, the object of placing two on the rails being merely to guard against a miss-fire, considerable saving can thus be eff'ected. Many attempts have been made to design a mechanical apparatus for conveying to a driver the requisite information as to the state of the signals during a fog, and for enabling the fogmen to be dispensed with. Such inventions usually consist of two parts, namely, (1) an inclined plane, or block, or trigger, placed on the permanent way alongside the track or between the rails, and working in connexion with the arm of the signal ; and (2) a lever or rod connected with the steam-whistle, or an electric bell or indicator on the foot-plate, and depending from the under- side of the engine in such a position as to come in contact with the apparatus on the ground, when the latter is raised above the level of the rails. Most of the proposed systems only give an indication when the signal is at danger, and are silent when the signal is off. This is contrary to good practice, which requhes that a driver should receive a positive indication both when tlie signal is "off" as well as when it is "on." If this is not done, a driver may, if the signal is "off" and if the fog is thick, be unaware that he has passed the signal, and not know what part of the line he has reached. The absence of a signal at a place where a signal is usually exhibited should invariably be taken to mean danger. Fog signals that depend on the explosion of detonators or cartridges have the drawback that they require recharging after a certain number of explosions, varying with the nature and size of the machine. Even when a satisfactory form of appliance has been

discovered, the manner of using it is by no means simple. It is clearly no use placing such an apparatus immediately alongside a stop signal, as the driver would receive the intimation too late for him to be able to stop at the required spot. To place devices of this description at or near every stop signal in a large station or busy junction would involve a multiplication of wires or rods which is undesirable. Every such apparatus should certainly be capable of giving an "all-right" signal as well as a "danger" signal. It requires very careful maintenance, and should be in regular daily use to ensure its efficiency.

*The fundamental principles of railway signalling are simple, but the development of the science has called for much study and a large money outlay. On every railway of any consequence the problems of safety, economy, and convenience are involved, one with another, and cannot be perfectly solved. Not for twenty years after block signalling was acknowledged to be desirable did the rail- ways of Great Britain deem themselves able to afford the money to make its use universah Even so funda- mental a duty as that of guarding the safety of life and limb is a relative one, when we have to con- sider whether a certain expenditure is ymtiSi.- develop- able for a given safety device. Having good***^^ discipline and foregoing the advantages of high speed, many a manager has successfully deferred the introduction of signals ; others, having to meet severe competition, or, in Great Britain, under the pressure of the Government, have been forced to adopt the most com- plete apparatus at great cost. In large city terminal stations, where additions to the space are out of the ques- tion, interlocking is necessary for economy of time and labour, as, indeed, it is in a less degree at smaller stations also ; as a measure of safety, however, it is desirable at even the smallest, and the wise manager extends its use as fast as he is financially able. At crossings at grade level of one railway with another, and at drawbridges, inter- locked signals with derailing switches obviate the necessity of stopping all the trains, as formerly was required by law everywhere in America, and saving a stop saves money. The block system was introduced primarily for safety, but where trains are frequent it becomes also an element of economy. Without it trains must usually be run at least five minutes apart (many managers deem seven or ten minutes the shortest safe interval for general use), but with it the interval may be reduced to three minutes, or*

less, according to the shortness of the block sections. With automatic signals trains are safely run at high speed only one and a half miles apart. Automatic signals are liable to dangerous failure from sticking of movable parts or from lightning : but records show that a series of signals properly cared for will fail only once in a million times (from all causes) ; and in view of the lower cost of the automatic, and its perfect adaptability to permissive signalling, makers and users of the system offer the defence that (1) not all failures cause collision; and (2) human attendants also make dangerous mistakes. The signal equipment of the largest railways costs from ??100 to ??1000 per mile. The electro-pneumatic on a four-track American line has cost S5000 a mile, not counting inter-locking plants. British manufaetiu-ers of signals (not railway companies) employ enormous capital. In America automatic signals have been developed at a cost of prob- ably two or three million dollars ; and the investment in interlocking represents a still larger sum. On the Con-tinent and in India signalling development has followed that of Great Britain. The German and French lines have many signals, but the equipment of the several lines is far from complete, and the very numerous modifications which have been made in British theories by Continental engineers have not proved improvements, but quite the contrary. (b. b. a. ; h. a. y.)

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Locomotive Engines.

The increase in the weight and capacity of locomotives constitutes the most marked feature in their recent de- velopment aU over the world. Many, factors ^”” have contributed to this change. Two of the most important have been the increase of the axle-weight limit and the raising of the boiler above the ground to a sufficient height to allow of almost any desired dimensions of boiler and fire-box, independently of the width between the frames and the diameter of the driving wheels. The improvement in quality of steel boiler plate has permitted an increase in

tractive effort with cylinders of a given diameter, and the substitution of cast steel for cast iron in details has reduced useless weight. The general tendency in railway working at the present time is towards higher average speeds with heavier trains, and' this circumstance has forced attention to the importance of adequate boiler capacity combined with the highest efficiency of boiler and machinery, especially as the Umits of weight and clearance dimensions are being rapidly reached. Clearance dimensions are those heights and widths which must not be exceeded by the engines, carriages, Ac, running over a line if they are to avoid coming into contact with fixed structures, such as bridges, tunnels, and platforms. In America, as may be seen from Fig. 14,

Fig. 14. ??? British and American clearance gauges.

the maximum permissible measurements are considerably larger than they are in Great Britain, and this fact par- tially explains the superior size and weight of American engines as compared with British. It is not, however, the ???whole explanation, for British locomotive designers have not worked nearly up to the extreme dimensions possible until quite recently, and then only in comparatively few ???cases. Even first-class lines occasionally run some of their fastest and heaviest trains with engines whose designs are thirty years old, and which were suited to a time when the weights to be drawn were much smaller and the average of speed lower. The result is that the wasteful practice of using two engines to one train has frequently to be followed. Even so, there is frequently no reserve of power that will enable a driver to make up lost time ; and once late, owing to whatever cause, the train continues so to the end of its journey. It is sometimes argued, however, that even when a driver has an engine capable of " playing with " the load behind it, he has no right to run faster than the speed indicated in his working time-tables, and that if an acci-

dent should happen when he was doing so, he might incur a grave legal responsibility. Still, of late years British railway engineers have come to recognize the advantages of ample locomotive power, just as the managers are per- ceiving the economy of big and full train loads ; and recent designs, as may be seen from the examples given below in Table XVI.,

show increase in boiler capacity, in extent of heating surface, in steam-pressure (which in several cases now reaches 200 B) per square inch), in cylinder dimensions, and in adhesive weight. Increased production of steam is the problem that confronts the locomotive engiiieer, and he has attempted to solve it by the use of larger and longer boilers, and by the employment of various special devices. The employment of liquid fuel is also being tried by several railways in Great Britain, notably the Great Eastern (see Petkoleum, ►► Liquid Fuel, vol xxxi.).

Locomotives may be classified, according to the kind of service for which they are employed, into "passenger," "goods" or "freight," and "shunting" or " switching." These broad divisions include j "^' many types, which differ with the weight to be hauled, the character of the Une, and the speed required, the selection of a type for a given duty being more or less controlled by the custom and tradition of the country. The two main factors governing a design are the required tractive effort and the speed, but locomotive types are best recognized and named according to the number and arrangement of the wheels used for driving. In the following sjmopsis the small diagrams are intended to indicate the arrangement, relatively to each other, of the boiler, wheels, and cylinders in the principal types into which locomotives may be classified : ►►►*

(1) " Single-driver " type. Still used by several rail- ways in Great Britain for express passenger service, but going out of favour ; it is also found j-j in France, and less often in Germany, Italy, and elsewhere in Europe. It is frequently designed with three axles only, the driving axle being in the middle. It is adapted for light, high-speed service, and noted for its simphcity, exceDent riding quahties, low cost of maintenance, and high mechanical efficiency ; but having limited adhesive weight, it is unsuitable for start- ing and accelerating heavy trains.

(2) "Four-coupled" type, with leading bogie truck. For many years this was practically the only one used in America for all traffic, and it is often spoken of as the " American " type. In America it is still the standard engine for passenger traffic, but for goods service it is

now employed only on branch fines. It has been ex- tensively introduced, both in Great Britain and the Con- tinent of Europe, for passenger traffic, and is now the most numerous and popular class. It is a safe, steady-running and trustworthy engine, with excellent distribution of weight, and it is susceptible of a wide range of adapt- ability in power requirements (see Table XVL, Nos. 1-7, 13, 19, 28, 31, and 34).

(3) "Four-coupled" three-axle type. Used to some extent in France and Germany and considerably in England for passenger traffic of moderate weight. Engines of this class, with 78-inch driving wheels and the leading axle (which is placed . much farther back than is shown in the diagram) fitted with Webb's radial axle-box, for many years have been doing excellent work on the London and North-Western Eailway. The famous engine "Charles

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Dickens "was one of this class. Built in 1882, it had, by 12tli September 1891, performed the feat of running a million miles in 9 years 219 days, and it completed two million miles on 5th August 1902, having by that date run 5312 trips with express trains between London and Manchester.

(4) "Four-coupled" three-axle t5rpe, with trailing axle. Used on several English Hues for fast passenger traffic, and also on many Continental _ railways. The advantages claimed for it are : short coupling – rods, large and unlimited fire-box car- ried by a trailing axle, compactness,

and great power for a given weight. Its critics, however, accuse it of lack of stability, and assert that the use of large leading wheels as drivers results in rigidity, and produces destructive strains on the machinery and per- manent way.

(5) "Four-coupled" type, with a leading bogie truck and a trailing axle. This was, in 1902, the most recent type for powerful express passen- n ger service. It is used to a limited extent both in England and on the Continent, and is rapidly increasing in favour in

the United States, where it originated and is known as the " Atlantic " type. It has many advantages for heavy high- speed service, namely, large and well proportioned boiler, practically unlimited grate area, fire-box of favourable pro- portions for firing, fairly low centre of gravity, short coupling rods, and, finally, a combination of the safe and smooth riding qualities of the four-coupled bogie type, with great steaming capacity and moderate axle loads (see Table XVI., Nos. 9, 10, 20, and 29). Occasionally a somewhat similar type is designed with the bogie under the fire-box and a single leading axle forward under the smoke-box ??? an arrangement in favour for suburban tank engines. In stUl rarer cases both a leading and a trailing bogie have been fitted.

(6) "Six-coupled" with bogie, (see Table XVI., Nos. 11, 12, powerful engine for heavy pas- senger and fast goods service. It is used to a limited

extent both in Great Britain and on the Continent, but is much more

common in America. The design combines ample boiler capacity with large adhesive weight and moderate axle loads, but except on heavy gradients or for unusually large trains requiring engines of great adhesion, passenger traffic can be more efficiently and economically handled by four-coupled locomotives of the eight-wheel or Atlantic types.

(7) “Six-coupled” total-adhesion type (all the weight

carried on the drivers). This is p

the standard goods engine of Great Britain and the Continent. In America the type is used only for shunting. It is a simple design of moderate boiler power.

(8) ” Six-coupled ” type, with a leading axle. This is of American origin, and is there known as the ” Mogul.” It is used largely in America for goods traffic. On the Continent it is in considerable favour for goods ‘ r-ji^s/^ /^\ and passenger traffic on heavy O ‘T^v^ J^‘J gradients. The type is, however,*

less in favour than either the Ten-wheel or the eight- coupled ” Consolidation ” for freight traffic (see Table XVI, No. 22).

or

21.

“Ten-wheel” type 30, and 35). A

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n.

(9) “Eight-coupled” total-adhesion type; now found

L

“^ggQgr

Nos.

on a good many English rail- ways and common on the Con- tinent for heavy slow goods traffic. .In America it is com- paratively infrequent, as total- adhesion types are not in favour (see Table XVI, 14-17, 32, and 36).

(10) ” Eight-coupled ” type, with a leading axle. This originated in America, where it is termed the ” Consohdar

tion.” In the United States it ft

is the standard heavy slow-speed

freight engine, and has been r-\/LS^^’\i^”\i^~\ built of enormous size and C)'7\T7.‘J^clJ weight. The type has been

introduced in Europe, especially in Germany, where the advantages of a partial-adhesion type in increased stability and a larger boiler are becoming appreciated. The wide range in capacity and weight of this type in America is illustrated in Table XVI., Nos. 23-26. No. 25 is an example of a very powerful pusher loco- motive for heavy gradients, and shows the application of the Wootten, or wide, shallow fire-box for burning fine anthracite or low-grade bituminous coal. Occasionally the American eight-coupled type has a bogie instead of a single leading axle, and is then termed a “Twelve- wheeler,” or “Mastodon.”

(11) “Ten-coupled” type, with a leading axle. This originated in America, where it is known as the ” Decapod.” It is used to a limited _q extent for mountain-grade goods traffic, and has the

gooas tramc, ana nas tne ???p-L:·, \/ ‘.y’\,„\ advantage over the ” Con- CTk^K^t^’ Jy ‘ J^’ J solidation ” or eight-coupled type of lighter axle loads for a given tractive capacity.

In addition to the foregoing Hst, various special loco- motive types have been developed for suburban service, where high rates of acceleration

and frequent stops are required. These are generally tank engines, carrjdng their fuel and water on the engine proper. Their boilers are of relatively large proportions for the train weight and average speed, and the driving wheels of small diameter, a large proportion of their total weight being "adhesive." Other special types are in limited use for " rack-railways," and operate either by engagement of gearing on the loco- motive into a rack between the track raUs, or by a com- bination of this and rail adhesion (see the section below on Mountain Railways).

Table XVI., the data for which have been mostly sup- plied by the various railway companies in Great Britain and the different manufacturers in America, is intended to give some idea of the state of locomotive-building at the beginning of the 20th century, chiefly in Great Britain and America. WhUe, therefore, it contains par- ticulars of some recent engines of which only a few examples ??? perhaps only one ??? are in existence, it ignores some t3qDe3 which, although in extensive use, do not seem likely to be perpetuated, or which do not present any novel features. Nos. 1-18 are British engines, Nos. 19-27 American, and Nos. 28-36 Continental.

Locomotives of similar type in the principal countries differ considerably in appearance and constructive detail. A broad distinction may be drawn between g, European and American practice in the framing parison ot and running gear. All American locomotives locomotive are built with bar or rectangular-section forged p""'"^- frames, and with a flexible system of levers and springs for equalizing, or distributing, the weight between the various axles. Enghsh and Continental locomotives, on the other hand, have side frames of plates braced together as a*

1. Caledonian Railway, "Dunalastair HI." class. (8t Rollox Works.)

2. London and Soutli -Western Railway.

3. Midland Railway. (Derby Works.)

4. Great Western Railway. "Atbara" class. (Swindon Works.)

5. Great Eastern Railway. “Lord Claud Hamilton “class. (Stratford Works.)

6. London and North -Western Railway. ” King Edward VII.” class, four-cylinder compound. (Crewe Works.)

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7. Glasgow and South- Western Railway. Pour-cylinder non-compound. (Kilmarnock Works.)

8. London and South-Westem Railway. Four-cylinder non-componud.

EAILWAYS (BRITISH LOCOMOTIVES).

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9. Lancashire and Yorkshire Railway. “Atlantic ” type. (Horwich Works.)

10. Great Northern Railway. ” Atlantic ” type, (Doncaster Works.)

11. North Eastern Railway. (Gateshead Works.)

12. Highland Railway. (Dubs and Co., Glasgow.)

13. Midland Railway. Three-cylinder compound. (Derby Works.)

14. Lancashire and Yorkshire Railway. (Honvich Works.)

15. Caledonian Railway. (St Rollox Works.;

RAILWAYS (BRITISH LOCOMOTIVES).

16. London and Nortb-Western Railway. Three-cylinder compound. (Crewe Works.)

.^^sigSI^I^M

17. “American” type. Seaboard Air Line Railway. (Baldwin Loco. Works.)

IS. “Atlantic” type. New York Central and Hudson River Railway “Empire State” Express engine. (Schenectady Loco. Works.)

19. Compound 10-wheel type. Union Pacific Railway. (Baldwin Loco. Works.)

20. “Mogul” type. Pennsylvania Railway. (Baldwin Loco. Works.)

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f^A

QM

Ic

^^*S|*

21. Compound, “Consolidation” type. Rio Grande We.stern Railway. (Baldwin Loco. Works.)

22. ” Coniulidation ” type. Pittsburg, Bessemer, and Lalve Erie Railway. (Pittsburg Loco. Works.)

23. Tandem compound, ” Consolidation ” type. Northern Pacific Eailway. (Schenectady Loco. Works.)

24. “Mastodon ‘ type. Chicago and Eastern Illinois Eailway. (Pittsburg Loco. Works.)

RAILWAYS ^AMERICAN LOCOMOTIVES)

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RAILWAYS

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Table XVI. ❓❓❓ Comparative Data of Locomotives.

a

3

‘A

Owning Railway.

6 1

Cylinders.

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3

Weight (Ton =2240 ft).

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1

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Remarks.

ID

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1

Position.

1

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6

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II

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m

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1

1

In.

In.

In.

Tons.

Tons,

Tons.

So. ft.

Sq. ft.

1600

1

Caledonian

2

Inside.

19

26

78

51-70

34-65

96-70

23

" Dunalastair III. "(900) class.

1

2

London and Sontli-Western

2

Inside.

m

26

79

48-85

33-45

93-00

24

1500

Fitted -vrith cross water tubes in fire-box, giving 165 sq. ft. of heating surface.

2

3

Midland .

2

Inside.

19J

26

81

51-60

34-09

102-97

25

1519

Belpaii-e flre-box.

3

4

Great Western .

2

Inside.

18

26

80

51-60

33-60

87-85

21-45

1663-02

4

5

Great Eastern .

2

Inside.

19

26

84

60-30

33-20

85-35

21-3

1630-5

Fired with liquid fuel on Holden's system.

5

6

London and North-Western

}^{

2 H. -P. outside. 2 L.-P. inside.

16

20i

24 24

|85

57-60

37-00

84-20

20-5

1557-5

The H.-P. valves are worked by means of a simple lever from the L.-P. valve-rods, which are continued through the valve – chests. These engines are like the "Iron

6

7

Glasgow and South-Westem

}^{

2 outside. 2 inside.

12i

*1*4*

24 26

}81i

48-70

31-70

81-05

18-0

1206

Duke ” class, but larger. Non-compound ; valves of both L.-P. and H.-P. cylinders on each side worked by one set

7

8

London and South-Western

> ???1

2 outside. 2 inside.

14 14

26 26

}79

57-90

40-00

105-00

27-4

1690

of valve-gear. Non-compound ; axles not coupled ; water tubes in fire-box give 190 sq. ft. of heat- ing surface.

8

9

Lancashire and Yorlisliire

5

Inside.

19

26

87

58-75

35-00

89-41

26-05

2052-8

Belpaire fire-box.

9

10

Great Northern

5

Outside.

19

24

78

58-00

31-00

99-00

26-75

1442

990 class.

10

11

North-Eastem .

6

Outside.

20

26

80

67-10

51-95

107-10

23

1769

Steam-pressure, 200 lb per

11

12

Highland .

6

Outside.

19J

26

69

58-85

43-85

96-95

26

2050

sq. in. Steam-pressure, 200 lb per

12

13

Midland ,

‘{

2 L.-P. outside. 1 H.-P. inside.

21 19

26 26

}

69-5

38-88

112-15

26

1719

sq. in.

2631 class ; Serve tubes ; steam- pressure, 195 lb per sq. in.

13

14

Lancashire and Yorkshire

9

Inside.

20

26

54

53-78

53-78

84-45

26-05

2038-64

14

15

North-Eastern .

9

Outside.

20

26

55i

58-30

58-30

96-90

21-5

1675

16

Caledonian

9

Inside.

21

26

54

60-60

60-60

102-00

2500

Tractive foroe,“28,665 lb.

15

17

London and North-Westem

}^{

2 H.-P. outside. 1 L. -P. inside.

15 30

24 24

U:

49-25

49-25

75-85

20-5

1489

16

18

Great Eastern .

???

?????????????I

IH.-P. inside. 2 H.-P. outside.

18} 18}

24 24

|54

71

71

42

3010

Ten – coupled, total – adhesion, tank engine ; steam-pressure, 200 lb per sq. in.

19

Seaboard Air

Line New York Cen-

2

Outside.

19

26

72

56-79

34-90

92-41

17-5

1866-3

17

20

5

Outside.

21

26 ‘

79

78-67

42-41

127-75

50-32

3505-17

Steam – pressure, 200 lb per

18

tral

sq. in.

21

Union Pacific .

??{

2 H.-P. outside. 2 L.-P. outside.

15i

28

28 28

[78

81-69

63-08

133-93

32

3011

19

22

Pennsylvania .

8

Outside.

20

28

62

71-43

62-09

125-00

30-25

2431-3

20

23

Eio Grande Western

M

2 H.-P. outside. 2 L.-P. outside.

17 28

30 30

}57

88-68

79-09

138-39

35

3330-2

21

24

Pittsburgh, Bes- semer,andLake Erie

10

Outside.

24

32

54

112-60

100-45

174-55

36-8

3805

22

25

Lehigh Valley .

10

Outside.

22

30

55

100-45

90-17

154-51

90-0

4100

Wootten fire-box.

23

26

Northern Pacific

10 1

2 H. -P. outside. 2 L.-P. outside.

15 28

34 34

|-63

88-39

78-12

138-75

52-29

2997-10

27

Chicago andEast ern Illinois

H.-P. L.-P.

21}

33

30 30

|-54

89-28

71-43

133-04

72

2447

24

28

Est .

2|

2 H.-P. outside. 2 L.-P. inside.

2l|

*26**

}-81i

58-29

33-24

27-12

1988-12

Steam-pressure, 213 lb per

29

Nord

‘???{

2 H.-P. outside. 2 L.-P. inside.

131 22

25i 25|

}-80A

62-99

32-48

108

29-5

2274-5

sq. m. Nos. 2641, 2642; steam –

30

Quest

???{

2 H.-P. outside. 2 L.-P. inside.

13i

264

2l| 25|

}mi

57-48

40-84

26-37

2088-25

pressure, 228 lb per sq. in.

31

Est .

2

Outside.

18

It

82A

55-87

32-87

23-12

1811-5

Flaman boiler.

32

Nosd

9

20

51

45-80

45-80

70-54

22-7

1340

33

Paris-Orleans .

5

Outside.

16J

25A

im

47-14

31-49

22-63

1869

Durant and Lencanchez valve- gear ; steam-pressure, 213 lb

34

Prussia State .

2{

H.-P. L.-P.

18

26|

23i 23l

l78

48-21

29-93

84-37

24-6

1280

per sq. in.

35

Kaiser Ferdin- and

}??{

H.-P. L.-P.

3l|

28|

281

[711

69-20

42-86

102-67

33-3

2240

36

St Gothard

9

*“^*

24

46

50-89

50-89

75-00

23-1

1700

152

RAILWAYS

[locomotives

rigid whole, and the weight is transmitted to the axles by independent spring supports, though equalizing levers are not entirely unknown.

American locomotives of standard gauge invariably have the frames inside of the wheels, and outside cylinders, with solid integral saddles to carry the forward end of the boiler. British and Continental locomotives have the frames either inside or out, or both ; and the cylinders are often inside, especially in Great Britain, the use of a cranked driving axle being a necessary incident of this practice. In American engines the height of the boiler from the ground and its larger diameter are noticeable features.' The fire-box, too, is larger, and often placed above, instead of between, the frames ; it is made of steel, not of copper as in Great Britain, An. extended smoke-box is another characteristic of American practice, but one which is also to be found in Great Britain and the Continent. In proportions, American engines have much larger ratios of grate area and heating surface to cylinder volume than are found else- where, the diflference being especially marked in contrast with British practice, and their actual dimensions and weight exceed those usual in other countries. High finish and absence of external pipes and visible mechanism are striking features of British engines, and to a less extent of those of the Continent. The aim of American designers is to have aU moving and wearing parts accessible for quick inspection and repair, and appearance and finish are regarded as of secondary importance.

(1) Train Resistance is a matter involved in much obscurity. It depends upon many variable conditions, such as the weather, Element ^^^'^^t kind and condition of equipment, as well as com- of design P►►^ition and weight of train. The formulae given below presuppose that the trains are of average weight, and that the bearings are well lubricated and warmed by ninning ; they also apply only after speeds of 12 miles an hour have been reached, since in starting a train from rest the frictional resistance is momentarily higher. On level straight track it should be taken at not less than 20 lb per ton of 2000 lb ; this falls rapidly to the normal amount at a speed of say 2 miles an hour, but up to 12 miles an hour resistance should never be assumed at less than 5 lb per ton of 2000 B. Train resistance may be expressed by the summation of the following factors : ►►►

g

At a given speed . . Y]=□□□-h3 . . . . (a)

6

Y□□□=0-38 M

Additional for gradients

Additional for curves

Additional for acceleration Y4=0‘0132V

*Or, for an increase in speedier _n.m qo/v 2 ir 2^*

from a velocity Yj to YJ^^~^ m6il,\^ – Vj)

Q>)

f =07 C (for oars) \ , >

\ ^ 3 = 1 -4 0 (for locomotive) / ^’>

(d)

In the above the resistances are in pounds per ton of 2000 lb of train weight, including the locomotive: S= speed in miles per hour ; M= gradient in feet per mile ; C = curvature in degrees; and V = velocity attained in one mile, starting from zero and expressed in miles per hour. Equations (d) and (e) include an allowance for energy stored in the rotating wheels.

A large number of the formulse which have been suggested by various observers for the calculation of train resistances are collected in a paper on “Train Resistance,” read before the Institution of Civil Engineers (London), on 26th November 1901, by Mr J. A. F. Aspinall, general manager of the Lancashire and Yorkshire Railway. This paper contains an account of numerous experiments carried out by the author with trains of various lengths, composed of the standard four-wheel-bogie passenger

stock of that railway, and the general formula which he gives as expressing the results he obtained is

R = 2-5-f

Vt

50-8H-0-0278L'

where R = resistance in pounds per ton (2240 tb) dra-\vn, V = velocity of train in miles per hour, and L= length of train in feet over the coach - bodies.

(2) Tractive Effort. ??? Theoretical tractive effort is represented by

T. E. = jr, m pounds (/)

where P=mean effective pressure in cylinders, in pounds per square inch; d=diam6ter of cylinder, in inches; S = stroke of piston, in inches ; and D = diameter of driving wheels, in

inches. For any given train, therefore, the following equation, is true : ???

?^=l-l(Yi + Y2 + Y3 + Y,)T . . . . (g)

where T= weight of train, including locomotive and tender, in tons of 2000 lb, 10 per cent, being allowed for internal friction of the engine. The tractive effort of a locomotive is greatest in starting, or at slow speeds ; it is dependent upon the mean effective pressure in the cylinders, which is greatest at long cut-off when starting, and is generally assumed at 85 per cent, of boiler pressure for a maximum.

(3) Steaming Capacity is a variable factor, depending upon the type of boiler, combustion rate, character of fuel, &c. In good practice on heavy work the following are maximum results : ??? In express passenger service, with simple expansion cylinders, one-horse power for each. two square feet of heating surface. In fast freight service, with simple

expansion cylinders, one-horse power for each three square feet of heating surface. In heavy freight service, with simple expansion cylinders, one-horse power for each four square feet of heating surface. In express passenger service, with compound cylinders, one-horse power for each half square foot of heating surface. In the heaviest goods and passenger service a new limit for performance has been approached in the capacity of the stoker to shovel coal into the fire-box ; 100 to 120 lb per minute appears to be the maximum practicable quantity.

The era of compounding, as applied to locomotives, was inaugurated by Mr A. Mallet in 1876 in France, followed by Mr A. von Borries in Germany, Mr T. W. Worsdell and Mr F. W. Webb in England, and Compound Mr S. M. Vauclain in America, all about the '^^'jy^^ year 1889. Since the latter date the growth in use of the compound has been rapid, especially in America and France, in both of which countries it has passed the experimental stage. The same may be said of England so far as concerns the London and North-Western Eailway, where many compounds on the Webb system are at work vrith satisfactory results ; but on other hnes, such as the North-Eastern, they are as yet scarcely more than experiments, though there are signs that such experiments will be widely tried in the near future.

The types proposed are many, and are known under the names of their designers. They may be classified (a) by the number of cyUnders, two, three, or four; (b) by the number of main crank connexions, two or four ; (c) by the peculiarities in starting mechanism, which may be either automatic or non-automatic ; (d) by the use or not of a receiver between the cylinders.

The main types are represented by the "two- cylinder " (Mallet in France, von Borries in Germany, WorsdeU in England) ; the " three-cylinder " (Webb and Johnson in England); and the "four-cylinder" (MaUet and de Glehn in France, Vauclain in America, Russia, &c., Webb in England). The four-cyhnder designs are by far the most used, and appear to give the best results.

Important advantages are claimed for compounding, especially for modern powerful locomotives. The principal ones are : ???

(a) Possibility of greater heat utihzation by increasing the range of steam expansion, which is accomphshed by successive expansion in two cylinders, instead of in one.

(5) Saving of steam by reduction of cylinder condensa- tion, due to the lower range of temperatures resulting from less expansion in each cylinder.

(c) Better steam distribution by working at long cut-offs, thus avoiding the mechanical difficulties with valve motions at short cut-ofis.

(d) Other mechanical advantages in certain types of multiple-cylinder compounds, such as the use of cylinders of shiaUer diameter, which with high pressure steam give a more uniform turning movement at the drivers than is possible in the two-cylinder simple engine.

(e) An important operating advantage obtained as the obvious result of the saving in fuel secured, namely, an

EOLIING stock]

increase in the reserve capacity of the boiler for a given amount of work done by the engine.

The obtainable economy in fuel varies with service conditions, but the following may be expected as reason- able average results for compound as compared with simple locomotives having the same characteristics and used in the same kind of service : ???

Passenger 10 to 15 per cent.

Goods 15 to 20 ??? ???

Heavy continuous grade goods . 25 to 40 ??? ???It is very difficult to compare the cost of locomotives in various countries, because

the specifications and material and weights vary. On the Continent of Europe it Cost of ig customary to sell locomotives by weight, while motives. ^ Great Britain and the United States they are sold at so much each. The cost of material causes fluctuations, apart from those which result from demand. We may, however, take as typical a British six-coupled goods engine and tender, with cylinders 18 by 24 inches. Such engines were sold in Great Britain in 1899 for about ►►3000. In the United States we may take as typical an eight-wheel or American-type locomotive and tender, with cylinders 17 by 24 inches. Such engines were sold in 1870 for about $12,750, in 1880 for $9000, in 1890 for $7000, and in 1900 for $8500. In the earher years such an engine was unusually large and few were built. Now it is smaller than is ordinarily used in the United States. Further, even with the same size of cyhnders these engines have increased in size and weight during the thirty years. In 1876 an eight-wheel American engine with cylinders 17 by 24 inches weighed about 72,000 S> ; now it would weigh about 90,000 K). Then the boiler was about 48 inches in diameter, now it is about 54. Steam-pressure has risen from 130 5i to 180 tt) and more. In the United States the prices in the last quarter of 1900 were about $11,500 for a 60-ton Consolidation locomotive, $15,500 for a 90-ton Consolidation, and from $12,500 to $15,000 for a 75-ton Mogul or 10-wheel engine.

Attthokitibs. ►►► The following books will serve to give the reader an insight into the principles, the details of construction, and the present state of the art of building locomotives : ►►► W. F. Pbttigeew. Manual of Locomotive Engineering. London, 1899. ►►► E. Satjvagb. La Machine Locomotive. Paris, 1894. ►►► M. Dbmotjlin. Traiti Pratique de la Machine Locomotive. Paris, 1898. ►►► M. N. FOKNEY. Catechism of the Locomotive. New York, 1890. ►►► A. T. "Woods and David L. Babnes. Compound Locomotives. Chicago, 1893. ►►► Proceedings of the American Rail- way Master Mechanics' Association, published annually by the Association, Chicago. (j- gh.)

EoLLiNG Stock.

Passenger Trains. ►►► The passenger carriage of Great Britain and the Continent and the passenger car of the United States are unKke in

many particulars. The carriage has, in general, transverse compartments, vsdth side doors, and without a longitudinal passageway or end doors, although the recent introduction of corridor cars, having end doors and platforms, with communication through the car or train, suggests the probability of a general though gradual change of practice in that respect. The American passenger car has end doors only, with a central longitudinal passageway or aisle. In general the whole interior space is open ; but just as the use of cars with end doors and through aisles is increasing in Great Britain and on the Continent, so the use of sleeping-cars divided into private compartments is increasing in the United States. Even in those cars, however, the end doors and through aisles are retained, and the number in use is not yet great enough to indicate a general change to the compartment plan, even for sleeping-cars. The relative merits of these two broad types of passenger-car design have been much discussed, but the question is too complicated to be con-

sidered here. It is enough to say that it is afiected by the temperament, or at least by the rooted habits, of the peoples, by the methods of dealing with baggage, and by the division of passengers into classes.

The three classes, which originally were universal in Great Britain, have now been reduced to two on several important hues, by the abolition of the second class. Where this alteration has been effected, third-class passengers are carried by all trains, even the fastest, at a maximum rate of one penny a mile, and the practice of restricting .certain expresses to firsts or first- and second- class passengers only lingers on two lines in the South of England and in Ireland. On the Continent third-class passengers are still excluded from many of the faster trains, though there is a tendency towards increased liberality in this respect. The ordinary fares, however, are there appreciably lower than in Great Britain. In Hungary, Austria, and Kussia a zone-tariff system is in operation, whereby the country is mapped out into zones, and the traveller pays according to the number of these he passes through, and not simply according to the number of miles he is conveyed. For example, on Russian rail- ways, for any distance up to 6 versts (= 4 miles), there is a minimum fare of 23 kopecks first class, 14 kopecks second class, and 9 kopecks third class. For distances between 6 and 300 versts, the charge

progressively increases verst by verst, though at a gradually diminishing rate, so that, for instance, the first-class fare for 300 versts (8 roubles 90 kopecks) is less than twice that for 150 (5 roubles 40 kopecks). For distances greater than 300 versts, the fares increase by zones ; these vary in length, but the increment of price is the same for each, whatever its length, namely, 50 kopecks first class, 30 kopecks second class, and 20 kopecks third class. The zones are 25 versts long between 301-500 versts, 30 between 501-710 versts, 35 between 701-900 versts, 40 between 901-1510 versts, and 50 for greater distances. By a change which came into efiect in May 1902, the 50- verst zones extend only from the 1511th to the 3010th verst, and for greater distances the zones contain 70 versts. The charges on these are increased to 100 kopecks first class, 60 kopecks second class, and 40 kopecks third class. In America there is nominally one class, the average fare being about l^d. per mile, but the extra charges levied for parlour, sleeping, and other cars practically constitute a differentiation of class, besides making the real cost of travelling higher than that just given. Immigrants are carried in special trains at much lower rates.

In America and other countries where long distances have to be travelled and passengers have to spend several days continuously in a train, sleeping-cars, res- taurant-cars, smoking-cars, &c., become almost ‘”’”“”’ a necessity, and accordingly are to be found as ^^ “^ a matter of course on most of the best through trains. On the continent of Europe they are largely in the hands of the International Sleeping-Car Company, and the charges for such accommodation de luxe frequently constitute a very heavy addition to the ordinary distance rates levied by the railways. In England, where the distances are comparatively small, sleeping and restaurant cars must rather be regarded as luxuries ; stiU, even so, they are very frequently to be met with. The J^Iidland Railway was the first to run sleeping-cars on its trains, the innovation being due to Sir James AUport about 1875. The earliest were Pullman cars imported from America ; but when other lines began to adopt them, they were made in England with such differences as commended themselves to the various designers. In the most recent type a side corridor runs the whole length of the vehicle, and terminates in a vestibule platform at either end, so that communication

[rolling stock

may be had vrith the adjacent coaclies. Off this corridor open small compartments or berths, made for one or two persons only, each being fitted with a folding lavatory similar to that found in a ship's cabin. Sleeping-cars are run on most of the important night trains between London and Scotland, Manchester, Liverpool, Holyhead, &c., and are available for passengers holding first-class tickets on payment of a uniform fee of five shillings. Such cars for third-class passengers have frequently been talked about, but have yet to make their appearance on any British railway. The number of restaurant-cars increased greatly about the end of the 19th century; and whereas at first they were attached only to two or three expresses, mostly running between London and Scotland, they are now frequent on trains covering much shorter distances, e.g., between London and Lancashire, Birmingham, Cromer, &c. The introduction of corridor trains has greatly ex- tended their usefulness, and, without extra charge beyond the amount payable for food, they are provided for all classes, except on the Great Western EaUway, which, although early in the field as regards corridor trains, for long excluded all but first-class passengers from its dining-cars, which, moreover, were very limited in number. However, the introduction in 1901 of corridor trains and dining-cars for all classes by its great rival, the London and South- Western Railway, compelled a change in its policy, and in 1902 orders were given for dining-stock for second- and third-class passengers.

European carriages were at first mounted on two, and later on three, axles, which were free to rise and fall

through a limited range, but not to turn with Construe- jespect to the carriage. Thus the length of the carriages, body was limited, for to increase it involved an

increase in the length of the rigid wheel-base, impossible with due regard to safety. Hence bogies or swivel trucks, which allow of longer car bodies, are fast coming into use; indeed, the standard coaching stock of Great Britain is now carried on bogies. The American passenger car has invariably been mounted on swivel trucks, having four wheels each for ordinary cars and six wheels each for sleeping, postal, and other heavy cars.

A noteworthy feature in British practice has been the large increase in the weight of passenger vehicles, both absolutely and stiU. more in relation to the number of persons they can accommodate. The result, which is attributable in great part to the lavatories now general, and to the introduction of corridor carriages, is refiected in the heavier trains run, and in the larger and more powerful locomotives that must be provided to haul them. Some idea of the extent to which rolling stock has increased in weight and decreased in capacity may be gained from the official figures, as given in Table XVII. , of the standard stock in use on the Midland Railway in 1901, if they are compared with those in the similar table to be found in the article Railways in the ninth edition of this Encyclopaedia (vol. xx. p. 248). Thus a standard bogie third-class passenger coach in 1885 weighed 17f tons and held 70 persons; in 1901 the weight had risen to almost 25 tons and the capacity fallen to 36 persons.

As a result of early practice in bridge, station, and tunnel construction, British and Continental carriages cannot be

made as large as American passenger cars ; and "^ though the restriction is less on the Continent llgbting. than in Great Britain (see Fig. 14 for clearance

gauges). One consequence is that larger cubic capacity per passenger is possible in the United States ❓❓❓ a fortunate circumstance, since the greater range of temperature there makes proper heating and ventilation relatively more important and at the same time more

difiicult. In the United Kingdom the ancient system of hot-water cans ^ is still largely employed for heating, but in the United States much the most common method is by steam taken from the boiler of the locomotive and

circulated through the train by a line of piping connected by flexible couplings between the cars ??? a method which is also finding increased favour in Europe. As to lighting, the feeble glimmer of the oil lamp is still to be seen in some English railway carriages, but it has mostly been displaced by gas and electricity. The former is a rich oil gas, compressed and stored in steel reservoirs under the carriages. The latter is obtained from dynamos driven from the axles of the coaches. In block-trains, where the component coaches are permanently coupled together, one dynamo sometimes lights all the carriages ; but usually each has its own dynamo, and so becomes an independent unit. In the system most commonly em- ployed in England the dynamo is connected to the axle in such a way that its speed, and consequently the current it yields, is approximately constant, whatever the speed of the train. In another system, which is of American origin, the required constancy of current is provided for by means of an automatic switch, which adds to or takes away resistance from the field-coils of the dynamo according as the speed of the train rises or falls. In both systems accumulators are used to maintain the light when the train is at rest or traveUing too slowly to admit of current being generated. Gas and electric lighting are also ex-tensively resorted to in American and Continental trains ; but up to 1902 compressed oil-gas was very much more common than electric lighting, and in the United States kerosene-oil lamps were still extensively employed.

Table XVII. ??? Details of Midland Bailway Stock.

Carriage.

Length

of Body.

Compartments.

Number of Passen- gers.

Weight.

1

E

t

i

???E -g

1

6 3

1

3 1

1

1

H

6- wheeled-bogie Isfc

class dining 6-wheeled-bogie3rd

class dining 4-wheeled-bogie 1st

class corridor . 4-wh8eled-bogie3rd

class corridor . 4-wheeled-bogie

composite . 6-wheeled -bogie

sleeping .

60 60 60 60 60 60

2 saloons

i

2

5 saloons

2 saloons

6 3

2 2 2

2 2

2

1

1

1

1

24

16

8 11

42

36 18

33 9 32 7 24 4 24 19 26 16

34 9

In Great Britain the railway companies are by the Regula- tion of Railways Act, 1868, required to fit trains which run more than 20 miles without a stop with commani- some means of communication between the cation passengers and the officials in charge. With '??'^' the system of Separate carriages this is not an *""""'??? easy matter to accomplish satisfactorily. On some lines electrical devices have been in use for many years, but the most common method has been a continuous cord running along the whole length of the train outside and above the carriage windows, which, when pulled down, was supposed to give an alarm signal to the guards and engine-driver. The arrangement had many disadvantages, not the least being that it frequently failed to act. Recently a number of the railway companies have decided*

' These cans in many cases do not contain water, but fused acetate of soda. Wlien cold, the contents are solid ; but when they are heated by being immersed in hot water, they liquefy, and in the process absorb heat, which is given out again on the change of state back to solid. Hence the cans remain warm for a very long time.

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to adopt a modification -whereby the cord, which runs along the cornice inside the compartments, is continuous through eacli carriage but not through the train, and is connected to the air-brake apparatus, so that, when pulled down, it jjuts the brakes on sufficiently to attract the attention of the driver. In the corridor trains, attendants can pass freely from one end to the other, and a system of electric bells enables the passenger to summon them at will.

There is a broad difference in practice in making up passenger vehicles into trains, which has come about partly because of the different mode of handling luggage. In the United States the passenger claims his luggage at the luggage – room of the station, or more often gives his receipt ("check") to a third party, and only sees his luggage at his hotel or house.

Hence the luggage going by any one train is concentrated in one or mora special vehicles (“baggage cars”), placed at or near the head of the train ; this is also true of Continental practice. Here also will often be found in the United States the ” express car,” which carries such packages as in other countries are carried by parcel post or by fast goods trains at special

rates. Here will often be found also a huge post-office car. Then follow, in order as mentioned, a smoking-car, ordinary day -cars (often called coaches), parlour – cars, sleeping-cars, and, finally, a dining-car. Dining, sleeping, and postal cars have no place in trains making short runs. In the United Kingdom passenger trains often contain vehicles which are never seen in the United States and seldom on the Continent, namely, horse-boxes and carriage- trucks. These are a part of the thorough organization for comfort and convenience in railway travelhng which is probably more complete in the British Islands than any- where else in world.

A comparison of the weights of passengers trains in Europe and the United States is difficult to make. In aU. countries trains of different weights are used according to the different services they are required to perform, and it would obviously be improper to compare a long-distance fast train, with sleeping or dining cars, with a slow short-distance train, carrying nothing but passengers. Moreover, the weight of a train timed to leave a given station at a particular time may vary from season to season, and even from day to day, according to the number

Table XVIIL ??? Weight and Speed of Trains.

Approximate

Weight, exolu- Speed, in-

Train.

Journey.

Distance.

sive of Engine and Tender

elusive

Eemarks.

of Stops.

(ton = 2240 lb).

Miles.

10 a.m. ex Euaton .

London to Edinburgh

399J

265-340

484

10 a.m. ex King’s Cross .

33 33 ??? ??? ???

393i

230-280

47g

2 p.m. ex Euston .

London to Carlisle .

299i

290-330

48

*33 33 ◆◆◆ **

London to Crewe

158

330

48

*33 33 * ◆◆◆*

Crewe to Carlisle

141J

290-330

49f

11.50 p.m. ex Euston

London to Crewe . ◆◆◆.

158

290

524

33 33

Crewe to Carlisle Carlisle to Edinburgh

141J lOOi

290

52

48i

11.30 p.m. ex King’s Cross

London to Grantham

105i

200-300

52|

33 „ ???

Grantham to York .

82J

200-300

544

33 It ‘

York to Newcastle .

80i

200-300

53S

33 33

Newcastle to Edinburgh .

124i

200-300

504

5.30 p.m. ex Euston

London to Crewe

158

330

54

5 p.m. ex Birmingham (L. & ‘.

^.-W

Railway)

Birmingham to London .

113

120

564

2 p. m. ex Leeds

Leeds to King’s Cross, London .

185}

90-170

51|

33 33 ??? ???

Grantham to King's Cross

105J

90-170

554

1.30 p.m. ex King's Cross

London to Leeds

185i

165-190

50i

London to Peterborough .

764

165-190

55

10.35 a.m. ex Paddington (Comisl

t

express) ....

London to Penzance .

325i

414

33 33

London to Exeter

1931

220

534

33 33

Exeter to Plymouth(North Road)

52f

230

41S

1.40 p.m. ex Paddington

London to “Worcester

1204

176

53

9.30 a.m. ex St Pancras .

London to Edinburgh

406

190

474

33 33

London to Leeds

196J

190

504

33 33 ???

Leeds to Carlisle

1124

49

12 p.m. ex St Pancras .

London to Glasgow .

423

155

47

3.44 p.m. ex Jersey City (Penn

sylvania RE.) . . .

New York to “Washington

2264

312

474

Congressional Limited.

10.14 p.m. ex Jersey City (Penn

sylvania ER.) . . .

New York to Chicago

911

336

384

Pennsylvania Limited.

12 noon ex Chicago (Pennsylvania

Chicago to New York (Jersey

RR.)

City)

911

215

464

Pennsylvania Special.

8.30 a.m. ex Grand Central Station

(New York Central) .

New York to Buffalo

4394

225

53i

Empire State Express.

* J j> *

New York to Albany

1425

225

534

*ij J3 *

Albany to Buffalo .

296i

225

534

*33 33 *

Syracuse to Rochester

804

225

574

12.30 p.m. ex Chicago (New York

Central)

Chicago to New York

9794

312

49

20th Century Limited.

5.30 p.m. ex Grand Central Station

(New York Central) .

New York to Chicago

9794

460

40|

Lake Shore Limited.

12.14 p.m. ex Jersey City (Lehigh

Valley RE.) . . . .

New York to Buffalo

4464

230

45-6

Black Diamond Express.

3.51 p.m. ex Jersey City (Philadel-

phia and Reading Railway and Baltimore and Ohio RE.) .

New York to “Washington

227i

300

47i

Royal Limited.

156

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[eolling stock

of coaclies required to accommodate the traffic. For short and middle distances probably the usual weight of trains varies between about the same limits in aU countries ; for long distances the necessity of providing sustained arrange- ments for living on the journey tends to increase of weight, and therefore in extensive countries like the United States heavier trains may be found than in small ones like Great Britain. At the same time, there are some long-distance trains in Great Britain quite as heavy, if not heavier than some in the United States, even though the average weight of roUing stock is distinctly greater in the latter country. General conclusions, except of the vaguest character, are therefore almost impossible, and the best that can be done is to consider specific instances. A number of these have been collected in Table XVIII., which gives some of the best and heaviest trains run in the two countries. In using it, the reader must remember that the weight of a particular train may vary not only initially from day to day, owing to variation of traffic, but also on any one journey from station to station, owing to carriages being added or taken away.

A comparison of average speeds is scarcely less difficult than of average weights. In 1888 a careful study was made of express train mileage in the United ^ ‘ Kingdom, on the Continent, and in the United States. For the United Kingdom and the United States 40 miles an hour, including stops,

was taken as express train speed, i.e., an average rate of 40 miles an hour from the beginning of the journey to the end. But on the Con- tinent so few trains reached this rate of traveUing that the arbitrary speed of 29 miles was taken there for express speed. It was found that in the United Kingdom trains ran 62,900 miles every day at and over 40 miles an hour, and in the United States 13,956 mUes, while on the Continent of Europe trains ran 118,000 miles at and over 29 mUes an hour, but at and over 40 miles an hour there was something less than 9000 miles a day on the entire Continent. Since that date an im- portant change has taken place in Great Britain, the United States, France, and Germany.' In aU these countries faster trains are run, and the average express speed has been raised. The fastest trains are no longer run in Great Britain, but in America, by the Philadelphia and Reading EaUway between Philadelphia and Atlantic City, in com- petition with the Pennsylvania Eailroad. Passengers are conveyed from Philadelphia by ferry-boat across the river Delaware to Camden, whence the distance to Atlantic City by the Philadelphia and Reading Company's lines is 55 J miles. This is covered by some trains in 50 minutes ; the booked speed thus is 66 '6 miles an hour, and on some occasions an average speed of over 71 miles an hour has been maintained from start to stop. By the Pennsylvania RaUroad Company's system the distance between Camden and Atlantic City is 58 miles, and trains weighing about 160 tons, exclusive of engine, are booked to perform the journey at the rate of 64-4 miles an hour. In Great Britain, on the Caledonian Railway from Forfar to Perth, one train covers 32J miles in 33 minutes (59"09 mUes an hour), and on the North-Eastern Railway a train runs from Darlington to York (43f miles) in 43 minutes (61 '04 miles an hour). In France, also, instances may be found of trains timed over 60 miles an hour, e.g., Paris to Arras 120 miles in 117 minutes. Of course stiU higher speeds, up to 75 and even 80 miles an hour, are reached and sustained for shorter or longer distances every day by express trains, the average speed of which between any two stopping-places is very much less. But isolated examples of high speeds afford little information as to the train service at the command of the traveller in different countries, for it is obvious that his convenience

will be better served by a large number of trains, all maintaining a good average of speed, than by a service consisting mostly of poor trains, with

only one or two exceptionally fast ones. From this point of view Great Britain remains ahead of all other countries. To give exact numerical expression to this superiority is impos- sible, but Table XIX. wUl supply a general idea of the volume and speed of express traffic in different countries. No train has been included which does not run daily (except Sundays) and travel at least 40 mUes an hour on the average, inclusive of stops. This Hmitation excludes many trains which are called ” fast ” and ” express,” both in the United States and on the Continent, but even if the speed necessary to gain admission to the table were reduced by a good many miles an hour. Great Britain would still hold the first place if the number of high-speed trains is taken into account as well as the average of speed attained : ???

Table XIX. ??? Speed and Number of Express TraAns.

Trains (Summer, 1902) in

1

???3

Speed in

Miles per

Hour.

*1^*

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11

both Directions between

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^ *c*

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3

London and Eugby ???

*92**

By L. & N.-W. Railway .

m

75

6

2

11

16

13

27

66-5

By G. C. Railway .

83i

17

3

3

4

3

0

4

60-5

London and Manchester ???

48

ByL.&N.- (Bui Stoke . W. Ely. \iM Crewe .

183}

6

0

3

1

1

0

0

47-8

1881

12

3

0

3

2

0

4

50-3

By Midland Railway

*189^*

16

1

4

6

0

6

0

49-4

ByG. N.Rly.(OTiJEetford)

209i

3

1

0

2

0

0

0

45-1

By G.C.Ely. .

206

12

6

3

2

2

0

0

46-6

London and Leeds ???

41

By G. N. Eailway .

185i

15

2

3

1

5

1

3

62-6

By Midland Railway

196

26

3

5

3

4

6

5

61-2 ???

London and Exeter ???

27

By G. W. Railway .

193}

15

2

4

1

0

2

6

53-5

By L. & S.-W. Eailway .

IVl}

12

6

1

4

0

2

0

49-0

*London and Edinburgh***???**

39

By East Coast Route

393J

16

0

2

0

10

0

4

60-7

By West Coast Route

399}

12

2

2

1

4

3

0

49-9

By Midland Eoute .

406

11

1

1

3

6

0

0

47-3 1

London and Edin. (Winter,

1901-02) ???

29

By East Coast Route

393}

10

0

1

1

6

0

2

50-7 1

By West Coast Eoute

399}

11

3

2

1

2

s

0

49-9

By Midland Route .

406

8

1

2

2

3

0

0

47-3

London and Aberdeen ???

19

By East Coast Route

623|

6

0

3

2

1

0

0

47-2

By West Coast Route

640

7

1

2

3

0

1

0

48-0

By Midland Route .

536}

6

2

3

1

0

0

0

44-4

New York (Jersey City) and

Philadelphia-

83

Pennsylvania ER. .

89}

44

14

5

8

7

7

3

60-1

P. and E. Railway .

90}

39

16

6

0

2

9

6

50-6

New York and Albany ???

21

N. Y. C. and H. E. EE. .

143

21

4

3

7

3

1

3

63-6

New York and Boston ???

4

N.Y.,N.H.,(OTi??Shore Line & H. EE. \vi&, Air Line .

233

4

0

0

0

4

0

0

46-6

214

0

0

0

0

0

0

0

New York and Buffalo-

17

N. Y. C. k. H. E, EE.

439}

13

7

1

1

0

3

1

63-2 1

Lehigh Valley (from Jersey

City) ....

446}

2

0

0

2

0

0

0

46-7

Del. Lack, and West. EE.

(from Hoboken) .

410

2

1

0

1

0

0

0

46-5

Paris and Calais (Nord)

185

8

8

1

2

0

2

0

3

56-5 ???

Paris and Marseilles

(P. L. M. Eailway)

636

4

4

2

2

0

0

0

0

431

Berlin and Hamburg

(Prussian State Elys.) .

177

8

8

0

1

1

1

3

2

51-3

Berlin and Halle (Prussian

State Elys.) .

100}

17

17

4

1

4

4

2

2

60-0

Berlin and Hanover

(Prussian State Elys.) .

160

13

13

7

2

3

1

0

0

46-0

- *Including trains that pass through Eugby without stopping.*

Ooodi Trains. ??? The vehicles for the transportation of goods are known as goods waggons or trucks in Great Britain and on the Continent, and as freight cars in America. The principal British and Continental types are open trucks or waggons (the lading often covered with sheets), mineral trucks, and covered or box waggons for

EOLLING stock]

RAILWAYS

157

cotton, grain, &c. The American freight cars of the prin- cipal types are known as box cars, gondola cars, coal Size and ^^^^' stock cars, tank cars, and refrigerator cars. construe- Most of these terms explain themselves. The tlonot gondola car corresponds to the European open trucks. waggon, and is used to carry goods not sub- ject to injury by the weather ; but in the United States the practice of covering the load with tarpaulin sheets is unknown, and therefore the proportion of box cars is much greater than in Europe. Indeed, the long hauls in the United States make it even more important there than in other countries to load cars in

both directions, and so it has come about that for the return journey coal, coke, ore, lumber, and other coarse articles are loaded into box cars that have carried grain or merchandise one way. It is common to put small end doors in American box cars, through which lumber and rails may be loaded. The fundamental difference between American freight cars and the goods waggons of Europe and all other lands is in carrying capacity. This difference is interesting as an _ example of development under the influence of surround- ing conditions. Indeed, the American freight car is so unlike those of other countries that comparisons are diflB.cult. In the United Kingdom the average carrying capacity of goods waggons must be under 10 tons, per- haps about 8 tons, and the capacity of heavy mineral trucks is 11 tons. On the Continent the average carrying capacity is a little over 10 tons; there are many cars stiU in service of less than 10 tons' capacity, but much the greater number are rated at 10 tons, while large numbers of 15-ton cars have been built within a few years, and the tendency is to raise the capacity. These are all short cars with four wheels. Freight cars in the United States have long bodies on two swinging trucks of four wheels each, and their average capacity is quite three times as great as that of European waggons. For years the standard freight car has been of 30 tons' capacity., (short tons, 2000 lb) ; in recent years many 40-ton cars have been put in service ; and still more recently several thousand cars have been built of 50 and even 55 tons' capacity. This great carrying capacity of the freight cars in the United States has worked in several ways to make possible those very low freight rates mentioned in the introduction to this article. It has diminished the ratio of non-paying to paying load ; it has diminished the interest on first cost and cost of maintenance relatively to the work done ; it has diminished in some degree, probably small, the amount of track and yard room required to do a unit of work ; it has diminished journal and rolling friction relatively to tons hauled, for these elements of train resistance grow relatively less as the load per wheel rises ; finally, and most important of all, the wages element has fallen as train loads have grown greater, since no more men are required to handle a heavy train than a hght one.

It is often said that if these things are true for one country they must be true for another, and that in Great Britain, for example, the use of more capacious cars would bring down the cost of goods carriage. This is not

the place to debate a controverted question, but it may be pointed out that social and geographical conditions are different in the United States and the United Kingdom, and in each country the methods of conveying goods and passengers have been developed according to the require- ments of those conditions. In one country the population is dense, large towns' are numerous and near each other, the greatest distances to be traversed are short, and rela- tively a large part of the freight to be carried is merchan- dise and manufactured material. In the other country precisely the opposite conditions exist. Under the first set of conditions quickness and flexibility of service are

relatively more important than under the second set; therefore goods are collected and despatched promptly, in numerous cars, often only partly loaded. But where the great volume of freight is raw material and crude food- stuffs, and the distances are great, a low charge per unit of transportation is more important than any other con- sideration ; therefore freight is massed into fuU car loads and enormous trains, and sent perhaps 1000 miles to a distributing-point, or to a seaport. At the same time it must be noted that several British railway companies are experimenting with trucks of large capacity, similar to those used in America, but appear to find some trouble in getting full loads for them.

The differences in the carrying capacity of freight cars in Europe and the United States have brought about the differences in the make-up of freight trains. Here, as with passenger trains, averages mean g^^g ? ? ? gg^^ little, but typical special cases give useful com- parisons. In Great Britain we find, on six of the great railways, mineral trains {i.e., trains carrying coal, coke, and ore) which weigh (trucks and load, but not the engine) from 525 to 765 tons. These weights, however, are in some cases greatly exceeded. Several British railways have engines capable of hauling loads of 1000 tons ; and on the North- Eastern one (No. 15 in Table XVI.) has taken a train of 81 loaded trucks and one van, weighing 1326;^ tons and nearly a third of a mile in length, up a bank of 1 in 108 at the worst point, where also there was a curve of 20 chains' radius. The speed of such mineral trains, like the weight, varies with the gradients and other conditions, and they may be timed from 10 to 30 miles an hour, not counting time spent on sidings. The fast goods trains carry

lighter loads and run faster ; on the same lines these vary from 214 to 460 tons and make 25 to 30 miles an hour, the speeds rising so high as 37 miles an hour for short dis- tances, and falling so low as 13. In Prussia an example of good practice for the various classes of goods trains gives weights from 900 to 1100 tons, and speeds (terminus to terminus) of 11 to 21 miles an hour, according to load and gradient. In the United States mineral and grain trains weigh from 1500 to 3800 tons (2240 ft), and 2000 tons would be only fairly good practice for this class of trafiic. These trains are necessarily and properly very slow, being timed at 10 or 12 miles an hour. The merchandise trains of the United States are lighter and faster than those carrying coal, ore, salt,

Couplings. ??? The means generally employed for connect- ing freight cars or goods waggons, one to the other, are not automatic ; that is, men must go between the vehicles to couple or uncouple them, or at best can only avoid doing so by the use of a stick to guide the couphng link to its

place. As a result, many men have been killed or maimed in the performance of their duties in railway yards, and a great body of public opinion has grown up which calls for automatic couplers, and has found expression in agita- tion, invention, and legislation. In the United States an automatic freight car coupler is used on possibly 90 per cent, of freight stock. To effect this took more than twenty-five years of discussion and experiment. The Master Car Builders' Association, which is a great body of mechanical officers organized especially to bring about improvement and uniformity in details of construction and operation, expressed itself in 1874 as understanding the importance of a " self ~~coupler," but none had then been invented which could be considered as useful. At that time a member of the Association spoke of the disappearance of automatic couplers which had been introduced thirty or forty years before. This body pursued the subject with more or less diligence, and in 1884 laid~~

~~*down the principle that the automatic coupler should be one acting in a vertical plane ; that is, the engaging faces should be free to move up and down within a considerable range, in order to provide for differences in the height of cars brought together. This principle having been fixed, the task of the inventor was considerably simplified. In 1887 a committee reported that the coupler question was "the knottiest mechanical problem that had ever been presented to the railroad," and over 4000 attempted solutions were on record in the United States Patent Office. The com*~~
mittee had not found one which did not have grave dis- advantages. In 1887, however, the Association recom- mended the adoption of a coupler of the Janney type, and this coupler as it has developed is shown in Fig. 15.

C 'j, B

no. 15. ***Automatic coupling for freight cars(U.S.A.).***

The committee concluded that " the principle of contact of the surfaces of vertical cylinders embodied in the Janney coupler affords the best connexion for cars on curves and tangents." The method of constructing the working faces of the Janney coupler is shown in Fig. 1 6, which illustrates

Fi9. 16. ***Development ot the working faces of the Janney coupler. The sides of the square are 6 inches, and the centres AA are taken at 2 inches from the top and bottom ot the square. The circles A' A', which are struck with 2-inch radius, define the first portion of the knuckle. The inner circle B has a radius of IJ inches. From its intersection with A' A' arcs are struck cutting B in two points. These intersections determine the centres of the semicircles CO which form the ends of the respective knuckles. These semicircles and the circles A' A' are Joined by tangents and short arcs struck from the centre of the figure.***

the principle of contact of vertical cylinders. This prin- ciple was patented, but the company owning the patent

undertook to permit its free use by railway companies which were members of the Master Car Builders' Associa- tion, and thus threw open

the underlying principle of this coupler to competition. From that time the numerous patents have been merely on details. There are fifteen different couplers of the Janney tjrpe, patented and made by as many different concerns, each of which is used on at least 10,000 cars, and, in addition, many other forms are in less extensive use. The movement towards the use of an automatic coupler was stimulated in some degree by laws enacted by the various states and by the United States; and in 1893 Congress passed an Act, one clause of which required raUway companies to have their freight cars equipped vdth automatic couplers by January 1898. The Interstate Commerce Commission, which has dis- cretion in the matter, extended the limit to 1st August

1900.

The coupler in general use outside of the United States is a chain and hook, with spring buffers, which, however, are no part of the coupler itself. In the United States the universal coupler, which has now almost disappeared, was the " link-and-pin " coupler, in which a draw-bar is spring-connected to the frame of the car. The out-board end of this draw-bar is a socket, into which one end of a soUd link is inserted, and the pull is exerted on a pin dropped through this link. The first strain of compression, when the cars close together, is also taken on this draw-bar and transmitted back through the springs to the frame of the car. Thus there is a fundamental difference between American and European practice in that in the United States the coupler is also a buffer.

The essential change from the link-and-pin to the automatic coupler is in the out-board end or head of the draw-bar. The socket to receive the link is replaced by a hook, shown at A, Fig. 15, which is usually called the knuckle. This hook swings on the pivot B. It has an arm which extends backwards, practically at right angles with the working face of the hook, in a cavity in the head, and engages with the locking-pin C. This locking-pin is lifted by a suitable lever, which extends to one side or to both sides of the car. Lifting the locking-pin releases the knuckle, which is free to svring open, disconnecting the two cars. The knuckle stands open until the coupling is pushed against another coupling, when the two hooks turn on their pivots to the position shown in Fig. 15, and the locking-pin drops

into place and the couplers are made fast. This coupler is only partly automatic. It often happens that when two cars are brought together to couple, the knuckles are closed and must be opened by hand. There are various contrivances by which this may be done by a man standing clear of the cars, but in most cases he must go between the cars to reach the knuckle. This defect will no doubt be corrected by comparatively simple means. This form of automatic coupler is the only one used to any extent in the United States, where it is now practically universal, and no reason now appears why any other should be used there. It has been adapted to British and Continental rolling stock in a few instances for experiment, but whether or not it will be found accept- able cannot be foretold. The tendency in Great Britain is- perhaps rather towards some non-automatic form of coupling which can be safely coupled and uncoupled with- out the necessity of men going in between the waggons.

Another question which is attracting the attention of inventors and railway companies in Ehgland is the problem of fitting waggons with hand-brakes which can be applied and released from either side of the waggon indifferently. The old form of brake is worked by a lever which is fitted at one side only, and thus the men, in order to work the brake, often have to incur the danger of passing

under the waggons. The Board of Trade has power, under the Prevention of Accidents Act of 1900, to insist on all waggons being fitted with " either-side " brakes. (See above, p. 137.)

Vestibules for Passenger Cars. ??? End platforms and end doors have always been characteristic of American passenger equipment, and are extending to British and Continental carriages. Their use secures a continuous passageway through the train, but is attended with some discomfort and some risk when the train is in motion. The opening of the end doors may make a draught through the car, disagreeable in cold

weather, and passengers occasionally fall from the open platform, or are blown from it, while the train is moving. The first object of the vestibule is to enclose the platform with a housing so arranged as to be continuous when cars are made up into trains, and fitted with side doors for ingress and egress when trains are standing. A second effect of the vestibule has developed in use. It appears that the lateral swaying of the cars is diminished by the friction between the vestibule frames. The fundamental American vestibule patent, issued to Mr H. H. Sessions, of Chicago, in November 1887, covered a housing in combination with a vertical metallic plate frame of the general contour of the central passageway, projecting slightly beyond the coupling line, and held out by horizontal springs top and bottom ; the plate frame being connected with the plat- form housing by flexible connexions at the top and sides,

Fio. 17. ???A "Vestibule"; the "lazjliongs" gate is folded away when two cars are coupled together, giving free passage from end to end of the train.

and by sliding plates below, vestibule is shown in Fig. 17.

A common form of this Subsequent improvements

on the Sessions patent have resulted in a modified form of vestibule in which the housing is made the full width of the platform, although the contact plate and springs, and the flexible connexions, remain the same as before. On long journeys the vestibule is a convenience and a com- fort ; but its application is practically limited to the cars which are run in such trains, as it is an obstruction to the free ingress and egress of passengers on local trains which make frequent stops.

Of American cars intended to carry passengers, the proportion equipped with vestibules in September 1900 was about as follows : cars owned by railway companies, 15 per cent. ; cars owned by the Pullman Company, 75 per cent. It appears probable that the application of vestibules will continue until the following maxima are reached : railway companies, 25 per cent. ; Pullman Com- pany, 100 per cent. (h. g. p. ; e. h. so.)

Intea-Ueban Eailways.

The great concentration of population in cities during the 19th century brought into existence a class of rail- ways to which the name of intra-urban may be applied. Such lines are primarily intended to meat?'" supply quick means of passenger communication within the limits of cities, and are to be distinguished, on the one hand frpm surface tramways, and on the other from those portions of trunk or other lines which lie within city boundaries, although the latter may incident- ally do a local or intra-urban business. Intra-urban rail- ways, as compared with ordinary railways, are characterized by shortness of length, great cost per mile, and by a. traffic almost exclusively passenger, the burden of which is enormously heavy. For the purpose of connecting the greatest possible number of points of concentrated travel, the first railways were laid round the boundaries of areas approximately circular, the theory being that the short walk from the circumference of the circle to any point within it would be no serious detention. It has been found, however, in the case of such circular or belt rail- ways, that the time lost in traversing the circle and in walking from the circumference to the centre is so great that the gain in journey speed over a direct surface tramway or omnibus is entirely lost. Later intra-urban railways in nearly every case have been built, so far as possible, on straight lines, radiating from the business centre or point of maximum congestion of travel to the outer limits of the city; and, while not attempting to serve all the population through the agency of the line, make an effort to serve a portion in the best possible manner, that is, with direct transit.

The actual beginning of the construction of intra-urban railways was in 1853, when powers were obtained to build a line, 2\ miles long, from Edgware Road to Bang's Cross, in London, from which beginning the Metropolitan and Metropolitan District railways developed. These rail-ways, which in part are operated jointly, were given a. circular location, but the shortcomings of this plan soon became apparent. It was found that there was not sufficient traffic to support them as purely intra-urban lines, and they have since been extended into the out- skirts of London to reach the suburban traffic.

The Metropolitan and Metropolitan District railways followed the art of railway building as it existed at the time they were laid out. Wherever

possible the lines were constructed in open cutting, to ensure adequate ventila- tion ; and where this was not possible, they were built by a method suggestively named "cut and cover." A trench was first excavated to the proper depth, then the side walls and arched roof of brick were put in place, earth was filled in behind and over the arch, and the surface of the

ground restored, either by paving where streets were followed, or by actually being built over with houses where the lines passed under private property. Where the depth to rail-level was too great for cut – and – cover methods, ordinary tunnelling processes were used; and where the

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Fig. 18. ??? Type-section of arched covered way, Metropolitan District Eailway, London.

trench was too shallow for the arched roof, heavy girders, sometimes of cast iron, bridged it between the side walls, longitudinal arches being turned between them (Fig. 18).

The next development in intra-urban railways was an elevated line in the City of New York Probably the first suggestion for an elevated railway was made by Colonel Stevens, of Hoboken, New Jersey, as early as 1831, when the whole art of railway con- struction was in its infancy. He proposed to build an elevated railway on a single line of posts, placed along the curb line of the street, a suggestion which not only em- bodies the general plan of an elevated structure, but the most striking feature of it as subsequently built, namely, a railway supported by a single row of columns. The first actual work, however, was not begun till 1870, when the con- struction of an iron structure on a single row of columns was undertaken. The superi- ority, so far as the conveni- ence of passengers is

con- cerned, of an elevated over an underground railway, when both are worked by steam locomotives, and the great economy and rapidity of con- struction, led to the quick development and extension of this general design. By the year 1878 there were four parallel lines in the City of New York, and constructions of the same character had already been projected in Brooklyn and Chicago and, with certain modifications of details, in Berlin. In the year 1894 an elevated railway was built in Liverpool, and in 1900 a similar railway was constructed in Boston, U.S.A., and the construction of a new one undertaken in New York.

FiQ. 19. ??? Single-column elevated structure.

These elevated railways as a rule follow the lines of streets, and are of two general types. One (Fig. 19), the earliest form, consisted of a single row of columns supporting two hnes of longitudinal girders carrying the rails, the lateral stability of the structure being obtained by anchoring the feet of the columns

to their foundations. ^11 in niXI|

The other type (Fig. 20) has two rows of columns connected at the top by transverse girders, which in turn carry the longitudinal girders that support the railway. In Ber- lin, on the Stadtbahn, which for a part of its length traverses private property, masonry arches, or an earthen embankment between retaining walls, were substi- tuted wherever pos- sible for the metallic structure.

The next great de- velopment, marking the third step in the progress of intra- urban railway con- struction, took place in 1886 when Great- head (q.v.) began the City and South London Railway, extending under the Thames from the Monument to StockweU, a distance of 3^ miles. Its promoters recognized the unsuitabihty of ordinary steam I'ocomotives for underground railways, and intended to work it by means of a moving cable ; but before it was

Fig. 20. ??? Double-column elevated structure (half -section).

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*Fig. 21.***Section of tunnel and electric locomotive, City and South London Kailway.*

completed, electric traction had developed so far as to be available for use on such lines. Electricity, therefore, and not the cable, was installed (Fig. 21). In the details of con- struction the shield was the novelty. In principle it had been invented by Brunei for the construction of the original

intea-ueban]

Thames tunnel, and it was afterwards improved by Beach, of New York, and finally developed by Greathead. (For the details of the shield and method of its operation, see Tunnelling.) By means of the shield Greathead cut a circular hole at a depth ranging from 40 to 80 feet below the surface, with an external diameter of 10 feet 9 inches ; this he lined with cast-iron segments bolted together, giving a clear diameter of 10 feet 2 inches. Except at the shafts, which were sunk on proposed station sites, there was no interference with the surface of the streets or with street traffic during construction. Two tunnels were built approximately parallel, each taking a single track. The cross-section of the cars was made to conform approximately to the section of the tunnel, the idea being that each train would act hke a piston in a cylinder, expelling in front of it a column of air, to be forced up the station shaft next ahead of the train, and sucking down a similar column through the station shaft just behind. This arrangement was expected to ensure a sufficient change in air to keep such railways properly ven- tilated, but experience has proved it to be ineffective for the purpose. This method of construction has been used for building other railways in Glasgow and London, and in

the latter city alone pro- jects for ” tube railways ” of this character were brought before Parliament in 1902, which involved a capital of about 100 millions. One of the largest of these was for a line running from the terminus of the London United Tramways at Hammersmith, through the heart of the City, to the north- east suburbs. The later examples of these tube railways have a diameter ranging from 13 to 15 feet.

The fourth step in the development of intra-urban railways was to go to the other extreme from the deep tunnel which Greathead introduced. In 1893 the con- struction was completed in Budapest of an underground railway with a thin, flat roof, consisting of steel beams set close together, with small longitudinal iack arches between

1902, has a total mileage of 38‘86 miles, of which seven- tenths are to be in tunnel and the remainder in open cutting or on viaduct. The lines complete and in opera- tion in September 1902 had a mileage of 8‘67 miles, and ran between the Porte de Vincennes and the Porte MaiUot, between the Place de I’Etoile and the Porte Dauphine, and between the Place de l’!^toile and the Trocad^ro. Each of these sections is self-contained and is worked independ- ently, thus abolishing junctions, with their inevitable signal delays ; even the northern loop, under construction in 1902, which will form a complete circle with the existing Porte de Vincennes-Porte Maillot line, is not to be worked as a closed circuit, but on the ” shuttle ” system as an independent line. The stations are very numerous ◆◆◆ for example, there are eighteen on the Porte de Vincennes- Porte Maillot line, which is 6 ‘6 miles long ◆◆◆ and the average speed is about 13 miles an hour. The terminal stations are constructed as loops, thus enabling trains to pass from the up to the down line without shunting delays, and exchange stations are provided wherever the lines touch each other or other railways. On the main line a three- minute service is maintained by day (5.30 a.m. to

Fig. 23. ◆◆◆ New

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*‘ ???:’.???<'' *

??? ???^ ???^f^- ,m >-A

Fig. 22. ??? Electric underground railway, Budapest.

them, the street pavement resting directly on the roof thus formed (Fig. 22). The object was to bring the level of the station platforms as close to the surface of the street as the height of the car itself would permit ; in the case of Budapest the distance is about 9 feet. This principle of construction has since been followed in the construction of the Boston subway, of the Chemin de Fer Metropolitain in Paris, and of the New York underground railway. The Paris line is built with the standard gauge of 4 feet 8 J inches, but its tunnels are designedly made of such a small cross-section that ordinary main line stock cannot pass through them. The system, so far as authorized in

York Eapid Transit Eailway, showing also the tracks and conduits of the electric surface tramway.

8.30 P.M.) and a six-minute one by night (8.30 p.m. to 1 A.M.). The motive power is electricity, continuous current at 500 volts being employed. The New York under- ground railway (Fig. 23), when completed, will mark a stUl further step in advance, in that there are practically two different railways in the same structure. One pair of tracks is to be used for a local service with stations about one-quarter of a mile apart, following the general plan of operation in vogue on all other intra-urban rail- ways. The other, or central, pair of tracks is for trains making stops at longer distances. Thus there is a differentiation between the long-distance traveller who desires to be carried from one extreme of the city to the other, and the short-distance traveller who is going between points at a much less distance.

To sum up, there are of intra-urban railways two distinct classes : the elevated and the underground. The elevated is used where the traffic is so light as not to warrant the expensive underground construction, or where the construction of an elevated line is of no serious detriment to the adjoining property. The underground is used where the congestion of

traffic is so great as to demand a railway almost regardless of cost, and where the conditions of surface traffic or of adjoining property are such as to require that the railway shall not obstruct or occupy any ground above the surface.

Underground railways are of three general types : The one of extreme depth,- built by tunnelling methods, usually with theshieldand without regard to the surface topography, where the stations are put at such depth as to require lifts to carry the passengers from the station platform to the street level. This type has the advantage of economy in first construction, there being the minimum amount of material to be excavated, and no interference during construction with street traffic or subsurface structures; it has, however, the disadvantage of the cost of operation

Operation,

of lifts at the stations. The other extreme type is the shallow construction, where the railway is brought to the minimum distance below the street level. This system has the advantage of the greatest convenience in operation, no lifts being required, since the distance from the street surface to the station platform is about 12 to 15 feet; it has the disadvantages, however, of necessitating the tear- ing up of the street surface during construction, and the readjustment of sewer, water, gas, and electric mains and other subsurface structures, and of having the gradients partially dependent on the surface topography. The third type is the intermediate one between those two, followed by the Metropolitan and Metropolitan District railways, in London, where the railway has an arched roof, built usually at a sufficient distance below the surface of the street to permit the other subsurface structures to lie in the ground above the crown of the arch, and where the station platforms are from 20 to 30

feet beneath the surface of the street ??? a depth not sufficient to warrant the introduction of lifts, but enough to be incon- venient.

In the operation of intra-urban railways, steam loco- motives, cables, and electricity have severally been tried, the first being used in the earlier examples of under- ‘ ground lines and in the various elevated systems in the United States. The fouling of the air that results from the steam-engine, owing to the production of carbonic acid gas and of sulphurous fumes and aqueous vapour, is well known, and its use is now practically abandoned for underground working. The cable is slow; and unless development along new lines of compressed air or some sort of chemical engine takes place, electricity will monopolize the field. Electricity is applied through a separate locomotive attached to the head of the train, or through motor carriages attached either at one end or at both ends of the train, or by putting a motor on every axle and so utilizing the whole weight of the train for traction, all the motors being under a single control at the head of the train, or at any point of the train for emergency. The distance between stations on intra- urban railways is governed by the density of local traffic and the speed desired to be maintained. As a general rule the interval varies from one-quarter to one-half mile, except on the express lines of the New York underground railway, where the inter-station interval averages about one and one-half miles. On the steam- worked lines the speed of trains is about 11 to 15 miles per hour, according to the distance between stations. Later practice takes advantage of the great increase in power that can be temporarily developed by electric motors during the period of accelera- tion ; this, in proportion to the weight of the train to be hauled, gives results much in advance of those obtained on ordinary steam railways. Since high average speed on a line with frequent stops depends largely on rapidity of acceleration, the tendency in modern equipment is to secure as great an output of power as possible during the accel- erating period, with corresponding increase in weight avail- able for adhesion. With a steam locomotive all the power is concentrated in one machine, and therefore the weight on the drivers available for adhesion is limited. With electricity, power can be applied to as many axles in the train as desired, and so the whole weight of the train, with its load, may be utilized if necessary. On the Central London Railway the acceleration of gravity is also utilized; the different stations stand, as

it were, on the top of a hill, so that outgoing trains are aided at the start by having a slope to run down, while in- coming ones are checked by the rising gradient they encounter.

The following table (No. XX.) gives the statistics of

*the most recent English and American electric practice, the eifort of the machines being actual output as measured by mechanical horse-power :^*

Table XX. English and American Practice.

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Oj

"H

i^i

|a

Weight of train tons (=2240 B)

160i

134

128i

iioi

„ motor „

42

27

34

2ii

Weight of motor on drivers tons

42

16

34

14

Number of motors

1

5

2

1

???,, cars ....

8

5

6

5

Average distance between stops ???

feet

2550

2587

1775

1775

Schedule speed ??? miles per hour .

14-8

17-2

13-6

11-5

Maximum horse – power during

acceleration ....

650

1600

950

250

Horse-power at full speed .

220

200

160

150

On the Central London each train is worked by a single electric locomotive, though, owing to complaints of vibration from householders above the line, a modification of this arrangement is to be adopted; the Manhattan Elevated contemplates two motor cars, one at each end of the train, all the axles of each being equipped with motors; while the Boston Elevated, in order to overcome- heavy gradients (8 per cent.), has one truck of every car supplied with power.

The cost of intra-urban railways depends not only on the type of construction, but more especially upon local conditions, such as the nature of the soil, the presence of subsurface structures, hke sewers, ** ‘

water and gas mains, electric conduits,

The burden of traffic on intra-urban railways assumes proportions not met on any trunk-line railways. During a. year the Metropolitan and Metropolitan District railways of London, on a combined trackage of something more than 100 miles, handled upwards of 150,000,000 passengers; but a portion of the mileage of both these lines cannot be-strictly reckoned as intra-urban. The elevated system in New York, with 40

miles of double track, has carried in a year over 221,000,000 passengers, and in a single day more- than 1,000,000 passengers. The Central London Eailway,.

team-ways]

RAILWAYS

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with a total of 5f miles of double track, has carried as many as 228,961 passengers in one day (29tli October 1900, the date of the return of the City Imperial Volunteers from South Africa), and its total for the year 1901 was 41,188,389. (w. b. p.)

Teamways.

The commercial development of tramways, or as they are called in the United States of America, street rail- ways, has become wholly a matter of mechanical traction. Since the introduction of the cable and electric methods, with notable economies and advantages, very few stage- coach or horse-tramway lines have been established ; and the abandonment of the cable itself for electricity on all ordinary levels was in progress at the end of last century. After a long period of experimentation, neither storage batteries nor compressed-air systems can be said to have demonstrated their commercial advantages sufficiently to ensure their wide use. Few storage battery cars were to be found in operation in 1900; and in Berlin the municipality had so far acknowledged their comparative failure as to grant larger privileges to the trolley in the streets of that city, from which it had previously been barred. In Paris and New York compressed-air cars were operated on a few routes, but not in increasing numbers or with any apparent economy. The beginning of the 20th century saw electricity everywhere the domin- ating motive power in urban traction : for underground lines, with a third rail; for elevated lines, with a third rail ; on streets and roads, whether city or surburban, with either the overhead trolley or the conduit system. Where the objection has still remained in cities to lajdng tracks through fine residential streets, a revival of earlier omnibus services has been

attempted in the use of auto- mobiles, propelled chiefly by electric motors and storage batteries. These cannot compete commercially with tram- ways, though they may be thought by some to be a desirable addition. Several cities in Europe and America have such lines in operation, and that in the city of Mexico may be mentioned as typical.

It is to the United States, with its new centres of busy popu- lation undergoing rapid development, that we must look for the most impressive figures of the tramway industry. The large areas covered, the great width of the streets, and the rectangular disposition of all the main thoroughfares have been favourable factors in stimulating a growth of remarkable proportions. In 1899 the number of cable cars declined from 4701 to 4250, and of horse cars from 3106 to 1489 ; but the number of electric cars increased from 46,549 to 50,658, and the track increased from 15,942 miles to 17,969. All told, there were 871 tramways of various types with a total of 19,213 miles of track and 58,736 cars. These represented a capital stock of $1,023,819,987 and a, funded debt of $777,862,571, making – total of 1,801,682,558, or an increase of nearly $200, 000,000 over the preceding year. The capitalization is at the rate of about $94,000 per mile of single track. There are no available statistics as to the return to capital from investment in tramways in America, but a study of the situation in 1897 went to show that they were then earning gross $150,000,000. In 1898 some 220 lines earned $130,000,000, these being large systems. The gain in gross earnings in 1898 over 1897 would doubtless reach $25,000,000, making $175,000,000 in 1898, when the total capitalization was about $1,622,000,000. If the net receipts be taken at 40 per cent., there remained applicable to bonds and stock from $60,000,000 to $70,000,000, or from 4 to 5 per cent, upon the entire capitalization as it stood, without regard to the proportion that may have been issued as a stock bonus with the bonds, or the newer construction not yet on an earning basis.

The economies wrought by the introduction of mechanical trac- tion on tramways are noteworthy. They are best evidenced by the analysis of some one system, and that which is available in the fullest detail is furnished by the Metropolitan Street Railway Company of New York, which has the largest composite system in the world, and is operating with animal,

cable, electric, and other powers. This company ran 45,390,318 car miles in the year ending 30th June 1900. The cost of operating with the cable per

car mile was 1776 cents ; with electricity, 13-16 cents ; and with horses, 18-98 cents. The total passenger receipts were $14,335,406. Had the horse mileage been operated electrically, there would have been an economy of $540,000 in the change. Had the whole system been operated by horses, the cost would have been $8,615,082 instead of the actual $7,034,033, showing that on this one system mechanical traction had already effected an annual saving with its present traffic of over $1,500,000. The item of the 13-16 cents cost of operation per electrical car mOe of the system is made up as follows : maintenance of way, 0 '81 ; maintenance of equipment, 1-41 ; power, 1-99 ; transportation, 7-29 ; general expenses, 1 -66. The percentage of operating expenses to gross receipts was as follows: cable, 61 ; electricity, 40-5 ; horses, 73-6. It is to be borne in mind that the Metropolitan electric system is regarded as the costliest of its class, namely, the underground trolley making contact with the feeding conductors by means of a "plough" lowered into a slotted conduit.

Mr J. Clifton Robinson, managing director and engineer of the London United Tramways, supplies the following particulars for the lines in West London ownecl by that company, which in 1901 were converted from horse to electric traction (overhead trolley), the mileage at the same time being doubled : . *The cost of operation per car mile was, with horses, 9-OOd. ; with electricity it is 5-40d., made up of maintenance of way 0-75d., maintenance of equipment l-02d., power 0-46d., and other expenses 3-l7d. The average number of passengers earned per car mile was, with the horse cars, 8-14 ; with electric cars it is 11-00 ; and in addition to this increase in the number of passengers per car mile the mileage has increased over 300 per cent. With horse traction, 8 mQes of route carried 9,000,000 of passengers per annum ; with electric traction, 16 miles carried 32,000,000. The percentage of operating expenses to gross receipts was 82-00 per cent, with horses ; with electricity it fell to 52-00 per cent., and it is expected that this figure will be improved upon when the plant in the power station is employed to the full capacity for which it is designed. In 1902 over 60 miles of line were authorized and in*

course of construction, and a total of not less than 100 miles is projected in West London and the Thames Valley.

The statistics as to the street railway earnings in America are based upon the universal practice there of charging a "iiat " 5 cent fare for the whole trip, which may be 15 or 20 miles long, and often includes one or two free transfers. The extent of this " trans- fer " practice, which is not at all a familiar condition in Europe, may be inferred from the fact that in Kansas City, Mo., there are no fewer than 85 points of intersection on the leading tram- way system, at each of which transfers are given out, so that any part of the city can be reached from any other part on one fare. The population of the urban district is only 215,000, but no fewer than 70,000 such transfers are issued daily. In Europe the measured tariff system prevails, so that while the short-distance rider for less than a mile pays one-fifth the American fare, the long- distance rider may pay two or three times as much. Curiously enough, the gross receipts per mOe in Europe are quite as high as in America, indicating that European tramways lie in areas of dense population, while in the United States long cheap rides to reach homes in the suburbs are common. In fact, the rapid building up of suburbs round the American cities has been one of the most obvious results of tramway development ; but it has not as yet become so pronounced in Europe as to excite com- ment. The general effect on American suburban real estate of the discrimination in favour of the citizen seeking a suburban home may be fairly judged from the experience of Brookline, Mass. From 1855 to 1885 the value of real estate had risen about $350,000 a year, reaching $17,000,000. In 1890, consequent on the intro- duction of the electric tramway and the rush of home-seekers to get out of Boston, the valuation jumped to $30,000,000, although property in the old centre was not injured.

A feature of commercial economy which does not appear at first sight in a study of the American figures is the ability to handle more passengers with fewer cars and fewer men. In the United States in 1890 there were 32,505 cars and 70,764 employes to 8783 miles of road. The electrical transformation was then getting into full swing, and 16-foot cars were in general use, the speed rarely exceeding 6 to 8 miles an hour. The average speed of the electric cars may now be put at 10 miles per hour, and the

length of the car at 24 feet. The number of horse and electric cars has been reversed in the ten years. The total number of pas- sengers carried in 1890 by all methods of power was 2,023,010,202, while for the year closing in 1900 the traffic for the electric cars alone is estimated at 4,000,000,000. On the latter basis, and estimating the daily car miles at 3,000,000, the daily saving to the tramways is $180,000. With the same mileage of track as in 1899, the New York Metropolitan showed a gain in 1900 of $1,562,920 in the gross and $695,896 in the net. On one line in New York with horse cars in 1897, the round trip occupied three hours, and 200 cars carried 17,000,000 passengers. With electric cars in 1900, the round trip required only two hours, and

[light

300 cars carried 50,000,000 passengers. The value of the daily saving in time by the trolley to the American working population alone is over |20,000 per day.

The following table (No. XXI.) gives some idea of the relative gi'owth of the development of electric tramways in the leading countries of Europe : ???

Table XXI. ??? Electric Railways and Tramways in Europe.

1894.

1895.

1896.

1897.

1898.

1899.

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Name of Country.

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Great Britain

70

3000

120

440

20,000

800

660

28,000

1500

900

40,000

2000

Germany

164

2934

686

6264

632

648

7194

SOT

1000

19,000

2000

1800

26,000

3100

2300

64,000

6400

Austria-Hungary

42

1116

72

16S9

129

114

1949

167

134

2,389

194

169

3,404

243

180

3,600

291

Belgium

6

90

35

1130

48

40

1130

48

56

1,220

73

110

2,415

107

120

3,000

200

Spain

12

210

1—

12

210

12

47

600

26

74

600

40

98

930

,60

167

2,460

144

France ....

68

1796

164

3610

162

211

4490

226

448

8,736

432

626

15,168

664

800

26,000

1000

Italy .

11

720

28

870

S3

62

1890

84

168

5,970

289

212

6,750

311

235

6,600

318

Switzerland .

250

7,600

330

4962

142,160

If to these figures there be added those of Norway and Sweden, Russia, Holland, Portugal, Kumania, Servia, and Bosnia, it would appear tliat for the last year under report there were in Europe 5092 miles of track, 147,760 kilowatt capacity of power plant, and 10,030 motor cars. The growth indicated by these figures did not slacken during 1900, when such cities as Paris and Geneva enjoyed the addition of extensive electric tramway systems ; the former city, like London, also seeing a large underground electric railway system put in operation. It has been estimated that the entire Continental tramway enterprise represents an investment of probably ––200, 000, 000. In Great Britain, according to Garcke's Manual of Eleelrical Undertakings, in 1901-1902 a total capital of nearly 40 millions sterling (ordinary, preference, and loan and debenture) was divided among 125 electric traction undertakings, and 47 municipalities had expended on electric traction an amount of lOJ millions. On 1st January 1900 British companies had been organized to build and operate foreign tram- ways with an authorized capital of ––18,543,517, and towards this there had been paid in ––9,854,372 for shares and ––2,793,777 debentures, a total of roughly two-thirds the amount. To this, again, must be added ––4,000,000 of British capital in Continental tramways ; ––2,000,000 in tramways in the colonies, but not of British corporate domicile ; and ––6,700,000 invested in American and Canadian tramway work. It should be added, however, that Continental capital, notably German, has of late been very active in the exploitation of tramway enterprises oiitside the respective territorial limits of the banking groups interested ; while a more recent feature of such international financing has been the endeavour to purchase London underground electric railway franchises and companies by American capital. While much of this work may be due to a desire to create markets for apparatus, as well as to bring new securities into existence, it seems to be a fact that no city in the world has yet transportation facilities adequate to the demands of its own resident and suburban population, and this is specially the case in London.

For some of the British systems a large quantity of American apparatus has been imported ; but British machinery and detail parts of excellent

construction and durability are now freely obtainable, large factories for its production having sprung up in different parts of the country. The figures for 1898-99 of the British tramway system show the following results : ???

Total number of cars 6,323

,, ,, locomotives (including motor cars) 584 ,, ??? horses 44,171

,, ,, passengers carried

,, ,, car miles run .

Gross receipts ....

,, per car mile

Operating expenses .

,, ,, per car mile

Net receipts .... ,, per car mile .

924,820,247 96,078,503

??4,879,602 Is. 0-192d. ??3,675,559

. 9-12d. ??1,204,043

. 3-072d.

Since these official figures were compiled, however, the advance, of electric traction has been so rapicl as to change many of them a,ppreciably. For example, Dublin reported a cost per car mile of only 5-24d., and Leeds reported 5-97d. per car mile with a per- centage of 47‘3 for operating expenses, although its electric system was far from complete. According to Garcke’s Manual for 1901- 1902, of electrical tramways and light railways in the United Kingdom, the track mileage

constructed was 1252 miles, under construction 846 miles, and authorized and about to be constructed

Great Britain.

1348 miles, a grand total of 3446 miles. The number of electrical cars constructed was 3834, and under construction 777.

The sociological side of the electric tramway has many interest- ing aspects, some of which have important commercial or industrial features. In many cities the conversion of the old horse-car stables into electric centres has enhanced the value of adjoining real estate materially ; while medical officers have noted a diminution of diseases that might be attributed to horses. The creation of new suburbs has been mentioned already. Another striking fact has been the deliberate effort manifested by tramway managers to reach parks and places of rural pleasure resort ; in the United States over 100 tramways have reported as to their ownership of parks, and some of them have gone so far as to organize vaude- ville entertainments, the performers during the summer travelling from place to place, and thus providing a constantly new pro- gramme. In Geneva, Switzerland, electric tramways have been developed with special reference to the parks on the outskirts ; and one of the electric lines runs several thousand feet up Mont Saleve, from the plateau of which an unsurpassed view is obtained of the Lake of Geneva on the left and the whole Mont Blanc range on the right. („. c. M.)

Light Railways.

The term light railways is somewhat vague and inde- finite, and therefore to give a precise definition of its significance is not an easy matter. No adequate definition is to be found even in the British statute-book; for although Parliament has on diiferent occasions passed Acts dealing with such rail- ways both in Great Britain and Ireland, it has not inserted in any of them a clear and sufficient state- ment of what it intends shall be understood by the term, as distinguished from an ordinary railway. Since the passing of the Light Railways Act of 1896, it is possible to give a formal definition by saying that a light railway is one constructed under the provisions of that Act ; but it must be noted that the Commissioners

appointed under that Act have authorized many lines which in their physical characteristics are indistinguishable from street tramways constructed under the Tramways Act, and to these the term light railways would certainly not be applied in ordinary parlance. Still they do differ from ordinary tramways in the important fact that the pro- cedure by which they have been authorized is simpler and cheaper than the methods by which special private Acts of Parliament have to be obtained for tramway projects. Economy in capital outlay and cheapness in construction is indeed the characteristic generally associated with light railways by the public, and implicitly attached to them by Parliament in the Act of 1896, and any simplifications of the engineering or mechanical features they may exhibit compared with the standard railways of the country are mainly, if not entirely, due to the desire to keep down their expenses.

light]

The saving of cost is effected in two ways : (1) Instead of having to incur the expenses of a protracted inquiry before Parliament, the promoters of a light railway under the Act of 1896 make an application to the Light Rail- way Commissioners, who then hold a local inquiry, to obtain evidence of the usefulness of the proposed railway, and to hear objections to it, and, if they are satisfied, settle the draft order and hand it over to the Board of Trade for confirmation. The Board may reject the order if it thinks the scheme to be of such magnitude or import- ance that it ought to come under the direct consideration of Parliament, or it may modify it in certain respects, or it may remit it to the Commissioners for further inquiry. But once the order is confirmed by the Board, with or without modifications, it has effect as if it had been enacted by Parliament, and it cannot afterwards be upset on the ground of any alleged irregularity in the proceed- ings. (2) The second source of economy is to be sought in the reduced cost of actually making the line and of working it when made. Thus the gauge may be narrow, the line single, the rails lighter than those used in standard practice, while deep cuttings and high embankments

may be avoided by permitting the curves to be sharper and the gradients steeper : such points conduce to cheapness of construction. Again, low speeds, light stock, less stringent requirements as to continuous brakes, signals, block-work- ing and interlocking, road-crossings, stations, &c., tend to cheapness in working. On the lines actually authorized by the Board of Trade under the 1896 Act the maximum speed permitted has in no case exceeded 25 miles an hour, and that only on the level and in the straight. For such lines the normal minimum radius of the curves has been fixed at about 600 feet ; when a still smaller radius has been necessary, the speed has been reduced to 10 miles an hour and a guard-rail insisted on inside the curve. Again,

the speed has been restricted to 20 miles an hour on long inclines with gradients steeper than 1 in 50, and also on a line which had scarcely any straight portions and in which there were many curves of 600 feet radius and gradients of 1 in 50. In the case of a line of 2| feet gauge, with a ruling gradient of 1 in 40, a maximum speed of 15 miles an hour and a minimum radius of curve of 300 feet have been prescribed. Curves of still smaller radius have entailed a maximum speed of 10 miles an hour. It must be understood that a railway described as ” light ” is not necessarily buUt of narrower gauge than the standard. Many lines, indeed, have been designed on the normal 4 feet 8^ inches gauge, and laid with rails weigh- ing from 50 to 70 5) per yard ; a flat-footed 60 lb rail, with the axle load limited to 14 tons, has the advantage for such lines that it permits the employment of a proportion of the locomotives used on main lines. The orders actually granted have allowed 50 ft, 56 ft, 60 ft, and 70 ft rail”?, with corresponding axle loads of 10, 12, 14, and 16 tons. On a line of 2 feet gauge, rails of 40 ft have been sanctioned. In regard to fencing and precautions at level-crossings, less rigid requirements may be enforced than with standard railways ; and in some cases where trains are likely to be few, it has been provided that the normal position of the gates at crossings shall be across the line. Again, if the speed is low and the trains infre- quent, the signalling arrangements may be of a very simple and inexpensive kind, or even dispensed with altogether.

Table XXII. gives particulars of the apphcations which had been made up to the end of 1901 to the Com- missioners since the passing of the Act in

1896. It should be mentioned that the Act, which in 1902 was re-enacted for a further term, provided that the Treasury might ad- vance a portion of the money required for a line in cases where the council of any county, borough, or district had

Table XXII. ❓❓❓ Applications for Light Railway Orders.

Sate.

i

6

t

Gauge.

Motive Power Proposed.

5′ 9″

4‘8i’

4′ 0″

3′ 6″

3′ 0″

2′ 6″

2- 0″

r Hi”

Steam.

Electric.

Mechanical, etc.

1

i

4

d

r3

a

1

%

i

i

1

i

i

3

i’

1

2

164

21 374

i

1

1 1

3

1

i

1

s

6

T

2 1

i

a

December 1896 May 1897 November 1897 , .

May 1898 November 1898

May 1899 November 1899

May 1900 November 1900

May 1901 November 1901

28

28′

30

352

54

40 2 43

24 27 =

*26^*

44 5

3071

273|

2924

430i

4994

412 4414

2064 1424

269

384|

i

1

19 20 16

23

38

25 28

15 11

20

29 ⍰⍰

208i 205|

186

260A 395i

322f 294J

157J 8O4

253

292|

1 1 1

1 1

1

1

i

8

14 12

4

18 18

14i 5|

“k 90i

6 6

8

9

15

12 14

6

5

1

12 ??

94

48

36i

654

135

99i

67i 129J

21i 42|

16

874

7484

1

i

1 1

4

26 “2

64 134

48

1 2 1

1 1

6

11

i9i

64

4

7i

484

114

14 44

13

17 22

18 128

7

2

1664

3024 256

242|

181

994 174

39

19J

16

17 32

19 30

17 16

16 37

1254

1271 2434

148J

2424

107 125

230

364i

* 4*

21

18

Totals

379'

36591

4

244

26561

30

1 One scheme (Leek) applied for 10 miles of V SJ” and 7J miles of 3' 6”, 4 Five amending: orders. 5 Three amending orders.

7 Nineteen amending orders.

2 One amending order, no new mileage involved. 3 Nine amending oredra.

6 One scheme (Derby and Nottingham) applied for 14 miles of 4' 8a" and 5^ of 3' 6", 8 Including one of 39| miles steam or electric.

agreed to do the same, and might also make a special advance in aid of a light railway which was certified by the Board of Agriculture to be beneficial to agriculture in any cultivated district, or by the Board of Trade to furnish a means of communication between a fishing-harbour and a market in a district where it would not be constructed without special assistance from the State.

As a general classification (Table XXIII.), the Commis-

sioners have divided the schemes that have come before them into three classes : (A) those which like ordinary railways take their own line across country; (B) those in connexion with which it is proposed to use the public roads conjointly with the ordinary road traffic; and (Neutral) which includes inclined railways worked with a rope, and lines which possess the conditions of A and B in about equal proportions.

[light

The so-called light railways in the United States and the British colonies have been made under the conditions peculiar to new countries. Their primary object being the development and peopling of the land, they have naturally been made as cheaply as possible ; and as in such cases the cost of the land is inconsiderable, economy has been sought

Table XXIII. ❓❓❓ Classification of Light Railway Applications.

imber of Lines olied for up to ist December

1901.

1 1

al Construction timate exclud- ing Rolling Stock.

unber of Lines proved by the ommissioners nd sent to the oard of Trade.

i

g.ig

gg’”

gH

gg.O<3ffl

*&^*

??

??

Class A .

144

1836J

11,117,213

86

923i

5,375,420

???B .

211

*1686^*

15,309,536

82

418

3,447,990

Neutral .

5

137

893,848

1

i

17,953

Amending

orders .

19

...

39,398

12

39,398

by the use of lighter and rougher permanent way, plant, rolling stock, &c. Such railways are not “light” in the technical sense of having been made under enactments intended to secure permanent lowness of cost as

compared with standard lines. On the Continent of Europe many countries have encouraged railways which are light in that sense. France began to move in this direction in 1865, and has formulated elaborate provisions for their construction and regulation. Italy did the same in its laws of 1873, 1879, 1881, 1887, and 1889 ; and Germany fostered enterprise of this kind by the Imperial edicts of 1875, 1878, and 1892. Holland, Hungary, and Switzerland were all early in the field ; and Belgium has succeeded, through the instrumentality of the semi-official Soci^t^ Nationale de Chemins de Fer Vicinaux, started in 1885, in developing one of the most complete systems of rural railway transport in the world. An account of the regulations prescribed by several of these countries is given below.

In France the lines which best correspond to British light railways are called " Ohemins defer d'intertt local." These are regulated by Prance. ^ decree No. 11,264 of 6th August 1881, which the Ministry of Public "Works is charged to carry out. Con- struction can be commenced after the Oonseil General of the de- partment has approved the project, and the Prefect the details ; only if the scheme interferes with rivers or great public lines of communication does the Ministry of Public Works interfere. The model "form of regulation " lays down the scales of the drawings and the information to be shown thereon. For the first installation a single line is prescribed, but the "concessionaire" must provide space and be prepared to double when required. The gauge may be either 1 '44 metres (4' 8 '7"), or 1 metre (3' 3 '37"), or '75 centimetres (2' 5 '5"). The radius of curves for the 1 "44 gauge must not be less than 250 metres, 100 metres for the 1 m. gauge, and 50 metres for the '75 m. gauge. A straight length of not less than 60 metres for the largest gauge, and 40 metres for the smallest, must be made between two curves having opposite directions. Except in special cases, gradients must not exceed 3 in 100 ; and between gradients in the opposite sense there must be not less than 60 metres of level for 1'44, and 40 metres for 1 m. and 75 m. gauges. The position of stations and stopping-places is regulated by the Council of the Department. The undertaking, once approved, is regarded as a work of public utility, and the undertakers are invested with all the rights that a public department would have in the case of the carrying out of public works, and are subject to the same responsi- bilities and conditions.

Within the areas that come under the ” Defence Acts ” the works are subject to all the military necessities and laws which are prescribed for works in such areas, both retro- spectively and prospectively.

The Prefecture is responsible for preventing and limiting all interference by the undertakers with public and private rights, and for regulating the precautions for public safety. The contracts for the work are made either under public competition, on the published price-list approved and in use in the department, or by sealed tenders from a selected list of contractoi’s. . The working of the lines is under detailed regulations, to which the approval of the Prefect of the department must be obtained ; and the penalty for non-observance of these is practically confiscation, if defalcation, or neglect, is carried far enough. The Prefect may step in and work

the line at the expense of the “concessionaires.” The matters as regards which the Prefect must be consulted and satisfied are : numbers of staff in respect to safe working ; efficiency, design, and construction of the locomotives and of the rolling stock ; classifica- tion and interior arrangements of the passenger and goods carriages ; separation of sexes ; size and composition of trains ; number of trains ; policing ; general bye-laws ; maximum and minimum speed ; and time-tables. At the end of the period of the con- cession the ” d^partement ” comes into possession of the road and all its fixed appurtenances, and in the last five years of the period the ” d^partement ” has the right to enter into possession of the line, and apply the revenue to putting it into a thorough state of repair, if it has been allowed to deteriorate. It has also the right to select and buy, at a price to be adjudged by experts, any part or all of the rolling stock and movables^ and the owners can only oblige it to take the fuel and stock of necessary working and maintenance materials at a valuation. It has also the right to purchase the undertaking at the end of the first fifteen years, the net profits of the preceding seven years to govern the calculation of the purchase price. The maximum 1st, 2nd, and 3rd class passenger fares are, per kilometre, ‘067 f. (???6d.), “050 f. (???455d.), and ???037 f. (‘Sid.) respectively, when the trains are mn at ” grande Vitesse,” the fares including 30 kilogrammes weight of personal baggage. All goods trains are at petite vitesse fares, except those for oysters, fish,

and perishable goods. Any reduction of rates must be subject to the approval of the Prefect and of the Minister of Public Works. All preference ratef, except on behalf of the pubUo service, are interdicted. All the details of tickets, way-bills, in- voices, and papers in connexion with traffic, delivery, and storage are specified, and the working hours prescribed by the Prefect.

*In Belgium a public company under Government control does all that in France forms the responsibility of the Ministiy of the Interior and of the Prefect of the department. Over an n / j average of years it appears that 27 per cent, of the * ^ ”’”’ capital cost was found by the State, 28 per cent, by the province, 40 ‘9 per cent, by the communes, and 4‘1 per cent, by private individuals. As far as possible, these railways are laid beside roads, in preference to independent formation ; the permanent way costs ––977 per mile in the former as against ––793 in the latter. If laid in paving, the price varies between ––1108 and ––2266 per mile. The total length in Belgium, either worked by the company or leased by it, is 726^ miles. To work this mileage, 253 loco- motives, between 18 and 30 tons in weight, 716 passenger vehicles, 400 covered vans, 1367 open waggons, and 10 special vehicles are in constant use. In the case of a Belgian light railway intended primarily to serve an agricultural district, about 12^ miles in length, and mainly dependent upon its goods traffic, the line is constructed on the road, excepting where steep gradients, &c., make slight diversions desirable. Usually a line of way is formed at one side of the road, raised slightly by ballast, &c., and separated from the remainder of the road by kerbstones ; it resembles a footpath alongside a country road. In this way the railway is not available for ordinary carriage traffic, nor is it used by pedestrians. Through villages, and where roads have to be crossed, the line is of the usual tramway type. The line is of 1 metre gauge, with steel rails weighing 21J kilos (42 lb) per yard. In the towns a deeper rail is used, weighing about 60 lb per yard. In three lines of the Vicinaux system, in the aggregate 45 miles in length, the sharpest curves are 30 metres, 35 metres, and 40 metres respectively. There are gradients of 1 in 20 and 1 in 25. The speed is limited, by regulation, to 30 kilometres (about 18 miles) in the country and 6 miles per hour in towns and through villages ; the time allowed in the time-table for the journey, for instance, from Andenue to Eghezee, 12J miles,*

averages one hour twenty-five minutes, but one train in the day each way only takes about one hour five minutes. The engine, 18 tons weight, has six wheels coupled, each of 3 feet diameter ; all moving parts are cased, and it is driven from either end (the driver, of course, always being in front).

A train, for example, at starting, is composed of one goods waggon, one passenger carriage, and one fourgon or luggage van. For suburban passenger traffic there is usually no van, but the Soci^t^ has a certain number of vehicles forming a second-class compartment and a small van. Vans have a post office letter-box, in which letters can be posted at the various halting-places.

A room in an inn generally forms a waiting-room for passengers, and a place where parcels can be loft, either until called for or to be picked up by the train. No tickets are, however, issued, or ordinary station business transacted ; and it is not usual to make any payment to the proprietor of the inn, who gladly affords these slight; facilities in return for the custom brought to the house. In addition to the stations as above, there are also fixed points (mth a notice-board only) where the train stops if there is any one to pick up or set down, such as at important cross-roads, &c.

In Italy many railways which otherwise fulfil the conditions of a light railway are constructed with a gauge of 4' SJ". The weights arc governed by what the railway has to carry and the speed. Light locomotives, light raQs, and light rolling stock are employed.

moxtntain]

RAILWAYS

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There are no bridges, except where watercourses occur. Cuttings are reduced to a minimum ; and where the roads are sufficiently wide, the rails are laid on the margins. The advantage of uni- Italy formity of gauge is in the use of trucks for goods

‘???which belong to the rolling stock of the main lines.

In Italy these railways are called ” Economic Railways,” and are divided into live types. Types I. , II. , and III. , are of 4' 8^” gauge, type IV.of 0‘95 m., and type V.of 0‘70 m. ; but as there is no example of type v., the classification is practically one of 1‘445 m. (4' 8^”) and one of 0-95 (3' 0-5”). The chief difference between the first three types lies in the weight of rails and rolling stock and in the radius of the curves. The real light railway of Italy is that of type IV.: gauge, 0-95 m. (3' 0'5") ; weight of rails, 12 (26-45 lb) to 20 (44 lb) kilos. ; mean load per axle, 6 tons ; minimum curve, 70 m. (229' 2-6”) radius ; width of formation, 3-50 m. (11' 5-5”) ; top width of ballast, 2-10 m. (6' 10-7”); depth of ballast under sleepers, O’lOm. (3' 9-5”) ; maximum gradients, 1 in 50 ; length of sleepers, 1 “70 m. (5' 6 '92") ; width between parapets and width of tunnels, 1 m. over width of carriage ; height of tunnels, 5 m. (16' 4 '85") ; locomotives, maximum weight per axle 6 tons, rigid wheel base 1-80 m. (5' 10-86”), diameter of driving wheels 1 m. (3' 3-37”).

In Germany the use of light railways {KUin-hahnen) has made great strides. The gauges in use vary considerably between 4' 8 J”, Oermaav ”^^ standard national gauge, and 1' 1 1|”, which appears to be the smallest in use. They are under the control of the Post and Telegraph Department, the State issuing loans to en- courage the undertakings ; the authorities in the provinces and communes also give support in various ways, and under various con- ditions, to public bodies or private persons who desire to promote or embark in the industry. These conditions, as well as the degree of control over the construction and working of the lines, are left to the regulation of the provincial governments. Similarly, the same authorities decide for themselves the conditions under which the public roads may be used, and the precautions for public safety, all subject to the confirmation of the Imperial Government. For instance, at speeds of less than 27 miles an hour, a buffer compart- ment (instead of a buffer vehicle) may be sufficient between the passenger carriages and the engine ; the conductor may have sole charge of the train, sell tickets at stopping-places where no ticket- office is maintained, and look after payments for luggage ; the driver and stoker may be charged with the care of the carriages and the greasing of the wheels ; women may be

employed as gate- keepers ; fencing need not be continuous ; gates at level-crossings need not always be insisted on ; telegraph and bell signals may be dispensed with ; trains may occasionally stop at points intermediate to the usual stopping-places ; trains of limited size (50 axles) may be pushed at low speeds ; brakes per axle on the carriages ??? actually applied ??? may be reduced in proportion to the gradients. The free- dom which the legislature in Germany has given to provincial and communal authorities to regulate these railways by rules growing

out of experience and common sense, in contradistinction to the empirical State regulation which exists in other countries, has resulted in a very large and rapid adoption of their use to the development of rural industries of all kinds.

What are known as ” portable railways ” should be in- cluded in the same category as light railways. With a 24" gauge, hnes of a portable kind can be made very handily, and the cost is very much ”“‘j”” less than that of a permanently constructed light ”” “^’ railway. The simplicity is great ; they can be quickly mounted and dismounted ; the correct gauge can be per- fectly maintained ; the sections of rails and sleepers (which are of iron) are very portable, and skilled labour is not required to lay or to take them up ; the making of a ” turn- out ” is easy, by taking out a 15 foot section of the way and substituting a section with points and crossings. The safe load per wheel varies between 12 cwt. on a 10 inch 16 ft wheel, and 40 cwt. on an 18 inch 56 a wheel. The roll- ing stock is constructed either for farm produce or heavy minerals, the latter holding 10 to 27 cubic feet. For timber, 4 or 5 feet bogies can be used. A useful waggon for agricultural transport on a 24-inch gauge line is 16 feet long by 5 feet wide ; it weighs 72 cwt. and costs ??30. A portable line of this kind will have 20 lb steel rails and 2112 steel sleepers ???4' 6" long ??? to a mile, laid 2' 6" apart centre to centre. The total cost per mile of such a hne, including all bolts, nuts, fish-plates, and fastenings, ready for laying, delivered in the United Kingdom, is under ??500 a mile.*

See Evans Atistin. The lAglit Railways Act, 1896, ‘which con- tains the rules of the Board of Trade. ??? W. H. Cole. Light Rail- ways at

Borne and Abroad. ??? Lieut. -Col. Addison. Report to the Board of Trade (1894) on Light Railways in Belgium.

(c. E. W.) Mountain Railways.

Railways having gradients above a certain limit, which may be taken as about 30 in 1000, are regarded as moun- tain railways. They are of three kinds : adhesion lines ; rack railways, either pure rack or rack and adhesion com- bined ; and cable railways.

Adhesion lines (Table XXIV.) may be either of normal or of narrow gauge. The maximum gradient is dependent on

Table XXIV. ??? Adhesion Lines.

Ceylon Government

Kadugannawa Incline.

id

.g.a

Id- ea >,

o

en

III

a

III

li

11

OKI

><

w

l|l

“‘1

I o %

f

Gauge

5 ft. 6 in.

4 ft. 8iin.

2 ft.

3 ft.

4 ft. 8 J in.

4 ft. 8iin.

4 ft. 81 in.

1 metre

1 metre

4 ft. 8 J in.

1-10 metre

Cost of construction

68,873,

4575

25,000

31,960

10,400

??11,520

...

??20,000

per mile

exclusive

of summit

tunnel

Eadiusofsharp-I metres est curve . j feet .

201

280

21-3

42-7

100

120

180

100

100

58

40

660

918

70

140

328

394

590

328

328

191

131

Steepest gradient

1:45

1:37

1:28

1:27

1:25

1:25

1:20

1:22

1:22

1 : 16-6

1:12

Length of incline

12 miles

18 and 21 miles

40 miles

23 miles

14 miles

100 miles

7 miles

13-7 miles

5-2 miles

One of 2-7

miles, and

various

others

6i mUes

Diameter of cylinder .

17 in.

15f and 22i in.

11 in.

15J in.

16 in.

18 in.

15 in.

19-3 and 13 in.

Hand 16|in.

12 in.

18 in.

Stroke

26 ???

25i in.

14 ???

20 ???

22 ???

24 ???

21 ???

21-7 in.

19f m.

10 ???

20 ???

Axles, number .

Sail coupled

6 coupled in threes

2coupled

3 coupled and 1 bogle

6 ft. 10 in.

6 coupled in threes

3 coupled

2 pairs of 2 coupled

4 coupled

4 coupled

3 coupled

Rigid wheel-base

9 ft. 6 in.

8 ft. 10 in.

5 ft. 6 in.

8 ft. 3 in.

14 ft. 9 in.

8 ft. 2 in.

5 ft. 3 in.

4 ft. 7 m.

4 ft. 2 in.

8 ft. 3 in.

Diameter of wheels

3 ,, 6 ????

4 ft.

2 ????2 ????

3 ft.

3 ????6 ????

4????1????

2 ????11 ????

3 ????3 ????

3????3i????731 sq. ft.

3????3????

Heating surface .

1342 sq. ft.

1660 sq. ft.

355 sq. ft.

872 sq. ft.

1712 sq. ft.

1066 sq. ft.

1022 sq. ft.

863 sq. ft.

Engine-weight loaded

32-5 tons

84 tons

13-8 tons

33-8 tons

92-2 tons

45 tons

36 tons

40 tons

34 tons

35 tons

40 tons

Net train weight

hauled up the incline

147 ???

200 ???

35 ???

68 ???

175 ???

75 ???

85 ???

70 ???

60 ???

75 ???

40 ???

Load drawn per ton

of locomotive weight

2-85 ???

2-38 ???

2-5 ???

2-02 ???

1-9 ???

1-15 ???

2-36 ???

1-75 ???

1-72 ???

2-14 ???

1 .,

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RAILWAYS

[mountain

climatic conditions, a dry climate being the most favourable. The theoretical hmit is about 60 in 1000 ; between 50 and 60 in 1000 an adhesional engine is able to haul only its own weight. The gradient should not in practice exceed 45 in 1000 ; and even that is too heavy, for theoretical conditions cannot always be realized. A wet rail will prevent the use of the theoretical adhesion of the driving ???wheels, and the gradients must be such that a locomotive can haul some paying load in all states of the weather. On the Albula or Engadine railway in Grisons, Switzer- land, the first intention was to lay out the line on a gradient of 45 in 1000; but after consultation with the leading engineers in Switzerland, a gradient of 35 in 1000 was chosen, on the ground of working economy.

Locomotives are of very varied types ; but the tendency is towards those which have as much of their weight as possible on the driving wheels, so as to be available for ad- hesion, and which possess great lateral flexibility for passing round sharp curves. In vehicles, reduction of dead weight and lateral flexibility are usually aimed at. The best have long carriages on bogies ; these, however, are more used in America than in Europe. The brakes are like those used on ordinary railways. On the mountain sections of the St Gothard the maximum speed is 45 km. an hour on a rising gradient of 1 in 39 ; on the Siidost railway it is 25 km. an hour on one of 1 in 20 ; while on the Land- quart Davos line it is 20 km. on one of 1 in 22.

Rack Railways. ??? For gradients above 40 in 1000 a rack railway is the more economical. Some railways which are mainly adhesional operate the steeper grades by means of a rack. When the incline is above 40 in 1000 for the major part of the distance, the rack alone is employed.

Above 250 in 1000 the rack is impracticable, partly because the locomotive has to be made disproportionately heavy, and partly because of the danger that the cog-wheel

will mount the rack. Since the construction of the Mount Washington and the Eigi lines, the number of rack rail- ways has rapidly increased ; and many systems have been introduced, the development of which is illustrated by the names of the early Blenkinsop rack, the Washington, the Kiggenbach, the Abt, the Klose, the Pilatus, and the Strub. On the Abt rack, which has the unique advantage that several rack-plates can be placed parallel, the teeth break joint at \, ^, or ^ of their pitch, according to the number of rack-plates. The cog-wheels are therefore con- stantly in action with the rack, an arrangement which conduces to smooth working. The rack introduced by Colonel Locker on the Pilatus railway is peculiar in having its teeth placed horizontally, in consequence of the heavy gradients, the steepest of which is 480 in 1000. The Strub rack introduced on the Jungfrau railway is very simple ; a rail of the ordinary Vignoles type is employed, the teeth being cut in its head, which is made correspond- ingly higher than usual (Table XXV.).

The permanent way has of late years mostly been made with steel rails and steel sleepers, bedded in ballast of coarse gravel. The rack is placed in the middle of the track, either fixed directly to the sleepers or elevated on chairs. As the space allowed for change of temperature must necessarily be kept as small as possible, the rack is composed of pieces 3 to 3 ‘5 m. long. To prevent the permanent way from creeping downhill, stops are placed on the downside of the sleepers. Trains are transferred from one track to another either by means of sUding platforms or movable and fixed rack arrangements. On combined rack and adhesion lines the entrances to the rack sections are provided with a piece of rack placed in springs, to enable the pinions of the engine to pass on smoothly and without stoppage. Swiss engineers mostly prefer the Kiggenbach rack, on account of its rigidity and

Table XXV. ??? Back Railways. (Pure rack railways and rack and adhesion combined.)

k

WE”” 1 ^ . II r 1 ll 9 % ^ . If ll c S g.-g .a s a-d |51 1 III i 1 1 1 System .

Combined

Combined

Combined

Kiggen-

Combined

Abt rack

Abt rack

Abt rack

Kiggen-

Kiggen-

Abt rack

Patented im-

Abt rack

Abt rack

Abt rack

bach rack

Abt rack

bach rack

bach rack

provement on

and

and

and

and

Riggenbach- rack

adhesion

adhesion

adhesion

adhesion

Gauge

Cost of construc- tion per mile

Radius of sharpest curve ??? metres

4 ft. 8J in.

2 ft. 6 in.

4 ft. Si in.

3 ft. 6 in.

1 metre

2ft.7iin.

4ft.8Jin.

0-80 metre

4ft.8iin.

1 metre

1 metre

0-80 metre

??10,468

...

??46,160

??11,400

??7150

??11,560

??11,409

??17,684

??26,208

??19,840

??10,040

200

126

180

150

80

80

116

60

180

160

80

60

Steepest gradient .

1 : 16-6

1:16-6

1:14-7

1:12-5

1:8

l:6i

1:4

1:4

1:4

1:4

1:3-9

1:4

Lenjfth of incline .

4^ miles

6-7 and 12

9 miles

19 miles

4 miles –

4J miles

8-8 miles

4-7 miles

4-2 miles

3-4 miles

3-7 miles

10 miles of rack

of rack

miles of rack 13 in.

of rack

of rack

of rack

of rack

of rack

of rack

of rack

of rack

Diameter of

17-7 in.

19 in.

17 in.

13 in.

12 in.

17 in.

12 in.

11 in.

12 in.

IS in.

12 in.

cylinder

adhesion 11 -Sin. rack

adhesion 12 in. rack

adhesion 17 in. rack

adhesion 14 in. rack

Stroke ,

23-6 in.

18 in. adhesion 14 in. rack

20 in. adhesion 18 in. rack

20 ???

18 in. adhesion 18 in. rack

24 ???

20 ???

22 ???

16 ???

20 ???

23 ???

20 ???

Axles, number

3 coupled

3 coupled

3 coupled

2 coupled 1 trailing

2 coupled 1 trailing

(two-

^two-

3 < pinion

(axles

ftwo-

3 ^ pinion

(axles

1 driving

2

3

2

1 trailing

1 trailing

1 trailing

3 .j pinion

1 trailing

(axles

Rigid wheel-base .

10 ft.

7 ft. 8 in.

11 ft. 6 in.

8 ft. 2 in.

6 ft. 5 in.

4 ft. 2 in.

4 ft. 7 in.

8 ft. 10 in.

7 ft. 9 in.

Diameter of

4 ft. 1 in.

2 ft. 7 in.

3 ft. 6 in.

3 ⬩⬩⬩3 ⬩⬩⬩

3 ft.

23 in.

26-6’in.

pinions

26’in.

28 in.

28 in.

28 in.

wheels

2 ft. 6 in.

24 in.

wheels

27 in.

400 sq. ft.

adhesion 28 in. rack

Heating surface . Engine -weight

1463 sq. ft.

763 sq.ft.

1660 sq.ft.

864 sq.ft.

697 sq. ft.

366 sq. ft.

...

617 sq. ft.

678 sq.ft.

390 sq. ft.

560

loaded Net train – load

66 tons

30-6 tons

66 tons

21 tons

29 tons

17-2 tons

23-8 tons

17-6 tons

16 tons

24 tons

17‘3 tons

17-6 tons

hauled up the

incline

120 ???

70 ???

110 ???

40 ???

46 ???

w ??

18-7 ???

8-B ???

10-6 ???

13 ???

10 ???

Load drawn per

??????????

ton of locomo-

tive weight

2-14 ???

2-3 ???

2 ???

1-9 ???

1-66 ???

-81 ???

0-78 ???

0-49 ???

0-7 ???

0-64 ???

0-57 ???

fn

M

*i^*

X

1-5 a,

Pi

2

S

CO

JuNGFTiAu Railway.

Viaduct on the MOrren Funicular Railway.

MOUNTAIN RAILWAYS. {Reproduced from originals by the Photoglob Co,, Zuri.h.)

mountain]

RAILWAYS

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simplicity. The Abt rack haa the advantage of smoother working, and is more frequently employed outside of Switzerland. On street railways and railways with numerous level-crossings the Riggenbach system is preferred, because it only breaks the road in one line, and the rack teeth are on a level with the street. For the Abt at least three lineal spaces must be kept clear.

In designing rack-rail locomotives the same rules hold as for ordinary locomotives. In the later rack lines adhesion is not utilized, the wheels being loose on the axles. Originally the boilers were placed vertically ; but

it was not long before the present plan was adopted of arranging them in such a way that their axis is about horizontal when the engine is on the average gradient of the line. The fire-box and grate should be of the largest possible dimensions. In the most recent practice big locomqtives working with combined rack and adhesion have separate mechanical arrangements for the two, each driven by its own pair of cylinders. Engines are fitted both with air-brakes and with a brake to be applied by the driver or fireman, the action in each case being on the cog-wheel axle. The discharge of smoke is so great, owing to the heaviness of the gradients and the slow rate of progress, that it is not only a great nuisance but in the larger tunnels positively dangerous. As far as possible, therefore, tunnels are avoided, especially on the heavy gradients, and apparatus for ventflation and smoke-con- sumption has to be provided.

Of late years electric motors have been largely used. They were first employed on the Barmen mountain railway, which is fitted with the Riggenbach rack and has a maxi- mum gradient of 185 in 1000. Other electrically-driven lines are the Mont Saleve (250 in 1000), the Salgo Tarjan (140 in 1000), the Gornergrat (200 in 1000), and the Jungfrau (250 in 1000). The engines on the Gornergrat railway have two independent, asynchronous, three-phase, six-pole motors, with wound armatures (rotors) and slip- rings ; these with a current of 40 periods per second make 800 revolutions a minute, and develop together 180 horse-power at that speed with 540 volts in the trolley wires. They are fixed on the frame of the engine, and drive the cog-wheel axles by means of 12:1 gearing. At the normal speed of 7 kilometres (i^ miles) an hour, the tractional force is about 6 tons, the weight of the locomotive being 10 “6 tons. There are two distinct brakes. A hand-brake apparatus acts on the driving axles, and the motors are supplied with braking drums and straps, the latter being applied -(1) by hand, (2) automatically when a certain speed is exceeded, (3) as soon as the electric current is from any cause interrupted. The last arrangement is worked by means of a solenoid. The most remarkable mountain railway is perhaps the Jungfrau, which is to be carried ◆◆◆ almost entirely in tunnel ◆◆◆ 4093 metres above sea-level, or more than 1000 metres above the Hne of perpetual snow, amid glacial surroundings of the most magnificent character.

Vehicles differ according to the type of line. On mixed rack and adhesion lines they depart but little if at all from the ordinary style. On the steep gradient pleasure lines they are built as light as possible, the dead weight being in some cases reduced to 75 kilometres per passenger place. The wheels are loose on the axles. Passenger carriages contain 48 to 60 places, while the goods vans have a carrjdng capacity of 6 tons, with a dead weight of 2 to 5 tons. All the waggons are fitted with 1 or 2 cog-wheels for braking purposes. On the tourist railways with heavy gradients the speed is 5 to 7 kilometres an hour; in easier gradients 8 to 10 kilo-metres, and on well-constructed rack lines and combined rack and adhesion, 12 to 15 kUometres on the rack

and about 18 kilometres on the adhesion sections. On the heavier inclines the locomotive, as a matter of safety, is always behind the train and not coupled to it.

On the pure rack railways the slowness of the speed renders it impossible to get big returns from the roUing stock ; hence the working expenses per mile of line appear high. Maintenance also costs more than with an ordinary adhesion line. For rack railways the cost of construction varies between ►►3000 and X32,000 a kilometre, and is only slightly influenced by the particular rack system chosen, apart from the expenses of the rack mechanism on the permanent way and engines; other expenses are quite independent of the system adopted. At the end of 1897 the number of rack railways in the world was 71, with a total length of 887 '8 kilometres; and of these, 32 were on the pure rack principle. Of the Locker, Bissinger, and Telfner systems there was one example of each, of the Kloae 2, of the Abt 29, and of the Riggenbach 35.

Cable Eailways (Table XXVI.). ►►► There are two main systems of cable railway: (1) that in which a continuous cable is carried over two main drums at each end of the line, the motion being derived either (a) from the weight of the descending waggons, or (6) from a motor acting on one of the main drums ; (2) that in which each end of the cable is attached to waggons, one set of which accordingly ascends as the other descends. The latter is the system ordinarily applied on mountain cable railways. The weight required to cause the downward motion is obtained

either by means of material that has to be transported to the foot of the hill, or by water ballast ; while to aid and regulate the motion generally, steam or electric motors are arranged to act on the main drums, round which the cable passes in sufficient turns to prevent slipping. When water ballast is employed, the water is filled into a tank in the bottom of the waggon ; if passengers are carried, its quantity is regulated by the number ascending or descending.

In order, to control the acting force and render the working of the line as easy as possible, the longitudinal section must be laid out according to certain fixed rules, which, if strict economy is aimed at, must also be observed in cases where the movement of the waggons is governed by water-power acting on the main turning drums. The alignment is perfectly straight, but curves are admissible when they improve the lie of the railway. The permanent way consists of two, three, or four rails, facility of crossing being the end aimed at when more than two are used. In the modern system, however, which admits of very good crossing arrangements, only two rails are employed. On the Stanzerhorn cable railway, Switzerland, both the outer rails are through rails ; while the inner ones are provided with counter rails, to leave room for the passage of the cable, which is guided by the rollers below the track. The cars have four wheels keyed to the axles. On one side these have double flanges, whereas on the other they are very broad and without flanges. When the car reaches the siding, the double-flanged wheel keeps it to the through rail, so that it is taken automatically through the siding, while the other broad wheels pass smoothly over the points. Each metal of the double-railed line being a through-rail on the outer half of the sidings, the two cars on each division of the track have theit double-flanged wheels on opposite sides. The rails weigh 16 to 30 kilos a metre. Both wooden and steel sleepers are used ; on the heavier gradients they are generally bedded in masonry, and on the gentler in gravel anchored to firm supports, to prevent sliding. The gauge, as a rule, is one metre. The total weight of the permanent way varies from 100 to 200 kilos per metre. The cable, which weighs from 2 to 6 kilos per metre, is of such a size as to give a factor of safety of 8 to 10 on the maximum strain, and its end is so

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RAILWAYS

[mountain

*Table XXVI. ***Cable Eailways of Switzerlamd***

Name of Line.

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bo

Elevation above Sea-Level

at

1

h

go.

1

*a ***J***

I.S

1

II

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4513

1

1897.

Remarks.

i

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a t

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.11

Eeatenberg …. Biel-Maglingen . Burgenstock

Ecluse-Pean (Neuchatel) . Giessbach .... Gutsch (Lucerne) Lausanne-Ouchy Lauterbrunnen-Grutschalp Lugano .... Marzili

Salvatore .... Rheineck-Walzenhausen . Territet-Glion . Ziirichberg .... Ragaz-Wartenstein . Stanzerhom Cossonay-Gare (Vand) St Gallen Muhleck . Bolder (Zurich) .

1889 1887 1888 1890 1879 1884 1877 1891 1886 1885 1890 1896 1883 1889 1892 1893 1894 1896 1897

Metre

4ft.8Jin. Metre

2 ft. 7} in.

Metre l-20metres

Metre

l-20metres Metre

Yards.

1760

1777

904

402

350

155

1620

1320

260

110

1648

1340

606

178

833

3959

1334

340

883

Feet. (Lake of Thun . . 1863 iBeatenberg . . 3638 (Biel .... 1430 (Maghngen . . 2884 (Lake of Four Cantons 1437 tBurgenstock . . 2880 (Eoluse . . . 1460 jPean …. 1808 (Lake of Brienz . . 1880 iHotel Giessbach . 2176 (Untergrund . 1454 tGutsch . . . 1700 (Lausanne . . . 1675 touchy . . . 1240 JLauterbrunnen . 2677 tGriitschalp . . 4872 (Lugano . . .919 tRailway station . 1106 (Marzili . . . 1667 [Bern .... 1772 (Paradiso . . .922 tSan Salvatore . . 2894 (Rheineok . . . 1328 (Walzenhausen . . 2205 JTerritet . . 1280 (Glion . . . 2261 (Limmatquai . . 1355 t Polytechnicum 1480 (Ragaz . . . 1640 (Wartenstein . 2316 jStanz . . . 1483 tstanzerhom . . 6063 (Cossonay . . . 1859 tGare (Jura Simplon) 1417 J St Gallen . . . 2222 tMiihleck . . . 2437 JZurich . . . 1466 tDolder . . . 1794

y 400

(320

[676 j-370 [320 [□□□ 630 I 116 [600 j-238 I 302 I 600 j- 260 ! □□□ 670 [□□□260 I 304 [-620

j-iso

|- 228 |-177

□□

19,400

16,300

8,600

6,700

6,000

2,800

121,300

28,400

6,400

2,000

22,200

19,600

17,400

9,400

8,800

47,900

16,200

10,000

11,300

7,500

2,400

6,900

1,000

840

600

1,200

1,200

900

800

1,200

1,900

1,200

760

1,600

12,100

1,800

1,600

1,200

27,100

18,000

14,600

7,700

6,000

3,400

134,900

29,800

7,400

2,800

23,600

21,400

18,900

10,400

10,400

60,000

17,000

11,600

12,500

5,260 6,380 3,420 6,480 820 1,440

43,000 8,070

10,720 6,520 3,890 9,750 7,790 9,670 6,010 7,820 3,710

10,970

16,000

s. d.

3 8

2 10

6 2

2 3

3 2 6 10 2 9 8 3 1 3 1 4

5 3

1 2

6 0

2 6 1 4

4 9

3 3

0 11

1 2

Water-tank, Riggenbach rack.

Dynamo by hydraulic

motor, Abt rack. Water-tank, Riggenbach

rack.

)>))

Hydraulic motor(turbine).

Water-tank, Riggenbach rack. ◆◆◆ Abt rack.

◆◆◆ Riggenbach rack. Dynamo by hydraulic

motor, Abt rack. Water-tank.

Watertank, Riggenbach rack.

j> ◆◆

Dynamo by hydraulic motor, special braking rail. Water-tank, Abt rack.

Water-tank.

Electric motor.

fastened that an automatic brake is brought into play if it slips from its grip. Guiding rollers are placed between the rails at such intervals that the cable does not touch the ground when the tension is least. For braking purposes a special rail ◆◆◆ frequently a rack, either Abt or Kiggenbach ◆◆◆ is generally employed ; and where the gradient exceeds 250 in 1000 a catch has to be introduced, to prevent the braking cog-wheels from mounting the rack. Other devices are sometimes used; on the Stanzerhom line, for example, there are brake jaws, which are screwed down on the tapered head of the brake rail Various methods of appljdng the brakes are employed. As a rule, there is an automatic brake, brought into action by turning a weighted lever, and a screw brake, manipulated by the guard ; sometimes also an automatic brake applies itself when the speed exceeds a certain maximum. The steepest

gradient used is about 650 in 1000. The waggons have rarely more than two axles ; and the passenger coaches, which hold 32 to 48 persons, weigh from 6 to 18 tons. The cost of construction varies from ◆◆10,000 to ◆◆30,000 per kilometre.

Construction. ◆◆◆ Mountain railways are frequently ex- posed to the special dangers of the regions they traverse, such as falls of stone, violent and sudden outbursts of torrents carrying heavy masses of debris,

avalanches, and slips of various kinds, aU of which have to be guarded against. The extent of these dangers is determined by the more or less close proximity of the snow-line, the topo- graphical nature of the country, and the character of the soil ; so it may happen that a railway may attain a very great elevation above sea-level and yet encounter only con- ditions that are comparatively, or even absolutely, easy.

Table XXYU. ??? Working Statistics.

Name of Line.

Train Kilo- metres.

Gross

Kilometre

Tons.

Net

Kilometre

Tons.

Gross

Weight

per Train

Tons.

Net Train Weight hauled

per Train Tons.

Working Expenses.

Cost per Train Kilometre.

Per Gross

Kilometre

Tons.

Per Net

Kilometre

Tons.

Siidost Railway .

256000

19-507000

11-008000

76

43

s. d.

0 9-6

d.

0-12

8. d.

0 0-22

Adhesion railway (normal gauge, 4 ft. 8J in.)

Adhesion railway,

Ehatiaclie ,,

343000

27 ‘638000

15-995000

80

47

0 8-5

0-10

0 0-19

Pilatus

12100

127000

14000

10-5

3 2

3-6

2 8-5

metre gauge. Rack railway, 0-80

Eigi ???.

28700

604000

188000

21

6-5

2 5-5

1-4

0 4-5

metre gauge. Rack railway, 4 ft.

Wengernalp,,

46900

i-onooo

299000

22

6-4

1 11

1-05

0 3-6

Si in. gauge. Rack railway, 0-80

Briinig ,,

223000

14-376000

9-373000

64-5

42

0 9-6

0-15

0 0-23

metre gauge. Rack and adhesion combined, metre gauge.

RAIPUR *RAJGARH*

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Where falls of stone are to be feared, it is usually prefer- able to put the line in a tunnel or gallery. If it is to be in the open, the protective works consist of stone *walls, with or without a backing of earth, or of heavy timber fences. In the case of torrents, the line is sometimes carried under their bed in a gallery ; they are also guarded against by the systematic arrangement of their courses, or by the erection of cross-walls, which serve to arrest the velocity of the water and prevent debris from rushing down in too heavy masses. Avalanches are often avoided by means of tunnels or galleries ; if these are too expensive or otherwise impracticable, the snow is held back by retaining walls or dams, or prevented from slipping by the friction of rows of poles, wattlework, or small stone-walls. To deal effectively with torrents, as well as avalanches, it is frequently neces- sary to carry the protective works to the highest regions of the mountains, where many of these dangers have their origin. (s. j. b.)*

Ra.ipur, a town and district of British India, in the Chhattisgarh division of the Central Provinces. The town is 994 feet above the sea, 188 miles east of Nagpur; railway station. Population (1881), 24,948; (1891), 23,759. There are ruins of an immense fort, with many tanks and old temples. Kaipur is the cantonment for a wing of a Madras native infantry regiment. It has a German mission, four printing-presses, a Government high school, with 1014 pupUs in 1896-97. The Eajkumar CoUege, for the education of the sons of the chiefs of Chhattisgarh, was transferred here from Jubbulpore in 1 894 j there are 23 pupils, maintained by fees and an endowment.

The district of Raipuk has an area of 11,724 square miles ; population (1891), 1,584,427, showing an increase of 13 per cent., which had heen continuous since 1872 ; (1901), 1,442,778, showing a decrease of 9 per cent., due to the results of famine. Land revenue, Es. 8, 66, 451, the incidence of assessment being under 4 annas per acre ; cultivated area (1897-98), 2,382,308 acres, of ???which 40,422 were irrigated from tanks, &c. ; number of police, 681 ; boys at school (1896-97), 15,384, being 13-2 percent, of the male population of school-going age ; registered death-rate (1897), 78 '68 per thousand. The principal crop is rice. Manufactures of cotton goods and brass ware ; steam cotton mill at Eajnandgaon, with 156 looms and 14,868 spindles, employing 800 hands. The north-west corner of the district is crossed by the main line of the Bengal- Nagpur Railway, and a branch tramway is now being con-structed from Eaipur town due south towards the state of Bastar. The district suffered severely from famine in 1896-97, and again in

1899-1900.

Rajahmunclry, or Rajamahendbi, a to^wn of British India, in the Godavari district of Madras ; on the left bank of the river Godavari, at the head of the delta, 367 miles north of Madras ; a station on the East Coast Railway, which is here carried across the river by a bridge of twenty-one spans. Population (1881), 24,555 ; (1891), 28,397; municipal income (1897-98), Rs.38,840. The Government college, one of the four provincial schools established in 1854, had 88 students in 1896-97. There are also a training college and high school, two printing- presses, issuing one

English and two vernacular news- papers ; a public library and reading-room ; and a teachers' association.

Rajendralala Mitra, Raja (1824-1891),

Orientalist and author, was bom in 1824 in a suburb of Calcutta, and died in that city on 26th July 1891. For half a century he was the life and soul of the Bengal Asiatic Society. Five years after his birth Dr H. H. Wilson proposed the admission of learned natives into the Society founded by Sir William Jones in 1784 ; and elected under this rule, Rajendralala Mitra fiUed successively the oiEces of librarian (1846), of vice-president (from 1861 onwards), and in 1885 of president of the Society. Of the Kayasth caste, descended from a family which had served ???with profit the Nawabs of Murshidabad, he devoted

himself from childhood to the study of the classic languages of the East in his father's hbrary. He owed none of his early education to British schools, although for a time he attended the Medical College and studied law. He held no public appointment except that of director of the studies of young zemindars, wards of Government. The dis- tinction which he won, both in Europe and in Asia, for his ability, industry, and research was not the product of State- aided education, .but of the spirit of inquiry infused into Indian society by the private efforts of such scholars and statesmen as Sir WiUiam Jones, Lord Teignmouth, Henry T. Colebrooke, Sir Charles Wilkins, Dr H. H. Wilson, and James Prinsep. The pubUc service, and the professions of law and medicine, so attractive to Bengalis, seemed to Rajendralala only a distraction from the higher purposes of life opened to him by the Asiatic Society. As he wrote : " Neither Ganesa, the Hindu patron of wisdom, nor Saras- wati, goddess of learning, seems ever to have paid any encouragement to history, and as a consequence Indian literature is almost void of all authentic historical records." He set himself to supply this deficiency, using the material supphed by poetry, fable, and tradition, and ???wresting from stone, brass, and pottery the secrets of the past. He brought to the task a rare knowledge of Sanskrit, Persian, and the classic languages of the East, and a power of ???writing pure Enghsh which few Europeans possess.

His principal work, published in 1875, The Antiquities of Orissa ??? described by him as " some relics of the past weep- ing over a lost civilization and extinguished grandeur " ??? is a storehouse of information on architecture, reUgion, and the social history of India. Three years later he published Buddha Gaya, the hermitage of Sakya Muni, containing the story of Buddha's penance, a learned discussion of chronology, and copious accounts of architectural remains, sculptures, and inscriptions. In the Indo Aryans he collected together many of his historical contributions to the Asiatic Society's Journal, and in the Bibliotheca Jndica a large number of Sanskrit texts were supplied and ex- plained by him. His catalogues, and his frequent papers published in the Bengal Asiatic Society's Journals, show the accuracy and ???wide range of his inquiry, and knowledge of religion, literature, philology, antiquities, and the manners and customs of India. Although he served as a member of the Calcutta municipality, he took little part in public affairs. Nevertheless, his influence upon modern Indian society was great ; and inspired as he was by a fearless search after truth, he naturally came into conflict ???with the orthodox Hindus, who regarded any questioning of myths and traditions as both heresy and want of patriotism. The University of Calcutta made him a Fellow and Doctor of Law. Foreign societies enrolled him in their ranks, and his Sovereign conferred upon him the dignity of CLE. But the distinctions which he valued above all others were his election as president of the Bengal Asiatic Society, and the discovery of a key to the history of the past by diligent research into the relics which the ravages of time and climate were too quickly destroying. (w. l.-w.)

Rajgfarh, a native state of Central India, in the Bhopal agency. Area, with the dependency of Sutalia, 655 square miles. Population (1881), 117,533; (1891), 119,489; average density, 182 persons per square mile. The estimated revenue is Rs.5,()0,000 and the tribute to Sindhia, Rs.85,172. The chief, whose title is Rawat, is a Rajput of the Omat clan, claiming descent from Vikrama- ditiya. The grandfather of the present chief became a Mahommedan, but the family have now been received back into Hinduism. British currency has recently been adopted in the state. The town of Rajgaeh, which is also called Biaora, has a population of (1881), 6881 ; (1891), 6476.

R A J K O T ???R A M :fi E

Rajkot, a town of India, in the Gujarat division of Bombay; the headquarters of the political agent for Kathiawar, and the capital of a petty native state of the same name. It is situated in the middle of the peninsula of Kathiawar, and is the centre of the railway system. Population (1881), 21,152; (1891), 29,247. There is a military cantonment. There is a Rajkumar College, for the education of the sons of chiefs on the lines of an English public school. Besides the high school there are training colleges for meters and mistresses. Easulkhanji Hospital has a department for women, opened in 1897 at a cost of Rs. 83,000. There are eight printing-presses, issuing an official gazette and two English newspapers. The state of Rajkot, which is a branch of Nawanagar, has an area of 283 square miles. Population (1891), 49,938.

Rajpipla.1 a native state of India, in the Gujarat division of Bombay ; occupying a hilly tract between the rivers Nerbudda and Tapti. Area, 1514 square miles. Population (1881), 114,756; (1891), 171,771. The esti- mated gross revenue is Rs.8,64,298, of which Rs.71,850 ???was expended on pubKc works in 1897-98 ; tribute to the Gaekwar of Baroda, Rs.65,009. The chief, whose title is Maharana, is a Gohel Rajput, of the same family as the Thakor Saheb of Bhaunagar. A steam tramway, of 2 feet 6 inches gauge, is being constructed through the state for a total length of 37 miles. The old fort of Rajpipla, in the hills, is now deserted. The modern capital is Nandod, situated on the river Karjan, 32 miles from Surat. Population (1891), 10,819. The high school had 165 pupils in 1896-97, and there are two printing-presses, issuing an official gazette and a vernacular newspaper.

Rajputana., a collection of native states in India, under the political charge of an agent to the governor – general, who resides at Mount Abu. Geo- graphically, this tract includes the small British pro- vince of Ajmere-Merwara. Politically, Rajputana is subdivided into nine subordinate agencies : (1) Mewar or Udaipur, including Banswara, Partabgarh, and Dungar- pur ; (2) western states, comprising Marwar or Jodhpur, Sirohi, and Jaisalmer ; (3) Jaipur, including Kishengarh ; (4)

eastern states, comprising Bharatpur, Karauli, and Dholpur; (5) Haraoti, comprising Tonk, Bundi, and Shahpura; (6) Alwar; (7) Kotah; (8) Jhallawar ; (9) Bikanir. Total area, 130,268 square miles. Population (1881), 9,959,012; (1891), 12,220,343 (inclusive of registered Bliils), showing an apparent increase of 23 per cent., largely due to more accurate enumeration ; average density, 94 persons per square mile, ranging from 327 in Bharatpur to only 7 in Jaisalmer. Classified according to religion, in 1891 Hindus numbered 10,192,829; Mahom- medans, 991,351; Jains, 417,618; aborigines, 411,078; Christians, 1855; Parsis, 238; "others," 205,374. In 1901, however, the population had fallen to 9,841,032 ??? a decrease of more than two millions, or 18 per cent., due to the famine of 1899-1900. The estimated aggregate revenue is Rs. 3, 50,00, 000; expenditure on public works (1897-98), Rs.53,00,000. The tract is traversed through- out by the Rajputana Railway, with its l\Ialwa branch in the south, and diverging to Agra and Delhi in the north. Jodhpur, Udaipur, and Bikanir have constructed branch railways at their own cost, the fir.st of which was extended in 1901 to Haidarabad in Sind. Rajputana is liable to famine, the average rainfall in the western states being only 14 inches, and irrigation practically unavailable. It suffered very severely in 1868-69, and again in 1900, when the number of persons on relief was about 500,000.

Rajshahi, a district and division of British India. The administrative headquarters are at Ranipur Boalia. Area, 2330 square miles. Population (1891), 1,313,336.

Classified according to religion, in 1891 Mahommedans numbered 1,033,972; Hindus, 278,938; Christians, 105, of whom 41 were Europeans; "others," 321. In 1901 the population on a slightly enlarged area was 1,460,644, show- ing an increase on the corresponding area of 1 per cent. The land revenue and rates in 1897-98 were Rs. 10,95,979 ; number of police, 475 ; boys at school (1896-97), 18,544, being 18 '8 per cent, of the male population of school-going age ; registered death-rate (1897), 34'9 per thousand. Indigo is a decaying industry. There are three factories, employing 1000 persons, with an out-turn of 734 maunds, valued at Rs. 84,000. Sericulture has received a stimulus from the efforts of the Agricultural Department, supported by private enterprise, to

improve the breed of silkworms. There are 15 nurseries for rearing seed; and an industrial school for sericulture, with 15 students. The number of silk filatures is 13, employing 5000 persons, with an out> turn of 135,000 &, valued at Rs. 10,00,000. The hemp grown on a small tract in the north of the district supplies all the ganja that is consumed in Bengal The district is traversed from south to north by the main line of the Eastern Bengal Railway to Darjiling, vpith a branch to Bogra. Most of the permanent buildings in the district were severely damaged by the earthquake of 12th June

1897.

The division of Rajshahi is coextensive with northern Bengal, from the Ganges to the moimtains. It comprises the seven districts of Rajshahi, Dinajpur, Jalpaiguri, Dar- jiling, Eangpur, Bogra, and Pabna. Total area, 17,351 square miles. Population (1891), 7,726,701.

Rakonitz (Czech, Rakovnih), the chief town of a government district in Bohemia, west of Kladno. It is a railway junction, in the coal-mining district, and has im- portant manufactures of pottery, porcelain, glass and hard- ware, paper, soda, &c. The town has two ancient gate towers (1515) and an old Gothic church. Population (1890), 5629 ; (1900), 6615, Czech.

Raleigfh, a city of North Carolina, U.S.A., capital of Wake county and also of the state. It is a little north of the centre of the state, at the intersection of lines of the Seaboard Air Line and the Southern Rail- way, at an altitude of 317 feet. It is regularly laid out, has a good water-supply and sewerage system, and contains many state institutions, including the peni- tentiary, one of the three state insane asylums, and insti- tutions for the blind, deaf, and dumb. It is the site of the North Carolina College of Agricultural and Mechanical Arts, which in 1899 had a faculty of 27 and was attended by 252 students. It contains also Shaw University (for the coloured), with in 1809 a faculty of 26 and 365 students. It has several other minor educational insti- tutions. Population (1900), 13,643, of whom 145 were foreign-born and 5721 negroes.

Ram6e, Louise de la (1840), English

novelist, better known as Ouida, was born at Bury St Edmunds in 1840, her father being an Englishman and her mother a Frenchwoman. While still a girl, she went with her mother and grandmother to live in London, and there she began to contribute at an early age to the New MontMy and Bentley's 2Iagadne. In 1860 her first story, afterwards republished as Held in Bondage, appeared in the former under the title of Granville de Vigne, and this was followed in quick succession by Strathmore (1865), Chandos (1866), and Under Two Flags (1867). The list of Ouida's subsequent works is too long to be recapitulated here ; it is sufficient to say that, together with Moths (1880), those already named are not only the most characteristic, but also the best. In a less dramatic genre, her Bimbi : Stories for Children (1882), may also be

mentioned; but it was by her more flamboyant stories, such as Under Two Flags and Moths, that her popular success was achieved. By purely literary critics and on grounds of morality or taste Ouida's novels are bound to be con- demned. They are generally flashy, and frequently un- wholesome. It is impossible, however, to dismiss books like Chandos and Under Two Flags merely on such grounds. The new and rather French note of sensual passion which Ouida introduced into English fiction was combined in her with an original gift for situation and plot, and also with genuine descriptive powers which, though disfigured by inaccurate observation, literary solecisms, and tawdry extravagance, enabled her at her best to construct a picturesque and powerful story. The character of " Cigarette " in Under Two Flags is full of fine touches, and this is not an isolated instance. In 1874 " Ouida " made her home in Florence, and many of her latest novels have an Italian setting. She contri- buted from time to time to the magazines, and wrote vigorously on behaK of anti- vivisection and on Italian politics ; but her views on these subjects were marked by injudicious violence.

Ra,nieSWa.r❓❓ilT1, an island extending 11 miles towards Ceylon, being separated from the mainland of India by the Pambam channel. It derives its name from the mythical journey of Eama to Ceylon, described

in the Kamayana, and is 'one of the holy places of Hindu pilgrim- age. The great temple, with its pillared corridors 700 feet long, is perhaps the finest example of Dravidian architecture.

Ram Mohan Roy (1774-1833), Indian religious reformer, and founder of the Brahma Somaj, or Theistic Church, was born at Eadhanagar, in the district of Hugli, in Bengal, in 1774. He was the son of a petty zemindar (landlord), and in his early life acquired a knowledge of Persian, Arabic, and Sanskrit, besides his own vernacular, Bengali. At the age of sixteen he first assailed idolatry in his Bengali work, entitled The Idolatrous Religious System of the Hindus. This gave ofience to his orthodox father, and Earn Mohan left home and spent some years in travel. At the age of twenty-two he began his study of the English language, and he also acquired a knowledge of other modern and ancient European languages. On the death of his father he obtained an appointment under the British Government in 1800, from which he retired in 1814, settled down in Calcutta, and devoted himself to religious reform. He wrote Bengali works on the Vedanta Philosophy, translated some of the Upanishads, entered into controversies with Christian missionaries, and in 1828 established the Brahma Somaj " for the worship and adora- tion of the Eternal, Unsearchable, Immutable Being who is the Author and Preserver of the Universe." He gave his support to the governor-general. Lord William Ben- tinck, for the abolition of the suttee rite, i.e., the custom of permitting Hindu widows to burn themselves on the funeral pyre of their husbands.

In 1830 the emperor of Delhi bestowed on Earn Mohan the title of raja, and sent him to England as his agent. Eaja Eam Mohan Eoy gave his evidence before the Select Committee of the House of Commons on the judicial and revenue systems of India. He presented petitions to the House of Commons in support of the abolition of the suttee rite, and had the satisfaction of being present in the House when the appeal against such abolition was rejected on 11th July 1832. As the first educated and eminent Indian who had come to England, he received a cordial welcome from learned men ; and Bentham addressed him as an "intensely admired and dearly beloved collaborator in the service of mankind." Eaja Eam Mohan Eoy died

on 27th September 1833, and his remains were interred at Bristol. A tomb subsequently erected there by hia friend Dwarka Nath Tagore stiU exists.

The Brahma Somaj founded by Raja Ram Mohan Roy has con- tinued to flourish since his death. Dwarka Nath Tagore himself helped the movement, but subsequently he came to England, was well received for his culture, wealth, and influence, and died in England. His son Debendra Nath Tagore became the head of the Brahma Somaj, and continued to be the leader of the oldest section of it. A schism took place in the third quarter of the 19th century, and Keshab Chandra Sen became the head of the seceding Church. A further schism took place in his church some years later, and the newest section, headed by Anand Mohan Bose and others, is now the most popular and progressive institution of the Reformed Church inaugurated by Ram Mohan Roy in 1828. AU the three sections of the Brahma Somaj have done good work in the cause of literary culture, social refonn, and female education in India.

(e. C. D.)

Ramnad, a town of British India, in the Madura district of Madras, at the base of the spit of land that projects towards the island of Eameswaram in Palk Strait. Population (1891), 13,600. It is the residence of a raja of old family, head of the Maravar caste, whose title is Setupathi, or lord of Adam's Bridge. The estate covers an area of about 2400 square miles, and pays a permanent land revenue of ►►31,400. There is a S.P.G. high school, and a mission printing-press, issuing an English periodical. A large taids, supplied from the river Vaigai, irrigates 6000 acres.

R^mniCU Strati a town in Eumania, the chief town of the district bearing the same name. It was completely destroyed by fire in 1854 and was rebuilt. E►►,mnicu was the scene of several remarkable battles between the Moldavians and Wallachians in 1434 and 1573, and between the Wallachians and Turks in 1634. Here also, in 1789, an Austro-Eussian army, under the Prince of Coburg and Suwaroff, completely routed the Turks. Population (1895), 12,500; (1900), 13,134, of whom about 1500 were Jews.

R^mniCU Valcea, a town in Eumania, situated on the right bank of the river Olt, and chief town of the district of Valcea. It is the seat of a bishop, and contains a seminary and twelve churches. Near it are the well-known thermal springs of Olanesci. It is said to be the ancient Castra Trajani, and many traces of old encampments bear evidence of this. Population (1895),

6000; (1900), 7317.

Rampolla, Count Maeiano del Tindaro (1843-

), Italian cardinal, papal secretary of state, was

born on 17th August 1843, at Polizzi, in the Sicihan diocese of Cefalii. Having completed his studies in the Capranica College at Eome, and having taken holy orders, he studied diplomacy at the College of Ecclesiastical Nobles, and in 1875 was appointed councillor to the papal nunciature at Madrid. Two years later he was recalled to Eome and appointed secretary of the Propa- ganda for Eastern Affairs, and for Extraordinary Ecclesi- astical Affairs. Consecrated titular archbishop of Her- aclea in 1885, he returned to Madrid as Nuncio, but was shortly afterwards created cardinal and appointed to the papal secretaryship of state. The choice created con- siderable surprise, but was attributable to the desire of Leo XIII. to possess a secretary more docile than Cardinals Franchi, Nina, and Jacobini, who had previously held that office. EampoUa fulfilled papal expectations. New to the Sacred College and free from traditional preconcep- tions, he became a ready and pliant instrument of the pontifical will. He accepted the papal ideas, especially with regard to France, and seconded them with vigour if not always with tact. Notwithstanding persistent attempts

to cast upon Mm responsibility for the failure of Vatican policy towards France, and for the prevalence of reactionary tendencies during the later years of Leo XIII. ‘s pontificate, there is no evidence to show Cardinal

Eampolla to have been more than a faithful exponent of ideas aheady formed, though not completely applied, before his appointment to the secretaryship of state.

Ra,mpur, a stative state of India, in subordination to the North-Western Provinces. It lies in Eohilkhand, between the British districts of Moradabad and Pihbhit. Area, 945 square miles. Population (1891), 551,249; (1901), 532,067, showing a decrease of 3 per cent. Gross revenue, Es.31,83,000; mihtary force, 2556 men, including Imperial Service troops. The chief, whose title is Nawab, is a Kohilla Pathan, whose family have always been loyal to the British connexion. The state is crossed by a branch of the Oudh and Eohilkhand Eailway from Bareilly to Moradabad. The town of Eampur is on the left bank of the river Kosila, 620 feet above the sea; rail- way station, 39 miles north-west of Bareilly. Population (1891), 76,733; (1901), 77,862. There are manufactures of damask and pottery.

Ra,linpur Boa.lia,, or Beulbah, a town of British India, the administrative headquarters of Eajshahi district in Bengal ; on the left bank of the Ganges. Population (1881), 19,228 ; (1891), 21,407. It was originally chosen as a commercial factory for the silk trade, which is again being officially encouraged by the Agricultural Department. The town contains a Government college, a collegiate high school, and an industrial school for sericulture ; there are eight printing-presses, issuing two vernacular periodicals, a public library and debating club. Most of the public buildings were severely damaged by the earthquake of 12th June 1897. There is a regular steamer service with Damukdia Ghat, 50 mUes south-east on the Eastern Bengal Eailway.

Ramsay, Sir Andrew Crombie (1814-

1891), British geologist, was born at Glasgow on 31st January 1814. Intended for commercial life, he was for a time actually engaged in business, but from spending his holidays in Arran he became interested in the study of the rocks of that island, and was thus led to acquire the rudiments of geology. A geological model of Arran, made by him on the scale of two inches to the mile, was exhibited at the meeting of the British Association at Glasgow in 1840, and attracted the notice of Murchison,

with the result that he invited its maker to accompany him on a geological expedition to America. Eamsay accepted the offer, but the arrangement subsequently fell through, and instead he received, by Murchison's good offices, an appoint- ment on the Geological Survey, on which he served for forty years, from 1841 to 1881. He was first stationed at Tenby, and to that circumstance may be attributed the fact that so much of his geological work dealt with Wales. He was chosen professor of geology at University College, London, in 1848, and lecturer in the same subject at the School of Mines in 1851. Eleven years later he was elected to the presidential chair of the Geological Society, and in 1871 he succeeded Murchison as director-general of the Geological Survey. In 1880 he acted as president of the British Association at Swansea, and in the follow- ing year retired from the public service, receiving at the same time the honour of knighthood. He died ten years later at Beaumaris, on 9th December 1891. The scope of his work may be gathered from the titles of the following, which are among his most important jiapers: "Denudation of South Wales," " Old Glaciers of Switzerland and North Wales," " Glacial Origin of Certain Lakes in Switzerland, the Black Forest, &o.," " The Eed Eooks of England," and

" Eiver Courses of England and Wales." It will be seen that he was especially interested in tracing out the causes which have determined the physical configuration of a district, and he devoted much attention to the effects pro- duced by ice, his name being identified with the hypothesis, which, however, has never commanded general assent, that in some cases lake-basins have been scooped out by glaciers. Sir Archibald Geikie, who published a biography of him in 1895, has characterized him as combining a faculty for bold and broad generalization with habits of patient observation and cautious induction. He received a Eoyal medal in 1880 from the Eoyal Society, of which he became a fellow in 1862, and he was also the recipient of the Neill prize of the Eoyal Society of Edinburgh in 1866, and of the WoUaston medal of the Eoyal Geological Society in 1871.

Ramsbottom, manufacturing town and urban district (1894), Lancashire, England, in the Heywood parliamentary division of the county, 13 J miles north of Manchester by rail. A Primitive Methodist chapel was erected in

1889, and a cottage hospital was opened in 1900. It has iron and brass foundries, machine factories, and establishments for calico printing, bleaching, spinning, and manufacturing. Population (1891), 16,726; (1901),

15,920.

RamSg^ate, municipal borough and watering-place in the Isle of Thanet parliamentary division of Kent, Eng- land, 79 miles easf>south-east of London by rail. The inner harbour covers (1899) an area of 12 acres ; the outer, of 35 acres. In 1888, 895 vessels entered with 118,636 tons of cargo, and 857 vessels cleared with 114,906 tons. In 1901, 1666, vessels entered with 324,145 tons, and 1531 vessels cleared with 266,458 tons. Steamboats run during the season to London, Tilbury, Margate, Deal, Dover, Calais, and Boulogne. Electric trams connect Eamsgate with Broadstairs and Margate. Extensive im- provements were carried out in 1895-96 on the sea-front. They include a new sea-wall and a widened approach to the sands. The corporation opened a public library in 1895. Technical schools occupy part of the same building. Ellington Park, area 12 acres, was opened in 1893. Population of the municipal borough (1891), 24,733;

(1901), 27,693.

RanavalO III. (1864), formerly queen of

Madagascar, born in 1864, was a great-niece of Eadama I. Her name originally was Easuaherina, but on succeeding to the throne of Madagascar after the death of Queen Eanavalo II., on 14th Jiily 1883, she assumed the style of Eanavalo III. Although nominally queen, she took no share in the government, which her prime minister, Eainilaiarivony, had controlled since 1864. After placing her on the throne, he married her before the close of the year. Eanavalo became queen just after the French had revived their claim to a protectorate over the island. The Hova Government refusing to admit the claim, war broke out, and several sharp engagements took place. The French bombarded the coast towns, but were unable to reach the interior of the island, where the strength of the Hovas lay. In December 1885 a treaty was concluded

by which it was agreed that the government of the French Eepublic should represent Madagascar in all foreign relations, but that in internal matters the Hova Government should be inde- pendent, as formerly. During the next ten years French influence was quietly extended over the island, in spite of the efforts of Eainilaiarivony, who pursued an anti-French policy, encouraging English and American planters and traders. In 1894 differences on commercial and territorial questions arose between the Hova Government and the French, which terminated in war. In 1895 a well-organized

expedition was despatclied from France to subjugate the island. Many of the inhabitants sympathized with the invaders, and even the Hovas themselves were divided. Although Ranavalo endeavoured to arouse a martial spirit in her subjects, the French advanced on the capital without encountering any effective opposition. On 30th September they captured Antananarivo. Eainilaiarivony was sent into exile, where he died in the following year; but Ranavalo was suffered to remain as nominal head of the Government, under a strict French protectorate. In 1896, to avoid commercial difficulties with foreign Powers, the island was- declared a French colony ; but no change was made in the internal administration. Later in the year, however, the civil governor was replaced by a military resident, General GaUieni. A formidable insurrection broke out, which GaUieni suppressed, executing or exiling several prominent members of the Hova administration. Finding that the court had been a centre of intrigue, he abolished the sovereignty by proclamation early in 1897, and exiled Ranavalo to Reunion. In 1899 she was removed to Algiers, but was subsequently permitted to visit Paris.

Ranch i, a town of British India, headquarters of Lohardaga district and of the Ghota Nagpur division in Bengal, situated in 23❓❓22' N. and 85❓❓22' E., 2100 feet above the sea. Population (1891), 20,306. It is an im- portant centre of local trade, and the headquarters of the German Lutheran mission. There is a high school and an industrial school; also

three printing-presses, issuing two periodicals, a public library and bar library.

Rand. See Gold.

Randazzo, a town of the province of Catania, Sicily, Italy, at the north foot of Mount Etna, 25 miles north-west of Giarre by the circum-Etna railway. It is a mediaeval- looking town, with Norman walls built of lava, a church dating from the 13th-14th centuries, a former ducal palace (now a prison), several medisBval private houses, and an antiquarian museum. Randazzo is the nearest town to the summit of Mount Etna, 9 miles distant, and stands 2474 feet above sea -level. Population (1881), 9908; (1899), about 8500.

Randers, a town of Denmark, 8 miles inland from Eanders Fjord, and 36 miles by rail north by west of Aarhus in Jutland. The high school is housed in a mediffival monastery, which was restored in 1894-97. There is a statue to Steen S. Blicher (1782-1848), the national author of Jutland. There are distilleries and manufactories of gloves, railway carriages, &c., and large slaughter yards. In 1899 the port was entered by 648 vessels of 74,968 tons, and cleared by 652 of 76,275 tons. The chief exports are butter and eggs ; the chief imports, sugar, petroleum, coal, and iron. Population (1890),

16,617; (1901), 20,057.

Ranenburgf, a district town of Russia, in the government, and 105 miles south of the town, of Ryazan. A considerable trade in grain is carried on, and the in- habitants have gained a reputation for gardening. The population in 1897 was 15,347.

Rang'e-Finder (or Telemetee). ??? ~~*The judgment of the most highly trained observer, guided by the un*~~ *assisted eye, is not sufficiently trustworthy to develop to the full the powers of modern weapons. Hence numberless inventors have produced instruments in endless variety to assist the gunner and infantry soldier in determining the distance or " range " to their objective. Such instruments are called telemeters, or, more generally, range-finders.*

Among the many inventors of range-finders the following names may be mentioned : ??? Eocsaudre (Austria) ; Deport, Goulier

(France) ; Amici, Braccialini (Italy) ; Souohier (Russia) ; Unge (Sweden) ; Crehore and Squier, Kiske, Gordon, Leslie, Lewis, Pratt (United States of America) ; Adie, Barr and Stroud, Christie, Mallook, Watkin, Weldon, &o. (Great Britain).

Nearly all range-finders may be described as instru- ments which automatically solve a triangle. Usually it is a right-angled triangle, the length of the base of which is known, and one of the sides is the range it is desired to find. They are, in fact, goniometers, but the angle which they measure, whether it may be at the end of the measured base, or that subtended by it, is usually expressed as a function of the angle in terms of the measured base. In fact, the range is recorded directly in metres or yards with- out calculation. It has frequently been observed that, if a convenient telescope could be devised of sufficient focal length for the travel of the eyepiece in focussing to be made the measure of the distance of the objective from the observer, a perfect range-finder would be obtained.

It is proposed in this article to describe briefly the range-finding instruments in the British services (1) as used in the fleet ; (2) by the army in the field ; and (3) in harbour defence.

(1) The necessity for a range-finder afloat caused the British Admiralty in 1891 to issue an advertisement in the press inviting inventors to produce an instrument, which would, amongst other conditions, record ranges with an accuracy of 3 per cent, at 3000 yards. The resulting competition was declared in favour of a range- finder the joint invention of Professor Barr of the Glasgow University and Professor Stroud of the Yorkshire GoUege.

The naval range-finder consists of a tube 60 inches in length by 3J inches in diameter, which contains two telescopes. It is carried on a frame by bearings, in which the tube is free to revolve about its longer axis. To the frame is attached a weight capable of movement within a tank. This weight balances the range-finder and frame upon knife-edges. By means

of the handle on the left of the instrument and an altitude worm beneath it, the motion of the tube is governed, and the line of sight is directed on the objective. By partially filling the tank with water, the swinging of the weight in a seaway can be checked. The frame is supported on a pedestal and can rotate in azimuth upon it (Fig. 1). A rubber guard is fitted round the eyepieces. Its functions are to guide the eyes of the observer into the correct position, and to protect them from side light and the distressing effect of wind. It also guards the forehead against the jar occasioned by firing heavy guns. The upper portion of the field presented to the left eye is used as a finder, the lower portion is occupied by the scale upon which the ranges are engraved. The finder is a low-power telescope of large field, to the centre of which the objective is brought. When the telescope is thus correctly aligned the objective will be seen with the right eye largely magnified, but as two partial images separated by a thin black horizontal line. When coincidence of the images is effected by means of the working head, the range can be read off against a pointer from the scale seen with the left eye. For night use, means are provided for illuminating the scale. The range to lights may be ascertained by the use of the astigmatizer, an optical device by which a point of light is drawn out into a vertical streak. A beam of light from the objective falls on each reflector (Fig. 2), and passing through the object glasses, each is received by an arrangement of" prisms about the centre of the tube, and reflected through the right eyepiece. Two partial images are thus seen. The images could be united by the rotation of one of the reflectors, but owing to the small base used the necessary movement would be so extremely small that it would be practically impossible to measure it. The difficulty has been surmounted by utilizing fixed reflectors and effecting coincidence by means of a prism of small angle. The deflecting prism is situated in the line of the beam of light from the reflector at the right-hand end of the tube. Its multiplying action is of great delicacy. The angle available for subdivision, to measure ranges between infinity and 250 yards, is only one-third of a degree. In a travel of 6 inches the prism renders accurate measurements possible within the required limits. To bring images of distant objectives into coincidence, the prism must be moved towards tho eyepiece, and for near objectives in the opposite direction. The range scale is attached to the prism. A consequent advantage is that the accuracy of the instrument is not affected by back lash arising from wear, or irregularity in the

actuating mechanism. When once installed the instrument is always ready for use.

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RANG E-F I N D E R

Should adjustment be required it is readily and easily applied. It is not within the sphere of this article to enter into the detail of

LEFT SCARINfr

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1 ??? T

RUBSER .WASHEU

Fig. 1.

the adjusting mechanism. For further p^irticulars the reader is referred to the Proceedings of the Institution of Mechanical Engineers, 30th January 1896. The working of the range-finder is

SUPPORT FINDER OBJECT GUSS SUPPORT

^

*)FRAME EYE PiECEPBlSMS^{^ SCALE'^*

lOBJECT GUSS CASE

^

OEFLECTIIIS PRISM OBJECT CLASS REFLECTOR

Fig. 2.

so^ simple that its use is quickly learnt by any man who can read, and with little instruction and practice he can ” take a range ” in 8 to 12 seconds. Besides its principal purpose, in connexion with gunnery, there are minor uses in navigation and nautical surveying to which the range-finder can be applied.

With the high speeds of modern war vessels, guns and their objective approach each other so quickly that unless ranges can be communicated from the instrument to the guns with rapidity and accuracy the range-finder is deprived of much of its value. In connexion with the naval range-finder an apparatus is provided, which though not part of the range-finder is sufiiciently important to claim passing notice. The apparatus consists of a trans- mitting and a receiving instrument of clockwork mechanism electrically controlled. In appearance they resemble the ordinary engine – room telegraph, on the dials of which ranges take the place of orders. The transmitter can communicate with a number of receiving instruments, disposed as required in difi’erent parts of the ship.

(2) For the army in the field there is but one type oi nightangie instrument

range-finder. To the set of instruments used the name of mdcometer has been given. The instruments used by the cavalry and infantry are smaller and lighter than those of the artillery pattern, but the principle involved is identical.

with index and horizon glasses permanently inclined at 45 ??. It consequently measures a right angle. In the other sextant, called the reading instrument, a graduated drum takes the place of the usual index arm and scale. The drum is graduated spirally with a scale of ranges. Both reading and right angle instruments are fitted with a vane of gun metal with a white strip down the centre to facilitate observations. Telescopes of low power can be fitted to the instruments, and two cords of 50 (or 25i) yards are provided with which to measure the base.

Two observers attach the ends of the cord of fixed length (usually 50 yards) to their in- struments and separate until it is taut. The observer

with the right angle instrument moves into sucli a position that coincidence of image will be given between the objective and the vane of the instrument at the other end of the base, i.e., he makes ABC a right angle (Fig. 3). When the right angle is established the observer at C turns the graduated drum of the reading instrument untu the image of the vane of the right angle instrument coincides with the direction of the objective. The range AC is then read on the drum. The ranges on the drum are measures of the angle BAG when the base BC is 50 yards.

The mekometer is open to the objection which is common to all range-finders requiring more than one observer. There is always a danger that observers may cause coincidence on different objectives or on different parts of the same objective, and thus inaccuracy in the recorded range must result. The instruments are expected to give an accuracy of less than 2 per cent, at 2000 yards. For ranges over that distance, i.e., for usual artillery ranges, it is desirable to use a double base (100 yards in length), in which case the range registered on the drum must be doubled. This operation, although slight, is a distinct disadvantage, because no calculation, however trifling, is desirable in action; since it adds to the time of taking a range and is a possible source of error. For field artillery, however, a range- finder is only an auxiliary adjunct. The true range can be found by a, process of trial and error in as short a time as the mekometer observers take to report it. To quote from the field artillery drill book, "The first round is fired with the elevation due to the range as estimated, or given by the range taker. If it is short the elevation is increased by 100, 200, or 400 yards, and after every round observed short the same alteration is made until a round is observed over ; the ' long bracket ' is then said to be found. The difference between the two elevations that have bracketed the target is then halved ??? until the target is enclosed between two rounds the difference of whose elevation is 50 yards, which is termed the " short bracket. " ' Thus the correct elevation is found. It must,

^.*Objective*

m

END- PUTE

‘Reading instrument

The mekometer is practically a box sextant (Fig. 2). Two instruments are used simultaneously at the ends of a base of fixed length. One sextant called the right-angle instrument is fitted

however, be remembered that as shrapnel shell is the principal projectile of field artillery, after the correct elevation has been given the true length of time fuze has to be found. This the

1 At the battle of Omdurman tlie infantry and machine guns obtained the ranges from tlie field artillery.

RANGOON

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range-finder cannot do. Hence it is that the range-finder for field artillery, although a valuable auxiliary, is not of the same importance as in purely defensive positions such as batteries for harbour defence and land forts. It is believed that in the German and French field artillery a range-finder is not used.

3. For harbour defence, owing to the long range of naval guns, and the fast targets which war vessels present, an accurate range-finder is of first importance. This is largely the case because “ranging” cannot be resorted to in the same manner as in the field, where the targets are comparatively motionless and the effective ranges are less. Successful artillery practice therefore depends, in a great measure, upon the range-finder.

Fig. 4.

The instrument much used in harbour forts is known as the de.‘pnssion range-finder. As its name suggests, it solves a triangle in the vertical plane, of which the base is the height of the instrument above sea – level. Its appearance resembles some forms of theodolite (Fig. 4). A framework, capable of rotating in azimuth on a vertical pivot, is supported on a plate carried by levelling screws, L, L, L. To the framework are pivoted two

arms DC and FE, at 0 and E respectively. The arm EF is supported at F by a vertical screw H ending in a drum, upon which, in a spiral scale, the ranges are graduated. Motion in altitude is thus given to the telescope. The arm CD is supported by a slider 6. This slider is set by a rack and pinion to the height above sea-level (represented on a scale of feet on EF) at which the instrument may be used. A telescope AB is suitably fitted in jaws at the top of the frame. There are spirit levels at M and Q for adjusting purposes. The telescope is provided with cross wires which can be illuminated for night use. An azimuth circle X and pointer Y enable the direction of any vessel to be indicated, the range of which it is desired to know. The instru- ment rests on a base plate R to which it is locked by the top- plate 0. The observer directs the cross wires of the telescope upon the water line of the objective, by means of the drum I and the azimuth handle P, the top of which just appears in the diagram. The reader watches the arrow on the drum and calls out the ranges as the figures arrive beneath it. The ranges are communicated to the olEcers at the guns by various devices, which differ according to local requirements. ,

The details of the Position Fiader are carefully guarded as confidential. From the brief published descriptions it may be gathered that directing the telescope upon the objective electrically communicates the bearing and range to the gun detachments. The position finder, and also the depression range fiader and mekometer, are inventions of Colonel Watkin, C.B.

The greatest advance in practical range -finding for harbour defence, in recent years, has been made in the apparatus to which the name has been given of automatic sight.

The mechanism is the invention ofSir George Clarke, K.C.M.G., F. R. S. , &c. The principle of the sight is the outcome of a process of evolution in range-finding. The depression range-finder gives ranges from the objective to the range-finder. The position-finder goes a step further, and automatically communicates range and

bearing to the vicinity of the guns. But by means of the auto- matic sight, the same muscular effort which aligns the laying points (or telescope) on the objective, imparts the requisite eleva- tion and direction to the gun.

Such a system of laying ordnance has long been a requirement, but quick-firing guns and smokeless powder demand it as a necessity. The automatic sight renders it possible to regard the individual gun as an independent unit, and with it the largest gun becomes as a rifle in the hands of the man who lays it. Range-finders bind the guns they serve to one objective, and necessitate a rigid fire discipline in order that the guns may be ready to fire at the moment the anticipated range is reported. The automatic sight allows convergence or dispersion of accurate fire, and in a measure restores the elasticity of control of the days of smooth bores. It economizes men, and the gun-layer who uses it does not require the high training necessary for range-finding specialists.

The principle of the apparatus is made clear by Fig. 5. AB is a bar carrying the fore and hind sights, or a telescope fitted at the focus with n pointer. AB is pivoted at C. CD is the attachment of the apparatus to the cradle E. (As the gun recoils through E, the gunner can continue to look over the sights whilst firing.) At right angles to AB is a bar FG, fitted at H with a guide working in a cam plate K. L is a case containing a spring, whose function it is to keep the guide H in contact with the cam. It will be seen that as the gun is elevated or depressed, motion in altitude is imparted to the sight bar AB. The amount of motion is regu- lated by the form of the cam K, which is cut in accordance with the range table of the gun and the height above sea-level. The sight, there- fore, is a depression range-finder, having for its base the height of the axis of the gun above the sea. A compensation for rise and fall of tide is consequently necessary, and is effected by the handle M. M works through a suitably engraved scale and, actuating an eccentric at N, imparts the necessary correcting motion about the pivot R to the cam plate K. The reader is referred for further details to Garrison Artillery Drill, 1899, or the Jowmal of the United States Artillery, vol. xiii. p. 323.

Fig. 6.

AUTHOKITIBS. ??? "War Office publications : Handbook for the Depression Range-Finder for Elevated Batteries, Sandhooh for the Mekometer, Garrison Artillery Drill, Field Artillery Drill, Hand- book for the Position Finding Instruments. ??? Bake and SxEOUD.

“Telemeters and Range – Finders, ” Proceedings Inst. Mech. Engineers, January 1896. ◆◆◆ Lassitek. “Range and Position Finding,” Journal of U.S. Artillery, April 1895. ◆◆◆ Db Kekillis. “Automatic Sights,” Memie Maritime et Coloniale, August 1895.

(r. M. L.) Ra.ng’OOn, the capital of Burma, situated on the left bank of the river Hlaing or Rangoon, 21 miles from the sea, in 16◆◆47′ K and 96◆◆13′ E. In 1880 Eangoon town was detached from the main district, called Hanthawaddy, and formed into a separate district, with an area of 22 square miles. Population of Rangoon (1891), 181,871 ; (1901);*

232,326.

Until 1874 the management of the town was in the hands of the local government, which devoted itself to raising the centre of the

town above the river level, providing land fit for building purposes from the original swamp, which was flooded at spring- tides, and making roads, bridges, culverts, and surface drains. In 1892 was introduced the Shone sewage system, which now includes 6 miles of sewage mains, 22 miles of gravitating sewers, 4f miles of air mains, and 44 Shone’s ejectors. The water- works for Rangoon proper and for the shipping were not completed till 1893. The water-supply is now derived from Victoria Lake, a reservoir near Kokiue, five miles distant. The town proper of Rangoon with the Kemmendine suburb is laid out on the block system, each block being 800 by 860 feet, intersected with regular

streets. In the extensions of Rangoon to the east and west it has been decided to have no streets less than 50 feet wide. The roads are still lighted by kerosene oil lamps, although Moulmein has adopted a lighting system of oil gas. The lighting extends over 42 miles of roads. Steam tramways run from the town to Pazun- daung in one direction and to

Alon and Kemmendine in the other, as well as to the foot of the Shwe Dag5n Pagoda hill. Latterly the erection of masonry buildings, instead of plank houses, has been insisted on in the central portion of the town, with the residt that fires have decreased in number. There are two large maidans, or commons, which are used as military parade

RANGOON.

Natural Scale. 1,63,360. Scale of I Mile

f ‘4 ►►}

Walker & Cockerell sc.

MAP OF KANGOON.

grounds and for racing, as well as for golf links and other purposes of amusement. There is a garden round the Phayre Museum, managed by the Agri-Horticultural Society, and an extremely pretty and well-kept garden in the cantonments under the Pagoda. Beyond these, however, the Royal Lake and Dalhousie Park, with 160 acres of water and 205 acres of well-laid-out and well-timbered park land, form one of the finest recreation grounds of which any city can >)0:ist. There are two cathedrals. Church of England and Roman Catholic, a Presbyterian church, and, besides tlie canton- ment church, many other houses of various forms of Christian worship. Religious buildings and lands, indeed, occupy an area in Rangoon out of all proportion to its total size. Christians, Buddhists, Mussulmans, Hindus, Parsis, Armenians, and Jews all own lands and churches, pagodas, temples, mosques, and synagogues. The Buddhist monasteries, in particular, occupy wide spaces in very central portions of the town and cantonments. They are very far from being properly kept, but the ground is devoted in perpetuity to religion, and cannot be resumed, for reasons of public policy. Burial-grounds are equally extensive, and exist in every direction in what were once the outskirts, but are now fast becoming central parts of the city. A large necropolis is being prepared outside Rangoon, and most of the graveyards, many of which are already dangerously overcrowded, will soon be closed. The civil general hospital has accommodation for 368

patients, and over 7000 in-patients aud 55,000 out-patients are annually treated in it. The military authorities have a hospital in cantonments. The Dufferin Institute for providing female medical aid to women has a branch and a small hospital in Rangoon, and a new hospital is in course of construction. Con- tagious diseases, cholera and small-pox, are treated in separate hospitals built outside the crowded part of the town. There are three municipal and eight private markets in Rangoon, which are being improved and extended. Everything, from sacking to jewellery, is sold in them. The introduction of pure water and the establishment of compulsory vaccination have greatly improved the health of Rangoon. The aggregate death-rate, which was 31 '41 per

mille in 1896, had fallen to 2316 in 1898-99. The rate is still high, and is due partly to the swampy nature of the outskirts of the town proper, and still more to the deaths among the Hindu immigrants from tile Madras Presidency. The death-rate among Christians is only 7 per mille. Of the population in 1898-99, the number of Buddhistsand Jains was 79,857 ; Hindus, 57,845 ; Mahommedans, 28,836 ; Christians, 12,698, of whom 4686 were natives, 1075 Karens and Shans, and 33 Parsis. The total rainfall in 1S9S-99 was 109-05 inches. The highest thermometer reading in May was 97 '5 , and the lowest reading in December 60 '8 F. (j. g. Sc.)

Rangpur, or Rungpoee, a town and district of British India, in the Rajslialii division of Bengal. The town is situated on the little river Ghaghat. Population (1891), 14,216. There is a high school, a normal school, and an industrial school. A public library was established in 1854. The earthquake of 12th June 1897 destroyed many of the public buildings, and diverted the drainage channels.

The BISTKIOT of Rangpur has an area of 3486 square miles. The population in 1891 was 2,065,464, showing a slight decrease ; average density, 592 persons per square mile. Classified according to religion, in 1891 Mahommedans numbered 1,295,411 ; Hindus, 768,233 ; Christians, 243, of whom 86 were Europeans ; "others," 1577. In 1901 the population was 2,152,518, showing an increase of 4 per cent. The land revenue and rates in 1897-98 were Rs.ll, 46,765 ; number of police, 465 ;

boys at school (1896-97), 26,068, being 16‘3 per cent, of the male population of school-going age ; registered death-rate (1897), 38 per thousand. After rice, the most important crop is jute. There are 21 jute presses, with a capital of Rs.5,28,000, producing 181,000 bales, valued at Rs.20,87,000. Tobacco also is largely grown. The Eastern Bengal Railway has two branches, one of which crosses the district to the Brahmaputra, and the other runs north to Cooch Behar. The railway bridge over the Tista at Kaunia was opened iu 1901.

R A N K E

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Ranke, Leopold von (1795-1886), German historian, was born, 21st December 1795, in the small town of Wiehe, in Thuringia, which then formed part of the electorate of Saxony. His father was an advocate, but his ancestors, so far back as the famOy can be traced, had been ministers of religion. To the end of his days he maintained the deep religious feeling and family affection which he had acquired as a child. He received his education first at Donndorf, a boarding-school established in an old monas- tery near his home, and then at Sohulpforta. Thence he passed to the University of Leipzig. His studies, both at school and university, were predominantly classical and theological ; he received no special training in, and during his early years he displayed no special vocation for, history. The great political events which occurred during his boyhood and youth seem to have had less effect on him than on many of his contemporaries, and he was not carried away either by enthusiastic admiration for Napoleon or by the patriotic fervour of 1813; nor was he implicated in the political movements which during the following years attracted many of the students. He already displayed that detachment of mind which was to be so characteristic of him. At the age of twenty-two he became master in a school at Frank- fort-on- the- Oder. He thereby entered the service of the Prussian Government : his birthplace had already been annexed to Prussia. The head- master was Poppo, the cele- brated Grecian. But besides his classical work, Eanke was entrusted with the teaching of history. With the scholar’s dislike of text-books, he rapidly acquired a thorough know- ledge of the ancient his- torians, quickly

passed on to medieval times, and here it was that he formed as the ideal of his life the study of universal history ⁂ the works of God as displayed in the history of the human race. Here, too, he composed his first work, which deals with the period to which most of his life was to be devoted. On the History of the Romance and German Races from 149-i- to 1516 (Berlin, 1824). To it was appended a critical dissertation on the historians who had dealt with the period, which, showing as it did how untrustworthy was much of tradi- tional history, was to be for modern history as epoch- marking as the critical work of Niebuhr ⁂ who in this was his master ⁂ had been in ancient history. A copy of the book was sent to the Prussian minister of education, Kampz, the notorious hunter of democrats. Within a week he received the promise of a post at Berlin, and in less than three months was appointed supernumerary professor, with a small salary ⁂ a striking instance of the promptitude with which the Prussian Government recognized scientific merit when, as in Ranke's case, it was free from dangerous political opinions. The connexion thus established was to last for fifty years. At the Berlin Library Ranke found a collection of MS. records, chiefly Italian, dealing

LEOPOLD VON EANKE. (By permission of E, Lmde and Co,)

with the period of the Reformation : from a study of them he found how different were the real events as disclosed in contemporary documents from the history as recorded by most writers ; and the result of his researches was embodied in his second work. The Princes and Peoples of Southern Ewrope (1827). (In later editions the title of this was altered to The Osnians and the Spanish Monarchy in the 16th and 17th Centuries^ It was now his ambition to continue his exploration of the new world thus opened to him : the Prussian Government provided the means, and in September 1827 he started for Italy. His first sojourn was in Vienna : the friendship of Gentz and the protection of Metternich opened to him the Venetian archives, of which many were preserved in that city ⁂ a virgin field, the value of which he first discovered, and which is stUl unexhausted. He found time, in addition, to write a short book on Servia and the Servian Revolution, from material supplied to him by Wuk Stephanowich, a Servian, who

had himself been witness of

the scenes he related. In 1828 he at last crossed the Alps, and the next three years were spent in Italy. The re- commendations of Metternich opened to him almost every library except the Vatican; and it was during these three years of study in Venice, Ferrara, Rome, and other cities, that he obtained that acquaintance vrith European history which was to make him the first historian of his time. At Rome, as he said, hri learned to see events from ilie inside. He wrote nothing but a critical examination of tlie story of Don Carlos, but 1)11 returned to Germany a master of his craft. He then f')r a time engaged in an occu- l>.ition of a different nature, for he was appointed editor of a periodical which Perthes designed to defend the Prussian Government against the de- mocratic press. Ranke, con- temptuous in politics, as in history, of the men who warped facts to support some abstract theory, especially dis- liked the doctrinaire Liber- alism so fashionable at the time. He hoped, by present- ing facts as they were, to vsdn the adhesion of aU parties. We need not be surprised that he failed : men desired not the scientific treatment of politics, but satire and invective. Exposed to the attacks of men like Heyne and Borne, his weakness, if not his venality, was long an article of faith among the Liberals. He did not satisfy the Prussian Conservatives, and after four years the Historische Politische Blatter came to an end. Two- thirds of the matter had been contributed by the editor, but the two stout volumes in which the numbers were collected contained the best political thought which had for long appeared in Germany. For Ranke the failure was not to be regretted: the rest of his life was to be wholly devoted to that in which he excelled. During 1834-37 appeared the three volumes of his History of the Popes, in form, as in matter, the greatest of his works, containing the results of his studies in Italy. Henceforth

his name was known in all European countries ; the Eng- lish translation by Mrs Austin was the occasion of one of Macaulay s most brilliant essays. Before it was completed he had already begun the researches on which was based the second of his masterpieces, the History of Gerwxiny

during the Reformation (1839-47), a necessary pendant to his book on the Popes, and the most popular of his works in his own country. In 1837 he became full professor; in 1841 Frederick William IV., always ready to recognize intellectual eminence, appointed him Prussian historiographer. Stimulated by this, he brought out his Nine Books of Prussian History (1847-48; subsequently expanded to twelve), a work which, chiefly owing to the nature of the subject, makes severe demands on the atten- tion of the reader ??? he is the " Dryasdust " of Carlyle's Frederick ; but in it he laid the foundation for the modern appreciation of the founders of the Prussian State. He took no immediate part in the movements of 1848, but in the following years drew up several memoranda for the king, whom he encouraged in his efforts to defend the character and identity of the Prussian State against the Revolution. Though never admitted into the inner circle of the king's associates (for indeed what place was there for him among the Gerlachs, Stahls, and Radowitzs 1), he found the king the most appreciative of readers and stimulating of companions, and the queen one of the most faithful of his friends ; in biographical works and on other occasions he always defended the memory of the unfortunate monarch. A friend even more sym- pathetic he found in Maximilian II. of Bavaria, whom he advised in his expansive schemes for the promotion of learning and letters. In the quieter years that followed he wrote the third of his masterpieces, the History of France, chiefly in the 16th and 17th Centuries (1852-61), which was followed by the History of England, chiefly in the 17th Centwry (1859-67). This, the longest of his works, added much to existing knowledge, especially as to the relations between England and the Continent, but it lacked something of the freshness of his earlier books ; he was over seventy when it was completed, and he was never quite at home in dealing with the parliamentary foundations of English public life. It is impossible even to enumerate his other and minor works, which chiefly deal with the German history of the last three centuries. In his later years his small alert figure was one of the most distinguished in the society of Berlin, and every honour open to a man of letters was conferred Upon him. He was ennobled in 1865, and in 1885 received the title of Excellenz. When the weakness of his eyes made it necessary for him to depend almost entirely on the service of readers and secretaries, in his eighty-first year he began to write the History of the

World. Drawing on the knowledge accumulated during sixty years, he lived to bring it down to the time of the Crusades.

Ranke married, at Windermere, in 1843, Miss Clara Graves, daughter of an Irish barrister. She died in 1870, leaving two sons and one daughter.

At the time of his death Ranke was, not in his own country alone, generally regarded as the first of modern historians. It is no disparagement to point out that the recognition he obtained was due not only to his published work, but also to his success as a teacher. His public lectures, indeed, were never largely attended, but in his more private classes, where he dealt with the technical work of a historian, he trained generations of scholars : no one since Heyne has had so great an influence on German academical life, and for a whole generation the Berlin school had no rival. He took paternal pride in the achievements of his pupils, and delighted to see, through them, his influence spreading in every university. While

his own work lay chiefly in more modern times, he trained in his classes a school of writers on German medieval history. As must always happen, it is only a part of his characteristics which they learnt from him, for his greatest qualities were incommunicable. The critical method which has since become almost a formal system, aiming at scien- tific certainty, was with him an unexampled power, based on the insight acquired from wide knowledge, which enabled him to judge the credibility of an author or the genuineness of an authority ; but he has made it impos- sible for any one to attempt to write modern history except on the ” narratives of eye-witnesses and the most genuine immediate documents ” preserved in the archives. From the beginning he was determined never to allow himself to be misled, in his search for truth, by those theories and prejudices by which nearly every other historian was influenced ??? Hegehanism, Liberalism, Romanticism, religious and patriotic prejudice; but his superiority to the ordinary passions of the historian could only be attained by those who shared his elevation of character. ” My object is simply to find out how the things actually occurred.” ” I am first a historian, then a Christian,” he himself said. In another way no historian is less objective, for in his greatest works the whole narrative is coloured by the quality of

his mind expressed in his style. An enemy to all controversy and aU violence, whether in act or thought, he had a serenity of character comparable only to that of Sophocles or Goethe. Apt to minimize difficulties, to search for the common ground of unity in opponents, he turned aside, with a disdain which superficial critics often mistook for indifference, from the base, the violent, and the common. As in a Greek tragedy, we hear in his works the echo of great events and terrible catastrophes : we do not see them. He also made it a principle not to relate that which was already well known, a maxim which necessarily prevented his works attaining a popularity with the unlearned equal to their reputation among historians. But no writer has surpassed him in the clearness and brevity with which he could sum up the characteristics of an epoch in the history of the world, or present and define the great forces by which the world has been influenced. His classicism led to his great limitations as a historian. He did not deal with the history of the people, with economic or social problems ❓❓❓ the dignity of history was to him a reality : he belonged to the school of Thucydides and Gibbon, not of Macaulay and Taine ; he deals by preference with the rulers and leaders of the world, and he strictly limits his field to the history of the state, or, as we should say, political history ; and in this he is followed by Seeley, one of the greatest of his adherents. The leader of modern historians, he was in truth a man of the ancien regime.

There is a collected edition of Ranke's works in fifty-four vol- nmes, published hy Dunkler and Humblot, 1881, &c. This does not include the JFeltgeschiditr. The last two volumes contain letters and autobiogi- aphical fragments. Besides the History of England and the History of the Papacy, there are English trans- lations of his History of the Romance and Teutonic Peoples by AsHWORTH ; of the Prinas and Peoples of Southern Europe, and of the first volume of the History of the Jf'orld, by Protheko. See also the article in the Allgemeiw deutsche Biographic by Dove. ❓❓❓ GuGLiA. Leopold v. Ranke. 1893. ❓❓❓ Ottokar Loeenz. Die Geschichtswixsenscha,ft. Berlin, 1891. ❓❓❓ LoRn Acton on " German Schools of History," in English Historical Revicv;, vol. i. Ko. i. ❓❓❓ GuiLLAND. L'Allemagne ISfouvelle et ses historicns. Paris, 1899.

(j. W. HE.)

Raoult, Francois Marie (1830-1901), French

chemist, was born at Fournes, in the Departemerit du Nord, on 10th May 1830. He became aspirant repetiteur at the lyc^e of Rheims in 1853, and after holding several inter- mediate positions was appointed in 1862 to the professor- ship of chemistry in Sens lyci^e, where he prepared the

thesis on electromotive force ???which gained him his doctor's degree at Paris in the following year. In 1867 he was put in charge of the chemistry classes at Grenoble, and three years later he succeeded to the chair of chemistry, which he held until his death on 1st April 1901. Eaoult's earliest researches were physical in character, being largely concerned with the phenomena of the voltaic cell, and later there was a period when more purely chemical ques- tions engaged his attention. But his name is best known in connexion with the work on solutions, to which he devoted the last two decades of his life. His first paper on the depression of the freezing points of liquids by the presence of substances dissolved in them was published in 1878 ; and continued investigation and experiment with various solvents, such as benzene and acetic acid, in addi- tion to water, led him to the discovery of a simple relation between the molecular weights of the substances and the freezing point of the solvent, which he expressed as the "loi g6n^rale de la congelation," that if one molecule of a substance be dissolved in 100 molecules of any given solvent, the temperature of solidification of the latter will be lowered by 0'63 ?? C. Another relation at which he worked was that the diminution in the vapour-pressure of a solvent, caused by dissolving a substance in it, is propor- tional to the molecular weight of the substance dissolved ??? at least when the solution is weak. These two generaliza- tions not only afforded a valuable new method of deter- mining the molecular weights of substances in the liquid state, but have also been utilized by van 't Hoff and Ostwald, among other chemists, in support of the hypo- thesis of electrolytic dissociation in solutions. An account of Eaoult's life

and work was given by Professor van t' HofF in a memorial lecture delivered before the London Chemical Society on 26th March 1902.

RsipclllO, a town and winter resort of the province of Genoa, Liguria, Italy. It occupies a beautiful and well sheltered situation on the east side of the Gulf of Eapallo, 18 miles east by south from Genoa, on the railway to Pisa. It has a fine church, a mediaeval castle (now used as a prison), and a Eoman bridge. Olives and other fruit are grown. Lace is made, and coral and tunny fishing carried on. Eapallo is a zoological and meteorological ###station. Population (1899), 3000.

Ra.ppoltSW0iler, in French Ribeauville, a town of Germany, in Alsace-Lorraine, district of Upper Alsace, 33 miles by rail south-south-west of Strasburg, is still in part surrounded by walls, and is knovra as " the pipers' town." In the town-hall is a collection of antiquities. The parish church (Eoman Catholic) dates from 1473. Population (1900), 6099.

Ra,Sht (Resht), the capital of the province of Gi'Mn, in Persia. A carriage road connecting it with Tehran was opened to traffic in 1899. There is also a good main road from the city to Pir Bazar, the dep6t for goods coming from Enzeli, the port on the Caspian, 16 miles north of Easht. Conflagrations are frequent, particularly in the months of December and January, when hot, dry winds, resembling the foehn of the Alps, come down from the snow-capped Elburz. In December 1899 several caravanserais and bazaars, containing large quantities of merchandise, were burned. For 1897-98 the value of the exports was esti- mated at ##900,000, and that of the imports at ##850,000. The principal exports were : rice, ##270,000 ; dry fruit, ##190,000; fish, ##70,000; sheep and cattle, ##40,000; wool, ##10,000; cotton, ##270,000; and the principal imports: sugar, ##400,000; siLk-worm seed, ##40,000; cotton goods, ##240,000; petroleum, ##15,000; glass and ###china, ##30,000. The trade in dried (silkworm) cocoons ias increased remarkably since 1893, when 76,150 H),

valued at ##6475, were exported, but in 1900 no less than 1,615,488 ft, valued at ##150,265, were exported.

Raspopina, a Cossack village of Eussia, in the pro- vince of the Don Cossacks, on the right bank of the Don river, 85 miles north-west of Tsaritsyn. It has consider- able trade in corn and cattle, and in 1897 had a population of 15,330.

Rastatt, a town of Germany, grand-duchy of Baden, 15 miles by rail south-west of Carlsruhe. Eastatt ceased to be a fortress in 1890. It has a museum and an in- dustrial school, and manufactures cooking-stoves, tobacco, &c. Population (1885), 11,743; (1900), 13,940.

Rastenburg', a town of Prussia, province of East Prussia, 64 miles by rail south-east of Konigsberg. It has a parish church dating from 1359, a large lunatic asylum, a provincial stud, and iron -works, oil and flour mills, breweries, &c. Population (1885), 7189 ; (1900), 11,140.

Ra,thenOW, a town of Prussia, on the Havel, 45 miles west by north of Berlin by rail. Eathenow has a Protestant and a Catholic (1893) church, a reaZ pro- gymnasium, a higher-grade school, 9 optical instrument, 4 stove, 2 machinery, and 2 furniture works, 2 ship- building yards, an asbestos and 2 glue factories. Popula- tion (1880), 11,394; (1900), 21,043.

Ratibor, a town of Prussia, Silesia, 97 miles by rail south-east of Breslau and 13 from the Austrian frontier, on the Oder, with manufactures of ironware, furniture, tobacco, paper, sugar, glass, machinery, chemicals, &c.; it also produces vegetables. Population (1885), 19,524;

(1900), 25,236.

Ratisbon, in German

a town and

episcopal see of Bavaria, Germany, district Upper Pala- tinate, on the Danube, 86 miles by rail north-north-east from Munich. The church of St Ubich contains a large portion of the antiquarian collections of the Historical Society, the rest being in the St Erhard House. The northern gate of the old Eoman town was unearthed in 1885. Among the public institutions should be mentioned the public library, picture gallery,

botanical garden, institute for glass staining, and some seminaries. Popula- tion (1885), 36,093; (1900), 45,426.

Ra.tlam, or Eutlam, a native state of India, in the Malwa agency. Area, 729 square miles. Population (1881), 87,314; (1891), 89,160. Estimated gross re- venue, Es.1,30,000 ; tribute, Es.84,000. The chief, whose title is raja, is a Eahtor Eajput of the Jodhpur family. The town of Eatlam is 1577 feet above the sea. Popu- lation (1881), 31,066 ; (1891), 29,822. It is a junction on the Eajputana-Malwa Eailway, and an important centre of trade, especially in opium. In 1897-98 the number of chests of opium exported through the Eatlam sub-agency was 1428, paying a duty of Es.8,02,450.

Ratnag^iri, a town and district of British India, in the Konkan division of Bombay. The tovsm is on the seacoast, 136 miles south of Bombay. Population (1881), 12,616; (1891), 14,303. Eatnagiri is a seaport, with a lighthouse, and an old fort sheltering a tidal creek. It has a good water supply. There is a Government high school and a school of industry. The district of Eatnagiei has an area of 3922 square miles. Population (1881) 997,090; (1891), 1,105,926. In 1901 the population was 1,166,890, showing an increase of 6 per cent., com- pared with an increase of 1 1 per cent, in the previous decade. Land revenue and rates, Es.9,84,448, the inci- dence of assessment being just over 8 annas per acre ; number of police, 703; children at school (1897-98), 18,781, being 2-1 per cent, of the total population;

registered death-rate (1897), 30 per thousand. The Bombay survey tenure has not been extended to the district, which possesses a peculiar land system, called hlioti. Fishing and maritime trade are active, there being twenty-nine ports altogether.

Ratnapura (which means ” The City of Gems”) is the chief town in the province of Sabaragamuwa, Ceylon, and is the centre of a native industry in digging for precious stones ❖❖❖ rubies, sapphires, cat’s-eyes,

. Rat Portage, a town and port of entry in Ontario, Canada, and the chief town of Kainy Kiver district, situated in 49 47' K, 94 30' W., at an alti- tude of 1087 feet above the sea. It is 133 miles by rail east of Winnipeg, on the Canadian Pacific Kailway, and at the outlet of the Lake of the Woods. The Winnipeg river has at this point a fall of 16 feet, which, with the lake as a great reservoir, furnishes an abundant and unfailing water-power. The industrial establishments comprise re- duction works, saw-mills, and ilour-miUs, one of the latter being the largest in Canada. It is the distributing point for the gold mines of the district, and during the summer months steamboat communication is maintained on the lake. There is important sturgeon fishing. Population

(1891), 1806; (1901), 5202.

Raudnitz (Czech, Soudnice nod Labem), a district town on the Elbe, in northern Bohemia. Its chief attrac- tion lies in the interesting and valuable collections in the 17th-century ch ,teau of Prince Lobkowitz. These include an extensive library, with a large number of the earliest specimens of printing and valuable MSS., together with a series of pictures from the time of Charles V. to the Thirty Years' War. In 1350 Kienzi, "the last of the tribunes," was confined by the emperor Charles IV. in the castle, which then occupied the site of the present ch&teau, previous to his despatch under arrest to the Pope at Avignon. The chief industries comprise tanning, distil- ling, brewing, and the manufacture of liqueurs, oil, vinegar, malt, chemicals, and metal goods ; its trade also including live stock, timber, and agricultural produce. In 1890 the population of the commune was 6615, and of the town 3349; in 1900, 7973, chiefly Czech.

Ravenna, a city and archiepiscopal see of Italy,' Emilia, capital of the province of Ravenna, stands in a marshy plain, more than 4 miles from the sea, and 45 miles by rail east of Bologna. In addition to its numerous ancient churches, for which it is principally famous, it possesses an archiepiscopal palace (5th century) ; the remains of the palace of Theodoric ; the tomb of Theodoric (6th century) ; the small temple (1482, rebuilt 1782) which contains the tomb of Dante, who died here in 1321 ; Byron's house; the Academy of Fine Arts (1827), with schools of design,

a picture gallery, and a library ; a public library, with several incunabula and MSS. ; a small museum ; a statue of Pope Clement XII. (1738); a monument to the states- man Farini ; outside the walls, a monument to Gaston de Foix and to the victory which the French won over the Hispano- Papal troops in 1512. The industries are few ??? the growing of vsdne, breeding of silkworms, making of agricultural instruments, printing, and the manufacture of laces being the chief. There is a technical school. In 1897 the port (4 miles distant) was cleared by 1088 vessels of 52,729 tons. Population (1881), 34,270; (1901), 63,839.

Rawalpindi, a city of British India, which gives its name to a district and a division in the Punjab. The city is situated on both banks of the river Leh, 1726 feet

above the sea. 111 miles east by south of Peshawar ; it has a railway station. Population (1881), 52,975; (1891), 73,795; municipal income (1897-98), Rs.2,09,817; death- rate (1897), 44 per thousand. It is the headquarters of a military district, with a strong force of aU arms and there is a first-class fortress, containing an arsenal. Rawalpindi is the starting-point of the cart-road to Murree, and the centre of trade vsdth Kashmir. There is an annual horse fair. A Gordon mission college was opened in 1893. There are three high schools, a normal school, an industrial school, and schools for European boys and girls. There are eight printing-presses, issuing three newspapers.

The district of Rawalpindi has an area of 4844 square miles. Population (1881), 820,512; (1891), 887,194. In 1901 the population was 780,080, showing a decrease of 12 per cent., compared with an increase of 8 per cent, in the preceding decade. Land revenue and rates (1897- 98), Rs.ll, 38,686, the incidence of assessment being 11 annas per acre; cultivated area, 739,172 acres, of which 58, 1 1 1 were irrrigated from wells, &c. ; number of police, 1056; number of schools, 623, attended by 15,483 boys, being 16 ‘7 per cent, of the boys of school-going age; death-rate (1897), 32‘7 per thousand. The principal crops are wheat, millet, pulse, barley, maize, oil-seeds, and cotton. The district is traversed by the main line of the North- Western Railway, crossing the Indus at Attock, and also by a branch to the Indus at Kushalgarh for Kohat ; total length, 167 miles.

Another branch roughly following the Indus, from Attock to Mari, was opened in 1899. The two boundary rivers are navigable for 178 mUes.

The division of Rawalpindi lies in the north of the Punjab, between Lahore and Peshawar. It consists of the six districts of Sialkot, Gujrat, Gujranwala, Shahpur, Jhelum, and Rawalpindi. Total area, 20,738 square miles. Population (1891), 3,560,699; average density, 172 persons per square mile.

Rawlinson, Georgre (1812-1902), EngUsh

scholar and historian, was bom at Chadlington, Oxford- shire, 23rd November 1812, being the younger brother of Sir Henry Rawlinson {q.v.). Having taken his degree at Oxford (from Trinity CoUege) in 1838, he was elected to a fellowship at Exeter College in 1840, of which from 1842 to 1846 he was fellow and tutor. He was ordained in 1841 ; was Bampton lecturer in 1859, and Camden professor of ancient history from lS61tolSS9. In 1872 he was appointed canon of Canterbury, and after 1888 he was rector of All Hallows, Lombard Street. In 1873 he was appointed to the office of proctor in Convocation for the Chapter of Canterbury. He married Louisa, daughter of Sir R. A. Chermside, in 1846. His chief publications are his translation of the His^tory of Herodotus (in collaboration with his brother Sir Henry Rawlinson, and Sir Gardner Wilkinson), 1858-60 ; The Five Great Monarchies of the Ancient Eastern World, 1862-67 ; The Sixth Great Oriental Monarchy (Parthian), 1873; The Seventh Great Oriental Monarchy (Sassanian), 1875 ; Mamial of Ancient History, 1869 ; Historical niustrations of the Old Testament, 1871 ; Tlie Origin of Nations, 1877 ; History of Ancient Egypt, 1881 ; Egypt and Babylon, 1885 ; History of Phoenicia, 1889 ; Parthia, 1893; Memoir of Major-General Sir H. C. Rawlinson, 1898. He was a contributor to the Speaker's Com- mentary, the Pulpit Commentary, Smith's Dictionary of the Bible, and various similar publications ; and he was the author of the article " Herodotus " in the ninth edition of the Encyclopaedia Britannica. He died 7th October 1902.

Rawlinson, Sir Henry Creswicke (1810-

1895), English soldier and Orientalist, was born at Chad-

lington, Oxfordshire, on llth April 1810. In 1827 he went to India as cadet under the East India Company ; and after six years' life with his regiment as subaltern, during which time he had become proficient in the Persian language, he was sent to Persia in company with some other English officers who were entrusted with the task of drilling and reorganizing the Shah's troops. It was during the years he spent in Persia at this time that he was first attracted to the study of inscriptions, more particularly those in the hitherto undeciphered cuneiform character. In the course of the two years during which he was in its immediate neighbourhood, he transcribed as much as he was able of the great cuneiform inscription in the Persian language on the rock at Behistun ; but his exertions in this direction were temporarily checked by the friction between the Persian Court and the English Government, which ended in the departure of the English mihtary officers from the Shah's dominions.

His experience and the ability he had shown in Persia gained him the appointment as political agent at Kandahar in 1840. In that capacity he served for three years with conspicuous success, his pohtical labours being as meri- torious as was his gallantry during various engagements in the course of the Afghan war ; for these he was rewarded by the distinction of C.B. in 1844. A fortunate chance, by which he became personally known to the governor- general, led to his being appointed, at his own desire, as political agent in Turkish Arabia ; thus he was enabled to settle in Baghdad, where his official duties were sufficiently light to allow of his devoting much time to the cuneiform studies which so strongly attracted him. He was now able, under considerable difficulties and with no small personal risk, to make a complete transcript of the Behistun inscription, which he was also successful in deciphering and interpreting. Having collected a large amount of invaluable information on this and kindred topics, in addition to much geographical knowledge gained in the prosecution of various explorations (including visits with Mr Layard to the ruins of Nineveh), he returned to England on leave of absence in 1849. He remained at home for two years, in the course of

which he received from various learned societies the honour due to his achievements in connexion with the decipherment of Babylonian and Assyrian inscriptions; published, in 1851, his Memoir on the Behistun inscription ; and was promoted to the rank of lieutenant-colonel. He disposed of his valuable collection of Babylonian, Sabaean, and Sassanian antiquities to the Trustees of the British Museum, who also made him a considerable grant to enable him to carry on the Assyrian and Babylonian excavations initiated by Layard. In 1851 he returned to his post at Baghdad. The excavations were carried on under his direction with valuable results, among the most important being the discovery of material that greatly contributed to the final decipherment and interpretation of the cuneiform character. An accident with which he met in 1855 hastened his determination to return to England and devote himself to the elaboration of the knowledge he had gained by his researches, and consequently in that year he resigned his post in the East India Company. On his return to Eng- land the distinction of K.C.B. was conferred upon him, and he was appointed a crown director of the East India Company, llie remaining forty years of his life were full of activity ❓❓❓ political, diplomatic, and scientific ❓❓❓ and were mainly spent in London. In 1858 he was appointed a member of the first India Council, but resigned in 1859 on being sent to Persia as envoy extraordinary and minister plenipotentiary. The latter post he held only for a year, owing to his dissatisfaction with circumstances connected with his official position there. Previously he

had sat in Parliament as M.P. for Keigate from February to September 1858; he sat again as M.P. for Frome 1865-68. He was appointed to the CouncU of India again in 1868, and continued to serve upon it until his death. He was a strong advocate of the forward policy in Afghanistan, and counselled the retention of Kandahar. His views were more particularly expressed in England and Ruaeia in the East, 1875. He was a Trustee of the British Museum from 1876 tiU his death. He was created G.C.B. in 1889, and a baronet in 1891 ; was president of the Geographical Society from 1874 to 1875, and of the Asiatic Society from 1878 to 1881 ; and received honorary degrees at Oxford, Cambrid_ge, and Edin- burgL He married, in September 1862, Louisa Carohne Harcourt Seymour, who bore him two sons and died in 1889. He died in

London on 5th March 1895. His published works, which were very largely concerned with his remarkable achievement in the transhteration and decipherment of the cuneiform character, and his equally remarkable geographical knowledge, include (exclusive of minor contributions to the publications of learned societies) four volumes of cuneiform inscriptions, published under his direction between 1870 and 1884 by the Trustees of the British Museum ; The Persian Cuneiform Inscription at Behistwn, 1846-51, and Outline of the History of Assyria, 1852, both reprinted from the Asiatic Society's Journals; A Commentary on the Cuneiform Inscriptions of Babylon and Assyria, 1850 ; Notes on the Early History of Babylonia, 1854 ; England and Russia in the East, 1875. He contributed to the Encyclopedia Britannica, (ninth edition) the articles on Baghdad, the Euphrates, and Kurdistan, and several other articles dealing with the East ; and assisted in editing a translation of Hero- dotus by his brother. Canon George Kawhnson. (e. f. s.)

Rawlinson, Sir Robert (1810-1898), English

engineer and sanitarian, was bom at Bristol on 28th February 1810. His father was a mason and builder at Chorley, Lancashire, and he himself began his engin- eering education by working in a stonemason's yard. In 1831 he obtained employment under Jesse Hartley in the engineer's office at the Liverpool docks, and for four years from 1836 he was engaged under Robert Stephenson as assistant resident engineer for the Blisworth section of what is now the London and Korth-Westem main line from London to the North. Eeturning to Liverpool, he spent some years as assistant surveyor to the corporation ??? a position in which he doubtless had ample opportunities of studying the connexion between dirt and disease ??? and then in 1844 accepted an engin- eering post on the Bridgewater Canal. Three years later he returned to Liverpool, to superintend the design and construction of the famous brick arched ceihng in the St George's HaU, in succession to his friend H. L. Elmes, who was obliged to give up the work in consequence of illness that quickly proved fatal. During this period Rawlinson's reputation as a sanitarian had been growing, and when the Public Health Act was passed in 1848 he was appointed one of the first inspectors under it. In the course of his duty he had to inspect many of the chief towns of England, and the

reports he was obliged to make of the insanitary conditions he found brought him in many cases into great unpopularity with the municipal rulers whose shortcomings he exposed. Seven years later a stiU wider field was opened to his energies. Early in 1855 popular feehng was so aroused by the waste of life that was going on among the British troops in the Crimea through disease, and by the mismanagement of the cam- paign, that the Aberdeen Ministry was forced to resign, and Lord Palmerston, who then became prime minister,

iad to adopt vigorous measures for improving the condition of affairs. To this end a Sanitary Commis- sion, consisting of Rawhnson and two medical members (Dr Sutherland and Dr H. Gavin), was despatched, with full and absolute powers from the War Office, to do what- ever it thought would lead to better hygienic conditions in camp and hospital. The Commission reached Constan- tinople in March, and, by insisting on what now seem the most simple and obvious precautions, succeeded within a few weeks in reducing the death-rate in the Levantine hospitals from 42 to 2^ per cent. Passing on to the Crimea, it effected a similar improvement there, and by the end gf the year the health of the whole British army in the field was even better than it enjoyed at home. The lesson was not thrown away, and from that time forward sanitary measures were systematically adopted, not only by the British but also by other armies of the world, which resulted in a large diminution of the death-rate from disease. Rawlinson's next great public service, for which he was made C.B. in 1865, was in connexion with the distress caused in Lancashire by the collapse of the cotton-manufacturing industry consequent on the American Civil War. In 1863 it was suggested that, in order to provide employment for the starving operatives, the Government should start works of "utility, profit, and ornament," and Rawlinson being sent to make an official investigation into the question, reported, after visiting nearly 100 towns, that 1|- million sterling might be advantageously expended in providing water-supply and drainage, forming streets, &c., in those places. The result was that the Treasury was

authorized to advance ►►1,200,000 (the amount was afterwards increased) at 3J per cent, for ►►►carrying out such works, which proved of enormous public benefit. In 1866 he acted as chairman of the Royal Commission on the Pollution of Rivers, and a few years later was appointed chief engineering inspector to the Local Government Board ; on retiring from this position in 1888 was promoted to be K.C.B. In 1894 he served as president of the Institution of Civil Engineers. He died in London on 31st May 1898. (h. m. e.)

Ra.Vtrtensta.ll, a municipal borough (since 1891) of Lancashire, England, in the Rossendale parliamentary division, 12 miles south-east of Blackburn. Liberal Club buildings were erected in 1894, and the Grand Theatre in 1899. Population (1881), 28,913; (1901), 31,052.

Rayleigrh, John William Strutt, 3bd

Baeon (1842), English physicist, was born in Essex

on 12th November 1842, being the son of the second baron. Going to Trinity College, Cambridge, he graduated as senior wrangler in 1865, and obtained the first Smith's prize of the year, the second being gained by Professor Alfred Marshall. He married in 1871 a sister of the Right Hon. A. J. Balfour, and succeeded to the title in 1873. From 1879 to 1884 he was Cavendish professor of ►►►experimental physics in the University of Cambridge, in succession to Clerk Maxwell; and in 1887 he accepted ►►►the post of professor of natural philosophy at the Royal Institution of Great Britain. His early mathematical and physical papers, written under the name of J. W. Strutt, made him known over Europe; and his powers rapidly matured until, at the death of Clerk Maxwell, he stood at the head of British physicists. Sir George Stokes and Lord Kelvin alone excepted. The special feature of his work is its extreme accuracy and definite- ness ; he combines the highest mathematical acumen with refinement of experimental skill, so that the idea of rank- ing him as higher in one department than another does not arise. His experimental investigations are carried out with plain and usually home-made apparatus, the

accessories being crude and rough, but the essentials thoughtfully designed so as to compass in the simplest and most perfect manner the special end in view. A great part of his theoretical work consists in resurveying things supposed superficially to be already known, and elaborating their theory into precision and completeness. In this way he has gone over a great portion of the field of physics, and in many cases has either said the last word for the time being, or else started new and fruitful developments. Possessing an immense range of know- ledge, he has filled up lacunae in nearly every part of physics, by experiment, by calculation, and by clear accurate thought. The following branches have especially felt his influence : ??? chemical physics, capillarity and viscosity, theory of gases, flow of liquids, photography, optics, colour vision, wave theory, electric and magnetic problems, electrical measurements, elasticity, sound, and hydrodynamics. The numerous scientific memoirs in which his original work is set forth are being collected in four large volumes, under his own editorship. His most extensive single work is a book on Sound, which, in the second edition, has become a treatise on vibrations in general, and is one of the finest examples of a scientific treatise extant. His familiarity with the methods of mathematical analysis and a certain refinement of taste in their application have resulted in great beauty of form. His papers are often difficult to read, but never diffuse or tedious; his mathematical treatment is never needlessly abstruse, for when his analysis is comphcated it is only so because the subject-matter is complicated. Of discoveries superficially sensational there are few or none to record, and the weight of his work is for the most part only to be appreciated by professed physicists. One remarkable discovery, however, of general interest, was the outcome of a long series of delicate weighings and minute experimental care in the determination of the relative density of nitrogen gas ??? undertaken in- order to determine the atomic weight of nitrogen ??? namely, the discovery of argon, the first of a series of strange new substances, chemically inert, which occur, some only in excessively minute quantities, as con- stituents of the earth's atmosphere (see the article Aegon in these new volumes, which is from his pen). He was also the author of the articles Optics and Wave Theory in the ninth edition of this Encyclopaedia. Lord Rayleigh has taken some interest in abnormal psychological investi- gations, and has long been a member and vice-

president of the Society for Psychical Research. He was one of the few selected for admission to the Order of Merit instituted in connexion with the coronation of His Majesty King Edward VII.

For a popular but authentic account of some of Lord Eayleigh's scientific work and discoveries, see an article by Sir Oliver Lodge in the National Semew for September 1898.

Razgrad, chief town of a department in the prin- cipahty of Bulgaria, on the Bieli-lom or Ak-lom, near a station on the railway from Rustchuk to Varna, 40 miles ."fouth-east of Rustchuk. Owing to evacuation by the Turks after the Russo-Turkish war of 1877, a large part of the town lapsed into ruin, but it is regaining its prosperity, and has a large agricultural and general trade. It possesses a magnificent mosque, built in 1614 by Ibrahim Pasha, but it is now in a partly ruined condition. Popu- lation (1892), 13,295.

Roading', the county town and a municipal, parlia- mentary, and county borough and market town of Berkshire, England. It lies on the Kennet, just above its junction with the Thames, 36 miles by rail and 47 by river west of Loudon. Its situation in a fertile vale, and in

proximity to the charming reaches of the upper Thames, has of late years made it a favourite place of residence ; and through the excellent railway accommodation provided by the Great Western, South- Western, and South-Eastern railways, it may be said to have been drawn into suburban London. The site of the old Hospice of St John is now occupied by the University Extension College, opened in 1892, which, affiliated to Oxford University and with accommodation for 600 students, was the first attempt to popularize higher university education. Its agricultural department is particularly flourishing. The Lady Warwick Hostel, named after its founder, is an institution for instructing young women in the lighter branches of agri- culture❓❓❓ fruit and poultry-farming, and gardening. The Great Western Railway station, so long an eyesore to passengers, has been rebuilt, the lines relaid, and thereby the through express traffic greatly facilitated. The great biscuit manufactory of

Huntley and Palmer has lately been much enlarged, and employs nearly 5000 hands. The extensive seed nurseries of Messrs Sutton, which vie with those of Erfurt and Quedlinburg in Germany, cover nearly 10,000 acres, and are of world-wide renown. Adjoining the free library is a museum containing a collection of Romano-British antiquities from Silchester. A public park 59 acres in extent, the gift of Mr G. Palmer, was opened in 189L

Besides its manufactures, which are in a flourishing condition, and embrace sauces, velvet, sacking, silk, ribbons, and tin boxes, Reading is also an important mart for corn and other agricultural produce. Beading returns only one member to Parliament since 1885, in which year the parliamentary borough was also extended. Area of municipal borough, 5878 acres; area of parliamentary borough, 2441 acres. Population (1891), 60,054; (1901),

72,214.

Reading', a city of Pennsylvania, U.S.A., the capital of Berks county. It is situated in 40 20′ N. and 75 55′ W., on the east bank of the Schuylkill river, on the Schuylkill canal, and on the Pennsylvania, the Philadelphia and Reading, and the Wilmington and Northern railways, in the south-eastern part of the state, at an alti- tude of 206 feet. Laid out on a fairly level site, the city is divided into sixteen wards, has a good water-supply, the works being owned by the city, is paved with asphalt, cobble-stones, and macadam, is sewered, and has a steam heating plant. Reading is an important manufacturing centre, especially of iron and steel. In 1900 it contained 843 manufacturing establishments, with a total capital of $27,975,628. These employed 12,165 hands, and the product was valued at $36,902,511. Iron and steel goods were valued at $9,530,286, hardware at $1,611,268, and foundry and machine-shop products at $2,437,355, and cars and general shop construction and repairs at $6,315,128. Tobacco and cigars had a value of $1,683,466, fur hats, $1,133,688, and hosiery and knitted goods, $1,326,397. Reading contains also the principal workshops of the Philadelphia and Reading Railway Com- pany. In 1899 the assessed valuation of real and personal property was $43,480,679, the net debt of the city was $1,371,567, and the rate of

taxation was $14-50 per $1000. Population (1890), 58,661; (1900), 78,961, of whom 5940 were foreign-born and 534 negroes.

Rechberg und Rothenloewen, Johann Bernard, Count von (1809-1899),

Austrian statesman, sprang from a noble family which from the 12th century has held a prominent posi- tion in Swabia. At the time of the Revolution the fief had been divided between the modern kingdoms

of Bavaria and Wiirtemberg, and his father. Count Aloys (1766-1849), was one of the foremost Bavarian statesmen during the first quarter of the 19th century, and took a great part at the celebrated Carlsbad Con- ferences. Count Johann, who was the second son, was destined for the Bavarian public service, his elder brother being a hereditary member of the Upper House in the Parliament of Wiirtemberg. He was educated at the univer- sities of Strasburg and Munich, but the part he took as second in a duel brought upon him the displeasure of King Ludwig, and at the age of twenty he transferred himself to the Austrian service. After holding various inferior diplomatic appointments, he was in 1843 sent as envoy to Brazil. He returned to Europe in 1847, and on the outbreak of the revolution in 1848 was of great ser- vice to Prince Metternich, whom he accompanied and assisted when, deserted by all his former friends, the aged statesman had to fly from Austria to England. In 1853 he was appointed civil coadjutor to Radetzky, who was governor of the Lombardo- Venetian kingdom ??? a very difficult post, owing to the jealousy with which he was regarded by the army. In 1855 he was made Austrian representative at, and president of, the Germanic diet at Frankfort. As a pupil of Metternich he would have wished to preserve the good understanding with Prussia which seemed the necessary foundation for a conservative policy; he was, however, made the instrument for the anti-Prussian policy of Buol ; this brought about constant disputes with Bismarck, at that time Prussian envoy at the Diet, which were sharpened by Rechberg's choleric temper, and on one occasion nearly led to a duel. Bis- marck, however, both in his despatches and his memoirs, always expressed a high appreciation of his character and abilities. In May 1859, on the eve of the war with France and Sardinia, Rechberg was chosen to succeed Buol as foreign minister. This post he held for five of the most

eventful years of Austrian history. After the defeat of Magenta he accompanied the emperor to Italy, and he had to meet the crisis caused by a war for which he was not responsible. He began the concessions to Hungary, but the chief influence in the Council soon passed to colleagues, especially Schmerling, with whose policy he was not in agreement. His attempts to establish a good understanding with Prussia were constantly frustrated, and in 1863 he offered his resignation as a protest against the Furstentag at Frankfort, which had been decided on without his knowledge. The emperor refused to accept his resignation, and, unfortunately for his own reputation, he did not insist on it, for it was the inconsistent and variable policy arising from the conflicting aims of different ministers which brought so many disasters on Austria. Rechberg succeeded, indeed, in establishing a close co-operation with Prussia in regard to the Elbe duchies ; but this was very unpopular in Austria, where it was said he had been made the dupe of Bismarck. He still hoped to establish a firm and permanent alliance with Prussia, but for this he had not sufficient influence, either in his own ministry or at Berlin ; and when his proposals for a customs union were rejected by the Prussian ministry, his fall was in- evitable. He resigned in October 1864, foretelling the speedy outbreak of a war which he had long striven to avert, and for which he saw that Austria was not strong enough. From this time he lived in complete retirement till his death, which took place at his country house at Schwechat in 1899.

*See also an article by FRiEnjUNG In Bettelman's Biographische Jahriucher, Berlin, 1900 ; also Der Kampf ⬛⬛m die Vorherrschaft in Deutschland, Stuttgart, 1898, by the same author. ⬛⬛⬛ Sybel. Die Begriindung des deutschen Beiches and Bismarck's Beflections and Beminiscences. / j_ -^_ gj. *

Recklinghausen, a town of Prussia, province of "Westphalia, 22 miles by rail north-west of Dortmund, with coal-mines, limestone quarries, brick-works, and manu- facture of linen, lamp-wicks, and tobacco, saw-niills and distilleries. Population (1885), 9199 ; (1900), 34,042.

Rectus, Jean Jacques Elis^e (1830-

-), French geographer, was born at Sainte-Foy la

Grande (Gironde), on 15th March 1830. He was the second son of a Protestant pastor, who had a family of twelve children, several of whom have also acquired some celebrity either as men of letters, politicians, or members of the learned professions. His education, begun in Khenish Prussia, was continued in the Protestant College of Montauban, and completed at the University of Berlin, where he followed a long course of geography under Karl Eitter. Withdrawing from France in consequence of the events of December 1851, he spent the next six years {1852-57) visiting the British Isles, the United States, Central America, and Colombia, losing no opportunity of studying the physical features and economic conditions of these lands, and acquiring a practical knowledge of English, Spanish, and several other European languages. On his return to Paris he contributed to the Eevvs des Deux Mondes, to the Tour du Mcmde and other serials, a large number of articles embodying the results of his geographical ◆◆◆ work. During the siege of Paris, Reclus shared in the aero- static operations conducted by M. Nadar, and also served in the National Guard, while as a member of the Associa- tion Nationale des Travailleurs he published in the Cri du Pev/ple a hostile manifesto against the Government of Versailles in connexion with the Communist rising of 18th March 1871. Continuing to serve in the National Guard, now in open revolt, he was taken prisoner on 5th April, and on 16 th November sentenced to transporta- tion for life ; but, largely

at the instance of influential deputations from England, the sentence was commuted in January 1872 to perpetual banishment. Thereupon, after a short visit to Italy, he settled at Clarens, in Switzerland, ???where he resumed his literary labours, and wrote nearly the whole of his great work, La Nouvelle Geographie Univer- selle, La Terre et les Hommes, 19 vols. (1875-94), a stupendous compilation, profusely illustrated with maps, plans, and engravings, and crowned with the gold medal of the Paris Geographical Society in 1892. An English edition appeared simultaneously, also in 19 vols., the first four by E. G. Ravenstein, the rest by A. H. Keane. A preliminary work, entitled La Terre, Description des PMno- menes de la Vie du Globe, 2 vols., had already appeared in 1867-68, the two forming the most comprehensive geographical series ever issued in any language. Extreme accuracy and brilliant exposition form the leading charac- teristics of these, as of all the author's writings, which thus possess permanent literary and scientific value. In 1882 M. Reclus initiated the "Anti-Marriage Movement," in accordance with which he allowed his two daughters to marry without any civil or religious sanction whatever. This step caused no little embarrassment to many of his well-wishers, and was followed by Government prosecutions, instituted in the High Court of Lyons, against the anar- chists, members of the International Association, of which M. Reclus and Prince Kropotkin were designated aa the two chief organizers. The Russian socialist was arrested and condemned to five years' imprisonment, but M. Eeclus, being resident in Switzerland, escaped the arm of French justice. After 1892 he filled the chair of comparative geography in the University of Brussels, and contributed several important memoirs to French, German, and English scientific journals. Amongst these may be mentioned " The Progress of Mankind " (Contemp.

Rev., 1896) ; " Attila de Gerando " {Rev. Giograph., 1898) ; "A Great Globe" {Geograph. Journ., 1898); "L'Extrgme- Orient " (Bui. Antwerp Geo. Soc, 1898), a thoughtful study of the political geography of the Far East and its possible changes; "La Perse" {Bui. Soc. Neuchateloise, 1899); " La Ph^nicie et les Ph^niciens " {ibid., 1900) ; La Chine et la Diplomatie ewrop^enne (" L'Humanit^ Nouvelle." series, 1900) ; L'EnseigneTnent de la Geographie (Instit. GeograpL de Bruxelles, No. 5, 1901).

Red Bank, a town of Monmouth county, New Jersey, U.S.A. It is at the head of navigation of the Shrewsbury river, on the Central of New Jersey and the Pennsylvania railways, in the eastern part of the state. Population (1890), 4145; (1900), 5428, of whom 508 were foreign-born and 620 negroes.

Red car, a watering-place and parish in the North Riding of Yorkshire, England, in the Cleveland parha- mentary division, 8 miles north-east of Middlesbrough, with a station on a branch of the North-Eastern Railway. Its long range (from Tees to Saltburn, a distance of 10 miles) of firm sands has made it a popular summer resort. Race meetings are held on the racecourse here on Whitsun Monday and Tuesday, and in August. Since 1894 the town has been governed by an urban district council. Population of the parish and urban district (1891), 2818. Population of area, extended in 1898 to include Coatham parish (1901), 7695.

Redd itch, a town and parish in the county of Worcester, England, in the Eastern parliamentary division of the county, 16 miles south-west of Birmingham by rail- way. The church of St Stephen was restored in 1894. Other places of worship have been rebuilt or enlarged. The Smallwood Hospital was erected in 1895, and the Smallwood Almshouses in 1897. Redditch is the centre of a district noted for its needles and fishhooks. The division of labour in the production of needles necessitates each passing through pearly twenty pairs of hands. Population of urban district (1891), 11,311 ; (1901), 13,493.

Redgrrave, Richard (1804-1888), English

artist, was born at Pimlico on 30th April 1804, and worked at first as a designer. He became a student in the Royal Academy Schools in 1826, and was elected an Associate in 1840 and an Academician in 1851 (retired, 1882). His ” Gulliver on the Farmer’s Table ” (1837) made his reputa- tion as a painter. He began in 1847 a connexion with the Government Art Schools which lasted for a long term of years, and among other posts he held those of inspector- general of art in the Science and Art Department, and art director of the South Kensington Museum. He was greatly instrumental in the establishment of this institution, and he claimed the credit of having secured the Sheepshanks

and Ellison gifts for the nation. He was also surveyor of the Royal Pictures. He was ofiered, but declined, a knighthood in 1869. Redgrave was an assiduous painter of landscape and (/ewre; his best pictures being "Country Cousins" (1848) and "The Return of Olivia" (1848), both in the national collection, "The Sempstress" (1844), "Well Spring in the Forest" (1865). He died on 14th December 1888.

See F. jr. Redgeave, Richard Redgrave, C.B., R.A.. A Memoir, compiled from his Diary. London, 1891.

Redon, chief town of arrondissement, department of Ille-et-Vilaine, France, 40 miles south-south-west of Rennes, on railway from Savenay to Landerneau, on the right bank of the Vilaine above the confluence of the Oust, and on the canal from Nantes to Brest. The church of St Sauveur, formerly abbatial, has a fine 14th-century belfry with spire, and a plain 14th-century square tower, with rounded angles. The choir, with deambulatory and radiating

chapels, forms one of the most remarkable ecclesiastical bmldings of the 13th century in Brittany. One of the ancient tombs, partly destroyed during the Revolution, is supposed to be that of Francis I. The abbey has been converted into an ecclesiastical college. Some 16th-cen- tury timbered houses have interesting carvings. French emery is manufactured on an extensive scale, and plate powder, coal-tar, agricultural implements, and tanning represent other branches of industry. The port is access- ible, at high tides, for vessels of 600 to 700 tons, and a line of railway connects the quays with the station. The port traffic, exclusive of coasting, amounted in 1900 to 12,529 tons, of which 12,147 tons were carried in British vessels. Including coasting trade, the total movement was 18,295 tons. Population (1886), 4847; (1896), 5599.

Redonda, See Antigua.

Redondela,| a town of Spain, province of Ponte- vedra, to the north-east of Vigo, in a bend of the estuary of that name ; it is a station on the Orense Vigo and Pon- tevedra lines. Population, 11,399 in 1887 and 10,966 in 1897. The river is only accessible for small coasting vessels. The town has a fine square, regular clean streets, markets, a casino, convents, and interesting parish church. The railway viaducts are fine structures, running actually over the town. In the neighbourhood are ruins of several feudal castles, and the fine hall of Marquess Vega de Armijo.

Redruth, a market-town and urban district, Corn- wall, England, in the Camborne parliamentary division, about 9 miles west of Truro by rail. This is the chief mining town of the county, and the bulk of its popu- lation is engaged in the tin mines or at the numerous tin-streaming works. Among modern public buildings are a mining exchange (1880), science and art school (1883), Liberal hall (1886), and Primitive Methodist chapel (1888). In 1895 Mr Passmore Edwards erected a public free library, at a cost of ––2000. Population of the urban district (1881), 9335; (1901), 10,451.

*Red Seat. ––– The Bed Sea is a narrow strip of water extending south-south-east from Suez to the Strait of Bab- el-Mandeb in a nearly straight line, and separating the coasts of Arabia from those of Egypt, Nubia, and Abys- sinia. Its total length is about 1200 miles, and its breadth varies from about 250 miles in the southern half to 130 miles in 27––45′ N., where it divides into two parts, the Gulf of Suez and the Gulf of Akaba, separated from each other by the peninsula of Sinai. *

The Gulf of Suez is shallow, and slopes regularly .down to the northern extremity of the Bed Sea basin, which has a maximum depth of 640 fathoms, and then over a shoal of 60 fathoms goes down to 1200 fathoms in 22––7′ N. The Gulf of Akaba is separated from the Bed Sea by a submarine bank only 70 fathoms from the surface, and in 28––39′ N. and 34––43′ E. it attains the considerable depth of 700 fathoms. South of the 1200-fathom depression a ridge rises to 500 fathoms in the latitude of Jedda, and south of this again a similar depression goes dowTi to 1190 fathoms. Through- out this northern part, i.e., to the banks of Suakin and Farisan in 20––N., the 100-fathom line keeps to a belt of coral reef

close inshore, but in lower latitudes the shallow coral region, 300 miles long and 70 to 80 miles across, extends farther and farther seaward, until in the latitude of Hodeida the deep channel (marked by the 100-fathom line) is only 20 miles broad, all the rest of the area being dangerous to navigation, even for small vessels. In the middle of the gradually narrowing channel three depressions are known to exist ; soundings in two of

Depths.

these are: 1110 fathoms in 20 N. and 890 fathoms in 16 N., a little to the north of Massawa. To the north-west of the volcanic island of Zebayir the depth is less than 500 fathoms ; the bottom of the channel rises to the 100-fathom line at Hanish Island (also volcanic), then shoals to 45 fathoms, and sinks again in about the latitude of Mocha in a narrow channel which curves westward round the island of Perim (depth 170 fathoms), to lose itself in the Indian Ocean. This western channel is 16 miles wide in the Strait of Bab-el-Mandeb ; the eastern channel of the strait is 2 mUes broad and 16 fathoms deep. Murray estimates the total area at 158,750 square miles, and its volume at 67,700 cubic miles, giving a mean depth of 375 fathoms. Karstens gives ^^^ the area at 448,810 square kilometres (130,424 volume, square geographical miles) and the volume at and mean 206,901 cubic kilometres (32,413 cubic geogra-””” phical miles), which gives a mean depth of 252 fathoms. Both these computations, however, were made before the date of the Austrian exploring expeditions (1896-98). Bludau’s measurements give the total area draining to the Bed Sea at about 255,000 square geographical miles.*

The Red Sea is formed by a line of fracture, probably dating from Pliocene times, crossing the centre of a dome of Archsean rocks, on both flanks of which, in Egypt and Arabia, c n aWoJi rest Secondary and Tertiary deposits. The granite rocks forming the core of the dome appear at the surface on the Ked Sea coast, at the ~~*western end of the transverse line of heights crossing El Nejed (see Arabia). Along the line of fracture traces of volcanic activity are frequent ; a group of volcanic islands occurs in 14 N., and on Jebel Teir, farther north, a*~~

~~volcano has only recently become extinct. The margin of the Bed Sea itself consists, on the Arabian side, of a strip of low plain backed by ranges of baiTen hills of coral and sand formation, and here and there by mountains of considerable height. The greater elevations are for the most part formed of limestones, except in the south, where tliey are largely volcanic. The coasts of the Gulf of Akaba are steep, with numerous coral reefs on both sides. On the African side there are in the north wide stretches of desert plain, which towards the south rise to elevated tablelands, and ultimately to the mountains of Abyssinia. The shores of the Red Sea are little indented ; good harbours are almost wanting in the desert regions of the north, while in the south the chief inlets aj e at Massawa, and at Kamaran, almost directly opposite. Coral formations are abundant ; immense reefs, both barrier and fring~~ ing, skirt both coasts, often enclosing wide channels between the reef and the laud. The reefs on the eastern side are the more extensive ; they occur in places as much as 25 miles from the land. It has long been known that the whole Red Sea area is under- going gradual elevation, and much has been done in recent years in investigating the levels of raised beaches found in different localities, but our knowledge is not yet sufiiciently complete to justify general statements as to the nature and progress of these movements.

*In the northern part, down to almost 19 N., the prevailing winds are north and north-west. The middle region, to 14 -16 N. , has variable winds in an area of low barometric pres- , sure, while in the southern Red Sea south-east and . * *”’ ”” east winds prevail. From June to August the north- ‘*

west wind blows over the entire area ; in September it retreats again as far as 16 N., south of which the winds are for a time variable. In the Gulf of Suez the westerly, or “Egyptian,” wind occurs frequently during winter, sometimes blowing with violence, and generally accompanied by fog and clouds of dust. Strong north-north-east winds prevail in the Gulf of Akaba during the greater part of the year ; they are weakest in April and May, sometimes giving place at that season to southerly breezes. During fine weather and near the coasts, land and sea breezes are met with in all latitudes in some places strongly developed. The high

temperature and great relative humidity make the summer climate of the Red Sea one of the most disagreeable in the world.

*The mean annual temperature of the surface waters near the head is 77 F. ; it rises to 80 in about 22 N., to 84 in 16 N., and drops again to 82 at the Strait of Bab- _, el-Mandeh. Daily variations of temperature are ^'"Per- observable to a depth of over 50 fathoms. Temper- * ""* ature is, on the whole, higher near the Arabian than the Egyp- tian side, but it everywhere diminishes with increase of depth and latitude, down to 380 fathoms from the surface ; below this depth a uniform constant temperature of 70 '7 F. is observed throughout. In the Gulf of Suez temperature is relatively low.*

falling rapidly from south to north. The waters of the Gulf of Akaba are warmer towards the Arabian than the Sinai coasts ; a uniform temperature of 70 '2 is observed at all depths below 270 fathoms.

The salinity of the waters is relatively great, the highest re- corded being 427 per mille (Gulf of Suez), and the lowest 36-2 Salinitv (~~P^" harbour). The distribution is, speaking generally, the opposite to that of temperature ; salinity increases from the surface downwards, and from the south north~~ wards, and it is greater towards the western than the eastern side. This statement holds good for the Gulf of Suez, in which the water is much Salter than in the open sea ; but in the Gulf of Akaba the distribution is exceedingly uniform, nowhere differing much from au average of 40 '6 per mille.

The movements of the waters are of great irregularity and com- plexity, rendering navigation difficult and dangerous. Two . . features stand out with special distinctness : the ex-

tion" ^' cliange of water between the Red Sea and the Indian Ocean, and the tidal streams of the Gulf of Suez. From the observations of salinity it is inferred that a surface cur- rent flows inwards to the Red Sea in the

eastern channel of the Strait of Bab-el-Maudeb, while a current of very salt water flows outward to the Indian Ocean, through the western channel, at a depth of 50 to 100 fathoms from the surface. In the Gulfs of Suez and Akaba, almost the only part of the Red Sea in which tidal phenomena are well developed, a sharply defined tidal circulation is found. Elsewhere the surface movements at least are controlled by the prevailing winds, which give rise in places to complex ‘ ‘ transverse ” currents, and near the coasts are modified by the channels enclosed by the coral reefs. During the prevalence of the north and north-west winds the surface level of the northern part of the Red Sea is depressed by as much as 2 feet. The great evaporation going on from the surface probably causes a slow vertical circulation in the depth, the Salter colder waters sinking, and ultimately escaping to the Indian Ocean. Extensive collec- tions of the deposits forming the bed were made by the expedi- tions of the Austrian ship Pola (1896 and 1898). These have been subjected to analysis by Dr K. Natterer, whose conclusions, however, have been disputed by a number of other investigators. The detailed reports on the zoological collections of the Pola ex- peditions have not yet been published, but their examination has already shown that certain well-defined districts are extremely rich in plankton, while others are correspondingly poor ; and it appears that the latter occur in disti’icts surrounded by currents of relatively low temperature, while the richer parts are where the movements of water are blocked by irregularities in the coast-line.

AiTTHORiriBS. ⁂ A. IssEL. Morfologia e genesi del Mar Rosso. Saggio di PaUogeografia. Congresso Geogr. Ital. Florence, 1899. ⁂ Die KoraUenriffe der Sinai- HalKnsel. Abhandl. Math.~~phys. Gesell. Wiss. vol. xiv. Leipzig, 18SS. ⁂ Meteorological Charts of the Bed Sea. Meteorological Office. 1895. ⁂ Report of the Voyage of the Russian Corvette ” Vitiaz.” 1889. ⁂ Berichte der Commis~~ sion filr Oceanographische Forschungen, 6th series, 1898, aus dem LXV. Bande der Denlcschr’iften der K.K. ATcademie der Wissen- schaften. Vienna. ⁂ Also various notes and preliminary reports in the Sitziingsierickte of the Vienna Academy of Sciences. ⁂ Report of theVoyageofS.M.S. “Challenger” “Oceanic Circulation,” p. 30. ⁂ Hann. Klimatologie, vol. iii. p. 76. 1897. (h. n. D.)

Red Wingf, a city of Minnesota, U.S.A., capital of Goodhue county. It is on the west bank of the Mississippi, at the head of Lake Pepin, in the south-eastern part of the state, at an altitude of 685 feet. It is irregu- larly laid out, and has a water-supply and sewerage system. It is on the Chicago, Milwaukee, and St Paul, the Duluth, Eed Wing, and Southern, and the Chicago Great Western railwa,ys. It contains lumber and flour mills, furniture factories, and other industries. It is an important shipping point for grain. Population (1890), 6294; (1900), 7525, of whom 2154: were foreign-born.

Reed, Thomas Brackett (1839-1902), American lawyer and statesman, was born at Portland, Maine, 18th October 1839. He graduated from Bowdoin College, and practised law in his native state. A Kepublican in politics, he served in the legislature and in other capacities in the state, and in 1876 was elected to the National House of Representatives, where he remained continuously till his voluntary withdrawal from pubUc life in 1899. In 1885 he was formally recognized as the leader of his party in the House, and in 1889, 1895, and 1897 he was elected Speaker. His

most conspicuous achievement was the modification of the procedure of the House so as to facilitate legislation. De- spite violent opposition, he forced through in 1890 a rule under which " constructive absence " (i.e., the mere re- fusal to vote) cannot be employed to break a quorum. The firm, and even arbitrary, measures he used to prevent filibustering caused him to be designated popularly as the " Czar." In 1899 he took up the practice of law in New York. He died at Washington December 7th, 1902.

Reeve, Henry (1813-1895), English pubHcist, younger son of a well-known Whig physician and writer of Norwich, and nephew of Mrs Sarah Austin, was born at Norwich on 9th September 1813, and educated at the grammar school there under Edward Valpy. During his holidays he saw a good deal of the young John Stuart Mill. In 1829 he studied at Geneva and mixed in Genevese society, then very brilliant, and including the Sismondis, Huber, Bonstetten, De CandoUe, Bossi, Kras- inski (his most intimate friend), and Mickievsdcz, whose Faris he translated. During a visit to London in 1831 he was introduced to Thackeray and Carlyle, while through the Austins he made the acquaintance of other men of

letters. Next year he was lanc6 in Paris, meeting Victor Hugo, Cousin, and Scott. He travelled in Italy, sat under Schelling at Munich and under Tieck at Dresden, became in 1835-36 a frequenter of Madame de Circourt's salon, and numbered among his friends and acquaintances Lamartine, Lacordaire, De Vigny, Thiers, Guizot, Jlontalembert, and De Tocqueville, of whose books, Dimocratie en Am^rique and the Ancien Regime, he made standard translations into English. In 1837 he was made clerk of appeal and then registrar to the judicial committee of the Privy Council. From 1840 to 1855 he "exhaled his soul "in newspaper articles, mainly for The Times, his close touch with men like Guizot, Bunsen, Lord Clarendon, and his own chief at the Privy Council Office, Charles GreviUe, enabling him to write with authority on foreign policy during the critical period from 1848 to the end of the Crimean War. His services assisted largely in making The Times the most authoritative exponent of inter- national policy among the journals of Europe. Reeve calculated that he wrote between two and three thousand articles for this paper alone, and received over thirteen thousand pounds for them. Upon the promotion of Sir George Cornewall Lewis to the Cabinet early in 1855, Reeve was asked by Longman to edit the April number of the Edinburgh Review, to which his father had been one of the earliest contributors, and in the following July he became the editor. He soon abandoned daily journalism. He had already been an occasional contributor both to the Quarterly and to the Edinburgh Revieir, and he maintained the Whig traditions of the latter for over forty years with undeviating loyaltj^. His friendship with the Orleanist leaders in France survived all vicissitudes, but he was appealed to for guidance by successive French ambassadors, and was more than once the medium of private negotiations between the English and French Governments. In April 1863 he pubhshed what was perhaps the most important of his contributions to the Edinburgh ??? a searching review of Kinglake's Crimea ; and in 1872 he brought out a selection of his Quarterh/ and Edinburgh articles on eminent Frenchmen, entitled Royal and Republican France. Three years later appeared the first of three instalments (1875, 1885, and 1887) of his edition of the famous Hfemoirs which Charles Greville had placed in his hands a few hours before his death in 1S65. A purist in point of form and style, of the school of

IMacaulay and Milman, Reeve outlived his literary generation : he had little in common with the views of Carlyle, Ruskin,

Morris, Darwin, and Spencer, and he became eventually one of the most reactionary of old Whigs. Yet he con- tinued to edit and upon the whole to maintain the reputation of the Edinburgh until his death, which took place at his seat of Foxholes, in Hants, on 2l8t October 1895. He had been elected a member of "The Club" in 1861, and was made a D.C.L. by Oxford University in 1869, a C.B. in 1871, and a corresponding member of the French Institut in 1865. A striking panegyric was pronounced ujion him by his lifelong friend, the Due d'Aumale, before the Academie des Sciences in November 1895. His Memoirs and Letters (2 vols., "with portrait) ???were admirably edited by Prof. J. K. Laughton in 1898.

(t. se.)

Reeves, John Sims (1818-1900), EngUsh

vocalist, was born at Woolwich, 26th September 1818, and received his musical education from his father, a musician in the Eoyal Artillery. At the age of fourteen he had progressed so far as to be appointed organist of North Cray church, and could play the oboe, bassoon, violin, and violoncello. In spite of these various musical gifts, he seems to have studied medicine for a year, but changed his mind when he gained his adult voice : it was at first a baritone, and he made his earhest appearance at New- castle in 1839 in various baritone parts. He studied with Hobbs and T. Cooke, and, his voice having become a tenor, he appeared under Macready's management at Drury Lane (1841-43) in subordinate tenor parts in Purcell's King Arthur, Der Freischutz, and Acis and Galatea, when Handel's pastoral was mounted on the stage with Stanfield's scenery. Four years were spent in study on the Continent, under Bordogni in Paris and Mazzucato in Milan, and his d^but in Italian opera was made at the Scala as Edgardo in Lucia. He reappeared in London in May 1847, at a benefit concert for Vincent Wallace, and at one of the Ancient Concerts in the following month, his career on the English operatic stage beginning at Drury Lane in December 1847 in

Lucia, under the con- ductorship of Hector Berlioz. In Balfe's Maid of Honour he created the part of Lyonnel in the same season. In 1848 he went to Her Majesty's Theatre, singing in Linda di Chamounix ; and in the autumn of that year, at the Norwich Festival, made a great sensation in " The enemy said," from Lsrael in Egypt, a song with which he was identified for many years, and in which the finest qualities of his ringing voice could be appreciated. From his first appearance at the Sacred Harmonic Society in the following November he was recognized as the leading English tenor ; and in the stock oratorios, as well as in Costa's Eli and Naaman, the tenor parts in both of which were written for him, his great artistic gifts were at once recognized by the pubhc. His first Handel Festival was that of 1857, and the effect of his wonderful declamation in the Crystal Palace was a main attraction of this and of many subsequent, festivals. His retirement from public life, at first announced as to take place in 1882, did not actually occur till 1891, when a fareweU concert for his benefit was given at the Albert Hall. His savings were invested in an unfortunate speculation, and he was compelled to reappear in pubhc for a number of years. As a lesson in the art of declaiming words, even after his voice had become a mere thread, these appearances were valuable to young singers, but they had little or no musical significance ; and that they did not lower the prestige he enjoyed for so long is a testimony to the power he had formerly exercised. He died at Worthing, 25th October 1900. (j. A. F. m.)

Reformed Episcopal Ciiurch, The, a

small community, with branches in the United States,

Great Britain, and Canada, was established in 1873 by Dr Cummins, who had just resigned his office as assistant- bishop of Kentucky in the Protestant Ejiiscopal Church in the United States. Dr Cummins (then canonically under suspension and unable to perform any episcopal act) con- secrated a bishop to assist him, and through this succession the Eef ormed Episcopal Church claims to derive historically valid orders. Its supreme authority is vested in a General Synod, in which the laity are represented. Each congrega- tion is self-governing. The distinguishing characteristics of the Church are indicated in its revised version of the

EngKsh Prayer-Book, in which everything that might be construed as " sacerdotal " is eliminated. In Great Britain and Canada it is reported that there are 35 congregations, with 2200 communicants, and in the United States 92 congregations, with 9500 communicants.

Cf. Eldeidge, Origin, Orders, Organization, and Worship of B. E. C. , London. Periodicals : Work and Worship, London. Evangelical Episcopalian and Episcopal Recorder, U.S.A.

Refrigfe rating: and ice-i>Aaking:

iVIachinery. ❖❖❖ Refrigeration is the coohng of a body by the transfer of a portion of its heat to another and therefore a cooler body. For ordinary temperatures it is performed directly with water as the coohng agent, especi- ally when well water, which usually has a temperature of from 52❖❖ to 55❖❖ Fahr., can be obtained. There are, how- ever, an increasingly large number of cases in which temperatures below that of any available natural cooling agent are required, and in these it is necessary to resort to machines which are capable of producing the required cooling effect by taking in heat at low temperatures and rejecting it at temperatures somewhat above that of the natural cooling agent, which for obvious reasons is gener- ally water. The function of a refrigerating machine, there- fore, is to abstract heat at a low temperature and reject it at a higher one.

This involves the expenditure of a quantity of work W, the amount in any particular case being found by the equation W = Q2 – Qi, where W is the work, expressed by its equivalent in British thermal units ; Qj the quantity of heat, also in B.T.U., given out at the higher temperature Tj ; and Qj the heat taken in at the lower temperature Tj. It is evident that the discharged heat Q2 is equal to the abstracted heat Qj, plus the work expended, seeing that the work W, which causes the rise in temperature from Ti to T2, is the thermal equivalent of the energy actually expended in raising the temperature to the level at which it is rejected. The relation then between the work expended and the actual cooling work performed denotes the efficiency of the process, and this is

expressed by -r ❖❖❖ L_ ; but as in a perfect refrigerating machine

it is understood that the whole of the heat Qi is taken in at the absolute temperature Tj, and the whole of the heat Q2 is rejected at the absolute temperature Tj, the heat quantities are proportional

T to the temperatures, and the expression = ⬛⬛⬛\^ gives the ideal 00-

efficient of performance for any stated temperature range, whatever working substance is used. These coefficients for a number of cases met with in practice are given in the following table. They show

Table L

Ti.

Temperature at

which Heat is

extracted in

Degrees Fahr.

T2.

Temperature at which Heat is rejected In

Degrees Fahr.

-10⬛⬛0⬛⬛10⬛⬛20⬛⬛30⬛⬛40⬛⬛

50”.

60”.

70”.

80”.

5-0 5-8 6-7 8-0 9-8 12-5

90”.

100”.

7-5 9-2 11-7 16-0 24-5 50-0

6-4

7-7

9-4

12-0

16-3

25-0

5-6 6-6 7-8 9-6 12-2 16-7

4-5 5 1 5-9 6-8 8-2 10-0

4‘1 4-6 5-2 6-0 7-0 8-3

that in all cases the heat extracted exceeds by many times the heat expended. As an instance, when heat is taken in at 0 and

rejected at 70 , a perfect refrigerating machine would abstract 6 ‘6 times as much heat as the equivalent of the energy to be applied. If, however, the heat is to be rejected at 100 , then the coeiiicient is reduced to 4”6.

By examining Table I. it will be seen how important it is to reduce the temperature range as much as possible, in order to obtain the most economical results. No actual refrigerating machine does, in fact, take in

heat at the exact temperature of the body to be cooled and reject it at the exact temperature of the cooling water, but, for economy in working, it is of great importance that the differences should be as small as possible.

There are two distinct classes of macliiiies used for refrigerating and ice-making. In the first refrigeration is produced by the expansion of atmospheric air, and in the second by the evaporation of a more or less volatile liquid.

Compressed-air Machines. ❓❓❓A compressed-air refrigerating machine consists in its simplest form of three essential parts ❓❓❓a compressor, a compressed-air cooler, and an expansion cylinder. It is shown diagrammatioally in Fig. 1 in con- nexion with a chamber which it is keeping cool. The com- pressor compresses air from the room, the work it expends

Corripression Cylinder

Expansion Cylinder

Coo I e r

*rP❓❓❓^*

M

V

nan .,.

1^ O O M

Fio. 1. ❓❓❓Compressed-Air Befrigerating Maclune.

being converted into heat. The compressed air, leaving the compressor at the temperature Tj, passes through the cooler, where it is cooled by means of water, and then is admitted to the expansion cylinder, where it is expanded, performing work on the piston, to atmospheric pressure. The

heat equivalent of the mechanical work performed on the piston is abstracted from the air, which is discharged at the temperature Tj. This temperature Tj is necessarily very much below the temperature to be maintained in the room, because the cooling effect is produced by transferring heat from the room or its contents to the air, which is thereby heated. The rise in temperature of the air in its passage through the room is, in fact, the measure of the cooling effect produced. If such a machine could be constructed with reasonable mechanical efficiency to compress the air to a temperature but slightly above that of the cooling water, and to expand the air to a temperature but slightly below that required to be maintained in the room, we should of course get a result approximating in efficiency somewhat nearly to the figures given in Table I. Unfortunately, however, such results cannot be obtained in practice, because the extreme lightness of the air and its very small heat capacity (which at constant pressure is ???2379) would necessitate the employment of a great volume, with extremely large and mechanically inefficient cylinders and apparatus. A pound of air, representing about 12 cubic feet, if raised 10?? Fahr. will only take up about 2‘4 B.T.U. Consequently to make such a machine mechanically successful a ci’)mparatively small weight of air must be used, and the temperature difference increased ; in other words, the air is discharged at a temperature very much below that to be maintained in the room.

This theory of working is founded on the Carnot cycle for a perfect heat motor, a perfect refrigerating machine being simply a reversed

heat motor. Another theory involves the use of the Stirling regenerator, which, as is well known, was proposed in connexion with the Stirling heat engine. The air machine invented by Dr A. Kirk in 1862, and described by him in a paper on the “Mechanical Production of Cold” (Proc. Inst. C.E. vol. xxxviL 1874, p. 244), is simply a reversed Stirling air engine, the air working in a closed cycle instead of being actually discharged into the room to be cooled, as is the usual practice with ordinary compressed-air machines. Kirk’s machine was used commercially with success on a fairly large scale, chiefly for ice-making, and it is recorded that it produced about 4 B of ice for 1 lb of coal. In 1868 Mr J. Davy Postle read a paper before tlie Royal Society of A“ictoria, suggesting the conveyance of meat

on board ship in a frozen state by means of refrigerated air, and in 1869 he showed by experiment how it could be done ; but his apparatus was not commercially developed. In 1877 a compressed-air machine was designed by Mr J. J. Coleman of Glasgow, and in the early part of 1879 one of his machines was fitted on board the Anchor liner Circassia, which successfully brought a cargo of chilled beef from America ??? the first imported by the aid of refrigerating machinery, ice having been previously used. The first successful cargo of frozen mutton from Australia was also brought by a Bell-Coleman machine in 1879, andfrom this period the practical application of refrigerating machinery in this country received a great impetus. In the Bell- Coleman machine the air was cooled during compression by means of an injection of water, and further by being brought into contact with a shower of water. Another, perhaps the principal, feature was the iuterohanger, an apparatus whereby the compressed air was further cooled before expansion by means of the comparatively cold air from the room in its passage to the compressor, the same air being used over and over again. The object of this interchanger was not only to cool the compressed air before expansion, but to condense part of the moisture in it, so reducing the quantity of ice or snow produced during expansion. A full description of the machine may be found in a paper on " Air-Eefrigerating Machinery" by Mr Coleman {Froc. Inst. C.E. vol. Ixviii. 1882). At the present time the Bell-Coleman machine has practically ceased to exist. In such compressed-air machines as are now made there is no injection of water during compression, and the compressed air is cooled in a surface cooler, not by actual mixture with a shower of cold water. Further, though the interchanger is still used by some makers, it has been found by experience that, with properly constructed valves and passages in the expansion cylinder, there is no trouble from the formation of snow, when, as is the general practice, the same air is used over and over again, the compressor taking its supply from the insulated room or compartment. So far as the air discharged from the expansion cylinder is concerned, its humidity is precisely the same so long as its temperature and pressure are the same, inasmuch as when discharged from the expansion cylinder it is always in a saturated condition for that temperature and pressure. The manufacture of compressed ??? air machines has practically been confined to Great Britain.

In an actual machine the air is compressed to about 65 ft absolute, and its temperature is then about 300 Fahr. With cooling water at 60 and without an interchanger it will enter the expansion cylinder at about 70, and after expansion will be cooled to about 70 below zero. The power given off in expansion is utilized for driving the compressor, the balance over and above that restored in expansion being applied either by a steam engine coupled to the machine or by some other source of power. With such a machine the ideal coefficient of performance is about 1, but the actual coefficient will be abotit , after allowing for the losses incidental to working. Moisture, from which atmospheric air is never free, exercises an important efl'ect in the working of

Fio. 2 Compressed.Air Refrigerating Machine.

compressed-air machines. Even when the same air is used over and over again, moisture is abstracted from the cold room and its

contents, and the bulk of this must be got rid of in the machines, either in the form of water or of ice. A steam-driven compressed- air machine in a simple form is shown in Fig. 2. It consists of a compressor A, air coolers BB, an expansion cylinder C, and a steam engine F. Air, drawn into the compressor at D, is com- pressed to about 50 lb per square inch above the atmosphere, and then passed through the coolers BB, which are constructed like the surface condenser of a steam engine, the cooling water being pumped through the tubes and the air being on the outside. In the coolers it loses a portion of its moisture, which is con- densed and runs off as water, and it then passes into the expansion cylinder C, where it is cut otf at about one-third of the stroke and expanded behind a piston, thus giving back a, portion of the power expended in compression. The thermal equivalent of the power given off on the piston, less an allowance for losses, is taken from the air, and the cold expanded air is discharged at E, to be utilized in the desired manner. The difference between the power expended in compression and that restored in expansion, plus the friction of the machine, is supplied by means of the steam engine F

coupled to the crank-shaft. In the figure the expansion cylinder is placed tandem to the compressor, the two pistons being on the same rod. For marine purposes two complete machines are mounted on one bed-plate, the machines either being worked together, or in case of accident to one, separately. They are also made without a steam engine, the power being applied by means of a belt.

Liquid Machines. ❓❓❓ Machines of tlie second class may conveniently – be divided into three types : ❓❓❓ (a) Those in which there is no recovery of the refrigerating agent, water being the agent employed ; they will be dealt with as " Vacuum machines." (6) Those in which the agent is recovered by means of mechanical compression ; they are termed " Compression machines." (c) Those in which the agent is recovered by means of absorption by a liquid ; they are known as " Absorption machines."

In the first class, since the refrigerating liquid is itself rejected, the only agent cheap enough to be employed is

water. The boiling point of water varies machines with pressure ; thus at one atmosphere or 14 '7

H) per square inch it is 212❓❓ Fahr., whereas at a pressure of ❓❓❓08.5 lb per square inch it is 32❓❓, and at lower pressures there is a stiU farther fall in temperature, This property is made use of in vacuum machines. Water at ordinary temperature, say 60❓❓, is placed in an air-tight glass or insulated vessel, and when the pressure is reduced by means of a vacuum pump it begins to boil, the heat necessary for evaporation being taken from the water itself. The pressure being still farther reduced, the temperature is gradually lowered until the freezing point is reached and ice formed when about one-sixth of the original volume has been evaporated.

The earliest machine of this kind appears to have been made in 1755 by Dr CuUen, who produced the vacuum by means of a pump alone. In 1810 Leslie combined with the air pump a vessel containing strong sulphuric acid for absorbing the vapour from the air, and is said to have succeeded in producing 1 to IJ lb of ice in a single operation. Carr^ later adopted

the same principle. In 1878 “Windhausen patented a vacuum machine for producing ice in large quantities, and in 1881 one of these machines, said to be capable of making about 12 tons of ice per day, was put to work in London. The installation was fully described by Carl Pieper {Trans. Soc. of Engineers, 1882, p. 145) and by Dr John Hopkin- son {Journal of Soc. of Arts, 1882, vol. xxxi. p. 20). The process, however, not being successful from a commercial point of view, was abandoned. At the present time vacuum machines are only employed for domestic purposes. The hand apparatus invented by Mr Fleuss consists of a vacuum pump capable of reducing the air pressure to a fraction of a millimetre, the suction pipe of which is connected first with a vessel containing sulphuric acid, and second ivith the vessel containing the water to be frozen. Both these vessels are mounted on a rocking base, so that the acid can be thoroughly agitated while the machine is being worked. As soon as the pump has sufficiently exhausted the air from the vessel containing the water, vapour is rapidly given off and is absorbed by the acid until sufficient heat has been abstracted to bring about the desired reduction in temperature, the acid becom- ing heated by the absorption of water vapour, while the water freezes. The small Fleuss machine will produce about 1 J lb of ice in one operation of 20 minutes. Iced water in a carafe for drinking purposes can be produced in about three minutes. The

acid vessel holds 9 lb of acid, and nearly 3 lb of ice can be made for each 1 lb of acid before the acid has become too weak to do further duty. Another machine, which can be easily worked by a boy, will produce 20 to 30 lb of ice in one hour, and is perhaps the largest size practicable with this method of freez- ing. The temperature attainable depends on the strength and condition of the sulphuric acid ; ordinarily it can be reduced to zero Fahr., and temperatures 20 lower have frequently been; obtained.

Though prior to 1834 several suggestions had been made with regard to the production of ice and the cooling- of liquids by the evaporation of a more volatile liquid than water, the first machine J^^i,i f,s_ actually constructed and put to work was made by John Hague in that year from the designs of Jacob Perkins (Journal of Soc. of Arts, 1882, vol. xxxi. p. 77). This machine, though never used commerci- ally, is the

parent of all modern compression machines. Perkins in his patent specification states that the volatile fluid is by preference ether. In 1856 and 1857 James. Harrison of Geelong, Victoria, patented a machine embodying the same principle as that of Perkins, but worked out in a much more complete and practical manner. It is stated that these machines were first made in New South Wales in 1859, but the first Harrison machine adopted successfully for manufacturing purposes was- applied in the year 1861 for cooling oil in order to extract the parafiin. In Harrison's machine the agent used was ether (C2H5)20. Improvements were made by Siebe and. Company, of London, and a considerable number of ether machines both for ice-making and refrigerating purposes, were supplied by that firm and others up to the year 1880. In 1870 the subject of refrigeration was investigated by- Professor Carl Linde of Munich, who was the first to con- sider the question from a thermodynamic point of view. He dealt with the coefficient of performance as a common basis of comparison for all machines, and showed that the- compression vapour machine more nearly reached the theoretic maximum than any other (Bayerisches Industrie und Gewerheblatt, 1870 and 1871). Linde also examined the physical properties of various liquids, and after making trials with methylic ether in 1872, built his first ammonia compression machine in 1873. Since then the ammonia compression machine has been most widely adopted, though the carbonic acid machine, also compression, which was first made in 1880 from Linde's designs, has of late years been used to a considerabl& extent.

A diagram of a vapour compression machine is shown in Fig. 3.. There are three principal parts, a refrigerator or evaporator, a compression pump, and a condenser. The refrigerator, which.

Condenser

Refrigerator

Re|ulatin^ Valve Fig. 3. ??? Vapour Compression Machine.

consists of a coil or series of coils, is connected to the suction side of the pump, and the delivery from the pump is connected to the condenser, which is generally of somewhat similar construction to

the refrigerator. The condenser and refrigerator are connected by a pipe in which is a valve named the regulator. Outside the refrigerator coils is the air, brine, or other substance to be cooled, and outside the condenser is the cooling medium, which, as previoiisly stated, is generally water. The refrigerating liquid (ether, sulphur dioxide, anhydrous ammonia, or carbonic acid) passes from the bottom of the condenser through the regulating valve into the refrigerator in a continuous stream. The pressure in the refrigerator being reduced by the pump and maintained at such a degree as to give the required boiling point, which is of course always lower than the temperature outside the coils, heat passes from the substance outside, through the coil surfaces, and is taken up by the entering liquid, which is converted into vapour at the temperature Tj. The vapours thus generated are drawn into the pump, compressed, and discharged into the condenser at the temperature Tj, which is somewhat above that of the cooling water. Heat is transferred from the compressed vapour to the cooling water and the vapour is converted into a liquid, which collects at the bottom and returns by the regulating valve into the refrigerator. As heat is both taken in and discharged at constant temperature during the change in physical state of the agent, a, vapour compression machine must approach the ideal much more nearly than a compressed-air machine, in which there is no change of state.

This will be seen by taking as an example a case in which the cold room is to be kept at 10►► Fahr., the cooling water being at 60►►. Under these conditions, the actual evaporating temperature Tj, in a well – constructed ammonia compression machine, after allowing for the differences necessary for the exchange of heat, would be about 5►► below zero, and the discharge temperature Tj, would be about 70►►. An ideal machine, working between 5►► below zero and 70►► above, has a coefdcient of about 6 -1, or more than 6 times that of an ideal compressed-air machine of usual construotion to perform the same useful cooling work.

A vapour compression machine does not, however, work precisely in the reversed Carnot cycle, inasmuch as the fall in temperature between the condenser and the refrigerator is not produced, nor is it attempted to be produced, by the adiabatic expansion of the agent, but results from the evaporation of a portion of the liquid itself. In other words, the liquid refrigerating agent enters the refrigerator at the condenser temperature and introduces heat which has to be taken \ip by the evaporating liquid before any useful refrigerating effect can be performed. The extent of this loss is determined by the relation between the liquid heat and the latent heat of vaporization at the refrigerator temperature. If ?□□□ represents the latent heat of the vapour, and jj and q^ the amounts of heat contained in the liquid at the respective temperatures of T^ and Ti, then the loss from the heat carried from the condenser into the

refrigerator is shown by □□□ □□□ □□□ and the useful refrigerating effect

produced in the refrigerator is r – (q,^ ~ ?i)- Assuming, as in the previous example, that Tj is 70□□ Fahr., and that Tj is 5□□ below zero, the results for various refrigerating agents are as follows : □□□

Table II.

Latent Heat.

r

Liquid Heat.

92-91

Net Re- frigeration.

r-(52-9i)

Proportion of Loss.

93-91

r

Anhydrous ammonia Sulphurous acid Carbonic acid .

590-9 173-1 119-9

67-5 27-3 42-6

523-4

145-8

77-3

-110

157 351

The results show that the loss is least in the case of anhydrous ammonia and greatest in the case of carbonic acid. At higher condenser temperatures the results are even much more favourable to ammonia. As the critical temperature (88-4 Fahr.) of carbonic acid is approached the value of r becomes less and less and the refrigerating effect is much reduced. When the critical point is reached the value of r disappears altogether and a carbonic acid machine becomes dependent for its refrigerating effect on the re- duction in temperature produced in the expansion of carbonic acid from the condenser pressure to that in the refrigerator. The ab- straction of heat does not then take place at constant temperature. The vapour enters the refrigerator at a temperature much below that of the substance to be cooled, and whatever cooling effect is produced is brought about by the superheating of the vapour, the result being that above the critical point of carbonic acid the dif- ference T.J ~~T] is much increased and the efficiency of the machine is reduced. The critical temperature of anhydrous ammonia is about 266 Fahr., which is of course never approached in the ordi~~ nary working of refrigerating machines. Some of the principal physical properties of sulphurous acid, anhydrous ammonia, and carbonic acid are given in Tables III., IV., and V.

Table III.

-Ledoux's Table for Saturated Sulphur Dioxide Vapour (SO2).

t

Temp, of Ebullition. Degs. Fahr.

"Vapour-tension

in Pounds per

sq. in.

Absolute.

9

Heat of Liquid

from 32 Fahr.

B.T.U.

r

Latent Heat of

Evaporation.

B.T.U.

w

Volume of

one Pound

of Saturated

Vapour.

Cub. ft.

-22

5-546

-19-55

176-98

13-168

-13

7-252

-16-31

174-94

10-268

- 4

9-303

-13-05

172-91

8-122

5

11-803

- 9-79

170-82

6-504

14

14-789

- 6-85

168-75

5-254

23

18-544

- 3-26

166-63

4-293

32

22-468

0-00

164-47

3-540

41

27-445

3-27

162-39

2-931

50

33-275

6-55

160-24

2-451

59

39-958

9-83

158-08

2-066

68

47-637

13-10

155-89

1-746

77

56-311

16-38

153-67

1-490

86

66-407

19-69

151-49

1-266

95

77-641

22-99

149-27

1-089

104

90-297

26-28

147-02

0-913

Table IV. ??? Mollier's Table for Saturated Anhydrous Ammonia Vapour (NH3).

t

Vapour-tension

9 ???

r

Volume of

Temp, of

in Pounds per

Heat of Liquid

Latent Heat of

one Pound

Ebullition.

sq. in.

from 32?? Fahr.

Evaporation.

of Saturated

Degs. Fahr.

Absolute.

B.T.U.

B.T.U.

Vapour. Cub. ft.

-40

10-238

-60-048

600-00

25-630

-31

13-324

-53-064

597-24

20-120

-22

16-920

-45-918

595-08

15-971

-13

21-472

-38-646

593-00

12-783

- 4

27-000

-31-212

590-00

10-316

5

33-701

-23-634

586-82

8-394

14

41-522

-15-894

581 -00

6-888

23

50-908

- 8-028

576-00

5-703

32

61-857

0-000

571-00

4-742

41

74 ???SIS

8-172

562-50

3-973

50

89-159

16-506

555-48

3-364

59

105-939

24-966

550-00

2-851

68

124-994

33-588

541-00

2-435

77

146-908

42^354

531 ???OO

2-098

86

170-782

51 ???282

523^00

1-810

95

197-800

60-336

512-50

1-570

104

227-662

69-552

501-50

1-361

Table V. ◆◆◆ Mollier's

Table for Saturated Carbon Dioxide Vapour (C0◆◆◆).

t

Vapour-tension

9

r

u Volume of

Temp, of

in Pounds per

Heat of Liquid

Latent Heat of

one Pound

Ebullition.

sq. m.

from 82◆◆ Fahr.

Evaporation.

of Saturated

Degs. Fahr.

Absolute.

B.T.U.

B.T.U.

Vapour. Cub. ft.

-22

213 -.345

-24-80

126-72

???4165

-13

248-903

-21-06

123-25

???3508

- 4

288-727

-17-19

119-43

???2964

5

334-240

-13-17

115-25

-2.^15

14

385-443

- 9-00

110-65

-2114

23

440-913

- 4-63

105-53

<?>1773

32

503-497

0-00

99 SI

<?>1490

41

573-187

4-93

93-35

???1233

50

649-991

10-28

85-93

???1025

59

733-906

16-22

77-40

???082

68

826-356

23^08

66-47

???0625

77

930-184

31-63

51-80

<?>0449

86

1039-701

45-45

27-00

<?>0208

87-8

1062-458

51-61

15-12

<?>0112

88-43

1070-991

59-24

0-00

0-00

The action of a vapour compression machine is shown in Fig. 4. Liquid at the condenser temperature being introduced into the re- frigerator through the regulating valve, a small portion evaporates and reduces the remaining liquid to the temperature Tj. This is shown by the curve AB, and is the useless work repre- sented by the expression ?iZl!. Evaporation then continues at

the constant temperature T, abstracting heat from the substance outside the refrigerator as shown by the line BC. The vapour

is then compressed along the line CD to the temperature Tj, when, by the action of the cooling water in the condenser, heat is

abstracted at constant tempera- ture and the vapour condensed along the line DA. Fig. 5 shows a complete ammonia compression machine applied to the cooling of a liquid such as water or brine. B is the refrigerator, consisting of a series of iron or steel coils placed inside a tank containing the liquid to be cooled, the liqui(

*Fig. 4.**Action of Vapoui Compression Machine.*

ammonia being admitted to the coils through a regulating valve. The compressor D draws off the vapour through the pipe C and compresses into the condenser F, the compressed vapour first passing through vessel E to separate any oil that may be held in suspension by the ammonia. Ine condenser is constructed on the same lines as the refrigerator, the cooling water being contained in the tank. A pipe takes the liquid from the bottom of the con- denser coil to the regulating valve. A steam engine placed along- side the compressor supplies the necessary driving power, but the compressor may be driven by a belt or in any other convenient manner. The condenser is often made up of a, series of coils without a tank, the cooling water falling over the coils into a col- lecting tray below ; and this form is perhaps the most convenient for ordinary use, as it affords great facilities for inspection and painting. A compression machine using

carbonic acid may be constructed on precisely the same lines as an ammonia machine, due allowance being made for the increased working pressures. In

FiQ. 5. ❓❓❓ Ammonia Compression Machine.

the case of ammonia, copper and copper alloys must be avoided, though for carbonic acid they are not objectionable.

The compression of ammonia is sometimes carried out on what is known as the Linde or "wet" system, and sometimes on the "dry" system. When wet compression is used the regulating valve is opened to such an extent that a little more liquid is passed than can be evaporated in the refrigerator. This liquid enters the compressor with the vapour, and is evaporated there, the heat taken up preventing the rise in temperature during compression which would otherwise take place. The compressed vapour is dis- charged at a temperature but little above that of the cooling water. With dry compression, vapour alone is drawn into the compressor, and the temperature rises to as much as 180 or 200 degrees. Besides being more economical in working, wet compression possesses practical advantages in keeping the working parts of the compressor cool, and it also greatly facilitates the regulation of the liquid, ❓❓❓ to ensure the full duty of the machine being continuously per- formed. Some makers use a compression intermediate between the two systems. Very exact comparative trials have been made by Prof. Schroeter and others with compression machines using sulphur dioxide and ammonia. The results are published in Vergleichende Versitche an Kdltemaschinen, by M. Schroeter, Munich, 1890, and in Nos. 32 and 51 of Bayerisches Industrie und Gewerbeblatt, 1892. Some of the results obtained by Prof. Schroeter in 1893 with an ordinary brine cooling machine on the Linde ammonia system are given in the following table.

Table VI.

Temperature reduction in

refrigerator. Degs. Fahr.

42-8 to 37 -4

28-4 to 23

14 to 8-6

-0-4to-5-S

I.H.P. in steam cylinder .

16-79

16-48

16-29

14-36

I.H.P. in compressor

14-32

14-3

13-64

11-98

Pressure in refrigerator

in pounds per sq. inch

above atmosphere .

46-2

32-6

19-8

9-9

Pressure in condenser in

pounds per aq. inch above

atmosphere

116-0

115-0

110-0

108-0

Heat abstracted in re-

frigerator. B.T.U. per hr.

342192

263400

171615

121218

Heat rejected in con-

denser. B.T.U. per hour

377667

301200

214347

158594

The principle of the absorption process is chemical or physical rather than mechanical ; it depends on the fact that many vapours of low boiling-point are readily absorbed in water, and can be separated ^^□□^f□□□□□□g" again by the application of heat. In its simplest form an absorption machine consists of two iron vessels connected together by a bent pipe. One of these contains a mixture of ammonia and water, which on the application of heat gives off a mixed vapour containing a large proportion of ammonia, a liquid containing but little ammonia being left behind. In the second vessel, which is placed in cold water, the vapour rich in ammonia is condensed under pressure. To produce refrigeration the operation is reversed. On allowing the weak liquor to cool to normal temperature, it becomes greedy of ammonia (at 60□□ Fahr. at atmospheric pressure water will absorb about 760 times its own volume of ammonia vapour), and this produces an evaporation from the liquid in the vessel previously used as a condenser. This liquid, containing a large proportion of ammonia, gives off vapour at a low temperature and there'fore becomes a refrigerator, abstract- ing heat from water or any surrounding body. When the ammonia is evaporated the operation as described must be again commenced. Such an apparatus is not much used now. Larger and more elaborate machines were made by Carre in France; but no very high degree of perfection was arrived at, owing to the impossibility of getting an anhydrous product of distillation. In 1867 Eees Reece, taking advantage of the fact that two vapours of different boiling-points, when mixed, can be separated by means of fractional condensation, brought out an absorption machine in which the distillate was very nearly anhydrous. By means of vessels termed the analyser and the rectifier, the bulk of the water was condensed at a comparatively high temperature and run back to the generator, while the ammonia passed into a condenser, and there assumed the liquid form under the pressure produced by the heat in the generator and the cooling action of water circulating outside the condenser tubes.

Fig. 6 is a diagram of an absorption apparatus. The ammonia vapour given off in the refirigerator is absorbed by a cold weak solution of ammonia and water in the absorber, and the strong liquor is pumped back into the generator through an interchanger through which also the weak hot liquor from the generator passes on its way to the absorber. In this way the strong liquor is heated before it enters the generator, and the weak liquor is cooled before it enters the absorber. The generator being heated by means of a steam coil, ammonia vapour is driven off at such a pressure as to cause its condensation in the condenser. From the condenser it passes into the refrigerator through a regulating valve in the usual manner. The process is continuous, and is identical with that of the compression machine, with the exception of the return from the temperature Tj to the temperature T^ which is brought about by the direct application of heat instead of by means of mechanical compression. With the same temperature range, however, the same amount of heat has to be acquired in both cases, though from the nature of the process the actual amount of heat demanded from the steam is much greater in the absorption system than in the compression. This is chiefly due to the fact that in the former the heat of vaporization acquired in the refrigerator is rejected in the absorber, so that the whole heat of vaporization has to be supplied

again by tlie steam in the generator. In the latter the vapour passes direct from the refrigerator to the pump, and power has to be expended merely in raising the temperature to a sufficient degree to enable condensation to occur at the temperature of the cooling water. On the other hand, a great advantage is gained in the absorption machine by using the direct heat of the steam, without first converting it into mechanical work, for in this way its

rtr

Condenser

Regulating

Generator

. Valve

^^^N. Interchanger

ratoB

l===ii Absorber

Fig. 6. *Absorption Apparatus.*

latent heat of vaporization can be utilized by condensing the steam in the coils and letting it escape in the form of water. Each pound of steam can thus be made to give up some 950 units of heat ; while in a steam engine only about 160 units are utilized in the steam cylinder per pound of steam, and in addition allowance has to be made for mechanical inefficiency. In the absorption machine the cooling water has to take up about twice as much heat as in the compression system, owing to the ammonia being

Fro.

-Modem Absorption Apparatus.

twice liquefied *namely, once in the absorber and once in the condenser. It is usual to pass the cooling water first through the condenser and then through the absorber.*

The absorption machine is not so economical as the compression, but an actual comparison between the two systems is difficult to make. Information on this head is given in papers read by Dr Linde and by Professor Ewing before the Society of Arts {Journal of the Society of Arts, vol. xlii. 1894, p. 322, and Society of

Arts 1897 Howard Lectures, January, February, and March 1897). The heat to be expended in the generator must at least equal the heat of absorption, plus the latent heat rejected in the condenser, plus the heat for superheating the vapours so as to give the pressure required for condensation. A modern absorption apparatus as applied to the cooling of liquids is shown in Fig. 7. A is the generator containing the coils, to which steam is supplied from an ordinary boiler not shown ; B is the analyser ; C, the rectifier ; D, the condenser, which is shown of the open type ; E, the refrigerator or cooler, in which the nearly anhydrous ammonia obtained in the condenser is allowed to evaporate ; F, the absorber, through which weak liquor from the generator continually flows and absorbs the anhydrous vapour produced in the refrigerator ; and G, the pump for forcing the strong liquor produced in the absorber back through the economizer, H, into the analyser, where, meeting with steam from the generator, the ammonia is again driven off, the process being thus carried on continuously. Sometimes an additional vessel is employed for heating the strong liquor by means of the exhaust steam from the engine driving the ammonia pump. Absorption machines are also made without a pump for returning the strong liquor to the generator. In these cases they work intermittently. In some machines the same vessel is used alternately as a generator and absorber, while in others, in order to minimize the loss of time, two vessels are provided which can be used alternately as generators and absorbers.

Applications. ❓❓❓ Apart from the economical working of the machine itself, whatever system may be adopted, it is of importance that cold once produced should not be wasted, and it is therefore necessary to use some form of instdation to protect the vessels in which liquids are being cooled, or the rooms or ships' holds in which the freezing or storage processes are being carried on. Such insulation generally consists of materials such as charcoal, silicate cotton, granulated cork, small pumice, hair-felt, sawdust,

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2 Lasers TiTlcBoords ^^g

FiQ. 8. ❓❓❓ Insulation of a Cold Store.'

wearing surface of the floor is generally made thicker than the inside lining of the sides. Should the walls or floor be damp, waterpoof paper is added. Granulated cork has practically the same insulating properties as silicate cotton, and the same thicknesses may be used. About 10 inches of flake charcoal and vegetable silica, or 11 of small pumice, are required to give the same pro- tection as 7 inches of silicate cotton. In Germany cork bricks are largely used ; these are made of granulated cork and some binding material, and they measure about 10 inches x4|x2| inches thick. For temperatures of about 35 Fahr. two courses of these bricks are laid against the wall of the building, and finished off on the inside with cement. For 20 three courses are used. The floors are similarly covered, and the bricks are protected by concrete or in some other manner according to the nature of the traffic on them. For lager-beer cellars and fermenting rooms, for bacon-curing cellars, and for similar purposes, brick walls with single or double air spaces are used, and sometimes a space filled with silicate cotton. In Australia and New Zealand pumice, which is found in enormous quantities in the latter country, takes the place of charcoal and silicate cotton. In Canada air spaces are largely used either alone or in combination

with silicate cotton or planer shavings. The air spaces, two or three in number, are formed between two layers of tongued and grooved wood, and the total thickness of the insulation is about the same as when silicate cotton alone is used. On board ship up to the present time charcoal has been almost entirely employed, but lately several vessels have been insulated with silicate cotton. The charcoal is either placed directly up to the skin of the vessel, and kept in place by a double lining of wood inside, in which case a thickness of about 10 inches is used, or it is placed between two layers of wood. With an air space, about 6 inches of flake charcoal is employed for the insulation of ships' holds, but for deck-houses and other parts exposed to the sun the thickness must be greater. A layer of sheet zinc or tin has frequently to be used as protection from rats. Given a certain allowable heat transmission, the principal points to

be considered in connexion with insulation are, first cost, durability, weight, and space occupied, the two last named being specially important factors on board ship. No exact rules can be laid down, as the conditions vary so greatly ; and though experiments have been made to determine the actual heat conduction of various materials per unit of surface, thickness, and temperature difference, the experience of actual practice is at present the only accepted guide.

Compressed-air machines discharge the cold air direct into the insulated room or hold, a snow box being generally provided close to the outlet of the expansion cylinder to catch the snow and congealed oil. The air is distributed by means of wood air trunks with openings controlled by slides, and similar trunks are pro- vided in connexion with the suction of the compressor to conduct the air back to the machine. With machines of the compression and absorption system, the rooms are either cooled by means of cold pipes or surfaces placed in them, or by a circulation of air cooled in an apparatus separated from the rooms. The cold pipes may be direct-expansion pipes in which the liquid ammonia evaporates, or they may be pipes or walls through which circulates an iincongealable brine previously cooled to the desired temperature. The pipes are placed on the ceilings or walls, according to circum- stances, but they must be arranged so as to induce a circtdation of air throughout the compartment and ensure every part being cooled. With what is termed the air circulation system the air is generally circulated by means of a fan, being drawn from the rooms through ducts, passed over a cooler, and returned again to the rooms by other ducts. In some coolers the cooling surfaces consist of direct-expansion pipes placed in clusters of convenient form ; in others brine pipes are used ; in others there is a shower of cold brine, and in some cases combinations of cold pipes and brine showers. Whether pipes in the rooms or air circulation give the best results is to some extent a matter of opinion, but at the present time the tendency is decidedly in favour of air circulation, at any rate for general cold storage purposes. Whichever system be adopted, it is important for economical reasons that ample cooling surface be allowed, and that aU surfaces be kept clean and active, to make the difference between the temperature of the evaporating liquid and the rooms as small as possible. Small surfaces reduce first cost, but involve higher working expenses by

T increasing the value of s^ ~ , and thus demanding more energy,

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and consequently more fuel to effect the given result than if larger surfaces were employed.

Liquids are generally cooled in a refrigerator similar to that shown in Fig. 5, entering the tank at the top and passing off at the bottom.

The general arrangement of an ice factory for producing can ice is shown in Fig. 9. The water to be frozen is contained in galvanized or terned steel moulds suspended in a tank filled to the proper level with brine maintained at the desired temperature. The moulds are frequently arranged in frames, so that by means of an overhead crane one complete row is lifted at a time. When the water is frozen the moulds are dipped in a tank containing warm water, and on being tipped the blocks of ice fall out. Ordinary water contains air, and ice made from it is generally opaque, due to the inclusion of numerous small air-bubbles. To produce clear ice the water must be agitated during the freezing process, or previously boiled to get rid of the air. Distilled water is frequently used, as well as the water produced by the condensation of the steam from the engine, which of course must be thoroughly purified and filtered. It should be noted, however, that with an ice- making plant of moderate size and a steam engine of good con-

struction the weight of steam used will not nearly equal the weight of ice produced, so that the difference must be made up either by distillation, which is a costly process, or by ordinary water. Can ice is usually made in blocks weighing 56, 112, or 224 ft, and from 4 to 8 inches thick. For cell ice ordinary water is used, agitated during freezing. The cells are flat and constructed of galvanized iron, so as to form a hollow space of about 2 inches in width, through which cold brine is circulated by a pump. They are placed vertically in a tank, the distance between them being from 8 to 14 inches, according to the thickness of the ice to be produced. The tank is filled with water, which is kept in agitation by means of a reciprocating paddle or piston ; in this way the air escapes, and with proper care a block

of great trans- parency is produced. To thaw it off warm brine is circulated through the cells. A usual size for cell ice is 4 feet by 3 feet by

FlQ. 9 ◆◆◆ General Arrangement of an Ice Factory.

1 foot mean thickness, the weight being about 6 cwts. If perfectly transparent ice is required, the two sides of the block are not allowed to join up, and it is then called plate ice, which is often made in very large blocks, afterwards divided by saws or steam cutters. In such cases the evaporation of the ammonia or other refrigerating liquid generally takes place in the cells themselves, the brine being dispensed with. With a well-constructed can ice-plant of say 25 tons capacity per day, from 15 to 16 tons of ice should be made in Great Britain to a ton of best steam coal. For cell and plate ice the production is considerably below this, and the first cost of the plant is much greater than that for can ice.

Fig. 10 shows an arrangement of cold storage on land, refrigerated on the air circulation system. The insulated rooms, on two floors, are approached by corridors, so as to exclude external air, which if allowed to enter would deposit moisture upon the goods. The air cooler is placed at the end, and the air is distributed by means of wood ducts furnished with slides for regulating the temperature of the rooms which are insulated according to the method shown in Fig. 9. In some cases, instead of the entrance being at the sides or ends, it is at the top, all goods being raised to the top floor in lifts and lowered by lifts into the rooms. With good machinery the cost of raising is not great, and is probably equalled by the saving in refrigeration, since the rooms hold the heavy cold air as a glass holds water.

Large passenger vessels and yachts are now generally fitted with refrigerating machinery for preserving provisions, cooling water and wine, and making ice. Usually two insulated compartments are provided, one for frozen meats at about 20◆◆ Fahr., and one for vegetables, &e., at about 40◆◆. They have a capacity of from 1500 to 3000 cubic feet, according to the number of passengers carried, and they are generally cooled by means of brine pipes, though direct expansion and air circulation are sometimes adopted. A passenger

vessel requires from 2 to 4 cwts. of ice per day. On battle-ships and cruisers the British Admiralty use small compressed-air machines for ice-making, the present standard being a produc- tion of 80 lb of ice per day, without provision rooms. A modern frozen meat carrying vessel will accommodate as much as 120,000 carcases, partly sheep and partly lambs, requiring a hold capacity of about 300,000 cubic feet. In some vessels both fore and aft holds and 'tween decks are insulated. Lloyd's Committee now issue certificates for refrigerating installations, if constructed according to their rules, and most modern cargo-carrying vessels have their refrigerating machinery classed at Lloyd's. In the meat trade between the River Plate, the United States, Canada, and

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Fio. 10.◆◆◆ Cold Stores.

Great Britain, ammonia or carbonic acid machines are now ex- clusively used, but for the Australian and New Zealand frozen meat trade compressed – air machines are still to some extent adopted. The holds of meat – carrying vessels are refrigerated either by cold air circulation or by brine pipes.

Though the adoption of refrigerating and ice-making machinery for industrial purposes practically dates from the year 1880, the manufacture of these machines has already assumed very great pro- portions ; indeed, in no branch of mechanical engineering, with the exception of electrical machinery, has there been so remarkable a development in recent years. The sphere of application is extend- ing year by year. The cooling of residential and public buildings in hot countries is yet untouched, the manufacture of ice and the preservation of perishable foods (apart from the frozen meat trade) have in many countries hardly received serious consideration, while in breweries, dairies, margarine works, and many other industries there is a large and increasing field for refrigerating and ice-making machinery.

For further information reference may be made to the following : SiEBEL. CmnpeTid. of Mechanical S^frigeration. Chicago. ◆◆◆ Red- wood. Theoretical and Practical Ammonia Refrigeration. New York. ◆◆◆ Steph ANSKT. Practical Running of an Ice and Refriger atin^ Plant. Boston. ◆◆◆ Ledoux. Ice-Making Machines. New York, ◆◆◆ Wallis – Taylor. Refrigerating and Ice – Mahing Machines. London. ◆◆◆ Ritchie Lease. Refrigerating Machinery. London. ◆◆◆ Db Volson Wood. Thermodynamics, Heat Motors and Refriger- ating Machinery. New York. ◆◆◆ Linde. Kdlteerzeugungsmaschine Lexikon der gesamten Technik. ◆◆◆ Behrend. Bis und Kat teerseugungs Masckinen. Halle. ◆◆◆ Db Marchena. Kompressions Kdltemaschinen. Halle. ◆◆◆ Hans Lorenz. Neuere Kilhl maschinen. Munich. ◆◆◆ Theodore Koller. Die Kdlteindiistrie, Vienna. ◆◆◆ Vooehees. Indicating the Refrigerating Machine. Chicago. ◆◆◆ ◆◆◆ Norman Selfe. Machinery for Refrigeration. Chicago. (t. B. L.)

Regreneration of Lost Parts. ◆◆◆ A loss and

renewal of living material, either continual or periodical, is a familiar occurrence in the tissues of higher animals. The surface of the human skin, the inner lining of the mouth and respiratory organs, the blood corpuscles, the ends of the nails, and many other portions of tissues are continuously being destroyed and replaced. The hair of many mammals, the feathers of birds, the epidermis of

reptiles, and the horns of stags are shed and replaced periodically. In these normal cases the regeneration depends on the existence of special formative layers or groups of cells, and must be regarded in each case as a special adaptation, with individual limitations and pecu- liarities, rather than as a mere exhibition of the funda- mental power of growth and reproduction displayed by living substance. Many tissues, even in the highest animals, are capable of replacing an abnormal loss of sub- stance. Thus in mammals, portions of muscular tissue, of epithelium, of bone, and of nerve, after accidental destruc- tion or removal, may be renewed. The characteristic feature of such cases appears to be, in the higher animals at any rate, that lost cells are replaced only from cells of the same morphological order ??? epiblastic cells from the epiiblast, mesoblastic from the mesoblast, and so forth. The process is in direct relation to the general power of growth and reproduction possessed by protoplasm, and is regarded by pathologists as the consequence of "removal of resist- ances to growth." It is much less common in the tissues of higher plants, in which the adult cells have usually lost the power of reproduction, and in which the regeneration of lost parts is replaced by a very extended capacity for budding. Still, more complicated reproductions of lost parts occur in many cases, and are more difficult to under- stand.

Fraisse has shown that in Amphibia the entire epidermis, to- gether with the slime-glands and the integumentary sense-organs, is regenerated by the epidermic cells in the vicinity of the defect. The whole limb of a Salamander or a Triton will grow again and again after amputation. SimOar renewal is either rarer or more diflicult in the case of Siren and Proteus. In frogs regeneration of amputated limbs does not take place. Chelonians, crocodiles, and snakes are unable to regenerate lost parts to any extent, while lizards and geckoes possess the capacity in a high

degree. The capacity is absent almost completely in birds and mammals. In coslenterates, worms, and tunicates the power is exhibited in a very varying extent. In Hydra, Nais, and Lumbriculus, after transverse section, each part may complete the whole animal. In most worms the greater, and in particular the anterior part, will grow a new posterior part, but the separated posterior portion dies. In Hydra, sagittal and horizontal amputations result in the completion of the separated parts. In worms such operations result in death, which no doubt may be a mere consequence of the more severe wound. Extremely interesting instances of regeneration are what are called "Hetero- morphoses," where the removed part is replaced by a dissimilar structure. The tail of a lizard, grown after amputation, diff'ers in structure from the normal tail : the spinal cord is replaced by an epithelial tube which gives off' no nerves ; the vertebrae are replaced by an nnsegmented cartilaginous tube. Loeb produced many heteromorphoses on lower animals. He lopped off the polyp head and the pedal disc of a Tubularia, and supported the lopped stem in an inverted position in the sand ; the original pedal end, now superior, gave rise to a, new polyp head, while the neck-end, on regeneration, formed a. pedal disc. In Cerianthus, a sea-anemone, and in Clone, an ascidian, regeneration after his operations resulted in the formation of new mouth-openings in abnormal places, surrounded by elaborate structures characteristic of normal mouths.

It appears that, in the same fashion as more simply organized animals display a capacity for reproduotion of lost parts greater than that of higher animals, so embryos and embryonic structures generally have a higher power of renewal than that displayed by the corresponding adult organs or organisms. Moreover, experi- mental work on the young stages of organisms has revealed a very striking series of phenomena, similar to the heteromorphoses in adult tissues, but more extended in range. Driesch, 0. Hertwig, and others, by separating the segmentation spheres, by destroying some of them, by compressing young embryos by glass plates, and by many other means, have caused cells to develop so as to give rise to structures which in normal development they would not have formed.

It is clear that there are at least three kinds of factors involved in regeneration, and that theoretical explanations must take into account, more definitely than has yet been done, these essential differences. There are : (1) Eegenera- tions due to the presence of undifferentiated, or little differentiated, cells, which have retained the normal capacity

of multiplication when conditions are favourable. (2) Regenerations due to the presence of special complicated rudiments, the stimulus to the development of which is the removal of the fully-formed structure. (3) Eegeneration involving the general capacity of protoplasm to respond to changes in the surroundings by changes of growth. The most general viewis to regard regenerations as special adapta- tions ; and Weismann, following in this matter Arnold Lang, has developed the idea at considerable length, and has found a place for regenerations in his system of the germ -plasm (see Heeedity) by the conception of the existence of "accessory determinants." Hertwig, on the other hand, attaches great importance to the facts of regeneration as evidence for his view that every cell of a body contains a similar essential plasm. Our knowledge of the facts is not yet suflBciently systematic to allow of useful criticism of these opposing views. (p. c. m.)

Reg'g'io di Ca.la.bria,, a town and archiepiscopal see of Calabria, Italy, capital of the province of Eeggio, stands at the south-west extremity of Italy, on the Straits of Messina, 7 miles south-south-east of Messina in Sicily, and 248 miles frdm Naples by rail. In 1894 the town suffered from an earthquake, though less severely than in 1783. It possesses an archaeological museum, a school of the industrial arts, and statues to Garibaldi and Italy. Ancient Grseco-Eoman baths have been excavated near the shore. The port has been enlarged and improved since 1896, and a new town hall was built in 1897. The manu- facture of bergamot and other essential oils, of olive oil, and of silk, with some printing, are the principal industries. In 1897 its port was cleared by 624 vessels of 433,349 tons. Population (1881), 35,437 ; (1901), 44,417.

Reg'g'io nell' Emilia, a city and episcopal see of Emilia, Italy, capital of the province of the same name, 38 miles north-west of Bologna by rail. Its public buildings include the church of the Madonna della Ghiara (1597), a Renaissance structure with fine domes, built in the form of a Greek cross ; an archaeological museum ; and an industrial institute, a school of design, and a specialized school of agriculture (1879). Its industries embrace the making of cheese, objects in cement, matches, and brushes, the production of silkworms, and printing. Population

(1881), 18,634; (1901), 59,176.

Regina, a town and port of entry of Assiniboia, Canada, and the capital of the North-West Territories, is situated 357 miles (by rail) west of Winnipeg, on Wascana creek and the Canadian Pacific Railway, in 104 36' W. and 50 27' N., at an altitude of 1885 feet above the sea. It contains the Government buildings and head- quarters of the Indian Department and of the North- West Mounted Police. Population (1901), 2645.

Registration of Voters. Registration was not altogether unknown in Great Britain in connexion with the parliamentary franchise before the Reform Acts of 1832. Thus in the Scottish counties the right to vote depended on the voter's name being upon the roll of free- holders established by an Act of Charles II. ; a similar register existed in Ireland of freeholders whose freeholds were under 20 annual value; and in the Universities of Oxford and Cambridge the rolls of members of Con- vocation and of the Senate were, as they still are, the registers of parliamentary voters. But except in such cases as the above, the right of a voter had to be determined by the returning officer upon the evidence produced before him when the vote was tendered at a poll. This necessarily took time, and the result was that a contested election in a large constituency might last for weeks. The celebrated Westminster election of 1784, in which the poll began on

the 1st of April and ended on the 17th of May, may be mentioned as an illustration. Moreover, the decision of the returning officer was not conclusive ; the title of every one who claimed to vote was liable to be

reconsidered on an election petition, or, in the case of a rejected vote, in an action for damages by the voter against the returning officer. The inconvenience of such a state of things would have been greatly aggravated had the old practice con- tinued after the enlargement of the franchise in 1832. The establishment of a general system of registration was therefore a necessary and important part of the reform then effected. It has enabled an election in the most populous constituency to be completed in a single day. It has also been instrumental in the extinction of the "occasional voter," who formerly gave so much trouble to returning officers and election committees ??? the person, namely, who acquired a qualifying tenement with the view of using it for a particular election and then disposing of it. The period of qualification now required in all cases, being fixed with reference to the formation of the register, is necessarily so long anterior to any election which it could affect, that the purpose or intention of the voter in acquiring the qualifying tenement has ceased to be material, and is not investigated.

England. ??? The reform of parliamentary representation in 1832 was followed in 1835 by that of the constitution of municipal corporations, which included the creation of a uniform qualification (now known as the old burgess qualification) for the municipal franchise. In 1888 the municipal franchise was enlarged, and was at the same time extended to the whole country for the formation of constituencies to elect county councils; and in 1894 parochial electors were called into existence for the election of parish councils and for other purposes. Inasmuch as provision was made for the registering of persons entitled to votes for the above purposes, there are now three registers of voters, namely, the parliamentary register, the local government register {i.e., in boroughs under the Municipal Corporation Acts, the burgess rolls, and elsewhere the county registers), and the register of parochial electors. Under the Municipal Corporations Act, 1835, the registration of burgesses, though on similar lines to that of parlia- mentary voters, was entirely separate from it. Since, how- ever, the qualification for the municipal franchise covered to a great extent the same ground as that for the parlia- mentary franchise in boroughs which sent members to Parliament, a considerable number of voters in such boroughs were entitled in respect of the same tenement to be upon both parliamentary register and burgess roll. The

waste of labour involved in settling their rights twice over was put an end to in 1878, when the system of parlia- mentary registration was extended to the boroughs in question for municipal purposes, and the lists were directed to be made out in such a shape that the portion common to the two registers could be detached and combined with the portion peculiar to each, so as to form the parliamentary register and the burgess roll respectively. This system of registration was extended to the non-parliamentary boroughs and to the whole country in 1888, the separate municipal registration being completely abolished.

The procedure of parliamentary registration is to be found in its main Hues in the Parliamentary Registration Act, 1843, which superseded that ^'□□"""- provided by the Reform Act of 1832, and has itself been considerably amended by later legislation. The Acts applying and adapting the system to local government and parochial registration are the Parliamentary and Municipal Registration Act, 1878, the County Electors Act, 1888, and the Local Government Act, 1894. Registration is carried out by local machinery, the common-law parish being taken

as the registration unit ; and the work of preparing and publishing the lists, which when revised are to form the register, is committed to the overseers. The selection of these officers was no doubt due to their position as the rating authority, and to their consequent opportunities for knowing the ownership and occupation of tenements within their parish. They do not always perform the duties themselves, other persons being empowered to act for them in many parishes by general or local Acts of Parliament ; but in all or almost all cases they are entitled to act personally if they think fit, they sign the lists, and the proceedings are conducted in their name.

In order to render intelligible the following summary of the procedure, it will be necessary to divide the voters to be registered into classes based on the nature of their qualification, since the practice diiFers in regard to each class. The classes are as follows : □□□ (1) Owners, including the

old f orty-shiUing freeholders, and the copyholders, long leaseholders, and others entitled under the Reform Act of 1832 to vote at parliamentary elections for counties; (2) occupiers, including those entitled to (a) the ►►10 occupation qualification, (b) the household qualification, and (c) the old burgess qualification ; (3) lodgers, sub- divided into (a) old, i.e., those on the previous register for the same lodgings, and (6) new ; (4) those entitled to reserved rights, i.e., in addition to those (if any still remain) who were entitled to votes before the Reform Act of 1832 in respect of qualifications abolished by that Act, (a) freehold and burgage tenants in Bristol, Exeter, Norwich, and Nottingham, and (6) liverymen of the City of London and freemen of certain old cities and boroughs, whose right to the parliamentary franchise was permanently retained by the same Act. In regard to these classes it may be said that the general scheme is that owners must make a claim in the first instance before they can get their names upon the register, but that, once entered on the register, the names will be retained from year to year until removed by the revising barrister ; that the lists of occupiers and of freehold and burgage tenants are made out afresh every year by the overseers from their own information and inquiries, without any act being required on the part of the voters, who need only make claims in case their names are omitted ; that lodgers must make claims every year ; and that liverymen and freemen are in the same position as occupiers, except that the lists of liverymen are made out by the clerks of the several companies, and those of freemen by the town clerks, the overseers having nothing to do with these voters, whose qualifications are personal and not locally connected with any parish.

The overseers and other officers concerned are required to perform their duties in connexion with registration in accordance with the instructions and precepts, and to use the notices and forms prescribed by Order in Council from time to time. The Order at present in force is the Registration Order, 1895. It directs the clerk of every county council, on or within seven days before the 15th of April in every year, to send to the overseers of each parish in his county a precept with regard to the registration of owner- ship electors, and to every parish not within a parliamentary or municipal borough a precept with regard to the registration of occupation electors (which expression for this purpose includes

lodgers as well as occupiers proper). The town clerk of every borough, municipal or parliamentary, is to send to the overseers of every parish in his borough a precept with regard to the registration of occupation electors. These precepts are set out in the Registration Order, and those issued by the town clerks differ according as the borough is parliamentary only, or municipal only, or both parliamentary and municipal ; in the cases of Bristol, Exeter, Norwich, and Nottingham they contain

directions as to freehold and burgage tenants. The duties of the overseers in regard to registration are set out in detail in the precepts. Along with the precepts are for- warded forms of the various lists and notices required to be used, and with the ownership precept a certain number of copies of that portion of the parliamentary register of the county at the time in force which contains the owner- ship voters for the parish, the register being so printed that the portion relating to each parish can be detached. It is the duty of the overseers to publish on the 20th of June, in manner hereinafter described, the portion of the register so received, together with a notice to owners not already registered to send in claims by the 20th of July. Meanwhile the overseers are making the inquiries necessary for the preparation of the occupier list. For this purpose they may require returns to be furnished by owners of houses let out in separate tenements, and by employers who have servants entitled to the service franchise. The registrars of births, deaths, and marriages are required to furnish the overseers with returns of deaths, and the assessed tax collectors with returns of defaulters ; the relieving officers are to give information as to recipients of parochial relief. On or before the 31st of July the over- seers are to make out and sign the lists of voters. These are the following : the list of ovraership electors, consisting of the portion of the register previously published with a supplemental list of those who have sent in claims by the 20th of July ; the occupier list ; and the old lodger list, the last being formed from claims sent in by the 25th of July. The overseers do not select the names in the first and last of these lists ; they take them as supplied in the register and claims. It is, however, their duty to write "dead" or "objected "in the margin against the names of persons whom they have reason to believe to be dead or not entitled to vote in respect of the qualification described. The ownership and old lodger lists will be divided into two parts, if the register contains names-

of owners entitled to a parochial vote only, or if claims by owners or old lodgers have been made limited to that franchise. The occupier list contains the names of persons whom the overseers believe to be qualified, and no others, and there- fore will be free from marginal objections. Except in the administrative county of London, it is made out in three divisions ??? division 1 giving the names of occupiers of property qualifying for both parliamentary and local government votes, divisions 2 and 3 those of occupiers of property qualifying only for parliamentary and only for local government votes respectively. It happens so frequently that a tenement, if not of sufficient value to qualify for the ??10 occupation franchise (parliamentary and local government), qualifies both for the household franchise (parliamentary) and for the old burgess franchise (local government), that division 1 would in most cases be the whole list, but for two circumstances. The service franchise is a special modification of the household franchise only ; and the service occupants, being therefore restricted to the parliamentary vote, form the bulk of division 2 ; while peers and women, being excluded from the parlia- mentary vote, are consequently relegated to division 3. In the administrative county of London the local govern- ment register, being coextensive with the register of parochial electors, includes the whole of the parliamentary register. The occupier lists are consequently there made out in two divisions only, the names which would else- where appear in division 2 being placed in division 1. The lists of freehold and burgage tenants in Bristol, Exeter, Norwich, and Nottingham are to be made out and signed by the same date. The overseers have also to make out and sign a list of persons qualified as occupiers to be elected aldermen or councillors, but as non-residents

disqualified from being on the local government register. By the same date also the clerks of the livery companies are to make out, sign, and deliver to the secondary (who performs in the City of London the registration duties which elsewhere fall on the town clerk) the lists of livery- men entitled as such to the parliamentary vote ; and the town

clerks are to make out and sign the lists of freemen so entitled in towns where this franchise exists.

On the 1st of August all the above lists are to be published, the livery lists by the secondary, lists of free- men by the town clerks, and the rest by the overseers. In addition the overseers may have to publish a list of persons disqualified by having been found guilty of corrupt or illegal practices ; this list they will receive, when it exists, from the clerk of the county council or town clerk with the precept. Publication of lists and notices by overseers is made by affixing copies on the doors of the church and other places of worship of the parish (or, if there be none, in some public or conspicuous situation in the parish), and also, with the exception to be men- tioned, in the case of a parish wholly or partly ???within a municipal borough or urban district, in or near every public or municipal or parochial office and every post and telegraph office in the parish. The exception is that lists and notices relating to ownership electors need not be published at the offices mentioned when the parish is within a parliamentary borough. Publication by the secondary is made by affixing copies outside the Guild- hall and Royal Exchange ; publication by town clerks is made by affixing copies outside their town hall, or, where there is none, in some public or conspicuous place in their borough. From the 1st to the 20th of August inclusive is allowed for the sending in of claims and objections. Those whose names have been omitted from the occupier or reserved rights lists, or the non-resident list, or whose names, place of abode, or particulars of qualification- have been incorrectly stated in such lists, may send in claims to have their names registered ; lodgers who are not qualified as old lodgers, or who have omitted to claim as such, may claim as new lodgers ; persons whose names are on the corrupt and illegal practices list may claim to have them omitted. Any person whose name is on the list of parliamentary, local government, or parochial electors for the same parliamentary county, administrative county, borough, or parish, may object to names on the same lists. Notices of claim and objection in the case of liverymen and freemen are to be sent to the secondary and town clerk, and in other cases to the overseers ; and notices of objection must also in all cases be sent to the person objected to. All notices must be sent in by the 20th of August, and on or before the 25th of August the overseers, secondary, and town clerks are to make out,

sign, and publish lists of the claimants and persons objected to. It remains to be added that any person on a list of voters (i.e., on one of the lists published on the 1st of August) may make a declaration before a magistrate or com- missioner for oaths correcting the entry relating to him. In the case of ownership electors the correction can only deal with the place of abode ; in the case of other lists it extends to all particulars stated, and is useful inasmuch as it enables the revising barrister to make corrections as to the qualification which he could not make in the absence of a declaration. The declarations must be delivered to the clerk of the county council or town clerk on or before the 5th of September.

The next stage is the revision of the lists. For this purpose revising barristers are appointed yearly, for the Middlesex circuit (which includes the whole of the old county of Middlesex and the City of London) by the Lord Chief -Justice, for the other counties and boroughs by

the senior judge going the summer assize on the circuits to which they respectively belong. The period within which revision courts can be held is from the 8th of September to the 12th of October, both fe'~~'f'"^ days inclusive. The clerk of the county council attends the first court held for each parliamentary division of his county, and the town clerk the first court held for his city or borough ; and they are respectively to produce all lists, notices, and declarations in their custody, and to answer any questions put to them by the revising barrister. The overseers also attend the courts held for their parish, to produce the rate books, original notices of claim and objection, &c., and to answer questions. The claimants, objectors, and persons objected to appear per~~ sonally or by representative to support their several con- tentions. Any person qualified to be an objector may also appear to oppose any claims, upon giving notice to the barrister before such claims are reached. The powers of the revising barrister are as follow : ❓❓❓ As regards persons whose names are on the lists of voters published on the 1st of August, he is to expunge the names, whether objected to or not, of those who are dead or subject to personal incapacity, such as infants and aliens, and for parliamentary purposes peers and women ; but this class of persons has been held not to include those incapacitated by receipt of parochial relief, whose names therefore cannot be expunged unless objected to. If an entry is imperfect,

the name must be removed, unless the particulars necessary for completing it are supplied to the barrister. All names marginally objected to by over- seers must be expunged, unless the voters prove to the barrister that they ought to be retained. Objections made by other objectors must be supported by primd facie proof, and if this is not rebutted the name is struck out. Claimants (including owners and old lodgers who have duly claimed, but whose names for whatever cause have been omitted from the lists of voters published on the 1st of August) must be ready to support their claims. The declaration attached to a lodger claim is indeed primd facie proof of the facts stated in it, but other claimants require evidence to make out even a primd facie case, and if they fail to produce it their claims will be disallowed. The barrister is required to correct errors in the lists of voters, and has a discretion to rectify mistakes in claims and objections upon evidence produced to him. But his power in this respect is limited, and in particular he may not correct the description of qualification in a list of voters (except upon the evidence of a declaration made as above mentioned), or in a claim, so as to make it a different qualification from that stated in the list or claim. Lastly, the barrister has to deal with duplicates. A voter is entitled to be on the register once, but not more than once, as a parliamentary voter for each parliamentary county or borough, as a burgess for each municipal borough, as a county elector for each electoral division, and as a parochial elector for each parish in which he holds a qualification. But inasmuch as the overseers of a parish cannot say with certainty what entries relating to any person will appear on the lists of other parishes, nor which of them or of any duplicates on their own lists will be retained on revision, it is their duty to place each name on the lists where it would be if there were no duplicate, leaving it to the revising barrister to deal with the duplicate entries by expunging or transferring them to a separate parochial list, or, in the case of occupiers, to division 2 or 3 of the occupier list, as re- quired. The revising barrister has also, as regards freemen in a divided parliamentary borough, to allot the non-residents equally as nearly as may be among the parliamentary divisions, the residents being placed on the

list of the division where they reside. The decision of the revising barrister is final and conclusive on all questions of fact ; but an appeal lies from him on questions of lave at the instance of any person aggrieved by the removal of his name from a list of voters, by the rejection of his claim or objection, or by the allowance of a claim which he has opposed. Notice of the intention to appeal must be given to the barrister in writing on the day when his decision is given. The barrister may refuse to state a case for appeal ; but if he does so vrithout due cause he may be ordered by the High Court to state a case. The appeal is heard by a Divisional Court, from whose decision an appeal lies (by leave either of the Divisional Court or of the Court of Appeal) to the Court of Appeal, whose decision is final.

On the completion of the revision the barrister hands the county and borough lists (every page signed and every alteration initialled by him) to the clerk of the county council and the town clerk respectively, to be printed. It is to be observed that the ownership list is a county list, whether the parish be within a borough or not, and will in all cases be handed to the clerk of the county council. With the following exceptions the revised lists are to be made up and printed by the 20th of December, and come into force as the register for all purposes on the 1st of January. In the boroughs created by the London Government Act, 1899, the whole register is to be made up and printed by the 20th of October, and to come into force for the purpose of borough elections under the Act on the 1st of November. In boroughs subject to the Municipal Corporations Acts, divisions 1 and 3 of the occupiers' list are to be made up and printed by the 20th of October, and come into force for the purpose of muni- cipal and county council elections on the 1st of November. Corrections ordered in consequence of a successful appeal from a revising barrister are to be made by the officers having the custody of the registers, but a pending appeal does not affect any right of voting. The register in its final form will consist of the lists published on the 1st of August as corrected, with the claims which have been allowed on revision incorporated with them. It is printed in such form that each list and each division of a list for every parish can be separated from the rest for the pur- pose of making up the

parliamentary, local government, and parochial registers respectively. The alphabetical order is followed, except in London and some other large towns, where street order is adopted for all except the ownership lists and lists of liverymen and freemen. The parliamentary register for a parliamentary county will consist of the ownership lists for all parishes in the county, and of the lodger lists and divisions 1 and 2 of the occupier lists for parishes within the county and not within a parliamentary borough. The parliamentary register for a parliamentary borough will consist of the lodger lists, of the lists of freehold and burgage tenants (if any), and of divisions 1 and 2 of the occupier lists for all parishes within the borough, and also of the borough lists (if any) of liverymen or freemen. The local govern- ment register for an administrative county will consist of divisions 1 and 3 of the occupier lists for all parishes in the county, and the burgess roll for a municipal borough of divisions 1 and 3 of the occupier lists for all parishes in the borough. It will be seen, therefore, that, except in county boroughs, the burgess roll is also a part of the local government register of the administrative county within which the borough is situate. The register of parochial electors consists of the complete set of lists for each parish ; but this does not include the lists of livery- men and freemen, which, as has been stated, are not parish lists.

No one whose name is not on the register can vote at an election. The fact that a man's name is on the register is now so far conclusive of his right that the returning ofiicer is bound to receive his vote. Only two questions may be asked of him when he tenders his vote, namely, whether he is the person whose name is on the register, and whether he has voted before at the election. The Reform Act, 1832, allowed him to be asked at parlia- mentary elections whether he retained the qualification for which he had been registered ; but the Eegistration Act, 1843, disallowed the question, and made the register conclusive as to the retention of the qualification. When, however, a petition is presented against an election, the register, although conclusive as to the retention of the qualification, does not prevent the court from inquiring into the existence of personal incapacities, arising in connexion with the election or otherwise, and striking off on scrutiny the votes of persons subject thereto, e.g., aliens, infants, or in parliamentary elections peers, &c. But this power has been held not to extend to the in- capacity arising from receipt of parochial

relief, which here, as before the revision court, enjoys an exceptional position.

The expenses incurred by the overseers in the per- formance of their registration duties are laid before the revising barrister, whose certificate of allowance signed in open court is final and conclusive. One-half of the amount certified to be due is to be paid out of the poor- rate of the parish ; the other half in municipal boroughs out of the borough fund, and elsewhere out of the county fund. The expenses of the clerk of the county council, and the expenses of a town clerk in respect of an area not within a municipal borough, are to be laid before the county council, and the expenses of a town clerk in respect of an area within a municipal borough are to be laid before the town council. The amount allowed by the county council is to be paid out of the county fund ; and of the amount allowed by the town council one-half is to be paid out of the borough fund, and one-half to be contributed by the several parishes of the borough out of their poor-rates. The fee of the revising barrister (which is to cover all his expenses) is paid by the Treasury ; and one-half of the total amount so paid for each circuit is to be apportioned by a certificate of the Treasury among the counties and boroughs of the circuit, and repaid by them to the Exchequer.

The City of London is not within the Municipal Cor- porations Acts, and is not subject to the general registra- tion law in the formation of its roll of citizens for municipal purposes. But a register of parliamentary, county, and parochial electors is made in the ordinary way. The universities are also exempt from the general law of registration. At Oxford and Cambridge the members of Convocation and the Senate respectively have always formed the parliamentary constituencies; and, as has been already stated, the registers of those members were before 1832, and still are, the parliamentary registers. Similarly, the Reform Act of 1867, which gave parlia- mentary representation to the University of London, simply enacted that the register of graduates constituting the Convocation should be the parliamentary register of that body.

Scotland. ??? In Scotland the qualifications for local govern- ment and parish electors are the same as those for parlia^ mentary voters, the

only difference in the registers being in respect of personal incapacities for the parliamentary franchise, incapacity for the other franchises by reason of non-payment of rates, and duplicates. The principal Act regulating registration in burghs is 19 and 20 Vict. c. 58, amended in some particulars as to dates by 31 and 32 Vict.

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c. 48, ►►20. County registration, formerly regulated by 24 and 25 Vict. c. 83, has been assimilated to burgh registration by 48 and 49 Vict. c. 3, ►►8 (6). The pro- cedure consists, as in England, of the making and publica- tion of lists of voters, the making of claims and objections, and the holding of revision courts ; 'but there are important differences of detail. Though the parish is the registration unit, parochial machinery is not used for the formation of the register. The parliamentary lists for a county are made up yearly by one or more of the assessors of the county, and those for a burgh by one or more of the assessors for the burgh, or by the clerk of the commis- sioners. They are published on the 15th of September; and claims and objections must be sent in by the 21st and are published on the 25th of the same month. Publication is made in burghs by posting on or near the town hall, or in some other conspicuous place, in counties by posting the part relating to each parish on the parish church door, and in both cases giving notice by newspaper advertisement of a place where the lists may be perused. The revision is conducted by the sheriff, the time within which his courts may be held being from the 25th of September to the 16th of October, both days inclusive. An appeal lies to three judges of the Court of Session, one taken from each division of the Inner House, and one from the Lords Ordinary of the Outer House. The revised lists are delivered in counties to the sheriff clerk, in burghs to the town clerk, or person to whom the registration duties of town clerk are assigned. The register comes into force for all purposes on the 1st of November.

The municipal register of a royal burgh which is co- extensive, or of that part of a royal burgh which is co- extensive with a parliamentary burgh, consists of the parliamentary register with a supplemental list of women

who but for their sex would be qualified for the parlia- mentary vote. The municipal register for a burgh, or for that part of one which is not within a parliamentary burgh, consists of persons possessed of qualifications within the burgh which, if within a parliamentary burgh, would entitle them, or but for their sex would entitle them, to the par- liamentary vote. The register of county electors consists of the parliamentary register for a county with the sup- plemental list hereafter mentioned ; but inasmuch as ex- emption from or failure to pay the consolidated county rate is a disqualification for the county electors' franchise, the names of persons so disqualified are to be marked with a distinctive mark on the register ; as are also the names of persons whose qualifications are situated within a burgh, such marks indicating that the persons to whose names they are attached are not entitled to vote as county electors. Every third year, in preparation for the tri- ennial elections of county and parish councils (casual vacancies being filled up by co-optation), a supplemental list is to be made of peers and women possessed of qualifications which but for their rank and sex would entitle them to parliamentary votes. The register of county electors in a county and the municipal register in a burgh form the registers of parish electors for the parishes comprised in each respectively. Inasmuch, however, as a man is entitled to be registered as a parish elector in every parish where he is qualified, duplicate entries are, when required, to be made in the register, with distinctive marks to all but one, to indicate that they confer the parish vote only. These distinctive marks and those previously mentioned are to be made in the lists by the assessors, subject to revision by the sheriff. The register is conclusive to the same extent as in England, except that the vote of a parish elector who is one year in arrear in payment of a parish rate is not to be received. The clerk of the parish council is to furnish the returning officer one week before an election

with the names of persons so in arrear ; and the returning oflacer is to reject their votes except upon the production of a written receipt. The expenses of registration in counties are to be laid before the county councils ; and the amount they allow in respect of the parliamentary register is paid out of the county rate, while the additional amount allowed in respect of the county register is paid by a rate levied on lands and heritages which are not within a burgh. In burghs the expenses are

laid before the magistrates or commissioners ; and the amount allowed is either apportioned by them among the parishes in pro- portion to their yearly rent or value, or otherwise levied by rate. Provision is made by 31 and 32 Vict. c. 48, ►►►►27-41, for the formation of registers of parliamentary electors for the universities. The register for each university is to be made annually by the university registrar, with the assistance of two members of the council, from whose decisions an appeal lies to the university court.

Ireland. ►►►There are no parish councils in Ireland, and no parochial electors. There are therefore but two registers of voters, the parliamentary and the local government regis- ters, the latter of which consists of the former with a local government supplement containing the names of those ex- cluded from the parliamentary register by reason of their being peers or women, and duplicate entries relating to those whose names are registered elsewhere for the same parliamentary constituency. The principal Acts regulating registration are 13 and 14 Vict. c. 69, 31 and 32 Vict. c. 112, 48 and 49 Vict. c. 17, and 61 and 62 Vict. c. 2. The Lord Lieutenant is empowered to make by Order in Council rules for registration, and to prescribe forms ; and under this power has made the Eegistration (Ireland) Rules, 1899, now in force. The registration unit is not the parish, but the district electoral division, except where such division is subdivided into wards, or is partly within and partly without any town or ward of a borough or town, in which cases each ward of the division or part of a division is a separate registration unit.

The procedure is as follows, subject to variation in cases where there are clerks of unions who held ofiice on the 31st of March 1898, and have not agreed to transfer their registration duties. The clerk of the peace sends out on the 1st of June a precept in the form prescribed for county registration to the secretary of the county councQ and clerks of urban district councils, together with a copy of the existing register for their county or district ; and a precept in the form prescribed for borough registration to town clerks of boroughs. As regards registration units not in a parliamentary or municipal borough, the secretary of the county council or clerk of the urban district council is to put marginal objections, "dead" or "ob- jected," where required, to ►►10 occupiers and

householders in the copy of the register, both in the parliamentary list and in the local government supplement. He is also to make out supplemental parliamentary and local govern- ment lists of ►►10 occupiers and householders not on the existing register, and to put marginal objections where required to these. He is to verify on oath before a magis- trate the copy of the register and supplemental lists, and to return them to the clerk of the peace by the 8th of July. As regards registration units in a parliamentary borough, but outside a municipal borough, the secretary of the county council or clerk of the urban district council is to make out lists of ►►10 occupiers and householders with local government supplement, and transmit them to the town clerk of the municipal borough or town. The clerk of the peace is to publish the copy of the register, after himself placing marginal objections where required to voters other than ►►10 occupiers and householders, and the sup- plemental lists as received, and also the corrupt and illegal

practices list, if any, on the 22nd of July. On the same day the town clerk will publish the lists received as afore- said for registration units outside the municipal borough, and the lists, which he will have made out himself for the municipal borough, including the freemen's list and corrupt and illegal practices list. Freemen being entitled to the local government vote wiU, if resident, be placed on the list of the registration unit where they reside, and will, if non-resident, be allotted by the revising barrister among the registration units of the borough for local government purposes in proportion to the number of electors in each registration unit. Claims are to be sent in to the clerk of the peace and town clerk by the 4th of August, including old lodger claims and, in the case of the clerk of the peace, ownership claims. Lists of claimants with marginal ob- jections, where required, are to be published by the clerk of the peace and town clerk by the 11th of August. Notices of objection to voters or claimants may be given by the 20th of August ; and lists of persons objected to are to

be published by the clerk of the peace and town clerk by the 24th of the same month. Publication of lists and notices by a clerk of the peace is made by posting copies of those relating to each registration unit outside every court-house, petty sessions court, and other public offices in the unit ; publication by a town clerk is made by posting copies outside the town hall, or, if there be none, in some public and conspicuous place in the borough.

Eevising barristers are specially appointed for the county and city of Dublin by the Lord Lieutenant ; elsewhere the county court judges and chairmen of quarter sessions act as such ex officio, assisted, when necessary, by additional barristers appointed by the Lord Lieutenant. The time for the holding of revision courts is from the 8th of September to the 25th of October inclusive. An appeal lies to the Court of Appeal, whose decision is final. The revised lists are handed to the clerk of the peace ; they are to be made up by him by the 31st of December, and come into force on the 1st of January. ' The registration expenses of the clerk of the peace are to be laid before the county council, and the amount allowed is to be levied from the county. The expenses of the town clerk are to be laid before the revising barrister ; and the amount allowed by the barrister is to be laid before the county council, who may allow the whole or part of such amount, and levy the sum they allow from the county. In county boroughs the council of the borough acts in the place of the county council. The extra cost, if any, incurred by the Treasury in connexion with revision in consequence of the creation of the local government register, is to be certified by the Treasury, and repaid to the Exchequer by the county councils.

The registrar of the University of Duolin is to make out in December a list of the persons entitled to the parlia- mentary vote for the university, and to print the same in January, and to publish a copy in the university calendar, or in one or more public journals circulating in Ireland. He is to revise the list annually, and expunge the names of those dead or disqualified ; but an elector whose name has been expunged because he was supposed to be dead is entitled, if alive, to have his name immediately restored and to vote at any election. (l. l. s.)

ReglSL, an important suburb of Havana, opposite the city, on the east side of the bay, where most of the sugar warehouses of the Havana trade are situated, and where outgoing ships are laden. The eastern railways have their termini here. Formerly it was the scene of the Havana bull-fights. The population in 1899 was 11,363.

Reichenbach, a town of Germany, 11 miles by rail south-west of the town and in the circle of Zwickau,

kingdom of Saxony. There are a commercial and a weaving school, and a museum ; the industries include woollen, cotton, bleaching, cloth-dressing, spinning, wool- carding, and wool-dressing mills, aggregating in all about 150 firms. Population (1885), 18,406; (1900), 24,498.

Reichenbergf (Czech, Liberec), a town of Bohemia, Austria, near the Saxon and Prussian frontiers, and practi- cally the capital of German Bohemia. After Prague, it is one of the largest and most important centres of trade and industry in the crownland, although within the last decade the population of Pilsen and Aussig show a more rapid increase. Population (1890), 30,890; (1900), 34,204, chiefly German and Catholic (estimated at 5 per cent. Czech, 4 per cent. Protestant, and 3 per cent. Jewish). The garrison has been increased to 1518 men. In 1890 the district within the jurisdiction of the Chamber of Commerce comprised over 370 factories for spinning and weaving of wool, cotton, and linen, besides carpet factories and establishments for the manufacture of carding and other machinery, beer, malt, liqueurs, hosiery, dyeing, &c. The industrial community, including a considerable section of the large manufacturers, has manifested strong German- Nationalist sentiment in the recent phases of the nationality strife in Austria.

Reid, Sir George (1841), Scottish artist,

was born in Aberdeen. After the usual school education he developed an early passion for drawing, which led to his being apprenticed in 1854 for seven years to ^Messrs Keith and Gibb, lithographers in Aberdeen. In 1861 Keid took lessons from an itinerant portrait-painter, William Niddrie, who had been a pupil of James Giles, RS.A, and after- wards entered as a student in the school of the Board of Trustees in Edinburgh.

After the usual course of study Keid returned to Aberdeen, to paint landscapes and portraits for any trifling sum which his work could command, gradually gaining the notice of those who re- cognized his earnestness. The first portrait to attract attention, from its fine quality, was that of George Mac- donald, the poet and novelist, now the property of the University of Aberdeen. His early landscapes were con- scientiously painted in the open air and on the spot. But Eeid soon came to see that such work was inherently false, painted as the picture was day after day under varying conditions of light and shade. Accordingly, in 1865 he proceeded to Utrecht to study under A Mollinger, whose work he admired, from its unity and simplicity. This change in his method of viewing Nature was looked on as revolutionary by the Eoyal Scottish Academy, and for some years his work found little favour in that quarter ; but other artists gradually adopted the system of tone- studies, which ultimately prevailed. Conscious of imper- fect training in drawing, Reid went to Paris in 1868 to study under the accomplished figure-painter Yvon ; and, still further to master the mysteries of his art, he worked in 1872 with his friend Josef Israels at The Hague. From this time forward Eeid's success was continuous and marked. He showed his versatility in landscape, as in his "Whins in Bloom," which combined great breadth with fine detail ; in flower-pieces, such as his " Eoses," which were brilliant in rapid suggestiveness and force ; but most of all in his portraits, which are marked by great indi- viduality, and by fine insight into character. His work in black-and-white, his admirable illustrations in brush- work of Edinburgh and its neighbourhood, and also his pen-drawings, about which it has been declared that " his work contains all the subtleties and refinements of a most delicate etching," must also be noted. Elected Associate of the Eoyal Scottish Academy in 1870, Eeid attained the full membership in 1877, and took up his residence in

Edinburgh in 1882. In 1891 lie was elected President, receiving also the honour of knighthood, and he was awarded a gold medal at the Paris Exhibition of 1900. For a specimen of his work, see Poeteaituee.

Reigate, a municipal borough and market town of Surrey, England, in the Reigate parliamentary division, 23 miles south of London, with a station on the South- Eastern Railway. The Free Convalescent Home, removed from Bletchingly, was opened at South Park in 1880; and Brabazon Home, in connexion with the Girls' Friendly Society, in 1885. There is also a technical institute. Population (1881), 18,665; (1901), 25,993.

Reinecke, Carl Heinrich Carsten (1824-

), German composer and pianist, born at Altona,

23rd June 1824, came of musical stock, his father, Peter Reinecke (who was also his teacher), being an admirable musician. At the age of eleven he made his first appear- ance as pianist, and when scarcely eighteen he went a successful tour through Denmark and Sweden. After a stay in Leipzig, where he studied under Mendelssohn, in the recently founded Conservatorium, and Schumann, Reinecke went on tour with Konigslow and Wasielewski, Schumann's biographer, in North Germany and Denmark. From 1846 to 1848 Reinecke was court pianist to Christian VIII. of Denmark. After resigning this post he went first to Paris, and next to Cologne, as professor in the Conservatorium. From 1854 to 1859 he was music director at Barmen, in the latter year filling this post at Breslau University; in 1860 he became conductor of the famous Leipzig Gewandhaus, a post which (together with that of professor at the Conservatorium) he held with honour and distinction for thirty-five years. During this time Reinecke continually made concert tours to England and elsewhere. His pianoforte playing belonged to a school now almost extinct. Grace and neatness were its characteristics, and at one time Reinecke was probably unrivalled as a Mozart player and an accompanist. His compositions are as unimportant historically as Raff's, and even more numerous. His grand opera Konig Manfred, and the comic opera Auf hohen Befehl, were at one time frequently played in Germany ; and his cantata Halcon Jarl is melodiously beautiful, as are many of his songs ; while his Friedensfeier overture was once quite hackneyed. By far his most valuable works are those written for educational purposes. His sonatinas, his " Kindergarten," and much that he has ably edited, wiU continue to delight generations not yet born.

Reinkens, Joseph Hubert (1821-1896),

Old Catholic bishop, was born at Burtscheid, near Aix-la- Chapelle. He was educated at the gymnasium at Aix, and afterwards studied theology at the universities of Bonn and Munich. He was ordained priest in 1848, and in 1849 graduated as doctor in theology with considerable ^clat. He was soon appointed professor of ecclesiastical history at Breslau, by the influence of the Cardinal Archbishop Diepenbrock. In 1865 he was made rector of Breslau University. He wrote a number of treatises on various subjects during this period, the most noticeable among which were monographs on Clement of Alexandria, Hilary of Poitiers, and Martin of Tours. In consequence of an essay on art, especially in tragedy, after Aristotle, he was made doctor in philosophy in the University of Leipzig. When, in 1870, the question of Papal InfaUi- biBty was raised, Reinkens attached himself to the party opposed to the proclamation of the dogma. He had been confirmed in his Liberal sentiments by a visit he had recently paid to Rome. He threw himself vigorously into the controversy, and wrote several pamphlets on Church tradition relative to Infallibility, and on the procedure of

the Council. When the dogma of Infallibility was proclaimed, Reinkens joined those who resolved to offer an organized resistance to the decree. The head of this band of influential theologians was Dollinger, and among them were von Schulte, MicheUs, Friedrich, Knoodt, Langen, and Weber. Reinkens was one of those who signed the celebrated Declaration of Nuremberg in 1871. It was further resolved to appeal to other Episcopal bodies ; and at the Bonn conferences with Orientals and Anglicans, organized by DoUinger in 1874 and 1875, Reinkens was a conspicuous figure. In the meantime the question had to be decided whether the Old Catholics should or should not definitely separate themselves from the Church of Rome. The bishops of the so-called Jansenist Church in Holland, which had existed independently of Rome for about two centuries, and possessed an incontestably canonical Episcopate, had promised to convey a vahd succession according to the customs of the Western Church. Dollinger objected; and though he afterwards admitted that his objections were ill-founded, his dissent prevented all but a small band of eminent theologians and a few

*enthusiastic laymen from joining the new Church. It was nevertheless constituted, and Reinkens was chosen bishop of the Old Catholics in Germany at an enthusiastic meet- ing at Cologne in 1873. On the 11th August of the same year he was consecrated to the Episcopate by Dr Heykamp, bishop of Deventer, in Holland, Archbishop Loos of Utrecht, who had promised to consecrate the bishop if elected by the German Old Catholics, having been removed by death on the very day of Reinkens's election to the Episcopate. Reinkens devoted himself to his office of superintending the infant Church with the utmost soUcitude, as the number of his Hirtenhriefe and the variety of their subjects prove. Nor did his activity as a theologian cease. He wrote a number of theological works after his consecration, but none of them so important as his treatise on Cjrprian and the Unity of the Church, which he wrote in the year of his consecration. The chief act of his episcopal career was his consecration in 1876 of Dr Edward Herzog to preside as bishop over the Old Catholic Church in Switzerland. He would have performed the same office for the Old Catholics in Austria, but the Austrian Government interfered and refused its consent. In 1881 Reinkens visited England, and received Holy Communion more than once with bishops, clergy, and laity of the Church of England. Almost his last important public act was the pubUcation, in conjunction with Professor Friedrich, of a defence of the validity of Anglican orders against his co-reUgionists, the Old Catholics of Holland, who had distributed an attack on their vahdity among the clergy and theologians present at the Old Cathohc Congress at Rotterdam in 1894. Reinkens was gentle and inoffensive in disposition ; and if he was unable to command much support for the Church over which he presided, he won for himself great respect and affection among the German people. This was mani- fested at his funeral, when a great and sympathetic crowd hned the streets through which the cortege had to pass, and wreaths from the sons of the German emperor were laid upon the coffin. He died at Bonn on 4th January 1896. (j. j. j**

RemediOS, a large town of Santa Clara province, Cuba. The population in 1899 was 6633.

RemSCheid, a town of Prussia, Rhine province, 6 miles by rail south from Barmen, a centre for the manu- facture of cutlery and steel and iron

wares. The muni- cipal area was enlarged in 1893. Population (1885),

33,986; (1900), 58,108.

Renaix, a town of Belgium, in the province of East

Flanders, 25 miles south of Ghent, on a network of railways. It has dye-works, bleaohing-fields, and manufactories for cotton and woollen goods. Population (communal) (1880),

14,370; (1900), 19,936.

Renan, Ernest(1823-1892),the celebrated French thinker and writer, was born on the 28th of February 1823 in the town of Tr^guier, situated in the department of the CQtes-du-Nord, which occupies the north-west of the ancient province of Brittany. His father's people were of the fisher-clan of Eenans or Konans ; his grandfather, having made a small fortune by his fishing smack, bought a house at Tr^guier and settled there, and this man's son, captain of a small cutter and an ardent Kepublican, married the daughter of Royalist trading-folk from the neighbouring town of Lannion. All his life long Kenan's mind was divided between his father's and his mother's political beliefs. His father died when the child was five years old. His sister Henriette, twelve years older than Ernest, a girl of remarkable character, was henceforth morally the head of the household. She determined to pay her father's debts, to help her mother, and to educate her little brother. Having in vain attempted to keep a school for girls at Tr^guier, she left her native place and went to Paris as teacher in a young ladies' boarding-school. Ernest meanwhile was educated in the ecclesiastical seminary of his native place. His family still preserve his good-conduct notes for this period : " Docile, patient, diligent, pains-taking, thorough," are adjectives which occur often. We do not hear that he was brilliant or clever, but then the priests cared little for such qualities ; occasionally they complain that " Ernest Eenan is inattentive during service in church." While the priests were grounding Eenan in

mathematics and Latin, and teaching him the value of dis- interestedness and duty, his mother, with her fund of myth and local traditions, completed his education at home. Very early in life the future historian of religions learned how the unexplained becomes the supernatural in a rustic imagination, and how a fact becomes a faith. Madame Eenan Tiiere, a lively little gipsy of a woman, was only half a Breton. Her paternal ancestors came from Bordeaux, and Eenan used to say that in his own nature the Gascon and the Breton were constantly at odds.

In the summer of 1838 Renan carried off all the prizes at the college of Tr^guier. His sister in Paris told the doctor of the school in which she taught about the marvellous success of her brother, and he carried the news to M. Dupanloup, then engaged in organizing the ecclesi- astical college of St Nicholas du Chardonnet, a school in which the young Catholic nobility and the most gifted pupils of the Catholic seminaries were to be educated to- gether, with a view to cementing the bond between the aristocracy and the priesthood. When M. Dupanloup heard of the new Breton prodigy, he sent for him at once. Eenan was fifteen and a half. He had never been outside his Breton province. " What I saw in Paris was as strange to me as if I had been sent into the wilds of Tahiti or Timbuctoo." The breath of the boulevards penetrated through a thousand fissures into the closed circle of the Parisian seminary, where the students discussed with passion the rising glories of Lamartine, Victor Hugo, and Michelet. "I learned with stupor that knowledge was not a privilege of the Church ... I awoke to the meaning of the words talent, fame, celebrity." Above all, religion seemed to him a wholly different thing in Tr^guier and in Paris. The superficial, brilliant, pseudo-scientific Catholi- cism of the capital did not satisfy the new recruit, who had accepted the austere and primitive faith of his Breton masters.

In 1840 Eenan left St Nicholas to study philosophy at

the seminary of Issy, in the suburbs of Paris. He entered with a passion for Catholic scholasticism. The rhetoric of St Nicholas had wearied him, and his serious intelligence hoped to satisfy itself with the vast and solid material of Catholic theology. Eeid and Malebranche first attracted him among the philosophers, and after these he opened the tomes of Hegel,

Kant, and Herder : "I studied the Germans, and I thought I entered a temple." But it was not that temple of which Issy is a portal. Renan began to perceive the essential contradiction between the metaphysics which he studied and the faith that he professed, but a curious appetite for truths that can be verified restrained his scepticism. " Philosophy excites and only half satisfies the appetite for truth ; 1 am eager for mathematics," he wrote to his sister Henriette, his confidante, his guide, and friend. The letters had far to go. Bent on her self-imposed charges, Henriette had accepted in the family of Count Zamoyski an engagement more lucrative than her place as under- mistress in a Paris boarding-school. From her Polish steppes she exercised the strongest influence over her distant brother. All that Jacqueline Pascal was to the great French reformer Henriette was to Ernest Renan, and her recently published letters reveal a mind almost equal, a moral nature superior, to his own. It was not mathematics but philo- logy which was to settle the gathering doubts of Ernest Renan. His course completed at Issy, he entered the great college of St Sulpice in order to take his degree in philo- logy prior to entering the Church. And here he began the study of Hebrew. His mind, hitherto nourished on dogmas and ideas, on views and opinions, was famished for reality and alert in detecting the importance of a fact. He was already prompt to accept the proofs of experience as the sole authentic proofs. He saw that the second part of Isaiah differed from the first not only in style but in date ; that the grammar and the history of the Pentateuch are posterior to the time of Moses ; that the book of Daniel is clearly apocryphal. It followed from his training that, if you admit one error in a revealed text, you incriminate the whole. Secretly, Renan felt himself cut off from the com- munion of saints, and yet with his whole heart he desired to live the life of a Catholic priest. " The priest lives for his fellows, to teach them and to counsel them. He is a man of books ; he lives the contemplative life, and yet he is a brother unto his brethren ... I am not born for a life of action ; a merely private life would seem to me a sort of selfishness ... I am only fit for one sort of life." Hence a bitter struggle between vocation and conviction ; owing to Henriette, conviction gained the day. In October 1845 Renan left the seminary of St Sulpice for Stavistas, a lay college of the Oratorians. Finding himself even there too much under the domination of the Church, a few weeks later, most reluctantly, he broke the last tie which bound him to the religious life and

entered M. Crouzet's school for boys as a pupil teacher ⁂ or, rather, as usher ⁂ receiving his board and his room in return for his supervision of the evening class.

It is always dangerous to educate a really great mind in only one order of truth ; so soon as it perceives the hidden half of the world, it will realize and even magnify its im- portance, embracing it with the ardour of a spiritual con- version. Thus Pascal, trained by a set of savants to observe, to calculate, to reason, to concern himself solely with ex- periments and mechanical inventions, Avas to become the tormented enthusiast of the religious life. Renan, brought up by priests in a world ruled by authority and curious only of feeling and opinion, was to accept the scientific ideal with the same e'xtraordinary expansion of all his faculties. He was henceforth and for ever ravished by the splendour of the cosmos. Quite at the end of his life he wrote of Amiel, " The man who has time to keep a private diary has

never understood the immensity of the universe." The magnificent certitudes ofy physical and natural science were revealed to Renan in 1846 by the great chemist Marcellin Berthelot, then a boy of eighteen, his pupil at M. Crouzet's school. To the day of Renan's death their friendship continued. " It consisted in what we learned together." M. Crouzet's usher v^^s occupied only in the evenings. In the daytime Renan continued his researches in Semitic philo- logy. In 1847, an obscure young man of four-and-twenty, he obtained the Prix Volney ⁂ one of the principal dis- tinctions awarded by the Academy of Inscriptions ⁂ for the manuscript of his " General History of Semitic Languages." In 1847 he took his degree as Agr^g^ de Philosophie; that is to say, fellow of the university, and was offered a place as master in the lyc6e of Vend6me. In 1848 a small temporary appointment to the lyc^e of Versailles permitted him to return to the capital and resume his studies.

The revolution of 1848 aroused in Renan that side of him which loved the priest- hood because "the priest lives for his fellows." For three years the

problems of faith and the glories of science had filled his mind and soul, to the exclusion of this sense of fraternity, which was, none the less, fundamental, and was yet to inspire some of his most beautiful pages. Among the gun ~~smoke and the fusillades of 1848 Renan for the first time confronted the problems of Democracy. The result was an immense volume, The Future of Science which was to remain in manu script until 1890. L'Aveni de la Science is an attempt to conciliate the privilege of a necessary elite with th diffusion of the greatest good of the greatest number. Thi difficulty was to haunt Ernest Renan throughout his life. By the time he had finished his elaborate scheme for re~~ generating society by means of a devoted aristocracy of knowledge, and the diffusion of culture, the year 1848 was past and gone, and with it his fever of Democracy. In 1849 the French Government sent the young scholar to Italy on a scientific mission. He remained eight months abroad, during which he forgot his anxiety about the toilers' lot. Hitherto he had known nothing of art. In Italy the artist in him awoke, and easily triumphed over the savant and the reformer. On his return to Paris Renan chose a small flat near the Val-de-grace, and went to live there with his sister Henriette, his devoted secre- tary. A small post at the National Library, together with his sister's savings, henceforth furnished him with the means of livelihood. In the evenings he wrote for the Revue des Deux Mondes and the Debats those exquisite essays, some of the most perfect he was to produce, which were to appear in 1857 and 1859 under the titles ??tudes d'lTistoire Beligieuse and Essais de Morale et de Critique. Already in 1852 his book on Averroh had brought him not only his doctor's degree, but his first reputation as a thinker. In his two volumes of essays

{From a photograph I

Renan shows himself a Liberal, but no longer a Democrat. Nothing, according to his philosophy, is less important than prosperity. The greatest good of the greatest number is a theory as dangerous as it is illusory. Man is not born to be prosperous, but to realize, in a little vanguard of chosen spirits, an ideal superior to the ideal of yesterday. Only the few can attain a complete development. The bulk of humanity lives by proxy; it is the enormous useless residue from which is distilled that small drop of exquisite aroma ??? the elite. Yet there is a

solidarity between the chosen few and the masses which produce them ; each has a duty to the other. The acceptance of this duty is the only foundation for a moral and just society. The aristocratic idea has seldom been better stated.

The success of the Etudes d'Histoire Beligieuse and the Essais de Morale had made the name of Renan known ,, to a cultivated public. While Mademoiselle Renan remained shut up at home copying her brother's manuscripts or com- piling material for his work, the young philosopher began to frequent more than one Parisian salon, and especi- ally the studio of Ary Scheffer, at that time a noted social centre. In 1856 he proposed to marry Made- moiselle Compile Scheffer, the niece and adopted daughter of the great Dutch painter. Not without a struggle did the devoted but jealous Henriette resign her claim to be her brother's sole companion. At last she con- sented not only to the mar- J ' age, but to make her home ???\ ith the young couple, whose 1 msekeeping depended on tie sum that Mademoiselle I enan could contribute. The 1 story of this humble ro- ance has been told by Ernest t.snan, with rare tenderness and beauty, in the memorial essay which he wrote some six years later, entitled Ma Sceuir Henriette. His marriage brought much brightness into his life, a rare naturalness and piquancy into his style, and a greater attention to the picturesque, as if at last he dared to be altogether himself, even at the ex- pense of a certain noble simplicity. He did not forsake his studies in Semitic philology, and in 1859 appeared his translation of the Boolt of Job with an introductory essay, followed in 1859 by the Song of Songs.

Renan was now a candidate for the chair of Hebrew and Chaldaic languages at the College de France, a chair which he had consistently desired since first he studied Hebrew at the seminary of St Sulpice. The death of the famous scholar Quatremfere had left this post vacant in 1857. _ No one in France save Renan was capable of filling it. The Catholic party, upheld by the empress, would not appoint an unfrocked seminarist, a notorious heretic, to what is, in point of fact, a chair of Biblical exegesis. Yet the emperor, ever anxious to stand well with men of letters and men of science, wished to con- ciliate Ernest Renan. He

offered to send the young scholar on an archseological mission to Phoenicia. Renan

I A. LUbert, Paris.)

immediately accepted. Leaving his wife at home with their baby son, Eenan left France, accompanied by his sister, in the summer of 1860. Madame Eenan joined them in January 1861, returning to France in the course of July. Her husband and her sister-in-law would have done well to accompany her. But the mission jjroved fruitful in Phoenician inscriptions which Renan was to publish in his Mission de Phenicie. They form the base of that Corpus Inscriptionum Semiticarwm on which, a little perversely, he used in later years to declare that he founded his claim to remembrance. He wished to complete his exploration of the upper range of Lebanon ; he remained, therefore, with Henriette to affront the dangerous miasma of a Syrian autumn. At Amschit, near Byblos, Henriette Eenan died of intermittent fever on the 24th September 1861. Her brother, himself at death's door, was carried unconscious on board a ship waiting in harbour and bound for France. The sea air revived him, but he reached France a broken man apparently in heart and health. Fortunately, he had more than one great project which attached him to life. His sister in her last days had entreated him not to give up his candidature for the chair of Hebrew, and on the 11th of January 1862 the Minister of Public Instruction ratified Eenan's election to the post. But the scandal of his opening lecture, in which, amid the applause of the students, Eenan declared Jesus Christ " an incomparable Man," alarmed the Catholic party. Eenan's lectures were pronounced a disturbance of the public peace, and the young professor was forthwith suspended from his functions. On the 2nd of June 1864, on opening the morning newspaper, Eenan saw that he had been transferred from the chair of Hebrew at the College of France to the post of sub-librarian at the National Library. The fund of combativeness, which even the most detached philosopher hides in the bottom of his heart, seethed within him at this high-handed proceeding. He wrote to the Minister of Public Instruction : " Pecunia tua

tecum sit ! ” He refused the new position, was ofiicially deprived of his chair, and henceforth depended for his daily bread solely upon his pen.

Henriette had told him not to abandon the chair of Hebrew. She had also said, “Write the hfe of Jesus.” They had, in fact, begun it together in their Syrian retreat, she copying the pages as fast as her brother wrote them, with a New Testament and a Josephus for all his library. The book bears the mark of its origin ??? it is filled with the living, vibrating atmosphere of the East. It is the work of a man familiar with the Bible and theology, and no less acquainted with the inscriptions, monuments, types, and landscapes of Syria; it is, above all, the work of a man who has sounded the human heart. But it is scarcely the work of a great scholar : Eenan’s debt to the school of Tubingen has certainly been exag- gerated, in so far at least as regards the Life of Jesus. The book appeared on the 23rd June 1863 ; before Novem- ber sixty thousand copies of it were in circulation. There was no longer any doubt as to Ernest Eenan’s future. The professor had become a great writer, the philologist was seen to be a genius. But Eenan still used his literary gifts to pursue a scientific ideal. In the days when he had composed his huge, immature treatise on the Future of Science, he had written : ” I envy the man who shall evoke from the past the origins of Christianity. Such a writer would compose the most important book of the century.” He set to work to realize this project, and produced the Apostles in 1866, and St Paul in 1869, after having visited Asia Minor with his wife, where he studied the scenes of the labours of St Paul as minutely as in 1861 he had observed the material surroundings of the life of Jesus.

Renan was not only a scholar. In St Paul, as in the

Apostles, he shows his deep concern with the larger social life, his sense of fraternity, and a revival of the Democratic sentiment which had inspired L’Avenir de la Science. In 1869 he presented himself as the candidate of the Liberal opposition at the parliamentary election for Meaux. WhUe his temper had become less aristocratic, his Liberalism had grown more tolerant. On the eve of its dissolution Eenan was half prepared to accept the Empire, and, had he been elected to the Chamber of Deputies, he would have joined the group of V Empire Liberal. But he

was not elected. A year later war was declared with Germany, the Empire fell, and Napoleon III. went out into exile. The Franco-German war was to be a turning-point in Eenan's history. Germany had always been to him, as he had exclaimed at St Sulpice, a sanctuary, "un temple," the asylum of thought and disinterested science. Now he saw the land of his ideal destroy and ruin the land of his birth ; he beheld the German no longer as a priest, but as a brutal and wanton invader. With a great revulsion his heart turned to France. In his noble and thoughtful work. La Reforme Intellectuelle et Morale (1871), he en- deavoured at least to bind her wounds, to raise her head, to safeguard her future. Yet, in spite of himself, he was still under the influence of Germany. The ideal and the discipline which he proposed to his defeated and mangled country were the ideal and the discipline of her conqueror ??? a feudal society, a monarchical government, a France directed by a superior class, an elite, which the rest of the nation exists merely to support and nourish ; an ideal of honour and duty imposed by a chosen few on the recal- citrant and subject multitude. The savage and ignorant errors of the Commune confirmed Renan in this reaction. At the same time the note of irony, always perceptible in his work, grows more bitter, more concentrated, more brilliant. His Dialogues Philosophiques, written in 1871, his Ecclesiastes (1882), and his Antichrist (1876) (the fourth volume of the Origins of Christianity, dealing with the reign of Nero), are incomparable in their literary genius, but they are examples of a disenchanted and sceptical temper. He had vainly tried to make his country follow his precepts. He resigned himself to watch her drift her own way, probably, as it seemed to him, towards perdition. The progress of events showed him, on the contrary, a France which every day left a little stronger, and he aroused himself from his dis- believing, disillusioned mood, and observed with genuine interest the struggle for justice and liberty of a Democratic society. For his mind was the broadest of the age, incapable of blindly taking a side, of setting a limit to the laws of reason. And when Truth spoke from the mouth of an opponent he was ever ready with an unqualified assent. The fifth and sixth volumes of the Origins of Christianity (the Christian Church and Marcus Aurelius) show us a Eenan reconciled with Democracy, confident in the gradual ascent of man, aware that the greatest catastrophes do not really interrupt the sure if imperceptible progress of the world ??? reconciled also in some

measure, if not mth the truths, at least with the moral beauties of Catholicism and with the remembrance of his pious youth.

On the threshold of old age, the philosopher turned and cast a last long lingering glance at the days of his childhood. He was nearly sixty when, in 1883, he pub- lished those Souvenirs d'Erifance et de Jeunesse, which, after the Life of Jesus, are the work by which he is chiefly known. _ They took the world by storm. They possess that lyric note of personal utterance which the public prizes in a man already famous. They showed the UasS modern reader that a world no less poetic, no less primi- tive than that of the Origins of Christianity exists, or

still existed witHn living memory, on the north-western coast of France. They have the Celtic magic of ancient romance and the simplicity, the naturalness, the accent of veracity which the 19th century prized so highly. They reflect the picturesque and emotional side of Eenan, the easiest to understand in that mind of many facets. But his Ecclesiastes, published a few months earlier, his Drames Philosophiques collected in 1888, give a more adequate image of his fastidious, subtle, critical, most disenchanted, yet not unhopeful spirit. These books are often bitter and melancholy, yet not destitute of traces of optimism. They show the attitude towards uncultured Socialism of a philosopher Liberal by conviction, by temperament an aris- tocrat. We learn in them how Caliban (Democracy), the mindless brute, educated to his own responsibility, makes after all an adequate ruler ; how Prosper❓❓(the aristocratic principle, or, if we will, the mind) accepts his dethronement for the sake of greater liberty in the intellectual world, since Caliban proves an effective policeman, and leaves his superiors a free hand in the laboratory ; how Ariel (the religious principle) acquires a firmer hold on life, and no longer gives up the ghost at the faintest hint of change. Indeed, Ariel flourishes in the service of Prosper❓❓under the external government of the many-headed brute. For the one thing needful is not destined to succumb. Keligion and knowledge are as imperishable as the world they dignify.

Thus out of the depths rises unvanquished the essential ideahsm of Ernest Renan.

Re nan was a great worker. At sixty years of age, having finished the Origins of Christiwnity, he began his History of Israel, based on a lifelong study of the Old Testament and on the Corpus Inscriptionum Semiticarum, published by the Academic des Inscriptions under Kenan's direction from the year 1881 till the end of his life. The first volume of the History of Israel appeared in 1887, the third and finest volume in 1891, the last two only after the historian's decease. As a history of facts and theories the book has many faults ; as an essay on the evolution of the religious idea, it is (despite some passages of frivolity, irony, or incoherence) of extraordinary im- portance ; as a reflection of the mind of Ernest Renan it is the most lifelike of images. In a volume of collected essays, Feuilles Detaehees, published also in 1891, we find the same mental attitude, an afSrmation of the necessity of piety independent of dogma : " the most logical attitude of the thinker towards religion is to behave as though religion were true." Renan had never been strong, and the last years of his life were much chequered by rheu- matism, which gradually affected the structure of the heart. On the 12th of October 1892 he died after a few days' illness. " I have done my work," he said to Madame Renan; "I die happy." Dead, he continued to, delight his readers. Two volumes of the History of Israel, his correspondence with his sister Henriette, his Letters to M. Berthelot, and the History of the Beligious Policy of Philippe-le-Bel, which he wrote in the years immediately before his marriage, all appeared during the last eight years of the 19th century. (a. m. p. d.)

Renfrew, a royal and parliamentary burgh (Kil- marnock group) and the county town of Renfrewshire, near the Clyde, about 6 miles west of Glasgow by road. A large dock is about to be constructed by the Clyde Trust at a cost of ►►335,000. Two engineering works, cabinet-making factories, and la.rge bolt and rivet under- takings are new industrial features. The construction of dredgers and floating docks is a speciality connected with the staple industry, shipbuilding. The school board manages a grammar school, and has recently built a new elementary school. Population (1881), 4825; (1901),9297.

Renfrewshire, a maritime county of west Scot- land, is bounded N. by the Clyde, N.E. by Dumbarton- shire and Lanarkshire, E. by Lanarkshire, S. by Ayrshire, and W. by the Firth of Clyde.

Area and Population. ??? In 1891 the Renfrewshire part of the city of Glasgow was transferred to the county of Lanark, as was the Renfrewshire police burgh of Kinning Park ; the wholeof the parish of Cathcart was placed in Renfrewshire, and the whole parish of East Kilbride in Lanarkshire ; while the parishes of Beith and Dunlop, which had been pre%'iously divided between Ayrshire and Renfrew- shire, were placed wholly in the former county. According to the latest official estimate, the area of the county (foreshore excluded) is 155,965 acres, or about 244 square miles. The population was, in 1881, 263,374 ; in 1891, 290,798 ; in 1891, on the above area, 230,812, of whom 110,520 were males and 120,292 females; in 1901, 268,934. On the old area, taking land only (156,785 acres, or 245 square miles), the number of persons to the square mile in 1891 was 1187, and the number of acres to the person 0'5. In the registration county the population increased between 1881 and 1891 by 87 per cent. Between 1881 and 1891 the excess of births over deaths was 31,459, and the increase of the resident population 19,571. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 : ???

Tear.

Deaths.

Marriages.

Births.

Per cent, of Illegitimate.

1880 1890 1899

5239 4861 5291

1636 1778 2010

7730 7842

8548 ???

6-2

5-08

4-1

The following table gives the birth-rate, death-rate, and marriage- rate per thousand of the population for a series of years : ???

1880.

1881-90.

1890.

1891-98.

1899.

Birth-rate Death-rate Marriage-rate .

34-64

23-48

7-33

34-57

21-21

7-31

32-18

19-94

7-29

31-92

19-99

7-05

32-68

20-22

7-68

At the census of 1891 there were 6114 Gaelic-speaking persons in the county, of whom 51 spoke Gaelic alone, and 2411 foreigners. Valuation in 1889-90, ––783,061 ; 1899-1900, ––612,633.

Administration.' ––– Since 1885 the county has returned two members to Parliament, one for the East and the other for the West division of the shire. Paisley (79,355), Greenock (67,645), Port-Glasgow (16,840), and Renfrew (9297) are all parliamentary burghs. Paisley and Greenock having a member each, and the other two belonging to the Kilmarnock group. Renfrew, the county town, is the only royal burgh. Police burghs are Barr- head (9856), PoUokshaws (11,169), Gourock (6244), and Johnstone (10,502). There are 16 civil parishes, and the number of paupers and dependants in September 1899 was 5386 ; there are poor- houses at Greenock and Paisley. Renfrewshire forms a sheriffdom with Bute, and there is a resident sheriff-substitute at Paisley and one at Greenock.

Education. ––– Twenty -three school boards manage 81 schools, which had an average attendance of 34,638 in 1898-99, while 22 voluntary schools (17 Roman Catholic and 2 Episcopal) had 6395. There is an academy at Greenock, and a grammar school and a, technical

school at Paisley ; five other schools in the county earned grants in 1898 for giving higher education ; while the county secondary committee makes provision also for the free education of Renfrewshire children in Glasgow high schools and the Spier School at Beith. The Paisley Technical School and the Glasgow and West of Scotland Technical College are subsidized out of the residue grant, part of which goes also to defraying the travelling expenses of students and to supporting science and art and technological classes in the burghs and throughout the county.

Agriculture. ??? The percentage of the area under cultivation was, in 1898, 59 per cent. Arable farming predominates, but dairying grows with the increasing town populations in and adjoining the county. The following table gives the principal acreages at intervals from 1880 :
???

Tear.

Area under Crops.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1880 1885 1890 1895 1899

93,786 95,529 96,247 93,907 92,695

17,477 16,806 15,573 14,078 13,322

8095 6670 6015 5951 5858

17,332 23,573 29,501 21,437 24,773

50,355 48,268 44,986 52,216 48,551

527 212 102 134 90

The table in the next colunm gives particulars of the live stock during the same years.

208

RENNES ❓❓❓ RENOUYIER

Tear.

Total Horses.

Total

Cattle.

Cows or Heifers

in Milk

or ill Calf.

Sheep.

Pigs.

1880 1885 1890 1895 1899

3330 3296 3470 3516 3314

24,677 27,619 27,878 26,125 26,813

14,945 16,131 17,247 16,808 17,452

35,436 32,432 36,667 38,370 42,584

1192 1815 1541 1584 1458

There were 6661 acres under wood in 1895. Of the 1096 holdings in 1895, the date of the last return, the average size was 86 acres. The percentage under 5 acres was 12‘13, between 5 and 50 acres 27 ‘92, and over 50 acres 59 ‘95. The number of farms between 50 and 100 acres was 295, between 100 and 300, 342, between 300 and 500, 14 only, and there were 6 over 500.

Industries and Trade. ??? Industries have advanced generally in importance throughout the county, but no change has taken place in their fundamental character. For details see the separate articles on Johnstone, PoUokshaws, Barrhead, Kilbarohan, Paisley, Greenock, and Renfrew. The following table shows the output of coal, ironstone, fireclay, and sandstone in 1890 and 1899 : ???

Year.

Coal.

Ironstone.

Fireclay.

Sandstone.

Tons.

Value.

Tons.

Value.

Tons.

Value.

Tons.

Value.

1890 1899

58,351 12,491

16,693 4,424

162,661 162,765

89,409 77,309

37,591 76,999

7,048 10,625

73,112

15,010

40,757 tons of limestone valued at 4345 were also raised in 1899. It is impossible to disentangle the figures relating to oil shale from the confusion of the mining inspectors' reports, but the out- put has certainly fallen off since 1885. In 1891, 50,388 men and 24,391 women were engaged in industrial handicrafts or were dealers in manufactured substances. Of these, 7339 men and 15,992 women were connected with the manufacture of textiles, 5471 men with ships, 5128 men with machines and implements, and 8219 with minerals. Commerce engaged the attention of 10,984 men and 484 women. About 22 miles were added to the railway mileage of the county in the last quarter of the 19th century, and considerable further extensions are now in progress.

Authorities. Wilson. General View of the Agriculture of Menfrewshire. 1812. Archceological and Historical Collections of the County of Menfrew. Paisley, 1885. Cbaig. Historical Notes on Paisley. Paisley, 1881. W. Hector. Vavduara. Paisley, 1881 ; Lichens from an Old, Abbey. Paisley, 1876. Gilmour. Paisley Weavers of Other Days. Paisley, 1879. D. Campbell. Historical Sketches of the Town and Harbours of Greenock. 1879- 1881 ; Old Greenock. Greenock, 1888. A. H. Millar. Castles and Mansions of

Renfrew. Glasgow, 1889. ??? Harp of Eenfrewshire. Paisley, 1872-73. ??? P.A.Ramsay. View of Renfrewshire. Edin- burgh, 1839. (w. Wa.)

Rennes, chief town of department Ille-et-Vilaine, France, and an important railway junction, 232 miles west-south-west of Paris. It is the seat of a Court of Appeal for the five Breton departments. The second trial of Captain Dreyfus took place here. A preparatory school of medicine and pharmacy, in connexion with the university academy, has been reorganized, and there are a national school of agriculture and a school of dairying. A statue of Bastard, former mayor and local ???benefactor, stands in front of the Chamber of Commerce, a handsome modern structure in the Eenaissance style. Population (1881),

47,774; (1896), 57,249.

Renouf, Sir Peter Le Pag^e (1822-1897),

Egyptologist, was born in Guernsey, 23rd August 1822. He was educated at Elizabeth College in his native island, and proceeded thence to Oxford, which, upon his becoming a Koman Catholic, under the influence of Dr Newman, he quitted without taking a degree. Like many other Anglican converts, he proved a thorn in the side of the Ultramontane party in the Eoman Church, though he did not, like some of them, return to the communion of the Church of England. He opposed the promulgation of the dogma of Papal Infallibility, and his treatise (1868) upon the condemnation of Pope Honoriua for heresy by the Council of Constantinople in a.d. 680 had the distinction of being placed upon the index of prohibited

books. Previously to this stirring episode in his career he had been from 1855 to 1864 professor of ancient history and Oriental languages in the Eoman Catholic university which Nevraian vainly strove to establish in Dublin, and during part of this period edited the Atlantis and the Home and Foreign Revieiu, which latter periodical had to be dis- continued on account of the hostility of the Eoman Catholic hierarchy. In 1864 he was appointed S Government in- spector of schools, which position he held until 1886, when his growing celebrity as an Egyptologist procured him the appointment of Keeper of Oriental Antiquities in the British Museum,

in succession to Dr Samuel Birch. He was also elected in 1887 president of the Society of Biblical Archjeo- logy, to whose Proceedings he was a constant contributor. The most important of his numerous and highly valued contributions to Egyptology are his Hibbert lectures on the Eeligion of the Egyptians, delivered in 1879; and the translation of The Booh of the Dead, with an ample com- mentary, which was published in the transactions of the society over which he presided. He retired from the Museum under the superannuation rule in 1891, and died in London on 14th October 1897. He had been knighted the year before his death. He married in 1857 Ludovica von Brentano, member of a well-known German literary family. (e. g.)

Renouvier, Charles Bernard (I8I8-

-), French philosopher, was born at Montpellier, 1st

January 1818, and educated in Paris at the Ecole Poly- technique. In early life he took much interest in poUtics, and the approval extended by Hippolyte Carnot to his Manuel republicain de I'homme et du citoyen (1848) was the occasion of that minister's fall. He has never held public employment, but has spent his life writing, retired from the world. His chief works are : Essais de critique generale, 4 parts (1854-64), La science de la morale, 2 vols. (1869), Uchronie (1876), Esquisse d'une classification spste'matique des doctrines philosophiques, 2 vols. (1885-86), La philo- sophie analytique de I'histoire, 4 vols. (1896 ? ? ? 97), Histoire et solution des problemes m^aphysiques (1901). Eenouvier has been the first Frenchman since Malebranche to formu- late a complete idealistic system, and he has had a vast influence on the development of French thought in the past century. His system is based on Kant's, as his chosen term Ndo-criticism^ indicates; but it is a trans- formation rather than a continuation of Kantianism. The two leading ideas discernible in it are a dislike to the Unknowable in all its forms, and a reliance on the validity of our personal experience. The former accounts for his decided acceptance of Kant's phenomenalism, combined with an equally decided rejection of the thing in itself. It accounts, too, jfor his strenuous polemic on the one hand against a Substantial Soul, a Buddhistic Absolute, an Infinite Spiritual Substance ; on the other hand against the no less

mysterious material or dynamic substratum by which naturalistic Monism explains the world. He holds that nothing exists except presentations, which are not merely sensational, and have an objective aspect no less than a subjective. To explain the formal organization of our experience he adopts a modified version of the Kantian categories. The insistence on the validity of personal experience leads Eenouvier to a yet more im- portant divergence from Kant in his treatment of volition. Liberty, he says, in a much wider sense than Kant, is man's fundamental characteristic. Human freedom acts in the phenomenal, not in an imaginary noumenal sphere. Belief is not intellectual merely, but is determined by an. act of will affirming what we hold to be morally good. In his religious views Eenouvier makes a considerable approximation to Leibnitz. He holds that we are ration-

ally justified in affirming human immortality and the existence of a finite God who is to be a constitutional ruler, but not a despot, over the souls of men. He would, however, regard atheism as preferable to a belief in an infinite Deity.

Rensselaer, formerly known as Greenbush and sometimes as East Albany, a city of Rensselaer county, New York, U.S.A. It is on the Hudson river, opposite Albany, with which it is connected by bridges, and on the New York Central and Hudson Eiver and the Boston and Albany railways. Population (1880), 3295;

(1890), 7301; (1900), 7466, of whom 1089 were foreign- born.

Renton, a manufacturing town of Dumbartonshire, Scotland, on the river Leven, 2J miles north by west of Dumbarton by rail. It is the centre of the Turkey-red dyeing industry, and calico-printing and bleaching are also carried on. A parish church stands on the site of Dal- quhurn House, the birthplace of Tobias Smollett, to whom there is a monument (1775). There is a drUl hall and a Jubilee Victoria Institute, with library and recreation rooms. Population (1881), 4319; (1901), 5227.

REPRODUCTION.

IN recent embryological work no idea has been more prominent than that of germinal continuity. From one point of view it may be said that multicellular organisms give rise by a process of division to macro-gametes or ova, and to microgametes or spermatozoa ; that these unite in fertilization to form a new indi- viduality, and that after a period of development this again produces gametes. But, from another point of view, it may be said with equal accuracy that the fer- tilized ovum gives rise in development to two sets of elements ??? to the somatic cells which become dififerenti- ated into the various tissues of the body, and to a lineage of non-specialized germ-cells, some of which will eventu- ally be separated off to begin a new generation. This lineage of germ-cells is often distinguishable from the somatic cells at an early stage in development, e.g., in some leeches ; Sagitta ; some Nematodes ; many Polyzoa ; Moina ; some Cladocera and other Crustaceans ; Chirono-mus, Platygaster, and some other insects; Phalangidee among Arachnids, and the Teleostean fish Micrometrus aggregatus. Perhaps the most striking instance of early differentiation of germ-ceUs is that of Ascaris megalo- cephala, described by Boveri (1887, 1891), where from the two-celled stage onwards the germ-cell lineage is distin- guishable from the somatic cell Hneage by the greater size and richness of the chromatin, and (for a time) by a difier- ence in the process of mitosis. By a process of chro- matin elimination, repeated through five or six successive divisions, the somatic cells come to contain a reduced quota of chromatin, while the germ-cells retain the whole amount. More instances of this sort might make it possible to give a precise statement of the relation between germ-cells and somatic cells, but at present only a general contrast is permissible. The somatic cells difiierentiate in manifold variety, most of them losing all likeness to the fertilized ovum or to its immediate descendants, the blastomeres, though in many cases some retain a power of helping one another to regenerate lost parts or even an entire organism. The germ-cells, on the other hand, are not implicated in building up the body, but remain virtually unchanged, preserving the original organization or " proto- plasmic tradition " intact. As the sex-cells in an offspring are thus genetically continuous with the parental sex- cells which gave rise to it, they will in turn develop into organisms

like the parents ⁇ a conception fundamental to an understanding of inheritance and development. The idea of germinal continuity was expressed by Owen, Haeckel, Eauber, Jaeger, Nussbaum, Brooks, and Galton, but it has been most clearly stated and consistently worked out by Weismann, who has, moreover, adjusted it to meet an obvious difficulty. In many forms, especi- ally among plants, it is only after the differentiation of the body is relatively far advanced that the future repro- ductive cells are recognizable as such, and thus we have

to pass from cases where germ-ceZZs form a demonstrable continuous lineage with the fertilized ovum, to the theory of a continuous germ – plasm. Weismann assumes that "in each development a portion of the specific germ- plasm, which the parental ovum contains, is not used up in the formation of the offspring, but is reserved unchanged for the formation of the germinal cells of the following generation." This germ- plasm, of definite chem- ical and special molecular constitution, is supposed to have its seat in the nucleus, and to have great powers of persistence and growth. Part of it is distributed throughout the "body," and may be the material con- dition of asexual multiplication and regeneration, as well as the determinant of differentiation ; but part of it con- tinues with approximately intact stability to form the reproductive cells of the body.

Correlation. ⁇ While it may be admitted that the body is the bearer rather than the producer of the germ-cells, it must also be allowed that these cannot lead a charmed life, uninfluenced by somatic accidents and incidents. Vascular and other fluids form a common medium for all parts of the system ; the gonads of animals are often under nervous control ; alteration of diet may alter repro- ductivity and even sex ; various poisons and the like are known to affect not only the whole bodily system, but the germ-cells as well. Even Weismann, the most pro- minent upholder of the distinction between soma and germ- cells, finds one of the chief sources of congenital variation in the nutritive stimuli exerted on the germ-plasm by the varying state of the body. On the other hand, many instances are known, if not understood, of correlations between the reproductive system and bodily organs. Thus Rorig (1899) shows that a diseased state of the ovaries in a female deer is correlated with the development of antlers, that

atrophy of the testes is always followed by a peculiar growth of antlers, that castration of a young male always inhibits the development of antlers, and so on. SeUheim (1898, 1899) has described some of the numerous somatic changes which follow castration in vari- ous animals, one of the most frequent in both sexes being a prolongation of the period of bone-growth. When young cocks are castrated, the whole body is affected; the larynx is intermediate in size between that of cock and hen, the sjrrinx is weakly developed, the brain and heart are light in weight, fat accumulates in the sub- cutaneous and subserous connective tissue, and the skeleton shows many abnormalities. From ancient times a correlation between the gonads and the state of various parts of the body ??? even of the nose ??? has been recognized in man, and many instances suggest that while the germ- cells are in a sense apart from the general bodily system, an even greater fact is the unity of the organism.

Galton' s Law. ??? Beside the idea of germinal continuity we may rank another generalization of great importance,

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REPRODUCTION

namely, Galton's law of ancestral inheritance, based partly on studies in the inheritance of human qualities, and partly on a series of observations on basset hounds. There is a sense in which we may think of an inheritance as dual ??? half derived from the father and half from the mother ??? but the heritable material of each parent was also dual, being derived from the grandparents, and Galton's law expresses this conception of inheritance as necessarily multiple. "The two parents between them contribute on the average one-half of each inherited faculty, each of them contributing one-quarter of it. The four grand-parents contribute between them one-quarter, or each of them one-SLKteenth ; and so on, the sum of the series ^ + J-t-^-l- J-L-I-&C., being equal to 1, as it should be. It is a property of this infinite series that each

term is equal to the sum of aU those that f oUow : thus ^ = i + i + J^-(- &c.; J = I -f iV +

Sexual Differentiation. ??? Numerous facts point to the conclusion that maleneas and femaleness may be regarded as expressing meta- bolic alternatives open to the germ-cell in its development, and that the bias in one direction or the other is largely due to environ- mental stimuli. In illustration we may recall the very diverse sexual conditions ??? hermaphrodite, male, female, parthenogenetie, asexual, &c. ??? observed in the simple multicellular organism Vblvox, which has been described as furnishing an epitome of the evolution of sex. According to Cu^not, the little starfish Asterina gibbosa is in certain localities first male for a variable period, and then female, while in other localities permanent males, females, and hermaphrodites seem to occur. According to W. M. Wheeler's interpretation, Jlyzostoma glabrum has a functional male phase, succeeded by a functional hermaphrodite phase, and that again by a functional female phase during which the testes disappear, while in other species the hermaphrodite period may be almost or wholly suppressed. In plants, in particular, it seems that environmental conditions are often effective in changing a hermaphrodite into a unisexual condition. Very striking both in their results and in the carefulness of method are the experiments of Klebs, which show that environmental changes will determine in various Algae and Fungi the occurrence of sexual or of asexual reproduction, or will cause a normally hermaphrodite form to become unisexual. It need hardly be pointed out that the view which regards sexual dimorphism as expressing two opposed metabolic diatheses is com- plementary, not antagonistic, to that which points out how the dimorphism is adaptive to securing cross-fertilization and other

Oogenesis. ??? It is convenient to distinguish in the history of both ova and spermatozoa three periods : (a) of multiplication, (b) of growth, and (c) of maturation. During the growth-period in a num- ber of cases there occurs what may be called a struggle for existence among potential germ-ceUs. Thus among the numerous possible ova in the ovary of Hydra there is usually but one survivor, which has grown strong at the expense of its neighbours, and almost the same thing is known in Tubularia and

in some other cases. Imma- ture ova of sea-urchins have been seen engulfing others, and even spermatozoa (without resulting fertilization), i. e. , exhibiting phagocy- tosis. Many potential ova are often used up to form follicular or other investments for the few which succeed. It may sometimes be that the elimination process, both among young ova and among spermatozoa, is discriminative, i.e., that the survivors survive in virtue of particular fitness ; if so, the process may be of racial importance. This extension of the conception of the stiuggle for existence to the germ - cells may suggest the further extension expressed in Weismann's daring hypothesis of " germinal selection," which supposes the occurrence of an intimate competition among the hereditary units within the germ-cell.

Spermatogenesis. ❓❓❓ Recent researches on spermatogenesis have not greatly altered the state of knowledge outlined in the article Eepeo-DtroTlox in the ninth edition of the Sncydopcedia Britannica, but it may be noted that although the parallelism between spermato- genesis and oogenesis suggested in the jirevious article does not seem to have been accepted, a deeper parallelism has been estab- lished (see infra) ; that there is often in the testes of higher animals, as in the ovaries, a division of labour between the germ-

cells proper and associated nutritive cells ; that the middle piece of the spermatozoon bears a centrosome which plays an important role in the division which follows fertilization ; that the locomotor tail has often a fibrillated structure which suggests an analogy with a muscle-fibre ; that in various Cycads the male nuclei issue from the pollen tube as motile spermatozoa, whose occurrence re- moves one of the distinctions between flowering plants and Crypto- gams ; that there is sometimes dimorphism of spermatozoa, e.g., in water-beetles, which suggests another parallel between spermato- genesis and oogenesis (cf. the familiar dimorphism of the ova of Eotifers, &c.).

Hediicing Divisions. ❓❓❓ Since van Beneden discovered that each of the two nuclei which unite in fertilization contains one-half of the number of chromosomes character- istic of the somatic cells, though the nuclei of the earlier stages of the germ-ceUs have the same number as the somatic cells, it has been plain that a reducing process must occur at

some phase, and there is now general agree- ment that the reduction takes place in the last two ceU- divisions by which the definitive germ-ceUs arise, namely, when the ovarian ovum gives rise to the mature ovum and two or three polar bodies, and when a spermatocyte divides into four spermatids or young spermatozoa. The parallelism in the two cases is very striking, but as O. Hertwig says, "while in the latter case the products of the division are all used as functional spermatozoa, in the former case one of the products of the egg-mother- ceU becomes the egg, appropriating to itself the entire mass of the yolk at the cost of the others, which persist in rudimentary form as polar bodies." The hypothesis of Minot, adopted also by van Beneden, that each germ- cell is originally hermaphrodite, and that the maturation processes imply the removal of male qualities from the ovum and of female qualities from the spermatozoon, has been abandoned ; and the reducing divisions are recog- nized as securing a constancy in the number of chromo- somes characteristic of each species, for without some such preliminary reduction the number would obviously be doubled at each fertilization. That a reduction does really occur in both plants and animals seems now incon- trovertible, but as to the precise manner of the reduction the results are at present too discrepant to admit of any brief statement. It should be noted, however, that in some parthenogenetie ova, e.g., of Aphides, only one polar body is formed and no reduction in number is effected, while in other parthenogenetie ova, e.g., those eggs of bees which develop into drones, two are formed ??? a strange fact, in part at least explained by Brauer, who showed that in the parthenogenetie ova of Artemia both types occur, but that when two polar bodies are formed the second remains in the egg and behaves practically like a sperm-nucleus.

Fertilization. ??? Kecent work has forcibly suggested that there are in fertilization two more or less distinct processes ??? on the one hand, the process by which the gametes, bearing the hereditary characters, unite to form the beginning of a new individuality ; on the' other hand, the process by which the microgamete supplies some stimulus prompting the ovum to divide. The first aspect is that of amphimixis, believed by many to be of import- ance in initiating ??? and, it may be, also in checking ??? variation, but in any case impljdng the union of the hered- itary

qualities contained in the two gametes. The second aspect is that of mitotic stimulus, believed by some to be afforded by an enzyme ??? for which the name of ovulase has been suggested ??? and by others to be localized in the sperm-centrosome. It is seen in many cases that equivalent numbers of chromosomes are contributed by the two nuclei ; it is evident that the ovum contributes by far the larger quantity of cytoplasm; it seems to have been securely demonstrated in some cases that "from the

father comes the stimulus inducing the organization of the machinery of mitotic division by which the egg spKts up into the elements of the tissues, and by which each of these elements receives its quota of the common heritage of chromatin." While the ovum centrosome of many animals seems to disappear, that introduced by the spermatozoon divides into two, and around each a system of rays develops. They migrate to opposite sides of the segmentation nucleus, and between them there appears the spindle of the first cleavage. It may be hasty to call them 'kinetic centres,' but they seem to have an important r61e in the division-process. " Huxley hit the mark two score years ago when he compared the organism to a web of which the warp is derived from the female and the woof from the male. Our principal advance upon this view is the knowledge that this web is probably to be sought in the chromatic substance of the nuclei ; and perhaps we shall not push the figure too far if we compare the amphiaster to the loom on which the fabric is woven " (Wilson, 1900, p. 231).

The experiments of Maupas on ciliated Infasorians, where an elaborate nuclear reduction is followed by an intimate nuclear amphimixis, seemed to show that conjugation is not effective between the members of an isolated colony all descended by suc- cessive iissions from one form, and that after a large number of generations senile degeneracy sets in, and leads to the extinction of the colony unless it be checked in time by the removal of some members to the vicinity of unrelated forms with which they may conjugate. This suggests the view that amphimixis is necessary to sustain the standard of vitality in a stock, but while some believe that there is a primary need for this "rejuvenescence" (a view which is

certainly not supported by the entire absence of any amphimixis in forms like Bacteria, nor by persistently partheno- genetic forms, like many Rotifers), others hold that the dimorphism and mutual dependence of the germ – cells is only an elaborate adaptation to secure the origin or multiplication of variations (a view which has found its most thoroughgoing exponent in Weismann). That Maupas's undoubtedly careful work requires contirmation may be inferred from the experiments of Joukowsky (1898), which suggest that degeneracy depends not merely on the number of asexual generations, but on the rapidity of their succes- sion ; in Pleurotricha loMceolaia over 458 generations were observed without the occurrence of degeneracy ; after five months' culture a colony of Parammciwm caudatum showed no nuclear senility, but o^ly a marked reduction of ciha and consequent sluggishness ; in P, putrinum effective conjugation between the descendants of one individual was observed, but the author admits the probability that this has its limits.

A remarkable experiment made by Boveri (1889, 1895) cannot be overlooked, though it is still in some respects unsatisfactory, as SeeUger and Morgan have pointed out. Following a method used by the Hertwigs, Boveri subjected Echinoid eggs to shaking, and obtained enucleated fragments. He showed that these were capable of fertilization, and that they gave rise to dwarf larvse, which were normal except in size and in having only half the usual number of chromosomes in their cells. Boveri went on to fertilize enucleated ovum-fragments of SphcerecMnus gramularis with spermatozoa of Echinus microtuberculatus, and obtained in a few cases dwarf larvae showing purely paternal characteristics. From this he drew the conclusion that it is the nucleus, not the cytoplasm, which forms the material basis of inheritance ; and there are many facts, e.g., the history of the chromosomes in maturation, which point in the same direction. It should be borne in mind, however, that as the life of the cell probably depends on the complex interaction of various materials more or less localized in different parts of the unit-area, since the nucleus cannot live for more than a short time without the cytoplasm as its agent, nor the cytoplasm without the nucleus as its trophic or formative centre, it may be misleading to seek too hastily for a definite localization of functions ??? to attempt, for instance, to abstract the ovum – cytoplasm altogether from any share in bearing the burden of

inheritance. In Boveri's experiment it may have been that the hereditary qualities of the sperm proved themselves prepotent over the hereditary qualities of tfhe ovum-cytoplasm, weakened as these might well be by enucleation. In 1899 Delage succeeded in fertilizing non- nucleated fragments of the ova of Echinus, Dentaliuin, and Lcmice conchilega, and reared Pluteus, Veliger, and Trochosphere larvae respectively. Three larvse were reared from one ovum of a sea- urchin ??? from one nucleated and two non-nucleated portions ??? and in one case a normal blastula was obtained from a ~~gVth ovum~~ fragment. He showed, moreover, that an egg-fragment of Echinus

without any chromosomes gave rise after fertilization by a sperma- tozoon with nine chromosomes to a larva whose cells had the normal number of eighteen chromosomes ; which led him to infer that the number of chromosomes is a property of the cellular organiza- tion, and not dependent on the persistent individuality believed by most to be characteristic of the chromosomes. The experiments will require confirmation and extension, but unless the cutting operation caused an escape of nucleoplasm into the cytoplasm frag- ments (which Delage does not believe to have been possible), it is difficult to avoid the conclusion that fertilization may be efiective without any fusion of nuclei. In connexion with these remarkable phenomena of "merogonic" fertilization and development, it is perhaps appropriate to recall the observations of Marchal on Eneyrtus fuscicollis, where the ovum gives rise not to one embryo, but to "a legion of small morulae," forming a chain of 50-100 embryos. Even more striking, however, are the experiments of Loeb (1899) on the artificial production of normal larvse (plutei) from the unfertilized eggs of the sea-urchin. He found that this may be effected by placing the unfertilized eggs for about two hours in sea- water to which a dilute solution of magnesium chloride has been added in certain proportions. ' ' When brought back into normal sea-water the eggs began to segment and form blastula, gastrulse, and plutei, which were normal in every respect. The only differ- ence was that fewer eggs developed, and that their development was slower than in the case of the normal development of fertilized eggs." The precise nature of the physical, or chemical and physical, stimulus in this and in other cases of "artificial parthenogenesis " remains uncertain.

Cleavage. ??? Many hundreds of researches within the last few years have had for their subject the cleavage or segmentation which follows fertilization, but we cannot do more than refer to one general result which seems to be true of most cases of indirect cell-division. The chro- matin nuclear material is disposed in a number of seg- ments or chromosomes (whose number is practically con- stant for each species) ; each of these chromosomes is split lengthwise during the division process, and the two halves are borne in opposite directions to the two poles, there to form, or to help to form, the daughter-nuclei. As a chromosome is built up of a single series of chromatin- granules, each of which is cleft by the longitudinal split- ting, each daughter-nucleus has a contribution from each chromatin-granule. In the movement towards the poles the system of spindle-fibres which radiate from the centro- somes appears to play a part, but whether they push or puU or act in some more subtle way remains uncertain ; nor is it known what precise part is played by the astral rays which surround the centrosome but are quite dis- tinct from the spindle-fibres. What is certain is, that the result of the mitotic process is to divide the chromatin substance with exact equality, so that, in the case of a segmenting ovum, each daughter-nucleus is half maternal and half paternal in its composition ??? a discovery of much interest in connexion with inheritance. Our under- standing of the different forms of ovum segmentation advances very slowly, for though some useful " laws " have been stated ??? e.g., that each new plane of division tends to intersect the preceding plane at right angles (Sachs), or that the axis of the mitotic figure typically lies in the longest axis of the protoplasmic mass, so that the division tends to cut this axis at right angles (Hertvdg) ??? these are only preliminary descriptive formulae. It is possible that the experiments of Driesch and others, who have observed the cleavage of eggs under the pressure of glass plates, may be of service in enabling us to eliminate the mechanical factors. The associated problem of the relation of the early cleavages to the axes of the future embryo is not less difficult. It is indeed a familiar fact that the ovum may show polar differentiation and bilateral symmetry, and that in some cases, e.g., frog and Tunicate, the first cleavage plane coincides with the median plane of the adult body. On the other hand, the first cleavage sometimes corresponds approximately to the transverse plane of the body (newt); or separates an ectoderm cell from an endoderm cell ; or separates a germ-

cell from a somatic cell (Ascaris), and so on ; so that what it does admits of no general statement. Moreover, the orientation of the ovum may be entirely altered, as in the frog, by artificial conditions, without the normality of the resulting embryo being affected; and a minute ovum-fragment, as in sea-urchins, may give rise to a complete larva ; so that there are strong reasons for the view that the egg-cytoplasm is at first isotropous or indifferent, and that its polarity or anisotropy is secondarily acquired, sometimes earlier, sometimes later, and in very varied degrees.

Experimental Embryology. ❓❓❓ Particularly significant of recent embryological work has been the frequent recourse to experiment, and within a few years a large literature has grown, with its centre in Eoux's Archiv fur Entwich- lungsm^chanik. Artificial isolation of blastomeres by cut- ting or shaking apart ; subjection of the developing ova to pecuUar conditions of pressure; modifications of tem- perature, illumination, &c. ; and alterations in the chem- ical character of the medium, have been the four most frequent hues of experiment. The main aim has been to analyse the immediate factors in development, and while it is too soon to estimate the value of the results, some illustrations may be given.

Isolation of Blastomeres. ❓❓❓ As long ago as 1869 Haeckel divided the blastulae or morulse of Siphonophora with a fine needle into two, three, or four pieces, and observed that each developed into a complete larva. This was one of the first experiments along a line which many investigators followed during the last decade of the 19th centmy. In 1877 Chun made, though he does not appear to have published, the observation that when the first two blastomeres of a Ctenophore ovum were shaken apart, each formed a half-larva, with four ciliated ridges, four meridional vessels, and one tentacle ; moreover, each became sexual, and the half which was wanting was eventually regenerated. The ova of frog, newt, fishes, lancelet, ascidian, mollusc, sea-urchin, medusa, &c., have been made the subjects of similar experiments, in which blasto- meres are isolated by shaking the segmenting ovum until separation occurs, or by actually cutting off or puncturing a portion so as to destroy its power of

development. By shaking the water iu which the two-cell stages ofthe segmenting ova of ^mpfc'oKws floated, E. B. Wilson produced from the separated halves two independent twins of half the normal size, each of the isolated cells segmenting like an intact ovum, and giving origin, through blastula and gastrula stages, to a half-sized metameric larva. When incomplete separa- tion was effected by the shaking, double embryos ??? ^like Siamese twins ??? resulted, and formed shortlived segmented larvae. Com- plete isolation of the first four blastomeres resulted in four dwarf blastulae, gastrulae, and oval larvae ; separation into two pairs of cells yielded two half-sized larvae ; incomplete separation resulted in (a) double embryos, (i) triple embryos ??? one twice the size of the others ??? or (c) quadruple embryos, each a quarter size. An isolated blastomere from the eight-ceU stage proceeded to segment, but did not reach the gastrula stage.

Numerous experiments on the developing egg of the frog by Roux, Hertwig, Schultze, Morgan, Endres, Waljier, "Wetzel, and others have after no Kttle controversy made one interesting result clear, that one of the first two blastomeres may develop into a half-embryo, or into a half-sized whole embryo, according to the conditions of the experiment. " So long as the first two blasto- meres remain in contact without any disturbance of the cell-contents, each blastomere develops its half of the body. On the other hand, if the protoplasm is disturbed by reversing the position of the egg after the first cleavage, there generally results a whole embryo from each blastomere " (Morgan, 1897, p. 131). Thus we may place the behaviour of the frog^s ovum intermediate between that of the Ctenophor (where an isolated blastomere forms a half-embryo) and that of the lancelet (where an isolated blastomere forms a whole embryo of small size).

Pressure Experiments. ??? By causing a developing ovum {e.g., of frog) to segment between parallel glass plates, or in a glass tube of smaller calibre than the diameter of the egg, this general result has been established, that the distribution of the nuclei may bo entirely different from that in normal conditions, and yet normal embryos result. It seems difficult to avoid the conclusion that the sequence of the early nuclear divisions has no necessary relation to the sub- sequent formation of the

embryo, and that the nuclei in these early stages are all equivalent (Morgan, 1897, chap. x.). 0. Hertwig (1898) found that when centrifugal force was exerted in a certain degree on the eggs of Rana esculenta, it produced a more marked separation of the lighter and heavier substances, in consequence of

which the cleavage was restricted to the upper or "animal half" of the ovum. Indeed, a meroblastio type was closely approached, for an undivided yolk-containing portion occupied from one-half to two-thirds of the egg, the remainder was formed by a blastoderm with a blastocoel, and the resemblance was heightened by the forma- tion of a special layer of merocytes ❓❓❓ a yolk-syncytium ❓❓❓ beneath the blastoderm. But here again, if removed in due time from the dis- turbing influences, the eggs gave rise to embryos with the normal equipment of organs.

Influence of Temperature. ❓❓❓ Numerous experiments have also been made on the infiuence of temperature on developing ova, but few of the results are at present intelligible. Thus Driesch, prompted by Vejdovsky's note that the eggs of the earthworm, Allolobophora trapezoides, most frequently form twin ~~*embryos in warm weather, tried the effect of warming the developing ova of Sphmrechinus granularis, with the result that in some cases almost all of them formed distinct twin blastulae, gastrula, and even plutei. Similarly, prompted by Selenka's observation that in*~~ *creased temperature produced deviations from the normal cleavage in marine Planarians, Driesch experimented and found that increase of temperature wholly or partially inhibited the formation of the smaller cells or micromeres, and otherwise disturbed the segmenta- tion, without, however, in the end affecting the normality of the result. Again, he found that when the blastulae of Sphcereckinus granularis, about twenty-six hours after fertilization, were kept on a stove heated to about 30❓❓C, the great majority showed in about eighteen hours the exogastmla state ; i.e., the growing zone at the so-caUed vegetative pole, which is normally invaginated to form the archenteron, bulged outwards instead of inwards, the final result being shrivelled, gutless, or anenteric larvae, which survived for a week.*

Chemical Meagents. ⁂ Another series of studies in experimental embryology is concerned with the influence of chemical reagents upon the developing ova. Thus Curt Herbst has observed the results of placing the eggs of sea-urchins (Sphcerechinus granularis) in sea-water to which a little lithium chloride has been added, in the proportion of 2 ‘5 cubic centimetres of 3 ‘7 per cent, aqueous solution to 97 “5 cubic centimetres of sea- water. In this the fertilized ovum segments into an elongated blastula which becomes constricted into two vesicles, one thick-walled (the archenterio portion), the other thin-walled (the gastrula waU) ; the thick- walled portion, which should normally be invaginated to form the endoderm, grows out of proportion to what is normally the ecto- derm-forming area, and the series ends in a form (holo-entoblastic) in which the thin-walled vesicle or ectodermic area has wholly disappeared. If rather less lithium is used, the type of larva which results is somewhat different, though the two are connected by transitional forms ; it is an exogastrula, in which, as the name suggests, the endoderm is evaginate instead of invaginate.

Development. ⁂ More clearly than even a dozen years ago we now recognize that the germ-cells, and especially their nuclei, form the material basis of inheritance ; that there is genetic continuity between the germ-cells of the parents and those of their offspring; that fertihzation implies a union of two individualities condensed for the time being into minute cells ; that paternal and maternal characteristics are distributed in exact equality by the nuclear or cellular divisions which constitute the mode of all development ; and so on. On the other hand, we have still to confess our entire inability to solve the old problems : How are the specific characters potentially contained within the germ-cells, and by what mechanism do they attain expression in development %

Germiiial Areas. ⁂ On one view it is supposed that the germ-cell has an architectural organization predetermined before develop- ment begins, and that development is in part a ” histogenetic sundering ” of the pre-existing germinal localization. Some author- ities, e.g., Ray Lankester and Whitman, Flemming and van Beneden, have suggested that the predetermination is expressed in the organization of the egg-cytoplasm ⁂ the essential idea of the theory of ” organogenetio germinal

areas" which His elaborated in 1874. This theory may be supported by Roux's experiments on the frog ovum, where, after one of the first two blastomeres had been punctured, the intact half developed into a one-sided embryo ; and it may be opposed by Wilson's experiments on the lancelet ovum, where an isolated blastomere of the four-cell stage still formed a complete embryo. It may be supported by the experi- ments of Morgan and Driesch on Ctenophor ova, where a defect in the cytoplasm is often followed by a modified cleavage and a defective embryo, even when the whole of the nuclear material is intact ; and it may be opposed by Delage's experiments on the ova of sea-urchins, &c., where a small (and non-nucleated) fragment of

an egg may be fertilized and give rise to a complete larva. In fact, the experimental results do not as yet settle the question.

Idiiyplasm. ??? Supplementary, rather than opposed, to the idea of germinal localization is that of a specific idioi)lasm, a complex substance which in ii,s molecular organization and in the metabolism which it induces is different for each species. The idea of an idioplasm was first elaborated by Nageli (1884), who did not concern himself, however, with its particular localization in the germ-cell ; this further step was taken by Hertwig, Strasburger, Kblliker, and Weismann, who, from the importance of the nucleus in metabolism, in the regeneration of Protozoon fragments, in maturation, in fertilization, and in cleavage, argued that it ??? and even more definitely its chromatin ??? must be the bearer of the idioplasm. On this view the locality of the pre-established organ- ization is shifted from the cytoplasm to the nucleus, though it may still be admitted that in certain cases a cytoplasmic predetermina- tion arises as a secondary result of idioplasmio influence.

Starting from the assumption that the idioplasm of the germ- nuclei was a complex aggregate of different kinds of granules ??? the material expressions of different sets of qualities ??? Roux invented the hypothesis of two kinds of nuclear-division, quantitative and qualitative.

The former results in equ valent, the latter in dis- similar nuclei ; the former is an integral, the latter a differential division. It is the latter mode which is supposed to be character- istic of the early stage, of development during which the different components or qualities of the idioplasm are distributed among the blastorneres, eaon of which, though not independent of its neigh- bours, is regarded as endowed with a power of "self-difi'erentiation " due to its specific share of the idioplasm.

Similarly, Weismann in his "Germ-Plasm" and elsewhere has elaborated a theory of development which, while confessedly hypothetical, is remarkable in its logical completeness. He supposes the idioplasm or germ-plasm to be built up of numerous different components or " biophores " corresponding to the character- istics of the adult ; the biophores are aggregated in groups or "determinants"; the determinants are grouped in "ids" ??? the chromatin granules; and the "ids" in "idants ??? the chromosomes. In the early stages of development there is by differential division a distribution of the components of the germ-plasm. " Ontogeny depends on a gradual process of disintegration of the id of the germ-plasm, which splits into smaller and smaller groups of determinants," till finally only one kind of determinant remains in each cell, there breaking up into its constituent biophores which give the cell its inherited specific character. But while this is going on, there is also a process of quantitative division, which gives rise to the lineage of future germ-cells. The theory of development here outlined has been criticized from many sides. It has often been pointed out that there are no visible phenomena of nuclear division which suggest that the partition may be quali- tative ; on the contrary, that the whole elaborate process of mitosis seems adapted to secure the equivalence of the two daughter-nuclei. That the division may be differential or qualitative must, of course, be admitted, though we cannot prove it. It is perhaps more to the point to inquire whether the hypothesis fits the known facts, and critics bring forward some of the results of experimental embryology, especially where one of the first two or first four blastomeres is seen to form a normal embryo, or where under artificial conditions (of pressure, &o.) certain cells develop into tissues which in normal conditions are formed by quite different cells. To explain these and other difBculties, e.g., in

regenerative phenomena, various ingenious sub-hypotheses have had to be invented.

Without abandoning the position to which almost all modern embryological work has led up, that the essential intrinsic factor in development is the pre-established and inherited organization of the germ-plasm, and without attempting to deny that the nuclear substance may be gradually specialized as differentiation proceeds, it is possible (as Hertwig, Driesch, Morgan, Wilson, and others have shown) to consider the facts of development in a manner somewhat different from that suggested by Roux and Weismann. We may suppose that from the youngest ovarian ovum onwards the nucleus exerts a "control" upon the surrounding cytoplasm, whether by the migration of "pangens" (De Vries, Hertwig), or of specific " formative substances " (Sachs, Loeb), or of enzymes (Driesch), or by a propagation of molecular movements (Nageli). We may suppose that in some way ❓❓❓ varying greatly in degree in different cases ❓❓❓ the nucleus prepares in the cytoplasm a framework for its future operations. This may be so slightly pre-established that from a minute fragment of the egg a complete larva may be reared (Echinoid, &c.), or so well established that if a part of the unseg- mented egg is removed the remainder forms a defective larva (Ctenophore). When division occurs, the daughter-nuclei, though equivalent, find themselves in a not wholly isotropic medium, and this incites further differentiation, both in the nuclear material and in its cytoplasmic sphere of influence. If the initial cytoplasmic differentiation was slight, the first steps in differentation wiU be correspondingly slight, and in these cases the isolated blastomeres

may still form complete embryos. If the initial cytoplasmic differentiation was more pronounced, the isolated blastomere may not be able to do more than form a partial embryo ; the setting of the oytoplasmio mosaic may be too strong to be overcome even by the completely equipped blastomere-nucleus. Thus we reach the idea expressed, for instance, by Driesch : ' ' The relative position of a blastomere in the whole determines in general what develops from it ; if its position be changed, it gives rise to something different ; in other words, its prospective value is a function of its position." But the "position " is more than merely topographical ; it

means, as Wilson says, ” the physiological relation of the blasto- mere to the inherited organization of which it formed a part. ” But even when we recognize the importance of the initial inherited organization, of the influence of segment upon segment as develop- ment proceeds, and of the normal environmental stimuli, we have stOl to confess that the problem of development remains unsolved.

The Eecapitidation Doctrine. ??? The generalization that the individual development or ontogeny of an organism tends to be a recapitulation of the racial evolution or phylogeny is no longer accepted so readily as it was twenty years ago. Many facts have shovra that this luminous idea which has certainly guided research may also mislead. Precise embryological investigation has given prominence to the fact ??? which von Baer himself clearly recognized ??? that while there is a parallelism between the stages of organogenesis in the individual and the grades exhibited in phylogeny, or in presumed phylo- geny, yet there are individual characteristics present from the first. There is a parallelism between the stages of organogenesis in the frog and grades of structure exhibited in fishes, but no one can accurately call the larval frog at any stage piscine ; it is an amphibian from first to last. There is a parallelism between the stages in the develop- ment of the lens in a higher mammal and grades of lens- structure exhibited in lower Vertebrates, but the rudiment of the lens in the dog is from the first specifically a dog’s lens, and nothing else, as Rabl (1899) has shown in detail. In short, the idea of ontogenetic and phylogenetic parallel- ism must be corrected by the conception that the organism develops as a specific unity.

Begeneration. ??? Within recent years our knowledge of the occurrence of regeneration and of the internal pro- cesses involved has been greatly increased ; our understand- ing of the facts, however, lags far behind. What Reaumur, Lessona, and Darwin suggested, that regeneration is especially characteristic of those organisms and of those parts of organisms which atp or have been in the course of nature most liable to breakage or other non-fatal injury, has been especially elaborated by Weismann, who is the chief exponent of the view that regeneration is an adaptive phenomenon, ” that the regenerative power of

a part is to be considered, not as a direct and necessary expression of the nature of the organism, but rather as a capability which, though it may be absent, is found wherever it is necessary in the interests of species-preservation. The capability of a part for regeneration depends on whether the part was frequently liable to be lost in the ordinary course of life, and also on its relative biological importance for the animal." That internal organs, which are but slightly subject to non-fatal injury, should show little regenerative capacity ; that the weak limbs of Siren and Proteus should not be replaced, though the gills are, and though the strong limbs of Triton are ; that there should be special regenerative capacity when the leg of an insect is excised at the point where breakage is most apt to occur in the struggles of moulting or ecdysis ; that it should be possible to find in the conditions of life some good reason why the beaks of certain birds, e.g., storks, or the eyes of certain animals, e.g., newts, should be readily regenerated ; that regeneration should be so common in animals like branching polypes, elongated worms, starfishes, and arthro- pods ; ??? these are illustrations of the evidence which has led many to regard the occurrence of regeneration as the

adaptive result of natural selection, and not simply as an expression of the primary reproductive capacity of cells. On tlie other hand, it is pointed out that in some cases there is no definite relation betveeen the regeneration of a part and its liability to injury. Thus, in opposition to Weismann's interpretation, T. H. Morgan has pointed out that the small fourth and fifth thoracic limbs of a hermit- crab, which do not seem to be often (if ever) injured, regenerate readily, that the terminal abdominal append-ages, vyhich are entirely protected, likewise regenerate quickly and normally. Or, again, it seems almost impossible that a hermit-crab's walking-leg should under ordinary conditions of life be broken oflf proximal to the basal "breaking-joint" (between the fifth and sixth segments), where the leg, if injured, is usually thrown oflf; yet if it be cut off proximal to that joint there is regenera- tion. Under ordinary circumstances, if a leg is injured distal to the "breaking-joint," the leg is

thrown oflf at the joint; yet regeneration was observed from the cut end of a limb artificially excised outside the breaking-joint. Such facts seem to the observer to show that there is no relation between the regeneration of the leg and its liability to injury. Thus the case for and against the interpretation of regenerative phenomena as adaptive in their occurrence must remain sid> judice until a large number of instances have been carefully studied. It has also been urged against Weismann's position that the result of regenerative growth is sometimes non-adaptive, as in the instance of a posterior half of an earthworm, observed by Spallanzani (1768), by Morgan (1899), in which the new part was a tail, not a head ??? the result being a worm with two tails turned in opposite directions. But unless there were many instances of this kind there is no argument, since no one supposes that adaptations are perfect. Two other interesting questions rise out of the study of regeneration : (a) How far there is similarity between the regenerative growth and the process of normal develop- ment, a question to which opposite answers have been given in diflferent cases and by different observers in the same case ; (b) how far it is possible at present to form any scientific conception of the manner in which the potentiality of regeneration is distributed and locaHzed within the organism, and kept latent until specific stimuli liberate it. But neither of these questions will at present admit of brief discussion.

Alternation of Generations. ??? The distinction which Cela- kowsky introduced in 1868 between two kinds of alterna- tion of generations has been much discussed. Homologous alternation is illustrated by many Algse and Fungi where oflfspring of similar appearance are produced in two different ways, either vegetatively or sexually; antithetic alternation is best illustrated by Bryophytes and Pterido- phytes where there is a regular alternation between a vegetative sporophyte and a sexual gametophyte which differ entirely in their structure. But there is difference of opinion as to the value of this distinction, or, if it be admitted, as to its applicability to particular cases. Apart from this, it is interesting to note that in many cases the number of chromosomes in the dividing nucleus of the sporophyte is twice that which occurs in the gametophyte. Here too may be noticed the subtle theory of Beard (1896), which suggests that there is a disguised alternation of generations in Vertebrate animals, just as there

is in flowering plants. In several Invertebrates, e.r/., Echino- derms and Phoronis, the egg gives rise to a larva which does not directly develop into the definitive organism, but serves as the foundation on which the develoiDment recom- mences, as it were, on a new tack; similarly Beard maintains that in Vertebrates, whether skate or chick, there are traces of an asexual larval stage, on the top of

which the embryo proper develops. At the "critical stage," when the embryo begins to put on its generic and specific characters, it also sets about the task of suppress- ing the larval foundation.

In-breeding and Crossing. ??? In regard to close in-breed- ing there is still much need of experiment, but it seems certain that in many cases with a healthy stock this may go far without disadvantageous results. It seems to fix and strengthen characters, and to develop prepotency ??? a fact of considerable evolutionary interest, since various forms of isolation may bring about in-breeding in natural conditions. But even when the stock is sound to start with, there seem to be limits to close in-breeding, as von Bath and von Guiata found with rats and mice. As many breeders have recorded, there is a tendency to debility, abnormality, and sterility. According to Eeib- mayr, the success of a human race is in part dependent on the alternation of periods of sustained in-breeding, in which characters are fixed, and periods of cross-breeding, in which the advantages of " fresh blood " are secured. It is appropriate here to notice that an increased know- ledge of the number of cases in which self-polhnation or autogamy occurs in plants has led to a somewhat modified statement of the Knight-Darwin conclusion that nature abhors self-fertilization ; and the essay of Mobius may be referred to for its vigorous protest against the prevalent idea that continuous vegetative multiplication necessarily results in degeneration.

Hybridization. ??? Our knowledge of the possibilities of hybridization in artificial conditions and of its actual occurrence in nature is slowly increasing, but few general statements can as yet be ventured. That it occurs readily in some cases, and is rarely successful in others, is well known, but the reasons for this appear to be manifold. One of the results of Pfliiger's extensive experiments on the hybridizing of Amphibians

points to the importance of what may be called the mechanical factors ; thus the spermatozoa of Rana, fusca, which have very pointed heads, thinner than those of related forms, can fertilize the eggs of nearly all other species {R. arvalis, B. esculenta, and Bufo communis), but the blunt, thick-headed sperma- tozoa of R. arvalis and R. esculenta cannot fertilize the eggs of any other species. On the other hand, Hertwig's experiments on sea-urchins suggest that the possibility of crossing depends in great part on the state of the egg; thus eggs in good condition resist the entrance of foreign spermatozoa to which stale eggs prove receptive. It has also been made clear that segmentation may occur after hybridization without further development succeeding; thus T. H. Morgan fertilized the ova of a starfish with the spermatozoa of a sea-urchin, and reared hybrid gastrulse, but no further stages. While a general result of hybridiza- tion is to induce variation, i.e., to alter the normal expres- sion of inheritance, the results seem extraordinarily diverse and unpredictable, the offspring sometimes resembhng the male parent, sometimes the female, sometimes neither. In some cases the result is novel, in other cases there seems to be a return to the characters of an ancestral form. In the latter case it may be that latent characters which have for a time been unexpressed are suddenly permitted to develop, or that a new permutation of hereditary qualities independently reproduces an old pattern. Ewart paired a pure white fantail cock-pigeon vsdth a cross previously made between an owl and an archangel pigeon, and the result was a couple of which one resembled the Shetland rock-pigeon, and the other the blue rock of India; von Guiaita found that if the Japanese dancing mouse was crossed with an albino, the second generation consisted of grey mice like the wild forms. Standfuss has suggested that in crossing butter-

flies tlie phylogenetically older species is prepotent over the younger; Vernon has shown that in sea-urchins the characters of the hybrid offspring incline to be those of the species whose elements were relatively the more mature when fertilization occurred. In short, the variable results seem to be such as might ensue from a germinal struggle between

hereditary characteristics of varying strength. Suchetet has recorded 82 cases of what he believes to be genuine species-hybridism in mammals, and 178 in birds : of the 82 crosses between mammals of different species, 62 resulted in sterile offspring; of the 178 crosses between distinct species of birds, only 22 have been known to result in fertile offspring. As to the causes of the sterility little is as yet known, but Suchetet speaks of cases where the gonads were atrophied and of others where the ducts were abnormal.

Telegony. ◆◆◆ The ancient and stiU widespread belief that offspring may resemble not so much, or not only, their parents or ancestors, but a previous mate of their mother, has been much discussed during recent years. Ewart (1899) has experimented especially with horse and zebra, and has not in any case found satisfactory evidence of telegony. Moreover, he has pointed out that the rever- sions which not infrequently follow the crossing of different breeds may have supplied the material on which the belief in telegony has grown. Other critics have for the most part been content to point out the inherent difficulties in any theory of the mechanism of telegony, whether on the infection-hypothesis (according to which the sperm of the previous sire exerts an influence upon the bodily constitution or gonads of the mother) or on the saturation-hypothesis (according to which an influence from the unborn offspring of the first crossing is supposed to affect the body or gonads of the mother in a manner so specific that offspring by a second sire may pres nt resemblance to the first, with which they ◆◆,re in no way genetically related). At present the scientific evidence is so distinctly unfavourable to belief in the occurrence of telegony, that to discuss suggested explanations or criticisms seems unnecessary.

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(j. A. T.)

Reptiles, as known in the existing world, are the modified, and in many respectS’degenerate, representatives of a group of vertebrate animals which attained its maximum development in the Mesozoic period. So far as can be judged from the skeleton, some of the members of this group

then living might have become mammals by very slight change, while others might as readily have evolved into birds. It is therefore probable that the class Reptilia, as now understood, comprises the direct ancestors both of the Mammalia and Aves. Assuming that its extinct members, which are known only by skeletons, were organized essen- tially like its existing representatives, the class ranks higher than that of the lowest five-toed vertebrates (class Amphibia) in the investment of the foetus by two mem- branous envelopes (the amnion and aUantois), and in the total absence of gills even in the earliest embryos. It ranks below both the Mammalia and Aves in the partial mixture of the arterial blood with the venous blood as it leaves the heart, thus causing the organism to be cold-blooded; it also differs both from Mammalia and Aves in retaining a pair of aortic arches, of which only the left remains in the former, while the right one is retained in the latter. No feature in the endoskeleton is absolutely distinctive, except possibly the degeneration of the parasphenoid bone, which separates the Reptilia from the Amphibia. In the exoskeleton, however, the epidermis forms horny scales, such as never occur in Amphibia, while there are no traces of any structures resembling either hairs or feathers, which respectively characterize Mammalia and Aves.

There is little doubt that true reptiles date back to the latter part of the Palaeozoic period, but at that epoch the Amphibia approached them so closely in the characters of the skeleton that it is difficult to distinguish the members of the two classes among the fossils. Some of the Pateozoic Amphibia ??? a few of the so-called Labyrin- thodoits ??? are proved to have had well-developed gUl- arche: in their immature state, while there are conspicuous marks of slime-canals on their skulls. Others are merely regarded as Amphibia because they closely resemble the genera which are proved to have been gill-breathers when immature. All these genera, however, so far as known, agree with the existing Amphibia in the production of their large parasphenoid bone as far forwards as the vomers to form a rigid and complete basicranial axis (Fig. 1, A). Those genera which less resemble the typical Labyrinthodonts are characterized by the reduction of the parasphenoid bone so that it no longer reaches the vomers ; in these animals the weakened skull exhibits a secondary basicranial axis formed by the approximation of the pterygoids to the

median line (Fig. 1, B). The latter condition is universal in existing reptiles, and may there- fore perhaps be regarded as a diagnostic feature. If so, the oldest known undoubted reptile is Paleeohatteria, from the Lower Permian of Saxony.

In the structure of the skull Paleeohatteria is much like the existing Sphenodon, the cheek-plates which cover the temporal and masseter muscles on each side being pierced by two great vacuities, one superior-temporal, the other lateral – temporal. The majority of the earliest reptiles, however, either resemble the Labyrinthodonts in having the biting muscles completely covered with a roof of bony plates, or exhibit a slight shrinkage of this investment so that a superior-temporal vacuity appears. As the various groups or orders become diflFerentiated, this shrinkage or reduction continues, while the shape of the ossifying ear-capsule changes, and the squamosal

pmx.

mir- pi. nor: –

except at its hinder angle. The resultant modifications are diagrammatically repre- sented in Fig. 2. In one series of orders, comprising the Anomodontia, Chelonia, Sauropterygia, and Ichthyopterygia (Fig. 2, B, C), the superior-temporal vacuity (s) first appears ; and the cheek-plates in the broad temporal arch thus formed may be variously fused together, sometimes even irregularly perforated ❓❓❓showing at first, indeed, the usual inconstancy of a new and not completely established feature. From the earliest members of this series of reptiles, palaeontology seems to demonstrate that the Mammalia (with one robust tem- poral arcade or zygomatic arch) arose. In a second series, comprising the orders Khynchocephalia, Dinosauria, Crocodilia, and Ornithosauria (Fig. 2, D), the broad arch of cheek-plates is regularly pierced by

*Fio. 1.**A, Palate of PalsBOzoio Amphibian {Archegosaurm decheni). (After Credner.) B, Palate of a lateral-temporal vacuity, which leaves a*

*Mesozoio Eeptile (Piesiosc[Mr**s macrocepftaZlts). (After C. W. Aiidrews.) 6. occ, basioccipital ; ,* *u* *v,/^+T,q,. T,ay.Y..TT7 V,o*

bs, basisphenoid ; ecpt, eetopterygoid ; i.pt, interpterygoid vacuity ; j, jugal ; mx, maxilla ; narrow Dar aoove, anotner narrow Dar

pas, parasphenoid ; pi, palatine ; pmx, premaxilla ; pt, pterygoid ; pt. nar, posterior nares ; beloW, and uncOVerS the middle part of the

*9U, quadrate ; s.o, suborbital vacuity : v, vomer. t , i -r**,i , ^ i p .i*

quadrate bone. By the constant loss or the lower, and the frequent loss of the upper, bar, some members of this series eventually pass into the order

bone, which covers the organ of hearing in the fishes, and presumably also in the Palaeozoic Amphibia, is gradually thrust outwards from all connexion with this capsule

Squamata (Lacertilia -f Ophidia), in which the quadrate

-pi/” ../

*Fio. 2.**Diagram of the Cranial Roof in a Labyrinthodont Amphibian, Various Types of Eeptiles, and a Bird. A, Labyrinthodont Amphibian (Masto- donsaurus giganteus). B, Generalized Anomodont or Sauropterygian, passing with slight modification into the Chelonian (sutures dotted to denote inconstancy in fusion of elements). C, Ichthyosaurus. D, Generalized Ehynohocephalian, Dinosaurian, Crocodilian, or Ornithosaurian. E, Generalized Laoertilian, often losing even the arcade here indicated. F, Generalized bird, fr, frontal ; j, jugal ; I, lateral temporal vacuity ; la, lachrymal ; mx, maxilla ;* *, narial opening ;* *fi, nasal ; o, orbit; pa, parietal ; pmx, premaxilla ; prf, prefrontal ; ptf, poatfrontal ; pto, postorbital ; ly.j, quadrato-jugal ; qu,*

quadrate; s, supratemporal vacuity; s.t, supratemporals and prosquamosal ⬛⬛⬛ so squamosal Vacuities shaded with vertical Unes, cartilage bones dotted. (From A. S. Woodward, "Outlines of Verteirate Palaiontology ⬛⬛⬛')

bone is completely exposed and loosely attached to the skull (Fig. 2, E) ; other reptiles exhibiting a similar modifi- cation may readily have acquired the typical Avian skull (Fig. 2, F) by the loss of the upper and the retention of the lower temporal bar in question.

In view of these and other palajontological considera- tions, the Reptilia may be classified into orders as follows : ⬛⬛⬛

Okdees of Class Reptilia.

1. Anomodontla. ⬛⬛⬛ Bones of postero-lateral region of skull form- ing a complete roof over the temporal and masseter muscles, or contracted into a single broad zygomatic arch, leaving a superior- temporal vacuity. Pineal foramen present. Ribs double-headed. No abdominal ribs. A large separately ossified epicoracoid. Limbs for support as well as progression ; third and fourth digits with not move than three phalanges. Dermal armour feeble or absent. Range. ⬛⬛⬛ Permian and Triassic.

2. Chelonia. ⬛⬛⬛ Postero-lateral region of skull as in Anomodontia, except bones of ear-capsule more modified. No pineal foramen. Ribs single-headed. No sternum. Pectoral and pelvic arches unique in being situated completely inside the ribs. No epicora- coid. Abdominal ribs replaced by three or four pairs of large plates, which, with the clavicles and interclavicle, form a plastron. Limbs only for progression ; some of the long bones with separ- ately ossiiied epiphyses ; third and fourth digits with not more than three phalanges. A regular dorsal carapace of bony plates intimately connected with the neural spines, and ribs of seven to nine dorsal vertebrfe. Range. ⬛⬛⬛ Upper Triassic to Recent.

3. Sauropterygia. ??? Bones of postero-lateral region of skull contracted into a single broad zygomatic arch, leaving a superior- temporal vacuity. Pineal foramen piresent. No fused sacral vertebra;. All dorsal ribs single-headed, articulating with transverse processes of the neural arches. Abdominal ribs forming dense plastron. Ap]iarently no sternum. Coracoid, pubis, and ischium in form of much expanded plates. Humerus and femur with separately ossified conical epiphyses. Limbs modified as paddles, with not more than five digits, of which the third and fourth always have more than three phalanges ; all digits usually consisting of numerous phalanges. No dermal armour. Range. ??? Upper Triassic to Cretaceous.

4. Idithyopterygla. ??? Bones of postero-lateral region of skull contracted into a single broad zygomatic arch, leaving a superior-

??? temporal vacuity. Pineal foramen present. Vertebral centra short and deeply biconcave, with feeble neural arches which are almost or completely destitute of zygapophyses. No fused sacral vertebrae. Cervical and dorsal ribs double-headed, articulating with tubercles on the vertebral centra. Abdominal ribs forming dense plastron. Apparently no sternum. Coracoid an expanded pilate, probably with cartilaginous epicoracoid. Pelvis very small, not connected with vertebrae. Limbs modified as paddles, with digits of very numerous short phalanges, which are closely pressed together, sometimes with supplementary rows of similar ossicles. No dermal armour. A vertical triangular caudal fin, not supported by skeletal rays. Ramie. ??? Upper Triassic to Cretaceous.

5. Rhyncliocephalia. ??? Bones of postero-lateral region of skull contracted into two slender zygomatic bars, leaving a superior- temporal and a lateral-temporal vacuity, and partly exposing the quadrate bone from the side. Pineal foramen present or absent. Ribs single-headed. Abdominal ribs present. Sternum present. Epicoracoid cartilaginous. Limbs only for progression ; third and fourth digits with four or five phalanges. Dermal armour feeble or absent. Range. ??? Lower Permian to Recent.

6. Dinosauria. ⁂ Postero-lateral region of skull as in Rhyncho-cephalia. No pineal foramen. Cervical and dorsal ribs double- headed. No abdominal ribs. Sternum present, but apparently no clavicular arch. Limbs for support as well as progression ; third and fourth digits with four and five phalanges respectively. Dermal armour variable. Range. ⁂ Triassic to Cretaceous.

7. Crocodilia. ⁂ Postero-lateral region of skull as in Rhyncho-cephalia. No pineal foramen. Cervical and dorsal ribs double- headed. Abdominal ribs present. Sternum present ; also inter- clavicle, but no clavicles. Limbs only for progression on land or swimming ; third and fourth digits with four or five phalanges. Dermal armour variable. Range. ⁂ Lower Jurassic to Recent.

8. Omitliosauria. ⁂ All bones extremely dense, light, and hollow, the organism being adapted for flight. Postero-lateral region of skull as in Rhynchocephalia. No pineal foramen. Cervical and dorsal ribs double-headed. Abdominal ribs present. Sternum present, and keeled for attachment of pectoral muscles ; no clavicular arch. Fifth digit of hand much elongated to support a wing- membrane, but with only four phalanges. Hind limb feeble. No dermal armour. Range. ⁂ Lower Jurassic to Cretaceous.

9. Squamata. ⁂ Bones of postero-lateral region of skull much reduced and partly wanting, never forming more than a slender

superior-temporal bar, thus completely exposing the quadrate, which is only loosely attached to the cranium at its upper end. Pineal foramen present. Ribs single-headed. No abdominal ribs. Sternum present when there are limljs. Limbs, when jiresent, only for progi'ession ; third and fourth digits at least with more than three phalanges. Dermal armour feeble or aksent. Ra,nge. ⁂ Cretaceous to Recent.

Order 1. Anomodo^'tia. ⁂ The Anomodonts are so named in allusion to the peculiar and unique dentition of the first-discovered genera. They are precisely inter- mediate between the Labyrinthodont Amphibia and the lowest or Monotreme Mammalia. They flourished at

the period when the former are known to have reached their culmination, and when the latter almost certainly began to appear. Many of them would, indeed, be regarded as primitive Mammalia, if they did not retain a pineal foramen, a free quadrate bone, and a complex mandible. The term Therommyiia or Theromora is thus sometimes applied to the Order they represent. So far as known, they are all land-reptiles, with limbs adapted for habitual support of the body, and their feet are essentially identical with those of primitive mammals. Most of them are small, and none attain a gigantic size. They first appear in the Permian of Europe and North America, and also occur in the Triassic both of Europe and India, but they are best repjresented in the Karoo formation (Permian and Triassic) of South Africa. The Pariasauria most closely resemble the Labyrinthodont Amphibia, but have a single occipital condyle. One genus {Otocoelus) has a carapace suggesting that it may be an ancestral Chelonian. The Theriodontia exhibit the marginal teeth differentiated

Fia, 3. ***Skull of an Anomodont (Theriodont) Reptile (Cynognathus craten- notus), one-fifth nat. size.*** *Karoo formation (Permian or Triassic), South Africa, d, dentary ; j, iugal ; l.t.f, incipient lateral temporal vacuity ; to, lachrymal ; mx, maxilla ; na, nasal ; orb, orbit ; pa, parietal ; pmx, premaxilla ; prf, prefrontal ; pi.o, postorbital ; ptf, postfrontal ; s.t, Bupratemporal (prosquamosal) ; S}, squamosal. (From A. S. Woodward, " Outlines o.f Vertebrate Palasontology.")*

(in shape) into incisors, canines, and molars (Fig. 3). They have two occipital condyles, as in mammals. The Dicynodontia have one pair of upper tusks or are toothless : their occipital condyle is trefoil-shaped, as in Chelonia.

Order 2. Chelonia. ***This Order occurs first in the Upper Triassic of Wiirtemberg, where a complete "shell" has been found {Proganochelys). They are proved to have been toothless since the Jurassic period, and have only changed very slightly since their first appearance. The marine turtles seem to have first acquired elongated paddles and vacuities in the shell during the Cretaceous period, and the Trionychia, destitute of epidermal shields, apparently arose at the same time.***

Order 3. Saueopteeygia. ◆◆◆ These are amphibious or aquatic reptiles (Fig. 4). The head is comparatively small in most genera, and the neck is usually elongated though not flexible. The tail is insignificant, generally short, and both pairs of paddles seem to have been concerned in progression. The Order appears to have arisen from a group of land-reptiles, for its earliest members, from the Triassic of Europe (Lariosaurus), South

Africa {Jlesosaurus), and Brazil {Stereosternum), are all amphibious animals. Tliey are comparatively small, and their limbs are only just becoming piaddle-like. The skull suggests affinities with the terrestrial Anomodontia, and the shape of the scapula and the epiphyses of the humerus and femm' seem to show some connexion with the Ghelonia. The truly aquatic Sam-opterygians of the

FlQ. i. ◆◆◆ Plesiosaurus rostratus : restoration of skeleton by W. G. Eidewood. ◆◆◆ Lower Lias, Dorsetshire.

Jurassic (Fig. -t) and Cretaceous periods possess most effective paddles with elongated digits, and as the genera are traced upwards in the geological formations it is possible to observe how the arches supporting the limbs become more rigid until the maximum pf strength is reached. Some of the largest Upper Jurassic and Cretaceous species must have been 10 metres in length. They were cosmopolitan in their distribution, but became extinct before the dawn of the Tertiary period.

Order 4. Ichthyopteeygia. ◆◆◆ The Ichthyosaurians are all fi.sh-shaped, with a relatively large head and very short neck. Both pairs of paddles are retained, but the hinder jjair is usually very small, and locomotion seems to have been chiefly effected by a large caudal fin. This fin, as shown in impression by certain fossils from Wiirtemberg and

Bavaria, is a vertical, triangular, dermal expansion, without any skeletal support except the hindermost piart of

the attenuated vertebral column, which extends along the border of its lower lobe (Fig 5). Another triangular fin, without skeletal supjport, is known to occur on the back, at least in one species (Big. 5). Some of the genera are proved to have been viviparous. Like the Sauropterygia, the Ichthyopterygia appear to have originated from terrestrial ancestors, for their earliest Triassic representa^ fives (Jlixosazirus) have the teeth less uniform and the hmbs slightly less fiaddle-shaped than the later genera. In this connexion it is noteworthy that their hollow coni- cal teeth exhibit curious infoldings of the wall, like those observed in many Labyrinthodonts, while their short, biconcave vertebras almost exactly resemble those of the Labyrinthodont Mastodonscmrus and its allies. As the Ichthyosaurs are traced upwards in geological time, some genera become almost, or quite, toothless (Baptanodon), while the paddles grow wider, and are rendered more flexible by the persistence of cartilage round their constituent bones (Oj:ihthalmosaurus). They were cosmopjolitan in distribution, but disappeared from all seas at the close of the Cretaceous period. The largest forms, with a skull 2 metres in length, occur in the Lower Lias.

Order 5. Rhynchocephalia. ??? These are small lizard- shaped reptiles, which have scarcely changed since the Triassic period. Though now repiresented only by Sphen- odon or Hatteria, which survives in certain islands off New Zealand, in the Mesozoic ei:ioch they ranged at least over Europe, Asia, and North America. They comprise the earliest kno^^l reptile, Palixohatteria, from the Lower Permian of Saxony, which differs from the Triassic and

FiQ. 5. ??? Ichthyosaurus quadnscusus : outline of specimen showing dorsal and caudal tiny, about one-sixth natural size. ??? Upper Lias, Wiirtemberg. {After E. Fraas.) The irre{,^ularities behind the triangular dorsal fin are torn pieces of skin.

later genera in having an imperfectly ossified pubis and ischium, more numerous alidominal ribs, and the fifth meta- tarsal bone normal. They

also seem to include various Triassic genera (e.g., Aetosaurus, Belodon), which may pjerhaps belong to the ancestral stock of the Dinosauria and Crooodilia. Other Triassic genera (llyperodapedon, Rhynchosaurus) scarcely differ from Sphenodon, except in the dentition. In the late Cretaceous and early Eocene periods one geima (CliiiiiipHoxiiiirux) was truly acjuatic, with gaviabsha[ieil head.

Order 6. Dinosauima. ??? The Dinosaurs are lamb reptiles which flourished on all tlic continents during the Jurassic and Cretaceous periods, in the inter--al between the decline of the Anomodontia and the dominance of the Mammalia. They first appeared as carnivorous reptiles in the Triassic period in Eurojie, India, South Africa, and

North iVmerica, but afterwards also comprised numerous massive herbivores in nearly all parts of the world except the Australian and New Zealand regions. Among the latter are the largest known land animals of any age :]>ro)itosiiuriix, from the Jurassic of Wyoming, measm'es at least 17 metres in length, and the femur of Atlantosaurus, from the Jurassic of Colorado, indicates a still larger animal. The species of some genera (e.g., L; it a nod on, Fig. G) appear to ha-e had a bipedal gait, with the pelvis and hind linilis much like those of the struthious birds. The hones (if some are also hollow, thin-walled, and dense, with jierfectly ossified articulations. It has therefore been suggested that certain arboreal Dinosam-s were the ancestors of the class Aves. Those genera which com- prise species evidently quadrupedal in gait exhibit a very different and typically reptilian pelvis, and are often

heavily armoured. Some of the latest Cretaceous forms from North America bear large horns on the head (e.g., Triceratops, Fig. 7).

Order 7. Ceocodilia. ??? Typical crocodiles can be traced downwards to the Lower Lias at _

the Vjase of the Jurassic formations, but all the Jurassic and some of the Cretaceous genera have the secondary bony palate less extended backwards than that in the Tertiary and existing genera, while their vertebrEe have flattened or concave ends, instead of exhibiting a ball – and – socket articulation. Some of the Upper Jurassic crocodiles {Metriorhynchus) were more truly aquatic than any now living, with the fore limbs degenerate, the hind limbs much enlarged for swimming, and the dermal armour lacking. Typical crocodiles and alligators date back to the close of the Cretaceou.s period, and they did not become extinct in Europe until the beginning of the Miocene period. Remains of an extinct alligator {Diploeynodon) are com- mon in the Upper Eocene sands of the Hordwell cliffs, Hampshire.

Order 8. Oenithosaueia. ❓❓❓ The flying reptiles are completely evolved at their earliest known appearance in the Lower Lias (Dmwrphodon), and exhibit little essential change as they are traced upwards through the Mesozoic formations. The latest Cretaceous genera, how- ever, comprise the largest species, which have been found in Europe, North America, and Brazil. Some of these (Pteranodon) are toothless, and their wings are so large that for ade- quate support the pectoral arch is fixed to the vertebrae like a pelvis. The wing-mem- branes are only known in the European Jurassic genus, RhannphorhyncliuB (Fig. 8), found well preserved in the fine-grained lithographic stone of Bavaria.

Order 9. Squamata. ❓❓❓ The ancestors of the lizards and snakes can only be traced back definitely to the latter part of the Cretaceous period. They were then repre- sented by two suborders of aquatic reptiles, the Dolichosawia and Pythonomorpha (or Mosasauria), which are in many respects intermediate between the existing Lacertilia and Ophidia. The Dolidwsauria, from the Upper Cretaceous of Europe, are small and snake-like in shape, but with completely formed limbs. The Pytlwnomorpioa are known from Europe, North and South America, and New Zealand, and sometimes attained a very large size, the typical Mosasaurus camperi from Maastricht being about L5 metres in length. Their limbs are powerful paddles. The Lacertilia and Ophidia, so far as

known, are ex- clusively Tertiary and Recent reptiles. Marine snakes (Palceophis) occur in the Eocene of the London and Hamp- shire basins.

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FlG. 6.^Ioifanodon Bemissartensis : restoration of skeleton by O. C. Marsh, one-eightieth natural size. ⬛⬛⬛ Wealden, BerniBsart, Belgium.

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Fig. 7. ⬛⬛⬛ Triceratops pror-m^ : restoration of skeleton hy O. O. Marsh, one-eightieth natural size. ⬛⬛⬛ Cretaceous, Wyoming.

561. ⬛⬛⬛ Technical papers by Quenstedt in Wurtt. Jakresh. vol. xlv. (1889), p. 120 (Proganochelys). ⬛⬛⬛ WiELAND in Amer. Journ. Sci. ser. 4, vol. ii. (1896), pp. 399 (gigantic Cretaceous leathery turtle), and Case, Journ. Morphol. vol. xiv. (1897), p.

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Fig. 8. ⬛⬛⬛ Ehamphorhynchits phyllurus : restoration by O. C. Marsh, showing extent of Gying membranes, one-seventh natural size. ⬛⬛⬛ Upper Jurassic (lithographic stone) ; Bavaria.

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*ReO|Uen**l, a town of Spain, province of Valencia, on the left bank of the river Magro, with a station on the railway from Valencia to Utiel. Population (1877), 13,527 j (1897), 14,495. The town is irregularly built, with only a few good-looking streets, a modern theatre and town – hall, and two squares. There are three parish churches, San Nicolas being the oldest, of the 13th century, partly restored in 1727. Near the town are the sulphurous springs of Fuentepodrida.*

Reservation of the Eucharist. ********* *The*

practice of reserving the sacred elements for the purpose of subsequent reception prevailed in the Church from very early times. The Eucharist being the seal of Christian fellowship, it was a natural custom to send portions of the consecrated elements by the hands of the deacons to those who were not present (Justin Martyr, Apol. i. 65). From this it was an easy development, which prevailed before the end of the 2nd century, for churches to send the consecrated Bread to one another as a sign of communion (the so-called Eulogise mentioned by Irenseus, ap. Eus. S. E. V. 24), and for the faithful to take it to their own homes and reserve it in arcm or caskets for the purpose of communicating themselves (Tert. ad Uxor. ii. 5, de Orat. 19 ; St Cypr. de Lapsis, 132). Being open to objection on grounds both of superstition and of irreverence, these customs were gradually put down by Councils of the 4th and 5th centuries. But some irregular forms of reservation still continued : the prohibition as regards the lay people was not extended, at any rate with any strictness, to the clergy and monks ; the Eucharist was still carried on journeys ; occasionally it was buried with the dead, and in a few cases the pen was

even dipped in the chalice in subscribing important writings. Meanwhile, both in East and West, the general practice has continued unbroken of reserving the Eucharist, in order that the "mass of the presanctified " might take place on certain " aliturgic " days,

that the faithful might be able to communicate when there was no celebration, and above all that it might be at hand to meet the needs of the sick and dying. It was reserved in a closed vessel, which took various forms from time to time, known in the East as the aprocfjopLov, and in the West as the turris, the capsa, and later on as the pyx. In the East it was kept against the wall behind the altar ; in the West, in a locked aumbry in some part of the church, or (as in England and France) in a pyx made in the form of a dove and suspended over the altar.

In the West it has been used in other ways. A portion of the consecrated Bread from one Eucharist, known as the " Fermentum," was long made use of in the next, or sent by the bishop to the various churches of his city, no doubt with the object of emphasizing the solidarity and the continuity of "the one Eucharist"; and amongst other customs which prevailed for some centuries, from the 8th onward, were those of giving it to the newly ordained in order that they might communicate themselves, and of burying it in or under the altar-slab of a newly consecrated church. At a later date, apparently early in the 14th century, began the practice of carr3dng the Eucharist in procession in a monstrance ; and at a still later period, apparently after the middle of the 16th century, the practice of Benediction with the reserved sacrament, and that of the "forty hours' exposition," were introduced in the churches of the Eoman communion. It should be said, however, that most of these practices met with very considerable opposition both from Councils and from theologians and canonists, amongst others from the English canonist William Lyndwood (Provinciale, lib. iii. c. 26), on the following grounds amongst others : that the Body of Christ is the food of the soul, that it ought not to be reserved except for the benefit of the sick, and that it ought not to be apphed to any other use than that for which it was instituted.

In England, during the religious changes of the 16th century, such of these customs as had already taken root were abolished ; and with them

the practice of reserving the Eucharist in the churches appears to have died out too. The general feeling on the subject is expressed by the language of the 28th Article, first drafted in 1553, to the effect that " the sacrament of the Lord's Sapper was not by Christ's ordinance reserved, carried about, lifted up, or worshipped," and by the fact that a form was provided for the celebration of the Holy Eucharist for the sick in their own homes. This latter practice was in accordance vnth abundant precedent, but had become very infrequent, if not obsolete, for many years before the Keformation. The first Prayer-Book of Edward VI. pro- vided that if there was a celebration in church on the day on which a sick person was to receive the Holy Communion, it should be reserved, and conveyed to the sick man's house to be administered to him ; if not, the curate was to visit the sick person before noon and there celebrate according to a form which is given in the book. At the revision of the Prayer-Book in 1552 all mention of reservation is omitted, and the rubric directs that the communion is to be celebrated in the sick person's house, according to a new form ; and this service has continued, with certain minor changes, down to the present day. That the tend- ency of opinion in the English Church during the period of the Eeformation was against reservation is beyond doubt, and that the practice actually died out would seem to be equally clear. The whole argument of some of the con- troversial writings of the time, such as Bishop Cooper on Private Mass, depends upon that fact ; and when Cardinal du Perron alleged against the EngHsh Church the lack of the reserved Eucharist, Bishop Andrewes replied, not that the fact was otherwise, but that reservation was unnecessary

in view of the English form for the Communion of the Sick : "So that reservation needeth not ; the intent is had without it" {Answers to Cardinal Perron, &c., p. 19, Library of Anglo-Catholic Theology). It does not follow, however, that a custom which has ceased to exist is of necessity forbidden, nor even that what was rejected by the authorities of the English Church in the 16th century is so explicitly forbidden as to be

unlawful under its exist- ing system ; and not a few facts have to be taken into account in any investigation of the question. (1) The view has been held that in the Eucharist the elements are only consecrated as regards the particular purpose of reception in the service itself, and that consequently what remains unoonsumed may be put to common uses. If this view were held (and it has more than once made its appear- ance in Church history, though it has never prevailed), reservation might be open to objection on theological grounds. But such is not the view of the Church of England in her doctrinal standards, and there is an express rubric directing that any that remains of that which was consecrated is not to be carried out of the church, but reverently consumed. There can therefore be no theological obstacle to reservation in the English Church : it is a ques- tion of practice only. (2) Nor can it be said that the rubric just referred to is in itself a condemnation of reservation : it is rather directed, as its history proves, against the irreverence which prevailed when it was made ; and in fact its wording is based upon that of a pre-Reformation order which coexisted with the practice of reservation (Lyndwood. Provinciate, lib. iii. tit. 26, note q). (3) Nor can it be said that the words of the 28th Article (see above) constitute in themselves an express prohibition of reserva- tion, strong as their evidence may be as to the practice and feeling of the time. The words are the common property of an earlier age which saw nothing objectionable in reservation for the sick. (4) It has indeed been con- tended (by Bishop Wordsworth of Salisbury) that reserva- tion was not actually, though tacitly, continued under the second Prayer-Book of Edward VI., since that book orders that the curate shall " minister," and not " celebrate," the communion in the sick person's house. But such a tacit sanction on the part of the compilers of the second Prayer- Book is in the highest degree improbable, in view of their known opinions on the subject ; and an examination of contemporary writings hardly justifies the contention that the two words are so carefully used as the argument would demand. Anyhow, as the bishop notes, this could not be the case with the Prayer-Book of 1661, where the word is "celebrate." (5) The Elizabethan Act of Uniformity contained a provision that at the universities the public services, with the exception of the Eucharist, might be in a language other than English ; and in 1560 there appeared a Latin version of the Prayer-Book, issued under royal letters patent, in which there was a rubric prefixed to the

Order for the Communion of the Sick, based on that in the first Prayer-Book of Edward VI. (see above), and providing that the Eucharist should be reserved for the sick person if there had been a celebration on the same day. But although the book in question was issued under letters patent, it is not really a translation of the Eliza- bethan book at all, but simply a reshaping of Aless's clever and inaccurate translation of Edward VI. 's first book. In the rubric in question words are altered here and there in a way which shows that its reappearance can hardly be a mere printer's error ; but in any case its importance is very slight, for the Act of Uniformity specially provides that the English service alone is to be used for the Eucharist. (6) It has been pointed out that reservation for the sick prevails in the Scottish Episcopal Church, the doctrinal standards of which correspond with those of

the Church of England. But it must be remembered that the Scottish Episcopal Church has an additional order of its own for the Holy Communion, and that consequently its clergy are not restricted to the services in the Book of Common Prayer. Moreover, the practice of reservation which has prevailed in Scotland for over 150 years would appear to have arisen out of the special circumstances of that Church during the 18th century, and not to have prevailed continuously from earlier times. (7) Certain of the divines who took part in the framing of the Prayer- Book of 1661 seem to speak of the practice as though it actually prevailed in their day. But Bishop Sparrow's words on the subject {Bationale, p. 349) are not free from difficulty on any hypothesis, and Thorndike (Works, v. 578, Library of Anglo-Catholic Theology) writes in such a style that it is often hard to tell whether he is describing the actual practice of his day or that which in his view it ought to be. (8) There appears to' be more evidence than is commonly supposed to show that a practice analo- gous to that of Justin Martyr's day has been adopted from time to time in England, viz., that of conveying the sacred elements to the houses of the sick during, or directly after, the celebration in church. And in 1899 this practice received the sanction of Dr Westcott, then bishop of Durham. (9) On the other hand, the words of the oath taken by the clergy under the 36th of the Canons of 1604 are to the effect that they will use the form prescribed in the Prayer-Book and none other, except so far as shall be otherwise ordered by lawful authority; and the Prayer- Book does

not even mention the reservation of the Eucharist, whilst the Articles mention it only in the way of depreciation.

The matter has become one of no little practical im- portance owing to modern developments of English Church life. On the one hand, it is widely felt that neither the form for the Communion of the Sick, nor yet the teaching with regard to spiritual communion in the third rubric at the end of that service, is sufficient to meet all the cases that arise or may arise. On the other hand, it is probable that in many cases the desire for reservation has arisen, in part at least, from a wish for something analogous to the Roman Catholic customs of exposition and benediction ; and the chief objection to any formal practice of reserva- tion, on the part of many who otherwise would not be opposed to it, is doubtless to be found in this fact. But however that may be, the practice of reservation of the Eucharist, either in the open church or in private, has become not uncommon in recent days.

The question of the legality of reservation was brought before the two archbishops in 1899, under circumstances analogous to those in the Lambeth Hearing on Incense (q.v.). The parties concerned were three clergjmien, who appealed from the direction of their respective diocesans, the bishops of St Albans and Peterborough and the arch- bishop of York : in the two former cases the archbishop (Temple) of Canterbury was the principal and the arch- bishop of York (Maclagan) the assessor, whilst in the latter case the functions were reversed. The hearing extended from 17th to 20th July; counsel were heard on both sides, evidence was given in support of the appeals by two of the clergy concerned and by several other witnesses, lay and clerical, and the whole matter was gone into with no little fulness. The archbishops gave their decision on 1st May 1900 in two separate judgments, to the effect that, in Dr Temple's words, " the Church of England does not at present allow reservation in any form, and that those who think that it ought to be allowed, though perfectly justified in endeavouring to get the proper authorities to alter the law, are not justified in practising reservation until the law has been so altered." The

archbishop of York also laid stress upon the fact that the difficulties in the way of the communion of the sick, when they are really ready for communion, are not so great as has sometimes been suggested.

Atjthorities. ⬛⬛⬛ W. E. Soudamoee. Notitia Eucharistica, 2nd cd. London, 1876; and art. "Reservation" in Dictionary of Christian Antiquities, vol. ii. London, 1893. ⬛⬛⬛ Guardian news- paper, July 19 and 26, 1899, and May 2, 1900. ⬛⬛⬛ TAe Archbishops of Canterbury and York on Meservation of the Sacrament. London, 1900. ⬛⬛⬛ J. S. Franey. Mr Dibdin's Upeech on Heservation, and some of the Evident. London, 1899. ⬛⬛⬛ f . C. Eelbs. Reservation of the Holy Eucharist in the Scottish Church. Aberdeen, 1899. ⬛⬛⬛ Bishop J. WOEDSWORTH. Further Considerations on Public Worship. Salisbury, 1901. (w. E. Co.)

ResiCZabsinya, {Besicza), a mining town of south Hungary, in the county of Krasso-Sozr^ny. In the neighbouring coal and iron mines, and in the forges and iron -works belonging to the Austrian State Railway Company, above 3000 workmen are employed. In the vicinity is the bath and sanatorium of Anina. Population

(1891), 10,164; (1901), 11,770.

Respiratory System. See PATHOLoaY and

Physiology.

Ret'fordi East, a municipal borough and market- town, Nottinghamshire, England, in the Bassetlaw parlia- mentary division of the county, 36 miles by rail north- east of Nottingham. A scheme of drainage to cost ⬛⬛44,000 has been undertaken. Swimming baths were built in 1896 by the corporation at a cost of ⬛⬛3000. Population of the municipal borough (1881), 9748; (1901), 12,339.

Reunion, a French island and colony in the Indian Ocean, 130 miles south-west of Mauritius and 371 east of Madagascar. It is elliptic in form ; its greatest length is 45 miles, and greatest breadth 32 miles ; and it has an area of about 1000 square miles. In 1878 the population amounted to 183,529; in 1898 to 173,230. The falling off is entirely due to the economic troubles which have weighed on the island since the extension of sugar produc- tion in Europe. Of the population in 1898, 143,000 were

of French nationality; this number included 2400 Euro- peans or descendants of the old colonists, the remainder being negroes and of mixed race. The foreign element consisted of 30,000 imported labourers, of whom from 15,000 to 16,000 were from India, 14,000 from Africa, and about 1000 from China. The number of labourers from India has decreased since 1882, when the Indian Government ceased to authorize the sending of coolies for service on the plantations. The number in E^union in 1887 was 26,400, of whom 17,600 were men. It is re-markable that the birth-rate of these Indians should be lower than their death-rate. E^union is administered by a governor, who has under his orders a director of the interior and a procureur g^ndral, and is assisted by a privy councU. The elective general council sits at St Denis, and the island sends a senator and two deputies to the French Parliament. The island is divided into two arrondissements, the Windward with five cantons and nine communes, and the Leeward with four cantons and seven communes. The important towns are St Denis, which had, in 1881, 30,835, and in 1899, 32,850 inhabitants, and which has a bishopric, a court of first instance, and an appeal court ; St Pierre (27,901) ; St Paul (20,000) ; and St Louis (13,300).

Agriculture ◆◆◆ The area of the cultivated lands is estimated at 148,200 acres (or 230 square miles), of which 86,450 acres are under sugar-cane, the remainder being under either alimentary produce (maize, manioc, potatoes, haricots) or colonial produce (coffee, vanilla, cacao). The sugar-cane and coffee represent the essential agricultural wealth of the colony, though both labour under serious difficulties. The sugar crop in 1860 amounted to 68,000 tons ; in 1889, to 28,000 tons ; but in 1897 rose to 46,000

tons. The coffee harvest about the middle of the century reached 60,000 cwt., had fallen to 3800 cwt. in 1883, but has since risen to 14,000 cwt. Tfiis diminution is due partly to foreign competition, partly to diseases of the coffee plant. On the other hand, the cultivation of vanilla has made steady progress since 1848. In that year the production amounted to 110 lb; in 1873 it reached 44,000 lb; in 1886, 110,000 lb; in 1897, 220,000 B ; but this enormous increase has caused a fall in the prices. The cacao yield is still about 6600 lb ; cinchona cultivation is profitable, unlike

cotton-growing, which has not succeeded. The forests formerly extended all over the island ; now they only cover about 200 square mUes, and the administration is attempting to replant the higher circles, Salazie among others, with eucalyptus and caoutchouc trees. The number of live stock is smaE and tends to diminish, comprising oidy 2500 horses, 8000 asses and mules, 8000 oxen, 28,000 pigs, 28,000 goats and sheep. E^union possesses many fowl, and agriculture is held in esteem.

Industries. ❓❓❓ Although the sand on the beach contains ferruginous elements, no mining enterprise is carried on. The island has ❓❓❓warm springs at Cilaos (3500 feet), at Salazie (2600 feet), and at Mafatte (1860 feet), and these places form so many sanatoria. There are works for sugar, rum, flour, and for plaiting straw for hats. Many of the sugar factories, however, have disappeared, ruined by outside competition.

Commerce. ❓❓❓ The total trade amounted in 1860 to the value of ❓❓4, 464, 000 (the highest during the century) ; in 1880, to ❓❓2, 394, 000; in 1900, to ❓❓1,533,240. In 1900 the imports amounted to ❓❓883,570 (❓❓547,700 from France) and the exports to ❓❓698,500 (❓❓649,670 to France, ❓❓33,710 to French colonies, and the remainder to Maur- itius). France sent to the colony in 1897 cottons (❓❓66,000), wines (❓❓68,000), salt fish (❓❓22,280), utensOs (❓❓12,680), furs (❓❓18,920), toys (❓❓17,760), machinery (❓❓8960), and buys from the colony, sugar (❓❓490,000), vanilla (❓❓80,000), sago (❓❓25,040), spirits (❓❓24,000), oils (❓❓16,400).

Shipping. ❓❓❓ The shipping movement in 1900 comprised 138 vessels of 189,626 tons entered, and 135 of 188,308 tons cleared. Of these, 95 of 151,650 tons and 93 of 151,126 tons respectively were under the French flag. The ports are those of St Pierre and of Pointe des Galds (opened in 1886). St Denis and St Paul have, besides, open roadsteads.

Communications. ❓❓❓ The island has 199 miles of national roads and many local roads. The railway, 83J miles in length, opened in 1882 between St Benoit and St Pierre, was taken over by the State in 1887, in consequence of forfeiture by the company. At the latter date the annual

receipts amounted to no more than ►►33,880, and this condition has scarcely improved. E^union is connected by a regular service of the Messageries Maritimes with Marseilles. The distance is 6637 mOes, and the passage 23 to 29 days.

Finance. ►►► The budget of the island amounts to ►►332,000, of which ►►178,800 is contributed by the mother country. This sub- sidy has almost doubled since 1885, in which year it did not exceed ►►94,000.

Dtr BuissoN. lie de la Reunion. St Denis de la Eeunion, 1889. ►►► Lbvassette. La France. T. ii. Paris, 1893.

(P. L.)

Reus, a town of Spain, province of Tarragona, im- portant railway station; its port, Salou, is 4 mUes off, on the Mediterranean. Population, 26,752 in 1897. It has suburbs full of villas, with gardens extending over several thousand acres, all weU irrigated. There is an active trade in the agricultural products of the fertile region around the city. The local industries, that have been important since the Middle Ages, developed consider- ably in the last quarter of the 19th century. They include (besides cotton, linen, and woollen goods) silk, alcohol, leather, flour, ceramics, mosaics, soap, earthen- ware, jams, wine, shoemaking, and refineries. The town has important flour, wine, and fruit export houses. There is a model farm belonging to the municipality in the suburbs. Eeus has excellent primary, normal, and higher ~~grade schools, many private and religious schools, an academy of fine arts, and pubKc hbrary. The new town has con~~ tinuously spread Qutside the promenades. Marshal Prim was a native of Eeus. The hospitals and foundling refuge, the institute, and the town-hall are handsome modern build- ings. The inhabitants are famous for their enterprising spirit and laborious habits, and Eeus is considered second only to Barcelona in the Lancashire of Spain for its manufacturing success.

REUSCH►►► REUTLINGEN

Reusch, Franz Heinrich (1823-1900), Old

Catholic theologian, was born at Brilon, in Westphalia, on 4th December 1823. He studied general literature at Paderborn, and theology at Bonn, Tubingen, and Munich. The friend and pupU of Dollinger, he took his degree of Doctor in Theology at Munich, the university of ???which Dollinger was so long an ornament. He was ordained priest in 1849, and was immediately afterwards made chaplain at Cologne. In 1854 he became privat- docent in the exegesis of the Old Testament in the Catholic Theological Faculty at Bonn; in 1858 he was made extraordinary, and in 1861 ordinary, professor of theology in the same university. From 1866 to 1877 he was editor of the Bonner Theologisches Literaturblatt. In the controversies which followed upon the proclama- tion of the InfaUibiUty of the Pope, Eeusch attached himself to the party of his leader Dollinger, and he and his colleagues Hilgers, Knoodt, and Langen were interdicted by the archbishop of Cologne in 1871 from pursuing their courses of lectures. In 1872 he was excommunicated. For many years after this he held the post of Old Catholic cwr4 of Bonn, as well as the position of vicar-general to the Old Catholic Bishop Eeinkens, but resigned both in 1878, when, with Dollinger, he dis- approved of the permission to marry granted by the Old Catholic Church in Germany to its clergy. From that time he retired into lay communion, but continued to give lectures as usual in the Old Catholic Faculty of Theology in the University of Bonn, and to write on theological subjects. He was made rector of that university in 1873. In 1874 and 1875 he was the official reporter of the memorable Keunion Conferences held at Bonn in those years and attended by many distinguished theologians of the Oriental and Anglican communions.

Eeusch was a profound scholar, an untiring worker, and a man of simple and lovable character, clear in expres- sion and exact in method. His_ works were voluminous, and among them were contributions to periodical literature, and especially to the Revue Internationale de Theologie, a review started at Bern at the instance of the Old Catholic Congress at Lucerne, in order to promote inter- communication and eventual reunion between the Churches opposed to the .papal claims. Among his works are several on the Old Testament, and chief among these is a manual of introduction to it, which passed through four editions ; a pamphlet on Die

Deutschen Bischofe und der Aberglaube ; and another on the falsifications to be found in the treatise of Aquinas against the Greeks ; as well as essays on the history of the Jesuit Order, and a book of prayers, which passed through three editions. But his fame will mainly rest on the works which he and Dollinger published jointly. These consisted of a work on the Auto- biography of Cardinal Bellarmine, the Geschichte der Moral- streitigen in der Somisch-Katholischen Kirche seit dem XVI. Jahrhvmdert, and the Erorterungen uber Leben vmd Schriften des M. Ligvori. During the last few years of his life he was smitten with paralysis and was unable to work. His last contribution to literature was an article on the inspiration of the Scriptures, communicated to the Bevue Internationale de Theologie of April 1894. He died 3rd March 1900, leaving behind him in manuscript a collection of letters to Bunsen about Eomish cardinals and prelates, which has since been published. (j. J. l.)*

Reuss, Edouard Guillaume Eug:&ne

(1804-1891), Protestant theologian, was born at Strasburg, studied theology at Gottingen under Eichhorn, and Oriental languages at Halle under Gesenius, and afterwards at Paris under Silvestre de Sacy. From 1829 to 1834 he taught biblical criticism and Oriental

languages at the Strasburg Theological School; he then became assistant and afterwards regular professor of theology at that university. The sympathies of Eeuss were German rather than French, and after the annexation of Alsace to Germany he remained at Strasburg, and retained his professorship till, in 1888, he retired on a pension. He had a fuU mastery of both languages, and wrote sometimes in French and sometimes in German. In 1852 he published his Histoire de la tMologie chritienne an decle apostolique, which gives a systematic narrative of the causes which stimulated and directed the theological labours of the first generation of Christians, with a view to linking together all the theories that form the main subject of this book. This was followed in 1863 by L'histoire du canon des saintes dcritures dans Viglise chritienne. It was the criticism and exegesis of the New Testament which formed the subject of Eeuss's earlier labours ??? in 1842, indeed, he had published in German a history of the books of the New Testament ; but after a time he

turned his attention also to Old Testament criticism, a study for which he was especially fitted, owing to his profound knowledge of Hebrew. In 1881 he published in German his History of Old Testament Scriptv/re, a veritable encyclopaedia, which embraces the public and domestic history of Israel, the literature and thought, art, archaeology, and general life of the people from the dawn of history till the taking of Jerusalem by Titus.

Eeuss, who died at Strasburg on the 15th of April 1891, belonged to the more modern section of the Liberal party in the Lutheran Church. His critical position was to some extent that of Graf and Wellhausen, allowing for the circumstance that he was in a sense their forerunner, and was actually for a time Graf's teacher. His earliest views were summed up in the formula "The Prophets are earlier than the Law, and the Psalms are later than both," a statement that, with the necessary additions in detail, expresses the present position of Old Testament criticism. For many years Eeuss edited the Beitrdge zu den theologischen TTissenschaften. With Baur and Cunitz, and after their death alone, he edited the monumental edition of Calvin's works. His critical edition of the Old Testament appeared a year after his death. (a. Z.)

Reuss, two principalities of Germany, in Thuringia. (1) Eeuss the Eldee, with an area of 1 22 square miles, and population (1885), 55,904 ; (1900), 68,287. Density, 559 inhabitants to the square mUe. Of the total, 98 per cent, were in 1895 Evangelical Lutherans. In 1900 there were 1953 horses, 14,447 cattle, 10,118 pigs, and 2337 sheep. In 1895 there were 5225 farms, of which 4552 were each less than 25 acres in extent. In 1900 the state revenue and expenditure were balanced at ??77,050. There is no public debt. The contribution to the imperial exchequer was fixed at ??33,980 for the year 1900. (2) Eeuss the Youngek, with an area of 319 square miles, and population (1885), 110,598; (1900), 138,993, the density being 435 inhabitants to the square mile. Except for 2090 Eoman Catholics, 181 Jews, and 477 " others," the people in 1895 were all Protestants. In 1900 there were in the principality 34,009 cattle, 27,013 pigs, 8929 sheep, and 4579 horses. Out of a total of 8558 farms in the principality in 1895, no less than 7086, or 82-8 per cent., were each less than 25 acres. For the period 1899- 1901 the public revenue and expenditure were each fixed at ??136,570 annually. The public debt

was ►►52,000 in 1899, and the contribution to the imperial exchequer in 1900 was fixed at ►►66,545.

Reutii ng^en, a town of Wiirtemberg, Germany, 36 miles by rail south of Stuttgart'. The church of St Mary

was restored in 1899-1900. There are a textile school, a school for women's work, and an agricultural school. It has multifarious industries. Population (1900), 21,481.

Revel, or Keval, a fortified seaport, State dockyard, and district town of Eussia, in the government of Esthonia, 249 miles by rail west-south-west of St Petersburg. Its population in 1881 was 50,490, and in 1897, 64,578, of whom half were Esthonians and 30 per cent. Germans. It is the seat of a branch Board of the Admiralty and of the administration of the Baltic lighthouses. Its port, which is one of the most important in Russia, has a depth of from 4 to 6 fathoms, and a roadstead 3^ miles wide ; this is not quite protected from the north-west winds, and freezes nearly every winter, but is annually visited by about 400 foreign ships and about 1400 vessels engaged in the coasting trade. The exports, chiefly grain, timber, flax, and hemp, were valued at 33,826,000 roubles in 1897 ; and the imports, chiefly manufactured goods and machinery, at 56,305,000 roubles. There is considerable trade with Finland. Baltic Port is a sort of annex to the port of Revel.

Revelstoke, British Columbia, on the Canadian Pacific Railway, where it crosses the Columbia river. It is a divisional point of the railway, and the junction for connexion with the Arrow Lakes and the West Kootenay district. It is also a distributing point for the mines to the north and the important and promising section of country known as the Trout Lake district to the south. Population (1800), 1600.

Revere, a town of Suflfolk county, Massachusetts, U.S.A. It is a few miles north-east of Boston, of which it is a suburb, in the eastern part of the

state, on a line of the Boston and Maine Railroad. Population (1880), 2263 ; (1890), 5668 ; (1900), 10,395, of whom 2917 were foreign- born.

Revilla. GigedO, an uninhabited insular group belonging to Mexico, in the North Pacific, about 420 miles from the coast of the state of Colima, 18 N. and 112 W. It comprises the large island of Socorro (San Tomas), 25 miles by 12, and the three scattered islets of San Benedicto, Roca Partida, and Clarion, with a total area of 320 square miles. It is probably of volcanic formation, with an extinct cone 3660 feet high in Socorro. The archi- pelago, which takes its name from a Spanish viceroy who ruled from 1746 to 1755, presents some remarkable zoo- logical features, comprising several birds and reptiles allied to, but of different species from, those of the mainland.

Rewa, a native state of India, in the Baghelkhand agency. Area, about 10,000 square miles. Population (1881), 1,305,124; (1891), 1,508,943. Many of the inhabitants belong to the Gonda and Kols. Gross revenue (1897-98), Rs.11,45,915, of which Rs.6,31,828 was derived from land, Es.l, 70,928 from customs, and Rs.l, 73,660 from forests. Expenditure, Rs.18,20,343, of which Rs.3,24,469 was for palace, Rs.2,59,188 for army, Rs.l, 45,514 for public works, and Rs. 4,16,253 for famine relief.

The Maharaja Raman Singh was bom in 1876 and succeeded in 1880. During his minority the administration was reformed. The southern portion of the state is crossed by the branch of the Bengal-Nagpur Railway from Bilaspur to Katni, which taps the Umaria coal-field, yielding 150,000 tons, now under the manage- ment of the state. A branch line from Sutna on the East Indian Railway, the residence of the political agent for Baghelkhand, to the town of Eewa, has recently been constructed as a famine relief work. The state suflfered from famine in 1896-97, and again to a less extent in 1899-1900 ; but on both occasions adequate measures of relief were j)rovided.

The town of Rewa is 131 miles south of Allahabad. Population (1891), 23,626. It has a high school, with 432 pupils ; also the Victoria and zenana hospitals, ‘and a model gaol. The town of Sutna

or Satna, headquarters of the Baghelkhand political agency, has a population (1891) of 6771.

Rewa. Ka.ntha., a political agency or collection of native states in India, within the Gujarat division of Bombay; stretching for about 150 miles between the plain of Gujarat and the hills of Malwa, from the river Tapti to the Mahi, crossing the Nerbudda or Rewa, from which it takes its name. The number of separate states is 61, many of which are under British jurisdiction. The only important one is Rajpipla (q.v.). Total area, 4980 square miles. Population (1881), 549,892; (1891), 733,506. In 1901 the population was 478,889, showing a decrease of 35 per cent., due to the results of famine. Estimated gross revenue, Rs.27,07,329; tribute (mostly to the Gaekwar of Baroda), Rs.l, 16, 700; number of police, 1167 ; number of schools, 185, with 9779 pupils in 1897-98. Many of the inhabitants belong to the wild tribes of Bhils and Kolis. The Panch Mahals were constituted a British district out of this tract in 1876.

ReW►►iri, a town of British India, in the . Gurgaon district of the Punjab, situated in 28►► 12' N. and 70►► 40' E., 32 miles south-east of Gurgaon. It has a railway station. Population (1881), 23,972; (1891), 27,934; municipal income (1897-98), Rs.57,161. It is on an ancient site, formerly a nativt capital, and at one time a British canton- ment. It is now an important centre of trade, being the junction for the Rewari-Ferozepore branch of the Rajputana Railway. There are manufactures of brass-ware and tur- bans, and two factories for ginning and pressing cotton. There is a municipal high school.

-), French composer,

Reyer, Ernest (1823-

was born at Marseilles, 1st December 1823. At the age of sixteen he went to Algeria, and remained there some years. The outcome of his residence there was a symphonic ode entitled Le Sdlam, the musical orientalism of which had, unluckily for him, already been anticipated by F^licien David in Le Desert. Maitre Wolfram, a one- act opera from his pen, was produced at the Opera Comique in 1854 ; and in 1858 Sacuntala, a ballet of his composition, figured on the bills of the Op^ra. It was the

production of La Statue at the Theatre Lyrique in 1861 that brought Reyer's name prominently before the pubhc. This work is notable for the sincerity of its accents, and also for the picturesqueness of its Eastern colouring. Reyer was now to wait several years before obtaining a real and permanent success. Erostrate, an opera produced at Baden-Baden in 1862, and given at the Paris Opera some ten years later, was a failure. The composer had in the meanwhile set to work on an opera founded upon the Nibelungen-lied. Sigurd, the subject of which is the same that inspired Wagner in Siegfried and Gotterdammerung, lay on hand for a long while, being at last produced for the first time in Brussels in 1884, and subsequently brought out at the Paris Op6ra, where it has since re- mained in the repertoire. Despite crushing comparisons, Sigurd is a work of great value, revealing high and noble aspirations, and displaying its composer's elevated notions as regards the form of the " lyrical drama." Salammho, Reyer's last opera, founded upon Flaubert's well-known romance, followed the same road as Sigurd, reaching Paris vid Brussels, being produced in the Belgian capital in 1890, and meeting with emphatic success. Gluck, Weber, Berlioz, and Wagner are the composers who have exercised most influence over Reyer. An intimate friend of Berlioz, Reyer was also one of the earliest champions of Wagner in France. He is well known as a ^VTiter on music, and preceded Berlioz as musical critic to the Journal des DSats. Reyer is librarian of the Paris Op6ra, and a member of the Institute.

R H E I M S ❓❓❓ R H I N E

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Rheims (or Eeims), a town of France, in the depart- ment of Marne, 97 miles from Paris by rail. It is important on account of its industries, which increased very consider- ably during the last quarter of the 19th century. Popula- tion (1881), 93,683; (1901), 107,773. The increase was most marked in the suburb of Les Contures on the east of the town. Wool, combed and carded in numerous establish- ments, is spun in 20 factories, and in 30 others woven into flannel, merino, cloth, and woollen goods of all kinds. Some of these establishments are important ; for example, two machine combing mills employ more than 2000 work- men, and the whole

wool industry occupies in all 24,000 hands. Eheims possesses an office for the conditionnement of wool, similar to that in Lyons for silk. This office, which determines the loss of weight resulting from the drying of the wool, registers annually about 8800 tons of combed and spun wool. The woollen industry has, how- ever, been on the decline. In 1898 the measuring house dealt with only 123,097 pieces measuring 4,575,150 metres, as compared with 275,333 pieces measuring 12,941,193 metres in 1890, the decline having been con- tinuous; but in 1899, 137,898 pieces measuring 6,272,843 metres were ^ealt with. Fifteen dyeworks employ 1000 workers, and one of these factories annually treats 50,000 pieces, each 110 yards in length. Rheims is also the most important market for raw wool in France. Trans- actions annually reach a value of from ––5,000,000 to ––6,000,000, half of which is appropriated by the indus- tries of Rheims itself. Fifty firms trade in champagne wines, and employ 16,000 workmen, exporting in 1899 29,368,825 bottles ––– one-quarter of them for France ––– and barrels totalling in weight 11,893 tons. The value of the trade in this commodity reaches ––4,000,000. Rheims, an important railway centre, is surrounded by a chain of detached forts measuring 39 miles and extending as far as Epernay. A large garrison occupies the town and forts. The Mus^e Lapidaire of the archiepiscopal palace has been transferred to the cloister of St R6mi, and the courtyard of the hospital which occupies the old abbey of that name was in 1898 enriched with a handsome sculptured foun- tain. A statue of Jeanne d'Arc has been erected, and in 1888 a monument to the Abb6 de la Salle, founder of the order of Christian Brothers.

Rheinberger, Joseph Gabriel (1839-

1901), German composer, was born at Vaduz, Liechten- stein, 17th March 1839. His musical abilities were mani- fested so early that he was appointed organist of the parish church when he was but seven years old, an appli- ance being specially attached to the organ by which the pedals could be brought within reach of the child's feet. A three-part Mass composed by him was performed in the following year. He was taught at first by Philipp Schmutzer, choir director at Feldkirch; he entered the Munich Conservatorium in 1851, and remained there till 1854 as a pupil

of Professor E. Leonhard for piano. Pro- fessor Herzog for organ, and J. J. Maier for counterpoint. After leaving the school he had private lessons from Franz Lachner, and was appointed a professor in the conservatorium in succession to Leonhard in 1859. In 1860 he became professor of composition, and was appointed organist of the Michelskirche, a post he held till 1866. From 1854 he was accompanist, and from 1864 conductor, of the Munich Oratorio Society, resigning in 1877; and from 1865 to 1867 was "repetitor" at the Hofoper. In 1877 he succeeded Wiillner as Hofkapell- meister, and from that time his attention was largely devoted to sacred music. His compositions include works of importance in every form, from the operas Die sieben Rahen (Munich, 1869) and Thiirmers Tochterlein (Munich,

1873) and the oratorio Christoforus, op. 120, to the well-known quartet for piano and strings in E flat, op. 38, the nonet for wind and strings, op. 139, and the seventeen organ sonatas, which form notable additions to the literature of the instrument. A splendid teacher, he was a master of contrapuntal effect, and had a strong sense of the different styles required for various musical forms, while the flowing, melodious character of his music, the fertility of his invention, and the brilliance of his technique, gained for him the title of the "Raff of Southern Germany." He died in November 1901.

Rheine, a town of Prussia, province of Westphalia, on the Ems, at the point where it becomes navigable, 29 miles by rail west of Osnabriick. It is the seat of cotton industries, and has also manufactures of jute, machinery, tobacco, and flour. Population (1900), 10,373.

Rheydt, a town of Prussia, Rhine province, 19 miles west by south of Diisseldorf by the railway to Aix-la- Chapelle. The manufacture of velvet has now been added to the industries. Population (1900), 34,034.

Rhine, the principal river of Germany, flowing also through Switzerland and Holland. The traffic on this stream has increased enormously since the foundation of the German empire. In 1871 the traffic between the Rhine ports and the seaports of the Baltic and North Seas was confined to three small vessels which plied between Cologne and London, though there was of course a much larger purely river traflSc. A dozen or fifteen

years later vessels of 800 to 1200 tons began to make the voyage between Cologne and London, and afterwards the carrying capacity was increased first to 1600 tons, and subsequently to 1750 tons. In 1899 this particular traffic gave occupation to 32 vessels of 24,240 tons, and the bulk of goods they carried amounted to 105,540 tons ; while there were in addition 105 lighters varying in capacity from 70 to 950 tons.

Besides London, Hamburg, Bremen, and the chief Baltic ports as far as Riga and St Petersburg participated in this trafBo. The boats which ply up and down the river itself, without venturing upon the open sea, are mostly craft of 100 to 200 tons, owned in the great majority of cases by their captains, men principally of German or Dutch nationality. This fleet is computed to number some 8500 craft, with an aggregate capacity of over 2 million tons, of which about one-tenth are steamships. The traffic at the chief German ports of the river aggregated 4,489,000 tons in 1870, but by 1900 this had grown to a total of 17,000,000 tons, thus dis- tributed : ❓❓❓Euhrort, 6,512,000 tons ; Duisburg, 3,000,000 tons ; Cologne, 1,422,000 tons; and Mannheim, 6,021,000 tons. And these are not the only ports on the river ; a large trade is also done at Kehl (a new port), Maxau (for Carlsruhe), Ludwigshafen, Mainz, Bonn, Rotterdam, and a host of smaller places. The amount of traffic which passed the town of Emmerich near the Dutch frontier, both ways, increased from an annual average of about 6 million tons in 1881-85 to over 21i million tons in 1899. Notwithstanding the inherent difficulties of construction caused by the great variations in the level of the stream, amounting some- times to 20 feet or more, the chief ports of the Rhine are admirably constructed, and well equipped with modern contrivances for load- ing and unloading vessels. Boats carrying as much as 600 tons are often able to proceed as far up stream as Strasburg, and smaller craft get as far as Htiningen, a little above Basel. Large passenger boats ply regularly between Mainz and Dusseldorf, and sometimes extend their journeys as high up as Mannheim, and as far in the other direction as Rotterdam. The efforts of the river authorities are being directed to the deepening and improvement of the navigable channel from the sea to Strasburg, the low-water depths aimed at being 10 feet from Rotterdam to the German frontier, and 10 feet thence to Cologne ; 8 feet 3 inches from Cologne to St Goar, and 6 feet 6 inches from St Goar to Mannheim. At present the Rhine in Holland has a

depth of about 9 feet and a width of 1200 to 1300 feet, though the Merwede branch exceeds this depth by 8 inches. Altogether a sum approaching ►►2,500,000 was spent in Holland within the latter part of the 19th century on the im- provement of the Rhine and its principal arteries. Above Mann- heim the depth of the stream is always less than 5 feet, and

generally varies between tliat figure and 4 feet 6 inches. The difBculty of ascending the rapids near Bingen is usually surmounted by the help of steam hauling machinery placed on the bank, though powerful tugs are also coming into use for this purpose. The work of blasting out the rocks which at that spot projected in the bed of the river, begun in 1830, was continued down to the year 1887, so that now there are two navigable channels of sufficient depth for all vessels which ply up and down that part of the stream. The navigability of some of the chief German tributaries of the Rhine has also been improved. For instance, in the years preceding 1886 the Main was canalized for 20 miles above Frankfort, the depth being increased from 2| feet to 8J feet at a cost of ►►400,000. In addition three new canals have still further increased the usefulness of this great waterway. The first of these is the Merwede canal, which connects Amsterdam with the Waal at Gorinchem (Gorkum). The next connects Strasburg with the Ehine ►►► the Strasburg-Rhine canal, 4 miles long, 40 to 60 feet wide and 8 feet deep. The third is the Rhine-Weser-Elbe canal, which consists of three divisions ►►► the middle division, co- inciding with the Dortmund-Ems canal (see Ems), opened in 1899 ; the eastern division, to coincide with the Midland canal, which is only in part constructed ; and the western division, which exists only in the plans, of which there are two ►►► (a) the South Emscher canal, from the Rhine at Neuenkamp, near Duisburg, to the Dortmund-Ems canal at Heme, 27 miles long ; and (b) the Lippe canal, 40 miles long, from the Rhine at Wesel along the river Lippe to the Dortmund-Ems

canal at Datteln. These pro- jected works would give a continuous waterway from the busiest mining and industrial districts of Westphalia to the extreme east of the empire. In 1884 the German Reichstag appointed a com- mission to inquire into the "relations" of the Rhine, that is, its tendency to cause floods, the distribution of its precipitation, its fall in various parts of its course, and so forth. The results of these investigations were published in the elaborate work, Der Rheinslrom und seine Nehenfliisse (Berlin, 1889), and in the further Bericht der zur Unter^ucliung der BheinstroTYiverhdlinissc nieder- gesetzten Seichskommission (1891). The Rhine is no longer the barrier between east and west, but is spanned by railway bridges in about thirty places, notably at Dordrecht, Zalt-Bommel, and Nimeguen in Holland ; at Wesel, Duisburg, Diisseldorf, Cologne, Bonn, Coblenz, Mainz, Mannheim, Spires, Kehl, Schaffhausen, and Constance in Germany ; and at Basel and Ragaz in Switzerland.

See Tkeutlein. ' ' Die neueren Deutschen Rheinstromstudien und ihre Ergebniase," in Ausland (1893), a series of papers giving the digested results of the two works quoted in the text. ❓❓❓H. Blink. " Der Rhein in den Niederlanden," in KirchhofFs Forschungen zur Zandes- und Volkskuitde, vol. iv. Heft 2. ❓❓❓Chambalu. Die Strom- verdnderungen des Niederrkeins seit der vorrbmischen Zeit. Cologne, 1892. ❓❓❓ Horn. Der Mhein, Geschichte und Sagen seiner Burgen,

Rhine Province. See Pkitssia, Rhenish.

Rhode lsi❓❓incl, one of the six New England states, the smallest in the American Union, and the last of the original thirteen to adopt the Federal Constitution, lying between 41❓❓18' and 42❓❓3' K and 71❓❓8' and 71❓❓53' W. Its greatest length is 48 miles; its greatest width 37 miles. Its area covers 1250 square miles, of which 165 square miles is water surface. It is bounded on the N. and E. by Massachusetts, on the W. by Connecticut, and on the S. by the Atlantic Ocean. Nar- ragansett Bay, running north 30 miles, divides it into two unequal parts. In the bay are many islands ; the largest is Rhode Island, whence the state derives its name. Block Island lies 10 miles out in the ocean. The surface is hilly, though the highest elevation, Durfee Hill, Gloucester, is only 805 feet

above the sea. The climate is not as change- able as that of other parts of New England. Narragansett Bay tempers the atmosphere, and the cold east winds that afflict Boston, 40 miles away, are rarely felt. Newport and the towns upon the coast are warmed by the influence of the Gulf Stream.

Pojndation. ❓❓❓ In 1880 the population was 276,531 ; in 1890, 345,506; in LSOn, 384,758; and in 1900 it was 428,556. The population, therefore, increased 24 per cent, from 1890 to 1900, and the density per square mile rose from 328‘1 to 407. Rhode Island is consequently the most densely peopled state in the Union. Of the total population in 1900, 210,516 were males and 218,040 were

females, constituting respectively 49-1 per cent, and 50-9 per cent, of the total population, as compared with 48-6 per cent, and 51-4 per cent, respectively in 1890. The foreign-born poiJulation, which in 1850 constituted 16 ‘5 per cent, of the population, numbered in 1890, 106,305 (or 30-8 per cent.), and in 1900, 134,519 (or 31-4 per cent.). Of the native-born white population in 1900, nearly one-half (140,292 out of 285,278) were sprung from parents of whom at least one was of foreign origin. Providence was slightly above the average percentage in its foreign-born population. Of the foreign-born population in 1895 Ireland contributed the largest number, followed by Canada, England, Scotland and Wales, Italy, Sweden, Germany, Russia, Portugal, in the order named. The Canadians were mostly of French descent. The coloured population, which in 1748 amounted to 94 per cent, of the total, has become relatively stationary, being 2-2 per cent, of the total both in 1890 and in 1900. Out of 127,144 adult males in 1900, 11,675 were illiterate (unable to write), of whom 9932 were foreign-born.

The state is divided into five counties. There are 5 incorporated cities: Providence, the capital (175,597), Pawtuoket (39,231), Woonsocket (28,204), Newport (22,034), Central Falls (18,167) ; 32 towns (of which 12 contain more than 4000 inhabitants) ; and 1 “district.” Newport is the most fashionable watering-place in the Union. Bristol is famous for its yacht-building establishments. The defenders of the “America Cup” have been built there for several years. The urban population in 1890, designating as such the total population of all places of more than 4000

inhabitants, was 310,335, or 89-8 per cent, of the total ; in 1900 it was 392,509, or 91‘6 per cent. ??? a higher ratio of urban to total population than exists in any other state of the Union. The death-rate of the entire state in 1890 was 20-9 ; in 1900 it was 19-1.

In manufactures, notwithstanding its small size, Rhode Island is one of the most important states of the Union.

1890.

1900.

Increase, per cent

Number of establish-

ments .

3377

4189

24

Capital .

$126,483,401

$183,784,587

45-3

Wage-earners (aver-

age number) .

81,111

96,528

19

Total wages

133,239,313

$41,114,084

23-7

Value of products .

142,500,625

184,074,378

29-2

In 1890 the wage-earners engaged in manufactures comprised 23 ‘5 per cent, of the population ; in 1900, 22-5. It is interesting to note that while the number of men, 16 years of age and over, among the wage-earners increased nearly 30 per cent., the number of women of like age so employed increased only 5 ‘4 per cent, (while their total wages increased 20 ‘4 per cent.), and the number of children under 16 so employed decreased 13‘5 per cent, (although their total wages decreased only 1-8 per cent.). The three most important manufacturing products of the state are textiles, jewellery, and foundry and machine-shop products. There were 218 establishments engaged in the manufacture of textiles, with products valued at $78,133,258 ; 214 in the manufacture of jewellery, with products valued at ??13,320,620; and 149 in the manufacture of foundry and machine-shop products, which were valued at $13,269,086. Under the general group of textile industries are included the manufacture of cotton goods (pro- ducts, $26,435,675), of worsted goods (products, $33,341,329), of woollen goods (products, $5,330,550), dyeing and finishing textiles (products, $8,484,878). In the manufacture of cotton goods the state in 1900 was third in the United States. In 1895, 1,924,486 spindles were running and 43,106 looms ; one establish- ment

in Providence contained more than 400,000 spindles. Providence is the first city in the United States in the manu- fucture of jewellery.

Other Industries. ??? Underlying Narragansett Bay and the land east of it are extensive coal deposits, the extreme eastern bed of anthracite in the United States. Graphite is mined in Cranston for blast furnaces. Magnetic iron is found in Cumberland. At Lime Rock, Lincoln, the best lime in America has been steadily produced for more than 200 years. In the southern part of the state are extensive granite quarries. Westerly "granite is universally known and employed in monumental work. The fisheries reported in 1896 an invested capital of $921,429, and

the yearly product is more than $1,000,000. Agricultural productions are not important, though market – gardening is carried on on a large scale not far from Providence, large crops being secured by irrigation. In 1900 there were 5948 farms in the state, comprising altogether 455,602 acres, or 67 '6 per cent, of the total land surface of the state. The total value of farm property in 1900 was |26,989,189, and of farm products (1899)

16,333,864.

Transportation. ??? In 1899 there were 548 miles of steam and 182 miles of electric railways. More than 500 miles of steam railways are controlled by the New York, New Haven, and Hartford Rail- road, which corporation also controls the steamboat lines running from Providence to New York. Steamships, owned largely outside the state, run from Providence to Philadelphia, Baltimore, Norfolk, Savannah, and Jamaica, "W.I. The total steam tonnage of the state (not including yachts) is 22,391'13.

Finances. ??? The total valuation of property was $399,897,333. The state tax (18 c. per $100) is always included in levying local taxes. The state debt, 1st January 1899, was $2,300,000. The town and city debt was

$28,612,407. In January 1900 the banks of the state, with their capital and deposits, were as follows : ???

Banks.

59 National .

6 State

8 Trust companies 35 Savings .

Capital (including Surplus).

$24,222,980

916,675

4,926,909

Deposits.

$26,587,874

837,220

27,745,177

73,186,624

108

$30,066,564

$128,356,895

Depositors in savings banks, 146,321.

Education, Religion, ofcc. ??? ^The present school system is largely the work of the late Henry Barnard. The attendance in 1899 was 65,527;

the number of teachers, 1858. The schools are supported by the towns and cities and not by the state, the "Permanent School Fund" amounting (December 1899) to only $245,525. The state normal school and the Rhode Island School of Design are situated in Providence. In Kingston is the Rhode Island College of Agriculture and Mechanic Arts, with a faculty of 23 and 180 students in 1899. Brown University is the chief educa- tional institution. Though it is under Baptist control, it is un- sectarian in spirit. Within ten years the faculty has increased from 26 to 92, the students from 285 to 925, and the endow- ment has been more than doubled. Two million dollars was secured by subscriptions for its permanent fund in 1900- 1901 A women's college is connected with the university. Its students are taught in separate classrooms by the uni- versity professors, and receive degrees on the same terms as men. The system is not one of co – education, but of co- ordinate education. Of religious denominations, the Roman Catholic has 52 churches, with 96,755 members, and property valued at $2,295,700 ; the Baptist (Regular) has 75 churches, with 12,055 members, and property valued at $1,151,960 ; the Protest- ant Episcopal has 63 churches, with 9468 members, and property valued at $1,189,700 ; the next denominations in order are: Con- gregational, Methodist Episcopal, Baptist (Free Will) and Unit- arian. Of charitable institutions, the principal are the Butler Hospital for the Insane and the Rhode Island Hospital, in Provi- dence, and the soldiers' home, in Bristol. In Cranston, on the "state farm" of 538 acres, are the reformatory and penal institu- tions of the state, the workhouse, the hospital for insane, the alms- house, the prison, the Providence county gaol, and the reform school ; the number of inmates in 1899 was 2193.

History and Politics. ??? Roger Williams was the founder of the colony. Ordered in 1636 to leave the colony of Massachusetts Bay because of religious opinions, he fled to the " Narragansett country," and at Providence founded the state, of which religious liberty was the chief corner-stone. A royal patent obtained by him limited authority exercised under it to "civil things," and a charter granted by Charles II. in 1663 provided for entire freedom in religious matters. A property qualification was required of all voters. Under this charter the state was governed until 1843. The present laws relating to suffrage were enacted in 1888 ; their

chief defect is that they entail unequal representation. All towns and cities are represented in the State Senate by one senator, with- out regard to population. The membership of the House of Re- presentatives is limited to 72, and each town must have one representative. But no city may have more than one-sixth of the whole number of members. Thus Providence, with 176,597 people, can have but 12 members, one to 14,633 persons, while West Greenwich has one representative for 721 inhabitants, and the twelve smallest towns, with 14,657 people, have as many repre- sentatives as Providence. All state officers are elected annually. The governor has no veto power. The state is Republican in politics ; McKinley received a plurality of 22,978 votes over Bryan in 1896, and 13,972 votes in 1900. (w. H. Mu)

Rhodes, the most easterly of the islands in the Aegean Sea, forming, with the islands of Symi, Kasos, Karpathos, Castelorizo, Tilos, and Sharki, one of the four sanjaks into which the Archipelago vilayet of Turkey is divided. The governor-general of the vilayet resides at the town of Rhodes, at the north-east extremity of the island. The facilities afforded by the lines of steamers that run from Smyrna to the islands of the Sporades and the small towns on the Asia Minor coast have destroyed the important transit trade which Rhodes formerly enjoyed. In 1900 the exports ??? sponges, storax oil, valonea, and fruits??? amounted to ??27,400, and the imports to ??180,500. The population of the island comprises 7000 Moslems, 21,000 Christians, and 2000 Jews.

Rhodes, Cecil John (1853-1902), British

colonial and Imperial statesman, was bom on 5th July 1853, at Bishop Stortford, in Hertfordshire. His father was a clergyman, but he claimed descent from yeoman stock. His family appear to have been first known as farmers and graziers about the beginning of the 18th century. Towards the middle of that century his great- grandfather, Mr Samuel Rhodes, acquired considerable wealth, and became the possessor of a large estate at Dalston. His grandfather, Mr William Rhodes, owned a property attached to Layton Grange, in Essex, and Mr Rhodes's father, the Rev. Francis WiUiam Rhodes, after- wards succeeded to this estate. Cecil John Rhodes was the fifth son in a large family of sons and daughters. At the

time of his birth his father held the living of Bishop Stortford. The boy was educated at Bishop Stortford grammar school with the intention of preparing for the Church ; but at the age of sixteen his health broke down, and in the latter part of 1870 he was sent to join an elder brother, then engaged in farming in Natal. In that year diamonds were discovered in the Kimberley fields. By the end of 1871 Mr Rhodes and his brother were among the successful diggers. The dry air of the interior restored Mr Rhodes's health, and before he was fully nineteen he found himself financi- ally independent, physically strong, and free to devote his life to any object which commended itself to his choice.

Rhodes has left behind him an interesting record of the manner in which he was aifected by the situation. He determined to return to England, and to complete his edu- cation by reading for a degree at Oxford ; but before doing so, he spent eight months in a solitary journey through the then little known parts of the country lying to the north of the Orange and Vaal rivers. He went through Bechuana- land to Mafeking, thence to Pretoria, Murchison, Middel- burg, and back through the Transvaal to Kimberley. The journey, made in an ox-waggon at a rate of progression of some 1 5 to 20 miles a day, represented a walking tour of eight months through the vast spaces of rolling veldt which at that time filled those regions of Southern Africa. He saw one of the healthiest countries in the world barely occupied. He knew the agricultural possibilities of NataL He knew its mineral wealth. The effect of the combined influences on his mind, in the circumstances in which he found himself, was profound. The idea took passionate possession of him that the fine country through which he moved ought to be secured for occupation by the British race, and that no Power but Great Britain should be allowed to dominate in the administration of South Africa. When he brought his self-imposed pilgrimage to an end, he had found an object to which he proposed to devote his life. It was nothing less than the governance of the world by the British race. A will exists written in Mr Rhodes's own handwriting a couple of years later, when he

was still only twenty-two, in which he states his reasons for accepting the aggrandizement and service of the British Empire as his highest ideal of practical achievement. The document begins with the characteristic sentence : "I contend that the British race is the finest which history has yet produced." The argument, continued through some twenty foolscap pages, is a clear if somewhat crude summary of the articles of faith on which the edifice of modern British Imperialism is based. It puts forward broadly, as an aim which must appeal to every elevated mind, the conception of working for the governance of the entire world by its finest race ; and it ends with a single bequest of everything of which he might die possessed, for the furtherance of this great purpose. Five-and-twenty years later his final will carried out, with some difference of detail, the same intention.

The share which he allotted to himself in the general scheme was the extension of the area of British settlement in Africa, but he did not attempt to address himself immediately to public work. He returned, in accordance with his first resolve, to Oxford, where he matriculated at Oriel. In 1873 his health again failed, and he was sent back to South Africa under what was practically a death sentence. Years afterwards he saw the entry of his own case in the diary of the eminent physician whom he consulted, with a note, " Not six months to live." South Africa again restored him to health. Three years later he was back at Oxford, and from 1876 to 1878 he kept his terms. During this period he spent the Long Vacation each year in South Africa, where his large financial interests were daily increasing in im- portance. He was a member of the Cape Ministry when, after a further lapse of years, he kept his last term and took his degree. He did not read hard at Oxford, and was more than once remonstrated with in the earlier terms for non-attendance at lectures. But he passed his examina- tions; and though he was never a student in the university sense of the term, he was to the end of his life a keen devourer of books. He kept always a special liking for certain classic authors. Aristotle was the guide whom as a lad he followed in seeking the " highest object " on which to exercise the " highest activity of the soul." Marcus Aurelius was his con- stant companion. There exists at Grote Schuur a copy of the Meditations deeply scored with Mr Rhodes's marks.

During this Oxford time, and on to 1881, Mr Rhodes was occupied with the amalgamation of the larger number of the diamond mines of Kimberley with the De Beers Company, an operation which established his position as a practical financier and gave him an important con- nexion and following in the business world. This follow- ing and connexion, extended as it was by subsequent developments, was to Mr Rhodes in many of his larger political undertakings as a fighting army to a general. His enemies made it the subject of severe criticism. To

CECIL RHODES. (From a photograph by Elliott and Fry, London.)

many admirers who shared his ideas on pubhc questions his connexion with the financial world and his practical success were a stumbling-block. It was often wished for him that he had "kept himself clear of all that." But this was not his own view. His ideals were political and practical. To him the making of money was a necessary preliminary to their realization, and he was proud of his practical ability in this direction. He was personally a man of most simple tastes. His immense fortune was spent in the execution of his ideals, and it has been justly said of him that he taught the world a new chapter of the romance of wealth. He rallied round him what may be called a new school of millionaires, who found in his example an inspiring suggestion for the employment of money.

In 1881 Mr Rhodes entered public life as a member of the Cape Assembly. It was the year of the Majuba settlement. South Africa was convulsed with questions

*which had arisen between the British and the Dutch, and leaders of Dutch opinion at the Cape ventured to speak openly of the forma- tion of a United States of South Africa under its own flag. The British party needed a raUying-ground, and Mr Rhodes took his stand on a policy of local union com- bined with the consolidation and expansion of Imperial interests. He offered to Dutch and British aUke the ideal of S, a South African Federation *, governing itself within the Empire, and extending, by its gradual absorption of native territories, the range of Im- perial administration. Local self-government was, in his opinion, the only enduring basis on which the unity of the Empire could be built, and throughout his life he was as keen a defender of local rights as he was of*

Imperial unity. There was a period somewhat later in his career when this attitude on his part gave rise to a good deal of misapprehension, and his advocacy of the elimination of direct Imperial inter- ference in local affairs caused him to be viewed in certain quarters with suspicion as a Separatist and Independent. Those who were inclined to take this view were greatly strengthened in their suspicions by the fact that at a critical moment in the struggle for Home Rule in Ireland Mr Rhodes contributed ►►10,000 to the funds of the Separatist party. The subsequent publication of his correspondence on the subject with !Mr Parnell, who was at that time leading the Home Rule party, demonstrated, however, the essential fact that, whatever might have been the secret intentions of the extreme Irish Home Rulers, Mr Rhodes's contribution was made strictly subject to the retention of the Irish members at Westminster, and that his interest in the Irish question arose solely from a belief that the Home Rule movement, if successful in establishing the double principle of local self-government combined with Imperial representation, would be, in his own words, the " commencement of changes which will eventually mould and weld together all parts of the British Empire." He remained of the opinion that the

Home Rule movement, wisely treated, would have had a consolidating and not a disruptive effect upon the organ- ization of the Empire.

In South Africa the influence which he acquired over the local independents and over the Dutch vote was subsequently an important factor in enabling him to carry out the scheme of northern expansion which he had at heart. His .first attention on entering public life was given to this question. In 1881 Cape Colony was con- fined upon the north by the Orange river. The Bechuana territory, which lay beyond the river, was a sort of no man's land through which ran the trade routes to the north. It was evident that any Power which commanded the trade routes would command the unknown northern territory beyond. The London Con- vention of 1881 limited the westward extension of the Transvaal to a line east of the trade routes. Nevertheless the reconstituted

Republic showed itself anxious to encroach by irregular overflow into native territories, and Mr Rhodes feared to see the extension of the British colonies permanently blocked by Dutch occupation. One of his first acts as a member of the Cape Assembly was to urge the appointment of a delimitation commission. He served in person on the commission, and obtained from the native chief Mankoroane, who claimed about half of Bechuanaland, a formal cession of his territories to the British Government of the Cape. The Cape Government refused to accept the ofi'er ; but as a result of Mr Ehodes's urgent representations, an Imperial Protectorate was, after much discussion, declared over Bechuanaland in 1884. The British flag was thus carried to the 22nd parallel. In the same year a second Convention was signed in London laying down definite frontiers on the eastern border of Bechuanaland within which the Transvaal undertook to confine itself. With the consent of Great Britain, Germany occupied almost at the same time the territory on the Atlantic coast which is now known as German South-West Africa. Mr Rhodes occupied the position of resident deputy commissioner in the new British territory towards the end of 1884. When he took up the duties of his oflice he found that, not- withstanding conventions to the contrary, a further determined attempt had been made on the part of the Dutch to overrun the border. The country had been practically seized by a Boer commando. An old Dutch- man who knew the value of the position said privately to Mr Rhodes, " This is the key of South Africa." The question at issue was whether Great Britain or the Trans- vaal was to hold the key. It was a question about which at that time the British public knew nothing and cared nothing. Mr Rhodes made it his business to enlighten them. President Kruger, speaking for the Government of the Transvaal, professed to regard the Dutch com- mandoes as freebooters, and to be unable to control them. It devolved upon Great Britain to oblige them to evacuate the territory. As the result of Mr Rhodes's exertions the necessary step was taken. The Warren expedition of 1884 was sent out. In the presence of British troops upon the frontier President Kruger re- covered his controlling power over the Transvaal burghers, and without any fighting the commandoes were with- drawn.

It was the first round in the long duel fought on the field of South Africa between Mr Rhodes, as the repre- sentative of British interests, and

President Kruger, as the head of the militant Dutch party. The score on this occasion was to Mr Rhodes, and the entrance to the interior was secured. But the 22nd parallel was far short of the limits to which Mr Rhodes hoped to see British influence extend, and he feared lest Germany and

the Transvaal might yet join hands in the native territory beyond, and bar his farther progress towards the north. The discovery of gold at Johannesburg in 1886, by adding to the wealth and importance of the Transvaal, gave substance to this fear.

The territory to the north of the 22nd parallel was at that time under the domination of Lobengula, king of the Maltabele, a native potentate celebrated alike for his ability and for the despotic character of his rule. There were rumours of Dutch and German emissaries at the kraal of Lobengula, engaged in persuading that chief to cede certain portions of his territory. Portugal also was putting forward shadowy claims to the country. It was in these circumstances that Mr Rhodes conceived the idea of forming a British Chartered Company, which should occupy the territory for trading and mining purposes as far as the Zambezi, and bring the whole under the protec- tion of Great Britain. The idea took shape in 1887, in which year Mr Rhodes's first emissaries were sent to Loben- gula. The charter of the British South Africa Company was granted in October 1889. Between the two dates his conception of the possibilities to be achieved by the Company had expanded. Mr Rhodes no longer limited the sphere of his operations to the Zambezi, but, crossing the river at the back of the Portuguese settlement at its mouth, he obtained permission to extend the territories of the Chartered Company to the southern end of Lake Tangan- yika, including within the sphere of its operations a British settlement already made upon Lake Nyasa. He hoped to go farther still, and to create a connected chain of British possessions through the continent which might eventually justify the description " Africa British from the Cape to Cairo." The treaty negotiated between Great Britain and Germany in 1890 extended the German sphere of influence from the East Coast to the frontier of the Congo Free State, and defeated this hope. But Mr Rhodes did not wholly renounce the idea. In 1892, when the question of the retention or abandonment of Uganda

hung in the balance at home, he threw aU the weight of his influence into the scale of retention, and undertook at his own personal expense to connect that territory by telegraph with British possessions in the south. In the following year, 1893, it was found inevitable to fight the Matabele, and a war, prosecuted with a success that is perhaps unique of its kind, placed the country entirely in British hands. The territory thus added to the British Empire covered an extent of 750,000 square miles, of which large portions consist of healthy uplands suitable for white colonization. From this time onwards through his very active life Mr Rhodes gave constant attention and encouragement to the development of British administration in the new territory, to the construction of roads, telegraphs, and railways, the laying out of towns, the introduction of good breeds of farming stock, the planting and draining of agricultural land, and the working of minerals, upon which the financial stability of the new protectorate mainly depended. The pioneer party who constructed the first road and founded the first British stations in the country received their orders to cross the frontier in the end of 1889. By the and of 1899, before the outbreak of the South African war, though the country had passed through the trial of a war, two native rebellions, and the scourge of rinderpest, it had become, under the name of Rhodesia, a well settled province of the British Empire, with a white population of some 12,000 to 13,000 persons, already clamouring for the privileges of self-government.

The six years which followed the granting of the charter may be regarded as the most successful of a singularly suc- cessful life. In 1896, not many months after the granting of the charter, Mr Rhodes accepted the position of prime

minister of the Cape. He was maintained in power very largely by the Dutch vote, which he spared no pains to con- cihate ; and having the confidence of both political sections of the colony, he found himself practically in a position to play the part of benevolent despot in South Africa. He used the position well so far as the public was concerned. While his scheme of northern expansion was making the rapid progress

which has been indicated, he did much to elevate and to enlarge the field of local poUtios. He frankly declared and worked for the policy of uniting British and Dutch interests in South Africa; he took a keen interest in local education. He also during this period carried through some important reforms in native policy. He had the courage to restrict the franchise, intro- ducing an educational test and limiting the exercise of voting power to men enjoying an income equal to a labourer's wage ❓❓❓ thus abolishing, without making any distinction of colour, the abuses of what was known as the " blanket " vote. Long before the passing of the Franchise Act j\Ir Rhodes had openly stated his opinion that in dealing with an entirely distinct people there was no alternative between receiving them on an equal footing as citizens or treating them as a subject race. He was not prepared to receive the black races of South Africa on equal terms as citizens with the white, and he accepted the, to him, logical conclusion that ther must be class legislation. In his heart he had perhaps a suspicion that every man who denied this conclusion was either fool or knave. For his own part, having accepted it, he accepted it frankly, and made no attempt to conciliate the senti- mental party with pretences.

But his native policy was far from being one of simple restriction. He liked the natives ; he employed them by thousands in the mining industry, he kept native servants habitually about his person, he seemed to understand their peculiarities and was singularly successful in dealing with them. The first canon of his native policy was that liquor should be kept from them ; the second, that they should be encouraged to labour, and guaranteed the full possession of their earnings ; the third, that they should be educated in the practical arts of peace. He appreciated the full im- portance of raising their territorial condition from one of tribal to individual tenure ; and while he protested against the absurdity of permitting the uncivilized Kaffre to vote on questions of highly civilized white policy, he believed in applying to the native for his own native afiairs the principle of self-government. Of these views, some received practical embodiment in the much-disputed Act known as the Glen Grey Act of 1894. In this connexion it may also be noted that he was one of the warmest and most convinced supporters of Lovedale, the very successful missionary institution for the education of natives in South Africa.

The position of benevolent despot has obvious draw- backs. In Mr Ehodes's case the dependence which the populations of Cape Colony were led to place on him had its reaction on the public in a demoralizing loss of self- reliance, and for himself it must be admitted that the effect on the character of a man already much disposed to habits of absolutism in thought and action was the reverse of beneficial. Mr Ehodes felt himself to be far stronger than any man in his own surroundings ; he knew himself to be actuated by disinterested motives in the aims which he most earnestly desired to reach. Of this, when his life is viewed as a whole, there can be no reasonable doubt. He was profoundly impressed))y a sense of the shortness of life, and he so far abused his power as to become in- tolerant of any sort of control or opposition. In the con- ception of his great schemes he frequently erred in detail, but he had not the patience to accept correction. Neither

could he make allowance for candid difference of opinion. The man who thought with him was his friend, and was accepted as such ; the man who difiered from him was an antagonist, and either to be overridden or pushed aside. The inevitable result followed, that though Mr Ehodes did much of great and good work during the six years of his supreme power, he entirely failed during that period to surround himself, as he might have done, by a circle of able men fit to comprehend and to carry on the work to which his own best efiforts were directed. To work with him was practically impossible for those who were not willing to accept without demur the yoke of dogmatic authority ; and the methods which he employed were at times so crude as to alienate not only men naturally opposed to his political ideals, but some of the best minds working in the interests of Empire for aims not unlike his own. He had a few devoted personal friends, who appreciated his aims and were inspired by his example ; but he was lacking in regard for individuals, and a great part of his daily life was spent in the company of sateUites and instruments, whom he used with cynical unconcern for the furtherance of his ends. That the ends were generous and impersonal redeems, but cannot be held to justify, an insensitiveness to some of the finer elements of human intercourse which limited the range of his character and led him into his gravest errors.

In 1896 the brilliant period of his premiership was brought to an end by the incident which became famous under the name of the Jameson Eaid. The circumstances which led to the Eaid belong properly to the history of the Transvaal. It is enough to say briefly here that the large alien population which had been attracted to the Transvaal by the phenomenal wealth of the Johannesburg gold-fields, conceiving themselves to have reason to revolt against the authority of the Transvaal Government, resolved towards the end of 1895 to have recourse to arms in order to obtain certain reforms. Arming was to take place secretly, and the revolution was to be carried out when the mining population was sufficiently prepared to be in a position to take concerted action. Mr Rhodes, as a large mine-owner, was theoretically a member of the mining population. In this capacity he was asked to give his countenance to the movement ; and in so far as his extensive property in the Transvaal suffered from conditions which other mine- owners pronounced to be intolerable, he had the same right as others to decide by what means it was advisable to endeavour to obtain redress. But as prime minister of a British colony he was evidently placed in a false position from the moment in which he became cognizant of a secret attempt to overturn a neighbouring Government by force of arms. He did more than become cognizant. The subsequent finding of a Cape committee, which he accepted as accurate, was to the effect that " in his capacity as controller of the three great joint-stock companies, the British South Africa Company, the De Beers Consolidated ilines, and the Gold Fields of South Africa, he directed and controlled the combination which rendered such a proceeding as the Jameson Eaid possible." He gave money, arms, and influence to the movement ; and as the time fixed for the outbreak of the revolution approached, he allowed Dr Jameson, who was then administrator of the British South Africa Company in Rhodesia, to move an armed force of some 500 men upon the frontier. Here Mr Ehodes's participation in the movement came to an end. It became abundantly clear from subsequent inquiry that he was not personally responsible for what followed. The intention had been that Dr Jameson, with the force under his orders, should assist the development of the revolution in the Transvaal, and hold himself ready to move across the frontier if required. Changes in the local situation in the

Transvaal gave promise of averting or postponing the open conflict, when unfortunately, by a series of misunderstand- ings, Dr Jameson, whose personal chivalry in the matter was not questioned, conceived it to be his duty to lead his force across the frontier and to deliver the first blow. The Transvaal military authorities, fully warned by secret in- formation, had no difficulty in dealing with the incursion. The little force was surrounded and led ignominiously prisoners to Pretoria. A cipher correspondence, seized and published by the Boers, left the civilized world in no doubt as to Mr Khodes's share in the previous preparation, and he wat) for a time believed to be responsible for the Raid itself. Subsequent inquiries held by committees of the Cape Parliament and of the British House of Commons acquitted him entirely of responsibility for Dr Jameson's final movement, but both committees found that he had acted in a manner which was inconsistent with his duty as prime minister of the Cape and managing director of the British South Africa Company .He himself practically ac- quiesced in this finding, though from a somewhat different point of view, blaming himself, not for having encouraged the revolution, but for having failed to hold the movement so completely in check as to have been able to prevent disaster. No one recognized more fully than himself the scope of the blunder which had been committed.

He displayed, in the circumstances, characteristic quali- ties of pluck and candour. He made no concealment of his own share in the catastrophe ; he took full responsibility for what had been done in his name by subordinates, and he accepted all the consequences which ensued. He resigned his premiership of the Cape ; and recognizing that his presence was no longer useful in the colony, he turned his attention to Ehodesia. His design was to live in that country, and to give all the stimulus of his own presence and encouragement to the development of its resources. The Matabele rebellion of March 1896 intervened to pre- vent the immediate realization of his plans. In June Imperial troops were sent up, and by the end of July the result of the military operations had driven the natives to the Matoppo HUls, where they held a practically impregnable

position. The prospect was of continued war, with a renewal of a costly campaign in the following year. Mr Ehodes conceived the idea that he might effect single- handed the pacification which military skill had failed to compel. To succeed, it was essential that he should trust and be trusted. He accordingly moved his ‘ tent away from the troops to the base of the Matoppo Hills. He lay there quietly for six weeks, in the power of the enemy if they had chosen to attack. Word was circulated among the natives that he had come alone and undefended to hear their side of the case. A council was held by them in the very depths of the hills, where no armed force could touch them. He was invited to attend it. It was a case of staking his life on trust. He displayed no. hesitation, but mounted and rode unarmed with the messenger. Three friends rode with him. The confidence was justified. They met the assembled chiefs at the place appointed. The native grievances were laid before Mr Ehodes. At the end of a long discussion Mr Ehodes, having made and exacted such concessions as he thought fit, asked the question, “Now, for the future is it peace or is it war 1 ” And the chiefs laying down their sticks as a symbol of surrendered arms, declared, ” We give you one word; it is peace.” The scene, as described by one of the eye-witnesses, was very striking. Mr Ehodes, riding away, characterized it simply as ” one of the scenes which make life worth living.”

His life was drawing towards its end. He had still a few years, which he devoted with success to the develop- ment of the country which bore his name. The railway

was brought to Bulawayo, and arrangements were made for carrying the line on in sections as far as the south end of Lake Tanganyika, a construction which was part of his pet scheme for connecting the Cape by a British line of communication with Cairo. He also concluded arrange- ments for carrying a telegraphic land line through to Egypt, and had the satisfaction of seeing the mineral development of the country fairly started. But the federal union of South Africa, to which he had always worked as the secure basis of the extension of British rule in the southern half of the continent, was not for him to see. The South African war broke out in 1899. Mr Ehodes took his jjart at Kimberley in sustaining the hardships of a siege ; but his health was broken ; and though he lived to

see victory practically assured to British arms, peace had not been concluded when, on 26th March 1902, he died at Cape Town.

His life's work did not end actually with his death. He left behind him a will in which he dedicated his fortunes, as he had dedicated himself, exclusively to the public service. He left the bulk of his vast wealth for the purpose of founding scholarships at Oxford of the value each of ►►300 a year, to be held by students from every important British colony, and from every state and territory of the United States of America. The sum so bequeathed was very large; but it was not for the munificence of the legacy that the will was received with acclamation throughout the civilized world ; it was for the striking manifestation of faith which it embodied in the principles that make for the enlightenment and peace and union of mankind, and for the fine constancy of Mr Ehodes's conviction that the unity of the British Empire, which he had been proud to serve, was among the greatest of organized forces uniting for universal good. The bequests to American scholars were made with the expres- sion of a hope " that such an education will encourage and foster an appreciation of the advantages which I implicitly believe will result from the union of the English-speaking peoples throughout the world." Those to British colon- ists were for the purpose " of giving breadth to their views, for their instruction in life and manners, and for instilling into their minds the advantage to the Colonies, as to the United Kingdom, of the retention of the unity of the Empire." The will was drawn up some years before nis death. A codicil, signed during the last days of his life, gave evidence of some enlargement of his views as to the association of races necessary in order to secure the peace of the world, and added to the original scheme a certain number of scholarships to be held at the disposal of German students.

The publication of the will silenced Mr Ehodes's de- tractors and converted many of his critics. It set a seal which could not be mistaken upon his completed life. The revulsion of sentiment towards him was complete, and his name passed at once in the public estimation to the place which it is probably destined to take in history, as one which his countrymen are proud to count among the great makers of the British Empire. (f. l. s.)

Rhodesia, North. See Centeal Africa, British ; and conclusion of Rhodesia, South : History.

Rhodesia, South, comprising the whole of that section of British South Africa which stretches from the Limpopo northwards to the Zambezi, and from the Bechuanaland Protectorate eastwards to Portuguese East Africa. It thus includes the former native territories of Matabeleland and Mashonaland, which, with the circum- jacent Banyai, Manica and jMakalaka districts, have a total area of 175,000 square miles, with a population

estimated at 425,000, roughly distributed between the two main sections as under : ???

Area in

Square Miles.

61,000

114,000

Population.

156,000 270,000

Matabeleland, with Makalaka, Mashonaland, with Banyai and Manica.

But these divisions have now little more than a historical interest, and since 1S94 the whole region forms a single political domain. It was administered by the British South Africa Company till 1898. In that year the Company was partly relieved of its strictly administrative functions by a resident commissioner appointed by the Secretary of State, and an executive council, consisting of the resident commissioner, the Company's adminis- trators, and at least four others nominated by the Company, with

the approval of the State Secretary. There is alfeo a legislative council, including the senior administrator as president, the resident commissioner, five nominees of the Company approved by the State Secre- tary, and four members elected by the registered voters. To this council the president submits the yearly budget, which must be approved by the high commissioner, who has the direct control of the military police, and the final decision in all land disputes with the natives, mineral rights being reserved to the Company. There is a high court, with civil and criminal jurisdiction, besides district courts and a secretary for native affairs, with subordinate native commissioners, natives and non-natives all having equal rights, except in respect of arms and liquor.

Townships have been established at Salisbury (the capital), at Victoria, Umtali, Bulawayo, Gwelo, Enkel- doorn, and Melsetter. Others are being formed else- where, and the demand for building sites is increasing, especially at Salisbury and Bulawayo, where there are municipalities, Government offices, banks, churches, hotels, schools, public libraries, and hospitals. Another indication of progress is the extent of land already surveyed, which in 1900 exceeded ten million acres, distributed in about equal proportions over Matabeleland and Mashona- land. This almost sudden transition from the sheer savagery everywhere prevailing down to past the end of the third quarter of the 19th century to the establish- ment of European institutions, and the spread of civilizing influences amongst the rude aborigines, was primarily due to the introduction of law and order under a strong and just Government, but also to the fairly salubrious climate, the almost boundless agricultural and mineral resources of the land, and the rapid development of its communica- tions. In 1899 nearly 3000 miles of roads and post routes had already been opened, besides 500 miles of cross-roads in the mining districts. In November 1897 the Khodesian Railway, forming a continuation of the Cape trunk line to Vryburg, in Bechuanaland, had reached Bulawayo. Another section of 150 miles was completed by .June 1900, and the system is to be continued for 300 miles northwards to the Zambezi through the valuable coal-fields, at least 400 square miles in extent, which were discovered in November 1900 some 180 miles north-west of Bulawayo. Provision has also been made for a branch from Bulawayo south to Gwanda (80 miles), to be ultimately connected through Tuli with

the Transvaal system ; while another branch is projected from Bulawayo north-east to Salisbury, the present inland terminus of the line running through Umtali and Portuguese territory to the coast at Beira (opened 1st May 1899).

In 1899 nearly 1,250,000 letters and packages were forwarded through the 55 post offices already opened ; and in the same year the telegraph system comprised over 2500 miles of wires, with 75 offices, through which 86,000 messages were despatched. For the climate, physical features, and other geographical details, see South Africa, British. (a, h. K.)

History. ??? The first people to establish themselves in historic times in the territories now forming Rhodesia were the Matabele, a famous Bantu tribe and an off- shoot of the Zulus.]\Ioselekatze, their first chief, was a warrior and leader who served under the Zulu despot Chaka. Being condemned to death by Chaka, Mosele- katze fled, with a large division of the Zulu army. About 1817 he settled in territories north of the Vaal, not far from the present site of Pretoria; and in 1836 his tribe had become so important that a treaty of friend- ship was entered into with him by the governor of Cape Colony. In the same year a large number of the " trek Boers" had settled north of the Vaal river, and came in contact with the ^Matabele, who attacked and defeated them, capturing a large number of Boer cattle and sheep. In November 1837 the Boers felt themselves strong enough again to assail Moselekatze, and they did so with such success that they drove him and his tribe north of the Limpopo, where they settled and occupied the country sub- sequently known as Matabeleland. In 1870 Moselekatze died, and was succeeded by his son Lobengula. In 1882 President Kruger, who was then bent on extending the boundaries of the Transvaal in every direction, endeavoured to make a treaty with Lobengula, but without success. The Warren expedition of 1884 to Bechuanaland, while it checked for a time the encroachments of the Transvaal Boers, and preserved to Great Britain the highway to the north through Bechuanaland, also served to encourage colonists to speculate as to the future of the interior.

Foiled in Bechuanaland, it soon became evident that the Boers were determined to get a footing in !Mashona- land, and that the Portuguese

and Germans were also anxious to get as much of the territory there as they could obtain. In 1887 Lord Salisbury had his attention called to the fact that the Portuguese Government had recently issued a map in which their territories were repre- sented as extending over the greater portion of Mashona- land, and even Matabeleland. He thereupon protested that under the Berlin Act no claim to territory in Central Africa could be recognized unless it was supported by actual occupation, and he further said that the Zambezi should be regarded as the natural northern limit to the territories of Great Britain in South Africa, ileanwhile gold prospecting had been taken up actively all over South Africa, following on the discoveries at Barberton and the Rand; and at this time Lobengula was besieged for all sorts of concessions by both Portuguese and Boers, as well as by adventurers from various parts of the world. Mr Cecil Rhodes, who for a long time had kept his eyes on the great territories of the north, for the route to which he had striven so keenly in political circles in Cape Town, decided to make an effort to retain the country for Great Britain. "With considerable difficulty he persuaded Sir Hercules Robinson, then high commissioner, to send Mr Moffat, the missionary, as an embassy to Lobengula, to endeavour to obtain an understanding with him. The result was a treaty under which Lobengula promised to enter into no correspondence or treaty with a foreign Power, nor to sell or otherwise dispose of any part of his territories, without the consent of the high com- missioner. In October 1888 Mr C. D. Rudd, who for a long time had been associated with Mr Rhodes in mining operations, visited Lobengula at considerable personal risk, and succeeded in obtaining a concession of all the mining rights in the country from him. In consideration of this concession ^Ir Rudd (representing the Gold Fields of South Africa Company, and also a syndicate in which Jlr Alfred Beit, Mr Rhodes, and Mr Rudd were the largest holders) promised Lobengula ►►100 a month, 1000 rifles, and a considerable amount of ammunition. At the same

time Lobengula was induced to issue a notice warning off all other concession-hunters. Mr Rhodes then applied to the Imperial Government for a Royal Charter with which to consolidate and develop the new territories and their mineral wealth. In applying for this charter the founders of the company stated their objects to be the following; ??? (1) To extend northwards the railway and telegraph systems in the direction of the Zambezi ; (2) to encourage emigration and colonization ; (3) to promote trade and commerce ; (4) to develop and work minerals and other concessions under the management of one powerful organization, thereby obviating conflicts and com- plications between the various interests that had been acquired within these regions, and securing to the native chiefs and their subjects the rights reserved to them under the several concessions. In making this applica- tion the boundaries were purposely left somewhat vague. They were described to be the region of South Africa lying immediately to the north of British Bechuanaland, to the north and west of the South African Republic, to the west of the Portuguese dominions.

At the outset of the company's existence Mr Rhodes and his directors determined to effect the . occupation of the country. A pioneer force was therefore sent in under Colonel Pennefather, consisting of 500 mounted police and a few hundred pioneers. Accompanying this force as guide was the accomplished traveller, well known throughout South Central Africa, Mr F. C. Selous. The work of transport was attended with considerable diffi- culty, and roads had to be cut as the expedition advanced. Nevertheless in a few months the expedition had reached the site of what is now the town of Salisbury, and had also established on the Une of march small forts at Tuli, Victoria, and Charter. Mr Archibald Ross Colquhoun was the first administrator. He had not long been in office when, in May 1891, difficulties arose with the Portuguese on their north-west frontier, both parties claim- ing a certain tract of territory in which a Portuguese trading station had been established. The result was a skirmish, in which a small company of British South Africa Police were victorious. In 1891 Dr Leander Starr Jameson was appointed administrator in succession to Mr Colquhoun. The Boers for several years past had been planning a settlement in the territories north of the Limpopo, and they now determined, in spite of the Moffat treaty and the

British occupation, to carry out their object. An expedition known as the Banyailand Trek was organ- ized under the leadership of Colonel Ferreira, and two large parties of Boers proceeded to the banks of the Limpopo. Information of the intended trek had been conveyed to Cape Town, and Sir Henry Loch (the high commissioner) at once sent a strong protest to President Kruger, informing him that any attempt to invade the Chartered Company's territories would be an act of hos- tility against the British Crown ; and Mr Kruger issued a proclamation forbidding the trekkers to proceed. Mean- while, however, a party had already started and reached the Limpopo, where they were met by Dr Jameson in com- mand of the British South Africa Company's forces. He told them that they would on no account be allowed to proceed except as private individuals, who might obtain farms on application to the Chartered Company. Colonel Ferreira was arrested and detained for a few days, and the expedition then broke up and dispersed.

The pioneers having been settled in Mashonaland, Mr Rhodes recognized the extreme importance of endeavouring to give the country a port nearer than that provided by Cape Tovra. He therefore made overtures to Portugal, and in 1891 a treaty was concluded between Great Britain and Portugal which provided that a railway might be

constructed to Beira through Portuguese territory, on condition that Portugal should receive a duty not exceed- ing 3 per cent, on the value of the goods imported. The treaty further stipulated for the free navigation of the Zambezi and the construction of telegraphs. The bound- aries of the Chartered Company's territories and those of the Portuguese were clearly defined. Prospecting operations were at once started, and various gold mines were discovered containing traces of old workings. Fresh gold reefs were also opened up. The prospects of the country seemed promising, and although a good deal of fever occurred in the low-lying valleys under the condi- tions of camp life, the health of the community soon improved as more suitable habitations were erected.

The first pioneers settled in Mashonaland. Ever since the advent of Moselekatze north of the Limpopo, the unfortunate Mashonas had been the prey of the Matabele ; they therefore accepted British occupation

gladly, recognizing that the British South African forces were likely to protect them against the raids of Loben- gula and his warriors. The Matabele, on the other hand, were loth to abandon their predatory excursions among the Mashonas, and in July 1893 a large impi (native force) was sent into Mashonaland, and entered not only native kraals, but also the streets of the new township of Victoria. An attempt was made to preserve the peace, but it was evident from the attitude taken by the Matabele that nothing short of the authority which only superior force could command would settle the question. The Matabele were a proud and fearless race of warriors, who had never yet come in conflict with white men, and had never been defeated in their conflicts with native foes. It is true that under Moselekatze, a generation before, they had been driven out of the Trans- vaal by the Boers, but the indunas (petty chieftains) of 1890 were but children when this defeat had been inflicted upon them. Dr Jameson's forces were slender ; and Mr Rhodes, on being consulted, urged him by telegram to "Read Luke fourteen, thirty-one." On obtaining a Bible, Dr Jameson read the words : " Or what king, going to make war against another king, sitteth not down first, and consulteth, whether he be able with ten thousand to meet him that cometh against him with twenty thousand?" He telegraphed in reply : " All right. I have read Luke fourteen, thirty-one." The position, though dangerous, admitted of no delay, and Dr Jameson determined to risk an expedition with the forces at his command. His success on this occasion doubtless weighed with him on another and less fortunate one. The force available consisted of about 700 volunteers and 225 British Bechu- analand police, with some 700 natives. Dr Jameson determined to march to Bulawayo, the headquarters of Lobengula and the capital of Matabeleland. The force was divided into two columns, and was to be met by a further column of natives marching from the south under Khama. The first engagement took place on the Shangani river, where the two columns which had started from Fort Charter and Fort Victoria were both engaged. Majors Forbes and Allan Wilson commanded in these engagements ; and after a hot contest with between 4000 and 5000 Matabele, the latter were repulsed, machine guns being used vsdth terrible effect upon the enemy. On 1st November a second fight occurred on the high ground, in which it was estimated that 7000 of the Matabele attacked the laager of the two columns. The oldest and most tried regiments of Lobengula dashed right

up to the muzzles of the guns, but were swept down before the modern rifles and machine guns with which the invaders were armed. Meanwhile the column of Kiama's men from the south had reached the Tati,

and won a victory on the Singuesi river on 2nd November. On 3rd November Bulawayo was reached, and the columns from Mashonaland, accompanied by Dr Jameson and Sir John Willoughby entered the town, Lobengula and his followers being in full flight. An endeavour was made to induce Lobengula to surrender; but as no replies were received to the messages, Major Forbes, on 13th November, organized a column and started in pursuit. The pursuing party were delayed with difficult roads and heavy rains, and did not come up with Lobengula until the 3rd December. Major Allan Wilson, in command of thirty-four troopers, crossed the Shangani river in advance, and bivouacked close to Lobengula's quarters. In the night the river rose, and reinforcements were unable to join him. During the early morning the Kaffres surrounded the little band, and after fighting most gallantly to the last, Major Allan Wilson and all his followers, with the exception of three messengers who had been sent back, were killed.

In January Lobengula died. His indunas submitted to the Chartered Company's forces, and the war, which cost the Chartered Company ◆◆100,000, was thus ended. Matabeleland was rapidly occupied by pioneers and others who went to join them. The climate was healthy, the altitude of the country being higher than that of Salisbury. Various gold reefs were discovered. A township was started and grew rapidly at Bulawayo.

In 1895 a question arose between the Chartered Com- pany and the Imperial Government as to the annexation of the Bechuanaland Protectorate. An Annexation Bill had just been passed by the Cape Government, annexing British Bechuanaland proper to the Cape Colony.

The British South Africa Company now put in a claim for the British Bechuanaland Protectorate, and provisional ar- rangements for the administration of these territories under their control were made (see Bechuanaland). But the ” Jameson Raid ” interfered with their completion, and the whole constitution of the British South Africa Company was subsequently remodelled. In 1896 Mr Cecil Rhodes resigned his position as managing director of the British South Africa Company, and Mr Alfred Beit retired from the Board in London. While these changes in the directorate were going on, there occurred, in March 1896, a revolt of the Matabele, near Bulawayo. A general massacre of outlying settlers took place, and the whole country was in a state of rebellion. Imperial troops were hurried up to the assistance of such police as the British South Africa Company still had at its command. Volunteers were enrolled, and much fierce fighting followed. Early in October Mr Rhodes, who had just returned from London, went to Bulawayo. After conference with the military and other authorities in command on the spot, he determined to go, with Dr Hans Sauer and Mr Colen- brander, and interview the native chiefs. They went unarmed into the heart of the Matoppo hills, and there arranged terms of peace with the native indunas. The interview involved grave personal danger to the emissaries, and depended for its success entirely upon Mr Rhodes’s personahty and influence over the native races ; but it terminated what promised to be a long and disastrous native war.

>” In 1897 a Select Committee appointed by the British House of Commons “to inquire into the origin and circumstances of the incursion into the South African Republic by an armed force, and into the administration of the British South Africa Company,” held their sessions. Among the numerous witnesses called upon to give evi- dence were all the directors of the British South Africa Company, with the exception of Lord Grey. The Com- mittee were unanimous in condemning the Jameson Raid,

and in holding Mr Rhodes mainly responsible for the measures which led up to it.

In April 1898 the shareholders in the Chartered Company unanimously re-elected Mr Rhodes a director. Mr Alfred Beit was also proposed, but declined to accept the position. He was, however, reappointed in June 1902. As a result of the report of the British South Africa Select Committee, the whole future administration of Rhodesia was taken into consideration by the British Government (the armed forces of the Company had already been placed under the direct control of the Crown), and on 20th October 1898 an Order in Council was passed providing for the future regulation of the country. An Imperial resident commissioner was appointed, who was also to be ex officio a member of the executive and legislative CouncUs ; and there was to be a legislative Council, consisting of five nominated and four elected members. These changes tended rather to increase the direct influence of the High Commissioner. It was also provided that this Order in Council, technically known as the Southern Rhodesia Order, might, if required, be ex- tended to any other part of South Africa under British protection south of the Zambezi. The first meeting of the newly appointed Council took place at Salisbury on the 15th of May 1899.

In the earlier part of 1899 Mr Rhodes visited London and Berlin in connexion with the furtherance of his schemes for the Trans – Continental telegraph extension from Cape Town to Cairo, and the Trans – Continental Railway. He endeavoured while in London to obtain from the Government the guarantee of a loan for the purpose of extending the railway, to be raised at 3 per cent., but was unsuccessful. He received, however, the support of various companies in Rhodesia, who amongst them subscribed ––252,800 at 3 per cent, for the imme- diate extension of the railway for 150 miles; and on 2nd May he stated, at a meeting of the Chartered Company, that the Rhodesia Railways Limited would raise another ––3,000,000 at 4 per cent, to be guaranteed by the Char- tered Company. In this way he hoped that the remaining 1050 miles of railway from Bulawayo to the frontier of German East Africa might be constructed. In Berlin Mr Rhodes had an interview with the German Emperor, when arrangements were arrived at with regard to the passage of telegraph lines over German territory. Mr Rhodes acted on behalf of the African Trans-Continental Telegraph Company, of which he was the promoter and principal director ; and on their behalf he received from the

German Government leave to construct a telegraph line across German East Africa, from south to north, at the cost of the Company, the work having to be completed within five years, from October 1899, the Company being called upon further to erect an additional line at its own cost between the two stations nearest to the German frontiers, from Rhodesia on the one side and British East Africa on the other, for the telegraphic traflic of German East Africa.

The early settlers of Rhodesia, for the first ten years of that country's existence, had a great deal to contend against. The political unrest of the country, the final breaking up of the Bantu power within its territories, the immense difficulties of transport, the Matabele rebellion, and a terrible cattle plague, known as rinderpest, all tended to keep back the country's progress. Never- theless, the sturdy colonists settled there never lost heart, and persistently, as occasion offered, continued their development of the various gold properties which offered sufficient inducement to mining. The progress of the whole counti-y, in spite of all draw- backs, has in many respects been remarkable. In no colony in South Africa, and probably in very few countries elsewhere in the world, has the extension of telegraphic communication and railways been so rapid and considerable in proportion to the population of the country. The telegraph line reached Salisbury in 1892, and at the end of 1899 a total of 3613 miles had been constructed. In addition to the telegraph lines, telephones have also been established

in many townships, and police posts in the country. Bulawayo is already a considerable town, with massive stone and brick buildings in the streets. The churches, hospitals, Stock Exchange, Government offices, banks, clubs, and hotels are equal to those of many of the older towns in South Africa. Both Salisbury and Bulawayo have municipalities ; and municipal authorities are doing excellent work in the shape of road-making, lighting, tree-planting, &o., as well as in the laying out of public parks. The railway from Beira reached Salisbury in May 1899.

An efficient and mobile police force of a thousand Europeans, and three hundred native troops under Imperial officers, have their headquarters at Salisbury and Bulawayo, and detachments of these are ijlaced at various outposts. In addition to gold, coal has been found in Rhodesia in various parts, of excellent quality and in considerable abundance. Good timber is found in the valleys, and excellent examples of locally made furniture and of wood for paving have already been sent to England. In some parts of the country have been found ancient ruins of extreme interest, especi- ally those of Zimbabye, near Victoria. At these various ruins, implements and ornaments, some of them in gold and of great antiquity, have been discovered.

Northern Rhodesia is divided into two territories ❓❓❓ North- Eastern and North-Western Rhodesia ❓❓❓ and is administered by the British South Africa Company under the Orders in Council of 1899 and 1900. There is a separate administrator for each territory, the headquarters of the former administration being at Fort Jameson, and of the latter at Lealui. Tho country, although more tropical than Southern Rhodesia, is, for the greater part, a continuation of the high and healthy South African plateau, which extends from the Karroo in Cape Colony through Southern Rhodesia and north of the Zambezi. The territories are believed to be highly mineralized, and valuable deposits of copper have already been discovered, and are being developed. The African Trans-Continental Telegraph line has been constructed through North-Eastern Rhodesia, and the proposed Cape to Cairo Railway will, after leaving Victoria Falls on the Zambezi river, pass through North-Western and North-Eastern Rhodesia to the northern border at Lake Tanganyika.

Authorities. ❓❓❓ E. F. Knioht. EhodeHa of To-day. ❓❓❓ Bktce. Impressions of South Africa. ❓❓❓ T. H. Bent. Suined Cities of Mashonaland. ❓❓❓ F. 0. Selous. Sunshine and Storm in Rhodesia. ❓❓❓ Peatt. Leading Points in South African History.

(a. p. h.)

Rhondda^ an urban district and coal -mining locality of Glamorganshire, Wales, crossed by the river Ehondda, a right-bank tributary of the Taff,

and separated on the east by the Rhondda-fach river from the parliamentary borough of Merthyr Tydfil. Population (1891),

88,351 ; (1901), 113,735.

RhdnGj a department of south-eastern France, trav- ersed by the Cevennes Mountains and watered by the Sa6ne and by the Rh6ne, two rivers uniting at Lyons.

Area, 1104 square mUes. The population, 741,470 in 1881, had increased to 835,157 in 1901. The births in 1899 were 15,998, of which 2143 were illegitimate ; deaths, 17,662 ; marriages, 6236. There were in 1896, 1207 schools, with 91,000 pupils, not more than 1 per cent, of the population being illiterate. Out of 610,090 acres of land cultivated in 1896, 321,100 acres were plough-land and 74,100 acres vineyards. In 1899 the wheat harvest was valued at ££536,000; rye, ££84,000; oats, ££104,000; potatoes, ££296,000; vines, ££1,120,000. The live stock in 1899 included 16,880 horses, 90,120 cattle, 38,100 sheep, 24,470 pigs, and 29,280 goats. Mining in 1898 yielded 32,400 metric tons of coal and 310,000 tons of copper, from the mines of Chessy. The metal industry turned out in 1898, 17,000 metric tons of cast-iron, 450 tons of iron, and 3100 tons of steel, of the total value of ££58,000. The department is, however, mainly engaged in textile industries. Tarare manufac- tures muslins ; Ample, pins and cottons ; Thizy, linens. Lyons shares with St]6tienne the monopoly of the silk manufacture, the value of the annual production of velvets and ribbons of this second eity of France amounting to 20 millions sterling. Lyons, the capital, had in 1901, 453,145 inhabitants.

RhdnCi a river of France, rising in Switzerland in the Ehone glacier, between the Furka and Grimel peaks of the St Gothard mass. It flows generally south-west and west, though with many windings, through Switzerland and eastern France to its confluence with the Sa6ne at Lyons, where it turns south to the Mediterranean. The following particulars with regard to the navigation of the Eh6ne are taken from the Stafistique de la Navigation

Interiewre, 1901. The figures are those for 1900. The tonnage includes wood floated. The Rhone is ofiicially classed in three sections :❓❓❓ (1) From the Swiss frontier to Lyons, 96 miles, mean depth 3”28 feet, crossed by 20 bridges. This includes the s,o-csA\tA. Jlottahle part between the Swiss frontier and Pare, a distance of 25 miles, but in which the traffic is nil. Number of boats, 8469 (of which 8271 in descent); total tonnage of merchandise carried, 197,402. In this section the boats come down laden, but are usually drawn up empty by horses. (2) Lyons to Aries, 178 miles, mean depth 5‘25 feet, crossed by 29 bridges. Number of boats, 4628 (of which 3108 in descent); total tonnage, 580,423. (3) Aries to the sea, 30 miles, depth 6-56 feet; boats 1607 (902 in descent); total tonnage, 328,733. Petit Shone, 38 miles, mean depth 5‘25 feet, boats 53 (all in descent) ; total tonnage, 4725.

The Sa6ne is classed between Jonvelle and Lyons ; total length 260 miles, in two sections, each comprising two sub-sections: ❓❓❓ (1) Jonvelle to Gray, 61 miles; Gray to St Jean-de-Losne, 40 miles ; total, 101 miles. Of this the part between Jonvelle and Corre, 7 miles, is classed a.s Jlottable, but is without traffic, while of the part classed as navigable, a length of about 20 miles to Corre is practi- cally abandoned. From this place the Sa6ne is canalized. Mean depth 6 “56 feet, crossed by 53 bridges; number of boats 2785 (1879 in descent); total tonnage, 501,624. (2) St Jean-de-Losne to Verdun 27 miles, Verdun to Lyons 104 miles, total 131 miles, crossed by 50 bridges, mean depth 6‘56 feet, number of boats 6914 (5277 in descent); total tonnage, 814,858. The traffic from He Barbe across Lyons to the Rh6ne comprised 4560 boats (3377 in descent); total tonnage, 617,215.

Statistique de la Navigation Intiriewre (MinistJre des Travaux Publiques), 2 vols. 4to, Paris, 1901.

Rhyl, a seaside resort of North Wales, at the end of the Vale of Clwyd, about half-way between Chester (30 mUes east-south-east) and Bangor. It is visited for its fine stretch of sands and its dry and bracing air. Its other attractions embrace an esplanade a mile long, golf links, and a pier 700 yards long. The Queen Alexandra Hospital was opened in 1902 by the Prince of Wales. Population (1891), 6491 ; (1901), 8473.

Ri beira, a township of Spain, in the province of Corunna, on the extreme south of the peninsula formed by the river of Muros y Noya and the estuary of Arosa. It lies in a hOly country, abounding in wheat, wine, fruit, fish, and game. Its port is Santa Eugenia de Ribeiro, on the Arosa estuary. The church and parish buildings are not worth notice. The population, chiefly occupied in agriculture, rearing of cattle, and fisheries, was 10,352 in 1887, and 10,700 in 1897.

Ribot, Alexandre F4lix Joseph (1842-

), French statesman, was born at St Omer on

7th February 1842. After a brilliant career at the Uni- versity of Paris, where he was lawreat of the Faculty of Law, he rapidly made his mark at the bar. He was secretary of the Conference of Advocates and one of the founders of the Societe de legislation comparee. During 1875 and 1876 he was successively director of criminal affairs and secretary-general at the Ministry of Justice. In 1877 he made his entry into political life by the conspicuous part he played on the Committee of Legal Resistance during the Broglie ministry, and in the follow- ing year he was returned to the Chamber as Moderate Republican member for Boulogne, in his native department of Pas-de-Calais. His impassioned yet reasoned eloquence gave him an influence which was increased by his articles in the Parleimnt. He devoted himself especially to financial questions, and in 1882 was reporter of the

budget. He became one of the most prominent opponents of the Radical party, and distinguished himself by his attacks on the shortlived Gambetta ministry. Notwith- standing his dishke to the policy of colonial expansion he yet joined hands with M. Clemenceau, with whom he shared the chief part in the overthrow of Jules Ferry. At the general election of 1885 he was one of the victims of the Republican rout in the Pas-de-Calais, and did not re- enter the Chamber till 1887. After 1889 he sat for St Omer. He was a determined opponent of the Boulangist movement; and, alarmed by

its menace to the existence of the Republic, he became a convert to the policy of Republican concentration. He entered office in 1890 as foreign minister in the Freycinet Cabinet. He had an intimate acquaintance and sympathy with English institu- tions, and his only published works ◆◆◆ an address, Biographie de Lord Ershine (1866), and ◆◆tvde sur I'acte du 5 avril 1873 pour rStablissement d'une cour supreme de justice en Angleterre (1874) ◆◆◆ both deal with English questions; but he gave a fresh and highly important direction to French policy by the understanding with Russia, which was declared to the world by the visit of the French fleet to Cronstadt in 1891, and which subsequently ripened into a formal treaty of alliance. He retained his post in the Loubet ministry (February-November 1892), and on its defeat was entrusted with its reconstruction, remaining at the Foreign Office, and at the same time becoming president of the Council. In a few days fresh developments of the Panama scandal forced him to drop some of his colleagues. In the new allocation of offices he himself took the ministry of the intei^or. The Government resigned in March 1893 on the refusal of the Chamber to accept the Senate's amend- ments to the budget. On the election of F^lix Faure as president of the Republic in January 1895, M. Ribot again became premier and minister of finance. By the irony of fate it was the opponent of French expansion in Tongking whose premiership saw Madagascar added to possessions of France ; but this expedition had been decided long before, and M. Ribot himself had, in the preceding year, been president of the commission des crMits for that purpose. On 10th June he was able to make the first announcement of a definite alliance with Russia. Internal politics centred round the Carmaux strike. On 28th October the premier's action was ap- proved by the Chamber ; but two days later the Govern- ment was defeated on the question of the Chemins de fer du Sud, and resigned office. The real reason of its fall was the mismanagement of the Madagascar expedition, whose cost in men and money exceeded all expectations, and the alarming social conditions at home. M. Ribot was elected, at the end of 1898, president of the important commission on education, a post for which he was peculiarly fitted by his practical experience as professor at the ◆◆cole des sciences politiques. His staunch Republicanism did not deter him from an alliance with the forces of reaction and Csesarism against M.

Waldeck-Rousseau ; but at the general election of 1902, though he himself secured re- election, his pohcy suffered a severe check.

Ribot, Theodule Armand (1839),

French psychologist, was born at Guingamps, 18th December 1839, and was educated at the Lyc6e de St Brieuc. In 1856 he began to teach, and was admitted to the Ecole Normale Sup(4rieure in 1862. He was made sub-professor of philosophy in 1867, and Doctor of Letters in 1873. In 1865 he accepted the chair of philosophy at the Lyc^e de Vesoul, three years later removing to the corresponding chair at Laval, where he remained till 1872. In 1885 he gave a course of lectures on "Experimental Psychology" at the College of France. In 1887 he was

decorated witb. the Legion of Honour. His thesis for his doctor's degree, republished in 1882, Heredite: etude psycho- logique, is his most important and best known book. Following the experimental and synthetic methods, he has brought together a large number of instances of inherited peculiarities ; he pays particular attention to the physical element of mental life, ignoring all spiritual or non-material factors in man. In his work on La Psychologic anglaise contemporaine (1870), he shows his sympathy with the sensationalist school, and again in his translation of Herbert Spencer's Principles of Psychology. Besides numerous articles he has written on Schopenhauer and on the contemporary psychology of Germany, also four little monographs on Les Maladies de la memoire (1881), De la Volonte (1883), De la Personalite (1885), and La Psycho- logie de V attention (1888), which supply useful data to the student of mental disease. As the editor of La Revue philosophique, a periodical which he himself founded, he has had a useful influence in encouraging the scientific study of psychology.

Ricasoli, Bettino, Baeon (1809 – 1880),

Italian statesman, was born at Brogho, 19th March 1809. Left an orphan at eighteen, with an estate heavily encumbered, he was by special decree of the grand duke of Tuscany declared of age, and entrusted with the guardianship of his younger brothers. Interrupting his studies, he withdrew to BrogHo, and by careful manage- ment disencumbered the

family possessions. In 1847 he founded the journal La Patria, and addressed to the grand duke a memorial suggesting remedies for the difficulties of the state. In 1848 he was elected Gonfa- loniere of Florence, but resigned on account of the anti- Liberal tendencies of the grand duke. As Tuscan minister of the interior in 1859, he promoted the union of Tuscany with Piedmont, which took place on 12th March 1860. Elected Italian deputy in 1861, he succeeded Cavour in the premiership, and upon acquiring personal experience of the Southern provinces, abandoned his regionalist ideas in favour of a thoroughly unitary pro- gramme. As premier he admitted the Garibaldian volun- teers to the regular army, revoked the decree of exile against Mazzini, and attempted reconciliation with the Vatican ; but his efforts were rendered inefiectual by the lion poeswmus of the pope. Disdainful of the intrigues of his rival Rattazzi, he found himself obliged in 1862 to resign office, but returned to power in 1866. On this occasion he refused Napoleon III.'s offer to cede Venetia to Italy on condition that Italy should abandon the Prussian Alliance, and also refused the Prussian decoration of the Black Eagle because Lamarmora, author of the alliance, was not to receive it. Upon the departure of the French troops from Rome at the end of 1866, he again attempted to conciliate the Vatican with a convention, in virtue of which Italy would have restored to the Church the pro- perty of the suppressed religious orders in return for a gradual payment of ►►24,000,000. In order to mollify the Vatican he conceded the exequatur to forty-five bishops inimical to the Italian regime. The Vatican accepted hia proposal, but the Italian Chamber proved refractory, and, though dissolved by Ricasoli, returned more hostile than before. Without waiting for a vote, Ricasoli resigned office and thenceforward practically disappeared from political life, speaking in the Chamber only upon rare occasions. He died at Broglio on 23rd October 1880. His private life and public career were marked by the utmost integrity and by a rigid austerity, which earned him the name of the " Iron Baron." In spite of the failure of his ecclesiastical scheme, he remains one of the most noteworthy figures of the Italian Risorgimento. (h. w. s.)

RICHARDSO N ►►►R I C H M O N D

Richardson, Henry Hobson (1838-1886),

American architect, was bom in the parish of St James, Louisiana, 29th September 1838. He graduated from Harvard College in 1859, and the same year went to Paris to study architecture, where he was admitted a member of the ►►cole des Beaux Arts. After his return to America he opened an office in New York, and was for eleven years (1867-78) in partnership with Mr Charles Gambrill, when he removed to Brookline (Boston), Massa- chusetts, where he resided till his death, 27th April 1886. His first commission (1866) was to design a church in Springfield, Mass. Thereafter he rose rapidly in his profession, and at the age of thirty ~~four (1872) was appointed the architect, after competition, for Trinity Church, Boston,^ of which Phillips Brooks was the rector. The building was dedicated in 1877, and is generally con~~ sidered to be his masterpiece and the best example of ecclesiastical architecture in the United States. The style of the building, constructed of yellowish-grey granite trimmed with red sandstone, is ►►► like much of Eichardson's work►►► strongly influenced by the Romanesque of the South of France ; whUe the massive square tower in the centre, perhaps the dominating feature, was suggested by the tower of Salamanca. Among his other buildings are the Court House in Pittsburg (which he himself considered his most successful work), the Brattle Square Church in Boston, Sever Hall at Harvard, the town-hall, raUway station, and library at North Easton, Mass., and the City Hall, Albany, N.Y. He also designed the Field Building, Chicago, the Chamber of Commerce, Cincinnati, and a number of private residences. (For his place in the development of architecture in America see the article Aechitbcttjee in volume xxv. of this work.) His qualities as an artist have been summarized by an admiring critic and biographer (Mrs Schuyler van Renssalaer, in Henry Hohson Richardson and his Works'), as strength, clearness, breadth in treatment, imagination, and a love for massive dignity of aspect and often for romantic effect. He married, in 1867, Miss Julia Gorham Hayden, of Boston.

Richepin, Jean (1849), French poet,

novelist, and dramatist, was born at Medea (Algeria), 4th February 1849. His youth gave evidence of brilliant, if somewhat undisciplined, powers, for which he found physical vent in different directions ??? first as a franc tirev/r in the Franco-German War, and afterwards as actor, sailor, and stevedore ??? and an intellectual outlet in the writing of poems, plays, and novels which vividly reflected his erratic but unmistakable talent. A play, L'Moile, written by him in collaboration with Andr6 Gill, was produced in 1873 ; but Richepin was virtually unknown until the publication, in 1876, of a volume of verse entitled Chanson des Gueux, whose outspokenness resulted in his being imprisoned and fined for mitrage aux moeurs. The same quality has characterized his suc- ceeding volumes of verse : Les Caresses (1877), Les Blas- phemes (1884), La Mer (1886), Mes Paradis (1894), La Bomharde (1899). His novels have developed in style from the morbidity and brutality of Les Morts bizarres (1876), La Glu (1881), and Le Pavd (1883), to the more thoughtful psychology of Madame Andrd (1878), Sophie Monnier (1884), C^sarine (1888), L'AimJ (1893), Grandes Am,oureuses (1896), and Lagibasse (1899), and the more simple portrayai of life in Miarha (1883), Les Braves Gens (1886), Truandailles (1890), La Miseloque (1892), and Flamhoche (1895). His plays, though occasionally marred by his characteristic proneness to violence of thought and language, constitute in many respects his best work. The most notable are Nana Sahib (1883), Monsieur Scapin (1886), Le Mibustier

(1888), Par le Glaive (1892), Vers la Joie (1894), Le C/iemineau (1897), Le Chien de Garde (1898), Les Truands (1899), La Beine de Tyr (1900), La Cavaliere

(1901).

Rich Hill, a city of Bates county, Missouri, U.S.A., on the Osage river, at the intersection of the Kansas City, Fort Scott, and Memphis and the Missouri Pacific railways, in the western part of the state, at an altitude of 784 feet. It is in a coal-mining region, and has varied manu- factures, including zinc smelting, flour milling, and cigar making. Population (1880), 36; (1890), 4008; (1900), 4053, of whom 255 were foreign-born and 61 negroes.

Richmond, a parish and, since 1890, municipal borough in the Kingston division of Surrey, England, on the Thames, 10 miles west of the City of London by rail. The borough now includes Kew, Petersham, and North Sheen. In 1894 a footbridge and lock were opened. A new church has been erected ; also a new theatre and opera house, and a town-hall in the Elizabethan Renaissance style, which cost, with some adjoining pleasure grounds, ??24,000. The famous view from the top of Richmond Hill is secured to the public by an agreement, sealed 7th February 1896, between the corporation and the trustees of the Earl of Dysart, by an Act of Parliament of 1902, and by the acquisition in the same year, by the London County Council, with the assistance of the borough of Richmond and other interested local authorities, of the Marble Hill Estate and other property on the Middlesex shore. Population (1881), 19,066; (1891), 26,875; (1901),

31,677.

Richmond, a city of Indiana, U.S.A., capital of Wajme county, on a branch of the river Whitewater, and on the Grand Rapids and Indiana and the Pittsburg, Cin- cinnati, Chicago, and St Louis railways, in the eastern part of the state, at an altitude of 962 feet. The city is divided into seven wards, has a good water supply and drainage system, and has natural gas. It is in a rich farming region, and has considerable trade and manufac- tures of varied character. It is the site of Earlham College, which in 1899 had a faculty numbering 15 and was attended by 228 students, about half of whom were women. Population (1890), 16,608; (1900), 18,226, of whom 1467 were foreign-bom and 1009 negroes.

Richmond, a city of Kentucky, U.S.A., capital of Madison county, a little east of the centre of the state, on the Louisville and Nashville Railroad, at an altitude of 926 feet. It is in an agricultural region, devoted to the cultivation of tobacco and the raising of fine horses. It contains Central University, a Presbyterian institution, opened in 1874, which had, in 1899, a faculty of 77 and was attended by 811 students, 145 of whom were women. Population (1880), 1424; (1890), 5073; (1900), 4653, of whom 52 were foreign-bom and 2087 negroes.

Richmond, the chief city and capital of Virginia, U.S. A., on the north bank of the river James, near the head of navigation and at the foot of the falls. The city spreads over a group of hills, on which it is laid out in a fairly regular plan, and is divided into six wards, which, instead of being numbered, as in most cities, have received names. Clay, Jackson, Jefferson, Madison, Marshall, and Monroe. The water-works, which pump the supply from the river, and the gas-works are owned by the city. It is sewered, and its business streets are paved with granite blocks, while its residential streets are in the main macadamized.

The city has five railways, the Atlantic Coast Line, the Chesapeake and Ohio, the Richmond, Fredericksburg, and

Potomac, the Seaboard Air Line, and the Southern. The large commerce by sea which Eichmond enjoyed before the Civil War has in great part disappeared, but its place has been taken by tratfic by rail and by manufactures, in which the city has been aided by the fine water-power in the falls of the James. In 1900 Eichmond contained 763 manufacturing establishments, .with a total capital of $20,848,620. They employed 16,692 hands, and the product was valued at $28,900,616. Of this large_ total, the manufacture of tobacco made more than one-third, or $10,537,803, which illustrates the importance of the place as a tobacco market. Other manufactures of importance were boots and shoes, flour, fertiKzers, and foundry and machine-shop products. Eichmond is the seat of Eich- mond College, a Baptist institution opened in 1832. In 1899 it had a faculty of 17 and was attended by 262 students. Womans College, of the same denomination, opened in 1854, had in 1896-97 a faculty of 19, and was attended by 205 students. The assessed valuation of real and personal property was, in 1899, $69,552,821, the net debt of the city was $6,856,604, and the rate of taxation, $18-00 per $1000. Population (1890), 81,388; (1900), 85,050; of whom 2865 were foreign-born and 32,230 negroes.

Richmond, Sir William Blake (1842-

-), English painter and decorator, was born in London

on 29th November 1842. At the age of fourteen he entered the Eoyal Academy schools, where he worked for about three years ; but he was also guided in his art education by the teaching of his father, George Eichmond, K.A., and by the advice of John Euskin, who took much interest in his career. A visit to Italy in 1859 gave him special opportunity for studying the works of the old masters, and had an important effect upon his develop- ment. His first Academy picture was a portrait group, exhibited in 1861 ; and to this succeeded, during the next three years, several other pictures of the same class. In 1865 he returned to Italy, and spent four years there, living chiefly at Eome. To this period belongs the large canvas, " A Procession in Honour of Bacchus," which he exhibited at the Academy in 1869 when he came back to England. A visit to Algiers followed in the winter of 1870; in 1882 and 1883 he travelled through Greece and the Aegean Isles; and in 1885 went to Egypt, making on each occasion a great number of studies of the local scenery and architecture. His picture, " An Audience at Athens " (see Plate), was exhibited at the Grosvenor Gallery in 1885. He became Slade professor at Oxford, succeeding Euskin, in 1878, but resigned three years later. He was elected an Associate of the Eoyal Academy in 1888, and Eoyal Academician in 1895; he received the degree of D.C.L. in 1896, and a knighthood of the Bath in 1897, and has held the office of professor of painting to the Eoyal Academy. His pictures have always been dis- tinguished by notable qualities of design and by sound knowledge of the human form, and his portraits by elegance and refinement ; but perhaps his highest capacity appears in his decorative work. His most conspicuous achievement in this branch of art is the internal decoration and the glass Mosaics of St Paul's Cathedral. Sir WilUam Eichmond has, it should be added, taken a keen interest in social questions, particularly in smoke-prevention in London.

Richter, Eugen (1839-

-), German politician,

was bom on 30th July 1839 at Diisseldorf. After attend- ing the universities of Bonn, Heidelberg, and Berlin he entered the Government service, being stationed in his native town. In 1864 he was chosen burgomaster of Neuwied; but he was already known for his Liberal opinions, and the Government refused to confirm the appoiatment.

He was hereupon transferred to Bromberg, in East Prussia, which to an inhabitant of the Ehineland was the worst form of exile, and in consequence he resigned his place in the public service. He now went to Berhn, where he earned his living as a journaUst. He had aheady pub- lished a pamphlet advocating the freedom of public- houses from the control whether of gilds or the police, and was the most consistent advocate of those doctrines of laissezfaire and individual liberty which the Germans call Manche&terthum. He was also keenly interested in the attempts made at that period to create co-operative societies among the working men, and wrote a work on co-operative stores. It was not long before he came into conflict with the Government; an electioneering pamphlet published in 1867 was confiscated; he was put on his trial but acquitted. In 1867 he was elected a member of the newly-formed Eeichstag, and in 1869 of the Prussian Parliament. He soon became one of the most influential politicians in Germany. No one was more assiduous in his attendance or more frequent as a speaker; endowed with great fluency and an admirable memory, quickness in rejoinder, and a very great knowledge of affairs, and especially of financial matters, he at length became the most experienced member of Parliament in Germany. A member of the Progressive party, in 1880 one of the founders, and eventually the leader, of the Freisinnige, he was always in opposition. Next to Windthorst {q.v.) he was Bismarck's most dangerous opponent. After the great change of policy in 1878, for a time his influence was a great impediment to the Government; as a consistent adherent to free trade, he was the leader of the opposition to the introduction of protection, to the new Colonial policy, and to State Socialism. It was after 1880 that he raised the cry BisTnarch m,uss fort. He always took a great part in debates on the military and naval estabhsh- ments, in vain opposing the constant increase -of army and navy. It was his refusal to support the Government proposals in 1893 for an increase of the army which led to the break up of his party : he was left vpith only eleven

followers; and except among the middle class of Berlin and some other Prussian cities, the old Eadical party, of which he was the chief representative, from that time had little influence in the country. Though a bitter enemy both to Clericalism and to Socialism, it is to his credit that he had so much faith in the justice of Liberal principles that he never was led to support the exceptional legislation by which the Prussian Government and the German people attempted to crush opinions with which they did not agree. He was equally active as a writer. Since 1882 he has been editor of the Freisinnige Zeitung ; of his numerous brochures the most successful was his attack on Socialism, entitled Der socialistische Zukunfts-Staat, a clever and successful satire on the Socialist State of the future. This has been translated into English. He also wrote much on Prussian finance, and under the title Bos politische A, B, C Buck compiled a very useful pohtical handbook for Eadical voters. He also published reminiscences of his youth (Jugend-ErinTierungen), and two volumes of parUa- mentary reminiscences {Im alien Beichstag).

-), Hungarian musical

Richter, Hans (1843-

conductor, born at Eaab, 4th April 1843, was the son of the Domcapellmeister there and of his wife, n^e Josephine Csazinsky, the first Viennese Venus in Tannhduser. Naturally, the offspring of this couple was musical. Young Hans sang either soprano or alto in the Cathedral choir, according to requirement, and occasion- ally played the organ. But his pubhc d^but was made as a drummer in Haydn's Pauhenmesse. In 1853, at the age of ten, he appeared in a concert as pianist in

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Hummers E flat quintet; and in 1854, after his father's death, went to the Lowenburg Convikt (where Schubert was educated) in Vienna, and there became chorister in the Court Chapel. For five years from 1860 Richter studied under Heissler and Sechter in the Vienna Con- servatorium, and the horn under Kleinecke. A year and a half after his first lesson he became hornist in the old Karnthnerthor Theatre at ??3 a month. Meanwhile he had devoted time to conducting. His orchestral post he resigned in 1866 on being appointed copyist to Wagner, then living at Triebschen, near Lucerne. There he copied Die Meistersinger. In December of the following year Von Billow induced him to go to Munich, where he actually sang the part of Kothner in the 6th performance of Die Meistersinger. It was not till August 1868 that Richter made his first appearance as a conductor, at the Hof Theater, Munich (where he had just been appointed), in William Tell; but in the next year he resigned this post, went first to Paris, then to Brussels, and finally to Triebschen, where he copied Der Ring des Nibelimgen. In April 1871 Richter took up his new duties as conductor of the Hungarian National Opera at Budapest, where he remained four years, until he began in May 1875 his long connexion with the Vienna Opera, which terminated only with the century. In the same year Richter directed the rehearsals and performances of Der Ring at Bayreuth, and in 1877 paid his first visit to England to conduct the Wagner Festival at the Albert Hall. There in 1879 he founded the Richter Concerts; in 1885 he became conductor of the Birmingham Triennial Festival, and was created Mus. Doc. Oxon. honoris causd. In 1882 Richter also conducted a famous series of performances of Wagner's works (including the first in England of Die Meistersinger and Tristan) at Drury Lane, and some years afterwards became conductor of the Hall6 Orchestra in Manchester. That Richter must be considered one of the most richly gifted and the most experienced of modern conductors is universally acknowledged. In the works of

Beethoven and Brahms his surpremacy is unchallenged, while as a Wagnerian conductor few have reached his level.

Rickets: See Pathology : Metabolic Diseases.

Ricotti, Maernani Cesare (1822 — ???),

Italian general and knight of the Annunziata, was born at Borgo Lavezzaro on 30th June 1822. As artillery lieutenant he distinguished himself and was wounded at the siege of Peschiera in 1848, and in 1852 gained further distinction by the courage with which he sought to prevent the explosion of a burning powder magazine. After serving from 1856 to 1859 as director of the Artillery School, he took part in the war against Austria, and commanded the 5th division at the battle of San Martino. In the war of 1866 he stormed Borgoforte, to open a passage for Cialdini's army. Upon the death of General Govone in 1870 he was appointed minister of war, and after the occupation of Rome bent all his efforts to army reform, in accordance with the lessons of the Franco-German War. He shortened the period of military service ; extended conscription to aU able-bodied men ; created a permanent army, a mobile militia, and a reserve ; commenced the renewal of armaments ; and placed Italy in a position to put 1,800,000 men on a war footing. Ricotti fell from power with the Right in 1876, but returned to ofiice with Depretis in 1884, and amended his previous scheme of reform. Resigning in April 1887, he took little part in public life until 1896, when, after the battle of Adowa, he was entrusted by King Humbert with the formation of a Cabinet. Having constructed his ministry, he made over the premiership to the Marquis di Rudini, retaining for himself the portfolio of war, and

seeking to satisfy popular demands for the reduction of military expenditure by consolidating the tactical structure of the army without weakening its fighting power. Rudini, however, finding that Ricotti'a ideas, which he himself shared, were not acceptable in the highest quarters, obliged him to resign office. His prestige as creator of the modern Italian army remained unimpaired, and his views on army consolidation enjoyed a large measure of technical and public favour.

Riesa, a town of Germany, on the Elbe, 12 miles by rail north-north-west of Meissen, in the circle of Dresden, kingdom of Saxony. There are 2 churches, a harbour with quays and a dockyard, rolling-mills and saw-mills, agri- cultural implement and other works, and sandstone quarries. The most important shipping station on the Elbe in Saxony, Riesa is the lading -place for transmarine goods to and from Bavaria, and a mart for herrings, petroleum, coal, grain, &c. Population (1890), 9389 ; (1900), 13,492.

Rifle. ❖❖❖ A rifle is a musket with a grooved bore. The rifling of a firearm is the cutting away of the interior of the barrel or bore so as to form spiral grooves upon its surface. The objects of this spiral grooving are to guide the projectile down the barrel, force it to turn upon its own axis and impart to it a rotatory motion which it shall maintain during flight, and thus equalize any irregularities in its form or weight, and so lessen the tendency to depart from a straight line, and also in a measure to overcome atmospheric resistance. Rifling was invented about 1520, by Gaspard KoUner, a gunmaker of Vienna, according to some authorities ; by Augustus Kotter of Nuremberg, according to others. In some cases the grooves were made straight, to admit a tight-fitting bullet and relieve the effects of fouling ; they were more usually spiral. Parallel, half-round narrow grooves, probably two or more in number, constituted the rifle in its most primitive form ; later, from three to twelve grooves were more common. The amount of turn varied in old rifles, from a half or three-quarters turn to one turn in two to three feet. The form and depth of grooving also greatly varied. Rifles were at first used for amusement, and were not employed in warfare until about the middle of the 17th century.

Military Rifles. ❖❖❖ Rifles were not generally used in the British army until 1855. There are, however, instances of their occasional employment in the 17th and 18th centuries, particularly by Continental nations. In 1631 the Landgraf of Hesse had a troop of riflemen. Ten years later Maximilian of Bavaria had several troops armed with rifled arquebuses. Louis XIII. armed his bodyguard with rifles. Napoleon withdrew the rifle from his troops, to whom it had been issued during the wars of the Republic, nor did the French make any considerable use of it again until 1830, when the Chasseurs d'Orleans were armed with it for the invasion

of Algeria. The British learnt the value of rifles during the American War of Independence, when the Government subsidized Continental Jdgers armed with rifles to oppose the American backwoodsmen, whose rifle-shooting was most deadly.

It is interesting here to note the chief infantry firearms that preceded the modern military rifle. The hand cannon of 1471 was quickly superseded by the matchlock, which remained in use until the Commonwealth. About 1530 the wheel-lock was first brought to England, but few were supplied to English soldiers until the time of Charles I. In the reign of James I. some flint-locks were issued to leading regiments, and in the reign of WiUiam III they came into general use. From them was developed the renowned " Brown Bess," a flint-lock smooth bore, for a century and a half the regulation musket of the British Army. Thus the weapon that won at Waterloo was

of the same type as that which the British used at Ramillies and Blenheim. In the Brown Bess and similar military muskets the bullet was two sizes smaller than the bore, wrapped in a loosely-fitting patch which formed the cartridge ; the loading was therefore easy, whereas the muzzle-loading rifle with a closely-fitting ball was loaded with difficulty, particularly when foul, and for this reason was not generally used as a weapon of war. The Brown Bess had a high trajectory and a very low velocity, with an effective range of under 200 yards. The percussion system was only generally applied to the Brown Bess in 1842, a quarter of a century after its invention, and after an elaborate test at Woolwich in 1834. In 1800 the 95th Regiment (afterwards the Rifle Brigade) were armed with a weapon known as " Baker's Rifle," which weighed 9^ Bb. The barrel was 2^ feet long, its calibre 20 bore, vsdth seven grooves making a quarter turn in its length. A small wooden mallet was at first supplied with this rifle to make the ball enter the barrel, and it was loaded vnth great difficulty. In 1826 Delvigne, a French infantry officer, invented a breech with abrupt shoulders on which the spherical bullet was rammed down until it expanded and filled the grooves. The objection was that the

deformed bullet had an erratic flight. In William IV. ‘s reign the Brunswick rifle was introduced into the British army. Its weight with bayonet was 11 Hi 5 J ozs. ; length of barrel

2 feet 6 inches; with two grooves making one turn in the length of the barrel; weight of spherical belted bullet 557 grs. ; diameter ‘696 inch ; charge of powder 2 J drs. This rifle was not easily loaded, soon fouled, and shot wild beyond 400 yards.

In 1835 W. Greener produced a new expansive bullet, an oval ball, a diameter and a half in length, with a flat end, perforated, in which a cast metallic taper plug was inserted. The explosion of the charge drove the plug home, expanded the bullet, fllled the grooves and prevented windage. A trial of the Greener bullet in August 1835, at Tynemouth, by a party of the 60th Rifles, proved suc- cessful. The range and accuracy of the rifle were retained, while the loading was made as easy as with a smooth-bore musket. The invention was, however, rejected by the military authorities on the ground that the bullet was a compound one. In 1852 the Government awarded Minie, a Frenchman, ––20,000 for a bullet of the same principle adopted into the British service. Subsequently in 1857 Greener was also awarded ––1000 for ” the first public sug- gestion of the principle of expansion, commonly called the Mini^ principle, in 1836.” The Mini^ bullet contained an iron cup in a cavity at the base of the bullet. In 1851 a rifle musket of the Mini6 pattern was introduced into the British army, and, though not generally issued, was used in the Kaffre War of 1851, and in the Crimea at the battles of the Alma and Inkerman. Its weight with bayonet was 10 lb 8f ozs., length of barrel 3 feet

3 inches, with four grooves, making one turn in 78 inches; charge of powder 2^ drs., and sighted from 100 to 1000 yards. The form of its bullet was at first conoidal, after- wards changed to cylindro-conoidal with a hemispherical iron cup. In 1855 the Enfield rifle, having in a series of trials competed favourably with the Mini^ and Lancaster rifles, was introduced into the British army; was used during the latter part of the Crimean war, having there replaced the Mini6 rifle pattern 1851 and the percussion musket 1852, and remained the general weapon of the entire infantry until the introduction of the breech-loader in the year 1867. This

rifle weighed, with bayonet, 9 lb 3 ozs., with 39-inch barrel ; diameter of bore ‘577 inch ; three- grooved with one turn in 78 inches. It flred a bullet of cylindro-conoidal form with hollow base, weighing 530 grains, made up into cartridges and lubricated as for the

Mini^ rifle, adapted to this rifle by Pritchett, who was awarded ►►1000 by the Government. Short rifles of the same pattern, with five-grooved barrels 2 feet 9 inches long, and a sword bayonet, were supplied to the 60th Rifles and to the Rifle Brigade. Two small carbines of the same principle were at this time introduced for the cavalry and artillery, also a rifled pistol.

In 1854 Lord Hardinge, then Commander-in-Chief of the British army, sought the aid of Sir Joseph Whitworth, the first mechanician of the day, in considering the subject of rifling. After a long series of experiments the Whitworth rifle was produced with hexagonal bore, ‘45 inch calibre, and with one turn in 20 inches. It was tried at Hythe in 1857, and beat the Enfield rifle by 3 to 1, up to 1800 yards upon a fixed rest. This trial and Whitworth’s experiments proved the .advantages of a sharp twist, a smaller bore, and elongated projectile ; but Whitworth’s rifle was never adopted into the Government service, probably because the hexagonal rifling wore badly, and ovnng to the difiiculty of equal mechanical perfection in all similar rifles and ammunition. Several improvements were subsequently made in the sighting, grooving, and some other details of the Enfield rifle. In 1855 a box- wood plug to the bullet was used.

Between 1857 and 1861 four breech-loading carbines were experimentally introduced in the cavalry ►►►viz.. Sharp’s, Terry’s, Green’s, and Westley- Richards’. The general adoption of the breech-loading principle may be said to date from 1867. The Prussians were the first to see its great advantages, and in 1848 had adopted the needle-gun breech-loader, afterwards so celebrated in the Danish war of 1864, against the Austrians in 1866, and against the French in 1870. In June 1864, and in October 1866, special military committees were appointed by the British War Office to consider and report on breech- loading arms, and proposals were invited from the various gunsmiths and manufacturers. Jacob Snider’s method of conversion of the muzzle-

loading Enfield to a breech- loader was first adopted, out of nearly fifty different pro- posals, and after laborious and protracted experiments, with the metallic cartridge-case improved in 1867 by Colonel Boxer, R.A. All available Enfield rifles were thus converted, and new arms made with steel barrels instead of iron. Great Britain was the first Power to adopt for her army a breech-loading rifle vsith metallic cartridge- case, which effectually secured the perfect obturation of the breech. In 1866 France adopted the Chassepot rifle; in 1867 Sweden the Hagstrom, and Russia the Carte; in 1868 Italy the Carcano. All these were breech-loaders flring paper cartridges containing their own means of ignition. After further experiments by a fresh committee the Martini-Henry rifle was definitely adopted by the British Government in April 1871, with the short chamber Boxer-Henry ammunition. This rifle was a combination of Martini's block-action breech mechanism with Henry's barrel of ???45-inch calibre, firing a bullet of 480 grains from Boxer cases with a wad of wax lubrication at base of bullet, as proposed by Henry. The Henry rifling had seven grooves vvdth one turn in 22 inches ; the lands and the centres of the grooves were contained in the same circle. In the same year Spain adopted the block-action Remington rifle, Germany the Mauser, Holland the Beau- mont, Italy the Vetterli, and Russia the Berdan II., all bolt - action rifles. All these weapons had a calibre of about 11 millimetres ('433 inch).

The next stage in the history of military firearms was the introduction of the repeating or magazine system. The Winchester rifle, an American invention, appeared in 1867 as one of the earliest magazine rifles. This weapon was used by Turkey in the Russo-Turkish war of 1877-78,

and there proved the enormous advantage of the repeating or magazine rifle, owing to its largely increased rapidity of fire, ilean while, in 1886 the question of the best calibre for small arms was reopened in England. In June 1887 the Small Arms Committee, after experiments with the small ~~calibre rifle invented in 1883 by Major Eubin, director of the Swiss Laboratory at Thun, recommended the small calibre for adoption into the~~

~~British service. The essential features of Eubin's system were the employ~~ ment of a compound buUet with a leaden core in a copper envelope, and the use of a compressed charge of black powder. In January 1888 a pattern of 'SOS-inch-calibre rifle, rifled on the Metford system and with the improved Lee bolt and magazine, was approved for trial by British troops. The Metford rifling is as follows : ??? diameter of bore, -303" ; depth of rifling, -004" ; width of lands, ~~023"; twist of rifling, one turn in 10" (left hand) ; radial grooves, 7 in number. About 1862, and later, W. E. Metford had carried out an exhaustive series of experiments on bullets and rifling. He invented the important system of light rifling, with increasing spiral with a hardened bullet. The Metford match rifle was prominent in all N.E.A. com~~ petitions from 1871 to 1894. In 1887 he laid down for the Small Arms Committee the proper proportions for the grooving, spiral, and cartridge chamber of the "303 military rifle. This weapon proved satisfactory, and was finally adopted by the War Office as the Lee-Metf ord Kifle, Mark I., in December 1888. It had a magazine of eight cartridges. In December 1891 the Mark II. pattern was finally approved, with a ten-cartridge magazine, a much- simplified bolt, and many minor improvements. A magazine carbine, with barrel 21 inches long and a six- cartridge magazine, otherwise identical with the Lee-Metford Mark II., was also approved. The Lee-Metford Mark II. rifle has been further improved in its rifling to resist the wear of smokeless powder, and also in its bolt action, and is now known as the Lee-Enfield rifle, and under that name has been officially adopted as the rifle of the British army. The number of grooves has been reduced from seven to five. Neither the Lee-Metford nor the Lee-Enfield has increasing spiral grooves, which are found inconvenient for military arms from a manu-facturing point of view.

The efficiency of the modem smaU-bore magazine rifle is largely due to the production and adoption of smoke- less nitro-compound powder within recent years. France was the first country to adopt, about 1885, a smokeless powder with the Lebel magazine rifle. It was known as " Vielle " powder, or " Poudre B." Since then smokeless explosives have been universally adopted in aU small-bore magazine military rifles. After exhaustive and lengthened experiments the smokeless explosive known as " Cordite," a composition of nitro-glycerine, gun-cotton, and mineral

jelly, has been definitely adopted by the British authorities for the cartridges of the Lee-Metford and Lee-Enfield magazine rifles and other arms of the same calibre. In addition to its smokelessness, it possesses the further advantages of being comparatively non-fouling, giving a much higher muzzle velocity, with a smaller charge, than black powder, ovidng to the greater amount of gas pro- duced, and at the same time developing lower maximum pressures, owing to its homogeneous character. (For further information about explosives, see Peopellai^ts.)

It is difficult to imagine how any further substantial im- provement can be efiected in the range and trajectory of the modern magazine rifle, although its mechanism, rifling, and rapidity of fire may continue to be improved. Its great value in warfare and the efiect of its high velocity, low trajectory, long range, and smokeless ammunition on mili- tary tactics and strategy were fuUy demonstrated by the

Boer war of 1899-1902. The Lee -Enfield military rifle weighs 10 S) 3| ozs. with bayonet; is 4 feet 1‘85 inches in length (without bayonet), ???n’ith a barrel of 30‘197 inches long; ‘303 calibre, with five shallow grooves of increasing spiral with a left-hand turn of 1 in 10" ; fires a long thin nickel bullet with leaden core with smokeless cordite explosive from a solid metallic cartridge – case ; carries a ten-cartridge magazine with bolt -action and a cut-off that enables the rifle to be used as a single firer ; and is sighted up to 2800 yards.

Match or Target Bifle. ??? The sport or pastime of target shooting has many times changed its character, owing to the steady improvement in the rifle and the different ranges or distances at which shooting is practised. Range usually governs the construction of the target rifle, long-range rifles not being necessarily the best weapons for a short range of, say, 200 yards. Limitations ??? such as the amount of powder charge, weight of bullet and rifle ??? are also usually arbitrarily imposed in order to encourage marksmen by starting all competitors on equal terms. The long-range match rifle is not the superior of the military rifle as a weapon, but as a scientific shooting instrument is the best small arm produced. The ordinary target rifle is a hybrid arm, combining the points of the long-range match, modern military, and best sporting rifles. The

miniature match rifle is a gallery weapon, adapted for trick shooting, for a beginner, or for short- range practice.

The pastime of rifle shooting at fixed marks has been practised continuously in Switzerland from mediaeval times. A rifle club ("Soci^t6 de ITiarquebuse et de la Navigation") has existed continuously in Geneva since 1474 ; and the "Schutzen-GeseUschaft der Stadt Zurich" since about the same date. It is not clear at what period rifles superseded smooth-bores in the practices of these clubs. From the beginning of the 19th century up to 1844 the rifle generally used in Great Britain had a polygrooved barrel ???630 inch in diameter, with spherical ball, and the arm weighed from 11 to 15 ft. It was not fired in military fashion, but had a handle extending downwards fixed in front of the trigger-guard which was grasped by the left hand, the left arm being steadied against the body. This method of shooting is stiU followed by Swiss and German riflemen. The Swiss and Americans were formerly accredited as the finest rifle shots in the world, and are still fine rifle shots at medium ranges and with their customary conditions allowed. At long ranges they are behind the standard of shooting now ruling in Great Britain and her colonies. Target shooting as a sport or business was rarely practised in Great Britain until after the Crimean war and the establishment of volimteer rifle corps. Eanges were then obtained for practice. The inauguration of the " National Eifle Association " in 1860 opened a new and most important era in the history and development of the rifle. This admirable institution was established " for the encouragement of rifle corps and the promotion of rifle shooting throughout Great Britain. ... As a national pastime to make the rifle what the bow was in the days of the Plantagenets, the familiar weapon of those who stand forth in the defence of their country." The N.E.A. has identified itself with the history of target rifle shooting wherever the English language has penetrated, and full information of such history will be found in its annual reports. The first meeting of the N.E.A. was held at Wimbledon in 1860. The first shot was fired by the Queen from a Whitworth rifle on a machine rest, at 400 yards, and struck the bull's-eye. The Whitworth muzzle- loading rifle won many of the important prizes at this and subsequent meetings prior to 1871. The use of this rifle was, up to that date, compulsory in the final stage of the

Queen's competition, except in 1865-66-67. Its most important features, arrived at after exhaustive experi- ments, were a smaller bore of '450 inch, with an increased twist of rifling of one turn in 20 inches, and an elongated mechanically – fitting projectile. Long – range rifle con- struction is also largely indebted to Whitworth for the highly accurate and superior tools and processes introduced by him in this branch of manufacture.

In 1866 and after, Metford's system of hardened ex- panding bullets and shallow rifling gradually superseded the mechanically-fitting system of Whitworth, and the Whitworth rifle gradually lost its position.

In 1861 the Henry grooving for a cylindrical bullet, a modification of the Whitworth, first appeared. In 1864 Rigby, with a five-grooved rifle and a mechanically-fitting bullet, tied with the Whitworth rifle in the preliminary rifle trial of the N.R.A. at 1000 yards, and in a subse- quent trial took the first place. In 1865 the Rigby rifle was consequently used in the second stage of the Queen's prize. By 1871 the Whitworth rifle had given place to the Metford system with hardened cylindrical bullets, shallow rifling, and increasing spiral. In 1867 the modern breech-loading rifle was first introduced, using a metallic cartridge containing its own means of ignition. The Met- ford system of rifling greatly assisted its development. In this year Rigby also produced his new model long- range rifle on the lines followed by Metford. In 1869 the work of the Government Committee caused a great impulse to be given to experimental rifle manufacture, and the Henry barrel came well to the front when used as a breech-loader. In 1870 the Martini -Henry, the new service arm, won the duke of Cambridge's prize, the extreme range in this competition being 800 yards. In 1871 the Enfield-Snider breech-loader replaced the Enfield muzzle-loader, and the Martini-Henry replaced the Whit- worth in the second stages ? ? ? 800, 900, and 1000 yards ranges ? ? ? of the Queen's prize. The Metford barrel was also used in breech-

loaders, and the duke of Cambridge's prize ??? for the first time fired at 1000 yards ??? fell to it. During the twenty-three years from 1871 to 1894 the Met- ford military match rifle only four times failed to win this prize, while it took a preponderating share of other prizes. The years 1872 and 1873 marked a decided advance in the military breech-loader, though for fine shooting the muzzle-loader still seemed hard to equal. In 1873 an Irish team armed with Rigby muzzle-loading rifles visited Creedmoor, U.S.A., and were defeated by three points only by an American team armed with breech-loading rifles. In 1875 a team of American riflemen first visited Wimbledon with " army-pattern " breech-loading rifles, which were cleaned out after every shot, and met with considerable success. A feature of their shooting was the " back position," then a novelty. In 1876 the duke of Cambridge's prize was easily won with a Metford breech- loader, the same type of rifle also doing well in other long- range competitions. A great rifle contest took place at Creedmoor, U.S.A., this year ??? Ireland, Scotland, Australia, and Canada sending teams, the conditions being those of the Elcho Shield competition. A United States team secured first place, the Irish team being a close second. In 1877 the superiority of the cleansable and cleansed breech-loader over the increased fouling of the muzzle- loader was clearly demonstrated, though the muzzle-loader did not at once disappear. In 1878 the highest scores ever made with the muzzle-loader in Great Britain were recorded, greater care in cleaning the rifle after every shot being observed.

In 1883 the N.R.A. Council altered the conditions, vriping out after every shot was forbidden, but muzzle- loaders were not disqualified. The result was that the

American type of rifle disappeared. The poor shooting of the Martini at 1000 yards induced the Council to take the retrograde step of reducing the maximum range for the Queen's prize to 900 yards, the 1000 range being con- sidered beyond the power of the weapon. In 1890 the N.R.A. first met at the new ranges at Bisley. This year was noticeable for the excellent shooting made in the "any" rifle competitions by the Gibbs-Metford match rifle, parti- cularly at 1000 yards range. The accepted type was '461 calibre ; 7 grooves '0045 inch in depth ; 80 grains of special

black gunpowder, and a bullet of 570 grains. In 1892 and 1893 the Lee-Metford "303 rifle with cordite ammunition was first used by the army teams. In 1890 and later the Hon. T. F. Fremantle and some others used Metford's copper -coated bullets in the Gibbs-Metford rifle with success, and in 1894 Captain Gibbs used these in his match rifle and achieved remarkable results, in many competitions making top) scores. In 1895 many match rifle shots followed his example and used copper-coated bullets. In 1895 and 1896 the -303 was equalled, and in some instances beaten, by the smaller ~~*calibre Mann*~~ *licher rifle. This was partly due to faulty Lee-Metford ammunition. The '303 now proved its superiority to the ❓❓❓450 Martini, the regulars defeating the volunteers, espe- cially at the longer ranges. The Bisley meeting of 1896 practically closed the series of contests with both the Martini and the military match rifles. The volunteers were to be thenceforth armed vrith the '303, and with that bore future contests for the Queen's and St George's were to be held.*

The results of the Bisley meetings since 1895 have proved that rifles of '303 class, the British '303 rifle particularly, are not so good for match rifles pure and simple as the larger bores using black powder. The light bullets are more subject to deflection by the wind at long ranges than the heavier speed -retaining bullets of the larger bores. Cordite powder cartridges also appear to give varying velocities. None of the nitro-powders used appears to have equalled the black powder in regularity of shooting. At the same time the object of the N.R.A. competitions is to encourage excellence in the use of the military service rifle in the first place, and in the case of the "any" rifle competitions to encourage the production of weapons of the highest efficiency for military purposes. Acting on these principles the rifles and carbines allowed by the N.R.A. regulations (1900) are classed as follows :❓❓❓Class I. ❓❓❓Service rifle (S.R.) : '303 magazine rifles as issued by the Government or bearing the Government viewer's mark ; inclusive weight not to exceed that of the corresponding regulation rifle ; maximum length, 49| inches; minimum pull of trigger, 6 tt>; sights ❓❓❓strictly in accordance with Government service pattern, and without any shading appliances, extraneous supports, or laterally sliding wind-gauge. This is the rifle to be used in all the numerous S.R. competitions at Bisley, including the duke of Cambridge's prize, the St George's challenge vase, and the King's

prize. Class II. ⬛⬛⬛ Match rifles (M.R.) : any breech-loading rifle complying with the following conditions : when of British make to bear proof marks on barrel and breech; maximum weight, 10 ft; maximum length, 52 inches; maximum calibre, ‘315; stock sufficiently strong, in the opinion of the Bisley committee, for service purposes, and without pad or shoe on the heeli>late ; minimum pull of trigger, 6 ft ; sights, of any description except telescopic or magnifying. Class III- ⬛⬛⬛ Sporting rifles (Spor.) : calibre, any; minimum pull of trigger, 3 ft ; sights, open or such as are sanctioned by the council or committee. The Lyman backsight and the Beech combination foresight have been sanctioned. No lateral adjustment of fore or backsight is permitted.

Spirit levels are allowed. Class IV. ⬛⬛⬛ Carbines (Car.). Any bond fide Government pattern of carbine of ‘303 calibre as issued by the Government or bearing the Government viewer’s mark. Minimum pull of trigger, 6 B). Only service ammunition issued by the N.R.A. at the firing point is allowed to be used in the S.R. competitions. In M.R. competitions there are certain restrictions as to weight of bullet and length and diameter of cartridge. In sporting competitions any ammunition may be used.

Modern American Target Rifles. ⬛⬛⬛ In America, according to some authorities, there are three recognized depart- ments of target shooting ⬛⬛⬛ namely, off-hand shooting ; shooting from a simple rest ; and shooting from a machine rest, with telescopic or any other sight. For the first two classes small-bore rifles of ‘380 calibre or under only are used. The usual weight is from 8 to 10 S), with 28- or 30-inch barrel. Light charges for the shorter ranges are used. In the ‘380 bore only 55 grains of powder with a 330-grain bullet is employed. In the second-class contests, from a simple rest, the barrel is longer and the weight increased to just under 12 B). The bore is generally ⬛⬛⬛380. The usual range is 200 yards. The third-class shooting from a machine rest, generally with telescopic sights, is not much practised. Every kind of rifle is employed,

usually of large bore and weighing from 20 to 60 B>. The long-range breech-loading match rifle, with which so much fine shooting was done when wiping out after each shot was allowed, weighed about 10 S) ; the breech mechanism, any falling block, as the Sharp, Farquharson, Deeley, and Edge or Wiley, that admitted the insertion of the cleaning rod at the breech ; length of barrel 32 to 34 inches ; seven or more grooves ???003 to ^005 in depth with a complete turn in 20 inches. A sharp continual spiral and very shallow grooves consti- tuted the feature of the American plan. Rigby's plan was similar, with one turn in 18 inches and eight grooves, the lands being about half the width of the grooves. In the Wiley the grooves were fewer and vdder. The Met- ford is an increasing tvidst, starting with one turn in 60 inches and finishing with one in 20, or sharper. The usual bore of the American long-range rifle was ???iSS or ???461; powder, 76 grains of special "fouling" rifle powder; elongated cylindrical bullet of -540 grains. The pull-off was under 3 lb. During recent years smaller-bore smoke- less-powder rifles have also been used.

Continental Match Rifles. ??? The target rifle used by Continental marksmen is a modification of the old pattern Swiss rifle, with scroll guard, hollowed butt plate and hair trigger. This latter, a mechanical device to free the tumbler from the skear without sufficient pull on the trigger to influence the aim, is disallowed in military arms.

Sporting Rifles. ??? Prior to 1845 smooth-bore ball guns vnth double charge of powder and an ounce spherical ball were generally preferred to rifles for sporting purposes and for large game ; sixteen-bore muzzle-loading rifles were occasionally used by British sportsmen in the East Indies before that date, firing 1|- drs. of powder with a spherical ounce ball. These rifles were sighted to 200 yards, but the trajectory was high and the penetration weak; they were also difficult to load when foul. The twist of the rifling was also too rapid, causing the bullet to strip with heavy charges of powder. According to Captain Forsyth and others, up to 1860 there was no known rifle suitable for sporting purposes in India. Rifles of twelve-bore gauge, firing a spherical ball, were subsequently made, with broad and shallow grooves making one turn in 10 feet. The

bullet, of the same dia- meter as the bore, was loaded vsdth a thin patch that took the grooving. These rifles proved very successful, pos-

*sessing velocity equal to a smooth-bore of the same calibre, accuracy for sporting distances, flat trajectory, and great striking power. In 1855 W. Greener produced the " Cape rifle " for South African sport, calibre 450 or ***500 ; rifling, two deep grooves with one turn in 26 inches, with a flanged bullet to fit the grooves ; weight, 1 2 R ; sighted up to 1200 yards. This rifle was successful, and others were built by Purdey, who in 1856 named the pattern "Express Train." Since that date the word "Express" has been generally used to denote a rifle possessing high velocity, flat trajectory, and long fixed-sight range. In America small-bore rifles were used earlier in the 19th century. The celebrated Kentucky rifles were of various sizes, firing spherical balls of 90, 60, and 40 to the lb, and were renowned for their accuracy and fixed-sight range up to 100 yards. Some suppose that the modern Express rifle was developed from the Kentucky model. The modern Express rifle may be defined as a breech-loading rifle with a trajectory not exceeding 4|- inches at 150 yards, with a muzzle velocity of at least 1750 feet per second. These rifles are usually double-barrelled, vsdth 26- to 28-inch barrels of -360, "400, ^450, ^500, and -577 bores, weighing respectively from 6J to 7 ft, 7 to 8 ft, 7| to 9 ft, 8J to 10 ft, and 10 J to 12 ft. The respective charges usually are: bullet, 150 grains; powder, 50 grains; 209 and 82; 270 and 110; 340 and 130; 520 and 160; but the leading gunmakers vary the respective amounts of these charges. The fixed-sight ranges of these rifles are respec- tively 130, 160, 150, 130, and 120 yards. Double and single Express rifles of '303 bore with 26-inch barrels are also made. The rifle trial of 1883 arranged at Putney by J. H. Walsh ("Stonehenge"), then editor of the Field, originally established the excellence of the principle of these rifles; but they have since been improved in rifling and mechanism. The usual modern Express rifling is from five to seven shallow grooves, the grooves and bands being of equal width, with a twist suited to the length and diameter of the buUet.*

The sights of sporting Express rifles are of some variety, and are usually designed and made with more care and accuracy than those of military rifles. The open V back- sight on an ivory pjrramid with two or three leaves up to 300 yards, and the enamelled bead foresight, are the most usual form. The more elaborate Lyman and Beech peep- sights are also

popular. Solid-drawn brass cartridge-cases are now always used for sporting rifles, except occasionally for some of the larger bores, in which paper cartridges may be used. The peculiarity of the Express bullet is its hollow point to ensure the expansion of the projectile on impact. This diminishes its penetration, but translates its velocity or energy into " shock." The size and shape of the hollow in the point vary according to the purpose required. If greater penetration is needed, the leaden bullet is hardened with mercury or tin, or the military nickel-coated bullet is used in the small-bore rifle. Ex- plosive bullets filled with detonating powder were at one time used in Express and large-bore rifles for large game. The use of these bullets is now practically abandoned, owing to their uncertainty of action and the

^ The term "point-blank range" Is often used in this connexion. Strictly speaking, there is no such thing as "point-blank range," the bullet commencing to drop immediately it leaves the muzzle of the rifle. The path or trajectory of the bullet if fired horizontally is therefore always a downward curve. The higher the muzzle velocity the flatter is this curve. The "fixed-sight," or so-called "point- blank " range, is usually taken at such range and with such elevation as render the amount of drop of the bullet or curve of its path practically immaterial for sporting purposes, say a maximum of 4J inches. At shorter range this curve would therefore take the bullet so much above the line of fixed-sight aim, and must where necessary be allowed for.

danger in handling them. The use of the large four- and eight-bore rifle is restricted to the hunting of large and dangerous game. These are usually double-barrelled. The four-bore weighs from 14 to 18 D) with 20-inch barrels, and fires a charge of 12 to 14 drs. of powder, with a spherical bullet of 1510 grains. The great weight of this rifle is against its general use. The eight-bore rifle weighs from 11 J to 15 ffi) with 20- to 24 -inch barrels, with a charge of 8 to 12 drs. of powder with a spherical ball. These rifles are accurate and effective up to 120 yards.

Book and rabbit rifles are usually single-barrel breech- loading rifles of from ‘220 to ‘SSO bore, hammerless, ejectors. The range is ordinarily restricted to 200 yards. The combination of a rifle and shot-gun is generally used in countries where the kind of game to be met with is not known beforehand, and by emigrants who can only aff’ord one gun. The weapon is double-barrelled ; the left usually rifled, and the right a smooth-bore. The proper propor- tions of bore are ‘450 rifle barrel and sixteen-bore short barrel ; or ‘500 rifle and twelve-bore shot. This weapon has many drawbacks, being too heavy for a shot-gun and too light for a rifle, with a bad balance. More modern combinations of the rifle and shot-gun are Holland’s “Paradox,” a smooth-bore with the last three inches of the barrel ratchet-rifled ; Lancaster’s ” Colindian ” twisted oval bore without sharp-edged grooves or ridges in the barrel ; and Bland’s ” Euoplia ” with ” invisible ” undu- lating rifling, also without sharp-edged grooves or ridges. All these weapons fire heavy bullets more or leas accurately up to 100 yards, are also used as shot-guns, and are made double or single barrelled and of various calibres, twelve-bore being the most common. The Morris tube is a small-bore rifle barrel capable of being inserted aiid used as required in a shot-gun or larger rifle. A shot-gun may thus be utilized as a small-bore rifle, or a large rifle as a saloon rifle for gallery practice.

The modem small-bore military rifle already described, such as the Lee-Enfield or the German Mauser or Austrian Mannlicher, now possesses all the best qualities of an Express sporting rifle ??? namely, accuracy, flat trajectory, high muzzle velocity, and long point-blank range up to 200 yards. This weapon is also a ” long-range Express,” and can be sighted up to 2800 yards. A sporting variety of the military weapon is now made, either double or single, ‘256 to ‘303 bore, the double-barrel with a very strong breech mechanism ; the weight, as desired, beyond 8 J tt). The standard charge of black gunpowder is 71 J grains ; of cordite, 30 grains ; of ” rifleite,” 38 grains. The muzzle velocity of the ???303 bore with black powder is 1850 feet per second; with cordite, 2000 feet. This weapon is now one of the most efficient rifles for general game shooting. The hollow- pointed expanding bullet with soft lead nose is generally used in these rifles for ordinary sporting purposes, with the military solid metal cartridge-case. Some leading gunmakers make their latest single and

double Express sporting rifles, firing nitro-powder cartridges, cordite, or rifleite, of from ~~360 to '577 bore, thus possessing the greater power and shock of the old eight~~ bore rifle firing black powder, combined with much of the handiness, long range, and flat trajectory of the smaller- bore smokeless Express rifle. The automatic principle, by which the firing of each cartridge loads the next and cocks the weapon, has not yet been applied to rifles, but is applied to some pistols and carbines, such as the Mauser. (h. s.-k.)

Rigfa, one of the chief seaports of Eussia, at the head of the gulf of same name, in the government of Livonia. Its population, which was 180,935 in 1891,

had increased to 281,884 in 1897, so that it now ranks sixth in the empire in order of population ; 47 per cent, of the inhabitants are Germans, 25 per cent. Bussians, and 23 per cent. Letts, with a small admixture of Esthonians, Jews, &c. The city has now a polytechnic, five gymnasia, several technical and theological middle schools, a pilot and navigation school, and a number of primary institutions, with about 20,000 pupils of both sexes. Industrial activity has also developed, and there are now 275 factories (mainly railway -carriage works, works for the manufacture of machinery, oil mills, and breweries), giving employment to 30,000 workmen, and showing yearly returns of 60,000,000 roubles. No less than 33 newspapers (18 in German) are published, and there are 43 public libraries. Having direct railway communication with all the fertile parts of southern and south-eastern Bussia, Biga has become the second port for foreign trade on the Baltic, ranking next after St Petersburg. The chief exports are grain, flax, seed, eggs, butter, hemp, and timber, while the imports, which have rapidly increased, are chiefly colonial and manufactured goods. The port, which freezes on an average for 127 days every year, was visited in 1899 by 1236 ships, of which only 253 were under the Bussian flag. The larger ships cannot reach Biga, and consequently are unloaded at Ust Dvinsk (formerly Dunaburg). By no means aU the trade with the interior is commanded by the railways ; no inconsiderable portion of the goods is carried by water. Every year about 28,000 tons are shipped to the town from the basin of the Dnieper, 50,000

tons from the basin of the Duna, and 89,000 tons from the other river basins ??? in all, 167,000 tons per annum.

Rimbaud, Jean Arthur (1854 – 1891),

French poet and adventurer, was bom at CharleviUe, in the Ardennes, on 20th October 1854, the second son of a captain in the French army, who in 1860 abandoned his wife and family. From early childhood Arthur Bimbaud, who was severely brought up by his mother, displayed rich intellectual gifts and a sullen, violent temperament. He began to write when he was ten, and some of the poems which now appear in his works belong to his fifteenth year. Before he was sixteen, in consequence of a violent quarrel with his mother, the boy escaped from CharleviUe vrith a packet of his verse, was arrested as a vagabond, and for a fortnight was locked up in the Mazas prison, Paris. A few days after being taken home, Bimbaud escaped again, into Belgium, where he lived for some time as a tramp, almost starved, but writing verses with feverish assiduity. A curious letter of this period exists, in which Bimbaud says that all recent French poetry, except certain pieces of Verlaine, absolutely ” disgusts ” him, and in which he announces his intention of creating a new thing in verse. In February 1871 he left his mother for a third time, and made his way to Paris, where he knew no one, and whence, after very nearly dying of hunger and exposure, he begged his way back to CharleviUe. There he wrote in the same year the extraordinary poem of Le Bateau Ivre, which is now hailed as the pioneer of the entire ” symbolist ” or ” decadent ” movement in French litei-ature, in all its forms. He sent it to Verlaine, who encouraged the boy of seventeen (whom he supposed to be a man of thirty) to come again to Paris. Bimbaud spent from October 1871 to July 1872 in the capital, partly with Verlaine, partly as the guest of Theodore de Banville, and served in the army of the Commune. With Verlaine he traveUed for thirteen months, after the fall of the Commune, through England and Belgium, where in 1873 he published the only work which he ever printed, Une Saison en Enfer, in prose ; in

this he gives an allegorical account of his extravagant relations with Verlaine, which ended at Brussels by a double attempt of the latter to murder his young com- panion. On the second occasion Kimbaud was dangerously wounded by Verlaine's revolver, and the elder poet was imprisoned at Mons for two years. Meanwhile Kimbaud, deeply disillusioned, determined to abandon Europe and literature, and he ceased at the age of nineteen to write poetry. He settled for a while at Stuttgart, studying German, and in 1875 he disappeared. He set out on foot for Italy, and after extraordinary adventures found employment as a day-labourer in the docks at Leghorn. Returning to Paris, he obtained a little money from his mother, and then definitely vanished. For sixteen years nothing whatever was heard of him, but it is now known that he embarked as a Dutch soldier for the Sunda Isles, and presently deserting, fled to Sumatra and then to Java, where he lived for some time in the forest. Eeturn- ing to Europe, after a vagabond life in every capital, he obtained in 1880 some menial employment in the quarries of Cyprus, and then worked his way to Aden and up into Abyssinia, where he was one of the pioneers of European commercial adventure. Here he settled, at Harrar, as a trader in coffee and perfumes, to which he afterwards added gold and ivory; for the next eleven years, during which he led many commercial expeditions into unknown parts of northern Africa, Shoa and Harrar were his headquarters, and he lived almost entirely with the natives, and as one of themselves. From 1888 to 1891, having prospered greatly as a merchant, he became a sort of semi-independent chieftain, intriguing for France, just outside the borders of civilization. From documents which were first produced in 1902, it appears that from 1883 to 1889 Rimbaud was in close relations with the Ras Makonnen and with Menelek, then only king of Shoa. At the death of the Negus John, in 1888, he was concerned in the formation of the empire of Ethiopia. From this time Rimbaud had a palace in the town of Harrar, and intrigued with the French Government in favour of Menelek and against Italy. Meanwhile, in 1886, believing Rimbaud to be dead, Verlaine had pubKshed his poems, under the title of Les Illuminations, and they had created a great sensation in Paris. But the author, in his Abyssinian hut of palm-leaves, was, and remained, quite unconscious of the fact. In March 1891 a tumour in his knee obliged Rimbaud to leave Harrar and go to Europe for surgical advice. He reached Marseilles, but the case was

hopeless ; the leg had to be amputated, and Rimbaud died there in hospital on the 10th of November 1891. The poems of Rimbaud all belong to his earliest youth. Their violent originality, the influence which they have exercised upon younger writers, the tumultuous existence of their author, and the strange veil of mystery which still hangs over his character and adventures, have given to Rimbaud a remarkable fascination. His life has been written by M. Paterne Berrichon (1898), and valu- able reminiscences by his sister. Mile Isabella Rimbaud. His CEuvres were collected in 1898 by MM. Berrichon and Delahaye, and in 1901 his statue was unveiled at CharleviUe. (e. g.)

Rimini, a town and bishop's see of the province of Forli, Emilia, Italy, on the Adriatic coast, 69 miles south- east of Bologna by rail. Among the buildings may be mentioned an archaeological museum, a bronze statue of Pope Paul v., and a technical school (1882). Rimini attracts numerous visitors for the sea-bathing it offers at Porta Marina ; it also has mineral springs. Various industries are carried on ??? ironworks and foundries, sulphur furnaces, silk-mills, rope-walks, match factories, brick-works,

flour-mills, and furniture shops. Population(1881), 19,158; (1899), about 21,000.

Riobamba, or Riobamba Nuova, chief town of the province of Chimborazo, Ecuador, Central America, situated on a high plateau, on the San Juan river, an affluent of the Chambo, 100 miles south-south-west of Quito, and 22 north-west of Chimborazo. It has manu- factures of woollens and sacking. The plain to the south was the scene of a great battle with the Indians during the conquest, and in the vicinity are remains of an Inca palace. Population, 12,000.

Rio de Janeiro, capital and principal commercial centre of Brazil. The principal part covers an area of about two square kilometres, bounded on the S. by the Morros Castello and S. Antonio, and on the N. by S. Bento and Concei9ao. This section is divided into regular squares by narrow streets ; in the principal ones are tramway Unes, some horse lines, others electric. The length of these lines in the city limits is about 177 mUes. The city has been spreading along the shores of the bay to the north and far

back over the hills behind it, so that it now ex- tends over a distance of 18 miles. The number of the buildings is estimated at 50,000. The former imperial palace of Boa Vista is now the National Museum. The present Government Palace is in the populous district of Cattele. Rio is one of the most unhealthy and, until almost the end of the 19th century, one of the most insanitary cities of Brazil, yellow fever being endemic. Tuberculosis and smallpox also make constant ravages. The mortality in 1896 was : pernicious abscesses, 766 ; yellow fever, 2919; other fevers, 1403; smallpox, 258; other diseases, 14,144. In 1898 the number of cases of yellow fever in Rio was 1177, deaths 1094 ; and of small- pox, 204, deaths 66. In 1899 there were 928 cases of yellow fever, and 720 deaths; in 1900 there were 2726 deaths from tuberculosis, 631 from smallpox, 344 from yellow fever, and 292 from bubonic plague, which made its first appearance there that year. Rio de Janeiro con- stitutes a separate political and administrative division, called the Federal District. It is governed by a mayor appointed by the president of the Republic, and has a municipal council elected by the people. The district is divided into 20 urban circumscriptions and 8 suburban ones. In 1890 the population of the Federal district was 674,972, and for 1900 was reported as 779,000. The receipts of the Federal District for 1898 were estimated at 17,656,436 milreis, and the expenditure at 15,826,270. Rio is the principal port of shipment in Brazil for cofiee : in 1896, 2,784,958 bags (60 Ml.) were exported; in 1897, 4,066,734 bags; in 1898, 3,441,166 bags; in 1899, 3,504,708 bags; and in 1900, 2,658,990 bags. The average value in 1898 was about 31s. 6d. per bag. The total exports of all kinds were valued at ££6,750,000 in 1900, of which ££5,670,000 was for coffee, ££482,000 for gold, ££151,000 for manganese, and ££149,000 for hides. The principal imports are wheat, flour, coal, wines, cottons and textiles, machinery, &c. But the import trade has declined: ££12,631,000 in 1898; ££11,468,000 in 1899; ££9,462,000 in 1900. The greater part of the immigra- tion to Brazil passes through the port; in 1896 there were 100,547 immigrants ; and in 1898-99, 27,650 were reported landed at Rio. The movement of all shipping engaged in foreign trade during the years 1896, 1897, 1898, 1899, and 1900 was : entered in 1896, 1535 vessels, of 2,469,628 tons; cleared, 1404 vessels, of 2,283,499 tons: entered in 1897, 1274 vessels, of 2,146,854 tons; cleared, 1220 vessels, of 2,044,858 tons; in 1898, 1218 vessels, of 2,069,161 tons,

entered, and 1130 vessels, of 1,957,712 tons, cleared; in 1899, 1077 vessels, of 1,916,936 tons,

entered, and 1019 vessels, of 1,853,707 tons, cleared ; in 1900, 843 vessels, of 1,522,754 tons, entered, and 790 vessels, of 1,407,122 tons, cleared. In the above the entries of British shipping in 1898 were 552 vessels, of 1,030,149 tons; in 1899, 482 vessels of 936,393 tons; and in 1900, 385 vessels of 791,250 tons.

Rio de Janeiro, an Atlantic state of Brazil, be- tween 20◆◆50' and 23◆◆19' S. and 41◆◆01' and 44◆◆52' W. Area, 26,634 square miles. Population in 1890, 1,227,575 (exclusive of the city of Eio de Janeiro, which constitutes the Neutral Federal District or Distrito Federal). It is bounded on the N. by Minas Geraes, on the W. by Sao Paulo, on the S. and E. by the . Atlantic. The capital, Nictheroy, on the Bay of Guanabara (or Kio), has 36,000 inhabitants. Amongst other towns may be named Kio Bonito (2 1 , 000), Campos (20,000), Itaborahy (1 8,200), Barra Mansa (12,200), Parahyba do Sul, Paraty, Pirahy, Rezende ,(16,000), S.Fidelis (14,500), Petropolis (12,200), Cabo Trio, Valenza, Carmo, Marica. The state is well supplied with railways. The principal agricultural product is coflFee, the exports in 1900 amounting to 87,105,716 kilograms.

Rio de Oro, a Spanish colony on the north-west coast of Africa. It is situated about the middle of that part of the Sahara coast which Spain considers her own by right of occupation and exploration, between 23◆◆35' and 23◆◆55' N. The peninsula of Rio de Oro is united to the mainland by a sandy isthmus, and its length is 23 miles, and its breadth 1 J to 2 miles, on an average about 20 feet above the sea-level. The bay between peninsula and mainland is 22 miles long, 5 broad, navigable over two-thirds of its extent, and with good anchorage in most of the channel, but the bar at its mouth is not always easy to pass in rough weather. The peninsula has very sparse vegetation, except in its southernmost part near Cape Durnford. There is an island in the bay, Isla Heme.

The climate is generally temperate, and not unhealthy except in the autumn. Esparto grass and manzanilla are grown in many places, but European plants are not easily acclimatized. On the peninsula and on the coast itself there are many hares, wolves, foxes, hyenas, gazelles, lizards, pelicans, and large crows. The natives of the coast are Arab tribes, a cross of Berbers and negroes, Mussulmans, very poorly clad, who rear cattle, sheep, camels, and have but few horses. They are very suspicious and treacherous in their intercourse with the Spaniards.

In 1884 the Hispano-African Company built a factory 7 miles from Cape Durnford, but in the following year it was pillaged and burnt by the natives. The Hispano-African Company for a while renewed its trade with the natives, but iinally ceded its rights to the Transatlantic Company of Barcelona. War vessels from the Canary Isles visit Rio de Oro several times in the year, to carry reliefs, provisions, and war stores.

The best works of reference on Eio de Oro are those of Bonelli, who founded the Nation in 1884, the articles of Francisco Quiroga and Costa and Lorenzo Rubio in vols. i. and ii. of the Eevista de Geographia. Costa thinks Rio de Oro is the Ciranis of Herodotus.

Rio Gra.nde, one of the longest and most eccentric of the North American rivers. It is nearly 1800 miles from its source, in the Rocky Mountains of southern Colorado, to its mouth, on the Gulf of Mexico. Although navigable only in its lower 100 miles, normally without running water for vast stretches, and extending for almost its entire course through deserts, it has had a dominating influence over the cultural and political conditions of the vast country which it threads. For nearly 1000 miles it forms the natural and political boundary between the United States and Mexico. Below El Paso and along the Lower Rio Grande the course often shifts, thereby causing international complications. Historically the Rio Grande is interesting from its connexion with the early Spanish explorations of the 16th century. It presents many features of a complex physiographic type, being in portions a river of the Rocky Mountains, of the interior

deserts, and of the Atlantic Coastal Plain. It also pre- sents a complicated geological history, including the union of what were originally several

streams. The different parts were given three distinct names by the Mexican inhabitants. The upper stretch, of some 500 miles, flow- ing southward from Colorado through New Mexico into Texas, was called the Rio del Noete. Except a small portion of the head-waters, this section is an intermittent stream, flowing sluggishly through' the interior deserts of the Cordilleran region. Its bed above and below El Paso is at times dry. In May and June the sun melts the accumulated winter snows of the Colorado Rockies and floods the dry bed, the water from which the inhabitants turn upon their fields. A few miles below Presidio del Norte, Texas, the river enters a series of vast canons cutting across range after range of the eastern line of the American Cordilleras, seeking an outlet from the basin deserts to the Atlantic coastal plain. This stretch, extend- ing to the mouth of Devil's river, is 400 miles long, and is known as the Rio Beavo. In this portion of its course the river makes an angle, changing its course from south-west to north-east, and is popularly known as the Big Bend. Just above Del Rio the Eio Bravo emerges upon the broad coastal plain of the Gulf of Mexico. It now becomes the Rio Geande.

The Rio Grande, as a whole, attracts almost no lateral drain- age except in the upper 300 miles of its course. In passing through the greater part of New Mexico and Texas it is constantly fed only by the Conchas and Pecos, which bring their permanent waters from distant countries. Its iiow is continuous from its source to about the 35th parallel in New Mexico ; thence to Presidio, Texas, it is interrupted. In this stretch the run-off aggregates far more than that of all the other portions combined. Even this normal run-off progressively decreases down stream (three years' observations) from 11 "63 second feet at Del Norte, Colorado, to "64 second feet at San Marcial, 500 miles below El Paso. At Presidio the flow first becomes continuous and copious, through the accession of the waters of the Conchas river of Chihuahua. In the Big Bend its volume is enhanced by copious subterranean springs breaking forth in its bed. The inflow of the Pecos largely increases the volume of the Lower Rio Grande. From below the mouth of the Pecos the river has no large contributing laterals. Below Presidio there are two seasons of overflow ??? in May or June, from the melting of the snows, and in August, from the tropical rains near the sources of the Conchas in Mexico.

Although the United States Government has made many observations upon the flow of the Upper Rio Grande north of El Paso, none is recorded of the stream below that point. Of the two flowing tributaries, the Rio Grande and the Pecos, either might be considered the mother stream or head-tf ater continuation of the Lower Rio Grande, as much as the Rio del Norte, now so considered. The Rio Conchas rises in the mountains of Chihuahua and flows almost due northward into the Rio Grande. The Pecos is almost equal to the Upper Rio Grande in length, and, so far as constant volume is concerned, a larger stream. Like the Rio Grande, it receives its waters from the ranges of the Rocky Mountains in northern New Mexico. It is also reinforced by numerous streams from the Sacramento Mountains. /jj_ t. h.)

Rio Grande do Norte, an Atlantic state of

Brazil, the extreme eastern part of the republic, with Cape St Roque as its most easterly port, situated between 4►►54' and 6►►28' S. and 34►►52' and 37►►48' W. Area, 22,195 square miles. Population in 1872, 233,979; and in 1890, 313,979. It is bounded on the N. by the state of Ceard and the Atlantic Ocean, on the W. by Ceara, on the S. by Parahyba, and on the E. by the Atlantic. The capital. Natal, which is also the principal port of the stnte, has a population of 46,000, Mossoro has 3000, Ceard- Llirim 4000, and Macao 5000.

Rio Grande do Sul, or SSo Pedeo do Rio

Geande do Sul, a state of Brazil between 27►►05' and 33►►45' S. and 49►►32' and 57►►20' W. Area, 91,335 square miles. Population in 1872, 434,816; in 1890, 880,878; and in 1900, 968,231. It is bounded on the N. by S. Catharina, on the W. by the Argentine Republic

and Uruguay, on the E. by the Atlantic, and on the S. by Uruguay. The capital, Porto Alegre, has a popula- tion of nearly 100,000, of whom 10,000 are Germans. Between 1886 and 1894, 75,766 immigrants entered

the state, principally Germans, Italians, and Poles. Other towns include Pelotas (30,000), Alegrete (12,000), Jaguarao (8000), Kio Grande, Bag6, Ca^apava, Eio Pardo, S. Jos6 do Norte. There are 670 miles of railway in operation, and other lines are in process of construction. There are numerous prosperous German colonies, and their number and importance are constantly increasing. The oldest, S. Leopoldo, was founded in 1824.

Rioja., La., a province in the west of the Argentine Republic, bounded on the N. by Catamarca, on the E. by Catamarca and Cordoba, on the S. by San Luis, and on the W. by San Juan and Chile. Official area at the census of 1895, 34,546 square miles. Population in 1895, 69,502. The capital, La Rioja, had a population in 1895 of 5931. The gold, silver, and copper mines near Famatina and Chilecito constitute the principal sources of wealth of the province. The province is divided into eighteen departments. In 1895 there were 6446 farms, and 40,920 acres planted in cereals.

Rio Negro, a territory of the Argentine Republic, bounded on the N. by the territory of Pampa, from which it is separated by the Rio Colorado, on the S. by Chubut, on the E. by the Atlantic, and on the W. by Neuquen and Chile. Official area at the census of 1895, 75,924 square miles; population, 9241. The capital is Viedma, on the right bank of the Rio Negro, 20 miles from its mouth. The territory is divided into seven departments. In 1895 there were 82,050 head of cattle, 1,009,777 head of sheep, and 35,599 horses in the territory, and only 1168 acres planted in cereals.

Riot. ??? The criminal law as to riot has not been modified since 1885, but the materials for ascertaining the duties of justices, the police, ordinary citizens, and soldiers, with respect to the suppression of riots have been increased by the publication in the New Series of State Trials of the full reports of the prosecution of the mayor of Bristol for dereliction of duty in suppressing the Bristol riots of 1831, and a number of other leading cases on riot; and Lord Bowen and his fellow-commissioners in the report on the Featherstone riots (Pari. Paper, 1893-

94, c. 7234) have dealt with the duty of soldiers called in to suppress riots. The substance of their views is as follows : ???

By the law of England every one is bound to aid in the suppreasion of riotous assemblages. The degree of force, however, which may be lawfully employed in their suppression depends on the nature of each riot, for the force used must always be moderated and proportioned to the circumstances of the case and to the end to be attained. The taking of life can only be justified by the necessity for protecting persons or property against various forms of violent crime, or by the necessity of dispersing a riotous crowd which is dangerous unless dispersed, or in the case of persons whose conduct has become felonious through disobedience to the provisions of the Riot Act, and who resist the attempt to disperse or apprehend them. The necessary prevention of such outrage on person or property justifies the guardians of the peace in the employment against a crowd of even deadly weapons. Oflicers and soldiers are under no special privileges and subject to no special responsibilities as regards the principle of the law. A soldier for the purpose of establishing civil order is only a citizen armed in a particular manner. He cannot because he is a soldier be exonerated if with- out necessity he takes human life. The duty of magistrates and peace oflicers to summon or abstain from summoning the assistance of the military depends in like manner on the necessities of the case. A soldier can act only by using his arms. The weapons he carries are deadly. They cannot be employed at all without danger to life or limb, and in these days of improved rifles and perfected ammunition without some risk of danger to distant and possibly innocent bystanders. To call for assistance against rioters from those who can interfere only under such grave conditions ought, of course, to be the last expedient of the civil authorities. But when

the call for help is made and a necessity for assistance from the military has arisen, to refuse sui'h assistance is in law a mis- demeanour. The whole action of the military when once called in ought from first to last to be based on tlie principle of doing, and doing without fear, that which is absolutely necessary to prevent serious crime, and of exercising care and skill with regard to what is done. No set of rules exists which governs every instance or defines beforehand any contingency that may arise. The

presence of a magistrate is not essential, but is usual, and of the highest value to aid the commander of the troops by local knowledge. But his presence or absence has no legal effect on the duties or responsibilities of the military to use their arms when it becomes necessary to do so, and without recklessness or negligence and with reasonable care and caution ; and where they have so acted the killing of a rioter is justifiable homicide, and the killing of an innocent bystander is homicide by misadventure. It is not usual to resort to extremities with rioters until after reading the proclamation under 1 Geo. I. ; but this preliminary is by no means a condition precedent to the exercise of the common-law powers of suppressing riots.

The Crown cannot charge upon the local rates the expense of maintaining soldiers called into a district by the magis- trates to suppress riots (B. v. Glamorgan Comity Council, L.R. 1899, 2 Q.B. 536), but the cost of extra police called in for the like purpose falls on the local rates. The old exceptional civil remedy against the inhabitants of a hundred in which damage to private property was done by rioters was abolished in 1886. When the Piccadilly riots occurred in that year no one knew that the injured shops were in the hundred of Ossulston, and difficulties arose in applying the old procedure. So a statute was passed (49 Vict. c. 11) for a special settlement of the claims, and the old statutes were repealed and replaced by the Riot Damage Act, 1886. Under this Act compensation is payable where rioters have injured or destroyed houses, shops, buildings, fixed or movable machinery, and appliances prepared or used for or in connexion with manufactures or agriculture, or for mines or quarries, or vessels stranded or in distress (see Webck), or have injured, stolen, or destroyed property in houses, shops, or buildings. The compensation is payable out of the police rate for the district in which the damage is done; or if it was done afloat, for the district near- est to the scene of action. The claim is made on the police authority for the district. The time and form for making claims and the mode of fixing the amount of compensation, is regulated by rules made by the Home Secretary on 30th June 1894 (Stat. R. and O. 1894, No. 636). In adjusting the amount regard is had to the conduct of the claimant, viz., as to precautions taken by him, his share, if any, in the riot, or provocation offered to the rioters. Failure to carry out a programme for athletic sports has been held to debar a claimant for

damage done by a riot among the disappointed spectators who had paid to see the sports. The claimant must give credit for insurance money, or any other com- pensation received in respect of the damage; but the insurers or persons who paid such compensation may file a claim against the police-rate for the amount paid by them. Persons dissatisfied with the award of the police authority may sue for the recovery of their claim subject to a liability to pay all the costs if they do not get judgment for more than the amount awarded. The action, if it is not for more than ––100, is to be brought in the county court. In Scot- land there is also a civil remedy against the county or borough in which a riot takes place in respect of damage done by the rioters to houses, churches, buildings, and ships, and buildings or engines used in trade or manu- facture. The remedy is given by a series of statutes : 1 Geo. L St. 2, c. 5, ––9 ; 52 Geo. IIL c. 130, ––––3, 4 ; 56 Geo. IIL c. 125, ––2; 57 Geo. IIL c. 19, ––38, and 57 and 58 Vict. c. 60, ––515. The procedure for its enforcement is now regulated by 3 Geo. IV. c. 33, and amending statutes. The county or borough authorities may adjust claims without litigation, and pay them out of the general assessments. In Ireland the civU remedy against the county or borough

for malicious injury to property, real or personal, including ships in distress and their cargo, is wider than in England or Scotland, but it includes malicious injury by rioters where the injury is a crime within the Malicious Damage Act of 1861. Claims are now dealt with in the civil bill court, and not as formerly by the grand jury and judge of assize (61 and 62 Vict. c. 37, ––5). (w. f. c.)

Ripon, Georgfe Frederick Samuel

Robinson, 1st Maequis op (1827), British

statesman, only son of the 1st earl of Kipon and his wife Lady Sarah, daughter of the 4th earl of Buckingham- shire, was born in London, 24th October 1827. He began his political life as attacM to a special mission to

Brussels in 1849. Under his courtesy title of Viscount Goderich he was returned to the House of Commons for Hull in 1852 as an advanced Liberal. In 1853 he was elected for Huddersfield, and in 1857 for the West Eiding of Yorkshire. In January 1859 he succeeded to his father's title, and in November of the same year to that of his uncle. Earl de Grey. A few months after entering the Upper House he was appointed under-secretary for war, and in February 1861 under-secretary for India. Upon the death of Sir George Cornewall Lewis in April 1863, he became secretary for war, with a seat in the Cabinet. In 1866 he was appointed secretary of state for India. On the advent of the Gladstone Administration in December 1868, Lord Ripon was appointed lord president of the CouncU, and held that office until within a few months of the fall of the Government in 1873, when he resigned on purely private grounds. In 1869 he was created a Knight of the Garter. In 1871 Lord Ripon was appointed chairman of the High Joint-Commission on the Alabama claims, which arranged the Treaty of Washington. In recognition of his services he was elevated to a marquisate. In 1874 he became a convert to Roman Catholicism, and this involved his resignation of the office of grand master of the English Freemasons. On the return of Mr Gladstone to power in 1880 Lord Ripon was appointed Viceroy of India, the appointment exciting a storm of controversy, meetings of protest being held in Exeter Hall and elsewhere, the marquis being the first Roman Catholic to hold the viceregal office. An account of his viceroyalty will be found in the article India : History. The new Viceroy was called upon to decide grave questions between the native popu- lation and the resident British, and he resolved upon a liberal policy towards the former. He extended the rights of the natives, and in certain directions curtailed the privileges of Europeans. Several of the Viceroy's measures, notably the Ilbert Bill of 1883 ??? the object of which was to subject Europeans to trial by native magistrates in certain cases ??? irritated the Anglo-Indian population, and the measure was fiercely assailed. There probably never was a Viceroy so unpopular among Anglo-Indians or so popular with the natives. On Lord Ripon's departure from India in Xovember 1884 there were extraordinary manifestations in his favour on the part of the Hindoo population of Bengal and Bombay, and more than a thousand addresses were presented to him. On his arrival in England the marquis delivered a number of vigorous speeches in defence of his administration.

In 1886 he became first lord of the Admiralty in the third Gladstone Ministry ; and on the return of the Liberals to power in 1892, he was appointed Colonial Secretary, which post he continued to hold until the resignation of the Government in 1895. For many years Lord Ripon was president of the Yorkshire College of Science at Leeds, and chairman of the West Riding County Council.

Ripon, a cathedral city and municipal borough, York- shire, England, West Riding, in the Ripon parliamentary division, 23 miles north-west of York by rail. A new cemetery, completed in 1894, has one chapel available for all denominations. In the same year new premises were erected for the Mechanics' Institution, in which a continuation evening school and technical classes are held. A clock tower was presented as a memorial of Queen Victoria's Diamond Jubilee, and a church institute was erected in 1900. There is a somewhat extensive trade in varnish, and its manufactures of saddle-trees, leather, &c., are in high repute. Population of the municipal borough (1881), 7390; (1891) (altered area), 7826; (1901), 8225.

RipOStO, a seaport town of the province of Catania, Sicily, Italy, 19 miles north by east of Catania, on the east coast railway to Messina. It is one of the principal wine- exporting places in the island. In 1897 the port was cleared by 758 vessels of 365,116 tons. It has several cooperages. Population (1899), about 9000.

Ristitch, Jova,n (1831-1899), Servian statesman, was born at Kragujevats in 1831. He was educated at Belgrade, Heidelberg, Berlin, and Paris. After failing to obtain a professorship in the High School of Belgrade, he was appointed in 1861 Servian diplomatic agent at Constantinople. His reputation was enhanced by the series of negotiations which ended in the withdrawal of the Turkish troops from the Servian fortresses in 1867. On his return from Constantinople he was ofiered a ministerial post by Prince Michael, who described him as "his right arm," but declined office, being opposed to the reactionary methods adopted by the Prince's Government. He had already become the recognized leader of the Liberal party. After the assassination of Prince Michael in 1868, he was nominated member of the Council of Regency, and on the 2nd January

1869 the first Servian Constitution, which was mainly his creation, was promulgated. When Prince Milan attained his majority in 1872, Ristitch became foreign minister; a few months later he was appointed prime minister, but resigned in the following autumn (1893). He again became prime minister in April 1876, and conducted the two wars against Turkey (July 1876- March 1877 and December 1877-March 1878). At the Congress of Berlin he laboured with some success to obtain greater advantages for Servia than had been accorded to her by the treaty of San Stefano. The provisions of the Treaty of Berlin, however, disappointed the Servians, owing to the obstacles now raised to the realization of the national programme; the Ristitch Government became unpopular, and resigned in 1880. In 1887 King Milan (who had assumed the royal title in 1882), alarmed at the threatening attitude of the Radical party, recalled Ristitch to power at the head of a coalition cabinet; a new Constitution was granted in 1888, and in the following year the king abdicated in favour of his son. Prince Alexander. Ristitch now became head of a Council of Regency, entrusted -^dth power during the minority of the young king, and a Radical ministry was formed. In 1892, however, Ristitch transferred the government to the Liberal party, with which he had always been connected. This step and the subsequent conduct of the Liberal politicians caused serious discontent in the country. On the 1st (13th) April 1893 King Alexander, by a successful stratagem, imprisoned the regents and ministers in the palace, and, declaring himself of age, recalled the Radicals to office. Ristitch now retired into private life. He died at Belgrade on 4th September 1899. Though cautious and deliberate by temperament, he was a man of strong will and firm character. He was the author of two published works : The External Relatiom

of Serviafrom 184.8 to 1867 (Belgrade, 1887) and A Diplo- matic History of Servia (Belgrade, 1896). (j. D. B.)

RitSChI, Albrecht (1822-1889), German theo- logian, was born at Breslau, 21st March 1822. He studied at Bonn and at Halle. At the latter place he came under Hegelian influences through the teaching of

Schaller and Erdmann. In 1845 he was entirely captivated by the Tubingen school. This did not last long with him, how- ever, for his most important work on the Origin of the Old Catholic Church shows in its second edition (18.57) entire emancipation from Baur's method. He was professor of theology at Bonn and Gottingen, his Addresses on Religion delivered at the latter university showing the impression made upon his mind by his enthusiastic studies of Kant and Schleiermacher. Finally, in 1864 came the influence of Lotze. He wrote a large work, Rechtfertigung und Versbhnung ("Justification and Eeconciliation"), published during the years 1870-74, and in 1880-86 a History of Pietism. His system of theology is contained in the former. He died at Gottingen 28th March 1889.

Kitschl claims to carry on the work of Luther and Schleiermacher, especially in ridding faith of the tyranny of scholastic philosophy. His system shows the influence of Kant's .destructive criticism of the claims of Pure Reason, recognition of the value of morally conditioned knowledge, and doctrine of the kingdom of ends ; of Schleiermacher's historical treatment of Christianity, regulative use of the idea of religious fellowship, emphasis on the importance of religious feeling; and of Lotze's theory of knowledge and treatment of personality. Ritschl's work made a profound impression on German thought and gave a new confidence to German theology, while at the same time it provoked a storm of hostile criticism : his school has grown with remarkable rapidity. This is perhaps mainly due to the bold religious positivism with which he assumes that spiritual experience is real and that faith has not only a legitimate but even a paramount claim to provide the highest interpretation of the world. The life of trust in God is a fact, not so much to be explained as to explain everything else. No " theoretic " knowledge can exhaust its meaning : none can assail it. It is the highest and richest experience of man : there is no alter- native but to take it as the fixed point from which all else is to be regarded. But Kitschl's standpoint is not that of the individual subject. The objective ground on which he bases his system is the religious experience of the Christian community. He starts from the point of view of a member of that believing society which refers its existence to the historical revelation of Jesus Christ, Founder and Eedeemer. The "immediate object of theological knowledge is the faith of

the community," and from this positive religious datum theology constructs a " total view of the world and human life." Thus the essence of Ritschl's work is systematic theology. He does not attempt to prove his data, but accepts their reality as if they were matter for natural science. Nor does he painfully work up to his master-category, for it is given in the knowledge of Jesus Christ revealed to the community. That God is love and that the purpose of His love is the moral organization of humanity in the "Kingdom of God" ??? this idea, with its immense range of application ??? is implied in Ritschl's initial datum.

From this vantage-ground Eitschl oritioizes the use of Aristotel- ianism and speculative philosophy in scholastic and Protestant theology. He holds that such philosophy is too shallow for theology. Hegelianism attempts to squeeze all life into the categories of logic : Aristotelianism deals with " things in general " and ignores the radical distinction between nature and spirit. Neither of them is "vital " enough to sound the depths of religious life. Neither conceives "God" as correlative to himian "trust" (cf. Theologie und Metaphysik, esp. p. 8 f.). But Ritschl's recoil

carries him so far that he is left alone with merely "practical" experience. "Faith" knows God in His active relation to the "kingdom," but not at all as " self-exiatent. "

His limitation of theological knowledge to the bounds of human need might, if logically pressed, run perilously near phenomenalism ; and his epistemology ("we only know things in their activities") does not cover this weakness. In seeking ultimate reality in the circle of ' ' active conscious sensation, " he rules out all ' ' metaphysic. " Indeed, much that is part of normal Christian faith ??? e.g., the Eternity of the Son ??? is passed over as beyond the range of his method. Ritschl's theory of "value-judgments" {WerthurtheiU) illustrates this form of agnosticism. Religious judgments of value determine objects according to their bearing on our moral and spiritual welfare. They imply a lively sense of radical human need. This sort of knowledge stands quite apart from that pro- duced by ' ' theoretic " and ' ' disinterested " judgments. The former moves m a world of "values," and judges things as they are related to our "fundamental self-feeling." The latter moves in a world of cause and

effect. {N.B. Ritschl appears to confine Metaphysic to the category of Causality.) If this only meant that value-judgments are necessary for determining the relative value of given objects ??? e.g., that, supposing the historical work of Christ to be a fact, we must be conscious of the need of redemption before we can appreciate the meaning of that work ??? then Ritschl's theory wouM be a welcome reassertion of an old but neglected truth. But the theory as formulated has such grave ambiguities, that his theology, which, as we have seen, is wholly based on uncompromis- ing religious realism, has actually been charged with individualistic subjectivism. If Ritschl had clearly shown that judgments of value enfold and transform other types of knowledge, just as the "spiritual man" includes and transfigures but does not annihilate the "natural man," then within the compass of this spiritually- conditioned knowledge all other knowledge would be seen to have a fmjction and a home. The theory of value-judgments is part too of his ultra -practical tendency: both "metaphysic" and ' ' mysticism " are ruthlessly condemned. Faith-knowledge appears to be wrenched from its bearings and suspended in mid-ocean. Ritschl has no catholic medium in which spiritual and theoretic truths can be reconciled and harmonized. Perhaps if he had lived to see the progress of will-psychology he might have welcomed the hope of a more spiritual philosophy.

A few instances will illustrate (1) Ritschl's positive systematic theology, which takes for granted the data of Christian experience in the community and of historical revelation, working them up by the thoroughgoing teleological application of the conception of the Kingdom of God ; (2) his repudiation of all ' ' metaphysic " ; (3) hia elimination from faith of all that does not seem to bear on practical needs. The conception of God as Father is given to the community in Revelation. He must be regarded in His active relationship to the " kingdom, " as spiritual personality revealed in spiritual pur- posiveness. His " Love " is His will sis directed towards the realiza- tion of His purpose in the kingdom. His " Righteousness " is His fidelity to this purpose. With God as "First Cause" or "Moral Legislator " theology has no concern ; nor is it interested in the ' ' speculative " problems indicated by the traditional doctrine of the Trinity. "Natural theology " has no value save where it leans on faith. Again, Christ has for the religious life of the community

the unique value of Founder and Redeemer. He is the perfect Revelation of God and the Exemplar of true religion. His work in founding the kingdom was a personal vocation, the spirit of which He communicates to believers, "thus, as exalted king," sustaining the life of His kingdom. His Resurrection is a necessary part of Christian belief (Eoke, pp. 198-199). "Divinity" is a predicate applied by faith to Jesus in His founding and redeeming activity. We note here that though Ritschl gives Jesus a unique and un- approachable position in His active relation' to the kingdom, he declines to rise above this relative teaching. The "Two Nature" problem and the eternal relation of the Son to the Father have no bearing on experience, and therefore stand outside the range of theology.

Once more, in the doctrine of sin and redemption, the governing idea is God's fatherly purpose for His family. Sin is the contra- diction of that purpose, and guilt is alienation from the family. Redemption, justification, regeneration, adoption, forgiveness, reconciliation all mean the same thing ◆◆◆ the restoration of the broken family relationship. All depends on the Mediation of Christ, who maintained the iilial relationship even to His death, and communicates it to the brotherhood of believers. Everything is defined by the idea of the family. The whole apparatus of "forensic" ideas (law, punishment, satisfaction, &c.) is summarily rejected as foreign to God's purpose of love. Eitschl is so faithful to the standpoint of the religious community, that he has nothing definite to say on many inevitable questions, such as the relation of God to pagan races. His school, in which Herrman, Kaftan, Hamack are the chief names, diverges from his teaching in many directions; e.g., Kaftan appreciates the mystical side of religion, Hamaok's criticism is very diflterent from Ritschl's arbitrary

exegesis. They are united on the value of faith-knowledge as opposed to " metapliysio. "

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1898, London ; and A. E. Garvie, The Ritschlian Theology,

1899, Edinburgh, in both of which the bibliography of the movement is given. The German literature on the subject is very large. (g. E. N.)

Riukiu. See LucHU.

Riva,, a fortified district town near the Italian frontier in Tirol, Austria. It is a lake port and steamship station at the northern extremity of the Lago di Garda. There are two forts on the Monte Brione a little over a mile north-east of the town, and the old castle of La Rocca was reconstructed and extended in accordance with modern requirements in 1850. The ilinorite Church (1603), with altar pictures by Guido Reni and other Italian painters, is much frequented as a place of pilgrimage. In addition to its transit trade and the entertainment of visi- tors, the principal resources of the town are the manufacture of paper, iron wares, and pottery, the cultivation of the silk -worm and the olive tree, and a considerable commerce in timber, planks, and coal. Riva is connected with the Ledro valley by a picturesque road, which passes in a series of tunnels and galleries along the rocky and precipitous west shore of the lake Population (1890), 6480; (1900), 7550.

RiVcirolO, a town of the province of Turin, Piedmont, Italy, in the Oreo valley, 25 miles north of Turin by rail. It is a seat of cotton manufacture, and bicycles are also made and cocoons produced. The town stands picturesquely, and is sometimes called "Little Turin." Population (1899), about 7000.

River Eng'ineering'. ◆◆◆ Since the

article in the Encyclopcedia Britannica on River Engineering i was written in 1884, several interesting works have been carried out or completed, exhibiting distinct progress in the improvement of rivers, and in some instances constituting novel undertakings ; while some matters relating to the natural condition of rivers and their improvement, not included in the original article, require to be considered, in order to complete the review of the subject.

Improvement above the Tidal Lim,it.

When large rivers with a fairly good and regular flow at their low stage need only a moderate increase in depth at certain places to afford the requisite waterway for local inland navigation, the necessary improvement can often be effected by contracting the low-water channel with longi- tudinal and cross dykes, thereby promoting scour and in- creasing the depth. Of this the Rhine, the Rhfine, the Elbe, the JSTiemen, and some rivers in North America furnish examples. These works leave the capacity of the river for discharging floods unaffected, or sometimes slightly im- proved, for the increase of the discharge in the deepened channel fully compensates for any obstruction the dykes may offer in the outer flood-channel. In rivers, also, which,

with a rapid flow and inadequate depth, bring down so much detritus in flood-time as to preclude their improve- ment by canalization, the systematic regulation of the bed and banks has to be undertaken to increase the navigable depth.

The Rhone below Lyons, which has an average fall of 1 in 2080 and a maximum fall in some places of 1 in 250, and brings down large quantities of shingle and gravel, is a notable instance of the latter class of rivers, whose navigable depth at a low stage has been increased to a moderate extent by regulation works. These works, carried out between Lyons and the St Louis Canal close to the mouth of the river, a distance of 201 miles, were commenced in 1878, considerably modified after 1884, and com- pleted for the most part by 1894, when consolidation works chiefly remained to be gradually executed. The expenditure at that period reached about ►►1,463,000 for the regulation works alone, or ►►7276 per mile, which may eventually be raised to ►►8000 per mile

by the time the works are completely finished.^ The works consist of (1) dykes across secondary and old channels, to close them and prevent their reopening during floods, when the main channel formerly tended to wander, and to concentrate the low-water flow in a single fixed channel (Kg. 2) ; 12) longitudinal

‘ Encyclopcedia Britannica, 9th edition, vol. Plate V.

. pp. 571-581, and

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FiQS. 1 and 2. ⬛⬛⬛ Regulation Works, River Rhfina

dykes for protecting and easing the concave curves of the banks in the bends, which, being extended somewhat into the channel to reduce the curvature, are connected at the back to the banks by cross dykes to prevent the current during floods from forming a channel behind them (Fig. 1) ; (3) dipping cross dykes projecting downwards into the water from the banks, or in front of the longitudinal dykes, to concentrate the flow of the river at a low stage and increase its depth, and pointing some-what up-stream so as to direct the water passing across them into the central channel (Figs. 1 and 2) ; and, lastly, (4) sub- merged dykes, the tops of which are kept well below the re- quired navigable depth, placed across the deep pools found below shoals in the centre of the channel. These arrest scour in the hollows, and by moderately raising the water-level up-stream, owing to their checking the flow through the deep pools, improve the depth over the shoals above them, and adjust slightly the irregularities in the surface fall of the river, which is naturally rapid over the shoals and small over the deep portions (Fig. 1). The minimum depth in the navigable channel of the river, at its lowest stage, was increased by the regulation works from 1 foot 3J inches in 1878, to 2 feet llj inches in 1884, and 4 feet IJ inches in 1893 ; and it is anticipated that on the final completion of the works, a depth of about 5 feet will be attained, amounting to a gain of 3| feet of water at the lowest water-level. Before the commencement of the works, navigation on the Rhfine below Lyons was impracticable for three months in the year, diflioult during four months, and easy for the remaining five months ; whereas now,

navigation is only liable to be interrupted during a fortnight, is difficult for another

‘ Sixth International Inland Navigation Congress, The Hague^ 1894, ” Regulation of Rivers at Low Water,” H. Giradon.

fortnight, and is easy for fully-laden vessels during eleven months in the year.

The success of regulation works depends largely upon the degree of uniformity in the flow of a river, and especially on the volume of the minimum discharge and its duration ; and consequently, these works are best suited for the lower portions of large rivers, where the regularity of flow attains a maximum, and are not adapted for rivers with a very variable discharge. Thus the Ehflne, in spite of its considerable fall, possesses capabilities for regulation in respect of its flow ; for its minimum discharge just below the confluence of the Saone at Lyons is four times that of the Seine at Paris. The volume of its flow exhibits a greater regularity than many rivers of similar size, owing to the flow of the main river being regulated by passing through the Lake of Geneva, and the occurrence of the floods of some of its tributaries at diS’erent periods of the year. Thus the floods of the Saone, which rises in the Vosges, occur in the winter months; while the Arve, the Ain, and the Isire, coming from the Alps, are subject to floods in the summer from the melting of the snow and glaciers. Regulation works possess the merit of leaving a river entirely open for naviga- tion, while increasing the depth and rendering the passage of vessels easier round the flat- tened bends ; but, on the other hand, they only slightly modify the velocity of the downward flow, which continues to be a serious hindrance to the up-stream traflSc in. a river with a rapid current like the Rh6ne.

Dredging with bucket ~~ladder dredgers fur~~ nishes a well-known method of gradually improv- ing and maintaining the depth of navigable _ . rivers over long distances ; and sand- pump dredgers

reag ttg. jjg^yg been employed with success, for many years past, in gradually lowering the bars of sand obstructing the entrance channels of some of the North Sea ports. The greatly increased efliciency, however, of the powerful sand-pump dredgers constructed within the last few years, especially when provided with cutters, and still more recently with water-jet agitators, has, since 1896, enabled the Mississippi River Commission to out temporary channels rapidly through the shifting sand-bars which impede the navigation of the Lower Mississippi at its low stage, and thereby to increase the available navigable depth of the river during the low-water season. Centrifugal pumps on the dredger draw up sand mixed with water through the suction pipes lowered down from the dredger on to the sandbank, the amount of sand thus removed from the bar being much increased by churning up the sand by large revolving steel cutters at the orifices of the pipes, or still more effectually by jets of water forcibly ejected through pipes against the sand- bank by centrifugal pumps, since the cutters are liable to jam on encountering debris embedded in the bar. The sand thus pumped up is dis- charged, through floating pipes, some distance off into deep water on the down-stream side of the cut.

Four of these sand ~~pump dredgers, work~~ ing on different sections of the Mississippi below Cairo in the autumn of 1897, provided a navigable depth of from 6 to 9 feet over fourteen bars during the low – water season ; and the two newest dredgers were able to raise, on the average, 1523 cubic yards and 1850 cubic yards of sand respectively per hour, discharging it to a distance of about 1000 feet.^ The dredgers start work if possible at the beginning of September, to prepare the channels across the bars beforehand, the lowest stage of the river being reached at the end of October or early in November. A channel which has been opened out maintains its depth fairly well for a certain time ; but the dredgers are kept constantly ready, during the low stage, to clear away any obstructions which may make their appearance. Two additional dredgers have been since built ; and it is antici- pated that these six dredgers, with a seventh about to be con- structed, will be able to make and maintain,

each autumn, a, navigable depth of 9 feet at the lowest stage over all the bars below Cairo, for a width of 250 feet ; so that this depth will be always available for navigation, except when the river is closed by ice.

Canalization, in converting a river into a succession of nearly level reaches resembling a canal, hinders navigation by the introduction of locks, which occupy time to pass Caaallza- ^jj^Qugh . an,j tj^g discharge of the river is also im- tlon. peded by the weirs needed to maintain the requisite

depth of water in the dry season. Canalization, however, pro-

vides a more assured navigable depth at the low stage of the river than regulation works, especially when the low-water dis- charge is liable to become small ; and it also generally secures a greater depth, which can often be increased to a moderate extent without difficulty or great expense. Moreover, in spite of delays in the passage of vessels through the locks, canalization is decidedly advantageous for the up-stream traffic, owing to the reduction in the velocity of the descending current by the weirs, except during high floods ; and it is also safer for the down-stream traffic with rivers having a somewhat rapid current and a winding course. The time occupied in locking vessels can be much reduced by furnishing the locks with large culverts at the sides for rapidly filling and emptying the lock-chamber, and by adding an inter- mediate pair of gates, or a small lock, for accelerating the passage of the smaller vessels ; while by placing the locks in a side out, and erecting movable weirs which can be removed from

FRANKFORT

NIEDERRAO

Fig, 3. ⁇⁇⁇ Canalization of the Main.

the channel when the river rises in flood-time, the safety of the navigation is ensured, and the river channel is left as unimpeded as possible for the discharge of floods.

One of the most successful and recent of these works is the canalization of the river Main, by the construction of five weirs and locks between Frankfort and the junction of the river with the Rhine opposite Mainz, a distance of about 22 miles, in 1883- 1886,^ and the enlargement of the locks and the provision of an in- creased depth a few years subsequently. The regulation of the river Main below Frankfort by longitudinal and cross dykes, previously carried out, had only secured a navigable depth of 3 feet at the low stage of the river ; so that the traffic on the river had to be conducted by small barges, and, just before the commence- ment of the works, amounted to only about 12,000 tons a year.

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' Report of the Chief of Engineers, 1898, Part v. Appendix xx., "Report of the Mississippi River Commission," pp. 3139 and 3162, and plates 4 to 11, and 30 to 88.

Fig. 4. ??? Lock and Weir on the Main,

The five movable weirs across the river, with locks m side cuts on the left bank (two with lifts of 8 feet 10 inches, and three with lifts of 5 feet 11 inches, giving an average rise from the Rhine to Frankfort of 35 feet 5 inches at a low stage), increased the navigable depth to 64 feet at the lowest water-level (Fig. 3) ; and the traffic consequently rose to about 300,000 tons in 1887, in spite of the competition of two railways connecting Frank- fort with the Rhine valley, one on each side of the Main. The general arrangement of the weirs and locks is indicated by a plan of the works highest up the river, 2 miles below Frankfort, given on Fig. 4. The original locks were made 279 feet long between the gates, and 34^ feet wide, in order to be able to receive the steamboats navigating the Rhine, 246 feet long and 32 feet broad, partially loaded ; and their sills were placed 8J feet below the water-level retained by the weirs, to allow*

*for a further deepening of the river. The principal weir, stretching from the left bank nearly across the river, is a needle weir * of improved type in each case, divided by masonry piers into two to four bays, one of the openings in each weir, from 154 to 193 feet wide, serving as the navigable pass for vessels in flood-time with its sill lOi feet below the water-level retained by the wefrs. A timber pass has been formed alongside the right bank at each weir, by a long embankment in the river shutting off a channel*

^ "Die Canalisirung des Main von Frankfurt a. M. bis zum Ehem," B. Cuno and P. Gutzmer, Zeitschrift fur Bauwesen, 1888, p. 19, and plates 14 to 17.

3 -Encydopcedia Britannica, 9th edition, p. 574, and Plate V. Fig. 3.

with a bottom width of 39J feet. This is closed at its upper end by a drum weir ^ of the same width between masonry piers, with its upper paddle retaining a head of water of 5 feet 7 inches, which can be readily lowered for the passage of timber down the channel, and raised again against the full force of the current, by adjusting the water-pressure in the drum, below the sill, on the under paddle by means of sluice-ways in the river pier of the drum weir. These works were carried out by the State at a total cost of ??275,000 ; and no tolls are charged for vessels passing through the locks. A haven has been formed above the weir near Frank- fort, by an embankment in the river, about 580 yards in length, parallel to the right bank and raised above flood-level, as a refuge for vessels in winter from floods and floating ice. This also serves in ordinary times for commercial purposes, direct communi- cation with the upper river being provided by an opening at the upper end, which is closed by a pair of gates when necessary (Mg. 4). The great increase in traflic resulting from the above canaliza- tion led to a decision in 1889 to enlarge each of the five locks on the Main, below Frankfort, sufficiently to admit six of the largest barges navigating the Ehine with their tug at one time. A third pair of gates was erected in the cut, 820 feet below the lower gates of the

original lock ; and the navigable depth was increased to 8J feet by dredging the bed of the river towards the upper end of each reach. This additional depth has enabled the river to be navigated by the large Rhine steamboats when fully loaded with 1300 tons of cargo, and drawing 7% feet. The river traffic, which was 9,388,640 ton-miles in 1887, rose to 22,543,700 ton-miles in 1892, and reached 36,630,830 ton-miles in 1898.

An entirely novel type of frame weir was completed on the Lower Seine in September 1885 at Poses, and a second one about 25 miles higher up a year or two later. In all the pre- vious frame weirs, closed with square spars (needles), roUing-up curtains, or panels, erected across French and American rivers, and also in the needle weirs on the river Main, the frames which are hinged on the apron of the weir in a row, and carry a foot-bridge, are laid flat on the bed of the river in flood-time, each partially resting upon the frame previously lowered. They are therefore exposed during the winter months to the action of the flooded river, and the detritus it carries down. At Poses and Port Mort, on the contrary, the frames are sus- pended vertically from a wide overhead foot-bridge, and rest at their lower ends against a sill in the bed of the river ; while the weirs are closed by hinged curtains, let down and rolled up again by aid of a winch travelling on a small foot-bridge formed by a series of brackets hinged to the back of each frame (Fig. 5).^ The weir is opened by rolling up the curtains, and raising the hinged frames one by one into a horizontal position by chains from the overhead bridge, so that all the movable parts of the weir are raised out of the water in flood-time, quite secure from injury,

SECTION OF WeiR.

Movable weirs.

to be made high enough for the raised frames underneath them to leave a clear headway for vessels of 17J feet above the highest navigable water-level (Fig. 5). The merits of this type of weir consist in its ease of working, the security of the movable parts, and its applicability to high weirs ; but the high wide piers and the broad foot-bridges necessarily make the system costly.

The drum weirs across the timber passes in the river Main are an extension to deeper channels of the system adopted originally for the shallow portions of the weirs across the river Marne, the depth of water retained by the upper paddle of the Main weirs being 5 feet 7 inches, as compared with 3 feet 7^ inches at the Marne weirs, and the radius of the drum 6 feet 11 inches in place of 4 feet 3 inches. The most notable example, however, of this type is the drum weir, erected at about the same period as the Main weirs, across the navigable pass of the weir constructed for canalizing the river Spree at Charlottenburg.' The upper paddle of this weir, 39J feet wide, retains a depth of 9J feet of water above it ; and the drum in which its lower paddle revolves, on a

\ff^fp;^^^f|f

ELEVATION.

Fig. 5. ❓❓❓ Lifting tYame Weir, Poses, River Seine.

and yet ready to be lowered for closing the weir at any time. The foot-bridges across the shallow openings have only to be placed at a sufficient heiijlit for the raised frames underneath them to be well above the highest flood-level ; but the foot-bridges across the navigable passes, of which there are two at Poses, 1064 f^^t in width, and five at Port Mort, each about 99 feet wide, have had

*' JSncyclopmdia Britanhica, 9th edition, p. 575, and Plate V. Fig. 7. * "The River Seine," L. F. Vernon – Harcourt, Proc. Inst. G.E. vol. Ixxxiv. pp. 234 and 236, and plate 3.*

*< ❓❓❓-' Z9'. *❓❓❓., : ❓❓❓*

Fig. 6. ❓❓❓ Drum "Weir, Charlottenbllrg, River Spree.

horizontal axis common to the two paddles, in opening and closing the weir, has a radius of lOJ feet (Fig. 6). A bridge resting on the abutment of the right bank, and on the river pier of the drum weir, spans the opening closed by the weir, and afl'ords a headway for vessels of slightly over llj feet for nearly the whole width above high flood-level, which is about 6

feet higher than the normal water-level retained by the weir. ^ The great value of this type of weir is the ease ^ and rapidity with which the weir is not only lowered, but also raised against a very strong current, rendering it peculiarly suitable for regulating the discharge at a weir, and for controlling passes which may have to be frequently and quickly opened and closed. It possesses, however, the serious drawback of the large cost involved in the construction of the drum, which, irrespectively of its foundations, has to be carried down deeper below the sill of the weir than the height of the actual weir formed by the upper paddle. It can therefore be only adopted with advantage where ease and rapidity of working are so essential that the cost is quite a secondary consideration. Accordingly, though drum weirs were first constructed on the river Marne between 1857 and 1867, to provide a movable crest on the top of eleven submerged solid weirs, the system was not extended until much later to the closing of passes under somewhat exceptional conditions in Germany.

A modification, however, of the drum weir for forming a movable crest, 7 feet high, on the top of a concrete weir resting upon piles, and raised llj feet above the bed of the Osage river, a tributary of the Missouri, in connexion with its canalization, has been experimented on with a full-sized model, and is in course of construction." The weir across the river, adjoining the lock built ' " Die Stauanlage in der Spree bei Charlottenbnrg," E. Mohr, Zeitschrift fiiT Bauwesen, 1886, p. 338, and plates 31 and 32.

⬛⬛⬛⬛⬛ lUport of the Chief of Engineers, 1897, Part vi. Appendix WW, "Report of the Missouri River Commission," pp. 3947 and 3949 J and 1898, Part vi. Appendix YY, pp. 3471 and 3646 and plate.

close alongside the left bank, consists of ten bays, each 75 feet in width, separated by masonry piers containing the sluice-ways for connecting the drums with the upper or lower pool. The movable portion of the weir, extending along the crest of each bay, is formed by a sector of a circle, subtending an angle of 67i⬛⬛, encased all round with close planking,

and strengthened internally by iron framing. The sector, which revolves on a horizontal axis along the crest of the solid weir, forms the upper 7 feet of the weir when raised, and, when lowered, fills the drum at the back of the solid weir, which has a radius pf nearly 9 feet, and is encased in close planking. A triangular space is left between the underside of the lowered sector and the down-stream verti- cal face of the concrete weir, through which the water- pressure, developed on opening communi- cation with the upper pool, raises the sector and closes the weir. The completion of the weir was delayed by floods in 1900.

The half-tide lifting-gate weir, with overhead foot-bridge, erected across the river Thames at Richmond ^ ,o fairly regarded as a type of mov-

able weir, as the weirs with frames suspended from an overhead foot-bridge at Poses and!^ Port Mort on the Seine. In both cases the overhead bridge forms a necessary fixed adjunct for operating the weir ; the river piers carrying the foot-bridge are inevitable obstructions in the channel in flood -time, though of no great importance ; and all the movable parts can, in each case, be readily removed from the river, so as to leave the channel unobstructed, with the exception of the piers, and secure the parts themselves

each pier against a vertical row of free rollers suspended by the loop of a chain attached at one end to the pier and at the other end to the gate, whereby the friction due to the water-pressure against one side of the gate is much reduced. The raising of the gate, weighing 32 tons, is further considerably facilitated by its being counterpoised by weights above (Fig. 8). The discharge of the fresh-water flow of the river, during the lower half of the tide, is provided for by slightly raising the gates above their sills pro-

Fig, 7 Lifting-gate Weir and Foot-bridge at Richmond, Surrey.

from injury during the descent of floods. The openings, indeed, between the piers are wider at the Seine weirs; but, on the other hand, the Richmond weir is much more rapidly opened and closed. It was erected to retain the river at half- tide level between Richmond and the tidal limit at Ted- dington, so that the unsightly mud-banks which had become exposed

at low tide, owing to the consider- able lowering of the low-water level result- ing from the removal of obstructions and dredging in the chan- nel below, may be always covered with water, without ab – stracting the whole of the tidal flow and ebbbetweeuEichmond and Teddington from the river below. The lifting -gates forming the weir are 12 feet high, and close the three central spans, each 66 feet in width, of the arched double foot-bridge, when the river falls below half- tide level on the down-stream side of the weir (Figs. 7, 8, and 9).' The gate, when being lifted, slides in a recess in

' Engineering, vol. Ixi. p. 47, and plate.

Fig. 8. ??? Mechanism of Lifting-gate, Richmond,

Fig. 9. ??? Plan of 'Works at Richmond, Surrey

portionately to the volume of the flow. As soon as the rising tide has reached half- tide level, the gates are lifted out of the water, and on approaching the level of the crown of the arch, are turned by guides in the piers into a horizontal position between the two foot-bridges, so as not to interfere with the view of the river through the arches. Here they remain till the fall of the river again to half-tide level necessitates their being lowered. Each gate can be fully raised in seven minutes by two men on the foot-bridge. The similar weirs erected at Belleek in 1883, and at Ballinasloe in 1885, for controlling the drainage works above them on the rivers Erne and Suck, and enabling works to be carried out to facilitate the discharge of floods, close four openings each, only 30 feet, and 25 feet in width respectively. Their gates are merely raised for the passage of the river water ; and the head of water against these weirs, as in all non-tidal rivers, is always on the up-stream side. At Richmond, however, though the head of water against which the much wider gates there have to be raised is usually considerably less than at Belleek and Ballinasloe, the water-pressure maybe on the down-stream side with a rising tide. On this account, free rollers have had to be provided on both sides of the gates ; and the complete raising and lowering of the Richmond weir gates is a daily operation, except during floods and at night.

Outlets of Tideless Rivers.

The success wliicli resulted at tlie Sulina moutli of tiie Danube, and at the South Pass outlet of the Mississippi, from the concentration of the discharge by the formation of parallel jetties, extending beyond these outlets towards their bars, which were considerably lowered by the induced scour over the shoals, has been previously described.'^ The period, however, which has elapsed since the jetty works were carried out enables a more accurate view to be formed of the prospects of the continuance of the im- proved depth over the bars in front of these outlets, and to determine whether an extension of the jetties is likely to be required in the near future, either at the navigable outlet of the Danube, or the Mississippi. The prolonga- tion of the current of a sediment^bearing river farther out into a tideless sea, by extending parallel jetties beyond its outlet, does not merely lower the bar in front of the outlet by scour, but also enables the issuing current to con- vey the materials with which it is charged into deeper water. Here the continual accumulation of deposit takes much longer to rise to a sufficient height to impede navigation,

^ EncydopcBdia Britannica, 9th edition, vol. xx. pp. 580-581, and Plate V. Pigs. 19 to 23.

Su/lna Outlet of Danube.

and sometimes brings tlie suspended matter witMn the influence of a littoral current ???which, occasionally flows across in front of the outlet at a short distance from the shore. The rate of advance of a delta depends upon the volume and density of the materials brought down by the river, the depth of the sea in front of the outlet, and any disturbing influences which may be encountered in the sea outside, such as a littoral current or wave-action.

The Sulina jetties extending the outlet of the Sulina branch of the Danube beyond the coast into the Black Sea, which increased the depth in the navigable channel over the bar from 10 feet to 20 feet by the scour alone of the concentrated current, maintained this latter depth up to 1894, when dredging with a bucket-ladder dredger was carried out in the shoal parts of the channel between and beyond the jetties. The available depth was thus increased to 24 feet by the autumn of 1895, in spite of deposits which necessarily occurred from the alluvium brought down by the floods of the river. Not- withstanding, however, the remarkable mainten- ance of the depth obtained by works completed about 1870, and the facility with which the depth has been increased by dredging, a com- parison of the charts of 1856 and 1894 shows that though the inevitable accumula- tions of .deposit have not hitherto affected the available depth of the navigable channel, their influence on the depth of the sea at some distance in front of the Sulina outlet is clearly manifested by the steady advance seawards of the 5-fathom line, which amounted to an average of 59 yards a year between 1856 and 1894.^ The shoaling, indeed, is somewhat slow, owing to the lightness " of the alluvium brought down by the Danube, and to this alluvium being brought under the influence of a, southerly littoral current, and it has mostly taken place in greater depths than the shallowest part of the navigable channel ; but the deposits, which have been considerable in depths of between 3 and 5 fathoms, will, in course of time, raise the shoals to a height inconvenient for navigation, and necessitate an extension of the jetties. Moreover, it has been calculated that the Sulina mouth will, in about 170 years, come within the zone of

the large deposits of the rapidly advancing Kilia outlets to the north of Sulina.

*The parallel jetties, 1000 feet apart, extending from the outlet of the South Pass of the Mississippi into the Gulf of Mexico, which ,. p increased the maximum available depth at the outlet outlet ot from 8 feet in 1875 to 31 feet in 1880, have not been JUIssissloDl ^^^^ * ^^ii'tain the stipulated depth of 26 feet, for a width of 200 feet, and a central depth of 30 feet quite continuously, either in the jetty channel itself, or outside to deep water in the gulf. Up to the middle of 1898 there had been a*

year there was a deficiency of depth during 133 days in the jetty channel, and during 4 days outside. The jetty works, accordingly, which produced such a large increase in depth at the outlet of the South Pass, have been unable to maintain the depth for twenty years after their completion. The changes which have occurred at the outlet are indicated by the plan showing the lines of sound- ings in front of the outlet in 1883 and 1898 (Fig. 10) ; and by longitudinal sections of the jetty and outer channels, in 1875 before the commencement of the jetty works, in 1880 after their comple- tion, and in 1898 (Fig. 11). Deposit from the river is evidently taking place in ffont of the outlet, being shown upon the plan by the advance of the lines of soundings since 1883, and by the relative depths on the section in 1880 and 1898. The greatest advance occurred at the 70-feet line of soundings, amounting to 2154 feet between 1877 and 1897, and averaging 108 feet a year ; whilst the 20-feet line of soundings shows the least advance of 655 feet, or an average of 33 feet a year. In a fan-shaped area of IJ square miles, extending out about 5300 feet from the

EAST POINT

.HIGH WATER AVERAGE FUOOD TIDE.

END or JETTIES.

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Fig. 10. ◆◆◆ Plan of Jetties, Soutli Pass Outlet, Mississippi Eiver.

deficiency of depth in the jetty channel on 309 days, and outside on 44 days, during a period of about 17 J years. ^ Efforts have been made to secure the required depth in the jetty channel by narrowing the channel to a width of about 650 feet by inner jetties, with some projecting spurs effecting a further reduction in width of about 50 feet (Fig. 10), and also by dredging, which has, moreover, been employed to a small extent for deepening the outer channel. In the year 1897-98 dredging was carried on during 50 days in the jetty channel, and 5 days in the channel outside, and the proper depth appears to have been maintained during the year, except for 4 days in the jetty channel ; but in the previous

1 ” The Sulina Mouth of the Danube,” C. H. L. Kiihl, Proc. Inst. O.E. vol. xci. p. 329, and plates 3 and 4 ; and ” The Survey of the Delta of the Danube in 1894,” Proc. Inst. G.E. vol. oxxii. pp. 339-341.

^ Report of the Chief of Engineers, 1898, part ii. appendix i., “Improvement of the South Pass of the Mississippi Eiver,” pp. 1447 and 1451, and plate,9 1 and 2,

Fio. 11. ◆◆◆ Section of Outlet Channel, Mississippi Eiver.

extremities of the jetties, there has been an average reduction in depth all over of 17i feet between 1876 and 1899, the accretion being slight near the jetty channel, except on the western side, and greatest in the outer zone.^ The outer 30-feet channel is already somewhat narrow, and is deflected to the east of the jetty channel ; and considering the large quantities of alluvium which are being deposited in the outer channel about a mile beyond the jetties (Fig. 11), it seems probable that though the central 30 feet in depth may be maintained for some little time longer by the aid of dredging, an extension of the jetties will be necessary to carry a channel of the required depth across the bar in process of formation again beyond the outlet.

Great difficulties have been experienced in the attempts to im- prove the depth at the outlets of the two main branches of the V olga delta, owing to the great width of the shoals ry fi t / obstructing these channels, the shallowness of the y . Caspian Sea in front of the mouths of the Volga, resulting in the rapid advance of the delta, and the exposed position of the outlets. Many years ago an __ endeavour was made to improve the outlet of the ;' smaller Kamysiak branch, by concentrating the ; discharge in one of its outlet channels by a ??? discontinuous line of fascine mattresses on each side, and closing the minor outlets of this branch, ??? and also by dredging to a small extent. These ???s"& works, however, gave little permanent increase in depth, owing to the discontinuity of the training or jetty works, the injuries they are exposed to from waves and ice, and the shallow- ness of the foreshore in front of the outlet. Subsequently, the larger Bakhtemir branch was deepened by dredging its shoals along a total length of 5| miles, increasing the available depth at the ordinary water-level from about 4 feet to 8 feet, which latter depth has been maintained for several years ; but a further increase of even 1 foot in depth would necessitate dredging through 17 miles of shoals. Accordingly, in order to obtain a deeper channel than 8 feet between Astrakhan and the Caspian, it is proposed to revert to the Kamysiak branch. This pos- sesses an available depth of 14 feet between Astrakhan and its bar, which is only about IJ miles across ; its outlet is much nearer 3 fathoms depth in the Caspian than the Bakhtemir outlet ; and its discharge being less, the advance of the delta at its outlet is less*

than at the other outlet. ^Vith adequate dredging plant, it is anticipated that the depth on the Kamysiak bar can be increased

*lie**

‘ Report of the Chief of Engineers, 1898, pp. 1459 and 1460 ; and 1900, p. 2237, and charts 1 and 2.

- *“Les embouchures du Volga,” V. E. de TimonofiF, Yme. Congrii International de Navigation Intlrieure,*

from 4J feet to 14 feet, and maintained without difficulty, so as to provide an available depth of 14 feet between Astrakhan and the sea.

When a considerable increase in depth is required across the bar of one of the deltaic outlets of a tideless river, it must be obtained by the construction of parallel jetties extending out towards the bar, whereby the concentrated current scours a channel through the bar. A small additional increase in the depth of the out- let channel thus formed may sometimes be

obtained, or the original depth maintained, t ❓❓❓ J ❓❓BovtLw. by dredging across narrow shoals which occasion a reduction in the available depth. Eventually, however, the continual deposits of alluvium brought down by the river in the sea in front of the outlet will lead to the reappearance of the bar farther out, which, owing to the volume of the accre- tions in the sea formed by large sediment- bearing rivers, can only be prevented from impeding navigation by a prolongation of the jetties, resulting in the formation of a deep channel across the bar for another period. Where the sea is shallow in front of a deltaic outlet, and the river current feeble, the conditions are not favourable for an improvement of depth by parallel jetties; but, provided the shoals obstructing the outlet channel are not very wide, and the proportion of sediment brought down

not very great, a moderate increase in depth may be obtained by large and continuous dredging operations.

The Improvement of Tidal Bivers.

Since the size and depth of tidal rivers mainly depend on the volume of tidal water entering the river, especially when the tidal rise is large and the fresh-water discharge small, the maintenance or, where practicable, an increase of the tidal volume constitutes a primary consideration with regard to any proposed improvement works in the tidal portions of rivers.

The tidal condition of any river is very well shown graphically, by a series of simultaneous tidal lines, obtained from simul- taneous observations of its varying height, taken at several stations along the river, at suitable intervals, throughout a whole tide ; for when these respective sets of heights are plotted at their relative distances apart, and joined by lines, these simultaneous tidal lines represent the actual surface of the river at the particular times when the observations were made (Fig. 12). The passage of a tide up and down a river is thereby clearly indicated, and any irregularities in the flow are manifested ; while the lines enable the volume of

the tide. The full lines in the diagram show the successive levels of the flood tide, and the dotted lines the levels of the ebb tide.

The appearance of a nearly vertical face at the upper end of the simultaneous lines representing an incoming tide, as visible (Fig. 13) to some extent opposite Moyapur, and more marked at Konnagar and Chinsurah, indicates that the flood tide encounters obstructions to its progress along this portion of the river, leading to the formation of a 6ore. This phenomenon occurs when the flood tide at the

Tidal bores.

Fio. 13. ??? Moyapur Beach, Eiver Hiigli, January 1896.

UPPER NURPUR.

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Fia. 12. Simultaneous Tidal Lines, Eiver Hilgli. tidal water entering a river to be calculated. Simultaneous tidal lines of the river Hiigli, derived from tidal observations made throughout a spring tide during the dry season, at several stations along the river, from near the mouth of the estuary up to Nadia, only about 5 miles below the tidal limit, a distance of 162 miles, are given in Fig. 12, in which the vertical scale has been made very much larger than the horizontal to magnify adequately the variations in the water-level at different periods of

CEWANKMAU

Fig. 14. James and Mary Beach, Biver Hiigli, April 1890.

height of springs, especially when raised by a narrowing river and impelled by wind, in flowing rapidly up the channel is checked by shoals, till the tide rising behind gains a sufficient head to overcome the frictional resistance and impel the water over the shoal. Under these conditions, the earliest part of the flood tide travels up the river like a breaking wave with an almost vertical face, producing on its passage an instantaneous reversal of the current and a, sudden rise of the river. Bores of 6 to 7 feet in height have been often observed on the Severn, the Seine, and the Hugli ; whilst bores of 10 to 15 feet high are said to have passed up the Amazon and the Tsientang-kiang. By lowering the obstructive shoals by training works or dredging, the passage of the flood tide is facilitated, and the bore con- sequently reduced in height ; and at the same time the navig- able channel is improved, and the tidal condition of the river ameliorated.

Tidal rivers in their natural condition have a winding course, accompanied by irregularities in depth ; and the gradual erosion of the

*concave banks at bends often effected by the current, which is followed by accretion in front of the "^^'Sfable convex banks, aggravates these defects. The main ***"""'- current of the river, flowing in a direct line, when not impeded by any obstacle, impinges against the concave bank opposing its course at a bend, where, being guided and deflected by this bank, it scours out and maintains a deep channel close alongside the bank. At the termination of the concavity of the bank at the end of the bend, the current being no longer controlled, passes in a straight direction diagonally across the river to the following concave bank facing its path at the next bend. Deep channels are consequently always found alongside the concave banks of a winding river ; hut the main current being perfectly free in crossing over from one concave bank to the next on the opposite side, spreads out and varies somewhat in direction, in accordance with changes in its velocity and obstacles encountered, so that its scouring influence becomes irregular and much reduced at the crossing, and the navigable channel is shallow, and liable to shift somewhat between the bends. "Where scour occurs at the concave bank, the further deterioration of the river should be prevented*

by protecting these banks from erosion with suitable materials, or by putting out dipping cross dykes to direct the force of the current away from the bank into a more central channel. In rivers above the tidal limit, the shoals in the channel between the bends can be lowered by narrowing the river at these places, so as to direct and concentrate the current at the crossing, and thereby increase its scour, and deepen the channel.

The improvement of the navigable channel between bends in a tidal river is a more complicated problem, because in this case an adequate narrowing of the channel between the bends would check the influx of the tide ; and the flood and ebb tides, flowing in opposite directions, tend to follow a different course along opposite banks between the bends, and to form, consequently, two distinct channels. The main currents, accordingly, of the flood and ebb are liable to act in antagonism ; and where they pass alongside opposite banks, the gradual erosion of both

these banks leads to a widening of the river, and an increasing divergence of the channels formed by the flood and ebb currents respectively. The result is the growth of a central shoal between the channels at the crossing, which reduces the available depth for vessels (Figs. 13 and 14). The ebb tide and the fresh-water discharge, constituting the descending current, necessarily follow the same course as the downward current of a non-tidal river, and generally form the navigable channel, especially when the fresh- water discharge is large ; whereas the ascending flood tide takes a somewhat straighter course, and tends to form blind channels in the shoals between the bends, nearer the convex banks than the ebb-tide channel. Eventually, however, the two main currents of ebb and flood both come, at different points, into the deep channel alongside each concave bank.

The divergent channels formed by the ebb and flood tides, in cases where the flood tide has the predominance during a portion of the year, owing to the smallness of the fresh-water discharge in the dry season, are very clearly exhibited on the low-water charts in the dry season of the two worst crossings on the river Hugli below Calcutta, given in Figs. 13 and 14.^ At the Moyapur crossing (Fig. 13), the main current of the ebb tide forms a deep channel along the concave right bank almost down to Hiragunj Point ; and when the right bank, becoming convex, turns away from the direction of the ebb current, this current disperses, and passing over a shoal which it is no longer concen- trated enough to scour, it finally reaches the opposite bank near the centre of the bend, whence, being guided by the concave left bank, it runs in a deep channel along this bank to the next change of curvature. The main flood-tide current, on the other hand, coming along the right bank from the bend below, after forming some blind channels towards this side, passes on to the left bank, over a shoal projecting from the point near the centre of the bend, which it follows in a deep channel to the change of

curvature above, where the current is dispersed and the deep channel ceases. In the James and Mary reach (Fig. 14), the main ebb current follows the concave left bank till the curving away of this bank towards Hiigli Point leaves the current undirected, which results in the spreading out of the current and the conse- quent disappearance of the deep

channel in passing on towards the opposite bank. The main flood-tide current runs up from below along the right bank opposite Hugli Point, at right angles to the ebb- tide channel wliieh it silts up more or less at the extremity in the dry season ; and passing round the sharp concave bend of the right bank, it is at length dispersed on approaching Shipgunj Point in the centre of the bend ; and the deep channel formed by its scour alongside the right bank terminates in a shoal. The extent of the deep ebb- and flood-tide channels, and the depth over the dividing shoal, vary according to the changes in the relative scouring power of the ebb and flood currents at the different seasons of the year, and the volume and duration of the floods passing down in the rainy season ; but the gradual widening of the two reaches, by erosion along both banks, has led to a reduc- tion in the depth over the crossings at the worst periods, and to the appearance in the middle of the James and Mary reach, since 1865, of a sandbank which dries at low water of spring tides in the dry season, and by its growth has still farther separated the ebb- and flood-tide channels.

In winding tidal rivers, where the descending current predomi- nates, and forms a continuous low-water channel which serves as the navigable channel, the diverging action of the flood tide in forming blind channels between the bends, may be mitigated by widening and deepening the ebb-tide channel at the place where the flood-tide channel diverges, and on the side to which it deviates. In this way the influx of the flood tide into the enlarged ebb-tide channel is facilitated, and its flow diverted from the blind channels without impeding its progress up the river, and, consequently, without reducing the tidal capacity, upon the preservation of which the maintenance of tidal rivers largely depends.

Tidal rivers in tropical countries ave subject to much greater variations in their conditions of flow than those in temperate regions ; for during the rainy season the downward current over- powers the tidal influx in the upper tidal part, the rise of tide at some distance from the outlet being merely due to the backing- up of the fresh-water discharge, and the deep channel corresponds to that formed by the current of a non-tidal river. During the dry season, on the contrary, the fresh-water discharge becomes so insignificant that the rivers depend almost wholly for their maintenance on the flow and ebb of the flood tide. Moreover, the fresh-

water discharge is obliged to obtain an outlet to the sea ; whereas the flood tide only flows up a river where space is avail- able for its reception ; and therefore for those rivers whose main- tenance depends on the flood tide for a portion of the year, no

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BREMEN,

Pio. 15. 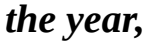 *Plan of River Weser. 1895.*

works should be undertaken which might impede its influx, and every effort should be directed to facilitating its progress. The improvement, accordingly, of winding rivers under these con- ditions, such, for instance, as the Hiigli, which depends on the tidal flow and ebb for its maintenance during about two-thirds of the year, should aim at guiding the descending current by a very low concave training wall, forming a somewhat projecting con- tinuation of the concave bank alongside which this current flows, into the flood-tide channel on the opposite side at a crossing, as proposed for lowering the shoals at Moyapur, and the James and Mary reach.^ By this arrangement, the freshets in the rainy season would scour out a channel across the shoal at the crossing, and maintain the down-stream part of the flood-tide channel along the opposite bank, which they otherwise would silt up ; and thus whilst the incoming flood tide, on the subsidence of the freshets, would not be impeded by the low training wall, submerged at, or even below, the lowest low water, on the land side of the

^ Report on the River HUgli, L. F. Vernon -Harcourt, Calcutta, 1897, plan 6, fig. 3, and plan 7, fig. 2.

‘^ Ibid., pp. 89 to 94, and plan 6, fig. 3, and plan 7, fig. 4.

ebb-tide channel, it would find a continuous channel prepared for it by the freshets whereby its progress up the river would be facilitated ; and

thus both the tidal condition and the navigable depth of the river would be improved.

*Occasionally the systematic regulation of a tidal river of moder- ate size has been undertaken between a town of importance on its banks and its outlet into the sea or its estuary, _ with the object of improving its navigable condition '^'S"'"""' for sea-going vessels, instead of confining the improve- ^ * ment works to special obstructions in the channel, "***"❓❓❓ which is all that can be attempted in large rivers. Two in- stances of the regulation of tidal rivers, by aid of training works and dredging, are furnished by the works on the river Weser between iJremen and Bremerhaven, carried out for the most part between 1887 and 1894, though the channel has been sub- sequently further deepened by dredging, and on the river Nervion, on a smaller scale, between Bilbao and the sea from 1878 to 1891.*

The river Weser, draining an area of 18,600 square miles, and with an average tidal rise at its outlet into its estuary at Bremer- haven of nearly 11 feet, had formerly a very irregular channel,

obstructed in many places along the lower 31 miles by islands, and by shoals emerging at low water, which so impeded the influx of the flood tide that the tidal limit was reached at Bremen, 42 miles above Bremerhaven, the available navigable dej)th up to Bremen being only 9 feet. The river has been trained from Bremen downwards, by 22❓❓ miles of training walls, and 9i miles of cross dykes and dams, into a single straightened channel increasing regularly in width seawards.' Thus the flood tide is freely admitted up the river ; and uniformity of flow is obtained, so as to avoid the formation of shoals by a reduction at places in the velocity of the current (Fig. 15). The low- water channel was made as small as practicable consistently with providing for the discharge of the low-water flow, in order to maintain its depth and regulate its flow ; and where necessary it has been trained by low -water training walls of fascine mattresses, backed by materials dredged from the channel. The

high-water channel has been left as large as possible, in order to maintain the tidal capacity, and thus by reinforcing the scour of the ebb to preserve the depth of the low- water channel. By these works, together with over 40 million cubic yards removed by dredging, the navigable depth up to Bremen has been increased to 164 feet (Fig. 16), the volume of tidal water entering and leaving the river has been materially augmented by the lowering of the low-water line, the tidal limit has been extended about

5 miles above Bremen, the discharge of floods has been acceler- ated, and the liability of the river to be blocked by ice has been diminished owing to the increased tidal flow and ebb. The navigable depth is eventually to be increased to 22 feet by dredging.

The river Nervion has similarly had its channel straightened and deepened between Bilbao and its mouth, a distance of nearly

8 miles, by training work^ These works have enlarged the width from 210 feet at Bilbao to 525 feet at the outlet (Fig. 17) ; have facilitated the influx of the tide, which has an average rise of

9 feet at the mouth of the river ; and have increased the navigable depth in the channel up to the port of Bilbao by about 7 feet, thereby providing a minimum depth of 12 feet at the lowest low waten ^

*It has previously been stated that a bar often obstructs the outlets of tidal rivers, because the lieaping-up action of the sea, aided by the drift of sand and shingle along the coast , under the influence of the prevailing winds, tends to ‘“‘P***^’ form a continuous beach across their mouth ;’ and some “^ f account has been given of the jetties constructed at ” * ** the outlets of certain tidal rivers for lowering their bars.* The works, however, carried out for improving the outlets of the Weser, the Nervion, and the Mersey possess certain novel features rendering them worthy of notice.*

BREMEN.

HASENBUREN VEGESACK. FARGE.

ELSFLETH. . SAtmSTEDT.

NORDENHAM. BREMERHAVEN.

Pio. 16. *Longitudinal Section of the River Weser.*

The river Weser on passing Bremerhaven emerges into a wide estuary encumbered by sandbanks rising above low water ; but the channel in the estuary, instead of being carried through the estuary between two training walls, is guided by a single fascine mattress training wall forming a continuation of the left bank of the river at low-water level, 8f miles long. This, with the adja- cent shore line opposite, provides an expanding outlet for the river through the upper part of the estuary. Secondary and side channels farther down the estuary have been closed, in order to concentrate the scour in the main channel ; and the outlet channel

PORTUCALETE.

Fig. 17. *Plan of Outlet, River Nervion*

is to be further deepened by dredging, aided, if necessary, by an extension of the training wall (Fig. 15).

As the outlet of the river Nervion was fully exposed to the waves of the Bay of Biscay, the sea had heaped up a bar across it, with an available depth of only 4J feet over it at the lowest tides. This bar has been removed by the scour of the river guided between two jetties carried out from the shore on each side of the outlet, and by the concave prolongation of the western jetty, aided by dredging, so that a depth of 15g feet has been secured in the outlet channel (Fig. 17). In order to prevent the obstruction of the improved outlet by drift during north-westerly storms, and to provide a sheltered approach to the river for vessels on that very exposed coast, two breakwaters are being constructed projecting from the coast on each side of the mouth of the river, and converging together so as to provide a harbour in which

- *" L'Am^lioration des Fleuves dans leur partie maritime, &c.," L. Franzius, Congres International de Navigation InOrieure, Paris,*

1892 ; and "Kiver, Harbour, and Canal Works in Germany," L. Franzius and G. H. de Thierry, Proc. Inst. C.E. vol. cxxxv. p. 224, and plate 5, figs. 4 and 5.

- *Memoria que manifesta el Estado y Progreso de las obras de inqora de la, Rio de Bilbao, 1879-91. E. de Churruca, Bilbao, 1899.*

' Encyclopcedia Britannica, 9th edition, voL ix. pp. 575-576.

- *Ibid. p. 577, and plate 6.*

vessels will be fully protected,^ and from which they can pass into the river in perfect safety (Figs. 17 and 18).

The bar of the river Mersey is about 11 miles seawards of the actual mouth of the river at New Brighton ; and this fact, com- bined with the configuration of the adjacent coast and the exposure of the site, prevented any attempt from being made to lower the bar by the concentrated tidal scour which would be produced by carrying out longitudinal or converging solid jetties or break- waters from the shore to the site of the bar. Accordingly, up to 1890 the Mersey bar remained in its natural condition, with a depth in the main channel across it of only 10 to 11 feet at low water of spring tides, under ordinary conditions, thereby causing delay to vessels of large draught in getting up to Liver- pool. In 1890, however, two sand-pump dredgers were tried for the first time for lowering the bar. This system had been successfully employed in a considerable deepening of the approach channel across a sandy foreshore of the open sea, at Dunkirk since 1876, and at Calais since 1881, and had effected an increase in the depth of the approach to Ostend harbour from 6^ feet at low water of spring tides in 1880 up to 204 feet in 1884 ; whilst the dredging of Gedney's Channel at the entrance to New York harbour, under- taken in 1885, had eventually increased the navigable depth from 24 feet up to 30 feet at low water for a width of 1000 feet. These sand-pump dredgers, which were able to raise and load them- selves with 500 tons of sand in between 20 minutes and 1 hour, according to the conditions, increased the minimum depth in the channel across the Mersey bar from 11 feet in 1890 to 18 feet at low water of spring tides by the beginning of 1892 ; but the dredging

Pig. 18. ***Section of West Breakwater, River Nervion.***

done by them in 1892 and 1893 only widened the channel, without increasing its depth." In 1893, however, a large specially-built sand-pump dredger was set to work, with hoppers capable of holding 3000 tons of sand, which the sand-pump is able to fill in

^ Memoria que manifesta elEstado y Progreso de las obras de mgora de la Rio de Bilbao, 1879-91. E. de Churruca, Bilbao, 1899.

'^ "Dredging Operations on the Mersey Bar," A. G. Lyster, International Maritime Congress, London, 1893, Proc. of Section I. p. 50.

between half and tliree-quarters of an hour ;' and a second similar dredger was added in 1895, to aid or replace the first in the event of a breakdown, though work is generally carried on in the bar channel with only one of the dredgers. By means of this increase of the dredging plant, the depth in the bar channel was increased in two years, by the middle of 1895, from a minimum of 18 feet to 23 feet, and from an average of 204 f^et to 24^ feet over a width of 1500 feet^; and these depths were further increased by the middle of 1899 to a minimum of 27 feet, and an average of 28 feet for the same width, by the removal, since 1890, of over 41 million tons of sand from the bar and inner shoals, 29 million tons of which were raised in the last four years of the period.' These dredging operations have enabled vessels of large draught to cross the bar at any state of the tide. A greater depth of channel could be obtained if necessary, though it would involve the removal of an increasing amount of sand for each increment of depth gained. The deepening of the bar channel has caused an additional volume of tidal water to be drawn into it from other outlets in the estuary, which will assist in maintaining the channel ; but dredging will always be necessary to preserve the depth attained.

Working models and experimental channels have been occasionally employed for investigating the movements of water, and their effects on an unstable bed.

Probably the first model exhibiting the ebb and flow of tide in an estuary was the one made of the inner Mersey ??? estuary in 1885, with the object of indicating that

Moaelex- ^^ slight regulation in places of the Cheshire ” shore of the inner estuary between Runcorn and Eastham, proposed at that time for the Manchester ship-canal, and subsequently carried out closer inshore, would produce no appreciable effect on the tidal condition of the estuary. After the water-level had been raised and lowered many times in succession at the outer extremity of the model, producing the effect of a number of tides, a very fair resemblance in miniature to the channels and banks of the inner Mersey estuary at low water was obtained in the sandy bed of the model. In 1886 a working model of the Seine from its tidal limit to the sea beyond its estuary was constructed, with the obj ect of ascertaining whether the accretion caused by training walls in a tidal estuary encum- bered with sand could be reproduced in a model, and the effects, accordingly, of the various schemes which had been proposed for the prolongation of the Seine training works in its estuary could be determined. After various substances had been tried for forming the bed of the model, an extremely fine clean sand mixed ???with peat was employed. A previous condition of the Seine estuary, as recorded on a chart of 1834 before any training works had been commenced, was eventually very fairly reproduced in the model, in which the tidal flow and ebb, with a period of 25 seconds and a range of 0 ‘71 inch, were effected by the tipping of a hinged tray of suitable size flxed to the outer end of the model, at the proper angle for the current produced to correspond with the direction of the tidal propagation at the entrance to the Seine. The fresh -water discharge was supplied from a little cistern at the upper end of the model. ^ The well-known bore, moreover, of the Seine, which attains its maximum at Caudebeo, and also the reverse current, or second tide, which occurs just before high water at Havre, were clearly visible when the model was worked. The lines of the existing training walls in the Seine estuary were then inserted, in the form of strips of tin in the model ;*

and the accretion caused by them in the Seine estuary having been reproduced after the action of a large number of miniature tides, the various lines proposed for the extension of the training works seawards were successively introduced, and their several effects on the estuary recorded on low-water charts. On the completion of these experiments with the Seine model at the end of 1888, similar investigations were made with a model of the Mersey, extending from the tidal limit right out into Liverpool bay beyond the bar. These furnished interesting results as to the effects of training works in the inner and outer parts of an estuary very different in form from that of the Seine. ^

* " Dredging Operations on the Mersey Bar, " A. Bleohynden, Proc. of Section III. p. 52.*

2 "Physical and Engineering Features of the Eiver Mersey," G. F. Lyster, Brit. Assoc. Reports, 1896, pp. 555-556.

' "Sand -pump Dredgers," A. G. Lyster, Proc. Inst. O.E. vol. cxxxviii. p. 394.

- *" Oa certain Laws relating to the regime of Rivers and Estuaries, and on the possibility of experiments on a small scale," Professor Osborne Reynolds, Third International Inland Navigation Congress, Frankfort, 1888, 6th question.*

' Proc. Royal Society, vol. xlv. p. 504, and plates 2 to 4.

' Proc. Royal Society, vol. xlvii. p. 142 ; " Rivers and Canals," 2nd edition, vol. i. p. 337, and plate x. ; and " Am(51ioration des Pleuves dans leur partie maritime," &o., L. F. Veruou – Harcourt, Congris International de Navigation, Paris, 1892.

These investigations appear to prove the feasibility of testing the effects of training works in a sandy estuary by means of working models. Engineers will thus be enabled to avoid works which might result in the deterioration of a tidal estuary, and to select with confidence beforehand the particular scheme [illegible] which affords the best prospects of a successful issue.

Additional information about river engineering and subjects connected with it wiU be found in the following books and papers : L. F. Vernon – Hakcoukt. Rivers and Canals, 2nd edition, 1896. ~~~ Civil Engineering as applied in Construction, 1902, Part iii. pp. 325-383. ~~~ "The River Seine, "Proc. Inst. C.E. vol. Ixxxvi. p. 210, and vol. cxlv. p. 303 ; " Canal and River Works in France, Belgium, and Germany," Proc. Inst. C.E. vol. xcvi. p. 182 ; "The Training of Rivers," Proc. Inst. C.E. vol. cxviii. p. 1 ; "Maritime Navigation Works in Belgium," Proc. Inst. C.E. vol. oxxxvi. p. 282. "Delta of the Danube," Proc. Inst. C.E. ~~vol. cxxii. p. 336. " La Canalisation des Rivieres et les divers Systemes de Barrages Mobiles," Congris International de V Utilisation des EauxFluviales, 1889, p. 174. "Report on the River Hiigli," Calcutta, 1897. ~~~ Major S. S. Leach, U.S.A. "Inland Navigation in the United States," Proc. Inst. C.E. voL cxxix. p. 247. ~~~ B. F. Thomas. "Movable Dams," Trans. Am. Soc. of C.E. vol. xxxix. p. 431. ~~~ A. GtJERAKD. "Mouth of the River Rh8ne," Proc. Inst. C.E. vol. Ixxxii. p. 305. ~~~ C. H. L. Kuhl. "Sulina Mouth of the Danube," and "Sulina Branch of the Danube," Proc. Inst. C.E. vol. xci. p. 329 ; and vol. cvi. p. 238. ~~~ Annual Reports of the Chief of Engineers U.S. Army. ~~~ P. Guillbmain. Riviires et Canaimc. Paris, 1885. ~~~ E. Lavoinne. La Seine maritime et son Estv/iire. Paris, 1885. ~~~ L. Franzius. Der Wasserlau. Berlin, 1890. ~~~ W.H. Wheeler. Tidal Rivers. 1893. ~~~ " Reports and Proceed ings of International Navigation Congresses," Brussels, 1885 ; Vienna, 1886 ; Frankfort-on-the-Main, 1888 ; Manchester, 1890 ; Paris, 1892 ; The Hague, 1894 ; Brussels, 1898 ; and Paris, 1900. ' ' Reports of the Committee appointed to investigate the Action of Waves and Currents on the Beds and Foreshores of Estuaries by means of Working Models," Brit. Assoc. Reports, 1889, p. 327, and plates 1 to 9 ; 1890, p. 512, and plates 1 to 18 ; and 1891, p. 386, and plates 2 to 14. (l. F. V.-H.)

Rivers, Anthony de Wydeville, or Wood-

TiLLB, 2nd Eaul of (1442-1483), an enlightened states- man and patron of literature, and author of the first book printed on English soil, ~~~ was the son of Kichard de Wyde- ville (1408 ?-1469) and his ~~wife, Jacquetta de Luxembourg, duchess of Bedford. HIs father ~~~ was

raised to the peerage in his son's infancy, and ???was made an earl in 1466. Anthony, who was knighted before he became of age, and fought at Towton Wydeville in 1461, married the daughter of Lord Scales, and became a peer jure iixoris in 1462, two years after the death of that nobleman. Being Lord of the Isle of Wight at the time, he was in 1467 appointed one of the ambassadors to treat ???with the duke of Burgundy, and he exalted his office by challenging the famous Bastard to single fight in what was one of the most famous tournaments of the age. In 1469 Anthony was promoted to be Lieutenant of Calais and Captain of the King's Armada, while holding other honorary posts, and, his father having been beheaded after the battle of Edgecot, he succeeded in August of that year to the earl dom. In 1473 he became guardian and governor to the young prince of Wales, and for the next few years there was no man in England of greater responsibility or enjoy- ing more considerable honours in the royal service. It is now that for the first time we become aware of Lord Elvers' literary occupations. His mother, the Duchess, died in 1472, and his first -wife in 1473 ; in 1475 and the following year he went on pilgrimage to the holy places of Italy; from this time forth there was a strong tincture of serious reflection thro'wn over his character ; he was now, as we learn from Caxton, nominated " Defender and Director of the Siege Apostolic for the Pope in England." Caxton had in 1476 rented a shop in the Sanctuary at Westminster, and here had set up a printing-press. The first MS. which he undertook in London was one sent to him by " the noble and puissant lord, Lord Antone, Erie of Ryvyers," consisting of a trans- lation "into right good and fayr Englyssh" of Jean de TeonviUe's French version of a Latin work, " a glorious

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fair mirror to all g9od Christian people." In 1477 Caxton brought out this book, as I)iA:tes and Sayengis of the Fhilo- s^hers, and it is illustrious as the first production of an English printing-press. To this succeeded the

Moral Proverbs of Christine de Pisan, in verse, in 1478, and a Cordial, m prose, in 1479. The original productions of Lord Rivers, and, in particular, his Balades against the Seven Deadly Sins, are lost. In 1478 a marriage was arranged between him and the Princess Margaret, sister of King James III. of Scotland, but it was mysteriously broken off. Rivers began to perceive that it was possible to rise too high for the safety of a subject, and he is now described to us as one who " conceiveth weU the mutability and the- unstableness of this life." After the death of Edward IV., he became the object of Richard III.'s peculiar enmity, and was beheaded by his orders at Pontefract on the 25th of June 1483. He was succeeded by his son Richard, the third and last earl of the Wydeville family, who died in 1491. Lord Rivers is spoken of by Com- mines as "un tres-gentil chevalier," and by Sir Thomas More as " a right honourable man, as valiant of hand as politic in counsel." His protection and encouragement of Caxton were certainly of inestimable value to English literature, and in the preface to the Dictes the printer gives an account of his own relations with the statesman which illustrates the dignity and modesty of Lord Rivers in a very agreeable way. The latter was also one of the purest writers of English prose of his time.

Riverside, a city of California, U.S.A., capital of Riverside county. It is near the southern base of San Bernardino range, on Santa Ana river, and on the Southern California and the Southern Pacific railways, in the southern part of the state, at an altitude of 873 feet. It occupies a level site, has a good water supply and drainage, and is beautifully built up in detached cottages and villas, with ample grounds, containing subtropical plants and trees. The town, which is in a region devoted to the production of oranges, lemons, and other subtropical fruits, and has a large trade in these products, was founded in 1870 by people from New England. Population (1890), 4683; (1900), 7973, of whom 1525 were foreign-born and 195 negroes.

Riviera, the narrow belt of coast which lies between the mountains and the sea all round the Gulf of Genoa in the north of Italy, extending from Nice on the west to Spezia on the east. It is usually spoken of as Riviera di Ponente (" the coast of the setting sun "), the portion between Nice and the city of Genoa ; and as Riviera di Levante ("the coast of the rising

sun”), the portion from Genoa to Spezia. All this district, being open to the south, and sheltered from the north and east winds, enjoys a remarkably mild climate (winter mean, about 49 Eahr.) ; so much so that the vegetation in many places partakes of a subtropical character {e.g., the pomegranate, agave, prickly pear, date, palm, and banana). Large numbers of flowers, especially roses, violets, hya- cinths, &c., are grown near Nice, Mentone, Bordighera, and other towns, and sent to the London and Paris markets. Bordighera is particularly noted for its noble groves of date-palms, one of the few places in Europe where these trees grow. The uncommon mildness of the climate, conjoined with the natural beauty of the coast scenery the smother of greenery, the vineyards climbing up the hills, the steep sea-crags, the ruined towers, and in the background the range of the Maritime Alps, often rugged, often snow-capped attracts thousands of invalids and convalescents to spend the winter in the chain of towns and villages which stretch from the one end of the Riviera to the other. Proceeding from west to east, the

following are the places to which visitors principally resort : Nice, Monaco, Monte Carlo, Mentone, Ventimiglia, Bordighera, Ospedaletti, San Remo, Porto Maurizio, Diano Marina, Alassio, Borgio Verezzi, Arenzano (in the Riviera di Ponente), and Nervi, Rapallo, Santa Margherita, Chiavari, Spezia, and San Terenzo (Lerici) in the Riviera di Levante. The Riviera labours, however, under the grave drawback of being liable to earthquakes. In the 19th century there were four such visitations in 1818, 1831, 1854, and 1887. A railway runs close along the shore aU through the Riviera, the distance from Nice to Genoa being 116 miles, and the distance from Genoa to Spezia 55 miles. In the latter stretch the line burrows through the many projecting headlands, which ripple the coast, by means of more than 80 tunnels. Several dis- tinguished men have been born along the Riviera di Ponente Columbus, Popes Julius II. and Sixtus IV., the Roman emperor Proculus, the Genoese admiral Andrea Doria, the great soldier Mass^na, the poet Chiar brera, Paganini the violinist, and Gambetta. Genoa, Sestri Ponente, and Savona, on this same coast, are places of exceptional industrial activity, especially in shipbuilding and other iron industries (see Ligueia). The pearl of the eastern Riviera is the stretch (6 to 7 miles) between Rapallo and Chiavari. Lord Byron and Shelley both lived and wrote on

the shores of the Gulf of Spezia ??? and Dickens wrote The Chimes at Genoa. Spezia itself is the seat of the chief arsenal and shipbuilding yards of the Italian navy. Francis I. of France was detained for some time at Portofino (peninsula of Rapallo) after being taken captive at Pa via by the Emperor Charles V. in 1525; and in the same neighbourhood is a burial-place of the house of Doria. Lavagna was the ancestral seat of the Fieschi family, known as having produced one Pope, Innocent IV., and from Schiller's play. The women of Rapallo and Santa Margherita are famous lace- makers.

-), English artist, was

Riviere, Briton (1840-

born in London on 14th August 1840. His father, WiUiam Riviere, was for some years drawing-master at Cheltenham College, and afterwards an art teacher at Oxford. He was educated at Cheltenham College and at Oxford, where he took his degree in 1867. For his art training he was in-debted almost entirely to his father, and early in life made for himself a place of importance among the artists of his time. His first pictures appeared at the British Institu- tion, and in 1857 he exhibited three works at the Royal Academy, but it was not until 1863 that he became a regular contributor to the Academy exhibitions. In that year he was represented by " The Eve of the Spanish Armada," and in 1864 by a " Romeo and Juliet." Subjects of this kind did not, however, attract him long, for in 1865 he began, with a picture of a " Sleeping Deer- hound," that series of paintings of animal-subjects which has since occupied him almost exclusively. Among the most memorable of his productions are " The Poacher's Nurse " (1866), "Circe" (1871), "Daniel" (1872), "The Last of the Garrison" (1875), "Lazarus" (1877), "Persepolis" (1878), "InManusTuas,Domine"(1879), "The Magician's Doorway" (1882), "Vse Victis" (1885), "Rizpah" (1886), "An Old- World Wanderer " (1887), "Of a Fool and his Folly there is no End " (1889), " A Mighty Hunter before the Lord" (1891), "The King's Libation" (1893), "Be- yond Man's Footsteps " (1894), now in the National GaUery of British Art; "Phoebus Apollo" (1895, see Plate); "Aggravation" (1896), "St George" (1900), and "To the Hills" (1901). He has also painted portraits; and at the outset of

his career made some mark as an illustrator, beginning with Punch. He was elected an

Associate of the Royal Academy in 1878, and KA. in 1881, and received the degree of D.C.L. at Oxford in 1891.

See Sir Walter Armsteong, "Briton Riviere, E.A. ; His Life and "Work," Art Annual, 1891.

Rivoli, a town in the province of Turin, Piedmont, of Italy, a summer resort of Turin, nine miles west of that city. It has a royal castle, in which King Victor Ama- deus II. died a prisoner in 1732 ; and carries on the manufacture of silks, linens, and woollens. There is also a school of agriculture. Population, about 6000.

Rivoli Veronese, a village in the province of Verona, Venetia, Italy, on a hill on the right bank of the Adige, thirteen miles north-west of Verona. Here, on the 14th of January 1797, Napoleon defeated the Austrians under Alvinczy (Baron von Barberek). A famous street in Paris commemorates the victory, and the village gave the title of Duke to Marshal Mass^na.

Road -IVIaking. Stimulated by the growing demands of vehicular traffic and encouraged by a more liberal expenditure of pubhc money, the art of road-making made substantial progress during the latter part of the 19th century. Questions of foundation being for the time settled, attention was concentrated on the superficial layer, its cost and rate of wear. A perfect pavement would have a surface smooth to the wheel and rough to the hoof. These qualities are not so incompatible as they may seem. In most countries rough pavements have been made smoother, with benefit to both horse and vehicle, and the smoothest might be roughened materially without affect- ing the rolling wheel. If this process can be carried far enough for safe foothold, the desired roadway will be attained. Foothold should be provided not only at certain places where the shoe

may or may not strike or to which it may slide, but wherever the foot may fall. So the modern roadmaker has relied more upon the sur- face and less upon the joint. Eoads of macadam, asphalt, wood, and brick have gained much by recent experiments.

If the ideas of the inventor are strictly followed, macadam, when the fine network of jointsds thinly masked with hardened mud worn from the stone, comes near to a perfect surface. But stones that will pass through a ring of a given size may be twice as much in length, and unless their form is about that of a cube not exceeding IJ inches on its longest side, they cannot be rammed or rolled into the regular mosaic characteristic of the true macadam. The best modern roads are of hand-broken stone dressed slightly on the surface with stone chips, while the mass of the road-metal is kept free from any kind of binding. Some roadmakers, however, have found the large irregularly-shaped stones from the machine so difficult to consolidate that they have had to reconsider the question of binding. The engineer of Central Park, New York, found that, with the greatest care and attention to rolling, such stones would not con- solidate properly without admixture ; indeed they became more intractable the more they were abraded by rolling. Mr .Deacon of Liverpool has advocated a binding com- posed of large chips of trap rock or else of silioioua gravel from the size of three-quarters of an inch down to that of a pin's head, together with about one-fourth part of macadam sweepings obtained in wet weather. This wiU enable the roller to consolidate the road-metal in a third of the time required for broken stone alone. The harder materials here suggested differ essentially from the sand and dirt formerly used for binding, since they fill up all the vacant spaces and cannot be washed down. Foundations of large and rough hard-core should be rolled down to a surface close enough to keep the finer pieces of road-metal from dropping down, so as to create hollows

Macadam roads.

which, though they may escape the roller, will be detected by the laden wheel and by the pounding of the heavy hoof. But there is no foundation equal to sand, which has the property of spreading pressure over an enlarged area. A 12-inch bed of sand rolled down to 8 inches has been

recommended, but military engineers have found that a layer of so little as 3 or 4 inches is sufficient as a founda- tion for macadam in very bad ground that has been rolled, or on an embankment that has had time to settle.

Broken stone mixed with some bituminous composition has been found very suitable for suburban roads, and for towns where the nature of the traffic requires smooth roadways reasonably free from noise and ^'j.,,. dust. In its simplest form, tar macadam is made from a good hard limestone broken into the usual sizes, the fine chips being used for top-dressing. In a shed a large hearth is formed of stone flagging, under which the flues of a furnace are constructed, and upon the hearth the broken stone is spread in a layer just as thick as the heat may be able to penetrate, to dry ofi' the moisture and make the stones distinctly hot. The load of an ordinary barrow is tipped on an iron plate and gas tar is poured over it (from 8 to 12 gallons per cubic yard), while a couple of men with shovels turn it over exactly as they would turn concrete. No more tar should be used than is required completely to blacken the whole surface of every stone ; and when this has been done, the stone can be thrown upon the heap, where it may be kept for one or two months, under cover, to allow the volatile oils to evaporate. Fine siftings are treated in the same way. When it has been properly seasoned, the mass should assume a greenish lustre; and when cut into by a shovel, the particles wiU cling together and creep down slowly so that the heap is said to be "alive." In that state it may be used. The tar ought to be boiled ; and if too thin, a little pitch may be added to it, though not enough to make the heap consoUdate. A mixture of tar vnth pitch and creosote oil is used by more precise makers, one formula being 12 gals, tar, \ cwt. pitch, and 2 gals, creosote oil to a ton of stone. But these ingredients diflfer considerably in their chemical com- position, and the proportions have to be varied according to experience. Moreover, as regards the tar and pitch used in the manufacture of pavements, the varieties that come directly from a vegetable source are liable to melt in hot and to become brittle in cold weather ; coal tar is only moderately proof against these extremes.

Tar macadam must be put down in dry weather. If the material seems too dry, hot tar may be applied as before, but only as an expedient, and with

great economy, so that the pavement may not soften in the sun. Upon a well-rolled foundation of hard material a layer of the coarser macadam should be put and rolled, then a layer 'of the smaller grade. For a road of light traffic a coat of the fine siftings may be put down and heavily rolled to a finished surface. For a road of heavier traffic the second coat should be dressed before rolling with tarred stone of a gauge of three-quarters of an inch to an inch and a quarter, and rolled first with a roller of not more than 10 or 12 cwt., then with one of 30 cwt. After the traffic has been turned on the road for a few days it should again be rolled as heavily as may be necessary to restore any parts that have been disturbed. But such roads are often consolidated by steam-rollers of 10 or 15 tons. For refacing an old road the prongs attached to a steam-roller will easily lift the old layer. Small depressions may be well tarred and levelled up with fine stuff, and the whole surface may be dressed every three years with tar and a fresh coat of fine chips. If the surface of the road is irregular, water will hang upon it, and frost may cause it to become slippery. The lack of affinity between granite

Concrete macadam.

Otavel roads.

and bitumen prevents the use of tar macadam upon roads of heavy traffic.

Rocks like granite and syenite may be used in combina- tion with Portland cement. The ingredients are mixed in about the proportion of four parts of broken stone that has first been well wetted, one and a quarter or two parts of clean sharp sand, and one of cement put on in two layers, the second being rolled by hand to the required shape and to a good surface. It should remain for two or three weeks to dry and set. Want of elasticity may be urged against concrete macadam, and it is productive of dust, but in some cases it has proved satisfactory.

Smooth rounded gravel is unsuitable for roads unless a large proportion of it is broken, and about an eighth part of ferruginous clay added for binding. Rough pit gravel that will consolidate under the roller may be applied in two or more layers, but each must be of similar composition, or the smaller stuff will work downwards. A gravel road should be always under inspection, and repairs should be done without delay. A track for equestrian exercise should be made of hoggin or fine gravel, that will remain soft when raked or harrowed and watered. It should be well drained. A foundation of rough hard core will let the hoggin pass down into it, so that the hard core will appear at the surface. The best material is rough chalk sufficiently rolled to stop the gravel while draining off the surface water.

In Great Britain compressed asphalt for carriage-ways has came into greatly extended use, its perfect suitability for vehicles of all kinds, and its noiselessness Asphalt yji(jer the wheel, being set against its slipperi- ness, especially when not quite clean. While the road is kept clean, a very slight depression is made by the horse-shoe, which for foothold is a great advantage. The noise made on asphalt by horse-traffic is about the same as that made on hard wood, and is not much more than is necessary for the safety of foot-passengers. In American cities asphalt has been adopted in a totally difierent form. All asphalt pavements are composed of a very large proportion, perhaps five parts in six, of a hard non- bituminous material In America it is found cheaper to get the purer bitumen of the island of Trinidad, and to procure in the localities the bulky material required for ad- mixture ??? a coarse angular sand with a little pure carbonate of lime. An asphaltic cement is made from refined as- phaltum. Of this, from 12 to 15 per cent, is used with 70 to 80 per cent, of sand and 5 to 15 per cent, of lime- stone dust. These materials are heated and stirred together into a stiff mastic paste to form the wearing surface of the road. Upon the concrete foundation is first spread a layer of fine bituminous concrete called "binder," \ inches thick, to unite the wearing surface to the concrete foundation. Upon the binder the asphalt is laid to a thickness of 2 inches, being spread with iron rakes and brought to its finished surface by the steam roller. Obviously this is a process requiring great judgment and experience ; but the system has become established in America, to the exclusion of European methods. Its great

recommendation is the freedom from slipperiness that is said to result from the admixture of sharp sand, and this freedom is really the one quality in which asphalt pavement is seriously deficient. This system has been introduced into England.

The great advance in the use of wood for roadways is due chiefly to the introduction of Australian hard woods, which have to a large extent supplanted fir and pine. The softer woods, which afford reasonably good foothold and are comparatively noiseless, wear rapidly under heavy traffic, and are very liable to decay. Moreover, the wood actually used has been of

Wood pavement.

mixed qualities, and when a block fails, those near it suffer; thus holes are formed, so that the pavement has to be renewed before its time. English oak and beech, which are perhaps too hard, have been used with varying results ; but the AustraUan woods of the genus Eucalyptus have been most extensively tried, and with the most satisfactory results. Those which are best known are jarrah and kauri, but tallow wood, black-butt, blue-gum, red-gum, and spotted-gum, with others, have been tried. Of these, one or two are too dense and hard to afford foothold, others are not easily procured, but jarrah and kauri are used extensively. When cut from the matured heart-wood they are uniform in quality, hard enough for durability, and rough enough to afford fairly good foothold. A very large quantity of wood has been used in London under the name of American red-gum. In substance it comes between the soft and hard woods above mentioned. Wood blocks for paving must be cut with the utmost pre-cision as to the depth of 5 or 6 inches and the breadth of 3 inches. The usual length of 8 or 9 inches should also be kept well enough for bond. A long block is liable to tilt. As to depth, although a slight depression may be of little account, the least projection in a block will be imme- diately noted as a jolt by the swift-moving wheel. The lajdng and jointing of wood blocks on concrete is still a matter of experiment. They may be set on a half-inch bed of sand, which is supposed to, though it is doubtful whether it actually does, make the pavement elastic to the tread. If the blocks are not accurately gauged, the sand enables the paviour to adjust them to a

uniform surface. But the practice most approved is to pave directly upon the smoothly finished concrete, trusting for elasticity to the wood. On the revival of wood-paving it was thought necessary, for foothold, to leave wide joints filled with small gravel grouted with cement ; but this is mischievous. The cement breaks up, and when the blocks shrink, the fUling-in is driven downwards, and when they again get wet, they have less room to expand, the side kerbs are driven back, and the foot-pavements are displaced, so as to require relaying. To guard against this, a space of about 2 inches has been left between the pavement and the kerb, to be temporarily filled with clay or sand, which can be cleared out as the pavement expands. But cement has no affinity for wood, and its use, together with the wide joints that were thought necessary to give foot-hold, has been abandoned. They permitted tke edge of the block to be beaten down below the centre, so as to produce a succession of ridges, having much of the char- acter of a " corduroy " road. Asphalted felt placed in the joints has not succeeded. A method very successfully adopted is to leave the end joints slightly open, and to place strips or laths one-tenth of an inch thick between the courses, so that hot pitch can be poured down to fill the joint and cover the surface. The roadway is then strewn with fine sharp gravel. Hard wood blocks- so laid expand very slightly, so that a space of an inch and a quarter is suffi- cient between the kerb and the two courses of blocks that are usually laid parallel to it ; this, when filled with pitch, is more than enough to allow for expansion. Paving has been laid with close joints, small vessels of hot pitch being provided, into which each paviour dips the blocks more or less completely before laying them ; but wood blocks are more commonly laid dry, a little pitch being brushed over the surface. The gradual abandonment of the wide joints once considered necessary for foothold vrill be noticed. Soft wood seems to wear under very heavy traffic about five times as fast as hard wood.

Since about 1885 brick as a paving for carriage-ways has been adopted to a considerable extent, chiefly in the form of shale bricks, in American cities. The clay is a

ROANNE ROANOKE

tydrated silicate of alumina, containing about 24 per cent.

of alumina with. 15 per cent, of iron, lime, soda, potash,

and magnesia. Lime is injurious, but alkalis

”””’ . to the extent of 3 per cent, are needed to pavements. ^ . .^ tr

ensure a shght degree oi vitrincation. Various

tests are used for absorption and abrasion. That for abrasion is made by rolling half bricks in an iron barrel or rattler in company with pieces of cast-iron for a given time, and noting the effect on the surfaces, but particularly on the angles, which should be tough enough to resist chipping. Comparisons are also made with test pieces of granite that are mixed with the bricks. To guard against chipping, the best made bricks are pressed over again, and the upper angles rounded to a radius of three-eighths of an inch. Upon a foundation of concrete or well-rolled ballast a cushion or bed of coarse sand from half an inch to three inches thick is laid, and on this the bricks are set. They are then rolled till level, or are heavily rammed, a plank being interposed between the bricks and the rammer. No channel-courses are used. Pitch is poured in at the joints, but by no means on the surface, as that would make them slippery. Brick roadways have stood well under hard wear for fourteen years. Although in the United Kingdom bricks are produced unequalled for hard- ness and finish, no serious attempt has been made to intro- duce a tough brick for roadways that will neither chip nor wear smoothly. In various experiments with bricks that seemed most suitable they stood hard traffic for about a year. Clay of absolutely uniform character, and kilns that will ensure perfect equality in firing, are requisite. Slag bricks, made to interlock in the form of a double hexagon, the surface being grooved to a small pattern, have stood good tests for wear and foothold on a perfectly level surface. Many attempts have been made to use compositions, into which asphalt or cement usually enters, for making blocks or slabs, square or hexagonal, that can be laid down on a concrete foundation. A

mosaic of macadam set in an iron frame is fixed by running molten slag into the back of the block. Small square pieces of oak are formed into blocks, end-grain upwards. Stafford- shire blue bricks, made with holes to hold wooden plugs, have been used with some success. Broad blocks not firmly fixed down usually become loose and tilt when subjected to traffic.

Bricks made of cork, granulated and mixed with fibre and asphalt, are also used ; they are set in pitch, and

seem to be suitable for rather steep gradients. Noiseless ipjjgy g^pg comparatively noiseless. For a per- pavemeats.. J ???, '^ ???' , , . .S,

rectly noiseless pavement, such as is specially

required where a carriage entrance under bedrooms is used by night, no substance is equal to indiarubber. For this purpose it is made in inch sheets about 3 feet wide and as long as the width of the roadway ; it is fixed over concrete and secured by iron clips. This arrangement carries the whole of the passenger traffic to St Pancras Station, London, and also a considerable amount of traffic passing under the Euston Square Station Hotel.

In opening up a new country, roads, temporary or per- manent, must be made vidth such materials as may happen to be at hand. The plank road often used in American forests makes an excellent track for all kinds of traffic. Upon that side of the space devoted to the road, which the heavy traffic leading to a town will use, two parallel rows of sills 15 to 20 feet long, 12 inches wide, and 4 deep, are laid longitudinally flatwise 4 feet from centre to centre, the earth being well packed and rammed to the level of their faces. The joints are not opposite ; a short piece of sill is put either under or by the side of each joint. Cross boards about 8 feet 3 inches long and 3 inches thick are laid down loosely, so

Plank roads.

Log roads.

that groups of four boards together wiU project on alter- nate sides of the road 3 or 4 inches, forming a shoulder to enable vehicles to get on to the track at any point. The remainder of the road space is formed as an earthen track, 12 feet wide, for light vehicles. Its slope outwards may be 1 in 16, that of the plank road 1 in 32. If the soil is too bad for the earthen track, short lengths of plank road of double width are made at intervals to form passing places. The cross boards are spiked down on five sills, and are sprung so as to give a fall both ways.

The log road is formed across swamps by lajdng young trees of similar length close together. This is ridiculed as a ” corduroy ” road, but it is better than the swamp. Good temporary roads may be made ‘ by laying down half logs roughly squared upon the ground, close together or with spaces between of a couple of inches, into which earth is well rammed. They may be 8 or 9 feet long, alternate logs being made to project a foot on each side for convenience of driving on and off the track.

When fuel is available, good roads can be formed of burned materials. Clay is burned into ballast for founda- tions, or for a temporary track. In American forests charcoal roads have been largely used. ZzfT’ Logs from 6 inches to 2 feet in diameter are piled along the whole route, the stack being 9 feet broad at the base, 6 feet high and 2 feet broad at the top. Dry materials for lighting are intermixed, and the stack is covered up with sods and earth from the side ditches. When burned, the charcoal is simply raked down so as to form a 15-feet road of a well-rounded section. These roads are dry and hard, and otherwise satisfactory.

The mode of carrying a road across a bog upon a foundation of faggots or brushwood is well known. In India the native roads have been made equal to heavy traffic by laying branches of the Mimosa across the track. And in the great plains, where the soil, when dry, would otherwise be made deep in dust, this is entirely prevented by laying across the track a, coarse reed or grass like the Pampas grass, and covering it with 3 or 4 inches of loam.

In carrying traffic over a clay soil a covering of 3 or 4 inches of coarse sand will entirely prevent the formation of the ruts which would otherwise be cut by the g^j,^, wheels ; and if the ground has already been deeply cut

up, a dressing of sand wiU so alter the condition of the clay that the ridges will be reduced by the traffic, and the ruts filled in.

See BouLNOis, Carriage- Ways and Footicays ; Aitken, Soad- Making and Ifaintenance ; Maxwell, ConstrvclAon of Roads. Modern American works are : ??? Byrne, Highway Construction ; Gil- more, Moods, Streets, and Pavements ; and TiLLSON, Street Pave- ments. See also Capt. W. W. Robinson, R.E., Hood-Making in Western India. Original papers in the Proceedings of Ass", of County and Municipal Engineers, Inst, of Civ. Eng. ; Hele-Shaw in Proc. of Mech. Eng. , Journal of Sanitary Institute, (r. bl.)

Roa.nne, chief town of arrondissement and an im- portant railway junction, department of Loire, France, 50 miles north-north-west of St Etienne, on the railway from Paris to St Etienne. The making of knitted articles gives employment to about 3000 women and girls in the sur- rounding districts. There are besides extensive engin- eering workshops, iron and copper foundries, numerous dyeworks, and pottery and tile works. Population (1881),

24,274; (1901), 33,775.

Roanoke, a city of Virginia, U.S.A. Though within the limits of Koanoke county, it is not subject to county government. It is situated on the Roanoke river, in the south-western part of the state, at an altitude of 907 feet. It has an excellent water system and sewerage. Situated on the main line of the Norfolk

and Western Railway, at the junction of two branches, its industries are connected with the manufacture of iron and steel. It has blast furnaces, rolling mills, foundries, locomotive and car works, and other manu- factures. Formerly known as the town of Big Lick, it was chartered under its present name in 1884. Popu- lation of Big Lick (1880), 669; of

Roanoke (1890), 16,159; (1900), 21,495, of whom 539 were foreign-born and 5834 negroes.

Roberts, Frederick Sleigti, Earl (1832-

), British Field Marshal and Commander-in-Chief,

K.G., second son of General Sir Abraham Roberts, G.C.B., was born at Cawnpore, India, on 30th September 1832. Educated at Eton, Sandhurst, and Addiscombe, he obtained a commission in the Bengal Artillery on 12 th December 1851. In the following year he was posted to a field battery at Peshdwar, where he also acted as aide- de-camp to his father, who commanded the Peshdwar division. In 1856 Roberts was appointed to the Quarter- master-General's department of the Staff, in which he remained for twenty – two years, passing from one grade to another until he became Quartermaster – General in India. On the outbreak of the Mutiny in 1857, Roberts, at first, was staff ofiicer to the movable column operating against the mutineers in the Punjab, successively com- manded by Colonels Neville Chamberlain and John Nichol- son, but, towards the end of June, he joined the Delhi Field Force, and was Deputy Assist- ant Quartermaster – General with the artillery during the operations against Delhi. He was wounded in the fight of the 14th July, but was suffi- ciently recovered in September to take command as a regi- mental officer of the left half of No. 2 Siege Battery during the siege. He rejoined the headquarters staff for the assault, and took part in the storm and subsequent seven days' fighting in the city. He then accompanied Colonel Greathed's column to Cawnpore, and during September and October was present at the actions of Bulandshahr, AUgarh, Agra, Banthira, and Kanoj. He served under Sir Colin Campbell at the second relief of Lucknow in November, at the battle of Cawnpore on the 6th December, and the subse- quent pursuit and defeat of the Gwalior Contingent near Sheorajpur. Roberts distinguished himself at the engage- ment of Khudaganj, on the 2nd January 1858, by capturing, in single-handed combat, a standard from two sepoys, and also by cutting down a sepoy about to kill a sowar. For these acts of gallantry he was recommended for the Victoria Cross. He was present at the reoccupation of Fatehgarh on the 6th January, the storm of Mianganj in February, the siege and

capture of Lucknow in March, and the action at Kursi on the 22nd of that month, after which he went home on sick leave. For his services in the

FIELD MARSHAL EAKL EOBEETS, K.G. (From a photograph by Elliott and Fry, London.)

Mutiny war he was seven times mentioned in despatches, received the medal with three clasps, the Victoria Cross, and on his promotion to captain in October 1860, a brevet majority. On the 17th of May 1859 he married, at Waterford, Miss Nora Bews, and on his return to India was entrusted with the organization of the Vicerojr's camps during the progresses through Oudh, the North-West Provinces, the Punjab, and Central India in 1860 and 1861. In December 1863 he took part, under Major-General Garvock, in the Umbeyla campaign among the mountains to the north of Peshdwar, and was present at the storm of Lalu, the capture of Umbeyla, and the destruction of Mulka, receiving for his services the medal and clasp.

In 1867 Roberts was appointed Assistant Quarter- master-General to Sir Donald Stewart's Bengal Brigade for Abyssinia. He showed judgment in embarking each unit complete in every detail, instead of despatching

camp equipage in one ship, transport in another, and so on, as was customary. He arrived at Zula, Annesley Bay, in the Red Sea, the base of the expedition, on 3rd February 1868, and re- mained there as senior base staff officer during the four months' campaign. At its close he superintended the re-embarkation of the whole army. His duties were so well performed that Sir Robert Napier sent him home with his final despatches. He was three times "men- tioned," and received a brevet heutenant-colonelcy and the war medal. He returned to India the following year as First Assistant Quarter- master – General In the autumn of 1871 he made the arrangements for the expedi- tion into Lushai, between south-east Bengal and Burma, fitted out two columns under Brigadiers-General Bourchier and Brownlow, and himself accompanied the first. A road, over 100 miles long, was cut through dense gloomy forests in stifling heat, and the column was attacked by cholera; but the object of the expedition was successfully accomplished, and Roberts, who was present at the capture of the Kholel villages and the

action in the Northlang range, and commanded' the troops at the burning of Taikum, was mentioned in despatches and made a Companion of the Bath. On his return in March 1872, he became Deputy Quarter- master-General in Bengal, and in 1875 Quartermaster- General and Colonel He settled the details of the great camp of exercise at Delhi on the occasion of the visit of the Prince of Wales in January 1876, and attended H.R.H. at the manoeuvres. He also superintended the arrange- ments for the great durbar at Delhi on 1st January 1877, when Queen Victoria was proclaimed Empress of India.

In 1878 Roberts was appointed to the command of the Frontier Field Force at Abbottabad, in Hazara ; but in the autumn, on the repulse of the Chamberlain Mission by the Afghans, and the formation of three columns to advance

into Afghanistan by the Khaibar, the Bolan, and the Kuram passes, he was given the command of the Kuram Field Force, with the rank of Major-General. Concentrat- ing his column at Thai, he advanced to Kuram towards the end of November, and having formed an advanced base there, moved on to Habib Kila. Under cover of prepara- tions for a front attack on the Peiwar Kotal, he recon- noitred that formidable position, and on the night of the 1st December moved part of his force to attack the Spingawi Kotal, in order to turn the Afghan left flank, leaving the remainder of the force to feign a front attack on the Peiwar, and to guard the camp. After a very difficult night march the Spingawi Kotal was carried at daybreak on the 2nd, and, later, the Afghans on the Peiwar Kotal, threatened in rear, abandoned the position. The next morning Roberts occupied the Peiwar, and on the 6th advanced to Ali Khel. He reconnoitred the Shutar- gardan and the Sapari passes, and made a strong recon- naissance through Khost, in which some fighting took place, and at the end of January returned to Hagir Pir, in Kuram, where his force remained in occupation. In July, Major Cavagnari, the British envoy to the new Amir, Yakub Khan, passed through Kuram on his way to Kabul, and, shortly afterwards, Roberts left his Kuram command and

went to Simla to take his seat on the Army Commission, where he strongly advocated the abolition of the three Presidency armies, and the substitution for them of four army corps, a measure which was carried out sixteen years later. While he was at Simla, news arrived on 5th September of the murder of Cavagnari and his companions at Kabul. The Peshawar Valley Force had been broken up ; Sir Donald Stewart was still at Kandahar, but most of his troops had started for India; Roberts, therefore, had the only force ready to strike rapidly at Kabul. It was hastily reinforced, and he hurried back to Kuram to take command, as a Lieutenant-General, of the Kabul Field Force (7500 men and 22 guns). By the 19th September a brigade was entrenched on the Shutargardan, and as Roberts advanced, the Amir Yakub Khan came into his camp. An Afghan force of 8000 men blocked the way in a strong position on the heights beyond Charasia, and on 6th October Roberts repeated the tactics that had done him such good service at the Peiwar in the previous year, and sending Brigadier- General T. D. Baker with the greater part of his force to turn the Afghan right flank, threatened the pass in front with the remainder. By the afternoon Baker had seized the position, and the enemy, severely defeated, were in full retreat. Kabul was occupied without further opposition.

The city was spared, but punishment was meted out to those convicted of complicity in the murder of the British Mission. Yakub Khan abdicated on the 12th October, and was eventually deported to India. The troops occupied the Sherpur cantonments; but in November a religious war was proclaimed by the Mullahs, and early in December, in order to prevent a threatening combination of Afghan tribes against him, Roberts moved out two columns to attack them in detail. After considerable fighting around Kabul, the numbers of the enemy were so great that he was forced to concentrate his troops again at Sherpur, the defences of which had been greatly improved and strength- ened. Sherpur was invested by the enemy, and early on the 23rd December was attacked by over 100,000 Afghans. They were driven off with great loss ; and on making a second attempt to storm the place, were met by Roberts, who moved out, attacked them in flank, and defeated them, when they broke and dispersed. Roberts now recommended the political dismemberment of Afghanistan, and negotia- tions were carried on with the northern tribes for the appointment of an

Amir for the Kabul district only. On the 5th May Sir Donald Stewart arrived with his column

from Kandahar and assumed the supreme command in Afghanistan, Roberts retaining, under Stewart, the command of the two liabul divisions, and organizing an efficient trans- port corps under Colonel R. Low, which was soon to be of inestimable value. On the 22nd of July Abdur Rahmaa was proclaimed Amir of Kabul ; and Roberts was preparing to withdraw his troops to India by the Kuram route, when news arrived that a British brigade had been totally defeated at Maiwand on the 27th July, and that Lieutenant-General Primrose was besieged in Kandahar. Roberts was ordered to proceed thither at once with a specially selected column of 10,000 troops and his new transport corps. He started on his famous march on the 9th August and arrived at Kandahar on the morning of the 31st, having covered 313 miles in twenty-two days. On the following day he fought the battle of Kandahar and gained a complete victory. His services in the Afghan campaigns of 1878 to 1880 are recorded in eight Gazettes, and were recognized by the thanks of both Houses of Parliament, of the Govern- ment of India, and of the Governor-General in Council. He was created K.C.B., G.C.B., and a baronet, received the medal with four clasps, and the bronze star, and was given the command of the Madras army.

Before proceeding to Madras, Roberts went home on fur- lough, and when the news of the disaster at Majuba Hill in South Africa arrived in London at the end of February 1881, he was appointed Governor of Natal and Commander-in- Chief in South Africa. He arrived at Cape Town to find that peace had been made with the Boers, and that instruc- tions were awaiting him to return home. The same year he attended the autumn manoeuvres in Hanover as the guest of the German Emperor. He declined the post of Quartermaster-General to the Forces in succession to Sir Garnet Wolseley, and returned to India, arriving at Madras in November. The following year he visited Burma with the Viceroy, and in 1885 attended the meeting between Abdur Rahman and Lord Dufferin at Rawalpindi at the time of the Pendjeh incident, in connexion with which he had been nominated to the command of an army corps in case of hostilities. In July he succeeded Sir Donald Stewart as Commander-in-

Chiei in India, and during his seven years' tenure of this high position instituted many measures for the benefit of the army, and greatly assisted the development of frontier communications and defence. At the end of 1 86, at the requestof the Viceroy, he tookpersonal command for a time of the forces in Burma, and organized measures for the suppression of dacoity. For his services he received the medal, was created G.C.I.E., and promoted Supernumerary General. In 1890 he did the honours of the army to Prince Albert Victor at a standing camp at Muridki, and in 1891 his attention was occupied with the Zhob and Hunza Naga frontier campaigns. On the 1st January 1892 he was raised to the peerage as Baron Roberts of Kandahar and Waterford. In 1893 he left India for good, and the G.C.S.I. was bestowed upon him. He was promoted to be Field Marshal in 1895, and in the autumn of that year succeeded Lord Wolseley in the Irish command and was sworn a Privy Councillor. At Queen Victoria's Diamond Jubilee in 1897 he was created K.P.

After the disastrous actions in the Boer war in South Africa in December 1899 at Magersfontein, Stormberg, and Colenso, where his only son was killed. Lord Roberts was sent out as Commander-in-Chief. He arrived at Cape Town on the 10th January 1900, and after organizing his force, advanced with sound strategy on Bloemfontein, the capital of the Orange Free State, and soon changed the aspect of afiairs. The sieges of Kimberley and Lady- smith were raised, and the Boer General, Cronje, flying towards the capital, was overtaken at Paar Jeberg and, after a fine defence, compelled to surrender, with 5000 men, on

the anniversary of Majuba Day, the 27th February 1900. Eoberts entered Bloemfontein on the 13th March, and after six weeks' preparation, advanced on Pretoria, the capital of the Transvaal. Mafeking was relieved on the 17th May, and Pretoria occupied on the 5th June. The two Boer states were annexed, and the war gradually assuming a guerilla character, Roberts handed over the command to Lord Kitchener, and returned to England to fill the office of Commander-in-Chief of the Army in suc- cession to Lord Wolseley.

He arrived in the Solent on the 2nd January 1901, and the same day, at Osborne, had an audience of Queen Victoria, who handed him the insignia of the Order of the Garter. The next day he was received at Paddington by the Prince and Princess of Wales, and drove in procession to Buckingham Palace, where he was entertained as the guest of the Queen. He again had an audience of the Queen at Osborne on the 14th January on his elevation to an earldom, the last audience given by Her Majesty before her death, which took place eight days later. When the German Emperor came to London for the Queen's funeral, ho decorated Lord Roberts with the Order of the Black Eagle. Earl Roberts received the thanks of both Houses of Parliament and a grant of ––100,000 for his services in South Africa. He is the author of The Rise of Wellington, 1895, and Forty-one Years in India, 1897, which has passed through more than thirty editions.

Robertson, Georg^e Croom (1842-1892),

Scottish philosopher, was born at Aberdeen on 10th March 1842. In 1857, when only fifteen, he gained a bursary at Marischal College, and graduated as M.A. in 1861, with the highest honours in classics and philosophy. In the same year he won a Fergusson scholarship of ––100 a-year for two years, which enabled him to pursue his studies outside Scotland. He first went to University College, London; thence to Heidelberg, where he worked at German; and to Berlin, where he studied psychology and metaphysics; also physiology under du Bois-Reymond, and heard lectures on Hegel, Kant, and the history of philosophy, ancient and modern. He then spei t two months at Gottingen ; and in June 1863 went to Paris. In the same year he returned to Aberdeen and helped Professor Bain with the revision of some of his books. In 1864 Croom Robertson was appointed to help Professor Geddes with his Greek classes, but he gave up the vacations to philosophical work. In 1864 he wrote an article on German philosophy for the British and Foreign Evangelical Review, and one on Kant and Swedenborg for Macmilla.n's Magazine. In 1866 he was appointed Professor of Philosophy of Mind and Logic at University College, London. This post he retained until ill-health compelled him to resign, a few months before his death in 1892. Professor Robertson lectured on logic, deductive and inductive, systematic

psychology, and ethical theory. He was a most industrious worker and accumu- lated large stores of materials, but left little published work. He had projected a comprehensive work on Hobbes ; but this was never completed, though part of the materials were used for an article in the Encyclo- pcedia Britannica, and another portion was published as one of Blackwood's "Philosophical Classics." Together with Professor Bain, he edited Grote's Aristotle ; and he was the editor of Mind from its foundation, in 1876, till 1891. He was keenly interested in German philosophy, and took every opportunity of making German works on English writers known in the United Kingdom. In philosophy his affinities were chiefly with the school repre- sented by Mill and Bain, but he was widely acquainted with the philosophical literature of all schools. He was associated with his wife (a daughter of Mr Justice Crompton)

in many kinds of social work ; he sat on the Committee of the National Society for Women's Suffrage, and was actively associated with its President, John Stuart MiU. He warmly supported the admission of women students to University College.

Robilant, Count Nicolas Carlo

Felice (1826-1888), Italian soldier and diplomatist, was born at Turin on 8th August 1826. Entering the army as artillery lieutenant in 1845, he was wounded at the battle of No vara, where he lost a hand. In 1860 he took part in the campaign in the Marches, and during the war of 1866 was chief of staff of the 3rd Army Corps. After serving on the Italo-Austrian Frontier Commission, and acting as Prefect of Ravenna at a critical moment in 1869, he was sent to Vienna in June 1871, first as minister and afterwards as ambassador. While approv- ing of the rapprochement between Italy and the Central Powers, he opposed the visits of Victor Emmanuel II. to Vienna and Berlin in 1874, and that of King Humbert to Vienna in 1881, since he desired that the Triple Alliance should only be concluded after the Austrian Emperor should have recognized Italian Unity by returning at Rome the visit of the Italian Sovereign to the Austrian capital Reluctantly accepting the portfolio of Foreign Affairs in 1886, he displayed tact and firmness during the Bulgarian crisis of that year ; and before leaving the Foreign Office, after

the disaster to Italian troops at Dogali, in Abyssinia, he succeeded (March 1887) in renewing the Triple Alliance on terms more advantageous to Italy than those of the original treaty, and in supplementing it by an understand- ing with Great Britain in regard to Mediterranean afiairs. After his fall from power he re-entered the regular army, but was selected by Crispi for the post of Ambassador to London, where he died on 17th October 1888. (h. w. s.)

Rochdale, a municipal, county (1888), and parlia- mentary borough of Lancashire, England, on the Roch, 196- miles north-west of London by raU. The corporation acquired powers in 1900 to purchase the tramways and to replace them by electric lines. The electric light has also been recently introduced. Several new mills, board schools, and other buildings have been erected. Specially noticeable are the technical school (1893), costing ??15,000; a school of art (1889), and a Roman Catholic orphanage. There is a statue of John Bright (1891). The Equitable Pioneers Society (1844), pioneer of co-operation, numbers over 11,000 members, with a capital of over ??350,000. A handsome new co-operative store, belonging to the Rochdale Provident Co-operative Society, was opened in 1900. In 1891, 5699 males and 8353 females were engaged in the cotton, 1860 males and 2107 females in the wool and worsted, and 591 males and 395 females in the silk manufacture; and 1423 persons in the making of machines. Area of parliamentary borough, 4185 acres ; population (1881), 68,866; (1891), 71,401. Till Nov- ember 1900 the municipal and county borough was coincident with the parliamentary borough ; it was then, however, extended to include the urban district of Castleton, and now has an area of 6454 acres with a population in 1901 of 83,112.

Rochefort, chief town of arrondissement, depart- ment of Charente Inferieure, France, 20 miles south-south- east of Rochelle, on the railway from Nantes to Bordeaux. Manufactures include tiles and drain pipes, preserved foods, artificial fuel, and steam saw and planing mills. Large quantities of wine are produced in the districts around Rochefort and Tonnay- Charente, amounting in 1899 to 28,963,700 gallons. The third floating basin of the commercial port was completed in 1890; it has an area of 15 acres, with 3692 feet of quayage, and a depth, spring

and neap tides respectively, of 29^ and 25| feet. Ex- clusive of coasting trade, the number of vessels entered at Eochefort and Tonnay-Charente in 1900 was 151 of 117,284 tons; cleared, 130 of 105,359 tons. The total movement, including coasting trade, amounted to 339,582 tons. At Tonnay-Chaeente (4 miles to the north), in the same year, the total tonnage, including coasting trade, amounted to 218,225. A ” bridge with suspended carrier ” has been constructed across the Charente between Eochefort and the sea, at a height which admits of the tallest ships passing underneath at any time. The ” carrier,” suspended some 150 feet below the bridge, but above the highest water-line, conveys persons, animals, goods, and vehicles from side to side, a distance of 300 or 400 yards. This bridge was completed at a cost of about ◆◆28,000. Population (1881), 21,608; (1901), 31,613. Tonnay-Charente : population

(1901), 4640.

Rochefort, Victor Henri, iVIarquis

de Rociiefort – LU9ay (1830), _ French

journalist and politician, generally known as Henri Eoche- fort, the son of a Legitimist noble, was born 30th January 1830, at Paris. He was successively in early life a medical student, a clerk in the H&tel de Ville, a suc- cessful playwright, and a journalist. When one of the writers of the Charivari, his articles led to his appoint- ment as sub-inspector of Fine Arts in Paris, but this post he resigned in 1861. In 1863 he joined the staff of the Figaro, at a salary of 30,000 francs ; but his severe comments on the Second Empire brought the paper into collision with the authorities, and led to his retire- ment. His articles were collected and published in three volumes, entitled Les Frangais de la Dicadence. Eoche- fort now founded La Lanterne ; but it was seized on its eleventh appearance, and in August 1868 the editor was fined 10,000 francs, vfith a year’s

imprisonment. The publication was afterwards rigorously suppressed. Eoche- fort fled to Belgium ; and after two unsuccessful candida- tures, he was returned to the Chamber of Deputies by the Ultra-Democrats of the first circonscription of Paris. After a brief arrest on crossing the frontier, he took his seat. He attacked the Imperial regime violently in the Chamber ; and in 1869 started a new paper, the Mar- seillaise, in which Victor Noir and Pascal Grousset were collaborators. The attacks in this journal on Prince Pierre Bonaparte led to the killing of Victor Noir by the Prince ; the paper was seized, and early in 1870 Eochefort and Grousset were fined, and committed to prison for six months. Upon the downfall of the Empire in September

1870 Eochefort was released by the mob, and for a short time he became connected with the Government of National Defence; but was compelled to resign on account of his open sympathy with the first Communistic outbreaks. When the Commune was established in March

1871 Rochefort at first supported its terrible excesses in the Mot d'Ordre, but finding its tyranny insupportable, he fled from Paris in disguise on 11th May. Arrested by the Versailles Government, he was condemned by martial law to imprisonment for life, and notwithstanding Victor Hugo's efforts to procure his release, he was transported to New Caled'onia. In November 1872 he was temporarily released to enable him to legitimize his children by marry- ing their mother, who was dying. Then he was reconveyed to New Caledonia, whence he escaped in 1874 in an open boat. He made his way to San Francisco, and thence to London and Geneva, where he contributed to the Parisian press, and attempted to revive La Lanterne, but without success. After being severely wounded in a duel, ??? a form of hostility in which he was always conspicuous, ??? he took advantage of the general amnesty to return to

Paris, where he founded a new journal called L'lntransv- gdant. He resumed his assaults upon all the French Governments in turn. He also attacked with special incisiveness the Tunis expedition, which he declared to be a mere stock-jobbing affair ; and he secured a triumphant acquittal in an action for libel brought against him by M. Eoustou, the Eesident at Tunis, who had been the chief promoter of the annexation. During the

Boulangist fever he was a staunch partisan of the General, whom he accompanied to England in 1889, having escaped through Belgium from France. Eochefort remained in exile in England for some years, and was always hospitably re- ceived there. In January 1895 a French Amnesty Bill was passed by the Chamber, and Eochefort, with many other proscribed persons, took immediate advantage of it and returned to Paris. He played a prominent part against ex-Captain Dreyfus during his second trial at Eennes. In 1900, during the course of the South African war, he initiated a movement in France on behalf of the Boers, and no words in his vocabulary were too insulting for the country which had so long given him refuge.

Rochelle, La, chief town of department Charente Inf6rieure, France, 293 miles south-west of Paris, on the railway from Nantes to Bordeaux. The new Pare Charruyer lies outside the fortifications west of the town. Local in- stitutions include an academy of belles-lettres and science. Shipbuilding, the manufacture of briquettes, chemicals, sardine- and tunny-preserving, and petroleum-refining are among the principal industries. The maritime commerce, included vdth that of La Pallice, is very important. La Pallice, the new port of La Eochelle, inaugurated 1890, is situated nearly 4 miles to the south-west on the ocean, and is defended by a fort. At La Pallice petroleum refineries and chemical manure works have been estabhshed, and it has a repairing shipyard. Its importance, however, centres in its magnificent port, entirely artificially excavated, which, sheltered by the islands of E6 and Oleron, affords excellent and safe anchorage in all weathers. The outer part, protected by two jetties, respectively 1420 and 2054 feet in length and each terminated by a lighthouse, has an area of 29 acres and depth 16^ feet below lowest tide level. Ships drawing up to 16 feet can enter at any time, and those drawing from 16 to 26 feet during six hours daily. At the extremity of the breakwater is a wharf 680 feet long where ships may discharge without entering the basin. A lock 770 feet long and 72 feet wide connects with the inner basin, which has an area of 27 acres, with 5900 feet of quayage, a minimum depth of 28 feet, and depths of 29|- feet and 36 feet at high neap and spring tides. Connected with the basin are two graving docks, respectively 616 and 364 feet in length, with depths ranging between 23 and 30 feet. The number of vessels entered at La Pallice in 1900 was 205,

of 317,080 tons; cleared 200, of 305,220 tons. At La Eochelle basin 207 vessels entered, of 139,695 tons; cleared 169, of 123,267 tons. Including coast trade, the total movement for the two ports amounted to 2,215,210 tons. The total value of the imports at La Eochelle was, in 1899, ––2,556,000, and of the exports, ––1,020,000, chiefly brandy (8103 tons). Belonging to the port in 1899 were 253 vessels of 23,520 tons, mostly small sailing ships. In 1900, 198 sailing boats, manned by 743 persons, were engaged in the fisheries. The fish market of La Eochelle is the most important on the west coast. The value of fish sold in 1900 was ––154,240. Population (1881), of La Eochelle,

17,2.34; (1901), 28,578.

Rochester, an episcopal city and municipal and parliamentary borough, Kent, England, in the Medway par- liamentary division of the county, on the JMedway, 33 miles

east of London by rail. The restoration of the west front of the cathedral (Norman style) was commenced in 1888 by Dean Hole, and was completed about 1898, costing, with other work, ––7358. The church of St Nicholas was restored in 1892. A museum was opened in 1894 in the basement of the corn exchange, and a handsome Elizabethan mansion has been acquired by the corporation for museum purposes, as a memorial of Queen Victoria's Diamond Jubilee. In 1888, 9680 vessels entered the port with 704,207 tons of cargo, and 9290 cleared with 669,233 tons. In 1901, 1540 vessels entered with 386,879 tons, and 1567 vessels cleared with 392,872 tons. The population of the municipal and parliamentary borough was in 1891, 26,290; in 1901, 30,622. The parish of Strood lies mainly within the borough, and is connected with the city by a bridge. Population (1901), 14,432.

RochCGter, a city of Minnesota, U.S.A., the capital of Olmstead county. It is on the Zumbro river, and on the Chicago and North- Western and the Winona and Western railways, in the south-eastern part of the state, at an

altitude of 991 feet. It contains one of the state insane asylums, and is in the midst of a fertile farming region, with grain elevators and flour-miUs, utilizing the water- power furnished by the river. Population (1890), 5321 ; (1900), 6843, of whom 1680 were foreign-born.

RocheS'ter, a city of Strafford county. New Hamp- shire, U.S. A- It is on Salmon Falls and Cocheco rivers, and at the junction of several branches of the Boston and Maine Kailroad, in the south-eastern part of the state, at an altitude of 226 feet. It has fine water-power, and manufactures of boots and shoes, wooUen goods, and other articles. Eochester was settled in 1728, incorporated as a town in 1737, and received a city charter in 1891. Population (1890), 7396; (1900), 8466, of whom 1651 were foreign-born.

Rochester, a city of New York, U.S.A, the capital of Monroe county. It is on both banks of the Genesee river, in the north-western part of the state. The plan of the city is irregular, with broad, well-shaded streets, a large proportion of which are paved, mainly with asphalt. It has a fine water-supply and is well sewered. It is the seat of Eochester University, which in 1899 had a faculty numbering 15 and was attended by 213 students. Eochester is a lake port, the river being navi- gable to this point. It is also a railway centre of great importance, being entered by seven railways, the Bufi'alo, Eochester, and Pittsburg, the Erie, the Lehigh Valley, the New York Central and Hudson Eiver, the Eochester and Lake Ontario, the Western New York and Pennsylvania, and the West Shore, which afford internal communication in aU directions. Eochester is a manufacturing city of much importance, aided by water-power derived from the falls. In 1900 it contained 2616 manufacturing estab- lishments, with a total capital of $49,086,212. These employed 33,408 hands and paid $13,832,122 in wages. The raw materials had a value of $31,557,122, and the finished product of $69,129,820. The principal of these products, with their values, were as follows : ???

Boots and shoes $6,933,111

Men's clothing 11,138,220

Flouring and grist miU products . . 3,010,539 Foundry and machine-shop products . 4,036,479

Malt liquors 2,748,290

Tobacco 3,040,331

Furniture 2,069,972

The assessed valuation of real and personal property was, in 1900, $115,570,890, the net debt of the city was $10,574,431, and the tax-rate was $24.29 per $1000. The total municipal receipts, apart from loans, were

$4,336,506, and the expenditures for maintenance and operation, $3,645,343. Population (1890), 133,896; (1900), 162,608, of whom 40,748 were foreign-born and 601 negroes. Of 45,395 males 21 years of age and over, 1327 were iUiterate (could not write).

Rocka.wa.y, formerly a village of Queens county, New York, U.S.A., but since 1st January 1898 a part of the borough of Queens, one of the five boroughs of which New York City is composed. It is a summer resort, situated on a sandbar on the south coast of Long Island.

*Rockford, a city of Illinois, U.S.A., the capital of Winnebago county. It is situated in 42 15' N., 89 5' W., on Eock river, which furnishes a fine water- power, in the northern part of the state, at an altit*ade of 714 feet. The city has an excellent water-supply from artesian weUs and from the river; its business streets are paved with brick, wood, and asphalt, and many of its residential streets are macadamized. It is upon four railways, the Chicago, Burlington, and Quincy, the Chicago and North- Western, the Chicago, Milwaukee, and St Paul, and the Illinois Central, which give it a large trade. In manufactures, the census of 1900 reported that the city contained 450 estabhshments, with a total capital of $14,126,834, employing 6620 hands, and with a product valued at $12,586,116. The principal articles of manufac- ture were furniture, knitted goods, foundry and machine-shop products, and agricultural implements. In 1 900 the assessed valuation of property, real and personal, was $5,266,804, a very*

low assessment. The net debt of the city was $565,134, and the rate of taxation was $60.75 per $1000. Population (1890), 23,584 ; (1900), 31,051, of whom 9337 were foreign-bom and 212 negroes. Of 8856 males 21 years of age and over, 129 were iUiterate (could not vrrite).

Rockha.mpton, a town of Queensland, Australia, in the county of Livingstone, on the Fitzroy river, about 420 miles north-west of Brisbane. It has frequent com- munication by steamer with the principal Australian ports, and is the outlet for a wide agricultural district, which produces also gold and copper. The value of the exports in 1899 amounted to ––2,390,000. Much of the trade is carried on through the ports of Alma and Broadmount, near the mouth of the river, both available for ocean steamers. The Central EaUway starts from this town. Population (1891), 11,629 ; (1901), 15,461. North Eock- hampton is a separate municipality on the opposite side of the river. Population (1901), 2865.

Rock Hill, a city of York county, S.C, U.S.A. It is situated on the Southern and the South Carohna and Georgia railways, in the northern part of the state. Population (1890), 2744 ; (1900), 5485, of whom 33 were foreign-born and 1706 negroes.

Rock Island, a city of Illinois, U.S.A, the capital of Eock Island county. It is situated in 41––32′ N., 90––31′ W., on the east bank of the Mississippi, in the western part of the state, at an altitude of 570 feet at the river bank. The city has a water-supply pumped by the HoUy system, is sewered, and is divided into seven wards. It has five railways, the Chicago, Eock Island and Pacific, the Chicago, Burlington, and Quincy, the Chicago, Milwaukee, and St Paul, the Davenport, Eock Island, and North-Western, and the Eock Island and Peoria. The city has a large trade by raU and river, and, aided by ample water-power derived from the Eock Island Eapids, it has important manufactures, including flour, lumber, glass, and agricultural implements. Eock Island is the seat of Augustana CoUege, a Lutheran in- stitution, opened in 1860, which in 1899 had a faculty numbering 27 and was attended by 458 students. Popu-

lation (1890), 13,634; (1900), 19,493, of whom 4412 ❓❓❓were foreign-born and 282 negroes.

Rockla.nci, a city and seaport of Maine, U.S.A., the capital of Knox county. It is on the shore of Penobscot bay, and on a branch of the Maine Central Kailroad, in the southern part of the state. It is divided into seven wards, and has a water-supply and sewer system. The principal industries are the quarrying of granite, the burning of lime, and shipbuilding. Owing to its strength and durability, Kockland granite is used for building in various parts of the country. Population (1890), 8174; (1900), 8150, of whom 610 were foreign-born.

Rockland, a town of Plymouth county, Massa- chusetts, U.S.A. It is an inland town in the south-eastern part of the state, on a branch of the New York, New Haven, and Hartford Eailroad. It contains an area of 11 square miles, well settled, mainly with rural population. There is a village bearing the same name as the town. Population (1890), 5213; (1900), 5327, of whom 796 were foreign-born.

Rockport, a town of Essex county, Massachusetts, U.S.A. It is at the eastern point of Cape Ann, in the north-eastern part of the state, on a branch of the Boston and Maine Kailroad. It has an area of seven square miles of broken, rocky country, bordered by a rugged coast-hne. It contains several villages, Eockport, Ocean View, and Pigeon Cove, which are popular seaside resorts. Rockport is widely known for its granite quarries. Popu- lation (1890), 4087 ; (1900), 4592, of whom 1290 were foreign-born.

RockvillG, a city of Tolland county, Connecticut, U.S.A. It is on the Hockanum river, and on the New York, New Haven, and Hartford Railroad, in the northern part of the state, at an altitude of 403 feet. It possesses excellent water-power, which has been put to use in manu- factures. These consist largely of envelopes and woollen and silk goods. RockviUe was separated from Vernon town and chartered as a city in 1889. Population (1890), 7772 ; (1900), 7287, of whom 2548 were foreign-born.

Rodin, AugfUSte (1840), French sculptor,

was born in 1840, in Paris, and at an early age displayed a taste for his art. He began by attending Barye's classes, but did not yield too completely to his influence. From 1864 to 1870, under pressure of necessity, he was em- ployed in the studio of Carrier-Belleuse, where he learnt to deal with the mechanical difficulties of a sculptor. Even so early as 1864 his individuality was manifested in his " Man with a Broken Nose." After the war, finding nothing to do in Paris, Rodin went to Brussels, where from 1871 to 1877 he worked, as the colleague of the Belgian artist Van Rasbourg, on the sculpture for the outside and the caryatides for the interior of the Bourse, besides exhibiting in 1875 a "Portrait of Gamier." In 1877 he contributed to the Salon "The Bronze Age," which was seen again, cast in bronze, at the Salon of 1880, when it took a third-class medal, was purchased by the State, and placed in the gardens of the Luxembourg. Between 1882 and 1885 he sent to the Salons busts of " Jean-Paul Laurens " and "Carrier-Belleuse" (1882), "Victor Hugo" (see Plate) and "Dalou" (1884), and " Antonin Proust " (1885). From about this time he chiefly devoted himself to a great decorative composition six metres high, which was not finished for twenty years. This is the "Portal of Hell," the most elaborate perhaps of all Rodin's works, executed to order for the Musee des Arts D6coratifs. It is inspired mainly by Dante's Inferno, the poet himself being seated at the top, while at his feet, in under-cut relief, we see the writhing crowd of the damned,

torn by the frenzy of passion and the anguish of despair. The lower part consists of two bas-reliefs, in their midst two masks of tormented faces. Round these run figures of women and centaurs. Above the door three men cling to each other in an attitude of despair. After beginning this Titanic undertaking, and while continuing to work on it, Rodin executed for the town of Damvillers a statue of " Bastien-Lepage " ; for Nancy a "Monument to Claude le Lorrain," representing the Chariot of the Sun drawn by horses ; and for Calais " The Burgesses of Calais " sur- rendering the keys of the town and imploring mercy (see Plate). In this, Rodin, throwing over all school tradition, represents the citizens not as grouped on a square or circular plinth, but walking in file. This work was ex- hibited at the Petit Gallery in 1889. At the time of the secession of the

National Society of Fine Arts, or New Salon, in 1890, Rodin withdrew from the old Society of French Artists, and exhibited in the new Salon the bust of his friend " Puvis de Chavannes " (1892), "Contemplation " and a " Caryatid," both in marble, and the " Monument to Victor Hugo" (1897), intended for the gardens of the Luxembourg. In this the poet is represented nude, as a powerful old man extending his right arm with a sovereign gesture, the Muses standing behind him. In 1898 Rodin exhibited two very dissimilar works, " The Kiss," ex- hibited again in 1900, a marble group representing Paolo Malatesta and Francesca di Rimini, and the sketch in plaster for a " Statue of Balzac." This statue, a commis- sion from the Society of Men of Letters, had long been expected, and was received with vehement dissensions. Some critics regarded this work, in which the poet was represented in his voluminous dressing-gown, as the first- fruits of a new phase of sculpture ; others, on the con- trary, declared that it was incomprehensible, if not ridiculous. This was the view taken by the society who had ordered it, and who "refused to recognize Rodin's rough sketch as a statue of Balzac," and withdrew the commission, giving it to the sculptor Falguiere. Falguiere exhibited his model in 1899. In the same Salon Rodin, to prove that the conduct of the society had made no change in his friendship with Falguiere, exhibited a bust in bronze of his rival, as well as one of " Henri Rochefort." In 1900 the city of Paris, to do honour to Rodin, erected at its own expense a building close to one of the entrances to the Great Exhibition, in which almost all of the works of the artist were to be seen, more especially the great "Portal of Hell," still quite incomplete, the "Balzac," and a host of other works, many of them unfinished or mere rough sketches. Here, too, were to be seen some of Rodin's designs, studies, and water-colour drawings. He has also executed a great many etchings and sgraffiti on porcelain for the manufactory at Sfevres. His best known etching is the portrait of Victor Hugo. Rodin's works may be found in some private collections, and at the Luxembourg he is represented by a " Danaid " (in marble), a " Saint John "(in bronze, 1800), "She who made the Helmet" (bronze statuette), and the busts of " J. P. Laurens " and of " A Lady." In the JIuste Galliera is a very fine bust of Victor Hugo. Rodin has exerted a marked influence on many contemporary artists.

BiBLioGKAPHY. ⬛⬛⬛ Grffkoy. La Vie Artistiqiie. Paris, 1892, 1893, 1899, 1900. ⬛⬛⬛ L. Maillard. Sodin. Paris, 1899. ⬛⬛⬛ ia Plmne. Bodin et son auvre. Paris, 1900. ⬛⬛⬛ Alexandre. Le Balzac de Bodin. Paris, 1898.

RodOStO, a town of European Turkey, is an open roadstead on the Sea of Marmora, about 85 miles west of Constantinople, of which it is practically a commercial dependency. It is the administrative centre of a district producing and exporting barley, oats, spelt, and canary seed, and largely planted with mulberry trees, on which.

"Thf, Buugesses of Calais." By Auguste Rodin.

Victor Hugo. By Atjguste Rodin.

are fed silkworms of the "Baghdad" breed. White cocoons to the amount of 394 cwt. were exported to western Europe in 1901, besides a large quantity of silk- worms' eggs to Russia and Persia. Being financially dependent ori the capital, Eodosto suffered heavily during the commercial crisis which paralysed the trade of Con- stantinople in the years 1896-99, and a considerable area of land fell out of cultivation. This period of depression was followed, however, by two years of exceptional abundance. Population (1890), 19,558; (1902), 35,000.

Roebuck, John Arthur (1802-1879), British

politician, was born at Madras on 28th December 1802. After the death of his father, a civil servant, his mother's second marriage transferred him to Canada, where he was chiefly brought up. He came to England in 1824, was called to the Bar, became intimate with the leading Radical and utilitarian reformers, was elected M.P. for Bath in 1832, and took up that general attitude of hostility to the Government of the day, be it what it might, which he retained throughout his life. At all times conspicuous for his eloquence, honesty, and recalcitrancy, he twice came with especial

prominence before the public ❓❓❓ in 1838, when, although at the time without a seat in Parliament, he appeared at the bar of the Commons to protest in the name of the Canadian Assembly against the suspension of the Canadian constitution; and in 1855, when, having over- thrown Lord Aberdeen's ministry by carrying a resolution for the appointment of a committee of inquiry into the mismanagement in the Crimean War, he presided over its proceedings. In his latter years his political opinions became greatly modified, but with one interruption he retained his seat for Sheffield, which he had gained in 1849, untn 1879, when he died with the reputation of an intrepid, pugnacious, perfectly disinterested and thoroughly impracticable senator.

Rofreit. See Roveeeto.

Rogfers, James Edwin ThoroEd (1823-

1890), political economist, was born at West Meon, Hamp- shire, in 1823. He was educated at King's College, London, and Magdalen HaU, Oxford. After taking a first-class degree in 1846, he was ordained, and was for a few years a curate in Oxford. Subsequently, however, he resigned his orders. For some time the classics were the chief field of his activity. He devoted himself a good deal to classical and philosophical tuition in Oxford with success, and his publications included an edition of Aristotle's Ethics (in 1865). Simultaneously with these occupations he had been diligently studying economics, with the result that in 1859 he was appointed professor of statistics and economic science at King's College, London, a post which he filled till his death. From 1862 to 1867 he also held the position of Drummond professor of political economy at Oxford. During that period he pubHshed (in 1866) the first two volumes of his History of Agriculture and Prices in England, a minute and masterly record of the subject and the work upon which his reputation mainly rests. Two more volumes were published in 1882, a fifth and sixth in 1887, and he left behind him at his death copious materials for a seventh and eighth. In 1868 he published a Manual of Political Economy, and in 1869 an edition of Adam Smith's Wealth of Nations. In 1875 he collected and edited the Protests of the Lords. An intimate acquaintance with Cobden and John Bright led Rogers to take an active part in politics

: he represented Southwark in Parliament from 1880 to 1885, and Ber- mondsey from 1885 to 1886, as a Liberal. In 1888, on the death of Professor Bonamy Price, who had succeeded him at Oxford as professor of political economy, he weis re-elected to the post, and held it tiU his death. Previously

(in 1883) he had been appointed lecturer in political economy at Worcester College, Oxford. His latter years were mainly spent at Oxford, where he died on 12th October 1890. He was celebrated in society as a wit and humorist. Of his miscellaneous economic and historical writings, which were numerous, the most noteworthy is his Six Centwries of Work and Wages, published in 1884.

(e. f. s.)

Rogfier, Charles Latour (1800-1885), Belgian

statesman, descended from a Belgian family that had settled in the department of the Nord in France, was born at St Quentin on 17th August 1800. His father, an officer in the French army, perished in the Russian cam- paign of 1812 ; and the family moved to Li^ge, where the eldest son, Firmin, held a professorship. Charles, after being called to the Bar, founded, in collaboration with his lifelong friends, Devaux and Lebeau, the journal Mathieu Laensberg (afterwards Le Politique), which by its ardent patriotism and its attacks on the Dutch adminis- tration soon acquired a widespread influence. When the insurrection of 1830 broke out at Brussels, Rogier put himself at the head of 300 Li^geois, and inscribing on his banner the motto, " Vaincre ou mourir pour Bruxelles," marched upon the capital. Here he took his place at once among the leaders of the revolutionary party. His influence saved the town-hall from pillage on 19th Sep- tember. On the 24th a commission administrative was formed, of which Rogier became president. The energetic measures of this body and of its successor, the gouverne- ment provisoire, soon freed the greater part of the country from the Dutch troops. Rogier was sent as delegate of the provisional Government to Antwerp, where the citadel still held out for Holland. He succeeded in arranging an armistice, and then, in the exercise of the absolute power with which he was invested, organized afresh the entire administration of the city. He sat for Li^ge in

the National Congress, voted for the establishment of a hereditary monarchy, and induced the Congress to adopt the principle of an elective second chamber. In the long- drawn debates on the bestowal of the crown, he ranged himself on the side of Louis Philippe : he first supported the candidature of Otto of Bavaria, and on the latter's rejection declared for the Due de Nemours. Finally, when Louis Philippe declined the crown on behalf of his son, Rogier voted with the majority for Leopold of Saxe-Coburg. In June 1831 he was appointed governor of the province of Antwerp, a post rendered exceptionally difficult by the continued presence of Dutch troops in the citadel. The ability he displayed was so marked that in October 1832 he was made minister of the interior in the Goblet-Devaux cabinet. In the following June he inter- vened with characteristic courage in a quarrel in the Chamber of Deputies between Devaux and the Opposition leader Gendebien, claimed a prior right to give satisfaction, and fought a duel, in which he was severely wounded. During his term of office he carried, in the teeth of violent opposition, a law that established in Belgium the first railways on the continent of Europe, and thus laid the foundation of her industrial development. Owing to dissensions in the cabinet, he retired in 1834, together with Lebeau, and resumed the governorship of Antwerp. On Lebeau's return to power in 1840, Rogier became minister of public works and education. The proposals that he made in the latter capacity were defeated by the determined opposition of the Clerical party, and on the resignation of the ministry in 1841, Rogier gave his support to a compromise on the subject of education, which passed into law in 1842. He led the Liberal party in Opposition till 1847, when he formed a cabinet in which he held the ministry of the interior. He at once

embarked on a programme of political and economical reform. He took eflective steps to remedy the industrial distress caused by the decay of the Flemish linen trade. The limits of the franchise were extended ; and as the result of the Liberal policy of the Government, Belgium alone escaped the revolutionary wave that spread over the Continent in 1848. He passed

a law in 1850 organizing secondary education under the control of the State, and giving the clergy only the right of religious instruction. The Clerical party, though unable to defeat this measure, succeeded in shaking the position of the cabinet ; and it was finally undermined, after the coup d'etat of 1851, by the hostility of the French Government, which found its political exiles welcomed by the Liberal cabinet at Brussels. Rogier retired in October 1852, but was brought back into office by the Liberal reaction of 1857. He again became president of the council and minister of the interior in a cabinet of which Fr^re-Orban was the most conspicuous member. The first important measure passed by the ministry was one for the fortification of Antwerp. In 1860 the fear of French designs on the independence of Belgium led to a movement of reconciliation with Holland, and inspired Eogier to write the only one of his numerous poems that is likely to survive, his national anthem, " La Nouvelle Braban9onne." Some of the ministers resigning in 1861, on the question of recognizing the kingdom of Italy, the cabinet was reconstructed, and Eogier exchanged the ministry of the interior for that of foreign affairs. In this capacity he achieved a remarkable triumph of diplomacy in freeing the navigation of the Scheldt, and thus enabling Antwerp to become the second port on the mainland of Europe. Defeated at Dinant, he sat for Tournai from 1863 tUl his death. His younger and more energetic colleague, Frere-Orban, gradually overshadowed his chief, and in 1868 Rogier finally retired from power. He continued, however, to take part in public life, and was elected president of the extraordinary session of 1878. From this time his age, his devoted patriotism, and the un- assuming simplicity of his life made him the idol of all classes. The fiftieth anniversary of the kingdom of Belgium in 1880, and two years later that of his entry into parliament, were the occasion of remarkable demonstrations in his honour. He died at Brussels on 27th May 1885, and his remains were accorded a public funeral. (h. sy.).

Rohilkhand, or Rohilcund, a division of British India, in the North-Western Provinces. It comprises the six districts of Bijnor, Moradabad, Budaun, Bareilly, Shahjahanpur, and PiUbhit. Area, 19,908 square miles; population (1891), 5,343,674, being 489 persons per square mile. It also includes the native state of Rampur. In 1897-98 the Rohilkhand system of canals irrigated 122,767 acres; the gross receipts were Rs.l,

89,414, giving a net return of 3-67 per cent, on a capital outlay of Rs. 17,73,000.

See Sir John Steaohey, Eastings and the Rohilla War. Oxford, 1892.

Rohlfs, Friedrich Gerhard (1831-1896),

traveller, was the son of a physician, and was born at Vegesack, near Bremen, 14th April 1831. After the ordinary course at the gymnasium of Osaabriick, he entered the Bremen corps in 1848, and took part as a volunteer in the Schleswig-Holstein campaign, being made an officer after the battle of Idstedt, July 1850. He then for several years devoted himself to the study of medicine at the universities of Heidelberg, WiirzljurR, and Gottin- gen ; but yielding to his natural inclination, he travelled over nearly all Europe, and then proceeded to Algeria, where he acted as military surgeon during the French

campaign of 1855-60, and was appointed for his bravery Chevalier of the Legion of Honour. Having studied the language and customs of Algeria, Rohlfs went to Morocco in 1861, and presenting himself as a Mussulman, gained the favour of the enlightened Sherif of Wezzan, and was thus enabled to travel over the length and breadth of the country. He then explored the western portion of the Sahara and the entire extent of the Wed Draa, being the second European (the first being Rene CaiUi6) to visit Tafilet. Between that town and Kanatsa he was robbed by his guides and left for dead, 1862 ; but two marabuts charitably succoured him, and quickly recovering health, he again set forward in 1864 to Tuat, which he was the first European to reach and describe. Returning by Gha- dames and Tripoli, he spent a few months in Germany, and then went back to Tripoli, intending to explore the high- lands of the Ahaggar; but being prevented by a war among the Tuaregs, he went to Muzzuk, where he remained until 1866, and then entered Bornu, when he explored and mapped the oasis of Kawar. Rohlfs then passed through Mandara and its ancient capital Mora, and struck out for the coast of the Gulf of Guinea. Passing through Gugeba and Gongola, he crossed the Sokoto mountains, descended the Benue to Lakodja, and ascending the Niger to Rabba, proceeded on horseback to Lagos, and landed at Liverpool, 2nd July 1867. In the following year he accompanied the Abyssinian expedition,

and traversed the Cyrenaica, reaching Egypt by way of the oasis of Siwa, 1869. Rohlfs then returned home, married, and settled down in Weimar. He did not rest long, however, for in 1873-74 he carried out an expedition to the desert of Libya for the Khedive. Commissioned by the German African Society, he proceeded to Wadai in 1878, but was driven back by the natives. In 1880 he accompanied Dr Stecker in the German exploring expedition to Abyssinia; but after delivering a letter from the Emperor to the Negus, he returned to Europe. In 1885 Prince Bismarck appointed him consul at Zanzibar ; but he was shortly recalled, and did not again visit Africa. Rohlfs published accounts of each of his expeditions, as well as several works on Africa and its people. His death took place at Riingsdorf, near Bonn, 2nd June 1896. ' (g. f. b.)

Rohtcik, a town and district of British India, in the Delhi division of the Punjab. The town is a railway station, 42 miles north-west of Delhi. Population (1881), 15,699; (1891), 16,702; municipal income (1897-98), Rs.23,758. Cotton turbans are manufactured. The muni- cipal high school cost Rs.22,000.

The district of Rohtak has an area of 1797 square miles. Population (1891), 590,475; (1901), 630,711, show- ing an increase of 7 per cent. Land revenue and rates (1897-98), Rs.ll, 25,828, the incidence of assessment being R. 0.13.5 per acre; cultivated area, 548,493 acres, of which 182,968 were irrigated, including 147,531 from Government canals ; number of police, 433 ; number of schools (1896-97), 103, attended by 5087 boys, being 10-3 per cent, of the boys of school-going age; death-rate (1897), 32-64 per 1000. The principal crops are millet, pulse, wheat, barley, cotton, sugar-cane, and indigo. The district is traversed by the line of the Southern Punjab Railway from Delhi to Jhind, and also touched on by the Rewari-Firozpur branch of the Raj- putana Railway ; total length, 52 miles. Part of it is watered by the Western Jumna canal. It is peculiarly exposed to drought, suffering in the famine of 1896-97 (when the maximum number of persons on relief was 12,781 in June 1897), and again in 1899-1900.

Roman, a town in Rumania, situated on the left bank of the river Moldava, near its junction with the

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Sereth, is the chief place of the district of the same name. It is the seat of an Orthodox bishopric created in 401 by Alexander the Good. There are several fine churches, including the cathedral Population (1895), 15,687 ; (1900), 14,019, of whom 6099 were Jews.

Roman Catholic Church. *The history of*

the Catholic Church since 1880 roughly coincides with the history of the Pontificate of Leo XIII. , who came to the throne in 1878. It may be considered, therefore, in the present outline from that standpoint, i

As regards his own position at Eome, Leo XIII., Kke his predecessor, has kept up the protest against the in- vasion of his temporal sovereignty. The prin- Ttiott "^ip^l occasions on which he has spoken to this eft'ect were his first Encychcal, which announced his accession and indicated the policy of his reign; the Allocution to the Cardinals of 4th August 1881, on the occasion of the insults offered to the remains of Pius IX. during their transfer from St Peter's to San Lorenzos with- out the Walls; and his Allocution of 2nd March 1884, on the occasion of the practical confiscation, under the guise of conversion, of the property of the Congregation de Propaganda Fide, the great central missionary agency of the Catholic Church. A recent clear account of the grounds on which the Pontifical protest is based may be read in Archbishop Ireland's Pastoral Letter (given by the Tablet for 11th January 1901), which cites the interesting analogy of the District of Columbia kept free from in- corporation in the states of the Union in order to guard the independence of the Federal Government. So far from being animated by any temporal ambitions, as has been alleged, the Pontiffs declare that they must ever claim the restitution of the small temporal sovereignty which Provi- dence has assigned them, precisely because without it it is impossible for them to discharge adequately their spiritual office as rulers of the universal Church. It is a continual charge made by their enemies against the Popes,

that their action on the local Church administration in the different countries is the action of a " foreign Power." There would be some justification of the charge, or at least of the suspiciousness out of which it springs, if the Popes con- sented to be the subjects of any one temporal ruler ; and it is only by their persistent protests against the subjection in which it is sought to place them that they have hitherto been able to avoid the difficulty. Again, the Popes require to surround themselves with various institutions through which, as central agencies, they may control and guide the work of the Church in its different depart- ments throughout the world. Such are the Sacred Con- gregations, particularly the Holy Office, the Congregation of Bishops and Kegulars, the Propaganda, the Mother- Houses of the Eeligious Orders. Unless the Pope can maintain these institutions in due freedom and with the necessary resources to enable them to do their work in the spirit, in the manner, and with the effectiveness which he judges desirable, the ill effects must be felt not in Eome only, but in every country. Once more, the region which is the headquarters of the Pontifical govern- ment should, above all others, be one in which the Church is free to display fully and publicly the characteristic features of Catholic life. It is certainly not one in which it ought to be exposed to anti-Christian restrictions and persecutions. Yet in regard to all these matters the Pope, if not a temporal ruler himself, must be at the mercy of the ruler under whom he is placed ; a ruler whose govern- ment may be favourable to the Church's best interests, but

' See also the article Vatioanism for a treatment of some of these questions from a rather different point of view. ??? Ed.

may equally weU be actively hostile to them. It is obviously with the view of showing that these liabilities are not merely theoretical that Leo XIII. has timed his recurrent protests as he has done.

If in Eome the necessity of securing for the Holy See its perfect liberty of action and immunity from suspicion in the exercise of a spiritual office affecting the whole world renders it impossible for the Popes to acquiesce in the invasion of their temporal jurisdiction, in other countries the same insistence on a particular form of government or objection to political

change is by no means essential to Catholicism. Men who are Catholics by creed wiU have also their political opinions Kke other men, with whom they will divide off into parties, differing among themselves; _ and again, like other men, may take action in accordance with their political opinions. But as Catholics they have no complaint against any government solidly established in their midst on account of its form, as monarchical or republican, but only if it attempts to penahze the practice of their ancient religion, or their endeavour to bring up their children in the same. When this is done, they find themselves in the necessity of choosing whether they wiU obey God or comply with the laws imposed on their country, and it is obvious on which side lies their con- scientious duty. On the other hand, where no attempt is made thus to interfere with their worship of God, there is no class of citizens on whose peaceful submission to their civil rulers greater reliance can be placed. The truth here stated is important, as explaining the contrasts between the Catholics and their respective governments in the three principal European countries.

In Great Britain, speaking generally, there is no longer a Catholic question, and the Catholics in consequence live in perfect contentment with the national institutions, and cause no anxiety to their rulers. In Ireland, indeed, there is dissatisfaction and agitation, but this is due partly to some serious religious grievances, but mainly to causes which are political and social, not religious.

In Germany, when the Pontificate of Leo XIII. began, a disastrous conflict between the Imperial Government and the Church was in progress. It was called the Kulturkampf, as professing to be undertaken on behalf of civilization and culture ; but it had originated in the belief, instilled into the Government by interested persons, that the Vatican Decrees on Infallibility were issued for a political purpose. The May Laws ⬛⬛⬛ so caUed because passed through the Eeichstag in May 1873 ⬛⬛⬛ besides suppressing the religious orders, gave the entire control over the education, appointments, and tenure of office of the clergy into the hands of the State : they for- bade also all disciplinary control over the clergy by any foreign ecclesiastical authority ⬛⬛⬛ in other words, by the Holy See. Compliance with such laws as these would have meant

co-operation in a speedy conversion of German Catholicism into a schism and a heresy. The Catholics had therefore no other course left open to them save to continue as best they could their own system under the rule of the Holy See, and offer to the May Laws a resolute and as far as possible an organized passive re- sistance. This they did with the aid of the Centre or Catholic party in the Eeichstag, but the consequences to themselves were terrible. Before many years were over five bishops, together with numbers of their clergy, were in prison, whilst several sees were vacant, and innumerable parishes left without other pastors than the few priests who went about in secret. At length it became evident even to the authors of the Kulturkampf that the effects of their campaign were the exact opposite of what they had desired : that they, by alienating a perfectly peace- ful section of its subjects, were weakening instead of

strengthening the bonds of the empire, and that this result was the more sad as they had been entirely misled as to the character of the Vatican Decrees, and were fighting against a purely imaginary danger. Thus by the time Leo XIII. came to the throne an opportunity had been created which, with his diplomatic instincts, he did not fail to perceive and use. In announcing his election to the German Emperor he took occasion to hope that the peace which had formerly prevailed throughout the empire between the Church and the Government might before long be restored ; and in another letter to the Archbishop of Cologne he expressed his intention of working for that happy end to the extent of his power. The friendly overtures were received in a corresponding spirit ; and although nothing was altered at the time, the rapproche- ment grew, and by 1886 had led to the withdrawal of the more obnoxious clauses of the May Laws, though some still remain. The consequences have been seen proportion- ately in the revived attachment of the Catholics for the empire and its rulers. It would, however, be an error to suppose that all traces of unfairness to this portion of the German people have been removed.

Whilst in Germany the relations oetween the Church and the State improved, in France they went from bad to worse, and all because the ruling party had not learnt the lesson taught it by the two neigh- bouring kingdoms. It was the Second Republic, and the Third Republic in its earlier stage, which conceded to the French Catholics their most valuable rights and liberties ; and had the same tolerant spirit continued, probably the republican form of government would have been in general favour among them. But in 1879 the anti-religious party came into power, and the governmental principle which Gambetta had proclaimed shortly before was henceforth to prevail ??? "Ze ClA-icalisme voild rennemi." The Ferry Ministry, which was under his domination, brought before the Chambers in 1879 two Bills framed with the express purpose of rendering impossible the Catholic education of the young. Of these the first and most important, besides suppressing the charters of the recently established and flourishing Catholic universities, declared all members of religious congregations unauthorized by the State incapable of giving public or even private education of any kind ??? a declaration aimed chiefly at the Jesuits, who had numer- ous schools throughout the country. The Senate refusing to pass the latter portion of the Bill, M. Jules Ferry re- solved to accomplish his purpose in a more arbitrary way. In March 1880 he issued two ministerial decrees to the same effect as the rejected Bills. By the first the Jesuits were ordered to quit all their houses within the space of three months ; and the other congregations of both sexes, under pain of incurring the same proscriptions, were ordered to apply vrithin six month for an authorization, which it was intended in most cases to refuse. That these measures were illegal was made manifest by the fact that more than five hundred magistrates gave up office rather than enforce them ; but they were none the less ruthlessly carried into effect, and the work of Catholic education was for the time in ruins. Gradually, however, thanks to the enormous energy of the French Catholics and the comparative tolerance of some of the cabinets which succeeded M. Ferry's, a tolerance due to the realiza- tion that the decrees had only proved sources of national division, the Catholic schools were re-established under lay proprietorship, but with staffs partly composed of members of the teaching congregations. Their numbers increased considerably, and they were preferred to the State schools by a grovping

number of parents, including those from whose political proclivities one would have least expected it. Hence the return of 1902 to the policy of

M. Ferry, but with the aid of laws much more drastic than his decrees. Side by side with these endeavours to withdraw secondary education from the influence of the Church went on the process of "laicizing" the primary schools, orphanages, hospitals, and other State institutions ??? that is, of substituting staffs of lay officials for the brothers and nuns of the different congregations to whose care they had been previously entrusted. This process could only be gradual, in proportion as lay teachers and nurses were obtainable to fill up so many posts, but by the end of the 19th century the transformation was practically complete. Other measures tending in the same direction were the imposition of military service on candidates for the priesthood, and the serious diminution of the budget for the maintenance of the bishops and parochial clergy, which budget, by the terms of the Concordat, the State had pledged itself to provide annually, in exchange for the Church property then made over to it at its desire. These assaults of its adversaries on the Catholic Church in France were aided by the political divisions in the Catholic party, split up into Legitimists, Orleanists, Bonapartists, and Eepublicans, and thereby rendered incapable of any sustained action on a common principle. The evil seems to have been a matter of concern to Leo XIII. from the beginning of his Pontificate, and in February 1892 he wrote his famous Encyclical to the French People, exhorting them to lay aside political aims, over which they are so much at variance, and accept the form of government under which they were actually living, a form which in itself was not unlawful or incom- patible with their religion on the one hand or with national progress on the other. He bade them unite to form a Catholic party on this basis, and use their consti- tutional rights to work for the restoration of their religious liberties and the pacification of their country. He ad- dressed himself "not only to the Catholics, but to all upright and reasonable Frenchmen," appealing to them on the ground that only thus could domestic peace return to the nation under a durable social bond. The pohcy recommended in this Papal letter was not without its influence on the course of the religious movement in France. It was resented, indeed, in some circles, but was accepted and obeyed by the bishops and clergy gen- erally, and gradually made its way among the

CathoUc body. The future alone can reveal to us whether it is destined to achieve a wider success ; but at least it bears witness that the Holy See will always do its best to remove all needless causes of strife, and may help to dispel the delusion that the free development of Catholic life and work is a danger, and not rather a support, to any Government which will leave it unharassed. On the other hand, it is writ large on the page of modern French history that a policy of religious persecution tends only to cleave a nation in two, by parting off its sons into hostile camps, to the great detriment of the national welfare.

A special feature of the history of the Pontificate of Leo XIII. is the series of Encyclicals by which that Pontiff endeavoured to guide Catholic thought on various subjects of importance. Among them Bacyall' the following have been the most notable : The ^Eterni Fatris of 1879, in which an impulse was given to philosophical study, and the philosophy of St Thomas of Aquinas was indicated as the basis on which it should rest; the Immortah Dei, of 1st November 1885, on the Constitution of Christian States, in which the teaching of catholic philosophy on the origin, character, and limits of civil government was expounded; the Libertas, of 20th June 1888, which distinguishes between true and false hberty; the Beruvi Kovanim, of 15th May 1891, in which the right of personal property is vindicated, and the respective

rights and duties of employers and employed are set forth; the Providentissimm Deus, of 18th November 1894, which encourages Biblical studies, and declares ???what it is necessary for a Catholic to hold about inspiration. With these Encyclicals may be counted the Letter, of 18th August 1883, addressed to Cardinals Luca, Pitra, and Hergenroether, on the importance of a solid study of Church history. They were to prepare the Vatican Library for the use of scholars of all nations, without distinction of religious belief. Important use has been made of this permission, and the different Governments sent their

representatives to search for documents bearing on the history of their respective countries. Of Leo XIII. 's letters of an administrative character three may be mentioned as having attracted much attention. The Romanos Pontiflces, of 9th May 1881, settled within what limits the religious communities should henceforth be exempt from, or subject to, the jurisdiction of the bishops. It was originally issued to terminate certain controversies which had arisen in England, but has since been extended to other countries where the Church is similarly on a missionary footing. The Officiorum, et Munerum, of 22nd February 1897, recast the Eules of the Index, with a view to adapting them better to the condi- tions of the modern period. The Testen BenevolenticB, of 22nd January 1899, condemned a set of opinions which, having been advocated chiefly in America, had most unfortunately and inappropriately come to be called Americanism. Another class of Apostolic Letters was inspired by Leo XIII. 's ardent wish for the reunion of Christendom. In 1894, on 2nd July, appeared the Prce- clara Gratulationis, addressed to " the rulers and nations of the world." It was universal in its scope, but contained an urgent appeal to the Orientals, exhorting them to desire and work for the reconciliation of East and West. It was followed shortly afterwards by the establishment of a Roman Commission "for the reunion of Christendom," which was to sit regularly and work for that end. It was followed also in the same year by the Orientalium dignitas, or ApostoUc Constitution for the Eastern Churches, which sought to remove the false impression that submission to the Holy See meant the abandonment of the ancient Eastern rites for those of the Latin Church. With this end in view it enforced the restrictions even previously enjoined, which compelled converts from the Eastern schismatic communions to attach themselves to corresponding Uniat Churches, and use their rites only. Shortly after the Prmdara Gratulationis, namely, on 14th April 1895, appeared the Letter ad Anglos. It was likewise an appeal to work for reunion, and was intended to remove any impression which might exist that the Pope was animated by other than cordial and sympathetic feelings for English Protestants. This letter was suc- ceeded on 29th June 1896 by the Satis cognitum, an exposition of the grounds on which the Holy See bases its duty of claiming supreme jurisdiction over the Church ; and on 13th September 1896 by the Bull Apostolicce Curos. The latter was the outcome of a fresh inquiry into the validity of Anglican orders,

which Leo XIII. had insti- tuted to satisfy the desire of those who thought that previous inquiries had not been thorough enough to com- mand confidence. This Bull declared the orders in ques- tion to be altogether null and void.i

Catholicism m England. The Clergy- -On the accession of Queen Elizabeth a considerable portion of the clergy and people conformed to the new laws concerning Roman CathoHcism, but the

‘ See also the article Auqlioan Oedees.

bishops, with the exceptions of Kitchin of Llandaff, Stanley of Sodor and Man, some 180 or more of the “dignified clergy,” and an unknown number of the lower clergy, remained steadfast in the old faith and refused to take the oath of supremacy. Accordingly, the bishops were all at once dispossessed of their sees, and either imprisoned or placed under detention. The clergy likewise were gradu- ally removed from their benefices. Thus the old machinery for ecclesiastical administration was destroyed, and the faithful found themselves without regular pastors. A portion, however,, of the dispossessed priests contrived to live in concealment, and minister as best they could to the spiritual wants of those whom they could reach. Dodd says of them in his History (vol. ii. p. 141) ”There was not a province through all England where several of Queen Mary’s clergy did not reside, and were commonly called the old priests. They served as chaplains in private families. Their names and residences I have frequently met with in the manuscripts in composing this work. Again, several Catholic clergymen found such friends as to be permitted to enjoy sinecures, without being disturbed by oaths and injunctions.” But these ” old priests ” must die out soon, and the old faith with them, unless new arrangements could be made for a continuous supply to take up and extend their work. The need was fore- seen, and the ” foreign seminaries ” were established to provide for it. These were Douay College, founded by Dr (later Cardinal) Allen in 1568 ; the English College at Rome, remodelled for the purpose in 1576 ; St Alban’s College, Valladolid, founded in 1589; and the establish- ments founded shortly after at Seville and Lisbon. Thither resorted young men of zeal and capacity to receive their ecclesiastical education, who were

afterwards sent back as missionaries to their own countrymen. In distinction to the Marian clergy, they were called the ” seminary priests,” and were a special object of aversion to the Government, which had been counting on the inevitable extinction before long of the Marian clergy. Accordingly, it was made a capital offence for them to enter the country, and likewise for any person to harbour them under his roof for a night. Nevertheless they braved the danger, and came over regularly in yearly detachments, until by 1596 we learn, from a letter of Father Holt, there were about three hundred of them at work in the country. Many of them, however, paid the price of their zeal, suffering long and painful imprisonments not unaccom- panied by the apphcation of torture, whilst nearly two hundred shed their blood for their faith on the scaffold. . The seminary priests were secular clergy, but they were supplemented in their work by members of two of the religious orders, the Jesuits and Benedictines, The Jesuits began to come in 1580, when Parsons and Campion were sent over, to be followed by regular supplies, which continued aU through. At the beginning of the 16th century the Benedictines were also coming ⍰⍰⍰that is to saj’, the Benedictines from abroad, who by this time were provided with some English subjects. The old English congregation of this order had died out with the Marian priests, except that there was just one former monk of Westminster, Father Sigebert Buckley, still surviving, who in 1607 admitted to profession twelve English- speaking Benedictines from abroad, and thus preserved the unbroken continuity of that congregation up to the present day. Some others of the reUgious orders ap- peared in small numbers, but took no part in the per- manent missionary work of the country tiU much later. Still, some insight into the ultimate proportions between the different sections of the clergy may be had from the report to Propaganda of the Vicars – Apostolic towards the close of the period of the Penal Laws. According

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to these reports, in 1773 there were then on the mission in England "121 Jesuits, 44 Benedictines, 37 Franciscans, 8 Dominicans, 7 regulars of other orders, and 175 secular priests." Besides the clergy actually working in the country, there were others belonging to the same categories retained on the Continent to carry on the schools there established for the education of youth, schools for them in England being forbidden under heavy penalties. Of these schools, one was at Douay in connexion with the seminary, and under the charge of the secular clergy; another, under the charge of the Jesuits, was at Saint Omer ; and there were also estabhshments under the charge of the Benedictines at Douay, Paris, and Dieulwart. Men- tion should also be made of the English convents for Englishwomen wishing to lead the life of nuns, some of which also received young girls for their education. Such were the Bridgettines of Lisbon (the lineal representatives of the nuns of Sion House, Isleworth, who went into exile at the accession of Elizabeth) ; the Benedictines at Brussels, Cambrai, and Ghent ; the Poor Clares at Gravelines ; the Franciscans at Nieuport and Bruges ; the Carmelites at Antwerp ; the Sepulchrines at Li^ge ; and the Augustians at Louvain. An effect of the French Eevolution was to send all these houses of prayer and education back to England, where now they all have their representatives.

Ecclesiastical Administration. ??? The principle of autho- rity pervades the Catholic system, and it would be accounted impossible for the clergy to engage in missionary work except in so far as they were commissioned and supervised by a competent ecclesiastical superior. When, therefore, the older system of administration broke down through the dispossession of the Marian bishops and those who held under them, it was necessary for the Holy See to substitute some other arrangement. The first measure of reconstruction was the granting of apostolic faculties (that is, faculties issued directly by the Apostolic See) to Drs Harding and Sander by Pius V. in 1566. These in- cluded the power to subdelegate ; and a similar power was granted to de Qaadra, the Spanish ambassador, who was a bishop. When Douay College was founded, Dr Allen was empowered by the Holy See to grant missionary faculties for the whole of England to the priests sent forth from the college. The next step in the development of the post-Reformation administration was the appointment in 1599 of an archpriest to reside in the country and exercise jurisdiction

over the secular clergy, the regulars being still left under their ovra superiors for this purpose. As this arrangement curtailed the liberty of action which the seminary priests had till then enjoyed, it was not received without protest, and led to the "Archpriest controversy." George Blackwell, the first archpriest, was succeeded in that office by George Birkhead and William Harrison, the latter of whom died in May 1611. It was felt to be a great misfortune that the ruler of the missionary clergy should not be in episcopal orders ; but the rigour of the persecution had hitherto made that appear impracticable, as a bishop would have been specially watched, and could not have hoped to avoid a speedy capture, as also to draw down a still fiercer persecution on the rest. On the death of Harrison, however, it was thought safe to make a further advance. The marriage of Prince Charles with the Catholic princess, Henrietta Maria, led to negotiations with the French Court, which insisted as a condition of the marriage that some relief from persecution should be extended to the English Catholics. Nothing definite was indeed settled, but advantage was taken by the Holy See of the passing disposition to mitigate the enforcement of the existing laws, and Dr William Bishop was appointed Vicar-Apostolic with episcopal orders. This prelate died almost immediately, but was succeeded by Dr William

Smith, appointed, like his predecessor, titular Bishop of Chalcedon and Vicar-Apostolic over the whole of England. Bishop Smith's tenure of office was very brief. He be- came involved in what came to be called after him the " Bishop of Chalcedon controversy," over the question of the apostolic faculties of the regular clergy. As this drew attention to his presence in the country, he had to fly across the Channel, and took up his abode in Paris, where he remained till his death in 1665. He had also incurred the displeasure of the Pope by the position he had taken up in the aforesaid controversy, and was deprived of his office of Vicar-Apostolic. After -him, and until 1685, the government of the clergy on the English mission was assumed by the Chapter, a body instituted by the first Vicar-Apostolic immediately after his own appointment. Their action in thus assuming to rule over the clergy was based on the common law of the Church, which entrusts the government of a diocese during the time of vacancy to the cathedral chapter ; but as a Vicar- Apostolic has no right to a chapter, and the Holy See had never given the necessary formal

approval to this English Chapter, the state of things ensuing was irregular, and amounted to a sort of anarchy. Three Papal envoys were sent over during the reign of Charles I. ??? Panzani, Con, and Rosetti ??? to reduce matters to order again. They were accredited to Queen Henrietta Maria, and probably would have succeeded in their task, only that the great EebeUion then broke out, during which nothing further could be done. After the Restoration, Monsignor Airoldi, the Papal Nuncio at Brussels, was sent over to resume the work, being accredited to Queen Catherine of Braganza ; but nothing was accomphshed till the reign of James II. James at once opened negotiations with Innocent XL, which led to the appointment of a new Vicar-Apostohc, Dr Leyburn, who was consecrated on 9th September 1685. He was appointed in the first instance, like his predecessors. Vicar- Apostolic over the whole country ; but the area was too large for one man, and was divided in 1687 into two districts, and again in the following year into four, called respectively the London, the Midland, the Northern, and the Western districts. This arrange- ment was able to persist in spite of the renewal of per- secution after the Revolution, and continued into the 19th century. In 1840 the growing needs of the Catholic body made necessary the subdivision of the four vicariates into eight, but even this was intended only as a temporary measure. Vicars-Apostolic are delegates of the Pope. Their indefinite powers are most suitable for regions where the Church is on a missionary footing, but they are not bound to their flocks by the same intimate ties as bishops in ordinary, and cannot become such effectual centres of pastoral work. Hence it is that there had been for some time a movement among the English Catholics for a restoration of the hierarchy, that is, of bishops in ordinary set over dioceses of their own, and formed into an ecclesiastical province under an arch- bishop. Probably the Holy See would have granted this sooner, only that it was most anxious to avoid offending English susceptibilities ; and probably it would have de- layed the measure still longer, could it have foreseen the fierce outburst of bigotry which it occasioned ??? contrary to the assurances received from English statesmen that the Government would view the matter with indifference. But it was well that it came when it did, for it was sadly wanted, and the English people soon discovered that it was a measure without political significance of any kind, but merely an arrangement for the better regulation and development of their spiritual life among the

adherents of the ancient faith. The Bull Universalis Ecclesice, restor- ing the hierarchy, was dated 29th September 1850. It

mapped out the country into twelve dioceses, a number which has since been increased by subdivision to fifteen. Care was taken in the selection of the sees to avoid all the names held at the time by the Anglican bishops, and in this desire the seat of the archbishop was placed at Westminster, not London. To give more impressiveness to the new order, a cardinal, Dr Wiseman, was appointed to be the first Archbishop of Westminster, and the pre- cedent has been followed in the case of his two successors.

Statistics. ???At the beginning of the reign of Elizabeth, even after her first penal laws had begun to tell, the adherents of the old faith were roughly estimated at about half the population of the country. By the end of her reign her repressive policy had achieved a practical success. There are no means of arriving at any figures, but it may be near the mark to conjecture that the Catholics then formed one-tenth of the whole. In the 17th century they continued to decrease, the persecu- tions following on the Gunpowder Plot and the Great Rebellion being specially disastrous to them. They in- creased again under James II., but the more skilfully contrived penal laws of William and Mary caused them to undergo another considerable fall. By the third quarter of the 18th century this fall had reached its ebb. A return to the House of Lords in 1780 gave the total number for England and Wales as 69,376, but this must have been a serious understatement. At all events, the turn of the tide began soon after, for Bishop William Gibson, who in 1819 computed the Lancashire CathoUcs alone at 50,000, stated that "within the last thirteen or fourteen years the mass of Catholics has been very great, in consequence of the abolition of the penal laws " ; he means by the Acts of 1788 and 1791. During the 19th century, under the reign of tolerance introduced by the Emancipation Act of 1827, the number rose consider- ably, and is set down in the Catholic Director^/ for 1901 as about a million and a half.

The contributory factors to this increase are (1) the natural growth of population, (2) the Irish immigration, and (3) the converts. The Irish immigration dates back in some measure to the end of the 18th century, but assumed large dimensions after the great famine of 1845. It was soon, however, super- seded by emigration to the United States and the colonies, an emigration which drew off many of those who had previously immigrated into England. It is these Irish immigrants and their descendants who form the mass of the Catholic poor, particularly in the large towns, although this class has its numerous representatives of English birth in north Lancashire, as well as sprinklings in other parts of the country. In the upper and middle classes, in which, however, the absolute numbers are small, the English element probably predominates over the Irish, a fact largely due to the influx of converts during the last fifty years. As each reception of a convert is entered in the register of the church where it takes place, the means exist of computing their number with exactness. The average thus established during the later years of the 19th century was between eight and nine thousand a year. For the past it is more difficult to say, but in 1837, before the Oxford Movement began to influence the figures, we find Bishop Griffiths reporting to the Holy See that "last year 518 Protestants were converted to the Cathohc faith in the London district," i.e., in London and the home counties.

Against the growth of the Catholic population through the above-mentioned causes has to be set what is usually called the "leakage." This is a subject which has engaged much attention. Apart from neglected children who are picked up by Protestant institutions, there are apparently few CathoHcs who pass over to the religious

practices of other denominations. But the number of those who neglect the practice of their own rehgion, and lapse into an indilferentism which either in themselves or their children tends to become permanent, must be very considerable, and perhaps balances, or even more than balances, the accessions to the Cathohc population from other causes. This conclusion is estabHshed partly by actual observation, partly by inference from the number of baptisms and marriages^ For the particulars on this point see Morris's Catholic England in Modern Times and Mr Britten's Catholic Truth Society's tract entitled The Leakage. The causes of the leakage are

not difficult to recognize. The prevalent tone of thought and hterature, so anti-dogmatic and agnostic, accounts for much. So too does the want of earnestness about their eternal destiny, which is to be expected in a proportion of the adherents of every religion, and naturally disposes them to abandon a rehgion whose tenets are disliked by the majority in the country where they hve. But the most potent cause of all is the absence of proper parental control over the children of the poor in the period of life following on their school- days, an absence largely due to parental neglect, but largely also to the difficulty of exercising such control under the conditions of modern labour.

Catholic Institutions. ??? The growth of Catholic churches, chapels, and institutions since the establishment of the hierarchy has been very striking. In 1851 there were 826 priests and 586 churches in England and Wales ; in 1880 there were 1962 priests and 1175 churches in the same area; in 1901 there were 2837 priests and 1536 churches. Some, too, of these churches are really fine buildings, as St George's Cathedral, Southwark; the Brompton Oratory ; the Dominican Church at Haverstock Hill; the churches at Arundel, Norwich, and Cambridge. The Westminster Cathedral is recognized as destined to rank among the architectural monuments of London. Besides the growth in clergy and churches is the increase in colleges, monasteries, and convents. In 1851 there were only 12 monasteries and some 40 or 50 convents, most of which were in their infancy. Now there are some 80 monasteries, and convents innumerable, some 150 of which latter are engaged in the work of teaching. The number of colleges has also received accessions, whilst the few which are in the first rank have developed to considerable proportions. Some of these latter, as St Edmund's (Old HaU, Herts), Ushaw, and Stonyhurst, have already kept the centenaries of their abode on English soil, on the occasion of which some interesting books were written containing valuable information for the historical inquirer. It would have been impossible for a body so small and poor as the Catholics in England to provide for the educational needs of their children of the poorer class without aid from the pubhc funds. Accordingly, since 1848, when the opportunity was first ofi'ered, the Catholic elementary schools have taken their place among the voluntary schools under Government. A great develop- ment has followed. In 1849 there were 89 schools, con-

taining 8445 children, under Government inspection. By 1884 their numbers had grown to 828 schools and 169,115 children in average attendance, and by 1900 to 1049 schools and an average attendance of 251,768 children. The certificated teachers during the same interval grew from nil in 1848 to 2409 in 1886, and 2732 in 1900. To keep up the supply of these teachers there are three training colleges, one at Hammersmith for the male teachers, and two at Mount Pleasant, Liverpool, and West Hill, Wandsworth, for female teachers, to which another has been added at Glasgow for the female teachers in Scottish schools. A joint pastoral of the Catholic bishops in 1898 states that the Government grants earned by the

out by Propaganda to a variety of missionary agencies or religious orders. The government of the various mission- fields is generally carried on by " Vicars- Apostolic " (i.e., titular bishops acting as vicars or delegates of the Apostolic See) or " Prefects- Apostolic " (i.e., priests with similar powers, but without episcopal rank). In some few cases (notably India and Japan) a regular territorial hierarchy has been established, just as in the United Kingdom and the Netherlands. Of the religious societies engaged in the evangelizalsion of these many fields of labour, some have been established exclusively for foreign missionary work among the heathen ❓❓❓ notably the famous Soci^t^ des Missions Etrangeres of Paris, the oldest and greatest of all (dating from 1658, and consisting of 34 bishops, 1099 European missionaxies, and 598 native priests); the German " Society of the Divina Word," whose head- quarters are at Steyl in Holland; the Belgian Society of Scheat; the celebrated French Society of the "White Fathers," founded by the late Cardinal Lavigerie for African missions; the English Society of St Joseph, founded at Mill HiU by Cardinal Vaughan; and some others. The other missions are entrusted to the care of various religious orders and congregations, wliich take up foreign missionary work in addition to their labours in Christian countries. Such are the Franciscans, Domin- icans, Jesuits, Lazarists, Augustinians, Marists, &c. Besides the above orders of priests, an

immense number of religious societies of women are engaged in works of education and charity throughout the whole of the foreign mission field. These have been reckoned at about 42,000 Europeaa and 10,000 native sisters. Again, there are some 20 congregations of " Brothers " (not priests) engaged in teaching, and numbering some 4500 members.

Turning now to the individual fields of labour under the care of Propaganda, we may briefly summarize the latest information as follows : ??? ???

Catholic schools in 1897 amounted to ??391,107, and the Government grants earned since 1848 to ??6,013,513; also, that "between 1863 and 1895 the Catholic voluntary schools had subscribed (see Blue-books) ??1,520,000; between 1870 and 1896, Catholics had spent on school premises (part of which is still owing) ??1,850,000 ; whilst expenses on schools not under Government, or incurred before 1863, are estimated at over ??1,000,000." And the bishops add that "if to the'sum ??4,370,000 (the sum total of the items just set down) be added the amount of school pence paid by parents of children in Catholic schools (??1,480,000), it will be found that the total con- tributed by Catholics towards public elementary educa- tion has been in reality much larger than the amount received in grants." It was not without a severe strain that the Catholic community supplied these sums; and besides them, there has been the expense of the training colleges, the condition of Government aid as regards which has been that the buildings and 25 per cent, of the cost of maintenance shall be provided by voluntary contributions. In connexion with Catholic elementary schools mention should be made of the Catholic School Committee, formed of priests and laymen representing the difierent dioceses. This was founded by the bishops in 1847, and has rendered invaluable service ever since. To it belongs the duty of maintaining and managing the training colleges, of making representations to the Education Office on questions that arise from time to time, of carrying out a system of religious inspection, and generally of unifjdng the action of all engaged in the work of the elementary schools. Besides elementary schools, it has been necessary to provide charitable institutions of various kinds ??? poor law schools, indus- trial schools, homes for destitute children, homes for penitents,

homes for the sick and aged, nursing institu- tions, &c. A list of these may be found in the Catholic Directory, pubhshed annually, and a comparison of the current number with that for 1884 will show that during the interval good progress has been made. None the less, it is keenly felt by all Catholic workers how inadequate the existing supply is to meet the almost overwhelming demand. Further particulars as to these institutions may be learnt from the Catholic Truth Society's Handbook of Catholic Charities.

FoEEiGN Missions.

The foreign missionary work of the Catholic Church has never been carried on with such a system of organ- ization and on so large a scale as during the latter part of the 19th century. As regards organization, the whole of the foreign missions are placed under the supreme control of a central " Congregation," a kind of ministry or board, well known as "Propaganda" (Sacra Congre- gatio de Propaganda Fide), established by Gregory XV. in 1622, This important Congregation has been described as corresponding pretty much in the Catholic Church to the Colonial Office in the British Empire, and its head, the "Prefect of Propaganda," to the Secretary of State for the Colonies. It holds supreme control over all the foreign missions vn heathen countries, and also over large and important parts of the Church in Christian countries whose Governments are not Catholic ??? including the British Empire, the United States, Holland, the Norse kingdoms, Greece, and some parts of Germany and Switzerland. A special section (erected by Pius IX.) has charge of the afi'airs of all the Oriental Kites in union with the Eoman See. Confining our attention at present to the missions strictly understood under " foreign," i.e., to heathen or non-Christian countries, we shall find the whole of these parts of the globe carefully mapped and parcelled

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Africa . Asia ???

61

649

1,000

1,027

1660

231

463,824

India and Cey-> Ion , . j”

35

4,756

J826Europ.1 (1680 Nat.)

2662

162

2,005,925

Farther India &) Indo-China f

14

2,566

isSOEurop.) (363 Nat.)

1762

143

783,237

Chinese Empire, Japan, and Korea

45

3,218

(SlOEurop.) 1385 Nat.)

2842

86

651,165

Turkey, Pe-rsia,

Arabia

9

105

216

424?

62S

138,830

East Indian Is-

lands

2

116

62

60

17

60,280

A merica ???

British North

America .

32

2,716

2,763

6716

132

2,187,480

United States .

87

10,922

10,049

6022

648

9,479,230

West Indies

4

162

119

120

..

256,200

Central and S.

America l

7

120

131

161

11

182,600

Australasia .

27

4G5

1,394

930

769

73

793,216

Oceanic Islands .

9

128

166

184

166

13

60,868

Other Pacific Is-

lands a

4

199

61

66

3

134,800

Europe ???

Sweden and Nor-

way .

2

17

25

34

27

10

2,760

Denmark (and

Iceland) .

1

18

33

40

28

7

7,000

Germany 3 .

5

128

138

87

207,180

Holland and Lux-

emburg .

6

1268

1,826

3,168

1468

1,864,340

Balkan Peninsula

18

684

890

332

30

686,210

Greece and Crete

9

195

116

78

8

36.310

Gibraltar 4 . . 1

“2

8

12

14

4

16,300

1 Only British, French, and Dutch Guiana, British Honduras, Pati^onia, and Lower California.

2 Carolines, Marquesas, Hawaii, Otaheite.

3 Embracingr Anhalt, some North German Duchies, Hanse Towns, &c., Schleswig-Holstein, Saxony, Lansitz.

**** Malta is not under Propaganda,*

FOREIGN MISSIONS] ROMAN CATHOLIC CHURCH

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*FoKEiGN Missionary Societies and their Fields of Work.^ I. SocUti des Missions **traugires (Paris, 1658). *** Missions: Manchuria, Korea, Tibet, Japan, China (Sze-Uhuen, Kui-Chow, Kwang-tong, Yunnan), Indo-China (W., S., and Upper Tongking, E., W., and N. Cochin-China ; Cambodia, Siam), Malay Peninsula, Burma (S. and N.), S. India (dioceses of Pondicherry, Korabakonam, Mysore, Coimbatore). Staff: 34 bishops, 1099 European mis- sionaries, 598 native priests. Catholic fiock : 1,227,161. II. Society of ” White Fathers ” (founded by Cardinal Lavigerie, 1868). *** Missions : Algeria, Sahara, Nyasa, Victoria Hyanza, Tanganyika, Unyanyembe, Upper Congo. Staff: 9 bishops, about 150 missionaries.*

III. I/yons Seminary for Foreign Missions (1856). ❖❖❖ Missions:

Nile Delta, Benin, Ivory Coast, Gold Coast, Dahomey, Upper Niger. Staff': 58 missionaries.

IV. Congregation of the Holy Ghost (1703 and 1848). ❖❖❖ Missions:

Senegambia, Gambia, Sierra Leone, Lower Niger, Gaboon, French Congo, Lower Congo, Mayotte, Nossib^, and Comoro Islands. Staff : 311 missionaries (9 bishops). V. Milan Seminary for Foreign Missions (1850). ❖❖❖ Missions: China (Hong Kong, W. and S. Ho-nan), East Burma, India (dioceses of Kishnagar and Haidarabad). Staff: 59 missionaries (7 bishops).

VI. Steyl Society of Foreign Missions (German, 1875). ❖❖❖ Missions:

S. Shan-tung, China ; Togo, W. Africa. Staff: 1 bishop, 213 missionary priests, 555 lay brothers.

VII. Scheat Society of Foreign Missions (Belgian, 1863). ❖❖❖

Missions: Mongolia, Kang-Su (China), Belgian Congo. Staff: 4 bishops, 61 missionaries. VIII. Picputian Society^ (Paris, 1817). ❖❖❖ Missions: Hawaii, Tahiti, Marquesas Islands. Staff: 3 bishops, 50 mis- sionaries. IX. Mill Sill Society (English, 1866). ❖❖❖ Missions: N. Borneo and Labuan ; N. Punjab, Kashmir ; and Ladak ; Telugu missions of Madras ; Maori missions of N. New Zealand ; N. Uganda. Staff: 1 bishop, about 100 missionaries. X. Congregation of the Sacred Heart (Issoudun, France, 1 855). ❖❖❖ Missions : New Guinea, New Pomerania, Gilbert Islands. Staff: 3 bishops, 34 missionary priests, 38 lay brothers. XI. Society of the Divine Saviour (Rome, 1881). ❖❖❖ Mission: Assam. Staff: 10 missionary priests, 3 lay brothers. XII. Verona Society for African Missions. ❖❖❖ Mission : The Sudan, Upper Egypt. Staff: 12 missionaries (1 bishop).

The following societies are engaged in home as well as foreign missions : ❖❖❖

XIII. iferis^s (French, 1816). ⬛⬛⬛ Missions: Fiji, Navigator's Island,

New Caledonia, Central Oceania, Solomon Islands, parts of New Zealand (dioceses of Wellington and Christ- church). Staff: 6 bishops, 130 missionaries.

XIV. Lazarists (founded by St Vincent de Paul, 17th century).

⬛⬛⬛ Missions: Abyssinia, Persia, China (Peking or N. Chih-li, S.-W Chih-li, Kiang-si, Che-Kiang), S. Mada- gascar. Staff:. 226 missionaries (9 bishops). XV. Dilates of Mary Immaculate (1840). ⬛⬛⬛ Missions: Ceylon (nearly all), S. Africa (Basutoland, Natal, Transvaal, Orange River Colony), the "Great North-West" of Canada (Athabasca-Mackenzie, Saskatchewan, St Boni- face, New Westminster). Staff: 270 missionaries (9 bishops). XVI, Salesians (founded by Don Bosco). ⬛⬛⬛ Missions: Patagonia and Tierra del Fuego, Falkland Islands, Indians of S. America (Ecuador, Brazil, Argentine) ; some missions in Palestine. XVII. Pallottines. ⬛⬛⬛ Missions: Cameroon, W. Africa; Australia

(Beagle Bay, native settlement). XVIII. Jesuits. ⬛⬛⬛ Missions: India (dioceses of Bombay, Poena, Calcutta, Madura, Mangalore, Trichinopoly), Ceylon (dioceses of Galle and Trincomalee), China (Kiang-nan, S.-E. Chih-li), Madagascar, Koango (W. Africa), Zam- bezia, Jamaica, British Guiana, British Honduras, Alaska. Staff: 800 missionaries, of whom 460 are priests. XIX. Dominicans. ⬛⬛⬛ Missions: Asiatic Turkey (Mosul), Tongking (N., E., and Central), China (Amoy, Fokien), Cura9ao, Trinidad. XX. Franciscans. ⬛⬛⬛ Missions: Egypt, Tripoli, Morocco, China (N. and S. Shan-si, N. and E. Shan-tung, N. Shen-si, E., N.-W., and S.-W. Hu-pe). Capuchins: Aden and Arabia, India (dioceses of Agra, Allahabad, Lahore), Seychelles, Eritrea (Red Sea), Gallas, Cephalonia, Trebi- zond, Mardin, Crete, Caroline Islands, Araucania, Brazil, Bulgaria. Conventuals: Jassy (Rumania).

1 Many statistics only up to 1890.

2 Father Damien belonged to this society, which talces its popular name from the Kue de Picpus, Paris.

XXI. Benedictines. ◆◆◆ Missions: Ceylon (diocese of Kandy), New Zealand (diocese of Auckland), N. American Indians (Indian Territory and Oklahoma), Australian natives (New Nursia). XXII. Trappists. ◆◆◆ Missions: Settlements in Natal (MarianhiU), West Africa (Congo), China, Japan.

XXIII. Augustinians. ◆◆◆ Missions- Philippines,' China (N.Hu-nan),

Balkan Peninsula, Asia Minor (" Assumptionists ").

XXIV. Carmelites. ◆◆◆ Missions: Bagdad, India (dioceses of Verapoly

and QuHon). XXV. liedemjjtorists. ◆◆◆ Missions: Dutch Guiana. XXVI. Passionists. ◆◆◆ Missions: Bulgaria (diocese of Nicopolis).

Societies for the Support of Foreign Missions.

Society of the Propagation of the Faith (est. in Lyons, 1822). Eeceipts, 1822-31 ◆◆72,000

1862-61 1,100,000

1882-91 2,604,000

Total in 70 years, 1822-1892, ◆◆10,714,000 (of which sum France contributed ◆◆3,000,000). Society of the Holy Childhood (est. 1843 as auxiliary to the former ; "children for children ").

Receipts, 1843-91, ◆◆3,336,000 (of which France contributed ◆◆1,500,000),

fTwA. ◆◆◆ Supports 624 orphanages, 3022 schools, 332 work- shops, 167 farms, 837 dispensaries ; educates 146,000 children. Number of children subscribers (Jd, a month), about five millions. Society of the Schools of the East (est. 1855).

Smaller and special societies attached to each of the missionary congregations and societies.

Authorities. ◆◆◆ I. For General Beference. ◆◆◆ The latest and most comprehensive dictionary is the second edition of Wetzer und Wette's Kirchenlexikon (edit. Hergenrother and Kaulen, 1882, &c., Freiburg in B. Herder). Taken together with the Staatslexikon (same publishers), this work, when completed, will supersede the first edition (1847-1860), of which there is a French translation (edit. I. Goschler, 1870). ◆◆◆ Migne's ample Encydopedie Thiolo- gique, though partly antic^uated, contains much useful matter, The same may be said of Gaetano Moreki, Dizionario di Erudi- zione. Venice, 1840-1861; Index, 1875, 107 vols. ◆◆◆Addis and Arnold (and Soannell). A Catholic Dictionary. London, Kegan Paul, 1884, 1893, 1897.

II. On the Machmery of Modem Government at Borne, with allied Questions. ◆◆◆ 6. Goyan (and others). Ze Vatican. Paris, Firmin Didot, 1895. ◆◆◆ Ch. de T'Sbkolaes. Le Pape Lion XIII., sa vie, son action religieuse, politique, et sociale. Paris, Desclee, 1894. ◆◆◆ Bernard O'Reilly. Life of Leo XIII. London, Low,

1887.

III. Collections of Modem Papal Decrees. ◆◆◆ The best is the Analecta Juris Pontificii, 1855 to 1891, since 1893 called Analecta Ecclesiastica. Rome, Palazzo Cenci. The Constitutions, etc., of Pope Leo XIII., S. D. N. Leonis, PP. xiii., Allocationes, etc. Bruges, 1887-1894, 4 vols. ◆◆◆ Shorter English handbooks on this subject : W. Humphrey. Urbs et Orbis. London, Baker, 1899. ◆◆◆ W. H. Eyre, The Pope and the People. Leamington, Art and Book Co., 1895. ◆◆◆ Many valuable documents concerning the questions discussed at the Vatican Council: Acta et Decreta S. Conciliorum recentiorum, Colleciio Lacensis, vol. vii. Freiburg im B., Herder, 1890, in progress.

IV. English Catholic Periodicals, which report the decrees of Roman congregations, and discuss literary, educational, and legal questions : The Dublin Review (quarterly. Bums), The Month, (monthly, Longmans), The Tablet (London, weekly).

V. Catholicism in England since the Eeformation. ??? Joseph GlLLOW. Bibliographical Dictionary of the English Catholics. London, Burns, 1885-1895. In progress, goes to Met, 4 vols. On the general history of Catholicism in Great Britain, the amplest modern work is that of Alphons Bellesheim, Cardinal Allen und die Englishen Seminare (Mayence, Kirchheim, 1885), Katholische Kirche in Schottland (ibid. 1886), Katholische Kirche in Irland (ibid. 1890). His Catholic Church in Scotland has been translated and enlarged by D. 0. Hunter Blair, O.S.B. Edinburgh, Black- wood, 1887. ??? Charles Dodd (vere Hugh Tootell). Church History of England (1737, 3 vols , goes down to 1688). New edition 1839-1843, "with notes, additions, and continuation, by Rev. M. A. Tierney" (unfinished). ??? Butler, Charles. Historical Memoirs respecting the English, Irish, and Scottish Catholics. London, 1819, &c. ??? W. Mazierb Brady. Episcopal Succession in England, Scotland, and Ireland. Rome, Typ. della Pace, 1876, 3 vols. The last volume treats of the post -Reformation period exclusively. ??? T. F. Knox. The Douay Diaries. London, Nutt, 1878. Letters of Cardinal Allen. Ibid. 1882. ??? J Morris. Catholic England in Modem Times. London, Bums, 1892. ??? T.

s Not under Propaganda.

Mttepht. OathoUc Church in England during the Last Two Cen- turies. Ibid. 1892.

VI. Nineteenth Century. ??? W. J. Amhbbst. The History of Catholic Eman^ipaticm, 1771-1820. London, Kegan Paul, 1886, 2 vols. ??? F. C. HusENBETH. Life of John [Bishop] Milncr. Dublin, 1862. ??? W. Waed. Life and Times of Cardinal Wiseman. London, Longmans, 1897, 2 vols. W. O. Ward and the Oxford MovcTnent. Ibid. 1892. W. G. Ward and

the Catholic Sevival. Ibid. 1895. ◆◆◆ E. S. Pueoell. Life of Cardinal Manning. London, MaomDlan, 1895, 2 vols.

VII. Catholic Education. ◆◆◆ J. Geeaed. Stonyhurst College. Belfast, Ward, 1894. ◆◆◆ R. C. Laing. Ushaw College. Newcastle, Mawson, 1895. ◆◆◆ B. Waed. St Edmund's College, Old Hall. London, K. Paul, 1893. A chronicle of the strenuous efforts of Catholics to provide elementary schools is a desideratum, but much valuable information may be found in the annual Reports of the Catholic School Committee (London, 42 Gerrard Street), founded in 1847.

VIIL Catholic Sufferings under the Penal Laws. ◆◆◆ For general reference : R. Stanton. A Menology of England and Wales. With supplement, London, Burns, 1892. No part of Catholic history has been better explored than this. The principal modem writers are : T. E. Beidgett, A. Gasqitbt, A. Jbssopp, J. Moeeis, R. Simpson ; but Bishop Challonee's Missionary Priests (1741, &c.) still remains the classical work on this subject.

IX. Present State of English Catholics. ◆◆◆ The Catholic Directory. Annual, London, Burns. Handbook of Catholic Charities. London, Catholic Truth Soc., 1894. ◆◆◆ W. S. Lilly and J. E. P. Wallis. Manual of the Law especially affecting Catholics. London, Clowes, 1893. The addresses and papers read in the annual Conference of t?ie Catholic Truth Society. Reported in the CathoUo newspapers. The C.T.S., 21 Westminster Biidge Road, publications also deal briefly with most modern subjects.

X. Foreign Missions. ◆◆◆ Missiones Catholicce cura S. Congre-gationis de Propaganda Fide descriptce. Eomse, ex Typographia polyglotta S. C. de Prop. Fid. [official biennial publication]. ◆◆◆ Loitvet. Les Missions Catholigues au xinf. Siicle. Nouvelle Edition, 416 pp. Lyon, Bureau des Missions CathoKques, 14 Rue ds la Charity, 1900. ◆◆◆ Piglet. Les Missions Catholigues Franfaises au xisrf. Siicle, 6 vols. Paris, A. Colin, 5 Rue des M^zieres. ◆◆◆ 0. Weenbe. Atlas des Missions Catholigues. Tribony en Brisgan, Herder, 1886. Album des Missions Catholigues, 4 vols. Paris, Soci^te St Augustin, 1888.

Periodicals. ??? Les Missions Catholigues (weekly), publ. in Lyons, and corresponding monthly or weekly papers in Italian, German, Dutch, Spanish, Polish, Hungarian, and English. (The last-named is monthly, price 3d., published in London, 19 Henrietta Street, Strand, W.C.) Aniiales de la Propagation de la Foi (monthly), published in Lyons, with translations in nearly aU countries.

(^ H. E. V.) United States.

The history of Eoman Catholicism in the Nev? World begins with the Norse discoveries of Greenland and Vinland the Good. In the former the bishopric of Gardar was established in 1112, and extinguished only in 1492. To the latter (the coast of New England) the Northmen during the same period made "temporary visits for timber and peltries, or missionary voyages to evangeUze for a season the natives." Beyond these facts, the Norse sagas and chronicles contribute Kttle that is certain (cf. "The Norse Hierarchy in the United States," American Cath. Quart. Review, April 1890). Although a bishop was appointed by the Pope for the vaguely defined territory of Florida so early as 1528, the oldest Catholic community in what is now the United States dates from 1565, when the Spanish colony of St Augus- tine was founded. Hence the aboriginal tribes of the South were evangelized. In 1582 the missions of New Mexico were undertaken, and from 1601 Catholic mis- sionaries were at work along the Pacific coast, especi- ally in California. Early in the 17th century trading posts and mission centres were established on the coast of Maine, and during the same century French priests laboured zealously in northern New York, along the entire course of the Mississippi from Wisconsin to Louisiana, and around the Great Lakes. Their principal concern was for the savages, over whom they acquired an extraordinary influence. Political jealousies, human avarice, and treachery arrested the progress of most of their missions.

The foundation of the English colony of Maryland (1634) by the Catholic George Calvert (Lord Baltimore), and of Pennsylvania (1681) by the tolerant Quaker William Penn, first permitted the legal existence of Catholicism in English-speaking communities of the New World. It is from these centres that it spread during the 18th century. In 1784 the Kev.

John Carroll was appointed Prefect-Apostolic for the Catholics of the English colonies, hitherto dependent on the Vicar-Apostolic of London. In 1790 Father CarroU was made bishop of the see of Baltimore, and given charge of all Catholic interests in the United States. There were then about 30,000 CathoKcs in the land, of which number 16,000 were in Maryland and 7000 in Pennsylvania. In 1807 they had grown to 150,000, with 80 churches. In the follow- ing year Baltimore found itself the first metropolitan see of the United States, vsdth New York, Philadelphia, Boston, and Bardstovm as sufiragans.

The growth of the Catholic population by decades since 1820 was calculated by a competent historian, the late John GUmary Shea, as follows : ???

1820 .

244,500

1860 .

3,000,000

1830 . 1846 .

361,000

1870 .

. 4,685,000

. 1,000,000

1880 .

. 7,067,000

1850 .

. 1,726,470

1890 .

. 10,627,000

According to this ratio of increase, the Catholic popula- tion of the United States ought to have been in 1900 something over 14,000,000. Hoffmanns' Directory, how- ever, for that year puts it at 10,129,677. The reason of this discrepancy is found in the fact that absolutely trustworthy official figures of the Catholic population are not accessible. The main source of this growth has been immigration. Originally the Irish and the Germans furnished the greater quota^ Later, the French Canadians, Italians, Poles, and Bohemians added notably to the Catholic population ; an appreciable percentage of Oriental Catholics is also found ??? Greeks, Syrians, Armenians, &c. Natural increase, especially among the descendants of the first Catholic immigrants, and a certain percentage of conversions from Protestantism, are contributory sources. Being under the protection of the constitution, and enjoy- ing the advantages of the common law, Catholicism could not meet with any official opposition ; such few outbursts of fanaticism as there have been were but temporary or local, and did not represent the true feehngs of the great Protestant majority of the country.

As to the future of the Church in the United States, all Catholics feel, vsdth their latest historian, that "the Catholic Church is in accord with Christ's revelation, with American liberty, and is the strongest power for the preservation of the Republic from the new social dangers that threaten the United States as well as the whole civilized world. She has not grown, she cannot grow, so weak and old that she may not maintain what she has produced ??? Christian civilization."

Internally, Catholicism in the United States has been free from any noteworthy schisms or heresies that might impede its development ??? its doctrinal history offers nothing of importance. The discipline "" "^ differs little from that of the other Churches of aiscipiltte. Catholicism. The unity of doctrine, liturgy, and moral ideals is preserved by an intimate union with the see of Eome. The general canonical legislation of the Church, the legislation by papal rescript and the Con- gregation of the

Propaganda, the decisions of the Apos- tolic Delegation at Washington, and a certain amount of immemorial custom and practice, form the code that governs its domestic relations. Decennially each bishop of the United States is expected to pay a visit to Rome (Ad Limina Ajvatolorum), and to make a report of the

spiritual condition of religion within hia diocese. In addition, a system of synods provides for local unity among bishops, priests, and laity. Thus each diocese holds occasional synods, each province or body of bishops under a metropolitan holds provincial councils, while at greater intervals a plenary or national council is held. Of these last, three have taken place ??? their decrees, when approved at Rome, are binding on all Catholics in the United States.

In education the Catholic Church endeavours to keep abreast with the best. There were, according to Hoffmanns' (Milwaukee, 1900) Directory, 3811 parochial schools, in which 854,523 children of both sexes receive instruction. If to these be added the children in Catholic charitable institutions, the number reached is nearly one mUlion. There were 170 colleges for boys and 662 academies for girls. This system of education is crowned by the Catholic University of America at Washington, established by Leo XIII. and the American hierarchy, and endowed with all the privileges of the old pontifical universities of Europe. In addition, there are several other schools that rank as universities. The education of the clergy is provided for by seminaries. In 30 of these that are under episcopal direction there are 2630 students; in 79 that belong to religious orders, 1998 students are reckoned. The charitable institutions of the Church in the United States are very numerous. There are 251 orphan asylums, with 35,243 inmates. The other char- itable institutions are 827 in number, and include every form of public and private charity ; no diocese is without one or more such establishments. The actual govern- ment of the Catholic Church in the United States is represented by 1 cardinal, 14 archbishops, 77 bishops, 8660 diocesan clergymen under the sole and immediate direction of their bishops, 2976 members of religious

orders subject to episcopal supervision ⁂ in all, 11,636 clergymen. There are 6409 churches with resident priests, and 3930 mission churches ⁂ in all, 10,339, to which must be added 1723 chapels. Several hundred weekly publications are printed in English and in foreign tongues, to minister to the religious needs of the Catholic population. There exist also several literary and academ- ical magazines and reviews of a high order of merit.

The principal religious events since 1880 were the hold- ing of the Third Pfenary Council of Baltimore (1884), the Catholic Congress (1889), the opening of the Catholic University (1889), the Columbian Educational Exhibit at Chicago (1893), the establishment of the Apostolic Delegation at Washington (1893).

The Catholic Church in the United States conducts no foreign missions, but takes care of its ovra percentage of Indians and negroes. Of the Indian population of the United States about 90,000 are Catholics. They are attended by 113 priests, who look after 183 churches or chapels. There are 73 schools conducted by the members of 24 sisterhoods, in which over 5000 Indian children are educated. The Catholic negroes are about 140,000 in number. They have 40 churches, conducted by 45 white clergymen ; 81 schools, in which 6401 coloured children are educated by 24 sisterhoods, who also conduct 1 1 charitable institutions. The expenses of these missions are borne by private charity, and by a general annual collection, which in 1899 amounted to $59,247.

There exists no satisfactory history of American Catholicism. Among the more useful helps may be indicated the following : ⁂ General History: John Gilmaky Shra. Life and Times of Archbishop Carroll, N.Y., 1888 ; The Catholic Church in Colonial Days, N.Y., 1886 ; The Hierarchy of the Catholic Church in the United States. N.Y., 1886. ⁂ -Bishop O'Gokman. A History of the Catholic Church in the United States. 1895. This work contains a useful bibliography. ⁂ Clabke. Lives of the Deceased Bishops,

1872. Statistics : The Annual Directory of the Catholic Clerqy. Of these, two are published ; one by D. and J. Sadlier, New York, the other

(Hoffmanns') by M. Wiltzius and Co. of Milwaukee. The Catholic general statistics of the eleventh (1890) census may be found in The Religious Forces of the United States, by H. K. Carroll, N.Y., 1893. Those of the twelfth (1900) are printed in the official reports of that census. Legislation : Acta et Decreta Concilii Plenarii Baltimorensis, iii., Baltimore, 1886. This is illustrated and brought into relation with the general laws of the Church in Smith's Elements of Ecclesiastical Law, New York. In connexion with this may be read Humphrey's Urhs et Orbis, London, 1899, an account of the general government of Roman Catholicism.

*(*J. G.)*

RoiTia.n Wa,lls {Recent Excavations). ❓❓❓The main- land of Great Britain twice contracts to a narrow width ❓❓❓once north and once south of the English and Scottish border. From Clyde to Forth is barely 35 miles ; frotn Tyne to Solway, barely double the distance. The Romans at one time or other took each isthmus as their frontier ; and since the distances were short, fortified each vnth a continuous wall. The southern line, Hadrian's Wall, was occupied far longer, and was far more important, than the northern " Wall of Pius."

For modern purposes, the dominant feature of the southern isthmus is the easy natural passage which the valleys of the Tyne and Irthing provide for road and rail- way between Newcastle and Carlisle. But the utilization of this passage is modern. It was not used by the Romans, and even in 1745 it was found to be roadless. The Roman frontier works followed the high ground to the north of the valleys. In the east they commenced at Wallsend-on-Tyne and traversed the moors of south- east Northumberland; inland they climbed along pre- cipitous basalt cUffs ; in the west they descended through the lowlands of Carlisle, south of Scaleby and Solway mosses, to the coast at Bowness. Military reasons ❓❓❓the shortness of distance and the advantages of cliff and moss ❓❓❓seem to have suggested this line. Politics and commerce had no share in determining it : the land south of the wall is for miles as desolate as the land north of it, and no native racial boundary can be traced in this neighbour- hood.

The actual frontier works are threefold. First, there is a wall of stone, with a ditch in front, forts behind, and a connecting road. The wall was 8 feet thick and originally perhaps 16 feet high; the forts, walled in stone, varied in size, but the larger covered from 3 to 5 acres. Secondly, there is the so-caUed vallum ??? in reality no vaUum at all, but a broad flat-bottomed ditch, out of which the earth has been cast upon either side, and heaped into regularly made mounds resembling ramparts. Thirdly, there is the turf wall, constructed of sods laid in regular courses, with a ditch in front. The stone wall and " vallum " have long been known, and are among the stateliest monuments of Roman military power that time has spared. The turf wall was first found in 1895, is nowhere clear on the surface, and is only traceable at all at special points.

Excavations along the Wall have had two objects ??? either to examine the forts, to plan their buildings, and collect inscriptions, &c. ; or to ascertain the relations of stone wall, "vallum," and turf wall??? that is, to recover the history of the Roman frontier. Earlier excavators, like Clayton and Bruce, essayed principally the first task; since 1893 both have been tried.

(a) Forts. ??? Before 1893 much of Chesters {Cilwrnvm) had been uncovered, and casual search made elsewhere. In 1894-97 bits of Greatchesters were dug; in 1898 Housesteada (Borcovicitim) was entirely excavated by Mr R. C. Bosanquet and others. If we combine the results won on these sites with those won at High Rochester (partly excavated about 1850), at Hardknott (1892), at Gellygaer, near Cardiff (1900-01), and in Scotland, we

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Fia. 1. ??? Plan of Housesteads (Borco^‘icium).

may seem to have acquired much evidence respecting Koman forts in Britain. We have, however, achieved less than the Germans on the Limes and the French in Algeria. What we do know may be illustrated from Housesteads. This fort measures about 120 by 200 yards, and covers 5 acres (see Plan, Fig. 1). Its walls are stone, its north wall the same as the great wall which runs from sea to sea. Within, it is full of buildings of stone. Chief among these is the ” Prsetorium,” in the centre of the fort ??? a rectangular structure enclosing two small open courts and a row of small rooms (shrine for official worship, treasury, &c.), which faced on to the inner (western) court (Plan, x.). This was the official centre of the fort. Close by were officers’ quarters (Plan, xi., xii.) and storehouses with buttresses and dry basements (Plan, viii.). The long blocks which filled the ends of the fort were doubtless principally barracks (Plan, i.-vi., xii.-xviii.). Outside the fort stood various buildings

not all yet explored ❓❓❓ a bath-house, a little way east; a shrine of Mithras, and perhaps other shrines, a little way south; and huts of camp-followers, women, &c. To the north-east, outside the great wall, is a tiny hollow, formerly explained as an amphi- theatre, now thought to be only a quarry. Such is Housesteads, and such probably were nearly all the Koman forts in Britain. They differ somewhat from Koman forts in Germany, notably in the details of their " Pretoria " and in the number of their stone-built structures. Even in military matters, it seems, the Roman provinces varied from each other.

(6) Wall, " Vallum," cfcc ❓❓❓ Ancient writers assert that

Hadrian (about a.d. 120) built in North Britain a wall for 80 Koman miles from sea to sea. The mileage and various inscriptions prove that this refers to some part of

lOUTH Mound OF Vallum

SOUTH

DITOH

FlO. 2.-

B.

NORTH

-A, Hadrian's Wall ; B, Section of the same. (From Soeial England, by pernuaaion of Cassell and Co. Ltd.)

the frontier works of the southern isthmus. Ancient writers also say that Severus (about a.d. 208) built a wall in North Britain from sea to sea. But they diffi;r as to its length ; inscriptions do not whoUy support them, and their

statement has been variously explained. Hodgson and Bruce, the chief local authorities of the last century, main- tained that Hadrian erected the stone wall, with its forts, against northern enemies, and the ” vallum ” against southern insurgents, while the work of Severus was con- fined to a few repairs in the stone wall. This was the accepted view till lately, but recent excavations show that in several points it is not tenable.

In the first place, the stone wall and its forts, which the visitor now admires, were not the earliest frontier works. An earlier line (as it seems, a wall of turf) has left clear traces of itself at Chesters and Birdoswald (Amboglanna), and we have not one wall but two walls to deal with. The dates of these are stUl doubtful’. But our ancient vpriters mention two wall-builders, Hadrian and Severus ; and the most natural conclusion is that Hadrian built the first wall in turf, and Severus reconstructed it and its forts in stone. It has been acutely suggested that probably Severus adhered as closely as possible to his predecessor’s line, in order to use the existing ditch ; in one or two cases, however, as at Birdoswald, he deviated. Evidence can be adduced from other parts of the Roman Empire to show that the Roman military engineers con- tinued to use earthworks for permanent fortifications till after the reign of Hadrian, and that Severus ” converted ” some of these earthworks into stone.

The ” vallum ” can no longer be explained as of old, but it is still a puzzle. Many of its features have been eluci- dated by recent excavations. It has been definitely proved to be Roman, which certain despairing minds had doubted. Its course, not quite accurately known to Bruce and Hodgson, has been better traced. The method of its con- struction is now plain. Its date has proved to be not earlier than the turf wall; probably it is contemporane- ous either with that or with the stone wall. Its object was not military : it must have marked some Hmit of the civil province. But more precise we cannot be. The “vallum” is one of the largest of extant Roman earth- works ; speculation has busied itself about it for two centuries, and excavation for some years. It remains unexplained, a proof of the imperfection of our knowledge of antiquity.

The Wall of Pius consists of a continuous rampart, a ditch in front of it, forts behind it, and a connecting road ; it was constructed about a.d. 142,

and abandoned within 45 years. An ancient writer states that the rampart was built of regularly laid sods, like the turf wall of the southern frontier : this was verified by excavations in 1891-93. Except for this, the wall is entirely un- explored : a commencement of excavation was, however, being made in 1902 at the fort of Castlecary, 15 miles east of Glasgow. The site has been cut into by road and railway, and the stones of the fort have been taken away wholesale by later builders. But a bath-house, a but- tressed storehouse, and a latrine have been found, and also massive stone substructures for the northern rampart. The surviving masonry is finer than that usually visible along Hadrian's Wall, and the work of Pius was plainly far more substantial than has been thought. Tacitus states that Agricola erected a line of forts across the northern isthmus. No trace of these has yet been found, unless possibly at Camelon near Falkirk, recently exca- vated by the Society of Antiquaries of Scotland.

No report of the Housesteads work lias yet been published (July 1902) ; the writer is indebted to Dr Hodgkin and Mr R. C. Bosanquet for the plan, reduced from surveys by Messrs Bosanquet and Dickie. For other excavations, see Archmologia .^iana, vols, xvi., xvii., xxiii., xxiv. ; Transactions of the Cumberland Archce- ological Society, 1894-1902 ; Report of the Glasgow Archoeological Society on the Antonine Vallum.

(f. J. H.)

Romanes, Georg^e John (1848-1894), British

biologist, was born at Kingston, Canada, 20th May 1848, being the third son of the Rev. George Romanes, D.D., professor of Greek at the university. He was educated in England, going in 1867 to GonviUe and Caius College, Cambridge. He early formed an intimate friendship with Charles Darwin, whose theories he did much during his life to popularize and support. His first appearance as a man of science was at the Royal Society, where he delivered the Croonian lecture for 1875 on the Locomotor System of Medusae, in which he described the nervous system of these little beings, thereby rendering valuable service to the study of elementary physiology. These studies he continued to prosecute, publishing a few years later a work on Jelly -Fish, Star-Fish, and Sea-Urchins. In 1881 came Animal Intelligence, in 1883 Mental Evolution in

Animals, in which he traced the parallel development of intelligence in the animal world and in man. He followed up this line of argument in 1888 vrith Mental Evolution in Man, in which he maintained the essential similarity of the reasoning processes in the higher animals and in man, the highest of all. In 1892 he brought out an Examination of Weissmanism, in which he sturdily upheld the theory of the hereditability of acquired character. In 1890 he settled at Oxford. Here he founded a lectureship similar to the "Rede" of Cambridge. Darwin, and after Darwin, which came out in 1892, he was obliged, owing to failing health, to publish without fully completing. His religious opinions are somewhat interesting : he began life as an Evangelical, and then came under agnostic influences, to which he gave expression in an anonymous book, A Candid Examination of Theism, the tone of which is reluctant disbelief in the Deity. Subsequently he was much im- pressed by the teaching of liberal High Churchmen, and recovered his faith in Christianity. Thoughts on Religion, published after his death, shows how very far the pendulum of his mind had swung from the Evangelical and agnostic standpoints. He died 23rd May 1894.

Rome, the capital of the kingdom of Italy. Very great changes in the municipal and social conditions of Rome followed the occupation of the city by the Itahans (20th September 1870), and the rapid increase of popula- tion due to immigration from other parts of Italy; and even in 1902 it could not be said that the new Rome had assumed its fitnal shape. It is a mistake, however, to attribute all the works undertaken and executed since 1870 to the initiative of the new Government. A plan for the improvement of the city was made, under the direction of Mgr de Merode, during the reign of Pius IX. ; and although but a small portion of the projected changes were carried out under the Pope, the general scheme was in most respects satisfactory, and proved a good foundation for further extensive developments. It did not include, however, the destruction of villas such as the Villa Ludovisi, nor the wholesale removal of trees, which is so greatly to be deplored. These acts of barbarism were the consequences of the reckless speculations in land and buildings that accompanied and followed the active and excellent work done by the municipality, and might have been checked by vigorous and timely action of the Government. As it was, a number of the most important Roman

families were ruined. At the outset, and as soon as political circumstances admitted the consideration of such matters, the municipality set to work ; and though a comprehensible love of the picturesque has caused many persons to regret the result, altogether or in part, it is not to be denied that the improvements carried out have been of the highest advantage to the city, and that the work is in many instances of creditable solidity. Two principal

problems presented themselves at once. By far the more important was the confinement of the Tiber in such a manner as to render impossible the serious floods which had from time to time inundated the city, often causing great damage to property and rendering the lower streets more or less impassable. There were floods which almost reached the level of the first storey near San Carlo in the Corso, and it was common to see the great Piazza Navona and the neighbourhood of the Pantheon full of water for days together during the winter. The interruption of traffic can be imagined, and the damage to property was serious. The other urgent matter was one of which the Government of Pius IX. had been partially aware, namely, the necessity for opening better thoroughfares between different parts of the city. In the Middle Ages the population of Eome had dwindled to twenty or thirty thousand inhabitants, who lived huddled together about the strongholds of the barons, and the modern city had slowly grown again upon the exiguous foundation of a mediagval town. The need for changing this condition of things, which had been felt imder Pius IX., became overwhelmingly apparent as the population rapidly increased. That which under a con- tinuance of the old Government might have been done by degrees during a long period, had to be accomplished in the shortest possible time, with means which, though con- siderable, were far from adequate, and in the face of stormy opposition exerted by many holders of real estate, the most important of

whom were conservatively attached to the Papal Government, and resisted change for no other reason. In what was now done it is necessary to distin- guish clearly between the work undertaken and carried out by the municipality, under considerable pressure of circumstances, and that which was done in the way of private speculation. The first was on the whole good, and has proved enduring ; the second was in many cases bad, and resulted in great loss. As soon as the opening of such streets as the Via Nazionale and the Via Cavour, the widening and straightening of the Via dell' Angelo Custode, now the Via del Tritone Nuovo, and similar improvements, such as the construction of new bridges over the Tiber, had demonstrated that the value of property could be doubled and quadrupled in a short time, and as soon as the increase of population had caused a general rise in rents, owners of property awoke to the situation of affairs, and became as anxious as they had at first been disin- clined to improve their estates by wholesale building.

By far the most important and expensive work done by the municipality was the construction of the embank- ments along the Tiber. Though damaged by the great flood of December 1900, their truly Koman solidity saved the city from the disastrous consequences of a wide inun- dation. It is impossible not to admire them, and not to feel respect for a people able to carry out such a plan in such a manner and in so short a time, in the' face of such great difficulties. But so far as the life of the city was concerned, the cutting of new streets and the widening of old ones produced a more apparent immediate result. The opening of such a thoroughfare as the Via Nazionale could not but prove to be of the greatest value. It begins at the Piazza delle Terme, in which the princijial railway station is situated, and connects the upper part of the city by a broad straight road, and then, by easy gradients, with the Forum of Trajan, the Piazza dei Santi Apostoli, and the Piazza di Venezia, whence, under another name, it runs through the heart of the old city to the Bridge of Sant' Angelo. It is true that in order to accomplish this, a part of Villa Aldobrandini had to be destroyed ; but this is almost the only point which lovers of beauty can regret, and in compensation it opened to full view the famous palace of the Massimo family, the imposing church of

Sant' Andrea deUa Valle, and the noble pile of the Cancelleria, one of the best pieces of architecture in E-Dme. Another great artery is the Via Cavour, which was in- tended to connect the railway station with the south- western part of Eome, descending to the Forum, crossing it by a light iron bridge, and continuing to the river behind the Palatine. These are only examples of what was done, for it would be impossible, within any ordinary limits, to give a just idea of the transformation of the city. Eome is now divided very clearly into two parts, the old and the new, of which the old is incomparably the more artistic and the more beautiful, as it will always remain the more interesting.

Municipal Administration. ❓❓❓ After the taking of Eome, those persons who remained loyal to Pius IX. took no part whatever in public aflairs, and the municipal administra- tion was entirely in the hands of the Monarchists. The expression " nfe eletti ne elettori," meaning that Catholics are to be neither voters nor candidates, which came to be regarded as a sort of rule of the party, was invented at that time by an epigrammatic journalist, and it seems at first to have been applied also to municipal matters, whereas it was later understood to refer only to parHa- mentary elections. Leo XIII. encouraged the formation of a Catholic party in the municipal administration, and the municipal government drifted largely into the hands of Catholics, though circumstances make it necessary that the Syndic (Mayor) should always be a Royalist. Between 1870 and the end of the century, the Socialist party had no great influence in Eome, which can never be a city of manufacturing interests. For purposes of municipal government the division of the city into districts has been changed. It was formerly divided into fourteen " EionL" It is now further divided for various purposes of admin- istration into more than one series of divisions. The municipality consists of a Mayor and 78 "Communal Councillors," of whom a considerable proportion are usually members of the aristocracy ❓❓❓ a fact which shows the extremely conservative and aristocratic tendency of the city in municipal matters.

Population. ❓❓❓ The population on 31st December 1870 was 226,022, as against 512,423 on 31st December 1899. It therefore more than doubled in thirty years. The in- crease, however, did not take place at a

very regular rate, owing to the changes in the rates of immigration and emigration. The largest incresLse was in 1870, reaching 22,186 J the next most important in 1884, 1885, 1886, 1887, in which years it constantly remained near 20,000. The least increase in later years was 4417 in 1891. In 1899 it was 11,813. The garrison of Eome may be taken at about 10,000 men. Careful inquiry has placed it beyond doubt that there are in Eome about the same number of ecclesiastics of all orders, including about 1500 students in the theological seminaries. The average birth-rate of Eome is about 22 per 1000, as against 13J in Budapest, the lowest in Europe, about 30 in London, and 40 in Cologne, the highest in Europe. It is lower in Eome than in the majority of cities, but is higher than in a considerable number of others, as shown in the Bulletin de statistigue d^mographirjue et midical de la Yille de Bruxelles. The number of births increased after 1870 very nearly in pro- portion with the increase of population.

Hygiene. ❓❓❓ The hygienic conditions of Eome have greatly improved, largely through the ceaseless efibrts of Commen- datore Baccelli, who is a distinguished man of science, and has repeatedly held office in the Italian Ministry. The publication of exceedingly accurate graphic tables in February 1900 shows the following facts. Ninety per 1000 deaths occurred in 1871 from typhoid (the so- called "Roman fever"), and the average has now fallen

to a low constant. Deaths from small-pox, formerly of alarming frequency, can be said not to occur at all, and their numbers diminished suddenly after the introduc- tion of compulsory vaccination. A great decrease in the number of deaths from malarial fevers is referred to the increased use of quinine among the poor in the out- lying districts. Tuberculosis alone produces precisely the same mortality as formerly. On the whole, the tables show a notable decrease in the death-rate, which has now fallen below an average of 18 per 1000, a fact which places Rome

among the healthiest cities in Europe. The death-rate of Moscow is nearly 30, for instance, and that of Dublin about 26. With regard to the consumption of meat in Rome, it increased until 1887, after which it suddenly decreased in a remarkable manner, coincidently with the failure of the numerous building speculations; and though the population had increased by nearly 120,000 since 1887, there were slaughtered in 1899 only 116,661 head of cattle, whereas the number in the former year was 140,549, showing a decrease of 23,888 head. In this connexion it should be noted that the slaughter-house of Rome is one of the best organized establishments of the sort in Europe.

Charities and Education. ❓❓❓ A great number of small charitable institutions for children and old people have been founded, which are organized on the most modern principles, and in many of these charitable persons of the upper classes give their individual assistance to the poor. There are also private hospitals for diseases of the eye, in which poor patients are lodged and treated without payment. There are two hospitals entirely main- tained by private resources, where infants are treated whose mothers fear to send them to a public hospital, or in cases refused by the latter as not being serious enough for admission. Of course the numbers of the poor greatly increased with the growth of population, especially after the failure of buUding speculations between 1888 and 1890, though great efforts were made by the munici- pality to send all persons then thrown out of employment back to their homes. One of the difficulties under which Rome labours is that while it attracts the population of the country, as other capitals do, it possesses no great mechanical industries in which the newcomers can be em- ployed. Efforts to create small industries in the populous quarters of the poor met with little success. Previous to 1870 a society was formed, and it has since greatly developed as an intelligent private enterprise, of which the object is to provide the poor with sanitary tene- ments ; but its success is much hampered by the absence of employment, which, again, is partly due to the heavy taxation of small industries. A number of trade schools are also maintained by private funds, such as the Istituto degli Artigianelli, managed by the Fratelli della Dottrina Cristiana, and the Ricovero pei Fanciulli Abbandonati (home for friendless children), which is under lay manage- ment and has flourishing workshops. The character of official

charities has certainly improved in principle, so far as their educational and moral scope are concerned ; for whereas in former times the limited number of the poor made individual and almost paternal relief possible, that form of charity had a pauperizing influence. If anything, the present tendency is to go too far in the opposite direction, and to require too many formalities before any relief is granted ; and while the union of the principal charities under a central management on ad- vanced theories improved the methods of administration, it destroyed numerous small sources of immediate relief on which the poor had a traditional right to count, and was in that way productive of hardship. At the same time, however, mutual benefit societies {societa di tnutuo

soccorso) have been organized in great numbers by the different crafts and professions, and are chiefly distin- guishable by the political parties to which they belong. It is characteristic of the modern Roman people that the most widely different elements subsist without showing any signs of amalgamating, yet without attacking each other. Some of these societies have an exclusively Clerical character, others are merely Conservative, some consist of Monarchists, and some of avowed Republicans.

Popular education is fully half in the hands of private persons, for, over and above the schools officially mentioned in the municipal reports, a very large number of religious institutions impart elementary instruction to children of the lower classes, following, of course, the Government curriculum, and being under the supervision of municipal inspectors Isoth as regards their teaching and their hygiene. The Pope also expends large sums in the maintenance of the people's schools, managed entirely by laymen and also under Government inspection. For education of the higher grade there are many private so-caUed lyceums and gym- nasiums, from which pupils can present themselves for the regular Government examinations, the privilege of con- ferring certificates and degrees having been allowed only to very few private institutions.

Society. ❓❓❓ ^After 1870 both the aristocracy and the middle classes were divided into hostile factions, each of which maintained a press of its own and rallied round representative individuals. So far as the middle classes were concerned, the common interest of commercial opera- tions

soon concentrated political differences. The aristo- cracy, however, kept rigidly aloof from all speculations for a time, and maintained its traditional attitude of contemptuous superiority, to which the middle class answered with its profound hatred. This state of things lasted about ten years, until the time of the great building speculations, into which a number of noble families were tempted, and in which they soon found themselves hope- lessly involved, and brought into close contact with the middle class. The two classes thus became necessary to each other, and the result was a notable and salutary diminution of prejudice, soon leading to alliances by marriage which would formerly have seemed impossible, but which the redistribution of wealth rendered mutually advantageous. The appearance at social gatherings of an official element, almost exclusively taken from the middle class, also tended to reduce inequalities of caste. Yet it must be admitted that the parties composing Roman society were drawn together mechanically, rather than fused into anything really homogeneous. It is worth mentioning that the Jewish element, which is very strong in business, in journalism, and in the administra- tions, has made no attempt to enter Roman society. Rome and Genoa are practically the only Italian cities in which Israelites are rigidly excluded from social in- timacy, and are only met on official occasions.

(m. ce.)

AECHiEOLOGY OP RoME AND NeIGHBOUEHOOD.

Modern archaeological research in Rome and its neigh- bourhood has proceeded on lines previously traced, and has considerably increased knowledge of the eariy inhabit- ants and conditions of life in and about the city. Single buildings and groups of buildings within the walls have been searchingly studied in the effort to elucidate their original form and use, a branch of research particularly valuable in Rome, where continuous habitation and events of war have caused many ancient buildings to be diverted from their original forms and purposes. Excavations con- nected with the rapid growth of the modern city have, moreover, brought to light an enormous number of the

most varied objects, for the preservation of whicli, as for the preservation of the results of carefully directed research, several museums, some of purely scientific character and others vrith artistic intent, have been formed. In most cases the archaeologists entrusted with excavations and ???with the formation of museums have been moved by desire to work in ways fully consistent with modern knowledge and methods. Unfortunately, in some notice- able instances (to be mentioned later) the work was unworthily done, either carelessly or hurriedly, under the influence of momentary excitement.

It was inevitable that the great development of the city should involve much destruction of ancient ruins and monuments. In consequence of the building of the Tiber embankment and scientific regulation of the course of the stream, the channel to the left of the island of San Bartolomeo became filled with silt and joined to the bank by a noisome mud-flat, i The Ponte Sant' Angelo has been added to at each end, and its ancient appearance altered. During the work on this bridge in 1892 a piece of the original paved roadway leading from it to the Campus Martins was laid bare. Most of the other bridges have been more or less destroyed, two of the arches of the Pons ^milius being demolished in 1887, and the Pons Cestius completely altered between the years 1886 and 1889. Fragments of the Servian Wall and tombs on the Flaminian Way were further destroyed in connexion with the building of the monument to Victor Emmanuel. More than once portions of the Golden House of Nero were found and destroyed during the laying out of streets. Outside the walls, the arches of the Claudian Aqueduct near Roma Vecchia were much shaken by the passing trains. In addition to this perhaps inevitable destruction, harm was done by certain methods of preservation. Quan- tities of unrelated objects from all parts of the city and neighbourhood were heaped together in storehouses, in such a way as to deprive them of value as expressions of ancient life and character, and to make them mere curi- osities, mere refuse of "past, incompatible ages." The formation of modern museums is carried out in a spirit very diflferent from that which

prevailed when the great private collections or the Papal Galleries were being gathered. Then scientific study of archaeology was almost unknown, but much greater interest was taken in beauty per se. Humanists cared little for products of barbaric ages, or tribes, and sought objects noteworthy especially for beauty, both in order to develop their own faculties and to multiply opportunities of enjoying adequate ex- pressions of the intellectual life of the highly civilized men of earlier days. Judged by this standard, a modern museum such as the Museo delle Terme seems less satis- fying than the Vatican Gallery. In the Museo delle Terme objects are grouped together without system, or scattered through the dark cells and narrow passages of a mediaeval convent, where not only is it impossible to see them in the way their makers intended, but even to see them in any way completely. In the Vatican, though the marbles sufiered from ignorant restoration, an attempt was made to present them in a proper setting as things of beauty rather than as examples of odd fashions of the past. It would often be well to leave objects where they are found, and to form local museums, or at least to gather on one spot things found together. For instance, it would have been well to make a museum on the Palatine and another in the Forum, for the preservation of antiquities found on those sites, instead

1 In consequence of the fall of a part of the embankment opposite S. Bartolomeo in November 1900, a special commission was appointed to consider the best means of removing this mud-flat, and of causing the stream again to surround the island, as in former times.

of transporting some of them to the Museo delle Terme and leaving others where they were excavated. An attempt in the right direction was made by Signer Boni in connexion with the excavations in the Forum, where two small museums were formed. The general system of scattering antiquities among various museums prevailed, however, in the case of objects found elsewhere in the city. Some were stored at the Botanic Gardens, some in the Museo delle Terme, and some in the Museo dei Conservatori. The authorities had, it is true, to contend with the serious difficulty that, according to the circum- stances of their discovery, antiquities may belong to the municipality or to the State ; yet this circumstance ought not to form an insuperable obstacle to intelligent arrangement.

A more serious ground for complaint came to light in 1 899 in connexion with the Papa Giulio Museum of Etruscan Antiquities. Doubt as to the scientific value of the museum was expressed by Professor Helbig in the preface to the second edition of his guide to Roman museums. Inquiry conducted by three Government commissioners (two of whom held ofiices under Professor Bernabei, organizer of the museum) proved : (1) That, contrary to the public statements of two Ministers of Public Instruc- tion, the Etruscan tombs, to hold the contents of which the museum was formed, had been excavated without proper supervision, and in large measure by a "boy scarcely fifteen years old." (2) That the published plans and maps could not be certified because, with one exception, all the original topographical notes had been destroyed. (3) That the directors of the museum " did not always act in a praiseworthy manner." (4) That no proper inventories of objects bought for the museum were kept for ten years, and that lists actually forthcoming were inaccurate. (5) That in the case of some twenty tombs the objects exhibited did not tally with the official descriptions of them (Supplemento al No. 2S del Bollettino Ufficiale del Ministero dell' Istruzione Pubblica, . June 1899). It therefore became evident that the value of the Papa Giulio Museum, as a co-ordinated illustration of the development of Etruscan civilization, is open to serious question.

While so many famous private collections were sold and scattered, two collectors at least gathered objects of interest and beauty with the declared intention (at any rate in the case of one of them) of giving them to their country. One of these is King Victor Emmanuel III., whose collec- tion of Italian coins is unrivalled ; the other is Baron Barracco, who has collected choice marbles, selecting them for their artistic excellence rather than for archaeological peculiarity (see La Collection Barroeco, by Helbig, text and plates).

Intimately bound up with the questions of the management of museums, and their arrangement in such manner as to offer facilities for study to properly accredited students, are the problems of scientific excavation and of disposal of important private collections which may come into the market. The various foreign arcb??ological institutions having headquarters in Rome are refused permission to excavate in Ifcily,

although there is vastly more work to do than the Government can possibly undertake, and though permission to excavate is freely given to similar institutions by Greece, and even by Turkey. The attitude of the Italian Gov- ernment delays the progress of knowledge, prex'cnts the formation of local museums, allows much harm to be done by untrained Italian antiquity dealers, to whom excavation rights are often granted, and who dig merely to find objects to sell, induces much secret digging, and keeps money out of the country. In cases like those arising from the purchase en bloc of the Borglicse and Boncomp:igni collections, which contain some masterpieces and much second-rate work, the problem is compli- cated by the fact that the collections were formed, at least in part, as a public trust. The Government thus possesses the right of pre-emption, but, considering the innuniei-able treasures already in the various Government museums, would it not be well to let a permanent board of properly trained exports select the objects of

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most moment, and sell the remainder at a Government office, as in Kgypt? One other question calls for brief notice, namely, the rights of foreign students to study and publish results of research. No one can wish to place foreign students in a more favourable position tlian native scholars, but the ItaUan authorities are often slow in publishing proper accounts of discoveries, and unwilling to let foreigners make photographs, or even take notes, of objects exhibited in the museums. It is an exaggeration to say, " We are most liberal in allowing strangers to study the archaeological riches excavated and arranged by us, and we favour their researches in every possible way " {SuppUmento al No. $3 del Bolletlino UfficiaU del Ministero dell' Istruzitme Fubblica, June 1899).

The most important modern excavations took place in the Roman Forum under the direction of Commendatore Bxcava- Giiacomo Boni. They began tentatively in tionsin September 1898 with the re-erection of a little

""" ??? 3rd-century shrine at the north-west angle of the Atrium Vestae. The plan adopted by Boni in regard to reconstruction was simple and wise. When large portions of a monument have been preserved and their original positions known with certainty, it is better to replace them in their true relation with each other, supplying missing portions with materials that cannot mislead, than to leave them lying on the ground in unintelligible disorder and liable to injury. From this beginning the work was extended by degrees to the whole Forum. The discoveries were so varied, and in some cases so significant, as to necessitate the re-writing of all existing literature on this part of Roman archaeology. The principal modifications and discoveries were as follows : ???

Honorary Columns, which formerly stood opposite the Basilica Julia, but of which the chief portions were lymg where they had fallen, were in two cases reconstructed and raised on their bases.

Hereon of Ccesar (October 1898). It was manifest that the remains of this temple had not been completely cleared of earth by earlier excavators. This was now done, and in the semicircular recess of the front wall was found the base of the altar erected on the pavement of the republican Forum on the spot where Cfflsar's body was burned. The foundation walls were traced, and the temple shown to be larger than previously supposed.

Arch of Augustus. ??? Lower blocks of the piers, found but not recognized some years ago, were replaced in their original position.

Temple of Vesta. ??? The shapeless mound previously ??? called by this name proved to be in large part simple earth. This was removed, and in the centre, below the level of the temple floor, was found a trapezoidal chamber of early date, rebuilt (like the temple above) in later times. In the chamber, which was probably fkefavissa, was found a quantity of fragments of vases, bones (ox, dog, sheep, and pig), charred oak, and ashes.

House of the Vestals (September 1899). ??? Much earth was cleared away, mosaic floors laid bare, and the lower steps of the stairs leading to the second floor discovered. A hoard of 397 solidi aurei was found. The

coins were mostly of the 4th and 5th century A.d. ; ten were of Euphemia, wife of Anthemius. One republican and three mediasval wells were emptied, and an early altar with traces of sacrifices brought to light. The sewers were found to be full of oyster-shells and of various objects used by the Vestals.

Hegia (May-August 1899). ??? The foundation walls were more accurately traced than before, and various fragments of the last (imperial) reconstruction collected. The basis of what may have been the sacrarium for the sacred spears of Mars was un- earthed, and a subterranean beehive chamber of large dimensions discovered. This chamber, or tholus, which had a thick external coating of fine clay and an internal coating of cement, contained, among other objects, seventy-eight bone styluses, a bone ???writing- tablet, and a piece of well-kerb with the word "Kegia" inscribed in republican characters.

Domus Publica (September 1899). ??? Cleared and examined more accurately than before, mosaic floors (previously known) cleaned and examined, and the impluvium found.

Temple of Castor and Pollux (August 1899-January 1902). ??? The standing columns, which were in great danger of falling, were strengthened ; many architectural fragments, previously scattered heedlessly about the Forum, were gathered together ; the western side of the stylobate and the foundations were excavated. The excavation was carried round the temple.

Vicus Tuscus was cleared of mediaeval paving-stones, and a short stretch of curious pavement, composed of small brick tesserce, like a mosaic, brought to light.

Arch of Fabius (1899). ??? The exact site of this arch was not found, but three large voussoirs of travertine belonging to it

were discovered opposite the Hereon of Romulus underneath the previously existing modern pavement, on the line of the Sacra Via. The arch is thus shown to have been larger than hitherto supposed, and to have had a span at its spring 4 '58 metres wide. One republican and three

mediaeval wells were found near by, one of the latter containing, among other things, three large weights of serpentine with bronze handles. Their excellent state of preser- vation makes them valuable material for the study of Roman metrology.

Forum, Facts (1899). ^Cleared of earth and made accessible from the Forum Romanum, in such way as to render visible the well- known door in the eastern side of the Templum Sacrae Urbis and the side of the Basilica of Maxentius (Basilica of Constantine). Some four hundred fragments of the marble plan of Rome which was affixed to the northern wall of the Templum by Septimius Severus were found in April 1899 behind the Farnese Palace.

Temple of Antoninus and Faustina (June 1900). ??? The modern stairs in front were removed, and the core of the original steps exposed. The lower half and the head of a statue of a seated female figure and another early well were found. Under the ancient steps a grave, dating probably from the 8th century B.C., was found. Its contents were not remarkable, but it shows that at that epoch the Forum was outside the city boundaries. The town was probably limited at that time to the Palatine.

Via Sacra (June 1899). ??? The finding and clearing of a large early sewer built of opus quadratum and opus reticulatum, running under the so-called Via Sacra, prompted further exploration, which proved the pavement, hitherto considered ancient, to be of mediaeval or of even later date. Several pieces of mediaeval carving and coins, some of the 16th century, were found below this pavement ; also pieces of the porphyry columns which once stood at the southern entrance of the Basilica of Maxentius. Sevral republican wells were discovered, containing many small objects of bronze, bone, terra-cotta, or stone. In two mediaeval wells several carved marble fragments were found. About two metres below the above-mentioned pavement an early imperial pavement of large, well-laid, polygonal blocks came to light. A continuation of this pavement was also found immediately under the Church of Sta Francesoa Romana, thus showing that the Sacra Via originally ran due east from the Forum, a circumstance which suggests that the Arch of Titus is not now standing in its original position.

Horrea Margaritaria (spring 1900). ??? Deeper excavations than those previously made on this site revealed the existence of buildings earlier than the imperial constructions hitherto known. Many small objects of various materials were found among them, fragments of Aretine pottery, and some three hundred terra-cotta lamps of diverse patterns.

Basilica Emilia (begun spring of 1899). ??? This was one of the first large undertakings, and its success led to the continuation of Signer Boni's work. It was necessary to expropriate a block of houses which partly covered the site, and this expense was borne by an Englishman, Mr Lionel Phillips. The southern half of the Basilica was cleared, and work gradually proceeded with. Although the Basilica was rebuilt at various times, it is now a complete ruin. Nevertheless, much has been learned concerning its character. The plan consisted of a nave, with aisles on each side running east and west, surrounded by a colonnade. Several important inscrip- tions and architectural fragments were found, including portions of the large pillars of African marble (about 3 feet in diameter and 30 feet high) which separated the nave from the aisles. These columns show that the pavonazzetto pillars in St Paul's outside the WaUs were not, as was previously believed, taken from the Basilica Emilia. Traces of many partial reconstractions have been found, the last having apparently been executed in the time of Theodoric. The final destruction of the edifice was due to fire.

Niger Lapis (spring of 1899). ??? On 10th January 1899 a square pavement some 12 feet by 12 in extent, composed of thick slabs of black marble veined with white, was discovered at a short distance from the front of the Arch of Septimius Severus. The objects found below this pavement are convincing proof that it is the "black stone" mentioned by Festus as marking the spot where, according to tradition, Romulus was buried (cf also Schol. Drug, ad Hor. Epod. xvi. 13 ; Dion. Hal. i. 87). Beneath the "black stone" are two bases on which, in all probability, stood the two lions known to have been near the Tomb of Romulus. Close by, also under the "black stone," were discovered a (hitherto unexplained) cone shaped shaft of tufa and a cippus, of which the upper half had been destroyed. On the four sides of this cippus was a Latin inscription,

perhaps of the 6th century B.C., which, so far as it can be deciphered, relatsti to sacrificial ritual. Around these monuments lay a thick stratum of sacrificial remains, in which were found, among other objects, half a dozen finely worked bronze figurines, similar to the Apollo of Tenea.

Comitium (January-November 1900). ***** *The various strata, more than twenty in number, were carefuUy examined down to the*

original geological stratum. Each of the principal epochs was characterized by a different flooring ***** *the medieval of travertine, the imperial of marble, the republican of tufa, and others perhaps of beaten earth. Many inscriptions and statue bases were found, among the latter being one dedicated to Mars and to the founders of the Eternal City by Maxentius on 21st April 308 A.D., the anniversary of the foundation of Rome. Four rows of ritual pits (22 in all) of the republican epoch, and set according to the early orientation of the Forum, were found in front of the Comitium, but, unfortunately, contained little of special interest. Cloaca Maxima (August 1899-September 1900),* ***** *When, after exploring the Comitium and the Basilica .fflmilia, the outside of this sewer was uncovered, it become evident that it was built of blocks taken from republican buildings, and that its date could not be anterior to the time of Agrippa. A large drain, perhaps two centuries older, was found under the Basilica MwiVia., together with another massive sewer, which may be the original Cloaca Maxima. This latter is made of rough-hewn blocks of tufa, and has rather the appearance of a walled-in stream than that of a regular sewer.*

Rostra (December 1898-November 1900). ***** *Some discoveries of great interest were made, although not entirely explained. Signor Boni shows reason for the belief that he has found traces of the original Rostra near the "black stone." He also advances convincing architectural proof that the construction considered by Middleton and others to be the Rostra*

built by Caesar in 45 B.C. was reaUy built in the time of Domitian, with, as was already known, an addition at the northern end dating from the 5th century a.d. Behind this construction is a curved platform, sometimes called the Grsecostasis, to the rear of the southern half of which Signor Boni found another construction of opus mcertum, consisting of barrel-vaulted niches some 5 feet high, with carefully laid floors of brick tesserce and piers and archivolt of neatly out well-set blocks of tufa. The whole structure, except the floors, was covered with stucco. The materials and the excellent method of construction show the monument to date from the republican epoch. The arches suggest that it may be the Rostra shown on the famous Palikanus coin of the geris LolUa; but one serious difficulty lies in the way of this explanation, namely, the absence of all trace of an attachment of the rostra either within or without the arches. It is to be noted that the traces of the Miliarium Aureum, placed by some students on the spot where this arched structure was found, can never have existed. There was no evidence to justily, and many architectural reasons against, the belief that the curved mouldings in this locality had anything to do with the monument. Nor is there the slightest evidence that the fragment of granite column was, as it has been asserted to be, part of the shaft of the miliarium.

Fountain of Jutuma. ??? This fountain and the sacrarium con-nected with it were found on the precise spot indicated in the marble plan of Rome, slightly to the south-east of the Temple of Castor and Pollux. The square basin in which the water from the spring was collected was in early times made of tufa, and was larger than the marble-lined basin of the imperial epoch. Ample traces of both basins were found. On a high level, somewhat to the south of the fountain, stood the sacrarium, in front of which was found a well, the marble kerb of which bears a dedicatory inscription of the Curule .ffldile, Marcus Barbatius Pollio. The water ran to the well through a leaden pipe from the basin of the fountain. The sacrarium, though of late construction, has the orientation of the earliest buildings in the Forum. Several fragments of sculp- ture were found on this site, by far the most important being pieces of the group of Castor and Pollux, OTth their horses. This group formerly stood in the middle of the basin of the fountain, upon a base of which traces exist. The spirit of the sculptures is that of 5th-century Greek work, but certain details of

treatment make it probable that they were executed by some Italianized Greek from one of the numerous Greek colonies, or by some native trained by Greek masters, as were the terra-cotta decorations of the temple of the Capitoline Jupiter.

Palatine Basilica (begun in June 1899). ??? Discoveries made since the demolition of the modern Church of Sta Maria Liberatrice (recently expropriated by the Italian Government) settled the controversy as to the site of Sta Maria Antiqua. A iine imperial basilica, built probably by Domitian and afterwards converted into a church, was unearthed.. Inscriptions prove this to have been the Church of Sta Maria Antiqua, which, according to the Liber Pontificalis, was decorated by John VII. (795-707). By him also the amhan was made, and an episcopal residence erected close by. Within the basilica Signor Boni has found an inscription in Latin and Greek, in which Pope John VII. calls himself "Servant of the most holy Mary "???the same title as is inscribed on his tomb in the Saore Grotte of St Peter's. The outer of the two halls of which the church consists contains many mural sepulchres, and was probably considered as an atrium. Between this atrium and the shrine of Juturna, at right angles to the left side of the church, is a chapel which frescoes show to have been dedicated to the Forty

Martyrs, and which may possibly have been the secretarium. The interior of the main building is covered with frescoes of the 8th century in remarkable preservation. Among them are rows of saints of the Greek and Latin Churches, conventional religious groups, scenes from the lives of saints and of Biblical characters. The most interesting are portraits of Popes Paul I. (757-767), Zacharias (774-752), and Theodotus, uncle of Hadrian I. The best preserved of the frescoes is a Crucifixion, practically uninjured, and as fresh as the day it was painted. This church, which was decorated and endowed with precious objects by many Popes (cf. Liber Pontificalis, Leo III., Benedict III., and Nicholas), was after the time of Nicholas called Sta Maria Nova. In 1702 the" site was dug over by men hunting for marbles, and parts of the paintings were seen, but the erection of the modern Church of Sta Maria Liberatrice on the spot prevented thorough investi- gation, and gave rise to many theories. The facts are at last known.

*The importance of the work in the Forum is obviously very great. During the searches marble and bronze objects, some of beauty and many more of great historical interest, were found, together with a ***””*<?>*<?>*<?> number of valuable inscriptions. Much was learned con- cerning the history of the Forum, and after many centuries the position and ground-plan of the most ancient buildings is known with reasonably complete certainty. In other parts of Rome two monuments were subjected to critical study. One is the Pantheon (see Luca Beltrami, II Pantheon, 1898), which, by the presence of certain brick-stamps throughout the edifice, was proved to be of the time of Hadrian. The other is the Church of Sta Maria in Cosmedin, which is buUt above an ancient temple of Ceres. It was freed from all Renaissance and later additions, and restored to its 12th-century form. In places the early temple walls can be seen ; in others, 4th and 6th century structures can be detected; but as a whole its form and its interesting frescoes are of the 12th century. It is no light task to sift the mass of explorations and discoveries in Rome and neighbourhood, or to gain a clear view of archaeological progress in this part of the world. Certain broad features are to be noted. Just as the modern city has lost much of the charm of the years before 1870, so the character of archaeological study has largely changed. The old school of students, who, with fewer objects to consider, had more time to think, and who sought rather to grasp general points of view than to burden their minds with particular facts, has given way to a class whose work partakes of the nature of catalogues, and who lengthily debate the value of scattered fragments. It is no longer common to find private individuals collecting the objects of beauty and interest which continually come to light ; nor are pubhc collections governed by any understanding of the meaning and proper treatment of works of fhie art. Xot unfre- quently they appear to aim at exhibiting to a restless public mere masses of dull, unrelated material. Doubtless much work of detail was necessary, and must be regarded as an inevitable consequence of the valuable modern con- tributions to knowledge ; but the question arises whether such work may not engender a tendency to seek enter- tainment in a maze of detail, and to forget the value of fruitful and inspiring generalization. It is often said with truth that the ancients knew less than we about the development of themselves and of their arts ; but of what value is such knowledge as*

compared with their power to carve the splendid portraits of Egypt or the thrilUng masterpieces of Greece ?

Among the antiquities discovered in a semi-accidental manner are the various objects and remains found during the construction of the forts encircling the city. In 1877 (see Notizie degli scavi, p. 311) tombs ^^^* ”” were found on the Via Appia, and a reservoir on the Via Gianicolenzi, outside Porta San Pancrazio. In 1878 (ibid. pp. 38, 134-369) more tombs were found on

the Via Appia. In 1883 {ibid. pp. 130, 422) a mausoleum with statues and inscriptions was found on the Via Ostiensis ; these objects were of little beauty but of considerable interest. In the same year a somewhat elaborate system of water-works was found on the Via Latina. In 1884 {ibid. pp. 43-81) a large villa was discovered on the Via Tiburtina. It was in fairly good condition, and many of the patterns of the mosaic floors and the designs of the stuccoed walla could be made out ; statues of Apollo and sculapius were also found here. The most interesting discoveries were made in 1881 {ibid. p. 60; and Lanciani, Ancient Home, p. 28) and in 1887 {Notizie degli scavi, p. 64). In the former year the military engineers working on the summit of “Monte Mario came upon the burial-chamber of the family of Minicia Marcella, the friend of Pliny the Younger, by whom she was charmingly immortalized. The burial- chamber, some 26 feet square, was of simple construction, with brick floor and stuccoed walls. In it were six sarcophagi, beside which stood an urn with an inscrip- tion declaring it to contain the ashes of the mother of Pliny’s girl frieod, and in the centre of the room a marble slab with the inscription D . M . (minicia) maecell

FUNBANi r. vix. A.xii.M. xi.D. VII. In 1887 a fort was planted on the site of Antemnse the tvrrigerce Antemnte of Virgil {^n. vii. p. 631). The site mentioned by various ancient authors (Strabo v. 3; Dionysius i. 17. 11. 35 ; Plutarch in Sulla 30 and Varro v. 5, who explains the name, quia ante amnem qui influit in Tiberim) was already known, although no visible traces existed, and it had not been explored. Some rudely made

stone objects found during the construction of the fort probably date from the earlier periods of the history of Antemnse, when it was a member of the league formed against Rome after the rape of the Sabines. Portions of an early wall made of tufa without cement, some wells and reservoirs, bronze pins and rude terra-cotta vases similar to those found in the archaic tombs on the Esquiline Hill in Eome, were discovered on the site ; though not of special importance, they afforded clear indications as to the original character of Antemnse. In imperial times a viUa was built there (as on other similar sites). During the construction of the forts many remains of terra-cotta antefixes and life-sized human figures, vdth which the villa was decorated, were brought to light.

In September 1880 several bronze busts of the 1st century, and other bronze objects, were found during the excavation of the foundations of the English Church in Via Babuino. These objects were dispersed by antiquity dealers. The same fate befell several fine bronzes and marbles found about the same time at the corner of Via Nazionale and Via Santa Eufemia. In 1884 a burial- chamber with nine sarcophagi, decorated with exception- ally beautiful carvings, was found on the Via Salaria (see Bulletin de I'Institut de CorrespoTidan^e ArcMologique, 1884-85). The sarcophagi were those of Cn. Pompey, Licinius Crassus, Calpurnius Pisonis Frugus, Scribonius Libo, and others of the same families. Concerning these persons, it is known that M. Licinius Crassus and his vpife Scribonia were condemned to death by the Emperor Claudius ; Cn. Pompey, son-in-law of Claudius, was put to death at the instigation of Messalina ; L. Calpurnius Piso Frugi Licinius was adopted by Claudius in the presence of the Praetorian Guard, and by the same guard put to death a few days later. Among the scenes carved on the sarcophagi were ; The Triumph of Bacchus, Bacchus and Ariadne, Rape of the Daughters of Lucipus, Childhood of Bacchus. Of this most interesting set of sarcophagi, one is in the Museo delle Terme, and the others in the collection of Don Marcello Massarenti.

Numerous and interesting sculptures were found on the sites once occupied by the gardens of Mtecenas and of Sallust. Portrait busts, fountains, original Greek works of various dates, in relief or in the round, and copies of Greek originals, suggest that these gardens were, in fact,

museums. The throne of Aphrodite, which has been bought by the Government, with the rest of the Boncom- pagni collection, was found in 1887 in the gardens of Sallust. This is perhaps the most beautiful piece of Greek bas-relief of the early 5th century in existence. A similar and even better preserved throne, discovered at the same time and place, was sold by the antiquity dealers. Several of the works found in these gardens were sold to foreign purchasers. In 1884 two colossal bronze statues, prob- ably of the 2nd century B.C., were found in digging the foundations of the Teatro Nazionale. One is a seated figure of a pugilist, and the other a standing figure of a man. Both are in perfect preservation, and are fine examples of a coarse but powerful school of art. In 1887 a fine though imperfect replica of the Apollo Barberini was found in the Prati di Castello. It is now in the Museo dei Conservatori. In 1899 a good copy of a very fine statue of Apollo of the early part of the 5th century B.C. was brought out of the Tiber. The river continues from time to time to give up works of the greatest interest. Several other works were discovered in making the foundations of the monument to Victor Emmanuel II., and in 1897 a broken copy of the Athena of Velletri was unearthed in Piazza Sciarra. This sum- mary description of objects accidentally found from time to time in Rome wiU serve to convey an idea of the vast amount of sculpture buried within the city. Those which have not been bought by foreigners are placed in the Museo delle Terme, the Museo dei Conservatori, or the Magazzino Archeologico.

*Under the following headings we give a summary of the progress made in elucidating the archaeological interest connected with various sites near Rome : ***

*Alba Longa (see Ashby, Journal of Philology, vol. xxvii.). *** In the light of modem knowledge, and with the advantage of dis- cussion with Professor Lanciani, the chief authority on the Campagna and neighbourhood of Rome, Mr Ashby *******’* *** ” reviewed the various theories propounded with regard u”^^ to the site of Alba Longa. He decided in favour of n***__ Castel Gandolfo (see Tomasetti, Campagna di Soma nel medio evo, 1-587).*

Conca (see Notizie degli scavi, 1896, and Melanges d'ArchMogie et d'Hisloire, 1896). ??? Nibby (Analisi della Carta dei dintorni di BoTna, p. 748 f.) believed this place to be the site of the ancient town of Satricum, and excavations carried on in 1896 have shown this belief to be well founded. Satricum is not often mentioned by ancient authors (see Livy, vi. 22, vii. 27, xxviii. 1 1 ; Diodorus xiv. 102 ; Pliny, Hist. Nat. iii. 5. 9). But it is clear that the town was famous for the Temple of Mater Matuta. Though Satricum was twice destroyed, the temple seems not to have suffered, probably because it stood outside the actual city limits. This inference is borne out by the results of excavations, which were undertaken privately by the late Count Tyskiewicz, with the help of students from the French School of Rome. The site explored was at Conca, one of the largest properties in the so-called Agro Romano, and situated in a marshy region south of the Alban Mountains. After five weeks' work, notwithstanding the great interest of the results obtained, operations were suspended, by order of the Government, because ' ' it was necessary to confirm the rule that in Italy no archaeological explorations are to be made by foreigners, not even by scientific schools or societies " (see Supple- mento al No. S3 del Bollettino Ufficiale del Ministero dell' Istru- zione Fubblica, Rome, 10th June 1899). The excavations, as far as they went, made it clear that the temple was more than once reconstructed. The earliest form of which traces were found dated from the 7th century B.C. The temple was then built of red tufa, with an orientation from east to west, the columns, used only in the portico, being of heavy proportions and of the Tuscan order. In the following century the temple was enlarged and rebuilt on a more elaborate plan, with a whiter kind of tufa and a somewhat different orientation. This second temple was probably made peripteral, and was elaborately decorated with terra-cotta figures

and omamentB. Large quantities of these ornaments were found, mostly painted with white, red, and black. The figures were in bold relief, and

apparently formed a frieze, of which the subject cannot be made out. Possibly it consisted not of one subject only, but of a series of groups, one of which represented the not un- common scene of a satyr embracing a nymph. Besides the figures, many antefixes, with relief heads, and many geometrical designs were found, some painted and some consisting of open-work patterns, like those discovered at Civita Castellana. The subjects represented, the heavy proportions of the figures, and their bold but loose modelling, show the work to be akin to the branch of Greek art called Ionian. The artists were evidently trained on Greek models by Greek masters ; in no sense did they produce true Etruscan or Italian work.

Gabii (see Notizie degli scavi, 1885). ***The usually good results obtained when this site was partially explored by Gavin Hamilton in 1792 justified hope that more statues and inscriptions might be found here. No attempt at further excavations has, however, been made. In 1885 the site was surveyed, but no new knowledge obtained, beyond the picking up of two fragments bearing a few letters of the Fasti Gabini, or lists of Roman public officials. Many ruined tombs and other Roman structures exist in the neighbour- hood, and it is noteworthy that the tombs differ from those nearer Rome in having a square plan. As Gabii was used as a quarry during the Roman Empire, most traces of it have been destroyed. Much harm has been done in modern times, the mosaic floor of the Temple of Juno (Virgil vii. 176), which was in reasonably good condition forty years since, having been entirely destroyed.***

Hadrian's Villa at Tivoli. ***The writings of earlier students, such as Ligorio, Piranesi, or Canina, are still valuable, though superseded by the more accurate work of modern scholars. Re- constructions, bused by Daumet in 1860 upon careful exploration and measurements, were continued by Girault in 1885 and by Esqui^ in 1887. Their attention was directed to the so-called Piazza d'Oro and the neighbouring buildings. In 1892 similar investigations were made by Wiiinefeld, and his results published in 1895 as Ergdnzungsheft III. zum Jahrhuch des kaiserlich-deutschen Archeologischen Institwts. This is the most useful book on the subject as a whole. From 1873 the excavations were conducted by the Government. First the "Poikile," the "Room of the Seven Wise Men," and***

the “Natatorium” were explored, and in the summer of 1880 these excavations were joined to those of the “Library,” “Piazza d’Oro,” &c., to the left of the “Vale of Tempo” (see Notizie degli scavi, 1880, p. 479). In 1884 the “Poikile” was further explored, but after that no work was done, except in preserving the ruins. Many rooms, corridors, porticos, courts, and nymphaia were cleared ; their floors, as a rule, were of mosaic laid in simple patterns, and in fairly good preservation. Most of the marble or stucco mural decoration was found to have been destroyed, though in several cases the original designs were still perceptible. Unfortunately, most of the architec- tural fragments were removed from the rooms in which they were found, and stored in odd corners in such way as to impede study. Considering the extent of ground excavated, compara- tively few works of art were found, the most important being a nearly finished marble copy of a life-size Greek bronze, represent- ing the youthful Dionysos (see Notizie degli scavi, 1881, p. 195), which was placed in the Museo delle Terme. The original bronze was probably the work of some disciple of Polykleitos.

Nemi (see Notizie degli scavi, 1885, 1887, 1888, 1895, 1896). ??? *Two main objects governed the work at the Lake of Nemi, called by the ancients Speculum Diance : (1) to clear the ground formerly occupied by the temple and temenos sacred to Diana ; (2) to deter- mine the exact character of the ancient boats visible at the bottom of the lake near the temple. The work, which in view of its importance should have been done by trained archaeologists under Government supervision, was carried out partly by the British ambassador to the Quirinal (Sir John Savile Lumley, now Lord Savile), partly by an antiquity dealer, and only in small measure by the Government. The result was unsatisfactory : most of the objects excavated were sold, and much needless damage was done to the boats. During 1885 parts of the ancient paved road leading to the temple from the surrounding hillside were laid bare, the favissce of the temple found, and a portico to the rear of the temple partially cleared. Architectural fragments, some of gilded bronze ; some sculpture ; thousands of statuettes, mostly in terra- cotta, but many in bronze ; and several hundred coins, from ars rude to imperial currency, were unearthed in 1885, and an astonishing quantity of similar objects were found in 1886, 1887, and 1888. In 1895 an antiquity dealer obtained from the*

Government per- mission to work on the sunken boats, the existence of which had been known for some centuries. Leon Battista Alberti had tried to raise them ; in 1827 some fragments had been raised to the surface ; but in 1895 the smallest of them, which measured 60 by 18 metres, was wrenched to pieces by divers, whose methods were "both reckless and ignorant. After tlio damage had been done, a .survey by Government engineers showed the possibility of raising

the boats ; but no attempt was made to raise the larger vessel, still intact. The boat demolished by the divers seems to have been a sort of floating palace moored by ropes to the shore. The floors were of glass mosaic, the windows were closed by bronze gratings, and the beams fastened together by splendid bronze nails often more than a foot long. The hawsers by which the boat was moored ran through bronze rings held in the mouths of colossal wolves' and lions' heads. These heads projected from massive bronze bands or frames, which were originally attached to stakes or pillars. A Medusa head of similar character, but without the ring for the hawser, and a forearm and hand (doubtless used, as in other cases, as a charm on the bow of the ship) were also found. Considered artistically, these works show great vigour, and the over-dramatic treatment of the hair and facial expression character- istic of periods when sculpture is used chiefly for decorative ends. From inscriptions found in 1895 it appears certain that these boats were built by Caligula, who also built the fantastic ships in which he coasted along the shores of Campania (see Suetonius, Caligola, 37).

Lake Regillus (see Ashby in the Rendiconti della Reale Acca- demia dei Lincei, February 1 ? ? 98). ? ? ? Nibby's suggestion {Analisi della Carta dei dintorni di Soma, iii. 9), that Pantano Secco is the site of Lake Regillus, is probably correct.

Terracina. ? ? ? A nymphoeum, subsequently used sis a tomb, was discovered in 1891 during the excavation of the foundations of the railway station of Terracina, which stands on the site of the ancient city of the same name. Fragments of statues of Venus, a nymph, and an unknown male figure were afso found, togetlier with some architectural remains. In another part of the town were discovered a sarcophagus and

a copy of the marble Faun of Praxiteles. During 1894 more important discoveries were made in connexion with the Temple of Jupiter Anxur, where Jupiter was worshipped as a child (see Livy xxviii. 11, xl. 45 ; Virgil, ^^u. vii. 799 ; and Servius, ad JEn. vii. 799). The ruins are situated on a hill called Monte Sant' Angelo. The dimensions of the foundation walls, of which the orientation is north and south, are 33-50 by 1970 metres. The cella measured 14-10 by 13-60 metres. The walls were decorated with engaged half-columns, six on each side and four at each end. All the walls and the upper parts of the columns were of opus incertum, but the lower parts of the columns were of travertine. The pronaos, 12-80 metres long, was decorated with Corinthian columns of early imperial style made of a local stone. The temple was destroyed by fire, but also bears traces of having been razed by the hand of man. In front of the temple cisterns were found, and on the east side a curious cleft in the rock, intended perhaps for the taking of the oracle. Some metres below the temple ran a great arcade of 02ms incertum, for. the distance of 62 metres towards the south and 24 metres towards the west ❓❓❓ a structure traditionally known as the Castle of Theodoric, but shown by the excavations to be the retaining wall of the terrace on which the temple stood. Many curious leaden objects (now in the Museo delle Terme) were found in the favissce situated on the east side of the temple. They represent plates, dishes for cooking fish, tables, chairs, dolls, pitchers, and candelabrum ❓❓❓ toys dedicated to the baby Jupiter. A few small fragments of the sculpture which once adorned the temple were also found.

Veii. ❓❓❓ Little more is known of this site than in the days of Nibby and Gell. In 1889 (see Notizie degli scavi, 1889) Italian officials did some unimportant work at the expense of the Empress of Brazil. Some traces of buildings were found, and large numbers of tombs were opened. They contained objects of an early date {circa 6th century B.C.), some of Eastern character suggesting Phoenician trade, but of little importance. Objects of precious metal were few and small. Much bucchero ware came to light, with some aretine cups and several thousand votive ofi'erings in terra-cotta. These latter represented various human organs, but were of coarse make and similar to these discovered on many other sites.

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Roirie, a city of Georgia, U.S.A., the capital of rioyd comity. It is situated in 34 16′ N., 85 10′ W., on a plain in the angle of junction of the Etowah and Oostanaula rivers, which here form the Coosa, navigable to this point, in the north-western part of the state, at an altitude of 652 feet. The town is divided into five wards, and has a good water-supply and sewerage system. It has three railways, the Chattanooga, Kome, and Southern, the Southern, and the Western and Atlantic. It is in a fertile cotton region, has cotton compresses and a large trade in that staple, and is the seat of Shorter College, a Baptist institution for women, opened in 1877, which had in 1899 a faculty of 14 and was attended by 129 students. Population (1890), 6957; (1900), 7291, of whom 108 were foreign-born and 2830 negroes.

Rome, a city of Oneida county. New York, U.S.A. It is situated in 43 13′ K, 75 27′ W., on the Mohawk river, on the Erie Canal, and on the New York Central and Hudson Eiver and the New York, Ontario, and Western railways, in the central part of the State, at an altitude of 445 feet. The city derives its water-supply from the Mohawk, and is well drained and lighted, but few of its streets are paved. Eome is in the dairying region of central New York, and contains butter and cheese factories. It has varied manufactures of iron, brass, and copper goods, breweries, and locomotive works. Population (1890), 14,991; (1900), 15,343, of whom 2527 were foreign-born and 89 negroes.

Romesh Chandra Mitra, Sm (1840-

1899), Indian judge, was born in 1840. When the East India Company's charter was renewed in 1853, the old Supreme Courts and Sadr Courts in the presidency towns were changed into High Courts, and Eoma Prasad Eoy, son of the great reformer Eaja Eam Mohan Eoy, was the first Indian who was appointed a judge of the new High Court of Calcutta. He did not live, however, to take his seat on the Bench, and was succeeded by Sambhu Nath Pandit, and then by Dwarka Nath Mitra, perhaps the most talented judge that India produced in the 19th century. Dwarka Nath's

great ability and thorough insight into cases were universally recognized in India ; his decisions were valued and often quoted ; and his name was often mentioned as an illustra- tion of the judicial capacity of the natives of India. Anukul Chandra Mukerji also sat on the Bench for a time; and on his death in 1871, Eomesh Chandra Mitra was appointed judge in his place. He maintained the high reputation of his predecessors, and for a period of nearly twenty years, down to 1890, he performed his judicial duties with credit and distinction. When the post of Chief-Justice was temporarily vacant in 1882, the Marquis of Eipon, then Viceroy of India, appointed Eomesh Chandra to ofiiciate in that post ??? the highest judicial position in the Indian Empire. Lord Dufferin, who succeeded Lord Eipon as Viceroy of India, appointed Eomesh Chandra a member of the Public Service Com-

mission, and in this capacity he did valuable work. Fail- ing health compelled him to retire from the High Court in 1890, and he was then knighted and appointed a member of the Viceroy's Legislative Council. Till he died in 1899, he continued to take interest in all social, educational, and political reforms in India. (e. c. d.)

Romford, a parish, urban district (1894), and market town, Essex, England, in the Eomford parlia- mentary division of the county, about 12 miles east-north- east of London by rail. In 1895 the ancient civil parish was divided into three civil parishes. A new Wesleyan chapel and a public hall have been erected. Population of urban district (1891) (extended area), 10,473; (1901),

13,656.

Romilly-SUr-Seine, town and railway station, arrondissement of Nogent-sur-Seine, department of Aube, France, 22 miles in direct line north-west of Troyes, on the Seine. It is an important industrial town, vrith extensive manufactures of cotton and woollen hosiery, and of the special machinery and appliances required for the industry. The Eastern Eailway Company has large workshops here. Population (1896), 7733; (1901), 8991.

Romney, New, municipal borough, Cinque Port, railway station, and parish, Kent, England, in the Southern or Ashford parliamentary division

of the county, 22 miles south -south -west of Canterbury, in the alluvial district called Eomney Marsh, a rich grazing area of 24,950 acres secured against the sea by an immense embankment under the management of an ancient corporation. It was formerly a busy port, but its harbour was destroyed by the silting up of shingle, and the town is now 1 mile inland. Littlestone-on-Sea is on the sea-front of the borough, with a fine sandy beach, and is growing in popularity as a summer resort. Population of the borough (1881), 1007 ;

(1901), 1327.

Romsey, a municipal borough and market town, in the New Forest parliamentary division of Hampshire, England, 7 miles north-west of Southampton by rail. The town is very ancient, and was called by the Eomans " Eomana Insula," because it (and its abbey) stood upon an island partly washed by the river Test. The abbey church of SS. Mary and Elfleda, dating from the first half of the 12th century, is cruciform and mainly fine Norman in style, but with an Early English west front. It was partially restored in 1892. The town has tanyards and ironworks, and the Berthon Boat Company has extensive works here. Population of the municipal borough (1881),

4204 ; (1901), 4365.

RonCOni, Giorgio (1810-1890), Italian baritone vocalist, was born in 1810. He learnt singing from his father Domenico, who had been a celebrated tenor in his time, and made his d6but in 1831 at Pavia. After sing- ing in Italy for some years with ever-growing success, he appeared for the first time in England, in 1842, as Henry Ashton in Lucia di Lammermoor. His success was immediate, and he continued to be one of the most popular artists on the lyric stage until his retirement in 1866. His voice was neither extensive in compass nor fine in quaUty, but the genius of his acting and the strength of his personality fully atoned for his vocal defects. He was equally at home in comedy and tragedy, and the two parts by which he is best remembered, Eigoletto and Figaro, show conclusively the range of his talent. In his later years Eonconi founded a school of singing at Granada, and he also accepted the post of professor of singing at the Madrid Conservatoire. He died in

1890.

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R 0 N D A ◆◆◆R 0 0 N

Rondcli a town of Spain, province of Malaga, on the river Guadalaviar. It has a station on the railway line from Algeciras to the junction of Bobadilla, on the Cordova-Granada-Malaga lines. The local industries are chiefly soap, flour, chocolate, tanneries, alcohol, and hat-making. Konda has four parish churches. The most important public buildings are the town-hall, bull- ring, casino, Casa del Eey Moro, the hospital of Santa Barbara, refuge for aged paupers, eight municipal schools for both sexes, and normal schools. Population (1897),

19,307.

Ronsdorf, a town of Prussia, Ehine province, 4 miles south of Barmen by rail, the seat of iron, steel, and copper industries, ribbon factories, brewing, and distilling. Has monuments to the Emperors William I. and Frederick III. Population (1885), 10,542; (1900), 13,299.

Rbntiren, Wiihelm Konrad (1845-

-),

German physicist, was born at Lennep on 27th March 1845. He received his early education in Holland, and then went to study at Zurich, where he took his doctor's degree in 1869. He then became assistant to Kundt at Wiirzburg and afterwards at Strasburg, becoming privat- docent at the latter university in 1874. Next year he was appointed professor of mathematics and physics at the Agricultural Academy of Hohenheim, and in 1876 he returned to Strasburg as extraordinary professor. In 1879 he was chosen ordinary professor of physics and director of the Physical Institute at Giessen, whence in 1885 he removed in the same capacity to Wiirzburg. It was at the latter place that he made the discovery for which

his name is chiefly known, the Kontgen rays. In 1895, while experimenting with a highly-exhausted vacuum tube on the conduction of electricity through gases, he noticed that a paper screen covered with barium platinocyanide, which happened to be lying near, became fluorescent under the action of some radiation emitted from the tube, which at the time was enclosed in a box of black cardboard. Further investigation showed that this radiation had the power of passing through various substances which are opaque to ordinary light, and also of affecting a photo- graphic plate. Its behaviour being curious in several respects, particularly in regard to reflection and refraction, doubt arose in his mind whether it was to be looked upon as light or not, and he was led to put forward the hypo- thesis that it was due to longitudinal vibrations in the ether, not to transverse ones like ordinary light ; but in view of the uncertainty existing as to its nature, he called it X-rays. For this discovery he received the Rumford medal of the Royal Society in 1896, jointly with Professor Philip Lenard, who had already shown, as also had Hertz, that a portion of the cathode rays could pass through a thin film of a metal such as aluminium. Professor Ront- gen has also carried out researches in various other branches of physics, including elasticity, capillarity, the conduction of heat in crystals, the absorption of heat-rays by differ- ent gases, piezo-electricity, the electromagnetic rotation of polarized light, (fee.

Rontgren Rays. See Electricity.

Roon, Albrecht Theodor Emil, Count

VON (1803-1879), Prussian field-marshal, author, and reorganizer of the Prussian army, was born at Pleushagen, near Colberg, in Pomerania, on the 30th April 1803. His family was of Flemish origin, and was settled in Pomerania. His father, an officer of the Prussian army during the French occupation, died in poverty, and young von Roon was brought up by his maternal grandmother. He entered the corps of cadets at Kulm in 1816, whence in 1818 he

proceeded to the military school at Berlin, and on the 19th January 1821 received a commission in the 3rd (now 14th) Pomeranian regiment quartered at Stargard in Pomerania. In 1824 he went through the three

years' higher course of study at the war school in Berhn. In 1826 he was transferred to the 15th Foot at Minden, but the same year was appointed an instructor in the military cadet school at Berlin, where he devoted himself especially to the subject of military geography. He published in 1832 the well-known Principles of Physical, National, and Political Geography, in three volumes {Grundzuge der Erd-Volher-und-Staaten-Kunde), thereby founding a practically new system and making a name for himself. This work was followed in 1834 by Elements of Geography (Anfangsgriinde der Erdkunde), in 1837 by Military Geography of Europe (Militdrische Ldnderbeschreibung von Europd), and in 1839 by The Iberian Peninsula {Die Iherische Halbinsel).

Meantime, in 1832, he rejoined his regiment, and was afterwards attached to the headquarters of General von Miiffling's corps of observation at Crefeld, when he first became alive to the very inefficient state of the Prussian army. In 1833 he was appointed to the Topographical Bureau at Berlin, in 1835 he entered the General Staff, and in the following year was promoted captain and became instructor and examiner in the mihtary academy at Berlin. In 1842 he was promoted to be major, and was present at the manoeuvres on the Rhine under General von Pfhiil, when he was again impressed with the inefficiency of the organization of the army, and occupied himself with schemes for its reform. Two years later, as tutor to Prince Frederick Charles, he attended him at the Bonn University and in his European travels. In 1848 he was appointed chief of the staff of the 8th Army Corps at Coblenz, under the command successively of Generals von Dunker, von Schreckenstein, and von Hirschfeld. During the disturbances of that year he served under the Crown Prince Wilham (afterwards German Emperor) in the suppression of the insurrection at Baden, and distinguished himself by his energy and bravery, receiving the 3rd class of the order of the Red Eagle in recognition of his services. While attached to the Crown Prince's staff at that time he broached to him the subject of his schemes of army reform. In 1849 he was promoted to be lieutenant-colonel and entrusted with the details of the mobilization to take place the following year; but the defective condition of the organization of the army was so serious that the differences with Austria had to be arranged by the humiliating treaty of Olmiitz in November 1850.

Promoted to be major-general in 1856 and lieutenant- general in 1859, von Roon had held since 1850 several commands and had been employed on important missions. Prince William became regent in 1857, and in 1859 he appointed von Roon a member of a commission to report on the reorganization of the armj'. Supported by Manteuffel and von Moltke, von Roon was able to get his plans seriously considered and generally adopted. His aim was to create an armed nation, to extend Scharn- horst's system, and to adapt it to Prussia's altered cir- cumstances. To attain this he proposed a universal three years' service, and a reserve (Landnvhr) for the defence of the country when the army A^-as actively engaged. During the Italian war ho was charged with the mobilization of a division. At the end of 1859 he succeeded von Bonin as War]\nnister, and two years later the ^Ministry of i\[ai'ine was also entrusted to him. His proposals of army reorganization met with the bitterest opposition, and it was not until after long fighting against a hostile majority in the Chambers that, with Bismarck's aid, he

carried the day. Even the Danish campaign of 1864 did not wholly convince the country of the necessity of his measures, and it required the war with Austria of 1866 to convert obstinate opposition into enthusiastic support. Then von Boon, from being the best hated man in Prussia, became the most popular, and his reforms were ultimately copied throughout continental Europe. The system adopted by the North German Confederation produced its inevitable result in the victorious war with France in 1870-71, throughout which von Roon was in attendance on the German Emperor. The fiftieth anniversary of his entrance into the army was celebrated at Versailles on the 19 th January 1871, when the Emperor expressed his gratitude for the great services he had rendered. He was created a count, and in December 1871, having resigned the Ministries of War and Marine, he succeeded Bismarck as President of the Prussian Ministry. Ill-health com- pelled him to resign in the following year. He was pro- moted to be field-marshal on the 1st January 1873. He died at Berlin on the 23rd February 1879.

After his death his son published the valuable Denkwiirdigkeiten mis dein Leben des Oeneralfeldmarschalls Kriegsministers Grafen Bocm, Sainmlung von Briefen, Schriftstilcken v/nd EnnneruTigen (2 vols., Breslau, 1892), and Kriegsminister von Soon ah Bedner poliiisch und militdrisch erldutert (Breslau, 1895). (u. h. V.)

Roorkee, or Rurki, a town of British India, in the Saharanpur district of the North- West Provinces ; situ- ated in 29 52′ N. and 77 55′ E. ; on the Oudh and Rohilkhand Railway, 22 miles east of Saharanpur. Population (1891), 14,291 ; municipal income (1897-98), Rs. 13,730. Headquarters of the workshops of the Ganges canal, and also of the Bengal sappers and miners. Thomason Civil Engineering College, founded 1847, was transferred from the Public Works to the Education Department in 1895, and then reorganized. It consists of an engineer class of 22 English and 11 native students, an upper subordinate class of 31 English civil and military and 16 native students, a lower subordinate class of 66 native students, a military survey class of 8 English and 10 native students, together with mechanical apprentice and industrial classes. The college, which is not affiliated to the Allahabad University, works in co- operation with the workshops and foundry of the canal, and also trains in surveying and in photography.

-), President

Roosevelt, Theodore (1858-

of the United States, was born in New York City on the 27th October 1858. His ancestry connected him with old and substantial families in both the Northern and the Southern section of the Union. The Roosevelts, his father's forebears, had been, from the middle of the 17th century, conspicuous in the Dutch element of the citizens of New York, and his mother, itJe Bullock, was a member of an old family which furnished the first revolutionary governor to the state of Georgia. The education of Theodore Roosevelt was that common to the well-to-do boys of his time, and culminated in the course at Harvard College, from which he graduated in 1880. After a period of travel in Europe, he returned to New York in 1881, and studied for a year in the law school of Columbia College and in the office of his uncle. The law proved, however, to have

little attraction for him, and the year during which he was nominally engaged in its study saw the beginning of 'his active career in the two lines which were most to his taste ??? literature and politics. It was at this same time, moreover, that he began his familiar acquaintance with Western frontier life, and added another and most significant element to those hereditary interests which attached him in sympathy to widely diverse sections of the country.

Mr Roosevelt entered political Ufe as a Republican, but in opposition to the " machine." As the nominee of a body of independents in the party, he was elected member of the state legislature from New York City in the autumn of 1881, and served continuously for three years, 1882-84. During this period his energy, honesty, and fearlessness won for him a very prominent position in his party and in general public esteem. He devoted himself especially to the cause of administrative reform in New York City, and pursued to extinction a number of grave abuses in the government of the municipality. In 1884, as a delegate to the National Convention of the Republican party, he joined with the faction which opposed the nomination of Mr Blaine for President ; and while he did not, Uke many of his associates in that cause, refuse to accept Mr Blaine when nominated, his support of the candidate lacked some- thing of his familiar vehemence, though he strenuously proclaimed himself a loyal party man. Two years later he justified his professions of party loyalty by accepting the RepubKcan nomination for mayor of New York City, at a time when most of the reform element in the party wished to unite in a non-partisan movement against Tammany HaU. His conduct at this time brought upon him censure from many who had hitherto warmly supported him, and he was badly defeated in the election. For three years after this Mr Roosevelt devoted himself chiefly to litera- ture and to the enjoyment of life on his ranche in the mountains of Dakota. In April of 1889, at the beginning of Mr Harrison's administration, the President appointed Mr Roosevelt a member of the National Civil Service Commission, on which he served for six years. In this position he found congenial occupation in promoting with all his energy the substitution of competitive examina- tion for congressional patronage in filling the minor administrative offices. He retired from this position only when the scheme had been worked out through which, by President Cleveland's

order, practically the whole civil service was brought under the operation of the new system. From this work of reform Mr Roosevelt was called back to municipal afi”airs in 1895, through his appointment as one of the police commissioners of New York City. A legislative investigation had revealed widespread and inveterate corruption in the police force, and Mr Roosevelt found a field for all his energy in restoring in some measure the moral of the organization. The two years of service in this work confirmed his reputation for great administrative efiiciency, and general approbation was given to his appointment by President McKinley as Assistant Secretary of the Navy in 1897. In this position it fell to Mr Roosevelt to contribute very greatly to the preparation of the navy for the war with Spain. Himself anticipating and convinced of the justice of the war, he saw to it that the vessels and supplies were so distributed, both at home and in the Orient, that when hostilities broke out the victories in the waters of Cuba and the Philippines followed as matters of course. Dis-satisfied with a function that kept him from participation in the actual fighting, Mr Roosevelt resigned from the Navy Department 6th May 1898, and devoted himself to the organization of a volunteer regiment of cavalry ??? popularly known as the ” Rough Riders ” ??? of which he was commissioned lieutenant-colonel. His reputation and extensive acquaintance throughout the country brought together in this regiment a remarkable assortment of typical characters, from the fashionable clubs and the police force of New York, football players and all-round athletes from the prominent colleges, and cowboys and other venturesome spirits from the West. With this command, which was quickly drilled into a well-disciplined and formidable body of troops, he took part in the campaign

???which resulted in the fall of Santiago. For conspicuous gallantry in action Mr Eoosevelt was promoted to be colonel. After the surrender of the Spaniards he quickly became weary of the idle waiting, in the hot and fever- stricken region, for the return to America, and his vigorous and reasonable, if somewhat insubordinate, repre- sentations to the commander-in-chief greatly hastened the withdrawal of the troops to the

United States, where the regiment was mus- tered out of service at the end of the summer.

With the addition of conspicuous mili- tary achievement to his record for strength and effici- ency in civil office, Mr Roosevelt's politi- cal career was now assured. Nominated on his return from Cuba as the Repub- lican candidate for governor of New York State, he was elected by a sub- stantial majority in November 1898. His administration was characterized by the same devotion to honest and straight- forward party poli- tics and to pure and efficient administra- tive methods that had been manifest in his earlier career. When the presi- dential elections of 1900 drew near, there was evidently a strong feeling in the rank and file of the RepubKcan party that Governor Roose- velt should receive national office. Since many circumstances conspired to make the renomination of Mr McKinley as President inevitable, the demand arose that Governor Roosevelt should be named for Vice-President. The relatively insignificant duties of this office, however great its dignity, offered no attraction to so active a spirit as that of Mr Roosevelt, and he was, moreover, anxious to serve another term as governor. Hence he resisted openly and with all his power the movement to name him for Vice- President. But the popular enthusiasm was sedulously stimulated by the New York politicians of the baser sort, who were very willing to get rid of a governor who had little sympathy with their general aims and methods, and the National Republican Convention, disregarding the per- sistent refusals of Mr Roosevelt, put him by main force in nomination aa Vice-President. The elections of 1900 gave an easy victory for McKinley and Roosevelt. In- augurated in March 1901, the Vice-President's only service

was a nominal presidency of the Senate in the special session in March. The assassination of Mr McKinley brought the succession to Mr Roosevelt, who took the oath and assumed the functions of President on the day of Mr j\IcKinley's death, 14th September 1901.

Mr Roosevelt's contributions to literature have had a pretty close relation to the events of his active life. His first work. The Naval History of the War of 1812, was

published in 1882, at the outset of his career. Between 1885 and 1889, when not in the public service, he entered upon that systematic study of frontier life which produced not only his chief his- torical work, Tlie Winning of tlie West, but also a series of volumes descriptive of his experiences in hunting and ranch- ing in the Far West. His experiences in political life resulted in a number of volumes and very many magazine ar- ticles in all of which the leading feature was the gospel of activity and effort ❖❖❖ the "strenuous life," as opposed to either the aloofness of the mere philosopher and critic, or the indo- lence and idleness of the Sybarite or the C5Tiic. Some of these articles were published in 1902 under the title of The Strenuous Life.

Rops, Fan- cier! (1833-1898), Belgian painter, de- signer, and engraver, excelled in these three methods of artistic expression ; but his engraved work is the most important, both as to mastery of technique and originality of ideas, though in all his talent was exceed- ingly versatile. Hardly any artist of the 19th century equalled him in the use of the dry-point and soft varnish. By his assured handling and admirable draughtsmanship, as well as the variety of his sometimes wildly fantastic con- ceptions, he made his place among the great artists of his time. " Giving his figures a character of grace which never lapses into limpness," says his biographer, E. Ramiro, "he has analysed and perpetuated the human form in all the elegance and development impressed on it by modern civilization." F^licien Rops (born at Naniur, in Belgium, 10th July 1833) spent his childhood in that town, and afterwards in Brussels, where he composed in 1856, for his friends at the university, the Almanach Crocodilien,

his first piece of work. He also brought out two Salons Jllustrds, and collaborated on the Crocodile, a magazine produced by the students. The humour shown in his con- tributions attracted the attention of publishers, who offered him work. From 1864 to 1866 he designed, among other things, almost all the frontispieces for Poulet-Malassis, and afterwards for Gay and Douc^. In 1865 he started a satirical journal ; Uylenspilgel,

a sort of Charivari. The issue, limited unfortunately to two years, included his finest lithographs. In the same year he brought out his famous "Buveuse d' Absinthe," which placed him in the foremost rank of Belgian engravers; and in 1871 the "Dame au Pantin." After 1874 Kops resided in Paris. His talent, which commanded attention by its novel methods of expression, and had been stimulated by travels in Hungary, Holland, and Norway, whence he brought back character- istic sketches, now took a soaring flight. To say nothing of the six hundred original engravings enumerated in Ramiro's Catalogvs of Raps' Engraved Worh (Paris, Conquet, 1887), and one hundred and eighty from litho- graphs (Ramiro's Catalogue of Sops' Lithographs, Paris, Conquet, 1891), besides a large number of oil-paintings in the manner of Courbet, and of pencil or pen-and-ink drawings, he executed several very remarkable water-colour pictures, among which are "Le Scandale," 1876; "Une Attrapade," 1877 (now in the Brussels Museum) ; a "Tentation de St Antoine," 1878; and "Pornocrates," 1878. Most of these have iDsen engraved and printed in colours by Bertrand. From 1880 to 1890 he devoted himself principally to illustrating books : Les Rimes de Joie, by Th6o Hannon; Le Vice Sv/preme and Curieuse, by J. Peladan ; and Les Diaboliqiies, by Barbey d'Aur^villy; L'Amante du Christ, by R. Darzens; and Zadig, by Voltaire ; and the poems of St^phane Mallarm^ have frontispieces due to his fertile and powerful imagination. Before this he had illustrated the Ligendes Flamandes, by Ch. Decoster ; Jeune France, by Th. Gautier ; and brought out a volume of Cent Croquis pour rejouir les HonnStes Geiis. His last piece of work, an advertisement of an exhibition, was done in November 1896. Rops died, 23rd August 1898, at Essonnes, Seine-ef^Oise, on the estate he had purchased, where he lived in complete retirement with his family. Scorning display, Rops almost always opposed any exhibition of his works. However, he consented to join the Art Society of the " XX.," formed at Brussels in 1884, as their revolutionary views were in harmony with the independence of his spirit. After his death, in 1899, the Libre EstMtique, which in 1894 had succeeded the "XX.," arranged a retrospective exhibition, which included about fifty paintings and drawings by Rops. Rops was a Chevalier of the Legion of Honour.

In 1896 La Pluine (Paris) devoted a special number to this artist, fully illustrated, by which the public were made aware how many of his works are unsuitable for display in the drawing-room or boudoir. E. Deman, the publisher at Brussels, brought out a, volume in 1897 with the title, Filicien Mops et son asuvre ❓❓❓ papers by various writers. We may also mention a study of FeKcien Bojis, by Eugene Demolder (Paris, Prineebourde, 1894), and another by the same writer in Trois Oontemporains (E. Deman, 1 901) ; Les Sopsiaques, by Pierre Gaume, brought out in London, 1898 ; and the admirable notice by T. K. Huysmans in his volume called Certains. (p. M.)*

Rosa,riO, a city and important river port of the Argentine Republic, in the province of Santa F6, on the river Parani, in 32❓❓ 56' S. and 60❓❓ 33' 39" W. Population in 1900, 112,461, an increase of 23 per cent, as compared with the census of 1895. ‘ Railways following seven distinct routes afibrd communication with the other cities of the republic, and within Rosario itself various tramways are laid down. There are a municipal zoological garden, several parks and recreation grounds, and monu-

ments in honour of Garibaldi and the ” 25th of May,” (Revolution Day, 1810). A public hospital has been erected ; there are also Italian and Anglo-German hospitals. Public buildings also include a handsome Palais de Justice, a normal school for teachers, a school for secondary educa- tion, and a theatre. The exports consist chiefly of cereals and other agricultural produce from the busy settlements that have been established in the district. In 1900 the grain exported from Rosario was 809,000 tons of wheat, 202,000 tons of maize, and 64,000 tons of linseed. The railways carry much of the trade, but besides the river and coast traffic, steamers maintain direct communication with Europe. In 1880 the imports were valued at ❓❓1,130,000, and the exports at ❓❓1,230,000; in 1890 at ❓❓3,120,000 and ❓❓3,280,000; in 1898 at ❓❓1,840,000 and ❓❓5,160,000; in 1899 at ❓❓2,027,442 and ❓❓7,350,121; and in 1900 at ❓❓1,913,803 and ❓❓5,851,239. In 1890, 1039 vessels of 742,967 tons entered, and 913 of 654,623 tons cleared; in 1898, 664 vessels of 696,550 tons entered, and 831 of 922,000 tons cleared. In 1900,

682 ocean-going vessels of 1,027,353 tons entered the port, and approximately the same number cleared.

Roscher, Wilhelnn Georg Friedrich

(1817-1894), German political economist, was born at Hanover, 21st October 1817. He studied at Gottingen and Berlin, and obtained a professorship at Gottingen in 1844 and subsequently at Leipzig in 1848. He is one of the most important in what is knovni as the "historical" school of political economy. He published a number of works on this and kindred subjects, the two chief being his great System der Volkswirthschaft, published in 5 vols, between 1854 and 1894, and his Geschichte der Nationaldhorwmie in Deutschland (1874). He also published in 1842 an excellent commentary on the life and works of Thucydides. He died at Leipzig, 4th June 1894.

ROSCOITinnon, an inland county of Ireland, province of Connaught. The area of the administrative county in 1900 was 607,002 acres, of which 120,406 were tillage, 358,090 pasture, 69 fallow, 7444 plantation, 75,431 turf bog, 9875 marsh, 6213 barren mountain, 29,474 water, roads, fences, &c. The administrative county under the Local Government (Ireland) Act, 1898, includes one electoral division formerly situated in Galway, and two electoral divisions formerly situated in Mayo, but does not include the portions of the towns of Balluiasloe and Athlone formerly in Roscommon.

Population. ❓❓❓ The population in 1881 was 132,490 ; in 1891, 114,397 ; and in 1901, 101,639, of whom 51,143 were males and 50,496 females, divided as follows among the different religions: Roman Catholics, 98,985 ; Protestant Episcopalians, 2229 ; Presby- terians, 247 ; Methodists, 96 ; and other denominations, 82. The decrease of population between 1881 and 1891 was 13'65 per cent., and between 1891 and 1901, 12'8 per cent. The average number of persons to an acre in 1891 was ❓❓❓19, and of the total population, 107,201 inhabited the rural districts, being an average of 147 to eacli square mile under crops and pasture. The following table gives the degree of education in 1891 :
❓❓❓

Males.

Females.

Total.

Percentage.

R.C.

Pr.Ep.

Presb.

Meth.

Read and write Read only Illiterate .

37,646 5,579 9,186

34,702 6,450 9,621

72,248 12,029 18,807

69-2 12-0 18-8

92-3 4-0 3-7

95-9 2-7 1-4

95-8 1-7 2-5

The percentage of illiterates among Roman Catholics in 1881 was 28 ‘2. In 1891 there were 5 superior schools, with 237 pupils (Roman Catholics 49, and Protestants 188), and 236 primary schools, with 17,714 pupils (Roman Catholics 17,211, and

Protestants 503). The number of pupils on the rolls of the National schools on 31st December 1900 was 20,707, of whom 20,241 were Roman Catholics and 466 Protestants. The follow- ing table gives the number of births, deaths, and marriages in various years : ???

Births.

Deaths.

Marriages.

1881 . 1891 . 1900 .

3615 2383 1921

2001 1717 1536

593

388 404

In 1900 the birth-rate per 1000 was 18-9, and the death-rate 15-1 ; the rate of illegitimacy was 7 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 102,273, of whom 50,328 were males and 51,946 females. The chief towns in the county are Boyle, Castlerea, and Roscommon.

Administration. ??? The county is divided into two parliamentary divisions, North and South, tlie number of registered electors in 1901 being respectively 8871 and 9610. The rateable value in 1900 was ??300,187. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were estab- lished, and under that Act the county now comprises seven rural sanitary districts.

Agriculture. ❖❖❖ The following tables give the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900. The figures for 1900 are for the new administrative county : ❖❖❖

Wheat.

Oats.

Barley, Eye.

Pota- toes.

Tur- nips.

Other Green Crops.

Meadow

and Clover.

Total.

1881 1891 1895 1900

452 455 172 409

28,329 21,815 19,528 17,603

803 2168 1075 1425

28,901 23,547 20,609 20,764

4543 4820 4186 3939

2369 3220 3677 3833

68,367 68,227 72,487 72,425

133,564 124,252 121,335 120,406

For 1900 the total value of the cereal and other crops was estimated at ►►771,870. The number of acres under pasture in 1881 was 335,118 ; in 1891, 344,186 ; and in 1900, 358,090.

Horses

and Mules.

Asses.

Cattle.

Sheep.

Pigs.

Goats.

Poultry.

1881 . 1891 . 1395. 1900.

10,552 12,733 13,421 12,247

8,514 10,639 10,916 11,844

103,759 124,502 121,644 134,528

138,067 196,305 171,165 192,469

28,181 37,059 37,939 42,774

10,646 15,787 14,279 14,368

466,076 500,083 535,498 59.5,507

The number of milch cows in 1891 was 31,128, and in 1900, 34,635. It is estimated that the total value of cattle, sheep, and pigs for 1900 was ––2,146,410. In 1900 the number of holdings not exceeding 1 acre was 925 ; between 1 and 5, 226C ; between 5 and 15, 8718 ; between 15 and 30, 5796 ; between 30 and 50, 1750 ; between 50 and 100, 924 ; between 100 and 200, 539 ; between 200 and 500, 282 ; and above 500, 21 ; total, 21,211. The number of loans issued (the total of loans being the same as that of tenants) under the Laud Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901, was 1811, amounting to ––347,437. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, between 1882 and 1901, was 575, and the amount issued was ––38,029. The total amount issued on loan for all classes of works under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1901, was ––232,683.

(w. H. Po.)

Rosebery, Archibald Philip Primrose,

5th Eakl OP (1847), British statesman, born in

London on 7tli May 1847, was the grandson and successor to the title of Archibald John Primrose, 4th earl of Rosebery {d. 1868), a representative peer of Hcotland, who was in 1828 created a peer of the United Kingdom as Baron Rosebery, and was an active supporter of the Reform Bill. The Scottish earldom was first conferred in 1700 upon the 4th earl's great-grandfather, Archibald Primrose of Dalmeny (1661-1723), a staunch Whig and

commissioner for the Union. The 5th earl's mother was Catherine Lucy Wilhelmina, only daugher of Philip Henry, 4th Earl Stanhope ; she was thus a sister of Earl Stan- hope the historian, and a niece of Lady Hester Stanhope, who was the niece of William Pitt. A celebrated beauty, a maid of honour and bridesmaid of Queen Victoria, she married, on 20th December 1843, Archibald Lord Dalmeny (1809-1851), member for the Stirling Burghs, who became a lord of the Admiralty under Melbourne. After his death she became the wife of Harry George Vane, 4th duke of Cleveland, and died in 1901.

The young Lord Dalmeny was educated at Brighton and at Eton, where he had as slightly junior contempor- aries Mr A. J. Balfour and Lord Randolph Churchill. He was described by the most brilliant Eton tutor of his day, William Johnson Cory (author of lonica), as a ” portentously wise youth, not, however, deficient in fun.” He added that Dalmeny “desired the palm without the dust.” In 1866 he matriculated at Christ Church, Oxford, but went down in 1868, by the request of the dean, rather than abandon the possession of a small racing stud. In the same year he succeeded to the earldom and to the family estates. In February 1871 he seconded the Address in the House of Lords; a more original effort followed in November 1871, when he delivered a remark- able essay on the Union of Scotland and England at the Edinburgh Philosophical Institution. Three years later he was elected president of the Social Science Congress at Glasgow, where, on 30th September, he gave a striking address upon the discovery of means for raising the con- dition of the working class as the ” true leverage of empire.” In the meantime he travelled in the south of Europe and in North America. On his return he acquired an English country house called The Durdans, Epsom, which he largely rebuilt and adorned with some of the finest turf portraits of George Stubbs. Following the example, as he declared, of Oliver Cromwell (for whom he showed an admiration in other respects ??? cul- minating in 1900 in the erection of a statue outside Westminster Hall, which was not appreciated either by the Irish Nationalist party or by others among his political associates), he took a pride in owning racehorses, and afterwards twice won the Derby, in 1894 and 1895. No former premier had attained to the distinction of being Derby-winner during office ; but though the distinction was popular among many classes, it did not endear Lord Rosebery to the Nonconformists, who considered a race- horse a mere gambling-machine. On 20th March 1878 he married Hannah, only child of Baron Jleyer Amschel de Rothschild, of Mentmore, Bucks. The newly married couple took a lease of Lansdowne House, which for several years was a salon for the Liberal party and a centre of hospitality for a much wider circle.

Though impeded in his political career by his exclusion from the House of Commons, Lord Rosebery’s reputation as a social reformer and orator was steadily growing during these years. In 1878 he was elected Lord

Rector of Aberdeen and in 1880 of Edinburgh University, where he gave an eloquent address upon Patriotism. In 1880 he entertained Mr Gladstone at Dalmeny, and during the " Midlothian campaign " he had much to do with the stage-management of the demonstrations. It is possible that their success may have led him to form a somewhat unduly histrionic conception of the part of a political leader, and this tendency was not weakened by an enthusiastic Study of Lord Beaconsfield's political novels, more particularly of Syliil, after the heroine in which he named one of his daughters. In August 1881 he became uuder-secretary at the Home Office, his immediate chief being Sir William Harcourt. His

work was practically confined to the direction of the Scottish department of the Office. A clamour was never- theless raised in regard to the incompatibility of the under-secretaryship with a position in the House of Lords, and Lord Eosebery resigned the post in June 1883. He and his wife utilized the interval to make a trip round the world, being most warmly received in AustraUa, and returning by way of India. At the close of 1884 he resumed office as first commissioner of works with a seat in the cabinet, and his adherence carried with it a distinct accession of strength to the Liberal ministry, which was much discredited by the tragedy attached to the fate of Gordon. The attitude of the Government on the Afghan question and generally in regard to Russia was held by many to have been perceptibly stiffeijed owing to Lord Eosebery's influence.

In June 1885 the Liberal administration broke up, but Lord Salisbury's ministry, which succeeded, was beaten early in February 1886, and when Mr Gladstone adopted Home Eule, Lord Eosebery threw in his lot with the old leader, and was made secretary of state for foreign affairs during the brief Liberal min- istry which followed. He rather distinguished himself in the Lucia Bay negotiations then being carried on with Germany. If Busch is to be believed, Prince Bismarck's view was that Lord Eosebery had "quite mesmerized" Count Herbert Bismarck, and the latter, from his father's stand- point, conceded too much to Lord Eosebery, who proved himself to be, in Bismarck's language, "very

sharp." His views on foreign policy differed materially from those of Gran- ville and Gladstone. His mind was dwelling constantly upon the political legacy of the two Pitts ; he was a reader of Sir John Seeley ; he had him- self visited the colonies ; had predicted that a war would not, as was commonly said, disintegrate the Empire, but rather the reverse; had mag- nified the importance of tak- ing colonial opinion; and had always been a convinced advocate of some form of Imperial Federation. He was already taunted with being an Imperialist, but his independent attitude won public approval. Cambridge gave him the degree of LL.D. in 1888 ; in January 1889 he was elected a member of the first County Council of London, and on 12th February he was elected chairman of that body by 104 votes to 17. The tact, assiduity, and dignity with which he guided the deliberations of the council made him exceedingly popular with its members. In the spring of 1890 he presided over the Co-operative Congress, but with a view to the impending political campaign he found it necessary to resign the chairmanship of the County Council in June. In November of this year, however. Lady Eosebery died, and he withdrew for a period from public business. In 1891 he made some brief Continental visits, one to Madrid, and in October he saw through the press his little mono- graph upon William Pitt, in the " Twelve English States-

THE BAEL (FroTn a photograph 6j

men " series, of which it may be said that it competes in interest with Mr John Morley's Walpole. In January 1892, upon a new election, he again for a few months became chairman of the County Council. It was already recognized that in him the country possessed not only a public man of exceptionally attractive personahty, but one whose literary tastes were combined with a gift for expression which was at once original and fluent. In October the Garter was conferred upon him by Queen Victoria.

Meanwhile, in August, upon the return of Gladstone to power, he was induced with some difficulty (for he was suffering at the time from insomnia) to resume his position as Foreign Minister. His acceptance was construed as a security against the suspicion of weakness abroad which the Liberal party had incurred by their foreign policy during the 'eighties. He strongly opposed the evacuation of Egypt ; he insisted upon the

exclusive control by Great Britain of the Upper Nile vaUey, and also upon the retention of Uganda. In 1893 the question of Siam came near to causing serious trouble with France, but by the exercise of a combination of firmness and forbearance on Lord Eosebery's part the crisis was averted, and the lines were laid down for preserving Siam, if pos- sible, as a buffer state between the English and French fron- tiers in Indo-China. In the spring of 1895 he was clear- sighted enough to refuse to join the anti-Japanese League of Russia, France, and Ger- many at the end of the China- Japan war.

Lord Eosebery's personal popularity had been increased at home by his successful in- tervention in the coal strike of December 1893, and when in March 1894 the resignation of Gladstone was announced, his selection by Queen Victoria for the premiership was wel- comed by the public at large and by the majority of his own party. On all hands he was then considered dignus imperio ❓❓❓ it was only as went to pieces that people The conditions he had to The Liberal majority of

OF EOSEBERY.

' Elliott and Pry, London.)

the new administration began to add nisi imperasset. face were by no means hopeful.

44 was already dwindling away, and the malcontents, who considered that Sir William Harcourt should have been the prime minister, or who were perpetually in- triguing against a leader who did not satisfy their idea of Eadicalism, made Lord Eosebery's personal position no easy one. A systematic policy of detraction was pursued by the small section of the Eadical party who objected to a peer premier as such, and a great deal of adverse criticism was also aroused by a speech in which the prime minister, taunted for not again bringing forward a Home Eule measure, insisted upon the truism that the conversion of England, the " predominant partner," was a necessary condition of success. The support of the Irish Nationalists was by no means secure. Lord Eosebery's foreign policy, moreover, was too Tory for his Eadical followers ; he in- sisted upon " continuity of policy in foreign afi'airs," which

meant carrying on the Conservative policy and not up- setting it. The premier was thought to have shown a restlessness and a rawness at the touch of censure, which did not increase his reputation for reserve power or strength, but this was undoubtedly due in large measure to the recrudescence of the insomnia from which he had suffered in 1891. The Government effected little. In Mr Asquith's phrase, it was " ploughing the sands." The Parish Councils Act was only passed by compromising with the Opposition. Local Veto and Disestablishment of the Welsh Church were put in the forefront of the party programme, but the Government was already to all appearances riding for a fall, when on 24th June 1895 it was beaten upon an adverse vote in the Commons in regard to a question of the supply and reserve of small arms ammunition.

The general election which followed after Lord Salisbury had formed his new ministry was remarkable for the un- disciplined state of the Liberal party. At the Eighty Club and the Albert Hall, Lord Kosebery advised them to concentrate upon the reform of the House of Lords, that assembly being, as he said, a foremost obstacle to the passing of legislation on the lines of the Newcastle programme, but he was unable to suggest in what direction it should be reformed. Sir WiUiam Harcourt and Mr John Morley, on the other hand, concentrated respectively upon Local Option and Home Rule. The result was an overwhelming defeat. Lord Eosebery handed over the seals of office with undisguised relief. Considerable difficulties in Africa, in Chitral, and in the Levant were trans- mitted to the new Government. The question of inter- vention between the Sultan and the Armenians became a burning one in the country in 1896, and Mr Gladstone emerged from his retirement to advocate intervention. Lord Rosebery declined to support this demand at the risk of a European war, and on 8th October 1896 he announced to the Liberal whip, Mr Thomas Ellis, his resignation of the Liberal leadership. On the following day he made a farewell speech at the Empire Theatre, Edinburgh, to over 4000 people, and for some time he held aloof from party politics, "ploughing his furrow alone," as he afterwards phrased it.

In 1898, on the death of Mr Gladstone, he paid a noble and eloquent tribute in the House of Lords to the life and public services of his old leader. He was a pall-bearer at his funeral on 28th May, as he had previously been at the burials of Tennyson and Millais. His influence in the country was still a strong one on personal grounds, and he came forward now and again to give expression independ- ently to popular feeling. In the autumn of 1898 he gave valuable support to the attitude taken up by Lord Salisbury upon the Fashoda question. He was indeed bound by consistency to withstand what his own Govern- ment, by the words of Sir Edward Grey, had declared would be an unfriendly act on the part of France. Again, after Mr Kruger's ultimatum in October 1899, Lord Rosebery spoke upon the necessity of the nation closing its ranks and supporting the Government in the prosecution of war in South Africa. After Nicholson's Nek he re- iterated the resolution of the country " to see this thing through." Nevertheless, in a letter to Captain Lambton, an unsuccessful Liberal candidate for Newcastle, in Sep- tember 1900, he condemned the general conduct of affairs by Lord Salisbury's Government, while in several speeches in the House of Lords he strongly urged the necessity of army reform. Since his abandonment of the leadership in 1896, the lack of coherence in the Liberal party had become more and more manifest. The war had brought to the front a pro-Boer section, who seemed gradually to be compromising the whole party, and had apparently suc- ceeded in winning the support of Sir Henry Campbell-

Bannerman, the leader in the House of Commons. Lord Rosebery maintained for the most part a Sphinx-like seclusion, but in July 1901 he at last came forward strongly as the champion of the Liberal Imperialist section.

In deference to the wishes of supporters such as Mr Asquith, Sir Henry Fowler, and Sir Edward Grey, he determined to " put his views into the common stock " at a representative meeting of Liberals held at Chesterfield in December 1901. There he advised the Liberal party that "its slate must be cleaned," and, as he subsequently explained, this cleansing must involve the elimination of Home Rule for Ireland. His appeal for " spade work " resulted in the formation of the Liberal League,

inside the Liberal Opposition ; and what Lord Rosebery himself described as his ” definite separation ” from Sir Henry Campbell-Bannerman’s ” tabernacle ” took place. This announcement, however, was no sooner made than it was explained away by the supporters of both, and early in 1902 Lord Rosebery spoke at the National Liberal Club in a way which indicated that an understanding might still be arrived at. But, as he candidly admitted in a recent speech delivered at the Liberal League dinner, 31st July 1902, the principles of Liberal Imperialism have not yet prevailed, and until they prevail the reconciliation of the two vsdngs of the party may, in Lord Eosebery’a opinion, remain impossible.

In 1900 he published a volume called Napoleon: the Last Phase, an ingenious, if paradoxical, attempt to vindicate Napoleon’s conduct during his exile at St Helena; and he also showed his interest in hterature by an address on Biography at EdinburgL His family consists of two sons and two daughters, his elder son. Lord Dalmeny, having been born in 1882. His younger daughter was married in 1899 to the earl of Crewe, who as Lord Houghton was Lord Lieutenant of Ireland,

1892-95.

Rosecrans, William Starke (1819-1898),

American soldier, was born in ICingston, Ohio, 6th September 1819, and graduated in 1842 from the U.S. Military Academy. After serving (1843-47) as assistant professor at West Point, and in fort construction, he resigned, April 1854, from the army and went into business in Cincinnati. Early in the Civil War he organ- ized Ohio regiments, and in June 1861 was made colonel of the 23rd Ohio volunteers, and afterwards a brigadier- general of regulars. He was second to General ilcClellan in the operations in West Virginia, fought and won at Rich Mountain, 11th July 1861, and succeeded to the command when McClellan was called to Washington. In March 1862 he was made a major-general of volunteers, and by and by was sent to the west, where he served under Generals Halleck and Grant. After the battles of luka (19th September) and Corinth (3rd-4th October), he was transferred to the command of the department of the Cumberland, to relieve General Buell. This command he held for a year from October 1862, with brilliant successes alternating

with disappointments. He beat the Confed- erate General Bragg in the bloody battle at jSIurfreesboro, 31st December 1862-lst January 1863; and then, after long inaction, resumed operations the next summer, and in the fighting between 24th June and 3rd July 1863 drove his adversary out of Jliddle Tennessee ; next, after some delay, he pursued and compelled Bragg, 9th September, to with- draw from impregnable Chattanooga. But he had lost favour, and misfortune now overtook him : he was defeated, 1 9th-20th September, at Chickamauga, and forced back to Chattanooga, to which Bragg laid confident siege. When General Grant took full direction, Rosecrans was succeeded, 20th October, by General Thomas. After a brief service

shortly before the disaster of Majuba, and was one of the commissioners for negotiating a peace which waa personally distasteful to him. It left him with the task of conciliating on the one hand a Dutch party elated with victory, and on the other hand a British party almost ready to despair of the English connexion. He was called home in 1883 to advise the Government on the terms of the London Convention of 1884. Charged on his return with a protectorate over the natives of Bechuanaland, he soon found that the excesses of the Boer settlers in Goshen and Stellaland must be put down by the Imperial authority. His declaration, that the advice of his ministers to patch up a settlement was equivalent to a condonation of crime, led to the expedition of Sir Charles Warren and the annexation of Bechuanaland. A dispute arose between Robinson and Sir C. Warren, who declared that the high commissioner's duties to the home Government were at times in conflict with the action which, as governor of Cape Colony, he was bound to take on the advice of his ministers in the interests of the colony. Sir Hercules Eobinson succeeded in winning the confidence of President Kruger by his conspicuous fair-mindedness, while he heartily seconded Mr Ehodes's efforts to unite the British and Dutch parties in Cape Colony, and to open up its territory to the north. His cast of mind, however, was essentially that of the administrator as distinguished from the statesman, and he was content to settle difficulties as they arose. In 1886 he investigated the charges brought against Sir John Pope-Hennessy, governor of Mauritius, and decreed his suspension

pending the decision of the home authorities, who eventually reinstated Pope-Hennessy. Robinson retired in 1889. In his farewell speech he declared that there was no permanent place in South Africa for direct Imperial rule. This was absurdly inter- preted to mean that South Africa must ultimately become independent ❖❖❖ an idea wholly repugnant to his mind. He himself explained in a letter to The Times in 1895 that he had referred to the "direct rule of Downing Street over the Crown colonies, as contrasted with responsible colonial government." He was made a baronet in 1891. Early in 1895, when he had entered his 71st year and was by no means in robust health, he yielded to the entreaties of Lord Rosebery's cabinet, and went out again to South Africa, in succession to Sir H. Loch. His second term of office, however, was not fortunate. The Jameson Raid produced a permanent estrangement between him and Mr Rhodes, and he was out of sympathy with the new colonial secretary, Mr Chamberlain, who had been prominent in criticizing his appointment, and now desired Robinson to take this opportunity of settling the whole question of the Uitlanders in the Transvaal. Robinson curtly answered that the moment was inopportune, and that he must be left to choose his own time. Alarmed at the imminent danger of war, he confined his efforts to inducing the Johannesburgers to lay down their arms on condition that the raiders' lives were spared, not knowing that these terms had already been granted to Jameson. He came home to confer with the Government, and waa raised to the peerage as Baron Rosmead. He returned to South Africa later in the year, but was compelled by ill-health, in April 1897, to quit his post, and died in London on 28tli October 1897. (h. sy.)

Ross and Cromarty, a highland county of northern Scotland, bounded on the N. by the Dornoch Firth and ^utherlandshire, on the E. by the Moray Firth, on the S. by Inverness-shire, and on the W. by the Atlantic.

Area and Population. ❖❖❖ In 1891 the counties of Ross and Cromarty were amalgamated, the latter having previously been made up of detached portions scattered through the former. At the same time some alterations were made in the boundaries

in Missouri, Rosecrans was relieved, December 1864. Resigning from the army 1867, he was minister to Mexico 1868, and between 1869 and 1881 was engaged in railway and industrial enterprises there. He was a member of Congress, from California, 1881-85, and register of the Treasury, 1885-93. Under an Act of Congress he was, 2nd March 1889, restored to the rank of brigadier-general, and retired. He died near Redondo, Cal., 11th March 1898. On 17th May 1902 his body was reinterred with military honours in the National Cemetery at Arlington, in the presence of President Roosevelt, members of the Cabinet, and many of his campaigning comrades.

Rosenheim, a town and watering-place of Bavaria, Germany, district of Upper Bavaria, on the river Inn, 40 miles by rail south-east of Munich, frequented for its saline, sulphur, and other springs. There are important salt-works, the brine being conveyed from Eeichenhall in pipes ; also machine factories, metal-works, and breweries. Population (1885), 9257; (1900), 14,247.

Rosieres. See Sudan, Anglo-Egyptian.

Roskilde, or Roeskilde, a market-tovm of Den- mark, capital of Roskilde county, 20 miles by rail west of Copenhagen, during the Middle Ages next after SchJeswig the most important town of Denmark. Here is the Danish Westminster Abbey, with numerous monuments and tombs of Danish kings and queens. Other public build- ings are the town-hall (1883), hospital (1878-80), diocesan library (in part 15th century, in part 1858-59), royal palace (1733), institute for daughters of noblemen (1670), church of Our Lady (originally 11th century, rebuilt 1242, restored 1864-65). Population (1890), 6974; (1900), 8368.

Roslavl, a district town of Russia, in the government and 67 miles south-south-east of the town of Smolensk, on the railway from Orel to Riga and on the highroad between St Petersburg and Warsaw, near the Oster river. It is a very old town, founded by Vladimir Monomach, and often mentioned in the annals after 1150. It frequently changed hands between Russia and Lithuania, before it was finally annexed by Russia in 1686. It has two gymnasia, a railway technical school, and a number of

philanthropic institutions, and carries on an active trade in flax, hemp, corn, hides, and tobacco. In 1897 the population numbered 17,848.

Rosmead, Hercules George Robert

Robinson, 1st Baeon (1824-1897), British colonial administrator, was born on 19th December 1824. He was of Irish descent on both sides ; his father was Admiral Hercules Robinson, his mother a Miss Wood of Rosmead, Co. Westmeath, from which he afterwards took his title. Passing from Sandhurst into the 87th Foot, he attained the rank of captain ; but, deciding that the army was not his proper vocation, he obtained in 1846, through the influence of Lord Naas, a post in the Board of Public Works in Ireland, and subsequently became chief com- missioner of fairs and markets. The energy he displayed in these positions, notably during the great famine of 1848, and the clearness and vigour of his reports, secured for him at the age of thirty the office of president of the island of Montserrat. Subsequently he was governor of St Christopher, from 1855 to 1859, when he was knighted in recognition of his services in introducing coolie labour into the island; of Hong-Kong; of Ceylon (K.C.M.G. in 1869); and in 1872 of New South Wales. It fell to his lot to annex the Fiji Islands to the British Empire, and his services were rewarded in 1875 by promotion to G.C.M.G. In 1879 he was transferred to New Zealand, and in 1880 he succeeded Sir Bartle Frere as high com- missioner of South Africa. He arrived in South Africa

between the united county and the shires of Inverness and Nairn, the parish of Urray being restricted to Koss-shire and part of the Inverness parish of Kilmoraok being added to it, and the parish of Urquhart and Logie- Wester, which had been divided between Ross and Nairn, being placed wholly in the former county. The county includes Lewis and a number of smaller islands. The official estimate of the area is 2,049,423 acres, or about 3202 square miles. The population was, in 1881, 78,547 ; iu 1891, 77,810 ; in 1901, 76,421 ; in 1891 on the above area, 78,727, of whom .37,279 were males and 41,448 females ; in 1901 it was 76,421. On

the old area, taking land only (1,970,004 acres, or 3078-1 square miles), tUe number of pei-sons to tlae square mile was 24 ‘8, and the number of acres to the person, 257. In the registration county the decrease of the population between 1881 and 1891 was 1-06 per cent. Between 1881 and 1891 the excess of births over deaths was 8605, and the decrease of the resident population 824. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 :

Year.

Deaths.

Marriages.

Births.

Percentage of Illegitimate.

1880 1890 1899

1197 1299 1277

363 303 346

2087 1893 1809

4-6 4-6 4-3

The following table gives the birth – rate, death – rate, and marriage-rate per thousand of the population for a series of years :

1880.

1881-90.

1890.

1891-98.

1899.

Birth-rate . Death-rate . Marriage-rate

26-20

15-03

4-66

25-36

15-74

4-18

24-05

16-50

3-85

24-27

16-76

4-08

23-26

16-42

4-43

At the census of 1891, 38,018 persons were returned as Gaelic- speaking, and of these 18,620 spoke Gaelic only ; there were 43 foreigners. Valuation iu 1889-90, ►►277,948 ; 1899-1900, ►►275,996.

Administration. ❓❓❓ The county returns a member to Parliament, and contains Fortrose (1179), one of the Inverness group of parlia- mentary burghs, and Cromarty (1233), Dingwall (2519), and Tain (2074), which belong to the Wick or northern group. All of these are royal burghs except Cromarty, and Dingwall is the county town. Police burghs are Invergorden (1014) and Storno- way (3711). There are 33 civil parishes, and there are poor- hoiises at Tain and Fortrose ; the number of paupers and de- pendents in September 1899 was 3339. Ross and Cromarty forms a sheriffdom with Sutherland, and there are resident sherift's- substitute at Dingwall and Stornoway, the former sitting also at Tain and Cromarty.

Education. ❓❓❓ Thirty-five school boards manage 135 schools, which had an average attendance of 11,747 in 1898-99, while 5 voluntary schools (1 Episcopal) had 236. There are academies at Tain and Fortrose, and 33 schools in all earned grants in 1898 for giving higher education. The county council hands over the "residue" grant to the county committee on secondary education, which subsidizes science and art classes in various schools and higher grade (science) schools in process of being built at Dingwall, Tain, and Stornoway.

Agriculture. ❓❓❓ Oats are the predominant corn crop, and the barley acreage is rather less than half the oats acreage. Wheat shows a tendency to recover after a prolonged and continuous de- cline from 7527 acres in 1854 to 694 in 1897 ; it was 1090 in 1898. The following table gives the principal acreages at in- tervals of live years from 1880 : ❓❓❓

Tear.

Area under Crops.

Com Crops.

Green

Crops.

Clover.

Perma- nent Pasture.

Fallow.

1885 1890 1895 1899

134,399 136,974 137,703 141,324

47,639 46,082 44,878 44,206

26,496 26,326 25,309 24,330

40,819 41,662 40,405 43,219

19,075 22,621 26,957 29,3-12

370 469 135 196

The following table gives particulars of the live stock during the same years : ???

Yea.1.

Total liurses.

Total Cattle.

Cows or

Heifers in

Milk or Calf.

Sheep.

Pigs.

1885 1890 1895 1899

7366 7256 8060 8093

42,976 41,686 41,922 43,965

17,811 17,678 17,622 18,126

309,590 311,933 320,969 326,144

6770 6359 6201 4790

At the date of the last return, 1895, the average size of the 7221 holdings was 19 acres ; the percentage under 5 acres was 59-80, between 5 and 50, 32-61, and over 50 acres 7-59. Only Sutherland has a larger proportion of holdings under 5 acres. The total number under 20 acres was 6269 ; between 50 and 100 acres 229 ; between 100 and 300 acres, 231 ; between 300 and 500, 77 ; between 500 and 1000, 10, and there was one over 1000 acres. The excessive proportion of small holdings is partly due to the overcrowding of the island of Lewis (q.v.). There were 61,482 acres under wood in 1896, and the cultivated area was 6-8 per cent, of the whole. From the commencement of the operations of the Crofters' Commission in 1886 down to the end of 1898, 1097 applications to fix a fair rent were dealt with, and rents of a total amount of ––16,182 were reduced- to ––11,509, while arrears amounting to ––41,988 out of ––69,801 were can- celled ; 438 applications for enlargement of holdings were dealt with, and 400 acres were added to existing holdings. Deer forests covered 795,545 acres in 1899, an increase of 147,662 since 1883, and the annual value of the whole was ––34,776.

Industries and Trade. ––– According to the census of 1891, 14,407 men and 3221 women were engaged in agriculture and fishing, and 9947 men and 3032 women in agriculture alone. The county contains two fishery districts, Stornoway and Cromarty, and part of two others, Lochbroom (which includes part of Sutherland) and Lochcarron and Skye (which includes part of Inverness). The following table gives particulars of the industry for the first three districts : –––

Year.

Boats.

Value of Gear.

Besident Fishermen and Boys.

Total Value of All Fish.

No.

Tons.

Value.

1890 1898 1899

2443 1383 1312

15,291 9,476 8,672

***62,725 **14,509 **41,271*

***79,031 **47,318 **46,667*

8646 6718 6236

***198,118 **179,804 **118,671*

***73,294 of the total value of fish iu 1899 represented the value of the herring catch. The number of persons employed in 1899 in connexion with the various branches of the sea fisheries was 10,044. In Ross and Cromarty alone there are about 100 ports, which had, in 1898, 1372 boats of 8818 tons, and 6291 resident fishermen and boys. The Black Isle (1894) and Kyle (1897) branches of the Highland Railway added 24 miles to the mileage of the country.*

*Authorities. *** R. Bain. History of the Ancient Province of Boss. Dingwall, 1899. *** A. Macbae. History of the Macraes. Dingwall, 1899. *** J. WiLLOCK. Sir Thomas Urquhart of Cromarty. Edinburgh, 1899. *** M. Macdonald. The Covenanters in Moray and Ross. Inverness, 1892. *** J. Kennedy. The Days of the Fathers in Moss-shire. Inverness, 1895. *** J. H. DixoN. Gairloch. Edinburgh, 1888. *** W. Taylor. Fragments of Early History of Tain. Tain, 1865. *** F. N. Reid. The Earls of Boss. Edinburgh, 1894. *** Becords of the Presbyteries of Inverness and Dingwall. Edinburgh.*

(w. wa)

Rossetti, Christina Georgfina (1830-

1894), English poet, ~~was the youngest of the four children of Gabriels and Frances Mary Eossetti. She vi'as born at 38 Charlotte Street, Portland Place, London, on the 5th of December 1830. She enjoyed the advan~~ tages and disadvantages of the strange society of Italian exiles and English eccentrics which her father gathered about him, and she shared the studies of her gifted elder brother and sister. As early as 1847 her grand-father, Gaetano Polidori, printed privately a volume of her Verses, in which the richness of her vision was already faintly prefigured. In 1850 she contributed to The Germ seven pieces, several of which are still among the very finest of her lyrics. In her girlhood she had a grave, religious beauty of feature, and sat as a model not only to her brother Gabriel, but to Mr Holman Hunt, to j\Lidox Brown, and to Millais. In 1853-54 Christina Rossetti for nearly a year heliied her mother to keep a day-school at Frome in Somerset. Early in 1854 the Rossettis returned to London, and the father died. In poverty, in ill-health, in extreme quietness, she was now performing her life-work. She was twice sought in mar- riage, but each time, from religious scruples, she refused her suitor ; on the former of these occasions she sorrowed greatly, and her suffering is reflected in much of her early song. In 1861 she saw foreign countries for the first

time, paying a six weeks' visit to Normandy and Paris. In 1862 she published what was practically her earliest book, Goblin Market, and took her place at once among the poets of her age. In this volume, indeed, is still to be found a majority of her finest writings. The Prince's Progress followed in 1866. In 1867 she, with her family, moved to 56 Euston Square, which became their home for many years. Christina's prose work Commonplace appeared in 1870. In AprU 1871 her whole life was changed by a terrible affliction of the head, known as " Graves's disease"; for two years she was not merely very ill, but her life was in

constant danger. She had already composed her book of children's poems, entitled Sing-Song, which appeared in 1872. After a long convalescence, she published in 1874 two works of minor importance, Annus Domini and Speaking Likenesses. The former is the earliest of a series of theological works in prose, of which the second was Seek and Find in 1879. In 1881 she published a third collection of poems, A Pageant, in which there was evi- dence of slackening lyrical power. She now gave herself almost entirely to religious disquisition. The most interest- ing and personal of her prose publications (but it contained verse also) was Time Flies (1885), a sort of s3rmbolic diary or collection of brief homilies. She collected her poetical writings in 1891. In 1892 she was led to publish a very bulky commentary on the Apocal3rpse, entitled The Face of the Deep. After this she wrote little. Her last years were spent in great retirement at 30 Torrington Square, Bloomsbury, which was her home from 1876 to her death. In 1892 her health, always extremely delicate and fluctu- ating, broke down finally, and she had to endure very terrible suffering. From this she was at length released on the 29th of December 1894. The Bishop of Durham, Dr Westcott, with whom she had been greatly in sympathy, preached her funeral sermon, and a memorial to her, designed by Sir E. Burne-Jones, was erected at Christ Church, Woburn Square, where she habitually worshipped. In spite of her manifest limitations of sympathy and experience, Christina Rossetti takes rank among the fore- most poets of her time. In the purity and solidity of her finest lyrics, the glow and music in which she robes her moods of melancholy reverie, her extraordinary mixture of austerity with sweetness and of sanctity of tone vpith sen- suousness of colour, Christina Eossetti, in her best pieces, may challenge comparison with the most admirable of our poets. The union of fixed religious faith with a hold upon physical beauty and the richer parts of nature has been pointed to as the most original feature of her poetry. Hers was a cloistered spirit, timid, nun-like, bowed dovsm by suffering and humility ; her character was so retiring as to be almost invisible. All that we really need to know about her, save that she was a great saint, was that she was a great poet. (e. g.)

Rossetti, Dante Gabriel Cliaries

(1828-1882), English painter and poet. A biography of Dante Gabriel Rossetti is given in the ninth edition of this Encyclopaedia (vol. xx. p. 857), in which his career, more especially as a poet, is treated. It is felt, however, that the view there taken of Eossetti as a painter, and the account given of his artistic work other than literary, require, in the light of the history of the subsequent developments of Eossetti's influence on British art, to be supplemented ; and in this article, accordingly, Rossetti's record solely as an artist is briefly estimated, without any reference to other considerations. It is certain that throughout his own career he looked upon himself as a painter who wrote rather than as a verse- maker who painted. Nevertheless, there can be no doubt that with regard to the constructive portion of his genius

Rossetti was better equipped in verse than in design. He made himself an artist by means of enormous pains and amazing struggles against the difficulties imposed by a naturally desultory habit.

It was rather late in 1843 that Gabriel Rossetti entered Sass's art school (then conducted by Mr Gary), which was in great repute, and numbered John Everett Millais among its pupils. Here, working in a characteristically irregular manner, but making more progress than met the eye, he remained till July 1846, when, having passed the proba-tionary stage required at the Royal Academy, he was admitted a student in full : he did not aspire to grades higher than that of the Antique School, but continued to divide himself between drawing proper, poetic reading, and writing poetry. Time passed, and Rossetti, being much impressed by some of the early works of Ford Madox Brown exhibited at the Academy (1841), Westminster HaU (1844-45), and the British Institution (1845), sought from that master of technique technical instruction of a more direct and stringent kind than he had previously submitted to. Brown, ever generous in that way, undertook without a fee the training of Rossetti as a painter, and set him to work upon such rudimentary studies as pickle-pots and other "still-life." The pupil's course of such work was, as might be expected, short; the master's example and that of Millais, together with the uncompromising energy of Mr Holman Hunt, with both of whom Eossetti became intimate about this time, helping and encouraging him. Most of all, perhaps, so far as his temporary

impressions were concerned, a picture of Brown's which was shown at the " Free Exhibition," Hyde Park Corner, in the spring of 1848 profoundly affected Rossetti. This was, of course, months before the formation of the Pre-Raphaelite Brother- hood in the autumn of the last-named year, when five painter-students, a sculptor (Thomas Woolner), and a layman (W. M. Eossetti) agreed upon certain principles they desired should obtain in art. None of the five owed the initiative of his views to any of the others or to Brown, whose impulse was purely technical and connected with Rossetti only ; neither Millais, Holman Hunt, J. Collinson, nor F. G. Stephens needed the help of Madox Brown. The point of Pre-Eaphaelite crystallization which had so great though brief an influence upon Eossetti's life and art was found at a chance meeting of Eossetti, Millais, and Holman Hunt in Millais' house in Gower Street, where certain prints from early Italian frescoes were studied. The enthusiasm of Eossetti led him to propose the formation of a "Brotherhood" with more or less defin- ite views and much loftier aims than artists generally venture to announce. This took effect ; the views of the remaining three men were already known, and in a few days they joined the new society and took their shares in the obloquy which attended the doings of Millais, Hunt, and Collinson. Brown, though invited, declined to be- come a P-E.B. Eossetti's first effort was by means of " The Girlhood of Mary, Virgin," which in March 1849 was exhibited at Hyde Park Corner. It was a picture which attested ~ the prodigious value of his studies since the previous October, and the native genius of the painter and the sincere jjassion with which he had accepted the obli- gations of Pre-Eaphaelitism, as they were then, but not for long, understood. Nothing of his producing was more independent than the inception of " The Girlhood of Mary, Virgin " ; indeed (as the present writer believes) the design for it was made s^me half a year before the meeting in Gower Street, though the execution of this work owed not a little to the influence, if not the actual help, of Millais and Hunt. Its mysticism was Eossetti's own, its technique owed something to Brown. On the whole, there can be no doubt that in this work was the first pronouncement of a

new view of art, a fresh teclinique and power rapidly de- veloping itself. Of course, the style of this noteworthy and epoch-marking picture was jejune, its handling was timid, while its coloration and tonality were dry, not to say thin. Such was Eossetti's advent in art under the Pre-Raphaelite banner. The picture's reception was not encouraging, nor did the next work from his hands induce him to emerge from that proud exclusiveness in which all such minds as his are content to abide. The diverse moods of the other Brothers chose otherwise, but of Eossetti's immediate circle it has been truly said : "It appears that of seven young men and Brethren five have attained eminent positions, four of them being pre-eminent, although for years after the society was formed no single member, whatever his position might be, escaped insult, obloquy, and wicked and malicious misrepresentation. The more conspicuous the Brother [e.ff., Millais], the more outrageously was he attacked." No estimate of Eossetti's genius, his triumph, and his life as a whole can be justly based without ample allowance being made for the circumstances which attended his advent as a painter. " Ecce Ancilla Domini ! " the smaller picture which is now in the National Gallery of British Art at Millbank, was the natural sequence to that which we have been considering. It is so well known that its name suffices now, but it should be recognized as the one perfect outcome of the original motive of the Pre-Eaphael- ite Brotherhood by its representative and typical member. It is replete with the mystical mood which then ruled the painter's mind; that mood chose what may be called virginal white and its harmonies as its aptest coloration, and the intense light of morning sufficed for its tonality. It was exhibited at the Portland Gallery in 1850. After these pictures were finished, the outside world saw no more of Eossetti as a painter until it had prepared itself to see modern art from a higher plane than before.

In December 1850 there appeared the first number of The Germ, a magazine in which Eossetti had a leading place as the poet in verse and prose. The influence of Browning upon Eossetti was more potent in The Germ than in that splendid romance in water-colours called " The Laboratory," where a court lady of the ancien regime visits an old poison-

monger to obtain from him a fatal potion for her rival in love. This wonderful gem of colour, glowing in lurid and wicked passion and voluptuous suggestion, marked the opening of the artist's second period and signalized his departure from that phase of Pre-Eaphaelitiam of which " Ecce Ancilla Domini ! " was the crowning achievement, and, so far as he was concerned, the artistic ne plus ultra. Millais and the other Brothers remained faithful during several years yet to come. Later in 1850, Eossetti produced the original, which is in ink, of the famous " Hesterna Eosa," a gambling scene of men and their mistresses in a tent by lamplight, while pallid dawn gathers force between the trees without. Then came from his hands "Borgia," which, like "The Laboratory," is in water-colours, and, like " Hesterna Rosa," is a sardonic tragedy. " How they met Themselves " came next, and, in illustrating a legend similar to that of the Ddppelganger, affirmed the force, the originality, and the tragic passion of Eossetti's genius. Two lovers are walk- ing in a twilight wood, where they are confronted suddenly by their apparitions, portending death. The year 18.52 produced " Giotto painting Dante's Portrait," and saw a new development of the painter's mind and mood, dashed with a humour not often to be seen in him. In its somewhat dry coloration it differed from the ardent jewel- like glow and deeper gloom of " Borgia " and its successor and the sumptuous visions of womanhood in later pictures. " Found," Eossetti's sole contribution of the sort which Mr Holman Hunt affected, was begun somewhere about this

period ; but this piece of pictorial moralizing (the analogue of the poet's own " Jenny "), vigorous and intensely pathetic as it is, was never really finished by its author, being, indeed, far remote from Roasetti's inner self, which was rather over-scornful of didactic art, and thoroughly indisposed towards attempts to ameliorate anybody's condition by means of pictures. Nor did the stringency of naturalistic painting suit his mood or his experience. Nevertheless, what is his in the existing picture remains a masterpiece of poetry with exquisitely finished parts.

Passing a few fine but comparatively unimportant draw- ings, such as " Lancelot and Guinevere at the Tomb of Arthur," "Lancelot looking at the Dead Lady of Shalott," "Mariana of the South," "Sir Galahad," "The Blue Closet," and various works ovsdng subjects to the Arthurian cycle of

romances, we may note that the artist illustrated by five cuts Poems by Alfred Tennyson, on which MUlais and Mr Holman Hunt were also engaged, and which was pubKshed by Moxon in 1857. As in "Ecce AnciUa Domini ! " we had virginal white and morning light em- ployed to strengthen the mystical significance of the design, so in " Borgia " Venetian voluptuousness and sensuous splendours obtained, and in " The Blue Closet " is a very potent and suggestive exercise intended to symbolize the association of colour with music. The last is one of the subtlest of the artist's " inventions," and it shows how he had developed upon " Borgia " an artistic sympathy which is but too likely to be "caviare to the general." "The Wedding of St George " is not so fine ; nor was " The Damsel of the Sangreal," Rossetti's part in the luckless decorations of the Oxford Union (1857-58); nor are " Guinevere and Sir Lancelot," " Galahad in the Chapel," and other Arthurian examples quite worthy of his art. " Bocca Baciata," the super-sensuous portrait of a woman, a work of wonderful fire, and the pictures on the pulpit at Llandaff Cathedral, marked the expiration of the second epoch in Rossetti's art and the beginning of a new, the third, last and most powerful of all the phases of his career. The picture "Dr Johnson at the Mitre," when the " pretty fools " consulted the lexicographer anent Methodism, is a good example of his humour.

In 1861 Rossetti produced several fine designs for stained glass, and in the revival of stained-glass paint- ing as an art he had a larger share than has frequently been ascribed to him. The practice of designing upon a large scale, and employment of masses of splendid though deep-toned colours, had probably something to do with the prodigious development of his powers and the enlarge- ment of his views as regards painting which took effect at this period (1862-63). At this time a striking and highly imaginative triptych, representing three events in the careers of Paolo and Francesca, was produced; it is a great improvement upon an earlier design. There is unpre- cedented energy in the group of the lovers embracing in the garden-house just as they have paused in reading the fatal romance. The composition of this group, with the circular window behind their figures, is as fine as it was comparatively novel in Rossetti's practice. Its lurid coloration was so thoroughly in harmony with the pathos of the subject that in this respect the work excelled all the painter

had previously produced. The same elements, energy, a sympathetic and poetic scheme of colour, and composition of a fine order, combined with far greater force and originality in "The Bride," or "The Beloved," that magnificent illustration of The Song of Solomon. The last named is a life-size group of powerfully coloured and diversely beautiful damsels accompanying their mistress with music and with song on her way to the bridegroom. This picture, as regards its brilliance, finish, the charms of four lovely faces, and the splendour of its

"EccE AxciLLA DoMixi!" By Dante Gabriel Rossetti. (From a Photograph iy Frederick Hollijer.)

lighting, occupies a great place in the highest grade of modern art of all the world. It is likewise, so far as the qualities named are concerned, the crowning piece of Kossetti's art, and stands for him much as the " Sacred and Profane Love" of Titian represents that master. Very fine, indeed, but hardly so passionate and virile, is the " Beata Beatrix," now in the National Gallery of British Art with " Ecce Ancilla Domini ! " which he produced thirteen years earlier. These works belong to a category of fine and quite original examples, all replete with similar technical qualities, poetry, and pathos. The group com- prises paintings by which Rossetti is best known, such as " Proserpina in Hades," which is, on the whole, perhaps the most original, if not indeed the most poetical and powerful, of all his output ; " Sibylla Palmifera ; " " Venus Verticordia ; " " Lilith " (the better of the two versions is now referred to) ; " Washing Hands ; " " Monna Vanna ; " "II Ramoscello;" "Aurea Catena;" "La Pia;" "Rosa Triplex ; " " Veronica Veronese ; " "La Ghirlandata ; " " Pandora ; " " The Blessed Damosel ; " and, last and largest, but not, perhaps, the greatest, of his paintings (a distinction for which the " The Bride " and " Proserpina " must contend), the famous " Dante's Dream," now in the Walker Art Gallery at Liverpool. Besides these, Rossetti produced a large number of fine things. Nearly the whole of them were exhibited by the Royal Academy and at the Burlington Fine Art Club in 1883, after their author's death.

Authorities. ◆◆◆ W. M. Eossetti. Bante Gabriel Rossetti as Designer and Writer, 1889 ; Ruskin, Rossetti, Pre-Raphaelitism, 1899, and other texts. ◆◆◆ F. G. Stephens. D. G. Rossetti. “Port- folio ” monograph, 1894. ◆◆◆ H. C. Mamllier. Z>. G. Rossetti. 1899 and 19U1. ◆◆◆ W. Sharp. Dante Gabriel Rossetti : A Record and a Study. Maemillan, 1882. ◆◆◆ T. Hall Caike. Recollections of Dante Gabriel Rossetti. Elliot Stock, 1882. ◆◆◆ W. Allingham. Letters of Dante Gabriel Rossetti to William Allingham,, 1854-70. T. Fisher Unwin, 1897. ◆◆◆ See also “Vernon Lushington ” in the Oxford and Cambridge Magazine, 1856. (f. G. S.)

RoSSland, the most important city (incorporated in 1897) of the Kootenay district of British Columbia, the centre of a rich mining district. Some of the best known mines of British Columbia are in the neighbourhood of Rossland, which has been connected with the Canadian Pacific Railway, as well as vdth systems belonging to United States companies. It is distant a few miles by railway from Trail, on the banks of the Columbia, where an extensive smelting plant is in operation. Population

(1901), 6159.

RoSSlaU, a town of Germany, duchy of Anhalt, on the right bank of the Elbe, by rail 3 miles north of Dessau and 35 south-east of Magdeburg. It has two castles, a good church, and produces machinery, paper, sealing-wax, wire goods, sugar, bricks, and chemicals, and has some boat-building. Population (1885), 6567; (1900), 10,061.

Rostock, a seaport town of Germany, grand-duchy of Mecklenburg-Schwerin, on the Warnow, 8 miles above its entrance into the Baltic, and 46 miles by rail south- west of Stralsund. An assembly hall of the estates of Mecklenburg was built in the Gothic style in 1889-93. Other buildings, &c., include the theatre (1895) and the provincial lunatic asylum (1896), the latter on the right bank of the river. In 1900 the university was attended by 495 students and had 55 professors ; its library numbers some 175,000 volumes. Amongst the public institutions are the zoological, geological-mineralogical, commercial, and several medical institutes, the municipal picture gallery, a collection of municipal antiquities, a

theological seminary, an astronomical observatory, an agricultural experimental station, a seamen's school, and a botanical garden. Rostock is the chief commercial tovsn of Jlecklenburg, and owns a considerable fleet ❓❓❓49 vessels of 30,170 tons in 1900. In

1898 its port was cleared by 1743 vessels of 342,900 tons. Vessels drawing 16 feet are able to get up to the wharves. It is also a place of some industry. For a German town it enjoys a large share of autonomous government. Popu- lation (1885), 39,356; (1900), 54,713.

Rostov-On-the-Don, a seaport of Russia, in the province of the Cossacks of the Don, 40 miles from the Sea of Azov. Its population has grown rapidly, and in 1897 numbered 119,889, exclusive of the suburbs; if these, which already form part of the town and comprise Nakhichevan (29,312), be included, the population is well over 150,000, a figure which is still further swollen in the summer by the influx of about 60,000 men, who flnd work in connexion with the shipment of grain for export. Owing to its very advantageous situation, on the navigable river Don and at the junction of three railways radiating to north-western Russia, the Caucasus, and the Volga, Rostov has become the chief seaport of south-eastern Russia, being second in importance on the Black Sea only to Odessa. It has immense storehouses for all sorts of goods shipped to the Caucasus and to the Don province, and is the chief centre for the supply of agricul- tural machinery to all the prairie provinces of south- eastern Russia. Its foreign exports, which were valued at 41,000,000 roubles in 1882, were only 37,000,000 roubles in 1895; but on an average 35,000,000 roubles worth of wheat and 10,000,000 roubles worth of rye are exported annually, besides considerable quantities of flax, vegetable oils, raw wool, and caviare. The imports are insignificant. There are now a shipbuilding yard, two large tobacco factories, iron works, machinery works, distilleries, soap works, timber mills, bell foundries, paper mills, and rope works. Rostov is the chief centre of steam flour mills for south-eastern Russia and the Caucasus. The aggregate returns from aU industrial establishments exceed ❓❓2,000,000 per annum. In 1897 the port was visited by 2840 ships of about 450,000 tons. The town is well built, and has about sixty schools, gjrmnasia, navigation schools, technical schools, &c., the city contributing freely to education. It has

also a good municipal library, two theatres, two news- papers, and extensive systems of telephones and electric tramways.

Rostov Velikiy, a district town of Russia, in the government and 34 miles by rail south-west of the town of Yaroslav, near Lake Rostov or Nero. It has a gym- nasium for girls and a school of art, and there are twenty- one factories (cotton and linen miUs), employing about 1000 workmen and showing yearly returns of 1,000,000 roubles. Its great fair has lost its importance, but the town remains a centre for a variety of domestic trades : tailoring, the manufacture of leather, and the making of boots and small enamelled ikons ; it is also a great centre for kitchen gardening and the export of pickled and dried vegetables. The restoration of the buildings of the large Kreml was begun in 1901. Its population in 1897 was 14,342.

Rothenburgr ob der Tauber, a town of

Bavaria, district of Middle Franconia, 49 miles by rail west by south of Nuremberg. It presents a characteristic- ally mediaeval appearance, with walls pierced by pictur- esque old gates. Amongst the more interesting buildings are the town-hall (1578 and earlier), hospital (1570-76), Topler Castle, the church of St James (1373-1471, restored in 1851), with three carved altar-pieces of the 15th century, and St Wolfgang's church (1473-83). It also possesses a technical school, interesting archives, and manufacture of toys, agricultural machinery and implements, brewing, dyeing, &c. Rothenburg, which is first mentioned in 942, was a free imperial city from 1172 to 1803. In

the Thirty Years' War it suffered severely. Population

(1885), 6826 ; (1900), 7923.

Rotherhcim, a municipal borough and market town, Yorkshire, England, in the Eotherham parliamentary division of the West Biding, 5 miles

north-east of Sheffield by rail. The manufacture of railway waggons is now an important industry. Population of municipal borough

(1891), 42,061 ; (1901), 54,348.

Rothesay, a royal burgh and the chief town of the county and island of Bute, Scotland, on a fine bay, 40 mUes west by north of Glasgow. Fishing has left the port, which is almost exclusively given up to the Clyde passenger and tourist traffic. Modern buildings are a hydropathic (rebuilt after fire), a second institute (1885), and a new post office ; there are also a Roman Catholic orphanage and an academy. Population (1891), 9108;

(1901), 9323.

Rotten burgf, a town and episcopal see of Wiirtem- berg, Germany, on the left bank of the Neckar, which is crossed by two bridges connecting the town with the suburb of Ehingen, 7 miles by rail south-west of Tiibingen. It is the see of the Eoman Catholic bishop of the kingdom, and possesses the (Gothic) cathedral of St Martin, a former Jesuit monastery with a collection of Roman antiquities from Sumelocenna near by, and an old castle now used as a prison. Tanning, machinery making, brewing, and the growing of hops are carried on. Popula- tion (1900), 7027.

Rottercla.lTI, the first commercial and the second largest city of the Netherlands, extended by the incorpora- tion in 1886 of Delfshaven and in 1895 of Charlois and Krahngen, in the province of South Holland, 14 J miles by rail south-east of The Hague. Among the institutions of Botterdam are a large infirmary (Groot Ziekenhuis), a school of music, a natural science society, with rich collections, and three theatres. A new building was erected in the west of the city to accommodate the archives in 1899-1900. The new waterway between Botterdam and the North Sea, only 15 feet deep in 1880, has since been deepened to 29|- feet. The new docks opened include Bynhaven, on the left bank of the Maas, Parkhaven, the first and second Katendrechthaven, and the Dokhaven. Nassauhaven, newly constructed, also on the left bank of the river, is connected by railway with the large factories. Another dock, 143 acres in area, to cost ►►750,000, was in 1902 in process of construction. Between 1850 and 1897 the area of the docks increased from 96 to 309

acres, about two millions sterling having been spent on the building of docks in the final quarter of the 19th century.

The following table shows the increase in the shipping of Kotter- dam from 1885 to 1900 :

Sailing

Vessela.

Steam Vessels.

Total Tonnage of Sailing and Steam Vessels.

Percentage of

all Outgoing

Vessels from

Holland leaving

Rotterdam.

1885 1900

43 84

50 101

99,018 458,968

45 63-1

Tonnafye of Exports from Rotterdam.

Shipping on the New Waterway,

Number of Ships.

Tonnage.

1885 . 1900 .

about 2,000,000

22,623,000

8,177 15,202

4,382,100 36,349,000

According to the report of the Rotterdam Chamber of Com- merce, the shipping of Rotterdam with a draught of from 24 to 26i feet, to the exclusion of smaller vessels and fishing-smacks, numbered in 1899, 6890 vessels of 9,779,229 tons. Rotterdam's share in the Rhine traffic has increased from 1,706,587 tons in 1883 to 6,494,375 tons in 1898. Of the total imports into Holland, more than 40 per cent, have in recent years entered by way of Rotterdam, and of the total imports into Holland of grain, ores, margarine, petroleum, and oils, 50 to 80 per cent, land at Rotterdam. Of the total imports into the kingdom of coffee, tobacco, rice, sugar, and seeds, Rotterdam receives respectively 49, 39, 26, 24, and 37 per cent. There are separate wharves, with six tanks, for the imports of petroleum from America and Russia. Of the total imports into Holland in 1898, estimated at 8,486,000 cwt., those entering by way of Rotterdam amounted to 5,952,000 cwt. Besides the river commerce with Germany, Rotterdam trades principally with the Dutch colonies of the East and West Indies, New York, La Plata, and the east and west coast of Africa. Shipbuilding yards, extending along the Maas to great distances above and below Rotterdam, build iron steamers and large ships, also for foreign countries. The population, 169,477 in 1884, numbered 332,185 in 1900.

See Feuin. De oudste OorTccmden ietreffende Botterdam. ??? SoHEFFEE and Obrebn. Hotterdamsche Ristoriebladen. 1869-78. ??? Db Bas. Botterdam van 1853-78. ??? Tijdschrift Taw het Aardrijkskundig Genootschap, iv. 22.

Rottweil, a town of Wiirtemberg, Germany, above the river Neckar, 46 miles by rail south-west of Tiibingen. It is still in part surrounded by walls. It possesses a fine church of the Holy Cross (1364-1473), a collection of mediaeval wood-carvings, Roman antiquities, a salt mine and brine springs. Population (1885), 6052; (1900),

7970.

ROUba,ix, an industrial tovm in the north of France, situated 6 miles north-east of LUle, and only 1 mile from the Belgian frontier, on the Roubaix canal which connects the Deule with the Scheldt in Belgium. Its population has risen from 91,000 in 1881 to 124,660 in 1901. With the adjoining communes of Tourcoing, Croix, and Watrelos the combined population is 250,000. The woollen industry is the chief business of Boubarx. In 1898 there were 8 wool-combing works with 750 combing machines ; 44 spinning mills (28 for combed or carded wool, 15 for cotton, 1 for floss silk); 129 weaving establishments (26 for cloth, 18 for woollen goods, 9 for velvet, 8 for upholstery, 2 for black goods, 1 for linen thread, 65 for novelties and miscellaneous goods). In 1897 Boubaix contained 39 dyeworks and 17 establish- ments for finishing and dressing. Mechanical work prevails in the town, as shovm by the fact that there are 20,000 steam looms and only 5000 hand looms. Four hundred firms act as commission agents for the sale of raw material and the other requisites for industries. The station of the Northern Bailway at Boubaix, where the merchandise arriving by goods train in 1887 amounted to 443,350 tons, in 1898 received 952,016 tons. On the canal the transport tonnage has also risen, and from 491,651 tons (English) in 1887 reached 595,322 tons in 1898. The trade of the port consists principally of building materials, agricultural produce, and coal. A modern in- dustry is that of tomato and grape growing, under glass, for the winter market. To maintain the high standard of artistic taste which has made the industry of Boubaix a success, schools have been multiplied, and by the co- operation of the town and the State the National School of Industrial Arts has been founded.. This is a small university of art, commerce, and industry, the twenty-two courses of which include all the branches of knowledge useful in any of those pursuits. There is also a special establishment {bureau de comJitionnement) for determining the nature and weight of silk, wool,

and cotton. The chief streets, lined with elegant buildings, contrast in their luxury with the poverty of the sordid working-class quarters. The town, a third of the population of which

is Belgian, is a centre of socialism and collectivism. The number of public-houses is exceedingly high in proportion to the kihabitants one for every 60 persons or for every 15 adult males.

Rouen, chief tovra of the department of Seine- Inf^rieure, 84 miles from Paris by rail. It is now only the eleventh town of France in respect of population, after having occupied the fifth rank.

Its port on the Seine has grown in importance, but industry in general has made no progress. > The port is accessible to ships of about 5000 tons, which can come up to it on a single tide. The bassin maritime is lined with quays and continuous wharves for a, length of about H mile on both the right and left banks of the river. Its platforms cover 42 acres on the north and 33 acres on the south. Those of the bassin aux bois (wood dock) cover 30 acres, and there are 11 wharves of a total length of 3176 feet. The petroleum dock has 8 wharves, with a length of 2362 feet. The total available length of these docks in which ships can lie and discharge is 4 miles, and the total platform area round the docks is 111 acres. Railway lines run across the quays and connect them with the stations of Martainville on the north and of Orleans and St Sever on the south. Subterranean canalization conveys the petroleum direct from its special dock to the refineries. The river dock covers 28 acres. The maritime port has a repairing dock for vessels 312 feet long and of 1800 tons. Its quays are lighted by electricity or gas. Formerly the Seine at Rouen was crossed only by the stone bridge of Corneille and by a suspension bridge, the middle portion of which opened to permit the passage of ships. The latter has been replaced by the Boieldieu bridge, the first steel bridge built in France, costing 140,000, and inaugurated in 1888. A slung moving bridge has a height of not less than 197 feet, and connects the banks of the Seine. Steam ferry boats also place the shores in communication. In

1899, 2604 vessels of 1,145,921 tons entered and 2637 of 1,149,382 tons cleared, showing a progression corresponding to the improvement in the channel of the Seine. The value of the exports amounted to ►►2,144,000, and that of the imports to ►►8,364,000. In 1898 the river dock was entered and cleared by 10,437 ships of 2,072,442 tons. The principal imports of Rouen are cereals (165,000 tons in 1899), wine (191,000 tons), petroleum, wood (254, 600 tons), and wood pulp (39,900 tons). The exports are sugar, plaster, sand, and pyrites. On 31st December 1899 there were 176 ships of 36,669 tons attached to the port, at which 16 French and 10 foreign shipping companies call regularly. The cotton industry, which made the fortune of Rouen, and reached its highest prosperity in the middle of the 19th century, is in a depressed state. In 1896 only 1,223,442 spindles were working in the whole department of Seine-Inf&ieure, and the decline continued till the end of 1898. Subsequently, however, the situation somewhat improved. In 1883 there were 48 power- loom weaving mills in the department, 29 of which were in Rouen, employing 14,000 power-looms and 10,000 hand-looms. The latter are decreasing. In 1890 there were only 3700 hand-looms in the whole department. Neither has cotton-printing made progress. Rouen enjoys protective tariffs in Indo-China and Madagascar. In 1895, through an Indo-China syndicate, 1195 tons of white cotton goods, bleached and unbleached, and nearly 600 tons of coloured and printed goods were exported. Flax, hemp, and jute are spun in the neighbourhood, and there is a flourishing manufacture of braces. That of printed calico declines. In 1897, 14 firms each turned out 560,000 pieces of 1083 yards length each; 300,000 pieces were made in the homes of the workers. These products are sent to Algeria, Madagascar, &c. Dyeing progresses, 12,000 tons of cotton being dyed annually, but the bleaching and finish- ing Industries are depressed ; the manufacture of carding combs is, on the other hand, rising. Rouen is an important centre of chemical industries, producing various acids, salts of tin, lead, zinc, cobalt, and nickel. One company alone employs 800 work- men, and produces 160,000 tons of products. There are two im- portant soap-works. The clothing industry, the manufacture of machine-made boots, which increases rapidly, and the hat industry deserve notice. The manufacture of machinery declines. There are only two important workshops making steam motors, boilers, and various machinery, and five factories for heavy copper ware and

safety fittings for boilers. Much grain is distilled at Rouen, mainly maize and rice. The petroleum industry is considerable, engaging four mills, each able to produce annually from 50, 000 to 60,000 tons of raw and 40,000 to 50,000 tons of refined petroleum. In 1899 Rouen imported 115,000 tons of raw petroleum from Russia and the United States. A celluloid factory has also some importance. Rouen is being improved by the gradual restoration of the grand /afcjK^e of its cathedral. Monuments of recent erection include one to Jeanne d'Arc. The population in 1896 was 106,825, and in 1901, 115,914.

Rouher, Eughne (1814-1884), French states- man, was bom at Riom, in the Puy de D6me, 30th November 1814. He was educated at the lyc6e of his native town, and having taken his law degree at Paris in 1835, began to practise his profession at Eiom. At this stage in his career he was a Liberal, but greatly to the astonishment of both friends and enemies, in 1846 he stood in the Conservative interest for Eiom, with the support of the Guizot ministry. Though unsuccessful, he again championed the Conservative cause at the general election of 1848, and was returned to the Constituent Assembly for the Puy de D6me. Ke-elected to the Legislative Chamber in 1849, to the great surprise of the poHtical world he became prime minister of the Prince President, with the title of Minister of Justice and Keeper of the Seals. Cautious and subservient, he was entrusted by Napoleon with the drawing up of the new Constitution after the Coup d'Mat of 2nd December 1851 had laid France prostrate at his feet. But as it required a more daring nature than that of the provincial barrister to carry the drastic scheme into effect, the cabinet was reconstructed under Marshal St Arnaud, Rouher remaining out of office. When Louis Napoleon became emperor of the French in 1852, Rouher had his reward. He re-entered the Imperial service as vice-president of the Council of State. The emperor likewise presented him with ►►40,000 and the estate of Cirey. In 1855 he became minister of commerce and public works. In this capacity he provided the emperor and Baron Haussmann with enormous sums of money for the rebuilding and embellishment of Paris, and for various undertakings in the provinces. To Rouher was also intrusted the important task of preparing the treaty of commerce with England, a work involving great and detailed labour. In 1860 the treaty was carried through, and some time afterwards its French

sponsor visited England, where he was much f6ted. Though pliant towards the emperor, Rouher was not popular with his ministerial colleagues, towards whom he assumed a haughty attitude. In 1863 he was appointed minister of state, and as such was spokesman of the Government in the Corps L^gislatif. Though no orator, he was now the most prominent statesman, as well as the most powerful minister, of the Second French Empire. But with men like Thiers, Berryer, and Jules Favre arrayed against him, he could only carry out the Imperial policy by a frequent use of the cloture, although the Government had an enormous majority in the Chamber. After a constitutional contest in the Chamber prolonged over several years, the emperor was convinced in 1869 that reforms must be granted. A manifesto was accordingly issued restoring parliamentary institutions, and M. Emile OUivier was placed at the head of a Liberal cabinet in order to carry them out. Rouher, however, was the moving force behind the cabinet, and in January 1870 he was appointed president of the Senate. After the fall of the empire, Rouher fled to England. The rest of his life was spent as the representa- tive of the fallen empire in France, and the faithful and untiring agent there of the Imperial family. A constituency in Corsica, which had always been faithful to the Bonapartes, returned him as deputy to the National Assembly in February 1872. From that period until the death of the Prince Imperial in 1879 he carried on a ceaseless Bonapartist propaganda, and his house in Paris was used as the headquarters of the party. In 1875 he delivered a violent speech against the Republic at Ajaccio. His prosecution was mooted, but the Government finally contented itself with dismissing the mayor of Ajaccio from office. The untoward death of the Prince Imperial was a calamity from which Rouher never recovered, and

in the summer of 1883 he was stricken -with paralysis and lost Ms reason. His death occurred at Cirey on 3rd February 1894. ‘ (g. b. s.)

Roulette. ^Eoulette is one of the most ingenious games ever devised, for the reason that temptation to continue assails the player from

so many directions and in so many ways : rich successes are sometimes attained, and very frequently only just missed, whilst all the time there is a steady, infallible, and undeviating bias against the player in favour of the bank. It is solely a game of chance, a fact strenuously contradicted by half-informed students, for so-called "systems" are innumerable, and some of them for a greater or a longer period often appear to give the player an advantage. There is no possible system, however, which will assure success in the long run, and it is herein that the ingenuity of the game con- sists. Every systematic method of play must depend upon increased stakes to retrieve past losses ; and though a player with an unlimited capital might be practically certain to achieve his end in the course of time, the cir- cumstance of there always being a maximum renders the bank invincible. The roulette table, covered with a green cloth, is made up of precisely corresponding halves, a circular space let into the middle holding the wheel, on either side of which the cloth is marked out as in the accompanying illustration. The wheel is divided into thirty – seven com- partments, marked alternately black and red, numbered from one to thirty- six, the thirty- seventh being zero. Pair indicates even numbers, impair odd numbers; tnanque includes the numbers from 1 to 18 ; passe, from 19 to 36. The methods of staking are innumerable. Houge, noir, pair, impair, manqiie, and passe are even chances ; i.e., a stake put upon any of them ??? five francs being the minimum at rou- lette??? is paid in corresponding coin should the player win, the exception being when the little ball which is spun round the wheel falls into zero, in which case

the even money chances are put " in prison " ; that is to say, laid aside in the place shouin in the design (the thick vertical line in the spaces marked passe, pair, manque, impair and the black and red diamonds) until another spin, when if the bank wins they are lost, if the player wins he is allowed to retrieve his money. The maximum in the case of these chances is 6000 francs. Any one who desires to play en plein puts his stake on one of the thirty- seven numbers. If the ball falls into the corresponding number on the cylinder, the stake is paid thirty-five

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times ; and as there are thirty-seven numbers on the board, with the advantage already described of imprison- ing the even money chances when zero comes up, it will be seen that there is a steady percentage in favour of the tables and consequently against the player. The maximum stake allowed en plein is 180 francs. The next most daring selection is a cheval, when the stake is placed on the line separating any two numbers, and if either of them wins the player is paid seventeen times, the highest stake permissible being 360 francs. Transversale pleine covers any three numbers in a line, the coin or note being placed on the line dividing either of the numbers from the neighbouring even money chance, as for instance between 4 and passe, or 6 and m,anque. A transversale simple covers six numbers, as for example where the line between 4 and 7 joins joowse, or between 6 and 9 joins manqioe ; and if either of these numbers wins, five times the value of the stake is paid, the maximum here being 1200 francs. En carr4 includes four numbers, the coin being placed, for instance, on the cross between 1, 2, 4, 5, or 28, 29, 31, 32; eight times the value of the stake is paid, and the maximum is 760 francs. It will be seen from the board that the dozens and the columns are also indicated, the first dozen of course including 1 to 12. In each of the columns are twelve numbers in difierent order. A stake placed on either a dozen or a column is paid twice its value, the maximum here being 3000 francs. A stake very constantly played is called the quatre premiers, which includes zero, 1, 2, and 3, the stake being placed on the line where zero and 1 join passe, or where zero and 3 join manque. K either of these four numbers, including

zero, wins, the stake is paid eight times ; and four times eight being thirty-two, there is a greater advantage to the table than when it loses en plein or on certain other chances. Zero can also be played in combination with any one or two of its neigh- bours ; if with one of them the stake is paid seventeen times, if with two of them eleven times. A croupier sits on either side of the wheel ; there is also one at each end of the table, their business being to assist the players in staking and recovering their winnings. Behind each of the former pair an official on a high chair supervises the table. The croupier whose duty it is to spin the wheel waits for a time till stakes have been made, and then, exclaiming, " Messieurs, faites votre jeu ! " sets the cylinder in motion, throwing the ball in the direction contrary to that in which the wheel revolves. When it is seen that the ball will soon fall at rest in one of the compart- ments of the cylinder the croupier gives the notice, " Eien ne va plus," after which no stakes can be placed. ^Vhen the ball finally rests in the compartment, the croupier announces the number and the even money chances that win, as for instance rouge, impair, and manque. He and his fellows then proceed to gather in with a rake all the money that has been lost, after which the winnings are paid and the game proceeds. (a. e. t. w.)

Rou mania. See Bumania.

Rousseau, Pierre Etienne Theodore

(1812-1867), French painter, one of the artists of Barbizon, in many ways the strongest of the group, and a landscape painter who devoted himself in his prime almost entirely to pictures of the Forest of Fontainebleau. He was an only son, and was born in Paris on 15th April 1812, of a bourgeois family which included one or two artists. At first he received a business training, but very soon displayed a special aptitude for painting. Although his father re- gretted the decision at first, he speedily became reconciled to his son leaving business, and throughout the artist's career (for he survived his son) was an ardent sympathiser

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with him in all hia conflicts with the Salon authorities. Theodore Rousseau shared to the full the difficulties of the romantic painters of 1830 in securing for their pictures a place in the annual Paris exhibition. The whole influence of the classically trained artists was against them, and not until 1848 was Rousseau adequately presented to the public. He had exhibited one or two unimportant works in the Salon of 1831 and 1834, but in 1836 his great work ” La D^scente des Vaches ” was rejected by the vote of the classic painters; and from then until after the revolution of 1848 he was persistently refused. He was not without champions in the press, and under the title of ” le grand refuse ” he became known through the writings of Thor^, the trenchant critic who afterwards resided in England and wrote under the name of Biirger. During these years of artistic exile Rousseau produced some of his finest pictures : ” The Chestnut Avenue,” ” The Marsh in the Landes ” (now in the Louvre, see Plate), ” Hoar- Frost” (now in America); and in 1851, after the re-organization of the Salon in 1848, he exhibited his masterpiece, “The Edge of the Forest” (also in the Louvre), a picture similar in treatment to, but slightly varied in subject from, the composition called ” A Glade in the Forest of Fontainebleau,” in the Wallace collection at Hertford House.

Up to this period Rousseau had lived only occasionally at Barbizon, but in 1848 he took up his residence in the forest village, and spent most of his remaining days in the vicinity. He was now at the height of his artistic power, and was able to obtain fair sums for his pictures (but only about one-tenth of their value thirty years after his death), and his circle of admirers steadily increased. He was still ignored by the authorities, for while Diaz was made Chevalier of the Legion of Honour in 1851, Rousseau was left undecorated at this time, but was nominated shortly afterwards.

At the Exposition UniverseUe of 1855, where aU Rousseau's rejected pictures of the previous twenty years were gathered together, his works were acknowledged to form one of the finest of the many splendid groups there exhibited. But during his lifetime Rousseau never really conquered French taste, and after an unsuccessful sale of his works by auction in 1861, he seriously contemplated leaving Paris for Amsterdam or London, or even New York. Misfortune then overtook him : his wife, who had been a source of constant anxiety for years, became almost hopelessly insane ; his aged father looked constantly to him for pecuniary assistance; his patrons were few in number. Moreover, while he was temporarily absent with his invalid wife, a youth living in his home (a friend of his family) committed suicide in his Barbizon cottage ; when he visited the Alps in 1863, making sketches of Mont Blanc, he fell dangerously iU with inflammation of the lungs ; and when he returned to Barbizon he suffered from insomnia and became gradually weakened in strength. He was elected president of the fine art jury for the 1867 Exposition. His extreme disappointment at being passed over in the distribution of the higher awards told seriously on his health, and in August he was seized with paralysis. He slightly recovered, ' but was again attacked several times during the autumn. Finally, in November, he began to sink, and he died, in the presence of his lifelong friend, J. F. Millet, on 22nd December

1867.

Rousseau's other friend and neighbour, Jules Dupr^ himself an eminent landscape painter of "Barbizon, relates the diSiculty Rousseau experienced in knowing when his picture was finished, and how he, Dupr^ would sometimes take away from the studio some canvas on which Rousseau was labouring too long. Millet, the peasant painter, for

whom Rousseau justly had the highest regard, was much with him during the last years of his life, and at his death Millet took charge of the insane wife, whose malady had so seriously harassed the artist. Rousseau was a very good friend to Diaz, teaching him how to paint trees, for up to a certain point in his career Diaz considered he could only paint figures.

Rousseau's pictures are always grave in character, with an air of exquisite melancholy which is powerfully attractive to the lover of

landscapes. They are well finished when they profess to be completed pictures, but Rousseau spent so long a time in working up his subjects that his absolutely completed works are comparatively few in number. He left many canvases with parts of the picture realized in detail and with the remainder somewhat vague; and also a good number of sketches and water- colour drawings. His pen work in monochrome on paper is rare ; it is particularly searching in quality.

There are a number of fine pictures by Rousseau in the Louvre, and the Wallace collection contains one of his most important Barbizon pictures. There is also an example in the lonides collection at the Victoria and Albert Museum.

Authorities. ◆◆◆ Alfred Sensibr. Souvenirs sur Th. Rous- seau. Paris, 1872. ◆◆◆ E. Michel. Les Artistes CiUbres: Th. Rousseau. Paris, 1891. ◆◆◆ J. W. MoLLETT. Rousseau cmd Diaz. London, 1890. ◆◆◆ D. Croal Thomson. The Barbizon School of Painters: Th. Rousseau. London, 1892. ◆◆◆ Albert "Wolff. La Capitate de VArt: Th. Rousseau. Paris, 1886. ◆◆◆ E. Chesnbatt. Peintres Romantiques : Th. Rousseau. Paris, 1880. ◆◆◆ Ph. Burtt. Mattres et Petit-Maitres : Th. Rousseau. Paris, 1877.

(d. C. T.)

Rouxville. See Oeange River Colony.

RoveretO, or Roveeedo, one of the chief in- dustrial cities of South Tirol, and, after Trent, the prin- cipal seat of the Tirolese silk manufacture. Population (1890), 9030; (1900), 10,180, Italian and Catholic (about 5 per cent. German). Leather and paper are manufactured, in addition to the staple silk industry, and there is a con- siderable trade in silk, sumac, corn, wine, hams, and sausages.

Rovig'nO, a town on the Adriatic coast, in the Austrian province of Istria, of which it is the chief trading centre. Population (1890), 9662; (1900), 10,205, Italian and Catholic. It is the principal centre of the Austrian tunny and sardine fishery. The industries, in addition to shipbuilding and

the preservation of fish, include the manufacture of tobacco, cement, macaroni and similar preparations, and fiour.

Rovig'O, a town and episcopal see of Italy, Venetia, capital of the province of Rovigo. It stands on the low ground between the lower Adige and the lower Po, 50 miles by rail south-west of Venice, and on the Adigetto canal. Its institutions include a 17th-century campanile, a technical school, a bronze equestrian monument (1894) to Garibaldi by Ferrari, and a monument (1881) of Victor Emmanuel by Monteverde. Population (1881), 10,800 ; (1899), about

7500.

RovnO, a district town of Russia, in the government of Volhynia, 150 miles by rail west-north-west of Zhitomir. Population (1897), 24,905. It has several steam flour mills and Crown provision factories, and carries on an active trade in corn, cattle, and timber. Under the name of Rovensk it was one of the oldest towns of Volhynia, having been founded in the 13th century. It became subsequently a dependency of Poland, and was an important centre of trade in the 16th century. Later on

it was utterly ruined by the Cossacks and the Tatars, and was finally annexed to Russia.

Rovnoye, a town of Russia, in the government of Xherson, on the Tashlyk river, 23 miles from Bobrinets. It was founded in 1785 by runaways from all parts of Russia, and has become a wealthy town, carrjdng on trade in agricultural produce and the manufacture of carriages. Its population in 1897 was 24,905.

Rovuma., a considerable river in East Africa, iorming during the greater part of its course the boundary between German and Portuguese territory.

The lower Rovuma is formed by the junction in 38" 1' E. of two branches of nearly equal importance, the longer of which, the Lujenda, comes from the south-west, the other, which .stUl bears the name Rovuma, from the west. Its source lies on an undulating plateau, 3000 feet high, immediately to the east of Lake Nyasa, in 10 45' S., 35 40' E., the leadstream flowing first due west before turning south .and east. In its eastward course the Rovuma fiows near the base of the escarpment of an arid sandstone plateau to the north, from which direction the streams, which have cut themselves deep channels in the plateau edge, have almost all short courses. On the opposite bank the Rovuma receives, besides the Lujenda, the Msinje and Luchulingo, flowing in broad valleys running from south to north. The Lujenda rises in close proximity to Lake Chilwa or .Shirwa, in the small Lake Chiuta (1700 feet), the swamps to the south of this being separated from Chilwa only by a narrow wooded ridge. The stream which issues from Chiuta passes by a swampy valley into the narrow Lake Amaramba, from which the Lujenda finally issues as a stream 80 yards wide. Lower down it varies greatly in width, containing in many parts long wooded islands which rise above the flood level, and are often inhabited. The river is fordable in many places in the dry season. At its mouth it is about a mile wide. The lower Rovuma, which is often half a mile wide but generally shallow, flows through .a swampy valley flanked by plateau escarpments contain- ing several small backwaters of the river. The mouth, which lies in 10 28' S., is entirely in German territory, the .boundary near the coast being formed by the parallel of 10 40'. The length of the Rovuma is about 500 miles.

See Proc. E.O.S., February 1882, September 1884, December 1886, AprU 1890 (map).

Rowing'. United Kingdom. The last twenty jrears of the 19th century witnessed a further decline in the standard of English professional sculling, but "the period since 1880 has been one of remarkable prosperity in the amateur world. Efforts have been made not only in England but also in the British colonies, in the United States of America, and in several countries on the continent of Europe, to keep amateur rowing pure and free from the taint of professionalism, and these efl'orts have on the whole met with considerable success.

*Nearly all the minor regattas in England are now held under the rules of the Amateur Rowing Association, and even the stewards of Henley Regatta hold their regatta "in accordance with" the rules of that body. The exact
ॷ effect of the distinction is not obvious, but ॷ such as it is ॷ it is probably due to the fact that should any difi'erenoe of -opinion arise between these bodies, the committee of the Amateur Rowing AMHociation (founded in 1876) are hardly in a position to dictate to the stewards of Henley Regatta (founded in 1839).*

The Amateur Rowing Association exists for the follow- ing objects: ॷ (1) To maintain the standard of amateur rowing as recognized by the Universities and principal Tjoat clubs of the United Kingdom. (2) To promote the

interests of boat-racing generally. It consists of clubs which adopt the following definition of an amateur, namely : ॷ No person shall be considered an amateur oars- man, sculler, or coxswain (1) who has ever rowed or steered in any race for a stake, money, or entrance fee ; (2) who has ever knowingly rowed or steered with or against a professional for any prize ; (3) who has ever taught, pursued, or assisted in the practice of athletic exercises of any kind for profit ; (4) who has ever been employed in or about boats, or in manual labour, for money or wages ; (5) who is or has been by trade or employment for wages a mechanic, artisan, or labourer, or engaged in any menial duty; (6) who is disqualified as an amateur in any other branch of sport. Any amateur club vpilling to bind itself to observe the rules of the association may become affiliated, subject to election by the committee, and all the amateur clubs of any importance in the United Kingdom are members. The government and management of the Amateur Rowing Association (or AR.A., as it is usually designated) is vested in a committee of twenty-five, who have power to affiliate clubs, appoint officers, make or alter rules, suspend, dis- qualify, and reinstate amateurs, and generally determine all questions and disputes relating to boat-racing which may be referred to them. The principal amateur regattas and boat-races have been, held in accordance with the " Rules for Regattas " and " Laws of Boat-Racing " drawn up by this body. They are of the greatest assistance to the stewards or committees of small regattas, as the local officials might often be unwilling to inquire too

closely into the amateur status of visiting crews, or to enforce the laws of boat-racing too strictly, had they not bound themselves, when they accepted the entrance fees and offered prizes, to hold their regattas " under the rules of the A.R.A."

Two important changes have been made in the Henley Regatta course. Before 1886 the races started at the upper end of the Temple Island and finished at Henley Bridge. This course was practically straight for three-quarters of the distance, but at the end there was a curve which, in a close race, gave a distinct advanta,ge to the boat which rowed from the Berkshire side. In 1886 a new course was instituted, starting at the lower end of the island and finishing at the upper end of the wall of Phyllis Court lawn. This course is of the same length as the old one, namely, 1 mile 550 yards, but, although it has two slight angles in favour of the Buckinghamshire station, it is to all intents and purposes straight. The course is marked out on either side by a line of piles driven into the river-bed. Between 1886 and 1899 some minor alterations were made in the course. In 1888 it was narrowed to 120 feet, and in 1897 it was brought farther over to the Berkshire side, in order to diminish the advantage given to the Buckinghamshire boat in a westerly wind by the shelter of the trees upon that bank. Between 1889 and 1899 the number of spectators continued to increase, and there were frequent instances of races being interfered with by craft which were forced out on to the course by the crush of boats; and consequently, in 1899, the regatta stewards resolved to place floating booms between the piles along the greater portion of the Bucking- hamshire side of the course, and along the last part of the Berkshire side. This proposal to boom off the course was very severely criticized, but the stewards had the courage of their opinions, and carried it into effect. It proved to be a great advantage not only to the competitors, who thus have a clear course, but also to the spectators, who are able to take their ease and watch the rowing without fear of being pushed out on to the course during the progress of the races. These and many other minor improvements

****were instituted on the initiative and under tte personal supervision of Mr Herbert T. Steward, for many years chairman of the managing committee of the regatta stewards, and it is not too much to say that the continued success of the meeting was to a great extent due to the enthusiastic and practical interest which he took in its welfare.*

Another noticeable modern feature of the Henley Kegatta has been the increase of foreign competition. Twice have the British colours been lowered in the Diamond Sculls. In 1892 these sculls were won by Mr J. J. K. Ooms, a Dutch sculler of considerable power and undoubted pace ; and in 1897 the winner was Mr E. H. Ten Eyck, the son of an American professional sculler. This oarsman sent in his entry again in 1898, but it was refused by the stewards. In the principal rowing events Englishmen have held their own. In 1895 a Canadian crew were beaten by two feet only for the Stewards' Cup, but on few other occasions, if any, have the home crews been really hard pressed by any of the Canadian, American, French, Dutch, or German crews who have competed. A Dutch crew, the Nereus Boating Club (Amsterdam University), won the Thames Challenge Cup in 1895, but this is not considered a first-class event. In 1901 a very strong crew from the University of Pennsylvania, U.S.A., competed for the Grand Challenge Cup, and were beaten after a good race by Leander Club in the final heat. The former crew had practised together for nearly a year, while business and other engagements prevented the Leander men from getting a crew together till within a fortnight of the regatta. An outcry was raised in the newspapers against the unfairness of subjecting Enghsh crews, who with true amateur spirit treated rowing as a pastime, to competition with foreign crews who, although they obeyed the letter of the amateur definition, really made a business of their rowing. A motion was proposed at the October meeting of the Henley Stewards to exclude foreign crews from the regatta, but it was defeated by a large majority. On July 21, 22, and 23, 1902, a regatta for eights, organized by Lord O'Brien on the river Lee near Cork, Ireland, over a two-mile course, attained the character of an international meeting, by reason of the entry, at the instance of the German Emperor, of a strong Berlin eight. The final heat, in which this crew met Leander, aiforded a fine exhibition of the different styles of British and Continental rowing ; and the result, a victory for Leander by one and a quarter length

clear, was in accordance with general anti- cipations. In order to allow the stewards to make proper inquiry into the amateur status and elegibility of foreign competitors, they have as a rule to make their entries prior to the 1st of April ; but members of any club affiliated to the Union des Soci^tes Frangaises de Sports Athletiques, or to the E^d^ration Beige des Soci^t^s d'Aviron, or of the Deutscher Kuder Verband, or of the Verbouden Neder- landsche Eoeivereenigingen, may make their entries on or before the 1st of June.

Speaking generally, the high standard of Enghsh rowing was well maintained during the closing period of the century. The ideal style aimed at is much the same as it was at the beginning of the 'eighties, and very few coaches would now find fault with the directions for rowing laid down in the ninth edition of this work. The doctrine that the extra length of reach given by the sliding seat is to be used in addition to the long body- swing of fixed-seat rowing, and not in substitution for it, has long been preached by theorists, but it was not until some ten or fifteen years after the introduction of the sUding seat that oarsmen really learned to put it into practice. On a fixed seat the muscles of the legs do a certain amount of work, while the bulk of it falls on the

muscles of the back : the sliding seat allows the muscles of the legs to be used to the fullest extent ; and the primary object of a coach should be to get the correct combination of these two sets of muscles in every member of his crew. A man who has got over this difiiculty and uses his slide and swing simultaneously from the moment that his blade enters the water until the moment that it leaves it is said to "slide well," and a crew which shdes well but has many minor faults will in most cases travel faster than a crew which slides badly, even although the latter has got rid of nearly all the minor faults in style, and has the greater polish and more taking appearance of the two.

The art of coaching has made a distinct advance, and those who superintend the training of crews appear to make a more minute study than they did formerly, not only of the faults of a crew, but also of the best methods of pointing out those faults to their pupils, and of assisting them to efi'ect a remedy. There have been, of course, from the earliest days a

few coaches who thoroughly understood this art ❓❓❓ for it is an art ❓❓❓ but it is in the instructions given to college crews at the Universities and to junior crews of the metropohtan clubs that this improvement is most noticeable, although it must be admitted that the latter class do not seem to have benefited very much by the advice they have received. The value of good coach- ing to a crew cannot be over-estimated, for even the best oarsmen are apt unconsciously to develop faults in style, which grow upon them unless they are at once eradicated.

In 1901 Dr Warre, the headmaster of Eton, designed a boat for the Oxford crew, which was considerably shorter and broader than those generally used. She carried the crew for whom she was designed to victory, but she did not meet with universal approval. She was used again (in 1902) by a crew for whom she was much too small. With this exception, there has not been any substantial change in the lines or construction of the hulls of racing-boats. Some of our best scullers set their faith on boats of a short and broad build, but it is doubtful if they will ever entirely supersede the long narrow craft which have been in vogue since keel-less boats were first introduced. Many new internal fittings have, however, appeared from time to time. Some of them have stayed, and others have vanished as suddenly as they appeared. Sliding seats running upon " rollers " (small vulcanite wheels) have permanently superseded those which moved backwards and forwards upon oiled steel runners. Out- riggers are made of tubular steel, which is at once lighter and more rigid than the old-fashioned solid metal. Swivel rowlocks are sometimes used in pair-oars and four- oars, but they are considered unsuitable to eight-oared rowing, where the beginning of the stroke has to be firmly and smartly caught.

The only universal change in the pattern of oars has been the introduction of Messrs AyUng's patent button, by which the risk of breakage at that point has been reduced to a minimum. Formerly the leather button where the oar rests in the rowlock was attached by two long nails driven into the wood, and there were many instances of the oar giving way at that point under the strain of a race. The patent button is fixed by screws to a metal plate, which is placed flush with the oar and kept in place by a tight covering of leather, and this covering is attached

to the oar by two rows of small tacks, which do not pene- trate more than an eighth of an inch into the wood. Since these buttons have been in use there has been no instance of an oar being broken at the button by fair rowing in any of the more important races.

The literature of rowing has been increased by three works which deal in detail with the arts of rowing, souUing, steering, and train- ing, the measurements of boats and oars, and the history of boat-

taoing since the inception of the sport ; these are the Tolume on Sowing in the Isthmian Library series, the volume on Rowing and Punting in the Badminton Library series published by Messrs Longmans, Green, & Co., and Oxford Bovnng, by the Rev. W. E. Sherwood. (o. M. P.)

United States. ❓❓❓ ^Eowing is one of the oldest of well- defined sports in America, having been taken up in the colleges about 1840. In 1852 the first race between Yale and Harvard was rowed at Lake Winipiseogee. For a time the races were rowed in all sorts of crafts and under all kinds of rig ❓❓❓ four-oar, six-oar, eight-oar, barges, lap streaks, &c. But after a while the universities settled down to six-oared shell racing, and later to eight-oared. The National Rowing Association of American colleges was formed in 1872, and regattas were held at Springfield on the Connecticut river. Afterwards Saratoga offered greater inducements, and the lake there was adopted. In 1875 thirteen colleges sent crews to the races at this meeting ; but the organization was apparently too bulky, and, the loss of Yale in 1876, and of Harvard in the following year, seemed to put an end to the interest, and the association fell to pieces. Since that time Harvard and Yale have conducted a series of annual races in eight- oared shells with coxswains, held for the most part on the Thames at New London, Connecticut; but in 1896 Yale sent her crew to the Henley Eegatta in England, and in the following year Harvard, Yale, and Cornell rowed in a triangular race on the Hudson river at Poughkeepsie. In the years 1897 and 1898 Mr Rudolph C. Lehmann, the English oarsman and coach, took charge of the Harvard crews, which had for some years been consistently

unsuccessful ; and though the crews he coached were beaten, the system and traditions thus inculcated, together with other influences, regenerated Harvard boating. A beginning was made toward a renewal of the old general inter-coUegiate regatta by races upon the Hudson river near Poughkeepsie. In 1900 and 1901 the Universities of Pennsylvania, Wisconsin, Cornell, Columbia, Georgetown, and Syracuse furnished the largest and most exciting of the regattas thus far held there. While college rowing is the oldest form of well-organized boating in the United States, there has been considerable rowing, both profes- sional and amateur, outside the colleges. Single-scull racing was the most common professional event, but there was not always perfect confidence in the genuineness of the races. The National Amateur Association from time to time held the most satisfactory meetings, and did much to keep up the interest in amateur boating. American crews have occasionally competed abroad, mainly in Eng- land. Harvard sent a crew in 1869 to row against Oxford on the Thames; Columbia in 1878, Cornell in 1881 and 1895, Yale in 1896, and Pennsylvania in 1901 competed at Henley. Single scullers were also sent. Upon the occasion of the Centennial Exposition in 1876, English crews competed on the Schuylkill. Many attempts to arrange for other English crews, especially university crews, to visit America were unsuccessful. (w. ca.)

Rowland, Henry Augfustus (1848-1901),

American physicist, was born at Honesdale, Pennyslvania, on 27th November 1848. Although from an early age he exhibited marked scientific tastes and spent all his spare time in electrical and chemical experiments, it was not until he was sixteen that he was allowed to abandon the classical studies which were so distasteful to him and devote himself to scientific and mechanical pursuits. Entering the Rensselaer Polytechnic Institute at Troy, N.Y., he followed the usual engineering curriculum of the place, and graduating in 1870, soon obtained an engagement on the Western New York Railway. But the work there was not to his liking, and after a short time he gave it up for I

an instructorship in natural science at Wooster CoUege, Ohio, which in turn he resigned in order to return to Troy as assistant professor of

physics. Finally, in 1876, he became the first occupant of the chair of physics at the Johns Hopkins University, Baltimore, a position which he retained until his premature death on 16th April 1901. Rowland was one of the most brilliant men of science that America has produced, and must be assigned a high rank among the experimental physicists of the 19th century. It is curious that at first his merits were not perceived in his own country, and his early work, treated there with indifference, first- won adequate recogni- tion in the Eastern hemisphere. In America he was unable even to secure the publication of certain of his scientific papers ; but Clerk Maxwell, when they were sub- mitted for. his consideration, at once saw their excellence, and had them printed in the Philosophical Magazine. So much impressed, indeed, were European physicists by his merits, that when the managers of the Johns Hopkins University asked advice in Europe as to whom they should make their professor of physics, he was pointed out in all quarters as the best man for the post, and was accordingly chosen. In the interval between his election and the assumption of his duties at Baltimore, he studied physics under Helmholtz at Berlin, and carried out a well-known research on the effect of an electrically charged body in motion, showing it to give rise to a magnetic field. His conclusions were subsequently disputed, but he reassured himself of their accuracy by a repetition of the experi- ments only a short time before his death. As soon as he was settled at Baltimore, two important pieces of work engaged his attention. One was a redetermina- tion of the ohm. For this he obtained a value which was substantially different from that ascertained by the committee of the British Association appointed for the purpose, but ultimately he had the satisfaction of seeing his own result accepted as the more correct of the two. The other was a new determination of the mechanical equivalent of heat. In this he used Joule's paddle-wheel method, though vdth many improvements, the whole apparatus being on a larger scale and the experiments being conducted over a wider range of temperature. He obtained a result distinctly higher than Joule's final figure ; and in addition he made many valuable observations on thermometrical questions and on the variation of the specific heat of water, which Joide had assumed to be the same at all temperatures. In 1882, before the Physical Society of London, he gave a description of the diffraction gratings with which his name is specially associated, and which have

been of enormous advantage to astronomical spectroscopy. These gratings consist of pieces of metal or glass ruled by means of a diamond point with a very large number of parallel lines, on the extreme accuracy of which their efficiency depends. For their production, therefore, dividing engines of extraordinary trueness and delicacy must be employed, and in the construction of such machines Rowland's engineering skill brought him conspicuous success. Some account of the minute pre- cautions and refinements observed for the elimination of error to the greatest possible extent may be found in the ninth edition of this Encyclopedia in the article Sceews, which came from his pen, as also did Diffeaction Geatings in vol. xxvii. In addition to making gratings, Rowland also used them, and the results of his labours may be found in the elaborate Photof/raphic Map of tlie Normal Solar Spectrum (1888) and the Table of Solar Wave-Lengths (1898). In the later years of his life he was engaged in developing a system of multiplex telegraphy, an account of which is given in the article Telkgeaphy. (h. m. e.)

Roxburgh, an inland border county of Scotland, is bounded on the E. and S.E. by Northumberland, on the S.E. by Cumberland, on the S.W. by Dumfries, on the W. by Selkirk, on the N.W. by Midlothian, and on the N.E. by Berwick. It occupies the greater part of the border line between England and Scotland.

Area and Population. In 1891 the parishes of Aahkirk, Gala- shiels, and Selkirk, which were shared between Roxburgh and Selkirk shires, were placed wholly in Selkirk, and the Selkirk part of the parish of Mefrose was transferred to the parish of Gala- shiels. Of parishes divided between Berwick and Roxburgh, Earlston and Mertoun were restricted to Berwick, part of Lauder was transferred to Roxburgh, and Roberton was placed wholly in Roxburgh. According to the official estimate, the. area of the county is 428,527 acres, or nearly 670 square miles. The population was, in 1881, 63,442 ; in 1891, 53,741 ; in 1891 on the above area, 53,600, of whom 24,901 were males and 28,599 females ; in 1901 it was 48,793. On the old area, taking land only (425, 656 acres, or 665 -1 square miles),

the number of persons to the square mile in 1901 was 73, and the number of acres to the person 8-7. In the registration county the population increased between 1881 and 1891 by 5-9 per cent. Between 1881 and 1891 the excess of births over deaths was 5936, and the increase of the resident population 312. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 :

Tear.

Deaths.

Marriages.

Births.

Percentage of Illegitimate.

1880 1890 1899

838 876 773

297 246 282

1623 1343 1054

11-0

10-27

9-9

The following tabic gives the birth-rate, death-rate,and marriage- rate per thousand of the population for a series of years :

1S80.

1881-90.

1890.

1891-98.

1899.

Birth-rate . Death-rate . Marriage-rate

31-06

16-04

5-68

28-42

17-18

4-84

25-37

16-55

4-64

22-19

15-78

5-02

19-67

14-42

5-26

There were 174 Gaelic-speaking persons in the county in 1891, and 43 foreigners. Valuation in 1889-90, ??366,056 ; 1899-1900, ??384,459.

Administration. ❖❖❖ The county returns a member to Parliament, and contains Hawick (17,303), one of the Border group of parlia- mentary burghs and a police burgh. Jedburgh (2222), the county town, is the only royal burgh, and Kelso (4006) is the only considerable police burgh. There are 30 civil parishes, with combination poorhouses at Hawick, Jedburgh, and Kelso ; and the lunatic asylum for Roxburgh, Berwick, and Selkirk is at Bowden, near Melrose. The number of paupers and dependants in September 1899 was 963. Roxburgh, Berwick, and Selkirk form a sheriffdom, and a resident sheriff-substitute sits at Jed- burgh and Hawick.

Education. ❖❖❖ Thirty – two school boards manage 63 schools, which had an average attendance of 7269 in 1898-99, while 5 voluntary schools (1 Roman Catholic and 2 Episcopal) had 663. Tliere are secondary schools at Hawick and Kelso, and Jedburgh and Melrose public schools have secondary departments. The greater part of the "residue " grant is spent in assisting teachers to attend science and technical classes at Edinburgh IJniversity and Hawick, and in subsidizing science and art and technical classes at Hawick, Kelso, and elsewhere.

Agriculture. ❖❖❖ Oats are the principal corn crop, and the barley acreage is about two-fifths of that under oats. The percentage of cultivated area in 1898 was 41-9. There were 16,285 acres under wood in 1895, of which 757 had been planted since 1881. Of the 1241 holdings in 1895, the date of the last return, the aver- age size was 146 acres. The percentage under 5 acres was 21-76, between 5 and 50 acres 33-44, and over 50 acres 44-80. The number of farms between 50 and 100 acres was 100, between 100 and 300, 253, between 300 and 500, 102, and between 500 and 1000, 85, while as many as 16, a proportion exceeded in Berwick-shire only, were over 1000 acres. The following table gives the principal acreages at intervals of five years from 1880 : ❖❖❖

Tear.

Area under Crops.

Corn Crops.

Green Crops.

Clover.

Perma- nent Pasture.

Fallow.

1885 1890 1895 1899

184,322 185,726 180,962 182,337

48,303 46,792 43,380 42,966

27,423 27,183 25,312 24,379

67,682 58,270 56,745 52,650

50,845 53,379 65,408 62,236

69 56 47 58

The following table gives particulars of the live stock during the same years : ???

Tear.

Total Horses.

Total Cattle.

Cows or

Heifers in

Milk or Calf.

Sheep.

Pigs.

1885 1890 1895 1899

4396 4394 4462 4300

18,679 18,576 17,327 17,787

6373 5179 4684 4560

494,152 517,629 610,227 532,989

4174 4286 3938 3260

At the census of 1891, 4895 men and 1106 women were returned as being engaged in agriculture.

Industries and Trade, ◆◆◆ The county is the principal seat of the tweed and hosiery manufacture in the kingdom. The industries of Hawick and Jedburgh include also engineering, iron-founding, and dyeing, and fishing tackle is made on a considerable scale at Kelso. The salmon fishings on the Tweed are valuable. The in- dustrial population in 1891 numbered 8102 men and 4445 women, of whom 2385 men and 2623 women were connected with the manufacture of textiles.

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Roya,n, town, arrondissement of Marennes, depart- ment of Charente Inf^rieure, France, 37 mUes in direct line, south of Rochelle, on branch line from Pons to Tremblade. A municipal casino was opened in 1895. A statue of Eugfene Pelletan (died 1884), a benefactor of the town, has been erected. Eoyan is the seat of a Protestant consistory. There is an active coasting trade. In 1900, 1064 vessels of 65,760 tons entered, and 1038 of 65,064 tons cleared. Population (1891), 6241 ; (1896), 6864 (comm.), 8258.

R6zsa.hegy, a market-town of Hungary, in the county of Lipt6, near, the Vdg, with 6879 inhabitants in 1891. It has an upper gjrmnasium, textile manufactories, paper mill, saw mill, and other industrial establishments. Its commerce is brisk. Not far from Rozsahegy lies Koritnicza, a popular bathing-place. Population (1901),

8198.

RU??lbon, a parish, town, and railway station, Den- bighshire, North Wales, in the Eastern parliamentary division, near the Shropshire border, 5 miles south-west of Wrexham. In the neighbourhood there are colKeries, engineering works, an iron foundry and chemical works, and an extensive industry in the manufacture of bricks, terra-cotta, encaustic and tesselated tiles, glazed bricks, and sanitary pipes. Population of civil parish (1901),

3491.

Rubinstein, Anton Grigforowitz (1830-

1894), Russian pianist, born at Wechwotynetz, in Podolia, of Jewish parentage, was the son of a pencil manufacturer who migrated to Moscow. Besides his mother he had but one teacher, Alexander Villoing, of whom he declared at the end of his own career that he had never met a better. In July 1839 Rubinstein appeared in the theatre of the Petrowski Park at Moscow, and was promptly acclaimed a genius ; and in the year following he went to Paris after Villoing, and played with success before Liszt. For some time after this Rubinstein travelled in Holland, Germany,

and Scandinavia, and reached England in 1842, whsre on 20th May he made his first appearance at a Choral

Fund Concert witli complete success. After a brief visit to Moscow in 1843, he went with his family (incltiding his afterwards distinguished brother Nikolaus) to Berlin for purposes of the complete musical education which the parents had now determined to give their sons. Dehn was their master, and Mendelssohn, whom Kubin- stein had met previously in London, their best friend. The sudden death of Rubinstein pere necessitated the with- drawal of his wife and Nikolaus to Moscow, while Anton, on Dehn's advice, went to Vienna to seek a livelihood. Hence, after more hard study for nearly two years, he went with the flautist Heindl, and later alone, on a concert tour in Hungary ; and the outbreak of the revolution in Vienna preventing his return there, he went vid Berlin to St Petersburg, where he met with immediate and hearty encouragement, the Grand Duchess H^lene appointing him Kammervirtuos. About this time an unfortunate error of the police nearly caused his expatriation to Siberia, from which he was saved by his patroness. During the next eight years Rubinstein spent most of his time in St Peters- burg studying, playing, and composing. His opera Dmitri Donskai was produced there in 1851, and Toms der Narr in 1853. Die Sibirischen Jager, written about the same time, was not produced. In Russia his success was so great, and his fame had already spread so far abroad, that on the advice of his patroness and Count WiLhorski he set out on a tour to convince foreigners of his abilities. After a visit to Hamburg, he appeared as composer, conductor, and pianist at the Gewandhaus at Leipzig, and after further travels he arrived for the second time in London in 1857, when at a Philharmonic Concert he introduced his own concerto in G. In the following year he was in London again, having in the meantime been appointed Concert Director of the Royal Russian Musical Society. In 1862 he founded the St Petersburg Conservatorium, of which for many years he remained the guiding spirit. In 1868 he began again to travel in Germany, France, and England, and

remained for some time in Vienna, where he introduced a large number of his own compositions. Thence he went to America in 1872 and 1873, when he returned to Russia, and after a short rest set oflf once more on concert tours. In this manner the. rest of his life was spent, until in 1885 he began a series of historical recitals of immense interest, which he gave in most of the chief European capitals. He died 20th November 1894.

In addition to the works already named, Rubinstein left compositions in almost every known form. Among other of his operas are Die Kinder der Haide, Feramors {Lalla Bouhh), Nero, Der Daman, and Die Makkahder, this last perhaps more frequently played than aU the others, the bane of which is the lack of dramatic point. On the subject of oratorio Rubinstein held original views, though his attempt to realize them in Moses and Cliristus was not completely successful, while his efforts in Berlin and London to found a Sacred Theatre failed entirely. All the same, he regarded his Christus as his greatest achievement. The most familiar of his five symphonies are the " Ocean " and the "Dramatic." He wrote scores on scores of pianoforte works, from complex concertos to the most commonplace salonstiicke ; abundance of concerted chamber-music ; and a number of songs and duets, which enjoyed some vogue. He also published several books, including his Reminis- cences and Die geistlidw Oper. What Dr Hanslick once said of Rubinstein is perfectly true, that "people admired the Russian's bold, powerful, occasionally even rough playing, without being won over in the least by his com- positions." As a composer Rubinstein is practically dead. His fame as one of the greatest of pianists, his exquisite touch and perhaps his waywardness, will live in history.

(e. h. l.)

Ruby Mines, a district in the Mandalay division of Upper Burma, lying between the Bhamo district on the north, the Shan States on the east, Mandalay district on the south, and Kalta on the west. Area, 1915 square miles; population (1891), 34,062; (1901), 87,815. In 1898-99 it had 193 villages, which paid a revenue of Rs. 1,09,649. The district geographically forms part of the Shan plateau, and is to a great extent a mass of hills, with a general north and south direction. Of a total acreage of 3,504,480

acres, only 7347 were cropped in 1898-99. There were 2980 acres of current fallow, and the area remaining available for cultivation was 349,661 acres ; 118,296 acres were under forest, and the remainder, 747,068 acres, were uncultivable. The population in 1891 was classified as: Buddhists, 31,227; Hindus, 884; Ma- hommedans, 350; and Christians, 269. Kachins and Palaungs together probably outnumbered the Burmans and Shans, but there were no exact statistics. The total rain-fall in 1898-99 was 103-20 inches, taken at Mog6k. The highest shade maximum in that year was 83 , and the lowest temperature in December, 35 F. The headquarters town is Mog6k, which is reached by a cart-road from Thabeikkyin, 61 miles distant, on the Irrawaddy. The town stands in the centre of a valley, at a height of 4000 feet above searlevel. It is the centre of the ruby-mining industry. Population (1891), 5630; (1898), about 8000. The Ruby Mines Company employs, about 40 Europeans and Eurasians in its works, which are situated at the north end of the town. The company has constructed a dam across the Yeni stream and set up an electric installation of about 200 horse-power, which pumps and lights the principal mine.

RUdesheim, a town of Prussia, in the Rhine pro- vince, on the right bank of the Rhine, 19 miles by rail west by south of Wiesbaden, famous for its wine. It has three ancient towers, and an EvangeHcal (1855) and a Roman Catholic (1390-1400) church. Immediately above the town, on the Niederwald hill (985 feet), stands the national monument (" Germania "), designed by Schilhng, commemorative of the war of 1870-71. Population

(1900), 4812.

Rudini, Antonio Starabba, Mahquis

Di (1839), Italian statesman and Knight of the

Annunziata, was born on 6th April 1839 at Palermo. In 1866 he was elected syndic of his native city, and dis- played considerable personal courage in quelling a separat- ist insurrection organized by the reactionary party. The prestige thus acquired led to his appointment to the prefecture of Naples in 1867, and in October 1869 to the Ministry of the Interior in the Menabrea cabinet. His term of office was short, as he fell

with Jlenabrea in the following December, and held no prominent position until, upon the death of Minghetti in 1886, he became leader of the Right. Early in 1891 he succeeded his fellow-Sicilian, Crispi, in the premiership and Ministry of Foreign Affairs, by forming a coalition cabinet with a part of the Left under Nicotera ; but his administration proved weak and vacillating, its only important act being the renewal of the Triple Alliance for a period of twelve years. After an attempt to modify his cabinet, he was overthrown in May 1892 by a vote of the Chamber. Upon the return of his rival, Crispi, to power in December 1893, he resumed political activity, allying himself \Yith the Radical leader, Cavallotti, whose defamatory anti-Crispian campaign he openly encouraged. The crisis consequent upon the disaster of Adowah (1st March 1896) enabled Rudini to return to power as Premier and]\[inister of the Interior in a cabinet formed by the veteran Conservative, General Ricotti. He concluded peace with Abyssinia, but

endangered relations with Great Britain by the unauthor- ized publication of secret diplomatic correspondence in a Green-book on Abyssinian affairs. His internal policy was marked by continual jdelding to Eadical pressure and by persecution of Crispi. Dissolving the Chamber early in 1897 in obedience to Eadical dictation, and supporting Radical candidatures in the ensuing general election, he augmented the influence of the subversive parties, and inadvertently paved the way for the outbreak of May 1898, the suppression of which, manu militari, entailed considerable bloodshed and necessitated the proclamation of a state of siege at Milan, Naples, Florence, and Leghorn. Indignation at the results of his policy led to his overthrow in June 1898, when, in order to prevent the advent of his Conservative opponents, he resigned office without permitting Parliament to designate a successor. During his second term of office he thrice modified his cabinet (July 1896, December 1897, May 1898) without strengthening his pohtical position. In many respects Rudini, though leader of the Right and nominally a Conservative pohtician, proved a dissolving element in the Italian Conservative ranks.

By his alliance with the Liberals under Nicotera in 1891, and by his understanding with the Radicals under Cavallotti in 1894-98; by his betrayal of his Conservative colleague. General Ricotti, to whom he owed the premiership in 1896 ; and by his vacil- lating action since his fall from power, he divided and demoralized a constitutional party which, with greater sin- cerity and less reliance upon political cleverness, he might have welded into a solid parhamentary organization.

Rudok. See Tibet.

Rudolf (otherwise knovra as Basso Nokok and Gallop), a large lake of eastern equatorial Africa, form- ing the centre of an inland drainage system, occupying the southern part of the Abyssinian highlands and a portion of the great equatorial plateau. The lake itself lies towards the north end of the great East African rift valley, between the parallels of 2 26′ and 5 N., while the meridian of 36 E. runs down the centre of the northern wider part, the narrower southern portion bending slightly eastward. The length along the curved axis is 185 miles, the maxi- mum width probably about 35, and the area roughly 3500 square miles. Its altitude is 1250 feet. Towards the south end it seems to be deep, but it is comparatively shallow in the north. Its water is brackish, but drinkable. The country bordering the lake on almost every side is sterile and forbidding, and the only permanent river which enters it is the Nianam or Omo, from the north. The southern end, for some 50 miles on the west and for a longer distance on the east, is shut in by high cliffs the escarpments of a rugged lava-strewn country, which shows abundant signs of volcanic activity, great changes having been reported since 1889. In particular, the great volcano of Lubburua is said to have been destroyed between 1889 and 1897 by a sudden explosion, and according to native report the lake contours have considerably changed -ndthin 30 years. Farther north, on the west side, sandy plains alternate with lines of low hills, the immediate shores (on which the water appears to have encroached in very modern times) being marked by spits of sand, which in places cut off lagoons from the main body of the lake. These are the haunt of great numbers of water-birds. In 3 8′ N. the dry bed of the Turkwell in its upper course a large river descending the slopes of Mount Elgon approaches the lake, which seems, however, to

receive no water from it at the present day. Near the north end mountains again approach the shores, the most prominent being Mount Lubbur, an extinct volcano with a well- preserved crater, and a bold rocky escarpment below the

summit. At the extreme north-west corner a bay some 35 miles long (Sanderson GuH) is almost separated from the rest of the lake by two long points of land. On the eastern side, open arid plains, with few trees, occupy most of the northern country. Near the south end is the volcanic island of Elmolo, 10 miles long, and there are a few small islets near the middle point of the length. At the north end a level swampy plain is traversed by various arms of the lake and by the Nianam river. This river has been shown to be identical with the Omo, the course of which was long one of the most debated questions of African geography. Its northernmost feeders rise on the high plateau south of the Blue Nile, in 9 10′ N., and being swollen by other streams from the east and west, soon form a large river running in a deep wooded vaUey flanked on either hand by masses of high mountains. During its lower course it makes two considerable bends to the west before finally entering the lake as a deep stream a quarter of a mile wide. Lake Rudolf (previously known on the east coast by report) was discovered in 1889 by Teleki, and has since been visited by Donaldson Smithy Bottego, Cavendish, Austin, and others.

Authorities. Oeographiccd Journal, September 1896, April 1898, August 1899. Von Hohsel. Discovery of Lakes Rudolf and Stephanie. London, 1894. Smith. Through VnTcnown- African Countries. London, 1897. Neumann. Elephant-Hunt- ing in East Equatorial Africa. London, 1898. Vannutelli and CiTEUNi. L'Omo. Milan, 1899. Wellby, 'Twixt Sirdar and Menelilc. London, 1901. (e. He.)

Rufiji, a large river of German East Africa, entering the sea by a considerable delta, between 7 45′ and 8 13′ S. Its upper basin, which extends from north to south through over 300 miles, is drained by three main branches, which unite to form the lower Rufiji. This receives no further tributary in a course of some 150 miles, so that here the width

of the basin is reduced to a minimum. Of the three upper branches, the two southern, the Luvegu and the Ulanga, though shorter than the northernmost (the Ruaha), carry a greater volume of water, as they come from a more rainy region, and by their junction the Rufiji proper may be said to be formed.

The Luvegu rises in 10 50′ S., 35 60′ E., and flows north-west in a wooded valley, generally narrow, and bordered by a broken country in great part uninhabited and covered with thin forest. In its lower course it is a large stream 100 to 150 yards wide.

The Ulanga is formed by a number of streams descending from the outer escarpment of the high plateau which runs north-east from the head of Lake Nyasa, and in Uhehe becomes broken up in ranges of mountains. The most importantheadstream, the Ruhudye, rises in about 9 30′ S., 34 40′ E. As a whole, the Ulanga valley is broad, level, and swampy, the river running in a very winding course and sending off many diverging arms. It is navigable throughout the greater part of its course, having even iu the dry season a general depth of 3 to 12 feet, with a width of 40 to 120 yards. In April and May nearly all the streams overflow their banks and cover a great part of the plain.

Just below the junction of the Luvegu and Ulanga, the Rufiji flows through a narrow pass by the Shuguli falls, and continues north-east in a fairly straight course to the junction of the Ruaha, in 7 55′ S. The most remote branches of the Ruaha rise north of LakeNyasa in the Livingstone mountains, and descend into abroad sun-baked valley, which seems to belong to the East African system of rift valleys. The united stream makes a wide sweep to the north of the Uhehe mountains, from which it receives various tributaries, finally flowing south-east and east to the Rufiji. A little below the junction, the Rufiji is broken by the Pangani falls (37 42′ E.), but is thence navigable by small steamers to its delta. The country on either side is a generally level plain, inundated, on the south, in the rains, and the river varies in width from 100 to 400 yards, with an average current of 3 miles an hour. The main mouth of the river is that known as Simba Uranga, the bar of which can be crossed by ocean vessels at high water, but all the branches are very shallow as the

apex of the delta is approached. Saw-mills have been established on some of them, and much of the delta is suited for rice-growing.

See Beakdall in Proc. B.G.S., 1881. *Pfeil in Petermanns Mitteilun.gen, 1886.* 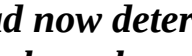 *Pkittwitz and Adams in Mitt, aus den Deutschen Schutzgelieten, 1898.* 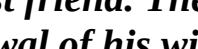 *Prussing, Ibid., 1901.*

Fund Concert with complete success. After a brief visit to Moscow in 1843, he went with his family (including his afterwards distinguished brother Nikolaus) to Berlin for purposes of the complete musical education which the parents had now determined to give their sons. Dehn was their master, and Mendelssohn, whom Eubin- stein had met previously in London, their best friend. The sudden death of Rubinstein pere necessitated the with- drawal of his wife and Nikolaus to Moscow, while Anton, on Dehn's advice, went to Vienna to seek a liveHhood. Hence, after more hard study for nearly two years, he went with the flautist Heindl, and later alone, on a concert tour in Hungary ; and the outbreak of the revolution in Vienna preventing his return there, he went viA Berlin to St Petersburg, where he met with immediate and hearty encouragement, the Grand Duchess H^lene appointing him Kammervirtuos. About this time an unfortunate error of the police nearly caused his expatriation to Siberia, from which he was saved by his patroness. During the next eight years Rubinstein spent most of his time in St Peters- burg studying, playing, and composing. His opera Dmitri Donskoi was produced there in 1851, and Toms der Narr in 1853. Bie Sibirischen Jdger, written about the same time, was not produced. In Russia his ' success was so great, and his fame had aheady spread so far abroad, that on the advice of his patroness and Count Wilhorski he set out on a tour to convince foreigners of his abilities. After a visit to Hamburg, he appeared as composer, conductor, and pianist at the Gewandhaus at Leipzig, and after further travels he arrived for the second time in London in 1857, when at a Philharmonic Concert he introduced his own concerto in G. In the following year he was in London again, having in the

meantime been appointed Concert Director of the Royal Russian Musical Society. In 1862 he founded the St Petersburg Conservatorium, of which for many years he remained the guiding spirit. In 1868 he began again to travel in Germany, France, and England, and remained for some time in Vienna, where he introduced a large number of his own compositions. Thence he went to America in 1872 and 1873, when he returned to Russia, and after a short rest set off once more on concert tours. In this manner the, rest of his life was spent, until in 1885 he began a series of historical recitals of immense interest, which he gave in most of the chief European capitals. He died 20th November 1894.

In addition to the works already named, Rubinstein left compositions in almost every known form. Among other of his operas are Die Kinder der Haide, Feramors (Lalla Roukh), Nero, Der Damon, and Die Makhabaer, this last perhaps more frequently played than all the others, the bane of which is the lack of dramatic point. On the subject of oratorio Rubinstein held original views, though his attempt to realize them in Moses and Christus was not completely successful, while his efforts in Berlin and London to found a Sacred Theatre failed entirely. AU the same, he regarded his Christus as his greatest achievement. The most familiar of his five symphonies are the ” Ocean ” and the ” Dramatic.” He wrote scores on scores of pianoforte works, from complex concertos to the most commonplace salonstiic/ce ; abundance of concerted chamber-music ; and a number of songs and duets, which enjoyed some vogue. He ??? also published several books, including his Reminis- cences and Die geistUche Oper. What Dr Hanslirk once said of Rubinstein is perfectly truo, that ” people admired the Russian’s bold, powerful, occasionally even rough playing, without being won over in the least by his com- positions.” As a composer Rubinstein is practically dead. His fame as one of the greatest of pianists, his exquisite touch and perhaps his waywardness, will live in history.

(e. h. l.)

Ruby Mines, a district in the Mandalay division of Upper Burma, lying between the Bhamo district on the north, the Shan States on the east, Mandalay district on the south, and Kalta on the west. Area, 1915 square

miles; population (1891), 34,062; (1901), 87,815. In 1898-99 it had 193 villages, which paid a revenue of Rs. 1,09,649. The district geographically forms part of the Shan plateau, and is to a great extent a mass of hills, with a general north and south direction. Of a total acreage of 3,504,480 acres, only 7347 were cropped in 1898-99. There were 2980 acres of current fallow, and the area remaining available for cultivation was 349,661 acres; 118,296 acres were under forest, and the remainder, 747,068 acres, were uncultivable. The population in 1891 was classified as: Buddhists, 31,227; Hindus, 884; Ma- hommedans, 350 ; and Christians, 269. Kachins and Palaungs together probably outnumbered the Burmans and Shans, but there were no exact statistics. The total rain-fall in 1898-99 was 103-20 inches, taken at Mog6k. The highest shade maximum in that year was 83 ??, and the lowest temperature in December, 35 ?? F. The headquarters town is Mogok, which is reached by a cart-road from Thabeikkyin, 61 miles distant, on the Irrawaddy. The town stands in the centre of a valley, at a height of 4000 feet above sea-level. It is the centre of the ruby-mining industry. Population (1891), 5630; (1898), about 8000. The Ruby Mines Company employs. about 40 Europeans and Eurasians in its works, which are situated at the north end of the town. The company has constructed a dam across the Yeni stream and set up an electric installation of about 200 horse-power, which pumps and lights the principal mine.

Rudesheim, a town of Prussia, in the Rhine pro- vince, on the right bank of the Rhine, 19 miles by rail west by south of Wiesbaden, famous for its wine. It has three ancient towers, and an Evangehcal (1855) and a Roman Catholic (1390-1400) church. Immediately above the town, on the Niederwald hill (985 feet), stands the national monument (" Germania "), designed by Schilling, commemorative of the war of 1870-71. Population.

(1900), 4812.

Rudini, Antonio Starabba, Mabquis

Di (1839), Italian statesman and Knight of the

Annunziata, was born on 6th April 1839 at Palermo. In 1866 he was elected syndic of his native city, and dis- played considerable personal

courage in quelling a separat- ist insurrection organized by the reactionary party. The prestige thus acquired led to his appointment to the prefecture of Naples in 1867, and in October 1869 to the Ministry of the Interior in the Menabrea cabinet. His term of office was short, as he fell with Menabrea in the following December, and held no prominent position until, upon the death of ilinghetti in 1886, he became leader of the Right. Early in 1891 he succeeded his fellow-Sicilian, Crispi, in the premiership and JNIinistry of Foreign Affairs by forming a coalition cabinet with a part of the Left under Nicotera ; but his administration proved weak and vacillating, its only important act being the renewal of the Triple Alliance for a period of twelve years. After an attempt to modify his cabinet, he was overthrown in May 1892 by a vote of the Chamber. Upon the return of his rival, Crispi, to power in December 1893, he resumed political activity, allying himself with the liadioal leader, Cavallotti, whose defamatory anti-Crispian campaign he openly encouraged. The crisis consequent upon the disaster of Adowah (1st March 1896) enabled Rudini to return to power as Premier and ilinister of the Interior in a cabinet formed by the veteran Conservative, General Eicotti. He concluded peace with Abyssinia, but

endangered relations with Great Britain by the unauthor- ized publication of secret diplomatic correspondence in a Green-book on Abyssinian affairs. His internal policy was marked by continual yielding to Radical pressure and by persecution of Crispi. Dissolving the Chamber early in 1897 in obedience to Eadical dictation, and supporting Radical candidatures in the ensuing general election, he augmented the influence of the subversive parties, and inadvertently paved the way for the outbreak of May 1898, the suppression of which, manu militari, entailed considerable bloodshed and necessitated the proclamation of a state of siege at Milan, Naples, Florence, and Leghorn. Indignation at the results of his policy led to his overthrow in June 1898, when, in order to prevent the advent of his Conservative opponents, he resigned oifice without permitting Parliament to designate a successor. During his second term of

office he thrice modified his cabinet (July 1896, December 1897, May 1898) without strengthening his pohtical position. In many respects Rudini, though leader of the Eight and nominally a Conservative pohtician, proved a dissolving element in the Italian Conservative ranks. By his alhance with the Liberals under Nicotera in 1891, and by his understanding with the Radicals under CavaUotti in 1894-98; by his betrayal of his Conservative colleague, General Ricotti, to whom he owed the premiership in 1896 ; and by his vacil- lating action since his fall from power, he divided and demoralized a constitutional party which, with greater sin- cerity and less reliance upon political cleverness, he might have welded into a solid parliamentary organization.

Rudok. See Tibet.

Rudolf (otherwise known as Basso Noeok and Gallop), a large lake of eastern equatorial Africa, form- ing the centre of an inland drainage system, occupying the southern part of the Abyssinian highlands and a portion of the great equatorial plateau. The lake itself lies towards the north end of the great East African rift valley, between the parallels of 2 26' and 5 N., while the meridian of 36 E. runs down the centre of the northern wider part, the narrower southern portion bending slightly eastward. The length along the curved axis is 185 miles, the maxi- mum width probably about 35, and the area roughly 3500 square miles. Its altitude is 1250 feet. Towards the south end it seems to be deep, but it is comparatively shallow in the north. Its water is brackish, but drinkable. The country bordering the lake on almost every side is sterile and forbidding, and the only permanent river which enters it is the Nianam or Omo, from the north. The southern end, for some 50 miles on the west and for a longer distance on the east, is shut in by high cliffs the escarpments of a rugged lava-strewn country, which shows abundant signs of volcanic activity, great changes having been reported since 1889. In particular, the great volcano of Lubburua is said to have been destroyed between 1889 and 1897 by a sudden explosion, and according to native report the lake contours have considerably changed within 30 years. Farther north, on the west side, sandy plains alternate with lines of low hills, the immediate shores (on which the water appears to have encroached in very modern times) being marked by spits of sand, which in

places cut off lagoons from the main body of the lake. These are the haunt of great numbers of water-birds. In 3 8′ N. the dry bed of the Turkwell in its upper course a large river descending the slopes of ilount Elgon approaches the lake, which seems, however, to receive no water from it at the present day. Near the north end mountains again approach the shores, the most prominent being Mount Lubbur, an extinct volcano with a well- preserved crater, and a bold rocky escarpment below the

summit. At the extreme north-west comer a bay some 35 miles long (Sanderson Gulf) is almost separated from the rest of the lake by two long points of land. On the eastern side, open arid plains, with few trees, occupy most of the northern country. Near the south end is the volcanic island of Elmolo, 10 miles long, and there are a few small islets near the middle point of the length. At the north end a level swampy plain is traversed by various arms of the lake and by the Nianam river. This river has been shown to be identical with the Omo, the course of which was long one of the most debated questions of African geography. Its northernmost feeders rise on the high plateau south of the Blue Nile, in 9 10′ N., and being swollen by other streams from the east and west, soon form a large river running in a deep wooded valley flanked on either hand by masses of high mountains. During its lower course it makes two considerable bends to the west before finally entering the lake as a deep stream a quarter of a mile wide. Lake Rudolf (previously known on the east coast by report) was discovered in 1889 by Teleki, and has since been visited by Donaldson Smith, Bottego, Cavendish, Austin, and others.

AiiTHOKiTiES. Geographical Journal, September 1896, April 1898, August 1899. Von Hohkbl. Discovery of Lakes Rudolf and Stephanie. London, 1894. Smith. Through Unknown- African CourUries. London, 1897. Neumann. Elephant-Hunl- ing in East Equatorial Africa. London, 1898. Vannutelli and CiTERNl. L’Omo. Milan, 1899. ^Wbllbt, ‘Tvdxt Sirdar and Menelik. London, 1901. (e. he.)

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*See Beaedall in Proc. R.G.S., 1881.**Pfeil in Petermanns MUteilungen, 1886.**Peussing, Ibid., 1901.*

RUGBY RUMANIA

Rugby, a market-town and parish of Warwickshire, England, in the Rugby parliamentary division of the county, 80J miles north-west of London by rail. In 1895 the parish church was completed, by the addition of a tower with a spire and eight bells, at a cost of 10,000. A free public library building was presented to the town in 1891. The books were furnished by the Kugby Institute, since dissolved. In 1895 the Rev. Herbert Armitage James, D.D., late principal of Cheltenham College, succeeded the Rev. John Percival, LL.D. (late principal of Trinity College, Oxford), on his becoming bishop of Hereford, as headmaster of Rugby School. Among modern public buildings are the municipal offices, and additions to the technical schools. Population of urban district and parish (1891), 11,262; (1901), 16,830: of parliamentary division

(1891), 49,737; (1901), 56,221.

Ruhia, a town and summer resort of Germany, partly in the duchy of Saxe-Weimar and partly in the duchy of Saxe-Coburg-Gotha. It stretches 2^ miles along the valley of the Erb, in the Thuringian Forest, 8 miles south of Eisenach. Visitors are attracted by its natural surround- ings, its mineral and other baths, and by its whey and cold- water "cures." It has a staple industry in the manufac- ture of pipes, cigarette-holders, &c., and iron wares. In the Middle Ages this place, locally known as Die Ruhl, was famous for its armourers, subsequently for its cutlers. Population (1900),

6581, of whom 3081 belonged to the Weimar part and 3500 to the Coburg-Gotha part.

Ruhrort, a town of Prussia, in the Rhine province. It stands on the Rhine, at the confluence of the Ruhr, 24 miles by rail north of Diisseldorf, and is the principal shipping port for the coal of the Westphalian coal-field, the

harbour extending 4^ miles along the river. In 1899 the port was entered and cleared by 13,951 vessels of 6,927,000 tons. Ruhrort has iron-puddling furnaces, dye- works, tanneries, and brickworks. Population (1885),

9866; (1900), 12,407.

Rukwa. (sometimes also Rikwa and Hikvita), a shallow lake in German East Africa, lying in a north- western continuation of the rift valley which contains Lake Nyasa. The sides of the valley here run in steep parallel walls 30 to 40 miles apart, from south-east to north-west, leaving between them a level plain extending from about 7J►► to 85^►► S. This whole area was probably once covered by the lake, but this has shrunk, apparently within quite modern times, so that the permanent water occupies only a space of 30 miles by 1 2 at the south end immediately under the eastern escarpment. In the rains it extends some 40 miles farther north, and the north end of the plain is likewise then covered with water to a depth of about 4 feet. The rest of the plain is a bare expanse intensely heated by the sun in the dry season, and forming a tract of foul mud near the lake shores. The principal feeder of Rukwa is the Saisi, which traverses a winding valley cut out of the high plateau between Lakes Nyasa and Tan- ganyika. The maximum depth of the lake is about 10^ feet. Its water is very brackish and of a milky colour, from the mud stirred up by the wind. It contains great quantities of fish. First seen from the north by Thomson in 1880, it has since been visited by many travellers, both British and German, including Johnston, Nutt, Wallace, Ramsay, Glauning, Fiilleborn, and Kohlschiitter.

See especially Pi-oc. B.G.S., December 1890 ; Geographical Journal, June 1899 ; Ilitteilungen aus den DeutscTien Schutzgebieten, 1899, No. 4 ; 1900, No. 1.

EUMANIA.

R

UMANIA, a kingdom of the Balkan Peninsula, bounded by Russia on the north, the Danube on the

south, Hungary on the west, and the Black Sea ►►on!' "' '^^ ^^►► (►►'" details, see History, below).*

The population in 1884 was 4,648,123, and in 1899, 5,912,520, this giving a density of 117 per square mile. The excess of births over deaths in the five years from 1894 to 1899 was 370,205, but the average annual excess during the last quarter of the 19th century was 43,609, which would in forty years indicate a natural increase of 1,744,360 in the population; the actual in- crease, however, according to the census returns, was over two millions, which would indicate that during that period some quarter of a million strangers settled in the country. Much of this increase is due to immigration of Jews from Galicia and Russia. Of the total population, 18 '8 per cent, live in towns and 81 '2 per cent, in the country; 50'7 per cent, are males and 49'3 per cent, females; 55 per cent, are unmarried, 38-6 per cent, married, 6'1 per cent, widows and widowers, and 0'3 per cent, divorced.

As regards nationality, there are Rumanians, 5,469,036 ; foreigners, 171,063; and nondescript (principally Jews), 272,241. vi- 1 .r /.

The following table shows the thirty-two adminis- trative districts into which the country is divided, their respective pi^pulations in 1899, thoir area in square miles, and the number of inhabitants per mile. The Dobruja, which comprises the districts of Constantza and Tulcea, is less thickly populated than the rest of the country.

District.

Area in Square Miles.

Population,

1899.

Inhabitants

per Square

Mile.

Argesh ....

1,712

205,882

120

Bacau ....

1,533

192,963

125 ‘9

Botoshani . , . .

1,215

170,455

140-1

Braila ....

1,682

147,006

89-5

Buzeu ....

1,877

220,439

117-5

Constantza ….

2,567

135,050

52-6

Covurlui (Galatz)

1,143

144,075

126

Dimbovitza

1,334

209,440

157

Dolj (Craiova) .

2,532

364,193

143-8

Dorohoi . . . .

1,089

158,605

145-6

Falciu . . . .

852

93,317

109-5

Gorj

1,813

169,324

93-3

Ilfov (Buoliarest)

2,231

545,766

244-6

Jalomitza ....

2,500

187,193

74-8

Jassy ....

1,205

191,828

159 1

Mehedintzi (Turn Severin) .

1,910

247,223

129-4

Muscel ....

1,140

113,458

99-5

Neamtz (Piatra) .

1,543

146,894

93-1

Olt

1,090

142,496

133

Prahova (Ploesti) ◆◆◆.

1,800

304,376

169

Putna (Focsani) .

1,254

150,410

119-9

Eamnio-Sarat

1,262

136,467

108

Roman ....

807

108,704

134-7

Eomauatzi

1,767

202,499

114-4

Suceava

1,319

129,687

98-2

Teouciu

983

120,026

122-1

Teleorman

1,808

236,129

130-6

Tulcea

3,329

123,192

37

Tutova

923

115,786

125-4

Vaslui

884

109,356

123-7

Valcea

1,636

189,865

116

Vlaslica (Giui'gevo)

1,732

200,536

115-7

50,472

5,912,520

117

statistics]

RUMANIA

313

The principal towns are Bucharest, with (1900) 282,071 inhabitants, of whom 43,274 are Jews ; Jassy, 78,067, with 39,441 Jews; Galatz, 62,678, including 13,970 Jews; Braila,58,392, with 10,811 Jews; Craiova, 45,438 ; Ploesti, 42,687 ; and Botosani, 32,193, of whom 16,660 are Jews. The government of Rumania is a hereditary and con- stitutional monarchy. The constitution of 1866 was modi- Coastitu- ^^^ ??? ???'^^^^ ^^^ *1884. All citizens of full age, Hon ana paying taxes, are divided into three electoral govern- colleges, classed according to wealth, position, and ""*"'* ??? education. The first and second colleges, and in the third college those who can read and write and have an income of ??12 from land, vote directly, as also do the village priests and schoolmasters ; but the residue of the third college vote indirectly, i.e., every fifty indirect electors select a delegate, who votes along with the direct electors. The Senate is elected by the first two colleges only. The Senate, consisting of 120 members elected for eight years, includes the heir-apparent, eight bishops, and four members elected by the universities of Jassy and Bucharest. The Chamber of Deputies consists of 183 members, elected for four years. Both senators and deputies must possess certain*

qualifications, and are paid. The executive is vested in a council of eight ministers, the president of which is Prime Minister. The penalty of death has been abolished, except for military offences in time of war.

The Julian calendar is used in Rumania, which, since the year 1900, is 13 days behind the Gregorian, which latter is employed in the railways and in the administration of posts and telegraphs.

For administrative purposes the country is divided into 32 districts (see Population), of which Wallachia contri- butes 17, Moldavia 13, and the Dobruja 2. Each district (jiidete) has at its head a prefect, who is assisted by an elected council. The districts are divided into subdistricts (plasi), administered by sub- prefects, and each of these contains a certain number of communes, governed by a communal council, who elect their mayor, subject to confirmation by the Government. There are mayors and municipalities in all the large towns, and very heavy octroi duties, which provide the means for municipal administration. Rumania is one of the most bureaucratic countries in the world, and spends annually half a million sterling, or more than one-fourth of its entire budget, on the personnel of the public services, ex- clusive of the army and the employes of the State railways. The judicial department is entirely independent of the executive, and the judges are irremovable. The judicial hierarchy comprises, first, a High Court of Appeal "t ^ (cour de cassation), at Bucharest ; four Courts of ' Appeal, at Bucharest, Craiova, Galatz, and Jassy ; courts of first instance in each district; subdistrict tri- bunals (justices of the peace) ; and communal tribunals, composed of the mayor and two assessors, who have juris- diction in minor cases. There are also commercial tribunals in the large towns. Legislation is based on the Code Napoleon, and in all criminal cases the judges are assisted by a jury. On the whole, justice works well, although sometimes very dilatorily.

Crime is apparently on the decrease. In 1893 there were 4693 per.sons imprisoned for varioiis misdemeanours, whOst in 1897 there were only 2573 admissions. The average number for the last thirty years of the 19th century was 3964. Out of a total of 40,249 prisoners that passed through the prisons during the last five years of that period, no less than 14,343 were sentenced for murder and murderous assaults. Of these prisoners,

only 18,065 knew how to read ; of 70,702 prisoners in the ordinary gaols, 13^ per cent, were illiterate. In addition to the ordinary prison institutions of civilized countries, there are workshops in the central prisons, where the men receive payment for their labour, of which, how- ever, the State takes a percentage.

Adminis- tration.

*As regards religion, the population of Rumania is divided (1900) as follows: Orthodox (Greek), 5,40**, 743 ; CathoUcs and Protestants, 168,276; Mahommedans, 43,470; Armenians, 6598; Jews, 269,015; others, 16,148. **”*”<"'*** The Catholics are principally found in Bucharest and in the districts of Roman and Bacau ; the Mahommedans almost exclusively in the Dobruja; and the Jews in Bucharest, Braila, Galatz, Jassy, and the districts of northern Mold- avia. It is estimated that the Protestants number about 13,000. The Zingari or Gypsies, who formerly numbered about 200,000, are now mostly incorporated in the Orthodox community.*

The number of Orthodox churches in Rumania is 6787, of which 218 are kept up by the State, 5909 by the communes, and 660 by private individuals and pious foundations. The Roman Catholics have two bishops, 63 churches, and 80 priests; the Protestants, 12 churches and 19 clergymen; the Armenians, 16 churches; the Jews, 305 synagogues; and the Mahommedans, 260 mosques.

The Rumanian Church is autooephalous, but holds the same dogmas as the Orthodox Greek Church, it is administered by a. Holy Synod, composed of the bishops of the eight dioceses. Its president is the archbishop and metropolitan of Hungary- Wallachia, primate of Rumania ; the other members are the archbishop and metropolitan of Moldavia (resident at Jassy), the bishops of Ramnicu-Valcea, of Roman, Buzeu, Husi, Curtea. d’Argesh, and the Lower Danube (Galatz). There are also eight bishops in partibus, coadjutors of the above. The metropolitans and bishops are elected by the Senate and Chamber of Deputies sitting together ad hoc; the former must be selected from the bishops, and the latter from the bishops in partibus. These, in their turn, are selected by the Minister of Public Worship from lists prepared by the

Synod. The clergy are divided into two classes, the "Kalugari" or monks, and the secular clergy, who marry before taking orders. The Kalugari only are eligible for the higher dignities of the Church. Monasteries abound. There are no leas than 168 scattered throughout the country, principally in the mountainous districts, which shelter 1429 monks and 2709 sisters. Many monasteries have, however, ceased to be inhabited, and have become, since the confiscation of their property (owing to flagrant abuses) in 1864, simple churches, institutions, or even prisons. The monasteries of Moldavia and Wallachia diff'er materi- ally from those of western Europe. They are, generally speaking, perched in inaccessible places and strongly fortified, and served in troublous times as harbours of refuge to the inhabitants, or as rallying points to demoralized troops. The property held by the monasteries prior to 1864 amounted to more than six million acres, the greater part of ►►hich has been utilized in the formation of a peasant proprietary (see History).

Primary education is compulsory and free from the age of 7 to 11, but only 17 '3 percent, of the population can read and write. In the urban districts, indeed, the proportion is 42 per gj^^atlon cent., but in the rural it sinks as low as 11 '5 per cent. Secondary education is provided for in the lycees and gymnasiums for boys, and in the secondary day-schools for girls, and higher education at the universities. Both secondary and higher education are given gratuitously. In 1900 for primary rural education there were 22 boys' schools, 22 girls' schools, and 3213 mixed schools, with 3261 masters and 817 mistresses, educating 220,410 scholars, of whom 185,094 were boys and 35,316 girls. These establishments cost the State about ►►200,000 per annum. For primary urban educa- tion there were 386 schools, with 605 masters and 728 mistresses, educating 46,834 boys and 31,029 girls, at a cost of about ►►170,000 per annum. The institutions for secondary education are shown below : ►►►

Male.

Professors.

Scholars.

13 Classical lycdes .

477

7322

19 „ gymnasiums

356

4594

11 Real lycfes and gymnasiums

190

1887

5 Clergy schools .

95

644

7 Normal schools .

124 1242

680

15,127

^^^

Female.

Professors.

Scholars.

16 Professional schools .

140

1429

9 Secondary day-schools

155

1733

3 Normal schools .

107

680

.

402

3842

****

s. vni.

**** 40*

314

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*To the above figures should be added 1623 boys and 1952 girls who follow the secondary course of instruction in private institutions. The total cost of secondary education is about **240,000 per annum. There are also commercial schools, schools, of arts and crafts, and a school of agriculture intended for preparation for university studies.*

For higher education there are two universities, one at Bucharest (founded in 1864) and the other at Jassy, each having faculties of literature and philosophy, law, science, and medicine ; at Bucharest there are, besides, faculties of theology and pharmacy. The Uni- versity of Bucharest has 90 professors and 2141 students, of whom 79 are women. At Jassy there are 60 professors to 423 students.

The budget of the Minister of Public Instruction, which tripled during the period 1870-1900, amounted for 1902-03 to a fraction under one million sterling, or nearly one-eighth part of the total expenditure of the country. Of this siim ►►8000 only is covered by students' fees (for board). The higher education, however, has produced what has been aptly termed a " proletariat intellectuel, " containing hosts of candidates for official employment, and has formed "anarchical, demagogic, and revolutionary elements," which have been of no profit to the country. It is seriously proposed, while continuing to give free education in the primary schools, that pupils attending the secondary schools and the universities should pay at least some portion of the cost of their instruction, as is the case in other coimtries.

The public debt, incurred between 1864 and 1900, amounted on the 1st April 1901 to ►►57,957,652. Almost the whole of the public Finance ^^^^ ^^^ been contracted abroad, mostly in Germany. It is calculated that half the existing debt will be redeemed by 1930, but it may be noted that the interest on the debt has increased by nearly 1 million sterling since 1894. Although this debt is very large in comparison with the resources of the couutry, none of it is due, as in so many other countries, to actual war. Preparations for war and for national defence have, however, absorbed in all ►►10,640,000 of the public debt; some 6J milUons has gone to making good budget deficits, and smaller sums have been spent on various public objects other than public works, it being these last which have absorbed by far the largest portion of the debt ►►► ZZ^ millions sterling.

The following table shows the rapid and steady increase of revenue and expenditure between 1872 and 1896, arranged for purpose of comparison in periods of five years. The State, as a result of this somewhat prodigal

expenditure for so small a country, owns and itself works the entire railway system, the docks and elevators at Galatz and Braila, and a small fleet of merchant steamers. It has also the entire monopoly for the sale of tobacco, salt, playing-cards, matches, gunpowder, and cigarette paper. In an almost purely agricultural country like Rumania, a bad harvest entails an extraordinary falhng off in its general revenues. This was bitterly felt in the budgets for 1899-1900 and the follow- ing year, and in 1900 the Government had to raise a fresh loan of 7 millions sterling to meet the difficulties of the situation directly occasioned by the bad harvest. One of the conditions of the loan was that no further loan, should be raised for a period of five years.

Years.

Revenue.

Expenditure.

1872-76 . 1877-81 . 1882-86 . 1887-91 . 1892-96 .

??

17,517,956 24,778,500 26,332,424 32,603,184 31,975,940

??

17,588,676 24,490,428 26,486,188 31,926,734 32,100,780

The debit sides of two budgets, as given below, will show the nature and increase of public expenditure in the course of the 20 years 1880-1900 :???

1880-81.

1899-1900.

Interest on public debt . Ministry of War

,, of PubUc Instruc- tion

„ ITinance

„ Interior

Public Works .

„ Justice State Domains . Foreign Office . Council of Ministers .

Totals .

1,869,448 991,555

415,424 459,008 368,490 312,133 168,549

58,735 1,210

3,430,299 1,837,213

1,138,748

1,096,847

742,099

227,283

267,930

285,580

71,866

2,852

4,644,552

9,100,717

The estimated expenditure for the year 1902-03 amounted to ►►8,740,000, of which the largest item►►► ►►3,457,000►►► was required for the interest on the debt, the Ministry "of War claiming

►►1,500,000. The estimated revenue included ►►2,260,000 from indirect and ►►1,744,000 from direct taxation, and a, little over 2 millions from State monopolies. Of the receipts from direct taxation, two-fifths are produced from the land tax, and the remainder, in nearly equal proportions, from road taxes, spirit licences, taxes on professions, and a tax of 5 per cent, on all salaries. Of the receipts from indirect taxation, customs produce about three-eighths, the tax on spirits and beer a somewhat smaller sum, the remainder being made up by stamps, registration fees, and taxes on sugar, petroleum, and vineyards. Among the State mono- polies, the sale of tobacco produces ►►1,620,000 ; salt, ►►300,000 ; matches, ►►120,000 ; cigarette paper, ►►60,000 ; and the river transport service, ►►100,000.

Conscription is in force, and the annual contingent of all recruits numbers some 36,000 men. In time of peace the army consists of four complete >army corps, with headquarters at Craiova, Bucharest, Jassy, and Galatz, with an inde- Army. pendent divisioa in the Dobrudja, and a separate cavalry division with headquarters at Bucharest. The infantry consists of thirty- five regiments, on partly a permanent and partly a non-permanent footing, and of six battalions of chasseurs (venatori). The cavalry is similarly constituted to the infantry. There are six regiments of hussars (rosMori) and eleven territorial (calarashi) regiments. The artillery is divided into twelve regiments, and consists of 52 field, 8 horse, and 1 mountain batteries in time of peace ; in war there are twenty additional field batteries. There are also two regiments of fortress artillery, and well-organized ammunition columns. Of engineers there are two regiments. In time of peace the permanent embodied force consists of 59,000 officers and men (in addition to an equal number of non-permanent troops, who are called out for short periods only), 11,359 horses, and 390 guns. The war footing of the active ai-my is : infantry, 130,341 officers and men; cavalry, 14,297, with 13,044 horses; field

artillery (including ammunition columns), 19,432 officers and men, 19,242 horses, and 494 guns ; fortress artillery, 4000 officers and men ; various (marines, engineers, pontoon train), 20,760 officers and men and 12,000 horses ⬛⬛⬛ total, 189,780 officers and men, 44,286 horses, and 494 guns. It is estimated that the militia should finally furnish an additional force of 100,000 men, but up to 1900 this branch of the service was not completely organized. The arrange- ments for mobilization are very complete, and the army is main- tained in a high state of efficiency. The ordinary war budget for 1898-99 was ⬛⬛1,815,213, in addition to ⬛⬛800,000 voted for extra- ordinary expenditure. Rumania possesses an extensive, elaborate, and very costly system of defensive works, designed by the famous Belgian engineer General Brialmont, and completed at a cost (including armaments) of more than four millions sterling. The Sereth line, commenced in 1889, extends over a front of 45 miles, from Galatz to Focsani, and is intended to cover an army defend- ing the country from a Russian invasion. The Bucharest fortifica- tions (commenced 1885), consisting of 18 detached forts, -n-ith the same number of intermediate batteries, lie around the city on a circle of about 7 miles radius.

The navy is insignificant. Among the 19 small vessels, manned by 113 officers and 1993 men, are, however, 6 first-class torpedo boats.

The chief mineral wealth consists of petroleum and salt. Petroleum exists in large quantities in Rumania. From Turn Severin, on its western border, the petroleum zone can p rf ⬛⬛ be traced at the foot of the Carpathian Mountains, '^ " "" skirting them in their course through the country y^jj^^^ towards Bukovina and Galicia on the north-east. ⬛⬛⬛i⬛⬛⬛grals'. Along the whole length of the zone mentioned may be seen primitive workings in the shape of comparatively shallow hand- dug wells. From 1873 the industry fell ofi' considerably, probably on account of the American oil-field discoveries. In 1895 modifications were introduced into the mining laws, and a new stimulus given to the industry that had gradually been reviv- ing, and from that date we find an ever- increasing development. It is claimed for Rumanian petroleum that the raw product contains 14, 15, and 23 per cent, more pure oil than

American, Galician, and Caucasian oils respectively. In July 1898 there were in the four principal petroliferous districts ; ???

Borings.

Hand Wells.

Productive.

Non-Pro-

ductive or

being Bored.

Productive.

Non-Pro- ductive or being Dug.

Dimbovitza Prahova . Buzeu Bacau

Totals .

42

4

40

45

10

8

115

400

90

340

40 450

10 120

86

63

945

620

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The production in these same districts which in 1895 only reached 14,600 tons, amounted in 1897-98 to 134,180 tons, of which 93,382 tons were refined in the country ??? 19,511 tons were exported, and 21,291 tons of residue were employed as com- bustibles. In the last year of the century the output amounted to 224,760 tons, of which 75,879 tons were exported.

The rook-salt strata are of large extent, reaching from the district of Sueeava, in northern Moldavia, to the district of Gorj, in Wallachia, and attain a thickness in some places of 1000 feet. The production since 1875 has becu : ???

Production.

Export.

1875 1880 1885 1890 1895 1898

70,283 tons.

73,410 ???

83,340 ??? 107,971 ???

98,807 ???

112,650 ,,

23,612 tons. 34,113 ???

39,290 ,,

86,045 ???

The export is practically confined to Bulgaria, Servia, and Russia There is no doubt very varied and considerable imdeveloped min- eral wealth in the country, but it was long before any serious attention was paid to it. The Mining Law of 1895 has, however, been the means of attracting foreign capital and foreign specialists, and it may be confidently expected that at some no very distant period the wealth now produced above ground by agriculture, forests, vineyards, pasture, flocks, and herds will be largely supple- mented by underground riches.

The total superficies is 32,302,080 acres, subdivided as follows: ??? 40‘82 per cent, is arable land, 2576 per cent, is waste, 1973 per

cent, forest, 7 “92 per cent, natural pastm-e, 4 ‘28 per cent.

artificial pasture, 1-06 per cent, vineyards, and 0 “43 per

cent, plum orchards. The accompanying table gives the mean annual area under cul- tivation, the produce per acre, and the total amount of the principal grain crops produced, calculated from the returns of five years, from 1894 to 1898 ; also the out-turn of 1899, when, owing to drought, there was almost a complete failure of the crops : ??? ???

culture.

Surface sown- Acre3.

Yield in

Bushels per

Acre.

Total Yield in Bushels.

Total Yield,

1899.

Bushels.

Wheat

Eye .

Barley

Oats.

Maize

Eapeseed .

Linseed

Millet

Beans

3,618,846 505,605

1,495,257 690,762

4,708,282

108,241

67,161

191,800

308,059

15-12

15-81

15-89

17-36

14-34

11-56

8-69

8-36

9-95

54,718,403

8,073,100

23,638,985

12,092,680

67,534,499

1,299,655

585,055

1,604,658

3,067,754

25,258,475

1,926,925

4,402,475

6,062,100

26,873,893

440,825

33,275

1,641,686

224,069

Eoughly speaking, about one-half of the cereals produced is employed in home consumption, whilst the other half is exported to foreign countries.

The vineyards have not been spared by the phylloxera, which made its first appearance in 1882, and developed seriously in 1884 ; but they are recovering from its effects, and the acreage under vines has risen from 126,000 acres in 1865 to 343,800 acres in 1898. The wines produced in the mountainous and hilly districts are greatly superior to those of the plains : they contain more alcohol and less tannin, and although slightly more acid, have a superior flavour. The best known vineyards are those of Cotnar and Socala (near Jassy), for white wines ; Nicoreshti (Tecuciu), Odobeshti (Putna), Dealu Mare, Drancea, and Dragashani, which mostly produce red wines. The grape harvest varies enormously in different years. In 1865 the acreage under vine cultivation was only 236,910 acres, yielding 14,080,300 gallons ; the production has now risen to 99,000,000 gallons.

In 1897 horses numbered 670,909 ; donkeys, 5214 ; mules, 247 ; horned cattle, 2,138,315 ; sheep, 6,847,825 ; goats, 286,876 ; and swine, 1,079,322. Of the three divisions, Wallachia, Moldavia, and Dobruja, the first is by far the most prolific of live stock, particularly sheep. Comparing these figures with similar returns of 1890, it appears that in seven years the number of horses has increased 11 per cent. ; sheep and goats, 37 per cent. ; swine, 14 per cent. ; and that the number of horned cattle has fallen off 18 per cent.

Eumania is very rich in forests, which cover over 5,000,000 acres, or more than one-sixth of the country. Two-fifths are the property of the State ; about one-half belongs to private indi- viduals, and the remainder to private establishments and the Crown domains. The net profit derived by the State in the year 1898-99 was about ??100,000, i.e., about one shilling per acre. In the Crown domains forest schools have been established for the

Manu- factures.

more scientific working of the forests, and it is to be hoped with more profit to the State.

About 139,000 acres are under plums, the produce of which is chiefly employed in the manufacture of tzuica, an ardent spirit much in vogue among the peasantry, the consumption of which is very considerable on the numerous ritual holidays of the Greek Church. The annual out-turn of this spirit is about 10,248,480 gallons, and in 1892 32,000 gallons were exported.

*The fisheries extend over a vast area, comprising the whole of the delta of the Danube between the Kiiia and St George branches of the river, as well as the Danube itself and adjoining p, t ??? lakes, and the Black Sea liitoral. The Government * e'-'es. in 1895 introduced a close time, besides other measures, for the preservation of the fish. Since then the hshiug indubtry has revived. The import of fish rose from 5981 tons in 1894 to 7583 tons in 1895, but by 1898 had dropped to 4238 tons. The export of fish rose steadily from 1315 tons in 1894 to 5562 tons in 1898. The fish exported consist principally of salted sturgeon (found in the vicinity of the*

Danube mouths, especially at that of St George, from which large quantities of excellent caviare are extracted), sterlet, and carp. The revenue from the State fisheries amounts to about ––100,000 annually. More than half of the fish exported goes to Austria-Hungary.

Up to the passing of a law in 1887 for encouraging national industries, Eumania was essentially a non-manufacturing country, but since that date much progress has been made. The law provided that any one undertaking to found an industrial establishment with a capital of at least ––2000, or employing at least 25 workmen (of whom two-thirds should be Eumanians), should be admitted to certain substantial benefits, including the grant of about 12 acres of State land, exemption for a term of years from all direct taxes, freedom from customs dues for machinery and raw material imported, exemption from road taxes, reduction in cost of carriage of materials on the State railways, and preferential rights to the supply of manu- factured articles to the State. Up to the end ot February 1891 the number of firms which had been admitted to the benefit of this law was 84, with a total capital of about one million sterling. By the end of the century factories had increased to 178, and the capital invested to close upon three millions sterling.

Among the principal industrial establishments of Eumania are flour-mills, of which there are (1900) 7500 small local mUls, besides 86 mechanical mills, of which 20 are large establishments (capital invested, ––640, 000), with a collective output of 2200 tons a day.

There are 43 large distilleries, each employing over 200 hands, besides many small stills. In 1898-99 the output of the 19 breweries in the country was 2J million gallons.

The introduction in 1895 of the system of Government bounties caused a great development in the production of sugar, and there were in 1900 six large factories at work. More than half a million sterling has been invested in this industry. In 1892, 2500 acres only were under beetroot cultivation. In 1900 the area had increased to 30,720 acres.

There are 3 meat-preserving and 3 vegetable-preserving factories, 7 starch, paste, and biscuit factories, cement and lime factories, brick and

basalt works, mechanical joinery works, 5 large glass factories, and 6 paper and 3 cardboard mUls.

The production of chemicals and by-products has increased from 3000 tons in 1886 to 11,700 in 1898, while in the same interval the out-turn of vegetable oils has increased from 1900 to 3015 tons.

Eumania now possesses 7 iron foundries, besides factories for machines and various kinds of iron-work.

There has been considerable development of the textile indus- tries, whOe domestic industry is still widespread. Tanning and leather- work is also growing in importance ; but the wood indus- tries are the most important of aU branches of industry, and give employment to thousands of hands. There are 42 large saw-mills, turning out annually 25,000 waggons, jointly worth ►►600,000; nrach of which, mostly deal planking, finds its way by sea to Rotterdam and up the Rhine.

The great bulk of the exports consists of cereals ; but other impoi-tant articles are animal products (wool, hides, &c.), timber, salt, wine, and brandy (made principally from cereals and plums), and of late years there has been a rapid ”<"""'►►'►►►"►►► development of the production and export of flour and petroleum.

The following table shows the value of the import and export trade of Rumania since 1876 : ►►►

Year.

Imports.

Exports.

1876 . 1886 . 1896 ... 1898 . 1900 .

►►

6,637,340 11,759,892 13,616,916 15,596,337

8,463,439

* *

9,410,250 10,221,888 12,962,266 11,327,262 11,200,017

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The principal imports are textile goods, metals, and metal-work, such as railway material and agricultural machinery, coal, &c. The following table shows the value of the principal articles exported and imported in the years 1887, 1897 ; the latter year may be considered as a good average year both for exports and imports : ???

Thousands of Pounds

Sterling.

1887.

1897.

Exports.

Farinaceous products and their derivatives .

8560

7200

Fruits, vegetables, and other plants .

240

588

Animal products

104

160

Textnes .

192

100

Timber

164

264

Live animals

232

92

Mineral combustibles, &o.

64

88

Hides and leather

104

60

Wine and alcohol

660

104

Metals and metal- work

84

72

Dyes, tannins, colours, &o.

4

4

Carriages, carts, &c. .

4

Paper, cardboard, &o. .

8

4

Imports.

Farinaceous products and their derivatives .

120

200

Animal products

160

220

TextUes .

5520

6000

Timber

240

‘228

Live animals

16

108

Mineral combustibles .

160

400

Hides and leather goods

720

640

Metals and metal-work

2120

2960

Dyes, tannins, colours, &c.

120

280

Carriages, carts, &c. .

412

64

Paper, cardboard, &c. .

480

240

Colonial products and fruits

1040

840

Minerals, glass-ware, &o.

640

300

00s, fats, wax, &o. .

200

280

Chemicals, &c. .

120

220

Indiarubber, guttapercha

80

120

Preserves and confectionery

64

132

The following table shows the relative values of Rumanian trade with foreign countries, in percentages of the total value, which is also given, in the years 1889 and 1898 : ???

Country.

1889.

1898.

Imports from

United Kingdom .

27-80

19-55

Austria- Hungary .

13-42

27-97

Germany

29-42

28-55

France. .

8-92

6-62

Belgium

5-25

3-62

Other countries

15-19

13-69

Total value . Exports to

??14,717,763

??15,596,337

United Kingdom .

52-89

15-33

Belgium

13-31

32-32

Austria-Hungary .

5-54

30-22

Italy . . .

8-44

7-08

Turkey .

2-18

3-60

Germany

5-31

3-20

France .

4-37

2-25

Other countries

7-96

5-00

Total va

ue .

??10,966,685

??11,327,262

The value of the trade between Great Britain and Rumania has varied greatly : m 1881 the value of the imports from Great Britain was ►►2,020,330; in 1889, ►►4,084,444; in 1895, ►►2,359,359 ; in 1899, oAlrAll- , J”’^ exports to Great Britain amounted in 1881 to ►►3,289,082; 1889, ►►5,622,040; 1890, ►►6,455,420; 1895, ►►3,014 520- 1898, ►►1,498,364, but only ►►422,751 in 1899. The principal imports from Great Britain are tissues and textiles, coal and coke, machinery and metal goods.

Exports of cereals from Rumanian Danube ports through Sulina have been as follow in quinquennial periods 1875-99 : ►►►

1876.

1880.

1886.

1890.

1896.

1899.

Wheat . Barley . Oats . Eye . Maize .

*Totals**

Quarters.

1,339,682

745,792

33,770

123,706

984,586

Quarters.

1,286,253

1,219,406 117,216 270,049

1,216,416

Quarters.

1,338,234

1,141,460 266,692 608,141

2,378,140

Quarters.

4,666,864 1,210,197 56,367 465,879 8,542,986

Quarters.

6,685,740 1,628,899 84,746 1,388,169 1,613,021

Quarters.

970,479 546,736 204,861 343,394

3,974,874

8,267,476

4,261,331

6,902,167

10,402,023

10,806,768

6,224,160

Flour .

Tons.

8090

Tons.

10,289

Tons.

10,494

Tons.

9007

Tons.

28,688

Tons.

22,252

- *Including other cereals not specified.*

By the Berlin Congress of 1878 and a special conference of 1883 the Danube is regarded as an international waterway from its mouth to the Iron Gates, and the interests of the several countries are specially provided for. In 1898, ??"“PP"“S- 1419 vessels of 1,476,119 tons

cleared from Sulina, 446 of 694,773 tons being British ; 190 of 174,607 tons, Greek ; 126 of 156,150 tons, Austro-Hungarian ; 72 of 87,583 tons, Italian ; 224 of 62,455 tons, Turkish; 133 of 59,989 tons, Russian; 43 of 43,263 tons, Rumanian ; 33 of 41,593 tons, French ; and 25 of 30,205 tons, German. Further information about the naviga- tion of the Danube will be found under that head.

Bailways. ❓❓❓ The first railway line between Bucharest and Giur- gevo, a distance of 45 English miles, was constructed in 1866-69. By 1874, 636 miles were open ; by 1884, 994 miles ; and by 1899, 1932 miles. As will be noticed under ”” ❓❓❓❓❓❓ ” ❓❓❓ - Finance, the entire railway system is owned by the “^ ‘”’ ❓❓❓ State. The total amount actually expended on railways has been ❓❓28,705,082, including the construction of the bridge over the Danube at Cernavoda, which cost ❓❓1,375,480. The total revenue from the railways amounted in 1898 to ❓❓2,170,056, the working expenses ❓❓1,545,345. The railways give employment to 6559 permanent oflScials, and to 13,570 plate-layers, navvies, &c. The number of passengers carried by rail in 1898 was 5,779,090, while the merchandise carried amounted to 47,786,888 tons.*

The railway system consists of a main central line carried from Suceava, on the frontier of the Austrian province of the Bukovina, and passing south through the whole length of Moldavia, and west through Wallachia to the Austrian frontier at Verciorova, with branch lines extending on the one side up the lateral valleys of the Carpathians, and on the other to Jassy, Galatz, and other large towns on the Danube. Jassy and Galatz are also connected by a direct line. Besides the above-mentioned points of junction, the Rumanian system is connected with that of Hungary at Predeal and at Palanka, with the Russian system at Ungheni, and with the Bulgarian at Rustohuk by a steam ferry. Another line through the Dobruja connects the Rumanian system (by means of a magni- ficent bridge over the Danube at Cernavoda) with the rising port of Constantza (formerly Kustenji) on the Black Sea, where extensive harbour works are now in progress.

Roads. ❓❓❓ There are roads throughout the country of varying degrees of quality, and aggregating about 12,000 miles in length. In 1897-

98 ►►170,000 was spent in repairs to roads and bridges.

Rivers and Canals. ►►► The Danube is navigable for vessels draw- ing 9 feet of water, from the Iron Gates above Turn Severin down to Braila, and from thence to the sea at Sulina for vessels draw- ing from 18 to 20 feet (see Danttbe). Rumania possesses no canals, but rafts of timber are brought down many of the streams which rise in the Carpathians and fall into the Danube ; and the Pruth is navigable for vessels of light draught for a distance of some 300 miles from where it enters the Danube at Reui.

Since 1890 there has been a very large devolopment in the telegraphic and telephonic system of Rumania. The a t h length of tele.graph wire is about 4000 miles. The fol- 1^►► . lowing figures speak for themselves : ►►► * egrap s.*

Number.

1888-S9.

1897-98.

Staff

Letter-boxes ....

Letters

Postcards .... Printed matter and papers Telegrams, inland, presented (private) .... Telegrams (ofBoial)

„ presented (foreign) „ received

1,474

812

12,772,976

3,436,453

4,907,377

870,313 105,862 176,870 136,311

6,245

4,550

18,498,355

14,386,586

29,873,428

1,473,701 147,349 284,002 253,434

history]

RUMANIA

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The principal bank, the Banque Nationale, foundeii in 1880 with a paid-up capital of 12 million francs (□□480,000), has its Baaklnit l^^^'Jli^rtBrs at Bucharest, and branches in all the prin- and credit ''P" towns ; it has the right to issue notes, repayable □□□ at sight and in gold. The reserve fund in 1890 stood at □□460,000, the net prolits for the same year amounted to □□165,520, and the notes in circulation to □□6,440,000, or rather more than double the metallic stock. Other Bucharest banks are the Banque de Eoumanie, founded in 1884 with a paid-up capital of 7 J million francs (□□300,000) ; the Banque G6nerale Eoumaine (1897), capital, 12 million francs (□□480,000) ; the Crcidit Belgo Roumain, capital, 5 million francs (□□200,000) ; and the Banque d'Escompte, also with a capital of 5 million francs ; Marmorosoh, Blank, and Company, capital, 5 million francs ; and other private banks. The CrMit Fonoier Rural was founded in 1873, with the object of advancing money on mortgage of land. Since its foundation 4^ million acres of land have Jjeen hypothecated to it against advances of

more than 12 millions sterling, provided by the issue of "lettres de gage" at 5 per cent, and 4 per cent., of which 10 millions were in circulation in 1897. Similar institutions exist for urban pro- perty in the cities of Bucharest and Jassy. In the former, in 1890, advances to the extent of 54 millions sterling had been made on the security of house property. The Banque Agricole, founded by the State in 1894, with a capital of ►►500,000, for the purpose of advancing money on loan to small proprietors on the security of cattle, crops, wine, and other agricultural produce, does a large and profitable business, and is of great assistance to the poorer agricultural classes, besides returning a considerable revenue to the State. Government savings banks also exist in all the principal towns. On the 10th September 1898 the deposits amounted to IJ million sterling, furnished by 105,000 holders.

Recent History.

The present kingdom of Rumania consisted in the middle of the 19 th century of two separate provinces, Wallachia and Moldavia, placed under the suzerainty of Turkey and the protectorate of Russia. It was autonomous in name, but its princes or hospodars were merely governors of provinces, acting under the orders of subordinate officials of the suzerain and pro- tecting powers. The military occupation of the princi- palities by Russia immediately preceded the Crimean war, one of the principal results of which was the decision, under the Treaty of Paris, that the two countries, with their existing privileges, were placed under the collective guarantee of the Great Powers, still remaining, however, tinder the suzerainty of the Porte. Under the same treaty that portion of Bessarabia lying on the left bank of the Pruth and to the north of the Danube was restored to Moldavia, from which it had been taken by Russia in 1812. It was further decided to maintain the separate existence of the two principalities, but their inhabitants ardently desired a complete union, and in order to effect this Colonel Alexander Couza was in 1859 simultaneously elected prince of both Moldavia and Wallachia. In 1861 the union of the principalities was recognized by the Powers for the lifetime of Prince Couza, with a common ministry and a common assembly. The prince, by his ultra ~~democratic and despotic measures, succeeded in alienating the sympathy of aU classes, of the clergy by the~~

~~*confiscation of the enormous landed property belonging to the Rumanian monasteries (whose revenues, however, principally went to feed the parent monasteries of Mount Athos); of the boyards by the abolition of the feudal obli*~~ *gations of the peasantry and the establishment of a class of peasant proprietors ; and, finally, by the introduction of a tobacco monopoly he estranged the sympathy of the masses. His own dissolute conduct increased his unpopularity, and at last the leading statesmen in both provinces, who had long been of opinion that the welfare of the country could only be secured by having a foreign prince to rule over it, conspired to dethrone the prince, and in February 1866 he was compelled to abdicate. The same day a council of regency was formed, composed of General N. Golesco, Colonel N. Haralamba, and Lascar Catargi, with Prince John Ghika as head of the ministry.*

The count of Flanders, brother of the king of the Belgians, was proclaimed hospodar of the united provinces, but declined the profTered honour.

Meanwhile a conference of the Powers assembled at Paris to consider the situation, and decided by a majority of four to three that the new hospodar should be a native of the country. WhUe the conference was discussing, the principalities were acting, and had resolved not to be baulked of their foreign prince. The choice of the country, by a happy insjairation, fell on Prince Charles of HohenzoUern : an appeal was made to a plebiscitum, and 685,969 electors voted in his favour, with only 224 dissentients. Prince Charles was the second son of the late Prince Charles Antony of HohenzoUern-Sigmaringen (famous for having from patriotic motives, and in the interest of German unity, voluntarily surrendered his principality to be merged into the kingdom of Prussia), and a cadet of the Catholic branch of the imperial family of Germany. Prince Charles was an officer in the Prussian army, 27 years of age, and was also related to the French imperial family : his nomination not only obtained the tacit consent and approval of his friend and kinsman King William of Prussia, but also the warm and more open support of Napoleon III. The young cbaries. prince was in a position of great difficulty. The king of Prussia, through his plenipotentiary at Paris, had agreed to the resolution of the conference that the hos- podar to be elected

should be a native of the principalities, and could not therefore openly approve of Prince Charles's election. The prince meanwhile received a telegram from Bucharest stating that five millions of Rumanians had proclaimed him their sovereign. The genius of Count Bismarck came to his aid, and acting on that statesman's advice, the prince determined to confront the Powers with a, fait accompli. He asked for a short leave of absence, resigned his commission in the Prussian army on crossing the frontier, and hastened secretly to Rumania, under a feigned name and with a false passport ; descended the Danube in an Austrian steamer, and surreptitiously landed on Rumanian soil on the 20th May at Turn Severin, where he was enthusiastically welcomed as soon as his incognito was thrown off. Travelling thence by post, the prince reached Bucharest on the 22 nd May, and on the same day, in the presence of the provisional government, the deputies, the judges, and all the high officials, solemnly took the oaths to respect the laws of the country, to maintain its rights and the integrity of its territory. From that date to the present day the modern history of Rumania is indissolubly connected with its distinguished ruler. Prince Charles of HohenzoUern, afterwards King Charles I., one of the wisest and best of European sovereigns.

The coup suggested by Bismarck succeeded, thanks to the tact and energy of the young prince, whose first step was to commence the reorganization of the army, and to make preparations for resisting a menaced Turkish invasion, while at the same time carrying on negotiations with the Porte with the view of peaceably obtaining the recognition of his position by the sultan and the European Powers. After lengthy and complicated discussions, this object was attained, and in October the prince proceeded to Constantinople to pay his respects to his suzerain the sultan. His reception there was cordial, and he received from his majesty the firman of investiture. The principle of hereditary succession in the prince's family was agreed to, and also the right of the prince to maintain an army of 30,000 men. On the other hand, Rumania was to form an integral part of the Ottoman empire, within the limits fixed by the capitulations and the Treaty of Paris. The first Rumanian ministry formed under the new regime was composed of the leading statesmen of the country, of all political parties, care being also taken that the two provinces should be equally represented. Thus Moldavia contributed the Conservative, Lascar

Catargi, the president of the council and minister of the interior ; Pierre Mavrogheni, the minister of finance, also a Conservative ; Prince John Ghika (Moderate Right),

minister of war ; and Demetrius Stourdza (Centre), minister of public works. Wallaohia, on the other hand, was represented by John Bratiano (Liberal) as minister of finance ; C. A. Rosetti (Extreme Left), minister of worship ; and John Cantacuzene (Centre), jnstice. Most of these have subsequently taken a pro- minent part in public alfairs. Catargi died in 1899. The first business of the Assembly was the preparation of a new constitu- tion, which was unanimously passed by the Chamber on 11th July, and on the following day the prince solemnly took the oath to maintain it. It provided for an Upper and Lower House of Repre- sentatives, and conferred on the prince the right of an absolute and unconditional veto on all measures passed by the Chambers. A few days after the proclamation of the constitution dissensions arose in the ministry. Bratiano and Rosetti could not work in harmony with the Conservative Catargi ; the latter resigned, and Prince John Ghika was called on by Prince Charles to form a new ministry. The first Parliament elected under the new regime met on 27th November, but the Government of Prince Ghika could not command a majority in either house. The position was difficult in the extreme : the finances of the country were in a deplor- able condition, there was an empty treasury, and the floating debt amounted to seven millions sterling ; maladministration was rampant in every department of the state ; the national' guard were mutinous and out of hand, while the small army of regulars was badly organized and inefficient. The existence of famine and cholera added materially to the difficulties of the Government, and in March 1867 the Lower House, by a majority of three, passed the laconic resolution, ' ' The Chamber inflicts a vote of blame on the Government." As the result of this vote M. Kretzulesco, a Moderate Conservative, was called to the head of aflairs, and J. Bratiano entered the Government as minister of

the interior. ‘ The new ministry, of which Bratiano was the leading spirit, showed considerable energy : a concession was granted for the construction of the first Rumanian railway, viz., from Bucharest to Giurgevo on the Danube. The active army was raised to 20,000, with a reserve of 10,000 men, and a, militia was formed 30,000 strong. It was further decreed that every able-bodied Rumanian between the ages of 20 and 40 was liable to serve in the army or in the landsturm, which was to consist of an additional force of 50,000 men.

Amongst other measures which were not so judicious was a, decree ostensibly directed against vagabond foreigners, but in reality against the Jews, although it provided for the expulsion of all persons who were without proper means of subsistence. Large numbers of Jews were expelled from Jassy, Bacau, and other parts of northern Moldavia, and many respected proprietors and men of business were exiled and imprisoned under pretence of carrying out the new law. These harsh and unjustifiable measures created great excitement and indignation, especially in France and England, and the Emperor Napoleon wrote personally to Prince Charles, protest- ing against this persecution and against the minister who had caused it. The venerable Sir Moses Montefiore himself proceeded to Bucharest to interfere on behalf of his co-religionists. The country could not afford to lose the goodwill of the emperor of the French, at that time one of the most powerful factors in Europe, and in July Bratiano, although immensely popular in Rumania, found it necessary to resign office, and with him fell the rest of the cabinet.

[The Jewish question has always been a thorn in the side of Rumania. When the new constitution was drawn up in 1866, . . one of its original provisions was that ‘ ‘ religious belief ”’ shall be no obstacle to naturalization in Rumania.”

goes on. rpj^j^ excited so much indignation in the country that serious rioting took place at Bucharest, and the synagogue recently erected there was burned to the ground (though subsequently re- built at the expense of Prince Charles). The obnoxious proposition was withdrawn, and the following article was substituted, ” Only Christians can become citizens of

Rumania." The bitter feeling against the Jews in Rumania is not so much due to religious fanaticism as to personal interest, and to the not ungrounded fear that if given political and other rights they will gradually possess themselves of the whole soil and oust the original proprietors of the country. In many towns in northern Moldavia the Jews are in a majority, and their total numbers in the united provinces are about .300,000, i.e., aXtont ^th of the entire population, a larger ratio than exists in any other country in the world. In most places they have the monopoly of the wine and spirit shops, and retail trade generally ; and as they are always willing, like most of their race, to advance money on usury, and, moreover, are more intelligent and better educated than the ordinary peasant, there is little doubt that in a country where the large landowners are pro verbially extravagant and reckless, and the peasant proprietors

^ Under the new Government the Chambers passed a resolution conferring the honorary citizenship of Rumania on W. E. Gludstone and J. A. Roebuck, as well as on the Frenchmen Miohelet and Quinet, in recognition of their efforts on behalf of the Balkan States.

poor and needy, the soil would soon fall into the hands of the Jews were it not for the stringent laws which prevent all foreigners (including therein all non – naturalized Jews) from owning land outside the towns. When in addition it is con- sidered that the Moldavian Jews, who are mostly of Polish and Russian origin, speak a foreign language, wear a distinguishing dress, and keep themselves aloof from their neighbours, the antipathy in which they are held by the Rumanians generally may be understood, although perhaps not justified. The fact, however, that no attempt has ever been made to interfere with their religion, or religious practices and customs, is a proof that this antagonism has nothing to do with religious fanaticism.

*Another difficulty for Prince Charles's Government came to the front at this period, which, like the Jewish question, has been and still is a constant source of anxiety to Rumanian politicians ??? the so-called " national question. " Out- ' "f^ side the limits of the united provinces of Moldavia '"** '"" and Wallachia, now forming the kingdom of Rumania,*

exist more than four million people of Rumanian race, speaking the Rumanian language ; of these one and a quarter million inhabit the Hungarian province of Transylvania, where they form a large majority of the population. A still larger number are to be found in the Banat and other districts west and north of Transylvania. Some 230,000 inhabit the Austrian province of Bukovina, and close upon one million are in Russian Bessarabia ; they are also numerous in Servia, while some 500,000 are scattered over the European provinces of Turkey under the name of Koutzo-Vlacks. Now, these Rumanians, especially those living in the south-eastern provinces of Hungary, have always been jealous in maintaining their language, religion, and customs against encroachments from without. A Rumanian printing press was established at Brasso (Kronstadt) in 1533. In the 17th century the ancient Slave language of their religious books was replaced by Rumanian, and the inhabitants of Moldavia and Wallachia were chiefly indebted for their earlier civilization to the efforts of their com- patriots in the north of the Carpathians. As early as 1791 two Rumanian bishops of Transylvania submitted to the emperor of Austria a list of grievances to which their people were subjected, and petitioned that they might receive equal administrative rights with their neighbours the Magyars, the Slaves, and the Saxons. In 1848, when the Hungarians revolted under Kossuth, and were crushed by the united forces of Austria and Russia, the Ruman- ians of Transylvania took an active part against their Magyar oppressors, and committed many atrocities, after which Hungary and Transylvania came under the direct, absolute, and reactionary rule of Austria. As long as this lasted the Rumanians had com- parative peace, for at least they were treated no worse than the Magyars and other races : a metropolitan and two bishops were appointed, Rumanians of mark sat in the Transylvanian Diet, and the people were fairly content. But in 1867, when the federation and centralization of the Austrian empire came to an end, and was replaced by the Dual Monarchy, Transylvania again came under direct Hungarian rule, and later on was deprived of its auto- nomy. Ever since then the Hungarians have done their best to Magyarize the Rumanians, Saxons, and other constituent races of the kingdom. Whilst Austrian policy has been directed towards decentralization and the bestowal of ?? reasonable amount of independence on its various constituent nationalities, the policy of the Hungarian monarchy has been exactly the

reverse. But the formation of a strong Rumanian principality in 1866 naturally encouraged the Rumanians to the north of the Carpathians in their endeavour to resist all attempts at Magyarization, and although no Irredentist movement has openly taken place, there is no doubt that secret hopes exist among large numbers on both sides of the Carpathians that at some future time the whole of the Rumanian people may be united in one common kingdom. As early as 1867 tlie Emperor Napoleon wrote to Prince Charles, warning him that his Government had nothing to gain by protect- ing the propaganda which was being undertaken in favour of a more Intimate connexion with the Rumanian co-religionists of Transylvania. This was, no doubt, an allusion to the foundation at Bucharest of a "Transylvanian Society," which within a year of its foundation (1867) had 1200 adherents. Its policy was not to confine itself to the development of the culture of the Rumanians of "Central Dacia," but was also to give it a national and Latin direction, instead of the so-called Gothic and Scythian. The Hungarians maintain that the Rumanians have not much to complain of Their Church is recognized, their bishops have seats in the National Assembly and are paid out of State funds. They are also allowed their schools, their associations, their literary societies, and their newspapers. They have the electoral franchise, and from their numbers they might, it is said, be represented by seventy deputies in the Chamber at Budapest ; but the influence of the landed classes (mostly Magyars), the electoral qualifications, the arrangements of the districts, and, above all, the unfair and active interference of the Magyar officials, make it impossible for the Rumanians to obtain a fair share of representation. In 1892

they had only one deputy in the Assembly, and in that same year the Rumanians decided in future to take no part whatsoever in the elections, so that two and a half millions of people are now without a representative. Although the Rumanian communes in Hungary possess more than 2000 elementary schools, receiving no State aid, the study of the Magyar

language is compulsory, and in the more advanced schools and colleges which are assisted by State funds the professors are nearly all Magyar. These schools are attended by a very small number of Rumanian students, and constitute a powerful agency for the Magyarization of the country. In 1872, 1881, 1884, 1887, and 1890 manifestoes were issued by the national party demanding autonomy, the recognition of Rumanian as the official language, universal suffrage. State subsidies for schools, &c. ; and in 1892 large numbers of citizens went to Vienna to present a memorandum to the emperor, protest- ing against the Magyar Government and demanding separation. This step naturally excited indignation and reprisals, the more so as the Ligue Roumaine of Bucharest agitated in favour of the petitioners, who on their return to their homes in Transylvania were prosecuted and imprisoned for treason. The same fate befell several editors of national newspapers. Another result of the increased bitterness caused by this agitation was a decree of the Hungarian Government substituting Magyar names for the existing Rumanian names of districts, towns, villages, and even rivers. Nevertheless the Rumanian element continues to increase, owing mainly, it is said, to the influence of the Rumanian women, who, when married to Magyar husbands, bring up their families as Rumanians and not as Magyars.

It may well be supposed that this national question often caused very great friction between the Austro-Hungarian monarchy and the neighbouring state of Rumania, the more so as in the latter country it has been made a great party question. The national movement has found its chief support in the National Liberal party, but, whichever party is in power at Bucharest, it has to temporize in order to maintain friendly relations with the Austro-Hungariau empire on the one hand and to avoid running counter to public opinion on the other. Thus, every adminis- tration when in power is attacked by the Opposition for not giving adequate support to the national cause. M. Demetrius Stourdza, wh(jwheu in Opposition was prominent in hisdenunciation of Magyar misrule, had when taking office in 1894 to issue a sort of manifesto explaining away his previous utterances. The question of a State subvention to the church at Brasso, which owns large properties in Rumania, has thus given rise to most heated debates in the Rumanian

Parliament, as well as to very delicate negotiations with the Austro-Hungarian Government. A study of an ethno- graphical map shows a population of some nine millions of Rumanians forming an almost compact circular mass, of which the middle Carpathians form the centre ; two-thirds of it form the kingdom of Rumania, and in spite of the present efforts to Magyarize the remaining third, it is by no means impossible that at some not very far distant period the whole may be united in one common nation.]

Kretzulesco's ministry was followed by that of Etienne Golesco. John Bratiano, however, went to Paris, where he succeeded in con- ciliating the French emperor, and shortly after his return he again entered the Government as minister of finance ; but no ministry could reckon on a majority in the Chambers : in February various factions combined to defeat it, but the new majority was divided into three sections, and in November the prince decided to use his prerogative, and dissolved both Chambers. The elections passed off quietly, and the Chambers met on the 15th January 1868, when the speech from the throne insisted on the necessity for legislation for the army, the church, and finance. The Liberal Government had a large majority both in the Chamber and the Senate. But external pressure brought about another change of ministry : a revolution in Bulgaria, crushed with great severity by Midhat Pasha, gave rise to accusations that it had been fomented and encouraged by Rumania, and Austria showed itself bitterly hostile to the Government of Golesco and Bratiano. France, which had sent a military mission to Rumania for organizing the army, was indignant at the purchase by that country of Prussian needle-guns and the introduction of German officers to give in- struction in their use, and was also angry with Prince Charles for having sent a political mission to St Petersburg with the view of establishing more favourable relations with Russia. Etienne Golesco resigned, and was succeeded as president of the council by his brother the general, while J. Bratiano became minister of the interior. An important measure was at once passed by the new ministry for the reorganization of the army, in which corporal punishment was abolished ; a rural police was formed, and an important railway concession with the German financiers Straus- berg and Offenheim was voted, a measure which was the cause of subsequent troubles. In June the Senate, having refused a

credit to the ministers, was dissolved, and the new Senate which assembled in September was more pliable. Several useful measures were passed, including a Bill under which every able-bodied Rumanian

was compelled to give three days' work in the year towards the construction of roads, or to pay a money equivalent. But foreign mistrust of Bratiano, especially in France and Prussia, reached such a point that another change in the ministry became in- evitable, and on the 16th November Demetrius Ghika was called to the head of affairs, with Kogalniceano as minister of the interior. In 1869 the French military mission was recalled, and the rela- tions between France and Rumania were greatly strained. The sympathies of the former country were entirely alienated by the endeavours of the latter to improve its relations with Russia and Prussia. During the early part of 1869 the country was quiet. At the head of Austrian foreign affairs was Count Andrassy, who sympathized with Rumania, and during his term of office the relations between the two countries greatly improved.

Postal conventions were passed with Austria and with North Ger- many, and the prince found leisure to preside at the military camp which he had formed at Furcani, where 12,000 men were assembled. The prince, ever since his arrival in the country, had made a point of becoming personally acquainted with all parts of his dominions, and had made himself very popular with the army and the masses, and it was a relief to him to tear himself away from the intrigues of politicians in Bucharest to receive a warm welcome from all classes in the interior. After a residence of three years in his adopted country, he felt that the time had arrived to make the tour of foreign countries, and to endeavour to improve his friendly relations with their sovereigns. Before leaving Rumania an amnesty was granted for all political and press offences, in order to show the prince's confidence that no intrigue was able to shake his hold upon the hearts of his people. In August he paid a visit to the Russian emperor Alexander at Livadia, by whom he was most kindly received and welcomed. This was followed by visits to the emperor of Austria, the king of Prussia, the king of the Belgians, and lastly the Emperor Napoleon. While staying at his ancestral home at Sigmaringen an arrangement was made, through his friend the crown prince Frederick of Prussia, _, for a me'eting with the

Princess Elizabeth of Wied. ^ , The romantic story of the meeting and rapid courtship, ^-~j 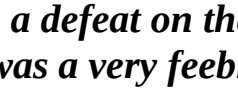 *- which lasted only a few hours, is well told in the **

published memoirs of the prince. The betrothal was very shortly followed by marriage (15th November 1869), and when they landed at Turn Severin they were received with the utmost enthusiasm 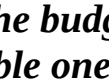 *a strange and pleasing contrast to the prince's surreptitious disem- barkation at the same spot three years previously on his first arrival in the country. The marriage was in every respect a happy one. The queen is a clever linguist, an accomplished artist, and a good musician. She has been described as a woman above the ordinary level of humanity, detached from material interests, living in the ideal, loving nature, poetry, music, painting, and all the arts, wholly devoted to noble causes, to Rumania and the Rumanians, particularly to the poor and suffering. She is well known to Europe, under the Tiom de guerre of "Carmen Sylva," as a royal authoress, who, even if she had not the advantage of rank, would still have made a name in literature. She has worked hard to protect native industries, and when living at her beautiful summer residence of Pelesoh in the Carpathians she and her maids of honour wear the picturesque and lovely embroidered costumes of Rumanian women. The journey of the princely pair to Bucharest was one constant triumphal march, and their reception at the capital was in every respect worthy of the occasion. But the prince's difficulties and trials were by no means at an end: the Opposition made most violent attacks on the ministry and the dynasty, which in no wise diminished in intensity after Prince Ghika's resignation (February 1870), following a defeat on the budget. The succeeding ministry under A. Golesco was a very feeble one, and lasted only a few months, M. Jepurana being called on to form a cabinet in AprU. The latter's accession to power was followed by a general election, during which serious riots took place at Piteshti and Ploeshti, at both of which places collisions took place between the troops and the mob, and at the latter the national guard had to be disbanded.*

Much excitement was caused in Rumania by the outbreak of the war between Prussia and France, one of the immediate causes of which was the nomination of Prince Charles's elder brother, the crown prince of

Hohenzollem, to the throne of Spain. The sympathies of the Rumanian nation were entirely on the side of their Latin sister, while those of the prince were naturally with his native country ; and in spite of the opposition of the ministers, who were strictly neutral, a motion was passed in the Chamber to the effect that the sympathies of Rumania would always be with the Latin race. The excitement culminated in a revolutionary outbreak at Ploeshti, where a hot-headed deputy, Candiano Popescu, after the mob had stormed the militia ^^^^^^j’”’ barracks, issued a proclamation deposing Prince Charles ??”^”- and appointing General Golesco regent ad interim. Owing to the loyalty of the regular army the insurrection was speedily quelled, and Bratiano and Golesco, who were both believed to be implicated in the plot, were arrested, although shortly afterwards released.*

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No doubt many influential men were involved, but the movement broke out prematurely and before due preparations had been made. It is worthy of note, as showing the magnanimity and wisdom of the prince, that Bratiano lived to render the greatest services to his prince and country, and that the rebel Popescu only a few years afterwards commanded the Rumanian battalion that successfully stormed the famous Grivitza redoubt at Plevna. But the feeling in the country was strong against the German sovereign. Six weeks later a jury acquitted the accused rebels, and the prince seriously thought of abdicating. On 7th December he wrote confidentially to the sovereigns of the guaranteeing Powers, suggesting that the future of Rumania should be regulated by a European congress, and stating that ” only a strong government could remedy the internal and external evils of the country, which at present was in a most deplorable condition despite the wealth of its resources.” A few days subsequently the prince learned that the German railway contractor Strausberg was unwilling or unable to pay the coupons of the railway bonds due on 1st January, which were mostly held by influential people in Germany. This threw the moral responsibility of payment on Rumania,

and was a bitter blow to the prince, through whose instrumentality the loan had been placed, and whose one great consolation in life had been that it was to him that Rumania owed its railway system. He now hesitated about abdicating, as he was unwilling to forsake the country in the day of its peril. But more troubles were in store. The chief instigators of the recent rebellion succeeded in passing through the Chamber a resolution most insulting to the prince. Exciting and passionate debates ended in a vote of no confidence in the ministry. Prince John Ghika formed a new Government, and declared that his policy lay in effecting a compromise between the prince, who had lost all ???confidence in the country, and the representatives of the people. Matters were brought to a crisis by the Prussian Government threatening to use pressure to force the Rumanian Government to act in accordance with its guarantee, and provide for the unpaid coupons of the German railway loan. The country was financially in no condition to comply. Bitter indignation prevailed against everything German, and culminated in an attack on the German colony of Bucharest on the occasion of a banquet given on the emperor's birthday on 22nd March 1871. The mob was only dispersed by the military after having been in possession of the streets for two and a half hours, shouting ' ' Long live the republic ! "

This was more than the prince could bear. On the following morning he summoned the members of the Lieutenance Princiere of 1866, and informed them of his intention to place the govern- ment in their hands. Lascar Catargi and General Golesco, the only two members present, as well as Demetrius Stourdza and other influential persons, solemnly adjured the prince to abstain from a step which they felt convinced could only bring the greatest mis- fortune on Rumania, and they declined to accept the responsibility. Catargi offered to unite the different sections of the Conservative party in order to conjure away the difficulties that beset the country. The prince accepted his offer. Catargi formed a ministry to which all the most respectable members of the country rallied, compris- ing Kretzulesco, General Tell, Mavrogheni, General Floresco, and other well-known patriots, and the hostile Chamber was dissolved. The excellent reception accorded to the prince and princess in a tour through Moldavia while the elections were pending drove all thoughts of abdication out of the prince's head. There had been a reaction in public

opinion, greatly owing to the publication of a most pathetic letter from the prince, containing the reasons which had induced him to contemplate abdication. The elections took place early in May (1871), and the Government, to which all the most respectable elements in the country had Tallied, had a large majority in the Chambers. When Parliament met in May the prince had a most enthusiastic reception. It was the inauguration of a new r(5gime. Catargi's ministry was the tenth that had held office in the five years that had elapsed since the prince's arrival, but it was the first one that was stable, and was destined to last till 1876. The anti-German feeling in the country had greatly subsided, in consequence of the crushing defeat of France, and in January 1872 the Chambers passed a law by which Rumania undertook to pay the railway coupons. The German syndicate was satisfied, and the railway crisis was ended. Rumania now passed through a peaceful stage. The death of Napoleon III. in January 1873 moved the nation greatly, for the dead emperor had been the champion and protector of the national existence of Rumania in its darkest days. The universal sympathy shown with the widowed empress and the prince imperial created a certain temporary friction with the republican Government. Later in the year Rumania was well represented at the Menna Exhibition, when the prince was most cordially received by the Austrian emperor. On leaving Vienna visits were jiaid to the Tsar (at Ems) and the Emperor William. On the 9th April 1874 the country was thrown into the deepest grief by the death of the Princess Marie, the only and di'iirly loved child of Prince Charles and the Princess Elizabeth. The universal sympathy shown on all

sides to the bereaved parents helped much to strengthen the bonds by which the prince was attached to the country. In March 1875 the budget for 1876, amounting to 100 million francs, nearly double in amount that of the year 1866, was passed without difficulty, and on the 28th of the month the parliamentary session was closed. It was the first occasion in Rumania that the same Chamber had sat for the whole constitutional period of four years, and also the first time that the same ministry had opened and closed the same Chamber. The speech from the throne dwelt with satisfaction on the work that had been accomplished during the above period, viz., financial and administrative reform, regulation of the public debt, loans both external and internal successfully floated, new

resources derived from stamp and licence taxes, and from the crea- tion of a tobacco monopoly, the foundation of the State agricultural bank, organization of the State domains, the passing of a customs law with a new tariff, and the provisional settlement of the various complicated questions connected with the railways. Important reforms had also been carried out in the army, the Church, and the judicial department. During the same period international con- ventions had been signed with Austria, Russia, and Servia, and Rumania had joined the International Postal Union.

The Liberal Opposition under Bratiano, tired of being so long out of office, did their utmost to secure a majority against the Govern- ment in tlie new Chambers, the election for which took place in May. No stone was left unturned : emissaries were sent into the districts to preach revolt ; in the Liberal press it was declared that all or any means were legitimate with the view of upsetting the ministry ; tumultous and riotous meetings toot place at Bucharest ; but in Rumania the Government which superintends the elections has always means at its command to ensure a majority, and M. Catargi, in spite of the most unscrupulous and powerful opposition, found himself with a large majority in the new Chambers, and was able before the close of the year to obtain from Parliament approval of a commercial treaty to be signed with Austria- Hungary, a most important measure, not only giving great commercial relief to the country, but being a long step forward in the direction of obtaining Rumanian independence, an aim never absent from the minds of patriotic Rumanians, and now shortly to be realized. Before obtaining it, however, the country had to pass through difficult times. The budget presented to the Chambers in March (1876) showed a deficit of 30 million francs ; the Senate refusefl to pass it, and was dissolved ; and the new elections gave but a feeble majority for the Government. Dissensions broke out in the cabinet, which was defeated in the Chambers on the budget. This was followed by the resignation of the Catargi ministry, which for five eventful and on the whole prosperous years had governed the country.

The fall of the ministry saved the country from revolution. A widespread conspiracy was on foot, fomented by the leading Liberals, for the arrest and expulsion of the prince, and the formation of a provisional

government under General Dabija. The prospect of a return to power put an end to these machinations. Catargi's ministry was succeeded by a very short-lived administration under General Florescu, known as the "cabinet of the generals," which after an existence of only one month was succeeded on 8th May by a so-called "ministry of conciliation " under M. Jepureano, during whose short tenure of office a new Chamber was elected, by which the commercial treaty with Austria was ratified, under strong pressure and even menace on the part of the Austrian Government. A commission of the Chambers drew up an indictment against Catargi and his late colleagues, accusing them of violating the constitution and the public liberties, squandering the State revenues, and abuse of power when in office. Unable to stem the tide of popular passion, which was crying for impeachment, Jepureano resigned office, and M. Bratiano on 4th August was entrusted with the formation of a new Liberal cabinet, destined to guide the country through many eventful years. A pro- minent member of it was M. Stourdza, who subsequently suc- ceeded Bratiano as head of the Liberal party. The programme of the new ministry was declared to include respect for the con- stitution and the law, honesty in the administration, great economies in expenditure, and the decentralization of the adminis- trative services. But the reopening of the Eastern question was destined to bring to a climax the great struggle of Rumania for existence and independence as a nation, and temporarily to throw into the shade all domestic questions. The revolution in Bosnia and Herzegovina towards the close of 1875, followed a few montlis afterwards by the declaration of war between Turkey and the tributary states of Servia and Montenegro, were events which could not leave Rumania unconcerned. Her powerful neigh- bours Austria and Russia had sounded her ruler as to his intentions in case of a universal outbreak ; Prince Milan of Servia had unsuccessfully begged Prince Charles to join him in deolai'ing war against their common suzerain the sultan ; and Prince Charles, altliough declining this tempting offer, seized the opportunity of reminding the Sublime Porte of certain unsettled disputes between them, and made various proposals, all of them

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tending to the practical emancipation of lii3 country from the sub-ordinate position in which it was placed. The insurrection in Bulgaria, with its accompanying horrors, followed by the deposition of Sultan Murad and the succession of the Sultan Abdul Hamid, contributed to indicate the near approach of a Russo-Turkish war. Russia had shown symptoms of anger against Rumania for not having taken up a decided attitude in the approaching struggle, and the Russian ambassador Ignatieff had some months previ- ously threatened that his Government would seize the Danube principalities as a pledge as soon as the Turks occupied Servia and Montenegro. The whole of Russia, with the exception perhaps of the Tsar himself, was bent on war. Prince Charles decided to send a mission, composed of Bratiano and Colonel Slaniceanu (the minister of war), to the imperial headquarters at Livadia. They were well received by the emperor (October 1876), but in spite of mixed threats, menaces, and cajoleries on the part of Gortsohakoff, Ignatieff, and others, Bratiano returned without having definitively committed his country to active measures.

On 11th November six Russian army corps were mobilized to form the army of the south under the Grand Duke Nicholas. A few days later two secret envoys arrived at Bucharest, the one M. de Nelidoff, to negotiate on the part of the Russian Goverument for the passage of their army through Rumania, the other Ali Bey, to arrange on behalf of the sultan a combination with Rumania against Russia. Prince Charles cleverly temporized with both Powers. Negotiations with Russia were continued, and M. Bratiano was sent to Con- stantinople to put pressure upon Turkey to secure certain rights and privileges which would de facto have made Rumania an independent power, except that it would ‘’”‘ still have paid a iixed tribute ; but the conference of

the Powers assembled at that capital came to a definite end on the 19th January 1877, when the Turkish Government declined every proposal of the conference as being opposed to the “integrity, independence, and dignity of the empire.” Meanwhile the Porte, in issuing Midhat Pasha’s

famous scheme of reforms, had greatly irritated Rumanian politicians by including their country in the same category as the other privileged provinces, and designating its inhabitants as Ottoman subjects. A secret convention was signed between Russia and Rumania on the 16th April, by which the latter allowed free passage through the country to the Russian armies, the Tsar engaging in return to maintain its political rights and to protect its integrity, while all matters of detail connected with the passage of the Russian troops were to be regulated by a special treaty. On the 23rd April Russia declared war against Turkey, and the Grand Duke Nicholas issued a proclamation to the Rumanian nation, announcing his intention of entering their territory in the hope of finding the same welcome as in former wars. The entry of Russian troops into Moldavia preceded by some hours the declaration of war, and various important strategic points were at once seized and occupied. The Rumanian Govern- ment made a platonio protest against the crossing of the frontier, and the Rumanian troops fell back as the Russians advanced ; pro- visions and stores of all kinds were supplied to the invading army against cash payments in gold, and the railways and telegraphs were freely placed at their disposal. The Rumanian Chambers were assembled on the 26th April, and the convention with Russia was sanctioned by 69 to 25 votes in the Chamber, and by 41 to 10 in the Senate, in spite of vigorous opposition on the part of Stourdza, Carp, and Epureano. The Ottoman Government imme- diately broke off diplomatic relations with Rumania, and on the 11th May the Chambers of Bucharest passed a resolution that a state of war existed with Turkey. Rumania has been much blamed for joining Russia in this war against the suzerain power. There is no doubt that the prince from his first connexion with Rumania had the independence of the country in view. It is on record that in his interview with King William of Prussia in 1866, prior to his accepting the call to the principality, he stated that "although he was ready to acknowledge the Turkish suzerainty for a time, he reserved to himself the task of freeing his country by force of arms, and of gaining perfect independence on the field of battle." For eleven years he had been developing the military forces of the principality in order to be prepared for all eventualities, and when the crisis arrived he had neither the power nor the inclination to resist the passage of the Russian armies through his territory ; stiU less had he the wish to see his country 'become the scene of conflict between the two great opposing

Powers, which would inevitably have resulted from the maintenance of a strict neutrality. Turkey, on the other hand, hoped up to the last that Rumania would not openly join Russia against her, and it was perhaps this hope that induced her to observe a strictly defensive attitude, and to abstain from commencing hostilities against Rumania by an invasion of that country.

Russia thought herself quite capable single-handed of waging a successful war against Turkey, and being quite content with the grant of a free passage through Rumania, had at first no desire to insist on her active co-operation in the field. It was arranged, there- fore, that the Rumanian army should retire into Lesser Wallaohia,

and occupy Kalafat and other points on the left bank of the Danube as far down as Giurgevo, thus protecting that part of the country from invasion, and at the same time covering the right wing of the Russian army while it was taking up its strategic positions between Giurgevo and Galatz. As soon as the Russians were ready to occupy Giurgevo (which covered Bucharest), the Rumanians retired westward as far as the river Olt. Thanks to the development of the military resources of the country. Prince Charles was able to put into the field and take command of two corps d'armee with 48,000 men and 180 guns, with about 70,000 men of the national guard and militia in reserve. On the 27th May the bombardment of Widdin from Kalafat, under the prince's personal orders, was one of the opening events of tlie war, and the coolness of the prince under fire created much enthusiasm among his soldiers and people. In the course of May Russia had placed 200,000 men on the north of the Danube, but owing to heavy floods it was not till the 27th June that the main passage of the Danube was effected at Simnitza, the crossing of a small force having taken place a few days previously at Braila. But it was soon discovered that the Russians had underrated the Turkish power of resistance, and that instead of a mere military promenade to Constantinople, Russia would have to put forth all her strength to bring the war to a successful issue. General Gourko's force, after a successful raid across the Balkans, was forced to retire in the face of strongly superior numbers. General Schilder-Schuldner, after capturing Nicopoli and taking 8000 Turkish prisoners, was defeated on the 20th July by

Osman Pasha at Plevna, to which place the latter had hurried from Widdin in order to prevent the main Russian army from marching to Sofia. On the 30th July the Russians, having collected 30,000 men, made the second unsuccessful attack on Plevna, losing some 8000 men in the fight, and it was at one time feared that the Russian armies might be driven back across the Danube. But Russia's failure was Rumania's opportunity, which Prince Charles was not slow in seizing. In May the 'Tsar had intimated that Russia had no need of the support of the Rumanian army, and that if Prince Charles's Government wished to take part in the campaign, it must do so at its own risk and expense. After the first defeat at Plevna the Russian headquarters staff' requested that the Rumanian army should occupy Nicopoli and take charge of the prisoners of war : Prince Charles declined to move his troops untQ he should receive a positive promise that the Rumanian corps should be maintained as a separate unit, under its own officers. After the second defeat at Plevna, which was attributed by the Grand Duke Nicholas to the fact that the Rumanians had not complied with his request to occupy Nicopoli, the Grand Duke again made repeated and urgent endeavours to secure the active assistance of Prince Charles and his army, but the former would not give way until the Russians agreed to give him the undivided command of the Rumanian army. This burning question was at last settled in his favour ; the Rumanian troops proceeded at once to occupy Nicopoli, and the main Rumanian army commenced crossing the Danube on the 25th August at Corabia. Prince Charles himself joined the Russian headquarters on the 20th, and the same day the Tsar conferred on the prince the command of all the Russian troops before Plevna, and the Russian General Setoff' was appointed his chief of the stafE The troops placed under his orders (including the Rumanians] amounted at first to 75,000 men with 8000 horses and 442 guns. The third and last assault on Plevna took place on the 11th September, when the Rumanian army covered itself with glory, and, with the loss of 2600 men, captured and held the famous Grivitza redoubt (the unsuccessful attack on which on the 30th July had caused the Russians a loss of 6000 men). General Skobeleff the same day captured with fearful loss the Green Hill, but was unable to maintain his position.

The heavy losses incm-red by the allied armies, no less than 16,000 killed and wounded, made it evident that Plevna was not to be reduced by assault. General Todleben, the famous defender of Sebastopol, was summoned to act as second in command to Prince Charles, with Prince Imeritinski as chief of the staff. Enormous reinforcements were brought up by Russia, and it was decided to attempt to compel the surrender of the Turkish army by a blockade. On the 18th September the Rumanians attacked the second Grivitza redoubt, but were repulsed with the loss of 20 officers and 583 men killed and wounded. On the 19th October a further attempt was made, and the redoubt was captured ; but the Turkish reserves eventually recaptured it, inflicting a loss of 300 killed and 707 wounded. It was not till the 10th December that Osman Pasha made his desperate but unsuccessful attempt to break throuifh the investing armies, and was finally compelled to surrender; 40,000 men and 77 guns fell into the hands of the victors. Two divisions of the Rumanian army were now detailed to blockade the virgin fortress of Widdin, whilst a third escorted the prisoners of war to the Russian frontier. The'fall of Plevna left the Russian army free to commence its victorious march to Constantinople, and on the 31st January 1878 the preliminaries of peace were signed at Adrianople, one of the provisions of which was that Rumania

should be independent and receive an increase of territory. Widdin was surrendered to the Rumanians on 24th February, when the Turkish garrison marched out with all the honours of war.

The definite treaty of peace between Russia and Turkey was sigued at San Stefano on the 3rd March. But Rumania was now to learn that in politics there is no such thing as gratitude. Although anxious to be represented at the peace negotiations, this claim was disallowed by Russia. On 29th January the Rumanian agent at St Petersburg was officially informed of

the intention of the Russian Government to regain possession of the Rumanian c I f portion of Bessarabia, i.e., that portion which was Bessarabi ‘^^^^^ to Moldavia by Russia after tlie Crimean war. Rumania was to be indemnified at the expense of Turkey by the delta of tlie Danube and the Dobrudja as far as Kustendjie. The motive assigned was that this territory had not been ceded to Rumania, but to Moldavia, and had been separated from Russia by a treaty (Paris) of which scarcely a single provision remained in force. Moreover, the national dignity and honour of Russia demanded the reacquisition of this district. In reply to all remonstrances Prince Gortschakoff blandly stated, ” Whatever arguments you employ, they cannot modify our decision, which is unalterable.” Ignatieff was sent to Bucharest to try and reconcile the prince to make this sacrifice, and hints were thrown out that under certain circumstances Prince Charles might be elected to the throne of Bulgaria. But the proposed exchange of territory roused the most bitter indignation at Bucharest. It was discussed before a secret sitting of the Chamber and the Senate on 4th February, when, amidst the greatest excitement, the representatives of the nation declared that Rumania would defend the integrity of its territory to the last, with armed force if necessary. But in the end the weaker had to submit to the stronger. Bratiano and Cogalniceano were sent to Berlin to endeavour to prevail on the representatives of the Powers there assembled in June 1878 to veto the cession of Bessarabia to Russia ; but the Rumanian delegates were not permitted to attend the sittings of the Congress until the Powers had decided in favour of the Russian claim. The Treaty of Berlin in dealing with Rumania decided to recognize its independence, subject to two conditions : ??? First (Art. xlv.), that the principality restores to the emperor of Russia that portion of the Bessarabian territory detached from Russia by the Treaty of Paris of 1856, bounded on the west by the mid-channel of the Pruth, and on the south by the mid-channel of the Kilia branch and the Stary Stamboul mouth. Second (Art. xliv.), that in Rumania the difference of religious creeds and confessions should not be alleged against any person as a ground for exclusion or in- capacity in matters relating to the enjoyment of civil and political rights, admission to public employments, functions, and honours, or the exercise of the various professions and industries in any locality whatsoever ; that freedom and outward exercise of all forms of worship should be assured

to all persons belonging to the Rumanian state and to foreigners, and that no hindrance should be offered to the hierarchical organization of the different com- munions, or to their relations with their spiritual chiefs ; and, further, that the subjects and citizens of all the Powers, traders or others, should be treated in Rumania without distinction of creed, on a footing of perfect equality. Article xlvi. declared that the islands forming the delta of the Danube, the Isle of Serpents, and the province of Dobrudja, as far as a line starting from the east of Silistria and terminating on the Black Sea south of Mangalia, should be added to Rumania. Other articles defined tlie inter- national position of Rumania, while Article liii. decreed that it should have ??, representative on the European commission of the Danube. It was a bitter blow to the Rumanians, after all the sacrifices they had made on the field of battle, to find that the re- cognition of their long-hoped-for independence was to depend on the performance of two conditions, both of which were deeply re- pugnant to the nation at large. Bratiano wrote with some truth, that the Great Powers by sacrificing Rumania were able to obtain more concessions for themselves from Russia, and Lord Beaconsfield was constrained to admit that "in politics ingratitude is often the reward of the greatest services." The Rumanians submitted eventually, but with bad grace, to the retrocession of Bessarabia. "The Russian occupation (13th October 1878) passed off unevent- fully, the Rumanian officials retired without a word, and Prince Charles was spared the pain of signing his name to any document in connexion with the cession," but the transaction caused bitter animosity in Rumania against Russia ; while the diplomatic pro- tests and violent language in the Chambers also produced a deep impression on Russian official circles, which was not without fruit when the new frontier between the Dobrudja and Bulgaria was delimited by a European commission, on which occasion Russia did her utmost to thwart and resist the pretensions of Rumania, especially as regards the proposals to include Arab Tabia (a fort commanding Silistria in Rumanian territory). The Powers, with the exception of Russia, supported Rumania ; and although the point was ultimately decided in 1879 in favour of the latter, yet owing to Russian opposition the boundary was not finally demarcated

till 1885. The Dobrudja was quietly occupied by Rumanian troops on the 26th November 1878. It was personally visited by the prince in October 1879, and in 1880 an organic law of a liberal nature was passed and promulgated. Most of the laws and regulations existing in Rumania were made to apply to the new possession ; and although Art. iv. laid down that a special law would be passed regulating the representation of the population in the Rumanian Parliament, this has never been carried out, and the Dobrudja is still unrepresented in Parliament, and is governed by prefects depending on the minister of the interior at Bucharest. At the time of its cession the province was regarded as of but little value, so much so that many Rumanian statesmen wished to decline the proffered gift, yet it has since proved a most useful acquisition, especially since the connexion (1894) of the port of Kustendjie (now called Constantza) with the Rumanian rail- way system by the construction of a bridge over the Danube at Tchernavoda.

But it was Art. xliv. of the Treaty of Berlin that was to cause real trouble and tremendous agitation throughout the country. It will be remembered that Art. vii. of the constitution of 1866 laid down that "only Christians can become citizens of Rumania" ❓❓❓ in other words, all Jews were excluded from the rights of citizen- ship, and as no foreigner could own land in Rumania outside the towns, it follows that no Jew could become a country proprietor. The Great Powers, moved by the demands and complaints of the Jews, and desirous of removing this disqualification, legislated accordingly, as has been shown in Art. xlvi. of the Treaty of Berlin ; but public opinion in Rumania, already excited by the compulsory retrocession of Bessarabia, rendered it almost impdssible for any Government to legislate in accordance with the wishes of the Berlin tribunal. In the first place, it involved a change in the constitution, which could only be effected by a constituent assembly elected ad hoc, and it was with the greatest difficulty, and amidst the greatest excitement throughout the country, that Bratiano was able to obtain the requisite majority in favour of the election of new Chambers for this purpose. The revising chamber met on 3rd June, and sat through the entire summer, and at one time the irritation of the Powers at the unexpected delay in carrying out their decision was so great that England proposed a collective note on the subject, to be executed by the Austrian cabinet ; while Prince Bismarck

threatened, in case the Berlin proposition was not carried out, to refer to the suzerain power at Constantinople ! The prince was confronted with the choice of a rupture with the Powers or a revolution in the country, where there was a tremendous popular outcry against all concessions to the Jews. At last, how- ever, on 18th October, the new Chamber repealed Art. vii. of the constitution of 1866, and it thus became possible for Rumanian Jews to become naturalized and to hold land. It was further decided to admit en bloc to naturalization the 883 Jewish soldiers who had served in the war of independence ; but with all other Jews individual naturalization was required, and this was hedged about by so many difficulties, a special vote of the Legislature being required, with a two-thirds majority in each individual case, that although the compromise thus effected was accepted by the Powers, /aute de mieux, the result in practice has been that, from 1880 to 1884, out of 385 persons who were naturalized in Rumania, only 71 were Rumanian Jews. Since that time they have been ad- mitted by small driblets of not more than a few individuals in a year, so that the 300,000 Jews said to inhabit Rumania have practically derived no benefit whatever from the benevolent inten- tions of the Powers at Berlin, and are still regarded as foreigners ; and although liable to military service and to the payment of taxes, are unable to own land or possess electoral or other civil rights. However, the Powers agreed to accept the resolutions that had been passed by the Chambers as meeting the necessities of the case. The two conditions on the performance of which depended the recognition of Rumanian independence had now been carried out.

*Italy was the first of the Great Powers to formally notify its recognition of Rumanian independence (December 1879) ; but Bismarck succeeded in prevailing on the western Powers not to give official recognition until another matter which . vitally affected Germany's financial interests had been ”””*P* ”” settled in its favour. This was the never-ending rail-*”””” way question, in which so much German capital was engaged. Groat pressure was put on the Rumanian Government to pass a\ law through the Chambers for the purchase of the railways from the German capitalists. This measure was most unpopular in the country, and it was difficult to induce the Chambers to agree to the proposed terms of purchase ; but at last, in the end of January 1880, the necessary Bill was*

passed ; and then, but not till then, Bismarck gave the word, and England, France, and Germany formally recognized the independence of the country on the 20th February 1880. The first British minister accredited to Rumania after its admission into the family of European states was that able diplomatist Sir "William "White, who for two years previously had resided at Bucharest as her Majesty's representative. Six weeks

after his nomination as minister he signed a treaty of commerce and navigation between Great Britain and Rumania. The circum- stances connected with it are curious. In 1875 the Rumanians, in order to emancipate themselves from the commercial engage- ments formerly contracted on their behalf by the Porte, and with the desire of bringing the Great Powers to recognize the right of the principality to conclude commercial conventions, drew up a most oppressive tariff of imposts on foreign products, which was to come into force on the 1st July 1876. The Government of Austria- Hungary lost no time, and concluded a convention in June 1875, stipulating for much lower duties than those of the general tariff. Russia and Germany followed suit. England, in order to spare the susceptibilities of the Porte, would not conclude a treaty direct with Rumania, but an arrangement was come to in November 1876 provisionally securing to British trade the full benefit of the Austrian commercial tariff. This was subsequently extended to 12th May 1878, but no farther; but through Sir "W. White's exertions, on the 13th August the Rumanian Legislature con- ferred on British productions the benefit of the most favoured nation clause until such time as a definite treaty could be con- cluded. This arrangement lasted until the 5th April 1880, when the definite treaty was signed.

In the autumn of 1880 Prince Charles visited Germany, and as there now appeared but little prospect of the birth of a son and heir, it became necessary to regulate the succession to the throne. Art. Ixxxiii. of the

constitution of 1866 decreed that, in default of male heirs in lino direct of Prince Charles, the succession should pass to the eldest of his brothers or to their descendants. In case of the line becoming extinct, or of the members of the Hohenzollern family renouncing their rights, Prince Charles was accorded the power of naming his successor from one of the reigning dynasties of Europe, subject to the approval of the national representatives. The prince now (1880) negotiated and obtained from the princely house of Hohenzollern a formal assent to and acceptance of this article of the constitution. His elder brother. Prince Leopold, hereditary prince of Hohenzollern, renounced his own claim to the succession in favour of his sons, whom he declared he would bring up with the view of one of them succeeding to the throne. An intimation of this decision was laid before the Chambers on Prince Charles's return to Rumania, and was received with hearty satis- faction. Early in 1881 it was generally felt that the time had arrived for Rumania to be created a kingdom. On 13th March the Tsar Alexander was assassinated, and the Rumanian Opposi- tion made it the occasion of accusing the Liberal Government of aiming at republican and anti-dynastic ideals. To refute this calumny the ministry proposed the elevation of the Rumanian principality into the kingdom of Rumania, amidst the enthusiastic plaudits of Chamber and Senate. The prince, in accepting the resolution, declared that it was the beginning of a new page in the _ volume of Rumanian national life, and the end of a

kl rf"' period full of struggle and difficulties, but also full of*

ng om. ^jj.jjg effort and heroic deeds : the wish of the nation was the guide and goal of his life, the love and confidence of the nation by which he had been surrounded during the fifteen years he had ruled the country had made the good days brighter, and had strengthened and confirmed him during those which were evil. He accepted the kingly title to fulfil the long-cherished wish of every Rumanian, and expressed the hope, "May the first king of Rumania enjoy the same love that has supported the last prince through all his troubles ! The affection of this noble and brave nation, to whom I have devoted my whole existence, is more to me than all the greatness and brilliancy of a crown." Within ten days of this declaration the new kingdom was recognized by all the Great Powers. The coronation took place at Bucharest with much pomp and ceremony on the

22nd May 1881. The ceremony was attended by the king's elder brother, the hereditary prince of Hohenzollern, and his two sons, one of whom, Prince Ferdinand, was destined later on to become heir-apparent. 'The royal crown was constructed of steel made from Turkish cannon captured at Plevna, while that of the queen was of pure gold, without jewels or orna- ments. Delegates attended from every district in the kingdom, throughout which there was universal rejoicing. King Charles was now able to continue to work out the development of the country, comparatively, but not entirely free from fears of serious foreign complications. Relations with Russia had remained strained ever since the war, and it was not tiU January 1881 that the Russians appointed Prince Durosoff as minister at Bucharest after the post had been vacant for two years. The question of the Dobrudja frontier was still unsettled, and owing to Russian opposi- tion was not finally disposed of till three years later. At one time the dispute became very acute, and Rumanian troops forcibly occupied the Arab Tabia at Silistria, from which, however, they subsequently had to retire. Difficulties also frequently arose from the enforcement of an Alien Bill passed in April 1881, which gave the Government the right to expel all aliens whose presence was considered objectionable. Much trouble was experienced in settling the claims and counter-claims about the war accounts,

especially as regards the claim made by the Russian Government for a return of a sum of 3,000,000 francs advanced during the war to enable the Rumanians to mobilize, which had been considered by the latter as a free gift. A compromise was made, both parties withdrawing their claims, and a final settlement was arrived at in April 1882.

Relations with Austria-Hungary were also on a very unpleasant footing. There were two principal subjects of discord ??? the navi- gation of the Danube and the national question. As _ . regards the former (see Danube), the pretensions of .

the Austrian Government to have a preponderating position in the " Commission mixte du Danube," which was to be the governing power of that portion of the river between Galatz and the Iron Gates (no part of which is in Austrian territory), aroused a most bitter feeling in Rumania,

which found vent in the speech from the throne addressed to the Chambers on the 27th November 1881, when the king asserted that the country was ready, both for the present and in the future, to make every sacrifice that might be necessary to ensure complete freedom of navigation. This speech gave great offence in Austria, nearly causing interruption in the diplomatic relations between the two countries. Apologies were . made and explanations offered in the Chambers, and the matter was amicably arranged, not without violent attacks by the Opposition on both the king and the Govern- ment of M. Bratiano for their supposed subserviency to Austria. The Danube question reached another acute stage in 1883, when, on account of Austrian opposition, Rumania, although under the Treaty of Berlin she had a representative on the European com- mission of the Danube, was refused permission to participate in the congress held at London to regulate the Danube question. The formation of the " Commission mixte " was then finally sanctioned, but Rumania refused to submit to arrangements which so seriously affected her interests, and to which she was not a consenting party ; and although sanctioned by treaty, Rumania gained her point, and the " Commission mixte " has never come into existence. The Danube question again came prominently forward in 1899, when strong protests were made by Rumania, this time supported by Russia, against the claims of Austria- Hungary to nx the tariffs for vessels passing through the Iron Gates, and to have exclusive police supervision over that part of the river. It will be seen that the Danube and the national questions are two very delicate matters, always more or less en Mdence, and liable to compromise the relations between the dual kingdom and Rumania, and requiring great tact in their management.

Another measure adopted by Rumania in 1883 caused much irritation both in Austria and Russia, viz., the decision to construct extensive fortifications both around Bucharest and on the line of the Sereth, the latter to enable the country to concentrate troops against an invasion from the north-east. Austria considered that the former were directed against her, while Russia, with more show of reason, considered the construction of the Sereth works as directed against herself. Both sets of works had been designed by General Brialmont in 1882. In March 1883 the Rumanian Chambers voted ??400,000 for their commencement,

and they have since been completed at a total cost (including armament of the most modern type) exceeding four million pounds sterling. Eortu- nately, there has never been occasion to try their efficacy against either of her powerful neighbours, but they will no doubt materi- ally help to defend Rumanian neutrality in any future complication that may arise.

It was not till towards the end of 1883 that a better feeling began to prevail between Rumania and her western neighbour. The king in the summer had paid visits to Berlin and Vienna, whilst Bratiano had interviews with Prince Bismarck at Gastein, and subsequently with the emperor of Austria at Vienna. Between them they succeeded in convincing the emperor of their wish to be on friendly terms with both Germany and Austria, and the rela- tions between the latter and Rumania perceptibly improved. The entente was still further strengthened by the visit of the Austrian heir-apparent to the Rumanian court in April 1884, a visit which caused some irritation in Russia. The king's sympathies are and always have been thoroughly German, and were naturallv extended to Germany's partner in the Triple Alliance, while he could never forget the ingratitude of Russia as displayed subsequent to the war. Bratiano, too, was no doubt at this period a sincere advocate of Austrian friendship on political grounds, whilst his own experience taught him to be very suspicious of Russia. But there was a strong anti-German party in the country, especially among the old boyards and the peasantry, among whom community of creed, ancient traditional influence, the entire absence of Russiim merchants in the country (and the consequent avoidance of many petty but litigious questions), all contributed to bring about a sort of passive preference for Russia, whilst the bitter disputes that had occurred with Germany on the question of railway finance had left a very hostile feeling, often very detrimental to the king's popularity, notwithstanding the fact that the latter was constantly exerting:

his utmost energies to further the material development and well- being of his country.

In March 1883 the Chamber and the Senate, on the demand of

the Government, after most violent discussions, decided by over-

whelming majorities to proceed to a revision of the con-

^ ^ *“* *stitution, and, as a necessary consequence, fresh Chambers had to be elected for tliat special purpose. The new Chambers consisted almost entirely of supporters of the Government, only twelve members of the Opposition being elected in each house, and at the opening of the session in May sixteen out of the twenty-four declined to take any part in the proceedings of the Chambers, as a protest against the violent and illegal manner in which they asserted the elections had been conducted by the Government. The principal mover in the direction of revision was the veteran Rosetti, who had preserved the full feelings of his early democratic aspira- tions, and insisted on bringing forward radical measures of electoral reform, by increasing the number of peasant freeholders, and by the establishment of a single electoral college, instead of the four, arranged according to wealth, provided for by the constitution. M. Bratiano would not agree to these fundamental changes, which would practically have resulted in universal suffrage. The moderate party was successful, aed revision of the constitution was effected, but on non-revolutionary principles : three electoral colleges were formed instead of four (and in consequence Rosetti, with thirty-one of his partisans, took no further part in the proceedings) ; a considerable addition was made to the numbers of the Senate and Chamber of Representatives ; trial by jury was established for press offences, with the exception of those com- mitted against the royal family and the sovereigns of foreign states ; these were to be tried by the ordinary tribunals without jury. Another Bill was passed by the same Parliament, but not without violent opposition, endowing the Crown with State lands, giving an annual rent of* *2i,000, in addition to the civil list fixed in 1866 at* *49,000; another measure granted free passes on the railways and an allowance of twenty-five francs a day during the sitting of Parliament to*

all senators and deputies. The revision of the constitution was the cause of a split between the two heads of the Liberal party, Rosetti and Bratiano. These two were united by a most intimate friendship, and had in their early days conspired together as leaders of the revolutionary movement in 18i8 ; both were elected members of the provisional govern- ment, and had been imprisoned and exiled together for many years ; they were the principal movers in the revolution which upset Prince Couza in 1866, and in the election of Prince Charles as his successor. One never acted without the other. Rosetti was said to be the soul whilst Bratiano was the voice of the same personality. Their joint action had produced the most brilliant results for the country which gave them birth, but exposed them to much hatred and obloquy, chiefly on the part of the old boyards and their adherents. Since 1876 the Liberal party, under the direction of their two popular leaders, with Bratiano as prime minister, had held ofiioe without interruption, with the exception of a few weeks in 1881 at the time of the coronation, when John Bratiano surrendered the reins of government to his elder brother Demetrius. Rosetti did not long survive the quarrel, and died on the 24th April 1835, only surviving by one year another Rumanian veteran, Prince Michel Stourdza, who had ruled Moldavia with an iron hand from the time of the Russian evacuation in 1835 until 1849. He died an exile in Paris, leaving a fortune of nearly two millions sterling. Within a few weeks of Rosetti's death in May 1885, the king lost a beloved parent and a trusted friend and counsellor by the death of Prince Charles Antony of Hohenzollern. The revising Chambers having finished their special mandate, were dissolved in September 1884, and a new Parliament assembled in November, the Government, as usual, obtaining a large majority in both houses.

The year 1885 was marked by one very important event. The independence of the Rumanian Orthodox Church was formally recognized by the cecumenical patriarch of Constantinople. The Rumanian Church had claimed its independence from very ancient times, but under the Turkish suzerainty and Phanariote hospodars Greeks were generally elected as bishops, and the influence of the Greek patriarch at Constantinople came to be more and more felt. In 1872 a law was passed by which the bishops were elected by the iSenate, the Chamber of Deputies, and the synod sitting as an assembly (the only other occasion on

which provision is made for such an assembly is in the event of the throne becoming vacant without any apparent heir). It was subsequently decided to con- secrate the holy oil in Rumania instead of procuring it from Russia or Constantinople ; but the Greek patriarch protested. Secret negotiations were entered into which came to a successful issue. The patriarch feared on the one hand that the growing influence of the Russian Church would give a colour of Slavism to the whole Church, and that a Russian might eventually be appointed cecumenical patriarch at Constantinople, while the Rumanians hoped by means of the independence of their Church to deprive the Russians of all excuse for interfering in their internal affairs

under the pretext of religion. The Rumanians, although obtain- ing complete independence, agreed to recognize the patriarch at Constantinople as the chief dignitary of the Orthodox Church.

The remaining years of Bratiano's administration were not marked by any very important events. Since the declaration of independence he had exercised an almost dictatorial power, and anything like a powerful parliamentary Opposition had ceased to exist, but this did not prevent the most violent attacks being made on him by an unscrupulous press, and by orators at public meetings. He had been too long in power ; the numerous State departments were exclusively filled with his nominees ; and some pecuniary scandals, in which the minister of war and other superior officers were implicated, helped to augment his fast-grow- ing unpopularity in the country. New parties were formed in opposition, and National Liberal and Liberal-Conservative parties combined to oppose him. The former of these maintained that the Government should be the expression of the national will, and be guided by national rights and interests at home and abroad ??? in fact, that it should be essentially Rumanian, and, while maintaining friendly relations with foreign Powers, should in no wise allow them to interfere with the internal afiairs of the country. They also advocated reduction of expenditure and the independence of the magistracy. The Liberal – Con- servatives held generally the same views, but had as their ideal of foreign policy a guaranteed neutrality. Another party which now attracted considerable attention was that of the Junimists, or Young Conservatives. The name

*was taken from a _. literary society formed in Jassy in 1874 by Messrs P. j ^ i i t Carp, Rosetti, and Maiorescu, and transformed into a ******^^ political association in 1881. Their programme for home affairs involved the amelioration of the position of the peasantry and working classes, whoso progress they considered had been overlooked, the irremovability of the magistracy, and a revision of the communal law in the sense of decentralization. In financial matters they advocated the introduction of a gold standard and the removal of the agio on gold, also the introduction of foreign capital to develop industries in the country; and as regards foreign policy, they were strong advocates of intimate and friendly relations with Austria-Hungary.*

*In 1886 the Government negotiated a consular convention with Germany, under which all lawsuits connected with German suc- cessions in Rumania were to be submitted to and judged by German tribunals, and reciprocally Rumanian successions in Germany were to be dealt with by Rumanian courts. As few, i**any, Rumanians resided in Germany, the proposed law was manifestly much in favour of the Germans ; and the Opposition, with Demetrius Bratiano (brother of the premier), Vernescu, and J. Lahovari at their head, succeeded in stirring up such an agitation throughout the country against the proposed measure that it had to be withdrawn. On the 16th of September an attempt was made on Bratiano's life by a tavern-keeper named Stoica. This caused a temporary reaction against the flood of his rapidly-increasing unpopularity, and in the autumn session he was able to carry through the Chambers a further vote of thirty million francs for the Bucharest fortifications, and to pass other important measures, including a law for increasing the powers and improving the position of the communes. Stoica was subsequently condemned to twenty years' penal servitude, but his accomplices and instigators, who were believed to be connected with the parliamentary Opposition, were acquitted. In May 1887 the king was present at the consecration of the newly-restored metropolitan church of Jassy, where he was fairly well received, in spite of the most strenuous attempts of the Opposition to stir up the populace to a demonstration against his majesty and his absolutist minister, a good deal of whose unpopularity rested on the king, who, however, shortly afterwards strengthened his position in the country by publicly announcing that the heir to the throne had been*

finally selected in the person of his brother's younger son, Prince Ferdinand of Hohenzollern, who had been appointed a lieutenant in the Rumanian army the previous year. An unusual proceeding in Rumania, where the greatest possible license is allowed to the press, was the prosecution of the Opposition news- paper, the Lupta, for violent attacks upon the king : the editor was sentenced to two years' imprisonment and a fine of 5000 francs. Elections for a new Chamber took place in February 1888, and in spite of the very strong pressure which the Government in power invariably exercises on these occasions (although always proclaim- ing from the housetop the absolute freedom of election), the whole of the leaders of the Opposition were elected, viz., Demetrius Bratiano, Catargi, Lahovari, Blaremberg, and Fleva ; and their partisans, who in the preceding Chamber mustered only about thirty strong, now formed fully one -third of the whole house. Both Conservatives and Radicals were imbued with the same fear that Bratiano, in consequence of his dislike of Russia, would throw the country headlong into the arms of Germany and Austria.

Almost immediately after the elections Bratiano tendered his resignation to the king, who only accepted it on the under-

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standing that he should form one of a new ministry under Prince Ghika : this idea proving impracticable, Bratiano returned to power. On the 26th and 27th of March very serious riots broke out in the capital : the mob, at the head of whom were some prominent leaders of the Opposition, surrounded the palace, and were only dispersed by force. On the following day the Chamber of Deputies was invaded, and one of the ushers shot dead with a revolver. Two of the leaders of the mob, Messrs Fleva and Filipescu, were arrested ; and although the Chambers passed a vote of confidence in the ministry, M. Bratiano definitively retired on the 4th April, after having held the premiership for twelve eventful years. It was no doubt high time that he did so, and if he had continued much

longer in office it is probable that there would have been a revolutionary movement against the dynasty. During the previous Parliament a Conservative manifesto, signed by Catargi and D. Bratiano and other leaders of the Opposition, openly threatened that if the ministers were not removedT prior to the general election the responsibility would be thrown, "not on those who served the crown, but on him who bore it" ; and the name of Prince George Bibescu had been openly mentioned as a possible successor. There was great distress and discontent amongst the peasantry, in spite of three million francs having been voted by the legislature for their relief, and there was much anti- dynastic agitation throughout the country, owing to the fact that an unscrupulous Opposition tried to make out that the king was responsible for all the evils that befell the country. M. Teodor Rosetti, a prominent member of the Junimist party, was now called on to form a ministry, of which Messrs Carp, Maioresou, Prince Stirbey, and M. Germani were the principal members. Fleva and Filipescu, the leaders of the recent rioting at Bucharest, were released almost immediately after the ministers had taken office. Serious agrarian riots broke out in many parts of Wallachia ; several of the landlords' houses were pillaged, and the rioters were not put down without considerable loss of life. The close of the year was marked by the visit of the prince of Wales to the king at Sinaia, and by a general amnesty granted to the peasants implicated in the agrarian riots ; also by the decision of the Cour de Cassation condemning General Anghalescu, who had been minister of war under Bratiano, to three months' imprisonment, loss of his rank, and u, fine of 5000 francs, as well as the resti- tution of 25,000 francs which the State had lost through his maladministration.

As the new ministry was unable to obtain a working majority in a Chamber that had been elected under Bratiano's auspices, it was dissolved. In the new Chamber elected in October 1888 only five members of Bratiano's party retained their seats. The house was composed of 39 Junimists, 51 Conservatives (17 of Vernesoo's party), i Socialists, and 40 Independent Liberals. In the Senate there was a strong Conservative majority, and the presidents of both houses were elected from that party. In November the ministry was modified in a Conservative direction by the accession to its ranks of General Manu, Vemesco, and A. Lahovari, all members of the old Conservative party. A determined effort was made in

the new house for the impeachment of M. Bratiano and the members of his administration. It was resisted by the ministry, as the resolutions included condemnation of Bratiano's foreign policy, and were in fact directed against the king. After a three days' debate the motion was lost by one vote : a modified proposal for impeachment, from which criticisms on foreign policy were ex- cluded, was then brought forward in the Chamber, and passed on the 21st of February by a majority of 101 to 41. In the course of the spring session (1889) M. Carp brought forward and passed through the Chambers a Bill for the amelioration of the position of the peasantry by the distribution among them of State lands.

[The question of peasant proprietorship being of great importance in an agricultural country like Rumania, it seems desirable to give a retrospective glance at previous legislation on the subject. Up to the year 1864 the greater part of the soil was owned by the Church and monasteries, and by large boyard proprietors ; there was also a small class of peasant proprietors, called mochen4ni in "Wallachia, risecM in Moldavia, living and working in family communities ; but the great mass of the ^, peasantry cultivated the lands of the large proprietors,

- *"***???***giving a certain number of days' work to their*

manorial lord, in addition to a tithe of the raw produce. They received in return a plot of ground proportionate to the number of animals they owned, and had also rights of grazing and of collect- ing fuel in the forests. In the above year, under the Government of Prince Couza, a new law was promulgated, conferring on each

Eeasant family freehold property in lots varying from 3 to 6 ectares (1 hectare = 2^ acres) according to the number of oxen that they owned. The man with no cattle received the minimum ; the owner of 2 oxen got 4 hectares, and the possessor of 4 received 5 or 6 hectares. The price of the land, which was calculated on the basis of the value of the forced labour to which the landlord had been entitled, was about ??4, IDs. per hectare, paid to the landlord by the State as compensation, and subsequently recovered from the

peasants in fifteen annual instalments. In the first distribution, which took place almost immediately after the law was passed, 280,000 families in Wallachia and about 127,000 in Moldavia became freeholders, holding nearly 4 million acres or one ~~third of the cultivated area of the country. These peasant plots were all declared inalienable for 30 years. The law of emancipation, although passed with the best of motives, did not to any great extent benefit the peasantry. The limited size of their farms, and the necessity for buying wood and paying for pasturage, both of which were formerly free, prevented them from obtaining comxJete independence of the large proprietors, on whose estates they still had to work for payment in money or kind, while their improvi~~ dence soon got them into the hands of Jewish money-lenders, who, fortunately for the peasants, were by law unable to become pro- prietors of the soil. In 1866 and 1872 laws were passed for still further improving the position of these small proprietors, and in 1879 a measure passed the Chambers for allotting lands to 48,000 recently married couples, and also for restoring to many peasant families lands which had been alienated.

In 1882 great difficulties arose, especially in Moldavia, in con- nexion with contracts for labour between the peasants and the large landowners. M. Rosetti succeeded, after violent opposition from the boyards, in passing through the Chambers measures for the relief of the peasants. But legislation, however well meant, had not succeeded in greatly ameliorating their position, and in 1889 M. Carp, the Junimist leader, passed a most important measure, by which the State domains, amounting to nearly one-third of the total area of Rumania (originally the property of the Church and the convents, confiscated by Prince Couza in 1866), were to be gradually distributed among the peasantry. The land was divided into lots of 5, 10, and 15 hectares. Peasants having no land might purchase the smaller lots on very easy terms. Those who already held less than 5 hectares might purchase up to that amount. When a change of residence became necessary to enable the peasant to take up the new allotment, the State advanced 600 francs to each family to defray expenses. The price to be paid for the land differed in different districts, and was to be paid to the State in small annual instalments. If any land remained after satisfying the wants of the peasants, it was to be sold by public auction in lots of from 20 to 25 hectares. All lots in both cases were

declared inalienable for 30 years. Under M. Carp's law 1200 model farms were also formed in the Baragan, or low ground lying to the north of the Danube. As a consequence of this law and pre- vious legislation there are now no less than 556,127 peasant pro- prietors in Rumania (exclusive of the Dobrudja), owning 2,390,170 hectares of land, or roughly speaking about one-half of its cultivated area. The sale of the larger lots under M. Carp's law gave rise to so many abuses that in 1896 a law was passed abolishing their further sale.]

Shortly after the passage of M. Carp's Bill through the Senate the minister of justice, M. Ternesco, made some outrageous judicial appointments without the knowledge of his colleagues, and his action being disapproved of by them, he declined either to with- draw the nominations or quit the cabinet. M. Catargi was then called on to form a purely Conservative administration, and took office, with Vemesco, Lahovari, and Manu as colleagues. This shuffle of the cards was, rightly or wrongly, attributed in great measure to the influence of M. Hitrovo, the active and energetic Russian minister at Bucharest, who ever since his arrival in 1886 had been a thorn in the side of the ministers, who had great cause for anxiety in connexion with contemporary events in Bulgaria, viz., the incorporation of eastern Rumelia, the war between Bul- garia and Servia, the subsequent kidnapping, return, and final with- drawal of Prince Alexander of Battenberg, all of which events gave rise to fears of further complications and of Russian interven- tion which might have involved Rumania in serious difficulties. The advent of Catargi to power was regarded as a triumph for Russia, as the sympathies of the Junimist minister had been entirely on the side of Austria. The close of the Rosetti adminis- tration was marked by a royal decree (5th April 1889) conferring on Prince Ferdinand the title of His Royal Highness Prince of Rumania, the title of Crown Prince being withheld, as he was not the direct heir to the throne. Shortly afterwards the prince took his seat in the Senate amidst great enthusiasm.

Catargi's administration did not last long. He found it difficult to command h. working majority in the Chamber that had been elected after Bratiano's downfall, and resigned on the king refusing to grant a dissolution. A new ministry was formed in November 1889 by General

Manu out of mixed Conservative and Junimist elements, who pulled well together on all internal measures, although somewhat divided as to their foreign policy ; and much good work was effected by the new Government. The old 6 per cent, loan was converted into 4 per cent. A gold standard was introduced, whereby the agio on gold was got rid of ; a satisfactory budget was passed, and the 5 per cent, tax which had been imposed, prior to the war with Turkey, on the salaries of all Government employes, was abolished. The sale of State

lands to peasants under Carp's law was actively proceeded with, half of the State lands being parcelled out, and one-fourth actu- ally sold. AH further proceedings regarding the impeachment of Bratiano and the members of his ministry were stayed by a vote of the Chamber and Senate on the 15th February, to the great satis- faction of tlie king, who had always stood by the minister who had served him so well. On the 24th October 1890 the king laid with much ceremony the first stone of the new railway bridge over the Danube at Tchernavoda, and large sums were voted tor railway extensions and for the completion of the Bucharest and Focsani fortifications. The country also was relieved in August of the presence of M. Hitrovo, who had lost much influence while his Conservative allies were in power, as his openly expressed Pau- Slavist views had alienated all his friends among the Rumanians. General Manu's ministry was destined, like the preceding one, to a short life. There was much distress and consequent discontent in the country, especially in Moldavia, which was by no means diminished by the consideration that that province was entirely unrepresented in the cabinet. In February 1891 the Government met with a defeat in the Senate by the rejection of their pro- posals on public education, and General Floresco was called on to form a new ministry. L. Oatargi was appointed minister of the interior, and Vernesco was named minister of finance. On the meeting of the chambers M. Carp carried a vote of no con- fidence in the new ministry, and the king dissolved the Chambers.

The new elections (April 1891) gave a large majority to the Government, but there were elected 40 National Liberals and only 6 Juminists.

The veteran statesman John Bratiano died on the 16th May, aged 76, and the king went to his residence at Florica to visit the widow and place a wreath on the tomb of his old and faithful servant. On the 6th July Kogalniceano, another veteran, passed away. Like Bratiano, he had been implicated in the national or rather revolutionary movement in 1848, and spent many years in exile striving for the union of the two principalities. He was minister of the interior under Prince Couza, and responsible for the important measures of the suppression of the corvfe, the formation of a peasant proprietary, and the confiscation of the properties of the monasteries ; and later on, as minister of foreign affairs for Prince Charles, he accompanied Bratiano to Berlin to struggle in favour of the rights and interests of his country. On 22nd May 1891 the jubilee festivities (25th year's reign) of the king were celebrated with much enthusiasm throughout the country. In November, a few days after the opening of the autumn session, Floresoo's ministry resigned, and Catargi was once more called on to form a new Government. His new colleagues (including Tache lonesco, a young and promising statesman) were all Conservatives, but the Government shared the fate of many previous adminis- trations, and before it had been ten days in office was defeated in the Chambers on a vote of no confidence. M. Catargi, however, reconstituted his cabinet by the addition to it of Messrs Carp and G'lermani, prominent Junimists ; Parliament was dissolved, and in the elections which followed the Conservative-Junimist coalition obtained a large majority.

The first year of the new administration was marked by the betrothal of Prince Ferdinand of Rumania to the Princess Maria, daughter of the duke of Goburg and the Grand Duchess Alexandra of Russia, and grand-daughter of Queen Victoria and of the Tsar Alexander : the betrothal was followed by a visit of King Charles to Queen Victoria at Windsor, on which occasion his majesty was invested with the order of the Garter. The marriage took place at Sigmaringen on the 10th January 1893. Prince Carol (born on the 15th October 1893) and the Princesses Elizabeth and Maria, the issue of this marriage, have been brought up in the Orthodox

faith. The well-deserved affection of the country towards the dynasty was subsequently displayed during the dangerous illnesses from typhoid fever of Prince Ferdinand in 1897 and the young Prince Carol in 1899, when spontaneous expressions of sympathy poured in from all quarters.

The new ministry during their four years' tenure of office passed several useful measures through Parliament. The State credit was improved by tiie conversion of the public debt, the sale of the State lands to the peasantry was actively proceeded with, greatly assisted by the establishment of an agricultural bank founded by the Government with a capital of nearly a million sterling, for the purpose of making advances to the poorer landed classes ; a rural gendarmerie was formed, a law was passed making irremovable the judges of the Court of Appeal and the presidents of the tribunals, and other important judicial reforms were carried out ; a mining law was passed with the object of intro.lucing foreign capital, and the commercial marine was developed by the formation of a State ocean service of passenger and cargo steamers. Great reforms, which had been unsuccessfully attempted by former Governments, were made in the service of public instruction and in the organiza- tion of the clergy. In 1893 and 1894 commercial and extradition treaties and a trade-mark convention were made with Great Britain. The commercial treaty with Great Britain, as well as similar treaties

with Austria and Germany, were for a period of ten years, expiring in 1903. In May 1894 the king inaugurated with much ceremony the opening to navigation of a new waterway in the Sulina branch of the Danube, constructed by the European commission, and in September of the following year opened for traf&c the magnificent railway bridge over the Danube at Tchernavoda (constructed by the Rumanian Government at a cost of about one and a half million sterling), which connects the whole of the Rumanian railway system with the port of Constantza, where a year later he laid the first stone of the new works destined to make that port a first-class harbour. Meanwhile the Liberal Opposition was being reorganized. On the death of John Bratiano his brother Demetrius was proclaimed chief of the united Liberal party, but he survived his brother only one year, and on his death in June 1892 the veteran statesman Demetrius Stourdza was recognized as the head of the National Liberal

party. M. Stourdza had com- menced his political career in 1857 as secretary to the divan ad hoc of Moldavia ; in 1866 he was minister of public works, and in 1870 of finance. He had led the anti-dynastic agitation during Lascar Catargi's first ministry. In 1877 he was a strong opponent of the Russo-Rumanian alliance, but returned to power under Bratiano in 1878, and became a faithful defender of the dynasty and a strong partisan of the Triple Alliance. A man of great talent, tremendous application, and full of energy, he was the leading spirit of the most important financial institutions of the country, and was very popular in Liberal circles. In 1894 he started a very violent agitation in favour of the Rumanians of Transylvania and the Banat, who were being persecuted by their Magyar rulers after the unsuccessful attempt to present their famous " memorandum " to the Austrian emperor. Public meet- ings were held all over Rumania in favour of their oppressed countrymen. Interpellated in the Senate, the Qovernment could only reply that they were unable to interfere in the internal affairs of a neighbouring state ; and although they retained their parliamentary majority, they rapidly lost ground in public esti- mation. Another popular Opposition cry referring to internal matters was ' ' Rumania for the Rumanians ! " The new mining law, among other concessions, gave foreigners the right to lease lands for long periods for the working of petroleum, and this was denounced by the Opposition as being hostile to national interests, and also as being against the spirit of the constitution, which pro- hibited foreigners from holding lands. The Bill, in spite of the Opposition, was carried by the Government in April 1895, as well as another important measure favouring the construction of local railways by private individuals. The Liberal Opposition protested, and retired from the Chamber, and took no further part in legis- lative proceedings. The Liberal party had been out of office for eight years, the Conservative-.lunimist coalition had practically carried out their complete programme, and legislation was at a deadlock owing to the abstention of the Liberal Opposition. The popular agitation against the Government was most violent, and the king thought it high time that there should be a change of ministry, and that the Liberal party should have its turn. The three Junimist members of the cabinet tendered their resignation, but Catargi undertook to carry on the Government if the king would grant an immediate dissolution of the Chambers, antici- pating by a few months its constitutional term of four years. His majesty

refused his consent ; the Government resigned, and M. Stourdza was called on to form a new ministry.

In December Parliament was dissolved, and the elections took place under the auspices of M. Fleva, the new minister of the interior. In no so-called constitutional country in the world has the Government so much power in influencing the elections as in Rumania. On a change of ministry the first act of the new minister of the interior is to dismiss nearly all the prefects of the thirty districts into which the country is divided. (The Dobrudja, which consists of two additional districts, does not send any representatives to the Chamber.) The under-prefects share the same fate. The communal councils are then dissolved, and new provisional members appointed under Government pressure. Then follows the general election ; and as all the executive officers are partisans of the Government, and are by no means scrupulous as to the means they employ, and as the hosts of officials scattered over the country almost invariably vote on the side of the Government, the result of the election can be foretold to a certainty. In the present case, although M. Fleva ostentatiously declared that there should be no oflicial interference with the elections, there was the somewhat startling result that, whereas in the previous Parliament the Conservatives had an overwhelming majority in both houses, five Conservatives only wore elected in the new Chamber, and two in the Senate. The advent to power of the Liberal party under M. Stourdza, who had recently been making such violent attacks on the Hungarian Government, caused some anxiety in .Austria- Hungary, which was dispelled, however, by public declarations at Jassy and subsequent official explanations. "When once office was obtained, it was to the interest of the new Government that the agitation should subside, and this was rendered comparatively

easj', as an amnesty had been granted to the political prisoners in Transylvania.

The official opening by the emperor of Austria of the new canal through the Iron Gates of the Danube on the 27th September 1896 (one of the episodes of the Hungarian ” Millennium ” festivities), was the means of bringing about a great improvement in the relations between the two countries. The kings of Rumania and Servia were the honoured guests of the emperor on this occasion, and immediately afterwards the emperor paid an official visit to King Charles at Bucharest, where great preparations had been made to give his imperial majesty a befitting reception. The improved relations which resulted from this exchange of courtesies between their sovereigns were unfortunately not of very long dura- tion. In the following autumn King Charles paid aVisit to the emperor at Budapest, the Hungarian capital ??? a visit which was intended further to cement the friendly feeling between their respective subjects ; but, most unfortunately, the king of Rumania, in conferring numerous orders and decorations on the occasion of his visit, bestowed one, probably by an oversight, on a Hungarian official who was only known to fame as a very violent anti-Rumanian writer in the Magyar press. This incident was the signal for the reopening of an acrimonious newspaper war between the two countries, and the ill-feeling caused thereby had probably much to do with reconciling the Rumanians to a visit made by their sovereign in the following year (August 1898) to his other powerful neighbour, the Tsar. Accompanied by Prince Ferdinand and M.Stourdza, he was for a fortnight the emperor’s guest at Moscow, Kieif, and St Petersburg. His reception everywhere was most cordial, on the part not only of the emperor, but also of the military, who had not forgotten that the king had commanded the Russian army before Plevna. This visit was the outward symbol of a reconciliation between the Rumanians and Russians ??? the relations between whom had been the reverse of cordial ever since the termination of the war of 1877-78, resulting as it did in the forcible alienation of Bessarabia from one country to the other. As regards foreign relations with other Powers during M. Stourdza’s administration, it may be noted that diplomatic relations were renewed with Greece after an interruption of several years. The rela- tions of the Government with Turkey were also very friendly, and a commercial convention was signed between the two countries ; at the time of the Armenian troubles the entry of Armenian refugees into Rumanian territory was rigorously prevented, ostensibly on the grounds

that the Government did not wish Bucharest to become the centre of a conspiracy against a neighbour. In the Greco- Turkish war, also, much sympathy was shown to Turkey, probably with the object of obtaining friendly treatment for the numerous Eoutzo-Vlach population scattered over Turkey in Europe, but the friendliness shown by Rumania was not thoroughly reciprocated. The sultan would not grant the concessions she desired with regard to the nomination of an independent bishopric forthe Vlach communities, and later on in 1900 the commercial treaty was denounced by Turkey, and Rumania lost the privilege of most favoured nation treatment and of the special tariff which had previously been accorded.

As regards home politics, the overwhelming majority of the Liberal party at the elections of 1895, instead of being a source of strength, proved the very reverse. It caused the party to split up into factions, Stourdzists, Aurelianists, and Flevists, so called after the names of their respective chiefs. M. Fleva, who now held office for the first time, after having battled in the Liberal cause for twenty years, was the first to quarrel with his chief, and had to leave the ministry after only a few months' tenure of office. He was replaced as minister of the interior by M. Statesco. Some months later, shortly after the visit of the emperor of Austria, M. Stourdza himself had to retire from office in circumstances which caused a great and painful sensation throughout the country. The head of the Orthodox Church, the Metropolitan Gennadius, who had formerly taken an active part in insisting that the younger members of Prince Ferdinand's family should be brought up in the Orthodox faith, had for some years past, as ex-officio head of the richly-endowed philanthropic establishments founded by the Princess Brancovan, been desirous of getting the entire management of these wealthy foundations into his own hands, and had made violent attacks on the two administrators. Prince George Bibescu and Prince Stirbey, both members of the Brancovan family. In the quarrel that ensued much that was questionable in the early career of the prelate was brought to light, and he was openly accused of simony, of heresy, and other matters more suitable for a criminal court. The scandal created was so great that the Government called on the metropolitan to resign, and on his refusal to do so ordered his arraignment before the Holy Synod, by whom, after a public trial, he was found guilty of certain canonical

offences, and sentenced to be deposed from his high estate. The same night, by order of the head of the Government, he was seized in his archiepiscopal residence by the police, and removed by force to a neighbouring monastery. This harsh treatment of the head of the Church led to a tremendous outcry against M. Stourdza. Indignant

meetings of protest were held throughout the country, and by no one was the prime minister more eloquently and vigorously denounced than by his late colleague M. Fleva. M. Stourdza had to yield before the storm, and on the 3rd December 1896 the president of the council, M. Aurelian, was called on to reconstitute a Liberal cabinet, with the principal object of calming public opinion by the settlement of this exciting question, which was putting a stop to parliamentary and all other business. M. B. Lascar Catargi, an able and experienced public servant, was called to the ministry of the interior. M. Aurelian then appealed to the patriotic sentiments of the Conservative party to help to solve the difficulty, and with the aid of Messrs Lascar Catargi and Tache lonescu, after a long and anxious discussion, the following decision was arrived at : ??? The Holy Synod was to reverse its judgment (M. lonescu, a clever lawyer, had discovered some technical flaw which would enable the members of the Synod, all more or less subservient to their political chiefs, to go through the somewhat humiliating process of reversing their first decision), and the metropolitan was to be restored to his ecclesiastical rank and dignities, which, after holding them for a few days, he was voluntarily to resign and to receive as compensation a handsome pension. This scheme was carried out to the letter, except that the metropolitan did not receive his pension until the year 1899, when the Conservatives were again in power.

Calm was restored in the country. Monsignor Joseph Gheorgian, who had previously held the same high office, but who had retired into private life, was re-elected metropolitan, and the Liberal party was again torn by intestine quarrels. M. Aurelian and his colleagues having tasted the sweets of office, were not inclined to hand over their portfolios to M. Stourdza and his partisans. The struggle terminated in the success of M. Stourdza, who in April 1897 returned to power and remained president of the council until 1899. The discords among the Liberal party prevented

the carry- ing out of the extensive projects of reform that had been promised by M. Stourdza's Government on its first accession to power, and but few important measures were passed ??? one for the reform of public instruction being the most noteworthy. The Liberal Govern- ment abstained from putting into force the mining law passed in 1895, and it remained a dead letter until the Conservatives came back into power in 1899. The Rumanian mercantile marine was expanded by the organization of a line of cargo steamers belonging to the Government to run between the Danube and Rotterdam, and considerable progress was made in the extension of railways and other public works, notably those at the port of Constantza. M. Stourdza's Government, which had risen to power mainly on the national question, was also destined to fall on it. A tremendous popular agitation was raised on the subject of certain subsidies, made by the Rumanians for the support of the Rumanian schools at Kronstadt in Transylvania, and M. Stourdza was accused of too great subserviency to the Hungarian Government. The agitation culminated in street riots at Bucharest. On the same evening that M. Stourdza tendered his resignation to the king (April 1899) the veteran Conservative statesman Lascar Catargi suddenly died ; and it is said that the king was preparing a summons to him to form a new ministry when the news arrived at the palace. The Conserva- tive party held a hurried meeting, and without consulting M. Carp (the leader of the Junimist party, who had for so many years acted as a colleague of M. Catargi), they elected as their chief M. G. Gr. Cantacuzene, a gentleman of great wealth and highly respected, but not by any means a brilliant statesman. He was called on by the king to form a ministry. The Junimists, feeling hurt by the action of the Conservative party, declined to take any part in it, and M. Cantacuzene ultimately formed a ministry composed of five pure Conservatives ??? himself, the veteran General Manu, Tache lonescu. General Jaques Lahovary, and his brother Jean, and four recruits from the Independent Liberal party, Messrs Fleva, Istrati, Disescu, and Gradishteanu, who now formally rallied to the Conservative party. The new ministry was hardly in office when serious agrarian riots broke out in the Olt district in AVallacbia, due in great measure to Socialistic agitation. The Government acted energetically, and the revolt was promptly suppressed by the military, but not before many of the misguided peasants had paid the penalty of their folly with their lives.

In the new Chamber of Rejiresentatives elected after the chant^e of Government there were 149 Conservatives, 13 Junimists, and 7 Liberals. But the Conservative administration had a heavy task before it, and the years 1899-1900 will long be remembered in Rumania for the economical and financial crises throuch which it passed, owing principally to the disastrous failure of tlie harvest of 1899, which caused so much distress among the poorer classes that in the autumn several thousand emigrants left the Dobrudja for foreign countries, and in 1900 at least 5000 Jews emigrated from Moldavia. The financial position of the countrv had hitherto on the surface been very satisfactory. The public debt, mostly placed in Germany, amounted to about 51 millions sterling, of which the interest had been regularly paid, but the facility with which money had always been borrowed gave rise to great extravagance. Expenses which ought to have been defrayed out of the ordinary budget, such

aa material for railways, construction of roads and public buildings (especially in the erection, regardless of expense, of magnificent public offices at Bucharest), equipment and ammunition for the army, &c., were frequently defrayed out of the produce of the loans, and the custom had arisen when money was scarce of issuing treasury bonds. When the Conservative Government came into office they found that the payment of 2 J millions of these bonds would shortly become due, and there were no resources in the treasury to meet them. Owing to the Transvaal war and other causes the money market was most unfavourable, especially in Germany, where their loans had always hitherto been negotiated. To add to their difficulties, there was an almost entire failure of the harvest, and a certainty of a large deficit in the ordinary budget for 1898-99, since estimated at ❓❓1,200,000. The value of cereals exported in 1898 was about 9 millions sterling, in 1899 only 3J millions ; and when it is recollected that the railways and navigation services are all State property, and that the State is also the owner of the tobacco, salt, and other monopolies, which bring in on an average year some 2J millions, it may well be imagined that the failure of the harvest, which affects materially all these

as well as other sources of revenue, is a tremendous blow to the financial position of the country. The Government managed to extricate itself from its immediate difficulties by raising a loan at Berlin of 9 millions sterling in the autumn of 1899, but on very stringent terms. Besides paying a much higher rate of interest than heretofore, it bound itself not to contract any further new loans until this one was paid off. The budget for 1900-1901, after allowing for the increase of the public debt, showed a nominal surplus of about ––280,000 in a total of close on 10 millions, the expenditure of the country having nearly doubled in ten years. To balance the budget new taxes were levied to the extent of ––750,000, some of which caused great discontent, notably a tax on tzuica or plum brandy, the injudicious and premature application of which provoked serious riots among the peasantry in the districts concerned, which were not suppressed without loss of life. The Conservative Government durmg its tenure of office passed several useful measures, and did one very substantial service to the country in settling by an amicable compromise with the Hungarian Government the long – vexed question concerning the subsidy granted by Rumania to the national schools at Kronstadt. The Hungarian Government, through its prime minister, M. Szell, openly announced its inten- tion of inaugurating a more just and liberal policy towards the Rumanians of Transylvania and the Banat.

In the summer of 1900 the financial crisis was so acute that it was generally felt that M. Cantacuzene's ministry was not strong enough to cope with it. Secret negotiations took place between the Juniraists and some of the Conservative ministers, the out- come of which was a public declaration of the fusion of the old and new Conservatives into one united Conservative party. M. Cantacuzene resigned the presidency of the council, although remaining the nominal head of the party, and M. Carp, who had been the leader of the Junimists, was called on by the king to form a new ministry. General Lahovary and Gradishteanu retained their portfolios. Olanescu was given the interior, and Marghiloman the ministry of foreign affairs. Messrs Arion, Filipesou, and Maiorescu were appointed ministers of public instruction, the domains, and justice, while M. Carp himself took the department of finance. Later on in the year the various factions of the Liberal party also decided to combine as National Liberals under the leadership of the veteran Stourdza. But the new

ministry, which had come into power by intrigue, was soon destined to fall in the same way. One formidable adversary, the ex-demagogue and late Conservative minister, M. Fleva, had been got out of the way by being appointed to the Rumanian legation at Rome, but General Manu, M. Taohe lonescu, and M. Lahovary, other members of the late ministry, remained. They had been passed over and ignored at the time of the Conservative fusion, but soon made their power felt. The Conservatives as a whole were united in wishing to meet the financial crisis by a moderate reduction of the expenditure and a large increase of taxation, while M. Stourdza and the Liberal Opposition advocated the permanent reduction of the annual expenditure by 20,000,000 francs, which would necessitate the raising of 5,000,000 only by fresh taxation. The Conservative ex-ministers, who had a large following in the Chambers, formed a majority in the budget committee of the house, and strenuously opposed some of M. Carp's financial proposals, notalily a largely increased tax on professions. The premier, unable to have his way, resigned in February 1901,' and M. Cantacuzene was ayiiin called on to form a ministry, but being unable to obtain the adherence of any members of M. Carp's ministry, declinsd the task. A truce was agrued on and M. Carp returned to power, but only for a few days. M. Stourdza delivered a very violent speech in the Senate, attacking several of the members of M. Cantacuzene's ministry, and M. Carp, replying to an interpellation in the Chambers, declined to defend them or to accept responsibility for their past proceedings. This proved too great a strain on the loyalty of the ex-ministers and their followers,

and on the 25th February the Chamber of Deputies, after a stormy sitting, rejected by 75 votes to 74 a vote of confidence in the financial policy of the Government. The majority was composed of dissenting Conservatives and of Liberals, who had, however, only eight seats in the house. M. Carp again resigned, and as the Conservatives, through party dissensions, had proved themselves quite incapable of dealing with the financial crisis, the king decided to entrust M. Stourdza with the formation of a Liberal ministry. He was summoned on the morning of the 26th, com- pleted the ministerial list by the evening, and on the following morning {i.e., within 40 hours of the passing of the hostile resolution in the Chamber) read the king's decree dissolving both the Chamber of Deputies and the Senate. '

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Rum burg;', the chief town of a government district in Bohemia, Austria, on the Saxon frontier, with Saxon and Austrian custom-houses. Important industrial centre, with textile industry (linen, woollen, and cotton goods, sewing thread, (fee), turnery in horn, dyeing, corn- miUing, (fee. Population (1890), 10,178; (1900), 10,382, all German and chiefly Roman Catholic (estimated at 3 per cent. Protestant, 1 per cent. Old Catholic, and 1 per cent. Jewish).

Runcorn, a market town and seaport, Cheshire, England, in the North wich parliamentary division, 15 miles north-east of Chester by rail, on the south side of the Mersey. Several places of worship have been enlarged, and among new buildings are a Catholic church, seamen's institute, church house, technical institute, and free library. Runcorn is a sub-port of Manchester, with which it is con- nected by the Manchester Ship Canal, and has extensive wharfage and warehouse accommodation. The chief ex- ports are coal, salt, and pitch; but there is also a large traffic in potters' materials (such as bone ash, china clay, flints, (fee), also a miscellaneous one in slates, pig-iron, ochre, and amber. A transporter bridge between Run- corn and Widnes, with a suspended car worked by elec- tricity to convey passengers and vehicles from one side of

the river to the other ⬛⬛⬛the first bridge of the kind in England ⬛⬛⬛was constructed in 1902. Population of parish and urban district (1891), 20,050; (1901), 16,491.

Rupa,r, a town of British India, in the Umballa dis- trict of the Punjab, on the left bank of the river Sutlej, 43 miles north of UmbaUa; 1120 feet above the sea^ Population (1881), 10,3-26; (1891), 8693; municipal income (1897-98), Ks. 11,038. It is historically interest- ing as the scene of Ranjio Singh's visit to Lord William Bentinck when governor-general in 1831. Here are the head works of the Sirhind canal. It is also a centre of

local trade, and has manufactures of cotton cloth and hardware. Hindu and Mahommedan fairs are held.

Rupert's La,nd> See North-West Tekeitoeies.

Ruskin, John (1819-1900), was bom in London, at Hunter Street, Brunswick Square, on 8th February 1819, being the only child of John James Euskin and Margaret Cox. They were Scots, first cousins, the grandchildren of a certain John Ruskin, of Edinburgh (1732-1780). In Praeterita the author professes small knowledge of his ancestry. But the memoirs published on the authority of the family trace their descent to the Adairs and Agnews of Galloway. In this family tree are men famous in arms and in the public service : Sir Andrew Agnew of Lochnaw, Admiral Sir John Ross, Field-Marshal Sir Hew Dalrymple Ross, Dr John Adair, in whose arms Wolfe died at Quebec, and the Rev. James Tweddale of Glenluce, to whom the original Covenant, now in the Glasgow Museum, had been confided. The name Ruskin is said to be a variant of Erskine, or Eoskeen, or Rogerkin, and even Roughskin. It is more probably Rusking, an Anglian family, which passed northwards and became Ruskyn, Rusken, and Ruskin.

John Ruskin, the author's grandfather, a handsome lad of twenty, ran away with Catherine Tweddale, daughter of the Covenanting minister and of Catherine Adair, then a beautiful girl of sixteen. He settled in Edinburgh and engaged in the wine trade, lived liberally in the cultivated society of the city, lost his health and his fortune, and ended his days in debt. His son, John James Ruskin (1785-1864), father of the author, was sent to the High School at Edinburgh under Dr A. Adam, received a sound classical education, and was well advised by his friend Dr Thomas Brown, the eminent metaphysician. When of age, John James was sent to London to enter the wine trade. There, in 1809, he founded the sherry business of Ruskin, TeKord, and Domecq ; Domecq being proprietor of a famous vineyard in Spain, Telford contri- buting the capital of the firm, and Euskin having sole control of the business. John James Ruskin, a typical Scot, of remarkable energy, probity, and foresight, built up a great business, paid off his father's debts, formed near London a most hospitable and cultured home, where he maintained his taste for

literature and art, and lived and died, as his son proudly vsrote upon his tomb, ” an entirely honest merchant.” He was also a man of strong brain, generous nature, and fine taste. After a delay of nine years, having at last obtained an adequate income, he married his cousin, Margaret Cox, who had already lived for eighteen years with his mother, the widow of John Ruskin of Edinburgh. When this marriage of the two cousins, who had known each other all their lives, took place in 1818, neither of them was young. John James was thirty-three and Margaret was thirty-seven. In the foUovring year (8th February 1819) their only child, John, was born in Hunter Street, London.

Margaret Euskin, the author’s mother, was a handsome, strong, stern, able, devoted woman of the old Puritan

school, Calvinist in religion, unsparing of herself and others, rigid in her ideas of duty, proud, reserved, and ungracious. She was the daughter of Captain Cox, of Yarmouth, master mariner in the herring fishery, who died young ; whereupon his widow maintained herself as land- lady of the King’s Head Inn at Croydon. Her younger daughter married Mr Eichardson, a baker, of Croydon ; the elder, Margaret, married John James Ruskin. Jessie, a sister of John James, married Peter Richardson, a tanner, of Perth, so that the author had cousins of two Richard- son families, unconnected with each other. In his own memoirs he speaks much more of these than of any Ruskins, Tweddales, Adairs, or Agnews. The child was brought up under a rigid system of nursing, physical, moral, and intellectual; kept without toys, not seldom whipped, watched day and night, but trained from infancy in music, drawing, reading aloud, and observation of natural objects. When he was four the family removed to a house on Heme Hill, then a country village, vidth a garden and rural surroundings. The father, who made long tours on business, took his wife, child, and nurse year after year across England as far as Cumberland and Scotland, visiting towns, cathedrals, castles, colleges, parks, moun- tains, and lakes. At five the child was taken to Keswick ; at six to Paris, Brussels, and Waterloo ; at seven to Perth- shire. At fourteen he was taken through Flanders, along the Rhine, and through the Black Forest to Switzerland, where he first imbibed his dominant passion for the Alps. His youth was largely passed in systematic travelling in search of

everything beautiful in nature or in art. And to one so precocious, stimulated by a parent of much culture, ample means, and great ambition, this resulted in an almost unexampled testhetic education. In childhood also he began a systematic practice of composition, both in prose and verse. His mother trained him in reading the Bible, of which he read through every chapter of every book year by year ; and to this study he justly attributes his early command of language and his pure sense of style. His father read to him Shakespeare, Scott, Don Quixote, Pope, and Byron, and most of the great English classics ; and his attention was especially turned to the formation of sentences and to the rhythm of prose. He began to compose both in prose and verse as soon as he had learned to read and write, both of which arts he taught himself by the eye.

His first letter is dated 1823, when he was only four. In it he corrects his aunt, who had put up the wooden pillars of his Waterloo bridge " upside down." At five he was a bookworm. At seven he began a work in four volumes, with " copper-plates printed and composed by a little boy, and also drawn." His first poem, correct in rhyme and form, was written before he was seven. At nine he began " Eudosia, a poem of the Universe." From that year until his Newdigate Prize, at the age of twenty, he wrote enormous quantities of verse, and began dramas, romances, and imitations of Byron, Pope, Scott, and Shelley. What remain of these effusions have no special quality except good sense, refined feeling, accuracy of phrase, and a curious correctness of accent and rhythm. Of true poetry in the higher sense there is hardly a single line.

His schooling was irregular and not successful. At the age of eleven he was taught Latin and Greek by Dr Andrews, a scholar of Glasgow University. About the same time he had lessons in drawing and in oil painting from Runciman. French and Euclid were taught by Row-botham. At fifteen he was sent for two years to the day school of the Rev. T. Dale of Peckham, and at seventeen he attended some courses in literature at King's College, London. In painting he had lessons from Copley Fielding and afterwards from Harding. But in the incessant

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travelling, drawing, collecting specimens, and composition in prose and verse he had gained but a very moderate classical and mathematical knowledge when he matri- culated at Oxford ; nor could he ever learn to write toler- able Latin. As a boy he was active, lively, and docile ; a good walker, but ignorant of all boyish games, as naif and as innocent as a child ; and he never could learn to dance or to ride. He was only saved by his intellect and his fine nature from turning out an arrant prig. He was regarded by his parents, and seems to have regarded him- self, as a genius. As a child he had been " a savant in petticoats " ; as a boy he was a poet in breeches. At the age of seventeen he saw Adfele, the French daughter of Monsieur Domecq, Mr Euskin's partner, a lovely girl of fifteen. John fell rapturously in love vdth her ; and, it seems, the two fathers seri- ously contemplated their mar- riage. The young poet wooed the girl with poems, romances, dramas, and mute worship, but received nothing except chilling indifference and lively ridicule. To the gay young beauty, familiar with Parisian society, the raw and serious youth was not a possible ^(xr<. She was sent to an English school, and he occasionally saw her. His unspoken pas- sion lasted about three years, when she married the Baron Duquesne. Writing as an old man, long after her death, Ruskin speaks of his early love without any sort of rapture. But it is clear that it deeply coloured his life, and led to the dangerous illness which for some two years interrupted his studies and made him a wanderer over Europe.*

As the father was resolved that John should have every- thing that money and pains could give, and was one day to be a bishop at least, he entered him at Christ Church, Oxford, as a gentleman ~~commoner ??? then an order reserved for men of wealth and rank. Ruskin's Oxford career, broken by the two years passed abroad, was not very full of incident or of usefulness. Though he never became either a scholar or a mathema~~ tician, he did enough accurate work to be placed in the honorary fourth class both in classics and in mathematics. By the young bloods of the " House " he was treated pleasantly as a raw outsider of genius. By some of the students and tutors, by Liddell, Newton, Acland, and others, he was regarded as a youth of rare promise, and he made some lifelong

friendships with men of mark and of power. Both he and his college took kindly the amazing proceeding of his mother, who left her husband and her home to reside in Oxford, that she might watch over her son's health. The one success of his Oxford career was the winning the Newdigate Prize by his poem " Salsette and Elephanta," which he recited in the IShel- donian Theatre (June 1839). Two years of ill-health and absence from home ensued. And he did not become " a Graduate of Oxford" until 1842, in his twenty-fourth year, five years after his first entrance at the University.

John (From a photograph

In fact, his desultory school and college life had been little more than an interruption and hindrance to his real education ??? the study of nature, of art, and of litera- ture. Long before Ruskin published books he had ap- peared in print. In March 1834, when he was but fifteen, Loudon's Magazirite of Natural History published an essay of his on the strata of mountains and an inquiry as to the colour of the Rhine. He then wrote for Loudon's Magazine of Architecture, and verses of his were inserted in Messrs Smith and Elder's Friendship's Offering, by the editor, T. Pringle, who took the lad to see the poet Rogers. At seventeen he virote for Blackwood a defence of Turner, which the painter, to whom it was first sub- mitted, did not take the trouble to forward to the magazine.

At eighteen he wrote a series of papers, signed Kata Phusin, i.e. " after Nature," for Lou- don's Magazine, on " The Poetry of Architecture." In 1838 (he was then nineteen) Mr Loudon wrote to the father, " Your son is the greatest natural genius that ever it has been my fortune to become acquainted with." Having recovered his health and spirits by care and foreign travel, and having taken his degree and left Oxford, Ruskin set to work steadily at Heme Hill on the more elaborate defence of Turner, which was to become his first work. Modern Painters, vol. i., by " a Graduate of Oxford," was published May 1843, when the author was little more than twenty-four. It pro- duced a great and immediate sensation. It was vehemently attacked by the critics, and coolly received by the painters. Even Turner was somewhat disconcerted ; but the painter was now known to both Rus- kins, and they freely bought his pictures. The

family then went again to the Alps, that John might study mountain formation and ” Truth ” in landscape. In 1845 he was again abroad in Italy, working on his Modem Painters, the second volume of which appeared in 1846. He had now plunged into the study of Bellini and the Venetian school. Era Angelico and the early Tuscans, and he visited Lucca, Pisa, Florence, Padua, Verona, and Venice, passionately devoting himself to architecture, sculpture, and painting in each city of North Italy. He wrote a few essays for the Quarterly Peview and other periodicals, and in 1849 {cet. 30) he published The Seven Lamps of Architecture, with his own etchings, Avhich greatly increased the reputation acquired by his J\ [odern Painters.

On the 10th April 1848, a day famous in the history of Chartism, Ruskin was married at Perth to Euphemia C. Gray, a lady of great beauty, of a family long intimate with the Rusldns. The marriage, we are told, was arranged by the parents of the pair, and was a somewhat hurried act. It was evidently ill-assorted, and brought no happiness to either. They travelled, lived in London, saw society, and attended a ” Drawing-room ” at Buckingham

Palace. But Euskin, immersed in various studies and projects, was no husband for a brilliant woman devoted to society. No particulars of their life have been made public. In 1854 his wife left him, obtained a nullification of the marriage under Scots law, and ultimately became the wife of John Everett Millais. John Euskin returned to his parents, with whom he resided till their death ; and neither his marriage nor the annulling of it seems to have affected seriously his literary career.

Euskin’s architectural studies, of which The Seven Lamps was the first fruit, turned him from Turner and Modern Painters. He planned a book

about Venice in 1845, and The Stones of Venice was announced in 1849 as in pre- paration. After intense study in Italy and at home, early in 1851 (the year of the Great Exhibition in London) the first volume of The Stones of Venice appeared {cet. 32). It was by no means a mere antiquarian and artistic study. It was a concrete expansion of the ideas of The Seven Lamps ??? that the buildings and art of a people are the expression of their religion, their morality, their national aspirations and social habits. It was, as Carlyle wrote to the author, " a sermon in stones," " a singular sign of the times," " a new Renaissance." It appeared in the same year with the Construction of Sheepfolds ??? a plea for the reunion of Christian churches ??? in the same year with the essay on Pre – Rapliaelitism, the year of Turner's death (1 9th December). The Stones of Venice was illustrated with engravings by some of the most refined artists of his time. The author spent a world of pains in having these brought up to the highest perfection of the reproductive art, and began the system of exquisite illustration, and those facsimiles of his own and other sketches, which make his works rank so high in the catalogues and price- lists of collectors. This delicate art was carried even farther in the later volumes of Modern Painters by the school of engravers whom Euskin inspired and gathered round him. And these now rare and coveted pieces remain to rebuke us for our modern preference for the mechanical and unnatural chiaroscuro of photogravure ??? ??? the successor and destroyer of the graver's art. Although Euskin was practised in drawing from the time that he could hold a pencil, and had lessons in painting from some eminent artists, he at no time attempted to paint pictures. He said himself that he was unable to compose a picture, and he never sought to produce anything that he would call a work of original art. His drawings, of which he produced an enormous quantity, were always intended by himself to be studies or memoranda of build- ings or natural objects precisely as they appeared to his eye. Clouds, mountains, landscapes, towers, churches, trees, flowers, and herbs were drawn with wonderful pre- cision, minuteness of detail, and delicacy of hand, solely to recall some specific aspect of nature or art, of which he wished to retain a record. In his gift for recording the most subtle characters of architectural carvings and details, Euskin has hardly been surpassed by the most distinguished painters.

In 1853 The Stones of Venice was completed at Heme HiU, and he began a series of Letters and Notes on pictures and architecture. In this year (mt. 34) he opened the long series of public lectures wherein he came forward as an oral teacher and preacher, not a little to the alarm of his parents and amidst a storm of controversy. The Edinburgh Lectures (November 1853) treated Architec- ture, Turner, and Pre-Eaphaelitism. The Manchester Lectures (July 1857) treated the moral and social uses of art, now embodied in A Joy for Ever. Some other lectures are reprinted in On the Old Road and The Two Paths, 1859. These lectures did not prevent the issue of various Notes on the Eoyal Academy pictures and the Turner

collections; vio\:]is on thB Harhows of England, 1856; on the Elements of Drawing, 1857 ; the Elements of Perspec- tive, 1859. And at last, after prolonged labour, the fifth and final volume of Modern Painters was published in 1860 {(Bt. 41). This marks an epoch in the career of John Euskin; and the year 1860 closed the series of his works on art strictly so called ; indeed, this was the last of his regular works in substantial form. The lastiforty years of his life were devoted to expounding his views, or rather his doctrines, on social and industrial problems, on education, morals, and religion, wherein art becomes an incidental and instrumental means to a higher and more spiritual life. And his teaching was embodied in an enormous series of Lectures, Letters, Articles, Selections, and serial pamphlets. These are now collected in up- wards of thirty volumes in the final edition. The entire set of Euskin's publications amounts to more than fifty works having distinctive titles. For some years before 1860 Euskin had been deeply stirred by reflecting on the condition of all industrial work and the evils of modern society. His lectures on art had dealt bitterly with the mode in which buildings and other works were produced. In 1854 he joined Mr F. D. Maurice, Mr T. Hughes, and several of the new school of painters, in teaching classes at the Working Men's College. But it was not until 1860 that he definitely began to propound a new social scheme, denouncing the dogmas of political economy. Four lectures on this topic appeared in the Cornhill Magazine, until the public disapproval led the editor, then W. M. Thackeray, to close the series. They were published in 1862 as Unto this Last. In the same year he wrote four papers in the same sense in Eraser's Ma{/a- zine, then

edited by J. A. Froude ; but he in turn was compelled to suspend the issue. They were completed and ultimately issued under the title Munera Pulveris. These two small books contain the earliest and most systematic of all Euskin's efforts to depict a new social Utopia : they contain a vehement repudiation of the orthodox formulas of the economists ; and they are for the most part written in a trenchant but simple style, in striking contrast to the florid and discursive form of his works on art.

In 1864 Euskin's father died, at the age of 79, leaving his son a large fortune and a fine property at Denmark Hill. John still lived there with his mother, aged 83, infirm, and failing in sight, to whom came as a companion their cousin, Joanna Euskin Agnew, afterwards Mrs Arthur Severn. At the end of the j'ear 1864 Euskin delivered at Manchester a new series of lectures ??? not on art, but on reading, education, woman's work, and social morals ??? the expansion of his earlier treatises on economic sophisms. This afterwards was included with a Dublin lecture of 1868 under the' fantastic title of Sesame and Lilies (perhaps the most popular of his social essays), of which 44,000 copies were issued down to 1900. He made this, in 1871, the first volume of his collected lectures and essays, the more popular and didactic form of his new Utopia of human life. It contains, with Eors, the most complete sketch of his conception of the place of woman in modern society. In the very characteristic preface to the new edition of 1871 he proposes never to reprint his earlier works on art; disclaims many of the views they contained, and much in their literary form ; and specially regrets the narrow Pro- testantism by which they were pervaded. In the year 1866 he published a little book about girls, and written for girls, a mixture of morals, theology, economics, and geology, under the title of Ethics of the Lust ; and this was followed by a more important and popular work, The Crown of Wild Olive. This in its ultimate form contained lectures on "Work," "TraflSc," "War," and

the "Future of England." It is one of his most trenchant utterances, full of fancy, wit, eloquence, and elevated thought. But a more serious volume

was Time awl Tide (1867), a series of twenty-five letters to a workman of Sunderland upon various points in the Kuskinian Utopia. This little collection of "Thoughts," written with wonderful vivacity, ingenuity, and fervour, is the best summary of the author's social and economic programme, and contains some of his wisest and finest thoughts in the purest and most masculine English that he had at his command. In 1869 he issued the Queen of the Air, lectures on Greek myths, a subject he now took up, with some aid from the late Sir C. Newton. It was followed by some other occasional pieces ; and in the same year he was elected Slade professor of art in the University of Oxford. He now entered on his professorial career, which continued virith some intervals down to 1884, and occupied a large part of his energies. His lectures began in February 1870, and were so crowded that they had to be given in the Sheldonian Theatre, and frequently were repeated to a second audience. He was made honorary fellow of Corpus Christi, and occupied rooms in the college. In 1871 his mother died, at the age of 90, and his cousin. Miss Agnew, married Mr Arthur Severn. In that year he bought from Mr Linton, Brantwood, an old cottage and property on Coniston Lake, a lovely spot facing the mountain named the Old Man. He added greatly to the house and property, and lived in it continuously until his death in 1900. In 1871, one of the most eventful years of his life, he began Fors Clavigera, a small serial addressed to the working men of England, and published only by Mr George Allen, engraver, at Keston in Kent, at 7d., and afterwards at lOd., but without discount, and not through the trade. This was a medley of social, moral, and religious reflections interspersed with casual thoughts about persons, events, and art. Fors means alternatively Fate, Force, or Chance, bearing the Clavis, Club, Key, or Nail, i.e., power, patience, and law. It was a desultory exposition of the Euskinian ideal of life, manners, and society, full of vsdt, play, invective, and sermons on things in general. It was continued with intervals down to 1884, and contained ninety-six letters or pamphlets, partly illustrated, which originally filled eight volumes and. are now reduced to four.

The early years of his Oxford professorship were occu- pied by severe labour, sundry travels, attacks of illness, and another cruel disappointment in love. In spite of this, he lectured, founded a museum of art, to which he gave pictures and drawings and ??5000 ; he sought to

form at Oxford a school of drawing ; he started a model shop for the sale of tea, and model lodgings in Marylebone for poor tenants. At Oxford he set his pupils to work on making roads to improve the country. He now founded " St George's Guild," himself contributing ►►7000, the object of which was to form a model industrial and social movement, to buy lands, mills, and factories, and to start a model industry on co-operative or Socialist lines. In connexion with this was a museum for the study of art and science at Sheffield. Euskin himself endowed the museum with works of art and money ; a full account of it has been given in Mr E. T. Cook's Studies in Ruskin (1890), which contains the particulars of his University lectures and of his economic and social experiments. It is unnecessary to follow out the history of these somewhat unpromising attempts. None of them came to much good, except the Sheffield museum, which is an established success, and is now transferred to the town. In Fors, which was continued month by month for seven years, Euskin poured out his thoughts, pro-

posals, and rebukes on society and persons with mex- haustible fancy, wit, eloquence, and freedom, until he was attacked with a violent brain malady in the spring of 1878 {cBt. 59); and, although he recovered in a few months sufficiently to do some occasional work, he resigned his professorship early in 1879. The next three years he spent at Brantwood, mainly in retire- ment, and unhappy in finding nearly all his labours in- terrupted by his broken health. In 1880 he was able to travel in northern France, and began the Bible of .4 wiiewi, finished in 1885; and he issued occasional numbers of Fors, the last of which appeared at Christmas 1884. In 1882 he had another serious illness, with inflammation of the brain ; but he recovered sufficiently to travel to his old haunts in France and Italy ►►► his last visit. And in the following year he was re-elected professor at Oxford and resumed his lectures ; but increasing brain excite- ment, and indignation at the establishment of a labora- tory to which vivisection was admitted, led him to resign his Oxford career, and he retired in 1884 to Brantwood, which he never left. He now suffered from frequent attacks of brain irritation and exhaustion, and had many causes of ^rrow and disappointment. His lectures were published at intervals from 1870 to 1885 in Aratra Pentelici, The Eagle's Nest, Lov^s Meinie, Ariadne Floren- tina, Val d'Arno, Proserpina, Deucalion, The

Latos of Fesole, The Bible of Amiens, The Art of England, and The Pleasures of England, together with a series of pamphlets, letters, articles, notes, catalogues, and circulars.

In the retirement of Brantwood he began his last work, Prceterita, a desultory autobiography with personal anec- dotes and reminiscences. He was again attacked with the same mental malady in 1885, which henceforth left him fit only for occasional letters and notes. In 1887 it was found that he had exhausted (spent, and given away) the whole of the fortune he had received from his father, amounting, it is said, to something like ––200,000 ; and he was dependent on the vast and increasiog sale of his works, which produced an average income of ––4000 a year, and at times on the sale of his pictures and realizable pro- perty. In 1872 a correspondent had remonstrated vsith him in vain as to taking "usury," i.e., interest on capital lent to others for use. In 1874 Euskin himself had begun to doubt its lawfulness. In 1876 he fiercely assailed the practice of receiving interest or rent, and he hence- forth lived on his capital, which he gave freely to friends, dependants, public societies, charitable and social objects. The course of his opinions and his practice is fuUy explained in successive letters in Fors. Until 1889 he continued to write chapters of Praiterita, which was designed to record memories of his life down to the year 1875 (at. 56). It was, in fact, only completed in regular series down to 1858 {cet. 39), with a separate chapter as to Mrs Arthur Severn, and a fragment called Bilecta, containing letters and early recollections of friends, especially of Turner. These two books were published between 1885 and 1889 ; and except for occasional letters, notes, and prefaces, they form the last \mtings of the author of Modern Painters. His literary career thus extends over fifty years. But he has left nothing more graceful, naif, and pathetic than his early memories in Prmterita ––– a book which must rank with the most famous " Confessions " in any literature. The last ten years of his life were passed in complete retirement at Brantwood, in the loving care of the Severn family, to whom the estate was transferred, with occasional visits from friends, but with no sustained work beyond correspondence, the revision of his works, and a few notes and prefatory words to the books of others. He wished to withdraw his early art writings from circulation, but the public

demand made this practically impossible. And now the whole of his writings are under the control of Mr George AUen, in several forms and prices, including a cheap series at 5s. per volume.

The close of his life was one of entire peace and honour. He was loaded with the degrees of the universities and membership of numerous societies and academies. ” Euskin Societies ” were founded in many parts of the kingdom. His works were translated and read abroad, and had an enormous circulation in Great Britain and the United States. Many volumes about his career and opinions were issued in his lifetime both at home and abroad. His 80th birthday, 8th February 1899, was celebrated by a burst of congratulations and addresses, both public and private. His strength failed gradually : his mind remained feeble but unclouded, and his spirit serene. An attack of influenza struck him down, and carried him off suddenly after only two days’ iUness, 20th January 1900. He was buried in Coniston churchyard by his own express wish, the family refusing the offer of a grave in Westminster Abbey.

Any complete bibliography of Euskin’s writings would demand more space than can be admitted in this sketch of his life. It is moreover unnecessary, since the admirable and copious catalogues which exist ⬛⬛⬛ (1) that by Thomas J. “Wise and J. P. Smart, London, 1889-93 ; (2) that summarized, in 13 pp., by Mr W. G. CoUing- wood in his Life, London, 1900 ; and lastly, Mr George Allen’s List, July 1900 (pp. 5-17) ⬛⬛⬛ are all easily accessible. Much less is any criticism of his works either needed or possible in this sketch. The enormous bulk of his writings and their curious range of topic make any complete review of them impracticable. His literary life may be arranged in three divisions. From 1837 to 1860 {(xt. 18 to 41) he was occupied mainly with the arts. From 1860 to 1871 {oet. 41 to 52) he was principally occupied with social problems. From 1871 to 1885 {(st. 52 to 66) he was again drawn back largely to art by his lectures as professor, whilst prosecuting his social Utopia by speech, pen, example, and purse. But the essential break in his life was in 1860, which marks the close of his main works on art and the

opening of his attempt to found a new social gospel. With regard to his views of art, he himself modified and revised them from time to time ; and it is admitted that some of his judgments are founded on imperfect study and personal bias. But the essence of his teaching has triumphed in eifect, and has profoundly modified the views of artists, critics, and the public, although it is but rarely accepted as complete or final. The moral Of his teaching ??? that all living art requires truth, nature, purity, earnestness ??? has now become the axiom of all aesthetic work or judgment. John Ruskin founded the Keformation in Art.

With regard to his economic and social ideas there is far less general concurrence, though the years that have passed since Unto this Last appeared have seen the practical overthrow of the rigid plutonomy which he denounced. So, too, the vague and sentimental Socialism which pervades Munera Pulveris, Time and Tide, and Fors is now very much in the air, and represents the aspirations of many energetic reformers. But the negative part of Ruskin's teaching on economics, social and political problems, has been much more effective than the positive part of his teaching. It must be admitted that nearly the whole of his practical experiments to realize his dreams have come to nothing, which is not unnatural, seeing his defiance of the ordinary habits and standards of the world. A more serious defect was his practice of violently assailing philosophers, economists, and men of science, of whom he knew almost nothing, and whom he perversely mis- understood : men such as Adam Smith, Comte, Mill, Spencer, Darwin, and all who followed them. In art, Euskin had enjoyed an unexampled training, which made him a consummate expert. In philosophy and science he was an amateur, seeking to found a new sociology and a Utopian polity out of his own inner conscious- ness and study of nature, of poetry, and the Bible. It is not wonderful if, in doing this, he poured forth a quantity of crude conceits and some glaring blunders. But in the most Quixotic of his schemes, and the most Laputan of his theories, his pure and chivalrous nature, his marvellous insight into the heart of things and men, and his genius to seize on all that is true, real, and noble in life, made his most startling proposals pregnant with meaning, and even his casual play full of fascination and moral suggestion.

In mastery of prose language he has never been surpassed, when he chose to curb his florid imagination and his discursive eagerness of soul. The beauty and gorgeous imagery of his art works bore away the public from the first, in spite of their heretical dogmatism

and their too frequent extravagance of rhetoric. But his later economic and social pieces, such as Unto this Last, Time and Tide, Sesame and Lilies, are composed in the purest and most lucid of English styles. And many of his simply technical and explanatory notes have the same quality. Towards the close of his life, in Fors and in Prceterita, will be found passages of tenderness, charm, and subtlety which have never been surpassed in our language.

Ruskin's life and writings have been the subject of many works composed by friends, disciples, and admirers. The principal is the Life, by W. G. Gollingwood, his friend, neighbour, and secre- tary (Methuen and Company, 1900), which must be regarded as the biography authorized by Ruskin himself and the family, and is the basis of the foregoing notice. His pupil, MrE. T. Cook, published his Studies in Ruskin in 1890 (G. Allen), with full details of his career as professor. Mr J. A. Hobson, in his John RusMn, Social Befmmer (Nisbet and Company, 2nd edition, London, 1899), has elaborately discussed his social and economic teaching, and claims him as "the greatest social teacher of his age." An analysis of his works has been published by Mrs Meynell (Blackwood and Sons, 1900). And his art theories have been discussed in numerous periodicals and essays, and at large by Professor Waldstein, of Cambridge, and in France in the eloquent work of M. Robert de la Sizeranne, Buskin et la Religion de la Beauti, and quite recentlv by Prof. H. J. Brunhes of Fribourg ❓❓❓ Ruskin et la Bihle, Paris, i901. (f. H.)*

Russell of Klllowen, Charles Russell,

Baeon (1832-1900), Lord Chief Justice of England, was born at Nevpry, County Down, on the 10th November 1832. He was the elder son of Mr Arthur EusseU, a Roman Catholic gentleman, who was engaged in commerce and brewing in Newry. His mother was the daughter of Mr Mullen, a Belfast merchant, and at the time of her marriage to Mr Arthur RusseU was the widow of John Hamill of that city. Within a few years

after the birth of Charles EusseU the home was changed to Seafield House, KiUowen, on the shores of Carlingford Lough, and there his early boyhood was spent. At the age of twelve he was sent to school ??? first at Belfast, afterwards in Nevrry, and finally at St Vincent's College, Castleknock, Dubhn. In the latter part of 1847 he went into the office of Messrs Hamill and Denvir, solicitors in Newry, and in 1849 he was articled to Mr Denvir, one of the partners in that firm. In March 1852 Mr Denvir died, and Charles EusseU's articles were transferred to Jlr O'Rorke, a solicitor in Belfast. In 1854 he was admitted, and began to practise his profession. He did well. Disturbances be- tween Eoman Catholics and Orangemen were at that time prevalent in this part of Ireland, and in the legal proceed- ings which ensued at quarter and petty sessions young EusseU distinguished himself as a bold and skUful advocate in the cause of his co-reUgionists. The poUtical zeal which always formed an important element in EusseU's character happily harmonized with these professional duties. After practising, however, for two years, he determined to seek a wider field for his abilities, and to become a barrister in England. It was a wise ambition, early conceived by young EusseU, stimulated by his present success, and en- couraged by the counsel of at least one competent adviser, Judge Jones, who was much impressed by EusseU's abUity in the conduct of a case at the Newry quarter sessions. He believed, moreover, that to succeed at the Irish Bar he would have (to use his ovsn phrase) to " swallow his convictions." With this end in view RusseU, whUst stiU practising and residing in Belfast, became a student of Trinity College, Dublin. He matriculated there in 1855, and passed examinations from time to time, but did not wait to become a graduate. In 1856 he went to London and became a student of Lincoln's Inn. He worked hard privately. He read in the chambers of Mr Bagshawe, of the Chancery Bar (after- wards a county court judge), and in the chambers of Mr HUward, a barrister of the Northern Circuit, who in later years became one of the leaders in the Admiralty Court. He also availed himself of the lectures given

by the readers of the Inns of Court, to one of whom, Sir Henry Maine, Eussell in later years often referred in terms of special praise. In 1858 he married, in Belfast, Ellen, the eldest daughter of Dr Mulholland, a physician of distinction in that city. On the 26th January 1859 he was called to the Bar, after gaining by examina- tion a first-class honour certificate, and joined the Northern Circuit. Never was that great circuit richer in legal talent. The period of 1859-72, whilst Eussell was winning Ms way to a silk gown, included, on the circuit ??? to take only the names of some of the older men ??? ilellish, Edward James, Brett, Quain, Manisty, Davison, Holker, AspinaU, Butt, Herschell, Benjamin, Pope, K. G. Williams, Gainsford Bruce, and Baylis. It was a meet training- ground and arena for the young Irishman, who was destined not only to become leader of his circuit, but to reach a pre-eminence amongst English advocates such as it would be difficult to match in the annals of the Bar. Except some valuable introductions to friends in London and Liverpool, which his uncle, the distinguished president of Maynooth, had given to him, Eussell brought to the work of his profession no external aids. He had to rely upon himself. But the equipment was sufficient. A well-built frame ; a strong, striking face, with broad forehead, keen grey eyes, and a full and sensitive mouth ; a voice which, though not musical, was rich, and responded well to strong emo- tions, whether of indignation, or scorn, or pity; an amaz- ing power of concentrating thought ; an intellectual grasp, promptly seizing the real points of the most entangled case, and rejecting all that was second- ary, or petty, or irrelevant ; a faculty of lucid and forcible expression, which, without liter- ary ornateneas or grace of style, could on fit occasions rise to impassioned eloquence ??? all these things Eussell had. But beyond and above all these was his immense personality, an embodiment of energetic will which riveted attention, domin- ated his audience, and bore down opposition. His successful advocacy in the Colin Campbell divorce case in 1886, and his famous cross-examination of hostile witnesses and still more famous speech before the Parnell Commission in 1888, afforded perhaps the best examples of Btussell's character- istic powers. He was not a learned lawyer in the sense in which Willes, or Mellish, or Blackburn were learned lawyers ; he did not possess the fine legal acumen of his great contemporary, Herschell ; but he had a sufficient apprehension of legal principles. He handled a point of law with telling

directness and force. His argument as the leading counsel for Great Britain in the Bering Sea Arbitration in 1893, and his address at Saratoga on Inter- national Law and International Arbitration in August 1896, were expositions of law in its practical application to matters of State which the most learned jurist must admire for their thoroughness and perspicuity.

Eussell's success, after he joined the Northern Circuit, did not, of course, come to him at once. For some time

LOKD KTJSSELL OF KILLOWEN. {From a photograph by the London Stereoscopic Company.)

his work in court was principally in the Court of Passage at Liverpool, which he regularly attended from London. He wrote a book on its procedure, which was published in 1862. This ancient local court, possessing both common law and Admiralty jurisdiction, had as its presiding judge ––– then styled "assessor" ––– an eminent leader of the Northern Circuit, Mr Edward James. Sub- stantial commercial cases were tried there,- and of these Eussell soon had a goodly portion. Steadily, and, for a barrister, speedily, Eussell's fortune grew. His bio- grapher, ilr Barry O'Brien, has given, in The Life of Lord Russell of Killowen (Smith, Elder, and Company, 1901), an account of Eussell's fees, which shows that they were, in round figures: in 1859, ––117; in 1862, ––1016; in 1866, ––2367; and in 1870, ––4230. At the commencement of this period Eussell wrote occasionally for the newspapers, and especially for the Irish press. From early boyhood onwards he maintained a keeft interest in politics, and pre-eminently in the public affairs of Ireland. In 1859

he published a pamphlet en- titled The Catholic in the Workhouse, and an article from his pen is to be found in The Dublin Review, vol. xlviii. p. 497. His legal work was not wholly confined to the north of England. He was employed at the Guildhall and elsewhere by solicitors of position in the City of London. He was one of the counsel engaged in the Windham lunacy case in 1861, and in the action of Saurin V. Starr in 1869. In 1865 he argued in ex parte Chavasse before Lord Westbury, L.C., and soon

afterwards was hon- oured by him with the offer of a county court judgeship. Two subsequent judges of the High Court of Justice ??? Mr Justice Bigham and j\Ir Justice Walton ???were among his pupils during this period.

In 1872 Eussell took ” silk,” and from that date for some time he divided the best lead- ing work of the circuit with Holker, Herschell, and Pope. In 1874 Holker became soli- citor-general in the Conserva- tive administration. In 1880 Herschell accepted the same office in a Liberal ministry, and about the same time Pope practically left the circuit, to become in a short time one of the most successful advocates at the Parlia- mentary Bar. Eussell’s success as a Q.C. during this period of his career was prodigious. He excelled in the conduct alike of commercial cases and of those involving, as he used to say, “a human interest,” although un- doubtedly it was the latter which more attracted him. He was seen to the least advantage in cases which involved technical or scientific detail. If his advocacy suffered a defeat, however, it was never an inglorious defeat. Those who were on the Northern Circuit at the time will not easily forget the case of Dixon v. Plimsoll, ???a libel action brought by a Liverpool shipowner against Mr Plimsoll ???tried before Baron Amphlett and a Liver- pool special jury, in which Holker won a notable victory for the defendant ; or Nuttall v. Wilde, a breach of promise action, in which Pope led brilliantly for the

successful plaintiff, and Eussell’s speech for the defence was one of the finest in point of passion and pathos that was ever heard upon the Northern Circuit. At the same- time, with all his fighting power, Eussell was eminently a sagacious adviser. No barrister knew better how and when to settle a case, where the client’s true interest called for a settlement.

In 1880 a new phase of Russell’s arduous life began. He was returned to Parliament as an independent Liberal member for Dundalk, a constituency which he had twice before unsuccessfully contested. From

that time forward until his appointment to a lordship of appeal in succession to Lord Bowen in 1894, he sat in the House of Commons : for Dundalk until 1885, and afterwards for South Hackney, where he was returned as the Liberal member on four successive occasions ??? once in 1885, twice in 1886, and again in 1892. The entrance into Parliament laid upon Russell's time and labour a heavy addi- tional tax. His was a nature which could not, in work or even in pleasure, be content to do anything lightly or by halves. He was essentially a man of action ; intensity ??? at times almost fierce intensity ??? both of purpose and of devotion to its fulfilment characterized everything he did. Upon such a man parliamentary life between 1880 and 1894 necessarily entailed a severe strain. During the whole of this epoch, in home affairs, Irish business almost monopolized the political stage ; and Russell was Irish to the core. From 1880 to 1886, as a private member, and as the attorney-general in Mr Gladstone's administrations of 1886 and 1892, he worked in and out of Parliament for the Liberal policy in regard to the treatment of Ireland as few men except Eussell could or would work. He never spared himself. After a long day in the turmoil of the courts, he cheerfully gave a long evening to a distant and often, from the standpoint of personal notoriety, an obscure, platform. His position throughout was clear and consistent. Before 1886 on several occasions he supported the action of the Irish Nationalist party. He opposed coercion, voted for compensation for disturbance, advocated the release of political prisoners, and voted for the Jlaam- trasna inquiry. He wrote to the Daily Tdegraph a series of letters on the Irish land question, which were afterwards published (Macmillan and Company, 1889) in a collected form. But he never became a member of the Irish Home Rule or of the Parnellite party ; he was elected at Dundalk as an independent Liberal, and such he remained. He was proud of the kingdom in whose might and glory Ireland could claim so large a part ; and when, as attorney-general in the Gladstone administration, he warmly advocated the establishment of a subordinate Parliament in Ireland, he did so because he sought the amelioration and not the destruction of Ireland's relations with the rest of that kingdom. "I am absolutely opposed," he said (The Life of Lord Eussell of Killowen, p. 194) to the South Hackney voters, "to separation; but, reserving imperial control on all imperial questions, I think Irishmen on Irish soil should have the power of dealing in the way which seems

best to them with all questions that concern them." It is impos- sible to say that Russell's success in the House of Commons, considerable as it was, was comparable to his success as an advocate in the courts of justice. He was listened to, always with respect and often vsdth admiration, but he was not made for a debater ; and the position of a law. officer has generally not proved favourable to the attainment of parliamentary eminence. In great pubhc affairs the law oflScer advises and supports, but not for him is the glory of initiating public policy.

Russell's parliamentary duties, fully as he discharged them, first as a private member and afterwards as attorney-general, were not allowed by him to obstruct

his professional career. He rapidly became in London what he was already in Lancashire, the favourite leader in nisi prius actions. The list of causes cdlehres in the period 1880-1894 is really a record of Russell's cases, and, for a great part, of Russell's victories. The best known of the exceptions from the latter category was the libel action Belt V. Lawes in 1882, which, after a trial before Baron Huddleston and a special jury lasting more than forty days, resulted in a verdict for the plaintiff, for whom Sir Hardinge Giffard (afterwards Lord Chancellor Halsbury) appeared as leading counsel. The triumph of his client in the Colin Campbell divorce suit in 1886 afforded perhaps the most brilliant instance of Russell's forensic capacity in private litigation. His fees in 1885, the year before he became attorney-general, amounted to nearly ??17,000. More important, however, as well as more famous, than any of his successes in the ordinary courts of law during this period were his performances as an advocate in two public transactions of mark in British history. The first of these in point of date was the Parnell Commission of 1888-90, in which Sir Charles Russell appeared as leading counsel for Mr Parnell. The Commission held its first sitting on the 22nd of October 1888, and presented its report in February 1890. In April 1889, after 63 sittings of the Commission, in the course of which 340 witnesses had been examined. Sir Charles EusseU, who had already destroyed the chief personal charge against Mr ParneU by a brilliant cross-examination, in which he proved it to have been based upon a forgery, made his great opening speech for the defence. It lasted several days, and concluded on

the 12th of April. This speech, besides its merit as a wonderful piece of advocacy, possesses permanent value as an historical survey of the Irish question, during the last century, from the point of view of an Irish Liberal. It was in the same year published after careful revision by its author (MacmiUan and Company, 1889). The second public transaction was the Bering Sea Arbitration, held in Paris in 1893. Sir Charles Eussell, then attorney- general, with Sir Eichard Webster (afterwards Lord Alverstone, L.C.J.), was the leading counsel for Great Britain. Russell, in the course of his very powerful argument before the tribunal, maintained the proposition, which he again handled in his Saratoga address to the American Bar Association in 1896, that "International law is neither more nor less than what civilized nations have agreed shall be binding on one another as inter- national law." The award was, substantially, in favour of Great Britain. In recognition of their distinguished ser- vices the Queen bestowed upon both the leading repre- sentatives of Great Britain the honour of the Grand Cross of St Michael and St George.

In 1894 Russell's career as an advocate ended. A judgeship, if he had wished it, had been within his reach twelve years before. In 1894, on the death of Lord Bowen, he accepted the position of a lord of appeal. A month later he was appointed lord chief justice of England in succession to Lord Coleridge, to whose memory he devoted in the following September a paper in the North American Review. To the discharge of his functions as a judge Russell brought with him aU the qualities of intellect and character which had made him so eminent as an advocate, and their greatness was not less conspicuous in his new position. Brief as was his tenure of the office, he proved himself well worthy of it. He was dignified without pompousness, quick without being irritable, and masterful without tyranny. He was scrupulously punctual. Suitors and hearers could not but be impressed by the manifest determination of the lord chief justice to get at the truth, and to do so without waste of time. If this was a fault, it was that of excessive zeal for despatch..

When, occasionally, there were flashes of impatience, they were elicited by the exhibition, as he deemed it, of want of preparation, or slovenliness, or verbosity on the part of the advocate before him. Even the youngest and most obscure practitioner could always count upon the assiduous atten- tion of the lord chief justice to a pertinent and thought- ful argument. In 1896 Lord Russell (Pollock B. and Hawkins J. being on this occasion his colleagues on the bench) presided at the trial at bar of the leaders of the unlawful expedition into the Transvaal which is commonly known as the Jameson Raid. It was a State trial of grave importance. Russell's conduct of it, in the midst of much popular excitement, was by itself sufficient to establish his reputation as a great judge. One other event at least in his career while lord chief justice deserves a record, namely, his share in the Venezuela Arbitration in 1899. Lord Herschell, who had been nominated to act with Lord Justice Collins (afterwards master of the rolls) as a British representative on the Com- mission of Arbitration, of which the distinguished Russian jurist M. I\Iarteus was president, died somewhat suddenly in America before the commencement of the proceedings. The lord chief justice accepted the invitation to take the vacant place, and performed his very onerous duty with conspicuous ability.

Nor was it only on the bench or as an international judge that Lord Russell of Killowen sought, during the last years of his busy life, to do service to his country. He signalized his zeal as a law reformer by the public advocacy of radical changes in the system of legal educa- tion in the Inns of Court, and by the promotion of measures to put down the vice of secret and illicit com- missions in commercial and business life. On the former subject he delivered in 1895 an address in Lincoln's Inn Hall, under the auspices of the Council of Legal Education, which was afterwards printed and published (Wyman and Sons, Limited). In 1899, dealing with the latter question, he introduced in the House of Lords a Bill, which had its first reading. He again introduced a Bill in the session of 1890, which was read a second time, but did not become law. On the 10th August 1890 the great advocate and great judge passed quietly away at his London residence, after a short illness due to an internal malady.

In private, as in public life, Russell was always strenuous, and moat attracted by things that called for the exercise of activity, whether bodily or intellectual. Inaction he disliked both for himself and in others. Though not an athlete, he took an interest in manly pastimes : he was fond of riding and of breeding horses ; he liked being on the racecourse ; and he enjoyed games, both of skill and of chance. A student of books he was not ; he could lay no claim to wide learning or elegant scholarship ; but he could appreciate a good book ; he was versed in Shakespeare ; and he knew and loved the poetry and the songs of his native land. When he wrote, his style, inornate, clear, and forcible, reflected the character of his thought. He was a staunch and sympathetic friend, ever ready in an unos- tentatious way to help, where help was really needed. While he undoubtedly exhibited at times, chiefly during the earlier part of his career, a certain brusqueness and impetuousness of speech and demeanour, those who came into contact with him rec(jgnized that such occasional out- bursts never sprang from any desire to hurt, or from any unkindness of disposition. In his contests at the Bar he never made an enemy. He was a strong man, and he liked to have his way ; but he was also large-hearted and without a tinge of rancour in his disposition. He was never offended by opposition. Whilst he did not himself shine as a wit or a humorist in conversation or in after-

dinner oratory, he heartily enjoyed fun and humour in others; and, wherever he was, the force and distinctness of his personality never failed to impress his company. Probably no English lawyer ever excited abroad the admiration which was accorded to Lord Russell of Kil- lowen, alike on the Continent and in America. To the United States he paid two visits, the first in 1883 and the second in 1896. On both occasions he won golden opinions, which were manifested in widespread and warm expressions of sympathy and regret when the news of the death of Lord Russell of Killowen passed across the Atlantic. Between 1894 and 1897 Lord Russell of Killowen received the degree of Doctor of Laws honoris causd from the universities of Dublin, Edinburgh, and Cambridge, and from the Laval University, Quebec. In 1892 he was treasurer of Lincoln's Inn. He left surviv- ing him, besides his widow, five sons and four daughters. His sister Katherine (in religion, Sister Mary Baptist Joseph), pioneer sister of mercy in California, had died two years before at San Francisco. (w. e. k.)

Russell, Thomas (1762-1788), English poet, was the son of John Russell, who, according to the preface to his son's poems, was an attorney at Bridport, in Dorset- shire ; the poet was born, however, at Beaminster, early in 1762. His mother had been Miss Virtue Brickie, of Shaftes- bury. He was educated at the grammar school of Bridport, and in 1777 proceeded to Winchester, where he stayed three years, under Dr Joseph Warton, and Thomas Warton the poetry professor. In 1780 Russell, already distinguished as a classical scholar, was elected a fellow of New College, Oxford. He was ordained in 1785. During his residence at the university he devoted himself not merely to the ancients, but, what wg^ then extremely unusual, to French, Italian, Spanish, Portuguese, Provengal, and even German literature. His health, however, broke down, and he retired to Bristol hot wells to drink the waters ; but in vain, for he died there on the 31st of July 1788. He was buried in Powerstock chiu- chyard, Dorset. In 1789 was published a thin volume, containing his Sonnets and Miscellaneous Poems, now a very rare book. It contained twenty-three sonnets, of regular form, and a few para- phrases and original l5Tics. The sonnets are the best, and it is by right of these that Russell takes his place as one of the most interesting precursors of the romantic school. " War, Love, the Wizard, and the Fay he sung " ??? in other words, he rejected entirely the narrow circle of subjects laid down for 18th-century poets. In this he was certainly influenced both by Chatterton and by CoUins. But he was still more clearly the disciple of Petrarch, of Boccaccio, and of Camoens, each of whom he had carefully and enthusiastically studied. His sonnet " Suppos'd to be written at Lemnos " is his masterpiece, and was greatly admired both by Wordsworth and Landor, who said that it " authorized Russell to join the shade of Sophocles " ; it has been remarked that this is unquestionably the greatest English sonnet of the 18th century. The anonymous editor of Russell's solitary volume is said to have been William Howley (1766-1848), long afterwards arch- bishop of Canterbury, who was a youthful bachelor of New College when Russell, who had been his tutor, died. His memoir of the poet is very prefunctory, and the fullest account of Russell is that published in 1897 by Mr T. Seccombe. As the elder by nine months of Bowles, whose schoolfellow he was at Winchester for four years, and whom he seems to have slightly preceded as a composer of sonnets, Russell takes his place as the precursor of the school of romantic poets

inspired by the study of natuie and of the modern literature of the Continent. (e. g.)

*R U S S E L L ***B U S S I A***

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Russell, Sir William Howard (1821-

), English war correspondent, was born at Lilyvale,

near Tallaght, in the county of Dublin, 28th March 1821, being one of the Eussells of Limerick, whose settlement in Ireland dates from the time of Kichard II. After a preliminary education under Mr Geoghegan in Dublin, he entered Trinity College in 1838. Three years later he was thrown very much on his own resources, but a relative, Mr R. W. Russell, who had been sent to Ireland by The Times, deijuted him to report the Irish elections at Longford, and his success definitely turned his attention to journalism. Coming to London in 1842, he went to Cambridge, but left before taking a degree. In the following year he was sent by Tlie Times to Ireland to report the O'Connell meetings. In 1845 he was ap- pointed to superintend the reports on the Irish railways, and was shortly afterwards sent by Tlie Times to inspect the O'Connell property in the south-west of Ireland, when his plain speaking drew forth a characteristic tirade from the " Liberator." For a short period in 1847 his services were temporarily transferred to the Morning Chronicle, but with that exception he remained permanently connected with The Times. He was sent as special correspondent to Denmark in the war of 1849-50. He did not, however, at once relinquish a legal career, and was called to the Bar at the Middle Temple in 1851. On the outbreak of the Crimean war in 1853 he went out as special correspond- ent with the vanguard of the British expedition, and, accompanying the light division to Gallipoli, proceeded with the first detachment to Varna. It was a new departure in journalism, and Russell was the first of the great war correspondents. On the embarkation for the Crimea he was attached to the second division, and landed with it on the 14th of September. He was present at the battle of the Alma on 20th September, at the investment of Sebastopol, at Balaclava 25th October, and Inkerman 5th November.

Towards the end of May 1855 he accompanied the expedition to Kertch, and did not return to the Crimea until the following August. In September and October he described the attacks on the Malakoff and Redan, the occupation of Sebastopol, and the capture of Fort Kinburn ; and when the British forces finally evacuated the Crimea in July of the following year, he was among the last who left. The popularity of Th^ Times' Crimea correspondence led to its republication in two volumes under the title of Tlie War, 1865-66. Russell's letters to The Times were mainly responsible for the enlightenment of the public at home as to the conduct of affairs at the scene of action, and his exposure of the mismanagement during the winter of 1854 ??? the accuracy of which was afterwards fully corroborated ??? did more than anything else to cause the downfall of Lord Aberdeen's ministry. Apart alto- gether from his material, his descriptions were brilliant and powerful, and he returned home to find himself famous as "Balaclava RusselL" In 1856 Russell was sent to Moscow to describe the coronation of the Tsar,

and in the following year was attached to the headquarters of Lord Clyde in India. He was present at the siege and capture of Lucknow in 1858, the operations in Oude, the battle of Bareilly, and the actions in Rohilkhand, which preceded the suppression of the revolt, and he received the Indian war medal with the Lucknow clasp. The events of those stirring times are vividly recorded in My Diary in India in 1868-59. Next year he was sent to Italy, but too late to see any active service, for he arrived on the eve of the armistice at Villafranca. On 7th January 1860 appeared the first number of the Army and Navy Gazette, which he founded, and of which he is stUl editor and principal proprietor. When it became evident in 1861 that civil war was imminent in the United States, Russell proceeded to Washington, and reached M'Dowell's headquarters just before the first battle of Bull Run, and his account of the Federal retreat drew much hostile criticism. He published a full account of the war, in so far as he had witnessed it, in My Diary, North and South, dwring the Civil War in America, 1862. Returning to England in 1863, he described the ceremonies and festivities on the occasion of the marriage of the Prince of Wales, and remained at home until the outbreak of the Austro-Prussian war of 1866, when he proceeded to the headquarters of General Benedek and witnessed the battle of Koniggratz, 3rd July. During the interval of peace that followed

he accompanied the Prince of Wales to the Nile, Constantinople, the Crimea, and Greece in 1868, and published an account of the tour in the fol- lowing year, when he also contested the borough of Chelsea unsuccessfully in the Conservative interest. On the outbreak of the Franco-Prussian war in 1870, RusseU repaired to the headquarters of the crown prince at Worth, and was with him from the battle of Worth, 6th August, and Sedan, 12th September, till the capitula- tion of Paris, ilis account of the scenes he witnessed appeared in 1874 under the title of My Diary during the Last Great War. His description of the burning of Paris by the Communards was not the least of his journalistic triumphs. In 1875-76 he was honorary private secretajry to the Prince of Wales during his tour through India, of which he published an account in 1877. Wien Lord Wolseley was sent to quell the Zulu rebellion in 1879, RusseU was attached to his staff as correspondent. In 1881 he went with the Duke of Sutherland's party for a tour in the United States and Canada, described in Hesperothen, and in 1882 he was again with Lord Wolseley in the Egyptian campaign. In 1889 he undertook to report upon the nitrate fields of Tarapaca, and published the account of his journey in the following year, under the title, A Visit to Chile. In 1895 he published a personal retrospect entitled The Great War .with Russia. Sir Howard was knighted in May 1895, and was the recipient of numerous war medals and various foreign orders. He married twice, first in 1846 Miss Burrowes, who died not long afterwards, and secondly in 1884 the Countess A. Malvezzi.

E U S S I A.

THE Russian empire, which represents an extensive territory in eastern Europe and northern Asia, has an area exceeding 8,660,000 square miles, thus covering one- sixth part of the land surface of the globe. The popula- tion, however, estimated in 1901 at about 135,000,000, represents only one-fourteenth of the inhabitants of the world. In 1898 the limits of the empire were extended by the " lease " from China of the Liaotung peninsula, in the Gulf of Pechili, i.e., Port Arthur and Ta-lien-wan, with

the adjacent seas and territory to the north. Out of this territory a separate province, Kwang-tung, was created in 1899, its area being estimated at

1224 square miles, out of which 141 square miles are occupied by a number of small islands, and the population at 250,000, including 7000 afloat and 15,000 on the islands (see map and de- scription in Izvestia of the Russian Geographical Society, 1 900). After the Boxer rising in China of 1 901, Manchuria was also practically occupied by Russian troops, being

[statistics

treated for all practical purposes as a sort of vassal terri- tory to Kussia, standing towards the empire in a position not unlike that occupied by Bokhara and Khiva. Of these two khanates, the latter (area, 22,320 square miles, popu- lation about 800,000) is practically subject to Eussia; whUe the former (area about 92,000 square miles, popula- tion about 2,500,000) is every day becoming more and more a Russian dependency now that the railway connect- ing the Russian Transcaspian territory with Turkestan (Samarkand and Tashkent) has been completed. Russian influence is at the same time rapidly extending over Mongolia {q-v.). In Afghan Turkestan the most southern point reached by the Russian empire is, according to the International Commission, 35??38' 17" N., 62??21' 52" E. The total length of the frontier line of the Russian empire by land is 2800 miles in Europe and 9550 miles in Asia ; by sea, 11,090 miles in Europe and about 19,590 miles in Asia.

The population of the empire, which was estimated at 74,000,000 in 1856-59, was found to be nearly

*129,000,000 at the census of 1897, taken over Uon ¯ *^??empire except Finland. Thus since 1860*

the population has increased 74 per cent. The increase has chiefly taken place in the large cities of Siberia, Poland, Lithuania, and Caucasia. The

area and population of the various official divisions of the empire are given in the following table : ???

rro\Tnce.

1. Ewropean Russia ??? Arkhangelsk Astrakhan Bessarabia Chernigov Courland Don, Region of Ekaterinoslav Esthonia Grodno . Kaluga . Kazan . Kiev . Kostroma Kovno . Kursk Kharkov Kherson . Livonia . Minsk . Moghilev Moscow . Nijni -Novgorod Novgorod Olonets . Orel

Orenburg Penza Perm Podolia . Poltava . Pskov . Ryazan . St Petersburg Samara . Saratov . Simbirsk Smolensk Tambov Taurida Tula Tver Ufa Vilna

Carry forward

Area: English Square Miles.

331,640 91,327 17,619 20,233 10,535 63,532 24,478 7,818 14,931 11,942 24,601 19,691 32,490 15,692 17,937 21,041 27,523 18,158 35,293 18,551 12,859 19,797 47,236 57,439 18,042 73,816 14,997 128,211 16,224 19,265 17,069 16,255 20,760 58,321 32,624 19,110 21,638 26,710 24,497 11,954 25,225 47,112 16,421

Domiciled

Population,

1897.

1,569,614

347,589

994,775 1,933,436 2,321,900

672,634 2,575,818 2,112,661

413,724 1,617,859 1,185,726 2,191,058 3,676,125 1,429,228 1,549,444 2,396,577 2,509,811 2,732,832 1,300,640 2,156,123 1,708,041 2,433,356 1,600,304 1,392,933

366,715 2,054,749 1,609,388 1,491,215 3,003,208 3,031,613 2,794,727 1,136,640 1,827,639 2,107,691 2,763,478 2,419,884 1,549,461 1,661,068 2,716,463 1,443,666 1,432,743 1,812,826 2,220,497 1,591,912

Density

per Square

Mile.

80,076,766

1

11

113

115

64

41

86

54

109

181

44

100

134

119

100

74

61

92

189

81

33

7

114

22

99

24

187

145

68

113

123

46

74

81

72

106

62

120

73

47

51

Province.

Area : English Square Miles.

Domiciled

Population,

1897.

Density

per Square

Mile.

EiLTopean Kussia (continued) ???

Brought forward

1,569,614

80,076,756

51

Vitebsk

17,440

1,502,916

89

Vladimir

18,864

1,570,733

84

Volhynia

27,743

2,997,902

109

Vologda .

156,498

1,365,587

9

Voronezh

25,443

2,646,265

109

Vyatka .

59,329

3,082,788

52

Yaroslav

13,751

1,072,478

78

Sea of Azov

14,520

Total, Russian Provinces . 2. Poland

1,902,202

94,215,415

61

Kalisz

4,392

846,719

194

Kielce

3,897

763,746

196

Lomza .

. ^ .

4,667

586,781

144

Lublin .

6,501

1,169,463

177

Piotrkow

4,729

1,409,044

297

Plock .

4,200

656,877

153

Radom .

4,769

820,363

171

Siedlce .

6,535

775,316

140

Suwalki .

4,846

604,945

127

Warsaw

Total, Poland .

6,623

1,933,689

286

49,169

9,455,943

193

Total, Russia and Poland . 3. Grand- Duchy of Finland ???

1,951,361

103,671,368

53

Abo-Bjbmeborg

9,333

413,361

47

Kuopio

16,499

297,120

22

Nyland .

4,584

268,834

61

St Michel

8,819

183,811

28

Tavastehus

8,334

271,943

40

Uleaborg

63,957

256,730

4

Viborg .

13,530

372,016

33

Vasa

16,105

429,445

30

Lake Ladoga

3,094

Total, Finland . Total, European Russia 4. Russia in Asia ???

144,266

2,483,249

20

2,095,616

106,154,607

51

Kuban

36,441

1,922,773

54

Stavropol

23,398

876,298

38

Terek

Northern Caucasia .

Baku

26,822

933,485

35

86,661

3,732,556

43

15,095

789,659

55

Black Sea

2,836

54,228

Daghestan

11,332

586,636

68

Elizabethpol ,

16,721

871,567

52

Erivan .

10,075

804,757

101

Kars

7,308

292,498

43

Kutais .

13,968

1,075,861

54

Tiflis with

15,306

* 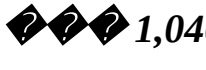 1,040,943*

Zakataly .

1,541

62

Transcaucasia

Total, Caucasus . Akmolinsk ....

94,182

5,516,139

64

180,843

9,248,696

54

229,609

678,957

3

Semipalatinsk

184,631

686,197

4

Turgai

176,219

453,123

3

Uralsk

139,168

644,001

4

Lake Aral .... The Steppes .... Semiryeohensk

26,166

755,793

2,461,278

4

152,280

990,107

Samarkand ....

26,627

857,847

32

Car

ry forward

178,907

1,847,954

11

statistics]

RUSSIA

339

Province.

Area: English Square

Miles.

Domiciled

Population,

1897.

Density

per Square

Mile.

Bussia in Asia {continued) ??? Brought forward

Fergana

Syr-Daria

Turkestan ....

Transoaspjan .... Caspian Sea ....

Total, Central Asian dominions

Tobolsk

Tomsk

Western Siberia

Irkutsk

Transbaikalia …. Yakutsk .... Yeniseisk ....

Eastern Siberia

Amur

Primorskaya ....

Amur Region ….

Sakhalin ....

Total Siberia ....

Total, Asiatic dominions

Russians in Finland, Bokhara, Khiva, and in the navy abroad

Grand Total* .

178,907

85,654

194,853

1,847,954 1,560,411 1,479,848

11 43

7

409,414

4,888,213

12

214,237 169,381

372,193

2

1,548,825

7,721,684

5

539,659 331,159

1,438,484 1,929,092

3 6

870,818

3,367,576

4

287,061

236,868

1,533,397

987,186

506,517 664,071 261,731 559,902

2 3

???2

1

3,044,512

1,992,221

???7

172,848 715,982

118,570 220,557

**

888,830

339,127

* 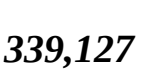 *

29,336

28,166

1

4,833,496

5,727,090

1

6,563,164

22,697,469

4

42,909

8,658,780

128,894,985

15

- ***The areas occupied by the larger lakes and rivers (see ninth edition) are included in the above tahle, but they have been excluded in calculating the densities of the population.***

It has been found, from a comparison of the densities of population of the various provinces in 1859 with the distribution in 1897, that the centre of density has distinctly moved southwards, towards the shores of the Black Sea, and westwards, the greatest increase having taken place in the eastern Polish and Lithuanian provinces, along the south-western border, in the prairie belt beside the Black Sea, and in Orenburg. Northern Caucasia and south- western Siberia likewise show a considerable increase. The census revealed a remarkably low proportion of men to women in several provinces. This was owing to the fact that large numbers of the men engaged in agri- cultural pursuits daring the summer temporarily move every year into the large industrial centres for the winter. Consequently there were only 87 "4 and 89'8 women to each 100 men in the provinces of St Petersburg and Taurida, but as many as 133 in Yaroslav, 119 in Tver, and 11 7 in Kostroma. The average number of women to each 100 men in the Russian provinces proper was 102 "8; in Poland, 98-6; in Finland, 102-2; in Caucasia, 89-5; in Siberia, 95 7; and in Turkestan and the Transcaspian territory, 83 '0.

The natural increase of the population per annum is very nearly 2,000,000, as will be seen from the follow- ing statistics of births and deaths, which are the latest available : ???

1896.

Births.

Per

1000.

*Deaths. 4^5_*

Surplus.

European Russia and Poland . Finland . Siberia Caucasus . Central Asia .

Total .

1898,

without Finland

4,892,949

83,884

266,442

355,508

107,143

47-2 33-3 46-5 37-0

3,279,572

49,289

186,299

204,023

73,462

31 ‘8 19-5 32-5 21-2

1,613,377

34,595

80,143

151,485

33,681

5,705,926 5,769,218

46-7

3,792,645 3,845,968

30 g

1,913,281 1,923,350

The figures for European Russia alone (without Poland) are: 857,371 marriages, 4,692,621 births, 2,976,453 deaths; natural increase, 1,716,168.

The effects of emigration and immigration cannot be estimated with accuracy, because only those who cross the frontier with passports are taken account of. The statistics of these show that there was during the thirty-two years 1856-88 an excess of emigration over immigration of 1,146,052 in the case of Russians, and a surplus of immi- gration of 2,304,717 foreigners. On the other hand, in the six years 1892-97 the excess of Russian emigration over immigration was 207,353, as compared with an excess of foreign immigration over emigration of only 136,740. It is also known that the number of Russian immigrants into the United States in 1891-97 was: 292,032 from European Russia, 91,994 from Poland, and 24,977 from Finland, as compared with only 313,469 from the Russian Empire generally in 1873-90. The total emigration of Russians to America through the three chief German ports was 519,000 during the eleven years 1887-97. 29,226 went to Brazil in 1890, and about 6000 to Canada in 1898. No less than 41,108 in 1900 and 36,961 in 1901 emigrated through Hamburg alone to America. The emigration to Siberia varies much from year to year. It was about 80,000 in 1898, and from 150,000 to 200,000 during the two previous years, as also in 1901. Altogether no less than 1,150,095 persons migrated to Siberia during the years 1882-97. There is also some emigration from central Russia to the southern Urals, as also to some of the Steppe provinces. 1

Cities. ??? Taken as a whole, only 13 per cent, of the population of Russia lived in towns in 1897, but in the years 1857-60 less than 10 per cent, of the population was urban. In Russia proper less than 2 per cent emi- grated from the villages to the towns during the forty years ending

1897. The foUovring table shows the urban population in the various divisions of the empire in 1897 :

Urban Population.

Percentage of Total.

European Russia Poland .... Finland .... Caucasia …. Siberia .... Central Asia .

Russian Empire .

12,027,038

2,055,892

281,216

1,010,615

473,796

936,655

12-8 21-7 11-0 10-9.

9-3'

12-0

16,785,212

13-0

There were only twelve cities with more than 100,000 inhabitants in 1884; in 1897 there were nineteen, namely, St Petersburg (1,267,023; 1,439,739 on 27th December 1900), Moscow (988,614; 1,035,664 in Decem- ber 1900), Warsaw (638,208), Odessa (405,041), 6d2 (315,209), Riga

(256,197; 282,943 in 1900), Kiev (247,432), Kharkov (174,846), Tiflis (160,645), Vilna

‘ See statistics collected by State Secretary Kulomzin, ISOS ; Siberia, by the Ministry of the Interior, 1899.

[statistics

(159,568), Taslikent (156,414), Saratov (137,109), Kazan (131,508), Ekaterinoslav (121,216), Eostov – on – the – Don (119,889), Astrakhan (113,001), Baku (112,253), Tula (111,048), and Kishinev (108,796). It is interesting to note that while only three of these are in Middle Eussia (Moscow, Tula, and Kazan), eight are in South Eussia, and two in Caucasia. There are thirty-seven cities with from 50,000 to 100,000 inhabitants. The mortahty in most towns is so great that during the last ten years of the 19th cfentury, in a very great number of cities, the number of deaths exceeded that of births by from 1 to 4 in the thousand.

Meligion. ??? The approximate distribution of the population ao-oording to religion is as follows : ??? Greek Orthodox (including all dissenters), nearly 96,000,000 ; United Church and Armenians, 1,350,000 ; Roman Catholics, 12,200,000 ; Protestants, 6,760,000 ; Jews, 4,050,000; Mahommedans, 12,150,000; others, 2,700,000. The empire is divided into 64 bishoprics, which were in 1897 under 3 metropolitans and 62 archbishops and bishops. The number of monasteries and nunneries has considerably increased of late ; in 1897 there were 497 monasteries and 268 nunneries, with 8076 monks and 6978 male aspirants, and 8942 nuns and 27,166 female aspirants. The Holy Synod received in 1900 over 23,500,000 roubles from the Imperial budget, in addition to its own considerable revenue and the private revenues of the churches and the monasteries.

Education. ??? Little progress has been achieved as regards educa-tion. Distrust of natural sciences, even in their technical appli- cations,

and of ” “Western ” ideas of free democratic government ❓❓❓ desire to make university education, and even secondary education, a privilege of the wealthier classes ❓❓❓ neglect of primary education, coupled with suppression by the Ministry of Public Instruction of all initiative, private and public, in the matter of spreading education among the illiterate classes ❓❓❓ these were the distinctive features of the educational poHoy of the last twenty years of the 19th century. Only quite recently has a change taken place in the attitude of the Government towards technical education, and a few high and middle technical schools have been opened.^ Only recently, too, has a reform been started in secondary educa- tion with the object of revising the so-called “classical” system which has been favoured in the lyceums since the ‘seventies, the complete failure of which has now been demonstrated after nearly thirty years of experiment. As to primary education, there is nothing at present to brighten its gloomy outlook ; only the opening of Sunday schools, which was prohibited since 186l, was allowed in 1870, and rendered easier still some years later.

The total number of primary schools in the Russian empire (exclusive of Finland) in 1898, and their different categories, are best seen from the following table ^ : ❓❓❓

Under the

Number

of Schools.

Number of Pupils.

Boys.

Girls.

Total.

Ministry of Public In-

struction .

37,046

1,965,549

684,509

2,650,058

Holy Synod

40,028

1,118,404

350,085

1,476,124

Institutions of Empress

Marie

153

2,537

2,560

5,097

Ministry of Interior .

553

16,432

4,078

20,510

„ Navy

4

226

153

379

War .

848

30,498

13,905

46,420

Various

Tftal .

67

2,517

2,141

4,658

78,699

3,136,163

1,057,431

*4,203,246**

⁇ This last sum is slightly in excess of the sum of the two preceding, as the Bex of 9652 pupils is not known.

Nearly 30,000 Jewish heders and Mussulman mcdreses and mekiehes must be added to the above. Besides, all soldiers are taught, at least reading, in nearly 7600 schools in the regiments. Thus, apart from the schools under the Ministry of War (Cossack vMskos and schools at the barracks), the great bulk of the primary schools are either under the Ministry of Public In-

‘ Sketch of the Developrmnt of Technical Education in 183S-9S, by the Ministry of Public Instruction, 1900.

2 Statisque de Fenseignement primaire, published by the Ministry of Public Instruction in 1900.

struction or the Holy Synod. Those under the latter body are of recent growth, the policy of the last twenty years of the 19th century having been to spend the budget allowances upon primary instruction by handing them over to the Holy Synod, which opened parish schools under the local priests. The schools under the Synod are themselves divided into two categories : parish schools, with 614,609 pupils ; and reading schools, of an inferior grade, with 501,883 pupils (in European Russia). No teaching certificate is required by the teachers in either class of school, the permission of the bishop (like the French lettre d’obedi- ence of 1849) being suflScient. The consequence is that, the village priests being too much occupied with their parish duties, they cannot give more than nominal attention to the schools, and the numerous pupils either exist on paper only, lOr are handed over to half-educated cantors, deacons, or hired teachers, very often of a low description. In fact, in 1898 the teachers in the schools of the Holy Synod were : priests, only 1203 ; deacons, 3399 ; cantors, 4232 ; hired teachers, 22,987. Of properly organized primary schools ⁇ besides the special ones ⁇ there are, consequently, only those under the ministries of Public Instruction and War, and the Interior, in Siberia. The distribution of the first and the third categories of these schools in 1896 is shown by the following table,

the figures being below the preceding, chiefly on account of a less complete registration : ???

Schools under the

Ministries of

Instruction and

Interior.

Schools supported

So

Number of Pupils.

1

en

1

i

II

SO

V

Boys.

Girls.

TotaL

European Russia Poland Caucasia . West Siberia East Siberia Turkestan . Amur Region

Total .

2407 98 96 31 10 45

408 ??

23,116

2,899

1,022

106

171

60

416 29 8 2 19

26,691 3,026 1,125 139 200 106 408

1,675,044

141,289

70,839

26,418

8,121

3,226

466,153 66,684 17,804 7,861 2,386 1,080

2,131,197 206,973 88,643 33,279 10,607 4.305 14,418

3094

27,373

473

31,694

1,738,364

660,968

2,289,322

- *Maintained by the Ministry of the Interior, by means of moneys supplied by the local administration.*

Thus the number of primary schools actually maintained by the Ministry of Public Instruction is only 2407 in European Russia, and less than 2700 throughout the whole empire, that is, less than 10 per cent, of the aggregate number of piimary schools, the great bulk of the schools (as well as the normal schools for teachers) being supported by the zemstvos and the municipalities. Notwithstanding this, the main efforts of the ministry, and the pur- port of recent legislation, have been to exclude the local institutions from any share in matters affecting primary education, other than the supply of schoolhouses and current expenses. Taking the figures of the preceding table, it appears that only 4-8 per cent, of the total male and 1-6 per cent, of the total female population received primary education in 1899. The schools were distributed very unequally ; in five provinces (Olonets, Esthonia, Tula, Livonia, Arkhangelsk, and Novgorod) there was only one primary school for every 638 to 983 inhabitants, while in other provinces (including Kovno, in European Russia) the proportion was even less than one school for each three thousand. One good feature of the Russian primary schools, however, is that in as many as 7247 village schools there are school gardens or fields ; in 951 schools, bee- keeping, and in 322 schools, silkworm culture is taught; while in 865 schools the children receive instniction in various trades ; and in 305 schools in slojd. Girls are taught handwork in 4556 schools. The average number of teachers was 1 for evei-y 27 pupils, and 44 per cent of the teachers were women. There were in the same year 9

teachers' institutes and 76 normal schools for teachers, with 6227 pupils. The total expenditure on primary schools in 1899 was 29,612,392 roubles (about the average in recent years), of which 13 per cent, was supplied by the State, 28 per cent, by the zemstvos, 37 per cent, by the village communities and the municipalities, and 13 per cent, by private persons.

Tlie middle schools of Russia (exclusive of Finland) were com- posed in 1899 as per table on next page.

For higher education there were only 9 universities, with 16,570 students in 1899, 2 medical academies, 6 theological academies (944 students), 4 military academies (1360), 2 philo- logical institutes, 3 Eastern languages institutes, 4 judicial military academies, 4 veterinary institutes, 3 agricultural colleges, 2 mining institutes, 4 engineering institutes (2497 students in all the higher technical schools), 2 universities for women (930 students at St Petersburg), and 1 medical academy for women. Finland has a university of its own at Helsingfors.

statistics]

RUSSIA

341

Boys.

Girls.

Under tlie

Schoola.

PupiJa.

Schools.

Pupils.

Ministry of Public Instruction ???

Gymnasia and progymnasia .

237

77,041

346

94,078

Realschulen ....

113

34,495

Girls' middle schools

13

"432

Special schools Normal schools

"5

1^467

9

537

"366

Normal seminaries and prac-

tical schools

52

4,388

Institutions of the Empress Marie:

Gymnasia and institutes

...

62

20,246

Cossack Voiskos ???

Gymnasia and progymnasia .

67

2,845

22

1,368

Ministry of War ???

Cadet corps and special schools

85

12,556

Various Ministries ???

*Agricultural schools **

12

1,449

Technical schools .

11

Commercial schools

16

...

Holy Synod ???

Seminaries ....

58

19,151

Girls' schools

69

15^138

Normal schools

'u

iji'oo

- *Lower agricultural schools, 105, with 3191 pupils.*

Government, ???No substantial changes have lately taken place in the fundamental laws of the empire. The fact has been brought to light that a complete scheme of constitutional government was drawn up in 1809 by Alexander I., with Speranskyas collaborator, though only the first step towards carrying it out ???that is, the remodelling of the Council of State in 1810 ???was ever taken, the Napoleonic wars preventing anything further being done in the matter. The idea, however, was not

abandoned, and a new scheme was drawn up in 1818 by NovosUtseff, a personal friend of Alexander I., and the French lawyer Deschamps. The intention of the emperor was partly reahzed by granting a constitution to Poland in 1815, and his intention of extending to Russia the beneficial effects of free and lawful institutions was publicly announced by him in 1818 at the opening of the Diet at "Warsaw. The idea of granting to Russia a consultative Assembly of a repre- sentative character {une assembUe des notables) reached maturity under Alexander II. in the first month of 1881, and on 17th Feb- ruary (1st March) 1881 the emperor confirmed a report of Count Loris Melikoff to that effect.'

An imperial decree summoning that Assembly was laid before Alexander II. on 1st (13th) March 1881, and its wording approved by him a few hours before his death, on condition that the decree should be laid before the Committee of Ministers on 4th (16th) March for its definitive sanction. The death of the monarch prevented this important step from being carried out. The decree was laid before the Committee of the Ministers and approved by the majority of them on 8th (20th) March, but on 29th April (11th May) Alexander III. issned a manifesto in which he wrote : "The voice of God orders Us to take in hand the work of government vigorously, in our hope in God's providence, and with faith in the power and truth of Autocratic power, which We are called upon to enforce and to protect from all attempts against it."

"The powers of the Committee of Ministers, created by Alexander II. in November 1861, still remain undefined, although it must be noted that this committee has occasionally assumed the powers of a "ministry." Considerable alterations in local government were effected under Alexander III. by the laws of 12th (24th) June 1890 concerning the zemstvos, or councils for provincial self-government ; 11th (23rd) June 1892, concerning municipal self-government ; and 12th (24th) July 1889, concerning the peasants' self-government. In the zemstvos the influence of the nobUity was increased, and the peasants were deprived of the right of electing their representatives, who are now nominated by the governor of the province from candidates elected by the peasants. At the same time the decisions of the zemstvos were made subject to the approval of the governors not only in the case of unlawful decisions, but in every

particular. Similar limitations were applied to municipal self-government. As to the peasants, their self-government was placed under the direct control of ” land- chiefs ” nominated by the governors, who received, moreover, the right of nominating the cantonal judges of the peasant cantonal courts (volostnoi svAiya), and of inflicting punishments (including corporal punishment) upon the peasants, without bringing the

*1 Its text is given in the Russian Encyclopcedic Dictionary, article * vol. x-tvii. A, St Petersburg, 1599.*

Bussia,”

culprits before any court. At the same time, the justices of peace, who had been elected since 1861, were abolished in the country, and were maintained only in the two capitals and six principal cities ??? the judicial power being transferred to the police officers. The zemstvos, which were first instituted in thirty-four out of the fifty governments of European Russia, have recently been granted to three more governments ; but further reductions of their powers as regards education, statistical researches about the peasants, and even the administration of famine-relief funds took place. A ‘ ‘ lesser state of siege ” continues to be maintained in the governments of St Petersburg, Moscow, Kiev, and several western provinces ; in 1902 it was extended to all principal indus-trial towns.

Justice and Crime. ??? The judicial institutions introduced by the Judicial Law of 1864 also underwent certain limitations during the reign of Alexander III. The law of 20th May (1st June) 1885 con- siderably limited the principle of the independence of the magis- trates ; that of 7th (19th) July 1889 reduced the competence of the juries, special courts with ” class representatives ” nominated ad hoe being introduced instead in a number of cases; the introduction of the ‘ ‘ landohiefs ” reintroduced the principle of combining the judi- cial and the administrative power in the hands of the same persons. Finally, the right of sentencing persons to the so-called “adminis- trative exile ” to Siberia (including the Arctic region of Kolymsk) and other remote portions of the empire, without trial and by simple orders of the administration, which was formerly an arbitrary act of the State police, was rendered legal and brought within the province of

the Minister of the Interior, the term of sentence ranging from two to five years, and being capable of being prolonged, once or more than once, for another five years by a special order of the minister. In 1889 the judicial procedure of 1864 (with the above limitations) was introduced in the Baltic provinces ; in 1894-98, in the governments of Olonets, Orenburg, Ufa, and Astrakhan ; in 1896, with further limitations, in Ark- hangelsk ; and in 1897-99 in Siberia, Turkestan, the Steppe pro- vinces, the government of Vologda, and the Transcaspian province. The justices of peace introduced in these provinces are nominated by the Government. The criminal statistics for 1874-94, for 33 governments into which the reformed tribunals had been intro- duced since 1874, show that there was no increase of criminality during these years, and that for a population of 64,030,000 there were on the average 63,787 condemnations per annum, of which nearly two-thirds (39,500) were for minor crimes dealt with by the justices of peace. There is, however, a notable increase (100 to 230) in crimes against persons, and a notable decrease (100 to 72) in those against property. The proportion of criminality varies fi'om 156 to 90 to each 100,000 of the population in the judicial districts of Poland and Revel, and from 77 to 23 to each 100, 000 inhabitants in all other judicial districts.

Prisons. ❓❓❓ In the year 1899 there were 886 lock-ups and 7 hard-labour prisons, the population of which was 640,439 men and 88,869 women. There were 12,059 inmates in the hard-labour prisons, and 1285 children in 37 reformatories. It is worthy of note that during the year there was not one single case in which flogging was applied in the hard-labour prisons of Sakhalin ; but the condition of the children of the exiles on the island is very miserable, owing to a want of schools : only 834 children, out of 4954, go to school. A step of considerable importance was taken on 12tli June 1900, when it was decided that exile to Siberia was to be brought to an end.

Finance. ❓❓❓ The ordinary revenue is in excess of the ordinary expenditure, but the extraordinary expenditure not only swallows up this surplus, which exceeded 200,000,000 roubles in 1898 and 1899, but necessitates the conclusion of fresh loans every year. It must be admitted, however, that there is much to show for this extraordinary expenditure. A

considerable number of new rail- ways, including the Trans – Siberian, have been built ; the old loans, at from 4^ to 6 per cent. (3,037,675,234 roubles), have been converted into 4 per cent, loans at a cost of 72,724,063 roubles ; and the value of the paper money has been settled at a permanent rate of exchange ►►►1 rouble 50 copeks in paper for 1 rouble in gold. The paper money in circulation has also been reduced : while it was 1, 121, 300,000roub]esinl896,itonly amounted to 630,000,000 roubles in 1901. The guarantee fund, too, in gold, destined to cover the paper money, has increased from 750,000,000 roubles in 1896 to 807,800,000 roubles in 1901, and thus exceeds the paper money in circulation by 28 per cent. The State debt, which was increased in the 10 years 1890-99 by 893,971,568 roubles (17 per cent.), amounted to 6,225,095,992 paper roubles on 1st January 1900 (►►656,547,764 in 1901; net interest paid, ►►25,418,303). The budget estimates have grown in proportion. The ordinary revenue, which was 952,045,496 roubles in 1890, amounted to 1,800,784,482 roubles in 1902, an increase of 89 per cent., chiefly due to (1) an increase in the revenue from new railways bought by the State (325, 624, 000 roubles) ; this is absorbed by the costs of exploitation and the payment on obligations ; (2) the introduction of a State monopoly for the sale of spirits (445,807,000 roubles) ; (3) an

increase in the import duties (78,883,000 roubles); and (4) an increased revenue from sugar, spirits, various duties. State monopolies. State domains, and direct and indirect taxes, partly due to increased taxation, and partly to natural growth correspond- ing to the industrial development of the country. The expendi- ture, which was 1,038,690,982 roubles in 1890, was estimated at 1,946,671,976 roubles for 1902. The army and the navy were esti- mated to cost 420,957,521 roubles in 1902, the national debt and the railway obligations 368,460,000 roubles, the working expenses of railways and canals 435,547,758 roubles, new

railways and ports 165,660,000 roubles, while public instruction had a grant of only 36,624,000 roubles. It must be observed that in the State budget considerable sums with which the Ministries of Finance, Ways and Communications, are credited and debited (335,198,000 roubles and 435,547,000 roubles respectively) are mere transfers, the Ministry of Finance retaining ip. its hands the sale of spirits in many provinces of the empire, while the Ministry of Ways and Communications administers the State railways, of which the gross receipts appear in the budget as revenue and the working expenses as expenditure. Turning to the question of local finance, it is found that the 34 provinces which enjoy the right of being administered by the local ze-mstvos yield a yearly revenue of from 60,000,000 to 66,000,000 roubles, while the other provinces have an aggregate revenue of about 18,000,000 roubles. The towns of European Russia proper, Poland, and Siberia have an aggi'egate revenue of about 75,000,000 roubles, and the village communities of European Russia proper are taxed to the amount of 62,000,000 roubles.

Army. ??? The system of obligatory military service for all, introduced in 1874, has been maintained, but the six years' term of service has been reduced to five, while the privileges granted to young men who have received various degrees of education have also been reduced to a small extent. During the reign of Alexander. III. efforts were mainly directed towards (1) reducing the time required for the mobilization of the army ; (2) increasing the immediate readiness of cavalry for war and its fitness for serving as mounted infantry (dragoon regiments taking the place of hussars and lancers) ; (3) strengthening the western frontier by fortresses and railways ; and (4) increasing the artillery, siege, and train reserves. Further, the age releasing from service was raised from 40 to 43 years, and the opolcheniye (militia, landsturtn) was reorganized. The measures taken during the reign of Nicholas II. have been chiefly directed towards increasing the fighting capacity and readiness for immediate service of the troops in Asia, and towards the better reorganization of the local irregular militia forces. Obligatory military service has also been in part extended to Finland. Broadly speaking, the army is divided into regulars, Cossacks, and militia. The peace strength of the army is esti- mated at 42,000 officers and 1,100,000 men (about 950,000 com- batants), while the war strength is approximately 75,000 officers and 4,500,000 men.

However, this latter figure is merely nominal, the available artillery and train service being much below the strength which would be required for such an army : estimates which put the military forces of Russia in time of war at 2,750,000 ❓❓❓ irrespective of the armies which may be levied during the war itself ❓❓❓ seem to approach more nearly the strength of the forces which could be mustered. The infantry and rifles are armed with small-bore magazine rifies, and the active artillery have steel breach-loaders with extreme ranges of from 4150 to 4700 yards.

Navy. ❓❓❓ Owing to its geographical situation and its widely separated seas, Russia has to maintain four distinct squadrons : the Baltic, the Black Sea, the Pacific, and the Caspian. Conse- quently, notwithstanding a very considerable and continuous increase in the expenditure on the navy, the fleet is strong in none of these seas : the Baltic fleet is constantly being drawn upon for reinforcements for the Pacific flotilla, while the Black Sea fleet has no access to the Mediterranean. The strength of the Russian fleet in March 1902, according to the international classiHoation of the Statesman's Year-Boole, was : ❓❓❓

Baltic and other Stations.

Black Sea.

Glass of Ship.

Total.

Com-

Build-

Com-

Build-

pleted.

ing.

pleted.

mg.

Battleships, 1st class

1

6

1

1

9

2nd ???

7

2

6

15

3rd ???

2

2

Coast defence vessels

7

1

8

Cruisers, armoured .

1

1

2

„ belted or

pro

tected .

16

7

2

24

Gunboats .

30

2

8

41

Old armour – clads

anc

.

armour gunboats .

8

There were, moreover, 21 destroyers afloat and 13 buQding, and 45 first-class torpedo-boats afioat and 6 building, besides 41 second- class and 101 third-class boats. The torpedo-boats can be trans- ported overland from the Baltic to the Black Sea. The total number of officers and men is about 45,000.

Fortresses. ❓❓❓ The chief first – class fortresses of Russia are Warsaw and Novogeorgievsk in Poland, and Brest – Litovsk and Kovno in Lithuania. The second-class fortresses are Kron- stadt and Sveaborg in the Gulf of Finland, Ivangorod in Poland, Libau on the Baltic Sea, Kertch on the Black Sea, and Vladivostok on the Pacific. In the third class are Viborg in Finland, Ossovets and Ust Dvinsk (or Dtinamtinde) in Lithuania, Sebastopol and Ochakoff on the Black Sea, and Kars and Batum in Caucasia. There are, moreover, 46 forts and fortresses unclassed, of which 6 are in Poland, 8 in West and South-West Russia, and the remainder (mere fortified posts) in the Asiatic dominions.

Agriculture. ❓❓❓ Thechief occupation ofapproximately seven-eighths of the population of European Russia is agriculture, but its character varies considerably according to the soil, the climate, and the geo-graphical position of each region. From detailed researches that have lately been made by Professor Dokuchaefl' and his pupils into the soils of Russia, it would seem that a sinuous line drawn across European Russia from Zhitomir to Kiev, Tula, Ryazan, Simbirsk, and Ufa, that is, from west-south-west to east-north-east, represents a characteristic boundary separating the "northern soils " from the " southern soils." To the south of this line, as far as the sandy deserts of Astrakhan and the prairies of North Caucasia, lies the ' ' black earth " region, covering nearly 270, 000, 000 acres. Forests give place to prairies, and the soil, which contains from 4 to 16 per cent, of humus, is very fertile ; but the whole region suffers periodically from drought. The "northern soils," which are glacial deposits more or less redistributed by water, are much less fertile as a rule, and ofi'er all possible varieties from a tough boulder clay to loose sand. They require heavy manuring ; phosphates, which are extracted in

four distinct regions of European Russia (Podolia, Central Russia, Ryazan, and the Upper Volga), being especially beneficial. The agricultural zones are disposed jaralle] to the above-mentioned boundary line. The prairie zone, where cornfields and pasturages prevail, lies in the extreme south ; then to the north, on both sides of the boundary line, comes the " ante- Steppe," the zone in which fields prevail, but in which there are also some forests ; farther north still is the zone in which fields and meadows are intermingled with forests ; and beyond that again is the forest zone. The actual distribution of fields, forests, and meadows in European Russia and Poland is best seen from the fol- lowing table :

European Russia.

Poland.

Acres.

Percent- age.

Acres.

Percent- age.

Fields and fallow . Meadows and pas- turages Forests . Uncultivated

Total .

287,868,000

174,958,000 425,622,000 210,060,000

26

16 39 19

15,933,000

5,605,000 6,763,000 1,631,000

53

19

23

5

1,098,508,000

100

29,932,000

100

The proportion of land under crops varies very much in different parts of European Russia ; it is 74 and 73 per cent, in Kursk and Tula, from 45 to 70 per cent, in the two above-mentioned southern zones, from 30 to 50 per cent, in Middle Russia, from 20 to 30 per cent, in Western Russia and in the southern Urals (Ufa) ; from 10 to 20 per cent, in the lake region, and less than 10 per cent, in Northern and North-Eastern Russia. The highest standard of agriculture is met with in Poland and in the western governments (Baltic, Lithuanian, and South- Western), and the standard gets lower and lower as one moves eastwards. Rye and oats are the chief cereal in Central and North Central Russia. AVheat is sown in only small quantities in Western and Central Russia, but is the chief crop in the southern prairie belt. In the far north barley takes the place of oats and partly of rye. Buckwheat is sown everywhere in the middle zone, but millet takes its place to the south of the above-mentioned boundary, and maize in the extreme south-west (Podolia, Bessarabia, and Kherson), and in the Caucasus. Potatoes are extensively cultivated in the west. The use of agricultural machinery is rapidly spreading, reapers and steam threshing-machines being largely used in the ” black earth ” prairie belt.

Taking the whole empire, nearly six-tenths of the cultivated

statistics]

area is sown every year witli cereals, the areas under which in the various divisions of the empire in 1900 are shown in the following table :
>

Region.

Acres.

European Kussia

Poland

Four governments of North Caucasia * . Four governments of Siberia t Four provinces of Central Asia J .

178,963,600

10,770,000

10,470,700

9,182,000

2,181,400

Total, iu 72 governments

211,517,700

- ***Kuban, Stavropol, Terek, and Tchernomorsk.***

t Tobolsk, Tomsk, Yeniseisk, and Irkutsk.

X Akmollnsk, Semipalatinsk, and Turgai ; Semiryechensk of Turkestan.

The crops are now given in official documents in units of weight, and the quarter of each different grain having a different weight, which varies with the year and even the region, it is not easy to compare the present returns with those of former years. The crops of 1900, which were 10 per cent, in excess of the average crops of the preceding years, are given in the following table, iu thousands of cwt. : ???

Region,

Crops, in Thousands of Cwt.

Wheat.

Rye.

Barley.

*Oats. Various.**

1

Total.

Potatoes.

European Ruaaia

Poland

North Caucasia t

Sitorla: . . .

Steppes ??.

Total

170,999 10,565 30,508 10,807 3,728

414,413

33,812

3,751

7,927

171

80,243 7,891

11,617

1,272

641

212,586 14,639 5,005 9,977 1,710

48,895 2,001 5,036 726 2.528

927,225 68,908

30,709 8,679

332.428

166,289

7,151

9.04S

597

226,007

460.074

101,564

243,917

69,275

1,091,436

515,508

- *Mbced rye and wheat, buckwheat, and millet.*

t Kuban, Stavropol, Terek, and TcheTnomorak.

t Irkutsk, Tobolsk, Tomsk, and Yeniseisk.

***Akmolinak, Semipalatinsk, Semiryechensk, and Turgai.*

*The yield of maize was 12,785,000 cwt. in European Russia, and 4,342,000 in northern Caucasia ; the aggregate yield of peas, leutils, and beans was 18,942,000 cwt. The hay crop in 1900 was as follows : ****

Region.

Area in Acres.

Yield in Thousands of Cwt.

European Russia

Poland ....

North Caucasia

Siberia ....

Steppes ....

Total

69,796,000 2,427,000 6,684,000 9,080,000 2,511,000

744,961 36,652 77,915 83,146 24,425

90,498,000

967,099

Beetroot for sugar is especially cultivated iu Poland, the western provinces (Kiev, Podolia, Volhynia, and Kharkov), and the south- western (Bessarabia, Kherson), as also to some extent in South Central Russia; 1,454,000 acres were under beet in 1901, and 754, 760 tons of refined sugar were obtained in 277 sugar works. Tobacco is widely grown in the south (1,672,000 cwt.), and the hop crop of 1897 was 107,000 cwt. Flax is grown chiefly in Central and North-Western Russia, the yearly crop being about 10,780,000 cwt. of flax (half of which is exported) and 12,932,600 cwt. of linseed. Hemp is cultivated both for fibre (yearly yield, 6,014,000 cwt.) and seed (6, 245, 000 cwt.). Various other oil seeds are also grown, the yearly production of various oils being estimated at 1,000,000 cwt. The vine is grown as far north as 49 N. (Bessarabia, Crimea, Don, besides Caucasia and Central Asia), the yearly pro- duction of wine being 19,990,000 gallons in Russia, 17,000,000 in Caucasia, and 116,000 in Central Asia. Market-gardening and fruit-growing are extensively engaged in in portions of Central and South Russia, and very important works have lately been established for the manufacture of jam, pickles, and canned fruit. Turkestan, Khiva, and Bokhara supply every year about 1,160,000 cwt. of cleansed cotton, and Transcaucasia about 20,000 cwt.

The live stock in the empire in 1896 is estimated by Russian statisticians to have been as follows :

“^ Rimltats g^n^raiix de la RicoUe en Rtissie en 1900.

1901.

St Petersburg,

Region.

Thousands of Head.

Horaea.

Horned av◆◆◆◆◆◆◆◆◆ Cattle. ◆◆◆’“‘P-

Pigs.

Goats.

Camels,

Rein- deer.

Total.

European Russia and Poland .... Finland . Caucasia*

Siberia .... Steppe provinces t .

Empire, 1890 .

Including Turlteatan, 1898

20,867

271

1,018

2,318

2,4ijl

27,922 1,103 6,883 2,429 1,216

48,000 1,067

12,000 3,000

10,000

10,742 197 960 636

1,393 14

2,000 117 146

26 24 403

263 130

198

109,213 2,782

21,885 8,598

11,225

20,935 33,000

38,653 37,413

74,067 74,789

12,435 11,968

3,670 3,190

453 1,279

591 600

166.703 162,239

*** Incomplete data ; the figures for sheep and goats are approximate only, i Data incomplete.***

Thus in European Russia and Poland there were in 1896 23 horses, 31 horned cattle, 53 sheep, and 12 swine to every 100 in- habitants. However, even within Russia proper the live stock is very unequally distributed, there being 109 horned cattle to every 100 inhabitants in the Don province, 51 in Esthoiiia, and only 14 in Orel and Tula. From an enumeration taken in 41 provinces of European Russia in 1896, it appeared that 82 per cent, of the total number of horses belonged to the peasants, but f^&t 28 per cent, of the peasant households did not own any horses, and that there were 1820 private horse-breeding establishments with about 40,000 head. The most common kind of animal is the small, weak, peasant horse ; the best are found in Poland, the western governments, and in the Steppe provinces. The South Russian "bityu^s" are a fine breed, and so are the Cossack horses, while the Kirghiz breed in South-Eastern Russia are especially appreci- ated for their endurance. Finland ponies are largely exported. The best races of horned cattle are found in Poland, the western provinces. Little Russia, and the Far North (Holmogory). Swine- breeding is in a primitive condition. Of the nearly 75,000,000 sheep kept in Russia, only about 15,000,000 belong to the fine merino breed ; these yield, however, over 1,000,000 cwt. of fine wool annually ; they are chiefly kept on the Black Sea prairies. The export of live stock is rapidly increasing ??? horses being exported to Germany, Austria, and Great Britain to the value of about ??500,000 per annum, cattle to Turkey and China, sheep to France, China, and Turkey, and pigs to Germany (to the value of ??325,000 annually). On the other hand, considerable quantities of cattle and sheep are imported from Central Asia. Modem dairy-farming is still new in Russia, and butter is still imported, chiefly from Finland ; but it is also exported, and in increasing quantities, to Western Europe, being sent to Great Britain alone, in part vid Copenhagen, to the value of ??685,493 in 1900. Poultry-farming, for the supply of both the home and foreign markets, is being more and more extensively engaged in, and the export of eggs has of late developed enormously: on the average, 1,743,000,000 eggs, in each of the three years 1897-99, valued at ??2,844,000, were sent out of the country.

Viewed as a whole, it must be confessed that agriculture stands at a very low level in Russia. Considerable progress was made in the fertile prairies bordering the Black Sea and the Sea of Azov, where modern agricultural

machinery was largely introduced, and a very considerable number of machinery works, large and small, have grown up. But the famines which periodically visit large districts ??? especially in the fertile but dry prairie belt of South- Eastern Russia, and in some of the central provinces ??? are chiefly due to the primitive methods of husbandry employed. The misery of the peasants, who up to the present time have borne nearly all the burden of taxation, the lack of education, and the almost total absence of those institutions by means of which agricultural education is spread among the farmers in the United States, in France, and in Germany, have all hampered the development of agriculture. The general improvement of the agricultural popula- tion of the central provinces of European Russia is now the sul ject of a wide inquiry, from which it appears (in a summary published by A. D. Poly^noff) that within the years 1871 and 1899 the arrears in the payment of the direct taxes grew from 10 to 42 per cent, of the aggregate sum ; the yearly sowings, taken per head of popula- tion, decreased by 35 per cent., and the number of horses, also per head of agricultural population, by 4.S per cent., and so on ??? the result being a rapid growth of a totally destitute peasant class even in the most fertile provinces of European Russia. Within the last few years some efforts have been made by the Ministry of Agriculture to help the peasantry in education ; but in 1 899 there were only 114 agricultural and dairy schools (4 for women), with 5157 pupils ; as was noticed under Education, farms and gardens have been widely established in connexion with the village schools ; numerous agricultural societies (320, of which 80 are in the Baltic provinces) have been founded lately. The zemstvos have made a notable effort to improve the condition of agriculture by appointing agricultural councOs and inspectors, establishing museums, meteorological stations, and depots for the sale of agricultui-al machinery at cost price. Measures are also being

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taken to increase the very low productivity of the forests.' These cover a, considerable area, as may be seen from the following table : ???

Region.

Area under Forests. Square Miles.

Percentage of Total Area.

European Russia . Poland .... Finland .... Caucasia ....*

Total

717,730 10,480 78,905 29,605

39-4 21-4 62-8 16-3

836,720

38-4

- *Without Erivan and Tchemomorsk.*

According to more recent estimates, the areas under forests are ??? 453, 617, 000 acres in European Russia, 7, 358, 000 acres in Poland, and 19,352,000 acres in Caucasia. Nearly 54,000,000 acres must, however, be excluded from the figures for European Russia and Poland as marsh land and land under lakes. The distribution of forests is very unequal in European Russia, the area covered by them in the various provinces varying from 89 per cent, of the total area in the north to 9 per cent, and even 2 per cent, in the south-east. The State is the chief owner of forests (almost exclu- sive owner in Arkhangelsk), and owns no less than 272,000,000 acres in European Russia and Poland (235,000,000 acres of good forests), while private persons own 108,000,000 acres, the peasant communities 43,000,000, and the Imperial family 13,500,000 acres.

Sericulture, which was in a flourishing condition in the 'sixties, both in the Caucasus and in Southern Russia, was reduced to a very low ebb in consequence of the silkworm disease, and was only renewed with any

vigour towards the end of the ‘eighties. At the beginning of the 20th century it was most developed in Transcaucasia (Kutais, Elisabethpol), and extended into Northern Caucasia; from 100,000 to 130,000 cwt. of cocoons, valued at ––400,000 to ––600,000, is obtained annually, and sent to Moscow (mainly) and France. Sericulture is taught in a number of special schools and in a great number of village schools. It is widely engaged in in Turkestan, and to some extent in the Trans- oaspian territory, Khiva, and Bokhara. Attempts are being made to re-establish the silkworm industry in South Russia, where at present only 800 to 1000 cwt. of cocoons are obtained per annum, and in Poland. Altogether about 250,000 cwt. of cocoons, repre- senting about 13,000 cwt. of silk of the value of ––850,000 to ––900,000, are obtained annually in the Russian empire. The cotton plant is widely cultivated in Turkestan, 840,000 cwt. of cleaned cotton, representing 2,080,000 cwt. of raw cotton, being obtained in 1899 ; to this must be added 322,000 cwt. from Bokhara and Khiva, and 408,000 cwt. from Transcaucasia (1898).

Fishing, ––– Fish continues to form an important article of national food, and to provide an important part of the national income. Along the Murman coast of the Arctic Ocean and in the White Sea (where nearly 40,000,000 herrings are caught annually) the yearly produce is estimated at 370,000 cwt., of the value of about ––140,000. In the Baltic Sea, as well as in the lakes of its basin (Ladoga, Onega, Ilmen, &c.), the yearly value is estimated at ––200,000. Of anchovies alone 10,000,000 jars are prepared annually, while salted fish is the chief, next after bread, food of large masses of the population. The Black Sea fisheries yield 925,000 cwt., valued at ––300,000 per annum. The value of the fish has much increased lately owing to the introduction of cold storage ; as a result of the employment of this method of packing, the fish is now exported in a fresh state from the Black Sea to all parts of South-West Russia, and even to Moscow. The annual yield of the Azov Sea fisheries is valued at ––600,000. In the Volga section of the Caspian Sea about 930,000,000 fish are caught annually, of a value of about ––1,100,000; in the Ural section 836,500 cwt. of fish and 29,000 cwt. of caviare are obtained. The total value of the Caspian fisheries is estimated at ––3,000,000 per annum. Taking the Lake Aral and Siberian river fisheries into account, it is estimated that altogether more than 1,100,000 tons offish are obtained

every year (in addition to 200,000 cwt. of caviare, 230,000 cwt. of fine con- serves, and 1700 cwt. of glue), yielding a revenue to the State of ??330,000, and requiring for its preservation over 200,000 tons of salt.^ In addition, from 13,000 to 60,000 seals and about 200 whales are killed annually otf the Murman coast.

Industry. ??? The growth of Russian industry is shown in the

1 See Russian Forests, published by the Ministry of Agriculture, 1900 ; Report of the Forestry Department for 1899 ; M'orks (Trudy) of the Com- mittee of Prof. Dokuchaeil, 1898 ; Irrigation, Industrial Huntirw, by A. Silantieff, and a number of other official publications of the Ministry of Agriculture.

2 See Researches into the State of Fisheries in Russia, 9 vols., edited by Minister of Finance, 1896 (Russian) ; Kusnetzow's Fiseherei und Thiererbeu- twng in den Gewassern Russlands, 1898.

following table, which compares the returns for 1887 and 1897 of all factories throughout the empire of which the annual produc- tion was valued at more than 2000 roubles : ???

Branch of Industry.

1887.

1897.

Number of Workers.

Yearly Returns. Roubles.

Num- ber of Fac- tories.

Number of Workers.

Yearly Returns. Roubles.

Textiles Food products Animal products . Wood . Paper .

Chemical products Ceramics

Mining and metals Metal goods . Various .

Total

399,178 205,223 38,876 30,703 19,491 21,134 67,346 390,916 103,300 41,882

463,044,000

376,286,000

79,495,000

26,688,000

21,030,000

21,069,000

28,965,000

156,012,000

112,618,000

60,862,000

4,449

16,512

4,238

2,357

532

769

3,418

8,412

2,412

935

642,620 265,367 64,418 86,273 46,190 36,320 143,291 644,333 214,311 66,249

946,296,000 648,116,000 132,058,000 102,897,000 46,490,000 69,555,000 82,690,000 393,749,000 310,626,000 117,767,000

1,318,048

1,334,049,000

59,059

2,098,262

2,839,144,000

The following table shows the growth of the mining industry in greater detail ; ???

Metal.

1887.

1897.

Production.

Value. Roubles.

Production.

Value. Roubles.

Gold

34,840 kilos

40,413,000

38,182 kilos

43,072,000

Silver .

15,020 ???

4,390 ???

386,000

Platinum .

4,406 ???

2,018,000

5,586 ???

3,095,000

Copper

4,783 tons

3,604,000

6,192 tons

4,639,000

Zinc

3,720 ???

884,000

4,506 ???

1,373,000

Lead .

983 ???

120,000

442 ???

58,000

Mercury

64 ???

623 ???

Salt .

1,167,000 ???

5,649,000

1,562,000 ???

6,778,000

Coal .

4,534,000 ???

13,839,000

11,203,000 ???

38,945,000

Pig iron

694,000 ???

26,406,000

1,848,000 ???

77,731,000

Iron .

362,000 ???

35,338,000

499,000 ???

60,033,000

Steel .

167,000 ???

22,094,000

920,000 ???

126,942,000

Raw naphtha

2,733,000 ???

6,006,000

7,831,000 ???

36,668,000

Naphtha products

18,317,000

45,736,000

Nearly all these figures showed an increase in 1899, the output being: gold 38,776, silver 4637, and platinimi 5962 kilograms; copper 6495 (1898), zinc 7419, lead 238, mercury 357, salt 1,643,000, coal 13,705,000, pig iron 2,630,000, iron 573,000, steel 1,314,000, and naphtha 8,827,000 tons; also manganese ore, 319,400 tons. Though still in its infancy, the chemical industry is making rapid progress in Russia. In 1890 there were only two soda works, but seven years later there were ten such works and about thirty other chemical works, which yielded in 1899 over 82,000 tons of carbon- ated soda. With the natural resources of Russia, and the awaken- ing interest of its people in the industrial possibilities that lie before them, this branch of industry, as well as that connected with the utilization of the vast supplies of raw naphtha still waiting to be tapped, is sure to advance by leaps and bounds. Unfortunately, the extravagant prices which Russia has to pay for iron and all iron goods, owing to its prohibitive tariffs, combined with the obstacles laid in the way of spreading education, hamper the development of all industries. The cotton industry uses nearly 270,000 tons of raw cotton annually, 100,000 tons of which are supplied by Central Asia and Transcaucasia : it represents 6,500,000 spindles and 200,000 power looms, and excels chiefly in the production of red and printed cottons. Since 1880 power looms have been made in Russia itself. And while the total value of all imports in cottons is only about 5,900,000 roubles, the exports to Persia, China, and Turkey are valued at 8,000,000 roubles ; every year, too, the home market absorbs more and more cotton goods. The woollen industry is rapidly growing, but it cannot yet satisfy the local demands, and e\en raw wool continues to be imported. In the flax mills there are 300,000*

spindles and 15,000 power looms. The tendency is to produce the finest flax tissues as well as the coarser. Of the 200,000 tons of hemp grown every year,' nearly 50,000 tons are retained for home use, and, further, about 1500 tons of Italian and Manila hemp and 18,500 tons of jute are imported for the mills. The silk mills employ silk obtained from the Caucasus, Italy, and France. The sudden growth of the silk industry will be seen when it is stated that whereas in 1879-88 the import of all sorts of raw silk averaged only 79 tons per annum, in 1896-98 the average yearly importation was 1243 tons. The growth of the sugar industry is shown by the

3 See The Iron Industry of the World, The Cotton Industry of Rxmia and The Influence of Railways upon Agriculture, Industry, and Trade bv Anton Radzig. St Petersburg, 1891-96. '

fact that in 1888-93 the average annual production of raw sugar was 925,540 metric tons, and of the refineries, 444,520 tons ; in the years 1894-98 the figures were 1,159,200 and 620,640 tons respectively ; while in 1900 the refineries yielded 670,680 tons in European Russia and 74,920 tons in Poland. In 1899-1900 there were in the empire 2025 distilleries, which used 2,500,000 tons of cereals and 1,800,000 tons of potatoes, the yield being 86,094,000 gallons of pure alcohol. The yearly consumption of spirits per head of population, which was 13 '6 pints in 1889, steadily decreased to 10 '8 pints in 1898. Of beer, which is chiefly made in Poland and the Baltic provinces, 124,080,000 gallons were produced in 1897-98. Tanneries exist in nearly every province of Russia, but it is especially at Warsaw and St Petersburg, and after these at Moscow, that the largest and best modern tanneries and shoe and glove factories are established. The governments of Orel (shoe factories), Kherson, Vyatka, Nijni Novgorod, Perm, Kiev, and Kazan rank next in this respect. Furniture factories are greatly developing ; and in 1899 the paper industry was repre- sented by 184 factories in Russia and Poland

and 12 in Finland, the yearly production having increased in Finland from 12,000 metric tons m 1890 to 27,200 tons in 1899, and in Russia from 80,000 tons in 1887 to 192,000 tons in 1899. The growth of mechanical works has also been great, as may be seen from the following table : ???

Year.

Factories,

Number of Workers.

Yearly Returns.

1870 .... 1885 .... 1897 ....

198 336 682

30,000

42,772 120,339

??2,900,000

4,100,000

14,200,000

*The yearly production includes about 400,000 tons of rails per annum, and 700 railway steam engines, 66,000 tons of iron and steel wire, 23,000 tons of pipes. -^*

The relative industrial importance of the leading manufacturing provinces of the Russian Empire is shown in the following table, which gives the returns for 1897 of all factories and mining in- dustries in the governments enumerated (P stands for Poland, and C for Caucasia) : ???

Millions of Roubles.

Millions of Eoubles.

Moscow .

380-0

Kostroma .

. 61-1

St Petersburg .

289-6

Kharkov .

. 44-5

Piotrkow(P) .

256-8

Nijui-Novgorod

. 44-1

Vladimir

206-6

Don.

. 39-5

Ekaterinoslav .

155-7

Orel .

. 38-7

Warsaw (P) .

106-3

Podolia .

. 37-1

Livonia .

88-2

Saratov

. 34-4

Perm

87-1

Tver

. 32-7

Baku (C)

82-6

AU others less

than 30,(500,000

Kiev

74-4

roubles.

Kherson .

62-8

Far from being destroyed by the competition of the factories, the domestic industries, while undergoing certain modifications required by the new conditions, have well maintained their ground, even new branches of petty trade having sprung up iu some districts. Among these new branches the manufacture of agricultural machinery (thrashing machines in Ryazan, Vyatka, and Perm ; ploughs in Smolensk, &o.) deserves notice. Cotton-weaving alone, in the Moscow central region, still gives occupation to more than 60,000 families ; and furniture-making has lately developed on a large scale in several provinces.

Commerce. ??? It is impossible to give even an approximate estimate of the value of the internal trade in Russia. The chief fairs are held at Nijui-Novgorod and Irbit in Siberia. The yearly returns of goods actually sold at these two fairs are as follows (000 omitted) : ???

Fair.

1881-90.

1891-96.

1896.

1897.

1898.

1899.

Nijni- Novgorod Irbit .

Roubles.

187,127 56,700

Roubles.

151,958 36,200

Roubles

153,338 41,000

Roubles.

142,664 41,000

Eoubles.

128,721 30,300

Eouble

170,000 31,600

The value of the commercial transactions which take place at both these fairs greatly exceeds the above figures. Altogether, no less than 16,604 fairs are held in Russia (European Russia 14,048, Poland 1877, Caucasia 143, Siberia 447, and Central Asia 89). Of these, 30 show returns of goods imported to the value of over 1,000,000 roubles each, 41 from 500,000 to 1,000,000, and 437

1 For all information concerning the development and geographical distribu- tion of industries, see Kovalevsky's La Russie d l(t Jin du xix^ sidciCt Paris, 1900 (official publication) : B. F. Brandt's Foreign Capital : Its Influence^ 2 parts, 1899 (Eussian) ; and numerous official publications of the Ministries of Finance, Agriculture, and Trade.

from 100,000 to 500,000 roubles each, while 7363 fairs show returns of less than 5000 roubles each.

On 1st January 1898 there were in Russia 1146 shareholders' companies, with a capital of 2,061,000,000 roubles, of which 938 were industrial and 208 commercial, banking, and insurance com- panies. 115, with an

aggregate capital of 337,000,000 roubles, were foreign companies ; 23 more foreign companies (capital 96,000,000 roubles) were formed in 1898.

The external trade of the Russian empire (bullion not included, nor the external trade of Finland) since the year 1886 is shown in the following table : ???

Year.

Exporta

Imports.

1886-90, average

1891-95,

1896 .

1897 .

1898 .

1899 .

1900t

Paper Eoubles.

675,200,000 636,515,000 688,572,000 726,624,000 732,673,000 626,475,000 688,552,000*

Paper Roubles.

415,100,000 468,961,000 689,810,000 559,998,000 617,459,000 642,778,000 572,184,000

- *1891 and 1892, fam*

ne

years.

t European frontier and trade with Finland only.

The chief exports pass across the “European frontier,” which includes the Black Sea ports of the Caucasus. The relative im- portance of trade with Europe, Finland, and Asia is shown by the following table : ???

i

1895.

1896.

1897.

1898.

1899.

1000

1000

1000

1000

1000

Exports.

Roubles.

Roubles.

Roubles.

Roubles.

Roubles.

Across European

frontier .

652,262

649,709

673,900

675,600

566,533*

Across Asiatic

frontier .

21,307

21,208

22,300

23,800

25,334

To Finland Total .

15,514

17,655

30,400

33,300

35,116

689,083

688,572

726,600

732,700

626,983

Further, to

Russian Man-

churia . Imports.

23,771

24,600

24,900

26,700

Across European

frontier .

457,800

514,600

489,500

541,500

576,882

Across Asiatic

frontier .

47,600

50,400

51,400

55,400

53,374

From Finland .

Total . Goldand silver in

20,700

20,500

19,100

20,600

20,229

526,100

585,500

560,000

617,500

650,485

money and ingots.

Exported .

2,063

3,101

12,740

4,868

50,810

Imported .

56,394

177,599

209,117

131,489

82,221

- ***Bad crops.***

The character of the trade passing across the ‘ ‘ European frontier ‘ is as follows : ???

1896.

1897.

1898.

1899.

1900.

Exports. Articles of food . Raw and half-

1000

Roubles.

381,525

1000

Roubles.

413,635

1000

Roubles.

433,496

1000

Roubles.

317,170

1000

Roublea

381,215

manufactured

articles . Animals . Manufactured

257,839 15,144

254,594 17,092

238,397 16,848

249,873 17,254

269,942 17,900

goods .

Total .

Imports. Articles of food . Raw and half-

12,906

19,026

21,243

17,352

19,495

667,414

704,347

709,984

601,649

688,552

69,803

64,058

69,803

73,441

79,780

manufactured

articles . Animals . Manufactured

306,656

2,278

291,622 1,620

302,134 1,511

301,376 1,802

304,579 1,136

goods . Total .

161,528

151,231

188,565

217,856

187,001

520,265

608,531

662,013 594,475

572,496

S. VIII. ???

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[statistics

The chief articles of export across the ” European frontier ” are grain and flour, the figures for which were 147,4’j8,8B0 ewt, valued at 370,463,000 roubles, in 1898; 111,143,000 ewt, valued at 259,022 roubles, in 1899 ; and 135,040,000 ewt., valued at 304,698 roubles, in 1900. Then come flax and hemp to the value of 58, 518, 000 roubles, in 1900 ; dairy produce and eggs, 45,292,000 roubles ; timber and wooden goods, 58,384,000 roubles; naphtha and naphtha oils, 45,973,000 roubles; animals, 17,900,000 roubles; oil-cakes, 15,540,000 roubles ; bristles, hair, and feathers, 7,343,000 roubles; sugar, 16,330,000 roubles; and manufactured goods, 19,495,000 roubles. The chief imports in 1900 across the same frontier were machinery, 76,665,000 roubles; raw cotton, 63,201,000; raw wool and wool yarn, 21,759,000 roubles; raw silk and silk yarn, 13,282,000 roubles ; raw metals, 36,673,000 roubles ; metal goods, 29,022,000 roubles ; coal and coke, 42,589,000 roubles; chemicals and colours, 23,586,000 roubles; and tea, 23,639,000 roubles.

In the trade with Asia the chief exports were, in 1898, naphtha and naphtha oils, 21,260,000 roubles ; cereals, 16,125,000 roubles ; cottons, 9,023,000 roubles; and sugar, 6,309,000 roubles; while the chief imports

were tea, 24,496,000 roubles ; textiles, 5,678,000 roubles; and machinery (to Russian Manchuria), 4,716,000 roubles.

The chief external trade was formerly with Great Britain, but is now with Germany, the exports to which ??? chiefly grain, flax, timber, eggs, hemp, live fowls, tea, hides, bristles, and linseed ??? amounted to 187,515,000 roubles in 1900, while the imports from which ??? chiefly machinery, woollen yarn, raw wool, and iron goods ??? amounted to 215,416,000 roubles in the same year. The discrep- ancy between the British and the Bussian returns of the trade between the two countries is so great as to be worthy of notice. These differences for the 20 years ending 1900 are exemplified in the following table ; ???

British Returns.

Russian Returns.

Exported to Russia.

Imported from Russia.

Imported from Great Britain.

Exported to Great Britain.

1881-90

average .

1891-95

average .

1896 .

1897 .

1898 .

1899 .

1900 .

⬖⬖⬖⬖⬖

7,783,000

9,931,000 7,185,180 7,513,160 9,227,970 11,720,330 11,001,300

⬖⬖⬖⬖⬖

19,687,000

21,423,000 22,667,440 22,284,360 19,489,510 18,711,170 21,974,952

*Paper Roubles.**

108,850,000

111,039,000 111,041,000 102,016,000 115,082,000 129,353,000 128,176,000

*Paper Roubles.**

198,350,000

160,744,000

l“0,903,000

150,908,000 139,906,000 129,168,000 145,564,000

One pound sterling =9 “37, or practically 10, paper roubles.

The chief exports to the United Kingdom are grain, flax, hemp, and eggs, while the chief imports are machinery, metals, coal, and raw cotton in transit. France ranks third in the foreign trade of Russia ; in 1900 the exports thereto (grain, timber, oil seeds, and flax) werevaluedat

57,444,000 roubles, and the imports therefrom (wine, raw silk, and wool) at 31,228,000 roubles. The trade with Holland has been on the increase, but the exports to that country, which reached 72,257,000 roubles in 1898, only totalled 69,192,000 roubles in 1900. In the trade with the United States the goods exported from Russia are insignificant, but those imported into Russia (chiefly machinery) reached 50,059,000 roubles in 1898 and 43,615,000 roubles in 1900.^ The trade with China (imports therefrom 40,000,000 roubles on the average ; exports thereto only 5,000,000 roubles) is mainly dependent on the importation of tea (32,000,000 roubles in 1897) ; some cottons and silks are also imported. Considerable quantities of Ceylon teas were im- ported lately. Even in her trade with Persia, Russia imports more fruit, rice, cotton, silks, and woollens (to the value of 18,000,000 roubles) than she exports (15,000,000 roubles, half of which represents sugar, and the remainder cottons and other manufactured goods). It may be added that in international trade Russia occupies the sixth place (after Great Britain, Germany, the United States, France, and Holland), her commerce representing 6 per cent, of that of the world.

On 1st January 1899 the mercantile fleet of Russia, including Finland, consisted of only 657 steamers of 299,700 tons, and 2143 sailing vessels of 254,100 tons. In 1900 the ports of the Baltic, the Black and the White Seas, Avere enterecf by 10 '573 vessels above 20 tons, 8,549,000 tons in all; but only 5."j18

1 According to the offlcial returns of the U.S. Treasury Department, the total exports from the Russian empire to the United States in 1901 amounted to 87,034,421 (□□1,406,884), and the impnrts into the Russian empire from the United States amounted to $9,645,904 (□□1,909,181).

(4,097,000 tons) came loaded with goods, the remainder coming with ballast to take goods for export. The Caspian ports were entered by 943 vessels, and Vladivostok by 384 vessels, only one-tenth of which were under the Russian ^^ "^ flag. And 66,723 vessels engaged in the coasting trade tj"- ' entered the Russian ports in 1898. Inland navigation, however, is, as in the United States, immense and quite out of proportion to the

foreign shipping. The total length of rivers available for carrying trade throughout the empire is 101,000 miles, of which 46,000 miles are used for floating rafts, and 55,000 are navigable by craft; 33,000 miles are navigable by steamers. European Russia alone, without Finland, has 24,432 miles of navigable rivers (16,590 miles by steamers). There are, further, 507 miles of canals and 711 miles of canalized rivers. In 1895 the fleet on the rivers of Russia proper and Poland (on the Volga it had doubled in 10 years) numbered 2539 steamers, of 129,760 nominal horse-power and with an aggregate capacity of 198,000 tons (2894 steamers in 1897) ; there were also 20,580 other vessels, aggregating 8,504,300 tons. Both categories together employed no less than 118,297 persons. Nearly 125 steamers are added every year to this fleet (173, all built in Russia, in 1897), and about 5500 various vessels, of which the greater number are destroyed every year. In 1899, 167,204 vessels and 260, 144 rafts were loaded at the river ports of Russia proper, the total weight of the merchandise thus transported being 30,380,000 tons (about 12,240,000 by raft), of a total estimated value ??? much below the real value ??? of 468,582,000 roubles. Timber, fuel wood, corn, and naphtha supply the chief loads (22, 800, 000 tons). The rivers of West Siberia were navigated in 1896 by 114 steamers of 5000 tons, and 369 barges ; those of East Siberia (Lena, Yenisei) by 41 steamers of 2000 tons ; and the Amur by 116 steamers of 4300 tons, and 145 barges.

A considerable number of new railways, some of which are of great importance to the empire, were built during the last twenty years of the 19th century. At the same time p.;;^.y_ the chief lines of railways, which had been built by '

public companies with a State guarantee, and which represented a loss to the empire of about 30,000,000 roubles per annum, as well as a growing indebtedness, were bought by the State, which derives a small net profit from its railways, although several of the later lines, while imperative for State purposes must necessarily yield but a very small revenue, or be worked at a loss.

On 1st January 1883 there were 14,316 miles of railways in Russia, Poland, and Caucasia, 734 miles in Finland, and 141 in the Transcaspian

region ⬛⬛⬛ a total of. 15,191 miles, of which 738 miles belonged to the State and the remainder to public com- panies. On 1st June 1900, 33,425 miles of railways were opened to trafiic, 22,712 miles being owned by the State and 10,713 miles by public companies ; there were also 2904 miles of line under construction (1110 miles owned by the State) ; and over and above all, 1600 miles in Manchuria and 1586 miles in Finland.

The most important of the new railways is the Ti-ans-Siberian, of which the first section, Chelyabinsk to Omsk, was opened in December 1895, and which in 1901 was virtually completed right through to Sryetensk, on the Shilka, the head of navigation on the Shilka and the Amur, 2804 miles from Chelyabinsk and 4168 miles from Moscow, vid Samara and Chelyabinsk. There is only one interruption in that line ⬛⬛⬛ Lake Baikal, the railway round the lake being under construction. At the Pacific end of the Trans-Siberian Railway a line connecting the Pacific town and fortress of Vladivostok with Khabarovsk, at the junction of the Amur and the Usuri, was first of all built, following the very thinly-inhabited valley of the Usuri, which, owing to natural conditions, can never become the seat of a numerous agri- cultural population. But it was soon found that the cost of the section required to complete the railway along this route, that is, of a line between Sryetensk and Khabarovsk, along the Shilka (240 miles) and the Amur (1320), would be enormous, while neither the wild mountainous tracts on the lower Shilka (Gazimur range) and upper Amur (high plateau), nor the marshy, often inundated region between Khabarovslc and the Little Khingan (250 miles), could ever be the scat of a numerous agricultural or mining population. Consequently a company was formed by the Russian Government in 1896 to construct, with the consent of the Chinese Government, a railway from "S'ladivostok right across Manchuria to Kaidalovo, a point in Transbaikalia on the Sryetensk line, near to Chita. This runs for 330 miles on Russian territory and for 951 miles on Manchurian territory, and passes through the Manchurian towns of Tsitsikar, Harbin on the Sungari, and Ninguta. Plans were also mnde for a branch line, from Kharbin to Port Arthur, vid Bedune, Mukden, and Niuohwang. The first portion of the Trans – Manchurian railway, built by Russian engineers, with Chinese labour, and under the protection of Russian troops, was in a fair way of progress before the Boxer uprising ; and though the troubled

state of the country compelled operations to be suspended for some time in 1900-01, work was recommenced in the summer of the latter year. Both sections,

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Kaidalovo-Vladivostok and Harbin-Port Arthur, are now (1902) virtually completed. At the same time, several secondary lines were built in connexion with the Trans-Siberian line. Chelyabinsk has also been connected by a transverse line with the Middle Urals Railway, which connects Perm, the head of navigation in the Volga basin, with Tyumen, the head of navigation on the Ob and Irtysh, passing through Ekaterinburg and other mining centres of the Middle Urals. Tomsk is now counected with the main line, and various lines are being built in the Urals. A railway has also been built to connect Perm with Kotlas, near the junction of the Sukhona with the Yug, at the head of the Northern Dvina. Throughout its length, which is 538 miles, it passes through a very thinly populated region, but it is hoped that it will provide an outlet for Siberian grain and other produce in the direction of the White Sea. The traffic along the Trans-Siberian line is rapidly growing, and in 1899 the exports had attained 280,000 tons, chiefly grain, butter, meat, cattle, hides, &c.

Another line of great strategic, and apparently of commercial, importance has been built across the Transcaspian territory to Fergana. Starting from Uzunada and Krasnovodsk, it runs first south-east to Merv (604 miles), with a branch line (194 miles) to Kushka, near Herat, then north-east across the desert to Charjui, on the Amur river, Bukhara, and the Russian fort Katty- kurgan, and then to Samarkand, Kokand, and Andijan in Fer- ghana, 1267 miles from Merv, with a branch to Tashkent (204 miles), and another to New Marghilan and Kuva (about 50 miles). This great railway, 2319 miles long with the above- mentioned branches, was partly built by the military railway battalions, and has already become an important line of trafiBo for the' export of raw cotton from Central Asia to Russia. A line of steamers runs from Uzunada in regular

communication with the Caucasus at Baku. The Central Asian line is going to be connected now by another line of great importance, from Tashkent down the Syr-Daria to Kazalinsk, and thence to Orenburg.

A third line of great importance that has lately been com- pleted is the junction line between the Transcaucasian railway ❓❓❓ which runs from Batum and Poti to Baku, vid Tiflis, with a branch line to Kars ❓❓❓ and the railway system of Russia proper. This junction has been effected not across the main Caucasus Range, but at its eastern extremity, that is, vid the Caspian ports of Baku and Petrovsk, which are connected with Vladikavkaz (Beslan junction). The Black Sea port of Novorossiysk, in Western Caucasia, having been connected with the Rostoif-Vladikavkaz line, has consequently also been brought into touch with the Russian railways. A number of important railways have also been built in Russia proper, especially on the western frontier. The Volga is now reached from Central Russia by seven lines of rail- ways, including one to Kazafi, and three main lines radiate from the Volga eastwards (one to Siberia and two to the Ural river), while the upper Volga (Yaroslavl) is connected with Arkhangelsk by a line 523 miles long. A zone tariff was introduced on the Russian railways in 1894, and the cost of long journeys was con- siderably reduced ; a journey of 1000 versts (623 miles) can be made third class at a cost of only about 17 shillings, while for less than twice as much 1990 miles can be covered. Since that time the passenger traffic has much increased and attained 91,537,000 in 1900. The rolling-stock on the Russian railways (9964 locomotives in 1899) still remains insufficient. It is estimated, however, that about 400 engines and 15,000 carriages can be built every year within Russia itself. The State railways in Finland represent a network comprising 1585 miles of line, and advance as far north as Uleaborg (continued to Tornea), Kuopio, and loensun.

Posts mid Telegraphs. ❓❓❓ The number of letters, books, periodicals, and parcels carried by the Russian post office internally has rapidly increased, from 344,320,000 in 1890 to 668,859,800 in 1899, while in the same time the foreign pieces of mail carried increased from 44,320,000 to 79,700,000. The length of telegraph lines in 1899 in the Russian empire

was 98,590 miles (18,719,460 messages, exclusive of railway telegrams), and of telephone lines 45,977 miles.

Authorities. ??? The Husskiy Encyclopedicheskiy Slovar, edited by Brockhaus and Efrox, was begun in 1890, with the idea of giving a Russian version of Brockhaus's Conversations Lcxikon, but from the very first volumes it became a monumental encyclopedia, to which all the best Russian men of science contributed ; it is, indeed, an inexhaustible source of information, on everything Russian. ??? A general popular description of Russia entitled Rossiya, containing excellent geographical, geological, and other descriptions of separate regions, and very well chosen illustrations, was begun in 1899 by a number of young Russian geographers and naturalists, under the editorship of V. P. Semenofp and the general super- vision of P. P. Semexoff and V. I. Lamanskiy. Two volumes of this excellent publication had been issued up to 1901. ??? Besides the official publications mentioned in the ninth edition and in this article, several volumes of statistics have been published, in English and French, in connexion with the Exhibitions of Chicago

and Paris, of which La Mussie a la Jin du xix' sUcle, under the editorship of M.W. Kovalevsky, is especially worthy of notice. See also Norman. All the Eussias. 1902. (p. a. K.)

Eecent Histoey.

Tn the history of Riissia the period extending from 1882 to 1902 was much less eventful than the thirty years immediately preceding. The reign of Alexander II. (1855-81) had been a time of important administrative reforms and of great economic, social, and intellectual changes in the Hfe of the nation. Serfage had been abolished, the emancipated peasantry had been made communal proprietors of the soil, a democratic system of rural and municipal self-government for local affairs had been introduced, the tribunals of all degrees had been radically reorganized, means had been taken for develop- ing more energetically the vast natural resources of the country, pubUc instruction had received an unprecedented impetus, a considerable amount of liberty had been accorded to the press, a Liberal spirit had been suddenly evoked and had spread rapidly among all

sections ^ .. . of the educated classes, a new imaginative and changes critical literature dealing largely with economic, during philosophical, and social questions had sprung reign ot into existence, and for a time the young genera- ^^e-^*’”’” tion fondly imagined that Russia, awakening from her traditional lethargy, was about to overtake, and soon to surpass, on the path of national progress, the more advanced nations of western Europe. These sanguine expectations were not fully realized. The economic and moral condition of the peasantry was not much improved, and in many districts there were signs of positive impoverishment and demoralization. Local self-govern- ment, after a short period of feverish and not always well-directed activity, showed sjmiptoms of organic ex- haustion. The reformed tribunals, though incomparably better than their predecessors, did not give universal satisfaction. In the imperial administration the corrup- tion and long-estabHshed abuses which had momentarily vanished began to reappear. Industrial enterprises did not always succeed. Education produced many unforeseen and undesirable practical results. The liberty of the press not unfrequently degenerated into licence. The Liberal spirit, which had at first confined itself to demanding feasible reforms, soon soared into the region of Socialistic dreaming and revolutionary projects. In short, it became only too evident that there was no royal road to national prosperity, and that Russia, hke other nations, must be content to advance slowly and laboriously along the rough path of painful experience. In these circumstances sanguine enthusiasm naturally gave way to despondency, and the reforming zeal of the Government was replaced by tendencies of a decidedly reactionary kind. Already in the last years of the reign of Alexander II. these tendencies had found expression in ukases and ministerial circulars, and zealous Liberalism was more and more dis- countenanced in the official world. Partly from a feeling of despondency, and partly from a conviction that the country required rest in order to judge the practical results of the reforms already accomplished, the Tsar refrained from initiating any new legislation of an important kind, and the Government gave it to be understood that the period of radical reforms was closed.*

In the younger ranks of the educated classes this state of things produced much dissatisfaction, which soon found expression in revolutionary agitation. At first the agitation was of an academic character, and was

dealt with by the press Censure, but it gradually took the form of secret association, and the police had to interfere. There were no great, well-organized secret societies, but there were

many small groups, composed chiefly of male and female students of the universities and tecltnical schools, which worked independently for a common purpose. That pur- pose was the overthrow of the existing regime and the reorganization of society on CoUectivist principles. Find- ing that the walls of Autocracy could not be overturned Revola- ^y blasts of revolutionary trumpets, the young tionary enthusiasts determined to seek the support of move- the masses, or, as they termed it, "to go in meats. among the people " {idti v narod). Under the disguise of doctors, midwives, teachers, governesses, factory hands, or common labourers, they sought to make proselytes among the peasantry and the workmen in the industrial centres by revolutionary pamphlets and oral explanations. For a time the propaganda had very little success, because the uneducated peasants and factory workers could not easily understand the phraseology and principles of scientific Socialism; but when the propa- gandists descended to a lower platform and spread rumours that the Tsar had given all the land to the peasants, and that the proprietors were preventing his benevolent inten- tions from being carried into effect, there was a serious danger of agrarian disturbances, and energetic measures were adopted by the authorities. Wholesale arrests were made by the police, and many of the accused were im- prisoned or exiled to distant provinces, some by the regular judicial procedure, and others by so-called " administrative procedure," without trial. The activity of the police and the sufferings of the victims naturally produced intense excitement and bitterness among those who escaped, and a secret body caUing itself the Executive Committee announced in its clandestinely printed organs that those who distinguished themselves by endeavouring to suppress the propaganda would be removed. A number of officials were condemned to death by this secret terrorist tribunal, and in some cases its sentences were

carried out. General Mezentsof, the head of the gendarmerie which fulfilled the functions of political police, was assassinated in open daylight in one of the principal streets of St Petersburg, and in the provinces a good many officials of various degrees shared the same fate. As these terrorist measures had quite the opposite of the desired effect, repeated attempts were made on the life of the Emperor. In April 1879 a man called Solovieff fired six shots from a revolver at his Majesty at close quarters. In the fol- lowing December an attempt was made to blow up the imperial train near Moscow, and in February 1880 a

number of conspirators caused an explosion of CeatA of dynamite under the dining-room of the Winter jj Palace, by which ten persons were killed and

thirty-four wounded, and the imperial family narrowly escaped by not having sat down to dinner punctually. At last, on 13th March 1881, the carefully- laid plans of the conspirators were successful. When driving home from a military parade, near the Winter Palace, Alexander II. was terribly wounded by the explo- sion of several small bombs, and died shortly afterwards.

Finding repressive police measures insufficient to suppress the revolutionary movement, Alexander II. had entertained the idea of giving a certain satisfaction to moderate Liberal opinion without restricting his auto- cratic power. With this object in view he had appointed General Loris-Melikoff, who was credited with Liberal views, minister of the interior, and on the morning of his death he had signed a ukase creating several com- missions, composed of high official iicrsonages and eminent private individuals, who should prepare reforms in various branches of the administration. His son and successor Alexander III. (1881-94), who had never shown much sympathy with Liberalism in any form,

*entered frankly on a reactionary policy, which was pur- sued consistently during the whole of his reign. He could not, of course, undo the great reforms neaction of his predecessor, but he amended them in under such a way as to counteract what he con- Alexander sidered the exaggerations of Liberalism. Local "***?***'***?***self-government in the village communes, the rural districts, and the towns was carefully restricted, and*

placed to a greater extent under the control of the regular officials. The reformers of the previous reign had en- deavoured to make the emancipated peasantry adminis- tratively and economically independent of the landed proprietors ; the Conservatives of this later era, proceeding on the assumption that the peasants did not know how to make a proper use of the liberty prematurely conferred upon them, endeavoured to re-establish the influence of the landed proprietors by appointing from amongst them "land-chiefs," who were to exercise over the peasants of their district a certain amount of patriarchal juris- diction. The reformers of the previous reign had sought to make the new local administration (zemstvo) a system of genuine rural self-government and a basis for future parliamentary institutions ; these later Conservatives transformed it into a mere branch of the ordinary State administration, and took precautions against its ever assuming a poKtical character. Even municipal in-' stitutions, which had never shown much vitality, were subjected to similar restrictions. In short, the various forms of local self-government, which were intended to raise the nation gradually to the higher political level of western Europe, were condemned as unsuited to the national character and traditions, and as productive of disorder and demoralization. They were accordingly re- placed in great measure by the old autocratic methods of administration, and much of the administrative cor- ruption which had been cured, or at least repressed, by the reform enthusiasm again flourished luxuriantly.

In a small but influential section of the educated classes there was a conviction that the revolutionary tendencies, which culminated in Nihilism and Anarchism, proceeded from the adoption of cosmopolitan rather than national principles in all spheres of educational and ad-ministrative activity, and that the best remedy for the evils from which the country was suffering was to be found in a return to the three great principles of Nation- ality, Orthodoxy, and Autocracy. This doctrine, which had been invented by the Slavophils of a previous genera- tion, was early instilled into the mind of Alexander III. by M. Pobiedonostsef {q.v.), who was one of his teachers, and later his most trusted adviser, and its influence caii be traced in all the more important acts of the Government during that monarch's reign. His determination to main- tain autocracy was officially proclaimed a few days after his accession. Nationality and

Eastern Orthodoxy, which are so closely connected as to be almost blended together in the Russian mind, received not less attention. Even in European Russia the regions near the frontier contain a great variety of nationalities, languages, and religions. In Finland the population is composed of Finnish-speaking and Swedish-speaking Protestants; the Baltic provinces are inhabited by German – speaking, Lett – speaking, and Esth-speaking Lutherans; the inhabitants of the south- western provinces are chiefly Polish – speaking Roman Catholics and Yiddish – speaking Jews ; in the Crimea and on the Middle Volga there are a considerable number of Tatar-speaking Mahommedans ; and in the Caucasus there is a conglomeration of races and languages such as is to be found on no other portion of the earth's surface. Until recent times these various nationalities were allowed to retain unmolested the language, religion,

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and peculiar local administration of their ancestors, but when the new nationality doctrine came into fashion attempts were made to spread among them the language, religion, and administrative institutions of the dominant race. In the reigns of Nicholas I. and Alexander II. these attempts were merely occasional and intermittent ; under Alexander III. they were made systematically and with very little consideration for the feelings, wishes, and interests of the people concerned. The local institutions were assimilated to those of the purely Eussian provinces ; the use of the Piussian language was made obUgatory in the administration, in the tribunals, and to some extent in the schools ; the spread of Eastern Orthodoxy was encouraged by the authorities, whilst the other confessions were placed under severe restrictions ; foreigners were prohibited from possessing landed property, and in some provinces administrative measures were taken for making the land pass into the hands of Orthodox Eussiana. In this process some of the local officials displayed probably an amount of zeal beyond the intentions of the Govern- ment, but any attempt to oppose the movement was rigorously

punished. Of all the various races the Jews were the most severely treated. The great majority of them had long been confined to the western and south-western provinces. In the rest of the country they had not been allowed to reside in the villages, because their habits of keeping vodka-shops and lending money at usurious interest were found to demoralize the peasantry, and even in the towns their number and occupations had been restricted by the authorities. But, partly from the usual laxity of the administration and partly from the readi- ness of the Jews to conciliate the needy officials, the rules had been by no means strictly applied. As soon as this fact became known to Alexander III. he ordered the rules to be strictly carried out, without considering what an enormous amount of hardship and suffering such an order entailed. He also caused new rules to be enacted by which his Jewish subjects were heavily handicapped in education and professional advancement. In short, com- plete Eussification of all non-Eussian populations and institu.tions was the chief aim of the Government in home affairs.

In the foreign policy of the empire Alexander III likewise introduced considerable changes. During his father's reign its main objects were : in the West, the maintenance of the alhance with Germany; in South-Eastern Europe, the recovery of what 'had been lost by the Crimean war, the gradual weakening of the Sultan's authority, and the increase of Eussian infl^ience Foreign aj^ong i}^q minor Slav nationalities j in Asia, the gradual but cautious expansion of Eussian domination. In the reign of Alexander III. the first of these objects was abandoned. Already, before his accession, the bonds of friendship which united Eussia to Germany had been weakened by the action of Bismarck in giving to the cabinet of St Petersburg at the Berlin Congress less diplomatic support than was expected, and by the Austro-German treaty of aUiance (October 1879), concluded avowedly for the purpose of opposing Eussian aggression ; but the old relations were partly re-established by secret negotiations in 1880, by a meeting of the young Tsar and the old Emperor at Danzig in 1881, and by the meeting of the three Emperors at Skiernevice in 1884, by which the Three Emperors' League was reconstituted for a term of three years (see Eueope : Recent History). Gradually, however, a great change took place in the Tsar's views with regard to the German alliance. He suspected Bismarck of harbouring

hostile designs against Eussia, and he came to recognize that the permanent weakening of France was not in accordance with Eussian political

interests. He determined, therefore, to oppose any further disturbance of the balance of power in favour of Germany, and when the treaty of Skiernevice expired in 1887, he declined to renew it. From that time Eussia gravitated slowly towards an alliance with France, and sought to create a counterpoise against the Triple Alliance of Germany, Austria, and Italy. The Tsar was reluctant to bind himself by a formal treaty, because the French Government did not offer the requisite guarantees of stability, and because he feared that it might be induced, by the prospect of Eussian support, to assume an aggressive attitude towards Germany. He recognized, however, that in the event of a great European war the two nations would in all probability be found fighting on the same side, and that if they made no preparations for concerted military action they would be placed at a grave dis- advantage in comparison with their opponents of the Triple Alliance, who were behoved to have already worked out an elaborate plan of campaign. In view of this contingency the Eussian and French military authorities studied the mihtary questions in common, and the result of their labours was the preparation of a military con- vention, which was finally ratified in 1894. During this period the relations between the two Governments and the two countries became much more cordial. In the summer of 1891 the visit to Kronstadt of a French squadron under Admiral Gervais was made the occasion for an enthusiastic demonstration in favour of a Franco-Eussian alliance ; and two years later (October 1893) a still more enthusiastic reception was given to the Eussian Admiral Avelan and his officers when they visited Toulon and Paris. But it was not till after the death of Alexander III. that the word ” aUiance ” was used publicly by official personages. In 1895 the term was first publicly em- ployed by M. Eibot, then president of the council, in the Chamber of Deputies, but the expressions he used were so vague that they did not entirely remove the prevailing doubts as to the existence of a formal treaty. Two years later (August 1897), during the official visit of M. Felix Faure to St Petersburg, a little more light was thrown on the subject. In the complimentary speeches deHvered by the President of the French EepubKc and the Tsar, France and Eussia were

referred to as allies, and the term ” nations alliees ” was afterwards repeatedly used on occasions of a similar kind.

In south-eastern Europe Alexander III. adopted an attitude of reserve and expectancy. He greatly increased and strengthened his Black Sea fleet, so as to be ready for any emergency that might arise, and in June 1886, contrary to the declaration made in the Treaty of Berlin (Art. 59), he ordered Batum to be transformed into a fortified naval port, but in the Balkan Peninsula he persistently refrained, under a good deal of provocation, from any intervention that might lead to a European war. The Bulgarian Government, first under Prince Alexander and afterwards under the direction of M. Stambolof, pursued systematically an anti-Eussian policy, but the cabinet of St Petersburg confined itseK officially to breaking off diplomatic relations and making diplomatic protests, and unofficially to giving tacit encouragement to revolutionary agitation.

In Asia, during the reign of Alexander III. the expan- sion of Eussian domination made considerable progress. A few weeks after his accession he sanctioned the annexa- tion of the territory of the Tekke Turkomans, which had been conquered by General Skobelef, and in 1884 he formally annexed the Merv oasis without military operations. He then allowed the military authorities to push forward in the direction of Afghanistan, until in March 1885 an engagement took place between Eussian

and Afghan forces at Penjdeli. Thereupon the British Government, which had been for some time carrying on negotiations with the cabinet of St Petersburg for a delimitation of the Russo – Afghan frontier, intervened energetically and prepared for war; but a compromise was effected, and after more than two years of negotia- tion a delimitation convention was signed at St Peters- burg on 20th July 1887. The forward movement of Russia was thus stopped in the direction of Herat, but it continued with great activity farther east in the region of the Pamirs, until another

Anglo-Russian conven- tion was signed in 1895. During the whole reign of TUexander III. the increase of territory in Central Asia is calculated by Russian authorities at 429,895 square kilometres.

*On 1st November 1894 Alexander III. died, and was succeeded by his son, Nicholas II., who, partly from similarity of character and partly from veneration for his father's memory, continued the existing lines of policy in home and foreign affairs. The expectation entertained in many quarters that great legislative changes Alexander would at once be made in a Liberal sense was ///.; acces- not realized. When an influential deputation slon of from the province of Tver, which had long * 'enjoyed a reputation for Liberalism, ventured to hint in a loyal address that the time had come for changes in the existing autocratic regime, they received a reply which showed that the Emperor had no intention of making any such changes. Private suggestions in the same sense, ofi'ered directly and respectfully, were no better received, and no important changes were made in the legislation of the preceding reign. But a great alteration took place noiselessly in the manner of carrying out the laws and ministerial circulars. Though resem- bling his father in the main points of his character, the young Tsar was of a more humane disposition, and he was much less of a doctrinaire. With his father's aspira- tion of making Holy Russia a homogeneous empire he thoroughly sympathized in principle, but he disliked the systematic persecution of Jews, heretics, and schisma- tics to which it gave rise, and he let it be understood, without any formal order or proclamation, that the severe measures hitherto employed would not meet with his approval. The officials were not slow to take the hint, and their undue zeal at once disappeared. Nicholas II. showed, however, that his father's policy of Russification was neither to be reversed nor to be abandoned. When an influential deputation wais sent from Finland to St Petersburg to represent to him respectfully that the officials were infringing the local rights and privileges solemnly accorded at the time of the annexation, it was refused an audience, and the leaders of the movement were informed indirectly that local interests must be subordinated to the general welfare of the empire. In accordance with this declaration, the policy of Russification in Finland was steadily maintained, and caused much dis- appointment, not only to the*

Finlanders, but also to the other nationalities who desired the preservation of their ancient rights.

In foreign afiairs Nicholas II. likewise continued the policy of his predecessor, with certain modifications sug- gested by the change of circumstances. He strengthened the cordial understanding with France by a formal agree- ment, the terms of which were not divulged, but he never encouraged the French Government in any aggressive designs, and he maintained friendly relations with Germany. In the Balkan Peninsula a slight change of attitude took place. Alexander III., indignant at what he considered the ingratitude of the Slav nation- alities, remained coldly aloof, as far as possible, from

all intervention in their affairs. About three months after his death, M. de Giers, who thoroughly approved of this attitude, died (26th January 1895), and his suc- cessor. Prince Lobanof, minister of foreign affl'airs from 19th March 1895 to 30th August 1896, endeavoured to recover what he considered Russia's legitimate influence in the Slav world. For this purpose Russian diplomacy became more active in south-eastern Europe. The result was perceived first in Montenegro and Servia, and then in Bulgaria. Prince Ferdinand of Bulgaria had long been anxious to legalize his position by a reconciliation, and as soon as he got rid of M. Stambolof he made advances to the Russian Government. They were well received, and a reconciliation was effected on certain conditions, the first of which was that Prince Ferdinand's eldest son and heir should become a member of the Eastern Orthodox Church. As another means of opposing Western influence in south- eastern Europe, Prince Lobanof inclined to the policy of protecting rather than weakening the Ottoman empire. When the British Government seemed disposed to use coercive measures for the protection of the Armenians, he gave it clearly to be understood that any such proceeding would be opposed by Russia. After Prince Lobanofs death and the appointment of Count Muravieff as his successor in January 1897, this tendency of Russian policy became less marked. In April 1897, it is true, when the Greeks provoked a war with Turkey, they received no support from St Petersburg, but at the close of the war the Tsar showed himself more friendly to them; and afterwards, when it proved extremely difficult to find a suitable person as governor-general of

Crete (see Ceete), he recommended the appointment of his cousin, Prince George of Greece ??? a selection which was pretty sure to accelerate the union of the island with the Hellenic kingdom. How far the recommendation was due to personal feeling, as opposed to political considera- tions, it is impossible to say.

In Asia, after the accession of Nicholas II. the expan- sion of Russia, following the line of least resistance and stimulated by the construction of the Siberian Railway, was effected at the expense of China. That she had already in 1895 marked out Manchuria as within her sphere of influence was proved by the fact that, at the close of the Chino-Japanese war of that year, she objected to all annexations by Japan in that quarter, and insisted on having the treaty of Shimonoseki modified accord- ingly. Subsequently, by means of railway construction, annexation of Port Arthur and the Liaotung peninsula, financial operations, and various conventions with the Chinese Government, she greatly tightened her hold on that portion of the Chinese empire (see China and Siberia).

As a necessary basis for a strong foreign policy the army was systematically strengthened (see Armies : Russia). At one moment the schemes for military re- organization involved such an enormous expenditure that the Tsar conceived the idea of an agreement among the Great Powers to arrest the increase of national armaments. The idea was communicated to the Powers somewhat abruptly by Count Muraviefi', Prince Lobanofs successor in the direction of foreign affairs, and an international conference was held at The Hague to discuss the subject ; but it had very little practical result, and certainly did not attain the primary object in view (see Peace Con- ference).

A sketch of the recent history of Russia, however brief, would be incomplete without some mention of the remark- able industrial progress made during the period under consideration. Protected by high tariffs and fostered by the introduction of foreign capital, Russian manufacturing

industry made enormous strides. By way of illustration

a few figures may be cited. In the space of ten years

(1887-97) the number of workers employed in the various

branches of industrial enterprise rose from

l□□□!!firf ‘ 1,318,048 to 2,098,262 (see under Industey). progress. J, ‘ ^- j i.j. j □□□ □□□

ihe consumption ot cotton for spmning pur- poses, which was only 117 million kilograms in 1886, was 257 millions in 1898, and the number of spindles, accord- ing to the weekly journal Russia of 2nd August 1902, was estimated at that date at 6,970,000. Thanks chiefly to this growth of the cotton industry, the town of todz, which was little more than a big village in 1875, has now a population of over 300,000. The iron, steel, and petroleum industries have likewise made enormous progress. Between 1892 and 1900 the estimated value of metallic articles manufactured in the country rose from 142 millions to 276 millions of roubles. As is generally the case in such circumstances, protection led to temporary over-production, which brought about a financial and economic crisis ; but if we may accept certain figures given by Mr Henry Norman in his All the Russias (London, 1902), the crisis could not have been very severe, for he states that ” no fewer than 580 com- panies declared a dividend during the first nine months of 1901, their total nomiual capital being □□105,000,000, and the average dividend no less than lO’l per cent.” Much of this progress is due to the intelligence and energy of M. Witte, minister of finance. (d. m. w.)

Eecent Liteeattjre.

The death of Nekrasoflf in 1877 deprived Kussia of her most eminent poet since the days of Pushkin and Lermon- toff. During the last generation of the 19th century the Titans of her literature departed, and cannot be said to have left successors of equal merit. Dostoievski, Pisemsky, Tourguenieff, Goncharofi’, Ostrovski, and Salti- koff followed each other to the grave in rapid succession. In 1895 Apukhtin, author of many

graceful lyrics, died; in 1897 ApoUon Maikoff, also a lyric poet of considerable power; and soon afterwards Polonski. These men were well known throughout Kussia. A new school of poets has sprung up, consisting for the most part of the so-called decadents and symbolists. Among them may be mentioned A. Korinfski ; Ivan Bunin, who shows much feeling for nature, and has published an excellent translation of Long- fellow's Hiawatha ; and Constantine Balmont. The last of these has given to the public several volumes of Ijn^ics, many of which exhibit a graceful imagination and a capacity for skilfully reproducing various poetic moods. His command of all rhythms is astonishing, and owing to this gift, he has been a successful translator. Thus we may point to his excellent version of Shelley, besides translations from Edgar Allen Poe, Ibsen, and Calderon. We must also find room for the names of V. Briusoff and K. Sluchevski. Two female poets may be mentioned here, Mme Gippius- Merszhkovskaya and Mme Lokhvitskaya. It will be seen that the modern tendency in Eussia is wholly to lyric poetry. These productions are often pervaded by an air of melancholy and Weltschriierz. The drama is not in a flourishing condition. Very little of merit has been produced since the great trilogy of Alexis Tolstoy dealing with the reign of Ivan the Terrible ??? full of picturesque horrors for the dramatist ??? and the bourgeois comedies of Ostrovski.

If we turn to history, in which the Eussians have always shown considerable talent, we can cite some really good work. Of course we cannot here find room to dis- cuss the publications of the various historical societies in the country, nor the valuable memoirs and other

documents which are constantly appearing in the Russian Antiquary (Russkapa Starina) ; the Historical Mes- senger {Istoricheski Viestnih), and other journals, the name of which is legion. In 1897 Professor Bestuzhefi-Riumin, of the University of St Petersburg, died. He had held his chair of history since 1865. His valuable History of Russia must now remain a torso only, the first volume and the first half of the second having alone appeared. Solovieff and Kostomaroff are dead. The famous school of Russian historians is thus almost extinct. But some excellent writers in this department have come to the front. Professor Miliukoff has published the first volume of his Sketches of the Histcyry of Russian

Culture {Ocherki pa istorii russkoi hdturi), wluch has been much read. Pro- fessor BUbasoff is continuing his History of Catherine II. Some parts of this work appear to have been extensively mutilated by the censor. D. Evarnitski has added a third volume to his interesting work on the Zaporozhian Cossacks. The Russians have always enjoyed a considerable reputation as memoir – writers, and the Recollections of Mme Smirnoff, which first appeared in the Northern Messenger (Sievernii Viestnik) proved very interesting owing to her familiarity vvdth court life and her intimacy with the leading men of the time who frequented her salon. Pushkin appears before us in the most minute detaUs of his everyday life. The centenary of his birth (1899) was signalized by the publication of many interesting monographs on his strange career. The details furnished by his nephew, L. Pavlistchefl', were especially noteworthy. The second volume appeared of the classical History of the Russian Church, by E. Golubinski. A valuable contribution to early Russian history was furnished .by the Legal Antiquities (Youri- dicheskia Drevrosti) of V. Serguievich, by which quite a new light has been thrown upon the Russian sobor. The weU-known savant, Maxime Kovalevski, published the second volume of his Economic Development of Europe to the Rise of Capitalism. N. Eozhkoff wrote an im- portant work entitled Village Economy in Muscovy in the Sixteenth Century. This book analyses the conditions under which economic production was developed in Old Eussia. S. Platonoff published a History of the Insur- rections in Russia in the Sixteenth and Seventeenth Cen- turies. He holds entirely new views on the oprichina, the famous bodyguard of Ivan the Terrible. Professor B. Kliuchevski, of the University of Moscow, published in 1 883 a valuable book on the Eussian Duma, as the Privy Council of the emperors was called, and in 1899 he issued his Aids to Lectures on Russian History. The study of the early institutions of their own country has always been actively pursued by Eussian writers. They have less often devoted themselves to the political and social conditions of other countries, but an exception must be made in the case of the book by Professor Vinogradoff of Moscow, entitled Investigations into the Social History of England in the Middle Ages (1887). The learned author also prepared an edition of this work for the English public.

As yet no worthy successors have appeared of the great Eussian novelists, Gogol, Tourguenieff, Dostoievski, and Tolstoy. We can hardly hope for such a constellation to appear again. Tolstoy, however, although advanced in years, and having almost deserted artistic production, shows no falling off in his latest work. Resurrection, a monument of his vigorous and deeply pathetic realism. In the region of fiction A. Chekhov of the younger school is especially remarkable. He is still in the prime of life, and has already shown great power in his short stories. Some of the tales of Gorki, Ertel, and Yasinski are also of great merit. The brilliant Garshin died insane in 1888.

(w. E. M.)

Rustchuk, or EoucHCHOUK, capital of a depart- ment in the principality of Bulgaria. It is situated on the south bank of the Danube, opposite the Eumanian town of Giurgevo, 139 miles north-west of Varna, on the railway line to Varna, and at the terminus of a line joining the central Sofia- Varna Railway near Tirnovo. Though no longer of strategic value, the town has acquired new importance owing to a great revival of commercial prosperity. The principal buUdings are the custom-house, the municipal buildings, the theatre, the arsenal, and the barracks. The town possesses tobacco and cigarette factories, soap works, breweries, aerated water factories, dye-works, tanneries, saw-mills, brick and tile works, and a celebrated pottery. In 1897 the exports amounted to 20,225 tons, valued at ❓❓110,968, and in 1900 to 18,827 tons, valued at ❓❓110,470 ❓❓❓ the imports in the same years being 44,223 tons, valued at ❓❓616,573, and 20,285 tons, valued at only ❓❓240,844. Population (1900), 32,661.

Rustenburg. See Teansvaal.

Ruthergflen, a royal and parliamentary burgh (Kilmarnock group) of Lanarkshire, Scotland, on the Clyde, 2 miles south-east of Glasgow by rail. Dye-works, chemical works, cotton- weaving factories, chair, tube,

and rope and twine works are among the industrial features. Population of royal burgh (1891), 13,361 ; (1901), 18,280.

Ruthin, a municipal borough and market-town, Den- bighshire, North Wales, 21 miles west by south of Chester by rail, on the river Clwyd. It belongs to the Denbigh district of boroughs, which returns one member to Par- liament. It is governed by a mayor, 4 aldermen, and 12 councillors. The grammar school has produced many distinguished men, and new buildings, in grounds 8 acres in extent, were opened in 1893, near the town. Scholar- ships connecting it to the universities have been established. Population of the municipal borough (1891), 2760 ;

(1901), 2641.

Rutland, a north midland county of England, bounded on the N. by Leicester and Lincoln, on the S.E. by Northampton, and on the W. by Leicester.

Area and Population. ??? In 1891 the area of the ancient (geograph- ical) county, with which that of the administrative county coincides, was 97,273 acres, and the population 20,659, of whom 10,323 were males and 10,336 females ; and in 1901, 19,708. Thus there was a decrease of 951 between 1891 and 1901, or at the rate of 4-6 per cent., as compared with a decrease of 3 ‘6 per cent, between 1881 and 1891, and of 2-9 per cent, between 1871 and 1881. In 1901 there were 0‘20 persons to an acre, and 4‘94 acres to a person. In the same year the area of the registration county was 108,700 acres, and the population 20,742.

The subjoined table gives particulars of the birth-rate, death- rate, and illegitimacy-rate, and the number of persons married per thousand inhabitants : ???

of the corn crops, and in fallow land, and an increase in the per- manent pasture and meadow land. In 1900 a total of 78,188 acres were farmed by tenants and 8263 acres by the owners ; the corre- sponding figures in 1889 were 74,811 and 12,113 acres, and in 1895, 74,159 and 13,165 acres respectively.

The following table shows the areas under the different kinds of crops at the periods named : ???

1871-80.

1881-90.

1889-98.

1899.

Birth-rate . Death-rate . Illegitimate-rate . Marriage-rate

30-7 18-5 53 12-9

27-6 16-3 52 11-2

24-0 14-9 49 13-3

22-9 14-2 49 12-3

In 1891 the county contained 113 persons of Scottish birth, 71 of Iri.ih birth, and 71 foreigners. At the same date there were 22 blind persons, 6 deaf and dumb, and 21 insane.

Administration,

Education. ??? The number of elementary schools in the county on 31st August 1900 was 38, namely, 2 board schools and 36 voluntary schools, the latter including 35 National Church of England schools and 1 Roman Catholic school. The average attendance during the year amounted to 2803 out of 3349 on the register.

AgricuUwe. ??? Since 1885 there has been a decrease in the areas

Area in

Area under

Area under

Area of

Area under

Year.

Cultiva-

Com

Green

Bare

Permanent

tion.

Crops.

Crops.

Fallow.

Glass.

1885

86,477

22,820

7,520

1,768

47,816

1890

86,966

21,945

7,107

1,815

49,438

1895

87,324

20,541

7,612

1,422

51,850

1900

86,451

20,672

7,403

1,132

50,946

The next table shows the numbers of the live stock at the same periods : ???

Tear.

Cows and Heifers.

Other Cattle.

Total

Cattle.

Horses.

Sheep.

Pigs.

1885

4,251

15,559

19,810

3,062

81,328

3,054

1890

4,026

15,815

19,841

3,097

86,382

2,989

1895

3,420

14,092

17,512

3,151

82,809

3,234

1900

3,455

15,663

19,118

3,232

84,794

2,277

Eutland produces a little limestone and sandstone (8030 tons in all in 1900).

See C. "WoEDSWOETH. Rutland JFbrds (English Dialect Society). London, 1891.

Rutland, a city of Vermont, U.S.A., the capital of Eutland county. It is situated in 43 37′ N., 72 57′ W., in the valley of Otter Creek, and on the Ben- nington and Rutland, the Delaware and Hudson, and the Eutland railways, south-west of the centre of the state, at an altitude of 562 feet. It is divided into eleven wards, and has an excellent water-supply from East Creek by gravity. Eutland is best known for the quarries of fine marble in its vicinity. It contains large and varied manufactures, producing, among other things, machinery of various sorts and lumber products. Popu- lation (1890), 11,760; (1900), 11,499; showing a slight diminution in the preceding ten years. Of the population in 1900, 1533 were foreign-born.

Rutland, John James Robert

Manners, 7th Duke of (1818), English states- man, was born at Belvoir Castle on 13th December 1818, being the younger son of the 5th duke of Eutland by Lady Elizabeth Howard, daughter of Byron's guardian, the 5th earl of Carlisle. Lord John Manners, as he then was, was educated at Eton and Trinity College, Cambridge. In 1841 he was returned for Newark in the Tory interest, along with W. E. Gladstone, and sat for that borough until 1847. Subsequently he sat for Colchester, 1850-57; for North Leicestershire, 1857-85; and for East Leicestershire from 1885 until in 1888 he took his seat in the House of Lords upon succeeding to the dukedom. Melbourne's Whig Government had been doomed for some time before it went out in June 1841. The Tories came in with a large majority under Peel, and among Manners's friends who were successful in the constituencies, besides Gladstone, were Smythe (after- wards 7th Viscount Strangford) at Canterbury, Baillie- Cochrane (afterwards 1st Lord Lamington) at Bridport, and Disraeli at Shrewsbury. Cherishing many of the ideas of the Cavaliers of the 17th century, and full of political and literary ardour, he was soon prominent in the social group which revolved round Lady Blessington. He seems to have inherited the poetical ambition of his maternal grandfather, and in 1841 he committed some of his Loyalist and other fancies to a volume called England's Trust, and other Poems, which he dedicated to his friend Smythe, in which occurred the familiar line about " laws and learning" and "our old nobility." Before the end of

this year Manners had definitely associated himself with the "Young England" party, under the leadership of Disraeli. The Young England party sought to extinguish the predominance of the middle-class bourgeoisie, and to recreate the political prestige of the aristocracy by resolutely proving its capacity to ameliorate the social, intellectual, and material condition of the peasantry and the labouring classes. At the same time they looked for a regeneration of the Church, and the rescue of both the Church and Ireland from the trammels inherited from the Whig predominance during the 18th century. Out- side as well as inside Parliament Manners strenuously advocated these principles. He made an extensive tour of inspection in the industrial parts of northern England, in the course of which he and his friend Smythe expounded their views with a brilliancy which frequently extorted compliments from the leaders of the Manchester school. In 1843 he supported Lord Grey's motion for an inquiry into the condition of England, the serious disaffection of the working classes of the north being a subject to which he was constantly drawing the attention of Parliament. Among other measures that he urged were the disestablish- ment of the Irish Church, the modification of the Mortmain Acts, and the resumption of regular diplomatic relations with the Vatican. In the same year he issued in pamphlet form a strong Plea for Rational Holy days. In 1844 he vigorously supported the Ten-hours BiU, which, though strongly opposed by Bright, Cobden, and other members of the Manchester school, was ultimately passed in May 1847. In October during this year he took part in and spoke at the brilliant soiree held at the Manchester Athenaeum under the presidency of Disraeli. A few days later he and his friends attended a festival at Bingley, in Yorkshire, to celebrate the allotpient of land for gardens to working men, a step which, through the agency of his father, he had done a great deal to further. About the same time Smythe dedicated to him his Historic Fancies as to "the Sir Philip Sidney of our generation." Manners figured as Lord Henry Sydney in DisraeU's Goningsby, and not a few of his ideas are represented as those of Egremont in Sybil and Waldershare in Endymion. But the disruption of the Young England party was already

impending. Lord John's support of Peel's decision to increase the Maynooth grant in 1845 led to a difference with Disraeli. Divergences of opinion with regard to Newman's secession from the English Church produced further defections in the ranks, and the rupture was com- pleted by Smythe acquiescing in Peel's conversion to Free Trade. Lord John produced another volame of verse, known as English Ballads, chiefly patriotic and historical, in 1850. In the same year, as the fruit of a cruise in, Scottish waters, he wrote the letterpress for a sumptuous atlas of coloured views by J. C. Schetky ; and he published several pamphlets, one on the Chv/rch of England in the Colonies in 1851. During the three short administrations of Lord Derby (1851, 1858, and 1866) he sat in the cabinet as first commissioner of the Ofiice of Works. On the return of the Conservatives to power in 1874 he became postmaster-general in DisraeU's ad- ministration, and was made G.C.B. on his retirement in 1880. He was again postmaster-general, in Lord Sahs- bury's administration 1885-86, and was head of the department when sixpenny telegrams were introduced. Finally, in the Conservative Government of 1886-92 he was chancellor of the duchy of Lancaster. He succeeded to the dukedom in March 1888, upon the death of his elder brother, Charles Cecil John Manners (the Marquis of Beaumanoir of Coniiigsby), 6th duke of Rutland, an unflinching Protectionist and supporter of Lord George Bentinck. He was made KG. in 189L

RUVO, a town and episcopal see of Italy, Apulia, province of Bari, 21 miles west of Bari, with a cathedra], technical school, and a collection of antique vases (others at Naples) found in the place. It has olive-oil presses. Population (1900), about 17,000.

RuwenZOri, or Runsoeo, a great mountain range in Central Africa, lying between the equator and 1 N., and intersected at about its centre by 30 E. It possesses probably the most extensive snow-fields which exist in the whole of Africa, but being still imperfectly known, its greatest height cannot be estimated with any accuracy. The range forms a great volcanic mass, of which the core seems to be composed of coarse-grained granite rocks, flanked by schists,

The upper parts of the range are almost constantly veiled in cloud, which, however, gradually rises during the day, sometimes leaving the summits clear at about 5.30 P.M. As a result, perpetual moisture prevails above 7000 feet, and there is a very heavy rainfall, especi- ally in the districts on the east, a number of rushing streams descending to Lake Ruisamba (an arm of the Albert Edward Lake) on the east and the Semliki valley on the west, thus plajdng an important part in filling the source-reservoirs of the Nile. As on other high mountains of equatorial Africa, there is a regular succession of zones of vegetation, the belts being defined by Mr Scot1>Elliot as follows : ???

3850-5350 feet : Bananas and tall grasses. 6700 feet : Kmit of settlements, with Colocasia

and beans. Up to 8530 feet : forests of deciduous trees, with

Erica and bamboo. Up to 11,800 feet: Erica forests, bogs, and

Vaccineum. Up to snow-line (about 13,000 feet) : bushes,

tree ferns, grass, mosses, lichens. First seen from the Albert Lake by Gessi and Mason,

s. vni. ???45

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the true character and extent of the range were first brought to light by Stanley in 1888-89, when Lieutenant Stairs ascended (in 0??30′ N.) to a height of 10,677 feet. The northern and eastern slopes were first traversed by Lugard in 1891, while ascents to the snows, or near them, were afterwards made by Stuhlmann (1891), Scott-EUiot (1894; 12,640 feet), Moore (1900), Johnston (1900), and Wylde (1901), the last-named having possibly reached a higher point (15,000 feet by aneroid) than had been before attained.

AuTHOEiTlES. ►►► Stanley. In Darkest Africa. London, 1890. ►►► Stuhlmann. Mit Emin Pasha in's Eerz von AfriTca. Berlin, 1894. ►►► Scott-Elliot. A Naturalist in Mid-Africa. London, 1896. ►►► MooKE. "Tanganyika," &c., Geographical Journal, January 1901 ; To the Mountains of the Moon. London, 1901. ►►► Johnston. "The Uganda Protectorate," &c., GeograiMcal Journal, January 1902. (e. He.)

Ryazan, a government of Middle Kussia, lying to the south-east of the government of Moscow, with an area of 16,255 square miles. Its geology has now been carefully explored, and the physical description given in the ninth edition may now be supplemented by the statement that the province is vddely covered with the so-called Volga deposits, intermediate between Jurassic and Chalk, and by Chalk in the north-east. Quaternary deposits, represented by the Glacial boulder clay, also cover extensive areas. The domiciled population numbered 1,713,581 in 1882 and 1,827,539 in 1897, when there were 962,085 women in the province and the total urban population was only 166,122. More than half of the land (52 per cent.) is owned by the village communities, 40 per cent, by private owners, 5 per cent, by the Crown, and 2 per cent, by various institutions. During the last thirty years of the 19th century the nobles sold 36 per cent. (1,261,000 acres) of their lands, mainly to merchants and peasants ; the latter cultivate two-thirds of the total cultivated area. In 1900 there were 3,045,300 acres under cereal crops, and the average yield per annum in 1895-99 was : wheat 77,000 cwt., rye 10,044,000, oats 4,971,000►►► all cereal crops 17,037,000 cwt. ; potatoes also yielded 11,484,000 cwt. But the crops are still insufiicient for the needs of the inhabitants. Tobacco, hops, vegetables and fruit, however, are grown for export. The live stock included in 1896, 303,583 horses, 323,600 horned cattle, and 806,800 sheep, thus showing a considerable increase on the number of head in the province in 1882. Bee- keeping is also developing and manufactures increasing, there being in 1897, 4008 factories, which gave occupation to nearly 25,000 workers and showed a yearly output of ►►2,212,000. These factories are chiefly cotton mills, flour mills, machine works, tanneries, soap works, boot factories, match factories, and chemical works. Coal is extracted to the amount of about 77,000 tons per annum. The province is divided into twelve districts, the chief towns of which are Ryazan (see below), Dankov (9097), Egorievsk (19,241), Kasimoff

(13,545), Mikhailoff (9149), Pronsk (7827), Ranenburg (15,347), Eyazhsk (12,993), Sapozhok (8544), Skopin (14,737), Spassk (4760), and Zaraisk (8078). Small industries are carried on in the villages, especially in the northern part of the government, which belongs, properly speaking, to the Vladimir industrial region. Domestic trades, such as lace-making (supported by two schools) and embroidering on leather, give occu- pation to 40,000 women. Trade, especially in corn and manufactured goods, is brisk, and has been stimulated by the opening of coal mines, of which the Chulkovo mine, in the district of Skopin, is one of the largest. A number of secondary railways have been built in the government, and steamers now ply on the Oka river

from Nijni – Novgorod to Ryazan. Considerable efforts have been made by the local governing bodies to increase the number of schools, of which there were 964 in 1897. Most interesting archseological finds have been made in the government, which have been placed in the new museum at Ryazan.

RyaZEtn, the capital of the above government, 119 miles by rail south-east of Moscow, 1 mile above the junction of the Trubezh with the Oka. Owing to its situation on the great railway connecting Moscow with South-East Russia, and on a navigable river, Ryazan occupies a very advantageous position both as a centre of trade and of railway traffic. Its twenty factories (works for the manufacture of machinery and wax candles, and distilleries) give occupation to only a few hundred workers ; but its trade in grain and live stock is grovsdng, as also is its population, which was 30,325 in 1883 and 44,552 in 1897. In 1896 there were 31 schools, with 3860 pupils; and there is a good historical museum and library, with an archseological section, and various philanthropic institutions.

Ryazhsk, a district tovra of Russia, in the govern- ment and 70 miles south of the tovsoi of Ryazan. It is one of the chief railway junctions of Russia, where meet the lines from Moscow to South Russia and the Caucasus, and the railway from Poland to Samara and Siberia. Consequently it has become a very important centre of trade for all the

grain-growing regions of Russia, and is a wealthy place. Its population in 1897 was

12,993.

Rybinsk, a district town of Russia, in the govern- ment of Yaroslavl. It stands on the Volga, 186 miles by rail east of Bologoye, a junction on the St Petersburg- Moscow Railway. It is one of the most important towns of Central Russia, and has an exchange, a theatre, gymnasia for boys and girls, technical and navigation schools, and a great number of primary schools ; also numerous flour- miUs and breweries. It derives its importance mainly from being a centre for navigation on the upper Volga, and for trade in corn. Every year from 3800 to 4500 vessels enter (of which 1823 were steamers in 1898), while as many as 6300 clear. The aggregate tonnage of goods passing through the port annually is 1,327,310 entered and 1,124,200 cleared ❓❓❓ one-third by rail and two-thirds by the way of the canals connecting the Volga with St Petersburg. From 300,000 to 400,000 tons of wheat and rye and from 290,000 to 340,000 tons of oats pass through the port every year. The permanent population, which was 18,900 in 1883 and 25,223 in 1897, is increased in the summer by nearly 100,000 workers from difi^erent parts of Russia. Through- out the summer, indeed, Rybinsk might almost be said to be one huge fair for trade in agricultural produce.

Rydbergr, Abraham Viktor (1828-1895),

Swedish author and publicist, was born in Jonkoping on 18th December 1828. He showed an inclination to literature from his early boyhood. He was educated at the high school of “';ixio, and passed on to the University of Lund in 1851. While at school he was publishing verse and prose in the periodicals ; some of these early miscellanies he collected in 1894, in the volumes called Varia. As a student he turned to more precise labours, and devoted himself to science. He had almost determined to adopt the profession of an engineer, when he was offered in 1855 a post on the staff of one of the largest Swedish newspapers. This caused his thoughts to return to imaginative literature, and it Avas in

the feuilleton of this journal (the Goteborgs Handels-och ^dfartstidning)tlaa.t Viktor Eydberg's romances successively appeared ; he was editorially connected with it until 1876. The Freebooter on the Baltic (1857) and The Last of the Athenians (1859) gave Kydberg a place in the front rank of contemporary novelists. It was a surprise to his ad- mirers to see him presently turn to theology, but with The Bible's Teaching about Christ (1862), in which the aspects of modern Biblical criticism were first placed before Swedish readers, he enjoyed a vast success. He followed this up by a number of contributions to the popular philo- sophy of religion, all inspired by the same reverent and yet searching spirit of inquiry. The modernity of his views led to his being opposed by the orthodox clergy, but by the wider public he was greatly esteemed. Never- theless, it is said that it was his religious criticism which so long excluded him from the Swedish Academy, since he was not elected until 1877, when he had long been the first living author of Sweden. A very engaging work of Eydberg's is his Roman Days, a series of archaeological essays on Italy (1876). He collected his carefully polished poems in 1882 ; his admirable version of Faust dates from 1876. In 1884 he was appointed professor of ecclesiastical history at Stockholm. He died, after a short illness, on 1st September 1895. In Viktor Kydberg Sweden possessed a writer of the first order, who carried on the tradition of Bostrom and Geijer in philo- sophy and history, and possessed in addition a glow of imagination and a marvellous charm of style. He was an idealist of the old romantic type which Sweden had known for three-quarters of a century ; he was the last of that race, and perhaps, as a mere writer, the greatest. In personal character Eydberg was extremely like his writings ??? stately, ardent, and ceremonious, with a fund of amiability which made him universally beloved. It may make him more intelligible to the English reader to say that both in temperament and in the character of his writings Eydberg possessed a curious similarity to Charles Kingsley. His premature death was the subject of national mourning, and had even a historical signifi- cance, for with him the old romantic influence in Swedish literature ceased to be paramount. (e. g.)

Ryde, a municipal borough and watering-place, Hampshire, England, in the Isle of Wight, 5 miles south by west of Portsmouth and 12 miles by rail from Cowes. The pier has been entirely reconstructed by a combination of railway companies, so that passengers may step direct

from train to boat. This involved a pier half a mile long by the eide of the original pier, and also a tunnel under part of the town. Population of municipal borough

(1891), 10,952; (1901), 11,042.

RyCi a municipal borough, cinque port, and market town, Sussex, England, in the Eye parliamentary division of the county, on the river Eother, 63 miles south-south-east of London by rail. A steam tram-line from Eye to Camber, which has golf-links, was opened in 1895. Almshouses in honour of Queen Victoria's Diamond Jubilee were erected on the green by public subscription in 1897. Population of municipal borough (1891), 3871 ; (1901),

3900.

Ryezhitsa, a district tovra of Eussia, in the govern- ment and 199 mUes by rail north-west of the town of Vitebsk, on the railway from St Petersburg to Warsaw. It is an old town, founded in 1285, and temporarily annexed to Poland in 1561, but retaken by the Eussians in 1577, and finally annexed to Eussia in 1773. It has a very picturesque old castle. In 1897 its population was 10,681.

Rylsk, a district town of Eussia, in the government and 83 mUes west-south-west of the town of Kursk. It is connected by a branch line with the Kursk-to- Kiev Eailway. In the way of industrial establishments it has only oil works, but its merchants carry on an active trade in corn, hemp, and scythes imported from Austria. It has gjminasia for both boys and girls. In 1897 its population was 11,415. It is a very ancient town, founded in the 9th century, and is frequently mentioned in the annals from 1152 onwards. It derived importance from being an important post on the Eussian frontier down to the 18th century; its cathedral was buUt in the 15th century.

Rzeszdw, the chief town of a government district of the same name in Gahcia, Austria. It is situated on the Wislok, a tributary of the San, and is a station on the Cracow-Lemberg Eailway. It is the headquarters of an infantry and a cavalry brigade, has the most important horse fairs of GaUcia, and manufactures cloth and linen goods, goldsmiths' work, and tobacco pipes. It contains an old chateau of the princely family of Lubomirski, a Polish gymnasium, and a training college. Population (1890), 11,953; (1900), 14,714 (including gar- rison of 2296 men), almost exclusively Polish-speaking.

Sa,a.le, a river of Germany, originating between Bayreuth and Hof in the north-east of Bavaria, springing out of the Fichtelgebirge at an altitude of 2390 feet. It pursues a winding course in a northerly direction, flowing past Hof, Saalfeld, Eudolstadt, Jena, Naumburg, Weissen- fels, Merseburg, Halle, Bernburg, and Kalbe, and joins the Elbe (from the left) just above Barby, after traversing a distance of 226 miles. It is navigable from Naumburg, 100 miles, with the help of sluices, and is connected with the Elster near Leipzig by canal. The soil of the lower part of its valley is of exceptional fertility, and produces, amongst other crops, large supplies of sugar beetroot. Among its afiluents are the Elster, Eegnitz, and Orla (right bank), and the Ilm, Unstrut, Salza, Wipper, and Bode (left). Its upper course is rapid. Its valley (down to Merseburg) is picturesque, and even romantic, because of the many castles which crown the enclosing heights. It is sometimes called the Thuringian or Saxon

Saale, to distinguish it from another Saale (70 miles), a right-hand tributary of the Main, in the Bavarian district of Lower Pranconia.

Sa.a.r, a river of Alsace-Lorraine and Ehenish Prussia, rising on the north-east shoulder of the Vosges Mountains, under the foot of Mount Donon. It flows northwards past Saarburg, Saar Union, Saargemiind, Saarbriicken, then north-north-westwards past Saarlouis, and joins the Mosel (Moselle) from the right a few miles above Treves. Its total length is 153 miles, of which 75 (namely, from Saargemiind) are navigable. Its valley is broad and shallow. By means of the Saar canal (40 miles long), made by the French Government in 1862, it is connected with the Ehine-Marne canal.

Saarbriicken, or Sankt Johann-Saaebeucken,

a town of Prussia, in the Ehine province, 49 miles by rail east-north-east of Metz, on the left bank of the Saar, the

sister town of Sankt Johaan being immediately opposite. The Saar coal-fields are estimated to yield 9 to 10 million tons annually, and give employment to nearly 42,000 men. The two towns together possess important iron and glass works, and manufactures of machinery, chemicals, tobacco, &c., and a large trade in coal. In Saarbriicken there are a mining academy and a monument to Bismarck (1899). The town-hall has been adorned with paintings by Anton von Werner, illustrating the battles of the neighbouring Spicheren Heights in 1870. Population of Saarbriicken (1885), 10,453; (1900), 23,242; of Sankt Johann (1885), 13,598; (1900), 21,257.

Sa,a.rburg^, a town of Germany, Alsace-Lorraine, district Lorraine, on the Saar, 44 miles west-north-west of Strasburg. It is still surrounded with walls. Its manu- factures include watch-springs, gloves, lace, and beer. It is identified with the Pons Saravi of the Eomans. Popular tion (1900), 9178.

Sa.a.rlOUiS, a fortified town of Prussia, in Ehine province, 40 miles by rail south of Treves, on the left bank of the Saar. Its fortifications were laid out by Vauban in 1680-85. There are coal-mines, and consider- able manufacture of porcelain, glass, and leather. It was the birthplace of Marshal Ney (1769-1815). Population

(1900), 7864.

Sa.a.Z (Czech, ??atec), a manufacturing and commercial town in the north of Bohemia, on the river Eger, 30 miles east by north of Carlsbad. Population (1890), 13,234; (1900), 16,168, mainly German and Catholic. Together with the important export of hops ??? of which business it is

the chief centre ❓❓❓ there is a trade in vegetables, machinery, brewing and corn-milling, &c. The town was provided with a new water-supply in 1894. It has latterly become prominent for its strong German-Nationalist sentiment and its efforts to exclude the Czech element, which forms, however, only about 5 per cent, of the population.

Sa.ba.de 1 1, a tovm of Spain, province of Barcelona, on the river KipoU, with a station on the Barcelona-Sara- gossa EaUway. Population (1887), 19,645; (1897), 23,044. The industries comprise cloths and linen, which give employment to 11,000 workmen in a hundred factories, producing goods valued at haK a million sterling annually. There are also manufactures of alcohol, paper, and flour, besides foundries and saw-mills. The town has handsome modern public buildings, including the tovm-hall, schools for primary and higher education, hospitals, and casinos. The churches are not interesting. Sabadell is said to be the Koman Sebendunvm,, but in Spanish annals it is not noticed until the 13th century.

Sables d'09onne, LeS, chief town of arron- dissement, department of Vendue, France, 21 miles west- south-west of Eoche-sur-Yon by rail. There are a municipal school of maritime fisheries and a maritime laboratory. In 1900, 372 boats manned by 1788 men were engaged in the fisheries, the total annual value of which is esti- mated at about ❓❓95,000, the average annual product of the sardine fishery alone amounting to over 160,000 cwts., while the tunny fishery is also important. More than 7 million oysters are annually exported. The port is now accessible for vessels of 800 to 2000 tons. The total movement of shipping, including coasting trade, amounted in 1900 to 164,392 tons. Foreign exports are unim- portant ; the principal imports are coal, wood, petroleum, and phosphates. Population (1891), 9905; (1901), 11,870.

Sachs, Julius von (1832-1897), German botanist, was born at Breslau on 2nd October 1832. At an early age he showed a taste for natural history, and on

leaving school he became, in 1851, private assistant to the physiologist Purkinje at Prague. In 1856 he graduated as doctor of philosophy, and then adopted a botanical career, establishing himself as privat-docent for

plant physiology in the University of Prague. In 1859 he was appointed physiological assistant to the Agricultural Academy of Tharandt in Saxony; and in 1861 he was called to be director of the Polytechnic at Chemnitz, but was almost immediately transferred to the Agricultural Academy at Poppelsdorf, near Bonn, where he remained until 1867, when he was nominated professor of botany in the University of Freiburg-im-Breisgau. In 1868 he accepted the chair of botany in the University of Wiirz- burg, which he continued to occupy (in spite of calls to all the important German universities) until his death on 29th May 1897.

Sachs achieved distinction as an investigator, a writer, and a teacher ; his name will ever be especially associated with the great development of plant physiology which marked the latter half of the 19th century, though there is scarcely a branch of botany to which he has not materially contributed. His earUer papers, scattered through the volumes of botanical journals and of the pubhcations of learned societies (a collected edition was published in 1892-93), are of great and varied interest. Prominent among them is the series of " Keimungsgeschichten," which laid the foundation of our knowledge of micro- chemical methods, as also of the morphological and physiological details of germination. Then there is his resuscitation of the method of "water-culture," and the application of it to the investigation of the problems of nutrition ; and further, his discovery that the starch-grains to be found in chloroplastids are the first visible product of their assimilatory activity. His later papers were almost exclusively published in the three volumes of the Arbeiten des botanischen Instituts in Wurzburg, 1871-88. Among these are his investigation of the periodicity of growth in length, in connexion with which he devised the self- registering auxanometer, by which he established the retarding influence of the highly refrangible rays of the spectrum on the rate of growth ; his researches on heho- tropism and geotropism, in which he introduced the " clino- stat " ; his work on the structure and the arrangement of cells in growing-points ; the elaborate experimental evidence upon which he based his "imbibition-theory" of the transpiration-current ; his exhaustive study of the assimi- latory activity of the green leaf ; and other papers of interest. Sachs' first published volume was the Handbuch der Experimental-Physiologie der Pflanzen, 1865 (French edition, 1868), which gives an admirable account

of the state of knowledge in certain departments of the subject, and includes a great deal of original information. This was followed in 1868 by the first edition of his famous Lehrbuch der Botanih, by far the best book of its kind. It is a comprehensive work, giving an able summary of the botanical science of the period, enriched with the results of many original investigations. The fourth and last German edition was published in 1874, and two English editions were issued by the Oxford Press in 1875 and 1882 respectively. The Lehrbuch was eventually superseded by the Vorlesungen vher Pflamen-physiologie (1st ed., 1882; 2nd ed., 1887; Eng. ed., Oxford, 1887), a work more limited in scope, but yet covering more ground than its title would imply : though it is a remark- able book, it has not gained the general recognition accorded to the Lehrbuch. Finally, there is the Geschichte der Botanik (1875), a brilliant and learned account of the development of the various branches of botanical science from the middle of the 16th century up to 1860, of which an English edition was published in 1890 by the

Oxford Press. As a teacher Sachs exerted great influence, for his vigorous personality and his ready and lucid utterance enabled him not only to instruct, but to fire his students with something of his own enthusiasm.

A full account of Sachs' life and work has been given by Prof. Goebel, formerly his assistant, in Flora, 1897, of which an English translation appeared in Science Progress for 1898. There is also an obituary notice of him in the Proc. Boy. Soc. vol. Ixii.

(s. H. V.) Sa.CO, a city of York county, Maine, U.S.A., on the left bank of the Saco river, just above its mouth, opposite Biddeford, and on two lines of the Boston and Maine Railroad, in the south-western part of the state. It has fine water-power derived from a fall of 40 feet in the river, which is utilized in the manufacture of cotton goods, machinery, boots and shoes,*

Sacramentary of Serapion, The,

contained in a collection of Egyptian documents in an 11th-century MS. at the Laura on Mount Athos, was published by A. Dmitrijewskij in 1894, but attracted little attention until independently discovered and published by G. Wobbermin in 1899. It is a celebrant's book, containing thirty prayers belonging to the mass (19-30, 1-6), baptism (7-11, 15, 16), ordination (12-14), benediction of oU, bread, and water (17), and burial (18), omitting the fixed structural formulae of the rites, the parts of the other ministers, and almost all rubrication, except what is implied in the titles of the prayers. The name of Serapion, bishop of Thmuis, St Athanasius's friend, is prefixed to the anaphora of the mass (1) and to the group 15-18 : but whether this indicates authorship is doubtful ; for whereas the whole collection is bound to- gether by certain marks of vocabulary, style, and thought, 15-18 have characteristics of their own not shared by the anaphora, while no part of the collection shows special affinities with the current works of Serapion. But his name is at least a symbol of probable date and provenance : the theology, which is orthodox so far as it goes, but "conservative," and perhaps glancing at Arianism, shows no sign that the Macedonian question has arisen; the doxologies, of a tjrpe abandoned by the orthodox, and by c. 370 treated by St Didymus Al. as heretical; the apparent presupposition that the population is mainly pagan (1, 20) ; the exclusive appropriation of the mass to Sunday (19 ; cp. Ath. ap. c. Ar. 11), whereas the liturgical observance of Saturday prevailed in Egypt by c. 380 ; the terms in which monasticism is referred to ??? together point to c. 350 : the occurrence of official interpreters (25) points to a bilingual Church, i.e., Syria or Egypt; and certain theological phrases (dyeVT^Tos, ???Tn8rjfj.La, (ionj KaOoXiKr/ iKKX.rjcrLa) characteristic of the old Egyptian creed, and the liturgical characteristics, indicate Egypt; while the petition for rains (23), without reference to the Nile-rising, points to the Delta as distinguished from Upper Egypt. The book is important, therefore, as the earliest liturgical collection on so large a scale, and as belonging to Egypt, where evidence for 4th-century ritual is scanty as com- pared with Syria.

The rites form a link between those of the Egyptian Church Order (a 3rd- or early 4th-century development of the Hippolytean Canons, which are perhaps Egyptian of c. 260) and later Egyptian rites ??? marking the stage of development reached in Egypt by c. 350, while exhibiting

characteristics of their own. I. The Mass has the Egyp- tian notes ??? a prayer before the lections, elsewhere unknown in the East; an exceptionally weighty body of inter- cessions after the catechumens' dismissal, followed by a

penitential act, probably identical with the c^o/toXdyj/o-ts , of Can. Hippol. 2, which disappeared in later rites ; a setting of the Sanctus found in several Egyptian anaphoras ; the close connexion of the commemorations of the ofierers and of the dead; and the form of the conclusion of the anaphora. The structure of the communion ??? with a prayer before and prayers of thanksgiving and blessing after ???shows that Egypt had already developed the common type, otherwise first evidenced in Syria, c. 375 (Ap. Const, viii. 13). Among the special characteristics of Serapion are the simplicity of the Sanctus, and of the Institution, which lacks the dramatic additions already found in Ap. Const.; the interpolation of a passage containing a quotation from Bidache 9 between the institutions of the bread and of the chalice ; the form of the dva/jonja-K ; and the invoca- tion of the Word, not of the Holy Ghost, to effect con- secration. That the Lord's Prayer before communion is not referred to may be only because it is a fixed formula belonging 'to the structure of the rite. II. The Order of Baptism has a form for the consecration of the water, and a preliminary prayer for the candidates, perhaps alluding to their exorcism; a prayer for steadfastness following the renunciation and the confession of faith; the form of anointing with oil; appropriate prayers preceding and following the act of baptism; and the prayer of confirmation with imposition of the hand, chrism, and crossing. AU this corresponds to and fills up the outline of the Church Order and allusions in 4th- century writers, and is in line with later Egyptian rites. III. Porms of Ordination are provided only for deacons, presbyters, and bishops, the orders of divine institution (12). They are concise, but of the normal type. That for deacons (12) commemorates St Stephen, invokes the Holy Ghost, and prays for the gifts qualifying for the diaoonate. That for presbyters (13) recalls the Mosaic LXX, invokes the Holy Ghost, and asks for the gifts qualifying for administration, teaching, and the ministry of reconciliation. That for bishops (14) appeals to the mission of our Lord, the election of the apostles, and the apostohc succession, and asks for the " Divine Spirit "

conferred on prophets and patriarchs, that the subject may ” feed the flock ” ” unblameably and without offence continue in ” his office. The minor orders^ interpreters, readers, and subdeacons (25) are evidently, as elsewhere in the middle of the 4th century, appointed without sacramental ordination. IV. The use of exorcised or blessed oU, water, and bread is fully illustrated by the lives of the fathers of the desert (cp. the Gnostic use, Clem. Al Excerpta 82). Serapion has a form of bene- diction of oil and water (5) offered in the mass (like Can. Hippol. and Ch. Ord. for oU), probably for the use of individual offerers. A longer form for all three matters (17) perhaps has in view the general needs of the Church in the visitation of the sick. The occurrence in both prayers of ” the Name ” and the commemoration of the Passion, Eesurrection, &c., corresponds with early allusions, in Origen and elsewhere, to the usual form of exorcism. V. For burial of the dead Serapion gives a prayer for the departed and the survivors (18). But the funeral preces- sion is alluded to (iKKoixi^o/ji&ov), and in the mass (1) the particular commemoration of departed persons is provided for. Hence we have the elements of the 4th-century funeral, as we know it in Egypt and elsewhere: a pre- liminary office (of readings and psalms) to which the prayer belongs, the procession (with psalmody) to the cemetery, the burial, and the mass pro domitione.

*AuTHOKiTiBS.**Dmitrijewskij in Trudy (Journal of the Eccl. Acad, of Kiev), 1894, No. 2 ; separately, Kiev, 1894 : reviewed by A. Pavlov, XpoviKh Bv^amri, i. 207-213 ; cp. Byzant. Zeitschr. iv. 1 (1895), p. 193.* *G. WOBBEKMIN in Hamack-Gebhaidt, TexU u.*

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Sacramento, a city of California, U.S.A., capital of the state and of Sacramento county, on the river Sacra- mento, at the mouth of the river American, on the eastern side of Sacramento valley, at an altitude of 30 feet. It has a level site and its street plan is regular, with broad streets, fev? of vchich are paved. The north and south streets are numbered, the east and west designated by letters. Its water-supply is derived from the river. Be- sides the state Capitol, the notable buildings are the Koman Catholic cathedral, agricultural hall, the court house, the city hall, and the Croker art gallery. The city is practically at the head of navigation on the river, and has daily steamer connexion with San Francisco. It is on the direct hue east of the Southern Pacific Railroad, the starting-point of the line to Portland, Oregon, and the terminus of several smaller branches, aU of which give it a large trade. In 1900 it contained 279 manufacturing estabhshments, with a total invested capital of $7,492,313 ; they employed 4393 hands, and the product was valued at $11,78.5,621. The principal product was flour, with a value of $1,128,536. In 1898 the assessed valuation of real and personal property was $15,654,625 ; the net debt of the city was but $164,000; and the rate of taxation was $35-40 per $1000. Population (1890), 26,386; (1900), 29,282, of whom 6723 were foreign- born and 1806 were coloured (negroes, Chinese, &c.).

ScidO, an island belonging to Japan, lying 32 miles westward of Niigata, on 38?? N. and a little to the east of 138?? E. It has a circumference of 130 miles, an area of 336 square mUes, and a population of 112,738. The port is Ebisu-minato, on the west coast ; and at a distance of 16^ miles, near the east coast, is the town of Aikawa, having in its vicinity gold and silver mines, for which Sado is famous, and which have been worked from very early times. The loftiest peak is that of Kimpoku- san (3815 feet), to the north of Aikawa.

SstdOWci (Czech, Sddovd), a village in north-east Bohemia, Austria, near Koniggratz. Sadowa, with the small adjoining wood, was one of the principal and most hotly-contested Prussian positions in the decisive battle of 3rd July 1866, which is still frequently spoken of as the battle of

Sadowa. In 1890 it had 205, and in 1900 183 Czech inhabitants, chiefly engaged in agri- culture, sugar-refining, and brewing.

Sa.fes a.nd Vaults. ??? From the earliest times strong receptacles for valuables have been constructed, and as the ingenuity of robbers successively overcame them, improvements have followed. As the name indicates, the earliest vaults were of masonry ; the thickness of the walls was relied upon for security, and the entrance was closed by a heavy wooden door, secured by some form of lock. In the ancient days the bolts were of wood, and the locking mechanism of the Egyptian pin type. Later the doors were made of metal, and the iron bolts were often secured by padlocks, the lock protection probably being quite as strong as the door it fastened. The modern safe is doubtless an evolution from the old strong box, and to-day many so-called burglar-proof safes are nothing more than iron chests secured by key locks, and offering no defence whatever against the attacks of burglars. At the present time safes are divided into two distinct classes : fire-proof safes and burglar-proof safes, although occasion-

ally the two constructions are combined. In each case the term is of relative meaning, no safe being either fire- or burglar-proof if unlimited time be given. What is aimed at is to provide protection which shall be efficient during the duration of any probable conflagration, and to prevent forcible entry within the limited period in which the safe is left unguarded.

The usual method of fire-proofing a safe is to make the walls of sufficient thickness to contain a filling of some material which shall be at the same time a good non-conductor of heat and also contain a large P'^-P">of proportion of combined water. Such fillings are found in plaster of Paris, alum,

The most acceptable construction for the body of a burglar-proof safe is generally conceded to be that of laminated plates, the walls being built up of layers of steel of different thicknesses, riveted Burglar- through adjacent plates ??? none of the rivets ^^^?? passing through the whole series of plates, but being offset, so that driUing through a rivet would termin- ate after the thickness of two plates had been pierced. The

plates are made of different thicknesses, and are usually alternately hard and soft, the outer plate being heavier than the others, and very hard. The change from hard to soft, or vice versd, is almost certain to break any drill which may be employed, and thus greatly prolongs the time required for penetration. The latest improve- ments in the manufacture of steel have been utilized in providing material for this work, both chrome steel and manganese steel having been employed for the hard plates, the latter material with especial success.

The door of a safe may be attacked in various ways. Drilling is resisted by the use of a similar construction to that used for the walls of the safe. The door itself is accurately fitted to its seat by a series of offset bearings, in order to prevent the introduction of wedges ; and the bolts shoot in all four directions, in order to hold the door in place independently of the hinges, which are only used to carry the open door. In order to prevent the use of liquid explosives, as described below, one or more tongue- and-groove joints are provided, an elastic packing being fitted in the grooves, and the door forced up to its seat by a powerful cam or lever device. The hinge in such con- struction is of the ao-called "crane" type, enabling the door to be brought round squarely in front of its seat and pushed directly up to its bearings. In many modern safes the door is round instead of being rectangular ; this form enables it to be ground to a bearing very effectiwly after hardening. When a door is thus made and fitted, it is found that the joint offers no less resistance to attack than the walls of the safe. The bolts by which the door is secured are usually thrown by a special handle attached to^ a spindle passing through the door, the bolt-work being locked in position by a separate locking mechanism,

controlled by one or more combination dial locks with separate spindles. These spindles must be very closely fitted and packed, otherwise they become points of weak- ness, at which liquid explosives may be admitted. If it is intended to prevent this weakness of a perforated door, an automatic bolt-work is employed, the bolts being thrown by springs upon

the closing of the door, and retracted by another set of springs after the lapse of a determinate period of time controlled by a time lock.

Modern vault construction is practically burglar-proof safe-work on a far larger scale. The walls are best made of laminated steel plates, alternately hard and soft, fitted and riveted in the most solid manner, and of such thickness that the time required for drilling materially exceeds, even in the most favourable circumstances, the time avail- able for attack. There are usually two doors, a heavy outer door, carrying the main locking mechanism, and ranging from 8 to 11 inches in thickness ; and an inner door, with dial locks, adapted for quick and secure closing in case of sudden alarm. The interior of such vaults is fitted with tiers of drawers and boxes ; the partitions being of sheet steel, and each drawer having its own locL These compartments are of various sizes, and may either be used solely for the purposes of the institution owning the vault, or, more frequently, may be rented for safe-deposit purposes to customers. The compartments are generally furnished with key locks, the usual form having two keyholes and requiring the use of two keys, one of which is in the possession of the renter and the other in the hands of the vault attendant. The combination operated by the attendant's key is identical in all the locks, and this key must be turned before the renter's key can be operated ; this arrangement requires the identification of the renter by the attendant, but at the same time gives the latter no access to the compartment.

The main points of difference in various vaults lie in the mechanism by which the door is secured. While reference must be made to Lord Grimthorpe's article on Lock (Ency. Brit. vol. xiv.), for the state of the art down to the date at which he wrote, some later features may here be added. Key locks are now only suitable for use on inner compartments of safes or vaults, the most secure of this type being the improved forms of Yale lock. The main improvement consists in the deep corrugation of the keyway, forming what is termed the " paracentric " construction, an arrangement which effectively prevents the vertical motion of any picking tool which might be inserted with the intention of lifting the pins and picking the lock by the so-called " tentative " method. Dial locks, or, as they are sometimes termed, combination ' locks, are generally employed

for fire-proof safes ; and when carefully constructed with packed spindles and balanced fence, are also suitable for burglar-proof work. The dial lock is fitted with two, three, or four circular discs or tumblers on one spindle, each tumbler having a gating or square notch at one point in its periphery. When all the gatings coincide with each other and are at the proper point with regard to the ” fence ” or releasing member of the locking mechanism, the bolts may be thrown back. As each tumbler is free upon the spindle, and is turned only by a projection upon the adjacent tumbler, the correct unlocking position can only be given to all the tumblers by the proper rotations of the knob upon the dial outside the safe. The numbers on the dial indicats the positions of the tumblers within to the person familiar with the combination to which the lock has been set ; to all others it is a ” puzzle ” with such a vast number of permutations as to render the method of “trial and error” out of the question. Taking a lock with 100 divisions, the number of changes with one

tumbler would be 100 ; with two tumblers, 100^ = 10,000 ; with three tumblers, 1003 = 1,000,000; and with four tumblers, 100= 100,000,000. Additional security is obtained by the use of two independent dial looks, each operating the same bolt mechanism. This arrangement may be employed in various ways, the most usual being with two locks set to the same combination, either lock releasing the bolt-work, or with two locks set to different combinations, and both requiring to be correctly set before the bolts can be thrown, the secrets of the combinations being in the possession of two difierent persons. This latter method is intended to prevent the dishonest access to the vault by either custodian, the presence of both being required.*

A number of years ago there occurred in the United States many masked burglaries. The thieves entered the residence of the cashier or other custodian at night, and under threat of death or torture compelled him to go with them to the vault and unlock the combination of the vault. They then looted the place at their leisure, and left the custodian bound. The result of this form of attack was the introduction of the time lock. The original form of the time lock was merely that of a simple clock movement, similar in mechanism to that of an ordinary alarm clock, except that instead of releasing an alarm at a predetermined time, an

obstruction was introduced to the movement of the bolt-work which effectually prevented the retraction of the bolts, even when the combination lock was correctly set. At the proper time the clockwork lifted the obstruction, and the bolts could be withdrawn. It will be seen that this addition did not change the security given by the combination lock, but added to it the mechanical limitation of operation to certain hours, and made it impossible for compulsion to be employed at other times. The time lock in this form practically put an end to masked burglaries, but introduced a new difficulty, namely, the " lock-out." Any failure of the time lock to perform its work rendered it impossible for the proper persons to operate the lock ; and at first it was feared that this defect might be a serious objection. The next improvement was the introduction of the double time lock, in which there were two independent move- ments, either of which operated the mechanism ; and this was followed by the triple and the quadruple time locks, this reduphcation of movements giving practically com- plete immunity from danger of lock-out from stoppage of the clockwork.

With the perfection of modern high explosives a new form of attack was developed. It was found that nitro- glycerine could be so diluted as to become so exceedingly limpid that it could readily penetrate . "J"""""" joints hitherto supposed to be liquid-tight. Thus if a gutter of clay be formed along the top joint of a safe or vault door and fiUed with the liquid, in a short time it will be found to have passed in through the crack. In like manner a cup of clay, formed round the knob of a dial lock, or about the T-handle by which the bolts were operated, could be filled with the liquid explosive, which in a few minutes would penetrate through the space about the spindle, no matter how carefully fitted. The con- cussion of an exploding primer, attached to the outside of the door, would then explode the charge ~~*nithin and blow the door off. Although this form of attack has been provided against by packing the door joints and spindles, to prevent the access of liquid explosives, a more effective defence is that of employing automatic bolt mechanism, which requires the use of no holes whatever through the door. In automatic bolt devices powerful spring mechan*~~ *ism is employed to shoot and retract the bolts, there being two sets of springs, one to lock the door and the other to*

unlock it. These springs require to be compressed by band, a powerful lever mechanism being used, and each set is caught when compressed, and held by a suitable trigger. The trigger of the locking springs is released when the door is tightly closed, and the bolts are shot. When the predetermined time has elapsed, the unlocking springs are released by the time lock, and the bolts are retracted and the door may be pulled open. It will be seen that this mechanism introduces anew the danger of lock-outs by reason of its jjossible failure to act, and the difficulty has been met in the same manner as in the time lock, i.e., by the duplication of the parts.

The direction in which modern bank locks and locking appliances have advanced may be described generally as inaccessibility from the exterior of the door. The difficulty with all key locks, however complicated, was that they were accessible through the keyhole, so that explosives could be introduced; and also that the loss of the key itself, or its illicit possession, would enable any one readily to open the lock. In the first forms of combination locks the construction was such that by the manipulation of the dial a skilful operator could form an accurate deviV judgment of the positions of the tumblers, and was thus enabled to pick the locks. Modem combination locks are so constructed that by means of independent bearings, which are operated through the revolution of the spindle, and by use of a balanced fence arbour (that is, the connecting piece between the spindle and the tumblers), it is impossible for any one manipulating the spindle or the dial to form any idea of the position of the tumblers on the inside, because the moment the spindle is revolved, the fence arbour is lifted away from the tumblers, and there is no possibihty of feeling their motion. The only way, therefore, of opening the modern combination lock is by knowledge of the combination, or by forcing the one who has the combination to open the lock, either by torture or by threats of death.

The next step was to add to the combination lock a time lock which had no connexion with the exterior of the door, and which, when set to remain locked for a certain period, could not be opened by any one. This was followed by the attack by liquid explosives, as discussed above, and the

new attack was opposed by the new defence of the automatic bolt-throvidng devices. The modern time lock is protected against unlocking by jarring, whether from explosives or otherwise, by having all its time-move- ments and locking mechanism mounted upon a movement block, which is cushioned on springs at its back and front, so that all the operative mechanism is, as it were, floating. The mechanism is operated generally by three, sometimes by four, time-movements, each of which is entirely independent and fully able of itself to operate the mechanism, even if all the other movements should stop. Automatic bolt-operating devices are so designed that the effect of jarring will simply be to lock the lock- ing levers tighter. The unlocking mechanism of the best of these is double, so that in case of any accident to part of the mechanism, the reserve mechanism will operate the bolt.

In all the advances which have been made in burglar- proof protection, it will be observed that the burglars are the experts, and as soon as they succeed in penetrating a defence, a new and stronger one is devised. Plans have been suggested by which the locks may be operated electrically from a distance, but that simply removes the point of attack to a new place, and does not constitute any greater protection. At the present time the exist- ing defences, as described above, have held good, and the best modern devices have not yet been successfully attacked. (h. h. s.)*

Saffi, or AsFi, a seaport on the west coast of Morocco, 106 miles west - north -west of Morocco. Although the principal wool and grain port of central Morocco, it is sadly hampered by bad landing in certain weathers. There are several important European business houses, a Scottish mission, and the usual consular officials. Exports : 1896, ►►92,716; 1900, ►►143,438. Imports: 1896, ►►81,730; 1,900, ►►83,073. Shipping: 1896, 68,286 tons; 1900, 84,682 tons. Population, about 15,000.

Saffron Wa.lden, a municipal borough, market town, and railway station in the Saffron Walden parlia- mentary division of Essex, England, 24 miles north-north- west of Chelmsford. A British and Foreign School Society's training college for mistresses has been opened, and the library of the literary institution reconstructed. Area, 7502 acres. Population (1891), 6104; (1901),

5896.

SSigSLingf a division and district iu Upper Burma, lying to the south and west of Mandalay. The Sagaing division includes the districts of Upper and Lower Chindwin, Shwebo, and Sagaing, and covers an area of 30,039 square miles, with a population of 821,769 in 1891, and 999,168 in 1901, of whom 463,966 were males and 535,202 females. In 1898-99 it had 3666 villages, paying a revenue of Ils.20,86,158. The Sagaing district has an area of 1862 square miles ; population (1891), 246,141, living in 593 villages and paying Es.6,80,827 in 1898-99. In 1901 the population was 282,691, of whom 132,028 were males and 150,663 females. The inhabitants are almost whoUy Buddhists and Jains. Except for a ridge of hUls along the Irra- waddy the greater part of the district is flat. Paddy is the chief crop. The total acreage is 1,191,469. Of this, 266,754 acres were cultivated in 1898-99, 253,088 acres were current fallow, 49,562 acres were available for cultivation, and 622,065 acres were not cultivable. The total rainfall in 1898-99 was 31 "37 inches, taken at Sagaing. In the hot weather the maximum shade tem- perature rises to a little over 100 F. The lowest readings in the cold weather average about 56 F. Sagaing, the headquarters town, opposite Ava, a few mUes below Man- dalay, had a population in 1891 of 9934. The hiUs above are studded with pagodas, and the town itself is well shaded by large tamarind trees. It was formerly a capital of Burma. It is connected by railway with Myitkyina. A steam ferry connects with the Eangoon-Mandalay line, and the steamers of the Irrawaddy Flotilla Company call daily.

Sagraneiti. See Ebitbea.

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Sagasta, Praxedes Mateo (1827-

Spanish statesman, was born on 21st July 1827, at Torrecilla de Cameros, in the province of Logrono. He began life as an engineer, and from his college days he displayed very advanced Liberal inclinations. He entered the Cortes in 1854 as a Progressist deputy for Zamora. After the coup d'etat of O'Donnell in 1856, Sagasta had to go into exile in France, and promptly retm'ned, to become the manager of the Progressist paper La

Iberia, and to sit in the Cortes from 1859 to 1863. He seconded the Progressist and revolutionary campaign of Prim and the Progressists against the throne of Queen Isabella, conspiring and going into exile with them. He returned, vid Gibraltar, with Prim, Serrano, and others, to take part in the rising at Cadiz, which culminated in the revolution of September 1868, that made Sagasta in succession a minister several times under Serrano and then under King Amadeo of Savoy, 1868-1872. Sagasta ultimately headed the most Conservative groups of the

revolutionary politicians against Ruiz ZorriUa and the Eadicals, and against the Federal Republic in 1873. He took office under Marshal Serrano during 1874, after the pronunciamiento of General Pavia had done away with the Cortes and the Federal Republic. He vainly at- tempted to crush the Carlists in 1874, and to check the Alphonsist military conspiracy that overthrew the Govern- ment of Marshal Serrano at the end of December 1874. Barely eight months after the restoration of the Bourbons in the autumn of 1875, Sagas ta accepted the new state of things, and organized the Liberal dynastic party that confronted Canovas and the Conservatives for five years in the Cortes, until the Liberal leader used the influence of his military allies, JoveUar, Campos, and others, to induce the king to ask him to form a Cabinet in 1881. The Liberals only retained the confidence of the king by postponing the realization of almost all their democratic and reforming programme, and limiting their efforts to financial reorganization and treaties of commerce. A mili- tary and republican rising hastened Sagasta's fall, and *he was not readmitted into the councils of Alphonso XII. On the death of that king in 1885, Sagasta became premier under the regency of Queen Christina, and re- mained in office until 1890, long enough to carry out all his reform programme, including universal suffirage. A coalition of generals and Conservatives turned Sagasta out in July 1890, and he only returned to the councils of the regency in December 1892, when the Conservative party split into two groups under Canovas and Silvela. In his tenure of office from 1892 to March 1895 Sagasta did not do much, and he had to*

cope with many difficulties, including a serious conflict with Morocco, in which he averted a war and secured a heavy indemnity for the aggression of the Riflf tribes on Melilla. He was stUl in office when the final rising of the Cubans began in February 1895, and he had to resign in March of the same year because he could not find generals or superior officers in the army willing to help him to put down the turbulent and disgraceful demonstrations of the subalterns of Madrid garrison against newspapers which had given offence to the military. Sagasta kept quiet until nearly the end of the struggle with the colonies, when the queen- regent had to dismiss the Conservative party, much shorn of its prestige by the failure of its efforts to pacify the colonies, and by the death of its chief, Canovas del Castillo. Sagasta gallantly undertook the hopeless task of conciliating both the Cubans and the United States by a tardy offer of colonial home rule, the recall of General Weyler, and other concessions that did not avert either the disastrous war with the United States or the loss of Cuba, Porto Rico, and the Philippine Islands. The Liberal party and Sagasta paid the penalty of their lack of success, and directly the Cortes met after the peace treaty of 12th December 1898 with the United States, they met with a parUamentary defeat in the Senate that sent them into the cold shade of opposition. Sagasta did not obstruct too much the Conservative Cabinet that undertook to reorganize Spain after the loss of her colonies. He ever pursued his policy of plajring into the hands of the sovereign whilst keeping up the appearances of a Liberal, almost democratic, leader, skilful in debate, a trimmer par excellence, and abler in opposition than in office.

Sa.gf►►iStyr, an island of Russian Siberia, at the mouth of the Lena, situated in 73►►22′ 48″ N. and 126►►35′ E. It was during the years 1882-83 the seat of an International polar station. The average temperature throughout the year, from two years' observations, appears to be r F.

Sag^inaw, a city of Michigan, U.S.A., capital of Saginaw county, on both banks of the Saginaw river, at an altitude of 589 feet. The city has a level site, a regular street plan, is divided into fifteen wards, has good water-supply and sewerage systems, and is well paved, mainly with wood. The river is navigable for large vessels from Lake Huron to this point, making

it prac- tically a lake port and giving it a share of the lake com- merce. It has four railways, the Grand Trunk, the Pere Marquette, the Michigan Central, and the Saginaw, Tuscola and Huron, which afford ample means for inland trade. Saginaw is situated in a farming, lumber, and salt region, and its manufactures are related to these indus- tries. In 1900 it had 480 manufacturing estabUshments, with a total capital of 87,558,806. They employed 4866 hands, and the product was valued at $10,034,499. The most important of these products was lumber, the value of which was .^2, 647,461. The product of foundries and machine shops was valued at $1,256,183. Flour was manufactured to the value of $412,962. The assessed valuation of real and personal property was, in 1900, $18,998,090; the net debt of the city was $1,314,326; and the tax rate $19.80 in the east district and $21.96 in the west district per $1000. The city was formed on 1st April 1890 by the consolidation of the former city of Saginaw with East Saginaw. Population (1890), 46,322 ; (1900), 42,345, of whom 11,435 were foreign-born and 348 negroes.

Sahara^ the great desert of northern Africa, with an area, according to Dr Bludau's calculation of the areas of African river basins, of 3,459,500 square miles, which is made up as follows : ???

Drainage or slope to Atlantic 131,000 square miles.

???Mediterranean 502,000 ,,

???inland .... 2,602,500 ???

Slope to Niger basin . . . 224,000 ???

Total

3,459,500

This includes Tripoli and Fezzan, which practically belong to the desert zone, but does not include arid portions of the basins of the Nile and Niger, in which the drainage is at most intermittent, and which might with reason be included in the Sahara. The area would thus be brought up to at least 3J million square miles.

Although some additions to our knowledge of the Sahara by exploration were made within the last dozen years of the 1 9th century, the most valuable results have been obtained by the study of material already available, which has thrown considerable light on the physical history of the region.^ An admirable investigation of this, and summary of our knowledge of Saharan geography in all its aspects, was published in 1893 by M. Henri Schirmer, whose conclu- sions may be briefly summarized here. !M. Schirmer con- tests the idea that the desert nature of the Sahara has been acquired within comparatively modern times, showing that it is due to forces which have been at work for ages in the region in question, although, as in all deserts, the dryness is probably progressively increasing. The primary cause is to be sought in the existing distribution of land and sea, the great land mass of North Africa causing an outflow of air in all directions (and consequent absence of rain) in winter, and an indraught in summer, when the surface is intensely heated and the relative humidity of the atmosphere becomes so small that condensation is all

^ M. de Lapparent has called attention to a marine fossil of Cretaceous age brought home by llonteil from the central Sahara, as indicating that m Cretaceous times that region was covered by the sea, and so modifying current views as to its geological history- (see La Glogr.,

1901).

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SAHARA

but impossible. To this must be added tliat the vicinity of the comparatively oool Mediterranean in the north accentuates the force of the winds from that direction, which, blowing as they do towards a lower latitude, are in their very nature dry winds. The influence of moun- tain ranges, such as the Atlas, round the border of the desert, is thus but a subordinate cause of the latter's dryness, which would probably be little diminished did the Atlas not exist. This dryness reacts again on the

temperature conditions of the Sahara, accentuating both the daily and annual variation. The intense heat of the days is compensated by the cold of the nights, so that the mean annual temperature is not excessive. The difference between the mean temperature of the hottest and coldest month has been found to be as high as 45 F., and the extreme range at least 90 F., maxima of 112 and over having been frequently observed. As a result of the extreme dryness of the air, evaporation is excessive, and, being greater than the precipitation, involves a progressive desiccation of the Sahara. This being the case, it is plain that any attempt to improve the climatic conditions of the Sahara as a whole, which some have considered possible, can hardly meet with real success. Much may, however, be done to modify local conditions, and fairly satisfactory results have been obtained within recent years, in the direction of fixing the dunes and covering them with a growth of vege- tation. Experiments carried out at Ain Sefra, on the northern border of the desert, have shown that by protect- ing the sand from the action of the wind by a litter of aUa grass, time is given for the establishment of suitable trees, which include the tamarisk, acacia, eucalyptus, prickly pear, peach, and aspen poplar, the last-named having proved the most capable of all of resisting the desert conditions. Such planting operations can only be carried out in favour- able localities, such as valleys in which a certain amount of water is available. Wide areas like the arid stony plateaux (Hammada) must be abandoned as hopeless, so that a change for the better in the general atmospheric conditions of the Sahara is certainly not to be looked for.

Our knowledge of the history and mutual relations of the races who inhabit the Sahara is still very imperfect, but the facts have been weU summarized by M. Schirmer. The attempts made by many explorers and writers to trace in certain of the existing inhabitants the remnants of an aboriginal race of negro affinities, which inhabited the Sahara before the arrival of the Berbers and Arabs, is, he shows, not justified by the facts at our disposal. That negro influence is to be seen in various parts is undeniable, but it can be shown to date from a much more recent period than has been supposed. The connexion between many of the place-names in Fezzan and the language of Bornu is attributable, e.g., to the northward extension of the influence of the Bornu-Kanem empire between the 11th and 14th centuries of our era. The allusions by classical

writers to Ethiopians as inhabitants of the Sahara prove little, in view of the very vague and general meaning attached to the word by many ancient authorities. The physical characters, and especially the dark colour, of many of the Saharan populations is apparently a stronger argument, but even this is capable of another explanation. Caravans of negro slaves have from time immemorial passed northwards along the main desert routes, and it is just in the oases on these that the dark element in the population is chiefly found. It may therefore be attributed to the intermarriage of the original lighter inhabitants of the oases with such slaves. The Tebu or Teda, once thought to be almost pure negro, who inhabit the east-central portion of the desert, proved, when examined by Nachtigal in Tibesti, where they are found in greatest purity, to be a superior race with well-formed

features and figures, of a light or dark bronze rather than black. Their language is related to that of the Kanur in Bornu, but it appears that these have derived theirs from the Tebu, not the Tebu from the Kanur. Physically, the Tebu appear to resemble somewhat the Tuareg, their western neighbours, but their true afiinities have so far remained unsolved.

The chief centres of population in the Sahara are, firstly, the oases, which occupy positions where the underground water makes its way to the surface or is readily reached by boring ; and, secondly, certain mountainous districts where the atmospheric moisture is condensed, and a moderate rainfall is the result. Except in the south of Algeria, where cultivation has been extended by means of artesian wells, the condition of the Sahara oases is far from prosperous. A feeling of insecurity has been engendered by the marauding habits of the nomad tribes ; cultivation has become more restricted ; and the decline of the caravan trade has brought ruin to certain centres, such as Murzuk. The most important are the oases of the Tuat region, especially Insalah ; those of Rhat and Ghadames, on the route from Tripoli to Zinder ; and of Kufra, in eastern Sahara. The various confederations of the Tuareg, in central Sahara, are gi'ouped round hilly districts, which serve them as refuges from their enemies. The most important are the Awellimiden, on the left bank of the Middle Niger ; and the Kel-Ui, grouped around the mountainous districts of Air or

Azbeu ; the two northern confederations, those of the Ahaggar and Azjer, being less powerful. The chief centre of the former seems to be the mountainous district of Aderar or Adghag (not to be confounded with Adrar in western Sahara), which lies north of the Middle Niger, but has not yet been visited by any European. Much informa- tion respecting the present state of the confederation was, however, obtained during the voyage down the Niger, in 1896, of Lieutenant Hourst, who was much struck with its powerful organization under the chief Madidu. The Kel-Ui of Air have not maintained the purity of their race to the same extent as other divisions of the Tuareg, showing some signs of mixture with a negroid race, which is still to be found in the country as the result of former relations with Hausa and Songhai stocks. The residence of the sultan is at Agades, which has some importance as a, halting-place of caravans, though less than formerly. When visited by M. Foureau in 1899, more than half of its area, which is considerable, was found to be occupied by ruined houses. Those still intact are built of mud, some having an upper storey. A few houses of a better style belong to merchants of Tuat or Tripoli. The sultan's residence, however, has architectural merit, being a massive two-storeyed structure pierced with small windows. The mosque, with its minaret in the form of a tnmcated pyi'amid, still remains as in Earth's time. The country receives a fair amount of rain during the summer, and the valleys are green and dotted over with trees of the mimosa class. Little of the land is, however, cultivated.

Other mountainous districts in which a certain amount of rain falls regularly, and which contain a population above the average for the Sahara, are Tibesti and Borku, in the east centre, and Adrar, in the west. Tibesti, which, as already stated, is peopled by the Tebu race, lies on the line of elevation, with a core of crystalline and volcanic rooks, which traverses central Sahara from south- east to north-west. In the mountain group of Tarso it rises to an average height of some 7000 feet, the volcanic cone of Tusside probably approaching 8000 feet. 'The slopes are bare and rocky, the summer rains running off quickly by the beds of watercourses which traverse the valleys. The occupation of the inhabitants is mainly pastoral. Borku lies to the south-east, in part on the same line of heights, and is also inhabited by the Tebu, but the extent of inhabited country is smaller. Adrar is still imperfectly known, the attempts

made by travellers to reach it having met with little success. In 1900 the oasis of Atar, on the western borders of the country, was reached by M. Blanchet. It has a permanent population of 2000, but is described as a wretched spot. The other centres are Shingeti, "Wadan, and TJjcft, Shiiigeti being the chief commercial centre, whence caravans take tn St Louis gold-dust, ostrich feathers, and dates. A considerable trade is also done in salt from the sebkha of Ijil, in the north-west. Adrar occupies the most elevated part of a plateau which ends westwards in a steep escarpment and falls to the east in a succes- sion of steps.

During the last two decades of the 19th century considerable changes have come over the commercial and political relations of the Saharan populations, even apart from the attempted extension of European influence over that region, to which reference will shortly be made. The most important fact is with- out doubt the great impetus which the Senussi movement has received during that period, especially in eastern Sahara. The chief centre of this powerful and fanatical sect is now at Kufra, on

the northern border of the Libyan desert, while the old focus of Senussism Jarabub now serves as a kind of university for its adherents. One of the main doctrines of the sect is that of emi- gration from infidel countries, under the influence of which new centres are coming into prominence and new routes being opened, while the quasi-masonic brotherhood of the members facilitates intercourse between widely-distant districts. This movement has been one out of several causes which have brought into prominence the desert routes between Wadai in the south and Jalo and Benghazi in the north, which has to some extent superseded some of the older caravan routes across the Sahara. Other causes have tended to reduce the importance of these. The long established route from Darfur to the Kharjah and Dakhilah oases has fallen into entire disuse since the closing of eastern Sudan by the Mahdist troubles, though with the cessation of these it may possibly again acquire importance. Again, the route from Kuka in Bornu to Tripoli, by Murzuk, which had been for

some time sinking in importance, has now practically fallen into disuse, largely in consequence of the political troubles in Burnu since its conquest by the adventurer Eabah. The next in order towards the west of the great trade routes ??? that leading from Tripoli vid Ghadames and Rhat, to Ziiider, Kano, and other great centres of the Hausa States ??? has up to the present maintained its importance, but with the opening of trade from the side of the Niger may be expected in time to decline. This has already been the fate to some extent of the routes across western Sahara to Timbuktu, owing to the opening up of a route from Medina on the Senegal vid Nioro to the Upper Niger, by which European goods now make their way to western Sudan. The old route will, however, retain some of its importance on account of the salt trade from the Sahara, which still centres at Timbuktu.

The extension of French influence over central and western Sahara, so long a desideratum on the part of that nation, has of late years made a decided advance. The work of French pioneers to the south of Algeria was recognized in 1890 by the Anglo- French agieeraent, which assigned to France the whole central Sahara from Algeria to a line from Siy on the Niger to Lake Chad ; and this was soon followed (1892) by Monteil's great journey from Senegal to Lake Chad and across the desert to Tripoli. The southern limit of the territory was, however, not strictly defined until 1898, when a new agreement gave to France a rectangular block south of the line mentioned, including the important frontier town of Zinder. To the north-east and east the boundary of the French sphere was defined, by the supplementary declaration of 1899, as running south-east, from the intersection of the Tropic of Cancer with 16?? E., until it meets the meridian of 24?? E., following this south to the frontier of Darfur. French Sahara is thus connected with French Sudan in the south-west, and with the Congo-Shari territories on the south-east. On the west, where Spain claimed the Sahara coast between Capes Blanco and Bojadoi', the interior frontier was defined by the Franco- Spanish agreement of 1900, being so drawn as to leave to France the whole of the country of Adrar, the boundary mirth of the tropio being the 12th meridian east of Greenwich. French authority has been established over a small part only of the vast area included within the above boundaries. South of Algeria military posts have been gradually pushed into the

desert. El Golea being until 1900 the farthest point which acknowledged French rule. The great desideratum was the opening up of a route to the Sudan which might in time divert the trade from Tripoli to Algeria, but all attempts long proved fruitless, owing to the dangerous character of the tribes by which the way was infested. In 1886 Lieutenant Palat was murdered a little south of Giirara, and in 1889 the same fate befell Camille Douls in Tidikelt (Tuat) in his attempt to reach Timbuktu from the north. In 1890 F. Foureau^ who in 1883 had undertaken a first journey of exploration south of Wargla ♦♦♦ reached the Tademayt plateau in 28♦♦ N., and in 1892-93 came the first of his long series of expeditions undertaken with a view of penetrating the country of the Azjer Tuareg, the powerful confederacy which lay on the route to Air and Lake Chad, never traversed in its entirety by a European. The borders of their country were reached in the same year by M. Mery, and in 1894 by D'Attanoux, while in 1895-96 M. Foureau did valuable work in the Erg region south of Tunis, between Tuggurt and Ghadames. But all efforts to obtain a passage were unavailing until in 1898-99 this indefatigable traveller, accompanied by an escort of ti'oops under Major Lamy, at last attained his object, finally reaching Zinder, the important trade centre on the borders of the Sudan, on 2nd November 1899.

The important section of M. Foureau's route began at Ain El-Hajaj, in about 26^ ♦♦ N. , immediately beyond which the frowning massif of Tindesset had to be crossed by a most difficult route among a chaos of rocks and ravines, the geological formation being principally sandstone. After descending the southern escarpment of the " Tassili," the expedition crossed a mountainous region named Anahef, composed of quartz and granite, through which the line of partition between the basins of the Mediterranean and Atlantic

was found to ran. Beyond this the route lay across the wide plain of quartz gravel, strewn with blocks of granite, known to the Tuareg as Tiniri, to the well of In-Azaua, beyond which a march of eleven days, with a water-supply at one point only, led to the first village of Air, where the Tuareg proved hostile. Agades, the capital of Air, was reached by a march through difficult mountains, with valleys which gradually opened into a wide plain. From Agades to Zinder the route lay, first, through the bare

and arid dis- trict of Azauak ; next, through the bush ~~covered Tagama, a district abounding in game ; and, lastly, through the cultivated country of Damerghu. Zinder had only once before been reached by way of Air ~~ by Barth's expedition in 1850. It was now occupied by a French garrison, established by the expedition from the Niger under Lieutenant Joalland, who had thus retrieved the disasters of the two previous expeditions by this route, the first under Caze~~ majou, the second under Voulet and Chanoine. M. Foureau's farther route round Lake Chad and south to the Congo does not come within the scope of the present article.

M. Foureau's achievement was quickly followed by increased political activity of the French in the Sahara south of Algeria, where, in addition to the work of explorers already mentioned, surveys had been carried by French officers (especially Captains Germain and Laperrine in 1898) as far as the important centre of Insalah, the position of which had, as a result, been shifted some twenty-five miles east of its former position on our maps, being found to lie in 2 16′ E., 20 17′ 30″ N. Early in 1900 M. Flamand, who had been entrusted with a scientific mission to the Tuat oases, came into collision with the natives, and Insalah was occupied by the military escort which accompanied him. This was quickly followed by the occupation of 'Tuat, and, later, by that of Igli, a position of some importance, as securing the communications with Tuat and the region to the south. As, however, it lies west of the southward continuation of the frontier of Algeria with Morocco, its occupation did not pass without protests on the part of the Moorish authorities, but these are little likely to stem the tide of French expansion in this region. Simultaneously with these events, an attempt was made to pave the way for the establishment of French influence in western Sahara by the expedition of M. Blanchet to Adrar, which had not been visited since the middle of the 19th century. It returned in September 1900, only partially successful, M. Blanchet and his companions having been detained for some time as virtual prisoners on the borders of Adrar. The leader almost immediately succumbed to fever.

The hope of an eventual commercial exploitation of the Sahara rests mainly on the possible existence of mineral wealth, of which nothing is yet known. For the supply of easy communication between Algeria and

the Sudan the construction of a railway across the desert has found many advocates, though others have con- sidered the idea impracticable and useless, pointing out that such a route could not hope to compete with the shorter and more natural outlets from the Sudan to the south and west. Two prin- cipal routes have been suggested, the one, recommended especially by M. Leroy-Beaulieu, taking an easterly line from Biskra through Wargla to Air (Agades) and Zinder ––– generally, the route followed by Foureau ; the other, of which M. Laferriere is an advocate, starting from the terminus of one of the more westerly railways already existing ––– preferably that opened early in 1900 to Jenien- bu-Rezg ––– and reaching Timbuktu viA Igli and the Tuat oases. A third suggested route is one from Igli to the Senegal, still farther west. Pending the possible adoption of any such scheme, it has been suggested that a telegraph line by one of these routes would do good service, while the establishment of a regular caravan service is also advocated.

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Sa.ha,ra.npur, a city and district of British India, in the Meerut division of the North-Western Provinces. The city is situated on a stream called the Damaula Nadi, 907 feet above the sea, and 1041 miles north-west from Calcutta by rail. Population (1891), 63,194; (1901), 63,850, of whom more than half are Mahommedans. The municipal income in 1897-98 was Es.57,253, mostly

derived from octroi, and the incidence of taxation was R. 0.12.8 per head. The death-rate in 1897 was 35 per thousand. It~"is an important junction of the North- Western with the Oudh and Eohilkhand Eailway, and point of departure by road for Mussoorie. The Govern- ment botanical gardens were established in 1817. There are two high schools, and seven printing-presses, issuing one vernacular newspaper. The district of Sahaeaijpue has an area of 2242 square miles. Population (1881), 979,544; (1891), 1,001,280; (1901), 1,046,412, showing an increase of 2 per cent, in the earlier and 4 per cent, in the later decade.

The land revenue and rates are Es.18,69,282, the incidence of assessment being R.1.8.4 per acre; cultivated area (1897-98) 739,651 acres, of which 188,983 were irrigated, including 122,642 from Government canals ; number of police, 2650 ; vernacular schools, 151, with 4665 pupils ; registered death-rate (1897), 35 "e per thousand. The principal crops are wheat, rice, pulse, maize, sugar-cane, and cotton.

Sa,ida.pet, a town of British India, administrative headquarters of the Chingleput district of Madras ; station on the South Indian RaUway, 5 miles south-west of Madras city by rail, from which it is separated by a line of tanks. Population (1881), 4917; (1891), 5702. There is a Government coUege of agriculture, with museum, chemical laboratory, and veterinary hospital. The model farm, established in 1865, is now attached to the college. The Government teachers' coUege, with 46 students in 1898, has a hostel or boarding-house for Brahmans, opened in 1897. The high school, used as a practising school, had 303 pupils in 1898.

Sa.ig'On, capital of French Indo-China, on the right bank of the river Saigon, about 8 miles from its junction with the Donnai, 34 miles from the sea. Before the French conquest, Saigon, then knovra as Giordinh-thanh, was the capital of Lower Cochin – China, which consisted of the "six southern provinces," and constituted a vice- royalty under the government of a hinh-luoc. The popula- tion, which at the time of the

French occupation did not exceed 5000 or 6000 inhabitants, rose in 1882 to 13,348, and in 1896 to 44,764 of whom 3258 were Europeans or assimiMs, namely, nationalized persons, and 41,506 Asiatics. Of these latter, 25,411 were Annamese, 13,801 Chinese, and the remainder Asiatic foreigners. The town covers an area of 1730 acres. It is enclosed in an irregular trapezium, formed by the river Saigon on the east, the Chinese Arroyo on the south, and the canal on the west. The streets are wide and straight, running in parallel lines or united at right angles. Double rows of trees give shade in all the streets and boulevards. All public oflS.ces are situated in the upper part of the town. The floating- dock, sunk several years ago, is furnished with a repairing- dock in which vessels of the largest size can be accommodated. The movement of the port in 1898 was as follows : 598 arrivals, 579 departures, representing 731,368 tons entering and 729,781 clearing. In the same year French vessels made 444 entries and departures, carrying 609,008 tons ; British vessels, 310, carrying 426,040 tons (an increase on 1897 of 61 entries and departures and 65,555 tons) ; German vessels, 279, carry- ing 314,939 tons (a decrease on 1897 of 32 entries and departures and 45,545 tons) ; Japanese vessels 42 entries and departures, with 67,58() tons. The arsenal of Saigon occupies an area of 55 acres. The town is lighted by gas and electricity. Its water-supply is secured by a filtering- basin, which yields 16,000 cubic metres daily. Three great banks are established in Saigon : the Bank of Indo- China, the Hong Kong and Shanghai Banking Corpora- tion, and the Chartered Bank of India, Australia, and China. The Messageries Maritimes and the Messageriea

Fluviales have their headquarters at Saigon. The chan- nels of the river Saigon between the town and the sea have been dredged, widened, and rendered available at aU times. At a distance of 3 J miles from Saigon, to which it is united by a railway, lies Cholon, or Cholen, "the great market," the largest commercial town of Cochin- China. Its population is almost entirely Asiatic, and has more than trebled since 1885. In that year it had only 40,000 inhabitants; in 1901 it numbered about 127,000, among whom were a smaller proportion of Chinese than formerly. There are 41,500 Chinese in Cholon, 80,061 Annamese, 135 Frensh, and 15 nationalized ; the remainder consists of Cambodians and Asiatic foreigners. During the rice season the town is visited by a floating

population of more than 20,000 persons. Cholon is traversed by two railways. The Chinese Arroyo is frequented by in- numerable boats. Cholon is administered by a municipal council, composed of French, Annamese, and Chinese traders. An administrator of native business, nominated by the governor, fills the office of mayor. The rice trade is the leading industry. The rice is treated in seven immense steam miUs (the husks being used as fuel), which daily treat 96,400 piculs of paddy (the miU picul weighs 68 kilogrammes), yielding 44,000 piculs of rice cargo and 24,200 piculs of white rice. There are also, in Saigon, copper foundries, potteries, and marqueterie works.

(j. M. A. HE L.)

St Alba,nS, a city, municipal borough, and market town in the St Albans parliamentary division of Hertford- shire, England, 20 miles north-west of London by rail. The renovation of the cathedral by Sir Gilbert Scott was completed by Lord Qrimthorpe in 1894. Modem erections are a technical school, a hospital, and a hospital for infectious diseases. A public park of 24 acres was opened in 1894, and a recreation ground in 1898. The industries include brush-making and letterpress and chromo- litho- graphic printing. Area, 997 acres. Population (1891),

12,898; (1901), 16,019.

St Albans, a tovm of Vermont, U.S.A., capital of Franklin county. It is in the north-western part of the state, 3 miles from Lake Champlain, and on lines of the Central Vermont Railway, at an altitude of 390 feet. The surrounding country is largely devoted to dairy farming, and the town has considerable trade in its products. It is the headquarters of the Central Ver- mont Railway, and contains its car shops, &c. Popula- tion (1890), 7771 ; (1900), 6239, of whom 1201 were foreign-born.

St Andrews, a city, royal and parliamentary burgh (St Andrews group), and university town of Fife, Scotland, on a bay of the German Ocean, 1 1 miles south- south-east of Dundee by rail. The increasing interest in golf, and the educational enterprise manifested by the university, have furthered the prosperity of the city. The golf links were acquired by the town in 1894, and an additional course was opened in 1895. For the

Roman Catholics an iron church was erected by the Marquis of Bute in 1885. The University College of Dundee was in 1890 affiliated to, and made to form part of, the university of St Andrews. This arrangement was set aside by the House of Lords in 1895, but a reaffiliation took place in 1897. In 1887-88 a common dining-hall for the students was established; in 1892 provision was made within the university for the instruction of women ; and for the board and residence of lady students a permanent building was opened in 1896. In 1889-90 a large addition was made to the university library building, and to the south of the library new medical buildings, erected in the English Renaissance style, by the munificence of the Marquis of

Bute, were opened for classes in October 1899. The annual number of matriculated students is over 400, including about 120 at University College, Dundee. The endowments of the university have been greatly increased through private bequests, the annual value of bursaries, scholarships, and prizes open for competition being about 3000. Dr Donaldson became Principal in 1886 in succession to Tulloch, and Lord Balfour of Burleigh was installed as Chancellor in 1901. In addi- tion to the town-hall there is a large volunteer hall, and a recreation hall with tennis courts. A new marine laboratory, erected by Dr C. H. Gatty, was opened in 1896, and a boys' brigade hall was completed in 1900. Population of the royal and police burgh (1891), 6853 ;

(1901), 7621.

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St Austell, a parish and market-town, Cornwall, England, in the St Austell parliamentary division of the county, 14 miles north-east of Truro by rail. Public rooms were erected in 1895 at a cost of 5000. Other public buildings are Liberal club (1890), Bible Christian chapel (1890), Y.M.C. Institution (1894), Baptist chapel (1900), masonic hall (1900), and Exchange (1900). St AusteU is the centre of the China clay (kaolin) district. About 400,000 tons are annually despatched to the Potteries and Lancashire. The tin and copper mines of the district have added to the prosperity of the town. An extensive steam brewery was built in 1893. Population (1891), 11,377; (1901), 11,76L

St Bees, a township and railway station in the Egremont parliamentary division of Cumberland, England, on the coast, 4 miles south of Whitehaven. The nimnery of St Bega, founded about 650, was succeeded in 1120 by a Benedictine priory, to which belonged the present parish church, restored in 1855-58. St Bees College, founded in 1816 for the theological education of Church of England students, was closed in 1897. The free grammar school, founded 1583, is liberally endowed, and has many scholarships and exhibitions. Area, 1814 acres. Popula- tion (1881), 1142 j (1901), 1236. The ancient parish includes Whitehaven.

Saint-Bon, Simone Arturo (1823-1892),

Italian admiral, was born at Chamb^ry on 20th March 1823. Leaving the Naval Academy in 1847, he attained the rank of commander in 1860, and that of vice-admiral in 1867. He took part in the Crimean war, distinguished himself in 1860 at the siege of Ancona, and was decorated for valour at the siege of Gaeta. At the battle of Lissa, in 1866, his vessel, the Formidahile, forced the entrance of the port of San Giorgio and silenced the Austrian batteries, for which exploit he received a gold medaL In 1873 he was elected deputy, and appointed by Min- ghetti to be minister of marine, in which position he revolutionized the Italian navy.

Insisting upon the need for large battleships with high powers of attack and defence, and capable of fighting as single units, he intro- duced the colossal types of which the Duilio and the Dandolo were the earliest examples. FaUing from power with the Eight in 1876, he resumed active service, but in 1891 was again appointed minister of marine. His death

on 26th November 1892, while stiU in office, precluded the accomplishment of his naval programme, but his name is still revered in Italy as that of the originator of the modem Italian fleet.

St BrieuC, chief town of department C6tes du Nord, France, 278 miles west-south-west of Paris, on the railway from Paris to Brest. There are important iron and steel works, and wool-spinning and dyeing are flourishing industries. Its port is Le L6gu4 at the mouth of the Gouet. Including coasting trade, the total movement in 1900 was 84,517 tons. Nearly all the foreign trade is with England, from which the chief imports are metals and coal. Population (1881), 12,029 ; (1901), 22,198.

St Catharines, a city of Ontario, Canada, on the Welland canal and the Grand Trunk and St Catharines and Niagara Central railways, 30 mUes north-west of Buffalo. The principal industrial establishments are the electric-car works, bicycle, saw, axe, and canning factories, and flour-mUls. It is in the midst of the finest fruit- growing district of Canada. It has electric tramways. Imports (1900-01), $1,537,084. Population (1891),

9170; (1901), 9946.

St Chamond, town, arrondissement of St Etienne, department of Loire, France, 8 mUes east-north-east of St i^tienne by rail. The manufacture of laces of every variety has grown by rapid strides throughout the district of which St Chamond is the centre. The annual value of the manufactured products exceeds ►►900,000. There are noted dye-works, and metallurgical manufactures are very extensive. The naval and railway workshops employ a considerable number of hands. Population (1881), 13,713; (1901) (comm.), 15,469.

St Charles, a city of Missouri, U.S.A., capital of St Charles county. It is on the north bank of the river Missouri, 23 miles north-west of St Louis, and

on the Missouri, Kansas and Texas and the Wabash railways, in the eastern part of the state, at an altitude of 614 feet. The business portion is built in the bottom lands, stretch- ing along the river, while the residential portion is on the face and summit of the cliffs. The city has flour-milla and elevators, tobacco factories, breweries, and car works. Population (1890), 6161; (1900), 7982, of whom 966 were foreign-born and 719 negroes.

St Claude, chief town of arrondissement, depart- ment of Jura, France, 27 miles in direct line south-east of Lons-le-Saunier, with terminal station on the branch line from La Cluse, on the railway from Bourg to Geneva. The town is situated at an altitude of over 1300 feet, at the confluence of the Bienne and the Tacon ; the former crossed by a stone bridge, the latter by a suspension bridge. The cathedral of St Pierre, 13th to 15th centuries, contains fine 15th-century stalls and a reredos of the same period. St Claude has been noted, since the close of the Middle Ages, for its fancy articles in horn, tortoise-shell, hard- wood, ivory, &c., and many establishments are specially engaged in the manufacture of briar-root pipes. Diamond- cutting and lapidary work, introduced in 1870, is a prosperous and expanding industry. The town derives its name from a penitent bishop of Besangon who died in the 12th century in the monastery founded here in the 5th century. The monks subsequently acquired enormous and almost independent judicial authority, and held their retainers in a state of serfdom tUl the Revolution, refusing to relinquish their claims even when St Claude was constituted a bishopric in 1762. Yoltaire pleaded the cause of the serfs, though unsuccessfully, before the Parliament of Besangon, and in memory of his services a

statue was erected to Hm in 1887. Population (1881),

7129; (1901), 10,449.

St Cloud, a city of Minnesota, U.S.A., capital of Stearns county. It lies on both banks of the river Mississippi, and on the Northern Pacific and the

Great Northern railways, in the central part of the state, at an altitude of 1037 feet. Situated in a lumber region, it derives power for its mills from the river. It has many lumber and flour mills and other manufactures of varied character. Population (1890), 7686; (1900), 8663, of whom 1907 were foreign-born.

St Croix, West Indies. See St Thomas.

St Cunegonde, an incorporated city of Hochelaga county, Quebec, Canada, on the north bank of the Lachine canal, adjoining the city limits of Montreal. It contains a college, convent, two schools, rolling mills, a sewing- machine factory, and brass foundry. Population (1891),

9291 ; (1901), 10,912.

St Denis, chief town of arrondissement, department of Seine, France, 5 miles north of Paris (Ndtre Dame), an important junction on the Northern Eailway. Although at the head of an arrondissement, it is only a titular sub- prefecture, separate administration having been suppressed in the department in 1886. Modern erections are an orphanage, founded and endowed in 1886, the monument commemorative of the Eevolution, added to the public statues in 1888, and the railway station, 1897. The ancient H6tel-Dieu was in 1888 converted into a hospital for aged men. Population (1891), 49,275; (1901),

60,808.

St Dizier, a town and railway station, arrondissement of Vassy, department of Haute-Marne, France, 37 miles, in direct line, west-north-west of Chaumont, on the Marne and the Marne and Sadne canal. There is a public library and museum. The town is a very important centre of the iron trade, with foundries of iron, steel, copper, and bronze, engineering works, (fee. Population (1881), 8582 ;

(1900), 14,601.

St Etienne, chief town of department of Loire, 310 miles from Paris by rail. In respect of population it is the seventh town of France. It owes its importance to its rich coal basin and to the attendant industries. Eibbon weaving occupies 80,000 workpeople (men and women) in St Etienne and its environs, and goods are annually made to the value of X4,000,000, and even of ►►4,800,000 if the laces (boot and shoe, (fee), for which St Chamond is the centre of production, be included. The work is mainly done in small factories, electricity supply- ing the necessary motive power ►►► 659 weaving factories being thus operated. The manufacture of heavy iron goods occupies 16,000 workmen, the production at St !lfitienne, St Chamond, and Eive de Gier being valued at ►►3, 200,000. Powerful steam hammers forge the enormous quantities of steel needed for cannon, armour-plating, great locomotive wheels, (fee. Some 4000 workmen are occu- pied in making nails, bolts, locks, wire, and agricultural implements. Goods of this class are valued at ►►800,000 a year. Mines occupy 15,000 men in the extraction of 4,000,000 tons of coal, worth ►►2,000,000 annually. Ex- clusive of the national manufacture of arms, private factories make to the yearly value of ►►400,000. The glass industry in Eive de Gier, St l^tienne, (fee, amounts to ►►400,000 per annum. The Company of the Loire for the supply of electricity distributes it for lighting or motive power to 23 communes in the neighbourhood of St feienne. Population (1886), 103,229; (1896),

120,300; (1901), 139,350.

St Gall, a Swiss canton. It ranks officially and politically as the 14th canton, but in area it is the 6th ; the total area being 779‘3 square miles, of which 661‘4 are reckoned as “productive ” ??? forests cover 149 square miles, vineyards 2”1, and arable or pasture land the remaining 510-3. In 1880 the population was 209,719, and in 1888 228,174, while in 1900 it was 250,285. The canton is practically only German-speaking. In 1900 the canton had 321 inhabitants per square mile. In 1900 the following towns in the canton besides the city of St Gall had populations exceeding 5000 : ??? Tablat (12,590), Altstatten (8724), Straubenzell (8090), Eorschach (9140), Gossau (6051), and Kirchberg (5025). The canton is divided into 15 administrative districts. In 1896 the number of ” alps ” or mountain pastures in the canton amounted to 304, capable of supporting 21,744 cows, and of an estimated capital value of 13,986,700 francs. The cantonal constitution dates from 1890. The legislature is elected by the “communes,” each “commune” of 1500 inhabitants or less having the right to one member, and as many more as the divisor 1500 (or a fraction of 750 at the least) justifies. For the election of the 7 members of the Executive all the ” communes ” form but a single electoral circle. Proportional representation was rejected by a popular vote in 1893. The right of “facultative referendum ” and ” initiative ” as to legislative projects can be exercised if 4000 vote for it, but 10,000 voices are necessary for a demand for the revision of the cantonal constitution. In 1897 the State revenue of the canton was 4,217,913 francs (a rise of nearly 70 per cent, since 1885), and the State expenditure 4,018,457 francs (a rise of over 70 J per cent, since 1885), while in 1898 there was a surplus of 132,013 francs. In 1897 the public debt was 22,400,000 francs.

St Ga.ll, the capital of the above canton, 2208 feet above sea-level, 12^ mUes by raU from its port, Eorschach, on the Lake of Constance, and 49f miles from Ziirich. Its population was 21,204 in 1880 and 33,116 in 1900. Practically German is the only language spoken, and the inhabitants, so far as creed is concerned, are about equally divided between the Protestant and Eoman Catholic Churches, though there are a few Jews. The archives of the convents of St Gall and Pfafiers are in the Government offices (part of the old monastery), while the town library is rich in works relating to the Eeformation.

AuTHOEiTiES. ◆◆◆ Baumgaktner. Geschichte d. schweiz. Freistaaies u. Kant. St Oallen. 3 vols. Zurich and Stuttgart, 1868-90. ◆◆◆ St GalUsche Oeschichtsquellen (original chronicles). Edited by Meyer v. Knonatj. 5 vols. St Gall, 1870-81. MitteU. z. vaterldndisch. Geschichte (published by the Cant. Hist. Soc). From 1861. ◆◆◆ ScHNiDEE. hie Alpwirthschaft im Kant. St Gallen. Soleure, 1896. ◆◆◆ Urkundenhuch d. Ahtei St Gallen. Edited by Waktmann (original documents up to, as yet, 1411).

(w. A. B. C.)

St Helena, an island possession of Great Britain, situated in the South Atlantic Ocean, in 15◆◆55′ S. and 5◆◆42′ W. It is a Crown colony, administered by a governor and executive council consisting of three mem- bers. The climate is exceptionally healthy, being kept cool by the south-east trade wind and by the cold waters of the South Atlantic current. Farm and garden produce constitute the whole wealth of the colony, and there is no trade except that connected with supplying provisions to the garrison and to passing ships. The prosperity of St Helena was destroyed by the Suez Canal and the disuse of sailing vessels. The annual revenue is now not more than about one-third of its former amount. Custom duties are the chief item, and in 1898 amounted to less than ◆◆5000, against an average of ◆◆16,000 in the three years preceding the opening of the Suez Canal. In 1900 they amounted to nearly ◆◆10,500 owing to the

presence of the Boer prisoners of war and of British ti-(jops and sailors. There is practically no export trade, though a certain amount of specie is annually exported. The resident population in 1891 showed a decrease of 14 per cent, from that of 1881, which in turn had been less by 23 per cent, than the figures of 1871. The civil population was in 1891, 3877, of whom 2000 lived in Jamestown. The estimated population in 1900 was 5316,

inclusive of troops. There is telegraphic com- munication between St Helena and Europe and South Africa.

For history under the East India Company see Extracts from the St Helena Records from 16T3 to 1S35, Jamestown, 1885 ; Historical Geography of the British Colonies, vol. iii., West Africa, 2nd ed., Oxford, 1900 ; and M. Danvees' Report on the Records of the India Office, London, 1887. See also Report on the Present Posi- tion aiid Prospects of the Agricultural Resources of the Island of St Helena, by D. MoERis (printed for the Colonial Office), 1884, and Colonial Reports ??? Annual,

St Helens, a municipal, county (1888), parlia- mentary borough, and market-town of Lancashire, Eng- land, 193 miles north-west of London by rail. A canal communicates with the Mersey. The borough was in 1893 extended, and the enlarged borough constituted the township of St Helens. Modern erections are two Estab- lished churches, the Cowley schools, seven voluntary schools, public baths, and the Gamble Institute, erected and presented by Sir David Gamble, Bart., for a technical school and library, costing about ??30,000, and educating some 2000 students. Victoria Park (36 acres) was opened in 1887, Thatto Heath Park (17 acres) in 1890, Taylor Park (48 acres) in 1893, and three further recreation grounds, comprising in all 44 acres, in 1901. Besides St Helens hospital (1873) and EainhUl county lunatic asylum, enlarged in 1886, there are a Eoman Catholic hospital (1884) and two isolation hospitals, one of which was extended in 1893, 1896, and 1898. Works for the disposal of the sewage, costing about ??50,000, date from 1890. In 1891 there were 4845 males and 573 females engaged in the manufacture of glass, 1748 persons in that of alkali, 4320 in coal-mining, and 538 in the manufacture of iron and steel. The municipal and county borough, as extended, has an area of 7254 acres. Population (1891), 72,413; (1901), 84,410. Previous to extension the municipal borough was coextensive with the parliamentary borough, which had an area of 6558 acres,

St Helier, See Chaijnel Islands.

St Henri, incorporated city of Hochelaga county, Quebec, Canada, 2^ miles south-west of the centre of Montreal, on the north bank of the Lachine canal and on the Grand Trunk Eailway. It contains municipal build- ings, a college, and convent. The principal industrial establishments are sewing-machine, calico, shirt and coUar, leather, confectionery, and rock-drill manufactories, rolling mill, tanneries, foundries, and one of the largest cotton mills in Canada. Population (1891), 13,413; (1901),

21,192.

St Hya.Cinthe, a city and port of entry of Quebec, Canada, and capital of St Hyacinthe county, 29 miles east-north-east of Montreal, on the left bank of the river Yamaska and on the Grand Trunk, Canadian Pacific, Intercolonial, and Quebec Southern railways. It is the seat of a Roman Catholic bishop, and contains a classical college, dairy school, a number of educational and char- itable institutions, and two monasteries. It has manu- factories of organs, leather, wooUens, and agricultural implements. Population (1891), 7016; (1901), 9210.

St Ing'bert, a town of Bavaria, Germany, in the Palatinate, 14 miles by rail west of Zweibriicken. It has coal-mines, iron-works, and manufacture of glass and machinery. Population (1885), 10,321 ; (1900), 14,048.

St Ives, a. municipal borough and market-town in the St Ives parliamentary division of Cornwall, England, on St Ives Bay, 8 miles north-east of Penzance by rail. The works and property of St Ives harbour were in 1886 vested in the corporation. Modern buildings are a pier and a free library. The old stone pier has been repaired and lengthened. Area, 1019 acres. Population (1891),

6094; (1901), 6697.

St Johann, a town of Prussia, in the Rhine province. See SAAEBRtJCKBN.

St John, the capital of St John county. New Bruns- wick, the largest city in the province, 275 miles from Hahfax by the Intercolonial Railway, and

481 miles from Montreal by the Canadian Pacific Railway, of which it is the Atlantic terminus. In 1889 the cities of St John and Portland were united under one government. Through its direct connexion with Montreal and the West, St John has rapidly come into prominence as the winter port of Canada. The city expended about $750,000 in providing terminal facilities, in the shape of wharves, elevator, &c., on the west side of the harbour. The winter port trade opened in 1895-96, and has since steadily increased. Another large grain elevator has been constructed at the deep-water terminus of the Intercolonial Railway, where extensive wharf accommodation has also been provided by the Dominion Government, the two costing over $1,000,000. A large tract of forest land, including a beautiful sheet of water called Lily Lake, just north of the city, has been secured for a public park, the natural beauties of which are being constantly improved. It has the nucleus of a zoological garden. Through the munificence of one of its late citizens, St John has a home for incurables, $100,000 having been bequeathed for that purpose. The most important modern buildings are the Intercolonial Railway station, opera house, quarantine station, the market build- ing, and high school, and a site has been selected for a Carnegie library. The geology and natural history of the province are well represented in the museum of the Natural History Society of New Brunswick, situated in the market building. This collection includes the specimens formerly in the mechanics' institute.

The city is governed by a mayor and fifteen aldermen, thirteen of whom represent separate wards and two the city at large, but each alderman is elected by the whole city. St John city and county return two members to the House of Commons, instead of three, as formerly. The following figures show the condition of the coasting trade in 1901: ??? Steamers and sailing vessels, arrived, 2620, tonnage 408,055, men 18,890 ; departed, 2790, tonnage 562,778, men 22,431. The number of steamers and sailing vessels entering from British and foreign ports was 1663 (668,227 tons); cleared, 1465 (478,613 tons). On the 31st December 1900 there were 399 sailing ships and steamers (net tonnage 61,072) on the registry books ; of these, 68 were steamers, gross tonnage 7564. In 1900, 12 new vessels (410 tons) were built. In 1902 there were 153 schools, attended by 6947 pupils, 40 churches, 1 bank and 6 branch banks, and a

good electric street railway. The city is lighted by gas and electric light. In 1880 the exports amounted to $3,249,718 and the imports to $3,197,568. In 1890, exports $3,596,877, imports $4,352,018; in 1901, exports $11,094,908, imports $4,623,134. Population (1881, including Portland),

41,353 ; (1901), 40,711.

St John, West Indies. See St Thomas.

St Johns, the capital of Newfoundland, situated on the east coast of the island, in 47 33′ 54″ N. and 52 40′ 18″ W., the seat of government and the chief seaport and place of trade in the colony. From all records St Johns may fairly claim the distinction of being the earliest English settlement in America. The

old city, built entirely of wood, was twice completely destroyed by the French, and twice (1816-17 and 1846) by fire. Half of the capital was again burnt down in 1892. From all these disasters and, worse than all, the bank crash of 1894, St Johns arose, better built and more prosperous than ever. The town is well drained and its sanitary arrangements are fairly good. The main street is admirably paved, and there is an electric railway of the most modern construction. The railway across the island to Port aux Basques has one terminus in the east end of the town ; another in the western quarter, has a fine station, ^Yhence a branch line connects with the main line, about 7 miles west. The English cathedral, an admirable specimen of Gothic architecture, is not yet complete. Unfortunately part of the nave was burned, and the central tower is unfinished. The hotel accommoda- tion is quite inadequate to the needs of the city. There are several good public halls. Education is purely de- nominational. The colleges for the higher education are modern buildings ; and the council of higher education, formed of all the denominations, has worked well. St Johns is not an incorporated town. A municipal council was abolished after having increased the city debt to a

million and a half dollars. The town is now governed by three commissioners appointed by the governor in council.

St Johns, with its narrow .entrance and surrounding hills, is a great natural fortress, the Gibraltar of North America. As a naval base it would control the trade of the Korth Atlantic, which all passes within a short radius of Cape Eace. Both in the war of the Revolution and in that of 1812 St Johns was the head- quarters of the British fleet, and at one time the western end of the harbour was filled up with American prizes. The forts are all dismantled and in decay ; but a very elaborate survey of St Johns and the surrounding country has been made by the naval officers on the station, with a view to the fortification and defence of the port. Steamship lines run to Liverpool, New York, Halifax, N.S., the north and west coasts of the island, and Labrador. Local steamers in connexion with the railway also run on Plaoentia, Trinity, Bonavista, and Notre Dame Bays. Out of 399,852 tons of British steam shipping entered in Newfoundland in the year ending 30th June 1900, St Johns represented 243,367 tons. The total tonnage of sailing vessels entering and clearing from the port was in the same year 88,731 tons. Ninety per cent, of all duties collected are paid in the capital. Up to the bank crash of 1894, there were only local banks ; three Canadian banks have now established branches, and the financial condition of the city is to-day thoroughly sound. At the census of 1891 St Johns electoral district had 36,027, and the city 29,007 inhabitants. By the census of 1901 the electoral district contained 39,994 inhabitants, divided as regards religion as follows : ◆◆◆Church of England, 9566 ; Roman Catholic, 21,575 ; Methodists, 6737 ; Presbyterians, 1062 ; Congregationalists, 412 ; Salvation Army, 520 ; other denominations, 122. The population of the municipality was 30,486.

St Johns, a town and port of entry of Quebec, Canada, and capital of St Johns county, 19 miles south- east of Montreal by rail, on the bank of the river Richelieu and at the head of the Chambly canal. There are county buildings, head office of the St Johns Bank, silk works, drain-pipe and chinaware factories, potteries, &c. A large export trade in lumber, grain, and farm produce is carried on. Three railways, the Grand Trunk, Canadian Pacific, and Central Vermont, enter St Johns. Imports for the

year 1900-01, $2,477,942, and exports, $2,709,172. Population (1891), 4722; (1901), 4030.

St Johns bury, a town of Vermont, U.S.A., capital of Caledonia county. It is on the river Passumpsic, and on the St Johnsbury and Lake Champlain and the Boston and Maine railways, in the north-eastern part of the state, at an altitude of 572 feet. The principal village bears the same name as the town, and has some prominence as a manufacturing place. Population (1890) of the town, 6567; of the village, 3857; (1900) of the town, 7010; of the village, 5666, of whom 1309 were foreign-born.

St Joseph, a city of Michigan, U.S.A, capital of Berrien county. It is on Lake Michigan, at the mouth of the river St Joseph, and on the Vandalia and the Pere Marquette railways. Population (1890), 3733; (1900), 5155, of whom 1183 were foreign-born and 103 negroes.

St Joseph, a city of Missouri, U.S.A., capital of Buchanan county. It is ◆◆◆situated in 39◆◆45′ N., 94◆◆53′ W., on the east bank of the river Missouri, in the north-western part of the state, at an alti- tude of 825 feet. The city is divided into nine wards, is supplied with water by pumping from the Missouri, is sewered, and its streets are paved with brick or macadam- ized. It is one of the most important railway points of the interior, since six railways enter the city, the Atchison, Topeka and Santa F^, the Chicago, Burlington and Quincy, the Chicago Great Western, the Chicago, Rock Island and Pacific, the Missouri Pacific, and the St Joseph and Grand Island. These make it a commercial centre of the first importance, and to its immense trafiic by rail is to be added that by the river. Its manufac- tures, though not of so great relative importance, are considerable. In 1900 there were 440 manufacturing establishments, with a total capital of $11,068,825; they employed 7429 hands, and their output was valued at $31,690,736. The chief items of production were slaughtering and meat-packing, valued at $19,009,332 ; clothing, $1,782,395 ; and bakery products, $1,327,470. In 1901 the assessed valuation of real and personal pro- perty was $23,588,380, the net debt of the city was $1,655,140, and the rate of taxation was $28‘50 per $1000. Population (1890), 52,324; (1900), 102,979; showing an

extremely rapid growth. Of the population in 1900, 8424 were foreign-born and 6260 negroes.

St Junien, a town, arrondissement of Rochechouart, department of Haute- Vienne, France, 18 miles in direct line west by north of Limoges, on the railway from Limoges to Angouleme, and on the right bank of the Vienne. The 12th-century church, a fine example of the Roman Limousin style, contains a richly sculptured tomb of St Junien, the 6th-century hermit, from whom the town takes its name ; and adjacent to the church is a canonical refectory of the 13th century. Another interesting edifice is the Gothic chapel of Notre Dame, with three naves, rebuilt by Louis XL, standing close to an ancient bridge over the Vienne. The town, which ranks second in the department in population and industry, is noted for leather- dressing and the manufacture of gloves and straw paper ; other considerable establishments are felt and clog works, and there are spinning, flour, and saw mills. Near the forest of Brigueil, 4 miles north-east of the town, are large porcelain works, one of the most important in the Limousin region. Population (1881), 5499; (1901),

11,432.

St Kitts, or St Cheistophee, forming, with Nevis and Anguilla, one of the presidencies of the colony of the Leeward Islands (British West Indies). The island is well watered, healthy, and fertile. The temperature varies from 67 to 89 . The rainfall for 1900 was 38-00 inches. The roads are good. Population (1881), 29,137 ; (1901), 29,782. Basseterre, the capital, has a population of about 10,000. Sugar-growing is the sole staple industry. Revenue of the presidency (1900), 39,904; expenditure, 43,964; pubUc debt, 73,950. Primary education is by law compulsory. Most of the inhabitants are Pro- testants. The local legislative council of St Kitts-Nevis comprises ten official and ten unoflScial members, all of whom are nominated by the representative of the Crown.

ST LAWRENCE

St Lawrence. ❓❓❓ The river St Lawrence, in North America, with the five fresh-water inland seas ❓❓❓ Lakes Ontario, Erie, Huron, Michigan, and Superior ❓❓❓ that are linked to it, is one of the great river systems of the world. Its length, from the source of the river St Louis (which rises near the source of the river Mississippi and falls into the head of Lake Superior) to Cape Gasp^, where it empties into the Gulf of St Lawrence, is 2100 miles. From the head of Lake Superior the lakes are navigable to Buffalo, at the foot of Lake Erie, a distance of 1023 miles, for vessels having a draught of from 17 to 20 feet; from Buffalo to Montreal, 348 miles, the draught is limited by the capacity of the canals to 14 feet; from Montreal to Quebec, 160 miles, the ship channel accommodates vessels with a draught of 27J feet, rapidly being increased to 30 feet; below Quebec the river is navigable to vessels of any draught. The lakes, and the river to the point where it crosses the 45th parallel of north latitude in its north-easterly course, form the boundary-line between the Dominion of Canada on the north and the United States of America on the south; thence to the sea the river is wholly within Canadian territory.

The population of the states and provinces bordering on the St Lawrence system was estimated in 1899 to be 35,000,000. In Pennsylvania and Ohio, south of Lake Erie, there are large coal- fields. Surrounding Lake Michigan, and west of Lake Superior, are vast grain-growing plains, and the prairies of the Canadian North-West are rapidly increasing the area and quantity of wheat grown ; while both north and south of Lake Superior are the most extensive iron mines in the world, from which 18J million tons of ore were shipped in 1899. The natural highway for the ship- ment of all these products is the Great Lakes, and over them coal is distributed westwards and grain and iron ore are concentrated eastwards. The great quantity of coarse freights, that could only be profitably carried long distances by water, has revolutionized the type of vessel used for its transportation, making large steamers imperative, driving out sailing and small steam vessels, consoli- dating interests, and cheapening methods. With every increase in available draught, larger ships have been built to take advantage of it, and now the bulk of the trade is done in steel steamers of large tonnage, many of which tow barges, also of large size. It is usual for the vessels in the grain trade and in the iron-ore trade to

make their up trips empty ; but in consequence of the admirable facilities provided at terminal points, they make very fast time, and carry freight very cheaply. The cost of freight per ton-mile fell from ,%❓❓❓cent in 1887 to ^Sir cent in 1898 ; in 1899 the rate rose again, because there were not sufficient vessels to handle the freight offered. The large shipping trade is assisted by both the United States and Canadian Governments by a system of aids to navigation that very carefully mark every channel and danger. In 1901 there were on the Great Lakes 437 United States and 191 Canadian lighthouses; and on the river and gulf, 184 Canadian lights, including 11 lightships ; besides steam fog-alarms, gas and bell buoys, and buoys and beacons in great numbers. There are also life-saving stations at all dangerous points.

Duluth, at the head of Lake Superior, has rapidly developed into a harbour of great shipping capacity. Other large iron-ore shipping ports on Lake Superior are Ashland, Two Harbours,

Marquette, Superior. Fort William, at the mouth of the river Kaministiquia, Thunder Bay, is important as the most westerly point at which the Canadian Pacific Railway strikes the St Lawrence system, and is the outlet for much of the wheat of the Canadian North-West. There are large elevators at this point, and a line of fine Tyne-built passenger steamers runs to Owen Sound. These, and a line of passenger steamers running between Buffalo and Duluth, are equal in accommodation to transatlantic liners.

The river St Mary, 55 miles long, is the only outlet of Lake Superior. From Point Iroquois, which may be considered the foot of the lake to Sault Ste Marie, St Mary's Falls, or St Mary's Rapids, as it is variously called, a, distance of 14 miles, there is a single channel, which has been dredged by the United States Govern- ment to give a minimum width of 800 feet, and a depth of 23 feet at mean stage water. Below the Sault, the river, on its course to Lake Huron, expands into several lakes, and is divided by islands into numerous contracted passages. There are two navigated channels ; the older one, following the international boundary-line by way of Lake George, has a vndth of 150 to 300 feet and depth of 17 feet ; the other, some 12 miles shorter, an artificial channel dredged by

the United States Government in their own territory, has a minimum vpidth of 300 feet and depth of 20 feet.

*Between Lake Superior and Lake Huron there is a fall of about 20 feet, of which the Sault, in a distance of half a mile, absorbs from 18 to 194 ffist, the heiccht varying as the lakes change in level. The enormous growth of inter-lake freight traffic has justified the construction of three separate locks, each overcoming the rapids by a single lift ??? two side by side on the United States, and one on the Canadian, side of the river. These locks, the largest in the world, are all open to Canadian and United States vessels alike, and are operated free from all taxes or tolls on shipping. The Canadian ship canal, opened to traffic on the 9th September 1895, was constructed through St Mary's island, on the north side of the rapids, by the Canadian Government, at a cost of $3,684,227, to facilitate traffic and to secure to Canadian vessels an entrance to Lake Superior without entering United States territory. The canal is 5967 feet long between the extremities of the entrance piers, has one lock 900 feet long, and 60 feet wide, with a depth on the sills at lowest known water-level of 20i feet. The approaches to the canal are dredged to 18 feet deep, and are well buoyed and lighted.^*

On the United States side of the river the length of the canal is 1?? miles, the channel outside the locks having a varying width of 108 to 600 feet, and depth of 25 feet. The locks of 1855 were closed in 1886, to give place to the Poe lock. The Weitzel lock, opened to navigation 1st September 1881, was built south of the old looks, the approach being through the old canal. Its chamber is 615 feet long between lock-gates, and 80 feet wide, narrowing to 60 feet at the gates. The length of masonry walls is 717 feet, height 39J feet, with 17 feet over mitre sills at mean stage of water.

???The Poe lock, buUt because the Weitzel lock, large and fully equipped as it is, was insufficient for the rapidly-growing traffic, was opened on the 3rd August 1896 ; length between gates, 800 feet ; width, 100 feet ; length of masonry walls, 1100 feet ; height, 43J to 45 feet, with 22 feet on mitre sills at mean stage of water.

The canals are closed every winter, the average date of opening up to 1893 being 1st May, and of closing 1st December. The pres- sure of business since that time, aided possibly by some slight climatic modification, has extended the season, so that the average date of opening is now ten days earlier, and of closing twelve days later. The earliest opening was in 1898, on 11th April, and the latest closing in 1899, on the 20th December. The following table gives the average yearly commerce for every five years since 1880, and serves to show the rapid increase in freight growth : ???

Statement of the Commerce through the several Sault Ste.

*Marie Canals, averaged for every Five Tears**

Tears.

Pas- sages.

Registered Tonnage.

Pas- sengers.

Coal. Net Tons.

Flour. Barrels.

Wheat. Bushels.

Other Grains. Bushels.

General Merchan- dise. Net Tons.

Salt. Barrels.

Iron Ore. Net Tons.

Lumher.

M. feet

B.M.

Total Freight. Net tons.

1880-84 . 1885-89 . 1890-94 . 1895-99 .

1901 alone

4,457

7,908

11,965

18,352

20,041

2,267,166

4,901,105

9,912,589

18,451,447

24,626,974

34,607 29,434 24,609 40,289 59,663

463,431 1,398,441 2,678,805 3,270,842 4,593,136

681,726 1,838,325 5,764,766 8,319,699 7,634,350

5,435,601 18,438,085 34,875,971 57,227,269 52,812,636

936,346

1,213,815

1,738,706

23,349,134

24,760,547

81,966

74,447

87,540

164,426

558,041

107,225 176,725 231,178 282,156 443,774

867,999

2,497,403

4,939,909

10,728,075

18,090,618

79,144

197,605

610,482

832,968

1,072,124

2,184,731

5,441,297

10,627,349

19,364,974

28,403,065

- *statistical Report of Lake Commerce passing through Canals, published annually by the U.S. Engineer officer in charge.*

The outlet of Lake Michigan, which is the only lake lying wholly in United States territory, is near the point where the river St Mary reaches Lake Huron. The level of Chicago, above Lake Michigan, is so slight that much difficulty arose in draining it. A drainage canal has consequently been constructed, 34 miles long, to divert the river Chicago, a small stream which flowed into the lake, into the river Joliet, which flows into the Mississippi. Water

was let into the drain in December 1899. The estimated flow through it is 10,000 cubic feet per second. It is proposed to utilize this drainage canal as a ship canal, to give the lakes a freight out- let into the Gulf of Mexico.

Lake Huron empties into Lake Erie through the river St Clair,

‘ Report of Department of Railways and Canals, 1899, pp. 10 and 31.

Lake St Clair, and the river Detroit. On these connecting waters are several important manufacturing aud shipping towns, and through this chain passes nearly all the traffic of the lakes, both that to and from Lake Michigan ports, and also that of Lake Superior. It is estimated that the tonnage of a single short season of naviga- tion exceeds in the aggregate 40, 000, 000 tons. Extensive dredging and embankment works have been

carried on by the United States Government in Lake St Clair and the river Detroit, and a 20-feet channel now exists, which is being constantly improved.

The Grand Trunk Railway opened in 1891 a single-track tunnel under the river St Clair, from Sarnia to Port Huron, the only tunnel under the river St Lawrence. It is 6026 feet long, a cylinder 20 feet in diameter, lined with cast iron in flanged sections.

From Buffalo, at the foot of Lake Erie, the river Niagara runs northwards 36 miles into Lake Ontario. Niagara Falls are 23 miles below Buffalo. The river is spanned by five important railway and tramway bridges.

To overcome the difference of 327 feet in level between Lakes Erie and Ontario, the Welland canal, accommodating vessels of 255 feet in length, with a draught of 14 feet, was built, and is main- tained, by Canada.

The Murray canal, opened for traffic on 14th April 1890, extends from Presqu'ile Bay, on the north shore of Lake Ontario, a distance of 6J miles, to the headwaters of the Bay of Quinte, and enables vessels to avoid the open lake navigation. It is 11 feet deep below the lowest lake level, and has no locks.

Trent canal is a term applied to a series of water stretches in the interior of Ontario which are ultimately designed to connect Lake Huron with Lake Ontario. At Peterboro a hydraulic balance- lock, with a lift of 65 feet, 140 feet in length and 33 feet clear in width, allowing a draught of 8 feet, has been constructed. The ordinary locks are 134 by 33 feet, with a draught of 6 feet. When the whole route of 200 miles is completed, there will not be more than 15 miles of actual canal, the remaining portion of the water- way being through lakes and rivers.

The name St Lawrence is first applied to the river where it leaves Lake Ontario at Kingston. The canals on the St Lawrence have been enlarged to the capacity of the Welland and Lachine canals, the system having been opened to commerce in the autumn of 1899. Instead of enlarging the Beauharnois canal, on the south side of the river, a canal, the "

Soulanges, ” was built from Coteau Landing to Cascades Point, on the north side, the Beau- harnois canal still being utilized for small barges. The locks of all these canals are 45 feet wide, with an available depth of 14 feet and a minimum length of 270 feet. The following table shows the canalized stretches in this portion of the river : ???

Name.

From

To

Length in Miles.

Number of Locks.

Rise in Feet.

Galops

Head of Galops Rapids

Iroquois

7i

3

15i

River

i

Rapide

HeadofOgden

Morris-

3 ? ?

2

lii

Plat

Island

burg

River

lOi

Farrans

Head of Croils

Farrans

1

“i

“ ? ? ? 34

Point

Island

Point

River

5

Cornwall

Dickinsons

Cornwall

11

6

48

Canal

Landing

Lake St

30J

...

...

Francis

Soulanges

Coteau Landing

Cascades Point

14

4

824

Lake St

14

Louis

Lachine .

Lachine

Montreal

8i

5

45

109J

21

206

The river St Lawrence is spanned by the following railway bridges : ❓❓❓ 1. A truss bridge, built near Cornwall in 1900 by the New York and Ottawa Railroad. 2. A truss bridge with a swing, built in 1890 by the Canada Atlantic Railway at Coteau Landing. 3. A cantilever bridge, built in 1887 by the Canadian Piicific Railway at Caughnawaga. 4. The Victoria Jubilee bridge, built as a tubular bridge by the Grand Trunk Railway in 1860, and transformed into a truss bridge in 1897-98. The new bridge rests on the piers of the old one, enlarged to receive it, is 6592 feet long by 67 feet wide, with 25 spans, has double tracks, trolley tracks, driveways, and sidewalks, and was erected without interruption of traffic. Between Quebec and Montreal the ship channel, begun by the Montreal Harbour Commissioners, has been assumed by the Government as a national work.

The river St Lawrence is the shortest freight route from the Great Lakes to Europe. From Buffalo to Liverpool iiid New York involves r.ail or 7-foot canal transport of 496 miles and an ocean voyage of 3034 nautical miles. ViS, Montreal, there is 14-foot canal transport of 348 miles and

river and ocean voyage in transatlantic ships of 2772 nautical miles. From Quebec to Liverpool by Cape Race is 2801 nautical miles, while the route by Belle Isle, more nearly a great circle course, usually taken between July and October, is only 2633 nautical miles. The St Lawrence route suffers in com- petition with more southerly routes in consequence of not being open throughout the year. The Great Lakes never freeze over completely, but the harbours, and often the connecting rivers, are closed by ice. The navigable season at the Sault is about 7i months ; on Lake Erie it is somewhat longer. The average time between the arrival of the first vessel at Montreal from sea and the departure of the last ocean vessel is seven months. From Kingston to Quebec the river freezes over every winter, except at points where the current is rapid. Below Quebec, although there is heavy border ice, the river never freezes over. For a few winters, while the bridge accommodation at Montreal was restricted to the old single track Victoria bridge, railway freight trains were run across the ice bridge on temporary winter tracks.

Efforts have been made to lengthen the season of navigation by using specially constructed steamers to break ice ; and it is claimed that the season of navigation could be materially lengthened, and winter floods prevented, by keeping the river open up to Montreal. Car ferries run through the winter across Lake Michigan and the strait of Mackinac, across the rivers St Clair and Detroit, and across the middle^ of Lake Erie. The largest of these steamers is 350 feet long by 56 feet wide, draught 14 feet, horse-power 3500, speed 13 knots. She carries on four tracks 30 freight cars, with 1350 tons of freight.' Winter ferries are maintained at Quebec, between Prince Edward Island and Nova Scotia, and between Newfoundland and Sydney, Cape Breton. In the winter of 1898-99 an attempt was made to run a winter steamer from Paspebiac to England, but was not successful, principally because an unsuitable vessel was used. To pass through the field ice that is always pre- sent in the gulf, in gi-eater or lesser quantity, specially streugthened vessels are required.

The river St Lawrence above tide water is not subject to exces- sive flooding, the maximum rise in the spring and early summer months, chiefly from northern tributaries from the Ottawa east- wards, being 10 feet. The Great Lakes serve as impounding reservoirs for the gradual

distribution of all overflows in the west. At Montreal, soon after the river freezes over each winter, there is a local rise of about 10 feet in the level of the water in the harbour, caused by restriction of the channel by anchor ice ; and in the spring of the year, when the volume of water is augmented, this obstruction leads to a farther rise, in 1886 reaching a height of 27 feet above ordinary low water. To prevent flooding of the lower parts of the city a dyke was in 1887 buUt along the river front, which prevented a serious flood in 1899.

*The level of the lakes varies very gradually, and is affected by the general character of the season, and not by individual rainfalls. The variations of level of the several lakes do not necessarily syn- chronize. There is an annual fluctuate n of about 1 foot in the upper lakes, and in some seasons over 2 feet in the lower lakes ; the lowest point being at the end of winter and the highest in midsummer. In Lake Michigan the level has ranged from a maximum in the years 1859, 1876, and 1886, to a minimum, nearly 5 feet lower, in 1896.^ In Lake Ontario there is a range of 5^ feet between the maximum of May 1870 and the minimum of November 1895. In consequence of the shallowness of Lake Erie, its level is seriously disturbed by a persibtent storm ; a westerly gale lowers the water at its upper end exceptionally as much as 7 feet, seriously interfering with the navigation of the river Detroit, while an easterly blow produces a similar effect at Buffalo. There is geological evidence to show that the whole basin of the lakes has in recent geological times gradually changed in level, rising to the north and subsiding southwards ; and it is claimed that the movement is still in gradual progress, the rate assigned being '42 foot per 100 miles per century.^*

The maintenance of the levels of the Great Lakes is a matter of vital importance to the large freight boats, which always load to the limit of depth, at critical points in the dredgtd channels or in the harbours. Fears have been entertained that the water-power canals at Sault Ste Marie, the drainage canal at Chicago, and the dredged channel in the river Detroit will permanently lower the levels respectively of Lake Superior and of the Michigan-Huron- Erie group. An international deep-waterway commission considered this question, and army engineers appointed by the United States

1 Tmns. RoycU Soc. Canada, 189.1-99, vol. iv. sec. lii. T. C. Keeper on Ice Floods and Winter Navigation of the St Lawrence.

2 Appendices CCO and DDD to tlie Annual Eeport of the Chief of Eneineers U.S. Army, 1807.

s Eighteenth Annual Report U.S. Geological Survey, 1896-97.

Government worked on the problem.' Wing dams in the rivers St Mary and Niagara, to retard the disuharges, were proposed as remedial measures.

The Great Lakes are practically tideless, though some observers claim to find true tidal pulsations, said to amount to 3i inches at spring tide at Chicago. Secondary undulations of a few minutes in period, ranging from 1 to 4 inches, are well marked. Tides enter the Gulf of St Lawrence from the Atlantic chiefly through Cabot Strait (between Cape Breton and Newfoundland), which has a width of 75 miles and a depth of 250 fathoms. The tide entering through Belle Isle Strait, 10 miles wide and 30 fathoms deep, is com- paratively little felt. The tidal undulation, in passing through the gulf, expands so widely as to be almost inappreciable in places, as, for example, at the Magdalen Islands, in the middle of the gulf, where the range amounts to about 3 feet at springs, becoming effaced at neaps. There is also little more tide than this at some points on the north shore of Prince Edward Island. The greatest range is attained locally in Northumberland Strait and in Chaleur Bay, where it amounts to 10 feet. At the entrance to the estuary of the river St Lawrence, at Anticosti, it has again the oceanic range of about 6 feet, and proceeds up the estuary with an ever- increasing range, which attains its maximum of 19 feet at the lower end of Orleans Island, distant 660 miles from the ocean at Cabot Strait. This must be considered as the true head of the estuary. At Quebec, 30 miles farther up, the range is nearly as great ; but at 40 miles above Quebec it is largely cut off by the Richelieu Rapids, and

finally ceases to be felt at Three Rivers, at the lower end of Lake St Peter, 760 miles from the ocean.

The St Lawrence system is rich in water-powers, which are being increasingly utilized, and promise to add greatly to the resources of both countries. The river at Sault Ste Marie has been diverted into power canals on both sides, and furnishes electric light, traction, and power to both towns, and operates a very large pulp mill. The Niagara at the Falls is led through tunnels on both sides of the gorge, and electricity at a very high voltage is supplied to Buffalo, 22 miles distant, as well as being used locally. The St Lawrence Rapids have long been utilized for milling audi factory purposes ; a wing dam on the north side of the Laehine Rapids furnishes electricity to Montreal ; the Falls of Montmorency light Quebec and run her street oars ; and from Lake Superior to the gulf there are numerous water-powers on tributaries to the St Lawrence, only awaitiug population and capital for profitable development.

The Great Lakes are well stocked with fish of commercial value. These are largely gathered from the fishermen by steam tenders, and taken fresh or in a frozen condition to railway distributing-points. In Lakes Superior and Huron salmon-trout {Salvelinus namaycush, Walb) are commercially most important. They ordinarily range from 10 to 50 lb in weight, and are often larger. In Georgian Bay the catches of whitefish {Ooregonus clupeiformis, Mitchill) are enormous. In Lake Erie whitefish, lesser whitefish, erroneously called lake-herring (C artedi, Le Sueur), and sturgeon (Acipeiiser rviicundus, Le Sueur) are the most common. There is good angling at numerous points on the lakes and their feeders. The river Nepigon, on the north shore of Lake Superior, is famous as a stream abounding in speckled trout (Salvelinus fontinalis, Mitchill) of unusual size. Black bass [MicropUrus) are found from Georgian Bay to Montreal, and the Maskinong^ [Esox nobilior, Le Sueur), plentiful in the same waters, is a very game fish that often attains a weight of 70 lb. Nearly all the rivers flowing into the St Lawrence below Quebec are stocked with salmon (Salmo salar), and are preserved and leased to anglers by the provincial government. In the salt water of the gulf and lower river, mackerel, cod, herring, smelt, sea-trout, striped bass, and other fish are caught for market. (w. p. a.)

St LeonardSi a parish of Sussex, England, on the south coast, included in the municipal borough of Hastings. Population (1881), 7165; (1891), 10,283; (1901), 26,872. (See Hastings.)

St Louis, the most important city in the state of Missouri and the 4th in size in the United States, situated on the right, or west, bank of the river Mississippi, about 20 miles below its junction with the Missouri, in 38 38' 3-6" N. and 90 12' 17" W. It has an area of 62|- square miles and a river front of 19 miles. Twenty lines of railway have their terminus in the Union station, which covers 11 acres and was opened in Sep- tember 1894. The cost of the station, including the site, was $6,500,000. The lines from the east cross the

1 Report of the Chief of Engineers U.S. Army in Report of War Department U.S., 1898, p. 3776.

Mississippi by Eads Bridge, which was opened for traffic 4th July 1874, and also by Merchants' Bridge, 3 miles above the former, which was finished in 1890 and is controlled by the Terminal Kailway Company. An Act of the legislature, passed in 1899, authorized the con- solidation of nearly all the rapid transit lines within the city. A single company owns and controls 361 miles of single track, and runs about 2000 cars. By a system of transfers, passengers can go from almost any point in the city to another upon payment of one fare. The suburban system owns 100 miles of single track, and its equipment includes 200 cars.

Population. The population in 1890, not including any suburban locality, was 451,770, an increase of 28-89 per cent, over that of 1880. In 1900 it was 575,238, an in- crease of 27-33 per cent, over that of 1890. In 1900 the foreign-born population numbered 111,356, and the native white population born of foreign parents was 239,170. The total number of negroes, or persons of negro de- scent, was 35,516. The death-rate by the census of 1890 was 17-4. In 1900 it was 17-9, being nearly 90 per cent, higher among the coloured than among the white population. The birth-rate by the census of 1890 was 26-46 per 1000 for white persons and 26-36 for coloured persons.

Education, Libraries, &c. ◆◆◆ The number of public schools in 1901 was 188; the number of teachers, 1751; the number of pupils, 82,712. The total amount expended for school purposes in 1899 was $1,888,670.22, and the esti- mated value of all public school property, including that held for investment, was $6,803,704. During the year 1899 and the spring of 1900 Washington University, an endowed non-sectarian institution, increased its endowment fund by more than $4,000,000, and began preparations for removal to a new site comprising 150 acres on the out- skirts of the city. The land, which cost about $350,000, the fund for the new buildings, amounting to $750,000, and the increased endowment, were the gifts of citizens of St Louis. The St Louis University, belonging to the Eoman Catholic order of Jesuits, occupies large and com- modious buildings in the city, and is one of the most important institutions of learning controlled by that religious body in the United States.

St Louis has a large number of clubs for social and business purposes, chief among which are the St Louis, the University, the Mercantile, the Noonday, the Union, the Commercial, and the Round Table. The Mercantile library contains upwards of 112,000 volumes. The public library contains 135,000 volumes.

Municipal Affairs, Taxation,

Commerce, and Manufactures. ◆◆◆ Foreign shipments of flour and grain by rail and river on through bills of lading during the year 1901 were: of flour, 2,961,563 barrels; of wheat, 16,922,890 bushels ; of corn, 14,942,915 bushels ; of oats, 6,219,540 bushels ; cotton, 973,837 bales. The total value of the gross receipts of

cotton for 1901 was about 140,000,000. Among other receipts for 1901 were : lumber andlogs, 824,201,000 feet ; wool, 26,877,110 lb ; sugar, 253 hhds., 465,246 barrels, 534,576 bags; coal, 4,407,890 tons ; butter, 13,476,929 K>. The total number of tons of freight of ail kinds received and shipped was 28,758,664. St Louis produces more than three-fourths

of all the manufactures of the state of Missouri. The estimated product of the manufactures of St Louis for 1901 is valued at |340, 000,000, of which the following are the chief: tobacco, 80,766,883 lb; flour, 1,505,234 barrels,; furniture of the value of about 133,000,000. Boots and shoes have been sold valued at $43,500,000 ; bagging, 12,500,000 yards.

Banking. ❓❓❓ The number of banks in St Louis has been reduced by consolidation from twenty-five in 1896 to nineteen in 1901 ; the total capital has, however, been increased. There are eight trust companies. In 1901 the bank deposits increased to $788,801,986, and those in the trust companies increased to $19, 016,293. The total capital of the nineteen banks in December 1901 was $30,059,963, and of the trust companies, $29,278,007. The dividends paid by both banks and trust companies in 1901 amounted to $2,604,000, an increase of $619,000 over those of 1900. The clearings for 1901 exceeded those of any previous year by $562,830,722, aggregating $2,270,680,216. The balances for the year 1898 were $182,014,792, and for 1899, $214,166,941.

Political Parties. ❓❓❓ The city several years gave a decided majority to the candidates of the Republican party in municipal, state, and Federal elections, although the state of Missouri was Democratic by a large majority for many years. The city, however, gave a majority to the candidates of the Democratic party in 1901. The vote for Presidential electors in 1896 was as follows : for Republican electors, 65,708 ; for Democratic electors, 50,091 ; in 1900, for Republican electors, 60,597 ; for Democratic electors, 59,931. In the election of a state supreme judge iu 1898 the vote was as follows : for the Republican candidate, 48, 900 ; for the Democratic candidate, 39,697.

AUTHOKITIBS. ❓❓❓ Encyclopcedia of the Bistory of St Louis, a compendium of history and biography, in four volumes, published in 1899. A Blue Book is published yearly by the Merchants' Exchange, compiled by its secretary, dealing with the business progress of the year. (m. S. S.)

St Lucia, the largest of the British Windward Islands, West Indies. Population (1891), 42,220 ; (1901), 49,895. Of these, a small percentage are of European descent, but the majority are negroes, with about 2000

*East Indian coolies. The death-rate is about 22*50 per 1000. The dangers from venomous reptiles have been ex- aggerated. Only one death from snake-bite was recorded in 1898, none in 1900; and snakes are now but rarely met with.*

The climate is humid ; the rainfall varying from 70 to 120 inches per annum, with a very uniform average temper- ature of about 80 F. In 1899 the highest temperature was 91 (in May) and the lowest 68 (in December). Great damage was done on 11th September 1898 by a hurricane and the accompanying rains steep hillsides, surcharged with water, slid away in all directions, carrying with them plantations, houses, roads, and bridges, and leaving rocks and rubbish behind. Castries, the capital (with a population of about 7900), by reason of its harbour, wharfage, and coaling facilities, is the second naval station and one of the most important shipping ports in the British West Indies. It is strongly fortified, and is the chief coaling station of the fleet in the West Indies. It is in telephonic communication with seven small towns or villages. Crown lands occupy about one-half of the island. Amongst the principal products are sugar, cacao, logwood, coffee, nutmegs and mace, kola nuts, and vanilla. Tobacco is grown, but not for export. The imports of 1900 were valued at 403,592, largely owing to increased importation of military stores, the total of 1899 having been only 282,693; the exports at 229,436, of which 55,561 was for sugar. Revenue (1900), 72,107 ; expenditure, 64,750; public debt in 1901, 176,680. In 1900, at Castries, 1240 steam vessels and 617 sailing vessels entered and cleared, giving a total tonnage of 1,841,593, of which 82 per cent, was British. Of the total trade values in 1900, the United Kingdom sent 55 per cent, of the imports and the United States 31 per cent. ; while the

former took 26 per cent, of the exports, but the United States 71 per cent.

In 1900 there were 42 state-aided elementary schools under the control of the Roman Catholics, to whom were handed over all the Government schools in 1898. The number of children on the roll in 1900 was 6365, and the amount spent on primary education was 3138. There are also a grammar school for boys and a high school for girls. The military

expenditure for 1898 was ––54,385. There is a police force numbering 59, with a rural constabulary of 100. Knowledge of the English language is increasing amongst the country people, who formerly spoke a French patois, the result of frequent French occupation of the island.

St MsilO, chief tovra of arrondissement, department lUe – et – Vilaine, France, 43 mUes north – north – west of Rennes, with terminal station on the railway from Rennes. Shipbuilding, engineering, and iron and copper f oimding are the most important industries. The harbour, including the contiguous and connected basins belonging more especially to St Servan, comprises an outer basin, a tidal harbour, two wet docks, and an inner reservoir, affording a total length of quayage of over two miles. The inner harbours have a minimum depth of 18 feet, but in the tidal harbours the depth at low water is nil. The number of vessels entered in 1900 was 784, of 208,080 tons; cleared 791, of 217,083 tons. Nearly all the trade is with England. The total port movement, including coasting trade, was 509,051 tons ; 37 vessels with 824 men were engaged in the cod fishery. The number of passengers arriving by regular hues of vessels in 1900 was 10,271, and of departures, 9530. Population (1881), 9432; (1901), 11,486. The trade and industries of St Servan are of the same nature as those of St Malo, but are on a much smaller scale. Population

(1881), 9583; (1901), 12,597.

St Marys, a village of Auglaize county, Ohio, U.S.A. It is on the Lake Erie and Western Railroad, and on the Miami and Erie canal, in the western part of the state. Population (1890), 3000; (1900), 5359, of whom 246 were foreign-born.

St Michael, Alaska Territory, formerly Redoubt St Michael, a settlement on an island of the same name, founded by Tebenkoff in 1833, is situated at the southern end of Norton Sound in 63––28′ N. and 162––05′ W. Since the discovery of gold on the Yukon, this place has been garrisoned by the United States army, and forms the centre of a military reservation with a radius of 100 miles. The island is low, volcanic, and covered with herbage. It derives its importance from the fact that it is the only port for Yukon commerce. This is carried on through a channel called the Uphoon, available for light draught vessels, behind the bar of

the main river. It has a population of about 400 Eskimo natives, and a variable number of whites, which at times has amounted to several thousands. Thirty-five river steamers in 1899 were en- gaged in the river traffic from this place, and the commerce amounted to several millions of dollars. Navigation opens in June and closes in September. The annual mean tem- perature is 26”6 F. and the rainfall about 12 inches. The discovery of rich gold fields at Cape Nome, on the north shore of the Sound, attracted a temporary popula- tion estimated at 5000. The permanent population was reported by the United States census of 1900 as 857 ; in 1890 it was 101.

St Nazaire, chief town of arrondissement, depart- ment of Loire-Inf6rieure, France, 37 miles west of Nantes by rail. The parish church was completed in 1891. The Institut Verneuil established at La Baule is an

important sanatorium. The shipbuilding yards of the Transatlantic and Loire Companies, where are built large ships for the navy as well as for the mercantile marine, employ about 2500 men. Three dry docks are leased from the French Government. Forges, at a little dis- tance from the town, employ 1600 men, and turn out large quantities of steel rails, sheet and bar iron, &c. There are also several large flour-mills and steam saw-mills. Great improvements have been effected in the port. A channel was dredged at the mouth of the river in 1892-93, sufficient to admit the passage of battleships. The old basin was considerably deepened, and has a depth on sill, high spring tides, of 30^ feet ; an entrance with a minimum depth of 16 feet affords direct access from the roads to the old dock. There is regular com- munication with Newhaven. In 1900, including coasting trade, 807 vessels of 776,059 tons entered, and 832 of 786,403 tons cleared. The total port traffic, including coasting trade, amounted to 1,930,980 tons. The value of the imports was 2,608,000, and of the exports 3,488,000. The principal exports are wooUen fabrics, wines and spirits, fruits, vegetables, sardines, silk goods, poultry, (fee, and coffee. Foreign trade is chiefly with England, and the import of

coal from Great Britain ex- ceeded 1,000,000 tons. There are several stations much visited by the English and Americans for sea-bathing and as health resorts, especially La Baule and St Marguerite. The air in this district is noted as remarkably health- giving. At Fort de Lfeve are subterranean batteries. Population (1881), 15,843 ; (1901), 35,813.

St Onrier, chief town of arrondissement, department of Pas-de-Calais, France, 42 miles north-west of Arras, on the railway from Paris to Calais. The fortifications have been demolished, making way for important alterations and improvements begun in 1892. Population (1881), 17,404 ;

(1901), 20,867.

Sainton, Prosper Philippe Catlierine

(1813-1890), French violinist, was the son of a merchant at Toulouse, where he was born 5th June 1813, and educated at the college of his native town. He entered the Paris Conservatoire under Habeneck in 1831, and after gaining various prizes and undertaking a successful tour, became professor of the violin in the Conserva- toire of Toulouse. In 1844 he made his first appearance in England, at a Philharmonic concert directed by Men- delssohn, and settled in London in the following year, in the course of which he was appointed professor at the Koyal Academy of Music. In the early organizations for chamber music which culminated in the establishment of the Popular concerts, Sainton bore an important part ; and when the Eoyal Italian Opera was started at Covent Garden, he led the orchestra under Costa, with whom he migrated to Her Majesty's Theatre in 1871. From 1848 to 1855 he was leader of the Queen's Band, and in 1862 he conducted the music at the opening of the Interna- tional Exhibition. Two years before this, in 1860, he had married the famous contralto singer. Miss Charlotte Dolby. He was leader of the principal provincial festivals for many years, and gave a farewell concert at the Albert Hall in 1883, dying on 17th October 1890. His method was sound, his style artistic, and his educational work of great value, the majority of the most successful orchestral violinists having been his pupils. (j. A. r. m.)

Sainton-Dolby, Ciiarlotte Helen (1821-

1885), English contralto singer, was born in London 17th May 1821, studied at the Eoyal Academy of Music from 1832 to 1837, Crivelli being her principal singing-master. In 1837 she was elected to a king's scholarship, and first

appeared at a Philharmonic concert in 1841. In October 1845 she sang at the Gewandhaus, Leipzig, through the influence of Mendelssohn, who had been delighted by her singing in St Paul. The contralto music in his Elijah was written for her voice, but she did not appear in that work till the performance at Exeter Hall on 16th April 1847. She married M. Sainton in 1860, and in 1870 she retired from the career of a public singer, but two years afterwards started a "vocal academy" in London. She made various successful attempts as a composer, and the cantatas "The Legend of St Dorothea" (1876), "The Story of the Faithful Soul " (1879), and " Florimel " (1885), enjoyed considerable success. Her last public appearance was at her husband's farewell concert in June 1883, and she died 18th February 1885. A scholarship in her memory was founded at the Koyal Academy of Music. Her voice was of moderate power and of fine quality, but it was her dignified and artistic style that gave her the high place she held for so many years both in oratorio and ballads.

(j. A. F. M.)

St Ouen, town in the department of Seine, France, 1 mile north of the fortifications of Paris. Besides other important industries, it has manirfactures of firearms (military and sporting^, tinned foods, indiarubber goods, perfumery, soap, blacking, varnish, printers' ink, with glass works, sugar and saw mills, and distilleries. Population

(1901), 35,351.

St Paul, one of the "twin" cities of Minnesota, U.S.A., situated in 44►► 52' 46" N. and 93►►5' W., on the river Mississippi. With Minneapolis it constitutes the centre of the commercial life of the North-West. The population in 1895 was 140,292; in 1900 it was 163,632, of whom 46,819 were foreign-born, and 2263 were negroes. Out of 51,027 adult males, 1351 were illiterate (unable to write), of whom 1225 were foreign- born.

The birth-rate was 14‘80 and the death-rate (1900) only 9 ‘7 per thousand. The pubhc school system has 49 buildings and employs 534 teachers. Pupils enrolled in 1899 numbered 24,344. The other educational institutions are enumerated in the article on Minneapolis. St Paul has 167 churches, a public library of 47,000 volumes, 29 parks aggregating 560 acres, not including New Phalen Park of 600 acres, and many mUes of boulevards, and 103 miles of electric and cable street railways. Fifty-sLx news- papers and periodicals are published. There are 5 national banks, 8 state banks, 4 savings banks, and 13 trust com-panies. The aggregate capital of these institutions is $5,559,000. St Paul is distinctively a commercial city ; its jobbing interests in 1898 did a business amounting to $168,000,000. It possesses the largest boot and shoe and clothing manufactures in the west. According to the United States census of 1900, there were in St Paul 1591 manufacturing concerns. The capital invested amounted to $28,208,389, the number of persons employed was 17,593, and the product $38,541,030. St Paul is the head of navigation on the Mississippi; but the channel will be extended to Minneapolis by dams and locks. The assessed valuation of real and personal property in 1900 was $86,637,646. The tax upon this amount was 22-40 mills on the dollar. A total debt of $8,404,035 rests upon the city, but a considerable part of this amount consists of water bonds issued to build a water-works system. The city government is what is called the board type. The cost of maintenance is about $2,150,000 each year. (f. l. m^v.)

St Peter Port. See Channel Islands.

St Petersburg^, a government of north-western Russia, at the head of the Gulf of Finland, stretching for

130 miles along its south-east shore and the southern shore of Lake Ladoga, and bordering on Finland, with an area of 20,760 square miles. It is hiUy on the Finland border, but flat and marshy elsewhere, with the exception of a small plateau in the south (Duderhof Hills), which rises

only from 300 to 550 feet. It has a damp and cold climate, the average temperatures being : at St Petersburg, for the year 39 F., for January 15 , for July 64 ; yearly rainfall, 18-7 inches; at Sermaksa (60 28' N.), for the year 37 , for January 13 , for July 62 ; yearly rainfall, 20‘8 inches. The population, which was 635,780 in 1882, numbered 873,043 (census population, domiciled only) in 1897, without the capital and its suburbs. Of this latter number 466,750 were women and 160,499 lived in towns. The average density was 122 per square mile. The population is chiefly composed of Kussians, with a small admixture of Finns and Germans, and according to religion it is distributed as follows : Greek Orthodox, 78 percent.; Nonconformists, 1‘6 per cent.; Lutherans, 17 per cent. ; Koman Catholics, 2‘4 per cent. ; ” others,” 1 per cent. A remarkable feature is the very slow natural increase of the population. Up to 1884 there was even an excess of deaths, and it is only since 1886 that a small yearly excess (4922) of births over deaths has been noticed ; thus during the 25 years 1867 to 1891 the natural increase of the population was only 867. This is easily explained, how- ever, by the fact that large numbers of both men and women (especially young girls) are continually moving into the capital. The Government is divided into eight districts, the administrative headquarters of which are : St Petersburg (see below), Gdov (2254 inhabitants), Luga (5687), Novaya Ladoga (4144), Peterhoff (1130), Schliis- selburg (5285), Tsarkoye Selo (23,353), and Yamburg (4166). The other towns are : Gatchina (14,735), Narva (16,577), Oranienbaum (5333), Pavlovsk (4949), Okhta, Kolpino (12,030), Pulkova, and Krasnoye Selo. Most of the towns are summer resorts for the population of the capital. TiU the latter part of the 19th century education stood at a very low level, but progress has since been made, and now three-quarters of all who enter the army from the province can read. There were in 1898, 875 primary schools, with 45,500 pupils, which means that more than one-half of all children of school age went to school. The local zemstvo (council) has also organized village libraries and lectures on a wide scale. Many improvements have been made, especially since 1897, in the sanitary organiza- tion of the province. The zemstvo maintains 144 hospitals and dispensaries, with 626 beds, 64 doctors, 144 assist- ants, and 41 midwives. Out of an area of 10,806,000 acres (still excluding the capital and suburbs), 29 per cent, was owned by the village communities in 1896, and 8 per cent, by the peasants, the

remainder being private property, distributed as follows : nobles, 31 per cent. ; merchant class, 9 per cent. ; Imperial domains, 3 per cent. ; members of the Imperial family in private, 3 per cent. ; State, 9 per cent. ; artisans, &c., 8 per cent. Generally speaking, agriculture stands at a low ebb. There were in 1898, 590,000 acres under cereals (rye, oats, and barley), 43,000 acres under potatoes, and 30,000 acres under green crops, the total area under cultivation being 972,000 acres. The average yield in 1895-99 was : rye 1,941,300 cwt., wheat 17,000 cwt., oats 1,553,000 cwt., barley 386,800 cwt., potatoes 4,400,000 cwt. These crops, which are often ruined by heavy rains in the late summer, are insuflBcient for the population, which has to live on imported grain. Flax is cultivated to some extent. There were in 1898, 132,500 horses, 192,700 horned cattle, 106,900 sheep, and 22,400 pigs. Dairy-farming is developing. Timber, ship- ping, quarrying, and fishing are important industries; and the chief factories are paper mills, chemical works, and

printing works, but the aggregate returns of all factories amount only to 16,000,000 roubles per annum.

St Petersburg', the capital of the Kussian empire, situated at the head of the Gulf of Finland, at the mouth of the Neva, in 59 56' N. and 30 40' E. It was formerly generally believed that in consequence of the gradual upheaval of land in the Gulf of Finland there would be no more inundations such as occurred in the 18th century and early in the 19th century. There has, indped, been no very disastrous inundation since that of 1824, but in 1890, 1897, and 1898 the waters of the Neva rose over 8 feet, whereas a rise of 4 feet is sufiicient to flood the lower parts of the city, and in the terrible year of 1824 the rise was 14 feet. Consequently, the question whether it would not be advisable to protect the whole of the capital by means of dams has again been raised, and is being seriously considered. Being stiU partly built of wood, St Petersburg continues to suffer a great deal from fire, the average yearly loss being estimated at from 2,000,000 to 3,000,000 roubles. Electricity is in fair progress, but half of the city contiaues to have only parafiin oil lamps in the streets. A great number of handsome buildings and wide new streets have been built, and various monuments have been erected to the best Russian writers.

The population of St. Petersburg proper at the five censuses specified was as follows : ???

Proportion

Tear.

Total.

Men.

Women.

of Men to every 100 Women.

1864 .

539,122

313,443

225,679

139

1869 .

667,207

377,380

289,827

130

1881 .

861,303

473,229

388,074

122

1890 .

954,400

512,718

441,682

116

1897 .

1,132,677

616,855

515,822

119

A further increase was revealed by the municipal census of 26th December 1900, when the population of the city was 1,248,739, having thus increased 39 '3 per c^nt. in ten years. The population of the suburbs was 134,710 in 1897, and in 1900, 190,635. Taken with its suburbs, St Petersburg is the 5th city of Europe in point of size, coming after London, Paris, Berlin, and Vienna. The large proportion of men in its population is due to the fact that great numbers come from other parts of Russia to work during the winter in the textile factories, and during the summer at unload- ing the boats. The consequence of this periodical inflow is that though among children up to 10 years of age the female population is the more numerous (only 97 boys to each 100 girls), among those from 10 to 20 years old the proportion is reversed, and becomes 152 men to each 100 women, \vhile among those aged from 20 to 40 years it is 134 men to each 100 women. After that age the pro- portion of males rapidly decreases, being only 89 men to each 100 women among those of from 40 to 60 years

old. The proportion of strangers to those who are born at St Petersburg itseli' is as 2 to 1 ; in 1897 the population included 135,717 males and 168,013 females, total 303,730, born at St Petersburg, while the number of persons born elsewhere was 377,001 males and 273,669 females, total 650,670. The influence of the influx of adult people is seen in this connexion also, for among children the proportion of strangers is only from one-eighth to one-fourth, while among those from 21 to 55 years of age it is as 4 and even 5 to 1. The peasants form more than half the population ; and this proportion is likely to increase, for in 1869 they formed only 32 per cent, of the population, in 1881 42 per cent., in 1890 50 per cent., and in 1897, all told, 58 per cent. The census of 1890 also showed that more than one-half of the population (56 per cent.) was engaged in industries and trade, 16 per cent, in the service of the State, State and other companies, and the liberal professions, and 14 per cent, in domestic service, while 7 per cent, received their income from rents and pensions, and 7 per cent, had no definite occupation. The predominance of adult workers is again shown by the very small proportion (338 per thousand) of persons supported by the incomes of others. Russians numbered 828,354 in 1897, or 87 per cent, of the population ; Germans 43,798, or 4-6 per cent. ; Poles 22,307, or 2'3 per cent. ; Finns 16,731, or 1-8 per cent. ; and Jews

10,353, or 1 per cent. Of the remainder, the subjects of foreign nations are chiefly Germans, French, English (1881), Austriaus, and Swedes. The number of marriages is very low, being only six per thousand in the years 1894-98, births numbered 29 per thousand, and deaths 25 '2. The proportion of illegitimate children is nine times higher than in the rest of Eussia, namely, from 250 to 286 per thousand births. It is thus nearly the same as in Paris, but lower than in Moscow (292 per thousand) and Vienna (349 per thousand). Out of each thousand women, 424 had their first child illegitimate. The mortality varies very much in the different parts of the city ??? from 12 per thousand in the best situated, the Admiralty quarter, to 16 in other central parts, and to 25 and 27 in the

out- lying quarters. It may be stated, however, that the mortality has notably decreased, as it averaged 36 per thousand in the years 1870 to 1874, and only 27 from 1886 to 1895, and 24 in 1897. Infec- tious diseases, i.e., tuberculosis, diphtheria, inflammation of the lungs, typhoid, scarlet fever, and measles, are the cause of from 37 to 38 per cent, of all deaths. Disorders of digestion come next, various forms of cholerine, and even cholera itself, being endemic in St Petersburg. The high mortality in certain quarters is largely due to overcrowding and bad water. According to the census of 1890, there were in St Petersburg 142,523 separate sets of apart- ments, with 315,537 rooms, exclusive of kitchens and halls. This number is evidently quite insufficient ; and although nearly 500 large stone houses and 500 wooden houses are added every year, the rents run very high, whUe nearly 50,000 persons live in under- ground rooms ??? most insanitary on account of the low ground upon which the city is built. The city is supplied with water from the Neva, which early analyses appeared to show was quite pure. From analyses made in 1893-98, however, it would seem that even the water that is drawn from the middle of the river, at the head of the delta, contains bacteria in far greater num- Water ^^^.^ |^t^ jjj^y safely be permitted in drinking-water,

^Sanliatl. n ^^^ ^^^^ ^^^ powerful filters through which the water

??? supplied to the better parts of the city is passed soon become choked with the germs. So impure, indeed, was the water shown to be, that the wealthier inhabitants of St Petersburg have their water brought in casks from the Duderhof heights. The average daily municipal supply of water was 59,900,000 gallons in 1898, and 65,311,000 gallons in 1899. For sanitary purposes, the city is divided into twenty-one districts, in each of which the nmnicipality maintains one doctor (usually female) and several assistants, while the schools are regiilarly visited by twenty-eight municipal doctors. Six municipal laboratories are maintained for sanitary purposes.

Justices of the peace, though abolished in Russia generally, are still maintained in a few large cities, including St Petersburg, and . ., the city is divided into fifty-two justice of the peace

districte. The number of persons arrested duiing the year 1898 was 128,895, of whom only 46,496 were arrested for crimes, while no less than 54,645 were only charged with breaches of the passport regulations and 18,528 with begging iu the streets. Only 12,785 were condemned, 11,048 by the justices of the peace and the remainder by the courts of justice. St Petersburg contains two monasteries, and 247 churches and chapels of ^. . all denominations, including Jewish synagogues and Brf c H it Mussulman temples. It is also a great educational

‘ centre, to which youths flock from all parts of the empire. It has universities and high schools for male pupils, with an aggregate of 12,000 students ; yet this number is so insufficient that there were, in 1897, 3612 applications for admission to the technical institutes, and only 711 vacancies. There is one medical academy for women, with 1630 students in 1900, one university with 839 students, and four other institutions for the higher edu- cation of women with 631 students, as also a school for agricultural education (50 students). For secondary education there were for boys sixty-six gymnasia, lyoeums, military schools, and technical schools, with 16,000 pupils; and for girls sixty-two lyceums and high schools, with 9690 pupQs. The Musical Conservatory has 870 pupils (522 women). The primary schools are in a far less satisfactory condition, as in 1898 there were only 600 schools, with nearly 40,000 pupils, out of which 341 schools, with 20,000 pupils, were kept by the municipality. Six libraries for the people are maintained by the municipality. Of the several modern museums the Historical Museum ol Alexander III. deserves special mention. The number of scientific, literary, artistic, musical, and other societies is very great, and grows every year. St Petersburg is a great centre for printing, publishing as many books as Moscow. It contained in 1899, 60 printing ofBces, The Press ^^ lithographic establishments, 140 typo-lithographic

offices, 95 photograpliic establishments, 141 bookshops, and 55 public libraries. No fewer than 319 newspapers and reviews (including 25 dailies and 122 monthly reviews), that is, 38 per cent, of all periodical publications published in Russia, were issued at St Petersburg. It is estimated that all these publica- tions represent an aggregate of 1,700,000

copies, and that every year no less than 134,000,000 separate numbers of difi'erent

periodicals are issued. iS' early two-thirds of these go to the pro- vinces. Philanthropic societies numbered 334 in 1898, and main- tained 638 different institution.>i. They owned a capital of nearly 160,000,000 roubles, and their aggregate yearly income ???. . was estimated at over 2,000,000 roubles. Ko less than ”””””^^??? 107,000 persons applied to these institutions for as.sistance during 1898. The Foundling House and the institutions of the Empress Marie, the Imperial Philanthropic society, the Red Cross society, the Merchants' society, the Blue Cross society, the society of cheap restaurants and tea shops, and the society for supplying reading in the hospitals, are the most worthy of mention. The city and difl'erent philanthropic institutions maintain fifty-one hospitals, with nearly 14,000 beds, giving every year relief to about 75,600 persons.

From 1880 to 1890 was a very critical period in the history of the northern capital. With the development of the railway system, the southern and south-western provinces of . . . Russia began to prosper more rapidly than the Upper Volga provinces ; St Petersburg began to lose its relative import- ance in favour of the Baltic ports of Riga and Libau, and its rapid growth since the Crimean war seemed in danger of being stayed. The danger, however, passed away, and in the last decade of the 19th century it continued its advance with renewed vigour. A gi'eat influx of functionaries of all sorts, consequent upon the State taking into its hands the administration of railways, spirits, &o. , resulted in the rapid growth of the population, while the introduc- tion of a cheap railway tariff, and the subsidizing and encouraging in other ways of the great industries, attracted to St Petersburg a considerable number of workers, and favoured the growth of its larger industrial establishments. At the present time the province of St Petersburg ??? that is, properly speaking, the capital ??? is one of the foremost industrial provinces in Russia, its yearly returns amounting to 289,616,000 'roubles, and placing it immediately after Moscow (380,000,000 roubles), and before Piotrk6w, in Poland (257,000,000 roubles). Out of a population in the capital of 954,400 in 1890, 218,354 were employed in industrial work of all sorts.

Factories employed, in 1894, 75,775 workpeople (as against 26,000 only in 1866), of whom 51,095 were men and boys, 24,313 women and girls, and 367 children below 10 years of age. The chief factories were : cottons (17,092 workpeople, yearly returns 37,500,000 roubles), other textiles (7909 work- people, yearly returns 18,640,000 roubles), metal and machinery works (18,155 workpeople, yearly returns 32,303,000 roubles), tobacco (10,090 workpeople, yearly returns 14,553,000 roubles), paper (2421 workpeople, yearly returns 4,414,000 roubles), soap and candles (2820 workpeople, yearly returns 6,478,000 roubles), breweries (2168 workpeople, yearly returns 6,346,000 roubles), distilleries (1953 workpeople, yearly returns 7,888,000 roubles), pastry and confectionery (1460 workpeople, yearly returns 3,159,000 roubles), chemicals (1314 workpeople, yearly returns 4,455,300 roubles). In all there were 503 factories, with 75,775 workmen, and yearly returns amounting to 173,000,000 roubles. These figures, however, must be below the actual ones, because it was found that 94 public companies showed returns of 204,500,000 roubles inl898, and there are, besides, over 8000 workshops and small factories showing yearly returns of 73J million roubles. Trade gave occupation in 1890 to 60,200 persons, and the 12,006 large shops and commercial enterprises showed in 1894 an aggregate return of 1,787,578,600 roubles. The export trade of St Peters- burg is chiefly in grain (especially rye and oats), flour and bran, oil seeds, oil cakes, naphtha, eggs (271,236,000 in 1899), flax, and timber. It shows very great fluctuations, varying in _ accordance with the crops, and was valued "during '□□□" """ 1895-99, at from 73,000,000 roubles to 96,000,000□□□"^""□□"- roubles. The exports are almost entirely to western Europe by sea (from 52,000,000 roubles to 62,500,000), and to Finland (from 15,000,000 to 27,000,000 roubles). The imports consist chiefly of coal, metals, building materials, herrings, coffee and tea, various better-class woods, raw cotton, wood pulp and cellulose, and manu- factured goods. The ports of St Petersburg and Cronstadt were visited in 1898 by 2061 ships, of 1,518,400 tons, engaged in foreign trade, and by 3231 ships, of 261,000 tons, engaged in the coasting trade. Of all of these, only 3494 ships of 389,000 tons were under the Russian flag. Navigation on the Neva, which is the channel for all goods shipped from central Russia by way of the canals, is very great, no less than 20,737 vessels being unloaded in 1898. The number of passengers coming to St*

Petersburg or leaving it is also very great, the arrivals being (1898) 4,419,756 passengers, of whom nearly 730,000 came from the provinces. For internal com- munication there is a tramway system 88 miles long, which carried, in 1898, 85,000,000 passengers ; and numerous services of steamers, both on the Neva and the canals, by which 9,663,000 passengers were transported in 1898.

There is not the slightest doubt that the population of St Petersburg has made considerable intellectual progress, and that all-round education has begun to reach artisans and factory hands. Sunday schools, since they were reopened, have immensely con-

tributed to this result ⁂ chiefly owing to the voluntary efforts of a great number of men and women connected with education. The cheap daily press has penetrated into the masses of the Eussian people, and especially of the population of the capitals, . to an extent that is hardly realized outside of Russia ; i>oclal while quite a number of weU-meaning publishers ⁂ progress. ^^^^ ^j. j^j^ women ⁂ taking advantage of the fact that Russian books are printed for a population of a hundred million people, have edited the works of the Russian classics and the best authors, as also translations from west European authors, at prices which seem simply ridiculous in western Europe. Thus all works of Turguenieff, Goncharoflf, &u., are published as free supplements to an excellent illustrated weekly, which costs only 10s. a year ; or, all the works of Darwin are sold for lOs., while the works of the best Russian classics ⁂ Pushkin, Gogol, Lermontoff ⁂ are sold either for 3s. the complete edition, or for 2, 3, or 5 farthings as separate poems or novels. At the same time the industrial necessity of spreading education amongst the factory hands and artisans contributes to the same result, notwithstanding the opposition of the Government. As to the educated classes of St Petersburg, they have always stood at the head of progressive thought in Russia, and it is well known that it was chiefly owing to their support that it was possible to carry through the great reforms of the years

1861-66. Their demand for political reforms is supported now by a rapidly increasing class of artisans, working- men, and clerks, who all grow more and more conscious of their political rights. (p. a. K.)

St Pierre and Miquelon, two islands belonging to France in the Atlantic, 10 miles from the south coast of Newfoundland. Their united area covers 59,527 acres, or about 93 square mUes. Both are mountainous, and several points are over 600 feet in height. Their im- portance is due to their proximity to the great Bank. In 1898 the settled population numbered 4700, of whom 1611 were men, 1494 women, and 1595 children. The floating population reaches 1650, giving a total of 6350 inhabitants. In 1888 the corresponding number was 6000, but it is doubtful whether the population increases. The chief town is St Pierre.

The islands are administered by a governor, assisted by a privy council and, since 1887, by a general council. They send a delegate to the Superior Council for the Colonies at Paris. The local Budget for 1899 was 519,865 francs ; expenditure of France (Budget 1900), 282,938 francs. There is a colonial coUege for primary and secondary education, with 42 pupils ; a higher class school for girls, with 76 pupils ; and an ouvroir or workroom for training girls, with 40 pupils. Primary instruction is free. There are three commercial schools for boys and three for girls, with (in all) 23 teachers and 720 pupils. There are, besides, infant schools, salles d'asile, frequented by 342 children. Agriculture in the islands does not extend beyond vegetable gardens. Fishing is the great resource of the population, lasting from April to September, the port of St Pierre itself equipping 220 boats, which swell the num- bers of French fishers at Cancale, St Malo, St Brieuc. In 1899 the catch on the great Bank amounted to 44,870 tons, valued at ––296,000. In 1880 the weight caught was 17,000 tons. The subsidy granted to 309 boats of 21,948 tons and 6660 men, amounted to ––13,100. The total commerce of the two islands in 1880 amounted to ––1,280,000; in 1900, to ––880,000: of the value in 1900, ––388,000 was for imports and ––492,000 for exports. The exports consisted of fish, fresh or dried, ––388,000 ; cod oil, ––41,200 ; lobsters, ––16,000. The imports comprise alimentary substances and other articles of consumption. St Pierre is con- nected with Halifax and St Johns (Newfoundland) by a regular packet service.

Besides the English cable, there has been a French cable to St Pierre since 1880.

See Henrique. Les Colonies Frcmgaises. Paris, 1889. ??? Lbvas-BEUE. Jja France, t. ii. Paris, 1893. L' Annie Coloniale, 1900.

St Pierre. See Maetinique.

St Pol ten, a small town and episcopal see in Lower Austria, on the railway from Vienna to Salzburg. Popu- lation (1890), 10,906; (1900), 14,510, including garrison of 1219 men, almost exclusively German and Catholic. The industries include cotton spinning and milling, as well as the manufacture of iron and hardwares and small-arms.

St Quentin, chief tovra of arrondissement, depart- ment of Aisne, France, 95J miles north-north-east of Paris by rail. Besides the very important, extensive, and varied

textile industries, of which tulle, lace, and guipure forid considerable branches, there are important foundries, large boiler works, machinery works for various special industries, and many brick and tile yards, while in the district are numerous sugar mills. The manufactured products, cotton and linen yarn, and grain are the objects of an active commerce. A monument of the siege of 1557 was erected in 1897, another monument commemorates the defence of the town in 1870, and there are statues of the artist Quentin Delatour (1704-88) and of the historian Henri Martin (1810-83), both natives of St Quentin. Port traffic (1900), 172,391 tons. Population (1901), 50,150.

Saint-Saens, Charles Camille (1835-

), French composer, was born in Paris on 3rd October

1835. He lost his father when young, was brought up under the care of his mother, and began the study of music at an early age. After having as a child taken lessons in the piano from Stamaty, and learned the elements of composition from Maleden, both distinguished teachers of their time, he entered the Paris Conservatoire in the organ class, then presided over

by Eugene Benoist, obtain- ing the second prize in 1849, and the first two years later. For a short time he studied composition under Hal^vy, and in 1852 competed without success for the Prix de Kome. Several years later, in 1864, he again attempted to win the much-coveted prize, but with no better result. Notwithstanding these unaccountable failures to obtain academic recognition of his extraordinary gifts, Saint-Saens worked indefatigably at his art. In 1853, when only eighteen, he was appointed organist at the Church of St Merry. Eight years later he was called upon to preside at the organ of the Madeleine, in succession to Lef^bure- W^ly, a post which he retained until 1877. An overture entitled " Spartacus," which has remained unpublished, was crowned at a competition instituted in 1863 by the Soci^t6 Sainte C^cUe of Bordeaux. The greatest triumph of his early career was, however, attained in 1867, when the prize was unanimously awarded to him for his cantata "Les Noces de Prom^th^e " in the competition organized during the International Exhibition of that year, a prize com- peted for by over two hundred musicians.

The name of Saint-Saens was gradually becoming known, if not to the bulk of the public, at least to the frequenters of concerts. He had acquired a great name as a pianist, and had made successful concert tours through Europe. So far, however, he had not succeeded in reaching the ears of the larger public by the production of an opera, which in France counts for more than anjrthing else. After the tragic events of 1870, when Saint-Saens did his duty as a patriot by serving in the National Guard, the oppor- tunity at last offered itself, and a one-act opera from his pen. La Princesse Jaune, with words by Louis GaUet, was produced at the Op^ra Comique with moderate success on 12th June 1872. Le Timbre d'Argent, a four-act opera performed at the Theatre Lyrique in 1877, was scarcely more successful. In the meanwhile popularity accrued to the composer in the concert room, and his "symphonic poems" "Le Rouet d'Omphale," "Danse Macabre," " Phaeton," and " La Jeunesse d'Hercule " obtained for him a world-wide celebrity. These admir- able examples of " programme music " count among his best known works.

His star was now in the ascendant, and was destined to shine on the operatic stage as well as in the concert room. Liszt, moMt noble-minded and unselfish of artists, ever ready to champion the cause of others,

entertained the highest admiration for Saint-Saens, and it was through his all-powerful influence that the French composer's Biblical opera Samson et Dalila was brought out at

Weimar in 1877. This work, wHch tas been generally accepted as the composer's operatic masterpiece, had been begun as far back as 1869, and an act had been heard at one of Colonne's concerts in 1875. Notwithstanding its great success at Weimar, several years were destined to pass before it was to be heard in France, its &st perform- ance on French soil taking place at Kouen in 1890. The following year Samson et DalUa was given in Paris at the Eden Theatre, and finally in 1892 was produced at the Grand Opdra, where it has since remained as one of the most attractive works of the repertoire. Its Biblical subject has unfortunately stood in the way of its being performed on the London stage, but it has frequently been given in concert form with great success. The composer's subsequent operas may show an equal com- mand of resource, but in none has he been so well inspired as in his musical setting of this Biblical tale. No work is better calculated to exemplify the dual tendencies of his style. The first act, vpith its somewhat formal choruses, suggests the influence of Bach and Handel, and is treated rather in the manner of an oratorio. The more dramatic portions of the opera are not uninfluenced by Meyerbeer, while in the melQfluous strains allotted to the temptress there are occasional suggestions of Gounod. Of Wagner there is but little trace, save in the fact that the composer has followed the German master's lead by dividing his work into scenes, thus avoiding the old-fashioned de- nominations of "air," "duet," "trio," &c. The score of Samson et Dcdila, however, is not devoid of individuality. The influences mentioned above, possibly excepting that of Bach in the earher scenes, are rather of a superficial nature, and do not detract from the originahty that asserts itself throughout the work ; for Saint-Saens has undoubtedly a style of his own. It is a composite style, certainly ; and all the materials that go towards forming it may not be absolutely his, that is, the eclecticism of his mind may lead him at one moment to adopt an

archaic form of expression, at another to employ the current musical language of his day, and sometimes to blend the two. It is perhaps in the latter case that he shows most individuality ; for although his works may denote the varied influences of such totally dissimilar masters as Bach, Beethoven, Liszt, and Gounod, he ever contrives to put in something of his own that gives his music the stamp of its authorship.

After the production of Samson et Dalila, Saint-Saens stood at the parting of the ways. Looked at askance by the reactionary section of the French musicians, and sus- pected of harbouring subversive Wagnerian ideas, a notion strengthened by the enthusiastic articles he had published concerning the production of the Ring des Nibelungen at Bayxeuth in 1876, but ready to be welcomed by the pro- gressive party, it now remained to be seen which road he would follow. Both sides were doomed to disappointment, for in his subsequent operas Saint-Saens attempted to efiect a compromise between the older and the newer forms of opera. He had for some time caressed the idea of utilizing the history of France for operatic purposes. The first and only result of this project has been Etienne Marcel, an opera produced at Lyons in 1879. Although of unequal merit, owing partly to its want of unity of style, this work contains much music of an attractive kind, and scarcely deserves the neglect into which it has fallen. Forsaking the history of France for that of England, Saint-Saens now set to work on an opera having for its hero "bluff King Hal" Henry YIII. was pro- duced at the Paris Grand Op^ra in 1883. The librettists had concocted a piece that was sufficiently well knit and abounded in dramatic contrasts. While adhering to his system of compromise by retaining certain conven- tional operatic features, Saint-Saens had in this instance |

advanced somewhat by employing leit motivs in a more rigorous fashion than hitherto, although he had not gone so far as to discard airs cut after the old pattern, duets, and quartets. Henry VIII., which was given at Covent Garden during the season of 1898, certainly occupies an honourable place among the composer's works. Proser- pine, a lyrical drama produced at the Paris Op^ra Comique in 1887, may be said to have achieved a succes d'estime and no more. A not much better fate befell Aseanio, an opera founded on Paul Meurice's drama Benvenuto Cellini,

and brought out at the Grand Op6ra in 1890. PhrynJ, however, a two-act trifie of a light description, produced at the Opera Comique in 1893, met with success ; and his " lyrical drama " Les Barbares, given at the Grand Op6ra in 1901, has been received with marked favour.

Saint-Saens worked in every field of his art and succeeded in aU. The following condensed list of his compositions proves this better than words. Besides the operas above alluded to, he composed the following oratorios and cantatas : " Oratorio de Noel," " Les Noces de Pro- m^thee," Psalm "Cosli enarrant," "Le Deluge," "La Lyre et la Harpe " ; three symphonies ; four symphonic poems ("Le Rouet d'Omphale," "Phaeton," "Danse Macabre," " La Jeunesse d'Hercule ") ; five pianoforte concertos ; three vioUn concertos ; two suites, marches, and other works for orchestra ; the baRet Zavotte ; music to the drama Dijanire, given at the open-air theatre of B^ziers ; a quintet for piano and strings, a quartet for piano and strings, two trios for piano and strings, a string quartet, a septet, violoncello sonata, two violin sonatas; a Mass, a Requiem, besides a quantity of piano and organ music, and many songs, duets, and choruses. He also published three books, entitled Harmonie et Milodie, Portraits et Soimenirs, and Prohlemes et Mysteres, besides a volume of poems, Rimes fa/milieres. The honorary degree of Doctor of Music was conferred upon him by Cambridge University in 1893.

St Servan. See St Malo.

St ThomaSi an incorporated city and port of entry of Ontario, Canada, capital of Elgin county, on Kettle creek, 13 miles south of London and 8 miles north of Lake Erie. It ig an important station on the Grand Trunk, Michigan Central, Lake Erie and Detroit River, and Canadian Pacific railways. The principal public buildings are the city hall, court house, and post office ; there are six schools, a collegiate institute, and Alma ladies' college. The Michigan Central railway shops, car- wheel foundry, flour, flax, and planing mlUs, are the principal industries. Population (1891), 10,366; (1901),

11,485.

St Thomas, St Croix, aitd St John,

three of the Virgin islands of the West Indies, situated ??? the first-named 40 miles east of Porto Rico, the second 65 miles south-east of Porto Rico and 40 miles south of St Thomas, and the third 4 miles east of St Thomas. Their respective dimensions, areas, and populations are given in the following table : ???

Island.

Length. Miles.

Width. Miles.

Area. Square Miles.

Popula- tion,

1835.

Popula- tion,

1890.

Popula- tion,

1901.

Density per

Square Mile,

1901.

St Thomas St Croix . St John .

Total .

13

22 10

1-4 1-6

2i

33 84 21

14,022

26,681

2,475

12,019

19,783

984

11,012

18,567

925

334 221

44

...

138

43,178 32,786

30,504

221

The population has thus diminished by 29-3 per cent, since 1835. In 1901 there were 14,026 males and 16,478

females; and 58‘4 per cent. (17,826) lived in the towns and 41-6 per cent. (12,678) in the country districts. The chief towns are Charlotte Amalie, the capital of St Thomas, with 8540 inhabitants in 1901 ; Christiansted, the capital of St Croix, with 5483 inhabitants ; Frederik- sted, also on St Croix, with 3745 inhabitants ; and Cruxbay, on St John, with 58 inhabitants. Five-sixths of the in- habitants are the descendants of negro slaves brought from Africa, chiefly in the period of the Napoleonic wars ; the remaining one-sixth are whites, mostly Danes and British. The prevailing language is English, but Danish, Dutch, French, Spanish, and German are also used. Except in the southern half of St Croix, the islands are all hilly, the culminating point in St Thomas being West Mountain (1555 feet); in St Croix, Blue Mountain (1155 feet); and in St John, 1270 feet. St Thomas and St John stand on a continuation of the ridge which supports the Greater Antilles (Cuba, Hayti, Porto Rico) ; but St Croix is the westernmost promontory of the submarine elevation on which the Lesser AntUles stand. All three islands are built up of eruptive rocks (porphyry and granite) of ancient origin and much disintegrated. The cultivable area is relatively small, but the soil is generally from 10 to 50 feet deep. St Croix possesses relatively the largest share of cultivated ground, namely, 57|^ per cent, pasture and 32 per cent, planted with the sugar-cane, tobacco, and fruits, while the remaining 10 J per cent, is uncultivated. Sugar, tobacco, bay rum, and tropical fruits are the principal productions, the first-named being by far the most im- portant. Tijiag as they do within the tropics, these islands are naturally hot, and the daily range of temperature is comparatively small, only 9◆◆ ; indeed the yearly range is not great, the maximum being 92◆◆ in September, and the minimum 69◆◆ in January. The annual mean of St Croix (81◆◆) is about 3 ‘5◆◆ higher than the annual mean of St Thomas (77 “5◆◆). But the heat is greatly modified by the constant and invigorating trade-winds ; so that, on the whole, the climate is fine and salubrious. The rain falls, as a rule, in short, heavy showers, the annual

mean of both St Thomas and St Croix lying between 44^ and 47 inches. Earthquakes are frequent, but as a rule are not severe. The fierce hurricanes are much more dreaded ; those of the years 1713, 1738, 1742, 1772, 1793, 1819, 1837, and 1899 having been especially destructive.

Since tlie introduction of steam ocean-going vessels St Thomas has gradually lost the greater part of the trade which she had as one of the chief emporia of the West Indies, and the decline has been more marked since 1885, when Barbados took the place of St Thomas as a trade-distributing centre. Whereas in 1885 the total trade was valued at ––594,130 (of which ––446,290 represented St. Thomas' share), the total value in 1898 did not exceed ––342,350. The country which has the largest share in this trade is the United States. In 1821 the trade between these three islands and the United States was valued at ––692,222 ($3,461,110) ; in 1861, ––365,880 ($1,829,400) ; and ––234,082 ($1,170,410) in 190). But the principal value and importance of the little group lies in the suitability of St Thomas for a coaling station, and eventually, no doubt, as a naval base for the United States, for its geographical position invests it with a high strategic value (Captain Mahan). It is a port of call for coaling of the Hamburg-American line, Transatlantic Steamship Company, Royal Mail Company, and others. The port is situated about the middle of the south coast of the island, and consists of an almost landlocked basin, about three-quarters of a mile across, approached by a narrow entrance of only 300 yards at its minimum ; the depth varies from 27 feet to 36 feet. It is equipped with a floating dry dock, 300 feet long, which can accommodate vessels up to 3000 tons burden, and with well-fitted ship-repairing yards. The port of Christiansted, on a creek on the north side of St Croix, is to a large extent choked up with mud ; and Frederiksted, at the western end of the same Island, is little better than an open roadstead. But in Coral Bay St John possesses one of the best harbours of refuge in the Antilles, when the dreaded hurricanes are raging.

From 1865 the islands were continuously governed at a loss to the mother country of Denmark ; their total indebtedness on this score amounted in 1898 to the sum of ––216,720. The idea of the United

States buying these islands from Denmark was first broached by Secretary Seward in 1865, and the islands were virtually sold for the sum of 74 million dollars, but the treaty failed to get the rati- fication of the United States Senate. Negotiations were reopened in 1892, and matters were again so far advanced that in 1902 another treaty of cession was signed on 17th February, in virtue of which the purchase price was fixed at 5 million dollars ; and this was duly ratified by the United States Senate, and by the Danish Folkething, subject to the assent of the inhabitants of the islands. The earlier history of these islands is given under the several headings in the ninth edition of this work.

See Hev. John P. Knox, A Historical Accouoit of St Thomas, and Incidental Notices of St Croix and St John (1850), and James Pakton, The Danish Islands (1869).

St Vincent, one of the British Windward Islands. Population (1891), 41,054 (2445 white, 7554 coloured, and 31,055 black); (1900), estimated at 44,600. About 330 of these were East Indian coolies, and a few Caribs of somewhat mixed blood, the majority of the aboriginal Caribs having been deported to British Honduras in 1797. Kingstown, the capital, situated on a bay at the south- western extremity of the island, has a population of about 4000. The climate is healthy. The coolest time of the year is from December to May; the wet season is from August to November. The maximum reading of tha thermometer during 1899 was 88‘5 (in August); the minimum 68”5 (in December). The average annual rain- fall is 111 ‘82 inches. There are 77 miles of highway running round the island, for the most part close to the coast ; but on the leeward side communication is mainly by boat. There are 129 miles of telephone. Imports in 1899, 103,627 ; exports, 63,293. In the hurricane of

1898 nearly 300 persons lost their lives, and no less than 30,000 persons were rendered homeless; damage was done to the extent of 225,000. Eevenue (1899) (including 31,075 from Imperial funds), 33,575; ex- penditure (including 17,534 from Imperial funds), 47,855; public debt, 15,710. The principal trade is with the United States of America, trade with the United Kingdom having

declined. Sugar and arrowroot were, until 1898, the principal products; the hurricane of that year almost extinguished the sugar industry, which was already deca3dng ; whilst, on the other hand, the arrowroot works then destroyed were replaced by better equipped premises. Other articles of export are cacao, cotton, spices, fruit, vegetables, live stock, and poultry. Crown lands, situated in the centre of the island at altitudes varying from 200 to 4000 feet, com- prise between one-half and one-third of the whole island. The tonnage of the vessels entered and cleared during

1899 was 245,588, nearly all being British. The Angli- can, Wesleyan, and Eoman Catholic churches are well represented, and there are some Presbyterians. In 1898 there were 98 State-aided schools, with 7509 children on the roll, and an average daily attendance of 3158. There is a grammar school at Kingstown, the capital. An agri- cultural school was opened in 1900.

The present constitution dates from 1877, when the legislative council, consisting of four official and four nominated unofficial members, was formed. In 1899 an important scheme was entered upon, by means of a grant of ??15,000 from the Imperial treasury, for settling the labouring population, distressed by the failures of the sugar industry, in the position of peasant proprietors.

In May 1902 the island was devastated by a terrible eruption from the Soufri^re, contemporaneously with the eruption of Mont PeWe in Martinique {q.v.), and extensive damage and loss of life was caused, the remaining Black Caribs being reported to be entirely wiped out. An account of the calamity was given in a letter to the Standard by Mr F. H. Watkins, the Commissioner of Montserrat, which, in the absence of fuller details at the

time when this article had to go to press, may here be quoted : ???

“St Vincent is divided by a high mountain ridge, running from north to south, at the northern end of which is the SovfrUre, which, rising to about 3000 feet in the centre of the island, domi- nates both the leeward and windward districts in that portion of it. The Saufriire has, or rather had, two craters, the old and new, the latter, to the south-east of the former, having been formed by the eruption of 1812, which has been so vividly described in Charles Kingsley’s At Last. The craters are divided by an exceedingly knife-like ridge, along which it required a cool head to creep. The old crater, 3 miles in circumference, contained a lake, reposing at the depth of several hundred feet below the edge, over which clouds of vapour and mist were constantly hover- ing. The new crater, smaller than its neighbour, but more rugged and precipitous, looked, as it has been graphically described, like ‘an opening into the great infernal regions.’ At the leeward base of the SoufrUre lay the estates of Wallibou and Richmond, Morne Eonde, the settlement of the Black Caribs, and, to the south-west, the small town of Chateaubellair ; while on the wind- ward side were the great sugar estates of the Carib quarter, Sandy Bay, the settlement of the pure Caribs ; and to the extreme north, the arrowroot estates of Owia and Fancy. Almost opposite to Chateaubellair, on the windward coast, is Georgetown, the second town of St Vincent. The SoufrUre may be said to have at least one-third of the island within its range of possible destruction. Premonitory signs of eruption had been given since February 1901, when shocks of earthquake and deep reverberations were felt ; but as they passed away, little attention was given to them. These warnings were repeated as soon as the Mont Pel^e volcano at Martinique showed activity, and increased in force until 6th May, when all doubts as to their true meaning were dissipated. At three p.m. on that day huge columns of smoke were seen from ChS,teaubellair to issue from the old crater, followed by streams of flame. So serious was the condition of affairs, that several officials were sent from the capital, Kingstown, 15 miles off, to report upon what was happening, and they found the mountain in fiUl eruption. Early on the following (Wednesday) morning the eruption ceased, and left the surrounding country in gloom. So far the windward side had escaped with little damage. Shortly after eight the volcano once more burst into activity, the full force being experienced from one o’clock to three o’clock p.m. For more than 400 mUes the sound as of heavy cannonading at sea was heard throughout

the West Indies. In Kingstown lamps had to be lighted at four o'clock in the afternoon, and ashes fell in Bar- bados, which lies about 100 mUes to windward of St Vincent. On the windward side the estate works at Tourama, Orange Hill, and Lot 14 were completely destroyed ; on the leeward side Walli- bou was covered up, and the chimney at Richmond was the sole sign of the works."

A Mansion House Fund was at once started in London for the relief of the suflFerers, and subscriptions were sent from all parts of the civilized world, and notably from the United States. (f. cu.)

Saiyid Ahmad, Sm (1817-1898), Mahommedan educationist and reformer, was born at Delhi,' India, in 1817. He belonged to a family which had come to India with the Afghan conquest, and had held high offices under the Mogul emperors. Although his imperfect acquaintance with English prevented his attainment of higher office than that of a judge of a small cause court, he earned the title of the recognized leader of the Mahommedan com- munity. To the British he rendered loyal service, and when the wave of mutiny reached Bijnaur in Eohilkand in ilay 1857, the British residents owed their lives to his courage and tact. The same spirit of loyalty made him oppose the Congress movement at a later date. His faithfulness to his religion was pronounced, and in 1876 he defended the cause of Islam in A Series of Essays on Mahommed, written in London. Of good ancestry, and true to the faith, he used these advantages to act as interpreter between the Mahommedans and their rulers, and to rouse his countrymen to a sense of the benefits of modern education. The task was no light one. The horrors of the invasions of Nadir Shah and Ahmad Shah were fading from the memories of the rising generation. A flicker of hope excited society when Shah Alam was rescued from his Maratha guard, and in 1803 restored to

some measure of independence. Disappointment followed when in 1832 the Company began to administer Delhi, but Hindustan was used to revolutions, and it awaited a turn of fortune. At least the Mahommedans might keep aloof from British officials and English education and study Persian and Arabic in their mosques. Saiyid Ahmad felt their mistake and set himself to alter their resolution. He established a translation society,

which became the Scientific Society of Aligarh. He wrote letters from England to draw the hearts of the East to the West. In 1873 he founded the Mahommedan Anglo- Oriental College, and raised funds for the buildings of which Lord Lytton laid the foundation stone. He stimulated a similar movement elsewhere, and among other cities Karachi, Bombay, Haidarabad caught the infection of his spirit. Thus he effected a revolution in the attitude of Mahommedans towards modern education. He was made K.C.S.I., and became a member of the legislative councils of India and Allahabad, and of the Education Commission. These honours marked the official view of his services, but his lasting monument is the Aligarh College, with its regular outflow of educated Mahom- medans into public Hfe. He died at Aligarh on 2nd March 1898. (w. l.-w.)

Sakhalin, an island of Kussia, in the Pacific Ocean, lying opposite the mouth of the Amur, with an area of 29,336 square miles and a domiciled Eussian population which in 1897 numbered 28,113, of whom only 7641 were women. The population is chiefly composed of convicts and exiles, but a number of free settlers have lately gone to the island. There were, in 1897, 4979 hard-labour convicts (755 women), 1566 released convicts (293 women), and 6934 exiles (879 women), making a total of 13,479, or 42 per cent, of the Russian population; besides which there were 4500 natives, Ghilyaks, and Ainos. The chief military posts on the island are Due (1049), Alexandrovsk (3857), Southern (1166), and Kor- sakovsk (1664). The chief villages are Eykovskoye and Derbinskoye. The convicts are employed in obtaining coal, timber, and fuel, and in making roads. Owing to a dearth of schools, less than one-fourth of the children are educated. Only 7890 acres were under crops in 1898 ; rye, wheat, oats, barley, and vegetables are grown. There were in 1898, 1890 horses, 6000 horned cattle, and 1020 swine. Some 2300 tons of coal are obtained annually. The natives, as also a number of Japanese and a Russian company, are engaged in fishing, which seems to be productive, as the duty paid on exported fish amounted to 32,220 roubles in 1897. The Japanese also carry on a large export trade in edible sea-weeds.

Sakura-jima, an island belonging to Japan, oval in shape and measuring 7 miles by 5, lying in the northern part of the Bay of Kagoshima (30 40′ K, 130 35′ E.). It has a steaming volcano 3743 feet high (last

eruption 1779), and is celebrated for its springs, its oranges, and its giant radishes (daikon), which sometimes weigh as much as 70 lb.

Sal a, a town of Sweden, county of Vestmanland, between two small lakes, 39 miles west by north of Upsala by rail. It owes its importance to the silver mine of Salberg, l-^ miles south-west of the town, which has been worked since 1510, and produces about 33,000 oz. of silver annually, as well as dolomite. Population (1900), 6593.

Sala, Georgre Augustus Henry (1828-

1895), Enghsh journalist, was born in London, 24th November 1828; his father (1792-1828) being the son of an Italian who came to London to arrange ballets at the theatres, and his mother (1789-1860) an actress and

teacher of singing. He was at school at Paris from 1839 to 1842, and learnt drawing in London, and in his earlier years he did odd jobs in scene-painting and book illustra- tion, the connexion of his mother and elder brother (Charles Kerrison Sala) with the theatre giving him useful introductions to authors and artists. At an early date he tried his hand at writing, and in 1851 attracted the atten- tion of Charles Dickens, who published articles and stories by him in Household Words and subsequently in All the Year Rownd, and in 1856 sent him to Eussia as a special correspondent. About the same time he got to know Edmund Yates, with whom, in his earUer years, he was constantly connected in his journahstic ventures. In 1860, over his own initials, " G. A. S.," he began writing " Echoes of the Week " for the Illustrated London News, and continued to do so till 1886, when they were continued in a syndicate of weekly newspapers almost to his death. Thackeray, when editor of the Cornhill, published articles by him on Hogarth in 1860, which were issued in volume form in 1866 ; and in the former year he was given the editorship of Temple Bar, which he held till 1866. Meanwhile he had become in 1857 a contributor to the Daily Telegraph, and it was in this capacity that he did his most characteristic work, whether as a foreign

correspondent in all parts of the world, or as a writer of “leaders” or special articles. His literary style, highly coloured, bombastic, egotistic, and full of turgid peri- phrases, gradually became associated by the public with their conception of the Daily Telegraph; and though the butt of the more scholarly literary world, his articles were invariably full of interesting matter and helped to make the reputation of the paper. He collected a large library and had an elaborate system of keeping common-place-books, so that he could be turned on to write upon any conceivable subject with the certainty that he would bring into his article enough show or reality of special information to make it excellent reading for a not very critical public ; and his extraordinary faculty for never saying the same thing twice in the same way had a sort of ” sporting ” interest even to those who were more particular. He earned a large income from the Telegraph and other sources, but he never could keep his money. In 1892, when his popular reputation was at its height, he started a weekly paper called Sala’s Journal, but it was a disas- trous failure ; and in 1895 he had to sell his library of 13,000 volumes. Lord Eosebery gave him a civil list pension of ►►100 a year, but he was a broken-down man, and he died at Brighton on 8th December 1895. Sala pubKshed many volumes of fiction, travels, and essays, and he edited various other works, but his mdtier was that of ephemeral journalism ; and his name goes down to posterity as perhaps the most popular and most voluble of the newspaper men of the period.

Salaam, Dar-es-. See East Afbica, German.

Salado River. See Plate Eivee.

Salamanca, a province of western Spain ; area, 4940 square miles, divided into 8 districts and 388 parishes; population, 314,472 in 1887, 317,005 in 1897. The average of births is 4-38 per cent., of deaths 3-36 per cent., and the proportion of illegitimate births is 4-83. It is one of the provinces of Spain which loses least by emigration. The railways of the province have been much developed. Besides the line that branches off from the Northern Eailway at Medina del Campo, there are lines from Bejar to Zamora vid Salamanca, Salamanca to Avila by Penaranda. The

principal industries are connected with agriculture. The cloth manufactories of Bejar, Candelairo, Penaranda, are decaying.

Three-quarters of the province are well wooded ??? beech, oak, chestnut, pines, abounding in the south and south-west districts. Timber for building purposes and firewood are largely sent to the rest of Spain. About 2,500,000 acres are cultivated, only a small proportion being well irrigated. In 1897 wheat was grown on 278,127 acres ; maize, oats, barley, rye, on 176,137 ; pod fruit on 172,492 ; vines on 34,897 ; olives on 9500. Badajoz, Caceres, and Teruel alone, out of the 49 provinces of Spain, have more live stock than Salamanca. Out of 925,319 head registered in 1897, 8082 were horses, 8745 mules, 35,399 asses, 98,494 cattle, 623,272 sheep, 65,167 goats, and 86,220 pigs.

Salamanca, capital of the above province, with a station on the railway from Medina del Campo to the Portuguese frontier. The oldest of Spanish university towns is still rich in educational establishments, though much shorn of its ancient prosperity, when it had a population of 50,000 souls, including 10,000 students from all parts of Spain and from abroad. Salamanca still keeps up her university, with the separate faculties of letters, philosophy, sciences, law, and medicine ; her university and provincial public library, with 100,000 volumes, a provincial institute, a superior normal school, a seminary founded in 1778, economic and other learned societies, and very many charitable foundations. The city has still its 25 parishes, 25 colleges, and as many more or less ruinous convents and 10 yet flourishing religious houses. Side by side with the remains of a great past are the modern buildings : two theatres, casino, a bull-ring, the town-hall, and electric light factory. Salamanca maintains its Irish college, the rector and teachers of which are in general Irishmen. Population (1887), 22,199; (1897), 24,156.

Saldr Jungr, Sde (1829-1883), Indian states- man, born in 1829, was the descendant of a family which had held various court and mihtary appointments, first under the 'Adil Shahi kings of Bijapur, then under the Delhi emperors, and lastly under the Nizdms. While he was known to the British as Sir Salar Jung, his personal name was Mir Turdb All, he was styled by native officials of Haidarabad the Mukhtaru I-Mulk, and was

referred to by the general public as the Ndwab Sahib. He succeeded his uncle Suriju 'l-Mulk as prime minister, 1853. Owing to the failure of the Nizam to fulfil his treaty obligations to the British Government, the province of Berar had just been separated from his dominions and incorporated with the British possessions. The condition of the Nizim's state was at that time a scandal to the rest of India, and Saldr Jung at once set about reform. He commenced by infusing a measure of discipline into the Arab mercenaries, who composed the more valuable part of the Nizdm's army. He then employed them against the rapacious nobles and bands of robbers who had annihilated the trade of the country. When he had attained some degree of internal security, he con- stituted courts of justice at Haidarabad, organized the police force, constructed and repaired irrigation works, and established schools. On the outbreak of the Mutiny he supported the British, and although unable to hinder an attack on the residency, he warned the British minister that it was in contemplation. The attack was repulsed ; the Haidarabad Contingent remained loyal, and their loyalty served to ensure the tranquillity of the Deccan. Saldr Jung took advantage of the preoccupation of the British Government with the Mutiny to push his reforms more boldly, and when the Calcutta authorities were again at liberty to consider the condition of affairs in the native states, his work had been carried far towards completion. During the lifetime of the NizAm Afzalu'd- daula, SdUr Jung was considerably hampered by his master's jealous supervision. His actions were watched by innumerable spies, and in the palace his attitude could only be compared to that of an abject slave. When Mir

Mahbub Mi, however, succeeded his father in 1869, Sd.ldr Jung, at the instance of the British Government, was associated in the regency with the principal noble of the state, the Shamsu 'l-Umdra or Amir Kabir, and en- joyed an increased authority. In 1876 he visited England with the purpose of obtaining the restoration of Berar. Although he was unsuccessful, his personal merits met with full recognition. He died of cholera at Haidarabad on 8th February 1883. He was created G.C.S.I. on

28th May 1870, and received the honorary degree of D.C.L. from the University of Oxford on 21st June 1876.

See Memoirs of Sir Sdldr Jung, by his private secretary, Syed Hossain BUgrami, 1883. (b. I. 0.)

SalCi an urban district, Cheshire, England, in the Altrincham parliamentary division of the county, about 5 miles south of Manchester by rail, on the Mersey and the Bridgewater canal. Among modern buildings are St Paul's Church and Roman Catholic and Wesleyan chapels. In 1892 works for the purification of sewage were con- structed at a cost of ††18,000. A public free library was erected in 1891. Population of the urban district

(1891), 9644; (1901), 12,088.

Sale of Goods. ††† Sale is commonly defined as the transfer of property from one person to another for a price. This definition requires some consideration in order to appreciate its full scope. The law of sale is usually treated as a branch of the law of contract, because sale is eflfected by contract. Thus Pothier entitles his classical treatise on the subject, Traite du contrat de vente, and the Indian Contract Act (ix. of 1872) devotes a chapter to the sale of goods. But a completed contract of sale is something more. It is a contract plus a transfer of property. An agreement to sell or buy a thing, or, as lawyers call it, an executory contract of sale, is a contract pure and simple. A purely personal bond arises thereby between seller and buyer. But a complete or executed contract of sale effects a transfer of ownership with all the advantages and risks incident thereto. By an agreement to sell Sujiis in personam is created ; by a sale s.jiis in rem, is transferred. The essence of sale is the transfer of property for a price. If there be no agreement for a price, express or implied, the transaction is gift, not sale, and is regulated by its own peculiar rules and considerations. So too if commodity be exchanged for commodity, the transaction is called barter, and not sale, and the rules relating to sales do not apply in their entirety. Again, a contract of sale must contemplate an absolute transfer of the property in the thing sold or agreed to be sold. A mortgage may be in the form of a conditional sale, but English law regards the substance and not the form of the transaction. If in substance

the object of the transaction is to secure the repayment of a debt, and not to transfer the absolute property in the thing sold, the law at once annexes to the transaction the complex consequences which attach to a mortgage. So too it is not always easy to distinguish a contract for the sale of an article from a contract for the supply of work and materials. If a man orders a set of false teeth from a dentist the contract is one of sale, but if he employs a dentist to stop one of his teeth with gold the contract is for the supply of work and materials. The distinction is of practical importance, because very different rules of law apply to the two classes of contract. The property which may be the subject of sale may be either movable or immovable, tangible or intangible. The present article relates only to the sale of goods, that is to say, tangible movable property. By the laws of all nations the alienation of land or real property is, on grounds of public policy, subject to special regulations. It is obvious that the

assignment of "things in action," such as debts, contracts, and negotiable instruments, must be governed by very different principles from those which regulate the transfer of goods, when the object sold can be transferred into the physical possession of the transferee.

In 1847, when Mr Justice Story wrote his work on the sale of personal property, the law of sale was still in process of development. Many rules were still unsettled, especially the rules relating to im- plied conditions and warranties. But for several years the main principles have been well settled. In 1891 the subject seemed ripe for codification, and Lord Herschell introduced a codifying Bill which two years later passed into law as the Sale of Goods Act, 1893 (56 and 57 Viet. c. 71). Sale is a consensual contract. The parties to the contract may supplement it with any stipulations or conditions they may see fit to agree to. The code in no wise seeks to fetter this discretion. It lays down a few positive rules, such, for instance, as that which reproduces the 17th section of the Statute of Frauds. But the main object of the Act is to provide clear rules for those cases where the parties have either formed no intention or have failed to express it. When parties enter into a contract they contemplate its smooth performance, and they seldom provide for contingencies which may

interrupt that performance, such as the insolvency of the buyer or the destruction of the thing sold before it is delivered. It is the province of the code to provide for these contingencies, leaving the parties free to modify by express stipulation the provisions imported by law. When the code was in contemplation the case of Scotland gave rise to difficulty. Scottish law varies widely from Enghsh. To speak broadly, the Scottish law of sale differs from the English by adhering to the rules of Koman law, while the English common law has worked out rules of its own. Where two countries are so closely connected in business as Scotland and England, it is obviously inconvenient that their laws relating to commercial matters should differ. The Mercantile Law Commission of 1855 reported on this question, and recommended that on certain points the Scottish rule should be adopted in England, while on other points the English rule should be adopted in Scotland. The recommendations of the Commission were partially and rather capriciously adopted in the English and Scottish Mercantile Law Amendment Acts of 1856. Certain rules were enacted for England which resembled but did not really reproduce the Scottish law, while other rules were enacted for Scotland which resembled but did not really reproduce the Enghsh law. There the matter rested for many years. The Codifying Bill of 1891 applied only to England, but on the advice of Lord Watson it was extended to Scotland. As the English and Irish laws of sale were the same, the case of Ireland gave rise to no difficulty, and the Act now applies to the whole of the United Kingdom. As regards England and Ireland very little change in the law has been effected. As regards Scotland the process of assimilation has been carried further, but has not been completed. In a few cases the Scottish rule has been saved or re-enacted, in a few other cases it has been modified, while on other points, where the laws were dissimilar, the English rules have been adopted. It is perhaps to be regretted that the process of assimilation was not fully carried out by the Act. In mercantile matters the certainty of the rule is often of more importance than its substance. If the parties know beforehand what their legal position is, they can provide for their particular needs by express stipulation. Still, the way has been paved for future uniformity. The law is contained within the four comers of the Act, and it is

a much easier matter to amend a statute than to alter common law.

Now that the law has been codified, an analysis of the law resolves itself into an epitome of the main provisions of the statute. The Act is divided into six parts, the first dealing with the formation of the contract, the second with the effects of the contract, the third with the per- formance of the contract, the fourth with the rights of an unpaid seller against the goods, and the fifth with remedies for breach of contract ; the sixth part is supplemental. The 1st section, which may be regarded as the keystone of the Act, is in the following terms : ??? " A contract of sale of goods is a contract whereby the seller transfers or agrees to transfer the property in goods to the buyer for a money consideration called the price. A contract of sale may be absolute or conditional. When under a contract of sale the property in the goods is transferred from the seller to the buyer the contract is called a ' sale,' but when the transfer of the property in the goods is to take place at a future time or subject to some condition thereafter to be fulfilled the contract is called an ' agreement to sell.' An agreement to sell becomes a sale when the time elapses or the conditions are fulfilled subject to which the property in the goods is to be transferred." This section clearly enunciates the consensual nature of the contract, and this is confirmed by section 55, which provides that " where any right, duty, or liability would arise under a contract of sale by implication of law," it may be negatived or varied by express agreement, or by the course of dealing between the parties, or by usage, if the usage be such as to bind both parties to the contract. The next question is who can sell and buy. The Act is framed on the plan that if the law of contract were codified, this Act would form a chapter in the code. The question of capacity is there- fore referred to the general law, but a special provision is inserted (section 2) relating to the supply of necessaries to infants and other persons who are incompetent to contract. Though an infant cannot contract he must live, and he can only get goods by paying for them. The law, therefore, provides that he is liable to pay a reasonable price for necessaries supplied to him, and it defines necessaries as " goods suitable to the condition in life of such minor or other person, and to his actual requirements at the time of the sale and delivery."

The 4th section of the Act reproduces the famous 17th section of the Statute of Frauds, which was an Act "for the prevention of frauds and perjuries." The object of that statute was to prevent people from setting up bogus contracts of sale by requiring material evidence of the contract. The section provides that " a contract for the., sale of any goods of the value of ten pounds or upwards shall not be enforceable by action unless the buyer shall accept part of the goods so sold, and actually receive the same, or give something in earnest to bind the contract, or in part payment, or unless some note or memorandum in writing of the contract be made and signed by the party to be charged, or his agent in that behalf." It is a much disputed question whether this enactment has done more good or harm. It has defeated many an honest claim, though it may have prevented many a dishonest one from being yiut forward. When judges and juries have been satisfied of the bona fides of a contract which does not appear to satisfy the statute, they have done their best to get round it. Every expression in the section has been the subject of numerous judicial decisions, which ran into almost impossible refinements, and illustrate the maxim that hard cases make bad law. The last edition of the late IVIr Benjamin's book on Sale contains 950 pages, of which number no less than 180 are

devoted to the decisions on the few lines cited above. Only one thing is certain. The Statute of Frauds has brought much grist to the legal mill. It is to be noted that Scotland is excluded from the operation of section 4. The Statute of Frauds has never been applied to Scotland, and Scotsmen appear never to have felt the want of it.

As regards the subject-matter of the contract, the Act provides that it may consist either of existing goods or "future goods," that is to say, goods to be manufactured or acquired by the seller after the making of the contract (5). Suppose that a man goes into a gunsmith's shop, and says, " This gun suits me, and if you will make or get me another like it I will buy the pair." This is a good contract, and no question as to its validity would be likely to occur to the lay mind. But lawyers have seriously raised the question, whether there could be a valid contract of sale when the subject-matter of the contract was not in existence at the time when the con- tract was made. The price is an essential element in a

contract of sale. It may be either fixed by the contract itself, or left to be determined in some manner th-ereby agreed upon, e.g., by the award of a third party. But there are many cases in which the parties intend to effect a sale, and yet say nothing about the price. Suppose that a man goes into a hotel and orders dinner with- out asking the price. How is it to be fixed? The law steps in and says that, in the absence of any agreement, a reasonable price must be paid (►►8). This prevents ex- tortion on the part of the seller, and unreasonableness or fraud on the part of the buyer.

The next question dealt with is the difiicult one of con- ditions and warranties (►►►►10 and 11). The parties may insert what stipulations they like in a contract of sale, but the law has to interpret them. The '"^^ ►►►>'►►► term " warranty " has a peculiar and technical meaning in the law of sale. It denotes a stipulation which the law regards as collateral to the main purpose of the contract. A breach, therefore, does not entitle the buyer to reject the goods, but only to claim damages. Suppose that a man buys a particular horse, which is warranted quiet to ride and drive. If the horse turns out to be vicious, the buyer's only remedy is to claim damages, unless he has expressly reserved a right to return it. But if, instead of buying a particular horse, a man applies to a dealer to supply him with a quiet horse, and the dealer supplies him with a vicious one, the stipulation is a condition. The buyer can either return the horse, or keep it and claim damages. Of course the right of rejection must be exercised within a reasonable time. In Scotland no distinction has been drawn between conditions and warranties, and the Act preserves the Scottish rule by providing that, in Scotland, " failure by the seller to perform any material part of a contract of sale " entitles the buyer either to reject the goods within a reasonable time after delivery, or to retain them and claim compensation (►►11 (2)). In England it is a very common trick for the buyer to keep the goods, and then set up in reduction of the price that they are of inferior quality to what was ordered. To discourage this practice in Scotland the Act provides that, in that country, the court may require the buyer who alleges a breach of contract to bring the agreed price into court pending the decision of the case (►►59). It seems a pity that this sensible rule was not extended to England.

In early English law caveat emptor was the general rule, and it was one well suited to primitive times. Jtlen either bought their goods in the open market-place, or from their neighbours, and buyer and seller contracted on a footing of equality. Now the complexity of modern com- merce, the division of labour, and the increase of technical

skill, have altogether altered the state of affairs. The buyer is more and more driven to rely on the honesty, skill, and judgment of the seller or manufacturer. Modern law has recognized this, and protects the buyer by imply- ing various conditions and warranties in contracts of sale, which may be summarized as follows : ◆◆◆ First, there is an implied undertaking on the part of the seller that he has a right to sell the goods (◆◆ 12). Secondly, if goods be ordered by description, they must correspond with that description (◆◆ 13). This, of course, is a universal rule ◆◆◆ Si CBS pro auro veneat, non valet. Thirdly, there is the case of manufacturers or sellers who deal in particular classes of goods. They naturally have better means of judging of their merchandise than the outside public, and the buyer is entitled within limits to rely on their skill or judgment. A tea merchant or grocer knows more about tea than his customers can, and so does a gunsmith about guns. In such cases, if the buyer makes known to the seller the particular purpose for which the goods are re- quired, there is an implied condition that the goods are reasonably fit for it, and if no particular purpose be in- dicated there is an implied condition that the goods sup- plied are of merchantable quality (◆◆ 14). Fourthly, in the case of a sale by sample, there is "an implied condition that the bulk shall correspond with the sample in q^uality," and that the buyer shall have a reasonable opportunity of comparing the bulk with the sample (◆◆ 15).

The main object of sale is the transfer of ownership from seller to buyer, and it is often both a difficult and

an important matter to determine the precise Effects of jnoment at which the change of ownership is

effected. According to Eoman law, which is stUl the foundation of most Continental systems, the property in a thing sold did not pass until delivery to the buyer. Traditionibus et usucapionibus dominia rerum, non nvdis pactis, transferuntur. English law has abandoned this test, and has adopted the principle that the property passes at such time as the parties intend it to pass. Express stipulations as to the time when the property is to pass are very rare. The intention of the parties has to be gathered from their conduct. A long train of judicial decisions has worked out a more or less artificial series of rules for deter- mining the presumed intention of the parties, and these rules are embodied in sections 16 to 20 of the Act. The first rule is a negative one. In the case of unascertained goods, i.e., goods defined by description only, and not specifically identified, "no property in the goods is trans- ferred to the buyer unless and until the goods are ascer- tained." If a man orders ten tons of scrap iron from a dealer, it is obvious that the dealer can fulfil his contract by delivering any ten tons of scrap that he may select, and that until the ten tons have been set apart, no ques- tion of change of ownership can arise. But when a specific article is bought, or when goods ordered by description are appropriated to the contract, the passing of the property is a question of intention. Delivery to the buyer is strong evidence of intention to change the ownership, but it is not conclusive. Goods may be delivered to the buyer on approval, or for sale or return. Delivery to a carrier for the buyer operates in the main as a delivery to the buyer, but the seller may deliver to the carrier, and yet reserve to himself a right of disposal. On the other hand, when there is a sale of a specific article, which is in a fit state for delivery, the property in the aiticle primd facie passes at once, even though delivery be delayed. When the con- tract is for the sale of unascertained goods, which are ordered by description, the property in the goods passes to the buyer, when, with the express or implied consent of the parties, goods of the required description are " uncon- ditionally appropriated to the contract." The cases which

determine what amounts to an appropriation of goods to the contract are numerous and complicated. Probably they could all be explained as cases

of constructive de- livery, but at the time when the law of appropriation was worked out the doctrine of constructive delivery was not known. It is perhaps to be regretted that the codifying Act did not adopt the test of delivery, but it was thought better to adhere to the familiar phraseology of the cases Section 20 deals with the transfer of risk from seller to buyer, and lays down the primd facie rule that " the goods remain at the seller's risk until the property therein is transferred to the buyer, but when the property therein is transferred to the buyer, the goods are at the buyer's risk whether delivery has been made or not." Hes peril domino is therefore the maxim of English, as well as of Koman law.

In the vast majority of cases people only sell what they have a right to sell, but the law has to make provision for cases where a man sells goods which he is not ❓❓❓. entitled to sell. An agent may misconceive or exceed his authority. Stolen goods may be passed from buyer to buyer. Then comes the question. Which of two innocent parties is to sufier ? Is the original owner to be permanently deprived of his property, or is the loss to fall on the innocent purchaser ? Koman law threw the loss on the buyer, Nem,o plus juris in aliwn transferre potest quam, ipse habit. French law, in deference to modern commerce, protects the innocent purchaser and throws the loss on the original owner. "En fait de meubles, possession vaut titre" {Code Civil, art. 1599). English law is a compro- mise between these opposing theories. It adopts the Roman rule as its guiding principle, but qualifies it with certain more or less arbitrary exceptions, which cover per- haps the majority of the actual cases which occur (❓❓❓❓21 to 26). In the first place, the provisions of the Factors Act, 1889 (52 and 53 Vict. c. 45, extended to Scotland by 53 and 54 Vict. c. 40), are preserved. That Act validates sales and other dispositions of goods by mercantile agents acting within the apparent scope of their authority, and also protects innocent purchasers who obtain goods from sellers left in possession, or from intending buyers who have got possession of the goods while negotiations are pending. In most cases a contract induced by fraud is voidable only, and not void, and the Act provides, accord- ingly, that a voidable contract of sale shall not be avoided to the prejudice of an innocent purchaser. The ancient privilege of market overt is preserved intact, and section 22 provides that "where goods are sold in market overt, according to the usage of the market, the

buyer acquires a good title to the goods provided he buys them in good faith, and without notice of any defect or want of title on the part of the seller." The section does not appl^to Scotland, nor to the law relating to the sale of horses which is contained in two old statutes, 2 and 3 Phil, and Mar. c. 7, and 31 Eliz. c. 12. The minute regulations of those statutes are never complied with, so their practical effect is to take horses out of the category of things which can be sold in market overt. The privilege of market overt applies only to markets by prescription, and does not attach to newly-created markets. The operation of the custom is therefore fitful and capricious. For example, every shop in the City of London is within the custom, but the custom does not extend to the greater London outside. If then a man buys a stolen watch in Fleet Street, he may get a good title to it, but he cannot do so if he buys it a few doors off in the Strand. There is, however, a qualification of the rights acquired by purchase even in market overt. When goods have been stolen and the thief is prosecuted to conviction, the property in the goods thereupon revests in the original owner, and he is entitled

Perform- ance.

unpaid sellers.

to get them back either by a summary order of the con- victing court or by action. This rule dates back to the statute 21 Hen. VIII. c. 11. It was probably intended rather to encourage prosecutions in the interests of public justice than to protect people whose goods were stolen.

Having dealt with the effects of sale, first, as between seller and buyer, and, secondly, as between the buyer and third parties, the Act proceeds to determine what, in the absence of convention, are the reciprocal rights and duties of the parties in the performance of their contract (□□□□ 27 to 37). " It is the duty of the seller to deliver the goods and of the buyer to accept and pay for them in accordance with the terms of the contract of sale " (□□ 27). In ordinary cases the seller's duty to dehver the goods is

satisfied if he puts them at the disposal of the buyer at the place of sale. The normal contract of sale is represented by a cash sale in a shop. The buyer pays the price and takes away the goods : " Unless otherwise agreed, delivery of the goods and payment of the price are concurrent condi- tions" (►► 27). But agreement, express or implied, may create infinite variations on the normal contract. It is to be noted that when goods are sent to the buyer which he is entitled to reject, and does reject, he is not bound to send them back to the seller. It is sufficient if he inti- mate to the seller his refusal to accept them (►► 36).

The normal theory of sale is cash against delivery, but in the great majority of actual cases, especially in commercial transactions, this theory is departed from in Rights of practice. The interests of the seller are there- fore protected by two rules, namely, those as to lien and as to stoppage in transitu. In the absence of any different agreement, as for instance where there is a stipulation for sale on credit, the unpaid seller has a right to retain possession of the goods until the price is paid or tendered. The right may, of course, be waived, even when it is not negatived by the contract. It is to be noted that when the seller takes a bill of exchange or other negotiable instrument for the price, the instru- ment operates as conditional payment. On the dishonour of the instrument the seller's rights revive (►►►► 38-43). If the buyer becomes insolvent the unpaid seller has a further right founded on ancient mercantile usage. He may have parted with both the property in and possession of the goods sold, but he can attach the goods as long as they are in the hands of a carrier or forwarding agent, and have not reached the actual possession of the seller or his immediate agent. " Subject to the provisions of this Act, when the buyer of goods becomes insolvent, the unpaid seller who has parted with the possession of the goods has the right of stopping them in transitu, that is to say, he may resume possession of the goods as long as they are in course of transit, and may retain them until payment or tender of the price" (►► 44). The right of stoppage, however, cannot be exercised to the prejudice of third parties to whom the bill of lading or other docu- ment of title to goods has been lawfully transferred for value (►► 47).'

The ultimate sanction of a contract is the legal remedy for its breach. Seller and buyer have each their appropriate remedies. If the property in the goods has Remedies p^gggd to the buyer, or if, under the contract, and seller. " the price is payable on a day certain irrespect- ive of delivery," the seller's remedy for breach of the contract is an action for the price (►►49). Ih other cases his remedy is an action for damages for non-acceptance. In the case of ordinary goods of commerce the measure of damages is the difference between the contract price and the market or current price at the time when the goods ought to have been accepted. But this test is often

applicable. For instance, the buyer may have ordered some article of special manufacture for which there would be no market. The convenient market-price rule is there- fore subordinate to the general principle that " the measure of damages is the estimated loss directly and naturally re- sulting in the ordinary course of events from the buyer's breach of contract" (►►66). Similar considerations apply to the buyer's right of action for non-delivery of the goods (►►51). Section 52 deals with a peculiar feature of English law. In Scotland, as a general rule, a party who complains of a breach of contract is entitled to claim that the con- tract shall be specifically performed. In England a court of common law could only award damages, and apart from certain recent statutes, a claim for specific performance could only be entertained by a court of equity in a very narrow class of cases when the remedy by damages was deemed inadequate. But now, under the Act of 1893, " in any action for breach of contract to deliver specific or ascertained goods the court may, if it thinks fit, direct that the contract shall be performed specifically without giving the defendant the option of retaining the goods on pay- ment of damages." The buyer who complains of a breach of warranty on the part of the seller has two remedies. He may either set up the breach of warranty in reduction of the price, or he may pay the price and sue for damages. The primd facie measure of damages is the difference between the value of the goods at the time of delivery and the value they would have had if they had answered to the warranty (►►53).

The sixth part of the Act is supplemental, and is mainly concerned with drafting explanations, but section 58 contains some rules for regulating

sales by auction. It prohibits secret bidding on behalf of the seller to enhance the price, but is silent as to combination by buyers to reduce the price. Such a combination, commonly known as a ” knock out,” is left to be dealt with by the ordinary law of conspiracy.

The Sale of Goods Act, 1893, was the third attempt made by Parliajnent to codify a branch of commercial law. It would be out of place here to discuss the policy of mercan- tile codification, but it may be noted that there are very few reported cases on the construction of the Act, so that its interpretation does not seem to have given rise to difficulty. As has been noted above, the Act preserves some curious anomalies and distinctions between English and Scottish law. But the amendments required to re- move them would be few and simple, should the Legisla- ture ever think it worth while to undertake the task.

The ordinary text-books on the law of sale are constantly re- edited and brought up to date. The foUowiug among the others maybe consulted : ❓❓❓ Benjamin’s Sale of Persoiial Property ; Black- burn’s Contract of Sale ; Campbell’s Law of Sale and Mercantile Agency ; Brown’s Sale of Goods Act (Scotland) ; Chalmers’s Sale of Goods Act ; Moyle’s Contract of Sale in the Civil Law ; Bbddar- ridb’s Des Achats et Ventes Commercialcs ; Story’s Sale of Personal Property (United States). (m. D. Ch.)

Sa.leiTI, a city and district of British India, in the Madras presidency. The city is on both banks of the river Tirumanimuttar ; 3 miles from a station on the Madras Railway, 207 miles south-west of Madras. Popu- lation (1881), 50,667; (1891), 67,710, showing an increase of 34 per cent. ; (1901), 70,627. Municipal income (1897-98), Rs.80,530. There is considerable weaving industry and some cutlery, and a Loudon mission. The municipal college had 19 students in 1896-97, and the 2 municipal and mission high schools had 471 pupils. There are three printing- presses, one of which issues the dis- trict gazette, and 4 reading-rooms and literary associations.

The district has an area of 7529 square miles ; population (1881), 1,592,915; (1891), 1,962,591; (1901), 2,205,898, showing an increase of 23 per cent, in the earlier, and 12 per cent, in the

later decade ; average density, 261 persons per square mile. The land revenue and rates in 1897-98 were Ra.28,09,847, the incidence of assessment being E.1.6.1 per acre ; cultivated area, 1,287,329 acres, of which 169,166 were irrigated from tanks, wells, &c., including 26,534 from Government works ; number of police, 1133 ; boys at school (1896-97), 29,030, being 20 per cent, of the male population of scliool-going age ; registered death-rate (1897), 19 '3 per thousand.- The principal crops are millet, ragi, rice, other food grains, and oil seeds, with a little cotton, indigo, and tobacco. Coffee is grown on 11,271 acres in the Slievaroy Hills. The chief irrigation work is the Barur tank system, on which the capital outlay has been Rs.4,25,025. In 1897-98 the area irrigated was 4421 acres ; and the receipts were Rs. 9774, compared with an expenditure of Rs.19,939. Salem suffered very severely from the famine of 1877-78. The Madras Railway runs through the district for 131 miles. The chief industry is cotton-weaving, and there is some manufacture of steel. There are 141 saltpetre refineries, but no large industries.

Sa,letT1| a city and seaport of Massachusetts, U.S.A., capital of Essex county. It is on the north coast of Massachusetts Bay, in the north-eastern part of the state, and on a line of the Boston and Maine Railroad, by which it is connected with Boston, 15 miles to the south-west. It is situated on a rocky peninsula, has a very irregular street plan, is divided into six wards, has an excellent water-supply pumped from Wenham Lake, four miles distant, and is sewered. The business streets are paved with granite blocks, the residential streets macadamized or gravelled. Salem, once famous as a com- mercial city and the home port of many sailing vessels engaged in foreign commerce, is now an important manu- facturing city. In 1900 there were 446 pianufacturing establishments, with a total capital of $7,450,935. They employed 6424 hands, and the product had a value of $12,257,449. Of this not less than $2,974,631, or almost one quarter, consisted of boots and shoes, and $3,076,869 consisted of leather. In 1900 the assessed valuation of real and personal property was $27,876,291, the net debt of the city was but $864,169, and the rate of taxation was $18.00

per $1000. The income of the city, exclusive of loans, was $765,979, and the expenditure for main- tenance and operation, $620,552. Population (1890), 30,801; (1900), 35,956, of whom 10,902 were foreign- born and 156 negroes.

Salem, a city of New Jersey, U.S.A., capital of Salem county, on the river Salem, at the mouth of Fenwick Creek, and on the West Jersey and Seashore Eaihoad, in the south-western part of the state. Its site is low and level, the street plan is irregular, and the city is divided into east and west wards. It is in a rich fruit-growing region, and the town has some manu- factures of varied character. Population (1890), 5516; (1900), 5811, of whom 263 were foreign-born and 809 negroes.

Salem, a city of Columbiana county, Ohio, U.S.A. It is on the Pennsylvania Railroad, in the eastern part of the state, at an altitude of 1172 feet. It has varied manufactures, consisting mainly of highly manufactured articles of iron and steeL Population (1890), 5780 ; (1900), 7582, of whom 677 were foreign-born and 227 negroes.

Sa.lem, a city of Oregon, U.S.A., capital of Marion county and of the state. It is on the river Willamette, and on the Southern Pacific Raihoad, in the north- western part of the state, at an altitude of 195 feet. It has broad streets, and a water-supply from the river Santiam. Its manufactures are of a varied character. Willamette University, situated here, had in 1899 a faculty numbering 37, and was attended by 180 students, 68 of whom were women. Population (1890), 4515; (1900), 4258, of whom 522 were foreign-bom.

ScllernO, a seaport town, archiepiscopal see, and capital of the province of Salerno, Campania, Italy, on the north shore of the Gulf of Salerno, 33 miles by rail south- east of Naples. The chief industry is cotton-spirming and printing, with factories for leather -work, thread, linen, glass, pottery, tiles, macaroni, iron-works, and printing. Good wine is produced in the neighbourhood. There is a technical school. Population (1881), 24,275; (1901),

42,736.

Sa.leyer (Dutch, Saleijer), a group of islands belong- ing to the government of Celebes and its dependencies in the Dutch East Indies, numbering altogether 73, the principal being Saleyer, Tambalongang, Pulasi, and Bahul- uwang; between 5 36′ and 7 25′ S. and 119 50′ and 121 30′ E. The main island, Saleyer, is 248 square miles in area. The strait separating it from Celebes is more than 100 fathoms deep and, running in a strong current, is dangerous for native ships to navigate. The east coast is very steep. On the west, the Bay of Bon- tobangun (988 acres) is protected by an island from the onset of the west winds. The strata of the island are aU sedimentary rocks : coralline limestone, occasionally sand- stone ; everywhere, except in the north and north-west, covered by a fertile soil The watershed (of incon- siderable rivers) is formed by a chain running the length of the island from north to south, reaching in Bontona Haru 5840 feet, sloping steeply to the east coast. There are no lakes or morasses. The island is densely populated, averag- ing 233 inhabitants per square mile. There are frequent emigrations to Celebes and other parts of the archipelago. For that reason, and also on account of its excellent horses and numerous buffaloes, Saleyer is often compared with Madura, being of the same importance to Celebes as is Madura to Java.

SalgfO Tcirj^n, an important mining town of Hungary, in the county of Nogrdd, with 9478 inhabitants in 1891. In the coal-mines more than 3000 workmen are employed; the mines produce yearly about 10 miUion metric centners of coal. There is a special estabhshment for the workmen, having a hospital, baths, school, &c. There are also an iron-refinery and an iron-plate factory, with about 400 houses for workmen, together with several public institutions. Population (1901), 13,552.

Sa,li iny, a district tovpn of Russian Transcaucasia, in the government and 33 miles from the Adji-Kabul rail- way station (112 miles from Baku), on the river Kura, at the head of an island of same name. In 1897 its popu- lation was 10,168, chiefly Tatar. It is the centre of the fishing-grounds on the river Kura, the yearly revenue derived from which is 1,174,700 roubles; thousands of workers come together from aU parts of Russia during the fishing season. Saliany was annexed to Russia in the 18th century, but was retaken by the Persians, and only became Russian

finally in 1813. Five miles to the north are situated the ruins of Hershasib, the capital of the Shahs of Shirvan, destroyed by the Mongols in 1285.

Salina, a city of Kansas, U.S.A., capital of Saline county, on the river Smoky HiU, near the mouth of the Saline, and near the centre of the state, at an altitude of 1224 feet. It is situated in a fertUe farming region, and has grain elevs^tors and flour-mills, power being obtained from the river. It is the seat of Kansas Wesleyan University, a Methodist Episcopal institution, opened in 1886, which had in 1899 a faculty of 7 professors, and was attended by 79 students. Population (1890), 6149 ; (1900), 6074, of whom 579 were foreign-born and 356 negroes.

Salisbury, or New Saeum, a city, municipal and parliamentary borough (returning since 1885 only one member), and county town of WHtsliire, England, on the Avon, 83 miles west-south-west of London by rail. In recent years the cathedral tower and spire have undergone considerable repairs. The more important educational establishments comprise a theological college, a diocesan training school for elementary teachers, a school for boys, with numerous scholarships, a school of science and art, a school built by Bishop Wordsworth in 1889, used for technical instruction, and the Godolphin high-class school for girls. Modern erections are a county hall, a free library, and swimming baths. A Victoria Park of 16 acres was provided in 1887, when there was erected a statue of Henry Fawcett, a native of Salisbury. Area of municipal borough, 600 acres. Population (1881), 14,792 ;

(1901), 17,117.

Salisbury, a city of North Carolina, U.S.A., capital of Rowan county. It is on the Southern Eailway, in the ” piedmont ” region, west of the centre of the state. It is the seat of Livingstone College for negroes. Population

(1890), 4418; (1900), 6277, of whom 69 were foreign- born and 2408 negroes.

Salisbury {Rhodesia). See Ehodesia (South).

Salisbury, Robert Arthur Talbot Gascoyne-Cecil, 3ed Maequis of, (1830),

British statesman, second son of James, 2nd marquis (Lord Privy Seal 1852, Lord President of Council 1858) by his first wife, Frances Mary Gascoyne, was born at Hatfield on 3rd February 1830, and was educated at Eton and Christ Church, Oxford, where he took his degree in 1850. At Oxford he was an active member of the Union Debating Society, and filled the office of treasurer. The first few years after leaving the university were spent by Lord Eobert Cecil (as he then was) in travel, as far afield as New Zealand; but in 1853 he was returned unopposed to the House of Commons as Conservative member for Stamford, being elected in the same year a fellow of All Souls. He made his maiden speech in Parliament on 7th April 1854, in opposition to Lord John Russell's Oxford University Bill. The speech was marked by scepticism as to the utility of reforms, and Lord Robert prophesied that if the wishes of founders were disregarded, nobody would in future care to found any-thing. Fifteen months later he was chosen by his party to second " the previous question " in the debate on Mr Roebuck's vote of no confidence in Lord Palmerston's Government. In 1857 he appeared as the author of Early ^^^ '[illegible]" ^^ [illegible] "" establishing the voting-paper years In system at parliamentary elections; and in Parlla- the same year he married Georgina Caroline, ""'[illegible] daughter of Sir Edward Holt Alderson, a baron of the Court of Exchequer, a large share of whose great intellectual abilities she inherited. From that time Lord Robert Cecil continued to be active not only in politics, but, for several years, in journalism, the income he earned by his pen being then a matter of pecuniary importance to him. One of his contemporaries at Oxford had been Thomas Hamber of Oriel, who became editor of the Standard, and during these years Cecil was an occasional contributor of " leaders " to that paper. He also con- tributed to the Saturday Review, founded in 1855 by his brother-in-law Beresford Hope, and edited by his friend Douglas Cook ; not infrequently he wrote for the Quarterly (where, in 1867, he*

was to publish his famous article on “the Conservative Surrender”); and in 1858 he con- tributed to Oxford Essays a paper on “The Theories of Parliamentary Reform,” giving expression to the more intellectual and aristocratic antagonism to doctrinaire

Liberal views on the subject, while admitting the exist- ence of many anomalies in the existing electoral system. In February of the next year, when the question was taken up by the Conservative Government, and Disraeli introduced his Reform Bill with its “fancy franchises,” the member for Stamford was prominent among its critics from the Tory point of view. During the seven years that followed. Lord Robert was always ready to defend the Church, or the higher interests of Conservatism and property ; and his speeches then, not less than later, showed a caustic quality and a tendency to what became known as ” blazing indiscretions.” For example, when the repeal of the paper duty was being discussed in 1861, he asked whether it ” could be maintained that a person of any education could learn anything worth knowing from a penny paper” ⬛⬛⬛ a question the answer to which has been given by the powerful, highly organized, and admirable Conservative penny press of a subsequent day. A little later he declared the proceedings of the Govern- ment ” more worthy of an attorney than of a statesman ” ; and on being rebuked, apologized ⬛⬛⬛ to the attorneys. He also charged Lord John Russell with adopting ” a sort of tarifi’ of insolence ” in his dealings with foreign Powers, strong and weak.

It was not, however, till the death of Lord Pahnerston and the removal of Lord John Russell to the House of Lords had brought Mr Gladstone to the front, that Lord Eobert Cecil ⬛⬛⬛ who became Lord Ca/ne< ^ Cranborne by the death of his elder brother on ^^^ 14th June 1^65 ⬛⬛⬛ began to be accepted as a Franchise politician of the first rank. His emergence Question: coincided with the opening of the new area in "g'J^fger. English politics, ushered in by the practical steps taken to extend the parliamentary franchise. On 12th March 1866 Mr Gladstone brought forward his measure to establish a ⬛⬛7 franchise in boroughs and a ⬛⬛14 franchise in counties, which were calculated to add 400,000 voters to the existing lists. Lord Cranborne met the BiU with a persistent opposition, Ms rigorous logic and merciless hostility to clap-trap tending*

strongly to reinforce the impassioned eloquence of Mr Lowe. But though he attacked the Government BiU both in principle and detail, he did not absolutely commit him- self to a position of hostility to Reform of every kind ; and on the defeat of Mr Gladstone's Ministry, no surprise was expressed at his joining the Cabinet of Lord Derby as secretary of state for India, even when it became known that a settlement of the Reform question was part of the Tory programme. The early months of the new Govern- ment's tenure were marked by the incident of the Hyde Park riots ; and whether or not the fall of the Park railings determined the question of Reform, it is at least certain that if there had been members of the Cabinet and party who believed up to that time that the Reform question was not urgent, the action of the Reform League and the London populace forced them to a different con- clusion. On 11 til February Mr Disraeli informed the House of Commons that the Government intended to ask its assent to a series of thirteen resolutions ; but when, on 26th February, the Liberal leaders decided to oppose them and to demand that the Government should produce a Bill, Mr Disraeli at once consented to do so. The intro- duction of a Bill was, however, delayed by the resigna- tion of Lord Cranborne, General Peel, and Lord Carnar- von. The Cabinet had been considering two alternative measures, widely different in kind and extent, and the final decision between the two was taken in ten minutes (whence the nickname of the " Ten Minutes Bill ") at an informal gathering of the Cabinet held just before Lord Derby was engaged to address a general meeting

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of the party. At a Cabinet council, held on 23 rd February, measure A had been agreed upon, the three doubtful ministers having been persuaded that the checks and safeguards provided were sufficient ; in the interval between Saturday and Monday they had looked more closely into the statistics, and had come to the con- clusion that the checks were inadequate ; on Monday morning they had gone to Lord Derby and told him so ; at two o'clock the rest of the Cabinet, hastily summoned, had been informed of the new situation, and had there and then, before the meeting at half-past two, agreed, in order to retain their three colleagues, to throw over measure A, and to present measure B to the coimtry as the fruit of their matured and unanimous wisdom. Lord Derby at the meeting, and Mr Disraeli a few hours later in the House of Commons, explained their new measure ??? a measure based upon a ??6 franchise ; but their own side did not like it, the Op- position were furious, and the moral sense of the country was revolted by the undis- guised adoption of almost the very Bill which the Con- servatives had refused to accept from their opponents only a year before. The re- sult was that the Bill was never introduced; the Government reverted to measure A, and the three ministers again handed in their resignations. In the de- bate on the third reading of the Bill, when its passage through the House of Com- mons without a division was assured, Lord Cranborne showed with caustic rhe- toric how the "precautions, guarantees, and securities " with which the Bill had bristled on its second read- ing had been dropped one after another at the bidding of Mr Gladstone.

In countries where politics are conducted on any other than the give-and-take principles in vogue in England, such a breach as that which occurred in 1867 between Lord Cranborne and his former colleagues, especially Mr Disraeli, would have been beyond repair. In the But, Lord Cranborne, though an aristocrat Lords " ^^^ by birth and by conviction, was not imprac- ticable; moreover, Mr Disraeli, who had him- self risen to eminence through invective, admired rather than resented that gift in others ; and their common opposition to Mr Gladstone was certain to reunite the two colleagues. Nothing of great moment occurred during the

session of 1868. Everybody was content to look forward to the new elections in the autumn. But although no legislation of great moment was attempted, Mr Glad- stone was not afraid to show his hand, and to announce that he meant to take up the Irish question, and to deal especially with the celebrated "Upas tree," of which the first branch was the Established Church. By way of givin" full notice to the electorate, he brought in a series of resolutions on this question ; and though the attitude

THE MARQUIS OF SAI 1-1 I (From a photo by Elliott and Fry, Loiidtm.)

adopted by the official Conservatives towards them was not one of serious antagonism, Lord Cranborne vigorously attacked them, and declared himself altogether in favour of upholding the Establishment. This was his last speech in the House of Commons, for on 12th April his father died, and he became 3rd marquis of Sahsbury. In the House of Lords the new Lord SaUsbury's style of eloquence ??? terse, incisive, and wholly free from false ornament ??? found an even more appreciative audience than it had met with in the House of Commons. The questions with which he was first called upon to deal were questions in which his interest was keen ??? the recommendations of the Kitual Commission and, some time later, the Irish Church Suspensory Bill. Lord Salisbury's argument,

with which the Lords readily agreed, was that the last session of an expiring Parlia- ment was not the time in which so grave a matter as the Irish Church Establish- ment should be judged or prejudged; that a Suspensory Bill involved the question of disestablishment ; and that such a principle could not be accepted by the Lords until the country had been appealed to upon it and had pronounced decisively in its favour. Even then there were those who raised the cry that the only business of the House of Lords was to register the decisions of the Commons, and that if they refused to do so it was at their periL Lord Salisbury met this cry boldly and firmly : ???

” When the opinion of your countrymen has declared itself, and you see that their convic- tions ??? their firm, deliberate, sus- tained convictions ??? are in favour of any course, I do not for a, moment deny that it is your duty to yield.”

In the very next session Lord Salisbury was called upon to put his view into practice, and his influence went far to persuade the peers to pass the Irish Church Disestablishment BUI. In his opinion the general election of the autumn of 1868 had been fought on this question ; his friends had lost, and there was nothing for them to do but to bow to the necessities of the situation. The story of his conduct in the matter has been told in some fulness in the Life of Archbishop Tait, with whom Lord Salisbury acted, and who throughout those critical weeks played a most important part as mediator between the two extreme parties ??? those of Lord Cairns (representing Ulster) and Mr Gladstone. October 1869 saw the death of the old Lord Derby, who was still the titular leader of his party ; and he was succeeded as leader of the House of Lords by Lord Cairns. For the dignified post of chancellor of the university of Oxford, Convocation unanimously chose as Lord Derby’s successor the marquis of Salisbury. Lord Derby had translated the Hiad very well, but his successor was far more able to sympathize with the academic mind and temper. Lord Salisbury was at heart a student, and found his best satisfaction in scientific

research and in scientific speculation ; wMle still a young man he had made useful contributions to the investigation of the flora of Hertfordshire, and at Hatfield he had his own laboratory, where he was able to satisfy his interest in chemical and electrical research. As regards his con- nexion with Oxford may be mentioned, in particular, his appointment, in 1877, of a second University Commis- sion, and his appearance, in September 1894, in the Sheldonian Theatre as president of the British Association. It is not necessary to dwell at any length upon the part taken by Lord Salisbury between 1869 and 1873 in respect of the

other great political measures of Mr Gladstone's Government ??? the Irish Land Act, the Act Abolishing Purchase in the Army, Mr Forster's Education Act, &c. Nor does his attitude towards the Franco – German War of 1870-71 call for any remark; an English leader of Opposition is bound, even more than a minister, to preserve a discreet silence on such occasions. But early in 1874 came the dissolution, suddenly announced in the famous Greenwich letter of Mr Gladstone, with the promise of the abolition of the income tax. For the first time since 1841 the Conservatives found themselves in office with a large majority in the House of Commons. In Mr Disraeli's new Cabinet in 1874 Lord Salisbury c' Wn It accepted his old position at the India Office. of 1874. The first task with which the new secretary of state had to deal was one of those periodical famines which are the great scourge of India ; he aupported the action of Lord Northbrook, the viceroy, and refused to interfere with private trade by prohibiting the export of grain. This attitude was amply justified, and Lord Salisbury presently declared that the action of the Govern- ment had given so much confidence to private traders that, by their means, "grain was pouring into the distressed districts at a greater rate than that which was being carried by the public agency, the amount reaching nearly 2000 tons a day." The Public Worship Regulation Bill of 1874 was the occasion of a famous passage of arms between Lord Salisbury and his chief. The Commons had in- serted an amendment which, on consideration by the lords. Lord Salisbury opposed, with the remark that it was not for the peers to attend to the " bluster " of the lower House merely because a small majority there had passed the amendment. The new clause was accordingly rejected, and the Commons eventually accepted the situa- tion ; but Disraeli, banteringly criticizing Lord Salisbury's use of the word " bluster," alluded to him as " a man who does not measure his phrases. He is one who is a great master of gibes and flouts and jeers."

From the middle of 1876 the Government was occupied with foreign affairs. In regard to the stages of Eastern fever through which England passed between the occurrence of the Bulgarian "atrocities" and the signature of the Treaty of Berlin, the part played by Lord Salisbury was considerable. The excesses of the Bashi-Bazouks took place in the early summer of 1876, and were recorded in long and highly-coloured

despatches to English newspapers ; pre- sently there followed Mr Gladstone's pamphlet on Bulgarian Horrors, his speech on Blackheath, and his enunciation of a " bag and baggage " policy towards Turkey. The autumn went by, Servia and Montenegro declared war upon Turkey and were in imminent danger of something like extinction. On 31st October Russia officially interfered and demanded an armistice, which Turkey granted ; and England immedi- ately proposed a conference at Constantinople, Eastern ^^ which the Powers should endeavour to make Question, arrangements with Turkey for a general pacifica- tion of her provinces and of the inflammable communities adjoining. At this conference England was represented by Lord Salisbury. It met e^rly in December,

taking for its basis the English terms, namely, the status quo ante in Servia and Montenegro ; a self-denying ordin- ance on the part of all the Powers ; and the independence and territorial integrity of the Ottoman empire, togethei with large administrative reforms assured by guarantees. General Ignatieff, the Russian ambassador, was effusively friendly with the English envoy; but though the philo- Turkish party in England professed themselves scandalized, it is certain that Lord Salisbury made no improper con- cessions to the schemes of Russia, and departed in no way from his instructions and from the agreed policy of the British Cabinet. On 20th January the conference broke up, Turkey having declared its recommendations inadmissible ; and Europe withdrew to await the inevitable declaration of war. Very early in the course of that war the intentions of England were clearly indicated in a despatch of Lord Derby to the British representative at St Petersburg, which announced that so long as the struggle concerned Turkish interests alone Great Britain would be neutral, but that such matters as Egypt, the Suez Canal, the regulations afiecting the passage of the Dardanelles, and the possession of Constantinople itseK would be regarded as matters to which she could not be indifferent. The war went on, and for some nine months none of these British interests appeared to be threatened, nor had Lord Salisbury's own department to concern itself very directly with the progress of the belligerents. Once or twice, indeed, the Indian secretary committed himself to state- ments which laid him open to a good deal of attack, as when he rebuked an alarmist by bidding him study the Central

Asian question “in large maps.” But with the advance of Russia through Bulgaria and across the Balkans, English anxiety grew. In mid-December explanations were asked from the Russian Government as to their intentions with regard to Constantinople. On 23rd January the Cabinet ordered the fleet to saU to the Dardanelles. Lord Carnarvon resigned, and Lord Derby handed in his resignation, but withdrew it. The Treaty of San Stefano was signed on 3rd March ; and three weeks later, g^^ceeds when its fuU text became known, the Cabinet ►►,orrfDer6y met and decided upon measures which ^&].j as foreign induced Lord Derby, at the end of the month, to ”’”’’”►►► retire from the Foreign Office, his place being immediately filled by Lord Salisbury. The new foreign secretary at once issued the famous ” Salisbury circular ” to the British representatives abroad, which appeared in the newspapers on 2nd April. This elaborate and dignified State paper was at once a clear exposition of British policy, and practically an invitation to Russia to reopen the negotiations for a European congress. These negotiations, indeed, had been proceeding for several weeks past; but Russia having declared that she would only discuss such points as she pleased, the British Cabinet had withdrawn, and the matter for the time was at an end. The bulk of the document consisted of an examination of the Treaty of San Stefano and its probable effects, Lord Salisbury justifying such an examination on the ground that as the position of Turkey and the other countries afiected had been settled by Europe in the Treaty of Paris in 1856, the Powers which signed that treaty had the right and the duty to see that no modifications of it should be made without their consent.

The effect of the circular was great and immediate. At home the Conservatives were encouraged, and many moderate Liberals rallied to the Eastern policy of the Government. Abroad it seemed as if the era of divided councils was over, and the Russian Government promptly recognized that the circular meant either a congress or war with England. For the latter alternative it was by no means prepared, and very soon negotiations were reopened, which led to the meeting of the congress at Berlin on

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13th June. The history of that famous gathering and of its results is narrated under Europe. Lord Beaconsfield

on two or three subsequent occasions referred to Conrres” ^^^ important part that his colleague had played

in the negotiations, and he was not using merely the language of politeness. Rumours had appeared in the London press as to a supposed Anglo-Russian agreement that had been signed between Lord Salisbury and the Russian ambassador, Count Shuvaloff, and these rumours or statements were described by the foreign secretary in the House of Lords, just before he left for BerHn, as ” whoUy unauthentic.” But on 14th June what pur-ported to be the full text of the agreement was pub- lished by the Globe newspaper through a certain Charles Marvin, at that time employed in occasional transcribing work at the Foreign Office, and afterwards known by some strongly anti-Russian books on the Central Asian question. Marvin was prosecuted, but the law as it then was could not touch him for his breach of confidence, and it was only by a subsequent Act of Parliament that such conduct was made penal. Besides the general inconvenience of the dis- closure, the agreement, which stipulated that Batum and Kars might be annexed by Russia, made it impossible for the congress to insist upon Russia entirely withdrawing her claim to Batum, though at the time of the meeting of the congress it was known to some of the negotiators that she was not unwilling to do so. In one respect Lord Salisbury’s action at the congress was unsuccessful Much as he dis- liked the sentimentalism of Mr Gladstone, he was not without a certain sentimentaHsm of his own, and at the Berlin Congress this took the form of an unexpected and, as it happened, useless pushing of the claims of Greece. But in the main Lord Salisbury must be held to deserve, almost equally with his great colleague, the credit for the Berlin settlement. Great, however, as was the work done at Berlin, and marked the relief to aU Europe which was caused by the signing of the treaty, much work, and of no pleasant kind, remained for the British Foreign Office and for the Indian Government before the Beaconsfield Parlia- ment ended and the Government had to render up its accounts to the

nation. Russia, foreseeing a possible war with England, had during the spring of 1878 redoubled her activity in Central Asia, and almost at the very time that the treaty was being signed, her mission was received at Kabul by the Amir Sher Ali. Out of the Amir's refusal to receive a counterbalancing British mission there grew the Afghan war; and though he had ceased to control the India Ofiice, Lord Salisbury was naturally held re- sponsible for some of the preliminary steps which, in the judgment of the Opposition, had led to these hostilities. But Lord Granville and his friends entirely failed to fix upon Lord Salisbury the blame for a series of events which, considering the action of Russia, the personal disposition of Sher Ali, and the excited nature of the frontier tribes, was generally seen to be inevitable. A defence of the foreign policy of the Government during the year which followed the BerUn Treaty was made by Lord Salisbury in a speech at Manchester (October 1879), which had a great effect throughout Europe. In it he justified the occupation of Cyprus, and approved the beginnings of a league of central Europe for preserving peace.

In the spring of 1880 the general election overthrew Lord Beaconsfield's Government and replaced Mr Glad- stone in power, and the country entered upon five eventful years, which were to see the consolidation of the Parnellite party, the reign of outrage in Ireland, disasters in Zululand and the Transvaal, war in Egypt, a succession of costly mistakes in the Sudan, and the final collapse of Mr Gladstone's Government on a trifling Budget question. The defeat of 1880 greatly depressed Lord Beaconsfield,

who tiU then had really believed in that " hyperborean " theory upon which he had acted in 1867 ??? the theory that beyond and below the region of democratic storm reader??/ and violence was to be found a region of peaceful Coaserra- conservatism and of a dislike of change. After ""e the rude awakening of April 1880 Lord Beacons- p^'^^- field seems to have lost heart and hope, and to have ceased to believe that wealth, birth, and education would count for much in future in England. Lord Salisbury, who on Lord Beaconsfield's death a year later was chosen, after the claims of Lord Cairns had been vdthdrawn, as leader of the Conservative peers (Sir Stafford Northcote continu- ing to lead the Opposition in the lower House), was not so disposed to counsels of

despair. After the Conservative reaction had come in 1886, he was often taunted with pessimism as regards the results, and he certainly spoke on more than one occasion in a way which appeared to justify the caricatures which appeared of him in the Radical press in his character of Hamlet; but in the days of Liberal ascendancy Lord Salisbury was confident that the tide would turn. We may pass briefly over the years of Opposition between 1880 and 1885; the only policy that could then wisely be followed by the Conservative leaders was that of giving their opponents sufficient rope. In 1884 a new Reform BiU was introduced, extending household sufirage to the counties; this was met in the Lords by a resolution, moved by Lord Cairns, that the peers could not pass it unaccompanied by a Redistribution BilL The Government, therefore, withdrew their measure. In the summer and autumn there was a good deal of agita^ tion ; but in November a redistribution scheme was settled between the leaders of both parties, and the BUI passed. When, in the summer of 1885, Mr Gladstone resigned, it became necessary for the country to know whether Lord Salisbury or Sir Stafford Northcote was the real Conserva- tive leader ; and the Queen settled the matter by at once sending for Lord Salisbury, who became prime minister for the first time in 1885.

The " Forwards " among the Conservatives, headed by Lord Randolph Churchill, brought so much pressure to bear that Sir Stafford Northcote was induced to enter the House of Lords as earl of Iddes- ???"'^'"e leigh, whUe Sir Michael Hicks Beach was made jsss. ' leader of the House of Commons, Lord Randolph Churchill secretary for India, and Mr Arthur Balfour president of the Local Government Board. The new Government had only to prepare for the general election in the autumn. The ministerial programme was put forward by Lord SaUsbury on 7th October in an important speech addressed to the Union of Conservative Associations assembled at Newport, in Monmouthshire; and in this he outlined large reforms in local government, poured scorn upon Mr Chamberlain's Radical poUcy of "three acres and a cow," but promised cheap land transfer, and opposed the disestablishment of the Church as a matter of life or death to the Conservative party. In this Lord Salisbury was declaring war against what seemed to be the danger should Mr Chamberlain's "unauthorized pro- gramme " succeed ; while the

comparative slightness of his references to Ireland showed that he had no more suspicion than anybody else of the event which was about to change the whole face of Enghsh politics, to break up the Liberal party, and to change the most formidable of the advanced Radicals into an ally and a colleague. The general election took place, and there were returned to Parliament 335 Liberals, 249 Conservatives, and 86 Home Rulers ; so that if the last two parties had combined, they would have exactly tied with the Liberals. The Conservative Government met Parhament, and after a short time were put into a minority of 79 on a Radical

*land motion, brought in by Mr Chamberlain's henchman, Mr Jesse Collings. Mr Gladstone's return to office, and Unionism :^^ announcement of a Bill giving a separate Prime Parliament to Ireland, were quickly followed minister, by a great meeting at Her Majesty's Theatre, '**"*** *at which Lord Salisbury, Lord Hartington, Mr*

Goschen, and some Radical members met on the same plat- form ; the secession of the Unionist Liberals ; the defeat of the Bill ; an appeal to the country ; and the return of the Unionist party to power with a majority of 118. Lord Salisbury at once offered to make way for Lord Harting- ton, but the suggestion that the latter should form a Government was declined; and the Conservatives took office alone, with an Irish policy which might be summed up, perhaps, in Lord Salisbury's words as " twenty years of resolute government." For a few months, until just before his sudden death on 12th January 1887, Lord Iddesleigh was foreign secretary; but Lord Salisbury, who meanwhile had held the post of lord privy seal, then returned to the Foreign Office. Meanwhile the increasing friction between him and Lord Eandolph Churchill, who, amid many qualms on the part of more old-fashioned Conservatives, had become chancellor of the exchequer and leader of the House of Commons, had led to the latter's resignation, which, to his own sur- prise, was accepted ; and from that date Lord Salisbury's effective primacy in his own party was unchallenged.

Only the general lines of Lord Salisbury's later polit- ical career need here be sketched. As a consequence of the practical monopoly of political power en- ⬛⬛⬛joyed by the Unionist party after the Liberal disruption of 1886 ⬛⬛⬛for even in the years 1892-95 the situation was dominated by the permanent Unionist majority in the House of Lords ⬛⬛⬛Lord Salisbury's position became unique. These were the long-looked-for days of Conservative reaction, of which he had never despaired. The situation was, of course, complicated, so far as Lord Salisbury personally was concerned, by the coalition with the Liberal Unionists, which was confirmed in 1895 by the inclusion of the duke of Devonshire, Mr Chamberlain, and other Liberal Unionists in the Cabinet. But though it appeared anomalous that old antagonists like Lord Salisbury and Mr Chamberlain should be working to- gether in the same ministry, the prime minister's position was such that he could disregard a superficial criticism which paid too little heed to his political faculty and his patriotic regard for the requirements of the situation. Moreover, the practical work of reconciling Conservative traditions with domestic reform depended rather on Lord Salisbury's nephew, Mr Balfour, who led the House of Commons, than on Lord Salisbury, who devoted himself almost entirely to foreign aifairs. The new Conserv- ative movement, moreover, in the country at large, was, in any case, of a more constructive type than Lord Salis- bury himself was best fittod to lead, and though he was necessarily prime minister and was deeply respected both for his character and his past work, he was not the real source of the political inspiration even of the Conservative wing of the Unionist party during this period. He began to stand to some extent outside party and above it, a moderator with a keenly analytic and rather sceptical mind, but still the recognized representative of the British empire in the councils of the world, and the trusted adviser of his sovereign. Though himself the last man to be selected as the tyjic of a democratic politician ⬛⬛⬛for his references to extensions of popular government, oven when made by his own jiiirty, were full of mild contempt ⬛⬛⬛Lord Salisbury gradually ac- quired a higher place in public opinion than that occupied by any contemporary statesman. His speeches ⬛⬛⬛which.

though carelessly composed, continued to blaze on occa- sion with their old fixe and their somewhat mordant cynicism ⬛⬛⬛were weightier in

tone, and became European events. Without the genius of Disraeli or the personal magnetism of Gladstone, he yet inspired the British public with a quiet confidence that under him things would not go far wrong, and that he would not act rashly or unworthily of his country. Even political opponents came to look on his cautious and balanced conservatism, and his intellectual aloofness from interested motives or vulgar ambition, as standing between them and something more distasteful. Moreover, in the matter of foreign affairs his weight was supreme. He had lived to become, as was indeed generally recognized, the most experienced working diplomatist in Europe. Lord SaUsbury's position in this respect was shown in nothing better than in his superi- ority to criticism. In foreign affairs many among his own party regarded him as too much inchned to "split the difference " and to make " graceful concessions " ??? as in the case of the cession of Heligoland to Germany ??? in which it was complained that Great Britain got the worst of the bargain. But though occasionally, as in the withdrawal of British ships from Port Arthur in 1898, such criticism became acute, the plain fact of the preservation of Euro- pean peace, often in difficult circumstances, reconciled the public to Lord Salisbury's conduct of affairs. His patience frequently justified itself, notably in the case of British relations with the United States, which were for a moment threatened by President Cleveland's message concerning Venezuela in 1895. And though his loyalty to the European Concert in connexion with Turkey's dealings with Armenia and Crete in 1895-98 proved irritatingly ineffectual ??? the pace of the concert, as Lord Salisbury explained, being rather Uke that of a steam-roUer ??? no alternative policy could be contemplated as feasible in any other statesman's hands. Lord Salisbury's personal view of the new situa- tion created by the methods of the Sultan of Turkey was indicated not only by a solemn and unusual pubhc warning addressed to the sultan in a speech at Brighton, but also by his famous remark that in the Crimean war Great Britain had " put her money on the wrong horse." Among his most important strokes of diplomacy was undoubtedly the Anglo-German agreement of 1890, de- limiting the British and German spheres of influence in East and West Africa ; but it is impossible in this place to give a final appreciation of the actual part played by Lord Salisbury in the various diplomatic questions of so busy a time.

A peer premier must inevitably leave many of the real problems of democratic government to his colleagues in the House of Commons. In the Upper House Lord Salisbury was paramount. Even when the peers had rejected the second reading of the Government Vaccination Bill, as emasculated in the House of Commons by the introduction of the "conscientious objector," Lord Salis- bury brought all his authority to bear and got the vote reversed at another sitting, in spite of the obvious sense of the majority both of that House and of the Conservative party outside Parliament. Yet while vigorously opposing the Eadical agitation for the abolition of the House of Lords, he never interposed a non possumus to schemes of reform. He was always willing to consider plans for its improvement, and in May 1888 himself introduced a Bill for reforming it and creating life peers ; but he warned reformers that the only result must be to make the House stronger. To abolish it, on the other hand, would be to take away a necessary safeguard for protect- ing "Philip drunk" by an appeal to "Philip sober."

Lord Salisbury suffered a severe loss by the death in 1900 of his wife, whose influence with her husband had

been great, as her devotion had been unswerving. Her protracted illness was one among several causes, including his own occasional iU-health, which after 1895 made him leave as much as possible of the work of political leader- ship to his principal colleagues ❓❓❓ Mr Arthur Balfour more than once acting as foreign secretary for several weeks while his uncle stayed abroad. But for some years it was felt that his attempt to be both prime minister and foreign secretary was a mistake ; and after the election of 1900 Lord Salisbury handed over the seals of the Foreign Office to Lord Lansdowne, remaining himself at the head of the Government as lord privy seal. In 1902, upon the conclusion of peace in South Africa, he felt that the time had come to retire from office altogether; and on 11th July his resignation was accepted by the king, and he was succeeded as prime minister by Mr Arthur Balfour. >

Salmon. ??? Since the appearance of the article SALMONiDiE in the ninth edition of the Encyclopmdia Britannica, important advances have been made in our knowledge of the life-history of the salmon, and the exten- sion of our information promises to have a considerable influence on the future management of salmon fisheries. These advances are chiefly due to the investigations of Pro- fessor Miescher on the Khine at Basel, of Professor Hoek in Holland, of Mr Archer as lessee of the river Sands in Norway and as inspector of salmon fisheries for Scotland in conjunction with Messrs Gray and Tosh, and of a number of workers in the laboratory of the Koyal College of Physicians of Edinburgh. With regard to the food of salmon, the enormously rapid growth of smolts to grilse and of salmon from year to year shows that they feed in the sea. In a few months a smolt will increase from a few ounces to 4 or 5 tt> ; while Mr Archer's weighings of 16 salmon which had been marked and recaptured in the following year showed an average gain of 36 per cent., reckoned on from kelt stage to kelt stage. During the season of 1895 Mr Tosh, at Berwick-on-Tweed, opened be- tween March and August 514 fish, and found food in the stomachs of 76, or over 14 per cent, of the whole. As to the nature of the food, it was found to be as follows : ???

Herring in .

36

or 47 per cent

Crustacea, amphipods, he. .

14

??? 18 ???

Sand eels ....

11

., 14 ,.

Haddock and whiting .

8

* 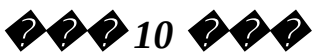 10 *

Feathers and vegetable matter

7

*n 9 *

Excluding the feathers and vegetable matter, which are not really of the nature of food, all the material found in the stomach was of marine origin. Hoek, out of 2000 fish examined by him, found 7 vsdth food in the stomach, and, curiously enough, 4 of these were taken on the same day. In each case marine fish constituted the food. As to where salmon go to feed in the sea, our information is still very deficient, but the prevalence of herring in the stomach would seem to indicate that they must follow the shoals of these fish which approach the coast during the summer months. While there can be no doubt that salmon feed in the sea, the question of whether they feed in fresh water has been much debated. It is difficult for the popular mind to conceive of an active fish like the salmon sub- sisting for several months vsdthout food, and the fact that the fish so frequently not only takes into its mouth but actually swallows worms and various lures has still further tended to confirm many people in the conviction that salmon do feed in fresh water. In discussing the question it is well clearly to understand what is meant by feeding. It is the taking, digesting, and absorbing of material of use in the economy in such quantities as to be of benefit to the individual Accepting this definition, it may at

once be said that all the evidence we possess is entirely opposed to the view that salmon feed when in fresh water. Miescher examined the stomachs of about 2000 salmon captured at Basel, about 500 mUes from the mouth of the Ehine, and in only two did he find any indication of feeding. These two fish were male kelts. One contained the remains of a cyprinoid fish, and the other had a dilated stomach with an acid secretion but no food remains. Hoek, who, as already stated, examined about 2000

*fish, found food of marine origin in 7, but in none food derived from fresh water. Of the 132 stomachs of salmon from the estuaries and upper waters of Scottish rivers examined in the laboratory of the CoUege of Physicians not one contained any food remains. The stomach of salmon captured in fresh water is collapsed and shrunken. Its mucous membrane is thrown into folds, and it contains a small amount of mucus of a neutral reaction. The intestine, which usually contains numerous tape-worms, is full of a greenish-yellow viscous material which, when examined under the microscope, is found to consist of mucus with shed epithelial and other cells and with masses of crystals of carbonate of lime. In no case does the microscope reveal any food remains such as fish- scales, plates of Crustacea, or bristles of worms or annelids. In the fish taken in the estuaries up to the month of August the gall-bladder is distended ; in those taken later in the year it is empty. In all the fish from the upper waters the gall-bladder is empty and coUapsed. According to the investigations of Hoek and of GuUand, the lining membrane of the stomach and intestine degenerates while the fish is in the river, but the correctness of these obser- vations has been denied by Brown and Kingston-Barton. Gillespie finds that the activity of the digestive processes is low in fish taken from the rivers, and that micro- organisms, which would be killed by the hydrochloric acid of the gastric juice were it actively secreted, flourish in the intestines of the fish from the upper waters. Those who believe that the salmon feeds in fresh water explain the fact that the stomach is always foimd empty by the sup- position that the fish vomits any food when it is captured, and several descriptions of cases in which this has been observed might be quoted ; but such observations must be accepted with caution, and the contracted state of the stomach, the absence of the hydrochloric acid of the gastric juice, and lastly the absence of any traces of digested food remains in the contents of the intestine, negative this explanation.^*

The question may be presented in another way. Is there any reason why the salmon should feed whUe in fresh water 1 An animal feeds to get energy for the work it has to do, and to get material to make good the waste from its body and to build up its various tissues. The investigations carried on in the laboratory of the College of Physicians have definitely shown that the salmon leaves the sea with an enormous supply of

nourishment stored in its muscles, and that during its sojourn in fresh water it gets its energy and builds up its rapidly growing ovaries and testes from this stored material. The method of in- vestigation was to take specimens, some from the estuary and some from the upper reaches, from the stream of salmon constantly passing from the sea up the rivers. These were carefully examined, measured, weighed, and analysed, and from the difference of composition the

*1 The following extract from the report of the Brighton Aquarium further supports the view that salmon abstain from food for a pro- longed period.**** *"The Usk salmon . . . was placed there [in the Aquarium] as a smolt on April 5, 1878, and in the following month was transferred to salt water, in which it remained for upwards of five years, feeding freely on shrimps, &c., during a portion of the year, but abstaining from food between August and February ; this, it may be remarked, is the time when it would naturally have been in the river."*

changes they had undergone during their sojourn in the fresh water were determined. Briefly stated, these in- vestigations show that the supply of albuminous material and fats stored in the muscles and used while the fish is in the river is amply sufficient, first, to afford the material for the construction of the ovaries and testes, and, second, to yield an amount of energy so enormous that even the most sceptical must admit that it is amply sufficient for the greatest requirements of the fish. The amount of energy liberated from the fats and albuminous material is 570 times more than is required to raise the fish from the level of the estuary to that of the upper waters ! These analyses further show that all the materials required for the construction of the ovaries and the testes are to be found in sufficient quantity in the muscles, vsdth the exception of iron, which is, however, abundantly present in the blood.

It is a very common opinion that kelts feed voraciously while still in fresh water, and this has been used as an argument that they should be destroyed. It is not easy to bring forward such satisfactory evidence as has

been adduced in the case of unspawned salmon, since it is illegal to kill kelts ; but none of the 25 kelts procured by the Scottish Fishery Board, and examined in the College of Physicians' laboratory, contained any food, and Mr Anderson, formerly of Dunkeld, informs the writer that in the old days, when kelts were habitually killed when captured, he has opened a large number and never found any trace of food in the stomach. On the other hand, some fishers declare that they have seen kelts devouring salmon fry, but it is not easy to make accurate observations in deep water. According to Dr GuUand's investigations, the mucous membrane of the stomach and intestine is completely regenerated while the gall-bladder contains bile, and the digestive activity of the alimentary canal is greater than in salmon before spawning. Kelts thus appear at least to be capable of feeding.

The rate of growth of the genitalia has been carefully studied by Miescher, Archer, and Hoek. From January till about the end of May the growth of the ovaries is slow. In Hoek's series of observations, which are the most com- plete, they increased from '35 to '85 per cent, of the body weight. After this they enlarge more rapidly, and by the end of August are about 3 per cent, in salmon taken at the mouth of the Tweed, about 4 per cent, in the salmon from the mouth of the Rhine, and about 8 per cent, in the salmon from the Basel fisheries. By November they have risen to 20 per cent, in the Tweed and in Holland, and to 23 per cent, in the upper reaches of the Ehine. According to Mr Archer's observations, the development of the ovaries in grilse in the earlier months somewhat lags behind that in the salmon. The growth of the testes has been chiefly investigated by Archer and Tosh in the Tweed and by Miescher at Basel. From March to the middle of July in the Tweed these organs increase from about '19 to '35 per cent, of the weight of the fish. In July their rate of growth increases, and they reach their maximum development at the end of September, when they are about 6 per cent, of the body weight. In the Ehine in March they weigh about ???1 per cent., and they reach their maximum development of alMut 5 per cent, in October.

What leads to the migration of salmon from sea to river and river to sea 1 It is usually supposed that they come to the river to spawn ; that it is the nisus generativus that drives them from the sea, where their ova will not

develop, to the fresh water where development is possible. But it is found that salmon are passing from sea to river at all seasons of the year, and vrith their genitalia in all stages of development ??? some fish running in March with ovaries only 1 per cent, of the body weight, other fish not running till October with ovaries 15 or 16 per cent, of the body

weight. It is difficult, then, to accept the theory that the sexual act is the governing factor. That it is a secondary factor seems to be indicated by the great run of fish in June, July, and August, when the -genitalia are most rapidly growing. There is one respect, however, in which. all the fish leaving the sea for the river agree, and that is in the amount of stored material accumulated in their bodies. In the early running fish this material is largely confined to the muscles, but in the later coming fish it is more equally distributed between muscles and genitalia. The amount of stored material may be measured by the amount of solids, and if we express the results of all the fish examined in terms of fish of uniform size ??? 100 cm. in length ??? the following results are obtained : ???

*Nov.**

Feb.

Mar.

Apr.

May and June.

July and Aug.

Oct. and Nov.

Kelts.

Muscles . Ovaries .

Total .

2481 23

2214 24

2355

24

2599 33

2210 47

2270 72

1750 545

946 9

2504

2238

2379

2632

2257

2340

2295

955

- *Winter fish not due to spawn till following November.*

It would thus appear that, when the salmon has in the sea accumulated a certain definite amount of nourishment, it ceases to feed, and returns to the river irrespective of the state of its genital organs. Nutrition, and not

the nisus generativus, appears to be the motive power. That the fish after spawning returns to the sea in search of food is fully recognized by all.

Course of Migration. ⬛⬛⬛ It is well known that whUe salmon run all the year through in greater or lesser numbers, the run of grilse takes place in the summer months, from May to August. But it is further possible to divide the salmon into classes- ⬛⬛⬛ the so-called winter salmon of the Ehine, large fish running from October to February, with unripe ovaries and testes ; and the summer salmon, running for the most part from March to October, with genitalia more or less ripe. These summer fish are smaU in the early months, but increase in size as the autumn advances. The winter sahnon, along with the early summer or spring fish, appear to pass directly to the upper reaches of the river, and to spawn there, whUe the larger late-coming fish appear to populate the lower waters. This seems to be indicated by the comparison of upper-water and estuary fish throughout the year. The period at which male and female fish enter the rivers also appears to be somewhat different. The following table gives the percentages of males to the total number of salmon cap- tured during the different months of the year, according to the observations of Tosh, Miescher, and Hoek : ⬛⬛⬛ ⬛⬛⬛

Percentage of Male Fish.

Tosli. Mouth of

Hoek. Mouth of

Miescher. Upper Beaches of

Tweed.

Rliine.

187S.

1879.

January

34-3

February

26-7

29-7

March ,

28-8

29-4

April .

20-5

34-7

May .

22-3

28-7

June .

22-5

32-9

July .

27 ‘3

37-6

29-7

19-4

August

26-1

32-7

24

26-8

September

29-6

44-5

38-4

October

44

42-4

52-4

November

39-6

28-8

46 ‘2

December

31-7

To

tal

24-6

33-2

34-4

40-5

S A L 0 N ???S A L T A S H

393

These figures show that throughout the year the female fish exceed the males in number, and, secondly, that during the earlier months of the year female fish run in much larger numbers than do male fish. In fact, it is only in September that anything like an equality between the two sexes is established. But in Great Britain it is not until the end of August that the nets are removed, and one cannot but believe that the destruction of such a very large proportion of females as are captured during the early months of the season must have a most prejudicial effect upon the breeding stock.

Rate of Migration. ???By a comparison of the first appear- ance of winter salmon and of grilse in the markets of Holland and of Basel ???500 miles up the river ???Miescher gives some data for the determination of the average rate at which salmon ascend an unobstructed stream. It was found that winter salmon appeared at Basel about 54 days after their appearance in Holland, which would give a rate of passage of about 10 miles per diem. From a smaller number of observations on grilse, it appears that they travel at a somewhat slower rate. It is, however, doubtful how far these figures are of value in deciding the rate at which fish pass up the lower reaches of the river.

The Food Value of Salmon from the Estvaries and the Upper Waters at different Seasons. ??? Dr Dunlop, using the extensive series of analyses made in the laboratory of the Royal College of Physicians of Edinburgh, concludes that " the food value of salmon flesh is greater when the fish is fresh run than when it has been some time in fresh water ; that it diminishes as the season advances both in the estuaries and in the upper- water fish ; and that the flesh of salmon caught in the upper reaches in October and November has only about one-half the value of the flesh of early estuary fish." The total food value of a salmon depends upon the quantity and quality of the flesh. The amount of flesh depends upon its length and its muscular development. (1) The total food value of estuary fish remains nearly constant throughout the year, the poorer quality of flesh in the later months being compensated for by the larger average size of the fish. (2) From May to August the total food value of fish caught in the upper waters is about one-third less than that of estuary fish. (3) The food value of upper-water fish in October and November is only about one-half that of the upper-water fish earlier in the year, and about one -third that of the estuary fish.

Authorities. ??? Die histochemischen uiid physiologisehen Arbeiten, von FKiF.DiilOH Mieschbk, Zweiter Band, pp. 116, 192, 304, 325. Leipzig, F. C. W. Vogel, 1897. ??? Statistische und biolo- gische Untersuchungen an in den Niederlanden gefangenen Laclisen^ von Dr T. T. C. Hoek. Charlottenburg, Adolf Gratz, 1895. ??? Annual Reports of the Fishery Board for Scotland. Part ii. Report on Salmon Fisheries. Numbers 11, 12, 13, 14. 1893-94- 95-96. ??? Report of Investigations on the Life-History of the Salmon to the Fishery Board for Scotland, edited by D. Noel Paton. Presented to Parliament, and published 1898. (d. n. P.)

Sell on, a town and railway station, arrondissement of Aix, department of Bouches du Ehone, 30 miles north-west of Marseilles, on the Canal de Craponne. Manufactures of so-called olive oil (but to the preparation of which various oil ~~seeds largely contribute) and soap are extensively carried on in numerous establishments ??? about 400 of the former and 20 of the latter. The town is of con~~ siderable antiquarian interest. Population (1881), 4983 ;

(1901), 12,872.

Sa.lonica, a vilayet (province) of Turkey, with an area of about 19,375 square miles and an estimated population of 1,050,000 inhabitants. The population of the town numbers 95,000, of whom 32,000 are Turks; 47,000, Jews; and 16,000 Greeks and Europeans. It is divided into 74 "quarters" ???45 Turkish, 16 Jewish,

12 Greek, and 1 European. It contains 56 mosques, 23 tekk^s, 16 churches, and 25 synagogues. Salonica is the centre of the import trade of the whole of ilacedonia and part of Albania, being at the same time the principal port for shipment for the numerous products of that fertile region. The new harbour, which was opened to navigation in December 1901, allows the direct transhipment of aU merchandise, whatever may be the direction of the wind, which was previously apt to render shipping operations diflacult. The harbour works consist of a breakwater 560 metres long, with 28 feet depth of water on its landward side for a width of 1 50 metres. Opposite the breakwater is a quay 450 metres long and 85 metres in breadth, at each end of which a pier 200 metres long projects into the sea. Between the extremities of these two piers and those of the breakwater are the two entrances to the harbour. Salonica exports grain, silk cocoons, manganese, hides and skins, cattle, wool, opium, tobacco, oil -seeds, and fennel. In 1900 the exports were valued at ??1,220,575 ???this is exclusive of the coasting trade ; and the imports at ??2,553,450. The latter consist principally of textiles, iron goods, sugar, tobacco, fiour, coffee, and chemicals. The volume of the export trade has appreciably decreased. The main reason for this diminution is to be found in the rude methods of cultivation, which disable farmers from competing, either in quality or price, with the produce of countries wherein agricultural practice is more advanced. The industrial enterprises consist of several steam flour-mills, two cotton-spinning mills, two steam brick and tile factories, a brewery, a soap factory, and a small tannery. The making of morocco leather and other leather- work, such as saddlery, harness, and foot-gear of all sorts, affords employment to a large number of persons. Cutlery of the coarser sort, side-arms, field implements, and other ironmongery are made in considerable quantities. The spirit called mastic or raki is largely produced. Road- making in the

vilayet of Salonica is not carried out on any settled plan or fixed principle, and the maintenance and repair of existing roads is equally a matter of chance. These latter, however, are few in number. Three railways traverse the vilayet ??? (1) a branch of the Oriental Rail- way, going due north from Salonica to Uskub and Nish ; (2) the Junction Railway, between Salonica and Dede- agatch ; (3) the Salonica-Monastir line. Salonica is well provided with schools ??? Turkish, Greek, Jewish, Italian, French, Servian, and Bulgarian.

Scllop. See Sheopshieb.

Salta., a province in the north-west of the Argentine republic, bounded on the N. by the province of Jujuy and Bolivia, on the E. by the territories of Formosa and of the Chaco, on the S. by the provinces of Santiago, Tucuman, and Catamarca, and on the W. by Chile. Official area at the census of 1895, 62,184 square miles. Population in 1869, 88,933 ; in 1895, 118,015. The capital, Salta, on the Rio Salta, had a population of 16,672 in 1895, and is distant by rail 1571 kilometres from Buenos Aires. The province is divided into 21 departments. In 1895 there were 7398 farms and 134,993 acres planted in cereals.

Saltash, a municipal borough, Cornwall, England, in the Bodmin parliamentary division of the county, on the river Tamar, 5 miles north-west of Plymouth by rail. It was first incorporated in the reign of King John, and its charter has been confirmed in several reigns, finally in 1883. Until disfranchised in 1832 the borough returned two members to Parliament. It is governed by a mayor, 4 aldermen, and 12 councillors. The Royal Albert bridge, which carries the railway across the river, was built in 1857-59 at a cost of ??230,000. A cottage hospital was erected in 1887, and the Wesley centenary chapel in 1891.

In Victoria Park is a monument to General Sir W. Penn- Symons, killed in the South African war, 1899. A steam ferry, free to inhabitants of the town, belongs to the corporation. There is also an efficient service of river passenger steamers. Population (1881), 2563; (1901),

3357.

SstltCOatS, a police burgh (1885), seaport, and watering-place of Ayrshire, Scotland, 19 miles north of the county town by rail. Modern erections are a town-hall and a bathing station ; there is also a mission coast home. Some fishing is done. A large number of the inhabitants find employment at Ardrossan and Stevenston. Two public schools had an average attendance of 1064 in 1898-99, and a Roman Catholic school 277. Valuation in 1885-86, ––14,687 ; 1899-1900, ––33,240. Population (1881), 5096 ;

(1901), 8121.

SaltiilO. ––– See CoAHTJiLA.

Sa.lt Lake, the largest city and capital of Utah, U.S.A., and capital of Salt Lake county. It it situated in 40––46' N., longitude 111––54' W., at the west base of the Wasatch range, near the river Jordan and the west shore of Great Salt Lake. It is in the northern part of the state, and has an altitude in the lower part of the city of 4240 feet. It is the headquarters of the Mormon Church, or the Church of Jesus Christ of Latter Day Saints. The site of the city is a plain, sloping gently towards the north-west. On this it is laid out with the greatest regularity, in blocks 660 feet square, separated by well-shaded streets 132 feet wide. Temple Square, enclos- ing most of the buildings of the Mormon Church, is the centre of the city, and the streets surrounding it are known respectively as North, East, South, and West Temple Streets. The streets north of North Temple are known as 1st North, 2nd North, &c., and those west, east, and south similarly. The city is divided into five wards. It has an excellent water-supply from small streams flow- ing out of the Wasatch range, and is well sewered. A few of the streets in the business part are paved with asphalt, but most of them are merely gravelled. The Mormon Temple, which was completed in 1893, forty years after the laying of its corner-stone, is an exceedingly ornate

building of grey granite, and is said to have cost $4,000,000. Other buildings in the Temple block are the Tabernacle, assembly hall, endowment house, offices and former residences of Brigham Young, &c. Salt Lake is entered by the Rio Grande Western, the Oregon Short Line, and the Salt Lake and Ogden railways, besides lines running to the resorts on the shore of Great Salt Lake, known as Saltair and Garfield Beach. The manufactures are not of great importance. In 1890 there were 175 manufacturing establishments, with a total capital of $3,354,035. They employed 2287 hands, and the product was valued at $4,624,419. It is the seat of the University of Utah, a non-sectarian institution, opened in 1850. In 1899 it had a faculty numbering 22, and was attended by 641 students, more than half of whom were women. The assessed valuation of real and personal property was, in 1900, $31,950,210, the net debt of the city was $3,383,135, and the rate of taxation was $28.10 per $1000. Popula- tion (1890), 44,843; (1900), 53,531, of whom 2741 were foreign-born and 514 coloured, including 278 negroes. Of 13,639 males 21 years of age and over, 203 were illiterate (could not write).

SaltO, a city of Uruguay and capital of the depart- ment of the same name, situated on the banks of the Rio Uruguay, and an important port for foreign trade, as vessels of heavy draught cannot ascend the river beyond this point. A large amount of merchandise for and from

Brazil passes overland through this port. The city was founded in 1817, and has a population of about 16,000. It is well built, has fine public buildings, and weU-paved streets lighted by electricity. In 1898 the imports were valued at $634,838, and exports $1,679,095 ; and in 1900 the imports were $748,375, and the exports $2,067,513.

Saltykof-f (Stchedrin), Michael

Evg^rafOVitch (1826-1889), a celebrated Russian satirist, born on his father's estate in the province of Tula, 15th (27th) January 1826. His early education was completely neglected, and his youth, owing to the severity and the domestic quarrels of his parents, was full of the most melancholy experiences. Deprived of all rational instruction and left entirely to himself, he soon developed a love for reading ; but the only book in his father's house was the Bible, which he studied with such deep

attention that it appears to have exercised a decided influence in the formation of his thought and morals. At ten years of age he entered the Moscow Institute for the sons of the nobility, and subsequently the Lyceum at St Petersburg, where Prince Lobdnof Rostofski, afterwards minister for foreign affairs, was one of his schoolfellows. While in this estabhsh- ment he published several pieces of poetry, and translations of some of the works of B3rron and Heine ; and on leaving the Lyceum he obtained employment as a clerk in the Ministry of War. In 1884 he published Zaputennoye Dyelo (" A Complicated Affair "), which, in view of the revolu- tionary movements at that time in France and Germany, was the cause of his banishment to Vyatka, where he spent eight years as a minor Government official. This experi- ence enabled him to study the life and habits of civil servants in the interior, and to give a clever picture of Russian provincial officials in his Guhernshie Otcherhi (" Provincial Sketches "). On his return to St Petersburg he was quickly promoted to administrative posts of con- siderable importance. After making a report on the condition of the Russian police, he was appointed deputy governor, first of Ryazan and then of Tver. His predilec- tion for literary work induced him to leave the Govern- ment service, but pecuniary difficulties soon compelled him to re-enter it, and in 1864 he was appointed president of the local boards of taxation successively at Penza, Tula, and Ryazan. In 1868 he finally quitted the civil service in order to devote the rest of his life to literature. During this period he wrote his principal works, namely, Poshehh- onshaya Starina ("The Old Times of Poshekhona "), which possesses a certain autobiographical interest ; Istoria. odnavo Goroda (" The History of a Town ") ; A Satirical History of Russia ; Messieurs et Mesdanies Pompadours ; and Messieurs Golovloff. At one time, after the death of the poet Nekrasoff, he acted as editor of a leading Russian magazine, the Contemporary. He died in St Petersburg, 30th April (12th May) 1889. (g. d.)

Salvador (Republic of), a country of Central America extending from 13 12′ to 14 28′ N. and from 87 37′ to 90 6′ W. It lies on the Pacific coast, and is bounded inland by the frontiers of Guatemala and Honduras. The lowlands are generally hot and, on the coast, malarial ; but on the tablelands and mountain slopes of the interior the climate is temperate and healthy. There are only two seasons : the wet, which

Salvadorians call wnter, from]\Iay to October ; and the dry, or summer, season, from November to April. In July and August there are high winds, followed by torrents of rain and thunderstorms ; in September and October the rain is not heavy, but is continuous.

The territory comprised within the limits of the republic has an area variously estimated at 7230 square miles and at 8130 square miles. It is divided for political and

administrative purposes into 14 departments, which are subdivided into 31 districts. The population in 1887 was stated to be 664,513; (1892), 703,500; (1894), 803,534; (Ist January 1901), 1,006,848, of whom 493,893 were males and 512,955 females. The number of Ladiuos (whites and persons of mixed blood) was returned at 772,200, and of Indians at 234,648. The various elements were, before 1901, estimated as follows, and the propor- tion still holds good in the main ; whites (Creoles and foreigners) 10 per cent., mestizos 50 per cent., Indians 40 per cent, and a very small proportion of negroes. The whites of pure blood are very few, a liberal estimate putting the proportion at 2 '5 per cent. There is no immigration into the country, and the rapid increase with which the population is credited can be due only to a large surplus of births over deaths. The chief towns, with their popula- tions, are given as follows : ❓❓❓ San Salvador the capital (59,544), Santa Ana (48,120), San Miguel (24,768), Ahuachapdn (14,136), San Vicente (17,832), Sonsonate (17,016), Sensuntepeque (12,456), Nueva San Salvador (18,768), Zacatecoluca (15,120).

The constitution of 1864, modified in 1880, 1883, and 1886, vests the legislative power in a chamber of 42 deputies (3 for each department), chosen by the direct vote of the people. The president and vice-president of the republic are likewise chosen by direct popular vote, and they hold office for 4 years. The president is not eligible for the presidency or vice-presidency during the following presidential term. He is assisted by 4 ministers, the heads of departments of administration. Local government

is carried on in each of the 14 departments by governors appointed by the central executive. The municipalities are administered by officers (alcaldes, regidores, &c.) elected by the inhabitants.

The Eoman Catholic religion prevails throughout the republic, but there is complete religious freedom, so far as is compatible vnth public order. Civil marriage is legal, monastic institutions are prohibited, and education is in the hands of laymen. Primary education is gratuitous and obligatory. Statistics of school work are published irregularly, but in 1893 there were within the republic 585 primary schools, with an average attendance of 29,427. For secondary instruction there were 18 higher schools, including 3 institutes, a polytechnic school, and 2 normal schools, one for men and the other for women, these six institutions being supported by the Government. At San Salvador there is a national college for the higher educa- tion of women. Private secondary schools are carried on in various parts of the country. Superior and professional instruction is provided at the national university in the capital, where there are faculties of law and of various branches of science. In 1893 the secondary schools had about 1200 pupils, and the university had 180 students.

Justice is administered by a supreme court, and in district, circuit, and local courts. The active army consists of about 3000 men, and the militia, of about 18,000.

The revenue of Salvador is mainly derived from import and export duties, but considerable sums are also obtained from excise p. duties, and smaller amounts from stamps and other

sources. The principal branches of expenditure are the public debt, defence, and internal administration. The official figures showing the revenue and expenditure for three years and the estimates for two years are as follows (pesos being converted into sterling at the rate of 10 to ??1) : ???

Years.

Bevenue.

Expenditure.

??

??

1897 ....

766,940

863,600

1898 ....

460,960

526,660

1899 ....

447,890

517,620

1900 ....

49??,250

520,170

1901 ....

561,980

575,210

The foreign debt, amounting to ??726,420 (??240,000 of a 6 per cent, loan of 1889, and ??485,720 of another of 1892) was in 1899 converted into 5 per cent, mortgage debentures of the Salvador Railway

Company Limited, to which the Government has guaran- teed, for 18 years from 1st January 1899, a fixed annual subsidy of ►►24,000. The internal debt, on the whole of which interest is paid at the rate of 4 per cent, per annum, amounted at the end of 1900 to 9,225,864 pesos, or about ►►922,590.

The only industry extensively carried on is agriculture, but the methods employed are still primitive. The more important ^iro- ducts are coifee, of which 38,626,480 lb were produced , ^ , in 1898 ; 55,600,000 lb in 1901 ; sugar, 1965 tons in ’”””►►”” ►►► 1898 ; indigo, 1,041,798 lb in 1897 ; balsam, 105,579 lb in 1897. Rubber is collected ; tobacco is grown in small quantities ; cocoa, rice, cereals, and fruits are cultivated. The Government seeks to encourage cotton-growing, and in August 1900 published a decree offering to supply cotton seeds, to give instruction in the cultiva- tion of the plant, and to bestow a bounty of one silver peso on each centner (about 220 lb) of cotton exported. The Government has, moreover, established in the suburbs of the city of Sau Salvador, an agricultural educational establishment and model farm, which is to be stocked with selected breeds of cattle, horses, hogs, and fowls from the United States.

In the Cordillera which runs through Salvador there are veins of various metallic minerals ►►► gold, silver, copper, and lead being found mostly in the eastern, and iron in the western, ►►►. . part of the country. Coal has been discovered at various points in the valley of the Lempa. In the republic there are about 180 mining establishments, about half of them being in the department of Morazau, but there are no recent statistics of their operations.

The trade of Salvador is almost entirely confined to the import of cotton goods, woollen goods, saeks, and machinery, and to the export of coffee and a few other agricultural products. _ In the year 1900 the formation of a statistical office was ►►”””” - decreed. The total imports for 1896 were estimated at the value of 3,347,718 pesos, or, approximately, ►►334,770, and the exports at 7,485,384 pesos, or ►►748,540. In 1900 the imports amounted to the value of 6,570,000 (►►657,000) ; and the exports to 9,132,958 pesos (►►913,290), including coffee, 7,568,339

pesos; indigo, 638,700 pesos ; and balsam, 295,439 pesos. In 1900, according to British statistics, the imports from Salvador into the United Kingdom amounted to the value of ––137,364, comprising ––103,220 for 32,016 cwt. of coflfee, and ––23,166 for 1659 cwt. of indigo; the exports from the United Kingdom to Salvador amounted to ––244,325, comprising ––195,301 for cotton goods and yarns, ––16,513 for sacks, and ––12,138 for iron-work and machinery. The United States in the year 1899-1900 imported from Salvador 6,616,775 lb of coffee, valued at ––118,740, and 54,971 lb of rubber, valued at ––3940. The imports are (in order of value) from Great Britain, the United States, France, and Germany ; the exports (chiefly coffee) are mostly to the United States and France.

In 1896, 338 vessels entered and cleared at the ports of Salvador. The railway system which formerly connected the port of Aeajutla with Sonsonate, Santa Ana, and Ateos, and San Salva- dor with Santa Tecla, has been improved by the con- Sbipping struction of a line from Santa Ana to San Salvador, ““o^oni- putting the capital in direct communication with the ’””“K^’ coast. The old port of Aeajutla has been closed, and a ””––– new port opened in a more sheltered position about a mile to the north, where an iron pier, warehouses, and custom house have been erected. A railway between San Miguel and La Union (22 miles) is intermittently under construction. The postal system has some 260 post offices, through which pass annually about 232, 000 letters and packets in the inland service, and 563,000 in the foreign. In 1896 there were 1730 miles of telegraph wire, and 121 telegraph offices, through which in the year there passed 60,682 messages.*

*At the end of 1899 there were three commercial banks and an agricultural bank within the republic. One of these, an English bank, had a capital of ––275,700 and a reserve fund of ––10,000 ; the three other banks had an aggregate capital S^*”^ stated at 8,250,000 pesos, and reserve funds amounting *” credit. to 1,035,000 pesos. In 1897 a law was passed adopting the gold standard. The currency of the country in 1900 consisted entii-ely of silver pesos, the fractional money under ‘900 fine having, by arrangement with the Government, been all exported by the banks. The peso or dollar at par is valued at 4 shillings ; its actual*

value is under 2 shillings. In foreign exchange at the end of 1899 the premium of gold was 96 per cent., in July 1900 it was 130 percent.

The metric system of weights and measures was adopted by decree of January 1886, but the old Spanish weights and measures still continue in general use.

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(W. W. E. ; I. P. A. E.)

Sa,lv igfei ***There is no general rule or principle of law whicli entitles one who saves the life or property of another to be rewarded by him. But in certain special classes of cases the law does require the appointed courts to reward those who by their exertions have rescued lives or property from probable damage or destruction. The reward so given is called salvage, and the same word is often used to denote the service rewarded. The subject divides into (1) civU salvage, (2) military salvage.***

(1) Civil Salvage is defined as such a service as may become the ground of a reward in the (Admiralty) Court on the civil side of its jurisdiction, and consists in the preservation of life or property from some of the manifold dangers which are at all times incident to the navigation of the sea. The jurisdiction to give it is an Admiralty jurisdiction. But the right to reward was recognized in the courts of common law before the Admiralty Court became, as it now is, a part of the High Court of Justice, e.g., by enforcing a possessory lien of the salvor over the salved property. The origin of the rule has been traced to the doctrine of Eoman law that " spontaneous services " in the protection of lives and property should be rewarded. But that doctrine has not found a place in English law, except as part of the maritime law administered in the Court of Admiralty. Thus services on land, say in rescuing lives or houses or goods from fire, do not entitle the person rendering those services to reward, unless he has acted under some contract or employment. But at sea the right to reward springs from the service itself, if it has been rendered to a ship, or her passengers, crew, or cargo, or to property which has been thrown or washed out of her. And such a service entitles to salvage though the ship may be in harbour, or within a river, or even in a dock. This connexion of the lives or property with a ship seems essential. The right does not arise upon saving goods which have got adrift in river or harbour, even if they have been washed out to sea, nor upon saving property of other kinds which may be in peril on the sea, or on the seashore. Thus a claim to reward for saving a gas-buoy, or beacon, which had broken from its moorings in the Upper Humber, and was aground on the Lincolnshire coast, was disallowed by the House of Lords, affirming the Court of Ajiiical, in the case of the Gas-float Whitton No. 2, 1897, A.O. 3.37. The buoy was not a ship; and the Admiralty jurisdiction hitherto confined to salvage of ships, apparel, cargo, and freight could not be extended to the buoy merely because it was property connected with navigation.

The definite right to salvage for saving lives from ships is the creation of modern statutes (now the Merchant Shipping Act, 1894, ►►544). Formerly the Admiralty judges treated the fact that lives had been saved as enhancing the merit of a salvage of property by the same salvors, where the two could be connected ; and so indirectly gave life salvage. And this is still the position in cases where the Merchant Shipping Act

does not apply. This Act (□□544) applies to all cases in which the "services are rendered wholly or in part within British waters in saving life from any British or foreign vessel, or elsewhere in saving life from any British vessel." Also (□□545) it

can be applied, by Order in Council, to life salvage from ships of any foreign country whose Government " is willing that salvage should be awarded by British courts for services rendered in saving life from ships belonging to that country where the ship is beyond the limits of British juris- diction." By section 544 the life salvage is made payable " by the owner of the vessel, cargo, or apparel saved " ; and is to be paid in priority to aU other claims for salvage. Where the value of the vessel, cargo, and apparel saved is insufiicient to pay the life salvage, the Board of Trade may in their discretion make up the deficiency, in whole or in part, out of the Mercantile Marine Fund. The efl'ect of the Act is to impose a common responsibility upon the owners of ship and cargo to the extent of their property saved. Whatever is saved becomes a fund out of which life salvors may be rewarded, and to which they are entitled in priority to other salvors. In the case of the cargo ex Schiller (1877, 2 P.D. 145) salvage was allowed out of specie raised by divers from the sunken vsreck, to persons who had saved some of the passengers and crew.

This limitation of liability to the amount of the property salved is also true with regard to salvage of property. The ordinary remedy of the salvor is against the property itself ; by proceedings in rem, to enforce the maritime lien given him by the law upon that property. This enables him to arrest the property, if within the jurisdiction, into whose hands soever it may have come ; and, if necessary, to obtain a sale, and payment of his claim out of the proceeds. The salvor has also a remedy in personam, used only in exceptional cases, against the owners or others interested in the property saved (Five steel barges, 15 P.D. 142) ; but it seems certain that that depends upon property having been saved, and having come to the owner's hands ; and that the amount which can be awarded is limited hj the value of that property.

An essential condition is that the lives or property saved must have been in danger □□□ either in immediate peril, or in a position of " difiiculty

and reasonable appre- hension." Danger to the salvor is not essential, though it enhances his claim to reward ; but to constitute a salvage service there must have been danger to the thing salved. Again, the service must have helped usefully towards saving the lives or property. Ineffectual efforts, however strenuous and meritorious, give rise to no claim. But the service need not be completely successful. If it has contributed to an ultimate rescue it will be rewarded, though that may have been accomplished by others. And as we have seen, there must have been ultimate success. Some of the property involved in the adventure must have been saved. And the value of that, or the fund realized by its sale, limits the total of the awards to all the salvors. Cases, of course, occur in which services at sea are employed by sliips in danger ; as where a steamer with a broken propeller shaft employs another steamer to tow her ; or where a vessel which has lost her anchors employs another to procure anchors for her from shore. In such cases the conditions of reward above set out may not apply. Reward may be payable, notwithstanding entire failure of success, by the express or implied terms of the employment. But such a reward is not truly " salvage."

Services rendered in the performance of a duty owed do not entitle to salvage. The policy of the law is to stimulate voluntary efi'ort, not to weaken obligation. Thus the crew cannot (while still the crew) be salvors of the ship or cargo ; nor can the passengers, useless they have voluntarily stayed on the ship for the purpose of saving her. Nor can a pilot employed as such be salvor, unless he has boarded her in such exceptional circumstances that his doing so for pilotage fees could not reasonably be required ; or unless the circumstances of the service,

entered upon as pilotage, liave so changed as to alter its character ; and it may be doubted whether such a change of circumstances is a valid ground for a claim of salvage remuneration by the pilot where he has had no oppor- tunity of leaving the ship. So again of the owners and crew of a tug employed to tow a ship. They cannot claim salvage for rescuing her from a danger which may arise during the towage, unless circumstances

have supervened which were not contemplated, and are such as to require extraordinary aid from the tug, or to expose her to extra- ordinary risk. Officers and crew of a ship of the royal navy may have salvage where they have rendered services outside the protection which their ship ought to afford. But by the Merchant Shipping Act, 1894, ►►557, such a claim must be with consent of the Admiralty; and no claim can be made in respect of the ship herself.

The kinds and degrees of service are very various. The rewards given vary correspondingly. Eegard is paid, first, to the degree of the danger to the property salved, to its value, and to the effect of the services rendered ; next, to the risks run by the salvors, the length and severity of their efforts, the enterprise and skill displayed, and to the value and efficiency of the vessel or apparatus they have used, and the risks to which they have exposed her. In a modern case (the Olengyle, 1898, A.C. 519) a specially large award was given to vessels kept constantly ready for salving operations in Gibraltar Bay. It was owing to that readiness that the rescue had been possible. On the other hand, any negligent or improper conduct of the salvors will be considered in diminution of the award ; as where they have negligently exposed the ship to damage, or have plundered the cargo, or dealt with it contrary to the owner's interests. And where the rescue has been from a danger which was brought about by the negligent or improper conduct of those who effected the rescue, no salvage is allowed. So that where two colliding ships were both to blame for the collision, the master and crew of one of them were not allowed salvage for services in saving cargo of the other (cargo ex Capella, L.E. 1 A. and E. 356).

In apportioning the total award given for a salvage service among the owners, master, and crew of the vessel by means of which it has been rendered, the special cir- cumstances of each case have to be considered. In nearly all cases a large portion goes to the owners, and as in recent times the value and efficiency of ships (especially of steamships) have increased, so the proportion of the whole usually awarded to the owners has also increased. In an ordinary case of salvage by a steamship tovring a dis- tressed ship into safety, the share of the owners is usually about three-fourths ; of the remainder the master usually gets about one-third ;

and the officers and crew divide the rest in proportion to their ratings. But where the salving ship has sustained special damage in the service, or her owners have been put to loss by it, that is taken into account. On the other hand, where special personal services have been rendered by members of the crew they are specially rewarded.

As an illustration take the case of the Rasche (L.R. 4 A. and E. 127). The brigantine Easche, derelict, was fallen in with by the ship Scythia (carrying a very valuable cargo) 220 miles north of the Lizard. The mate and three hands of the Scythia were put on board, and in circumstances of much hardship and danger they brought her after eighteen days safely to Liverpool. After deducting expenses incurred by the owners of the Scythia, the value of the property saved was ––6294. Sir R. Phillimore awarded ––3290 ; and of this he gave ––600 to the mate, ––510 to each of the three men who had accompanied him ; ––500 to the owners of the Scythia ; and ––350 to her other officers and crew.

An agreement as to the salvage to be paid is sometimes made at the time the assistance is given. When made

fairly the court will act upon it, though it may turn out to be a bad bargain for one or other of the parties. But if the facts were not correctly apprehended by one or both, or if the position was one of such difficulty that those salved had no real option as to accepting the salvor's terms, the courts will set the agreement aside.

This happened, for instance, where the salving ship refused to rescue 550 wrecked pilgrims from the Parkin Rock in the Red Sea for a less sum than ––4000. An agreement had in consequence been signed for their conveyance for that sum to Jedda, two or three days' sail. The Parkin Rook stands six feet above the water, and had bad weather come on the lives would have been in great danger. It was held that the sum asked for was exorbitant ; and that the agreement, made under practical compuUion, could not stand (the Medina, 2 P.D. 5). On the other hand, an agree- ment to tow, for a fixed sum, a vessel which had suffered consider- able damage, was set aside, and salvage awarded, on the ground

that the damaged condition had not been disclosed to the tug when the contract was made (the Kingaloch, 1 Spink, 265).

The award of salvage is generally made in one sum against ship, freight, and cargo ; and those interests con- tribute to the amount in proportion to the values saved. No distinction is made between the degree of service rendered to one interest and another. But, with a possible exception in the case of life salvage, there is not a joint liability of the several interests. Each is liable to the salvors for his ovm share, and for no more. The ship cannot be made to pay the cargo's share, nor the cargo the ship's. If, however, the shipowner pays the cargo's share, he has a lien upon it for the amount. In practice the liabilities for salvage are ordinarily adjusted as part of general average. Strictly, however, there is a difference. The liability to pay salvage is a direct liability to the salvors, arising at once, e.g., at the port of refuge, and pro- portional to the values there ; whereas the liability to contribute to a general average loss or expenditure is postponed until the completion or break up of the ad- venture, and depends upon the values of the interests which have arrived there ; which may be very different. (See General Average.)

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(2) Military Salvage is analogous to civil salvage. It is defined as such a service as may become the ground for the demand of a reward in the court as a prize court, and consists in the rescue of property from the enemy in time of war. Such cases almost invariably relate to ships and their cargoes ; and they have always been dealt with by courts having Admiralty jurisdiction, sitting as prize courts. They involve the determination of two questions : first, whether the property is to be restored to its original ovmer or condemned as prize to the recaptor ; and second, what amount of salvage, if any, is to accompany restitution. Generally speaking, the first question depends upon the law of nations, which may be taken to be that where a ship has been carried by an enemy infra praesidia, and especially after a sentence of condemnation, the title

of the original owner is divested, and does not revest upon re- capture by third parties. In such a case, therefore, jure gentium restitution cannot be claimed. The municipal law_ of civilized countries, however, does not encourage subjects to "make reprisals upon one another," (the Eenard, Marr. Adm. Dec. 222), and laws are generally found, as in England, which as between subjects of that particular state provide for restitution irrespective of any change in the title to the subject matter which may have occurred. But (speaking henceforth of England), in cases which do not fall strictly within these Acts, the old maritime law, which was in unison with the general law of nations, is applied by the courts. Moreover, the English Prize Acts do not

apply to foreign owners of recaptured prizes, and there- fore no award can be made against them unless in accord- ance with the law of nations. In practice the courts have acted upon the " rule of reciprocity " where recaptures have been made of the property of formal allies, dealing with them as the allied state would have dealt with English property. In the case of neutral recaptures restitution is always ordered. An exception to the rule of restitution as between British subjects is made in the case of a British ship which has been " set forth as a ship of war " by the captor, and subsequently retaken by a British ship. Such a ship is not liable to restoration, but is the prize of the recaptor. This exception, the object of which is to en- courage the capture of armed ships, dates from 1793, pre- vious Acts having provided for restitution upon payment of a moiety as salvage. The condition of setting forth as a ship of war is satisfied, where under a fair semblance of authority, which is not disproved, the ship " has been used in the operations of war, and constituted a part of the naval force of the enemy" (the Ceylon, 1 Dod. 105). Such a user permanently obliterates the ship's original character, and extinguishes all future claims to restitution {L'Actif, Edw. 185).

As to the right to salvage and the amount which will be allowed, this is also a question of thsjus gentium, though usually governed by municipal law. The right was re- cognized so long ago as the 11th century, when the

” Consolato del Mare ” laid dovm elaborate provisions on the subject. In England the first statutory recognition of the right occurs in 1648, when an Act of the Common- wealth, which in its outline has been the model for all subsequent Prize Acts, provides that British vessels captured by an enemy and retaken by British ships shall be restored upon payment of one-eighth of the value of the property in lieu of salvage, or one-haK in the case of a prize ” set forth as a ship of war.” From that date until 1864, the date of the Act now in force, there have been thirteen Prize Acts deal- ing vrith recapture, each of which, except that of 1864, has been passed to meet a particular occasion, and has expired with the cessation of the then existing hostilities. Since the first Act, and down to the Act of 1805 inclusive, a dis- tinction has always been dravra between a recapture effected by one of the royal ships of war and a recapture by a privateer or other vessel. In the former case the allow- ance has always been one-eighth, in the latter it varied, but was usually one-sixth. In the Act of 1692 a clause taken from a Dutch law gave salvage to a privateer, rising in amount from one-eighth to one-half according to the number of hours the prize had been in the enemy’s posses- sion, but this clause has disappeared since 1756. There is no provision in the present Act for the payment of salvage, except in case of recapture by one of His Majesty’s ships, but it seems beyond question that recaptors are entitled at law to salvage, although they may hold no commission from the Crown. “It is the duty of every subject of the king to assist his fellow-subjects in war, and to retake their property in the possession of the enemy : no commission is necessary to give a pernon so employed a title to the reward which the policy of the law allots to that meritorious act of duty” (the Helen, 3 C. Bob. 226, ^ir,- Sir W. Scott). Though it is improbable that jirivatecrs will figure in any future war, it may reasonably be anticipated that recaptures may be made by private vessels, and in such cases salvage would probably be awarded, the proportion lying in the discretion of the court. Similarly, salvage is awarded in the case of recapture from pirates or from a mutinous crew. In the case of royal ships the present Act allows one-eighth salvage, which in cases of ” special difficulty or danger ” the court may increase to u quarter. The latter provision is an innovation.

It may appear that the grant of salvage to ships of war, the duty of whose commanders it is, according to the naval instructions, ” if possible, to

rescue any British vessel which he may find attacked or captured by the enemy," needs some justification. Objections on this ground have never been seriously treated, it being urged that it is politic to encourage the undertaking of such enterprises, even where they coincide with the path of duty. Where, however, a transport was rescued from under the guns of an enemy by a ship of war, under whose charge she sailed, salvage was refused on the ground that the salvor was only doing what he was bound to do (the Belle, Edw. 66). So no salvage is due to a crew who rescue a ship from mutineers, this being only their duty under a subsisting contract (the Governor Baffles, 2 Dod. 14). On the other hand, a crew who rescue their ship from the prize crew of a belligerent are entitled to salvage, since the capture discharges them from their contract with the owner, and they act as volunteers (the Two Friends, 1 C. Rob. 271). In the case of a neutral captured by one belligerent and recaptured by the other, which has been already alluded to, no salvage is as a rule allowed, upon the supposition that if the vessel had been carried into the port of the enemy justice would have been done and the vessel restored. In the ca;Se of the French war at the opening of the 19th century no such supposition existed, and salvage was usually awarded on the recapture of neutral property from the French.

(m. BT.)

Salvage Corps. ??? The London Salvage Corps is maintained by the fire offices of London. The corps was first formed in 1865 and commenced operations in March 1866. The staff of the corps when first formed consisted of 64. Since that time, owing to the many improvements that have taken place in the system of dealing with salvage, and the increase in the work to be done, the corps has necessarily been strengthened, and the staff now numbers 106. The various stations of the corps are well placed, and the Metropolis has been mapped out so that when a fire takes place the various districts may be attended to at the earliest possible moment, and the salvage operations commenced at once before any great damage has been done. The headquarters are situated at "Watling Street, which is called the No. 1 station, and this station protects the large and valuable risks in the City of London enclosed by the Euston Koad, Tottenham Court Road, City Road, and the river Thames; this is

known as the “B” district. No. 2 station is situated at Commercial Road, and this station attends to the fires occurring within the whole of the eastern and north-eastern portion of London to the north of the Thames, and is known as the ” C ” district. No. 3 station, opposite the headquarters of the Metro- politan Fire Brigade Station in the Southwark Bridge Road, protects the whole of south London, and is known as the “D” district. No. 4 station, at Shaftesbury Avenue, is in constant attendance at fires in the west of London, called the “A” district, which extends to and embraces the vast district and the valuable risks of the West End and Kensington. Finally, No. 5 station, in Upper Street, Islington, acts as guardian to the large parish of Islington. The working staff of the corps, which is mainly recruited from the royal navy, consists of the chief ofiicer, and a superintendent, foreman, and crew of men at each station, ready to turn out immediately on receipt of a ” call.” The stations of the corps are con- nected by telephone with the fire brigade stations from whence the _” calls ” are received. In addition to the home staff, there is also a staff constantly employed during the daytime in inspecting docks, wharves, Manchester goods and uptown warehouses, and reports are made weekly to the committee, when various defects that have been pointed

out by the inspectors are considered and definite action taken in order to prevent disaster from the continuance of the evils.

Generally speaking, the work of the London Salvage Corps may be divided into two distinct classes ??? (1) ser- vices at fires ; (2) watching and working salvage.

(1) Services at Fires form the most important feature of the work. Much depends upon the method of dealing with the salvage. If, for instance, a large Manchester goods warehouse was on fire in the top part, it would be very little advantage to the offices interested in the risk if the men were set to work removing the stock off the ground floor. The best method would be to cover up with tarpaulin all goods there, and prevent the water from collecting on the lower floors. It will be gathered that the most important

work of the corps is to prevent damage to goods, and that water is mostly looked after. Of course the damage likely to accrue from fire is not overlooked, though this is left almost entirely to the fire brigade. The traps, which immediately on receipt of an alarm proceed to the scene of the fire with their crew of men, carry every kind of appliance for the saving of goods from destruction by fire or damage by water, such as waterproof cloths, torches, axes, hand-pumps, buckets, shovels, sawdust, crowbars, ropes with large iron hooks attached (for pulling down dangerous walls or pulling out burning bales of goods), picks, &c., as well as lime-light apparatus for use in working after the fire has been extinguished, thus enabling the men to note the position of dangerous walls, &c. ; and a portable coal-gas apparatus, which can be employed in the interior of buildings when the ordinary means of illumination has failed ; in addition to ambulance appliances for emergencies. The following table contains statistics of the working of the London Salvage Corps for the years specified : ???

Fires attended by Corps.

Services rendered.

Tear.

Within

Without

Metropolitan

Metropolitan

Contents.

Buildings.

Area,.

Area.

1892 .

2324

109

903

615

1893

2241

118

830

558

1894

1936

84

596

521

1895

2193

119

777

542

1896

2035

137

744

640

1897

1999

136

700

527

1898

2122

116

741

473

1899

2180

149

804

590

1900

2170

122

1056

794

1901

2488

167

1167

850

(2) Working Salvage. ??? When a fire takes place, a man is left behind in charge of the salvage if the property is insured; or if that fact cannot be ascertained, but it appears probable that it is, a man is left until the in- formation is obtained later. The duty, if an important one, is divided into a day and night duty. This enables an experienced man to be sent on day duty to meet the s irveyor, and to carry out his instructions regarding the working out of the salvage ; and a junior man . at night. The duties vary so considerably that it would be impossible to frame one set of rules to apply to all cases. Each man on picking up his duty is given certain orders by the superintendent, and fully informed as to the nature of the duty and any special points requiring attention. The day man, if working out salvage, would employ a number of men called strangers, over whom he acts as a kind of fore- man. The " working out " may take the form of dividing up damaged goods into certain lots ready for a sale to be held by the surveyor, or it may be f jr the purpose of

sifting over the debris to find remains of certain articles claimed for. If, for instance, a large fire occurred at a pianoforte manufacturer's, and the

debris was all in one common heap, if considered advisable the men of the London Salvage Corps would have to arrange certain quantities of j)egs and wires in order to give an idea as to the number of pianos before the fire. The watching con- tinues until the loss is settled, when the charge of the premises is given over to the assured.

It would be absolutely impossible to estimate in any degree the large sums that are saved by this valuable body every year.

There are also salvage corps on similar lines, but on a smaller scale, in Liverpool and Glasgow. (c. j. f.)

Salvation Army, The. *A religious philan- thropic organization founded by the Rev. William Booth, who in 1865 began to hold meetings for preaching in the streets of London, and in tents, music halls, theatres, and other hired buildings. Large numbers attended, many of whom had never before entered a place of worship, and presently an organized society was formed, called "The Christian Mission." Mr Booth was assisted by his wife, Catherine Booth, a woman of remarkable gifts, who won the sympathy for the new movement of many among the cultured classes. In 1878 the Mission, which had spread beyond London, was reorganized on a quasi-military basis. The local societies became "Corps," and their evangelists "Ofiicers," with Mr Booth as "General" of the whole body. The operations of the Army at once rapidly expanded ; and in spite of much disorderly opposition in particular places, its work has grown ever since, large numbers of outcasts having been reclaimed. In 1878 there were reported 80 corps and 127 officers in the United Kingdom. In doctrine, the Army is in harmony with the main principles of the evangelical bodies, " as embodied in the three creeds of the Church." Its preach- ing is practical and direct, asseverating the reality of Sin and Eedemption. The Army proclaims the supreme duty of self-sacrifice for the sake of the salvation of others.*

The Army is under the control of the General for the time being, who issues all orders and regulations; but large powers devolve upon other officers, such as the " Chief of the Staff'," the " Foreign Secretary," and the "Chancellor," who direct affairs from the "Inter- national Headquarters " in London. The Army is divided, usually in harmony with

national boundaries, into ” Terri- tories,” each under a ” Commissioner,” vsdth headquarters in the capital of the country. The Territories are again divided into ” Provinces ” or ” Colonies,” and these again into ” Divisions,” wliich include a number of Corps, each supporting its own “Captain” and “Lieutenant.” The “soldiers” or members are drawn from all classes of the community. The property of the Army in the United Kingdom is held by the General for the time being, for the benefit of the Army exclusively, he being constituted a trustee of the property, in the disposal of which and in the appointment of his successor he is placed under the government of a deed poll, enrolled in the Court of Chancery in August 1878. In other countries various modifications have been necessary, but the General’s ultimate control has been practically assured. Funds are raised from the voluntary offerings of the Corps, from friends interested in charitable work, and from the profits on publications. A strict system of accounts and audit is everywhere observed, the financial statements of the various national headquarters funds being annually pub- lished, certified by public accountants, in each country. The total receipts for 1899 from all sources at home and abroad was reported as ►►1,659,782.

400

SALVINI ►►►SALWEEN

Statistics reported October 1901.

Corps.

Outposts.

Officers.

The British Isles ....

1281

238

4859

The United States, South America,

and West Indies

697

104

3052

Canada and Newfoundland .

319

140

938

Australia and Java

484

874

1810

India, Ceylon, and Japan

S70

1260

1745

South Africa and St Helena .

64

13

239

France, Switzerland, and Italy

132

170

4" 7

Germany, Holland, and Belgium .

168

39

682

Sweden, Norway, Denmark, Fin-

land, and Iceland

447

383

1709

Gibraltar and Malta

Total

2

8

4164

3221

15,509

Mr Booth's scteme for Social Belief, described in In Darkest England, and the Way Out (1890), attracted widespread interest, and was started with subscriptions amounting to ►►100,000. A separate trust was declared for the property and funds of this branch of work. Since then, both in Great Britain and abroad, the scheme has been actively carried out. The amount received in the year ending 30th September 1901 for cheap food and lodging in the United Kingdom was returned at ►►35,925. Help has been given to large numbers of unemployed, ex-criminal, and lost persons. In the year ending 30th September 1901, the number of persons received into factories was reported as 3515, of women and girls received into rescue homes as 2223. The farm colony at Hadleigh in Essex has a large acreage under cultivation, with fruit and market gardens and various industrial undertakings.

Summary of Social Operations throughout the World, October 1901.

Number of Institutions.

Great Britain.

Abroad.

Total.

Total Accommo- dation.

Children's Homes Rescue Homes . Ex-Criminal Homes . Food and Shelter Dep&ts . Labour Bureaux ,, Factories Farm Colonies . Other Social Instikitions .

Total Institutions .

2

23

1

24

13

9

1

8

31

88

12

133

10 67 15 51

33

111 13

157 23 76 16 59

1,014

2,526

511

16,709

81

407

488

20,760

Slum Posts

41

91

132

Total number of officers engaged exclusively in social work,

2669.

In the Army there are a number of subsidiary branches of work, such as the Orphanages, the Naval and Military League for work among the troops in peace and war, and the Life Assurance Branch in England. Women take the same rank as men. All officers and many of the rank and file wear a special uniform. Music is universally employed.

Authorities. ??? William Booth. Salvation Soldiery. Interview with W. E. Gladstone. In Darkest England, and the JVay Out. ??? Bkamwell Booth. Social Meparation. Servants of AIL^Booth- Tl'ckee. The Life of Mrs Booth. ??? Eailton. Heathen England. Tvjenty-one Years' Salvation Army. ??? Aknold Whitk. Truth about the. Salvation Army. Various Reports and Accounts. The War Cry, &o. (q_ j.. N.)

Salvini, ToiTimaso(l829-

was born at Milan, 1st January 1829.

??? ???), Italian actor, An actor from the

age of fourteen, he had the advantage at an early stage in his career of joining the company headed by the famous actress Eistori, with whom he was for long associated. He fought in the cause of Italian independence in 1849 ; otherwise his life was an unbroken series of successes in his art.

He acted on various occasions in England and in America, as well as in most of the European capitals. His most famous impersonations included Othello, Conrad in La Morte Civile, Egisto in Alfieri's Merope, and Paolo in Francesca da Rimini. He took part in January 1902 in the celebration of Eistori 's eightieth birthday.

Salween. This river, called Nam K6ng by the Shans, Thanlwin by the Burmese, Lu Kiang, or Nu Kiang, or Lu Tzu Kiang by the Chinese, is the longest river in Burma, and one of the wildest and most picturesque streams in the world. Its sources are still undetermined, but there seems little doubt that it rises in the Tanla mountains, south of the Kuen Luen, somewhere in 32 or 33 N., and that perhaps it draws some of its water from the Kara Nor. It is thus a much longer river than the Irrawaddy. From the time it leaves Tibet it has a very narrow basin, and preserves the char- acter of a gigantic ditch, or railway cutting, with for long stretches no other affluents than the mountain torrents from the hills, which rise from three to five or six thousand feet above the level of the river-bed. In the dry weather the banks are alternate stretches of blinding white, fine sand, and a chaos of huge boulders, masses, and slabs of rock, with here and there, usually where a tributary enters, long stretches of shingle. In the rains aU these disappear, and the water laps against forest trees and the abrupt slope of the hills. The average difference between high and low water level of the Salween throughout the Shan States is between fifty and sixty feet, and in some places it is as much as ninety. There are many rapids, caused by reefs of rock running across the bed, or by a sudden fall of from one to several feet, which produce very rough water below the swift gUde ; but the most dangerous places for navigation are where a point juts out into the stream, and the current, thrown back, causes a violent double back- water. Nevertheless, long stretches of the river, extend- ing to scores of miles, are habitually navigated by native boats. The current is extremely variable, from half a mile an hour to ten knots. For this reason the river is practically unnavigated. Launches ply regularly from Moulmein to the mouth of the Yonzahn, in Lower Burma. The worst part of the whole Salween, so far as is known, is the gorge between the mouth of the Yonzalin and Kyaukhnyat. It is quite certain that steam launches could ply over very long sections of the river above that, perhaps as far as the Kaw ferry, or

even the Kun Long ferry. In British territory, however, there are very few settlements on the river itself, and frequently the ferry villages are built a thousand feet above the river.

The Chinese believe the Salween valley to be deadly to all strangers, but it is in Chinese territory ❖❖❖ particularly in the Lu. Kiang, or Mong Hkb state ❖❖❖ that there is the largest population on the river of any place until Lower Burma is reached. A de- scription of the Salween resolves itself into a list of the ferries at which it can be crossed, for no one marches up the river. Tlie river is bridged by the Chinese on the main route from Tcng Yiieh (Moraien) and Bhamo to Tali-fu. There are two spans ; these are not in a straight line, but parallel to one another at the distance of the breadth of the central pillar. Each span is formed by twelve: or fourteen massive iron chains, with jilanks laid across them. There was a bridge some 20 miles lower down, but this was destroyed in 1894. In Biitish territory there are no bridges, and the ferries are the same as those maintained before the annexation. There are a great number of these ferries, but only a few are used, except by the local people. From Ta Hsang Le large trading boats ply regularly to Kyaukhnyat, whence the traders make

their way by land ovei the hill to Papun, and so down the Y6nzalin.

The chief tributaries of the Salween in British territory are the Nam Yu and the Nam Oi or Nam Mwe on the right banlt, and the Hsipa Haw on tlie left. These are short but lair-sized streams. Near the Kun L6ng ferry the Nam Nim, ou the right bank, and the Nam Ting, on the left, are considerably longer, and the Nam Ting is navigable by native craft for considerable stretches up to Mgng Ting, and farther. To the south the next tributary is the Nam Kyek, on the right bank, down the valley of which the railway will reach the Salween. Below this are two streams called Nam Ma, one entering on the right bank, the other ou the left, at no great distance from one another, but of no great length. A little below is the Nam Nang, on the left bank, coming from the Wa country. The

Nam Kao enters in a cascade of nearly 200 feet in the cold weather from the right, and then there are no afBuents till the Nam Hka comes in on the left. This has a great volume of water, but is unnavigable because of its steep gradient and many gorges. After the Hwe L6ng, entering from the left at Ta Kaw, is passed, the Nam Pang comes in 22 miles lower down on the right bank. This is probably the largest tributary of the Salween ; some distance above its mouth, at Keng Hkam, it is 400 yards wide and quite unfordable. The next important tributary is the Nam Hsim, on the left bank, rising in the latitude of Keng Tung. It is a large but quite unnavigable stream. Except the Me Sill and Me Sala, from opposite sides, and the Nam Hang, which burrows its way through a range of hills from the east, an d the Nam Pan, coming from the west, there is no considerable tributary till 19 52' N., where the Nam Teng comes in on the right from the central Shan States. This is a considerable river, and navigable for long stretches in its upper course, but the last few miles before it enters the Salween are little better than a cataract. Below this the only large afSuent is the Nam Pawn, which drains all Karenni and a considerable portion of the Shan States, but is quite unnavigable. Below this the tributaries are again only mountain streams till the Thaung-yin comes in from the south-east. Thirty miles lower down is Kyodan, the great timber dep6t. Here a cable, stretched across the river, catches all the timber, which is then made up into rafts and floated down to Kado, near Moulmein, where the revenue is collected. The Y6nzalin enters the Salween from the right about 10 miles below Kyodan. Boats can ply from Kyodan southwards, and light draught steamers ascend as far as Shwegdn, 63 miles from Moul- mein. The Salween outs the British Shan States nearly in half, and is a very formidable natural obstacle. It seems probable, how- ever, that long stretches of it can be opened to trade. It is cer- tainly no less navigable than the Middle Mekong or the Yangtzu above I-ohang.

S llw n, a district in the Tenasserim division of Lower Burma. Area, 2666 square miles. Population (1891), 31,439 ; (1901), 19,500. The district is in charge of a superintendent of police, and had 229 villages in 1898-99. The revenue of the district is incorporated with that of the Amherst district. The population in 1891 was made up of aboriginal tribes, Karens and Shans, 26,677, Buddhists and Jains 4322,

Mahommedans 209, Hindus 173, Christians 58. Of the total area of 1,706,240 acres, 180,721 were cultivated in 1898-99. Of the remainder, about half of the acreage was un- cultivable, and there were 98,240 acres of grass. The total rainfall in 1898-99 was lOl'l inches, recorded at Papun, which is the headquarters of the district.

Salzburgf, a duchy and crownland in the Cisleithan part of the Austro-Hungarian monarchy. It lies between 40" 57' 20" and 48►► 2' N. and 12►► 5' and 13►► 59' K, and is bounded on the W. by Bavaria and Tirol, on the E. by Upper Austria and Styria, on the N. by Upper Austria and Bavaria, and on the S. by Carinthia and Tirol. It has an area of 2762 square miles. The surface is for the most part mountainous, the duchy lying on the northern slope of the Eastern Alps. Its most fertile por- tions belong to the series of longitudinal valleys of that region and the surrounding hills. It falls into three divisions : first, the high-lying^ valleys of the Hohe Tauern, which open on the depression of the river Salzach ; then, to the south, the valleys and slopes of the limestone region ; and finally, the undulating forelands. A portion of the Da'chstein lies within the duchy. Salzburg is almost

entirely within the watershed of the Danube, its principal river being the Salzach, a tributary of the Inn. The Emis and Mur rise in this ijrovince. Salzburg has some 200 lakes in all, of which the most important are Lake Zell, celebrated for its beautiful mountain panorama, and the Waller, Fuschel, and Traumen lakes. It has a total area of over 7000 acres of peat moss, and numerous mineral and thermal springs. The climate, although healthy, is very changeable, with great extremes of temperature ►►► at Salz- burg from 82'4►► to 184►► F. below zero ►►► and heavy rains.

The mineral wealth of Salzburg includes salt (at Hallein), copper (at Mitterberg), iron-ore (at Werfen), and small quantities of gold, together with marble and precious stones. In 1898 the iron, gold, and copper ore amounted m value to about ►►18,500, and the salt to ►►183,100. Although a large portion of the soil is unproductive (13'71 per cent, occupied by glaciers, snow-fields, &c.), and 32"4 per cent, consists of forest, Salzburg is one of the principal pastoral regions of Austria. Of its

total area, 28 ‘9 per cent, consists of Alpine pastures available during the summer months, 4 ‘95 per cent, of lowland pasturage, and 8 ‘3 per cent, of meadows, while only 9 ‘2 per cent, is arable. The chief resource is cattle-breeding and dairy- farming. Sheep, goats, and pigs are kept in large numbers. The great quantities of game constitute a considerable resource of the population, large numbers of whom are also engaged in the im- portant timber trade. For administrative purposes the province is divided into six departments, of which the capital, Salzburg, is one and its environs the second. The other four are Hallein, St Johann, Tamsweg, and Zell-am-See. The inhabitants are a handsome and powerfully-built peasant race, very conservative not merely in the matter of religion, but in the maintenance of their traditional manners, customs, games, and national costume.

Population (1890), 173,510 ; (1900), 193,247, which is equivalent to 70 inhabitants per square mile. The proportion of females to males was 1019 to 1000 in 1890. The population is almost exclusively Gennan and Catholic, the proportion of Czechs being less than one-third of 1 per cent., while the Jews and Protest- ants together are less than 1 per cent. In 1896 the marriage- rate was 8‘13, the birth-rate 32‘50 or, excluding still births, 31-54, and the death-rate 24-05. Of the births, 26-42 per cent, were illegitimate. The marriage- and birth-rates are rising, the death-rate and proportion of illegitimacy declining. The duchy sends 6 members to the Reichsrath. The 26 members of the Diet are all Gei-man. The archbishop is an ex-officio member of this body, in which the large landed proprietors have 5 seats, the towns and market-places TO, the chamber of commerce 2, and the country communes 8. Elementary education is comparatively advanced, particularly for an Alpine province. In 1890 the illiterates only amounted to 8 ‘2 per cent., an improvement of 3-4 on the preceding census. There are 2 theological seminaries, 3 intermediate and 179 elementary schools, together with 30 technical, musical, and other special schools. In 1899 Salzburg had 236 miles of railway, 800 miles of roads, and 62 miles of water- way, of which 33 miles were only available for floating timber. At the same date there were 114 post and 73 telegraph offices, with 538 miles of line and 2433 miles of wire. (^_ o’n.)

Salzburg^, the capital of the Austrian duchy and crownland of the same name. Population (1890), 27,244, German and Catholic (505 Protestants and 146 Jews) ; (1900), 32,924, including garrison of 1931 men. The increasing popularity of Salzburg and the entire duchy as a summer resort constitutes a considerable addition to the resources of the town, which is manifest in the con- struction of new hotels, villas,

Salzkammergfut, a district in the south-west angle of Upper Austria. The annual production of salt (the principal industry) is increasing, and amounted in 1898 to about 90,000 tons, valued at ►►683,870. This was 26‘3 per cent, of the total Austrian production.

Salzwedel, a town of Prussia, province Saxony, 106 miles by rail west by north of Berlin, half-way between Berlin and Bremen, on the navigable Jeetze, a tributary of the Elbe. In 1895 the town-hall was burnt down.

The industries include linen and damask wea\4ing, tanning, brewing, and manufacture of pins, chemicals, machinery, Ac. Population (1885), 8883; (1900), 10,175.

Samain, Albert (1859-1900), French poet, was torn at LLUe on ith April 1859. He was educated at the lycee of that town, and on leaving it entered a bank as a clerk. He enjoyed no literary associations, and Ms talent developed slowly in solitude. About 1884 Samain went to Paris, having obtained a clerkship in the Prefecture de la Seine, which he held for most of iis life. He presently began to send poems to the Mercure de France, and these attracted attention. In 1893 he allowed a friend to collect and print his earliest volume of poems, Au Jardin de I’Infante, in a very .small edition. This led to the sudden recognition of his talent, and to applause from critics of widely different .schools. In 1897 this book was reprinted in a more popular form, with the addition of a section entitled VUrne PencMe. Samain’s second volume, Aux Flancs du Vase, appeared

in 1898. His health began to fail, and he withdrew to the country, where he died, in the neighbourhood of the village of Magny-les-Hameaux on 18th August 1900. A third volume of his poems, Le Chariot d'Or, appeared after his death, with a lyrical drama, Polypheme, 1901. The fame of Samain rapidly advanced when he was dead, and the general public awakened to the fact that this isolated writer, who formed few friendships and stood entirely aloof from all the Parisian cliques, was a poet of rare originality. He was neither of the old Parnassian nor of the new S3Tn- bolist school, but cultivated a dehcate, languid beauty of imagery and an exquisite sense of verbal melody with- out attempting any revolution in prosody or identifying limself with any theory. Samain had no great range ???of talent, nor was he ambitious of many effects. His poetry has an extreme dignity and distinction in its somewhat morbid melancholy : it celebrates the magic of fading light in twilight gardens, when the shadows of fair ladies cross the dim lawns in a silence only broken by the murmur of a melancholy violin played somewhere iar away. Samain's natural life was patiently spent in squalid conditions ; he escaped from them into an imagin- ative world where all was of the most exquisite refinement. He has been compared to Watteau and Schumann; in iis own art he bore some resemblance to Baudelaire, .and to the EngHsh poet Arthur O'Shaughnessy. (b. g.)

Samara, a government of south-east Russia, on the left bank of the Lower Volga, with an area of 58,320 square miles. Its geology has been the subject of careful investigation, and much valuable information about the province has been acquired. It is chiefly built up of Carboniferous sandstones, conglomerates, clay slates, and limestones, representing mostly deep-sea deposits. The Permian formation appears along the rivers Sok and ???Samara, and is represented by limestones, sands, and marls containing gyp.sum, all of marine origin, and by continental deposits dating from the same period ; sand- stones impregnated with naphtha also occur. In the north the,se deposits are covered with " A^ariegatcd I\Iarls " and with a variety of Triassic, Juras.sic, and Cretaceous deposits. The Tertiary formation (Eocene) appears only at Novouzensk, the remainder of a vast sheet of this forma- tion, which at one time covered all the region between the Volga and the Urals, having been removed during the Glacial period. Post-Tertiary Caspian deposits

penetrate far into the province along the main valleys, and a thick layer of loess spreads in the north. Selenites, rock- crystal, and agates are found, as also copper ores, rock-salt, and sandstone extracted for building purposes.

The domiciled population of the province, which was only 1,388,500 in 1853, numbered, in 1897, 2,763,478, of whom 1,398,263 were women, and 159,485 lived in towns. The bulk of the popu- lation was composed of Great and Little Russians, who formed 69 per cent, of the inhabitants ; Mordovians formed 8 per cent., Chuvashea and Votyaks 3 per cent., Germans 9 per cent., Tatars 9 per cent., and Bashkirs 2 per cent. Nonconformity is widely spread, and the official figures, which are much below the actual, give 91,400 adherents. Out of a total area of 37,299,400 acres, 4,143,800 acres belong to the Crown, 7,979,000 to private persons, and 22,486,700 acres to the peasants, who rent, moreover, about 6J million acres. The area under cereal crops in 1900 was 9,623,700 acres, and the average annual yield in 1895-99 was : wheat 13,350,000 cwt., rye 10,518,000 cwt., oats 3,338,500 cwt., barley 768,000 cwt. ???all cereal crops 31,813,000 cwt. ; also potatoes 3,390,000 e-B-t. Water melons and sunflowers are extensively cultivated in fields, and gardening is widely engaged in, as also mustard and inferior qualities of tobacco. Cereals being grown in excess of the needs of the population, considerable quantities of cereals and flour are exported during the years of good crops (about 15,000,000 cwt. in 1896), as also are hemp-seed, linseed, and other oil-seeds, bran, &c. However, there are also years of total faOure of the crops, when famine harasses the population. Cattle-breeding is widely spread, and there were in the province, in 1897, 553,300 horses, 484,030 horned cattle, 933,540 sheep, and 88,000 swine. Bee-culture is another pursuit that is widely followed, there being no less than 200,000 hives in the province. The export of poultry, especially of geese, has increased greatly. Manufacturing in- dustries are still undeveloped, and all factories, employing an aggregate of 4700 workers, only showed a return of 11,500,000 roubles in 1898. Both the external and the internal trade are very flourishing, 247 fairs being held in the province every year ; the chief are those at Novouzensk and Bugulma. Owing to the efforts of the local zemstvos, there are more than the average number of primary schools, namely, one school for every 1810 inhabitants ; the total number

of children receiving primary edu- cation is estimated at about 50,000. The province is divided into 7 districts, the chief towns of which are Samara (see below), Bugulma (7577), Buguruslan (12,141), Buzuluk (14,471), Kiko- layevsk (12,524), Novo-Uzeii (13,475), and Stavropol (5974). The Serghievsk sulphurous mineral springs, 57 miles from Buguruslan, are visited by numbers of patients. There are eleven springs, five of which yield 1,353,000 gallons for the baths per day.

Samara, the capital of the above province, 743 miles by rail south-east of Moscow. Its population, which was 63,479 in 1883, numbered 91,659 in 1897 ; and owing to its situation on the Volga, and at the head of the Siberian and Central Asian railways, it has acquired great commercial importance. All through the autumn and winter the peasants from the neighbouring country and the railways bring in considerable quantities of corn, the im- ports of which by rail and water alone are estimated at 154,700 tons, and the exports at 386,900 tons yearly ; five large steam mills and one water mill are capable of grinding 128,000 tons of grain per annum. A considerable trade is also carried on in animal products, particularly hides, of which nearly 150,000 are exported every year. The port is the best on the Volga ; and in 1897, 956 vessels, of 23,000 tons, entered, while 1491 vessels, of 306,000 tons, cleared. The railway returns for 1897 show that 170,000 tons of goods were imported hy rail and 139,000 tons exported. Three great fairs are held every year. The city is well provided with schools and philanthropic institutions. It has three public libraries, several scientific societies, a good theatre, and a natural history and archseological museum ; four newspapers are published.

Samarkand, a province of Russian Turkestan, of which it occupies the south-east corner, formed in 1887 out of the Zerafshan district. It has on the N. and K.-E. Syr-dariinsk, on the E. Ferghana, on the "W. Bokhara, and on the S. the khanates of Hissar, Karateghin, and l)ar\az. Its area is 26,627 square miles.

It is very hilly in the south, where it is intersected by a series of mountain ranges belonging to the Alai-Pamir system. The orography of this part of the Tian Shan is not yet well . .

worked out, and they are traced on our maps mainly , ^ in accordance with the river system. Thus the high Hissar range is traced along the water-parting between the system of the Zerafshan and the upper tributaries of the Amu ; another

high range, the Zerafshan, is traced in the same direction between the two parallel rivers, the Zerafshan and its tributary, the Yagnob ; while a third range, often called Turkestan ridge, is traced from west to east parallel to the Zerafshan, on its northern bank. It is very probable, however, from what is known about the structure of the Tiau Shan and the western Pamir, and their direction north-eastwards, that the three ranges referred to will, when they are better known, be found to be of a much more complicated character than is at present supposed. All three ranges are snowolad, and in their highest peaks reach altitudes of from 18,500 feet in the west to 22,000 feet in the east, while the passes over them, which afford difficult travelling as a rule, lie at altitudes of about 12,000 feet. Several Alpine lakes, such as Iskander-kul, 7000 feet high, have been found nestling under the high precipitous peaks.

The Alpine zone extends as far north as the 40th parallel, beyond which the province is covered with steppes, which are broken by only one range of mountains, Nuratyn-tau (also known as Sanzar and Malguzar, in its south-eastern, aud Kara-tau in its north- westera, extremity). This treeless range shoots for 160 miles, from the western Tian Shan, in a north-western direction, reach- ing 42◆◆ N. and 65◆◆ E. ; it has a width of about 35 miles, and reaches altitudes up to 7000 feet ; it is now pierced, in the renowned Sanzar gorge, or Tamerlane's Gate, by the railway leading from Samarkand to Tashkent. The other mountains in the province are well wooded, and it is estimated that nearly 4,500,000 acres are under forests. The north-western portion of the province is occupied by the Famine Steppe ◆◆◆ which was for a long time an obstacle to the advance of the Eussians southwards, but which probably might be irrigated ◆◆◆ and by the desert of Kyzyl-kum, which is covered in

places by moving sand. The Famine Steppe (not to be confounded with another desert of the same name, or Bek-pak-dala, to the west of Lake Balkhash) occupies nearly 6,000,000 acres, covered with a loess -like clay; the water is nearly always brackish, and can only be obtained from wells. In the spring the steppe is clothed with grass, and offers good pasture – grounds for the Kirghiz, but the grass withers as summer advances. Nearly 1,500,000 acres might, however, be irrigated and rendered available for the cultivation of the cotton- tree ; and indeed a beginning has been made in that direction. The Kyzyl-kum (or Kizyl-kum) Steppe, which occupies 88,000 square miles, is covered partly with rocky hills, reaching an altitude of 3500 feet, and partly with salted clays, patches of prairie land, and sands. The sand is especially prevalent in the parts on the margin, where the moving barkhans (crescent- shaped sandhills) invade the Kara-kul oasis of Bokhara. The vegetation is very poor, as a rule ; grass and flowers (tulips, Bheum, various Umbelliferse, &c.) appear for a short time in the spring, but for the rest of the year only the bushes and the grasses characteristic of the steppes of Central Asia are to be seen, and the TjarJchans are covered merely with Haloxylon ammodendron, Poligonum, Halimodendron, Atraphaxis, and other steppe bushes ; occasionally some Stipa grass is seen on the slopes of the sand-mounds, whfle Artemisia and Ta-marix bushes cover the more compact sands. Water can only be obtained from wells, which sometimes have to be 140 feet deep. A few Kirghiz are the only inhabitants, and they are only to be found in the more hilly parts of the steppe.

The chief river of the province is the Zerafshan (see also ninth edition), which, under the name of Match, takes its rise in the Koksu mountain group where the Hissar range meets with the Alai ranges, near the Match Pass (13,800 feet). The glacier from which it ilows is 16 miles long, and reaches by its lower end the altitude of 9000 feet ; formerly, however, it crept at least 33 miles farther down the valley. The Zerafshan flows first westwards, in a wild gorge, with ►► fall of 37 feet per mile ; near Varzaminor it receives the Fan-daria ►►► formed by the junction of the Yagnob, which flows in a gorge parallel to the Upper Zerafshan, with the Iskander-daria ►►► and pierces the Zerafshan range in a wild transversal gorge. It then bends northwards, receives the Kshtut and the Maghian from the left, and issues from the mountains into the steppes

near Penjakent. After flowing past Samarkand, it divides into two branches (the Ak-daria and Kara-daria), 65 to 67 miles long, which unite near the Bokhara frontier ; these surround the fertile, well watered, and well populated Miankal Island. To the west of Kermineh (altitude 970 feet) the Zerafshan bends to the south-west, flows past Bokhara, a few miles north of the city, and ia lost in the sands 15 miles west of the Kara-kul villages. Its total length is 400 miles, for 260 of which it flows in the province of Samarkand. The current in the Zerafshan is so rapid that navigation is only possible by rafts ; these are floated from Penja- kent downwards. The quantity of water varies at the junction with the Maghian from 800 cubic feet per second to 27,800, or even 33,400, cubic feet per second in different periods of the year. The name of the Zerafshan, "distributer of gold," is fully explained by its value for purposes of irrigation : 83 main canals are drawn from it in the Samarkand province, watering 1200 square miles ; while

another 1640 square miles are watered in Bokhara by means of 43 main canals (of which the Shahrud brings to the Bokhara city 1610 cubic feet of water per second) and 939 secondary canals. The north-eastern portions of Samarkand are watered by the Syr-daria. One of the lakes, the Tuz-khan (40 miles from Jizak) yields about 1300 tons of salt.

The climate is very dry and continental in character. The average temperature for the year is 55 F. at Samarkand, and 58 at Khojent and Jizak ; but the average temperature for . the winter is only 34 , and frosts of 4 and 11 have '"are-

been experienced at Samarkand and Khojent respectively ; on the other hand, the average temperature for July is 79 at Samarkand and 86 at Khojent and Jizak. The total precipitation (including snow in winter) is only 6 '4 inches at Khojent, 12 inches at Samar- kand and Khojent, and 24 inches at Jizak. The hilly tracts have a healthy climate, but malaria prevails in the lower regions and the mosquitoes are quite a plague in summer.

In 1897 the domiciled population numbered 867,847, of whom 384,392 were women, and 135,568 lived in towns. The Uzbegs form over two-

thirds of the population, and after them /□□□j,-fcj,. the Kirghiz and Tajiks are the most numerous ; Jews, ^^^^ Tsigans, Tatars, Afghans, and Hindus are also ”’^^ j□□□aa’strles with. The Eussians had 9 villages (2000 inhabitants) ^^_ ‘

on the Syr-daria, in the Famine Steppe, in 1897.

In 1898 nearly 1,000,000 acres were irrigated, and about 800,000 acres half-irrigated. The chief crops in 1897 were : wheat 4,156,000 cwt., rice 2,584,000 cwt., and barley 1,240,000 cwt. Sorghum, millet, Indian com, peas, lentils, haricots, flax, hemp, poppy, lucerne, madder, tobacco, melons, and mushrooms are also grown. Agriculture has reached a high level of perfection, and two crops are often taken from the same land in one season. Over 1100 tons of raw cotton, chiefly American, were obtained in 1897, and 21,000 acres were under vineyards. Sericulture prospers, especially in the Khojent district (15,100 cwt. of raw cocoons). The forests have been already referred to. Plantations of trees near Samar- kand have proved very successful. Cattle-breeding forms the chief occupation of the Kirghiz, and there were in 1897 in the province 82,760 horses, 170,890 cattle, 1,087,500 sheep and goats, 39,500 donkeys, and 45,800 camels. Weaving, saddlery, boot- making, tanneries, oil works, and metal works are widely spread in the villages and towns, while the nomad Kirghiz excel in making felt goods and carpets. But all these industries are simply domestic in character, and of large esta,blishments there are only 1 glass works, 24 cotton-cleaning works, 3 steam flour mills, and a few distilleries. Mining is in its infancy ; but some coal (5000 tons), sulphur, ammonia, and gypsum is obtained. Trade is considerable, the chief exports being rice, raw cotton, raisins, dried fruit, nuts, wine, and silk. The Central Asian Eailway now crosses the province from Bokhara to Samarkand and Tashkent ; a branch line runs to Andijan in Fergana.

Education is at a low ebb. There were only 9 schools for Eussians in 1899, attended by 350 boys and 240 girls ; 8 mixed schools, with evening classes, had 259 pupils ; and 1785 Mahom- medan schools, about 17,000 pupils. The province is divided into 4 districts, the chief towns of which are : Samarkand (see below). Fort Jizak (16,041), Kattykurgan (10,083), and Khojent, or Hodjent (30,076). (p. a. K.)

Sa.ina.rksincl, the capital of the above province, situated in 39 39' N., 97 18' E., 5 miles from the left bank of the Zerafshan, at an altitude of 2260 feet. It is connected by rail with Krasnovodsk (938 miles), via Merv, arnd with Tashkent (126 miles). In 1897 the population numbered about 40,()00 in the native city, and about 15,000 in the new Russian town, inclusive of the military (80 per cent. Russians). Out of the total of 54,900, only 23,194 were women. The Russian town is well built, with broad boulevards, gardens, and a park. Although the building of the railway as far as Tashkent and Andijan has diminished the commercial importance of Samarkand, it still remains an important depot for the export of raw cotton, rice, raw silk, silk goods (blankets), leather, fruit, horses, and wine.

Sa.mba.lpur, a town and district of British India, in the Chhattisgarh division of the Central Provinces. The town is on the left bank of the river Mahanadi, 495 feet above the sea, and has a railway station. Population (1881), 13,939 ; (1891), 14,571. There is a ruined fort, with old temples. The cantonment contains a wing of a Madras native infantry regiment. The Government high school had 444 pupils in 1896-97. There is considerable trade.

The district of Sambalpttk has an area of 4948 sq^iiare miles. Population (1881), 693,499 ; (1891), 796,413, showing an increase of 15 per cent., which has been continuous since 1872. Average density, 161 persons per square mile. In 1901 the population was 829, 823, showing a further increase of 4 per cent. The land revenue and rates are Es. 2, 06, 334, the incidence of assessment being little more than two annas per acre ; cultivated area (1897-98), 1,117,439 acres, of which 18,712 were irrigated from tanks, &c. ; number of police, 491 ; boys at school (1896-97), 8137, being 13-6 per cent, of the male population of school -going age ; registered death-rate (1897), 30 per thousand, compared with 68 for the province generally. This last figure is sufficient to show that Sambalpur entirely escaped the famine of 1896-97, which indeed can be said to have

brought prosperity to the district by causing high prices for a good rice crop, rice being the staple of cultivation. It was almost equally fortunate in 1900. The main line of the Bengal-Nagpur Railway runs along the northern border of the district, with a branch (30 miles) south to Sambalpur town.

Sam bo r, the chief town of a government district in Galicia, situated on the Dniester, to the south-west of Lemberg. The industries consist in brewing, corn-milling, and the manufacture of damask silk, oil and salt from the brine wells in the neighbourhood. There is a con- siderable trade in flax, hemp, eggs, and cattle. Popu- lation (1890), 14,324; (1900), 17,027, chiefly Polish and Roman Catholic (estimated at 9 per cent. Ruthenians and 3 per cent. German; 29 per cent. Jewish and 17 per cent. Greek Catholic).

Sstmilcin, a small province of Persia, which, includ- ing the city and district of Damghdn, is generally known as "Samndn va Damghdn." It is bounded on the W. by the districts of Khdr (the ancient Choara) and Firiiz- kuh, on the N. by Mdzandardn, and on the E. by Shahrud and Bostdm. In the S. it extends to beyond the oasis of Jendek in the desert north of Yezd. Its northern part is stiU. known as Komush, or Komish, the ancient Commisene. The revenue which the State derives from the whole province amounts to about ––7000 per annum.

Sa.m n^n, the capital of the above province, situated 145 miles east of Tehran, on the high road thence to Mash- had, at an altitude of 3740 feet and in 35––34' N., and 53––22' E. It has a population of about 10,000, post and telegraph offices, and a fine minaret, 100 feet high and some inches out of the perpendicular, built in the 12th century. It exports large quantities of pistachios and almonds and some coarse tobacco grown in the district. In the town and some of the neighbouring villages a dialect with many old Persian forms and resembling the Mdzan- dardn dialect is spoken.

A. Houtum-Schindler, " Bericht iiber d. Samnan Dialect," Zeitsch. d. Morgenl. tiesellschaft, vol. xxxii., 1878.

Samoa, an archipelago which occupies a somewhat central position in the Pacific Ocean, about 150 miles north of Tonga and nearly midway between the New Hebrides and Tahiti, 1600 miles from Auckland (New Zealand), 2410 from Sydney, and 4200 from San Fran- cisco. The group, which was discovered by Bougainville, and by him named the Navigators' Islands, com[)rise3 altogether fourteen volcanic islands disposed in the direc- tion from west to east between 13 ̊-1 5 ̊ S. andl68 ̊-173 ̊ W., with a total area of 1100 square miles, and a population (1900) of 35,000, all Polynesians except about 500 Euro- peans (British, American, German). The chief members of the group are ; ̊ ̊ ̊

Area in sq. miles. Population.

Savaii 660 12,500

Upohi 340 16,600

Tutuila 54 3000

Manua, with Ofu and Olosenga . 26 2000

All are forest-clad and mountainous, with several extinct or quiescent craters rising from 2000 feet in Upolu to 4000 (Mua) in Savaii, and the peak of Vaea in the former

island will always be associated with the memory of the late R. L. Stevenson, whose monument crowns the summit. Although there are now no active cones, Upolu has in com- paratively recent times been subject to violent volcanic disturbances. Several parts of the islands are strewn with modern eruptive matter, and according to a local tradition, the last explosion occurred not more than 200 years ago. In 1866 a submarine volcano near the islet of Olosenga was the scene of a violent commotion, discharging rocks and mud to a height of 2000 feet, and discolouring the surrounding waters for many miles in all directions. The whole group is abundantly watered, and such is the fer- tility of the igneous soil that the means of subsistence are said to be more easily raised than in any other part of the world. But the archipelago lies in the track of the fierce hurricanes which occur usually between the months of December and April.

Of the extremely limited Samoan fauna, consisting mainly of an indigenous rat, four species of snakes, and a few birds, the most interesting member is the Didunculus strigirostris, a ground pigeon of iridescent greenish-black and bright chestnut plumage, which forms a link between- the extinct dodo and the living African Treroninae. The Samoans are typical members of the large brown Polynesian race (see Polynesia), and according to some ethnologists Savaii was the cradle and centre of dispersion of these aborigines over the Pacific Ocean from Hawaii to New Zealand. This view is largely based on the fact that Samoan is the most archaic of all the Polynesian tongues, and still preserves the organic letter s, which becomes h or disappears in nearly all the other archipelagoes. Thus the term Savaii itself, originally Savaiki, is supposed to have been carried by the Samoan wanderers over the ocean to Tahiti, New Zealand, the Marquesas and Sandwich groups, where it still survives in such variant forms as Eavaii, Hawaiki, Havaiki, and Hawaii. The theory is supported by the local traditions, legends, and cosmogonies in which Polynesian oral literature abounds.

The exports from Samoa (chiefly copra) were valued in 1897 at ►►48,000 and the imports at ►►66,000 (►►35,000 from British empire), while of the shipping (82,000 tons) about half was British, and 32,000 tons were American. Apia, the capital and chief centre of trade, lies in the German island of Upolu ; but Pago Pago (Pango Pango) in Tutuila, is used as a coahng station for the United States Navy in the Central Pacific waters. (a. h. k.)

History. ►►► Subsequently to the year 1881, the Samoan Islands assumed a much greater international importance than before. Their situation in the direct pathway of commerce from the United States to Australia, their central position in the South Pacific, and the fact that European Powers had acquired nearly all other groups of islands and valuable harbours in the South Pacific, made Samoa a desirable possession to any maritime Power. Under a political arrangement between Great Britain, Germany, and the United States, no single Power was to appropriate them. But in 1887 and 1888 civil war prevailed, the Germans supporting their candidate, the native Tamasese, as the lil^Yful king, and the British and American residents of the islands supporting MaUetoa. After the latter had been deported by the Germans, the British and American support was transferred to his successor, Mataafa. In the course of the fighting which ensued, some fifty German sailors and marines were kUled or wounded by the adherents of Mataafa. A conference between the three Powers was thereiqion held at Berlin, and a treaty was executed by those Powers and by Samoa, under date 14th June 1889, by virtue of which the inde- pendence and autonomy of the islands were guaranteed,

Malietoa was restored as king, and the three Powers constituted themselves practically a protectorate over Samoa, and provided a chief justice and a president of the municipality of Apia, to be by them appointed, to aid in carrying out the provisions of the treaty. The government was administered under this treaty, but with considerable

friction, until the end of 1898, when, upon the death of Malietoa, two rival candidates for the throne appeared, and the chief justice selected by the three Powers decided against the claims of Mataafa, one of the rival claimants, and in favour of a boy, Malietoa Tanu, a relative of the deceased Malietoa. Civil war immediately ensued, in which several American and British officers and sailors were slain by the natives, the Germans upholding the claims of Mataafa, and the British and Americans supporting the rival candidate. The three Powers thereupon sent a commission to Samoa to investigate and adjust the difficulties. The situation, however, was found to be so complicated and embarrassing that, early in the year 1900, the so-called Berlin treaty was abrogated. Great Britain withdrew her claims to any portion of the islands and received compensation from Germany by concessions in other parts of the world, and the United States withdrew from aU the islands west of Tutuila, leaving Upolu and Savaii and their outlying islands for exclusive German control, the United States retaining the island of Tutuila and the small islands near to it. The Germans immediately made a Crown colony of their new possessions, and appointed a governor for their control. The United States, having received the written assent of all the chiefs of the islands that fell to it by the partition, assumed sovereignty over them and proceeded, as we have already seen, to erect a weU-equipped coaling station in the harbour of Pago Pago.

On 16th March 1889 a hurricane prevailed in the South Pacific, and the heavy tidal waves swept into the harbour of Apia and created great havoc among the warships of the three Powers congregated there. The American war- ship JVipsic was cast upon the beach, but was afterwards floated and saved. Two other United States warships Trenton and Vandalia, were beaten to pieces upon the coral reef, and sank ; and the German warships Olga and Eber were wrecked. Great loss of life ensued. The British warship Calliope was in the harbour, but succeeded in getting up steam and, standing out to sea, escaped destruction. It was fitting that E. L. Stevenson's should be the pen to describe in vivid and dramatic language the heroism of the captain and crew.

The Germans had the largest financial interests in the islands for many years, and acquired by the new treaty the most valuable portions thereof.

The particular value of Tutuila lies in the excellence of the harbour of Pago Pago and its central position in the South Pacific. The Samoan climate is equable and delightful, the tem- perature ranging from 60 to 90 P., the average for summer being about 5 higher than that for winter. The regularity and strength of the trade winds temper the heat and, with the picturesque native life, make the islands an attractive place of residence for Europeans. Eobert Louis Stevenson passed his last years there, and his body lies buried on the summit of Mount Vaea, overlooking Vailima, his South Sea home, and the coral-encircled harbour of Apia. The steamers of the Oceanic Steamship Company of San Prancisco all touch at the group in their regular trips to Sydney, and communication is also furnished once a fortnight by the Union Steamship Company of New Zealand. (h. c. i.)

Sa.tTIOS, an island of the Aegean, separated from the Anatolian coast by a strait less than a mile wide. It is

tributary to Turkey in the sum of 2700 annually, but otherwise is practically an independent principality, governed by a prince of Greek nationality nominated by the Porte. As chief of the executive power the prince is assisted by a senate of four members, chosen by him out of eight candi- dates nominated by the four districts of the island Vathy, Chora, Marathocumbo, and CarlovasL The legislative power belongs to a chamber of 36 deputies, presided over by the metropolitan. The Budget estimate for receipts and expenses for 1900-01 was 31,848. There is no public debt. The seat of the Government is Vathy (5000). There ia a telephone service. The island is remarkably fertile, and a great portion of it is covered with vine- yards, the wine from the Vathy grapes enjoying a specially high reputation. There are three ports : Vathy, Tegani, and Carlovasi. They were visited in 1899 by 1402 steamships, of 304,250 tons, as compared with 1178, of 287,095 tons, in 1895, and by 3604 sailing vessels, of 449,560 tons, as compared with 3562, of 252,897 tons, in 1895. In 1899 the ships belonging to the principality numbered 368, of 3491 tons, as compared with 306, of 3562 tons, in 1895. The total value of the exports in' 1900 was 211,000, as compared with 164,876 in 1895, and of the imports 213,000, as compared with 173,545. The principal exports are wine (140,000 in 1900 and 13,698 in

1896), olive oU (about ??20,000), raisins (??25,000), locust beans, and tobacco (??20,000). The population in 1900 was 54,830, not comprising 15,000 natives of Samos inhabiting the adjoining coasts. The predominant religion is the Orthodox Greek, the metro- politan district including Samos and Icama. In 1900 there were 634 foreigners on the island (523 Hellenes, 13 Germans, 29 French, 28 Austrians, and 24 of other nationalities). In 1881 the remarkable aqueduct and tunnel of Eupalinus, cut through the mountain behind the ancient capital for a distance of about 1400 yards, was discovered.

See TozEE. Islands of the jEgean, 1890.

Sa.mOSa.ta., now Samsat, Turkey in Asia, alti- tude 1500 feet, the capital of the Seleucid kings of Commagene, and a place of strategical importance. The town was situated on a broad plain, on the right bank of the Euphrates, where there is the first easy passage across the river below the point at which it leaves the mountains. Samosata, according to Strabo, was the starting-point of the great road to India, and it was probably the place at which the Persian " Royal Eoad " crossed the Euphrates. Taken by Mark Antony, it was finally included in the Eoman empire by Vespasian, and was the birthplace of Lucian and of the heretical bishop Paul, who maintained the simple humanity of Christ. A Kurdish village occupies a corner of the site of the ancient town.

Samothrace (Turkish, Semadrek), the " Thracian Samos," a rugged mountainous island in the Aegean Sea, altitude 5248 feet, situated 20 miles south of Dedeagach, on the coast of Thrace. The island is a kaza of the Lemnos sanjak, and has a population of 3500, nearly all Greek. On the north coast are much frequented hot sulphur springs. In 1873 and 1875 excavations were carried out under the auspices of the Austrian Government with interesting results.

Sampson, William Thomas (1840-1902),

American naval commander, was born at Palmyra, New York, 9th February 1840, and graduated at the head of his class from the U.S. Naval Academy in 1861. He served in the Potomac in 1861, in which year he was pro- moted to master, and in the following year was made

lieutenant. He was executive officer in the Patapsco when she was blown up in Charleston Harbour, 10th January 1865. Varied service on distant stations followed, with promotion to the rank of Ueutenant- commander in 1866 and commander in 1874. He was a member of the International Prime Meridian and Time Conference, 1884, and was afterwards a member of the Board of Fortifications. He was superintendent of the Naval Academy from 1886 to 1890, being meanwhile pro- moted to captain, and serving as delegate at the Inter- national Maritime Conference at Washington, 1889.

From the first Sampson threw himself energetically into the work of developing the United States navy. The con- struction of the gun factory was in his charge, and it fell under his absolute control when he became chief of the Bureau of Ordnance, which position he held until he was appointed to the Iowa, shortly before the war with Spain. For a number of years from 1892 onwards all the guns built for the American navy were constructed under his supervision, and the heavier guns were from his own design. It is said that 95 per cent, of the guns employed in the Spanish-American war had been made under his superintendence. He was a member of the Advisory Board and the Board on Construction for five years up to 1897, and his influence was felt not only in the matter of general design, but still more decisively in regard to the distribution of guns and armour. Equally important was his influence in the training of the personnel of the navy. He superintended the gunnery training and prepared a new drill-book for the fleet.

When the 2Iaine was blown up in Havana harbour in Feb- ruary 1898, Sampson, then a captain, was one of the court of inquiry appointed to investigate the cause of the disaster. At the outbreak of the war with Spain he was placed in charge of the North Atlantic squadron, and conducted the blockade of Cuba. When it was known that Admiral Cervera, with a Spanish fleet, had left the Cape Verde Islands, Sampson withdrew a force from the blockade to cruise in the Windward Passage, and made an attack upon the forts at San Juan, Porto Kico. After his return to the coast of

Cuba, he conducted the blockade of Santiago, and the ships under his command destroyed the Spanish vessels when they issued from the harbour of Santiago and attempted to escape. Sampson himself was not actually present at the battle, having started for Guantanamo just before it began. He was, however, only a few miles away at the most, and reached the scene of battle as the last Spanish vessel surrendered, and the engagement was fought in accordance vsdth his instructions. He was promoted to commodore in 1898, to rear – admiral, 3rd March 1899, and was made commandant of the Boston (Charlestown) Navy Yard in October of the same year. He died 6th of May 1902. Admiral Sampson rose from a comparatively humble station in life by distinguished ability, power of command, and sheer force of character. He exercised an influence in every department of naval activity, won the high professional esteem of his brother officers, and was held in warm regard by all but a small section of his countrymen. He was the man whose personal energy entered more largely than that of any other into the construction, armament, organization, and fighting qualities of the American fleet as constituted in the Spanish-American war.

Sa.lTIShui, a treaty port in the province of Kwang- tung, China, situated on the left bank of the river West, 99 miles from Canton. Its position is at the junction of the rivers North and West, and is favourably situated as a distributing centre for foreign goods. The town itself is of no importance, and the trade, which is almost

entirely with Hong Kong, so far is not great. The im- ports by steamer in 1899 amounted to H. taels 2,967,000 (►►445,000), but in 1900 to only ►►355,400. This, however, is only part of the trade, as the country abounds in creeks suitable for junk navigation.

Scimsun, the ancient Amisus, the chief town of the Janik sanjak of the Trebizond vilayet of Asiatic Turkey, situated on the south coast of the Black Sea between the deltas of the Kizil and Yeshil Irmaks, and connected by metalled roads with Sivas and Kaisarieh, and by sea with. Constantinople. It is a thriving town, of considerable importance as the outlet for the trade of the Sivas vilayet. Steamers lie about a mile from the shore in an open road- stead, and in winter landing is sometimes

impossible. In 1900 the exports ??? cereals, flour, tobacco, &c. ??? were valued at ??759,760, and the imports ??? cotton stuSs, iron, &c. ??? at ??468,230. The population rose from about 3000 in 1860 to about 13,000, of whom 10,000 are Christians. Amisus, which stood on a promontory about 1^ miles north-west of Samsiin, was, next to Sinope, the most flourishing of the Greek settlements on the Euxine, and under the kings of Pontus it was a rich trading town. By the 1st century a.d. it had displaced Sinope as the northern port of the great trade route from Central Asia, and later it was one of the chief towns of the Comneni of Trebizond. There are stiU a few remains of the Greek settlement.

Sa.na??l, capital of Yemen. The journeys of General Haig in January 1887, of Professor Schweinfurth in 1888-89, and of Harris in 1892, have thrown some new light on the physiography of Yemen, and have added some interesting details to our previous knowledge of Sanaa. According to Haig, Sanaa is situated 140 miles to the north and east of the Red Sea port of Hodeida and 260 miles north of Aden. The co-ordinate position in latitude and longitude of Sanaa is most uncertain. The best authorities seem to agree that it is about 44?? 30′ E. and 15?? 20′ N., but these values have never been satisfactorily verified. Haig makes its altitude to be 7800 feet above sea-level, but Harris, following Glaser, fixes it at 7300. It is approached from the west by the Turkish military road from Hodeida, passing through a succession of steppes and gently sloping vaUeys, terraced and cultivated, between. low hiUs of trap, a faU. of 2000 feet occurring between the western plateau and the open plain of Sanaa.

Turkish occupation and misrule are the predominant features throughout the town. The fortress of Jebal Nigcim has been repaired, and from its citadel, on one of the spurs of the hill, the guns are significantly pointing into the streets of the city. There is much of the atmo- sphere of a second-class Egyptian port about Sanaa. Restaurants are to be found about the central square, and cafes adjoin the numerous khans or caravanserais. The old palace of the Imams, which is now occupied by the Turkish governor, is whitewashed, and the walls of its rooms are picked out with an inferior style of French, decoration. The most flourishing community in Sanaa, appear to be the Jews, of whom there are about 20,000 (the

total population is estimated at 45,000), who live on distinctly better terms with the Turks than the Arab in- habitants do. They possess 23 synagogues and 20 schools, with 700 boys in them. The whole male population can read, but few of the females. The boys are taught to be masons and artificers, and are preferred to jMahommedans as servants by the few Europeans who live at Sanaa. The pretentious stylo of the houses seems to have struck all travellers. They are often stone-built (in colour patterns) and three or four storeys high, the upper storeys projecting over the street, with long narrow windows filled in with.

stained glass. The streets of the bazaars are winding and narrow, and are arranged (as is usual in Asiatic towns) with reference to particular crafts and trades, each street main- taining its own special business. The manufacture of arms and jewellery, trade in silks and cottons, china, and hardware are all well represented, the jewellery (especially jewelled sheaths) being a speciality of Sanaa.

_ Authorities. ◆◆◆ Haio. H.O.S. Proceedings, vol. xi. ◆◆◆ Harris. Journey through Yemen. London, 1893. ◆◆◆ Schweinfurth. R.G.S. Proceedings, vol. xi. ◆◆◆ Kay. Omrah's History of Yemen. London, 1892.

San Antonio, a city of Texas, U.S.A., capital of Bexar county. It is the largest city in the state, and is situated in 29◆◆25' N., 98◆◆25' W., on the river San Antonio, at the mouth of the San Pedro, in the southern part of the state, at an altitude of 645 feet. The present city combines three different elements of growth : the old Mexican town, in the district known as Chihuahua, west of the San Pedro; San Antonio proper, including the business part of the city, between the rivers San Antonio and San Pedro, inhabited mainly by Americans ; and the portion east of the river San Antonio, settled mainly by Germans. The city has a level site on both banks of the river, its street plan is irregular, and it is divided into eight wards. It has an abundant water- supply from artesian wells and from the San Antonio, and it is well paved and sewered. It is the intersecting point

of four railways, the Galveston, Harrisburg, and San Antonio, the International and Great Northern, the San Antonio and Aransas Pass, and the San Antonio and Gulf, making it the most important commercial centre in this part of the state. Its manufacturing interests also are large. In 1900 the city contained 312 manufacturing establishments, with a total capital of $4,252,197. They employed 3073 hands, and the product was valued at $6,821,297. The assessed valuation of property, real and personal, for 1900, was $31,879,369, the net debt 12,015,449, and the rate of taxation $27.00 per $1000.

Within the city is a United States arsenal in spacious grounds, and a mile north of the city is a United States military post, known as Fort Sam Houston. The town contains many fine buildings and many historical relics. Among the former are the new court house, the city hall, and the cathedral of San Fernando. Among the latter the first in interest is the Alamo, an adobe church, which in the Texan War for Independence, in 1836, a garrison of 175 men defended for 12 days against the assaults of 4000 Mexicans, and finally perished to a man. In and about the city are several of the early Spanish mission buildings, still in a good state of preservation. The city is the site of St Louis College, a Roman Catholic institution, opened in 1894, which five years later had a faculty numbering 15 and was attended by 110 students. Population (1890), 37,673; (1900), 53,321, of whom 9348 were foreign -born and 7538 negroes.

San Antonio de lOS BariOS, a small Cuban town, vrith well-built houses, about 23 miles from Havana, on the road to Guanajay. It has mineral springs and baths, and is frequented as a summer resort by the people of Havana. The population in 1899 was 8178.

San Bernardino, a city of California, U.S. A., capital of San Bernardino county. It is situated in 34 ° 07', N., 117 ° 17' W., in the valley at the south base of the San Bernardino range, in southern California, at an altitude of 1048 feet. The broad streets are well shaded and bordered with the beautiful grounds of private resi- dences. It is on the Southern California and the Southern Pacific railways, in the fruit region of southern California,

and is surrounded by orange and lemon groves, which furnish a large part of its trade. Population (1890), 4012; (1900), 6150, of whom 873 were foreign-born and 166 coloured.

Sancti SpirituS, a Cuban city in Santa Ckra province, situated in the centre of a region principally devoted to grazing. It was one of the seven original municipalities founded by Diego Velasquez. The popular tion in 1899 was 12,696.

Sandbactl, a market-town, urban district (1894), and parish, Cheshire, England, in the Crewe parliamentary division of the county, 5 miles north-east of Crewe by rail, on the Trent and Mersey canal. The urban district council owns the water-works, constructed at a cost of ►►7000. In 1889 a town and market hall was erected at a cost of .►►5000, and in 1891 the old town-hall was demolished. The population of the urban district was in (1881), 5493; (1901), 5556.

Sandefjord, the oldest and most famous spa in Norway, county of Jarlsberg and Laurvik, 53 miles south- south-west of Christiania by rail, with sulphur and other baths and a bath-house. Population (1891), 4238 ; (1900),

4847.

Sandg'ate, a towa, railway station, and bathing- place, Kent, England, in the Eastern or St Augustine's parliamentary division of the county, 1^ miles west of Folkestone, and about 3 miles east of H3rthe with which it is connected by tramway (belonging to the South- Eastern and Chatham Railway) running along the shore. The camp of Shorncliffe, an important military station, lies north of the village on a plateau. It forms three sides of a square and can accommodate more than 5000 troops. A convalescent home with accommodation for 230 patients, erected at a cost of ►►20,000, was opened in 1897. The population of the urban district in 1891 was 1756, exclu- sive of 2822 officers and soldiers in camp; in 1901, 2023.

Sandhurst, a parish, Berkshire, England, in the Eastern or Wokingham parliamentary division of the county, 4 J miles south-east of Wokingham

by rail, and 1 J miles from Wellington College station. The Royal Military College was settled here in 1812 in beautiful park-like grounds. Population (1901), 2386.

Sandhurst. See Bendigo.

San Dieg'O, a city and seaport of Cahfornia, U.S.A., capital of San Diego county. It is situated on the Pacific coast, near the southern boundary of the state, on a harbour formed by a sand-spit from the south, the entrance being around its northern end. The site is nearly level, with a slight slope towards the harbour ; there is a water- supply as well as other municipal improvements. The principal railway to the city is the Southern California, in addition to which there are three small local lines of steam railway, besides troUey lines. On a sand-spit enclos- ing the harbour has sprung up, around the well-known Coronado hotel, a village of fine residences, known as Coronado. This is connected with the city on the main- land by ferry. Population (1890), 16,159 ; (1900), 17,700, of whom 3768 were foreign-born and 623 were coloured, including 313 negroes.

San do way, a district in the south of the Arakan division of Lower Burma. Population (1891) 78,425; (1901) 90,200. Area, 3784 square miles. Of the popu- lation in 1891, 69,250 were Buddhists and Jains; 3128 Mahommedans; 5452 aborigines, mostly Chins; 175 Hindus ; and 420 Christians, 384 of whom were natives. Of a total area of 2,421,760 acres, only 61,719 bore crops

in 1898-99, but 2,350,000 were uncultivable, and apart from fallow only 8233 were available for cultivation. The rainfall in 1898-99 was 21 7 '7 inches. Except 1974 acres of tobacco, all the cultivation is rice. The chief town, Sandoway, had a population in 1891 of 2537 persons. It has a municipal committee of eight members, six of whom are elective, four being Burmese and two Mussulmans.

Scindur, or Sundooe, a petty state of southern India, surrounded by the Madras district of Bellary. Area, 161 square miles. Population (1891), 11,388; (1901), 11,205. The chief, whose title is Kaja, is a Maratha, tracing back his descent to the 17th century. In 1897-98 the estimated gross revenue was Es.50,000. On the western border is a hill range of the same name, which contains the military sanitarium of Kamanmalai.

Sandusky, a city of Ohio, U.S.A., the capital of Erie county. It is situated in 41 32' N., 82 42' W., on Sandusky Bay, an arm of Lake Erie, in the northern part of the state, at an altitude of 596 feet. It has broad streets, and a good water -supply and sewerage systems. It is traversed by five railways, the Baltimore and Ohio, the Cleveland, Cincinnati, Chicago, and St Louis, the Columbus, Sandusky, and Hocking, the Lake Erie and Western, and the Lake Shore and Michigan Southern. These, with vessels on the Lakes, give the city a large commerce, particularly in coal, iron-ore, grain, fruit, and fish. Its manufactures are not large, and consist in great part of agricultural implements. Population (1890), 18,471; (1900), 19,664, of whom 4002 were foreign- born and 295 negroes.

Scindwich, a municipal borough, cinque port, and market-town in the St Augustine parliamentary division of Kent, England, on the Stour, 5 miles north of Deal, with a station on the South-Eastern and Chatham Kail- way. St Peter's church has been restored and modern grammar-school buildings have been erected. Corporation water-works were constructed in 1894. The St George's golf-links are amongst the finest in England, and are one of the three upon which the Championship contests are held. Area, 756 acres. Population (1881), 2846; (1901),

3174.

Sandys, Frederick (1832), English

painter and draughtsman, was born at Norwich on 1st May 1832, and received his earliest lessons in art from his father, who was himself a painter. His early studies show that he had a natural gift for careful and beautiful draw- ing, and that he sought after absolute sincerity of present-ment. It was to be expected, therefore, that he would sooner or later join

*himself to those who were associated ***with the Pre-Kaphaelite Brotherhood, the one great move- ment in British art during the 19th century. At an early gathering of the P.-R. B. in 1848 Millais showed, as examples of sound work, engravings after the frescoes in the Campo Santo at Pisa by Orcagna, Benozzo Gozzoli, and other painters of the quattrocento, and said, " This is what the Pre-Raphaelite clique should follow." Sandys worked along the same lines as Millais, Madox Brown, Holman Hunt, and Rossetti, and it was not long before he was recognized as one of the most promising of the young artists of the day. He first met Rossetti in 1857, and carried away ***with him the impression of the painter-poet's features, which he reproduced so cleverly in " A Nightmare," a caricature of "Sir Isuml)ras at the Ford," by l\lillais. Both the picture and the skit \\icin it by Sandys attracted much attention in 1857. The caricaturist turned the horso of Sir Isumbras into a donkey labelled "J. R., Oxon." (John Euskin). Upon it were seated Millais himself *** an excellent likeness of him in his handsome youth *** in the*

*character of the knight, ***with Rossetti and Holman Hunt as the two children, one before and one behind. The humour was chiefly directed against Ruskin, but all con- cerned took it in good part. Rossetti and Sandys, in fact, became intimate friends, and for about a year and a quarter, ending in the summer of 1867, Sandys lived with Rossetti as one of his numerous guests at Tudor House (now called Queen's House), in Cheyne Walk, Chelsea. By this time Sandys was known as a painter of remarkable gifts. He had begun by drawing for Once a Week, the Cornhill Magazine, Good Words, and the other periodicals which contained the best illustration work that has ever been done in England. Among the men who were then drawing for woodcuts, and creating a body of work which was not until long afterwards recognized at its full worth, 'Sandys took a leading place. He drew only in the magazines. No books illustrated by him can be traced. So his exquisite draughtsmanship has to be sought for in the old bound-up periodical volumes which are now hunted by collectors, or in publications such as Dalziel's Bible Gallery and the Cornhill Gallery and books of drawings, with verses attached to them, made to lie upon the draw- ing-room tables of those who had for the most part no idea of their merits. Every drawing Sandys*

made was a work of art, and many of them were so faithfully engraved that they are worthy of the collector's portfolio. Early in the 'sixties he began to exhibit the paintings which introduced him to a ???wider public and set the seal upon his fame. The best known of these are "Vivien," "Morgan le Fay," "Cassandra," and "Medea."

The rejection of " Medea " by the hanging committee of the Royal Academy aroused Rossetti to burning indig- nation. In a letter of April 1868 he ???wrote: " Sandy s's picture of Medea has been turned out of the R.A. ??? a most disgraceful affair." However, it was exhibited in the following year and won the warm admiration of the judicious. Sandys never became a popular painter. His imagination was too fine for that. He painted httle, and the dominant influence upon his art was the influence exercised by lofty conceptions of tragic power. There was in it a sombre intensity and an almost stern beauty which lifted it far above the ideals of the crowd. ^Vhen he chose classic subjects, he treated them with Gothic freedom from convention and with a passionate determination to lay bare the human soul. The Scandinavian Sagas and the Morte W Arthur gave him subjects after his own heart. " The Valkyrie " and " Morgan le Fay " represent his work at its very best. His portraits also had qualities far more in common with Gothic art than with any other school. His oil-paintings were of a marvellous fidelity, and have been said to be the finest in their way seen in England since the days of Holbein. He made as ???ncll a number of chalk drawings of famous men of letters, including Tennyson, Browning, Jlatthew Arnold, and James Russell Lowell.

See al.so Esther Wood. The Arlist ("Winter number), 1896, finely illustrated ; which also refers to some other sources of information concerning Sandys.

Sa.n Fernando, a town of Spain, province of Cadiz, south-east of the capital, with a station on the Seville to Cadiz Railway. Population (1887), 23,756 ; (1897), 28,951. There are a very handsome, large town- hall, several storeys high, with marble staircases and stately columns, a good hospital for both sexes, a bull-ring, and a fish-market. The place is famous for its private schools and academies, which]irejiare boys for the

navy. Between San Fernando and Puerto Real there is a tract of country studded with gardens, vineyards, and stone quarries. In this region is the arsenal of La Carraca. The principal local industries are salt, alcohol, liqueurs, starch, beer, tanneries, esparto grass rugs, soap, hats.

SAN FBANCISCO

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There are many flour-mills, and manufactures of rope, sails, and barrels.

San Francisco, the 9th city in size in the United States and the metropolis of California and of the Pacific coast, is situated in 37 ° 47′ 22-55″ N. and 122 ° 25′ 40‘76″ W. Important changes in form of government, the coming of additional transcontinental railways, the Oriental outlook, caused by the control of the Philippine Islands by the United States, the increased trade with China, Japan, and the islands of the Pacific, caused a remarkable development during the last years of the 19 th century.

Topography. ° ° ° Within the decade from 1890 ta^ 1900 the Golden Gate, or entrance to the harbour, was fortified in the most approved modern manner. Within the ba^ several islands are controlled by the Government, and fortified, while at the Government navy yard at Mare Island, north of the city, and at the Union ironworks, on the peninsula, are docks capable of receiving the largest modern warships. Suburban communities have grown up about the city, chief among which are Oakland, Alameda, Berkeley, San Kafael, Sausalito, San Mateo, Menlo Park, and Palo Alto. Electric and steam railways and ferries bring these places into close communication with the city. There are in the city over 140 miles of electric railways, 77 miles of cable roads, 12 miles of the steam system, and 10 miles of horse railways. The steep hills caused the invention here of the cable railway, now used in many cities of the world. Market Street is the artery from which diverge all the principal streets. It is paved with bituminous rock, material used largely for all the streets. The city has 195 miles of paved streets and 305 miles of sewers. In the early days the number of wooden dwell- ings was considerable, but builders are no longer hampered by the fear of earthquakes. Brick and stone are exten- sively employed, excellent stone being found in the Sierra

and the Coast range, and business buildings of ten and eleven storeys or higher have been erected. Among the notable modern buildings are the United States post ofiice, the Ferry building, Mills building, Spreckels building, hall of justice, hotel St Francis, mutual savings bank, and the Crocker building.

Population. ❖❖❖ The population in 1890 was 298,997 and in 1900, 342,782, of whom 116,885 were foreign-born, and 17,404 were coloured, including a large proportion of Chinese; 1654 were negroes. Out of 128,985 adult males, 3596 were illiterate (unable to write), of whom 3354 were foreign-born. The death-rate in 1890 was 22‘5, in 1900 it was 20-5.

Education, Libraries, Newspapers. ❖❖❖ There are ten daily newspapers. Three morning and two evening papers are in the English language, the others represent the interests of the foreign population and of commerce and trade. There are six first-class theatres. The chief libraries are the Free Public Library of 143,000 volumes, and those of the Mechanics’ Institute and the Mercantile Library Association. The private libraries of the late Adolph Sutro and of Hubert Howe Bancroft contain collections of rare books and pamphlets, including volumes relating especially to the history and development of the Pacific coast. The Free Library has six branches in various parts of the city, and circulated in the year ending 30th June 1901, 711,409 books. Chief among the museums are those of the Academy of Sciences, the State Mining Bureau, the State Board of Trade, and the Alaska collec- tion, the last named controlled by the university of California. There is also a nucleus of an excellent museum owned by the city and situated in Golden Gate Park, the result of the California Midwinter Fair, a successful exhibi-

tion held there in 1894, following the World’s Fair at Chicago. There are 82 public schools, with 1017 teachers, a total enrolment of 48,517 pupils (30th June 1901), with average daily attendance of 34,771. The university of California, a state institution at Berkeley, an hour’s ride from San Francisco, and the Leland Stanford, Jr. University, at Palo Alto, south of the city, aiford excep- tional advantages for advanced education. The university of California has its departments of medicine, law, phar- macy, and dentistry, and the Mark Hopkins Institute of Arts and other minor

departments situated in the city. The city has in all 1 1 medical and dental colleges. There are 145 churches of all denominations, 102 charitable and benefit organizations, and 44 hospitals and asylums.

Mmmfactures and Commerce. ??? For the year ending 30th June 1901 the chief manufactures, with tlie value of the product, were as follows : ???Bookbinderies $800,000, breweries 14,000,000, coffee and chocolate, $2,200,000, confectionery $700,000, cigars $2,000,000, crackers $1,750,000, chemicals $1,500,000, clothing $1,500,000, electrical $3,750,000, flour $3,000,000, fruit-canning $3,700,000, gas $4,500,000, glass $1,300,000, millinery $810,000, provisions $3,500,000, shirts $1,700,000, ships $3,000,000, shoes $2,300,000, sugar $14,211,516, tanneries $1,310,000, tinware $1,750,000, wire $1,500,000, wool-soouring $2,000,000.

The harbour and its branches are such that deep-water ships may go directly to docks within short distances of their source of supply, saving large cost of loading. The import of tea in 1890 was valued at $923,025 ; in 1899 the valuation had risen to $1,233,857, repre- senting an import of 10,370,630 lb ; 1900, 13,417,970 lb. During the year ending 30th June 1901 wheat exports were 13,262,796 bushels, valued at $8,232,916, and wheat flour exports for the same period were valued at $3,083,532. The exports of treasure by sea, 1901, were $4,330,308, and the imports $28,649,923. The total merchandise exports for 1901 were valued at $34,596,792, of which $11,316,448 were wheat and flour. The total imports for 1901 were $35,161,753.

Railways, Banks, and Finances. ??? The city is connected with the Eastern states by three through overland railways, the Central Pacific, the Southern Pacific (which controls the Central Pacific), and the Atchison, Topeka and Santa Fe routes. Besides these, it has trafBc connexions with the Canadian Pacific, Northern Pacific, and Great Northern transcontinental roads. Lines of the Southern Pacific and its branches connect the whole state with the city, besides the smaller lines of the California North-Western and other roads that penetrate the agricultural, mining, and lumbering dis- tricts. On 1st July 1900 the first train of the Santa F^ Railway left San Francisco for the east, a significant event,

since there had been practically but one railway corporation (the Southern Pacific Company) controlling transcontinental traffic, with San Francisco as its western terminus, since the first overland road was completed in 1869. The construction of the Santa Fe was the outgrowth of the building of the San Joaquin Valley Railway, to which citizens subscribed $2,500,000.

There are 38 banks. The total clearings in 1890 were $851,066,172 ; in 1895 they were $692,079,240. In 1899 they were $955,851,466, an increase of $143,638,308 over 1898. In 1901, they were $1,165,301,561. In the nine savings banks of the city there was due to depositors on 11th August 1900, $120,480,927. The United States mint during 1899 coined $63,254,886 ; since the mint was established in 1854 the total coinage has been $1,206,122,701.

The assessed valuation of real and personal property in 1901 was $413,388,420, of which the former amounted to $289,970,519 and the latter to $123,417,901. Property is assessed at 60 to 80 per cent, of its value. The tax rate is $1,556 on the hundred dollars. The city's net debt (funded and floating, less sinking fund) was on 30th June 1902 only $17,185.77.

Administration. ❓❓❓ After many years of notorions "Boss" rule the city in 1896 elected a reform mayor. This was the most im- portant movement for good government in the history of the city since the vigilance committee of 1856. It was followed by the adoption (1899) of a new charter, formed by a board of freeholders, and based upon the most approved models of modern municipal government. The city's control is centralized, giving more power to the mayor, who has the appointment and removal of the follow- ing commissions ❓❓❓ fire, police, school, election, park, civil service, health, and public works. The principle of the "initiative and referendum " was incorporated in the charter, by which a percent- age of the voters can compel the submission of measures for public approval. There are 12 departments of the superior court, 5 justices' courts, and 4 police courts. The board of supervisors has 18 members. The board of education has 4 members. There is a paid fire department of 446 members ; the police department

has 588 members, with provision for an increase of one ofBoer for each 500 of the population. The board of public works controls the streets, sewers, and public improvements of the city, and is composed of engineers of recognized standing. The water-supply is excellent, beiug furnished by a private corporation, but the city plans for the ownership of its water and lighting system.

(j: D. p.)

Sa.n Germa,n, a primitive and decadent inland city- near the west end of the south coast of Porto Eico, settled in 1511. It is a picturesque place with narrow streets, churches, and convents, largely constructed in the 16th century. It has several religious retreats and hermitages, which are frequented by the devout. The population in 1899 was 3954.

Sa.n Gimig'na.nO, a town of the province of Siena, Tuscany, Italy, 24 miles north-west of Siena (16 by rail to Poggibonsi), at an elevation of 1181 feet. Being surrounded by its ancient walls, and retaining thirteen out of its original fifty towers, it is, with its predominantly Gothic architecture, a thoroughly mediaeval-looking town. The most noteworthy of the public buildings are the town-hall (1288-1323), with a museum, and paintings by Benozzo Gozzoli, Sodoma, and others ; the cathedral, with fine frescoes by Ghirlandajo (1475) ; the church of S. Agostino, with famous frescoes (1463-65) by Gozzoli ; other churches of the 12th and l3th centuries; and a small public library. Population of commune (1881), 8524; (1901), about 9000.

San Giovanni a Teduccio, a town of the

province of Naples, Campania, Italy, on the east shore of the Bay of Naples, and at the foot of Mount Vesuvius, 3 miles south-east of Naples by the railway to Salerno. It has railway workshops, iron and zinc works,

flour-mills, distilleries, tanneries, and macaroni factories. Iron is mined here. There is a school of design and the mechanical arts. Population (1881), 14,397 ; (1899), about 18,000.

Sang^lii a native state of India, in the Deccan division of Bombay, ranking as one of the Southern Maratha Jagirs. The territory is widely scattered among other native states and British districts. Area, 1083 square miles. Population (1881), 196,832; (1891), 238,945; gross revenue (1897-98), Ks.11,75,800; tribute, Es. 1,35,000; number of police, 782; number of schools, 101, with 7043 pupils. The chief, whose title is Tatya Saheb Patwardhan, is a Brahman by caste. The town of Sangli is situated in 16►►51' N. and 74►►36', E., on the river Kistna, and has a station on the Southern Maratha Eailway, 11 miles from Miraj junction. Population (1881), 13,272; (1891), 14,798; municipal income (1897-98), Rs.10,341. There is a high school, and state printing- press, issuing a monthly gazette.

San Jose, a city of California, U.S.A., capital of Santa Clara county. It is situated in 37►►20' N. and 121►►53 W., in the beautiful Santa Clara valley, which lies between two of the coast ranges. It is 46 miles south-east of San Francisco, and at an altitude of 87 feet. The site is level, vsdth broad streets well shaded with semi-tropical vegetation. It has excellent water-supply and sewerage systems. The city is upon lines of the Southern Pacific Railroad, connecting it with San Fran- cisco, Monterey, and other points. The Santa Clara valley is one of the most fertile and most productive of the fruit regions of California, and the chief business of San Jose is the treatment, handling, and marketing of its fruit crop. Population (1890), 18,060 ; (1900), 21,500, of whom 4577 were foreign-born and 810 were coloured, including 209 negroes.

San Jos4 de Costa Rica, the capital of the

republic of Costa Rica, situated in 9►►56' N. and 84►► W.

Population (1897), 25,000. Altitude above sea-level, 3868 feet. It is connected with Port Limon by a railway. The city is well laid out and paved, and has many fine build- ings and public gardens. It possesses a

national theatre, numerous charitable institutions, a museum, public library, and a number of learned societies.

San Juan, the fuU name of which is San Juan Bautista de Puerto Rico, a city on the northern coast of Porto Eico, on a small and narrow island which is united to the mainland by the bridge of San Antonio. It is the political capital of Porto Eico, and is known throughout the country as "El Capital." The city was founded about 1577 by Governor Juan Ponce de Leon. It is chiefly noteworthy for its fortifications and public buildings. A strong mediaeval wall faces the land, and steep fortified cliffs overlook the sea. The fine strongholds include the Morro at the entrance of the harbour. Forts Santa Elena and San German, and the citadel of San Cristobal, which overshadows the city and commands the sea front. There are many large and handsome public edifices, including all the island administration buildings, the captain- general's palace, the casa de ajnintamiento municipal (city hall), the barracks of Ballaja, the artillery barracks, and the casa blanca, which is said to have been built by Ponce de Leon. As building space is scarce, the houses are all two or three storeys high. The streets and public plazas are neatly paved. The harbour is capacious and landlocked, except on the north. A highway running across the island from north to south connects San Juan with Ponce. The city is purely a political and social capital, and not a distributing or commercial centre, except for a small surrounding local area. Population (1899),

32,048.

San Lucar de Barrameda, a town of the

province of Cadiz, Spain, near the mouth of the Guadal- quivir, on the railway from Bonanza to Jerez. . The town has an active trade in wines and agricultural products. Population (1887), 22,667 ; (1897), 23,377. The town is divided into two parts, Alta and Baja, the former being the older and crowned with the ruins of a strong castle. Besides the old parish church, there are the palace of the dukes of Medina Sidonia and several convents, and in both church and palace there are interesting pictures and works of art. There are good schools, chiefly directed by religious Orders. In 1898, 232 English steamers, of 194,854 tons, entered Bonanza,

the port of San Lucar. The chief imports were coal from England, sulphur and dry vegetables from France ; the exports, salt, oats, wine, and fruit.

San Luis, a city in Brazil, and capital of the state of Maranhao. It is well built, and has fine public build- ings and gardens, an episcopal palace, and thirteen churches. Population, 38,000.

San Luis, interior town of Santiago province, Cuba, about 25 miles from Santiago. It is the terminus of the railway leading from that city across the Sierra Maestro to the thickly populated district of Cauto valley. The population in 1899 was 5059.

San Luis Potosi, a state of Mexico, bounded on the N. by the state of Coahuila ; on the S. by those of Hidalgo, Queretaro, and Guanajuato; on the E. by Vera Cruz, Tamaulipas, and Nuevo Leon ; on the W. by Zacatecas. Area, 25,323 square miles. Population (1879), 516,486; (1895), 568,449. The state is noted for the salubrity of its climate, being high and dry on the table- lands, and is rich in agricultural and mineral resources. The Mexican National Eailway traverses the state from

north to bouth, and the Mexican Central Railway from east to west. The internal commerce is very extensive. It is one of the most progressive states of the Mexican Republic, and agriculture and mining are in a flourishing condition. Stock-raising is also extensively carried on. The principal agricultural products are cereals, sugar-cane, coffee, oranges, and tropical fruits. The value of the agri- cultural produce of this state in 1897 was $3,834,541. Some of the richest silver mines in the republic are found in the mining district of Catorce. The value of the mineral products in 1897 was $3,105,941. The state is divided into thirteen districts or partidos. San Luis Potosi, the capital, population in 1895, 69,050, is one of the most im- portant cities of the republic. It is at an altitude of 1810 metres above sea-level, and is noted for its fine public buildings and churches. It is also one of the smelting centres, large quantities of

argentiferous lead and gold-bear- ing ores being sent there for reduction. The chief towns in the state are Matehuala (13,101), Catorce (9547), Rio Verde (6628), Santa Maria del Rio (6589), Cedral (6333), Yenado (5750), Soledad Diez Gutierrez (5730).

Scin Ma,rinO, the smallest republic in the world ??? its boundary-line measures about 18|- miles. It lies about the three peaks, together known as Monte Titano, which terminate the Apennines towards Rimini. It is enclosed on all sides by Italian territory, but maintains complete independence, and treats with Italy as one sovereign Power with another. During the twenty-five years 1874-99 the population increased from 7816 to 11,000, or more than 40 per cent., and San Marino is now relatively the most thickly populated country in Europe, having in 1899, on an average, 443 inhabitants to the square mile. It is divided into eight parishes : Pieve (in which stands the Cittd or town), Serravalle, Montegiardino, Faetano, Fioren- tino, Chiesanuova, Domagnano, and Aquaviva.

Though the government is now conducted by a council of sixty, it was originally purely democratic, public business being transacted by the "fathers of families" at a mass meeting known as the "Arengo." This mass meeting is still held twice a year, when the retiring captains-regent (two in number) give place to those newly elected. The captains-regent have no executive power ; they are merely the representatives of the council. The meetings of the latter are held whenever necessary. Its debates are earned on with closed doors in the main hall of the Government palace, which was restored in 1894, and. is a fine specimen of mediseval architecture. Justice is administered by a legal commissary who resides in the republic, and must be an Italian. Three years is the term of office, and it may be renewed. Like the captains- regent, the commissary is answerable to the great council. Two judges, one of appeal, reside in the kingdom of Italy, and send their judicial sentences to be read before the council. Capital punishment was abolished within the republic in 1848, and in 1865 a, penal code was promulgated. The civil legislation is mainly contained in the ancient statutes, but there are a few additional laws : a bill relating to mortgages (1354), a, short modern code concerning bills of exchange, and some fiscal laws dealing with stamp duties, &c. Taxation is so slight as to be practically non-existent, the two

most important taxes being those of 1 per cent, (about) on country property and f per cent, on town property. The revenue ranges from 350,000 lire to 450,000 lire (??14,000 to ??18,000). There is no public debt, but for the last few years of the 19th century the Budgets showed a deficit. It has been proposed to levy fresh taxes, but the council has refused to vote them. San Marino possesses an army of 900 men and 60 officers, but the military spirit is lacking among the people, and it is only on high days and holidays that the troops, with their excellent military band, are called on for service. Attendant on the council is the Guardia Nobile, with picturesque uniform. The carabineers must be foreigners. Trade is carried on by means of large fairs, there being no railway nearer than Rimini. Among the exports are oxen, corn, wine, and building-stone, while the imports include all the manufactured goods used by the inhabitants. BuUding-stone, which is the almost only source of mineral wealth possessed by Sau Marino, is extracted around the Citta, or town, the central point about which is gathered the historical interest of the republic. Small deposits of chalk, sulphur, and iron are found in various places, and Valle Sant' Anastasio is known for its

mineral waters. San Marino has a coinage of its own, but Italian money is used by preference. It has hitherto retained its own intricate system of weights and measures, and issues a complete set of stamps. Public charity is widely distributed, and there is an excellent hospital and refuge, the operating-room in which has been lately furnished with modern appliances. Three doctors and a qualified surgeon, all foreigners, are maintained at the expense of the State.

The Italo-Sanmarinese Treaty, renewed in 1896, is on the same basis as before the renewal. Thereby either State recognizes the validity of contracts by deed signed in the other, and promises to grant extradition for criminal (not political) offences, provided that the criminal be not a citizen of the State in which he shall have taken ref'nge, nor have been domiciled there for a, space of ten years. In 1899 San Marino couoluded a similar extradition treaty with England. The republic exercises its right of repre- sentation by consuls and chargfe d'affaires, having representatives in London, Paris, Vienna, Budapest, and several Italian cities (Rome, Naples, &c.).

AuTHOKiTiBS. ❓❓❓ ^TuoKBK. The Republic of San Marino. Cambridge, 1880. ❓❓❓ Malagola. II Cardinal Alberoni e la Republica di San Mariiw. Bologna, 1886. ❓❓❓ P. DB Cazeneuve. San Marirw. P❓❓ris, 1887. ❓❓❓ Fattoki 0. H palaixx) ecc. ZanicheUi, 1894. ❓❓❓ AsTEAUDO Balme e Galati. Dizionario della Republica di San Marino. Paris, 1899. ❓❓❓ Gwinnee. Die Republik San Marino. Augsburg, 1899. ❓❓❓ Giansini. La Costituzione di San Marino. Naples, 1899. La Repuhli/jiie de San Marino. Paris, 1899. "The Legal Aspect of San ilarino," Law Magazine and Review. November, 1899. Procedura civile della Rep. di S. Marino. Firenze, 1901. (t. C. G.)

San Migfuel, a city of Central America, in the republic of Salvador, about three-quarters of a mile from the right bank of the Rio Grande and 107 miles east of the capital, at an altitude of 360 feet above sea-level. It is the 3rd city in importance as to population, having about 25,000 inhabitants, and is a handsome town, with fine buildings and streets, and transacts considerable foreign trade. It is not deemed healthy, being exposed to malarial exhalations arising from the swamps to the south-east.

San Miguel de Mayumo, a town in the

northern part of the province of Bulacan, Luzon, Philippine Islands. It has a cool and very healthy climate, com- mands a beautiful view of the surrounding country, and was one of the finest provincial towns in the Philippines until its principal buildings were destroyed in a fire started by a band of thieves in 1901. Near the town are quarries of limestone, and the agricultural lands in its vicinity produce rice, sugar-cane, Indian com, and cotton in abundance. Cotton fabrics are woven in con- siderable quantity by the women ; and there are a few good cabinet workers, who utilize the beautiful hard woods of the neighbouring forests in their work. The principal language is Tagalog. Population, 20,000.

San MiniatO, a tovm and episcopal see of the province of Florence, Tuscany, Italy, 21 miles west by south of Florence by the railway to Pisa. Its cathedral dates from the 10th century. It manufactures glass, olive oil, leather, and hats. It is notable as the cradle of the Bonaparte family. Population (1881), 7271 ; (1899), about 8000.

San Pablo, a tovm in the southern part of the province of Laguna, Luzon, Philippine Islands. Its people engage in agriculture ❓❓❓ rice, abaci, and copra being the principal crops raised. The language is Tagalog. Popu- lation, 19,000.

San Remo, a famous seaside resort of the province of Porto Maurizio, Liguria, Italy, on the coast of the west Riviera, 84 miles by raU south-west of Genoa and 32 east- north-east of Nice. It has come into increased repute since the stay there in 1887-88 of the German Emperor Frederick III. In 1898-99 the visitors numbered 21,850. A new casino was opened in 1888. There is a meteoro-

logical observatory. Flowers, especially roses and carna- tions, are extensively grown for export. Olives, lemons, and palms are also reared. The port is shallow, despite dredging in 1896-97, and exposed to east winds. Popula- tion (1881), 14,002; (official estimate, 1897), 19,636.

S❓❓in Roque, a town of the province of Cadiz, Spain, near the northern shore of the bay of Algeoiras, with a station on the railway to that place. The country around San Eoque is hilly and watered by the river Guadarrunque and the Guadiaro to the north. The neighbourhood produces wheat, wine, fruit, olives, oranges, cork, and the local industries are alcohol, liqueurs, starch, flour, tanneries. The town looks clean and modern. Its streets are steep, and from the heights there is a splendid view of the bay and straits. The fortifications were razed after the War of Independence against Napoleon I. Popu- lation (1887), 8792; (1897), 7809.

Sa.n Salvador, a city in Central America and the capital of the republic of Salvador, in the valley of Las Hamacas, on the river Acelhuate, in 13❓❓ 45′ N. and 80❓❓ 8′ W., at an altitude of 2115 feet above sea- leveL Population (1892), 30,000. It was founded by Jorge de Alvarado in 1528 at a spot a short distance from the present site, to which it was transferred in 1539. From 1834 to 1839 it was the capital of the republic. Then for a

year the chief town was San Vicente. Since 1840 it has remained the capital. Besides aU the offices of government, the city has a university, an academy of science and belles-lettres, a national library, an astronomical observatory, a museum, botanical garden, a national insti- tute, polytechnic school, the Eosales hospital, an asylum and poorhouse, orphanage, &c. Considerable commerce and manufactures are carried on. The city has in the past often suffered from earthquakes ; but a Style of build- ing has been adopted with a view to preventing serious damage to the structures. The railway connecting the capital with the port of Acajutala on the Pacific was opened to traffic on 19th March 1900.

San Salvador Island. See Bahamas.

San Sebastian, capital of the province of Guipuzcoa, Spain, the summer residence of the court since 1886. The influx of visitors, attracted by the presence of the court, and by the prolonged local festivi- ties, the bull-fights, the handsome casino and gambling- rooms, increases the permanent population by about twelve thousand to fifteen thousand. Fixed population, 21,355 in 1877; 35,975 in 1897. Until very modern times, San Sebastian was a walled and fortified town. On the hill still stand the castle of La Mota and the batteries and redoubts of both slopes of Monte UrguU. The bull-ring, in Moorish style, will hold 10,000. The new town of San Sebastian begins at the Alameda boulevard on the site of the old fortifications, and occupies the greater part of the peninsula that lies between the river Urumea and the Bay of La Concha. In the new town a fine church and markets have been built since 1895, and a Jesuit college and chapel. On the opposite side of Concha Bay, on the brow of a hill, stands the Queen's summer palace of Miramar in well laid-out grounds. The palace is not remarkable for its architecture, being a chalet-like irregular building, which, however, cost more than ??85,000. In few Spanish towns has more been done to improve public education and with better results than in San Sebastian. The industries of the town have developed, and there are many breweries, saw and flour mills, manufactures of preserves, soap, candles, glass, paper, especially in the busy suburb that has sprung up on the right bank of the Urumea, connected with San

Sebastian by a fine stone bridge and a wooden bridge. The fisheries are important.

Santa Ana, a city of Salvador and capital of the department of the same name, about 50 miles north-east of the city of San Salvador, and at an elevation of 2093 feet above sea-level. It is a finely built city, the largest in Salvador, its population being about 33,000. Santa Ana has a number of fine public buUdings, the municipal palace, barracks, hospital, public market, being the most noteworthy. The city is well supplied with water, and has wide and well-paved streets. It was connected in 1899 by a telegraph line with the capital, and the railway between the two cities was opened to traffic on 19th. March 1900. An institute has also been founded.

Santa Ana, a city of California, U.S.A., capital of Orange county. It is in the southern part of the state, 33 miles south-east of Los Angeles, on the Southern California and the Southern Pacific railways, at an alti- tude of 135 feet. It is in the orange, lemon, and wine region of southern California, and its industries are con- nected with the handling and transportation of these products. Population (1890), 3628; (1900), 4933, of whom 506 were foreign-born.

Santa Barbara, a city of California, U.S.A., capital of Santa Barbara county. It is on the coast, in the southern part of the state, at the southern foot of the Santa Inez Mountains, and is reached by a branch of the Southern Pacific Railroad. On account of its mild and equable climate, it has become a well-known winter resort. The Spanish mission, founded in 1786, is near the city, and is stiU well preserved. Population (1890), 5864; (1900), 6587, of whom 1143 were foreign- born and 269 coloured.

Santa Catharina, an Atlantic state of Brazil, between 26 30' and 29 18' S. and 48 18' and 54 12' W. Area, 27,434 square miles. Population in 1890, 283,770; in 1900, estimated at 320,000. It is bounded on the N. by Parana, on the W. by the Argentine republic, on the S. by Rio Grande do Sul, and on the E. by the Atlantic. Coal, iron, silver, gold, and petroleum are found in the state, but very little is extracted. The capital, Desterro, officially called Florianopolis, has a population of about 25,000. Its trade is effected through the port of Sao Francisco.

Amongst other towns are Lages, Laguna, Sao Francisco, San Jos6, and Tubarao.

Santa Clara, the capital of Santa Clara province, Cuba, an old town in the interior, founded in 1689. It is surrounded by fertile plains cultivated in cane, which are interspersed with many picturesque hiUs, and is the eastern terminus of the railway system from Havana. Population

(1899), 13,763.

Santa Cruz, a city of California, U.S.A., capital of Santa Cruz cou.nty. It is on the north side of Monterey Bay, and on a branch of the Southern Pacific Railroad, 75 miles south of San Francisco. It is a popular seaside resort. The city has asphalt pavements, water-works, a sewerage system, and several large hotels. It is built on the site of the old Santa Cruz mission, founded in 1791. Population (1890), 5596; (1900), 5659, of whom 1123 were foreign-born, and 189 were coloured.

Santa Fd, a province in the centre of the Argentine republic, bounded on the N. by the territory of Chaco, on the S. by Buenos Aires, on the E. by Entre Rios and Corrientes, and on the W. by Cordoba and Santiago del Estero. Official area at the census of 1895, 50,916 square miles. Population (1869), 89,117; (1895), 397,188, or an increase of 3457 per thousand. The

province is divided into 18 departments. In 1895 there were 19,809 farms, 3,688,118 acres planted in cereals, 2,315,007 head of cattle, 422,101 horses, 1,988,777 sheep. Santa ❓❓6, the capital, stands near the junction of the Salada with the Parana, 299 miles north-west of Buenos Aires by rail. The town has quite a modern appearance, and the population (24,755) has more than doubled. There is a normal school for teachers. Three tramways run through the city. The building of small trading vessels is one of the chief industries.

Santa, F6, a city of New Mexico, U.S.A., capital of Santa F& county and of the Territory. It is situated in 35 42′ N. and 105 57′ W., on a plain at the west base of the Sangre de Cristo range, north of the centre of the Territory, at an altitude of 6954 feet. The site is nearly level, with a gentle slope to the west, but the town is very irregular in plan, having been laid out centuries ago by the Spaniards, and having undergone little change since it came within the United States. It is the meeting-point of a branch of the Atchison, Topeka, and Santa & and of the Denver and Kio Grande railways, but being off the direct line of travel and traffic, it has made no progress. Population (1890), 6185 ; (1900), 5603, of whom 256 were foreign-born.

Santa. Maria, a tovm of the province of Caserta, Campania, Italy, 4 miles west of Caserta, occupying the site of the ancient Capua. It has a cathedral (restored) and a technical school. Glass, bricks, ropes, and leather are manufactured. Population (1881), 17,896; (1900), about 20,000.

Santa Maura. See Greece (Ionian Islands).

Santander, a province on the north coast of Spain. Area, 2113 square miles. Population in 1887, 244,274, and 263,673 in 1897.' The average of births is 3”63 per cent., that of deaths 3‘02, and the proportion of illegitimate births 4‘60 per cent. The province is traversed by several railways, and possesses besides many good state, provincial, and municipal roads, and several narrow-gauge mining railways. The industries, up to the eve of the loss of the islands of Cuba and Puerto Kico in the Spanish – American war in 1898, had steadily increased, except the glass and crystal factories, which decayed rapidly from 1886. Beer is brewed in large quantity. Salt and tinned fish are extensively prepared for export. The export and coasting trade is chiefly carried on through the ports of Santander, Suances, Santona, and Castro Urdiales. A hardy race of seamen mans the fishing fleet at these four ports and many small places along the coast, and there are numerous industries connected with the fisheries. The people have shown considerable energy iu agriculture, sylviculture, and mining, but have been greatly assisted by foreign capital and enterprise.

In 1897 wheat was grown on 11,272 acres, rye, barley, oats, maize, on 42,957, pod fruit on 4500, vine on 3000. Live stock is both abundant and valuable, especially in the highlands of Santander. In 1897 there were 516,089 head registered, including 5377 horses, 1092 mules, 2228 asses, 193,392 cattle, 178,549 sheep, 65,937 goats, 69,514 pigs. The mining interests are important, and were much developed in the last decade of the 19th century. Thirty-five zinc, 1 graphite, 31 iron, 1 lignite, and 1 salt mines are worked. These mines give emjiloyment to 4773 hands, and the output in 1898 was 34,416 tons of zinc, 756,165 tons of iron- ore, 352 tons of lignite, 356 tons of lead (from the zinc mines), and 130 tons of salt. The production of calamine was 33,484 tons, valued at ––46,034, chiefly at Eeooin ; and the Castro Urdiales mines alone produced 188,840 tons of iron-ore.

Santander, capital of the above province and one of the most important ports of the peninsula. It is the terminus of the railway from Madrid and Palencia,

and of the Bilbao-Santander coast line and several pro- vincial and mining lines. Population, 42,725 in 1887; 50,640 in 1897. The industries, the trade and fisheries of Santander are prosperous and important. The primary schools, schools for training teachers, the institute, the nautical school, are numerously attended. There is a tobacco factory, where 1800 women are employed. Among the modern improvements of the town are its town-hall, theatre, markets, barracks, bull-ring, clubs, civil and mili- tary governors' residences, custom house, hospitals. Many of the houses on the bay front and public buildings have been restored since the catastrophe of 3rd November 1893, when the steamer Cabo Machichaco, laden with 1700 cases of dynamite, blew up near the quay. The port of San- tander is very important. The dredging of the harbour is satisfactory, and the water in the channel right up to the quays is deep enough to allow heavy-draught vessels to come alongside at almost any state of the tide. In 1898, 222 British vessels entered with cargoes valued at ––264,425, and 222 cleared with cargoes valued at ––173,682. The vessels of other countries that entered were : 80 French, 39 . Swedish and Norwegian, 3 Dutch, and 1176 Spanish, the majority of the last being coasters. The iron-ore trade is steadily increasing, the exports having been 332,974 tons

in 1897 and 406,996 tons in 1898, of which 265,549 tons went to the United Kingdom.

Santarem, a city of Portugal, capital of the district Santarem, crowning a height above the right bank of the Tagus, 44 miles north-east of Lisbon. Between the foot of the hiU and the river is the suburban port of Eibeira de Santarem, where the Tagus is crossed by a fine bridge. The town is still surrounded by walls, pierced by eight gates. Population (1900), 8704.

The district of Santaeem has an area of 2649 square miles. Population (1890), 254,844; (1900), 283,676, or 107 to the square mile. It consists in great part of the fertile valley of the Tagus.

Santa Rosa, a city of Cahfomia, U.S.A., capital of Sonoma county. It is 51 mUes north of San Francisco, on the California North-Western and the Southern Pacific railways, among the Coast ranges, at an altitude of 181 feet. The city is regularly laid out on a level site, and has broad well-shaded streets, and an excellent water- supply. Situated in a region admirably adapted for fruit and grain, its industries in great measure consist in the handhng of these products. It has flour-mUls and fruit canning and drying works. It is the site of Pacific Methodist College, opened in 1861. This had in 1899 a faculty of 7 teachers and was attended by 42 students. Population (1890), 5220; (1900), 6673, of whom 1029 were foreign-born and 140 were coloured.

Santiago, capital of Chile, and also of the province and department of the same name, in 33►►26' 26" S. and 70►►38' 15" W. ; mean altitude above sea ~~level, 1600 feet. Population (1895), 256,413 ; (1900), 269,886. The mean summer temperature is 67►►F., the mean winter temperature 47►►, that for the whole year 57►►. The maximum recorded yearly rainfall is given as 25^ inches, the minimum 4 inches. The city is divided into 10 circumscriptions, and 3 municipalities, which form the municipilidad. Besides the Government buildings, the city has 17 charitable institutions, in which are in~~ cluded a lying ~~in hospital, an orphan asylum, lunatic asylum, poorhouse, &c. Among its educational establish~~ ments mention should be made of the university, the medical

school, the national institute, the military school, the agricultural school, conservatory of music, schools of

painting and sculpture, of mining, normal schools for both sexes, deaf and dumb schools, and professional schools for girls. It has also an astronomical observatory, and a museum of natural history, a zoological garden, and a national library. Eight large daily papers are published, which have a circulation of over 50,000 copies, and about 26 literary, artistic, economic, scientific, and other periodicals. There are some 10 Uterary, scientific, and other societies in the city, and 9 clubs. Since 18-92 Santiago has a superior council of public hygiene, and an institute of hygiene, with bacteriological laboratory, a museum, &c.

Sa.ntiSlg^O, or Santiago db Compostela, a town of Spain, province of Corunna, on the Sar, with a station on the Carril Kailway. Population, 16,223 in 1887, and in 1897, 24,335. In the neighbourhood are pastures and fertile valleys that produce much corn, hemp, maize, and fruit. The local industries are distilleries, breweries, soap, chocolate, matches, crystal, linen, and paper. Santiago is still the seat of a university. There are also a veterinary school, an institute founded in 1501, a high normal school, excellent primary schools for both sexes, and a seminary. The library of the university contains 60,000 volumes and several hundred MSS., many valu- able and one dating from 788 a.d. The tovm has several hospitals and refuges, which are open to the pilgrims, still numerous, who flock to the shrine of the patron saint of Spain.

Sa.ntia.g'O de Cub⁇⁇l, the capital of the province of Santiago, Cuba, situated at the north-eastern end of a capacious harbour indenting the straight south coast of the eastern end of Cuba. It is second only to Havana in population, and equals it in strategic and pohtical import- ance. It was founded in 1514 by Lieutenant-Governor Diego Valasquez, and it was made the capital of Cuba in the place of Baracoa a few years later. It continued to be the capital during the first century of Spanish occupa- tion, and from it were fitted out most of the expeditions,

including that of Cortez, which explored Spanish North America. The city is very antique and dilapidated in appearance, and is surrounded by a barren, mountainous country. Extensive iron and manganese mines in the vicinity give material support to the population. Much trade from the interior flows into the city through a gap in the mountains to the northward, through which extends a short railway. Extensive commerce is maintained with the remainder of Cuba by coasting vessels, and there are steamer connexions with New York and Europe. The harbour is completely landlocked and easily defensible, entrance being gained through a passage hardly vsdde enough for vessels to pass, which opens out into a bay sufiicient in area to float the navies of the world. It is noted for manjr historical events connected with the early settlement of Cuba, and the various insurrections. On 3rd July 1898, during the Spanish-American war, the Spanish fleet issued from this harbour and, in the attempt to escape, was destroyed by the blockading American squadron. The surrender of the town to the American army took place a fortnight later. Population (1899),

43,090.

Santiago de Las Vegas, an interior town of Havana province, Cuba. Population (1899-), 7151.

Santipur, a town of British India, in the Nadia district of Bengal, situated on the left bank of the Hooghly, with a railway station, 55 miles north of Calcutta. It is a site of an old commercial factory, and still a centre of the weaving trade. There is a municipal high school. Population (1881), 29,687; (1891), 30,437.

SantSey, Charles, (1834-

~~), English vocal~~ ist, son of an organist at Liverpool, was born 28th February 1834. He was given a thorough musical education, and having determined to adopt the career of a singer he went in 1855 to Milan and studied under Gaetano Nava. He had a flne baritone voice, and while in Italy he began singing small parts in opera. In 1857 he returned to London, and on 16th November made his first appearance in the part of Adam in The Creation at St Martin's Hall. In 1858, after appearing in

January in The Creation, he sang the title-part in Elijah in March, both at Exeter Hall ; and his future was now assured. In 1859 he sang at Covent Garden as Hoel in the opera Dinorah, and in 1862 he successfully appeared in Italian opera in II Trovatore. He was then engaged by Mapleson for Her Majesty's, and his regular connexion with the English operatic stage only ceased in 1870, when he sang as Vanderdecken in The Flying Dutchman. His last appearance in opera was in the same part, with the Carl Rosa Company at the Lyceum Theatre in 1876. Meanwhile, in 1861 he sang Elijah at the Birmingham Festival, and in 1862 was engaged for the Handel Festival at the Crystal Palace. From that time he was recognized as the first of English baritones, the wonderful conviction which he threw into his singing and his dramatic fire and rehgious fervour being specially noteworthy. At the musical festivals and on the concert stage his success was immense. In such songs as " To Anthea," " Simon the Cellarer," or " Maid of Athens," he was unapproachable, and his oratorio singing carried on the finest traditions of his art. In 1868 Santley married Gertrude Kemble, and their daughter, Edith Santley, had a great success as a concert singer.*

Santos, a city and port of southern Brazil, in the' state of Sao Paulo, 34 miles from the capital of Sao Paulo by rail. Population (1900), 41,000. It is the principal port of shipment of Brazilian cofiee, the total export for 1899 being 364,928,493 kilogrammes, valued at about ►►8,275,000. In 1900, 5,849,114 bags of 60 kilogrammes each (valued at about ►►9,000,000) were exported ; and in 1896, 4,157,971 bags. In 1900, 699 ships, of 869,718 tons, entered and about the same number cleared at the port of Santos.

Santo Domingo. See Hayti.

Sa6ne, Haute-, a department of eastern France, resting on the southern end of the Vosges.

Area, 2075 square miles. The population, 280,856 in 1891, had decreased to 265,179 in 1901. The births in 1899 were 6773, of which 494 were illegitimate ; deaths, 6809 ; marriages, 2038. There were in 1896 1061 schools, with 44,000 pupils, 1 per cent, of the population being illiterate. The land under cultivation in 1896 was 1,210,800 acres ; 577,980 acres

being plough-land and 19,760 acres vineyards. The department in 1899 grew wheat to the value of ––692,000; rye, ––80,000; oats, ––440,000; potatoes, ––380,000. The vintage of 1899 was valued at ––108,000. The live stock (1899) included 22,730 horses, 166,800 cattle, 71,640 sheep, and 66,480 pigs. Mining in 1898 produced 217,000 metric tons of coal, 9000 tons of lignite, 1760 tons of iron, and 6872 tons of rock-salt. The industry in metals yielded 1209 tons of cast-iron, 188 tons of iron, and 1280 tons of steel. There are also extensive industries in textiles, glass, and distillation. Vesoul, the capital, had in 1901, 9704 inhabitants.

Sa6ne-et-Lolre, a department in east central France, traversed by the mountains of Morvan and Charo- lais, and watered by the Sa6ne and the Loire.

Area, 3331 square miles. The population, 619,523 in 1891, numbered 616,389 in 1901. The births in 1899 were 14,099, of which 655 were illegitimate ; deaths, 12,072 ; marriages, 6005. The schools, primary grade, numbered (1896) 1339, with "104,000 pupils, 2 per cent, of the population being illiterate. Out of 1,962,415 Jtcres of land cultivated in 1896, 1,034,930 acres were arable, and 61,750 were in vines, a wide area of the department being in pasture. A

wheat-growing country, Sa6ne-et-Loire produced in 1899 wheat valued at ––1,470,000; rye, ––96,000; oats, ––205,000; maize, ––232,000; mangold- wurzel, ––108,000; potatoes, in which this department ranks prominently, ––846,000. Its vintage in 1899 was valued at ––883,000 ; its crop of colza, ––32,000 ; its rape, ––8800 ; beetroot, ––11,200. While its agricultural value is very consider- able, the department is not less noted for its live stock, which in 1899 included 26,830 horses, 352,930 cattle, 126,770 sheep, 223,710 pigs, and 33,190 goats. The mineral basin of the SaSne and Loire (Autun, Creuzot) is one of the most important in France, and pro- duced in 1898 2,096,000 metric tons of

coal, 125,000 tons of iron, 9000 tons of manganese and other metals, and 142,000 tons of various substances. Creuzot is the chief centre in France of the metallurgical industry, and turned out in 1898 105,000 metric tons of cast-iron, 47,000 tons of iron, and 112,300 tons of steel, of the value of ►►2,500,000, the workmen employed numbering over 11,000. There are important glass manufactures in the arrondisse- ment of Autun. Distillation produced 44,000 gallons of alcohol. Macon, the capital, had in 1901, 18,928 inhabitants ; Chalon-sur- Sa6ne, 29,058 ; and Creuzot, 30,175.

SSio Pa.UlO, an Atlantic state of Brazil, betv^een 19►►54' and 25►► 15' S. and 44►►6' and 53►►28' W. ; coast line 373 miles. It is bounded on the N. by Minas Geraes, Goyaz, and Matto Grosso ; on the W. and N. by Goyaz ; on the S. by ParanA ; and on the E. by Kio de Janeiro and the Atlantic. Area, 112,330 square miles. Population (1890), 1,384,753. There is a large and constant immigration from Europe, and it is estimated that in 1898 there were about 500,000 Italians in the state. The capital, Sao Paulo, has a population of about 270,000 ; other towns, Santos (41,000), Sorocabo (14,000), Parahybuna (11,000), Piracicaba (11,000), Itii (11,000), Iguape (10,000), Botucato (7000), Caconde, Braganza and Cacapava, Franca and Sao Sebastiao, each with about 5000. There are over 100 towns in the state. In 1900 there were in operation over 2000 miles of railway. It is the greatest coffee-producing region in the world, and manufactures cottons and flour.

SSlO Thom^, or St Thomas, an island in the Gulf of Guinea, lying immediately north of the equator and belonging to Portugal. Along with the neighbouring island of Principe (Prince's Island), it forms the province of St Thomas (in Portuguese Sao Thomd). During the dry season (June to September) the temperature ranges in the lower parts between 66'2►► and 80'6►► F., and in the higher parts between 57 '2►► and 68►►; in the rainy season it ranges between 69-8►► and 89 '6►► in the lower parts, and between 64'4►► and 80'6►► in the higher parts. On Coffee Mount (2265 feet) the mean of ten years was 68'9►►, the maximum 90'5►►, and the minimum 47'3►►. Area, 318 square miles. Population (1895), 22,000. The natural products of the island embrace oranges, lemons, figs, mangoes, and in the lower-lying

districts the vine, pine- apple, guava, and banana; and the principal cultivated products are cocoa, coffee, and cinchona. Vanilla, india-rubber, balsam, cinnamon, camphor, cocoa, and kola-nut are also produced. The total trade of the province in- creased in value from ––318,000 in 1888 to ––933,900 in 1898 ; ––564,250 being for exports, namely, ––234,000 for cocoa, ––131,350 for coffee. In 1900 the imports from Portugal were valued at ––692,000, and the exports to the same country at ––186,310. But the export of cocoa alone to all countries amounted to ––587,100 in 1900, and 2405 tons of coifee in all were sent out of the island. The imports coming next in value are cocoa-nut, cinchona, arrovPTOot, palm oil, bamboo, balsam, kola-nuts, manioc flour, fruit, timber, pepper, and oU-seeds. Cocoa is the principal product of Principe. The total trade in 1899 was valued at ––1,188,888.

Sapporo.––– The official capital of the island of Yezo, Japan, situated in 43––04' N. and 141––21' E. It has a population of 37,482. It was chosen in 1870,

and owed its prosperity at the outset chiefly to the public institutions established there by the Japanese Government in connexion with the colonization bureau, which had for its object the development of Yezo's resources. It is now a garrison town, being the headquarters of the 7 th division. It has ah agricultural college, a museum, saw- mills, flour-miUs, a brewery, and hemp and flax factories.

-), Italian

Saracco, Giuseppe (1821-

politician and financier, and knight of the Annunziata, was born at Bistagno on 9th October 1821, and, after qualifying as an advocate, entered the subalpLne ParUa- ment in 1849. A supporter of Cavour until the latter's death, he afterwards joined the party of Piattazzi, and became secretary-general of public works in the Eatta^zi Cabinet of 1862. In 1864 he was appointed, by Sella, secretary – general of finance, and after being created senator in 1865, acquired considerable fame as a financial authority. In 1879 he succeeded in postponing the total abolition of the

grist tax, and was throughout a fierce opponent of Magliani's loose financial administration. Selected by Depretis as minister of public works in 1887, and again by Crispi for the same office in 1893, he contrived, by careful management, to mitigate the worst consequences of Depretis's corruptly extravagant policy, and introduced a sounder system of government partici- pation in public works. In November 1898 he was elected president of the senate, and in June 1900 succeeded in forming a "Cabinet of pacification" after the Obstruc- tionist crisis which had caused the downfall of General Pelloux. His term of ofiice was clouded by the assassina- tion of King Humbert (29th July 1900), and his adminis- tration was brought to an end in February 1901 by a vote of the Chamber condemnatory of his ambiguous attitude towards a great dock strike at Genoa. After his fall he resumed his functions as president of the senate. He received the supreme honour of the knight- hood of the Annunziata from King Humbert in 1898.

S^ran, a district of British India, in the Patna division of Bengal. Area, 2653 square miles. Population (1881), 2,297,666; (1891), 2,467,477. The average density, 930 per square mile, is the highest rate for all India. Classified by religion, in 1891 Hindus numbered 2,174,734; Mahommedans, 290,980; Christians, 278, of whom 178 were Europeans; "others," 1485. In 1901 the population was 2,361,079, showing a decrease of 4 per cent., compared with an increase of 7 per cent, in the previous decade. The land revenue and rates in 1897-98 were Ks.15,89,076 ; number of police, 565; boys at school (1896-97), 21,800, being 12-8 per cent, of the male population of school-going age, compared with 28 per cent, for the province generally; registered death- rate (1897), 31 '55 per thousand. The principal industry is indigo. There are altogether 42 factories and out- works, with an English capital of ??150,000, employing 21,000 persons, and producing 4000 maunds, valued at Es.7,00,000. Opium also is largely cultivated. Saran is exposed to the two calamities of drought and flood. It suffered from the famine of 1874, and again in 1896-99. An irrigation scheme from the river Gandak, started in 1878, proved a failure, after a capital expenditure of Es.7,00,000. The Bengal North-Western Eailway runs through the south of the district. The administrative headquarters are at Chapra.

Saransk, a district town of Russia, in the govern- ment and 88 miles north of the town of Penza, on the railway from Moscow to Kazan. Its chief factories are steam flour-mills, oil-mills, tobacco and rope-works, and tanneries. A brisk trade is carried on in corn and hemp,

tallow, spirits, leather^ and hemp-seed oil. The town was founded early in the 17th century, when it was a small fort erected against the invasions of the Bashkirs. In 1897 it had a population of 13,743.

Sa,ra,pul, a district town of Kussia, in the govern- ment and 388 mUes south-east of the town of Vyatka, on the right bank of the river Kama. This town, the population of which numbered 21,395 in 1897, is an important centre for the manufacture of boots, shoes, and gloves ; no less than 450,000 pairs of boots are made per annum and mostly exported to Siberia, the Caucasus, and Turkestan. It has also many tanneries, ilax mills, distilleries, iron- works, and rope -works, and is at the same time an important port; more than 1000 boats clear every year, and the movement of the port is 57,500 tons imported, and 32,500 tons, chiefly corn and timber, exported. There are gymnasia for boys and girls, a lace-making school, a municipal library, and a hospital maintained by the local government.

Sa.rSi'toff, a government of south-east Russia, on the right bank of the Lower Volga, with an area of 32,624 square miles, and a domiciled population which numbered 2,113,077 in 1882 and 2,419,884 in 1897. The density in the different districts in 1897 varied from 55 to 107 inhabitants per square mile, and the urban population amounted to 319,918; the female population numbered 1,230,957. There are a few Germans, but nearly all the inhabitants are Russians ; 83 per cent, belong to the Orthodox Church, 5 per cent, are Nonconformists, 6 per cent. Lutherans, and 2 per cent. Catholics. The govern- ment is divided into ten districts, the chief towns of which are Saratoff (see below), Atkarsk (9750), Balashoff (1 2, 166), Kamyshin (15,934), Khvalynsk (15,455), Kuznetsk (20,555), Petrovsk (13,212), Serdobsk (12,721), Tsaritsyn

(55,967), and Volsk (27,039). Education makes some progress ; the number of young men taken into the military service in 1897 who could read was 40 per cent, of the total number taken, as against 21 per cent, in 1874. The proportion of women, however, who know how to read and write continues to remain very small. In 1898 primary schools were attended by 56,180 boys and 22,870 girls. Of the total area (19,956,000 acres), 52 per cent, belonged to the peasants in 1896, 38 per cent, to private landowners, 5 per cent, to the Crown, and 5 per cent, to the Imperial family and the municipal authorities. These figures, how- ever, are rapidly altering, as the peasants constantly buy considerable quantities of land. No less than 58 per cent, of the total area, that is, 11,510,000 acres, is under fields, 19 per cent, under meadows and pasture, and 13 per cent. (490,000 acres) under woods, while 10 per cent, is un- available for culture. Green crops are now being culti- vated more widely, both on the private estates and among the peasants. Agriculture suffers, however, very much from droughts, and the attacks of marmots, mice, and insects, and consequently the yield varies from 3,200,000 cwt. to 11,550,000 cwt. in different years. The average yield in 1895-99 was 6,524,000 cwt. of wheat, 14,797,000 cwt. of rye, 5,181,000 cwt. of oats, 357,000 cwt. of barley ??? for all cereal crops, 30,065,000 cwt. ; also 4,198,000 cwt. of potatoes. The field culture of melons and sunflowers is very widely siiread, as also is gardening. Cattle-breeding is on the decUne; in 1897 there wore 535,660 horses, 792,710 horned cattle, 1,199,430 sheep, and 116,750 swine. On the other hand, the export trade in poultry, especially geese, has developed greatly. In 1897 the factories employed 25,165 workers, their aggre- gate returns being about 34,400,000 roubles. They mainly comprise steam flour-mills, oil-works, distilleries, timber mills, tanneries, and fur-dressing works. Weaving, the

fabrication of agricultural machinery and pottery, boot- making, and a great variety of other trades are widely spread in the villages as domestic industries. The fairs of the province have lost much of their importance ; that at Bekovo, however, in the district of Serdobsk, has held its own, especially as regards trade in cattle and animal products. The province is well provided with railways (862 miles in 1900).

Sa.ra.toffy the capital of the above government, on the right bank of the Volga, 532 miles by raU south- east of Moscow, and on the railway from Ryazan to the Urals. Its population increased from 86,000 in 1870 to 137,109 in 1897. The city is one of the best built in the provinces. Its factories occupy 3800 workers, and show an aggregate yearly return of 8,400,000 roubles. They chiefly comprise flour-mills, iron-works, oil-works, works for the manufacture of railway plant, and tobacco factories. Saratoff is a very important centre for the trade of eastern Russia. Its port shows an annual move- ment of 3400 vessels entered and cleared; 125,000 tons of (mainly) corn and flour are sent up the Volga every year, and 557,000 tons, chiefly of naphtha, by rail. In 1896 there were 96 primary schools, with 10,570 pupils, several technical schools, and Radischeff's museum, which is one of the richest in pictures, sculptures, and archaeo- logical collections in the provinces. The theatre is also one of the best in provincial Russia. Saratoff is the seat of several scientific societies, and pubhshes five news- papers, (p. A. K.)

SaratOgra Springs, a village of Saratoga county. New York, U.S.A. It is situated in 43 ° 05′ N. and 73 ° 47′ W., in the southern foothills of the Adi- rondack mountains, in the eastern part of the state, at an altitude of 323 feet. The village has a fine water- supply from mountain springs. It is reached by three railways, the Delaware and Hudson, the Adirondack, and the Fitchburg. Saratoga is one of the best-known and most fashionable of American summer resorts. There are about forty springs, which differ widely in the con- stituents of their waters. The city contains many large hotels, boarding-houses, and hundreds of costly and beauti- ful villas. It has been a popular place for holding political conventions, and contains a Convention HaU, seating 5000 people. Saratoga Lake, 4 miles east of the city, is a favourite place for rowing races. Saratoga is known as the scene of the surrender of Burgoyne's army to the Americans under General Gates, which took place about 12 miles south-east of the village, on 17th October 1777, after a month's fighting in the neighbourhood. Population of the village (1890), 11,975; (1900), 12,409, of whom 1684 were foreign-born and 619 negroes.

Saravia, a town on the north-west coast of the island of Negros, Philippine Islands. It is situated in a rich sugar-producing region, and

sugar culture is its only important industry. The language is Panay-Visayan. Population, 15,000.

Sarawak, a state situated in the north-west of Borneo, with an area of 50,000 square miles and a popula- tion of about 500,000. The coast line extends from Tanjong Datu, a prominent cape in 2 3′ N., northwards to the mouth of the river Trusan, in 4 58′ N. and 1 1 5 1 3′ W., but a tract 80 miles in length of Brunei territory still remains between the mouth of the river Baram and the river Limbang, the whole distance being about 440 miles in a straight line (but following the sinuosities, about 560 miles). In the year 1842 the government of the district from Tanjong Datu to the entrance of the river Sumarakan was obtained from the sultan of Brunei by Sir James

Brooke. The frontier of the southern portion of Sarawak is formed by the Serang, Kelingkang, and Batang Lupar ranges of mountains ; inland, on the eastern side, the territory, along the watershed, is bounded by the following mountains : Batu Puteh (5000 feet), Tebang (10,000 feet), Ubat Siko (5000 feet), Bela Lawing (7000 feet), and Batu Leihun (8000 feet), from which the Eejang and Baram, on the Sarawak side, and the Koti and Balungun, on the Dutch side, take their rise. To the north of Sarawak is the Pamabo mountain range (8000 feet), situated in 3 30′ N. and 115 15′ W. whence flow the rivers Limbang and Trusan and the mountains Batu Lawei (8000 feet) and Lawas (6000 feet). The interior of Sarawak is moun- tainous, the greatest elevations being that of Mount Mulu (9000 feet), of limestone formation; Batu Lawei (8000 feet), Pamabo (8000 feet), Kalulong, Poeh, and Penrisan.

The Eejang is the largest river, the Baram ranking second, the Batang Lupar third, and the Limbang fourth. A formidable bar at the mouth of the Baram proves a great hindrance to shipping. The Rejang is navigable for small steamers for about 160 miles from its mouth. The chief town of

Sarawak is Kuching, with a population of about 25,000. In 1885 the state was placed under British protection.

The fauna is exceedingly rich in all branches. The most im- portant mammals are the mias, or orang utan, the gibbon, the proboscis, semnopithecus and maoaous monkeys ; lemurs, cats, otters, bears, porcupines, rhinoceros, wild pigs, wild cattle, deer, and pangolin. Bats, shrews, rats, and squirrels are included among the smaller mammals, while sharks, porpoises, and dugongs are found on the coast. Of birds, Sarawak has over five hundred species, including many kinds of thrushes, flycatchers, swifts, cuckoos, barbets, hawks, owls, pigeons, pheasants, and herons. Fish and reptiles are abundant ; the jungle swarms with insect life, and is rich in many varieties of fern and orchid.

The mineral wealth gives promise of considerable development in the future. The Borneo Company have commenced working gold from the quartz reefs at Bau, on the Sarawak river, by the cyanide process, and have met with great success. Antimony and cinnabar are worked successfully in the same district by this company. Antimony occurs in pockets in various localities, notably at Sariki, in the Rejang district, and at Burok Buang and Telapak, in the Baram district, and in the river Atun. Cinnabar has also been found in small quantities at Long Liman and in the streams about the base of Mount Mulu. Sapphires of good quality, but too small to be of commercial value, are found in large numbers in the mountain streams of the interior.

Coal is worked at Sadong and Brooketon, whence it is shipped to Singapore. The great coal-iield of Selantik, along the Kelingkang range in the Batang Lupar district, is about to be developed. In- dications of coal seams have also been found in the river Mukah ; at Pelagus, in the Rejang ; at Similajau and Tutau and on Mount Dulit, in the Baram district.

Timber is one of the most valuable products, but at present, with the exception of billian (iron wood) from the river Rejang, very little is exported. The most important timbers to be found in the Borneo forests are : billian, merebo, rasak, kruin, tapang, kranji, benaga, bintangor, gerunggang, medang, meranti, and kapor. Except near the banks of the

rivers, which have been cleared by the natives for farming purposes, the whole country is thickly clothed with timber.

The industrial establishments also comprise sago-miUs, brick- works, cyanide-works, and saw-mills.

In 1900 the total trade was valued at 113,025,000, as compared with 14,564,200 in 1890. The following are the principal articles of export, with quantity and value given for the year 1900 :-

Gutta Rubber Rattans Gambler Pepper Sago flour Gold

Value of total imports exports

7,964 piculs 3,464 ❓❓❓ 41,340 ❓❓❓ 36,624 ❓❓❓

32,967 ,, 215,910 ,,

45,180 oz.

$78,829 35,181 27,999 20,060

125,442 75,026 84,370

,159,120 or ❓❓615,912 6,865,860 or ❓❓686,586 The revenue for 1900 amounted to |915,966 (as compared with $413,000 in 1890), and the expenditure to $901,172, leaving a surplus of $14, 794. The population of the state, in addition to a very small number

of European government ofiioiala and others, consists of Malays, Dyaks, Melanaus, Kayans and Kenyahs, Kedayans and Muruts, with a large number of Chinese traders, and pepper planters.

The Government consists of the Raja, Sir Charles Johnson Brooke, G.C.M.G., who is absolute, assisted by a supreme council of seven, consisting of three chief European residents and four natives nom- inated by himself ; there is also a general council of fifty, which meets every three years. For purposes of administration the country is arranged in four divisions, these being subdivided into districts. The first division

consists of Sarawak proper, wliich comprises the districts of the river Sarawak and those of Lundu and Sadong. The second division is formed by the Batang Lupar, Saribas, and Kelakah districts. The third division consists of the Rejang, Mukah, Oya, and Bintulu districts ; and the fourth division, of the I3aram, Limbang, and Trusan districts. Each district is in charge of a Resident.

Since 1880 there has been a considerable increase of both popu- lation and territory, the increase of the former being estimated at 170,000 people, and of the latter at 15,000 square miles. On 12th August 1882 the Baram district from Kidurong Point to Baram Mouth, situated in the northern part between 3 and 4 30′ N. and 113 and 115 30′ W., with 100 miles of coast line and an area of 10,000 square miles, was ceded to Sarawak by the late sultan Mumin of Brunei. "Three years later the Trusan district, in the far north, was also ceded to the Raja by the same sultan. A few years after these cessions had been obtained, many of the people of the Limbang a large river which has one of its outlets passing through the town of Brunei rose in rebellion against the sultan of Brunei, and as a solution of the difficulty then- territory was annexed by Sarawak, with the subsequent approval of the British Government. The total area is therefore now 50,000 square miles.

The coast is well lighted, lighthouses having been built and maintained in good order at Tanjong Po, Sirik, Mukah, Oya, Tanjong Kidurong, Baram Mouth, and Brooketon.

The climate is equable, the daily temperature ranging on the average between 70 and 90 . The nights are generally cooL The rainfall averages aboat 200 inches annually ; but falls during both the fine (S.W.) and the wet (N.E.) monsoon. (c. h.)

Sarcey, Francisque (1828-1899), French

journalist and dramatic critic, was bom at Dourdan, 8th October 1828. After his education was finished, he spent some years as schoolmaster in various lyc^es, but his independent and impetuous temperament was little fitted to the work. He abandoned it in 1858, and henceforward devoted himself to journalism. He contributed miscel- laneous papers to the

Figaro, L' Illustration, Le Gaulois, Le XIX ⁇ ⁇ Sikcle, and other periodicals ; but his chief bent was towards dramatic criticism, of which he had his first experience in L'Opinion, Nationale in 1859. In 1867 he began to contribute to Le Temps the " feuilleton " vfith which his name was associated till his death. His position as dictator of dramatic criticism was unique, and his in- fluence enormous. He had the secret of taking the public into his confidence, and his pronouncements upon new plays were accepted as final. This was to a great extent justifiable, for he was a masterly judge of acting and of stage effect ; his views as to the drama itself were some- what narrow and indifferent to the march of events. He published several miscellaneous works, of which the most interesting are Le Siege de Paris, an account compiled from his diary (1871), ComJdiens et ComMiennes (1878-84), Souvenirs de Jetonesse (1884), Souvenirs d'dge mur (1892), Quarante Ans de ThJdtre (1900, &c.). He died in Paris, 16th May 1899. (e. f. s.)

Sardhana, a town of British India, in the Meerut district of the North-Western Provinces; station on the North-Western Railway, 12 miles north-west of Meerut. Population (1891), 12,059 ; municipal income (1897-98), 11,046. Though now a decayed place, it is historically famous as the capital of the state founded at the end of the 18th century by the Begum Sumru. This extras ordinary woman, who survived till 1836, was a Mussulman who married Reinhardt or Sombre (Sumru), the per- petrator of the massacre of British prisoners at Patna in 1763. On her husband's death in 1778 she succeeded

to the command of Hs mercenary troops. Ultimately she was baptized into the Eoman Catholic Church, and be- queathed an immense fortune to charitable and religious uses. Her estate of Sardhana was the subject of litigation, and is now under the Court of Wards. She built here a Eoman Catholic cathedral, a college for training priests, and a handsome palace.

Sardinia (Italian, Sardegna; French, Sardaigne ; Spanish, Cerdena), an island in the Mediterranean, about 14:0 miles from the west coast of Italy, of which kingdom it forms a part. Although the Italian Government neglected considerably the needs of the island during the last quarter of the 19th century, progress has undeniably been made. In 1881 the population was 682,002, and in 1901 it was estimated to be 789,314, or an average density of 85 per square mile. The populations of the chief cities are ??? Cagliari, 53,700; Sassari, 38,200; Iglesias, 12,000; Alghero, 12,000 ; Tempio, 12,000 ; Oristano, 8000 ; Ozieri, 8800; Bosa, 7000; Nuoro, 7000. The Sardinians are passionately attached to their island, and as a consequence emigration is comparatively small. The year 1896 fur- nished an exception to this general rule; in that year 2510 emigrants left the island, as compared with 150 in 1895 and 66 in 1892; the statistics for the years 1897-99 showed that emigration soon fell once more to insignificant proportions. The Sardinian is, as a rule, mild in character, hardworking, simple, and temperate in his habits. His domestic affections are extremely strong, as is also his attachment to the soil. This last sentiment is the chief cause of the excessive splitting-up of landed property. Politically the Sardinians are tenaciously attached to the existing institutions. At Sassari there exists a republican party which puts up its ovni candidates in general elections, but it is by no means intraiisigdant and still less subversive. The Sardinian clergy is favourably distinguished from the rest of the Italian clergy by its patriotic spirit. The Catholic party is most tolerant. Socialism counts few adherents. For administrative purposes the island retains the old division into 9 districts (circondarii) with a total of 364 communes. There are 12 parliamentary constitu- encies, but the island is represented in the senate by only

2 senators. Sardinia has a single court of appeal at Cagliari, 5 assize courts, and 6 common courts. There are

3 archbishoprics and 9 suffragan bishoprics ; 2 intendants of finance, 2 chambers of commerce, and 9 agricultural unions.

Agricultwre. ??? At least three-fifths of the Sardinian population are engaged in agriculture. Most of the re- maining two-fifths are occupied in subsidiary industries, based upon the manufacture of" agricultural

products. Considerable progress was made in agriculture during the last twenty-five years of the 19th century, mainly as a result of the special agricultural schools established throughout the island. The old Sardinian plough is being replaced by modern ploughs, and attempts are being made to spread the use of artificial manure. Improved methods are being adopted for protecting vines against disease, and the importation of American vines has now ensured immunity against a rei)etition of former disasters. The cultivation of the vine prevails especially in the province of Cagliari, considerable progress having been made of late both in the extent of land under cultivation and in the ratio of produce to area. Between 1889 and 1896, the area under vines had increased from about 110,000 acres to 180,000 acres in four of the districts alone. The total extent of land covered by vineyards is calculated at 222,000 acres, giving a total average annual product of 5 million gallons. The entire island produced 19,809,000 gallons of wine in 1900, but 28,613,000 in the year 1899.

The most flourishing districts are those of the Campidano of Cagliari, where intelligent and enterprising proprietors have pushed specialization in vine culture to a high degree, the district of Ogliastra, and the Campidano of Oristano, where the celebrated vernaccia is produced. Everywhere notable progress has been made.

Though much land previously devoted to grain culture has been planted with vines, the area under wheat, barley, beans, and maize is still considerable. Most of the Sardinian soil, except the rugged mountain regions, is adapted to corn growing. In 1896 the grain area was 380,000 acres, a slight diminution having taken place since 1882. The yield of corn varies from six to ten times the amount sown. In 1900 the total production of wheat in the island was 3,025,000 bushels. The low price of corn renders com cultiva- tion hardly profitable. The cultivation of olives is widespread in the districts of Sassari, Bosa, Iglesias, Alghero, and Callura. The Government is taking steps to check the decrease of olive culture in Sassari by offering prizes for the grafting of wild olive trees, of which vast numbers grow throughout the island.

Next to the wine-making industry, cattle-raising is becoming the principal source of wealth in Sardinia. "Whereas in 1881 Sardinia was estimated to possess only 157,000 head of cattle, 478,000 sheep, and 165,000 goats, the numbers in 1896 had increased to 1,159,000 head of cattle, 4,960,000 sheep, and 1,780,000 goats. The nomadic system prevails in the island. Breeding is un- regulated and natural selection prevails. The weaker animals either die off or do not breed, while those that do survive are poor in quality and in yield of products. A more progressive form of pastoral industry is that of the tanche, or enclosed holdings, in which the owner is both agriculturist and cattle raiser. On these farms the cultivation of the soil and the rearing of stock gp hand in hand, to the great advantage of both. Nevertheless the idea of the value of improving breeds is gaining ground. Good cattle for breeding purposes are being imported from Switzerland and Sicily, and efforts are likewise being made to improve the breed of horses.

Trade and Industry. ❓❓❓ Next to agriculture, mining is the prin- cipal Sardinian industry. It is carried on on a large scale, with capital and costly machinery. Although 583 mines of various metals have been assayed, only 100 are actively worked. The principal are those of Monteponi, near Iglesias, and those of Mon- tevecchio, near Guspini. Lead, mixed with sUveT, zinc, copper, magnesium, and antimony are the chief minerals ; lignite nas been discovered, and is extracted in considerable quantities. In 1899 the province of Cagliari exported minerals to the value of 15,883,428 lire (nearly ❓❓600,000), an increase of 3,404,427 lire over 1898. The mines give employment to 12,060 workmen. The extraction of salt, monopolized by the Government, is another im- portant industry. Formerly the Government leased the industry to a private company, but in 1900 resumed direct control of the works. The annual average production is 1,500,000 quintals (cwt). In 1899, 1,247,525 quintals were exported, a diminution of 412,148 quintals as compared with the total for 1898. The value of the salt produced in 1899 was 1,175,342 lire (❓❓47,000). The tunny fisheries yielded in 1899 a value of nearly ❓❓62,000 ; but the industry is rapidly declining ; and the coral fishery is almost extinct. Distilleries have grown up in large numbers since the Government abolished, by special laws for Sardinia, the heavy tax upon alcohol. It has, however, abolished also the premium

previously accorded to distillers for exportation. Thus exportation has become practically impossible. Progress worthy of note has also been made in the tanning industry, the manufacture of artistic furniture, and in all kinds of printing.

Communications and Transport. ❓❓❓ There exists a network of rail- ways and ordinary roads, while numerous lines of steamers place the principal ports of the island in direct communication with Italy, Sicily, France, and the North African coasts. The high level of tariffs, both railway and maritime, has, however, prevented the realization of the advantages previously hoped for. Nevertheless the international trade of the province of Cagliari, where the chief ports are situated, attained in 1900 a value of ❓❓981,075, of which imports represented ❓❓238,340, and exports ❓❓742,735, 88 percent, of this being for minerals. In 1899 this trade reached the value of ❓❓771,590 ; and the coasting trade a total of ❓❓1,449,550, making a total traffic of ❓❓2,221,140. While the ports of the island are entered annually by vessels aggregating 150,000 to 200,000 tons, engaged in foreign trade, the total entries of the foreign and coasting traffic by sea amounts to about 800,000 tons annually. The tariff war with France between 1887 and 1898 struck a heavy blow at Sardinian trade. Before that period Sardinian wine found its chief market in France. The loss of the chief market rendered inevitable a crisis, the consequences of which were scarcely counter- balanced by the efforts to find new outlets. Other industries were equally affected. Since the conclusion of the Franco-Italian com- mercial treaty of September 1898, and especially since the abroga- tion of the French decree, prohibiting the importation of Sardinian

cattle, in April 1899, trade with France has revived to some extent. Considerable trade is done in charcoal, but it leads to increasing deforestation without any rational provision for replanting.

Taxation. ◆◆◆ It is estimated that Sardinia pays, in local and general, direct and indirect taxation of all kinds, 23,000,000 lire (◆◆920,000), a sum corresponding to 35 '44 lire per head.

Banks and Institutions of Credit. ◆◆◆ In 1887 a severe banking crisis occurred in Sardinia. Though harmful to the general economic condition of the island, the crisis left agriculture comparatively unaffected, because the insolvent institutions had never fulfilled the objects of their foundation. Agricultural credit operations in Sardinia are carried on by the Bank of Italy, which, however, displays such caution that its action is almost imperceptible. An agrxoultural loan and credit company has been formed on the ruins of the former institutions, but hitherto no charter has been granted.it. Institutions possessing a special character are the monti frumentarii, or public grain deposits, founded for the purpose of supplying peasant proprietors with seed corn, debts being paid in kind with interest after harvest. After passing through a period of decadence, the monti frumentarii are work- ing well under regulations drafted and applied by the Eudini ministry in 1897.

Education. ◆◆◆ Sardinia holds a low place in regard to education. In the province of Cagliari 73 per cent. , and in that of Sassari 69 per cent., of the inhabitants neither read nor write. These figures, however, are steadily diminishing now that every commune in the island has at least a mixed school, and other schools are being opened year by year even in the mining districts. The university ot Cagliari, which in 1874-76 had only 60 students, had 226 in 1899-1900. At Sassari in the same year there were 161. There are besides in the island 10 gymnasia, 3 lyc^es, 6 technical and nautical schools and institutes, and 9 other institutes for various branches of special education. A tendency is growing up towards the ex- tension of technical and commercial education in place of the exclusively classical instruction hitherto imparted. To the growth of this tendency the excellent results of the agricultural schools have especially contributed.

Police. ◆◆◆ A noteworthy improvement in the conditions of public safety has taken place. Bobberies by armed bands, formerly frequent, have become rare, and the classical type of bandit is practically extinct.

The great needs of the island are (1) a legal remedy for the ex- cessive subdivision of landed property ; (2) regulation of the water- courses and mountain torrents ; (3) replanting of forests ; (4) a system of irrigation ; (5) a vigorous administration ; and (6) re- duction of laud and sea transport tariffs.

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Sardou, Victorien (1831-

-), French

dramatist, was born at Paris on 5tli September 1831. The Sardous were settled at Le Cannet, a small village in the vicinity of Cannes, where they owned a fairly large estate, planted with ohve trees. A night's frost killed all the trees and the family was ruined. The father of Victorien came to Paris in search of employment. He was in succession a book-keeper at a commercial establish- ment, a professor of book-keeping, the head of a provincial school, then again a private tutor and a schoolmaster in Paris, besides editing grammars, dictionaries, and treatises on various subjects. With all these trades and manifold occupations, he hardly succeeded in making a bare liveli- hood, and when at last he gave up the unequal struggle and retired to his native country, the boy Victorien was left to fight out the battle with his own resources. He had begun studying medicine, but had to desist for want of funds. He taught French to foreign pupils; he also gave lessons in Latin, history, and mathematics to students, and wrote articles for cheap encyclopaedias. At the same time he was trjing to make headway in the literary world. His precocious talents had been noticed and encouraged by an old bas-bleu, Mme de Bawl, who

had published novels and enjoyed some reputation in the days of the Eestoration. But she could do very little

for her young protdgd. Victorien Sardou made desperate efforts to attract the attention of Mile Eachel, and to win her support by submitting to her a drama, La reine Ulfra, founded on an old Swedish chronicle. A play of his. La Taverne des Mtvdiants, was received and actually produced at the Od^on on the 1st April 1854, but met with a very stormy reception, owing to a rumour which had been circulated to the effect that the young debutant had been instructed and commissioned by the Government to insult and provoke the students. The unlucky Taverne was withdrawn after five nights. Another drama by M. Sardou, Bernard Palissy, was, however, accepted at the same theatre, but the arrangement was cancelled in con- sequence of a change in the management. A Canadian play, Fleur de Liane, would have been produced at the Ambigu but for the untimely death of the manager. Le Bossu, which he wrote expressly for Feohter, did not satisfy the actor ; and when the play was at last success- fully produced, the nominal authorship, by some un- fortunate arrangement, had been transferred to other men. M. Sardou submitted to Montigny, manager of the Gymnase, a play entitled Paris d VEnvers, which con- tained the love scene, afterwards so famous, in Nos Intimes. Montigny thought fit to consult Scribe, who was revolted by the scene in question, and pronounced : "It is filthy ! Where are we going to ? " Such was the old man's verdict on the young playwright who was destined to foUow closely in his footsteps and to uphold his dramatic system to the last.

Sardou felt the pangs of actual want, and the long series of misfortunes culminated in a severe attack of typhoid fever. He was dying in his garret, surrounded with his rejected manuscripts. A lady who was living in the same house unexpectedly came to his assistance. Her name was MUe de Brecourt. She had theatrical connexions, and was a special favourite of MUe D^jazet. She nursed him, cured him, and, when he was well again, introduced him to her old friend. Then fortune began to smile on the young author, and her favours rained on him as fast as her cruelties had done formerly. It is true that Gandide, the first play he wrote for Mile Dejazet, was stopped by the censor, but Les Premieres Armes de Figaro, Monsieur Garat, and Les Pres Saint Gervais, produced almost in

succession, had a splendid run, and Les Pattes de Mouche obtained a similar success at the Gymnase. Then Victorien Sardou carried everything before him, and aU theatres were open to him.

He soon ranked with the two undisputed leaders of dramatic art, Augier and Dumas. He lacked the powerful humour, the eloquence and moral vigour of the former, the passionate conviction and pungent wit of the latter, but he w►►is a master of clever and easy flowing dialogue. He adhered to Scribe's constructive methods, which com- bined the three old kinds of comedy ►►► the comedy of character, of manners, and of intrigue ►►► with the drame bourgeois, and blended the heterogeneous elements into a compact body and living unity. He was no less dexterous in handling his materials than his master had been before him, and at the same time opened a wider field to social satire. He ridiculed the vulgar and selfish middle class person in Nos Intimes, the gay old bachelors in Les Vieux Gargons, the modern Tartufes in Sdraphine, the rural element in Nos Pons Villageois, the old-fashioned customs and antiquated political beliefs in Les Ganackes, the revolu- tionary spirit and those who thrive on it in Rabagas and Le Roi Garotte, the then threatened divorce laws in Divorgons.

He struck a new vein by introducing a strong historic element in some of his dramatic romances. Thus he borrowed Theodora from Byzantine annals, La Haine from

Italian ctronicles, La Dv^hesse d'Athenes from the for- gotten records of mediceval Greece. Patrie is founded on the rising of the Dutch gueux at the end of the 16th century. The French Ee volution furnished him with three plays, Les Merveilleuses, Thermidor, and Eobespierre. (The last named was produced by Sir Henry Irving at the Lyceum, and has never yet been seen on any French stage.) The Imperial epoch was revived in La Tosca and Madame Sans Gene. In many of these plays, however, it was too obvious that a thin varnish of historic learning, acquired for the purpose, had been artificially laid on to cover modern thoughts and

feelings. But a few ??? Patrie and La Maine, for instance ??? exhibit a true insight into the strong passions of past ages.

jM. Sardou married his benefactress, Mile de Brecourt, but eight years later he became a widower, and soon after the revolution of 1870 was married a second time, to Mile Souli^, the daughter of the erudite Eudore Soulie, who for many years superintended the Mus^e de Versailles. He was elected to the French Academy in the room of Autran, and took formal possession of his seat on the 22nd May

1878.

Sarikoi. See Pamirs.

Sark. See Channel Islands.

Sarnen, the capital of the west half (or Obwalden) of the Swiss canton of Unterwalden. It stands at a height of 1558 feet above the sea, at the north end of the Lake of Sarnen (3 square miles in extent), and on the river Aa. In 1900 the little town contained 3949 in- habitants. It has a large parish church on a knoll above, as well as two convents. In the archives is preserved the famous MS. known from the colour of its binding as the " White Book of Sarnen," which contains the earliest known version of the Tell legend. Sarnen is a station on the Briinig Eailway, being 4J miles from Alpnachstad, its port on the Lake of Lucerne, and 12 J miles below the summit of the Briinig Pass.

Sa,rnia, town and port of entry, Ontario, Canada, capital of Lamb ton county, 55 miles north-east of Detroit, on the left bank of the river St Clair. It is on the Grand Trunk and Lake Erie and Detroit Kiver railways, and is a port of call for steamers plying on the Great Lakes, It contains a large oil-refinery which handles the whole product of the Ontario oil region ; also salt, stove, carriage, and agricultural implement works, and flour-mills. The Grand Trunk Eailway crosses the river at this point by the famous St Clair tunnel. 6025 feet long, or, including the approaches, 2 J miles. Population "1891), 6692;

(1901), 8176.

Sd.rOSpa.ta.k, a market-town of Hungary, in the county of Zempl^n, on the Bodrog, with 6350 inhabitants in 1891 and 7911 in 1901, partly engaged in stone-industry. Its famous Calvinist high school (gymnasium, seminary, law academy) was founded in 1530, and conducted in the years 1650-54 by the celebrated pedagogue Amos Comenius. It possesses rich foundations and an excellent library (54,700 vols.), and affords free support and instruc- tion yearly to some 300 students. There is an old fort, built in the 11th century, and near it a castle with an extensive park.

Scirpsborg^, a seaport and manufacturing town of Norway, county Smaalenene, 68 miles by rail south-south- east of Christiania. It sprang into importance through the utilization of the falls in the river Glommen (Sarpsfos, 140 feet wide, 74 feet descent) for driving saw-mills, and especially for generating electric power. Since 1895 there have been built wood-pulp factories (one by an English company employing over 1000 hands), factories for calcium

carbide (used for manufacturing acetylene gas), paper and aluminium factories, and spinning and weaving mUIs. There are two large electric supply stations, one of which furnishes Fredrikstad (7 mUes to the south-west) with electric light. The port is at Sannesund, one mile south ; its quays can be reached by vessels drawing 20 feet of water. The town was originally founded in the 11th century, and destroyed by the Swedes in 1567. The existing town dates from 1839. Population (1875), 3272 ; (1900), 6888.

*Sa.t*the, a department in the north-west of France, watered by the river Sarthe.*

Area, 2412 square miles. The population, 438,917 in 1881, had decreased to 422,944 in 1901. The births in 1899 were 8593, of which 705 were illegitimate ; deaths, 9596 ; marriages, 3223. There were in 1896 821 schools, with 54,000 pupils, 8 per cent, of the population being illiterate. The land cultivated in 1896 measured 1,424,990 acres, of which 948,480 acres were arable and 22,230 acres vineyards. The department in 1899 raised wheat valued at ––880,000; meslin, ––160,000; rye, ––120,000; barley, ––280,000 ; oats, ––223,000 ; potatoes,

***492,000 ; mangold-wurzel, **44,000 ; vines, **148,000. Sarthe takes the first rank among the departments of France for the production of hemp, which in 1899 was valued at **108,000, while its crop of apples (1899) was esti- mated at **480,000. It owned in 1898 59,250 horses, 7440 asses, 209,680 cattle, 47,990 sheep, 100,530 pigs, and 20,690 goats. Mining in 1898 produced 10,000 metric tons of coal and 2277 tons of peat, but only 30 tons of iron. The spinning of hemp is extensively carried on. The distillation of 1898 counted only 81,000 gallons of alcohol. Le Mans, the capital, numbered in 1901, 62,948 inhabitants.*

Sarzana, a town and episcopal see of the province of Genoa, Liguria, Italy, 10 miles east of Spezia, on a branch of the railway to Pisa. Its principal buildings are the cathedral (1355-1470), the former citadel (now gaol), and the castle of Sarzanello. It was the birthplace of Pope Nicholas V. It has one of the most important glass-bottle factories in Italy, also brick- works, and a patent fuel factory. Fruit, wine, and olive oil are cultivated in the vicinity. Population of commune (1881), 9845; about 14,500 (1899).

Saskatchewan River. See Nelson Eivee.

Saskatchewan Territory. See Noeth- West Teeritoeies.

Sassari, a town, archiepiscopal see, and capital of the province of Sassari, Sardinia, Italy, situated near the north-west corner of the island, 12 miles south-east of its port, Porto Torres, on the Gulf of Asinara. Fine modern quarters have been built on and beyond the site of the old Genoese walls and the citadel. It possesses provincial offices, the modern Gothic Giordano Palace, and the Duke's Palace (now municipal offices). The university, which in 1898 was attended by 148 students (24 professors), owns scientific collections, a library of nearly 40,000 volumes, and a collection of Carthaginian and Eoman antiquities. There is a bronze bust of Mazzini (1889). The chief industries are the maniifacture of matches, tobacco, and macaroni, tanning, and printing. Population (1881),

31,596; (1901), 38,178.

Satara, a town and district of British India, in the Deccan division of Bombay. The town is 2320 feet above the sea, near the confluence of the rivers Kistna and Yena, 56 miles south of Poona. Population (1881), 29,028; (1891), 29,601. The high school had 363 pupils in 1897-98. There are sixteen printing-presses, most of which issue a vernacular newspaper.

The district of Satara has an area of 4987 square miles. Popu- lation (1891), 1,225,989, showing an increase of 15 per cent, after the disastrous famine of 1876-77 ; (1901), 1,146,521 ; average density, 229 persons per square mile, considerably the highest in the Deccan. The land revenue and rates are Es.27, 50,808, the incidence of assessment being E.1.1.3 per acre, again the highest in Deccan ; cultivated area (1897-98), 1,529,541 acres, of which 124,738 were irrigated from wells, &o., hicluding

9395 acres from Government canals ; number of police, 1022 ; children at school (1897-98), 17,290, being 1-5 per cent, of the total population ; registered death-rate (1897), 54 per 1000. The principal crops are millet, pulse, oil-seeds, and sugar-cane. The only manufactures are cotton cloth, blankets, and brass-ware. The district is now traversed from north to south by the Southern Mahratta Railway, which, however, passes 9 miles from Satara town. The Satara Agency comprises the two feudatory states of Phaltan and Aundh. Total area, 844 sq^uare miles. Population (1891), 131,529 ; (1901), 109,614. The estimated revenue of Phaltan is Es.2,29,000 ; tribute, Rs.9600; estimated revenue of Aundh, Rs.18,900; no tribute. The chief of Aundh is the descendant of a Brahman official of Sivaji, called the Pratinidhi.

SdtOraljaujheiy, a corporate town of Hungary, capital of the county of Zempl^n, at the foot of Hegyalja, with 13,017 inhabitants in 1891 and 16,886 in 1901. The most remarkable buildings are the gymnasium, the hospital, and the tobacco factory. Its population is partly engaged in viticulture. In the vicinity is the village of Sz^phalom, where dwelt Francis Kiizinczy, the initiator of modern Hungarian literature.

Slltun. See Malay Peninsula,

SatSUma Islands, a group of islands belonging to Japan, lying westwards of the province of Satsuma (31 40' N. and 129 40' E.). The two principal are Kami-Koshiki-jima, which measures 24J miles by 5^, and Shimo-Koshiki-jima, which measures 8^ miles by 5^.

Sail go r, or Sagae, a tovra and district of British India, in the Jubbulpore division of the Central Provinces. The town is 1758 feet above the sea; raUway station. Population (1881), 44,416 ; (1891), 44,674. The canton-ments contain a Ijattery of artillery, a detachment of a European regiment, a native cavalry and a native infantry regiment. The town is handsomely built, and an emporium of trade. The Government high school had 849 pupils in 1896-97.

The district of Satjgok has an area of 4007 square miles. Population (1891), 591,743, showing an increase of 5 per cent.; (1901), 470,666 ; average density, 117 persons per square mile. The land revenue is Ks. 5, 70, 000, the incidence of assessment being R.0.4.7 per aefe ; cultivated area, 754,777 acres, of which 5943 were irrigated from wells ; number of police, 735 ; boys at school (1896-97), 6343, being 13 ‘8 per cent, of the male popula- tion of school-going age ; girls at school, 1391, being 3‘2 per cent., the highest proportion in the province; death-rate (1897), 85 ‘39 per 1000. The principal crops are millet, wheat, pulse, oil-seeds, and a little cotton. The branch of the Indian Midland Railway from Etawah to Saugor was extended to Damoh in 1898, and opened throughout to Katni, on the East Indian line, in 1899.

Sailijbuld.g’h, the principal town of the Mukri district, in the province of Azerbaijan in Persia, in a fertile valley, about 30 or 40 miles south of Lake Urmia, at an elevation of 4270 feet, in 36 46' K and 45 47' E. It has post and telegraph offices, and a population of about 7000, mostly Kurds of the Mukri tribe, and exports dried fruit, grain, and tobacco. There are many more localities with this name (Turkish, meaning cold stream, or cold spring) in Persia, the most notable, after the above-mentioned Kurdish city, being a district of the province of Tehran, with many villages.

Sault Ste Marie, a city of Michigan, U.S.A., capital of Chippewa county. It is at the rapids of the river St Mary, the outlet of Lake Superior, at the

eastern end of the Upper Peninsula. There are three railways, the Canadian Pacific, the Duluth, South Shore, and Atlantic, and the Milwaukee, St Paul, and Sault Ste Marie. The industries of the city are in great part con- nected with lumber, there being many saw and shingle mills, besides flour-mills, foundries, and machine shops. The river is here crossed at the head of the rapids by a fine railway bridge. The rapids make a descent of 18 feet in half a mUe. For the use of commerce these have

been avoided by locks ; the first, on the American side, having been superseded by a second and larger one, the largest in the world, and capable of holding the largest vessel on the lakes. The Canadians, also, have built a lock on their side of the river. Population (1880), 1947 ; (1890), 5760 ; (1900), 10,538, of whom 5329 were foreign- born.

Savag^e Island. See Polynesia.

Scivah, a small province of central Persia, situated north of Irik and south-west of Tehran, comprising the districts of Savah, Khalejistan (inhabited by the Turkish Khalej tribe), Zerend, and Karaghan. It pays a yearly revenue of about ►►5000. The capital is the ancient city of Sivah, which has a population of about 7000, and is situated 72 miles south-west of Tehran, at an elevation of 3380 feet, in 35►►4′ N. and 50►►30′ E. The soil is very fertile, is well watered, and produces much wheat, barley, and rice. It is occasionally joined to the province of Tehran in order to facilitate the governor's arrangements for supplying the capital of Persia.

Savannah, a city and seaport of Georgia, U.S.A., capital of Chatham county. It is situated in 32►►05′ N. and 81►►06′ W., on the river Savannah, near its mouth. Its site is in part on low ground, in part on a cliflF. It has an excellent water-supply from artesian weUs, and is well sewered. The harbour has been deepened by dredging by the United States Government. Formerly one of the chief export ports, especially for cotton, it has lost its relative position, not because of a decrease in business, but because of an increase in that of its rivals, especially New Orleans and Galveston. Its exports, chiefly cotton, fertilizers, and naval stores, had a value in 1898 of $28,937,614. Its imports were trifling. It is

at the junction of five railways, the Central of Georgia, the Florida Central and Peninsula, the Georgia and Alabama, the Plant System, and the Southern. In 1900 it contained 155 manufacturing establishments, vrith a total capital of $5,716,491. They employed 2870 hands, and the product was valued at $6,461,816. The principal item of manufacture was fertilizers. The manufacture of lumber also was of importance, as was the cleaning and polishing of rice. The assessed valuation of real and personal property was, in 1900, $37,108,077, the net debt was $3,196,350, and the rate of taxation was $25‘95 per $1000. Population (1890), 43,189, of which 22,978, or 53 per cent., were negro; (1900), 54,244, of whom 3434 were foreign-born, and 28,090, or 52 per cent., were negroes. Of 15,994 males 21 years of age and over, 2628 were ilHterate (unable to write), of whom 2435 were negroes.

Savig'lianO, a town of the province of Cuneo, Piedmont, Italy, 32 miles south of Turin by rail. It has important iron- works and foundries and silk manufactures, as well as sugar factories, printing, and cocoon raising ; also a technical school. Population (1881), 10,990; (1899), about 11,250.

Savings Banks. *The United Kingdom.* *The early history and working of savings banks down to 1884 is given in considerable detail in the ninth edition of this work. It is therefore only necessary to repeat that the idea of receiving small sums on deposit from the comparatively poorer classes, which seems to have been first suggested by Daniel Defoe, gradually developed from the middle of the 19th century in various parts of Europe, and especially in the United Kingdom. Like all sound movements for the welfare of the community, that of the extension of savings banks grew on a solid*

basis, and in a great variety of forms. Many Acts of Parliament have been passed for the management of these institutions in Great Britain, culminating in the establishment on a very broad basis of the Post Office savings banks, which are treated in a separate article in this work. It may be said that the pro- motion of thrift, which was at the end of the 18th

century an experiment, commenced and carried on by a few far-seeing individuals, had by the end of the 19th century become to be almost universally adopted, and to be regarded practically as an adjunct to the institutions of every civilized community. Friendly societies, co- operative societies, trade societies, and other agencies, all being based on this same principle of thrift, or the hus- banding of small resources for future use, have been brought into existence, and now count their members by hundreds of thousands. The idea has also developed, that in order to render schemes of savings as far-reaching as possible, and to embrace the less thrifty and thought- ful in the community, these institutions should be brought even to the doors of those for whom they are intended, and who might otherwise neglect or overlook the benefits they are intended to afltbrd.

Many of the old trustee savings banks which were put on a systematic basis in 1817, have been absorbed by the Post Office, but while the total amount Trustee of their deposits increases, the number of ?Miks.^ their depositors remains about the same. In 1863 there were 622 of these banks carrying on operations with 1,558,000 depositors, and deposits amounting to ►►40,563,000. In 1889 the number of banks had decreased to 380, with 1,500,000 depositors, and ►►45,000,000 of deposits; while in 1898 they had still further decreased in number to 231, but still had 1,527,000 depositors, and their deposits had increased to ►►49, 500,000. The reason for this is that the smaller trustee savings banks, open often only once a week for a short time, do not and cannot give such facilities as the Post Office, which is open every day and all day. Further than this, owing to the break up of the Cardiff bank in 1886, and other smaller irregularities, a select committee of the House of Commons was appointed to inquire into these banks. By the recommendations of this committee, an independent and permanent inspection committee was appointed, which has carried on its work of inspection ever since, and reports annually to Parliament. This action has rather tended to merge the smaller trustee savings banks in the Post Office. At the same time the large banks continue to do a very great business, and have become in many ways similar to ordinary joint stock banks, afford- ing to persons of smaller means daily facilities for saving. Those who have studied the habits of thrift among the people have usually come to the conclusion that its de-

velopment depends largely on the ready facilities which exist for its exercise. To this fact may perhaps be at- tributed the efforts, already referred to, that have been made in various directions for establishing some means of saving close to the places where wages are paid. To carry out this idea, some of the large railway corporations have obtained powers in special Acts of Parliament to establish savings banks for those in their employment. The success of these banks has been great, though it has varied much, and it is difficult to trace any general rule of progress. Thirteen of such institutions return their operations to the Eegistrar of Friendly Societies. The total amount held was, by the same return for 1898, ►►3,016,146 in 38,503 accounts. In these banks the interest paid, as well as the deposits, are really guaranteed by the whole assets of the companies. Further, in order to encourage thrift among their employes, the companies have formally agreed and

bound themselves, by the provisions of their special Acts, that the rate of interest paid shall be higher than can be obtained in the open market on the same security. Thus the South-Eastern and Chatham Eailway gives 4 per cent., and their 4 per cent, debenture stock, which is not a better security than the savings bank, is considerably above par. Other efforts have been made to establish savings banks at factories, to be open at the time wages are paid. One great difficulty, however, has been met with, and that is the objection many of those employed have to their em- ployers knowing of their savings, and their fear lest it may affect their rate of pay. To get over this objection the plan has been tried of employing an outside agency to hold the savings bank. This has not been much more successful, as the suspicion that accounts may be looked at by em- ployers is difficult to overcome. It is found that the most successful savings banks are those which are carried on as a business, where the transactions are so numerous that the individual feels that his own private account is not likely to become known.

Another class of savings bank which of late years has developed considerably, is the penny bank. These banks have a twofold object : one to provide facilities for putting by extremely small sums for those banl^. whose means are very limited, and the other to attract children in their earliest years so as to train them to habits of thrift and the realization of

the importance and use of even quite small savings. Some form of penny bank now exists in nearly every district, and indeed in nearly every parish. No returns have been collected, but it may be safely said that there are tens of thousands in operation. Many of these penny banks are feeders to the Post Office, which gives them special advantages to invest in that institution. Not only is the gross amount of money thus taken large, but (what is more important) the habit of thrift and of husbanding resources is being taught to the young in all parts of the United Kingdom. This has been one cause of the large extension of the Post Office savings bank itself, and has no doubt .led to considerable change in the habits of the people. In a few cases success- ful efforts have been made to establish permanently these penny banks on a commercial basis, as in the case of the Yorkshire Penny Bank, which has 928 branches, 432,786 depositors, and deposits, ––12,500,861 ; and the National Penny Bank, which has 13 branches in London, most of them open from 9 in the morning till 9 at night, with 129,228 depositors, and ––1,811,334 in deposits on the 31st December 1899. The establishment of penny banks in schools has been carried on for many years, and it is difficult to exaggerate the useful work they have done in inculcating habits of thrift in the children, and in adding depositors to the Post Office savings banks when the children start in life. In England and Wales as many as 7393 of these savings banks were held in the 19,937 elementary schools inspected by the Education Department. The number seems to be somewhat dimin- ishing––––in 1894, 8668; in 1895, 8410; in 1896, 8065; in 1897, 7489. The reason for this diminution may be the very great amount of clerical labour which the conduct of these institutions imposes on the teachers in addition to their many other duties. The Board schools in London have done much to promote this movement. From the last return of these institutions under the London School Board, it appears that school penny savings banks are held in 231 departments of these Board schools. In these during 1898 there were 41,879 depositors on the books, who deposited ––17,428 in the year ; of this sum, ––16,692 was withdrawn, leaving with previous balance ––6161 in hand. This may not be considered a large financial result with over half a million children on the

registers, but its educational effect is considerable. It is also found that many children open accounts at outside penny banks in preference to going to those carried on at their own schools, though it is probable that the idea of so doing is often suggested by the school savings bank.

With a view of bringing the savings bank still nearer the doors of the people, efforts have been made to estab- lish collecting savings banks. In these the collector calls at fixed periods for the deposits. This scheme has grown out of the investigations of a committee of the Charity Organization Society, and is based on the idea, which undoubtedly is the fact, that many people will make contributions when the money is called for, who will not take the trouble to walk a few yards themselves to make the same deposit. That this is so is proved most conclusively by the Post Office life insurance experience, a branch of the Post Office which is scarcely used by the people, while at the same time collecting life insurance companies (which of course must charge a considerable extra premium for collecting) do business to the extent of millions. From the report of these collecting savings banks in 1898, it appears that 49 such institutions were in operation in England, the number of depositors being about 23,000, and the amount deposited in the year about ??20,000. In most of these banks no interest is given, but facilities and encouragements are afforded for the transfer of each individual account to the Post Office as soon as it is large enough to earn interest.

Closely allied, though essentially different, are the very numerous sharing-out clubs which may be called temporary savings banks. These nearly all take a weekly subscrip- tion from their members, and, should any member die, his representative receives a certain sum, the balance left being divided at Christmas equally among the survivors, in pro- portion to the weekly subscriptions. Some of these clubs are registered, and a rough estimate in 1899 gave the number as 847, with 115,000 members. The unregistered are, however, much more numerous, though no official information is to be had of them, and it is certain that hundreds of thousands of pounds are divided in this way each Christmas.

The attempt to induce sailors and soldiers to exer- cise habits of thrift by the establishment of naval savings banks under the Act of 1866, and military savings banks under the Act of 1859, should be mentioned. The amount in the naval savings bank in March 1898 was ––262,772. As might be expected the amount does not grow. This is accounted for by the fact that the depo- sitors leave the service and draw out their savings. About ––200,000 a year, however, goes in and out of the naval banks, and ––80,000 in the army banks. This sum repre- sents a good deal of self denial, when the margin within which it is possible to save among sailors and soldiers is considered.

Closely allied to savings banks are a number of societies which need only be briefly referred to here. The largest of them are building societies under the Act of 1874, which are a very popular form of saving, especially in certain localities. The cojitributions to the shares of these societies, which are paid by instalments, differ but little from the periodical payments into savings banks ; and although the money is not so readily repaid, notice and other forms having to be gone through, large numbers of persons pay in and draw out money, and receive the interest on the shares in much the same way as they do on deposits in savings banks without any idea of building or buying houses. In 1898 the receipts were ––38,394,220 in the United Kingdom, and the accumulated capital was more than ––57,000,000, with a membership of 619,741. The action of industrial and provident societies

regulated under the Act of Parliament of 1893, must also be mentioned with reference to that part of their business which is closely allied to savings banks. These societies are divided into three classes ; ––– (a) ordinary co- operative societies with 1,256,666 members; (4) societies for carrying on various businesses, including loaa and banking, with 42,312 members; (c) land and building societies, with 11,144 members. The total, therefore, is 1,310,122 members. Most of these societies, indirectly or directly, act as savings banks, and have had con- siderable influence in the growth of thrift in the United Kingdom. In the co-operative societies the sales amounted to more than ––48,000,000, and the profits to nearly ––5,000,000. These profits are divided in different ways among the members, and they form a saving fund of large dimensions. The

societies for carrying on various businesses, such as working men's clubs, loan and banking organizations, registered under the 1893 Act, numbered 127 in 1898, with total receipts ––1,773,849. These are not rapidly increasing, but they must be in- cluded as one exhibition of the savings of the people, and they are practically used as savings banks. The land and building societies under the Act of 1893 are not the same as those above referred to, though their action as regards savings is similar. They are not under the Act of 1874, but carry on a trade or business, including dealings of any kind in land. Their operations are slightly in- creasing. They received ––131,739 from subscriptions and other sources, according to the last return in 1898, and the value of the land and mortgages was ––632,790. Two other classes of institutions should be referred to, the friendly and trade societies, which exist for special purposes, namely, to make provision in sickness, for death, for a want of employment, and to a limited extent for old age. They differ essentially from savings banks, as the subscriptions are parted vnth and cannot be with- drawn. But as the subscriptions are for certain definite needs, almost certain to be required by each member, which but for those societies would have to be provided for by direct savings in banks, they must be mentioned in treat- ing of the subject as a whole. The amount held by the friendly societies is estimated at ––37,917,702, subscribed by 11,424,810 members. The income from 630 trade societies in 1898 was ––2,856,354, received from 1,219,474 members.

The general conclusions to be drawn from the progress of savings banks of all kinds during the last quarter of the 19th century must certainly be that facilities exist, and are in active operation for the exercise of thrift in many new channels. The gross number of members must form a large proportion of the entire population, even allowing for the fact that many are making use of several of the forms of savings banks that have been referred to. It was once stated, and with truth, that the national debt was held by a very small proportion of the population ; but this is not so now. The various agencies which may be described as savings banks in different forms, hold at least ––200,000,000, or a third of the National Debt of Great Britain. (x.)

United States.

There are two kinds of savings banks in the United States, Mutual Savings Banks, or savings banks proper, and Stock Banks, having capital and doing a combined commercial and savings business. To these might be added School Savings Banks. There are no postal banks of this kind. AU these institutions are organized under the laws of the states where they are located, and are generally under the supervision of an officer appointed by the governor. The distinctive feature of Mutual Savings

Banks ia that they have no capital, and do a strictly invest- ment business, all their earnings going to the depositors. Their management is vested in a board of trustees, a self- perpetuating body who serve without pay, except for specific service such as appraising property. Executive officers and clerks are paid moderate salaries. The pro- portion of annual expense to each dollar of assets is sometimes less than ???0025. The rate of interest on deposits usually ranges from 3 to 4 per cent. Depositors have no voice in the management, except as citizens of the state, through their representative in the state legislature. Nearly all the states limit investments carefully, though a few permit considerable latitude : in New York the deposits in savings banks are considered next to Govern- ment bonds as safe investments. In eight out of the fifteen states having mutual savings banks, deposits are exempt from taxation ; in the others the rate varies from J^ to f of 1 per cent. The amount which each person may deposit each year or half-year and the total amount to his credit are usually limited by the by-laws. Deposits are in practice generally payable on demand, though the banks reserve the right to require notice, generally from sixty to ninety days, and sometimes enforce this right in times of panic. The first savings bank incorporated in the United States was the Provident Institution for Savings, incorporated in Boston in 1816. The oldest in New York is the Bank for Savings, of New York City, incorporated in 1819. The largest deposit of any bank of this kind in the United States, $67,735,560, is that of the Bowery Savings Bank of New York. Mutual savings banks are confined chiefly to the New England and Middle states. There is no other kind of savings bank in Maine, New

Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, and New Jersey. The growth of banks in these states from 1887 to 1897 was as follows :

1887.

1897.

Number of banks . Number of depositors . Amount of deposits Average to each depositor

593

3,030,094

$1,099,313,155

362

646

4,311,972

$1,667,486,734

386

The only mutual banks outside the North-Eastern states are four in Ohio, five in Indiana, four in Minnesota, and one each in West Virginia and Wisconsin.

Though the laws governing mutual banks vary in the different states, the following abstract of the New York Savings Bank Law of 1875, re-enacted in 1892, and subsequently amended, gives the main principles on which they are organized. It is of especial interest in view of the fact that the savings banks of New York are the most important banking institutions chartered by any of the states :

Thirteen or more persons may incorporate a savings bank, two- thirds of whom shall be residents of the county where the proposed bank is to be situated. When the certificate of organization is filed ???with the superintendent of banks, who exercises supervision over all banks chartered by the state, he is required to ascertain whether the bank is in fact needed in the community where it is to be organized, and to investigate the chariirter and genoral fitness of the trustees. The present superintendent of l];inks rnquires that the incorporators of a savings bank shall defray personally the expenses of the institution until its earnings are sufficient to meet such expenses, and also return dividends at the rate of 3 \m- cent. The board of trustees havi' entire control of the management of the bank. They elect the jiresidcnt and other officers. A trustee who borrows any of the bank's funds, or who becomes a surety for any other borrower, forfeits his office. Trustees arc not allowed to have any interest in the profits, or to borrow the deposits or funds of the bank.

The trustees of any savings bank may invest the moneys deposited therein and the income derived therefrom as follows : ???1. In the

stocks or bonds or interest-bearing notes or obligations of the United States, or those for which the faith of the United States is pledged, including the bonds of the District of Columbia. 2. In the stock or bonds or interest-bearing obligations of this state.

3. In the stocks or bonds or interest-bearing obligations of any of the United States which has not within ten years defaulted in the payment of any part of any debt authorized by its legislature.

4. In the stocks or bonds of any city, county, town, or village, school district bonds, and union free school district bonds, issued for school purposes, or in the interest-bearing obligations of any city or county of this state. 5. In the stocks or bonds of a number of specified cities without the state, subject to the condition that if at any time the indebtedness of any of said cities, less its water debt and sinking fund, shall exceed 7 per cent, of its valuation for purposes of taxation, its bonds and stocks shall cease to be an authorized investment. 6. In bonds and mortgages on unen- cumbered real property situated in this state, worth at least twice the amount lent thereon. Not more than 65 per cent, of the whole amount

of deposits shall be so lent or invested. If the loan is on unimproved and unproductive real property, the amount lent thereon shall not be more than 40 per cent, of its actual value. No investment in any bond and mortgage shall be made by any savings bank, except upon the report of a committee of its trustees. 7. Also, by virtue of a law passed by the legis- lature of 1898 : In the first mortgage bonds of any railway corpora- tion of this state, or in the mortgage bonds of any such railway corporation of an issue to retire all prior mortgage debt of such rail- way corporation, provided the bonds satisfy certain precautionary conditions. Not more than 20 per cent, of the whole amoimt of deposits shall be thus lent or invested. Street railway cor- porations shall not be considered railway corporations within the meaning of this section. An Act passed in 1900 permits the invest- ment of deposits in the bonds of certain railways situated in other states. These investments must conform to conditions assuring

Savings banks in New York are preferred creditors of insolvent state banks and trust companies. In 1901 a law was passed pro- viding for a tax of 1 per cent, on the surplus of savings banks, computed on the par value of their securities. In the year 1900 the resources of the savings banks exceeded those of both the discount and deposit banks and of the trust companies chartered by the state ; in 1900 the savings banks held $1,000,209,099 ; the dis- count and deposit banks $323,864,743; and the trust companies 1672,190,671. The deposits in the savings banks amounted to $887,480,650, distributed amongst 1,981,371 depositors ; interest credited for the preceding year amounted to $29, 539, 688 ; expenses for the year were $2,629,835, or $2-62 for each SIOOO of resources. Loans on real estate, secured by bond and mortgage, amount to $406,210,574, and investments in stocks and bonds, market value, $502,265,621. The gain in resources in 1899 was over $76,000,000, and was the highest ever known. The savings depositors through their banks have puTchased ? ? 3, 733, OOOof the state debt, $146,399,233 of the bonds of cities in the state, and $43,420,043 of town, county, village, and school district bonds.

Stock Savings Banks do not as a rule differ from ordinary banks of deposit and discount, except in receiving smaller sums on deposit. They

are found in the more purely agricultural parts of the country, the Southern, Mississippi Valley, and Western states, where only a small proportion of people earn wages in manufactures and commerce, suitable investments are not numerous, the benefits of mutual savings banks are not familiar, and the people are unwilling to accept a low rate of interest. In some states having stock banks there are no laws relating to banking, and in others the savings banks carry on their business under the same laws as commercial banks. Several of the states restrict the investments of the stock savings banks. Prior to 1865, \'lien the issue of circulating notes by state banks was suppressed by a prohibitory tax, there was a distinction between state banks and stock savings banks ; the former could issue notes, while the latter, as a rule, could not. Stock savings banks are conducted frequently as adjuncts of stute and national banks, occupying the same rooms and being under the same management.

The law of the state of Iowa, enacted in 1874, is typical of those states where stock banks are under public supervision. A savings bank may be organized by not less than five persons. In towns of ten thousand inhabitants or less it must have a onpitAl of $10,000, and in towns or cities with more than ten thousand inhabitants 150,000. The usual corporate powers are granted. The amount of deposits is limited to ten times the paid-up cai-.ital, and in case

this amount should be exceeded, the capital must be increased In proportion. The usual provisions for repayments of deposits are made, and in addition the savings banks are given the privilege of requiring sixty days' notice for the withdrawal of deposits.

TliB banks are allowed to invest their funds in the following securities : ⬚⬚⬚(1) Stocks, bonds, or interest-bearing notes of the United States. (2) Stocks, bonds, or evidences of debt bearing interest of the state of Iowa. (3) Stocks, bonds, and warrants of any city, town, village, or school district in the state regularly issued, but the investments of any savings bank should not consist of such bonds or warrants to a greater amount

than 25 per cent, of the assets. (4) Mortgages or debts on unencumbered real estate within the state worth at least twice the amount lent. (5) It is lawful for such banks to discount, purchase, sell, and make loans upon personal or public security, except shares of their own capital stock.

Property acquired by foreclosure of mortgages, &c., may not be held more than ten years. The rate of interest to be paid is left to the discretion of the trustees, and the profits, after the payment of such interest and expenses, go to capital stock. Stockholders are liable to the creditors for double their stock, and for such liabilities continued for six months after the transfer of any stock. Directors receive no compensation. Officers and directors of the bank are required to give the same security for loans that is required of others, and such loans can only be made by the board in the absence of the party applying. The savings banks are prohibited from lending to any individual or firm more than 20 per cent, of the capital stock. All savings banks are required to make a quarterly statement to the auditor of the state, giving in detail the statement of condition upon a given day. This statement is made under oath of the officers, and is required to be published. The state auditor is given the power to examine any savings bank at any time, and should the conditions warrant, he is required to report to the attorney-general, who iustitutes proceedings under the law relating to insolvent corporations. Provision is made for increasing the capital stock by a two-thirds vote of the existing shares. The corporate existence of the banks is placed at fifty years.

Under the above law the number of banks increased from 19 in 1875 to 195 in 1899; their capital from $755,500 to $7,800,000 ; and the deposits from $2,338,685 to $48,147,860. In 1899 the 287 stock savings banks of the United States held savings deposits amounting to $218,759,168 and deposits subject to check, $2,538,125.

Loans and Investments. ??? In his annual report dated 31st October 1899, the comptroller of the currency gave data of the loans and investments of 942 out of the 987 savings banks in the United States, of which 655 were mutual and 287 stock banks. As the banks are not under his supervision, being under the control of the respective states, reports are available from only such banks as choose to send them. The loans of

the 942 banks aggregate $1,098,598,589, of which $878,126,859 were secured by real estate, $156,359,308 by collateral other than real estate, and $64,112,422 by personal and other security. The investments in United States bonds amount to $136,930,208; state, county, and municipal bonds, $512,777,336 ; railway bonds and stocks, $167,998,336; bank stocks, $36,637,920; other stocks, bonds, and securities, $230,796,388.

The following are the statistics as to the deposits of the total number of mutual and stock savings banks in the United States : ???

Tears.

No.

of

Banks.

No. of Depositors.

Deposits.

Average, due each Depositor.

Average per Caput in the U.S.

1896 1897 1898 1899

988 980 979 987

5,065,494 5,201,132 5,385,746 5,687,818

$1,907,156,277 1,939,376,035 2,065,631,298 2,230,366,954

$376.50 372.88 383.54 392.13

$26.68 26.56 27.67 29.24

School Savings Banks were first established in the United States in 1885 by J. H. Thiry, at Long Island City, New York. On 1st January 1900 the system was in use in 526 schools, distributed throughout 97 cities or villages and 15 states. Out of 179,630 pupils registered in these schools, 52,694 have saved $806,0159, of which

$525,209 has been withdrawn, leaving a balance of $280,806 due depositors. In those parts of the country where there are no savings banks their place is largely supplied by building and loan associations. For further details see the articles on the several states. (b. e.)*

SclVOie, a department of the south-east of France, bordering on Italy, traversed by the chain of the Alps and its ramifications, and watered by the Isfere and Arc.

Area, 2389 square miles. The population, 266,438 in 1881, had decreased to 249,460 in 1901. The births in 1899 were 5853, of which 315 were illegitimate ; deaths, 5577 ; marriages, 1670. The schools in 1896 numbered 989, with 47,000 pupils, 2 per cent, of the population being illiterate. The acreage under cultivation in 1896 amouuted to 854,620, of which only 219,830 acres were in plough-land and 24,700 acres in vines. The wheat grown in 1899 was valued at ►►165,000 ; rye, ►►98,000 ; oats, ►►56,000 ; maize, ►►40,000 ; potatoe.s, ►►148,000 ; natural pastures, ►►402,000 ; tobacco, ►►40,000 ; walnuts, ►►78,000. The vintage of 1899 was valued at ►►248,000. The horses in Savoie (1899) numbered only 3080, the asses, 5200 ; cattle, 124,840 ; sheep, 71,630 ; pigs, 11,980 ; goats, 15,900. Savoie in 1896 produced 10,582 metric tons of coal, 6217 tons of lignite, 140 tons of peat ; 636 tons of iron ; and 69 tons of other minerals, of a total value of ►►5500. The industry in metals registered (1898) 29 metric tons of iron and 162 tons of steel, amounting, with inclusion of the other metals, to the value of ►►6100. The other industries are in a backward state. Chamb^ry, the capital, had 22,108 inhabitants in 1901.

Savoie, Haute-) a department of south-east France, bordering on the Lake of Geneva and on Switzer- land, and dominated by Mont Blanc.

Area, 1775 square miles. The population, 274,087 in 1881, had decreased to 259,595 in 1901. The births in 1899 were 6010, of which 310 were illegitimate ; deaths, 5534 ; marriages, 1771. There were in 1896 917 schools, with 43,000 pupils, 1 per cent, of the population being illiterate. The land under cultivation in 1896 comprised 827,460 acres, of which 291,460 acres were plough-land and 18,525 acres in vines. The wheat produce of 1899 was valued at ––358,000; oats, ––113,000. The vintage of the same year was estimated at ––234,000 ; the potato crop, ––241,050. In green crops (trefoil and sainfoin) the department reaped in 1898 the value of ––256,000, and its natural pastures and grass lands yielded ––412,000. Its live stock included 10,040 horses, 1960 mules, 13,090 cattle, 35,580 sheep, 28,210 pigs, and 23,940 goats. Mining in 1898 produced 215 metric tons of coal, 40 tons of peat, and 2660 tons of bitumen, valued altogether at ––1510. Metallurgical industry turned out (1898) 2310 metric tons of iron and 440 tons of steel, valued at ––21,000. Other industries are silk, tanning, and weaving. Annecy, the capital, had in 1901, 13,611 inhabitants,

Sa.VOna, a town and episcopal see of the province of Genoa, Liguria, Italy, on the coast of the west Riviera, 26 miles west by south of Genoa by railway. It is one of the chief seats of the iron industry, having iron-works and foundries, iron shipbuilding, railway workshops, engineer- ing shops, brass foundry, tinplate works, sulphur mills, and glass-works. It is also a considerable seaport, importing commodities to the value of nearly two millions sterling (––1,754,300 in 1899), chiefly coal, with petroleum, iron, cereals, &c. There is a small export trade (––30,000 to ––40,000 annually), of which preserved tomatoes, wood, and candied fruits are the chief elements. In 1899 the port (22 to 26 feet deep) was entered by 1139 vessels of 559,200 tons, as compared with 855 vessels of 356,300 tons in 1892. There are a technical institute and a commercial institute. Population (1881), 24,481 ; (1899), about 28,500.

Savory, Sir William Scovell, Baet. (1826-

1895), British surgeon, was born 30th November 1826, in London. He entered St Bartholomew s Hospital in 1844 (M.R.C.S. 1847, F.R.C.S. 1852). From 1849 to 1859 he was demonstrator of anatomy and operative

surgery at St Bartholomew's, and for many years curator of the museum, where he devoted himself to pathological and physiological work. In 1859 he succeeded Sir James Paget as lecturer on general anatomy and physiology. In 1861 he became assistant surgeon, and in 1867 surgeon, holding the latter post till 1891 ; and from 1869

to 1889 lie was lecturer on surgery. In the College of Surgeons lie was a man of the greatest influence, rising to be president for four successive years, 1885-88. As Hunterian professor of comparative anatomy and physio- logy (1859-61), he lectured on " General Physiology" and the "Physiology of Food." In 1884 he delivered the Bradshaw Lecture on the "Pathology of Cancer." In 1887 he delivered the Hunterian Oration. In 1879, at Cork, he had declared against " Listerism " at the meeting of the British Medical Association ; " the last public ex- pression," it has been said, "by a prominent surgeon against the now accepted methods of modern surgery." In 1887 he became surgeon-extraordinary to Queen Victoria, and in 1890 he was made a baronet. Savory was an able operator, but averse from exhibitions of brilliancy, and was altogether a powerful and authorita- tive man in his profession ; his lucidity of expression being almost as valuable in that respect as his great knowledge of physiology and anatomy. He died in March 1895.

Sa.wa.ntwa.ri, or Savantvadi, a native state of India, in the Konkan division of Bombay. Area, 926 square miles. Population (1891), 192,948; (1901), 217,800; average density, 235 persons per square mile.

The estimated gross revenue is Rs. 4,31, 867, of which Rs. 46,814 was expended on public works in 1897-98 ; no tribute ; military force, 400 men ; number of schools, 170, with 6386 pupils in 1897-98, being 3'2 per cent, of the population, compared with 2'4 per cent, for Bombay generally. The chief, whose title is Sir Desai, is a Maratha of the Bhonsle family. The late chief, who had been educated at the Eajkot College, died

in December 1899, with no direct heir. It has special manufactures of ornaments carved out of bison-horn, painted and inlaid lacquer-work, and gold and silver embroiderv. The town of Sawantwaki, or Wari, is 17 miles from the seaport of Vengurla. Population (1881), 8584 ; (1891), 9269 ; municipal revenue (1897-98), Es.6348, the incidence of taxation being 9 annas per head. It was founded in 1670, on the edge of an artificial lake amid hills. There is a high school, and Westropp hospital, with an endowment of Es.10,000, raised to commemorate the Diamond Jubilee.

Saxe, John Godfrey (1816-1887), American poet, was born at Highgate, Vermont, 2nd June 1816. He graduated at Middlebury College in 1839, and became a lawyer, being at one time attorney-general of Vermont. He also engaged in politics as a Democrat, and edited a newspaper in Burlington ; but he was best known as a humorous poet and a lecturer. His swiftly-moving lines abounded in puns and witty turns, his travesties and satires found many readers or listeners, and some of his love lyrics or other pieces combined sparkle with real feeling. During a part of his later life he was editor of the Evening Journal at Albany, New York, where he died 31st March 1887.

Saxe-Altenburgf, a duchy of Germany, one of the Thuringian states, has an area of 511 square miles, and a population (1895), 180,313; (1900), 194,273, of whom 95,442 were males and 98,831 females; the density being 380 inhabitants to the square mile. In 1895 the Protestants numbered 168,549, or 93-5 per cent., and the Koman Catholics 2091. In the same year the duchy contained 16,180 farms, of which 13,589, or 84 per cent., were each less than 25 acres. The live stock in 1900 totalled 69,172 cattle, 66,895 pigs, 12,282 horses, and 9860 sheep. The lignite mines yielded (1900) 1,865,517 tons, valued at ––229,300. For the period 1899-1901 the state revenue was fixed at ––228,600 annually, and the expenditure at approximately the same. The public debt in 1900 amounted to ––44,370, and the contribution to the imperial exchequer in 1901 to ––98,550.

Saxe-Coburg^-Gotha, a duchy of Germany, one of the Thuringian states, with an area of 755 square miles,

and population (1895), 216,603; (1900), 229,567, of whom 110,949 were males and 118,618 females; the density being 304 inhabitants to the square mile. About 98 per cent., or 212,514, of the inhabitants were Pro- testants, and 2956 Roman Catholics. In 1895 the duchy comprised 29,458 farms, of which 15,230 were each less than 2|- acres in extent and 11,100 between 2|- and 25 acres. The number of persons supported by agricul- ture was 60,633, or 28 per cent, of the population. In 1900 the live stock numbered 95,988 pigs, 68,780 cattle, 47,718 sheep, and 10,301 horses. The public revenue during the period 1899-1901 was fixed at ►►135,600 annually, and the expenditure at ►►165,800 ; in addition, there was a special revenue for the duchy of Coburg of ►►70,960 annually, and expenditure of ►►63,740, and a special revenue of ►►126,150 annually for the duchy of Gotha and an expenditure of ►►177,210. The public debt of Coburg amounted in 1900 to ►►141,560, and of Gotha to ►►107,330; and in 1901 their joint contribution to the imperial exchequer to ►►116,350. The duke of Albany, grandson of Queen Victoria, succeeded to the duchy in 1900 on the decease of his uncle, the duke of Edinburgh, who had become duke of Saxe-Coburg-Gotha in 1893.

Saxe-Meiningen, a duchy of Germany, one of the Thuringian states, with an area of 953 square mUes, and population (1895), 234,005; (1900), 250,683; of whom 123,027 were males and 127,656 females. Density, 263 inhabitants to the square mile. Of the total popula- tion in 1895, 228,969, or 98 per cent., were Evangelical Lutherans, 3188 Eoman Catholics, and 1487 Jews. Agri- culture supports 67,540, or 29 per cent, of the population. Out of the total number of farms (31,907), in 1895, 15,370 were each under 2-|- acres in extent, 13,469 be- tween 2\ and 25 acres. In 1900 the live stock numbered 74,491 cattle, 80,322 pigs, 31,232 sheep, and 7780 horses. For the period 1900-02 the public revenue was fixed at ►►437,225, and the public expenditure at ►►394,430. The public debt in 1901 amounted to ►►415,175, and the contribution to the imperial exchequer to ►►127,225.

Saxe- Wei mar, a grand-duchy of Gtermany, one of the Thuringian states, with an area of 1388 square miles, and a population (1895), 339,217 ; of whom 325,315, or 95-9 per cent., were Evangelical Lutherans, 12,112

Eoman Catholics, and 1290 Jews. In 1900 the population was 362,018, of whom 176,650 were males and 185,368 females. In 1895 the population was rural to the extent of 60‘3 per cent., the rest being urban (39-7 per cent.). During the years 1890-98 inclusive, an average of 119 persons emigrated annually; in 1900 they numbered 86. The university of Jena is common to the four Saxon duchies. The supreme court of Jena serves as a common court of appeal for these duchies, for Schwarzburg-Eudolstadt, for the two Reuss principalities, and for certain parts of Prussia. The number of persons supported by agriculture in 1895 was 123,011, or 36‘2 per cent, of the population. The total number of farms in 1895 was 42,227, of which 16,575 were each less than 2i acres and 19,419 between 2-^ and 25 acres. In 1900 the live stock numbered 156,995 pigs, 134,628 cattle, 88,300 sheep, and 22,207 horses. For the financial period, 1899-1901, the state revenue and expenditure were balanced at ––523,000. In 1900 the public debt was ––97,000, and in 1901 the amount contributed to the imperial exchequer ––183,550.

Saxony, a kingdom of the German empire, rank- ing fifth in area, third in population, and first in density.

Area and Population. ––– The census returns for 1885, 1895, and 1900, together with the area and density of the

kingdom and its administrative districts, are given in the subjoined table : –––

District.

Population,

1885.

Population,

1895.

Population,

1900.

Area in aq. miles.

Density

per sq.

mile in

1900.

Bautzen Dresden Leipzig . . Chemnitz . Zwickau .

Total .

356,560 860,558 774,036

|l,190,849

385,080 1,067,757

945,179 / 734,044

\ 655,628

405,092

1,216,044

1,059,273

791,896

727,453

953

1674

1377

799

984

425 726 769 991 739

3,182,003

3,787 688

4,199,758

5787

726

The former district of Zwickau has been divided into the two new districts of Chemnitz and Zwickau, and the 1895 population (1,389,672) is duly divided for that year between them. Of the total population in 1900, 2,042,437 were males and 2,157,321 females, or 1056 females to every 1000 males. As will be seen, the density is exceptionally high ??? in fact, the highest in the empire, with the exception of the Hanseatic towns.

The average density of the entire empire in the year 1900 was 270. Of the total population in 1900, 2,100,475, or 50‘01 per cent., lived in towns, the remaining 49‘99 per cent, in rural communes. The largest towns of the country in 1900 were Leipzig (455,089), Dresden (395,349), Chemnitz (206,584), Plauen (73,891), Zwickau (55,825), and eight others with above 20,000 inhabitants each. The next table shows the movement of the population for the years 1888 to 1899 : ???

Mar- riages.

Total Biriihs.

Illegiti- mate.

Total Deaths.

Biriih- rate.

Death- rate.

Illegiti- macy per- centage.

Mar- riage Rate.

Annual average,

1888-97

161,000

96,109

41-8

26-6

12-6

9-1

1898 1899

38,6U

38,980

162,655 164,184

21,059 21,148

92,785 99,609

41 40-4

22

24-5

12-9 12-9

9-1 9-6

The number of emigrants gradually diminished from 4920 in 1892 to 950 in 1897, and, after an increase to 1128 in 1898, again fell to 876 in 1900; the annual average for the ten years 1889-98 being 2521.

Agriculture. ??? In 1895 agriculture supported 716,450 persons, or 19 per cent, of the population. The annexed table shows the farms classified according to size : ???

Under 2i acres.

Between 2} and 25 acres.

Between 25 and 250 acres.

Above 250 acres.

Total Farms.

96,796

67,685

28,392

764

193,627

In 1900 there were 687,587 cattle, 676,825 pigs, 166,713 horses, and 74,518 sheep in the kingdom.

Industry and Mining, ❓❓❓ In 1898, 601,677 peraons were engaged in these occupations, distributed as follows : ❓❓❓ 178,571 in the textile industries, 74,234 in the manufacture of machinery and instru- ments, 92,807 in mining, quarrying, and smelting and founding metals; 34, 573 in forestry, saw-milling, &c. ; 27, 088 in paper manu- facture ; 22,230 in printing and similar branches; and the rest (72,174) in other branches. In 1900, 120 coal-mines were in active work, 89 being lignite mines ; their output was 6,843,213 tons, valued at ❓❓3,230,600. There were 13 iron and salt mines at work, and they produced 13,087 tons of ore, valued at ❓❓24,000, and 8 mines of cobalt, nickel, and bismuth produced 696 tons of ore valued at ❓❓29,650. The iron works, foundries, &c., produced 342,152 tons of iron and steel, valued at ❓❓3,507,850 ; the breweries 107,386,660 gallons of beer, the distilleries 2,965,100 gallons of pure alcohol, and the sugar factories 19,850 tons of sugar. Quarry- ing is extensively carried on, over 3800 persons being employed in quarrying sandstone near Pima alone.

Communications. ❓❓❓ In 1900, 1880 miles of railway were open for traffic, all except 25 miles belonging to the state. In 1898 the telegraph lines reached a total of 3760 miles, and telegraph wires 17,910 miles ; the length of telephone lines was 2686 mUes.

Religion and Education. ❓❓❓ In 1895, 3,611,670 persons, or 95‘3 per cent, of the population, belonged to the Evangelical Lutheran

Church, 140,285 were Roman Catholics, 10,538 were “Reform- ists,” 15,069 belonged to other Christian sects, and 9902 were Jews. The university of Leipzig ranks after Berlin and Munich in respect of the number of students attending it (3586 in 1900-01). The remaining educational facilities embrace the technical higli school (polytechnic) at Dresden, 2 “provincial ” schools, 17 classi- cal, and 10 semi-classical schools, 34 “modem” schools, 22 semin- aries, and 3 higher girls’ schools. There are also about 4340 elementary and advanced elementary schools in the kingdom, and they are attended by approximately 792,200

children. In 1900 the mining academy at Freiberg had 330 students ; the 2 mining schools, about 160 pupils ; the academy of forestry at Tharandt, 89 pupils ; the 7 schools of navigation (1898), 17 teachers and 157 pupils ; the veterinary high scliool, 212 students : besides which there are 2 art academies, 3 industrial art schools, 2 conservatories of music, a shorthand institute, school of political economy, 4 architects' schools, some 200 schools for training artisans and designers in special industries, 8 agricultural and horticultural schools, 44 commercial schools, 15 music schools, and 1 dramatic school. The military schools are mentioned in the next section.

Army. ❓❓❓ In 1900 the peace footing of the Saxon army (12th Army Corps of the imperial forces) numbered 43,288 men of all arms. The cadet school at Dresden has about 250 pupils, and 2 non-commis- sioned olfioers' schools at Marienberg are attended by 500 men.

Finances. ❓❓❓ For the period 1900-01 the ordinary annual revenue was fixed at ❓❓4,609,900, and the ordinary annual expenditure at the same figure ; but there were in addition an extraordinary revenue and an extraordinary expenditure, balancing at ❓❓4,934,100, this expenditure being for public works. Of the ordinary revenue ❓❓2,504,400, or 544 P^r cent., was derived from state-owned sources, e.g., forests, domain lands, mines, the porcelain factory of Meissen, and railways (❓❓1,784,100). Direct taxes, chiefly income-tax, yielded ❓❓2,105,500. The amount upon whicli income-tax was levied was ❓❓83,326,100 in 1894, and ❓❓110,703,670 in 1900. Out of the total number of persons who paid income-tax in 1898, viz., 1,467,070, no less than 1,396,218, or 95 per cent., paid on incomes under ❓❓165 per annum, and of these again 319,813 paid on incomes between ❓❓20 and ❓❓26 a year. In 1900 the amount of the national debt was ❓❓41,491,120, and in 1901 the amount contributed to the imperial treasury ❓❓2,133,650. See Kalender und Statistisches Jahrbuch filr das Kimigreich Sachsen auf das Jahr 1900, &C. (Dresden, 1899).

Saxony, a province of Prussia, with an area of 9750 square miles, and population (1895), 2,698,549 ; (1900), 2,833,224 ; of whom 1,389,204 were males and 1,444,020 were females. The mines in 1897 yielded

13,009,653 tons of lignite, valued at ►►1,583,750 (in 1900, 17,035,074 tons valued at ►►2,101,200) ; 273,364 tons of coal, valued at ►►55,700 ; 716,348 tons of kainite, valued at ►►505,900 ; 640,236 tons of potassium salts, valued at ►►379,700 ; and 632,168 tons of copper, valued at ►►909,700 (in 1900, 671,918 tons valued at ►►1,108,850) ; total value in 1897, ►►3,434,750. The produce of salt-works and furnaces, &c., in 1900 was 108,734 tons of salt, worth ►►147,600; 163,458 tons of chloride of potassium, worth ►►1,040,050. The province of Saxony is famous for its high-class farming, and ranks as the first agricultural province of all Germany. Besides the university agricultural college at Halle, there are two agricultural colleges and six agri- cultural schools, as well as two experimental stations, in the province. The barley and chicory (50 per cent, of that grown in Germany) of Saxony are famous. In 1900 the live stock included 1,259,737 pigs, 833,580 sheep, 778,353 cattle, and 213,040 horses. This province, especially in the neighbourhood of Erfurt, Quedlinburg, and Aschersleben, is far-famed for its gardening and seed farms. The sugar factories in 1900 produced 447,895 tons of sugar; the breweries, 53,700,000 gallons of beer; and the distilleries, 3,897,300 gallons of pure alcohol. For further particulars, see under Prussia. See also "Agriculture in Germany," Brit. Cons. Hep., No. 452

(1898).

Say, Jean Baptiste L6on (1826-1896),

French statesman and economist, was born in Paris on 6th June 1826. From his father, Horace Say, and his grand- father, Jean Baptiste, the author of a celebrated Traits d'^conomie politique, founded on Adam Smith, he inherited

an ardent zeal for economic studies, of wliicli lie gave a remarkable proof by publishing at the age of twenty-two a brief Histoire de la Caisse

d'escompte. He was at first destined for the law, next entered a bank, and finally obtained a post in the administration of the Chemin de fer du Nord. Meanwhile he became a regular contributor to the Journal des Dibats, where he established his reputa- tion by a series of brilliant attacks on the financial ad- ministration of the prefect of the Seine, Haussmann. He displayed a remarkable talent for interesting popular audiences in economic questions. His sympathies, like those of his grandfather, were with the British school of economists; he was, indeed, the hereditary defender of free-trade principles in France. He had, moreover, an intimate acquaintance with the English language and institutions, and translated into French Goschen's Theory of Foreign Exclianges. He was one of the pioneers of the co-operative movement in France. Elected to the Assem- bly of 1871 by the departments of Seine and Seine-et-Oise, he adopted the former, and took his seat among the j\Ioderate Liberals, to whose principles he adhered through- out his life. He was immediately chosen as reporter of the commission on the state of the national finances, and in this capacity prepared two elaborate statements. Thiers, though opposing their publication on grounds of public expediency, was much struck by the ability displayed in them, and on 5th June appointed Say prefect of the Seine. The fall of the Empire, the siege of Paris, and the Com- mune had reduced the administration of the capital to chaos, and the task of reconstruction, amid the urgent problems that called for immediate solution, severely tried the new prefect's power of organization. This was, how- ever, a gift with which he was pre-eminently endowed; and he only quitted his post to assume, in December 1872, the ministry of finance ??? a remarkable tribute to his abilities from Thiers, who himself held strongly protec- tionist views. In all other respects Say always regarded himself as the disciple of Thiers, who, in his last public utterance, designated Say as one of the younger men who would carry on his work. He fell from office with Thiers on 24th May 1873, and was elected president of the Left Centre group, as whose candidate he unsuccessfully con- tested the presidency of the Chamber with Buffet. In spite of their divergence of views, he consented, at the urgent request of President MacMahon, to take office in March 1875 in the Buffet Cabinet; but the strongly re- actionary policy of the premier led to a sharp and long- continued dispute between him and Say both in the press and in the constituencies, and brought about Buffet's resignation.

Say continued to hold the ministry of finance under Dufaure and Jules Simon, and again in the Dufaure ministry of December 1877, and its successor, the Waddington ministry, till December 1879. During this long period, in which he was practically the autocratic ruler of the French finances, he had first to complete the payment of the war indemnity ⁇ an operation which, thanks largely to his consummate knowledge of foreign exchanges, was effected long before the prescribed time. It was at a conference held between Say, Gambetta, and M. de Freycinet in 1878 that the great scheme of public works introduced by the latter was adopted. Say's general financial policy was to ameliorate the incidence of taxation. As a pendant to his free-trade principles, he believed that the surest way of enriching the country, and therefore the Treasury, was to remove all restrictions on internal commerce. He accord- ingly reduced the rate of postage, repealed the duties on many articles of prime utility, such as paper, and fought strongly, though unsuccessfully, against the system of octrois. On 30th April 1880 he accepted the post of ambassador in London for the purpose of negotiating a

commercial treaty between France and England, but the presidency of the Senate falling vacant, he was elected, on 25th May, to fill the post, having meanwhile secured a preliminary understanding, the most important feature of which was a reduction of the duty on the cheaper class of French wines. In January 1882 he became minister of finance in the Freycinet Cabinet, which was defeated in the following July on the Egyptian question. Say's infiu- ence over the rising generation grew less; his "academic Liberalism" was regarded as old-fashioned; Socialism, which he never ceased to attack, obtained even greater power, and free-trade was discarded in favour of M. M^line's policy of protection, against which Say vainly organized the Ligue contre le rendierismment du pain. He had, however, a large share in the successful opposition to the income-tax, which he considered likely to discourage individual effort and thrift. In 1889 he quitted the Senate to enter the Chamber as member for Pau, in the belief that his efforts for Liberalism were more urgently needed in the popular Assembly. Throughout his career he was indefatigable both as a writer and as a lecturer on economics, and in both capacities exerted a far wider infiuence than in parliament. Special mention must be made of his work, as editor and contributor, on the Bic-

tionnaire des finances and Nouveau dictionnaire d' economic politique. His style was remarkably easy and lucid, and he was often employed in drawing up important official documents, such as the famous presidential message of December 1877. He was for many years the most pro- minent member of the Academic des Sciences Morales et Politiques, and in 1886 succeeded to Edmond About's seat in the Academie Fran►►aise. He died in Paris on 21st April 1896. A selection of his most important writings and speeches has since been published in four volumes under the title of Les Finances de la France sous la troisieme H^pmblique (1898-1901). (h. sy.)

Sa,yre, a borough of Bradford county, Pennsylvania, U.S.A. It is on the North Branch of the river Susque- hanna and on several railways, in the north-eastern part of the state. Population (1900), 5243, of whom 337 were foreign-born.

Sca.rboroug'h, a municipal and parliamentary borough and fashionable watering-place, Yorkshire, Eng- land, North Riding, in the Whitby parliamentary division, 40 miles north-east of York by rail. A promontory divides the town into north and south parts. The former was greatly improved by the addition of the promenade and drive, known as the Royal Albert Drive and Clarence Gardens, opened in 1890. In 1891 the corporation purchased Ramsdale Valley bridge, spanning a picturesque ravine which separates the southernmost part of the town from the rest. The People's Park occupies both sides of the valley. Modern public buildings include the church of St James's, two Wesleyan chapels, a Congregational chapel, Constitutional and Liberal clubs, and central fire station. Population of the municipal and parliamentary borough (1881), 30,504; (1901), 38,160.

Scha.fFha,USen, one of the Swiss cantons. Its total area is 113^- square miles. Of this, lOS'-t square miles are classed as "productive," forests covering 44 '8 square miles, vineyards 4-2 square miles, and arable or pasture land the remaining 59-4 square miles. The popu- lation of the canton was 37,783 in 1888, while in 1900 it was 41,514. In 1900 there were 365 inhabitants to each square mile. The people are mostly Protestant ►►► roughly, the Roman Catholics number 10 per cent.

* and German- speaking. With the exception of a small portion of the town of Stein, the whole canton lies north of the Rhine.*

The cantonal constitution is that of 1876, slightly modified. The legislature is elected as stated in the ninth edition of this work, but only "communes" with over 250 inhabitants form separate electoral circles, the smaller being united electorally to their greater neigh- bours. The executiye of five members is also elected by popular vote for four years. Besides the right of "initiative" of 1000 citizens as to legislative projects, and the revision of the cantonal constitution, there was adopted in 1895 the "obhgatory refer- endum " for all legislative projects, as well as a curious institution (formerly existing in several cantons) by which the legislature can consult the people on certain questions involving principles, and not merely rally drafted legislative projects. In 1897 the state revenue of the canton was 1,647,481 francs (a rise of 42 per cent, since 1885), and the state expenditure, 1,664,118 francs (a rise of 46 per cent.), while in 1898 the surplus was 95,999 francs; the system of accounts in this canton is rather intricate. In 1897 the public debt was nil. The taxes are very small, while the state pro- perty is the most considerable in Switzerland, so that from a finan- cial point of view it is the most favoured among the Swiss cantons.

AUTHOKITIES. Beitrdge z. vaterldnd. Geschichte. Schaffhausen, 1863-84. 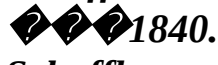 IM Thurs. Der Kant. S. St Gall and Bern, 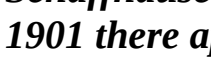 1840. Pfaff. Das StaatsrecJit d. alien Eidgenossenschaft. Schaffhausen, 1870 (pp. '89-97 contain a history of SohafFliausen). In 1901 there appeared at Schaffhausen two elaborate historical " Festschriften," one for the canton and the other for the town. h^, x. B. c.)

Scha.'fFha.USen, the capital of the above canton. There is a railway (1;^ miles) to Feuerthalen (1253 inhabit- ants), the first station on the line to Constance, which keeps on the Swiss side of the Khine. There is a fine promenade on the west of the town, called the Fasenstaub. Popula- tion (1880), ll,-753; (1900), 15,275.

Schandorph, Sophus.

ATUEE.

See Danish Litee-

Scharf, Sir Georgfe (1820-1895), director of the British National Portrait Gallery, was born in London on 16th December 1820, the son of George Scharf, a Bavarian miniature painter who settled in England in 1816, and died in 1860. He was educated at University College School, and studied in the schools of the Eoyal Academy. In 1840 he accompanied Sir Charles Fellows on the second of his archaeological visits to Asia Minor, and in 1843 acted as draughtsman to a Government expedition to the same country. After his return he devoted himself with great industry and success to the illustration of books relating to art and antiquity, of which the best known are Macaulay's Lays of Ancient Home, 1847 ; Milman's Horace, 1849 ; Kugler's Handbook of Italian Painting, 1851 ; and Dr Smith's classical dictionaries. He also engaged largely in lecturing and teaching, and took part in the formation of the Greek, Roman, and Pompeian courts at the Crystal Palace. He acted as art secretary to the great Manchester Art Treasures Exhibition of 1857, and in that year was appointed secretary to the newly founded National Portrait Gallery. The remainder of his life was given to the care of that institu- tion, which during the thirty-seven years of his able and zealous management gradually developed into a collection of first-rate importance. Scharf acquired an unrivalled knowledge of all matters relating to historic portraiture, and was the author of many learned essays on the subject. He was elected a fellow of the Society of Antiquaries in 1852, and a corresponding member of the Archaeological Institute of Rome in 1858. In 1885, in recognition of his services to the Portrait Gallery, he was made C.B., and on relinquishing his post, early in 1895, was created K.C.B. and a trustee of the Gallery. He died on the 19th .4pril of the same year. (f. m. o'd.)

Schaumburg'~~Lippe, a principality of Ger~~ many, in the valley of the Weser, between the Prussian provinces of Westphalia and Hanover. Area, 131 square miles. Population (1895), 41,224; (1900), 43,132; of whom 21,449 were males and 21,683 females. The people

are almost entirely Evangelical Lutherans. Density, 329 inhabitants to the square mile. Of the total population in 1895, 11,725, or 28'4 per cent.,

were supported by agricul- ture. The number of farms was 7218, of which 6585, or 91 per cent,, were each less than 25 acres; 625 were between 25 and 250 acres, and only 8 exceeded 250 acres. In 1900 the principality contained 32,243 pigs, 12,434 cattle, 4088 horses, and 1632 sheep. The state revenue and expenditure for 1900 were estimated to balance at ––53,530. The public debt amounted in 1900 to ––24,100, and in 1901 the contribution to the imperial exchequer to ––21,845.

ScheffeB, Joseph Victor von (1826-1886),

German poet and novehst, was born at Carlsruhe, where his father was an officer in the Baden army, 1 6th February 1826. His mother, nee KJrederer, was a poet of some distinction. He went to school at Carlsruhe, and after- wards studied law at Munich, Heidelberg, and Berlin. After graduating doctor juris, he held a secretaryship for a short time, and subsequently was appointed to various judicial posts. Eventually, in 1854, he retired in order to devote himself entirely to his pen, coming to this deter- mination as a consequence of the great success achieved by his poem Der Trompeter von Sdckingen, published in 1853. The popularity of this work in (Germany has been extraordinary, more than 200 editions of it having been issued. In 1857 he published Gaudeam/us (a volume of poems) and a historical romance, Ehhehard, which also became very popular. In 1864 he married Caroline von Malzen and settled at Carlsruhe, where he lived practically in retirement. He died there on 9th April 1886. His later works never achieved the popularity of those men- tioned above, which by themselves were sufficient to procure him enthusiastic eulogiums and various marks of honour on his "jubilee," which was celebrated all over Germany. He was on this occasion granted a patent of hereditary nobility by the grand duke of Baden. His works subsequent to Ekkehard were Frau Aventure (1863), Juniperus (1868), Waldeinsamkeit (1880), Der Heini von Steier (1883). Volumes of Reisebilder (1887), Gedichte (1888), Episteln (1892), and Briefe (1898) were published posthumously. {&. p. s.)

Scheldt, a river flowing through France, Belgium, and HoUand. In its Belgian course it is regulated hj^ locks as far as Ghent, below which it flows freely east and north to the estuaries indenting Zeeland, which are,

how- ever, really inlets of the sea, being at many places over 3 miles broad from dyke to dyke, and showing no movement but the ebb and flood of the sea. The river water running through these estuaries is, moreover, shrink- ing in breadth, and the alluvium, especially between the islands, is accumulating. The Dender, a tributary on the right bank, and the Lys, on the left, are both largely canal- ized. At Antwerp the Scheldt at high water has a breadth of 1706 feet. Sixteen miles north-west of Antwerp the river divides at Fort Bath (Holland) into the Western and the Eastern Scheldt. The Western Scheldt flows, between Dutch Flanders on the south and the islands of South Beveland and Walcheren on the north, into the North Sea at Flushing. Altogether the Scheldt is navigable for 207 miles. On the north side, near Flushing, and along the south coast of South Beveland, as also on the south side near Terneuzen, the Western Scheldt has a depth of 131 feet. Steamers ply between these places and Fort Breskens, on the south bank opposite Flushing. The roadstead of Zierikzee (island of Schouwen) and the navi- gable water along the northern coast of North Beveland have a depth of 100 to 130 feet. The strait (Mastgat) between the islands of Tholen and North Beveland is

also very deep. The Sloe, an arm of the Western Scheldt between Walcheren and South Beveland, and also both sides of the dyke connecting South Beveland with North Brabant, are silting up ; the Braakman, a southern arm of the Western Scheldt, is fast drying up. The difference of level between ebb and flood tide is at Flush- ing 12, at Antwerp 14, feet.

Schenectady, a city of New York, U.S.A., capital of Schenectady county. It is situated in 42◆◆47′ N. and 73◆◆57′ W., in the valley of the river Mohawk, 17 miles north-west of Albany, in the eastern part of the state, at an altitude of 246 feet. It is irregularly laid out, the older and business part of the city being in the valley, while the newer and residential portion is built on higher land in the rear. Its water-supply is pumped and filtered. The city is reached by branches of the Delaware and Hudson and the New York Central and Hudson Eiver railways. The manufacturing interests

are very important. There are extensive locomotive, electrical, and agricultural implement works, besides foundries, car works, planing mills, and clothing factories of various kinds. It is the seat of Union College (founded 1795), which had in 1900 a faculty of 24 and was attended by 184 students. Population (1890), 19,902 ; (1900), 31,682, of whom 7169 were foreign-born and 127 negroes. Of 11,093 males 21 years of age and over, 656 were illiterate (could not write).

Scherer, Edmond Henri Adolphe

(1815-1889), French theologian, critic, and politician, was born in Paris, 8th April 1815. After a course of legal studies he found himself strongly attracted to theo- logy, and spent several years in theological study at Strasburg, where he graduated and was ordained. In 1843 he was appointed to a professorship in the Ecole Evang^lique at Geneva, but the development of his opinions, which were becoming strongly in favour of the Liberal movement in Protestant theology, led to his resign- ing the post six years later. Having had already some experience of journalism, he now settled in Paris, where he at once attracted attention by brilliant literary criticisms contributed to the Reviue des Deux Mondes and other journals. He was elected municipal councillor at Ver- sailles in 1870, deputy to the National Assembly for the department of Seine-et-Oise in 1871, and senator in 1875. As a politician he was a steady supporter of the Repub- lican party. Towards the end of his life he devoted him- self mainly to literary and general criticism, and was for many years one of the ablest contributors to Le Temps. His critical work is marked by keen insight, individuality, and remarkable lucidity of expression. He was a frequent visitor to England, and took a lively interest in English politics and literature. He died at Versailles, 16th March 1889. His chief works are : Dogmatique de Vdglise ri- formAe (1843), De Vitat actuel de Veglise rifwmie en France (1844), Esquisse d'une tMorie deV^glise chrMienne (1845), La Critique et la Foi (1850), Alexandre Vinet (1853), Lettres a mon CurS (1853), Etudes critiques sur la litterature contemporaine (1863), Etudes critiques de littdrature (1876V Diderot (1880), La Democratic et la France (1883), Etudes sur la litterature au xviii' siecle (1891). A memoir of him, by V. C. 0. Grdard, appeared in 1890. (e. k s.)

Schevening^‘en, a fishing village and fashionable watering-place in the Dutch province of South Holland, 2 miles north-west of The Hague, with which it is con- nected by the old and the new road, and by horse, steam, and electric tramways. Among modern buildings is the large Kurhaus (1886), with a Kursaal accommodating 2900 guests. Many villas have been built for the require-

ments of about 20,000 annual visitors, chiefly Dutch and Germans. The fishing fleet comprises about 200 boats, and a new fisher-haven is to be constructed at the mouth of the Hague-Scheveningen Canal. Population (1900), about 20,000.

Schiedam, a manufacturing town and seaport in the Dutch province of South Holland, near the influx of the Schie into the Maas. In 1899 there were 190 grain and 141 other distilleries, producing the “Geneva” or Dutch gin (Hollands). The yeast and the grain refuse of the distilleries form an article of export. Population

(1900), 27,081.

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Schimmel, Hendriic Jan (1825-

Dutch poet and novelist, was born 30th June 1825, at ‘S Graveland, in the province of North Holland, where his father was a notary and the burgomaster. From 1836 to 1842 young Schimmel served his apprenticeship in his father’s ofiice, and upon his death he was taken into the office of the agent of the Dutch Treasury in Amsterdam, exchanging the work in 1849 for a post with the Dutch Trading Company there. In 1863 he became a director of the Amsterdam Credit Association. His first volume of poems appeared in 1852 ; but it is as a writer of historical dramas in blank verse, and one of the regenerators of the Dutch stage, that his literary position was made. His finest production is his Struensee (1858), which was preceded by Napoleon Bonaparte (1851) and Juffrcmw Serklaas (“Mrs Serklaas,” 1857). Among his other dramatic works may be mentioned Joan Woutersz (a drama, 1847), Twee Tudors (“Two Tudors,” 1847), Gondelbald (1848), Schuld en Boete (” Guilt and

Retribu- tion," a drama, 1852), Het Kind van Staat ("The State Child," a dramatic fragment, 1859); Zege na Strijd ("Struggle and Triumph," a drama, 1878). Schimmel's renderings of Casimir de la Vigne's Louis XI., Geibel's Sophonisbe, and Ponsard's Lucrece are also still acted in the Netherlands. His novels are distinguished by their vigorous style and able characterization. The earlier, better-known ones betray the writer's English proclivities. The plots of Mary Mollis (1860, 3 vols. ; English transla- tion, London 1872, under the title of "Mary HoUis, a Romance of the Days of Charles II. and William, Prince of Orange," 3 vols.) and of Mylady Carlisle (1864, 4 vols.) are laid in England, whereas those of his Sinjeur Semeyns (1875, 3 vols.), a powerful picture of the terrible year 1672, and of De Kapitein van de Lijf garde (1888, 3 vols. ; English adaptation, 1896, under the title of " The Lifeguardsman," 1 vol.), a continuation of " Master Semeyns," are almost entirely centred in the Holland of those stirring days. He had many points of style and manner in common with Madame Bosboom – Toussaint, though both remained highly original in their treatment. Both exhausted their foreign themes and heroes, and finally reverted to essentially national subjects. To the earlier romances of Schimmel belong : Bonaparte en zyn Tyd ("Bonaparte and his Time," 1853), De Eerste Dag eeiis Nieuwen Levens ("The First Day of a New Life," 2 vols., 1855), Sprohen en Vertellingen ("Legends and Tales," 1855), Sen Haagsclie Joffer ("A Hague Damsel," 1857), De Vooravond der Revolutie ("The Eve of the Revolution," 1866). Schimmel was an early collaborator of Potgieter on the Gids staff. His dramatic works appeared in a collected edition in 1885-86 at Amsterdam (3 vols.), followed by a complete and popular issue of his novels (Schiedam, 1892).

Schizomycetes. See Bacteriology.

Schlan (Czech, Slan^), the chief to-^Ti of a district in Bohemia, Austria, about 40 miles north-west of Prague,

on the railway between the latter town and Briix. There are extensive coal-fields and important iron, metal, and machine industries, together with the manufacture of chemicals and corn-milling. Population (1890), 9115; (1900), 9494, Czechs.

Schleiz, a town of Germany, second capital of the principality of Eeuss the Younger, 20 miles by rail west by north of Plauen (in Saxony). Here are two royal residences, an old church, with the burial vaults of the reigning princes, a deaf and dumb asylum, teachers' seminary, wood-carving school, and various small industries (toys, belts, (fee). Population (1900), 5331.

Schleswig^, a town of Prussia, capital of the province of Schleswig – Holstein, 29 miles north-west of Kiel. In 1894 the tower of the cathedral was carried up to 368 ft. The town possesses provincial lunatic and deaf and dumb asylums, and numerous modern monuments to local celebrities. There are tanneries, breweries, flour and saw-mills. Population (1895), 17,253 ; (1900),

17,909.

SchleSWigf-Holstein, the most north-westerly province of Prussia, with an area of 7337 square mUes, and population (1890), 1,219,523; (1900), 1,387,587, of whom 701,583 were males and 686,004 females; the density being 189 inhabitants to the square mUe. The population of the northern circles is still predominantly Danish ; the total Danish population of the province being (in 1890) 134,064, as compared with 144,400 at the date of the conquest in 1864. In the circle of Hadersleben 88 per cent, of the population are Danes, in circle Sonderburg 85 per cent., in Apenrade 82 per cent., in Tondern 49 per cent. In these four circles 83 "5 per cent, of the children attending school in 1891 spoke Danish as their mother tongue, and only 11 '4 per cent, spoke German; whilst 5'1 per cent, spoke both languages. The live stock in 1900 included 897,615 cattle, 611,003 pigs, 235,469 sheep, and 184,658 horses. The sugar factories in 1900 produced 5800 tons of sugar; the breweries, 35,128,200 gallons of beer; and the distilleries, 933,100 gallons of pure alcohol. In 1900 the province owned a mercantile fleet of 770 sea- going vessels of 182,797 tons. The principal ports are Altona, Kiel, Flensburg, Neumiihlen, Sonderburg,

Wyck, Tonning, and Heligoland. In 1892 Dr Eugen Traeger called attention ^ to the perilous condition of the smaller of the North Frisian Islands, called halligen ; and in 1896 measures were taken to protect them against the encroach- ment of the North Sea by warping them {e.g., Oland and Langenes) together, and binding them in the same way to the mainland. For this purpose the Prussian Government voted a sum of ►►66,000 (see Globus, 1896, pp. 290-293). Since 1872 an area of 4000 acres has been reclaimed from the sea in South Dithmarsh, at the south-western extremity of the province, and additional areas were enclosed in 1900 and subsequent years. Altogether 16,000 acres were enclosed between 1785 and 1899.

Schliemann, Heinrich (1822-1890), known

to the general world for his archaeological discoveries at Hissarlik and Mycense, and held in special honour by scholars as the first who let in clear light upon the pre- historic civilization of the Greek lands, was born on 6th January 1822 at Neu Bucko w, in Mecklenburg-Schwerin, the son of a poor pastor. He has stated in his auto- biography that through all his early years of struggle,

" In Die Halligen derNordsee (Stuttgart, 1892), "being part of vol. vi. of A. Kirchhoit's Forsehvmgen zur Devischen Landes- und Volks-hmde; also Globus, vol. Ixxviii. (1900), No. 15 ; and Christian Jensen, Vom Dunenstrand der Nordsee wtid ►►om Wattenmeer (Schleswig, 1901).

when he was successively grocer's apprentice at Fiirsten- berg, cabin-boy on the Dorothea, bound for Venezuela, and, after her wreck, ofiice attendant and then book-keeper in Amsterdam, he nourished a passion for the Homeric story and an ambition to become a great hnguist. In the end, thanks to an unusually powerful memory and a determined energy, which would have made him remarkable in any line of life, he acquired a knowledge of seven or eight tongues besides his own, including ancient and modern Greek. The foundation of his fortune was laid by the house of B. H. Schroder of Amsterdam, which in 1846 sent him to St Petersburg, where he established a business of his own and embarked in the indigo trade. He made a fortune at the time of the Crimean war, partly as a mili- tary contractor. Being accidentally present in California, when

made a state of the Union in 1850, he became and remained an American citizen. After travels in Greece, Tunis, India, China, and Japan, and writing a short sketch of the last two countries, he took his large fortune to Greece in 1868, and proceeded to visit Homeric sites. In an ensuing book ‘‘‘Ithaka, der Peloponnes, und Troja ‘‘‘he propounded two theories which he was destined eventually to test in practice, viz., that Hissarlik, not Bunarbashi, was the site of Troy, and that the Atreid graves, seen by Pausanias at Mycenae, lay within the citadel wall. ‘Two years later he took up Mr Calvert’s work on the former site, and, convinced that Troy must be on the lowest level, hewed his way down, regardless of the upper strata, wherein lay unseen the remains of which he was reaUy in search. By 1873 he had laid bare considerable fortifications and other remains of a burnt city of very great antiquity, and discovered a treasure of gold jewellery. We now know this city to have belonged to the middle pre-Mycen‘‘an period, long prior to the generation of Homer’s Achaeans ; but Schliemann far and wide proclaimed it ” Troy,” and was backed by Mr Glad- stone and a large part of the European public. Trying to resume his work amid universal attention in February 1874, he found himself inhibited by the Ottoman Govern- ment, whose allotted share of the gold treasure had not been satisfactory, and it was not tUl April 1876 that he obtained a firman. During the delay he issued his Troy and its Remains (1875), and betook himself to Mycenae, the other object of his early plans. There in August 1876 he began work in the Dome-tombs and by the Lion Gate, and opened a large pit just within the citadel. The famous double ring of slabs and certain stone reliefs came to light. Schliemann, thinking it was only a platform levelled as a place of Achaean assembly, paused, and did not resume till November. Then, resolved to explore to the rock, he cleared away some three feet more of earth and stones, and lighted on the five shaft graves which have placed him first among fortunate excavators. A sixth grave was found immediately after his departure. The immense treasure of gold, silver, bronze, fine stone and ivory objects, which was buried with the sixteen corpses in this circle, is worth intrinsically more than any treasure trove known to have been found in any land, and it revealed once for all the character of a great civilization preceding the Hellenic. The find was de- posited at Athens, and gradually cleaned and arranged in the Polytechnic; and the discoverer, publishing his Mycerm

in English in 1877, had his full share of honours and fame. He had now settled in Athens. There he married a Greek lady, and there successively he buUt two splendid houses, which became centres of Athenian society. In 1878 he dug in Ithaca, but unsuccessfully, and in the same year and the following resumed work at Hissarlik, and summed up his results in a discursive memoir, Rios, upon which a sequel, Troja, issued in 1884,

after Wilhelm Dorpfeld, associated in 1882, had intro- duced some archEeological metliod into the explorations, was a considerable improvement. In 1880 and 1881 Schliemann cleared out the ruined dome-tomb of Orcho- menus, finding little except remains of its beautiful ceiling ; and in 1885, with Dorpfeld, he laid bare the upper stratum on the rock of Tiryns, presenting scholars with a complete ground plan of a Mycenaean palace. This was his last fortunate excavation. While Tsountas, for the Greek Archseological Society, picked up his work at My-cenae in 1886, and gradually cleared the Acropolis, with notable results, Schliemann tried for traces of the Caesareum at Alexandria, of the Palace of Minos at Knossos, in Crete, and of the Aphrodite temple at Cythera (1888) ; bat he was not successful, meeting in the two former enterprises with a local opposition which his wealth was unable to bear down. In 1889 he entertained at Hissarlik a committee of archaeological experts, deputed to examine Botticher's absurd contention that the ruins represented not a city, but a cremation necropolis ; and he was con-templating a new and more extensive campaign on the same site when, in December 1890, he was seized at Naples with an illness which ended fatally on the morning of Christmas Day. His great wealth was left mainly to the two families that he had in Russia and Greece ; but a sum was reserved for Hissarlik, where Dorpfeld in 1891 and 1892, by clearing away the debris of the former excavations, exposed the great walls of the sixth stratum which Schliemann had called Lydian, and proved their synchronism with Mycenae, and identity with Mycenaean remains ; that is to say, with Homer's Troy, if Troy ever was.

Schliemann was on several occasions in England, in 1883 to receive honours from the great universities, and in 1886 to confute, at a special gathering of the Hellenic Society, the assertion of StiUman and Penrose that the Tirynthian palace was posterior to the Christian era. Nowhere was he better appreciated, and most of his books were first issued in English. (d. g. h.)

SchliiSSelburg, a district town and fortress of Russia, in the government and 40 miles east of the city of St Petersburg, at the issue of the Neva from Lake Ladoga, situated on low ground surrounded by marshes. It was founded in 1323 by the Novgorodians, and though afterwards lost by Russia, was reconquered by Peter the First. It has a fortress, built on an island in the Neva, which is now used as a political prison. Population

(1897), 5285.

Schmerling:, Anton von (1805-1893),

Austrian statesman, was born on 23rd August 1805 at Vienna, where his father held a high position on the judicial side of the civil service. After studying law at the university of Vienna, in 1829 he entered the public service, and during the next eighteen years was constantly occupied, chiefly in Lower Austria. In 1847, as a member of the lesser nobility, he entered the Estates of Lower Austria, with which he had already had some con- nexion in his ofiicial work, and took an active part in the Liberal movement for administrative and constitu- tional reform of which they were the centre. On the outbreak of the revolution in Vienna in March 1848, when the mob broke into the Assembly, Schmerling was one of the deputation which carried to the palace the demands of the people, and during the next few days he was much occupied in organizing the newly formed National Guard. At the end of the month he was sent by the ministry to Frankfort as one of the men of " public confidence." For the next year he was one of the leading figures in the city which was the centre of the German

revolution. He soon succeeded Count CoUeredo as presi- dent of the Diet, and in this capacity officially transferred to the Archduke John, the " administrator " of the country, the powers of the Diet. For this he was

violently attacked in the Assembly by the extreme Radicals ; but on this and other occasions (he had himself been elected to the Assembly) he defended moderate and constitutional principles, all the more effectively because he depended not on eloquence but on a recognition of what has been called the " irony of facts " ??? to which the Assembly as a whole was so blind. He was the first and the most influential member of the ministry which the adminis- trator formed ; he held the ministry of the interior and, later, also that of foreign affairs, and it was almost entirely due to him that at least for a short time this phantom government maintained some appearance of power and dignity. A defeat in the Assembly when he defended the armistice of Mahno led to his resignation ; but he was immediately called to office again, with practically dictatorial power, in order to quell the revolt which broke out in Frankfort on 18th September. His courage and resolution averted what nearly became a terrible cata^ strophe. It was his hope to establish in Germany the supremacy of a Liberal and reformed Austria. This brought him into opposition to the party of Prussian supremacy ; and when they attained a majority, he resigned, and was suc- ceeded by Gagern. He remained at Frankfort, holding the post of Austrian envoy, and was the leader, of the so- called Great German party. This position he resigned when the dissolution of the Austrian Parliament showed that the forces of reaction had conquered at Vienna, and shattered all hopes of Austria attaining the position he had hoped for her. After the abortive election of the king of Prussia to be emperor, he, with the other Austrians, left Frankfort. He was at the time one of the most unpopular men in Germany, but his conduct in the extremely difficult position he had held for the last year caused him to be regarded as the most promising of the younger generation of Austrian officials. On his return to Vienna he became minister of justice, and the reforms which he carried out added to his reputation. His popularity among all Liberals was increased by his resignation in 1851, as a protest against the failure of the Government to establish the constitution they had promised. During the next few years he was judge of the supreme court of appeal. When his forecast was fulfilled and the system of absolutism broke down, it was natural that he should be summoned to power. He became minister in January 1862, and his first act was the publication of the celebrated constitution by which the whole of the empire was to be organized as a single state with a parliamentary

government. The experiment failed, chiefly because of the opposition of the Croatians and Magyars, whom he bitterly offended by his celebrated saying that " Hungary could wait." Faults of manner, natural in a man whose life had been spent as an official and a judge, prevented him from keeping together the German Liberals as a strong and united party ; he was opposed by a powerful faction at court, and by the Clerical leaders. After the first few months the emperor gave him only a very lulcewarm support ; and with his retirement in 1865 the attempt to carry out the ideals of Joseph II. to Germanize while he liberalized the whole of the empire, and to compel Hungarians, Poles, Czechs, and Croatians to accept a system in which the government of the whole should be carried on by a German-speaking Parliament and bureaucracy, failed. The constitution of 1862, though suspended on Schmerling's fall, was still regarded as legally valid for the cis-Leithan territories, and is the basis on which the present constitution for half the empire was framed. Schmerling, therefore, not only in

the ideas wtich te upheld, but in the practical working out of them, was one of the most influential Austrian states- men of the 19th century. On his retirement he returned to his judicial duties; in 1867 he was made hfe-member of the Upper House in the Eeichsrath, of which he became vice-president, and in 1871 president. This post he laid down in 1879, and came forward as leader of the Liberal German opposition to the administration of Count Taaffe. In 1891 he retired from public life, and died at Vienna on the 23rd of May 1893.

Schmerling married, in 1835, Pauline, daughter of Field- Marshal-Lieutenant Baron von Koudelka. Frau von Schmerling, who was distinguished by literary and artistic abilities, at that time rare in the Austrian capital, died in 1840, leaving two daughters.

AuTHOKiTiES. ❓❓❓ Aeneth, Aiiton V. Schemerling. Prague, 1895. (This contains a full account of Schmerling's life during 1848-49, but does not deal witli his later life.) ❓❓❓ Wttrzeach. Biograph- isches

Lexicon des Kaiserthums Oesterreich. ❓❓❓ Feiedjung. Der Kampf um die VorherrscJiaft in SeutscMand. ❓❓❓ Eoggb. Qeschichte Oesterreichs. (j. -w^. he.)

SchneidOITIUhl, a town of Prussia, province of Posen, 60 miles by rail north of Posen. It has three churches, a synagogue, and a deaf and dumb asylum. Con- siderable damage was done to the town in 1893 by a violent overflow of water from a deep artesian well. Machinery is made here. Population (1885), 12,406 ; (1900), 19,656.

Schofield, John McAllister (1831),

American soldier, was born in Chautauqua county, N.Y., 29th September 1831, and graduated at the U.S. Military Academy in 1853. He was assistant professor at West Point, 1855-60, and while on leave (1860-61) ~~fiUed the chair of physics at Washington University, St Louis. When the Civil War broke out he became major in a Missouri volunteer regiment, and served on General Lyon's staff until the death of that brilliant officer; was brigadier~~ general of volunteers, November 1861, and performed various duties in Missouri (1861-64), rising to major- general, 29th November 1862. In February 1864 he commanded the Missouri department ; and, transferred in April to General Sherman, his corps remained with General Thomas when Sherman left Atlanta for the sea. He won the battle of Franklin, 30th November 1864 ; fought again at Nashville, 15th December IB 6 4, and was promoted to brigadier-general in the regular army. Ordered next to North Carolina, he occupied Wilmington, 22nd February 1865; and joined Sherman at Goldsboro in March for the final capture of Johnston's army. After the war he served in various departments : was secretary of war ad interim, June 1868-March 1869; and then appointed major-general. He commanded the United States army, 1888-95; was made lieutenant-general, February 1895, that grade having been revived ; and retired in September of that year.

Schonba.Ch, a small town in the government dis- trict of Eger, in North Bohemia. It is remarkable from the circumstance that it is almost exclusively devoted to the manufacture of musical instruments. It produces annually nearly 100,000 violins and violoncellos, 14,000

guitars, &c., and 7000 wind instruments, in addition to accordeons, harmonicas, &c. Population (1890), 3639 ;

(1900), 4157.

Schonbergf, or Maheisoh – Schonbeeg (Czech, Sumperk), the chief town of a district in Moravia, on the river Tess, a tributary of the March. It has an important textile industry, including linen, silk, and cotton goods. Population (1890), 10,493; (1900), 11,636, almost ex- clusively German and Catholic.

Schonfeid, Eduard (1828-1891), German astronomer, was born at HUdburghausen, in the duchy of

Meiningen, on the 22nd December 1828. He had a distinguished career at the gymnasium of his native town, and on leaving desired to devote himself to astronomy, but abandoned the idea in deference to his father's wishes. He went first to Hanover, and afterwards to Cassel to study architecture, for which he seems to have had but httle inclination. In 1849 we find him studying chemistry under Bunsen at Marburg, where his love for astronomy, never quite cooled, was revived by Gerling's lectures. In 1851 he visited the Bonn Observatory, and, expressing to Argelander an earnest wish to study astronomy under him, was received with open arms. In 1853 he was appointed assistant, and in the following year won a distinguished doctor's degree with his treatise JV^ova Elenienta Thetidix. At Bonn he took an important jjart in preparing the DurchTrmsterung of the northern heavens. He was indefatigable as an observer and critical in discussing results, thinking no labour too great in the pursuit of his favourite study. He took up vigorously the investigation of the light-changes in variable stars, devoting to this work nights which, on account of moonlight, were unsuit- able for zone observations. The results of these researches are published in the Sitz. Berich. Wien. Akad. vol. xlii. For a short time he was a privat – decent at Bonn, but in 1859 he was appointed director of the Mann- heim Observatory. The instrumental equipment of that observatory was somewhat antiquated, his largest telescope being a small refractor of 73 lines aperture, but he selected a line of work to suit the instruments at his disposal, observing nebul►► and variable stars and keeping a watch on comets and new planets. The

results of his observa- tions of nebulae are contained in two catalogues published in the Astronomische Beobachtungen der Grossherzoglichen Sternwarte zu Mannheim, 1st and 2nd parts (1862 and 1875), and those of his variable star obvervations appeared in the Jahresberichte des Mannheim^r Vereins fiir Natur- hmde, Nos. 32 and 39 (1866 and 1875). On the death of Argelander, which occurred on 17th February 1875, Schonfeid was appointed to succeed him as director of the Bonn Observatory, and soon after his appointment he began his last and greatest piece of work, the extension, on Argelander's plan, of the survey of the heavens down to 23►► of south deoKnation. The experience gained on the northern survey under Argelander's direction enabled Schonfeid to introduce some improvements in the methods employed, which increased the accuracy and added con- siderably to the value of this work, which was practically accomplished in March 1881, some revision only remain- ing to be done. These zone observations afforded 363,932 separate places of stars, and form the groundwork of the catalogue of 133,659 stars between 2►► and 23►► south declination, which was published in 1886 as the eighth volume of the Bonn observations.

Schonfeid was a member of the Astronomische Gesell- schaft from its foundation in 1863, being a member of Council up to 1869, and in 1875 becoming editor of its publications and secretary in conjunction with Winnecke. In the latter capacity he was brought into friendly relations with many fellow-workers in his own subject. In 1878 he was elected a Foreign Associate of the Eoyal Astro- nomical Society. In 1887, as delegate of the Prussian Government, he attended the first Paris Congress for the Photographic Survey of the Heavens. In 1864 he was present at the celebration of the 25th anniversary of the Pulkowa Observatory, and again, in 1889, he was sent, on behalf of the Prussian minister of education, to convey the congratulations of German astronomers on the occasion of the jubilee of that observatory. Illness prevented him from attending the meeting of the Astronomische Gesell- schaft in the same year at Brussels, whither the Watson

medal had been sent to him from America. He died, after a long and painful illness, on 1st May 1891. (a. a. e.)*

Schdni ngen, a town of Germany, duchy of Brunswick, 29 miles by rail west of Magdeburg. It has a salt-mine and brine spring, lignite mines, and chemical

and iron-works. The place is mentioned in the year 747, and still possesses remains of a ducal castle, 17th-century wooden houses, and a 15th-century church. Population

(1885), 6921 ; (1900), 8460.

Schools of Art. See Aet-Teachinq.

SCHOOLS OF PAINTING.

Beitish.

AT the beginning of the last quarter of the 19th century British art was held to be in a vigorous and authoritative position. During the years immediately preceding, it had been developing with regularity and had displayed a vitality which seemed to be full of promise. It was supported by a large array of capable workers ; it had gained the widest recognition from the public; and it was curiously free from those internal conflicts which diminish the strength of an appeal for popular appreciation. There were then few sharp divergences or subdivisions of an important kind. The leadership of the Royal Academy was generally conceded, and its relations with the mass of outside artists were little wanting in cordiality. One of the chief reasons for this understanding was that at this time an almost imprecedented approval was enjoyed by nearly all classes of painters. Picture-collecting had become a general fashion, and even the yoimgest workers received encouragement directly they gave evidence of a reasonable share of capacity. The demand was equal to the supply; and though the number of men who were adopting the artistic profession was rapidly increasing, there seemed little danger of over-production.

Pictorial art had established upon all sorts of people a hold too strong, as it seemed, to be affected by change of fashion. All pointed in the direction of a permanent prosperity.

Subsequent events provided a curious commentary on the anticipations which were reasonable enough in 1875. That year is now seen to have been, not the beginning of an era of unexampled success for British pictorial art, but rather the culminating point of preceding activity. During the period which has succeeded we have witnessed a rapid decline in the popular interest in picture-painting and a marked alteration in the conditions under which artists have had to work. In the place of the former sympathy between the public and the producers, there grew up something which almost approached indifference to their best and sincerest efforts. Simultaneously there developed a great amount of internal dissension and of antagonism between different sections of the art com- munity. As an effect of these two causes, a new set of circumstances came into existence, and the aspect of the British school underwent a radical change. Many art workers found other ways of using their energies. The slackening of the popular demand inclined them to experiment, and to test forms of practice which formerly were not accorded serious attention, and it led to the formation of detached hostile groups of artists always ready to contend over details of technical procedure. Kestlessness became the dominant characteristic of the British school, along with some intolerance of the popular lack of sympathy.

The first sign of the coming change appeared very soon after 1875. The right of the Eoyal Academy to define and direct the policy of the British school was disputed in 1877, when the Grosvenor Gallery was started " with the intention of giving special advantages of exhibition to artists of established reputation, some of whom have previously been

imperfectly known to the public." This exhibition gallery was designed not so much as a rival to the Academy, as to provide a place where could be collected the works of those men who did not care to make their orosveaor appeal to the public through the medium of a aaiiery large and heterogeneous exhibition. As a rally- "' '[illegible] ing place for the few unusual painters, standing ^^ '"' apart from their fellows in conviction*

and method, it had good reason for existence ; and that it was not regarded at Burlington House as a rival was proved by the fact that among the contributors to the first exhibition were included Sir Francis Grant, the President of the Eoyal Academy, and such artists as Leighton, Millais, G. F. Watts, Alma-Tadema, G. D. Leslie, and E. J. Poynter, who were at the time Academicians or Associates. With them, however, appeared such men as Burne- Jones, Holman Hunt, Walter Crane, W. B. Richmond, and J. JIcN. Whistler, who had not heretofore obtained the publicity to which they were entitled by the exceptional quality and intention of their work. There was doubtless some sug- gestion that the Academy was not keeping touch with the more important art movements, for shortly after the open- ing of the Grosvenor Gallery there began that attack upon the official art leaders which has been one of the most note- worthy incidents in recent art history in Great Britain. The initial stage of this conflict ended about 1886, when the vehemence of the attack had been weakened, partly by the withdrawal of some of the more prominent " outsiders," who had meanwhile been elected into the Academy, and partly by the formation of smaller societies, which afforded the more " advanced " of the younger men the opportunities which they desired for the exposition of their views. In a modified form, however, the antagonism between the Academy and the outsiders has continued. The various protesting art associations continue to work in most matters independently of one another, with the common belief that the dominant influence of Burlington House is not exer- cised entirely as it should be for the promotion of the best interests of British art, and that it maintains tradition against the development of individualism and a " new style."

Meanwhile the policy of the Academy {q.v.) has under- gone some little change. As things have turned out, there is evidence that the agitation in all branches of art effort has not been entirely without result even inside Burlington House. Some of the older academic views have been modified, and changes seriously discussed, which formerly would have been rejected as opposed to all the tradi- tions of the society. Its calmness under attack, and its ostentatious disregard of the demands made upon it by the younger and more strenuous outsiders, have veiled a great deal of shrewd observation of passing events. It may be said that the Academy has known when to break up an organization in which it recognized a possible source

of danger, by selecting the ablest leaders of the opposition to fill vacancies in its own ranks ; it has given places on its walls to the works of those reformers who were not un- willing to be represented in the annual exhibitions ; and it has, without seeming to yield to clamour, responded

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perceptibly to the pressure of professional opinion. In so doing, though it has not checked the progress of the changing fashion by which the popular liking for pictorial art has been diverted into other channels, it has kept its hold upon the public, and has not to any appreciable extent weakened its position of authority.

It is doubtful whether a more definite participation by the Academy in the controversies of the period would have Changed ^^^^ of ^^7 "se as a means of prolonging the conditions former good relations between artists and the otBiltlsb collectors of works of art. The change is 'the " ??? result of something more than the failure of one

art society to fulfil its entire mission. The steady falling off in the demand for modern pictures has been due to a combination of causes which have been powerful enough to alter nearly all the conditions under which British painters have to work. For example, the older collectors, who had for some years anterior to 1875 bought up eagerly most of the more important canvases which came within their reach, could find no more room in their galleries for further additions ; again, artists, with the idea of profiting to the utmost by the keenness of the competition among the buyers, had forced up their prices to the highest limits. But the most active of all causes was that the younger generation of collectors did not show the same inclination that had swayed their predecessors to limit their attention to modern pictorial art. They turned more and more from pictures to other forms of artistic effort. They built themselves houses in which the possibility of hanging large canvases was not contemplated, and they began to call upon the craftsman and the decorator to supply

them with what was necessary for the adornment of their homes. At first this modification in the popular taste was scarcely perceptible, but with every successive year it became more marked in its effect.

Latterly more money has been spent by one class of collectors upon pictures than was available even in the best of the times which have passed away ; but this lavish expenditure has been devoted not to the acquisition of works by modern men, but to the purchase of examples of the old masters. Herein may often be recognized the wish to become possessed of objects which have a fictitious value in consequence of their rarity, or which are " sound investments." Evidence of the existence of this spirit among collectors is seen in the prevailing eagerness to acquire works which inadequately represent some famous master, or are even ascribed to him on grounds not always credible. The ' productions of minor men, such as Henry Morland, who have never been ranked among the masters, receive an amount of attention which is quite out of pro- portion to what merits they possess, if only they can be proved to be scarce examples, or historically notorious. All this implies in the creed of the art patron a change which has necessarily reacted on living painters and on the conditions of their art production.

These, then, are the conclusions to which we are led by a comparison of the movements which affected the British school between 1875 and 1902. To a wide appreciation of all types of pictorial art has succeeded a grudging and careless estimate of the value of the bulk of artistic endeavour. Only a few branches of production are still encouraged by anything approaching an efiicient demand. Portraiture is the mainstay of the majority of the figure painters; it has never lost its popularity, and may be said to have maintained satisfactorily its hold upon all classes of society, for the desire to possess personal records is very general and is inde- pendent of any art fashion. It has persisted through all the changes of view which have been increasingly active in recent years. In 1902 the hope of any marked revival

Por- traiture.

in other branches of picture-painting might well seem somewhat remote. Episodical art, illustrating sentimental motives or incidents with some

touch of dramatic action, remained popular, because it had some Pj“”’”” degree of literary interest ; but imaginative works and pictures which had been produced chiefly as expressions of an original regard for nature, or of some unusual conviction about technical details, found com- paratively few admirers. The one hopeful sign was that the designers and the workers in the decorative arts were finding opportunities which formerly were denied to them. They had more scope for the display a”” ??? ^” of their ingenuity and more inducement to exercise their powers of invention. It was, indeed, not unreasonable to assume that the first stages were being witnessed in the development of a vigorous and influential school of design which in the near future would evolve work of originality and excellence. Already British designers had gained a hearing abroad, and had earned emphatic approval in countries where a sound decorative tradition had been maintained for centuries ; so that there seemed to be the germ of vitality in a movement which had scarcely had time as yet to give more than a hint of its possibilities.

Not only in matters affecting the relations between artists and the public has the period been full of change, but also in the convictions of the workers themselves, and in some surprising educational ^^”^^”^ departures. The one dominant influence, that napbael- of the Pre-KaphaeUte Brotherhood, which in the Itlsm ‘fifties altered the whole complexion of British ””^rlse art, had begun to wane early in the ‘seventies, influence. and it was rapidly being replaced by another scarcely less distinctive. The younger generation of artists had wearied, even before 1875, of the Pre-Raphaelite precision, and were impatient of the restrictions imposed upon their freedom of technical expression by a method of practice which required laborious application and un-questioning obedience to a rather formal code of regula- tions. They yearned for greater freedom and boldness, and for a better chance of asserting their individual capacities. So they gave way to a strong reaction against the creed of their immediate predecessors, and cut them- selves deliberately adrift.

With the craving of young artists for new forms of technique came also the idea that the “old-master tradi- tions ” were opposed to the exact interpretation of nature, and were based too much upon convention to be

adapted for the needs of men who believed that absolute realism was the one thing worth aiming at in picture-production. So Paris became the educational centre instead of Rome. There was to British students, dissatisfied with the half- hearted and imperfect systems of teaching with which they were tantahzed at home, a peculiarly exhilarating atmosphere in the French studios ??? an amount of enthu- siasm and a love of art for its own sake without parallel elsewhere. They saw in operation principles which led by the right sequence of stages to sure and certain results. In these circumstances they allowed their sympathies with French methods to become rather exaggerated, and were somewhat reckless in their adoption of both the good and bad qualities of so attractive a school

At first the results of this breaking-away from all the older educational customs were not wholly satisfactory. British students came back from France better craftsmen, stronger and sounder draughtsmen, more skilful manipu- lators, and with an infinitely more correct appreciation of refinements of tone-management than they had ever possessed before; but they brought back also a dispro- portionate amount of French mannerism and a number

of affectations which sat awkwardly upon them. In the first flush of their conversion they went farther than was wise or necessary, for they changed their motives as well as their methods. The quietness of subject and reserve of manner which had been hitherto eminently character- istic of the British school were abandoned for foreign sensationahsm and exaggeration of effect. An affectation of extreme vivacity, a liking for theatrical suggestion, even an inclination towards coarse presentation of un- pleasant incidents from modern hfe ??? all of which could be found in the paintings of the French artists who were then recognized as leaders ??? must be noted as importations from the Paris studios. They were the source of a dis- tinct degeneration in the artistic taste, and they introduced into British pictorial practice certain unnatural

tendencies. Scarcely less evident was the depreciation in the instincts ive colour-sense of British painters, which was brought about by the adoption of the French habit of regard; ing strict accuracy of tone-relation as the one important thing to aim at. Before this there had been a prefer- ence for rich and sumptuous harmonies and for chromatic effects which were rather compromises with, than exact renderings of, nature ; but as the foreign influence grew more active, these pleasant adaptations, inspired by a sensuous love of colour for its own sake, were abandoned for more scientific statements. The colder and cruder tone-studies of the modern Frenchmen became the models upon which the younger artists based themselves, and the standards against which they measured their own success. "Actuality " was gained, but much of the poetry, the deli- cacy, and the subtle charm which distinguished British colourists in the 'fifties was lost.

For some whUe there was a danger that the art of Great Britain might become hybrid, with the French Danger strain predominating. So many students had at the succumbed to the fascination of a system of French training which seemed to supply them with a Influence, pgjfggt equipment on all points, that they were inclined to despise not only the educational methods of their own country, but also the inherent characteristics of British taste. The result was that the exhibitions were fuU of pictures which presented English people and English landscape in a purely arbitrary and artificial manner, strictly in accordance with a French convention which was out of S3rmpathy with British instincts, and indeed, with British facts. Ultimately a discreet middle course was found between the extreme application of the science of the French art schools and the comparative irresponsibility in technical matters which had so long existed in the British Isles. In the careers of men like Stanhope Forbes, H. S. Tuke, Frank Bramley, and other prominent members of the school, many illustrations are provided of the way in which this readjustment has been effected. Their pictures, if taken in a sufficiently long sequence, summarize instructively the course of the move- ment which has been so active since 1875. They prove how valuable the interposition of France has been in the matter of artistic education, and how much Englishmen have improved in their understanding of the technique of painting.

One noteworthy outcome of the triumph of common sense over fanaticism must be mentioned. Now that the Weaken- exact relation which French teaching should Ing of the bear to British thought has been adjusted, an French inclination to revive the more typical of the Influence. fQpjjjg Qf pictorial expression which have had their vogue in the past is becoming increasingly evident. Picturesque domesticity is taking the place of theatrical sensation, the desire to select and represent what is more than ordinarily beautiful is ousting the former pre-

ference for what was brutal and ugly, the effort to please is once again stronger than the intention to surprise or shock the art lover. Even the Pre-Raphaelite theories and practices are being reconstructed, and quite a con- siderable group of young artists is springing up who are avowed believers in the principles which were advocated so strenuously in 1850.

*To French intervention can be ascribed the rise and progress of several movements which have had results of more than ordinary moment. There was a few arouos years ago much banding together of men who within the believed strongly in the importance of asserting British plainly their behef in the doctrines to which *”””’ ” they had been converted abroad ; and as a consequence of this desire for an offensive and defensive association, many detached groups were formed within the boundaries of the British school. Each of these groups had some peculiar tenet which it sought to advocate, and each one had a small orbit of its own in which it revolved, without concerning itself much about what might be going on outside. Roughly, there were three classes into which British artists could then be divided. One included those men who were in the main French in sympathy and manner ; another consisted of those who were not insensible to the value of the foreign training, but yet did not wish to surrender entirely their faith in the British tradition ; and the third, and smallest, was made up of a few individuals who were independent of all assistance from without, and had sufiicient force of character to ignore what was going on in the art world. In this third class there was practi- cally no common point of view : each man chose his own direction and followed it as he thought best, and each one was prepared to stand or fall by the opinion which he had formed as to the true function of the painter. Necessarily, in such a gathering there were*

several notable personalities who may fairly be reckoned among the best of English modern masters.

*Perhaps the most conspicuous of the groups was the collection of painters who established themselves in the Cornish village of ISTewlyn. This group ??? "The Newlyn School," as it was called ???was afterwards much modified, and many f, * . of its most cherished beliefs were considerably altered. ft/*

In its beginning it was essentially French in atmo- sphere, and advocated not only strict adherence to realism in choice and treatment of subject, but also the suhordination of colour to tone-gradation, and the observance of certain technical details, such as the exclusive use of flat brushes and the laying on of pigments in square touches. The colony was fonned, as it were, in stages ; and as the school is to be reckoned in the future history of the British school, the order in which the adherents arrived may here be set on record. Edwin Harris came first, and was joined by Walter Langley. Then, in the following order, came Ralph Todd, L. Suthei-s, Fred Hall, Frank Bramley, and T. C. Gotch, and Percy Craft and Stanhope Forbes together. H. Detmold and Chevallier Tayler next arrived ; then Miss Elizabeth Armstrong (Mrs. Stanhope Forbes), F. Bourdillon, W. Fortescue, and Korman Garstin. Ayerst Ingram, H. S. Tuke, H. M&tin, and F. Millard were later visitors. The earlier leaders of this school were said to have chosen Newlyn as their working centre because the pre- vailing greyness in the atmosphere of the place facilitated their interpretation of subleties of tone. Almost the only one of the original set who in 1902 remained at Newlyn was Stanhope Forbes (b. 1857), who was trained at the Lambeth School and at the Eoyal Academy, and afterwards in Bonnat's studio in Paris. His best known pictures are "A Fish Sale on a Cornish Beach" (1885), "Soldiers and Sailors "(1891), "Forging the Anchor" (1S92), and " The Smithy " (1895). He was elected an Associate of the Royal Academy in 1892. Frank Bramley (b. 1857) studied art in the Lincoln School of Art and at Antwerp. He gained much popu- larity by his pictures "A Hopeless Dawn" (1888), "For of such is the Kingdom of Heaven " (1891), and " After the Storm " (1896), and was elected an Associate in 1894. Of late years he has made a very definite departure from the technical methods which he followed in his earlier

period. T. C. Gotch (b. 1854) had a varied art ti'nining, for he worked at the Slade School, then at Antwerp, and finally in Paris under Jean Paul Laurens. He did not long remain faithful to the Newlyn creed, but diverged about 1890 into

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a kiu-i of decorative symbolism, and subsequently devoted himself entirely to pictures of this type. The other men who must be ranked as supporters of the school adhered closely enough to the principles which were exemplified in the works of the leaders of the movement. They were faithful realists, sincere observers of the facts of the life with which they were brought in contact, and quite earnest in their efforts to paint what they saw, without modification or idealization. Their art was honest, but too material and uninspired to gain a permanent hold upon any but a small section of the public. The Newlyn school has ceased to be an association of artists sharing a common conviction or possessing a united aim. The name continues, but it is used now chiefly as the title of an art colony settled in the village, and including a varied assemblage of workers who have gathered there because the neighbourhood is rich in picturesque material. But Newlyn will always have a place in art history as the head- quarters of a movement which proposed to effect a drastic reform in British art.

Another group which received its inspiration directly from France was the Impressionist school (see Impressionism). This Yh I . group never had any distinct organization like that of aresslonlst ʻ^ I'rcnch Sooi6t6 des Impressionistes, but among the school members of it there was a general agreement on points

of procedure. They based themselves, more or less, upon prominent French artists like Mauet, Renoir, Pissarro, and Claude Monet, and owed not a little to the example of J. McN. Whistler, whose own art may be said to be in a great measure a product of Paris. One of the fundamental

principles of their practice is the subdivision of colour masses into their component parts, and the rendering of gradated tints by the juxtaposition of touches of pure colour upon the canvas, rather than by attempting to match them by previously mixing them on the palette. In pictures so painted greater luminosity and more subtlety of aerial effects can be obtained. The works of the British Impressionists have been seen mostly in the exhibitions of the New English Art

Club. This society was founded in 1885 by a number K ^ II h' ►► yo^^'ig artists who wished for facilities for exhibition A-fri h ^^^"^^ they felt were denied to them in the other

galleries. It drew the gi'eater number of its earlier supporters from the men who had been trained in foreign schools, and a complete list of the contributors to its exhibitions includes the names of many of the best known of the younger painters. It was the meeting-place of numerous groups which advocated one or other of the new creeds, for among its members or exhibitors can bo counted P. Wilson Steer, Fred Brown, J. S. Sargent, Solomon J. Solomon, Stanhope Forbes, T. C. Gotch, Frank Bramley, Arthur Hacker, Francis Bate, Moffat Lindner, J. L. Henry, W. W. Russell, George Thomson, Arthur Tomson, Henry Tonks, C. W. Furse, R. Anning Bell, Walter Osborne, Laurence Housman, J. J. Shannon, W. L. Wyllie, H. S. Tuke, Maurice Greiffenhagen, G. P. Jacomb Hood, Alfred Parsons, Alfred East, J. Buxton Knight, C. H. Shannon, Mark Fisher, Walter Siokert, W. Strang, Frank Short, Edward Stott, Mortimer Menpes, Alfred Hartley, William Stott, J. R. Reid, Mouat Loudan, T. B. Kenningtou, H. Muhrman, A. D. Peppercorn, George Clausen, and J. McN. Whistler, and a number of the Scottish artists, like J. Lavery, J. Guthrie, George Henry, James Paterson, A. Roche, E. A. Walton, J. E. Christie, and E. A. Hornel. A number of the men who have been more or less actively identified with it have been elected members of the Royal Academy, so that it may fairly claim to have exercised a definite influence upon the tendencies of modern art. It has certainly done much to prove the extent of the foreign influence upon the British school, and it has summarized in- structively the varieties of artistic practice and point of view which have been so noteworthy during recent years. That there has been latterly a change in the atmosphere of its exhibitions is due to the

new conditions which prevail in the art world. It reflects the steadying of conviction and the reaction towards a more national style which are affecting British artists as a mass. It shows less the undiluted influence of France, and much more of that growing, or rather vaguely expressed, desire for individuality which suggests now that British painters recognize the futility of trying to transplant to their country a mode of thought unsuited to their innate convictions and at variance with their mental traditions and vrith their own temperament.

In its wider sense the Impressionist school may be said to include now all those students of nature who strive for the repre- sentation of broad effects rather than minute details, who look at the subject before them largely and comprehensively, and ignore all minor matters which would be likely to interfere with the simplicity of the pictorial rendering. To it can be assigned a number of artists who have never adopted, or have definitely abandoned, the prismatic analysis of colour advocated by the French Impressionists. These men are headed by J. McN. Whistler {q.v.), born in America in 1835, and trained in Paris under Gleyre. His pictures have always been remarkable for their beauty of colour combination, and for their sensitive management

of subtleties of tone. They have gained for the artist a place among the chief modern executants, and have attracted to him a host of followers. Other notable painters who have places in the school are Mark Fisher, an American landscape painter who studied for a while in Gleyre's studio, one of the ablest inter- preters in England of effects of sunlight and breezy atmosphere ; A. D. Peppercorn, a pupil of Guromc, who makes landscapes a medium for the expression of a dignified sense of design and a carefully simplified appreciation of contrasts of tone ; and P. Wilson Steer, an artist who began as a follower of Monet, and lias based upon his training in the Ecole des Beaux Arts a style of his own, which he displays effectively in both landscapes and figure pictures. In its pure form Impressionism has not gained much hold upon British painters, but in a certain degree some of its principles have affected a great number of men who cannot be strictly considered as avowed believers in the teachings of the school.

Generally speaking, the very large class of artists who fell only to a limited extent under the spell of French teaching includes most of the figure and landscape men and practically the whole of the portrait painters. In all sections of ^~^rs the figure school individual workers of improved ‘’” technical methods have appeared, but most of them have gradually lost their distinguishing peculiarities of manner, and have year by year assimilated themselves more closely to their less advanced brethren. The section in which their energetic propagandism has been most effective is certainly that of imaginative composition. A definite mark has been made there by men like S. J. Solomon (b. 1860), trained at, the Royal Academy Schools, the Munich Academy, and the Ecole des Beaux Arts in Paris, elected an Associate of the Academy in 1896, and widely known by such pictures as “Samson” (1887), “The Judgment of Paris ” (1890), and the “Birth of Love” (1895); and Arthur Hacker (b. 1858), educated at the Academy and in Bonnat’s studio, elected an Associate in 1894, and the painter of a considerable series of semi-historical and symbolical canvases. They have exercised a considerable influence upon their contemporaries, and have introduced some new elements into the later practice of the school. But at the same time admirably eft’ective work has been done in this section and others by many painters who have kept much more closely in touch with the older type of aesthetic belief, and have not associated themselves openly with any of the newer movements. Among the more prominent of these figure painters there are, or have been, some excellent craftsmen, whose contributions to tlie record of native British art can be accepted as full of permanent interest. In the school of historical incident good work was done by Sir John Gilbert (1817-1897), a robust and ingenious illustrator of romantic motives, with a never-failing capacity for picturesque invention ; John Pettie (1839-1893), a fine oolourist and a clover manipulator, whose scenes from the life of past centuries Were full of rare vitality ; P. H. Calderon (1833-1898), a graceful and sincere artist not wanting in originality ; and H. Stacy Marks (1829-1898), who treated mediaeval motives with a touch of real humour. Besides these, there are Sir J. D. Linton (b. 1840), who has produced many fine compositions in oil and water colours ; Frank Dicksee (b. 1853), elected an Associate of the Royal Academy in 1881 and an Academician in 1891, who has gained wide popularity by pictures in which romance and sentiment are

combined in equal proportions ; A. C. Gow (b. 1848), a member of the Academy since 1881, whose "Cromwell at Dunbar" (1886), "Flight of James II. after the Battle of the Boyne" (1888), and "Crossing the Bidassoa " (1896) maybe noted as typical examples of his performance ; J. Seymour Lucas (b. 1849), trained at the Royal Academy Schools, elected an Associate in 1886 and an Academician in 1898, and a brilliant painter of what may be called the by-play of history ; W. Dendy Sadler (b. 1854), trained partly in London and partly at Diisseldorf, and well known by his quaintly humorous renderings of the lighter side of life in the olden times ; G. H. Boughton (born in England, but educated first in America and aftenvards in Paris), elected an Associate in 1879 and an Academician in 1896, and long recognized as a specialist in paintings of old and modern Dutch subjects ; the Hon. John Collier (b. 1850), trained at the Slade School, at Munich, and in Paris, and a capable painter both of the nude figure and of costume ; and Edwin A. Abbey, an American (b. 1852), educated at the Pennsylvania Academy of the Fine Arts. Abbey came to England in 1876 with a great reputation as an illustrator, but did not begin to exhibit oil pictures until 1890 ; he was elected an Academician in 1898. Then there are to be noted classicists like Lord Leighton, Sir L. Alma-Tadema, Sir E. J. Poynter, and Edwin Long (1839-1891), a student of the East like Frederick Goodall (J. 1822), elected an Associate in 1853 and an Academician in 1863 ; and an idealist like Sir W. B. Richmond- all of whom have done much to uphold the reputation of the British school for strength of accomplishment and variety of motive.

The painters of sentiment have in the main adhered closely to the tradition which has been handed down through successive genera- tions. They were headed in 1902 by Marcus Stone (b. 1840), elected

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an Academician in 1887, an original artist whose dainty fancies are familiar to students of modern art. His pictures have nearly ⬛⬛⬛. all

appeared in the exhibitions of the Royal Academy,

*seatiment *□□ "which institution he has been consistently faithful. □□□ Another popular artist is G. D. Leslie (b. 1835), elected an Associate in 1868 and an Academician in 1876, who has been responsible for a number of domestic subject pictures remark- able for freshness of treatment and delicacy of feeling. The list may also be held to include Henry Woods (b. 1846), elected Associate of the Royal Academy in 1882 and Academician 1893, and since 1877 a painter of scenes from Venetian life ; R. W. Macbeth (b. 1848), elected an Associate in 1883, whose elegant treatment of rustic subjects displays a very attractive individuality ; E. Blair Leighton (b. 1853), who has occupied himself chiefly with imaginative motives which combine historical romance with sentiment ; and P. R. Morris (1833-1902), elected an Associate 1877, who in his earlier career dealt with modern life poetically and with graceful simplicity. Among the painters of sentiment may perhaps also be included Luke Fildes (b. 1844), educated at the South Kensington and Royal Academy Schools, elected an Academician in 1887, the painter of such famous pictures as "The Casual Ward" (1874), "The AVidower" (1876), "The Return of the Penitent" (1879), and "The Doctor" (1892) ; and Hubert von Herkomer (b. 1849), elected an Associate in 1879 and Academician 1890, famous not only by his many memorable canvases and by his extraordinary versatility in the arts, but also as a teacher and a leader in a number of educational movements.*

Not many military pictures of high merit have been produced

during the period. The artists, indeed, who occupy themselves

with this class of art are not numerous, and they

y fP' mostly devote their energies to illustrative pictures pa n ng. ᵍ^j^gj. than large canvases. Lady Butler (mfe Elizabeth Thompson), whose "Roll Call," exhibited in 1874, brought her instantaneous popularity, continued to paint sub- jects of the same type, among which "Quatre Bras" (1876), "The Defence of Rorke's Drift" (1881), "The Camel Corps" (1891), and "The Dawn of Waterloo" (1895), are perhaps the most worthy of record. Ernest Crofts (b. 1847), trained in London and Dusseldorf, has taken a

prominent position by such pictures as "Napoleon at Ligny " (1875), "Napoleon Leaving Moscow" (1887), "The Capture of a French Battery by the 53rd Regiment at Waterloo" (1896), and by many similar representations of historical battles ; he was elected an Associate in 1878, an Aca- demician in 1896, and became Keeper of the Royal Academy. Occa- sional pictures have come also from A. C. Gow (see above), R. Caton Woodville, W. B. WoUen, J. P. Beadle, and a few more men who are better known by their work in other directions ; but the sum total of military paintings- is inconsiderable.

The number of artists who have devoted the greater part of

their energies to portraiture has been steadily on the increase.

Most of the men who have taken definite rank among

o ra ure. j^ figure painters have made reputations by their portraits also, but there are many others who have kept almost exclusively to this branch of practice. Into the first division come such noted artists as Sir John Millais, Sir E. J. Poynter, G. E. Watts, Luke Fildes, Hubert von Herkomer, Sir L. Alma-Tadema, Sir W. B. Richmond, Seymour Lucas, the Hon. John Collier, S. J. Solomon, Arthur Hacker, W. Q. Orchardson, J. M'N. Whistler, Frank Dicksee, Stanhope Forbes, Frank Bramley, H. S. Tuke, T. C. Gotch, P. W. Steer, and Frank Holl. In the second must be reckoned J. S. Sargent, an American (b. 1856), a pupil of Carolus Duran, elected an Associate in 1894 and an Academician 1897, who after 1885 was recognized as one of the most brilliant portrait painters of the day ; J. J. Shannon, also an American (b. 1862), trained at the South Kensington School, and elected an Associate in 1897, a graceful and accomplished artist, with a sound technical method and a delightful sense of style ; A. S. Cope (b. 1857), trained in Paris, and elected an Associate in 1899, who carries on soundly the better traditions of the British school ; James Sant (b. 1820), elected an Academician in 1870, a strong favourite of the public throughout a long career ; W. W. Ouless (b. 1848), elected an Associate in 1877 ami an Academician in 1881, trained in the Royal Academy Schools, an industrious and prolific worker ; H. T. Wells (b. 1828), trained in London and Paris, elected Associate in 1866 and Academician in 1870, who has pro- duced a long series of portraits and portrait groups, and

many miniatures ; W. Llewellyn (b. 1860), educated at the South Kensington School and in Gormen's studio in Paris, an able draughtsman and a thorough executant ; C. W. Furse (b. 1868), trained first in the Slade School under Professor Legros and after- wards in Paris, one of tlie strongest of the younger men ; and others like Walter Osborne, Richard Jack, Ralph Poacoci;, H. de T. Glazebrook, and J. H. F. Bacon. Gencially, the school of Portraiture can be praised for its sturdy vitality. It has thrown aside most of the empty conventions by which it was once hampered ; and it has gained from the French influence just enough freshness of idea to increase in the right way its power of

initiative and to enhance the value of its eflfort. The men who belong to it are plainly convinced of the necessity for bringing to bear upon their work a proper spirit of investigation. They observe far more closely than their predecessors of half a century ago, and they analyse and depict character with a much shrewder perception of shades of individuality. But the school as a whole has lost none of its British essentials : it has, indeed, recovered much of the breadth and dignity which made it so remarkable in the 18th century, and has advanced in understanding of technical devices.

In the class of figure painters, who are individual in their work, and owe little or nothing to the suggestions of foreign teachers, a number of artists can be enumerated who have in , ., .. common little besides a sincere desire to express their '"'"'"'"'" personal conviction in their own way. Among them ^^ are some of the most distinguished of modern artists, " '" who stand out as the unquestioned chiefs of the school. Sir John Millais occupies a place in this group by virtue of his admirable pictorial work, and with him are W. Holman Hunt, Dante Gabriel Rossetti, G. F. Watts, Sir Edward Bume-Jones, Albert Moore, and Ford Madox Brown, each one of whom may be regarded as a leader. There are also J. M. Strudwick, E. Spencer Stanhope, and Evelyn de Morgan, who are followers of Bume-Jones, and J. W. Waterhouse, elected an Associate of the Royal Academy 1885 and an Academician in 1895, in many ways the most original and inspired of English imaginative painters, and, again, M. Greiffenhagen and Mrs Swynnerton. Into this class come also the decorative painters, Walter Crane (b. 1845), practically self-educated

* 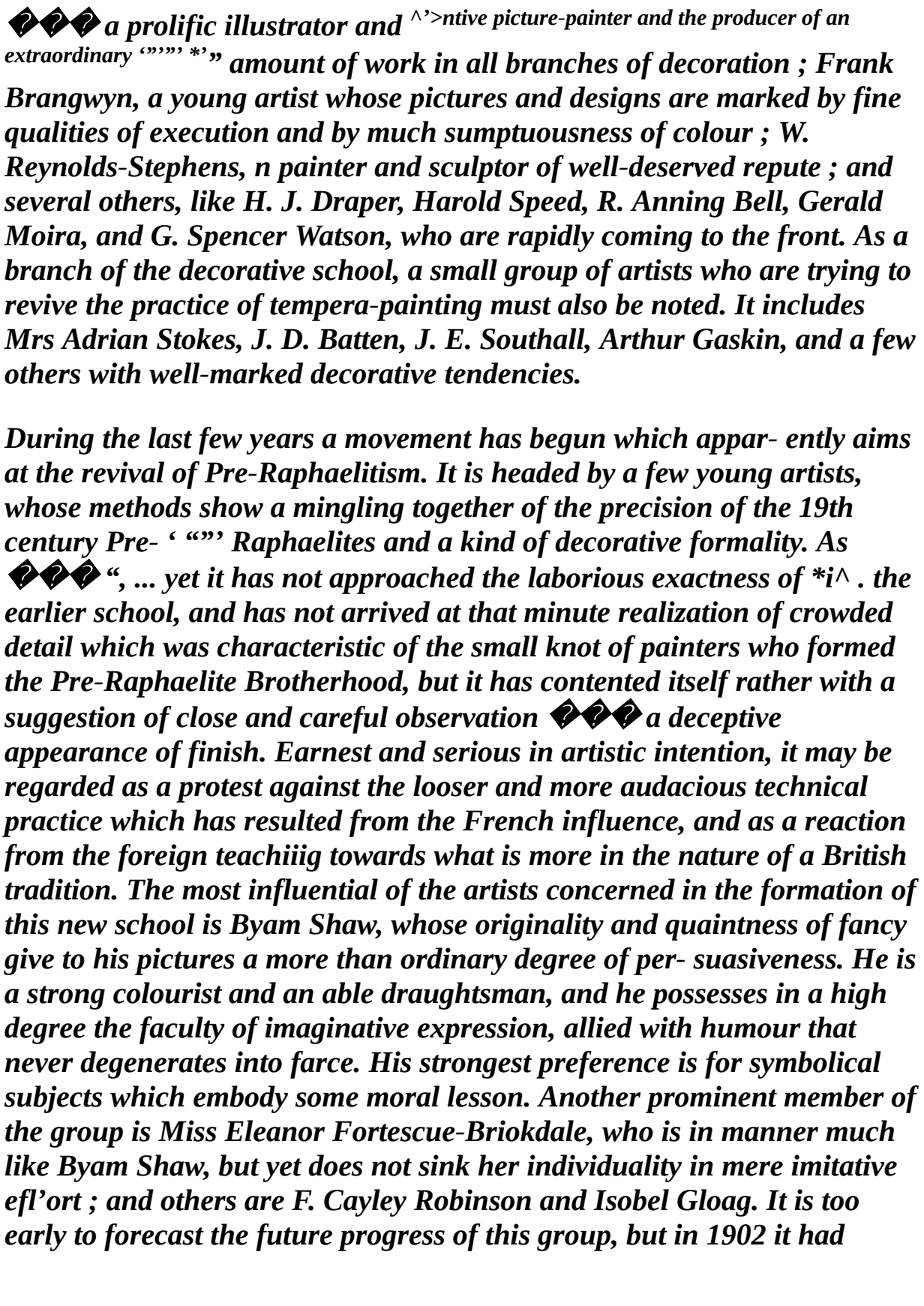 *

*a prolific illustrator and ^'>ntive picture-painter and the producer of an extraordinary '"""' *'" amount of work in all branches of decoration ; Frank Brangwyn, a young artist whose pictures and designs are marked by fine qualities of execution and by much sumptuousness of colour ; W. Reynolds-Stephens, n painter and sculptor of well-deserved repute ; and several others, like H. J. Draper, Harold Speed, R. Anning Bell, Gerald Moira, and G. Spencer Watson, who are rapidly coming to the front. As a branch of the decorative school, a small group of artists who are trying to revive the practice of tempera-painting must also be noted. It includes Mrs Adrian Stokes, J. D. Batten, J. E. Southall, Arthur Gaskin, and a few others with well-marked decorative tendencies.*

During the last few years a movement has begun which appar- ently aims at the revival of Pre-Raphaelitism. It is headed by a few young artists, whose methods show a mingling together of the precision of the 19th century Pre- ' "" Raphaelites and a kind of decorative formality. As ", ... yet it has not approached the laborious exactness of *i^ . the earlier school, and has not arrived at that minute realization of crowded detail which was characteristic of the small knot of painters who formed the Pre-Raphaelite Brotherhood, but it has contented itself rather with a suggestion of close and careful observation a deceptive appearance of finish. Earnest and serious in artistic intention, it may be regarded as a protest against the looser and more audacious technical practice which has resulted from the French influence, and as a reaction from the foreign teachiiig towards what is more in the nature of a British tradition. The most influential of the artists concerned in the formation of this new school is Byam Shaw, whose originality and quaintness of fancy give to his pictures a more than ordinary degree of per- suasiveness. He is a strong colourist and an able draughtsman, and he possesses in a high degree the faculty of imaginative expression, allied with humour that never degenerates into farce. His strongest preference is for symbolical subjects which embody some moral lesson. Another prominent member of the group is Miss Eleanor Fortescue-Briokdale, who is in manner much like Byam Shaw, but yet does not sink her individuality in mere imitative efl'ort ; and others are F. Cayley Robinson and Isobel Gloag. It is too early to forecast the future progress of this group, but in 1902 it had*

already taken a certain position among the more active of the organizations into which the British school was subdivided.

The painters of landscapes and sea pictures have for the most part been little aff'ected by the unrest which has caused so many new departures in figure-work. A love of nature has always been one of the best British characteristics, '[illegible]*~~"'P^ and it has proved itself to be strong enough to keep P*""*"~~ those artists who seek their inspiration cut of doors from falling to any great extent under the control of particular technical fashions. Therefore there is in the school of " open-air " paint- ing little evidence of any change in point of view, or of the growth of any modern feeling at variance with that by which masters of landscape were swayed a, century or more ago. Im- pressionism has gained a few adherents, and the French Barbizon school* [illegible] *itself created in response to suggestion from England* [illegible] *has reacted upon a small section of the younger artists. But, on the whole, in this branch of art the British school has gained in power and confidence, without surrendering that sturdy*

independence which in the past produced such momentous results. The absence of any common convention, or of any set pattern of landscape which would lead to uniformity of effort, has left the students of nature free to express themselves in a personal way. The most devout believers in the value of French training, and in the infallibility of the dogmas which emanate from the Paris studios, have not, except in rare instances, demanded any radical remodelling of the British landscape school ou French lines, as local conditions alfeoting the practice of this branch of art make impossible all drastic alterations. "What modifications there have been have tended chiefly in the direction of wider choice of subject and increased freedom of executive method ; and now most workers in the front rank can claim to be judged on individual merits, and not as a member of a particular coterie. Still, it is convenient to divide the

members of the landscape school into such classes as realists, romanticists, and painters of subjective landscape.

Among the most notable of the first class are H. "W. B. Davis (b. 1833), elected an Associate in 1873, and an Academician in ???. 1877, the painter of a long series of dainty scenes

Kea s 0 jjjji- suggest happily the charm of rural England ; an scape, pg^gj. (jraham elected an Academician in 1881, who has alternated for the greater part of his working life between Scottish moorland subjects, with cattle wandering on bare hill- sides, and pictures of coast scenery, with sea-gulls perched on dark rooks ; David Murray (b. 1849), elected an Associate of the Eoyal Academy in 1891, an artist whose career has been marked by consistent effort to interpret nature's suggestions with dignity and intelligence ; Sir Ernest A. Waterlovv (b. 1850), trained in the Koyal Academy Schools, elected an Associate in 1890, and aftenvards President of the Royal Society of Painters in Water-Colours, a graceful painter, with a tender colour feeling and an excellent technical style ; Yeend King (b. 1855), trained partly in England and partly in Paris under Bonnat and Cormon, a sound craftsman who has made a reputation by landscapes in which are introduced groups of figures on a fairly important scale ; Alfred Parsons (b. 1847), elected an Associate in 1897, who paints rich river scenery with careful regard for actuality and with much miuuteness and exquisiteness of detail, especially in the rendering of flowers ; and Frank Walton (b. 1840), who chooses, as a rule, landscape motives which enable him to display unusual powers of accurate draughtsmanship. To the same class of realists belong several deceased painters, like Vicat Cole, Birket Foster, J. W. Oakes, Keeley Halswelle, and perhaps Alfred W. Hunt, though in his case realism was tempered by a delicate poetio imagination.

*The romanticists and pastoral painters have been perceptibly affected by the example of the Barbizon school, but they owe much to such famous Englishmen as Cecil Lawson, Romantic ^^^^ Linnell (both of whom died in 1882), George ana pas. y^^^^ (– ⁻ ^-j^), and Frederick Walker (d. 1875). In oalnters ???'???^"^ * large number of very able artists could be ??? included in this section of the landscape school, and this*

number seemed likely to be greatly increased as years went on. The most prominent member of the group is, perhaps, Alfred East (b. 1849), trained first in the Glasgow School of Art and afterwards in Paris, elected an Associate in 1899, a painter with an exceptional faculty for suggesting the poetry of nature, and endowed with an admirable sense of decorative arrangement ; but there are, besides, Leslie Thomson (b. 1851), whose art is especially sound and sincere ; J. Aumonier, a pastoral painter with very re ined appreciation of subtleties of aerial colour ; 0. W. Wyllie, a painter of delicate vision and charm of presentation ; J. S. Hill, whose sombre landscapes are distinguished in design and impressive in their depth of tone ; E. W. Allan (b. 1852), who uses a robust technical method with equal skill in landscapes and coast subjects ; J. Buxton Knight, (b. 1842), a vigorous manipu- lator, with a liking for rich harmonies and low tones ; Joseph Knight (b. 1838), practically self-taught, whose well-drawn and broadly painted pictures in oil and water-colour have been for many years appreciated by lovers of unafi'ected nature ; Lionel P. Smythe, elected an Associate of the Eoyal Academy in 1898, a oolourist who handles exquisitely the most delicate atmospheric effects and is unusually successful in his rendering of quiet, diffused daylight ; J. W. North, elected an Associate in 1893, a painter of fanciful landscapes in which definition of form is subordinated to modulations of decorative colour ; Claude Hayes, who studied in the Royal Academy Schools, and has carried on consistently for some years the tradition established by David Cox and his contemporaries ; J. L. Pickering, a lover of dramatic light-and- shade contrasts and a student of romantic mountain scenery ; A. D. Peppercorn, who gives breadth and dignity, with sombre colour and delicate gradation of tone ; Adrian Stokes and M. Ridley Corbet, who died in 1902, only a few months after his election as an Associate of the Eoyal Academy, a classicist in landscape, in whose pictures can be perceived a definite reflection of the teaching of Professor Costa, the Italian master. There must

also be noted, as leaders among the pastoral painters, George Clausen (b. 1852), trained first in the South Kensington School and afterwards in Paris under Bouguereau and Robert-Fleury, and elected an Associate in 1895, who began as a strict realist and has developed since into a rustic idealist ; H. H. La Thangue, trained in the Eoyal Academy Schools and in

Paris, elected an Associate in 1898, an artist of amazing technical vigour, and an uncompromis- ing interpreter of rural subjects ; Edward Stott, trained in Paris under Carolus-Duran and Cabanel, who paints delicately the more poetic aspects of the life of the fields ; and Amesby Brown, a pupil of Professor von Herkomer, who has taken latterly a very prominent place among the younger artists ??? his picture "Morning" was bought in 1901 by the Ghantrey Fund Trustees, and "River Bank" in 1902 for the Guildhall Art Gallery.

*The painters of subjective landscape, who conventionalize nature with the idea of giving to their pictures a kind of sentimental suggestion, are most strikingly represented by B. W. Leader (b. 1831), trained in the Worcester School "f^^^"" ??? Design and in the Royal Academy Schools, and elected '^*

an Academician in 1898. He is a strong favourite of the public, and his somewhat formal and precise technical methods are widely admired by the many people who are not satisfied with un- affected transcriptions of natural scenes.

In marine painting no one has appeared to rival Henry Moore, perhaps the greatest student of wave-fofms the world has ever known ; but good work was being done in 1902 by the ???. Irish painter, Edwin Hayes, a veteran whose powers __/?????????????? showed no sign of failure after some half-century of con- ^ tinuous labour ; W. L. Wyllie (b. 1851), trained in the Eoyal Academy Schools, and elected an Associate in 1889, who paints sea and shipping with intelligent understanding ; T. Somerscales, a self-taught artist, with an intimate knowledge of the ocean derived from long actual experience as a sailor ; C. Kapier Hemy (b. 1841), trained at the Antwerp Academy and in the studio of Baron Leys, elected an Associate in 1898, a powerful manipulator, with a preference for the dramatic aspects of his subject ; and J. C. Hook, who retained into old age the subtle qualities which made his pictures notable among the best productions of the British school. Of the men who have fallen out of the ranks, mention must be made of John Brett (1830-1902), the one Pre-Eaphaelite sea painter, and Hamilton Macallum (1841-1896), who

painted rippling water in bright sunlight with delightful delicacy and charm of manner.

*The school of animal painting is a small one, and includes only a few of marked ability. The chief members include Briton Riviere, one of the most imaginative and inventive . of living artists ; J. M. Swan, trained first at Lam- . . beth, and afterwards in Paris under G^rome and '^ *'*

Fr^miet, elected an Associate of the Eoyal Academy in 1894, a skilful manipulator and a sensitive draughtsman, and especially remarkable for his intimate understanding of animal character, especially of the felidce (see also Sculptttbe) ; J. T. Nettleship (1841-1902), trained chiefly in the Slade School, whose studies of the greater beasts of prey are admirably sincere and well painted ; Miss Lucy Kemp-Welch (b. 1869), trained in the Herkomer School at Bushey, who paints horses with unusual power ; and John Charlton {h. 1849), trained in the South Ken- sington School, also well known by his pictures of horses.

*There are some local schools which have a right to attention because of the value of their contributions to the aggregation of British art. One of the most active of these is the Scottish school, with its centres at Glasgow and Edin- ^ * burgh, which has produced some of the most distin- *" "" *' guished British artists. The Royal Academy, indeed, with most of the other leading art societies, has been largely recruited from Scotland. There have been added to its modern roll the names of W. Q. Orohardson, Peter Graham, J. MacWhirter, J. Pettie, Erskine Nichol, T. Faed, David Murray, Colin Hunter, R. W. Macbeth, J. Farquharson,"all of them painters of well-established reputation ; and outside the Academy there are many well-known Scottish artists, who have made London their headquarters, like Arthur Melville, a portrait and subject painter and a masterly water-colourist ; E. A. Walton, who is equally successful with portraits, landscapes, and decorative compositions ; J. Coutts- Miohie, who alternates between portraiture and landscapes of admirable quality ; John Lorimer, who has exhibited a number of excellent subject pictures and many fine portraits ; T. Graham, an unaflTected painter of sentiment and a good colourist ; Grosvenor Thomas, known best by his freely handled and expressive land- scapes ; T. Austen Brown, who paints semi-*

decorative pastorals with unusual vigour of statement ; John Lavery, who has taken rank among the best of the younger portrait painters ; and Robert Brough, another portrait painter of vigour, with a subtle sense of colour. The most notable of the men who still remain in Scot- land include Alexander Roche, whose remarkable capacity has brought him many successes in portraiture, figure compositions, and decorative paintings on a large scale ; W. Y. MacGregor, a

Water- colour,

leader of the school of landscape painters, fine in style and a master of effect ; D. Y. Cameron, an admirable oil painter and a famous etcher ; George Henry, Harrington Mann, and James Guthrie, well known by their excellent portraits ; James Paterson, R. B. Kisbet, Robert Noble, R. Macaulay Stevenson, and David Farquharson, all landscape painters of marked originality and sound technical method ; W. McTaggart, an impressionist who is regarded as a leader of the school ; E. A. Hornel and W. Hole, decorative painters who have produced many canvases remarkable for robust originality and rare breadth of treatment ; W. Mouncey, a landscape painter who united the dignity of the Barbizon school with a typically Scottish freedom of expression ; and Sir George Reid, one of the ablest and most distinguished of portrait painters.

The chief characteristics which all these artists have in common are unusual directness and readiness of brushwork, remarkable subtlety of tone-management, and great sensitiveness to modu- lations of delicate colour. They are brilliant craftsmen, and are eminently sincere in their regard for nature's suggestions ; and as a school tbey show a unanimity of artistic conviction which keeps them closely in touch without leading them into excess of con- vention.

The water-colour painters can fairly be said to have kept un- changed the essential qualities of their particular form of practice. They have departed scarcely at all from the executive methods which have been recognized as correct for nearly a century, but they have amplified them and have adapted them to a gi'eater range of accomplishment, developing, it may be added, the " blottesque " or accidental manner suggestive of summary decision. Latterly water-colour painting has come to rival oils in its application to all sorts of subjects ; and it is used now with absolute freedom by a very large number of skilful artists. Many of the men who have done the best work in this medium are known as oil painters of the highest rank ; and among living workers the same capacity to excel in either mode of expression is by no means uncommon. There have been in recent times such masters as Sir John Gilbert, Sir E. Burne-Jones, Ford Madox Brown, Dante Gabriel Rossetti, A. W. Hunt, H. G. Hine, Henry Moore, Albert Moore, G. E. HoUoway, and, perhaps, E. M. Winiperis, whose water-colours are at least as worthy of admiration as their oil pictures. As water-colourists, much credit is due to Sir E. J. Poynter for his landscapes, portraits, and figure drawings, Sir L. Ahna-Tadema for his minutely detailed classic sulDJects, Sir J. D. Linton for his historical and romantic compositions, Sir E. A. Waterlow for his delicately expressive landscapes, Hubert von Herkomer for his admirably handled figure subjects, George Clausen for pastorals charming in sentiment and distinguished by fine qualities of colour, J. Aumonier, A. D. Peppercorn, J. S. HOI, J. W. North, Leslie Thomson, Frank Walton, and R. W. Allan for landscapes of special excellence, E. J. Gregory for figure compositions painted with amazing sureness of touch, Alfred Parsons for landscapes and flower studies, J. R. Reid, W. L. Wyllie, E. Hayes, and C. N. Hemy for sea and coast pictures, R. W. Macbeth, Claude Hayes, and Lionel Smythe for rustic scenes with figures in the open air, J. M. Swan for paintings of animals, and G. H. Boughton for costume subjects and delicately poetic fancies. Besides, there is a long list of noteworthy painters whose reputations have been chiefly or entirely made by their successful management of water- colour, and into this list come Birket Foster, the head of the old-fashioned school of dainty rusticity ; Carl Haag, a wonderful manipulator, who occapied himself almost exclusively with Eastern subjects ; Thomas Collier, A. W. Weedon, H. B. Brabazon, G. A. Fripp, P. J. Naftel, G. P. Boyoe, Albert Goodwin, R. Thorne-Waite,

F. G. Cotman, Harry Hine, Clarence “Whaite, and Bernard Evans, whose landscapes show thorough under- standing of nature and distinctive individuality of method ; Mrs Allingham, an artist of exquisite refinement, whose idealizations of country life have a more than ordinary degree of merit ; Clara Montalba, an able painter of impressions of Venice ; Kate Greenaway, unrivallecl as an intorjireter of the graces of child- hood, and endowed with the rarest originality ; Mrs Stanhope Forbes, an accomplished executant of well-imagined ron]antio motives ; and J. R. Weguelin, one of the most facile and expres- sive painters of fantastic figure subjects. By the aid of these artists, and many others of hardly less ability, such as J. Craw- hall, J. Paterson, R. Little, and J. Walter AVcst, traditions worthy of all respect are being maintained sincerely and with intelligent discrimination ; and to their efforts has been accorded a larger measure of popular sujiport than is bestowed upon any other form of pictorial production.

*Books upon the British School of Painting are numerous, and a vast number of biographies and autobiographies of painters have been published, all bearing on the subject. Of the first-named class the following may be enumerated :-^*

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*See also the Transactions of the National Association for the Advancement of Art (Liverpool 1888, Edinburgh 1889, and Birmingham 1890); the magazines devoted to the arts ⁂ The Portfolio, the Magazine of Art, the Art Journal, and the Studio ; and the principal reviews, such as "English Ai't in the A'ictorian Age" {Quarterly Peview, January 1898). /ji_ g_ g *

Feance.

The period between 1870 and the end of the 19th century ⁂was singularly important in the history of France, and consequently of her art. The internal life of the people developed on nevr lines with a vigour that left a deep mark on the outcome of mental effort. Literature was fore- most in this new movement. The novels of Balzac, Zola, Flaubert, the brothers de Goncourt, Daudet, Guy de Mau- passant, and the plays of Alexandre Dumas Jils, filled as they are with the scientific spirit and social atmosphere of the time, opened the eyes of the young generation to appreciation of the visible beauty and the spiritual poetry of the world around them, and helped them to view it with more attentive eyes, more insight, and more emotion. The aim of art was also to emancipate itself, by the growing efforts of independent artists, from the slavery of tradition, and to devote itself to a more personal contemplation and knowledge of contemporary hfe under every aspect. Modern French art tends to become more and more the art of the people ⁂ a mixture of naturalism and poetry, deriving its inspiration, by preference, from the world of the working man ; no longer appealing only to a restricted and more or less fastidious public, but, on the contrary, adapting its aesthetic or moral teaching to popular appre- hension. The whole past was not, of course, wiped out. The younger generation had to learn and profit by the lessons taught by their great precursors. To understand the true character of this recent development of French art it is needful, therefore, to glance at the past.

We need not dwell on the individual authorities who constitute the official hierarchy of the contemporary French school; these masters belong for the most part, by the date of their best work, to a former generation. Starting in many cases from very opposite points, but reconciled and

united by time, they carried on, during the last quarter of the 19th century, with more or less distinction, the inevitable evolution of their personal gifts. We still see the works of some of the staunch Romanticists : Jean Gigoux (d. 1892), Robert Fleury (d. 1890), Jules Dupri (d. 1889), Lami (d. 1890), Cabat (d. 1893), and Isabey (d. 1886); and with these, though they did not follow quite the same road, may be named Fran^ais (d. 1897) and Charles Jacque (d. 1894). Next to them, Meissonier (d. 1891) crowded into the last twenty years of his life a mass of work which, for the most part, enhanced his fame ; and Eosa Bonheur (d. 1899), working in re- tirement up to the age of seventy-seven, went on her accustomed way unmoved by external changes. Hubert, Harpignies, Ziem, and Paul Flandrin survived. Among the generation which grew up under the Second Empire wc find men of great intelligence and distinction ; some, like Alexandre Cabanel (1824-89), by pictures of historical genre, in a somewhat insipid and com-entional style, but more particularly by female portraits, firm in flesh-paint-

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ing and aristocratic in feeling; others, like Paul Baudry (1828-86, q.v.), wtose large decorative works, with their pure and lofty elegance, secured him lasting fame, and whose allegorical compositions were particularly remarkable ; not less so his portraits, at first vivid, glow- ing, and golden, but at the end of his life, under the influence of the new atmosphere, cooler in tone, but more eager, nervous, and restless in feeling. L^on G^r6me (b. 1824, q.v.) was the orginator, during the Second Empire, of the Neo-Greek idea, an Orientalist and painter of historic genre, whose somewhat arid instinct for archaeo- logical precision and finish developed to better ends in sculpture during later years. William Bouguereau (b. ???1825, q.v.) painted symbolical and allegorical subjects in a sentimental style. Jules Lefebvre (b. 1836) had a brilliant career as a portrait painter, combined, in his earlier years, with admirable studies of the nude. These were followed by Benjamin Constant (d. 1902), a clever painter of past ages in the East and of modern Oriental life, who latterly

directed his powers of vigorous and rapid brush- work to portrait-painting ; Fernand Carmon, the inventive chronicler of primeval Gaul, and a solid and learned portrait painter ; Aim6 Morot, a man of versatile gifts, a painter of portraits full of life and ease. These formed the heart of the Institut. On the other hand, we find a group who betray a close affinity with the realist party ??? rejecting, like them, tradition at second-hand, though returning for direct teaching to some of the great masters : L6on Bonnat (b. 1833), educated in Spain, and preserving through a long series of official portraits an evident worship of the great realists of that nation ; and again, under the same influence, Jean Paul Laurens (b. 1837), who has infused some return of vitality into his- torical painting by his clear and individual conceptions and realistic treatment. Jean Jacques Henner (b. 1829, q.v.), standing even more apart, lived in a Correggio-like dream of pale nude forms in dim landscape scenery. His love of exquisite texture, and his unvarying sense of beauty, with his refined dilettantism, link him on each side to the great groups of realists and idealists.

About the middle of the 19th century, after the vehe- ment disputes between the partisans of line and the votaries of colour, otherwise the Classic and the Komantic schools, when a younger generation was resting from these follies, exhausted, weary, devoid even of any fine technique, two groups slowly formed on the opposite sides of the horizon ??? seers, or dreamers, both, protesting in different ways against the collapse of the French school, and against the alleged indifference and sceptical eclecticism of the painters who were regarded as the leaders. This was a revolt from the academic and conservative tradition. One was the group of original and nature-loving painters, keen and devoted observers of men and things, the realists, made illustrious by the three great personalities of Corot (q.v.), Millet (q.v.), and Courbet (q.v.), the real originators of French contemporary art. The other was the group of men of imagination, the idealists, who, in the pursuit of perfect beauty and an ideal moral standard, reverted to the dissimilar visions of Delacroix and Ingres, the ideals of rhythm as opposed to harmony, of style versus passion, which Theodore Chass^riau had endeavoured to combine. Eound Puvis de Chavannes (q.v.) and Gustavo Moreau (q.v.) we find a group of artists who, in spite of the fascination exerted on their intelligence by the great works of the old masters, especially the early

Florentines and Venetians, would not accept the old technique, but strove to record in splendid imagery the wonders of the spiritual life, or claimed, by studying contemporary individuals, to reveal the psychology of modern minds. Among them were Gustave Ricard (1821-73), whose portraits, suggest-

ing the mystical charm sometimes of Leonardo and some- times of Eembrandt, are full of deep unuttered vitality ; Elie Delaunay (1828-91), serious and expressive in his heroic compositions, keen and striking in his portraits; Eugene Fromentin (1820-76), acute but subtle and silvery, a man of elegant mind, the vrriter of Les Maitres d' Autrefois, of Sahel, and of Le Sahara, the discoverer ??? artistically ??? of Algeria. And round the loud and showy individuality of Courbet ??? healthy, nevertheless, and inspiring ??? a group was gathered of men less judicious, but more stirring, more truculent, thoroughly original, but not less reverent to the old masters than they were defiant of contemporary authorities. They were even more ardent for a strong technique, but the masters who attracted them were the Dutch, the Flemish, the Venetians, who, like themselves, had aimed at recording the life of their day. Among these was Francois Bonvin (1817-87), who, following Granet, carried on the evolution of a subdivision of genre, the study of domestic interiors. This Drolling, too, had done, early in the 19th century, his predecessors in France being Chardin and Le Nain. This class of sub- jects has not merely absorbed all genre-painting, but has become a very important factor in the presentment of modern life. Bonvin painted asylums, convent-life, studios, laboratories, and schools. Alphonse Legros {q.v.), painter, sculptor, and etcher, who settled in London, was of the same school, though independent in his individuality, celebrating with his brush and etching-needle the life of the poor and humble, and even of the vagabond and beggar. There were also Bracquemond, the reviver of the craft of etching ; Fantin-Latour, the painter of highly romantic Wagnerian dreams, figure compositions grouped after the Dutch manner, and flower-pieces not surpassed in his day. Ribot, again, and VoUon, daring and dashing in their handling of the brush ; Guillaume R^gamey, one of the few military painters gifted with the epic sense; 'and even Carolus Duran, who, after painting " Murdered " (in the Lille Museum), combined with the professional duties of an official teacher a brilliant

career as a portrait painter. A later member of this group, attracted to it by student friend- ship in the little drawing-school which under Lecoq de Boisbaudran competed in a modest way with the ficole des Beaux Arts, was J. C. Cazin, well known afterwards as a pronounced idealist. Finally, there was Manet, a con- necting link between the realists and the impressionists. These two radiant focuses of imagination and of observation respectively were to be seen still intact during the later period, as represented by the most energetic of the masters who upheld them.

After the catastrophe of 1870, French art appeared to be reawakened by the disasters of the country ; and at the great exhibition in Vienna in 1873 Count Andrassy ex- claimed to Leon Bonnat, "After such a terrible crisis you are up again, and victorious ! " Immense energy prevailed in the studios, and money poured into France in consequence. The output increased rapidly, and at the same time study became more strenuous, and ambition grew bolder and more manly. Renewed activity stirred in the public academies, and a crowd of foreign students came to learn. Two great facts give a characteristic stamp to this new revival of French art : I. In the class of imaginative painting, the renewed impulse towards monumental or decorative work. II. In the class of nature studies, the growth of landscape painting, which developed along two parallel lines ⬛⬛⬛ impressionism and the " open-air " school.

I. Decoration. ⬛⬛⬛ In decorative painting two men were the soul of the movement: Puvis de Chavannes and Philippe de Chennevieres Pointel. As we look back on the last years of the Second Empire, we see decorative painting sunk in profound lethargy. After Delacroix,

Ctasseriau, and Hippolyte Flandrin, and tlie completion of the great works in the Palais Bourbon, the Senate House, the Cour des Comptes,

and a few churches ⬛⬛⬛ St Sulpice, St Vincent de Paul, and St Germain des Pres ⬛⬛⬛ no serious attempts had been made in this direction. Ex- cepting in the Hotel de Villa, where Cabanel was winning his first laurels, and in the Opera House, a work that was progressing in silence, a few chapels only were decorated with paintings in the manner of easel pictures. But two famous exceptions led to a decorative revival : Puvis de Chavannes' splendid scheme of decoration at Amiens (all, with the exception of the last composition, which is dated 1882, executed without break between 1861 and 1867), and his work at Marseilles and at Poitiers ; Baudry, with his ceiling in the Opera House, begun in 1866 but not shown to the public till 1874. There was also a move- ment for reviving French taste in the industrial arts by following the example of systematic teaching set by some foreign countries, more particularly by England. Decora- tive painting felt the same impulse. Philippe de Chen- nevieres, curator of the Luxembourg Gallery and directeur des Beaux Arts (from 1874 till 1879), determined to en- courage it by setting up a great rivalry between the most distinguished painters, like that which had stimulated the zeal of the artists of the Italian Eenaissance. Taking up the task already attempted by Chenavard under the Kepublic of 1848, but abandoned in consequence of poiitioal changes, M. de Chenneviferes commissioned a select number of artists to ~~decorate the walls of the Pantheon. The panels were to record certain events in the history of France, with due regard to the sacred character of the building. Twelve of the most noted painters were named, with a liberal breadth of selection so as to include the most dissimilar styles : MiUet and Meissonier, of whom one refused and the other did not carry out the work ; Cabanel and Puvis de Cha~~ vannes. The last named was the first to begin, in 1878, and he too was the painter who put the crovraing end to this great work in 1898. His pictures of the "Childhood of Ste Genevieve " (the patron saint of Paris), simple, full of feeling and of innocent charm, appropriate to a popular legend, with their airy Parisian landscape under a pallid sky, made a deep impression. Thenceforward Puvis de Chavannes had a constantly growing influence over younger men. His magnificent work at Amiens, " Ludus pro Patria" (1881-82), at Lyons, and at Kouen. in the Sor- bonne and the Hotel de Ville, for the Library at Boston, U.S.A., and on to his last composition, "The Old Age of Ste Genevieve," upheld to the end of the 19th century the sense of lofty purpose in decorative painting. Besides the

Pantheon, which gave the first impetus to the movement, Philippe de Chennevieres found other buildings to be decorated : the Luxembourg, the Palace of the Legion of Honour, and that of the Council of State. The paintings in the Palais de Justice, the Sorbonne, the Hotel de Ville, the College of Pharmacy, the Natural History Museum, the Op^ra Comique, and many more, bear witness to this grand revival of mural painting. Every kind of talent was employed ??? historical painters, portrait painters, painters of allegory, of fancy scenes, of real life, and of landscape. Among the most important were : J. P. Laurens and Benjamin Constant, Bonnat and Carolus Duran, Cormon and Humbert, Joseph Blanc and L. Olivier Merson, Koll and Gervex, Besnard and Carrifere, Harpignies and Pointelin, Raphael Collin and Henri Martin.

XL Impressionism. ??? In 1874 common cause was made by a group of artists drawn together by sympathetic views and a craving for independence. Various in their tastes, they concentrated from every point of the compass to pro-

test, like their precursors the realists, against the narrow views of academic teaching. Some had romantic pro- clivities, as the Dutchman Jongkindt, who played an important part in founding this group ; others were followers of Daubigny, of Corot, or of MiUet ; some came from the realistic party, whose influence and effort this new set was to carry on. Among these, l^douard Manet (1833-83) holds a leading place; indeed, his influence, in spite of ??? or perhaps as a result of ??? much abuse, extended beyond his circle even so far as to affect academic teaching itself. He was first a pupil of Couture, and then, after Courbet, his real masters were the Spaniards ??? Velas- quez, El Greco, and Goya, all of whom he closely studied at the beginning of his career ; but he soon felt the influence of Millet and of Corot. With a keen power of observation, he refined and lightened his style, striving for a subtle rendering of the exact relations of tone and values in light and atmosphere. With him, forming the original group, as represented by the CaiUebotte collection in the Luxem- bourg, we find some landscape painters : Claude Monet, the painter of pure daylight, and the artist who by the title of one of his pictures, "An Impression," gave rise to the designation accepted by the group ; Camille Pissarro, who at one time

carried to an extreme the principle of dotting with pure tints, known as pointillisine, or dot- work ; Sisley, Cezanne, and others. Among those who by preference studied the human figure were Edgard Degas (q.v.) and Auguste Eenoir. After long and violent an- tagonism, such ‘as had already greeted the earlier inno- vators, these painters, in spite of many protests, were officially recognized both at the Luxembourg and at the great Exhibition of 1900. Their aims have been various, some painting Man, and some Nature. In the former case they claim to have gone back to the principle of the greatest artists and tried to record the life of their own time. Manet, Degas, and Eenoir have shown us aspects of city or vulgar life which had been left to genre-painting or caricature, but which they have represented with the charm of pathos, or with the bitter irony of their own mood, frank transcripts of life with a feeling for style. For those who painted the scenery of nature there was an even wider field. They brought to their work a new visual sense, released from the clinging memories of past art ; they endeavoured to fix the transient effects of moving life, changing under the subtlest and most fugitive effects of light and atmosphere, and the play of what may be called the elements of motion ◆◆◆ sunshine, air, and clouds ◆◆◆ caring less for the exact transcript of motionless objects, which had hitherto been almost exclusively studied, such as the soil, trees, and rocks, the inanimate features of the landscape. They introduced a fresh lightness of key, which had been too subservient to the relations of values ; they discovered for their ends a new class of subjects essentially modern : towns, streets, railway stations, fac- tories, coal-mines, iron -works, and smoke, which they represent with an intelligent adaptation of Japanese art, taking new and audacious points of view, constantly varying the position of their horizon. This is indeed the very acme of naturalism, the last possible stage of modern landscape, covering the whole field of observation, doubling back to the starting – point of imagination. Notwithstanding ◆◆◆ or because of ◆◆◆ the out- cry, all these views, peculiarities, and tendencies soon penetrated schools and studios. Three artists in particular became conspicuous among the most individual and most independent spirits : Besnard, who had taken the Grand Prix de Eome, and carried to the highest pitch his inex- haustible and charming fancy in studies of the figure under the most unexpected play of light ; Carri^re, a pupil of Cabanel, who sought and found in mysterious gloom the

softened spirit of the humble, the warm caress of mother- hood; and Raffaelli, a pupil of G6r6me, who brought to light the unrecognized picturesqueness of the lowest depths of humanity.

III. The ” pleiTi-air” or operirair, school. The same causes explain the rise of the particular class of work thus commonly designated. Between Millet and Courbet, both redolent of the romantic and naturalistic influences of their time, though apart from them, stands an artist who had some share in establishing the continuity of the line of painters who combined figure-painting with landscape. This is Jules Breton (b. 1827, q.v.). More supple than his fellows, less harsh and less wilful, caring more for form and charm, he found it easier to treat “masses,” and contributed to diffuse a taste for the artistic presentment and glorification of field labour. He was the chief link between a past style and Jules Bastien-Lepage (1848-84, q.v.), who was in fact the founder of the scjhool of open-air painting, a compromise between the academic manner and the new revolutionary ideas, a sort of academic continua- tion of the naturalistic evolution, which therefore exerted considerable influence on contemporary art. As a pupil of Cabanel and the Academy schools, enamoured of rustic life, he absorbed at an early stage, though not without hesitation, the love of atmospheric effects characteristic of Corot and of Manet. In his open-air heads and rural scenes he is seen as a conscientious nature worshipper, accurate and sincere, and, like Millet, imbued with a touch of mysticism which becomes even more evident in his immediate pupils. Round him there arose a little galaxy of painters, some more faithful to tradition, some followers of the best innovators, who firmly tread this path of light and modern life. These are Butin, Duez and Renouf, Roll and Gervex, Dagnan-Bouveret, Priant, Adolphe and Victor Binet, and many more.

Immediately after the Exhibition of 1889 an event took place which was not without effect on the progress of French art. This was the schism in

the Salon. The audacious work of the Soci^t^ Rationale des Beaux Arts, which left anything that the Impressionists could do far behind, had accustomed the eyes of the public to the most daring attempts, while the numerous contributions of foreigners, especially from the north, where art aimed solely at a direct presentment of daily life, was a fresh encouragement to the study of modern conditions and of the lower classes. But, at the same time, the encroach- ment on space at the Exhibition (where no limit of number was imposed) by mere studies, hastened the re- action against the extravagances of the degenerate followers of Courbet, Manet, and Bastien-Lepage. Remonstrances arose against their perverse and narrow-minded devotion to "truth," or rather to minute exactitude, their pedantry and affectation of documentation ; sometimes derived from some old colourists who had not renounced their former ideal, sometimes from younger men impelled unconsciously by literature, which had as usual preceded art in the revolt. The protest was seen, too, in a modified treatment of land- scape, which took on the warmer colours of sunset, and in a choice of religious subjects, such as a pardon, or a funeral, or a ceremonial benediction, and generally of more human and more pathetic scenes.

Bastien-Lepage, like his great precursor MiUet, bore within him the germs of a reaction against the movement he had helped to promote. Dagnan-Bouveret, who began by painting " Sitting for a Photograph " (now at Lyons) and "An Accident," after painting "Le Pain b^nit," ended with " The Pilgrims to Emmaus " and " The Last Supper." Friant, again, produced scenes of woe, "All Saints' Day " and " Grief " ; and their younger successors, Henri Royer, Adler, Duvent, and others, who adhered

to this tradition, accommodated it to a more modern ideal, with more vivid colouring and more dramatic composition.

Still, this normal development could have no perceptible effect in modifying the purpose of painting. More was needed. A strong craving for imaginative work was very generally felt, and was revealing itself not merely in France but in Belgium, Scotland, America, and Germany. This tendency ere long resulted in groups forming round certain weU-known figures. Thus a group of refined dreamers, of poetic dilettanti and

harmonious colourists, assembled under the leading of Henri Martin (a strange but attractive visionary, a pupil of Jean Paul Laurens and direct heir to Puvis de Chavannes, from whom he had much sound teaching) and of Aman-Jean, who had appeared at the same time, starting, but with more re- serve, in the same direction. Some of this younger group affected no specific aim ; the others, the larger number, leant towards contemporary life, which they endeavoured to depict, especially its aspirations and ??? according to the modem expression now in France of common usage ??? its " state of soul," typified by melody of line and the eloquent language of harmonies. Among them should be named, as exhibitors in the Salons and in the great Exhibition of 1900, Ernest Laurent, Ridel, and Hippoljrte Fournier, M. and Mrs H. Duhem, Le Sidaner, Paul Steck, &c. On the other hand, a second group had formed of sturdy and fervent naturalistic painters, in some ways resembling the school of 1855 of which mention has been made; young and bold, sometimes over-bold, enthusiastic and emotional, and bent on giving expression to the life of their own day, especially among the people, not merely recording its exterior aspects but epitomizing its meaning by broad and strong synthetical compositions. At their head stood Cottet, who combined in himself the romantic fire and the feeling for orchestrated colour of Delacroix with the in- cisive realism and bold handling of Courbet ; next, and very near to him, but more objective in his treatment, Luoien Simon, a manly painter and rich colourist. Both by preference painted heroic or pathetic scenes from the life of Breton mariners. After them came Rene Menard, a more lyrical artist, whose classical themes and land- scape carried us back to Poussin, and Dauchez, Prinet, Wery, &c.

Foreign influences had meanwhile proved stimulating to the new tendencies in art. Sympathy, with the populace derived added impulse from the works of the Belgian painters Constantin Meunier, Leon Frederic, and Struys ; a taste for strong and expressive colouring was diffused by certain American artists, pupUs of Whistler, and yet more by a busy group of young Scotsmen favourably welcomed in Paris. But the most unforeseen result of this reaction- ary movement was a sudden reversion to tradition. The cry of the realists of every shade had been for " Nature ! " The newcomers raised the opposition cry of "The Old Masters

! ” And in their name a protest was made against the narrowness of the documentary school of art, a demand for some loftier scheme of conventionality, and for a fuller expression of life, with its complex aspirations and visions. The spirit of English Pre-Raphaelitism made its way in France by the medium of translations from the English poets Shelley, Rossetti, and Swinburne, and the work of their followers Stephane MaUarme and Le Sar Peladan; it gave rise to a little artificial impetus, which was furthered by the simultaneous but transient rage for the works of Burne- Jones, which were exhibited with his consent in some of the Salons, and by the importation of WiUiam Morris’s principles of decoration. The out- come was a few small groups of symbolists, the most famous being that of the Rose ij Croix, organized by*

Le Sar Peladan; then there was Henri Martin, and the httle coterie of exliibitors attracted by a dealer, the late M. le Bare de Bouttiville, in - which Cottet was for a short time entangled. But few interesting names are to be identified : Dulac (d. 1899), who became known chiefly for his mystical lithographs in colour ; Maurice Denis and Bonnart, whose decorative compositions, with their refined and harmonious colouring, are not devoid of charm ; Vuillard, &c. But it was in the school and studio of Gustave Moreau (1826-1898, q.v.) that the fire of idealism burned most hotly. This exceptional man and rare painter, locked up in his solitude, endeavoured, by a thorough and intelligent assimilation of all the traditions of the past, to find and create for himself a new tongue ??? rich, nervous, eloquent, strong, and resplendent ??? in which to give utterance to the loftiest dreams that haunt the modern soul. He revived every old myth and rejuvenated every antique symbol, to represent in wonderful imagery all the serene magnificence and all the terrible struggles of the moral side of man, which he had explored to its lowest depths and most heroic heights in man and woman, in poetry and in death. Being appointed, towards the end of his life, to a professorship in the Ecole des Beaux Arts, he regarded his duties as a real apostleship,

and his teaching soon spread from his lecture-room and studio to those of the other masters. His own work, though hardly known to his pupils at the time, at first influenced their style; but, especially after his death, they were quickly disgusted with their own detestable imitation of subjects on which the master had set the stamp of his great in- dividuality; they deserted the fabulous world of the Greek Olympus and the wonderful gardens of the Bible, to devote them to a passionate expression of modern life. DesvaUieres, indeed, remained conspicuous in his original manner ; Sabatte, Maxence, B^ronneau, Besson, and many more happily worked out their way on other lines.

In trying to draw up the balance-sheet of art in 1902, it were vain to try to enter its work under the old-world headings of History, Genre, Portraits, Landscape. All the streams had burst their channels, all the currents mingled. Historical painting, reinstated for a time by Puvis de Chavannes and J. P. Laurens, in which Benjamin Constant and Cormon also distinguished themselves, had but a few adherents who tried to maintain its dignity, either in combination with landscape, like M. Tattegrain, or with the ineffectual aid of archaeology, like M. Koche- grosse. At certain times, especially just after 1870, the memory of the war gave birth to a special genre of military subjects, under the distinguished guidance of Meissonier {q.v.), and the peculiar talents of Alphonse de Neuville {q.v.), of Detaille {q.v.), and Protais. This phase of contemporary history being exhausted, gave way to pictures of military manoeuvres, or colonial wars and incidents in recent history ; it latterly went through a revival under a demand for subjects from the Empire and the Eevolution, in consequence of the publication of many memoirs of those times. Side by side with " history," religious art formerly flourished greatly ; indeed, next to mythology, it was always dear to the Academy. Apart from the subjects set for academical competitions, there was only one little revival of any interest in this kind. This was a sort of neo-evangelical oflshoot, akin to the literature and stress of religious discussion ; and its leader, a man of feeling rather than conviction, was J. G. Cazin (d. 1901). Like Puvis de Chavannes, and under the influence of Corot and Millet, of Hobl-iema, and yet more of Kembrandt, he attempted to renew the vitality of history and legend by the added charm of landscape and the introduction of more

human, more living and more modern, elements into the figures and accessories. Following him, a little group de-

veloped this movement to extravagance. The recognized leader at the beginning of the 20th century was Dagnan- Bouveret.

Through mythology and allegory we are brought back to real life. No one now thinks in France of seeking any pretext for displaying the nude beauty of woman. Henner, perhaps, and Fantin-Latour, were the last to cherish a belief in Venus and Artemis, in naiads and nymphs. Painters go direct to the point nowadays ; when they paint the nude, it is apart from abstract fancies, and under realistic aspects. They are content with the model. It is the living female. The whole motor force of the time lies in the expression, under various kinds of real life. This it is which has given such a soaring flight to the two most primitive forms of the study of Life, landscape and portrait- ure. Portraits have in fact adopted every style that can possibly be imagined : homely or fashionable, singly or in groups, by the fire or out of doors, in some familiar attitude and the surroundings of daily life, analjrtically precise, or synthetically broad, a literal transcript or a bold epitome of facts. As to landscape, no class of painting has been busier, more alive, or more productive. It has overflowed into every other channel of art, giving them new spirit and a new life. It has led the van in every struggle and won every victory. Never was army more numerous or more various than that of the landscape painters, nor more independent. AU the traditions find representatives among them, from Paul Flandrin to Een4 Menard. Naturalists, impressionists, open-air painters, learned in analysis or potent in invention. We need only name Harpignies, broadly decorative ; Pointelin, thoughtful and austere ; and Cazin, grave and tender, to give a general idea of the strength of the school.

Every quarter of the land has its painters : the North and the South, Provence and Auvergne, Brittany, dear to the young generation of colourists, the East, Algeria, Tunis ??? all contribute to form a French school of landscape, very living and daring, of which, as successors of Fromentin and Guillaumet, must be named Dinet, Marius Perret, Paul Leroy, and Girardot. But it is more especially in the association of man and nature, in painting simple folk and their struggle

for hie amid their natural surroundings or by their homely hearth, in the glorification of humble toil, that the latest French art fimds its most characteristic ideal life. (l. be.)

Belgium. Belgium fills a great place in the realm of art ; and while its painters show a preference for simple subjects, their technique is broad, rich, and sound, the outcome of a fine tradition. Since 1855 international critics have been struck by the unity of effect produced by the works of the Belgian school, as expressed more especially by similari- ties of handhng and colour. For the things which dis- tinguish all Belgian painters, even in their most unpictorial divagations, arc a strong sense of contrast or harmony of colouring, a free, bold style of brushwork, and a prefer- ence for rich and sohd painting. It is the tradition of the old Flemish school. It would be more correct, indeed, to say traditions ; for the modifications of each tendency, inevitably reviving ~~\when the success of another has exhausted itself, constantly show a reversion either to the domestic "Primitives" (or, as we might say, Pre~~ Raphaehtes) of the Bruges school, or to the " decorative " painters of the later time at Antwerp, and no veneer of modern taste will ever succeed in masking this traditional perennial groundwork. In this way the prevaihng authority of the French painter Louis David may be accounted for ; as acknowledged at Brussels at the beginning of the 19th century, it was a reaction in antagonism to the heavy

and flabby work of the late Antwerp school, an unconscious reversion perhaps to the finish and minuteness of the early painters of Bruges. Indeed, in France, Ingres, himself David's most devoted disciple, was reproached with trying to revive the Gothic art of Jean de Bruges. Then, when David's followers produced only cold and feeble work, Wappers arose to restore the methods of another tradition, for which he secured a conspicuous triumph. Classical tinsel made way, indeed, for romantic tinsel. The new art was as conventional as the old, but it had the

advantage of being adaptable to the taste for show and splendour which characterizes the nation, and it also admitted the presentment of certain historical personages who survived in the memory of the people. 'The inevit- able reaction from this theatrical art, with its affectation of noble sentiments, was to brutal realism. Baron Henry Leys (1815-1869) initiated it, and the crudity of his style gave rise to a belief in a systematic purpose of supplanting the Latin tradition by Germanic sentimentality. It would be interesting to trace how far the famous Belgian painter was influenced by the English artist Ford Madox Brown, whom he met at Antwerp whUe both were students. Still, as far as Leys was concerned, this reversion to realism was a matter of will rather than of study. His art is not that of a close observer ; he lived in a dream of the period depicted by the masters of the past he delighted in. He himself was a master, a painter by nature, gifted with great powers of draughtsmanship, a firm hand, and a broad, rich sense of colour. As M. CamUle Lemonnier has pointed out, it was his hatred of academical conventionality that lured Leys into a sort of wilful barbarism and a sometimes childish artlessness. Modern art was influenced by him to an extraordinary degree. He substituted for the mannered elegance of the so-called classical school, angular attitudes, coarse and common types, and the slow but determined temperament of a people caring little for external beauty and reserving its admiration for mental qualities. But it was soon recognized that there was a Teutonic as well as a Latin recipe, and Leys's archaic realism was transformed at Brussels into a realism of observation and modern thought, in the painting of Charles de Groux. The influence of Leys on this artist was merely superficial ; for though he, too, affected painful subjects, it was because they appealed to his compassion. The principle represented by de Groux was destined to pioneer the school in a better way ; at the same time, from another side the authority of Courbet, the French realist, who had been for some time in Brussels, and that of the great landscape painters of the Fontainebleau school, had suggested to artists a more attentive study of nature and a remarkable reversion in technique to bolder and firmer handling. At this time, among other remarkable men, Alfred Stevens appeared on the scene, the finished artist of whom Camille Lemonnier truly said that he was " of the race of great painters, and, like them, careful of finish " ❓❓❓ that in him " the eye, the hand, and the brain all co-operated for the mysterious elaboration" of impasto, colour,

and chiaroscuro, and “the least touch was an operation of the mind.” A brief period ensued during which the greater number of Belgian artists were carried away by the material charms of brushwork and paint. The striving after brilliant effects of colour which had characterized the painters of the last generation then gave way to a devout study of values ; and at the same time it is to be noted that in Belgium, as in France, landscape painters were the first to discover the possibiUty of giving new life to the interpretation of nature by simplicity and sincerity of expression. They tried to render their exact sensations ; and we saw, as has been said, ” an increasingly predominant revelation of instinctive feeling in all classes

of painting.” Artists took an impartial interest in all they saw, and the endeavour to paint well eliminated the hope of expressing a high ideal; they now sought only to utter in a work of art the impression made on them by an external fact ; and, too often, the strength of the effort degenerated into brutahty.

These new influences, which, in spite of the con- servative school, had by degrees modified the aspect of Belgian art in general, led to the formation at Brussels of an association under the name of the Free Society of Fine Arts. This group of painters had a marked in- fluence on the development of the school, and hand in hand with the pupils of Portaels ??? a teacher of sober methods, caring more for sound practice than for theories ??? it encouraged not merely the expression of deep and domestic feeling which we find in the works of Leys and de Groux, but also the endeavour to paint nature in the broad light of open air. The example of the Free Society found imitators ; various artistic groups were formed to organize exhibitions where new works could be seen and studied irrespective of the influence of dealers, or of the conservatism of the authorities which was increasingly conspicuous in the official galleries ; till what had at first been regarded as a mere audacious and fantastic demon- stration assumed the dignity of respectable effort. The ” Cercle des Vingt ” (” The Twenty Club “) also exerted a marked influence. By introducing into its exhibitions works by the greatest foreign artists, it released Belgian art from the uniformity which some too patriotic theorists would fain have imposed. The famous ” principle of in-

dividuality in art ” was asserted there in a really remark- able manner ; for side by side with the experiments of painters bent on producing certain effects of light, hung the works of men who clung to literary or aljstract subjects. Other groups, again, were formed on the same lines; but then came the inevitable reaction from these elaborations of quivering light and subtle expression, pushed, as it seemed, to an extreme. The youngest genera- tion of Brussels painters, in revolt against the lights and ultra-refinements of their immediate predecessors, seem to take pleasure in a return to gums and bitumen, and to seek the violent effects so dear to the romantic painters of a past time.

Brussels is the real centre of art in Belgium. Antwerp, the home of Eubens, is resting on the memory of past glories, after vainly trying to uphold the ideal formerly held in honour by Flemish painters. And yet, so great is the prestige of this ancient reputation, that Antwerp even now attracts artists from every land, and more especially the dealers who go thither to buy pictures as a common form of merchandise. At Ghent the wonderful energy of the authorities who get up the triennial exhibitions makes these the most interesting provincial shows of their kind; other towns, as Li^ge, Tournay, Namur, Mons, and Spa, also have periodical exhibitions.

From 1830, in the early days of the Belgian school of painting, we may observe a tendency to seek for the fullest qualities of colour, with delicate gradations of light and shade. In this Wappers led the way. At a time when his teachers in the Antwerp Academy would recognize nothing but the heavy brown tones of old paintings, he was already representing the transparent shadows of natural daylight. But heroic and sentimental romanticism was already making way for the serious expression of domestic and popular feeling, and thenceforward the prominence assumed by genre, and yet more by landscape, led to a deeper and more direct study of the various aspects of nature. At the same time a special sense of colour was the leading characteristic of the artists of the time, and it was truly said that “the ambition to be a fine painter was stronger than the desire for scrupulous exactitude.” Artists evidently aimed, in the first place, at a solid impasto and glowing colour ; an undertone, ruddy and golden, gleamed through the paler and more real hues of the over-

painting. In this we may certainly recognize the influence of the French colourists of Courbet's

time ; just as we may trace the influence of the grey tone prevalent in Manet's day, in the effort to paint with more simple truth and fewer tricks of recipe, which became evident when the ' ' Free Society" was founded at Brussels, and the pupils from Portaels' studio came to the front.

Among the artists who were then working, the following must be named (with their best works iu the Brussels Gallery) : Alfred Stevens {q.v.), an incomparably charming painter, characterized by exquisite harmony of colour and marvellous dexterity with the brush. In the Brussels Gallery are his "The Lady in Pink," "The Studio," "The Widow," "A Painter and his Model," and "The Lady-Bird." Joseph Stevens, his brother, a master-painter of dogs, broad in his draughtsmanship, and painting in strong touches of colour, is represented by "The Dog-Market," "Brussels ??? Morning," "A Dog before a Mirror"; Henri de Braekeleer, the nephew and pupil of Leys, a fine painter of interiors, in warm and golden tones, by "The Geographer," "A Farm ??? Interior," "A Shop " ; Lievin de Winne, a portrait painter, sober in style and refined in execution, by "Leopold I., King of the Belgians"; Florent Willems, archaic and elegant, by " The Wedding-Dress " ; Eugene Smits, a refined colourist, always working with the thought of Venice in his mind, by "The Procession of the Seasons"; Louis Dubois, a powerful colourist with a full brush, striving to resemble Courbet, by "Storks," "Fish"; Alfred Verw^e, a fine animal painter, with special love for a sheeny silkiness of texture, by "The Estuary of the Scheldt," "The Fair Land of Flanders," "A Zeeland Team" ; Alfred Verhaeren, a pupil of L. Dubois, by some "Interiors" ; Felicien Eops, an extraordinary artist, precise in drawing, sensual, and incisive, by "A Parisienne" ; F^lix ter Linden, a restless, refined nature, always trying new subtleties of the brush and palette-knife, by "Captives." Amongst other painters may be named Camille van Camp, Gustave de

Joughe, Franz Verhas, and his brother Jan Verhas, the painter of the popular ‘ ‘ School Feast ” in the Brussels Gallery ; and Jan van JBeers, the clever and brilliant painter of female coquettishness, by pictures in the Antwerp Gallery.

As landscape painters, the chief are : Hippolyte Boulenger, a refined draughtsman and a delicate colourist, represented in the Brussels Gallery by “View of Dinant,” “The Avenue of Old Hornbeams at Tervueren,” “The Meuse at Hastiere”; Alfred de Knyfi’, noble and elegant, by “The Marl Pit,” “A Heath ►►►Campine” ; Joseph Coosemans, by “A Marsh ►►►Campine” ; Jules Montigny, by “Wet Weather” ; Alph. Asselbergs, by “A Marsh ►►►Campine.” There are also Xavier and Cesar de Cock, painters in light gay tones of colour, Gustave Den Duyts, a lover of melan- choly twilight, represented in the same gallery by “A Winter Evening ” ; Mme Marie CoUart, a seeker after the more melancholy and concentrated impressions of nature, by “The Old Orchard” ; and Baron Jules Gcethals.

Of the Antwerp school, Francois Lamoriniere, archaic and minute, has in the Brussels Gallery his “View from Edeghem,” and there is also Theodore Verstraete, sentimental, or frenzied.

As marine painters : Paul Jean Clays, who delights in vivid effects of colour, is represented at Brussels by “The Antwerp Koadstead,” “Calm on the Scheldt” ; Louis Artan, who prefers dark and powerful effects, by “The North Sea,” besides, Robert Mols, A. Bouvier, and Lemayeur.

As painters of town scenery may be named F. Stroobant, a draughtsman rather than a painter, who is represented in the Brussels Gallery by “The Grande Place at Brussels,” and J. B. Van More, a colourist, chiefly by “The Cathedral at]3elem.”

The flower painter, Jean Robie, has in the Brussels Gallery ” Flowers and Fruit.”

Jean Portaels, the painter of ” A Box at the Theatre,” at Buda- pest, is represented in the Brussels Gallery by ‘ ‘ The Daughter of Sion Insulted ” ; l^mile Wauters, a master of free and solid brush- work, equally skilled

in portraiture, historical composition, and decorative portrait painting, by "The Madness of Hugo van der Goes" ; lildouard Agnecsens, a genuine painter, with breadth of vision and facile execution, by Portraits ; Andr^ Hennebicq, a painter of historical subjects, by "Labourers in the Campagna, Kome " ; Isidore Verheyden, a landsoapist and portrait painter, by "Woodcutters"; Eugene Verdyen and ^fimile Charlet should be mentioned, and the landscape painter Henri van der Hecht, whose "On the Sand-Hills" is in the Brussels Gallery.

The principal landscape painters of what is known as the "neutral tint ' school (VMcoledib gris) are : Tlidodore Baron, faith- ful to the sterner features of Belgian scenery, represented in the Brussels Gallery by "A Winter Scene ❓❓❓Condroz" ; Adrieu Joseph Heymans, a careful student of singular effects of light, by " Spring- Time" ; Jacques Rosseels, a painter of the cheerful brightness of the Flemish country, by "A Heath," besides Isidore Meyers and Florent Orabeels.

Some figure painters who may be addeil to this group are : Charles Hermans, whose picture "Dawn" (Brussels Gallery), ex- hibited in 1875, betrays the ascendancy of the principles upheld by the Free Society of Fine Arts ; Jean de la Hoese, who has since

made portraits his special line ; 6mile Sacre ; Leon Philippet, represented in the Brussels Gallery by " The Murdered Man " ; and Jan Stobbaerts, a masterly painter, powerful but coarse, by "A Farm ❓❓❓Interior."

Three more artists were destined to greater fame : Constantin Meunier, a highly respected artist, equally a painter and a sculptor, known as "the Millet of the Flemish workman," who has depicted with noble feeling his admiration and pity for one contemporary state of the human race, and who is represented in the Brussels Gallery by "The Peasants' War"; Xavier Mellery, who tries to express in works of high artistic merit the inner life of men and things, and personifications of thought, by "A Drawing"; and Alexandre Struys, a strong and clever painter, expressing his sym- pathy with poverty and misfortune in works of remarkable ability.

Besides these, Charles Verlat, a powerful and skilled artist, painted a vast variety of subjects ; his teaching was influential in the Antwerp Academy. In the Brussels Gallery he is represented by "Godfrey de Bouillon at the Siege of Jerusalem, " "A Flock of Sheep attacked by an Eagle " ; Alfred Cluysenaar, whose aim is to produce decorative work on an enormous scale, by "Canossa"; Albreoht de A'^riendt, by "Homage done to Charles V. as a Child"; Juliaan de Vriendt, by "A Christmas Carol"; Victor Lagye, by "The Witch." Franz Vmck, Wilhelm Geets, Karl Ooms, and P. van der Ouderaa, endeavour to perpetuate, while softening down, the style of historical painting so definitely formu- lated by Leys. Finally, Joseph Stallaert, a painter of classical sub- jects, is represented in the Brussels Gallery by " The Death of Dido." Eugene Devaux, a remarkable draughtsman, should also be named.

Works by all those artists were to be seen in the Historical Exhibition of Belgian Art at Brussels, 1880. Camille Lemonnier, in his History of the Fine Arts in Belgium, discussed this Exhibi- tion very fully, pointing out three distinct periods in the history of the century. The first, romantic, literary, and artificial, ex- tended from 1830 till nearly 1860 ; the second was a period of transition, domestic in feeling, gradually developing to realism in the course of about 20 years ; the third began in the 'seventies, a time of careful study, especially in landscape. This was followed by the beginning of a fourth period, characterized by a freer sense of light and atmosphere.

Apart from the exclusive tendency, inevitable under bureaucratic administration, the mere arrangement, on an antiquated plan, of the great Academic Salons was unsuited to the display of works intended to represent individual feeling or peculiarities of pictorial treatment. Hence it was that a great many painters came to prefer smaller and more eclectic shows, leading to the fashion, which still persists, of exhibitions by clubs or associations. The Fine Arts Club at Brussels had long since afforded opportunities for showing the pictures of the Soci^t^ Libre, founded in 1868, which were condemned by the authorities as tending to "revolu- tionize " art. After this, two associations of young painters were formed at Brussels with a view to organizing their own exhibitions.

The ” Ohrysalide ” Club was founded in 1875, and the ” Essor” (the “Soaring”) Club, in 1876. In 1882, however, the Essor obtained leave to open their exhibition in a room in the Palais des Beaux Arts at Brussels. This tolerance was all the more appreciated by the younger party because a new departure was in course of development, again a modification in the effort to represent light in painting. The “neutral tint” school had given way to the school of “whiteness” ; a luminous effect was to be sought by a free use of brilliant colour with a very full brush. But ere long this method proved unsatisfactory, and attention was now turned towards a “sincerer and acuter perception of local values ” ; and again the influence of certain French painters was brought to bear ??? those of the group headed by C. Monet, preparing for that of the French painter G. Seurat, the first who carried into practice the systematic decomposition of colour b)’ the process known as pointillisme (the intimate juxtaposition of dots of colour). In 1884, in consequence of a division in the Essor Club, the “XX” Club was founded, Avho, though thus limiting their number, reserved the right of “issuing yearly invitations, and thus testifying the sympathy they felt with the most independent artists of Belgium and with those foreign painters with whom they had the most pronounced aflSnity.” For ten years the ex- hibitions of the “XX,” whose careful and artistic arrangements were in themselves admirable, were the fount in Belgium of dis- cussions on art. The limit of its existence to ten years was deter- mined when the club was formed ; but as it was desirable that the principle of liberty in art should still be held in honour, M. Octave Maus, the secretary of the “XX” Club, organized the exhibitions of the Libre Esthitiqtie in and since 1894. Other clubs had been formed in Brussels: the Fine Art Society in 1891 and “The Furrow ” {le Sillon) in 1893. In 1894 another breach in the Essor Club, which, growing very weak, was soon to disappear, as the “Art Union” and the Voorwaerts Club had done, led to the formation of the Society “For Art” {“pour I’Art”) ; and in 1896 a party of that club established a Salon of idealist art which favoured an exaggeration of the intellectual tendency already

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begun in the exhibitions of the “XX.” Subsequently, in the exhibitions of the Sillon and of the Labeur Club (founded in 1898) a reaction set in, in favour of lieavy brown tones and ponderous composition. At Antwerp the influence of the local societies ??? the ” Ais Ik Kan,” the Independent Art Club, and the “XIII” ??? was less sensibly felt ; it was, however, enough to confirm certain waverers in the direction of purely disinterested eff’ort.

It would be impossible to classify into definite groups those painters whose first distinctive appearance was subsequent to the Historical Exhibition in 1880. Only an approximate grouping can be attempted by assigning each to the association in whose exhibitions he made the beat display of what he aimed at express- ing. Thus it was chiefly in the rooms of the Essor Club tliat works were shown by the following : L. Fred&ic, a remarkable painter, combining wonderful facility of execution with a sincerely simple sentiment of homely pathos, represented at the Brussels Gallery by ” Chalk Sellers ” ; E. Hoeterickx, a painter of crowds in the streets and parks ; F. Seghers, a pleasing colourist, who had made flower-painting his speciality ; two animal painters, F. van Leem- putten, “Return from Work” (Brussels Gallery), and E. van Damme-Sylva, as well as the marine painter, A. Marcette. The landscape painters include J. de Greet, almost brutal in style, “The Pool at Rouge-Cloltre” (Brussels GaUery), C. Wolles, and Hamesse. L. Houyoux, IT. Halkett, L. Herbo are known for their portraits. And there are E. van Gelder, J. Mayne, A. Crespin, a learned decorative painter, and E. Duyck, a graceful draughtsman, “A Dream” (Brussels Gallery). As designers may be named A. Heins, a clever illustrator, and A. Lynen, of a thoroughly Brussels type, keenly observant and satirical.

At the exhibitions of the ” XX ” were pictures by the following : Fernand Khnopff (“Memories,” a pastel, in Brussels Gallery), an admirer of the refined domesticity of English contemporary art, and of mystical art, as represented by Gustave Moreau ; H. van der Velde, a well-known exponent of the new methods in applied art ; J. Ensor, a whimsical nature, loving strange combinations of colour and inconsequent fancies

(Brussels Gallery: “The Lamp- Man “) ; Th. van Rysselberghe, a clever painter, especially in the technique of dot painting {pointillisme) ; W. Sohlobach, a remark- able colourist of uncertain tendencies ; Henry de Groux, son of Ch. de Groux, a seer of visions represented in violent tones and workmanship ; G. Vogels, a painter of thaw and rain ; G. van Strydoneck, R. Wytsman, J. Delvin, F. Charlet, Mile A. Booh, all of whom have striven to bring light into their pictures ; W. Finch and G. Lemmen.

To the Triennial Salons, to the exhibitions of the “Artistic” clubs, to the House of Art (Maison cCArt), at Brussels, and to the various Antwerp clubs, the following have contributed : F. Courtens, Rosseels’ brilliant pupil, an astonishing painter with a heavy impasto (Brussels Gallery : “Coming Out of Church”) ; J. de Lalaing, full of lofty aims, but showing in his painting the qualities of a sculptor (Brussels Gallery : “A Prehistoric Hunter “) ; E. Glaus, a lover of bright colour, and a genuine landscape painter (Brussels Gallery : “A Flock on the Road”); A. Baertsoen, who delights in the quiet corners of old Flemish towns ; H. Evenepoel, a fine artist whose premature death deprived the Belgian school of a highly distinguished personality (Brussels Gallery: “Child at Play “) ; G. Vanaise, a painter of huge historical subjects ; Ch. Mertens, a refined artist; E. Motte, an interesting painter vrith a love of archaic methods (Brussels Gallery ; “A Girl’s Head”) ; A. L^veque, an accomplished draughtsman with a distinctive touch ; L. Wolles, an admirable draughtsman ; J. Leempoels, elaborate and minute ; H. Riohir, a portrait painter ; J. van den Eeckhout, a clever pupil of Verheyden ; J. Rosier, a skilful follower of Verlat ; L. Abry, a painter of military subjects ; E. Carpentier, E. Vanhove, Luyten, and Desmeth.

Essentially of the Antwerp school are F. van Euyck, P. Ver- haert, de Jans, and Brunin of Ghent, Ch. Doudelet, C. Moutald, and van Biesbroeck.

There is a group of artists at Li^ge whose sincerity and high technical qualities have been recognized : A. Donnay, A. Rassen- fosse, E. Berchmans, F. Marechal, Dewitte. Of lady painters : Mmes E. Beernaert, L. Hdger, and J. Wytsman paint landscape. Mmes B. Art, A. Ronner, G. Meunier, and M. De Bi^vre paint flowers. Mmes A. d’Anethan, Lambert

de Rothschild, M. Philipp- son, H. Calais, and M. A. Marcotte paint figures and portraits.

The chief exhibitors at the Society ^OTtr I'Art are A. Ciamberlani, a painter of large decorative compositions in subdued tones ; H. Ottevaere, a painter of night or twilight landscapes ; O. Coppens, R. Janssens, and A. Hannotiau, who study old houses, deserted churches, and dead cities ; F. Baes, an excellent pupil of Fr^d^ric Fabry, 0. and J. Dieriokx, painters of decorative figures ; H. Meunier, an ingeniously decorative draughtsman ; J. Delville, founder of the Salons of Idealist art.

Leading exhibitors at the Voorwaerts Club have been E. Laer- mans, a strange artist, as it were a Daumier with anohylose joints, but a colourist (Brussels Gallery: "A Flemish Peasant"); V. Gilsoul, a clever pupil of Courtens (Brussels Gallery: "The

Kennel"); J. du Jardin, the writer of L'Art Flamand, an im- portant critical work illustrated by J. Middeleer.

Contributors to the exhibitions of the Sillon Club comprise G. M. Stevens, P. Verdussen, P. Matthieu, J. Gouweloos, Bastion, Blieck, Wagemans, and Smeers ; and V. Mignot, ingenious in designing posters.

At the Exhibitions of Water Colours have been seen the works of Huberti, F. Bing^, V. Uytterschaut, Stacquet, and H. Cassiers, who work with light washes or a clever use of body colour ; Hage- mans, who paints with broad washes ; Delaunois, the painter of mysterious interiors ; Th. Lybaert, minute in his brushwork ; M. Romberg and Titz, correct draughtsmen.

Since 1870 several important works of decorative painting in public buildings have been carried out in Belgium. Guftens, Swerts, and Pauwels have succumbed to the influences of German art, often cold and stifl' ; A. and J. Devriendt, V. Lagye, W. Geets, and Vander Onderaa have followed more or less in the footsteps of Leys. J. Stallaert has cleverly revived a classic style. Emile Wauters and A. Hermebicq have adopted the traditions of Historical Painting ; and so too have L. Gallait, A. Cluysenaar, J. de Lalaing, and A. Bourland, though with a more

decorative sense of concep- tion and treatment. But of all these works, certainly the most remarkable in its artistic and intelligent fitness is that of M. Delbeke, in the market haR at Ypres.

See Camillb Lbmonnier, Histoire des Arts en Belgique ; A. J. Wautbks, La Peinture Flamande ; J. du Jaedin, L'Art Flamand..

(f. K.) Holland. The entire Impressionist movement of the end of the 19th century failed to exercise the slightest influence upon the Dutch. They are only modern in so far as they again resort to the classics of their Fatherland. For a whole generation Josef Israels was at the head of Dutch art. Born in 1827 at Groningen, the son of a money- changer, he walked every day in his early years, with a linen money-bag under his arm, to the great banking house of Mesdag, a son of which became later the famous marine painter. During his student days in Amsterdam he lived in the Ghetto, in the house of a poor but orthodox Jewish family. He hungered in Paris, and was derided as a Jew in the Delaroche school there. Such were the experiences of life that formed his character. In Zantvoort, the little fishing village close to Haarlem, he made a simUar discovery to that which Millet had already made at Barbizon. In the solitude of the remote village he discovered that not only in the pages of history, but also in everyday life, there are tragedies. Having at first only painted his- torical subjects, he now began to depict the hard struggle of the seafaring man, and the joys and griefs of the poor. He commenced the long series of pictures that for thirty years and more occupied the place of honour in all Dutch exhibitions. They do not contain a story that can be rendered into words ; they only tell the tale of everyday life. Old women, with rough, toil-worn hands and good- natured wrinkled faces, sit comfortably at the stove. Weatherbeaten seamen wade through the water, splashed by the waves as they drag along the heavy anchors. A peasant child learns how to walk by the aid of a little cart. Again, the dawning light falls softly upon a peaceful deathbed, on which an old woman has just breathed her last. A sad and resigned melancholy characterizes and pervades all his works. His toilers do not stand up straight ; they are broken, without hope, and humble, and accomplish their appointed task without pleasure and without interest. He paints human beings upon whom the oppressions of centuries are resting ; eyes that neither gaze on*

the present nor into the future, but back on to the long, painful past. A Jew, bearing the Ghetto yet in his bosom, is talking to us ; and in his painting of the lowly and oppressed, he recounts the story of his own youth and the history of his own race.

The younger painters have divided Israels' subjects among them. Each has his own little field, which he tills and cultivates with industry and good sense; and paints one picture, to be repeated again and again during

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his lifetime. Christoph Birscliop, born in Friesland, settled as an artist in the land of hia birth, where the national costumes are so picturesque, with golden chains, lace caps, and silver embroidered bodices. As in de Hoogh's pictures, the golden light streams through the window upon the floor, upon deep crimson table-covers; and upon a few silent human beings, whose lives are passed in dreamy monotony. Gerk Henkes paints the fogs of the canals, with boats gliding peacefully along. Albert Neuhuys selects simple family scenes, in cosy rooms with the sun- light peeping stealthily through the windows. Adolf Cortz, a pupil of Israels, loves the pale vapour of autumn, grey-green plains, and dusty country roads, with silvery thistles and pale yellow flowers. The landscape painters, also, have more in common with the old Dutch classic masters than with the Parisian Impressionists. There, on the hill, Eembrandt's windmill slowly flaps its wings; there Potter's cows ruminate solemnly as they lie on the grass. There are no coruscation and dazzling brightness, only the grey brownish mellowness that van Goyen affected. Anton Mauve, Jacob and Willem Maris, are the best known of the landscape men. .Others are Mesdag, de Haas, Apol, lOinkenberg, Bastert, Blommers, de Kock, Bosboom, Ten Kate, du Chattel, Ter Meulen, Sande-Bakhuyzen. They all paint Dutch coast scenery, Dutch fields, and Dutch cattle, in excellent keeping with the old-master school, and with phlegmatic repose.

A few of the younger masters introduced a certain amount of movement into this distinguished, though some- what somniferous, excellence. Breitner and Isaak Israels seem to belong rather to Manet's school than to that of HoUand. The " suburb " pictures of W. Tholen, the flat landscapes bathed in light by Paul Joseph Gabriel, and Jan Veth's and Havermann's impressionistic portraits prove that, even among the Dutch, there are artists who experiment. Jan Toorop has even attained the proud dis- tinction of being the enfant terrible of modern exhibitions, and his

works appear to belong rather to the art of the old Assyrians than to the 19th century. But those who will endeavour to enter into their artistic spirit will soon dis- cover that Toorop is deserving of more than a mere shrug of the shoulder ; they will find that he is a great painter, who independently pursues original aims. At the present time all criticism of art is determined by the ” line.” AU caprices and whims of the ” line ” are now ridden as much to death, and with the same enthusiasm, as were formerly those of “light.” Toorop occupies one of the first places among those whose only aim consists in allowing the line to talk and make music. His astonishing power of physical expression may be noted. With what simple means, for example, he renders in his picture of the “Sphinx” all phases of hysterical desire ; in that of ” The Three Brides ” nunlike resignation, chaste devotion, and unbridled voluptu- ousness. If his mastery over gesture, the glance of the eye, be remarked ??? how each feature, each movement of the hand and head, each raising and closing of the eyelid, exactly expresses what it is intended to express ??? Toorop’s pictures will no more be scoffed at than those of Giotto, but he will be recognized as one of the greatest masters of the ” line ” that the 19th century has produced.

See Max Roosbs. Dutch Painters of the Nmeteenth Century. English Edition. London, 1898-1901. (r. me.)

Geemany.

The German school of painting, like that of France, entered on a new phase after the Franco-German war of 1870. An empire had been built up of the agglomeration of separate states. Germany needed no longer to gaze back admiringly at older and greater epochs. The historical painter became neglected. Not the heroic deeds of the

past, but the political glories of the new empire were to be immortalized. This transition is particularly notice- able in the work of Adolf von Menzel. At the time of political stagnation he had recorded on his canvas the glories of Prussia in the past. Now that the present had achieved an importance of its own, he painted “The Coronation of King William at Konigsberg ” and ” King William’s Departure for the Army ” ; and ultimately ho became the painter of popular subjects. The motley throng

in the streets had a special fascination for him, and he loved to draw the crowd pushing its eager way to listen to a band on the promenade, in the market, at the doors of a theatre, or the windows of a cafe. He discovered the poetry of the builder's yard and the work- shop. In the " Moderne Cyklopen " (Ironworks), painted in 1876, he left a monumental mark in the history of German art; for in this picture he depicts a simple in- cident in daily life, without any attempt at genre ; and this was indeed the characteristic of his work for the next few years. Humorous anecdote, as represented by Knaus (b. 1829), Vautier (1829-1898), Defregger (b. 1835), and Griitzner (b. 1846), found little acceptance. Serious repre- sentations of modern life were required ; resort was made to all the expedients of the great painters, and the 'seventies were years of artistic study for Germany. Every great colourist in the past was thoroughly studied and his secrets discovered. In Germany, Wilhelm Leibl (b. 1844), holds the same prominent place that Courbet does in France. Leibl, like Courbet, {q.v.), showed that the task of paintiag is not to narrate, but to depict by the most convincing means at its disposal. He even went farther than Courbet in close scrutiny of nature. With loving patience he strove to translate into colour everything that his keen eye ob- served : he studied nature with the devotion of the medi- aeval artist. No feeling, strictly speaking, is discernible in his work. His greatest pictures are only of quiet life, with human accessories, and his painful accuracy di- vests his pictures of poetry. But when he first appeared, he was necessary. His painting of " Three Peasant Women in Church " is a grand documentary work of that period, whose first aim it was to conquer the picturesque. Leibl taught artists to study detail, to master the secrets of flower, leaf, and stalk.

A great number of pupils were encouraged by him to gain such a thorough mastery of every detail of technique as to be enabled to paint pictures that were thoroughly good in workmanship, irrespective of genre or anecdote. Among these, W. Triibner (b. 1851) stands pre-eminently as a painter. His works during the 'seventies are among the best painting done at Munich during that period; they are full and rich in colour, broad and bold in their treatment of the subject. A contemporary of his was Bruno Piglhein (b. 1848), a German Chaplin in this Courbet group, not heavy and matter-of-fact, but bold and witty. He revived the art of pastel

painting and pointed the way to a new style in panoramic and decorative painting, whilst infusing beauty and grace into all his works.

The movement in applied arts which began at this time is also important. The revival of the German empire led to a renaissance in German taste. The "old German dwelling-rooms," which now became the fashion, could only be hung with pictures in keeping with the style of the old masters, and this entailed a closer study and imitation of their works than had hitherto been customary. Wilhelm Diez (b. 1839) is at the head of the group, and as well acquainted with the epoch from Diirer and Holbein to Ostade and Rembrandt as any art historian. In Har- burger (b. 1846), Adrian Brouwer lived once more ; and in Lofftz (b. 1845), Quintin Massys. Glaus Meyer (b. 1846) imitated all the artistic tricks of Pieter de Hooch and Van

der Neer, of Delft. Holbein's costume studies were at first models for Fritz August Kaulbaoh (b. 1850). Later, he extended his studies to Dolci and Van Dyok, to Watteau and Gainsborough. Adolf Lier (1827-1882) applied the beauty of tone beloved by the old masters to landscape. Von Lenbach's works show the zenith of old-master talent in Germany. He had educated himself as a copyist of classical masterpieces, and passed through a schoohng in the study of old masters such as none of his contemporaries had enjoyed. The copies which, as a young man, he made for Count Schach in Italy and Spain are among the best the brush has ever accomplished. Titian and Kubens, Velasquez and Giorgione, were imitated by him with equal success. In like manner he gave to his own works their distinguished old ~~master charm. More than all other painters of historical subjects, Lenbach enjoys the dis~~ tinction of having been the historian of his epoch. He gave the great men of the era of the Emperor William I. the form in which they will live in German history, and beauty of colour is blended in all these pictures with their brilliant evidence of

thought. The aspirations of a whole generation to restore the technique of the old masters found their realization in Lenbach.

Such was the position of things when there was imported from France the desire to paint light and sun. It was argued that the views which the old masters held con- cerning colour were in glaring contradiction to what the eye actually saw. The old masters, it was said, paid particular attention to the conditions of light and shade under which they did their work. The golden character of the Italian Eenaissance was traceable to the old cathedrals lighted by stained-glass windows. The light and shade of the Netherlanders were in keeping with the light and shadow of the artists' studios lighted by little panes, and due partly to the fact that their pictures were intended to hang in dreamy, brown, panelled chambers. But was this golden or brown light suitable for the 19th century 1 Were we not Ulogical, when for the sake of reproducing the tones of the old masters, we darkened our studios and shut out the dayKght by coloured glass windows and heavy curtains ? Was not light one of the greatest acquisitions of recent times 1 When the Dutch painted, the world used only little panes of glass. Now the daylight streamed into our rooms through great white sheets of crystal. When our grandfathers lived, there were only candles and oil lamps. Now we had gas and electric light. Instead of imitating the old masters, let us paint the colouristic charms that were unknown to them. Let us do honour to the new marvels of colour. With such arguments as were advanced in France, did artists in Germany adopt the plein-air and abandon older methods ; and a develop- ment like that which took place in France after the days of Manet ensued in Germany also. Daylight, which had so long been kept down, was now to be reproduced as clear and bright. After the art of painting strong effects full of daylight had been grappled with, other and more difficult problems of light effects were attempted. After the fuU blaze of sunshine had been successfully reproduced, such effects as the haze of early morning, the sultry vaporous atmosphere of the thunderstorm, the mysterious night, the blue-grey dawn, the delicate colours of variegated Chinese lanterns, the scintillation of gas and lamphght, and the dreamy twilight in the interior were dealt vnth.

Max Liebermann (b. 1849) was the first to join the new departure. In Paris he had learnt technique. Holland, the country of fogs, inspired him with the love for atmo- spheric effects, and its scenes of simple life, provided him with many subjects. Perhaps the ” Net Menders ” in the Hamburg Kunsthalle is most typical of Liebermann’s art. Franz Skarbina (b. 1849), who was the second to join the

new movement ia Berlin, proceeded to studies of tvrilight and artificial light efi’ects.

Hans Herrman (b. 1858), who settled himself on quays and ports ; Hugo Vogel, who endeavoured to utilize scenes from contemporary life for decorative pictures ; . and the two landscape painters, Ludwig Dettmann (b. 1865) and Walther Leistikow (b. 1865), are other representatives of modern Berlin art. Carlsruhe, in the ‘eighties, produced some modern pictures of great merit, when Gustav Schon- leber (b. 1851) and Herrmann Baisch (b. 1846) showed daintily-conceived pictures of Dutch landscapes. In later years. Count Leopold Kalckreuth (b. 1855), whose power- fully-conceived representations of peasant life belong to the best productions of German realism, and Victor Weishaupt (b. 1848), the animal painter, removed thence to Stuttgart, the residence also of Otto Reiniger (b. 1863), a landscape painter of great originality. At Dresden we find Gotthard Kuehl (b. 1850), long domiciled in Paris, who was one of the first to accept Manet’s teaching. In North Germany, Worpswede became a German Barbizon ; Ende (b. 1860), Vogeler, and Vinnen (b. 1863) also worked there. In Weimar, two landscape painters of great refinement must be mentioned ??? Theodor Hagen (b. 1842) and Gleichen- Russwurm (b. 1866). As far back as the ‘seventies they rendered ploughed fields, hills enveloped in thin vapour at sunrise, waving fields of corn, and apple trees in full bloom trembling in the rays of the evening glow, with a delicate understanding of natural effects.

But Munich still remains the headquarters of German art, which is there the first of all interests and pervades all circles. Almost all those who are working in other German towns received in that city their inspiration, and have indeed remained its citizens in heart. The Inter- national Exhibitions have given a great European tone and impulse to creative work. Among

the elders, Albert von Keller (b. 1841) has perhaps the greatest originality. He is one of those who practised the art of the brush as long ago as the 'seventies, and painted, not for the sake of historical subjects or for genre, but for the sole love of his art. He painted everything, never restricted himself to any fixed programme, and never became trivial. He ia perhaps in Germany the only painter of female portraits who has caught in his pictures a little of the charm that betrays itself in the expression and movements of the modern woman. In the works of Freiherr von Habermann (b. 1849) this refinement of sentiment, as expressed in colour, is combined with a still more decided shade of eccen- tricity. Already in his " Child of Sorrow," which hangs in the National Gallery at Berlin, he struck that painful chord that always remained his favourite. However different the subjects he has painted, a morbid note pervades them all.

In Heinrich Zugel (b. 1850), the Munich school possesses an animal painter who rivals the great Frenchmen in original power. Ludwig Dill (b. 1848), whom one must still count as "Dachauer," in spite of his migration to Carlsruhe, had for some time past been famous as a painter of Venice, the lagoons and Chioggia, when the impres- sionist movement became for him the starting-point of a new development. He strove for stiU brighter light, tried to realize the most subtle shades of colour, and raised himself from a painter of natural impressions to free and poetical lyricism. Arthur Langhammer (b. 1855), Ludwig Herterich, Leo Bamberger (b. 1851), Hans von Bartels (b. 1856), Wilhelm Keller-Reutlinger (b. 1854), Beno Becker, Louis Corinth (b. 1858), Max Slevogt, are others that may be mentioned among the younger Munich artists.

Fritz von Uhde (b. 1848) occupies a peculiar position, as being the first to apply the principles of naturalism to religious art. Immediately before him, Eduard von Gebhardt (b. 1838) had gone back to the angular style of

the old northern masters, that of Roger van der Weyden and Albert Diirer, beheving he could draw the old Biblical events closer to present times by relating them in Luther's language and representing them as taking place in the most powerful epoch of German ecclesiastical history. Now that historical paintings had been dispossessed by modern and contemporary subjects, it foUowed also that scenes from the life of Christ had to be laid in modem times. "I do not assert that only the commonplace occurrences of everyday life can be painted. If the historical past be painted, it should be represented in human garb corresponding to the life we see about us, in the surroundings of our own country, peopled with the people moving before our very eyes, just as if the drama had only been enacted the previous evening." Thus wrote Bastien-Lepage in 1879, when creating his " Jeanne d'Arc," and in this sense did Uhde paint. But besides the charm of feeling expressed in the subtlest hues, there is also the charm of the noble line.

At the time when, in England, Eossetti and Burne-Jones, and, in France, Puvis de Chavannes and Gustave Moreau, stepped into the foreground, in Germany Feuerbach (1829- 1880), Martes (1837-188Y), Thoma (b. 1839), and Bocklin (1827-1901) were discovered. Feuerbach's life was one series of privations and disappointments. His " Banquet of Plato," "Song of Spring," "Iphigenia" and "Piet^," and his " Medea " and " Battle of the Amazons," met with but scant recognition on their appearance. To some they appeared to lack sentiment, to others they were " not sufficiently German." When he died in Venice in 1880, he had become a stranger to his contemporaries. But posterity accorded him the laurel that his own age had denied him. Just those points in his pictures to which exception had been taken during his lifetime, the great solemn restfulness of his colouring and the calm dignity of his contours, made him appear contemporary.

Hans von Martes fulfilled a similar mission in the sphere of decorative art ; his, likewise, was a talent that was not discovered until after his death. He is most in touch with Puvis de Chavannes. But the result was different. Puvis was recognized on his first appearance. Maries never had

a chance of revealing his real strength. He was only 28 years of age when he first went to Eome ; there, in 1873, he was commissioned to paint some pictures for the walls of the Zoological Station at Naples. After that time, nothing more was heard of him until 1891, when, four years after his death, the works he had left behind him were exhibited and presented to the gallery of Schleissheim. The value of these works of art must not be sought in their technique. The art of Puvis rests on a firm realistic foundation, but Martes had finished his studies of nature too prematurely for the correctness of his drawing. In spite of this defect, they encourage as well as excite, owing to the principle which underlies them, and which they share in equal degree with those of Puvis. Like Puvis, Maries repudiated all illuminating efi'orts whereby forms might be brought into relief. He only retained what was intrinsically essential, the large lines in nature, as well as those of the human frame.

Next to these artists stands Hans Thoma, like one of the great masters of Diirer's time. In Maries and Feuer- bach's works there is the solemn grandeur of the fresco ; in those of Thoma there is nothing of Southern loveliness, but something of the homeliness of the old German art of woodcut ; nay, something philistine, rustic, patriarchal ??? the simplicity of heart and childlike innocence that entrance us in German folk-lore, in the paintings of Moritz von Schwind (1804-1871) and Ludwig Richter (1803-1884). He had grown up at Bernau, a small village of the Black Forest. Blossoming fruit-trees and silver brooks, green

meadows and solitary peasants' cottages, silent vaUeys and warm summer evenings, grazing cattle and the cackle of the farmyard, all lived in his memory when he went to Weimar to study the painter's art. This pious faithfulness to the home of his birth and touching affection for the scenes of his child- hood pervade all his art and are its leading feature. Even when depicting classical subjects, the mythological marvels of the ocean and centaurs, 'Thoma still remains the simple- hearted German, who, like Cranach, conceives antiquity as a romantic fairy tale, as the legendary period of chivalry.

Whether it be correct to place Bocklin {q.v.) in the same category with these painters, or whether he has a right to a separate place, posterity may

decide. The great art of the old masters has weighed heavily upon the development of that of our own age. Even the idealists, who have been mentioned, trace their pedigree back to the old masters. However modern in conception, they are to aU intents and purposes "old" as regards the form they employed to express their modern ideas. Bocklin has no ancestor in the history of art ; no stroke of his brush reminds us of a leader. No one can think of tracing him back to the Academy of Diisseldorf, to Lessing, or Schorner, as his first teacher. Even less can he be called an imitator of the old masters. His works are the result of nature in her different aspects; they have not their origin in literary or historical suggestion. The catalogue of his con- ceptions, of landscape in varying moods, is inexhaustible. But landscape does not suffice to express his resources. Knights on the quest for adventure, Saracens storming flaming citadels, Tritons chasing the daughters of Neptune in the billovry waves; such were the subjects which appealed to him. He endowed aU fanciful beings that people the atmosphere, that live in the trees, on lonely rocks, or that move and have their being in the slimy bottom of the sea, with body and soul, and placed a second world at the side of the world of actuality. Yet this universe of phantasy was too narrow for the master mind. If it be asked who created on the Continent of Europe the most fervid reHgious paintings of the 19th century; who alone exhausted the entire scale of sensations, from the placidity of repose to the sublimity of heroism, from the gayest laughter to tragedy ; who possessed the most solemn and most serious language of form and, at the same time, the greatest poetry of colour ❓❓❓ the name of Bocklin will most probably form the answer.

These masters were for their younger brethren the pioneers into a new world of art. It was momentous for the painter's art that in Germany, no less than in England and France, a new movement at this time set in ❓❓❓ the so- called "arts and crafts." Hitherto the various branches of art had followed different courses. The most beautiful paintings were often hung in surroundings grievously lacking in taste. Now arose the ambition to make the room itself a work of art. The picture, as such, now no more stands in the foreground, but the different arts strive together to form a single piece of art. The picture is regarded as merely a decorative accessory.

Among the younger painters still to be mentioned. Max Klinger (b. 1857) is perhaps the most brilliant. He had begun with the etching-needle, and by its aid gave us entire novels, crisp little dramas of everyday life. But this realism was only a preliminary phase enabling him to pass on to a great independent art of form. His great picture, " Christ in Olympus," combines beauty of form with deep philosophical meaning. Ibsen in 1873, in his Emperor aitd Galilean, talked of a " third realm," combin- ing heathen beauty with Christian profundity. Klinger's " Christ in Olympus " strikes the beholder as the realization of this idea. Stuck (b. 1853) shares with him the Hellenic serenity of form, the classical simplicity. Apart from this,

his pictures are thoroughly different. It might almost be said " Klinger is the Nazarene who stepped into Olympus"; the thoughtful, deep son of the North who carries profound physical problems into the beauty-loving Hellenic worship of the senses. Stuck's art is, also, almost classical in its insensibility and petrified coldness. In his first picture (1889), "The Guardian of Paradise," he painted a slim wiry angel, who, like Donatello's "St George," in calm confidence and self-assurance points the sword before him. And similar rigid figures, standing erect in steadiness ??? always portraits of himself ??? recur again and again in his works. Even his rehgious pictures ??? the "Piet^" and " The Crucifixion " ??? are, in reality, antique. One would seek in vain in them for the piety of the old masters or the Germanic fervour of Uhde. Grand in style and line, firm, solemn, serious in arrangement, they are yet hard and cold in conception.

Ludwig von Hoffmann (b. 1861) stands next to him, a gentle, dreamy German. In Stuck's work everything is strong and rugged : here all is soft and round. There the massiveness of sculpture and stiff heraldic lines : here all dissolved into variegated fairy tales, glowing harmonies. However classical he may appear, yet it is only the old yearning of the German! for Hesperia ??? the song of Mignon ??? that rings throughout his

works ; the longing to emerge from the mist and the fog into the light, from the humdrum of everyday life into the remote fabulous world of fairydom, the longing to escape from sin and attain perfect innocence.

There are numerous others deserving of mention besides those already discussed. Josef Sattler, Melchior Lechter (b. 1871), and Otto Greiner (b. 1869), and likewise those who, such as von Berlepsch (b. 1852) and Otto Eckmann (b. 1865), devoted their energies again to "applied art."

See R. MuTHEK. The History of Modem Painting. London, 1895. ??? Deutsches Kiinstler-Lesnkon der Gegenwart in Biographisdhen Skizgen. Leipzig, 1898. ??? Mrs de la MAZELliKE. La Printure AUemande au XIX' Siicle. Paris, 1900. (e. mb.)

AUSTRIA-HUNGAKY.

In Austria the influence of Makart (1840-1884) was predominant in the school of painting during the last quarter of the 19th century. He personified the classical expression of an epoch, when a long period of colour- blindness was followed by an intoxication of colour. 'Whilst Piloty's ambition stopped short at the presentation of correct historical pictures, his pupil, Makart, felt himself a real painter. He does not interpret either deep thought or historical events, nor does he group his pictures together to suit the views of the art student. His work is essentially that of a colourist. Whatever his subject may be, whether he depicts "The Plague in Florence," "The Nuptials of Caterina Cornaro," " The Triumphal Entry of Charles V.," "The Bark of Cleopatra," or "The Five Senses," "The Chase of Diana," or "The Chase of the Amazons," his pictures are romances of brilliant dresses and human flesh. A few studies of the nude and sketches of colour, in which he merely touched the notes that were to be combined into chords, were the sole preliminaries he required for his historical paintings. Draperies, jewels, and voluptuous female forms, flowers, fruit, fishes, and marble ??? everything that is full of life and sensuous emotion, and shines and glitters, he heaps together into gorgeous still-life. And because by this picturesque sensuousness he restored to Austrian art a long-lost national peculiarity, his appearance on the scene was as epoch-making as if some

strong power had shifted the centre of gravity of all current views and ideas. In estimating Makart, however, we must not dwell on his pictures alone. He did more than merely paint ??? he lived them. Almost prematurely he dreamed the beautiful

dream which in later days came nearer realization, that no art can exist apart from life ??? that life itself must be made an art. His studio, not without reason, was called his most beautiful work of art. Whithersoever his travels led him ??? to Granada, Algiers, or Cairo ??? he made extensive purchases, and refreshed his eye with the luscious splendour of rich silks and the soft lustrous hues of velvets. He made collections of carved ivory and Egyptian mummies. Gobelins, armour and weapons, old chests, antique sculp- ture, golden brocades with glittering embroideries, encrusted coverlets and the precious textures of the East, columns, pictures, trophies of all ages and all climes. He scattered money broadcast in striving to realize his dream of beauty ??? to pass one night, one hour, in the world of Eubens, so bright in colour, so princely in splendour.

Uniting as he did these artistic qualities in his own person ??? not only because he was a painter, but because in no other besides did the great yearning for aesthetic culture find such powerful utterance ??? Makart exercised an influence in Austria far transcending the actual sphere of the painter's art. An intense fascination went forth from the little man with the black beard and penetrating. glance. At that time Makart dominated not merely Viennese art, but likewise the whole cultured life of the capital. Not only the Makart hat and the Makart bouquet made their pilgrimage through the world, he became also the motive power in all intellectual spheres. When Charlotte Wolter acted Cleopatra or Messalina on the stage, she not only wore dresses specially sketched for her by Makart, but she also spoke in Makart's style, just as HamerUng wrote in it. A veritable Makart fever, had, indeed, taken possession of Vienna. No other painter of the 19th century was so popular, the life of none other was surrounded by suqji princely sumptuousness. The scene when, during the festivals of 1879, he headed the procession of artists past the imperial box, mounted on a white steed glittering with gold, the Rubens hat with white feathers on his head,

amidst the boisterous acclamations of the populace, is unique in the modem history of art. It is the greatest homage that a Philistine century ever offered an artist.

The life of August von Pettenkofen (1821-1889), who should, after Makart, be accounted the greatest Austrian painter of the last quarter of the 19th century, was passed much more modestly and serenely. He had grown up on one of his father's estates in Galicia, and had been a cavalry officer before becoming a painter. His place in Austria is that of Menzel in Germany. With Pettenkofen a new style appeared. The representation of modern sub- jects now began to take the place of historical painting, which had for so long a time been the ruling taste ; not in the sense of the old-fashioned genre picture, but in that of artistic refined painting. Here, again, the distinctive Austrian note can be easily recognized. Pettenkofen's people are lazy, and yawn. All is contemplative and peaceful, full of dreamy, sleepy repose.

But neither Pettenkofen nor Makart has found followers. The great movement which, originating vpith Manet, took place in other centres of art, passed Austria by without leaving a trace. Hans Canon (b. 1829), who in his pictures transported the characters of the " Griinderzeit " to Venice of bygone days, and reproduced them as Venetian nobles and ladies of quality, is also a painter of note. So like- wise is Rudolf Alt (b. 1812), still active with the brush in 1902, a refined painter in water-colours, who reproduces the beauties of Old Vienna in his subtle architectural sketches. Leopold Karl Miiller (1834-1892), who had lived in Cairo with Makart, found his sphere of art in the variegated world of the Nile, and his ethnographical exactness, combined with his delicate colouring, made him for a long while much in request as a painter of Oriental

scenes, and a popular illustrator of Egyptological works. Emil Schindler was a great landscape painter, who often rose from faithful interpretation of nature to an almost heroic height. Heinrich von Angcli (b. 1840), again, fur- nished *as he continued to do* *the European*

Courts with his representative pictures, combining refined conception with smooth elegant technique. These are the only artists who during the 'eighties rose above local mediocrity. After Makart died in 1884, the sun of Austrian art seemed to have set. Stagnation reigned supreme.

Only since the "Secession" from the old Society of Artists {Kunstlerffenossenschaft), which took place in 1896, has the former artistic life recommenced in Vienna. Theodor von Hermann, long domiciled in Paris, was the gifted initiator of the new movement, and succeeded in rousing a storm of discontent among the rising school of Viennese artists. They found a literary champion in their hero's father, who pleaded in eloquent language for a new Austrian culture. In November 1898 the Secessionists opened their first exhibition in a building erected by Josef Olbriick on the Wienerzeil. At first the importance of these exhibitions lay almost exclusively in the fact that the Viennese were thus given an opportunity of making acquaintance vpith the famous foreign masters, Puvis de Chavannes, Segantini, Besnard, Brangwyn, Meunier, Khnopff, Henri Martin, Vischer, who had until then been practically unknown in Austria, so that the public only then realized the inferiority of their countrymen's artistic work. Thus while acquainting the Viennese pubUc with the strivings of European art, the Secession endeavoured at the same time to produce, in rivalry with foreigners, works of equal artistic merit. Leading foreign masters now joined the movement, and Vienna, which had so long stood aside, through inability to be represented worthily at inter- national exhibitions, became once more a factor in contem- porary European art.

Among the painters of the Secession, Gustav Klint pos- sesses, perhaps, the most powerful original talent. Refined portraits, subtle landscapes, and decorative pictures, painted for the Tumba Palace and for the Vienna Hof Museum, first brought his name before the world. But he became famous in consequence of the controversy which arose around his picture, "Philosophy." He had been com- missioned to paint the large ceiling piece for the " Aula " of the Vienna University, and instead of selecting a classical subject he essayed an independent work. The heavens open ; golden and silvery stars twinkle ; sparks of light gleam ; masses of green cloud and vapour form clusters ; naked human forms float about ;

a fiery head, crowned vrith laurel, gazes on the scene with large, serious eyes. Science climbs down to the sources of Truth : yet Truth always remains the inscrutable Sphinx. Klint paid the penalty of his bold originality by his work remaining dark and incomprehensible to most people. It has, notwithstanding, a historical importance for Austria corresponding to that which similar works of Besnard have for France. It embodies the first attempt to place monu- mental painting upon a purely colouristic basis, and to portray allegorical subjects as pure visions of colour. After Klint, Josef Engelhart (b. 1864) is deserving of notice. He is the true painter of Viennese life. On his first .appearance his art was centred in his native place, and was strong in local colour, which was lacking in refinement. To acquire subtlety, he studied the great foreign masters and became a clever juggler with the brush, showing as much dexterity as any of them. Yet this virtuosity meant, in his case, only a good schooling, which should enable him to return with improved means to those sub- jects best suited to his talent. His works are artistic, but ^t the same time distinctly local.

Carl Moll (b. 1861) understands how to render with equal skill the play of light in a room and that of the sunbeams upon the fresh green grass. The rural pictures of Eist produce a fresh, cool, and sunny effect upon the eye ; like a refreshing draught from a cool mountain spring ??? a piece of Norway on Austrian soU. Zettel's landscapes are almost too markedly Swiss in colour and conception. Julius von KoUmann worked a long time in Paris and London, and acquired, in intercourse with the great foreign painters ??? notably Carriere and Watts ??? an exquisitely refined taste, an almost hypersesthetical sense for discreetly toned-down colour, and for the music of the Une. In Friedrich Konig, M. von Schvpindt's romantic vein is revived. Even the simplest scenes from nature appear under his hand as enchanted groves whispering secrets. Everything is true and, at the same time, dreamy and mysterious. The mythical beings of old German legends ??? dragons and enchanted princesses ??? peer through the forest thicket. Ernst Nowak (b. 1851), compared with him, is a sturdy painter, who knows his business well. He sings no delicate lyric. When one stands close by, his pictures appear like masonry ??? like reliefs. Seen from a distance, the blotches of colour unite into large powerful forms. Bernatzik understands how to interpret with great

subtlety twilight moods ⁂ moonshine struggling with the light of street lamps, or with the dawn. Ticky followed Henri Martin in painting solemn forest pictures. Fer- dinand Andr^ leans towards the austere power of Millet. He tells us in his work of labour in the fields, of bronzed faces and hands callous with toil ; and especially must his charcoal drawings be mentioned, in which the colour over- lays the forms like light vapour, and which, small as they are, have a sculptural efiect. Auchentelier ⁂ known for his female studies ⁂ and Hanisch and Otto Friedrich (b. 1862), refined and subtle as landscape painters, must also be mentioned.

In rivalry with the Secession, the " Kiinstlergenossen- schaft " has taken a fresh upward flight. Among figure painters, Delug, Goltz (b. 1857), Hirschl, and Veith are conspicuous ; but stiU greater fascination is exercised by landscape painters such as Amesadan, Charlemont, ifec, whose works show Austrian art in its most amiable aspect. Apart from Austrians proper, there are also representatives of the other nationalities which compose "the monarchy of many tongues." Bohemia takes the lead with a celebrity of European reputation ⁂ Gabriel Max (b. 1840), who, although of PUoty's school and resid- ing in Munich, has never repudiated his Bohemian origin. The days of his youth were passed in Prague ; and Prague, the mediaeval, with its narrow winding alleys, is the most mysterious of all Austrian cities, enveloped in the breath of old memories and bygone legends. From this soil Max drew the mysterious fragrance that characterizes his pictures. His earliest work, the " Female Martyr on the Cross " (1867), struck that sweetly painful, half-tormenting, half-enchanting keynote that has since remained distinct- ively his. Commonplace historical painting received at Max's hands an entirely new nuance. The morbidness of the mortuary and the lunatic asylum, interspersed with spectres ⁂ something perverse, unnatural, and heartrending, ⁂ this is the true note of his art. His martyrs are never men ⁂ only delicate girls and helpless women. His colour- ing corresponds to his subjects. The sensations his pictures produce are akin to those which the sight of a beautiful girl lying in a mortuary, or the prison scene in Faust enacted in real life, might be expected to excite. He even applies the results of hypnotism and spiritualism to Biblical characters. In many of his pictures refinement in the selection of effects is

missing. By over-production Max has himself vulgarized his art. Yet, despite his

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manner of depicting the mysteries of the realms of shadows, and the intrusion of the spirit-world into realism, he remains a modern master. A new province ??? the spectral ??? was opened up by him to art.

Hans Schwaiger is the real raconteur of Bohemian legends. He, likewise, passed his youth in a small Bohemian village, over which old memories stUl brooded. In Hradec, places upon which the gallows had stood were still pointed out. The lonely corridors and passages of the ruined castle were haunted by the shades of its old possessors. This is the mood that led Schwaiger to . legend-painting. But underlying his fairy tales there are the gallows or the alchemy of Faust. The landscape with its gloomy skies, the wooden huts, turrets, dwarfed trees ??? such are ever the accompaniments of his figures.

Of the younger generation of painters, Emil Orlick (b. 1870) seems to be the most versatile. Having acquired technique in Paris and Munich, he practically discovered Old Prague to the world of art. The dark little alleys of the ancient town, swarming with hfe compressed within their narrow compass, fascinated him. In order to retain and convey all the impressions that crowded in upon him in such superabundant plenitude, he learned how to use the knife of the wood-carver, the needle of the etcher, and the pencil of the lithographer. His studio more resembles the workshop of a printer than the atelier of a painter. In the field of lithography he has attained remarkable results. Orlick has also made his own everything that can be learned from the Japanese. Besides these masters, Albert Hynais, the creator of decorative pictures, almost Parisian in conception, must be mentioned. The landscape painters Wickener, Jansa, Slavicek, and Hudecek relate, in gentle melancholy tones of colour, the atmosphere and solitude of the wide plains of Bohemia.

In Poland, painting has its home at Cracow. Down to the year 1893 Johann Matejko was hving there, in the capacity of director of the Academy. His pictures are remarkable for their originality and almost brutal force, and differ very widely from the conventional productions of historical painters. At the close of the 19th century Axentowicz, Olga Hojnanska, Mehoffer, Stanislawski, and Wyotkowski attracted attention. Although apparently lay- ing much less stress on their Polish nationality than their Russian countrymen, their works proclaim the soul of the Polish nation, with its chivalrous gallantry and mute re- signed grief, in a much purer form.

Hungary in the spring of 1899 lost him whom it revered as the greatest of its painters ⬛⬛⬛ Michael Munkacsy. Long before his death his brush had become idle. To the younger generation, which seeks different aims, his name has become almost synonymous with a wrongly-conceived old-masterly coloration, and with sensation painting and hoUowness. "The Last Day of the Condemned Prisoner," his first youthful picture, contained the programme of his art. Then came " The Last Moments of Mozart," and " Milton dictating Paradise Lost." These titles summon up before our eyes a period of all that is false in eclectic art, dominated by Delaroche and Piloty. Even the simple subjects of the Gospel were treated by Munkacsy in Piloty's meretricious style. " Christ before Pilate," " Ecce Homo," " The Crucifixion " ⬛⬛⬛ all these are gala representa- tions, costume get-up, and, to that extent, a pious lie. But when we condemn the faults of his period, his per- sonal merit must not be forgotten. When he first came to the fore, ostentation of feeling was the fashion. Munkacsy is, in this respect, the genuine son of the period. He was not one of those who are strong enough to swim against the stream. Instead of raising others to his level, he descended to theirs. But he has the merit of having painted spectacular scenes, such as the

period demanded, with genuine artistic power. Like Rahl, Ribot, Boybet, and Makart, he was a ⬛⬛⬛ maltre-peinfre, a born genius with the brush. Von Uhde and Liebermann were disciples of his school. And if these two painters have left that period behind them, and if independent natural sight has followed upon the imitation of the old masters, it is Munkacsy who enabled them to take the leap. (b- Me)

iTAiY.

Modem Italy has produced one artist who towers over all the others, Giovanni Segantini (q.v.). Segantini owes as little to his period of study in Milan as Millet did to his sojourn at Delaroche's school. Both derived from their teachers a complete mastery of technique, and as soon as they were in possession of all the aids to art, they discarded them in order to begin afresh. Each painted what he had painted as a youth. They dwelt far from the busy world ❓❓❓ MiUet in Barbizon, Segantini at Val d'Albola, 5000 feet above the sea-level. They are equally closely allied in art. Millet, who rejected aU the artifice of embellishment and perceived only beauty in things as they are, learned to see in the human body a heroic grandeur, in the movements of peasants a majestic rhythm, which none before him had discovered. Although repre- senting peasants, his works resemble sacred pictures, so grand are they in their sublime, solemn simplicity. The same is true of Segantini's works. Like Millet, he found his vocation in observing the life of poor, humble people, and the rough grandeur of nature, at aU seasons and all hours. As there is in Millet's, so also is there in Segantini's work a primitive, almost classical, simpKcity of execution corre- sponding to the simpUcity of the subjects treated. His pictures, with their cold silvery colouring, remind us of the wax-painting of old times and of the mosaic style of the Middle Ages. They are made up of small scintillating strokes; they are stony and look hard like steel. This technique alone, which touches in principle but not in effect, that of the pointillistes, permitted of his rendering what he wished to render, the stony crags of Alpine scenery, the thin scintillating air, the firm steel-like outlines. Finally, he passed from realistic subjects to thoughtful, Biblical, and symbolical works. His "An- nunciation," the " Divine Youth," and the " Massacre of the Innocents " were products of an art that had abandoned the firm ground of naturalism and aimed at conquering supernatural worlds. This new aim he was unable to realize. He left the "Panorama of the Engadine," intended for the Paris Exhibition, in an unfinished state behind him. He died in his 42nd year, his head fuU of plans for the future. Modern Italy lost in him its greatest artist, and the history of art one of the rare geniuses.

Few words will suffice for the other Italian painters. The soil that had yielded down to Tiepolo's days such an abundant harvest was apparently in need of rest during the 19th century. At the Paris Exhibition of 1867 About called Italy "the tomb of art," and indeed until quite recent times Italian painting has had the character of mere pretty saleable goods. Francesco Vinea, Tito Conti, and Frederigo Andreotti painted with tireless activity sleek drapery pictures, vdth Renaissance lords and smiling Renaissance ladies in them. Apart from such subjects, the comic, genre, or anecdote ruled the fashion ❓❓❓ somewhat coarse in colour and of a merrier tendency than is suitable for pictures of good taste. It was not until nearly the end of the 19th century that there was an increase in the num- ber of painters who aim at real achievement. At the Paris Exhibition of 1900 only Detti's "Chest" and Signorini's " Cardinal " pictures reminded one of the comedy subjects formerly in vogue. The younger masters employ neither

" drapery-mummeries " nor spicy anecdote. They paint the Italian country people with refined artistic discernment, though scarcely with the naturalism of Northern nations. Apparently the calm, serious, ascetic, austere art initiated by MUIet is foreign to the nature of this volatile, colour- loving people. Southern fire and delight in brilliant hues are especially characteristic of the Neapolitans. A tangle of baldacchinos, priests and choir boys, peasants making obeisance and kneeling during the passing of the Host, weddings, horse-races, and country festivals, everything sparkling with colour and glowing in Neapolitan sunlight ❓❓❓ such are the contents of Paolo Michetti's, Vincenzo Capri's, and Edoardo Dalbono's pictures. But Michetti, from being an adherent of this glittering art, has found his way to the monumental style. The Venetians acknowledge and honour as their leader Giacomo Favretto, who died very young. lie painted drapery pictures like most artists of the 'eighties, but they were never lackadaisical, never commonplace. The Venice of Canaletto and Goldoni, the magic city surrounded by the glamour of

bygone splendour, rose again under Favretto's hands to fairylike radiance.

The older masters, Signorini, Tito Tommasi, DaU. 'oca Branca, who depict the Piedmontese landscape, the light on the lagoons, and the colour charm of Venetian streets with so refined a touch, have numerous followers, whose pictures likewise testify to the seriousness that again took possession of Italian painters after a long period of purely commercial artistic industry. Side by side with these native Italians two others must be mentioned, who occupy an important place as interpreters of Parisian elegance and French art-history. Giuseppe de Nittis (born in Naples ; died in Paris 1884) was principally known by his repre- sentations of French street life. The figures that enlivened his pictures were as full of charm as his rendering of atmospheric effects was refined. Giovanni Boldini, a Fer- rarese living in Paris, also painted street scenes, full of throbbing life. But he excelled, besides, as a portrait- painter of ladies and children. He realized the aim of the Parisian Impressionists, which was to render life, and not merely mute repose. He understood in a masterly fashion how to catch the rapid movement of the head, the fleetest expression, the sparkling of the eye, a pretty gesture. From his pictures posterity wiU learn as much about the sensuous life of the 19th century as Greuze has told us about that of the 18th.

Among those who have been the leaders of modern Itahan art, not already mentioned, are Domenioo Morelli, Giovanni Costa, landscape painter ; Sartorio, an Italian Pre-Kaphaelite ; Pasini, painter of the East ; Muzzioli, a follower of Alma-Tadema ; Barabino, historical painter ; and most striking and original of all, MontioeUi, whose glow of colours was often obtained, not only by palette- knife painting, but by squeezing the colour straight from the tubes on to the canvas.

See AsHTON R. Willakd. History of Modem Italian Art. London, 1898. (r. me.)

Spain and Portugal.

Modern Spanish painting began with Mariano Fortuny (g'.v.), who, dying as long ago as 1874, nevertheless left his mark even on the following

generation of artists. During his residence in Paris in 1866 he had been strongly in- fluenced by Meissonier, and subsequently selected similar subjects ❓❓❓ scenes in 18th-century costume. In Fortuny, however, the French j>ainter's elaborate finish is associated with something more intense and vivid, indicative of the southern Latin temperament. He collected in his studio in Eome the most artistic examples of mediaeval industry. The objects among which he lived he also painted with incisive spirit as a setting for elegant figures from the

world of Watteau and of Goya, which are thrown into his pictures with amazing dash and sparkle ; and this love of dazzling kaleidoscopic variety has animated his successors. Academic teaching tries to encourage historical painting. Hence, since the 'seventies, the chief paintings produced in Spain have been huge historical works, which have made the round of European exhibitions and then been collected in the Gallery of Modern Art at Madrid. There may be seen " The Mad Queen Juana," by PradUla ; " The Conversion of the Duke of Gandia," by Moreno Carbonero ; "The Bell of Huesca," by Casado; "The Last Day of Numantia," by Vera; "Inesde Castro," by CabeUo.

It is jjossible, of course, to discern in the love of the horrible displayed in these pictures an element of the national character, for in the land of bull-fights even painting turns to murder and sudden death, poison and the rope. However, at least we must admit the great power revealed, and recognize the audacious colouring. But in point of fact these works are only variants on those executed in France from the time of Delaroche to Jean Paul Laurens, and tell their story in the style that was current in Parisian studios in the 'sixties. What is called the national garb of Spain is mainly the cast-off fashion of Paris. After all this magniloquent work Fortuny's rococo became the rage. The same painters who had produced the great historical pictures were now content to take up a brilliant and dazzling miniature style ; either, like Fortuny himself, using small and motley figures in baroque subjects, or adapting the modern national life of Spain to the rococo style.

Here again we observe the acrobatic dexterity with which the painters, PradiUa especially, use the brush. But here again there is nothing

essentially new^ ⬛⬛⬛ only a repetition of what Fortuny had already done twenty years before. The Spanish school, therefore, presented a very old-fashioned aspect at the Paris Exhibition of 1900. The pictures shown there were mostly wild or emotional. Bedouins fighting, an antique quadriga flying past, the inhabitants of Pompeii hastily endeavouring to escape from the lava torrent, Don Quixote's Eosinante hanging to the sail of the windmill, and the terrors of the Day of Judgment were the subjects ; Alvarez Dumont, BenUiure y Gil, Ulpiano Checa, Manuel Ramirez Ibafiez, and Slorena Carbonero were the painters. Among the huge canvases, a number of small pictures, things of no importance, were scattered, which showed only a genre-like wit. Spain is a somewhat barren land in modern art. There painting, although active, is blind to life and to the treasures of art which lie unheeded in the road. Only one artist, Agrasot, during the 'seventies painted pictures of Spanish low life of great sincerity ; and much later two young painters appeared who energetically threw themselves into the modern movement. One was Sorolla y Bastida, by whom there is a large fishing picture in the Luxembourg, which in its stern gravity might be the work of a Northern painter; the other was Ignacio Zuloaga, in whom Goya seems to live again. Old women, girls of the people, and cocottes especially, he has painted with admirable spirit and with breadth. Spain, which has taken so little part in the great movement since Manet's time, only repeating in old-fashioned guise things which are falsely regarded as national, seems at last to possess in Zuloaga an artist at once modern and genuinely national.

Portugal took an almost lower place in the Paris Ex- hibition. For whereas the historical Spanish school has endeavoured to be modern to some extent, at least in colour, the Portuguese cling to the blue-plush and red- velvet splendours of Delaroche in all their crudity. Weak pictures of monks and of visions are produced in numbers, together with genre pictures depicting the popular life

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of Portugal, spiced to the taste of tlie tourist. There are the younger men who aim at avaihng themselves of the efforts of the open-air painters; but even as followers of the Parisians they only say now what the French were saying long years ago through Bastien-Lepage, Puvis de Chavannes, and Adrien Dumont. There is always a Frenchman behind the Portuguese, who guides his brush and sets his model. The only painter formed in the school is Carlos Eeis, whose vast canvas ” Sunset ” has much in common vnth the first huge peasant pictures painted in Germany by Count Kalokreuth. One painter there is, however, who is quite independent and wholly Portuguese, a worthy successor of the great old masters of his native land, and this is Columbano, whose portraits of actors have a spark of the genius which inspired the works of Velasquez and Goya. (e. me.)

Denmaek.

Denmark resembles Holland in this : that in both, nature presents little luxury of emphasized colour or accentuated majesty of form. Broad flats are everywhere to be seen ❓❓❓ vague, almost indefinable, in outline. Danish art is as demure and staid as the Danish landscape. As in Holland, the painters make no bold experiments, attempt no pretentious subjects, no rich colouring, nothing sportive or light. Like the Dutch, the Danes are some- what sluggishly tranquil, loving dim twilight and the swirling mist. But Denmark is a leaner land than Holland, less moist and more thinly inhabited, so that its art lacks the comfortable self-satisfied character of Dutch art. It betrays rather a tremulous longing, a pleasing melancholy and delight in dreams, a trembling dread of contact with coarse and stern reality. It was only for a time, early in the ‘seventies, that a touch of cosmo- politanism afiected Danish art. The phase of grandiose historical painting and anecdotic genre was experienced there, as in every other country. In Karl Bloch (b. 1834), Denmark had a historical painter in some respects parallel with the German Piloty; in Axel Helsted (b. 1847), a genre painter reminding us of Ludwig Knaus. The two artists Laurits Tuxen (b. 1853) and Peter Kroyer (b. 1851), who are most nearly allied to Manet and Bastien-Lepage, have a sort of elegance that is almost Parisian. Kroyer, especially, has bold inventiveness and amazing skill. Open-air efiects and twilight moods, the glare of sunshine and artificial

light, he has painted vdth equal mastery. In portraiture, too, he stands alone. The two large pictures in which he recorded a " Meeting of the Committee of the Copenhagen Exhibition, 1887," and a " Meeting of the Copenhagen Academy of Sciences," are modern works which in power of expression may almost compare with those of Frans Hals. Such versatility and facile elegance are to be found in no other Danish painter. At the period of historic painting it was significant that next to Bloch, the cosmopolitan, came Kristian Zahrtmann (b. 1843), who painted scenes from the life of Eleonora Christina, a Danish heroine (daughter of Christian IV.), with the utmost simplicity, and without any emotional or theatrical pathos. This touching feeling for home and country is the keynote of Danish art. The Dane has now no senti- ment but that of home ; his country, once so powerful, has become but a small one, and has lost its political im- portance. Hence he clings to the little that is left to him with melancholy tenderness. Viggo Johansen (b. 1851), with his gentle dreaminess, is the best representative of modern Danish home-life. He shows us dark sitting- rooms, where a quiet party has met around the tea-table. "An Evening at Home," "The Christmas Tree," "Grand- mother's Birthday," are typical subjects, and all have the same fresh and fragrant charm. He is also one of

the best Danish landscape painters. The silvery atmo- sphere and sad, mysterious stillness of the island-realm rest on Johansen's pictures. Not less satisfactory in their little world are the rest: Holsoe (b. 1866), Lauritz Pang (b. 1854), Haslund, Syberg (b. 1862), Irminger (b. 1850), and listed paint the pleasant life of Copenhagen. In Skagen, a fishing town at the extreme end of Jutland, we find painters of sea life : Michael Ancher (b. 1849), Anna Ancher (b. 1859), and C. Locher (b. 1851). The landscape painters Viggo Pedersen (b. 1854), Phihpsen (b. 1840), Julius Paulsen (b. 1860), Johan Kohde (b. 1856) have made their home in the villages round Copenhagen. Each has his own individuality and sees nature with his own eyes, and yet in all we fiiid the same sober tone, the same gentle, tearful melancholy. The new Idealism has, however, been discernible in Denmark. Joakim Skov- gaard (b. 1856), with his "Christ among the Dead" and "Pool of Bethesda," is trpng to endow Denmark with a monumental type of art. Harald Slott-MoUer (b. 1864) and J. F. Willumsen (b. 1863) affect a highly symbolical style. But even more than

these painters, who aim at repro- ducing ancient folk-tales through the medium of modem mysticism, two others claim our attention, by the infusion into the old tradition of a very modern view of beauty approaching that of Whistler and of Carrifere : one is Ejnar Nielsen, whose portraits have a peculiar, refined strain of gentle Danish melancholy; the other, V. Ham- mershoj, who has an exquisite sense of tone, and paints the magical efiect of light in half-darkened rooms. Among the more noteworthy portrait painters, Aug. Jerndorff and Otto Bache should be included ; and among the more decorative artists, L. Frolioh. Hans Tegner is the greatest illustrator of the day. (e. mb.)

Sweden.

There is as great a difference between Danish and Swedish art as between Copenhagen and Stockholm. Copenhagen is a homely provincial town, and life is confined to home circles. In Stockholm we find the whirl of Ufe and all the elegance of a capital. It has been styled the Paris of the North, and its art also wears this cosmopolitan aspect. Diisseldorf, where in the 'sixties most painters studied their art, appeared to latter-day artists too provLnciaL Munich and, to a still greater extent, Paris became their "Alma Mater." Salmson (1843-1894) and Hagborg (b. 1852), who were first initiated into naturalism in Paris, adopted this city for a domicile. They paint the fishermen of Brittany and the peasants of Picardy ; and even when apparently interpreting Sweden, they only clothe their Parisian models in a Swedish garb. Those who returned to Stockholm turned their Parisian art into a Swedish art, but they have remained cosmopolitan until this day. Whilst there is something prosy and homely about Danish art, that of Sweden displays nervous elegance and cosmo- politan polish. Simplicity is in her eyes humdrum ; she prefers hght and brilliant notes. There, a naturalness and simplicity allow us to forget the difficulties of the brush : here, we chiefly receive the impression of a cleverly solved problem. There, the greatest moderation in colour, a soft all-pervading grey : here, a cunning play with delicate tones and gradations ❓❓❓a striving to render the most difla- cult effects of light with obedient hand. This tendency is particularly marked in the case of the landscape painters : Per Ekstr(5m (b. 1844), Niels Kreuger (b. 1858), Karl Nord- strom (b. 1865), Prince Eugen (of Sweden, b. 1855), Axel Sj6berg_Wallander (b.

1862), and Wahlberg (b. 1864). Nature in Sweden has not the idyllic softness, the veiled elegiac character, it displays in Denmark. It is more coquettish, southern, and French, and the painters regard it also vrith French eyes.

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As a painter of animals, Bruno Liljefors (b. 1860) created a sensation by his surprising pictures. Whatever his subjects ??? quails, capercailzies, dogs, hares, magpies, or thrushes ??? he has caught the ileetest motions and the most transitory effects of light with the cleverness of a Japanese. With this exception, the Swedish painters cannot be classified according to "subjects." They are "virtuosi," calling every technical aspect of art their own ??? as well in fresco as in portrait painting. Oscar Bj6rek (b. 1860), Ernst Josephson (b. 1851), Georg Pauli (b. 1855), Eichard Bergh (b. 1858), Hanna Hirsch (now Pauli, b. 1864), are the best-known names. Carl Larsson's (b. 1853) decorative ^a^t- neaux fascinate by their easy lightness and coquettish grace of execution. Ander Zorn (b. 1860), with his dazzling virtuosity, is as typical of Swedish as the prosaic sim- phcity of Johansen is of Danish art. His marine pictures, with their undulating waves and naked forms bathed in light, belong to the most surprising examples of the clever- ness with which modern art can stereotype quivering motions ; and the same boldness in handling his subjects, which triumphs over difficulties, makes his " interiors," his portraits and etchings, objects of admiration to every painter's eye. In his " Dance before the Window " all is vivacity and motion. His portrait of a " Peasant Woman " is a powerful harmony of sparkling yellow-red tones of colour. Besides these older masters who cleave to the most dazzling hght effects, there are the younger artists of the school of Carl Larsson, who aspire more to decorative effects on a grander scale. Gustav Fjalstad (b. 1868) ex- hibited a picture in the Paris Exhibition of 1900 that stood out like mosaic among its surroundings.

And great similar- ity in method has Hermann Nermann, who, as a landscape painter, also imitates the classic style. (e. me.)

Norway.

We enter a new world when in picture galleries we pass to the Norwegian from the Swedish section. From the great city we are transported to nature, solemn and solitary, into a land of silence, where a rude, sparse population, a race of fishermen, snatches a scanty sustenance from the sea. The Norwegians also contributed for a time to the international market in works of art. They sent mainly genre pictures telling of the manners and customs of their country, or landscapes depicting the phenomena of Northern scenery. Adolf Tidemand (1814-1876) introduced his countrymen ??? the peasants and fishermen of the Northern coast ??? to the European public. We are introduced to Norwegian Christmas customs, accompany the Norse- man on his nocturnal fishing expeditions, join the " Brude- fserd " across the Hardanger fjord, sit as disciples at the feet of the Norwegian sacristan. Ferdinand Fagerlin (b. 1825) and Hans Dahl are two other painters who, educated at Diisseldorf and settled in Germany, introduced the style of Knaus and Vautier to Norwegian art circles. Knud Badde (1808-1879), Hans Gude (b. 1825), Niels Bjornsen MoUer, ilorten-Miiller (b. 1828), Ludvig Munthe (184.3-1896), and Adelsten Normann (b. 1848) are known as excellent landscape painters, who have faithfully portrayed the majestic mountain scenery and black pine forests of their native land, the cliffs that enclose the fjords, and the sparkling snowfields of the land of the mid- night sun. But the time when actuality had to be well seasoned, and every picture was bound to have a spice of genre or the attraction of something out of the common to make it palatable, is past and gone. As early as the 'sixties Bjornsen was president of a Norwegian society which made it its chief business to wage war against the shallow conventionalities of the Diisseldorf school. Ibsen was vice- president. In the works of the more modern artists there is not a single trace of Diisseldorf influence. Especially in

the 'eighties, when naturalism was at its zenith, we find the Norwegians its boldest devotees. They portrayed life as they found it, without

embellishment ; they did not trouble about plastic elegance, but painted the land of their home and its people in a direct, rough-hewn style. Like the people we meet in the North, giants with stalwart iron frames, callous hands, and sunburnt faces, with their sou'~~westers and blue blouses, who resemble sons of a by~~ gone heroic age, have the painters themselves ??? notably Niels Gustav Wentzel (b. 1859),Svend Jorgensen (b. 1861), Kolstoe (b. 1860), Christian Krohg ??? something primitive in the directness, in, one might almost say, the barbarous brutality with which they approach their subjects. They preferred the most glaring effects of plein-air; they revelled in all the hues of the rainbow.

But these very uncouth fellows, who treated the figures in their pictures with such rough directness, painted even in those days landscapes with great refinement ; not the midnight sun and the precipitous chffs of the fjords, by which foreigners were sought to be impressed, but austere, simple nature, as it lies in deathlike and spectral repose ??? lonely meres, whose surface is unruffled by the keel of any boat, where no human being is visible, where no sound is audible ; the hour of twilight, when the sun has dis- appeared behind the mountains, and all is chill and drear ; the vsinter, when an icy blast sweeps over the crisp snow- fields ; the spring, almost like winter, with its bare branches and its thin young shoots. Such were their themes, and painters like Amaldus Nilsen (b. 1838), Eilif Petersen (b. 1852), Christian Skredsvig (b. 1854), Fritz Thaulow (b. 1848), and Gerhard Munthe (b. 1849) arrested public attention by their exhibition of pictures of this character.

Latterly these painters have become more civilized, and have emancipated themselves from their early uncouth- ness. Jorgensen, Krohg, Kolstoe, Soot, Gustav Wentzel, no longer paint those herculean sailors and fishermen, those pictures of giants that formerly gave to Norwegian exhibitions their peculiar character. Elegance has taken possession of the Norwegian palette. This transformation began with Fritz Thaulow, and indeed his art threatened to relapse somewhat into routine, and even the ripples of his waters to sparkle somewhat coquettishly. Borgen (b. 1852), Hennig (b. 1871), Hjerlow (b. 1863), and Stenersen (b. 1862) were gifted recruits of the ranks of Norwegian painters, whilst Halfdan Strom (b. 1863), who depicts raj's of light issuing from sUent windows and

streaming and quivering over solitary landscapes, dark blue streams and ponds, nocturnal skies, variegated female dresses, contrasting as spots of colour with dark green meadows, has a delicacy in colouring that recalls Cazin. Gerhard Munthe, who, as we have seen, first made a name by his delicate vernal scenery, has turned his at- tention to the classical side of art ; and, finally, Erik Wer- enskjold (b. 1855), who was also first kno-rni by his land- scapes and scenes of country life, afterwards gained success as an illustrator of Norwegian folk-lore. (e, mr.)

Russia.

Until late in the 19th century modern Eussian painting was unknown to western Europe. AVhat had been seen of it in international exhibitions showed the traditions of primitive European art, with a distinct vein of barbarism. In the early 'fifties, painters were less bent on art than on political agitation ; they- used the brush as a means of propaganda in favour of some political idea. Peroff showed us the miserable condition of the serfs, the waste- fulness and profligacy of the nobility. Vereschagin made himself the advocate of the soldier, painting the horrors of war long before the Tsar's manifesto preached uni- versal disarmament. Art suffered from this praiseworthy

misapplication ; many pictures were painted, but very few rose to tlie level of modern achievement in point of technique. It was only by the St Petersburg art journal Mir Iskustwa, and by a small exhibition arranged at Munich in 1892 by a group of Kussian landscape painters, that it was realized that a younger Russian school had arisen, fully equipped with the methods of modern technique, and depicting Eussian Ufe with the stamp of individuality. At the Paris Exhibition of 1900 the pro- ductions of this young Eussian school were seen with surprise. A florescence similar to that which literature displayed in Pushkin, Dostoiefsky, and Tolstoy seemed to be beginning for Russian painting. Some of these young painters rushed into art with unbridled zest, painting with primitive force and boldness. They produced historical pictures, almost barbaric but of striking force ; repre- sentations of the life of the people fuU of deep and hopeless gloom ; the poor driven by the police and huddled together in

dull indifference ; the popes tramping across the lonely steppes, prayer-book in hand ; peasants mutter- ing prayers before a crucifix. There is great pathos in ” The Karamasow Brothers,” or ” The Power of Darkness.” At the same time we feel that a long-inherited tradition pervades all Russia. We find a characteristic ecclesiastical art, far removed from the productions of the fin de siecle, in which the rigid tradition of the Byzantines of the 3rd century still survives. And, finally, there are landscapes almost Danish in their bloodless, dreamy tenderness. Among the historical painters Elias Eepin is the most impressive. In his pictures, “Ivan the Cruel,” “The Cossacks’ Reply to the Sultan,” and “The Miracle of Saint Nicholas,” may be seen ❓❓❓what is so rare in his- torical painting ❓❓❓genuine purpose and style. Terror is rendered with Shakespearean power; the boldness with which he has reconstituted the past, and the power of pictorial psychology which has enabled him to give new life to his figures, are equally striking in ” Sowing on the Volga” and “The Village Procession.” He was the first to paint subjects of contemporary Ufe, and the work, while thoroughly Russian, has high technical qualities ❓❓❓the sense of oppression, subjection, and gloom is all- pervading. But he does not ” point the moral,” as Peroff did ; he paints simply but sympathetically what he sees, and this lends his pictures something of the resigned melancholy of Russian songs. Even more impressive than Repin is Philippe Maliavine. He has rendered peasants, stalwart figures of powerful build and, in a picture called ” Laughter,” Macbeth-like women, wrapped in rags of fiery red, are throvra on the canvas with astonishing power. Among religious painters Victor Vasnezoff, the powerful decorator of the dome in the church of St Vladimir at KiefF, is the most distinguished figure. These paintings seem to have been executed in the very spirit of the Russian Church ; blazing with gold, they depend for much of their effect upon barbaric splendour. But Vasnezoff’ has painted other things : “The Scythians,” fighting with lance and battle-axe j horsemen making their way across the pathless steppe; and woods and landscapes pervaded by romantic charm, the home of the spirits of Russian legend. Next to Vasnezoff is Michael Nesteroff, a painter also of monks and saints, but as different from him as Zurbaran from the mosaic workers of Venice; and Valentin Seroff, powerful in portraiture and fascinating in his landscape. It is to be remarked that

although these artists are austere and unpolished in their figure-painting, they paint landscape with delicate refinement.

Schischkin and VassiHeff were the first to paint their native land in aU simplicity, and it is in landscape that Russian art at the present time still shows its most

pleasing work. Savrassoff depicts tender spring effects ; Kuindshi light birch – copses full of quivering light ; Sudkovski interprets the solemn majesty of the sea ; Albert Benois paints in water-colour delicate Finnish scenery; ApoUinaris Vasnezoff has recorded the dismal wastes of Siberia, its dark plains and endless primeval forest, with powerful simplicity.

A special province in Russian art must be assigned to the Poles. It is difficult indeed to share to the full the admiration felt in Warsaw for the Pohsh painters. It is there firmly believed that Poland has a school of its own, owing nothing to Russia, Austria, or Germany ; an art which embodies all the chivalry and all the suffering of that land. The accessories are Polish, and so are the cos- tumes. Jan Chelminski, Wojcliech Gerson, Constantino Gorski, Apolonius Kendzrierski, Joseph Eyszkievicz, and Roman Szvoinicki are the principal artists. We see in their pictures a' great deal of fighting, a great deal of weeping ; but what there is peculiar to the Poles in the ex- pression or technique of their works it is hard to discover.

Finland, on the other hand, is thoroughly modern. Belonging by descent to Sweden rather than to Russia, its painters' views of art also resemble those of the "Parisians of the North." They display no ungoverned power, but rather supple elegance. The play of light and the caprice of sunshine are rendered with much subtlety. Albert Edelf eldt is the most versatile artist of the group ; Axel Gallen, at first naturalistic, developed into a decorative artist of fine style ; Eero Jaemefelt charms vidth his airy studies and brilliant landscapes. Magnus Enckell, Pekka Halonen, and Victor Vesterholm sustain the school with work remarkable for sober and tasteful feehng. (e. me.)

Balkan States.

Until quite recent times the Balkan States had no part at aU in the history of art. But at the Paris Exhibition of 1900 it was noted with surprise that even in south- eastern Europe there was a certain pulsation of new life. And there were also signs that painting in the Balkans, which thitherto had appeared only as a reflex of Paris and Munich art, would ere long assume a definite national character. At this Exhibition Bulgaria seemed to be the most backward of all, its painters still representing the manners and customs of their country in the style of the illustrated papers. Market-places are seen, where women with golden chains, half-nude boys, and old Jews are moving about; or cemeteries, with orthodox clergy praying and women sobbing ; military pageants, wine harvests, and horse fairs, old men performing the national dance, and topers jesting with brown-eyed girls. Such are the subjects that Anton Mittoff, Eaymund Ubich, and Jaroslav Vesin paint. More original is Mvkuicka. In his most important work he represented the late princess of Bulgaria sitting on a throne, solemn and stately, in the background mosaics rich in gold, tall slim lilies at her side. In his other pictures he painted Biblical landscapes, battlefields wrapped in sulphurous smoke, and old Rabbis ??? all with a certain uncouth barbaric power. The Bul- garian painters have not as yet arrived at the aesthetic phase. One of the best among them, who paints delicate pale green landscapes, is Charalampi Ilieff; and Nicholas Michailoff, who lives at Munich, has executed pictures, representing n5rmphs, that arrest attention by their delicate tone and their beautiful colouring.

Quite modern was the effect of the small Croatian- Slavonic Gallery in the Exhibition. Looking at the pictures there, the visitor might imagine himself on the banks of the Seine rather than in the East. The French saying, " Faire des Whistler, faire des Dagnan, faire des Carriere," is eminently applicable to their work. Vlaho

[united states

Bukovak, Nicola Masic, Csiks, and Medovic all paint very modern pictures, and in excellent taste, only it is surpris- ing to find upon them Croatian and not Parisian signatures.

Precisely the same judgment must be passed with re- gard to Eumania. Most of the painters live in Paris or Munich, have sought their inspiration at the feet of the advanced masters there, and paint, as pupils of these masters, pictures just as good in taste, just as cosmopolitan and equally devoid of character. Irene Deschly, a pupil of Carriere, illustrates the songs of Francois Copp^e ; Verona Gargouromin is devoted to the pale symbohsm of Dagnan- Bouveret. Nicolas Grant paints bright landscapes, with apple trees with their pink blossoms, like Darnoye. Nicolas Gropeano appears as the double of Aman-Jean, with his female heads and pictures from fairy tales. Olga Koruca studied under Puvis de Chavannes, and painted Cleopatra quite in the tone of her master. A landscape by A. Segall was the only work that appeared to be really Eumanian, representing thatched huts.

Servia is in striking contrast to Eumania. No trace of modem influence has penetrated to her. There historical painting, such as was in vogue in France and Germany a generation ago, is the order of the day. Eisto Voucano- vitch paints his scenes from Servian history in brown ; Paul Ivanovitch his in greyish plein-air. But in spite of this paU painting, the latter's works have no modern effect ??? as little as the sharply-drawn small landscapes of his brother Svatislav Ivanovitch. (e. me.)

United States.

The history of painting in the United States is almost entirely a 19th-century record. The earlier years of the nation were devoted to establishing government, subduing the land and the aborigines, building a commonwealth out of primeval nature ; and naturally enough the aesthetic things of life received not too much consideration. In Colonial times the graphic arts existed, to be sure, but in a feeble way. Painting was made up of portraits of pro- minent people ; only an occasional artist was disposed to- wards historical pictures ; but the total result added little

to the sum of art or to the tale of history. The first artist of importance was J. S. Copley (1737-1815), with whom painting in America really began. Benjamin West (1738- 1820) belongs in the same period, though he spent most of his life in England, and finally became President of the Royal Academy. As a painter he is not to be ranked so high as Copley. In the early part of the 19th century two men, John Trumbull (1756-1843), a historical painter of importance, and Gilbert Stuart (1755-1828), a pre-eminent portrait painter, were the leaders ; and after them came John Vanderlyn (1776-1852), Washington Allston (1779- 1843), Eembrandt Peale (1787-1860), J. W. Jarvis (1780- 1834), Thomas Sully (born in England, 1783-1872)[illegible] *men of importance in their day. The style of all this early art was modelled upon that of the British school, and indeed most of the men had studied in England under the master- ship of West, Lawrence, and others. The middle or second period of painting in the United States began vrith the landscape work of Thomas Doughty (1793-1856) and Thomas Cole (1801-1848). It was not a refined or cul- tivated work, for the men were in great measure self- taught, but at least it was original and distinctly American. In subject and in spirit it was perhaps too panoramic and pompous; but in the hands of A. B. Durand (1796-1886), J. P. Kensett (1818-1872), and F. E. Church (1826-1900), it was modified in scale and improved in technique.*

A group of painters called the Hudson Eiver school finally emerged. To this school some of the strongest landscape painters in the United States owe their inspira- tion, though in almost every case there has been the

modifying influence of foreign study. Contemporary with Cole came the portrait painters Chester Harding (1792-1866), C. L. Elliott (1812-1868), Henry Inman (1801-1846), William Page (1811-1885), G. P. A. Healy (1813-1894), Daniel Huntington, and W. S. Mount (1807-1868), one of the earliest genre painters. Foreign art had been followed to good advantage by most of these painters, and as a result some excellent portraits were pro- duced. The excellence of the work was not, however, appreciated by the public generally, because art knowledge was not at that time a pubUc possession. Little was required of the portrait painter beyond a recognizable likeness. A little later the teachings of the Diisseldorf school began to have an influence upon American art through

Leutze (1816-1868), who was a German pupil of Lessing, and went to America to paint historical scenes from the Eevolutionary War. But the foreign influence of the time to make the most impression came from France in 1855 with two American pupils of Couture ??? W. M. Hunt (1824-1879) and Thomas Hicks (1823-1890). Hunt had also been a pupil of Millet at Barbizon, and was the real introducer of the Barbizon painters to the American people. After his return to Boston his teaching and example had much weight in moulding artistic opinion. He, more than any other, turned the rising generation of painters towards the Paris schools. Contemporary with Hunt and following him were a number of painters, some self-taught and some schooled in Europe, who brought American art to a high standard of excellence. George Fuller (1822-84), Eastman Johnson, Elihu Vedder, produced work of much merit ; and John La Farge and Winslow Homer were unquestionably in 1902 the fore- most painters in the United States. In landscape the three strongest men have passed away ??? A. H. Wyant, George Inness, and Homer Martin. Swain Gifford, Edward Gay, Thomas Moran, Jervis McEntee, Albert Bierstadt, are other landscape painters of note who belonged to the middle period and reflected the traditions of the Hudson Eiver school to some extent. With the Centennial Exhi- bition at Philadelphia in 1876 a widespread and momentous movement in American art began to shape itself. The dis- play of pictures at Philadelphia, the national prosperity, and the sudden development of the wealth of the United States had doubtless much to do with it. ilany young men from all parts of the country took up the study of art and began going abroad for instruction in the schools at Munich, and, later, at Paris. Before 1880 some of them had returned to the United States and founded schools and societies of art, like the Art Students' League and the Society of American Artists. The movement spread to the Western cities, and in a few years museums and art schools began to appear in all the prominent towns, and a national interest in art was awakened. After 1870 the predominant influence, as regards technical training, was French. Many students still go to Paris to complete their studies, though there is a large body of accom- plished painters teaching in the home schools, with satis- factory results as regards the work of their pupils. From their French training, many of the American artists have been charged with echoing Parisian art; and the charge is partly true. They have accepted French methods because they

think them the best, but their subjects and motives are sufficiently original.

Among the "younger element " in American art are W. M. Chase, for many years President of the Society of American Artists, Walter Shirlaw, T. W. Dewing, Kenyon Cox, Abbott Thayer, Robert Blum, J. C. Beckwith, G. W. May- nard, E. E. Simmons, W. H. Low, Robert Eeid, Wilton Lockwood, C. Y. Turner, H. S. Mowbray, J. W. Alexander, Irving Wiles, E. E. Blashfield, J. JtleClure Hamilton

painters who have done very good work in portraiture, in easel pictures, and in wall paintings. The most completely indigenous art yet produced in America has been in the field of landscape painting. In spite of the example of the famous Fontainebleau painters, the Americans have chosen the material of their own country and pictured it with fine atmospheric and colour effects, and no little sentiment. Men like D. W. Tryon, C. A. Piatt, Alden Weir, J. H. Twachtman, Theodore Eobinson, Childe Hassam, Horatio Walker, have received some inspiration from such French painters as Daubigny, Bastien-Lepage, and Monet, but no more than every painter receives from his master. Besides the painters who reside in the United States, there is a large contingent of Americans resident abroad which perhaps belongs to the American school as much as to any other. These painters do not, however, represent the land or the people to the extent usually assumed by Europeans. Indeed, it is questionable if they represent America in any way. James McNeill Whistler, though American-born, is an example of the modern man without a country. No nation can claim him as an artist, because he seems to have no nationality. E. A. Abbey, John S. Sargent, Mark Fisher, and J. J. Shannon are American only by birth. They are resident in London and are cosmopolitan in their methods and themes. This may be said with equal truth of many painters resident in Paris and elsewhere on the Continent. However good as art it may be, there is nothing distinctively American about the work of W. T. Dannat, Alexander Harrison, George Hitchcock, Gari Melchers, C. S. Pearce, E. L. Weeks, J.

L. Stewart, and Walter Gay. If they owe allegiance to any centre or city, it is to Paris rather than to New York. During the last quarter of the 1 9th century much effort and money were devoted to the establishment of institutions like the Metropolitan Museum in New York, the Carnegie Museum at Pittsburg, and the Art Institute in Chicago. Every city of importance in the United States has its gallery of paintings. Schools of technical training and societies of artists likewise exist wherever there are important galleries. Exhibitions during the winter season and at great national expositions, like the World's Fair at Chicago and the Pan-American Exhibition at Buffalo, give abundant opportunity for rising talent to display itself; and, in addition, there is a growing public patronage of painting, as shown by the extensive mural decorations in the Con- gressional Library building at Washington, in the Boston Public Library, in many colleges and churches, in courts of justice, in the reception-rooms of large hotels, in theatres and elsewhere. All these educational influences are being felt by the people, and there is an increasing appreciation of painting that augurs well for the future. (j. c. van d.)

Schorla.U, or Tchoelau, chief town of a sanjak in the vilayet of Kodosto, European Turkey, situated on an eminence on the right bank of a small tributary of the Erghene, and about 2 miles from the station on the Con-stantinople-Adrianople Eailway, 20 miles north-east of Kodosto. It possesses three mosques and several Christian churches. It has manufactures of woollen cloth {chayah) and native carpets, and exports cereals, oil-cloth, carpets, cattle, poultry, fresh meat, game, fruits, vdne, alcohol, hides, and bones. Population, 11,500, of whom about one-half are Greeks, one-third Turks, and the remainder Armenians and Jews.

SchOUValofF. See Shuvaiov.

Schulze-Delitzsch, Franz Hermann

(1808-1883), German economist, was born at Delitzsch, 29th August 1808. The place-name Delitzsch was added in 1848 to distinguish him from other Schulzes in the National Assembly. At the age of thirteen he was sent

to the NLkolaischule at Leipzig ; he proceeded to that uni- versity in 1827, and to Halle in 1829. Devoting himself to the study of law, he became at thirty years of age an assessor in the court of justice at Berlin, and three years later was appointed patrimonialrichter at Delitzsch. Entering the Parliament of 1848, he joined the Left Centre, and, acting as president of the Commission of Inquiry into the Condition of the Labourers and Artisans, became im- pressed with the necessity of co-operation to enalale the smaller tradespeople to hold their own against the capitalists. He was a member of the Second Chamber in 1848-49 ; but as matters ceased to run smoothly between himself and the high legal officials, he threw up his public appointments in October 1851, and withdrew to Delitzsch. Here he devoted all his efforts to the organization and development of co-operation in Germany, and to the foundation of Vorschuss- vereine (people's banks), of which he had established the first at Delitzsch in 1850. These developed so rapidly that Schulze-Delitzsch in 1858, in Die Arbeitenden Klassen und das Assoziationswesen in Deutschland, enumerated twenty- five as already in existence. In 1859 he promoted the first Genossensehaftstag, or co-operative meeting, in Weimar, and founded a central bureau of co-operative societies. In 1861 he again entered the Prussian Chamber, and became a prominent member of the Progressist party. In 1863 he devoted the chief portion of a testimonial, amounting to 150,000 marks, to the maintenance of his co-operative institutions and ofiices. This, however, was only to meet an exceptional outlay, for he always insisted that they must be self-supporting, and refused repeated offers of pecuniary aid. The next three or four years were given to the formation of local centres, and the establishment of the Deutsche Genossenschafts-Bank, 1865.

The spread of these organizations naturally led to legisla- tion on the subject, and this too was chiefly the work of Schulze-Delitzsch. As a member of the Chamber in 1867 he was mainly instrumental in passing the Prussian law of association, which was extended to the North German Confederation in 1868, and later to the Empire. Schulze- Delitzsch also contributed to uniformity of legislation throughout the states of Germany, in 1869, by the publica- tion of Die Gesetzgebung iiber die privatrechtlicke Stellung des Erwerbs- v,nd Wirthschaftsgenossenschaften, &c. His Kf e-work was now complete ;

and following the central idea of the inonts de pi4t4, he had placed the advantages of capital and co-operation within the reach of strugghng tradesmen throughout Germany. His remaining years were spent in consolidating this work Both as a writer and a member of the Eeichstag, his industry was incessant, and he died in harness on the 29th April 1883 at Potsdam, leaving the reputation of a benefactor to the smaller tradesmen and artisans, in which light he must be regarded rather than as the founder of true co-operative principles in Germany.

(g. f. b.)

Schumann, Clara Josephine (1819-

1896), German pianist, daughter of the distinguished pianoforte teacher Friedrich Wieck, was born at Leipzig, 13th September 1819. She was taught the piano by her father from her fifth year, and first appeared in public in 1828, obtaining the honour of an appearance at the famous Gewandhaus Concerts as early as 1832, when she played a concerto by Moscheles. Before this she had made a tour to Weimar, Cassel, Frankfort, and Paris, making a great success wherever she was heard. Her powers as a composer were already dawning, and a theme and varia- tions of her own appeared in some of her earliest pro- grammes. A performance of Bach's triple concerto with Mendelssohn and Kakemann in November 1832 marked her definite entry into the world of the highest music, and thenceforward she devoted herself to the interpretation of

the classical composers. In 1836 she visited Vienna, and it was about this time that she aroused the admiration of Eobert Schumann, to whom, after many delays and troubles of all kinds, arising from the opposition of her parents to the match, she was married on 12th September 1840. From this time forth she undertook the difficult task of compelling the public to understand Schumann's music, and she succeeded in winning for it the admiration of all cultivated musicians in the various countries where she played. Her first visit to England took place in 1856, two years after her

husband's insanity had declared itself in an attempt at suicide. The leading critics of the day set themselves in violent opposition to Schumann's music, and although they accepted her as a great pianist, her reception was so far from enthusiastic that she did not pay London a second visit until 1865 ; but after that time her visits were annual until 1882, with the exception of some four seasons. From 1885 to 1888 she regularly appeared each year in London, arousing more and more enthusiasm. In 1878 she was appointed teacher of the piano at the Hoch Conservatorium at Frankfort, and held the post until 1892, when she was compelled to retire owing to a distressing affection of the auditory nerve, but from this she recovered almost completely, and her death on 20th jMay 1896 was almost unexpected. Her most prom- inent qualities as a pianist were the wonderful sympathy with which she interpreted nearly all schools of music, her mastery of tone-gradation, and her entire concealment of all manual effort. As a composer her work is worthy to "be remembered, quite apart from her playing. Her com- positions are mainly for the piano, and have individuality and charm, while her few songs are exquisitely expressive. She edited her husband's works for Breitkopf and Haertel, and wrote cadenzas to two of Beethoven's concertos, in addition to her original compositions. (j. a. p. m.)

Schu rz, Carl (1829), American statesman

and reformer, was born in Liblar, near Cologne, Germany, on 2nd March 1829. At the age of twenty he left the uni- versity of Bonn to join the revolutionary movement in South Germany, and in consequence was obliged to flee the country. After a short stay in England he went to the United States in 1852. Engaging in the practice of law and journalism in Wisconsin, he soon attained prominence as a Eepublican politician. In 1861 he was appointed minister to Spain, but soon resigned to join the Union army, in which he rose to the rank of major-general of volunteers. After the war he resumed editorial work at St Louis, and became United States senator from Missouri 1869-75. In 1872 he was conspicuous in the Liberal RepubKcan (anti-Grant) movement, presiding at the National Convention. During the Hayes administration he was secretary of the interior (1877-81), and at its close removed to New York City, where he ever afterwards resided. As editorial writer on the New York Evening Post

(1881-84) and Harper's Weekly (1892-98), and in other literary enterprises, he vigorously promoted the ideas through which Mr Cleveland was twice elected to the Presidency. With the cause of administrative reform he was peculiarly identified, serving continuously as president of the Civil Service Reform Association since 1893. Mr Schurz's books on Henry Clay and Abraham Lincoln are of considerable merit.

Schwabach, a town of Bavaria, district of Middle Franconia, Germany, 9 miles by rail south of Nuremberg. It possesses an interesting parish church (1469-95), with an altar-piece (1506) by Veit Stoss, and paintings and carved work by Wohlgemut, Martin Schon, and others, and a lofty pyx by Adam Krafi't; also a fountain (1716), a Jewish theological school, and a teachers' seminary. It is a chief seat of the needle manufacture in Bavaria. Gold and

silver wire work, haberdashery, and brevidng are the prin- cipal industries. The Schwabacher Articles of 1529, drawn up by Luther, formed the foundation of the Augsburg Confession. Population (1900), 9385.

Schwarzburg'-Rudolstadt, a principality of Germany,. one of the Thuringian states, with an area of 363 square miles, and a population (1885), 83,836 ; (1900), 92,657; giving a density of 255 inhabitants to the square mile. In 1900, 45,082 of the inhabitants were males and 47,575 females ; and nearly the whole were Evangelical Lutherans. Agriculture supports 27,195 persons, or 30 '6 per cent, of the population. The number of farms in 1895 was 13,264, of which 12,258 were each less than 25 acres in extent, 986 were between 25 and 250 acres each, and 20 exceeded 250 acres. In 1900 the number of pigs was 31,877 ; of sheep, 23,562 ; of cattle, 22,152; and of horses, 3505. For the period 1900-02 the annual state revenue and expenditure were estimated to balance at ^ ►►1 04,840; nearly one-half of the revenue is derived from domains and state property. There is a public debt of ►►201,530 (1900), and in 1901 the state con- tribution to the imperial exchequer was fixed at ►►46,920.

Schwarzburgf-Sondershausen, a princi- pality of Germany, one of the Thuringian states, with an area of 333 square miles, and population (1885), 73,606; (1900), 80,678; giving a density of 242 inhabitants to the square mile. In 1900, 39,401 of the inhabitants were males and 41,277 females. The people belong almost entirely to the Evangelical Lutheran Church. In 1895 agriculture supported 25,064 persons, or 32 per cent, of the population. The number of farms was 11,787, of which 10,622, or 90‘1 per cent., were each less than 25 acres in extent, 1128 were between 25 and 250 acres, and 37 exceeded 250 acres. In 1900 the live stock consisted of 37,888 sheep, 40,863 pigs, 25,036 cattle, and 4948 horses. In 1900-02 the state revenue and expenditure were each estimated at ––167,000 annually. The public debt amounted in 1899 to ––162,400, and the state con- tribution in 1901 to the imperial exchequer to ––40,825.

Schwaz, a market-place in Tirol, Austria, on the river Inn, 18|- miles north-east of Innsbruck, on the Austrian State Railway. It is dominated by the old chiteau of Freundsburg, and on an adjoining hill is a Benedictine abbey, which was restored after a fire in 1868. There are some old silver, copper, and iron mines in the vicinity, and tobacco, stoneware, hosiery, woollen yarn, and wire are manufactured. Population (1890), 5888; (1900), 6545.

Schwechat,’ a market-place in Lower Austria, about 5 miles south-east of Vienna. It has the largest brewery of the monarchy (with an annual production of about 600,000 hectolitres), together with important smelt- ing and iron works, cotton-spinning, factories of electrical plant, &c. The meeting at Schwechat of the Emperor Leopold I. with Sobieski in 1683 is commemorated by an obelisk. The imperial troops defeated the Hungarian insurgents in a battle fought here in October 1848. Population (1890), 6031 ; (1900), 8241.

Sch weid n itz, a town of Prussia, province of Silesia, 35 miles by rail south-east of Liegnitz. It is the seat of a provincial industrial school, and manufactures woollens and linens, stoves, hosiery, carpets, and millstones in addi- tion to the industries already named in the 9th edition. Population (1885), 23,669 ; (1900), 28,432.

Schweinfurt, a town of Bavaria, district of Lower Franconia, Germany, on the left bank of the Main, 27 miles by rail north-north-east of Wiirzburg. A new classical school was built in 1881 to replace the one founded by Gustavus Adolphus of Sweden in 1631. There are

monuments to Eiickert (1890) and in commemoration of the war of 1870-71, a commercial institute, and a technical school. The industries remain as stated in the 9th edition, except that factories for steel shot and bicycle bearings have been added. Population (1885), 12,502; (1900), 15,295.

Schweinfurth, Georg August (1836-

-), explorer, was born at Eiga, 29th December 1836,

and educated at the universities of Heidelberg, Munich, and Berlin (1856-62), where he particularly devoted him- self to botany and palaeontology. Commissioned to arrange the collections brought from the Sudan by von Barnim and Hartmann, his attention was directed to that region ; and he proceeded thither himself in 1863, when he travelled round the shores of the Ked Sea, passed on to Khartum, and returned to Europe in 1866. His researches attracted so much attention that in 1868 the Humboldt-Stiftung of Berlin entrusted him with an important scientific mission to the interior of East Africa. Starting from Khartum in January 1869, he went up the White Nile to Bahr-el-Ghazal and Dyoor, and then, with a party of ivory dealers, through Dinka, Bongo, and Niam-Niam ; but unfortunately nearly all his collections, sketches, and other belongings were lost in a fire in the camp. He returned in 1871 and published an account of the expedition, under the title of Im Herzen von Afrika, Leipzig, 1874, which also contains interesting notices of the pygmies of Akka. In 1873-74 he accom- panied Rohlfs in his attempt to penetrate into the desert of Libya. Settling at Cairo in 1875, he founded a geograph- ical society, under the auspices of the Khedive, and devoted himself exclusively to African studies, historical and ethno- graphical. In the following year he penetrated into the desert of Arabia with Giissfeldt, and

continued the explora- tion at intervals until 1888, and during the same period made geological and botanical investigations in the neigh- bourhood of Cairo, in the valley of the Nile, &c. Since 1889 he has resided in BerUn ; but he visited the Italian colony of Erithrea in 1891, 1892, and 1894. The accounts of all his travels and researches have appeared either in book form or in periodicals, such as Petermanns Mitteilungen, the Zeitschrift fiir Erdhunde, &,c.

Schwerin, a town of Germany, capital of grand- duchy of Mecklenburg-Schwerin, 129 miles by rail north- west of Berlin and 20 miles south of the Baltic. The town has a fine equestrian statue of the grand-duke Frederick Francis II. (1893), a post office, a ducal library of about 180,000 volumes, a veterinary school, lunatic asylum, military and technical schools, and a "school of pages." Population (1885), 31,528; (1900), 38,667.

Schwerin, a town of Prussia, province of Posen, at the confluence of the Obra and the Warthe, 28 miles by rail east of Kustrin. There are tobacco and other factories. Population (1900), 7316.

Schwerte, a town of Prussia, province of West- phalia, 9 mUes by rail north-east of Hagen. There are iron and nickel works, and it has a Romanesque church, with carved altar of 1523 and 14th and 15th century stained- glass. Population (1895), 9892; (1900), 12,261.

Sch wetz, a town of Prussia, province of West Prussia, 29 miles by rail north-east of Bromberg, on the left bank of the Vistula. There are remains of a castle (1335-41) of the Teutonic Order, three churches, a provincial lunatic asylum, and some tanning and damask weaving. There is also a trade in wool and corn. Population (1900), 7010.

Schwetzing'en, a town of Germany, grand-duchy of Baden, 9 miles by rail south-east of Mannheim. It has a grand-ducal castle (1656, destroyed by the French in 1689, subsequently rebuilt) and gardens laid out in the middle of the 18th century in imitation of those of Versailles. There is a technical school. Cigars, yeast, &c.,

are manufactured, and there is a trade in hops and tobacco. Population (1900), 6417.

SchwiebuS, a town of Prussia, province of Branden- burg, 47 miles east of Frankfort-on-the-Oder by rail. It is still in part surrounded by its mediaeval wall, and has an ancient market-place, a couple of churches, a castle, and an orphanage. Cloth, machinery, and stearine candles are manufactured, and there are flour-mills, breweries, dis- tilleries, and lignite mines. Population (1900), 8659.

Schwyz, one of the Swiss cantons. Its total area is 350‘6 square miles. Of this, 254‘8 square miles are reckoned as “productive,” forests, covering 62 ‘4 square miles, and vineyards 1 ‘1 square mile. The population in 1880 was 51,109, and in 1900, 55,385, or 158 inhabitants to each square mile. The population is almost whoUy Roman Catholic, and also mostly German-speaking, the numbers of Italian-speaking and French-speaking inhabit- ants being quite inconsiderable. The capital is Schwyz, which in 1888 had 6616 inhabitants (in 1900, 7398); its port on the Lake of Lucerne is Brunnen. The largest town in the canton is Einsiedeln, which in 1900 had 8496 inhabitants. There are 6 administrative districts in the canton, comprising 30 “communes.” In 1897 the state revenue was 534,467 francs (a rise of 47|- per cent, since 1885), and the state expenditure 510,210 francs (a rise of 46 per cent, since 1885). The cantonal financial manage- ment is very defective. In 1897 the pubhc debt was 2,960,000 francs. In 1899 there were 417 mountain pastures, or ” alps,” in the canton, supporting 17,492 cows. There ‘ is a railway from Arth-Goldau to the Lake of Zurich, with a branch from Biberbriicke up to Einsiedeln. The cantonal constitution of 1876 was further revised in 1898. The legislature is elected for 4 years by the ” Gemeinden ” in the proportion of one member for each 600 (or fraction over 300) inhabitants. The 7 members of the executive are chosen for 4 years by popular vote in the whole canton. In case of elections to the legislature, it is provided that in each “Gemeinde” that is entitled to elect 3 or more members, the election shall take place according to the principles of proportional representation, the same system as in Zug. The ” obHgatory referendum ” obtains in the case of all laws, and the ” facultative referendum ” at the demand of 2000 citizens as regards resolutions and decrees of the

legislature. It must also be noted that 2000 citizens have the right of ” initiative ” as to the revision of the cantonal constitution, or as to legislative projects.

Atjthokitibs. ⁂ M. Kothing. Das Landiuch v. S. Zurich and Frauenfeld, 1850. ⁂ Meyek voN Enonatt. Der Kanton S. St Gall, 1835. ⁂ Mittheil. d. hist. Vereins d. Kant. S. From 1882. ⁂ Stein- AUEB. Geschichted. FreistaatesS. (1798-1861). 2 vols. Einsiedeln, 1861. ⁂ Stkubt and Schnebbbli. Die Alpwirthschaft im Kant. S. Soleure, 1899. (-w. A. B. C.)

SciaCCa, a seaport town and bishop’s see of Italy, Sicily, province of Girgenti, 30 miles west-north-west of Girgenti. It is the Sicilian headquarters of Mediterranean coral fishing. Dovm to 1888 such large quantities of coral were taken that in the year named fishing was suspended by Government order. It was resumed in 1893, during which and the year following 193 and 183 boats, manned by 2172 and 2205 men respectively, were engaged ; and they brought up 613 and 633 tons of coral, valued at ⁂78,325 and ⁂88,390 respectively. Of these Sciacca sent 73 and 72 boats. The town has manufactures of bricks and pottery, barrels, baskets, and olive oil, and cures fish. In 1897 its port was cleared by 489 vessels of 74,690 tons. Population (1881), 20,709 ; (1899), 23,000.

Scilla, a seaport town of Italy, Calabria, province of Eeggio, 14 miles by rail north by east of Reggio. It stands on a steep cliff overlooking the Strait of Messina, and has a citadel which withstood the French in 1806-08. It was

in great part rebuilt after the earthquake of 1783, and is famous for its silk and wine, and carries on fishing for tunny and sword-fish. It is the ancient Scylla. Popula- tion, about 7000.

Scillitan Martyrs. ❓❓❓ The recovery in their original form of the Acts of the Scillitan Martyrs has given us the earliest documents of the Church of Africa and, it would seem, the earliest specimen of Christian Latin. The martyrs take their name from Scilla (or Scillium), a town in Numidia. Their trial and execution took place in Carthage under the Pro-consul Vigellius Saturninus, whom TertuUian declares to have been the first persecutor of the Christians in Africa. The date of their mart3rrdom is 17th July 180 A.D. It is thus the concluding scene of the persecution under Marcus Aurelius, which is best known from the sufferings of the churches of Vienna and Lyons. The great emperor died on 17th March of the year in question, and persecution ceased almost immediately upon the accession of Commodus. A group of sufferers called the Madaurian martjTS seems to belong to the same period : for in the correspondence of St Augustine, Namphamo, one of their number, is spoken of as "archimartyr," which appears to mean protomartyr of Africa. We have in this martyrdom an excellent example of " Acts of Martyrs " properly so called. The document is in brief legal form, beginning with the date and the names of the accused, and giving the actual dialogue between them and their judge. It closes with the sentence, based on " obstinate " persistency in an illicit cult, and with the proclamation by the herald of the names of the offenders and the penalty. All this may quite well be a transcript of the acta, or official report of the proceedings. A Christian appends the words : " And so they all together were crowned with martyrdom ; and they reign with the Father and the Son and the Holy Ghost, for ever and ever. Amen."

The Scillitan sufierers were twelve in all^ ❓❓❓ seven men and five women. Two of these bear Punic names (Nartzalus, Cintinus), but the rest Latin names. Six had already been tried : of the remainder, to whom these acta primarily relate, Speratus is the principal spokesman. He claims for himself and his companions that they have lived a quiet and moral life, paying their dues and doing no wrong to their neighbours. But when called upon to swear by the genius of the emperor, he replies : "I recognize not the empire of this world ; but rather do I serve that God whom no man hath seen, nor with these eyes can see." Here he uses the language of 1 Tim. vi. 16 ; and it is interesting also to note that in reply to the question, "What are the things in your chest I " he says, " Books and

letters of Paul, a just man." The martyrs are offered a delay of thirty days to reconsider their decision, but this they aU alike refuse. These Acts have been long known in an expanded form, or rather in a variety of later recensions. The fame of the martyrs led to the building of a basilica in their honour at Carthage ; and their annual commemoration required that the brevity

and obscurity of their Acts should be supplemented and explained, to make them suitable for public recitation.

The historical questions connected with these martyrs are treated by Lightfoot, Ignatius (1889, ed. 2), i. 524 ff. The Latin text, together with later recensions and a Greek version, is published in Texts mid Studies, i. 2 (Passion of Perpetua, 1890). The original Latin was published independently about the same time in the Analeeta Bollandiana,, viii. p. 5. (j. a. E.)

Scilly islands, a group belonging to the county of Cornwall, England, 40 miles due west of Lizard Point, and reached by a service of steamers from Penzance. The government of the islands is vested in a county council, distinct from that of Cornwall, formed in 1892, consisting of a president, vice-president, 4 aldermen, and 18 councillors. Telephone and telegraph communication connects with the mainland. The early potato industry has given place largely to the raising of early asparagus and other vegetables, and spring flowers. This trade has increased so considerably that from 200 tons in 1889 it had risen to 515 tons in 1896. There is a coasting trade of about 20,000 tons clearances annually. The area of the principal islands is as follows : ???St Mary's, 1613 acres ; Tresco, 917 acres; St Martin's, 650 acres; St Agnes, 444 acres; and Bryher, about 350 acres. The population of the whole islands (area, 3980 acres) was in 1881, 2320; in 1891, 1911; in 1901, 1974. The population of St Mary's Island was in 1891, 1201; in 1901, 1275. Hugh Town, the capital of the islands, is on St Mary's. Its pier was extended in 1889 at a cost of ??4000, and new public buildings were erected in the same year. In 1882 a new church to St Nicholas was erected on Tresco.

SciO, the classical Chios, an island on the west coast of Asia Minor, forming, with the islands of Ipsara, Nicaria, Leros, Calymnos, and Cos, a

sanjak of the Archipelago vilayet. In 1881 Scio was visited by a very severe earth- quake. Over 5600 persons lost their lives, the villages in the Kampos were destroyed, the monastery bmlt by Con- stantino Monomachus was overthrown, and more than half the villages were seriously damaged. The island has now recovered its prosperity. A harbour has been made at Castro, and steam flour-mills, foundries, and tanneries have been established. Kich antimony and calamine mines are worked by a French undertaking, and good marble is quarried by an Italian company. In 1899 the exports ￿￿￿ gum mastic, fruit, and leather ￿￿￿ amounted to ￿￿247,400, and the imports to ￿￿265,000. The population of the island is 64,000 (Moslem 1000, Greeks 62,750, Jews 250), and of the town 16,000.

Scotland. ￿￿￿ The population at the census of 1891 was 4,026,647 (1,942,717 males and 2,082,930 females), and at the census of 1901, 4,472,000 (2,173,151 p￿￿￿p￿￿￿,a. males and 2,298,849 females). The net increase tion, vital between 1881 and 1891 was 290,074 (143,242 and social males and 146,832 females), or at a rate of 7-8 statistics. per cent., and between 1891 and 1901, 446,353, or at the rate of 11 '09 per cent. The areas (old and amended) and populations of the counties are given under the several headings which deal with them : ￿￿￿

Table l. ￿￿￿Showing Grouping of Population in 1871, 1881, and 1891.

Total Population.

Increase or Decrease.

Percentage to Total Population.

1871.

1881.

1891.

1871 to 1881.

1881 to 1891.

1871.

68-09 11-52 30-39

1881.

1891.

Towns

Villages

Rural districts .

Scotland

1,951,704

386,993

1,021,321

2,306,852 447,884 980,837

2,631,298 465,836 928,513

Actual.

+ 355,148

+ 60,891

-40,484

+ 375,555

Per cent.

+ 18-20

+ 15-73

-3-96

Actual.

+ 324,446

+ 17,952

-52,324

Per cent.

+ 14-06 + 4-01 -5-33

61-75 11-99 26-26

65-37 1 11-57 23 06

3,360,018

3,735,573

4,025,647

+ 11-18

+ 290,074

+ 7-77

100

100

1000

^ The incomplete returns show that in 1901 the town population was 75 per cent, of the whole.

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Calculated according to the corrected area of 1891, the population of 1881 gave about 121 persons to the square

Table II.

<?? Showing Population of Chief Tovms,

1881, 1891, and 1901.

1881.

1891.

1901.

Glasgow .

551,415

565,839 (of enlarged area, 668,198)

780,423

Edinburgh

226,357

261,225 (of enlarged area)

316,479

Dundee

140,239

153,330

160,871

Aberdeen .

105,189

121,623

143,722

Paisley

55,638

66,425

79,366

Leith

59,485

67,700

76,667

Govan

50,492

63,625

76,351

Greenock .

66,704

63,423

67,645

Partiok .

27,410

36,538

54,274

Coatbridge

24,812

30,034

36,981

Kilmarnock

23,901

28,447

34,161

Perth

28,980

29,899

32,872

Hamilton .

18,517

24,859

32,776

Motherwell

12,904

18,736

30,423

mile, instead of 125, as stated in the 9th edition of this work. In 1891 the density worked out at 131 persons to the square mile, and in 1901 at 149. Dumbarton, with 25‘44, showed the largest rise between 1881 and 1891,

owing to the development of its shipbuilding, engineering, and dyeing industries; Linlithgow, with 24‘4, the largest between 1891 and 1901. Decreasing counties were purely agricultural in character ; but Selkirk, owing to contraction of the woollen industry, showed the greatest loss ❓❓❓15 ‘8. Table II. shows the population of the principal towns in Scotland in 1881, 1891, and 1901.

Of the four large towns, Aberdeen, with 22‘9 per cent., increased most rapidly between 1891 and 1901 ; Dundee, with 4 ‘5 per cent., most slowly. The iron town of Motherwell, with 62 ‘5, shows the most phenomenal growth. Table III. shows the increase of popula- tion that should have taken place between 1871 and 1881 and between 1881 and 1891, compared with the actual increase, the grouping being into towns of over 25,000, towns with less than 25,000 and more than 10,000, towns between 10,000 and 2000, and rural districts. Comparison with Table IV. will show to what an extent the actual increase in large towns was due to immigratiou of Irish and English, in addition to immigration from Scottish rural districts : ❓❓❓

Table III. ❓❓❓Showing Increase or Decrease of Pojmlation in 1871, 1881, amd 1891.

Groups,

Population according to Grouping in 1871.

Population according to Grouping in 1881.

Births.

Deaths.

Births.

Deaths.

Increase or Decrease,

1871-81.

Increase or Decrease,

1881-91.

1871.

1881.

1881.

1891.

1871-80.

1871-80.

1881-90.

1881-90.

Actual.

Excess of

Births

over

Deaths.

Actual.

Excess of

Births

over

Deaths.

Principal towns . Large towns Small towns Eural districts

1,193,940 327,734 696,958

1,141,388

1,411,536 388,797 790,796

1,144,444

1,409,260 404,302 784,654

1,137,357

1,590,310 467,642 840,339

1,127,356

429,679 150,095 293,220 361,367

296,285 94,498 171,485 203,200

517,454 146,367 266,277 321,832

330,010 83,966 149,843 179,763

+217,596

+61,063

+93,838

+3,058

+133,394 +65,697 +121,736 +168,157

+181,050 +63,670 +65,686 -10,231

+187,444

+62 401

+116,434

+ 142,069 :

3,360,018

3,735,573

3,736,673

4,025,647

1,234,351

765,468

1,261,930

743,582

+376,556

+468,883

+290 074

+508,348 !

The novel facts to be noted in connexion with the distribution of the population in 1891 are : ??? The rural population, having previously all but ceased to rise, had actually begun to fall. The actual increase and the excess of births over deaths almost balanced one another in the large towns. In the principal towns the tide of immigration would seem to have turned by 1891, the actual increase of the population being 6394 less than the natm'al increase ; whereas in 1881, owing to

immigration, the actual increase over 1871 was 84,202 more than the natural increase. Table IV. shows the nationalities of the people of Scotland in 1881 and 1891, with the nationalities in burghs with a popula- tion of 10,000 and upwards : ???

Table

IV. ??? Illustrating Nationalities in 1881 and 1891.

Nationalities.

Scotland, 1881.

Scotland, 1891.

Burghs, 1891.

Per-

Per-

Per-

Number.

centage of Pop.

Number.

centage of Pop.

Number.

centage of Pop.

Scots

3,397,759

90-96

3,698,700

91-63

1,770,028

88-70

Irish

218,745

5-86

184,807

4-84

135,826

6-81

English .

90,017

2-41

108,736

2-70

67,949

3-40

British

Colonials

12,874

0-34

13,607

0-39

8,671

0-44

British b.

abroad or

at sea

7,024

0-19

8,051

0-20

5,028

0-25

Foreigners

6,399

0-17

8,510

0-21

6,078

0-30

Welsh .

1,806

0-05

2,309

0-06

1,362

0-07

Channel

Islanders

949

0-02

927

0-02

567

0-03

3,735,573

100

4,025,647

100

1,995,511

100

In contradistinction to that of 1881, the census of 1891 showed both an actual and a proportional decrease of non-natives in the population of Scotland. There were 337,814 in 1881 and 336,947 in 1891, the proportions to population being 9-043 and 8-370 respectively, the decline of Irish immigration being the cause of the falling off. Non-natives, however, continued to increase between 1881 and 1891, the percentage of increase being 1-584.

The number of persons of Scottish birth in England in 1891 was 282,271 and in Ireland 27,323 total 309,594. On the other hand, the natives of these two countries in Scotland in 1891 numbered together 303,543. Table V. shows how the population was affected by emigration and immigration in four decades :

Table V. Illustrating Emigration and Immigration.

1861-70.

1871-80.

1881-90.

1891-1901.

Excess of births over

deaths Actual increase

Balance ….

414,694 297,385

468,363 375,555

508,348 290,074

498,135 446,310

117,209

92,808

218,274

51,825

*The male population in 1891 was 1,942,717, an increase over 1881 of 7-9 percent., the female population 2,082,930, an increase of 7-7 per cent. In 1901 the males numbered 2,173,161 and the females 2,298,849, showing increases of 11-8 and 10-4 per cent, respectively. The proportion of 105-8 females to 100 males was the lowest ratio experienced since 1801. The highest was 118-5 in 1811, and since then the decline has been almost regular from census to census. In Scotland the ratio in 1891 was greater than in England, where it was 106-8 to 100 ; or in Ireland, where it was 102-8 to 100. The percentage of illegitimate births, after falling almost continuously during the century, rose from 7*04 in 1871-80 to 8-16 in 1881-90, but fell again to 7-11 in 1891-1900, 6-73 in the large towns, 7-88 in the small town districts, 10-33 in the mainland rural, and 6-02 in the insular-rural districts. Wigtown and Ross and Cromarty exhibited the two extremes, the former ??? a lowland rural district ??? having an illegitimacy per- centage of 16-51, and the former ??? a highland rural district*

having only 4-92 per cent. Table VI. shows the percentages to population of births, deaths, and marriages registered in the four decades specified : ???

Table VI. ??? Showing Birth, Death, and Marriage Patio.

1861-71.

1871-81.

1881-91.

1891-1901.

Birth-rate Death-rate . Marriage-rate

3-48 2-19 0-69

3-47 2-15 0-71

3-22 1-91 0-66

3-01 1-84 0-70

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The marriage-rate in decade 1881-91 was higher than that for Scotland in six counties ??? Forfar, Renfrew, Ayr, Lanark, Linlith- gow, and Edinburgh ??? and below in all the others. Renfi-ew had the highest rate ??? 73 '11 per ten thousand ??? and Sutherland the lowest ??? 31 "91. Five counties had a higher death-rate than Scot-land??? Forfar, Edinburgh, Bute, Renfrew, Lanark ; of the others, which were below the mean, Peebles was lowest with 14 '028. The mortality rate at ages under five years to the population alive at the same age varies from 1'7 in Orkney to 6 '8 in Lanark. Table YII. gives the percentage of single, married, and widowed to the total of each sex in Scotland, England and Wales, and Ireland respectively in 1891 : ???

Table VII. ??? Shoioing Percentage of Single, Married, and Widmoed in the United Kingdom {1891).

Sexes.

Scotland.

England and Wales.

Ireland-

Sing.

Mar.

Wid.

Sing.

Mar,

Wid.

Sing.

Mar.

Wid.

Males . Females

66-3 63-1

30-3 28-9

3-2

7-8

62-0 59-6

34-5 32-9

3-5 7-5

69-5 64-0

24-4 26-2

3-9

9-7

Blind, ibc. ??? The number of blind persons in Scotland in 1891 was 2797 (1417 males and 1880 females), the proportion to the total population being 1 to 1439, as against 1 to 1182 in 1881. The deaf and dumb numbered 2125 (1195 males and 930 females), the proportion to the population being 1 to 1894, compared with 1 to 1744 in 1881. The number of lunatics was 10,455 (4918 males and 5527 females), equal to 1 to 385 of the population ; in 1881 the number was 8406, or 1 in 444. In addition, there were 5017 imbeciles (2506 males and 2511 females), being 1 to 802 of the population, compared with 5991, or 1 in 623, in 1881.

Occupations. ??? Table VIII. exhibits the classification of the people in 1881 and 1891. The proportions of the professional, commercial, and industrial classes maintained the increase which they had shown in the preceding decade ; and while the agricultural class continued to diminish, there was no cessation of the diminution of the unproductive class, whose falling away in 1881 was put down to a change in classification since the previous census : ???

Table VIII.

-Classifying Population in Professions and Trades.

Per cent, of Total

Population.

Classes of Occupation.

1881.

1891.

1881.

1891.

Professional .

96,103

111,319

2-57

2-76

Domestic

176,565

203,153

4-73

5-05

Commercial .

132,126

180,952

3-54

4-49

Agricultural and fishing

269,537

249,124

7-21

6-19

Industrial

932,653

1,032,404

24-97

25-65

Unproductive

2,128,589

2,248,695

56-98

55-86

Pauperism. ??? In Scotland pauperism showed an almost con- tinuous decline from 1868 to 1891, the ratio of ordinary poor per thousand of estimated population being 40 in the former year and 20 in the latter. The average in the decade 1881-90 was 22-5 ; it fell from 21 in 1890 to 20 in 1891, and stood at that figure til)

the end of the ensuing decade, except in 1897 and 1898, when it was 21. On the other hand, the ratio of lunatic poor per thousand of estimated population has risen from 1-8 in 1868 to 3-1 in 1900, the increase being undoubtedly due, in part at least, to the fact that greater care has been taken to segi-egate this class of the popu- lation, coupled with a gi-owing disiuclination of the working classes to be burdened with the mentally weak in the home.

Crime. ◆◆◆Although the prison accommodation in the large centres of population is more and more taxed every year, crime continues to decline steadily, as is shown by Table IX., albeit the figures for 1898 indicate a set back from 1897 : ◆◆◆

Table IX. ◆◆◆Classifying Crimes.

Offences.

Average.

1900.

◆◆8 J.

1

S

3

i

i

i

3 6

◆◆◆^

566

fa

66

631

Against person .

789

686

656

663

643

Against property, with

violence ....

.’.**<?**<?**.’>

547

601

581

iS94

610

33

643

Against property, without

violence ....

X9.’)

906

831

862

H4()

627

170

797

Against property, mali-

cious

*K**??*

42

31

39

U

14

2

16

Forgery, &c. . . .

42

.^iS

23

31

24

18

4

22

Other offences Total

104

123

82

lOV

61

62

6

58

2477

2336

2224

2283

2186

1886

281

2167

Communications. ◆◆◆ By the Local Government Act of 1889 the oversight of the roads in Scotland was transferred from the Road Trustees to county councils, and the management is in practice in the hands of district committees, composed of repre- sentatives of the county council and the parish councils of the district. Table X. shows the development of railway com- munication in Scotland. The total capital of aU the railway companies in 1888 was ◆◆114,120,119 ; in 1898 it had been raised to ◆◆158,982,782 ◆◆◆ paid up and raised by loans and debenture stock.

Table X. ◆◆◆ niustraling Growth of Railxoay CommunicaiioTis.

i

1

Passengers.

Receipts.

a o

First Clasa.

Second Class.

Third

Class.

Total.

Passen- ger.

Goods.

Total.

1884 1888 1898 1900

2999 3097 3470 3485

4.711,600 4.626,971 4,718,024 6,375,684

2,715,932 1.643,992

46,877,642 62,142,386 109,389,421 116,825,418

64.305,074 68,413,349 114,107,445 122,201.102

42,931,737 3,163,195 4.356,182 4,715,592

4.426,023

4,564,627 6,105,581 6,431,693

7,357,760

7,994,427 10,873,318 11,603,010

The total disappearance of the second-class passenger from Scot- land during the decade ended in 1898 will be noted, together with the almost constant number and real decrease of the first-class passengers. From the passing of the Light Railways Act of 1896 down to the end of 1898, the Board of Trade had sanctioned the construction of nine light railways in Scotland, with a total mile- age of 66|.

Agriculture. The distribution of land in respect of ownership has not suffered an appreciable change since 1875. Table XI. is a comparative statement of the number and acreage of holdings in each class above five acres in the years 18C5 and 1895 :

Table XI.-

Illustrating Distribution

*** yf Holdings above Fire***

Acres.

Years.

5 to 20 Acres.

20 to 50 Acres. | 50 to 100 Acres.

100 to 300 Acres.

300 to 600 Acres.

600 to 1000 Acres.

Above lOOOAcres

Total.

No.

Acres.

No.

Acres.

No.

Acres.

No.

Acres.

No.

Acres.

768,823 782,369

No.

Acres.

No.

Acres.

No.

Acres.

1885 1895

22,132 23,104

236,995 245,664

10,677 10,817

361,675 9778 363,266 9834

725,499 731,977

12,.r)4a

12,968

2,139,133 2,203,207

2034 2070

632 620

409,641 397,682

90 76

137,104 104,410

57,892 59,489

4,778,870 4,828,675

The table contains striking evidence of the reversal of the tend- ency, long prevalent, to abolish the lowland crofting class, and of the natural reversion to the division of land into farms of manage- able size. There were altogether 54,071 holdings in 1895 under 50 acres (including 20,150 under 5 acres), or 67-89 of all the hold- ings in Scotland.

Since the passing of the Crofters Act of 1885, and the amending statutes of succeeding years, which added to the Commissioners' powers of fixing fair rents and nmcelling arrears, the power of en- larging crofts and common grazings, political agitation among the

Highland crofters has practically died out. The material condition of the class has not very markedly improved, except where, by Government assistance, crofter fishermen have been enabled to buy better boats ; but in some districts, even in the Lewis, superior houses have been built. The Crofters' Commission has been con- tiiuiously at work sini'O 1886, and had up to the end of 1898 dealt with 19,862 applications to fix fair rents, covering 192,283 acres held in indiviilual occupancy, and 1,243,328, acres of grazings or common hill pasture. The total amount of the fair rents fixed was ►►59,420, and the total amount of reduction on the old rents ►►21,448.

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Of ►►183,930 of arrears of rent, ►►123,651 was cancelled ; and 41,452 acres was assigned in enlargement of existing holdings. Under a Congested Districts (Scotland) Act of 1897, a Board ex- pends ►►35,000 a year of public moneys, within certain districts of Argyll, Inverness, Ross and Cromarty, Sutherland, Caithness, Orkney and Shetland, in Etssisting migration, improving the breeds of live stock, building piers and boatslips, making roads and bridges, developing home industries, &o. Deer forests in 1899 covered 2,287,297 acres ►►► an increase of 575,405 acres since 1883.

The epoch of agricultural depression which set in prior to 1885 was surmounted in Scotland with comparatively little trouble. A large amount of capital was lost by tenants, and a few farms were thrown here and there upon the landlords' hands, but in no district was rent extinguished or were holdings abandoned. The sub-com- missioners who reported to the Koyal Commission on Agriculture in 1895, found nearly everywhere a demand, sometimes competition, for farms, persisting throughout the crisis. In Banff, Nairn, Elgin, and the seven counties south of the Firth of Forth rent reductions varied from 25 to 30 per cent. In Perth, Fife, Forfar, and Aberdeen the average was 30 per cent. ; but in all the counties of both groups, towards the end at least of the period of depression, the coexistent demand and competition for farms were observable. In some dis- tricts of the western division of the country rents fell very little ; in others, especially sheep-farming districts, the fall was very severe. In Ayrshire the figure varied from 5 to 20 per cent. ; for Dumfriesshire 16 per cent, was given as a fair average, but here too the distressed farmer was compelled to admit that if he gave up his holding there were others ready to take it. Now, owing to the increased attention given to stock-fattening, dairying, &c. , and to a rise in prices all round, farming has reached a condition of equilibrium, and the most noticeable residuum of the period of depression is the large intrusion of the butcher and grazier class into the farmer class proper. Caithness-shire was declared to be the greatest sufferer by the period of depression ; rents fell in that county by 30 to 50 per cent, on large farms, 20 to 30 per cent, on medium, and 10 to 60 per cent, on small farms. Table XII. shows the total

area, the cultivated area, and the area under each kind of crops in 1888 and 1901: ???

Table XII. ??? Illustrating Acreage,

iinder Cultivation.

Total Area (Foreshore excluded), 19,456,788 Acreo.

1888.

1901.

Cultivated acreage ....

4,878,514

4,900,131

Permanent pasture ....

1,191,648

1,428,224

Arable land

3,686,866

3,471,907

Corn crops :

Wheat

68,735

36,225

Barley or here

223,468

235,115

Oats

1,015,395

956,389

Eye

9,690

5,541

Beans

15 738

13,037

Peas

Total corn crops

1,423

1,349

1,336,338

1,247,656

Green crops :

Potatoes

1^7,605

130,176

Turnips

480,626

458,556

Mangolds

1,345

2,950

Cabbage, kohl-rabi, and rape .

6,884

14,404

Vetches or tares ....

13,851

9,016

Other green crops .... Total green crops

2,848

2,384

663,159

617,486

Grasses under rotation

1,668,453

1,593,461

Flax

327

4

Small fruit

3,416

6,079

Bare fallow

15,083

7,221

The most notable movement in corn crops, if we except the revival in a limited area of wheat-growing, has been in barley, the acreage of which responded to the rapid development of distilling in Scotland up to 1899. In regard to green crops, the figures relating to cabbage, &c., and to small fruit reflect the development of market-gardening in the neighbourhood of the large towns. The area under orchards rose from 1562 in 1880 to 2149 in 1898. Woods and plantations covered 811,703 acres in 1880 and 878,765 acres in 1895, of which 54,956 acres had been planted between 1881 and 1895.

Table XIII. shows the yield of the principal crops per acre in 1888 and 1899, with the average yield per acre in 1899 : ???

Table XIII. ??? Showing Yield of Chief Crops per Acre.

Average per Acre.

1888.

1899.

1899.

Wheat

Bushels

2,139,282

1,768,320

37-42

Barley

7.630,661

8,222,891

34-19

Oats .

34,986,742

33,313,304

34-78

Beans .

409,535

439,613

33-66

Peas .

26,740

26,515

24-04

Potatoes

Tons

767,271

649,428

6-11

Turnips

J)

6,218,905

5,751,738

12-23

Table XIV. shows the number of live stock in 1888 and 1901 : Table XIV. ??? Illustrating Increase of Live Stock.

Horses used for agriculture Unbroken horses and breeding mares

Total Cattle : Cows or heifers in milk or calf Other cattle, 2 years and above Under 2 years

Total cattle

One year and above Under one

Total

Pigs

146,913 42,874

189,787

410,256 249,156 450,878

1,110,290

4,431,535 2,299,032

6,730,567 154,599

153,918 40,975

194,893

433,981 274,016 621,284

1,229,281

4,627,066 2,774,343

7,401,409 124,821

The table shows, when collated with Table XIII., the extent to which Scottish farmers have turned their attention to stock-raising in preference to crop-raising. The cow stock of the country has risen steadily, and the regular increase of the number of cattle under one year points to the breeding industry being in a healthy state. Horse-breeding, as indicated by the numbers of unbroken horses and breeding mares, is a declining industry ; it reached its maximum of prosperity in 1894, when the number of horses in the class named was 51,740.

Fisheries. ??? The development of the Scottish fisheries during the past decade is exhibited in Table XV. : ???

Table XV. ??? Showing Growth of Fisheries.

Total taken by Fat and Line.

Total taken b? Trawl.

Total Quantity and Value of Fish landed.

Cwt.

??

Price Cwt.

Cwt

??

Price Cwt.

Cwt.

??

Price Cwt.

1890 . 1898 . . 1900 . .

5,336,715 5,774,331 4,292,183

1,295,869 1,426,633 1.622,567

1/10 4/11 7/7

291,812 783,436 1,077,082

203,620 453,233 703,427

13/11 11/7 13/1

5,864,488 6,657,768 5,369,265

1,623,346 1,879,866 2,325,994

5/6 5(8 8/8

While net-fishing has not been at a standstill, the great progress of the fisheries has been due to the multiplication of beam-trawling vessels, in which a large amount of capital has been invested, and whose operations have scarcely been checked by the closing of the Moray Firth and other inshore waters to all but line boats. Line- fishing has suffered a decided set-back. For instance, while 1,420,789 cwt. of round fish were caught by line in 1890, only 650,000 cwt. were caught by line in 1900 ; trawlers landed 171,593 cwt. in 1890, and 892,000 cwt. in 1900. Trawlers have to go farther and farther afield for their fishing-grounds, and the line fishermen on the east coast are to some extent adapting themselves to changed conditions by employing larger boats, and in some cases ha-ving them propelled by steam ; on the west coast, on the other hand, the tendency is towards the employment of smaller boats. In 1900, 82,809 persons were employed in connexion with the various branches of the sea fisheries ; the fleet of fishing vessels num- bered 11,275, manned by 40,192 fishermen; and total value of the fish landed on Scottish coasts was ££2,401,900 (as against ££2,270,484 in 1899 and ££1,957,000 in 1898), made upof : herring, ££1,243,407 ; sprats, ££1876 ; spading, ££1086 ; mackerel, ££5025 £££ cod, ££205,994 ; ling, ££51,210 ; tusk, ££2295 ; saithe, ££12,208 ; had- docks, ££512,660 ; whiting, ££35,444 ; conger eel, ££7766 ; turbot, ££18,325; halibut, ££40,801; sole, ££41,688; flounder, plaice, and brill, ££109,829; skate, ££20,659 : other white fish, ££25,658 ; shell- fish, ££76,906.

S. VIII. £££ 59

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Mining Indiistries. ??? Table XVI. exhibits tbe development of the mineral industry of Scotland since 1885 so far as statistics are available : ???

Table XVI. ??? Illustrating Development of Mining Industry.

1885.

1896.

1900.

Tons.

??

Tons.

??

Tons.

??

Coal

Fire clay Iron ore . Oil, shale Lead ore Granite . Limestone Slate .

21,288,686

456,246

1,835,169

1,741,750

4,316

19,238 1 2,832,598

4,746,423 63,112 776,160 437,339

38,774

27|814

Impoi

1,957,199

28,792,693 7,672,747 687,658 101,663 824,673 311,303 2,236,224 659,066 4,111 30,882 351,268 190,606 493,347 120,411 44,235 75,742

???ts of Iron Ore.

4,460,311 2,977,952

33,112,204

1,061,836

849,031

2,279,879

1,839

1,182,067

604,730

36,277

1,371,684

18,065,968

160,220

408,713

626,966

24,067

381,244

90,647

72,613

1,171,026

Pig-iron Production.

1885.

1896.

1900.

Furnaces in blast .... Output in tons .

92 1,003,562

76 1,048,774

85 1,156,885

Coal is found in 15 Scottish counties. Of the total output since 1876, Lanark contributed 55‘90, Ayr 14”35, Fife and Kinross 11-95, Stirling 6-05, Edinburgh 375, Linlithgow 2-80, Dumbarton and Clackmannan each 1 ‘40, Haddington 1 ‘20, Renfrew 0‘35, and Argyll, Dumfries, Perth, and Sutherland together 0‘85. The total quantity worked up to the end of 1898 was 1,514,062,000 tons, and the quantity then remaining to work was estimated at 4,634,785,000 tons. The export of coal from the principal Scottish ports rose from 5,800,000 tons in 1889 to 9,000,000 tons in 1899. Lanark produces about 46 per cent, of the fire- clay production, and Ayr comes next with about 16 per cent. ; Edinburgh, Renfrew, and Stirling are the other counties in which the mineral is found in quantity. Ayrshire,

with an output of 36 per cent, of the whole, is the principal iron-mining county ; Renfrew follows with 20 per cent., and Lanark with 18 per cent.; iron ore is worked also in Edinburgh, Linlithgow, and Dumbarton on a considerable scale. Oil shale is found in Linlithgow, Ayr, Lanark, Stirling, and Renfrew ; but more than half the total output is credited to Linlithgow, where the principal refining works are situated. Argyllshire furnishes the bulk of the slate production. Limestone is found mainly in Lanark, Renfrew, Banff, Ayr, Stirling, and Haddington, in the order stated. Granite occurs in Aberdeen, Kirkcudbright, Argyll, Kincardine, the Aber- deen production being 69 per cent., of Kirkcudbright 15 per cent., and of Argyll 10 per cent., of the whole.

There are 25 iron-works in Scotland, and all were in active operation in 1900. They are owned by 22 firms and employ about 7000 operatives. The product consists of all classes of malleable iron ??? bars, angles, tees, hoops, strips, sheets, and plates, and amounts to some 350,000 tons per annum. There were working in the West of Scotland in 1900 about 115 open-hearth Siemens-Martin steel furnaces, ranging in capacity from 50 down to 20 tons per furnace. The average output per furnace is 210 tons a week ??? total, 24,150 tons ; ami the total produce of the year of 48 working weeks, 1,149,200 tons of ingot steel. There are also 2 Bessemer converters, which produce about 1000 tons weekly, so that the output of ingot steel in West Scotland is nearly 1 J million tons.

Manufactures. ??? The detailed statistics for 1890 about the manufactures exhibit the following facts : ??? The woollen in- dustry has the widest spread of all the textiles. There were in that year 2 wool-spinning factories in the northern district, 2 in the north-western, 8 in the north-eastern, 23 in the east midland, 8 in the west midland, 14 in the south-western, 14 in the south-eastern, and 14 in the southern. In 1900 there were 256 worsted and woollen factories, and 91 hosiers' and wool workshops. Weaving has its principal seats in Hawick, Galashiels, Dumfries, Elgin, Aberdeen, Inverness. Table XVII. shows the progress made in the previous decade : ???

Table XVII. ??? Illustrating Growth of Woollen Industry.

Factories.

Spindles.

Power

Persons employed.

Spinning.

Doubling.

Male.

Female.

Total.

1878 1890

246 282

569,021 565,146

62,013 73,978

6284 9836

10,083 12,915

12,684 18,162

22,667 31,077

The linen industry is confined mainly to the counties of Forfar, Fife, Aberdeen, Perth, and the speciality of thread-spinning to Paisley. Table XVIlI. offers a comparison between its condition in 1878 and 1890, and it may be said generally that the persistence of hostile tariff legislation in

the United States has prevented a recurrence of its former activity ;
???

Table XVIII. ??? Illustrating Growth of Linen Industry.

Factories.

Spindles.

Power Looms.

Persons employed.

Spinning.

Doubling.

1878 1890

155 136

265,263 187,755

18,495 20,599

16,756 18,687

36,476 34,222

There were in 1890, 27 hemp factories, with 14,460 spinning and 1735 doubling spindles and 3216 employes ; and 103 jute factories, with 242,206 spinning and 10,868 doubling spindles, 12,897 power looms, and 13,007 male and 26,878 female employes. In 1900 factories engaged in flax, jute, hemp, and tow numbered 243,

Cotton manufacture has stagnated in Scotland as compared with England, and it is certain that there has been no development of the industry since the publication of the last official statistics. Table XIX.

gives particulars for 1875, 1885, and 1890. The most important factories are still confined to Glasgow and neighbourhood : ???

Table XIX. ???

Illustrating

Growth of Cotton Industry.

Factories.

Spindles.

Power Looms.

Persons employed.

1875 . 1885 . 1890 .

96

147 124

1,711,214 1,149,514 1,204,113

29,171 19,684 28,093

35,652 37,167 34,878

The employes numbered 29,540 in 1897. In 1900 there were 92 cotton factories and 18 textile workshops engaged in cotton.

The textile industry that has made most marked progress in Scotland is the weaving of lace curtains, which is carried on chiefly in a number of Ayrshire towns and in Glasgow. In 1878 there was only one lace factory, employing 45 hands ; in 1890 there were 19 factories, with 2087 hands ; and the number has increased since. There were 11 silk factories in the south-western district in 1890, with 7917 spindles and 734 power looms, employing 1334 hands (2244 in 1897). Table XX. shows particulars of all

textile factories in Scotland subject to the Factories and Workshops Acts for a series of years : ???

The employes in this industry numbered 29,218 in 1897.

Table XX.-

-Illustrating Position of all Textile Factories.

Factories.

Number of Spindles.

Number

???a

Years.

60

Js^i

ta

S

of Power

H

=1

??o,

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c

s

.g

1

??1

??

H

???I

1875

229

195

211

45

680

2,436,947

446,429

74,195

1885

251

221

190

114

776

1,725,173

643,931

72,279

1890

220

227

184

116

747

1,713,899

699,836

71,471

1900

725

The Scottish industries that have made decided progi-ess are the manufacture of iron and steel, of which statistics are given above, and distUling and brewing. In the year 1900, out of a total of 199 distilleries at work in the United Kingdom, 159 were situated in Scotland. Table XXI. gives an indication of the progress of distilling and brewing actually and relatively to the United Kingdom : ???

Table XXI. ??? Illustrating Growth of Distilling and Brewing.

Scotland.

United Kingdom.

1890.

1900.

??

7,650,675 746,894

8,397,569

1890.

1900.

??

20,124,003 13,940,536

34,064,539

Spirit duty . Beer duty Total excise net receipt .

??

4,372,400 441,542

5,158,096

??

13,860,002

9,410,426

27,127,651

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The numlser of gallons of whisky distilled in Scotland in 1900 was 31,798,465 (United Kingdom 59,246,277), compared with 21,472,441 in 1894 and 20,164,962 in 1884. The number of barrels of beer brewed in Scotland (in Edinburgh, Leith, and Alloa chiefly) was 2,137,030 in 1900 (United Kingdom 36,394,565), compared with 1,744,512 in 1894. The number of barrels retained for home consumption in 1899 was 1,918,426, compared with 1,425,769 in 1890.

The cheapness of sugar, while it ruined the refining industry of Greenock, brought about an enormous development of the manufacture of confectionery and preserves in Scotland, and helped, with the increase in the importation of flour, to develop the bakery trade. Preserve and confectionery making is, however, mainly confined to Glasgow, Edinburgh, Dundee, and Forfar. Printing continues to be one of the most important industries of Edinburgh, linoleum and floor-cloth manufacture of Kirkcaldy, granite-polishing and comb-making of Aberdeen. The manufacture of chemicals has its principal seat in Glasgow and neighbourhood, the manufacture of explosives in Ayrshire. German competition has almost killed the glass-bottle industry, and all the important potteries are concentrated in Glasgow, Edinburgh district, and Fife. The other widely spread industries of the country do not call for special notice.

Commerce and Shipping. ??? In order of commercial importance the ports of Scotland now stand as follow : Glasgow, Leith, Dundee, Grangemouth, Greenock, Aberdeen, Kirkcaldy, Granton. Table XXII. shows the net tonnage registered at Scottish ports for 1889 and 1900 :???

Table XXII.-

-Showing Registered Tonnage in Port for 1889 and 1900.

1889.

1900.

No.

Tons.

No.

Tons.

Sailing vessels . Steam vessels

1644 1567

827,417 1,041,174

1104 1980

709,430 1,528,032

Table XXIII. shows the progress of the foreign and colonial and coasting trade in the same years : ???

Table XXIII. ??? Illustrating Growth of Foreign and Colonial and Coasting Trade.

Coasting.

Colonial and Foreign.

Total.

Entered.

Cleared.

Entered.

Cleared.

Entered.

Cleared.

1889 . 1898 . 1900 .

7,188,763 9,256,233 7,213,574

6,998,516 8,937,481 6,791,959

3,931,010 6,510,927 6,657,200

4,412,607 6,296,656 6,602,645

11,119,773 14,767,160 12,870,774

11,411,123 16,234,036 13,394,504

Table XXIV. shows the development of the foreign and colonial trade :
???

Table XXIV. ??? Showing Orowlh of Foreign and Colonial Trade.

Imports.

Exports of Products of United Kingdom.

1889 . 1898 . 1900 .

??

36,771,016 36,224,982 38,691,245

??

22,310,006 23,643,143 32,166,561

Foreign and colonial merchandise transhipped was valued at ??989,289 in 1889 and ??738,440 in 1900. The customs revenue rose from ??1,965,080 in 1894 to ??2,306,259 in 1900.

Notwithstanding one or two set-backs, shipbuilding made steady and satisfactory progress, chiefly on the Clyde. Table XXV. gives details of the Scottish output in each of the years from 1895, show- ing the decadence of sailing shipbuilding, the progress made in steam shipbuilding, and the increase in the size of the steamers turned out : ???

Table XXV.-

-Illustratvng Position of Shipbuilding Trade tince 1895.

Sailing Vessels.

Steamers.

Total.

No.

Tonnage.

No.

Tonnage.

No.

Tonnage.

1895 1896 1897 1898 1899 1900 1901

105 97

101 48 43

40,726 46,814 42,137 8,945 15,498

266 329 282 360 318

346,556 392,110 329,608 506,252 521,099

371 426 382 408 361 406 376

386,982 438,924 371,745 515,197 536,597 534,759 554,406

National Wealth. ??? The total amount of property and profits assessed to the income tax in Scotland was ??61,125,422 in 1885 and ??75,833,242 in 1900, the total remaining almost a constant tenth of the total for the United Kingdom. Keal property under Schedule A increased in annual value from ??19,790,187 in 1885 to ??22,949,891 in 1900, and the amount under Schedule D (profits and trades) from ??30,879,677 in 1885 to ??45,390,788 in 1900. The amount which the Post Office and Trustees Savings Banks owed depositors in Scotland increased by about 250 per cent, be- tween 1884 and 1900, the figure for the former year being ??8,612,910 and for the latter ??21,568,415 ; and while the Scottish total was little more than an eleventh of the total for the United Kingdom in 1894, it was between an eighth and a ninth in 1898. Joint-stock companies registered in Edinburgh averaged 268 yearly in 1891-1900, with an average total capital of ??12,330,313. The total paid-up capital of the Scottish banks, 10 in number, at date of balance in 1901 was ??9,302,000, and their total assets, ??138,317,871.

Universities and Schools. ??? The four Scottish universities ??? St Andrews, Glasgow, Aberdeen, and Edinburgh ??? had in 1899, 128

professors in all and 97 lecturers. Radical changes were made in their constitution by an Act of 1889 and a Royal Commission which carried out its provisions. The University Court of each was made supreme authority in regard to finance, discipline, and the regulation of the duties of professors and lecturers ; the universities were empowered to affiliate other academical institutions ; an en- trance examination was instituted ; and large options were intro- duced into the course of study and the subjects of examination for old and new degrees ; and women students were admitted on an equal footing with men. Under the Act the University College of Dundee was incorporated with the University of St Andrews, and Queen Margaret College became a part of the University of Glasgow, the buildings and endownjents, which are used for women students exclusively, being handed over to the University Court. St Mungo's College, Glasgow, incorporated in 1889 under a Board of Trade licence, has medical and law faculties, and Ander- son's College Medical School, Glasgow, was instituted in 1887. These are on the same footing as the extra-mural Edinburgh medical schools, their medical curricula qualifying for licence only, and not for Scottish university degrees. The Glasgow and West of Scotland Technical College, instituted in 1886 by the union of the non – medical part of the Andersonian University and other institutions in Gla.sgow, and the Heriot – Watt College, Edinburgh, incorporated under the Educational Endowments Act of 1882, are the leading technical schools of Scotland, and there are schools of almost equal rank at Aberdeen, Paisley, Coatbridge, and elsewhere. By the erection of chairs and lectureships in education, and otherwise, the training of teachers has been brought into closer touch with the universities, but the separate normal schools managed by the Churches are still carried on ??? the Established and Free Churches having each schools for both men and women in Edinburgh, Glasgow, and Aberdeen, the Episcopal Church a training school for women in Edinburgh, and the Roman Catholic Church one for women in Glasgow.

The secondary education system of the country has been largely reformed. After the reorganization of the Scottish Education Department in 1885, when it was separated from the English Department, it undertook the inspection of higher class schools ; two years later it instituted a leaving certificate, which has, in conjunction with inspection, improved

the efiicieney of these schools, and also of the secondary departments of elementary schools, to which it was applied in 1893 ; 86 higher class schools (public, endowed, and voluntary) are under inspection, and pupils from 398 schools sat for the leaving certificate in 1898. In 1898 the functions of the Science and Art Department, as far as Scot- land is concerned, were transferred to the Department, and arrangements are being made for spending part of the money avail- able in encouraging school boards to provide organized course of instruction for children who have passed the elementary stage of education. Parliament has since 1892 subsidized secondary educa- tion under an Education and Local Taxation Act of that year, some ––50,000 being dispensed by burgh and county committees, specially elected, to the managers of public secoudary schools and the higher departments of elementary schools, and a further sum was made available by a Local Taxation Account of 1898 for similar purposes. A Technical Schools Act was passed in 1887, and has been applied by a few local authorities ; but under an Act of 1890 burgh and county councils were empowered to expend a State subvention known as the "Residue" grant in supporting technical education, and about two-thirds of a sum which averages nearly ––50, 000 is either spent by the councils directly in subsidizing technical, science, and art institutions and classes, or handed over to the county committees mentioned above for allocation. In 1900 a Bill was introduced into Parliament which proposed to reconstitute the burgh and county committees, to give them com- plete control of the moneys mentioned above, and considerable

powers of supervision and guidance in regard to secondary and technical education.

Table XXVI. shows the progress that has been made in element- ary education since the passing of the Education Act in 1872 : –––

Table XXVI. ––– Illustrating Ed^icational Progress since lS7i.

1872.

1880.

1890.

1900.

Estimated population

3,395,808

3,706,314

4,109,276

4,324,944

Number of schools inspected

1,979

3,064

3,076

8,136

Accommodation

281,688

602,054

714,865

898,842

Average attendance :

Day scholars ....

213,649

404,618

612,690

626,089

Evening scholars .

3,653

14,297

11,636

43,962

Number of teachers :

Certificated ....

2,666

5,330

7,746

10,846

Assistant

444

1,820

2,418

Pupil

3,642

4,682

3,883

3,926

The percentage of average attendance to estimated population in- creased from 12-08 in 1884-85 to 14-48 in 1899-1900. For the pur- poses of education in Scotland there was raised by rates in 1898-99, ££861,078, by an average rate of 9-25 pence compared with 9-23 in the previous year ; by voluntary subscriptions, ££28,883 ; in lieu of school fees there was granted to boards and managers, mostly out of a parliamentary vote, ££367,618 ; and the ordinary parlia- mentary vote for day schools under inspection amounted to ££677,964 £££ total, ££1,935,543. Thus the cost of maintenance per child in average attendance was in public schools ££2 i3s. 7|d., in voluntary schools ££2 6s. 9d. School fees were almost entirely abolished in 1889, and the loss is made up mainly by annual parliamentary grant and partly by a proportion, earmarked for the purpose, of the proceeds of imperial taxation diverted to local purposes under various Acts. Down to March of 1900, ££7, 684, 577 had been spent in Scotland since 1872 in building public schools. The most important change effected in the elementary education system was the abolition of individual inspection of the lower standards, which was brought about in 1886. This reform has since been extended to the whole of the standards, and inspectors now apply a collective test to the eflSciency of a school. By the Code of 1899 a merit certificate was instituted, which at once fixes a standard of attainment for pupils who have passed through an elementary school course, and qualifies for entrance upon courses of higher education in higher grade schools or departments which managers were, by the same code, liberally encouraged to organize for systematic instruction in science, subjects appertaining to com- merce, or specially suited to girls. A Superannuation Act for teachers was passed in 1898.

Churches. ??? For the history of the Scottish Churches in recent years reference may be made to the separate articles, Scotland, Chukohes of, and Scotland, the Episcopal Chukch in. Table XXVII. gives comparative statistics (up to the union of the Free and United Presbyterian bodies in 1900) for the three Presby- terian Churches which command the allegiance of the bulk of the people of Scotland : ???

Table XXVII. ??? Illustrating Distribution and Contributions of Presbyterian Churches.

Congregations.

Members.

Contributions.

Church of Scotland . Free Church U.P. Church

1885. 1479 1067 643

1899. 1770 1109 589

1886. 665,261 329,461 177,617

1899. 648,476 404,828 197,476

1886.

??366,431

626,028

387,356

1899.

??484,275

712,742

423,106

The membership of the Free Church included in 1899, 111,144 adherents who were not communicants. The Reformed Presby- terian Church had in 1899 2 presbyteries and 12 churches ; the Original Secession Cliurch, 4 presbyteries and 29 charges ; the Evangelical Union Church (the section which refused to unite with the Congi-egational Union in 1896), 10 charges ; and the Free Presbyterian Church, which separated from the Free Church on account of the Declaratory Act of 1892, had 12 congregations. The Congregational Union of Scotland embraced 184 churches in 1899 ; the Baptist Union of Scotland had 109 churches and 15,260 members ; the Wesleyans had 44 congi-egations and missions and 6502 members. The Episcopal Cliurch of Scotland had 356 con- gregations, including missions, in 1899, 114,315 members, includ- ing 45,571 communicants, and raised ►►110,178 ; the corresponding figures for 1885 being 250 churches, 80,000 members, aii(T 30,000 communicants. The Roman Catholic Church had in 1898, 346 churches, chapels, and stations, cduipared M'ith 327 in 1885, and its missions numbered 209, while the "Catholic population" was 413,000, as against 340,000 in 1885.

Local Adminislmtlon. ►►►A large number of new police burghs have been formed since the passing of the Burgh Police (Scotland) Act, which consolidated burgh law and enlarged the powers of police commissioners. But the most important change intro-

duced into local administration during the latter part of the 19th century was effected by the Local Government Act of 1889, which constituted county councils and abrogated nearly all the powers of the commissioners of supply. The council of each county exercises (with two exceptions) the whole powers and func- tions of the commissioners of supply and of the old Road Trust, acts as local authority under the Contagious Diseases (Animals) Act, as local authority under the Public Health Acts in all parishes (burghs and police burghs excluded), and performs all the adminis- trative duties formerly committed to the justices of the peace. Only the judicial powers of the justices were left to them, and the principal function now discharged by the commissioners of supply is the

appointment of half (the county council appointing the other half) of the members of the standing joint committee, which manages the county police, and whose consent in writing must be obtained before the county council undertakes any work involving capital expenditure. All but the smallest counties are subdivided into districts, and the Road Acts and the Public Health Acts are administered in these areas by district committees, composed of members of the county council and representatives of the parish and burgh councils of the district. The county council may also enforce the Rivers Pollution Act within the area under its juris- diction. Another Local Government Act for Scotland was passed in 1894, by which the Board of Supervision was replaced by a Local Government Board, composed of the secretary for Scotland, the solicitor-general, and the under-secretary, and three ap- pointed members- ??? a vice-president, an advocate, and a medical practitioner. Parochial boards were abolished, and provision was made for the election in every poor-law parish of a parish council, to which the powers of the parochial board were transferred in regard to poor law, vaccination, registration, burial-grounds, &c. New powers conferred on the parish councils include the following : ??? A parish council may take over the management of any parish trust at the option of the trustees, and may accept the charge of churchyards, and move the county council in the matter of vindicating rights of way, or the formation of special lighting or scavenging districts ; and is entitled to the majority of seats in the sub-committee appointed to manage the affairs of such dis- tricts. The parish council may acquire recreation grounds, act as managers under the Allotments Acts, and may lease land for allotments ; and has certain powers of ensuring that the public health of its parish is properly looked after by the county council or district committee. (w. wa.)

Scotland, Churches of. ??? The history of the

Churches in Scotland during the last quarter of the 19th century was marked by increased ecclesiastical activity and a considerable decline in church-going, the num- ber of baptisms, and the attendance at Sunday schools. The number of congregations of all denominations as 3827 in 1879 and 4248 in 1899 ??? an increase of 421. During the same period the population increased by 580,151, so that the addition to the number of congrega- tions kept pace fairly well with the

addition to the population; there were 987 persons per congregation in 1879 and 1002 persons per congregation 1899. On the other hand, censuses of church attendance, taken in a number of urban and rural communities in 1876 and 1896, showed that the average best attendance per thousand members at the churches of the three leading Presbyterian bodies in these places had fallen from 861 in the former to 636 in the latter year, and it is esti- mated that there is probably a churchless population in Scotland equal to 37 per cent, of the whole, or more than 1,600,000 persons. The indifference of the age was, however, constantly combated, not only by church- planting, but by numerous additions to the Church agencies for Christian work. The labours of the Church of Scotland Committee on Christian Life and Work were emulated by the other Presbyterian Churches, and many elaborate inquiries into such subjects as the religious condition of the people resulted in the creation of new organizations for stimulating the religious sentiment, and checking the tendency to lapse from Church con- nexion. But the Committee on Life and Work kept the lead which it established in 1875, at least in devising novel aids to the parish minister. Women's work in the Church was fully recognized by the Assembly of the Establishment in 1886, and a Young Women's Guild and

Order of Deaconesses were founded, ???with, a training home and Deaconess Hospital. Six years, from 1890 to 1896, were spent by a committee of the same Assembly in investigating all over Scotland the " state of religion and morals," and in preparing a series of interesting reports thereon ; and a similar function is performed by a standing committee of the Free Church on Religion and Morals. The standard of parochial and congregational activity was everywhere raised ; most congregations have agencies for overtaking diiierent departments of socio-ecclesiastical work, in which the laity co-operate with the clergy; Young Men's Guilds, especially in the Church of Scotland, have an undoubted vitality; and the Free Church, at all events, has grappled seriously with the problem how to rid itself of inefficient ministers.

Concurrent with this evangelical energizing was a decided growth of tolerance and liberality of thought and scholarship in all the Presbyterian Churches. In contrast with the immediately preceding period, it was the Free Church, rather than the Establishment, that was, during the last twenty years of the 19th century, most " troubled " by advanced thinkers and scholars among its clergy ; and while it constantly swelled the roll of its bold and dis- tinguished Biblical critics and liberal thinkers, since the removal of the late Professor Robertson Smith from his chair in the Aberdeen College in 1881, it steadfastly refused to permit a prosecution for heresy; while the Established Church indulged in a heresy hunt so lately as 1896-97, when the Rev. Alexander Robinson, minister of Kilmun, was deposed for refusing to recant the views expressed in his book. The Saviour in the Newer Light. Development in the Church of Scotland in this respect has taken the line of mutual tolerance of the High, Broad, and Evangelical schools, which have marked themselves off more clearly from one another, while freely recog- nizing each other's right to be within the Church. The first-named school founded in 1892 the Scottish Church Society, "to defend and advance Catholic doctrine as set forth in the Ancient Creeds and embodied in the Standards of the Church of Scotland " ; and the Kilmun prosecution was followed by the foundation of the Scottish National Church Union by members of the Broad school. In the Free Church the College chairs were almost uniformly filled by advanced critics or theologians, inspired more or less by Professor A. B. Davidson, who went to the Hebrew chair in the New College, Edinburgh, in 1863. Dr A. B. Bruce (author of The Training of the Twelve, (fee, d. 1899) was appointed to the chair of Apologetics and New Testament Exegesis in the Glasgow College in 1889. Henry Drummond (author of Natural Law in the Spiritual World, &c., d. 1897) was made lecturer in Natural Science in the same College in 1879, and became professor in 1883; and Dr George Adam Smith (author of The Twelve Prophets, &c.) was called to the Hebrew chair in 1892. Attempts were made between 1890 and 1895 to bring all these professors, except Davidson, to the bar of the Assembly for unsound teaching or writing, but in every case these were abortive, the Assembly never taking any step beyond warning the accused that " their primary duty was to teach and defend the Church's faith as embodied in the Confession." .After the failure of the first movement towards union of the Free and United Presbyterian Churches,

the latter paid more attention to the efficient training of its ministry, and in 1891 its College was remodelled so as to furnish a full and regular theological curriculum, similar to those of the University Divinity Halls and the Free Church Colleges.

This Church showed the way to the others, with its Declaratory Act of 1879, in relaxing the stringency of the subscription to the Westminster Confession of Faith. In

1889 the Church of Scotland modified its formula for office-bearers' sub.scription ; and a Declaratory Act, similar to that of the United Presbyterian Church, was passed by the Free Church Assembly in 1892, with the result that a small number of ministers and congregations severed their connexion with the Church and formed the Free Presbyterian Church of Scotland, on strictly and straitly orthodox lines. From 1885 tiU about 1895 much of the energy of all the Presbyterian Churches was absorbed by the Disestablishment agitation. In the former year the Free Church, having almost entirely shed the Establish- ment principle on which it was founded, began to rival the United Presbyterian Church in its resolutions calling for the Disestablishment of the Church of Scotland ; and whUe the Established Assembly at first responded with ofiers to confer with both the dissenting Churches about union, the assaults upon its status waxed in vigour till in 1893 the Free Assembly hailed the result of the general election as a verdict of the constituencies in favour of Disestablishment, and insisted upon the Govern- ment of the day taking up Dr Cameron's Disestablishment BiU. The Church of Scotland began to counteract the agitation in 1890 by forming a defence organization all over the country, which was considered to be practically complete in 1895. After the general election of that year, however, the agitation became much less active. During the last four or five years of the 19th century the Free and United Presbyterian Churches devoted the greater part of their energy to arranging an incorporating union between them. The minor Courts of the Free Church first moved in the matter ; and the supreme Court of the United Presbyterian Church in 1896 resolved to "take steps towards union." In the following year the Free Assembly responded by appointing a committee to confer with a committee of the other Church. The joint- committee discovered a

“remarkable and happy agree- ment ” between the doctrinal standards and rules and methods of the two bodies, and with very little of concession on either side a common constitution and common ” questions and formula ” for the admission of ministers and office-bearers were arranged. The supreme Courts approved the proposals of the joint-committee, which embraced, besides a Uniting Act, declarations conserving the liberty and privileges of individual members and congregations on either side in various important respects; and the union was completed in October 1900, at a meeting of the first General Assembly of the United Free Church of Scotland. The use of instrumental music was sanctioned in Free churches during this period. The jubilee of the Free Church was celebrated in 1893, and of the United Presbyterian Church in 1897. Church congresses on the English model were held for the first time in 1899 by the Established and Free Churches.

The following table shows the material progress of the principal Churches in Scotland during the last twenty years of the 19th century :
???

1879.

1899.

Population ....

3,677,658

4,257,709

Congregations ???

Established Church

1,337

1,447

Free Church ….

1,033

1,101

United Presbyterian

533

577

Other Denominations in 1885

924

1,123

jKLeui ueibiiiu ???

Established Church

518,146

648,476

Free Church ….

246,250

293,684

United Presbyterian

172,150

195,498

Income ???

1886-86.

1889-1900.

Established Church

??311,378

??492,816

Free Church

594,050

706,546

United Presbyterian

367,915

392,116

470

SCOTLAND, EPISCOPAL CHURCH

WMle the population of Scotland increased by 580,151 in the twenty years, or 15‘78 per cent, congregations in- creased in the Established Church 8 ‘23 per cent., the Free Church 6 ‘58 per cent., the United Presbyterian Church 8‘25 per cent, and in other denominations (1885-1899) 21-54 per cent; and the membership of the Established Church 25”15 per cent., of the Free Church 19-26 per cent, and of the United Presbyterian Church 13 ‘56 per cent. It has to be pointed out, however, that the only thoroughly trustworthy index of progress is the in- crease of congregations (the Church of Scotland, by the way, completed in 1900 the endowment of 408 new parishes since the Disruption). In the first place, a local reluctance to communicate relegates to the category of “adherents” a body of adults in the Highlands fairly estimated at about 61,500, and by so many diminishes the membership of the Free Church. In the second place, the accuracy of the returns of membership of aU the Churches is seriously impugned on the ground of the dis- crepancy between the death-

rate of the country and the death-rates of the communicants of the three Presbyterian Churches ; for instance, in 1899 the death-rate for Scotland per ten thousand of the population was 185‘78 ; and of the Church of Scotland per ten thousand communi- cants 145-20, of the Free Church 181-83, and of the United Presbyterian Church 176-36. In the Free Assembly Eeports for 1900 it is correctly calculated that if the death-rate of the communicants of the three denominations were the same as the death-rate of the country, the exact number on the rolls of the Church of Scotland in the middle of 1899 would have been 509,798 (instead of 656,112), of the Free Church 288,622 (instead of 296,085), and of the United Presbyterian Church 188,234 (instead of 199,089).

The greater proportional increase of the congregations of ” other denominations ” is accounted for mainly by the remarkable growth of the Scottish Episcopal Church. During the last fifteen years of the 19th century, whUe the population rose by 7-78 per annum, the congregations of this Church increased by no less than 32-63 per 1000 per annum, as compared with 4-11 in the case of the Established Church, 3-29 in the case of the Free, and 4-13 in the case of the United Presbyterian Church.

The Roman Catholic hierarchy was restored in Scotland in 1878. There are six dioceses (with two archbishops, one of Edinburgh and St Andrews and the other of Glasgow), with, in 1900, 452 priests; 358 churches, chapels, and stations ; and a Catholic population estimated at 413,400.

The Original Secession Church has 4 presbyteries and 27 congregations; and the remnant of the Reformed Presbyterian Church which did not join the Free Church in 1876, 2 presbyteries and 12 congregations. The Congregational and Evangelical Union (formed by the amalgamation of the Congregational and Evangelical Unions in 1896) has 179 churches; and the remnant of the Evangelical Union, 9 churches. The Baptist Union has 121 congregations, and the Wesleyan Methodists, 49 churches. (w. wa.)

Scotland, The Episcopal Church in,

in communion ~~with, but historically distinct from, the Church of England, is composed of seven dioceses : Aber~~ deen and Orkney ; Argyll

and the Isles ; Brechin ; Edin- burgh ; Glasgow and Galloway ; Moray, Ross and Caith- ness ; and St Andrews, Dunkeld and Dunblane. All, except Edinburgh, founded by Charles I., are pre-Reforma- tion sees. The bishops constitute the Episcopal Synod, the supreme Court of appeal, whose president, elected by the members from among themselves, has the style, not the

functions, of a metropoUtan, being called Primus. The legislature is the Provincial Synod, consisting of the bishops, at whose discretion it is summoned, and a lower chamber of presbyters. The Canons have the authority of this Synod. The Representative Church Council, including laymen, administers finance. Each diocese has its Synod of the clergy. Its Dean is appointed by the Bishop, and, on the voidance of the see, summons the clerical and lay electors, at the instance of the Primus, to choose a bishop, who is presented to the Episcopal Synod for confirmation and to the Primus for consecration. There are cathedrals at Perth, Inverness, Edinburgh, and Cumbrae ; the sees of Aberdeen, Brechin, and Glasgow have no cathedrals. The Theological College was founded in 1810, incorporated with Trinity College, Qlenalmond, in 1848, and re-established at Edin- burgh in 1876. There are 356 congregations, with a total membership of 124,335, and 324 working clergy (1900). No existing ministry can claim regular historic continuity with the ancient hierarchy of Scotland, but the bishops of the Episcopal Church are direct successors of the prelates consecrated to Scottish sees at the Restoration. On the refusal of the bishops to recognize William III. (1689), the presbyterian polity was estabhshed in the Kirk, the effect of which on its ecclesiastical status is a matter of theological opinion, but the Comprehension Act of 1690 allowed episcopalian incumbents, on taking the Oath of Allegiance, to retain their benefices, though excluding them from any share in the government without a further declaration of presbjrterian principles. Many Non-jurors also succeeded for a time in retaining the use of the parish churches. The extruded bishops were slow to organize the episcopalian remnant under a jurisdiction independent of the State, regarding the then arrangements as provisional, and looking forward to a reconstituted national kirk under a "legitimate" sovereign. A few prelates, known as college bishops, were consecrated without sees, to preserve the succession rather than to exercise a defined authority. But at

length the hopelessness of the Stewart cause and the growth of congregations outside the Estabhsh- ment forced the bishops to dissociate canonical juris- diction from royal prerogative and to reconstitute for themselves a territorial episcopate. The act of Queen Anne (1712), which protects the "Episcopal Communion," marks its virtual incorporation as a distinct society. But matters were stiU. complicated by a considerable, though declining, number of episcopalian incumbents holding the parish churches. Moreover, the Jacobitism of the Non- jurors provoked a State policy of repression in 1715 and 1745, and fostered the growth of new Hanoverian congre- gations, served by clergy episcopaUy ordained but amenable to no bishop, who qualified themselves under the Act of 1712. This Act was further modified in 1746 and 1748 to exclude clergymen ordained in Scotland. These causes reduced the Episcopalians, who included at the Revolution a large section of the people, to what is now, save in a few corners of the west and north-east of Scotland, a small minority. The official recognition of George III. on the death of Charles Edward in 1788, removed the chief bar to progress. The " qualified " congregations were gradually absorbed, though traces of this ecclesiastical solecism still linger. In 1792 the penal laws were repealed, but clerical disabilities were only finally removed in 1864. In 1784 Seabury, the first American bishop, was consecrated at Aberdeen. The Book of Common Prayer, which came into general use at the Revolution, is now the authorized service book. The Scottish Communion Office, compiled by the Non-jurors in accordance with primitive models, has had a varying co-ordinate authority, and the modifications of the English liturgy adopted by the American Church were mainly determined by its influence. Among the clergy of

post-Revolution days the most eminent are Bishop Sage, a well-known patristic scholar ; Bishop Rattray, liturgiologist ; John Skinner, of Longside, author of Tullochgoriimi ; Bishop Gleig, editor of the 3rd edition of the Encyclopedia Britan- nica ; Dean Ramsay, author of

Reminiscences of Scottish Life and Cliaracter ; Bishop A. R Forbes ; G. H. Forbes, liturgiologist ; and Bishop Charles Wordsworth.

Authorities. ❓❓❓Caratares' /ila/i'- Papers; Keith's Historical Catalogue of the Scottish Bishops (Bussel's edition), 1824 ; Lawson's History of the Scottish Episcopal Church from the Revolution to the Present Time, 1843 ; Steplion's History of the Church of Scotland from the Reformation to the Present Time, 4 vols., 1843 ; Lathbury's History of the Nofnjurorrs, 1845 ; Grub's Ecclesiastical History of Scotland, 4 vols., 1861 ; Dowden's Annotated Scottish Communion Office, 1884. (j. g. si.)

Scott, Robert (1811-1887), English divine and classical scholar, was born in 1811 at Bondleigh in Devon- shire, of which parish his father was rector. Educated at Shrewsbury School under Dr Butler, he entered Christ Church, Oxford, and after a brilliant university career graduated in 1833 with a first class in Liter cb Hwmaniores. In 1834 he won the Latin Essay and was elected fellow of Balliol, where he was tutor from 1835 to 1840. After holding successively the college livings of Duloe and South Luffenham, he was elected in 1854, on the death of Dr Jenkyns, master of Balliol. This office he held, to- gether (from 1861) with that of the professorship of the exegesis of Holy Scriptures, down to 1870, when he accepted the deanery of Rochester. As master of BaUiol he kept the college up to the high level it had attained under his predecessor. As a Greek scholar, Dr Scott had few equals among his contemporaries. His great literary achievement, which may be said to constitute his life's work, was his collaboration with Dean Liddell in the great Greek lexicon which bears their name. He died at Rochester on 2nd December 1887.

Scott, William Bell (1811-1890), British poet and artist, son of Robert Scott (1777-1841), the engraver, and brother of David Scott, the painter {Ency. Brit. xxi. 543), was born in Edinburgh, 12th September 1811. While a young man he studied art and assisted his father, and he published verses in the Scottish magazines. In 1837 he went to London, where he became sufficiently well known as an artist to be appointed in 1844 master of the Government school of design at Newcastle-on-Tyne. He held the post for twenty years, and did good work in organizing art-teaching and examining under the Science and Art Department. He did

much fine decorative work, too, on his own account, notably at Wallington Hall, in the shape of eight large pictures illustrating Border history.

with life-size figures, supplemented by eighteen pictures illustrating the ballad of Chevy Chase in the spandrels of the arches of the hall. For PenhiU Castle, Perthshire, he executed a similar series, illustrating The King's Quhair. After 1870 he was much in London, where he bought a house in Chelsea, and he was an intimate friend of Rossetti and in high repute as an artist and an author. His poetry, which he published at intervals (notably Poems, 1875, illustrated by etchings by himself and Alma- Tadema), recalled Blake and Shelley, and was considerably influenced by Rossetti ; he also wrote several volumes of artistic and hterary criticism, and edited Keats, "L.E.L.," Byron, Coleridge, Shelley, Shakespeare, and Scott. He resigned his appointment under the Science and Art Department in 1885, and from then till his death (22nd November 1890) he was mainly occupied in writing his reminiscences, which were published posthumously in 1892, with a memoir by Professor Minto. It is for his connexion with Rossetti's circle that Bell Scott will be chiefly remembered.

Scranton, a city of Pennsylvania, U.S.A., capital of Lackawanna county. It is situated in 41 24' N., and 75 43' W., on the river Susquehanna, in the north-eastern part of the state, at an altitude of 738 feet. The city is well laid out with broad streets, is divided into 21 wards, is well paved (mainly with asphalt), has a good water-supply, and is well sewered. It is entered by five railways, the Central of New Jersey, the Delaware and Hudson, the Delaware, Lackawanna, and Western, the Erie and Wyoming Valley, and the New York, Ontario, and Western, which afford ample facilities for traffic. Scranton is in the heart of the anthracite coal region, and its industries relate to coal-mining and iron manufacture. In 1900 it contained 710 manufacturing establishments, in which was invested a total capital of $19,954,525. They employed 12,669 hands, and the product was valued at $27,646,418. Of this amount $10,231,139, or 37 per cent., consisted of iron and steel goods. Silk was manufactured to a value of $3,616,885, and foundry and machine shop products to a value of $1,755,909. It is perhaps the chief centre of

distribution of the anthracite coal product of the country. In 1900 the assessed valuation of real and personal property was $23,354,046, on a very low valuation ; the net debt of the city was but $747,463, and the rate of taxation was $38.70 per $1000. Population (1890), 75,215, showing 64 per cent, increase on the preceding ten years; (1900), 102,026, of whom 28,973 were foreign-born and 521 negroes. Of 28,075 males 21 years of age and over, 2985 were iUiterate (could not write).

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DURING the last quarter of the 19th century a great change came over British sculpture ❓❓❓ a change so revolutionary that it gave a new direction to the aims and ambitions of the artist, and raised the British school to a level wholly unexpected. It cannot be pre- tended that the school equals, in technical accomplishment or in richness or elasticity of imagination, the schools of France and Belgium, for these have been built up upon the example of national works of many genera- tions of sculptors during several centuries. British sculptors found themselves practically without a past of their own to inspire them, as there is no truly national

tradition; so that with them it was simply a case of beginning at the beginning.

The awakening came from without, brought to England mainly by a Frenchman ❓❓❓ ^Jules Dalou (d. 1902), and two Englishmen who had studied abroad, Alfred Gilbert and Onslow Ford. To Carpeaux, no doubt, the new inspiration was in a great measure due ; for Carpeaux, who infused life and flesh and blood into his marble (too much of them to please the lovers of purism), was to his classic predeces- sors and contemporaries much the same that in painting Delacroix was to David and the cold professors of his formal school. But it was to Jules Dalou that was chiefly due the remarkable development in Great Britain. A political refugee at the time of the Commune, he received

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a cordial welcome from the artists of England, and was invited to assume the mastership of the modelling classes at South Kensington. This post he retained for some years, until the amnesty for political offenders enabled him to return to his native land; but before he left, he had improved the work in the schools beyond all recognition. The whole conception of sculpture seemed to be modified, and intelligent enthusiasm was aroused in the students. When he departed, he left in his stead Professor Lant^ri, who became a naturalized Englishman, and who exercised an influence equal to that of his predecessor. Meanwhile, the Lambeth Art Schools ❓❓❓where Mr W. S. Frith, a pupil of M. Dalou, was conducting his modelling class under the directorship of Mr John Sparkes ❓❓❓were being maintained with great success. And latterly at the Eoyal Academy, where in 1901 the professorship of sculpture was revived after many years, the inspiring genius of Mr Alfred Gilbert aroused in the students an enthusiasm curiously contrast- ing with the comparative apathy of earlier days. British sculpture, therefore, when it is not coloured directly from the Italian Kenaissance, is certainly influenced from France. But it is remarkable that in spite of this turning of British sculptors to romantic realism as taught by Frenchmen and Italians, and in spite of the fact that the spirit of colour and decoration and greater realism in modelling, had been brought from abroad, the actual character of British sculpture, even in its most decorative forms, is not in the main other than British.

*Nevertheless, there has been shown a strong tendency towards reviving the application of colour in sculpture which has not met with universal approval. Revival^ Although the polychromatic work of the Ee- cbromatic naissance, for example, may keep its place, it is sculpture held to clash with the idea of sculptural art ; ’””’❓❓❓**^’” for though there is no absolute approach to imitation, there is a very strong suggestion of it. The use of a variety of marbles and metals, or other materials, such as has been increasingly adopted, does not offend in the same measure, as the result is purely formal. Yet, in the final result, the work becomes not so much sculpture as an “object of art.”*

Indeed, the sculptor has been greatly reinforced by the artificer in metal, enamel, and the hke. But the revival of metal-work, cut, beaten, and tvidsted, however fine in itself, does not help sculpture forward very much. It may even keep it back ; for popular and beautiful as it is, it really tends to divert the attention from form to design, and from light and shade, with planes, to ingenuity, in pleasing lines ??? a very beautiful and elevated art, but not sculpture. As an adjunct, it may be extremely valu- able in the hands of a fine artist who does not mistake the mere wriggles and doublings which are the mark of the more extravagant phase of the so-called " New Art," for harmonious "line." But it must always suggest the man with the anvil, shears, and pincers, rather than the man with the clay and chisel. It is mainly to Mr Alfred Gilbert, KA., that is due the delightful revival of metal-work in its finest form wedded to sculpture, vnth the introduction of marbles, gems, and the like, felicitous and elegant in invention and ornament, and so excellent in design and taste that in his hands, at least, it is subservient to the monumental character of his sculpture.

The first effectual rebellion against the Classic, and the birth of Individualism, dates back to Alfred Stevens (1817-1875; see 9th edition, vol. xxi. p. 561). The picturesque fancy of the Frenchman Koubiliac (1703- 1762), vrith his theatrical arrangement and skilful technique, had left little mark on the Englishmen of his day. They went on, for the most part, with their pseudo-classic

tradition, which Flaxman carried to the highest point. But until Stevens, few in England thought of instilling real life and blood and English thought and feeling into the clay and marble. It was not only Hfe that Stevens realized, but dignity, nobility of form, and movement, previously unknown in Enghsh work. Fol- lower though he was of Michael Angelo and '"^^ the Italian Renaissance, he was entirely per- a.h.a. ' sonal. He was no copyist, although he had the Italian traditions at his fingers' ends, and his feeling for architecture helped him to treat sculpture with fine decorative effect. Yet even Stevens and his brilliant example were powerless to weaken the passion for the Greek and Roman tradition that engrossed English sculp- tors ??? with their cold imitations and lifeless art, pursued in the name of their fetish, "the Antique."

Until towards the close of the 19th century this pseudo- classic art was blindly pursued by a non-Latin race, and a public favourite like W. Calder Marshall, R.A. (1813-1894) never attempted, except perhaps in j^;^^^*' the "Prodigal Son," to break away towards u_^_ ' originality of thought.

Thomas Woolner {q-v.), who had represented a modern heroine as a Roman matron, and had shown in his monu- ment to Bishop Jackson in St Paul's Cathedra) an archaic severity and dryness altogether ex- n'^_ '

cessive, sought elevation of conception such as brought him applause for his " Tennyson " in portraiture and for his "Virgilia Lamenting the Banishment of Coriolanus " ❓❓❓ probably his most admirable and most ex- quisitely touching work.

Meanwhile, Baron Marochetti, E.A. (1805-1867), an Italian of French parentage, had tried to introduce a more modern feeling, and his " Richard Coeur de Lion " at Westminster evoked great enthusiasm. Baron It is difiicult, now, to admire the incongruity of n.^. '

the 12th-century king, mounted on a modern thoroughbred, and raising arm and weapon with an action devoid of all vigour. The intention was excellent and fruitful, notwithstanding, and the statue is not without merit. Later Charles Bell Birch, A. R.A. (1832-1893), with his German training, mtro- -J;'"" duced a new picturesque element in his " Wood Nymph," " Retaliation," " The Last Call," and the " Me- morial to Lieut. Hamilton, V.C, dying before Kabul"; but neither the vigour nor the_ individuality of his work in- fluenced his contemporaries to any extent, doubtless on account of the German aspect in it, the outcome of his training.

Sir J. Edgar Boehm, R.A. (1834-1890), an Austrian by birth, was more successful, and his influence, helped by the talent of able studio-assistants (Professor gi^j Lant&i, Mr Alfred Gilbert, and others), contri- Edgar buted somewhat to thaw the chill which the cold Boebm, marble still seemed to shed around. There was "❓❓❓'❓❓❓ not much inspiration in his monument of " General Gordon" in St Paul's Cathedral, and his "Wellington Memorial" is cold and empty, though correct enough; but the " Herdsman and Bull," among his ideal subjects,*

the “Carlyle” on Chelsea Embankment, among his portrait- statues, had the right feeling in them.

J. H. Foley, R.A. (see vol. ix., 9th edition), who at first was all for “the unities” and a “pure style,” seemed in his later years to throw his previous convictions to the winds, when he produced the finely spirited equestrian statue of “General Sir James Outram,” now erected in India. This statue was welcomed with enthusiasm in the art-world, and helped to remind the public that monuments need not be staid to dulness, nor stiff and dead in their imperturbability.

*‘^*

*Alfred Dkury, A.H.A.**Ev<;u.*

, THOMAS CARLYLE

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AT

Thomas Brock. R. A. *Lord Leiirhton Memorial, St Paul’s Cathedral.*

*John JI. Swan, A. R.A.**Lt’i>i)nr*

*a. F. Watts, R.A.**Clytie.*

Sir J. Edgar Boehm, B.A. *Carlyle.*

*\V. R. CoLTON**The Crown of Love,*

*Thomas Brock, R.A.**The Genius of Poetry.*

*SCULPTURE. Plate I.**BRITISH {a).*

*G. Feampton, R.A,**Dame Alice Owen.*

W. Hamo Thornycroft, R. A. ⬛⬛⬛Dean Colet.

Lord Leighton, P.R.A.⬛⬛⬛ The Sluggard.

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H. Bates, A.R.A.⬛⬛⬛ Homer. {From a Photograph hy Frederick Holhjcr.)

H. H. Armstead, R.A. Lieutenant Waghorn.

G. F. Watts, R.A. ⬛⬛⬛Hugh Lupus. SCULPTURE. Plate II.⬛⬛⬛ BRITISH [b).

A. Gilbert, R.A. ⬛⬛⬛Icarus.

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Meanwhile Mr Henry Hugh Armstead (b. 1828 ; R.A. 1879), in 1902 the oldest of the living exhibiting sculptors

(Mr G. F. Watts is dealt with later), who had ^^^j"^⬛⬛⬛' begun by devoting himself to the art of the First ap- 'silversmith, fashioning the " St George's Vase," pearance " The Packington Shield," and " The Outram hmti n' ^^i^l^'" '^^^ working in the spirit of the younger (jssf). school. He was carrying out commissions of*

great magnitude ⬛⬛⬛ in the Palace of Westminster, and in the Abbey itself, for which he executed the marble teredos with its many figures, the whole of the external sculptural decorations for the Colonial Office in Whitehall, as well as the eighty-four life-sized figures on two sides of the podium of the Albert Memorial, with the four bronze statues, "Chemistry," "Astronomy," "Medicine," and "Rhetoric." Portrait-figures of all ages are here classed together, and the work is a better-sustained

piece of designing and carving than is commonly understood. The statue set up at Chatham of ” Lieutenant Waghorn ” is a good example of Armstead’s sculpture, impressive by its breezy strength and pioturesqueness ; but a more remarkable work, technically speaking, is the memorial to a son of the earl of Wemyss, ” David and the Lion,” now fixed in the Guards’ Chapel. It is in very flat relief; Ninevite in character of treatment, and carved wholly by the artist directly from the living model, it is, in point of technique, one of his best productions. The work of Mr Armstead is monumental in character ??? the quality which has been so rare among British sculptors, yet the finest quality of all ; and in almost everything he does there is a ” bigness ” of style which assures him his place in the British school.

Following the chronological order of the artists’ first public appearance, as being the most convenient and the only consistent method that will prevent overlapping, we come to Mr F. J. Williamson (b. 1853), who executed Q ^ many works for Queen Victoria; Mr John

Lawson, Hutchison, R.S.A. (b. 1856), a Scottish sculptor H.R.s.A. of the Classic school ; and Mr George A. Lawson, 0862). H.R.S.A. Mr Lawson was a pupil of Alexander Ritchie, of the Royal Scottish Academy, and in a measure of Rome. Born in 1832, he came to London in 1867, and soon proved himseK one of the best sculptors Scotland has produced. ” In the Arena ” was his first striking group. ” Daphnis ” is an excellent example of his Classic life-size work ; and ” Motherless,” one of his greater successes in a more modern and pictorial spirit, a group full of pathetic pathos and free and sympathetic handling. ” Callicles,” the weary ” Danaid,” ” Old Marjorie,” and the statue of ” Robert Burns,” erected at Ayr???-are all in their way remarkable. Mr Lawson’s work, which only requires a little more animation to be very fine, has the quality of ” style,” and is strong, manly, and full of distinction.

Mr George Simonds (b. 1844) is a product of the foreign schools. He is the author of many monumental

works and not a Httle decorative sculpture, but nfem””^^^^ is best recognized by ideal subjects, such as ^ ” ” The Goddess Gerd,” ” The

Falconer ” (in the Central ❓❓❓ Park, New York), ” Cupid and Campaspe,” and “Anemone, the Wind Flower.” His treatment of the undraped female figure is refined and delicate, and there

is an intellectual reality about his best work, A. Brace- g^g ^gjj ^g imagination in conception. Mr A.

Bruce-Joy (b. Dubhn, 1842) has produced ideal work and statues of our public men for public spaces.

Mr Thomas Brock (b. 1847), the amount of whose work is prodigious, as well as solid and scholarly, came to London from Worcester in 1866, and entered as a pupil the studio of Foley, whose ablest assistant he soon became, and

thus feU early under the influence of the sculptor who was soon to rebel against the formalism that prevailed. Had he gone on he would have become a second Foley ; in fact, when his chief died, in 1874, Mr Brock Thomas was appointed to carry out the great unfinished ~~^^g^/ works in the studio ❓❓❓ the ” O’Connell Monu~~ ment ” in Dublin, the ” Lord Canning ” in Calcutta, and several others. But he felt the foreign current ; and even when his style was formed, his career being already assured, he was perceptive enough to modify it, and, so developed, he left his master very far behind. The ideal work that marked this transition was ” The Moment of Peril,” a fine, scholarly work representing a mounted Red Indian repelling the attack of a great serpent which has thrown his horse to earth. How greatly he improved in technical quality and in refinement of taste is to be seen in the life-sized marble statue called ” The Genius of Poetry ” ❓❓❓ graceful where the ” Moment of Peril ” was violent in action, reposeful and harmonious where that was vigorous, and sculpturesque where that was anecdotal. A stiU higher intellectual point was reached in “Song” and in the ” Eve,” now in the Tate Gallery in London. A similar advance is to be observed in the portraiture of Mr Brock. The statues of ” Robert Raikes ” (on the Thames Embankment) and ” Sir Richard Temple ” (in Bombay Town Hall), for example, are finely treated, unconventional figures ; but ” The Rt. Rev. Henry Phil-potts, D.D., Bishop of Worcester,” in which the inherent difiiculty of a

seated figure is happily surmounted, marks the progress. The skill with which the artist has given the drapery, especially of the sleeves, a lightness not commonly seen, is striking. There are no black holes of shadow : the depressions are shallow and of the right shape to hold hght even while securing shadow; yet weakness is avoided and crispness is secured by the sharpening of the edge of the folds ??? the principle which is established in the Pheidian group of " The Fates," for example, among the Elgin Marbles. Other works of importance in the same class are the effigy of " Dr Benson, archbishop of Canterbury," and the admirable statue of " Sir Richard Owen " in the Natural History Museum, South Kensington, both of a high order whether as to character or handling. The bust of " Queen Victoria " is one of the noblest and most dignified works of its class executed in England ; full of tenderness and of character, lovingly rendered ; and with a delicate feeling for form, rightly realized. This head heralded the noble work by which the memory of Lord Leighton is to be kept green in the aisle of St Paul's Cathedral. In proportion and in harmony of design and of hne, alike in conception and in reticence, it is the sculptural expression of a well-ordered mind and taste. The effigy shows Leighton asleep, while figures personifying his arts, painting and sculpture, guard his sarcophagus at head and foot. There is a note of triumph in the great design for the " Queen Victoria Memorial," which is likely to provide London with its most elaborate sculptural efibrt, rising 70 feet high in a plateau 200 feet across, with numerous emblematical figures of great size and imposing arrangement. In Mr Brock's work the lines are always good. It is based on an elevated style, dignified, refined, and monumental ; for he is a sculptor in the fuU sense of the term.

Mr D. W. Stevenson, R.S.A. (b. 1842), in his general work has shown but little sympathy with modern develop- ments. The "Bronze Lectern" (in St Cuth-??? ^ bert's Church, Edinburgh) is perhaps the moat s'tevensoa, decoratively effective; but his most ambitious i?.S. A. work, called "The Pompeian Mother," is a <'???>??? modern inspiration of the " Nlobe and her Daughter " by a follower of the school of Scopas in the Uffizi Gallery.*

S. VIIL ??? 6o

Although Mr Horace Montford, modelling-master at the Eoyal Academy, passed much time in the studio of

*Matthew Noble (1818-1876), he did not thereby /’ dasTff) ‘**^ ^’** sculptural taste. Not that he displayed*

*it much in the share he had, as assistant to Mr Birch, in the modeUing of the notorious ” City Griffin ” at Temple Bar *** a weird but spirited beast, the design for which had been supplied by the City architect. Sir Horace Jones. The statue of ” Psyche and the Casket of Venus ” may be named as typical of the style of Mr Montford, whose work is usually broad and sculpturesque, and dis- tinguished by firmness and grace.*

*Sir Charles B. Lawes (b. 1843) has produced two large works which have attracted attention *** the first an elaborate*

and spirited equestrian group of a female sirC.B. Mazeppa, “They Bound me On” (1888), and ysro^’^”^** other “The United States of America”*

(1890), decorative and not without elegance. His work is strong and robust, though somewhat lacking in repose.

MrW. Hamo Thornycroft (b. 1850; A.R.A. 1881 ; E.A. 1888), a pupil of his father and at the Royal Academy, Hamo ^^ studied in Italy while yet a lad. Believing Tbomy that the pendulum had overshot the swing from croft, R.A. conventional classicality towards pictorial realism, (1871). j^g turned from this “fleshlyschool,” as represented by Carpeaux, towards the Greeks, but he realized the artistic demand and aspirations of modern days. When his prize work, ” A Warrior Bearing a Wounded Youth from the Field of Battle,” was seen in the Eoyal Academy Exhibition, it divided attention with Woolner’s ” Tennyson ” and Alfred Stevens’s ”

Wellington." Mr Thornycroft aimed at the cunning contrast of the mature and the youthful naked forms ??? the tense muscles of the one, and the supine, languorous limbs of the other. " Lot's Wife " (1878) shows none of the prettiness prevailing at the time it was produced, in the rendering of the female form. The fine structure and vigorous modelling of the turned head, the twisted neck with its tense muscles and the strong shoulder, emphasized the pure taste and sense of style of the sculptor. The dramatic action is daring ??? Lot's wife, with her snatched-up jewels, has turned her head to look, and her lower limbs and drapery are already beginning to take columnar form, as her whole being is struck cold with the sudden transformation. Then came " Artemis " (1879), a surprise to those who imagined that they had taken their measure of the sculptor's exceptional power. The attitude and arrangement are original. From every point of view the group is beautiful ; the forms and the head are nobly conceived ; and the dog is a good piece of animal life, freely, though statuesquely, treated. Two years later Mr Thornycroft reached the high-water mark of his career with " Teucer." The Homeric bowman, mortified, and eager to redeem his eightfold failure to hit his man, has let fly one shaft more at Hector ??? and, retaining his attitude, tense and strained, he watches his last arrow in its flight. This figure, simple and severe, is realistic yet classic, instinct with life, and noble in form. It is now in the Chantrey Collection at the Tate Gallery. The great exterior frieze for Mr John Belcher's fine building for the Institute of Chartered Accountants was an important revival of the attempt to set the example of using sculpture by sculptors, instead of by masons, for the worthy embellishment of public buildings ??? an example that promised to be widely followed.

Turning to the ideal, in works entirely modern in motive and treatment, Mr Thornycroft produced " The Sower," a semi-reaUstic statue in which he sought to combat the difficulty of dress in the British peasant or farm labourer. The head, inclined to be classic, is not

unsuited to the labourer ; and what the sculptor loses in form, by reason of the design, he gains in action and in movement. "The Mower" ??? the British equivalent to Constantin Meunier's Flemish or Walloon labourer or workman ??? is strong and natural in pose, incisive in

character, although but a type, masterly in modeUing and in restrained suggestion of textures. The ” Dean Stanley Memorial,” erected in the old church at Holyhead, seems purposely to depart from the severity of line and solemnity of treatment usual in such works. The memorial of the ” Bishop of Carlisle ” is at once more grave and more fanciful. This leads to Mr Thornycroft’s portrait- statues ❓❓❓ the ideal and the real. An admirable example of the real, the ” General Charles Gordon ” in Trafalgar Square, is suggestive of the masterfulness, dignity, and quiet self-confidence of the hero, and is one of the best portrait-statues in England. Prominent among the ideal statues is the colossal ” Oliver Cromwell ” at Westminster ❓❓❓ heavily handled in order to fit the character of the subject, and stolid in dignity and latent energy. The memorial to ” Dean Colet,” quaintly recalling Donatello or Verrocchio, appeared in its completed form in the Eoyal Academy of 1901 ; it is an illustration of the dignity, ease, and simplicity in Mr Thornycroft’s more ideal work, for it has in it much of the feeling of the Italian school at its best period, by reason of the quietness, quaintness, and charm in its unostentatious arrangement In Mr Thornycroft, then, we have to appreciate an un- affected S3mipathy with grandeur and style, and in all, a big, broad rendering of the human form, with something of the movement of the Greek sculptors and not a little of their repose, yet individual and unmistakably belonging to the British order of mind.

*❓❓❓ From the year 1873, Mr Eoscoe Mullins produced numerous busts and statues, and his work was in the main ideal and decorative. His best figure is probably that of ” Cain ❓❓❓ My Punishment is ‘ *^^ Greater than I can Bear,” executed in 1896. (1873). In architectural embellishment Mr MuUins’s work is good in style, appropriate, and effective.*

Mr Swynnerton is a sculptor who has spent a good deal of his time in Eome and worked under her influence. His colossal fountain of flowers, zephyrs, and splashing nymphs is, on the contrary, rather rococo in style, Z^”’ with charming passages. On the other hand, (j873). ” Love’s Chalice ” is classic in feeling. Generally speaking, Mr Swynnerton’s work has an appearance of strength, without commonness or lack of effect.

Onslow Ford (1852-1901; A.E.A. 1888; E.A. 1895) ◆◆◆ who was lost to British art before he had passed middle age ◆◆◆ became known by winning the competition for the statue of ” Eowland Hill,” ◆◆◆? ◆◆◆ ◆◆”^’◆◆Z

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now erected outside the Eoyal Jixcnange, London; ys/j). but he made his first real success with his seated life-sized figure in marble of ” Henry Irving as Hamlet,” now in the Guildhall. It is a well-conceived piece of realism, with expression subtly marked, and verging upon the theatrical ◆◆◆ which is precisely what an actor’s character- portrait should be. Compared with this work, a later seated statue, that of ” Huxley,” keen and refined, is more strictly sculpturesque ◆◆◆ for in it there is no ” subject,” and there are no ornaments to divert the attention and suggest a false appearance of decoration. The well-known statue of ” Gordon,” camel-mounted ◆◆◆ reminding us of the “Arab Chief ” by Barye ◆◆◆ is more open to criticism on the score of the elaborateness of the ornamental details, which almost reach the boundary of what is allowable in sculpture. It is erected at Chatham and a replica has been set up (1902) in Khartum. A finer memorial is that to the honour of “Shelley” ◆◆◆ better in its parts tJian in its entirety,

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because the decorative scheme injures, rather than helps, the sculptural dignity of the drowned poet’s exquisitely- rendered figure. This monument is at University College, Oxford ; but the replica of the figure, with a plain base, erected on the shore at Viareggio, where the body of Shelley was found, is perhaps finer, because a simpler and more perfectly proportioned work. Of Onslow Ford’s other memorials, that of ” Queen Victoria ” at Manchester is perhaps the most discussed. Although it does not rank by any means with the best of which the artist was capable, the

conception is dignified and characteristic. As a truthful portraitist Onslow Ford had few rivals. The busts of " Sir John Millais " as president of the Royal Academy, and of other distinguished artists, of " Sir Frederick Bram well," "Herbert Spencer," "Queen Victoria," " A. J. Balfour," and very many others, show his talent for producing speaking likenesses. The sitter is before the spectator, without undue flattery, yet without ever show- ing the commoner side of the model. Flesh, bone, hair, clothing, are all in their true relation, and the whole is admirably realized. Idealism, or at least poetic realism, Onslow Ford cultivated in a considerable series of small works. "Folly," "Echo," "Peace," were varied by the severer "Egyptian Singer" and "Applause." His last figure, "Glory to the Dead," though statuesque, carries realism rather far in treatment. It might be objected that in funerary art, so to call it, the nude was never resorted to by the Greeks in such a relation ; but Onslow Ford felt that he was working, not for ancient Greeks, but for modern Englishmen, and that sentiment, and not archaeology, must in such matters be the guide. Among Onslow Ford's chief works not yet mentioned are the seated statues of " Dr Dale " and the "Duke of Norfolk." The chief of the standing statues is perhaps the " W. E. Gladstone " at the City Liberal Club, London ; the principal equestrian statue, the "Lord Strathnairn," Knightsbridge, London; and the most ambitious monument, that to the " Maharaja of Durbarjah." There are, besides, the " Marlowe Memorial," set up in Canterbury, and the " Jowett Memorial," a wall decoration, in the style of the Italian Eenaissance. The work of Onslow Ford always charms, for he had a strong sense of the picturesque and a true feeling for beauty. But for his delight in decorative detail, he would have been greater than he was ; for over-enrichment is in inevitable opposition to the greater qualities of the monumental and the dignified in glyptic art, and abundance of small details involves poorness of effect. But against Ford's taste, especially against his admirable dexterity, little need be said. The high degree of refinement, the charm of modelling, grace of line and composition, sweet- ness of feeling, which are the note of his work, are in a great measure a set-off against occasional weakness of design and character.

Mr Hope Pinker is primarily a portrait-sculptor. Among all his works the seated statue of "Dr Martineau" is

perhaps the best, for interest, refinement, and Pinker ‘^ technical qualities. His reliefs are as (I87S). numerous as his statues, of which the most

popular is the ” Henry Fawcett ” in the Market Place of Salisbury, but his most important work is the colossal statue of Queen Victoria executed for the Govern- ment of British Guiana.

The most remarkable work executed by any British

amateur-sculptor is the ” Shakespeare Memorial,” q”’”’-^’ presented to the nation by Lord Ronald Gower, (,1876). and set up by him outside the Shakespeare

Theatre at Stratford-on-Avon. This monument, carried out in Paris, represents the poet on the summit, attended below by the four great characters ??? ” Hamlet,”

“Henry V.,” “Lady Macbeth,” and “Falstaff,” designed with singular ability. Lord Ronald has also modelled statues of ” Marie Antoinette,” ” The Dying Guardsman,” and other works which have secured wide attention.

In 1877 there burst upon the world a new sculptor, in the person of Sir Frederick (afterwards Lord) Leighton (q.v.), who, in the following year, was to be the ^^^^^ president of the Royal Academy. His first work Leigbtoa, was ” An Athlete Struggling with the Python,” to P-B-^- which a brief allusion was made in the 9th edition ^ ^’ (vol. xxi. p. 561). No piece of sculpture of modern times made a greater stir on its appearance ; for here was a work by a painter, a work, it was declared, which would have done honour to the ancients, fine in style, noble in type and in form, learned in the knowledge of the figure it displayed, original and strong in pose, in action, and movement ; scholarly in execution and instinct, with the manner of the painter himself. The group was hailed as a masterpiece by one who was thought to be not yet even a student in sculpture. Yet it is somewhat lacking in expression ??? in that kind of humanity which every really great master- piece of art should exhibit ; and connoisseurs applauded the technique, the surface qualities, and the like, when they

should have been caught by the sentiment. But as Leighton was seeking only the beauty and expression of form, to the neglect of sentiment, he was well content with the reception and world-wide recognition of his work. One day the model for the " Athlete," tired out, rose and stretched himself, and the sculptor was so enraptured by the pose that he forthwith began the model for "The Sluggard." This work is in its way of stiU higher ac- complishment than the " Athlete." It is just as Greek in its devotion to form and its worship of the beauty of the human frame. But it is a condition, a sensation, an idea, rather than an action, that is here recorded ; and so it is the higher conception. And it has some of the mystery which is distinctive of the finest art of ancient times, but in which modern sculpture is almost entirely deficient. Yet while the "Athlete" may be compared, in idea, with the relatively debased "Laocoon," which it seems in some degree to foUow if not to challenge, the " Sluggard " belongs to a more elevated expression of a distinctly pagan art, and, as it were, to a better period. Great as was the sensation made by these works, and by the charming statue of " Needless Alarms " (cast by the " waste-wax " process), Leighton seems to have left no direct follower or imitator among the younger men.

Mr Stirling Lee, by natural ability as well as by cultivation, is an artist of unusual elevation of mind and excellence of execution, and in his composition he aims at securing beauty by the arrangement T.'/^'J^^" of his figures in the panel, rather than at enrich- ing them with detaUs, as a designer would do. He is an ascetic in choice of materials, so that his works generally remain beautiful studies of the human form, draped or undraped. It is for his power of telling a story beautifully in marble ❓❓❓ as in his panels for St George's Hall, Liverpool^ which are among the finest work of their kind in England ❓❓❓ that Mr Lee wiU continue to be admired : he is, beyond almost all others, a sculptor's sculptor.

Mr John M. Swan, (b. 1847 ; A.E.A. 1897 ; A.R.W.S. 1896), a pupil of the Royal Academy and of M. G^r6me and Fr^miet, has specialized as a sculptor of a particular class of subject. He is a stylist i-aJ-^-Swan, a high degree, whose work is full of beauty and fi'j' importance. For the most part his sculptures are studies of animals, mainly of \h.e> felidae ; but Mr

Swan passes from the accentuation of action to the covering of skin and hair, without seeking much to emphasize the bone and flesh, because they alone display, with the

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fascinating expressiveness of their sinuous bodies, the whole range of the passions in the most concentrated form. In the “Leopard Playing with a Tortoise,” “Leopard Running,” ” Puma and Macaw,” and similar works, we have the note of his art ◆◆◆ sinuosity, with tense muscles, stretched and folded skin, suppressed frenzy of enjoyment. The note of Barye, the great Frenchman, from whom in some measure Mr Swan drew inspiration, is power and strength and decorative form, but Mr Swan aims rather at fine, grim, naturalistic studies of a great cat’s crawl, with vivacity and vitality.

Another student of animal life is Mr Harry Dixon, whose bronze ” WUd Boar ” is in the Tate Gallery. ” A

Bear Eunning,” excellent alike in character, form, assi^”” ^^^ construction, and especially in movement,

” Otters and Salmon,” and the figure-subject called ” The Slain Enemy ” ◆◆◆ a prehistoric man with a dead wolf ◆◆◆ are among his chief works.

Mr Andrea Lucchesi is one of the few who, in spite of all discouragement, has not only persisted in concentrating

his attention, on ideal work, but has devoted J ◆◆◆. most of it to the rendering of the female form. 11881). Prominent among his figures are those called

“Destiny,” “The Flight of Fancy,” “The Mountain of Fame,” and “The Myrtle’s Altar.” Mr Lucchesi’s main excellence is in the treatment of nude forms, in which he has succeeded, through agreeable idea and excellent execution, in interesting a public usually indifierent to this branch of sculpture.

Mr Alfred Gilbert (b. 1854; A.R.A. 1887; R.A. 1892; professor of sculpture, R.A., 1900) is one of the greatest

figures in British sculpture, not only as being a ff 4 master of his art, but as having preached in his

(1882). work a great movement, and in less than a

decade effected more than any other man for the salvation of the British school and influenced, quite as much as Carpeaux or Dalou, the young sculptors of the country. After acting as assistant to Boehm, he studied at the Beaux Arts under Cavelier, and then worked in Rome. His chief production there was the beautiful group of the ” Mother and Child,” produced when the classic sculptors of that city were immersed in the spirit of antiquity. This work brings to mind the teaching of the French school, and makes an irresistible personal appeal to the emotion and sympathy of the spectator. Mr Gilbert then produced “Perseus Arming,” “Icarus,” “The Offering of Hjonen,” two fine heads of a man and a girl, pure in style and incisive in character ??? most of which were cast by the cire perdue, or “waste-wax,” process, which he had learned in Naples. Its introduction into Great Britain had consider- able influence on the treatment of bronze sculpture by British artists. In Mr Gilbert’s portraiture we have not merely likenesses in the round, but little biographies full of character, with a spiritual and decorative as well as a physical side, and the mental quality displayed with manly sympathy. Flesh and textures are perfectly realized, yet broad, simple, and modest. Many of these qualities are as obvious in his portrait-statues, such as the fine efligy set up to ” John Howard ” in the marlvet-place of Bedford. The highly original pedestal has done a good deal to direct into a better channel what are apt to be the eccentricities of what is called the “New Art” school. But the monument with which Mr Gilbert’s name will over be associated is the magnificent ” Statue of Queen Victoria ” erected at

Winchester. The queen is shown with extra- ordinary dignity. Large in its masses, graceful in its lines, the person of the queen enveloped by all the symbolical figures and fanciful ornaments with which the artist has chosen to enrich it, the monument marks the highest level in this class to which any sculptor and metal-worker has

reached for generations. The profusion of an ardent and poetic imagination is seen throughout in the arrangement of the figure itself, in the exquisite " Victory " that sur- mounts the orb, in the stately throne. Invention, origin- ality, and inspiration are manifest in every part, and every detail is worked out with infinite care, and birth is given to a score of dainty conceits, not all of them, perhaps, entirely defensible from the sculptural point of view. In a measure it suggests goldsmithry, to which the genius of Mr Gilbert has so often jdelded, as in the exquisite epergne presented to Queen Victoria on her jubilee in 1887, typifying Britannia's realm and sea power in endless poetic and dainty suggestions of beautiful devices. Among Mr Gilbert's memorials are those to " Frank HoU, R.A.," and to "Randolph Caldecott," both in the crypt of St Paul's Cathedral, London ; the " Henry Fawcett " memorial in Westminster Abbey, which, with its row of expressive little symbolical figures, has been styled " a little garden of sculpture " ; and the finest work of its kind in England, the " 'Tomb of the Duke of Clarence " in St George's Chapel. Among Mr Gilbert's other works which should be mentioned are " The Kiss of Victory," " The Enchanted Chair," the statue of "Lord Reay" at Bombay, and the " Shaftesbury Fountain," London. Few artists in any age have shown greater genius as at once sculptor and artificer. Mr Gilbert is fond of dealing with a subject which allows his fancy full play. His work is f uU of colour ; it is play- ful and broad. "The smallest details are big in treatment, and every part is carefully thought out and most ingenious in design. His playfulness has caused him at times to be somewhat too florid in manner ; but his taste is so just, that he has safely given rein to his fancy where another man would have run riot and come to grief.

Mr Robert Stark is an animal sculptor who has usually attracted the notice of connoisseurs rather than of the greater public, and his fine bronze statuette of an " Indian Rhinoceros " is to be seen in the (jgg^ Chantrey Collection. Mr Stark has a profound knowledge of animal

anatomy ; his range is considerable, and he is as easy with a rhinoceros as with a cart-horse or a hunter.

Mr Conrad Dressier is best known for his busts of distinguished men, but his statue of "A Girl Tying up her Sandal," and his two large marble panels for St George's Hall, Liverpool, assTired tim ^'J^g^"^" his position. There is a cleverness, a daring, in his marked style, vigour of treatment, and a tendency towards emphasis, especially in his decorative work, much of which is designed for execution in DeUa Robbia ware.

Harry Bates (1850-1899; A.R.A. 1892), at first a carver's assistant, and then a pupil of the Royal Academy Schools and of Dalou and Rodin, made his first impression with the bronze relief of " Socrates ^- Bates, Teaching the People in the Agora," which pro- f{^gj^' claimed a new sculptor gifted with imagination and romantic feeling controlled, as it were, by classicism. In the three bronze panels on the subject of the " ^Eneid " which he exhibited in 1885, he gave the second of those admirable reliefs by which his name is best known, and will remain best known, to the public, for many years to come. Then followed his great panel, " Homer : A Blind Old Man, and Poor ??? Sweetest he Sings." In this work, with its balance and dignity, its rhythmical line and fine expression, is to be seen a flexibility which few young Englishmen had shown up to that time. Style and a genuinely modern treatment of classic form which is not weakened by touches of naturalism, were also to be recognized. Nor does the background detract from the main subject ??? Homer and Humanity in front ; and behind,

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A, Gilbert, R.A. ??? St.Ttue of Queeii Victoria.

E. OssLow Ford, R. A. ???Shelley Memorial.

AV. Hamo Thornycroft, R.A. ??? Teucer.

F. W. PoMEROY??? The Nymph of Loch Awe.

A. Toft ??? Hagar.

C. B. Birch, A.R.A. *The La.st Call,*

SCULPTURE. Plate III. *BPJTISH (c).*

GoscOMBE John, A.R.A. *St John the Baptist.*

J. Q. A. Ward *George Washin^'ton.*

D. G. French *Indian Corn ; Bull by E. C. Potter.*

Augustus St Gaudens *Momorial to Robert Gould Shaw.*

Frederick MacMonniks- Xatlian Hall.

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SCULPTURE. Plate IV. *AMERICAN.*

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a vision of the Partherion and Pallas Athene, and the great Sun of Art rising with the dawn of Poetry. " Psyche " (1887) is more delicate in thought and treatment, but it has little of the originality or force of the " Homer," or of the classic style in the head called " Khodope." The serene and reposeful statue of " Pandora," about to open her ivory casket, successfully achieves the purity of style at which the sculptor aimed. "Hounds in Leash" is a vigorous group which was undertaken by Bates in response to the criticism that he could design no figures but such as are at rest. It is in the Tate GaUery, where it figures along with the "Pandora." In "Endymion" the sculptor seems to have united in some degree the sculptural ideas expressed in the "Homer" and the central relief of " Psyche " : there is in it a good deal of the grace of the one and

of the decorative force of the other, together with a lofty sense of beauty. The portrait-busts of Harry Bates are good pieces of realism ??? strong, yet delicate in technique, and excellent in character. His statues have a picturesqueness in which the refinement of the sculptor is always felt. Among the chief of these is the fanciful "Maharaja of Mysore," somewha,t overladen with orna- ment, and the equestrian statue of Lord Roberts upon its important pedestal, girdled with a frieze of figures, now set up in Calcutta.

Mr George Frampton (b. 1860; A.RA 1894; E.A. 1902), pupil of the Royal Academy, the Lambeth Schools, Q_ j^ and Merci^ in Paris, is a particularly versatile

Frampton, and original artist, thoroughly in the " new A.R.A. movement" which he has done so much to (1884). direct. Highly accomphshed, he is at home in every branch of his art, and covers the whole field. He first exhibited "Socrates Teaching" (1884), and fol- lowed this with "The Songster" (1887), "An Act of Mercy" (1888), "In Silence Prayeth She," "The Angel of Death" (1889), "Caprice" (1891), and in 1892 "The Children of the Wolf " ??? his last ideal statue of the kind. It was followed by " Mysteriarch," heralding a class of work with which the artist has since identified himself ; for being in open rebellion against " white sculpture," he thenceforward devoted himself to colour. " Mother and Child " is an experiment in polychromatic figure-work. The half-length figure called "Lamia," with ivory face, head, and neck, and in a quaint head-and-neck dress of bronze jewelled, is a further departure from the true reserve of sculpture, but beautiful and delightful in feel- ing. The statue of "Dame Alice Owen," in bronze and marble, and "King Edward VI." are original, notwith- standing the pseudo-mediaeval taste of their conception. Mr Frampton is happiest in distinctly decorative sculpture. His prolific and inventive fancy has expressed itself in such works as the bronze " The Steamship " and " The Sailing Ship " for Lloyd's Registry in London, and in the memorial " Monument to Charles Mitchell," at New- castle-on-Tyne. Herein a new note is sounded, and we have some of the most striking features of Mr Frampton's design. That is to say, he seeks to escape from the purely architectural forms, pediments, and mouldings, introducing his own inventions of curved lines, and

frequently substitut- ing tree-forms for columns or pilasters, with roots for bases, trunks for pillars, and branches and foliage for capitals. Besides these should be mentioned “The Vision,” the seven heroines from the Morte d’ Arthur, “My Thoughts are my Children,” ” Music,” and ” Dancing,” and memorials and busts of “Charles Keene,” “R. Stuart Poole,” “Leigh Hunt,” “Passmore Edwards,” “Dr Garnett,” and a colossal statue of ” Queen Victoria ” erected in Calcutta. There are always charm of arrangement, delicacy of workmanship, and daintiness of feeling, as well as considerable power of design, simplicity, and breadth in his work.

*Mr W. S. Frith, one of the most successful teachers of sculptors in England, is chiefly remarkable for the decora- tive quality of his work. As in the monument to “Wheatstone, Inventor of the Telegraph,” ^^*****j^/”^’* or again, the standard lamps at the Astor Estate Office on the Thames Embankment, the sculptor shows charm of thought and spirit of design, vigour, and richness of effect. His ideal statuary and portraiture are not his chief work, however ; his decorative sculpture for ecclesiastical and secular buildings is vast in extent and has had good influence on the younger school.*

Mr Henry Pegram, pupil of Mr Hamo Thornycroft and at the Royal Academy, attracted early attention with “Death Liberating a Prisoner,” and by the two high reliefs “Ignis Fatuus” (acquired H. A. for the Chantrey Collection) and “The Doom (is84)’ of Medusa.” These were followed by “Eve,” “Sibylla Fatidica,” “The Last Song,” “The Bather,” “Labour,” and “Fortune,” by decorative work for the exterior of the Imperial Institute, and later by the great candelabra which flank the interior western end of St Paul’s Cathedral. His portraiture is also noteworthy, and his work generally is “big” in style and sculptur- esque, with movement and life.

Mr A G. Walker has produced notable work in the class of pure sculpture, including the relief representing ” The Last Plague : The Death of the Firstborn,” ” Adam and Eve : And They were Afraid,” and ^- O- “The Thorn,” graceful and quaintly charming, ngS’fi’ with elegance in the

pose and in the action. His chief decorative work includes the sculptural figures in Stamford Hill Church.

The name of Mr Adrian Jones is chiefly associated with the spirited work called "Duncan's Horses," a group displaying great knowledge of equine fissJ),"^ anatomy, form, and action.

Mr Reynolds-Stephens, latterly more devoted to gold- smith's figure ~~work than to larger and more searching sculpture, must be considered less as a statuary~~ y ~~ooo~~ than as " a poet who sings in metal." A relief, noUs after Sir L. Alma – Tadema's "Women of stepbeas Amphessa" (1889), was followed by a "WaU <'^^- Fountain," "Truth and Justice," and the "Sleeping Beauty," a bas-relief, full of thought, invention, and dainty conceits. In the highly decorated "Launcelot and the Nestling," " Guinevere and the Nestling," and similar works, the artist makes use of various coloured metals, ivory, gems, and the like, with pretty symbolism. Apart from his choice of material, there is a delicate languor about the lines of his figures and reliefs, which display a charming feeling and refined taste.

Mr Alfred Drury (b. 1857; A.E.A. 1900) is a pupil specially of Dalou, whose assistant he became. The first result was the curious echo of the master's style, "The Triumph of SUenus" (1885). "The A. Dnuy. Genius of Sculpture " and " The First Reflection " jfg' (bought by the Queen of Saxony), and "The Evening Prayer" (1890, Manchester Corporation GaUery), were followed by the statue of "Circe" (1893), which, through its grace, elegance of line, and symbolical realiza- tion of the subject, achieved a great popular success and was acquired by Leeds. The bronze head of "St Agnes " (1894) is one of the first examples of Mr Drury's later style, belonging to the higher order of conception which, generally speaking, he has since maintained. This may be seen in " Griselda " (bought for the Chantrey Collection), " The Age of Innocence," and other stories of childhood, and in the scenes of "The Months," at Barrow Court. For the decoration of the City Square at Leeds Mr Drury executed the statue of Dr Priestly, consisting of the

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colossal figure entitled “Even.” Mr Drury’s quiet, suave, and contemplative art lends itself well as decorative sculp- ture to architectural embellisliment. His portraiture is also good, reticent, and full of character, and as a manipu- lator of clay he represents the highest contemporary standard of Enghsh sculptors.

Mr Frederick W. Pomeroy (pupU at the Lambeth and Koyal Academy Schools, and of Mercie) is of equal taste

and ability. After 1888, when he exhibited P- - the bronze statuette ” Giotto,” he produced (tSSS)” many ideal works ??? “Love the Conqueror”

(Walker Art Gallery, Liverpool), ” Pleasures are like Poppies Spread,” “Boy Piping,” “Dionysos” and ” The Nymph of Loch Awe ” (both in the Tate GaUery), “A Nymph Finding the Head of Orpheus,” “Undine,” ” Pens^e,” and the clever study of the nude called ” The Potter.” “Perseus” is an inspiration from Benvenuto Cellini, but ” The Spearman ” is an original and powerful work. In ideal statuary he has produced “Admiral Blake,” ” Dean Hook ” (a colossal work for Leeds), ” Oliver Cromwell” (also colossal, for St Ives, Huntingdonshire), and “Eobert Burns” for Paisley. In true portraiture, Mr Pomeroy executed the Liberal Memorial Statue of Mr Gladstone, in the lobby of the Houses of Parliament, and the recumbent efl&gy of the Duke of Westminster, for Chester Cathedral. His work is strong and sculptur- esque, and his statues ” stand ” well. He sees nature in a big broad way, and his decoration is effective and well designed.

Mr Albert Toft became known by his statue of ” Lilith ” (1889), and emphasized the impression then created by

“Fate-Led” (1892, Walker Art GaUery), “Age

and the Angel of Death," "In the Sere and

Yellow Leaf" (a remarkable study of old age), "The Goblet of Life," and "Hagar." "The Spirit of Contemplation " and " The Cup of Immortality " are more complete and display dignity and refinement. Mr Toft's busts, such as those of W. E. Gladstone and Phihp Bailey, have force and breadth of character; and in his ideal work there is an effort, well sustained and successful, after dignity, harmony, evenness of balance, and relation of the whole.

Professor Edouard Lant&i, a naturaUzed Englishman, to whom British sculpture owes much, employed his

*own striking gifts to teach rather than to ^***g^l^"'"^" *produce. But "The Fencing Master," "The*

Duet," and "A Garden Decoration" have ex- ercised influence on the younger school through their fine sculptural qualities of vitality, richness, joyousness, sensuousness, and movement.

Mr Birnie Khind, E.S.A., has produced little work so important as the elaborate decorations for the doorway w. Bimie ^ *^^ *Scottish National Portrait Gallery, but Rbind, some of his statues and busts* *" King James V. R.s.A. of Scotland," "Lord Salisbury," and others-* *. ooo). sliow the influence of the modern school.*

Mr Goscombe John (A.E.A. 1899) achieved an early reputation with a figure of "St John the Baptist," an Ooscombe austere creation of real importance. His other John, chief works are "Morpheus," "A Girl Binding A.R.A. her Hair," "A Boy at Play" (Tate Gallery), (/ *). urpjjg Glamour of the Eose," and "The Elf"* *a weird creation of true comedy. In these are shovra a love of the purity and refinement of nature, realized with delicacy and a feeling for beauty. In portraiture Mr John is not less successful. The colossal seated statue of " The Duke of Devonshire " has been acknow- ledged by the best critics in France and England to be one of the finest things of its kind, good in design and quiet suggestion of power.*

Mr Bertram Mackennal, the son of a Scottish sculptor settled in AustraUa, acknowledges no school, but he has been chiefly influenced by study in Paris. In his ideal works, such as “Circe,” “For She Sitteth on a B.Mac- Seat in the High Places of the City,” there are fj886). boldness and sense of drama, with a keen appre- ciation of elegance of form, not vsdthout severity, and power of design. His sculpture is marked by good style, with movement and nervousness of treatment.

Mr. Herbert Hampton made his first appearance in the

Paris Salon with “The Mother of Evil,” and then the

statues of “David” and “ApoUo,” and “The

Broken Vow,” “A Mother and Child,” ” Narcis- f ??? “f “???^r „ 1 ; 1 . ‘. _ – ton (1886),

sus, and other works were seen m the London

galleries. Portraiture of merit has come from Mr. Hampton, but his greatest success, perhaps, has been achieved in decor- ative sculpture;

Mr F. E. Schenck is similarly and more emphatically an architect’s sculptor ??? one of those who have done so much to embellish rightly the numerous great buildings which during the last twenty years of the 19th ^- ^??? century were sprmgmg up all over Great Bntam. q886). The Municipal Buildings at Stafford and Oxford, the Public Library at Shoreditch, and the Scotsman Ofiices in Edinburgh ??? involving groups of colossal figures bear- ing close relation to their architectural setting ??? are among the works which have made his reputation.

Mr J. Wenlock Bobbins is another architectual sculptor of real power and individuality, whose work for the New General Hospital in Birmingham and for the Town Hall of Croydon is of a high order. His f ??? portraiture is also good, the colossal statue of n88r)’ ” Queen Victoria ” for Belfast being the most im- portant of his achievements. Of ideal work, the statue called ” Nydia ” is the best known.

Mr Henry C. Fehr (pupil at the Eoyal Academy and of Mr Brock) contributed the group of ” Perseus and Andro- meda “to the Academy in 1893, when it was purchased for the Chantrey Collection (Tate ,‘gg^^’”’ Gallery). His subsequent ideal works, ” Hypnos Bestowing Sleep upon the Earth,” “The Spirit of the Waves,” “St George and the Rescued Maiden,” and ” Ambition’s Crown Fraught with Pain,” confirmed the high opinion of his cleverness ; but in some of them his exuberance teUs somewhat against their general effect, in spite of their inherent grace and strength. On the other hand, the statue of ” James Watt ” for the City Square of Leeds exhibits those qualities needful for open-air portraiture ; and his busts and statues have character and life.

Mr. George Wade is essentially a sculptor of busts and statues ; the most noteworthy of his works are the memorial to Sir John Maodonald in Montreal, and the seated figure for Madras of the native judge, ?,\,f^”’^ Sir T. Aiyar Muthuswamy.

Mr Gilbert Bayes, at first a modeller in the fiat of horses treated in a decorative manner, produced “Vanity,” “A Knight-Errant,” and similar picturesque bibeldts on a large scale ; and later still, such work as ?,‘gf^^^ ” The Fountain,” showing a talent at once more serious, ordered, and graceful.

Mr W. E. Colton is a sculptor of strong individuality, capable equally of deep feeling and dainty fancy. ” The Girdle,” “The Image-Finder,” “The Crown of Love,” ” The Wavelet,” and the ” The Spring- ^;f/ggp)’ tide of Life” reveal a sculptor of exceptional ability, whose love of truth and life sometimes inspires him to place a touch of rather awkward realism in a graceful and charming composition ; the result is something unusual, yet quite natural and not objectionable. Mr Colton’s

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A. FALGUifcRE St Vincent rle Paul.

E. Barrias The First Funeral.

A. Idrac i^lHrcnry inventing the Cailuceus.

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Juste Becquer ◆◆◆ St Sebastian,

L. Gluume ◆◆◆ Bonaparte at Cairo. SCULPTURE. Plate V. ◆◆◆ FREXCH {a).

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Ik.

L. Marqueste ◆◆◆ Galatea.

li. DE SAiNT-MAKutiAUx ◆◆◆ (Jeiiius guardliig the Secret of the Tomb.

A. .Mlrlu, .^‘mvuiur.

SCULPTURE. Plate A’L ◆◆◆ FRENCH (&).

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true power of design and sense of style made him a force in the younger school of sculptors.

Mr David McGiU, an artist of the same class, &st attracted attention with the relief of “Hero and Leander,” following it with a series of figures, of

which the most striking is ” The Bather,” a work at once of vigour and of humour. His work is good in pose and line, refined in drawing and feeling, and excellent in style.

Mr Charles J. Allen belongs to the same group. ” Love

and the Mermaid” (Walker Art Gallery, Liverpool), “A

Dream of Love,” and ” Rescued ” are works of

figgo) liigli merit, in every case good in treatment, free

in modelling, and pleasing in design.

There are others who have to be recognized as important,

if young, members of the school. Mr Taubman, who has

had both French and Belgian teaching, has pro-

^ ❓❓❓^ ❓❓❓,J^p?‘duced a series of works which display his power

‘of design and strength of technique. “The

Angel of Sad Flowers,” “Orpheus and Eurydice,” and

” Adam and Eve ” reveal his strength in ideal work ; and

his statue of ” Sir Sidney Waterlow ” at Highgate is a good

example of his monumental portraiture.

Mr Pittendrigh Macgillvray, R.S.A., belongs to the rather meagre Scottish group. His chief work consists J. p. Mac- mainly of monuments and colossal memorials. giUvray, The “Peter Low” memorial in Glasgow Cathe- R.S.A. dral, the “Robert Burns,” the “Allan Family a89t). Memorial,” the fine reUef of “Rhythm,” and the ” National Gladstone Memorial ” for Scotland are his leading works.

Mr Paul Montford, Mr Oliver Wheatley, Mr John Tweed, Mr Hodge, Mr Poole, and Mr Derwent Wood are artists whose work is marked by strong individuaHty and elevated character, and may be considered leaders among those who are the hope of the future.

"Women-sculptors (among whom may be included clever amateurs, such as Princess Louise, Duchess of ArgyU, and Countess Gleichen) have attracted well-deserved Women- attention in a measure unprecedented in Eng- land. Miss Margaret Giles, whose group " After 1900 Years, and still they Crucify" shows power and ability. Miss Ruby Levick, Miss Ellen Rope, Miss Williams, and others, have shown their capacity alike in poetic conception, sound modelling, and decorative design.

In the section of sculptor-decorators are such workers as Mr Lynn Jenkins, whose frieze in bronze, ivory, and ' mother-of-pearl at Lloyd's Registry is a remark-

Scu ptor- g^jjjg achievement, and Mr Walter Crane, who de- ' signed for Manchester a mace that is remarkable for beauty of conception and felicity of symbolism. But other sculptors already mentioned, including Mr Thorny- croft, Mr Gilbert, Mr Frampton, Mr Pomeroy, Mr Colton, and Mr Toft, have all devoted themselves to sculptural decoration pure and simple, whether in metal, stone, or marble.

The painter-sculptors command extraordinary respect, for they may claim among them Alfred Stevens, Lord Leighton, Mr J. M. Swan, Mr Reynolds- f/j^'^^_ Stephens, George Richmond, and Mr G. F. Watts. Richmond's real talent may be gauged by his "Monument to Bishop Blomfield" in St Paul's Cathedral. But none surpasses the greatest living English painter (1902), Mr George F. Watts (q.v.). He had educated himself artistically on the Elgin Marbles, and he has produced half a dozen pieces of sculpture which place him high among the world's finest sculp- tors of the 19th century. The recumbent effigy of " Bishop Lonsdale " in Lichfield Cathedral was an

epoch-marking work, not only in the technical matter of the bold treatment of the drapery, but in large- ness and breadth and its noble sense of style, and the "Lord Lothian" in Bickling Church is ^1't also

very remarkable. The artist then produced /j.^j. the colossal equestrian group of ” Hugh Lupus ” for the duke of Westminster (Eaton Hall), a composition as imaginative and original as it is grand and sculpturesque. Then followed “Physical Energy,” another equestrian group, which, after being about twenty years in progress, was cast in 1902 ; it was to be erected in duplicate, one copy in South Africa, to the memory of Cecil Rhodes, whose character it may be held to symbolize, and the other to be set up in London by the British Government. In 1902, also, the statue of “Lord Tennyson,” destined for Lincoln’s Inn, was completed. But the bust of ” Clytie ” is sur- passed in ” bigness ” and classic purity of style and feeling by nothing ever produced in England : it is a complete and noble thing. There is no sculptor who has come nearer to obtaining the grandeur of form which is so wonderful in the Greek masterpieces. Simple in line, immense in character, full and rich in modelling, Mr Watts’s work is instinct with vigour, breadth, and move- ment. It sets the true standard, and is a constant and a noble warning to sculptors of the younger school not to be led away by the dainty and fanciful, however alluring. Especially it warns them against what has become a feature with a certain section ??? the devotion to metal-working, enamelling, and the like, and the ‘“eta/ free introduction of these accessories into serious sculptural work. Irresistible in the hands of a great artist like Mr Alfred Gilbert, such work, at all times attractive, is the goldsmith’s and ironsmith’s, but not the sculptor’s ; and if it has coloured the work of some of the younger sculptors of the day, it is not likely to obtain any very wide hold, or to exercise permanent influence for evil. As we have said, since the publication of the 9th edition no great section of the arts has so com- pletely changed its characteristics as the British school of sculpture.

The subject of British sculpture has been curiously neglected, except in newspaper notices and occasional articles in the periodical press, such as ‘ ‘ Living English Sculptors, ” Century Magazine, July 1883, by Edmund Gossb. The only volume published is the following : ??? M. H. Spielmann, British Sculpture amd Sculptors of To-day. London, 1901. (m. H. S.)

French.

After 1870, when a great artistic movement marked the resuscitation of France after the Franco-German war, sculpture especially revived with exceptional vigour, and the last thirty years of the 19th century were a memor- able epoch in its history. Not that many new and unex- pected men of genius suddenly arose, for most of the artists who then came to the front had already distin- guished themselves by equally noble work ; but sculpture, like the other arts, benefited by the pause for thought, and by the ripe and manly tone stamped on the national mind by the discipline of events. Intense ardour ani- mated the admirable group of French sculptors : the oldest still found some lofty expression ; the men in their prime showed their powers with unwonted force and fire ; and the younger generations grew up in rapid succession, a close phalanx of sculptors whose number is still in- creasing, for if we include only living artists, and those who have taken honours in the Salons, we find a list of seven hundred exhibitors. The first generation of sur- vivors of the war, who led the way in the new period, still boasted of such men as Dumont (1801-84), Cavelier (1814-94), Bonnassieux (1810-92), Joufi'roy (1806-82),

Schoenewerck (1820-85), Carrier-Belleuze (1824-87), Aim6 MUlet (1819-91), and Cleainger (1814-83). These artists, born in the first quarter of the 19th century, were for the most part each the head of a studio, their teaching being carried on till the end of the century. Next to them followed their immediate pupils, already their rivals, and some indeed famous before the new era ; such were Guillaume, Dubois, and Fremiet ; others, fresh from the Academy at Eome, at once rose to distinction, and all combined to form the remarkable group of artists to which the modern school of French sculpture owes its world-wide fame. At this time Eugene GuOlaume was exhibiting his " Koman Marriage," his " Bust of Mgr Darboy," his " Orpheus," and " Andro- mache," works of learned skill and severe distinction. Paul Dubois executed his " Narcissus," and the " Tomb of General Lamoriciere," on which the decorative figures of

Charity, Faith, and Military Courage are popular favourites, fuU of grave and pathetic feeling. Chapu executed his exquisite figure of ” Youth ” for the tomb of Henri Kegnault, and that of ” Thought ” for the tomb of Daniel Stern, his monuments to Berryer and to Mgr Dupanloup. Barrias’ ” First Interment ” won him the medal of honour in 1878 ; besides his patriotic group of the ” Defence of Paris.” Falguiere produced a remarkable series of statues, characterized by their life- like power ; some dignified or pathetic, as “St Vincent de Paul,” ” La Kochejacquelein,” and ” Cardinal Lavi- gerie ” ; some full of bold and dashing spirit, as his ” Diana,” his ” Nereids,” and ” Hunting Nymphs.” Merci^ gave us ” Gloria Victis,” ” Quand Mgme,” and his monuments, among which that called ” Memory ” must be mentioned ; his pediment for the Tuileries ; his ” Genius of Art,” &c. Delaplanche produced his ” Mother’s Teaching,” “Music,” “The Virgin with a Lily,” and ” Aurora ” ; and Allar ” The Death of Alcestis.” To these names must be added those of Degeorge, who, with Chapu, gave so powerful an impetus to the art of the medallist ; of Gautherin, HioUe, Thomas, Crauck, Laf ranee, Maniglier, and Moreau-Vauthier ►►► one of the men who, with Gerome (the painter) and Fremiet, revived the taste for coloured sculpture, a style first attempted long before by Simart ; besides many more. These artists created a supremely healthy and vital school of sculpture, dignified and elegant, learned and varied, fresh and charming, and, above all, as single-hearted and as well trained as in any period of history.

To understand, however, the position of contemporary sculpture in France, it will be necessary to look back even farther than 1870. It must be remembered that the whole history of French sculpture, as far back as the 17th century, is connected with the invasion of Itahan influence in the 16th century, which remained paramount over French art for more than three hundred years. Statue-making, until then an art of expression ►►► national, popular, human, and Christian ►►► lost its primitive character under the dilettante refinement of an aristocratic society closely gathered round a king who made art sub- servient to his splendour or his pleasure ; it sank into superficial and conventional beauty, and became almost exclusively the interpreter of trivial ingenuity or flattering allegories derived from the dead fables of heathen myth- ology. The best that would be expected from this was choice elegance of line, a

harmonious treatment of mass and composition, a loving study of the nude ⬛⬛⬛ in short, a purely plastic type of art. And sculpture had become the art of the nobility and of the court, having no hold, as it had in the past, on the great human family ⬛⬛⬛ the nation. Still, even at the high tide of Louis XIV. 's reign, some dissatisfaction became evident, even some rebellion,

in the great though solitary spirit of Puget, who strove to animate the marble with the passions of humanity. In the next century he found followers ⬛⬛⬛ Falconet, Pigalle, and Houdon, who also asserted their right to infuse life and passion and movement into their statues, seeking them in the despised province of stern reality. The great cataclysm of the Eevolution, which might have been expected to break the bonds of thought, turned men's minds to contemplate the Antique, and though it certainly modified the style of sculpture, was far from changing the source of its inspiration, since it sent it once more to the Antique. Indeed, at the beginning of the 19th century, when the teaching of David was paramount in spite of Gros, who, then in the master's studio, was unconsciously sowing the seed of romanticism in painting, a robust individuahty was developing among French sculptors ⬛⬛⬛ a spirit somewhat rugged, independent, and partly trained, beyond the academic pale, prepared to carry on the tradition of Puget, and quite simply, without any revolu- tionary airs of innovation, to shake off torpid convention- ality. By the mere force of a strong plebeian temperament Kude quite naturally happened on a style of art ⬛⬛⬛ high art ⬛⬛⬛ at once expressive and popular. He was the first to raise the cry of liberty in sculpture, and he left successors who bravely worked out what he had begun. Barye and Carpeaux were both in 1875 on the thres- hold of an era to which they bequeathed a fruitful in- fluence. Barye carried on Rude's tradition of expression, and transformed what had previously been mere decorative carving into a new style and branch of art now adopted by a whole phalanx of admirable artists : the sculpture, namely, of animals, the first glance that sculpture had till then bestowed on nature apart from man. Carpeaux, who was much younger, was in his day ⬛⬛⬛ as Puget had been ⬛⬛⬛ an exceptional personality ; he carried on the slow revolt of two centuries which was to break the narrow

mould of school-training and infuse a soul of more ardent vitality into sculptured forms.

The importance of these two great artists in relation to contemporary art was not fully seen till after their death. In point of fact Painting had until now amply filled the new part assigned to Art ; its vehement efforts had strongly influenced public opinion ; and as, in the early years of the 19th century, it had largely extended the field of human vision over the remote past and the domains of feeling, with the promise of surveying all nature, space, and time, the spirit of the age asked no more, and did not expect sculpture, too, to abandon old-world myths. It must also be said that those sculptors who at that time carried on the classical tradition had renewed its youth by their learned and enthusiastic love of it ; they had reverted to the past, but it was the past of the really great masters, either of antiquity or of the early Florentine school, no less enamoured of life, beauty, and nature. GuiUaume and Paul Dubois, Chapu and Falguifere, Merci^ and Delar planche, were the rivals in sculpture of the great idealist painters ❖❖❖ Puvis de Chavannes, Gustave Moreau, Eicard, Delaunay, Baudry, and Henner ❖❖❖ who were working at the same time.

This it is which accounts for the fact that romanticism then found so little acceptance among sculptors. But in the next generation the sowers of the seed might see their harvest. The pupils of Eude, of Barye, and of Carpeaux, allied by school sympathies, ❖❖❖ the little drawing-school conducted by Lecoq de Boisbaudran, which, in despite of the studios of the Beaux Arts, created a group of inde- pendent and highly original artists, ❖❖❖ formed the centre of a distinct force which increased day by day. Young men, fresh from Eome, persistently kept up the spirit I of the Antique. A galaxy of learned and refined artists

ROGEE Bloche ❖❖❖ The Child.

Faui. Dubois ❖❖❖ Militarj' Courage (Monument to General de la Moriclere at Nantes).

A. BARTHOLOMfi ❖❖❖ Fragment ❖❖❖ Recumbent

Group of the Monument to the Dead

(Cemetery of Pere Lachaise).

SCULPTURE. Plate VII. ***FRENCH (c).***

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Jef. Lambeaux The Human Passions. (Belgian.)

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SCULPTURR. Plate VITl. ***OTHER FOREIGN COUNTKIE^^.***

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SCULPTURE

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was represented by such men as HioUe (“Arion,” “Orpheus”), Idrac (“Mercury inventing the Caduceus,” ” Salammb6 “), Marqueste (” Galatea,” ” Eros,” ” Perseus beheading the Gorgon,” “The Rape of Europa”), and Coutan (“Eros,” “A Woman carrying Loaves,” “A Sergeant -at ~~Arms,” &c.), Lanson (“The Iron Age”), Longepied (” Immortality “), Peinte (” Orpheus charm~~ ing Cerberus to Sleep “), Gustave Michel (” In a Dream ” “Meditation”), Carles (“Innocence,” “Abel”), A. Boucher (” Earth,” ” Au but “), besides Carlier, Leonard, and Turcan soon to be followed by another generation : Puech (“The Siren,” “T^e Muse of Andr^ Ch^nier”), Verlet (“The Monument to Maupassant,” “Orpheus”), Larche (“The Brook and the Meadovy,” “Violets”), Sicard (” Hagar and Ishmael “), and DaiUon, Escoula, St Lami, and many more. In opposition to these there stood a group of sculptors, young and old, who sought their subjects in mythology, legend, history, or poetry, or merely in the scenes of daily life, and aimed at presenting the ideal of their time under its external aspects, but more especially the deepest emotions of the modern mind. It was Fr^miet, with his striking and vivid conceptions, who led the advance with new and dramatic subjects ; primeval man and the fierce beasts with which he disputed his rule (“A She-Bear and a Man of the Stone Age,” ” An Oran-utan and a Savage,” ” Gorillas “), or embodiments of the heroes of the past (“Joan of Arc,” “Saint Louis,” “Saint George,” “Louis of Orleans,” &c.); then followed Just Becquet, the excellent artist who represented the stricken figures of “Ishmael” and “Saint Sebastian”; Christophe, with his symbolical presentments of “The Human Comedy,” ” Fortune,” and ” The Supreme-Kiss ” ; Aub6 (” Monument to Gambetta,” “Dante,” “Bailly,” &c.) ; A. Legros, the naturalized English painter and sculptor, who executed some fine fountains for the duke of Portland ; Injalbert, returned from Rome (” Hippomfene,” ” Christ on the Cross,” “The Herald”); and, younger than these, Desbois (” Leda “), Dampt (” A Grandmother’s Kiss,” ” Melusine “), Alexandre Charpentier, Carries, Baffler, Pierre Roche, Madame Marie Cazin, and many more.

The disruption of the Salons in 1890 showed very plainly the bent of this group, who seceded to the Champ de Mars, where the leaders were Dalou and Rodin, and where Bartholom6 made an unexpected and original appearance. Foreigners added a contingent of the highest merit, such as

the American St Gaudens, and, more especially, the Belgian Constantin Meunier, affiliated to France by their early training, to say nothing of descent. Meunier especially, with his statues and statuettes of labouring figures ❓❓❓ miners, puddlers, hammerers, glass- blowers, and the like ❓❓❓ gave to his art a keynote new to France, which found a response even in academic circles. A broad democratic current was swaying public feeling. The questions which turn on the status of the working man had become the programme of every party, even of the most conservative. Art being the mirror of society, the novel, the drama, and painting devoted themselves to the glorification of a new factor in modern life, namely, Labour. Sculpture now, in rivalry with painting, through which Millet had immortalized the peasant, and Courbet the working man, also sought inspiration from such themes ; and at the same time the demands of the democratic move- ment called for monuments to the memory and deeds of great or useful men.

Sculpture, under this modern tendency, has assumed an unexpected aspect ; its highest expression is seen in the work of three very dissimilar men : Dalou, Rodin, and Bartholomd. In Belgium, as has been said, where modern social questions are strongly felt, Constantin

Meunier had interpreted the democratic impulse in a very striking manner, under the influence, no doubt, of J. r. Millet. In France, Jules Dalou, with a broader view, aimed at creating an art which should represent the aspirations .and dreams of this phase of society while adhering to the fine old traditions of the art of Louis XIV., stamped with magnificence and grandeur, but applied with graver, simpler, and severer feeling to the glorification of the people. He revived the older style of sculpture, giving it greater power and truer dignity by a close study of life, supported by a scholarly and serious technique. In his "Triumph of the Republic," and the monuments to "Alphand," to "Delacroix," to "Floquet," to "Victor Hugo," and others, he strove to create a style apart from Ufe, to which he is alien and indifferent, but based on life, the outcome of the needs of society, the impersona- tion of its characteristics, the expression in eloquent form of its nature, spirit, and moral idiosjmcrasy.

Treading the same path, though in a different step, is Auguste Rodin. He disregards every contingent fact; even when he takes his subject from legend or history, whether "Eve" or "St John the Baptist," "The Age of Bronze" or "The Burgesses of Calais," "Victor Hugo" or "Balzac," he avoids all the conventional details and attributes of his personages to embody the very essence of humanity as expressed in the quivering flesh. He, hke Carpeaux, has gone back to Dante and to Michael Angelo to force the " Gates of Hell " ??? the subject chosen for the entrance to the Mus^e des Arts D^coratifs ??? and to read the deepest mysteries of the human soul. His is the art of suffering, anguish, and terror, of cruel and despairing pleasure ??? a wild cycle of proud and bitter melancholy. All the efforts made in the past to infuse life into Art, aU that Puget, Falconet, PigaUe, and Houdon tried to effect, and that Rude, Barye, and Carpeaux strove for in their turn ??? aU this was part of the endeavour of these ' their successors, but with a clearer purpose and more conscious aim. By good hap or providence they were greeted on their way by the voice of the most devoted apostle who was to preach the new doctrine, namely, Louis Courajod, the founder of the French sculpture gallery in the Louvre. From his professor's chair in the schools he cursed the Italian intruders of the 16th century for having debased French art with "noble attitudes," extravagant gestures, and allegorical antics ; and he carried his pupils and his hearers back to the great national period of French sculpture, which, in the dark mediaeval ages, had created the splendid stone images of the noble French cathedrals.

A marked individuality now appeared in protest against academic traditions ??? Albert Bartholom^. He, after begin- ning as a painter, was tempted by sculpture, more par- ticularly, in the first instance, by a wish to execute a monument to a comrade he had loved. From this first effort, carried out in his studio, without any school train- ing, but with a firm determination to master technical diffi- culties and fulfil his dream, followed a broader purpose to execute a great expressive and vitally human work which should appeal to the heart of the populace. From this arose the idea of a " Monument to the Dead " in Pfere Lachaise. Bartholom^ had started without a guide, but he instinct- ively turned to the great tradition of Northern Christianity, which his mind subsequently

associated with that of the antique race who had ever done most honour to Death, the people of Egypt.

Thus two currents contended, as it were, for the guidance of French sculpture, each claiming a descent from the historic past ; one. inheriting the classic tradition of the Renaissance, of Latin and Hellenic origin, to which the French school, since the time of Jean Goujon, has owed

ttree centuries of glory. This is the pagan art of the South ; its marks are balance, reasonableness, and lucidity ; it was the composer of apotheoses, the preserver of the ideal of beauty. The other, reverting, after centuries of resignation or of impotent rebellion, to the genuine French past which produced the noble works of the 11th, 12th, and 13th centuries, ❓❓❓ to the tradition of Flanders and of Burgundy, which was smothered in the 16th century by Italian art, ❓❓❓ to the Christian and naturalistic art of the North, which renounced the canons of antiquity, and ex- pressed itself by methods essentially human and mutable, living and suffering, ❓❓❓ appeals to all mankind. The im- mediate result of this antagonism was no doubt a period of agitation. The outcome, on the whole, is confusion. Still, however vexatious the chaos of form and movement may be, it is Life, a true reflection of the tumult of modern thought in its complexity and bewilderment; it is the reawakening of sculpture.

Monumental and decorative statuary found an extended sphere through the founding or restoration of public build- ings after the events of 1870. Memorial sculpture obtained constant employment on patriotic or republican monu- ments erected in various parts of France, and not yet complete. Illustrious masters have done themselves honour in such work. Dalou, Jilerci^, Barrias, Falguiere, and many others less famous executed monuments to the glory of the Eepublic or in memory of the

national defence, and figures of Joan of Arc as a sjrinbol of patriotism, &c., as well as numberless statues erected in the market places of humble towns, or even of villages, in commemoration of national or local celebrities : politicians, soldiers, savants, and artists ??? Thiers, Gambetta, Jules Ferry, Carnot, Pasteur, Claude Bernard, Delacroix, Ingres, Corot, Millet, Victof Hugo, Lamartine, and many more. The garden of the Luxembourg alone has become a sort of Elysian Fields, where almost every day some fresh statue rises up in memory of contemporary French poets. The funereal style of monument, in which French art was at all times conspicuously distinguished, was also revived in sympathy with that general sentiment which regards reverence for the dead as a religion, and gave rise, as we have seen, to some splendid work by Chapu (the monuments to Eegnault, to Daniel Stern, of Mgr Dupanloup) ; by Paul Dubois (the monument to General Lamoriciere); by Merci^ (the tombs of Baudry, of Cabanel, of King Louis Philippe and his queen Marie Am61ie) ; by Dalou (the monuments to Victor Noir, to Floquet, and Blanqui) ; and by many more, with Bartholomd at their head. The cemetery of Pfere Lachaise is indeed one of the best spots to visit for a review of contemporary sculpture.

While man has been diligently studied in every class of sculpture, more particularly in portrait sculpture, which finds a more practical adaptation to daily uses by a bust or small statue, such as Theodore Eiviere was the first to produce, by medallions, or by medals, closely related to statuary, nature now holds a place in the sculpture of animals, ??? a place created, so to say, by Barye and carried on by Fremiet, Mgne, Cain, and, with even greater vigour and a closer study of character, by Gardet ("Panthers," in the Luxembourg, " Lions " and " Dogs," at Chantilly, &c.) ; Peter, Valton, Le Due, Isidore Bonheur, Peyrol, Cordier, Surand, Virion, M6rite, and others. Finally, the class of La Petite Scidptii/re ??? the statuette and small group ??? after long hesitation in the hands of the two men who first cultivated it, Fremiet and the painter G^rfime, made a sudden start into life, due in no small measure to the success attending the charming and pathetic statuettes of Theodore Riviere (" Salammbfi and MalthS," " Ulti- mum feriens," " Charles VI. and Odette," " The Vow," "I'ra Angelico," "The Shunamite Woman," kc). Riviere

was wont to use ❓❓❓ as G^rome did in his ” Bellona,” and sub- sequently in his small ” Tamerlane ” ❓❓❓ materials of various colours, and even precious stones and metals, which he em- ployed with great efi’ect. A whole class of art was not, indeed, originated, but strongly vivified by this method of treatment. Claudius Marioton and Dampt, who always afiected small and precious work, Agathon Leonard {e.g., a table decoration of ” Dancers ” in Sevres china), Laporte Blairsy, Ferrary, Levasseur, Belloc, E. Lafont, &c., utilized every process and every kind of material ❓❓❓ marble and metal, wood and ivory, enhanced by the most costly goldsmiths’ work and gems. ,

It would seem now that sculpture, thus endowed with new ideas and the most various means of expression, and adapted to every comprehension and every situation, was fully on a level v?ith the other graphic arts, ‘^hat it had chiefiy to fear was, in fact, the wealth of means at its dis- posal, and its competition or collaboration with other arts. And this the later generations seem to have under- stood❓❓❓ the men who were the outcome of the two conflict- ing traditions : order and moderation on one side ; character, life, and emotion on the other. Though very variously inspired by the facts or ideals of contemporary life, such young artists as Jean Boucher (” Evening,” ” The Antique and the Modern”), Roger Bloche (“Childhood,” “Cold”), Derre, Boverie, Hippolyte Lefebvre, Desruelles, Gaston Schnegg, Pierre Roche, Fix – Masseau, Couteilhas, and others, seem to show that French sculpture is about to assume a solid position on a sound foundation, while not ceasing to keep in touch with the tastes, aspects, and needs ❓❓❓ in short, the ideal ❓❓❓ of the day. (l. be.)

United States.

The early names in American sculpture ❓❓❓ Shem Drowne, the maker of weather-vanes ; Patience Wright ; William Rush (1756-1833), carver of figure-heads for ships and portrait sculptor; John Frazer (1790-1850), the stone- cutter; and Hezekiah Augur (1791-1858) ❓❓❓ have the interest of chronicle at least. Hiram Powers (1805-73), coming later, had a certain technical skill, and his statues of the ” Greek Slave ” and ” Eve

before the Fall ” were important agents in overcoming the Puritanic abhorrence of the nude.

Horatio Greenough (1805-52), Joel T. Hart (1810-77), S. V. Clevenger (1812-43), and Clark Mills (1815-83) aU received many commissions but made no additions to the advancement of a true art-spirit. Thomas Crawford (1814-57) began the bas-reliefs for the bronze doors of the Capitol and showed skill. They were finished by W. H. Rinehart, whose ” Latona ” has considerable grace. Henry K. Brown (1814-86) achieved, among less note- worthy works, the heroic Washington in Union Square, New York City. It is one of the noblest of equestrian statues, both in breadth and certainty of handling and in actual majesty. It reflects unwonted credit on its period. There is undeniable skill, which yet lacks the highest qualities, in the work of Thomas Ball (b. 1819), William Wetmore Story (1819-1896), whose “Cleopatra” shows power, Randolph Rogers (1825-1892), J. S. Hartley (b. 1845), Launt Thompson (1833-1894). The works of Olin L. Warner (1844-1896) and J. Q. A. Ward (b. 1830) reveal at times far greater originality. Warner’s two graceful classical figures for a fountain in Portland, Oregon, and his portrait statue of William Lloyd Garrison, show a nice discernment of the fit- ness of manner to matter. He was also successful in modelling medallions. Ward has a sturdiness and in- dividuality quite his own.

But almost all the works Aovai to this time lacked utterly that modernity, that sympathy with the present, which

are in some senses vital to art. American sculpture, like American painting, was awakened by French example. The leading spirit in the new movement was Augustus St Gaudens. Born in Ireland (1848) of Franco-Irish parentage, but brought to America in infancy, at the age of 19 he went to France for three years’ study. He must be counted one of the great sculptors of his generation, his perfect technique being the servant of a strong and magnetic , personality. In the ” Farragut,” with its bluff and cheerful grace, the ungainly majesty of “Lincoln,” the stern and

forceful “Puritan,” the monument to Colonel Shaw and his negro troops, and in other statues, he has won the hard victory over modern costume and made it contribute artistic feeling and character. In ideal works, such as the superb mortuary figure called ” The Peace of God,” decorative caryatids, and the like, he has shown a lofty sense of line and plane. His work in high and low relief is distinguished, notably in his girl with a guitar, the portraits of Stevenson and Bastien- Lepage. In all his works he shows the thorough har- monious welding of treatment with text.

Daniel Chester French has attacked difficult problems with success of the highest order. His ” Gallaudet Teaching a Deaf Mute ” is an example of how a difficult subject can be turned into a triumph of grace. His ” Death and the Young Sculptor ” is almost the laat word on the beautifying of the idea of death. In collaboration with E. C. Potter he has modelled various important groups of human and animal kind, particularly the ” Indian Corn ” and the equestrian ” Washington.”

Frederick MacMonnies stands high among contempor- ary sculptors by reason of his essentially sculpturesque methods and the magnetic sentiment that imbues them. His “Bacchante” is a triumph of modelling and of joyous humour. Minutely perfect handhng and reahstic vitahty characterize his ” Young Pan ” and many other works, while his statue of ” Nathan Hale ” in City HaU Park, New York, shows the artist’s power in the treatment of a serious theme, and combines strength, refinement, and lofty feeling.

Modelling in the nude is the test of a sculptor, though almost of necessity anachronistic, but the strenuous achievements of George Grey Barnard have both high skill and high sin- cerity. His “Two Natures,” his ” Brothefly Love,” his “Pan,” and the design for a Norwegian stove are among the strongest of modern statuary. Banking with him, though diiTerent in thought and method, stands Paul Wayland Bartlett ??? one of the best and most successful of modem sculptors. Success, too, artistically has been accorded to the fine works of Charles Grafly, Herman MacNeil, and Lorado Taft. The beautiful busts of Herbert Adams ; the thoroughly artistic miniature figures of Mrs Clio Hinton Bracken ; the graceful figurines of Mrs Potter Vonnoh ; Edwin F. Elwell’s “Egypt”

and “Orchid” ; and the work of F. Wellington Euokstuhl, J. Massey Rhind, Frederick Remington, John Donohue, and Charles H. Niehaus should also be mentioned.

(e. Hu.)

SCUta.ri, a town of Asia Minor, beautifully situated on the eastern shore of the Bosphorus opposite to Con- stantinople, of which it is reckoned a suburb. It has a lively trade in Asiatic products. It is built mostly of wood, but on the hills behind the town are many substantial residences. It has a population of about 50,000, mostly Turks. In June 1883 a gunpowder explosion caused the loss of 150 lives.

Scuta.ri, a town of Turkey, in Albania, with a population estimated at 35,000. ‘The trade, both inwards and outwards, has diminished through the connexion of Salonica with the European railway system, but its character has undergone no change. The exports consist of grain, wool, hides and skins, tobacco, and sumach ; the imports, of woollen and cotton yarns and piece goods, metals, and sundries. As nothing is done by the Govern- ment to develop local resources, the country remains stag-

nant, and Scutari is a less prosperous and less busy town than it was in 1885.

Sea, Command of the, is a technical term of naval warfare, and indicates a definite strategical condition. The term’ has been substituted sometimes for the much older “Donlinion of the sea” or “Sove- reignty of the sea,” a legal term expressing a claim, if not a right. It has also been sometimes treated as though it were identical with the rhetorical expres- sion, “Empire of the sea.” Mahan, instead of it, uses the term ” Control of the sea,” which has the merit of precision, and is not likely to be misunderstood or mixed up with a form of words meaning something different. The expression, ” Command of the sea,” how- ever, in its proper and strategic sense, is so firmly fixed in the language that it would be a hopeless task to try to expel it ; and as, no doubt, writers will continue to use it, it must be explained and illustrated. Not only does it differ in meaning from “Dominion or f^.^^ g ? ? ? yg. Sovereignty of the sea,” it is not even truly relgnty derived therefrom, as can be briefly shown.

orDomln- ” It has become an uncontested principle of “‘ ”’ modern international law that the sea, as a general rule, cannot be subjected to appropriation” (W. E. Hall, Treatise on Intemationl Laiv, 4th ed. 1895, p. 146). This, however, is quite modem. Great Britain did not admit the principle till 1805 ; the Russians did not admit it tin 182-1: ; and the Americans, and then only tacitly, not till 1894. Most European nations at some time or other have claimed and have exercised rights over some part of the sea, though far outside the now well-recognized ” three miles’ limit.” Venice claimed the Adriatic, and exacted a heavy toll from vessels navigating its northern waters. Genoa and France each claimed portions of the western Mediterranean. Denmark and Sweden claimed to share the Baltic between them. Spain claimed dominion over the Pacific and the Gulf of Mexico, and Portugal over the Indian Ocean and all the Atlantic south of Morocco (Hall, pp. 1 48-9). The claim which has made the greatest noise in the world is that once main- tained by the kings of England to the seas surrounding the British Isles. Like other institutions, the English sovereignty of the sea was, and was admitted to be, beneficent for a long period. Then came the time when it ought to have been abandoned as obsolete ; but it was not, and so it led to war. The general conviction of the maritime nations was that the Lord of the Sea would provide for the police of the waters over which he exercised dominion. In rude ages when men, like the ancients, readily “turned themselves to piracy,” this was of immense importance to trade ; and, far from the right of dominion being disputed by foreigners, it was insisted upon by them and declared to carry with it certain duties. In 1299, not only English merchants, but also “the maritime people of Genoa, Catalonia, Spain, Germany, Zealand, Holland, Frisia, Denmark, Norway, and several other places of the empire” declared that the kings of England had from time immemorial been in ” peaceable possession of the sovereign lordship of the seas of Eng- land,” and had done what was “needful for the main- tenance of peace, right, and equity between people of all sorts, whether subjects of another kindgom or not, who pass through those seas” (J. K. Laughton, “Sovereignty of the Sea,” Fortnightly Revieiv, August 1866). The English sovereignty was not exercised as giving authority to exact toll. All that was demanded in return for keep- ing the sea safe for peaceful traffic was a salute, enforced no doubt as a formal admission of

the right which per- mitted the (on the whole, at any rate) effective police of

the waters to be maintained. The Dutch in the I7th century objected to the demand for this salute. It was insisted upon. War ensued; but in the end the Dutch acknowledged by solemn treaties their obligation to render the salute. The time for exacting it, however, was really past. S. E. Gardiner ("The First Dutch War," Navy Records, vol. xiii. 1899) maintains that though the " question of the flag " was the occasion, it was not the cause of the war. There was not much, if any, piracy in the English Channel which the king of England was specially called upon to suppress, and if there had been the merchant vessels of the age were generally able to defend themselves, while if they were not their Govern- ments possessed force enough to give them the necessary protection. Great Britain gave up her claim to exact the salute in 1805.

The necessity of the foregoing short account of the " Sovereignty or Dominion of the Seas " will be apparent as soon as we come to the consideration of the first struggle, or rather series of struggles, for the command of the sea. Gaining this was the result of England's wars with the Dutch in the 17th century. At the time of the first Dutch war, 1652-54, and probably of the later wars also, many people, and especially seamen, believed that the conflict was due to a determination on her part to retain, and on that of the Dutch to put an end to, the English sovereignty or dominion. The ob- Attempts stinacy of the Dutch in objecting to pay the comn^nd. old-established mark of respect to the English flag was quite reason enough in the eyes of most Englishmen, and probably of most Dutchmen also, to justify hostilities which other reasons may have rendered inevitable. The remarkable thing about the Dutch wars is that in reality what England gained was the possibility of securing an absolute command of the sea. She came out of the struggle a great, and in a fair way of becoming the greatest, naval power. It is this which prompted Vice-Admiral P. H. Colomb to hold that there are various kinds of command, such as " absolute or assured," " tem- porary," " with definite ulterior

purpose," &c. An ex- planation that would make all these terms intelligible would be voluminous and is unnecessary here. It will be enough to say that the absolute command ??? of which, as Colomb tell us, the Anglo-Dutch wars were the most complete example ??? is nothing but an attribute of the nation whose power on the sea is paramount. It exists and may be visible in time of peace. The command which, as said above, expresses a definite strategical condition is existent only in time of war. It can be easily seen that the former is essential to an empire like the British, the parts of which are bound together by maritime communications. Inability to keep these com- munications 0[)en can have only one result, viz., the loss of the parts with which communication cannot be main- tained. Experience of war as well as reason will have made it evident that inability to keep open sea-communi- cations cannot be limited to any single line, because the inability must be due either to incapacity in the direction of hostilities or insufficiency of force. If Great Britain has not force enough to keep open all the communications of her widely extended empire, or if ??? having force enough ??? she is too foolLsh to employ it properly, she does not hold the command of the sea, and the umpire must fall if seriously attacked.

The stratugic command of the sea in a particular war or cf.mpaign has equal concern for all maritime belligerents. Before seeing what it is, it will be well to learn on high authority what it is not. Mahan says that command, or, to use his own term, "control of the sea, however real, does not imply that an

Strategic command.

enemy's single ships or small squadrons cannot steal out of port, cannot cross more or less frequented tracts of ocean, make harassing descents upon unprotected points of a long coast-line, or enter blockaded harbours. On the contrary, history has shown that such evasions are always possible, to some extent, to the weaker party, howeyer great the inequality of naval strength " (^Influence of Sea- Power on History, London 1890, p. 14). The Anglo- French command of the sea in 1854-56, complete as it was, did not enable the Allies to intercept the Russian ships in the north-western Pacific, nor did that held by the Federals in the

American Civil War put an early stop to the cruises of the Confederate vessels. What the term really does imply is the power possessed from the first, or gained during hostilities, by one belligerent of carrying out considerable over-sea expeditions at will. In the Eussian war just mentioned the Allies had such over- whelmingly superior sea-power that the Eussians aban- doned to them without a struggle the command of the sea; and the landing in South Africa (1899-1902), more than six thousand miles away, of a large British army without even a threat of interruption on the voyage is another instance of unchallenged command. In wars between great Powers and also between secondary Powers, if nearly equally matched, this absence of challenge is rare. The rule is that the command of the sea has to be won after hostilities begin. To win it the enemy's naval force must be neutralized. It may be driven into his ports and there blockaded or "marked," and thus rendered virtually innocuous ; or it must be defeated and destroyed. The latter is the preferable, because the more effective plan. As was perceptible in the Spanish-American war of 1898, as long as one belligerent's fleet is intact or at large the other is reluctant to carry out any considerable expedition over-sea. In fact, the command of the sea has not been secured whilst the enemy continues to have a " fleet in being " (see Sea-Power).

In 1782 a greatly superior Franco-Spanish fleet was covering the siege of Gibraltar. Had this fleet succeeded in preventing the revictualling of the fortress the garrison would have been starved into surrender. ???^'J"" A British fleet under Lord Howe, though much weaker in numbers, had not been defeated and was still at large. Howe, in spite of the odds against him, managed to get his supply-ships in to the anchorage and to fight a partial action, in which he did the allies as much dam- age as he received. There has never been a display of higher tactical skill than this operation of Howe's, though, curiously enough, he owes his fame much more to his less meritorious performance on the 1st of June. The re- victualling of Gibraltar surpassed even Suffren's feat of the capture of Trincomalee in the same year. In 1798 the French, assuming that a temporary superiority in the Mediterranean had given them a free hand on the water, sent a great expedition to Egypt. Though the army which was carried succeeded in landing there, the covering fleet was destroyed by Nelson at the Nile, and the army itself was eventually forced to*

surrender. The French had not perceived that, except for a short time and for minor operations, you cannot separate the command of the Mediterranean or of any particular area of water from that of the sea in general. Local command of the sea may enable a belligerent to make a hasty raid, seize a relatively insignificant post, or cut out a vessel ; but it will not ensure his being able to effect anything requiring considerable time for its execution, or, in other words, anything likely to have an important influence on the course of the war. If Great Britain has not naval force enough to retain command of the Mediterranean she will certainly not have force enough to retain command of the

*English Channel. It can be easily shown why it should be so. In war danger comes less from conditions of locality than from the enemy's power to hurt. Taking up a weak position when confronting an enemy may help him in the exercise of his power, but it does not constitute it. A maritime enemy's power to hurt resides in his fleet. If that can be neutralized his power disappears. It is in the highest degree improbable that Great Britain could attain this end by splitting up her fleet into fragments so as to have a part of it in nearly every quarter in which the enemy may try to do her mischief. The most promis- ing plan ??? as experience has often proved ??? is to meet the enemy when he shows himself with a force sufiiciently strong to defeat him. The proper station of the British fleet in war should, accordingly, be the nearest possible point to the enemy's force. This was the fundamental principle of Nelson's strategy, and it is as valid now as ever it was. If Great Britain succeeds in getting into close Seeking the proximity to the hostile fleet with an adequate tteet.^ * force of her own, her foe cannot obtain com- mand of the sea, or of any part of it, whether that part be the Mediterranean or the English Channel, at any rate until he has defeated her. If he is strong enough to defeat her fleet he obtains the command of the sea in general ; and it is for him to decide whether he shall show the efi"ectiveness of that command in the Medi- terranean or in the English Channel.*

*In the smaller operations of war temporary command of a particular area of water may suffice for the success of an expedition, or at least will permit the exe- oaemtlon” ‘^^^^ ^ ^ *^s preliminary movements. When the main fleet of a country is at a distance which it ought not to be except with the object of nearing the opposing fleet a small hostile expedition may slip across, say the English Channel, throw shells into a coast town or burn a village, and get home again unmolested. Its action would have no sort of influence on the course of the campaign, and would, therefore, be useless. It would also most likely lead to reprisals ; and, if this process were repeated, the war would probably degenerate into the antiquated system of ” cross-raiding,” discarded centuries ago, not at all for reasons of humanity, but because it became certain that war could be more effectually waged in other ways. The Power in command of the sea may resort to raiding to expedite the formal submission of an already defeated enemy, as Eussia did when at war with Swedeu in 1719 ; but in such a case the other side cannot retaliate. Temporary command of local waters will also permit of operations rather mote considerable than mere raiding attacks ; but the duration of these operations must be adjusted to the time available. If the duration of the temporary command is insufficient the operation must fail. It must fail even if the earlier steps have been taken successfully. The command of the English Channel, which Napoleon wished to obtain when matur- ing his invasion project, was only temporary. It is possible that a reminiscence of what had happened in Egypt caused him to falter at the last ; and that, quite independently of the proceedings of Villeneuve, he hesi- tated to risk a second battle of the Nile and the loss of a second army. It may have been this which justified his later statement that he did not really mean to invade England. In any case, the British practice of fixing the station of their fleet wherever that of the enemy was, would have seriously shortened the duration of his command of the English Channel, even if it had allowed it to be won at all. Moreover, attempts to carry out a great operation of war against time as well as against the efforts of the enemy to prevent it are in the highest degree perilous.*

In war the British navy has three prominent duties to discharge. It has to protect the maritime trade, to keep open the communications between the

different parts of the empire, and to prevent invasion. If Great Britain commands the sea these duties will be discharged effectu- ally. As long as she does that, the career of cruisers sent to prey on her commeijce will be precarious, because com- mand of the sea carries with it the necessity of possessing an ample cruiser force. As long as the condition men- tioned is satisfied her ocean communications will be kept open, because an inferior enemy, who cannot obtain the command required, will be too much occupied in seeing to his own safety to be able to interfere seriously with that of any part of the British empire. This being so, it is evident that the greater operation of invasion cannot be attempted, much less carried to a successful termination, by the side which cannot make head against the oppos- ing fleet. Command of the sea is the indispensable pre- liminary condition of a successful military expedition sent across the water. It enables the nation which possesses it to attack its foes where it pleases and where they seem to be most vulnerable. At the same time it gives to its possessor security against serious counter-attacks, and affords to his maritime commerce the most efficient pro- tection that can be devised. It is, in fact, the main object of naval warfare.

Authorities for tlie above may be given as naval histories in general, placing in the first rank the well-known works of Captain A. T. Mahan, U.S.N. The book which must be specially re- ferred to is the late Vice-Admiral P. H. Colomb's Naval Warfare, 3rd ed., London, 1900. (o. A. G. B.)

Seai-fishing'. ❓❓❓ Sea-fishing as a sport is a com- paratively modern institution. Many years ago a few amateurs might be found follovidng. the methods of the professional, laying long-lines, using coarse hand-lines, even netting on occasions, and whiffing and working drift-lines for pollack and bass. But it was not until the last few years of the 19th century that any considerable number of persons attempted to catch fish with the more refined and delicate methods, or modifications of them, practised on rivers and lakes. Several volumes on the subject were published between the years 1897 and 1900, and this diffusion of information, coupled with a serious falling- off of sport in many fresh-water fisheries, induced large numbers of anglers to look to the sea for the practice of their favourite recreation, and laid the founda- British tion

of the British Sea-Anglers' Society, which sea- soon numbered very nearly a thousand members. Anglers' The absence of private rights in sea- fisheries Society. renders the sea an appropriate fishing-ground for the general public. Even in navigable estuaries such rights do not exist, save where a charter from the Crovm was granted in ancient times.

*Sea -fishing as a sport, as we now understand it, is mainly concerned with the use of a rod and line in the sea, though for the heavier work with big bottom-swimming fish, such as the conger, the stronger and coarser hand-line is under certain conditions still deemed necessary by some fishermen. Probably the finest sea-fishing which has yet been discovered by the enthusiastic angler is that afforded by the tarpon, or silver king, of the Gulf of Mexico, a gigantic herring which often exceeds J"**^"" ""<' 100 K) in weight, and fights vsith demoniacal """ ''' fury when hooked. So favourite a form of sea-fishing has this become that tarpon hotels have sprung up on the coast of Florida, and not a few Englishmen journey across the Atlantic from time to time to take part in this exciting sport. The bait commonly used is a small mullet threaded on a large hook attached to an unleaded line. It is cast out from a boat and allowed to*

lie on the bottom. When the tarpon picks it up, time is allowed for the bait to be gorged, as the mouth of these fish is extremely hard and bony, and aJfords scant holding- place for the hook. Another kind of big fish angling afforded by American waters is tunny ~~fishing, which is carried on by the members of the Flying Tuna Club, of Avalon, Santa Catalina Island, who think little of captur~~ ing fish weighing considerably over 200 Bb. Tunnies and other big members of the mackerel family are also caught from ocean-going vessels. Sharks have been taken from time immemorial in tropical waters, and the capture of specimens 5 and 6 feet in length, on British coasts, is not uncommon ; but, generally speaking, the sea-angler desires to avoid rather than to capture them. The coasts of

Australia, Africa, India, and the tropical seas generally all afford excellent seEi-fishing of various kinds in due season.

In British and Irish waters the fish which holds the highest place in the angler's hst is undoubtedly the bass,

which will take fly, spinning, or indeed almost any

bait, and when hooked is as game as salmon. To capture the very large specimens of these fish, and such captures are not common, it is desirable to fish at night, or in the dusk of early morning. In the daytime success is not often obtained unless the water is slightly thickened by recent gales. The big fish particularly favour the mouths of harbours, where they may be caught on such malodorous baits as a stale piece of bloater, a piece of ray's liver, small dead fish, chicken's or rabbit's entrails, &c. They have the habit, either acquired in such places, or natural to them, of foul feeding. Sometimes the bait intended for bass is worked round the edges of rocks by means of float- tackle much the same as pike-fishers use, except that it terminates in a large, strong, single hook instead of the usual triangles. A better plan, where the bottom is clear, is to use a salmon-gut ledger with a lead of sufficient weight to hold the bottom. Medium-sized bass of from 2 to 5 lb are found in shoals during the late summer months, and when these are feeding close to the surface on the young of other fish ❓❓❓ herrings, sprats, mackerel, &c. ❓❓❓ the fly-fisher has an opportunity of enjoying some very excellent sport. The gaudier salmon-flies will take bass, but a piece of dried sole-skin, cut in the shape of a fish and whipped to a hook, is frequently used for the purpose. Baits such as sand-eels, or other small fish, are often trailed behind a boat, but they are better harled across the tidal current in the manner practised on salmon rivers. Perhaps the most deadly method of taking bass is to use a live fish on a drift line, two of the best baits being a sand-eel and a small flat-fish. The hook is attached to a snood several fathoms in length, above which are placed smaU pipe -leads at intervals of one and a half to two fathoms. The tide carries out the bait, and a sufficient amount of the lead-bearing Hne is let out to ensure the bait being at a proper depth. In this method, which is most suitable for

estuaries and channels between islands where there is a fairly good tide running, the boat should be moored.

Pollack and coal-fish, termed lythe and saithe in Scot- land, rank next after bass as sport-giving searfish, and are

far easier of ca])ture. Pollack lurk among rocks Pollack j^jj(j weeds, coming to the surface in the evening coal-fish. ^ search of food. Rocky points projecting far

out into the sea are certain places to find them. One of the best baits is a small conger -eel about 4 inches in length, trailed behind a boat. Failing this, the rubber imitation may be tried. Sand-eels are also very good. In fact, pollack, when feeding, will run at almost any small fish. In the daytime the line should be heavily leaded to bring the bait down close to

the weeds. In the evening the sea-angler fishes near the surface. Pollack will also take the usual pike spinning- baits, phantoms (red for preference), spoons, and the like. Live-baiting for them is carried on in exactly the same manner as for bass, and is suitable in places where the boat can be moored over a rocky ground in a current sufficient to extend the drift-line. The tackle has to be exceedingly strong, as these fish have a habit of darting down into the weeds when hooked, and must in consequence be given no line. Coal-fish, which have many local names, are some- what similar in form to pollack, but differ in colour, the beautiful ohve, bronze, and brown tints of the pollack giving way to a very dark greeny blue back and white sides and belly. They are freer swimming fish than pollack, roaming in shoals in search of food, and at times affording very fine sport. They wiU take all the usual pollack and bass baits, and in the Xorth they are often fished for with rough feather baits, from 2 to 4 inches in length. On the Irish coast the fishermen ‘ catch large numbers of medium-sized coal-fish, called, locally, “ghssaunes,” by trailing flies, the lines being attached to long bamboo poles projecting from the stern of sailing boats. For pollack, coal ~~*fish, and bass, ordinary salmon and pike rods fur*~~ *nished with strong lines can be used, except for the method of drift -lining, the special tackle for which has been described.*

*Grey mullet are much sought after by sea-anglers, but are extremely difficult of capture ovping to their shyness and to their peculiar mouths, which are apparently formed to suck in very soft food, and to eject "fi t quickly anything hard, such as a hook. The very large grey mullet are, indeed, rarely caught on hook and line ; but the bass fisher, using ray's liver or similar bait at the mouth of a harbour, sometimes obtains a specimen. During the summer months these fish run up rivers, and at night-time forage along the shore near towns, doubtless attracted there by the refuse. The smaller mullet of 1 or 2 S) are caught in large numbers in docks, harbours, and at the mouths of rivers on the south coast, on a stout perch paternoster baited with rag- worms ; but, generally speak- ing, success is only obtained by those who are on the water a little before daybreak. There are a few creeks round English coasts where large mullet are often seen. In such places an attempt may be made to catch them, their suspicions being lulled by the throwing in of ground- bait of a similar character to that on the hook. For this purpose boiled macaroni, chopped up, may be tried. The tackle may be a paternoster bearing several hooks sup- ported by a float, and allowed to svsdm down at whatever speed the current ******t11 take it. Mullet, however, are more likely to feed just at the top of high water when the tide is slack. If this tackle is drawn against the tide, or held in an unnatural way against it, the fish are likely to ignore the baits. This, however, does not apply to paternoster- ing with rag-worms for the small mullet in harbours and river mouths where a sink-and-draw motion is often given to the baits. A method of mullet-fishing which is occa- sionally successful is to float the paternoster, \ithout a lead, on the surface of the water by means of small fragments of cork placed at intervals, and to bait the hooks with macaroni or paste. Bread crumbs are sprinkled on the surface near the tackle to bring up the fish. The angler should keep himself at a considerable distance from the baits, out of sight of the fish.*

*Mackerel-fishing is, as a rule, carried on in much the same way by amateurs as by the professional fishermen, many of these latter having adopted the use of gut snoods with excellent results. When, however, ****<*e****" the wind is very slight and the day bright, the ****^' amateur often catches mackerel by using still finer tackle*

and very small lead, the professional fisherman's gear being absolutely useless under such conditions. In late summer, when the mackerel are inshore on some parts of the coasts, a very pretty method of capturing them is to moor the boat and use float-tackle, the float being about 10 feet or less above the bait ⬛⬛⬛ a strip of mackerel skin. This arrange- ment is carried out by the tide about 20 yards, the moving tide working the bait and giving it a lifelike appearance. If the current is very slight it is sometimes better to dispense with both float and lead, and fish by touch. Mackerel are also to be caught near the bottom on some parts of the coast towards the end of summer and in early autumn. The best Tjaits are squid, pilchard skin, mussels, and pieces of sand-eels. The tackle may be the ordinary paternoster, or a paternoster in which the plummet at the end is dispensed with, a pipe-lead placed where the run- ning line joins the gut taking its place. Mackerel, when near the surface, will take a fly, but when they are shoal- ing inshore, breaking the surface every now and again, it' is difficult to keep Avithin casting distance of them. The fly-fisher, however, sometimes obtains good sport with these fish when they have collected in narrow and shallow inlets of the sea. The best time of the day for mackerel- fishing is from six o'clock in the morning, or even earlier,

to 11 A.M.

*It is when fishing on the bottom for cod, conger, whit- ing, flat-fish, gurnet, (fee, with heavy leads, that special forms of tackle are most requisite. The ordinary ^** pike-rod 11 feet long is no use for working a*

sea-rod. tackle bearing a weight of IJ Bb to 2 K). The rings fray the line, and the leverage on the wrist, owing to the length of the rod, is enormous. The reels of freshwater fishermen are too small for this pur- pose. Very excellent sea-rods have, however, been de- signed by anglers and tacklemakers. These vary from 6 feet to 8 feet in length, are stout and strong, frequently have a spliced whalebone top, and in the place of rings are fitted small sheaves working between metal supports. At the end of the

rod are various forms of blocks, none, however, being more satisfactory than the ordinary block used by sailors, but, of course, very much reduced in size. Large reels of the Nottingham type, made of non-corrosive material, 6 inches and even 7 inches in diameter, are used. These will easily hold 200 yards of line, and by reason of their large diameter wind up as quickly as a hand-line can be hauled in. A modern innovation is the use of plaited wire lines. These have great strength, are fine, and do not hold the water ; but they are apt to kink and break unless very carefully used. The ordinary hemp or silk line for sea-fishing should be tanned - with, catechu.

The most generally useful form of tackle for fishing on or near the bottom is the paternoster, which may be of Adraa- single twisted gut or gimp, according to the tages of fish which are being sought after. Far better tbe pater- than the ledger for fishing from a boat is a noster. paternoster with the last link extended to 2 feet or a little more, and bearing two hooks which will lie on the bottom if the lead is lowered to a sufficient depth. Over weeds or rocks this tackle can be kept a foot or two from the bottom, and is very generally useful. Leads should be provided of various sizes, the angler always – using the lightest which will hold the bottom, increasing its weight as the tide strengthens, decreasing it as the tide slackens. The heavier the lead the more difficult it is to feel the bites of the fish. The eyed hooks of good quality used by freshwater fishermen have largely taken the place of the old flatted, tinned hooks of the professional sea-fisherman. In conger-fishing amateurs usually mount their hooks on gimp, but a soft snood of plaited hemp or flax is better. The best conger and bream

fishing is at night. When paternostering on the bottom, and the tidal current is slight, it may be found necessary to use small wire booms 3 inches or 4 inches in length to extend the hook-links from the vertical portion of the paternoster, which they might otherwise foul. A swivel to keep the line from kinking and one at the end of each boom are useful. Among the best baits for fishing on or near the bottom are lug-worms, mussels, sand-worms, rag-worms, shrimps, prawns, oysters, squid, cuttle-fibh, pilchard, her- ring, sprat, mackerel, hermit-crab, and soft-crab.

Authorities. ??? John Bickerdyke. Sea-Fishing (Badminton Library). London, Longmans. ??? J. C. Willcooks. The Sea- Fisherman. ??? John Biokerdtke. Letters to Young Sea-Fishers. London, Horace Cox. ??? F. G. Aelalo. Sea- Fishing. London, Lawrence and Bullen. ??? John Bickerdyke. Angling in Salt Water. London, L. Upoott Gill. ("J. B.")

SeSt'Tord, a parish, railway station, and watering- place, Sussex, England, in the Eastbourne parliamentary division of the county, 13 miles east of Brighton. Its ancient corporation was dissolved in 1886, and it is now governed by an urban district council. A parade was built in 1881-82, and in 1887 a concrete groyne. In 1896 Queen's Hall was built, a church institute was founded in 1898, and in 1897 a cemetery of 5 acres was opened. There are golf links extending for about 3 miles. The population of the urban district in 1891 was 1991 ; in

1901, 3355.

Seaham Harbour, a pari.sh, urban district (1894), and seaport town, Durham, England, in the South-Eastern parliamentary division of the county, 6 miles south of Sunderland by rail. Besides the coal trade there are extensive bottle works, and electrozone works. The population of the urban district was in 1891, 9044; in 1901, 10,163.

Seal. ??? The fur seals or "sea bears" and sea lions (Otariidce), with the walruses, constituting the sub-order Gressigrada, are closely related to the bears, and are very distinct from the true or hair seal (PhocidcE), with which they have been more or less confused. Of the two groups or genera of fur seals, Arctocephalus {A. townseridi, Guada- lupe Island ; A. philippii, Galapagos Islands ; A. australis, southern coasts of South America and neighbouring islands ; A. delalandii, islands and coasts of South Africa; A. gazella, Kerguelen and Prince Edward Islands ; A. forsteri, coasts of New Zealand and South-Western Australia) was once widely distributed over the pelagic islands of the southern hemisphere, but is now practically extinct in the greater part of its habitat. Remnants of importance exist only on Lobos Island in the mouth of the river Plata in Uruguay, and on the islands off Cape Horn; both of these now receive

protection from Government. The other genus, Callorhinus (C. ursinus, Commander Islands ; C. alaskanus, Pribiloflf Islands, both in Bering Sea ; C. Icurilensis, Robben Island and Kurile Islands, Sea of Okhotsk), is limited to the waters of the North Pacific Ocean.

Of the southern herds little authentic information exists, but the records for the northern herds are fairly complete. At the period of its maximum development, 1870 to 1880, the herd of the Pribiloff Islands numbered about 2^ million animals; that of the Commander Islands about , one-half as many. The third herd is one of minor im- portance, numbering in 1897 less than 1000 animals on Robben Island. All three herds became greatly reduced, and in 1896-97 numbered in all not more than 600,000 animals. The typical adult male or bull (sikatch) attains maturity about the seventh year, and weighs from 400 to 500 K). He is 6 feet in lei^th, with a girth of 4^ feet. His fur is blackish or dark brown, with long yellowish-

white water hairs, especially long and firm on the back of the neck, forming the so-called ” wig ” or mane. The fore limbs, or flippers, are modified as oars and used in swim- ming. The animal stands erect and runs or lopes along the ground when on land. The adult female, or cow {piatka), is much smaller, averaging about 80 lb in weight, with length and girth in proportJon. Her fur is of vary- ing shades of brown. She bears her first young at the age of three years.

The breeding – grounds are boulder – strewn beaches or rocky hill slopes near the shore. On these the gregarious instinct of the animals leads them to congregate in close- set masses called rookeries. The unit of rookery life is the family group, or harem, each bull getting about him as many females as he can control. The number ranges from 1 to 100 or more, averaging about 30. The bulls reach the islands early in May and take up their places. The cows begin to arrive the first week in June. The number on the rookeries from day to day grows steadily to a climax about the middle of July, when about one-half are present, the number actually on

the ground diminishing to about one-fourth at and after the close of the breeding season with the end of July. The single young, or pup {kotik), weighing 10 to 12 B) and jet black in colour, is born within six to forty-eight hours after the arrival of the cow. Within a week the latter is served by the bull, and by the end of another week she goes to sea to feed, returning at gradually lengthening intervals through the summer to nourish her young, left in the meantime to care for itseK on the rookeries. The bulls, having fasted since their arrival in May, go away in August to feed. The pups learn to swim at the age of a month or six weeks, and in November, with the approach of winter, they swim away with their mothers to the south. The winter migration of the Pribiloff seals extends as far south as the latitude of southern California, the return course following the coast. The Commander seals reach the latitude of southern Japan and return on their course. Tie fur seals find their food, chiefly squid {Gonatus aTfioenus), the Alaska pollack [Theragra chalcogramma), and especially a small smel1>like fish {Therobromus cal- lorhini), in deep water, and their feeding -grounds in Bering Sea and on the migrations lie mainly along the 100-fathom curve.

The Commander Islands were discovered by Vitus Bering in 1741, and our first knowledge of the northern fur seal herds comes from the notes of Georg Wilhelm Steller, a German naturalist accompanying Bering's ex-pedition. The Pribilofi' Islands were discovered in 1786, and were transferred with the territory of Alaska to the possession of the United States in 1867. The Eussians, in their half-century or more of experience with the fur seals, worked out the principle, based on the polygamous habit of the animals, of affording absolute protection to the breeding female herd, and confiaing the killing to the superfluous males. This principle is still rigidly adhered to in the operations of land killing. The young males, or bachelors, haul out to rest and sleep on beaches adjacent to, but distinct from, the breeding-grounds. Here they are surrounded at night by the sealing gangs (natives from the Aleutian Islands, brought over by the Eussians to carry on the sealing operations), rounded up in droves of from 1000 to 3000, and driven inland to the killing- grounds. The large droves are broken up into successive "pods," or groups, of from 20 to 50, of which the "killable" seals (animals of three years of age or ap- proximating to such in size) are knocked down with clubs, those too

large or too small being allowed to escape. The skins are removed, salted in kenches, and, when cured, shipped to London, where practically all the fur sealskins

of the world are dressed. The two important processes in dressing the skins are the removal of the long water hairs which grow out through the short thick fur, and the dyeing of the fur itself black ??? both deUcate and difiicult operations.

The decline already noted in the fur seal herds of Bering Sea is due to the growth of a rival sealing industry ??? the hunting of the animals at sea with spear or shot- gun, now known as pelagic sealing. Stragglers from the migrating herd had from the earliest times been taken by the Indians of Cape Flattery and Vancouver Island, going out from the shore in their canoes, but the number so captured was small. In 1879, however, sailing vessels began to be used to carry the hunters and their canoes out to the main body of the herd, and to enable them to follow its movements. The industry developed rapidly, by 1892 employing a fleet of 122 saihng vessels, each with from five to twenty hunting crews. The catch at sea grew to a maximum in 1894 of 140,000 skins. The operations of the fleet gradually extended to cover the entire migration route of the herd, and in 1883 the sealers entered its summer feeding-grounds in Bering Sea. Pelagic hunting, necessarily indiscriminate, affected most seriously the herd of breeding females. Investigations carried on in Bering Sea in 1895 and 1896 show that from 62 to 84 per cent, of the pelagic catch are of this class, the death of the female involving the death of her unborn offspring, as well as that of the unweaned young.

Under sanction of a claim made by Eussia in 1821 to exclusive jurisdiction in Bering Sea, a claim decided by the Paris Tribunal of 1893 to be untenable, the United States in 1886 seized sealing vessels operating in that sea ??? among them Canadian vessels. This brought on a diplomatic discussion with Great Britain, which culminated in 1892 in a treaty by which it was agreed to submit to a court of arbitration the claims of the United States to jurisdiction in Bering Sea in the interests of her fur seal herd when beyond the ordinary territorial limits. The Tribunal of Arbitration met in Paris in 1893. Its decision was adverse to the

contentions of the United States, and equally adverse to the life of the fur seal herds. As agreed upon in such event, the tribunal formulated a set of rules for the regulation of pelagic seaUng, with a view to the protection of the seals. These regulations pro- vided for a close season in Jlay, June, and July, and a protected zone of 60 miles' radius about the breeding islands. The regulations failed utterly of their object, because the breeding females do not feed within the protected area, but far outside of it, and are therefore taken without restriction on the feeding-grounds in August and September, their young being left to starve.

In 1896, with a view to a revision of the regulations, it was agreed between the United States and Great Britain that a new investigation of the facts of seal life should be made. At the close of this inquiry in 1897 the two Commissions met in Washington as a Joint Conference of Fur Seal Experts, and after a discussion of the results of their labours, a substantial agreement was reached on all essential facts. On the basis of this agreement the fur seal question passed into the hands of a Joint High Com- mission, representing Great Britain, the United States, and Canada, called at Quebec in September 1898 to consider a number of questions at issue between the United States and Canada. There the matter rested. Jleanwhile the herds have continued to decline, and the pelagic catch has itself fallen off rapidly with the depleted herds.

For a full discussion of the fur seals and fur seal industries reference should be made to the reports of D'Arcy W. Thompson, Commissioner for Great Britain, and his associates, for 1896 and 1897 (Parliamentary Papers, "United States," No. 3 (1897), and No. 1 (1898)), and especially to the elaborate final report of David S. Jordan, Commissioner for the United States, and his associateB,

for the same years {Treasury Department Docwnent, No. 2017, " Fur Seals and Fur Seal Islands of North Pacific Ocean," 4 vols, and atlas. Washington, 1898). Other papers of importance are : Henry W. Elliott's " Monograph of the Seal Islands of Alaska," Bull. 147, U.S. Fish

Commission, 1882, and the report of 0. Hart Merriam and Thomas C. Mendenhall, the American Commissioners for 1891, Froc. Fans Arb. vol. ii. pp. 311-396.

The table herewith appended gives the statistics, so far as avail- able, of the fur seal herds as represented by the product taken on land and at sea. The records prior to 1870 are more or less unsatisfactory, but those subsequent to that date are authentic ; ???

Fur Seal

Skins from various

Sources, 1743 to 1897.

Year.

Land Sealing.

Pelagic

Sealing.

Southern Seals.

Exported

from Russian Colonies.

Pribiloff Herd.

Com- mander Herd.

Pribiloff Herd.

Com- mander Herd.

Lobos Island.

Cape Horn.

1743

to

1820 .

2,167,040

...

1821

to

1842 .

468,502

...

...

1843

to

1867 .

571,612

1868 .

246i000

4i367

...

1869 .

87,000

4,430

...

1870 .

23,773

8,686

...

...

1871 .

102,960

3,658

16,911

. 1872 .

108,819

29,366

6,336

...

1873 .

109,177

30,899

5,229

3[966

1874 .

110,586

31,300

5,873

8,609

1876 .

106,460

36,279

6,033

8,179

1876 .

94,657

26,960

6,515

11,353

oisoe

1877 .

...

84,310

21,533

6,210

13,066

7,681

1878 .

...

109,323

31,340

6,544

12,301

8,227

1879 .

110,411

42,740

8,667

‘sio

12,296

12,180

1880 .

...

106,718

48,504

8,718

1,192

14,836

17,562

1881 .

106,063

43,622

10,382

13,569

13,164

1882 .

99,812

44,620

15,561

13,200

11,711

1883 .

79,609

28,699

16,667

“28

12,861

4,655

‘ 1884 .

106,434

63,263

16,971

212

16,258

6,743

1885 .

106,024

43,676

23,040

1,920

10,953

3,404

1886 .

104,521

64,691

28,494

11,000

13,667

909

1887 .

105,760

46,347

30,628

16,000

11,068 20,747

2,762

1888 .

103,304

47,362

26,189

726

4,403

1839 .

102,617

62,859

29,858

13,300

8,766

8,021

1890 .

28,069

63,780

40,814

11,000

18,641

2,460

1891 .

12,040

36,905

69,568

8,432

16,834

3,114

1892 .

7,511

31,244

46,642

26,762

12,202

6,292

1893 .

7,396

32,818

80,812

66,143

13,624

2,131

1894 .

16,270

27,287

61,838

79,306

12,146

62

1895 .

14,846

17,719

66,291

87,936

12,017

1,888

, 1896 .

28,964

14,741

43,917

24,191

14,019

2,510

1897 .

20,890

11,335

24,321

13,801

12,791

1,266

SDMMARY.

From all sources prior to 1868

Land sealing, 1868-97, Pribiloflf herd .

„ ❓❓❓Commander herd Pelagic sealing, 1868-97, Pribiloff herd

„ ❓❓❓Commander herd Lobos Island skins ....

3,197,164 2,440,213 942,736 651,282 312,247 316,746 122,390

Grand Total ….

7,982,768

(d. S.

J. ; G. A. c.)

Seamcinship. ❓❓❓The art of seamanship consists in causing a vessel to contend successfully with wind and with sea. The modern development of steam engines and the employment of steel in the construction of the hulls have created a further demand for punctuality and comfort in the performance of voyages, and have resulted in a great increase in the size of vessels for all but mere coasting and fishing purposes. The tendency of this demand, coupled with inter-oceanic thoroughfares of communication, such as the Suez Canal, has constantly lessened the proportion of vessels propelled by sails to that of machine-propelled ❓❓❓steamers, capable of attaining the habitual punctuality of the present day. In the United Kingdom, in the middle of the 'seventies, 132 steam-vessels of wood or of iron were in process of construction, and 317 sailing vessels of the same materials. In the latter part of 1898, 533 steamers of steel, iron, and wood were being built, and only 25 sailing vessels of greater size than 100 tons ; in that year ❓❓❓46 steamers were completed and added to the mercantile

marine of the United Kingdom, and 195 were either lost or broken up ; 242 sailing vessels, mostly small, were added, and 448 were wrecked or destroyed. Thus the steam navy has largely increased, and the sailing navy is rapidly dwindling. The same qualities in the seaman that led to national success in the era of sails are now required for corresponding efficiency under the stringent requirement of forcing passages in all weathers and at all seasons. In modern ships the demands on the human

endurance of executive officers, and of engineers and their subordinates, are greater and more prolonged than on those of a rapidly passing generation ; for while it may be granted that during heavy weather, and specially in narrow waters, severe strain is brought on the seamanship of officers and crews of sail- ing vessels, long interludes of moderate and calm weather afford periods of comparative relief. But in these days of almost universal steam-power, the hurry and drive of making rapid passages last without cessation from port to port. If we gauge the distances traversed by modern steamers by immunity from accident, as compared with the lesser distances covered by the sailing vessel, between year's end and year's end, the percentage of calamitous accidents has greatly diminished, for the men who follow the sea have developed qualities of seamanship suitable to the mechanical necessities of their time.

Seamen, Merchant. ??? Since the article on Laws relating to Seamen {EricyclopaBdia Britannica, 9th edition, vol. xxi. p. 605) was written, a reform therein indicated as urgently required has been effected. The law had at that date to be gathered from the Merchant Ship- ping Act, 1854, and a long series of amending Acts. Further amending Acts were passed until 1894, but in that year the whole of the existing merchant shipping Acts were repealed and consolidated in one statute, the Merchant Shipping Act, 1894. To that Act, and especially to Part II., which deals with masters and seamen, and Part V., which deals with safety, and not to the repealed Acts mentioned in the article, reference must now be made. With some modifications which are indicated below, the law is substantially as stated in the previous article, and it will here only be necessary to call attention to recent changes, and in some respects to amplify the earlier statement.

The law as to the engagement and discharge of seamen has not been altered. But it should be pointed out that these must take place before a superintendent only when the employment is on a foreign-going ship. If the ship is a home-trade ship, the signing on and discharge take place before a superintendent only if the master so desire. But if the signipg on does not take place before a superintendent, the master must cause the agreement to be read and explained to the seaman, and the seaman must

sign it in the presence of a witness ; copies of all such agreements must be transmitted to the proper Board of Trade officials. A copy of every agreement with the crew must be posted up in some part of the ship which is accessible to the crew. In any British posses- sion abroad other than that in which the ship is registered, a seaman must be engaged before a superintendent or officer of customs, and at any port abroad where there is a British consular officer, before such officer. Before a seaman can be discharged at any place abroad, the master must obtain the sanction, endorsed on the agreement with the crew, of the like officials or, in their absence, of merchants there resident. When a seaman is dis- charged in a foreign country, he is entitled to be provided with adequate employment on some other British ship bound to the port in His Majesty's dominions at which he was originally shipped, or to a port in the United Kingdom agreed to by the seaman, or to be furnished with the means of returning to such port or of a passage home. It is a misdemeanour wrongfully to force a seaman on shore, or otherwise wrongfully leave him behind in any place before the completion of the voyage for which he was engaged, or the return of the ship to the United Kingdom. The only persons by whom seamen may be engaged or supplied in the United Kingdom are a superintendent, the master, the mate, a servant hond fide in the constant employ of the owner, and any person holding a licence from the Board of Trade.

The law as to seamen's wages has not been altered. Where a seaman is discharged before a superintendent in the United

Kingdom, his wages must be paid tlirough or in the presence of the superintendent, and in the case of home-trade ships may be so paid if the master or owner so desire. The master must in every case deliver either to the superintendent or to the seaman a full account, in a form approved by the Board of Trade, of the wages and of all deductions therefrom ; such deductions will only be allowed if they have been entered by the master

during the voyage in a book kept for that purpose, together with a statement of the matters in respect of which they are made. Where a sea-man is left abroad on the ground of his unfitness or inability to proceed on the voyage, the account of wages must be delivered to the superintendent, chief officer of customs, consular ofBcer, or merchants, from whom the master obtains the certificate without which he may not leave the seaman behind. In order to protect seamen from crimps, advance notes, or documents authorizing or promising the future payment of money on account of a seaman's wages conditionally on his going to sea from any port of the United Kingdom, and made before those wages had been earned, were from 1880 to 1889 wholly void, and no money paid in satis- faction or in respect of any such document could be deducted from a seaman's wages. Since 1889 this restriction has been removed to the extent of one month's wages, provided that the agreement ' with the crew contains a stipulation for such advance. It is to be observed that this does not extend to cases where the seaman is going to sea from any port not in the United Kingdom. In such cases there is no limitation upon the right to make any agreement for advances or to make advances to any amount. It has been held that the old statute, 8 Geo. I. c. 24, ►►7, does not forbid an advance to a seaman engaged abroad, or if it does, does not enable a seaman to recover the sum advanced again as unpaid

As under the former law, the scale of provisions must be entered in the agreement with the crew, and compensation made for short or bad provisions, and means are provided whereby the crew can raise complaints. But, in addition, in the case of ships trading or going from any port in the United Kingdom through the Suez Canal or round the Cape of Good Hope or Cape Horn, the provisions and water are put under inspection by the Board of Trade, and if they are deficient, the ship may be detained until the defects are remedied.

The law as to the property of deceased seamen, the reimburse- ment of relief to seamen's families, the relief of destitute and dis- tressed seamen, discipline, and volunteering into the navy, remains substantially unaltered. The law as to medicines, anti-scorbutics, and medical inspection, and as to crew space, continues the same. If a seaman receives

hurt or injury in the service of the ship, the expense of medical attendance and maintenance, together with the cost of bringing him home, is to be borne by the owner of the ship, and cannot be deducted from wages.

'The safety of the crew is secured by provisions which are designed to prevent overloading and undermanning, to restrict the carriage of dangerous cargoes, to secure adequate life-saving appliances, and generally to prevent ships from being sent to sea in an unseaworthy state. The stringency of these provisions has been much increased. Life-saving appliances, including boats, life ~~belts, and the like, according to a scale and rules prescribed by the Board of Trade, must be carried by every British ship. Except where the ship is under 80 tons register, employed solely in the coasting trade, or is employed solely in fishing, or is a pleasure yacht, the position of each deck above water must be marked by conspicuous lines, and the maximum load line in salt water, to which it shall be lawful to load the ship, must be marked at such level as may be approved by the Board of Trade below the deck line, and in accordance with tables and regulations prescribed by the Board of Trade. It is this load line which is commonly known as the PlimsoU mark. It is an offence to load a ship so as to submerge the load line, and a ship so loaded may be detained as unsafe. Dangerous goods, e.g., explosives, must not be shipped or carried without being dis~~ tinctly marked as such. Timber must not be carried on deck in the winter months. In the carriage of grain cargoes, rules pre- scribed by the Board of Trade to prevent shifting must be com- plied with. The officers of the Board of Trade (subject to appeal to a Court of Survey from an order of final detention) have power to detain any unsafe ship, that is a ship which is, by reason of the defective condition of the hull, equipments, or machinery, or of undermanning, overloading or improjier loading, imfit to pro- ceed to sea without serious danger to human life, having regard to the service for which she is intended. Provision is made for the investigation of complaints by seamen that a ship is unfit to proceed to sea.

The manning of British merchant ships has received much consideration, but has hitherto been little affected by statute

law. The effect of the Acts is thus given in the report, issued in 1896, by a Board of Trade Committee on the Manning of Merchant Ships: ??? "Since the final repeal of the Navigation Laws, which required that the master and three – fourths of the crew of every British ship should be British subjects, and reserved the coasting trade entirely to British ships and British seamen, the whole world has been open as a recruit- ing ground to British shipowners, who have not been hampered in their selection by any restriction as to colour, language, qualification, age, or strength. Except with regard to certifi- cates, which must be held by masters, officers, and engineers in certain cases, and which, moreover, may be obtained by men of any nationality, there is at present practically no bar to the employment of any person of any nationality in any capacity whatsoever on board any British ship."

Certificates of competency as . masters, mates, and engineers are granted by the Board of Trade. Such certificates are for the follovraig grades, viz., master or first mate, or second mate, or only mate of a foreign-going ship, master or mate of a home-trade passenger ship, first or second class engineer. By virtue of Orders in CouncU under section 102 of the Act of 1894, certificates granted in many of the British colonies have the same force as if granted by the Board of Trade. The following are the requirements of the Act as to the officers to be carried by ships : ??? Masters : A properly certificated master must be carried by every foreign-going ship and every home-trade passenger ship, whatever their tonnage. Mates : A mate, with the certificate of the grade of first or only mate, or master, must, in addition to the certificated master, be carried by every foreign-going ship of 100 tons or up- wards, unless more than one mate is carried, in which case the first and second mates must have valid certifi- cates appropriate to their several stations on such ship or of a higher grade ; and a mate, with a certificate of the grade of first or only mate or master, must, in addition to the certificated master, be carried by every home-trade passenger ship of 100 tons or upwards. Engineers.- Every foreign-going 'steamship of 100 nominal horse power or upwards must have two certificated engineers ??? the first possessing a first-class engineer's certificate, and the second possessing a second-class engineer's certificate, or a certifi- cate of the higher grade. Every other foreign -going steamship, and every sea-going home-trade passenger

steamship, is required to carry as the first or only engineer an engineer having a second-class certificate, or a certificate of the higher grade. Vessels in the home trade {i.e., United Kingdom and continent of Europe between the Elbe and Brest) are not required to carry certificated masters or officers unless they are passenger ships of 100 tons or upwards ; and vessels in the foreign trade of less than 100 tons are not required to carry any mate.

The Merchant Shipping Act, 1897, gives power to the Board of Trade to detain ships unseaworthy by reason of undermanning, but prescribes no rules for determining when a ship is to be deemed to be undermanned. And apart from that Act, the law does not interfere ???nith the number or qualifications of the crew. The law does not prescribe that the crew or any portion of it should be British, or that it should consist, in any proportion, of able-bodied seamen. In 1898 a slight attempt was made to encourage shipovmers to carry apprentices to the sea service. The Merchant Shipping Act of that year, which dealt with light dues, provided that "on proof to the satisfaction of the Board of Trade that a British ship has during any financial year carried, in accordance with the scale and regulations to be made by the Board of Trade, with the concurrence of the Treasury, boys between the ages of 15 and 19, there shall be paid to the owner of the ship, out of moneys to be provided by Parliament, an allowance not exceeding one-fifth of the light dues paid during that year in respect of that ship. Provided that no such payment shall be made in respect of anybody

unless he has enrolled himself in the Eoyal Naval Eeserve, and entered into an obligation to present himself for service when called upon in accordance with rules to be issued by the Admiralty." This enactment is to continue until 1905; it has been so little acted upon that some niore efficient means will have to be devised, if apprentice- ship to the sea service is to be revived ; at present it has practically ceased to exist, except in the case of boys who intend to become officers.

Some only of the provisions of the Acts apply to ships belonging to the general lighthouse authorities and pleasure yachts. But, with these exceptions, the whole of Part IL (Masters and Seamen) applies, unless the contract or subject-matter requires a different apphcation, to all sea-going ships registered in the United Kingdom. Where a ship is a British ship, but not registered in the United Kingdom, the provisions of Part II. apply as follows : ❓❓❓ The provisions relating to the shipping and discharge of seamen in the United Kingdom and to volunteering into the navy apply in every case. The provisions relating to lists of the crew and to the property of deceased seamen and apprentices apply where the crew are discharged or the final port of destination of the ship is in the United Kingdom. All the provisions apply where the siiip is employed in trading or going between any port in the United Kingdom, and any port not situate in the British possession or country in which the ship is registered. The provisions relating to the rights of sea- men in respect of wages, to the shipping and discharge of seamen in ports abroad, to leaving seanlen abroad, and the relief of seamen in distress in ports abroad, to the pro-visions, health, and accommodation of seamen, to the power of seamen to make complaints, to the protection of seamen from imposition, and to discipline, apply in every case except where the ship is within the jurisdiction of the government of the British possession in which the ship is registered.

The law as to the registration of fishing boats, and generally as to men employed in fishing, is now to be found in the Merchant Shipping Act, 1894, and especially in Part IV. of that Act. The Act does not apply to fishing boats in British possessions, and, speaking generally, fishing boats in Scotland are governed by Part II. (Master and Seamen) and not by Part IV. By a recent change in the law, a trawler of 25 tons and upwards must carry a certificated second hand as well as a certificated skipper.

la most British colonies there are laws affecting mer- chant seamen. In some cases such legislation is identical with the Imperial Act, but in most there are differences of more or less importance, and the colonial statutes should be consulted. Reference may be made to the following Indian and Colonial Acts and ordinances : ❓❓❓ Bahamas: 2 Vict. c. 3 ; 21 Vict. c. 2 ; 27 Vict. c. 2 ; 28 Vict. c. 1 ; 28 Vict. c. 28 ; 33 Vict. c. 15 ; 36 Vict. c. 1 ;

43 Vict. c. 20. Barbados: No. 45 of 1891 ; No. 12 of 1898. Bermuda: No. 17 of 1782; No. 22 of 1848; No. 6 of 1849 ; No. 14 of 1867 ; No. 13 of 1873 ; No. 7 of 1876 ; No. 4 of 1878 ; No. 10 of 1878 ; Nos. 2 and 5 of 1880; No. 5 of 1884; Nos. 16, 25, and 31 of 1900. British Guiana: No. 6 of 1864; No. 4 of 1883; No. 2 of 1895; No. 10 of 1900. Canada: Revised statutes, chapters 73, 74, 76 and 77; Nos. 21 and 22 of 1889; Nos. 38, 40 and 41 of 1891; No. 22 of 1893; Nos. 42, 43, 44 and 45 of 1894; Nos. 45 and 46 of 1898; No.- 34 of 1901. Cape of Good Hope: No. 13 of 1855 ; No. 3 of 1863 ; No. 2 of 1870 ; No. 13 of 1874. Ceylon: No. 7 of 1863; No. 3 of 1880; No. 3 of 1884; No. 3 of 1888; No. 6 of 1899. Honduras: Consolidated Laws, chapters 54 and 55. Hong Kong : No. 36 of 1899. India: No. 1 of 1859; No. 13 of 1873; No. 13 of

1876 ; No. 7 of 1880; No. 5 of 1883; No. 7 of 1884; Nos. 6, 12, and 17 of 1891 ; No. 15 of 1894. Jamaica: 2 Will. IV. c. 32; 6 Will. IV. c. 19; No. 21 of 1875; No. 11 of 1878; No. 17 of 1881; No. 27 of 1900. Leeward Islands: No. 2 of 1878; No. 8 of 1888. Mauritius: No. 17 of 1855; No. 10 of 1858; No. 13 of 1869 ; No. 5 of 1874 ; No. 15 of 1887 ; No. 16 of 1891 ; No. 7 of 1892; No. 40 of 1897; No. 18 of 1899; Nos. 8 and 10 of 1900 ; No. 10 of 1901. Natal: No. 10 of 1883; No. 4 of 1884; No. 1 of 1890. New Bruns- wick : Revised Statutes, chapters 22, 86, and 87 ; No. 4 of 1865; No. 21 of 1866. Newfoundland: Consolidated Statutes, chapters 97 and 98 ; No. 5 of 1891 ; No. 4 of 1901. New South Wales: Nos. 46 and 47 of 1898 No. 60 of 1901. New Zealand: No. 4 (^ 1860 No. 54 of 1877; No. 15 of 1885; No. 10 of 1889 No. 15 of 1890; No. 62 of 1894. Queensland: No. 17 of 1840 ; No. 21 of 1843 ; No. 23 of 1847 ; No. 28 of 1849 ; No. 25 of 1852 ; No. 36 of 1853 ; No. 10 of 1874; No. 3 of 1876 ; No. 12 of 1882 ; No. 31 of 1896. South Australia: No. 237 of 1881 ; No. 541 of 1891 ; No. 614 of 1894; No. 691 of 1897. Straits Settlements: No. 1 of 1859 and 15 of 1863 (Indian Acts) ; No. 28 of 1867; No. 14 of 1869 ; No. 1 of 1873 ; No. 18 of 1889. Tas- mania: Nos. 7 and 8 of 1859; No. 22 of 1870; No. 11 of 1878; No. 34 of 1889; No. 27 of 1895; No. 33 of 1896. Trinidad: No. 8 of 1883. Victoria: No. 1139 (1890); No. 1165 (1890); No. 1357 (1894); No. 1360 (1894); No. 1557 (1898); No. 1771 of 1901; West Australia: No. 2 of 1870; No. 14 of 1877; No. 19 <?? 1878; No. 1 of 1880.

Secl-Power. ❓❓❓ A term used to indicate two dis- tinct, though cognate, things. The affinity of these two and the indiscriminate manner in which the term has been applied to each have tended to obscure its real significance. The obscurity has been deepened by the frequency with which the term has been confounded with the old phrase, "Sovereignty of the sea," and the still current expression, " Command of the sea " [vide Sea, Command of). A discussion ❓❓❓ etymological, or even archaeological in char- acter ❓❓❓ of the term must be undertaken as an introduction to the explanation of its now ʿ^"'yf generally accepted meaning. It is one of those compound words in which a Teutonic and a Latin (or Romance) element are combined, and which are easily formed and become' widely current when the sea is con- cerned. Of such are " sea-coast," " sea-forces " (the " land- and sea-forces " used to be a common designation of what we now call the " Army and Navy ") ; "searservice," " sea- serpent," and "sea-officer" (now superseded by "naval officer"). The term in one form is as old as the 15th century. Edward III., in commemoration of the naval victory of Sluys, coined gold "nobles" which bore on one side his effigy "crowned, standing in a large ship, holding in one hand a sword and in the other a shield." An anonymous poet, who wrote in the reign of Henry VI., says of this coin :
❓❓❓ ❓❓❓

For four tMngs our noble showeth to me, King, ship and sword, and power of the sea.

Even in- its present form the term is not of very recent date. Grote {Hist, of Greece, v. p. 67, published in 1849, but with preface dated 1848) speaks of "the con- version of Athens from a land-power into a sea-power." In a lecture published in 1883, but probably delivered earlier, the late Sir J. R. Seeley says that " commerce was swept out of the Mediterranean by the besom of the Turkish sea-power" {Expansion of England, p. 89). The term also occurs in vol. xviii. of this Encyclopaedia, pub- lished in 1885. At p. 574 of that volume (Persia) we are

told that Themistocles was ” the founder of the Attic sea-power.” The sense in which the term is used differs in these extracts. In the first it means what we generally call a “naval power” ??? that is to say, a State having a considerable navy in contradistinction to a ” military, power,” a State with a considerable army but only a relatively small navy. In the last two extracts it nleans all the elements of the naval strength of the State referred to ; and this is the meaning that is now generally, and is likely to be exclusively, attached to the term owing to the brilliant way in which it has been elucidated by Captain A. T. Mahan of the United States Navy in a series of remarkable works [Influence of Seorpower on History, pub- lished 1890 ; Influence of Sea-power on the French Revol-w- iion and Empire, 2 vols. 1892 ; Nelson : the Embodiment of the Sea-power of .Great Britain, 2 vols. 1897). The double use of the term is common in German, though in that language both parts of the compound now in use are Teutonic. One instance out of many may be cited from the historian Adolf Holm (Griechische Geschichte, Berlin, 1889). He says (ii. p. 37) that Athens, being in posses- sion of a good naval port, could become ” eine bedeutende Seemacht,” i.e., an important naval power. He also says (ii. p. 91) that Gelon of Syracuse, besides a large army {Heer), had ” eine bedeutende Seemacht,” meaning a con- siderable navy. The term, in the first of the two senses, is old in German, as appears from the following, extracted from Zedler’s Grosses Universal Lexicon,’ vol. xxxvi. (Leipzig and Halle, 1743) : ” Seemachten, Seepotenzen; Latin, sum^ mae potestates m,ari potentes.” ” Seepotenzen ” is prob- ably quite obsolete now. It is interesting as showing that German no more abhors Teuto-Latin or Teuto- Romance compounds than English. We may note, as a proof of the indeterminate meaning of the expression until his own epoch-marking works had appeared, that Mahan himself in his earliest book used it in both senses. He says (p. 35), ” The Spanish Netherlands ceased to be a sea-power.” He alludes (p. 42) to the development of a nation as a ” sea-power,” and (p. 43) to the inferiority of the Confederate States ” as a sea-power.” Also (p. 225) he remarks of the war of the Spanish Succession that “before it England was one of the sea -powers, after it she was the sea-power without any second.” In all these passages, as appears from the use of the indefinite article, what is meant is a naval power, or a State in possession of a strong navy. The other meaning of the term forms the general subject of his writings above enumerated. In his

earlier works Mahan writes “sea power” as two words ; but in a published letter of the 19th February 1897, he joins them with a hyphen, and defends this formation of the term and the sense in which he uses it. We may regard him as the virtual inventor of the term in its more diifused meaning, for ❓❓❓ even if it had been employed by earlier writers in that sense ❓❓❓ it is he beyond all question who has given it general currency. He has made it impossible for any one to treat of sea-power without frequent reference to his writings and conclusions.

There is something more than mere literary interest

in the fact that the term in another language tloa ot ‘^^s used more than two thousand years ago. sea-power Before Mahan no historian ❓❓❓ not even one of by the those who specially devoted themselves to the

narration of naval occurrences ❓❓❓ had evinced a more correct appreciation of the general principles of naval warfare than Thucydides. He alludes several times to the importance of getting command of the sea. Great Britain would have been saved some disasters and been less often in peril had British writers ❓❓❓ taken as guides by the public ❓❓❓ possessed the same grasp of the true principles of defence as Thucydides exhibited. One passage in his

history is worth quoting. Brief as it is, it shows that on the subject of sea-power he was a predecessor of Mahan. In a speech in favour of prosecuting the war, which he puts in the mouth ❓❓f Pericles, these words occur : ❓❓❓ ol fxkv yap ov)(^ e^ovaiv aXXrjV dvTiXa/Sctv dyuaj^ei, rjfji,iv 8e ecTTi yrj TroXXrj Kai ev vrjo’Oi’S Kal Kar’ rjirapov [iiya yap rb rrji 6a\da-(Tr)‘S KpaToi. The last part of this ex- tract, though often translated “command of the sea,” or “dominion of the sea,” really has the wider mean- ing of sea^power, the ” power of the sea ” of the old English poet above quoted. This wider meaning should be attached to certain passages in Herodotus (iii. 122 in two places ; v. 83), which have been generally inter- preted ” commanding the sea,” or by the mere titular and honorific “having the dominion of the sea.” One editor of Herodotus, Ch. F. Baehr, did, however, see exactly what was meant, for, with reference to the allusion to Polycrates, he says, classe maximum

valuit. This is perhaps as exact a definition of sea-power as could be given in a sentence.

It is, however, impossible to give a definition which would be at the same time succinct and satisfactory. To say that ” sea-power ” means the sum total of the various elements that go to make up the naval strength of a State would be in reality to beg the question. Mahan lays down the ” principal conditions affecting the sea-power of nations,” but he does not attempt to give a concise defini- tion of it. Yet no one who has studied his works will find it difiicult to understand what it indicates. Our present task is, within the necessarily restricted limits of an article in an encyclopasdia, to put readers in pos- session of the means of doing this. The best, indeed ❓❓❓ as Mahan has shown us ❓❓❓ the only efifective way canoniybe of attaining this object is to treat the matter explained historically. Whatever date we may agree to historic- assign to the formation of the term itself, the ’”^’ idea ❓❓❓ as we have seen ❓❓❓ is as old as history. It is not intended to give a condensed history of sea-power, but rather an analysis of the idea and what it contains, illus- trating this analysis with examples from history ancient and modern. It is important to know that it is not something which originated in the middle of the 17th century, and having seriously afiected history in the 18th, ceased to have weight till Captain Mahan appeared to comment on it in the last decade of the 19th. With a few masterly touches Mahan, in his brief allusion to the second Punic war, has illustrated its importance in the struggle between Eome and Carthage. What has to be shown is that the principles which he has laid down in that case, and in cases much more modern, are true and have been true always and everywhere. Until this is perceived there is much history which cannot be under- stood, and yet it is essential to the welfare of Great Britain as a maritime power that she should understand it thoroughly. Her failure to understand it has more than once brought her, if not to the verge of destruction, at any rate within a short distance of serious disaster.

The high antiquity of decisive naval campaigns is among the most interesting features of international conflicts. Notwithstanding the much greater frequency of land wars, the course of history has been profoundly changed more often by contests on the water. That this has not received

the notice it deserved is true, and Mahan tells us why. “Historians generally,” he says, “have been unfamiliar with the conditions of the sea, having as to it neither special interest nor special knowledge ; and the profound determining influence of maritime strength on great issues has consequently been overlooked.” Moral- izing on that which might have been is admittedly a sterile process ; but it is sometimes necessary to point, if

only by way of illustration, to a possible alternative. As in modern times the fate of India and the fate of North America were determined by sea-power, so also at a very remote epoch sea-power decided whether or not Hellenic colonization was to take root in, and Hellenic culture to Early dominate, central and northern Italy as it

manifests- dominated southern Italy, where traces of it iioas of are extant to this day. A moment’s considera- sea-power. j^ jjj gj,g^jg ^jg ^^ ggg j^^^ different the

history of the world would have been had a Hellenized city grown and prospered on the Seven Hills. Before the Tarquins were driven out of Rome a Phocsean fleet was encountered (537 B.C.) off Corsica by a combined force of Etruscans and Phoenicians, and was so handled that the Phocseans abandoned the island and settled on the coast of Lucania (Mommsen, Hist. Borne, English trans, i. p. 153). The enterprise of their navigators had built up for the Phoenician cities and their great off-shoot Carthage, a sea-power which .enabled them to gain the practical sovereignty of the sea to the west of Sardinia and Sicily. The control of these waters was the object of prolonged and memorable struggles, for on it ??? as the result showed ??? depended the empire of the world. From very remote times the consolidation and expansion, from within outwards, of great continental States have had serious consequences for mankind when they were accom- panied by the acquisition of a coast-line and the absorp- tion of a maritime population. We shall find that the process loses none of its importance in recent years. ” The ancient

empires," says ^the historian of Greece, Ernst Curtius, " as long as no foreign elements had intruded into them, had an invincible horror of the water." When the condition, which Curtius notices in parenthesis, arose the " horror " disappeared. There is something highly significant in the uniformity of the efforts of Assyria, Egypt, Babylon, and Persia to get possession of the maritime resources of Phoenicia. Our own immediate posterity will perhaps have to reckon with the results of similar efforts in our own day. It is this which gives a living interest to even the very ancient history of sea-power, and makes the study of it of great practical importance to us now. We shall see, as we go on, how the phenomena connected with it reappear with striking regularity in successive periods. Looked at in this light the great conflicts of former ages are full of useful, indeed necessary, instruction.

In the first and greatest of the contests waged by the nations of the East against Europe ??? the Persian wars ??? Wars of sea-power was the governing factor. Until the Greeks Persia had expanded to the shores of the Levant aad the European Greeks had little to fear from the

Persians, ambition of the great king. The conquest of Egypt by Cambyses had shown how formidable that ambition could be when supported by an efiicient navy. With the aid of the naval forces of the Phoenician cities the Persian invasion of Greece was rendered comparatively easy. It was the naval contingents from Phoenicia which crushed the Ionian revolt. The expedition of Mardonius, and still more that of Datis and Artaphernes, had indi- cated the danger threatening Greece when the master of a great army was likewise the master of a great navy. Their defeat at Marathon was not likely to, and as a matter of fact did not, discourage the Persians from further attempts at aggression. As the advance of Cambyses into Egypt had been flanked by a fleet, so also was that of Xerxes into Greece. By the good fortune sometimes vouchsafed to a people, which, owing to its obstinate opposition to, or neglect of a wise policy, scarcely deserves it, there appeared at Athens an in- fluential citizen who understood all that was meant by the

term sea-power. Themistocles saw more clearly than any of his contemporaries that, to enable Athens to play a leading part in the

Hellenic world, she needed above all things a strong navy. ” He had already in his eye the battle-field of the future.” He felt sure that the Persians would come back, and come with such forces that resistance in the open field would be out of the question. One scene of action remained ??? the sea. Persuaded by him the Athenians increased their navy, so that of the 271 vessels comprising the Greek fleet at Artemisium, 147 had been provided by Athens, which also sent a large reinforcement after the first action. Though no one has ever surpassed Themistocles in the faculty of correctly estimating the importance of ‘sea-power, it was understood by Xerxes as clearly as by him that the issue of the war depended upon naval operations. The arrangements made under the Persian monarch’s direction, and his very personal move- ments, show that this was his view. He felt, and prob- ably expressed the feeling, exactly as ??? in the war of American Independence ??? Washington did in the words, ” Whatever efforts are made by the land armies, the navy must have the casting vote in the present contest.” The decisive event was the naval action of Salamis. To have made certain of success, the Persians should have first obtained a command of the Aegean, as complete for all practical purposes as the French and English had of the sea generally in the war against Russia of 1854-56. The Persian sea-power was not equal to the task. The fleet of the great king was numerically stronger than that of the Greek allies ; but it has been proved many times that naval efficiency does not depend on numerical superiority alone. The choice sections of the Persian fleet were the contingents of the lonians and Phoenicians. The former were half-hearted or disaffected ; while the latter were, at best, not superior in skill, experience, and valour to the Greek sailors. At Salamis Greece was saved not only from the ambition and vengeance of Xerxes, but also and for many centuries from oppression by an Oriental con- queror. Persia did not succeed against the Greeks, not because she had no sea-power, but because her sea-power, artificially built up, was inferior to that which was a natural element of the vitality of her foes. Ionia was lost and Greece in the end enslaved, because the quarrels of Greeks with Greeks led to the ruin of their naval States.

The Peloponnesian was largely a naval war. The con- fldence of the Athenians in their sea-power had a great deal to do with its outbreak. The

immediate Pelooon- occasion of the hostilities, which in time in- nesiaa volved so many States, was the opportunity ^ar. offered by the conflict between Corinth and Corcyra of increasing the sea ~~power of Athens. Hitherto the Athenian naval predominance had been virtually confined to the Aegean Sea. The Coroyraean envoy, who pleaded for help at Athens, dwelt upon the advantage to be derived by the Athenians from alliance with a naval State occupying an important situation "with respect to the western regions towards which the views of the Athenians had for some time been directed" (Thirlwall, Hinf. Greece, iii. p. 96). It was the "weapon of her sea~~ power," to adopt Mahan's phrase, that enabled Athens to maintain the great conflict in which she was engaged. Repeated invasions of her territory, the ravages of disease among her people, and the rising disaffection of her allies had been more than made up for by her predominance on the water. The scale of the subsequent Syracusan ex- pedition showed how vigorous Athens still was down to the interruption of the war by the peace of Nicias. The great expedition just mentioned overtaxed her strength. Its failure brought about the ruin of the State. It was

held by contemporaries, and has been held in our own daj', that the Athenian defeat at Syracuse was due to the omission of the government at home to keep the force in Sicily properly supplied and reinforced. This explanation of failure is given in all ages, and should always be suspected. The friends of unsuccessful generals and admirals always offer it, being sure of the support of the political opponents of the administration. After the despatch of the supporting expedition under Demosthenes and Eurymedon no further great reinforcement, as Kicias admitted, was possible. The weakness of Athens was in the character of the men who swayed the popular assem- blies and held high commands. A people which remem- bered the administration of a Pericles, and yet allowed a Cleon or an Alcibiades to direct its naval and mili- tary policy, courted defeat. Nicias, notwithstanding the possession of high qualities, lacked the supreme virtue of a commander ❓❓❓ firm resolution. He

dared not face the obloquy consequent on withdrawal from an enterprise on which the popular hopes had been fixed ; and therefore he allowed a reverse to be coiiverted into an overwhelming disaster. ” The complete ruin of Athens had appeared, both to her enemies and to herself, impending and irreparable. But so astonishing, so rapid, and so energetic had been her rally, that [a year after Syracuse] she was found again carrying on a terrible struggle ” (Grote, Hist. Greece, v. p. 354). Nevertheless her sea-power had indeed been ruined at Syracuse. Now she could wage war only “with impaired resources and on a purely de- fensive system.” Even before Arginusae it was seen that ” superiority of nautical skill had passed to the Pelopon- nesians and their allies” {ihid. p. 503).

The great, occasionally interrupted, and prolonged contest between Rome and Carthage was a sustained struggle effort on the part of one to gain and of the other between to keep the control of the western Mediter- Romeand ranean. So completely had that control been Cart age. g- jercised by Carthage, that she had anticipated the Spanish commercial policy in America. The Romans were precluded by treaties from trading with the Cartha- ginian territories in Hispania, Africa, and Sardinia. Rome, as ilommsen tells us, “was from the first a mari- time city and, in the period of its vigour, never was so foolish or so untrue to its ancient traditions as wholly to neglect its war marine and to desire to be a mere con- tinental power.” It may be that it was lust of wealth rather than lust of dominion that first prompted a trial of strength with Clarthage. The vision of universal empire could hardly as yet have formed itself in the imagination of a single Roman. The area of Phcenician maritime commerce was vast enough both to excite jealousy and to offer vulnerable points to the cupidity of rivals. It is jirobaljle that the modern estimate of the sea-power of Carthage is much exaggerated. It was great by com- parison, and of course overwhelmingly great when there were none but insignificant competitors to challenge it. i\Iommsen holds that, in the fourth and fifth centuries after the foundation of Rome, ” the two main competitors for the dominion of the Western waters ” were Carthage and Syracuse. “Carthage,” he says, “had the pre- jjonderanoe, and Syracuse sank more and more into a second-rate naval power. The maritime importance of the Etruscans was wholly gone. . . . Rome itself was not exempt from the same fate ; its tn'n waters were likewise commanded by

foreign fleets." The Romans were for a long time too much (iccupied at home to take much interest in Alediterranean matters. The position of the Clarthaginians in the western basin of the ^lediterranean was very like that of the Portuguese lung afterwards in India. The latter kept within reach of the sea ; " nor did

their rule ever extend a day's march from their ships " (R. S. Whiteway, Bise of the Portuguese Power m India. Westminster, 1899, p. 12). "'The Carthaginians in Spain," says Mommsen, " made no effort to acquire the interior from the warlike native nations ; they were content with the possession of the mines and of stations for traffic and for shell and other fisheries." Allowance being made for the numbers of the classes engaged in administration, commerce, and supervision, it is nearly certain that Carthage could not furnish the crews required by both a great war-navy and a great mercantile marine. No one is surprised on finding that the land-forces of Carthage were composed largely of alien mercenaries. We have several examples from which we can infer a parallel, if not an identical, condition of her maritime resources. How, then, was the great Carthaginian carrying-trade provided for 1 The experience of more than one country wiU enable us to answer this question. The ocean trade of those off-shoots or dependencies of the United Kingdom, viz., the United States, Australasia, and India, is largely or chiefly conducted by shipping of the "old country." So that of Carthage was largely conducted by old Phoenicians. These may have obtained a " Carthaginian Register," or the contemporary equivalent ; but they could not all have been purely Carthaginian or Liby-Phoenician. This must have been the case even more with the war-navy. British India for a considerable time possessed a real, and indeed highly efficient navy ; but it was officered entirely and manned almost entirely by men from the old country. Moreover, it was small. The wealth of India would have sufficed to furnish a larger material element ; but, as the country could not supply the personnel, it would have been absurd to speak of the sea-power of India apart from that of England. As soon as the Romans chose to make the most of their natural resources the maritime predominance of Carthage was doomed. The artificial basis of the latter's sea-power would not enable it to hold out against serious and persistent assaults. Unless this is perceived, it is impossible to understand the story of the Punic wars. Judged by every

visible sign of strength, Carthage, the richer, the more enterprising, ethnically the more pre- dominant among her neighbours, and apparently the more nautical, seemed sure to win in the great struggle with Rome which, by the conditions of the case, was to be waged largely on the water. Yet those who had watched the struggles of the Punic city with the Sicilian Greeks, and especially that with Agathocles, must have seen reason to cherish doubts concerning her naval strength. It was an anticipation of the case of Spain in the age of Philip II. As the great Elizabethan seamen discerned the defects of the Spanish naval establishment, so men at Rome discerned those of the Carthaginian. Dates in connexion with this are of great significance. A comprehensive measure, with the object of "rescuing their marine from its condi- tion of impotence " was taken by the Romans in the year 2G7 B.C. Four qucestores c/assici ??? in modern naval English we may perhaps call them port-admirals ??? were nominated, and one was stationed at each of four ports. The objects of the Roman Senate, so IMommsen tells us, were very obvious. They were " to recover their inde- pendence by sea, to cut off the maritime communications of Tarentum, to close the Adriatic against fleets coming from Epirus, and to emancipate themselves from Cartha- ginian supremacy." Four years afterwards the first Punic war began. It was, and had to be, largely a naval contest. The Romans waged it with varying fortune, but in the end triumphed by means of their sea-power. The ???\ictory of Catulus over the Carthaginian fleet off the Aegadian Islands decided the war and left to the Romans the possession of Sicily and the power of possessing them-

selves of Sardinia and Corsica. It would be an interesting and perhaps not barren investigation to inquire to what extent the decline of the mother states of Phoenicia, con- sequent on the campaigns of Alexander the Great, had helped to enfeeble the naval efBciency of the Carthaginian defences. One thing was certain. Carthage had now met with a rival endowed with natural maritime resources greater than her own. That rival also contained citizens who understood the true importance of sea-

power. ” With a statesmanlike sagacity from which succeeding generations might have drawn a lesson, the leading men of the Eoman Commonwealth perceived that all their coast-fortifications and coast-garrisons would prove inadequate unless the war-marine of the State were again placed on a footing that should command respect” (Mommsen, i. 427). It is a gloomy reflection that the leading men of the United Kingdom could not see this in 1860. A thorough com- prehension of the events of the first Punic war enables us to solve what, until Mahan wrote, had been one of the standing enigmas of history, viz., Hannibal’s invasion of Italy by land instead of by sea in the second Punic war. Mahan’s masterly examination of this question has set at rest all doubts as to the reason of Hannibal’s action {In- fluence on Hist. pp. 13-21). The naval predominance in the western basin of the Mediterranean acquired by Eome had never been lost. Though modern historians, even those belonging to a maritime country, may have failed to perceive it, the Carthaginians knew well enough that the Komans were too strong for them on the sea. Though other forces co-operated to bring about the defeat of Carthage in the second Punic war, the Roman navy, as Mahan demonstrates, was the most important. As a navy, he tells us in words like those already quoted, ” acts on an element strange to most writers, as its members have been from time immemorial a strange race apart, without prophets of their own, neither themselves nor their calling understood, its immense determining influ- ence on the history of that era, and consequently upon the history of the world, has been overlooked.”

The attainment of all but universal dominion by Rome was now only a question of time. ” The annihilation of the Carthaginian fleet had made the Romans ^^-^P^^*’^” masters of the sea” (Schmitz, Hist. Eome, p. domlaloa 256). A lodgment had already been gained in furthered Illyricum, and countries farther east were before by sea- long to be reduced to submission. A glance at power. j^ ^^p jjj gjjjj, jj^ ^g effect this the com- mand of the eastern basin of the Mediterranean, like that of the western, must be secured by the Romans. The old historic navies of the Greek and Phoenician States had declined. One considerable naval force there was which, though it could not have prevented, was strong enough to have delayed the Roman progress eastwards. This force belonged to Rhodes, which in the years immediately following the close of the second

Punic war reached its highest point as a naval power (C. Torr, Rhodes in Ancient Times, p. 40). Far from trying to obstruct the advance of the Romans the Rhodian fleet helped it. Hannibal, in his exile, saw the necessity of being strong on the sea if the East was to be saved from the grasp of his heredi- tary foe ; but the resources of Antiochus, even vsath the mighty co-operation of Hannibal, were insufficient. In a later and more often quoted struggle between East and West ??? that which was decided at Actium ??? sea-power was again seen to "have the casting vote." When the whole of the Mediterranean coasts became part of a single State the importance of the navy was naturally diminished ; but in the struggles within the declining empire it rose a':;ain at times. The contest of the Vandal Genseric with Mijorian and the African expedition of Belisarius ??? not

to mention others ??? were largely influenced by the naval operations (Gibbon, Decline and Fall, chaps, xxxvi. xli.).

*A decisive event, the Mahommedan conquest of north- ern Africa from Egypt ???frestwards, is unintelligible untU it is seen how great a part sea-power played in effecting it. Purely land expeditions, or expe- es*w-ard ditions but slightly supported from the sea, had otMabom- ended in failure. 'The emperor at Constantinople "›n still had at his disposal a fleet capable of keep- """i"^- ing open the communications with his African province. It took the Saracens half a century (a.d. 647-698) to win " their way along the coast of Africa as far as the Pillars of Hercules" (Hallam, Mid. Ages, chap, vi.) ; and, as Gibbon tells us, it was not till the Commander of the Faithful had prepared a great expedition, this time by sea as well as by land, that the Saracenic dominion was definitely established. It has been generally assumed that the Arabian conquerors who, within a few years of his death, spread the faith of Mahommed over vast regions, belonged to an essentially non-maritime race ; and little or no stress has been laid on the extent to which they relied on naval support in prosecuting their conquests. In parts of Arabia, however, maritime enterprise was far from non-existent ; and when the Mahommedan empire had ex- tended outwards from Mecca and Medina till it embraced the coasts of various seas, the consequences to the neighbouring states were as serious as the rule above mentioned would lead us to expect that they would be. " With*

the con- quest of Syria and Egypt a long stretch of sea-board had come into the Saracenic power ; and the creation and maintenance of a navy for the protection of the maritime ports as well as for meeting the enemy became a matter of vital importance. Great attention was paid to the manning and equipment of the fleet " (Amir Ali, Syed, Short Hist. Saracens, p. 442). At first the fieet was manned by sailors drawn from the Phoenician towns, where nautical energy was not yet quite extinct ; and later the crews were recruited from Syria, Egypt, and the coasts of Asia Minor. Ships were built at most of the Syrian and Egyptian ports, and "also at Obolla and Bushire on the Persian Gulf," whilst the mercantile marine and maritime trade were fostered and encouraged. The sea ~~power thus created was largely artificial. It drooped ??? as in similar cases ??? when the special encourage~~ ment was vnthdrawn. " In the days of Arabian energy," says HaUam, "Constantinople was twice, in 668 and 716, attacked by great naval armaments." The same authority believes that the abandonment of such maritime enter- prises by the Saracens may be attributed to the removal of the capital from Damascus to Bagdad. The removal indicated a lessened interest in the affair^ of the iledi- terranean Sea, which was now left by the administration far behind. "The Greeks in their turn determined to dispute the command of the sea," with the result that in the middle of the 10th century their empire was far more secure from its enemies than under the first successors of Heraclius." Not only was the fall of the empire, by a rational reliance on sea -power, postponed for centuries, but also much that had been lost was regained. " At the close of the 10th century the emperors of Constantinople possessed the best and greatest part" of southern Italy, part of Sicily, the whole of what is now called the Balkan Peninsula, Asia Minor, with some parts of Syria and Armenia (Hallam, chap. vi. ; Gibbon, chap. li.).

Neglect of sea-power by those who can be reached by sea brings its own punishment. Whether neglected or not, if it is an artificial creation it is nearly sure to disappoint those who wield it when it encounters a rival power of natural growth. How was it possible for the Crusaders, in their various expeditions, to achieve even

ot Italian republics.

the transient success that occasionally crowned their efforts'! How did the Christian kingdom of Jerusalem contrive to exist for more than three-quarter's Sea-power Qf g, century? Why did the Crusades more Crusades ^^^ more become maritime expeditions? The answer to these questions is to be found in the decline of the Mahommedan naval defences and the rising enterprise of the seafaring people of the West. Venetians, Pisans, and Genoese transported crusading forces, kept open the communications of the places held by the Christians, and hampered the operations of the infidels. Even the great Saladin failed to discern the important alteration of conditions. This is evident when we look at the efforts of the Christians to regain the lost kingdom. Saladin " forgot that the safety of Phoenicia lay in immunity from naval incursions, and that no victory on land could ensure him against an influx from beyond the sea " (Amir Ali, Syed, pp. 359-360). Not only were the Crusaders helped by the fleets of the maritime republics of Italy, they also received reinforcements by sea from western Europe and England, on the "arrival of Malik Ankiltar [Eichard Coeur de Lion] with twenty shiploads of fighting men and munitions of war."

Participation in the Crusades was not a solitary proof of the importance of the naval states of Italy. That they had been able to act effectively in the Levant Sea-power m^y have been in some measure due to the weakening of the Mahommedans by the disinte- gration of the Seljukian power, the movements of the Moguls, and the confusion consequent on the rise of the Ottomans. However that may have been, the naval strength of those Italian states was great absolutely as well as relatively. Sismondi, speaking of Venice, Pisa, and Genoa, towards the end of the 11th century, says " these three cities had more vessels on the Mediterranean than the whole of Christendom besides" (/toZ. Republics, English ed., p. 29). Dealing with a period two centuries later, he declares it "difficult to comprehend how two simple cities could put to sea such prodigious fleets as those of Pisa and Genoa." The difficulty disappears when we have Mahan's explanation. The maritime republics of Italy ❓❓❓ like Athens

and Rhodes in ancient, Catalonia in mediaeval, and England and the Netherlands in more modern times ❓❓❓ were " peculiarly well fitted, by situa- tion and resources, for the control of the sea by both war and commerce." As far as the western Mediterranean was concerned, Genoa and Pisa had given early proofs of their maritime energy, and fixed themselves, in succession to the Saracens, in the Balearic Isles, Sardinia, and Corsica. Sea-power was the Themistoclean instrument with which they made a small State into a great one.

A fertile source of dispute between States is the ac- quisition of territory beyond sea. As others have done before and since, the maritime republics of Italy quarrelled over this. Sea-power seemed, like Saturn, to devour its own children. In 1284, in a great sea-fight off Meloria, the Pisans were defeated by the Genoese with heavy loss, which, as Sismondi states, "ruined the maritime ~~power" of the former. From that time Genoa, transferring her activity to the Levant, became the rival of Venice. The fleets of the two cities in 1298 met near Cyprus in an encounter, said to be accidental, that began " a terrible war which for seven years stained the Mediterranean with blood and consumed immense wealth." In the next cen'ury the two republics, "irritated by commercial quarrels " ❓❓❓ like the English and Dutch afterwards ❓❓❓ were again at war in the Levant. Sometimes one side, some~~ times the other was victorious ; but the contest was ex- hausting to both, and especially to Venice. Within a quarter of a century they were at war again. Hostilities

lasted till the Genoese met with the crushing defeat of Chioggia. "From this time," says Hallam, "Genoa never commanded the ocean with such navies as before ; her commerce gradually went into decay; and the 15th century, the most splendid in the annals of Venice, is till recent times the most ignominious in those of Genoa." Venice seemed now to have no naval rival, and had no fear that any one could forbid the ceremony in which the Doge, standing in the bows' of the Bvcentaur, cast a ring into the Adriatic with the words, " Desponsamus te, mare, in signum veri perpetuique dominii." The result of the combats at Chioggia, though fatal to it in the long run, did not at once destroy the naval importance of Genoa. A remarkable characteristic of sea-power is the delusive manner in which it appears to revive after a great defeat. The Persian navy

occasionally made a brave show after- wards ; but in reality it had received at Salamis a mortal wound. Athens seemed strong enough on the sea after the catastrophe of Syracuse; but, as already stated, her naval power had been given there a check from which it never completely recovered. The navy of Carthage had had similar experience ; and, in later ages, the power of the Turks was broken at Lepanto and that of Spain at Gravelines notwithstanding deceptive appearances after- wards. Venice was soon confronted on the sea by a new rival. The Turkish naval historian, Haji Khalifeh (Mari- time Wars of the Turks, Mitchell's trans., p. 12), tells us that, " After the taking of Constantinople, when they [the Ottomans] spread their conquests over land and sea, it became necessary to build ships and make armaments in order to subdue the fortresses and castles on the Eumelian and Anatolian shores, and in the islands of the Medi- terranean." Mahommed II. established a great naval arsenal at Constantinople. In 1470 the Turks, "for the first time, equipped a fleet with which they drove that of the Venetians out of the Grecian seas " (Sismondi, p. 256). The Turkish wars of Venice lasted a long time. In that which ended in 1503 the decline of the Venetian naval power was obvious. " The Mussulmans had made progress in naval discipline ; the Venetian fleet could no longer cope with theirs." Henceforward it was as an allied contingent of other navies that that of Venice was re- garded as important. Dyer (Hist. Europe, i. p. 85) quotes a striking passage from a letter of . (Eneas Sylvius, afterwards Pope Pius II., in which the writer afiirms that, " if the Venetians are defeated, Christendom will not con- trol the sea any longer ; for neither the Catalans nor the Genoese, without the Venetians, are equal to the Turks."

*The last-named people, indeed, exemplified once more the rule that a military State expanding to the sea and absorbing older maritime populations becomes sea-oower a serious menace to its neighbours. Even in and pro- the 1 5th century Mahommed II. had made sress of tbc an attack on southern Italy ; but his sea-power '***"**** was not equal to the undertaking. Suleymto the Magnifi- cent directed the Ottoman forces towards the west. With admirable strategic insight he conquered Rhodes, and thus freed himself from the danger of a hostile force on his flank. " The centenary of the conquest of Constantinople was past, and the Turk had developed a great naval power besides annexing*

Egypt and Syria ” (Seeley, British Policy, i. p. 143). The Turkish fleets, under such leaders as Khair-ad-din (Barbarossa), Piale, and Dragut, seemed to command the Mediterranean including its western basin; but the repulse at Malta in 1565 was a serious check, and the defeat at Lepanto in 1571 virtually put an end to the prospect of Turkish maritime dominion. The predominance of Portugal in the Indian Ocean in the early part of the 16th century had seriously diminished the Ottoman resources. The wealth derived from the

trade in that ocean, the Persian Gulf, and the Red Sea, had supplied the Mahommedans with the sinews of war, and had enabled them to contend with success against the Christians in Europe. ” The main artery had been cut when the Portuguese took up the challenge of the Mahom- medan merchants of Calicut, and swept their ships from the ocean ” (Whiteway, p. 2). The sea-power of Portugal wisely employed had exercised a great, though unper- ceived influence. However, though enfeebled and dimin- ishing, the Turkish navy was still able to act with some effect in the 17th century. Nevertheless, the sea-power of the Turks ceased to count as a factor of importance in the relations between great States.

In the meantime the State which had a leading share in winning the victory of Lepanto had been growing up in the West. Before the union of its crown with that of Castile and the formation of the Spanish monarchy, Spanish Aragon had been expanding till it reached the sea-power, sea. It was united with Catalonia in the 12th Catalonia, century, and it conquered Valencia in the 13th. Its long line of coast opened the way to an extensive and flourishing commerce ; and an enterpris- ing navy indemnified the nation for the scantiness of its territory at home by the important foreign conquests of Sardinia, Sicily, Naples, and the Balearic Isles. Among the maritime states of the Mediterranean Catalonia had been conspicuous. She was to the Iberian Peninsula much what Phoenicia had been to Syria. The Catalan navy had disputed the empire of the Mediterranean with the fleets of Pisa and Genoa. The

incorporation of Catalonia with Aragon added greatly to the strength of that kingdom. The Aragonese kings were wise enough to understand and liberal enough to foster the maritime interests of their new possessions (Prescott, Ferdinand and Isabella, Introd. sects, i., ii.) Their French and Italian neighbours were to feel, before long, the effect of this policy ; and, when the Spanish monarchy had been consolidated, it was felt not only by them, but by others also. The more Spanish dominion was extended in Italy the more were the naval resources at the command of Spain augmented. Genoa became " Spain's water-gate to Italy. . . . Henceforth the Spanish crown found in the Dorias its admirals ; their squadron was permanently hired to the kings of Spain." Spanish supremacy at sea was established at the expense of France (G. W. Prothero, in M. Hume's Spain, 1J^79- 1788, p. 65). The acquisition of a vast domain in the New World had greatly developed the maritime activity of Castile, and Spain was as formidable on the ocean as in the Mediterranean. After Portugal had been annexed the naval forces of that country we/e added to the Spanish, and the great port of Lisbon became available as a place of equipment and as an additional base of opera- tions for oceanic campaigns. The fusion of Spain and Portugal, says Seeley, "produced a single State of un- limited maritime dominion. . . . Henceforth the whole New World belonged exclusively to Spain." The story of the tremendous catastrophe ??? the defeat of the Armada ??? by which the decline of this dominion was heralded is well known. It is memorable, not only because of the harm it did to Spain, but also because it revealed the rise of another claimant to maritime pre-eminence ??? the English nation. The effects of the catastrophe were not at once visible. Spain still continued to look like the greatest power in the world ; and, though the English seamen were seen to be something better than adventurous pirates ??? a character suggested by some of their contemporary exploits ??? few could have comprehended that they were engaged in building up what was to be a sea-power greater than any known to history.

They were carrying forward, not beginning, the building

of this. " England," says Professor J. K. Laughton, " had always believed in her naval power, had always claimed the sovereignty of the Narrow

*Seas ; and more than two hundred years before Elizabeth came to the ***. throne, Edward III. had testified to his sense manifests- of its importance by ordering a gold coinage tioasof bearing a device showing the armed strength British and sovereignty of England based on the sea " **”’’’’’’’’******{Armada, Introd.) It is impossible to make intelligible the course of the many wars which the English waged with the F^rench in the Middle Ages unless the true naval posi- tion of the former is rightly appreciated. Why were Cr^^y, Poitiers, Agincourt *** not to mention other combats *** fought, not on English, but on Continental soil ? Why, during the so-called " Hundred Years' war," was England in reality the invader and not the invaded ? We of the present generation are at last aware of the significance of naval defence, and know that, if properly utilized, it is the best security against invasion that a sea-surrounded State can enjoy. It is not, however, commonly remembered that the same condition of security existed and was properly valued in mediaeval times. The battle of Sluys in 1340 rendered invasion of England as impracticable as did that of La Hogue in 1692, that of Quiberon Bay in 1759, and that of Trafalgar in 1805; and it permitted, as did those battles, the transport of troops to the Continent to support Great Britain's allies in wars which, had she not been strong at sea, would have been waged on the soil of her country. Her early Continental wars, therefore, are proofs of the long-established efficiency of her naval defences. Notvsdth- standing the greater attention now paid to naval affairs, it is doubtful if Great Britain even yet recognizes the extent to which her security depends upon a good fleet as fully as her ancestors did seven centuries ago. The narrative of pre-Elizabethan campaigns is interesting merely as a story ; and, when told *** as, for instance, D. Hannay has told it in the introductory chapters of his Short History of the Royal Navy *** it will be found instructive and worthy of careful study at the present day. Each of the principal events in England's early naval campaigns may be taken as an illustration of the idea conveyed by the term " sea- power," and of the accuracy with which its meaning was apprehended at the time. To take a very early case, we may cite the defeat of Eustace the Monk by Hubert de Burgh in 1217. Reinforcements and supplies had been collected at Calais for conveyance to the army of Prince Louis of France and the rebel barons who had been de- feated at Lincoln. The reinforcements tried to cross the Channel under the escort*

of a fleet commanded by Eustace. Hubert de Burgh, who had stoutly held Dover for King John, and was faithful to the young Henry III., heard of the enemy's movements. "If these people land," said he, " England is lost ; let us therefore boldly meet them." He reasoned in almost the same words as Raleigh about four centuries afterwards, and undoubtedly "had grasped the true principles of the defence of England." He put to sea and defeated his opponent. The fleet on which Prince Louis and the rebellious barons had counted was destroyed ; and with it their enterprise. " No more admirably planned, no more fruitful battle has been fought by Englishmen on water " (Hannay, p. 7). As introductory to a long series of naval operations under- taken with a like object it has deserved detailed mention here.

The 16th century was marked by a decided advance in both the development and the application of sea-power. Previously its operation had been conflned to the Mediter- ranean or to coast waters outside it. Spanish or Basque seamen ❖❖❖ by their proceedings in the English Channel ❖❖❖ had proved the practicability of, rather than been engaged

in, ocean Avarfare. The English, who withstood them, ❖❖❖ were accustomed to seas so rough, to seasons so uncertain,

*and to weather so boisterous, that the ocean Bxtendlag > i^ad few terrors for them. All that was want- sea^pow-er. ^❖❖S ' * sufficient inducement to seek distant*

fields of action and a development of the naval art that would permit them to be reached. The discovery of the New World supplied the first; the consequently increased length of voyages and of absence from the coast led to the second. The world had been moving onwards in other things as well as in navigation. Intercommuni- cation was becoming more and

more frequent. What was done by one people was soon known to others. It is a mistake to suppose that, because the English had been behindhand in the exploration of remote regions they were wanting in maritime enterprise. The career of the Cabots would of itself suffice to render such a supposition doubtful. The English had two good reasons for post-poning voyages to and settlement in far-off lands. They had their hands full nearer home ; and they thoroughly, and as it were by instinct, understood the conditions on which permanent expansion must rest. They wanted to make sure of the line of communications first. To effect this a sea-going marine of both war and commerce, and, for further expansion, stations on the way were essential. The chart of the world furnishes evidence of the wisdom and the thoroughness of their procedure. Taught by the experience of the Spaniards and the Portuguese, when unimpeded by the political circumstances of the time, and provided with suitable equipment, the English displayed their energy in distant seas. It now became simply a question of the efficiency of sea-power. If this was not a quality of that of the English, then their efforts were bound to fail ; and, more than this, the position of their country, challenging as it did what was believed to be the greatest of maritime States, would have been altogether precarious. The principal expeditions now undertaken were distinguished by a characteristic peculiar to the people, and not to be found in connexion with the explor- ing or colonizing activity of most other great nations even down to our own time. They were really unofficial speculations in which, if the Government took part at all, it was for the sake of the profit expected, and almost, if not exactly, like any private adventurer. The participa- tion of the Government, nevertheless, had an aspect which it is worth while to note. It conveyed a hint ??? and quite consciously ??? to all whom it might concern that the speculations were " under-written " by the whole sea- power of England. The forces of more than one State had been used to protect its maritime trade from the assaults of enemies in the Mediterranean or in the Narrow Seas. They had been used to ward off invasion arid to keep open communications across not very extensive areas of water. In the 16th century they were first relied upon to support distant commerce, whether carried on in a peaceful fashion or under aggressive forms. This, natu-rally enough, led to collisions. The contention waxed hot, and was

virtually decided when the Armada shaped course to the northward after the fight off Gravelines.

The expeditions against the Spanish Indies and, still more, those against Philip II. 's peninsular territory had

helped to define the limitations of sea-power. LImiia- jt became evident, and it was made still more

evident in the next century, that for a great

tlons of sea'power.

country to be strong it must not rely upon a navy alone. It must also have an adequate and properly organized mobile army. Notwithstanding the number of times that this lesson has been repeated Great Britain has been slow to learn it. It is doubtful if she has learned it even yet. English seamen in all ages seem to have mas-

tered it fully ; for they have always demanded ??? at any rate for upwards of three centuries ??? that expeditions against foreign territory over-sea should be accompanied by a proper number of land-troops. On the other hand, the necessity of organizing the army of a maritime insular State and of training it with the object of rendering effective aid in operations of the kind in question, has rarely been perceived and acted upon by others. The result has been a long series of inglorious or disastrous affairs, like the West Indies voyage of 1595-96, the Cadiz expedition of 1625, and that to the lie de K6 of 1627. Additions might be made to the list. The failures of joint expeditions have often been explained by alleging differences or quarrels between the naval and the military commanders. This way of explaining them, however, is nothing but the inveterate critical method of the streets by which cause is taken for effect and effect for cause. The differences and quarrels arose, no doubt ; but they generally sprang out of the recriminations con- sequent on, not producing, the want of success. Another manifestation of the way in which sea-power works was first observed in the 17 th century. It suggested the adoption of, and furnished the instrument for, carrying out a distinct maritime policy. What was practically a standing navy had come

into existence. As Aooear- regards England this phenomenon was now of ance of respectable age. Long voyages and cruises of standing several ships in company had been frequent “avles. during the latter half of the 16th century and the early part of the 17th. Even the grandfathers of the men who sailed with Blake and Penn in 1652 could not have known a time when ships had never crossed the ocean, and squadrons kept together for months had never cruised. However imperfect it may have been, a system of provisioning ships and supplying them with stores, and of preserving discipline among their crews, had been developed, and had proved fairly satisfactory. The Parliament and the Protector in turn found it neces- sary to keep a considerable number of ships in commis- sion, and make them cruise and operate in company. It was not till well on in the reign of Queen Victoria that the man-of-war’s man was finally differentiated from the merchant seaman ; but, two centuries before, some of the distinctive marks of the former had already begun to be noticeable. There were seamen in the time of the Com- monwealth who rarely, perhaps some who never, served afloat except in a man-of-war. Some of the interesting naVal families which were settled at Portsmouth and the eastern ports, and which ❓❓❓ from father to son ❓❓❓ helped to recruit the ranks of bluejackets till a date later than that of the launch of the first ironclad, could carry back their professional genealogy to at least the days of Charles II., when, in all probability, it did not first start Though landsmen continued even after the Civil War to be given naval appointments, and though a permanent corps, through the ranks of which every one must pass, had not been formally established, a body of real naval officers ❓❓❓ men who could handle their ships, supervise the working of the armament, and exercise military command ❓❓❓ had been formed. A navy, accordingly, was now a weapon of undoubted keenness, capable of very ‘‘f❓❓^’”’ effective use by any one who knew how to totlal ex- wield it. Having tasted the sweets of inter- pansioa la course with the Indies, whether in the occu- the “Sew pation of Portugal or of Spain, both English and Dutch were desirous of getting a larger share of them. English maritime commerce had increased and needed naval protection. If England was to maintain the inter- national position to which, as no one denied, she was entitled, that commerce must be permitted to expand.*

The minds of men in western Europe, moreover, were set upon obtaining for their country territories in the New World, the amenities of which were now known. From the reign of James I. the Dutch had shown great jealousy of English maritime enterprise. Where it was possible, as in the East Indian Archipelago, they had destroyed it. Their naval resources were great enough to let them hold English shipping at their mercy, unless a grand effort were made to protect it. The Dutch conducted the carrying trade of most of the world, and the monopoly of this they were resolved to keep, while the English were resolved to share in it. The exclusion of the English from every trade-route, except such as ran by their own coast or crossed the Narrow Seas, seemed a by no means impossible contingency. There seemed also to be but one way of preventing it, viz., by war. The sup- posed unfriendliness of the Dutch, or at least of an im- portant party amongst them, to the regicide Government in England helped to force the conflict. The Navigation Act of 1651 was passed and regarded as a covert declara- tion of hostilities. So the first Dutch war began. It established England's claim to compete for the position of a great maritime commercial power.

The rise of the sea-power of the Dutch, and the magni- tude which it attained in a short time, and in the most adverse circumstances, have no parallel in Sea-power Jiigtory. The case of Athens was different, be- Dutcb. cause the Athenian power had not so much been unconsciously developed out of a great maritime trade, as based on a military marine deliberately and persistently fostered during many years. Thirlwall believes that it was Solon who "laid the foundations of the Attic na.yy" (Hist. Greece, ii. p. 52), a century before Salamis. The great achievement of Themistocles was to convince his fellow-citizens that their navy ought to be increased. Perhaps the nearest parallel with the power of the Dutch was presented by that of Rhodes, which rested largely on a carrying trade. The Ehodian under- takings, however, were by comparison small and "restricted in extent. Motley declares of the Seven United Pro- vinces that they "commanded the ocean" (United Nether- lands, ii. p. 132), and that

it would be difficult to exag- gerate the naval power of the young Commonwealth. Even in the day^ of Spain's greatness English seamen positively declined to admit that she was stronger than England on the sea ; and the story of the Armada justified their view. The first two Dutch wars were, therefore, contests between the two foremost naval States of the world for what was primarily a maritime object. The identity of the cause of the first and of the second war will be discerned by any one who compares what has been said about the circumstances leading to the former, with Monk's remark as to the latter. He said that the Eng- lish wanted a larger share of the trade enjoyed by the Dutch. It was quite in accordance with the spirit of the age that the Dutch should try to prevent, by force, this want from being satisfied. Anything like free and open competition was repugnant to the general feeling. The high road to both individual wealth and national pro- sperity was believed to lie in securing a monopoly. Merchants or manufacturers who called for the abolition of monopolies granted to particular courtiers and favourites had not the smallest intention, on gaining their object, of throwing open to the enterprise of all what had been monopolized. It was to be kept for the exclusive benefit of some privileged or chartered company. It was the same in greater affairs. As Mahan says, " To secure to one's own people a disproportionate share of the benefits of sea commerce every effort was made to exclude others, either by the peaceful legislative methods of monopoly or

ocean trade.

Maban's survey.

prohibitory regulations, or, when these failed, by direct violence." The apparent wealth of Spain was believed to be due to the rigorous manner in which foreigners were excluded from trading with the Spanish over-sea terri- tories. The skill and enterprise of the Dutch having enabled them to force themselves into this trade, they were determined to keep it to themselves. The Dutch East India Company was a powerful body, and largely dictated the maritime policy of the country. We have thus come to an interesting point in the historical con- sideration of sea-power. The Elizabethan conflict with Spain had practically settled the question

whether or not the expanding nations were to be allowed to extend their activities to territories in the New World. The first two Dutch wars were to settle the ques- Effect on tion whether or not the ocean trade of the world was to be open to any people qualified to engage in it. We can see how largely these were mari- time questions, how much depended on the solution found for them, and how plain it was that they must be settled by naval means.

Mahan's great survey of sea-power opens in 1660, mid- way between the first and second Dutch wars. " The sailing-ship era, with its distinctive features," he teUs us, "had fairly begun." The art of war by sea, in its more important details, had been settled by the first war. From the beginning of the second the general features of ship design, the classifica- tion of ships, the armament of ships, and the handling of fleets, were to remain without essential alteration until the date of Navarino. Even the tactical methods, except where improved on occasions by individual genius, altered little. The great thing was to bring the whole broadside force to bear on an enemy. Whether this was to be impartially distributed throughout the hostile line or concentrated on one part of it depended on the character of particular admirals. It would have been strange if a period so long and so rich in incidents had afforded no materials for forming a judgment on the real significance of sea-power. The text, so to speak, chosen by Mahan is that, notwith- standing the changes wrought in naval materiel since about 1850, we can find in the history of the past instructive illustrations of the general principles of mari- time war. These illustrations will prove of value not only " in those wider operations which embrace a whole theatre of war," but also, if rightly applied, " in the tactical use of the ships and weapons " of our own day. By a remarkable coincidence the same doctrine was being preached at the same time and quite independently by the late Vice- Admiral Philip Colomb in his work on Naval War/are. As a prelude to the second Dutch war we find a repetition of a process which had been adopted somewhat earlier. That was the permanent conquest of trans-oceanic territory. Until the 17th century had well begun, naval, or combined naval and military operations against the distant possessions of an enemy had been practically restricted to raiding or plunder- ing attacks on commercial centres. The Portuguese territory in South America having come under Spanish dominion in

consequence of the aimexation of Portugal to Spain, the Dutch ??? as the power of the latter country declined ??? attempted to reduce part of that territory into permanent possession. This improvement on the practice of Drake and others was soon seen to be a game at which more than one could play. An expedition sent by Cromwell to the West Indies seized the Spanish island of Jamaica, which has remained in the hands of its conquerors to this day. In 166-i an English force occupied the Dutch North American settlements on the Hudson. Though the dispossessed rulers were not quite in a position to throw

stones at sinners, this was rather a raid than an operation of recognized warfare, because it preceded the formal out- break of hostilities. The conquered territory remained in English hands for more than a century, and thus testified to the efficacy of a sea-power which Europe had scarcely begun to recognize. Neither the second nor the third Dutch war can be counted amongst the occurrences to which Englishmen may look back with unalloyed satis- faction ; but they, unquestionably, disclosed some interest- ing manifestations of sea-power. Much indignation has been expressed concerning the corruption and inefficiency of the English Government of the day, and its failure to take proper measures for keeping up the navy as it should have been kept up. Some, perhaps a good deal, of this indignation was deserved ; but it would have been nearly as well deserved by every other Government of the day. Even in those homes of political virtue where the administrative machinery was worked by, or in the interest of speculating capitalists and privileged companies, the accumulating evidence of late years has proved that everything was not considered to be, and as a matter of fact was not, exactly as it ought to have been. Charles II. and his brother, the duke of York, have been held up to obloquy because they thought that the coast of England could be defended against a naval enemy better by forti- fications than by a good fleet and, as Pepys noted, were "not ashamed of it." The truth is that neither the king nor the duke believed in the power of a navy to ward off attack from an island. This may have been due to want of intellectual

capacity ; but it would be going a long way to put it down to personal wickedness. They have had many imitators, some in our own day. The huge forts which stud the coast of the United Kingdom, and have been erected within living memory, are monuments, likely to last for many years, of the inability of people, whom no one could accuse of being vicious, to rate sea-power at its proper value. It is much more likely that it was owing to a reluctance to study questions of naval defence as industriously as they deserved, and to that moral timidity which so often tempts even men of proved physical courage, to undertake the impossible task of making themselves absolutely safe against hostile efforts at every point.

Charles II. has also been charged with indifference to the interests of his country, or worse, because during a great naval war he adopted the plan of try- ii^ti ^"S ^❓❓weaken the enemy by destroying his commerce. The king " took a fatal resolu- tion of laying up his great ships and keeping only a few frigates on the cruise." It is expressly related that this was not Charles's own idea, but that it was urged upon him by advisers whose opinion probably seemed at the time as well worth listening to as that of others. Anyhow if the king erred, as he undoubtedly did, he erred in good company. Fourteen hundred years earlier the statesmen who conducted the great war against Carthage, and whose astuteness has been the theme of innumerable panegyrics since, took the same "fatal resolution." In the midst of the great struggle they " did away with the fleet. At the most they encouraged privateering ; and vsdth that view placed the war-vessels of the State at the disposal of captains who were ready to undertake a corsair warfare on their own account " (Mommsen, ii. p. 52). In much later times this method has had many respectable defenders. Mahan's works are, in a sense, a formal warning to his fellow-citizens not to adopt it. In France, within the last years of the 19th century, it found, and appears still to find, adherents enough to form a school. The reappearance of belief in demonstrated impossibilities is a recognized incident in

human history ; but it is usually confined to the emotional or the vulgar. It is serious and filled with menaces of disaster when it is held by men thought fit to administer the affairs of a nation or advise concerning its

defence. The third Dutch war may not have settled directly the position of England in the maritime world ; but it helped to place that country above all other maritime States ??? in the position, in fact, which Great Britain, the United Kingdom, the British Empire, whichever name may be given it, has retained up to the present. It also mani- fested in a very striking form the efficacy of sea-power. The United Provinces, though attacked by two of the greatest monarchies in the world, France and England, were not destroyed. Indeed, they preserved much of their political importance in the State system of Europe, The Republic " owed this astonishing result partly to the skill of one or two men, but mainly to its sea-power." The effort, however, had undermined its strength and helped forward its decline.

The war which was ended by the Peace of Ryswick in 1697 presents two features of exceptional interest : one was; the havoc wrought on English commerce by the enemy ; the other was Torrington's conduct at and after the engagement off Beachy Head. Mahan discusses the former with his usual lucidity. At no time has war against commerce been conducted on a larger scale and with greater results than during this period. England suffered " infinitely more than in any former war." Many of her merchants were ruined ; and it is affirmed that the English shipping was reduced to the necessity of sailing under the Swedish and Danish flags. The explanation is that Louis XIV. made great efforts to keep up powerful fleets. The English navy was so fully occupied in watching these that no ships could be spared to protect England's maritime trade. This is only another way of saying that her commerce had in- creased so largely that the navy was not strong enough to look after it as well as oppose the enemy's main force. Notwithstanding her losses she was on the winning side in the conflict. Much misery and ruin had been caused, but not enough to affect the issue of the war.

*Torrington's proceedings in July 1690 were at the time the subject of much angry discussion. The debate, still meriting the epithet angry, has been renewed within the last few years. The matter has to J^jjy^'**' be noticed here, because it involves the con- sideration of a question of naval strategy which must be understood by those who wish to know the real meaning of the term sea-power, and who ought to learn that it is not a*

thing to be idly risked or thrown away at the bid- ding of the ignorant and the irresponsible. Arthur Herbert, earl of Torrington ??? the later peerage is a viscountcy held by the Byng family ??? was in command of the allied English and Dutch fleet in the English Channel. ” The disparity of force,” says Mahan, ” was still in favour of France in 1690, but it was not so great as the year before.” We can measure the ability of the then English Government for conducting a great war, when we know that, in its wisdom, it had still further weakened the fleet by dividing it. Yice-Admiral Killigrew had been sent to the Mediterranean with a squadron, and had neglected, and indeed refused when urged, to take the necessary steps to repair this error. The Government having omitted, as Governments sometimes do, to gain any trustworthy intelligence of the strength or movements of the enemy, Torrington suddenly found himself confronted by a con- siderably superior French fleet under Tourville, one of the greatest of French sea-officers. Since then the intentions of the French have been questioned ; but it is beyond dis- pute that, in England at the time, ‘Tourville’s movements were believed to be preliminary to invasion. Whether

Tourville deliberately meant his movement to cover an invasion or not, invasion would almost certainly have followed complete success on his part; otherwise, his victory would have been without any valuable result. Torrington saw that as long as he could keep his own fleet intact, he could, though much weaker than his opponent, prevent him from doing serious harm. Though personally not a believer in the imminence of invasion, the English admiral knew that ” most men were in fear that the French would invade.” His own view was, ” that ??? whilst we had a fleet in being they would not dare to make an attempt.” Of late years controversy has raged round this phrase, “a fleet in being” and the strategic principle which it expresses. Most seamen were at the time, have been since, and still are in agreement with Torrington. This might be supposed enough to settle the question. It has not been allowed, however, to remain one of purely naval strategy. It was made at the time a matter of

party politics. This is why it is so necessary that in a notice of sea-power it should be discussed. Both as a strategist and as a tactician Torrington was immeasurably ahead of his contemporaries. The only English admirals who can be placed above him are Hawke and Nelson. He paid the penalty of his pre-eminence : he could not make ignorant men and dull men see the meaning or the advantages of his proceedings. Mahan, who is specially qualified to do him full justice, does not devote much space in his work to a consideration of Torrington's case, evidently because he had not sufiicient materials before him on which to form a judgment. The admiral's character had been taken away already by Macaulay, who did have ample evidence before him. William III., with all his fine qualities, did not possess a military genius quite equal to that of Napoleon ; and Napoleon, in naval strategy, was often wrong. William III. understood that subject ???ven less than the French emperor did ; and his favourites were still less capable of understanding it. Consequently Torrington's action has been put down to jealousy of the Dutch. There have been people who accused Nelson of being jealous of the naval reputation of Caracciolo ! The explanation of Torrington's conduct is this : ??? He had a fleet so much weaker than Tourville's that he could not fight a general action with the latter ???without a practical certainty of a crushing defeat. Such a result would have laid the kingdom open : a defeat of the allied fleet, says Mahan, " if sufficiently severe, might involve the fall of William's throne in England." Given certain movements of the French fleet, Torrington might have manoeuvred to slip past it to the westward and join his force with that under Killigrew, which would make him strong enough to hazard a battle. This proved impracticable. There was then one course left ???retire before the French, but not to keep far from them. He knew that, though not strong enough to engage their whole otherwise unemployed fleet with any hope of success, he vfould be quite strong enough to fight and most likely beat it, when a part of it was trying either to deal with our ships to the westward or to cover the disembarkation of an invading army. He, therefore, proposed to keep his " fleet in being " in order to fall on the enemy when the latter would have two affairs at the same^ time on his hands. The late Vice-Admiral Colomb rose to a greater height than was usual even with him in his criticism of this campaign. What Torrington did was merely to re- produce on the sea what has been noticed dozens of

times on shore, viz , the menace of the flanking enemy. In land ???warfare this is held to give exceptional opportunities for the display of good generalship, but, to quote Mahan over again, a navy " acts on an element strange to most writers, its members have been from time immemorial a strange

race apart, without prophets of their own, neither them- selves nor their calling understood." Whilst Torrington has had the support of seamen, his opponents have been landsmen. For the crime of being a good strategist he was brought before a court-martial, but acquitted. His sovereign, who had been given the crowns of three kingdoms to defend our laws, showed his respect for them by flout- ing a legally constituted tribunal and disregarding its solemn finding. The admiral who had saved his country was dismissed from the service. Still, the principle of the " fleet in being " lies at the bottom of all sound strategy.

Admiral Colomb has pointed out a great change of plan in the later naval campaigns of the 17th century. Improvements in naval architecture, in the methods of preserving food, and in the arrange- C'"'"xe la ments for keeping the crews healthy, permitted "^'^tions fleets to be employed at a distance from their home ports for long continuous periods. The Dutch, as allies of the Spaniards, kept a fleet in the Mediterranean for many months. The great de Ruyter was mortally wounded in one of the battles there fought. In the war of the Spanish Succession the Anglo-Dutch fleet found its principal scene of action eastward of Gibraltar. This, as it were, set the fashion for future wars. It became a kind of tacitly accepted rule that the operation of British sea-power was to be felt in the enemy's, rather than in British waters. The hostile coast was regarded strategic- ally as the British frontier, and the sea was looked upon as territory which the enemy must be prevented from invading. Acceptance of this principle led in time to the so-called "blockades" of Brest and Toulon. The name was misleading. As Nelson took care to explain, there was no desire to keep the enemy's fleet in ; what was desired was to be near enough to attack it if it came out. The wisdom of the plan is undoubted. The hostile navy could be more easily watched and more easily followed if it put to sea. To carry out this plan a navy stronger in number of ships or in general efficiency than that of the enemy was necessary. With the

exception of that of American Independence, which will therefore require special notice, England's subsequent great wars were con- ducted in accordance with the rule.

In the early part of the 18th century there was a remarkable manifestation of sea ~~power in the Baltic. Peter the Great, having created an efficient army, drove the Swedes from the coast pro~~ R'seof vinces south of the Gulf of Finland. Like the '

Russia's sea-power.

earlier monarchies of which we have spoken, Russia, in the Baltic at least, now became a naval State. A large fleet was built, and, indeed, a considerable navy established. It was a purely artificial creation, and showed the merits and defects of its character. At first, and when under the eye of its creator, it was strong ; when Peter was no more it dwindled away and, when needed again, had to be created afresh. It enabled Peter the Great to conquer the neighbouring portion of Finland, to secure his coast territories, and to dominate the Baltic. In this he was assisted by the exhaustion of Sweden con- sequent on her endeavours to retain, what was no longer possible, the position of a quasi-gieaA Power which she had held since the days of Gustavus Adolphus. Sweden had been further weakened, especially as a naval State, by almost incessant wars vidth Denmark, which prevented all hope of Scandinavian predominance in the Baltic, the con- trol of which sea has in these days passed into the hands of another State possessing a quickly created navy ??? the modern German empire.

The war of the Spanish Succession left Great Britain a Mediterranean power, a position which, in spite of twice losing Minorca, she still holds. In the war of the Austrian

Years War.

Succession, “France was forced to give up her conquests for want of a navy, and England saved her position by

her sea-power, though she had failed to use it Seven to the best advantage” (Mahan, Influence on

Hist. p. 280). This shows, as we shall find

that a later war showed more plainly, that even the Government of a thoroughly maritime country is not always sure of conducting its naval aifairs wisely. The Seven Years’ war included some brilliant displays of the efficacy of sea-power. It was this which put the British in possession of Canada, decided which European, race was to rule in India, and led to a British occupation of Havana in one hemisphere and of Manila in the other. In the same war Great Britain learnt how, by a feeble use of sea-power, a valuable possession, like Minorca, may be lost. At the same time, the maritime trade and the general prosperity of the kingdom increased enormously. The result of the conflict made plain to all the paramount importance of having in the principal posts in the Govern- ment men capable of understanding what war is and how it ought to be conducted.

This lesson, as the sequel demonstrated, had not been learned when Great Britain became involved in a war

with the insurgent colonies in North America.

First Mahan’s comment is striking : ” The magni-

me can ggg^gg pf sea-power and its value had perhaps

been more clearly shown by the uncontrolled sway and consequent exaltation of one belligerent ; but the lesson thus given, if more striking, is less vividly interesting than the spectacle of that sea-power meeting a foe worthy of its steel, and excited to exertion by a strife which endangered not only its most valuable colonies, but even its own shores ” {Influence on Hist. p. 338). Great Britain was, in fact, drawing too largely on the prestige acquired during the Seven Years’ war, and was governed by men who did not understand the first principles of naval warfare, and

would not listen to those who did. They quite ignored the teaching of the then comparatively recent wars which has been alluded to already ??? that the enemy's coast should be looked upon as the frontier. A century and a half earlier the Dutchman Grotius had written ??? ???

Quae meta Britannis Litora sunt aliis.

Though ordinary prudence would have suggested ample preparation, British ministers allowed their country to remain unprepared. Instead of concentrating their efforts on the main objective, they frittered away force in attempts to relieve two beleaguered garrisons under the pretext of yielding to popular pressure, which is the ofiicial term for acting on the advice of irresponsible and uninstructed busybodies. " Depuis le d^bUt de la crise," says Captain Chevalier, " les ministres de la Grande Bretagne s'etaient montr^s inferieurs & leur tache." An impressive result of this was the repeated appearance of powerful and indeed numerically superior hostile fleets in the English Channel. The war ???not- withstanding that, perhaps because, land operations con- stituted an important part of it, and in the end settled the issue ???was essentially oceanic. Captain Mahan says it was "purely maritime." It may be true that, whatever the belligerent result, the political result, as regards the status of the insurgent colonies, would have been the same. It is in the highest degree probable, indeed it closely approaches to certainty, that a proper use of the British sea^power would have prevented independence from being conquered, as it were, at the point of the bayonet. There can be no surprise in store for the student acquainted with the vagaries of strategists who are influenced in war by political in preference to military requirements. Still, it

is difficult to repress an emotion of astonishment on find- ing that a British Government intentionally permitted de Grasse's fleet and the French army in its convoy to cross the Atlantic unmolested, for fear of jjostponing for a time the revictualling of the garrison beleaguered at Gibraltar. Washington's opinion as to the importance of the naval factor has been quoted already ; and Mahan does not put the case too strongly when he declares that the success of the Americans was due to " sea-power being in the hands of the French and its improper distribution by

the English authorities.” England’s navy, misdirected as it was, made a good fight of it, never allowed itself to be decisively beaten in a considerable battle, and won at least one great victory. At the point of contact with the enemy, however, it was not in general so conspicuously successful as it was in the Seven Years’ war, or as it was to be in the great conflict with the French republic and empire. The truth is that its opponent, the French navy, was never so thoroughly a sea-going force as it was in the war of American Independence ; and never so closely approached the British in sea-experience as it did during that period. Great Britain met antagonists who were very nearly, but fortunately not quite, as familiar with the sea as she was ; and she never found it so hard to beat them, or even to avoid being beaten by them. An Englishman, would, naturally enough, start at the conclusion confront- ing him, if he were to speculate as to the result of more than one battle had the great Suifren’s captains and crews been quite up to the level of those commanded by stout old Sir Edward Hughes. Suffren, it should be said, before going to the East Indies, had ” thirty-eight years of almost uninterrupted sea-service ” (Laughton, Studies in. Naval Hist. p. 103). A glance at a chart of the world, with the scenes of the general actions of the war dotted on it, will show how notably oceanic the campaigns were. The hostile fieets met over and over again on the far sida of the Atlantic and in distant Indian seas. The French navy had penetrated into the ocean as readily and as far as the British could do. Besides this, it should be remem- bered that it was not until the 12th April 1782, when Rodney in one hemisphere and Sufi’ren in the other showed them the way, that British officers were able to escape from the fetters imposed on them by the Fighting Instruc- tions ??? a fact worth remembering in days in which it is sometimes proposed, by establishing schools of naval tactics on shore, to revive the pedantry which made a. decisive success in battle nearly imjiossible.

*The mighty conflict which raged between Great Britain on one side and France and her allies on the other, with little intermission, for more than twenty years, presents a diflFerent aspect from that of the war ^j,g French- last mentioned. The victories which the British Revolution fleet was to gain were generally to be overwhelm- *”<' ing ; if not, they were looked upon as almost ^"'P'"- defeats. Whether the fleet opposed to the*

British was or was not the more numerous, the result was generally the same ??? the enemy was beaten. That there was a dis- coverable reason for this is certain. A great deal has been made of the disorganization in the French navy con- sequent on the confusion of the Eevolution. That there was disorganization is undoubted ; that it did impair discipline and, consequently, general efficiency will not be disputed ; but that it was considerable enough to account by itself for the French naval defeats is altogether inadmissible. Revolutionary disorder had invaded the land-forces to a greater degree than it had invaded the sea-forces. The supersession, flight, or guillotining of army olficers had been beyond measure more freqiient than was the case with the naval officers. In spite of all this the French armies were on the whole ??? even in the

early days of the Revolution ??? extraordinarily successful. In 1792 "tlie most formidable invasion that ever threatened France," as Alison calls it, was repelled, though the in- vaders were the highly-disciplined and veteran armies of Prussia and Austria. It was nearly two years later that the French and British fleets came into serious conflict. The first great battle, "The Glorious First of June," though a tactical victory for Great Britain, was a strategical defeat. Villaret Joyeuse manoeuvred so as to cover the arrival in France of a fleet of merchant vessels carrying sorely-needed supplies of food, and in this he was com- pletely successful. His plan involved the probability, almost the necessity of fighting a general action which he was not at all sure of winning. He was beaten, it is true ; but the French made so good a fight of it that their defeat was not nearly so disastrous as the later defeats of the Nile or Trafalgar, and ??? at the most ??? not more disastrous than that of Dominica. Yet no one even alleges that there was disorder or disorganization in the French fleet at the date of any one of those affairs. Indeed, if the French navy was really disorganized in 1794, it would have been better for France ??? ^judging from the events of 1798 and 1805 ??? if the disorganization had been allowed to continue. In point of organization

the British navy was inferior, and in point of discipline not much superior to the French at the earliest date ; at the later dates, and especially at the latest, owing to the all- pervading energy of Napoleon, the British was far behind its rival in organization, in "science," and in every branch of training that can be imparted without going to sea. Great Britain had the immense advantage of counting among her officers some very able men. Nelson, of course, stands so high that he holds a place entirely by himself. The other British chiefs, good as they were, were not conspicuously superior to the Hawkes and Rodneys of an earlier day. Howe was a great com- mander, but he did little more than just appear on the scene in the Revolutionary war. Almost the same may be said of Hood, of whom Nelson wrote, " He is the greatest sea- officer I ever knew" (Laughton, Nelson's Lett, and Desp. p. 71). There must have been something, therefore, beyond the meritorious qualities of the principal British officers which helped the navy so consistently to victory. The many triumphs won could not have been due in every case to the individual superiority of the British admiral or captain to his opponent. There must have been bad as well as good among the hundreds on the lists ; and we cannot suppose that Providence had so arranged it that in every action in which a British officer of inferior ability commanded, a still more inferior French com- importance mander was opposed to him. The explanation of the nearly unbroken success is, that the British was a thoroughly sea-going navy, and became more and more so every month ; while the French, since the close of the American war, had lost to a great extent its sea-going character and, because it had been shut up in its ports, became less and less sea-going as hostilities continued. The war had been for the British, in the words of President Roosevelt, " a continuous course of victory won mainly by seamanship." The British navy, as regards sea-experience, especially of the officers, was im- mensely superior to the French. This enabled the British Government to carry into execution sound strategic plans, in accordance with which the coasts of France and its allied countries were regarded as the British frontier to be watched or patrolled by British fleets.

Before the long European war had been brought to a formal ending we received some rude rebuffs from another opponent of unsuspected vigour. In the quarrel with the United States, the so-called "War of 1812," the

of ses' experience.

American War.

great sea^power of the British in the end asserted its influ- ence, and the Americans suff'ered much more severely, even absolutely, than their enemy. At the same time the British might have learned, for the Ameri- Second cans did their best to teach it, that over- confidence in numerical strength and narrow professional self-satisfaction are nearly sure to lead to reverses in war, and not unlikely to end in grave disasters. The British had now to meet the elite of one of the finest communities of seamen ever known. Even in 1776 the Americans had a great maritime commerce, which, as Mahan says, " had come to be the wonder of the states- men of the mother country." In the six-and- thirty years which had elapsed since theh this commerce had further increased. There was no finer nursery of seamen than the then states of the American Union. Roosevelt says that " there was no better seaman in the world " than the American, who "had been bred to his work from infancy." A large proportion of the population "was engaged in sea-going pursuits of a nature strongly tending to develop a resolute and hardy character in the men that followed them " {Naval War of 1812, 3rd ed., pp. 29, 30). Having little or no naval protection, the American seaman had to defend himself in many circumstances, and was compelled to familiarize himself with the use of arms. The -men who passed through this practical, and therefore supremely excellent training school were numerous. Very many had been trained in English men-of-war, and some in French ships. The State navy which they were called on to man was small ; and therefore its personnel, though without any regular or avowed selection, was virtually and in the highest sense a picked body. The lesson 'of the war of 1812 should be learned by Englishmen of the present day, when a long naval peace has generated a confidence in numerical superiority, in the mere pos- session of heavier materiel, and in the merits of a rigidly uniform system of training, such confidence, as experience has shown, being often the forerunner of misfortune. It is neither patriotic nor intelligent to minimize the American successes. Certainly they have been exaggerated by Americans and even by the British. To take the frigate actions alone, as being those which properly attracted most attention, the captures in action

amounted to three on each side, the proportionate loss to the Americans, consider- ing the smallness of their fleet, being immensely greater than to the British. We also see that no British frigate was taken after the first seven months of a war which lasted two and a half years. Attempts have been made to spread a belief that British reverses were due to nothing but the greater size and heavier guns of the enemy's ships. It is now established that the superiority in these details, which the Americans certainly enjoyed, was not great, and not of itself enough to account for their victories. Of course, if superiority in mere materiel, be- yond a certain well-understood amount, is possessed by one of two combatants, his antagonist can hardly escape defeat ; but it was never alleged that size of ship or calibre of guns ❓❓❓ greater within reasonable limits than the British had ❓❓❓ necessarily led to the defeat of British ships by the French or Spaniards. In the words of Admiral Jurien de la Gravifere, " the ships of the United States constantly fought with the chances in their favour." All this is indisputable. Nevertheless in any future war British sea-power, great as it may be, should not receive shocks like those that it unquestionably did suff'er in 1812.

We have now come to the end of the days of the naval wars of the past. The subsequent period has been illustrated repeatedly by manifestations of sea-power, often of great interest and importance, though rarely understood

or even discerned by the nations whom they more particu- larly concerned. The British sea-power, notwithstanding the first year of the war of 1812, had come out of the great European conflict unshaken and indeed more pre- eminent than ever. The words used half a century before by a writer in the great French Encyclopedie, seemed more exact than when first written. " L' empire des mers," he says, is " le plus avantageux de tous les empires ; les Phceniciens le poss^doient autre fois et c'est aux Anglois que cette gloire appartient aujourd'hui sur toutes les puissances maritimes " {Encyclopedie, 7th January 1765, art. " Thalassarchie"). Vast outlying territories had been acquired or were more firmly held, and

the com- munications of all th^ over-sea dominions of the British crown were secured against all possibility of serious menace for many years to come. Her sea-power was so ubiquitous and all -pervading that, like the atmosphere. Great Britain rarely thought of it and rarely remembered its necessity or its existence. It was not till a late date that the greater part of the nation ??? for there still are some exceptions ??? perceived that it was the medium apart from which the British empire could no more live than it could have grown up. Forty years after the fall of Napoleon she found herself again at war with a great Power. She had as her ally the owner of the greatest navy in the

world except her own. Her foe, as regards, his Russian jjg^val forces, came the next in order. Yet so 18S4.S6. overwhelming was the strength of Great Britain

and France on the sea that Eussia never attempted to employ her navy against them. Not to mention other expeditions, considerable enough in themselves, military operations on the largest scale were undertaken, carried on for many months, and brought to a successful termination on a scene so remote that it was two thousand miles from the country of "one, and three thousand from that of the other partner in the alliance. " The stream of supplies and reinforcements, which in terms of modern war is called ' communications,' " was kept free from even the threat of molestation, not by visible measures, but by the undisputed efficacy of a real, though imperceptible sea-power. At the close of the Russian war there were, even in influential positions, men who, undismayed by the consequences of mimicking in free England the cast-iron methods of Frederick the Great, began to measure British requirements by standards borrowed from abroad and altogether inapplicable to British conditions. Because other countries wisely abstained from relying on that which they did not possess, or had only imperfectly and with elaborate art created, the mistress of the seas was led to proclaim her disbelief in the very force that had made and kept her dominion, and was urged to defend herself with fortifications by advisers who, like Charles II. and the duke of York two centuries before, were "not ashamed of it." It was long before the peril into which this brought the empire was perceived ; but at last, and in no small degree owing to the teachings of Mahan, the people them- selves

took the matter in hand and insisted that a great maritime empire should have adequate means of defending all that made its existence possible.

In forms difi'ering in appearance, but identical in essentials, the efficacy of sea-power was proved again in Later ^^^ American Civil War. If ever there were

maaltesta- hostilities in which, to the unobservant or short- tlons of sighted, naval operations might at first seem des- sea-power. tined to count for little they were these. The sequel, however, made it clear that they constituted one of the leading factors of the success of the victorious side. The belligerents, the Northern or Federal states and the Southern or Confederate states, had a common land frontier of great length. The capital of each section

was within easy distance of this frontier, and the two were not far apart. In wealth, population, and resources the Federals were enormously superior. They alone possessed a navy, though at first it was a small one. The one advantage on the Confederate side was the large propor- tion of military officers which belonged to it and their rare excellence as soldiers. In physique as well as in morale the army of one side differed little from that of the other ; perhaps the Federal army was slightly superior in the first, and the Confederate, as being recruited from a dominant white race, in the second. Outnumbered, less well equipped, and more scantily supplied, the Confeder- ates nevertheless kept up the war, with many brilliant successes on land, for four years. Had they been able to maintain their trade with neutral States they could have carried on the war longer, and ⬜⬜⬜ not improbably ⬜⬜⬜ have succeeded in the end. The Federal navy, which was largely increased, took away all chance of this. It estab- lished effective blockades of the Confederate ports, and severed their communications with the outside world. In- dispensable articles of equipment could not be obtained, and the armies, consequently, became less and less able to cope with their abundantly furnished antagonists. By dominating the rivers the Federals cut the Confederacy asunder ; and by the power they possessed of moving troops by sea at will, perplexed and harassed the defence, and facilitated the occupation of important points. Meanwhile the Confederates could make no reply on the water except by

capturing merchant vessels, by which the contest was embittered, but the course of the war re- mained absolutely unaffected. The great numbers of men under arms on shore, the terrific slaughter in many battles of a war in which tactical ability, even in a moderate degree, was curiously uncommon on both sides, and the varying fortunes of the belligerents, made the land campaigns far more interesting to the ordinary observer than the naval. It is not surprising, therefore, that peace had been re-established for several years before the American people could be made to see the great part taken by the navy in the restoration of the Union ; and what the Americans had not seen was hidden from the sight of other nations.

In several momentous wars in Europe waged since France and Great Britain made peace with Russia sea- power manifested itself but little. In the Russo-Turkish war the naval superiority of the Turks in the ??? Black Sea, where the Russians at the time had Turkish no fleet, governed the plans, if not the course, War, of the campaigns. The water being denied to 1S77-78. them, the Russians were compelled to execute their plan of invading Turkey by land. An advance to the Bos- phorus through the northern part of Asia Minor was im- practicable without help from a navy on the right flank. Consequently the only route was a land one across the Danube and the Balkans. The advantages, though not fully utilized, which the enforcement of this line of advance put into the hands of the Turks, and the diffi- culties and losses which it caused the Russians, exhibited in a striking manner what sea-power can effect even when its o])eration is scarcely observable.

This was more conspicuous in a later series of hostilities. The civil war in Chile between Congressists and Balnia- cedists was specially interesting, because it threw into sharp relief the predominant influence, when Chilian a non-maritime enemy was to be attacked, of a ‘j’^gj “‘ navy followed up by an adequate land-force. At the beginning of the dispute the Balmacedists, or President’s party, had practically all the army, and the Congressists, or Opposition party, nearly all the ChiKan navy. Unable to remain in the principal province of the republic, and expelled from the waters of Valparaiso by

the Balmacedist garrisons of the forts ??? the only and doubtful service which those works rendered to their own side ??? the Congressists went off with the ships to the northern provinces, where they counted many adherents. There they formed an array, and having money at command, and open sea communications, they were able to import equipment from abroad, and eventually to transport their land-force, secured from molestation on the voyage by the sea-power at their disposal, to the neighbourhood of Valparaiso, where it was landed and triumphantly ended the campaign.

It will have been noticed that, in its main outlines, this story repeated that of many earlier struggles. It was ^y itself repeated, as regards its general features,

*between by the story of the war between China and Cbtna and Japan in 1894-95. Every aspect of the war, itol” ►►*y^ Colomb, is interesting to Great Britain, ” as Japan is to China in a position similar to that which the British Islands occupy to the European continent” {Naval Warfare, 3rd ed., p. 436). It was additionally interesting because the sea-power of Japan was a novelty. Though a novelty, it was well known by British naval men to be superior in all essentials to that of China, a novelty itself. As is the rule when two belligerents are contending for something beyond a purely maritime object, the final decision was to be on land. Korea was the principal theatre of the land war ; and, as far as access to it by sea was concerned, the chief bases of the two sides were about the same distance from it. It was possible for the Chinese to march there by land. The Japanese, coming from an island State, were obliged to cross the water. It will be seen at once that not only the success of the Japanese in the struggle, but also the possibility of its being carried on by them at all, depended on sea-power. The Japanese proved themselves decisively superior at sea. Their navy effectually cleared the way for one army which was landed in Korea, and for another which was landed in the Chinese province of Shantung. The Chinese land-forces were defeated. The navy of Japan being superior on the sea, was able to keep its sister service supplied or reinforced as required. It was not, however, the navy, but the army, which finally frustrated the Chinese efforts at defence, and really ter- minated the war. What the navy did was what, in accordance with the limitations of sea-power, may be ex- pected of a navy. It made the transport of the army across the sea possible ; and enabled it to do what of itself the army could not have done, viz., overcome the last resistance of the enemy.*

The issue of the Spanish ~~American war, at least as regards the defeat of Spain, was a foregone conclu~~ sion. That Spain, even without a serious Spanish- insurrection on her hands, was unequal to the ^a^i898. ^^^^ ►►^ meeting so powerful an antagonist as the United States must have been evident even to Spaniards. Jlowever that may be, an early col- lapse of the Spanish defence was not anticipated, and however one-sided the war may have been seen to be, it furnished examples illustrating rules as old as naval war- fare. Mahan says of it that, ” while possessing, as every war does, characteristics of its own differentiating it from others,

nevertheless in its broad analogies it falls into line with its predecessors, evidencing that unity of teaching which pervades the art from its beginnings unto this day " {Lessons of the War with Spain, p. 16). The Spaniards were defeated by the superiority of the American sea- power. "A million of the best soldiers," says Mahan, " would have been powerless in face of hostile control of the sea." That control was obtained and kept by the United States navy, thus permitting the unobstructed

despatch of troops ??? and their subsequent reinforcement and supply ??? to Spanish territory, which was finally conquered, not by the navy, but by the army on shore. That it was the navy which made this final conquest possible happened, in this case, to be made specially evident by the action of the United States Government, which stopped a military expedition on the point of start- ing for Cuba until the sea was cleared of all Spanish naval force worth attention.

The events of the long period which we have been con- sidering will have shown how sea-power operates, and what it effects. What it involves will have appeared from this narrative more clearly than would have been possible from any mere definition. Like many other things, sea- power is composed of several elements. To reach the highest degree of efficacy it should be based upon a population naturally maritime, and on an ocean commerce naturally developed rather than artificially enticed to extend itself. Its outward and visible sign is a navy, strong in the discipline, skill, and courage of a numerous personnel habituated to the sea, in the number and quality of its ships, in the excellence of its materiel, and in the efficiency, scale, security, and geographical position of its arsenals and bases. History has demonstrated that sea-power thus conditioned can gain any purely maritime object, can protect the trade and the communications of a widely-extended empire, and while so doing can ward off from its shores a formidable invader. There are, however, limitations to be noted. Left to itself its operation is confined to the water, or at any rate to the inner edge of a narrow zone of coast. It prepares the way for the advance of an army, the work of which it is not intended, and is unable to perform. Behind it, in the territory of which it guards the shores, there must be a land-force adjusted in organization, equipment, and numbers to the circumstances of the country. The possession of a

navy does not permit a sea-surrounded State to dispense with all fixed defences or fortification ; but it does render it unnecessary and in- deed absurd that they should be abundant or gigantic. The danger which always impends over the sea-power of any country is that, after being long unused, it may lose touch of the sea. The revolution in the constructive arts during the latter half of the 19th century, which has also been a period of but little-interrupted naval peace, and the universal adoption of mechanical appliances, both for ship- propulsion and for many minor services ◆◆◆ mere materiel being thereby raised in the general estimation far above really more important matters ◆◆◆ makes the danger men- tioned more menacing in the present age than it has ever been before. (c. a. g. b.)

Sea-ttle, a city and seaport of Washington, U.S.A., capital of King county. It is situated in 47◆◆36' N. and 122◆◆20' W., on the east shore of- Elliott Bay, an arm of Puget Sound. Its site rises steeply from the water to a summit and descends eastwards to Lake Washington. On this site the city is laid out with much regularity on the whole, and is divided into nine wards. It has an excellent water-supply and is well sewered, but few of the streets are paved. Among its fine buildings are Providence hospital, the court house, opera house, high school, and many business blocks. It has seven public parks, besides Lake Washington, behind the city, a sheet of water 25 miles long, with very wild, picturesque shores. Seattle is the largest city of Washington and one of the busiest and most active of the North-West. It is an important commercial port of Puget Sound, having lines of steamers to Asiatic ports, to San Francisco, and to Alaska. It has also a large trade with other Puget Sound ports by small steamers. Here is the Pacific coast terminus of the

Great Northern Railway, and one of the termini of the Northern Pacific Eailway. The Columbia and Puget Sound and the Seattle and International railways also enter the city. Seattle has also large

manufacturing in- terests. In 1900 it contained 953 manufacturing estab- hshments, with a total capital of $10,131,651. These employed 8480 hands, and their product was valued at $26,373,402. Of the various products, lumber, including planing-mill products, had a value of $2,846,558 ; slaughter- ing and meat-packing, a value of $3,072,195 ; foundry and machine-shop, and flouring and grist mill products, canning and preserving fish, and the products of the building trades were also large. This city is the seat of the state uni- versity, a non-sectarian institution, opened in 1862, which in 1899 had a faculty of 27 and was attended by 264 students, 122 of whom were women. The assessed valuation of real and personal property was, in 1900, $40,148,265, the net debt was $5,410,755, and the rate of taxation was $25.50 per $1000. Seattle was founded in 1852, receiving the name of an Indian chief, and for many years had a slow growth, having in 1880 a population of only 3533. The rapid development of the lumber industry in this part of the state was mainly respon- sible for the tremendous stride which the city took in the ten years following, resulting in a population in 1890 of 42,837. In 1900 the population was returned as 80,671, of whom 22,003 were foreign-born and 3856 coloured, including 406 negroes. Of 39,503 males 21 years of age and over, 598 were illiterate (unable to VTite). In 1889 the business part of the city was almost entirely burned.

Seba.Stopol, a district town and military seaport of Russia, in the government of Taurida, in the south- west of the Crimea, in 44 37' N. and 33 31' E., 947 miles by rail from Moscow. Since it was connected with the Russian railway system, a new town has rapidly grown on the' ruins which were left after the famous siege it sustained during the Crimean war, and in 1897 it contained 50,710 inhabitants, of whom only 18,661 were women. The town is well built and is becoming a favourite watering-place on account of its sea-bathing and numerous sanatoria. It has three libraries, two news- papers, gymnasia for boys and girls, and two navigation schools. It was at one time hoped that it would become an important commercial seaport; its exports rapidly grew from 1885 to 1889, when they totalled as much as 370,000 tons, but in the year 1890 Sebastopol was made a fortress of the third class, and the commercial port has been transported to Theodosia.

SebenicO, a coast town on the Adriatic, in the Austrian province of Dalmatia, in about 43 44' N., nearly midway between Zara and Spalato. Population of town (1890), 7014, and of commune, 20,360, chiefly Serbo-Croatian; (1900), 24,751. It is the seat of a Catholic and a Greek bishop, is a steamship station, has trade with Turkey, and considerable quantities of wine, oil, corn, and honey are produced in the neighbourhood, a further important resource of the inhabitants being fishing and seafaring,

Sedalia, a city of Missouri, U.S.A., capital of Pettis county. It is situated in 38 43' N. and 93 14' W., a little north and west of the centre of the state, at an altitude of 982 feet. It has an elevated prairie site. Three railways intersect here, the Missouri, Kansas and Texiis, the Missouri Pacific, and the Scdalia, Warsaw and South-Western, making it a centre of importance. Loco- motive and car works are situated here, besides which the city has manufactures of flour, wool, iron and steel, and agri-cultural implements. Population (1890), 14,068 ; (1900), 15,231, of whom 972 were foreign-born and 1725 negroes.

Sedan, chief tovm of arrondissement, department of Ardennes, France, 12 miles eas1>south-east of Mezieres on the railway from Mezieres to Nancy. There is a municipal school of weaving, but the value of the textile production has declined, being estimated in 1898 at only 25,000,000 francs. Population (1891), 17,023; (1901), 19,349.

Sedgfley, a parish and urban district, Staflfordshire, England, 3 miles south and included in the parliamentary borough of Wolverhampton, li miles from Deepfields Station. Part of the parish is under an urban district council, the remainder being in the urban district of Coseley. The district abounds in coal, lime, and iron- stone. Nails, rivets, chains, fire-irons, locks, and safes are made here. Population (1891), 14,961 ; (1901), 15,951.

Seeley, Sir John Robert (1834-1895),

English essayist and historian, was bom in London in 1834. His father, R. B. Seeley, was a publisher and author of several religious books and of The Life and Times of Edward /., which was highly esteemed by

historians. From his father Seeley doubtless derived his taste for religious and historical subjects. He was educated at the City of London School and at Christ's College, Cambridge, where he was head of the classical tripos and senior chancellor's medallist, was elected fellow and became classical tutor of his college. For a time he was a master at his old school, and in 1863 was ap- pointed professor of Latin at University College, London. His essay Ecce Homo, published anonymously in 1866, and afterwards owned by him, was widely read, and called forth many rephes, being held to be an attack on Christianity. Dealing only with Christ's humanity, it dwells on His work as the founder and king of a theocratic state, and points out the effect which this society, His church, has had upon the standard and active practice of morality among men. Some who condemned the book seem to have forgotten that it was avowedly " a fragment," and that the author does not deny the truth of doctrines which he does not discuss. Its literary merit is unques- tionable ; it is written with vigour and dignity ; its short and pointed sentences are never jerky, and there is a certain stateliness in the admirable order of their sequence. His later essay on Natural Religion, which, premising that supernaturalism is not essential to religion, maintains that the negations of science tend to purify rather than destroy Christianity, satisfied neither the Christian nor tlie scientist, and though well written excited far less interest than his earlier work. In 1869 he was appointed professor of modern history at Cambridge. His influence as a teacher was stimulating ; he prepared his lectures carefully and they were largely attended. In historical work he is dis- tinguished as a thinker rather than a scholar. Avoiding research and disliking all attempts at a picturesque representation of the past, he valued history solely in its relation to politics, as the science of the State. He maintained that it should be studied scientifically and for a practical purpose, that its function was the solution of existing political questions. Hence he naturally devoted himself mainly to recent history, and specially to the rela- tions between England and other States. His Life and Times of Stein, a ^-aluable narrative of the anti-Napoleonic revolt, led by Prussia mainly at Stein's instigation, was written under German influence, and shows little of the stylo of his short essays. Its length, its colourlessness, and the space it devotes to subsidiary matters render it unattractive. Far otherwise is it with his Expansion of England. Written in his best manner, this essay

answers to his theory that history should be used for a practical purjiose ; it points out hoAv and why Great Britain gained her colonies and India, the character of her empire, and the

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light in whicli it should be regarded. As a historical essay the book is a fine composition, and as a defence of the empire is unanswerable and inspiring. It appeared at an opportune time, and did much to make Englishmen regard the colonies, not as mere, appendages, but as an expansion of the British state as well as of British nationality, and to remind them of the value of Great Britain's empire in the East. Seeley was rewarded for this public service by being made K.,C.M.G., on the recommendation of Lord Rosebery, His last book, The Growth of British Policy, written as an essay and intended to be an introduction to a full account of the expansion of Great Britain, was published posthumously, Seeley died on 13th January 1895. He married in 1869 Miss Mary Agnes Phillott, who survived hito.

See 6. W. Prothero. Memoir prefixed to Growth of British Tolicy. London, 1895. (w. Hu.)

Segantini, Giovanni (1858-1899), Italian

painter, was born at Arco in the Trentino on 15th June 1858. His mother, who died in 1863, belonged to an old family of the mountain country. His father, who was a man of the people, went to Milan, whence he set forth with another son to seek his fortune, leaving Giovanni behind. At the age of seven the child ran away ; he was found perishing of cold and hunger, and was obliged to earn his bread by keeping the flocks on the hills. He spent his long hours of solitude in drawing everything he saw. Owing to the fame of the boy-prodigy having reached the ears of a syndic, the child

was sent back to Milan; but, unable to endure domestic life, he soon escaped again, and led a wandering hfe till he met at Arco with his half-brother, who offered him the place of cashier in his provision shop. After more flights and more returns, Segantini remained at Milan to attend classes at the Brera, earn- ing a living meanwhile by giving lessons and painting portraits. His first picture, "The Choir of Sant AJitonio," was noticed for its powerful quality. After painting this, however, he shook himself free by degrees of academical teaching, as in his picture " The Ship." He subsequently painted " The Falconer " and " The Dead Hero," and then, thirsting once more for liberty, settled in Brianza, near Como. There he gave himself up to the study of mountain life, and became in truth the painter of the Alps. At this time he painted the " Ave Maria," which took a gold medal at the Amsterdam Exhibition (1883), "Mothers," "After a Storm in the Alps," "A Kiss," and "^Moonlight Effect." Deeply impressed by Millet, whose influence may be traced in some of Segantini's drawings, the artist neverthe- less quickly strove to reassert his individuality, as may be seen in "The Drinking-place," which gained a gold medal in Paris (1889), "In the Sheep-fold," " By the Spinning-wheel," and "Ploughing in the Engadine" (see Plate), for which he was awarded a gold medal at the Turin Exhibition (1892). Besides those works in which he studied simple effects of light and Alpine scenery, such as " Mid-day on the Alps " and " Winter at Savognino," he also painted symbolical subjects: "The Punishment of Luxury," and the "Unnatural Mothers" (in the Walker Art Gallery, Liverpool). Segantini died at Maloja in October 189S. An exhibition of his works was held in London, and after- wards at Brussels in 1899, and at Milan in 1900. Seven important pictures and nine drawings by Segantini were exhibited with success at the Paris Exhibition in 1900.

Authorities. ❓❓❓ H. Zimmern, Magazine of Art (London), 1897 ; "W. Ritter, Gazette des Beaux-Arts (Paris), 1898 ; Robert de la SiZERANNE, Bevue de I'Art (Paris), 1899 ; and Revue des Deux Mondes (Paris), 1900. (h. Fe.)

Seg^OVia, a provicne of Spain, in Old Castile. Area, 2670 square miles. Population (1887), 154,443;

(1897), 156,086. The birth-rate is 4-16 per cent., the death-rate 3‘41 per cent., and the proportion of illegiti- mate births 1‘80. Few of the inhabitants emigrate. Segovia is connected with Madrid and Medina del Campo by rail. This railway has not, however, stopped much of the traffic that still goes on through the passes of Nava Cerrada and Somosiera. Another line is in construction between Aranda de Duero and Segovia. The province is divided into 5 districts and 275 parishes.

*The industries of Segovia have much decayed, especially portfelaiu and woollen stuffs. There are manufactures of coarse porcelain, dyes, chalk, paper, alcohol, rosin, hats, pins and needles, beer, flour, oil. *- It is estimated that more than 256,000 acres are covered with forests. In 1897 wheat was grown on 121,550 acres, rye, oats, barley, maize on 77,805 acres, pod fruit on 37,742 acres, and vines on 23,595 acres. In the same year the live stock in Segovia included 4714 horses, 12,645 mules, 18,062 asses, 26,687 cattle, 345,302 sheep, 14,063 goats, and 13,119 pigs.*

Segovia) capital of the above province, on the railway from Villalba to Medina del Campo, near the river Eresma. It is still a walled city, and all its fine monuments of the Roman occupation as well as its mediseval buildings are kept in good state of preservation. Outside^ the older parts of the city modern suburbs have sprung up on all sides. The woollen industry has decayed, and its place has been taken by paper and flour mills, dyeing, foundries, earthenware, and some coarse porcelain. Segovia has a botanical garden, a savings bank, two public libraries, and two remarkable archive depots. Public education is well taken care of in the institute, a dozen primary schools, normal school for teachers, and arts and handicraft schools. Segovia has been for more than a century the royal artillery school of Spain. Population (1877), 11,318; (1897),

14,738.

Sell ore, a town of Central India, with British cantonment, within the native state of Bhopal, situated in 23 ir K and 77 7' E., with a station on the Bhopal- Ujain railway, 24 miles west of Bhopal. It is the residence of the political agent for the Bhopal agency, and headquarters of the Bhopal battalion. Population (1881), 15,595; (1891), 16,232. The number of police is 53 men. There are a high school, dispensary, and jaiL

Seiche. See Tides.

Seidi, Anton (1850-1898), Hungarian operatic conductor, was born at Budapest, 7th May 1850. He entered the Leipzig Conservatorium in October 1870, and remained there until 1872, when he was summoned to Ba3T:euth as one of Wagner's copyists. There he helped to make the first fair copy of Der Ring des Nihelungen. Thoroughly imbued with the Wagnerian spirit, it was natural that he should assist in the first Bayreuth Festival in 1876. His chance as a conductor came when, on Wagner's recommendation, he was appointed to the Leipzig Stadt-Theater, where he remained until, in 1882, he went on tour with Angelo Neumann's Nihelwngen Ring com- pany. To his conducting critics attributed much of such artistic success as attended the production of the Trilogy at Her Majesty's Theatre in June of that year. In 1883 Seidl went with Neumann to Bremen, but two years later was appointed successor to Leopold Damrosch as con- ductor of the German Opera in New York, and in the same year he married Fraulein Kraus, the distinguished singer. In America Seidl's orchestra became famous. In 1886 he was one of the conductors at Bayreuth, and in 1897 he filled a similar position at Co vent Garden, London. He died in New York, 28th March 1898! Seidl was essentially a " modern " conductor of very con- siderable ability. (e. h. l.)

Seine, a river of France, rising in the Cote d'Or, and ilowing generally north-west and west to the English Channel, at Havre. At Chatillon (C6te d'Or), 38 miles from its source, it has an altitude of only 705 feet, more than half its total descent having been accomplished. Its breadth on entering Paris is about 182 yards, and, on leaving, 149 yards. At Clichy, 1 mile north of the forti- fications, the great sewer, into which practically the whole drainage system of Paris is directed, is discharged into the Seine. The tide begins to make itself felt at Poses, 11 miles above Elbeuf, and between Caudebec and Villequier the mascaret, or bore, has its greatest development. In 1878 it was decided, in order to facilitate the navigation of the river below Paris, that between the capital and Eouen several additional locks should be constructed and other improvements

effected, so as to divide this part of its course into ten easy stretches. The work was completed in 1886. The head of the estuary is now found near Quillebeuf, and four miles lower down, between the lighthouses of Tancarville on the north-north-east, and Pointe de la Eoque on the south-south-west, the width is 3| miles. A canal 14 miles in length is carried across the alluvial plains north of the bay, between Tancarville and Havre. (See Eiveb. Engineering.)

The Seine is classed as navigable from Mery to the sea, a length of 337 miles, and divided into nine sections. The navigation statistics here given are those for 1900. The total tonnage includes wood floated.

1. Mery to Marcilly, 16 miles. In this section navigation is

purely nominal.

2. Marcilly to Montereau, 46 miles, mean depth 5 '25 feet,

crossed by 35 bridges ; number of boats, 998 (of which 661 in descent) ; total tonnage, 103,355.

3. Montereau to the limits of the departments Seine-et-Marne

and Seine-et-Oise, 36 miles, mean depth 5 '5 feet, 35

bridges ; 11,307 boats (6935 in descent) ; total tonnage,

1,945,287.

4. From preceding limits to Paris fortifications, 25 miles, mean

depth 6-5 feet, 20 bridges; number of boats, 29,316 (16,685 in descent) ; total tonnage, 6,496,304.

5. Across Paris, 7^ miles, mean depth 10'5 feet, crossed by 37

bridges ; number of boats, 32,633 (17,872 in descent); total tonnage, 7,494,037.

6. Paris fortifications to Briche, 13 miles, mean depth 10-5

feet, crossed by 13 bridges; number of boats, 16,461 (6357 in descent) ; total tonnage, 4,308,548.

7. Briche to confluence of Oise, 26 miles, mean depth 10 ‘5 feet,

15 bridges ; number of boats, 19,382 (4723 in descent) ; total tonnage, 4,966,029.

8. Confluence of Oise to Rouen, 106 miles, mean depth 10‘5

feet, bridges 23 ; number of boats, 8634 (3184 in descent) ; total tonnage, 2,054,284.

9. Eouen to Havre, 78 miles, mean depth 22 feet ; number of

boats, 1808 (772 in descent) ; total tonnage, 328,614.

(e. J. H.)

Seine, a department of France, having Paris for its capital, watered by the Seine and the Marne, which unite at Charenton.

Area, 185 square miles. The population, 2,799,329 in 1881, had increased in 1901 to 3,599,870, of whom 939,311 were settled out- side of Paris. The births in 1899 were 77,010, of which 19,054 were illegitimate ; deaths, 73,219 ; marriages, 32,105. There were in 1896, 1807 schools, with 351,000 pupils, not more than 1 per cent, of the population being illiterate. The area cultivated was in 1896 estimated at 66,339 acres, of which 43,435 were arable and 1198 under vines. The wheat grown in 1899 was valued at ––104,000 ; rye, ––8000 ; oats, ––43,000; potatoes, ––92,000; vines, ––29,000. The live stock in 1899 comprised 17,000 horses, 13,000 cattle, 1600 sheep, 2700 pigs, and 411 goats. There is no coal nor other minerals, except quarries of stone and plaster of Paris. There is, however, an active industry in metals, yielding in 1898, 34,000 metric tons of iron, 2300 tons of steel, and several tons of other metals, giving a total value of ––282,000. Excluding those of the

capital, the important industries are spinning, leather-dressing, chemical products, paper, &c. The chief places outside of Paris are St Denis, Boulogne, Puteaux, Choisy, Ivry, Montreuil, Vincennea, Suresnes, and Sceaux.

Seine-et-iViarne, a department of northern France, watered by the Seine and the Marne.

Area, 2273 square miles. The population, 348,991 in 1881, had grown in 1901 to 355,638. The births in 1899 were 7226, of which 441 were illegitimate ; deaths, 7815 ; marriages, 2679. With 927 primary scbools (1896), attended by 52,000 pupils, there was but 1 per cent, of the population illiterate. The land under cultivation in 1896 comprised 1,388, 140 acres, of which 992,940 acres were plough- land and 11,115 acres under vines. The harvest of 1899 yielded in wheat the value of ––1,801,000 ; rye, ––91,800 ; barley, ––43,200 ; oats, ––1,593,000 ; potatoes, ––160,000 ; mangold-wurzel, ––132,000 ; green crop (trefoil, lucerne, and sainfoin), ––585,000 ; vines, ––61,000. The live stock of 1899 included 43,960 horses, 92,050 cattle, 439,800 sheep, and 14,200 pigs. The milk produced in 1899 was valued at ––1,193,300. With the exception of clay and building stone, Seine-et-Marne produced in 1898, in the way of minerals, only 80 metric tons of peat, and the industry in metals was repre- sented by only 87 tons of iron, valued at ––607. The distilleries, on the other hand, produced 1,––41,000 gallons of alcohol, while the production of sugar exceeded 913,000 cwt. Melun, the capital, had in 1901, 10,820 inhabitants.

Seine-et-OiSe, a department of northern France, watered by the two rivers naming it.

Area, 2185 square miles. The population, 677,798 in 1881, had increased to 700,405 in 1901. The births in 1899 were 14,427, of which 1164 were illegitimate ; deaths, 15,849 ; marriages, 5234. There were in 1896, 1419 schools, with 95,000 pupils, 2 per cent, of the population being illiterate. Out of 1,286,870 acres under culti- vation in 1896, 886,730 acres were plough-land, 41,990 acres garden land, and 14,820 acres vineyards. This department has a larger area laid out in gardens than any other

department of France. The wheat grown in 1899 was valued at ––1,204,400 ; rye, ––93,000 ; barley, ––49,000 ; oats, ––853,000 ; potatoes, ––47,000 ; natural pas- tures, ––91,200 ; vines, ––104,000 ; beetroot, ––122,000. The live stock included (1899) 48,690 horses, 3312 asses, 95,700 cattle, 311,200 sheep, and 20,500 pigs. In the way of minerals this department yieliied, in 1896, only 260 metric tons of peat. Nor is there any important industry in metals, only 3700 tons of iron having been manufactured in 1898. Only the industries connected with agricultur–– are on a scale of importance. The distilleries manufactured in 1898, 2,854,000 gallons of alcohol, and the sugar output amounted to 338,000 cwt. Yersaillis, the capital, numbered in 1901, 44,563 inhabitants.

Seine-lnferieure, a department of the north of France, washed by the English Channel and watered by the Seine.

Area, 2448 square miles. The population, 814,068 in 1881, had increased to 843,928 in 1901. Tue births in 1899 were 23,588, of which 3017 were illegitimate ; deaths, 23,481 ; marriages, 6738. There were in 1896, 1479 schools, with 126,000 pupils, 7 per cent, of the population being illiterate. The land under cultivation in 1896 comprised 1,416,545 acres, of which 837,330 acres were plough- land, 14,820 acres in gardens, 148,200 acres in woods, and about 414,960 acres in natural pastures and grass lands, the vine not being cultivated in this department. One of the richest agricultural departments of France, Seine-lnferieure produced in 1899 wheat valned at ––1,204,000; rye, ––73,000; bariey, ––40,000; oats, ––800,000 ; potatoes, ––88,100 ; mangold-wurzel, ––92,000 ; colza, ––191,000 ; beetroot, ––53,000 ; apples, ––410,000. The live stock of 1899 included 71,650 horses, 279,010 cattle, 172,800 sheep, and 70,500 pigs. The milk produce of 1899 was valued at ––1,402,000. The mining of the department yielded in 1898 only 350 metric tons of peat, silica, and ashlar. The metallurgic production of the copper fonmlries of Rouen, however, exceeded ––190,000. The principal industry is that of cotton carried on in Eouen, Darnetal, Sotteville, Le Havre, and Yvetot, which maintains 1,600,000 spindles and more than 16,000 looms. The woollen industry is also very active in Elbeuf and its environs. The distilleries produced (1898) 1,437,000 gallons of alcohol. A good deal is

done in the refining of sugar and the manufacture of glass and paper. .The chief towns are Rouen, the capital, with 110,717 inhabitants ; Le Havre, the second port of France, with 127,639, the special commerce of which in 1899 was valued at ––54,400,000, and its general com- merce at ––68,300,000 ; Elbeuf, with 18,164 inhabitants.

Seismogri'ciph. See Eaethquakes.

Seismometer. See Earthquakes.

Sei^ng^or. See Malay States (Federated).

SELBORNE

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Selborne, Roundell Palmer, Earl of

(1812-1895), English lawyer and statesman, was born at Mixbury, in the county of Oxford, on 27th November 1812. His father was rector of the parish: his grand- father and great-grandfather were merchants in the City of London, where their descendants for a long while continued to be influential people ; his mother belonged to the family of Roundell, which had been settled for four centuries in the West Riding of Yorkshire. He was educated at Rugby and at Winchester, and in 1830 went into residence in the University of Oxford as a scholar of Trinity College. Here he lived in intimacy with many friends, especially Claughton and Charles Wordsworth. He soon joined the Union Debating Society, of which Gladstone was at that time president ; and there Palmer first tried his powers in debate. In 1834 he took his degree in the first class of the school of Literae Humaniores ; he won the Eldon scholarship and was elected to a fcUow- ship at Magdalen College ; and after a year, spent chiefly in private tuition, partly in Lord Winchilsea's house and partly in the University, he removed to London (November 1835) and commenced reading for the Bar. In London he found himself surrounded by members of his own family, and through their influential position, as well as through his own and his father's friends, he obtained a freer access to much good society than is usually the lot of a young man coming to

London from a university. ‘ Mean- while events had happened which were felt by Palmer, when he looked back in after life, to have been turning points in his mental history. In 1832 his mother had been affected by a very distressing illness, which continued for years, and in the winter of 1834-35 his brother Henry was lost at sea.

Palmer was called to the Bar on 7th June 1837, the same day on which John Rolt, a man of very different antecedents, but afterwards a worthy rival of Palmer, was also called. Through his family connexions in the City of London, clients soon came to Palmer’s chambers, and his business at the Chancery bar increased rapidly. Meanwhile his interests were not wholly confined to law : for some time (1840-43) he wrote for The Times and the ??ritish Critic ; he made a plunge into patristic learning, from which he soon recoiled; he was much interested in the controversies which distracted the Church on the subject of Tract 90 ; in the treatment of the Episcopal Church in Canada by the Canadian Government and the Colonial Office ; in the establishment by the Crown, in conjunction with the king of Prussia, of the Jerusalem bishopric; and in the contest for the professorship of poetry at Oxford on Mr Keble’s retirement.

In 1847, and again in 1853, Palmer was returned as member of Parliament for Plymouth, as a Peelite, and in the House of Commons he took an active and inde- pendent part. He advocated the admission of Jews to Parliament ; he opposed Lord John Russell’s measure to repel the so-called papal aggression; he opposed the admission of Dissenters into the University of Oxford; and he was hostile to the action of the Government in the Crimean war. On the question of the reform of the University of Oxford, he sympathized with the reformers, but felt himself prohibited, by the oaths which he had taken, from assuming any active part in the promotion of change. In 1855 he supported Gladstone in the efforts to bring about peace with Russia before the capture of Sebastopol ; in 1856 he opposed the opening of museums on Sunday ; in the following year he supported Cobden in his disapproval of the second opium war with China. At the general election on March 1857, Palmer, finding that the independent part he had taken, especially in reference to the Chinese

question, had alienated from him many of his constituents in Plymouth, abandoned the prospect of re-election for that borough, and did not seek for election elsewhere. In 1848 he married Lady Laura Waldegrave, daughter of Earl Waldegrave. In 1849 he had become a Q.C.; and in 1851 he took his seat in the Rolls Court, where he soon obtained a leading and very lucrative practice, and was engaged in many of the most important cases in the Court of Chancery. In July 1861 he accepted from Lord Palmerston the office of solicitor-general, a knighthood, and a safe seat for the borough of Richmond in Yorkshire, secured for him through the friendly action of Lord Zetland, and thus began the second spell of Palmer's membership of the House of Commons, which continued till his elevation to the woolsack and the peerage. In September 1863 he become attorney-general, and so continued till the Government of which he was a member resigned in 1866.

The Civil War in America, and the questions which arose from the relations of Great Britain with both belligerents, rendered the duties of the law officers of the Crown more than usually onerous, and Palmer was called upon to take part, as adviser of the ministry, in the Courts, and in the Hoiise, in the questions which arose in respect of the Trent and the Peterhoff, the cruisers AlabaTua and Florida, and the Alexandra, a ship which was seized by the Government, and other matters. In 1865 he took a large part in the passing of the Act under which all the law courts were gathered together in the Strand. In 1866 he expressed himself favourable to the making of household suffrage the basis of repre- sentation, an expression of opinion which probably in- fluenced the Reform Bill of the following year ??? in the discussions on which Palmer took a prominent part, and especially in opposition to^ the so-called " fancy franchises " originally proposed by its authors. In the same year he took part in supporting the measure for the abolition of compulsory Church rates.

In 1868 occurred an event of great importance in his career. In April of that year Gladstone proposed his resolutions with reference to the Irish Church on which the Bill for its disestablishment was subsequently based. This measure was opposed to many of the dearest beliefs and feelings of Palmer, who was a strong and conscien- tious Churchman, and he

evidenced his disapproval of his chief's measure by abstaining from voting on the resolutions. At the election of November 1868 Palmer was again returned for Richmond, and Gladstone ofl'ered him the office of lord chancellor or the office of a lord justice with a peerage; both offers were declined by Palmer, and he assumed a position of inde- pendent opposition to the measure relative to the Irish Church. On the 22nd March 1869 he deUvered a very powerful speech against the second reading of the Bill, and during its later stages exercised a considerable influence in modifying the severity of its provisions. The position of Palmer at this time was very remarkable. The foremost advocate at the Bar, he was known to have declined the highest prize in the profession rather than promote a measure of which he disapproved ; a very prominent member of the House of Commons, whose action had been more than usually independent of party, he had separated himself from his political friends and maintained a position as the dignified and forcible opponent of Disestablishment. Without office and without combination with the Conservative Opposition, he exercised great influence within and without the walls of St Stephen's. What made his position the more remarkable was that he was frequently consulted by the Government which he had declined to join, and that on some occasions

they invoked the assistance which his great influence in the House enabled him to afford to them.

In 1869 he sought to modify rather than to oppose the Bill for the abolition of tests in the universities. In 1870 he gave a qualified support to Gladstone's first Irish Land Act, and in the same year he supported Forster's Education Act. In 1872 he undertook the defence of his friend Lord Chancellor Hatherley, when attacked for his appointment of Sir Robert ColKer to the Judicial Committee of the Privy Council, and, by a line of argument more ingenious than convincing, secured a majority for the Government.

The Treaty of Washington was the means of casting a great duty upon Palmer. After the conclusion of the Civil War in America very large claims were preferred against Great Britain for alleged breaches of her duty as a neutral Power ; and after long negotiations, England and the United States agreed to arbitration. Palmer, who had been advising the British Government during these negotiations, and who (4th August 1871) had defended the treaty in the House . of Commons, was briefed on behalf of Great Britain. In the end the Geneva tribunal made an award requiring the payment by Great Britain to the United States of a simi of about ??3,000,000. To those who, in order to promote the cause of international arbitration, are desirous of acquiring a knowledge of the dangers and difficulties which beset this mode of settling disputes, the account which Palmer has left of his part in this arbitration may be commended.

In September 1872 Gladstone again offered him the Great Seal, which Lord Hatherley had resigned ; and he also for the first time took up his residence in his newly erected house at Blackmoor, in the parish of Selborne., in the county of Hampshire, from which he took his new title as a peer. In the following year (1873) Lord Selborne carried through Parliament the Judicature Act. The foundations of this measure were laid so long ago as February 1867, when Palmer had moved for a Royal Commission on the constitution of the courts, and had taken an active part in the work of that Commission, of which the first report was made in 1869. The result of this Act of 1873 was to effect a fundamental change in the judicature system. By the operation of the Judicature Act one supreme court with several divisions was con- stituted ; each division could administer the whole law ; the conflict of divergent systems of law was largely overcome by declaring that when they were at variance, the principles of equity should prevail over the doctrines of the common law. The details of this great change were embodied in a code of general rules prepared by a committee of judges, over which Lord Selborne for two years presided week by week, with unfaltering attention to the minutest detail. If, wrote Lord Selborne in his memoirs, speaking of the Judicature Act of 1873, " I leave any monument behind me which will bear the test of time, it may be this." It is impossible to separate this fusion of law .and equity, this union of all the higher courts into one supreme tribunal, from

the construction of a single home for this great insti- tution ; and the opening of the Royal Courts in the Strand in the year 1882, when Queen Victoria personally presided in her one supreme court, and handed over the care of the building to Lord Selborne, as her chancellor and as the head of this great body, was impressive as an outward and visible sign of the silent revolution, which owed more to Lord Selborne than to any other individual. To the student of the natural history of jurisprudence the fusion of the two systems of law and equity may well recall a similar result brought about in Imperial Rome ; to the student of British institutions, the supreme

court, for once presided over in person by the sovereign, could not but recall the Aula Regia, where the Norman kings sat amid their counsellors before equity had arisen to correct law, and before the separation between the three great common law courts had begun. A small incident may illustrate the novelty of the assemblage of the one great court on that day. The Queen, on the prayer of the attorney-general, ordered that the proceed- ings of the day should be recorded, an order which caused a momentary embarrassment to the lord chancellor, as the court had no existing registrar, and no existing book in which the record should be made. On the occasion of the opening of the Royal Courts Lord Selborne received an earldom.

The year 1885 was marked in Lord Selborne 's life by the death of his wife, and by his final separation from the party of which Gladstone was the acknowledged leader. That statesman had in the latter part of the year indicated his leaning towards the disestablishment of the Church of England, and towards Home Rule for Ireland. Both these leanings were opposed to the deepest convic- tions of Lord Selborne; and it was an inevitable result that when in January 1886 Gladstone resumed office as premier. Lord Selborne should not be again his chancellor : on the 30th January in that year they parted for ever ; and Lord Selborne felt that his public Ufe, except so far as he might serve his country by voice or pen, was now over, and that his "idols were broken." But neither his courage nor his industry forsook him; and he found, in opposing the new views of his old colleague, ample scope for both voice and pen ; and as a member of the House of Lords he continued almost to the last to take part in

hearing and deciding appeals, and sometimes in the ordinary business of the House.

In addressing the electors of Midlothian in September 1885, Gladstone had suggested the severance of the Church of England from the State as a subject on which the foundation of discussion had already been laid, and he averred the existence of " a current almost through- out the civilized world, slowly setting in the direction of disestablishment." Such an utterance from such a man greatly excited the hopes of Nonconformists, who had previously published a manifesto under the title of "The Case for Disestablisment." This stirring of the question deeply moved Lord Selborne, who was strongly opposed alike to disestablishment and disendow- ment, and in the following year, 1886, he published a work entitled A Defence of the Church of England against DisestablishTnent, with an introductory letter addressed to Gladstone. In the introductory letter he criticized Gladstone's pronouncement on the subject, and especially examined the allegation of a general tendency towards disestablishment in the civilized world at large, and arrived at a negative conclusion. In the body of the book the learned author treated of the history of the English Church, its endowments, and the case of the advocates of disestablishment. The work is throughout characterized by an abundant supply of learning and of information as to the history and the state of the Church of England at that time, and by great dialectical acuteness. It is a powerful defence as well as a valuable summary of the history of the Estabhshed Church in England. In 1888 Lord Selborne published a second work on the Church question, entitled Ancient Facts and Fallacies concerning Churches and Tithes, in which he examined more critically than in his earlier book the developments of early ecclesiastical institutions, both on the Continent and in Anglo-Saxon England, A\hich resulted in the formation of the modern jiarochial system and its general endowment with tithes. A second edition of this

work, embodying tte rftsult of its author's subsequent researches in the Vatican Library and elsewhere, was published in the year 1892. A perusal

of these books will show with how wide a range of investigation and with what care Lord Selborne prepared himself for the discus- sion of these ecclesiastical questions which deeply stirred him. But Lord Selborne did not carry on his opposition to Gladstone's proposals only in his library or by his pen ; in the year 1886-87 he travelled to many parts of the country, and addressed influential public meetings in defence of the union between the Church and State and against Home Rule ; and in September 1893, in his eighty-first year, he addressed a powerful speech to the House of Lords in opposition to the Home Rule Bill.

Lord Selborne's health had, with the exception of two collapses in 1883 and 1888, which appear to have been due to overwork, continued excellent till February 1895, when he was attacked by influenza. He died 4th May 1895 at his seat in Hampshire, full of years and of honours.

To the subject of university education Lord Selborne at different times in his life gave much time and attention. As a fellow of Magdalen College, he had been desirous of changes which he felt himself bound by his oath from advocating ; and he had taken part in the discussions on the abolition of tests in the old universities. ^ He gave much time and attention to his duties as chairman of the second Oxford commission under the Act of 1876 ; in 1878 he filled the office of lord rector of the university of St Andrews ; and in the following year he presided over a commission on the subject of university education in London. Lord Selborne's hterary labours included the pubUcation in 1862 of a selection of hymns, under the title of The Book of Praise, a work in which he was greatly assisted by Mr Daniel Sedgwick, a bookseller and publisher in the City of London. The work was characterized by the great pains taken to ascertain the true authorship of hymns which were either anonymous or attributed to those who had not composed them, and by a like effort to exclude all variations grafted on the original language, and to gi-^e the hymns " in the genuine uncorrupted text of the authors themselves." In the course of his labours as editor of this volume he was struck by the unity which was presented by Christian hymnody, "binding together by the force of a common attraction, more powerful than all causes of difference, times ancient and modern, nations of various race and language. Churchmen and Nonconformists, Churches reformed and

unreformed ” (Preface). In the same field of literature Lord Selborne further laboured by the publication of another collection called The Booh of Praise Hymnal ; a contribution to an edition of Bishop Ken’s hymns ; a paper on English Church Hymnody at a Church Congress ; an article in the Encyclopaedia Britannica on the h3Tnns of the Latin and Oriental Churches, as well as those of Germany and Great Britain, which was repub- lished as a separate volume in 1892.

During the last few years of his life Lord Selborne en- gaged in the composition, for the benefit of his children, of memorials of his own hfe and of the lives of many members of his family. These Memorials, Part I., Family and Personal, in 2 vols., which were published in 1896, Memorials, Pari II., Personal and Political, also in 2 vols., were edited by Lady Sophia Palmer and published in 1898. In the years 1880-81 Lord Selborne wrote to

^ In 1867 he foundecl an association for the improvement of legal education, in the hope of bringing abont the establishment or the restoration of ” a general school of law in London on a scale worthy of the importance of the law and of the resources of the Inns of Court.” This enterprise was not successful. The opposing forces were too strong to permit Lord Selborne to succeed.

his son a series of letters on religious subjects, dealing in an elementary way with natural and revealed religion, the inspiration of the Bible, and Biblical criticism. These were pubhshed in 1898, under the title of Letters to His Son on Religion, by Roundell, First Earl of Selborne.

In person Lord Selborne was of about the average height : his manners when among strangers were some- what reserved; his style, both in speaking and writing, was fluent, tending to diffuseness ; his oratory was marked by uniform good sense and lucidity, both jof arrangement and language ; and if he never reached the highest level of oratorical excellence, he never descended to what was commonplace or irrelevant. As a judge, whether in the Supreme Court or in the House of Lords, he displayed high qualities : he was patient, courteous, logical, and learned, and his judgments contain many valuable expositions of the principles of law. The fusion of law and equity, the reorganization of the whole judicial

system of England, and the association of all the supreme tribunals in one common home were works of no ordinary magnitude or importance, and give a character of unusual importance to his chancellorship.

That Lord Selborne was a truly religious man it is impossible to doubt : his whole life was regulated and inspired by a sense of his duty towards God and his fellowmen, and a long life spent amid the temptations of legal and public life left not the faintest stain on his memory. He was a devout member of the Church of England, to which he looked up with unstinted afi'ection and reverence ; and he found in its service and formu- laries an adequate satisfaction for all his rehgious feelings. He belonged to the High Church school, which was in- fluenced by the teaching of Newman and Pusey and the Oxford teachers of their day; but he by no means slavishly followed them. With the later High Church movement, usually described as Ritualism, he had less sympathy.

His life was prosperous, for from his first prize at the university tUl his acquisition of an earldom, he went on a course of almost unbroken success. He had the double dignity of having refused the highest prize in his profession for conscience' sake, and of having accepted that dignity without loss of consistency ; in his life he acquired a high reputation and the sincere admiration of his feUowmen, as well as an abundant fortune and ample titular distinctions. His life was also happy, for he had pleasure in his work, he loved and was loved by his wife and children ; he had a strong constitution, and retained his bodUy and mental powers to the last ; his faith in the religion of his youth was unshaken to the end ; and he lived throughout his long life with the consciousness of rectitude. (e. f.)

Seleng^hinsk, Old and New, two towns

of East Siberia, in the province of Transbaikalia, on opposite banks of the Selenga. The latter, on the left bank, is a district town, but both are small ; formerly important centres of trade with China, they lost their importance with the growth of Kiakhta. A colony of Engli.sh missionaries is close by. It was here that the Treaty of 1688 was concluded by Russia with the Mongol princes, who swore allegiance to their northern neigh- bour. The population of the district town in 1897 was

1076.

Selkirk, a royal and parliamentary burgh (Border group) and the county town of Selkirkshire, Scotland, on the riv^r Ettrick, 37 miles south-south-east of Edinburgh by rail. There are fourteen woollen factories ; also, engineering and millwright works. IModern erections in- clude a United Free church, a public hall, and a free library. Population (1891), 6397; (1901), 5701.

Selkirk Mountains. See Canada.

Selkirkshire, an inland lowland county of Scot- land, bounded on the N. by Midlothian, on the N. and W. by Peebles, on the S. by Dumfries, and on the E. by Koxburgh.

Area and Population. ??? In 1891 Innerleithen and Peebles parishes were placed wholly in Peebles ; Lyne and Megget was divided, and Lyne was restricted to Peebles, while Megget was added to the Selkirk parish of Yarrow. Part of Yarrow was given to the Peebles parish of Traquair. Selkirk, Ashkirk, and Galashiels were placed wholly in Selkirk, Roberton was placed wholly in Roxburgh, and part of Melrose was transferred to the Selkirk parish of Gala- shiels. The area of the county is 172,4-26 acres, or about 269 square miles. The population was, in 1881, 25,564 ; in 1891, 27,353; in 1891, on the above area, 27,712; in 1901, 23,371, of whom 10,680 were males and 12,691 females. On the old area, taking land only (164,545 acres, or 257‘1 square miles), the number of persons to the square mile in 1901 was 90-8, and the number of acres to the person 7 “4. In the registration county the population increased between 1881 and 1891 by 6 ‘6 per cent. Between 1881 and 1891 the excess of births over deaths was 3833, and the increase of the resident population 1781. The following table gives particu- lars of births, deaths, and marriages in 1880, 1890, and 1899 : ???

Tear.

Deaths.

Marriages.

Births.

Percentage of Illegitimates.

1880 1890 1899

450 474 365

163 176 160

927 757 473

8-6

6-74

5-3

The following table gives the birth-rate, death-rate, and marriage- rate per thousand of the population for a series of yeais : ???

1S80.

1881-90.

isoo.

1891-98.

1899.

Birth-rate . Death-rate . Marriage-rate

37-00

17-47

6-33

29-78 14-69

5-45

27-09

16-96

6-30

23-14

13-98

6-49

16-21

12-51

5-47

In 1891 there were 78 Gaelic-speaking persons in the county, and 24 foreigners. Valuation in 1889-90, ––63,061 ; 1899-00, ––63,806.

Administration. ––– The county unites with Peebles to return a member to Parliament, and contains two burghs of the Border parliamentary group, Selkirk and Galashiels. Selkirk (5701), the county town, is the only royal burgh, and Galashiels (13,598) is the only other place above the rank of village. There are six civil parishes, and the number of paupers and dependents in September 1899 was 432. Selkirk forms a sheriffdom with Rox- burgh and Berwick, and a resident sheriff-substitute sits at Selkirk and Galashiels.

EdvAXition. ––– Nine school boards manage 17 public schools, which had an average attendance of 3729 in 1898-99, and 5 volun- tary schools (2 Roman Catholic and 1 Episcopal) had 533. There are high schools at Galashiels and Selkirk, and 3 other schools in the county earned grants in 1898 for giving higher education. Part of the ” residue” grant is spent in supporting short courses of instruction in dairying, and Selkirk Town Council subsidizes popular science classes in the burgh school.

Agriculture. ––– Oats cover all but a few hundred acres of the corn land. The percentage of cultivated area in 1898 was 17-4. Of the 226 holdings in 1895 the average size was 134 acres. The percentage under 5 acres was 17-70, between 6 and 50 acres 38-50, and over 50 acres 43-80. The number of farms between 50 and 100 a’ res was 19 ; between 100 and 300, 42 ; between 300 and 500, 18 ; and over 500, 20. The following table gives the principal acreages at intervals of five years from 1886 : –––

Tear.

Area under Crops.

Com Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1886 1890 1896 1899

23,320 24,209 30,392 30,054

4656 4495 5279 5239

8013 2982 3410 3296

7698 7420 9545 9116

8,046

9, -291

12,065

12,391

14

9

28

The following table gives particulars of the live stock during the same yetirs : ???

Tear.

1885 1890 1895 1899

Total Horses.

667 609 738 714

Total Cattle.

Cows or

Heifors in

Milk or Calf,

Sheep.

Pigs.

2748 3088 3418 3223

1043 1109 1343 1323

164,314 163,724 181,031 184,957

496 469 509 373

The area under wood in 1895 was 4942 acres. At the census of 1891, 1084 men and 98 women were returned as being engaged in agriculture.

Industries and Trade. ???Galashiels and Selkirk produce a large output of woollen yarn, tweeds and tartans, besides hosiery. Galashiels has also iron foundries, engineering works, and dye- works. There are large market vineries at Clovenfords. In 1891 the industrial population numbered 6004 men and 3600 women, of whom 3434 men and 3048 women were engaged in the manufacture of textiles. '

See Sir Geokge Douglas. History of the Border Counii es. Edinburgh, 1899. ***** *George Reavely. History of Galashiels. Galashiels, 1875.* ***** *Proceedings of Society of Antiquaries of Scot- land.* ***** *C. Roger. Ettrick Forest. Edinburgh, 1860.* ***** *William Angus. Ettrick and Yarrow. Selkirk, 1894.* ***** *George Buist. "Geology of Selkirkshire" {Transactions of Highland and Agri- cultural Society). Second series, vol. xiiL* ***** *W. S. Crockett. In Praise of Tweed. Selkirk, 1899.* ***** *J. Russell. Meminiscences of Yarrow. 2nd edition. Selkirk, 1894. hff_ -ypA.)*

Sella, QuintinO (1827-1884), Italian statesman and financier, was born at Mosso, near Biella, on 7th July 1827. After studying at Turin and Paris, he was appointed to the chair of geometry at Turin University in 1852, and in 1860 was elected deputy. A year later he was selected to be secretary-general of public instruction, and in 1862 received from Rattazzi the portfolio of finance. The Kattazzi cabinet fell before Sella could efficaciously provide for the deficit of , ****** *17,500,000 with which he was confronted; but in 1864 he returned to the ministry of finance in the Lamarmora cabinet, and dealt energetically with the deficit of* ****** *8,000,000 then existing. Persuading the king to forego* ****** *120,000 of his civil list, and his colleagues in the cabinet to relinquish part of their minis- terial stipends, he effected savings amounting to* ****** *2,400,000, proposed new taxation to the extent of* ****** *1,600,000, and induced landowners to pay one year's instalment of the land tax in advance. A vote of the Chamber compelled him to resign before his preparations for financial restoration were complete; but in 1869 he returned once more to the ministry of finance in a cabinet formed by himself, but of which he made over the premiership to Lanza. By means of the grist tax (which he had proposed in 1865, but which the Menabrea cabinet had passed in 1868), and by other fiscal expedients necessitated by the almost desperate condition of the national exchequer, he succeeded, before his fall from power in 1873, in placing Italian finance upon a sound footing, in spite of the fiercest attacks and persistent misrepresentation of his aims. In 1870 his great political influence turned the scale against the proposed alliance with France, and in favour of an immediate occupation of Rome. From 1873 until his premature death on 14th March 1884, he acted as leader of the Right, and was more than once prevented by an ephemeral coalition*

of personal opponents from returning to power as head of a Moderate Conservative cabinet. A man of the utmost integrity and moral courage, Sella combined with both an intelligence and an ability rare among Italian statesmen. As a scientist he ~~was scarcely less eminent than as a poli~~ tician. Since his death the amplest homage has been rendered to his merits by those who during his lifetime were most active in attempting to thwart his patriotic activity. (h. w. s.)

Sellar, William Young (1825-1890), Scottish

classical scholar, was born at Morvich, Sutherlandshire, 22nd February 1825. Educated at the Edinburgh Academy and afterwards at the University, he passed to Balliol College, Oxford, of which he became a scholar. Graduating first class in classics, he was elected fellow of Oriel, and after holding assistant professorships at Durham and Glasgow, was appointed jirofessor of Greek at St Andrews. After filling that office for six years, he was elected in 1863 to the professorship of humanity at

Edinburgh University, and occupied that chair down to his death at his residence, Kenbank, near Dairy, Galloway, on 12th October 1890. Sellar was one of the most brilliant of modern classical scholars, and was remarkably successful in his endeavours to reproduce the spirit rather than the letter of Koman literature. The Eoman Poets of the Republic (1863), The Roman Poets of the Augustan Age (1877), and Horace and the Elegiac Poets (1892), are his most prominent works, and are recognized as standard author- ities on the subjects with wMch they deal. Professor Sellar also contributed to the 9th edition of the Encyclo- pcsdia Britannica a series of brilliant articles on the Koman poets.

Selnria, a city of Alabama, U.S.A., capital of Dallas county. It is situated in 32??25' N. and 87?? W., on the right bank of the river Alabama, near the centre of the state, at an altitude of 126 feet. The river is navigable to this point, and this with the four rail- ways centring here, the Birmingham, Selma, and New Orleans, the Louisville and Nashville, the

Southern and the Western of Alabama, give Selma a large trade. This is principally in cotton, the chief crop of the surrounding country, and in lumber from the great pineries. The city contains railway shops and manufactures and large cotton warehouses. Population (1890), 7622, of which 3914, or more than one-half, were coloured; (1900), 8713, of whom 214 were foreign-born and 4429 negroes.

Selwyn, Georgre Augustus (1809-1878),

bishop of New Zealand, was born at Church Row, Hamp- stead, 5th April 1809, and was the second son of WiUiam Selwyn, a distinguished legal writer. He was educated at Eton. Proceeding to Cambridge, he became scholar and afterwards fellow of his college. He was also famous as an athlete, having rowed in the University boat. He took his degree (second in the classical tripos) in 1831. He then returned to Eton as private tutor, was ordained deacon in 1833, and devoted himself with characteristic energy to work in the parish of Windsor. His vigour, determination, and ability soon marked him out for pre- ferment; but when it arrived, it was hardly in a form expected or altogether approved by his friends. In 1841 it was proposed that he should go out as &st bishop to New Zealand, which was just beginning to be colonized. The well-known mot of Sydney Smith embodied the opinion of London society on the unpromising nature of the career thus offered him. Selwyn, nevertheless, accepted the offer without hesitation. He started at once for his diocese, studying Maori on the voyage out, and threw himself into his work with all his heart. He lived a life of continual strain and hardship. He was days and sometimes nights in the saddle. He swam broad rivers ; and having pro- vided himself with a sailing vessel, soon became as much an expert in navigation as the most experienced sailor in the cblony. Unfortunately, when by his devoted labours he had gained the confidence of the natives, his ascend- ancy was rudely shaken by the first Maori war. Selwyn endeavoured to mediate ; but the only apparent result for the time was that he incurred the hostility of both parties. He went to the battlefield to minister to the bodily and spiritual needs of the sick and wounded in both camps ; but the Maoris were persuaded that he had gone out to fight against them, and years afterwards one of them pointed out a scar on his leg to an Anglican bishop, which he declared had been inflicted by Bishop Selwyn's own

hands. Still, the bishop persevered, through evil report and good report, but he was long before he could regain the confidence he had forfeited by his strict adherence to the line of his duty. In 1854 he returned to England for a short period of rest and refreshment ; but

he spent much of it in pleading the needs of his diocese, and there are those still who remember the scene when, in impassioned tones, and with eagle eye glancing round the crowded church, he advocated the cause of missions in his Eamsden Sermon at St Mary's, Cambridge, and bid those present to " fill up the void " then existing, an appeal which drew Bishop Mackenzie to the mission field, and to a virtual martyrdom by the river Zambezi. Selwyn re- turned to New Zealand with a band of able associates, and henceforth set himself to divide the single diocese he had hitherto endeavoured to administer into sees of more manageable proportions. By degrees he met with the appreciation his lofty character and high sense of duty deserved. The colonists came to respect his uprightness, and the Maoris learned to regard him as their father. In 1868 Bishop Selwyn paid another visit to England to attend the first General Conference of Bishops of the Anglican Communion. While in England, the bishopric of Lichfield became vacant, and it was offered to him, and unhesitatingly declined. A difficulty, however, having arisen about filling up the see, it was once more offered to him, with the intimation that his appointment, and his only, would put an end to the deadlock which had occurred. He then considered that it was his duty to accept it. In his new sphere of work he displayed the same unselfish activity as before, and in the " Black Country " portion of his diocese he won the hearts of the working classes by his frank and hearty sjrmpathy. He called his clergy and laity together for consultation in the diocesan conference, a part of the working of his colonial see of the value of which he had become convinced by experience. This was at first resisted as an innovation ; but its usefulness was proved by the fact that a similar confer- ence is now a feature in the working of every diocese in England and Wales. The health of the bishop soon began to suffer from the change from the freer hfe in the open air to which he had been accustomed. His splendid vitality slowly declined, and he died 11th April

1878.

The Anglican communion has reason to be grateful to him for the constitution for the Church under his care, which he elaborated in conjunction with Sir George Grey, the bishop and lajTnan working in brotherly accord. This constitution has served as a model for the organization of many other non – established branches of the Anglican Church. (j. J. L.)*

Selwyn, John Richardson (1844-1898),

bishop of the Melanesian Islands, the son of George Augustus Selwyn, first bishop of New Zealand and after- wards bishop of Lichfield, was born in New Zealand, 20th May 1844. He was educated at Eton and at Trinity College, Cambridge. He intended at first to foUow the profession of the law; but fired by the example of the privations cheerfully endured by his father for the sake of the Church, he ultimately offered himself for holy orders. His ordination to the diaconate took place in 1869, after his father had accepted the bishopric of Lich- field. At first he laboured with energy and tact in his father's English diocese ; but the news of the martyrdom of Bishop Patteson in Melanesia led him to volunteer for service in the Australasian Archipelago. After a period of three years, during which the bishopric remained vacant, he was nominated as Bishop Patteson's successor. This was in 1877. For twelve years he threw himself with intense energy into his most arduous work ; and then his health entirely broke down, and he returned to England a hopeless cripple, but found a most appropriate sphere in the headship of Selwyn College, Cambridge, an insti- tution founded in memory of his father's remarkable

work in New Zealand. He was appointed in 1893, and until Ha death, 12tli February 1898, he employed such strength as remained to him in inspiring the undergraduates committed to his care with the spirit of unselfish heroism which had characterized his life. (j. J. l)*

Semaphore, a town, South Australia, in the county of Adelaide, 9|- miles by rail from the town of Adelaide. It is one of the chief watering-places of the state, with a pier 1800 feet long. Its population is about

8000.

Semendria. (Servian, Smederevo), an important commercial town in the kingdom of Servia, on the Danube, between Belgrade and the Danubian Cataracts. It is believed to stand on the site of the Roman settlement Mons aureus, and there is a tradition that its famous vineyards ??? suppljdng Budapest and Vienna vidth some of the finest table grapes ???were planted by the Roman Emperor Probus in the 3rd century of the Christian era. At the eastern end of the town, close to the river, there is a picturesque triangular castle with 24 square towers, built by the Servian Prince Gyuragy Brankovich in 1430, on the model of the Constantinople walls of that time. Semendria was the residence of that Servian ruler and the capital of Servia from 1430 to 1459. It is the seat of the district prefecture and a tribunal, and has a garrison of regular troops. Besides the special export of grapes and white wine, a great part of the Servian export of pigs, and almost all the export of cereals, passes through Semendria. Since 1886 the town has been connected with the Belgrade – Nish Railway by a branch line. Population (1900), 6912.

SeirienOVka, or Semionovka, a town of Russia, in the government of Chernigov, 14 miles by rail from Gomel. Its industries comprise manufactures of leather, sheepskins, boots, pottery, and oil, and it is a centre for trade in bristles, and for pedlars ; it also has several fairs of local importance. Population (1897), 15,125.

Semipalatinsk, a province of Russian Central Asia belonging to the General-Governorship of the Steppes, bounded on the N. and KE. by Tomsk, on the S.E. and E. by the Chinese province of Chuguchak, on the S. by the Russian provinces Syr-Daria and Semiryechensk, and on the W. by Akmolinsk. Its area is 184,631 square miles, and in 1897 its domiciled population was 685,197 (688,639 accord- ing to other reports), of whom 320,358 were women, and 55,093 lived in towns. Only 6 per cent, of the population was settled, the remainder, chiefly Kirghiz, being nomads. 555,259 were Mussulmans and 65,718 belonged to the Russian Orthodox

Church. The province is divided into 5 districts, the chief towns of which are : Semipalatinsk (26,353), Pavlodar (7730), Kokbekty (2908), Karkaralinsk (4455), and Ust Kamenogorsk (8958). The standard of education is low; in 1895 there were only 100 primary schools, attended by 3115 boys and 675 girls, and two gymnasia, one for boys (57), and one for girls (182). The Kirghiz have their own schools, which they are very eager to found, and for which they collect their own funds. Agriculture is the chief occupation of the Russians and of part of the Kirghiz. It is impossible to carry it on without irrigation ; but it is nevertheless widely spread, and the average yield in the years 1895 to 1899 was; rye 72,800 cwt., wheat 1,237,800 cwt, oats 408,300 cwt., barley 41,400 cwt., millet 159,500 cwt., and potatoes about 100,000 cwt. Flax and hemp are also grown, and melons are cultivated in fields ; tobacco is widely grown. Cattle-breeding is the chief pursuit of the Kirghiz, and there were in 1895, 549,840 horses, 291,400 horned cattle, 1,700,000 sheep, and

61,600 camels. Bee culture is widely spread, especially among the Cossacks, and more than 15,000 beehives were registered in 1895. Fishing, which is carried on on Lakes Zaisan, Balkhash, and others, as also on the Black Irtysh, is of considerable importance. Gold is extracted, to the amount of 464 kilogrammes per annum, by nearly 4500 workers ; also silver (896 kilogrammes), copper (850 cwt.), salt (42,000 tons) from the salt lakes, and coal (1500 tons in 1897), which has only begun to be extracted. There are two iron -works, but industry remains in its infancy, and the only other industrial establishments of any size are a large steam flour-mill and a distillery ; the annual aggregate return of aU factories is only ►►33,000. A considerable amount of trade is carried on, however, within the province, in which twenty fairs are held every year. The trade with China is chiefly in cattle, hides, wool, and felt, imported ; and cottons and other manu- factured goods, exported.

Semipalatinsk, the capital of the above province, on the right bank of the Irtysh, and on the highway from Central Asia to Omsk, 481 miles south-east of that city. It carries on a considerable trade, especially with the Kirghiz, and has one flour-mill, one distillery, and several tanneries. It has also a Ubrary and museum, two gymnasia, for boys and girls, and

schools for the Kirghiz. Steamers ply on the Irtysh to Omsk and Lake Zaisan. Population (1881), 17,820; (1897),

26,353.

Semiryechensk, a province of Russian Turke- stan, bounded on the N. by Semipalatinsk, on the E. and S. by the Chinese provinces of Chuguchak, Kulja, Aksu, and Kashgar, and on the W. by the Russian provinces of Fer- gana, Syr-Daria, and AkmoUnsk, with an area of 152,280 square miles. Its chmate is thoroughly continental In the Balkhash Steppes the winter is very cold ; the lake freezes every year, and the thermometer falls to 13 F. In the Alakul Steppes the winds blow away the snow. The passage from winter to spring is very rapid, and the prairies are rapidly covered with vegetation, which, how- ever, is soon dried up by the sun. The average tempera- tures are : at Vyemyi (2430 feet high), for the year 46 F., for January 17 , for July 74 ; at Prjevalsk (altitude 5800 feet), for the year 44 , for January 23 , for July 63 ; still higher in the mountains, at Naryn (altitude 6640 feet) the average temperatures are only, for the year 37 , for January 1 , for July 64 . The yearly rainfall at these three places is 21 ‘6, 16‘0, and 11 ‘8 inches respectively. The population, which was estimated at 671,880 in 1891, in 1897 was found to be 990,107 (domiciled only), of whom 458,744 were women, and 59,659 lived in towns. Kirghiz formed 76 per cent, of the population, Taranchis 7 per cent., Russians 14 per cent., and Dungans most of the remainder. Of the Russians, 26,500 were Cossacks, about 15,000 were numbered in the military forces’ serving in the province, and 53,110 were peasants and artisans in towns. The province is divided into 6 districts, the chief towns of which are : Vj-ernyi, capital of the province (22,982), Jarkent (16,i372), Kopal (2842), Pishpek (6622), Prjevalsk (7987), which has superseded Tokmak, and Sergiopol (1044). The standard of education is low; in 1899 there were only 82 primary schools, attended by 8817 boys and 2473 girls. The chief occupa- tion of the Russians, the Taranchis, and the Dungans, and partly also of the Kirghiz, is agriculture. In an average year the crops yield about 137,500 cwt. of wheat, 47,500 cwt. of barley, 103,750 CArt. of oats, 61,250' cwt. of millet, 3075 cwt. of rice, and 5250 cwt. of potatoes a supply which more

than satisfies the needs of the population. A variety of oil-bearing plants and

green fodder, as also hemp, flax, poppies, &c., are grown. Cattle-breeding is very extensively carried on by the Kirghiz, there being in 1899, 755,000 horses, 425,000 horned cattle, 4,274,000 sheep, 100,000 camels, 282,000 goats, and 15,000 pigs. Orchards and fruit gardens are well developed; the Crown maintains two model gardens. Bee culture is also widely spread, nearly 6700 cwt. of honey being obtained every year. Hunting in the mountains still retains its importance. The factories consist of a few flour -mills, distilleries, tanneries, and tobacco works ; but a great variety of domestic trades, including carpet-weaving and the making of felt goods, saddlery, and iron goods, are carried on, both among the settled inhabitants and the nomad Kirghiz. Exports to China are valued at about 2,600,000 roubles annually, imports at a little over 1,000,000 roubles.

Semmelweiss, Ig^natius Philippus

(1818-1865), Hungarian physician, was bom at Buda 17th July 1818, and was educated at the universities of Pest and Vienna. At first he intended to study law, but soon abandoned it for medicine ; and such was his promise that, even as an undergraduate, he attracted the attention of men like Skoda and Eokitansky. He graduated M.D. at Vienna 4th April 1844, and in the following June was appointed assistant professor in the maternity department, under Professor Klein. In Klein's time the deaths in this department became portentous, the ratio being rarely under 5 '03 and sometimes exceeding 7 45 per cent. Between October 1841 and May 1843, of 5139 parturient women 829 died; giving the terrible death-rate of 16 percent., not counting those of patients transferred to other wards. It was observed that this rate of mortality pre- vailed in the students' clinic ; in the midwives' clinic it ruled much lower. Mothers, finding themselves in that dreaded quarter, would fall on their knees and pray to be allowed to return to their homes. Profoundly moved by pity and sorrow, Semmelweiss found no satisfactory ex- planations in such causes as

overcrowding, fear, mysterious atmospheric influences, or even contaminated wards ; yet that the cause lay in some local conditions he felt cer- tain. The patients would die in rows, others escaping; and women delivered before arrival, or prematurely, would escape. At last, he tells us, the death of a colleague from a dissection wound. " unveiled to my mind an identity " with the fatal puerperal cases. The students often came to the lying-in wards from the dissecting-room, their hands cleansed with soap and water only. In May 1847 Semmelweiss prescribed ablutions with chlorinated lime water : in that month the mortality stood at 12 '24 per cent. ; before the end of the year it had fallen to 3 '04, and in the second year to 1'27; thus even surpassing the results in the midwives' clinic. Skoda and other eminent physicians were convinced by these results {Zeit- schrift d. h. k. Gesellschaft der Aerzte in Wien, J. vi. B. i. p. 107). Klein, however, apparently blinded by jealousy and vanity, supported by other reactionary teachers, and aided by the disasters which then befell the Hungarian nation, drove Semmelweiss from Vienna, and silenced him. Fortunately, at Pest Semmelweiss was appointed obstetric physician in the maternity department, then as terribly afflicted as Klein's clinic had been; and during his six years' tenure of office he succeeded, by antiseptic methods, in reducing the mortality to 0'85 per cent. Semmelweiss was slow and reluctant as an author, or no doubt his opinions would have obtained an earlier vogue ; moreover, he was not only tender-hearted but also irascible, impatient, and tactless. Thus it cannot be said that the stupidity or malignity of his opponents was wholly to blame

for the tragical issue of the conflict which brought this man of genius within the gates of an asylum 20th July 1865. Strange to say, he brought with him into this retreat a dissection wound of the right hand ; and on the 1 7th of the following August he died of the very disease for the relief of which he had sacrificed health, fortune, and even life itself. For the relations in the order of discovery of Semmelweiss to Lister the reader is referred to the article on Lister (vol. xxx.). A brief biography of Semmelweiss by Dr Duka was published at Hertford (Austin and Sons) in 1892. (t. c. a.)

Sena.a,r. See Sudan ; Anglo-Egyptian.

Seneca. Falls, a village of Seneca county. New York, U.S.A. It is situated in 42 55′ N. and 76 45′ W., on the river Seneca, and the New York Central and Hudson Eiver and the Lehigh Valley railways, at an altitude of 463 feet. The falls in the river, from which the village derives its name, are 50 feet in height and furnish ample water-power, which has been put to use in the manufacture of woollen goods, machinery, and other articles. Population (1890), 6116; (1900), 6519, of whom 801 were foreign-bom.

Senegal, a river of West Africa, entering the Atlantic in 16 N. after a course of about 1000 miles. Explorations have improved our knowledge of the source- region of the river, showing that the Bafing, its chief upper branch, rises in 10 28′ N., 12 5′ W., and is joined in about 11 10′ N. by the Tene, formerly supposed to be the headstream of the Faleme. A little south of 12 the Bafing is a large stream 250 yards wide, and is here separated from the sources of the Faleme by a line of hUls 2600 feet high, which send to the latter river four important streams rising in about 12 N. The rise of the Lower Senegal is due to the rains in this source-region, the flood water passing down the Faleme more quickly than down the Bafing ovdng to its shorter course. From July to October the level of the Senegal shows a series of fluctua- tions, with, however, a; general increase till the end of August or beginning of September, when the maximum occurs. Boats drawing from 1 foot to 2 feet 6 inches can ascend to Kayes from the beginning of June to the middle of November ; steamers drawing 4 feet 3 inches, from July to October inclusive ; and ocean steamers, lightened so as to draw 11-13 feet, during August and September.

Senegfal, a French colony in West Africa, situated between the Gambia on the S., the French Sudan on the E., and the Sahara on the N. It covers about 80,000 square miles and presents no prominent orographic feature. The coast is low and bordered with sandhills. The only important river is the Senegal, which is formed by the confluence at Bafulabe of the Bafing and the Bakhu, the former rising in Futa Jallon, belonging to French Guinea, and the latter .in French Sudan. It passes, vtdthin the government of Senegal, the towns of Bakel, Matam, Sald6, Podor, and St

Louis ; near Bakel it receives the Faleme, which flows from south to north.

Senegal is placed under the immediate authority of the governor-general of West Africa, and comprises : (1) four communes with full communal powers (St Louis, Dakar, Goree, and Kufisque), containing a population of about 39,000; (2) nine circles, or territories administered directly, with a population of 61,000; (3) twenty-two countries on the middle and lower river, under the immediate protectorate of France, with about a million inhabitants ; (4) autonom- ous countries north of the Senegal, under the political protectorate (the Moorish tribes Trarza, Brakna, and Duaish), with a population of 80,000. To these districts have to be added the western portion of the Sudan, now in

administrative connexion with Senegal, wliich has an area of about 120,000 square miles and a population exceeding 2,000,000. Senegal produces, above alj, oil-seeds, castor, earth-nut, sesame, and cocoa-nut. The earth-nut, since 1888, has yielded about 30,000 tons a year. Millet, maize, and rice occupy about two-thirds of the cultivated land. On the Lower Senegal there are a model farm and a nursery. Worthy of mention among the products of the country are acacia gum, which the Moors gather in the northern region ; the kola-nut ; and especially caoutchouc, which is collected in increasing quantities (350 tons in 1898) in the outlying district of Casamance, which projects between Portuguese Guinea and British Gambia. The herds tend to increase : in 1898 there were about 90,000 cattle, 50,000 sheep, 40,000 goats, 3000 camels, besides asses and horses. Gold, iron, quicksilver, and copper are found. Industry is not organized, but the natives carry on weaving, pottery, brickmaking, and the manufacture of trinkets. The total trade, which in 1882 amounted to the value of ??1,920,000 sterling, and in 1889 to ??2,400,000, had faUen in 1898 to ??1,840,000, but by the year 1900 had increased to ??3,182,000. The imports from France consisted of tissues and clothing (??120,000), rice (??76,000), wines (??74,000),

implements, sugar, hides, and toys ; the exports to France were chiefly earth- nuts (??340,000), gums (??160,000), caoutchouc, and feathers. The vessels entered and cleared, with cargo only, at Dakar, Kufisque, and Goree, exceed 100,000 tons annually. Dakar is fortified and classed among the supports of the French navy. Goree is also fortified. Communication along the coast from Dakar to St Louis (160 miles) is by a railway constructed between 1882 and 1885. Inland, there is a river service from St Louis to Podor (3 days), extended in the rainy season as far as Kayar in the Sudan (6 days). Dakar is in regular communication with Marseilles (10 days) and Bordeaux (8 days). The chief towns in French Senegal are : St Louis, the capital, with 20,173 inhabitants, Bakel (3000), Dakar (1200), Goree (2000), and Kufisque (8000).

Seneka,!. See Oeange Rivee Colony.

Senendij. See Kurdistan.

SenuSSi. ??? Mohammad El-Mahdi (born in the Cyren- aica 1847, died in Kanem near Lake Chad 1902), son of Es-Seyyid Mohammad Es-Senussi, was a pious Moslem sheikh of North Africa, whose career has been rendered especially remarkable owing to the exaggerated importance attached to his spiritual and secular influence by certain French writers of the past generation. At one time it used to be seriously stated that he flourished as a veiled and awful Moslem pontiff away in the craggy fortress of Siwa, in the oasis of Jupiter Ammon ; that he was at the head of a large army, and possessed arsenals filled with unlimited supplies of modern guns and ammunition ; that his emissaries, with their secret passwords of the " Rose," were intriguing throughout Turkey as well as in India ; and that the day might come when, declaring himself the true Mahdi, or forerunner guided by Allah, he might raise all North Africa against Christianity. These legends of phantom armies, arsonals, and emissaries have come to nought, and there is no proof of gigantic combinations of Islam under his leadership against Great Britain or France. His father, Seyyid Mohammad, of Oran, escaping from the French during the war in Algeria, went to Mecca, and eventually settled in the province of Benghazi, where he built his white hermitage, the

Zdwia Baid^. Here, in 1847, a son was born, whom he called El-Mahdi {i.e., "He who is led by Allah "), a name not uncommon among the Arabs of North Africa, held both by individuals and

families, and meaning nothing more than many names from the Old Testament which are bestowed on Christian children. In 1853 Seyyid removed to Jaghbub (a small oasis some 30 miles west of the Egyptian town of Siwa), where he died in 1857, leaving the young Mahdi to the care of his friends, Amran, Reefi, and others. The peculiarity of the position lay in this : throughout Islam, in every town may be found a Shereef or noble, a Seyyid or lord, claiming descent from the Prophet and recognized as a local leader of society. Senussi El-Mahdi in the desert had no followers ; greater lords than he hved in Algeria, and even in Benghazi itseK he was of small account. His spiritual influence was, therefore, confined to the camel- men of the caravans across the Sahara, who slowly spread his reputation for quietism and holiness along the string of oases, Ojila-Jalo, Kufra, Borku, into Wadai and Kanem, and continued his work as a reviver of Islam in the central Sudan states. For more than forty years he lived in seclusion at Jaghbub, loyal to the sultan and keeping free from intrigues ; but in 1889 he was visited by the pasha of Benghazi at the head of some troops, an incident which showed Senussi that he was no longer safe from intrusion. In 1894 he abandoned North Africa and removed to Borku, and thence to Wadai, where he was welcomed with veneration. The great fact which stands to the credit of Senussi is connected with Wadai, when, in 1888, he urged its sultan to oppose the march westwards of the Mahdi's followers from Elartum. He himself scornfully rejected the Mahdi's overtures, showing the same nobihty and sound statesmanship as his fellow shereefs, Abu Fatma and Mirghani, in the eastern Sudan. Whatever was seriously known of Senussi was to his advantage ; and just as Wah- habi-ism implies aggressive fanaticism, so does Senussi's name suggest a policy of peace, quietism, and loyalty to constituted authority. Thus, if during the last years of his life he may have enjoyed any shght influence over the wild negro races beyond the Sahara, that influence was for good, in the form of piety and wise counsel. In Egypt he had no followers, nor was there ever a question of his intriguing against the British occupation. In like manner, it is important to understand that the so-called sect of

Senussiyeh, if genuine disciples of Senussi, can in no way be hostile to any civilizing mission of trade and prosperity in Nigeria. Senussi was the victim of much slander during his lifetime ; and it may be discovered ??? later, when falsehood and exaggeration shall have ceased, that he really tried to live up to his birth-name of El-!Mahdi, the servant of Allah, by leaving the savage Beduin and Sudanese, among whom his lot was thrown, a little better for his presence among them. (d. a. o.)

Seoni, a town and district of British India, in the Jubbulpore division of the Central Provinces. The town is 2043 feet above the sea, half-way on the road between Nagpur and Jubbulpore. Population (1891), 11,976. The district of Sboni is part of the Satpura tableland, containing the headwaters of the Wainganga. It is still largely covered with forest, and 42 per cent, of the in- habitants belong to aboriginal tribes. Area, 3198 square miles. Population (1891), 370,767; (1901), 327,217, showing a decrease of 12 per cent., due to the effects of famine. The density in 1901 was 102 persons to the square mile. The land revenue is Rs.l, 64,000, the inci- dence of assessment being less than two annas per acre ; cultivated area (1897-98), 574,339 acres, of which 19,268 were irrigated from tanks ; number of police, 285 ; boys at school (1896-97), 3489, being 12-5 per cent, of the male population of school-going age; death-rate (1897), 65-92 per thousand. The principal crops are wheat, rice, millet, pulse, and oil-seeds.

There is another town called Seoni in the Central Provinces, a railway station in Hoshangabad district, situated in 22 ?? 28′ N. and 77 ?? 29′ N. Population

(1891), 6779.

SepsiSZentg^Org^, a corporate town of south- eastern Hungary, chief place of the county of Hdromaz6k, 20 miles from Brasa<5, with 5753 inhabitants in 1891, and 7131 in 1901. It has a normal school, a Calvinist upper gymnasium, a female industrial school, a " Sz^kely " national

museum, an orphanage and asylum, a textile factory, &c. In its vicinity are many medicinal baths, the most important being that of Elopatak.

Serai ng, a town of Belgium, in the province, and 5 miles south-west of the city, of Li^ge by rail It has acquired a European reputation on account of its vast iron- works (Society Cockerill) and manufactories, in which more than 10,000 hands are employed. Population

(1890), 33,495; (1900), 37,845.

Serajevo, or Bosnia Seeai, the capital of the province of Bosnia, in Austria-Hungary, and the seat of a Roman Catholic bishopric, situated in a narrow valley ❓❓❓closed on the east by a semicircle of rugged hills❓❓❓on the river Miliatchka, and on the Bosnia Railway, 167 miles south of Bosnisch-Brod and 111 north-north-east of Metkovic. A great part of the town has been rebuilt in the European fashion, and extensive drainage works have been carried out. A telephone service was introduced in 1899. The chief public buildings are the Husref Bey mosque, dating from the 16th century; the Catholic cathedral (1889) ; the hmah, or official residence of the governor; the town-hall (1895); the bezesten, or market- hall; the museum, containing specially fine antiquarian and natural history collections ; the castle, on a rocky eminence commanding a magnificent view of the town and neighbourhood ; the Roman Catholic seminary ; the school- masters' college ; the hospital ; and the " association " buildings (1898), with a large hall for public entertain- ments. The town is famous for its native industries in metals. There are also large potteries, and silk- weaving is carried on. A brewery produces about 900,000 gallons annually. The Government tobacco factory has a large output, and employs over 2000 workpeople. At the mineral baths of Ilidze, near the town, a hydropathic establishment was opened in 1899. Population (1885),

26,268; (1895), 37,713.

Serampur, a town of British India, in the Hooghly district of Bengal, on the right bank of the river Hooghly, opposite Barrackpur ; station on the East Indian Railway, 12 miles from Howrah. Population (1881), 25,559; (1891), 35,952. Formerly a Danish settlement, it was sold to the British in

1845. It was the home of the Baptist mission founded by Carey. A jute mill, with 354 looms and 7260 spindles, employs 2700 hands. Paper is manu- factured. There is a public library. The famous Baptist mission press has been transferred to Calcutta, but a training college is still maintained by the mission.

Serapion. See Saceamentaet of Sbrapion.

Serdobsk, a district town of Russia, in the govern- ment, and 129 miles north-west of the town, of Saratoff, on a branch of the railway from Ryazan to the Urals. It has trade in grain and flour, of both of which over 32,000 tons are exported every year. Population (1897), 12,721.

Sere 11 Ai a town of Chile, capital of the province of Coquimbo and of the department of Serena, 9 miles east- north-east of Coquimbo, on the Pacific. Population (estimated), 17,230. It has a court of appeal, with juris- diction in the provinces of Atacama and Coquimbo, and

is the residence of a bishop. It has a large hospital, an orphan asylum, lazaretto, and poorhouse.

S►►reS| Sekeos, or SiEos, chief town of a sanjak in the vilayet of Macedonia, European Turkey, situated on Lake Talhino, an expansion of the Strouma, in one of the most fertile districts of the empire, 43 mUes north-east of Salonica. It consists of the old town, Varoch, situated at the foot and on the slope of the hiU crowned by the old castle, and of the new town built in the European fashion on the plain, and forming the commercial centre. The town is the main entrep6t of the Turkish cotton trade, and has also manufactures of cloth and carpets. There is a large trade in rice and cereals, and the other exports include tobacco and hides. Population, 30,000, of whom about half are Bulgarians (one-third of them being Mussulmans), nearly one-fourth Greeks, about one-seventh Turks, and the remainder Jews.

Serghinsk, Upper a^^d Lower, two towns

of East Russia, in the government of Perm, 43 miles west- south-west of Ekaterinburg. They are noted for their important iron-works, which deal

with the production of as many as eighteen mines. Uppee Seeghinsk, which had a population of 8000 in 1897, yields annually over 8050 tons of pig iron and 12,100 tons of steeL Lower Seeghinsk, with 14,000 inhabitants, yields about 7250 tons of pig iron and 14,500 tons of steel. The latter is well built, has a monument to Alexander II., and is well provided with schools. Mineral waters (sulphurous) are found close by.

Serg'ipe, a state of Brazil, for the most part situated between 9 5' and 11 28' S. and 36 17' and 38 7' W. Area, 15,000 square miles. Population in 1872, 176,243, and in 1890, 461,307; but in 1900 it was estimated at less than 400,000, of whom three-fourths were negroes and haU-castes. Europeans numbered only 500 to 600. The capital, Aracajii, has 20,000 inhabitants (1900). Amongst other towns are Estancia, Itabaiana, Lagarto, Larangeiras, Maroim, S. Christovao, Capella. Sugar, cotton, manioc, maize, tobacco, beans, and indiarubber are the crops chiefly growii. The exports (two-thirds sugar) were valued at 454,000 in 1900, and the imports (by sea) at 353,000. There is a railway extending north from Aracajii as far as CapeUa, and west as far as Simao Diaz.

Serpa Pinto, Alexandre Alberto de

la ROCha (1846), Portuguese explorer, was bom

at the castle of Polchras, on the Douro, 10th April 1846. After accompanying his father to America, he was sent in 1858 to the military school at Lisbon. Entering the army in 1864, he served in the colony of Mozambique, and being promoted major was given the command of an important expedition into South Africa. Starting from Benguela on the 12th November 1877, he explored the basins of the Kwando and Zambesi, and followed the latter river to Victoria Falls, and then went southwards to Shoshong, Pretoria, and Durban, 1879. He was thus the fourth, explorer who traversed the African continent from west to east, and was rewarded in 1881 with the large gold medal of the Geographical Society of Paris. The account of his travels appeared in English under the title How I Crossed Africa, 2 vols., London, 1881. In 1884 he attempted, with less success, the exploration of the regions between the Mozambique and

Lake Nyasa. Appointed governor of Mozambique in 1889, he endeavoured to bring the Matabele territory under the jurisdiction of Portugal, but his Government, finding that it could not support his pretensions against the veto of Great Britain, yielded to the ultimatum of 12th January 1890, and recalled him.

Serrano y Doming^uez, Francisco,

DUKE DE LA ToEEE A2<^D COUNT OP SaN AnTONIO

(1810-1885), Spanish marshal and statesman, was born in the island of Leon at Cadiz 17th December 1810. His father was a general officer and a Liberal. Serrano began his studies at Vergara in the Basque provinces, became a cadet in 1822, cornet in 1833 in the lancers of Sagunto, passed into the carabineers in 1829, and when the Carlist agitation began in 1833 he exchanged into the cuirassiers. He formed part of the escort which accom- panied Don Carlos, the iirst pretender and brother of Ferdinand VIL, to the frontier of Portugal. As aide-de- camp of Espoz y Mina, then under the orders of Generals Cordoba and Espartero, in the armies of Queen Isabella, Serrano took such an active part in the Carlist war from 1834 to 1839 that he rose from the rank of captain to that of brigadier-general. His services obtained for him the Cross of San Fernando and many medals. In 1839 he was elected a member of Cortes for the first time by Malaga, and in 1840 he was made a general of division and com- mander of the district of Valencia, which he relinquished to take his seat in congress. From that day Serrano became one of the chief military politicians of Spain. In 1841 he helped Espartero to overthrow the regency of Queen Christina; in 1843 at Barcelona he made a pro- nunciamiento against Espartero ; he became minister of war in the Lopez Cabinet, which convoked the Cortes that declared Queen Isabella of age at fifteen, served in the same capacity in an Olozaga cabinet, sulked as long as the Moderados were in office, was made a senator in 1845, captain-general of Granada in 1848, and from 1848 to 1853 lived quite apart from politics on his Andalusian estates or travelling

abroad. He assisted Marshal O'Donnell in the military movements of 1854 and 1856, and was his staunch follower for twelve years. O'Donnell made him marshal in 1856 and captain-general of Cuba from 1859 to 1862; and Serrano not only governed that island with success, and did good service in the war in Santo Domingo, but he was the first viceroy who advocated political and financial reforms in the colony. On his return to Spain, he was made duke de la Torre, grandee of the first-class, and minister of foreign afiairs by O'Donnell. Serrano gallantly exposed his life to help O'Donnell quell the formidable insurrection of 22nd June 1866 at Madrid, and was re- warded with the Golden Fleece. At the death of O'Donnell, he became the chief of the Union Liberal, and as president of the senate he assisted Bios Eosas to draw up a petition to Queen Isabella against her Moderado ministers, for which both were exiled. Nothing daunted, Serrano began to conspire with the duke of Montpensier, Prim, and Sagasta ; and on 7th July 1868 Gonzalez Bravo had Serrano and other generals arrested and taken to the Canary Isles. There Serrano remained until Admiral Topete sent a steamer to bring him to Cadiz on 18th September of the same year. On landing he signed the manifesto of the revolution with Prim, Topete, Sagasta, Martos, and others, and accepted the command of the revolutionary army, with which he routed the troops of Queen Isabella under the orders of the marquis of Novaliches at the bridge of Alcolea. The queen fled to France, and Serrano, having entered Madrid, formed a Provisional Government, con-voked the Cortes Constituyentes in February 1869, and was appointed successively president of the executive and regent. He acted very impartially as a ruler, respecting the liberty of action of the Cortes and cabinets, and bowing to their selection of Amadeus of Savoy, though he would have preferred Montpensier. As soon as Amadeus reached Madrid, after the death of Prim, Serrano consented to form a coalition Cabinet, but it kept together only a few months. Serrano resigned, and took the command of the

Italian king's army against the Carlists in North Spain. He tried to form one more cabinet under King Amadeus, but again resigned when that monarch declined to give his ministers dictatorial powers and sent for Ruiz ZoriUa, whose mistakes led to the abdication of Amadeus on 11th February 1873. Serrano would have nothing to do with the federal

republic, and even conspired with other generals and politicians to overthrow it on 23rd April 1873; but having failed, he had to go to France until General Pa via, on the eve of his coup d'etat of 3rd January 1874, sent for him to take the head of affairs. Serrano assumed once more the title of president of the executive ; tried first a coalition Cabinet, in which Martos and Sagasta soon quarrelled, then formed a Cabinet presided over by Sagasta, which, however, proved unable to cope with the military and political agitation that brought about the restoration of the Bourbons by another pronunciamiento at the end of December 1874. During the eleven months he remained in ofiice Serrano devoted his attention chiefly to the re- organization of finance, the renewal of relations with American and European powers, and the suppression of revolt. T^ter the Restoration Serrano spent some time in France, returned to Madrid in 1876, attended palace receptions, took his seat as a marshal in the senate, coquetted a little with Sagasta in 1881, and finally gave his open support to the formation of a dynastic Left with a democratic programme defended by his own nephew. General Lopez Dominguez. He died in Madrid 26th November 1885, twenty-four hours after Alphonso XII. (a. e. h.)

Servia, an independent kingdom in the Balkan

Peninsula, lying between Austria – Hungary on the N. (from which empire it is divided by the rivers Sava and Danube), the Turkish province Kossovo and a part of Macedonia on the S., Bosnia on the W., and Bulgaria on the E. Previous to the Treaty of Berlin (1878) it was an autonomous principality, vassal to the sultan of Turkey ; after that treaty it became an independent principality, and was proclaimed a kingdom in 1883. According to the measurements and computation of the Servian General Staff, the area of Servia is 4,858,940 hectares (or 18,782 square miles). Of this area, 3,418,768 hectares, or 70'36 per cent, of the total area, are considered as productive, and 1,440,172, or 29-64 per cent, as unpro- ductive. In 1897 there were 1,805,935 hectares under actual cultivation. The forests (mostly oak and beech) occupied in that year 481,214 hectares.

Population. ❓❓❓Official censuses were taken in the years 1884, 1890, 1895, and 1900, giving the following results :❓❓❓

Male. Female. Total.

1884 . . . 972,973 928,763 1,901,736

1890 . . . 1,109,885 1,052,076 2,161,961

1895 . . . 1,186,594 1,125,890 2,312,484

1900 . . . 1,282,625 1,211,145 2,493,770 ???

At the date last quoted the rural population numbered 2,035,364, or 81 '6 per cent, of the total, and the urban population 458,406, or 18-4 per cent, of the whole. The population increased from the beginning of 1885 to the end of 1900 by 592,034 inhabitants, which gives an annual increase of 1"83 per cent.

The number of foreigners, or inhabitants belonging to other nationalities, was found to be 206,017 in 1890 and 229,002 in 1895. Their number therefore increased by 11 -6 per cent, in the period 1890-95. In the last-named year Jews numbered 5048, Germans 6451, Gypsies 46,212, Rumanians CWallachians) 160,187. There were then only 14 Englishmen settled in Servia. According to religion there were in 1895 : Orthodox (Eastern Church) 2,281,018, Mahommedans 14,414, Roman Catholics 10,410, Jews 5102, Pro- testants 1002. For the period of ten years from 1881 to 1890 (inclusive), for every 1000 inhabitants there were born annually, on an average, 44'10 boys and 43'93 girls. For the same period the number of deaths among every 1000 inhabitants was annually, on an average, 25 '15 males and 24'89 females, which figures give

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an average of 50 per 1000 inhabitants. From the year 1885 to 1891 the average surplus of the births over the deaths was 18 '15 per 1000 inhabitants. During the five years 1893-98 the annual average surplus of

births over deaths amounted to 16 per 1000. In the year 1900 the birth-rate was 42 per 1000, the death-rate 23 ‘3 per 1000, and the marriage-rate 12 ‘5 per 1000, of the population. Although Servia is one of the most thinly populated countries in Europe, having only 133 inhabitants to the square mile, the density of its population is greater than in the other Balkan States.

Education. ❓❓❓ Education is free, the teachers and pro- fessors being paid either by the municipalities or the State. Government gives numerous bursaries to poor but gifted students in the middle and higher schools, and also to young men who have distinguished themselves in the higher schools and wish to complete their education by study at foreign universities. Attendance at elementary schools is compulsory for boys and girls from their seventh to their twelfth year, but in the villages, with their scattered houses and sparse population, it has been found impossible to insist on the strict execution of the law. In 1899 there were over 1100 elementary schools in Servia, giving one school to every 2270 inhabitants. Girls and boys in the villages go to the same school, but in towns they have separate schools. About 85,000 children are enrolled at the commencement of every school year. Besides the elementary schools, there are some 30 middle schools, mostly gymnasia with more or less classical instruction. There are also several special schools : 1 theological, 2 training schools for teachers, 2 commercial, 1 agricultural, 1 for viniculture, and 2 for weavers. There is an excellent military academy in Belgrade. The highest scientific instruction is given in the so-called Velika Shkola (” the Great School “) at Belgrade, which is practically a university with 463 students in 1899, but only three faculties : law, philosophy, technical science. In 1899 a Eoyal Commission was appointed to propose the ways and indicate the means by which the Belgrade Velika Shkola might be transformed into a regular university on the German model. At the census of 1895 it was found that there were 268,759 males and 52,4-3 females who could read and write. Deducting the number of children up to the sixth year from the rest of the population, only 280”5 men and 58‘3 women per 1000 inhabitants could read and write. It has been found that the present system of education furnishes only candidates for em- ployment in the State and municipal services, and barristers and solicitors. As the opportunity for employment

in these services is limited, every year a considerable number of young men are without occupation; therefore the Government, since 1897, has been trying to render the system of education less classical and more practical.

Church. ❓❓❓ The Servian Church belongs to the group of the Eastern Orthodox (Greek) Churches, but is otherwise independent and self-governing. The highest Church authority is the Bishops' CouncU or Synod, presided over by the Metropolitan of Servia. There are altogether five dioceses or bishoprics : Belgrade, Schabatz, Nish, Zicha, and Timok. The Archbishop of Belgrade is the Metro- politan of Servia. There are 48 monasteries in Servia, of which Studenitza, built in the 13th, and Manassiya, built in the 15th century, are by far the most interesting.

Finance. ❓❓❓ Up to the proclamation of independence, in virtue of the Berhn Treaty (1878), Servian finances were in a somewhat primitive, but, on the whole, healthy condition. The principal revenues were derived from the customs, excise, and a sort of poll tax. The Government required the town and village communities to pay into the State Treasury 30 dinars per head of the able-bodied citizens' living in the community, and the municipal board made repartition of the total amount, due to the Govern- ment, from its citizens according to their estimated wealth

or earnings. That system yielded without the slighteist diffi- culty about ❓❓750,000 annually. The State revenue from all sources was in 1879 19,780,929 dinars (❓❓791,235), while the expenditure did not exceed 20,206,410 dinars (❓❓808,256). But among the conditions on which the Congress of Berlin granted independence and accession of territory to Servia, were that she should construct her part of the international railway to Constantinople and to Salonica, and pay the Turkish landowners an indemnity for the estates which had been taken from them and divided among their old tenants. This and the necessity of indemnifying the people from whom, during the wars with Turkey (1876 and 1878), requisitions had been taken and money borrowed, forced the Government to enter the European financial markets. Up to that time (1881) Servia had practically no public foreign debt, although it owed Eussia about 6 million dinars lent privately for war preparations, and to

its own people about 8 million dinars taken by a forced internal loan for war purposes. The first public loans were made in 1881 by French banks at 7 If for 5 per cent, bonds, and the ex- penditure had to be immediately increased to 31 million dinars. The introduction of new taxes and the reorgan- ization of the financial administration of the country could not keep pace with the increase of public expendi- ture, chiefly because the National Assembly was for some time reluctant to replace the old system of direct taxation by a more modern system. When in 1884 the new law of taxation was adopted, it failed to realize the expectation of largely increased revenue, because the financial admin- istration could not be speedily reorganized. The situation became so serious that the three principal banks ❖❖❖ the Imperial Ottoman Bank of Paris, the BerUner Handels- Gesellschaft of Berlin, and the Landerbank of Vienna ❖❖❖ which were financing the Servian loans on the Continental markets, thought it necessary to consult with the Govern- ment about the best means to place the finances on a healthy basis. The result of the conferences (held in Carlsbad in June 1895) was the adoption of a new scheme by which the Government gave to the bondholders ad- ditional securities and two seats on the Board of Adminis- tration of Revenues, the bondholders at the same time accepting the new 4 per cent. Unified Bonds in exchange for their old 5 per cent, bonds. Since this conversion operation, the finances have rapidly improved.

Very few countries have to show such a rapid increase of State expenditure and revenue as Servia during the last 20 years of the 19th century, as will be seen from the following table : ❖❖❖

1871.

1881.

1891.

1900.

Expenditure . Eevenue .

550,132 520,448

* *

945,647 829,785

* *

2,290,450 2,332,069

* *

2,931,060 2,934,340

The king's civil list amounts to ??48,000. The expenditure on national education rose from ??58,522 in 1871 to ??183,863 in 1899. The expenditure on the sanitary service increased from ??3730 to ??63,597 in 1899. The military expenditure rose from ??147,372 in 1871 to ??800,000 in 1900. The interest on the national debt, which in 1881 did not exceed ??375,000, rose gradually every year, untU in 1900 it amounted to ??808,000.

On the 31st December 1899 the National Debt amounted to a total of 420,295,000 dinars (??16,812,000), and was composed of the following items : ???

Dinars.

29,445,000

9,600,000

351,250,000

30,000,000

Bank of Servia

2 per cent. Premium Loan, 1881 Tobacco Lottery bonds, 1888

4 per cent. Unified (Conversion) Loan, 1895

5 per cent. Railway Exploitation Loan, 1899 Besides this, the Government owes the National ??400,000, which temporary loan is to be repaid in instalments of 1,000,000 dinars a year.

Defence, ??? There are no modern fortresses, the citadels of Belgrade, Smederevo, Nish, and Pirot being mediseval

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constructions. But some strategic points on the Bulgarian frontier were between 1889 and 1899 fortified by earth- works. Servia's defensive force comprises the standing army and the national army. The former consists of 60 battalions, divided into 5 divisions, every man between 20 and 25 being obliged to serve in the barracks for 2 years (reduced to 1^ year by law of 1st February 1901). The national army consists of two classes : the first class is composed of men between 30 and 40 who have served in the standing army, and the second class is formed of men between 40 and 47 years of age. The first class of the national army gives 60 and the second 40 battalions. In the time of peace there are not more than 20,000 men of the standing army serving with the colours. On the war footing Servian forces consist of some 160 battalions of infantry, 6 regiments of cavalry, and 120 batteries of 6 field guns each. In 1899 the Government ordered 120,000 Mauser magazine rifles from Germany.

Agriculture. ??? Servia is essentially an agricultural and cattle-producing country. Nearly 90 per cent, of the whole population are occupied in agricultural pursuits. The characteristic feature of the country is the almost utter lack of large farms, the arable land being divided in small holdings, not exceeding, on an average, 20 acres. The small holdings are in themselves a hindrance to modem agricultural progress, inasmuch as small farmers are not in a position to buy the latest and most improved implements. But there is an additional impediment in

the fact that generally the lots of ground belonging to one household or family do not lie together, but are dispersed in ditferent, very often distant, parts of the village land. From ancient times the Servians have had a special institution called "Zadruga," which is an association of all the near and distant members of the same family into one co-operative organization under one chief (generally the oldest or otherwise most experienced member of the family). Usually all the members of the Zadruga lived jvithin the same en- closure, in small wooden houses built around the central house inhabited by the "stareshina" (chief). Under the direction of the stareshina all the members of the association used to work together, the products of their joint labour belonging to the whole Zadruga and not to the individual members. Zadrugas were very prosperous, as they had always a sufficient number of hands at command, and were able to obtain better implements and cattle. But with the establishment of order and security, the Zadrugas began rapidly to disappear, and at the end of the 19th century very few remained. Of course this breaking up involved still greater parcelling of the ground. During the five years 1894-99 a new stimulus was given to agriculture by the encouragement which King Alexander personally extended to the establishment of agricultural associations, or rural co-operative associations on the Eaiffeisen principles. The object of these associations is principally to facili- tate the acquisition of improved implements and better breeds of cattle. In 1899 there were 187 such associations. Another serious drawback to the economic position is that Servia has no seaboard, and that it is at some distance from the nearest export harbours (Galatz, Salonioa, Fiume). Still, agriculture made unmistakable progress, especially during the last ten years of the 19th century. The following tables, compiled from official statistics and showing in hectares (hectare = 2 '47 acres) the area under cultivation, wiU give confirmation to this statement : ???

1867.

1889.

1897.

Maize "Wheat Meadows . "Vineyards . Orchards .

340,606

254,722 32,855 56,011

302,700

319,820

358,164

43,304

59,461

448,334

600,321

355,051

68,330

97,971

The following two tables will give an idea of the prosperity of Servia as an agricultural country : ???

1890.

1896.

Number of households (families) .

348,257

375,196

Number of households possessed of

landed property ....

257,280

300,275

Number of households without landed

property

90,977

74,921

Number of households which possessed

cattle

267,466

284,065

Hectares under cultivation .

1,140,088

1,805,935

Live Stock.

1890.

1900.

Horses .... Oxen and cows . Sheep .... Pigs .... Goats ....

Beehives ....

163,391 819,251 2,963,904 908,603 502,738

124,600

180,871 942,087 3,013,644 940,609 425,565

1896. 167,765

The live stock of Servia represented the following value in dinars in the years specified : ???

1890.

1895.

Dinars.

Dinars.

Horses .

12,285,608

24,610,174

Cattle .

61,015,365

78,434,045

Buffaloes

1,453,690

395,272

Pigs . .

10,105,698

14,497,018

Sheep .

20,374,668

19,467,912

Goats .

3,466,213

2,925,602

Beehives Total value .

794,310

1,763,764

109,495,552

142,093,787

Commerce. ??? *The movement of Servian commerce mil be seen from the following table, compiled from official statistics, values being given :* ???

Year.

Imports.

Exports.

1879 . 1889 .

1899 .

1900 .

??

1,652,680 1,393,720 1,857,144 2,161,100

1,555,240 1,562,240 2,629,775 2,661,000

*Of the total imports, fully 59 per cent, come from Austria- Hungary, 12i per cent, from Great Britain, and lOi per cent, from Germany. The principal articles of import are : cotton and linen textiles (****388,996 in 1899), wool and wooUen textiles (****181,104), iron, copper, brass manufactures (****201,094), sugar, coffee (****136,749). The direct import of cotton yam and textile from Great Britain does not exceed ****110,000 per annum. Of the total exports, about 85 per cent, go to Austria-Hungary. There is no direct export to Great Britain, but it is generally believed that some of the Servian wheat and maize, exported down the Danube to Galatz, finds its way to England, as well as that prunes, which are exported to Germany, find buyers in London. The exports consist principally (42 per cent.) of agricultural produce and live stock, the value in 1899 being ****1,177,043, of which ****658,466 was for cereals, chiefly wheat and maize, and ****447,912 was for prunes. Next in point of value come hides (****126,291), bacon, cordage, copper and other metals.*

*Mailways. *** In 1879 Servia possessed no railway. In 1881 it began the construction of its part of the great line connecting central and western Europe with Constantinople and Salonica, and finished it in 1886. In 1899 Servia had 332 miles of raOways belonging to the nation and worked by the Government. For the construction of these railways she expended ****4,206,080, and an extra amount of ****566,480 for rolling-stock. The total receipts from the railway traffic in 1898 were ****247,705, while the total exiienditure amounted to ****162,863, giving a net revenue of ****84,842 ; in 1900 the gross receipts amounted to ****255,900. For the con- struction of a network of 600 miles of light railways connecting all parts of the country with the principal (international) line, Belgrade Nish, the Government granted in 1899 a concession to an English syndicate. One of the aims of this railway progi-amme was to connect the Servian railways on one side with the Bosnian network (and through that with Dalmatia and the Adriatic), and on the other side with the Rumanian railways, and through them with the*

Russian. A convention between Rumania and Servia concerning the building of a railway bridge across the Danube, connecting the two systems, was signed in 1898.

Banks. ***In 1879 Servia had only three joint-stock banks. In 1883 the National Bank of the Kingdom of Servia was created, with a nominal capital of ****400,000 (of which ****200,000 has been paid up), with power to increase it to ****800,000, and with a privilege of issuing notes secured by at least 33 per cent, in cash (gold and silver). The annual turn-over of the National Bank reached ****10,000,000 in 1898. In the beginning of December 1899 the*

*bank had notes in circulation to the value of ****1,440,000, covered by ****700,000 in gold and silver. Besides the National Bank, 72 small local joint-stock banks have been created in the period between 1880 and 1899. The total paid-up capital of the three banks exist- ing in 1879 did not exceed together ****72,000, whereas the total paid- up capital of the banks existing in 1899 reached the amount of ****800,000. In addition to this, about ****300,000 has been invested in a tew industrial enterprises since 1890. The total annual turn- over of the three banks existing in 1879 did not exceed ****1,400,000, whereas the total of the annual business of the 75 banks existing in 1898 amounted to ****65,665,000.*

History.

The kingdom of Servia is only one part of the territory inhabited by the Servians, the other parts being northern and north-western parts of Macedonia, the Turkish province of Kossovo, Bosnia, Herze- govina, Montenegro, Dalmatia, Croatia, Syrmia, and the Hungarian districts between the river Tisza and the Danube. Servia lost its independence in 1462, and became a Turkish vilayet under the direct rule of Turkish pashas. Servia remained a Turkish pashalik until the rising under Tzrni

*Gyorgy^, otherwise Kara-Gyorgy^ (Black George) in 1804, who succeeded in driving away the Turks and in organizing self-government. This partial independence, however, was completely lost, and Servia was reconquered by the Turks, when Russia concluded with the Porte the Peace of Bucharest in 1812 ******. without making sufficient provision for the safety of its Ob – ^^^y Servia. Voyvode (military chieftain) Milosh Obre- Icb't"' novich, who remained in the country after Kara-George " * and other voyvodes left Servia, headed a new national rising against the Turks on Palm Sunday 1815. By victories in the field and by clever negotiations Milosh succeeded in obtaining from the Sultan Mahmud II. the grant of internal autonomy as early as in 1820. This important result, obtained by the Servians without any foreign support, was placed on an international foundation by Russia in the Treaty of Adrianople, 1829. When in 1839 Prince Milosh Obrenovich I. , and (after the death of his elder son, Milan Obreno- vich II.) in 1842 his younger son. Prince Michael Obrenovich III., were obliged to leave the country, the Servians elected Alexander Karageorgevich (the younger son of Kara-George) to be prince of Servia. But in 1859 he was dethroned by the National Assembly, and the old Milosh Obrenovich I. recalled. It is a noteworthy fact that Milosh as early as in 1836 made efforts to enter into political and commercial relations with England. One of the causes of his dethronement in 1839 was his attempt to obtain British support against Russia's encroachments in the internal affairs of Servia. Prince Michael Obrenovich III. (whose wife. Princess Julia, nie Countess Hunyady, spent in 1863 and 1864 a considerable time in London on a political mission) also appealed to England when he grew impatient of the Russian treatment of Servian in- nilan IV. ^.g;.gg^g_ g***t Prince Milan Obrenovich IV., who suc- ceeded to the Servian throne (on the assassination of his cousin, Prince Michael, by the partisans of the Kara-George dynasty, 10th June 1868), was educated in the political school favourable to Russia, and faithfully and unhesitatingly followed the Russian lead up to the conclusion of the San Stefano preliminary treaty. By that treaty Russia, desiring to create a great Bulgaria, took within its limits districts inhabited by Servians, and considered by the Servian politicians and patriots as the natural and legitimate in- heritance of their nation. This act of Russia created H^I'tloBs gjgg^t dissatisfaction in Servia, and became the starting- P , ~~point for a new departure in Servian~~*

~~politics. At the “ f ”” Berlin Congress the Servian plenipotentiary, M. Ristich, in vain appealed to the Russian representatives to assist Servia to obtain better terras. The Russians themselves advised him to appeal to Austria and to try to obtain her support. The utter neglect of the Servian interests by Russia at San Stefano, and her evident inability at the Berlin Congress to do anything for Servia, determined Prince Milan to change the traditional])olicy of his country, and instead of continuing to seek support from, and to follow exclusively, Russia, he tried to come to an understand~~ ing with Austria-Hungary concerning the conditions under which that Power would give its support to Servian interests. This new departure was considered by the Russians ??? especially by those of the Panslavonic party??? almost as an apostasy, and it was decided to oppose King Milan and his supporters, the Progressives.*

The political history of Servia from 1879 to the abdication of King Milan on 3rd March 1889 was an uninterrupted struggle between King Milan and the Progressives on one side, and Russia with her adherents, the Servian Radicals, on the other. In that incessant .struggle King Milan and his Government The Pro- ^^^^.^ i^g^^jy handicapped by several unfortunate circum- gnsslve stances. To fulfil the engagements accepted in Berlin regime. ^^^ ¯^ conditions under which independence had been granted to Servia, railways had to be constructed within a certain time, and the Government had also to pay to the Turkish landlords in

the newly-acquired districts an equitable indemnity for their estates, which were divided among the peasants. These objects could not be attained without borrowing a considerable amount of money in the European markets. To pay regularly the interest on the contracted loans the Government of King Milan had to undertake the unpopular task of reforming the entire financial system of the country and of increasing. the taxation. The expenditure increased more rapidly than the revenue. Deficits appeared, which had to be covered temporarily by new loans, and which forced the Government to establish monopolies on salt, tobacco, matches, mineral oils, &c. Every such step increased the unpopularity of the Government and strengthened the Opposition. An attempt on the life of King Milan was made in 1882, and an insurrection in the south-eastern districts was started in 1883. But the majority of the people, and

especially the regular army, remained loyal to the king, and the revolt was quickly suppressed. Then, unfortunately, the union of Bulgaria and Eastern Rumelia inspired King Milan and his Government vrith the notion that either that union must be prevented, or that Servia should obtain some territorial compensation, so that the balance of power in the Balkan Peninsula might be maintained, w.. / This view, which did not find support anywhere outside g^/-^,;. Servia, led to the war between Servia and Bulgaria (November 1885), in which the Servians were defeated at Slivnitza and had to abandon Pirot, whilst the farther advance of the Bulgarian army on Nish was stopped by the intervention of Austria-Hungary. An honourable peace was concluded between the two contending Powers in March 1885. AU these misfortunes, however, failed to upset King Milan and his Government. Then came the unhappy events connected with Milan's domestic trouble and his divorce from Queen Natalie. That domestic misfortune was cleverly exploited by King Milan's enemies in the country and abroad, and did him more harm than all other political mistakes together. He tried to retrieve his position in the country, and succeeded in a great measure, by granting ^ very liberal Constitution (Dec- jp i__ ember 1888) at a time when all agitation for a ^^^ j^ig^ander Constitution had been given up. Then, to the great astonishment of the Servians and of his Russian enemies. King Milan voluntarily abdicated, placing the Government of the country in the hands of a regency during the minority of his only son Alexander, whom he proclaimed king of Servia on 6th March

1889.

*The leading man of the regency was Yovan Ristich, a man of great experience and ability, who had already been regent during the minority of King Milan (1868-71). Although he had been since 1868 the leader of the Liberal party, he showed himself, as regent, extremely Conservative. The new Constitution was the embodiment of Radical principles, and the numerically strongest party in the country was Radical. The _ * National Assembly was composed, therefore, almost ex- * " clusively of Radicals, and the Government was Radical likewise. From the very beginning the Conservative regency and the Radical Government distrusted each other. The Government was not strong enough to resist the clamour of their*

numerous partisans for partici- pation in the spoils of party warfare. Political passions, which had been stirred up by the long struggle against King Milan's Progressive regime, could not be allayed so quickly ; and as the anarchical ele- ment of the Radical party obtained the ascendancy over the more cultured and more moderate members, all sorts of political excesses were committed. The old system of borrowing money to cover the yearly deficits was continued, and the budget of expenditure went on increasing from year to year. The administration lost aU authority, and was demoralized by the precariousness of the position of the officials, who might be transferred or even dismissed at any moment at the instance of local politicians. The police also became paralysed and brigandage became rife. It was evident that the country was financially and politically in a worse plight than before. The Radical Government thought to strengthen their position by letting the National Assembly vote a law prohibiting the return of the king's father to Servia, and expelling by force from Belgrade the king's mother. Queen Natalie. But such laws and such acts only embittered political passions and gi-eatly encouraged the adherents of Prince Peter Karageorgevich, who, having married the eldest daughter of Prince Nicholas of Montenegro and living at Cettigne, was supposed to enjoy the support of Russia. The political situa- tion became still more confused when on the death of the third regent, General Kosta Protich, the Government tried to force the regency to accept in his stead M. Pashioh, the leader of the Radical party. The regents thereupon dismissed the Radical Cabinet and called the Liberals to the Government (August 1892). The Liberal Cabinet dissolved the Radical National Assembly, and at the general elections used very great pressure to secure a Liberal majority. In this they did not succeed, and the situation became hopelessly entangled by the fact that the National Assembly was Radical, the Government Liberal, and the regency practically in all its tendencies Conservative. The legislative machinery as well as the administration of the country was thus completely paralysed. Then the young king Alexander, who was supposed to be occupied

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exclusively with his studies and to take no interest in the political turmoil, suddenly stepped in, proclaimed himself of age (although at that time only in his seventeenth year), dismissed the regents and the Liberal Cabinet, and formed his first Cabinet from among the moderate Radicals (13th April 1893).

*The moderate Radicals quickly showed themselves unable to do any serious work. They were fettered by the dissatisfaction of the _ ???, Left wing of their own party. To satisfy the extreme Ad In7^- * K^dicals they had to impeach the members of the last tration *' Cabinet. This increased the bitterness of the Liberals, who, though not so numerous as the Radicals, included in their ranks more men of wealth and culture. Political passions were again in full blaze. The licentiousness of the press knew no bounds, and the king's parents and the king himself were constantly attacked. The anti-dynastic party raised its head again, and in many Radical prints the expulsion of the reigning dynasty and its replacement by the Karageorgevich were more than hinted at. At the same time reports were reaching King Alexander that Russia was discussing with tlie leaders of the extreme Radicals the con- ditions under which a Russian grand-duke was to be proclaimed king of Servia. In such circumstances King Alexander thought best to invite his father the ex-King Milan (who was Kving in Paris) to his side, and to use his great*

knowledge of men and his political experience. In the beginning of January 1894 King MUan arrived in Belgrade. The Radical Cabinet resigned and was replaced by a Cabinet composed of politicians standing outside the political parties. In June the Radical Constitution of 1888 was suspended, and in its place the Liberal (so-called, but in reality very Conservative) Constitution of 1869 was re-established.

Under that Constitution it became possible for the Government to infuse new confidence into the administration, and at the general election to obtain a majority of Conservative members in the National Assembly. The nation was evidently tired of the violent agitations of recent years. A natural reaction against the Radical excesses set in, and gave rise to Conservative, even somewhat reactionary, legislation. The duration of the legislature was extended from three to five years ; the liberty of the press was curtailed by the enactment that proprietors of political papers must make a deposit of 5000 dinars (►►200), and that the editors must have completed their studies at a university ; the laws on Use-majesU were made more severe. After the advent of the Cabinet of Dr Vladan Georgevich (October 1897) persistent and successful efforts were made to im- prove the country's financial and economic condition. The violent party strife which from 1880 to 1895 had absorbed the best energies of the country and paralysed every serious and productive work, ceased almost completely, and the nation as a whole turned to im- prove its agriculture and commerce. The sustained improvement in the political and commercial situation was not influenced materially by the temporary excitement in consequence of the attempt on the life of King Milan (6th July 1899), and of the State trial of several prominent Radicals accused of having conspired for the overthrow of the dynasty. One remarkable feature in the foreign policy of Servia iu the last years of the 19th century was that after King Milan was appointed commander-in-chief of the Servian regular army (December 1897), Russia and Montenegi'o practically, although not formally, broke olf their diplomatic relations with Servia, while at the same time the relations of that country with Austria- Hungary ►►►. .- became more friendly than under the Radical regime. "►►►" , AH this was suddenly and radically changed when in "" rrl^ July 1900 Bang Alexander married Mme Draga Maschin, ►►► once lady-in-waiting to his mother Queen Natalie. He*

threw himself into the arras of Russia, forbade his father Milan to return to Servia, and followed faithfully Russian guidance in all questions of foreign policy. To strengthen his position in the country he gave a sufficiently liberal Constitution in April 1901, establishing for the first time in the history of Servia a Parliament with two Houses (Skupshtina and Senate).

LlTEEATTTEE.

It cannot be said that in the last quarter of the 19th century the Servian nation produced either a great poet or a great artist. But when it is remembered that in the first quarter of that century Servians were only oppressed Turkish rayahs, absorbed in desperate attempts to obtain the simplest conditions for safety of life and property, it must be admitted that their intellectual activity towards the end of the 19th century is at least note- worthy. In Servia the centre of all scientific efl'orts in his- torical and archajological researches in the period from 1844 to 1883 was the Srpsko Ucheno Drushtvo (Servian Learned Society), Belgrade, with its periodical Glasnik. This society, which ren- dered valuable services by its collection of historical documents, has been merged into a new and more ambitious organization called The Royal Servian Academy, established in 1883 and reorganized in 1894. The essays and papers read before the Academy are

published in its periodical Glas {The Voice), while historical and archaeological materials are printed in another annual, the Spomenik (Memoir). Among the Servian Academicians, since the death of Dr Joseph Pancic (who was the first president of the Academy and was well known throughout Europe for his botanical researches in the Balkan Peninsula), M. Stoyan Novakovich took a prominent place by his philological and historical researches, and especially by his classical edition of, and learned commentaries on, the ZaTconik Tsara Dushana (the Code of Tsar Dushan). Besides M. Novakovich, as historians within the last quarter of the 19th century the following desei"ve mention : Panta Sretkovich (for his Istoriya Scpskoga Naroda, 3 vols.) ; Chedomil Miyatovich {Studies m, Old Servian Oommerce and Finances, Gyuragy Brankovich, The Fall of Constantinople), Stoyan Boshkovich {Servia

wnder Tsar Dushan), Lyuba Yovanovich and Lyuba Kovacevich, whose History of the Servian People has been adopted as the standard book for the higher schools. Serious scientific work has been done by two young academicians, Dr Yovan Zuyovich {Geology of Servia) smA Dr M. Tzviyich {Geographical Researches, Caverns of Servia). The Servians have the reputation of being a poetical nation. Their national ballads ??? recited by men to the accompaniment of the monotonous sourdine of the gusle (a primitive instrument in which the cords are made of horse-tail hairs) ??? and the lyric impromptus, sung generally by peasant women, have been admired all over the world. Goethe himself translated one or two of the lyric songs into German ; and Bowring gave a translation into English, as early as 1828, while in more recent times Owen Meredith freely translated several of them. The national ballads concerning the great battle of Kossovo (15th June 1389), when the Servian inde- pendent kingdom was supposed to have been lost, have been trans- lated into English by Mme Miyatovich (London, 1881). The Servian Government bought the copyright of the classical col- lection of national ballads and songs made by Vuk Stefanovich Karadjich, the father of modern Servian literature, and between 1887 and 1895 published a popular edition of them. Among the modern Servian poets the first place belongs to the prince- bishop of Montenegro, Petar Petrovich Nyegush (d. 1851) with his poem "Gorsky Viyenatz" ("The Mountain's Wreath"), in which the sufferings and heroism of the Montenegrins were sung. Perhaps the best and most melodious lyrical poet is Branko Radieevich (d. 1853) ; but he is certainly surpassed in depth of thought and versatility of subjects, if not in purity of language and music of rhythm, by Dr Yovan Yovanovich, called "Zmay" (the "Dragon") whose 50 years' jubilee as poet and author was solemnly celebrated by the Servians in 1899. Other poets whom their countrymen hold in high esteem are : Dr Laza Kostich, Gyura Yakshich, Aberdar, Vladimir Vassich, Vladimir Yovano- vich, and especially Voislav FUch. Prince Nicholas of Monte- negro has beeu one of the most popular poets among the Servians during the last quarter of the 19th century.

The Servians have as yet had no great novelist, but have had several excellent writers of short stories. Among them the first place belongs to Dr Laza Lazarevich, several of whose stories have been translated into

foreign languages. Yanko Vesselinovich is well known as a writer of stories depicting Servian peasant life. In the same line, M. Vukicevich has also distinguished himself. M. Miyatovich has written some historical novels, which were well received {Ikoniya, the Vizir's Mother, Eayko of Rassina, &c.). But by far the most popular novelist among Servians is M. Stephen Srematz, whose works, Ivkova Slava and Fop Spira i Fop Tyira, have won for him amongst his countrymen the title of " the Servian Dickens." In dramatic literature the Servians have been more prolific. This is probably to be ascribed to the fact that a National Theatre, subventioned by the State, has existed at Belgrade for many years. The two best tragedies in the Servian language are con- sidered to be Meyreemah, by Mathiya Ban, and Maxim Tzmoyemch, by Dr Laza Kostich, the translator into Servian of Shakespeare's Romeo and Juliet. The patriotic drama Balkanska Tsaritsa, by Prince Nicholas of Montenegro, has been often played in the Servian theatres, but critics deny to it much dramatic value. The most successful and most productive of modern Servian dramatic authors has been M. Milosh Tsvetich, formerly one of the prin- cipal actors at the Belgrade National Theatre. His drama Stephen Nemanya and his tragedy Theodor of Stalac are ranked among the best Servian dramatic productions.

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(c. Ml.)

Servo -Bulgrarian War of 1885 ??? The

Berlin Congress of 1878, by its revision of the Treaty of San Stephano, created two States in the Balkan Penin- sula ??? the principality of Bulgaria owning a nominal suzerainty to Turkey, and the autonomous province of Eastern KumeUa, presided over by a Turkish governor-general, and apparently intended to remain in close relations with the Porte. Such a settlement, failing to satisfy the conditions, racial or geographical, and being specially distasteful to Russia, could not be expected to secure permanence. National forces, encouraged for a time by Russian influence, quickly brought about a move- ment in favour of a united Bulgaria, which culminated in September 1885 in a revolution at Philippopolis. Prince Alexander of Bulgaria, recognizing that the movement was irresistible and that unless directed by authority it might degenerate into anarchy and civil war, placed himself at its head, and, proceeding to the Rumelian capital, for- mally accepted the government of the united Bulgarian states. The standing army of Bulgaria, organized and commanded by Russian officers since the war of 1877-78, consisted of 9 squadrons of cavalry, 12 field batteries of 4 guns, and 8 infantry regiments of 3 battalions, with a reserve, on the German system, filling up the cadres to war strength and forming additional units. When fully mobilized the field army numbered about 55,000 men. The Rumelian forces, organized on a militia basis, con- sisted of 2 squadrons of cavalry, 1 field battery of 4 guns, and 12 battalions, on a peace footing, supplemented by an equal number on mobilization. The total strength amounted to about 35,000 men. Previous to the war, three battalions of Macedonian volunteers and a number of Mahommedans were added to the armed strength at the disposal of Prince Alexander. In the Bulgarian army the whole of the staff and superior officers, as well as about half the regimental captains, were Russians. When the mobilization of the Bulgarian and Rumelian forces was decreed by the Prince, the whole of the Russian officers were at once withdrawn, and the heavy task of creating a staff and selecting young officers for all the superior commands had to be undertaken. As it was assumed that the sultan would intervene to reassert his claim by force of arms, the Bulgaro-Rumelian forces were concentrated as rapidly as possible near the Turkish frontier, the main body between Tirnovo and Jamboli, 4000 men at Philip- popolis,

and a brigade near Kiistendil, facing Macedonia. The railway bridge at Mustapha Pacha was destroyed. Prince Alexander, however, had taken the step of acknow- ledging the sultan's suzerainty ; and the Turks, who had no troops ready to act, gave no sign. A conference of ambassadors met at Constantinople to adjust a situation which was widely misunderstood. The Bulgarians had no intention of submitting to a mandate from the con- ference not backed by adequate military force, and Turkey was not inclined to begin a war which would probably cause a revolt in Macedonia and might end by rendering Russian influence paramount in Bulgaria. While the conference vainly deliberated, and Great Britain (in 1878 the main supporter of the separation of the two Bulgarias) proved now favourable to their union, the Gordian knot was cut by the announcement that Servia, seeking com- pensation for the aggrandizement of Bulgaria, had con- stituted herself the champion of the Treaty of Berlin.

In the latter half of October a concentration of the Servian army on the frontier began, and small Bulgarian forces were moved to Kiistendil, Tsaribrod, and Trn. On 14th November, after some minor violations of Bulgarian territory had occurred, King Milan declared war. It was now necessary for the young Bulgarian army, with its newly-appointed staff and superior oiBcers, to counter-march to the west, followed by the Rumelian militia. The Servian army consisted of five divisions, with about 10,000

reserves, making a total of at least 70, 000 men. One division was intended to act against Widdin, the rest to converge upon Sofia. A rapid succession of Servian victories were announced ; but the Bulgarian troops, about 4500 strong, showed great tenacity and fell back slowly from the frontier. The invaders occupied the Dragoman Pass on 16th November, and Bresnik two days later. The whole question now was whether Prince Alexander would be able to concentrate enough force to stem the invasion at Slivnitza, the only defensible position astride of the Tsaribrod-Sofia road. The position, which was about three miles long, was roughly fortified, the right resting upon the mountains and the weak left being strengthened by lines of trenches bent back. On 17th Novem- ber the Servians made their first attack against the Bulgarian right and

centre, and were repulsed all along the line. Prince Alexander was reinforced in the evening by four Bulgarian battalions and one Rumelian battalion, the latter being sent on from Sofia, two men on each horse of a cavalry regiment. On the morning of 18th November the Servians unsuccessfully attacked the left ilank, which was manned by the newly-arrived troops, and later they made a half-hearted advance against the centre. On the following day news arrived that the Servian right column was advancing on Sofia from Bresnik, and Prince Alexander hurried back to the capital to prepare for its defence. The danger was averted by three Bulgarian battalions, which had moved on the evening of the 18th from the left flank of the Slivnitza position in the direction of Bresnik, drove back the Servians, and followed them towards Trn. The prince returned to Slivnitza to find his army every- where victorious and advancing towards the frontier. On the 22nd the Servians were attacked in front of the Dragoman Pass, which they evacuated, and on the 25th Prince Alexander at Tsaribrod received from King Milan a proposal for an armistice, which was not accepted. The Bulgarian main body, of about 30,000 men, followed by about 15,000, now moved across the frontier towards Pirot, which was occupied on the 26th. On the 27th the Servians attacked, and the Bulgarians evacuated the town ; but Prince Alexander, now reinforced by 9000 men, drove the Servians from their positions on the surrounding hills, and was preparing to pursue their shattered forces, when, on the morning of the 28th, the Austrian minister at Belgrade arrived at head- quarters and hostilities ceased. The intervention of Austria saved the Servian army, which was greatly demoralized, and was now threatened by the united Bulgarian force of nearly 55,000 men. On the same day the Servians were repulsed with heavy loss in an attack on "Widdin, and would have been routed if the hands of the Bulgarians had not been effectually tied.

A more absolutely unjustifiable war than that begun by King Milan can hardly be conceived ; but the Bulgarians, though completely victorious, were not permitted to reap the fruits of their success. Their young army, with its improvised staff and newly-appointed field officers, dis- played admirable fighting qualities, and the Rumelian mUitiamen proved themselves to be excellent soldiers. The victory was, however, mainly due to the personal influence, the strenuous exertions, and the sound military

judgment of Prince Alexander ; and the brief but decisive campaign set the seal to Bulgarian unity. (g. s. c.)

Sestri Ponente, a town of the province of Genoa, Liguria, Italy, 4 miles west of Genoa, on the coast of the Gulf of that name. It has important shipbuilding yards and iron-works, with factories for macaroni, matches, and tobacco, tanneries, and saw-miUs, and, in the vicinity, alabaster quarries. The parish church has frescoes by Ansaldo and others. There is a music school. The town is a seaside resort. Population (1881), 10,686; (1899), about 11,000.

Settle, a market-town in the Skipton parliamentary division of Yorkshire, England, on the Ribble, 14 miles north-west of Skipton by rail. The town stands at the foot of the steep limestone rock called Castleberg Cliff, and in the neighbourhood is Victoria Cave, where bones of extinct animals were found. There are an institute, assembljfc rooms, and a Victoria hall, cotton factories and a tannery. Area of tovraship, 4490 acres. Population

(1891), 2253; (1901), 2302.

Setubai, a city of Portugal, district Lisbon, on the right bank of the river Sado, 3 mUes above its mouth and 19 miles south-east of Lisbon. It is the third port of the

kingdom, one of the constituents of the port of Lisbon, and the f oiirth largest town ; and an important fishing-station, with some thirty sardine-curing factories. It also makes lace, carries on boat-building, and has factories of fish guano. There is a school of industrial design, and a lyceum. In 1899 the port was entered and cleared by 1161 vessels, of 247,095 tons. In 1898 Setubal possessed 468 fishing-boats, which employed 2131 men and boys ; and the fish caught was valued at ❓❓41,550 (❓❓90,900 in the com- bined ports of Setubal, Cezimbra, Sines, and Villa Nova de Milfontes). Marble and porphyry occur in the vicinity. Population (1890), 17,581 ; (1900), 21,819.

Sevenoa.kS, a market-town in the Sevenoaks par- liamentary division of Kent, England, 22 miles south of London by rail. The neighbourhood contains many country residences. There is an orphanage and a public recreation ground. Knole Park, with its fine trees, is a popular resort. Area, 3273 acres. Population (1881),

6296; (1901), 8103.

Seville, a province of Spain, divided into 13 dis- tricts and 100 parishes. Population, 506,812 in 1887, and 547,020 in 1897. Birth-rate, 3-77 per cent. ; death- rate, 3 '40 per cent. ; proportion of illegitimate births, 7 '26 per cent. Area, 5429 square miles. Few provinces in Spain have so many railway lines as Seville. After a couple of centuries of decay, the industries increased con- siderably in the last quarter of the 19th century. The State foundries and manufactures of small-arms, shells, and gunpowder are important and conducted by royal artillery staifs. There are also iron and bronze works, tanneries, breweries, oil and flour-miUs, distilleries, manufactures of soap, porcelain, hardware, cotton, linen, wooUen, silk stuff's. The exports are valued at ??1,000,000 annually, mostly going to England, France, and America. The coasting trade was represented in 1898 by 1700 vessels entered, with 155,500 tons, and 1600 cleared, with 140,000.

More than 2 J millions of acres are well cultivated, and some few districts well irrigated. In 1897 391,830 acres produced wheat, 285,735 acres rye, oats, barley, and maize, 82,038 acres pod fruit, 26,000 acres wine, 477,202 acres olives. There are 89 mines actually worked (6 of alum, 25 copper, 30 iron-ore, 28 coal), and there are 369 registered unproductive mines. The mines that are worked give employment to 1710 hands, and the output in 1898 was 503 tons of alum, 69,849 of copper, 383,864 of iron-ore, 121,074 of coal, and 75,623 tons of agglomerates.

Seville, capital of the above province, on the Guadal- quivir. Population (1887), 143,182; (1897), 146,205. The township extends over nearly 30,000 acres. The surrounding country is very fertile and produces abund- antly cereals, olive, wine, fruit, and vegetables. Modern embankments have been built on the river, and many other precautions taken by the municipal corporation to prevent floods. Seville is the

terminus of three lines that put it into communication with Madrid, and of other lines to Cadiz, Almorchon, Ciudad Real, Huelva, Badajoz, and Lisbon. Three of these lines have branches down to the water-side on the quays, along which vessels of con- siderable size load and unload. The quay on the left bank is handsome, well paved, 4500 feet long, provided with powerful cranes, and sheds for merchandise. The late duchess of Montpensier gave a part of the grounds of the palace of San Telmo to the municipal corporation, and bequeathed the San Telmo residence to the arch- bishopric under certain conditions. The navigation up the Guadalquivir from its mouth to Seville is less dangerous for steamers than for sailing vessels, but is still uncertain. Nevertheless, Seville is one of the most important ports in Spain. In 1898, 487 sailing vessels, of which 4 were British and 464 Spanish, and 735 steamers, of which 246

were British and 443 Spanish, entered the port of Seville ; and 488 sailing vessek, of which 4 were British and 466 Spanish, and 734 steamers, of which 247 were British and 442 Spanish, cleared. The principal exports in 1898 were iron-ore (381,593 tons, valued at ––157,407), copper pyrites, lead and lead ore, corks, oranges, olives and olive oil, wine, and quicksUver. The exports to England in 1898 were valued at ––862,366, the imports ––162,769; exports to France, ––293,200, and imports ––75,420; the total exports of the port having been ––1,479,529, the imports ––486,606. The principal industries are iron, machinery, tobacco, chocolate, soap, porcelain, beer, liqueurs, brandies, corks, and silk in every shape. The royal artUlery works and foundries are very important. The ceramic, porcelain and coarse ware manufactory in the ancient Carthusian convent in the vega of Triana, on the right bank of the Guadalquivir, is a prosperous industry that employs more than 2000 hands. Equally important is the great tobacco and cigar factory, where 6000 women are employed. At great expense and under careful management, though slowly, repairs of importance have had to be undertaken in the noble cathedral La Giralda ; many of the columns had to be attended to urgently, as they were showing signs of decay. Seville is divided into 10 districts, subdivided into 35 barrios, with 612 streets, 57 squares. The outer barrios are : Los Humeros, La Macarena, San Roque and La Calzada, San Bernardo, La Cesteria, Carreteria, and Bataldlo, Triana, on the right bank of the Guadalquivir, with 50 streets and 15,000

souls, the favourite abode of the gypsies. Public education has progressed in Seville, which has numerous primary state and private schools, an institute, and the university now installed in the Jesuit college founded in the 16th century. The scientific and literary establishments are important. There is a seminary which was formerly the university of Seville.

Sevres, Deux-, a department of western France, watered by the Sfevre Nantaise and the Sfevre Niortaise.

Area, 2338 square miles. The population, 350,103 in 1881, had decreased to 339,344 in 1901. There were in 1896 895 schools, with 56,000 pupils, the illiterate amounting to 4 per cent, of the population. Out of 1,373,320 acres under cultivation in 1896, 1,047,280 acres were plough-land and 22,230 acres vineyards. The wheat crop of 1899 was valued at ––1,120,000 ; barley, ––120,000 ; oats, ––1,204,000 ; potatoes, ––328,000 ; mangold- wurzel, ––220,000 ; green crop (trefoil, lucerne, and sainfoin), ––383,000 ; hemp, ––14,200 ; vines, ––81,000 ; walnuts, ––16,200. Mining in 1898 turned out 18,418 metric tons of coal, but the department pro- duced only 30 tons of steel. Distillation yielded 552,000 gallons of alcohol. Much also is done in refining sugar and in paper manufacture. Niort, the capital, had in 1901 20,962 inhabitants.

Sewagfe Disposal. ––– The collection of sewage was fully discussed in the earlier article on Sewerage in the 9th edition of this Encyclopaadia ; it remains to con- sider the various methods of dealing with it at the outfall in order to render it innocuous. We must, however, have a clear conception of the composition of the liquid to be dealt with, and also know all the circumstances in which it is delivered at the works. Domestic sewage is the fouled water-supply of a community. The water is brought into the household, and after serving its purpose is discharged into the sewerage system as sewage. The composition of this liquid is now fairly well known, and is generally re- duced for the purposes of comparison to a standard ; that is to say, ordinary sewage is that due to a water-supply of about 30 gallons per head per diem. If the supply is less, and there is no leakage of subsoil water into the drainage system, the sewage will be stronger ; conversely, if there is leakage, &c., the sewage will be more

dilute, but obviously, the quantity of impurities will, for any given population,

SEWAGE DISPOSAL

525

be the same in amount. The subjoined table shows the kind of sewage referred to : ???

Average Domestic Sewage,

in Grains per Gallon.

Total solids In solution.

Organic carbon.

Organic nitrogen.

Am- monia.

OUorine.

Suspended. 1

Mineral.

Organic.

Total.

50-54

3-287

1-543

4-70

7-46

16-92

14-36

13-28

For all practical purposes we may say that average sewage contains two tons of suspended matters in each mUlion gallons, one -half of which is mineral matter. When, however, we come to a consideration of trade waste, the question becomes difficult in the extreme, because of the great variety of trades, and the ever varying quantities added to the sewage. Generalizations are of no value in these cases, and each town must be considered on its merits. We may, however, enumerate some of the principal trade wastes ; these are from dye-works, print-works, bleach-works, chemical works, tanneries, breweries, paper- makers, woollen-works, silk-works, iron-works, and many others. In some cases one only of these trade wastes finds its way to the sewers ; in others, several of them may be found. In some instances, again, these trade wastes are of an alkaline nature, in others they are acid ; the mixtures may be either, and of greatly varying character. Next comes the manner in which sewage is discharged at the works. The flow is variable throughout the entire 24 hours, but in the case of sewers discharging domestic sewage only, such sewage being of the standard strength, it wiU be a close approximation to the facts to say that about two- thirds is discharged between the hours of 7 a.m. and 7 p.m., one-half during during the eight hours of maximum flow, two-fifths during the six hours of maximum flow, and about 7|- per cent, per hour during the two hours of maxi- mum flow. These data will be sufficient for the design of the works intended for dealing ~~with the sewage. Separate calculations must be made if there is trade refuse, or much leakage of subsoil water. In very large systems, again, the maxima are rather less because of the time occupied by the sewage in travelling to the outfall from the more remote parts of the district. Eainfall is generally admitted to the sewers, either wholly or in part. In large cities like London, Glasgow, and many others, one system only is employed for both sewage and rainfall, and it is the best, because of the filthy condition of the street washings where there is much vehicular traffic. In these cases~~

~~*the sewage flow may be increased more than a hundredfold within the space of a few minutes by the occurrence of heavy rainstorms. Of course the sewage disposal works can only deal with a small proportion of such flow, and the balance is discharged into some convenient watercourse, or river, or other suitable place. Even when the separate system is employed, as in the case of the smaller towns, the flow may be increased ten to fifteen times by rain, because it is unusual to carry two sets of drains to the backs of the houses. In designing outfall works, there*~~ *fore, all these circumstances must be carefully considered. Again, when the sewage is pumped, as is frequently the case, the size of the tanks must often be increased, because in the smaller installations the whole of the day's sewage is frequently pumped out in a few hours ; this fact must also be remembered when designing filters.*

Nearly every town upon the coast turns its sewage into the sea ❓❓❓ a very proper course if the conditions are favour- able. That the sea actually has a purifying effect must be obvious to anyone who will take the trouble to follow the sewage after it leaves the outfall. The object to be attained is its dispersion in a large volume of sea-water. As it is lighter than salt water it tends to rise after leaving

the sewer ; the outfall should, therefore, if practicable, terminate in deep water, so that the two liquids may be- come weU mixed. The currents must be studied by means of floats, and in most cases the sewage must be discharged upon the ebb tide only, and then perhaps not throughout the entire period, the object being to prevent it from being carried towards the shore. That the purification is effected mainly by means of living organisms ❓❓❓ with which sea-water teems ❓❓❓ is now well established, and it has been urged by competent authorities that this system is not wasteful, since the organic matter forms the food of the lower organisms, which in turn are devoured by fish. Thus the sea is the richer, if the land is the poorer, by the adoption of this cleanly method of disposal. The next step is the partial purification of the sewage by means of a chemical process. When a town lies some distance up an estuary, as for example London, Glasgow, Kochester, and many others, the dilution may be insufficient to prevent a nuisance, or the suspended matters may be deposited upon the foreshore to be uncovered at low water. The first

stage of purification is then employed, namely, clarification in tanks. There is some scope for good work here, because badly designed tanks may be costly to work, and may not even then give good results. Practice varies with regard to tank capacity, but as a general rule it should be at least equal to half a day's dry weather flow. This will enable the works manager to turn out a good effluent, even in wet weather, when the volume is much increased. With regard to the practical effect of any particular treatment, it is now recognized that the matters in solution are scarcely touched by any chemical process that can be employed, but the removal of the suspended matter is a great gain, as has been proved in the case of London. Briefly, a good chemical process will do about one-half of the work of purification ; and in very many cases it is not necessary to go farther. With regard to the kind of chemical to use, lime, either alone or in conjunction with sulphate of alumina, or with proto-sulphate of iron, is most frequently employed ; and its prolonged use is obviously a case of the survival of the fittest. When the resulting sewage sludge has to be filter-pressed, lime is almost essential for the primary treatment of the sewage, in order to destroy the glutinous nature of the sludge. In the case of large towns like London, Manchester, and Salford, the sludge is shipped in specially designed steamers, of 600 tons to 1000 tons burden, and discharged into the sea at a distance from the coast, experience having proved this to be the most economical course to pursue. In the case of towns situated on rivers above the range of tidal waters, the further purification is effected either on land, or by means of artificial filters, or a combination of the two. The question of land treatment is frequently considered from the standpoint of so many persons to the acre ; but the best method is to ascertain how many gallons per day an acre of land will purify. As the quality of land varies greatly, the proper volume to be applied per acre can only be ascertained after a good deal of experience. The range lies between about 3000 gallons per acre per day in the case of poor land, to about 30,000 gallons in the same period in the case of the best. Let us assume an instance of the latter kind. The works have been designed on a basis of 1000 persons per acre, producing 30,000 gallons of sewage per day; the 'land being of a highly suitable character, and the sewage having been clarified, success is assured. Biit, conversely, through faulty construction of the sewers, the sewage amounts, say, to 60 gallons per head ; the land, unable to deal with the liquid, quickly

becomes water-logged and offensive, and the works are a failure. Precisely the same remarks apply to artificial filters, which are always designed upon the basis of so

many gallons per square yard of filtering material. Many failures of both land and filters have been due to the fact that the actual sewage flow was greatly in excess of the original estimates. We may say that clay soils lie at one end of the scale, and very porous sands or gravels at the other ; obviously, therefore, each case must be considered on its merits. It should be remembered that when such moderate quantities as 3000 gallons per acre per day are applied to land, there is no necessity to remove the suspended matter ; broad irrigation being resorted to, the land readily assimilates the solids, and thus one source of expense may be eliminated.

The artificial filters are now generally called bacteria beds ; although filters have been in constant use in some cases, as for instance at Wimbledon, for a great number of years. The first filters constructed at these works were made in 1876, and were about 7000 yards in extent. With the growth of population additions have been made of at least five times that area. One of the original beds was used for crude sewage, but the mineral matter choked it completely, and experience pointed to the necessity of clarifying the sewage before filtration. Whether the treatment should be in open or in closed tanks, or whether chemicals should be added, is at present much debated ; but seeing that ordinary sewage contains one ton of sus- pended mineral matter in each million gallons, it is clear that if this is not removed before filtration, it will be retained in the filters and ultimately choke them, as happened at Wimbledon. At the present time the common cesspool is being resuscitated and improved under the name of a septic tank. In this the disintegration of the suspended matter is brought about by anaerobic organ- isms, and the liquid in passing slowly through the tank absorbs most of the gases due to the breaking down of the organic matter. There is no oxidation at this stage. The liquid is next passed through artificial filters, of which there are many types. What is known as a “contact” filter was constructed,

jsrobably for the first time on a large scale, at the London (Barking) works. The object sought to be attained was that of making each cubic yard of filtering material perform the same amount of work, and the least expensive way was apparently to close the outlet, and charge the filter with liquid, allowing it to remain in contact for about two hours, and then drawing it off so that the bed could be thoroughly aerated. No doubt a better way would be to distribute the sewage in the form of a shower of liquid, and work the beds continuously, but this involves a good deal of expense for spreading ap- pliances, and a fall is necessary in the works, which is not always obtainable. Probably the most complete installa- tion of the kind last referred to is that at Salford. Iron pipes are led over the surface of the filters, and spraying nozzles are placed at short intervals, so that the sewage is applied in the form of a heavy shower. But whatever form the filters and appliances may assume, the final result is the same. If the beds are properly aerated, the aerobic organism establishes itself in prodigious numbers, and attacks the organic matter, breaking it down into harm- less, soluble, and gaseous products. It is, of course, assumed that the filters are adecjuate in area, and are properly managed. With regard to the materials to he employed in making sewage filters, it is now well estab- lished that the size of the particles has a more important bearing than their composition. At the same time, it may be remarked that materials with very rough surfaces, as for instance coke breeze, are more effective than those with smooth surfaces. Doubtless the former classes afford, in the interstices, a lodging for the bacteria, and no doubt a given quantity of material with rough surfaces will harbour greater numbers than the same amount of smooth.

A reference must be made to the Manchester experi- ments. The experts' report suggested the provision of 60 acres of filters for dealing with the sewage of the city, which is said to average 30 million gallons per day in dry weather. But after inquiry into the merits of the proposal the officials of the Local Government Board recommended that the filters should be 92 acres in extent, and that the effluent should be finished on land. Storm water filters to take the excess after the sewage was diluted six times were also recommended, such filters being designed to pass 500 gallons per square yard per diem. In this case clarified sewage was to be dealt with on filters 3 feet 4 inches in depth, composed of clinkers broken to pass a sieve

with meshes of 1^ inches, but retained on one with meshes of ^ of an inch. It wiU be observed, therefore, that the bacterial treatment of sewage has scarcely as yet emerged from the experimental stage, but it will certainly be adopted in many cases where it is impracticable to obtain good land in sufficient quantity for the purification of the sewage. With regard to the disposal of sewage-sludge in inland towns, untU it has been fairly established by a long trial that bacteria vrill dispose of this material, the reduction of its bulk by means of filter-presses wiU be found to be the most satisfactory method of dealing with it. The practical effect is the conversion of 5 tons of offensive mud into 1 ton of hard cake, which may be readily handled and carted. The cost is usually about 2s. 6d. per ton of cake, and a million gallons of average sewage produce about 8 tons. (s. Ce.)

Sewingf Machines. ??? The machines and stitches described in vol. xxi. p. 719, of the Uncy. Brit, continue in use, and have been supplemented by important inventions for special kinds of work. In sewing carpets the great weights of material make feeding difficult, and therefore machines have been invented that move along the carpet, which itself remains stationary. The earlier forms of this machine were hand-worked. The two lengths of carpet were stretched across the room, and the machine, followed by the operator, who turned it by means of a hand-crank, travelled along the seam. One of these machines was capable of doing the work of eight or ten hand-sewers. The new Singer carpet sevsdng machine is operated by electricity or other power and runs along a track. The carpet is stretched and sewed so rapidly that one power machine does the work of eight or ten hand machines. A machine for quilting and similar operations has been in- vented in which two needles produce parallel rows of stitching. The distance of these may be varied by thirty- seconds, from -^ to 1^ of an inch. As manufactured by the Singer Company, only one rotating hook is employed beneath the feed-plate to pick up the loops of both threads. Shoes are now sewn by machine, and the introduction of shoe sewing machines has revolutionized the shoe industry. Books are stitched by machine, the Brehmer wire sewing machine and Smyth thread sewing machine being prominent representatives. Button-hole sewing machines are another special type on the production of which years of experi- ment have been expended. A fast

hand operative can produce in ordinary sewing fifty stitches a minute. A foot-driven machine can produce one thousand, and a power-driven machine three to four thousand stitches per minute. For a rate of seven hundred stitches per minute about TT^j. horse-power is required.

Nearly three million sewing machines are produced annually, in about 150 factories, two-thirds of which are in Germany and the United States. Between 1880 and 1890 from 500,000 to 600,000 sewing machines were made in the United States. The number of factories decreased 50 per cent, in that period, but the same number

of employes were engaged. The labour cost represents 40 per cent, of the cost of a sewing machine. Over $67,000,000 worth of machines was exported from the United States between 1865 and 1895. At present about 150,000 machines are exported annually. (t. o'c. s.)

Sexta.nta ❓❓❓ For astronomical observations on shore, the sextant mounted on a stand, in skilled hands, gives results which are but little inferior to those derived from the portable transit instrument ; but in high latitudes the value of the sextant for time observations is somewhat diminished. It possesses the great advantage of being always ready for immediate use ; little or no preparation of the ground is necessary, as in the case of the transit instrument. Messrs Troughton and Simm construct the double-frame or pillar form of sextant, while Messrs Gary and Porter adopt the edge-bar principle to secure strength and rigidity of frame. The former is certainly much lighter, but sextants by either maker give equally good results ; and when a stand is used, weight is not of much consequence. Accuracy of graduation, small centring error, and superior workmanship can only be assured by makers of repute, and a first-class instrument is indis- pensable.

Telescopes are of two kinds : the direct, for tlie more ordinary sorts of observations ; and the inverting, for astronomical work, one of the eyepieces of which should be of high magnifying power, not less than 15

diameters. To each eyepiece there are two pairs of wires, each pair perpendicular to the other, and dividing the field of view into nine divisions, of which the central is square. Con- tacts should be made as nearly as possible in the centre of this square. It is convenient if the telescope is fitted with an interrupted thread to screw into the collar of the up and down piece. Shades. ??? Both mirrors are supplied with coloured shades of dift'erent degrees of shade, and may be used either singly or combined for sea observations ; they are subject to errors of refraction, due to non-parallelism of the sides of the glass. Coloured eyepieces of neutral glass of different intensities are fitted to slip on and off the conioally ground surface of the eyepieces of the telescope ; they are used for index error and for observations in the artificial horizon. Introducing no refraction error, they also ensure the suns being of the same brilliancy ; a very important point. The up and down piece, when adjusted to equalize the suns, will bring the axis of the telescope nearly exactly in line with the edge of the silvered surface of the horizon glass, which is the best position for observing, and from this it must never be moved until the equal altitude or other observations are complete. Vernier. ??? An extended vernier, i.e., a vernier whose divisions are twice the distance apart of those on the arc, will be found convenient for accurate observing.

Adjustments. ??? It is essential that the planes of both the index glass and the horizon glass should be perpen- dicular to the plane of the instrument, and they should also be parallel to one another when the vernier is set to zero. The line of coUimation of the telescope must be parallel to the plane of the sextant. This adjustment, though less liable to alter than either of the others, should nevertheless be examined from time to time as follows : ??? With the sextant mounted on a stand, move the index so as to separate the direct' and reflected images of a star by a distance nearly equal to the length of the parallel wires of the telescope, and turn the eyepiece until the direct image of the star coinciding with one extremity of the wire, the reflected image coincides with the other ex- tremity; the wires will then be parallel to the plane of the sextant. Select two bright stars, 120" or more apart, and make a coincidence of the reflected and direct images on the middle of one wire, and then on the middle of the other. If the two readings agree, the adjustment is correct ;

if not, the adjusting screws in the collar of the up and down piece must be moved until the coincidence is exact on both wires.

Centring error is a very important error, and is one that cannot be corrected. It may amount in an indifferent instrument to a quantity sufficient to vitiate the result of

any observations on one side only of the zenith. It arises from the eccentricity of the centres of the index arm and of the arc, and varies with the angle measured, being generally greater as the angle increases ; but the index arm becoming bent, or any part of the frame receiving a blow which alters its shape, the flexure of the instrument from varying temperature, and defective graduation, will all produce errors which it is generally impossible to dis- entangle, and they are all included in the one correction for centring. This correction is found by comjjaring the angle measured by the sextant (corrected for index' error) with the true angle. The most accurate method, because it employs a large number of observations for the same or nearly the same angle, is by observations of pairs of circum-meridian stars in the artificial horizon at various altitudes. Double the difierence between the resulting latitude by each star and the mean latitude vsdll be the centring error for an angle equal to the double altitude of that star, that is, the angle actually measured by the sextant, index error being carefully ascertained and applied before working out. Careful measurement of the angles between stars, compared with their calculated apparent distance, is another method. At Kew Observatory the centring error was determined for certain angles by fixed collimators. Including, as it does, errors from so many causes, the correction does not remain perfectly steady, and it should be ascertained from time to time for any sextant which is to be employed for accurate determination of positions in circumstances which do not permit of the use of methods whereby it as well as other errors are eliminated. In a good sextant the error should not exceed one minute over the whole of the arc.

Sextant Stand. ❓❓❓ For observations on shore the sextant should be mounted on a stand, in order to get the best results. In an im- proved form of stand, the bearing which carries the sextant is square, and the whole

bearing revolving on a centre is controlled by a clamp and tangent screw. The counterpoise weights should exactly balance the sextant, and they may be fitted to slide in and out, thus allowing of adjustment.

Levels. ⁂ A small spirit-level fixed on one of the arms of the sextant stand, and another level pivoting round the pillar on the index bar of the sextant carrying the microscope, working in a plane parallel to that of the instrument, and fixed by means of a set screw, are of great assistance in placing the sextant exactly in the required position when observing faint stars. With the tele- scope pointing to the centre of the artificial horizon, the direct and reflected images of the sun at any convenient altitude are made to coincide. The levels are then adjusted and permanently fixed by their set screws. To observe a faint star, it is only necessary to set its double altitude on the sextant, turn the instrument and the stand to bring the bubbles of their respective levels in the centre of their runs, and move the stand until the telescope points to the centre of the artificial horizon and in the direction of the star, when the direct and reflected images wUl be seen in the field.

Electric Light. ⁂ A small electric light fitted on the arm carrying the microscope, and worked by a dry battery, enables the sextant to be read off at night with facility.

Artificial Horizon. ⁂ The glass in the roof should be of the best quahty, and the faces of each pane accurately parallel. A new form of horizon has been introduced, with the object of diminishing the waves set up in the mercury by vibration. It consists of a shallow rectangular trough of metal gilt. This is amalgamated after getting the surface absolutely clean and free from grease by wetting it with a few drops of dilute sulphuric acid, and rubbing it with a drop of mercury until the whole surface is bright, when a very small quantity of amalgamated mercury added will flow evenly and form a horizontal surface. The dross is wiped off with a broad camel-hair brush. In this shallow trough waves are kUled almost instantaneously. The trough should be thoroughly washed on each occasion before being used.

The horizon is placed upon a stand, consisting of two iron plates, the upper resting on the lower, supported by

three long large-headed screws, by means of wHcli it can be levelled. If the stand is raised off the ground a foot or so, on a firm foundation, thus bringing the artificial horizon closer to the telescope, faint stars are more easily observed, and the movement of the sextant necessary to keep the star in the field, owing to its motion in the heavens, will be lessened. A lantern placed on the ground behind, or a little on one side of, the observer, and faintly showing on the artificial horizon, will sufficiently illuminate the wires of the telescope on a dark night.

(a. m. f.)*

Seychelles, an archipelago in the Indian Ocean, consisting of eighty islands ◆◆◆several of them mere islets ◆◆◆situated between 3◆◆ 38′ and 5◆◆45′ S. and 52◆◆55′ and 53◆◆50′ E. Of these, Mahe is the largest, most central, and has the greatest height above the sea (2998 feet). Only four others are inhabited, namely, Praslin, La Digue, Denis, and Bird. The islands are surrounded by coral reefs ; their soil is most fertile, and the climate, although tropical, is very healthy. Like all the other Indian Ocean islands, the Seychelles have a peculiar fauna, represented by as many as 60 species of plants. The principal exports are cocoa-nut oil, soap, vanilla, tortoise-shell, guano, cocoa- nuts, and cacao. The following statistics show the trade and revenue of the group : ◆◆◆

1884.

1889.

1894.

1900.

Imports Exports

Revenue Expenditure

Es. 4, 28, 605

3,92,175

1,30,047

Rs.5,70,990

6,53,102

2,00,096 1,69,083

Rs. 6,33,061

7,64,080

2,35,410 2,78,470

Rs.9,80,911

10,36,161

3,99,312 2,96,920

Population in 1881, 14,081 (7179 males and 6902 females). 1891, 16,440 (8302 ??? ??? 8138 ???). 1901 (estimated), 20,275.

These, as regards religion, consisted in 1891 of 2636 Protestants and 12,608 Koman Catholics, the rest being probably Hindu. In 1900 there were 27 Government schools with a total average attendance of 2037 children. In addition there are St Louis College, with about 100 pupils, and Victoria School with about 80. The rainfall in 1896 was 11 5-08 inches, considerably above the average fall for the previous five years, which was only 92-83 inches ; since 1896 it has varied between 88‘42 and 110‘75. Temperature, maximum, in shade, 88‘7??; minimum, 74 ‘l”.

Average temperature for year: maximum, shade, 83-0 ; minimum, 76 ‘8 .

Seymour, a city of Jackson county,’ Indiana, U.S.A. It is on the Baltimore and Ohio South-Western, the Southern Indiana, and the Pittsburg, Cincinnati, Chicago, and St Louis railways, in the southern i)art of the state, at an altitude of 607 feet. It contains the machinery works of the Baltimore and Ohio South- Western Eailroad, and has varied manufactures. Population (1890), 5337 ; (1900), 6445, of whom 321 were foreign-born and 204 negroes.

Seymour, Horatio (1810-1886), American statesman, was born at Pompey, N.Y., 31st May 1810. His father was prominent in the Democratic party of the state. The son inherited his principles as well as his wealth, and from 1841, when he was first elected to the legislature, to 1854, when he was elected as governor, gradually rose to a commanding position. On national issues he was Conservative, and supported the administration policy of Pierce and Buchanan. In 1860-61 he strongly advocated compromise to avoid secession ; but when war developed, he as strongly supported the maintenance of the Union. He remained, however, a Democratic partisan, and vigorously opposed the Administration’s policy in

respect to emancipation, military arrests, and conscription. In 1862 he was again elected governor of New York. His conduct in dealing with the great Draft Kiots of July 1863. drew on him vehement but ill-founded charges of weakness and incompetence. In 1868 the Democratic Convention, while he was its presiding officer, and despite his peremptory refusal, pressed upon him the nomination for President. He reluctantly withdrew his refusal, but in the campaign was overwhelmingly defeated. After- wards, though frequently urged to enter public life, he lived in retirement on his estate near Utica, where he died 12th February 1886.

Seyne-SUr-Mer, La, town, arrondissement of Toulon, department of Var, France, 4 miles south-west of Toulon by rail. The shipbuilding yard now covers nearly 40 acres, has ten slips available for the building of large ships, and vsdth the connected forges gives employ- ment to about 4500 persons. Population (1891), 8836;

(1901), 21,002.

Sgambati, Giovanni (1843), distin- guished Italian composer, was born in Eome, 28th May 1843, of an Italian father and an English mother. His early education took place at Trevi, in Umbria, and there he wrote some Church music, and obtained experience as a singer and conductor. In 1860 he settled in Rome, and definitely took up the work of vdnning acceptance for the best German music, which was at that time neglected in Italy. The influence and support of Liszt, who was in Rome from 1861, was naturally of the greatest advantage to him, and concerts of all sorts were undertaken, Sgambati conducting as well as playing the piano. His compositions of this period (1864-65) included a quartet, two piano quintets, an octet, and an overture. He conducted Liszt's Dante symphony in 1866, and made the acquaintance of Wagner's music for the first time at Munich, whither he travelled in Liszt's company. 'His first album of songs appeared in 1870, and his first symphony was played at the Quirinal in 1881 ; this, as well as a piano concerto, was performed in the course of his first visit to England in 1882; and at his second visit, in 1891, his Sinfonia epitalamio was given at the Philharmonic. His most extensive work, a Requiem Mass, was performed in Rome 1901. His many pianoforte works have won permanent success ; but his influence on Italian musical taste has been perhaps greater than the merits of his compositions, which, though often poetical and generally effective, are often very thin and slight in style.

Shabatz, a tovm in Servia, on the right bank of the river Sava. It has a mediasval castle, built in 1470 by Sultan Mahommed II. to facilitate the incursion of the Turks into Croatia and Syrmia, which lie on the left bank of the river. It is the principal market and commercial town of north-western Servia, and exports to Hungary cereals, prunes, cattle, and pigs. It is well known for the excellent white honey which comes from its neigh- bourhood. The district is rich in lime-trees. Shabatz is the seat of a bishop, of the district prefecture, and of a tribunal. It has a college and a library, and a garrison occupies the old fort. The people of Shabatz have the reputation of being the wittiest people in Servia. Popula- tion (1895), 10,917; (1900), 12,072.

Shadrinsk, a district town of Russia, in the government and 383 miles south-east of the town of Perm, on the river Iset. It is a growing to\^^l, with several dis- tilleries, and has become an important entrepot for the export of corn, cattle, hides, skeep skins, woollen cloth, and tallow. Population (1897), 11,686, or 17,050 with the suburbs. ^

Sha.ha,ba,Cl, a district of British India, in the Patna division of Bengal. The administrative head- quarters are at Arrah. Among other historic sites, it includes the fort of Rohtas, the tomb of Sher Shah at Sasseram, and the battlefield of Buxar.

Area, 4365 square miles. Population (1881), 1,952,647 ; (1891), 2,063,337. Classitied according to religion, Hindus numbered 1,911,372; Mahommedans, 148,439; Christians, 277, of whom only one was a native; "others," 3249. In 1901 the population was 1,963,762, showing a decrease of 5 per cent, compared with an increase of 6 per cent, in the previous decade. The land revenue and rates in 1897-98 were Rs. 19,06,495 ; number of police, 614 ; boya at school (1896-97), 23,891, being 16 per cent, of the male population of school-going age ; registered death-rate (1897), 35 '5 per thousand. The district has been protected against drought by a system of canals from the Sone, some of which are navigable. In 1897-98 the gross receipts from these canals were Es.12,54,790, and the net receipts Rs. 6, 36, 648, on a total capital expenditure of Rs.2,67,91,549. The district is traversed by the East Indian Railway near the. Ganges, and by a branch from Mogulsarai to Gaya, which follows the Grand Trunk Road, and crosses the Sone at Dehri-on-Sone, where are the workshops of the canal.

Shahjahanpur, a city and district of British India, in the Rohilkhand division of the North- Western Provinces, The city is on the left bank of the river Deoha or Garra, 507 feet above the sea ; railway junction, 780 miles north-west of Calcutta. Population (1891), 78,522 ; (1901), 75,662; municipal income (1897-98), Rs.70,953, more than half derived from octroi ; incidence of taxation, nearly 9 annas per head; registered death-

rate (1897), 30 per thousand. There is a miUtary cantonment. There are manufactures of sugar, but no great trade. There is an American Methodist mission. There are two printing- presses, issuing one vernacular periodical.

The district of Shahjahanptjk has an area of 1744 square miles. Population (1881), 856,946 ; (1891), 918,551, showing an increase of 7 per cent., compared with a decrease of 10 per cent, in the previous nine years ; average density, 526 persons per square mile. In 1901 the population was 921,624. The land revenue and rates are Es.ll, 08,165, the incidence of assessment being R.1.0.9 per acre; cultivated area (1896-97), 710,831 acres, of which 37,974 were irrigated from wells, &c. ; number of police, 2761 ; vernacular schools, 105, with 4958 pu])ils ; registered death-rate (1897), 43‘45 per thousand. The principal crops are rice, wheat, pulse, millet, sugar-cane, and opium. There are no Government canals. The district suffered very severel]’ from the famine of 1877-79. It is now traversed by the Luoknow-Bareilly section of the Oudh and Rohilkhand Railway, with a branch northwards from Shahjahanpur city. At Rosa is a sugar refinery and rum distillery, with an annual out-turn valued at Rs.13,48,000. In 1897-98 the excise duty paid or credited was Rs. 6, 49, 336.

Shahpur, a town and district of British India, in the Rawalpindi division of the Punjab. The town is near the left bank of the river Jhelum. Population (1891), 6337; municipal income (1897-98), Rs.l789. There is an Anglo-vernacular school, and a branch of the Arya Samaj.

The district of Shahpttr has an area of 4840 square miles. Popu- lation (1881), 421,508 ; (1891), 493,588, showing an increase of 17 per cent., due to the extension of irrigation ; average density, 102 persons per square mile. In 1901 the population was 524,572, showing an increase of 6 per cent. The land revenue and rates in 1897-98 were Rs. 6,95, 949, the incidence of assessment being 5 annas per acre ; cultivated area, 401,979 acres, of which 230,417 were Irrigated, including 48,637 from Government canals; number of police, 445 ; number of schools (1896-97), 343, attended by 7551 boys, being 14”2 per cent, of the boys of school-going age ; death- rate (1897), 32 per thousand. The principal

crops are wheat, millet, pulse, and cotton. The largest town and chief commercial centre is Bhera. The district is traversed from different directions by two branches of the North- Western Railway, which approach each other on opposite banks of the Jhelum ; total length, 75 miles ; and there are 112 miles of navigable rivers.

Shcl.hri!icl, capital of the Shdhriid-Bostdm province of Persia, situated about 258 miles east of Tehran, on the high road thence to Mashhad, at an altitude of 4460 feet, in 36 25′ N. and 54 59′ E. It has a population of

less than 10,000, post and telegraph offices, and a lively transit trade between western Khorassan and Astardbdd, the latter place 44 miles away to the north. Although capital of the province, it is not the residence of the governor, who prefers the more salubrious Bostim, a small city with fine gardens and a mosque of the 14th century, lying 3 miles to the north-east.

Shamokin, a borough of Northumberland county, Pennsylvania, U.S.A. It is situated in 40 47′ N., and 76 33′ W., on Shamokin creek, east of the centre of the state, at an altitude of 730 feet. Its site is very hilly, but the street plan is fairly regular, and it is divided into ten wards. It has three railways, the Lehigh Valley, the Northern Central, and the Philadelphia and Reading. Lying within the anthracite coal region and surrounded by coal-mines, its chief industries are mining and shipping coal. Its manufactures are mainly of iron and steel. Population (1890), 14,403; (1900), 18,202, of whom 2703 were foreign-born and 65 negroes.

Shanghai, a treaty port in the province of Kiangsu, China. This city is by far the most important of all the treaty ports of China. Its geographical situation gives it peculiar advantages as a centre of trade. It lies mid- way on the coast line between Canton and Peking, is at the mouth of the great river Yangtse, and is the natural terminus of the ocean-borne trade coming from the Pacific coast of America and from Japan. It is thus the meeting- point of four distinct streams of trade. Its commerce, more- over, is under the protection of all the flags of Europe and America, for all are equally interested. During the Chino- Japanese war, by agreement between Great Britain and Japan, Shanghai and its approaches were specially exempted from the sphere of warlike operations. This is a

precedent which will probably be followed in the event of future conflict between China and any foreign Power, while in the event of domestic revolution in China itself, aU the foreign Powers would combine to offer the protection of their war vessels. Notwithstanding, therefore, the somewhat un- stable condition of the Chinese Government, it would seem that whatever may happen Shanghai may reasonably be deemed safe. The value of the trade passing through the customs grew from H. taels 134,000,000 in 1880 (►►36,800,000) to H. taels 306,701,000 (►►46,005,000) in 1899 ►►► the silver valuation representing more nearly the volume. The principal items of import are cotton yarns (►►4,620,700 in 1899), opium (►►3,360,700), metals (►►933,400), sugar (►►907,800), petroleum (►►1,185,600), and coal (►►686,800) ; of export, silk (►►14,298,300), cotton (►►5,378,400), tea (►►1,345,500), rice (►►1,066,900), hides and skins (►►1,043,800), wool, wheat, and beans. Great Britain and the British colonies supply nearly 31 per cent, of the imports, Japan 12^ per cent., and the United States 12 per cent.; and of the exports Great Britain and the British colonies take 18 per cent., the United States 12 per cent., and Japan 10 per cent. In 1900 there entered and cleared 7,982,850 tons of shipping under foreign flag, of which 5,043,700, or rather over 63 per cent., were British. In addition, 1,449,560 tons under the Chinese flag entered and cleared. Shanghai holds with respect to northern and central China the same position in point of trade that Hong Kong holds for south China. Each is the terminus of the ocean steamer traffic and the general dep6t whence foreign imports are distributed to the outports, and where native produce is collected for export to foreign countries. The trade of Shanghai thus represents practically the trade of three-fourths of the country. Shanghai, moreover, is not only a port of trade, but is rapidly becoming a large manufacturing and industrial centre. In this category the

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first place must be given to cotton mills, wMch, though not as yet very numerous, give promise of considerable development. The demand in China for cotton yarn, chiefly the produce of the Bombay mills, has been steadily on the increase, and in 1898 the import into Shanghai amounted to 330,000 bales valued at ►►3,000,000. On the other hand, China produces raw cotton in indefinite quantity, and has hitherto been the main source of supply for the Japanese mills. At the close of 1898 there were running in all 300,000 spindles ►►► five out of eight mills being in foreign hands, the others being native. Cloth weaving was tried in two of the mUls, but abandoned in favour of spinning. Next in importance is the reeling of silk cocoons by machinery. This is gradually supplanting the wasteful method of native reeUng, giving a much better finished and consequently more valuable article. Shanghai also contains three large establishments for docking, re- pairing, and building ships. Among minor industries are match factories, rice and paper mills, ice, cigarette, piano, carriage, and furniture factories, wood carving, &c.

By virtue of extra-territorial clauses in the various treaties, all foreigners, subjects of any treaty Power, are exempted from the jurisdiction of the Chinese authorities, and made justiciable only before their own officials. As there are now fourteen treaty Powers represented at Shanghai, there are consequently fourteen distinct courts sitting side by side, each administering the law of its own nationality. In addition, there is also a Chinese court, commonly called the Mixed Court, though it is no more mixed than any of the others in an international sense, except that a foreign assessor sits with the Chinese judge in cases where any of his own nationality are interested as plaintiffs. At first sight this arrangement seems somewhat complicated, but the principle is simple enough, viz., that a defendant must always be sued in the court of his own nationality. In criminal cases there is of course no difficulty. For the British, English law alone pre- vails, and they can only be tried and punished in the British court. In the same way Frenchmen can only be tried in the French court, and so on for every nationality. In civil cases, where both parties are of the same nationality, there is also no difficulty, e.g., for British subjects the British court is the forum, for German subjects it is the German court. In cases involving cross actions with mutual accounts, say between an Englishman and a German, the case may be brought into

either the British or the German court according as the initiative is taken by the German or the Englishman. If the German constitutes himself plaintiff he must sue his opponent before the British court, and vice versd. The greatest anomaly, however, in respect of the government of Shanghai is the local municipal control. This is exercised by the foreign community as a whole without regard to nationality, and is a share of the power which properly belonged to the Chinese local authorities, but which by convention or usage they have allowed to fall into foreign hands. It is exercised only within the area termed the foreign settlements, which were originally nothing more than the "area set apart for the residence of foreign merchants." Of these "settlements " there were and are still only three ??? the British acquired in 1845, the French acquired in 1849, and the American acquired in 1862. At an early date, as a foreign town began to spring up, the necessity of having some authority to lay out and pave streets, to build drains, &c., for the common benefit, became evident, and as the Chinese authorities shirked the work and the expense, the foreigners resolved to tax themselves voluntarily, and appointed a Committee of Works to see the money properly laid out. In 1854 the consuls of Great Britain, France, and the United States drew up a joint code of regulations applicable to both the then settlements, British and French, which being ratified by the respective Governments became binding on their respective subjects. The two areas thus became an international settlement, and the subjects of all three nationalities ??? the only Powers then interested ??? acquired the same privileges and became liable to the same burdens. The code thus settled was acquiesced in by the Chinese autliorities and by other nationalities as they came in, and it conferred on the foreign community local self-government, practically free from oflicial control of any description. In 1863 the area covered by the regulations was extended by the addition of the American settlement, which meanwhile had been obtained by that Govern- ment from the Chinese. But about the same time, 1862, the French decided to withdraw from the joint arrangement, and pro- mulgated a set of municipal regulations of their own applicable to the French area. These regulations difFered from those appli- cable to the joint settlement, in that a general supervision over municipal affairs was vested in the French consul-general, his

approval being made necessary to all votes, resolutions, &o. , of the ratepayers before they could be enforced at law. Since the above date there have, consequently, been two municipalities at Shanghai, the French and the amalgamated British and American settlements, to which the original regulations continued to apply. The area of the latter has been very greatly extended within the last few years, and now amounts to some nine or ten square miles. The regulations have been altered and amended from time to time, and, they have been accepted expressly or impliedly by all the treaty Powers which have since come into the field. The settlements have thus lost their original character of British or American, and become entirely cosmopolitan. The consuls of all the treaty Powers rank equally, and claim to have an equal voice in municipal affairs with the British or American consuls.

The powers of self-government thus conferred on the foreign community consist in exclusive police control within the area, in draining, lighting, maintenance of streets and roads, making and enforcement of sanitary regulations, control of markets, dairies, and so forth. To meet these expenses the foreign ratepayers are authorized to levy taxes on land and houses, to levy wharfage dues on goods landed or shipped, and to charge licence fees. Taxes are payable by every one living within the settlements, Chinese included, though the latter have no voice in the local administra- tion. The executive is entrusted to a municipal council of nine, elected annually from among the general body of foreign rate- payers, irrespective of nationality. The legislative function is exercised by all ratepayers possessing a certain pecuniary qualifica- tion in public meeting assembled. Proxies for absentee landlords are allowed. One such public meeting must be held annually to pass the budget and fix the taxation for the year. No official sanction is required, and no veto is allowed for such money votes. Special meetings may be held at any time for special purposes. New legislation of a general kind requires to be approved by all the treaty Powers in order to be binding on their several nationalities, but within certain limits the ratepayers can pass by-laws which do not require such sanction. In 1899 the revenue of the municipality amounted to taels 916,000 (??137,400). The French municipality is worked on similar lines, except that every vote and every disbursement of money is subject to the approval of the French consul-

general. The executive council consists of eight members, four of whom must be French and four may be foreign. The French consul-general is chairman ex officio, so that the control in any case is French and practically official.

Both settlements were originally intended for the residence of foreign merchants only, but as the advantages of living under foreign protection became evident by reason of the security it gave from arbitrary taxation and arrest, Chinese began to flock in. This movement has continued, and is now particularly noticeable in the cases of retired officials, many of whom have made Shanghai their home. The total native population in the settlements by the census of 1895 was 286,753, and the estimated population of the native city was 125,000, making a total for all Shanghai of 411,753. In 1900 the foreign population was 6774, of whom 2691 were British. The magnitude of the foreign interests invested in Shanghai may be gathered from the follow- ing rough summary : ►►► Assessed value of land in settlements registered as foreign -owned ►►5,500,000 ; docks, wharves, and other industrial public companies ►►► ^ market value of stock, ►►2,250,000; private property estimated ►►1,500,000, ►►►total ►►9,250,000. This is exclusive of banks, shipping and insurance companies, and other institutions which draw profits from other places besides Shanghai. ((j. j.)

Sha,nha.i~Kwa.n, a garrison town in the extreme north-east of the province' of Chihli, China. It is situated at the point where the range of hills carrying the Great Wall of China dips to the sea, leaving a kivan or pass of limited extent between China proper and the provinces of Manchuria. It is thus an important military station, and the thoroughfare of trade between Manchuria and the great plain of China. The Imperial Northern Eailway from Tientsin and Taku, 174 miles from the former, runs through the pass, and continues skirting the northern shore of the Gulf of Pechili as far as the treaty port of Newchwang, where it is in touch wth the Eussian system of railways leading from Port Arthur to the Siberian main line. The pass forms the southern limit of the Eussian sphere of influence as defined in the convention between Great Britain and Eussia of April 28, 1899.

Sha.nklin, an urban district (1894), and watering- place, Hampshire, England, in the Isle of Wight, 8 miles south-east of Newport by rail. The pier was completed

in 1891, and in 1892 a lift connecting the town and esplanade was constracted at a cost of ►►6000. A Home of Rest for seventy-three inmates (women) was erected in 1893. Shanklin Chine is a picturesque chasm in a lofty cliff bordering the bay on which the town stands. Population (1891), 3921 ; (1901), 4533.

Shan Tribes. See Lolos.

Shari, an important river of North Central Africa, carrying the drainage of a large area of the interior into Lake Chad {q.v.). It has a considerable number of head- streams, which take their rise on the watersheds between the Lake Chad basin and those of the Nile and Congo. The most important is probably the Bamingi, one branch of which, the Kukuru, rises in about 7►►N. and 21►►15' E. At about 90 miles from its source the Bamingi is some 80 yards wide and 12 feet deep, with a gentle current, and is navigable from this point to Lake Chad. Flowing generally north-west, it receives the Gribingi on the left bank in 8►►42' N., the Bahr Sara (probably derived from a distant source in the south-west, and thought by some to be the principal branch of the river) in 9►►20', and the Bangoran on the right in 9►►14' N. The Gribingi is a narrow and tortuous river vsdth rocky banks, and often broken by rapids, though navigable at high water to 7►►N. It flows in great part through a forest-clad country. The Bangoran rises in about 7►►45' N. and 22►►E., in a range of hills which separates the countries of Dar Kunga and Dar Banda, and, like the Bamingi, flows through open or bush-covered plains with isolated granite ridges. Below the junction the Shari becomes a large river, reaching, in places, a width of over 4 miles in the rains; while its valley, bordered by elevated tree-clad banks, contains many temporary lakes and back-waters. Its waters abound with

hippopotami and crocodiles, and the country on either side with game of all kinds. In 9 46′ N. it receives the Bakare or Awauk from the east, known in its upper course as the Aukadebbe. This, like the Bahr es Salamat, which enters the Shari in 10 2′ N., traverses a wide extent of arid country in southern Wadai, and brings no large amount of water to the Shari. In 10 12′ a divergent branch, the Ergig, leaves the main stream, only to rejoin it in 11 30’. In 12 15′ the Shari receives on the west bank its largest tributary, the Logone, the upper branches of which rise far to the south between 6 and 7 . In 9 15′ N. it has a width of over 500 yards. Its system is said to be connected with that of the Benue (see Nigbe) by means of the Tuburi Swamp, but this is somewhat doubtful. Below the Logone the Shari, here a noble stream, soon splits up into various arms, forming an alluvial delta, flooded at high water, before entering Lake Chad. The whole upper basin of the Shari, as well as the right bank of the lower river, falls within French territory, and a steamer was placed on its waters in 1897 by the French pioneer Gentil.

Sharon, a borough of Mercer county, Pennsylvania, U.S.A. It is situated on the Lake Shore and Michigan Southern and the Pennsylvania railways, in the north- western part of the state, at an altitude of 855 feet. It has extensive iron and steel works, including blast fur- naces, rolling mills, foundries, and nail factories. Popu- lation (1890), 7459 ; (1900), 8916, of whom 1805 were foreign-born and 113 negroes.

Sharpsburgf, a borough of Allegheny county, Pennsylvania, U.S.A. It is on the river Allegheny, and on the Pennsylvania and the Pittsburg and Western rail- ways, in the south-western part of the state, at an altitude of 741 feet. Its industries are coal mining and iron

manufacturing, and it has blast furnaces, rolling mills, and foundries. Population (1890), 4898 ; (1900), 6842, of whom 1280 were foreign-born and 258 ijegroes.

Shasi, a city in the province of Hupeh in China, on the left bank of the river Yangtse, about 85 mUes below Ichang. It was opened to foreign trade under the Japanese treaty of 1895. The town lies below the summer

level of the Yangtse, from which it is protected by a strong embankment running for many mUes above and below. Its value consists in the fact that it is the terminus of an extensive network of canals which run through the whole of the low country lying on the north bank of the Yangtse as far down as Hankow. Native boats, as a rule, prefer the canal route to the turbulent waters of the Yangtse, their cargoes being transhipped at Shasi across the em- bankment into river boats. The population is estimated at 80,000. Foreign residents are very few, and the trade passing through the maritime customs is comparatively insignificant, amounting in 1900 to only ??85,600. The place is, however, a large distributing centre for native trade, and is besides the seat of an extensive manufacture of native cotton cloth.

Shatsk, a district town of Russia, in the government and 88 miles north of the town of Tamboff. It is a growing prairie town, with a considerable export trade in grain and flour. Population (1897), 13,928.

Shaw, Henry Wheeler(l8l8-1885), American

humorist, known by his nom de guerre of " Josh BiUings," was born at Lanesborough, Mass., 21st April 1818, his father being a well-known member of the Massachusetts Legislature and of Congress. After knocking about in the West for a time, Shaw, in 1858, settled down in Poughkeepsie, New York, as a land-agent, and began writing newspaper articles ; but it was not till he hit upon the idea of adopting a system of facetious mis-spelling that he made a success in 1860 with his " Essa on the Muel, bi Josh Billings," in a New York paper. He proceeded to work this vein of humour in a number of droU articles and volumes, which had a widespread circulation, the principal being : Josh Billings, his Sayings (1866), Josh Billings's Farmers' Almanax (1870), Josh Billings's Complete Works (1877), Josh Billings's Spice-Box (1881). He also became very popular as a platform lecturer, his mannerisms and apparently unstudied wdtticisms making him a conspicuous contemporary " character." He died at Monterey, California, 14th October 1885. His Life was published by F. S. Smith in 1883.

Shaw, Richard Norman (1831),

British architect, was born in Edinburgh, 7th May 1831. At the age of sixteen he went to London and became a pupil of William Burn. It was in Burn's office that he formed the friendship with William Eden Nesfield which so profoundly influenced the careers of both. There Mr Shaw was thoroughly grounded in the science of planning and in the classical vernacular of the period. This office-work was supplemented by attendance at the archi- tectural schools of the Eoyal Academy, and the careful study of old and of the best contemporary buildings. In 1854, having finished his term of apprenticeship with Burn, he gained the gold medal and travelling student- ship of the Royal Academy, and from then until 1856 he travelled on the Continent, studying and drawing old work. On his return in 1856 he was requested by the Council of the Eoyal Academy to publish his drawings. This work, entitled Architectural Sketches from the Con- tinent, was issued in 1858. In the meantime Nesfield was continuing his studies with Anthony Salvin; Mr Shaw also entered his office, and remained there until 1857, when he widened his experience by working for

three years under George Edmund Street. In 1863, after sixteen years of severe training, lie began to practise. For a short time he and Nesfield joined forces, but their lines soon diverged. ' Mr Shaw's first work of importance was Leyes Wood, in Surrey, a building of much originality, which was followed shortly afterwards by Cragside, for Lord Armstrong, begun in 1869. These buildings, and others taken in hand at about the same period, attracted immediate attention ; and from that time until he retired from active practice his works followed one another in quick succession. In 1872 Mr Shaw was elected an Associate of the Eoyal Academy, and a full member in 1877 ; he joined the " retired " list towards the end of 1901.

Other characteristic examples of Shaw's work are Preen Manor, Shropshire ; New Zealand Chambers, Leadenhall Street ; Pierre- pout, Wispers, and Merrist Wood, in Surrey ; Lowther Lodge, Kensington ; Adoote, in Shropshire ; his houses at Kensington, Chelsea, and at

Hampstead ; Flete House, Devonshire ; Greenhara Lodge, Berkshire ; Dawpool, in Cheshire ; Bryanstone, in Dorset- shire ; Chesters, Northumberland ; New Scotland Yard, on the Thames Embankment ; besides several fine works in Liverpool and the neighbourhood. He also built and restored several churches, the best known of which are St John's Church, Leeds ; St Margaret's, Ilkley ; and All Saints', Leek. His early buildings were most picturesque, and contrasted completely with the current work of the time. The use of "half timber " and hanging tiles, the projecting gables and massive chimneys, and the cunningly contrived bays and recessed fireplaces, together with the complete freedom from the con- ventions and trammels of "style," not only appealed to the artist, but gained at once a place in public estimation. Judged in the light of his later work, some of those early buildings appear almost too full of feature and design ; they show, however, very clearly that Mr Shaw, in discarding "academic style," was not drifting rudderless on a sea of fancy. His buildings, although entirely free from archaeological pedantry, were the outcome of much enthusiastic and intelligent study of old examples, and were based diiectly on old methods and traditions ; but although naturally they took more or less traditional forms, the architect concerned himself more with the spirit of old work than with its letter, and within these wide limits he allowed his imagination full play. As his powers de- veloped, his buddings gained in dignity, and had an air of serenity and a quiet homely charm which were less conspicuous in his earlier works; the "half timber" was more sparingly used, and finally disappeared entirely. His work throughout is especially distinguished by treatment of scheme. There is nothing tentative or hesitating. His planning is invariably fine and full of ingenuity. Adcote (a beautiful drawing of which hangs in the Diploma Gallery at Burlington House) is perhaps the best example of the series of his country houses built between 1870 and 1880. The exterior is simple and dignified, and the detail refined and elegant. The elements are few but perfectly proportioned and combined, and the scale throughout is consistent. The Great Hall is the keynote of the plan, and is properly hut not unduly emphasized. The group- ing of the rooms round the Hall is very ably managed ??? each room is in its right position, and has its proper aspect. The plan is a practical one, fulfilling its purpose as a modern house, but is never- theless full of originality and character. New Zealand Chambers, in Leadenhall Street, another work of about the

.same period (1870-80), is a valuable example of Mr Shaw's versatility. Here he employed a completely difi'erent method of expression from any of his preceding works, in all of which there is a trace of "Gothic" feeling. This is a facade only of two storeys, divided by piers of brickwork into three equal spaces, filled by shaped bays rich with modelled plaster ; above, drawing the whole composition together, is a finely enriched plaster cove. An attic storey, roofed with three gables, completes the building, which is the antithesis of the ac- cepted type of city offices ; it is yet perfectly adapted to modern uses. New Scotland Yard is undoubtedly Mr Shaw's finest and most complete work. The plain granite base is not only subtly sug- gestive of the purposes of the building, but by dividing the height with a strongly marked line, gives a greater apparent width to the structure ; it suggests also a division of departments. By its mass, too, it prevents the eye from dwelling on the necessary irregularity of the Liwer windows, which are not only different in character from those of the upper storeys, but more numerous and quite irregularly spaced. The projecting angle turrets are most happily conceived, and besides giving emphasis to the corners, form the main point of interest in the composition of the river front. The chimneys are not allowed to cut the sky-line in all directions, but have been drawn together into massive blocks, and contribute nmch to the general air of dignity and strength for which this building is remarkable. Simple roofs of ample span complete a composition conspicuous for its breadth and imity.

Mr Shaw's influence on his generation can only be adequately gauged by a comparison of current work with that which was in vogue when he began his career. The works of Pugin, Scott, and others, and the architectural literature of the time, had turned the thoughts both of architects and the public towards a "revived Gothic." Before he entered the field, this teaching had hardened into a creed. Mr Shaw was not content to hold so limited a view and with characteristic courage threw over these artificial barriers and struck out a line of his own. The rapidity with which he conceived and created new types, and as it were set a new fashion in building, compelled admiration for his genius, and swelled the ranks of his adherents. It is largely owing to him that there is now a distinct tendency to approach architecture as the art of Building rather than as the art of Designing, and the study of old work as one of methods

and expressions which are for all time, rather than as a means of learning a language of forms proper only to their period.

Sheba. See Arabia.

Sheboygfan, a city of Wisconsin, U.S.A., capital of Sheboygan county. It is on the shore of Lake Michigan, at the mouth of the river Sheboygan, and on the Chicago and North- Western Railway, in the western part of the state, at an altitude of 589 Teet. The city is regularly laid out, is divided into eight wards, has a good water-supply from the lake, and is well sewered. Its harbour is excellent, and it has a large lake commerce, principally in lumber. The manufactures consist mainly in the making of furniture, especially chairs, for which it is noted. The city was settled in 1836, incorporated as a village in 1846, and received its city charter in 1853. Population (1890), 16,359 ; (1900), 22,962, of whom 7399 were foreign-born.

Shechem, now Nablus, the chief town of a sanjak of the Beirut vilayet of Asiatic Turkey, altitude 1870 feet, situated in Central Palestine, in the valley which separates Ebal from Gerizim. There are Protestant and Roman Catholic missions, with churches and schools, and a Samaritan synagogue. The population of 24,000 includes 170 Samaritans, 700 Christians, and a few Jews.

Sheep. See Ageiculture.

SheerneSS, a garrison town and naval seaport of England, at the extreme north-west corner of the Isle of Sheppey, Kent, and on the right bank of the Medway estuary, 51 miles east of London by rail and 11 miles east-north-east of Chatham. Blue Town, the older part of the town, vidth the dockyard, is defended by strong modern-built fortifications, especially the forts of Garrison Point and Barton's Point. The dockyard, chiefly used for naval repairs, covers about 60 acres, and consists of three basins and five docks, the depth of water on the sill ranging from 15 to 25| feet. Within the yard there are extensive naval stores and barracks for 1000 men. Outside the dockyard are the residence of the port admiral and admiral of the Nore and military barracks. The harbour is spacious, sheltered, and deep even at low water. The place is also visited to some extent for sea-bathing. There is steamboat connexion between Sheerness and Port Victoria, on the opposite side of the Medway ; with Southend, on the

opposite side of the Thames ; and with Chatham and London Bridge. Queenborougli Pier, 1 mile to the south, is the port of embarkation for passengers travelling to the Continent vid Flushing. It was in this neighbourhood that the celebrated mutiny of the Nore broke out in 1797, the Nore being the name given to the estuary of the Thames between the Isle of Sheppey and the opposite coast of Essex. The Nore hght floats above a sandbank 4 miles north-east of Sheerness. Before 1894 Sheerness formed part of the parish of Minster, but it was then formed into a separate parish. Area, 876 acres. Population (1891), 14,492; (1901), 18,273.

SHEFFIEL D ►►►S HERBROOKE

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Sheffield, a city (1893), and a county (1888) and parliamentary borough of Yorkshire, England, at the con- fluence of the Sheaf with the Don, 39 miles south of Leeds, 157 miles by rail north-north-west of London. Of its con- stituent townships Upper Hallam still remains in large part agricultural. In 1897 the title of lord mayor was conferred on the chief magistrate, and under an Act of 1900 the city area was extended by 4003 acres. The water- works, supplying about 8^ million gallons daily to the city and district, were acquired by the corporation in 1887. New water-works are in course of construction in the Little Don valley, while Sheffield is also a constituent of the Derwent Valley Water Board (1899). The capital cost of the water- works undertaking up to 25th March 1900 exceeded ►►2,571,374. The electric lighting of the borough, dating from 1892, was in 1898 transferred to the corporation. From 1884 to 1886 a new sewage system, costing ►►132,000, and sewage disposal works, costing ►►44,000, were executed. Tramways, mostly electric traction, in 1900 stretched altogether over 17^ miles length of streets. Further, in 1900, 13 miles of new tramway line were sanctioned, involving in most cases the widening of the roads passed through, and an estimated expenditure of ►►349,495. A number of old streets have been pulled down, many narrow streets widened, new and handsome thoroughfares opened up. A handsome carriage bridge connects the districts of Walkley and Neepsend. At Newhall (Attercliffe) a single-span bridge, 46 feet 6

inches between parapets, has taken the place of the former one, only 1 2 feet 6 inches wide. At Carbrook a new carriage bridge displaces a wooden pedestrian structure. On 25th March 1900 the streets of Sheffield had a total length of 321-58 miles. The street improvements determined on in 1900 involved an estimated cost of ––445,176. Besides the parish church of St Paul's there are 35 churches and numerous dissenting places of worship. Eansmoor Church was rebuilt in 1888 at a cost of ––22,000. University College, constituted by that title in 1897, was founded in 1879 as the Firth College, enlarged in 1892, and com- prises, besides the college, a technical department (1886), occupying the buildings of the former grammar school, and equipped with metallurgical laboratories, steel works, iron foundry, a machine and fitting shop, &c. ; and a medical school (1888), together with a school of pharmacy (1885). Other modern buildings include a new town-hall (1897), costing, exclusive of the site, about ––130,000 ; the Mappin art gallery (1887); the Kuskin museum, since 1890 in the custody of the corporation, and transferred to Meers- brook Park; Jubilee memorial (1887); Lodge Moor hospital (1888); the Lyceum (1893), Alhambra, and other theatres. Since 1899 the markets, purchased from the duke of Norfolk for ––526,000, have been the property of the corporation. Several new parks and recreation grounds have been opened in recent years. Cutlery stUl continues the leading industry of Sheffield. j\Iinor in- dustries include important horse-hair cloth, railway-carriage fittings, and testing works. The Cutlers' Company (1624) of Sheffield, by Acts 1883-88, exercises jurisdiction, in all matters relating to the registration of trade marks, over all goods composed in whole or in part of any metal, wrought or unwrought, as also over all persons carrying on business in Hallamshire and vsdthin 6 miles thereof. The collieries include the Nunnery, with four drawing pits, and the Ald- warke main, vsdth machinery to raise 1500 tons daily. In 1891, 3385 persons were engaged in the making of machinery; 22,115 men and 3642 women in the manu- facture of cutlery, files, saws, &c. ; and 2476 persons in mining. There are three daily newspapers. Area of muni- cipal (coextensive with parliamentary) borough, 19,651 acres. Population (1891), 324,243 ; (1901), 380,717.

Shelbyville, a city of Indiana, U.S.A., capital of Shelby county. It is on the river Big Blue, and the Pitts- burg, Cincinnati, Chicago, and St Louis and

the Cleveland, Cincinnati, Chicago and St Louis railways, in the central part of the state, at an altitude of 768 feet. It is in an agricultural and coal-mining region and contains varied manufactures. Population (1890), 5451; (1900) 7169, 326 being foreign-born and 257 negroes.

Shenandoah, a borough of Schuylkill county, Pennsylvania, U.S.A. It is situated in 40 49′ N. and 76 12′ W., in the valley of Shenandoah creek, on the Pennsylvania, the Lehigh Valley, and the Philadelphia and Eeading railways, in the eastern part of the state, at an altitude of 1249 feet. Its site is hilly and uneven, the street plan is irregular, and it is divided into five wards. It is within the anthracite coal-field, several large collieries being within its limits, and others surrounding it. Its industries relate almost exclusively to mining, handling and shipping coal. Population (1890), 15,944; (1900), 20,321, of whom 8499 were foreign-born.

Shepton Mallet, a market-town in the Eastern parliamentary division of Somersetshire, England, 5 miles east-south-east of Wells by rail. The hospital and the Masonic hall have been enlarged. Urban district offices, including rooms for technical instruction, have been built. Area of civil parish (an urban district), 3825 acres. Population (1891), 5267; (1901), 5238.

Sher All Khan (1825-1879), Amie op Afghan- istan, was bom in 1825, and was one of the younger sons of the Amir Dost Mahommed, whom he succeeded in 1863. For some time after his succession Afghanistan was in a state of anarchy, and his rebellious half-brothers overran the country while he remained at Kandahar mourning the loss of a favourite son. At length, how- ever, the capture of Kabul in 1867 roused him to action; but in spite of his own bravery he sufiered general defeat until 1868, when he regained Kabul. Supported by the viceroys of India, Lord Lawrence and Lord Mayo, Sher Ali remained on good terms with the British Government for some years ; but after the rebelUon of his son Yakub Khan, 1870-74, he leaned towards Russia, and welcomed a Eussian mission at Kabul in 1878, and at the same time refused to receive a British mission. This led to long negotiations, and ultimately to war, when the British forced the Khaibar Pass in November 1878, and defeated the

Amir's forces on every occasion. Sher Ali fied from his capital, and taking refuge in Turkestan, died at Mazar-i-Sharif 21st February 1879.

SherbrOOke, a city and port of entry of Quebec, Canada, and capital of Sherbrooke county, 80 miles east of Montreal, at the confluence of the rivers Magog and St Francis, and on the Grand Trunk, Canadian Pacific, Quebec Central and Boston and Maine railways. It is the seat of a Eoman Catholic bishop and the district courts, and con- tains manufactories of wooUen and cotton goods and machinery, also saw- and grist-mills. Population (1891),

10,110; (1901), 11,765.

Sherbrooke, Robert Lowe, Viscount

(1811-1892), British statesman, was born on 4th Decem- ber 1811, at Bingham, Notts, where his father was the rector. He was educated at Winchester and University College, Oxford, where he took a first class in classics and a second in mathematics, besides taking a leading part in the Union debates. In 1835 he won a fellowship at Mag- dalen, but vacated it on marrying, in 1836, Miss Georgina Orred (d. 1884). He was for a few years a successful "coach" at Oxford, but in 1838 was bitterly disappointed at not being elected to the professorship of Greek at

Glasgow. In 1841 Lowe moved to London, to read for the Bar ("called" 1842); but Lis eyesight showed signs of serious weakness, and, acting on medical advice, he determined to try his fortune in the colonies rather than in London. He went to Sydney, where he set to work in the law courts. In 1843 he was nominated by Sir George Gipps, the governor, to a seat in the New South Wales Legislative Council ; owing to a diflference with Gipps, he resigned his seat, but was elected shortly afterwards for Sydney. Lowe soon made his mark in the political world by his clever speeches, particularly on finance and educa- tion ; and besides obtaining a large legal practice, he was one of the principal writers for the Atlas

newspaper. In 1850 he went back to England, in order to enter political life there. His previous University reputation and con- nexions, combined with his colonial experience, stood him in good stead. The TiTnes was glad to employ his ready pen, and as one of its ablest leader-writers he made his influence widely felt. In 1852 he was returned to Parlia- ment for Kidderminster in the Liberal interest. In the House of Commons his acute reasoning made a consider- able impression, and under successive Liberal ministries (1853-1858) he obtained official experience as secretary of the Board of Control and vice-president of the Board of Trade. In 1859 he went to the Education Office as vice- president of the Council in Lord Palmerston's ministry ; there he pursued a vigorous policy, insisting on the necessity of payment by results, and bringing in the revised code (1862), which embodied this principle and made an examination in " the three R's " the test for grants of pubUc money. He felt then, and still more after the Reform Act of 1866, that " we must educate our masters," ^ and he rather scandalized his old University friends by the stress he laid on physical science as opposed to classical studies. Considerable opposition was aroused by the new regime at the Education Office, and in 1864 Lowe was driven to resign by an adverse vote in Parliament with reference to the way in which inspectors' reports were " edited." Lord Palmerston's death in October 1865 was followed by the formation of the Russell-Gladstone ministry and the introduction of the Reform Bill of 1866. Lowe, a Liberal of the school of Canning and Peel, had already made known his objections to the advance of " democracy," ❓❓❓ notably in his speech in 1865 on Sir E. Baines's Borough Franchise Bill, ❓❓❓ and he was not invited to join the new ministry. He retired into what Bright called the "Cave of Adullam," and opposed the Bill in a series of brilliant speeches, which raised his reputation as an orator to its highest point and effectually caused the downfall of the Government. He remained, nevertheless, a Liberal ; and after the franchise question had been settled by what Lowe considered Disraeli's betrayal, and he had been elected the first member for London Univer- sity, he accepted ofiice again in the Gladstone Cabinet of 1868 as chancellor of the Exchequer. Lowe was a rather cut-and-dry economist, who prided himself that during his four years of ofiice he took twelve millions off taxation ; but later opinion has hardly accepted his removal of the shilling registration duty on corn (1869) as good states- manship,

and his failures are remembered rather than his successes. His proposed tax of a halfpenny a box on lucifer matches in 1871 (for which he suggested the epi- gram ex luce lucelluiri) roused a storm of opposition, and had to be dropped. In 1873 he was transferred to the Home Office, but in 1874 the Government resigned.

* 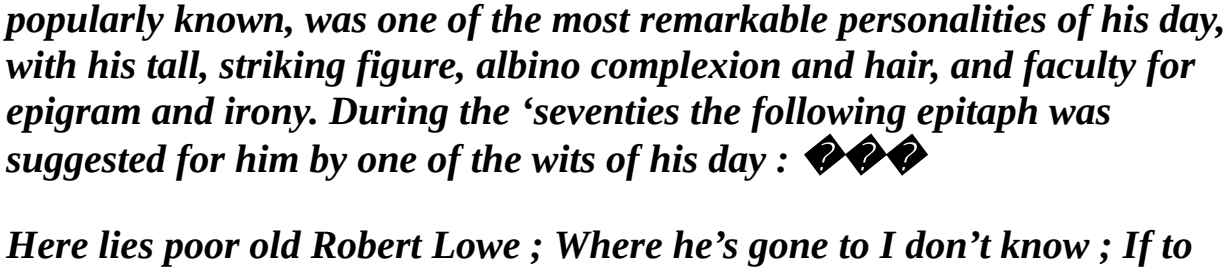 This phrase is always ascribed to Lowe, and has become history in association with him. But what he really said in his address to the Edinburgh Philosophical Institution in 1867, was that it was necessary "to induce our future masters to learn their letters."*

*When the Liberals returned to power in 1880 he was raised to the peerage as Viscount Sherbrooke, but from 1875 tiU his death at Warlingham, Surrey, on 27th July 1892, his health was constantly failing, and by degrees he figured less and less in public life. Bobby Lowe, as he was popularly known, was one of the most remarkable personalities of his day, with his tall, striking figure, albino complexion and hair, and faculty for epigram and irony. During the 'seventies the following epitaph was suggested for him by one of the wits of his day : 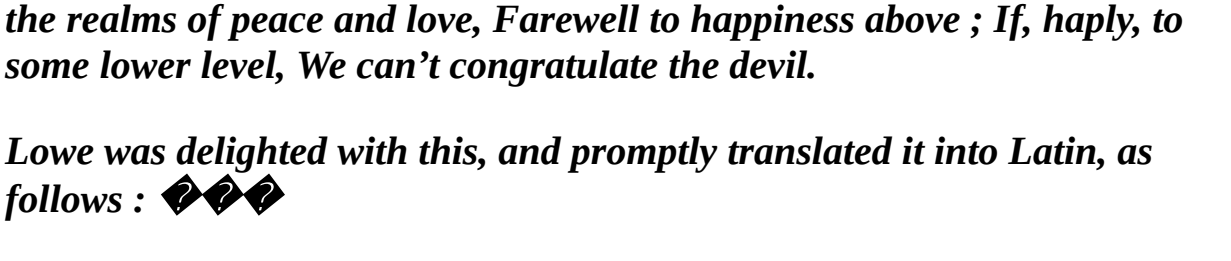 *

Here lies poor old Robert Lowe ; Where he's gone to I don't know ; If to the realms of peace and love, Farewell to happiness above ; If, haply, to some lower level, We can't congratulate the devil.

*Lowe was delighted with this, and promptly translated it into Latin, as follows : 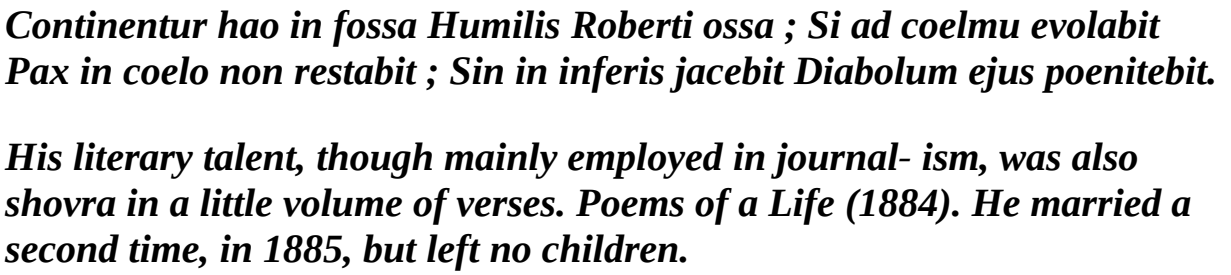 *

Continentur hao in fossa Humilis Roberti ossa ; Si ad coelmu evolabit Pax in coelo non restabit ; Sin in inferis jacebit Diabolum ejus poenitebit.

His literary talent, though mainly employed in journal- ism, was also shovra in a little volume of verses. Poems of a Life (1884). He married a second time, in 1885, but left no children.

See also Life and Letters, by A. Patchett MAETiy. Longmans, 1893. (h. ch.)

Shereef Pasha (1818-1887), Egyptian states- man, born in 1818, was a Circassian who filled numerous administrative posts under Said and Ismail Pashas. He was of better education than most of his contemporaries, and had married a daughter of Colonel Seves, the French non-commissioned ofiicer who became SoUman Pasha under Mehemet Ah. As minister of foreign affairs he was useful to Ismail, who used his bins' bonh/ymie to veil many of his most insidious proposals. Of singularly lazy disposition, he yet possessed considerable tact ??? he was in fact an Egyptian Lord Melbourne, whose policy was to leave ever)rthing alone. His favourite argument against any reform was to appeal to the P3rramjds as an immutable proof of the solidity of Egypt financially and politically. His fatal optimism rendered him largely responsible for the collapse of Egyptian credit which brought about the fall of Ismail Upon the miUtary in- surrection of September 1881, Shereef was summoned by the Khedive Tewfik to form a new ministry. The impossibility of reconciling the financial requirements of the national party with the demands of the British and French controllers of the public debt, compelled him to resign in the following February. After the suppression of the Arabi rebellion he was again installed in office by Tewfik, but in January 1884 he resigned rather than carry out the policy of the evacuation of the Sudan. He died at Gratz, 20th April 1887, on his way to take the waters at Carlsbad.

Sheridan, Philip i-ienry (1831 – 1888),

American soldier, third son of John and Mary (Minor) Sheridan, was born at Albany, New York, 6th Jlarch 1831. In 1832 his father removed to Somerset, Perry county, Ohio. His early education was acquired in the primitive common school of that early day ; his later at West Point, at which he graduated in 1853 as number thirty-four in a class of fifty-two. He was commissioned, July 1853, brevet second lieutenant. From 1853 to 1861 he served on the frontier and the Pacific coast, engaged in Indian war-

fare. He was appointed captain, 13th Infantry, 14th May

1861, having passed through the intermediate grades ❓❓❓second lieutenant, 22nd November 1854, and first Ueutenant, Ist March 1861. After serving as president of a board to audit claims, and as quartermaster and commissary, Sheridan was commissioned colonel, 2nd Michigan Cavalry, 25th May, and engaged in a raid on Booneville, Miss., and, in pursuit of the enemy from Corinth to Baldwin, Miss. He was in command of a cavalry brigade, 11th June, and participated in skirmishes at Booneville, Blackland, Donald- son Cross Koads, and Baldwin, and in the engagement at Booneville, 1st July, where he won his first star, being made brigadier-general of volunteers, 1st July 1862. He was engaged with Faulkner's command, 27th August, and was in command of " Pea Ridge Brigade," 6th September. He was then placed in command of infantry troops, 1st October to 2nd

November, the 11th Division of the Army of the Ohio, and took part in Buell's advance in Kentucky, being heavily en- gaged at the battle of Perry- ville, Ky., 8th October. He marched to the relief of Nash- ville, Tenn., October to Nov- ember, in command of the 3rd Division, Right Wing, 14th Army Corps, later designated the 3rd Division of the 20th Army Corps, Army of the Cumberland. His division rendered efficient service in the battle of Stone River, 31st December 1862 to 3rd Janu- ary 1863, where he won his double stars, being com- missioned major-general of volunteers, 31st December

1862, He took part in the pursuit of Van Dorn to Columbia, Tenn., in March

1863, capturing a train and prisoners near Eagleville ; in the advance on TuUahoma, 24th June to 4th July, captur- ing Winchester, 27th June ; in the campaign across Cumber- land mountains and the river Tennessee, 1 5th August to 4th September; engaged in the battle of Chickamauga, 19th and 20th September; was active in operations in and about Chattanooga from September to December 1863 ; and was engaged in the battle of Missionary Ridge, 23rd to 25th November, where his troops were the first to reach the crest of the ridge and to break the enemy's line. From December 1863 to March 1864 he was engaged in the occupation of East

Tennessee. He was then placed in command of cavalry once more, and was at the head of the Cavalry Corps of the Army of the Potomac from 4th April to 3rd August in the Richmond campaign. He took part in the battles of the Wilderness, 5th and 6th May ; Todd Tavern, 7th May ; Spottsylvania Court House, 8th May ; and Cold Harbor, 31st May and 1st June. He engaged in a raid to Haxall's Landing and the return, 9th to 24th May, destroying parts of the Virginia Central and Richmond and Fredericksburg railways; and in the Charlottesville raid, 7th to 28th June. Then again he was transferred to infantry troops, and placed in command of the army of the Shenandoah, 4th to 7th August, and of the Middle Military Division, 7th August 1864

GENEKAL PHILIP SHEKIDAN. {Fr(►►n a photograph by Sarony, New Tork.)

to 25th March 1865. He fought the battle of Opequan, 19th September, defeating Early ; and was made brigadier- general in the regular army, 20th September 1864. He again defeated Early at Fisher's Hill, 22nd September. He fought the battle of Cedar Creek, 19th October, in which he turned a disastrous defeat into a great victory, for which he received the thanks of Congress and his commission as major-general U.S. Army, 8th November 1864. He undertook a raid from Winchester to Petersburg, 27th February to 24th March 1865, in which the James River and Kanawha Canal was greatly injured, and the Richmond and Fredericksburg, Virginia Central, and GordonsviUe and Lynchburg railways were cut in several places. He was next engaged in the Richmond campaign, 25th March to 9th April 1865, where his services in a large measure hastened the final ending of the war, being

in command at the battles of Five Forks, 1st April; Sailor's Creek, 6th April; and Appo- mattox Station, 8th April. From 3rd June 1865 to 5th September 1867 General Sher- idan commanded successively, with headquarters in New Orleans, the Military Division of the South- West, the Military Division of the Gulf, the De- partment of the Gulf, and the Fifth Military District (Louis- iana and Texas). From 12th September 1867 to 16th March 1869 he was in command of the Department of the Missouri, and was engaged in the winter campaign of 1868-69 against the

Indians, residting in their defeat and surrender. He was com- missioned lieutenant – general U.S. Army, 4th March 1869 ; from 16th March 1869 to 1st November 1883 was in com- mand of the Division of the Missouri ; and from 1st Nov- ember 1883 to 5th August 1888 was in command of the armies of the United States, headquarters AVashington ; commissioned general U.S. He died at Nonquit, Mass., 5th

Army, 1st June 1888.

August 1888, aged fifty-eight years.

In person General Sheridan was 5 feet 5 inches high, of compact frame, with large round head. On horseback he appeared of ordinary height, owing to his body being relatively longer than his lower limbs. As a soldier he never knew what fear was ; he was cool, active, resolute, and resourceful, with every watchful care for the welfare of his troops. Fighting was his element, and to be in the thick of the fray was his greatest enjoyment. He was one of the great cavalry leaders of the world. He was president of the Society of Army of the Potomac and of the Society of Army of the Cumberland, the latter for fourteen years, and was noted as a presiding officer for despatching business by prompt military methods. In manner he was modest and unassuming. He married, 3rd June 1875, in Chicago, Miss Irene Rucker, daughter of General D. H. Rucker, of the regular army. He spent the summer of 1870 in Europe, and was the guest of the king of Prussia during the Franco-German war. He wrote his Personal Memoirs, 2 vols., published after his death. (h. m. c.)

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SHERMAN

Shernna,n| a city of Texas, U.S.A., capital of Gray- son county. It ia in the north-eastern part of the state, at an altitude of 720 feet, and is chiefly a railway centre, being entered by six railways, the Houston and Texas Central, the Missouri, Kansas, and Texas, the St Louis South-Western, the Gulf, Colorado, and Santa F6, the St Louis, and San Francisco, and the Texas and Pacific, all important lines. The surrounding country produces cotton, wheat, and corn, for which Sherman is the chief shipping-point. It

contains cotton gins, cotton seed oil mills, and other manufacturing establishments. Austin College, situated here, had, in 1899, 8 instructors and 108 students. Population (1890), 7335; (1900), 10,243, of whom 308 were foreign-born and 2131 negroes.

Sherman, John (1823-1900), American finan- cier and statesman, a younger brother of General W. T. Sherman (see below), was born at Lancaster, Ohio, in 1823. He began the study of law at Mansfield, Ohio, and was admitted to the Bar in 1844. For ten years he practised his profession with success, and with only casual interest in politics. His associations and pre- dilections were with the Whigs, and he was a delegate to the National Convention that nominated General Taylor in 1848. Upon the repeal of the Missouri Com- promise in 1854, he joined the great popular movement in Ohio against this policy, and was elected to Congress in the autumn of that year as an ” Anti-Nebraska ” man. In the summer of the next year he took an active part in the formal organization of the Eepublican party in the state, and at the opening of Congress in December began a long career of public service. As a member of the House, 1855-61, he quickly manifested the qualities which characterized his whole political life. Though a thorough and avowed partisan, he was vrithin the party the coun- sellor of moderate rather than extreme measures, and thus gained on the whole a position of great influence. He was a member of the committee sent by the House in 1856 to investigate the troubles in Kansas, and drafted the report of the majority. In 1859 he was the Eepub- lican candidate for Speaker of the House, but was obliged, after a contest that lasted two months, to withdraw, largely because of the recommendation he had inadvert- ently given to a virulent anti-slavery book. He became, however, chairman of the Committee on Ways and Means, and was instrumental in the enactment of the Morrill Tariff Act of 1860. In March 1861 he took his seat in the Senate, to which he had been elected to succeed Salmon P. Chase, when the latter became secretary of the Treasury. As senator he sat continuously till he became secretary of the Treasury in 1877. His interest and efficiency in financial legislation in the House led to his appointment on the Senate Committee of Finance, and after 1867 he was chairman of this influential committee. He thus became associated with the enactment of all the great fiscal laws through which the strain of war

and of reconstruction was sustained. He gave earnest support to the Legal Tender Act, and the substitution of the national for the state banking system. When, after the end of the war, the question of financial readjustment came up, he vigorou.sly opposed Secretary McCulloch's policy of retiring the legal tenders, and urged a different plan for effecting the resumption of specie pa3Tnents. On the questions relating to political reconstruction and the policy of President Johnson, he supported his party, though opposed to its Eadical leaders. He warmly advocated the insertion in the Eeconstruction Acts of a provision ensuring the early termination of military government ; and he opposed the impeachment of Pre- sident Johnson, though he voted for conviction on the

trial. During the administrations of President Grant his leadership in shaping financial policy became generally recognized. The Eesumption Act of 1875, which provided for the return of specie payments four years later, was largely his work both in inception and in formulation, and his appointment to the Treasury Department by President Hayes in 1877 enabled him to carry the poUcy embodied in the law to successful execution. His admin- istration of the department, in circumstances of great diflaculty arising out of the "greenback" agitation and the adverse political complexion of Congress, won him high distinction as a financier.

At the end of the Hayes Administration he was again elected to the Senate from Ohio, and held his seat till 1897. During this period he was largely concerned in the enactment of the Anti-Trust Law of 1890, and of the so-caUed Sherman Act of the same year, providing for the purchase of silver and the issuing of Treasury notes based upon it. This latter Act he approved only as a means of escaping the free coinage of silver, and he supported its repeal in 1893. In 1880 and 1888 he aspired actively to the Eepublican nomination for the Presidency, but failed to obtain the req^lisite support in the Convention. Upon the accession of President McKinley, in 1897, he resigned from the Senate and became secretary of State ; but under the tension of the war with Spain the duties of the office became too exacting for his strength at his age, and in April 1898 he resigned and withdrew into private life. Infirmities multiplied upon him, until death came at Washington 22nd October 1900. (w. a. d.)

Sherman, William Tecumseh (1820-

1891), American general, was born 8th February 1820, at Lancaster, Ohio. He was descended from Edmond Sher- man, who emigrated from England to the Massachusetts Bay Colony in 1634. His father moved from Norwalk, Conn., to Lancaster, Ohio, in 1810, became a judge of the Supreme Court of Ohio, and died suddenly in 1829, leaving his widow with a family of young children. William was adopted by the Hon. Thomas Ewing, a close friend of the father, sometime a senator of the United States and a member of the national cabinet. When sixteen years of age he was appointed a cadet in the United States Military Academy at West Point. He graduated in 1840, near the head of his class, and was made a lieutenant of artillery. His first field service was in Florida against the Seminole Indians. The usual ch9,nges of station and detached duty made him acquainted with the geography of all the Southern states, and Sherman improved the opportunity to make topographical studies, which became of distinct value to him later. When the war with Mexico began in 1846, he was stationed at Fort Moultrie, in Charleston Harbour, South CaroUna. He asked for field duty, and was ordered to join an expedi- tion going to California by sea. He was made adjutant- general to Colonel Mason, military governor, and as such was executive officer in the administration of local government, till peace came in the autumn of 1848 and the province was ceded to the United States. In 1849 he was sent home with despatches. In 1850 he married Miss Evping. In 1853 he resigned from the army, and went back to California to conduct at San Francisco a branch of an important St Louis banking-house. He continued successfully in the management of this business through a financial crisis incident to a wildly speculative time, until in the spring of 1857 the house by his advice with- drew from Californian affairs. In 1859 the state of Louisiana established a military college, and Sherman became its superintendent, including in his duties the

professorship of engineering. In the spring of 1860, when it was evident that Louisiana would join the states seced- ing from the Union, he

resigned the superintendency of the college and returned to St Louis, parting with the governor of the state and his colleagues in the school with regret and mutual esteem. Though his brother, John Sherman, the distinguished statesman, was a leader in the party which had elected Mr Lincoln, William Sherman was very conservative on the slavery question, and his distress at what he thought an unnecessary rupture between the states was extreme. Yet his devotion to the national constitution was unbounded, and he offered his services as soon as volunteers for the three-years' enlistments were caUed out. On 14th May 1861 he was appointed colonel of the 13th Infantry, a new regiment in the regular army, and was soon assigned to command a brigade in General McDowell's army in front of Washington. He served with it in the battle of Bull Run, 21st July, was promoted brigadier-general of volunteers, and, with his friend and class- mate General Thomas, was in August sent to Kentucky to serve under General Eobert Anderson. In October Anderson's health failed, and Sher- man succeeded him in com- mand of the department, coming eventually under Gen- eral Halleck, who with General Buell divided the departments of the Mississippi valley. After the capture of Fort Donelson (1862), Sherman, with a division of new troops, joined Grant's expedition up the river Tennessee. At the battle of Shiloh Sherman's gallant conduct gained him promotion to major-general. His appreciation of Grant, and his sympathy with the chagrin he suffered after this battle, cemented the friendship be- tween the two. In the campaign against Corinth, Miss., Halleck commanded in person; but in July 1862 he was made general-in-chief, and Grant resumed the command of the army of the Tennessee, with Sherman as senior subordin- ate. During the operations against Vioksburg, aiming at possession of the lower Mississippi valley, Sherman made expeditions to Chickasaw Bayou, near Vicksburg, and to Arkansas Post, on the Bed river, and then joined Grant's main army again, becoming commander of the Fifteenth Army Corps. After Vicksburg surrendered, on 4th July 1863, Grant was made commander of all the forces west of the Allegheny mountains, and Sherman became the head of the army of the Tennessee, which consisted of three corps. To relieve the army of the Cumber- land after the battle of Chickamauga, Grant and Sherman moved to Chattanooga, and in a series of brilliant victories (November and December) defeated the Confederates, under Bragg and Longstreet, again liberated East

Tennessee, and opened the way for an aggressive campaign southwards. To complete the preparation for this, Sherman made a winter expedition ffom Vicksburg into the heart of Mis- sissippi as far as Meridian, destroying railways and making impracticable for a season the transfer of military opera-

GENERAL W. (From, a photograiph

tions to that region. When Grant became general-in- chief of all the armies of the United States (March 1864), Sherman was made commander of the military division of the Mississippi, including his army of the Tennessee, now under McPherson, the army of the Cumberland, now under Thomas, and the army of the Ohio, under Schofield. Making detachments for garrisons and minor operations in a theatre of war over 500 miles wide, he assembled, near Chattanooga, his three armies, aggregating a hundred thousand men, and began (1st May 1864) the campaign of Atlanta, in the state of Georgia. The country was mostly forest-clad, the roads mere waggon-tracks, his line of communications a single railway, his base 400 miles away. Owing to the character of the country, both sides resorted to entrenched camps covered by formidable en- tanglements of felled trees, and to movements by the

flank, avoiding direct at- tacks on the enemy's front. Atlanta was taken on 1st September. The Confederate General Hood, who had super- seded Johnston, began early in October a vigorous movement on Sherman's communications, designed to carry the war back into Tennessee. After a de- vious chase of a month. Hood moved a-cross Alabama to northern Mississippi. Sher- man divided his army, leaving Generals Thomas and Scho- field to meet Hood, and vsdth sixty thousand men aban- doned his base and marched 300 miles across Georgia to the sea. Savannah, on the Atlantic coast, was taken, rail- ways were destroyed, and the Confederate Government was severed from its western states. In January 1865 Sherman marched northwards again, once more abandoning his base, and aiming for Richmond, the Confederate capital, near which the armies of Grant and Lee were waging a war of giants. Every mile of his march northwards through the Caro- linas diminished the supply region of the enemy, and desperate efforts were made to stop his advance. Gen- eral

Johnston was recalled to active service, and showed his well-known skill, but his forces were inadequate. Sherman defeated him and reached Raleigh, the capital of North Carolina, on 13th April, having marched nearly 500 miles from Savannah. Lee's position in Virginia was now desperate. Thomas and Schofield, in Tennessee, had routed Hood's army, and Schofield had been trans- ferred to the North Carolina coast (a movement of about 2000 miles by land and sea) and was now united again to Sherman, who had come into co-operation with Grant. Lee broke away from Petersburg, 3rd April, but was overtaken, and surrendered to Grant on the 9th. Johnston's surrender to Sherman soon followed, and the war was ended. When Grant became President in 1869, Sherman succeeded him as general-in-chief, and the re- mainder of his active service was spent in the administra- tion of the army in peace. He died at New York, 14th February 1891. Authorities. ♦♦♦ Sherman. Memoirs of General W. T. Sherman.

New York, 1875, 1886. ♦♦♦ Thorndike, Rachel Sherman. The Sherman Letters. New York, 1894. ♦♦♦ Bowman, S. M., and Ikwin, E. B. Sherman and his Campaigns : A Military Biography. New York, 1865. ♦♦♦ Cox, Jacob D. Atlanta (Campaigns of the Civil War). New York, 1882. The March to the Sea, Franklin and Nashville (Campaigns of the Civil War). New York, 1882. ♦♦♦ Johnson, W. Fletcher. Life of William Tecumseh Sherman, late retired General, United States Army. Philadelphia, 1891. ♦♦♦ Nichols, Geoese Ward. Story of the Great March. New York, 1865. ♦♦♦ Force, Manninq F. General Sherman (Great Commanders series). New York, 1899. ♦♦♦ United States Govern- ment. Official Records of the Union and Confederate Armies,

passim (for Sherman's reports, orders, military correspondence, and despatches in full). Washington, 1880-98. (j. D. Co.)

Shetland, a county of Scotland composed of a group of islands and rocks lying north-east of Orkney, the shortest distance between the two groups being 50 miles, if Fair Isle, which lies between them and belongs to Shetland, be excluded. About 20 of the islands are in- habited, and 70 others are used for grazing.

Area and Population. ??? The area of the county (foreshore ex- cluded) is 362,615 acres, or about 666 square miles. The popu- lation was in 1881, 29,705; in 1891, 28,711; in 1901, 28,185, of whom 12,430 were males and 16,756 were females. Taking the land area only (352,889 acres, or 551 "4 square miles), the number of persons to the square mile in 1901 was 51, and the number of acres to the person 12 "5. The population decreased between 1881 and 1891 by 3 "4 per cent., and between 1891 and 1901 by 1'8 per cent. Between 1881 and 1891 the excess of births over deaths was 1901, and the decrease of the resident population 994. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899 : ???

Year.

Deaths.

Marriages.

Births.

Percentage of Illegitimates.

1880 1890 1899

500 477 432

Ill

130 128

671 605 597

5-9

2-97

3-0

The following table gives the birth-rate, death-rate, and marriage- rate per thousand of the population for a series of years : ???

1880.

1881-90.

1890.

1891-98.

1899.

Birth-rate . Death-rate . Marriage-rate

22-48

16‘75

3-72

22-19

16-40

4-98

21-01

16-67

6-16

20-23

15.59

4.34

21.42

15.53

4-24

There were 67 Gaelic-speaking persons in the county in 1891, and 27 foreigners. Valuation in 1889-90, ££49,273 ; 1899-1900, ££46,680. £££

Administration. £££ Shetland unites with Orkney to return a member to Parliament. Lerwick (4061), the county town, is the only police burgh. There are 12 civil parishes, with a combina- tion poorhouse at Lerwick ; the number of paupers and dependents in September 1899 was 999. Shetland forms a sheritfdom with Orkney and Caithness, and there is a resident sheriff-substitute at Lerwick.

Education. £££ Twelve school boards manage 61 schools, which had in 1898-99 an average attendance of 3450, and 3 voluntary schools (2 Church and 1 Episcopal) had 163. Lerwick has a secondary school, and 2 other schools in 1898 earned grants for giving higher education. The "residue" grant is spent on swimming and navigation classes.

Agriculture. £££ In 1898 the percentage of cultivated land was 16-5. Of 3550 holdings in 1895 the average size was 16 acres. The percentage under 6 acres was 20-00, between 5 and 50 acres 77-44, and over 50 acres only 2-56. There were 710 crofts under 5 acres. 2391 between 5 and 20 acres ; 50 holdings between 50 and 100, 32 between 100 and 300, and 9 above 300, 3 being over 1000 acres. Crofting agriculture is still primitive, tillage being done with the spade to a large extent, and seaweed being the principal manure applied to the exhausted ground. Little pro- gress has been made, notwithstanding considerable reductions of rent. From the

commencement of the operations of the Crofters' Commission in 1886 down to the end of 1898, 2496 applications to fix a fair rent had been dealt with by the Com- missioners, and rents amounting to ►►11,203 reduced to ►►8015, while arrears of ►►13,438 had been cancelled to the extent of ►►9512. Of applications to enlarge holdings 217 had been dealt with and 936 acres added to existing crofts. The following table gives the principal acreages at intervals of five years from 1885 : ►►►

Year.

Area under Crops,

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

FaUow.

1885 1890 1895 1899

58,538 69,548 57,673 59,687

10,415 9,532 9,342 9,327

4622 6028 4997 4929

1045 1086 1090 1246

42,673 43,094 41,764 43,717

783 809 480 469

The following table gives particulars of the live stock during the same years ; the "horses " are Shetland ponies : ►►►

Year.

Total Horses.

Total Cattle.

Cows or

Heifers in

Milk or Calf.

Sheep.

Pigs.

1885 1890 1895 1899

5,605 4,803 5,603 6,863

22,377 18,876 18,883 18,859

8465 8020 7768 7994

84,727

98,320

102,098

110,795

3497 3129 2901 2301

In 1891, 1984 men and 606 women were returned as being en- gaged in agriculture. There is no wood in the county.

Industries. ??? Though the knitting of fine shawls and other articles with the wool of the native sheep is the distinctive industry, fishing is the

mainstay of the greater part of the population, the men being generally both crofters and fishermen. There are 52 stations in the Shetland fishery district, some statistics about which are given in the subjoined table :
* *

Year.

Boats.

Value of Gear.

Resident Fishermen and Boys.

Total Value of all Pish.

No.

Tons.

Value.

1890 1898 1899

865 789 807

5195 7604 – 8045

* 28,286 38,459 43,707*

* 29,455 26,311 27,827*

2884 3043 3059

* 89,604 134,237 263,888*

Of the total value of fish in 1899, 234,766 was the value of herrings only. The total number of persons engaged in the district in 1899 in various branches of the sea fisheries was 8294. The industrial population

in 1891 numbered 1602 men and 5318 women, of whom 4862 were engaged in the manufacture of textiles.

Communication with the mainland and between the islands is noticed under Lerwick.

See Jacob Jacobsen. The Old Shetland Dialect and Place Names of Shetland. Lerwick, 1897. ❓❓❓ Handbook to Lerwick Town Hall, 1864. ❓❓❓ W. F. Clark. Northern Gleams. Lerwick, 1898. ❓❓❓ J. Nicolson. Sprigs o' Aithstin' Hedder. Lerwick. ❓❓❓ F. J. Grant. Zetland County Families. Lerwick. ❓❓❓ H. L. Sunby. Birds of Shetland. Edinburgh, 1874. ❓❓❓ R. S. CowiE. Shetland. Aberdeen, 1896. ❓❓❓ C. Sinclair. Shetland and the Shetlanders. Edinburgh, 1840. ❓❓❓ C. Rampini. Shetland and the Shetlanders. Kirkwall, 1884. ❓❓❓ See also Orkney. hff, -wa.)

Shields, North. See Ttnemoute.

Shields, South, a seaport, county, municipal and parliamentary borough, and railway station, Durham, England, in the Jarrow parliamentary division of the county, on the south bank of the Tyiie, at its mouth, ❓❓❓ with stations on the North-Eastern Kailway. The Tyne dock has a water area of 50 acres, the tidal basin of 10 acres, and the quays and yards cover about 300 acres. In 1895 the construction of a new deep-water entrance was completed. Police buildings, erected at a cost of ❓❓ 22,000, were opened in 1893. Population (1891), 78,391 ; (1901),

97,267.

ShigatS^. See Tibet.

Shika.rpur, a town and district of British India, in the Sind province of Bombay. The town is about 18 miles from the right bank of the Indus ; railway station 23 miles north-west of Sukkur. Population (1891), 41,991 ; (1901), 49,491. Shikarpur has always been an important place, as commanding the trade route through the Bolan Pass. The administrative headquarters of the district have been transferred to Sukkur, where the North- western Railway crosses the Indus. It has a large market and

manufactures of carpets, cotton cloth, and pottery. There is a high school and also two printing-presses, issuing two commercial gazettes and a vernaciflar newspaper.

The district of Shikarpur has an area of 9296 sqnare miles. Population (1891), 915,497 ; (1901), 1,018,237, showing an increase

⁂of about 11 per cent, in each decade. Land revenue (1897-98), Hs.36,13,037, the incidence of assessment being Rs.3.3.11 per acre ; ⁂cultivated area, 1,084,603 acres, of which 829,945 were irrigated from Government canals ; number of police, 1059 ; children at school, 28,294, being 2-9 per cent, of the population ; death-rate (1897), 31 '21 per thousand. The principal crops are wheat, Tuillet, pulse, and oil-seeds. Both portions of the district are traversed by the main line of the JS'orth-Western Railway for 170 miles, with 22 stations, and the branch to Quetta runs from Kuk junction for 40 miles past Shikarpur town. Agriculture ⁂entirely depends upon canals from the Indus, and the river occasion- ally causes disastrous floods.

Shildon, a parish, urban district, and market-town of Durham, England, in the Bishop Auckland parliamentary ⁂division of the county, 9 miles west from Darlington by rail. At New Shildon (or East Thickley), a neighbouring village, are extensive railway engine and waggon works belonging to the North-Eastern Eailway Company. The population of the urban district (Shildon and East Thickley) was in 1891, 9537; in 1901, 11,759.

Shillong', a town of British India, in the Khasi Bills district of Assam, of which province it is the capital. It is situated in 25⁂32' N. and 91⁂55' E., on a plateau 4978 feet above the sea, 64 miles by cart-road south of Gauhati, on the Brahmaputra. Population (1881), 3640; (1899), 6720; municipal income (1896-97), Ks.41,276; ⁂death-rate (1891), 24'26 per thousand. Shillong prac- tically dates from 1864, when the district headquarters were transferred from Cherrapunji. It was chosen as the

seat of government in 1874, when the province of Assam was constituted. Every one of the public buildings and houses that quickly grew up was levelled to the ground by the great earthquake of 12th June 1897. Canton-ments are provided for a battalion of Gurkhas, 789 strong in 1898, with two guns, and it is the headquarters of a company of volunteers. There is a Government high

school, with 155 pupils in 1896-97, and a training school for masters. The school for European children has been discontinued, but will be re-established by the Government. There are three printing-presses, one of which issues two monthly periodicals in the Khasi language.

Shiloh, a name applied to a locality in Hardin county, Tennessee, U.S.A., about an old meeting-house called Shiloh church. The place has become famous as the scene of one of the fiercest battles of the Civil War. It is situated in the southern part of the state, about two miles west of Pittsburg Landing, on the Tennessee river, and occupies a plateau about haK a mile long and 80 feet above the river. On this ground, in April 1862, the Union forces, under General Grant, and the Confederates under Generals Johnston and Beauregard, fought fiercely for two days. The Confederates, who knew that General Buell was on his way to join Grant, determined to destroy the army of the latter, if possible, before his arrival. The attack was unexpected by the Union troops, and the first day's fighting resulted in driving them in disorder to the bluff at Pittsburg Landing, leaving a considerable number of guns and prisoners in the hands of the enemy. During the night, however, Grant was reinforced by Buell's and Lew Wallace's forces, which gave him about 50,000 fight- ing men, half of whom were fresh troops. To oppose them the Confederates had only about 3(),000. General Johnston had fallen in the first day's fight, and Beauregard was now in command. The Confederates, after a stubborn resistance, lost all the ground gained the first day and were forced back to Corinth, Mississippi, which place they soon afterwards destroyed and evacuated. More than 100,000 men were engaged in this battle, and the losses on both sides were enormous, sometimes estimated as high as 22,000 men. This is sometimes called the battle of Pittsburg Landing.

SHIP.

I. History and Statistics.

BEFOEE steam was applied to the propulsion of ships, the voyage from Great Britain to America usually took some weeks ; at the beginning of the 20th century the time was about six days. Similarly, the voyage to Australia, which took about thirteen weeks, was reduced to about thirty days, although it cannot be said that exceptionally fast vessels are employed in this service. The fastest of the sailing tea-clippers required about three months to bring the early teas from China to Great Britain; they are now brought to London by the ordinary P. and O. ???service in six weeks. In further illustration of the progress made, it may be mentioned that there are Atlantic liners now running between England and America which maintain a speed of 23 knots over the whole course, as compared with the 12 or 15 knots of a few years ago. The accommo- dation in the passenger ships above referred to is quite palatial compared with that in the corresponding wooden sailing ships of a date fifty or sixty years earlier, and the fare provided does not differ greatly from the best that can be obtained on shore.

The changes from sail power to steam power for propul- sion, and from wood to iron and steel for constructional purposes, proceeded together, though at first very slowly. Knowledge of the theory of steam and the steam engine was slowly acquired ; and for many years mechanical engin- eering as an art failed altogether to keep pace with theory. Thus the marine steam engine was at first a very imperfect

motor, and the services upon which steamships could be used to advantage were, in consequence, much restricted. There was, moreover, a national prejudice against steamships of any kind. Our fathers saw, with regret, the possibility and probabihty that the sailing ships upon which they prided themselves, and which had arrived after many years, even centuries, at something like perfection, might pass out of existence altogether. A similar prejudice existed against the substitution of iron for wood in shipbuilding. As regards warships, ” the Wooden Walls of Old England,” by which England had to a considerable extent achieved her

greatness, were held almost in veneration, and it was with profound regret that they were at last admitted to belong to the past.

It is recorded that an iron boat, intended apparently for passenger service, was built and launched on the river Foss, in Yorkshire, in 1777, and shortly after- wards iron was used for the shell plating of ^ ??? ” “‘ lighters for canal service. One of these, having struction. its shell constructed of plates five-sixteenths of an inch thick, was built near Birmingham in 1787. About the same time parts of wooden ships began to be replaced by iron, partly, no doubt, with the view of increasing the strength of the structure, but also because of the increasing difficulty of obtaining suitable shipbuilding timber in suflicient quantities for the requirements of the day. The first iron strengthenings thus introduced were beam knees ; early in the 19th century, iron “diagonal riders” for providing the longitudinal strength were introduced by

Sir Robert Seppings, and from this period down to the present day iron strengthenings for resisting both trans- verse and longitudinal strains have been generally used in wooden ships. The introduction of iron as a recognized material for ship construction is usually given as dating from 1818, when the lighter Vulcan was built on the Monkland canal, near Glasgow.

The advantages of the new material were admitted for service on canals, where there was no risk of grounding on a dangerous bottom, but they were not so readily ad- mitted for river service, and still less for coasting and sea voyages. Among the early objections to the use of iron were : (1) from its weight it could not be expected to float, and was therefore unsuitable for the construction of a floating body; (2) when a ship constructed of this material grounded and was exposed to bumping on a shore, the bottom would be easily perforated ; (3) the bottom could not be preserved from fouling by weeds and bar- nacles ; and (4) the iron

affected the compass, making it untrustworthy, if not useless. Gradually, however, the material made its way, and the objections to it proved to be for the most part untenable. Objection (1), although often repeated, was proved to involve a fallacy. With regard to objection (2), it was found that iron ships might ground and be subjected to a great deal of bumping and rough usage without being destroyed, and that, on the whole, they were better off -in this respect than wooden ships. On more than one occasion when iron and wooden ships were stranded together by the same gale and in approximately the same circumstances, the iron ships were got off and, apart from local injury, were found to be little the worse for the grounding, while the wooden ships were either totally wrecked, or, if got off, were strained to such an extent as to be ruined. The power of resistance of iron ships to the strains produced by grounding received, in 1846-47, a remarkable confirmation in connexion with the grounding of the Great Britain, the first large screw steamer built of iron. This ship had been initiated by, and was built under the supervision of, Mr I. K. Brunei, who had bestowed much attention upon the details of her construction. In 1846 she ran ashore in Dundrum Bay, in Ireland, and settled on two detached rocks ; and although she remained aground for eleven months, including a whole winter, she was subsequently got off and repaired, and afterwards did good service. As regards the fouling of the bottom, this evil, although not preventible, can be lessened materially by frequent cleaning and repainting, provided, of course, that docks are available. The ??? fourth objection, the effect of iron on the compass, was a matter of very serious moment, and the attention of one of the leading scientific men of the day (Sir G. B. Airy) became directed to it. After experimenting with the Rainbow at Deptford and the Ironsides at Liverpool, Sir G. B. Airy in 1839 read a paper on the subject before the Royal Society, and the rules which he gave for the correction of the error caused by the iron at once became the guide for future practice. Besides the above, a further objection was raised which applied only to warships, namely, the nature of the damage which would be done to an iron ship by the enemy's shot : this also was found to be less serious, when proper appli- ances were supplied, than the damage done in the same circumstances to a wooden ship. Thus during the Chinese war in 1842 the Nemesis, an iron vessel, was able to repair her damage from shot in twenty-four hours at the scene of the fight, while some wooden ships

which were damaged to about the same extent had to go to Bombay, the nearest port at which repairs could be carried out.

Steel, as a material for shipbuilding, was introduced under modern conditions of manufacture during the years

1870-75. It is a homogeneous metal, stronger than iron, and of a more uniform and more trustworthy character. Its quality is to a considerable extent independent of the skill of those employed in its manufacture, whereas iron is produced by a laborious and unhealthy process, and is largely dependent for its quality on the skiU of the work- men. Among the advantages which experience has proved iron and steel to possess over wood for the purposes of ship construction are : (1) the structure of the ship has less weight ; (2) it has greater durability ; (3) the requisite general and local strengths are much more easily obtained.

The importance of the first of these advantages can scarcely be overstated. The primary object of a particular ship is to carry cargo or passengers, or both, from place to place, at a given speed (in the case of a warship, the armament, ammunition, armour, &c., constitute the weight to be carried) ; and since at the maximum draught at which the vessel can properly and safely proceed on her passage the total weight of vessel, cargo, &c., complete, must be a definite quantity, namely, the weight of the water disjjlaced by the ship, it follows that the less the weight required for the structure of the ship, the greater is that available for the cargo, &c.

As to durability, in wooden ships the chief source of deterioration is dry-rot, in iron or steel ships the wasting of the surfaces, especially of such portions of the outer surfaces of the bottom plating as are frequently left bare of paint and exposed to the sea, and of the inner surfaces of the bottom in machinery spaces, &c. If dry-rot can be prevented, the life of the wood ship will be lengthened ; so also will the life of the iron or steel ship if the surfaces can be kept covered with paint, to prevent the action of air and water. With both wood and iron or steel ships, if the parts which have become deteriorated can be removed and replaced, this is usually worth doing whten the deterioration is only local. At the end of the 18th century the preservation of wood was not so well understood as it is at the

present day, and teak, one of the most durable of woods, was, in Great Britain at least, little known. The ships for the Royal Navy as then constructed were only expected to be available for service some fifteen or twenty years. The ships built for the East India Company made, on an average, four voyages, which occupied eight years. This at one time was considered the vessel's hfe, so far as the Company's service was concerned ; but subsequently, if on examina- tion at the expiration of that time they appeared worth repairing, this was done, and they were allowed to make two more voyages. It was very unusual for one of these ships to make more than six voyages ; after this they were sold for other services, or broken up. In certain cases, however, ships lasted a considerable length of time ; a number of vessels built in the 17th century continued in the service of the Royal Navy until the middle of the 18th century, though with a reduced number of guns. Of small wood merchant vessels there are in- stances of the attainment of very remarkable age. The collier brig Brotherly Love, of South Shields, was over one hundred years old when she was broken up ; and the schooner Polly, built in 1805, was stUl sailing in 1902 ; as also was the brig Hvalfishen, built at Calmar in Sweden in 1801. The dimensions of the last vessel are: length, 88 ft, 8 in. ; breadth, 21 ft. 2 in. ; depth of hold, 14 ft. 7 in. ; and her gross tonnage, 211. We have so far had very little experience concerning the life of iron and steel ships properly taken care of, as in most instances these ships have been condemned only because they were obsolete ; but when broken up, after twenty or even forty years' service, those parts which by accident or intention had remained properly covered and protected were found very

little the worse for wear. Thus the inner surfaces of the bottoms of such vessels, coated with cement, have been found to be in nearly as good condition as when the ships were first built.

That general and local strength is more easily obtained in an iron or steel ship than in a wooden one follows partly from the fact that the weight required for the structure is less in the former than in the latter, and also

from the fact that iron and steel are more suitable materials for the purpose. They can be obtained in almost any desired shape, the parts can be readily united to one another with comparatively little loss of strength, and great local strength can be provided in very little space.

For some purposes, and in some markets, wood is still in favour; for instance, for resisting ice-pressure. In scientific expeditions to the Polar regions, also, it is of the highest importance to avoid any disturbance of the compass, and this can be ensured by constructing the vessel of wood, with metal fastenings. The Fram, built in 1892 for Nansen's Arctic expedition, was of wood, her outside planking, in three thicknesses, amounting in the aggregate to from 24 in. up to 28 in. ; she was 117 ft. long, rigged as a three-masted schooner, and provided with auxiliary machinery working a screw propeller. The America, fitted out for the Ziegler expedition to the North Pole, was an old Dundee whaler (the Esquimaux;), and was reported to be still a " stout " ship with timbers as sound as on the day they were put in thirty-six years before. She is 157 ft. long, 29| ft. beam, l9^ ft. deep, net tonnage 466 ; her engines have a nominal horse-power of 100, and she has a lifting screw. During the year 1901 a wood vessel, the Discovery, 172 ft. in length, was built at Dundee for Antarctic exploration ; and in Germany another wood vessel for similar service has been constructed. On the other hand, in the Ermach, built on the Tyne for ice-breaking in the Baltic and for pioneer work farther afield, steel has been used as the most approved material for the service contemplated, and this after previous experience with similar vessels.

Some progress had been made in the introduction of

steam propulsion before the end of the 18th century, but

the advance became more rapid in the 19th.

steam pro- J ^j^g early steam vessels paddle-wheels only pulsion. .
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were used for propulsion.

In 1801-02 the Charlotte Dundas, one of the earliest steam vessels, was constructed by Symington in Scotland. She proved her capability for towing purposes on the Forth and Clyde canal, but, although successful in the work for which she was intended, did not see much service, as the canal-owners feared the wash of the steamboat would damage the banks of the canal. About the same time Fulton made his experiments in France, and after visiting Scotland and witnessing the success of the Charlotte Dundas, constructed the Clermont on the East Hudson river in America in 1807. The engines for this vessel were obtained from Boulton and Watt, of England. She ran as a passenger boat between New York and Albany, and at the end of her second season proved too small for the crowd that thronged to take passage in her. In 1809 the Phosnix made the passage from Hoboken, in New Jersey, to Philadelphia, and was thus the first steamer to make a sea voyage. In 1812 Bell began running his steamer Comet, with passengers, between Glasgow, Greenock, and Helensburgh : she was 42 ft. long, 11 ft. broad, 54 ft. deep, and her engine had one cylinder 11 in. in diameter, with a 16-in. stroke. Owing to the success achieved by these and other vessels in America and Great Britain, steamers soon began to make their appearance on many of the principal rivers of the world. Early in 1814 there were five steamboats on the Thames, and the steam- boat Margery, built on the Clyde, was brought through the Forth and Clyde canal and round by the east coast to the Thames. In the same year a writer in the Gentleman's Magazine was able to say : " Most of the principal rivers in North America are navigated by steamboats ; one of them passes two thousand miles on the great river Mississippi in twenty-one days, at the rate of five miles an hour against the descending cuiTent." In 1816 the first steam passenger – boat ran across the English Channel from Brighton to Havre, and a line of steamers was

started to run between New York and New London. All of these vessels were built of wood ; but in 1820 the first iron steamship, the Aaron Manby, was constructed and employed in a direct service between London and Paris. In 1822 a return was made to the House of Commons showing the times occupied by steamers as compared with sailing vessels on some thirty coasting routes : the average speed given for steamers in the best of these was from eight to nine knots, while the average time taken varied

from one-half to one-sixth (or even less) of the time taken by the sailing vessels.

Steam vessels were employed at a very early date upon the mail services, for besides being very much quicker than the sailing vessels, they were practically independent of the direction of the wind, and to a considerable extent of the weather ; consequently the regularity of their passages contrasted very favourably with the irregular times kept by the sailing vessels. The mail service across the Irish Channel, between Holyhead and Dublin, was especially uncertain in the days of the sailing packets, frequently occupying three or four days, and occasionally as much as seven and nine days. All this was altered when in 1821 the steamers Royal Sovereign and Meteor were placed on the service. The advantages were so apparent that steam mail packets between Great Britain and the Continent, and on many other services, were soon established. The mail boats had been for many years owned by the Crown, but in 1833 the carrying of the mails to and from the Isle of Man, and between England and Holland and Hamburg, was entrusted to private companies. Marked improvement in the services, and especially in the boats employed, resulted from the competition to secure the distinction and other advantages of carrying His Majesty's mails. An imtermediate stage followed, extending over a comparatively short period, during which the Crown still held many of the mail boats, while in a considerable number of cases the mail services were let to private companies. After this the British Government abandoned altogether the policy of being the owners of the boats, and ever since, the mail services have been competed for by private companies.

The Savannah was the first steamship to cross the Atlantic. She ran from Savannah to Liverpool in 1819 in twenty-five days, under steam, however, only for a portion of the time. She was built at New York as a sailing ship, but before launching was fitted with steam power, the paddle-wheels being arranged to be removed and placed on deck when not required. She was 130 ft. long, 26 ft. broad, 16^ ft. deep, and of about 380 tons. The success of the Enterprise, of 470 tons, which made the voyage from London to Calcutta by the Cape of Good Hope in 1825 in 103 sailing days, is noteworthy. The distance is 11,450 nautical miles, and the vessel

was under steam for 64 days and under sail for 39 days. The steamer afterwards (1 829-30) made the trip between Bombay and Suez in 54 days, in furtherance of a scheme to reach the former place from London by the Red Sea route. The year 1838 witnessed the successful trans-Atlantic voyages of the steamers Sirius and Great Western. The latter vessel, built under the advicA of I. K. Brunei, the engineer of the Great Western Railway Company, was the first steamer actually constmcted for the trans- Atlantic service. She was built of wood, her dimensions being length 212 ft., breadth 35^ ft., depth 23|: ft., and ton- nage 1340 B.O.M. ; and her total displacement on a draught of 16 ft. 8 in. was 2300 tons. Although not originally buOt for the service, the Sirius was subsequently placed on it at the recom- mendation of Mr M'Gregor Laird of Birkenhead. This vessel also was built of wood, and was 178 ft. long, 25^ ft. broad, 18J ft. deep, and her tonnage was 703. Mr Laird's arguments in favour of placing the vessel on the trans-Atlantic service throw light on the steaming capabilities of vessels of that day. He pointed to the steamers Dundee and Perth making 11 mUes per hour, " in all weathers, winter and summer, lair and foul"; and to the other vessels making from 10 to lOJ miles per hour. He based his estimate for the coal required on the voyage on a speed of 10 miles per hour and a coal consumption of 30 tons per day, which gave 525 tons for the whole voyage. Finally, he allowed 800 tons, corresponding to the difference of the displacement at 15 ft. load draught and at 11 ft. light draught, so that he had a margin of 275 tons for contingencies. (See also Steamship Lines in this volume.)

All the vessels just named were propelled by paddle- wheels, but in 1843, in the Great Britain, screw pro- pulsion was adopted for the Atlantic service. The screw propeller had been introduced a few years before by Erics- son, of Sweden, and by F. P. Smith, of Hendon, in Great Britain. The Archimedes, fitted by the latter investigator, had, after some very remarkable trials, been acquired by Brunei for further experiments, and as a result the paddle- wheel engine design, originally prepared for the Great Britain, was discarded, and a design for screw engines

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substituted. The advantages of the screw over the paddle- vfheel for vrar-vessels were recognized about this time by the British Admiralty. These advantages were chiefly that the screw did not interfere to the same extent as the paddle-wheel with the sailing qualities of the ship, and that it was protected against injury in action by its position below the surface of the water, while the latter was very liable to injury. In a few years the screw almost entirely superseded the paddle-wheel for war-vessels, and in 1854, during the war with Eussia, Great Britain possessed a screw steam fleet, including all classes of ships, buUt of wood.

The performances of the Great Western and other vessels had demonstrated that ships could traverse the oceans of the world by steam power alone, but great advance had to be made in the marine engine before the ordinary trade could be carried on by its means with economy. In the early marine engines only one cylinder was provided, and various means were employed for transmitting the power to .

the paddle shaft ; later came the oscillating |>-fc4^ cylinder engine and the diagonal engine, the -‘ N latter being the type of paddle engine now most frequently adopted in Great Britain. With the introduction of the screw-propeller the arrangements became much modified. At first the engines were run at comparatively low speeds, as in paddle-boats, gearing being supplied to give the screw-shaft the number of revolutions required, but direct- acting two-cylinder engines gradually replaced the geared engines. The compound engine was first adapted success- fully to marine work by John Elder in 1854, and in time the direct-acting vertical engines, with one high and one low pressure cylinder, became the common type for all ships. The boiler pressure, moreover, in 1854, had been raised to 42 Bb per square inch. The further change, accompanying still higher pressures of steam, from com- pound to triple-expansion engines was, like many other changes, foreseen and in some measure adopted by various workers at about the same time, but the first successful appli- cation of the principle was due to Dr A. C. Kirk. In 1874 he fitted a three-crank triple- expansion engine in the Propontis. The boiler used

proved a failure, but in 1882 he fitted a similar set of engines in the Aberdeen, with a boiler pressure of 125 K), and the result was entirely successful. All modern marine engines of high power have either triple or (in a few cases) quadruple expansion.

Notwithstanding the early advances made in the introduction of iron for construction purposes, and steam for that of propulsion, the bulk of the trade of the world was still carried ou as recently as 1870 by wooden sailing ships. At that date, however, the building of wood vessels had already begun rapidly to decline, so far as Great Britain was concerned, and this decline has continued at an almost uniform rate down to the present day. On the other hand, the construc- tion of iron vessels had in 1870 begun to increase at a grea,ter rate than that of the decline in the construction of wood vessels ; and including steel with iron ships, this increase, apart from fluctuations due to waves of trade and depression, has continued down to the present time. For some years previous to 1870 the construction of sailing vessels had gradually decreased, the decrease nearly corresponding to the rate of increase in the construction of steam vessels. But while from 1870 nearly down to the present day, apart from fluctuations, the construction of sailing vessels has remained generally constant, the construction of steam vessels has, on the other hand, rapidly increased. These changes for Cireat Britain will be clearly seen on examination of the figures given in Table I., but they are represented graphically and much more completely by the curves in Figs. 1 and 2.

It will be seen from Table I. that during 1860 there were 181

iron ships, of 100,830 tons aggregate, and 835 wood ships, of 161,180 tons aggregate, added to the register of the United Kingdom. Soon after 1860 the production of iron ships ex- ceeded the production of wood ships, and whilst in 1870 there were 445 iron ships, of 408,510 tons aggregate, added to the register, there were only 529 wood ships, of 80, 262 tons, added to the register ; during 1880 there were 431 iron and steel ships, of 525,568 tons, added, and only 293 wood ships, of 19,938 tons. The general increase in iron and steel ships and the diminution in wood ships continued, until in 1900 there were 613 iron and steel ships, of 1,128,283 tons, and only 223 wood ships, of 12,527 tons, added to the

register. It will be seen from Table I., but more clearly from Fig. 2, that although during the last few years of the period the amount of sailing tonnage registered fell off consider- ably, yet for some twenty to thirty years previously the amount registered did not show any general falling-off'. On the other hand, a rapid advance in the construction of steamships is shown ;

Fig. 1. ???Gross tonnage of all wood, composite, iron and steel merchant vessels over 100 tons gross built in and added to the register of the United Kingdom during each year from 1860 to 1901.

in 1870 there were 364,860 tons added to the register, in 1880 there were 485,661 tons added, and this general rate of increase was maintained until in 1900 the total added reached 1,123,074 tons. The variations in the rates of production, due to fluctuations in trade and other causes, will be seen at a, glance from Figs. 1 and 2, in which the ordinates of the curves represent tons of shipping produced and registered in the United Kingdom during the year, and the abscissae represent time. It will be seen that the decline in the production of wood and composite vessels has been fairly uniform since 1870, whereas the variations in the production of iron and steel ships have been exceedingly great. These variations synchronize with the improvements and depressions in trade which took place over the period named. The curves in Fig. 1 show how

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Fig. 2. ???Gross tonnage of all sailing and steam merchant vessels over 100 tons gross built in and added to the register of the United Kingdom during each year from 1860 to 1901. The dotted lines may be taken as representing the average production from year to year.

rapidly steel displaced iron as a material for shipbuilding. So rapid indeed was the change that the great depression between 1883 and 1886 had little or no effect in reducing the production of steel ships during these years. As might have been expected, the variations in the curve of steam vessels (Fio:. 2) correspond generally to the variations in the curve of iron and steel vessels in Fig. 1.

From Table II., which gives the distribution of ownership of existing merchant vessels and other vessels, excepting warships, of 100 tons and upwards throughout the world, it appears that the total tonnage of the existing shipping, excluding vessels under 100 tons, but including the wood vessels on the Great Lakes of America, is about 30J millions. Of this total, rather more than one-fifth is in sailing vessels, and the remainder in steam vessels. Taking the number of ships instead of their aggregate tonnage, the sailing vessels are 43 per cent, of the whole. Out of the 30J million tons. Great Britain and her colonies own about 14J millions, or 48 per cent, of the whole, 12J millions being steamers and 2 millions sailing vessels. Next to Great Britain, the largest ship- owning country of the world is the United States of America, with 3 million tons of shipping, nearly 10 per cent, of the total. Then come in order Germany, with nearly 3 millions, 9J> per cent, of the total ; Norway, with 5 '3 per cent. ; France, with 4 '6 per cent. ; Italy, with 3 '6 per cent. ; and Eussia and Spain, with 2 '6

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Table I. ???Shomng the Number, Tonnage {Gross and Average), and Description of all Vessels {excluding Warships) built in a/nd added to the Eegister of the United Kingdom during each year enumerated.

Year.

Mode of Propulsion.

Wood and Composite.

Iron.

Steel.

Totals.

Average

Gross Tonnage.

No.

Gross Tonnage.*

No.

Gross Tonnage.*

No.

Gross Tonnage.

No.

Gross Tonnage.

1860 .

Sail . Steam

786 49

154,130 7,050

32

149

14,290 86,540

818 198

168,420 93,590

206

473

1865 .

Sail . Steam

806 38

160,430 5,780

116 344

88,970 287,360

922 382

249,400 293,140

270 767

1870 .

Sail . Steam

478 51

72,9/0 7,290

63

382

50,940 357,570

541 433

123,910 364,860

229 843

1875 .

Sail . Steam

373 66

46,060 8,740

193 291

206,110 281,390

.566 357

252,170 290,130

446 813

1880 .

Sail . Steam

273 20

18,159 1,779

39 362

40,015 447,389

4 26

1,671 36,493

316

408

59,845 485,661

189 1190

1881 .

Sail . Steam

259 30

16,448 1,659

50 411

68,650 590,503

3

34

3,167 68,366

312 475

88,265 660,528

283 1391

1882 .

Sail . Steam

246 30

13,066 1,784

83 446

112,852 672,740

8 65

12,478 115,449

337

541

138,396 789,973

411 1442

1883 .

Sail . Steam

229 30

13,551 1,651

72 548

114,698 742,292

11 92

14,193 141,552

312 670

142,442 885,495

457 1322

1884 .

Sail . Steam

277 38

17,142 2,364

93 413

130,017 456,982

9

67

1

10

3

15

3,360 8,978

379 518

160,519 568,324

424 1097

1885 .

Sail . Steam

266 37

17,841 2,751

144

177

160,084 148,508

27 122

0,569 4,249

437 336

208,444 305,508

477 909

1886 ..

Sail . Steam

226 30

14,266 1,467

55 119

97,713 82,201

31 124

30,588 160,973

312 273

142,567 244,641

457 896

1887 .

Sail . Steam

170 24

8,782 1,097

27 66

44,979 40,070

29 196

25,994 326,530

226 286

79,755 367,697

353

1286

1888 .

Sail . Steam

177 23

8,686 2,370

13

87

18,882 31,697

33 321

42,666 571,437

223 431

70,234 605,504

315 1405

1889 .

Sail . Steam

157 25

8,256 1,368

11 97

12,385 46,402

47 411

90,469 783,193

215 533

111,110 830,963

517 1559

1890 .

Sail . Steam

142 26

7,704 1,326

6 110

5,911 40,144

59 432

96,374 817,010

207 568

109,989 858,480

532 1515

1891 .

Sail . Steam

156 25

8,541 1,212

3

167

1,544 31,381

93

388

178,593 730,051

252 580

188,678 762,644

749 1315

1892 .

Sail Steam

151 19

8,372 1,026

6 86

5,121 18,937

128 365

260,874 660,847

285 470

274,367 680,810

963 1449

1893 .

Sail . Steam

154 27

7,980 1,551

4 64

418 12,458

66 328

113,097 622,099

224 419

121,495 636,108

542 1518

1894 .

Sail . Steam

155 26

7,570 1,183

3 65

207 12,400

67 389

83,167 751,668

225 480

90,944 765,251

404 1594

1895 .

Sail . Steam

150 35

7,529 1,579

9

66

782 .9,897

32 379

41,313 736,412

191 480

49,624

747,888

260 1558

1896 .

Sail . Steam

161 17

7,519 591

5 79

792 11,593

36 398

37,709 750,106

202 494

46,020 762,290 ,

228 1643

1897 .

Sail . Steam

183 33

8,317 1,581

2 63

232 9,974

34 366

28,481 658,646

219 462

37,030 670,201

169 1451

1898 .

Sail . Steam

196 20

8,813 765

6 80

798 13,654

40 546

8.456 996,814

242 646

18,067 1,011,233

75 1565

1899 .

San . Steam

16J

29

7,342 1,497

2 64

182

12,184

60 534

11,757 1,152,999

227 627

19,281 1,166,680

85 1861

1900 .

Sail . Steam

159 64

8,718 3,809

5

86

420 16,375

46 476

8,598 1,102,890

210 626

17,736 1,123,074

84 1794

1901 .

Sail . Steam

146 83

???7,826

5,479

2

14

174 2,474

54 469

22,118 1,115,227

202 566

30,118 1,123,180

149 1984

The above table lias been taken from information supplied to Lloyd's Registry by the Registrar-General of Shipping.

- *As no actual returns are available for the gross tonnages for the years from 1860 to 1879 inclusive (only net tonnages having been recorded), the gross for these years are only approximate, and are based on the relation of gross to net for the years 1883 to 1900.*

per cent. each. The leading particulars as to the distribution of ownership of the merchant shipping throughout the world for 1873, 1890, and 1901 respectively are represented graphically in the three diagrams given in Fig. 3. These have been constructed from particulars given in Table II. and similar tables for 1873 and 1890. "Warships, all vessels under 100 tons, and the wood vessels on the Great Lakes of North America, unless known to be employed in sea trade, are not included. The total tonnage owned throughout the world in these years, with these exceptions, is represented by squares drawn to the same scale, and these squares are

divided up amongst the principal countries owning shipping, a small area on the right-hand side of each representing a number of holdings too small to be shown separately. Part of each holding is shaded so as to show what portion of this is sailing tonnage and what portion is steam tonnage. The total tonnage owned is given in

the heading, and this is represented by the square shown for each year. The percentages owned by various countries are tabulated ; and on each square the proportion of the shipping of the day which was severally steam and sailing is also recorded. For 1890 and 1901 in Fig. 3 there is also shown the distribution of the total as regards materials of construction in each country. The tonnage of the shipping of the world has advanced at an increasing rate for many years. The character of this rate will be gathered at once from the data given in Fig. 3. In 1873 Great Britain and her colonies owned 43i per cent, of the shipping of the world, and this number rose in 1880 to 52 per cent. ; but in 1900, although the advance in the shipping of Great Britain and her colonies had continued approximately at the same uniform rate, such was the increasing rate of the advance of the world's shipping that the percentage owned by the British Empire had fallen to 48-65.

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Greece

Sweden

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*_ ^ , -, Wood **

steel Iron Lomposite

/9-37 46 ~~20 34~~-4aX

Steam Steam

56-56

Sailing

J5-33%

Sailinc

*GreaZ Britain *

Sc CcJorties

U.S.Mrrurica ‘^cru^ai/ ►►►►►►►GerTnany ►►►Franc►►-Italy ►►► ►►► ►►►–

~~Sv/cd^n, ???~~, -Russia. –

/-Greece —Den.mti,rk

-^ujtna-ffujiffitrjj 1 2i- ???Turkey { f-t???

???Other CoxmlrieJt i 70 ???

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steel Iron Composite

S0-S4- S5 25 /5-4-/ %

Steam

75- 66

Sailing

SGrealBrttain > (& Colonies (

U S ???^Trieriio. ^Gerrrvtmy I ^JNcritfcly ???

-J^rance

‘Italy

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SncLtn

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HollofLd

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OUicr CoujUrUs 3 73

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Scale

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Fiff. 3. ??? Distribution of ownership of merchant shipping throughout the world. The tonnages are gross, and include, so far as ascertainable, those of all vessels over 100 tons in existence at the dates specified, with the exception of wood vessels on the Great Lakes of North America.

^teel

98-21

Iron Woods,

0 66 ^CComposite

Steam

Sailing

11-26 %

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J)ertrrvar^ ??? ???

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Scale

— ^00,000 Tons,

FiQ. 4. *Merchant shipping built in each of the countries of the world in 1900. The tonnages are gross, and include, so far as ascertainable, those of all vessels over 100 tons gross, except wood vessels on the Oreat Lakes of North America.*

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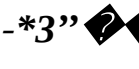

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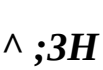 ***ss|***

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- ***1*** 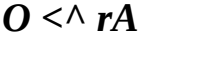 ***(***

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* 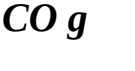 *

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This decline has been chiefly due to the increasing rate at which the shipping of the United States of America and of Germany has advanced.

Table III. gives the output of merchant and other vessels throughout the world in 1900, excluding warships, all ships of less than 100 tons, and the wood vessels of the Great Lakes of North America. It wiU be seen that the total output for the year was 2,343,854 tons, of which 1,509,837 tons, or 65 per cent, of the whole, was built in the United Kingdom and the British colonies; 13 per cent, by the United States of America; 9 ‘3 per cent, by Germany ; and 4 ‘5 per cent, by France. The leading par- ticulars given in Table III. are represented graphically in Fig. 4, which is similar in its construction to the diagrams of Fig. 3. The total tonnage built in 1900 is made up of 972 steamers, of which 59 were wood or composite, and 913 of iron or steel ; and 324 sailing vessels, of which 218 were wood or composite, and 106 of iron or steel. Of the 913 steamships built of iron or steel, 70 only were of iron, and these were all below 400 tons each. Thus iron has practically ceased to be used, except for some special purposes. Forty steel sailing ships of over 1000 tons were built in France, their aggregate tonnage being about 93,000, the production of these vessels being no doubt due in large measure to the French shipping bounties, which favour their construction. The relative sizes of the iron and steel ships built in different countries is worthy of note : thus the mean tonnage of those vessels built in Germany was 2354 ; of those built in Italy, 3626 tons ; whilst of those built in Great Britain it was only 2258 tons.

The average increase in size of ships registered in the United Kingdom from 1860 down to the present time is well shown by the figures of Table

I. For iron and steel ships combined the average size of those registered in 1860 was 560 tons ; in 1870 it was 920 tons ; in 1880, 1220 tons ; in 1890, 1580 tons ; and in 1900 it was 1840 tons. These figures may be taken as representing the general increase throughout the world ; but as in these averages large numbers of comparatively small vessels are included, the vast increase in the number of large-sized ships which have been built, especially daring recent years, is not adequately represented. Of the vessels built in 1890 only 1 per cent, exceeded 8000 tons in displacement, whereas the vessels of over 8000 tons built in 1900 made up 12 per cent, of the whcjle tonnage. In 1890 there were no vessels built whose displacement exceeded 9000 tons ; in 1900 such vessels constituted 11^ per cent, of the whole, and about f per cent, of the whole were over 16,000 tons.

Meechant Vessels.

Generally speaking, so far as tlie distribution of sails is concerned, except as regards the abolition of studding-sails, the sailing ships of to-day differ little from those ???^" ???' which existed in the middle of the 19th century, and in case of many types at a much earlier period. The change from wood to iron and steel resulted, of course, in some changes in rig, to suit the longer and larger vessels ; and steel masts, with wire rope standing rigging and various labour-saving appliances, have been intro- duced. The larger ships also carry steam winches for various purposes, steam vrindlasses, and steam steering gear, but the general appearance of the vessels has changed very little.*

Barges. ??? Rivers and canals abound with barges of various types, such as the Thames barge, the Tyiie wherry or keel, and the Dutch galliot or pink. The Thames barge, which may be taken as a representative vessel of this class, has a length of from 70 to 80 ft., and a carrying capacity of from 100 to 120 tons on about 6 ft. diaught. Like the Dutch galliot, she is provided with lee-boards, and is fore-and-aft rigged with sprit-sail and jigger.

In recent years the use of barges or lighters has been extended beyond river and canal service, and a rapiiUy increasing numlier are now used, in addition, for sea transport. For example, on the east coast of England

lighters of about 500 tons carrying capacity are used in the coal trade. These are loaded on the Tyne, sent down the river, towed from its mouth to thn Nore, and sent up the Thames to London. By this means the tug spends very little of her time going up and down rivers, and waiting at docks and wharves, and saving is eflfected on account of the small capital cost for the lighters, as well as their low cost of maintenance. The system has been carried much farther on the Great Lakes of North America, where cargo barges are in use of over 350 ft. in length, and ap- proaching 5000 tons displacement when loaded. There, however, it appears to have reached its limit, as the building of such vessels shows signs of falling off in favour of steamers of about the same carrying capacity; but on the east coast of the United States the practice is still growing, and barges, built sometimes of wood and

sometimes of steel, are employed, carrying from 2000 to 4000 tons of coal, oU, grain, &c.

Smacks or Cutters. ❖❖❖ This type of rigging is still largely adopted in the merchant service for small vessels, usually called smacks, of a length, say, from 60 to 90 ft., and a displacement from 150 to 200 tons. They are single-masted, sharp-built vessels, provided with fore-and-aft sails only, and fitted with a nmriing- bowsprit ; they have no standing jib stay. Such vessels were at one time generally used for coasting passenger traffic. The term ‘ ” cutter ” is also applied to an open sailing boat carried on board ship.

Schooners, Brigs, and Brigantines. ❖❖❖ A schooner (Fig, 5, Plate I.) is usually a two-masted vessel, with yards only on the foreii(iast and fore-and-aft sails on the main. The foresail is not bent to the yard, but is set flying. In some cases there are no yards at all ; and the schooner is then called a fore-and-aft schooner, a schooner with yards being sometimes called a square-rigged schooner. Before the days Of steam, two- and three-masted. schooners, known as “Fruiterers,” were extensively employed in the fruit trade from the Western Islands, Italy, Malta, and other orange^growing countries to London. In the ‘fifties as many as three hundred were thus employed ; they kept their place till the ‘eighties, and some even yet survive the introduction of steam as a motive power.

They were beautifully modelled craft, and very fast under canvas. A brig is a two-masted vessel having yards, or square-rigged on both masts. A brigantine is a two-masted vessel having the fore- mast square-rigged, as in a brig, the main mast being rigged as in a schooner. Much of the coasting trade of the world is carried on by schooners, brigs, and brigantines. These vessels were formerly employed in the Baltic, and to some extent in the "West Indies and the Mediterranean. Schooners such as the above are usually from 80 to 100 ft. long, 20 to 25 ft. broad, 10 to 15 ft. deep, and have a gross tonnage of 130 to 200 tons. Brigs are generally larger, varying in tonnage from 200 to 350 tons ; they are from 90 to 115 ft. long, from 24 to 30 ft. broad, and from 12 to 18 ft. in depth of hold. Brigantines usually occupy, as to size, a position intermediate between schooners and brigs. Brigs are used in various navies for the purpose of training boys. Some six exist at present in the British navy, and are stationed at Devonport and Portsmouth.

Vessels somewhat larger than two-masted schooners and brigs, but of a similar form, are often rigged as three-masted schooners and as the so-called barquentines. The former is like a schooner with a third or mizzen mast added, this being rigged fore and aft, as is the main mast. The latter resembles a brigantine with a third mast added, which is also fore-and-aft rigged. The two rigs thus very nearly resemble each other : both are square-rigged on the foremast, and fore-and-aft rigged on the main and mizzen ; but while in the former the foresail is set flying, in the latter it is bent to the yard.

Larger vessels than these are sometimes fitted with four, five, six, and even seven masts, as fore-and-aft schooners. A large number of vessels fitted in this manner are much in favour for the coasting trade of America. Fig. 6 (Plate I.) shows the Helen, W. Martin, a five-masted wooden schooner, built in 1900 in the United States ; she is 280 ft. 6 in. long, 44 ft. 9 in. broad, and 21 ft. depth of hold, and her gross tonnage is 2265. Another vessel built at the same time, also of wood, and named the Eleanor A. Percy, is 319 ft. 3 in. long, 48 ft. 9 in. broad, and 23 ft. depth of hold, with a gross tonnage of 2970 ; she is rigged as a six-masted schooner. An interesting vessel of this class is a seven- masted schooner, under construction in 1902 by the Hore River Ship and Engine Co.,

Quincy, Mass. This vessel is of steel, 368 ft. long, 50 ft. beam, 34^ ft. depth of hold, and on a draught of 26 ft. 6 in. will be of 10,000 tons displacement, thus being the largest sailing vessel yet constructed. These three must all be regarded as ocean-going vessels.

Barques and Ships. ??? Vessels intended to sail to all quarters of the globe are usually rigged as barques or ships ; but,. as indicated above, these rigs are very far from embracing all those in use ; many others are very common. A barque is a three-masted vessel, square-rigged on the two foremost masts (the fore and main masts) and fore-and-aft rigged on the mizzen mast. A ship (a ship-rigged vessel) has three masts, each of Avhich is square-rigged. These were the rigs employed in types of vessels now fast passing away, if indeed they must not be considered as already obsolete, in which great speed was the quality chiefly aimed at, and carrying power was of secondary importance. For instance, the Phoenician, built in 1852, had a length of 150 ft. and a net tonnage of 478 ; the Shannon, built in 1862, was 217 ft. long and her tonnage 1292. The former made the quickest run on record, up to 1852, from Sydney to London, accomplishing the distance in S3 days ; and the latter made a round voyage from Melbourne to London and back from thence to Sandbridge Pier in 5 months and 27 days, handling two full cargoes in the time. The American sliiji Witch of the Wave, built in 1852, and the British ship Cairngorm, built in 1853, were engaged in the keen competition carried on between Great Britain and the United States for the rapid conveyance of

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early teas from China to London. The American builders had for some years been more successful than the British builders, and the Cairngorm was the first ship which equalled the American ships in speed, and it was, moreover, claimed for her that she delivered her cargo in better condition than the American ships. She was 215 it. long, and her tonnage was 1250 old measurement, or 938 new measurement. The Witch of the Wave on her best voyage made the passage from Whampoa to Dungeness in 90 days, the best day's run being 338 knots in 24 hours, a very remarkable per- formance. Later, in 1856, the Lord of the Isles beat the two fastest American clippers then existing in a race from China to Great Britain, one of them only by a few minutes ; her length was 183 ft., and her tonnage, new measurement, 630. It is note- worthy that the competition in bringing the early teas home from China, started between British and American ships, was carried on subsequently between British ships alone. In the memorable race of 1866 from Foo-Ohow to London, five ships, the Ariel, Tacking, Seriea, Fiery Gross, and Taitsing took part. The first three left roo-Chow the same day ??? the Ariel first, followed 20 minutes later by the T(M}ying and Serica together. The vessels separated, and lost one another till they reached the English Channel, when the Ariel and Taeping got abreast, and raced to the Downs, the former arriving some ten minutes before the latter, the Serica reaching the Downs a few hours later. These three occupied 99 days on the voyage ; the Fiery Cross and Taitsing took two days longer, making the passage from Foo-Chow to the Downs in 101 days. The best day's run on the passage for all these ships differed but little, the Fiery Cross showing a slight superiority in this respect, having run 328 knots in the 24 hours. The time occupied in the above voyages was beaten in 1869 by the Thermo- pylce and Sir Lancelot, both British ships and of composite build ; the times occupied by their passages were respectively 90 days from Foo-Chow to Dungeness for the former, and 88 days from Foo- Chow to Deal for the latter, each taking one day more to get into the docks. The dimensions of the Thermopylce were 212 ft. by 36 ft. by 21 ft. depth of hold, and of the Sir Lancelot 197i ft. by 33J ft. by 21 ft. The best day's run of the Sir Lancelot was 354 knots in 24 hours. Shortly before the above voyage the Thermopylce made the passage from London to Melbourne in an unpreoedentedly short time, namely, 62 days from Gravesend to Port Phillip harbour. With the opening of the Suez Canal and the general introduction of steam, the

demand for exceptionally fast sailing vessels of these types has very considerably diminished, and, indeed, almost ceased to exist. The type of cargo sailing ship usually met with to-day is better illustrated by Fig. 7 (Plate I.), which represents the Victoria Regina, built of iron in 1881 at Southampton ; she is 270 ft. long and has a gross ton- nage of 2006. Although she has a good spread of canvas and is a fast vessel, she carries a very large cargo for her dimensions.

Ships with four and five masts were employed by several countries during last century. Sometimes, in the case of four- masted ships, these were square-rigged on the fourth or mizzen mast, and sometimes fore-and-aft rigged, in which case they are called four-masted barques in Great Britain and shipentines in America. Five-masted ships are sometimes square-rigged on the fourth mast and fore-and-aft rigged on the fifth mast, and some- times fore-and-aft rigged on both of these masts. The Naval Chronicle, vol. vii., 1802, contains particulars of the French priva- teer L' Invention, shown in Fig. 8 (Plate I.), which was captured by the British ship ImmortalW ; she was rigged as a four-masted ship, carried 26 guns, and had a complement of 220 men. It is remarkable how little her rig differs from that of modern vessels. A five-masted vessel is described in the same number of the Naval Chronicle which was square-rigged on the foremast and fore-and- aft rigged on the other four masts ; she was apparently a fore- runner of the American five-masted schooner of the present day. The shipentine clipper Oreat JRepublic, built in 1853, is note- worthy as being the first ship fitted with double topsails, now so generally adopted. She was 305 ft. long and her tonnage was 3400 ; she could spread 40,500 square ft. of canvas, excluding stay-sails ; she had four decks and was built of wood, though her framing was diagonally braced with iron. The shipentine Madeleine, built in France in 1896, is almost identical in rig to the Great Bepublie ; her length is 321 ft. and her gross tonnage 3026. A five-masted barque France, built in Glasgow in 1890, is 361 ft. long and has a gross tonnage of 3942. As further examples of the large saOing ships built in recent years may be mentioned the Astral and Potosi. The Astral was built by Arthur Surall and Co. at Bath, Maine, in 1900, for the oil trade. She is a full-rigged four-masted ship, 332 ft. long, 45J ft. beam, 26 ft. moulded depth, gross tonnage 3292, and intended to carry], 500, 000 gallons of oil in cases of 10 gallons each

from the United States to Shanghai, returning with cargoes of sugar, hemp, &c. The masts and yards of this vessel, as well as the hull, are of steel. The five-masted German barque Potosi. built in 1895, which is 366 ft. long, has a gross tonnage of 4027 and a dead- weight capacity of 6200 tons ; she has a splendid record of quick

passages, one reducing the record from Portland Bill to Iquique to 62 days.

As instances of the times occupied on the voyages of modern sailing ships the following may be given : ❓❓❓66 days from Iquique in Chile to the English Channel by the British ship Maxwell, gross tonnage 1856 ; 29 days from Newcastle, New South Wales, to Valparaiso by the British four-masted ship Wendur, 2046 gross tonnage ; 30 days from the Lizard to Rio de Janeiro by the British shi-p Salamanca, ofgi'oss tonnage 1262 ; and 78 days from Dover to Sydney for the same ship ; 153 sailing days for a voyage round the world., made up of 50 days from Cardiff to Algoa Bay, 28 days from Algoa Bay to Lytteltou, and 74 days from Lyttelton to the Lizard, by the British ship Talavera, gross tonnage 1796 ; 59 days from Cape Town to Iquique by the British ship Edenhallymore, of gross tonnage 1726 ; 88 days from San Francisco to Queenstown by the British four-masted barque Falls of Garry, of gross tonnage 2088 ; and 69 days from SciUy to Calcutta in 1876 by the Coriolamis, gross tonnage 1074. Amongst the voyages recorded recently by German ships the foUowiug may be enumerated : ❓❓❓71 days from Iquique to Hamburg by the ship Preussen, gross tonnage 1761 ; 68 days from the English Channel to Valparaiso by the four-masted barque Placilla, gross tonnage 2846 ; 71 days from the English Channel to Melbourne by the barque Selena, gross tonnage 1319 ; and 69 days from the English Channel to Adelaide by the four-masted barque Eebe, of gross tonnage 2722.

Although alterations in the rigs of ships have not caused much difference in their appearance over a very long period, a number of changes have been made, mostly for the purpose of saving labour. The mechanical reefing of topsails and top-gallant sails was introduced about 1858, but only remained in favour for a few years ; double topsails, on the other hand, first used in the four-masted American clipper ship Great Republic,

have held their own, and double top-gaUant sails have since been adopted. Until about 1875 almost all ships carried studding-sails, but since this date they have been gradually discontinued, and at present are usually only to be found in training vessels, and now and again in square-rigged yachts. As already stated, wire rope has been adopted for standing rigging, and deadeyes and lanyards have given place almost universally to rigging screws. Masts and the heavier yards have been made of iron for many years, and more recently of steel, and the lower masts and top masts have in a number of cases been made in one length ; when con- structed in this manner the mast is termed a pole mast. This arrangement is very common in America, where the latest steel sailing ships are so fitted. Most large sailing ships carry a steam boiler or boilers, and engines are pro- vided for all sorts of purposes, for which hand labour used to be commonly employed. The result of this and other labour-saving arrangements has been to effect a very considerable reduction in the number of hands carried. As indicating the nature of the change which has taken place, it may be mentioned that whereas a 1000-ton ship of the East India Company in the middle of last century had a crew of 80 all told, a modern four- masted barque of 2500 tons has a total complement of 33 only.

As to the employment of sailing ships, there can at the present day be seen at most large shipping ports a number of sailing ships of various types and sizes. Some of the largest ships are employed in the jute trade of India, the grain trade of California, British Columbia, &c., and the nitrate trade of Chile. From Great Britain they usually take out coal, which, however low freights may be, may in nearly all cases be relied on.

*Of merchant steamships, vessels of all sizes are to be met with, from a small launch to the stately Atlasriac liner of 16,500 tons gross and 23| knots speed, and ^^ the huge cargo ship of over 20,000 tons gross Steam- and 15 knots speed. They are employed on * ”*’ every service for which sailing ships are used, and upon others for which sailing ships are not employed, and they monopolize nearly the whole of the passenger traffic of*

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the world. In general, the different sizes have no bold characteristic features such as distinguish sailing ships; they possess different deck structures and certain differ- ences in form, but, to the ordinary eye, a photograph of a vessel of, say, 1000 tons, apart from details of knovifn size that may serve to fix the scale, may often be taken to represent a vessel of even ten or tvpenty times the size.

Merchant steamships may be classed into various types. There are Flush-deck Vessels, in which there are no deck structures, beyond possibly engine and boiler casings; there are vessels which have a Mmikey Forecastle forward, ???from which the anchors are worked, a small poop or Hood aft to protect the steering gear, and a deck-house under the bridge amidships, called a Bridge House. Some have a complete forecastle above the main deck, called a Top- gallant Forecastle, with a corresponding Poop and a Bridge House ; some have a Top-gallant Forecastle and a Bridge House associated with simply a Raised Quarter-deck. In others the bridge house and poop join one another, when the vessels are described as having a Top- gallant Forecastle vsdth a Long Poop and Bridge House combined, and are knovm as Well-decked Vessels, a name also applied to vessels in which the Bridge House joins a Raised Quarter-deck. The foregoing types include most small vessels, but comparatively few very large-sized vessels. Most of the latter have a continuous upper deck above the main deck : if this be of light construction, and openings be left between it and the main deck, the vessel is called a Shade-decked Vessel; if there be no openings between the decks, she is called an Awning-decked Vessel ; if there be no openings and the scantlings be somewhat heavier, she is called a Spar-decked Vessel; and if the scantlings be heavier still, she is called a Three-decked Vessel. Besides the above, vessels are built with almost every other conceivable variation of these features, and there are in addition Turret-deck Vessels, Trunk-deck Vessels, and Whale-back Vessels, the last named being peculiar to the Great Lakes of North America.

Sailing ships with machinery of low power, for use in calms and in getting into port, are called auxiliary steam- ships. In the early days of steam all sea-going vessels provided with means of steam propulsion may be said to have come under this description. The screw propeller offered less obstruction than paddle-wheels when the sails were set and the engines stationary, but the resistance caused by the screw when not in use led to a number of devices for either lifting it completely out of the water, or for fixing its blades in positions so as to offer the least obstruction in going through the water. Auxiliary steam yachts have in the present day many friends. In them the pleasures of sailing may be secured with a fair amount of certainty of making port when desired. Small vessels intended for seal and whale fishing are sometimes fitted as auxiliary steamships : six such vessels, all barque- rigged, and one of them fitted with a lifting screw, hailed in 1902 from Dundee, and a few also hailed from Norway, from Newfoundland, and from Bedford, U.S.A. Several navies possess auxiliary steam gunboats and other auxiliary steam vessels for service in distant parts of the world, and a few possess auxiliary steam training ships. The Chilian training ship Oeiieral Baquedano, for example, built in 1899, of steel sheathed with teak and coppered, is 240 ft. long, 45f ft. broad, and has a dis- placement of 2500 tons on a mean draught of 18 ft. ; she has a large spread of canvas and can steam 13 knots when required.

Steam Trawlers. ❓❓❓ Screw steam trawlers are among the vessels frequently met with round the British coasts. As an example the Anglesey may bo quoted. Built in 1898, she is 107 ft. long, with a beam of 204 ft. and a dejilh in hold of 11 ft. ; her gross ton- nage is 158 and her net tonnage 52. One of the chief advantages

which such vessels possess over sailing vessels lies in the certainty with which they can get to the fishing-ground, and then back again quickly to the market with their iish.

Tugs. ❓❓❓ Smaller tugs are employed on canals and ‘rivers and larger ones for ocean work. A sea-going steel tug, built by the Bath Iron Works, Bath, Me., for the American coal trade, is 165 ft. over all and 1045 tons displacement, with triple-expansion engines of 900 H.P. A paddle-tug, the Flywig Scotsman, built in 1898 has a length of 118 ft., beam of 20 ft.,

depth in hold of 10 ft. '; her gross tonnage is 177 and her net tonnage 29. A screw tug' the Hannah Jolliffe, built in 1900, is 103 ft. long, 23 ft. 6 in! broad, and 12 ft. deep ; her gross tonnage is 178 and net tonnage 11. As already stated, one of the earliest uses to which steam vessels were put was for towing other vessels on canals and rivers, into and out of harbour, &c. ; and in 1902 there was employed on the Clyde the paddle-tug Clyde, which was built of iron in 1851, of nearly the same dimensions as those of the vessels given above. '

Colliers and Tamk-steamers. ❓❓❓ In a number of cases vessels are built to carry special cargoes ; coal-carrying vessels, collurs, are well-known examples of this class. One of the first steam colliers was built at Wallsend as early as 1844, and called the Q.E.D. She was constructed of iron, had an over-all length of 150 ft., with a breadth of 27^ ft. She was propelled by a single screw- driven by a 20-H.P. engine, and her dead-weight capacity was 340 tons. In certain respects she was a remarkable vessel, for she was fitted with a double bottom, the space between the bottoms being divided into tanks and arranged for water ballast a system which is common in colliers, and indeed in most cargo ships. The advantage of the arrangement in the case of colliers is especially great, as they usually carry a full cargo one way and return empty. In their light condition suflacient water-ballast can be at once added to make them seaworthy, and this at the end of the voyage can be pumped out at a small cost. The Wallsend, a typical modern collier, is 210 ft. long, 30 ft. beam, 13 ft. 6 in. depth, and has a gross tonnage of 899, a net tonnage of 638, with triple-expansion engines. Tank-steamers form another example of vessels built for a particular cargo. Large numbers of these are employed in carrying oil in bulk from American and Russian sources, and from Borneo, to numerous ports all over the world. Their construction and the character of the material carried are such that they cannot be used to any considerable extent for any other purpose. Many of them are of large dimensions, while some are comparatively small. On the Caspian Sea, for instance, numerous small steamers are employed conveying oil from the Baku district to other ports, and to towns along the Volga. On the other hand, for longer passages when the demand is great, larger ships are employed, on account of their greater economy. As an example of a large oil vessel, the Pinna, engaged in carrying petroleum from Russian ports

to the East, may be mentioned. She is 420 ft. long, 52 ft. broad, and 34 ft. deep, and she can carry 9000 tons of oil in her fully-laden condition. The machinery is placed well aft, and the cargo-space is divided up into twelve _ large tanks, extending to the height of the main deck, by seven " transverse bulkheads and a longitudinal middle-line bulkhead. The spaces between the transverse bulkheads are called Nos. 1, 2, 3, 4, 5, and 6 holds respectively, and each hold has a port and a starboard tank. Each tank is provided with an expansion trunk, in order that the free surface of the oil may always be small, how- ever much the bulk of the latter may expand or contract with changes of temperature.

Cargo Ships. ??? Many vessels are built to carry a particular cargo on one voyage and a general cargo on the return voyage. This usually results in their having certain features which adapt them for the special cargo, and do not interfere materially with their carrying a general cargo at remunerative rates. Usually, indeed, the object kept in view in constructing these vessels is to have as large a range of cargoes to choose from as possible, and the arrangements by which a particular cargo or particular cargoes can be I'tirried are only provided with the view of achieving this object. Ordinary cargo ships, or ' ' Ocean Tramps, " as they are often designated, do a very large portion of the world's cargo-carrying. They may be of any size, and of any type required by the exigencies of trade, the fashion of the day, or the fancy of the owner. There is very little ornamentation about them, their decks even being often unsheathed with wood, but the greatest attention is paid to the arrangements for the rapid handling of the cargoes ; they are mostly built of steel, and their usual speed is from 10 to 11 knots. In the early 'nineties well -decked vessels formed a large proportion of the total number ; but ten years later comparatively few of this type were being built, and these were principally intended for the coal trade, or wore comparatively small vessels for coasting purposes. Partial awning-deck steamers, again, which were much in favour at the same period, gave place, a decade later, to other types ; and vessels having a raised fore-deck went entirely out of fashion, the tendency being to revert to flush-deck vessels, having short poop, bridge house, and forecastle.

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Table IV. ❖❖❖ Types of Cargo Steamers.

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When built .

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Type of Vessel

A. Built in

1881.

Well-decked.

With Top-gallant

Forecastle,

Bridge House,

and Poop.

B. Built in

1894.

C. Built in

1897.

Awning-decked.

D. BuUtin

1898.

Spar-decked.

E. Built in

1900.

American Lake Steamer.

Length

Breadth ...

Depth (moulded)

Draught (without keel)

“Weight of steel or iron in hull .

„ „ wood, outfit, &o.

„ ??? propelling machinery Total light displacement . Load displacement

„ block coefficient Ratio of light to load displacement Dead weight carried . Ratio of dead weight carried to load d: Cargo capacity in cubic feet Tonnage under deck .

„ net Water-ballast capacity

splacement

263′ 6″ 35′ 8″ 20′ 6″ 19” 3″

820 tons 166 ???

184 „

1170 ??? 3740 ??? ??? 72 ??? 313 2570 tons

687

115,000 1436 1816 1167

357 tons

300′ 0″ 40′ 0″ 23′ 6″ 19′ 2″

1620 tons

5530 80 293

3910 tons 707

170,000

2150

2385

1500

500 tons

470′ 0″ 50′ 0″ 34′ 10″ 27′ 5″

*3676 tons 509 *

615 ,, 4800 ,,

16,710 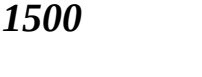 81 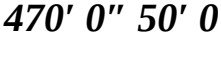 287 11,910 tons 713

680,000 7038 7296 4770

3346 tons

330′ 0″

45′ 6″

20′ 6″

21′ 10″

1875 tons

370 ???

2245 ,,

7695 ???

???82

???292

5450 tons

???708

288,000 3028 3222 2078

804 tons

0″ 0″

478′ 52′ 30′ 17′ 10″

/ 2850 tons I 280 ,, 300 ???

3430 ,,

10,600 ??? ???85 ???324 7170 tons

???676

468,000 5822 5946 4446

2960 tons

Table IV. gives the dimensions, carrying capacity, and other leading particulars of five existing cargo steamers of different types, arranged in the order in which they were built. A is a well- decked vessel (Fig. 9, Plate IL), having a top-gallant forecastle with a long raised q^uarter-deck and bridge house combined, and is fitted with one deck, but has two tiers of beams. B (Fig. 10, Plate IL) is a vessel with a top-gallant forecastle, bridge house, and poop, and a single deck. G is an awning-decked vessel, with two decks, but three tiers of beams. D is a spar-decked vessel of 3222 tons gross, and E (Figs. 11 and 12, Plate II.) an American Lake steamer in which the draught was restricted to 18 feet. Besides the princi- pal dimensions and light and load displacements, the block ‘ ‘ coeffi- cients ” corresponding to the load conditions are given in Table IV., in order to show the fulness of form commonly adopted in these vessels. The block coefficient is the ratio of the volume of the immersed portion of the ship to the volume of the parallelopi- pedon, whose length, breadth, and depth are the same as the length, breadth, and mean draught (without keel) of the vessel

*Fio. 12.**** *Plan of Great Lake steamer. A, cargo; B, hatches; C, engine-room; D, boiler- room ; E, coal-bunker ; F, accommodation ; G, crew’s space ; H, water ballast ; K, pilot- house.*

itself; and it will be seen that in four cases out of the five given, the immersed volume, i.e., the displacement, is 80, or upwards of 80 per cent, of this circumscribing parallelopipedon. The low speed, which is found economical for the “Ocean Tramp,” admits of this fulness, and provides that capability for large stowage accommodation for cargo which has brought them into existence. In vessels whose speed is of great importance the block coefficient varies from ***S *to ‘65, the lower limit being reached on the smaller vessels on cross-channel services, and the higher limit on very long vessels, such as the fast Atlantic liners. ‘The total weight of material in the hull, i.e., the iron or steel and woodwork, outfit, &c., and the propelling machinery, is called the vessel’s light displacement. The load displacement is made up of the light displacement, together with the weight of the cargo, &c., or the dead weight carried ; this, it will be seen from Table IV., varies from two to two and a half times the amount of the lio-ht displacement. This dead weight is fixed within*

certain limits" by the builders and owners with regard to the safety and economical working of the ship, but British law provides that a

vessel shall not be loaded deeper than a certain mark, known for many years as the PlimsoU mark, which has to be placed on the sides of all merchant vessels. The position of this mark, however, is, within certain limits, left to the discretion of the aforesaid builders and owners. The cargo capacity in cubic feet, the tonnage under deck, and the gross and net tonnage, are given in Table IV. for each vessel. The mode of measuring tonnage is based on the Act of 1854. (See Tonnage.) The cubic contents of all closed-in spaces, available either for cargo or passengers, is calculated, and a ton of measurement is assumed to be provided by 100 cubic feet of space. Gross tonnage is the tonnage of all such spaces. " Under-deck " tonnage is the tonnage of spaces below the tonnage deck, which is defined as the upper deck in all ships having less than three decks, and the second deck from below in all others. The net tonnage is obtained from the gross by deducting an allowance for machinery spaces ; for crew spaces, including accommodation for the master; for sail- room (in sailing ships) of not more than 2^ per cent, of the gross tonnage ; for helm, capstan, and anchor gear, boatswain's store, and chart spaces. Thus net tonnage is the space which is available for the stowage of cargo. It has nothing to do with the displacement of the vessel or with the dead weight carried, to each of which the term tonnage is often applied. It will be seen from the table that in the vessels A, B, C, and D the net tonnage is less than one-half the dead weight carried.

Fig. 13 (Plate II.) is an example of a Turret-deck

steamer, of which a considerable number have been

built by Messrs Doxford of Sunderland. Her

dimensions are : length 439 ft. 8 in., beam 51 ft.

7 in., gross tonnage 5995, and net tonnage 3794.

Such vessels have the reputation of being good

dead-weight carriers, and the shelf on each side

of the central trunking can very conveniently be

used for carrying timber, and for other purposes.

A general idea of the construction of a modern cargo steamer

may be had by reference to Fig. 19 in the article on Shipbuilding.

Fig. 14 shows the interior arrangements of the White Star Cedric,

a vessel designed to carry a large amount of cargo in addition to

many passengers.

Passenger Steamers. ◆◆◆ There are numerous varieties of passenger steamers, both as to size and shape. For river service, where the traffic is considerable, paddle-wheel vessels of limited speed are usually preferred, as possessing great manceuvring power, and there- fore the capability of being brought alongside the landing-places with rapidity and safety. The King Edward, a steamer which began to ply on the Clyde in 1901, is 250 ft. long, 30 ft. wide, 10 ft. 6 in. deep to the main deck, and 17 ft. 9 in. to the promenade deck. She was the first passenger steamer to be driven by Parsons's steam turbine, though she presents the usual appearance of a screw passenger vessel. Her speed is 20 knots. A second turbine steamer, the Queen Alexandra, began to run on the Clyde in 1902 ; she is generally similar to the King Edward, but larger and faster. The paddle-wheel steamer La Marguerite, which in the summer months

Fig. 14. ◆◆◆ Plan of Cedric.

makes trips from London to the coast of Kent and thence across the Channel, is 330 ft. long, has accommodation for a large number of passengers, and obtained 22 knots with 7500 I.H.P. on trial.

Cross-Channel Steamers. ??? The mail service between Holyhead and Kingstown has for many years employed a number of splendid vessels, which may be taken as typical of this class. The four paddle-steamers, Ulster, Munster, Leinster, and Connaughi, built in 1860 for this service, were 337 ft. long, 35 ft. broad, and 19 ft. deep ; their speed was 18 knots with 6000 I.H.P. A vessel of the same type, but larger, named the Ireland, was added to the fleet in 1885. In 1896 and 1897 the four new twin-screw steamers were built, and received the same names as the four vessels built in 1860, which they have replaced. Their length is 360 ft., breadth 41 ft. 6 in., depth 29^ ft., and displacement 2230 tons at 14 ft. 6 in. load draught. Their sea-going speed is 23 knots. They have sleeping-berths for 238 first-class and 124 second- class passengers, and large dining and other public rooms for general accommodation. Considerable space is set apart on the main and lower decks for the mails, &c. The engines consist of two sets of triple-expansion four-cylinder engines, there being two low-pressure cylinders of equal size in each set, an arrangement which lends itself readily to the balancing of the machinery.

Atlantic Liners. ??? Particulars of the famous liners which have had a share in the development of the trans- Atlantic service are

given in Table V., which is taken chiefly from The Atlantic Ferry, by A. J. Maginnis, and many more details may be foimd in the opening portion of the article Steamship Lines in this volume, and in the historical sketches it contains of the various lines, such as the Allan, the American, the City of DubUn, the CoUins, the Cunard, the Guion, the Hamburg- American, and the White Star. Some of the most noteworthy vessels are illustrated in Figs. 15-19 (Plates III. and IV.). The Persia (Fig. 15) was the first iron steamer to be placed on the Atlantic service by the Cunard Company (1856). Fig. 16 is the City of Rome, built in 1881 at Barrow for the Inman Line, one of the most graceful vessels on the Atlantic ; when first completed she was square-rigged on the three forward masts, and looked even better than she does in the illustration. The Campania (Fig. 17) and

her sister-ship the Lucania, each 600 ft. long, and built in 1893 for the Cunard Company by the Fairfield Shipbuilding Company, held the record for fast passages across the Atlantic for several years. With twin-screws and triple-expansion engines they attained a speed of 23| knots on trial with 31,050 I.H.P. On her best runs the Lucania crossed the Atlantic, 2823 nautical miles, in 5 days, 8 hours, 38 minutes, the mean speed being 22 knots for the run, maintained with a consumption of coal amounting to 20^ tons an hour. The second Oceanic, buUt for the White Star Line at Belfast in 1899, is shown in Fig. 18 ; and the Deutsehland (Fig. 19), built at Stettin for the Hamburg- American Line, broke the

Table V.,

shovring Dimensions

, cfec, of Famous Atlantic Liners

Name of Ship.

Owners.

1

s

I

* c*

1

11

1

1

1

a

i

1

o

I

How Propelled.

it

C (-1

Feet.

Feet.

Feet.

Tons.

Knts.

Lbs.

Savannah

Colonel Stevens

1819

New York

Wood

130

?6

16-6

1,850

320

6

Paddles

10

90

Royal William

City of Dublin Co .

1838

Liverpool

jj

145

27

17-6

1,980

720

7-5

”

6

400

Sirius ....

Brit. & Amer. St. Nav. Co.

1838

Leith

178

26-5

18-25

1,995

703

8-5

”

16

600

Great Western

Great Western S.S. Co. .

1838

Bristol

212

35 -.T

23-26

2,300

1,340

8-6

”

16

750

British Queen .

Brit. & Amer. St. Nav. Co.

1839

London

276

S7-6

27-0

2,970

1,863

8

16

700

Britannia

Cunard .

1840

Greenock

207

34-6

22-6

2,050

1,160

8-6

???

12

740

Great Britain .

Great Western .

1843

Bristol

274

48-2

31-6

6,780

3,270

11

Single Screw

25

1,600

America

,Cunard .

1848

Greenock

261

,38

25-3

4,250

1,825

10-26

Paddles

13

1,400

Asia .

Cunard .

1860

268

46

24

3,620

2,227

12

16

2,000

Arctic

Collins

1850

New York

282

46

31-6

6,200

2,860

12-6

17

2,000

Persia

Cunard

1856

Glasgow

Iron

360

45

29-9

7,130

3,300

12-6

20

3,600

Adriatic .

Collins . . . .

1867

New York

Wood

365

50

35-0

7,664

3,670

13-5

26

4,000

Great Eastern .

Great Eastern S.S. Co. .

1368

Millwall

Iron

680

82-8

48-2

32,160

18,916

13

S. Screw and Paddles

30

11,000

Scotia

Cunard . . . .

1802

Glasgow

J,

379

47-8

30-6

7,600

3,871

13-5

Paddles

26

4,000

City of Paris .

Inman

1866

”

346

40-4

26-2

6,411

2,651

13-5

Single Screw

30

2,600

Russia ....

Cunard . . . .

1807

”

jj

368

43

28-8

6,770

2,969

13-5

25

2,.'>00

City of Brussels

Inman

1869

^1

jj

390

40-3

27-1

6,900

3,081

14-5

30

3,000

Oceanic ....

White Star

1871

Belfast

”

420

41

31

7,240

3,707

14-76

66

3,000

City of Richmond .

Inman . . . .

1874

Glasgow

ji

441

43-5

34

9,320

4,623

16

70

4,000

Britannic .

White Star

1874

Belfast

???

465

46-2

33-7

9,600

6,000

16

76

5,100

City of Berlin .

Inman . . . .

1876

Greenock

jj

488-6

44-2

36

10,100

6,491

16

75

6,200

Arizona ....

Guion . . . .

1879

Glasgow

”

450-2

45-4

35-7

9,900

6,147

16-26

90

6,300

Servia ....

Cunard . . . .

1881

Steel

616

62-1

37-9

12,300

7,392

16-5

90

12,000

City of Rome .

Inman

1881

Barrow

Iron

660-2

62-3

37

13,600

8,144

17-6

90

11,500

Alaska ....

Guion . . . ,

1881

Glasgow

jj

600

60

38

9,600

7,142

17-76

100

11,000

Notting-Hill .

Notting-Hill S.S. Co. Cunard . . . .

1881

jj

Steel

420

46-1

26-6

6,210

3,920

12

Twin Screw

100

2,800

Aurania ....

1882

*j^*

470

57-2

37-3

13,360

7,269

17

Single Screw

90

8,500

Oreg-on

Guion and Cunard .

1H83

*j^*

Iron

601

64-2

40

12,600

7,376

19

110

13,000

America ....

National .

1S84

Steel

432

61-3

38-6

9,660

6,628

18-76

96

8,300

Etruria .

Cunard . . . .

1886

^^

jj

601

67-3

38-2

13,300

8,120

19-5

110

14,600

Aller . . . .

North German .

IKKH

438

48

34-6

10,460

6,400

16-5

1,50

8,-200

City of Paris (second of

name)

Inman . . . ,

1889

527-6

63-2

39 -2

17,270

10,670

20

Twin Screw

160

18,600

Teutonic ....

White Star .

1889

Belfast

566

57-8

39-2

16,740

9,984

20

isn

17,500

Fiirat Bismarck

Hamburg-American

1890

Stettin

602-6

57-6

38

16,200

8,874

19-6

??) ??i

IfiO

17,000

Campania

Cunard . . . .

1893

Glasgow

698

66

43

21,000

12,960

2-2

165

30,000

American . . . .

1895

Philadelphia

ji

635-7

(i3

42

16,000

11,630

20

9m

20,600

Kaiser WilhelmderGrosse

North German .

1897

Stettin

^^

625

66

43

23,760

14,350

22-8

178

32,000

Kaiser Friedrich

North German .

1898

Danzig Belfast

584

64

41

20,100

12,000

21-6

11 11

2W

27,000

Oceanic (second of name) Deutsehland (second of

White Star

1899

685

68

49

26,100

16,900

21-6

192

29,000

name) .

Ham burg- American

1899

Stettin

666

65-5

46-6

24,400

14,600

23-25

* *

225

36,000

rLATli III,

SHIP.

Fig. 15. Persia.

‘-ti

,11 ..,i, ‘

Fig. 16. Cidj of Uumc.

M

Fig. 17. Campania.

PLATE IV.

SHIP,

Fir:. lS. Oi:fniiii

.’ ”⬛⬛⬛⬛⬛⬛/I M \> ⬛⬛⬛

*;^*

Fig. ly. ⬛⬛⬛Dcutscldiiiiil.

MEEOHANT VESSELS]

SHIP

553

record in 1900, traversing the Atlantic from New York to the Eddystone in 5 days, 17 hours, 28 minutes, at a mean speed of 23-36 knots. In a subsequent voyage she maintained an average of 23-52 knots. A still larger vessel, the Kaiser Wilhelm der Zweite, launched in 1902 for the North German Lloyd, is 706^ ft. long, with a beam of 72 ft. Her gross tonnage is about 20,000, and when loaded with 5600 tons of eoal her displacement wdl be 26,000 tons. She is intended to maintain a speed of 23^-24 knots across the Atlantic.

In recent years a remarkable development in shipbuilding has proceeded ui_ the United States, following on the demands in connexion -with the building of the modern American navy, and work of every kind of the highest class is in progress on a large scale. The Newport News Co. has bmlt the Siberia and Korea, for the service of the Pacific Mail Go. from Hong Kong to San Francisco, which are far in advance of aU previous vessels on the Pacific lines. These vessels are 572 ft. over all, 63 ft. beam, and of 1 8, 600 tons displacement on a draught of 27 ft. Their machinery is of 18,000 I.H.P., and is capable of maintaining 18 knots ocean speed. The Philadelphia firm of Cramp and Son has turned out the American Line vessels St Louis and St Paul, which have run with great success on the New York and Southampton service ; and more recently the splendid vessels Sierra, Ventura, and Sonoma, for the Oceanic Steamship Co., for the mail service between Sydney, New Zealand, Honolulu, and San Francisco. Their dimensions length 425 ft. over all, beam 50 ft., moulded depth 28 ft.

3 in., tonnage about 6000, horse-power 8000, speed 17 knots. Although these vessels are smaller than the Siberia and Korea, they are far superior to any previous vessels on the Pacific routes, excepting the Empress of India and other vessels on the Hong Kong and Vancouver service. They have magnificent accommoda- tion for a large number of passengers, and are specially bralt so that in thirty-six hours they can be fitted up as armed cruisers for the U.S. navy. More remarkable than either of these are the vessels being built by the Eastern Shipbuilding Co. of New Loudon for the Oriental service of the Great Northern EaOway. The aim in these vessels is to carry an immense cargo at a low cost, and at the same time a considerable number of passengers with greatly improved accommodation ; they are 630 ft. long, 73 ft. beam, 55 ft. depth, and when fully laden their displacement will be nearly 33,000 tons, of which about 20,000 tons may be cargo. Their speed is stated to be about 14 knots, and their cost about ––500,000 per ship. With the exception of the Celtic and the Cedric of the White Star Line, these will be the largest vessels in the world.

Special Vessels. ––– Many vessels are built for special and exceptional purposes, and cannot be classed with either ordinary cargo or passenger vessels. Amongst these may be included dredgers, train-carrying ferry-boats, and ice-breakers. To dredgers a special article has been devoted (see vol. xxvii.). Train ferries have been in use since 1870. In 1869 Mr Scott Russell described (Trans. Inst. Nav. Arch.) a train ferry-boat of special construction in use on the Lake of Constance, having a length of 220 ft., a breadth over the paddle-boxes of 60 ft., and a displacement of 1600 tons ; the horse-power of her machinery was 200, divided between the two paddle-wheels, each of which was driven by ––––– pair of independent oscillating engines. The object of this steamer was to convey trains between Eomanshorn, on the one side of the lake, and Friedrichshafen, on the other ; she was built of iron, and was designed to have great strength combined with light draught. In 1872 train ferry- boats were introduced into Denmark to carry trains be- tween the mainland and the islands and, later, between Denmark and Sweden. In 1883 the Solano, a large train ferry 406 ft. long was built by Messrs Harlan and HoUings- worth, of Wilmington, Dela- ware, to run between Bernicia and Porto Casta in connexion with the Central Pacific Rail-

way. Two other interesting examples of train ferries, shown in Figs. 20 and 21 (Plate V.), were built on the Tyne by Sir W. G. Armstrong, Whitworth,

and Co. Ltd., in 1895 and 1896, the former for service on the river Volga, and the latter for service on Lake Baikal in Siberia. The Volga' has a rise and fall of no less than 45 feet between spring and midsummer, and the ice upon it in winter is usually 2 ft., and sometimes 3 ft., thick; thus the problem presented con- siderable difficulties, which were increased by the fact that the locks of the Marinsky canal system, through which all vessels

bound for the Volga must pass, are of such dimensions that it was impossible for vessels of suificient size to be got through in one piece. It was decided to use two vessels to do the work, the first to act only as an ice-breaker, and the other to act only as a train – carrier. The ice – breaker was built in two pieces, the parting being at the longitudinal middle-line plane of the vessel. This was satisfactorily carried out by means of a double longi- tudinal middle-Une bulkhead extending the whole length of the vessel. On arrival at the canal she was divided into halves, and was joined up again after passing through the last of the locks. Her dimensions were : length 147 ft., breadth 37 ft. 6 in., and depth 16 ft. 6 in., and she was fitted with compound engines and twin screws. The ferry steamer itself (Fig. 20, Plate V.) was 252 ft. long, of 55 ft. 6 in. beam, and of 14 ft. 6 in. depth. Four lines of rails were laid upon her deck, sufiicient space being provided for 24 trucks or caiTiages, which are shown in position in the figure. The difficulty presented by the great difference in the river level was got over by an aiTangement of hydraulic hoists, placed at the bow, by which two trucks could be lifted at once to a height of 25 ft., and by having lines of rails at the landing-stages at two levels. The vessel was fitted with twin screws and compound engines, which gave her a speed of 9 knots. It was found neces- sary to divide her into four parts for the passage through the canal locks ; the divisions were made at the longitudinal middle- line plane and athwartships at her middle. Each quarter, when apart, formed a water-tight hull, and reunion was effected while the parts were afloat.

The Baikal Ferry (Fig. 21, Plate Y.) is employed in carrying trains across the lake in connexion with the Siberian Railway. For more than half the year the lake is frozen over to a considerable thickness, and in this case the vessel must of necessity be herself a powerful ice-breaker as well as a ferry steamer. The figure is from a photograph of a model, in which part of the side is removed in order to show the railway carriages in position. Her dimensions are : length 290 ft., beam 57 ft., draught under ordinary conditions 18 ft. 6 in., and displacement 4200 tons. The hull is closely subdivided for additional safety in case of perforation. She has three sets of triple-expansion engines, working three independent screw propellers, two placed aft, as in ordinary twin-screw ships, and one placed at the forward extremity for the purpose of dis- turbing the water under the ice, thus assisting the heavy cast- steel stem and armoured bow to break up the solid field-ice which the vessel has to encounter. The complete structure was first erected on the Tyne, then taken to pieces and shipped to St Petersburg ; from thence its numerous parts were carried to the farthest point on the Siberian Railway, whence they were taken to their destination on sledges, and there the ship was re-erected and launched. The boilers constituted the heaviest individual pieces thus transported, as the weight of each could not be reduced below 20 tons.

Ice-breaking steamboats for securing a passage through frozen waters also date from an early period ; one is spoken of as early as 1851, and several have recently been constructed for the" Baltic and other parts for special purposes, instances of which have just been noticed in connexion with train ferries. The Ermaek (Fig. 22, Plate V.), built in 1898, aims at being more eff'ective than any previously constructed. Her dimen- sions are : length 305 ft., breadth 71 ft., depth to the upper deck 42 ft. 6 in., and displacement 8000 tons ; her engines

develop

I.H.P., giving

knots.

*Fia. 23.**???* *Section ol Ermaek.*

general outHne is shown in Fig. 23, from which it will be seen that her bow slopes upwards from below, so as to enable her to run up on to the ice and bring her weight to bear in breaking it. Her stern is so shaped as to protect the propellers as much as possible from masses of ice ; and her transverse form is such that when wedged in between masses of ice she wUl tend rather to rise than to be depressed. She is built of steel, and is of very

great strengtli, the bow being specially strengthened to enable it to withstand the impact with the ice. As first constructed, she had three screws aft and one forward. The forward screw was provided with the object of sucking water by its action from under the ice, and so giving more effect to the weight of the ship ; but on an experimental voyage in the Polar Sea, working through thick field-ice, the shaft of this screw became bent, and it was necessary to remove the propeller and provide temporary protection to the sbaft-end. A new bow, that shown in Fig. 23, was after- wards fitted, with this forward propeller omitted. The Ermmk made her maiden voyage in the middle of the winter of 1898-99, when she steamed through the Baltic to Kronstadt, crushing the ice with comparative ease. After this passage, during the remainder of the winter she assisted 41 steamers which were in difficulty, including the salvage of a Russian warship, which had unfortunately stranded on the island of Hogland. In the summer of 1899 she made the experimental voyage, above referred to, in the Polar Sea north of Spitsbergen, and notwithstanding her accident, continued far enough to demonstrate that she could make her way through this vast ice-field and deal with floes of the greatest thickness. An account of this vessel was given by Colonel Swan, C.B., before the Institation of Naval Architects in 1899.

Wae Vessels.

In the development of the modern warship during the latter half of the 1 9th century we shall have to deal with progress even more remarkable than that recorded for merchant ships. The adoption of iron and steel as the material for shipbuilding, and the development of the steam engine, have influenced warship construction in the same manner as they have influenced the construction of ships for the mercantile marine ; but, in addition, the intro- duction of armour for the protection of ships, the great advances made in its manufacture, and, above all, the mar- vellous improvements in explosives and in the design and manufacture of guns, have almost continuously changed the conditions of naval warfare, and called for corresponding change in the design of warships. Those who are con- cerned in such questions may refer with advantage to an interesting comparison between the old Victory and a modern battleship instituted by Sir Andrew Noble in his address to the Mechanical Science Section of the British Association in 1890. Sir Andrew Noble's remarks in this connexion are the more weighty as coming from the director of the largest arsenal in the world, the works of Sir W. G. Armstrong, Whitworth, and, Co., and from one whose scientific research has incalculably advanced our knowledge of artillery and explosives. Sir Andrew follows up this comparison by the following reference to the con- dition of things just before the Crimean war : ???

"The most improved battleships of the period just anterior to the Crimean war differed from the type I have just described mainly by the addition of steam power, and for the construction of these engines the country was indebted to the great pioneers of marine engineering, such as J. Penn and Sons, Maudslay, Sons, and Field, Ravenhill, Miller, and Co., Rennie Bros., &c., not forgetting Messrs Humphreys and Tennant, whose reputation and achievements now are even more brilliant than in those earlier days. Taking the Duke of Wellington, completed in 1853, as the type of a first-rate just before the Crimean war, her length was 240 ft., her breadth 60 ft., her displacement 5830 tons, her indicated horse-power 1999, and her speed on the measured mile 9 '89 knots. Her armament consisted of 131 guns, of which thirty-six 8-in. and 32-pdrs. were mounted on the lower deck, a similar number on the middle deck, thirty-eight 32-pdr3. on the main declc, and twenty short 32-pdrs. and one 68-pdrs. pivot gun on the upper deck. Taking the Ca-xar and the Hague as

*types of second- and third-rate line-of-battleships, the former, which had nearly the displacement of the Victory, had a length of 207 ft., a breadth of 56 ft., and a mean draught of 21. She had 1420 indicated horse-power, and her speed on the measured mile was 10 ‘3 knots. Her armament consisted of twenty-eight 8-in. guns and sixty-two 32-pdrs., carried on her lower, main, and upper decks. The lluijur had a length of 184 ft., a breadth of 48 ft. 4 in., a mean draught of 22 ft. 6 in. ; she had 797 indicated horse-power and a speed of 8^ knots. Her armament consisted of two 68-pdrs. of 95 cwt., four 10-in. guns, twenty-six 8-in. guns, and twenty-eight 32-pdrs. of 50 cwt.***

sixty guns in all.

” Vessels of lower rates (I refer to the screw steam frigates of the period just anterior to the Crimean war) were, both in construction

and armament, so closely analogous to the line-of-battleships that I will not fatigue you by describing them, and will only allude to one other class, that of the paddle-wheel steam frigate, of which I may take the Terrible as a type. This vessel had a length of 226 ft., a breadth of 43 ft., a displacement of about 3000 tons, and an indicated horse-power of 1950. Her armament consisted of seven 68-pdrs. of 95 cwt., four 10-in. guns, ten 8-in. gims, and four hght 32-pdrs.”

The warships which existed at the beginning of the latter half of the 19th century were, with the exception of special vessels, divided roughly into three classes

ships of the line, frigates, and gun- vessels. At the present day the corresponding types are known as battleships, cruisers, and gunboats, and a fourth class has been created in the torpedo-boat and torpedo-boat destroyer. It is proposed to refer to these in the order named. (See also Navies.)

Battleships.

The destruction of the Turkish fleet at Sinope (30th November 1853) by the Eussian fleet, the latter alone being armed with shell guns, and the combined experience of the British and French fleets before Sebastopol when engaging Fort Constantine, demonstrated’conclusively that for ships of the line armour – protection had become essential. The French Government immediately began to build five armour-plated vessels, or

batteries, as they were called, for service in the Black Sea; and eight similar vessels were begun shortly afterwards by the British Government for the same service. The British vessels did not arrive in time to take any part in the war; but three of the French batteries did, and were very favourably reported on by Admiral Bruat after an engagement with the Kinburn Forts on 17th October 1855. With the excsp- tion of these three French batteries, the whole of the fleets employed in the operations were composed of unarmoured wood ships, and a large number of them were sailing line- of-battleships. As the result of the engagement with the Kinburn Forts, the French commenced to build the first armour-plated wood frigate, Gloire, at Toulon in llarch 1858; and shortly afterwards (June 1859) the armour- plated iron frigate Warrior (Fig. 24) was commenced by the British Government. A number of vessels quickly followed, including, on the side of the British Government, the Black Prince, which was a sister ship to the Warrior, and four other vessels, the Achilles, the sister ships Mino- taur and Agincourt, and the Northumberland. The dis- tribution of the armour and other features of these vessels are shown in Fig. 24. The Warrior and Blcbck Prince, which were 380 ft. long and of 9210 tons displacement, had a speed of 12| knots, and were originally armed with twenty-six 68-pdrs. and eight 110-pdrs. on the main deck, and two 110-pdrs. and four 40-pdrs. on the upper deck, which armament was afterwards altered to four 8-in. 9-ton guns and twenty-eight 7-in. 6^-ton guns, all mounted on the broadside. They had a central citadel 213 ft. long, protected with 4J-in. iron armour extending from a few feet below the water-line to the height of the upper deck. Their outline was similar to the outline of the wooden frigates of the day, and their rudder-heads and steering-gear were above water and unprotected against injury by shot and shell. In the four vessels which immediately followed, which were from 500 to 1500 tons more displacement, the overhanging bow, as will be seen from Fig. 24, was given up, bows more adapted for ramming were introduced, and some protection was afforded to the steering-gear by water-line belts of armour which extended the whole length of the vessel. In 1861 the British Government began the construction of eleven armour- clads, six of which, including the Hector and Valiant, sister ships of 6700 tons, were iron vessels, and five,

battleships]

the Caledonia, Royal Oak, Ocean, Prince Consort, and Royal Alfred, were wooden vessels of rather over 4000 tons.

The reconstruction of the British fleet was taken in hand in earnest in 1863, when Mr (afterwards Sir) Edward J. Reed was placed at the head of the Construc- tion Department at the Admiralty, with Messrs Barnaby, Barnes, Crossland, Morgan, and Wright ??? the last named (afterwards Sir James Wright) holding the position of engineer-in-chief ??? as his immediate assistants. Various types of vessels were devised, with arrangements of armour and dispositions of guns, to provide for the new conditions which had been introduced; and, in addition, great advance was made in the struc- tural arrangements of ships, which up to this period had been considerably influenced by the old systems of con- struction in use in wooden ships. In investigating the qualities of ships, Sir Edward Reed had the good fortune to secure the co-

SlrB.J. Reed.

overtake or get away from an enemy. (7) Manoeuvring power to maintain, as far as possible, any desired position with regard to an enemy. (8) As large a radius of action as possible, coal-carrying capacity and economy of fuel being the two factors governing the radius of action and the strategical advantages dependent thereon in vessels pro- vided with steam power alone. (9) The proper provision for the berthing of ofiScers and crew. (10) The import- ance of limiting size and cost.

Objections were raised to the early armour-plated ships on the score of their unhandiness, heavy rig, exposed position of guns, &c. To meet these, Mr Eeed designed a number of vessels, among which may be mentioned the BelUrophon, launched in 1865. She was a vessel of 7550 tons displacement, 4000 I.H.P., 14 knots speed, and was 300 ft. long, or 100 ft. less than the Minotaur. Her armament consisted of ten 9-in. 12-ton and five 7-in. 6J-ton guns. Her water-line was wholly protected by 6-iii.

armour, and she was provided with a central battery 98 ft. long, protected with armour of the same thickness. She carried a considerable spread

operation and assistance of Mr WilUam Froude, F.KS., who had been the first to demonstrate accu- rately the theory upon which the behaviour of ships in a seaway depends. Mr Froude's experimental investigations on the forms of ships and kindred matters, begun in 1870 on behalf of the Admiralty and con- tinued till his death in May 1879, had a most import- ant bearing on the improve- ment of ships and on the science of naval construc- tion generally. It is not too much to say that nearly the whole of the accurate information as to the best forms of ships and their resistance at various speeds, in the possession of naval architects to-day, is the direct result of Mr Froude's work, and that of his son, Mr K. E. Froude, F.R.S., v^ho has continued the work since his father's death.

Among the considera- tions which Mr Eeed had in view in the re- construction of the navy, and which may be said to hold down to the present day, with variations dependent on the development of steam propulsion, gun attack, character of armour, and other conditions, may be enumerated the following : ??? (1) Steadiness of ship as a gun platform, with ample stability in all conditions of lading to enable her to keep the sea in all weathers, and sufficient stabihty in a partially-riddled condition to enable her to reach port in safety. (2) Protection by armour of the vitals of the ship, and of the heavy-gun positions, especially against shell fire. (3) The carrying of guns of power sufficient to penetrate the armour of any possible enemy. (4) Mount- ing the guns sufficiently high above the water-line to enable them to be fought in bad weather. (5) Simul- taneous all-round &e, with concentration of as many guns as possible on any given point of the compass, fire in the line ahead from as great a number of guns as possible being considered of special importance. (6) Speed to

WARRIOR & BLACK PRINCE.

~~*380 ft.*~~

MINOTAUR & A6INC0URT.

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NORTHUMBERLAND.

400ft-

FiG. 24. ??? Plan of Warrior and Black PHnce, Achilles, Minotaur and Agincourt, and N&rthuTnberland. A, engine-room ; B, boiler-room ; C, coal bunkers ; M, magazines ; S, shell-rooms.

of canvas, and she was fitted with a balanced rudder. The Hercules, completed in 1868, was a much more important ship than her predecessors, her dimensions being: length 325 ft., breadth 59 ft., draught 26^ ft., and her displacement 8680 tons. Her engines were of 8500 I.H.P., which gave her a speed of about 14^ knots. She had two 9-in. guns, movmted one forward and one aft on the main deck behind 6-in. armour, and eight 10-in. guns, mounted in a central battery on the main deck, four of which were mounted on revolving platforms, and could be worked from angle ports at the comers of the battery as well as from the broadside ports. Her water-line was protected by armour 9 in. thick amid- ships, reduced to 6 in. at her ends, and her battery was protected by 6-in. armour. She was handy under canvas, and was un- doubtedly the most successful sea-going armour-clad of her day. The Sultan, completed in 1871, was in many respects a similar ship to the Hercules, but rather larger, having a displacement of 9200 tons, the same length, 2 ft. more beam, and 1 foot more draught ; she attained a speed of upwards of 14 knots. Her main- deck battery carried the same guns as the main-deck battery of the Hercules, but the 9-in. guns at the extremities of the vessel on this deck were dispensed with, and she carried, in addition, an upper-deck battery, placed over the after-end of the main-deck battery,

in whiohL four 9-iii. guns were carried. Both batteries were pro- tected with 6-in. armour ; elsewhere the armour was of same thickness and was disposed in a similar manner to the correspond- ing armour in the Hercules. As originally completed, the Sultan was a fully-rigged ship, but on her refit in 1892 her old masts were removed and a pair of nulitary masts substituted, as shown by Fig. 25 (Plate VI.).

*Turret Ships.**** *The first turret ship in the British navy was the Royal Sovereign, built of wood and launched in 1857 as a 121-gun ship of 3760 tons, and afterwards cut down and reconstructed as a turret ship, under the superintendence of Captain Cowper Coles, between 1862 and 1864. The system of mounting heavy guns on revolving turrets had been worked out in America during the war by Captain Ericsson. Captain Cowper Coles, who had designed turret ships for foreign powers, became the advocate of the turret system in Great Britain ; and as the result of discussion and the pressure brought to bear by public opinion, the Monarch, of 8850 tons displacement, was laid down in June 1866 as a sea-going turret ship. She was launched May 1868. Her dimensions were : length 330 ft., breadth 57 ft. 6 in,, and draught 26 ft. ; her I.H.P. was 8000, giving her a speed of about 15 knots, and she carried a large spread of canvas. She had a complete armour belt 9 ft. 9 in. wide and 7 in. thick, reduced to 6 in. at the extremities. Above this armour belt amidships, for a length of 84 ft., she was provided with a citadel, also of 7-in. armour, which protected the bases of two revolving turrets, each protected with 10-in. armour and carrying two 12-in. guns. She also carried two 9-in. guns forward on the upper deck and one 7-in. gun aft on the main deck, all protected by armour.*

The design of the Monarch did not satisfy Captain Coles, and he induced the Admiralty to build a turret ship of much lower free- board, in accordance with his views. This vessel was the Captain, built at Birkenhead and launched in March 1869. By an unfor- tunate error her freeboard was even less than Captain Coles had contemplated. She was fully rigged, with tripod masts and large sail-spread ; this spread of canvas, with her low freeboard and deficient stability, resulted in the terrible disaster in the Bay of Biscay, when she capsized on 6th September 1870, amongst those drowned being her designer.

A number of low-freeboard turret vessels of the Monitor class, without masts and sails, were buUt for the British navy at this time, mostly for coast defence. Amongst these, the Gerherus for Australia and the Abyssinia and Magdala for India were com- pleted in 1870. The Abyssinia had a displacement 'of 2900 tons and a speed of about 9J knots ; her dimensions were : length 225 ft., beam 42 ft., draught 14J ft., and her armament consisted of four 10-in. 18-ton guns. The other two vessels had the same armament, but were somewhat larger, being of 3340 tons displace- ment ; and the thickness of their side armour was 8 to 6 in., against

7 to 6 in. in the Abyssinia. Several vessels of this type were also built for home service, including the single-turret vessels Glatton (Fig. 26, Plate VI.) of 4910 tons and Hotspur of 4010 tons, each carrying two 18-in. 25-ton guns, and the Cyclops, Gorgmi, Hecate, and Hydra, each of 3560 tons and provided with two turrets carry- ing two 10-in. 18-ton guns. They were protected with armour from

8 to 12 in. thick, and their speed was from 10 to 12 knots. A diagram of the original Monitor of the U.S. navy of this period is shown (Fig. 27). She is about 170 ft. long, of low speed, armed

P/7of House

Two 71"

Dahlgren Guns

with two powerful guns, and protected throughout with thick armour.

The Devastation, commenced in 1869, represented Mr Reed's views of what a sea- going turret ship should be. Low sides were adopted, but not in combination with rigging and sails. She was the first sea-going battle-ship in the British navy which depended wholly on steam power for propulsion. She was 285 ft. long, 62 ft. 3 in. broad, 26 ft. mean draught, and 9060 tons displacement. Her sides, which, except right forward, rose only to a height of 4 ft. 6 in. above water, were protected with armour 12 in. thick. Her armament consisted of four 25-ton guns, mounted in pairs

in two turrets, one at each end of a raised breastwork or redoubt which extended about 150 ft. along the middle of the upper deck. The guns were thus elevated to the height of some 14 ft. above the surface of the water. The turrets were protected by armour 12 in. and 14 in. thick, and the breastwork or redoubt by armour 10 in. and 12 in. thick. A forecastle extended forward from the fore-end of the breastwork at a height of 9 ft. 3 in. above the waterline ; but in wake of this forecastle the side armour dropped to a height of only 4 in. above the surface of the water, at which level there was an armoured deck. She was provided with twin-screw machinery of 5600 I.H.P., which gave her a speed of 12J knots, and she carried a large coal supply. A good idea of her general appearance may be obtained from Fig. 28 (Plate VI.). After the loss of the Captain, and to remove the doubt which naturally arose as to the safety of other ironclads, and particularly as to that of the Devastation, a special committee, including many of the highest professional and scientific authorities in the United Kingdom, was appointed to examine into the design of those vessels. Of the Devastation they reported that "ships of this class have stability amply sufficient to make them safe against the rolling and heaving action of the sea " ; they agreed, however, in recommending a plan, which the constructors of the Admiralty had proposed, with the view of increasing her range of stability and the accommodation of the crew. This consisted in the addition of side superstructures, formed by continuing up the ship's side with light framin'4 and plating as high as the level of the top of the breastwork, and carrying the breastwork deck over to the sides. The structures were continued aft on each side, some distance beyond the breastwork, providing two spacious wings, which added largely to the cabin accommodation.

Sir Edward Heed retired from the Admiralty a short

2 Thicknesses ofJ^ "each

Fia. 27. *Diagram of U.S. A. Monitor.*

time before the Captain foundered at sea. During his seven years' term of office some forty iron armour-clads of various sizes and types, besides iron cruisers and numerous other vessels, had been added to the British navy, the adoption of armour for the protection of the vital parts of ships

had become established, and especially had the importance of utilizing armour in such a manner as to exclude projectiles from the region of the water-line be- come recognized. The change from the widely-distributed armament of the first broadside armour-clads to the highly concentrated armament of the turrets, and from the high freeboard ship with sail-power to the low freeboard turret ship without sails, had also been effected ; so that when Sir Edward Eeed retired in 1870, the latest type of battle- ship was entirely different from that which existed when he took office ; and although the construction of broadside ironclads had not been discontinued, ” the wooden walls ” had practically ceased to exist. Sir Edward Reed was succeeded by a Council of Construction composed of his immediate assistants, with Mr Barnaby (afterwards Sir Nathaniel Barnaby) as its president ; but three years later this council was dissolved, and Sir N. Barnaby was placed at the head of the Construction Department.

The sea-going qualities of the Devastation had success-

PLATE V.

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*Fio. 20.****River Volga Train Ferry.***

Fig. 21.

Lake Baikal Train Ferry.

Fig. 22.

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fully demonstrated that the battleship of the future might depend wholly on steam propulsion; and although many ^^^ naval officers and others continued to hold the

Nathaniel ''."^^^^' ^^^\ sea-going ironclads must of necessity be Baraaby. "gged ships, in the designs which immediately f ol-*

IV OQ Tli►►^'ir^^^ P►►►►" "^ omitted. In the Inflexible (.i^ ig. ^y, i-late yi.), and the sister ships Ajax and AgameTn- non, the offensive power was concentrated mainly in two pairs of heavy guns, as it was in the Devastation and other turret ships which preceded them ; but in them the armour defence also was concentrated over a comparatively small space amidships, the unprotected ends being formed into what was called raft bodies by belts of cork, within which was placed a portion of the ship's coal, &c. Thus the buoyancy was secured by a citadel amidships which could not be penetrated, and by ends which might be riddled, but which it was contended could not be destroyed. The arrangement is shown in Fig. 30, which repre- sents the Agamemnon, but which may be taken as also representing the other vessels. Sir N. Barnaby described the design of the Inflexible in 1874 before the Institution of Naval Architects thus : ►►►*

" Imagine a floating castle 110 ft. long and 75 ft. wide, rising 10 ft. out of the water, and having above that again two round turrtts planted diagonally at its opposite corners. Imagine this castle and its turrets to be heavily plated witb armour, and that each turret has within it two guns of about 80 tons each ►►► perhaps in the course of a few years guns of twice 80 tons each. Conceive these guns to be capable of firing, all four together, at an enemy ahead or on either beam, and in pairs towards every point of the compass.

' ' Attached to this rect- angular armoured castle, but completely submerged, every part being 6 ft. to 7 ft.' under water, there is a hull of the ordinary form, with a powerful ram bow, with twin screws and a submerged rudder and helm. This compound struc- ture is the fighting part of the sliip. Seaworthiness, speed, and shapeliness would be wanting in such a structure if it had no additions to it ;

there is therefore an unarmoured structure lying above the submerged ship and connected with it, both before and abaft the armoured castle ; and as this structure rises 20 ft. out of the water, from stem to stern, without depriving the guns of that command of the horizon already described, and as it moreover renders a flying deck unnecessary, it gets over the objections which have been raised against the low freeboard and other features in the Devastation, Thunderer, and Fury. These structures furnish also most luxurious accommodation for officers and seamen. The step in advance has therefore been from 14 in. of armour to 24 in., from 35-ton guns to 80-ton guns, from two gims ahead to four guns ahead, from a height of 10 ft. for working anchors to 20 ft., and this is done without an increase in cost, and with a. reduction of nearly 3 ft. in draught of water, &c."

The dimensions of the Inflexible were : length 320 ft., beam 75 ft., mean draught 26 ft. 4 in., and displacement 11,880 tons, and her speed was 12 '8 knots. The dimensions of the Ajax and Agamem- non becun in 1876, were : length 280 ft., beam 66 ft., mean draught 24 ft. 9 in-) ai^d displacement 8660 tons. They carried four

12i-in. guns ; their citadels were 104 ft. long, protected with 18-in. armour, their turrets being protected by 16-in. armour ; and their speed was 12 knots. The Edinburgh and Colossus, begun three years later, were of the same type, but were built of steel and were of 9480 tons displacement. Their citadels were longer, and their speed was 14^ knots. Compound armour, adopted in these two ships for the first time, gave them a gi-eat advantage in defensive power.

The Oollingwood, begun in 1880, was the precursor of a new type of battleship, in which the main armament consists of four heavy guns mounted in pairs on the middle line of the ship, in fixed heavily protected gun-positions called barbettes, one at each end of an armoured central citadel, this main armament being associated with a secondary armament of lighter and more rapid-firing guns mounted on the broadsides between the barbettes. This arrange- ment of the armament, which is clearly illustrated in Fig. 31, has continued, with small modification, to be adopted in the battleships of the British navy down to the present day. The

principal features of the Oollingwood were as follows : length 325 ft. , beam 68 ft. , mean draught 27 ft., displacement 9500 tons. She carried 18-in.

Agamemnon

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Plan of VpperDeck

Plan of under water Protective Deck

Coffer-dam

Coffer -eUun.

Coffer-dam.

Coffer-dam.

*Fia. 30.**Arrangement of AgameWMOv,.*

armour -on her sides, 16-in. on bulkheads, llj-in. on barbettes, and 12-in. conning towers. Her armament consisted of four 12-in. 45-ton guns, six 6-in. guns, and a number of smaller guns. Her speed was 16J knots, and she carried 900 tons of coal, with capacity for 1200. She was followed two years later by the Rodney, Hovx, Benbovj, Oamperdown, and Anson, which were of the same type, but larger. The two first named were of the same length and beam as the Oollingwood, but of 800 tons more displacement ; they carried ISJ-in. guns against her 12-in., and had greater speed, namely, 16 ‘8 knots. The last three were 5 ft. longer than the others, 6 in. broader, and were 300 tons heavier than the Bodney and Howe. The armament was the same, except in the Benbow, which had two 16J-in. guns and ten 6-in. guns. These six ships constitute what is known as the Admiral class. A good idea of their general appearance is obtained

from Fig. 32 (Plate VII.), which represents the Oamperdoum. The Benbow and the Sans Parcil, built a few years later, are the only ships in the British navy carrying 110-ton guns, the former having them in barbettes, the latter in a turret heavily armoured. The Sans Pareil and her

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^/S’Armour

Fig. 31. ❓❓❓Arrangement of armament in CoUingwood. A, communicating tubes ; B, boiler-rooms ; D, water-chambers ; E, engine-room ;

M, magazines and shell-rooms ; W, water-ballast.

ill-fated sister the Victoria,^ begun in 1885, were a departure from the Admiral type in both disposition of armour and armament, and have not been repeated or developed.

Among the last of the ships designed for the British navy by Sir N. Barnaby were the Mle (Fig. 33, Plate VII.) and Trafalgar, which were begun in January 1886. The disposition of armament originated in the CoUingwood was adopted in these vessels, but the heavy guns were placed in turrets instead of in barbettes. These vessels were of rather greater displacement than the Inflexible, and were thus the largest ships then built for the British navy. They were 11,940 tons displacement, 345 ft. long, 73 ft. beam, and 28 ft. 10 in. mean draught ; had engines of 12,000 I.H.P., and a speed of 16| knots. Their armour-protection (see Fig. 34)

consisted of a belt 230 ft. long and 20 in. thick, with bulk- heads 18 in. and 14 in. thick. Above the belt was an armoured redoubt of 18 in. compound armour 141 ft. long at the sides of the ship, with paraholio ends which enclosed the turret bases. The turrets themselves had 18-in. armour, and between the turrets was an octagonal battery of 3 in. to 5 in. of steel containing the 4-7-in. Q.F. guns. The thick- ness of the protective deck was 3 in. The armament consisted of four 13-6-in. 67-ton B.L. guns, six 4-7-in. Q.F., eight 6-pdrs. Q.F., twelve S-pdrs. Q.F., besides boat guns and six torpedo tubes. They carried 900 tons of coal at normal displacement, and had stowage for 1100.

Sir Nathaniel Barnaby retired from office in 1885. During his term of office there were built for the British

‘ The Victoria was accidentally rammed by the Camperdmon and simk in a few minutes during the Mediterranean manoeuvres of 1893.

navy upwards of twenty armoured battleships of various classes, in addition to a much larger number of cruisers of all sizes. The fight for supremacy between the gun and the armour plate had begun in earnest when Sir N. Barnaby took office, the increased weight of projectile and penetra- tive power obtained by the concentration of the armament

Armour of Hile and TrctfatgaT.

into a few heavy guns being followed by the concentration of the armour into a short belt. The concentration of guns and armour reached a limit in the Inflexible and her immediate successors ; the later ships of Sir N. Barnaby’s design carried a secondary battery of lighter guns in addition to the heavy main armament, and had much These changes, combined with the

longer water-line belts.

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PLATE Yin.

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Fig. 39. ??? II.M..S. Hamiibal.

Fi:. 40. ??? I-I.M.S. Buhrark.

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Fig. 47. ??? Norwegian A’

battleships]

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mtroduction of compound armour and the adoption of steel mstead of iron for the building material, both of which date from this time, aUowed of greater armour protection and of other advantages, including increased speed, &c. This rearrangement was first worked out in the Colhngwood, and, as already stated, the principal features of this ship have, with few modifications, been reproduced down to the present time.

Sir Nathaniel Barnaby was succeeded in October 1885 by Mr W. H. White, F.K.S. (afterwards Sir W. H. White),

Dr Elgar, F.E.S., being shortly afterwards wiiuam appointed Director of Dockyards, and Mr E. White. Sennett, Engineei -in-Chief. Dr Elgar resigned

after holding office for five years, and was succeeded by Sir James Williamson, and in 1889 Mr Sennett was succeeded by Mr A. J. Durston (afterwards Sir John Durston). During Sir William White's tenure

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of office a very large number of ships were added to the British navy, some of which are considered below.

The Royal Sovereign class (see Fig. 35, Plate YII., which shows the Royal Oak) consisted of eight iirst-class battleships, built under the Naval Defence Act of 1889. With the exception of the Hood, which was a turret ship, the vessels of this class were all fitted with barbettes. They were of 14,150 tons displacement, were 380 ft. in length, 75 ft. beam, and 27i ft. draught. They had 13,000 H.P. and a speed of 17^ knots. They carried 900 tons of coal at normal draught, with bunker space for 1450 tons. Fig. 36 shows the distribution of their armour, which consisted of a partial water- line belt 18 in. thick of compound armour, extending far enough forward and aft to receive the bases of the barbettes. A protective deck 3 in. thick formed a flat top to this belt, and at the level of the bottom of the belt, continued to the ends of the ship. Between the protective and main decks, extending from one barbette to the other, was an upper belt of 4 in. thickness, and above this the main deck 6-in. Q.F. guns were enclosed in casemates. The barbette^ were 17 in. thick. The armament consisted of four 13J-in. B.L. guns in pairs in barbettes, ten 6-in. Q.F. ??? four in

casemates and six in shields ??? sixteen 6-pdrs., twelve 3-pdrs., eight Maxims, and seven torpedo tubes. The Royal Sovereign estab- lished a record in quick building, having been laid down in September 1889 and launched in February 1891. The Hood differs from the others in having her 13^-in. guns in turrets, and the decks between the turrets and the extremities lowered to the level of the main deck in' the other vessels of the class.

The Centurion (Fig. 37, Plate VII.) and Barflenr, begun in 1890, were smaller ships of the same general arrangement as the ships of the Rmjal Sovereign class, but with lighter armament and protec- tion and higher speed. The ISJ-in. guns of the Royal Sovereign are reduced to 10-in., and the 6-in. Q.F. to 4-7-in. Q.F. The belt thickness is reduced to 12 in., and the barbettes are 9 in. thick only, armour compound. The speed goes up from 17i to 18J knots. The normal coal allowance was 750 tons, with stowage for 1150. Their principal dimensions were 360 ft. length, 70 ft. beam, 25 ft. 6 in. mean draught, 10,500 tons displacement. An im- portant departure was made in these, vessels in that they were sheathed and coppered. The Renoivn (Fig. 38, Plate VII.) was also sheathed and coppered ; she was laid down in February 1893 and launched in May 1895. She may be described as coming between the Royal Sovereign and Centurion, but possessing the very great advantages that the adoption for the first time in the British navy of Harveyized armour conferred defensive power upon her. She was 12 350 tons displacement, length 380 ft., beam 72 ft., mean draught 254 ft., and had an increased speed of 18J knots. Her armament consisted of four 10-in. B.L. guns mounted in pairs in barbettes 10 in. thick, ten 6-in. Q.F. in 6-in. casemates ❓❓❓ six on main deck, four on upper ❓❓❓ twelve 12-pdr., and five torpedo tubes. The belt and bulkhead of this ship were of Harveyized armour 6 in. to 10 in. thick. She carried 900 tons of coal at the mean draught given above, but could stow 1200 in her bunkers.

Fig. 36. ❓❓❓ Armour of Royal Sovereign.

A larger and more powerful class qf battle- ship, known as the Majestic class, was begun about the same time as the Renotim. It consisted of nine first-class battleships, the design of which constituted a great advance upon that of the Royal Sovereign. This advance was due mainly to the use of Harveyized armour. The 18-in. compound belt of the Royal Sovereign disappeared, and was replaced by a belt of about twice the breadth and 9 in. thick, this offering a, resistance to penetration at least equal to the 18-in. compound belt. The protective deck was not carried flat across at the middle deck, but was above the L.W.L. at the middle line, and curved sharply down to the lower edge of the 9-in. belt, forming a strong arched roof to the vitals of the ship, to keep out any fragments of large shell

which might come through the belt and burst ; it was 2J in. thick on the flat and 4 in. on the slopes. The 13J-in. guns of the Royal Sovereign were replaced by lighter but more powerful 12-in. wire- wound B.L. guns, disposed in the same general manner in barbettes 14 in. thick. The Majestic class carried two more 6-iu. Q.F. guns, and all the twelve were in casemates 6 in. thick. There were sixteen 12-pdrs., besides smaller guns and five torpedo tubes. The speed was the same as Royal Sovereign class, and the coal carried 900 tons, with space for 2000 tons. The ships were of 14,900 tons displacement, 390 ft. long, 75 ft. beam, 27 ft. mean dra,ught. The Hannibal, shown in Fig. 39 (Plate VIII.), is one of this class.

The Formidable and Londmi classes, under construction in 1903, differ very slightly from each other, and for all practical purposes may be taken as identical, the main difference being in a rearrangement of the armour protection to the bow in the later ships (London). The former class consists of the three battleships Formidable, Irresistible, and Implacable, and the latter of the five battleships London, Bulwark, Venerable, Queen, and Prinxx of Wales. These classes represent a development of the Majestic

class, being 400 ft. long, 75 ft. beam, 26 ft. 9 In. draught, and 15,000 tons displacement, the belt being of the same general thickness and extent as in the Majestic, but of Krupp steel, and protection is given to the bow by 2-in. side-plating. In the Formidable the protective deck proper is formed as in the Majestic, but is thinner, being 2 in. to 3 in. thick, and a second protective deck, 1 in. thick, is formed at the main deck, giving a flat top to the box formed by the side belt. In the London class (Fig. 40, Plate VIII.) the lower protective deck is thinner and the upper one thicker than in the Formidable class, the belt protection being extended forward by thinner material, tapering to 2 in. at the bow, and the forward transverse armour bulkhead being omitted. The 12-in. guns in both classes are longer and heavier than in the ships of the Majestic class, and are in barbettes 12 in.

thick ; in addition, there are twelve 6-in. Q.F. guns ◆◆◆ all in casemates ◆◆◆ sixteen 12-pdr.<., and four torpedo tubes. These eight battleships are each provided with 20 Belleville boilers, develop 15,000 H.P., and have a speed of 18 knots. They carry 900 tons of coal at their normal displacement, and have bunker space for 2200 tons.

The line of development, as traced above, may be taken to begin with the Collingwood and to run through the Admiral class, the Nile and Trafalgar, the Royal Sovereign class, the Majestic class, and the Formidable class, to the London class, which may be re- garded as the most power- ful type of warship yet constructed for the British navy.i Branching ofi from this line, at a time when battleships be- came much heavier (the Royal Sovereign class were of 2200 tons more displacement than the Nile and Trafalgar), we find a series of smaller, faster, and more lightly armed and armoured battleships than the series terminating with the London class. These be- gan with the Barfleur and Centurion, which, though contemporary with the Royal Sovereign class, were of 1440 tons less displacement ; they were followed by the Renown, the Canopus class, and the Duncan class. claim our attention.

11 in. thick, with four 12-in. guns, and carry twelve 6-in. Q.F. guns in 6-in. casemates on the main and upper decks ; also a number of smaller guns and four submerged torpedo tubes. They are provided with 24 Belleville boilers, wiU develop 18,000 H.P., and attain a speed of 19 knots. Their normal coal supply will be 900 tons, and they will have hunker capacity for 2000 tons. Six of these ships were rmder construction in 1902. In external appearance the Canopus and Duncam, classes closely resemble the ships of the London class.

It will be seen that the advance in the two series of ships described above has been one of steady growth in size, power, and speed ; and the scheme of building such a number of ships of each class as to form a powerful squadron of exactly similar ships has been given effect to in a large degree.

The principal changes that have conduced to the steady and rapid development of the battleship type since 1885 are : ◆◆◆ (1) The

successive improvements in armour by the introduction of the Harvey and Krupp processes, which have enabled either a saving of weight to be effected for the same degree of protection, or a greater degree of protection

The last-named vessels now

The six ships of the Canopus class may be regarded as a develop- ment of the Renown. Begun in 1896, they are 12,950 tons in displacement, 390 ft. long, 74 ft. beam, and 26 ft. draught. They have a 6-in. Harveyized belt, 14 ft. broad and 195 ft. long ; two protective decks (anticipating the Formidable in this respect) ; and 12-in. barbettes, carrying four wire-wound 12-in. guns, against the Renown's 10-in. They also carry twelve 6-in. guns in 5-in. case- mates, ten 12-]idrs., a number of smaller and machine guns, and four submerged torpedo tubes. They were the first battleships of the British navy to be fitted with water-tube boilers ; they have 20 Bellevilles, develop 13,500 H.P., and have a s]iced of 18J knots. They carry 1000 tons of coal at normal loud, and have bunkers for 2300 tons. The ships of the Duncan class are longer and larger than those of the Can/ipui class. They were begun in July 1899, are of 14,000 tons displacement, 405 ft. long, 75 ft. 6 in. beam, 20 ft. 6 in. draught. They liave a belt of Krupp steel, 7 in. thick amidships, tapering to 3 in. at bow, and two protective decks, as in the Oanopus ; they have two barbettes,

^ In 1902 orders were placed for five battleships frnm Sir Wilham White's design, to be called the Kinrj liihnard VII. class, which are larger and more powerful than the Lninl.im, beiuK of 16,350 tons displacement, and carrying four 12-in. and four 9'2-in. guns in gun- houses ou the upper deck, with ten 6-iu. Q.F. guns in an armoured main-deck battery.

Fig. 41. ❓❓❓ U.S. Battleship Kearsarge.

to be provided for the same weight. The choice has been principally in the direction of the latter alternative ; the belt has been extended longitudinally and upward, shield- ing a greater portion of the hull and giving increased protection to the stability and to the secondary armament of the vessel. (2) Improvements in guns and explosives, by which more effective gun-fire has been obtained with guns of smaller calibre and

decreased weight than those previously in use. The growth in importance of the secondary armament of quick-firing guns has exercised great influence on the development of the modern battle- ship. (3) Improvements in machinery. The adoption of higher steam pressures, lighter and faster-running machinery, and of water-tube boilers have effected great Savings in weight for a given power, and enabled increased speed to be obtained in successive ships. Sir William White retired from the British Admiralty in February 1902, and was succeeded by Mr Philip Watts, F.K.S.

United Stales of America. ◆◆◆ Fig. 41 shows the main features of the United States battleships Kearsarge and Kcntiichj. Their principal dimensions are : length 368 ft., beam 72 ft., mean draught 23 ft. 6 in., displacement 11,525 tons. They carry four 13-in. guns in turrets 15 in. thick, four 8-in. guns in turrets 9 in. thick, fourteen 5-in. Q.F. guns, twenty-seven smaller guns.

FLATE IX.

SHIP.

Fig. 43. ◆◆◆ U.S.A. lllbmis.

Fig. 44. ◆◆◆ German Kaiser Frederick III.

SHIP.

PLATE X.

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Fig. 45. ◆◆◆ Jaraneso Ilaisucc

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and four torpedo tubes ; and at the above displacement they carry 410 tons of coal, but can stow 1200. Their speed is 16 knots. They are worthy ot special mention on account of the novelty introduced m tliera of the double-storeyed turret, two of which arrangements are provided m these ships, one forward and one aft. In this arrange- Tfit T!►► ”” ” superposed or built on the first, the structure so formed turning as a whole ; a pair of 8-in. guns is mounted in

tl^ir YT^’ ”” ‘“i”’”” “^ ^3-i►►- g”►►►►► ^^ tl^e lower. A later bnrtTii L►►/ f ‘ff’T ‘^’^ ‘^ furnished by the five first-class battleships of the Georgia class (Fig. 42), building in 1902, which have a displacement of nearly 15,000 tons, length 435 ft., beam y,i J►►► f ►►►’ ►►► ?: ”^ draught of 23 ft. 9 in ; they have a com- plete water-hne belt of Krupp armour, from 11 in. to 8 in. thick, tapermg to 4 in. at the bow ; above this belt there is a belt of lighter armour, 6 m. thick and 245 ft. long, forming a battery for the b-m. y. b . guns, which extends to the upper deck ; there are also tour turrets►►► two large double-storeyed turrets, as in the Kentucky, placed one forward and one aft, and two smaller turrets, placed on each side forward. The larger turrets carry each a pair of 12-in. guns and a pair of 8-in. guns, and are protected by a maximum thickness of 11-iu. armour, and the smaller carry each a pair of 8-in. guns and are protected by 6J in. armour. In addition to the four 12-m. and eight 8-in. guns thus disposed, there are also twelve 6-m. guns on the main deck and some forty-two smaller guns. These ships will develop 19,000 I.H.P. and have a speed of 19 knots. They will carry 900 tons of coal at normal displacement, and have capacity for stowing 1900 tons. The battleships which came between the Kentucky

belts of Krupp steel extending from the after barbette to the stem, with a maximum thickness of 12 in., tapering to 6 in. at the bow ; there is no side armour above this belt. The main armament consists of four 9-4-in. guns,

placwl in pairs in barbettes, one forward and one aft, protected by 10-in. armour. On the main deck they have four 5-9-in. Q.F. guns in 6-in. armoured casemates, two on each side ; and on the upper deck they have eight similar guns, protected in like manner, and six others in turrets ??? three each side ; in all, eighteen 5‘9-in. guns, besides twelve 3-5-in. and smaller guns. There are five vessels of the fFittelsbach class being built ; these represent a development of the Kaiser Friedrich III. The Wittelsbachs are about 700 tons more displacement, are 15 ft. longer and 1^ ft. more beam, but are of shallower draught. They have 15,000 H.P. and a speed of 19 knots, or a knot more than their predecessors. Their armament is the same, but the 9‘4-in. guns are better protected. The main armour belt is somewhat longer, but in other respects the thicknesses and general disposition of the protection are similar to the Kaiser Friedrich III. class.

Japan. ??? In 1902 the most recent Japanese battleships were the four ships of the Eatsuse class, built in Great Britain, of which the Satsuse herself (Fig. 45, Plate X.), built at Elswick, may be taken as a representative in her main features. The displacement is 15,000 tons, length 400 ft., beam 75 ft. 6 in., mean draught 27 ft. The I.H.P. is 15,000, giving a speed of 18 knots. The armour-belt extends the full length of the ship at the water-line, and has a maximum thickness of 9 in. Between the top of this belt and the main deck, for a length of some 220 ft., is an upper belt 6 in. thick,

and the Georgia classes (Alabama, Illinois (Fig. 43, Plate IX.), Wisconsin, Maine, Missouri, and Ohio) had not the double-storeyed turrets, and it is understood that in the new and ~~still larger class of battleships now to be pro~~ ceeded with {Pennsylvania class) this feature will not be reproduced.

France. ??? The latest and largest battleship in the French navy is the Suffren, commenced in 1899. Her displacement is 12,728 tons, length 410 ft., beam 70 ft., and draught 27 ft. 6 in. She has a complete water – line belt of Harveyized steel armour of llf in. maximum thickness, and above this, up to the main deck, similar armour, 5 in. thick, extend- ing from the after turret to the bow ; she has also a short armoured battery on the main

deck which encloses the funnel uptakes. There are eight turrets on her upper deck

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Fig. 42. ❓❓❓Gun and Armour Plan, Georgia Cla^ (Georgia, Nebraska, New Jersey, Rhode Island, and Virginia).

-one forward and one aft, each carrying two 12-in. guns, and six arranged three on each broadside, each carrying a 6‘4-in. gun. The armour of the larger turrets is of the same thickness as the armour belt, namely, 11} in., and that of the smaller turrets 5 in. She mounts eight 3 ‘g-in. guns on the superstructure, and also has twenty-two smaller guns and four torpedo tubes, of which two are submerged. She has triple screws, engines of 16,000 I.H.P., and a speed of 18 knots.

The B^publique and Patrie, examples of the latest French design, have a displacement of 14,865 tons, and are of 439 ft. length, 79 ft. 6 in. beam, and 27 ft. 6 in. extreme draught. They have three screws, develop 17,500 H.P., and are stated to be 18- knot ships, though if the power is realized the speed ought to be considerably more. They carry four 12-iu. B.L. guns in pairs in turrets on the middle line, as in the British ships, twelve 6‘4-in. Q.F. guns in pairs in turrets on the upper deck, six additional 6‘4-in. Q.F. guns in casemates on main deck, twenty -six 3-pdrs., three above-water and two submerged torpedo tubes. There is a complete water-line belt of a maximum thickness of 12 in., the bow is protected by 4 in. and there is a partial 4-in. belt above the 12-in. belt. The protective deck is 4 in. on the slopes and the armour of the main turrets is 12J in. thick, the whole armour being of Harvey quality.

Germany. ❓❓❓The latest battleships completed for the German navy are the five first-class battleships of the Kaiser class, the last of which, the Kaiser Friedrich III. (Fig. 44, Plate IX.), was finished in 1900. They have a displacement of 10,900 tons, a length of 377 ft., a beam of 66 ft. 10 in., and a draught of 25 ft. 9 in. ; their engines are of 13,000 I.H.P. and their speed is 18 knots. They have

which is continued by oblique bulkheads to the sides of the heavy- gun barbettes. The barbettes themselves, which are two in number, one forward and one aft, have armour 14 in. thick, and the conning- tower also is 14 in. thick. Krupp armour is used throughout. The armament consists of four 12-in. 49-ton B.L. guns, two mounted in each barbette and loading in any position ; fourteen 6-in. Q.F. guns, all in 6-in. casemates, eight on the main deck and six on the upper deck ; and twenty 12-pdrs. , besides smaller guns and four submerged torpedo tubes. The Mijcasa, building at Barrow in 1902, is a slight modification of the Hatsuse class design, being 200 tons heavier and 6 in. more in draught. The principal difference is that the eight 6-in. Q. F. guns on the main deck are increased to ten, and instead of being in separate casemates are in a 6-in. side- armoured central battery, screened from each other by 2-in. divi- sional bulkheads side and rear. The total number of 6-in. guns carried, however, is the same.

Russia. ❓❓❓ The Russian battleship Pobyeda (Fig. 46, Plate X.) is of the lightly armed and high-speed type which are sometimes spoken of as "Intermediates," coming, as they do, midway between the heavy first-class battleship and the armoured cruiser. Her prin- cipal dimensions are : length 436 ft., beam 7li ft., draught 27^ ft., and displacement 12,670 tons. She has engines of 15,000 H.p! and a nominal speed of 19J knots, carries an armament of four 10-in. guns, mounted in pairs in turrets on the middle line forward and aft ; eleven 6-in. guns, distributed five on each broadside and one in the extreme bow of the vessel ; twenty ^^n. guns and twenty- six smaller pieces ; and six torpedo tubes. She is protected by a complete water-line belt of Krapp armour, 9 in. thick amidships, tapering to 4 in. at the ends, reinforced by a protective deck 2J in!

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thick. Above the belt, for a length of 185 ft. amidships, is a lighter belt of 5-La. Krupp armour, protecting the bases of the 6-in. guns, and terminated by transverse bulkheads. The 10-in. gun turrets are 10 in. thick, and the 6-iu. guns are protected by casemates 5 iu. thick. This vessel carries 30 Belleville boilers, and has storage for 2000 tons of coal. The disposition of her guns and the other main features of the vessel are readily seen in the figure. In 1902 the latest completed battleship for the Russian navy was the Betvizan, which was built at Cramp's, U.S.A. She is of 12,700 tons displacement, 376 ft. long, 72J ft. beam, and 26 ft. draught. She has four 12-in. B.L. guns in pairs in turrets, twelve 6-in. Q.F. guns in 5-in. casemates, twenty 12-pdrs., and twenty-eight smaller guns, besides four submerged and two above-water torpedo tubes. She is protected by a water-line belt extending from the after turret to the stem, and tapering in thickness from 9 in. to 2 in. Above this is a complete belt of 6 in. maximum thickness, and the main armament is protected by turrets 10 in. thick. She has 16,000 H.P. and a speed of 18 knots, and has stowage for 2000 tons of coal.

Italy has undertaken the building of three new battleships, two of which are already under construction. They are designated the Vittorio EmanueU III. class, and have a displacement of about 12,500 tons, a length of 435 ft., a beam of 75 ft. 6 iu., and a draught of 25 ft. 7 in. They have twin screws and 19,000 I.H.P., giving them 21^ to 22 knots speed ; they have partial water-line belts of Harveyized steel 9| in. thick, and a l^-in. protective deck ; the gun positions are protected by 8 -in. armour. The armament consists of two 12-in. B.L. guns, twelve 8-in. B.L. guns, twelve 3-in. Q.F., with twelve smaller guns and four torpedo tubes. The 12-lii. guns are mounted singly in middle-line turrets, one forward and the other

aft, the aftermost gun being a deck lower than the foremost gun ; and the 8-in. guns are mounted in pairs in turrets, of which there are three on each broadside between the 12-in. tuixets, the amidship one each side being at the same level as the forward 12-in. gun, and the others at the same level as the after 12-in. gun. Although classed as battleships and having a very powerful armament, this type of ship aims at a speed little short of the armoured cruiser class of other navies. ???

Norway. ??? Fig. 47, Plate VIIL shows the completed Norwegian armour-clad Norge on her trial trip. This vessel and her sister the Eidsvold, with their predecessors Harold Haarfagre and Tordensk- jold, were built at Elswiok for the royal Norwegian navy, and com- pleted in 1900. They have a displacement of 3850 tons, length 290 ft., beam 50 ft. 6 in., draught 16 ft. 6 in., and with twin-screw engiues of 4500 horse-power have attained 16^ knots speed. They are heavily armed with two 8-in. B.L. guns in armoured gun-houses, one at each end of the vessel ; six 6-in. Q.F. guns, four mounted in 5-in. nickel steel casemates and two in the open, with strong shields ; eight 12-pdr3. and six 3-pdrs. ; and two submerged torpedo tubes. The water-line is protected with 6-in. Krupp armour over a length of 170 ft., and bulkheads of the same thickness are provided at each end of the belt. These ships represent a class of vessels of small size which are well protected, heavOy armed, and have a fair speed, which would prove formidable opponents to many larger armoured ships, and which are especially useful for coast-defence purposes.

Table VI. shows the development of the leading features of armoured battleships from the time of the Warrior to 1902. The particulars, it will be seen, are in a tabulated form, arranged in order of the date of launch, and to most of the ships therein mentioned reference will be found in the preceding pages.

Cruisers.

The cruiser type was primarily intended to co-operate with armour-clad fleets, in the same manner as sailing frigates did with fleets of sailing line-of-battleships, and the earliest cruisers were modelled directly upon the frigates which preceded them, the differences between the two being those incidental to the use of steam power and to the substitution of iron

for wood as the building material. As steam propulsion grew in favour, engines of greater power were provided, and the rig and sail-spread were reduced till at the present day they have almost entirely disappeared. When the final adoption of iron led to the remodelling of the details of construction by Sir E. J. Eeed, the new system of construction was applied to the cruisers of the day, but no attempt was made till much later to give these cruisers any protection, nor was the question of their armament given the importance which it afterwards came to have.

Lord Armstrong was one of the first to recognize the importance of developing this class of vessel. He con-

sidered the essential features of a cruiser to be high speed, protection without the use of side armour, a powerful armament, and minimum size and cost; and his views were adopted by the Elswick firm in a large number of cruisers for foreign Powers down to the introduction of high explosives, when side armour was advocated in place of, or in addition to, the armour deck. The cruisers built for the British navy prior to 1880 ??? of which the principal were such vessels as the Inconstant (Fig. 48, Plate XI.), of 5780 tons (1866) ; the Active, of 3080 tons (1867) ; the Raleigh, of 5200 tons (1871); and the faster despatch vessels Iris and Mercury (Fig. 49, Plate XI.), of 3730 tons (1875) ??? had been almost entirely unprotected; and although the Comus and Leander classes (see Fig. 50, Plate XL, and particulars in Table VII.) had been given a partial protec- tive deck, the Elswick-built Esmeralda (1883) (see Fig. 51, Plate XL) may be quoted as the first vessel in which the important features of a complete protective deck and good protection to the guns were combined with high speed and a powerful armament. On the other hand, the Imp^rieuse and Warspite (Fig. 52, Plate XII.), completed in 1881, of much greater displacement than the Esmeralda were provided with a partial belt of 10-in. compound armour in combination with a protective deck. Thus the necessity for protecting cruisers led to the introduction of two types ??? the " protected " cruiser, of which the Es- Tneralda may be taken as the pioneer, and the " armoured " cruiser, of which the Impdrieuse and Warspite are early representatives ; but while in the British navy the " pro- tected" cruiser type was repeated and developed, the " armoured " type was discontinued, and with the exception of the

Orlando class (Fig. 53, Plate XII.), built shortly afterwards, the whole of the cruisers built for the British navy for another fifteen years were of the " protected " type. In France and Russia, however, the armoured cruiser continued in favour, the Dupuy de Ldme of 1890, for the former, and the Burik of 1892, for the latter, being vessels of this type (see Table VII.).

The reintroduction of side armoiu- in British-built cruisers came about 1895, when, it should be observed, the improvement of armour by the development of the Harvey and subsequently Krupp processes of manu- facture enabled more efiicient protection to be provided in this way with a much thinner belt than had previously been possible. The Elswick cruiser Esmeralda (second), built for the Chilian Government in 1895, was one of the first in which the use of side armour was revived. She was followed by other vessels of the armoured type built by the same firm for the ChiUan and Japanese navies. In 1898 the Cressi/ class (Fig. 54, Plate XII.) was begun for the British navy, and since this date all cruisers of 10,000 tons and above for the British navy have been provided with side armour.

In the United States the adoption of armour belts of the new material for cruisers came somewhat earlier than it did in the British navy, the Brooklyn (Fig. 55, Plate XII.), built in 1895 (see Table VII.), being so protected ; and the development of the type has been similar to its develop- ment in Great Britain, the tendency being to go to larger displacements, in order to provide greater protection and heavier armaments, with each new class of vessel. Indeed the first-class armoured cruiser of the present day miaht be described as a high-speed battleship with a liSht primary armament. ??

Coming to more detailed descriptions of existing ships, we find in the British navy, as might be expected that the demand for vessels to meet the varied and diverse requirements that necessarily arise in a fleet of such magnitude has led to the production of a number of classes, each adapted to their special duties. They may

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be classified as (1) unprotected cruisers ; (2) protected cruisers of first, – second, and third classes ; and (3) armoured cruisers. Unprotected cruisers have neither side armour nor other protection against loss of buoyancy from injury by shot and shell. Protected cruisers have no side or vertical armour, but they have horizontal armour decks with strong sloping sides in the vicinity of the water, upon which coal is carried in minutely divided bunker compartments. Armoured cruisers have side or vertical armour.

Each of these classes includes a number of groups of sister ships, but we shall confine ourselves to a brief description of the main features of a

representative ship in a few of the most important groups comprising each of the classes defined above.

The protected cruiser of medium displacement affords a con- venieat starting-point, as it so happens that the latest vessels of this type are of about the same displacement as the largest first- class cruisers of thirty years before, and a comparison of represen- tative ships of these classes illustrates the great advances made in thirty years in ships of approximately the same size ; while a further comparison of these second-class cruisers (as the vessels of medium displacement are styled) with the first-class protected cruisers and the armoured cruisers of the present day shows the growth in size and power of the largest units of the cruiser type during the same period. It should, however, be noted that while the most recent second-class cruisers are of such a displacement (5600 tons) as to allow of this comparison being made, the great bulk of the vessels of this class are smaller, particularly those which have been in service for some years. Thus the Mersey (Fig. 56, , Plate XIII.) is an example of a vessel of this class Secoa ??? iiioii]ias seen considerable service. Begun in 1883, ‘ ^Tera ^^^ principal dimensions are : length 300 ft., beam 46 ft., mean draught about 20 ft., and displacement 4050 tons. Protection to the vitals of the ship is provided for by means of a protective deck a little above the level of the water-line, 2 to 3 in. in thickness, in combination with a system of coal-stowage in bunkers along the water-line. She carries two 8-in. and ten 6-in. B.L. guns and four torpedo tubes. Her horse-power is 6000 (forced draught) and speed 17 ‘3 knots, and she carries 750 tons of coal at normal draught, with capacity for 900 tons. The Astrcea (Fig. 57, Plate XIII.), begun in 1890, may be taken as representing the average of the various modern vessels classified as second-class cruisers. She is built of steel, sheathed and coppered, is 320 ft. long, 49 ft. 6 in. beam, 21 ft. 6 in. mean draught and 4360 tons displacement, and carries two 6-in. Q. F. guns and eight 4‘7-in. Q.F. guns, all on the upper deck and protected by shields, together with four torpedo tubes. She is protected by a steel deck 1 in. to 2 in. thick, and the engine cylinders, which project through this deck, are shielded by 5-in. sloping coamings. The coal bunkers in the neighbourhood of the water-line are minutely subdivided, and the stowage is arranged so as to make full use of the coal protection. Her

engines develop 9000 H.P. (under forced draught) .and her speed is 19”3 knots. Her coal stowage is 1000 tons.

The Hermes (Fig. 58, Plate XIV.) represented in 1902 the latest type of second-class cruiser added to the Royal Navy. She is 350 ft. long, 54 ft. beam, 20 ft. 6 in. mean draught, and 5600 tons dis- placement. She presents a striking contrast compared with the iTKonstant (Fig. 48), built in 1866, of almost the same displacement. The Inconstant was fully rigged, and sailed almost as fast as she steamed ; while the Hermes has no sail, and steams 20 knots, or 6 knots’ faster than did the older vessel. The Inconstant was entirely unprotected, and carried her guns on the broadside, with very limited arcs of training ; whilst the Hermes has all-round fire, the fire ahead and astern is a very large percentage of that on the broadside, and her guns all train through large arcs (120 and above), and are well protected by enveloping shields, and the ship herself is protected by a steel deck IJ to 3 in. thick, besides having coal protection. The IniConstant’s main armament consists often 9-in. and six 7-in. M.L. guns ; the Hermes’, of eleven 6-in. Q.F. guns, each firing probably ten rounds to one of the Inconstant’ s 9-in. , and with a perforation of wrought iron of about one-third as much again. A glance at the pictures of the two ships (Figs. 48 and 58) shows a great difference in appearance. The line of the topsides of the Inconstant is unbroken from stem to stern ; the Hermes has a forecastle forward, and amidships she has a large number of ventilators and funnels ; and the contrast extends to all the principal features of the ships. The Hermes is built of steel, sheathed and coppered. She carries, in addition to her eleven 6-in. Q.F. guns, eight 12-pdrs. and six 3-pdrs., besides machine-guns and two submerged torpedo tubes. She has

Belleville boilers, developing 10,000 H.P. and giving her a speed of 20 knots as long as her coal lasts.

Somewhat similar to the Hermes in external appearance, the four vessels of the Arrogant class (Fig. 59, Plate XIV.) possess certain features of special interest which distinguish them from all other second-class cruisers, in which class they are usually included. They are of 150 tons greater displacement than the Hermes, are 30 ft. shorter, but have 3 ft. 6

in. more beam and 6 in. more draught. They are built of steel and are unsheathed, have Belleville boilers, and engines giving 10,000 H.P. and a speed of 19 knots. They have an armament of four 6-in. Q.F. guns, three of which fire right ahead and one right astern; six i'l-m. Q.F. guns, three on each broadside ; eight 12-pdrs. ; nine smaller guns ; and two submerged torpedo tubes. All the guns are mounted on the upper deck in shields. The protective deck is of nickel steel, and varies from IJ in. to 3 in. in thickness. The bow is protected by a belt of 2-in. nickel steel extending about 40 ft. back from the ram, the top of this belt being level with the main deck, and the bottom edge sloping downwards to strengthen the ram. The bow spaces are packed with a water-excluding material, and a cofferdam formed by two water-tight transverse bulkheads about 3 ft. apart, and extending from keel to main deck, separates the bow from the rest of the vessel. The Arrogants are fitted with tandem rudders, and the deadwood at the after end of the ship is cut away, the manojuvring power being greatly increa.sed by these means. The strong bow fire, bow strengthening and pro- tection, and great manoeuvring power render these vessels specially adapted for use as rams.

The protected cruisers of greater displacement, or first – class cruisers, as they are called, may be divided into four well-marked classes : Blake and Blenheim class, Edgar class (Fig. 60, Plate XV.), Powerful and Terrible class (Fig. 61, Plate XV.), and the Diadem class (Fig. 62, Plate XV.). The Blake and Blenheim, begun in 1888, were amongst the earliest cruisers designed for the p, , , British navy by Sir William White in his oap^'City craisera of Director of Naval Construction : they are of 9000 tons displacement, 375 ft. long, 65 ft. beam, and 27 ft. draught. They carry two 9'2-in. B.L. guns, one firing directly ahead and the other directly astern, protected by shields 6 in. thick ; ten 6-in. Q.F. guns, of which four are on the main deck, protected by casemates of 6 in. compound armour, and six on the upper deck in shields ; sixteen 3-pdrs. ; two submerged and two above- water torpedo tubes. Their protection consists of a complete armour deck of steel 3 in. to 6 in. thick, with a dome or coaming over the tops of the cylinders 4 in. to 8 in. thick. Their machinery arrangements are somewhat unusual, consisting of four independent sets of vertical triple-expansion engines, two on each shaft, for which steam is provided from six double-ended cylin- drical boilers. The aggregate power of their

machinery is 20,000 H.P. under forced draught, giving them a speed of 21 knots ; with open stokeholds their power is 13,000 H.P., which gives them a speed of 19J knots. They carry 1500 tons of coal. The Edgar class (Fig. 60), begun in 1889, are vessels of 7350 tons displacement, 360 ft. long, 60 ft. beam, and 23 ft. 9 in. mean draught. Their armaments consist of two 9‘2-ui. Q.F. guns and ten 6-in. Q.F., disposed and protected in the same way as the corresponding guns of the Blake, with twenty-four smaller and machine guns, two submerged and two above-water torpedo tubes. The protective deck has a maximum thickness of 5 in., and the cylinders are protected by a raised coaming on this deck, with sloping sides 6 in. thick. They have six double-ended cylindrical boilers and two sets of vertical triple-expansion engines, developing with forced draught 12,000 I.H. P. and giving a speed of 20 knots. They carry 850 tons of coal at normal draught, with storage for 1250 tons. Nine vessels of this class have been built, four of them being sheathed with wood and coppered, the remaining five, including the Edgar, being unsheathed. The Powerful (Fig. 61), with her sister the Terrible, was in 1902 the largest pro- tected craiser afloat. They were begim in 1894. They are of steel, sheathed with wood and coppered, are of 14,200 tons dis- placement, 500 ft. length, 71 ft. beam, and 27 ft. mean draught. They are armed with bow and stem 9‘2-in. B.L. chasers, and twelve 6-in. Q.F. guns, of which eight are in 6-in. Harveyized casemates on the main deck and four in similar casemates on the upper deck. They have also seventeen 12-pdrs. Q.F. guns, twelve 4-pdrs., nine machine-guns, and four submerged torpedo tubes. The 9‘2-in. guns are protected by a shallow ring of 6-in. Harveyized steel, surmounted by a 6-in. shield enveloping the gun and crew. The ship herself is protected by a complete deck at the water-line level of Harveyized steel plates 3 in. to 6 in. in thickness, and by a double line of coal bunkers above it. The machinery arrangements constitute the striking feature of these ships. They have no less than forty-eight Belleville boilers in eight boiler-rooms, with two sets of triple-expansion 4-cylinder engines, developing 25,000 H.P. with open stokeholds and giving the ships a speed of 22 knots. The large boiler power and the great size of these ships enable them to maintain continuously at sea a

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Third- class cruisers.

speed closely approaching their majdmum. They carry as a normal supply 1500 tons of coal, and their bunkers will hold 3000 tons.

The Diadem class (Fig. 62) were in 1902 the latest first-class protected cruisers added to the British navy. There are eight vessels of this class, but in the four last-built vessels, of which the Spartiale was one, some changes were made. The first vessel of the Diadem class was begun in 1895, is of 11,000 tons displacement, 435 ft. length, 69 ft. beam, 25 ft. 3 in. mean draught, and is built of steel, sheathed and coppered. Her principal armament consists entirely of 6-in. Q.F. guns, of which there are sixteen, twelve being protected by 5-in. casemates of Harveyized steel, and the others disposed, two on the forecastle as bow chasers,^ and two on the quarter deck as stern chasers, all in separate shields. She also carries thirteen 12-pdrs., eleven smaller guns, including machiue-guns, and two submerged torpedo tubes. The protection consists of a steel deck, whose slopes are 4 in. thick and horizontal portions 2i in. thick, upon which is stowed the 1000 tons of coal which the vessel ordinarily carries, the full coal capacity being 2000 tons. She is provided with 30 water-tube boilers of the Belleville type, and her machinery develops 16,500 H.P., giving her a speed of 20-5 knots. All the ships of the class are similar to the Diadem, except that in the four Spartiates the casemates are 6 in. thick, and the machinery is of greater power, viz., 18,000 I. H.P., giving a speed of a quarter of a knot higher.

Third-class protected cruisers include vessels varying in dis- placement from 1500 to 3000 tons. The advances which enable modern second-class cruisers to compare so favourably with vessels of the same size built thirty years pre- viously also enable vessels of even smaller displacement to be provided with the essential features of a cruiser to a considerable degree. With a reduction of displacement come reduction of initial cost and cost of upkeep, a smaller crew, a shorter time for building, and the many advantages attendant upon reduced size and draught of water. It has been

found possible to embody in a, ship of about 2000 tons displacement many of the most important requirements of a, modern cruiser, and a large number of vessels of this class have been added to the fleet. Among these may be mentioned the Barham, (Fig. 63, Plate XV.), a typical small cruiser, which was built in 1889 of steel, of 1830 tons displacement ; she is 280 ft. long between perpen- diculars, 35 ft. broad, and 12 ft. 8 in. draught of water. As originally completed, this vessel had cylindrical boilers and a H.P. of 4700, giving a speed of 19 knots. In 1898 she and her sister, the JBellona, were reboilered with water-tube boilers of the Thornycroft type, and with these a H.P. of 6000 is obtained, ‘ and the vessel reaches a speed of nearly 20 knots. The protection aff’orded is in the usual form of a protective deck, 1 in. thick on the flat, and sloping sharply downwards near the water-line, where the thickness is increased to 2 in. ; and above this deck the coal stowage is arranged in subdivided bunkers. She carries an armament of six 4‘7-in. Q.F. guns in shields on the upper deck, four 3-pdrs., two machine-guns, and two above-water torpedo tubes. She carries 140 tons of coal in her normal condition, and her bunkers will take 250 tons. She has a light fore-and-aft rig. The latest type of third-class cruiser added to the British navy in 1902 may be regarded as a development of the Barham. It is known as the Pioneer class, which might be taken to include the Belarus class, the differences between them being small. Of the two classes eleven vessels have been built. The Pioneer is 305 ft. long, 36 ft. 9 in. broad, 13 ft. 6 in. mean draught, and 2200 tons dis- placement. She has water-tube boilers of the small tube type, and engines of 7000 H.P., giving her a speed of 20 knots. She carries 250 tons of coal at the above displacement, and has stowage for 550 tons. She has eight 4-in. Q.F. guns in shields on the upper deck, eight 3-pdrs., four machine-guns, and two above- water torpedo tubes. Her protection consists of a 2-in. steel deck, having sloping sides extending a few feet below the water-line, and upon which coal is stowed in the usual subdivided bunkers.

The Imp^rieuk and WarspUe, built in 1881 from designs by Sir Nathaniel Barnaby, may be described as the first armoured cruisers built for the British navy. The Impirieuse is Armoured gj^g^jj jjj pjg^ 52, and the WarspUe is a sister vessel. cruisers, rpj^^^ ^^^ ^^ gggg ^^^^^ displacement, 315 ft. long, and are protected by a partial belt amidships of

10-in. compound armour over a length of about 140 ft., with a protective deck above it IJ in. thick, and transveise bulkheads at the ends of the belt 9 in. thick, the protective deck from these bulkheads to the ends of the ship being 3 in. thick. They have machinery of 10,000 H.P. and a speed of lOf knots. They rank in the Navy List of to-day as first-class armoured cruisers, and carry four 9 ???2-in. B.L. guns in separate barbettes ??? one forward, one aft, and one on each beam ??? besides ten 6-in. guns, twenty-six smaller and machine guns, and six torpedo tubes. They are sheathed and coppered, and are thus able to keep the sea for a long period without docking. The next vessels of the typo were the Orlando class (Fig. 53), commenced in 1885. Seven of these were launched in 1886 and 1887. They are much smaller than

the Impirieuse, being only 5600 tons displacement, 300 ft. long, 56 ft. beam, and 24 ft. 8 in. draught. They have a water-line belt of compound armour, 10 in. thick and nearly 200 ft. long, closed in at the ends by bulkheads 16 in. thick ; extending over the top of this, and sloping down forward and aft to the ends of the ship, is a deck 2 in. to 3 in. thick. Their armament consists of two 9 ???2-in. B.L. guns ??? one forward and one aft??? -instead of the four carried in the Impirietise and WarspUe, but is in other respects the same as the armament of the latter ships. They have engines of 8500 H.P. and a speed of over 18 knots, are xmsheathed, and carry 750 tons of coal, with bunker space for 950 tons.

As already stated, between 1885 and 1898 no armoured cruisers were added to the British fleet. The Cressy class (Fig. 54, Plate XII.), commenced in 1898, consists of six vessels of 12,000 tons displacement,, 440 ft. length, 69 ft. 6 in. beam, and 26 ft. 3 in. mean draught. They are built of steel, sheathed and coppered, have a belt of Harveyized steel 11 ft. 6 in. wide, 230 ft. long, and 6 in. thick, with bulkheads 5 in. thick, and 2 in. protective plating on the sides from the forward bulkhead to the stem. They carry two 9 ???2-in. B.L. guns in barbettes and gun-houses 6 in. thick, mounted on the middle line forward and aft, twelve 6-in. Q.F. guns in 6-in. casemates, and twenty-five 12-pdr. and small guns, with two submerged torpedo tubes. Their H.P. is 21,000 with natural draught, steam being supplied by 30 Belleville boilers, and their speed is 21 knots.

They carry 800 tons of coal at normal draught, with capacity for 1600 tons.

The four vessels of the Drake class (see Fig. 64, Plate XVI.), laid down iu 1899, were in 1902 the largest armoured cruisers yet begun. They are of 14,100 tons displacement, are 500 ft. long, 71 ft. beam, and 26 ft. mean draught. They are unsheathed, are protected by a Krupp steel 6-in. belt extending from barbette to barbette, and from 6 ft. below water to the height of the main deck, completed at the after end by a 5-in. bulkhead, and carried forward to the bow by 2-Ln. plating extending right up to the upper deck. There are two protective decks, the lower being 3 in. to 2 in. in thickness, and the main deck, which is 1 iu. thick. Their armament consists of two 9 ???2-in. B.L. guns in barbettes and gun-houses 6 in. thick on the middle line forward and aft, sixteen 6-iu. Q.F. guns in 6-in. casemates, fourteen 12-pdrs., twelve smaller and machine guns, and two submerged torpedo tubes. Their speed was superior to anything in the British navy up to the time of their design, being 23 knots.' They have engines of 30,000 H.P., the boilers being of the BellevUle type. They carry 1250 tons of coal, with bunker capacity for 2500 tons.

A consideration of the above features will illustrate the difficulties of the classification of modern ships. The Drake is called an armoured cruiser, but she is superior to the battleships Renown, Barfleur, and Oanopus in armoiir protection and in her secondary quick-firing armament, as well as in speed and coal endurance, and is somewhat inferior to them only in the number, weight, and protection of primary armament. If 10-in. guns were given to this vessel in lieu of her 9 ???2-in., she would probably be called a first-class battleship, and would be a 23-knot battleship at that. Each successive increase of size has given the battleship more speed and the armoured cruiser heavier guns and armour, thus tending to merge the two types in one.

The Monmouth class are smaller and more lightly armed and armoured vessels than their predecessors, but not inferior in speed. They are of 9800 tons displacement, length 440 ft., beam 66 ft., mean draught 24 ft. 6 in. They are armoured with a belt of 6 in. of Krupp steel over the main part of the length, diminishing in thickness towards the extremities ; they

carry fourteen 6-in. Q.F. guns, of which ten are in 4-in. casemates, and the others mounted in pairs in turrets and gun-houses 4 in. thick, forivard and aft ; they also carry ten 12-pdrs., eleven small and machine guns, and two submerged torpedo tubes. Their horse-power is 22,000, giving them a speed of 23 knots. In six vessels of this class, begun in 1901, the pairs of 6-in guns are replaced by 7‘5-in. guns, and the thickness of the belt is increased to 6 inches.

With regard to cruisers of other navies than the British, it may be said that the vessels constructed at Elswick have by their success exercised considerable influence in the development of such cruisers, as well as of those of the British navy. The Esmeralda of 1883 (Fig. 51, Plate XL), built for the Chilian Government, but bought by Japan in 1896, was of 2950 tons displacement, had 6000 H.P. and 18‘3 knots speed, was protected by a complete 1-in. steel deck, and carried the very heavy armament of two 10-in. B.L. guns, six 6-in. Q.F., two 6-pdrs., seven smaller guns, and three torpedo tubes. The Piemonte (Fig. 65, Plate XVI.), built for the Italian navy in 1888, had a displacement of only 2640 tons, but was of 13,000 H.P. and had a speed of nearly 22J knots. She was protected by a steel deck of 3 in. maximum thickness, and carried six 6-in. Q.F., six 4‘7-in. Q.F., ten 6-pdrs.,

‘ The Drake herself in September 1902 obtained on trial a speed over 24 knots.

PLATE XIII.

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Fig. 56.???H.M.S. Mcrsrjj.

Fin. 57.???H.M.S. ^s^rffa.

PLATE XIV.

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Fig. 58. ⬜⬜⬜ H. M.S. J/cr

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Fio. 59. ⬜⬜⬜ H. M.S. Arrognvt.

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eleven smaller guns, and three torpedo tubes, an armament which, as pointed out by Lord Armstrong, was capable of discharging in a given time twice the weight of shot and shell that could be fired by the largest war vessel then afloat. The Buenos Aires, built in 1895 for the Argentine Republic, is a later example of Elswick design. She is 396 ft. in length and of 4800 tons displacement, her machinery developing 13,300 horse-power with open stokeholds, and giving her a speed of 23-2 knots. She is protected by a com- plete deck 14 in. to 3 in. thick, and carries a powerful armament of quick-firing guns, consisting of two 8-in., four 6-in., six I’V-

in., twenty-two smaller guns, and five torpedo tubes. Her normal coal supply is 350 tons, and she can stow 1000 tons in her bunkers. Rather smaller than the Buenos Aires, but of still later build (1901), is the Chilian cruiser Ohaeabuco (Fig. 66, Plate XVI.). She is a characteristic Elswick cruiser in design and general appearance, being heavily ^^ armed, fast, and of moderate ” displacement. Her dimensions are : displacement 4500 tons, length 360 ft., breadth 46 ft., and draught 18 ft. She carries an armament of two 8-in. Q.F. guns, mounted on the middle line forward and aft, and pro- tected by well-armoured gun- houses, ten 4-7-in. Q.F. guns in shields on the broadsides, and nineteen smaller guns, includ- ing machine – guns. She is protected by a strong armoured deck 1| in. thick on the flat to 44 in. on the slopes, and by the 1000 tons of coal which forms her normal supply. Her engines develop nearly 16,000 H.P., and her speed is 23 knots.

In the matter of armoured cruisers also Elswick has taken a leading place, the policy which has been so successful in the case of protected cruisers being followed mth these also, with the difference that in the armoured cruisers the main protection takes the form of side armour instead of, or rather in combination with, protective deck-plating. From what has been said previously as to the functions of armoured cruisers, it might be expected that the displacements of these ships built at Elswick would be greater than the protected cruisers, but with these also the endeavour was to keep displacement at the minimum. Examples of Elswick designs are found in the EsmeraZda (second), of 7000 tons, begun in 1895 for Chile ; .the O’JSiggins, of 8500 tons, begun in 1896 for the same state ; the Asama and Tokhoa, of 9700 tons, begun in 1897 for Japan ; and the Idzumo and Iwate, begun 1899, also for Japan. The Idzumo (►►ig. 67, Plate XVII.) is 9750 tons displacement ►►► or about the same as the English Monmouths ►►► 400 ft. long, 68 ft. 6 in. beam, 24 ft. 3 in. draught. She has 16,000 H.P. and a speed of 22 knots ; is protected by a com- plete belt of Krupp steel 7 in. thick, tapering to 3J in. at the ends, a 24-in. steel deck with a citadel above it 5 in. thick, and carries an arma- ment of four 8-in. Q.F., four- teen 6-in. Q.F., twelve 12-

pdrs., seven smaller, and four torpedo tubes. The 8-in. guns are in pairs in 6-in. barbettes and hoods, while the 6-in. guns are ten in 6-in. casemates

and four in shields. She carries, with bunkers full, 1300 tons of coal. Particulars of some further examples of Elswick cruisers will be found in Table VII.

United States. ❓❓❓ In the United States navy the proportion of "protected" cruisers is smaller than in the British navy, as the " armoured " type established itself at an earlier date. The Philadelphia, begun in 1888, may be taken as an example of the U.S. protected cruiser. She is 4345 tons in displacement and 327 ft. long, has twin screws and a horse-power of 8800, giving her a

speed of 19 '6 knots. She is protected by m steel deck 2J in. to 4 in. thick, and carries twelve 6-in. B. L. guns (later converted to Q.F.), seventeen smaller guns, and five torpedo tubes. She has bunker capacity for 1175 tons of coal. The Brooklyn (Fig. 55, Plate XII.), begun in 1893, is of the "armoured" type. She is of 9215 tons displacement and 400 ft. long, has twin screws and develops 16,000 horse-power with forced draught, giving a speed of 21 knots. She is protected by a steel belt for two-thirds of her length 8 ft. broad and 8 in. to 3 in. thick, and a complete steel deck 6 in. to 3 in. thick. She carries eight 8-in. B.L. guns in pairs in

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Fio. 68. ❓❓❓ Plan of Calijmmia.

15-in. barbettes ❓❓❓ disposed one forward, one aft, and one on each beam ❓❓❓ twelve 5-in. Q. F. guns in 4-in. shields, twenty smaller guns, and five torpedo tubes. Her normal coal stowage is 900 tons, and she can stow 1650 tons in her coal spaces.

In 1902 there were building, or projected, six armoured cruisers of the California class (Fig. 68), of 13,700 tons, and three of the St Louis class (Fig. 69), of 9700 tons. The former are vessels 502 ft. in length, 70 ft. beam, and 26 ft. 6 in. draught, have machinery developing 23,000 indicated horse-power, and a speed of 22 knots. The latter are 424 ft. in length, 66 ft. beam, and

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Fig. 69. 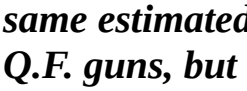 *Plan of St Louis.*

23 ft. 6 in. draught, with engines of 21,000 indicated horse-power, and the same estimated speed, namely, 22 knots. Both classes have fourteen 6-in. Q.F. guns, but the larger vessels have in addition four 8-in. guns in two 64-iu. turrets, besides a heavier battery of smaller Q.F. guns. The California class are completely belted with armour having a thickness of 6 in. over half the length amidships and ^ in. to the ends, and a batterv of 5-in. armour enclosing the 6-in. Q.F. guns, and extending to the upper deck. The 8t Louis class have only a water-line belt for about one- half the vessel's length, with a similar batterv above it, the whole of the armour being 4 in. thick of Krapp quality. The California

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*** 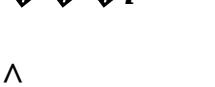 ***

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<u>class comes between the Englisli Cressy and Drake classes. The St Louis class is practically the English Monmouth, with about a knot less speed, bow-plating omitted, and a 4-in. battery added.</u>

<u>France. ⬜⬜⬜ A good example of the modern French cruiser is afforded by the Jeanne d’Arc, launched in 1899 at Toulon. She is about 11,300 tons displacement, 477 ft. in length, 63 ft. 8 in. beam, and 24 ft. 8 in. mean draught, has engines of 28,500 indicated horse-power, and a speed of 23 knots. In accordance with the usual practice of the French</u>

navy, she has a complete water-line armour belt of Harveyized steel, having a maximum thickness of 6 in., and the bow is also protected as far aft as the bow guns with 1\ in. steel to the upper deck. Her armament consists of two 7‘5-in. guns, fourteen 5‘5-in. Q.F., twenty-two smaller guns, and two submerged torpedo tubes. Of more recent date than the Jeanne d’Arc, but smaller in size, is the Montcalm (Fig. 70, Plate XVII.), an armoured cruiser launched in March 1902, of 9500 tons displacement, 453 ft. length, 63 ft. 8 in. beam, and 24 ft. 6 in. draught. She carries an armament of two 7. 6-in. guns in separate turrets of Harveyized steel 6 in. thick forward and aft, eight 6‘4-in. Q.F. guns in casemates on the broadsides, four 3‘9-in. Q.F. guns in shields on the broadsides, twenty-two smaller guns, and two submerged torpedo tubes. She is protected by a water-line belt 6-^- ft. deep which extends from the bow to within 30 ft. of the stem, where it is terminated by a transverse bulkhead 4 in. thick ; amidship this belt is 6 in. thick at its upper edge, diminishing to 2 in. at its lower edge, where it meets the 2-in. protective deck, but the maximum thickness tapers to 3 in. at the forward and after ends. Above this main belt is a thinner one extending over the same length, but only 3| in. maximum thick- ness and of about 4 ft. depth. The Montcalm has 20 water-tube boilers of the Normand-Sigaudy type, and engines of 19,600 H.P., giving her a speed of 21 knots. She carries 1000 tons of coal and some oil fuel. Her engine-rooms are placed between the two sets of boiler-rooms, instead of abaft them, as is usual, her peculiar appearance, with two pairs of funnels widely separated, being thus accounted for. There were also in hand in France in 1902 three armoured cruisers of the Gambella class, of about 12,400 tons dis- placement, length 480 ft., beam 70 ft. 3 in., draught 26 ft. 3 in., with an indicated horse-power of 27,500 and an estimated speed of 22 knots. Tliese ships approach in size and type to the Drake class in H.M. navy, particulars of which are given on page 566. They compare very favourably so far as water-line protection is concerned, but there is considerable difference in the armament, the Drake having two 9 ???2-in. against four 7‘6-in. in the Oambetta for main armament, and sixteen 6-in. Q.F. against sixteen 6 ???4-in. Q.F. for secondary armament.

Russia. ??? In 1902 the latest armoured cruiser added to the Russian navy was the Bayan, launched at La Seyne, June 1900. She has a

displacement of 7800 tons, and is 445 ft. in length, 56 ft. 9 in. beam, and 22 ft. mean draught. Her armament con- sists of two 8-in. , eight 6-in. Q.F., twenty 2”9-in. and seven 1^8-in. guns, and six torpedo tubes. Her armour consists of a water-line belt, having a maximum thickness of 8 in. Above the belt, and for a length of 335 ft. from forward, she is protected with 3-in. steel, which encloses the forward 8-in., six 6-in. Q.F., and the eight 2^9-in. guns, the two aft 6-in. Q.F. and aft 8-in. gun being separately protected. She has 26 Belleville boilers, engines of 16,500 I.H.P., and a speed of 21 knots, which it is expected will be maintained on a 24 hours’ trial. The Bogatyr {Yig. 71, Plate XVII.), of 6570 tons, was launched at Stettin for the Russian Government in January 1901 ; she is a, somewhat similar vessel to the Variag, of 6500 tons, built by Messrs Cramp, Philadelphia, in 1899. These two vessels are protected cruisers ; the latter obtained a speed of 24^6 knots on the measured mile, and maintained a continuous speed of over 234 knots for 74 hours before leaving the builders’ hands. Two more vessels of the Bogalyr type were building, and another was projected. Three other ships of approximately the same dis- placement, Pallada class, have also been added to the Russian navy, Ijut these have a speed of only 20 knots. The Gnnnolmi, armoured cruiser of 12,336 tons, length 473 ft., beam 684 ft., and draught 26 ft., was launched in 1899. She has an indicated horse-]]ower of 14,500, a speed of 20 knots, and carries an armament of four 8-in. Q.F., sixteen 6-in., twenty-four 3-in., and eight small i^l.F. guns, &c., with four toi’pedo tubes. She has a jiartial armour bflt of 6 in. Harveyized steel, and the main gun positions are also protected by 6-in. arm our. ‘ A special type of vessel recently evolved, and now building for the Russian Government, is the light cruiser or enlarged torpedo-boat destroyer A’ovik, of which the following particulars have been published. Principal dimen- sions : displacement 3000 tons, lengtli 361 ft., beam 40 ft. 1 in., draught 19 ft., armament six 4^7-in. Q.F. guns, nine smaller guns, and six above-water torpedo tubes. She has a 2-in. pro- tective deck, 16 Belleville boilers, engines of 17,000 indicated horse-power, and a speed of 2.5 knots. Particulars of the armoured cruisers Jlurik and RaHxia, which excited so much attention at the time they were built, arc given in Table VII., and the latter ship is shown by Fig. 72 (Plate X^‘II.).

Table VII. gives in chronological order particulars of the leading types of cruisers ??? armoured, deck-protected, and unprotected ??? of various nations, from the Inconstant of 5780 tons to the Drake, 14,100 tons, and Monmouth, 9800 tons, and shows the progress made in this type of warship during the period 1866-1900.

Gunboats and Torpedo Craft. Gunboats include numerous small vessels - which, even in times of general peace amongst the great maritime nations, have important duties allotted to them. For the patrolling of rivers and islands, protection of fisheries, ifec, a battleship or a cruiser, from its size, would be unsuitable, and for the performance of these and other duties special vessels have been built. These types, and those included in the torpedo-craft division, may for our purposes be conveniently grouped under three headings, as follows : ??? I. Sloops.

II. Gun-vessels and Gunboats. III. Torpedo-Boats, Torpedo Gunboats, and Torpedo- Boat Destroyers.

The Wild Swan class (Fig. 73, Plate XVIII.), the first of which was launched in 1876 for the British navy, represents one of the earliest of the sloop type. She was a single-screw com- posite-built vessel of 1130 tons displacement and 170 ft. oops.

length, vidth a, speed under steam of lOJ knots and an armament of two 6-in., six 5-in. B.L. guns, and four smaller guns. This proved a very useful class of ship, and in all sixteen of them were built. The Beagle class (Fig. 74, Plate XVIII.), commenced in 1889, represented an advance on the Wild Swan. They were buUt of steel, sheathed with wood and coppered, and had twin screws. Their displacement was 1170 tons, and they were 195 ft. long, steamed at 13 knots, and carried eight 5-in. B.L. guns and eight machine- guns. They were followed, at an interval of five years, by the Torch and Alert, the immediate forerunners of the Condor class, which were of 960 tons displacement, 180 ft. long, steamed at 13i knots, and carried an armament of six 4-in. Q. F. guns, four 3-pdrs. , and two machine-giins. They were single-screw vessels, built of steel, sheathed and coppered. The Condor class, which comprises six vessels built between 1898 and 1901, are very slightly modified Torches, having 20 tons more displacement and 6 in. more beam, with the same length,

speed, and armament. They are able, how- ever, to maintain a higher continuous speed, being fitted with water-tube boilers. In 1902 there were under construction four sloops of the Fanidme class, which are larger vessels than the Condors, being 1075 tons displacement and 185 ft. long. They are twin-screw vessels, built of steel, sheathed and coppered. They have water-tube boilers, giving 1400 H.P., and will attain a speed of 13J knots. Their armament is similar to that of the Condor. All the foregoing vessels are fitted as sailing vessels as well as steam. The Beagle is schooner-rigged, the others all barque-rigged. In their general arrangements the differences between the above- described classes of vessels are not great, and the illustrations given of the Wild Swan and Beagle will serve to give a fair idea of the general appearance of all of them.

Of the gun-vessel or gunboat type, one of the earliest built for the British navy is represented by the Staunch, a twin-screw vessel designed by Mr G. "W". Rendel, and built at Elswick in 1867. The guiding principle in the design G""""'. of this vessel was that she should simply be a floating gun- carriage, propelled by steam and provided with plenty of man-oeuvring power. The 9-in. 12-ton gun which constituted lu'r armament was arranged to sink into and be raised from a well by mians of hydraulic power. She was only 180 tons in displacement and 75 ft. long, and had a speed of 6i knots. The Medina class (Fig. 75, Plate XVIIl.), consisting of twelve gunboats built about 1876, were twin-screw vessels of 3ii3 tons displacement and 110 ft. length, and had a speed of SJ knots. Their armament was light, consisting only of three 64-pdrs. and three machine-guns. They were fitted with bow rudders in addition to those at the stern, in order to increase their manoeuvring power. In tlie Cockchafer class (1881) and the Thrush class (1SS9) successive increases' of size and speed wire made. The former, of which four were built, are composito-built single-screw ships of 465 tons displacement and 125 ft. length, with a fore-and-aft rig and a speed under steam of 94 knots. The latter, of which there are nine, are schooner- rigged composite vessels of 805 tons displacement and 165 ft. length, with a single screw and a speed of 13J knots. The armament of the Cockchafers consisted of two 64-pdr. R.M.L. guns two 20-pdr. R.B.L. guns, and two machine-guns; that of the Thrush

(Fig. 76, Plate XVIIL) consisted of six 4-in. B.L. guns and four smaller guns. The Bramble, launched in 1898, is a,

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PLATE XVI.

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Fig. 64. *H.M.S. Drake.*

Fig. 65. *Italian Piemonte.*

Fig. 66. *Chilian Clia:-tihvi-o.*

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representative of the most recent type of first-class gunboat. Her displacement is 700 tons, or 105 less than the Thrush. She is ISO ft. long and has a speed of 134 knots, is built of steel, sheathed and coppered, and carries two 4-in. Q.F. guns, 4 12-pdrs., and ten machine-guns. She has water-tube boilers, twin screws, and a light fore-and-aft rig. Four of these vessels have been built.

A number of gim-vessels have been designed for special services, among which may be mentioned the Mosquito and Herald (Fig. 77, Plate XVIII.), two stern- wheel steamers for the Zambezi built by Messrs Yarrow in 1890. They are of 80 tons displacement and 77 ft. long, having a speed of lOJ knots and carrying an armament of four 3-pdrs. and eight machine-guns. They are built in sections, each of which forms a separate pontoon, so that the whole vessel can be readily taken to "pieces for transport and easily put together in the water. Built for somewhat similar service but of different design are the six shallow-draught river gunboats of the Sandpiper class. They are steel twin-screw boats, built in 1897, also by Messrs Yarrow. They are 88 tons in displacement, 100 ft. long, and 20 ft. broad, and carry an armament of two 6-pdrs. and four machine-guns. Their speed is 9 knots, and they draw only 2 ft. of water, their screws working in arched tunnels, the summits of which are above the water-level outside. These arches always remain full of water, and serve the double purpose of enabling sufliciently large screws to be fitted for the economical propulsion of the vessel without increasing the draught, and of protecting them from damage. Two of these boats have been in service on the Niger, two in South Africa, and two on the Chinese station. In appearance they are somewhat similar to the Mosquito. The Woodcock and Woodlarlc are larger vessels of the same type, designed for service on the rapid and shallow rivers of China. They were built by Messrs Thornycroft in 1897, are 120 tons in dis- placement, 145 ft. long, 23 ft. beam, and 2 ft. draught of water. They have twin- screws, also carried in arched tunnels, and their speed is 15 knots. They carry the same armament as the Sandpiper class. In 1902 the two latest examples of this type of vessel built for the British navy, the Teal and Moorhen, designed for service in China, were also constructed in sections, but are considerably larger than either the Mosquito or the Woodcock, being about 180 – –

tons displacement. They are twin-screw – \ vessels, the propellers being in tunnels, as LZrr in the Woodcock, and their speed is over 13 knots. Their furnaces will burn wood. They carry two 6-pdrs. and four machine- guns.

Figs. 78 and 79 (Plate XVIII.) show a light-draught gunboat of the Sultan class, of which several have been built for service on the Nile. She has a

displace- ment of 140 tons, a length of 143 ft., a beam of 24 ft. 6 in., a draught of only 2 ft., and a speed of 12 knots. Her arma- ment consists of one 12-pdr., one howitzer, and four Maxims, and she is protected by a J-in. bullet-proof breastwork.

Other Countries. ??? The gunboats of other navies are generally similar to those described above. Fig. 80 (Plate XIX.), which re. .presents the Iota, is typical of eleven twin-screw gunboats built at Elswick for the Chinese Government between the years 1876 and 1881, and named after letters of the Greek alphabet, but afterwards given Chinese names. They were of 440 tons displace- ment and 126 ft. long, and had a speed of lOJ knots ; they carried one 11-in. S5-ton gun forward and two 12-pdrs. aft. The 35-ton gun could only be trained by moving the boat, but it could be loaded and elevated by hydraulic power. The Falumah and Oagundah (Fig. 81, Plate XIX.) were buUt at Elswick in 1884 for the Queensland Government. They have a displacement of 360 tons and are 115 ft. in length, were schooner-rigged, but had twin screws and a speed under steam of 10 knots. They carried one 8-in. B.L. gun forward, which was mounted behind a breastwork and had a considerable arc of training ; one 6-in. gun, which was mounted aft ; and three machine-guns. The Protector was a more important craft. Built for the Government of South Australia in 1884, she was 920 tons in displacement and 180 ft. long, had twin screws and a speed of 14 knots under steam. She carried one 8-in. B.L. gun forward, mounted as in the Falumah, five 6-in. 4-ton guns, and five Gatlings. The Brazilian twin-screw gunboat Tiradentes, built in 1892, of steel sheathed with teak and coppered, was only 165 ft. long and 800 tons displacement, but attained a speed of 14 '5 knots. She had an armament of four 4 ^-in. guns, three 6-pdrs. , and four machine-guns, and carried a considerable spread of canvas.

In torpedo gunboats and torpedo craft generally, possibly the last thirty years of the 19th century showed more development

and greater diversity than in any other type of War vessel now existing. The first small high-speed boat we have any record of is the Miranda, built by Messrs Thornycroft early in 1872. She was 45 ft. in length, 6i ft. beam, and 2^ ft. draught, and attained a speed of 16 "4 knots with a

single screw, thB engine running at 355 revolutions per minute and indicating lorpeao 58 H.P. The results obtained with her attracted ”’” *much attention, and the following year Messrs Thornycroft launched for the Norwegian Government a somewhat larger boat, armed with a spar torpedo, which attained a speed of 15 knots. The first torpedo-boat for the British navy was built by Messrs Thornycroft four years later ; she was called the Lightning, was 75 ft. in length and 34 tons displacement, had engines giving nearly 500 H.P., and obtained a speed of 19 knots. She was armed with a single torpedo tube. The boats which followed varied somewhat as regards size and speed, but on the whole pursued the usual course of growing larger and more powerful with each new design. By 1885 the length had gone up to 150 feet, the displacement to 125 tons, and the speed to 20 knots. This last was not the highest that had been obtained, some of the earlier and smaller boats having reached 214 knots ; but the boats of 1885 carried a heavier armament, consisting of six 3-pdrs. and three torpedo tubes, and were more serviceable and seaworthy craft.*

The torpedo-boat thus established was primarily a weapon of offence, the only two elements of a protective nature in its design being those of small size and high speed ; but even these were also necessary for purposes of offence. The deadly nature of their attack, and the difficulty of meeting it in the ship attacked, led to the construction of special vessels intended, among other duties, to

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FiQ. 78. Plan of Nile gunboat Sultan.

meet and destroy them. The French Somhe (1885) was one of the earliest of these ; and the Rattlesnake and three sister vessels, the first of the English torpedo gunboats, came closely after her. The Rattlesnake (Fig. 82, Plate XIX.) was launched in 1886, was of 525 tons displacement, and had a speed of 19J knots. She carried a more powerful armament than the torpedo-boats, namely, one 4-in. gun, six 3-pdrs., and 4 torpedo tubes. She was followed in 1888 by the Sharpshooter, with ten sister vessels, which were still larger and more heavily armed. They were 230 ft. long and 735 tons displacement, had engines developing 3500 H.P., giving a speed of 19 knots, and carried two 4‘7-in. Q.F. guns, four 3 pdrs., and two torpedo tubes. Fig. 83 (Plate XIX.) shows one of this class, the Karrakatta, built at Elswick for service in Australian waters. The Niger (Fig. 84, Plate XX.) class of 1892, which included eleven vessels, were repeats of the Sharpshooters, except that they carried an additional torpedo tube and three machine- guns, with certain hull additions and more durable machinery, the displacement being increased by these causes to 810 tons, and the speed being reduced by a quarter of a knot. In 1893 a fourth scries of this class of vessel was begun, known as the Dryad class, and considerably larger than the Nigers, being 250 ft. long and of 1070 tons displacement. They are of 3500 I.H.P., have a speed of 18^ knots, and carry an armament of two 4‘7-in. Q.F. guns, four 6-pdrs., and three torpedo tubes. Five vessels of this class were built, the difference between their general appearance and that of the preceding classes being illustrated by Fig. 85-(Plate XX.), which shows the Haza,rd, a vessel of this class, now employed on special service in connexion with the reception and trials of British submarines. In these thirty-one vessels of the torpedo

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gunboat class the elements of strength and seaworthiness are developed at the expense of speed, and they combine in themselres some of the functions of the torpedo-boat with many of the most important features of the small cruiser. The successive increases of displacement are very largely due to additions to the hull, giving greater habitability and trustworthiness for continuous work at sea. It will be noticed that the speed shows a continuous falling oif ; but the Sharpshooter class and subsequent vessels are being refitted with water-tube boilers in lieu of the locomotive boilers originally fitted, and some of them are in addition being re-engined, with the result that a speed of 21 knots is now obtained ; this, in the ordinary weather met with at sea, would probably enable them to overtake craft of lighter types possessed of considerably greater smooth-water speeds.

Torpedo-Boat Destroyers were primarily, as their name implies, intended to meet and destroy torpedo-boats, their larger size, greater coal capacity, heavier armament, and higher speed enabling them to overtake such boats before they could complete their attack ; but it soon became evident that these additional powers also enabled the destroyer to perform the duties of the torpedo-boat more efficiently than the boat herself, and with the advent of the destroyer the production of the smaller boat declined. At the present time it is doubtful whether the offensive power of the destroyer, regarded as a torpedo-boat for use against an enemy's fleet or ports, is not of more importance than her protective power to the fleet or port to which she is attached.

The pioneers of this type of vessel were the Daring, Decoy,

Bavodk, and Hornet, the construction of which was entered upon iu July 1892, the two first-named at Messrs Thornycrofts and the other two at Messrs Yarrows. They were thus contemporary with the Dryads, the last of the torpedo gunboats. The Daring and Decoy were 186 ft. long, 19 ft. broad, 64 ft. mean draught, and 265 tons displacement, had 4200 H.P., and reached a speed of 27 knots. They were armed with one 12-pdr., three

6-pdr. Q.F. guns, and three torpedo tubes. The Havock and Hornet were some- what smaller, being 5 ft. shorter, 6 in. less beam, and 25 tons less displacement, and they carried the same armament. The Havock developed 3000 H. P; and had a speed of 26 knots ; the Hornet, 3800 H.P. and 27 knots. The success of these four vessels was followed with great interest, and in the following year (1893) six others were begun, three of 26 knots speed and three of 27 knots ; but th e size went up to a displacement of 260 to 290 tons, and a length of 190 to 200 ft., while the power ranged between 3000 and 4400 H.P. A much greater number of destroyers (32 in all), nearly the whole of which were of 27 knots speed, were laid down in 1894. The sizes of these boats varied considerably, the displacement ranging from 265 to 296 tons and the length from 190 to 208 ft., while the power varied between 3600 and 4500 H.P. The succeeding year (1895) saw a great advance in size, power, and speed, thirteen destroyers being laid down, for each of which the contract speed was 30 knots. The displacement varied from 300 to 360 tons, the lengths from 208 to 215 ft., and the power from 5700 to 6200 H.P. Since 1895 these 30-knot destroyers have been built in consideraMe numbers ; and although in 1896 an attempt was made to realise

Fig. 88. ??? Plan of H.M. S. Cobra. A, provision-room ; E, commander'a cabin ; C, stores ; D, lavatory ; E, ward-room ; F, spirit-room ; G, mess-room ; H, g:alley ; K, torpedo heads ; LL, torpedo tubes ; MM, boiler-rooms ; N, coal ; O, magazines ; P, crew's space ; Q, dynamo-rooms ; R, searchlight ; S, naval stores ; T, provision-room ; V, slop-room ; W, chain locker ; X, IS-pdr. Q.F. gun ; Y, 6-pdr. guns.

even greater speeds than this, it was found that the power and cost necessary for the addition of a few knots were disproportionate to the value of the results obtained, and the attempt has not been followed by any general increase of speed above 30 to 31 knots. The general appearance of a typical modern destroyer is shown by Fig. 86 (Plate XX.), which represents the Albatross at full speed. She was built in 1896 at Messrs Thornycrofts' works, is 225 ft. long, 21J ft. broad, 74 ft. mean draught, and about 380 tons dis- placement. Her I. H.P. is 7500, and she has a speed of 31^ knots, which makes her the fastest destroyer at present

in the British navy. She carries one 12-pdr., five 6-pdrs., and two torpedo tubes.

Particulars of some other destroyers will be found in Table YIII., which also gives particulars of many other British and foreign torpedo vessels of various types which have been built between the time of the Miranda and that of the Cobm, some of which arc not described in the text.

Turbin/i Steamers. ??? While, however, the attempt to obtain speeds greater than 31 knots from torpedo-boat destroyers by the expedient of putting into them the lightest and most powerful boilers and reciprocating engines has not been completely success- ful, considerably greater speeds have been actually obtained by the adoption of turbine machinery. Experience with the marine steam turbines, the invention of the Hon. C. A. Parsons, dates only from the time of the TurUnia (Fig. 87, Plate XXI.), which made her successful trials in 1898 after much investigation and preliminary work on the part of the inventor. This boat had a length of

100 ft., a breadth of 9 ft., a draught amidships of 3 ft., and a displacement of 44J tons, and she attaiued a speed of 34^ knots with 2200 revolutions per minute and an estimated H.P. of 2300. The turbine machinery consisted of three separate turbines directly coupled to three screw shafts and working in series, one turbine being high pressure, one intermediate, and one low pressure. Each screw shaft carried three propellers, the total number of propellers thus being nine ; the weight of main engines was ap- proximately 3 tons 13 cwt., and the total weight of machinerv and boiler, screws and shafting, tanks, &c., 22 tons. The boilere are of the water-tube type, with a working pressure of 225 lb per square inch.

The Turhinia was followed by the Cobra (Fig. 88) and Viper torpedo-boat destroyers, which had a length of 210 ft., a breadth of 21 ft., and a mean draught of 6 ft. 9 in. The machinery of these boats consisted of two sets, one on each side of the ship ; each set had two expansions and drove two shafts (making four shafts in all), and the outer shaft on each side was driven by a high-pressure turbine, from which the steam passed to a low-pressure turbine on the inner shaft and thence to the condenser ; on the inner shaft also was a small turbine, added for going astern, the steam turbine not being adapted for reversal. Steam was supplied by water-tube

boilers of the express type. These vessels attaiued a speed of upwards of 34 knots, the revolutions of the engines approaching 1200 and the power being estimated at about 12,000 H.P. At the time of their completion these were the fastest vessels of any type afloat, but both were unfortunately lost at sea,

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the Viper after a very short period of service being run upon the Renouquet Rock in the Channel Islands, and the Cobra being lost at sea on her first voyage from the contractor's works.

While the idea of the torpedo-boat destroyer originated in Great Britain, and the first boats of the tj^pe were built for the British navy, foreign Powers were not slow in availing themselves of the results obtained, and large numbers of torpedo-boat destroyers have been added to the fleets of foreign navies, the boats built by Messrs Sehichau of Germany and Normand of France having especially achieved success in the attainment of high speeds on trial, while the boats of the Bainhridge class, built for the U.S. navy by Neatie and Levy of Philadelphia, William R. Trigg and Co., Richmond, Va., the Union Iron Works of San Francisco, and other American firms, are among the largest, fastest, and most seaworthy of the class afloat. Fig. 89 (Plate XXI.) shows the general appearance of these vessels ; they are 245 ft. long, 23 ft. 7 in. wide, draw 6 ft. 6 in. of water, and have a. displacement of 420 tons. Their sea-going speed is 29 knots, and their armament consists of two 18-in. torpedo tubes, two 3-pdr. Q.F. guns, and five 6-pdrs. The Japanese navy possesses in the Niji class (Fig. 90, Plate XXI.) a number of very fast and sea- worthy destroyers. They are of approximately the same dimensions as the most recent British vessels of this type, were built by Messrs Yarrow, and obtained on trial speeds in excess of 31 knots.

Table IX. shows warships efl'ective, building, or projected for the principal navies of the world. This table shows there are now built or projected 1346 torpedo-boats, having an average dis- placement of 76 tons, of which France owns 317, Russia 188, Italy 151, Germany 121, Great Britain coming fifth with 107, and of these 107 only four have been added since 1885. Further reference to this table shows that Great Britain takes the lead with torpedo- boat destroyers and torpedo gunboats in a very marked manner.

*Submarine Boats.**

Since about 1880 much attention has been paid by several of the naval Powers to the development of the submarine boat. The United States and France, in particular, have given special encouragement to workers in this direction ; and this encouragement, combined with the fascination which the subject has for many minds, has led to the construction of a number of boats and to many experiments.

The history of the subject goes back at least 300 years, but the first undoubted success with a submarine vessel

Table VIII. ??? Particulars of Various Types of Torpedo Craft f

rom 1872 to 1900.

Vessel's Name.

Country.

Where built.

???=4

Principal

Dimensions, &c.

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1

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Armament, &c.

fij

Length.

Beam.

Draught.

Displ.

d

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o

W

&

Ft. In.

Ft.

In,

Ft. In.

Tons.

Knots.

Miranda .

Great Britain

Messrs Thorny- croft, London J)

1872

45 0

6

6

2 6

1

58

16-4

Nil., Experimental boat.

1st Torpedo-Boa

Norway

1873

57 0

7

6

3 0

15-0

1 spar torpedo.

built

Lightning (after-

Great Britain

Sf.

1877

75 0

10

10

5 0

34

477

19-0

Single torpedo tube.

wards No. IT. B.

)

Ko. 10 Torpedo'-

J) '

>i

1880

90 6

10

10

4 0

28

450

21-7

1 torpedo tube.

Boat

Swift (afterwards

jj

Messrs J. S. White

1885

150 0

17

6

125

20-0

6 ??? 3-pdrs., 3 torpedo tubes.

No. 81T.B.)

& Co., Cowes

Falke

Austi'ia

Messrs Yarrow, London

1885

135 0

13

9

5 8

95

900

22-4

2 mach. guns, 2 torp. tubes.

Bombe

France

Havre

1885

196 10

21

7

5 11

420

2

1,800

19-0

3 ??? 3 -in. Q.F., 3 mack, 2 tubes.

El Destructor .

Spain

Messrs J. & G. Thomson, Clyde

1887

192 6

25

0

7 0

385

2

3,800

22-7

1 ??? 4-in. Q.F., 4 ??? 6-pdrs., 3 tubes.

Ist-class Torpedo

- China

Elbing

1886

144 4

16

5

7 6

128

1

1,500

24-2

4 ??? 1-pdr., 2 torp. tubes.

Boat

Rattlesnake

Great Britain

Messrs Laird Bros. , Birkenhead

1886

200- 0

23

0

9 0

550

2

2,700

19-25

1 ??? 4-in., 6 ??? 3-pdrs., 4 tubes.

Sharpshooter .

tt

Devonport .

1888

230 0

27

0

8 3

735

2

3,500

19-0

2 ??? 4-7-in. Q.F., 4 ??? 3-pdrs.

2 tubes. 9 ??? 1-8-in. Q.F., 3 tubes.

Kazarsky .

Russia

Elbing

1890

190 0

24

0

8 6

400

2

3,500

23-0

Niger

Great Britain

Vickers, Sons & Maxim, Barrow

1892

230 0

27

0

9 0

810

2

3,500

18-75

2 ??? 4-7-in. Q.F., 4 ??? 3-pdrs., 3 mach., 3 tubes.

Dryad

”

Chatham

1893

250 0

30

6

9 0

1070

2

3,500

18-25

2 ??? 4-7-in. Q.F., 4 ??? 6-pdrs., 3 tubes.

Daring

a

Messrs Thorny- croft, London

1893

185 0

19

0

7 0

240

2

4,300

27-5

1 ??? 12-pdr., 3 ??? 6-pdrs., 3 tubes.

Swordflsh .

it

Armstrong, Whit- worth, Elswick

1895

200 0

19

0

6 0

260

2

4,500

27-6

1 ??? 12-pdr., 5 ??? 6-pdrs., 2 tubes.

Sokol

Russia

Messrs Yarrow .

1895

190 0

18

6

7 0

240

2

4,400

29-7

1 ??? 12-pdr., 8 others, 2 tubes.

Forban

France

Messrs Normand .

1895

144 2

15

2

10 0

135

2

3,200

31-2

2 ??? l-pdrs., 2 tubes.

Corrientes

Argentina .

Messrs Yarrow .

1896

190 0

19

6

7 4

280

2

4,000

27-4

1 ??? 14-pdr., 2 tubes.

Chamois .

Great Britain

Messrs Palmer

1896

215 0

20

9

7 3

360

2

6,333

30-2

1 ❓❓❓ 12-pdr., 5 ❓❓❓ 6-pdrs., 2 tubes.

Express .

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Messrs Laird Bros.

1897

235 -0

22

0

9 0

430

2

9,500

31-0

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Gipsy

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Messrs Fairfield

Co. Hon. C. A. Parsons

1897

227 6

22

0

9 0

300

2

6,000

30-0

Turbinia .

a ???

1897

100 0

9

0

3 0

444

6

2,100

32-75

Ml. Experimental boat.

Albatross .

i}

Messrs Thorny- croft

1898

227 6

21

3

8 6

360

2

8,000

31-5

1 ??? 12-pdr., 5 ??? 6-pdrs., 2 tubes.

Cobra

i>

Armstrong, Whit- worth, Elswick

1899

210 0

21

0

6 9

350

8

12,000

34-0

1 ??? 12-pdr., 5 ??? 6-pdrs., 2 Hotchkiss, 2 tubes.

Bailey

United States

Morris Heights

1899

205 0

19

0

6 0

235

2

5,000

30-0

4 ??? 6-pdrs., 2 tubes.

Lawrence .

))

Weymouth, Mass.

1900

242 3

22

3

6 2

400

2

8,400

30-0

2 ??? 12-pdrs., 5 ??? 6-pdrs., 2

tubes.

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PLATE XX.

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Fig. 84.►►►► H.M.S. Sigcr.

Fig 85►►►► H M S Hi aid

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submarines]

was achieved by Bushnell in America in 1775. His boat was manoeuvred to the full extent contemplated in her design, and the one attempt made, as described below, to put her to practical use and sink the enemy's ship would have brought about this result if the operator had had more thought or more daring. It was worked by one man, for whom it provided just sufficient room; its general appearance, according to Bushnell's own description, bore some resemblance to two upper tortoise shells of equal size joined together, the entrance to the vessel being represented by the openings in the swellings of the shells at the animal's head ; the body of the vessel was constructed of wood. The operations on board were entirely manual. By an oar in form of a screw with its spindle passing through the top the boat was sunk or raised, by another oar at the after end it was propelled ; a rudder was used for guidance, and in some cases for propulsion, valves admitted water when submergence was required; and hand pumps discharged this water when it was desired to come to the surface, and a detachable weight of 200 lb was also supplied for emergency use. The air in the boat was capable of sup- porting the operator for thirty minutes ; and as soon as he brought the boat to the surface, two air pipes, for discharge of foul and supply of fresh air, opened automatically. A compass, a pressure-gauge, and a sounding-line and lead were among the fittings. Behind the vessel was a large magazine containing 150 5) of powder, and a time-control for exploding it. From the magazine was led a rope to a wood screw at the fore part of the crown of the boat, and this screw, being worked from within, could be driven into the object to be destroyed in such a manner as to keep the magazine required for the explosion in position after it had been detached from the boat. During the War of Inde- pendence the boat was submerged beneath the British warship Eagle, and the operator attempted to attach the wood screw to her bottom planking : in this he failed, apparently simply because he did not let go his detachable weight and so get enough upward pressure to drive the screw into the plank. The magazine was released and exploded an hour afterwards, but at some distance from its intended position.

The problem of submarine navigation received the practical attention of Fulton during the time that he was making his experiments upon steam propulsion, and even at an earlier period. He constructed two submarine boats in France, and one in America. One of the former, the Nautilus, was built with the direct encouragement of Napoleon in 1801. It was supplied with compressed air for respiration, and with it Fulton conducted a series of experiments under the direction of a commission of naval officers. He descended to a depth of 25 ft., and remained under water for fully four hours, placing below a vessel provided for the purpose a torpedo by which it was blown into fragments. As with his steam engine, so too with his submarine boats, the report of the commission charged with investigation was so unfavourable that Fulton was much discouraged, and though he afterwards continued his labours in this direction, the results achieved by him were practically lost. Fulton's boat, like Bushnell's, was propelled by manual power, two horizontal screws being employed for' propulsion, and two vertical screws for descending and ascending : it was built of wood with iron ribs, and was sheathed with copper.

The substitution of mechanical for hand power came later, and one of the first mechanically driven boats was the Plongeur, built in France in 1863 from the designs of Charles Brun. This boat had a length of 146 ft. and a diameter of 12 ft., and was propelled by an 80-horse-power compressed air engine. During the American Civil War in 1864, however, a hand-worked submarine boat 50 ft.

long was employed by the Confederates. Manned by a crew of nine men, she successfully attacked the Federal ship Ilousatonic, and sank her by means of a spar torpedo, but in so doing was herself sunk. It is claimed that the loss of the boat was due to faulty handling, and not to inherent defect. Against the protest of her builder, she was immersed only to the hatch coaming ; and the cover being left open, she was swamped and sunk by the wave throvni up by the explosion. It is said that this is the only submarine boat in connexion with which there is authentic record of loss of life ; with her no less than three crews were drowned, in addition to the crew engaged on her last fatal expedition, so that she was the cause of the loss of thirty-six lives.

About the same time another hand-worked submarine, called the Intelligent Whale, 26 ft. in length and 9 ft. in diameter, attracted some attention in America. An officer, with two other persons, dived with her in water about 16 ft. deep ; the officer, in diver's dress, left the boat through a manhole in the bottom, placed a torpedo under a scow, and blew the latter to pieces.

*In 1875 Mr J. P. Holland produced his first plan for a submarine vessel, and in 1877 he constructed a small experimental boat, which embodied features now accepted as essentials in American design. His j^^^^ * plan ensured that when, for the purpose of diving, water was admitted into compartments of limited size, the total weight of the boat and its contents should stiU be a little less than the total buoyancy. Immersion was main- tained by the action of horizontal rudders, which gave a dovniward tendency so long as the boat had any forward motion, and there always remained enough surplus buoy- ancy to bring the boat to the surface on the stoppage of her propelling machinery. Any weight consumed on board was automatically compensated for by admission of water, so that the total weight remained fixed and constant ; while the confinement of the water to small compartments further secured a fixed centre of gravity. The securing of these qualities of fixed weight and fixed centre of gravity is essential, and the want of them has been the cause of failure in many other designs. With the necessarily slight longitudinal stability possessed by a submarine boat, any change of centre of gravity in the fore-and-aft direction has a notable efiect on the angle of trim ; and such a change may readily occur, for instance, from the surging of water in a large ballast-tank not completely full. An uninten- tional alteration of trim when the submarine boat is being propelled involves several possible dangers : in extreme cases the crew or some of the fittings may be thrown out of position, but in any case the path of the submarine is altered, and may tend either to too great immersion on the one hand, or to breaking the surface of the water on the other. From the risk of these dangers it is claimed by Mr Holland that his design is free. The first of his boats now under discussion was steered down and up inclines by her horizontal rudders, and motive-power was obtained from a petroleum engine. The tests to which she was subjected showed that inefficiency of the engine,*

difficulty of vision, and trouble with the compass tended to destroy the boat's usefulness.

In 1883 Mr Nordenfelt, famous as an inventor in many directions, and especially associated vidth the gun which bears his name, built a submarine boat at Stock- holm. She had a length of 64 ft, a main Norden. diameter of 9 ft., and a displacement of 60 tons; ^^^^ she was propelled by a compound surface-condens- ing engine indicating 100 H.P., and on a measured mile trial, not being submerged, attained a speed of 9 knots. Steam was supplied by an ordinary marine return-tube boiler, worked under forced draught, which could be fired

as long as tlie boat was at the surface. Storage of steam was effected at the surface, and the steam thus stored was used to drive the engine in the submerged con- dition. To store sufficient steam two large tank reser- voirs or cisterns were connected with the boiler, and the contents of boiler and tanks (8 tons of water in all) were raised to a temperature corresponding to 150 & pressure. In preparing for submergence the firing of the boOer was stopped, and the steam given off by the heated water in boiler and tanks sufficed to propel the boat for a period. The smoke was driven out through two channels, which passed round the hull and pointed astern. The material of the huU was mUd steel, the frames being 3 in. by 3 in. by f in., and the plating | in. to f in. in thickness ; the depth to which she could safely descend was about 50 ft. When ballasted ready for a submerged trip, this boat showed only a very small dome for observation above the level of the water, the reserve buoyancy represented by this dome being but 1 cwt. To overcome this reserve two propellers working on vertical shafts were fitted in sponsons, one on each side of the boat, nearly amidships. These propeEers were driven by a 6-horse-power engine, and drew the boat under water to the desired depth ; an auto- matic contrivance, set in motion by the water pressure outside the boat, closing the throttle-valve when the safety limit of depth was approached. On

coming to rest, the reserve buoyancy brought the boat again to the surface. When propelled by the main engines in the submerged condition, the boat was kept horizontal by means of two bow rudders operated by a plumb weight. The crew con- sisted of three men only, this small number rendering unnecessary the employment of artificial means of main- taining a pure atmosphere. The scheme of attack was to approach the hostUe ship running at the surface untU the danger of discovery was imminent, then to descend to the " awash " condition with only the dome above water, and finally to go below the surface and advance to striking distance entirely submerged, rising if necessary once or twice to allow the direction to be adjusted by observations made from the dome " awash." The weapon of offence employed was a Whitehead torpedo, carried outside on the bow and discharged mechanically. Two or three larger boats were subsequently built from Mr Nordenfelt's designs ; they all involved the same principles, but were in some details made more efficient both for attack and defence.

The three main points insisted upon by the inventor were : (1) that his niethod of storing energy gave him a reservoir which was not Uable to get out of order, could readily be repaired if necessary, and required for its manipulation no knowledge beyond that possessed by an ordinary engineer ; (2) that for submergence he relied on mechanical means easily controlled, adding, as a criticism upon the alternative method of descending by steering downwards, " I need only point out the great risk of allowing an object 100 ft. long and of great weight to pro- ceed in the downward direction even at a small angle, as the impetus gained would very easily carry it beyond a safe depth so quickly that they might not have time to check it " ; (3) that the bow rudders always secured a horizontal position when the boat was running submerged, which position he had found to be a sine qud non for a submarine boat.

In response to an invitation for proposals for sub- marines, made by the U.S. Government in 1887, designs by Holland and Nordenfelt were submitted. After much consideration the proposals of the former designer were accepted, and formed the basis of the eight boats that were built or building in the United States in 1902. From what has been already stated, the criticism of

Admiral Hichbom (Chief Constructor of the U.S. Navy) wiU be understood when he characterizes Holland's method as a " steering-under " or " diving " device, and Nordenfelt's as a "down-haul" or "sinking" design. These two methods of obtaining submergence have each their sworn advocates, who approve of the one and dis- approve of the other.

The largest boat of Mr Holland's design is the Plunger, which, although authorized in 1893, was not complete in 1902, a change in the surface motive-power from steam to gas having been found advisable. This boat has a length of 85 ft., diameter 11 J ft., light displacement 154 tons, and load displacement 168 tons; she is of sufficient strength for a submergence of 75 ft., and when wholly submerged has a margin of buoyancy of J ton. In addi- tion to her horizontal rudders for diving, she has two down-haul screws, fitted in opposition to Mr Holland's recommendations ; she may therefore be said to be a com- bination, for diving purposes, of both the Holland and the Nordenfelt designs. The Plunger's main engines are used for propulsion when she is navigated at the surface of the water. As originally designed, they were triple-expansion steam engines, driving triple screws, but have since been altered, as we have indicated above, to gasoline engines driving a single screw. These engines are also used for charging electric accumulators, from which alone motive-power can be obtained when the boat is sub-merged. The current for charging the accumulators is obtained from a dynamo of 70 H.P., which can always be run in the awash condition, and the accumulators thus kept fuUy charged. In the awash condition, when the boat is otherwise air and water tight, communication is kept up with the OTiter air by means of ducts and a smoke-pipe, the former bringing in air for combustion and respiration, and the latter carrying off deleterious pro- ducts of all kinds. For submergence special fittings are used to close these ducts and pipes, and to stop the gasoline generator. The main engine is then no longer available, and for propulsion power is drawn from the accumulators, the dynamo thus becoming a motor which derives current from the accumulators, and itself drives the screw-shaft. As was the case with Mr Holland's earlier boats, great attention is given to automatic control of weights, and water-ballast is admitted to compensate for any change, such as would be produced by the discharge of a torpedo.

With her original machinery the Plunger was to have had a surface speed of 15 knots; her an- ticipated speed awash or submerged is now 8 knots. To assist in determining the boat's direction a catnera lucida is ordinarily provided, but for correcting this Mr Holland prefers trusting to observations made during occasional rises to the surface; for this purpose the boat is pro- vided with a conning tower 4 ft. high, protected with 4-in. steel. The Plunger is armed with Whitehead tor- pedoes, and has two tubes for discharging them.

The Holland, a smaller boat, having a length of about 59 ft., though begun after the Plunger, has already been completed, and is now the property of the U.S. Government. The official report of this vessel is that " she has shown herself capable of such perfect control in the vertical plane that she may be kept whilst moving within a few inches of any desired depth, and that she may be brought to the surface and submerged again in a very short time." A good idea of the general form of the Holland may be obtained from Figs. 91, 92, 93, and 94 (Plate XXII.), the last three "of which represent this vessel when undergoing trials to test her driving qualities.

Tho latest Holland design is shown in Kg. 95, which represents the design of the Adder and five other submarines, length 63 ft.

PLATE XXI.

SHIP.

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Fig. &7. ??? Turhinia.

Fig. 89. ??? U.S.A. Bainbridrje.

Fig. 90. ??? Japanese A^iji.

PLATE XXII.

SHIP.

*Fig. n.***V.i^.A. Hulhmd.**

Fif!. 92. **U.S.A. HvVfiiid.**

Fig. 9.’!. **U.S.A. Hulland.**

Fig. 91. **U.S.A. Holland.**

Fi(i. 07. **Fienrli Xitrrnl. (By permission of” Page’s Magazine”)**

submarines]

SHIP

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4 in., diameter 11 ft. 9 in. ; displacement for surface running 104 tons ; submerged displacement 120 tons. The main features of this class of boat are the same as have been described above for [h.] *Plunger, and are in essentials identical with the iirst live boats under construction for the British navy. The shell-plating is A in. 1.1 thickness, and the frames 3i in. by 3 in., witU a spacing b*[illegible]*i;l’*[‘ r,i]*‘?. machinery is a four-cylinder single-acting ,1*[illegible]*vT i*[illegible]*^ u g’^*[illegible]*l’?e engine, which at 360 revolutions wUl develop 160 H.P. and give the boat a speed of about 8 knots. 1 or propulsion m the submerged condition an electric motor is f in*[illegible]*r’i r?i ^^^5*[illegible] *revolutions, i.ud giving a speed of 7 knots, a single left-handed propeller being employed. The current for the motor is provided by storage batteries capable of supplying*

70 H.P. for 4 hours ; and these batteries are charged by the main engine in a manner similar to that already described for the Holla-iid. The requisite air supply is obtained when the vessel is at the surface, and is stored under a pressure of 2000 lb by a pump driven by gearing off the main engine or main motor. Air at a pressure of 50 lb is used lor the expulsion of torpedoes, and the same agent, at various degrees of pressure, works the trimming and ballast tanks and some parts of the machinery ; while the exhaust air from the latter subserves the purpose of ventilation. The vessel is fitted with steam and hand steering gear, and

there are automatic devices for securing a constant depth during submergence. Five Whitehead torpedoes 45 cm. (about 18 in.) in diameter and 11 ft. 8 in. long are provided, and there is

Fig. 96.-Plan of the U.S. Add^r (reproduced by permission of Admiral Hichbom). A, storage batteries : B

pntr.norfr*-.,-. 1? .^ u n 1. 1" ^ V,' r ”” ‘”’ &^ ”””“s i (A*, gas-Bnglne : C, dyTiamo and motof ; D, Water-tight

compartments ; E, main ballast tanks ; F, air-flasks ; G, gasoline tank ; H,expu ion tube.

one expulsion tube placed forward about 2 ft. below the light water-line.

The French submarine boat Flongeur has already been described. A further advance m this direction was made in 1881, when a Ooubet ^^^^^ submarine was completed by M. Goubet at Paris system. ‘- inspection of this vessel led to an order for the mechanism of a number of boats from this engineer for the Russian Government, and several sets were built and delivered early m 1883. The length of the boat constructed by M. Goubet in 1885 was 16 ft. 5 in. ; it had an oval section 5 ft. 9 in. in depth and 3 ft. 3 in. in breadth, and tapered to a point at each end. A longi- tudinal section of the boat is represented by Fig. 96. The main portion of the hull was of bronze, east in one piece, and at the centre of its length it was sur- mounted by a large dome having seven glazed openings. There was just sufficient room for an officer and a man seated back to back within it, their eyes in this posi- tion being level with the glass windows of the dome. All valves and other mechanism requiring regulation were brought within reach of these occupants, so that no movement on their part was required which might affect the trim ; a reservoir of compressed air supplied the means of respiration, and an air-pump removed the vitiated atmosphere. The motive- power was furnished by accumula tors, the electric energy stored therein driving a screw propeller by means of a motor. No means was provided on board of

recharg- ing these accumulators when ex- hausted. Submersion was effected by admitting water into tanks divided by transverse bulkheads at sufficient intervals to prevent the surging of the water in the fore and aft direction. A pump expelled this

water again when desired, and a safety weight attached to the bottom of the boat was ready for detachment in the presence of danger. A pressure gauge indicated the depth of water reached, and the officer could regulate the opening of the inlet valves or the action of the pumps to maintain or vary this depth as desired. For controlling the boat in a horizontal direction a specially devised pendulum was employed, by means of which a clutch was moved and a constantly running shaft was thrown into gear with a pump as soon as the boat departed appreciably from the horizontal plane. The action of the pump was reversible, and the clutch engaged it always in such a way that it drew water from a tank at "the low end of the boat, and delivered it to a tank at the high end. Several other devices of great ingenuity were employed in the boat ; notably a special form of universal joint introduced into the line of shafting. At the after end, close to the propeller, this universal joint was fitted in such a way that the screw could be

set at an angle to the line of motion, and steering effected without the aid of a vertical rudder. A torpedo containing 100 lb of dynamite or other explosive was carried outside the huU, and secured by a catch joint. This torpedo, on the submarine boat being manreuvred into position, could be thrown off and allowed to rise and attach itself, by means of spikes, to some vulnerable part of the ship doomed to destruction. Retiring then to a safe dis- tance, the submarine boat could explode the torpedo by the agency of an electric current.

Working in the light of his now considerable experience, M. Goubet built several other boats. These were of larger dimensions, having a length of 27 ft. ; their material was also bronze, and they were oast in three pieces, the centre one having a thickness

Reservoir

Fig. 96. ??? Section of Goubet submarine torpedo-boat.

of 1 in. , while the others were reduced to a little more than J in. at the ends. Possessing to a large extent the same contrivances as their predecessor, these improjed boats were fitted also with an automatic apparatus for regulating the depth of submersion. In this regulator a piston is moved along a cylinder by the rotation of a rod with a screw thread cut in it, and so increases or dimin- ishes the amount of water in the cylinder. The movement of the piston is effected by a small motor, and the direction of action of the motor is regulated by a commutator placed in juxtaposition to a pressure gauge. When the depth of submersion is too small, current is supplied to move the piston so as to admit more water ; when the depth is too great, cun-ent is supplied in the opposite direction, and water is expelled. The speed attained by this boat was from 5 to 6 knots.

The Gymnote was constructed at Toulon in 1888. She is a steel vessel, with a length of 59 ft. and a displacement of 30 tons ;

[submarines

being of an experimental character only, she has no weapon of attack. Her motive-power is obtained from accumulators, but she has within herself no means of recharging these. The maxi- mum speed obtainable is 8 knots. For control in the vertical direction a rudder was placed aft, but this did not act satisfactorily, and was replaced by two plate rudders, movable about a horizontal axis in the middle of the boat. For the purpose of controlling the horizontal direction this boat is fitted, in addition to her vertical rudder, with a "gyrostat," the motion of which instrument is maintained by an electric motor. Previous to making a start the boat must be headed in the direction in which it is intended to move ; when the gyrostat, once started, will, if not subjected to any accidental disturbance, continue to rotate about an axis invari- able in direction, and any departure from this wUl be at once detected, whether the boat be

above the surface or below it. The designs of the Chistave Zedi and of the Morse were both based on those of the Gymnote, the former having a length of 148 ft. and a displacement of 145 tons. In both of these the hull is of bronze ; one great advantage of this metal being that, like the bronze of the Goubet boats, it is non-magnetic in character, and cannot therefore disturb the equilibrium of the compass. With their large dimensions they were intended to be formidable engines of war, and were furnished for attack with Whitehead torpedoes ; of these latter they each carry three of 45 cm. (nearly 18 in.) diameter, discharging them by means of a torpedo tube. The Morse and the Oustave Zidi, like the Gymnote, possess only electric means of propulsion, the power being derived from batteries of accumulators. No power is provided in the vessel by which the accumulators can be recharged, so that the radius of action of these boats is neces- sarily very limited. A more recent boat, the Narval (Fig. 97, Plate XXIL), designed by M. Laubeuf, and the outcome of a general competition in 1897, has a length of 112 ft. and a total displacement of 200 tons. She was built at Cherbourg in 1898, and is furnished with a triple-expansion steam engine, obtaining its steam from a water-tube boiler of special form and heated by petroleum. As in the American submarines, this engine propels the boat when at the surface, and also drives a dynamo which recharges accumulators, the latter giving the reserve power for use in the submerged condition. A speed of 11 knots is obtained at the surface, and 8 knots when submerged. A new departure in the Narval is her double hull, the inner shell ofwliich is of steel plate of sufficient thickness to resist any water-pressure to which the boat may be subjected, and the outer shell, placed at varying distances from the inner, forms a protection to the inner against attack. An armoured dome surmounts the boat, cutting through the external shell and carrying a short and narrow telescopic funnel, which, as in the case of the American boats, must be withdrawn preparatory to diving. Control in the vertical direction is obtained, when diving, by the use of two pairs of horizontal i-udders, placed symmetrically ??? one pair forward, the other aft. By the above arrangement it is claimed that the horizontal direction of the boat is ensured, the American course of inclining the axis of the boat when diving being considered open to such grave objections that it is. desirable to avoid it.

In all the more recent submarine boats of French construction much ingenuity has been directed towards obtaining instruments of vision for use when the vessel is in a steady position somewhat below the water surface. The optical tube is the instrument which has so far given the most satisfaction. A total reflection prism at the upper end of a telescopic tube is placed above the water surface, and a similar prism at the lower end of the same tube ; this arrangement allows the officer in the boat to see, over a limited distance, the objects in his neighbourhood. Another instrument, tlie periscope, is now also employed, and has received much atten- tion. In this an image is formed in the focus of a parabolic reflector, and can then be examined by means of an ingenious optical contrivance ; but this instrument has scarcely given all the results expected of it, and in Mr Holland's boats is not used at all. American experts, indeed, place but little reliance even upon the optical tube.

Quite a difl'erent class of submarine boats from the above is the " bottom-worker," which is represented in Ameiica by the Argonaut, , built to the design of Itf r Lake. This boat is intended

"htf " crawling over the surface of the bottom, and rather

om- ►►^^ jj^g peaceful work of saving wrecks than for the purpose of attack, although the latter possibility has not been ignored in her conception. She consists of an under- water portion 56 ft. Ions;, with a circular section of 9 ft. diameter ; to this, for surface purposes, a superstructure has been added, with a total length fit 66 ft. She is driven by a gasoline engine, and there is no storage. Ventilation is carried on from the surface, for the purposes of respiration and combustion, by two flexible tubes held up by a buoy ; or, in shallow water, by pipes long enough to reach to the surface, there being also, in case of injury to these pipes, a sufficient supply of compressed air to \iit for some houri. For crawling purposes three wheels support

the boat on the sea-bottom ; two are forward and one aft, the steering being efi'ected by the latter. Men can leave or enter the boat, by means of a door placed forward, either with or without a diving suit. The compartment to which this door belongs is kept under air-pressure

sufficient to exclude the water, and is cut off from the rest of the boat by an air-lock chamber with double doors. Rising above the deck is a conning tower for observation, and at the forward end are a look-out compartment and search- light.

Summarizing the tactical elements established by the Holland, Admiral Hichbom, amongst other criticisms, makes the foUdwing : ”Control and direction in the vertical plane Perfectly satisfactory. Control and direc- tion in the Jwrizontal plane Perfectly satisfactory when running on the surface; unsatisfactory when submerged, since the object to be steered for cannot be seen. Accept- able, because any predetermined direction can be held as well as can any vessel’s course in a fog or on a dark night, and in the same way, i.e., per compass ; also acceptable because the quick rises and dives enable the helmsman readily to correct his course to intercept an off-shore enemy endeavouring to close with the shore. Field of vision when submerged Nil, and therefore unsatisfactory as such ; but acceptable because field of vision would carry with it the loss of the perfect invisibihty which so largely adds to her effectiveness in attack, and because the quick rises and dives give perfect field of vision for a few seconds, with a minimum of chance of disablement from gun fire. Sea-going qualities Perfect, since no sea, however heavy, can affect her when in the awash condition ready to dive, and when running light she can always be dropped to the awash condition in heavy weather. Submerged motive- power Unsatisfactory, since its source is the heavy and cumbersome storage battery. Acceptable, since it is the most available motive-power for use when air cannot be freely used, and since the supply can always be renewed as long as the fuel supply holds out.”

In considering the possible future of the submarine boat, it appears that for such depths of submergence as were and are contemplated in any of the above-mentioned designs, there is no difficulty in emplojdng scantlings ample for the pressures to be encountered, since the weight of hull necessitated by these scantlings introduces no abnormal difficulty into the design. The tendency at the present time is to increase the size of the boat, and what hmit may be reached in this direction it is impossible to say. The greatest obstacles to progress are at present the want of

satisfactory contrivances for artificial vision, and of durability in the electric storage arrangements for the requisite supply of motive-power or the substitution of a more perfect system of under water propulsion. Generally, however, it may be said that while such advances have been made in submarine construction as show that under certain conditions submergible boats may be of practical utility, they have not yet reached such a state of perfection as sensibly to modify the shipbuilding programme of great naval Powers. It is possible that for many years their value will remain moral rather than material ; and their ultimate efficiency, like that of the torpedo itself, must remain in doubt until a naval war on a serious scale shall set the question at rest.

In the meantime experience seems to show that designs which provide a certain surplus buoyancy, and attain submersion by propellers or similar means, have advan- tages over other systems ; that, under water, propulsion can be conveniently obtained by electrical motors and accumulators, and that the accumulators must be capable of being recharged by machinery in the boat, considera- tions of weight rendering it desirable that this machinery should be that which drives the boat in the " awash " condition. (p. wa.)

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SHIPBUILDING.

Theoeetical.

THEOEETICAL sMpbuilding embraces the considera- tion of all questions upon which the qualities and behaviour of a ship depend, and which thus determine the various features of the design. Among these are : the best size of ship to be adopted, having regard to the particular services which she will be required to perform ;. the requirements which must be fulfilled in order that she may make her various passages economically and with safety, in all conditions of wind and sea ; the beat form for the hull with regard to the resistance offered by the water at various speeds; the nature of waves and their action upon the ship; and the structural arrangements necessary in order that she may be sufficiently strong to withstand the various stresses to which she will be

subjected. The determination of the best size of ship to fulfil certain conditions is one of the most difficult and at the same time one of the most important questions which have to be settled. It involves the consideration of a different set of circumstances for almost every service, and these are often so compHcated that deductions from experience gained in vessels similarly employed are the only guide to be relied on, and tne question is not therefore usually left wholly in the hands of the naval architect. The requirements of economical working, safety, &c., determine the length, breadth, depth, and form. The length has a most important bearing on the economy of power with which the speed is obtained ; and on the breadth, depth, and height of side, or freeboard, depend to an important degree the stability and seaworthiness of the vessel. The best form for ships of high speed, their resistances at various speeds, and kindred matters of scientific interest, have been for many years the subject of experimental investigation with models ??? a mode of treat- ment which was devised and adopted by the late Mr William Froude, F.RS., to whom the shipbuilder is in- debted for very much of the trustworthy information at his disposal with regard to these matters. The stabiHty of ships, their rolling among waves, their resistances at various speeds, and their strength, with the calculations to be made in estimating these elements, have been discussed in the ninth and previous editions of the Encyclopedia Britannica, and we do not propose to consider them in detail in the present article, but we add notes on the roUing and on the resistances of ships in which the results- of recent investigation are given.

RoUing of Ships.

The unresisted rolling of ships in still water is of no im- mediate practical importance, as a ship will not roll in still water unless made to do so ; and even when thus set Unresisted j.ojji ???g^ ^jjg motion cannot be unresisted, since the flat rolllag. portions must experience resistance in passing through the water, and this and other causes of resistance bring about a degradation of the amplitude of rolling. The equation of motion of a ship rolling through moderate angles of inclination for which we can approximately say that the righting arm is proportional to the angle, i.e., 0Z=mx.9 is

= -2-m-e

(1)

where e=radius of gyration of the ship about the axis of rotation, TO = metacentric height, S = angle of inclination, and g = accelerating force of gravity. From this equation the time deduced for a single oscillation, i.e., from port to starboard, or vice versd, is

(2)

showin" that the time of oscillation varies directly as e, the radius of gyration, and inversely as the square root of the metacentric

height. This period, as fonnd by calculation, is very nearly the same as the actual period observed on the ship herself when set rolling. The resistances tu rolling do not sensibly affect the period of oscillation, but they do affect the amplitude. When the period is constant, i.e., the time occupied in making a com- plete roll from starboard to port, or vice versd, is the same, what- ever the angle of roll, the rolling is said to be isochronous.

For the unresisted roUing. of ships among waves the theory gener- ally accepted is due to the late Mr W. Froude (see Trans. Inst. Nav. Arch., 1861 and 1862). Before his work many eminent mathe- maticians had attempted to arrive at a solution of this most difficult problem, but for the most part their attempts met with scanty success, because wave-motion and wave-structure were imperfectly understood, and consequently the torces impressed on a ship by water in motion could not be correctly estimated. Mr Fronde's theory is based on the proposition that when a. ship is among waves the impressed forces on her tend to place her normal to the wave-surface. As in water at rest she is in equilibrium when her masts are normal to the surface of the water, so in waves she is in equilibrium when her masts are normal, instant by instant, to the surface of the wave that is passing her. When she at any instant deviates from this position, the effort by which she endeavours to conform herself to it depends on the momentary angle of deviation, in the same manner as the effort to assume an upright position, when forcibly inclined in still water,

depends on the angle of inclination. Hence her stability, i.e., her effort to become vertical in still water, measures her effort to become normal to the wave in undulating water. Mr Froude made the assump- tions that the profile of the wave was a cui-ve of sines, and that the ship was rolling broadside on in a regular series of similar waves of given dimensions and given period of recurrence. He was aware that the profile of the wave would be better represented by a trochoid, but he gave in his first paper several reasons why he pre- ferred to retain the sine curve as the profile of the wave passing the ship. He also assumed that the ship's rolling in still water was iso- chronous, and that the period from one side to the other was given

by T=7r/ ^ , as above. On these assumptions, by sub- stituting, in the equation of motion in still water, the instant- aneous angle between the ship and the normal to the wave-slope for the ordinary angle of inclination, the following equation of motion is obtained :

(Pe , it'

^= f2(*^i). (3)*

where S = angle of ship's masts to the vertical, and 9i= angle of normal to wave – slope to the vertical at the instant con- sidered. ^1 has to be expressed in terms of time, and we have

8, = Q,. sin ?fr- 1, where ei=the maximum wave-slope, and T, half 1

period of the wave, i.e., half the time the wave takes to travel from crest to crest or from trough to trough. Equation (3) can there- fore be written

(4)

which is the general differential equation of the motion of an unresisted ship in regular waves of constant period. The solution of this equation is as follows :

(5)

<u>[illegible] ^ ir.7rT.7r~l.7r TT</u>

<u>p = 9i ij2 sm Fp [illegible]f-rp. sm [illegible]- l + C]- sm $^{-t + C}$- cos ~-t</u>*

<u>where t dates from the mid-trough of the wave, and Ci and C^ are constants depending on the movement and attitude of the ship at that moment. The first term of this expression,</u>

<u>1 / . TT T . TT \</u>

<u>6] j2 ^^sm^ t$^{-sm\ r}$-t),</u>

<u>1 “rfTa</u>

<u>Ti</u>

<u>represents the forced oscillations imposed on the ship by the passage of the series of waves during the time t ; and the second term,</u>

<u>Cj- sin-m-i-FCj-cos-Fp- 1,</u>

<u>the continuance of the oscillations of the ship in still water which she had initially.</u>

<u>Equation (5) indicates, therefore, that the ship performs oscilla- tions as in still water, but has superposed on these a series of oscillations governed by the wave-slope and the relati’ n</u>

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<u>existing between the period of the ship and that of the wave. This equation shows that there will be innumerable phases ; of these, three are worthy of notice. If the initial conditions are suitably chosen (viz., ship</u>

stationary and upright at t = 0), the second part of equation (5) will disappear, and therefore we shall first consider the forced oscillations imposed on the ship by the waves, given by the equation

1 / . T , T

9 = e,,

1 / . TT

-t^(^“t;

- sin – t \ Ti T ^

(6)

Ti’

(a) In the ease in which the ship’s period in still water (T) is equal to the half period of the wave (Ti), we arrive ultimately at the equation

= j(sm^i-.---cos^^)

from which we deduce (a) that at the middle height of the wave the ship’s Jiiasts will have an inclination to the vertical equal to one-half the maximum wave-slope, and (/3) that at each successive wave crest and hollow the range of the ship’s oscillation will be augmented by irj2 times the maximum slope, so that the ship under these conditions would inevitably capsize but for the effect of the resistances and the want of synchronism.

(h) “When T/Ti = 0, i.e., the case in which the ship is assumed to be quick in her movements, or when the period of the wave is infinitely long as compared with that of the ship, the equation (6) becomes

1 Ti

that is to say, the ship will behave very much as a flat board in a seaway, so that her masts are always perpendicular to the surface, (c) If we choose

the initial conditions in equation (5) so that the

coeflioients of sin = t and cos ◆◆◆ t are zero, then the equation will

1 IT

become 9 = Bj :j s^ sin — t; and since the slope of the wave

1- L2 Ti

B^ = Sj sin ◆◆◆ t, we have the ratio of the ship's angle to the vertical

1-1

to that of the normal to wave-slope to the vertical, or ff/Sj, equal to

.. m.i= constant.

That is to say, the ship forsakes her own period and takes up that of the wave. This is termed s(eady or perinaiient rolling. Under these conditions, also, the ship's masts will lean towards the wave-crest if T is greater than Tj, and from the wave-crest if T is less than Tj. The above expression for 8 is ordinarily termed the "forced oscillation," and represents the only element in rolling which strictly depends on the waves ; if it be deducted from the first term of question (5) the remainder of that term with the two following terms represents a superposed " free oscillation " in the ship's natural period, which depends on accidental circumstances.

Mr Fronde in his first paper further showed how the successive angles of a, ship's rolling may be exhibited graphically, and he touched on the influence of resistance in reducing rolling. The following is the summary he gave of the conclusions he reached : ◆◆◆

"(i.) All ships having the same 'periodic time,' or period of natural roll, when artificially put in motion in still water, will go through the same series of movements when subjected to the same series of waves, whether this stability in still water (one of the conditions which governs the

periodic time) be due to breadth of beam, or to deeply stowed-ballast, or to any such peculiarity of form as is in practical use.

‘ ? ? ? This statement would be almost rigorously true if the oscillations were performed in a non-resisting medium, or if the surface-friction and keel-resistance, by which the medium operates to destroy motion, were of the same equivalent value for all the ships thus compared. It requires, however, to be modified in reference to the circumstance that of two ships having the same periodic time in still water, the comparative forms may be such that the one shall exiierience such resistance in a higher proportionate degree than the other, and the necessary modification may be ex- pressed in terras of their relative behaviour when sot in motion in still water. The vessel which is the more rapidly brought to rest by resistance in still water will in the greater degree resist the accu- mulations of angle imposed on her by consecutive wave-impulses, and will the more fall short of the maximum angle which both would alike attain if oscillating in a non-resisting medium.

” (ii.) The condition which develops the largest angles of rolling is equality in the periodic times of the ship and of tlie waves ; and this is true alike for all sliips, whether their scale of resistance, as above referred to, be large or small.

‘ ‘ (iii.) That ship will fare the best which, coeteris paribus, has the slowest periodic time.

” (a) The waves which have a periodic time as slow as hers will have a greater length from crest to crest than those of quicker period; and, on the whole, long waves are relatively less steep than short ones. Now it is the steepness of the waves in a wave-series, not their height simply, which governs the rate at which angles of rolling will accumulate in a given ship when exposed to it.

” (S) Of two ships one of which has periodic time rather slower than the waves in a given ratio, the quicker ship will accumulate the larger angles.

“(c) It will require a heavier or a more continued gale to rear waves which have the lengthened period.

” {d) When the gale has continued so long that the largest waves have outgrown the period of the ship, she will not thereby have been released from the operation of waves having her own period, since the larger waves carry on their surface smaller waves of every intermediate period (this, at least, I believe to be the case).

“(e) When the gale has ceased and the sea is going down, the slower the period of the ship the sooner she will be released from waves of as slow a period.

‘ ‘ (iv.) There are two, and only two, methods of giving a slow period to a ship.

” (a) By increasing her ‘ moment of inertia,’ as by removing her weights as far as possible from her centre of gravity ; an arrangement which for the most part can only be accomplished to a limited extent.

‘ ‘ (V) By diminishing her stability under canvas. This can always be accomplished in the construction of a ship, and generally in her stowage, to any degree consistent with her performance of her regular duties, by simply raising her weights. Were we to raise these so high as to render her incapable of standing up against the action of the wind on her sails, the steepest waves would pass under her without putting her in motion.

‘ ‘ Thus the enormous weights carried by the armour-plated ships, extended laterally to the greatest possible distance from the centre of gravity, and raised high above it, serve in both respects to moderate, not to enhance, this tendency to roll ; and when it is said that with the weights thus placed, and once put in motion, a ship ‘ must roll deep (deep, though easy),’ it should be remembered that those very relations of force and momentum, which show how diffieult it must be to check her motion when once it has been impressed on her, show also that it must be equally difficult to impart that motion to her in the first instance. The difficulty of starting her has a priority in point of time over the difficulty of stopping her, and prevents it from being felt by limiting the motion which would have called it into play.

” (v.) The conditions which govern pitching maybe noticed here, though they have not been discussed in the paper.

‘ ‘ Were it possible, by concentrating her weights or by extending her plane of flotation, to give to the ship a period indefinitely quick for both longitudinal and transverse oscillations, as compared with that of such waves as are large enough to put her in motion, she would acquire no cumulative oscillation, but would float always con- formably to the mean surface of the wave which passes under her.

‘ ‘ But this condition, which is so unapproachable in practice in reference to transverse oscillations that the attempt to approach it will but develop the evils pointed out in (iii.), is of necessity so closely approached in practice in reference to longitudinal oscilla- tions, that those evils can only be escaped by approaching it as closely as is possible. The plunging of a ship whose weights are extended far fore and aft is but an incipient development of those phases of oscillation which have their proper development in transverse motion only. The best that can be desired in reference to longitudinal motion is that the ship’s period, for longitudinal oscillation, shall be as quick as possible, and her position always as conformable as possible to the mean surface of the passing waves.

‘ ‘ I have insisted hero, more prominently than in the body of the paper, on the circumstance that a total loss of stability, using that word in the ordinary sense of power of carrying sail, implies the possession of absolute stability, as regards rolling motion due to wave-impulse, because it has been pointed out to me that the attention of readers should be more strongly directed to it, not indeed as representing a practically available possibility, but as serving best to force the mind, by contact with an extreme con- clusion immediately deducible from the theory, to appreciate its fundamental principles. And the proposition thus certainly furnishes a crucial test of whether the principles have been appre- ciated or not, and it supplies also a ready means of testing the theory by a crucial experiment. I must, in addition, express my own confident belief that any one who will try the experiment fairly will find the proposition so fully verified that he will feel obliged to admit that the theory which leads to so paradoxical yet true a conclusion deserves at least a careful study. But the

more praotioally useful aspect of the theory is that which presents to view the varying phases of cumulative oscillation which a ship tends to undergo when exposed to various types of wave-series ; the phases depending on the relation which her natural period of

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rolling, when set in motion in still water, bears to the period of wave-recurrence, and on the maximum steepneso of each individual wave of the series ??? phases, in fact, which she would actually undergo but for the effect of surface- friction and keel-resistance ; the nature and value of which conditions, as well as the nature and necessity of experiments for their determination, have been pretty fully dealt with in the body of the paper.

"I will here only add a synoptical statement ofll the principal features of those phases, given in a rather more complete form than in that part of the paper which referred to them, though they are pretty fully exhibited by the diagrams.

"By a 'complete phase' is meant that series of oscillations which the ship undergoes counting from the time when, for a moment, she is stationary and upright in a similar position, and is about to recommence an identical repetition of the movements she has just completed.

" For the benefit of those who may glance at the appendix before they read the paper, I will mention that T is the number of seconds occupied by the ship in performing a single oscillation in still water, starboard to port, or vice versd. Tj is the number of seconds occupied by the wave in passing from hollow to crest, or crest to hollow. G^ is the number of degrees in slope of the steepest part of the wave; and p/q is the ratio T/T,, with the numerator and denominator converted into the lowest whole numbers that will express the ratio, where, however, it must be noticed that for T/Ti = 1, p/q must be taken as the limit of such a form as AWWV- Then ???

” (i.) The ship will complete the phase in the time = 2qT.

“(ii.) In completing the phase the ship will pass through the vertical position 2 p times, or 2 y times, according as ^ or y is the smaller number.

” (iii.) The ship will pass through the vertical position at the middle of the phase.

” (iv.) On either side of the middle of the phase there must occur, as equal maximum oscillation, the maximum in the phase, say ,,

which will approximately (but never in excess) = + 6i S

q -p

” (v.) From these propositions it appears that if we compare two cases, in one of which the value of T/Tj is the reciprocal of its value in the other, the phase will in each ease consist of the same number of oscillations siniilarly placed ; but in that one in which the period of the wave is slower than the period of the ship, the angles of oscillation will be the larger in the ratio p/q or qjp, which- ever is the greater. The following table expresses the results of the above propositions, as exhibited in the diagrams, based on the assumption that the period of the ship is in every case T = 5”, and that tlie maximum slope of the wave Gj = 9 degrees :

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-S

ft-SoS

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i

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i

H

|3|i

5″

5″

1

rWA’A

Infinite.

Infinite.

Infinite.

5″

6-25″

0-8

i

50″

8

45 deg.

5″

4″

1-25

f

40″

8

36 ???

5″

10″

0-5

i

20″

2

18 ???

5″

2-5″

2

i

10″

2

9 .,

5"

9"

0-55

-

90"

10

20 ???

5"

2-77"

1-8

1.

50"

10

11 ???

It should be noted that the "wave-slope," spoken of as regu- lating the rolling, is not precisely the surface-slope, but a slope somewhat less (according to the depth of the ship), in virtue of the diminution of wave-motion with depth below the surface.

We have up to the present assumed that the rolling of ships

in still water and among waves is unresisted, but this is not the

, ^ J case. A ship, if set rolling in still water, will experi-

;H * ^^'^^ resistance to the rolling motion, and a degrada- "* "*'*** tion of the amplitude will take place until the ship finally comes to a position of rest. Similar forces operate when a vessel is rolling among waves.*

The earliest investigators of resisted rolling in still water were Mr Froude in England and Messrs Bertin, Dubil de Benaz^, Risbec, and Antoine in France. The method adopted was to roll a ship in still water and observe how the amplitude decreased roll by roll. As large an initial angle of roll as possible was obtained, generally by making men run from side to side of the ship, their runs being so timed as to add to the angle of roll swing by swing until the maximum angle was reached. This angle obtained, all movement on board was stopped, and the ship allowed to roll freely of herself until she came to rest. During this free movement a

complete record of her angular motion against time was registered by means of a short- period pendulum and an electric timer. From this record a curve was constructed, in which abscissae represented number of rolls and ordinates extreme angles of roll to one side of the vertical. Such a curve is termed a curve of " declining angles."

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SQ ao 4C

Count of successive sw

so

ings.

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Fig. 1. ??? Curves of declining angles, C, light, and D, deep draught, no bilge keels ; E, light, and F, deep draught, with bilge keels.

From this curve another curve is constructed, in which the abscissae represent angles of roll and the ordinates the angle lost per swing. Such a curve is termed a “curve of extinction.” Figs. 1 and 2 give these cuiTes as obtained from experiments on H.M.S. Puvvenge ; they are taken from a, paper by Sir W. H. White, read before the Institution of Naval Architects in 1895.

Having obtained such curves, Mr Froude proceeded to investi- gate the relation between the degradation of the amplitude and the resistances which cause it. He assumed that the resistance to rolling varied (1) as the

angular velocity, and (2) as the square of the angular velocity, and with these assumptions he obtained the following differential equation for the curve of extinction : ???

an , '

where fl = extreme angle reached at any particular oscDlation, n= count of the number of oscillations from the start of free rolling, and a and 6 are coefficients which bear a direct relation to the coefficients of resistance assumed to vary as the angular velocity and the angular velocity squared. Mr Froude assigned his reasons for expecting the resistance to vary partly as the first and partly as the second power of the angular velocity. The latter he considered due to surface-friction and the head-resistance of keels and deadwood, and the former to the resistance caused by the creation of a small wave each roll, which by travelling away from the ship becomes the cause of a dissipation of energy.

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Angle of roll (fl) from vertical.

Fig. 2. ???Curves of extinction. A, light, and B, deep draught, no bilge keels ???C, light, and D, draught, with bUge keels. ‘

Fronde’s views have been confirmed by the accuracy with which

the expression 7 = a???6-^6?????2 j^^y be made to fit the curve of

extinction of practically any ship by the judicious selection of the coefficients a and h. M. Bertin has, however, wished to substitute

an expression equivalent to – ??? =1-0^, chiefly because he was not

satisfied as to the mechanical conditions expressed by the other term. Other French investigators, again, have preferred an

expression equivalent to -^=a-e, but in Great Britain Mr

Fronde's expression has always been accepted as best renresentina- all the facts. ^ ^

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For the Mevenge the following equations represent the curves of extinction given in Fig. 2 : ??? For deep draught ???

without bilee keels – : = -0123^+ -00259= ; ?? an

with , ,

For light draught ???

-V=-065S+ -01791 an

de

without bilge keels – t- = -0169 + -00289= ;

with

Ja

3 =-0849+ -01992

ail

(9 in all oases being measured in degrees and not in circular measure).

The large increase in the 6 coefficient after bilge keels had been fitted has given rise to considerable discussion. Mr Froude had experimented with a deeply submerged plane oscillating in water, and he found that at a speed of 1 foot per second the resistance per square foot was 1-6 lb. Using this figure to calculate the work per swing (from an extreme angle of 6 degrees), the head-resistance of the bOge keels is found to be about one-fourth the energy lost in a single swing, due to the increased value of the h coeificient in the above formula. Thus the energy abstracted in this particular case is about four times what can be theoretically traced to the head-resistance of the bilge keels. This discrepancy has been obsenved in many previous cases, and it appears that when bilge keels are added to a ship they become eflective, not merely as flat surfaces moving with the ship and experiencing direct resist- ance, but also by indirectly influencing the stream line motions which would exist about the oscillating ship if there were no bilge keels. In this connexion reference must be made to a paper by Professor Bryan, read before the Institution of Naval Architects in 1900, on the "Action of Bilge Keels."

The problem of resisted rolling among waves Mr Froude attacked in an inverse manner, to ascertain ' ' what wave-series is required to keep the given ship at a given range of steady rolling with any assigned period, including the effect of resistance." Subsequently the problem was treated in a direct manner by the process of "graphic integration." This process is a most exact method of determining the motion of a ship, having given the elements of the ship's rolling in still water and the wave-series that is acting upon the ship, it enables the subsequent motion to be completely determined (see Trans. Inst. Nav. Arch. 1875). Some most valuable developments of the process were made by Sir William White in a paper read before the same society in 1881 on the "Rolling of Sailing Ships," in which the action of the wind on the sails, and the variation of the virtual weight of the ship on the wave are included. The efl'eot of wind-pressure in heeling a ship is very much greater when she is at the crest of a wave than when she is at the trough, because her virtual weight is less. This

must be taken account of in dealing with sailing vessels, the reduction of virtual weight, and therefore of righting moment, at the crest of a. wave being very considerable, though the heeling moments due to the wind suffer no such reduction. We have seen above that when the half-period of the wave- series affecting a ship is equal to the period of the ship (Ti=T), then at each successive wave crest and hollow the range of the

ship's oscillation (unresisted) will be augmented by – ___ Gj, where

Z 0] is the maximum wave-slope. If, however, under these circum-stances, the ship settles down to a steady roll of amplitude 9, we can say that the increase of amplitude due to the wave is exactly balanced by the effect of the resistance to the rolling. The decrease of amplitude in still water per roll due to resistance is given by ___ A9 = a- 9 + 6 ___ 9^, and for the angle 0 wDl equal a ___ 0 + 5 ___ 02. We can therefore equate these two quantities, and say

___ 0i = a ___ 0 + i ___ 02, where 0i= angle of maximum wave-slope and 0 = angle of steady rolling. With M. Bertin the equation would be

'!'-0,=iV-0.

2 '

In 1894 and 1895 M. Bertin, at the Institution of Naval Architects, extended this relation to cases in which Tj is not equal to T, obtaining at the same time not simply the angles of steady rolling for these cases, but the maximum angli's passed through on the way to the steady condition ; to these maximum angles he gave the name of " apogee " rolls. Mr R. E. Froude in 1896, at the I.N.A., investigated the probable maximum amplitude which she would attain under the influence of a non-synchronous swell if started with no roll. To arrive at the value of this "criterion amplitude," as he called it, Mr Froude superposed upon the steady resisted "forced oscillation" proper to 11 le waves (which is easily calculated), a resisted " free oscillation " of equal initial amplitude, so that the two oscillations should at the start cancel one another and give no roll. For this supposition the mathematics readily

give all the subsequent angles of roll. This treatment in effect assumes a curve of extinction such that the loss of roll per swing is proportional .to the angle of roll ; but provided the coefficient of extinction taken in the calculation was made to agree with the actual extinction at the angles mainly in question, little error was found to arise from the incon-ectness of this assumption.

The following table shows the difference between the "criterion angle " and ??ie angle of steady roll in the case of the Revenge, both without and with the bilge keels, and with the assumptions above mentioned:
???

Maximum Wave-Slope, 3 Degrees.

I =1-3.

1 =1-2.

1^ =1-1.

T

1-0.

Ti

Ti

Ti

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CQ

D

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deff.

deg.

deg.

deg.

deg.

deg.

deg.

d6g.

Revenge (deep

<?>

draught), with

no huge keels

8-25

4-35

12-25

6-8

21-2

13-9

41-1

41-1

Revenge (deep

draught), with

bilge keels .

6-6

4-24

8-6

6-4

11-65

10-8

14-85

14-85

Mr Froude iu his paper gives a number of instructive diagrams, from which he draws the conclusions that, however non-imiform initially, the roUing ultimately fedls into the uniform forced oscillation ; that it does so the sooner, aeteris paritus, the higher the resistance, and with the fewer "cycles" or alternations of amplitude of rolling, the more nearly synchronous the swell with the ship ; that the amplitude of the idtimate uniform rolling is an approximate mean of the alternate maxima and minima of the precedent non-uniform rolling ; that if the rolling starts from zero, the maximum amplitude faUs short of twice the ultimate uniform amplitude, the more so the higher the resistance and the more synchronous the swell ; and that in a synchronous swell the maximum amplitude cannot exceed the ultimate uniform ampli- tude, unless it does so initially. In two remarkable papers by Captain and Professor Kriloff of

St Petersburg, read before the I.N. A. in 1896 and 1898, the whole motion of a ship, including pitching and rolling, is dealt with ; these papers aim at taking account of every variation which can reasonably be conceived.

An extremely important practical matter very closely related to rolling is the effect of bilge keels. Some reference has already been made to these and the influence they exert on the ... roUing of a ship in still water, as illustrated by H.M.S. Revenge, in which there was one bilge keel on each side, 200 ft. in length and 3 ft. in depth, tapered at the extreme ends. The great value of bilge keels in diminishing rolling had been known as early as 1872, when Mr Froude experimented with the Perseus and the Greyhound, alike ia every essential respect except that the former was not provided with bUge keels and the latter was. The general conclusion in this case was that the rolling of the Grey- hound was only about one-half that of the Perseus.

Bilge keels were usual in warships until, in the design of the Royal Sovereign class, it was decided not to fit them, owing to the large dimensions of the vessels and the difficulties in certain circumstances of docking them if provided with bOge keels. Ultimately one of the class, the Repulse, had them fitted for purposes of comparison, and the result was so marked that it was resolved to fit sunilarly all the ships of the class. Before doing thie work on the Revenge a careful programme was drawn up of experiments to be made before and after the bilge keels were fitted, and by carrying out this programme very valuable results were obtained. The experiments were made at Spithead in smooth water, and the general effect of the bilge keels was found to be the reduction of the rolling to one-third its former amount. When instead of having no motion in the line ahead the ship had a speed of 12 knots, the effect was even greater.

The experience of Great Britain with regard to bilge keels has been largely repeated in America. In the ships of the U.S. navy bilge keels were omitted for much the same reasons as in the Royal Sovereign class ; then on the U. S. S. Oregon they were fitted, I'xperiraental investigation being made both without and with them, and the general . conclusion arrived at was that the rolling was diminished to one-third by the bilge keels. The

usual form of bilge keels fitted to warships to reduce rolling may be seen in Fig. 30.

As an alternative to bilge keels, water chambers at one time promised great results in the way of reduction of rolling. The effect of such chambers, with some numerical results, is described very fully in the ninth edition of this work. Exigencies of space

theoretical]

have, however, prevented them from becomiDg a permanent feature in the design of war or other ships ; in addition, the conditions of warship design have changed, and now admit of more moderate values of the metacentric height, which is a most important factor in increasing the time of oscillations and thus reducing rolling.

Resistance and Propulsion.

The resistance and the propulsion of ships are dealt with at con- siderable length in the ninth edition of this work, and the account given should be read in connexion with the following notes.

By means of experiments with models of different sizes towed by a steam launch, Mr W. Froude established the truth of his “law of comparison ” between vessels of different size, a law which he had conceived independently, but which had been previously worked out on mathematical lines by M. Reeoh in his Cours de Mimnique, published in 1852. He afterwards, in 1871, constructed a tank and apparatus at Torquay for dealing with these matters on behalf of the British Admiralty. When in 1885, six years after his death, the ground occupied by the Torquay tank was required for building pur- poses, a new tank was constructed at Haslar, near Portsmouth, from tlie designs and under the supervision of Mr K. E. Froude, F.E.S., such improvements being added as experience at Torquay had showed to be desirable. At both these tanks

models of V^ J propellers as well as of ships were experimented upon, . . besides a variety of matters connected with the general

”” ??? subject. Similar Government establishments have since

been established in Holland, Italy, France, Russia, and the United States, and by one private firm on the Clyde (William Denny and Brothers, Dumbarton). Others are in contemplation. The Admiralty experimental tank at Haslar is nearly 400 feet long, 20 feet wide, and 9 feet deep. The main experimental carriage spans the whole width of the tank, and carries a secondary railway on which the subsidiary carriages, which can’y the experimental apparatus of different kinds, are adjusted in position. The main carriage runs on rails on the side walls, and can travel the whole length of the tank ; it is driven at various speeds by a wire rope from a stationary engine of ample power. Ordinary speeds range from 100 to 800 feet per minute, while an extreme speed of 1200 feet per minute can be obtained ; the speeds are regulated by a highly sensitive governor. The modelsaremade of hard paraffin- wax, generally about 1 4 feet long and somewhat over one inch in thick- ness ; they are cast in a mould, with an allowance of about J inch for finishing. To shape a model accurately, it is placed bottom up on the bed of a machine in which a pair of revolving cutters, one on each side of the model, cut out on its surface a series of level lines, whose contours are precisely similar to those on the drawing of the ship whose model is under treatment. When all the level lines have been out in, the model presents the appearance of a series of steps, the bottom angles of which correctly represent the true form the model should possess. The paraffin ridges between these level lines are trimmed off by the use of suitable tools, and tlie outside surface made quite smooth with flexible steel scrapers. When ballasted to its required displacement and saddled with a frame, which carries the guiding attachment and also the towing-rod, the model is placed below the dynamometer carriage, and the dynamometer is lowered into place. The towing- rod at its forward end is then in a position to impart horizontal forces by a hard steel surface to a knife-edge on the dynamometer lever within the model at about the level of the water-surface. There are various delicate arrangements with knife-edge adjustments, which result in the horizontal forces being transmitted through a spiral spring, the

extensions of which are multiplied by a lever and recorded by a pen on a paper-covered cylinder, distances and time being simultaneously recorded. From these elements, the speed and resistance cori'esponding to each experiment are deduced, a most necessary condition being that the speed shall be uniform throughout each experiment. By somewhat similar arrangements on another subsidiary carriage, the action of model screw propellers is tested, either in undisturbed water or behind a model, the rate of rotation, rotary resistance, and thrust being measured.

One of the most recent experimental tanks is that constructed by the United States Government at the Washington Navy Yard. The building is 500 feet long and 50 feet wide inside ; the breadth of the water-surface is 43 feet, the length 470 feet, 370 feet of which has a depth of about 14 feet. The models are constructed of wood and not of paraffin, in consequence of the high temperatures reached at Washington in summer. The models are made by a copying machine adapted for the purpose ; after removal from the machine a little finishing by hand is necessary, and over the finished surface a waterproof varnish is applied. The carriage to which the model is attached for the purpose of experiment runs upon four pairs of wheels and spans the entire breadth of the basin ; it is driven electrically, one motor being applied to each pair of wheels ; the speed is controlled by a delicate governor on the generator. The possible speeds obtainable range up to 20 knots. In the dynamometric apparatus electricity is also used, and multiplying levers, as used by Mr Froude, are entirely dis-

pensed with, whenever it is desirable to avoid friction. Resistance is measured by the extension of a spring, as usual, and several in- genious arrangements have been devised to obtain the recorded results.

Mr W. Froude, basing his investigations partly on theory and partly on tlie results of experiments, found that in a body moving with uniform speed through water at, or near the surface, the resistance would consist of three parts :

Com' ponents of

(1) surface friction ; (2) eddy -making resistance, chiefly^ . due to rapid changes of form, especially towards the after end ; (3) wave-making resistance, aue to the expenditure of energy in continually supplying the waste of the attendant system of waves. For some purposes it is convenient to group (2) and (3) together under the name of residuary resistance ??? that is, the resistance left after deducting surface friction.*

Surface friction is of great importance, as it forms the chief cause of resistance at relatively low speeds, and a considerable pro- portion of the total even when the speed is high. It necessarily varies with the area and nature of surface exposed, and with the speed through the water ; it also varies with the density, but not with the pressure, and is therefore practically independent of the depth below the surface. Formerly it was thought to vary directly as the area and the square of the speed. Mr W. Fronde's experiments demonstrated that the resistance per square foot dimin- ishes somewhat as the length of the surface is increased, and with varying speeds its variation is expressed in most cases by a l"ss exponent than the second power. Thus for a surface covered with fresh clean paint 2 feet long in the direction of motion, at 600 feet per minute, the resistance is 0'41 lb per square foot, and it is varying as the second power of the speed. For the same surface 50 feet long in the direction of motion, the resistance is only 0'25 lb per square foot, varying as the 1 "83 power of the speed.

With regard to the second form of resistance, that due to the formation of eddies, Mr W. Froude spoke of it as hindering the necessary stream-line motions, altering their nice adjustment of pressures and velocities, defeating the balance of forward and backward forces acting against the surface of the body, and thus inducing resistance. This view was extended by Mr R. E. Froude in 1894, in a paper read before the Greenock Philosophical Society. In speaiing of the stream-line motion of a submerged body, he says : " Along the sides and at the shoulders of the body the particles in a frictionless fluid have a defective pressure and a corresponding excess of speed. In a frictional fluid the case will be the same so far as pressure is concerned. But in respect of speed the case will differ in this way, that near the surface of the body the particles will have

their speed reduced in consequence of the skin friction, thus embodying what is called the frictional wake. Now, how are these particles of reduced speed to continue their flow against the rise of pressure between the low-pressure region at the shoulder and the high-pressure region at the stern ? In the frictioidess fluid the particles do so in virtue of their excess of speed, which they exchange for pressure ; but what is to become of the particles near the side in the frictional fluid, which have already lost a great deal of their speed ? They, in advancing into the high-pressure region, will render up what speed they have left, tdl they are bankrupt altogether in the matter of speed, and then tend to stop still." Pursuing this line of argument, he (1) shows that this disturbance of stream – line speed intro- duces quite other conditions of flow than pure stream-line con- ditions, and (2) explains why given abruptness of form is far more potent as a disturbing cause when it is situated near the stern than when near the bow.

With regard to the third form of resistance, namely, that due to the formation of waves, it is important to note that although it is of small importance at relatively low speeds, yet for high speeds it forms a, considerable portion of the total. The rapid growth of resistance as the speed is increased, and consequently the large increase of horse-power for an increment of speed at high speeds, compared with that caused by a similar increment at low speeds, is due to the resistance caused by the formation of waves. In the motion of water past a body submerged deep enough below the surface to avoid wave-making, a portion at the forward end encounters increased pressure, due to the motion ; a succeeding portion encounters decreased pressure ; and the after portion, in- creased pressure again. In a frictionless fluid the sum of all these pressures resolved in the line of motion would be nil ; there would be no resultant force on the body, due to the fluid being pushed aside at the front and closing in at the rear. With the body near the surface, and still more with the body only partially immersed as a ship, the excesses of pressure at the ends, and the defects of pressure along the sides, due to the motion, have the immediate effect of causing the level of the water to be raised at the ends and lowered along the sides. In the case of a ship moving on the siirface of water supposed to be still, these variations of pressure will still exist, and the imaginary statical wave, first mentioned by Mr E. E.

Froude in his lecture before the Greenock Philosophical Society in 1894, would be their natural result. In this imaginary

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_ _ _wave " the elevations and depressions are the statical equivalent of the differences of pressure which there would be if the surface were forcibly kept smooth, as it might be conceived to be if the underwater hull were travelling beneath a rigid sheet of ice." This statical wave may be regarded as the cause of the actual wave-series we observe. Any disturbance of level in water tends to generate a series of waves, and so we have the bow series of waves, caused by the statical wave at the bow, and the stern series Oi waves, caused by the statical wave at the stern. The force required to maintain continually these waves is the measure of the wave-making resist- ance of the ship.

Each of these series of waves consists of a set having their crests nearly perpendicular to the line of motion, and a divei-ging set sloping aft. These latter pass at once away from the ship after being formed, but the transverse series initiated at the bow cause considerable interference with the corresponding series at the stern. The result- ing total energy of the wave-field will vary accord- ing to the way in which the two series interfere with each other, so affecting the resistance of the ship. This is the cause of the series of humps and hollows which has been noticed as a characteristic feature of a curve of resistance on base of speed. This was investigated by Mr "VV. Froude in his 1877 paper before the I.N.A. on the effect pro- duced on the wave-making resistance of ships by varying the length of the parallel middle body ; the matter of this paper is given in considerable detail in the ninth edition of this work. It be- came apparent from his experiments that a hump on the resistance-curve was due to the incidence of a crest of the bow-wave series on the crest of the stern wave, while a hollow on the resistance-curve was due to the incidence of a trough of the bow- wave series at the same place.

The form taken by the waves generated in the motion of ship models has been carefully observed by both Mr "W. and Mr R. E. Froude. To the peculiar arrangement of the crests of the diverging waves has been given the name iohelon ??? the arrangement, namely, by which the most highly raised portions stand in ridges, each stepped back from the line of the crest of its preceding neigh- bour, the line again connecting the summits of these successive crests forming a definite angle with the line of motion of the body. The true meaning of this ichelon series has been pointed out by Lord Kelvin ; he has shown that it arises from tlie same cause as the transverse series, the two series being both parts of a complete whole.

Of the enormotis number of experimental results that have now been obtained from the trials of ships models, in the tanks referred

to above, remarkably few have been made public.

In connexion with the Torquay and Haslar tanks

some few of the reports by Mr W. and Mr R. E.

Froude have been published by order or permission of the Board of Admiralty, chiefly through the I.N.A. and other societies. Amongst these may be mentioned the Oreyhound experi- ments in 1873 ; the Merkara results, in an I.N. A. paper in 1876 ; experiments on th j effect produced on the wave-making resistance of ships by varying the length of parallel middle body, in an I.N. A. paper in 1877 ; results obtained from models of three mer- chant liners in 1881 ; and a paper before the I.N. A. in 1888 on the "constant" system of notation of results of experiments on models used at the Admiralty experiment works. Of the Dutch results a number were published by the late Dr Tideman in the Memorial van de Marine in 1878. Of the Dumbarton experiments, results for three vessels were given by the late William Denny to the Institution of Engineers and Shipbuilders in Glasgow in 1884 ; and for two models at varying draughts by Mr A. Denny at the International Engineering Congress at Chicago in 1893, The results of some experiments at the Italian tank to ascertain the effect of depth of water on resistance were communicated to the I.N. A. in

1900 by Major Guiseppe Eota, and in the discussion Mr A. Denny gave the results of some similar experiments carried out at Dumbarton.

The experiments with the Greyhound were of special importance, as they lielped materially to confirm the accuracy for practical purposes of the "law of comparison." In this case dynamometric experiments were made on the ship as vmW as on her modeh Three different displacements were given to the ship, and for the least and greatest of these several different conditions of fore-and-aft trim were tried. Subsequently, .also, the vessel was fitted with bilge keels. Resistances at various speeds were obtaineil for no less than eleven different conditions of the vessel. The model was on a scale one-sixteenth full size, and the resistances were obtained in the Torquay tank under each of the conditions of displacement and trim corresponding to those adopted in the

ship herself. Very close agreement was found to exist between the resistances of the Greyhound and her model according to the "law of comparison." (This most important law is very fully dealt with in the ninth] edition of this work.) The Merkara results are of special interest, because of Mr "W. Froude's attempted

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Fig. 3. ⬜⬜⬜ Curves of I.H.P. tor a vessel of 2000 tons displacement.

analysis of the "indicated thrust" curve into its elements. Besides the curve of I.H.P. on base of speed, another curve was constructed showing ' ' indicated thrust " on the speed base. This "indicated thrust" was obtained at any given speed by multi- plying the I.H.P. by 33,000 and dividing by the product of pitch

Experi- mental results.

Fig. 4. ⬜⬜⬜ Curves of I. II. P. for a vessel of 5000 tons displacement.

and revolutions of the propeller. Mr Froude resolved this into its elements, namely : (1) useful thrust or ship's true resistance ; (2) augmentation of resistance due to the action of the propeller (since called thrust deduction) ; (3) edgewise friction of propeller blades ; (4) initial friction ; (5) working friction ; (6) air-^ump and feed-pump duty. The results obtained from this analysis are of extreme interest as indicating the various sources of loss between

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Indicated horse- power.

the actual I.H.P. and the H.P. due to the ship's net resistance (called Effective Horse-Power), but in the light of more recent ex- periments the values arrived at have been somewhat modified.

For estimating the indicated horse-power required to give a particular speed to a steamer there are two distinct courses open, according to the information available. One is the use of data obtained from tank experiments, the otlier the use of data obtained from actual ships. It is sometimes erroneously thought that the former of these courses excludes the latter ; so far from this 'being the case, a good deal of the experimental work of a tank is directed to obtaining as full a knowledge as possible of the inconstancy affecting all comparative speed -results. Models are tried under conditions exactly similar to those of the ships they represent, the speeds and powers of which are known ; from the models the effective horse-powers are deduced, and these are compared with the actual powers, the ratio of the former to the latter expressing what is known as the propulsive coefficient. In estimating for a new ship the designer has the propulsive eoefiicients of similar ships before him, together, with such knowledge as is available of the cause of their want of con- stancy. Besides propulsive ooeiEcients, other tank data are kept

*FiQ. 6.**Curves*

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of I.H.P. for a vessel of 9000 tons displacement.

in shape for ready application. From such particulars the curve of H. P. for the ship contemplated can be estimated.

With further reference to the propulsive coefficient, a very Toughly approximate iigure is 0'5 ; the difference between unity and this coefficient must be regarded as the combined loss of efficiency of all the different parts of the propulsive machinery, including the propeller. As already mentioned, these losses were analysed by Mr W. Froude in 1876 in his paper on the Merkara. The loss due to the propeller has since

received great attention at the hands of Mr R. E. Froude, but there would seem to be room for more investigation and experiment regarding this and other losses.

The method of estimating speed and power which is probably most commonly used is one involving a relation between I.H.P., displacement, and speed, expressed by the formula ???

(Speed) X (Displacement) '

C,

I.H.P.

C being called the Admiralty coefficient. The value of C varies considerably for different speeds even of the same ship. For it to be constant, the I.H.P. would have to vary as the cube of the speed ; if resistance varied as the square of the speed and I. H. P. as resistance and speed, the condition of constancy would be ful- filled. Resistance-variation, however, is not so simple. Again, in the dependence of I.H.P. on resistance and speed important terms

are involved causing considerable variations. Those who use the Admiralty coefficient for estimating are very careful to choose their data from practice with which they are well acquainted, and to see that they do not press the application beyond the limits

Fig. 6. ??? Curves of I.H.P. for a vessel of 14,000 tons displacement.

that the circumstances justify. In some cases great care is taken that the speed for the ship under estimate is the corresponding speed of the ship estimated^ from, or that the departure from the corresponding speed is not great. (Corresponding speeds are those varying as the square root of the lengths. These are the speeds

la " io 22 2? 26"

Fio. 7. ??? Curves of I.H.P. for a vessel of 20,000 tons displacement.

used in the law of comparison.) Again, between the ship under estimate and the ship estimated from, a general similarity as to form and as to proportions of length, breadth, and draught is sought. ►►

A general indication only can here be given of the value of the

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eoeffioient C. For good results it may be said to vary from 200 to 300 (speed in knots, displacement in tons), but many instances will be found of values both above and below this range ; in steam launches (to take only one 'instance), where the speed is high in relation to the square root of the length, it may be as low as 80.

As an illustration of the use of the law of comparison in estimat- ing I.H.P. from the performance of a similar ship, the following example is given : ►►► A vessel 300 feet long, 36i feet broad, se ot aw j^g J j.gg^ draught, and 2135 tons displacement requires Darisra ^►►"" I.H.P. for a speed of 20 knots. It is required to ►►► estimate the I.H.P. of a similar ship of 3000 tons dis placement at the corresponding speed. The ratio of displacements being 3000/2136, the ratio of linear dimensions will be the ^ ^ ^ cube root of this, or 1'12, and the ratio of corresponding ;sSSo speeds, the sixth root, or 1'06. The dimensions of the 3000-ton ship will therefore be 336 feet x 41 feet X 15-1 feet, and the corresponding speed 21 '2 knots. At this speed the I.H.P. of the 3000-ton ship will be according to '►►

the law of comparison, 7000 x f?'-)"" = 10,400 I.H.P. V2136/

about. Thus for a vessel similar to the above, 336 feet x 41 feet X 15 "1 feet, with a displacement of 3000 tons, 10,400 r.H.P. is reqidred for a speed of 21-2 knots. In this use of the law of comparison we make several

assumptions : ??? (1) The machinery and propellers will work with the same efficiency in both cases ; (2) the surfaces of the two vessels are in the same condition ; and (3) the correction for sur- face friction in passing from one ship to the other of different length is unnecessary. (This correction is of great importance when passing from a model to a fuU-sized ship.)

To illustrate what has gone before, and at the same time to afford useful data for estimating the I.H.P. of vessels of a particular type, a number of diagrams have been constructed (Figs. 3-7) showing for each of five displacements a series of

oweran ^^^^^^ g^ I.H.P. plotted to a base of speed for ships ??? of various lengths. They are based on the steam-trial

results of the Elswick cruisers and other data. The volume of displacement of the above vessels is approximately one-half that of the circumscribing parallelopipedon, or in other words the "co- efficient of fineness" is about 50 per cent. ??? a very fair average value for modern cruisers. These results will only hold for vessels of about the same coefficient of fineness, for experience with models has shown this coefficient to have an important bearing on resistance. With this restriction the series of curves enables an approximate estimate to be made, by a process of interpolation, of the I.H.P. necessary to drive at any required speed a ship of given dimen- sions within a wide range of displacement and length. It must be borne in mind, however, that there are many possible features in the form of a vessel which militate against a good performance, principal among which we may mention the following : ??? sudden change of curvature in the curve of sectional areas, parallel middle body, too full a water-line, unduly large ratio of beam to draught ; and to realize so good a performance as is represented by these curves we must suppose the lines of the ship designed to avoid, as far as possible, any of these features. Besides this, the engines and propellers must have been designed to minimize the waste of power in engine friction, churning of the water by the pro- pellers, &c. ; the ship must have a clean bottom, and be run in deep water under favourable con- ditions of wind and sea.

As a numerical example of the use of these curves, suppose we wish to estimate the I.H.P. necessary to drive a cruiser of 10,500 tons displacement and 460 feet length at a speed of 23 knots. We first plot a series of cross curves of I.H.P. on a base of length of ship (see Fig. 8) for each of the five displacements. By cutting this series at 460 feet length we again plot a cross curve of I. H. P. (Fig. 9), this time on a base of displacement. Lastly, we cut this curve at 10,500 tons displacement, which gives us 23,500 as the I.H.P. required. By repeating this process for a series of speeds, a com- plete curve of I.H.P. could be constructed.

The curves bring out very strikingly the great importance of giving a ship sufficient length if she is to run at high speeds. Take, for example, the curves on Fig. 3 for ships of 2000 tons displacement. The 350-feet ship here requires 2100 I.H.P. for 16 knots and 4200 for 20 knots, i.e., the I.H.P. is doubled in

(OA\ 3 ??? I approximately, in- dicating that for this ship the I.H.P. varies as the cube of the speed within these limits of speed, and therefore the resistance

varies as the square of the speed. On the other hand, as the speed of the 200-feet ship passes from 16 to 17 knots the I.H.P. increases from 3800 to 8200, or approximately in the ratio 2 '2.

??? I approximately, indicating that the resistance is

actually varying as the 12th power of the speed for this ship between 16 and 17 knots. Practically so short a ship of this form could not be driven at a greater speed than 17 knots, for after this speed is reached any moderate increase of I.H.P. would not sensibly affect the speed. This excessive rate of growth of I.H.P. does not continue in-

FlGS. 8 and 9. ??? Cross curves for determining: tiie LH.P. of a vessel of 460 feet length, 10,500 tons displacement, and 23 Isnots speed.

definitely, for after a certain speed is reached the rate suddenly begins to fall off, and eventually will again bear a reasonable relation to the rate of growth of the speed. The phenomenon is a result of the harmonic nature

of the wave system, and is not con- fined to abnormally short ships. In fact, it is most apparent in small fine vessels run through a wide range of speed, such as torpedo- boats and destroyers. Fig. 10 shows, for such a vessel, three curves plotted to a base of speed, the ordinates being respectively ???

LH.P. I.H.P. I.H.P., f?????? ^ ???j^' UT^^r, \3' '^^ second of these is of course a

(speed) curve of resistance, and the rapid rise and fall of the rate of growth

Pig. 10. ??? Curves of I.H.P.

I.H.P.

*I.H.P. ^^^^*

(speed)' (speed) ^

for a vessel of 120 tons displacement.

of resistance manifests itself in this resistance-curve by a very marked hump between 15 and 25 knots speeds. The third curve,

' I.H.P. . .

that of , j,3, is interesting as affording, by its slope

at

(speed)''

different points, a very good indication of this rate of growth.

Up to 13 knots speed this curve is not far from being hori- zontal, indicating that till then the resistance is varying about as the square of the speed. The rate of growth increases from this point till it reaches a maximum at 15 knots, and then falls off till at 19 knots the resistance

once more varies as the square of the speed. From this point onward the resistance increases approximately according to the above law. It may be noted that

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at 19 knots the ship's statical wave has approximately the same length as the wave which would travel freely at the same speed as the ship, and this determines the position of the maximum value of I H P

In this connexion a fact pointed out by Professor Biles

in a paper read before the Institution of Naval Architects in 1881 is interesting. When the resistance of a form varies as the 6th power of the speed, an increase in the displacement by a propor- tionate enlargement of dimension will not cause an increase in the resistance for the same speed ; and when the resistance varies as a higher power of the speed than the 6th, the resistance wiU actually be reduced by increasing the displacement.

As the speed is decreased, the advantage of the longer ship rapidly falls oflf, and at low speeds the longer ship actually requires more I. H. P. to drive it than the shorter one of the same displacement. For example, if we compare 5000-ton ships of 400 and 450 feet lengths (see Fig. 4) at 23 knots, the 400-feet ship requires 1800 more I.H.P. than the 450 feet, but at 174 knots the LH.P.'s re- quired are almost equal (shown by the curves crossing) ; and if the speed is further reduced, the 450-feet ship becomes" the worse of the two. The reason of this is not difficult to see. At high speeds the resistance is chiefiy caused by surface disturbance or wave-making, and this is less in a fine long ship ; but at low speeds the resistance consists almost entirely of surface friction, and consequently is pro- portional to the wetted surface of the ship. Now lengthening a ship of fixed displacement, with corresponding reduction of beam and draught, increases the wetted surface, just as increasing the eccen- tricity of an

ellipse of fixed area increases the perimeter. Conse- quently the longer ship has the greater surface-friction resistance. In fact, for a given displacement and speed we can find a definite lengtli of ship which will require the niinimum expenditure of I.H.P., but structural and other reasons would generally make this length too great for practical purposes. This ‘ ‘ best length ” will, of course, increase both with speed and displacement. As a result of this reasoning we should expect the order of the curves at low speeds to be the reverse of that at high speeds on each sheet, i.e., the ordinate for the longest ship should be highest instead of lowest, and so with the others. This would have been more apparent had the curves been plotted on a more open scale and continued to a lower speed than has been found convenient to do.

Before proceeding to discuss screw propellers, it will be desirable to define some of the terms employed. The product of revolutions and pitch is often called the speed of the propeller ; it ^., represents what the speed would be in the absence of ??? slip. Speed of advance, on the other hand, is applied to the movement of the propeller in the line of its action without relation to its rotation. The difference between speed of propeller and speed of advance is the sUp. Slip is often spoken of as either “apparent” or “real”: if it is “apparent” for speed of ad- vance is taken the speed of the ship, when it is not real, simply because it takes no account o7 the ” wake ” water carried with the ship. For analytical purposes this wake must be taken account of, and the speed of advance measured with respect to it ; the resulting slip deduced is then the “real” slip. Since the wake moves with the ship, the speed of advance of propeller through the wake is, speaking generally, less than the speed of the ship, and the real slip is greater than the apparent slip. ‘ ‘ Velocity of feed ” is the term employed by Mr Barnaby for the speed of advance through the wake, and in some respects it expresses what is wanted better than any other term.

Previous to 1878 investigations into the action of the screw propeller were made on the following lines : ??? The velocity of water flowing past a propeller blade was resolved (1) normally and (2) tangentially to the blade ; further, the normal velocity was resolved into (a) longitudinal and (6) rotational velocity. A fundamental error underlying this double resolution

was that it did not correctly measure the forces involved, or take account of the effect of the obliquity of a plane moving at an angle to itself through the water. In Mr W. Froude's 1878 paper " on the elementary relation between pitch-slip and propulsive efiiciency" this error was corrected. On the authority of Lord Rayleigh's investigations, supported by experiment, it was shown that the normal pressure acting on the face of a plane relatively narrow in the line of motion depends upon the sine of the angle of inclination rather than on the square of the sine, as had been previously assumed. Starting mth this fact as a basis, and using figures for normal pressure and for surface friction obtained from his own experiments, Mr W. Froude con- structed mathematical expressions for the forces acting on a plane area moving obliquely through the water at a given speed. Treat- ing this plane area as an elementary portion of a propeller blade, and considering the forces in relation to resolved speeds, he obtained further expressions for (a) effective work done by the plane in the direction corresponding to the line of motion of the ship, and (6) total work required to be done in the circumferential direction to maintain the motion. The ratio of (a) to (6) in any case repre- sented the efficiency for that case. He was led to the following exclusions regarding maximum efficiency : ??? (1) The slip angle

(obliquity of surface to the line of its motion) ought always to have the same value (proportional to the square root of the coefficient of friction) ; and (2) when this is so, the pitch angle should be 45??. The maximum efficiency obtained from this investigation was 77 per cent. This theoretical investigation, though of importance and interest, does not exactly represent the actual conditions, inasmuch as the deductions from a small element are applied to the whole blade, and, further, the considerable disturbance of the water when a blade reaches it, owing to the passage of the preceding blade, is ignored.

The experiments on screw propellers which Mr W. Froude was carrying out in 1878 at the Torquay tank, and the nature of which he had in the previous year described in a paper read before the Insti- tution of Civil Kngineers, were after his death continued by Mr E. E. Froude, and some of the results were commXinicated to the I.N. A. in 1883, 1886, and 1892. A partial series on somewhat the same lines was also described by Mr

Thomyoroft to the I.N. A. in 1883. In the Torquay experiments four four-bladed propellers were used, with a uniform diameter of 0‘68 feet, and having relation of pitch to diameter, or piteh-ratio, of 1-225, 1‘4, 1”8, and 2-2 respectively. The pitch of each blade was uniform and the shape elliptical. The width in the middle of the developed blade was

*0 ‘4 X , so that the developed surface (making no deduc- tion for the area of boss) was 0*4 X disc area. In the experiments a uniform speed of 206 feet per minute was obtained through- out ; for the most part the propellers were tried in the open, no ship model being represented in connexion with them. In each case, while the speed of advance was uniform, the number of revolutions was varied throughout a sufficient range of experiments, the slip or slip-ratio was thus varied, by slip-ratio being meant*

1 Speed of advance m ii t j i 4.1 j. ___ ^

1 ___ .=-7^ ; ___ -. ___ ___ ilie thrust and also the turning couple

Pitch X revolutions

were ascertained in each experiment, the relation of work done by thrust to work of turning moment expressing the efficiency. In combining the results from the four propellers great assistance was derived from the discovery that the curves expressing the variation of efficiency with slip-ratio had a close similarity, one curve being practically producible from another by an alteration of the scale used for the abscissa of the curves, namely, the slip-ratio. Making the alteration in each case, a, diagram was obtained in which one efficiency curve did duty for all the propellers. The ordinates of this curve represented efficiencies, the abscissae represented slip- ratios, varying uniformly for any one propeller, but requiring a difi’erent scale of interpretation for each propeller in question accord- ing to its pitch-ratio. The data given by this diagi-am, although derived from propellers with four pitch-ratios only, were readily made applicable, by interpolation, to any other pitch ratios within the limits of those actually experimented upon. For practical application the next step needed was to make the results obtained from propellers of, one diameter,

moving at one speed of advance, available for any speed and any size. For this purpose the follow- ing assumptions were made, which," however, are well supported by experimental results : ??? (1) With given slip-ratio the thrust of a given screw varies as the square of the speed of advance. (2) With given slip-ratio and given speed of advance and given design of screw, with varying size, the thrust varies as the square of the dimensions. (3) With given slip-ratio and given design of screw the efficiency is unaffected by variations of speed or size of screw. The data from the small propellers were interpreted in accordance with the above by the introduction of the necessary multipliers and divisors into the scales of the diagram already refeixed to. This diagram is capable of very considerable modification, in accordance with the class of problem to the solution of which it is to be applied. Sup- pose it is desired to ascertain the best propeller for a certain speed of a given ship. Mr Froude assumes the efi'ective horse-power to be known. There are then still four variables to be dealt with, namely, the diameter, the pitch or pitch-ratio, the revolutions, and the efficiency. If the revolutions, as is usually the case, are practically fixed by the size of the engines available and the horse-power to be developed, one other unknown is supplied, and Mr Froude's working diagrams (see Trans. Inst. Nav. Arch., 1892) then give the means of expressing diameter in terms of efficiency and pitch-ratio, these last two variables being mutually involved. In ultimately deciding upon the diameter there is the question of space to be considered ; and also, in fixing the pitch-ratio, a less efficiency than the maximum has often to be accepted, in order to avoid adopting a pitch-ratio either larger or smaller than seems justified by actual experience.

The results so far described were obtained from four-bladed pro- pellers of the size already given. Some supplementary experiments were made upon other propellers having three blades and two blades. Other things being approximately the same, these gave thrusts diff'ering from the thrusts of the four-bladed propellers in the ratios 0-865 to 1-0 and 0-65 to 1-0 respectively. The data for four-bladed propellers can therefore, with some qualification, be used

for tlie others, providing the thrusts, and consequently horse-powers, are reduced in the above ratios. A propeller with wider or narrower blades than used in these experiments would also require some corresponding modification of the thrust or horse-power read- ings of the data.

As already mentioned, the results just dealt with were obtained from propellers having no ship model in connexion with them. The effect of the presence of a ship model upon the screw has, how- ever, received very careful attention, as has also the correlative effect of the screw upon the resistance of a. ship model behind which it is working. The former is the effect of tfie wake, whereby the speed of advance of the propeller through the water is less than the speed of the ship. The latter is an enhancement of resist- ance due to the suction caused by the propeller, so that the thrust required to propel the model is greater than tlie net resistance ; this difference is generally spoken of as " thrust deduction. " Mr Fronde in his curves assumes certain standard values for water and tlimst deduction ; the actual wake, expressed as a ratio of the speed of advance, is given by him for h, number of ships, and a method of correction is pointed out for cases where the wake is known to be other than the normal.

*The phenomenon of cavitation in connexion with the action of a propeller was encountered in a practical form in 1894. Experiments C it tl n "- *^ torpedo-boat destroyer Daring, made by Mr 'Barnaby in 1894, showed that in this vessel when the total thrust of the screw, divided by its projected blade area, amounted to UJ lb per square inch, a sudden change took place in the slip-curve, the slip being abnormally increased. The reason for the change was traced to the inability of the water at the back of the blade to follow the blade's motion, a partial rupture of the column of water occurring, and cavities forming in consequence. A thrust of 11 '2 R) means approximately 5 '6 lb push on the water leaving the screw-face and 5'6 R) drag on the water approaching the screw-back. The discrepancy between 15 lb and 5 '6 lb shows "that rupture occurs at parts*

of the screw surface long before the mean thrust per square inch of the whole surface reaches the amount due to the external

air-pressure.

Peocbss of Design".

When a shipbuilder is approached for the production of a new ship, he must be informed of the requirements of the case ; the kind of trade or service in which the vessel will be engaged ; her speed ; if she is to be a steam vessel, the distance she must run on ordinary voyages without re-coaling ; the weight of cargo to be taken, or the number of passengers to be carried, and the kind of accommoda- tion required for them. Very frequently these require- ments vsdll include certain limits of size, draught, cost, or tonnage, which must not be exceeded. In addition, it must be stated in what socfety, if any, she is to be classed, as this will determine the details of the scantlings to be employed. The shipbuilder will usually have, to guide him, the details of some successful ship or ships previously built to fulfil the same or similar conditions as in the vessel required, and he will probably know what measure of success or popularity the respective features of the vessel or vessels have earned on service. The dimensions can in this case be at once fixed to provide the necessary speed, strength, stability, and seaworthiness, and the cost of the vessel determined. If the departures from some similar ship of known and approved qualities are small, the details of the new ship can be inferred directly from those of the similar ship, and modified drawings, specifica-tions, ifec, can be rapidly prepared, and the building pro- ceeded with. On the other hand, the departures from previous vessels or the usual practice may be very great, in which case much will depend on the shipbuilder's skill and judgment. Considerable investigation and calculation may be required to ascertain how the desired qualities and conditions can be best provided for. Outline drawings are first prepared to the dimensions which may be considered suitable, and the calculations are made on this assumed design. These will include estimate of the weights of the hull, of the machinery,, equipment, &c.; and if it is not intended to class the vessel in some registration or classifi- cation society, questions of strength will have to be con-

sidered. If, however, the vessel is to be so classed, the determination of the structural strength may be omitted, as the scantlings required by the rules of such society are arranged to provide sufficient strength. If the calcula- tions show that the dimensions assumed do not enable the required conditions to be fulfilled, the dimensions must be modified in the direction indicated by the calculations, and the calculations made over again. This process must be continued until a satisfactory result is obtained. As soon as the dimensions obtained for the vessel are found to be appropriate, more complete drawings are put in hand, and the final calculations pertaining to the displace- ment sheet, weights of hull and equipment, centre of gravity and trim, metacentric diagram and curves of stability and speed, are made.

There are many variations in the division of the work of designing and building a ship. In building large passenger ships the design often originates with the owner's or steamship company's staff, and in some cases naval architects are employed, completed drawings and specifications being handed over to the shipbuilder with the order for the vessel. In other cases shipbuilders work in close connexion vrith the steamship companies, and the business relations are of a very simple character, the com- pany being content simply to send an order, with a note of the principal dimensions and type of- .ship required, leaving the determination of all details of the design in the hands of the builders. The general practice lies between these two extremes. In any case, complete design drawings and detailed specifications are necessary for the shipyard operations, and if not supplied must be prepared by the shipyard staff. Sometimes outline draw- ings of the vessel on a small scale ??? including an elevation or side view, one or two plans of the main deck and other parts, and a short description of the vessel ??? are first pre- pared, and are called an outline or sketch design; but usually the information which constitutes a design com- prises a sheer plan, profile and plans of each deck on a |-inch scale, a midship section on a ^-inch scale, and a complete specification.

The sheer drawing gives the outside form of the ship. It consists of an elevation showing her longitudinal con- tour ; the positions of the decks ; the water-line or line at which she will float, and certain other lines

parallel to this and equally spaced below it, which are also called water-lines ; a series of vertical lines equally spaced from stem to stern, called ” square stations ” ; and certain other details : of a lody plan showing the sectional form of the ship at the square stations, supposing her to be cut by transverse planes at these stations : and of a lialf-hreadth plan showing the form of the ship at the several water- lines, supposing her to be cut by horizontal planes at the levels of these Knes. The profile and plans give all the internal arrangements of the vessel, the holds or spaces set apart for cargo, the passenger accommodation, the positions of the engines and boilers, the accommodation provided for the crew, and other principal fittings. In a warship there are no cargo holds or passenger accommoda- tion, but the distribution of the armament and magazines, the armour, and other arrangements for the protection of the vessel against injury in action are carefully shown, and the appropriation of every portion of the internal capacity of the vessel is clearly indicated. The midship .tivtion shows the structural arrangements of the vessel, and usually the scantlings of the most important parts. The fj’^viiicat.ion is a statement of all the particulars of the vessel, including what is shovra on the drawings as well as what cannot be shown on them ; the quality of the materials to be used is described, and the scantlings of the same carefully recorded ; and it is clearly stated

desion]

SHIPBUILDING

589

how parta not manufactured by the shipbuilders are to be obtained.

As already intimated, the register societies, the object of which

is to class ships with regard to their strength, durability, and

general seaworthiness, mainly for purposes of insurance,

<?><?>e^ s- gjj. ^jjg quality and strength of the material used, the

‘; ??il scantlings of all the parts, and other details for ships*

built under their rules. But they also record all the

important features of the ships so classed, and thus provide moat

of the information which the shipbuilder requires for the design

and construction of ordinary vessels. In fact, the design for such

ships, if design it can be called, consists in choosing from a large

number of examples, differing very little from one another and all

known to be good seagoing vessels, the exact dimensions and type

of ship which the price named will admit of, and preparing

outline drawings of the internal arrangements accordingly.

The principal registration and classitication societies in operation in 1901, and the number of vessels (sailing and steam) classed at each, were as follows : ???

Lloyds Register of British and Foreign Ship- ping, having its headquarters in London . 9290 vessels. British Corporation for the Survey and Register

of Shipping, in Glasgow .... 477 ,, Bureau Veritas International Register of Ship- ping, at Paris 5122 ,,

Norske Veritas, at Christiania . . . . 2076 ,, Germanischer Lloyd, at Berlin . . . 1954 ,, Record of American and Foreign Shipping, at

New York 1530 ???

Registro Italiano 1116 ,,

Veritas Austro-Ungarico . . . . . 1107 ,, Of these societies, Lloyds Register, as at present constituted, has existed since 1834 ; at that date it superseded two rival institutions having a similar object. The name Lloyds is traced back to Lloyds' Coffee-house, once situated -iu Lombard Street, in which underwriters met for business purposes, and from which iu 1696 thoy issued their first publication. The first printed register was issued about 1726, a copy dated 1764 being still extant. The office of surveyors is referred to in a register book of the date 1781, but there are evidences that in 1768 repairs were superintended by officers of the society. In 1799 surveyors were stationed at twenty-four ports in the United Kingdom. In 1822 the register for the first time recorded a steamship. In 1824 appeared the first "Instructions to Surveyors "as to the carrying out the rules for classification ; and in 1834, on the establishment of the present society, precise regulations were issued regarding the survey of steamers. An iron ship was liuilt under survey and received a class in 1837, while the first rules for the construction of iron ships were issued in 1855. In 1851 a composite vessel was classed, but it was not until 1867 that rules for the construction of such vessels were issued. Steel was accepted in 1867, experimentally, steel being then made by the Bessemer process. Steel by the Siemens- Martin process was first used for two small steamers in 1877. Engineer surveyors were first appointed in 1874. The society is maintained by the shipping community ; its affairs are managed by a committee of fifty- eight memljers ??? merchants, shipowners, and underwriters ???elected to represent the important shipping centres of the country, and there are branch committees at Liverpool and Glasgow. The society has a staff of 170 ship and engineer surveyors in the United Kingdom, and 114 at the principal foreign ports.

In the case of ????? new vessel intended for classification, the plans for its construction are in the first place submitted to and approved by the committee ; the building proceeds under the supervision of the local surveyor, and when completed, a character is assigned to the vessel by the committee upon that surveyor's report. The society issues annually to its subscribers a register containing particulars of the classification of vessels to which characters have been assigned, together with many other details. AU other merchant vessels of the world, of 100 tons and upwards, except wood vessels on the Great Lakes of North America, are included in

the work. This register contains particulars of the age, build, tonnage, dimensions, and ownership of some 28,000 vessels.

The Bureau Veritas was founded in Antwerp in 1828, one of its principal aims being to make known to underwriters the qualities and defects of ships frequenting Dutch and Belgian ports. In 1832 the headquarters were moved to Paris, and in due time its influence spread to all countries where shipowning or shipbuilding existed ; it is now represented in over 200 districts comprising 1500 ports. In 1S51 rules were drawn up for the construction of wood ships, and about 1867 for iron. Rules for steel came later, and also rules for the construction of machinery. A staff of surveyors formed part of the organization from the beginning ; and in the earlier days the professional experience of the surveyors was the only guide as to what was necessary and sufficient. With the lapse of time, and with increased variety of construction and

complication of interests, something more than individual judg- ment and expeiience became necessary, and with the Bureau Veritas, as with Lloyds and other similar societies, definite rules were introduced, and by their means a greater uniformity of practice was attempted and secured.

The British Corjjoration was founded in 1890, and obtained its charter under the Merchant Shipping Acts for the assignment of freeboards ; its first rules were issued in 1893. Its inception was due to the enterprise and influence of a number of leading ehipownurs, shipbuilders, and engineers throughout the country, and more particularly in Glasgow and the West of Scotland, the first aim of the founders being to provide an independent society, thoroughly capable of dealing with the complicated questions which were likely to arise under the Load Line Act then coming into operation. The Liverpool Registry, which had once been independent, had been absorbed into Lloyds some years before, and it was felt that the enormous shipbuilding interests of the country demanded the existence of a society whose friendly rivalry with the great society of Lloyds would have a beneficial influence on the shipbuilding of the country.

The Norske Veritas was established in 1864 by the various marine insurance clubs of Norway. Previously each club had its own separate staff of surveyors, on whose report to their club depended the class of the”

vessel and the premium to be paid. As ships rose in value and reinsurance became the rule, something had to be done for mutual protection. By the establishment of the Norske Veritas one uniform system of classing and valuing was substituted for the older methods. In the matter of rules this society kept pace with the changes of the mercantile marine ; it provided, as the occasion required, for the introduction of iion and steel in place of wood, and of steam in place of sails.

The Germanischer Lloyd vi&s established in 1867, and reorganized as a joint-stock company in 1889. Its functions are carried out by officers at the central office in Berlin, assisted by a staff of 49 ship and engine surveyors in Germany and 138 at the principal foreign ports, the latter under control of agents, who are mostly consuls.

The Record of American and Foreign Shipping was established iu 1867 by the American Shipmasters' Association (now called the American Bureau of Shipping), and is the standard American authority. Its rules for the construction and classification of vessels, as published in 1889 and amended in 1900, received the approval of the U.S. Navy Department and of the several boards of American underwriters. It has agents and surveyors in all the principal ports of the world.

The present rules of the above societies apply in every case to construction in steel and iron, and in most cases to construction in wood also. The tables accompanying the rules for steel and iron are in some oases quite distinct ; in others they are so arranged that steel or iron scantlings may be read off the same tables, interpreted, when the material is steel, to give some 20 per cent, less sectional area than when it is iron. The Bureau Veritas and Germanischer Lloyd make a, further distinction of materials by discriminating between common iron and superior iron.

The highest class assigned, upon the completion of a ship by the societies referred to, is as follows : ???

Lloyds

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lOOA

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Bureau Veritas .

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3/3L

1 1

British Corporation .

B.S.:}:

M.B.S.;};

Norske Veritas .

Al

1

Germanischer Lloyd .

+

100

A.L.

Record of Amer. Shippi

ng +

Al

M.C.

k|□□ L.M.C.

M. & K.V.

The star or cross in each case denotes special survey. In Lloyds 100 A refers to conformity of scantlings with the tables ; the figure 1, to the efficient state of the equipment, including anchors and cables ; L.M.C. denotes Lloyds Machinery Certificate. In the Bureau Veritas the large 1 expresses first division of classification (out of three) ; the two rings around the 1 denote that the ship is divided into a sufficient number of water-tight compartments to enable her to float in still water with any two of them in free communication with the sea. Very few ships in the register have the double ring, but some have a single ring (T), denoting power to float in still water with any one compartment in free communication with the sea ; 3/3 expresses completeness and efficiency of hull and machinery; the first 1, that the wood portions of the hull are entirely satisfactory ; while the second 1 has the same significance in respect to the equipment of masts, spars, rigging, anchors, chains, and boats. In the British Corporation Register, B.S. sitmifies conformity with all requirements, these letters standing for British Standard ; M.B.S. signifies that the machinery also conforms. In the Norske Veritas, Al refers to quality and scantlings, mode of construction, and state of preservation ; the second 1, to thickness of shell-plating ; M. & K.V., to efficiency of engines and boilers.

[design

The tests for steel material to be used in building the ships, as rec^uired by the same societies, may be tabulated as follows : □□□

Ultimate Tensile Strength.

Elongation on Length of 8 Inches

Temper Test.

Lloyds

Bureau Veritas . Brit. Corporation , Norske Veritas .

Germanischer

Lloyd Record of Amer.,

&c., Shipping-

Bet. 28 and 32 tons

per sq. in. Bet. 27 and 32 tons

per sq. in. Bet. 28 and 32 tons

per sq. in. Bet. 28 and 32 tons

per sq. in. Bet. 26 and 31 tons

per sq. in. Bet. 58,000 and 68,000 lb per sq. in.

Not less than 20 per cent.

Sample heated to a low cherry red and cooled in water at 82 F.

None required. Same as ahove.

Board ot Trade super- vision.

For thin plates 16 per cent, elongation is allowed ; for garboard strake plates Lloyds minimum strength is 26 tons, British Cor- poration 25 tons ; for frames and beams (either angles or bulbs), strength may be as high as 33 tons. For livet steel the British Corporation require a tensile strength between 25 and 30 tons per square inch, with elongation of 20 per cent, on a length of 8 inches. In view of the two Tarieties of iron accepted by the Bureau Veritas, the superior quality has also to be subjected to tests ;

the tensile strength of most parts must not be less than 22 tons per square inch with the fibre and 1 8^ tons across, the elongation on 8 inches, 7 per cent, mth the fibre and i across ; hot and cold bending and forge tests for angle bars are also prescribed.

The regulation of certain matters connected with the design of merchant ships falls upon the Marine Department of the Board of Trade. The authority of the Board is the Merchant Shipping Act of 1894, which consolidated previous enactments. These matters include the measurement of tonnage, and provision for the safety and comfort of passengers and crew. The former is discussed in a separate article (see Tonnage), but it may be mentioned here that the following countries have at various dates accepted the British rules for tonnage : United States, Denmark, Austria-Hungary, Germany, France, Italy, Spain, Sweden, Netherlands, Norway, Greece, Russia, Finland, Hayti, Belgium, and Japan. The amount of deduction for propelling power varies in Spain, Sweden, Nether- lands, Greece, Russia, and Belgium, but option is granted to owners to have the engine-room remeasured under the rules of allowance for engine-room relating to British ships. Special certi- ficates are at present also issued, on application, to vessels trading to Italian ports, as the Itiilian authorities do not at present recog- nize certain sections of the Act of 1894 in regard to deductions from tonnage and exemptions from measurement. Special tonnage certificates are al^o issued for the Suez Canal, where the measure- ments of ships and deductions from tonnage vary from British rules, and are detailed at length by the Board of Trade in their Instructions to Surveyors.

With regard to safety and comfort, the surveyors have to see, among other matters, that the crews are properly accommodated, and the passengers not too crowded ; that the boats and life-saving appliances are sufficient ; that the lights and signals are in order ; that the freeboard is sufficient and ship otherwise seaworthy ; that grain cargoes are properly stowed ; and that coal cargoes are ade- quately ventilated. Any question of doubt as to the strength of passenger vessels has to be referred to the Board of Trade, and in future midship sections, with all particulars marked thereon, are to be submitted in the case of all new steamships building under survey for which passenger certificates are required. A passenger

certificate is required whenever a steamer carries more than twelve passengers. In granting it, the Board of Trade recognizes five ditferent services, ranging from foreign-going steamers to excursion steamers in smooth water. The Board of Trade rules for scantlings are not published officially.

A Bill, intioduced into Parliament in 1869, dealing with the load line question, contained a clause requiring the draught of water to be recorded at which a vessel is floating when leaving port. This Bill did not pass; but in the following year the Jlerchant Shipping Code Bill was brought in, containing the same pro- vision, and, in addition, requiring a scale showing the draught of water to be marked on stem and stem post of every British ship. This became law in 1871. The same Act empowered the Board of Trade to record the draught of water of all sea-going ships on leaving port by surveyors duly authorized. In March 1873 a Royal Commission on "Un- seaworthy Ships " was ajjpointed by the British Government, and one of the questions considered was that of Ihe load line. In the final report in 1874 the conclusion was arrived at that a settlement of a load line should, in the main, be guided by reserve buoyancy as a first consideration. The Commissioners were, however, of opinion that an Act of Parliament, framed to enforce any scale of

Load line and tree- board.

freeboard, would be mischievous, if not impossible, as would be any universal rule for the safe loading of merchant ships.

In 1874, in a paper read before the Institution of Naval Archi- tects by Mr B. Martell, tables of freeboard were suggested from data collected at all the principal ports in the United Kingdom. These tables were based on the piinciple of reserve buoyancy, and were intended to apply to the loading of the various types of sea- going ships then to be dealt with. As an indication of the form of the vessel, it was suggested that a tonnage coefficient of fineness should be used, in order that the tables proposed might be readily adapted to all sea-going ships, whether at that time at sea or in port. In 1876 a short Act was passed, to remain in force only until October of the following year, which embodied as its chief feature the requirement of what was afterwards universally known as the " Plimsoll

mark " (after the late Mr S. PlimsoU, M.P., the prime mover in securing legislation for the prevention of overload- ing in British ships). All British ships were to have the position of the deck shown on the side of the ship, and every foreign-going British ship was to have a circular disc marked below the deck line, indicating the maximum draught to which it was intended to load. The Act in no way fixed the amount of freeboard ; this was left to the shipowner. The provisions of the 1875 Act were con- firmed by a more comprehensive Act in 1876, which extended the compulsory marking of the deck line and disc to all British ships, except those under 80 tons engaged in fishing and the coasting trades, also excepting yachts or war vessels. Before this Act was passed, the Board of Trade took action, by appointing a committee to consider the possibility of framing rules for the regulation of freeboard. The committee was to be composed of representatives of the Board of Trade, Lloyds, and the Liverpool Underwriters' Registry. This attempt to establish an authorized scale of free- board failed. Meanwhile the subject was not lost sight of; the collection of data was continued, investigations were carried out, and six years later (in 1882) the committee of Lloyds Register issued freeboard tables, and undertook to assign freeboard, on the basis of the tables issued, on owners making application for the same. In the course of three years 944 vessels had freeboards thus assigned to them, and in the case of 775 of this number the owners voluntarily accepted the freeboards assigned. In December 1883 the Load Line Committee was appointed by the Board of Trade ; and after two years' careful deliberation and investigation, involv- ing much labour, the committee presented its report. This report was accompanied by tables, which agreed closely with those pre- viously issued by Lloyds ; and they were accepted by the com- mittee of that society in September 1885. Between 1885 and June 1890 (the latter being the date the Load Line Act was passed) 2850 steam and sailing vessels had freeboards fixed by Lloyds, and of these 2520 were taken from the tables. After the passing of the Act in 1890 appointments to assign freeboards were granted to Lloyds, Bureau Veritas, and the British Corporation.

In 1893 the original tables were modified with respect to some of the ports in the United States on the Atlantic, the sailing from or to which in the winter was to subject the ship to a few inches additional freeboard. In

1898 they were further modified (a) to exempt ships over 330 feet in length from the additional freeboard just mentioned, and to limit the additional freeboard in smaller ships ; {h) to give some concession to turret-deck steamers ; and (c) in some other minor matters.

Ships laden with grain have to comply with rules of the Board of Trade, which provide that for single-decked ships there shall either be provision for feeding the hold, or there , j, shall not be more than three-quarters of the hold occu- "^ " j pied by grain in bulk, the remaining one-fourth being fJ^^Lf" occupied by grain or other suitable cargo in bags, bales, or barrels, supported on platforms laid on the grain in bulk. For ships with two decks, grain in bulk in the 'tween decks is for the most part prohibited ; but certain grains are allowed, provided there are separate feeders for hold and 'tween decks, or else suffi- ciently large feeders to the 'tween decks, and the hatches and other openings there made available for feeding the holds. In ships with two decks, longitudinal grain-tight shifting-boards must be fitted where grain is carried eitlier in bags or bulk ; these shifting- boards must extend from beam to deck and from beam to keelson, and in the case of bulk grain must also be fitted between the beams and carried up to the very top of the space. The regulations also impose a fine not exceeding five pounds for every hundred cubic feet of wood canied as deck cargo which arrives in a ship, British or foreign, in any port of the United Kingdom between the 31st October and 16th April, provided no tmforeseen circumstances, as defined by the Act, intervene. By deck cargo in this section is meant any deals, battens, or other wood goods of any description to a height exceeding 3 feet above the deck.*

In 1890 a committee was appointed by the Board of Trade to deal with the spacing and strength of transverse water-tight bulk- heads, and to make recommendations. The first matter submitted to this committee related to subdivision which should enable a ship to float in moderate weather with any two compartments in free con-

nexion with the sea. The committee, while recommending the above as a standard for sea-going ships of not less than 425 feet in length, Transver e ^^'^ " cross-Channel steamers irrespective of length, water-tight igg^ted less stringent conditions for sea-going ships bulkheads. ►►' shorter length. There was no suggestion of en- forcing such subdivision by law ; but as U reward for complying, some concession was to be allowed, under the Life Saving Appliances Act of 1888, as to the boats or life-rafts to be carried. On the presentation of the report the matter was however, allowed to drop, and the rules of Lloyds and the other classification societies are therefore the only rules with practical influence. The subdivision required by Lloyds for all steamers comprises a bulkhead at each end of the machinery spaces, and a bulkhead at a reasonable distance from each end of the ship, making four in all. In addition, for larger steamers other bulk- heads have to be fitted, making the total as follows, namely : ►►► Length of steamer, 280 feet to 330 feet . . 5 bulkheads. ►► ,, 330 ,, 400 ►►► . .6

400 ,, 470 ►►► . .7 ►►► 470 ►►► 540 ►►► . .8 540 ►►► 600 ►►► . .9 The positions of these additional bulkheads, and the height to which they are to be carried, are clearly stated, and rules are given for their scantlings. These scantlings are suitable for purposes of safety in the event of accident ; but it is understood that they have to be considerably increased when the bulkhead is also used to withstand frequently the pressure of oil or of water ballast ; a deflection of the plating which would do no harm in an emergency once encountered, would certainly become serious if often repeated in the ordinary service of the ship. The foremost bulkhead of the ship receives the name of collision bulkhead, or sometimes fon- peak bulkhead ; the aftermost, the after-peak bulkhead. In sailing ships the collision bulkhead alone requires to be fitted.

Practical.

Practical shipbuilding requires a knowledge of the properties of the materials used in the construction of ships, and of the processes by which they are produced or prepared for use, so that they may be suitably selected for the services for which they are intended ; also a knowledge of

the methods, means, and machinery by which, after delivery in the shipyard, the materials are brought to the requisite shape, erected in their proper relative positions, connected together, and completed so as to form a structure which shall fulfil the intentions of the design, whether large or small, merchant ship or warship. The varieties of ships are very great, and are constantly changing, and thus new problems continually present themselves to the shipbuilder. There is also an ever-increasing demand for rapid produc- tion, which necessitates a rigorous and constant search for simplification of methods of work, for labour-saving and time-saving machinery, for improved means of handling material in the shipyard, and for workshops and factories which will more completely prepare and finish their various products before despatch to the shipyard.

Whatever the size of the ship or the type to which she belongs, the general principles of construction remain very much the same in all cases. The following account appUes to steel and iron shipbuilding ; for particulars of wood and composite construction the reader is referred to the ninth and previous editions of this Encyclopaedia. The exterior parts ??? the bottom, sides, and decks ??? supply the strength required for the structure as a whole. The bottom and sides are spoken of as the shell or outside plating, and are, with the decks, kept to the proper shape by means of frames running across the ship, like the rafters in a roof or the ribs in the body. These are called transverse ^”’’*’’’’’’ frames or ribs, and beams where they run under ’” *’ the decks. The parts of the frames at the bottom of the ship, where they are made deep and strong to support her when she is docked or grounded, are known as floors, while the spaces between these floors are spoken of as the bilges. The transverse frames and floors are held upright in their proper relative positions by other frames which run lengthwise in the ship ; one at the middle line being called the centre keelson, and others fitted at the sides,*

keelsons, bilge keelsons, and side stringers. All the fore-and- aft frames, taken together, are spoken of as the longitudinal framing. Where tanks for carrying water ballast are built into the bottom of the ship, the centre keelson is called the centre girder, and the keelsons or bilge keelsons, the side girders. In large merchant vessels, and in all war vessels, except the smallest classes, an inner bottom is provided for in- creasing the security

against injury by grounding, and against ramming and torpedo attack in war vessels, in addition to forming tanks for carrying water, either as ballast or for use in the ship. In such cases the centre keelson is called the vertical keel, and the keelsons and girders are called longi^ tudinxils. When the deep vertical transverse plates form- ing the floors only extend between the keelsons, girders or longitudinals, and are attached to them by angle bars, the floors are called intercostal floors, and the keelsons, girders, and longitudinals are said to be continuous; on the other hand, when the keelsons, girders, or longitudinals extend only between the frames and floors, they are called intercostal keelsons, girders, and longitudinals, and the frames and floors are said to be contiguous. In large merchant vessels and war vessels, except the smallest classes, much of the longitudinal framing is continuous ; and the transverse framing, for the most part, is built up of angle bars upon the outer bottom and under the inner bottom, with short plates, called bracket plates, between them, attached to the longitudinals by short angle bars. Frames built up in this way are called bracket frames. In small vessels the transverse frames are usually continuous.

*Besides the transverse and longitudinal framing, there are partitions used for dividing up the internal spaces of the ship, which are called bulkheads ; they are partial, com- plete, water-tight or non-water-tight, as the circumstances of the case require. In warships the transverse bulkheads are so numerous, in order to restrict as much as possible the entrance of water from damage in action, that they go a long way towards providing the necessary transverse strength, and the transverse frames are consequently made of thinner materials and fitted at greater distances apart than they otherwise would be. Transverse frames are from 36 to 48 inches apart in large warships, and from 24 to 27 inches in large merchant ships. At the extreme ends of the ship the shell plating on the two sides is attached to forg- ings or castings, which are known as the stem at the fore end, and the stern frame or sternpost at the after end. The stem of a warship is generally made very massive, and pro- * jects under the water so as to form the ram.*

The longitudinal framing is carried right forward and aft when possible, and the ends of the several frames are connected together across the ship

by strong plates and angles, which are called knees or breasthooks, forward ; and knees or crutches, aft. Additional supports, introduced to enable the vessel to vnthstand the heavy blows of the sea in bad weather, are called panting stringers, panting knees, and panting beams, panting being the term applied to the movements which occur in the side plating if sufiicient strength is not provided. Where the ends of the ship are very full, or bluff, the frames are sometimes inclined, or canted out of the transverse plane, so as to be more nearly at right angles to the plating ; such are known as cant frames. At the stern a transverse frame, called a transom, is in some cases attached to the upper part of the sternpost to form a base for cant frames of the overhanging part of the stem which is known as the counter. To assist the beams and bulkheads in holding the decks in their proper positions, vertical pillars are introduced in large numbers ; but to avoid the loss of space and inconvenience in handling cargo, ordinary pillars are often dispensed with, and special pillars and deep deck girders or carlings fitted instead.

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The steel generally used in shipbuilding is known as mild steel. It is very tough and ductile, and differs from the hard steel, out of Material ''"i□□^ tools are made, in that it will not take a temper, i.e., if heated and plunged into oil or water, the sudden cooling has very little effect upon it, whereas with tool steels a great change takes place, the steel becoming very hard, and usually brittle. This quality of tempering depends chiefly on the amount of carbon in the steel, mild steel containing less than '25 per cent. Steel of greater strength than mild steel is used occasionally in certain parts of warships. The extra strength is obtained generally by the addition of carbon, nickel, or chromium, coupled with special treatment. The quality of the plates and bars used is tested by cutting off strips about 2 inches wide, and bending them double by hammering, or in a press, until the bend is a semicircle whose diameter is three times the thickness of the strip. The strips are sometimes heated and plunged into water to cool them suddenly before bending, and they*

may be cut from either side or the end of the plate. Strips are taken occasionally and ham- mered into various other shapes while hot and while cold, so as to ascertain the general quality of the material. To ensure its tenacity, strips are taken and machined to give a parallel part 2 inches in width, of at least 8 inches in length. Two centre-punch marks are made 8 inches apart, and the strip is secured in a testing- ijiachine constructed so that the ends can be gripped by strong jaws which do not injure the parallel part. The jaws are then gradually pulled apart, the amount of the pull required to break the strip being registered, and also the extent to whieh the strip stretches in the length of 8 inches before breaking. The tensile strength varies between 26 and 32 tons per square inch, calculated on the original sectional area of the parallel part before breaking, and the elongation in the 8 inches is about 20 per cent. The standard strength and elongation required by the principal registration societies have already been given. The steel used for making rivets is similarly tested ; and samples of the finished rivets are also taken, and hammered into various shapes, hot and cold, to

ensure that the metal is soft and ductile and suitable for the work.

The stem, stern-frame, &c. , are frequently made of forged iron ; but if of steel, they are cast to the form required. These castings are tested by being let fall on hard ground and then slung in chains and hammered all over, when faults of casting are generally discovered by variations in the sounds produced. By this hammer- ing the general soundness of the casting is ensured. To test the quality of the steel in the casting, small pieces, whieh are cast on for the purpose, are removed and tested in the same manner as just described for the strips out off from the plates ; they are required to give about the same tensile strength, but a little Itss ductility, say 10 per cent, instead of 20 per cent, elongation in 8 inches.

The sections of the iron and steel bars in common use are shown in Kg. 11, and are named as follows : ???

A. Angle bar. E. I bar. j. Half-round

B. T (Tee) bar. F. Plain bulb bar. moulding. 0. Channel bar. G and H. Angle bulb. K. Hollow D. Z (Zed) bar. i. T bulb bar. moulding.

The vertical, or central, portion in tlie I, T, and bulb sections is spoken of as the wei, and varies from about 3 inches to 9 inches in depth ; the horizontal parts are called flanges ; in an angle bar, both parts of the section are called flanges. The flanges vary in width from about 2 inches to 7 inches in the angle bar, and from 3 inches to 6 inches in the others. The thickness varies from about J inch to f inch. These dimensions taken together are called the scantlings of such material. The thicknesses of the plates in common use generally lie between J inch and 1 inch. Thicker or thinner plates are obtainable, but are not often used for merchant ships. These plates are of varying sizes as required, the tendency being to use very large plates where possible, and widths of 4 feet to 6 feet are used in lengths of from 40 to 20 feet. Angle bars are used in lengths of from 20 to 80 feet as required, or as may be limited by the means of transport between the steel works and the shipyard.

Fio. 11.

The various plates and bars are connected together by means of rivets of various forms. Specimens of the common kinds are

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Fia. 12.

shown in Fig. 12. as follows : ???

The heads and points have distinctive names,

(a) Countersunk head, chipped flush, (e) Ordinary countersunk head, (o) Snap head.

(d) Snap head with conical or swelled neck.

(e) Pan head with conical or swelled neck.

(f) Pan head.

(0) Countersunk point.

(n) Eough hammered point.

(1) Snap point, hand work, (j) Snap point, machine work.

The pan head rivet (e) with conical or swelled neck is the most commonly used, as it is convenient to handle and gives good sound work. The rough hammered point (h) is also very commonly used, is very effective, and is readily worked. The pan head (p) and snap head (o), without cones under the heads, are only used for small rivets ; the heads (a), (b), (o), (d), are used where con- sidered desirable for appearance sake, hut (c) and (d) are also adopted when the riveting is done by hydraulic machinery. The countersunk point (g) is used on the outside of the shell, and in other places where flush work is required. The snap head (j) is used when the work is riveted up by hydraulic machinery, and

the snap point (l) for internal hand riveting where desired for appearance, instead of the rough hammered point. The rivets vary in diameter from about | inch to 1 J inch, and the lengths are as re- quired to go through the holes and give enough material properly to form the points. The diameter of the rivet is settled according to the thickness of the plates to be connected, being generally about ^ inch more than the thickness of the separate plates. The dis- tance from centre to centre of the rivets is spoken of as the spacing, and is generally expressed in diameters. For connecting plates and bars in the framing, the spacing of the rivets runs generally to 7 diameters ; for securing edges which must be water-tight, the spacing is from 4J to 6 and, if they are to be oil-tight, 3 to 3J diameters. In butts and edges of shell-plating the spacing varies from 2i to 4J diameters.

In some positions rivets like the above cannot be driven into place and properly hammered up ; resort is then made to rivets which have screwed points, called tap rivets, shaped as shown in Fig. 13. That shown at (b) is used where it is necessary to make

Fig. 13.

the surface flush, but not necessary to remove the rivet for ex- amination of plating ; and when hove right up, the square head is chipped off and the surface hammered smooth. In other positions patterns (a) or (c) are used as may be most suitable.

The machines used in the shipyard have been much improved of recent years. The one most used is the punching and shearing machine, on one side of which plates of all thicknesses up to

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2 inches may be cut or sheared to any desired form, while on the other side rivet holes may be punched of any required size. Machine P^^^ shears are provided with V-shaped cutters for tools shearing angle bars, but in some cases the cutters of

ordinary shears may be replaced by V-shaped cutters for this purpose. When the plates and bars leave the shearing and punching machine their edges are rough and slightly distorted, to remove which it is necessary to plane them. This is usually done by special machines provided lor the purpose. In the most modern types the cutters are duplicated and tlie machine arranged to cut both ways. When it is required to cut a square edge on the flange of an angle bar, which is often done by hand-chipping, a pneu- matic chipping machine of recent introduction is frequently used. In shipbuilding a great deal of drilling must be done by hand, but, where it is possible, drilling machines are employed. The most modern forms can drill a number of holes at the same time. For countersunk work it is necessary to make the hole funnel shaped, as will be seen from Fig. 13. This shape is rapidly given to the holes already punched or drilled by means of a special drilling machine, which can be very easily and rapidly manipu- lated. The use of portable drills, to avoid hand labour, is rapidly increasing, and several types are in use, operated by electric motors,

compressed air, or flexible shafting. They are carried to any position required. The hole made by a drill is cylindrical, but that made in the process of punching is conical. On one side of the plate its diameter is determined by the diameter of the punch, and on the other by the diameter of the die, which must be greater than that of the punch. This taper tends to pro- duce close and sound riveting, as the joint is closed both by the knocking down of the rivet and by the contraction of the rivet on cooling. On the other hand, the operation of punching injures the steel in the neighbourhood of the hole, and for work subjected to great stress this deteriorated material must be removed by counter- sinking, or by drilling the hole to a larger size, or the quality of the material must be restored, or partially restored, by annealing. The process of annealing consists in heating the steel to a good red, then allowing it to cool very slowly ; during this process parts of the material which have been unduly distressed in working regain their strength by molecnlar rearrangements in the dis- tressed parts. This process occurs to some extent when hot rivets are introduced into tlje holes and hammered up. The steel im- mediately adjacent to the rivet is heated, and afterwards cools gradually as the heat becomes distributed into the body of the plate. In some experiments carried out by the Admiralty in IPembroke Dockyard in 1884, it was found that the efi'ect of punch- ing holes close together, as for a butt-strap, was to diminish the tensile strength of the plates about 20 per cent. ; that hot riveting restored about half of this ; and that when holes were drilled and countersunk right through, also when holes were punched f inch and countersunk right through, so as to enlarge hole to J inch in diameter, there was no loss.

In addition to the machines mentioned above, many special appliances have recently been introduced into shipyards for the purpose of economically carrying out definite operations rendered possible by the use of mild steel. Ships built with a bar keel require the garboard strake plates on each side to be flanged on one edge, so as to fit against the bar keel. This flanging was formerly carried out by heating the plates and treating them hot, but now a very powerful machine, called a keel-plate bending machine, and usually worked by hydraulic power, is employed for the purpose with the plate cold. Flanging plates cold has also become general for a variety of purposes. In a bulkhead, stiffening is necessary, and for

this purpose angle bars were commonly used ; the horizontal stiffeners are now frequently formed by flanging the lower edges of the plates. Instead of fitting an angle bar to connect two plates at right angles to one another, the edge or end of one may be flanged, and half the weight of the angle bar and the rivet work saved. For all such work somewhat lighter flanging machines than the keel-plate bending machine are used ; they are generally worked by hydraulic power, but there is no difficulty in driving them by any other means.

Another modern appliance is the scarfing machine, which is used chiefly in connexion with the lapped butts of shell and other plating. Before its introduction it was usual to bring the ends of the plates together and cover the joint with a short plate called a butt-strap, secured to both plates with a proper arrangement of rivets (see Fig. 14). It is now more usual in merchant ships to work overlap butts, some half of the weight of the butt-strap and riveting and other work being saved thereby, although the appear- ance may not be quite so sightly. The difficulty with this system is that the passing plates on each side have their edges lapped over the ends of the lap-butt, and in order that they may be brought close some machining is necessary; this is called scarfing, i.e., slotting away the corner of the projecting butt so as to produce smooth surfaces for the side laps (see section at A B, Fig. 14). The machine used for this operation is a slotting machine with two heads, so as to slot both edges of the plate at the same time ;

it is provided with a table which can be adjusted to the necessary bevel, so that the slotting tools may reduce the thickness of the edges operated on in a gradual taper to a knife-edge. A more recent appliance for reducing weight is the joggling machine. As already described, the usual method of working the shell-plating is by alternate inside and outside strakes of plating, the outside plates overlapping the inside plates, and the space between them and the frames being tilled in by slips or liners. These liners throughout the ship amount to a considerable weight, and the object of the joggling is to do away with the necessity for them. This is effected by shaping the outside plates as shown in section b, Fig. 15. Sometimes the frames are joggled instead of the plates, as shown in section c. Fig. 15 ; the inside plate lies in the recessed portion of the frame formed by the

joggling process, and the outside plate on the unreoessed portion, its edge lapping over the edge of the inside plate the usual width. The angle bar in this case must be heated, and the hydraulic press is placed so as to be readily accessible for the handling of the part to be heated. The system of joggling the frames has not been adopted to nearly so large an extent as that of joggling the plates.

Frame-bevelling machines appear to be growing in favour. The machine is placed on rails, near to and across the mouth of the frame furnace, so that it can be readily placed in position for the frame bar to be drawn out of the furnace directly through it, and moved to one side when not required. In the machine a series of rollers, which can be inclined to suit the varying bevel required, operate on the bar. The inclination of the roller is varied as the bar passes along, a dial and pointer giving the angle of bevel at each instant. As the bar passes through, the workman, with his eye on the dial, manipulates the machine so as to give it the required bevel. It is afterwards completed on the slabs, the form being taken from the scrive-board in the usual way.

The shipyard should be supplied with modern machinery of the most approved type, in order to produce the best work at economical rates : rolls for straightening and bending plates, for fairing and bending beams and angle bars ; shaping and slotting machines ; lathes and milling machines ; heavy planing machines. It should also have a blacksmith's shop, saw-mills, joiner's shops, &c., all fully equipped for completing, as far as possible, the work of the yard. The workshops and machines should be distributed so that, as far as possible, the material moves steadily along, as the various operations are performed upon it, to its place in the ship. Pneu- matic tools are often preferred for light work, such as chipping, drilling, rimering, and caulking ; they are also occasionally used for riveting, but they are not yet much in favour for this class of work. Hydraulic power is particularly well adapted for heavy presses, such as for keel-plate flanging, for punching and shearing, and especially for punching manholes and lightening holes in plates, and for heavy riveting. It is also very successfully applied for pressing to shape a great variety of small fittings made of steel or iron. For such machines as rolls, ordinary shears and punches, winches, &c., separate steam engines are

stUl frequently fitted, but there is a very marked tendency to replace all these by electric motors. Electric power for driving all the machinery has been introduced into many shipyards. It has many advantages : all the power required in the yard may be generated in one building in any position, containing the boilers, steam engines, and electric genei-ators, and the whole may be designed and worked so as to secure great economy. The current is supplied either to motors directly driving the heavier or outlying machines, or to motors driving a line of shafting where the machines are of a lighter character and are arranged in compact groups. Fixed machines can be placed where most convenient for the work, without any reference to the position of the boilers or other machinery, and a large number of machines can be very readily made portable for the lighter classes of work. The power may be transmitted with but little loss, whereas with steam-driven machines at a distance from the boilers, lines of steam piping must be introduced, and loss of power is entailed. The saving which the system of electric driving effects over that of steam driving in the consumption of coal in a large shipyard is considerable, and is claimed by those who have adopted it to be sufficient to justify the large capital expenditure required to convert a shipyard from the latter system to the former.

As the plates, beams, angle bars, Z bars, &c., are delivered, they must be stored in convenient racks, with marks showing for what purpose they are intended, so that they can be readily identified and removed without loss of time. When required, they are taken from the racks, and the edges, butts, and rivet holes carefully marked upon them before they are taken to the machines where the shearing, punching, drilling, shaping, &c., are carried out, after which they are taken to their proper position in the ship.

In many shipyards great attention has been given to the ques- tions of the economical handling of the material, and very costly and novel appliances are to be found in these yards for the pur- pose. As an example mention may be made of the overhead cranes fitted at the Union Ironworks of San Francisco. A framework of

Enlarged Section through C D.

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Enlarged Section through A B, shewing scarfed corner of Plate 1*1.

Fig. 14.□□□ Details of ahell-plating.

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wood is built up over the entire building berth, the structure being well braced in all directions for carrying two travelling girder cranes. There are four Building berths fitted in this manner, and the latest has a length of 408 feet, a clear breadth of 80 feet, and clear height of 72 feet. A swing crane nf 50 feet spread at each end of the erection in- creases its effective length to 500 feet. Each Cranes □□^ *^^ travelling girders carries a trolley, with motion transverse to the ship ; five tons can be so lifted, and parts of the ship's stmcture not exceeding this weight can be taken from the ground any- where in the neighbourhood of the structure and conveyed to any desired spot in the ship. The driving powpr is electric. The longi- tudinal travel of the girders is 180 feet per minute ; the transverse travel of the trolley and speed of lift, each 90 feet per minute. A manila rope is used for hoisting, except for plates under the bottom and counter, where a wire rope is used.

At Newport News, in Virginia, the struc- tures are differently arranged, being on the cantilever travelling-crane principle. There are five such struc- tures in the yard ; three of them are wood, the last two of steel. The largest is 700 feet long. One trestle structure, or gantry,

serves two building berths, and runs longitudinally between the two. On the gantry is mounted a double cantilever crane,

Section shewing Ordinary Type of Plating.

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Section shewing joggled Plating. -fnoLtii

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Section shewing joggled Frames.

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Fig. 16.►►► Methods of working shell-plating.

having an effective reach of 95 feet on each side of the centre ; this outreach is sufficient for a ship 70 feet broad on each side of the trestle. The height of the cantilever above the ground is some

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90 feet, the load that can be raised is 15 tons, and if necessary a bulkhead up to that weight can be lifted bodily into place. The speed of lift for this weight is 100 feet per minute, and for lighter loads 700 feet per minute. The speed of the trolley along the canti- lever is 400 to 800 feet per

minute, and of the whole crane longi- tudinally is 400 to 700 feet per minute. AU movements are made by electric power. Similar gantries and arrangements are used in other American shipyards. The view shown in Fig. 16 (Plate I.) represents one of tuese structures as fitted in Messrs Cramp's sliipyard in Philadelphia.

At the yard of Messrs C. S. Swan and Hunter, on the Tyne, similar structures have been erected since 1894 : besides carrying cranes, these have standards and stiffening girders, from which ships under construction are shored for fairing. Roofs and sides are fitted to protect the ship, and the workmen engaged in building her, from the weather. The side supports are three in number, and serve for two berths ; they are formed of steel lattice-work, with standards mostly 20 feet apart. The clear height of roof is 83 feet, and clear breadth of berths 68 feet and 73 feet ; a roadway on the ground level is left free on each side of the berths inside the standards. Two revolving 3-ton electric cranes travel along paths suspended from each roof ; their jibs have sufiicient radius to lift material from the roadways and deposit it at the centre of the ships building. The longitudinal speed of these cranes is 300 feet per minute ; speed of lift, 100 feet per minute. A third berth is served by a travelling cantilever crane on top of the adjoining roof. At Messrs Harland and Wolff's yard at Belfast another modi- fication was introduced in 1897 (see Fig. 17, Plate I.). In this case the structure takes the form of a travelling gantry or bridge over the building berth, the legs running on rails at the ground level. The gantry, which is driven by hydraulic power, has three travers- ing cranes and four 4-ton swing cranes. It was designed to facilitate the lifting of plates and portions of the structure into position, and also to support the hydraulic riveting machines and other appliances for the carrying out of the work. The success of the appliances, first used in the Oceanic, has led to a further exten- sion for other ships in hand.

The first steps taken in the construction of a vessel, after the receipt of the design, drawings, and specifications,

are with the view of obtaining the necessary Course particulars for ordering the material, making the stnct'ioa. moulds, and supplying other information for

shaping the various parts of the framing. A half-block model is prepared of the exterior of the vessel, on a quarter-inch or other convenient scale. On this the positions of the frames, deck edges, the edges of the shell plating, and other details are carefully drawn in, and then the butts of all the keel and shell plating are arranged, the sizes of the plates are measured, some allowance is made for cutting to shape, and the plates and many portions of the framing are at once ordered. Another block model is generally made showing the form of the top of the ballast tanks, or in warships the shape of the inner bottom. In the case of a warship a block model will also be made of the protective deck, the plates arranged thereon, and ordered by measurements so obtained.

While the material is being ordered, the laying off the vessel, which consists of enlarging the sheer drawings to full size on the floor of the mould loft, and deducing from it the shapes of the various parts of the framing, is proceeded with. The mould loft is a large room floored with stout boards, planed smooth and carefully painted so as to produce a good hard surface ; this is used as a large drawing-board, and on it nearly all parts of the vessel are drawn to full size before the work proceeds. The sheer drawing is transferred to the floor by measuring the ordinates or offsets from the |-inch or ^-inch scale, draw- ing and setting them off full size in their proper relative positions. Battens are bent to the curves passing through the spots thus obtained, and the lines are drawn and rased or scratched in, after being faired. The process of fairing is performed by laying off a series of vertical, horizontal, and oblique sections of the outside surface of the ship. These are modified as necessary to give fair curves, and the ordinates are adjusted accordingly. As

soon as the form is faired, moulds or templates are made, to enable the patterns of the stem, stern frame, and shaft brackets (if for a twin-screw vessel) to be completed by the pattern-makers, which, to prevent delay in launching, must be completed and sent to the steel-makers at an early date. For very large vessels the sheer is in some cases partially faired on paper, to save work on the floor, by reproducing the drawing on a large scale, say J inch or I inch to the foot, and fairing the lines as already described for the process on the floor. In some yards lajdng off on a large

scale on paper is relied on almost entirely, and very little full-sized work on the floor is considered neces- sary. Before the lines are rased in, a displacement sheet must be fully worked out from the lines on the floor, to ensure that the correct displacement and position of CB and metacentre are obtained, otherwise the ship may not float at the waterline intended, or with the desired initial stability. Moulds for a great many of the plates and angle bars can now be made, such as the various flat and vertical keel plates and keelsons, intercostals, margin plates, the stringer plates of the decks, the frames, and bulkheads. They are often made separate in thin wood ; but it is a common practice to make a copy of a large part of the body plan, showing the shapes of the frames, floors, reverse fraihes, &c., on a large wood platform prepared for the purpose, called a scrive-board, which is placed near the angle-bar furnaces for the use of the angle-smiths; and by its use the frames are set, instead of using separate wooden moulds for each frame. While the work on the scrive-board is proceeding, moulds for other parts are put in hand at the mould loft, such as the beams of each deck, the keelsons, girders, and stringers.

The practice in regard to laying-off and mould-making varies considerably in different places ; some prefer making moulds at the ship when possible, some use the mould loft to the fullest extent, and others are content with the scrive board and little else. For instance, in the American Lake shipyards templates are very carefully and ingeniously made for the framing, one set sufficing to mark off all the frames over the greater portion of the ship's length. In a similar way, one template is made for each strake of plating, and used to mark off the whole of the plates of that strake, a slip mould being used when they begin to depart from the parallel midship body.

In the drawing office, arrangements of the plating and angle bars required in all parts of the vessel are worked out, with the view of ordering the materials at the earliest possible date. In many cases the sizes required can be obtained from the model, or, as aheady stated, from the floor, but in many others they have to be measured from these working drawings. All the drawings of the structure and of the fittings must be pushed on and issued to the shipyard in good time. Very much of the success achieved in actual building will depend upon the efficiency of the

drawing office, and the rapidity with which the various detailed working plans can be supplied for guidance. These plans must be accurate and complete, and must be ready as soon as required. The drawing-office staff has the oversight of weights actually worked into the ship, a careful record of which should be kept. Each firm has its own system of work in these departments, but experience shows that the more thorough and systematic the work in the drawing office and its adjunct, the mould loft, the better the general result. Another important record is the cost of materials and labour. In all shipyards careful account is kept of workmen's time, whether employed on piece or by the day. Many different systems are in vogue ; but whatever the system, the aim is to record the cost of the labour in each trade, and the detailed cost of various parts of the ship.

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keel blocks.

Keel and frames.

While the work connected with laying-off and obtaining mate- rials, &o., is going on, the shipwrights, assisted by handy labourers, prepare the ground for the keel blocks, lay Lay ng -^ blocks at the proper height and inclination, and secure them against being floated away by the tide or being accidentally tripped while the ship is building. The blocks consist of several pieces of tough rectangular timber, 4 to 6 feet in length, and laid on each other to the height required. The top block is called the cap-jjiece, and is of oak or other hard wood. The blocks are spaced about i feet apart for ships of medium size, and somewhat less for ships of large size. They are usually placed upon a longitudinal bed of timber, which remains embedded in the ground for successive ships : the ground should be hard, or very well piled, otherwise the blocks may sink when weight becomes concentrated over them during building, and difficulty arises from the keel, or the propelling shafts, drooping from a straight line. The upper

surface of the blocks must be at such a height from the ground that men, especially riveters, can do their work with facility under the bottom of the vessel, that the launch can be fitted, and that when launched the vessel may move down into the water without striking the ground. The last named is a most important consideration ; and thus it comes about that the first thing to be settled, before the blocks are laid, is how the vessel is to be launched. The tops of all the blocks are accurately adjusted to a plane surface sloping about | inch in a foot from bow to stern. The shipwrights at the same time prepare the uprights for the staging, and erect them around the building berth in suitable position with the first line of staging, which will be required at an early period in the ship's construction. The platers and angle-smiths begin to prepare the keel, framing, bulk- heads, &c. , as soon as the material is delivered and the laying-off and mould-making are sufficiently advanced for the purpose. The actual building generally dates from the first work of this character.

Tlie keels of small vessels usually consist of a stout flat bar placed vertically and attached to the garboard strakes by through rivets. Occasionally the keel consists of a vertical centre through-plate, with side bars at its lower edge. In large merchant ships, and in war vessels, the keel usually consists of I- wide horizontal plate running along the centre line of the bottom, the sides being turned up as necessary to follow the shape of the bottom (see Figs. 26 and 27, Plate II.). The framing varies very considerably with the size and type of the ship, as already described. In small vessels a frame usually consists of an angle bar, called a frame iar, extending from gunwale to gunwale, to which is riveted a bar, also continuous from gun- wale to gunwale, called a reverse iar, in such a way as to form a built-up Z bar, and between these floor-plates are introduced across the bottom, to give the required strength when resting on the ground or on the blocks. Sometimes the frame consists of a Z bar, in which case the reverse bar is not required in the vicinity of the floor-plate. Sometimes angle bulbs are used for frames, as in the case of oil steamers, where internal ceilings are not required. The process of constructing ►► complete frame of angle bars and plate is as follows : ►►► From the scrive – boards the shape of the section at the frame is transferred to th►►► bending blocks or slabs, the outline being drawn in with chalk ; the necessary preparation is made, and the frame bar is drawn from the

furnace, and while hot bent to its shape and given the required bevel. The reverse bar is prepared in the same way, except that the inner edge of the frame and floor must be worked to. The floor-plate has to be cut to shape. In large ships the frame bars, reverse bars, 3,n

When the keel is in place, and as far as possible riveted, the frames, bulkheads, and beams, which have been made ready by the iron-workers, are brought to the building slip and got into position by the shipwrights. They are held in place and faired by means of shores and ribbands. The latter are made from straight- grained timber of considerable length, sawn out in long straight pieces of square transverse section. They hold the frames in posi- tion until the outside plating is riveted. Upon them are marked the lines at which they nmst be crossed by each frame, and they are bent round and attached to the frames in a fore-and-aft direction at certain heights, which are marked on the frames at the scrive-boards. Some four or more ribbanrls are used each side of the ship. As the work proceeds, the positions of the frames and ribbands are checked continuously, their positions being main- tained by shores from the ground, or some structure prepared for

the purpose. Except in small vessels, the beams are not attached to the frames before they are erected, but are hoisted into place as soon as possible afterwards.

The bulkheads are put together on some convenient flat surface, sometimes on the sorive-board or a similar platform constructed for the purpose. If of large size, they are transferred piece by piece and erected at their proper positions in the ship ; but when- ever possible, they are riveted up and hoisted into position complete. The stem and sternpost are obtained from the forge or foundry and erected at an early stage of the work. The part of the stern abalt the transom is sometimes framed separately on the ground before being erected in the ship. The centre keelson is generally worked intercostally between the floors, but it has continuous parts, usually angle bars, above the floors. Each intercostal plate is secured by angle bars or flanged edges to the floors and to the flat keel plate. Sometimes it is continuous, especially in large ships and in war- ships. The frames are then cut by it, and the floor-plates are attached

to it by short angle bars. After the centre keelsons, the side keelsons and side and deck stringers are fitted. The steel pillars- are substituted for the shores supporting the deck beams, being riveted at their heads to the beams and at their heels to the keel- son, inner bottom, or tank top.

While the work is proceeding, the shipwrights make the stages, put up gangways and ladders for carrying on the work, fit extra blocks and shores, or remove and re[ilace them as may be required. They line off all plate edges on the frames, the overlap being usually painted in with white paint, ready for the platers. They also erect the stem, sternpost, rudder, and shaft brackets, or strut in twin-screw vessels.*

In a ship fitted with an inner bottom the procedure is somewhat more complicated, as the transverse frames cannot be lifted into place as a whole. There are many varieties in the arrangements in such cases ; one frequently adopted is shown in Fig. 21, in which the inner bottom extends out to the turn of the bilge. This figure also shows the general construction of the vessel, including the framing at a bulkhead and elsewhere, the bulkhead itself with all its stiffening bars and attachments to the sides of the vessel, and the inner bottom. At the centre line, immediately over the flat keel plates, there is a vertical girder, the full depth of the double bottom, connected to the flat keel plate and to the centre plate of the inner bottom by continuous double-angle bars. This centre girder may or may not be water-tight, according to the desired tank arrangements. The transverse frames are in four parts : the two lower extending on either side from the centre girder to the margin plate of the double bottom, which is a continuous girder of special construction ; and the two upper, from the margin plates to the top- sides. The lower parts consist of a floor-plate with angle bars at its edges for attaching it to the outer and inner bottoms, the centre girder, and the margin plate. At the bulkheads these floor-plates are solid, and the angle bars are united and made water-tight ; else- where they are lightened by holes, and the angle bars at their upper and lower edges and ends are separate pieces. The two upper parts of the transverse framing consist of a frame and a reverse bar, each having a deep and a shallow flange, and are riveted to one another along their deep flanges, with their shallow flanges standing the reverse way to one another. The shell-plating is attached to the shallow

flange of the frame bar. Between the centre girder and the margin plate on each side of the ship there are two intercostal girders, the plates of which are connected by short angle bars to the floors and to the shell and inner bottom plating ; and between the margin plates and the lower deck on each side there are three stringers, consisting of intercostal plates attached by short bars to the outer plating, and three continuous angle bars riveted to part of the intercostal plates which extend beyond the reverse bars.

In the course of erection, after the flat keel plate is laid upon the blocks, and the centre girder placed upon it, the two lower parts of the frames, which have been constructed alongside, are put into position, their outer ends being carried by ribbands shored from the ground. The intercostal girders and margin plates are then fitted. The lower edge of the margin plate is brought close to the outer edge of the frames, and is connected by a longitudinal angle bar to the shell-plating, while its upper edge is flanged for the purpose of being attached to the inner bottom plating. The ship at this stage gives the impression that a flat pontoon is being constructed.

When the margin plates are up and faired and, as far as desir- able, riveted, the upper parts of the frames on each side are erected and the fairing proceeded with as before. The beams are now got into place, also the side and deck stringers. As will be seen, the margin plate outs completely through the transverse frames, and special brackets are provided to maintain the transverse strength. The chief advantages derived from cutting the frames by the margin plate are the cheapness with which water-tight work is secured, and the rapidity with which this part of the wotk can be proceeded with.

As soon as the keelsons and stringers are riveted, and the ship by their means sufficiently stiffened, the outside or shell plating is

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commenced. The plating squad is supplied with a drawing showing the disposition of the butts in each line of plates ; light wooden Shell or "lo^lds or templates are then made, outside ^^"^S tl'O t'>;act shape of the edges and plating. ^"tts, and the positions of all the rivet holes in the frames. From these moulds the edges and butts and the holes are marked off, the holes are punched, and the edges and butts sheared and planed. The plates are then rolled to shape, furnaciug being resorted to only when the curvature is too extreme to be obtained with the plate cold. The usual arrangement of the plating is that of inside and outside strakes alternately (see a, Fig. 15). The inside strakes, which are worked first, are templated off the ship, and lie directly on the flanges of the frame bars. The outside or over- lapping plates are then worked, and are templated from the place they are intended to occupy on the ship. They are kept at the proper distance from the frames bjr liners or slips of the same thickness as] ' ||V the adjacent inside plates. Towards the ends of the '^l \ ship the number of strakes of plating must be re- ^]] duoed, as the girth along the frames is much less than over the midship portions. Stealers are introduced for this purpose; they are single plates, which at one end receive the butts of two plates, and at the other the butt of only one. By them two strakes are merged into one.

The number of plates requiring to be furnaced is small in comparison with the whole number, but there are always some at the after end of the ship, especially in the neighbourhood of the boss (for the stern tube) and the counter, and a few at the for- ward end of most ships. As each plate is got ready, it is taken to the ship, hoisted into position, and temporarily secured by the platers by means of bolts and nuts. As the work of plating proceeds, and the weight of the ship increases, extra shores are put into place, and bilge blocks erected by the ship- wrights, to keep the structure to its shape and pre- vent local and general "unfairness." The shell-plating in way of the intended bilge blocks is completed at as early a period as possible, and painted, so that when once the bilge blocks are in place they need not be disturbed until immediately before launching. While the platers are at work on the sheU-plating, other squads of riveters are engaged on the deck-plating and internal work, such as the bunkers, engine and boiler bearers, the shaft tunnel, casings, and, in the later stages, the hatches, houses on deck, &c. , and as much as possible of the

internal work is done before the shell shuts out the daylight. As the work is completed by the platers, it is ready for the riveters and caulkers ; and these trades follow on without delay, except in some parts of the casings and decks in way of the machinery, which are left portable, and taken down after the launch, to allow the machinery to be put in place.

The platers usually work in squads, composed generally of three platers, a marker-boy, and a number of helpers or labourers, the number of whom depend on the size and weight of the plates, and the nature of the work to be done on them, and also on the facilities of the yard for handling such material. On the work of a large vessel many of these squads would be employed. The riveters also work in squads, a squad consisting of two riveters, one holder-up, and one heater-boy, with sometimes a catcher, i.e., a boy to pass on the heated rivets when the distance from the rivet-hearth is great. Pneumatic riveting has not made great progress in Great Britain. Hydraulic riveting to a, limited ex- tent is adopted, especially in the case of work that can be taken to the machine, such as frames, beams, and other parts ; but in shipbuilding the large proportion of the riveting is done by hand. In the Koyal dockyards platers' work is done by ship-wrights, and riveting is not considered a trade, though regarded as skilled labour. Shipwrights also lay the blocks, erect the ribbands, shore and fair the ship, but labourers construct the stages. Drillers' work consists in drilling by hand holes which it is not convenient or possible to punch or drill by machine ; they also rimer out and coun- tersink punched and drilled holes when this is necessary. Portable electric or pneumatic drills

are used when possible in hydraulic engine driUs

some shipyards, employed for some

and three-cylinder purposes, such

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FiQ. 18. ??? ^Modern Great Lake Cargo Steamer

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midship portion, in perspectire.

Fio. 19.

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-Modem British Cargo Steamer ; midsiiip portion, in perspective.

as in cutting armoiir bolt holes in thick plating behind armour. The caulkers follow closely upon the riveters, and generally work singly. A very important part of a caulker's duty is water- testing. In the large oil-tank steamers possibly 8000 tons of water are used for testing one ship alone, and about the same amount for a large war vessel. This water is pumped from the sea or river into the compartment to be tested. In the case of an oil vessel, each compartment is filled right up, and a pressure put on by means of a stand pipe, carried for a considerable height above the highest part of the tank ; any leakage found must be made good by the caulker, and the tank re-tested until it is perfectly water-tight. The double bottoms of merchant ships, and the smaller compartments and double bottoms of war vessels, are filled up and tested by a head of water rising a few feet above the load water-line. It is not usual to fill all the larger compartments, such as boiler and en- gine rooms in war vessels, or the machinery com- partments and cargo holds in merchant ships ; but water at a high velocity is played on the bulkheads by hose, to test the water-tightness and the strength. An occasional test, however, is made by filling a typical large compartment with water to a height of some feet above the load water-line. Angle-smiths form beam knees where these are welded, and generally all angle bar work where heating in a smith's fire is required. It is usual to defer the painting of certain parts of the steel structure of a ship as long as possible, so that ordinary red rust may form and dislodge the black mill scale which is answerable for a great deal of corrosion in steel ships, as in certain cii-cumstances it forms a galvanic

couple with the steel plate. For warships the British Admiralty requires the removal of this scale from these parts by immersing the plates in a weak solution of hydrochloric acid. Red and white lead, oxide of iron, and oxide of zinc form the bases of most of the paints used on steel ships.

Structural Arrangements.

The following are particulars of ships in course of construction at New London (Conn., U.S.A.) on th.& longitudinal system: ??? "The great centre girder, which in all vessels prior to these has been in the form of an I girder, is formed of a double II or box ; that is, these vessels have two vertical keels instead of one. The girder is of the same depth as the double bottom (6 feet). On each side of this girder there are several other vertical longi- tudinal members, having the plating on the top, forming the tank top, and the shell-plating below, forming the bottom of the tank. This tank or double bottom is 6 feet deep for the greater part of its length, and is increased at the extremities, where it merges into the fore-and-aft peaks at the collision bulkheads. The whole of this space can be filled with water when desired, to sink the ship to a suitable draught when making a voyage with- out a cargo or with a very light one, at the same time allowiug the ship to keep afloat whenever the outer shell or skin has been pierced by rocks or by colliding with other vessels. This bottom girder or double bottom forms the ' backbone ' of the ship, from which the great frames spring or extend up to the weather deck, about 60 feet above the keel. The frames are made of channel steel spaced 30 inches apart, but as they near the extreme ends they are spaced closer, and are composed of angle bars riveted together. At certain parts of the structure, where the heave of the sea will tend to strain the ship, the frames are double and made very strong. 'The outer surface of these frames is covered with a shell of steel plates averaging about 1 inch in thickness. These enormous plates are arranged to give a maximum of strength, and the riveting of them to the frames and to each other is receiving the utmost care.

"These ships have a continuous longitudinal bulkhead on the centre, extending from the inner bottom to the main deck. The side plating of the .shell, with this longitudinal bulkhead, form three vertical members of the entire structure. The upper flanges of the girder are formed by the upper

and main decks, which are laid with heavy steel plates. This great girder is designed to support a full cargo when suspended by long waves of the sea at either end. The side girders are kept in place by three inter- mediate decks between the tank and the main deck, making in all five complete decks, each covered with heavy steel plate. The beams supporting all these decks are of channel steel, and fitted

to every frame by large bracket plates. One of the many notable features in the construction of these vessels is the distribution of the water ballast. Various conditions of trim and safety can be obtaiued. The double bottom is divided longitudinally into three water-tight divisions and transversely into about twelve, making in all thirty-six separate tanks. In addition to these there are the fore-and-after peak tanks, and side tanks between the main and 'tween decks, about one quarter of the vessel's length from either end. The latter tanks are really fitted for the purpose of controlHng the ship's stability and seaworthiness.

"The vessels are divided transversely into thirteen water-tight compartments, while the longitudinal bulkhead is water-tight in the machinery space, which makes in all fifteen water-tight com-

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20. ❓❓❓ Cunard Liner Campania ; midsliip portion, in pergpective.

partments. The engine-rooms are completely independent of each other ; so are the boiler-rooms ; but access is had from one to the other by water-tight doors. The coal can gravitate direct to the stokehold floor. The method of pillaring is somewhat novel, and has never been attempted before by any American shipbuilder. . . . Strong girders run under the transverse beams and are supported at wide intervals by built stanchions. By this means the least possible trouble is experienced in stowing the cargo. . . . The building-slips rest upon a solid granite ledge, which at a suitable declivity runs down to the' bank of the Thames river. Opposite the yard there is over 60 feet of water, and it is proposed to run the

launching-ways about 300 feet from the shore- line into the water. The vessels will be the heaviest ever launched."

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Fio. 21. *Details'of framing and bulkheads.*

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Fig. 18 shows the conatruction of a, typical American Lake steamer, a diagram of which is given in the article Ship, Fig. 12.

Fig. 22. *Breast-hook and panting stringers.*

She is 450 feet over all, 50 feet heam, and 28 feet 6 inches moulded depth ; and when loaded to a draught of 18 feet 3 inches can carry about 6000 tons weight of cargo on a total

displacement of about 9000 tons. For half the length or more the ship is of the same transverse section, the frames being made identical in form. The outside plating is about f inch thick generally, but it is thicker at the garboards, flat Q^^^'t keel, and sheer strake, and becomes thinner generally . towards the ends of the vessel. The frames are 24 inches apart, and consist of four separj^te pieces *two across the bottom and one up each side. Those across the bottom consist of a 15-inch channel bar, with deep flanged brackets of 17i lb plating connecting their inner ends to the centre keelson and their outer ends to the bilge and tank top. Extending up each side, the frames consist of 6-inch channel bars of 17 lb per foot, worked 24 inches apart in the case of ordinary frames ; and 15-inch channel bars of 33 lb per foot, worked 8 feet apart, and called belt or special frames. The frames are all connected to the tank top and to the upper deck-plating by flanged bracket plates 17^ tt per square foot ; and*

the belt frames are stiffened by hold beams of I section, 12 inches deep and 35 lb per foot, attached to each by deep flanged brackets of 17J B plating as indicated, and sup- ported in tlie middle by stanchions or pillars of similar section. The stancliions are attached to the tank top by double clips of 6-inch angle bar, and to the upper deck beams by direct riveting and by flanged brackets of 15 lb plating. Each belt fiame is thus complete in itself, and very readily erected after the tank top is completed. The tank top is of 20 lb plating amidships and under the loading hatches, and 17J lb elsewhere. The margin plate is a continuation of the tank top, is made of 17^ lb plating, and flanged against the shell. The centre keelson is of about 22J lb plating and about 5J feet deep ; the side keelsons are of 17| lb and slightly less depth, so that with a small rise of floor on the outside, say 3 inches in the half-breadth of the ship, there is a small fall of the tank top towards the bilges, say 6

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Plan.

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Elevation.

EN&INE ROOM BULKHEADT WATERTIOHT ⍰⍰

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FiQ. 23. ??? Stem framing, shaft tunnel, &o. of single-acrew ship.

inches in the half-breadth, so as to drain the hold to the water- courses over the margin plates. The centre keelson extends from the inner to the outer bottom, being attached to the tank top and the fiat keel by heavy double angle bars, and well stiffened by the flanged floor brackets, which are connected to it by heavy double angle bars. The side keelsons are connected to the tank top and the floors by fore-and-aft angle bars 3 inches by 3 inches of 7J lb per foot, and stiffened by vertical 6-ineh angle bars at every frame. At the lower edge the keelson plates are connected to fore-and-aft intercostal channel bars 15 inches deep of 33 lb per foot, riveted to the shell-plating, which, with the channel floors, give very great local support to the bottom. This system of framing extends practically throughout the length of the vessel ; thus the bottom is very strong, and very large ballast tanks are formed, having a capacity of nearly 3000 tons. The upper deck is plated, and the stringers are made specially heavy, to compensate for the strength lost by cutting wide hatchways.

British

cargo

steamer.

FiQ. 24. ??? Stern framing of the Campania.

Fig. 19 represents a modern British cargo steamer of ordinary construction, of about the same breadth and depth as the American Lake steamer ju.st described, and it will be interesting to note the differences between the two vessels. These differences, so far as the outside form is concerned, are chiefly that the British cargo steamer has deck erections, topsides, and a main deck, whereas the Lake steamer has scarcely any deck erections and no topsides, while her hold extends from the top of the inner bottom to the upper deck ; they are due to the fact that the latter ship is only required to traverse inland waters, where heavy weather is not met with, whereas the former is an ocean-going vessel, and must be prepared to meet all conditions of wind and sea. As to the differences in the details of construction, they are chiefly that

in the American Lake steamer the bottom framing, which is of great depth, consists of deep channel-frame bars, above which the longitudinals are continuous, instead of the usual transverse framing in the British ship, extending between the outer bottom and tank top ; and that the margin plate continues the surface of the tank top out to the side, instead of being nearly vertical, as in the British ship. The system adopted in the American steamer conduces to security in case of grounding in the shallow waters through which she has to pass.

Fia. 26. ??? Bow framing of the Campania.

The general construction of a large passenger vessel is shown by Fig. 20, which gives a perspective sectional view of the framing, &c. of the (Junard liner Campania. The transverse frames and the girders or longitudinals extend in depth from Atlantic the outer bottom plating to the inner bottom plating. ‘’”??’”??? The centre keelson, the second longitudinal from the middle line and the margin plate on each side, are continuous, the transverse frames being fitted between them and attached to them by angle bars. The first and third longitudinals from the middle line are inter- costal, being fitted in short pieces between the frames and attached to the floor-plates by short angle bars. The floor-plates have

lar^e holes cut in them to lighten them, and to give access to the different spaces for inspection, painting, &o., and smaller holes for watercourses. From the margin plate the transverse frames consist of stout channel bars extending to the upper deck ❓❓❓ each tier of beams is securely riveted to them, and their lower ends are connected to the margin plate by strong brackets. At intervals the channel-bar frames are replaced by deep built-up frames the frequency of which depends on local requirements. Heavy' side stringers of the same depth as the deep frames run fore and aft

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to stiffen the side between the bilges and the first plated deck. Where the deep frames are out by these stringers, the strength of the frames is continued by gusset plates, as shown.

Some further structural arrangements usually adopted in British ships are shown in Figs. 21 to 23. Fig. 21, to which reference has already been made, shows in detail the construction of a bulkhead, with the framing in wake of it, and the same details at an ordinary frame ; also tlie stringers, beams, pillars, &c. The bulkhead itself stops at the tank top, being secured to it by double angle bars, and the floor immedi- ately beneath it is made water-tight. It would involve very costly work to make the bulkhead water-tight if the side and bilge stringers were made continuous ; these have therefore been cut, and the continuity of the longitudinal

strength is maintained, as far as possible, by the large brackets shown in the plan. Besides bulb stift'eners, the bulkhead is provided with built-up vertical stiffeners at AB and a built-up horizontal stitfener at CD. Fig. 22 shows the arrangement for special strength- ening at the extreme fore end of a vessel, between the collision bulkhead and the stem, and below the main deck, these consisting chiefly of panting stringers, panting beams, and breast hook. Fig. 23 shows the general arrangement of stem framing of a single-screw ship, including the shaft tunnel. A water-tight door, which can be closed wheu neces- sary from above the level of the outside water, shuts ofl' communication between the engine-room and tunnel ; the form of the stern post and aperture frame casting is shown, with its attachment to the centre keelson and other details.

Figs. 24 and 25 show the arrangements of the stern and bow framing of the Campania, which may be taken as those usually adopted in large passenger steamers of this class.^ In both the transverse framing becomes deeper and stronger as the extremities are approached, while the decks and side stringers are all continued to the extremities, finishing in strong breast-hooks, and additional stringers, breast-hooks, and panting beams are intro- duced. It is worthy of note that the rudder and steering gear are in this vessel entirely under water, so that she may be used for war purposes without running the risk of disablement by the radder or steering gear being struck by projectiles. Above the water the stem is finished off so as to have the appearance of being fitted with an ordinary rudder. This im- portant departure from the usual practice was first introduced by Professor Biles in the City of Paris, and the Campania and her sister the Lumnia were in 1902 the only British ships so fitted.

Fig. 30 gives in perspective the general stractural arrangements of the Japanese cruiser Jdzumo, and Figs. 26-29 (Plate II.) are from photographs of the vessel in course of construction. It will be seen that the departures from the structural aiTange- ments of ►► merchant ship are very considerable. As already pointed out, lighter scantlings are used in warships than in ordinary merchant ships. This is eff'ected by more carefully devised and more costly arrangements of framing and plating, and by making the structural features necessary in a warship for protection, &c., serve also for local and general strength. In warships,

frames are placed at greater distances apart, 4 feet amidships and 3 feet at the extremities being the usual .spacing, as compared with some 2 feet in a mer- chant ship. On the other hand, there are more continuous longitudinals in the framing of a war- ship, which extend in depth from the D/ffe/iencesjjijjg^ bottom to the shell-plating, and between ^^^ local support to the bottom as well war an general strength to the vessel. There

. . are in a warship so many sti'uctural

" features, such as water-tight bulkheads

and flats or platforms, required for the necessary subdivision, armour decks, plating and framing behind armour, &c. , which are made to contribute to the strength of the structure as a whole, that the strength of the shell-plating and the transverse framing can be proportionately reduced.

In a merchant ship there are many considerations which require the structure to be stronger and heavier than would be necessary to withstand the wind and waves which she may encounter. The continual change of cargo and of disposition of cargo necessitates

special local strength throughout. The custom, often pursued, of grounding vessels to discharge cargo, and their liability to touch the ground in the ports they frequent, make the provision of great strength in the floors and the shell-plating essential. Other

Fig. 30. ??? Japanese cruiser Idzwmo ; midship portion, in perspective.

considerations afl'ect the decks, and call for local strength in them with corresponding increa.se of weight.

Most warships, except gunboat, torpedo, and other small craft, have double bottoms, chiefly for protection against damage in action, but also against accidental grounding. The space between the bottoms is divided into a large number of compartments by making some of the frames and longitudinals water-tight. The

‘ We are indebted to Dr Elgar, the Campania.

F.R.S., for these and other plans of

Elevation.

Fig. 31. ??? Steering-gear of merchant ship.

inner bottom extends on each side to the turn of the bilge, and from that point is carried up vertically as a wing bulkhead, as shown in Fig. 28, the wing spaces thus formed being occasionally utilized for coal-bunkers. The framing, consisting of frame bars, reverse frame bars, and frame plates or brackets, is usually carried up in a fair curve to the armour shelf, supposing the vessel to be an armour-clad, as in Fig. 30. From the edge of the armour, which is generally about 5 feet below the load water-line, a change in structure is made, and the framing behind the armour is set back from the outside of the ship sufficiently to admit of an internal

[practical

skin of steel plating (often worked in two thicknesses), teak backing, upon which the armour is embedded, and the armour itself, to be carried witli the surface of the armour flush with the shell-plating. The vertical frames behind armour are spaced 2 feet apart, and the longitudinals are made intercostal, the whole having exceptional strength, to support tlie armour. Above the armour another change is made, the frames being brought again to the outside of the ship, and the topside plating directly attached to them becoming flush with the outside of the armour. There is generally a strong deck, called the protective deck, extending from stem to stern in the form of a turtle back, the lower edges being at the armour sliplf on each side of the ship, and the top of the arch forming the first deck above water, as indicated in Fig. 28. With a view to maintaining its defensive

power where it has to be perforated for funnels and air shafts, armour gratings, or armour bars as they are called, are fitted in the openings. As much water-tiglit subdivision as possible is introduced throughout the ship, but for communication between the various compartments openings are provided in the bulkheads, having water-tight doors which can be closed either from a posi- tion close to the door or from a deck above water, or from both. Below the protective deck are the engine and boiler spaces, magazines, shell-rooms, submerged torpedo rooms, and steering-gear. A passage is provided on each side of the ship just below the protective deck, for the supply of ammunition to the secondary armament.

Fig. 26 shows the Idzumo partially in frame, looking forward from the after extremity : the frames below the armour deck over a considerable length of the ship are complete, and a number of the beams which carry the armour deck are in place. Fig. 27 shows the ram stem, which has just been placed in position. The collision bulk- head and the framing below the armour deck are for the most part in place. Fig. 28 gives the top of the armour deck, which is nearly completed, as seen from the fore end, with the forward citadel bulkhead in course of construction. Fig. 29 shows the after part of the vessel, which is not so far advanced as the forward portion shown in Fig. 28. In Fig. 29 the framing has been carried to a bulkhead near the after extremity, the rudder post is in place, and the bearing for the rudder head can be seen in the foreground. The construction of the armour deck is proceeding, and the after citadel bulkhead is also well advanced, though no backing is yet u])on it, as in the case of the forward bulkhead, but the base of the redoubt which carries the after turret is erected.

The whole of a ship's fittings arc prepared during the building. The various plans are carefnlly worked out in . the drawing-office, sketches being prepared to show the mtC^ accommodation for passengers and crew, the rigging, "'*[illegible] bridges, and wheelhouse, the pumping and draining arrangements, steam piping and heating, details of steer- ing – gear, anchor and cable gear and electric lighting, and of all blacksmiths', joiners', and shipwrights' work, upholstery, &c. Such drawings as are necessary are issued to all the various trades for guidance in performing their parts of the work ; others are issued to manufacturers for the supply*

of completed fittings and special appliances, so that all may be ready at the proper moment for installation in place on board the vessel. In war vessels similar but more elaborate plans are required than in merchant ships, and, in addition, plans of magazine and shell room arrangements, gun foundations, torpedo installation, armour plates and bolts, transport of ammunition, and many others. The shares contributed by the various trades in completing the vessel are briefly as follows : ??? The shipwrights do all the heavier wood- work, such as laying decks, fitting ceilings, erecting and fitting storerooms, and completing all weatlier work. In the Royal dock- yards their work embraces the fitting of the pumping, flooding, draining, and ventilating arrangements throughout the ship, part of the steering-gear, the greater part of the hydraulic mechanism, the supporting structures of the heavy guns, and much other work which is usually performed by fitters in private yards. The joiners do the more highly finished woodwork, such as cabin and saloon fittings and the lighter store-room fittings. Blacksmiths complete all the forged work, pillars, handrails, davits, mast fittings, awning stanchions, and a large variety of dock fittings. Fitters make and fit the water-tight doors, sluice, drain, and flood valves, gun-mount- ings and torpedo gear, and fit the steam windlass, winches, parts of the steering-gpar, &c.

'The fittings in a ship cannot bo fully described in the present article, but we shall conclude with some account of the auxiliary machinery. Two ordinary arrangements of steering-gear fitted in merchant steamers are shown in Fig. 31. In the first example

a three-quarter circular grooved rim, keyed to the rudder head, carries the steering- chains, which are led forward one on each side of the hatches to the steam engine, placed in this case in the engine-room casing, and controlled by shaft- "'???"^O' ing from the bridge. The usual steering-wheel is fitted" "*"' ??? on the bridge, and actuates the controlling valve of the steam engine by means of the shafting. The second example is very similar to the first : a quadrant is keyed on the rudder head, and worked by chains led over pulleys one on each side of the ship to the steam gear, which in this case is placed on the bridge, close to the wheel. In all such cases gear is also provided by which in an*

emergency the ship can be steered by hand, by steering-wheels placed close to the rudder head, as indicated in the figures.

In a warship the arrangement is different, as it is necessary to keep the steering-gear below the water-line for protection. The breadth available at the rudder head is as a rule not sufficient for a tiller or quadrant to be fitted. Fig. 32 illustrates an arrangement frequently adopted. A crosshead of sufficient size is keyed on to the rudder heaxi, and is worked by connecting rods from a similar crosshead placed a little farther forward, where the breadth of the ship is sufficient to allow a tiller to be worked. The tiller is worked

f-^Cngint amtrollinf SJiaft from Wheel tlouwe and Conning

Fio. 82. ??? Steering-gear of warship.

by a block or carriage, which is dra^vn across the ship on a guide, at the same time sliding upon the tiller, which is machined for the purpose. The block-and-guide arrangement is known as Eapson's slide. The block is hauled to and fro across the ship by a chain which passes round a sprocket wheel upon a shaft, which is driven in either direction, as required, by the steering-engine. In many cases the steam steering-engine is placed in the engine-room, to avoid heating the after compartments by the steam pipes, and for the sake of easier control by the engineers.

Amongst the auxiliary machinery usually fitted in passenger and other well-found vessels may be mentioned the windlass for working the cables and weighing the anchors ; a warping capstan forward in connexion with the windlass, and another aft with its own engine ; steam winches for handling the cargo and baggage, and for hoist- ing coals on board ; and occasionally steam cranes, fitted either in addition to or in place of the winches. Then there are the electric light, pumping, ventilating, and refrigerating installations. , Hydraulic power is employed in many cases, especially for cranes, but here the source of the power is necessarily a steam engine, which is usually placed in the main engine-room. Electric power sometimes replaces steam for operating some of the machines enumerated above ; for instance, ventilating fans are now generally driven by electric motors in passenger and war ships. A large number of

comparatively small fans are used, each supplying air to a particular part of the ship. In warships the amount of au.xiliary machinery has been very much increased in recent years. On each side of the deck amidships there is generally a steam winch for raising and lowering the boats, one of the principal functions of the mast in the modern warship being to carry the derrick used for this purpose. Electric motors are fitted for working the after- capstans, ash hoists, sometimes the winches, and the workshop machinery ; also to traverse, elevate, and work the guns, and bring the powder and projectiles up from the magazines to the guns. But for the heavier gims, the steering-gear, and certain other purposes, hydraulic power or steam is still preferred. (p. 'WA.)

Ship Canals. See Canals.

SHIPLEY ??? SHOOTING

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Shipley, a township in the Shipley parliamentary division of Yorkshire, England, on the Aire, 3 miles north by west of Bradford by rail. The parish includes the village of Saltaire, so named after its founder. Sir Titus Salt, who here established large alpaca manufactures. Area of urban district, 2179 acres. Population (1891),

23,387; (1901), 25,570.

Shippard, Sir Sidney Godoiphin

Alexander (1838-1902), British colonial adminis- trator, was born in 1838, being the eldest son of Captain WiUiam Shippard, 29th Kegiment. He was educated at King's College School, and went thence to Oxford, where he obtained an exhibition at Oriel College, and subse- quently a scholarship at Hertford College. Taking his degree in 1863, he was called to the bar as a member of the Inner Temple in 1867. He then entered upon a long and honourable career in South Africa. In 1873 he was appointed Attorney-General of Griqualand West, a post which he continued to hold until 1877, when he was made Acting Recorder of the High Court of Griqualand. From 1880 to 1885 he sat as a judge of the

Supreme Court of Cape Colony ; and he was British Commissioner on the Anglo-German Commission in 1884 ... 85 for settling the Angra Pequena and West Coast claims. It is, how- ever, with Bechuanaland that his name is chiefly asso- ciated. He held the chief official position there from 1885 to 1895, being administrator, chief magistrate, and presi- dent of the Land Commission for British Bechuanaland, and resident commissioner for the Bechuanaland Protectorate and the Kalahari. In 1887 he was made K.C.M.G. In Bechuanaland the crucial problem of native adminis- tration was the liquor question. Khama, the great chief of the Bamangwato, addressed to Shippard in 1888 an appeal in which he said : "To fight against drink is to fight against demons, and not against men. I dread the white man's drink more than aU the assegais of the Matabele, which kill men's bodies, and it is quickly over ; but drink puts evil into men, and destroys both their souls and their bodies for ever. Its wounds never heal." Shippard took the same view, and the law prohibiting the supply of liquor to the natives was most strictly enforced by him, the result being that the natives became prosperous, happy, and peaceable. In 1896 Sir Sidney Shippard played a not inconsiderable, though unofficial, part in the negotia- tions between Sir Hercules Robinson, the High Commis- sioner, and the Johannesburg reformers after the Jameson Raid. On 7th January, in company vsdth Sir Jacobus de Wet, the British Agent, Shippard made a most efifective speech at the Johannesburg Club, which had considerable influence in inducing the Johannesburgers to lay down their arms. Sir Sidney Shippard was twice married, first to Maria, daughter of Sir Andries Stockenstrom, who died in 1870, secondly to Rosalind, daughter of Mr W. A. Sanford, of Nynehead Court, Wellington. He died on 29th March 1902.

Shipping' Companies. See Steam-ship Lines.

Shirley. See Southampton.

Shirwa, Chiewa, or more properly Chilwa, a shallow lake in British East Africa, cut by 35 .. 20′ E. and lying between 15 .. and 15 .. 35′ S. The lake has greatly diminished in area within recent years, the open water filling less than half its former bed except in the rainy season, when the level plain round its margin is flooded. Formerly the water seems to

have found an outlet northwards to the Lujenda branch of the Rovuma, but with the sinking of its level it is now separated from the latter by a wooded ridge some 30 to 40 feet above the surrounding plains. The per-

manentwater, which is often almost unapproachable byreason of the swampy nature of its shores, measures only some 38 miles by 14, the viddth between the former elevated banks being about 20. There are four islands, the largest rising 500 feet above the water.

ShklOV (Polish, Szhtovi), a district town of Russia, in the government of Moghilev, on the highway to St Petersburg, and on the left bank of the Dnieper, 38 miles from Orsha railway station. It carries on an active trade in agricultural produce and manufactured goods imported from Austria. Population (1897), 10,630.

Shoa. See Abyssinia.

Sholapur, a city and district of British India, in the Deccan division of Bombay. The city is 164 miles south-east from Poena by rail. Municipal area, about 8 square miles; population (1881), 61,281 ; (1891), 61,915; (1901), 74,521. Since 1877 it has ceased to be a military cantonment. The large bazaar is divided into seven sections, one of which is used on each day of the week There are two municipal gardens, with fine tanks and temples. A cotton miU, with 400 looms and 36,000 spindles, employs 1500 hands. The high school had 339 pupils in 1896-97. There are six: printing-presses, each issuing a vernacular newspaper.

The district of Sholapur has an areaof 4542 square miles ; popula- tion (1881), 583,411 ; (1891), 760,689, showing an increase of 29 per cent, after the famine of 1876-77 ; average density, 165 persons per square mile. In 1901 the population was 720,978, showing a decrease of 4 per cent. The land revenue and rates are Es.13,49,501, the incidence of assessment being just over 8 annas per acre ; culti- vated area (1897-98), 1,948,084 acres, of which 105,677 were irrigated from wells, &c., including 9145 from Government canals ; number of police, 588 ; children at school (1897-98), 9710, being 1-3 per cent, of the total population ; registered death-rate (1897), 44 ‘81 per thousand. The principal crops are millet, oil seeds, and pulse. The Ekruk tank, near

Sholapur city, is the second largest irriga- tion work in the Deccan. The capital outlay has been Es.13,40,000. In 1897-98 the gross receipts were Es.16,883, and the expenditure Rs.33,730, showing a loss of Rs.16,847. There are manufactures of silk and cotton cloth, and blankets. The chief trading mart is Barsi, in a tract surrounded by the Nizam's dominions, with 8 factories for ginning and pressing cotton. Pandharpur is a popular place of pilgrimage. The Great Indian Peninsula Railway runs through the district for 115 miles, with a junction for the Southern Mahratta railway (8 miles), and another junction for the Barsi Hglit railway (22 miles), now being extended to Pandharpur (30 miles).

Shooting'. ??? The taste for sport of all descriptions has developed so rapidly in modern times that, as regards shooting alone, for one person who handled a gun fifty years ago, probably twenty do so now, while the head of game reared and preserved for sporting in the United Kingdom had increased at least 50 per cent, during the same period. As a consequence, the art of gunmaking has im- proved in proportion, and in view of the modem hammer- less ejector gun, with its choke-bore, single-trigger, snap- action, and nitro-powder cartridges, it seems impossible to believe that in the middle of the 19th century sportsmen were still using muzzle – loaders and black powder. None the less it is open to discussion whether modern guns and powders can claim any extraordinary superiority of kiUing power : their supremacy lies in the ease with which they can be loaded and fixed, and, in the case of powders, in the absence of recoil and smoke.

For all practical purposes a 12-bore gun, weighing about 6J B) with 30-inch barrels, is the most useful for sports- men of average physical capacity ; lesser gauges can only be recommended for the aged or constitutionally infirm. Too great care cannot be exercised in the choice of such a weapon, and, despite the considerable initial expense, it vriU eventually prove an economy for the intending pur- chaser to place himself in the hands of a firm of London gunmakers of repute, and pay a good price for a good

article. Such a gun ⬛⬛⬛ will practically last a lifetime, while the care bestowed on its "fit" and finish proves a source of increased skill in shooting, and of consequent satisfac- tion to its owner. From this, however, it must not be supposed that there are not many excellent provincial gunmakers, nor that the price of a gun is an invariable proof of its excellence. A really first-class London-made, fitted, and proved gun should be obtained for ⬛⬛40 or ⬛⬛45, and a pair for from 90 to 100 guineas ; though these prices are of course susceptible of considerable modification or increase. Single-trigger guns, the latest fashion, are not specially desirable, nor is excessive choking to be recommended. A pattern of 140 for the right and of 160 for the left barrel is ample for ordinary game shoot- ing, while a load of 40 to 42 grains of nitro-powder, vsdth 1 or 1;| oz. of No. 5 or 6 shot, is sufficient for general purposes.

Although many varieties of game and vsT.ld-fowl exist in the United Kingdom, it is not within the scope of the present article to do more than merely touch on the shooting of those most commonly met with. Foremost among them must be placed the grouse, and it is hard to say whether grouse-shooting over dogs or grouse-driving be the more enjoyable form of sport. Until recent years the latter form of grouse -shooting was almost entirely confined to the English moors, but it is now very generally practised in Scotland as well ; though here, in the writer's opinion, it has not proved an unqualified success, at all events in the Highlands. The main advantage claimed for grouse-driving is that, by killing off the old birds which usually come first to the guns, the younger and healthier birds are left as a breeding stock, and on the English and Lowland Scottish moors, which are naturally adapted to driving, this has produced the most astonishing results. But in the rugged and mountainous Highland districts it is not possible properly to work the " tops " and summits, which are the strongholds of the noxious old cocks it is so desirable to exterminate, and consequently ⬛⬛⬛ ⬛⬛⬛ with some notable exceptions ⬛⬛⬛ driving has but too often had a retrogressive effect. The best proof of this is a com- parison of the bags obtained in the Highlands a generation ago, when driving was not practised, with those of the present day. In laying out a moor for grouse -driving, special attention should be paid to its configuration, and to the probable flight of the birds, which as a rule always follow the depressions and " slacks " in

its surface. Where possible, the " butts " should always be placed in a hollow of the ground ; this not only helps to conceal them from the birds, but also produces higher and prettier shots. Very long drives are to be deprecated ; moderately short ones, where the birds can be kept constantly moving, and sent backwards and forwards over the same line of butts, will be found the most effective, as by this means the coveys get broken up. In grouse-driving, where birds are fairly plentiful, the sportsman should never turn to fire at those which have passed him ; he will kill four birds in front of his butt for every one behind it. He should not crouch in his butt nor seek to conceal himself by stooping, but remain perfectly motionless, until the moment when he throws his gun up to his shoulder to fire. Above all, he should not reserve his fire until the birds are close upon him ??? a very common mistake among tyros in grouse driv- ing, which considerably lessens the probability of killing the grouse, and which moreoter leads to a cramped and "poking" style of shooting. It is a goodiplan before the beginning of a drive to mark some object about 40 yards in front of one's butt ??? a white stone or a prominent tuft of heather ??? and to open fire as soon as the grouse have come within that range. Grouse-shooting over dogs is a fine sport where grouse can be found to lie to

them, but its main features are so weU known and its methods so simple that it hardly merits further descrip- tion. Two rules, obvious, but frequently ignored, should be borne in mind ??? during the heat of the day grouse will generally be found near water, and in wild stormy weather they should be sought on the lower slopes, and not on high ground. Large, big-boned setters are the best dogs for grouse-shooting ; small, light-framed animals are un- able to bear the heavy work, and pointers are more easily affected by the cold, damp climate of the Highlands.

It is commonly but erroneously presumed that partridge- shooting over dogs is a thing of the past, but there are still many parts of Great Britain where the use of dogs ??? preferably pointers ??? is not only customary, but essential to success. Nor can the present wildness of partridges be ascribed, as it so often is, to the short stubbles left by the modern reaping-machine ; grouse have become equally vpild of- late

years, and the reaping-machine argument, which is quoted ad nauseam, can hardly be applied to them. Moreover, even if knee-deep stubbles ??? presuming them to have ever existed ??? have disappeared within the last half-century, root and clover crops, which afford far better cover, have increased in the proportion of two to one in the same period. The wariness of modern game must be attributed to its real cause ??? the enormous in- crease in shooters, and the corresponding improvements in firearms. The most general method of shooting partridges nowadays is to drive them off the stubble and grass fields into the root crops, and then walk them up in line ??? a rather uninteresting form of sport. Care should always be taken to walk across the drills ; and when, as must frequently happen, a dead or wounded bird cannot be found at once, it is advisable not to waste time in looking for it at the moment, but to beat the field out, as otherwise any game still in front of the guns will run down the furrows and rise out of shot. A stick should be thrust into the ground where the bird was seen to fall, and it can be looked for afterwards ; but the best plan, where practicable, is to have an attendant keeper with a couple of steady retrievers, whose sole business is to stay behind the line of guns to look for such lost or running birds. As vpith grouse so with partridges, the tendency of the age is to drive them where practicable, and of all forms of what may be termed " artificial " shooting, not one is so difficult of consumma- tion as partridge-driving. To attempt it in an unsuitable locality without careful attention to the usual line of flight of the birds, or above all, under the direction of a keeper who does not understand the art of driving ??? and how many are there who do ? ??? is merely to court disaster, and to spoil what otherwise might have been an excellent day's shooting " in, line " or over dogs. But, given the necessary essentials to success, partridge – driving is a delightful sport, which, moreover, tends enormously to increase the stock of birds. To kill driven partridges neatly and con- sistently is the highest test of skill in shooting, requiring great quickness of hand and eye, and, it is needless to remark, considerable experience. Space only permits of mention of one axiom for success. The shooter should stand as far back as possible from the hedge behind which he is placed, and as the covey tops it, concentrate his attention on the bird which first catches his eye, and not allow it to be diverted to another. Wherever possible, the guns should stand in a grass field ??? where running or wounded birds are more easUy retrieved

<u>✓✓✓ equidistant between two fields of roots, so that the birds, being gradually collected into the one, can be sent out of it over the guns into the other, and unless the ground or the wind be unfavourable, brought back again in a return drive ; the more partridges are broken up and kept on the move, the better. Frequent change of blood is essential</u>

<u>where it is intended to maintain a large stock of partridges, and all superfluous cooks should be killed off before the commencement of the breeding season ; this is easily done by an experienced keeper.</u>

<u>In dealing -with pheasant-shooting, or, to give it its modern title, “covert-shooting,” it is essential to point out that, except when treated as a ” rocketer,” the phea- sant is an uninteresting bird of sport, which, unless forced to the contrary, invariably seeks to escape by running , instead of flying. A rocketer is therefore an artificial production ; it is made, not born, and it has been rightly described as a bird flying high and fast towards the shooter ; but as such, if only it be high and fast enough, the pheasant has no superior from a shooting point of view. In order to ensure “rocketers,” pheasants, if possible, should always be driven down hill ; on flat ground, where this is not practicable, the guns should be placed at such a distance from the covert as enables the birds to rise high and get well on the v?ing before coming over them. In such localities, too, it will be found a good plan to cut away the undergrowth for a yard or two at the end of the covert to which the pheasants are driven ; this generally has the efiect of making them fly high. Where pheasants exist in any number, a ” false covert ” of spruce and fir loppings should be made at the point to which it is desirable to force the birds ; they will collect in this, and can then be sent over the guns in small lots at a time. As in grouse and partridge driving, much of the success of a day’s covert-shooting depends on the organizing skill of the head keeper and the manner in which he beats his coverts and places his “stops.” With regard to ground game, owing to legislation, the days have long since passed when hares would form one of the chief accessories to a day’s shooting. Whether this be advantageous from a national point of view it is not</u>

within the province of this article to discuss, but from a sportsman's point of view it is regrettable. Not, it must be confessed, that hares either afibrd great sport or demand much skill in shooting, but they form an agreeable addition to a bag, and supply an excellent article of food for the table. Babbits, on the other hand, which are far more injurious animals to vegetation of every description, show no signs of extinction. Where they are found in large quantities, the most generally practised method of shooting is to ferret them out of their burrows, which are then filled in with soil or drenched with paraffin, to induce the rabbits to remain above ground, when they are walked up in line, affording most excellent sport. Where cover is scarce, brushwood and fir-loppings should be strewn about for them to shelter under. Eabbits vidll readily lie out under such conditions for two, or even three, nights, pro- vided only the weather be dry, but in the event of snow or rain nothing will prevent them from going to ground again. Krst-rate sport is obtained during the summer months by stalking rabbits with a pea-rifle, but this should only be practised where there is no danger to live-stock or human beings from a stray or deflected bullet. Similar, but far finer, sport may be enjoyed by stalking black-cock, in districts where these beautiful birds are to be found.

Finally, with regard to the art of shooting. It is hardly necessary to point out that no amount of theoretical in- struction can produce proficiency in this, and that only experience and constant practice can ensure success. But the young or inexperienced shooter should bear one golden rule in mind ??? that in firing at a moving object his pur- pose should be to place his charge of shot not where such object actually is at the moment of pulling the trigger, but where it will be by the time the shot reaches it ; in other words, the game should fly, or run, into the shot. More- over, he should train himself to efiect this not by dwelling

on his game with his gun at his shoulder ??? a clumsy and dangerous style of shooting ??? but by firing at an imaginary point in front of it. This of course is a knack only to be acquired by practice ; but, paradoxical as it may seem, the man who wishes to acquire a quick and good style of shooting should refrain from aiming at ??? and consequently dwelling on ??? what he is trying to kill. Brain, eye, and hand must all operate in instantaneous sympathy, and the actions of

throwing the gun up to the shoulder and dis- charging it should be almost simultaneous.

Rifle Shooting. ??? Of late years there has been a remark- able tendency towards the use of smaU-bore rifles both for military and sporting purposes, on account of their low trajectory, extraordinary velocity, and absence of recoil and report. For thin-skinned animals, such as antelope or deer, the ???256 Mannlicher, with a bullet specially pre- pared to expand on impact, is probably the most perfect weapon extant. But it must be borne in mind that small- bore rifles do not inflict the " shock " of the larger gauges and heavier loads ; and although the largest and most dangerous game may be, and often is, killed by one of these tiny bullets, yet they are not to be relied on in those situations, occasionally inevitable in big game shooting, where the sportsman has to stop the charge of a dangerous and infuriated animal. Where such a possibility may ocdir, the use of a heavy rifie, a 10 or 12 bore, or a '577 Express, is to be preferred ; but gunmakers are now be- ginning to produce sporting rifles of moderate weight and gauge, -400 and -450 bores, for use on dangerous game, which fire cordite instead of black powder, the "smashing" powers of which are claimed to far exceed those of the old-fashioned large-bore rifles.

Among a score of useful works on shooting may be cited the volumes of the "Badminton Library" dealing with this subject; Hints to Young Shooters, by Sir R. Patnb-Gallwey ; The Fur and Feather series, published by Messrs Longmans, Green and Company ; and Wild Beasts and their Ways, by Sir Samuel Baker. (p. St.)

ShorehcllTI, a town and urban district, England, Sussex, in the Lewes parliamentary division of the county, at the mouth of the river Adur, 5 miles east of Worthing, with a station at the junction of the Horsham branch of the London, Brighton, and South Coast Kailway with its coast line. Formerly it returned two members to Parliament, but in 1885 its representation was merged in that of the county. The trade of the small port is chiefly in coals, corn, and timber. Shipbuilding is also carried on. It was from Shoreham that Charles II. escaped to Fecamp after the battle

of Worcester, 1651. The popula- tion of the parish and urban district of New Shoreham was in 1891, 3393 ; in 1901, 3837.

ShorncIifFe, a military station, Kent, England. See Sandgate.

Shortha.nd. ??? The distinctive features in recent shorthand history have been the widely-extended employ- ment of the art, the increased attention paid to instruction, and the growth of stenographic societies. Throughout the civilized world the systems employed are those of the lead- ing authors of the 1 9th century ; earlier systems have now a numerically small number of practitioners. Shorthand has become an almost indispensable qualification for the amanuensis, and practical stenographic ability is a neces- sary equipment of the typewriter operator. In professional and commercial offices, and more recently 'in the services, dictation to shorthand writers has become general. Short- hand has been included among examination subjects for the army, navy, civil service, and medicine in the United Kingdom, and to a certain extent in other countries. Its inclusion in the Technical Instruction Act of 1889 was the first recognition of shorthand by the British Parliament,

and it was subsequently comprised in the codes of elementary day and evening continuation schools. It first became an examination subject for secondary schools in the Oxford Local Examination in 1888, but the Society of Arts has examined students of polytechnics, &c., in shorthand since 1876. Examinations in connexion with the phonographic system of Isaac Pitman date from 1845.

In 1887 the tercentenary of the origination of modern shorthand by Timothy Bright and the jubilee of Isaac Pitman's phonography were celebrated by the holding of the first International Shorthand Congress in London. Subsequent congresses were held at Paris (1889), Munich (1890), when a statue of Gabelsberger was unveiled ; Berlin (1891), Chicago(1893), Stockholm(1897), and Paris (1900). These gatherings have promoted the improved organization of stenographic practitioners in

the respective countries. After the first congress, three national organizations were established in Great Britain by Pitman writers, which take the place of the Phonetic Society (established in 1843 and dissolved in 1895). In America the formation of national associations for reporters and teachers followed the fifth congress. The inventor of phonography. Sir Isaac Pitman (1813-97), was knighted three years before his death for his " great services to stenography." An enumeration made in 1894 showed that 95 per cent, of British news- paper reporters write Pitman's system. Recent essays in Enghsh shorthand authorship are almost entirely in the direction of script characters with connected vowels, as con- trasted with the geometric forms and disjoined vowels of Pitman's phonography. The majority are founded on the French system of the brothers Duploy^, but Cursive Short- ka-nd (Cambridge, 1889), by Professor H. L. Callendar, and Current Shortharid (Oxford, 1892), by H. Sweet, LL.D., may be noted as original methods, the first having a phonetic, and the second both an orthographic and a phonetic, basis.

The earlier article on Shorthand in the Sncyclopcedia Britanniea (xxi. 836) contains a fall account of the subject. Among the later publications dealing fully with the history and practice of short- hand are the Transactions of the London Congress in 1887, and similar publications in connexion with later congresses ; Biblio- graphy of Shorthand, by J. Westbt-Gibson, LL.D. (London, 1887), treating of English, colonial, and American authors ; Shorthand Instruction and Practice, by J. E. Rockwell, of the United States Bureau of Education (Washington, 1893), dealing with shorthand work throughout the world ; and Examen Critique des Stdno- graphics Fran^aises et Mrangires, by Dr Thierry-Mieg (Versailles, 1900). For Sir Isaac Pitman see Biography, by T. A. Reed (London, 1890) ; Eistory of Our Own Times, vol. v., by Justin-M'Cartht (1897) ; and Dictionary of Kational Biography, third supplementary volume (1901). An interesting discovery in short- hand biography may be noted, namely, that Samuel Taylor, the author of the system bearing his name, died in 1811 ; see M. Levy in The Times, 10th April 1902, and Notes and Queries, 24th May 1902. (e. Pi.)

Shorthouse, Joseph Henry (1834),

novelist, was born in Great Charles Street, Birmingham, 9th September 1834, eldest son of Joseph Shorthouse, chemical manufacturer, and Mary Ann, daughter of John Hawker, of the same town. He was educated at Grove House, Tottenham, where he proved a promising and industrious pupil, and upon leaving school entered his father's business, in which he was all his life actively engaged. He married, in 1857, Sarah, daughter of John Scott, of Birmingham. His literary interest was fostered by a local essay club, to which he contributed many papers. It was not until he was nearly fifty years old that Shorthouse made his public appearance as an author, and even then his remarkable story, John Inglesant, had undergone vicissitudes. It was kept for over three years in MS., and the author eventually printed one hundred copies for private circulation. One of these found its way into the hands of Mrs Humphry Ward, who recom-

mended it to a publishing house. Its first appearance was a quiet one; but Gladstone was at once struck by its quality, and made its reputation by his praise. It became the most discussed book of the day, and its author was suddenly famous. Besides John Inglesant (1881), Mr Shorthouse published The Little Schoolmaster Mark (1883), Sir Percival (1886), The Countess Eve and A Teacher of the Violin (1888), and BlancJie, Lady Falaise (1891); but none of these has been so popular as his first novel. He will always remain known to fame as " the author of John Inglesant." Mr Shorthouse was originally a Quaker, but the appeal of the Anghcan Church was insistent with him, and he was baptized into its body before the appearance of his story. Some- thing of his own stress of religious transition appears in the character of his hero, who is pictured as hving in the time of the Civil War, a pupil of the Jesuits, a philosopher and a Platonist, who is yet true to the National Church. The story, which is deeply mystical and imaginative, has for its central idea the dangers of bigotry and superstition, and the necessity of intuitive religion to progress and culture. It is a work full of opulent colour and crowded life, no less than of philosophy and spiritual beauty. Mr Shorthouse's work is always marked by high earnestness of purpose, a rich and luxuriant manner, and a naturally religious spirituality. He lacks dramatic faculty and the workmanlike conduct of narra- tive, but he has almost every other quaUty of the born novelist.

ShOShong. See Bechuanaland.

ShottS, a mining and manufacturing parish of Lanark- shire, Scotland, comprising five villages and parts of two others, and two stations on the North British and three on the Caledonian Railway. The parish contains large iron works, tile, fire-clay, and brick works, and quarries. There are four Established churches, three United Free, an Original Secession, a Congregational Union, and a Roman Cathohc. Seven public schools had in 1898-99 an average attendance of 1399, and a Roman Cathohc school 755. Population

(1891), 11,957; (1901), 15,561.

Shreveport, a city of Louisiana, U.S.A., the capital of Caddo county. It is situated in 32 ̊ 30′ N. and 93 ̊ 45′ W., in the north-western part of the state, at an altitude of 180 feet. It has seven railways, the Queen and Crescent, the Houston and Shreveport, the Port Arthur Route, the St Louis South – Western, the Shreveport and Red River Valley, the Texas and Pacific, and the Sherman, Shreveport, and Southern. These, with boats on the river, which is navigable, give the city a large trade. The surrounding country is a rich agricul- tural region, mainly devoted to the production of cotton, for which Shreveport serves as the principal shipping point. It contains cotton gins, compresses, and oil mills. Population (1890), 11,979; (1900), 16,013, of whom 726 were foreign-born and 8542, or 53 per cent., were negroes.

Shrewsbury, a municipal and parliamentary borough, capital of Shropshire, England, in the Newport pafliamentary division of the county, 30 miles south of Chester by rail. The wards of the municipal borough were rearranged in 1891. The church of St Mary's, much injured in 1894 by the fall of 50 feet of its spire, has been restored, and also the church of the Holy Cross, while that of Holy Trinity has been rebuilt with the exception of the chancel. The Shire Hall and Guildhall, burned down in 1881, were rebuilt in 1884 at a cost of over 30,000. The free library and museum installed in the old building of the grammar school were opened in 1885, and a new theatre was built in 1898. The Royal Grammar School

was removed in 1882 to Kingsland, on the Hereford side of the river, where a tract of 27 acres, formerly the scene of the Shrewsbury Show, had been acquired. The build- ings of the old foundling hospital, originally costing ❖❖12,000, were adapted to the purposes of the school; other buildings were erected, including residences for masters; and a handsome school chapel, part of which forms a memorial to Dr Kennedy, headmaster, 1836- 1866, was dedicated in 1883. In 1894 the Jubilee Baths were built. Population (1891), 26,967 ; (1901), 28,396.

Shropshire, or Salop, a north-western county of England, on the borders of Wales, bounded on the N. by Cheshire and an interpolated portion of Flint, on the E. by SUfford, on the S.E. by Worcester, on the S. by Hereford, on the S.W. by Eadnor, on the W. by Montgomery, and on the N.W. by Derby.

Area and Population. ❖❖❖ The area of the ancient and administra- tive county, as given in the census returns of 1891, is 859,576 acres, or 1343 square Ailes, with a population in 1881 of 248,022, in 1891 of 236,339, of whom 116,736 were males and 119,603 females; and in 1901 of 239,321 ; the number of persons per square mile being 178, and of acres to a person 3 ~~5. In 1895 the following changes were made in the area of the administrative county : ❖❖❖ To Hereford was transferred the part of the parish of Lantwardine in Shropshire, to Stafford the part of the parish of Bobbington in Shropshire, to "Worcester the parish of Dowles, and to Shropshire the parish of Tittenley from Cheshire, the part of the parish of Ludford in Hereford, and the part of the parish of Sheriff Hales in Stafford. The area of the registration county is 952,842 acres, with a population in 1891 of 254,765, of whom 84,549 were urban and 170,216 rural ; and in 1901 of 259,093. Within the registra~~ tion area there was between 1881 and 1891a decrease in the popula- tion of 4-18 per cent. The excess of births over deaths between 1871 and 1881 was 29,072, but the decrease in population was 11,112. The following table gives the

numbers of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 : ???

Tear.

Marriages.

Births.

Deaths.

Illegitimate Births.

Males.

Females.

1880 1890 1898

1500 1612 1772

7750 6858 6898

4619 4442 4055

339 283 254

281 235 240

The number of marriages in 1899 was 1779, of births 6718, and of deaths 4366.

The following table gives the marriage-, birth-, and death-rates per 1000 of the population, with the percentage of illegitimate births, for a series of years : ???

1870-79.

1880.

1880-89.

1890.

1SS8-97.

1898.

Marriage-rate

12-6

11-3

11-9

12-6

13-1

14-4

Birth-rate .

31-6

29-1

28-7

26-8

27-6

28-0

Death-rate .

19-1

17-3

17-4

17-4

17-2

16-5

Percentage of ille-

gitimacy .

8-6

8-0

8-2

7-6

7-4

7-2

The percentage of illegitimacy is exceptionally high for an English county. In 1891 there were in the county 797 natives of Scotland, 1284 natives of Ireland, and 2118 foreigners.

Constitution and Government. ??? Neither the parliamentary nor the judicial arrangements have undergone any change since 1886. There are six municipal boroughs : Bishop's Castle (1378), Bridge- north (6049), Ludlow (4552), Oswestry (9579), Shrewsbury (28,396), and Wenlock (15,866). The following are urban districts : Church Strettou (816), Dawley (7522), EUesmere (1945), Newport (3241), Oakengates (10,837), Weinngton (6273), and Whitchurch (5219). The ancient county, which is in the dioceses of Hereford, Lichfield, and St Asaph, contains 261 ecclesiastical parishes and districts, and parts of 24 others.

Education. ❓❓❓ Shrewsbury is the seat of a famous public school. The number of elementary schools in the county on 31st August 1899 was 310, of which 36 were board and 274 voluntary schools, the latter including 254 National Church of England schools, 5 Wesleyan, 7 Roman Catholic, and 8 "British and other." The average attendance at board schools was 6732, and at voluntary schools 28,030. The total school board receipts for the year ended 29th September 1899 were ❓❓23,806. The income under the Agricultural Rates Act was over ❓❓1010.

^i/ricM^tere. ❓❓❓ About five-sixths of the total area is under culti- vation, and of this area about five-eighths is in permanent pasture. There are also about 35,000 acres in hill pasturage, 4800 under orchards, and 50,000 under woods. The acreage under corn crops has been diminishing, the diminution being chiefly in the acreages under wheat and barley, oats tending rather to increase. About five-sixths of the acreage under green crops is occupied by turnips, cattle being largely kept specially for dairy purposes. The following table gives the acreages of the main divisions of the cultivated area at intervals from 1885 :

Year.

Total Area under Cul- tivation.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1885 1890 1895 1900

716,599 720,431 717,963 719,080

150,085 143,678 131,809 132,690

61,101 58,696 57,076 55,044

71,470 70,946 69,526 71,149

426,859 441,553 455,521 458,027

6978 5296 3577 1873

The following table gives the numbers of the principal live stock for the same years : ???

Tear.

Total Horses.

Total Cattle.

Cows or Heifers

in Milk or in

Calf.

Sheep.

Pigs.

1885 1890 1895 1900

32,323 32,683 35,205 33,736

162,932 166,660 164,928 180,113

60,976 60,669 59,406 63,604

438,664 479,880 437,987 470,577

61,067 74,025 81,560 66,594

Industries and Trade. ??? According to the report for 1898 of the chief inspector of factories (1900), the total number of jiersons employed in factories and workshops in 1897 was 14,318, as com- pared with 13,706 in 1896. Woollen goods are manufactured. Non-textile factories e-nployed 10,644 persons, there being an in- crease between 1895 and 1896 of 18-2 per cent., and between 1896 and 1897 of 1-2. Ofthese, 3201 were employed in the manufacture of machines, appliances, conveyances, tools, &c. (chiefly agricul- tural implements at Ludlow, Oswestry, Shrewsbury, Wellington, &o.), 2130 in the founding and conversion of metals, 2064 in the clay and stone industries (including earthen and china ware, bricks and tiles, encaustic tiles, and tobacco pipes in the Broseley district). Workshops employed 3014 persons, 1447 being em- ployed in clothing industries. The total number of persons employed in connexion with mines and quarries in 1899 was 5487. The same year 272,037 tons of igneous rocks were raised, 172,651 tons of limestone, 131,748 tons of clay, and 36,757 tons of sandstone. There is a general decline in the out- put of the more valuable minerals, but a considerable quantity of pig-iron is produced by the blast furnaces at Ironbridge and Shifnal, the quantity in 1885 amounting to 44,732 tons, in 1890 to 43,084 tons, in 1895 to 49,010 tons, and in 1899 to 40,597 tons. Lead is obtained at Minsterley, and barytes at Minsterley, Pontesbury, Stiperstones, and Chirbury. The follow- ing table gives particulars regarding some of the more valuable minerals in 1890 and 1899 : ???

Year.

Barytes.

Coal.

Iron.

Lead.]

Tons.

Value.

Tons.

Value.

Tons.

Value.

Tons.

Value.

1890 1899

4838 6680

_?_?8083

4567

766,629 766,219

_?_?229,988

287,332

44,630 28,571

_?_?17,862

10,394

1972 1468

_?_?18,927

14,414

Reoest AuTHOfilTlBs. ❓❓❓ Walcott. Introduction to Sources of Salopian Topography. Shrewsbury, 1879. ❓❓❓ La Touche. Handbook to the Geology of Shropshire. 1886. ❓❓❓ Boederer.

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Waktek. An Old Shropshire Oak, 4 vols. London, 1886-91.

Fletchek. Religious Cmis-us of Shropshire in 1676. London, 1891. ❓❓❓ Ceanage. Architectural Account of the Churches of Shropshire. Wellington, 1894-99. ❓❓❓ Timmins. Nooks and Comers of Shropshire. London, 1899. ❓❓❓ Various antiquarian and other items are also to be found in Shropshire Notes and Queries. (t F H ^

Shusha, a district town of Transcaucasia, Russia, in the government and 87 miles south-south-east of the town of Elizabethpol, situated at an altitude of 1380 feet. Various domestic industries, the chief of which are silk- weaving and the manufacture of leather, are carried on by its inhabitants. In 1897 its population was 25,656.

Sh UStav. See Aeabistan.

Shuvdiof (sometimes written Schouvaloff) Peter Andreivitch, Count (1827-1889), was born in 1827 of an old Russian family which rose to distinction

and imperial favour about the middle of tlie 18tli century. Several of its members attained high rank in the army and the civil administration, and one of them may be regarded as the founder of the Moscow University and the St Peters- burg Academy of the Fine Arts. As a youth Count Peter Andreivitch showed no desire to emulate his distinguished ancestors. He studied just enough to quahfy for the army, and for nearly twenty years he

led the agreeable, commonplace life of a fashionable officer of the Guards. In 1864 Court influence secured for him the appointment of Governor-General of the Baltic Provinces, and in that position he gave evidence of so much natural ability and tact that in 1866, when the revolutionary fermentation in the younger section of the educated classes made it advis- able to place at the head of the political police a man of exceptional intelligence and energy, he was selected by the Emperor for the post. In addition to his regular functions, he was entrusted by his Majesty with much work of a con- fidential, delicate nature, including a mission to London in 1873. The ostensible object of this mission was to arrange amicably certain diplomatic difficulties created by the ad- vance of Russia in Central Asia, but he was instructed at the same time to prepare the way for the marriage of the Grand Duchess Marie Alexandrovna with the duke of Edinburgh, which took place in January of the following year. At that time the Emperor Alexander II. was anxious to establish cordial relations with Great Britain, and he thought this object might best be attained by appointing as his diplomatic representative at the British Court the man who had conducted successfully the recent matrimonial negotiations. Count ShuvAlof was accordingly appointed ambassador in London ; and he justified his selection by the extraordinary diplomatic ability he displayed during the Eusso-Turkish war of 1877-78 and the subsequent negotiations, when the relations between Russia and Great Britain were strained almost to the point of rupture. After the publication of the Treaty of San Stefano, which astonished Europe and seemed to render a conflict inevit- able, he concluded with Lord Salisbury a secret convention which enabled the two Powers to meet in congress and find a pacific solution for all the questions at issue. In the deliberations and discussions of the congress he played a leading part, and defended the interests of his country with a dexterity which excited the admiration of his colleagues ; but when it became known that the San Stefano arrange- ments were profoundly modified by the Treaty of Berlin, public opinion in Russia condemned him as too conciliatory, and reproached him with having needlessly given up many of the advantages secured by the war. For a time Alex- ander II. resisted the popular clamour, but in the autumn of 1879, when Prince Bismarck assumed an attitude of hostility towards Russia, Count Shuvilof, who had been long regarded as too amenable to Bismarckian

influence, was recalled from his post as ambassador in London ; and after living for nearly ten years in retirement, he died at St Petersburg in 1889. (d. m. w.)

ShwebO, a district in the Sagaing division of Upper Burma; area, 8376 square miles; population (1891), 230,779; (1901), 287,049, an increase of 24-4 per cent. It lies between the Katha, Upper and Lower Chind- win, and Mandalay districts. The Irrawaddy forms the dividing line on the east. The physical features of the district vary considerably. The Minwun range runs down the whole eastern side, skirting the Irrawaddy. In the north it is a deflned range, but at Sheinmaga, in the south, it sinks to an undulation. WcKt of the Mu river, in the centre of the district, there is a ij;radual ascent to the hills which divide Sagaing from the Upper Chindwin. Between these ranges and on both aides of the Mu is a plain.

unbroken except for some isolated hills in the north and north-east and the low Sadaung-gyi range in the south-east. The greater part of this plain is a rice-growing tract, but on the sloping ground maize, miUets, sesamum, cotton, and peas are raised. A good deal of sugar is also produced from groves of the Tari palm. The Mu river is navigable for three months in the year, from June to August, but in the dry weather it can be forded almost anywhere. A good deal of salt is produced in a line which closely follows the railway. Coal is worked at Kabwet.

There are about 1050 square miles of protected forest east of the Mu, and in the Ye-u subdivision, to the west of the river, there are 800 square miles reserved. The Ye-u forests are much more valuable than those to the east on the Minwun and the Mudein. Extensive irrigation works existed in the Shwebo district, but they fell into disrepair iu King Thebaw's time. Chief of these was the Mahananda Lake. A scheme to restore the old works has been pre- pared. The rainfall follows the valleys of the Mu and the Irra-waddy, and leaves the rest of the district comparatively dry. It varies from an average of 31 to 34 inches in Shwebo. The average temperature is 90 in the hot weather, and falls to 60 or 61 in the cold season, the maximum and minimum readings being 104 and 56 . There were in 1898-99, 1200 villages, paying Es.5,29,292. The amount of

cultivated land iu the same year was 217,654 acres, and there remained 663,421 acres available.

Sialkot, a town and district of British India, in the Rawalpindi division of the Punjab; The town is 72 miles north-east of Lahore. Population (1881), 45,762 ; (1891), 65,087 ; municipal income (1897-98), Rs.l, 01,032 ; death- rate (1897), 33 per thousand. It is a military cantonment. It has manufactures of paper, cotton cloth, and shawl- edging. There are Scottish and American missions and a Scottish mission college, with 14 students in 1896-97, four high schools, a Christian training institute, and 4 secondary schools for girls.

The district of Sialkot has an area of 1991 square miles ; popu- lation (1881), 1,012,148; (1891), 1,119,817, showing an increase of 11 per cent.; average density, 562 persons per square mile. In 1901 the population was 1,084,515, showing a decrease of 3 per cent. The land revenue and rates in 1897-98 were Rs. 16,91, 323, the incidence of assessment being R.l:2:9 per acre ; cultivated area, 820,056 acres, ofwhioh 504,363 were irrigated, almost all from wells ; number of police, 663 ; number of schools, 411, attended by 13,875 boys, being 14 per cent, of the boys of school-going age ; death- rate (1897), 24‘9 per thousand. The principal crops are wheat, birley, maize, millet, sugar-cane, and cotton. There are no Government canals. The district is crossed by a branch of the North-Western Railway from Wazirabad to Jamu,

Siclirii known to its inhabitants as Muang Tai, the last independent kingdom of Indo- China, consists geo- graphically of two distinct portions. 1. Upper Siam, constituting the heart of the Indo-Chinese ^gg^raobr peninsula, is bounded, to the east of Chieng Sen (20 ́́ 15′ N. and 100 ́́ 5′ E.), by the Me Kong or Cambodia river, which, after the Franco ~~Siamese treaty of 1893, formed the western frontier of the French Indo~~ Chinese possessions down to 13 ́́ 13′ N. By the Franco-Siamese Convention of October 1902, the frontier between Siam and Cambodia starts on the left bank of the Great Lake from the mouth of the Stang Rolnos river, and follows the parallel of latitude eastwards until it meets the Prek Kompong Tiam river. Then, turning northwards, it coincides with the meridian from this point of meeting up to the Pnom

Dang Rek mountains. Thence it follows the watershed between the Nam Sen and Me Kong basins on the one hand, and meets the Pnom Padang chain, the summit of which it follows eastwards to the Me Kong, leaving to France the old Cambodian province of Meluprey and the Laos jirovince of Bassac. The northern frontier between Luang Prabang (right bank) and the provinces of iluang Phichai and Muang Nan was also rectified. Westwards from Chieng Sen and southwards to Kra (10 30' N.), the frontier divid- ing Siam from British Burma is formed by the high forested ranges which make the water-parting between the Bay of

Bengal and the Gulf of Siam, with the exception of an interval between the 15th and 19th parallels, where the Salween and the Taung-yin rivers form a portion of the frontier line. 2. Lower Siam comprises the portion of the Malay Peninsula under Siamese rule, which, from the 10th parallel southwards until Province Wellesley is reached in 5 33'N., stretches from sea to sea. It includes the protected Malay states of Keda on the west and of Kelantan and Treng- kanu on the east, the frontier between the Siamese posses- sions and the British protected states of Perak and Pahang running in a general east-south-east direction to the coast in about 4 20' N., which is the southernmost point of Siam.

The two important geographical features of Upper Siam are the basin of the Me Nam and the Korat plateau, which lies at a mean elevation of about 600 feet above sea^level and occupies a rectangular area of over 70,000 square miles. It is characterized by tracts of open shade- less jungle, alternating with wide swamps and salt wastes. It is drained by a number of unimportant streams flowing to the Me Kong ; the only river of importance is the Nam Mun, which drains the whole of the southern portion of the plateau. The Lao population is sparsely scattered in small villages, usually along the river banks, there being only four towns of any importance Korat, Ubon, Bassac, and Nawng Kai. But it is the Me Nam basin which constitutes in more senses than one the heart of Siam. Geographically, the tributaries of the river form trenches cut from north

to south through the rough hill country of the Lao states. The successive capitals of the Siamese were planted by the banks of the Me Nam, and the greater part of the population of the country is to this day settled upon it and its many creeks. At the north- east and north-western corners of the gulf the two rivers, the Bang Pa Kong and the Me Kong, flow to the sea, draining ??? the one the southern slopes of the Dawng Praya Yen and the rich rice districts of Pachim, Nakawn-Nayok, and Petriu ; the other, the steep eastern valleys of the Tenasserim frontier range and the garden lands of Kanburi and Ratburi. Both these rivers are connected by an admirable series of navigable canals with the Me Nam and Tachin channels.

The mountain districts encircling the head- waters of the Me Nam, which deflect the Me Kong eastwards along the 20th parallel, do not rise to any considerable height. On the west the watershed between the Salween and the Me Nam is more marked, and develops as it stretches south- wards into the well-defined granite wall which, with a slight interruption at Kra, forms the backbone of the Malay Peninsula as far as Junk Ceylon, in 8 ?? N., from which point a fresh range, rising to the eastwards in the province of Nakawn Si Tamarat, takes up its functions.

On the eastern side of the gulf, between the 11th and 13th parallels, the hill system of the Patat range and of Chantabun occurs, cutting off the Cambodian plains from the sea, and itself quite isolated from the hill districts of Indo-China by the plains of the Kabin and Sisopon rivers on the north and east. At the same time the geological conditions may be compared with those of the Me Kong valley of the 20th parallel. The basaltic outcrops, in the neighbourhood of which the gem deposits of both districts occur, although of different ages, are similar in their mode of occurrence ; the metamorphic schists of the Me Kong are represented in the Chantabun area by hard quartz grits. The limestones of the Kaw Chang group of islands show much the same symptoms of dislocation as those which form the prominent peaks of the Me Kong region. The general geological structure of both areas, however, in contradistinction toj that of the Malay Peninsula, is of a very complicated nature, and needs a more care- ful and detailed examination than has yet been possible.

The limestones referred to are a most striking feature of Indo-China, and appear to be of Carboniferous age. The fragments of this once vast formation are found tilted, con- torted, and weathered in inaccessible peaks and precipices from Perak to Tongking, their caves affording protection to many Buddhist shrines and to colonies of nesting swiftlets (chiefly Peate's Collocalia spodiopygia), from which Chinese epicures derive their birds'-nest soup. In many parts of Siam, on the other hand, dolomitization has taken place on a large scale.

Although enervating, the climate of Siam, as is natural from the position of the country, is not one of extremes. The wet season ﬁ May to October ﬁ corresponds with the prevalence of climate the south-west monsoon in the Bay of Bengal. The full force of the monsoon is, however, broken by the western frontier hills ; and while the rainfall at Mergui is over 180, and at Moulmein 240 inches, that of Bangkok seldom exceeds 54, and Chiengmai records an average of about 42 inches. Puket and Chantabun, being both on a lee shore, in this season experience rough weather and a heavy rainfall ; the latter, being farther from the equator, is the worst off in this respect. At this period the temperature is generally moderate, 65 ﬁ to 75 ﬁ F. at night and 75 ﬁ to 85 ﬁ by day ; but breaks in the rains occur which are hot and steamy. The cool season begins with the commencement of the north-tast monsoon in the China Sea in November. While Upper Siam enjoys a dry climate with cool nights (the thermometer at night often falling to 40 ﬁ-50 ﬁ F., and seldom being over 90 ﬁ in the shade by day), the eastern coast of the Malay Peninsula receives the full force of the north-easterly gales from the sea. This lasts into February, when the northerly current begins to lose strength, and the gradual heating of the land produces local sea breezes from the gulf along the coast-line. Inland, the thermometer rises during the day to over 100 ﬁ F., but the extreme continental heats of India are not known. The comparative humidity of the atmotphere, however, makes the climate a trying one for Europeans.

The rainy season is generally the most unhealthy, various forms of malarial fever, especially violent in the hill districts, being then prevalent. By far the largest percentage of deaths among the people are due to this cause. Dysentery and cholera, which are endemic, are most frequent in

the plains at the conclusion of the dry season and during the first rains. Cholera is for the most part confined to the natives, and in Bangkok is principally due to the want of a proper water-supply, the people drinking the water of the river and canals.

In its flora and fauna Siam combines the forms of Burma and the ShEln States with those of Malaya, farther south, and of Cam- bodia to the south-east. The teak tree grows all over . the hill districts north of latitude 15 , but seems to '"'' attain its best development on the west, and on the east does not appear to be found south of 17 - Most of the so-called Burma teak exported from Moulmein is iloated down from Siamese territory. Among other valuable forest products are thingan wood {Hcrpea adorata), largely used for boat-building ; damar oil, taken through- out Indo-China from the Dipterocarpus levis; agilla wood, sapan, rosewood, iron-wood, ebony, rattan, and a number of finely-grained woods, which, with cotton, silk, tobacco, and many spices, will become accessible to the market as communications improve. Among the chief productions of the plains are rice (the staple export of the country) ; pepper (chiefly from Chantabun) ; sirih, sago, sugar-cane, cocoa-nut and betel. Palmyra or sugar and attup palms ; many forms of banana and other fruit, such as durian, orange-pommelo, guava, bread-fruit, mango, jack fruit, pine-apple, custard-apple, mangosteen. In the hill country of the northern Lao States more temperate forms, such as oak, pine, and chestnut, are found.*

Few countries are so well stocked with big game as is Siam. Chief of animals is the elephant, which roams wild in large numbers, and is extensively caught and tamed by the people for transport. The tiger, leopard, fishing-cat, Pauva.

leopard-cat, and other species of wild-cat, as well as the honey- bear, large sloth-bear, and one- and two-horned rhinoceros, occur. Among the great wild cattle are the formidable gaur, or seladang, the banting, and the water-buffalo. The goat antelope is found, and several varieties of deer. Wild pig, several species of rats, and many bats one of the commonest being the flying-fox, and many species of monkey especially the gibbon are also met with. Of snakes, 56 species are

known, but only 12 are poisonous, and of these 4 are sea-snakes. The waters of Siam are particularly rich in fish. The crocodile is common in many of the rivers and estuaries of Siam, and there are many lizards ??? the largest, the water monitor, growing to a length of over 7 feet. The country is rich in birds, a large number of which appear to be common to Burma and Cambodia.

The mineral products of Siam include tin ; gold, which is dis-

eeminated in small quantities in nearly all the important river de- posits ; isolated reef workings have not as yet met with very great Minerals ^^'-^^^ ! iron (limonite and hematite), which is locally worked ; and other ores which, owing to the inaccessi- bility of the most mineralized zones, cannot in present circumstances pay commercially, and have not as yet been adequately prospected. Salt is also produced in some quantities for local consumption. Sapphires are worked by Shan diggers at Pailin on the eastern slopes of the Patat range, and have been found at Chieng Kawng and elsewhere. The Siam rubies, mostly from Chantabun, are generally inferior in colour to the Burma stones.

The total population is roughly estimated at 9,000,000, of whom a third are Siamese, a quarter Chinese or of Chinese descent, and ???. the remainder mainly Lao, with about 500,000 of Cam- tlMi' ' bodian and the same number of Malay origin. There are about 600 Europeans in Bangkok, of whom a third are British, about a quarter are American, and the rest principally German, Danish, and Belgian. There are over 10,000 British Asiatic subjects registered at the consulate. There are, however, no accurate statistics of the population ; owing to the high death-rate, it does not multiply at the rate which might be expected. The Siamese race has intermarried so largely with the Chinese and the surrounding peoples that, except in Rayong and some places on the Malay Peninsula, very few undoubtedly pure- blooded Siamese can now be found. The immigration

of the Chinese, which dates from very ancient times, continues uninterruptedly ; a regular supply is also kept up to all the mining districts of the Malay Peninsula. As has occurred wherever immigrant Chinese have come into contact with the easy-going natives of the neigh- bouring tropical countries, the Chinese in Siam have acquired the most important share in the trade and industries of the country. There are practically no Chinese women in the country, but the men freely intermarry with Siamese women, and there is growing up a considerable mixed population, especially in the neighbourhood of the capital, who are called Lulcchins. The Chinese are not loved by the Siamese, but they are tolerated. In fact, they are indis- pensable, and every form of work and business would be at a standstill without them.

Another immigration from the north-east has been constant since 1882 : that of the Ka Muk and other hill peoples coming from the highlands of south-western China ; but the acquisition by France of Luang Prabang and the neighbourhood of the Nam U valley will have the tendency in all probability of checking this movement. While the plain dwellers of Upper Siam consist mainly of the Tai (Siamese in the south and Lao in the north), the population which has been thrust by the Tai immigration into the hill country presents many different types. The Karens of the western frontier range extend northwards from latitude 13 ??. In the Lao country the Ka peoples, variously named Lawa, Lamet, Ka Hok, Ka Yuen, and Ka Mu, are met with ; and in the Me Kong valley and farther east come the Lu, Yao, Yao Yin, Lanten, Meo, and Musur, all of whom have many dis- tinct Yunanese characteristics, and are fine, hardy mountaineers. Around the forest edges of the Korat plateau are found small num- bers of Suey, aboriginal tribes answering to the Chong people of the Chantabun and Battambang Ghongs hill districts farther south. In the Malay Peninsula, below the southernmost Karen settlements, Malays begin to be met with near the sea, and Inland small roving bands of the Sakei and Samang inhabit the higher ranges.

There are very few towns with a population of over 10,000 in- habitants in Siam, the majority being merely scattered townships or clusters of villages, the muang, which gives its name to the province, being often merely a few houses round the governor's residence. The more important

towns of the delta include Petriu, Pechim, and Kabin on the Bang Pa Kong ; Kanburi, Eatburi, and Petcliaburi on the west ; Ayuthia, the old capital of Siam, Lopha- buri, Angtong, Chainat, and Paknam Po on the Me Nam ; Sara- buri and Lom Sak on the Nam Sak ; Pitsunalok, Pichai, and Utaradit on the upper Me Nam, and Raheng on the western branch ; while Korat, Ubon, Bassao, and Nawngkai are the oidy places of im- portance on the Korat plateau. In the Malay Peninsula, besides Singora on the east coast and Puket on the west, the im- portant points are Bangtapan, Champawn, Chaiya, Nakawn Si Tainaraj, Tani, Kelantan, and Treng Kanu on the east, and Renawng Takua Pa, Trang, and Keda on the west. The principal towns on the Cambodian side are Chantabun, Battambang, Siemrap, and Sioopon. (For the principal centres of population in the Lao States, see under Lao.) The mnjority of these places are little more than jungle settlements, forming administrative and com- mercial centres of mnrely local importance. The capital, Bangkok, has a population of about half a million, and is the seat of a highly centralized system of government ; it also contains the rpsidences of all the chief nobles and officials. The town next to Bangkok in importance is Chiengmai, the so-called capital of the north, with a populntion of at least over .50,000.

The Government of Siam is an absolute monarchy, and the suc-

cession to the throne is now limited to the oldest princes of the blood, who are sons of the king. The old office of second king was abolished on the death of its last occupant. There ^ is a council consisting of nine ministers at the head ment of the departments of foreign affairs, interior, finance, household, war, justice, local government, public works, and education, together with the chief of the staff and the European general adviser. There is also a legislative council, of which the ministers of state are ex-offijAo members, consisting of about sixty nobles appointed by the king. The council exercises legislative functions, and meets every Tuesday for the transaction of its ordinary business. The king is an autocrat in practice as well as in theory. He has an absolute power of veto, and the initiative of measures rests largely with him, though now, with the increasing complexity of government, he naturally leaves many details of administration to his ministere and council. Most departments have the

benefit of European advisers, though but little executive power is entrusted to these officials. The Government oflioes are conducted more or less on European lines. The Christian Sunday is observed as a holiday, and regular hours are prescribed for attendance. But the numerous palace and other functions form a great call on the ministers' time, and the majority of them continue to be very irregular and unbusinesslike in their methods. The king frequently keeps his courtiers in attendance on him through most of the night, so that early hours are, as a rule, impossible for high officials. There is nothing in the nature of a European civil service, and posts are usually obtained by favouritism ; but the certificates of proficiency awarded by the education department are every year acquiring a greater value. The drawing up of the new codes, which are to replace the transitory laws, has been entrusted to committees in which European expert advisers are usually included. Among these measures may be mentioned regulations concerning the law of evidence, criminal and civil procedure, pawnshops, mining, harbour, timber marks, village administration, forests, marriage, and secret societies, which have all been drafted under expert European advice. For administrative purposes the kingdom is divided into munlons (or circles), at the head of which chief com- missioners are appointed from Bangkok, who reside in the circle and are directly responsible to the central Government. Each munton is subdivided on the basis of the old existing provinces, each of which is under a governor (often hereditary), who is directly responsible to the chief commissioner. By the village regulations brought into force in 1897 every province is further subdivided into districts, each under an amp'ur, every district into villages under a Tcamnan, who is elected by the village elders, and each village into groups of from ten to twenty families, at the head of each of which an elder is appointed. With the exception of the metropolitan district of Bangkok, all the muntons are under the department of the interior, which also controls the gendarmerie recently established, with excellent results, for the suppression of dacoity. The police have been completely reorganized under Anglo- Indian officials.

The Siamese have not yet shaken off the system of personal feudalism, if it may be so called, which has prevailed for many centuries in the country. Every nobleman has a large ^ j i number of retainers, in addition to debt slaves, and the ⁄,, ,^ ,^ great mass of the people are

glad to rely upon some powerful personage for help and protection, and to give him their ser- vices in return. There is, however, no such thing as caste, or even caste feeling, and there is a remarkable absence of exclusiveness for so conservative and despotically governed a country, any man, however humbly born, being suffered to rise to the highest posi- tion, if only he have the opportunity. There are no hereditary titles, except in the case of royal princes, those in use being con- ferred for life, and being attached, in practice generally as well as theory, to some partionlar office. Thus the same title may be held in succession by the different holders of some post in a Government department, a practice which often leads to some confusion.

The revenue in 1898 was approximately estimated at ►►2,000,000, made up as follows : ►►►

Duties on liquors and general imports, and rice

and other exports ►►100,000

Farms and monopolies (opium, spirits, gamb- ling, &c.) 1,000,000

Land tax 200,000

Inland dues, taxes, &c. 700,000

Total

►►2,000,000

But by 1901-2 the revenue had increased to ►►2,088,000, while the expenditure was stated to be ►►2,239,660. The methods of collec- tion have greatly improved under the administration of ►►►. European revenue officers, and there is much less corrup- tion than formerly \, but little has been done to alter the funda- mentals of taxation, and the opium, spirit, and gambling monopolies still provide a large portion of the revenue. In 1 S98 a large number of transit dues were abolished, thus removing one of the most

serious obstacles to commercial development. With the adoption of more business-like methods, no doubt the budget will be regu- larly published.

*The army consists of a small standing force of about 4000 men. The navy comprises several steam gunboats under 600 Army and *_____^' ___'__^'i '"___^ small quick-firing uuns ; the king's navy yacht, a steel twin-screw cruiser of 2500 tons, armed*

with 6, 47, and other smaller quick-firing guns ; and a number of small craft for river and coast work, which are manned by several thousand bluejackets and marines, who constitute a very efficient body of men. Most of the soldiers and sailors are descendants of old prisoners of war, and the obligation to this form of service is transmitted from father to son.

The department of justice has since 1893 been completely re- organized, and the reorganization of the provincial courts has been Justice extended to seven muntons with admirable results. Extra-territorial jurisdiction is secured by treaty for the subjects of all the chief foreign Powers, who can therefore only be sued in their consular courts, while European assessors are employed in cases where foreigners sue Siamese. The prisons have been greatly improved, and a considerable check has been put on thieving in the capital by the passing of the Pawnshops Act in 1901.

It may be stated here that the gradual abolition of slavery, which was the first important measure of the King Chulalongkom's reign, Slaverr ^^^ nearly completed by 1886, although the law is often evaded, as serfdom offers to many a convenient method of paying off debts. The corvfe, which is quite distinct from slavery, and is the survival of the old system of personal feudalism which once prevailed in Siam, has been abolished in the outlying provinces, but still lingers in the neighbourhood of the capital. Obligation to personal service is being gradually com- muted for money payment.

While the pure-blooded Malays of the Peninsula are Mahom- medans, the Chinese in Siam adhere to the mixture of cowardice ??? .. . and superstition which does duty for a religion in

""??? most parts of China. The Siamese and Lao profess a form of Buddhism which is tinged by Cingalese and Burmese influences, and, especially in the more remote country districts, by the spirit-worship which is characteristic of the imaginative and timid Ka and other hill peoples of Indo-China. In the capital a curious admixture of early Brahminical influence is still noticeable, and no act of public importance takes place without the assistance of the divinations of the Brahmin priests. The Siamese, as Southern Buddhists, pride themselves on their orthodoxy ; and now that Burma, like Ceylon, has lost its independence, the king regards himself in the light of the sole surviving defender of the faith. There is a close connexion between the laity and priest- hood, as the Buddhist rule, which prescribes that every man should enter the priesthood for at least a few months, is almost univer- sally observed, even young princes and noblemen who have been educated in Europe donning the yellow robe on their return to Siam. A certain amount of scepticism prevails among the edu- cated classes, and political motives may contribute to their apparent orthodoxy, but there is no open dissent from Buddhism, and those who discard its dogmas still, as a rule, venerate it as an ethical system. Many of those, it is to be feared, who enter the priest- hood for life do so from motives of laziness ; and it is to be regretted that so much of the strength of Siamese manhood is thus frittered away, but the accounts given by some writers as to the profligacy and immorality in the monasteries are probably greatly exaggerated. Some of the temples in the capital are under the direct super- vision of the king, and in these a stricter rule of life is observed. A few of the priests are learned in the Buddhist scriptures, and most of the Pali scholarship in Siam is to be found in temples, but there is no learning of a secular nature. There is little public worship in the Christian sense of the word. On the Buddhist Wan Phra (or Sunday) the temples are nearly empty, and those who do attend are entirely women. Keligious or semi-religious ceremonies, however, play a great part in the life of the Siamese, and few weeks pass without some great function or procession, greatly to the detriment of public business. Among these the cremation ceremonies are especially

conspicuous. The more exalted the personage the longer, as a rule, is the body kept before cremation. Thus the late Crown Prince was not cremated until six years after his death. The cremations of great people, which often last several days, are the occasion of public festivities and are celebrated with processions, theatrical shows, illuminations, and fireworks. The missionaries in Siam are entirely French Roman Catholics and American Protestants. They have met with little success among the Siamese, who take their religion as lightly as the rest of life, and discard Christianity as readily as they adopt it. There are, however, a fair number of Chinese converts, especially to Ronian Catholicism, and the French cathedral in Bangkok is well attended. The missionaries have nevertheless done much to help on the general work of civiliza- tion, and the progress of education has been largely due to their effortf.

As in Burma, the Buddhist monasteries scattered throughout the country carry on the whole of the elementary education of the country. By means pf regular Government super- ❓❓❓vision and control, the monastic schools are to be ""^ '"" brought into line with the new Government educiitional organiza- tion. In the metropolitan district of Bangkok there are 290 of these monasteries, containing 8700 monks and novices, of the former of whom more than 400 are teachers. There are 61 Govern- ment schools, of which 56 receive grants in aid and 5 are entirely supported by the Government. There are 5 Anglo- vernacular schools for boys and 2 for girls in Bangkok, and there is also a normal college for training teachers for English and Siamese schools. In the interior there are over 4400 monastic schools, with a total of nearly 50,000 inmates of all classes, and 4000 teachers in Siamese and Pali. There are also 70 Roman Catholic missionary schools in the country, vrith about 4000 pupils, and the Protestant mission- aries have eight schools, with about 500 pupils, not including the Chiengmai district.

The education for the most part does not rise above the ele- mentary standard, though the two chief Anglo- veriwcnlar schools are developing into secondary schools. All the work in the upper classes of these schools is in English. French is an optional sub- ject. The schools in the wats or temples are being gradually improved. The buildings are being adapted to educational require- ments, the priests are provided as far as possible with

lay assistants, and a system of inspection is being organized, while the sum spent annually on education was increased nearly fourfold between the years 1899 and 1901. Two scholarships are given every year to boys under nineteen for the purposes of education in Europe, and other students are sent to England and elsewhere at the king's or their parents' expense. The system of teaching boys in the wats has caused education to be widely diffused in Siam, and most men can read and write a little. But Siam has no literary or scientific achievements to boast of. The boys, however, are teachable, and up to a certain age distinctly bright and clever.

*All travelling in the delta and far into the interior has been by boat along the rivers, canals, and creeks which intersect the country. Buffaloes and oxen are used for ploughing, and for carting when water transport is not available. ,. *"""" " In the hill country the elephant, the pack bullock, ponies, the Yonnanese mule, and even men, are used extensively.*

A steam tram, 16 miles in length, from the capital to Paknam at the mouth of the river, opened in 1893, was the pioneer line of the country. That to Korat, 170 miles in length, was ,. completed at the close Of 1900, and has already shown ' ^^ys. an excess of earnings over expenses on sections below the forest belt. An extension northwards to Lophburi (26 miles) on what should be the main line to Chiengmai and the north was opened in January 1901. Another line was begun through the rich country of the delta westward of Bangkok to Ratburi and Petchaburi : it is to be hoped that the short-sighted policy of the Government in allowing the main canals of this easily accessible district to silt up and become useless will not be continued.

Though there are about 40 miles of good streets in Bangkok and 10 of carriage roads, there has been no road-building or bridging done in the country, with the exception of a few miles near Chiengmai and in various provinces of the Malay Hoaas. Peninsula, the result of abnormal energy and generosity on the part of local governors. Hence all overland travelling involves slow and laborious marching over rough jungle trails.

A postal service has been extended to all parts of Siam, the country having entered the Postal Union in 1885. The service works as well as can

*be expected in the present state of communications. Much enterprise has been shown in f'f , clearing and laying telegraph lines throughout the ^ ' country ; but few of them work satisfactorily for more ""^ *□□□ than a few months at a time □□□ a fact due as much to ignorance and carelessness on the part of the operators as to the ravages caused by floods and by inquisitive and playful elephants.*

The trade of the port of Bangkok shows a steady increase. But, to estimate the total foreign trade of the country, it is necessary to add to its figure those of other routes. What trade there wa-; across the Me Kong dwiridled to Trade. vanishing-point after the acquisition of the left bank by France in 1893, though a revival may be hoped for in the future. The trade between French and Siamese Cambodia is also at present insignificant. The total exports for 1901 were □□4,292,640, and imports □□2,707,370, a total of over seven millions, of which nearly □□6,000,000 are by Bangkok and about a million by the east and west coasts of the Malay Peninsula. Of the total, about 80 per cent, represents the value of the direct trade with British possessions, including Hong Kong, Bombay, the Straits, Burma, and the Shan States.

By the convention made between Great Britain and France, and signed at London on 15th January 1896, the Governments of those countries engaged not to advance armed forces into the region which is comprised in the basins of the Petchaburi, Me Kong,

Me Nam, and Bang Pa Kong (Petriu) rivers, and their respective tributaries, together with the extent of coast from Muang Bang Taphan (on the west) to Muang Pase (on the east side of the gulf), the basins of the rivers on which those two places are situated, and the basins of the other rivers the estuaries of which are included in that coast ; and including also the territory lying to the north of the basin of the Me Nam, and situated between the Anglo- Siamese frontier, the Me Kong river, and

the eastern watershed of the Me Ing. This guarantee affects by far the most populous and flourishing portion of Siam. (h. W. Sm.)

HiSTOKY.

The history of modern Siam may be said to commence with the ratification of the treaty of friendship and commerce con- cluded with Great Britain in 1855, and negotiated through Sir John Bowring. There had been previous treaties, but this one first put the relations of Siam with Great Britain on their present basis, and it has been followed by treaties on similar lines with France, the United States, Germany, Russia, Japan, and other Powers. The most noteworthy feature of this treaty was the provision of extra-territorial consular jurisdiction, the result of which is that British subjects can only be tried for criminal offences or sued in civil cases in their own consular courts. A large portion of the work of the foreign consuls, especially the British, is consequently judicial, and in 1901 the office of judge was created by the British Government, one of the consuls being appointed to this post. Various commercial regulations were also included in the treaty of 1355, and subsequently trade steadily increased, especially with Great Britain and the British colonies of Hong Kong and Singapore.

The peaceful internal development of Siam seemed also likely to be favoured by the events that were taking place outside her frontiers. For centuries she had been distracted by wars with Cambodians, Peguans, and Burmans, but the incorporation of Lower Cochin China, Annam, and Tongking by the French, and the annexation of Lower and Upper Burma successively by the British, freed her from all further danger on the part of her old rivals. Unfortunately, she was not destined to escape trouble. The frontiers of Siam, both to the east and the west, had always been vague and ill-defiued, as was natural in wild and unexplored regions inhabited by more or less barbarous tribes. The frontier between Siam and the new British possessions in Burma was settled amicably and without difficulty, but the boundary question on the east was a much more intricate one .and was still outstand- ing. Disputes with frontier tribes led to complications with France, who asserted that the Siamese were occupying territory that rightfully belonged to Annam, which was now

under French protection. France, while assuring the British Government that she laid no claim to the province of Luang Prabang, which wns situated on the east or left bank of the \ipper Me Kong, roughly between the 18th and 20th parallels, claimed that farther south the Me Kong formed the true boundary between Siam and Annam, and insisted on the Siamese evacuating certain posts which they held to the east of the river. The Siamese refused to yield, and early in 1893 encounters took place between them and the French, in which a French officer was captured and French soldiers were killed. The Siamese continued to resist, though the British Government counselled moderation ; and the French despatched two gunboats, which forced their way up the Me Nam on 13th July 1893, after a short engagement at the mouth of the river, and anchored at Bangkok, in spite of the protests of the Siamese, who, on their interpretation of clause 15 of the treaty of 1856, asserted that the French were not allowed to send war vessels beyond Pakuam without their consent. The French now greatlj^ increased their demands. They insisted on the Siamese giving up all territory to the east of the Me Kong, including the province of Luang Prabang, and also on the neutralization of a zone of 25 kilometres to the west of the Me Kong. After some delay, during which the French blockaded the Me Nam from 25th July to 3rd August for the purpose of enforcing their demands, the Siamese at length gave way, and a treaty was signed with the French on 3rd October 1893. It was agreed that the French should occupy Chantabim until the terms of the treaty were carried out. They remained in possession of it until the conclusion of the further treaty of 1902, which stipulated that it should be evacuated upon the handing over to France of the provinces of Meluprey and Bassao and the ceded territory generally, which extended altogether to 20,000 square kilometres. By this treaty the king of Siam further bound himself to permit ports, canals, and railways in the Siamese portion of the basin of the Me Kong to be constructed by French personnel and capital in the event of Siam being unable to accomplish such works unaided.

There remained the question of the frontier between the French and BriHsh possessions to the north of Siam. By its conquest of Upper Burma Great Britain had obtained suzerainty over the Burmese Shiln States, which stretched across the river Mo Kong to the north of Siam, and lay between the 20th and 23rd parallels.

It was the intention of the British Government, by ceding the northern portion of these states to China and the southern portion to Siam, to create a buffer state between the French and British possessions, so that they should be nowhere coterminous. Pro- longed negotiations took place between the French and British Foreign oSices, but the object of the British was not achieved, and the French were suffered to extend their frontier in this region also as far as the Me Kong. These negotiations, however, though their immediate purpose was not fulfilled, bore important fruit in the Anglo-Frenoli convention of 15th January 1896. The chief provision of this convention was the neutralization by Great Britain and France of the central portion of Siam, consisting of the basin of the river Me Nam, with its rich and fertile land, which contains most of the population and the wealth of the country. Neither the eastern provinces bordering on tlie French possessions nor those of the Malay Peninsula were included in this agreement, but nothing was said to impair or lessen in any way the full sovereign rights of the king of Siam over these territories. Siam thus constitutes a buffer state, with its independence guaranteed by the two European Powers who alone have interests in Indo-China, between Burma on the west and the French possessions on the east, though to the north of Siam the river Me Kong forms, from the point where it leaves China, the only division between the French and British spheres. Siam has therefore a considerable- political interest for Europe, not unlike that of Afghanistan, which forms a buffer state between the Russian and British possessions on the north of India. This interest has, however, been for many years enhanced by the fact that Siam, apart from the value of her own trade and her actual and potential wealth, has been regarded in some quarters as affording a possible means of trade access to the provinces of southern China. The French undoubtedly had Chinese trade as their objective when they sent tlieir expedition of exploration, under de Lagree, up the Me Kong in 1866. This expedition proved a failure, the Me Kong being found to be of little use for purposes of naviga- tion north of the 14th, or at most the 18th, parallel, owing to the prevalence of rapids. But though the French turned their attention subsequently to Tongking and the Red River, the events of 1893 seem to indicate that they still attach some value to the Me Kong as a waterway. The Me Nam is, however, vastly superior to the Me Kong in this respect ; and when the Siamese complete the railway which they are

building to the north through central Siam, important commercial and political developments may be expected to follow. The importance of Siam, therefore, in European eyes must con- sist not only in the fact that it constitutes a buffer state between French and British possessions, but also in the large and increasing stake held by various Western nations in the commerce of the country, and the possibilities it has for the future. Great Britain and British colonies still retain the chief share of the trade, though British shipping in the port of Bangkok has decreased considerably, owing to the transfer of the Singapore and Hong Kong lines of steamships from British to German hands in 1899 and 1900. Other countries too, notably Germany and Denmark, have important trade interests. The independence and prosperity of Siam are therefore matters of no small moment to several European countries. It is impossible, however, to regard the external rela- tions of Siam as not having an intimate connexion with its internal development. Siam is the sole surviving country of tropical Asia that has preserved its independence, and its continued autonomy must depend in great measure on the capacity it shows for self- government. It undoubtedly made great progress in the last quarter of the 19th oeutury. (j. G. D. C.)

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<u>Siberia. [illegible] A great deal of exploring work has been, carried out in recent years in connexion with the Siberian rail- Pb I / ^^^' ^^^' '^^^^^^1'^ though this has been as provid- teauires. ^[illegible]S materials for the acquisition of a more detailed knowledge of separate regions, it has not modified our conception of the country generally, as expressed in the article in Ency. Brit. vol. xxii. (9th edition) under this head, while the exploration of Manchuria and the Stanovoi range along the coasts of the Sea of Okhotsk Has only confirmed the views of the orographical conformation of the country previously set forth. The description of the physical features of Siberia given in the ninth edition still holds good, therefore ; and it is sufficient to mention here that the results of recent exploration are especially valuable as regards the ethnology of the inhabitants of Yakutsk, the geography of the Kolyma region in the far north, on the Sea of Okhotsk, the hydrography of the Sea of Okhotsk and</u>

the Arctic Ocean, the geography of the Altai, and the economical conditions of the inhabitants of South Siberia.

At the general census taken in February 1897 the domi- ciled population was found to be 5,698,924. The natural increase (80,100 per annum) and the registered

" immigration (by land, 69,149 in 1897, 148,965

in 1898, and 181,895 in 1899; by sea, 2400, 4055, and 8300 respectively) have since added about 800,000, so that on 1st January 1901 the total population must have been about 6,500,000. In 1897 Russians numbered about 4,950,000 (87 per cent.) and the indigenous population about 750,000 (13 per cent.). The distribution of the population according to provinces, vrith the area of the same, was as follows : ???

Province.

Area. Square MUes.

Russians

(000

omitted).

Indigen- ous Popu- lation

(000

omitted).

Total Popula- tion.

Density

per Square Mile.

Tobolsk . Tomsk .

539,659 331,159

1373 1865

65 64

1,438,484 1,929,092

3 6

“Western

Siberia .

870,818

3238

129

3,367,576

4

Yeniseisk . Irkutsk . Yakutsk . Transbaikalia .

987,186

287,061

1,533,397

236,868

517

402

40

467

42 105 222

197

559,902 506,517 261,731 664,071

1 2

2

3

Eastern Siberia

3,044,512

1426

566

1,992,221

7

Amur . . Maritime .

172,848 715,982

99

185

19 35

118,570 220,557

9 3

Amur Region

888,830

284

64

339,127

_?_?_?3

Sakhalin . .

29,336

28,166

1

Total .

4,833,496

4948

749

5,727,090

1

The ethnographical composition of the population is given in the ninth edition. It may be added here that though at present forming only a small element in the population, the rapid increase of the Koreans and Chinese in certain districts is of importance. In the Maritime Province, before the Boxer uprising in 1900, 26 per cent, of the population of the North Usuri district and 36 per

cent, of the population of the South Usuri district were Koreans and Chinese, and in the Amur province there were nearly 15,000 Manchus and Koreans.

As to Russian immigration to Siberia, it has been organized on new principles, the immigrants being now directed into the regions where there is free land available for them, so that they may avoid the great hardships which they used formerly to undergo. In the eighteen years 1882-99, 1,367,391 came into the country to settle by land, and 41,280 by sea. The former settled mostly in West Siberia (chiefly in the Altai region), while the latter went mainly to the South Usuri district. It is worthy of note that the main flow of immigration was from the fertile northern belt of the black-earth provinces of European Russia, and to a smaller degree from the Lithuanian provinces and the Ural provinces of Perm and Vyatka.i

Cities. ??? Only 8‘1 per cent, of the population live in towns (6 ‘4 per cent, only in the governments of Tobolsk and Tomsk). There are fifteen towns vtdth a popula- tion of 10,000 or more, namely, Tomsk (52,000) and Irkutsk (51,000) ??? the capitals of Western and Eastern Siberia respectively ; Blagoveschensk (32,000), Vladivostok (29,000), Tyumeii (29,000) in West Siberia, head of Siberian navigation; Barnaul (29,000), capital of the Altai region; Krasnoyarsk (26,000) and Tobolsk (20,000), both mere administrative centres; Biysk (17,000), centre of Altai trade;

Khabarovsk (15,000), administrative centre of the Amur region; and ??? all vidth from 10,000 to 11,000 inhabitants ??? Tchita, the capital of Transbaikalia ; Koly- van, the centre of the trade of southern Tomsk ; Yeniseisk, the centre of the gold-mining region of the same name ; Kurgan, a growing town in Tobolsk; and Minusinsk, in the southern part of the Yeniseisk province, trading with north-west Mongolia. Several villages have sprung up very rapidly along the railway line.

Little has been done towards satisfying, or even giving free scope to, the growing demand for education in Siberia. The petitions for a university at Irkutsk, the money required for which has been freely ofi'ered ""“???”??? to the Government, have been refused, and the imperative demands of the local tradesmen for technical instruction have likewise met with but little response. The Tomsk University remains incomplete, and has only 500 students. In 1901 the provision for education could be approximately tabulated as follows : ???

Province

Total Number

of Schools.

Number in Towns.

Middle Schools.

Special Schools.

Total Number

of Scholars.

Tobolsk . Tomsk . Yeniseisk . Irkutsk . Yakutsk . Transbaikalia . Amur

Maritime Prov. Sakhalin .

Total

588

2015

235

412

77 375

73 106

28

69=

70

36

70

12^

45

9 9

7 7

4

5 5 2 6

6

21,000 48,125

9,320 13,755

1,507 12,760

4,600

3,470 870

3909

115,407

If the figures in the above table are compared with the total populations of the several provinces, it will be seen at once how inadequate is the provision for education in Siberia. As a rule, the girls form from a quarter to a third of the total number of pupils.

^ See Siieria (in Russian), a manual for immigration published by the Ministry of Agriculture in 1900, with maps of available lands, &o. 2 5650 pupils. 3 Also four at the gold mines.

There are 18 scientific societies in Siberia, which issue publica- tions of great value. Twelve natural history and ethnological museums have been established by the exiles ??? the Minusinsk museum being the best. There are also 20 public libraries, and 11 papers are published in addition to the eparohial Vyedomosti published in each bishopric.

Exiles. ??? Up to 1901 nearly 20,000 exiles continued to be transported every year to Siberia, half of whom were exiled by mere orders of the local and central adminis- tration. It was, however, announced officially in 1901 that the system was to be discontinued, and the measures to be taken for this purpose again came under discussion by the St Petersburg committees.

Land Tenure. ??? Out of the nearly 3,240,000,000 acres of land in Siberia, 3,104,000,000 acres belong to the State, while the cabinet of his

Majesty (the emperor reigning at the time being) owns 114,700,000 acres (112,300,000 in the Altai and 2,400,000 in Nerchinsk). Private property is insignificant in extent ??? purchase of land being only permitted in the Amur region. (In western Siberia it was only temporarily permitted in 1860-68.) In all there are only 1214 private estates, cover- ing an aggregate area of 1,415,845 acres (256,046 acres in the Amur region). Siberia thus offers an example of the nationalization of land unparalleled throughout the world. Any purchase of land within a zone 67 miles wide on each side of the trans-Siberian railway was absolutely prohibited in 1895, and the extent of Crown lands sold to a single person or group of persons never exceeds 1080 acres unless an especially useful industrial enterprise is projected, when the maximum is fixed at 2700 acres. The land is now held by the Russian village communities in virtue of the right of occupation. Industrial surveys, having for their object the granting of land to the peasants to the extent of 40 acres per each male head, with 8 additional acres of wood and 8 acres as a reserve fund, were started many years ago, and after being stopped in 1887 were commenced again in 1898. At the present time the land allotments per male head vary greatly, even in the populated region of southern Siberia. In the case of the peasants the allotments vary on an average from 32 acres to 102 acres (in some cases from 21 'B acres to 240 acres); the Transbaikalian Cossacks have about 111 acres per male head, and the indigenous population from 108 acres to 154 acres.

The total cultivated area and the total area culture inder crops every year have been estimated by A. Kaufmann as follows ^ : ???

Area

Under Crops (Acres).

Province.

cultivated, Acres.

Total.

Average per House- hold.

Average per 100 Inhabit- ants.

Tobolsk .

5,670,000

3,270,000

13 ‘2

243

Tomsk .

8,647,000

5,259,000

15-7

310

Yeniseisk .

1,830,000

977,000

13-0

267

Irkutsk .

1,800,000

910,000

13-2

265

Transbaikalia .

1,415,000

872,000

9-4

159

Yakutsk .

81,000

43,000

0-8

16

Amur (Russians)

143,000

143,000

19-4

275

South Usuri

(peasants only)

151,000

151,000

24-0

375

19,737,000

11,625,000

These figures are somewhat under – estiraatkd, but the official figures for 1900, published by the Statistical Committee, are still lower, especially for Tomsk. The crops yielded in 1900 are officially given, for four governments only, as follows : ???

‘ Russian Encyclopcedic Dictionary, vol. lix., 1900.

1900.

Eye.

Wheat.

Barley.

Oats.

Thousands of cwt.

Tobolsk.

1753

3888

467

3610

Tomsk ....

2338

5413

436

4351

Yeniseisk

1770

989

105

1154

Irkutsk .... Total

2065

517

265

863

7926

10,807

1273

9978

Percentage of the

average crops of

1895-99

62

53

62

59

These crops, as is seen from the last row of figures, were only between a half and two-thirds of the average crops for the five preceding years. The comparison with the crop of 1899 is 'still more unfavourable, the net produce of cereals available for the population being only 4 '2 cwt. per inhabitant in 1900, as against 11 '9 cwt. in 1899. This gives an illustration of the way in which the crops fluctuate in Siberia, and indeed the yield in a very good year will be almost three times that in a very bad one. The prices vary still more, the maximum being from 12 to 20 times (in 1892) higher than the minimum. Altogether it may be said that the southern parts of Tobolsk, nearly all the province of Tomsk (exclusive of the Narym region), southern Yeniseisk, and southern Irkutsk have in an average year a surplus of grain which may represent from 35 to 40 per cent, of the total crop, but that in bad years the crop falls short of the actual needs of the population. There is considerable movement of grain in Siberia itself, the populations of vast portions of the territory, especially of the mining regions, having to rely upon imported corn. Consequently at the present time Siberia is not a grain- exporting country of any importance, although it may become so, especially when the Altai region is more populated than it is now. (See Altai.) The forest area under supervision is about 30,000,000 acres (in Tobolsk, Tomsk, Yeniseisk, and Irkutsk), out of a total area of forest land of 63,000,000 acres.

Live Slock. ◆◆◆ As an independent pursuit, cattle-breeding is carried on by the Russians in eastern Transbaikalia, by the Yakuts in the province of Yakutsk, and by the Buriats in Irkutsk and Transbaikalia, but elsewhere it is secondary to agriculture. The numbers of the live stock have been estimated by A. Kaufmann as follows (small cattle not being separated from the full-grown) : ◆◆◆

Province.

Horses.

Horned Cattle.

Sheep

and

Goats.

Pigs.

Reindeer.

Tobolsk Tomsk Yeniseisk . Irkutsk 2 . Transbaikalia Yakutsk . Amur 3 Usuri J .

Total .

736,230 2,307,740 470,750 234,490 628,290 117,230 22,190 10,680

985,620

1,919,890

297,740

314,610

1,405,110

213,400

26,520

32,610

1,097,810

3,694,690

590,000

322,170

1,379,430

360

3,680

13,7905

226,620 635,330 62,000 62,630 138,760

186,460

19^960

4,527,600

6,194,400

7,101,930

1,016,240

206,420

Till lately, hides, tallow, and meat for the mining centres were the main exports of Siberia ; butter was also exported, but of low quality. At the present time the making of butter in co-operative creameries, introduced by the Danish co-operators, has rapidly developed in West Siberia ; improved machinery is being manu- factured and used in the villages, and butter is already a substantial item in the goods traffic on the Siberian railway.

It is estimated that about one-half of the Russian agricultural population supplement their income by engaging in non-agricul- tural pursuits, but not more than from 18 to 22 per ??? cent, carry on domestic trades, the others finding occu- ^”” pation in the carrying trade ??? which remains important, ”” ?? ”** ??? even after the construction of the railway ??? in hunting (chiefly squirrel-hunting), and in work in the mines. Domestic and petty trades are therefore developed only round Tyumeft, Tomsk, and Irkutsk. The principal of these trades are the weaving of carpets ???about Tyuraefi ??? which seem to find a sale even in London under various Eastern names ; the making of wire sieves ; the painting of ikons ; the makinc; of wooden vessels and of the necessaries for the carrying trade about Tomsk (sledges, wheels, &c.) ; the manu- facture of felt boots and sheepskins ; and, of recent introduction, the manufacture of dairy utensils and machinery. Weaving is also engaged in for domestic purposes. But all these trades are sporadic,*

‘^ District of Kirensk missing.

” Owned by Russian population only.

- *Owned by the peasants only.*

AU small cattle included.

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belonging to limited areas, and often only to a few separate villages. In 1897 all the factories of Siberia numbered only 4651, and employed only 25,200 workers, their yearly returns hardly exceed- ing 20,000,000 roubles. In short, the want of communications, of technical education, ??? and of skilled workers, coupled with the prospect of rapid enrichment by gold-mining, has hindered all manufacturing industries, though in respect of most fields of industry, the richness of much of the country and the abundant supply of raw materials afford every opportunity for a notable development.

This remark is especially true of mining, which is the main pursuit of the people, after agriculture. The chief centres for Mining. gold-mining are the Altai, the Mariinsk district of Tomsk, the southern parts of the province of Yeniseisk, the Yeniseisk district in the north of the same province, the Nerchinsk and the Vitim districts of Transbaikalia, the Olekma and Vitim district of Yakutsk, and the Bureya and Zeya districts of the Amur province ; some gold is also extracted by the Chinese in the South Usuri region. All these gold-washings, which were especially flourishing in the 'eighties, employed in 1897, 41,23.5 workers, and produced 55,147 tb avoir, of gold dust (^V goW). valued at 24,555,000 roubles after all taxes had been paid. It is supposed that from 1800 to 3600 B more were obtained fraudu- lently. Coal-mining is in its infancy, less than 50,000 tons of coal being extracted annually, including that obtained from Sak- halin. Great hopes are entertained, however, for the future of this industry, especially after the Eki-baz-tus mines of Akmolinsk have been connected by rail with the Setysh. Salt is obtained in antiquated works only to the amount of 1,000,000 cwt. per annum, and has to be imported. Its price stands very high in the villages of the interior, and the inhabitants feel the want of it greatly.

Fishing is an important source of revenue, especially on the lower parts of the great Siberian rivers and on Lake Baikal ; the Amur is as rich in salmon as the rivers of the Pacific slope in America. But the fisheries are still at a primitiye stage of their existence, and are hampered by the high price of salt, tinplate materials, &o. , and by the lack of skilled knowledge.

Commerce. ??? There are no figures from whicli even an approximate idea can be gained of the value of the internal trade of Siberia, but it is certainly considerable. The great fair at Irbit retains its importance, and there are, besides, 507 fairs in Tobolsk, 68 in Tomsk, 13 small ones in Yeniseisk, and from 3 to 12 in Transbaikalia, Irkutsk, and Yakutsk. The aggregate returns of all these is estimated at 25,000,000 roubles. There are also 71 fairs in Akmolinsk and Semipalatinsk, the returns for which are estimated at 13,500,000 roubles. The trade with the natives, which is a source of considerable income to the local merchants, continues to be mainly dependent on the sale of spirits, and to afford endless instances of abuse.

In the external trade the exports to Russia consist chiefly of grain, cattle, sheep, animal products, furs, game, feathers, and down. Trade with China is mainly in tea, which is imported. The total value of the imports from China is on an average about 20,000,000 roubles per annum, but the exports of Eussian goods to China hardly attain 1,500,000 roubles per annum. This is because textiles and manufactured goods generally are imported much more advantageously by sea than by the long overland route, and it remains doubtful whether the completion of the trans-Siberian line wOl alter these conditions. The trade with China via the provinces of Akmolinsk and Semipalatinsk remains insignificant (total annual returns, about 1,150,000 roubles), as does the trade of Tomsk vid Kom-agach, while the imports and exports from and to Mongolia, viS, Ulyasutai, total less than 1,000,000 roubles, and the trade along the Transbaikalian frontier (exclusive of Kyakhta) hardly exceeds 250,000 roubles. Cattle, however, are beginning to be imported in larger quantities from Mongolia. The trade with Manchuria, where large quantities of grain are bought, totals about 985,000 roubles for imports and about l,100,000roublesforexports. InlS96 Vladivostok was visited by 78 Eussian and 189 foreign ships, the imports being .262,000 tons (60,000 tons for the State) and the exports 60,000 tons, to which the export of nearly 2000 tons by 800 small Chinese and Korean vessels must be added. The chief article of export was edible seaweed, of which about 13,700 tons was shipped to China. It is also estimated that nearly ►►260,000 worth of imported goods reach Blagoveschensk. The Amur region is no doubt a growing region, which requires various goods for its agi'icultural and mining population, but the disproportionately large excess of imports over exports clearly indicates that the high customs duties levied, and the difficulties of transport along the Usuri railway and farther

up the Amur, prevent the development of the natural resources of the country. As to the northern maritime trade tid the mouths of the Siberian rivers, its results were very satisfeictory during the years 1896-98, especially as regards the import of machinery for the northern gold mines, and of brick tea, the sea route proving much more economical than the overland. But in 1899 none of the steamers which started for the Siberian rivers reached them, owing to the ice in the Kara Sea.

ItUand Navigation, ??? Navigation on Siberian rivers has developed both as regards the number of steamers plying and the number of branch rivers traversed. In 1900, 130 private and several Crown steamers plied on the Ob-Irtysh river system as far as Semipala- tinsk on the Irtysh, Biysk on the Ob, and Achinsk on the Chulym. Cartographical work of importance has been carried out in the estuaries of the Ob and Yenisei. The Ob-Yenisei canal is ready, but offers difficulties on account of the scarcity of water in the smaller streams forming part of that system, a difficulty which will probably be remedied by the formation of reservoirs. On the Yenisei 18 steamers ply from Minusinsk to Yeniseisk, and to Gliilghiha at its mouth ; 10 steamers ply on its great tributary, the Angara, of which some rapids have been cleared, though the Padun rapids have still to be rounded by land ; and 10 on the Selenga. On the Lena and the Vitim there are 20 steamers, and a small railway connects the Bodoibo river port with the Olekma gold-washings. On the Amur system, of which the Zeya, the Bureya, and the Aragun are already navigated, there were 105 steamers in 1900.

Railways. ??? The first railway to reach Siberia was built in 1878, when a line was constructed between Perm, at which point travellers for Siberia used to strike off from the Kama eastwards, and Ekaterinburg, on the eastern slope of the Urals. In 1884 this line was continued farther into Siberia, so as to reach Tyumen, the head of navigation on the Siberian rivers, it being supposed at that time that this line would form part of the projected trans- Siberian railway. But farther south the Russian railway system had already reached as far east as Orenburg, and the Volga had been bridged at Syzran in 1880 ; accord- ingly, it was finally decided, in 1885, to give a more southerly direction to the great trans-Siberian railway, and to continue the Moscow-Samara line to Ufa, Zlatoust, in the Urals, and Chelyabinsk, in the West Siberian prairies, at the head-waters of one of the tributaries of the Ob. Once this point was reached ??? and the construction of the railway so far was soon accomplished, without any serious engineering difficulties being encountered ??? the line had evidently to be continued across the prairies to Kurgan and Omsk, and thence along the great Siberian highway to Krasnoyarsk and Irkutsk. As to its farther direction, it was decided that it would be best to follow, broadly speaking, the great highway round Lake Baikal to Tchita and

Sryetensk on the Shilka ; then to push down the Amur to Khabarovsk ; and finally to proceed up the Usuri to Vladivostok. This general scheme was fixed upon in its broad outlines in 1891, and defimitely accepted, after the necessary reconnoitring explorations, in 1892. The building of the railway was begun at several points at once ; it had, indeed, been started before this time, the first stone of the line from Vladivostok to Grafskaya, on the Usuri, having been laid on 31st May 1891.

The several sections of the line as now built or planned, are as follows ; it will be seen ??? under (6) ??? that in its last portions the route had to be somewhat modified : (1) Chelya- binsk to the Ob (Krivoschokovo village), 881 miles. On this stretch the line crosses a fertile prairie very similar to the Winnipeg prairies in Canada, and well populated ; it crosses the Tobol, the Ishim, and the Irtysh. (2) From the Ob to Irkutsk, 1137 miles. This part of the line crosses first a slightly higher "rolling prairie" (similar to the Calgary rolling prairie of Canada), and at Achinsk enters the still h^her plains of eastern Siberia, crossing the low spurs of the mountain region of South Yeniseisk Excavations and high embankments had to be made on this last stretch, and several large rivers ??? Tom, Yaya, Kiya, Oka, Tchulym, all very rapid and liable suddenly to

inundate the surrounding country ??? had to be crossed, as well as the Yenisei, near Krasnoyarsk. (3) From Irkutsk to Listvenichnaya, on Lake Baikal (41 miles), along the rocky valley of the Angara. (4) Round the southern estremity of Lake Baikal. This section was not yet built in 1902, nor could it be built for some time, on account of the great difficulties oifered by the high and craggy mountains (Khamar-daban), sloping precipitously towards the lake, and pouring into it hundreds of streams, each of which is a wild torrent at certain times of the year. Meanwhile two powerful ice-breakers carry the trains over the lake to the Mysovaya station in Transbaikalia. (5) From Mysovaya to Tchita and Sryetensk, on the Shilka, 687 miles. This line gradually ascends by way of

the valleys of the Selenga and the Uda to the level of the plateau, and crossing the south-eastern border ridge of this ??? ^Yablonovoi Khrebet ??? at an altitude of 3412 feet, reaches the Tchita river near its junction with the Ingoda. This last river is followed to its junction with the Shilka, and the Shilka down to Sryetensk. (6) For reasons indicated elsewhere (see Russia, Railways), it was found inadvisable to continue the railroad along the Shilka and the Amur to Khabarovsk, and negotiations with the Chinese Government for a trans-Manchurian railway were successfully carried out. This line connects Kaidalovo, 20 miles below Tchita, with Vladivostok, with a branch from Harbin, on the Sungari, to Dalny and Port Arthur. Those parts of it which ran through Russian territory (in Transbaikalia, from Kaidalovo to Nagadan ??? 216 miles; in the neighbourhood of Vladivostok, from Nikolsk to the Manchurian frontier ??? 72 miles) were in 1902 in working order, and the trans-Manchurian line (1607 miles) was already opened for some traffic. However, parts of it were only in a preliminary state ; the crossing of the Great Khingan would be gradually rendered less steep, and the bridge over the Sungari had still to be completed. (7) A line was constructed from Vladivostok to the Amur before it became known that the idea of following the latter part of the route originally laid down would have to be abandoned. This line, which has been in working order since 1898, is 477 miles long, and proceeds first to Grafskaya, across the fertile and populous South Usuri region, then down the right bank of the Usuri to Khabar- ovsk, across marshy and woody tracts, almost useless for purposes of cultivation.

Returning westwards, it may be noticed that Chelya- binsk has been connected with Ekaterinburg (150 miles); and that a branch line has been built to Tomsk (60 miles). Altogether the trans-Siberian line has been built very rapidly. In 1893, 256 miles of rail were laid down; in 1894, 552 miles; in 1895, 832 miles; in 1896, 454 miles; in 1897, 438 miles; in 1898, 478 miles; in 1899, 490 jniles ; and in 1900, 288 miles, making a total for the eight years of 3788 miles. The total cost of the 3721 miles already opened for traffic in the first months of 1901 was 327,794,685 roubles, to which the estimated cost of the 193 miles round Lake Baikal, that is, 37,618,900 roubles, has to be added. Various works have also been carried out along the Siberian rivers and at the port of Vladivostok in order to

improve navigation, the total cost of which is estimated at 466,110,019 roubles. If the Perm-Kotlas railway and the feeding lines are taken into account, the whole enterprise had cost up to 1902 over 529,000,000 roubles.

Authorities. ??? The best recent sources of infoTmation alioiit the eeonomical conditions in Siberia are : Materials for the Study of the Economic Oondilions of West Siberia, 22 vols., St Peters- burg, 1889-98 ; these have been condensed in a book, Peasant Land-Tenure and Husbandry in Tobolsk and Tomsk, St Peters- burg, 1894. Similar Malmals for the Altai region, published at St Petersburg by the Cabinet of the Emperor, and for Irkutsk

and Yeniseisk, 12 fasc, Irkutsk, 1889-93 ; Materials of States Secretary Kulomzin's Commission for Transbaikalia, 16 vols., St Petersburg, 1898 : these have been summed ujj iu a book, Transbaikalia, by N. Eazumoff, St Petersburg, 1899. Other works deserving special mention are : Syeroshevskiv. The Yakuts. St Petersburg, 1896. ??? BussE and Rittick. Usuri Region. ??? Yadeintseff. Siberia as a Colony. New edition. 1892. ??? Ermoloff. Siberia as a Colony. 3rd edition, 1894. ??? Jarilow. Ein Beitrag zur Landwirthschaft in Siberen. Leipzig, 1896. ??? Semevskiy. Gold-Mines Workers. 1899. ??? Kadfmaxn. Sketch of Peasant Husbandry in Siberia. Tomsk, 1894 ; reprinted in Siberia and the Great Trans – Siberia Railway, and in the Guide to the Siberian Railway published by the Ministry of Ways and Communications. The article "Siberia," by several contributors, in the Russian Encyclopaedic Dictionary, vol. xxixA. 1900. A considerable number of monographs and general works relative to the history of Siberia (all in Russian) have also been published. A full bibliography, up to date, will be found in the above-mentioned article in the Russian Encyclopedic Dictionary, as also in Mbzhov, Siberian Bibliography, 3 vols. , St Petersburg, 1891-92, and in the great work of A. PypiN, History of Russian Ethnography, vol. iv. (p. a. K.)

Sibongfa, a town on the east coast of the island of Cebii, Philippine Islands, in 10?? 00' 06" N. Agricillture is the principal occupation of its inhabitants, rice and copra being the most important products. It has a

health- ful, though hot, climate. The language is Cebii-Visayan. Population, 23,000.

Sibpur, a town of British India, in the Hooghly district of Bengal, situated in 22 ́ 34′ N. and 88 ́ 16′ E., on the right bank of the river Hooghly, opposite Fort William. It is a suburb of Howrah, with which town its statistics are included. It contains jute-mills, flour -mill, rope - works, brick -works, and other industrial establishments; the Government botanical garden (the Kew of India) ; and the engineering college, which has been reorganized, with electrical and mining departments and a boarding-house. In 1896-97 there were in all 310 students; and the total cost was Rs.l, 09,226, of which Rs.96,481 was paid by Government.

SibSclg'Sir, a town and district of British India, in the Brahmaputra Valley division of Assam. The town is situated on the Dikhu river, about 9 miles from the left bank of the Brahmaputra. Population (18S1), 5868; (1891), 5249; municipal income (1897-98), Es.11,463; death-rate (1897), 42-1 per thousand. The Government high school had 175 pupils in 1896-97, of whom 4 passed the Calcutta matriculation.

The district of Sibsagar has an area of 2855 square miles. Population (1881), 370,274; (1891), 457,274, showing an increase of 23 per cent. , mainly due to the importation of tea coolies ; average density, 160 persons per square mile. Classified according to re- ligion in 1891, Hindus numbered 418,863; Mahommedans, 19,805; Christians, 1365, including 274 Europeans ; hill tribes, 16,243 ; "others," 998. In 1901 the population was 598,642, showing an increase of 31 per cent. The land revenue is Rs.13,26,839, the in- cidence of assessment being Rs. 2: 10: 11 per acre; number of police, 277; number of boys at school (1896-97), 11, 222, being 31 ́ 04per cent, of the male population of school-going age, the highest proportion in the province ; death-rate (1897), 42-6 per thousand. Sibsagar is the chief centre of tea cultivation in the Brahmaputra valley, which was introduced by the Assam Company in 1852. In 1897 there were 171 gardens, with 70,644 acres under tea, employing 139,755 persons, of whom 44,193 had been imported under con- tract, and yielding 24,000,000 lb, or 391 lb per acre. There are 3 timber mills, employing 200 hands, and producing 125,000 tea- chests, of

the value of Rs.l, 00, 000. A small State railway of 2 feet gauge runs from Jorhat to the Brahmaputra, 27 miles long ; but the district will shortly be traversed throughout by the Assam- Bengal railway, now under construction.

Sicily. ??? Sicily is an island separated from the Italian mainland by a strait which in its narrowest part (Strait of]\ressina) is hardly two miles wide. The area and popula- tion of the several provinces are shown in the subjoined table : ???

SICILY

617

Province.

Area in Square Miles.

Population,

1881.

Population,

1901.

- 1

Density per Square Mile,

1901.

Caltanissetta . Catania . Girgenti . Messina . Palermo . Syracuse . Trapani .

Total .

1263 1917 1172

1246 ???

1948 1442 948

266,379 563,457 312,487 460,924 699,151 341,526 283,977

330,972 711,923 371,471 548,898 785,016 427,429 353,557

262 371 317 440 403 296 373

9936

2,927,901

3,529,266

355

Thus between 1881 and 1901 the population increased at the rate of 20 '5 per cent. The average density is extremely high for a country which Uves almost ex- clusively from agriculture, and is much higher than the average for Italy in general, 293 per square mile.

Sicily, formerly called the granary of Italy, exported grain until the end of the 1 8th century. Now, although the island still produces Atrrlcul- ^^^^Y y^^^ some 15 million bushels, the supply barely tare and suffices for the consumption of a population of which . , bread is almost the exclusive diet. The falling-off in

*tural *^ ?? exportation of cereals is not a consequence of any*

products, decadence in Sicilian agriculture, but rather of the increase of population, which nearly doubled within the 19th century. Two types of agriculture prevail in Sicily ??? the extensive and the intensive. The former covers mainly the interior of the island and half the southern coast, while the latter is generally adopted on the eastern and northern coasts. Large holdings of at least 500 hectares (a hectare equals about 2^ acres) are indispensable to the profitable pursuit of exten- sive agriculture. These holdings are usually called feudi or latifcmdi. Their

proprietors alternate the cultivation of wheat with that of barley and beans. During the years in which the soil is allowed to lie fallow, the grass and weeds which spring up serve as pasture for cattle, but the poverty of the pasture is such that at least two hectares are required for the maintenance of every animal. This poverty is due to the lack of rain, which, though attaining an annual average of 74 centimetres (29 inches) at Palermo, reaches only 53 centimetres (21 inches) at Syracuse on the east coast, and 49 centimetres (about 19 J inches) at Caltanissetta, on the central high plateau. The system of extensive cultivation proper to the latifoTidi gives an annual average gross return of about 200 lire per hectare (£3, 4s. 5d. per acre).

Intensive agriculture in Sicily is limited to fruit trees and fruit- bearing plants, and is not combined with the culture of cereals and vegetables, as in central and parts of northern Italy. Originally the Sicilian system was perhaps due to climatic difficulties, but now it is recognized in most cases to be more rational than com- bined culture. Large extents of land along the coasts are therefore exclusively cultivated as vineyards, or as olive, orange, and lemon groves. Vineyards give an annual gross return of between £11 and £13 per acre, and orange and lemon groves between £32 and £48 per acre. Vegetables are grown chiefly in the neighbour- hood of large cities. Almonds are freely cultivated, and they seem to be the only trees susceptible also of cultivation upon the latifondi together with grain. A large export trade in almonds is carried on with north and central Europe. Hazel nuts are grown in woods at a level of more than 1200 feet above the sea. These also are largely exported to central Europe for use in the manu- facture of chocolate. The locust bean (used for forage), figs, and peaches are widely grown, while in certain special zones the pistachio and the manna-ash yield rich returns. On the more barren soil the sumach shrub, the leaves of which are used for tanning, and the prickly pear grow freely. The latter fruit con- stitutes, with bread, the staple food of the poorest part of the rural population for several months in the year. The cultivation of cotton, which spread during the American War of Secession, is now rare, since it has not been able to withstand the competition of more favoured countries. All these branches of intensive cultiva- tion yield a higher gross return than that of the

extensive system. Along the coast landed property is as a rule broken up into small holdings, usually cultivated by their owners.

Climatic conditions prevent cattle-raising in Sicily from being as prosperous an undertaking as in central Italy. The total number of bullocks in the island is calculated to be less than 200,000 ; and although thp ratio of consumption of meat is low in proportion to the population, some of the cattle for slaughter have to be imported. Sheep and goats, which subsist more easily on scanty pasturage, are relatively more numerous, the total number being calculated at 700,000. Yet the wool harvest is scarce, and the production of butter a negligible quantity, though there is abundance of the principal product of Sicilian pasture lands, cheese of various kinds,

for which there is a lively local demand. The Sicilian race of horses would be good, but that it is not prolific, and has degener- ated in consequence of insufficient nourishment and overwork. A better breed of horses is being obtained by more careful selection, and by crossing with Arab and English stallions imported by the Government. Donkeys and mules of various breeds are good, and would be better were they not so often weakened by heavy work before attaining full maturity.

The absence of forests, which cover hardly 3 per cent, of the total area of the island, constitutes a serious obstacle to the pro- sperity of Sicilian pastoral and agrarian undertakings. Porests The few remaining forests are almost all grouped around Etna and upon the high zone of the Madonian Mountains, a range which rises 40 miles west of Palermo, running parallel to the northern coast almost as far as Messina, and of which many peaks reach nearly 6000 feet above the sea.

In that part of the island which is cultivated intensively some four and a half million hectolitres of wine are annually produced. Had not the phylloxera devastated the vineyards during the last decade of the 19th centuiy, the production would be consider- ably higher. Three hundred and fifty thousand hectolitres of olive oil and 2500 million oranges and lemons are also produced, besides the other minor products above referred to. The zone of the latifcmdi, or extensive culture, yields, besides wheat, nearly 3,000,000 hectolitres of barley and beans every year.

The most important SioiUan mineral is undoubtedly sulphur, which is rained principally in the provinces of Caltanissetta and Girgenti, and in minor quantities in those of Palermo Mjnine and Catania. Up to 1896 the sulphur industry was in a state of crisis due to the competition of pyrites, to the subdivision of the mines, to antiquated methods, and to a series of other causes which occasioned violent oscillations in and a continual reduction of prices. The formation of the Anglo- Italian sulphur syndicate arrested the downward tendency of prices and increased the output of sulphur, so that the amount exported in 1899 was 4,240,183 quintals, worth 43,461,876 Ure (□□1,738,475), whereas some years previously the value of sulphur exported had hardly been 20,000, 000 lire (□□800,000). Now nineteen-twentieths of the sulphur consumed in the world is drawn from Sicilian mines, while some 50,000 persons are employed in the extraction, manufacture, transport, and trade in the mineral.

Another Sicilian mineral industry is that of common salt and rook-salt. The former is distilled from sea-water near Trapani, and the latter obtained in smaller quantities from mines. The two branches of the industry yield about 180,000 tons per annum, worth 2,000,000 lire (□□80,000). About half this quantity is exported, principally to Norway. Besides salt, the asphalt mining industry may be mentioned. Its centre is the province of Syracuse. The value of the annual output is about 1,000,000 lire (□□40,000).

Deep-sea fisheries give employment to some twenty thousand Sicilians, who exercise their calling not only off' the coasts of their island, but along the north African shore, from Morocco □□□. , . to Tripoli. In 1894 (the last year for which accurate statistics have been issued) 350 fishing smacks were in active service, giving a catch of 2480 tons of fish. Approximately, the value of the annual catch may be reckoned at from 15 to 20 million lire (□□600,000 to □□800,000).

The majority of the scanty Sicilian industries are directly connected with various branches of agriculture. Such, for in- stance, is the preparation of the elements of citric acid, , ^ ^^ which is manufactured at an establishment at Messina. " " **" Older and more flourishing is the*

Marsala industry. Marsala wine is a product of the western vineyards situated slightly above sea level. In 1899 more than 38,000 hectolitres were exported to the value of more than 3,000,000 lire (□□120,000). The quantity consumed in Italy is far greater than that exported.

Another flourishing Sicilian industry carried on by a large number of small houses is that of preserving vegetables in tins. Artichokes and tomato sauce are the principal of these products, of which several dozen million tins are annually exported from Sicily to the Italian mainland, to Germany, and to South America. Manufactories of furniture, carriages, gloves, and leather exist in large number in the island. They are, as a rule, small in extent, and are managed by the owners with the help of five, ten, or at most twenty workmen. Within the last decade several glass works have been established at Palermo, a match factory at Caltanissetta, a cotton dyeing works at Messina, and a large metal foundry at Palermo. Large shipbuilding yards and a yard for the construction of trams and railway carriages are now being laid out in the latter city.

Naturally Sicilian trade is almost all sea-borne. The ports of Palermo and Messina register a gross traffic of over three million tons annually. Prior to 1860 there was not a single kilometre of railway in Sicily. The total length of ^^y^□□f Sicilian railways is now 1000 miles. Their construction "o□□□□□□□"""" was rendered very costly by the mountainous character "f""- of the island. Traffic returns on the whole are not high, but are steadily increasing.

Like all southern Italy, Sicily in 1860 was poor, notwithstanding the possession of notable reserves of monetary capital. On the Economic <'□□□□□□pl'3Uoi of Italian unity part of this pecuniary latellec- ' '^^P^*'^ *^^ absorbed by the sudden increase of taxation, tual and "' ^ much greater part was employed by private moral con- individuals in the*

*purchase of lands formerly belonging anions of *□□ *^□□ suppressed religious corporations. These lands the papula- covered about one-fifth of the surface of the island. tlon. Both the revenue acquired by taxation and the pro-*

ceeds of the land sales were almost entirely spent by the State in northern Italy, where the new Government, for adminis- trative and military reasons, had been obliged to establish its prin- cipal organizations, and consequently its great centres of econonjic consumption. It was therefore necessary to meet from scanty local revenues the continually – increasing expenditure necessary for public instruction, ways of communication, hygienic improve- ments, and, generally, for introducing modern European civilization among a people who until then had lived penuriously, ignorant of many needs, consuming little, and resembling in many respects an Oriental population. Thus it is easy to understand that while in some respects the island has made rapid progress and the large cities have been beautified and developed, in other respects it remains in a backward state, many communes of the latifondi zone being still in the moral and material conditions of a century ago. As a general rule, trade and the increase of production have not kept pace with the development of the ways of communication.

The poverty of the Sicilian population is accentuated by the unequal distribution of wealth among the difi'erent classes of society. A small but comparatively wealthy class □□□ composed prin- cipally of the owners o{ latifondi, who are not invariably descended from the barons of former times □□□ resides habitually in the large cities of the island, or even at Naples, Rome, or Paris. Yet even if all the wealthy landowners resided on their estates, their number would not be suflioient to enable them to play in local public life a part corresponding to that of the English gentry. On the other hand, the class which would elsewhere be called the middle class is in Sicily extremely poor. The origin of most of the abuses which vitiate Sicilian political life, and of the frequent scandals in the representative local administrations, is to be found in the straitened condition of the Sicilian middle classes. The artisan class in the cities is not appreciably poorer than in other parts of Italy. The condition of the peasant in the zone of intensive culture is also bearable, many of the

peasants being themselves small proprietors. The peasants of the latifondi zone, on the contrary, are as a rule poverty-stricken.

Emigration, which might improve the condition of the agricul- tural proletariat, only attained serious proportions within the last decade of the 19th century. In 1897 the perma- nent emigation from the island was 15,994, in 1898, 21,320, and in 1899, 24,604.

The moral and intellectual defects of Sicilian society are in part results of the economic difficulties above described, and in part the effect of bad customs introduced or maintained during the long period of Sicilian isolation from the rest of Europe. When, in 1860, Sicily was incorporated in the Italian kingdom, hardly a tenth of the population could read and write. Upon the completion of unity, elementary schools were founded everywhere ; but, though education was free, the indigence of the peasants in some regions prevented them from taking full advantage of the opportunities olfered. Thus, even now, nearly 60 per cent, of the Sicilian conscripts come up for military service unable either to read or to write. Secondary and superior educa- tion is much more diffused, and Sicily perhaps furnishes more students to the lycfes and universities in proportion to population than any part of Italy.

Brigandage of the classical type has almost disappeared from Italy. The true brigands number hardly more than a dozen, and Bris d haunt only the most remote and most inaccessible and Matfia ^oi^ntains. Criminal statistics, though slowly dimin- ishing, are still high murders, which are the most frequent crimes, having been 27 per 100,000 inhabitants in 1897-98. Violent assaults with infliction of serious wounds are also frequent. While explicable in part by the violent temperament of the Sicilians and in part by the insufficiency and incapacity of the police, this readiness to commit bloodshed is still more attribu- table to the influence of the Maffia. The Maffia is not, as is generally believed, one vast society of criminals, but is rather a sentiment akin to arrogance which imposes a special line of conduct upon persons affected by it. In substance the majfioso considers it dishonourable to have recourse to lawful authority to obtain redress for a wrong or a crime committed against him. He therefore hides the identity of the offender from the

police, reserving vengeance to himself or to his friends and dependants. This sentiment, still widely diffused among the lower classes of many districts and not entirely unknown to the upper classes, renders difiicult legal proof of culpability for acts of violence, and multiplies sanguinary private reprisals.

Bmlgra' tlon.

Public In- struction.

The nature of Sicilian moral sentiment explains the elevated standard of family life, the small number of illegitimate births, the respect for women even among the lowest classes (the . , .. assertions of superficial observers notwithstanding), the "'

scrupulous fidelity with which a Sicilian workman executes his task, and the discipline and bravery of Sicilian soldiers and sailors attributable to their personal devotion towards their oflBcers. If to these qualities be added an almost universal industry, a certain spirit of dignity, order and thrift in all classes, and, finally, the general sobriety of the population (drunkenness is practically un- known in the island), it will be seen that elements exist by means of which Sicily may in time become a prosperous and morally elevated country when Italy, which has already passed through the laborious period which followed her national unification, shall liave completed that work of economic and moral restoration which may already be considered as well begun. (a, mo.)

Sidgrwick, Henry (1838-1900), English pHlo- sopher, born at Skipton, in Yorkshire, on 31st May 1838, was educated at Rugby and Cambridge, where his career was a brilliant one. In 1859 he was senior classic, 33rd wrangler, and Chancellor's medallist. In the same year he was elected to a fellowship at Trinity, and soon afterwards appointed to a classical lectureship there. This j)ost he held for ten years, but in 1869 exchanged his lectureship for one in moral philosophy, a subject to which he had been turning his attention more and more. In the same year he resigned his fellowship on conscientious grounds, when the question of the abolition of religious tests for fellow- ships was being pressed, a reform actually carried two years later. In 1874 Sidgwick published his Method

of Ethics, which first won him a reputation outside his university. In 1875 he was appointed prelector on moral and political philosophy at Trinity, in 1883 he was elected Knightbridge professor of moral philosophy, and in 1885 his college once more elected him to a fellow- ship. In 1883 he published the Principles of Political Economy; in 1885 the Scope and Method of Economic Science; in 1886 Outlines of the History of Ethics, enlarged from the article " Ethics " in the Encyclopaedia, Britannica; and in 1891 the Elements of Politics, in- tended to supply the want of an adequate treatise on the subject by starting from the old lines of Bentham and Mill. Besides his lecturing and literary labours, Sidgwick took an active part in the business of the university, and in many forms of social and philanthropic work. ^ He was a member of the General Board of Studies from its foundation in 1882 tUl 1899; he was also a member of the Council of the Senate of the Indian Civil Service Board and the Local Examinations and Lectures Syndicate, and chairman of the Special Board for Moral Science. He was one of the founders of the Society for Psychical Research and of the iletaphysical Society. None of his work is more closely identified with his name than the part he took in promoting the higher education of women. He helped to start the higher local examina- tions for women, and the lectures held at Cambridge in preparation for these. It was at his suggestion and with his help that !Miss Clough opened a house of residence for students ; and -when this had developed into Newnham College, and in 1880 the North Hall was added, "sh Sidgwick, who had in 1876 married Miss Eleanor Mildred Balfour, went with his wife to live there for two years. After jNliss Clnugh's death in 1892, Mrs Sidgwick became principal of the college, and she and her husband resided there for the rest of his life. During this whole period Professor Sidgwick took the deepest interest in the welfare of the college. Early in 1900 he was forced by ill-health to resign his jirofessorship, and he died in August of the same year. (See Ethics.) (a. z.)

Sidmouth, a watering-place and market town in the Honiton parliamentary division of Devonshire,

S I D N E Y ⁂ S I E M E N S

England, pleasantly situated at the mouth of the Sid, 15 miles by rail east by south of Exeter. The harbour is inaccessible for vessels over 200 tons. The church of St Nicholas contains a window, presented by Queen Victoria, 1866, in memory of the duke of Kent, who died here. There is a Roman Catholic convent, and public edifices are the market HsuUdings, a Masonic hall, a volunteer drill-hall, public baths, a promenade sea-wall, and a cottage hospital. Area of parish (an urban district) prior to extension in 1899, 1563 acres. Popula- tion (1891), 3758; (1901), 4201.

Sidney, a city of Ohio, U.S.A., capital of Shelby county. It is on the river Miami, the Miami and Erie canal, and the Cleveland, Cincinnati, Chicago, and St Louis and the Cincinnati, Hamilton, and Dayton railways, in the western part of the state. Population (1890), 4850; (1900), 5688, of whom 282 were foreign-born and 108 negroes.

Sidon (now Saidd), a small town on the Syrian coast between Beirdt and Siir (Tyre). The population is 11,000 (Moslems 8000, Christians 2500, Jews 500). The exports comprise olive oil and fruit, especially oranges and lemons. In 1887 tomb chambers were discovered close to the town, which contained several fine Greek and Phoenician sarco- phagi, including the "Alexander" sarcophagus, a unique work of art in the form of a Greek temple, and the sarco- phagus of Tabnith, king of Sidon. These sarcophagi are now in the Imperial Museum at Constantinople. Remains have been found of a building which apparently belongs to the Persian period.

Siedlce (Russian, Syedlets), a government of Russia in the east of Poland, with an area of 5535 square miles and a population which was 630,240 in 1884 and 775,316 (census population, domiciled only) in 1897, when there were 382,896 women and the urban popula- tion numbered 110,995. The inhabitants are chiefly Little Russians (43 per cent.), Poles (40 per cent.), Jews (15 per cent.), and Germans. The government is divided into nine districts, the chief towns of which are the capital, Siedlce (23,714 inhabitants), Biaia (13,123), Konstantinow (1840), Garwolin (5554), Lukow (8317), Radzyn(5718), Sokotow (7246), W??grow (8679), Wtodawa (6758). The main occupation is still agriculture ; 1,035,300 acres were under crops in 1900, and the average yield in 1895-99 was :

rye 3,086,000 cwt., wheat 730,000 cwt., oats 1,485,600 cwt., barley 436,500 cwt. ??? all cereals, 6,198,000 cwt.; also potatoes, 10,280,000 cwt., they being largely grown for distilleries. The area under forests in 1898 was 97,300 acres. Cattle-breeding is second in importance only to agriculture; in 1897 there were 84,250 horses, 323,240 horned cattle, 341,640 sheep, and 165,450 pigs. Manufactures and trade are insignificant.

Siegburg, a town of Prussia, in the Rhine province, on the river Sieg, 1 6 mUes by rail south-east of Cologne. It has a royal projectile factory, calico-printing mills, lignite mines, stone quarries, and tobacco factories. The parish church, dating from the 13th century, possesses several richly-decorated reliquaries of the 12th to 15th centuries. A former Benedictine abbey, founded in 1066, is now used as a prison. Population (1885), 7514; (1900), 14,164.

Sieg'en, a town of Prussia, province of Westphalia, 63 miles by rail east of Cologne. It is the centre of the iron- mining, iron-smelting, and tanning industries of southern Westphalia. In the town are two castles of the former princes and counts of Nassau-Siegen, and an equestrian statue of the Emperor William I. Population (1885),

16,676; (1900), 22,111.

Siemens, Ernst Werner von (1816-1892),

German electrician, was born on the 13th December 1816 at Lenthe, in Hanover. After attending the gymnasium at Liibeck, he entered the Prussian army as a volunteer, and for three years was a pupil in the Military Academy at Berlin. In 1838 he received a commission as lieutenant in the artillery, and six years later he was appointed to the responsible post of superintendent of the artillery workshops. In 1848 he had the task of protecting the port of Kiel against the Danish fleet, and as commandant of Friedrichsort buUt the fortifications for the defence of Eckernf orde harbour. In the same' year he was entrusted with the laying of the first telegraph line in Germany, that between Berlin and Frankfort-on-Main, and with that work his mihtary career came to an end. Thenceforward he devoted his energies to furthering the interests of the

newly-founded firm of Siemens and Halske, which under his guidance became one of the most important electrical undertakings in the world, with branches in different countries that gave it an international influence ; in the London house he was associated with Sir Charles Siemens, one of his younger brothers. Although he had a decided predilection for pure research, his scientific work was naturally determined to a large extent by the demands of his business, and, as he said when he was admitted to the Berlin Academy of Sciences in 1874, the filling up of scientific voids presented itself to him as a technical necessity. Considering that his entrance into commercial life was almost synchronous with the introduction of electric telegraphy into Germany, it is not surprising that many of his inventions and discoveries relate to telegraphic apparatus. In 1847, when he was a member of the committee appointed to consider the adoption of the electric telegraph by the Government, he suggested the use of gutta-percha as a material for insulating metallic conductors. Then he investigated the electrostatic charges of telegraph conductors and their laws, and established methods for testing underground and submarine cables and for locating faults in their insulation; further, he carried out observations and experiments on electrostatic induction and the retardation it produced in the speed of the current. He also devised apparatus for duplex and diplex telegraphy, and automatic recorders. In a somewhat less specialized sphere, he was an early advocate of the desirability of establishing some easily reproducible basis for the measurement of electrical resistance, and suggested that the unit should be taken as the resistance of a column of pure mercury one metre high and one square millimetre in cross -section, at a temperature of 0 ° C. Another task to which he devoted much time was the construction of a selenium photometer, depending on the property possessed by that substance of changing its electrical resistance according to the intensity of the light falling upon it. He also claimed to have been, in 1866, the discoverer of the principle of self ~~excitation in dynamo~~ electric machines, in which the residual magnetism of the iron of the electro-magnets is utilized for excitation, without the aid of permanent steel magnets or of a separate exciting current. In another branch of science he -nTote several papers on meteorological subjects, discussing among other things the causation of the winds and the forces which produce, maintain, and retard the motions of the air. In 1866 he devoted

half a million marks to the foundation of an imperial institute of technology and ^ physics, and in 1888 he was ennobled. He died at Berlin on the 6th of December 1892. His scientific memoirs and addresses were collected and published in an English translation in 1892, and three years later a second volume appeared containing his technical papers. (h. m. k.)

Siemrat, or Siemeap, one of the souti-eastern provinces of Siam, situated at the north end of the TaM Sap, the lake of Cambodia. The total population can- not exceed 10,000, and consists mostly of Cambodians and descendants of former Siamese garrisons, who have adopted that language. Agriculture and fishing are the chief pursuits of the people. The trade is very small ; the sandy soil produces a red-grained rice which has not a good reputation for quality. Close by the chief town ... a mere village of some 2000 inhabitants ... there are the remains of the old brick kampeng, or fort, erected by Praya Bodin after the capture of this province from the Cambodians in the 18th century. But Siemrat is best known for the great ruins of Angkor, or Nakawn, Wat, which stand a mile or two to the northward buried in dense forest, an unending source of awe and mystery to the native and of admiration to the European visitor. These, with the extensive remains of Nakawn Luang, the old city close by, form remarkable relics of the architectural genius of the Khmer race, which between the 8th and 1 2th centuries had spread itself from the sea to Korat and the Me Kong.

AuTHOKiTiES. ... ^Thomson'. Straits of Malacca, Indo-Ohina, and China; Antiquities of CaTnbodia. ... Gaknier. Voyage d' Explora- tion en Indo-Cliine. ... Henri Motjhot. Travels in Indo- China. ... ... CtjKzon, Lord. Geogr. Journal, vol. ii. No. 3. ... MOEKISON, Dr. "Times" Letters from Indo-China. 1896. ... H. Wareington Smyth. Five Years in Siam. ... Stienne Atmoniek. Le Camhoge. Paris, 1900.

Siena, a town and archiepiscopal see of Italy, Tuscany, capital of the province of Siena, 61 miles by rail south of Florence. The Victor Emmanuel hall in the town hall, adorned by frescoes by the Sienese artists Aldi, Cassioli, and Maccari, was opened in 1891. In 1882 some frescoes by Pinturicchio were discovered in an apartment of the palace- which was built for Pandolfo Petrucci in 1508. The church of San Francesco was finally restored in 1885-92. The university was attended by 231 students in 1898, and there were 31 professors. Siena is a place of some industrial activity, and possesses a school of the industrial arts and sciences. Population (1881), 23,445; (1901), 28,678.

SierO, a town of Spain, in the province of Oviedo, to the south of Gijon, on the river Nora, and on the Laviana- Gijon and Leon-Gijon railways. It is in the centre of a fertile agricultural district, in which live stock is exten- sively reared. There are coal mines in the neighbourhood, and the local industries include tanning and manufactures of soap, coarse linen, and cloths. Population (1897), 22,456.

Sierra, Leonei a British colony on the west coast of Africa. Sierra Leone proper consists of a peninsula, about 26 miles in length to Cape Shilling, by about 12 in breadth, with an area of about 300 square miles. The colony, as distinct from the protectorate, now takes in the entire seaboard southwards to the Mano river, which forms the Liberian boundary, including Sherbro Island, Banana, Turtle, Plantain, and other minor islands ; also Turner's peninsula, a narrow strip of land from Bahol, Shea Bar, extending in a south-east direction about 60 miles to the Kase Lake and lying between the Bum Kittam river and the North Atlantic ??? thence the coast is continued to the ports of Sulima and Mano Salija, Garinga, about 8 miles up the Mano river, being the extreme limit of the colony proper. Northwards, the Isles de Los, Yellaboi, Kortimo, and Leopard Islands, and other small islets are also included. There is no further room for extension, the whole being hemmed in ??? one-third by the North Atlantic, one – third by French territory, and the remaining one-third by Liberia.

In 1896 the entire area beyond the colony proper, containing about 30, 000 square miles, now described as the protectorate, was

proclaimed as such, and was divided into five sections or districts, each under a European commissioner, namely, Ronietta, Karene, Bandajuma, Panguma, and Koinadugu. The protectorate extends on the northern coast-side of the colony to Kiragba, between the Great Scarcies river and the MeUacouri river, and then follows the defined Anglo- French and Anglo-Liberian delimitations. Upon first acquaintance it is difficult to realize that a country presenting such naturally beautiful surroundings can have a climate which is so deadly to the European. Gambia was administratively separated from Sierra Leone in 1888, so that Sierra Leone now stands alone as a distinct government. After 1875 a complete transformation took place in the geographical disposition of the British sphere of influence, in the delimitation of British territory by the various boundary commissions, and in the introduction of a governmental interior policy which has led to the protectorate being proclaimed, with a population estimated at about 1, 000, 000.

Freetown, the capital, which has a reputed population of about 30,000 inhabitants, mostly negroes, has come into greater promi- nence from its having been made a coaUng station of the Imperial Government, the natural open roadstead, 5 miles from the Gape, being capable of receiving the largest ships of war, and is the finest and safest harbour on the west coast of Africa. Freetown is the headquarters of His Majesty's military forces on this coast, the barracks being at Tower HOI, Kortright HUl, Mount Oriel, and Wilberforce. The forces consist of a battalion of the West India regiment, detachments of Eoyal Engineers and Royal Artillery, and in 1898 was raised the West African regiment from local native tribes, commanded by Imperial European ofiicers. For the protectorate there are the frontier police, a native colonial force numbering 600, under European military officers ; and for the colony proper there are the Sierra Leone poHee, about 270 strong, under a European superintendent and inspector, for the performance of civil duties. There has been cable communication from Freetown to all parts of the world since 1886, and sea communication is weekly by mail steamers from Liverpool, supplemented by frequent steamers from Hamburg. A Government light railway was begun at Freetown in 1897, and the first section, costing ??150,000, as far as Songo Town, a distance of 30 miles, was opened for trafiie early in 1899 ; it passes through the villages of Kissi,

Wellington, Hastings, Waterloo, and Newton, the journey' occupying 3 hours 20 minutes. The railway has been continued across the Ribbi river to Moyamba, 45 miles ; and it is contemplated to advance a considerable way into the interior, where the heavier natural productions wUl be met with, which should yield a revenue for the maintenance of the line.

Commercially, Freetown is a great trading centre and depot for supplying the rivers ; it produces nothing in the way of exports ; the villages around cultivate ginger, coffee, fruits, vegetables, cassada, and Indian corn, and raise poultry, all of which articles find a ready market in the capital. The exports comprise palm oil, palm kernels, kola nuts, peppers, benni seed, all from the Sherbro district and the protectorate, which also produce rice.

Freetown is noted for the abundance and excellence of its water, which comes down from the hills ; but the sanitation of the town calls for great improvement, and the lighting remains surprisingly behind the times, kerosene lamps being stQl in use in the streets. Horses do not live, consequently all wheeled traffic is drawn by manual labour ??? hammocks and sedan-chairs are the customary means of locomotion. The principal buildings in the town are the cathedral, the Wilberforce Hall, the fruit -market, the railway station, the model school, the courts of justice, the post oflBce, the hospital, the Government buildings, and the gaol. Outside the town are the Princess Christian Hospital, Bishop's Court, Fura Bay College, and the railway depot at Clinestown,

According to the census returns of 1891, the whole statistics population in the colony proper, i.e., at places indicated of Sierra in the following table, was : ??? Leone.

White.

Coloured Population.

Total.

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3

g

13

S

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S

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Freetown Diatrint :

St Georg-e'a Parish

1G9

30

16,142

13,692

16,811

13,722

Eastern Division

2,100

2,113

2,100

2,113

Mountain IMvision

2

2

3,082

2,994

3,08-1

2,996

Western District .

2,8V6

2,665

2,S76

2,665

Eastern District

“l

6,494

6,186

6,495

6,186

Sherbro

19

i

Y,S24

6,164

7,343

6,166

The Isles de Los .

814

764

814

764

Kaikonki , . . .

71

19

71

19

Factories (Govt.) in S.L. River

26

9

26

9

TasBO

680

300

680

360

Sulima Suh-District

^^

191

S3

39,609

34,866

39,800

34,899

SIFAN ◆◆◆ SIGNALS

621

The total population was thus 74,699. The white population, owing to the influx of numerous military officers, officials for the protectorate, and extended mercantile operations, has greatly increased. The dangers of the climate on the coast from malaria and fever remain unabated, and the colony justly retains its evil repuD&tion : 40 or 50 miles inland, the country is much healthier, and is tolerable for Europeans ; but the isolated life they are compelled to lead, surrounded by savagery, is prejudicial to any lengthened residence.

The rainfall of Sierra Leone, accprding to the colonial hospital observations at Freetown for three years, was as follows: ◆◆◆ 1896, 203 inches ; 189?, 164 inches ; 1899, 144 inches. The months of January, February, and March are practically rainless near the coast ; desultory' showers occur in April to the early part of May ; towards the end of that month the wet season sets in, and con- tinues until the and of October. With November the rain is again desultory, gradually ceasing with December. Tornadoes open and close the seasons, which is considered the unhealthiest time, the best time being the middle of the raius or "dries." The Harmattan wind, known as "the smokes," comes in with December, and lasts from two to three months ◆◆◆ generally daily, from early morning to noon. This is a north-east dry and desiccating wind, making the atmosphere cool and invigorating, though treacherous to the newcomer.

The following figures show the value of the principal exports for the four years enumerated : ◆◆◆

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1896

12,677

38,362

14,146

13,641

161,846

17,546

79,196

12,258

1897 .

7,665

46,662

13,606

6,030

129,910

9,149

79,787

13,112

1898 .

6,260

49,670

11,935

602

112,063

3,465

52,504

9,058

1900 .

4,569

79,218

6,233

601

171,774

7,436

25,740

6,963

From these figures it will be seen that there was a falling off in every-thing except kola nnts, which, however, are chiefly exported to Gambia and to Senegal, and in palm kernels ; the cultivation of ground nuts, which was formerly one of the large exports, has been superseded by exports from India. On their extinction rubber was discovered, and has continued to be worked, most of it coming from the northern side. The

vine is plentiful in Upper Mendi, but as yet the Mendis have not given it much attention.

Before the rising of the natives in 1898, the whole country had been in a particularly tranquil state since 1890, when the ???. Government adopted a finn and greatly extended

- **”” ??? policy for the interior, it having been obvious for some time previously that the internecine wars which devastated and depopulated large areas, and were of constant recurrence, greatly hindered the prosperity of the colony. Travelling com- missioners were appointed to explore the hinterland, and to enter into friendly treaties with the paramount chiefs ; and the frontier police were organized. The abolition of slavery followed ; and with the introduction of the Protectorate Ordinance in 1897, a house tax of 5s. each was imposed, to come into operation in the three first-named districts on the 1st January 1898. Chief Bai Bnreh, in the Timini country, broke out into open war, necessitating a military punitive expedition. He was at length captured, and deported. In April 1898 the Mendi tribes rose, and massacred several American missionaries at Rotifunk and Taiama, some native officials in the Imperri district, and a large number of police throughout the country. Speedy retribution followed, which effectually put down the revolt. A Royal Commission was appointed to inquire into the disturbances, which resulted in a continuance of the house tax. The disturbances would appear to have arisen from a desire on the part of the paramount chiefs (who arranged and disseminated a powerful fetich^” swear,” called “Poro, ” to compel the people to join) to cast themselves off from British rule, owing to the abolition of the slave trade and a longing to revert to their old heathenish customs and practices.*

The principal port for the shipping of the largest item of export ??? palm kernels ??? is Sherbro, lying about 90 miles to the south-east of Sierra Leone. Bonthe is the seat of government, situated upon Sherbro Island.

The channel for ocean steamers has been buoyed by the Government at considerable expense. Sherbro is now producing d, revenue of over ►►30,000 a year. The total quantity '^"►►►"'"'- of kernels shipped in 1899-1901 from Sherbro averaged about 13,456 tons a year. The oil palms, from which the nuts are gathered twice a year, extend all over Sherbro and its hinterland, the Mendi country, and are practically unlimited, the production being entirely Nature's work, as the natives never plant them.*

Sherbro and Mendi produce large quantities of kola nuts and rice, and, in smaller quantities, benni seed, pepper, piassava, 'and rubber. Cotton for local consumption is extensively grown. It is

from the Sherbro side of the colony that the heavy natural productions are obtained and exported ; but there is much scope for far greater export, when the great barrier to the development of the hinterland ►►► the overland transport difficulty ►►► shall have been overcome ; at present all inland produce is brought down, in palm- leaf hampers upon the backs of native carriers, to some riverside trading factory, whence it is conveyed in canoes and lighters to the port of Sherbro for shipment to the ocean steamers, the anchorages being ofif the Bonthe channel and off York Island.

So far as salt water extends, the banks of the waterways are covered by mangrove trees, the haunts of crocodiles, but with fresh water the vegetation becomes mixed and of the usual tropical descriptions. The system of barter still prevail^, though it is not so universal as formerly; the stationing of Imperial troops and colonial police in the protectorate is causing a great deal of British coin to be circulated, which is much appreciated by the natives. The country generally is plentifully watered, many places which in the "dries " are mere streams and rivulets, to be stepped over, become in the rains so swollen as to be unfordable ; hence the difficulty of interior travelling during the wet season.

The total shipping entered and cleared for four years is as follows: 1897, 1,084,745 tons; 1898, 1,110,228 tons; 1899, 1,681,748 tons; 1900, 1,290,933 tons; about three-lburths British. The revenue of the colony

was as follows: 1888, ►►63,035; 1897, ►►107,033 ; 1898, ►►117,682 ; 1900, ►►168,668 ; and the expenditure for corresponding years: 1888, ►►63,288; 1897, ►►111,678; 1898, ►►121,112; 1900, ►►156,421. The total imports: 1888, ►►250,147; 1897, ►►457,389 ; 1898, ►►606,349 ; 1900, ►►558,271. Total exports : 1888, ►►339,047; 1897, ►►400,748; 1898, ►►290,991; 1900, ►►362,471.

See the Annual Blue-book and Colonial Office Report thereon ; Colonial Office List. ►►► Banbitet. Sierra Leone, the White Man's Grave. 1888. ►►► Ingham. Sierra Leone after a Hundred Years. 1894. ►►► Lucas. Historical Geography of the British Colonies, vol. iii. 1896. ►►► PiEESON. Seven Years in Sierra Leone. 1897. ►►► Alldeidge. The Sheriro and its Hinterland. 1901. (x, j. x.)

Sifan. See LoLOS.

Sig'nriciringl'en, a town of Prussia, chief town of the province of Hohenzollern, on the right bank of the upper Danube, ^5 miles by rail south of Tiibingen. The castle of the Hohenzollerns crowns a high rock above the river, and contains a collection of pictures, an exceptionally interesting museum (textiles, enamels, metal-work, &c.), an armoury, and a library. On the opposite bank of the Danube there is a war monument to the Hohenzollern men who fell in 1866 and 1870-71. Population (1900), 4-576.

SiglTialS (Army). ►►► There are two systems of

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Fia. 1. ►►► Morse System : the dash. The flag is waved from A to B and back again in one motion.

signalling in use in the British army, (1) the Morse (or dot

and dash, Figs. 1, 2), (2), the semaphore (Figs. 3, 4). The first is the more generally used, and is also employed in tele- graphy and naval signalling. It is carried on by means of a flag or heliograph by day, and lamps by night. The flag is either dark blue or white with a horizontal line, accord-

ing to the background. It is made in two sizes, the larger having drapery 3 feet square with a pole 5 feet 6 inches in length, the smaller 2 feet square of drapery and a 3 feet 6 inch pole. The former is visible with an ordi- nary telescope from 5 to 7 miles, but with a good glass can

B ,<=<—'

Pia. 2. ??? Horse System : the dot. The flag is waved from A to B and back again in one motion.

be seen at a much greater distance. The latter under similar conditions is visible from 3 to 4 miles. To form the dot and dash the flag is waved in a short or long arc, the latter being regulated to three times the length of the former. The heliograph, as its name implies, can only be

Fio. 3. ??? Semaphore System : letter J.

used in conjunction with the sun (Figs. 5, 6). It consists of a circular movable mirror, generally 5 inches or 3 inches in diameter, so arranged that it may reflect the rays of the sun on and off a distant station. The dot and dash are formed by the length of time the rays are allowed to

??^:?

:>’

Fig. 5. The Heliograph. A, the sun ; B, signalling mirror ; C, distant station.

d^B

^E

>c

Fig. 4. Semaphore System ; letter I.

remain on the station. When the sun makes an angle of more than 120 degrees with the mirror and the station, a duplex mirror is employed, the sun rays being collected on the signalling mirror, thence reflected on to the duplex mirror, and from there again to the station required. Three kinds of lamp are used for signalling by night :

Fin. fi. The Heliograph. A, the sun ; B, signalling mirror ; C, distant station ; D, duplex mirror.

(1) the ordinary hand-lamp, which is an enlarged bull’s eye burning colza or other vegetable oil, with a shutter for exposing and ob.scuring the light, visible 3 to 4 miles ;

(2) the Begbie, made in three sizes, burning kerosene oil and visible with glasses 10, 20, and 40 miles respectively these are principally used in India ; (3) the limelight

apparatus, visible 10 to 15 miles or more according to atmospheric conditions. The semaphore system is used for comparatively short distances. It is simpler and more rapid than the Morse system, but is only

adapted for use during the day. Two small flags are employed, and the letters of the alphabet are formed by the positions in which they are held.

In every regiment of cavalry on the higher establish- ment there are 4 signallers per squadron ; those on the lower establishment, household regiments, and regiments abroad, have 3 per squadron ; and there are at least 2 supernumeraries per service squadron. In the royal garrison artillery there are 4 signallers per company, and 3 per mountain battery. In the infantry there are 6 signallers per battalion, and at least 1 supernumerary per company. In addition to the above, 1 officer is appointed as instructor and 1 non-commissioned officer as assistant-instructor, both of whom should hold certificates from one of the schools of instruction. Signallers are inspected annually, and are required to send, transmit, and read messages accurately at a rate of not less than 6 words a minute. Those who qualify receive 15s. each and the right to wear a badge until the following year's inspec- tion. Signallers employed in the field may be combined to form either brigade or special signalling companies. The former consist of men drawn from regiments on the spot, and may contain any available number under an, officer. A special signalling company is an independent unit of an army corps ; it may be mounted or dismounted, and the signallers are taken from regiments not in the field.

Signalling is used on most campaigns to a large extent. In the Tirah expedition, 1897 and 1898, one signal station received and sent, between the 1st and 18th November, as many as 980 messages by heUograph, some of which were 200 to 300 words in length. It is often used as an auxiliary to the field telegraph, especially in mountainous countries, and when the wire is liable to be cut and stolen by hostile natives. In the Waziri ex- pedition, 1881, communication was maintained direct for a distance of 70 miles with a 5-inch heliograph. In the Boer war, 1899-1902, the system of heliographic signal- ling was employed very extensively by both sides.

The electric search-light is occasionally used for signal- ling purposes ; and when the intervening ground intercepts the light, the rays are projected on to a cloud, and thence read by the distant station. (g. a. br.)

Sigrna-IS (Naval). ??? A system of naval signals comprises different methods of conveying orders or in- formation between ships or with the shore by signs. In the British navy, which serves as a model to most others, visual signals are made with flags or pendants, the semaphore, flashing, and occasionally fireworks. Sound signals are made with fog-horns, steam ~~whistles, sirens, and guns. The number of flags in use in the naval code, comprising what is termed a "set," are 58, and consist of 26 alpha~~ betical flags, 10 numeral flags, 16 pendants, and 6 special flags. Flag signals are divided into three classes, to each of which is allotted a separate book. One class consists of two alphabetical flags, and refers to. orders usual in the administration of a squadron, such as, for example, the flags LE, which might signify " Captain repair on board flagship." Another class consists of three alphabetical flags, which refer to a coded dictionary, wherein are words and short sentences likely to be required. The remaining refers to evolutionary orders for manoeuvring, which have alpha- betical and numeral flags combined. The flags which con- stitute a signal are termed a "hoist." One or more hoists may be made at the same time. Although flag signalling is a slow method compared with others, a fair rate can be

attained with practice. For example, a signal involving 162 separate hoists has been repeated at sight by 13 ships in company in 76 minutes. Semaphore signals are made by the extension of a man's arms through a vertical plane, the different symbols being distinguished by the relati\e positions of the arms, which are never less than 45?? apart. To render the signals more conspicuous the signaller usually holds a small flag on a stick in each hand, but all ships are fitted with mechanical semaphores, which can be worked by one man, and are visible several miles. Flag signalling being comparatively slow and laborious, the ordinary message work in a squadron is generally signalled by semaphore. The convenience of this method is enormous, and by way of example it may be of interest to mention a record message of 350 words which was signalled to 21 ships simultaneously at the rate of 17 words per minute. Flags being limited in size, and only distinguishable by their colour, signals by this means are not altogether satis- factory at long distances, even, when the wind is suitable. For signalling at long range the British navy employs a semaphore with arms from 9 to 12 feet long mounted at the top of the

mast and capable of being trained in any required direction, and worked from the deck. Its range depends upon the clearness of the atmosphere, but instances are on record where a message by this means has been read at 16 to 18 miles.

Night signalling is carried out by means of "flashing," by which is meant the exposure and eclipse of a single light for short and long periods of time, representing the dots and dashes composing the required symbol. The dots and dashes can be made mechanically by an obscuring arrangement, or by electro-mechanical means where magnets do the work, or by simply svpitching on and off specially manufactured electric lamps. The ordinary rate of signal- ling by flashing is from 7 to 10 words per minute. In the British navy, as in the army, dots and dashes are short and long exposures of light ; but with some nations the dots and dashes are short and long periods of darkness, the light punctuating the spaces between them. The British navy uses the European modification of the so-called Morse code used in telegraphy, but with special signs added suitable to their code. The introduction of the "dot and dash" system into the navy was entirely due to the perseverance of Vice-Admiral Colomb, who, in spite of great opposition, and even after it had once been condemned on its first trial at sea, carried it through with the greatest success. The value of this innovation made in 1867 may be gauged by the fact that now it is possible to handle a fleet with ease and safety in darkness and fog ___ a state of affairs which did not formerly exist. The simplicity of the dot and dash principle is its best feature. As the system only requires the exhibition of two elements it may be used in a variety of different manners with a minimum of material, namely, by waving the most conspicuous object at hand through short and long arcs, by exhibiting two diflferent shapes, each repre- senting one of the elements, or dipping a lantern in a bucket, and so on. Its adoption has not only contributed very materially to the increased efficiency of the British navy, but it has been made optional for use with the mercantile marine. Curiously enough, flashing is not to any great extent used in foreign navies, who rely more on some system of coloured lights at night. This system generally takes the form of four or five double- coloured lanterns, which are suspended from some part of the mast in a vertical line. Each lantern generally contains a red and a white lamp, either of which can be

switched on. By a suitable keyboard on deck any combination of these coloured lanterns can be shown. The advantage of this system lies in the fact that each symbol is self-evident

in its entirety, and does not require an expert signalman to read it, as is the case with flashing, which is a pro- gressive performance.

- For long distances at night the search-light, or some other high power electric arc light, is utilized on the flashing system. Dots and dashes are then made either by flashing the light directly on the object, or else waving the beam up and down for short and long periods of time. Sometimes when a convenient cloud is available the reflection of the beam has been read for nearly 40 miles, with land intervening between the two ships. In a fog signals are made by the steam- whistle, fog-horn, siren, or by guns. Except for the latter method the dot and dash system is employed in a similar manner to flashing a light. Guns are sometimes used in a fog for signalling, the signification being determined by certain timed inter- vals between the discharges. The larger British ships are supplied with telegraph instruments for connexion with the shore, and heliographs are provided for land operations. Marine galvanometers are also provided, and can be used to communicate through submarine cables. To the various methods of naval signalling must be added Signer Marconi's system of wireless telegraphy, which in its application to ships at sea bids fair to solve some problems hitherto impracticable. (See Telegraphy,

WiEBLESS.)

The international code of signals, for use between ships of all nations, is perhaps the best universal dictionary in existence. By its means mariners can talk with great ease without knowing a word of one another's language. By means of a few flags you can ask any question and make any answer. The number of international flags and pendants used with the international code is 27, con- sisting of a complete alphabet and a

special pendant characteristic of the code. At night flashing may be used. (a. f. b.)

Sig^ur'SsSOn, Jon (1811-1879), Icelandic states- man and man of letters, was born in the west of Iceland in 1811. He came of an old family, and received an ex- cellent education. In 1830 he was secretary to the bishop of Iceland, the learned Steingrimr J6nsson. In 1833 he went to the university of Copenhagen and devoted himself to the study of Icelandic history and literature. His name soon became prominent in the learned world, and it may safely be said that most of his historical works and his editions of Icelandic classics have never been surpassed for acute criticism and minute painstaking. Of these we may mention Logsogumannatal og Lbgmanna d Islandi (" Speakers of the Law and Law-men in Iceland ") ; his edition of Landndma and other sagas in Islendinga Sogur, i.-ii. (Copenhagen, 1843-47); the large collection of Ice- landic laws edited by him and Oddgeir Stephensen ; and last, not least, the Diploniatarium Islandicum, which after his death was continued by others. But although he was one of the greatest scholars Iceland has produced, he was still greater as a politician. The Danish rule had, during the centuries following the Reformation, gradually brought Iceland to the verge of economic ruin ; the ancient Parlia- ment of the island, which had degenerated to a mere shadow, had been abolished in 1 800 ; all the revenue of Iceland went into the Danish treasury, and only very small sums were spent for the good of the island ; but worst of all was the notorious monopoly which gave away the whole trade of Iceland to a single Danish trading company. This monopoly had been abolished in 1787, and the trade had been declared free to all Danish subjects, but practically the old arrangement was con- tinued under disguised forms. Jon Sigurdsson began a hard struggle against the Danish Government to obtain a

reform. In 1854 the trade of Iceland was declared free to all nations. In 1840 the Althing was re-established as an advisory, not as a legislative body. But when Denmark got a free constitution in 1848, which had no legal validity in Iceland, the island felt justified in demanding full home rule. To this the Danish Government was vehemently opposed ; it convoked an Icelandic National Assembly in 1851, and brought before

that body a Bill granting Iceland small local liberties, but practically incorporating Iceland in Denmark. This Bill was indignantly rejected, and, instigated by J6n Sigurdsson, another was demanded of far more liberal tendencies. The Danish governor- general then dissolved the assembly, but J6n Sigurdsson and all the members with him protested to the king against these unlawful proceedings. The struggle continued with great bitterness on both sides, but gradually the Danish Government was forced to grant many important reforms. High schools were established at Reykjavik, and efforts made to better the trade and farming of the country. In 1871 the Danish Parliament (Riksdag) passed a law defining the political position of Iceland in the Danish monarchy, which, though never recognized as valid by the Icelanders, became de facto the base of the political relations of Iceland and Denmark. At last, in 1874, when King Christian IX. visited Iceland at the festival commemorating the millen- ary of the colonization of Iceland from Norway, he gave to the country a Constitution, with full home rule in all internal matters. An immense victory was gained, entirely due to J6n Sigurdsson, whose high personal qualities had rallied all the nation round him. He was a man of fine appearance, with an eloquence and diplomatic gifts such as no others of his countrymen possessed, and his unselfish love of his country made itself felt in almost every branch of Icelandic life. Recognizing the value of an intellectual centre, he made Reykjavik not only the political, but the spiritual capital of Iceland by removing all the chief institutions of learning to that city ; he was the soul of many literary and political societies, and the chief editor of the Ny Felagsrit, which has done m6re than any other Icelandic periodical to promote the cause of civilization and progress in Iceland. After Iceland had got home rule in 1874, the grateful people showered on J6n Sigurdsson all the honours it could bestow. He lived the greater part of his life in Copenhagen, and died there in 1879 ; but his body, together with that of his wife, Ingibjorg Einarsd6ttir, whom he had married in 1845, and who survived him only a few days, was taken to Reyk- javik and given a public funeral. On his monument was placed the inscription: "The beloved son of Iceland, her honour, sword, and shield." (s. bl.)

Si kki m, called by Tibetans, Dejong (the rice country), a protected state of India, situated in the eastern Hima- laya, between 27 5' and 28

10′ N. and between 88 ◆◆ 4′ and 88 ◆◆ 58′ E. It comprises an area of 2818 square miles of what may be briefly described as the catchment basin of the headwaters of the rivers Tista and Rungit. On the S. and S.E., branches of these rivers form the boundary between Sikkim and British India, while on the W., N., and N.E. Sikkim is separated from Nepal, Tibet, and Bhutan by the range of lofty mountains, which culminate in Kanchinjunga (28,156) and form a kind of horse-shoe, whence dependent spurs project south- wards, gradually contracting and lessening in height until they reach the junction of the Rungit and the Tista. Thus the country is split up into a succession of deep valleys surmounted by open plateaux cut off from one another by high and steep ridges, and lies at a very con- siderable elevation, rising from 1000 feet above sea-level at its southern extremity to 16,000 or 18,000 feet on the

north. The main trade-passes into Tibet, such as the Jelep (14,500), Chola (14,550), and Kangra-lama (16,000), are not nearly so high as those met with in the western Himalaya, while those into Nepal are less than 12,000 feet.

Formerly the area of the state was much more extensive, but in the beginning of the 18th century Bhutan appropi-iated a large tract of country on the east, while the close of the century saw the Gurkha kingdom of Nepal absorb a much larger slice on the west ; on the south the present British district of Darjiling was carved out of the residue at various times from 1835 to 1861. Tibet, moreover, appears to have resumed the Am-mochu valley towards the end of the 19th century.

Small though the country is now ◆◆◆◆◆◆ ’ wide variation of climate makes it peculiarly interesting. From a, naturalist’s point of view ◆◆◆. , , it can be divided into three zones. The lowest, stretch- Hhysical j^^ ^^.^^ ^ggg ^^ gQgg ^^^ ^^^^ ^ sea-lcvcl, may be called features. ^^^ tropical zone ; thence to 13,000 feet, the upper limit of tree vegetation, the temperate ; and above, to the line of per- petual snow, the alpine. Down to about 1880 Sikkim was covered with dense forests, only

interrupted where village clearances had bared the slopes for the purposes of cultivation, but at the present time this description does not apply below 6000 feet, the upper limit at which Indian corn ripens ; for here, owing to iucrease of population (particularly the immigration of Nepalese settlers), almost every suitable spot has been cleared for cultivation. The exuber- ance of its flora may be imagined when it is considered that the total flowering plants and ferns together comprise some 4000 species ; there are more than 200 diflferent kinds of ferns, 400 orchids, 20 bamboos, 30 rhododendrons, 30 to 40 primulas, and many other genera are equally profuse ; iu fact Sikkim contains types of every flora from the tropics to the poles, and probably no other country of equal or even larger extent can present such infinite variety. Butterflies abound and comprise about 600 species, while moths are estimated at 2000. Birds are profusely represented, numberiug between 500 and 600 species. Mammals, however, are not numerous, only amounting to 85 different kinds. Reptiles, though existent in some variety, are not commonly met with, and fatal oases of snake-bite are almost unknown. Copper and lime are the chief minerals found and worked in Sikkim, but they are of little commercial value at present.

The population is essentially agricultural, each family living in a house on its own land : there are no towns or villages, and the only collection of houses, outside the Laohen and Laehung Govern- valleys, are the few that have sprung up round country ”’”/□□ market-places, such as Rhenook, Dikkeling, and Gantok; popa a on-^mj. ^ jj^g above-mentioned valleys the inhabitants, who are Bhutanese in origin and herdsmen in occupation, have large clusters of well-built houses at various altitudes up the valleys, which they occupy in rotation according to the season of the year.*

The seat of government, or in other words the palace of the Eaja, was, untU the irruption of the Nepalese, situated at Eubdentze, in the western centre of the state ; but when that place was taken and destroyed by the Ghurkhas, a new palace was built at Tumlong, close to the eastern and Tibetan boundary, while a subsidiary summer residence was erected on the other side of the Chola range at Chombi, in the Am-mochu vaUey. At the present time the Raja and his court remain in the more open country

at Gantok, where the British political officer and a small detachment of native troops are also stationed.

The earliest inhabitants of Sikkim were the Eong-pa (ravine folk), better known as the Lepohas, probably a tribe of Indo-Chinese origin ; but when or how they migrated to Sikkim is unknown. The reigning family, however, is Tibetan, and claims descent from one of the Gyalpos or princelings of eastern Chinese Tibet ; their ancestors in course of several generations found their way westwards to Lhasa and Sakya, and thence down the Am-mochu valley : finally, about the year 1604, Penchoo Namyg^ was born at Gantok, and in 1641, with the aid of Lha-tsan Lama and two other priests of the Duk-pa or Red-hat sect of Tibet, overcame the Lepcha chiefs, who had been warring among themselves, established a firm government and iitroduced Buddhist Lamaism as a state religion. His son, Tensung Namgy4, very largely extended his kingdom, but much of it was lost in the succeeding reign of Chak-dor Namgy6 (1700-17), who is credited with having designed the alphabet now in use among the Lepchas.

Between 1776 and 1792 Sikkim was constantly at war with the

victorious Ghurkhas, who were, however, driven out of part of their

conquests by the Chinese in 1792 ; but it was not until

History. ^g^g j^^ ^.j^g j^^jj^ ^j ^j^g^^ jg known to us as Sikkim

was restored by the British, after the defeat of the Nepalese by General Ochterlony.

The British resumed the whole of the plains (Terai) and the outer hills, as punishment for repeated insults and injuries caused by the rulers of Sikkim, who had become wholly pro-Tibetan in feeling and policy. Matters grew so bad that in 1886 the Raja Tho-tub

Mamgy6 refused to carry out his obligations under the treaty of 1861, and defiantly persisted in living in Tibet ; his administration was neglected, his subjects oppressed, and a force of Tibetan soldiers was allowed, and

even encouraged, to seize the road and to erect a fort within sight of Darjiling. After months of useless remon- strance, the Government was forced in 1888 to send an expedition, which drove the Tibetans back over the Jelep pass. A convention was then ~~concluded with China in 1890 whereby the British pro~~ tectorate over Sikkim was acknowledged and the boundary of the state defined ; to this was added a supplemental agreement relating to trade and domestic matters, which was signed in 1893. Since that time the government has been a semi-independent one under the Maharaja, assisted by a council of seven or eight of his leading subjects, and guided by a resident British officer. Crime, of which there is little, is punished under local laws administered by local kazis or petty chiefs.

No trustworthy census has ever been taken in Sikkim ; prior to 1886 the population was put down at between 7000 and 10, 000, but in 1891 a rough enumeration gave a population of 30,500 ; statistics of this number 5800 were Lepchas, 5000 Bhuteas or Tibetans, 12,000 Limbus, Gunmgs, Murmis, and other hiUmen more or less aUied to one another, and in religion Hindu tainted with Lamaism, while the balance was made up of pure Nepalese. The census of 1901 gave a population or 59,242.

The state religion is Buddhism as practised in Tibet, but is not confined to one particular sect ; while among the heterogeneous popu- lation of Sikkim all manner of religious cults can be found. Educa- tion is at a low ebb, though the monasteries are supposed to main- tain schools, and missionary enterprise has established others.

The revenue of Sikkim has under British guidance increased from Es.20,000 a year to nearly Es.3,50,000, derived chiefly from a land and poll tax, excise, and sale of timber ; the chief expenditure is in the maintenance of the state, which practically means the Eaja's family, as there are no soldiers and no police ; and also in the improvement of communication. The country can now boast a very complete system of mountain roads, bridged and open to animal (but not cart) traflSc. British trade with Central Tibet is carried over the Jelep route, on the south-eastern border of Sikkim, and in 1898 amounted to 21J lakhs iu exports

and imports, but in 1901 it did not exceed 13 lakhs, though to this another 4 J lakhs must be added for the Bengal-Sikkim trade.

Eajas of SikHm (Dejong-Gyalpo) : Penchoo Namyg^ (1641- 70), Tensung Namgy^ (1670-1700), Chak-dor Namgy^ (1700- 17), Gyur-m^ Namgyi (1717-34), Penchoo Namgyd (1734- 80), Tenzing Namgy^ (1780-90), Cho-phoe Namgy^ (1790- 1861), Sikhyong Namgye (1861-74), Tho-tub Namgye, 1861, the present Maharaja.

Atjthokities. ??? Edgae. Jlejjort on a Visit to Sikkim and the Tiiettm Frontier in 1873. Calcutta 1874. ??? Maoaulat. Report on a Mission to Sikkim and the Tibetan Frontier. Calcutta 1885. ??? Tlie Gazetteer of Sikkim. Calcutta 1894. ??? Hookek. Himalayan Jour- nals. Murray, 1854. ??? Waddell. Lamaism. Allen and Co., 1895. Among the Sinnalayas. Constable and Co., 1898. (a. W. P.)

SilCha.r, a tovm of British India, in the Cachar dis- trict of Assam, of which ii is the headquarters ; situated in 24?? 49' N. and 92?? 51' E., on the left bank of the river Barak, with a railway station; 271 miles north of Chitta- gong. Population (1881), 6567 ; (1891), 7523 ; municipal income (1897-98), Rs.19,721; incidence of taxation, Kl.5.6; death-rate (1897), 65‘53 per thousand. Silchar is the centre of an important tea industry. The military cantonment had 336 men in 1898. Silchar is the head- quarters of the volunteer corps known as the Surma Valley Light Horse. The Government high school had 185 pupils in 1896-97, and there is a law class and an unaided school for girls. A branch railway (19 miles) from Badarpur, the terminus of the Assam-Bengal line, was opened in November 1898.

Silchester, a parish of Hampshire, England, lying half-way between Reading and Basingstoke. It has become one of the most interesting sites for archasological excava- tion. Here, on a hill with a wide prospect east and south and west, is an open space of 100 acres, in shape an ir-, regular hexagon, enclosed, in a circuit of a mile and a half,, by the massive ruins of a city wall, still standing here and there some twenty feet high (Fig. 1). Outside, on the east, is the grassy hollow of a tiny amphitheatre ; on the

west a line of earthworks runs in wider circuit than the waUs. The area within the walls is a vast expanse of cultivated land

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unbroken by any vestige of antiquity; yet the soil is thick with tile and potsherd, and in hot summers the unevenly growing corn reveals the remains of streets and houses close beneath the surface. This is the Eomano- British town Calleva Atrebatum. Ptolemy and the Itin- erary tell us its name ; of its history nothing is known ; its character has been disclosed for us by the spade.

Casual excavations were made here in 1744 and 1833; more systematic ones intermittently between 1864 and 1884 by the Rev. J. G. Joyce and others; finally, in May 1890, the complete uncovering of the whole site was com- menced by jNIr G. E. Fox and others, with the aid of the London Society of Antiquaries. The work was carried on with splendid perseverance, and in 1902 was three-quarters finished. The chief results concern the buildings of the town. Though these have vanished wholly from the surface, the foundations and lowest courses of their walls survive fairly perfect below ground : thus the plan of the town can be minutely recovered, and evidence accumulates on two points ◆◆◆ the character of the buildings which made up a town like Calleva, and the character

of Romano-British buildings generally. On the other ◆◆ |;

hand, little that is new has been learnt either as to the history of the place or as to that wide topic, the smaller details of ancient life ; for instance, the develop- ments of Roman provincial pottery have received scanty illustration. This is partly because Silchester has yielded few small objects of note, partly because its remains do not usually lie in strata which can be dated, and partly because the excavators have concentrated themselves on plans of buildings. Of these buildings the chief are : ◆◆◆

(1) Forum. ??? Near the middle of the town was a rect- angular block, covering two acres. It comprised a central open court, 132 feet by 140 feet in size, surrounded on three sides by a corridor or cloister, with rooms opening on to the cloister (Fig. 2)r On the fourth side was a great hall,

had their offices, justice was administered, traders, trafficked, citizens and idlers assembled. We cannot apportion the rooms to their precise uses, but the great hall was plainly

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Fi8. 1. ??? General Plan.

with rooms opening into it from behind. Thi.s hall was 270 feet long and 58 feet wide; two rows of Corinthian columns supported the roof, which may have stood 50 or 60 feet above the floor ; the walls were frescoed or lined with marble, and for ornament there was jjrobably a statue or two. Finally, a corridor ran round outside the whole block. This was the Forum where the local authorities

Fig. 2. ??? Plan of Forum, Basilica, and Surrounding.

the Basilica, for meetings and business ; the rooms behind it were perhaps law courts, and some of the rooms on the other three sides may have been shops. Similar municipal buildings existed in most towns of the western Empire, whether they were full municipalities or (as probably CaUeva was) of lower rank. The Callevan Forum seems in general simpler than others, but its Basilica is remarkably large. Probably the British climate compelled more indoor life than the sunnier south. Many Fora have been ex- amined in other provinces; this is the only instance adequately excavated in Britain.

(2) Temples. ??? Two small square temples were in the east of the town ; the cella of the larger measured 42 feet square, and was lined with Purbeck marble. A third, circular, temple stood between the Forum and the south gate.

(3) Church. ??? Close outside the south-east angle of the Forum was a small edifice, 42 feet long by 27 feet wide, consisting of a nave and two aisles, which ended at the east in a porch of the width of the building, and at the west in an apse and two flanking chambers (Fig. 3). The nave and porch were floored with plain red tesserae : in the apse was a simple mosaic panel in red, black, and white. Round the building was a yard, and in it a well near the apse, and a small structure of tile with a pit near the east end. No direct indication of date or use was discovered. But the ground plan is that of an early Christian church of the " basilican " type. This type comprised nave and aisles, ending

in an apse and two chambers resembling rudimentary transepts, and having at the other end a porch (narthe.i-). Previous to a.d. 420 the porch was often at the east end and the apse at the west ; the altar, often

movable, stood in the apse ❓❓❓ at Silchester perhaps on the mosaic panel. A court enclosed the whole ; near the porch was a laver (cantharus) for the ablutions of intending worshippers.

SILESIA, AUSTRIAN

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Several such churches have been found abroad, especially in Roman Africa ; no other satisfactory instance is known in Britain.

(4) Private Houses. ❓❓❓ The private houses of SUchester are of tvpo types. They consist either of a row of rooms,

BOUNOAWY

Of COURT?”.*

O WELL

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Fig. 3. ❓❓❓ Plan o ❓❓ Christian Church.

with a corridor along them, and perhaps one or two addi- tional rooms at the ends ; or of three such corridors and rows of rooms, forming three sides of a large square yard. They are necessarily detached houses, standing each in its own garden. The country houses of Roman Britain have long been recognized as embodying these (or allied) types ; now it becomes plain that they are the normal types throughout Britain. They differ widely from the town houses of Rome and Pompeii : they are less unlike some country houses of Italy and Roman Africa ; but their real parallels occur in Gaul, and they may be Celtic types modified to Roman use, like Indian bungalows. Their internal fittings ❓❓❓ hjrpocausts, frescoes, mosaics ❓❓❓ are every- where Roman ; those at Silchester are average specimens

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Fig. 4. ***Plan of Supposed Inn and Baths.***

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and, except for one mosaic, not individually striking. The largest Silchester house, vsdth a special annexe for baths, is usually taken to be a guest-house or hotel for travellers between London and the west (Fig. 4). Altogether, the town probably did not contain more than seventy or eighty houses of any size, and large spaces were hardly buUt over at all.

(5) Industries. ***Shops are conjectured in the Forum and elsewhere, but were not numerous. Remains of dyers' furnaces, of a little silver refinery, and perhaps of a bakery have been noted.***

(6) Streets, &c. ***The streets were paved with gravel : they varied in width up to 28| feet. They intersect regularly at right angles, dividing the town into square blocks, like Mannheim or Turin : plainly they were laid out all at once, possibly by Agricola (Tac. Agr. 21),***

possibly later. There are four jsrincipal gates : the eastern and western gates are not exactly opposite. The walls are constructed of flint, "bonded" with stone, and backed with earth ; they have no external bastions or towers. In the plans (but not in the text) of the excavators' reports they are shown as erected subsequent to the streets.

No traces of theatre, meat-market, public baths, or aqueduct have been found ; water was got from wells lined with wooden tubs, and must have been scanty in dry summers. Smaller objects ??? pottery, coins, window and bottle glass, bronze ornaments, iron tools, &c. ??? abound, but few pieces are individually notable. The most im- portant feature is the absence of " Late Celtic " artistic traditions and the dominion of Roman fashions : with which we may join the fact, proved by inscriptions, that even the lower classes spoke Latin. The old tribal centre of the Atrebates had become a Romanized country town. Such, sometimes larger, more often smaller, were (we may think) the country towns which sheltered most of the town life iu Roman Britain.

See ArchoBologia, xl., xlvi., lii., and following vols. ; Victoria History of HaTnpshire, i. 271, 350. Reading Museum has a rich collection of objects, models, &c. (f. j. H.)

Silesia, Austricltl (German, Oesterriechisch- Schlesien), a duchy and crownland of the cis-Leithan part of the Austro – Hungarian monarchy. Popula- tion in 1890, 605,649; in 1900, 680,529, equivalent to .342 '5 per square mile. In some parts of this crown- land, next to Lower Austria the most densely populated of the monarchy, there are 1000 inhabitants per square mile. The proportion of females to males in 1890 was 1096 to 1000 ; 48 per cent. German, 30 per cent. Poles, and 22 per cent. Czechs ; 84'4 per cent. Roman Catholics, 13'91 per cent. Protestants, and 1'65 per cent. Jews. In 1897 the marriage-rate was 8 '4 9, the birth-rate 39'9, or excluding stiU-births, 38"8, and the death-rate 27' 16 per thousand. Of the births 10 '6 per cent, were illegitimate.

Austrian Silesia sends 12 members to the Reichsrath, of whom 2 are returned by the new universal sufirage curia (9 German Opposition, 1 Pan-Germanic, 1 Social Demo- crat, and 1 Pole). The Diet is composed of 25 Germans, 3 Czechs, and 3 Poles.

There are 9 gymnasia and real gymnasia, a Protestant theological seminary, 15 technical agricultural and other schools, 10 intermediate and 505 public elementary schools (220 German, 116 Czech, 139 PoHsh, 30 mixed, &c.). In 1890 the proportion of illiterates was 8 '7 per cent., a

reduction of 3;1 per cent, in the preceding decade. Of the 49 periodicals published, 34 are German, 9 Polish, 5 Czech, and 1 ItaUan.

Since 1885 there has been a diminution of 7 per cent, in the pro- portion engaged in agricultural and forestry, now 41 '25 per cent., and an increase of 15 per cent, in the proportion engaged in mining and industry (42 '12 per cent.). This has been accompanied by comparatively little change in the nature either of the agricultural or industrial production. The mountainous parts are largely de- voted to dairy-fanning, the breeding of sheep, geese, and pigeons, hunting and fishing being also important resources. The coal- mines furnish some 5J million tons annually, equivalent to 41J per cent, of the entire Austrian product. With the exception of a small quantity of lignite, it is the only mineral produced. The staple textile, iron and steel industries ilourish. There were in 1899, 357 miles of railway,2303 miles of roads, and 17 miles of waterway. There were 183 post and 73 telegraph ofiBces, with 761 miles of line and 2270 miles of wire.

The political life of the province turns upon the efforts of the Poles and Czechs to secure increased educational facilities in their own languages, in which they are encouraged by their compatriots in the adjoining provinces, and upon the occasional explosions of the chronic discontent of the mining and industrial population.

*See Peter. Das Herzogthum Schlesien. ??? Slama. Oesterreich- isch Schlesien. (^ q'j^ *

S I L E S I A ??? S I L V E R

Silesia, an eastern province of Prussia, with an area of 15,566 square miles, and population (1895), 4,415,309 ; (1900), 4,668,857 ; tlie largest province of the kingdom in area, and in respect of population the second (after the Rhine province). The density per square mile amounts to 300 persons. The south-eastern extremity of the province contains one of the principal coal-fields of the Prussian monarchy, and is the centre of the zinc- mining industry of Germany. In 1900 the mines yielded 29,596,750

tons (in 1881, 16,220 tons) of coal, valued at ►►11,420,500; 802,500 tons of lignite, valued at ►►150,750; 437,370 tons of iron-ore, valued at ►►142,400; 521,570 tons of zinc, valued at ►►774,350; 39,575 tons of lead, valued at ►►214,900 ; and 7280 tons of iron pyrites, valued at ►►3450. In 1900 the number of workmen employed in the coal-mines was 93,286, in the other mines about 15,600. The smelting furnaces yielded 742,820 tons of iron, valued at ►►2,493,450; 102,130 tons of zinc, valued at ►►1,984,400; 24,925 tons of lead, valued at ►►424,200; 286,250 oz. of silver, valued at ►►46,050; and 84,415 tons of sulphuric acid, valued at ►►116,400. The iron foundries, forges, ifec, had an output of 681,900 tons of pig iron, iron bars, rails, &c., of the aggregate value of ►►5,177,550. In 1900 the live stock included 1,526,987 cattle, 951,577 pigs, 398,049 sheep, and 319,857 horses. In the same year 130 tons of tobacco were gathered off 250 acres of ground. In 1900 the sugar refineries and factories produced 238,650 tons of sugar; the breweries, 77,945,000 gallons of beer; and the distilleries, 10,985,950 gallons of pure alcohol. (For further particulars, see under Prussia).

Silistria, an ancient fortified town, chief town of a department of Bulgaria, on a peninsula of low ground pro- jecting into the Danube, 60 miles below Eustchuk. There are extensive vineyards in the neighbourhood, and tobacco is also cultivated. The town possesses flour-miUs, cloth factories, and tanneries, and has a considerable trade in wine, corn, and wood. Population (1892), 11,718 ; (1900),

12,133.

Silver. ►►► From the metallurgical point of view, silver ores may be classified as real silver ores and argentiferous ores. The former consist of silver minerals and gangue (vein matter, country-rock). The leading silver minerals are native silver, Ag ; cerargjnrite, AgCl ; argentite, Ag^S ; proustite, 3 Ag^S ŧ As^S, ; pyrarg)rrite, SAgjS Ł SbjS, ; dolybasite, 9Ag2S) AsjSj ; and stephanite, 5Ag2S-i- SbgSj. The silver is commonly recovered by milling, i.e., amalgamation or lixiviation. Argentiferous ores consist of silver-bearing base-metal minerals and gangue. Lead and copper ores, carrying silver in some form or other, are the leading representatives. The silver is extracted from the gangue with the base

metal, usually by smelting, and the two are then separated by special processes (see Lead ; Copper). Milling is cheaper than smelting, but the yield in silver is lower. Often it is more profitable to smelt real silver ores with argentiferous ores than to mill them, the greater cost being more than balanced by the increased yield. Milling is practised mainly in isolated localities near the mine producing the ore. As any given region is opened up by railways, cheapening transportation, milling is apt to give way to smelting. Thus on the American continent, which produces the bulk of the world's silver, milling is still prominent in South America and Mexico, while in the United States it has to a considerable extent been replaced by smelting.

Amalgamation is based on the property of quicksilver to extract the silver from finely-pulverized ore and collect it in the form of an amalgam. When the rock has been separated from the amalgam by a washing operation, the

quicksUver is recovered by distillation in an iron retort, and the remaining crude retort-silver melted into bars and shipped to a refinery, which removes the impurities, the leading one of which is copper. A silver ore is either free- milling or refractory, that is, the silver mineral is readily amalgamated or it is not. In free-milling ore the silver is present either in the native state, or as chloride or as simple sulphide. Complex silver minerals (sulph-arsenides and antimonides) which are difiicult to amalgamate must be made amenable to quicksilver, and the simplest way of doing this is to convert the silver into chloride. This is imperfectly accomplished, in the wet way, by cupric and cuprous chloride solutions, but completely so, in the dry way, by roasting vidth salt (chlorodizing roasting). Accord- ing as a preliminary chlorodizing roast has or has not been given, the process is classed as roast-amalgamation or raw-amalgamation. The leading raw-amalgamation processes are the Patio and Washoe ; then follow the Cazo, Fondon, and Krohnke ; of the roast-amalgamation processes, the European Barrel or Freiberg, the Eeese Eiver, and the Franck-Tina are the most important.

The Patio process (for an outline of which see Ency. Brit. vol. xxii. p. 70) is carried out principally in Mexico. It aims at amalgamating the silver io

the open in a circular enclosure, the floor of which is generally built of flagstones. In order to facili- tate the decomposition of the silver-mineral, salt and magistral are worked into the wet pulp spread out on the floor. Magistral is cupriferoiis pyrites roasted to convert the copper into soluble sulphate, which is the active agent. The amalgamation proceeds very slowly, as the sole extraneous heat is that of the sim. According to Laur, at Guanaxuato, Mexico, 92”77 per cent, of the total silver recovered was extracted after 12 days, 97 ‘65 per cent, after 25 days, 9970 per cent, after 28 days, and 100 per cent, after 33 days. The loss of quicksilver in the process is large, owing to the formation of calomel which is not saved. The yield in silver is low unless the ores are exceptionally free- milling ; the bullion produced is high-grade, as refiactory silver minerals are hardly attacked. The process is suited to easy oj’es and a region where the climate is warm and dry, and horse- or mule-power, labour, .and quicksilver are cheaper than fuel and water.

The Washoe process is the leading raw-amalgamation process of the United States, where it was invented in 1859 by A. B. Paul. It consists in wet-stamping coarsely crushed ore, settling the sands and slimes produced, and grinding and amalgamating them in steam-heated iron pans with or without the use of chemicals (salt and blue vitriol). The ores may contain a larger proportion of sulphurets and complex silver minerals than with the Fatio pro- cess and still give a satisfactory extraction. They are crushed to egg-size in a rock-breaker, and pulverized to pass a 40-mesh sieve in a California stamp-mill, which treats in 24 hours about 3 tons per stamp. A 10-stamp mill is fed by one rock -breaker, and discharges the liquid pulp into 10-15 wooden settling tanks, 9 by 5 by 8 feet, the settled contents of which are shovelled out and charged into the pans. The pan in general use is the combina- tion pan. It has a flat cast-iron bottom, 5 feet in diameter, and wooden sides about 30 inches high, the lower parts of which are lined with cast iron. In the centre is a hollow cone, through which passes the driving shaft, geared from below. This turns the grinding apparatus (driver with niuUer), which can be raised and lowered. The spfed is 60-90 revolutions per minute. To the bottom and muUer are attached grinding plates (shoes and dies), which are replaced when worn ; and to the sides three wings, to deflect the moving pulp towards the centre, and thus establish the necessary pulp current.

The lower side of the bottom has also a steara-ohest. A 10-stamp mill has 4-6 pans, which receive 2-ton charges. In working, the muller is raised half an inch, the pan charged with water and then with ore, the muller is lowered, salt and blue vitriol are added, and the charge ground for 8-4 hours. The pulp is heated with live steam to about 90 C, and kept at that temperature by exhaust steam in the bottom-chest. After grinding, the muller is raised and quicksilver added, and the silver then amalgamated in 3-4 hours. In amalgamating without the use of chemicals, finely dividfed iron, worn from the shoes and dies in the stamp-mill and the pan, decomposes cerargyrite and argeutite, and the liberated silver is taken up by the f|uicksilver ; the process is hastened by adding salt. When salt and blue vitriol are added to the charge, they form sodium sulphate and cupric chloride (2NaCl + 0uSO4 = NaSOj + CuClo), both of which are readily soluble in water. Cupric chloride acts upon argentite (AgjS t CuClj = 2AgCl H- CuS), proustite (4Ag3AsS3-H2CuCla =

SAgCl, 2Ag2S, 2CuS, AsaSj, 5S), pyrargyrite (2 AggSbSs + 4CuCl = 6AgCl + 2CuS + Sb2S3 + S), and is also reduced to cuprous chloride by metallic iron (2CuCl2 + Fe = CujClj + FeClj). This salt, in- soluble in water but soluble in brine, also acts upon argentite (Ag2S-l-Cu2Cl2=2AgCl + CuS + Cu) and pyrargyrite (2Ag8SbS3 + Cu2Cl2=AgCl + Ag2S + 2Ag + 2CuS + Sb2S3), and would give with silver sulphide in the presence of quicksilver, the Patio-reaction : metallic silver, cupric sulphide, and mercurous chloride (2Ag2SH- Cu2Cl2-l-Hg = 4Ag-l-2CuS-t-HgaCl2), but the iron decomposes the quicksilver salt (Hg2Cl2H-Fe=Hg2-i-FeCl2), setting free the quick- silver. The amalgamation is rapid. Thus Austin found that at the Charleston mills, Arizona, 9213 per cent, of the total silver recovered was extracted after 1 hour, 94 '10 per cent, after 2 hours, 95 '92 per cent, after 3 hours, and 100 per cent, after 4 hours. The loss in quicksilver is small, as there is no chem- ical loss inherent in the process ; the yield is relatively high, but the bullion is liable to" be low-grade, on account of copper being precipitated and amalgamated. When the charge has been worked, the contents of the pan

are discharged into a settler, in which the amalgam is separated from the sands. It has the same general construction as the pan. It is 8 feet in diameter and 3 feet deep. The bottom, slightly conical, has a groove near the circumference to catch the amalgam, which is withdrawn through a 'discharge-spout into a bowl. In the sides at different levels are three discharge-holes for water and sand. The muUer reaches to within three inches of the bottom and makes 12-15 revolutions per minute. In settling, the pulp is diluted by a small stream of water, and the thinned pulp drawn off, first through the top discharge-hole and then through the other " two, the bottom one being about 8 inches above the amalgam. Settling takes about half the time required to work a charge in the pan, hence one settler serves two pans. The amalgam is dipped out from the bowl into a canvas bag (the strainer), to separate the excess of the quicksilver from the pasty amalgam, which is then retorted and melted. The cost of treating a ton of ore in the western part of the United States is from $3 to $7. At some works treating ores containing sulpliurets which do not yield their silver to quicksilver, concentration apparatus (see Oee-Dkkssing) is inserted between the stamps and the settling tanks to remove the sulphurets, which are worked by themselves ; at other works they are recovered from the sands after these have left the settlers. In order to do away with the handling of the wet pulp, and to obtain a higher extraction, M. P. Boss has modified the ordinary plant by making the pulp flowing from the stamps pass through a grinding pan, then through a series of amalgamating pans followed by a row of settlers.

A 20-stamp mill is served by 12 men in 24 hours. The Washoe process is independent of the climate, but it requires cheap power and an abundance of water.

In the Gazo, Caldron, or Hot process the pulverized silver ore is boiled in a copper-bottomed wooden vat, first with brine until the silver has been reduced by the copper, and then with quicksilver. The Fondon is an improvement on the Cazo. Bars of copper drawn over the bottom by mules or water-power (like the stone drags in the arrastra) grind off fine particles of copper, which hasten the reduction of the silver and diminish the formation of calomel. In the Krohnke process the silver mineral of the

pulverized ore is decomposed in a revolving barrel by a hot solution of cuprous chloride in brine in the presence of zinc or lead and quicksilver.

Ghlorodizing Boasting. ??? In a chlorodizing roast chlorine produces its effect as nascent chlorine or gaseous hydrochloric acid. The leading reagents are salt (NaCl), sulphur trioxide (SOg, produced in the roasting), and vrater vapour (HjO). The decomposition of salt is expressed by 2N"aCl-l-2S08 = Na2S04 + S02-f Clj. In the presence of water- vapour the following reaction takes place : SNaCl + S03-)-H20 =]Sra2SO^ + 2HCl. As some water-vapour is always present, hydrochloric acid will invariably be formed with the chlorine. The roasting is carried on in hand and mechanical reverberatory furnaces, occasionally in mufHe-furnaces. A chloridation of over 90 per cent, silver is the rule.

The European Barrel or Freiberg process (see Eiicy. Brit. vol. xxii. p. 70),perfected at Freiberg, Saxony, was abandoned there in 1856. In the United States it was used quite extensively in Colorado and Nevada, but has now been given up. The main reasons for this are the length of time required to finish a charge, on account of the absence of any eitraneous source of heat, and the great care with which operations have to be carried out in order to obtain satisfactory results. The Seese River process consists in dry- stamping crushed dried ore and dried salt (separately or together), charging them into a roasting furnace, and amalgamating the

ohlorodized ore in an iron pan. The general arrangement and construction of a mill resemble those of the Washoe process. The apparatus for drying ore and salt varies greatly, drying-floors, dry- kilns, and continuous mechanical reverberatory furnaces with stationary and revolving hearths being used. The general con- struction of the pan is the same as in the Washoe process ; the management, however, differs. The steam-chest is not used to such an extent, as the bottom would be prematurely corroded ; less water is used, as the pulp would become too thin on account of the soluble salts (sodium cUoride, sulphate, &c.) going into solution ; and the roasted ore is not ground, as the hot brine readily dissolves the silver chloride from the porous ore, and thus brings it into intimate contact with iron and quicksilver. Chemical reagents are sometimes added ??? lime or sulphuric acid, to neutralize an excess of

acid or alkali ; bluestone, to form cuprous chloride with sodium chloride ; and iron and zinc, to make the galvanic action more energetic and reduce the consumption of iron. The rest of the apparatus (settler, retort, crucible furnace) is the same as with the Washoe process. The Eeese Biver process costs from half as much again to twice as much as the Washoe process.

The Franclc-Tina process was developed ia Bolivia for the treat- ment of refractory ores rich in zinc blende (ZnS) and tetrahedrite 4(Cu2,Fe,Zn,Ag2,Hg2)S + (Sb,As,Bi)2S3. The ore is given only a partiiil chlorodiziug roast, on account of the great loss in silver that would be caused by the formation of zinc chloride (ZnCl2). The large amount of soluble sulphates of iron and copper formed in the roast is made to act upon salt charged in a copper-bottomed amalgamating pan ; the chlorides formed finish in the wet way the imperfect chloridation obtained in the furnace.

Lixiviation. ??? Ores suited for amalgamation can, as a rule, be successfully leached. In leaching, the silver ore is subjected to the action of solvents, which dissolve the silver; from the solution the sUver is precipitated and converted into a marketable product.

The leading solvents are aqueous solutions of hyposulphite salts. Sodium chloride, characteristic of the Augustin process (see Fhicy. Brit. vol. xxii. p. 70), has almost wholly fallen into disuse ; and potassium cyanide, which has become a very important solvent for finely divided gold, is rarely used in leaching silver ores. The use of sodium hyposulphite as solvent, and sodium sulphide as precipitant, was proposed in 1850 by Hauoh and Percy, and put into practice in 1858 by Patera {Patera process) ; calcium hyposulphite with calcium polysulphide was first used by Kiss iu 1860 (Kiss process, now obsolete) ; sodium hyposulphite with calcium polysulphide was adopted about 1880 by Hofinann {Bofmann process) ; finally, sodium hyposulphite with cuprous hyposulphite was first applied by Russell in 1884, who included in his process the acidulation of the first wash-water (to neutralize any harmful alkaline reaction), and the separation of lead with sodium carbonate from the silver solution previous to precipitating with sodium sulphide. In all processes the silver ore is finely crushed, usually by rolls, as, because

making few fines, they leave the ore in the best condition for leaching. As a rule the ore is subjected to a preliminary chlorodiz- iug I'oast, though occasionally it may be leached raw. The vats in common use are circular wooden tanks, 16-20 feet in diameter and 8-9 feet deep if the leached ore is to be removed by sluicing, 5 feet if by shovelling. They have a false bottom, with cloth or gravel filters. The basis of the following outline is the Patera process. The ore, supposed to have been salt-roasted, is charged loosely into the leaching vat and treated with water (to wMch sulphuric acid or blue vitriol may have been added), to remove soluble salts, which might later on be precipitated with the silver (base-metal chlorides), or overcharge the solution (sodium chloride and sulphate), or interfere with the solvent power (sodium sulphate). The vatisfiUed with water from above or below, in-and out-flow are then so regulated as t6 keep the ore covered with water. Any silver dissolved by the first wash-water is recovered by a separate treatment. After the wash-water has been drained off, the ore is ready for the silver solvent. This is a solution containing up to 2 per cent, of sodium hyposulphite (NajSaOg-l- 5 aq.), of which one part dissolves 0 ___485 parts silver chloride, = 0 -365 parts metallic silver (2AgCl-l-3Na2S203 = Ag2S___03,2Na^S203-F 2]SraCl). Silver arsenate and antimoniate are also readily soluble, metallic sUver slightly so, silver sulphide not at all. (In the Russell process double salts: 4Na2S203-3Gu2S203, and SNajSjOs 3CU2S2O3 metallic silver and silver sulphide are readily soluble ; thus it supplements that of Patera). After the silver has been dissolved by percolation, the last of the solvent still in contact with the ore is replaced by a second wash-water. The silver solution, collected in a circular precipitating vat (10 feet in diameter and 10 feet deep), is treated with sodium sulphide (or calcium polysulphide), unless sodium carbonate was first added to throw down any lead, present in the ore as sulphate, that had gone into solution. Silver sulphide falls out as a black mud, namely 2Ag2S203 ⊣ NajSa = AgjS ⊣ Na4S206 and n&SiO^ +" ~

pajSjOg + aS (or Ag2S203 + CaS5=Ag2S + CaS203 + S4, and in part CaS203 +]Sra2S04=CaS04 + Na2S203), with about 5u per cent, silver, and the solvent will be regenerated. If the sodium cuprous hypo- sulphite was used as a solvent in addition to the simple sodium ❑❑❑hyposulphite, cuprous sulphide will be precipitated with the silver sulphide, and the precipitate will be of lower grade. At some works the silver is precipitated with sodium sulphide, and the liquor, after having been separated from the silver sulphide, is treated with calcium polysuiphide, that by the precipitation of calcium sulphate the accumulation of sodium sulphate may be prevented. The precipitated silver (copper) sulphide is filtered, dried, and usually shipped to silver-lead works to be refined ; sometimes it is converted into metallic silver at the works. The solution, freed from silver, is used again as solvent. Lixiviation has many advantages over amalgamation. It permits coarser crushing of the ore, the cost of plant is lower, the power required is nominal, the cost of chemicals is lower than that of quicksilver, less water is necessary, and the extraction is often higher, as silver arsenate and autimoniate are readily soluble, while they are not decomposed in amalgamation. On the other hand, silver and silver sulphide are readily amalgamated ; and while they are not dissolved in the Patera process, they are in the Russell process.

Statistics. ❑❑❑ The world's production of silver in 1900 was, accord- ing to The Mineral Industry, vol. ix. p. SlU, in troy oz. : United States, 59,561,797 ; Canada, 4,446,505 ; Mexico, 55,804,420 ; Cen- tral America, 1,446,795 ; Argentina, 383,561 ; Bolivia, 10,432,685 ; ChUe, 5,772,791 ; Colombia, 2,800,000 ; Ecuador, 81,000 ; Peru, 6,590,955 ; Austria, 1,272,022 ; Hungary, 675,750 ; France, 466,189; Germany, 6,243,326; Greece, 1,294,917 ; Italy, 1,081,707; Norway, 154,389; Russia, 163,960; Servia, 18,386; Spain, 5,909,418; Sweden, 73,626; Turkey, 65,363; United Kingdom, 191,927; Dutch East Indies, 1447 ; Japan, 1,810,375 ; Australasia,14, 063,244 ; other countries, 48,226; total, 180,854,781.

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(h. o. h.)

Si Ives, a town of the district of Faro, Portugal, on tlie right bank of the Silves, 30 miles west-north-west from Faro. It is surrounded with walls and possesses a castle. Its manufactures include corks and soap. It produces corn, vegetables, and fruits, especially oranges, carob beans, and almonds (all three exported). Pigs are bred, and fish- ing is carried on in the river and at sea. Alfonso III. wrested Silves from the Moors. Popxilation (1890), 8363 ;

(1900), 9688.

Simbirsk, a government of East Eussia, on the right bank of the Middle Volga, with an area of 19,110 square miles. Its geology has been carefully investigated, and it appears that all systems, beginning with the Car- boniferous, are represented. The "Variegated Marls," which have been the subject of animated polemics among the Kussian geologists, continue to remain prob- lematic as to their exact age, but the thorough in- quiries of Professor Pavloff have permitted the geological age of the Jurassic formations to be definitely settled. Triassic deposits uppear in the north ; Carboniferous and Cretaceous are spread in the eastern part of the province, where they are covered in many places by Tertiary de- posits ; Chalk and Eocene deposits chiefly crop up in the west, and the Chalk in the south. Post-Pliocene deposits containing bones of the mammoth and other extinct mammals cover the older formations. Sulphur, asphalt, salt ochre, and iron-ore are extracted, as well as various building stones. The domiciled population, which was estimated at 1,655,500 in 1891, proved to be only 1 549,461 in 1897, when there were 799,660 women, and the urban population numbered 109,175. Nearly all the inhabitants either belong to the Russian Orthodox Church or are Nonconformists, there being only 144,440 Mussul- mans. The government is divided into eight districts, the chief towns of which are Simbirsk (43,300), Alatyr (11,086), Ardatoff (4838), Buinsk (4216), Karsun (4613), Kurmysh (3484), Senghilei (5735), and Syzran (32,377).

The number of schools in 1899 was 944, with 39,000 boys and 11,000 girls. School gardens and school farms have been widely introduced, and no fewer than 240 schools were provided with such facihties for practical instruction, while bee culture was taught in 55 schools, and various trades in 14 schools. Owing to the efforts of the zemstvos (local councils), sanitation is well looked after, and there are 32 hospitals and 91 infirmaries. Out of a total area of 7,502,500 acres of cultivated land in 1898, the peasant village communities held 4,495,800 acres, private owners 2,330,300 acres, the Imperial domains 602,500 acres, and the towns and the Crown 73,400 acres.. In 1898 the forests covered 3,437,000 acres. The peasants are rapidly buying considerable quantities of land. Most of their allotments (more than 76 per cent.) are under fields, and besides what they own they rent 501,500 acres from the private owners. No fewer than 3,483,500 acres were under cereal crops in 1900, and the average yield in 1895-99 was : wheat, 884,000 cwt. ; rye, 9,945,000 cwt. ; oats, 4,402,000 cwt. ; barley, 50,000 cwt. ; all cereal crops, 17,436,000 cwt. ; also potatoes, 3,311,000 cwt.

In 1898 there were 288,890 horses, 326,000 horned cattle, and 916,820 sheep. Good breeds of horses are kept, and a considerable export trade in them is carried on. Domestic trades give employment to nearly 15,300 per-sons ; carts, sledges, wheels, and all sorts of wooden ware are made in the villages, as also are felt goods, boots, gloves, caps, handkerchiefs, ropes, and fishing-nets, all of which are widely exported. Large establishments, how- ever, are not very numerous ; factories, indeed, employ only 18,710 workers, and their aggregate annual returns do not amount to more than 10,640,000 roubles. They mainly comprise wool cloth mills (4,575,000 roubles), flour-mills (18 provided with rollers), and distilleries ; there are also tanneries, glass, and starch works. The internal trade is chiefly carried on at 82 fairs, the chief of which are held at Simbirsk, Syzrafi, and Karsun. There is a considerable export trade in grain, mostly rye and flour. (p. A. K.)

Simbirsk, the capital of the above government, 576 miles by rail east-south-east of Moscow, between the Volga and the Sviaga, which here closely approach each other. It is one of the best buUt provincial towns of Eussia. It has gymnasia for boys and girls, with a summer sanatorium for

the pupUs, numbers of other town and industrial schools for boys and girls alike, two public libraries, one of which has 44,000 volumes, three daily papers, a good theatre, and more than the usual number of philanthropic institutions. Its factories are of no im- portance, but its trade is considerable, especially that connected with its great fair in horses. In 1897 the population was 43,300.

Simla, a town and district of British India, in the Delhi division of the Punjab ; the summer residence of the Viceroy and of the staff of the supreme Government. The town is 7075 feet above the sea ; 58 miles by cart- road from the railway station of Kalka, which is 1116 miles from Calcutta. Population (1881), 12,258 ; (1891), 13,836; municipal income (1897-98), Es.3,22,280; death- rate (1897), 23 per thousand. The sanitarium of Simla occupies a spur of the lower Himalaya, running east and west for about 6 miles. Three miles west is the can- tonment of Jutogh. The minor sanitaria of Kasauli, Sabathu, Dagshai, and Solon lie some distance to the south. The hills all round are clothed with rhododendron and deodar. In 1897 the total rainfall was 51 inches, of which 38 inches fell from June to September ; the maximum temperature was 82 ►► "F. in May, the minimum 32 ►► in December; the prevailing winds are northerly.

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Simla is gradually becoming the permanent headquarters of many of the official establishments. A vice-regal lodge, foreign office, secretariat buildings, army headquarters, public works office, and clerks' quarters have been built at imperial expense. The municipality has provided water and sewerage works and a fine town-hall, out of a loan of R8.8,15,890. There are several hotels and banks. Simla is the headquarters of a volunteer rifle corps, 400 strong. Two breweries have a yearly out-turn of 39,000 gallons, with larger breweries at Kasauli and Solon. There are 1 1 printing-presses, issuing 5 newspapers and periodicals ; and there are numerous libraries and institutes, of which the chief is the United Service Institution, with a subsidy of Es. 3,000 from Government. The Ripen hospital receives Rs.10,000 from endowment and Rs.1,500 from Govern-

ment. Educational institutions include Bishop Cotton's school for boys, the Mayo industrial school for girls, several aided schools for European boys and girls, and two Anglo-vernacular schools for natives. The Lawrence military asylums are at Sonawar, near Kasauli.

The district of Simla has an area of 102 square miles. Popu- lation (1891), 44,642 ; (1901), 40,353 ; average den.sity, 395 persons per square mile. The land revenue and rates in 1897-98 were Es.21,151 ; cultivated area, 13,045 acres, of which 52 were under tea ; number of police, 307 ; number of schools, 41, attended by 18B4 boys, being 40 per cent, of the boys of school-going age ; death-rate (1897), 22 per thousand. A railway on the metre gauge is under construction from Kalka to Simla, 68 miles, \Yith several tunnels.

Simon, Sir John (1816-

-), English surgeon

and sanitary reformer, was born in London 10th October

1816. His father, Louis Michael Simon, was for many

years a leading member of the London Stock Exchange.

Both his grandfathers were French emigrants, who carried

on business in London and Bath respectively. His father

died at the advanced age of almost ninety-eight, and his

mother, after sixty-seven years of happy wedlock, when

she had almost attained ninety-five years of age. Simon

was educated at a preparatory school in Pentonville, spent

seven years at Dr Burney's school in Greenwich, and

then ten months with a German Pfarrer in Rhenish

Prussia. His father intended him for surgery, and he began the study of medicine on 1st October 1833, when he was a few days short of seventeen. After the fashion of the time, he became an apprentice of Joseph Henry Green, the distinguished surgeon at St Thomas's, well known for his friendship for Samuel Taylor Coleridge, whose literary executor Green became. He qualified in due course, became a demonstrator of anatomy, and was assistant surgeon to King's College Hospital for several years; and in the autumn of 1847 he was appointed surgeon and lecturer on pathology at his old school, St Thomas's, where, with progressive changes, he continued to remain an officer. His life was divided between two great pursuits ??? the career of a surgeon, and the mastery and solution of many of the great problems of sanitary science and reform. In the spring of 1844 he gained the first Astley Cooper prize by a physiological essay on the thymus gland, and the following year was elected a fellow of the Royal Society. In 184^ he gave his first lecture at St Thomas's Hospital, on the "Aims and

Philosophic Method of Pathological Research " ; followed a little later by lectures on general pathology in relation to the principles of diagnosis, and the treatment of disease. These lectures were of great importance at the time, and of the utmost value in directing energy into new and profitable channels of work. Simon published many clinical surgical lectures of the greatest importance, and contributed a masterly article on " Inflammation " to Holmes's System of Surgery, which has become a classic of its kind. It was, however, on his appointment in 1848 as medical officer of health to the City of London, and afterwards to the Government, that Simon's great abilities found scope for congenial exercise. His first report to the City Commissioners was characterized by The Times of 8th November 1849 as of extraordinary interest, and the ablest, most lucid, and most temperate statement of modern sanitary condition and wants. His work in sanitary science has stimulated and guided its development, untU it has reached in England the highest degree of excellence, and afibrds an example to the civi- lized world. He himself defined it as "proposing the physical, social, and, indirectly, the moral improvement of what is an immense majority of our fellow creatures. It transcends the importance of all other sciences, and seems in its beneficent operations most nearly to embody the spirit, and to fulfU the intentions, of practical Chris- tianity." It is impossible to overestimate the value of Sir John Simon's work, or the importance of his influence in the furtherance of the pubhc health, and the prevention of disease, and in inculcating right methods of medical government. In 1878, after filling other offices in the Royal College of Surgeons, he became its president, and in 1887 was created K.C.B. It was largely due to his advocacy that the

new St Thomas's Hospital was rebuilt on its present site after it was compelled to leave its old habitation near London Bridge. As a surgeon, Simon's work came second to his interest in sanitary science, but he claimed priority over Cock in the opera- tion of perineal puncture of the urethra in cases of reten- tion from stricture. (w. macc.)

Simon, Jules Francois (1814-1896), French

statesman and philosopher, was born at Lorient in December 1814. His parents were of Jewish extraction, and the family name was Suisse, which he dropped, making a surname out of the prenomen Simon. He became a schoolmaster, and after holding various appoint- ments at public schools in the provinces, was called to Paris by Victor Cousin, then omnipotent in all educa- tionl matters, to lecture on the history of philosophy at the Ecole Normale. In 1839 he became professor of philosophy at the Sorbonne ; in the following year he published his Etvdes sur la Thiodicie de Platon et d'Aristote; and in 1844-45 his history of the philo- sophical school of Alexandria. These works, as well as the brilliancy of his lectures, gave him a high reputation, and after the revolution of 1848 he was elected to the National Assembly, which he quitted in the foUovring year to serve on the Council of State, from which he was soon re- moved as too much of a Repubhcan. His Republicanism was in fact most moderate, but thoroughly sincere, as he proved by refusing to take the oath of allegiance to Louis Napoleon's Government after the coup d'etat of December 1851. Deprived of his professorship, he set, together with his wife, a splendid example of honourable poverty, living vidth the utmost frugality, and occupying himself with the production of a series of valuable treatises, vn-itten for general readers in a popular style, on religion, morals, and politics in their most practical aspects. Le Devoir appeared in 1854, La Religion Naturelle in ^1856, La Liberie de Conscience in 1857, La Liherti Politique and La Liherti Civile in 1859, L'Ouvriere in 1861. In 1863 M. Simon was again elected to the legis- lature, and until 1869 worked with the group of five, headed by M. ;6mile OUivier, who constituted the Re- publican parliamentary Opposition. He has given in his memoirs an entertaining account of this diminutive but by no means insignificant party. After the downfall of the Empire, M.

Simon was made minister of public in- struction by the Provisional Government, and after the

capitulation of Paris he became minister of the interior ad interim, and was sent to Bordeaux to put down the appre- hended resistance of Gambetta to the peace concluded with Germany and the elections ordered by the Government. He successfully acquitted himself of this difficult task, and although defeated at Paris, was elected for the Marne. Upon the definitive reconstitution of the Ministry he resumed the portfolio of public instruction, and retained it untU Thiers's fall in May 1873. Throughout his tenure of office his course was most conciliatory, especially towards the clergy, whose distrust of him he succeeded in greatly mitigating. In pursuance of this policy he directed the repair of the chapel founded as an expiation for the death of Louis XVI. on the one hand, and the restoration of Napoleon's statue in the Place Venddme on the other. His ministry was also memorable for the organization of the French School of Archaeology at Athens. In 1875 he was elected a member of the Academy and a life senator ; and in December 1876, upon the resignation of M. Dufaure, was summoned by Marshal MacMahon to form a Cabinet, in which he was premier and minister of the interior. Here, as previously, his policy was one of conciliation, and he and the President would probably have worked together in harmony could they have been left to themselves. The constant pressure of the more advanced Eepublicans, how- ever, alarmed the Conservative President, who on his part was worked upon by the anti-Eepubhcan conspirators about him, untU, on 16th May 1877, he addressed M. Simon a letter which, although not openly demanding his resignation, left him no alternative but to tender it, unless he was prepared to resist and appeal to the Chambers. It was a very general opinion that he ought to have done so ; and although he has vindicated himself by alleging his fear of provoking the Marshal to a coup d'etat, it is certain that the transference of the Government of the Republic to its enemies might well have been its ruin but for their timidity and the extraordinary exertions of Gambetta. M. Simon never again held office,

but frequently took an active part in the debates of the Senate, and proved himseK one of the first orators of his time in the resistance which his concihatory temper led him to offer to the sweeping edu- cational reforms of M. Jules Ferry, and in his advocacy of free trade in 1891. On both occasions, however, he failed to convince his audience. He wrote in 1878 the history of M. Thiers's Government, and in 1887 published a most vivid personal sketch of Victor Cousin, the author of his fortune, but from whose despotism he had had much to endure. In his latter years he wrote two volumes of autobiographical memoirs. Premiers Mdmoires, and Le Soir de ma Journie. They have many gaps, but contain much interesting matter. He died in Paris, 8th June 1896. No man prominently connected with French politics in the 19th century has left a higher reputation for modera- tion and patriotic disinterestedness ; it is impossible to find a fault with his public conduct, unless his failure to resist Marshal MacMahon be accounted one. As a moral philosopher he ranks high, and his treatises have enjoyed a very wide circulation ; in speculative philo- sophy he is less distinguished as a thinker than as a historian. (r. g.)

Simon's Town, a town and naval station in Cape Colony on Simon's Bay, an inlet on the west side of False Bay, 20 miles south of Cape Town, with which it is con- nected by rail. It occupies one of the finest sites in South Africa under the sickle-shaped headland, at the southern extremity of which stands the lighthouse of the Cape of Good Hope. The Imperial Parliament voted a sum of ??2,500,000 .for enlarging and strengthening the fortifica- tions, docks, arsenal, and approaches of this station ; and.

in course of time, Simon's Town will be the strongest and most convenient naval station in the southern hemisphere. False Bay, which corresponds on the south to Table Bay on the north side of Table Mountain, is a spacious inlet which has an average depth of from 15 to 20 fathoms, and is completely sheltered on all sides except towards the south. Here a whole fleet of the largest vessels can ride safely at anchor under the formidable batteries by which it is proposed to guard the southern entrance be- tween the Cape headland and Cape Hangklip, facing it on the opposite (east) side. The Cape headland forms the divide between the cold Antarctic current which passes to the west and the warm Mozambique current

which sweeps round from the Indian Ocean and penetrates into False Bay, thus raising the temperature of Simon's Town 4 or 5 F. above that of Cape Town. Population (1887),

3000; (1900), 5000.

Simson, Martin Eduard von (1810-

1899), German jurist and politician, was born at Kdnigs- berg, in Prussia, on 10th November 1810, of Jewish parentage. After the usual course at the gymnasium of his native town, he entered its university in 1826 as a student of jurisprudence, and devoted himself specially to the study of Eoman law. He continued his studies at Berlin and Bonn, and, ^having graduated doctor juris, attended lectures at the Ecole de Droit in Paris. Eeturning to Konigsberg in 1831 he estabhshed himself as a, privat-docent in Eoman law, becoming two years later extra- ordinary, and in 1836 ordinary, professor in that faculty at the university. Like many other distinguished German jurists, pari passu with his professorial activity, Simson followed the judicial branch of the legal profession, and, passing rapidly through – the subordinate stages of auscultator and assessor, became adviser (Eath) to the Landgericht in 1846. In this year he stood for the representation of Konigsberg in the National Assembly at Frantfort-on-Main, and on his election was immediately appointed secretary, and in the course of the same year became successively its vice-president and president. The ofiice to which he was called required in those days of storm and stress an unusual amount of nerve, tact, and calm judgment, and these qualities the young lawyer displayed to a remarkable degree. He controlled the sittings of the assembly during the revolutionary period with a dignity that would have done honour to a Speaker of ripe experience in any house of legislature in the world. In his capacity of president he appeared, on 3rd April 1849, in Berlin at the head of a deputation of the Frankfort Parliament to announce to King Frederick William IV. his election as German Emperor by the representatives of the people. The king, either apprehensive of a rupture with Austria on this account, or fearing detriment to the prerogatives of the Prussian crown should he accept this dignity at the hands of a democracy which he had alternately flouted and cajoled, refused the offer. Simson, bitterly

disappointed at the outcome of his mission, resigned his seat in the Frankfort Parliament, but in the summer of the same year accepted a mandate as deputy for Konigsberg in the popular chamber of the Prussian Landtag. Here he had at length an opportunity of displaying his skill in debate, and soon made his mark as one of the best orators in that assembly. A member of the shortlived Erfurt Parliament of 1850, he was again summoned to the presidential chair, and it was while acting in that capacity that he administered to Bismarck a well-merited rebuke. Bismarck, sitting as an ordinary deputy and being called to order by the president, made a loud aside to a colleague to the effect that they, being of noble birth, knew far better than the president

what licence to permit themselves. To this Simson replied, "What? You dare say that to me, a descendant in the direct line from Aaron ! " Bismarck, to his honour be it said, immediately rose and bowed profuse apologies to his rebuker.

On the dissolution of the Erfurt assembly, Simson retired from politics, and for the next few years devoted himself exclusively to his academical and judicial duties. It was not until 1859 that he re-entered public life, when he was elected deputy for Konigsberg in the lower chamber of the Prussian Landtag, of which he was president in 1860 and 1861. In the first of these years he attained high judicial office as president of the court of appeal at Frankfort on the Oder. In 1867, having been elected a member of the constituent assembly of the North German Federation, he again occupied the presidential chair, as he did also in the first regular Diet and the ZoU-parliament which succeeded it. On 3rd October of that year he presented on behalf of this body an address to King William I. of Prussia in the castle of Hohenzollern, the ancestral home of that royal house. On 18th December 1870 Simson arrived at the head of a deputation in the German headquarters at Versailles to offer the imperial crown to the King of Prussia in the name of the newly-elected Reichstag. The conditions under which Prussia might justly aspire to the hegemony in Germany at last appeared to have been accomplished. German unity

had been cemented on the field of battle, and no obstacles, as in 1849, were in the way of the acceptance of the crown by the leading sovereign of the confederation. Thus the mission of the tribune of the people, who had the unique experience of twice offering a crown, was successful, and on 18th January 1871 King William of Prussia was proclaimed with all pomp German Emperor in the Salle des Glaces at Versailles. Simson continued as president of the Reichstag untU 1874, when he retired from the chair, and in 1877 resigned his seat in the Diet, but at Bismarck's urging, " You owe it to your children, they will be proud of you," accepted, though reluctantly, the presidency of the supreme court of justice (Reichs- gericht), and this high office he filled with great dis- tinction until his final retirement from public life in 1891. In 1888 the Emperor Frederick bestowed upon Simson the order of the Black Eagle, which confers a patent of hereditary nobility, but it is characteristic of the modesty of this man that he never cared to adopt the title, but continued to sign himself simply " Dr Eduard Simson."

His political career coincides with the era of German struggles towards unity. As a politician he was one of the leaders of modern Liberalism, and though always loyal when appeals were made to patriotism, such as Government demands for the army, he remained obdurate on constitutional questions and refused to sacrifice a jot or tittle of popular rights ; and he resolutely opposed the reactionary policy of the Prussian Conservatives. As president of the popular assembly, he conducted the proceedings with dignity and good feeling. He was a profound lawyer, but ovring to the composition of the chambers in the supreme court not much scope was afforded for the display of individual talent. On his . retirement from the presidency of the Reichsgericht, he left Leipzig and made his home in Berlin, where he died on 2nd May 1899. His Life has been published by his son, Bernard von Simson, under the title Eduard von Simson, Erinnerungen aus seiiiem Leben, 1900. (p. a. a.)

Sina,'[illegible]*^ a small town in Rumania, picturesquely situated in the Transylvanian Alps at about 15 nules*

from the Austro-Hungarian frontier at Predeal. It has become the fashionable summer resort of Bucharest society since the construction of

the royal residence of Peles, " Castle Peles," called after the little mountain on which it is built. The building is of a mixed style of archi- tecture, principally Old German, and the interior is fitted with magnificent wood carvings, and stained-glass windows illustrating the principal scenes of Carmen Sylva's writings. The town is hghted throughout by electricity. Population (1900), 2210.

The monastery of Sinaia, founded by Michel Cantaouzene in 1695, was the residence of the royal family until the present chateau was buUt. It consists of two courts surrounded by low buildings, the residence of the monks. In the centre of each court is a small church buUt in the Byzantine style, which has been renovated. The monks possess a library, in which are kept the valuable jewels, belongiug to the Cantacuzene family.

Sina.lO ^ a state of Mexico, bounded on the N. by Sonora and Chihuahua, on the E. by Chihuahua and Durango, on the S. by the territory of" Tepic and the Pacific, on the W. by the Gulf of California. Area, 33,681 square mUes. Population (1879), 186,491 ; (1895), 258,865. It is the best watered state of the republic. The western hot belt or maritime zone is devoted to agriculture, the eastern or cold belt to mining. The yield of cereals, cotton, tobacco, sugar-cane, coffee, and fruits is valued at about $8,000,000 a year. It is claimed that Sinaloa is the richest mining region in Mexico, gold, silver, copper, iron, lead, being the principal products ; there are also salt deposits, mineral springs, &c. An active trade is carried on through the port of Mazatlan, valued at about $18,000,000 a year. The state is divided into ten districts. The capital, Culiacan Rosales, with 10,487 inhabitants, is an important commercial centre, and has fine public buildings, manufactures, and a mint, and is connected with the port of Altata by rail. The principal towns are Mazatlan (15,852 inhab.), Mocorito (9971), Sinaloa, El Fuerte, Rosario, and San Ignacio.

Sind, or SciNDE, an historic region of India, now forming a division of the Bombay presidency. It com- prises the four British districts of Karachi, Haidarabad, ShLkarpur, Thar and Parkar, and Upper Sind Frontier, together with the native state of Klairpur. Total area, 53,898

square miles. Population (1891), 3,003,711; (1901), 3,412,373. The administrative headquarters are at Karachi, the seaport for aU the Indus valley.

Excluding the native state of Khairpur, the area of British territory is 47,789 square miles. Population (1881), 2,413,823 ; (1891), 2,871,774, showing an increase of 19 percent., due to the extension of cultivation by means of canals ; average density, 60 persons per square mile, ranging from 100 in the irrigated dis- tricts of Haidarabad and Shikarpur to only 23 in the desert tract of Thar and Parkar. Classified according to religion, in 1891 Mahommedans numbered 2,216,147 ; Hindus, 567,536 ; Christians, 7764, of whom more than half were Europeans; "others," 81,327. The great majority of the inhabitants are undoubtedly of Hindu descent, converted to Islam a thousand years ago. They speak a language of their own, which is of special interest as being more nearly akin to the ancient Prakrit than any other of the modem tongues. In 1901 the population was 3,212,808, showing a further increase of 12 per cent.

Agriculture is almost entirely dependent upon irrigation from the Indus, the average annual rainfall not exceeding 8 inches. In 1897-98, out of a total cultivated area of 3,802,482 acres, no fewer than 2,917,624 acres, or 77 per cent., were irrigated, mainly from Government canals. The principal crops are millet, rice, wheat, oil -seeds, pulse, and cotton. In 1897-98 the receipts from 8 "major" irrigation works (of which only 4 were in opera- tion) amounted to Rs.13,24,256, and the working expenses to Rs. 3, 81, 653, showing a profit of Rs. 9, 42, 603, or 6-65 per cent, on a capital expenditure of Rs.l, 41, 83,196. In addition, on 7 "minor" works there was a profit of Rs.10,14,301, or 28'6 per cent, on a capital expenditure of Rs.38,67,927. The revenue and rates in 1897-98 was Rs.1,10,25,351 ; number of police,

4195 ; pupils at school, 58,980, being 2-4 per cent, of the popula- tion, the same proportion as for the whole of Bombay.

Sind is traversed by the North-Western Railway, which follows the Indus from tbe Punjab to the sea at Karachi. The Indus "is twice bridged : at Eohri, where the main line crosses the river, and a branch goes off to Quetta ; and at Kotri, opposite Haidar- abad, whence a line was opened into Rajputana in 1900. The sea-borne trade of Sind is concentrated at the port of Karachi, which ranks as the iifth port in India, with an aggregate of imports and exports (foreign and coasting) valued at about 15 crores of rupees (say ten millions sterling) a year. A little trade is carried on at the two petty ports of Sirgonda and Keti Bander. Navigation on the Indus by native boats is kept open by the Indus conservancy department. In 1897-98 the river- borne tratfic between Sind and the Punjab amounted to 1,055,297 maunds, compared with 1,437,321 niaunds in the preceding year. The external land trade of Sind with Afghanistan and Baluchistan was valued at Rs.52,18,329 for imports and Rs.29,06,489 for exports. The trade with Kandahar is declining, but that with Kalat and Las Beyla is increasing.

See A. W. Hughes. Oazetteer of the Province of Sind. London, 1876. (j. S. CO.)

Sindhia (Ali Jah Jaiaji Rao), Ma- haraja (1835-1886). The strength of loyal purpose which enabled Maharaja Ali Jah Jaiaji Eao to remain steadfast to his allegiance to the British Crown and faith- ful to his engagements, entitles him to a conspicuous place in the history of the 19th century. The full measure of credit which the Maharaja deserved for his behaviour in 1858 can only be appreciated by considering the past traditions of his family, the conditions of misrule which preceded his succession, and the circumstances of his own accession to ruling powers. The important state of Gwalior, now filling an area of 29,067 square miles in the centre of India, was at the commencement of the 18th century not only the first Maratha state, but a competitor for imperial rule. At the battle of Panipat, 1761, a Sindhia measured himself against Ahmad Shah Durani. The Em- peror Shah Alam was restored by the Marathas to Delhi, and from 1788 was practically a prisoner in Sindhia's charge.

Mahadaji Sindhia's influence reached to Mysore, for it was through his influence, in 1793, that the proposal of Lord Cornwallis to unite the Peshwa and the Nizam against Tipu was defeated. Daulat Kao Sindhia succeeded Mahadaji in 1794, and aided by French officers, he trained and collected a formidable army. His predecessor had in 1782 guaranteed the British treaty with the Marathas concluded at Salbai. But the growing power of Daulat Kao induced him to join with Berar in supporting Baji Eao against the British. Daulat Eao Sindhia secured Ahmednagar, seized most of Indore, and at the head of the strongest native army in India aspired to imperial rule. But the British victories of Assaye, Laswari, and Delhi broke his power, and before the outbreak of the Pindari war, Gwalior was reduced to the position of a protected principality. When Daulat Eao died in 1827, a distant relative succeeded, under the name of Jankoji Eao. The Kegent, Baiza Bai, widow of the last Maharaja, quarrelled with the young chief, and the army took sides in the palace disputes which followed. Disorder prevailed with- out, and intrigues within the capital. The army was without pay or discipline, and turbulent classes, intolerant of British justice, sought an asylum in Gwalior, relying upon its past traditions to give them an opportunity for pursuing their lawless occupations.

The weak Jankoji died in 1843, and a lad of eight years named Bhagirat Kao, a very distant relative, was adopted by the child-widow of the late Maharaja. He took the name of Ali Jah Jaiaji Eao, and Mama Saheb was appointed Eegent. The Eegent was ousted by Dada Khasgiwalla, who, being hostile to the British, won the support of the army. War was imminent in the Punjab, and thes,e proceedings at Gwalior could not be ignored. The sur-

render of Dada Khasgiwalla was obtained, and Lord Ellenborough demanded an interview with the young Maharaja on 16th December 1843. Sindhia's troops prevented the meeting, and on 29th December they attacked Sir Hugh Gough at Maharajpur, losing 56 guns and sustaining a decisive defeat. The victory of Panniar was won on the same day, and the army of Sindhia was scattered. By a treaty dated 13th January 1844 lands were ceded for the maintenance of a con- tingent force, the army was reduced, and the afiairs of Gwalior were settled. But beneath the surface

the embers of further disorder smouldered, until the outbreak of the Mutiny in 1857 again revived the hopes of Maratha supremacy. The Contingent mutinied in June, and the British agent withdrew. Every eflfort was made to induce the Maharaja to place himself at the head of a national movement. But Sindhia and his minister Dinkar Kao resisted all overtures. They resorted to presents and various expedients for keeping the troops of the state quiet, while Delhi was being recaptured and Cawnpore avenged. At last Tantia Topi appeared near Gwalior, and the Maharaja marched out to give him battle. His troops, however, went over to the mutineers and seized the fortress, and Sindhia, with his minister, escaped to Agra. On 19th June 1858 Sir Hugh Eose retook Gwalior and restored the Maharaja to his capital. Sindhia's name and influence would have been of incalculable value to the mutineers. His loyal conduct therefore received the grateful acknowledgment of the Government. The decorations of G.C.B., G.C.S.I., and CLE., the rank of an honorary general in the British Army, considerable grants of territory, and in 1886 the restoration of the fort of Gwalior, expressed the gratitude of the British for his services. Jhansi was received from Gwalior, and various territorial exchanges were efiected. In the matter of rail- ways, salt, and postal arrangements, the Maharaja readily co-operated with the Government of India. He died on 20th June 1886, leaving large accumulations of treasure, and was succeeded by his son Madho Eao. (w. l.-w.)

Singfapore, an island and town situated at the southernmost extremity of the Malayan Peninsula in 1 ° 20' N. and 103 ° 50' E. The island is the most important portion of the Crown Colony of the Straits Settlements, and the town, which is the administrative centre of the colony, is the principal emporium of the trade of Southern Asia. Singapore is one of the most valuable of the minor possessions of Great Britain. It is very strongly fortified by guns and works of a modern type, upon which large sums have been expended by the Imperial Government, aided by a heavy military contri- bution from the colony. Its geographical position gives it strategic value as a naval base, whence the routes to and from the Far East can be commanded. It possesses a good harbour, docks, extensive coaling wharves, an admiralty dockyard, and considerable facilities for ship- ping. As a commercial centre it is unrivalled in that

part of the world. The total value of the imports in 1898 was ►►16,416,831, and the exports in the same year valued ►►13,583,146. The ships using the port during 1898 numbered 10,013, with an aggregate tonnage of 9,086,556, of which 5768 were British, with an aggre- gate tonnage of 5,402,032. The revenue of Singapore, for 1898 amounted to $2,963,550, exclusive of $46,150 received for land sales, and the expenditure was $2,427,061. On the island of Pulau Brani stand the largest tin-smelting works in the world, which annually pass through their furnaces more than half the tin produced. Singapore has also establishments for tinning pine -apples and a large biscuit factory. The city possesses few fine buildings,

but Government House, the new law courts, the gaol, the lunatic asylum, and the Hong Kong and Shanghai Bank are exceptions, as also is the cathedral of St Andrew's. There are three Eom►►|,n Catholic churches, a Free church, an American mission, and several chapels belonging to other Nonconformist sects. There is a good racecourse and polo- ground, fine cricket and football fields, two golf links, and innumerable lawn-tennis courts. There is a town and a country club, as well as a German club, and both the latter have good bowling-alleys attached. Singapore is governed by its own municipality, under the supervision of the Colonial Government.

The atmospheric pressure registered in Singapore for 1898 showed 30'017 inches to be the highest on 28th January, and 29'711 inches to be the lowest on 9th November ; the range for the year was 0'104 inches, and the mean for the year 29 '870 inches. The temperature of Singapore registered 91 '9►► F. in the shade on 18th March 1898, that being the highest for the year. The lowest was 70 '2►► F., registered on 29th January. The range for the year was 127►► F., and the mean was 797►► Temperature of solar radia- tion for 1898 was : highest 163-2►► F. on 24th March ; lowest 81-0►► F. on 12th February ; mean for 1898, 142-3►► F. The tempera- ture of nocturnal radiation on grass

was : highest 75 1 F. on 30th June ; lowest 66-9 F. on 24th March ; mean of 1898, 71-2 F. Relative humidity : highest 98 per cent, on 7th September ; lowest 53 per cent, on 10th November ; mean for 1898, 81 per cent. Northerly and north-east winds prevail from the middle of October to the end of April, southerly and south-westerly winds from the beginning of May to the middle of October. The mean velocity of winds for the year 1898 was 177 miles, the greatest velocity recorded in 24 hours was 351 miles on 16th October. Rainfall : mean for 1898, 106-19 inches; maximum, 158-68 inches; maxi- mum monthly fall, 23-94 inches in October ; minimum monthly fall, 2-96 inches; greatest fall in 24 hours, 4-12 inches on 14th October.

The following shows the composition of the population, which numbered in all 228,555 in 1901 ; Europeans 3824, Eurasians 4120, Chinese 164,041, Malays 36,'080, Indians 17,823, other nation- alities 2667. The births registered in Singapore during 1898 numbered 3751, namely, 1960 males and 1791 females, being a ratio of 16-55 per mUle. The deaths registered during the same period numbered 7602, namely, 5894 males and 1708 females, a ratio of 33-54 per mille. The excess of deaths over births is due to the fact that there are comparatively few women among the Chinese ; the steady increase of the population in the face of this fact is to be attributed entirely to immigration, mainly from China, but to a minor extent from India also. The persons classed above under "other nationalities" are representatives of almost every Asiatic nation of importance, and of many African races, Singapore being one of the most cosmopolitan cities in the world. (h. Cl.)

Singfhbhum, a district of British India, in the Chota Nagpur division of Bengal. The administrative headquarters are at Chaibassa.

Area, 3375 square miles. Population (1881), 453,775 ; (1891), 545,488, showing an increase of 20 per cent., which must be partly due to more accurate enumeration ; average density, 145 persons per square mile. Classified according to religion, in 1891 Hindus numbered 230,999 ; Mahommedans, 3215 ; Christians, 4864, of whom 129 were Europeans ; aborigines, 306,410. In 1901 the population was 608,826, showing an increase of 12 per cent. The land revenue and rates in 1897-98 were Rs.l,

47,907; number of police, 184; boys at school (1896-97), 12,842, being 31-5 per cent, of the male population of school-going age ; registered death-rate (1897), 23-9 per thousand. The isolation of Singhbhum has been broken by the opening of the Bengal-Nagpur Railway, which has pro- tected it from the danger of famine, and at the same time given a value to its jungle products. In 1896-97 no less than 538,767 cubic feet of sleepers were exported for a railway beyond Benares ; and the net receipts of the forest department in that year were Rs. 2, 40, 000, or twice the land revenue. There are three missions in the district ??? S.P.G., Lutheran, and Roman Catholic ??? which have been very successful among the aboriginal tribes, especially in the spread of education.

Sing'Ora, or Sungkla, the Sangore of early navi- gators, the most important port on the east coast of the Malay Peninsula, situated in 7?? 12′ N. and 100?? 35′ E. It was settled at the beginning of the 19 th century by Chinese from Amoy, who placed themselves under the protection of the kings of Siam. Chinese influence is evident in the architecture of the walls of the town,

as well as in many of the houses, and practically the whole of the commerce is in Chinese hands. The population numbers about 10,000, the greater part consisting of Siamese, and of Malays who reside in a settlement on the north side of the harbour, and have mostly adopted the Siamese language. The channel to the inland sea or great lake of Patalung, which makes the harbour one of the most picturesque in the Far East, affords a safe and commodious anchorage, but is rendered difficult of access by a dangerous bar. A good road across the peninsula connects the port with Keddah on the west coast. A con- cession was granted for a railway along this route, but no work has been done upon it. The chief products of the province are paddy, tin, dried and salted fish and fruit. It is included in the munton or circle named after the historic and once powerful province of Nakawn Si Tamaraj, north of the lake, and is the residence of the chief commissioner. The rainy season is much later than in Upper Siam, commencing towards the end of the south-west monsoon. When the north-east monsoon breaks in the China Sea in October the coast becomes a leeshore, and receives the full force of the gales which sweep against it. A high sea and heavy rains then prevail.

Sins’ Sins’. The name of the village of Ossining {q.v.), Westchester county, New York, U.S.A., previous to

1901.

Sink ‹‹l’ti See Egypt : Military Operations.

Sinnall. See Kurdistan.

Si nope, now Sinub, the chief town of a sanjak of the same name in the Kastamilni vilayet of Asia Minor, situated on the south shore of the Black Sea, on a low sandy isthmus which connects the promontory of Boz Tepe with the mainland. It has the only safe roadstead be- tween the Bosphorus and Batum, but is shut off from the Anatolian plateau by high forest-clad mountains, over which there is no good road. It has little trade. Ths population consists of 5000 Moslems and 4000 Christians. The exports are about ‹‹80,000, and the imports ‹‹50,000.

Sion, or SiTTEN, the capital of the Swiss canton of the Valais. It is on the railway between St Maurice (25^ miles distant) and Brieg (33 miles distant). Sion is one of the most picturesque little cities in Switzerland, being built around two prominent hillocks that rise from the level valley of the Eh6ne. The north hillock is crowned by the castle of TourbiUon (built 1294, burnt 1788), which was long the residence of the bishops. The south hillock bears the castle of Valeria, long the residence of the canons, with the interesting 13th-century church of St Catherine. In the town below is the 15th-century cathedral, and the majoria (burnt in 1788), the former residence of the ” major ” (or mayor of the city). There are various other curious objects in the city, which is built on the banks of the Sionne torrent, and is at a height of 1680 feet above the sea. In 1888 Sion contained 5424 (in 1900, 6095) inhabitants (mainly Roman Catholics), of whom 1969 were German-speaking and 3271 French- speaking.

Sion dates from Roman times {Sedunum), and the bishop’s see was removed thither from Martigny (Octodurum) about 580. In 999 the bishop received from Rudolf III., King of Burgundy, the dignity of Count of the Valais, and henceforward was the temporal as well as spiritual lord of the Valais, retaining this posi- tion, at least in part, tm 1798.

See J. Gkemaud. Introduction to vol. v. (Lausanne, 1884) of his DocuTnents relatifs ci VMstoire du Vallais. ??? R. R. Hoppbler. Beitrage zur Geschichte des Wallis im Mittelaller, Ziirich, 1897. ??? B. Eameau. Le Vallais Hisiorique. Sion, 1886.

(w. A. B. C.)

S I 0 U X ??? S IPUNCULOIDEA

Sioux City, a city of Iowa, U.S.A., capital of Woodbury county. It is on the river Missouri, at the moutt of the Big Sioux, in the north-western part of the state, at an altitude of 1103 feet. The business portion of the city is in the bottom lands, while the residences are built upon the slope and summit of the cliffs. It has excellent water-supply and sewerage systems, is well paved, mainly with wood, and is divided into eight wards. It is a railway point of great import- ance, five railways meeting here ??? the Chicago, Milwaukee, and St Paul, the Chicago, St Paul, Minneapolis, and Omaha, the Illinois Central, the Great Northern, and the Sioux City and Pacific. These, with boats on the Mis- souri, give it a very large trade. In 1900 it had 329 manufacturing establishments, with a total capital of $5,691,644. These employed 3104 hands, and the pro- duction was valued at |l5,469,702. Of this more than one-half was the product of slaughtering and meat-packing houses. Sioux City is the seat of Morningside College, a Methodist Episcopal institution, opened in 1890, which in 1899 had a faculty of 18 and was attended by 217 students. The assessed valuation of real and personal property was, in 1900, $5,341,959, the net debt was $2,176,013, and the rate of taxation 69-00 per $1000, indicating a very low rate of assessment. Population (1890), 37,806; (1895), 27,371, showing a decided loss in the five years; (1900), 33,111, of whom 6592 were foreign-born and 280 negroes. Of 10,082 males 21 years of age and over, 117 were illiterate (could not write).

Sioux Fails, a city of South Dakota, U.S.A., capital of Minnehaha county. It is situated on the west bank of the Big Sioux, in the south-eastern part of the state, at an altitude of 1390 feet. The city has a regular plan, is divided into six wards, has good water-supply and sewerage systems, and

is well paved. It is in a rich farming region, producing mainly wheat, for which this city is the shipping point. It has five railways, the Burlington, Cedar Kapids, and Northern, the Chicago, Milwaukee, and St Paul, the Chicago, St Paul, Minnea- pohs, and Omaha, the Wilmar and Sioux Falls branch of the Great Northern, and the Ilhnois Central. It has an excellent water-power in the Falls, which descend 100 feet in half a mile, and which have been utilized in flour-mills. Sioux City was incorporated as a town in 1877, and received a city charter in 1883. Population (1880), 2164 ; (1890), 10,177; (1900), 10,266, of whom 1858 were foreign-bom.

Sipuncuioidea,. ??? The Sipunculoidea, formerly associated with the Echiuroidea (q.v.) in the group Gephyrea, are marine animals of uncertain affinities. Externally, the body of a Sipunculoid presents no projec- tions : its surface is as a rule even, and often glistening, and the colour varies from whitish through yellow to dark brown. The anterior one-quarter or one-third of the body is capable of being retracted into the remainder, as the tip of a glove-finger may be pushed into the rest, and this retractile part is termed the introvert. At the tip of the introvert the mouth opens, and is surrounded in iSipunc id us by a funnel-shaped, ciliated lojiliophore (Figs. 1 and 2). In Phascolosoma and Phascolion this funnel-shaped struc- ture has broken up into a more or less definite group of tentacles, which in Deiulroslomu are arranged in four groups. In As]iidosij>hoii and Physcosonia the tentacles are usually arranged in a horse-shoe, which may be double, overhanging the mouth dorsally. On the surface of the funnel-shaped lophophore are numerous ciliated grooves, and each of the tentacles in the tentaculated forms has a similar groove directed towards the mouth. These grooves

doubtless serve to direct currents of water, carrying with them small organisms towards the mouth.

The skin consists of a layer of cuticle, easily stripped off, secreted by an ectodermal layer one ceU thick. Within this is usually a sheath of connective tissue, which surrounds a layer of circular muscles ; the latter may be split up into separate bundles, but more usually form a uniform sheet. Within the circular muscles is a layer of longitudinal muscles, very often broken into bundles, the number of which is often of specific im-

portance. Oblique muscles sometimes lie between the cir- cular and longitu- dinal sheaths. On the inner surface is a layer of peritoneal ‘ epithelium, which is frequently ciliated, and at the bases of the retractor muscles is heaped up and modified into the reproductive organs. The ectoderm is in some genera modified to form certain ex- cretory glands, which usually take the form ___ of papiU with an apical opening. These ___ papiUse give the sur- face a roughened aspect ; the use of their secretion is un- known. They are best developed in Physcosoma.*

^Tien the body of a Sipunculoid is opened, it is seen that the body-cavity is spacious and full of a corpusculated fluid, in which the various organs of the body float. The most conspicuous of these is the long, white alimentary canal, crowded with mud.

The mouth is devoid Yia. l.___5!p__)i__titi__ni(dMsL., with introvert and of armature and head fiiUy extended, laid open by an incision

passes without break into the oesophagus ; this is surrounded by the retractor muscles, which are inserted into the skin around the mouth, and have their origin in the body-wall, usually about one-third or one-haK of the body-length from the anterior end (Figs. 1 and 2). Their function is to retract the introvert, which is protruded again by the contraction of the circular muscles of the skin; these, compressing the fluid of the body-cavity, force for- ward the anterior edge of the introvert, which in Lankester’s

along the right side to show the internal organs, X 2. a, mouth ; 6, ventral nerve – cord ; c, “heart” ; (?, oesophagus ; e, intestine : /, posi- tion of anus ; g, tuft – like organs ; h, right nephridimn ; i, retractor muscles ; 3, diverti- culum on rectum. The spindle-muscle is seen overlying the rectum.

phraseology is pleurecbolic, acrembolic. The number of musclea varies from one {Onchnesoma and TylosoTna) to four, the latter being very common. The alimentary canal is U-shaped, the dorsal limb of the U terminating in the anus, situated not very far from the level of the origin of the retractor muscles. The limbs of the U are further twisted together in a looser or tighter coil, the axis of which may be traversed by a "spindle" muscle arising from the posterior end of the body. No glands open into the alimentary canal, but a diverticulum, which varies enormously in size, opens into the rectum. As is so often the case with animals which eat mud and sand, and extract what little nutriment is afforded by the organic debris therein, the walls of the alimentary canal are thin and apparently weak. Ml along one side is a microscopic ciliated groove, into which the mud does not seem to enter, and along which a continuous stream of water may be kept up. Possibly this is respiratory ??? there are no special respira-

FiG. 2. ??? Right half of the anterior end of Si^unculus nudus. It., seen from the inner side and magnified. a, funnel-shaped grooved tentacular crown leading to the mouth ; &, oesophagus ; c, strands breaking up the cavity of the tentacular cro\vn into vascular spaces ; c', "heart"; d, brain; e, ventral, and e', dorsal re- tractor muscles ; /, ventral nerve-cord ; g, vascular spaces in tentacular crown.

tory organs. A so-called heart lies on the dorsal surface of the oesophagus ; it is closed behind, but in front it opens into a circumoesophageal ring, which gives off vessels into the lophophore and tentacles. The contraction of this heart, which is not rhythmic, brings about the expansion of the tentacles and lophophore. This system is in no true sense a vascular system : there are no capillaries, and the fluid it contains, which is corpusculated, can hardly have a respiratory or nutritive function. It is simply a hydro- static mechanism for expanding the tentacles. The ex- cretory organs are typical nephridia, with an internal ciliated opening into the body-cavity, and an external pore. One surface of the tube is prolonged into a large sac lined with glandular, excretory cells. The organs are typically two, though one is often absent, e.g., in Phas- colion. They serve as channels by which the reproductive cells leave the body,

and they are sometimes spoken of as "brown tubes." There is a weU-developed brain dorsal

to the mouth; this gives off a pair of oesophageal com- missures, which surround the cesophagus and unite in a median ventral nerve-cord which runs between the longi- tudinal muscles to the posterior end of the body. From time to time it gives off minute circular nerves, which run round the body in the skin and break up into a very fine nerve plexus. There are no distinct ganglia, but ganglion cells are uniformly distributed along the ventral side of the cord. The whole is anteriorly somewhat loosely slung to the skin, so as to allow free play when the animal is extending or retracting its introvert. A pit or depression, known as "the cerebral organ," opens into the brain just above the mouth ; this usually divides into two limbs, which are deeply pigmented and have been caUed eyes.

Sipunculoids are dicecious, and the ova and spermatozoa are formed from the modified cells hning the body-cavity, which are heaped up into a low ridge running along the line of origin of the retractor muscles. The ova and the mother-cells of the spermatozoa break oflF from this ridge, and increase in size considerably in the fluid of the body- cavity. Fertihzation is external ; and in about three days a small ciliated larva, not unlike that of the Echiuroids, but with no trace of segmentation, emerges from the egg- shell. This little creature, which has many of the features of a Trochosphere larva, svidms about at the surface of the sea for about a month, and grows rapidly. At the end of this time it undergoes a rapid metamorphosis : it loses many of its larval organs, cilia, takes in a quantity of water into its body-cavity, sinks to the bottom of the sea, and begins life in its final form.

The following genera of Sipunculoids are recognized : ??? (i.) Sipun- culus. This, with Physcosmna, has its longitudinal muscles divided up into some 17-41 bundles. It has no skin papillae. The mem- bers of this genus attain a larger sise than any other species, and the genus contains some 16-17 species, (ii.) Physcosoma (Fig. 3) has its body covered with papHlse, and usually numerous rows of minute hooks encircling the introvert. It is the most numerous genus, and consists for the most part of shallow-water (less than 50 fathoms) tropical and subtropical foi-ms.

They often live in tubular burrowings in coral-rook. The following three genera have their longitudinal muscles in a continuous sheath : ??? (iii.) Phascolosmna, with some 25 species, mostly small, with numerous tentacles, (iv.) PhascoUon, 10 species, small, living in mollusc- shells and usually adopting the coiled shape of their house ; only one kidney, the right, persists. (v.) Dendrostoma, with 4-6 tentacles, a small genus found in tropical shallow water, (vi.) Aspidosiphon, with 19 species, is easily distinguished by a cal- careous deposit and thickened shield at the posterior end and at the base of the introvert, which is eocentiic. (vii.) Clceosiphon has a calcareous ring, made up of lozenge-shaped plates, round the base of its centric introvert, (viii.) Petalostoma, a minute form with two leaf-like tentacles, is found in the English Channel, (ix.) Onch- nesoma, with 2 species, and (x.) Tylosoma, with 1 species, have no tentacles, only one brown tube, and only one retractor muscle. Both genera are found off the Norwegian coast. The last named is said to have numerous papillte and no introvert.

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The Priapuloidea, a peculiar group of only three genera, Priapulus, Priapuloides, and Halicryptus, are usually placed in the neighbourhood of the Gephyrea, though there is httle in their structure to warrant this classi- fication. They are cyhndrical worm-like animals, with a median anterior mouth quite devoid of any armature or tentacles. The body is ringed, and often has circles of spines, which are continued into the slightly protrusible pharynx. The ahmentary canal is straight, the anus ter- minal, though in Priajmlus one or two hollow ventral diverticula of the body-waU stretch out behind it. The

nervous system, composed of a ring and a ventral cord, retains its primitive connexion with the ectoderm. There are no Specialized sense-organs or vascular or respiratory

//. spinulosus, V. Sieb., of northern seas. They live in the mud, which they eat, in comparatively shallow waters up to 50 fathoms.

AuTHOEiTiEs. ❖❖❖ Apel. Zeitschr. wiss. Zool. xlii. , 1885. ❖❖❖ SOHAEFF. Quart. J. Micr. Sci. xxv., 1885. ❖❖❖ Ehlers. Zeitschr. wiss. Zool. xi., 1861. ❖❖❖ SCHAUINSLAND. Zool. Auz. ix., 1886. ❖❖❖ De GuEENB. Mission Scimtiflque du Oap Horn, vi., 1891. ❖❖❖ MiOHABLSEN. Jdhrh. Hamburg Aust. vi 1888. (^ E. S.)

Sirajsranj, a town of British India, in the Pabna district of Bengal, on the right bank of the Jamuna or main stream of the Brahmaputra; 6 hours by steamer from the railway terminus at Goalundo. It is the chief river mart for jute in northern Bengal, with several jute presses and a jute mill. Population (1881), 21,037: (1891),

23,267.

Sirmur, or Saemoe (also called Nahan, after the chief town), a native state of India, within the Punjab. It occupies the lower ranges of the Himalaya, between Simla and Mussoorie. Area, 1108 square miles Population (1881), 112,763 ; (1891), 124,134; (1901), 135,626, showing a con-tinuous increase of about 10 per cent, in each decade. Estimated gross revenue, Ks.5,12,000; military force, 604 men. The chief, whose title is Eaja, is a Eajput of high lineage. The Eaja Shamsher Perkash, G.C.S.I., who died in 1898, ruled with re- markable ability and success. A younger son commanded the Imperial Service sappers in the Tirah campaign of 1896-97, and was rewarded with the rank of honorary captain in the Indian army and the distinction of CLE. Attempts have been made to estab-

Fio. 3. ❖❖❖ A semi-diagrammatic figure of the anterior end of half a Physcosoma, seen from the inner side. The introvert is fully everted and

*the lophophore expanded. The collar which surrounds the head is not fully extended. Two rows only of hooks are shown. 1, lophophore ; 2, pig-mented pit leading to brain ; 3, section of dorsal portion of mesoblastic " skeleton " ; 4, pit , . , . r' j ending in eye ; 6, the brain ; 6, blood-sinus of dorsal side surrounding brain and giving off lisn an iron lOUndry, and to develop mines branches to the tentacles; 7, collar; 8, retractor muscle of head; 9, hook; 10, sense-organ; f ****l**** ****i**** ****j**** ****; rn-L + f xr.-iT.nT i 11****, nerve-ring; 12, coelom of upper lip, it is continuous with 21 ; 13, mouth; 14, lower lip; ****} '^^^ ^^ - l^MOa. lie tOWn Ot JSAHAN IS 15****, blood-sinus of ventral side, continuous with 6; 16, ventral portion of mesoblastic "skeleton"; situated about 40 miles SOUth of Simla 17****, ventral nerve-cord ; 18, coelom, continuous with 12 and 21 ; 19****, cesophagus ; 20, dorsal ' vessel arising from the blood-sinus 6 ; 21****, ccBlom.***

*systems. The Priapuloidea are dioecious, and their male and female organs, which are one with the excretory organs, consist of a pair of branching tufts, each of which opens to the exterior on one side of the anus. The tips of these tufts enclose a flame-cell similar to those found in Platyhel- minths, &c., and these probably function as excretory organs. As the animals become adult, diverticula arise on the tubes of these organs, which develop either spermatozoa or ova. These pass out through the ducts. Nothing is known of the development. The much-needed in-vestigation of this point would probably throw some light on the affinities of the group. There are three genera : (i.) Friajjulus, with the species P. caudatus, Lam., of the Arctic and Antarctic and neighbour- ing cold seas (Fig. 4), and F. bicau-: datus, Dan., of the north Atlantic and Arctic seas ; (ii.) Priapuloides australis, de Guerne, of the circum- Fm. i. ****Priapuluscavdatm polar waters of the south; and J;,rih****, ""surroLS by (iii.) IlalicryttM, with the species spines.***

3057 feet above the sea. The palace of the Eaja and several other houses are built of stone in European style. Population (1881), 5253.

Sirohi, a native state of India, in the Eajputana agency. Area, 1966 square miles. Population (1881), 142,903; (1891), 188,977; (1901),

154,350, showing an increase of 30 per cent, in the earlier, but a decrease of 17 per cent, in the later period, due to the results of famine. Gross revenue (1896-97), Es.4,21,587; tribute, Es.6880. The chief, whose title is Maharao, is a Deora Eajput of the Chauhan clan, and claims descent from the last Hindu king of Delhi. The state is traversed by the Eajputana Eailway. The town of Sirohi is 28 miles north of Abu-road station. Population (1881), 5699. It has manufactures of sword-blades and other weapons. The Crosthwaite Hospital, called after the late agent, which is built and equipped on modern principles, was opened by Sir Eobert Crosthwaite in December 1897.

Sirsa., a town of British India, in the Hissar district of the Punjab, situated on a dry bed of the river Ghaggar ; station on a branch of the Eajputana Eailway, half-way between Eewari and Ferozepore. Population (1881), 12,292; (1891), 16,415; municipal income (1897- 98), Es.19,942. It occupies an ancient site, and was re- founded in 1837 as the headquarters of a British district, which was subdivided in 1884 between Hissar and Feroze- pore. It is an important centre of trade with Eajputana, and has manufactures of cotton cloth and pottery.

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Si Si the ancient Sision, the chief town of the Khozan sanjak of the Adana vilayet of Asiatic Turkey, situated on the left bank of the Girgen Su, a tributary of the Jihiin, Pyramus, and at the south end of the important pass across Mount Taurus, which is followed by the road from Geuksiin {Kokusos), to the Cilician plain and Adana. It was besieged by the Arabs in 704, and rebuilt in 1086 by Leo II., king of Lesser Armenia, who made it his capital. In 1374 it was taken and demolished by the sultan of Egypt, and it has never recovered its prosperity. It is the seat of an Armenian Katholikos, and the monas- tery and church built by Leo II. are interesting.

Sisterhoods (Modern Anglican). ❖❖❖ The dissolu- tion of religious houses in England (1536-1540) under Henry VIII. swept away more than 140 nunneries, and the Anglican Church was left without sisterhoods for

three centuries. But as these had for 900 years formed part of her system, there were protests from time to time and attempts at restoration. Amongst such protests, which generally dwelt a good deal on the want of provision for unmarried women, may be mentioned three in successive centuries. The historian Fuller would have been glad " if such feminine foundations had still continued," those "good shee-schools," only without vows (Bk. vi.). Richardson the novelist, in Sir Charles Grandison, wishes there could be a Protestant nunnery in every county, " with a truly worthy divine, at the appointment of the bishop of the diocese, to direct and animate the devotion of such a society " ; in 1829 the poet Southey, in his Colloquies (cxiii.), trusts that "thirty years hence this reproach also may be effaced, and England may have its B^guines and its sisters of mercy. It is grievously in need of them." Also small practical efforts were made in the religious households of Nicholas Ferrar at Little Gidding, 1625, and of William Law at King's Cliffe, 1743 ; and under Charles II., says Fr. Bede, Autob., "about 12 Protestant ladies of gentle birth and considerable means " founded a shortlived convent, with Sancroft, then Dean of St Paul's, for director.

Southey's appeal had weight, and before the thirty years had passed, compassion for the needs of the destitute in great cities, and the impulse of a strong Church revival, aroused a body of laymen, among whom were included Mr Gladstone, Sir T. D. Acland, Mr A. J. Beresford- Hope, Lord Lyttelton, and Lord John Manners (chair- man), to exertions which restored sisterhoods to the Church of England. On 26th March 1845 the Park Village Community was set on foot in Regent's Park, London, to minister to the poor population of St Pancras. The "Rule" was compiled by Dr Pusey, who also gave spiritual supervision. In the Crimean war the superior and other sisters went out as nurses with Florence Nightingale. The community afterwards united with the Devonport Sisters, founded by Miss SeUon in 1849, and together they form what is known as Ascot Priory. 'The St Thomas's sisterhood at Oxford commenced in 1847 ; and the present mother – superior of the Holy Trinity Convent at Oxford, Marian Hughes, dedicated herself before witnesses to such a life as early as 1841 (Liddon's Life of Dr Pusey, iii.).

Four sisterhoods stand together as the largest : those of Clewer, Wantage, All Saints, and East Grinstead ; and the work of the first may stand as a specimen of that of others. The ‘ ‘ Com- munity of St John the Baptist ” at Clewer, near Windsor, arose in 1849 through the efforts of Mrs Tennant and the vicar, afterwards ???n-ardeu of the society, the Rev. T. T. Carter, to save fallen women. Under the first superior, Harriet Monsell, the numbers grew apace, and are now above 200. Their services to society and the Church include 6 houses for fallen women, 7 orphanages, 9 elementary and high schools and colleges, 5 hospitals, mission work in 13 parishes, and visiting in several “married quai-ters” of barracks. Many of these are important institutions, and their labours extend over a wide area ; two of the settlements are in India, and two in

the United States. A list of 26 sisterhoods is given in the Official Year-Book of the C.E., 1900, to which may be added 10 institu- tions of deaconesses, many of whom live in community under rale. The Episcopal Church of Scotland has 3 sisterhoods ; and they are found also at Toronto, “Saint John the Divine”; Brisbane, “Sacred Advent”; Grahamstown, “Resurrection”; Bloem- fontein, ” St Michael and AU Angels ” ; Maritzburg, ” Saint John the Divine.” The Year-Book of the Protestant Episcopal Church of America (Anglican) mentions 17 American sisterhoods and 7 deaconess homes and training colleges.

Practically all Anglican sisterhoods originated in works of mercy, and this fact largely accounts for the rapidity with which they have won their way to the good-will and confidence of the Church. Their number is believed to exceed 3000, and the demand for their- ser- vices is greater than the supply. Bishops are often their visitors, and Church Congresses, Convocation, and Lam- beth Conferences have given them encouragement and regulation. This change in sympathy, again, has gained a hearing from modern historians, who tend more and more to discredit the wholesale defamation of the dissolution period. This charitable activity, however, distiDguishes the modern sister from the nuns of primitive and mediaeval times, who were cloistered and contemplative, and left external works to deaconesses, or to lay women of a ” third order,” or to the freeer societies like the Beguines. St Vincent de Paul is considered to have begun the new era with his institution of

“Sisters of Charity” in 1634. Another modern feature is the fuller recognition of family ties : Rule 29 of the Clewer sisters directs that ” the sisters shall have free intercourse with relations, who may visit them at any time.” But in most essential respects modern sisterhoods follow the ancient traditions. They devote themselves to the celibate life, have property in common, and observe a common rule of prayer, fellowship, and work. Government is by a sister-superior, assisted by various officers. The warden and chaplain are clergy, and the visitor is commonly a bishop. In one important regard there has been hesitation, and authorities like Dr Littledale and Bishop Grafton contend strongly for the primitive ideal of the convent as family, with a constitu- tional government, as against the later and widespread Jesuit ideal of the convent as regiment, with a theory of despotic rule and absolute obedience. If some early mis- takes in the restoration of sisterhoods were due to this exaggerated doctrine of obedience, the doctrine itself may be trusted to disappear among a Church and people accustomed to free institutions and to respect for indi- viduality.

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SistOVa, or SiSTOW, chief town of a department of Bulgaria, on the right bank of the Danube, 40 miles above Rustchuk. It has improved considerably in pro- sperity since the Russian war of 1878, notvsdthstanding a large migration of the Turkish population, and has a considerable trade in corn and wine. A Russian petroleum dep6t has been established. The exports in 1897 amounted to 30,261 tons, valued at ––132,961, and the imports to 26,296 tons, valued at ––207,601 ; and in 1900 the exports and imports amounted respectively to only 17,295 tons, valued at ––94,520, and 15,065 tons, valued at ––91,691. Population (1892), 13,212.

Sita,pur, a town and district of British India, in the Lucknow division of Oudh. The town is on the river Sarayan, half-way between Lucknow and

Shahjahanpur ; railway station, 55 mUes north – west from Lucknow. Population (1881), 18,544; (1891), 21,380; municipal

income (1897-98), Es.30,592, less than half from octroi; incidence of taxation, E. 0.12.6 per head; registered death- rate (1897), 61 ‘5 per thousand. It is stiU a cantonment, with a European regiment. It has a high school and printing-press.

The district of Sitapue has an area of 2255 square miles. Popu- lation (1881), 958,251 ; (1891), 1,076,413, showing an increase of 12 per cent. ; average density, 477 per square mile. In 1901 the population was 1,175,579, showing an increase of 9 per cent. The land revenue and rates are Rs.15,34,427, the incidence of assess- ment being just R.l per acre ; cultivated area (1896-97), 874,472 acres, of which 121,608 were irrigated from wells and tanks; number of police, 1490 ; vernacular schools, 159, with 5811 pupils ; registered death-rate (1897), 36 ‘6 per thousand. The principal crops are rice, pidse, wheat, barley, sugar-cane, and opium. The district is traversed by the Lucknow-Bareilly section of the Rohilk- hand and Kumaon Railway. There are no Government canals.

Sitka., formerly Novo Arkhangelsk, the most notable town of S.E. Alaska, situated on Sitka Sound on Baranoff Island, in 57◆◆ 03′ N. and 135◆◆ 20′ W. Founded in 1804 by Lisianski and Baranoff, after the destruction of an earlier trading post (1800-04) in a less defensible situation, it was until 1867 the chief port and seat of government of Kussian America, a fortified trading-post, with churches, a seminary, library, shipyard, foundries, and all the belong- ings of a great mercantile corporation under military discipline. Since the purchase of Alaska it has continued to be the seat of government and of the United States courts, though its commercial importance has diminished relatively to other towns in Alaska. The transfer of the territory took place at Sitka (18th October 1867). .The settlement, besides Government buildings, comprises a large Indian village of frame houses, as well as numerous magazines, shops and dwellings of the white population, a saw-miU, a Greek church

and mission school, a large Presbyterian school and mission, and an ethnological museum. In the vicinity are numerous mines of gold and silver. The extinct volcano Mount Edgecumbe is a conspicuous landmark across the Sound. The population in 1890 was 300 whites and 893 natives; in 1900 the total population was 1396. The mean annual temperature of Sitka is 43 '3 ́ F. ; rainfall 81-7 inches. The prevailing winds are from the south and east.

Sitting'bourne, a market-tovm in the Faversham parliamentary division of Kent, England, on a creek of the Swale, 16 miles by rail west by north of Canterbury. Modern buildings are a free library, a Masonic hall, and public baths. Area of parish (an urban district), 1004 acres. Population (1881), 7856; (1901), 8944.

Siut. See AssiUT.

SiV3igSLnga., a town of British India, in the Madura district of Madras; situated in 9 ́ 51' N. and 78 ́ 32' E., 25 miles east of Madura. Population (1891), 8800. It contains the residence of a zamindar, whose estate covers an area of 1220 square miles and pays a permanent land revenue of ́ 25,864. The succession has been the subject of prolonged litigation. There is a high school.

Siva.S. ́ (1) One of the largest and most important vilayets of Asia Minor, lying between 38 ́ 30' and 41 ́ N. and 35 ́ 30' and 39 ́ E. It is divided into four sanjaks ́ Sivas, Tokat, Amasia, and Shabin Kara-hissar ; has an area of 32,300 square miles, and a population of 1,090,000 (Moslems, 840,000, of whom one -third are Kizilbash; Armenians, 172,000; Greeks, 78,000). The vilayet is rich in mineral wealth ́ silver, lead, copper, iron, manganese, arsenic, alum, salt, and coal ; has several hot and cold mineral springs ; and large forests of fir, pine, beech, and oak. The chmate is good, and the soil fertile. Wheat and barley are largely grown on the plateau, and in the lower districts there are extensive fruit orchards and vineyards. The port of the vilayet is Samsiin, whence

a chauss^e runs through Amasia, Tokat, and Sivas to Kharpiit. The exports in 1900 amounted to ►►422,175, and the imports to ►►502,506 ; the principal items in the former being grain and flour, opium, textiles, tobacco, wool, live stock, and carpets, while cotton goods represent 28 per cent, of the imports.

(2) The. chief tovra of the vilayet and of a sanjak of the same name, the ancient Sebasteia, altitude 4420 feet, situated in the broad valley of the Eazil Irmak, on one of its tributaries, the Murdan Su. The climate is healthy, but severe in winter. Coarse cotton cloth and woollen socks are manufactured. The medresses, or colleges, built in the 13th century by the Seljiik sultans of Riim, are amongst the finest remains of Seljiik art in Asia Minor. In one of them is the tomb of its founder, Izz-ed-din Kai Kiiis I. (1210-19). Near the town is the Armenian Monastery of the Holy Cross, in which are kept the throne of Senekherim and other relics. There are several Armenian churches of interest, a flourishing American mission with church and schools, and a Jesuit mission. Population, Moslems, 33,000 ; Armenians, 9000 ; Greeks, 2000. Sebasteia was the name given under the early empire to an unknown place, which had been called Megalopolis by Pompey. Under Diocletian it became the capital of Armenia Minor, and in the 7th century that of the Sebasteia Theme. Justinian rebuilt the waUs and, under the Byzantine emperors, it was second only to Csesarea in size and wealth. In 1021 Senekherim, king of the Armenian province of Vaspuragan (Van), ceded his dominions to Basil II., and became the Byzantine viceroy of Sebasteia and the surrounding country. This position was held by his successors until the town fell into the hands of the Turkomans after the defeat, 1071, of Eomanus II. by the Seljiiks. After having been ruled for nearly a century by the Danish- mand Emirs, it was taken, 1172, by the Seljiik sultan of Riim, and in 1224 was rebuilt by Sultan Ala-ed-dln Kai Kubad I. In 1400, when captured by Timiir, the city is said to have had 100,000 inhabitants. On this occasion the bravest defenders were massacred, and 4000 Armenians were buried ahve. From this disaster Sivas never recovered. In November 1895 most of the Armenians of wealth and influence were massacred. Mekhitar, the founder of the Mekhitarist Order and of the famous monastery at Venice, was born (1676) at Sivas. (c. w. w.)

Siyori, Ernesto Camillo (1815-1894), Italian

violinist, was born at Genoa 25th October 1815, and was taught by Restano and Costa until, when he was about six years old, Paganini heard him play, and was so impressed that he wrote a concertino for violin, guitar, viola, and violoncello, in which the composer used to play the guitar part. From 1827 Sivori began the career of a travelling virtuoso, which lasted almost without inter- ruption until 1864. He played Mendelssohn's concerto for the first time in England, in 1846, and was in England again in the seasons of 1851 and 1864. He lived for many years in Paris, and died at Genoa 18th February 1894. He was the recognized successor of Paganini, and his playing possessed all the qualities that distinguish the virtuoso.

Sivri-HiSSar, the ancient JusfiniarwpoKs-Palia, a town of Asia Minor, in the Angora vilayet, situated 8 miles north of the site' of Pessinus. It is a road and commercial centre, with a trade in opium and mohair. The population includes a large Armenian community. Justinianopolis was one of the strong places on the Byzan- tine military road, and became the chief city of Galatia Salutaris, and the seat of a metropolitan who held the title of archbishop of Pessinus.

iSKAGERRAC K ❓❓❓S K A T I N G

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Skagferrack, an arm of the North Sea giving access to the Cattegat, whilst northwards it forms Chris- tiania Fjord. (For the currents, temperature, and salinity of the water, &c., see Noeth Sea.)

Skag^ay, a town in S.E. Alaska at the mouth of the river of the same name, in 59❓❓27′ N. and 135❓❓16′ W., on an indentation of Taiya Inlet, a branch of Chilkoot Inlet, leading out of Lynn Canal. This settlement was made in 1895, though individuals had squatted there earlier. It originated in the rush for the Klondike gold-fields, for which Skagway is the most convenient entrance, by the trail over the lower of the two passes to the head-waters of the Yukon. After a stormy begin- ning, due to the usual mixed population of a community of diggers,

Skagway has steadily grown in population, business, and good order. It has water-works, churches, schools, &c., and being the seaward termination of the Yukon and White Pass Railway, by which goods and passengers reach the Klondike, its prosperity seems assured. In 1900 the population was 3117. It is connected with Dawson by telegraph, and with the outside world by frequent steamers.

Skating'. ??? Development in both branches of skating, speed and iigure, was great in the later years of the 19th century. The pastime profited both by increas- ing devotion to athletics and by increased facilities of communication, which led to international competitions, interchange of ideas, and the institution of skating clubs in Switzerland and elsewhere, especially those of Davos, St Moritz, and Grindelwald, where ice is available every winter. Although skating instruments are so simple, the evolution ??? of the skate has advanced considerably, contri- buting to marked improvement in the skater's skill. In speed-skating an epoch was marked, first, by the almost universal adoption of the Norwegian type of racing skate ; and, secondly, by the institution in 1892, at an inter- national congress held in Holland, of annual races for the championships of Europe and of the world.

(i.) The Norwegian skate, introduced and perfected (1887-1902) by Axel Paulsen and Harald Hagen, is con- structed with a view to lightness, strength, and diminution of friction. The blade, of specially hardened steel, is set in a hollow horizontal tabe of aluminium, and connected by .similar vertical tubes with foot-plates riveted to a closely- fitting boot with thin leather sole. It is 16-17f inches long and 1^-2 millimetres thick (i.e., ???019-'078 inch), the average employed for hard ice being f mm., often thinner towards the heel. This thickness is suitable for good English ice, but for softer ice ???^ or j^ inch is preferable. The blade" is flat on the ice throughout, except fur an inch in front ; this flatness distributes the weight, and with the extreme thinness of blade reduces friction to a minimum. The edges are right-angled and sharp.

The skater's style has been modified. The blade, when planted on the ice with weight upon it, describes a nearly straight line, the last few feet only curving slightly outwards as the skate leaves the ice. Hence the stroke of

the best modern skaters is almost, if not entirely, on the inside edge, a gain in directness and speed, the outside edge being used for curves only. The length of stroke has tended to diminish. Contrasted with the 12-18 yards' stroke attributed to the old English champion, W. "Turkey" Smart, which was partly on the outside edge, the modern racing stroke rarely exceeds 10 yards, and is usually nearer 6 or 7. Particular instances vary with conditions of ice, &c., but at St Petersburg, in 1896, Eden's stroke in the 10,000 metre race averaged about 7 J yards, that of P. Oestlund at Davos, in 1900, the same (for one lap, 8 yards). J. F. Donoghue's stride in 1891 was computed at about 6 yards. The general effect has been vastly increased speed, and a conjoint cause is the stricter training undergone before important races.

(ii.) The races held annually since 1892-93 for the championships of Europe and of the world, under the

auspices of the International Skating Union, have as- sembled representatives from the skating countries of Europe and from America; but up to 1902, after the victorious career of Mr J. F. Donoghue through Europe in 1890-91, Americans rarely competed in Europe, though America has produced some remarkably fine skaters, such as J. L. Johnson and Nilsson; whUe England, through lack of ice for practice, has fallen somewhat behind in skill, and up to 1902 entered but a single repre- sentative for the world's championship, Mr 0. Edgington (Oxford University), who from 1899 held successfully against the foreigners the only world's record made in recent years by an Englishman, viz., 19 miles 348 yards in an hour. Hence the struggle lies usually between Norway, Sweden, Germany, Austria, Hungary, Holland, Finland, and Russia. France has produced no speed-skater of note except M. G. de StoppanL

The professional championship was held in 1893-94 at ZwoUe, in Holland, and was won by H. Hagen (Norway), but since then has lapsed. The winners of the world's amateur championship are as foUow : ???

Date.

Place.

Name.

Nationality.

1892-93

Amsterdam

J. Eden

Holland

1893-94

Stockholm

Not decided

1894-95

Hamar

J. Eden

Holland

1895-96

St Petersburg

J. Eden

,j

1896-97

Montreal

J. K. McCuUoch

Canada

1897-98

Davos

P. Oestlund

Norway

1898-99

Berlin

P. Oestlund

j^

1899-1900 .

Christiania

E. Engelsaas

1900-01

Stockholm

F. Wathen

Finland

1901-02

Helsingfors

Not decided *

- ***R. Gundersen (Norway) won two races only.***

The races are four in number, over distances of 600, 1500, 5000, and 10,000 metres, and to obtain the title of champion a skater must win three races and finish in the fourth. In addition, each country, when possible, holds its own championship races. The English champions for 1899-1900 were A. E. Tebbit (amateur) and F. Ward (professional) ; and for 1901-2, A. E. Tebbit and J. Bates ; but the National Skating Association was prevented by unsuitable weather from holding the races from 1895-1900.

In England races are still skated, with rare exceptions, on straight courses, with a sharp turn round a post or barrel, the distance prescribed for N.S.A. championships being IJ miles with three turns. The Continental and international system in- volves a course with straight sides and curved ends of such a radius that no slackening of speed is necessary. In both instances the competitors race two at a time on a double track, and the time test is used. Each skater must keep his own course, to prevent either from using the other as pacemaker or wind-shield. The international regulations (Eiswettlauf Ordnung) prescribe that, if a single track be used, the hindmost skater must keep at a minimum distance of 5 metres from the other, on pain of disqualification. The advantage of inner curve on a Continental course is given alternately, and a space left open between the tracks at one point for the skaters to cross.

The curves are skated with a step-over-step action, and the direction is always from right to left. Hence, on entering the curve the right foot is brought across in front and set down on the inside edge, the left passing behind on the outside edge, and being in its turn set down on an outside edge in front. The strokes thus form a series of tangents to the curve, and are little shorter than in the straight. With a radius of 25 and 30 metres, as at Davos, the curves can be skated with safety at full speed. Skating records are somewhat confused, varying widely with conditions and form of track. The world's records for the four championship distances up to 1902 were : ???

Distance.

Time.

Holder andNationality.

Place and Date.

Metres. 600 (= 647 yds.) . 1500 (=1640 yds.). 6000 (=3 miles 188 yds.) 10,000 (=6 miles 376 yds.)

min. sees. 0 46i 2 22?

*8 37**

17 608

P. Oestlund (Norwaj-)

J. Eden (Holland') P. Oestlund (Norway)

Davos, 1900

Hamar, 1894 Davos, 1900

For other distances and times, cf. The Field {passim) ; Sporting

S. VIII. ??? 8i

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S K E A T ??? S K E G N E S S

and Athletic Beayrds, by H. Morgan- Browne (1897) ; The Sports-man'sYear-Book, 1899 ; The Spirit of the Tiines, W. Curtis (New York) ; The Badminton Magazine, January 1900 ; Whitaker's Almanac.

Figure-skating has received a great impetus ??? –

(i.) In England, {a) from the multiplication of clubs, e.g., Wimbledon (founded 1870), Thames Valley, Crystal Palace, (fee, in addition to the original " Skating Club " and those in Switzerland already mentioned ; and from the construction of numerous artificial rinks, such as " Niagara

" and the " National Skating Palace " ; (b) from the encouragement afforded by the National Skating Association, which offers 1st, 2nd, and 3rd class badges (and a special or " Diamond " badge for figure-skating) for figure tests, as well as for speed; and in 1893 founded a "London Skating Council," while in 1898 and in 1902 it held the figure-skating championship of the world in London. The N.S.A. has, however, occupied an anomalous position, holding inter- national competitions in Continental style, while encourag- ing a style which in itself disqualifies Englishmen from competing.

(ii.) Abroad, from increased organization and the insti- tution of rinks and minor competitions in every important town, in addition to the amateur championships of Europe and of the world held by the International Skating Union.

Thus figure-skating also has developed on international lines, and two separate styles or schools have been evolved, English and Continental, based no doubt on variety of national temperament ; the distinctive features of the latter being use of arms and "unemployed" leg, and the bending of the knee, which in the English school are rigidly forbidden. The foreign school was founded by Jackson Haynes, an American professional and accomplished dancer, and is the more shovry and seemingly the more graceful, the English being the more severe and the more self-restrained, but bolder and stronger, having for its object not an individual display, but perfect skating in combination. There are, of course, local modifications, the strictest exponents of the English school being the Davos and St Moritz skaters, while the Continental varies from the complete abandon of the French to the more restrained style of the Germans ; Canadians cultivate also grape-vines and other two-footed figures. The essential features are, however, identical. Thus Englishmen consider of secondary importance loops, cross-cuts, continuous and hand-in-hand skating, though such figures are included in the 1st class test of the N.S.A., and devote themselves mainly to "combined figures." Combined figures have been defined as "symmetrical execution of a figure by one or more pairs of skaters." Originally known as the "skating club figures," they have been gradually developed, and in 1891 delegates from the principal clubs established a regular terminology. The ideal

number of skaters for a combined figure is four, though sixes and eights are seen, one being chosen ” caller ” of the movement to be skated. Various sets of ” calls ” are arranged at the discretion of different clubs, and consist ordinarily of “turns” and “changes.” The N.S.A. offer a challenge shield for an annual competition in combined figure-skating. There has of late, however, been a marked tendency towards unification of style, through Englishmen adopting Continental methods, rendered almost a necessity by the circumscribed area of artificial rinks. In 1901 the Figure Skating Club was established for this purpose, and its members attained such success that an English lady, Mrs Syers, gained the second place in the world’s championship competition in 1902, and with her husband won the International Pair Skating.

Continental .skating culminates in the annual raueting for the amateur championsliip of the world, which was won by Herr Grenander (Stockholm), 1898, Herr G. Hii<,'cl (Vienna), 1899 and

1900, and Herr U. Salchow (Stockholm), 1901 and 1902. The competition consists of two parts, (a) compulsory figures, (5) free skating, the latter ati’ording scope for the performance of dance steps and brilliant individual figures, such as the ‘ ‘ sitting pirouette, ” of which Herr Hugel is master, and the “star,” consisting of four crosses (forward rocker, back loop, back counter), invented by Herr Engelmann and splendidly rendered by Herr Salchow.

As in speed-skating, important professional meetings are almost non-existent.

The skates used for the English and Continental styles differ in radius, though both are of the same type, i.e., a blade fastened to the boot by sole-plates, the ‘ ‘ Mount Charles ” pattern being the one generally adopted by Englishmen. The English radius is 7 ft., or now more usually 6 ft. ; the foreign, 5 J or even 5 ft., and the result is seen in the larger curves skated on the former, and the greater pace obtained owing to decreased friction ; at the same time, the difficulty of making a turn is greater. The English skate has generally right-angled edges and blade of same thickness throughout, except in the “Dowler” variety, which is thicker towards the

extremities. The foreign skate is sometimes thicker in the middle than at the ends.

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Skeat, Walter William (1835), EngUsh

philologist, was born in London, 21st November 1835, and educated at King's College, Highgate Grammar School, and Christ's College, Cambridge, of which he became a fellow in July 1860. In 1878 he was elected Ellington and Bosworth Professor of Anglo-Saxon at Cambridge. He completed Mitchell Kemble's edition of the Anglo- Saxon Gospels, and did much other work both in Anglo-Saxon and in Gothic, but is perhaps most generally known for his labours in Middle EngUsh, and for his standard editions of Chaucer and Piers Plowman. As he himself generously declared, he was at first mainly guided in the study of Chaucer by Henry Bradshaw, with whom he was to have participated in the edition of Chaucer planned in 1870 by the University of Oxford, having declined in Bradshaw's favour an offer of the editorship made to himself. Bradshaw's perseverance was not equal to his genius, and the scheme came to nothing for the time, but was eventually resumed and carried into effect by Professor Skeat in an edition of seven volumes, the last of which was pubUshed in 1897. He also issued an edition of Chaucer in one volume for general readers, and a separate edition of his Treatise on the Astrolabe, with a learned commentary. His standard edition of Piers Plowman was pubhshed in 1SS6, and, besides the Treatise on tlie Astrolabe, he edited numerous books for the Early English Text Society, including 'Barbour's Bruce and the romances of HavelocJc the Dane and William of Palerne. For the Scottish Test Society he edited The King's Quair, usually ascribed to James the First of Scotland, and he published an edition of Chatterton, with an investigation of the sources of the obsolete words employed by him. In pure philology Professor Skeat's principal achievement is his Etymological -English Dictionary, the most

important of all his works, which must be considered in connexion with the numercus publications of the English Dialect Society, in all of which, even when not edited by himself, he had a hand as the society's director and afterwards its president. He is also the author of a work on the principles of English etymology, and of a volume of essays entitled A iStvdent's Pastime, besides minor matters too numerous to mention. No modern scholar has laboured more assiduously, or produced a larger amount of first-class work.

Skeg^neSS, a popular bathing-resort in the South Lindsey, or llorncastle, parliamentary division of Lincoln- shire, England, 20 miles north-east of Boston. Since 1873,

when railway connexion was given with Firsby on the Lincolnshire loop line, the place has undergone a complete transformation, and possesses now broad tree-shaded streets, a marine promenade, public gardens, good hotels, a cricket ground, golf links covering 400 acres, and a long pier, opened in 1881. There are broad, firm sands, on which account Skegness is much visited. On bank holidays and similar holidays several thousands of excursionists are poured over the sands from the manufacturing towns of Yorkshire, Nottinghamshire, Derbyshire, Leicestershire, and Lancashire. Since 1894 it has been governed by an urban district councU. Population of the urban district

(1891), 1488; (1901), 2140.

Ski en, a seaport town of Norway, county of Bratsberg, on the south coast, on the river Skien, 5 miles below its issue from Lake Nord, and 6 miles above its outflow into Frier Fjord. It has been mostly rebuilt since a fire in 1886. Here Henrik Ibsen, the dramatist, was born in 1828. In 1892 a canal, nearly 50 miles long and ascending 189 feet by means of 15 lochs, was made between Lakes Bandak and Nord. In the town and district are numerous saw- mills, planing-, cotton-spinning-, and flour-mills, factories for wood-pulp, furniture, ironmongery, paper, bleaching-

powder, calcium carbide, tobacco, hosiery, shoes, butter, candles and soap, also a copper mine (at Om^al). The total trade approximates to half a million sterling (??173,000 in 1887); the exports being ice, timber (telegraph poles for the British Government), wood-pulp, and copper, and the imports coal and china-clay. In 1898 the port was entered and cleared by vessels of an aggregate of 123,100 tons. Population (1891), 8979; (1900) 11,343.

Skin. See Pathology : Shim.

SkiptOn, a parish and market-town in the SHpton parliamentary division of Yorkshire, England, on the Aire, 18 miles north-east of Bradford by rail. Science and art schools have been erected. There are extensive woollen and cotton factories, and, in the neighbourhood, a large limestone quarry. Area of township (an urban district), 4245 acres. Population (1891), 10,376 ; (1901), 11,986.

SkobelefF, iVIiciiaei Dimitri^vitch

(1843-1882), Eussian general, was born near Moscow

on 29th September 1843. After graduating as a staff

ofiicer at St Petersburg he was sent to Turkestan in 1868

and, with the exception of an interval of two years,

during which he was on the staff of the Grand Duke

Michael in the Caucasus, remained in Central Asia until

1877. He commanded the advanced guard of General

Lomakine's column from Kinderly Bay, in the Caspian, to

join General Verefkin, from Orenburg, in the expedition

to Khiva in 1874, and, after great suffering on the desert

march, took a prominent part in the capture of the Khivan capital. Dressed as a Turkoman, he intrepidly explored in a hostile country the route from Kliiva to Igdy, and also the old bed of the Oxus. In 1875 he was given an important command in the expedition against Khokand under General Kaufmann, showing great capacity in the action of Makram, where he outmanoeuvred a greatly superior force and captured 58 guns, and in a brilliant night attack in the retreat from Andijan, when he routed a large force with a handful of cavalry. He was promoted to be major-general, decorated with the order of St George, and appointed the first Governor of Fergana. In the Turkish war of 1877 he seized the bridge over the Sereth at Barborchi in April, and in June crossed the Danube with the 8th Corps. He commanded the Caucasian Cossack Brigade in the attack of the Green Hills at the second battle of Plevna. He captured Lovtcha on 3rd September, and distinguished himself again in the desperate fighting on the Green HiUs in the third battle of Plevna. Promoted to be a lieutenant-general, and given the command of the 16th Division, he took part in the investment of Plevna and also in the fight of 9th December, when Osman

Pasha surrendered, with his army. In January 1878 he crossed the Balkans in a severe snowstorm, defeating the Turks at Senova, near Schipka, and capturing 36,000 men and 90 guns. Dressed with care in white uniform and mounted on a white horse, and always in the thickest of the fray, he was kno'WTi and adored by his soldiers as the "White General." He returned to Turkestan after the war, and in 1880 and 1881 further distinguished himself in retrieving the disasters inflicted by the Tekke Turkomans, captured Geok-Tepe, and, after much slaughter, reduced the Akhal-Teke country to submission. He was advancing on Askabad and Kalat i-Nadiri when he was disavowed and recalled. He was given the command at Minsk. In the last years of his short life he engaged actively in politics, and made speeches in Paris and in Moscow in the beginning of 1882 in favour of a militant Panslavism, predicting a desperate strife between Teuton and Slav. He was at once recalled to St Petersburg. He was staying at a Moscow hotel, on his way from Minsk to his estate close by, when he died suddenly of heart disease on 7th July 1882. (e. h. v.)

Skopin, a district town of Eussia, in the government of Eyazan, 23 miles by rail from Ryazhsk junction. It is a very' old town, which is now a great centre for trade in corn, hemp, oil, meat, cattle, and salt exported to Moscow, and in hardware goods imported both from the capital and from Nijni-Novogorod. It has several flour-mills, oil-miUs, tanneries, and soap-works. Population (1897), 14,737.

SkOWliegan, a town of Maine, U.S.A., capital of Somerset county. It is on the river Kennebec 35 mUes above Augusta, and on a line of the Maine Central Eailroad. Using the ample water-power furnished by the river, it has manufactures of varied character. Population (1880), 3869; (1900), 4266, of whom 480 were foreign- born.

Skra.ni, Erik. See Danish Litbeatuee.

Skye, the largest island of the Inner Hebrides, Scotland, lying between 57 1' 12" and 57 42' 39" N. and 5 38' 50" and 6 47' 8" W. The sheep farms include some of the finest in Scotland, carrjring famous stocks. The crofters succeed best with turnips and potatoes. Since the passing of the Crofters Act in 1886, the old black huts have been

largely replaced by well-built houses in those parishes where stone is obtainable, and more attention is being paid to cleanhness in the home. The opening of an extension of the Highland EaUway has brought the fishing grounds somewhat closer to the markets. In 1899 the value of the fish caught in the Skye district was ►►159,988. Diatomite is found in the island, and is used for the manu- facture of explosives. A stone pier has been bmlt at Broadford. There is a fever hospital, a court house and resident sheriff-substitute, and a tweed factory, at Portree, near which tovra stands the combination poorhouse of the island. Population of the island (1891), 15,705 ; (1901)

14,608.

Slagelse, a town of Denmark, county Soro, island of Zealand, 58 mUes by rail west-south-west of Copen- hagen. It is one of the oldest towns of the kingdom, and was mentioned in the 12th century. In the vicinity are the ruins of the Knights Hospitallers' monastery of Ant- vorskov. Population, (1880), 6076; (1901), 8958.

Si at in a, chief town of the district of Olt, Rumania, 87 miles west of Bucharest, on the river Olt or Alutha.

It has nine churches, of which the most remarkable is that of St Jonascu. The town is very ancient. Population (1895), 6500 j (1900), 8028.

Slaughter-House, or Abattois. ►►► in the United Kingdom slaughter-houses are of two kinds, those which belong to individual butchers and those which belong to public authorities ; the former are usually called private slaughter-houses, the latter public slaughter-houses. Private slaughter-houses in existence in England before the passing of the Public Health Act, 1875, were established without licence by the local authority, except in those towns to which the provisions of the Towns Improvement Clauses Act, 18-i7, relating to slaughter-houses, were applied by special Act. By the Act of 1875 these provisions were extended to all urban

districts. Subsequently to 1890 urban authorities adopting Part III. of the Public Health (Amendment) Act of that year could license for limited periods of not less than one year all slaughter-houses coming into existence after such adoption. In London, slaughter-houses have been licensed since 1855. Private slaughter-houses are frequently situated at the rear of the shop in which the meat is sold. Each consists of a compartment in which the animals are killed, and in association with this are the pounds in which a few animals can be kept pending slaughter. These buildings are regulated by by-laws made under the Public Health Act by the several urban sanitary authorities. The by-laws usually provide for the floor to be made of jointless paving, to ensure that the earth shall not be fouled in the process of slaughtering ; for the walls to be cemented to a certain height above the floor, to provide a surface which can be easily cleaned ; for the doors to be of sufficient width to enable cattle to enter the slaughter-house without difficulty ; and for the poundage to have floor-space sufficient for each animal. These by- laws also provide for water-supply to the slaughter-house for cleansing, and to the pounds for the use of the animals, for the periodical lime-whiting of the premises, and for the observance of care to prevent the blood escaping in|;o the drains. Private slaughter-houses, especially those which were established without licence, are often in too close proximity to inhabited buildings. In towns in which by-laws are not strictly enforced they are often sources of nuisance. Private slaughter-houses are also objectionable on other grounds. They lead to the driving of cattle through the towns on the way to the slaughter-house, sometimes to the danger of the inhabitants, and they render impossible any systematic inspection of meat. It is in connexion with the increasing demand for such meat-inspection that the objections to private slaughter- houses are most manifested ; and hence, in countries in which the law provides for the obligatory inspection of meat, private slaughter-houses are ceasing to exist, and public abattoirs are being substituted for them.

Public slaughter-houses are of great antiquity and owe their beginnings to Eoman civilization. In .300 B.C. animals were slaughtered in the open air in the Forum in Rome. Later, to meet the convenience of butchers, a house on the river Tiber was given to them for the purposes of their trade. This house had been occupied by a Roman citizen named Macellus. The

building appears to have retained his name, and hence the maccUifm of Livy's time subsequently enacted in the Forum, which, inter alia, is believed to have contained rooms for tlie slaughter of animals. The rooms actually used for slaughter were lanii'iiii', from laniare, but t\v: word mareUum has been |iresrrvod in the Italian niacellare, to slaughter, and in the German tnetzgen or mct^jieln, and in the English mas!-acre.

Public.

Public slaughter-houses existed in many large towns of Germany in mediaeval times under the name of Kuttelhofe ; they were mostly situated on the rivers, which provided an ample supply of water, and afforded means for the removal of the blood which drained into them. Some of these Kuttelhofe continued to exist vidthin recent years. No law other than a town law governed their establishment and management. They were owned or controlled by the butchers' corporations or gilds, but all butchers were not members of the gilds ; and this appears to have led to a ministerial order in Prussia in 1826, which made it inadmissible to require every butcher to slaughter in them. Shortly after the middle of the 19th century the prevalence of trichinosis compelled a return to the use of public slaughter-houses ; and the en- actment of laws in 1868 and 1881 in Prussia, and similar laws in other German states, empowered urban authori- ties to require that all animals killed in towns should be slaughtered in pubHc slaughter-houses. (Schwarz, Bau, Einrichtwng und Betrieb offentlicher Schlacht- utuI Viehhbfe.)

In France, in the 15th and 16th centuries, numerous towns were provided with public slaughter-houses. It was required that they should be used by all persons killing animals the flesh of which was to be sold ; but their position and the conditions they created were such as urgently to demand amelioration, and some effort was made in this direction in 1567. It was not, however, until the time of Napoleon I. that it was decided that the atrocious nuisance which these slaughter-houses created should be removed. By decrees passed in 1807 and 1810 public slaughter-houses were required to be provided in all large tovsms in France, the needs of Paris being determined by a Commission, which recommended the establishment of five abattoirs or public slaughter-houses. In 1838 the

requirement that public slaughter-houses should be provided in large centres was extended to all towns in France, and it was further required that the slaughter-houses should be situated at a distance from dwelling-houses. In 1867 the large abattoir of La Villette was constructed to meet the needs of Paris, two of the five constructed under the decrees of Napoleon being closed. In 1898 the additional abattoir of Yaugirard was opened, and the remainder of the five were closed except Villejuif, which was restricted in its use to the slaughter of horses for human food.

For other countries the position may be more briefly stated. In Belgium public slaughter-houses have been pro- vided in all the large and many of the small towns. In Switzerland there are public slaughter-houses in nearly all places having more than two thousand inhabitants. In Italy a law of 1890 required that public slaughter-houses should be erected in all communities of more than six thousand inhabitants. In Austria a law of 1850 required the provision of such places in all the large and medium-sized towns. In Norway and Sweden a law of 1892 required the provision of public slaughter-houses ; but in Norway there is as yet only one, at Christiansund, and in Sweden there are none, though they are proposed at Stockholm, Gothenburg, and a few smaller towns. In Denmark there are public slaughter-houses in a few towns, including Copenhagen. In Russia, Spain, and Portugal some have existed fOr a number of years. It is in Germany, however, that the greatest progress has been made, and e.'ipccially in Prussia, where Professor Ostertag, of Berlin, states they have " literally grown out of the ground " {HavdI/ncli der FJeischbeschau) ; so much so that in 1897 there were .321 public slaughter-houses in the kingdom, 40 of which were provided in the period

1895-97.

In England tlio power to provide public slaughter-houses

was given by the Public Health Act, 1848, to the local authorities of cities, towns, boroughs, &c., to which the Act was applied by Order; and later,

was given to all urban sanitary authorities by section 169 of the Public Health Act, 1875. These authorities have, however, suffered from the disadvantage that they have had no power to control the continuance of private slaughter- houses (except in so far as these were annually licensed), and they have therefore been unable to ensure that the public provision would be used by the butchers. In Ireland and Scotland much the same powers exist; but in Scotland, if the burgh commissioners provide a public .slaughter-house, no other slaughter-house can be used. Some English local authorities have obtained in local Acts powers similar to those possessed by the burgh commis- sioners in Scotland. The need for still wider control is, however, manifest. Belfast may be cited as an illustration of a town in which a public slaughter-house has been

provided, and in which there are no private tions"' slaughter-houses, but which receives a quantity

of meat from private slaughter-houses erected beyond the boundaries of the city. The outcome of these difficulties is that the power of local authorities to provide public slaughter-houses has been but sparingly used. There is no law requiring that meat shall be inspected before sale for human food, hence there is no obUgation upon butchers to make use of public establishments for the slaughter of their cattle. This, indeed, is the position of some of the Continental slaughter-houses ; but the increasing strictness of the laws as to meat-inspection, and especially in requiring that all animals shall be inspected at the time of slaughter, is making the use of public slaughter-houses obligatory. Such a law now exists in Belgium, where it has served as a model to other countries. An Imperial German law of 1900 extends to all parts of that country the same requirement, and enacts that " neat cattle, swine, sheep, goats, horses, and dogs, the meat of which is in- tended to be used for food for man, shall be subjected to an official inspection both before and after slaughter." Antecedent to that year it wa,s in force in southern Germany, in Brunswick, and Saxony, but only in some parts of northern, western, and central Germany. A similar law exists in Norway and Sweden, but, as already stated, provision of public slaughter-houses is still want- ing; in Austria-Hungary there is a similar requirement, but Ostertag states that the administration is lacking in uniformity; in Italy, he writes, the

regulation of meat-inspection having been left to provincial authorities, thorough reform is impossible. In the British colonies advance is being made. The Meat Supervision Act of Victoria empowers the Board of Health to make regula- tions for ensuring the wholesomeness of meat supplies. Regulations have been made for Melbourne. Cattle are killed in public slaughter-houses and the carcases are stamped, thus showing in which slaughter-house they have been killed.

The planning and construction of public slaughter-houses have been the subject of excellent treatises by German writers, among whom may be mentioned Dr Oscar Sehwarz, of Stolp, Construe- ^^^ j^ j^^g ^^^ Osthoff, city architect, Berlin, to whose works the author of this article is largely indebted for information. After inspection of the public slaughter-houses in England and in a number of Continental cities, the writer considers that those of Germany are most deserving of description.

The slaughter-house should be situated outside the town, or so placed as to be isolated, and approached by wide roads, so that if cattle are driven through them there should not be interference with the traffic. If possible, the slaughter-house should be con- nected with the railway system by a branch line, with a platform which has an impervious surface capable of being readily cleansed and disinfected. The most convenient shape of the site is a rectangle or square, having one side abutting on the principal road and another side bounded by the railway. A cattle-market is

usually provided in connexion with the slaughter-house, and the position should be such that cattle brought by train can be taken immediately into the cattle-market and from the market or the railway to the slaughter-house. The cattle-market should be entirely separate from the slaughter-house area. Osthoff states (SchlacMhOfe fiir kleine xmd mittelgrosse Stadte) that the area of the slaughter-house should be as follows : ???

Sq. Metres. Townsof 5,000- 7,000 inhabitants . 0 -40 jjer inhabitant.
??? 7,000-10,000 ??? . 0-35 ???

??? 10,000-50,000 ??? . 0-30 ???

,, over 50,000 ??? . 0-25 ???,,

It is of course assumed that the population derives the whole of its meat-supply from this source.

The parts required, according to Dr Oscar Sehwarz, are : (1) an administrative block ; (2) a slaughtering-hall, with a sjiecial room for scalding swine ; (3) cattle lairs ; (4) room for scalding and cleansing tripe and intestines ; (5) an engine-house ; (6) separate slaughtering- room, with lairs for animals suttering from, or suspected to be sutfering from, contagious disease.

In small towns the slaughtering-hall and room for cleansing intestines may, to save cost of constraction, be under the same roof. A necessary adjunct is a cold chamber, to which carcases can be removed from the slaughtering-hall. The actual slaughter- ing compartment has been built on two plans ––– one, providing a separate slaughtering-room for each butcher ; the other, a common slaughtering-hall. The latter is greatly to be preferred, inasmuch as it is the only arrangement which gives adequate opportunity for inspection by the officials whose duty it is to examine the meat. The slaughter-house in Berlin was constructed on the separate-room system ; but the writer was informed, when visiting it a few years ago, that it was intended to reconstruct it, on account of the difficul- ties of inspection of which it was the cause. During recent years iu Germany the practice has been to construct slaughter-houses with common halls. The part occupied by each butcher at the time of slaughtering is, however, sufficiently distinguishable, and at Hamburg the position of the hooks hanging from above divides the hall into separate areas, each of which has an entrance from without. Sehwarz gives the following as the most convenient arrangement of the buildings : ––– The administrative building (with the house of the superintendent) at the entrance, so that from it the entrance and whole place can be seen. In the vicinity should be ––, weighing- machine for cattle. The centre of the area is occupied by the slaughtering-halls, and the lairs belongiug to them only separated from them by a road or passage way. The manure-house and tripe-house must be easOy accessible from all the slaughtering- halls, but not in direct communication with them, or smell from them may enter the hall.

The manure-house must abut upon a road, to enable its contents to be removed without passing through the premises. Next to the tripe and pig-scalding houses is the engine-house. The build- ing for diseased animals, with the slaughter-house for them, must be isolated from all other buildings. All buildings should be so arranged that they may be capable of extension as the population of the town increases. By the provision of grass plots and trees every effort should be made to relieve the premises of the dreary appearance they will otherwise present.

Gold chambers, although not included among the absolute essentials for small slaughter-houses, are an almost necessary adjunct, for they serve for the preservation of the meat alter slaughter, and are indeed absolutely necessary when the slaughter-house is of large sjze. The cold chamber should be situated opposite the slaughtering- halls, so that carcases can be conveyed by overhead carriers directly . from these halls to it. Within the cold chamber are separate com- partments or cages of different sizes, rented by butchers, who are thus able to preserve their meat and draw upon their supply as their business may require. The cold chamber is therefore a great convenience to the butchers, and is a source of profit to the authority owning the slaughter-hovise. A frequent adjunct to large German slaughter-houses is the "Freibank," at which is sold at low price cooked meat of quality which renders it unfit to be sold under ordinary conditions.

Much depends upon the design and details of construction of the several component parts of a public slaughter-house, upon the provision of adequate lighting and ventilation of the buildings, upon the construction of walls, floors, and fittings which are impermeable and can be readily cleansed, and upon the provision of an abundant water-supply. It is essential that the buildings should be well lighted, especially those which are used for the slaughtering operations, or for any detailed examination of meat which may be needed??? such, for instance, as for trichtaEe. The material generally used for the floor of the slaughtering-hall is cement or granolithic pavement, which must not present so smooth a surface as to be slippery. The floor must have an adequate fall, so that the washings may discharge into a system of drainage.

SLAUGHTE R-H 0 U S E

The plans of the public slaughter-house of Neusalz on the Oder and of Dtisseldorf well illustrate the provision which is now made respectively for a small and for a large town. The writer is indebted to Dr Schwarz for the plan and a description of the slaughter-house at Neusalz. It was completed in October- 1899,

The figures giye TneasurenLents in metres . Fia. 1. Plan of Public Slaughter-House at Neusalz on the Oder (1899).

and is erected on the Oder below the town, on land of an area of 8500 square metres. The building has been carefully planned by the town architect, Herr Brannaschk, so as to admit of increase within the next 10-20 years. Brickwork is used for the construc- tion of the buildings, and the roofs are wood and cement. The walls of all the rooms except those of the administrative block are lined partly with polished stone, partly with cement, to a height of two metres above the floor. The floors consist of stone slabs set in cement (Fig. 1).

The administrative block {A) is situated at the entrance and is a three-storey building, containing an office, a roon;i for examination of meat for trichiuje, and dweUiug-rooms for the superintendent. In the central block {B) two slaughter-halls are provided (a) for swine and (6) for cattle and sheep. “With these are associated (c) an engine-house, (i) a boiler and fnel room, (e) a workshop, (/) a passage communicating with the two slaughter-halls, {g) a cold chamber, {h) ante-rooms to the cold chamber, (i) dressing-rooms for assistants, and (i) stabling. The cold chamber has an area of 169 square metres and contains 28 cells of various sizes. In order to attain an even temperature of 2 G. to 4 C, air rendered cold by the ammonia process is conveyed to the room by channels. In the

engine-house (c) are a 48-horse-power engine, the cooling machines, and the water-pump, which pumps water from a well into two cisterns situated in a water-tower over the passage between the two slaughter-halls. In the outbuilding [C) are (a) and (6), the gut- washing rooms for cattle and swine respectively, (c) an ante-room with {A) openings for manure to be thrown into carts. The road (e) slopes downwards, so as to enable a cart to be driven below the openings through which the manure is discharged. In the out- building (-D) are (a) a horse slaughtering-room, (&) a stable, (c) a bathroom, (i) a room in which the floor washings axe treated chemically or by filtration before discharge into the river, and (e) a urinal In the outbuilding {E) are (a) a stable for sick animals, (J) a slaughter-house for diseased animals, (c) a sterilizing-room for meat to be subsequently sold in {d) the "Freibank," (e) a stable for horses, and (/) a cart-shed. The slaughter-honse is to be lighted -with electric light. The cost of the buildings is about ►►19,000, and provides for a population of from 20,000 to 25,000 inhabitants.

The slaughter-house at Dtisseldorf is on n. more extensive scale.

Fro. 2.►►► Plan o(Public Slaughter-House and Cattle-Market, Dusseldorf (1898).

S L I G 0

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It was erected at an estimated cost of from ►►162,000 to ►►175,000, and covers an area of about 23 '2 acres. Provision is made for each department to be practically doubled in size. It is unnecessary to describe it in any detail, but it may be noted that it has a market associated with it, and that separate slaughter-halls are pro- vided for large cattle, for small cattle (sheep and calves), and for swine (Fig. 2). The population of Diisseldorf was 212,949 in

1900.

The average cost of slaughter-houses in Germany is given by Osthoff, of Berlin {Randbuch dar Hygiene), as 7 to 8 marks per inhabitant if no cold

chamber is provided, and from 10 to 12 marks per inhabitant if there is a cold chamber, or, in more detail, as follows : ???

Number of Inhabitants.

Odst of Slaughter-house per Inhabitant, in Marks.

Without Cold Chamber.

With Cold Chamber.

5,000-6,000. 6,000-8,000. 8,000-15,000. 15,000-20,000.

Over 20,000.

8 7 6 7 8

12 10 9 10 10

Slaughter-houses in Germany pay their own expenses, the fees received lor the use of the slaughter-house, and for examination of meat and stamping after examination, providing a sufficient sum for this purpose. The fees vary in different places. From the works of Osthotf and Schwarz it would appear that these fees avei'age about one pfennig per kilogramme of the living animal, or about half a farthing per lb of meat.

In Chicago and certain other western American cities large num- bers of cattle are slaughtered and the meat prepared for trans- mission to all parts of the world. The important feature of these slaughter-houses is their adaptation for rapidly dealing with the animals which they receive. At the Chicago slaughter-houses the cattle to be slaughtered are driven up a winding viaduct, by which, in certain of the houses, they eventually reach the roof. Each animal now passes into a narrow pen, where it is at once stunned by a blow on the head. It then falls through a trap-door in the pen into an immense slaughtering-room, where the hind legs are secured, and the animal hoisted by a wire rope suspended from a troUey- line. A knife is then plunged into its throat and the carcase made to travel along the line. The carcase is next lowered to the iloor, the hide taken off,

*the head and feet cut off and the internal parts removed. The carcase again travels along the trolley-line to a place where it is divided into halves, which then, after washing, travel to the refrigeration-room, being trimmed while on the way. The extent of the business may be judged by the fact that over 400 cattle are killed per hour in the slaughter- ing-room. The oooling-rooms are so large that 13,000 halves of beef hang there at one time. The method of dealing with slieep is very similar. The animals are driven 'into narrow alleys, then into the slaughter-room, where their throats are cut. They next travel along a route where their skins and the internal organs are removed, and finally pass into the cooling-rooms. Swine are raised in the slaughter-room on to the troUey-line by a chain attached to the animals' feet and to a solid disc or wheel, which in revolving carries them until a mechanical contrivance throws the chain upon the trolley-Kne where a knife is plunged into their throat. In its subsequent passage the carcase is scalded, scraped by "**machine through which it passes, later decapitated, the internal parts removed, and the interior washed. The carcase then travels to the ooohng-room.*

The use of public slaughter-houses has not been found to affect the price of meat, although one of the numerous arguments used by butchers against being required to slaughter in public slaughter- houses was that they would have this effect. The increasing recognition in European countries of the need for inspection, at the time of slaughter, of the flesh of all cattle intended to supply food- for man, the necessity for the provision of public slaughter-houses to make such inspection practicable, the convenience which these slaughter-houses afford to those engaged iu the business of butcher, combine to ensure that, at any rate in aU populous places, they will in time sntii'ely supersede private slaughter-houses, which offer none of these advantages.

No doubt the provision of public slaughter-houses wiU continue to be opposed by the butchers' trade so long as private slaughter- houses are permitted, and, as already stated, local authorities in England are discouraged from making public provision by their inability to prevent the continuance of the use of all exist- ing private slaughter-houses. Probably the extension to English local authorities of the power which the law of

Scotland gives to the commissioners of Scottish burghs of closing private slaughter-

houses when "❓❓❓ pubUo slaughter-house has been provided, would facilitate the much-needed substitution of public for private slaughter-houses. (s. P. M.)

Slig'O, a maritime county of Ireland, province of Con- naught.

Population. ❓❓❓ The area of the administrative county in 1900 was 442,205 acres, of which 73,364 were tillage, 236,818 pasture, 82 fallow, 7123 plantation, 35,716 turf bog, 6517 marsh, 65,382 barren mountain, and 17,203 water, roads, fences,

Males.

Females.

Total.

Percentage.

E.G.

Pr. Ep.

Presb.

Meth.

Eead and write . Eead only Illiterate

29,729 4,458 9,615

29,387

4,989

10,131

59,116

9,447

19,746

64-7 11-2 24-1

88-8 5-5 5-7

92-5 3-6 3-9

94-4 2-9 2 ‘7

*The percentage of illiterates among Eoman Catholics in 1‘881 was 33‘3. In 1891 there were 8 superior schools, with 296 pupils (Romau Catholics 189 and Protestants 107), and 226 primary schools, with 15,061 pupUs (Eoman Catholics 13,629 and Protestants 1432). The number of pupils on the rolls of the national schools on 31st De- cember 1900 was 15,776, of whom 14,407 were Eoman Catholics and 1369 Protestants. The following table gives the number of births, deaths, and marriages in various years : ***

Tear.

Births.

Deaths.

Marriages.

1881 1891 1900

1999

2011

689

1157

1394

350

281 316 286

In 1900 the birth-rate per 1000 was 20-1 and the death-rate 16‘1 ; the rate of illegitimacy was ‘4 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 74,658, of whom 35,413 were males and 39,245 females. The only town of any importance in the county is Sligo, which in 1891 had a population of 10,274, and in 1901 of 10,862.

Administration. ❖❖❖ The county is divided into two parlia- mentary divisions. North and South, the number of registered electors in 1901 being respectively 8281 and 7570. The rateable value in 1900 was ❖❖213,457. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were trans- ferred to a county council, urban and rural district councils were established, and under that Act the county now com- prises 1 urban and 4 rural sanitary districts.

Agriculture. ❖❖❖The foUowing tables show the acreage under crops, including meadow and clover, and the amount

648

SLIGO ❖❖❖ SMALL ARMS

of live stock in 1881, 1891, 1895, and 1900. The figures for 1900 are for the new administrative county : ❖❖❖

Year.

1

1

i

‘S

m

a o

S

1881

324

25,907

1091 22,485 3362

1736

34,959

89,864

1891

387

17,892

726

16,382

2959

2225

33,534

74,105

1895

290

17,753

747

16,557

3184

2041

38,702

79,274

1900

288

14,388

697

14,658

2492

2859

37,982

73,364

For 1900 the total value of the cereal and other crops was estimated at ??488,295. The number of acres under pasture in 1881 was 225,099; in

1891, 240,301; and in

1900, 236,818.

Year.

Horses and Mules.

Asses.

Cattle.

Sheep.

Pigs.

Goats.

Poultry.

345,071 359,244 40.2,447 434,844

1881 1891 1895 1900

8638 9024 9438 7720

7806 8835 9045 9727

89,238 93,376 94,460 96,351

59,837 88,228 75,474 72,572

18,934 24,748 27,441 29,042

4074 6980 6393 6785

The number of milch cows in 1891 was 31,298, and in 1900, 31,374. It is estimated that the total value of cattle, sheep, and pigs for 1900 was ??1,383,087. In 1900 the number of holdings not exceeding 1 acre was

824 ; between 1 and 5, 1381; between 5 and 15, 5589; between 15 and 30, 4337; between 30 and 50, 1597; between 50 and 100, 781 ; between 100 and 200, 298; between 200 and 500, 129; and above 500, 35 ??? total, 14,971. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901, was 683, amounting 'to ??128,957. The number of loans for agricultural improvements sanc- tioned under sec. 31 of the Land Act, 1881, between 1882 and 1901 was 512, and the amount issued ??34,633. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commence- ment of operations in 1847 to 31st March 1901 was ??139,932.

Fisheries. ??? In 1900, 159 persons were employed in the salmon fishery district of Sligo.

SligfOi a maritime town, capital of the above county, on the river Garavogue, 137 miles north-west of Dublin by rail. Under the Local Government (Ireland) Act, 1898, it retains its mayor and corporation, but has practically the status of an urban district council. In all 740 vessels, of 107,060 tons, entered in 1900, and 607, of 66,012 tons, cleared. Population (1891), 10,274; (1901),

10,862.

Sliven, or Slivno, the chief town of a department in Eastern Rumelia, Bulgaria, near an important defile of the Balkans called the Iron Gate, 100 miles east-north- east of Philippopolis. Its black wine is still famous. Thoroughly modern machinery has been introduced into the Government factory, which employs about 300 hands ; and the cloth manufacture for the army equals that of any other European country. Bulgarian home-spuns (" shayak ") are also manufactured, and there is a small trade in silk. The general trade in staple articles is large. There is an important higher class school, with 40 professors and attended by about 800 pupils. Population (1892), 2.3,210; (1900), 24,542, of whom nine-tenths are Bulgarians.

SlObOdskOi, a district town of Bussia, in the government and 20 miles to the north-west of Vyatka, on

the river Vyatka. It was founded in 1546 and is now a growing town. It has distilleries, match and glue works, tanneries and breweries, and carries on a brisk trade, chiefly in oats, flax, linseed, and wooden ware. Population

(1897), 10,052.

Slocum, Henry Warner (1827-1894),

American soldier, was born in Onondaga county, New York, 24th September 1827, and graduated at the United States Military Academy in 1852. He resigned in 1856 to practise law at Syracuse, N.Y. When the Civil War broke out he became a colonel (May 1861) of the 27 th New York volunteers. He fought through the Virginia campaigns (1861-63), as brigadier and then as major- general of volunteers. In the west, in 1864, he occupied Atlanta in September, and led the left wing through Sherman's march of invasion. He resigned from the army, September 1865, resumed professional practice at Brooklyn, and was chosen to Congress, 1868, serving three terms. He died at Brooklyn 14th April 1894.

SlOUg'h, a market ~~town in the Wycombe parlia~~ mejitary division of Buckinghamshire, England, 18 miles west of London by rail, and 2 miles north of Windsor. The Leopold Institute is a memorial of the Duke of Albany. The town has been formed into a civil parish (an urban district), comprising the parish of Upton-cum- Chalvey and part of Stoke Poges. Area, 1639 acres. Population (1891), 8713; (1901), 11,461.

Sma.ldeel. See Orange River Colony.

Sma.ll Arms. ??? British and Foreign. ??? For a table of the rifles in use up to 1880, a short history of the development of firearms, and a general description of manufacture (the last being much the same at the present time), the reader is referred to the article " Gunmaking " in vol. xi. of the Unci/. Brit, 9th edition. The rifle, however, now in the hands of the soldier, whether British or foreign, differs very greatly from that of 1880, being superior to the latter in velocity, range, penetration, and accuracy; while the cartridges, with which it is loaded, are charged with a

smokeless explosive and contained in a magazine from which they are automatically fed, ready to be at once pushed home into the breech.

The repeating or magazine system, now universally adopted, may be said to date back to about 1840, when the flrst repeating rifle was brought out by ‘ Colt in America. The Henry, Spencer, and [l]””^ Winchester (all American) systems followed, the last-named still holding the field, and being perhaps the proximate cause of the general adoption of the maga-zine in all military rifles ; for in the Russo – Turkish war of 1877-78 some of the Turkish troops were armed with this rifle, and the rapidity of fire obtainable vnth it brought the repeating system prominently forward, with the result that by 1886 all the important Powers, with the exception of the United States, Great Britain, and Russia, had armed their troops with magazine rifles.

These earlier patterns were all of large calibre (that is, not less than “45 inch), being frequently conversions of the single-loaders previously used to avoid the heavy outlay on a completely new armament; but the advantages of a smaller calibre were soon discovered, the earliest experiments in this direction having apparently been originated by Major Rubin in Switzerland in 1883. The smaller calibre brings with it certain distinct advantages, viz., a lighter bullet and smaller charge, and as a consequence a lighter cartridge ; and a higher velocity without undue recoil, since the recoil varies directly as the weight of the bullet and charge. As a consequence of the lighter bullet, the soldier can carry many more

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advaat’ ages.

cartridges than formerly, while the absence of recoil com- bined with a flat trajectory enables him to shoot with far more accuracy and greater prospect of striking his foe. Owing to the trajectory of the British ‘SOS-

inch magazine SmaJl J:i&Q, when firing at an object 500 yards dis-
callbre: tant, never rising more than 4^ feet above the

direct line of sight, the British soldier is taught

always to aim at the feet of his enemy when once he has come within that range, and not to alter his sights as the range decreases, since, if his aim be moderately correct, though he will hit the objective higher and higher up, he will still hit it somewhere. At a range of 350 yards the bayonet is usually fixed, and this always tends to cause low shooting at a time when excitement is apt to make men shoot high. The 500-yard3 sight is therefore termed the " fixed sight." ^

On the other hand, the small calibre has some very definite disadvantages. In order to get the requisite weight, a small-calibre bullet must be much longer propor- tionately than the larger-calibre bullet. The ???303-inch bullet, for instance, weighing only 215 grains, is 1'25 inches long, while the Martini-Henry bullet, "45 inch in diameter and weighing 480 grains, is only 1'27 inches in length ; and this greater length, as compared to diameter, necessitates a much sharper pitch of rifling in order to revolve the bullet suflBciently rapidly to keep it point first. The pitch in the British '303 rifle is one turn in 10 inches,

and in the Martini-Henry one turn in 22 inches. ^'d"*/. Bullets of the hardest lead when fired from ages. barrels with this high-pitched rifling were found*

to " strip," that is, they were forced through the barrel without rotation being impressed on them, their surfaces being torn off. To remedy this, the lead bullet must be encased in an envelope of harder material (the envelope of the British bullet is made of cupro- nickel), and this hard envelope produces some ex- ceedingly important effects. The enveloped bullet has a much higher penetrative power than one of lead only ; but on the other hand there is no doubt that, unless it should happen to strike a large bone (more especially if it should do so when it first enters the body, as it then drives the splinters forwards), it does not inflict nearly such severe wounds, nor has it such a stunning effect as the old lead bullet. The cause is obvious : it cuts a small clean hole and does not deform.

This fact is of great military importance, especially in warfare with savages, in which the chief danger is usually a rush of enormous numbers at close quarters.

A minor disadvantage arises from the fact that the hard envelope wears away the rifling of the barrel more rapidly than lead does ; the latest pattern, British rifle, will, however, fire at least 8000 rounds before being sufficiently worn materially to impair its accuracy, and in ordinary circumstances any rifle vrill become unserviceable from other causes long before that number is fired. The advantages, however, of the small calibre have been judged to outweigh the disadvantages, and it has been universally adopted, the table at the end of this section.)

As already stated, a smokeless explosive has been adopted

universally. It is the natural concomitant of the maga- Smokeless ^^^^ system, and without it the advantages of the latter powaer, yfo^\^ \jq enormously reduced, since in the case of a, rapid fire with the old smoky powders the firer is quickly ‘ This applies especially when accurate range-finding is practically impossible. Of course there are occasions when alteration of sights should be made for short ranges.

enveloped in a cloud of smoke, which, besides betraying his position to his enemy, prevents him from seeing to take aim. France was the first to recognize and take action in this matter, and in 1886 armed her troops with a small-bore magazine rifle firing a smoke- less propellant

Most nations arm their cavalry with carbines. The. carbine generally has the same breech mechanism and fires the same cartridge as the rifle used by the infantry, but is much shorter and is rarely fitted for a bayonet. Italy is an exception, her carbine having a bayonet which folds under the carbine on a hinge. The carbine usually has a wooden hand-guard ei^tending nearly to the muzzle, to enable it to be grasped, when heated by rapid firing, in almost any position, so that the trooper may not be hampered in hurried mounting. The bolt knob is also made to fold down more closely, to be convenient for carrying slung on the back, or in the leather sheath or carbine ” bucket ” on the saddle. (See Figs. 12 and 16.)

Although no nation has yet armed her forces with an auto- matic rifle ___ that is, a rifle in which the recoil, or a portion of the gases of explosion, is used to do the work of opening and closing the breech which is now done by hand ___ it is not because such weapons have not been made to work practically. ^___^o^___a__c There are already some rifles, and more pistols, of this jfigg class before the world, notably the Maxim, "Wood- gate, Mannlicher, Bergmann, and Mauser. A perusal of the article on Maohinb Guns in this work will show the principles on ~~which automatic mechanism can be provided. So far the recoil~~ ing barrel has been mainly utilized. Of course, automatic rifles could not of necessity be so simple or so free from liability to damage as the existing rifles, and they would also probably be slightly heavier. Complication is, however, merely comparative, and many weapons of war which, with reasonable care, are now found to be perfectly serviceable for the roughest campaigning, would have been scouted as wholly unsuitable in the 'seventies. "The gain in rapidity of fire with an automatic rifle should be out of all proportion to that due to merely getting rid of the time taken m working the bolt ; for, with the slight recoil given by the light bullet of the modem rifle (especially if that recoil be largely absorbed in working the mechanism), it would appear possible with an automatic weapon to keep the eye continually on the sights and to maintain the aim, the recovery of aim being at present one of the great factors in the rate of fire, if accuracy be combined with rapidity. On the other hand, the potential waste of ammu- nition would be equally increased, and the rifies would be consider- ably more costly. Looking, however, to the past, it certainly appears more than probable that the adojjtion by any one great Power of the automatic system would force it on all.

British Rifles. ___ The Lee-Metford or Lee-Enfield magazine rifles

Pig. 1.

Fig. 2.

(Se

or carbines, with which the British army and navy are armed, have the Lee breech and magazine mechanism and the Metford or Enfield system of rifling. The latter has superseded the former, as it stands the wear caused by the enveloped bullet more success- fully. Compare Figs. 1 and 2. The various patterns (see General Table) differ only in details ; the principle of the mechanism is the same in all, and they take the same cartridge and bayonet.

The breech (see Figs. 3 to 9) is closed by a bolt I, with bolt- head 0, which slides in a "bolt-way" cut for it in the body B, much as does an ordinary door bolt. When pushed home, and the bolt knob turned down, the bolt is locked, the bolt-liead O

Fig. 4.

Fig. 5.

Fig. 7.

abutting against the base of the cart- ridge. Movement backwards is pre- vented by the rib P being brought in front of the lug Q on the body B, and a projection R (Fig. 6) being turned into the groove S in the interior of the bolt-way. Upward movement is prevented by the bolt being partially enveloped by the bolt- way and the bolt- head fitting into the recess T just in rear of the breech. The bolt contains the striker V and main spring "VV. The former is attached to the cocking-piece X. Supposing tlie bolt fully with- drawn (see Fig. 6) it is clear that as it is pushed forward the toe Y of the cocking-piece X will encounter the nose Z of the trigger sear K ; and if the bolt be then pushed home, the spring W will be compressed, owing to the cocking-piece and striker being held back. If now the trigger

J be pulled, the nose of sear K is depressed and the" striker flies forward and fires the cartridge. When released, the striker can be cocked by pulling out the cooking-piece by hand. If placed on half-cock, the shape of the half- cock notch Z' causes the sear nose to be locked and the trigger cannot be pulled. In the later patterns a safety catch is provided (see Fig. 10), This is a pro- longation (d) of the cocking-piece X carrying a thumb-piece (/). When the latter is turned up, a hulf-round axis- pin (□□) can be turned into either of the semicircular slots (6) or (c) on a prolongation {a) of the bolt I, and tlie cocking-piece is then locked to the bolt. The magazine M is a detachable sheet steel box (see Figs. 3, 4, and 9). It is provided with a platform (A) pushed upwards by a spring (□□). On this platform the cartridges (ten, in two parallel but overlapping columns of five, in the later patterns) rest, the spring (□□) being compressed as the magazine is filled. The tops of the side walls of the magazine are bent inwards, and, while per- mitting the magazine to be filled with cartridges one by one, wQl not allow them to escape until pushed forward about an inch. Pivoted in the body is the "cut-off" or lid {g) (see Figs. 7 and 8). When this is closed, the cartridges in the magazine are kept down clear of the bolt-way.

When using the rifle as a single-loader the cut-off is closed, the bolt is withdrawn, and a cartridge placed on the cut-off and partially in the breech. It is then puslied home by the bolt, and as this is done the claw (Jc) of the extractor rides up over, and hooks on to, the cartridge's rim ; consequently, when the bolt is with- drawn, the cartridge (fired or unfired) is pulled out with it, and is ejected, its base, on the side opposite to that held by the extractor claw, striking against the ejector screw (m) and being thus canted to the right and thrown clear of the rifle (see Fig. 7). It should be noted that, as the bolt is turned for opening, the pro- jection R working in the cam groove S causes the bolt to recede very slightly and to draw back the cartridge correspondingly. Owing to leverage, this first shift can be effected with considerable power in case a cartridge should stick. Once shifted the cartridge case can be readily extracted, as it is coned. This action is termed "primary extraction."

The forward part of the cocking-piece X has i^ stud X', which, in combin:ition with the cam groove 22 and projection 23 on the under side

of the bolt I, performs the function of prevent- ing the rifle from being fired when the breech is not properly closed, and also causes a slight with- drawal of the point of the striker when the bolt is opened. It should be observed in this con- nexion that the cocking-piece X, though it can move longitudinally, cannot turn with the bolt.

To load from the magazine (see Figs. 8 and 9) the cut-off (g) is opened. The cartridges im- mediately rise and a portion of tlie base of the top cartridge (ol) can be engaged by the bolt- head 0 and pushed into the breech. Immediately

foeeign]

fliis cartridge is iired, extracted, 'and ejected, another cartridge rises in front of the bolt ready to be pushed home ; (ol) (o2) (o3) represent the different positions of the cartridge, (ol), as it is pushed from the magazine into the breech.

The bolt, extractor, ejector, safety, and magazine actions, de- scribed above, are much the same in principle in all magazine rifles with box magazines, but the diversity of detail is considerable. The principal feature in which the British rifle differs from others is in the method of filling the magazine. Tlie underlying principle of the British magazine is tliat the rifle shall be normally used as a single-loader, and exceptionally as a magazine weapon, the store of cartridges in the magazine being retained intact for emergencies. Continental Powers, on the other hand, with a few exceptions, have adopted rifles without cut-off, and always load from the

magazine. To fill the latter rapidly the cartridges are carried packed in bundles of from three to six, in sheet metal or card- board receptacles. These receptacles are of two kinds, " clips" or "chargers."

The clip, employed in the Mannlicher system, is used with a magazine with parallel walls, being held down in the magazine against the pressure of the magazine platform spring by means of a spring catch. It has its sides turned over at top and bottom to retain the cartridges until pushed forward some distance by the bolt ; but openings are left through which the magazine platform spring can act on the cartridges, and also to permit the clip to fall out past the platform spring, through a hole in the bottom of the magazine, when empty (see Figs. 13 and 15). The charger, used in the Mauser system, does not enter the magazine, but is placed

*t^fehcloteS^*

Fig. 10.

over the top of the magazine, and all the cartridges in it pushed by one motion into the magazine. A magazine with overlapping walls allowing entry but not exit (except, of course, by the push of the bolt) is necessary with a charger. The Biitish rifle could be adapted easily for loading by charger, if this were considered desirable.

Besides the vertical box magazine systems there are the hori- zontal box and tube systems. The former, the Krag-Jorgensen, is described under the section United States below. The latter, the oldest European magazine system and termed the Kropatschek, consists of a tube under the fore end in which the cartridges lie base to point, being pushed backwards to the breech by means of a long spiral spring. By an extremely neat though intricate meclianism the cartridges are placed one by one on a pivoted carrier (A) and presented in front of the bolt (see Figs. 18 and 19). It is higl% improbable that France would again adopt the tube system in any new pattern of rifle, as it has the following objec- tions when compared with the box system, whetlier vertical or hoiizontal: ??? It is exceedingly cumbrous for an eijual number of

cartridges ; its feed and cut-off mechanism is very complicated ; the balance of the rifle is much more altered as the magazine empties ; the placing of the cartridges base to point, even when the bullet has a flat point, is not unattended with danger, especi- ally when the magazine is

full and the spiral spring strongly compressed ; lastly, loading by any form of charger is practically impossible.

As regards the foreign rifles and cartridges shown in Figs. 13 to 19, their principal features are as follows : ???

Austria-Hungary. ??? Both the 1890 and 1895 patterns have " straight puU" bolts; that is, bolts which are not turned for locking. The bolts are in two parts which "telescope" into each other. In the 1890 pattern (see Fig. 13) when the bolt I is home against the cartridge and the "lever cylinder" I', which carries the bolt knob, is further pushed forward, the hinged block E is caused to drop in front of the resistance piece Q, and so locks the bolt I against the cartridge. In the 1895 pattern (see Fig. 14) the final pushing forward of the lever cylinder causes the head of the bolt I to turn and projections on its head to lock into recesses SS just in rear of the breech. The turning is due to helical feathers (20) on the inside of the lever cylinder I' working in grooves in the rear of the bolt I. The trigger mechanism in the 1890 pattern is the "double pull," much used in Continental arms. It will be seen from the figure that as the trigger is pulled the bear ing is taken first at (8) and then at (9). This gives, owing to the change of leverage, power at the commencement and rapidity at the end of the pull ; and by this means a heavy pull, to give

SMALL ARMS

[BRITISH Aira

Fig. 13.

Fig. 14.

Fig. 15.

Fig. 18.

foreign]

SMALL ARMS

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SMALL ARMS

safety against accidental discharge, is combined with a light pull at the moment of firing. The loading hy clip has been explained.

Germany. ??? The rifle (see Fig. 15) has a turning bolt, projections on the bolt -head being turned into recesses SS in rear of the breech to lock the bolt. The special feature of this rifle is the steel barrel casing A’, which permits the use of a lighter and cheaper barrel, since it protects the latter ; it allows free expansion of the barrel when heated, facilitates equal radiation of the heat into the air-space between the barrel and

casing, and mitigates the evil effects of warping of the stock. There are, however, also very obvious objections to this casing, and it has only been adopted by Germany, Belgium, and JJenmark. The cartridge used is rimless (see Fig. 17). There is a slight.advantage in this class of cartridge in that there is no necessity to make any provision for preventing the rim of a cartridge getting in front of the cartridge next above it. A reference to Fig. 9 will show that a jam would result if this occurred. The Gei-man clip can therefore be put into the rifle either way up, the Austrian clip in only one way.

France. ??? This rifle (see Figs. 18 and 19) caUs for no special remark. Its holt is very similar to that of the British rifle, and its special peculiarity ??? its tube magazine ??? has already been discussed.

The rate of fire with magazine rifles, if we merely reckon the time to load and discharge the rifle, may be taken roughly at ten rounds in about 15 to 20 seconds. This rate is, however, valueless for practical purposes. The only rate worth considering is that of aimed fire. This is roughly about three times that of a single- loader, and at a very easy target ten rounds might be fired with fairly good results in from 30 to 40 seconds.

Description of Figures.

Number of Figure.

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(II.)

I (11.)

Description.

Metfnrd rifling.

Enfield ???

Lee-Metford, Mark I. Section, breech closed, rifle fired.*

,, Side elevations of rifle and bayonet.

,, II. Section, breech closed, full cocked.

,,,,, Side elevation of rifle and bayonet.

,, Side elevation, breech closed, full

cocked.

,, Side elevation, bolt fully withdrawn.

,,,,,, Top plan, bolt open, showing ejection.

{Lee-Metford, Marks 11. and II.\Top plan, showing magazine Lee-Enfield, Marks I. and I. / action.

{Side elevation, and part sec- tion, showing magazine action.

r Lee-Metford, mark II. 1 *^- e^r.e^*-^ <. i,*

JLee-EnHeld, mark I. and i..|Section of safety catch.

Cartridge, all magazine, and '303 inch calibre arms. Part sec- tion and elevation. Lee-Metford or Lee-Enfield carbine, mark I. Side elevation. Austro-Hungarian rifle, pattern 1S90. Section, bolt withdrawn.

,,j,,,,, Side elevation.

,,,,, 1895. Section, breech open.

German rifle, pattern 1888. Section, bolt withdrawn,

,,,,,, Side elevation.

German carbine, pattern 1888. Side elevation. German cartridge. Part section and elevation.

{French rifle, pattern 1886. Section, bolt nearly withdrawn, lired, case about to be ejected, carrier depressed. French rifle, pattern 1886. Side elevations.

* ,, ,, Section, bolt fully withdrawn,*

carrier raised.

Jieference Table for Figures.

N.B. The same letters and figures are used in all the plates to denote similar parts or parts which perform sftnilar functions.

Barrel.

Casing for barrel.

Body.

Butt.

Fore-end,

Hand-guard.

Stockbolt (British rifle only).

Bands securing barrel to fore-end.

Screws securing butt and fore-end

to barrel or body. Rivet securing fore-end to body

(British rifle only). Bolt, Liiver cylinder carrying knob

(Austro-Hungarian riOe only). Trigger. ‘{‘rv^’^fT .sear. ‘J”i-i;j;^pr sear spring. Magazine. Clip for cartridges. Magazine catch or clip catch with

spring. Bolt-head.

P, Bolt rib to strengthen bolt

(British rifle only). Q. Resistance pieces or lugs on body

which take or assist to take

the pressure on flischarge. R. ProJoclionH on bolt wliich lock

against Q or into resistance

grooves S. S. Cam-shaped resistance grooves. T. Recess at breech for bolt-hcjid. U. Groove for hook of buU-hc;ul

(British rifle only). V. Striker.

W, Striker or main spring. X. Cocking-piece attached to striker

X’. Projection on cocking-piece (Fig.

10 only) working in conjunction

with (il^) and (23). Y. Toe of cocking-piece. Z, Nose of trii,^ger soar K. Z’. Half- cork notch on cocking-

pieco X.

(a) Safety-catch projection. W I- Slots on projection (a).

(d) Body of safety catch.

(e) Axis of thumb-piece of safety I

catch. I ,

(/) Thumb-piece of safety catch. J “^ ig) Magazine lid or cut-off (British

rifle), or thumb-piece for action

lever (27) of French rifle. (A) Magazine platform or carrier for

cartridges. (h’) Horns on front of canier (French

rifle only), (fc) Extractor and extractor claw. (I) Extractor spring, (m) Ejector screw or lever.

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Kv I Magazine platform spring.

(ol) Top cartridge in magazine.

(ol) (o2) (o3) Positions of top cartridge

as it is being pushed from the

magazine into the breech, (p) Attachment link of magazine

(British rifle only), (g) Back-sight bed and leaf, (g) Short leaf of back-sight (German*

rifle only). (t-) Fore-sight, (s) Long range back-aght. (0 fore-sight, (u) Bead of (dial) long range \ British

fore-sight. I -g

(y) Aperture of long range (,

back-sight. J ^^’-

(1) Axis of falling block R (Fig. 13

only).

(2) “Wedge of lever cylinder (Fig. 13

only).

(3) Top slot of clip f ?‘l!f;l

(4) Bottom slot of clip “j ^y-C

(5) Front top corner of clip, at which

point the cartridge is freed from the clip (Figs. 13 and 15 only).

(6) Axis of trigger sear.

(7) Axis of trigger. ‘ Points of bearing of trigger

against body with “double pull-off.”

(10) Cartridge stop lever.

(11) ??? ??? ,, spring.

(12) ??? ??? ??? beak.

(13) ???,, ,, axis.

(14) Projection under carrier (A).

(15) ??? ??? bolt-headO.

(16) ,, on top of carrier (Ji).

(17) Long arm of cariridge stop

lever.

(IS) \ Cartridges in magazine (French (19)/ rifle only).

(20) Helical feathers for revolving

bolt-head (Fig. 14 only).

(21) Retaining bolt preventing bolt I

from being entirely withdrawn from body B. In this rifle it is worked by pushing the trigger J forwards (Fig. 14 only).

(22) Cam groove in rear of \ -p. ^

(23) Projection in cam f y.J: groove (22) ; ►►”^-

“Arms of a lever working in con- junction with the action lever (27) for single or magazine loading (French rifle only).

(27) Action lever. \ French

(28) Action lever spring. / rifle only. C Inclined faces on end of action

(29) J lever spindle, working in con-

(30) j junction with action lever \ spring (French rifle only).

(24) (25) (26)

(h. W. e.)

United States.

Rifles. ►►► The United States magazine rifle, calibre “30, model 1892, adopted after exhaustive competitive tests and improved in the models 1896 and 1898, is upon the Krag- Jorgensen system. The fixed magazine for five cartridges is placed horizontally under, and also to the left side of, the receiver. The normal use of the rifle is as a single -loader, a cut-olf allowinar the eartridsres ;^^►►►5”- m the magazine to be held m reserve. The model. main advantages claimed for this reserve maga- zine rifle over a clip ~~loading repeating rifle, designed only for magazine fire, are its convenient use as a single~~ loader, the full reserve of ammunition always instantly available for the supreme moment in an action, the moral support which a knowledge of ^his reserve is pre- sumed to give,

and the restraint upon officers and men produced by the desire to retain it intact until the instant when its expenditure shall produce the greatest efiect. This restraint, however, requires greater fire discipline on the part of the soldier. With guns of the repeating non- reserve type, a slightly more rapid fire can be obtained than from a reserve magazine rifle, but with the disadvantage that, at the very moment when the highest rate of firing is most desired it is probable that the soldier may find his gun either empty or only partially full.

The principal parts of the rifle are as follows : ??? The barrel (B, Fig. 20) is rolled from open-hearth steel of an elastic limit of 70,000 lb and an ultimate tenacity of 120,000 ft) per square inch ; annealed, bored, turned, chambered, tested at a high proof pressure, rifled, finished and oil - tempered to compress the bore initially ; length 30 inches ; rifling, uniform twist, one turn in lb inches ; 4 grooves "004 of an inch deep ; width of grooves, in terms of land, 3. The receiver (R) is a solid forging, machined to shape, having a hole or well to receive the bolt (0), the magazine (M) and a connecting channel enlarged in front so as properly to direct the passage of the cartridge from the magazine into the chamber (C) of the barrel. Excepting this channel, which is to the left, the bottom of the receiver is closed, and affords a smooth surface on which cartridges may be placed when using the arm as a single-loader. Fig. 20 is a sectional view of the operating parts, consisting of tho bolt and magazine mechanism.

The bolt mechanism consists of the bolt (0\ sleeve (V), extractor (X), safety lock (Y), firing pin (F), and striker (K), and main spring (Z). The bolt moves backwards and forwards and rotates in the well-bole of the receiver ; it carries a cartridge, either from the

tr.s.A.]

magazine, or one placed by hand in front of it, into the chamber, and supports its head when fired. The locking lug (L) will sustain any powder

pressure liable to occur. The sleeve unites the parts of the bolt mechanism and directly carries the extractor ; their rotation with the bolt is prevented by their engagement in the opening between the walls of the reoeiyer. The hook of the extractor engages the rim of the cartridge case, and retains the head of the latter in

*Pt^55^*

Fig. 20.

the countersink of the bolt until the case is thrown oat by the ejector (J), operated at the end of the rear movement of the bolt by a groove in tlie under surface of the latter. The safety lock prevents accidental firing of the piece. The firing pin is made of two pieces ??? tlie rod, with its cocking- piece (P) below, and the separate striker (K) easily re- moved for repairs.

The gun having been discharged, to remove the empty cartridge, reload, and fire, the bolt mechan- ism operates as follows : ??? To ojjen the bolt, raise the handle until it comes into contact with the sleeve, then pull directly to the rear until the locking lug strikes the shoulder of the receiver. Raising the handle rotates the bolt and separates the locking lug from the shoulder of its recess in the receiver. This separation is made easy by the slight inclination to the axis of the receiver of the vertical planes containing the rear surface of the locking lug and the shoulder of the recess. This rotation of the bolt causes a cocking cam on its rear under surface to force back the cocking- pieee and firing pin, withdrawing the point of the striker and])iirtially compressing the main spring (Z). Closing the bolt by a reverse motion compresses the main spring and cocks the piece completely, seats the cartridge in the chamber, and forces the extractor hook over the rim of the cartridge case. Pulling the trigger (T) releases the sear (S) and allows the firing pin and striker to move forward and strike the primer, firing the cartridge.

The magazine mechanism (Figs. 21 and 22) includes the gate (G), carrier (A), follower (W), magazine spring (N), hinge bar (H), and cut-off (U). Fig. 21 represents a cross section of the gun through the point of ejector, the bolt closed, the magazine filled and " off."

magazine is “off” (see Fig. 21). The point of the cut-off spindle then bears on the rim of the upper cartridge and holds it down in the magazine channel below the action of the bolt. The magazine mechanism then remains inoperative, and the arm can be used as a single-loader, the cartridges in the magazine being held in reserve. The stock with hand-guard is of walnut. The sight is graduated up to 2000 yards and provided with adjustment for windage, and jointed ramrod and oiler are carried in a hole in the butt. The bayonet is of the knife pattern and is carried in a metal scabbard with hook for attachment to woven cartridge belt Tiolding 100 cartridges ; weight of belt and cartridges, 7‘4 lb ; weight of gun, 9”2 lb. The United States magazine carbine, model 1899 (see Fig. 23) is practically the same as the rifle, using the same cart- ridge, giving about 80 feet per second less velocity. The stock and mountings are different, the barrel 22 inches long, and the total weight about 8 K).

The ball cartridge (see Fig. 24) consists of the case A, the bullet B, the primer C, and the charge of smokeless powder D. The bullet has a core of tin and lead composition, jacketed with cupro- nickel steel, weight 220 grains, velocity, fired in the rifle, 2200 feet per second. The maximum pressure is about 48,000 16 per square inch.

Forty-two aimed shots have been fired in two minutes with the arm, used as a single-loader, and 43 shots in the same time, using magazine. The maximum range is about 4400 yards. The penetra- tion in white pine at 53 feet from the muzzle is about 56 ‘5 inches.

Fig. 21.

Fig. 22.

Fig. 22 shows the same cross section, when all but the last cartridge have been fired; the magazine is “on “and the bolt opened.

To charge the magazine, open the gate, by revolving it to the right on the hinge bar pin (see dotted lines, Fig. 21), insert the cartridges hy hand or from a quick-loader, and then close the gate. As the gate is opened the carrier is retracted, leaving an unobstructed openingfor the insertion of the cartridges. As the gate is closed the magazine spring swings the

carrier into the magazine against the last cartridge inserted. When the thumb-piece of the cut-off is turned up the magazine is "on " (see Fig. 22). The spindle of the cut-off is then in its hole in the upper wall of the magazine channel and permits the top cartridge to rise high enough to be caught by the bolt in its forward movement. As the bolt is closed, this cartridge is pushed forward through the magazine channel and well of the receiver into the chamber, the point of the bullet being directed by a ramp on the receiver. "When the cut-off thumb-piece is turned down the

Fig. 23.

The infantry and foot artillery of the army are armed with the rifle, and the cavalry with the carbine ; both of them passed successfully the crucial test of field service in the Spanish -American war. In addition to the ready use of the United States njagazine rifle either as a single-loader with magazine in reserve or as a magazine arm, the following mechanical advantages are claimed for this gun : ??? (1) The mechanism requires but little force to operate. The first portion of the motion of unlocking the bolt and starting the empty cartridge shell, the final seating of the cartridge, and the locking,

Fig. 24

are accomplished by a motion of rotation, bringing into play the assistance offered by cams on the bolt and receiver. The compression of. the main spring is given in the same manner, and not by a direct forward push of the hand against the main spring ; (2) The locking lug which supports the bolt at discharge is at the forward end, with two supplementary supports in the nature of a rib and a lug farther to the rear ; (3) The cut-off can be easily seen by the squad leaders and operated with full, partially full, or empty magazine ;

(4) The magazine is readily charged or replenished with ?? single cartridges, or loaded by charging packets or quick-loaders, but these devices do not constitute any essential part of the mechanism ???

(5) The magazine can be charged whether the bolt is opened or closed, and whether the gun is adjusted for magazine or single- loader fire ; (6)

The bolt is in a single piece, without any sejiarate holt-head ??? the extractor does not rotate with the bolt ; (7) If the holt he not entirely closed upon pulling the trigger, the action of the main spring closes and securely locks the bolt before the firing pin can reach the primer ; (8) In case of miss-fire the piece is cocked either by turning the handle up and down rr by puUino- the firing pin directly to the rear by means of its thumb-piece ; (9') The mechanism is simple, strong, and composed of few parts, assembled with a minimum of screws or pins. The bolt can be readily removed and the bolt and magazine mechanisms easily dis-mounted or assembled without the use of special tools.

The United States magazme rifles and carbines, sabres and swords, are made at the Springfield Armoury, Spring- field, Massachusetts, established in 1795. The capacity of the armoury is 500 magazine rifles per day. A small- arms plant of about the same size is being installed at Eock Island Arsenal and Armoury, Eock Island, Illinois.

[tj.s.a.

Both these armouries are under officers of the ordnance department of the army. The national guard is armed ???with the Springfield rifle and carbine, calibre '4.5, mostly- model 1884. The model 1888 has a ramrod and bayonet combined.

The breech mechanism of the Spritig field rifle consists of a receiver or frame, and a breech lock which rotates around a hinge pin per-pendicular tto the bore of the gun, above the bore and in front of the block. Fig. 25 represents a section of the breech mechanism by a vertical plane through the axis of the receiver, with the several parts projected thereon, showing their relative position.

Fig. 25.

The barrel (B) is screwed into the receiver (A). The principal parts of the breech mechanism are the breech block (D), the hinge pin (E), the cam latch (F), the cam latch spring (G), the extractor (J), and the ejector spring and spindle (K). The breech block has an oblique hole through it for the firing pin (H). The hinge pin hole is elongated in the direction of the axis of the bore. The hinge pin passes through two holes in the lugs in the receiver. The cam latch locks the breech block in firing by entering a circular recess in the breech screw (C). The axis of the cam shaft projects on the right side, and to it is attached a thumb-piece, by which the cam latch is operated. This axis fits loosely. The extractor is mounted on the hinge pin, and part of its extremity is cut into such shape as to form, when in place, a part of the counterbore of the chamber, in which the rim of the cartridge rests. To load, the cartridge is inserted in the chamber in advance of the face of the breech block, when the block can be closed and locked (Fig. 26). When the piece is fired the breech block moves bodily slightly to the rear, owing to the elongation of the hinge pin hole. Owing to this motion of the block and to the loose fit of the cam latch shaft in its hole in the block, the pressure of the powder gas is transmitted directly through the breech block and the body of the cam latch to the breech screw, and there is no strain on the hinge pin or cam

*Fig. 26.**Action Closed.*

latch shaft. The bearing of the cam is above the centre of the breech screw, the resistance of which tends to press the rear end of the breech block downward and forward under pressure of the powder gases. The block is opened by pressing the thumb-piece forward, which disengages the cam latch from the recess (Fig. 27). When the block has nearly completed its upward rotation it strikes against the projecting lug of the extractor and rotates the latter slowly, ~~‘ thus partly extraoting the empty cartridge case. When the rear end of the ejector spindle passes below the axis of the hinge pin, the extractor becomes an ejector, and, with accelerated motion, completes the withdrawal of the shell and throws it against the ejeotor stud (L) and out of the gun. The Springfield rifle, without bayonet, weighs 9‘3 lb; the carbine, similar in con~~ struction, 7 ‘9 K>. The rifle cartridge consists essentially of a rim brass case, a lubricated bullet weighing 600 grains, and a charge of smokeless powder

substituted for the 70 grains of black musket powder formerly used, giving the same velocity, 1316 feet per second, and about the same pressure, 25,000 pounds per square inch.

For uniformity the United States navy and marine corps

have adopted the "Army Magazine Rifle," calibre '30, which will gradually replace the United States navy rifle, model 1895, calibre 6 millimetres (approximately 0'2362).

This latter arm is known as the Lee straight-pull rifle, and Is essentially a rapid-fire or repeating arm, rather than a magazine gun, since there is no provision for cutting off the supply of ammunition from the magazine and using the arm as a single-loader while the magazine contains cartridges. It may be used as a single- loader if the magazine be not charged, but in general it will be used as a repeater, five cartridges in a clip being entered in the magazine and the gun not being loaded until the charge is exhausted. In case loose ammunition is furnished, the magazine may be charged with single cartridges, any number from one to five being entered.

The motion of the hand, while not strictly "straight-pull," is such in effect that the operator makes no motion other than in a

Fig. 27. ??? Action Open.

direction straight to the rear, the shape of the cam and the cam seat causing the rear end of the bolt to rise in the first part of the motion, carrying the hand with it. The extraction of the cartridge case is accomplished by the motion to the rear of the extractor, a hook-shaped piece moving in a groove on the left side of the receiver and acted upon by a flat spring. The extractor does not move to the rear until the bolt has moved about If inches, when the front lug on the bolt strikes it and draws it to the rear with a sudden jerk. The ejection of the cartridge case is accomplished when the bolt has been fully drawn to the rear by the tail of the extractor striking the bevelled front face of the bolt-stop, which arrests it suddenly and imparts to it a quick, short, transversfr motion, which ejects the empty case. The retraction of the firing pin is caused by the first

motion of the lever handle, which brings the nib of the lever handle to bear against the cocking toe of the firing pin and pushes it to the rear, the bolt during this time having' practically only an upward motion of its rear part. At the same time the nib of the lever handle .slips into a notch in the cocking toe of the firing pin, preventing any forward motion of the firing pin with respect to the bolt. The cocking of the firing pin is caused by the sear arresting the forward motion of the firing pin (in closing- the breech) while the bolt moves on, compressing the main spring. The locking lug is part of the bolt, and is a rectangular lug on the under face. In closing the breech, in the final motion of the bolt (which is down), the locking lug is seated and bears against a corresponding shoulder in the lower part of the receiver. In open- ing the breech, the first motion of the bolt is upward, raising the bolt so that the locking lug clears the shoulder and the bolt can move to the rear. Safety devices are provided to prevent the bolt from being opened until the piece is fired, and to lock the firing pin when the gun is cocked.

Cartridge. ??? A cannelured cartridge, weight about 309 grains, having a charge of 33 grains of smokeless powder and a hardened lead bullet, with a copper jacket plated with tin, weighing 112 gi-ains, is used. The maximum chamber pressure is 49,000 Ife per square inch. The bullet has a velocity of 2550 feet (777'24 metres) per second at 60 feet from muzzle, with the consequent advantage of a very flat trajectory. The weight of the loaded belt>

Fip. 28. ??? Action closed.

containing 180 cartridges in 12 pockets of 3 clips each, is about 9|lh.

The Winchester repeating rifle, ealihre '30, model 1895, is a fixed box magazine lever-action gun (Figs. 28 and 29).

U.S.A.]

SMALL ARMS

The receiver, open at the top, permits the symmetrical lockings of the breech-bolt. The first opening motion of the lever with- draws the trigger from contact with the sear, before the gun is

*to meet the demand on the part of Mexico and Central and South American countries for a simple system for certain troops (Fig. 31). The Savage ***magazine rifle, model 1899, is a "hammerless," lever – action repeating arm, with a revolving cartridge carrier in a fixed magazine under the receiver for five rimmed cartridges, charged one at a time by hand. It can be used readily as a single-loader (Figs. 32 and 33).*

The magazine is charged while the system is open. The finger-lever (A) is opened to its fullest extent (see Fig. 32). The cartridges are inserted into the magazine by pushing them down and under the catch (B) on the automatic cut-off (C). A sixth cartridge can be placed in the breech-opening (D) above the catch (B). On closing the finger-lever (A) the cartridge in tha

*Fig. 29. *** *Action open.*

unlocked, so that it is impossible to fire the gun except when fully locked. The continued open- ing motion of the lever draws down the locking bolt and withdraws the breech-bolt, cocking the gun and ejecting the cartridge or fired shell. The breech-bolt, passing over the hammer, presses the firing pin lock against the latter, and makes fast the firing pin. When the breech-bolt is in its rearmost position, the hammer is made to hold it open by contact, so that the magazine may be easily loaded. When in this position, the npper cartridge in the magazine is so presented as to engage the breech-bolt.

The closing action of the lever carries forward the breech-bolt, forcing the cartridge out of the magazine into the chamber. After the breech-bolt has reached its closed position, the locking bolt is lifted into place, first locking the gun and afterwards unlocking the firing pin. The final closing movement of the lever presents the trigger against the sear, leaving the

gun in position for firing. The magazine, of the box type, contains five cartridges, and the number in the magazine can always be known by opening the gun, if light serves, or by feeling, if light fails. The magazine follower presents the cartridges to the lower front edge of the breech-bolt in position to be forced into the chamber, and is arranged to prevent the escape of the cart- ridge following before the preceding one is in the grasp of the extractor, thus preventing the jamming of the gun by false move- ment.

The Remington-Lee rifle (see Fig. 30) is a box magazine rifle, arranged to load with a filler or clip containing five cartridges. It is manufactured to fire the '30 calibre army, the 6 millimetre navy, and other small-calibre smokeless cartridges.

This rifle is also made of the same general form, with a flat cut-

Fig. 30.

off which can be pressed in, forming a false bottom for the receiver, so as to convert the gun into a single-loader, or with detachable magazines, a number of which, filled with cartridges, can be carried in a belt, so that the rifle can be used as a repeater for rapid con- tinuous fire. The Remington Armoury, at Ilion, N.Y., also manu- factures the single – loader small-bore rifle for smokeless powder.

Fig. 32. ◆◆◆ Action Open.

breech-opening (D) will be carried forward by the breech-bolt (E) into the chamber of the barrel, making the rifle ready to fire.

In using the rifle as a single-loader, the placing of a cartridge in the breech-opening (D) forces the automatic cut-off (C) back into its recess in the receiver, retiring the uppermost cartridge in the magazine below the line of movement of the breech-bolt (E), so that only the cartridge in the breech-opening will be engaged by the breech-bolt on its forward travel. For magazine fire, there being no cartridge in the breech-opening (DJ, but one or more ^ cartridges in the magazine, the breech -bolt (E)

on its forward travel, will engage and carry forward into the barrel chamber the uppermost cartridge in the magazine. The automatic cut- ofl' (C) has on its face a projection which ejects the fired shells, after being withdrawn by the extractor (F) on the breech ~~bolt (E). The numerals on the magazine carrier (G) show, through the opening in the receiver, the number of cart~~ ridges contained in the magazine. The breech- bolt (E) is positively operated by the finger-lever (A), without any intermediate mechanism, and when closed, ready for firing, is immovably locked by the finger-lever resting on a solid projection at (H) in the receiver. The recoil of the discharge is supported at (U), and is in the direct line of the strain. The breech-bolt (E) carries the extractor (F), a retractor (L), the hammer (IS), the main spring (0), and indicator (Y). The firing mechanism is operated as follows : ❑❑❑ If the rifle has been fired the act of opening the finger-lever, and thereby the breech-bolt, loi-ks a retractor (L) by engagement with the sear pin (P), and the hammer (N, with firing pin) is positively retracted and held back from the

face of the breech-bolt. The closing movement of the breech-bolt brings the hammer (N) in engagement with the face of the sear (K), compressing the main spring (0), and the rifle is fully cocked. The

Pig. 33. ❑❑❑ Action closed.

action can be locked by pushing forward the lock (V), which locks the trigger and lever. The indicator (Y) shows the position of the firing mechanism.

Revolvers. ❑❑❑ The Colt's double-action revolver, calibre '38, model 1896, is used in the United States axmy. The United States navy revolver, calibre '38, model 1895, is practically the same arm. The revolver can be

cocked by hand before each fire, or the cocking and firing can be accomplished by simply pulling the trigger.

The revolver consists of the barrel (B), the cylinder (C) with six chambers, the frame (F), and the firing mechanism, all of steel. The muzzle velocity with a charge of 16 grains of black powder and a bullet of 150 grains of lead, is about 708 feet per second, giving at 25 yards a penetration of about 5 inches in pine. Eighteen shots can be fired in 44 seconds, loading each chamber

Revolvers,

Fig. 34.

separately, and beginning and closing with cylinder closed and chambers empty (Figs. 34 and 35).

The lock mechanism consists of the hammer (h), with its stirrup (r), stirrup pin {p), strut (s), strut pin (i), strut spring [g] ; the trigger (t) ; the rebound lever (l) ; the hand (a), with the spring (z) ; the cylinder bolt (b), with its spring {x) ; the locking lever

the cylinder in position at the time of firing. An abutment on the side plate supports the hand spring in rear. The spring ensures the engagement of the hand with the ratchet (t/). The revolver is cocked by hand by withdrawing the hammer by the pressure of the thumb until its full-coek notch engages in the rear sharp comer of the trigger. Pulling the trigger then releases the hammer, allowing its firing pin (/} to move forward and strike the cartridge.

The locking lever is pivoted by its screw in a recess in the leftside of the frame, and so connected with the latch that it locks the hammer and trigger when the latch is pushed to the rear for opening the cylinder, and does not unlock them untQ the cylinder is positively closed and is locked by the latch. The cylinder revolves and is supported on a central arbour of the crane (E). The crane fits in a recess in the frame below the barrel and turns on its pivot arm (A).^ The ejector rod with its spring passes through the centre of the cylinder arbour and is terminated in rear by the ejector

with a ratchet {y). Pushing against the front end of the ejector rod will empty the chamberSj the cylinder being swung out for loading. The thumb-piece of the latch (j) slides to the rear in the left side of the frame, unlocking the cylinder for opening, but upon closing the cylinder, the body of the latch firmly enters a recess in

Fig. 35.

the ejector, locking the cylinder in position for firing. The barrel is firmly screwed to the frame. The Smith and Wesson revolvers are essentially of the divided frame type, the barrel and cylinder tipping downwards on a pivot in the lower forward part of the frame, at the time of loading the cartridges or ejecting the shells. The ejection is automatic.

Tke Colt Automatic Pistol, calibre 'SS. ??? The action of this pistol is semi-automatic, tlie trigger being slightly pulled for each shot fired. The magazine being charged with cartridges and in position, the first cartridge is loaded into the barrel by pulling the slide to the rear, and fired by pulling the trigger, when the operations of extract- ing the empty cartridge case, reloading a new cartridge into the barrel, and cocking the piece, are performed auto- matically.

The pistol (Figs. 36 and 37) consists of four main parts : the frame (F), the barrel (B), the slide (S), and the magazine (M). The frame

Fig. 36.

forms, at its rear and lower part, the handle (A), which is hollow, and contains the seat for the magazine. After being charged with seven cartridges, the magazine is seated from below and held in place by the magazine catch (tc), which slightly projects from the bottom of the handle. This projection serves to release the magazine from the catch, when it can be readily drawn from the

liandle for re-charging. In front of the handle is the trigger guard {g), in which the trigger {t) is found, and in the rear and above the grip the firing mechanism is placed in the part of the frame called the receiver (R). Tlje firing mechanism consists of the hammer (A), the sear {w), the trigger (t), a safety device (a), the main spring (s) and sear spring (??), the lo\Yer part of the latter serving to operate the magazine catch. The top of the receiver extends forward from the handle, and to it the barrel is attached by two short links, one (I) near the front end of the barrel, and the other (o) at its rear end ; these links are pivoted to the receiver and also to the barrel, and allow the barrel to swing rearwards thereon. As both links are of the same length, the rearward movement of the barrel in swinging on these links carries the barrel slightly downwards, but keeps its longitudinal axis in parallel positions during all its movements. Below the barrel the receiver forms a tubular seat for the retractor spring (r), which iji front is closed by a plug {u) fastened in the receiver by the lower pivot-pin (i) of the front barrel-link. The upper surface of the receiver and two longitudinal grooves on its sides form the seat for the slide which is guided thereon in its rearward and forward movements. The rear part of the slide forms the bolt or breech block (K), and the front part forms a partly tubular cover (s) which encloses the barrel. In the forward part of the receiver is a transverse mortice extending through the retractor spring seat, and transverse re- cesses in the forward part of the slide serve to admit a key (m) which, passing through the sides of the slide and through the mortice, serves to lock the slide to the frame. The retractor spring (r), in its seat in the frame, consists of a spiral spring, the rear enil of which rests against the receiver, and the front end of whii.h

Pig. 37.

carries a piston {p). The rear face of the key (??n) has a slight re- cess, and when tlie key is in its place the front end of the retractor spring rests in this recess, thereby confining the key laterally. The tension of the retractor spring is exerted to force the key and the slide to their forward position. Upon the barrel are provided three transverse ribs (J), and in the interior of the slide are three corresponding recesses. These serve to lock the barrel and the slide firmly together when in their forward position. Between the locking recesses and the bolt, the slide has an opening on its

right side for the ejection of the cartridge cases (J), and the bolt is provided with an extractor, a firing pin (/), a firing pin retraction spring (q), and a firing pin lock [y). This latter is pivoted at the rear end in the top of the slide, and when depressed, locks the firing pin in its retracted position, thus preventing its point from coming in contact with the cartridge primer. "When raised, the firing pin lock releases the firing pin, and in this position also serves as the rear sight, being provided on the top with a sighting notch.

The operation of the pistol is as follows : ??? When a charged magazine (M) is inserted, the slide (S) is drawn once to the rear by hand, thereby cocking the hammer {h). 'In this position of the slide, the carrier (c) and carrier spring in the magazine raise the topmost cartridge so as to bring it into the path of the bolt (K). On releasing the slide, it, with the bolt, is carried forward by the retractor spring (r), and during this movement the bolt forces the topmost cartridge into the barrel (B). As the slide approaches its forward position the front of the bolt encounters the rear end of the baiTel and forces the latter to its forward position. During this forward movement the barrel swings forward and upward on the links {I, o), and thus the locking ribs (i) on the barrel are carried into the corresponding locking recesses in the slide. The barrel a,nd slide are thereby positively interlocked, and the pistol is ready for firing.

A slight pull on the trigger {t) now serves to move the sear (w) so as to release the hammer (A) and fire a shot. The force of the powder gases driving the bullet from the barrel is exerted rear- wardly against 'the bolt, and, overcoming the inertia of the slide and the tension of the retractor spring, causes the slide and the barrel to recoil together. Aftflr moving rearwards together, for a distance, enough to ensure the bullet having passed from the barrel,

the downward swinging movement of the barrel releases the latter from the slide and stops the barrel in its rearmost position. The momentum of the slide causes the latter to continue its rearward movement, thereby again cocking the hammer and compressing the retractor spring, until, as the slide arrives at its rearmost posi- tion, the empty shell is ejected from the side of the pistol and another cartridge raised in front of the bolt.

During the return or forward movement of the slide, caused by the retractor spring, the cartridge is driven into the barrel, and the slide and barrel are interlocked, thus making the pistol ready for another shot. These operations may be continued f-o long as there are cartridges in the magazine, each discharge requiring only the slight pull on the trigger. The pistol is provided with a safety device (a) which makes it impossible to pull the trigger so as to release the hammer unless the slide and barrel are in their first forward position, and safely interlocked. (j. T. T.)

Smart, Henry (1813-1879), English organist and musical composer, born in London, 26th October 1813, was the son of a violinist, and nephevi^ of Sir George Smart. After studying for the legal profession, Smart turned to music and worked with W. H. Kearns. In 1831 he became organist of Blackburn Parish Church, where he ???^vrote his first important work, a Eeformation anthem; then of St Giles's, Cripplegate; St Luke's, Old Street; and finally of St Pancras, in 1864, which last post he held at the time of his death, 6th July 1879, less than a month after receiving a Government pension of ??100 per annum. Although Smart is now known chiefly by his compositions for the organ, which are numerous, effective, and very melodious if not strikingly original, he wrote many vocal works, including some of the best specimens of modem part songs. His cantata The Bride of Dunkerron was written for the Birmingham Festival of 1864; Jacob for Glasgow, in 1873 ; and his opera. Bertha, was produced vidth some success at the Haymarket in 1855. In the last fifteen years of his life Smart was, to aU intents and purposes, blind.

Smell. See Physiology, Special Senses.

Smetana, Friedrich (1824-1884), Bohemian

composer and pianist, was born at Leitomisohl, 2nd March 1824. He made such rapid progress in his studies under Ikavec, at Neuhaus, that at the age of six he appeared in public as pianist so successfully that his father's opposition to a musician's career was overcome. He then went to Proksch, at Prague, until, a spirit of restlessness seizing him, he left for Leipzig to make the acquaintance of Schumann and Mendelssohn. Limited means prevented him from studying with the latter, and he returned to . Prague, where he at once became Konzert-meister to the

Emperor Ferdinand. In 1848 he married Katharin Kolar, pianist, and with her founded a music school at Prague. At the same time he met Liszt, who subsequently influenced him greatly, and with whom he afterwards stayed at Weimar. In 1856 Smetana accepted Alexander Dreyschock's suggestion to go as conductor of the Phil- harmonic Society at Gothenburg. There he remained five years, when, owing to his wife's ill-health, he returned to Prague after a successful concert tour. The death of his wife at Dresden on their return, caused Smetana to change his mind, and he went back to Sweden. But the opening of the Interims Theater in 1866, and the offer of its con- ductorship, induced his return. In Sweden he had already written Hahon Jarl, Richard III., and Wallenstein's Lager, and had completed his opera Die Brandetiburger in Bohmen (5th January 1866). Five months later it was followed by his best-known opera. Die Yerhaufte Braut, and in 1868 Dalibor was given. Between 1874 and 1882 he produced Zwei Witiven, Huhicka (Der Euss), Tajewstvi (Das Geheimniss), Certova Stena, and Die Teufelsmauer, as well as the " grand prize " opera Libuse, written for the opening of the National Theatre at Prague, 11th June

1881. In Die Teufelsmauer were clear signs of decay in Smetana's powers, he having already in 1874 lost his sense of hearing. To celebrate his sixtieth birthday a fSte was arranged by the combined Bohemian musical societies ; but on that day Smetana lost his reason and was removed to a lunatic asylum, where he died, 12th May 1884. A great deal of his pianoforte music is interesting, the Stammfyuchbldtter, for example ; while his series of symphonic poems, entitled Mein Vaterland (Vlast), and his beautiful string-quartet, Aus meinem Lehen, have made the tour of the civilized world. He was an admirable pianist, and in many ways justified his countrymen's title of the " Czechish Beethoven." (e. h. l.)

SmethwiCk, a municipal borough (1899) in the Handsworth parliamentary division of Staffordshire, England, 3 miles west of Birmingham by rail. Among modern buildings are two Established churches and a Roman Catholic church. Victoria Park (35 acres) was

opened in 1888, and West Smethwick Park in 1895. Area, 1872 acres. Population (1891), 36,170; (1901),

54,560.

SmichOW, chief town of a government district in Bohemia, Austria, on the left bank of the Moldau, opposite Prague, with which it is connected by a bridge and in which it is now practically merged. Population (1890), 32,646; (1900), 47,094, mostly Czech.

Smiles, Samuel (1812), British author,

was born at Haddington, 23rd December 1812. He was educated there and at Edinburgh University, where he studied medicine ; and for some years practised as a sur- geon at Haddington. Abandoning the medical profession he took to journalism, and from 1838 till 1844 edited the Leeds Tirnes. Though he gave up regular journalism in 1844, he continued to be a frequent contributor to periodicals. From 1845 till 1854 he was secretary of the Leeds and Thirsk Railway, and from 1854 till 1856 of the South-Eastern Railway. In 1857 he published a Life of George Stephensmi, which was the precursor of a series of biographies from the world of industry, such as Lives of the Engineers (3 vols., 1861-62), Industrial Biography (1863), Lives of Boulton and Watt (1865), The Life of a Scotch Naturalist (Thomas Edwards) (1876), Life and Labour (1887), A Publisher and his Friends (a history of the house of Murray, under "glorious John ") (1891), Jasmin (1891), Josiah Wedgwood (1894). In 1859 appeared Self-IIelp, a volume of popular ethics which was very widely read. Its success prompted successors, such as Character (1871), Thrift (1875), Duty (1880). Dr Smiles (who was made hon. LL.D. of Edinburgh University) also published two works dealing with the history of the Huguenots, and a History of Ireland.

Smith, Goldwin (1823), British historian,

educational reformer, and publicist, was born at Reading on 13th August 1823. He was educated at Eton and Magdalen College, Oxford, and after an undergraduate career of exceptional brilliancy was elected to a fellowship at University College. A Liberal in his outlook, not only on

politics but on every aspect of life,, he threw his keen' intellect and trenchant style into the cause of university reform, the leading champion of which was another fellow of University College, Arthur Penrhyn Stanley. On the Royal Commission of 1850 to inquire into the reform of the university, of which Stanley was secretary, he served as assistant-secretary ; and he was secretary to the com- missioners appointed by the Act of 1854. His position as an authority on educational reform wan further recognized by a seat on the Popular Education Commission of 1858.

In 1868, when the question of reform at Oxford was again growing acute, he published a brilliant pamphlet, entitled The Reorganization of the University of Oxford. Besides the abolition of tests, effected by the Act of 1871, many of the reforms there suggested, such as the revival of the faculties, the reorganization of the professoriate, the abolition of celibacy as a condition of the tenure of fellow- ships, and the combination of the colleges for lecturing pur- poses, were incorporated in the Act of 1877, or subsequently adopted by the University. Among those that have not yet found favour are " the creation of a responsible department of government with adequate powers for the visitation of endowed institutions," to which would be transferred all powers now vested in the Privy Council or in the Visitors of Colleges, " with regard to the amendment of statutes or the appropriation of revenues " ; the abolition of religious tests in the theological faculty, and its conversion into a department of unfettered research; the conferment only of real degrees ; the election of the vice-chancellor by congregation ; the abolition of the Hebdomadal Council, and what he calls " the most indispensable though perhaps the most difficult reform," the abolition of the Convocation of non-resident graduates. He gave the counsel of perfec- tion that " pass " examinations ought to cease ; but he recog- nized that this change " must wait on the reorganization of the educational institutions immediately below the University, at which a passman ought to finish his career." His aspiration that colonists and Americans should be attracted to Oxford has been realized by jMr Ehodes's will. On what is perhaps the vital problem of modern education, the question of ancient versus modern lan- guages, he pronounces that the latter "are indispensable accomplishments, but they do not form a high mental training " ??? an opinion entitled to

peculiar respect as coming from a president of the Modern Language Asso- ciation. The same conspicuous openness of mind appears in his judgment, delivered after he had held the regius professorship of Modern History at Oxford from 1858 to 1866, that "ancient history, besides the still unequalled excellence of the vsriters, is the best instrument for culti- vating the historical sense." But though penetrated with the sense that all modern intellect and art derive their greatness from Greece and Rome, no man's -m-itings " palpitate with actuality " more than his, nor has any one wielded a more eager weapon on every battlefield of political or social reform.

The multiplicity of his interests, indeed, injured his work as a historian ; he did not, like Gibbon, devote his life to one monumental work that should preserve his fame to future generations. His chief historical writ- ings ??? The United Kingdom : a Political History (1899), and T/ie United States : an Outline of Political History (1893) ??? though based on thorough familiarity with their subject, make no claim to original research. Both are re- markable examples of terse and brilliant narrative, and of the subordination of details to a consistent effect. The United States stands without a rival in its kind ; the United Kingdom naturally challenges comparison with Green's Short History of the English People, but its insistence on the political rather than the picturesque aspect of history, its view of affairs from the arena no leas than from the study, and its fuller treatment of the great problems of the 19th century, make it rather the complement of Green's work than the rival. A peculiar Im-adth of outlook is lent to both his histories by his equal familiarity with the conditions of the Old World and the New. The outbreak of the American Civil War proved a turning-point in his life. Unlike most men of the ruling classes in England, he warmly championed the cause of the North, and by his pamphlets, especially one

entitled Does the Bible sanction American Slavery ? (1863), played a chief part in converting English opinion to what was afterwards universally recognized as the right side. Visiting America oh a lecture

tour in 1864, he received an enthusiastic welcome, and was entertained at a public banquet in New York. In 1868 he threw up his career in England and settled in the United States, where he held the professorship of English and Constitutional History at Cornell University till 1871. In that year he removed to Toronto, where he edited the Canadian Monthly, and subsequently founded the Week and the Bystander. He did not, however, cease to take an active interest in English politics. He had been a strong supporter of Irish Disestablishment, but he refused to follow Gladstone in accepting Home Eule. He expressly stated that "if he ever had a political leader, his leader was John Bright, not Mr Gladstone." Speaking in 1886, he referred to his "standing by the side of John Bright against the dismemberment of the great Anglo – Saxon community of the West, as I now stand agaiflst the dismemberment of the great Anglo – Saxon community of the East." These words form the key to his views of the future of the British Empire. He always maintained that Canada, separated by great barriers, running north and south, into four zones, each having unimpeded com- munication vrith the adjoining portions of the United States, was destined by its natural configuration to enter into a commercial union with them, which would result in her breaking away from the British empire, and in the union of the Anglo-Saxons of the American continent into one great nation. These views are most fully stated in his Canada and the Canadian Question (1891). Though describing himself as " anti-imperialistic to the core," he was yet deeply penetrated with a sense of the greatness of the British race. Of the British empire in India he said that "it is the- noblest the world has seen. . . . Never had there been such an attempt to make conquest the servant of civilization. About keeping India there is no question. England has a real duty there." His fear was that England would become a nation of factory-workers, thinking more of their trade-union than of their country. These forebodings were intensified in his Commonwealth or Empire? (1902) ___ a warning to the United States against the assumption of imperial re- sponsibilities. Among other causes that he powerfully attacked were liquor prohibition, female suffrage, and State Socialism. All these are discussed in his Essays on Questions of the Day (revised edition, 1894). He also published sympathetic monographs on Cowper and Jane Austen, and attempted verse in Bay Leaves and Specimens of Greek Tragedy. ' In his Guesses at the Riddle of Existence (1897), he abandons the faith in

Christianity expressed in his lecture of 1861 on Historical Progress (where he forecast the speedy reunion of Christen- dom on the " basis of free conviction "), and writes in a spirit " not of Agnosticism, if Agnosticism imports despair of spiritual truth, but of free and hopeful inquiry, the way for which it is necessary to clear by removing the wreck of that upon which we can found our faith no more." Particularly characteristic are his two little books, designed primarily as guides for American visitors to England. Oxford and her Colleges, with its blending of complete sympathy and knowledge, stands alone in its way. In A Trip to England he has, with a few masterly strokes, drawn a perfect miniature of English society and English landscape.

Smith, Sir William (1813-1893), lexico- grapher, was the eldest son of William Smith, of Enfield, a Nonconformist. He was originally destined for a theo-

logical career, but instead took up law, and was articled to a solicitor. In his spare time he taught himself classics, with such success that, when he entered University College as a student, he carried off both the Greek and Latin prizes. After pursuing his studies there^ he obtained a post at University College school, and at the same began to write on scholarly subjects and pubhsh editions of the classics. He next turned his attention to that branch of work for which he is chiefly known ??? the collection of information in lexicographical form. His first attempt was the Dictionary of Greek and Roman Antiquities, which appeared in 1842. The greater part of this was written by himself. In 1849 followed the Dictionary of Greek and Roman Biography, and the Greek and Roman Geography in 1857. In this work some of the lead- ing scholars of the day were associated with him. In 1850 he published the first of the school dictionaries; and in 1853 he began the Principia Series, which marked a distinct step in the school teaching of Greek and Latin. Then came the Students Manuals of History and Literatwre, in which the Greek History was the editor's own work. In carrying out this task Smith was most ably seconded by Murray, the publisher, who, when the original publishers of the dictionaries got into difficulties, volunteered to take a share in the undertaking, and con- tributed largely to the great success attained by these encyclopaedic volumes. The most important, perhaps, of the books

edited by William Smith were those that dealt with ecclesiastical subjects. These were the Diction- ary of the Bible (1860-65), the Dictionary of Christian Antiquities (1875-80), undertaken in collaboration with Archdeacon Cheetham ; and the Dictionary of Christian Biography (1877-87), jointly with Dr Wace. The Atlas, on which Sir George Grove collaborated, appeared in 1875. All these books have become standard works, and the Dictionaries of ‘ the Bible and the Greek and Roman Antiquities appeared in new and revised editions before the editor’s death. From 1853 to 1869 Smith was classical examiner to the University of London, and on his retire- ment he became a member of the Senate. He sat on the Committee to inquire into questions of copyright, and was for several years Registrar of the Royal Literary Eund. ??? He edited Gibbon, with Guizot’s and Milman’s notes, in 1854-55. In 1867 he became editor of the Quarterly Review, which he directed until his death in 1893 with marked success, his remarkable memory and accuracy, as well as his tact and courtesy, specially fitting him for such a post. He was D.C.L. of Oxford and Dublin, and the honour of knighthood was conferred on him the year before his death. (a. z.)

Smith, William Henry (1825-1891), English

man of business and statesman, was born in London 24th June 1825. His father was the founder of the great distributing firm of W. H. Smith & Son, in the Strand, and at an early age he became a partner and devoted himself to the business. He betrayed no political aspira- tions until 1865, when he came forward as a Conservative to contest Westminster against John Stuart Mill and the Hon. Mr Grosvenor. Defeated on that occasion, he triumphed in 1868, winning a victory when his party was in general vanquished on all sides. The prestige thus obtained, and the accident of representing so important a constituency, combined vrith wealth and his business abilities to recommend him to Disraeli, who in 1874 made him secretary to the Treasury. In 1877 he gained cabinet rank as first lord of the Admiralty ; in 1885 he was successively secretary for War and chief secretary for Ireland; in 1886 he was again at the Var Office; and when late in that year Lord Randolph Churchill’s

resignation necessitated a reconstruction of the ministry, Mr Smith found himself first lord of the Treasury and leader of the House of Commons. He was no orator, and made no pretence to genius, but his success in these high offices was complete, and was admittedly due, not merely to business abUity, but to the universal respect which was gained by his patience, good temper, zeal for the public service, and thorough kindness of heart. He died at Walmer Castle (which he occupied as Warden of the Cinque Ports) on 6th October 1891. In recognition of his services, a peerage in her own right was con- ferred on his widow, with the title of Viscountess Hambleden.

Smith, William Robertson (1846-1894),

Scottish philologist, physicist, arch◆◆ologist. Biblical critic, and the editor, from 1880, of the 9th edition of this Encyclo- psedia, was born 8th November ~~1846 at Keig in Aberdeen~~ shire, where his father was Free Church minister. He was educated at home and at Aberdeen University, where he attained the highest academic distinctions, winning among other things the Ferguson mathematical scholarship, which is open to all graduates of Scottish universities under three years' standing. In 1866 he entered the Free Church College at Edinburgh as a student of theology. During two summer sessions he studied philosophy and theology at Bonn and Gottingen, making friends in all branches of learning. From 1868 to 1870 he acted as assistant to the professor of natural philosophy in Edinburgh University. During this period he was not only most successful as a teacher, but produced much original work ◆◆◆ especially in the experimental and mathematical treatment of electricity ◆◆◆ which is still regarded as standard. In 1870 he was appointed and ordained to the office of professor of Oriental lan- guages and Old Testament exegesis at the Free Church College, Aberdeen, and here he began that series of theo- logical investigations which, characterized as they were by learned research and the use of the most scientific methods, were destined to make his name famous. He was the pupil and personal friend of many leaders of the higher criticism in Germany, and from the first he advocated views which, though now vsddely accepted, were then regarded

with apprehension. The articles on Biblical subjects which he contributed to the 9th edition of the Encyclopaedia Britannica distressed and alarmed the authorities of the Free Church. In 1876 a committee of the General Assembly of that Church reported on them so adversely that Smith demanded a formal trial, in the course of which he defended himself with consummate ability and eloquence. The indictment dropped, but a vote of want of confidence was passed, and in 1881 Smith was removed from his chair. During this long struggle he was sustained by the conviction that he was fighting for freedom, and at the end of the trial he was probably the most popular, if not the most powerful, man in Scotland. Marks of sympathy were showered on him from all sides.

In 1875 he was appointed one of the Old Testament Kevisers ; in 1880-82 he delivered by invitation, to very large audiences in Edinburgh and Glasgow, two courses of lectures on the criticism of the Old Testament, which he afterwards published {Tlie Old TrMawpnt in the Jewish Church, first edition 1881, second edition 1892, and The Prophets of Israel, 1882, which also passed through two editions) ; and soon after his dismissal from his chair he joined Professor Baynes in the editorship of the Encyclo- paedia Britannica, and after Professor Baynes's death re- mained in supreme editorial control till the work was completed. His versatility, firmness combined with tact, width of view, and painstaking struggle for accuracy

were largely responsible for the maintenance of its high standard. But he did not let his other duties interfere with his Semitic studies. He visited Arabia, Egypt, Syria, Palestine, Tunis, and southern Spain, and had an intimate knowledge of, and personal acquaint- ance with, not only the literature, but the life of the East. His early friendship with J. F. McLennan, that most original student of primitive marriage, had a great influence on Smittfs studies, and his attention was always strongly attracted to the comparative study of primitive customs and their meaning. His chief contributions to this branch of learning were his article Sacrifice in the Encyclopcsdia Britannica, his Kinship and Marriage in Early Arabia (Cambridge, 1885), and above all his Lectures on the Religion of the Semites, 1st edition 1889, 2nd edition 1894. His originahty and grasp of mind enabled him to seize the essential among

masses of details, and he had in a marked degree the power of carrying a subject further than his predecessors.

In 1883 Eobertson Smith was appointed Lord Almoner's Professor of Arabic at Cambridge, which henceforth be- came his home. He occupied rooms in Trinity College till 1885, when he was elected to a professorial Fellowship at Christ's College. In 1886 he became University Librarian, and in 1889 Adams Professor of Arabic. In 1888-91 he delivered, as Burnett lecturer, three courses of lectures at Aberdeen on the primitive religion of the Semites, of which only one course has been pubhshed (see above). Early in 1890 grave symptoms of constitutional disease manifested themselves, and the last years of his life were full of suffering which he bore with the utmost courage and patience. He never ceased to work, and when near his end was actively engaged in planning the Encyclo- paedia Biblica, which he had hoped to edit. He died at Cambridge, 31st March 1894, and was buried at Keig. Small and slight in person and never robust i"Q health, Eobert- son Smith was yet a man of ceaseless and fiery energy; of an intellect extraordinarily alert and quick, and as sagacious in practical matters as it was keen and piercing in specu- lation ; of an erudition astonishing both in its range and in its readiness ; of a temper susceptible of the highest enthusiasm for worthy ends, and able to inspire others with its own ardour ; endowed with the warmest affections, and with the kindest and most generous disposition, but impatient of stupidity and ready to blaze out at whatever savoured of wrong and injustice. The sweetness and purity of his nature combined with his brilliant conver- sational powers to render him the most dehghtf ul of friends and companions. (a e. s.)

Smolensk, a government of West Eussia, lying to the east of Moscow, with an area of 21,638 square miles and a domiciled population which numbered 1,191,172 in 1882 and 1,551,068 in 1897, when there were 810,765 women and the urban population numbered 121,383. In 1898 the population was estimated at 1,671,000. It is chiefly composed of White Eussians (47 per cent.), in the west. Great Eussians (42 per cent), in the east, and a mixture of both (11 per cent.). Most of the inhabitants (98 per cent.) belong to the Orthodox Greek Church ; the rest are Nonconformists. The province is divided into 12 districts, the chief towns

of which are Smolensk (see below), Byelyi (6956), Dorogobuzh (6640), Dukhovschina 3115), Elnya (2429), Gzhatsk (6312), Krasnyi (2755), Poryechie (5692), Eoslavl (17,848), Sytchevka (4805), Vyazma (15,676), and Yukhnoff (2253). In 1899 there were 1492 schools, attended by 78,700 scholars, of whom only 15,400 were girls. Forty per cent, of the children of school age received no education at all. The county and district councils, however, are very active in organizing

hospitals and infirmaries, and all the peasants in the province are embodied in a mutual insurance against fire. Out of a total area of 13,687,000 acres 5,342,000 were held by the village communities, 7,172,000 by private persons, and 324,000 by the Crown. No less than 5,029,000 acres, or 37 per cent, of the total area, are under forests, and 1,215,000 are uncultivable. Nearly 30 per cent, of the surface is arable land, and 20 per cent, is under meadows. In the year 1900 there were 2,200,000 acres under crops, and the average yield in 1895-99 was : rye, 6,932,000 cwt. ; wheat, 80,500 cwt. ; oats, 4,260,000 cwt. ; barley, 755,000 cwt. ; all cereals, 12,104,000 cwt.; also potatoes, 7,473,000 cwt. This supply is not sufficient for the population, and grain has to be imported. Improved agricultural implements are beginning to be manufactured within the province, and to be applied on the landlords' estates, and partly also by the peasants. Flax (121,500 acres) and hemp are important crops, and some tobacco is also grown. There were in 1898, 438,000 horses, 564,844 horned cattle, 629,250 sheep, and 242,920 pigs in the province. In the way of mining industries only phosphorite is extracted, and of this, 32,000 cwt. is obtained annually. The domestic trades are not so well developed as in the other parts of Central Eussia, while in 1898 there were only 1762 factories, employing 13,000 workers and showing a yearly return of about 14,000,000 roubles. The most important industry is that represented by a large paper mill, which employs no fewer than 4000 hands. A considerable part of the population is, however, compelled to leave their homes in search of work in different parts of Eussia. (p. A. K.)

Smolensk, the capital of the above government, built on both banks of the Upper Dnieper, 260 miles by rail west-south-west of Moscow, at the junction of the two important railways from Warsaw to Moscow and Eiga to Orel The city has much improved of late years. It has monuments in remembrance of the war of 1812 and of the Russian composer Glinka. It is well provided with schools, and has three public libraries, a historical and archaeo- logical museum which contains very interesting antiquities, a people's palace and a people's theatre, and several philanthropic and scientific societies. It is well supplied with water, and has an extensive network of telephones. Factories and trade, however, are but feebly developed. Population (1897), 46,900.

Smyrna., Ismir, the capital of the Aidin vilayet, and ';he most important town of Asia Minor, situated at the head, of a gulf 30 miles long, in 38 26' N. and 27 9' E. It is one of the principal ports of the Ottoman empire, and has a large trade, of which the greater part is with Great Britain. The total values of the general trade for 1898, 1899, and 1900 were :

Year.

Exports.

Imports.

1898 .

1899 .

1900 .

3,294,529

3,782,781 2,541,172

2,677,948

2,562,885 1,425,480

Earlier returns are not very trustworthy. The chief items of export are figs, tobacco, valonea, carpets, raisins, and silk. The British share of the total trade amounted in

1899 to 50 per cent., and in 1900 to 57 per cent. In

1900 the appearance of plague, and the consequent im- position of quarantine by Turkish and foreign ports upon all arrivals from Smyrna, paralysed trade. Until 1894 the two railways from Smyrna to the interior belonged to British companies, but in 1897 the Smyrna-Ala-shehr line passed into the hands of a French syndicate, which

completed an extension to Afiiin Kara-hissar, and so efiected a junction with the Anatohan railway system. The Smjn-na-Aidin line has been extended to Dineir. The population is about 250,000, of whom more than half are Greek, including 45,000 Hellenic subjects, and less than one - fourth Moslems. The Moslems, Armenians, Greeks, Europeans, and Jews live in separate quarters of the city. Interesting discoveries throwing light on the water-supply of Roman Smjo-na have been made.

Smyth, Charles Plazzi (1819-1900), British

astronomer, was born at Naples on the 3rd January 1819. He was called Piazzi after his godfather, the celebrated Italian astronomer of that name, whose acquaintance his father, Admiral Smyth, had made at Palermo when on the Mediterranean station. His father subsequently settled at Bedford, where he erected the well-known Bedford Observatory, at which Piazzi Smyth received his first lessons in astronomy. At the age of sixteen he went out as assistant to Maclear at the Cape of Good Hope Observatory, where he soon distinguished himself by his observations and drawings of Halley's comet and of the great comet of 1843 ; also taking an active part in the verifica- tion and extension of La Caille's arc of the meridian and the measurement of the Zwartland Base. In 1845 he was appointed astronomer royal for Scotland and professor of astronomy in the University of Edinburgh in succession to Henderson. On assuming this pOst his first task was to complete the reduction of the observations made by his predecessor (see Edinburgh Observations, vols. xiv. and XV.). In 1856 he undertook an interesting experiment to test the advantages of

a mountain station for astronomical observations, selecting for this pmrpose the Peak of Teneriffe, as being situated in a low latitude and fairly easy of ascent. The Admiralty made him a grant of ►►500 for the purpose of this mission, and a yacht ►►► the Titania ►►► of 140 tons and a fine 7|-inch equatorial telescope were placed at his disposal by friends. The first station occupied was at a height of 8900 feet on the southern wall of the crater of elevation, the 7|-inch telescope being afterwards erected at Alta Vista, 10,700 feet above the sea-level. The principal result of the astronomical observations made at these great heights was to verify Newton's surmise, that a " most serene and quiet air . . . may perhaps be found on the tops of the highest mountains above the grosser clouds," a discovery subsequently turned to splendid account at the American mountain observatories of Mount Hamilton, in California, and Arequipa, in Peru. Accounts of the results of this expedition, including measures of the radiation of heat from the moon, observations of the solar spectrum, and. of the meteorological characteristics, are contained in the " Report on the Teneriffe Astronomical Experiment of 1856, addressed to the Lords Commissioners of the Admiralty, 1858," in the Phil. Trans, of the Roy. Soc. of the same year, and the Edinburgh Observations, vol. xii. A more popular account of the expedition will be found in Teneriffe, an Astronomer's Experiment : or. Specialities of a Residence above the Clovds, 1858. About 1874 Piazzi Smyth began to study the spectra of luminous gases, of the rainband, the aurora, and zodiacal light. In 1877 he went to Portugal to observe the solar spectrum under more favourable conditions than was possible in the atmosphere of Edinburgh, and was eminently successful in resolving into their constituent lines the broad bands at the red end of the spectrum. For these results, published in the Trans. R. S. Ed. vol. xxix., he received the Macdougall-Brisbane prize in 1880. Accounts of later spectroscopic researches are pubUshed in Madeira Spectro- scopic (1882) and in the Trans. R. S. Ed. vol. xxxii. Pt. ii. He also carried out in the laboratory an extensive

investigation on the spectra of gases, and in conjunction with Professor A. S. Herschel discovered a remarkable relation connecting the chief lines of carbonic oxide. Amongst his other pubHshed works may be mentioned Three Cities in Russia (1862), Our Inheritance in the Great Pyramid, Life and Work at the Great Pyramid, and a volume On the Antiquity of Intellectual Man, from a Practical and Astronomical Point of View. In 1888 he resigned his professorship and the post of astronomer royal of iScotland, and retired to the neighbourhood of Eipon, where he died on 21st February 1900. (a. a. k.)*

Sneek, a town iu the Dutch province of Friesland, to the west of Sneek Lake, 12 miles south-south-west of Leeuwarden. It is connected by steam tramways with Heerenveen and Harlingen, and a railway to Stavoren was opened in 1885. There is an industrial school and a school for teachers. Population (1900), 12,100.

Sniatyn, the chief town of a district in Galicia, Austria, on the left bank of the Pruth, near the frontier of Bukovina, with important horse and cattle fairs and tanning. Population (1890), 10,939; (1900), 11,498.

Snoilsky, Carl Johan Gustaf, Count

(1841), Swedish poet, was born at Stockholm

on 8th September 1841. He was educated at the Clara School, and in 1860 became a student at Upsala. He was trained for diplomacy, which he quitted for work at the Swedish Foreign Office. As early as 1861, imder the pseudonym of " Sven Trost," he began to print poems, and he soon became the centre of the brilliant literary society of the capital. In 1862 he published a collection of lyrics called Orchids. During 1864 and 1865 he was in Madrid and Paris on diplomatic missions. It was in 1869, when he first collected his poems under his own name, that Snoilsky took rank among the most eminent contemporary poets. His Sonnets in 1871 increased his reputation. Then, for many years, Snoilsky seemed to have entirely abandoned the art of poetry, and to have, devoted himself to the work of the Foreign Office and to the study of numismatics. In 1876, however, he published a translation of the Ballads of Goethe. In 1879 SnoUsky's life underwent a violent crisis, which was the subject of

infinite gossip in Sweden. He had risen to the highest distinctions in official life ; he had in 1876 been appointed keeper of the records, and he had succeeded Bishop Genberg as one of the eighteen of the Swedish Academy. He resigned all his posts, and left Sweden abruptly in company with the Baroness Kuuth-Piper, whom he married in 1880. In his exile, Count Snoilsky turned again to poetry, and sent home in 1881 a volume of New Poems. Savonarola followed in 1883, and The White Lady in 1885. This period of activity also came to an end with the publication of a collection of Poems in 1887, and during later years Count Snoilsky contributed little to current literature. Since 1891 he has been principal librarian of the Royal Library in Stockholm. His influence, however, continues to be great ; his verses are read with eagerness by the old

and the young alike. He has always sung of joy and liberty and beauty, of the greenness of spring and the glory of the morning, and in his lyrics, more than in most modern verse, the ecstasy of youth finds its due ex-pression. He is remarkable, also, for the extreme delicacy and melodiousness of his verse-forms, for he is essentially and almost exclusively a lyrical poet.

SnOWdon (Welsh, Eryri), a mountain in North Wales. It is built up of slates, grits, and porphyries belonging to the Cambrian and Silurian systems, and consists of five ribs, meeting together at the summit (Y Wyddfa), 3560 feet above sea-level, and embracing between them steeply scarped depressions or vast pre- cipitous hollows, of which the best known are Cwm-Glas on the north and Cwm-y-Llan on the south. Snowdon lies far below the snow-line, and is indeed, as a rule, quite free from snow between April and October., The mountain is encircled by a cluster of similar peaks, 1500 to 50D feet lower in altitude. Between it and them there is, however, a girdle of glens or passes, which present much wild and striking scenery. Of these the most notable is the Pass of Llanberis, which skirts the north- east foot of Snowdon, and is steep and narrow, being shut in on both sides by bare mountain slopes. It disputes with the Pass of Aberglaslyn, which proceeds due south from Beddgellert, at the south foot of Snowdon, the supremacy as the wildest pass in this part of Wales. The two passes are connected by the Nant-Gwynant defile, which skirts the south-east foot of the mountain. Along the south-west foot runs

the glen of Nant-Colwyn, which is continued to Carnarvon, 12 miles north-west from Beddgellert. The summit of Snowdon is frequently shrouded in mist, of which good imaginative use is made in Mr Watts-Dunton's novel of Aylwin. Since 1897 it has been ascended by a rack-and-pinion railway, 4| mUes long, which starts at Llanberis, at the north-west foot of the mountain, and terminates at the hotel which crowns the top. One of the charms of Snowdon is its lakes, of which there are two at Llanberis ; one on the east side, filling the bottom of the hollow between the Crib-goch and Lliwedd ridges ; a couple in the Nant-Gwynant defile ; and another at the western foot of the mountain. Close to Llanberis the primitive beauties of the scenery are sadly impaired by the extensive slate quarries of Dinorwic, which employ some 2000 men. This region is naturally the resort of crowds of holiday-makers dur- ing the warmer months of summer. The most popular centres within the district itself are Llanberis, Beddgellert, Pen-y-Gwryd, and, a little farther away, Capel-Curig ??? the last two on the east side of the mountain ; while con-venient centres outside the immediate district are Car- narvon, Bangor, Bettws-y-Coed, and even Llandudno. The minor attractions of the region embrace Dolbadarn Castle, which figured in the Anglo- Welsh wars of the 13th and early 15th centuries, and the falls of Ceunant Mawr, both near Llanberis ; and the church and the re- puted tomb of Llewelyn's famous hound at Beddgellert.

SOCIALISM.

FOR the purposes of modern discussion. Socialism may be described as that policy which aims at a more equal distribution and, in subordination thereto, a better production of wealth by means of the direct action of the central authority. It is thus distinguished (a) from the policy of laissezfaire, or least-possible interference with the competition of private persons or groups of persons

among themselves, and (b) from the policy of Regulation,

where the central authority deliberately watches and

controls the action of industrial competitors, but

avoids direct initiative in production and direct Oeaerai

*attempts to level inequalities of wealth. The ** ”’*

leading idea of the Socialist is to convert into

a general benefit what is now the private gain of one or a

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few. He shares this idea with such reformers as the Anarchist, the Positivist, and the Co-operator ; but, unlike them, to secure his end he would employ the compulsory powers of the State or the municipality. Where the public direction or diversion of industry is mainly for the benefit of a few, as in the protective system of some countries, this is hardly Socialism. It employs the same machinery, the compulsory powers of the central authority; and it secures a revenue which may or may not be for the general benefit ; but so far as the ” protection ” is successful, the main result is the private gain of a few, whereas Socialism would secure the main benefit for society as a whole. Communism has the same aim as Socialism and the terms are often used convertibly. But the Communist need not be a Socialist or the Socialist a Communist. The Socialists of the beginning of the 20th century rarely demand that all wealth shall be held in common, but only that the large workshops, and the land, and the materials and means of production on a large scale, shall be owned by the State or municipality.

The Socialism of this period has in fact a quality of its own. It is founded on a more or less clearly understood economic theory, and therefore is frequently described as Economic or Scientific Socialism. It may be true that in the first instance men become Socialists not from logic but from observation of suffering and from sympathy with the sufferers. But the Socialism of our own tipie, without disowning sentiment, is better aware than its predecessors of the need of facts and arguments for the persuasion of the public. It is significant, in this connexion, that, while all over the civilized world there is evidence that the volume of suffering has

since the 'seventies grown somewhat less, the influence of Socialism has grown ^ somewhat more. Nowhere is this more true than in Germany, the birthplace and stronghold of the new doctrines.

The earlier history of Socialism in Germany has been

already given with sufficient fulness (Ency. Brit. 9th

edition, vol. xxii.. Socialism) ; and the briefest

ermaay. jQfgj,gjj(,g ^^ ^j^g chief common doctrines of the school may be made here. From the study of Hegel, both Marx and Lassalle had been impressed with the idea of Evolution ; they had learned that the world of men, like the world of things, was in constant process of development ; but, unlike Hegel, they conceived the evolu- tion as purely materialistic ; the progress of civilization was effected by a struggle between classes in society for material wealth and well-being. Feudalism, itself the result of such a struggle, had given place to the rule of the middle classes (bourgeoisie), and the struggle is now between the privileged capitalists and the disinherited working men. At present those who do not possess capital are so placed that they must work for such wages as will keep them alive, and the gains from invention and in- dustrial economies fall to the employers and the capitalists generally. Because of the helplessness of the labourer, he is forced (a) to work at his cost price (or the bare necessaries of civilized life), but (6) to produce much more than his cost, the surplus going to his employer. This is what Lassalle called the Brazen Law of Wages, founded on Ricardo's supposed doctrine that the value of an article produced under conditions of competition is determined by its cost in labour, and that the wages of labour tend to equal the labourer's subsistence. Without labour, capital cannot utilize its advantages, and the tendency of the labouring population to increase beyond the means of their constant employment is a frequent benefit to the capitalists in the periodic expansions of investment and enterprise arising in response to new inventions and new discoveries. Large businesses swallow up small ; not only

independent artisans and the workers in domestic industries, but small capitalists, who cannot afford the economies and low prices of their

larger rivals, are disappearing. But the growth of the proletariate, together with the concentra- tion of all business in fewer hands, will accompUsh the downfall of the present system of industry. The proleta- riate will realize their own strength ; and the means and materials of production wiU be concentrated one degree more, namely, in the hands of the commonwealth for the good of all. This revolution, like that which overturned feudalism, is simply the next stage in an evolution that will happen without human will, fatally and necessarily, in virtue of the conditions under which wealth is produced and shared in our times.

Such was in substance the view of all the leading German Socialists of the last half of the 19th century.' Eodbertus alone practised as well as preached the belief that "the social question was a purely economic question," and confined himself to his study; but even he was not content with a mere statement of the fact of evolution ??? he advanced, like the rest, a claim of right on behalf of working men. The others went further. They made " the social question " a question of politics. Marx and Engels from the days of the French Eevolution of 1848 had appealed to the "proletariate of aU countries" to unite to hasten the day of their emancipation. Marx founded the International Association of Working Men in the year of Lassalle's death (1864). LassaUe's Socialism was meant for Germany fijst. He had planned a centralized organiza- tion of workmen led by a dictator. He had called on the Government to establish from the funds of the State co-operative associations such as Schultze-Delitzsch had hoped to plant by "self-help." Lassalle's Sociahsm was rather national than international But before the common danger of police prosecution his followers united with the followers of Marx at the Congress of Gotha in 1875. The name Social Democrats crept into use about 1869, when the followers of Marx founded, at a Congress at Eisenach, "the Social Democratic Working Men's Party." The party began to be a power in Germany about the year 1875. It is a power now; but the doctrines and poUcy of the party have undergone some change.

The last quarter of the 19th century witnessed (1) the repressive laws of 1878, (2) the repeal of them in 1890, (3) the three Acts of Insurance, and, above all, (4) the progress of German industry and wealth. After the occurrence of two attempts (in 1877) on the life of the aged Emperor

William, Bismarck's Government, already alarmed by the increased number of votes given to Socialist candidates for the Reichstag, procured the passing in October 1878 of the " Exceptional Powers Act " (Austiahme- Gesetz). The legislation of 1878 resembled in its purpose and effects the Six Acts of 1819 in England. Combined action in Germany became almost impossible, and for organs of the press the Social Democrats had recourse to Ziirich. Liebknecht and Bebel could still raise their voice for them in Parliament, for Bismarck's attempts to deprive members of the Reichstag of their immunities was foUed (March 1879). But the agitation as a whole was driven underground ; and it speaks well for the steady patience and self-control of the German people that no widespread excesses followed. The declaration of the Social Demo- cratic Congress at Wyden, Switzerland, in 1880, that their aims should be furthered "by every means" instead of, as formerly, "by every lawful means," was a natural rejoinder to the law that deprived them of the lawful means ; and it seems to have had no evil consequences. After twelve years, repression was so far relaxed that (in 1881) workmen's trade unions were allowed to recover legal standing. In 1890 the Reichstag refused to

renew for a fifth period the obnoxious law of 1878 ; and finally, in 1899, the Reichstag repealed the law forbidding amalgamation of workmen's trade unions and specially- aimed at the new socialistic unions, the natural allies of the Social Democrats. It might thus seem that the party was never so powerful as at the opening of the 20th century. Since 1890 the vexatious prosecutions and condemnations for Use majeate have done the cause more good than harm. In 1878 the Socialists poUed 437,438 votes for the Reichstag; in 1881, 311,961; in 1884, 549,990; in 1887, 774,128; in 1890, 1,427,000; in 1894, 1,800,000; in 1898, 2,120,000; and the number of their representatives increased from 12 in 1877, 37 in 1890, 46 in 1894, to 56 in 1898.

This increase of Sociahsm in Germany is the more remarkable because of the remedial measures, intended to forestall Sociahsm, that had been passed in the interval between 1878 and 1890. Bismarck, as he himself allowed in the debates of 1878 (6th September), had known and admired LassaUe, and he had none of the scruples of abstract theorists against the intervention of the State. Accordingly, he planned the series of measures for the insurance of workmen against sickness, accidents, and old age, which became law, in 1883, 1884, and 1891 respectively. The Socialists at first sneered at these measures, and then accepted them. They not very un- reasonably regarded the Government as their convert. They could also point to at least two other unvTiUing witnesses ??? the Christian Socialists and the SociaKsts of the Chair (Kathedersocialisten).

In Protestant parts of Germany the Socialists as a rule were Social Democrats. In the Catholic parts the following of the Social Democrats was more scanty ; but Socialist sentiment and doctrine were represented as early as 1863 and 1864 by Dr Dollinger and Bishop Ketteler, followed by Canon Moufang. Ketteler, who had been under the influence of Lassalle, thought of inducing the Church to make productive associations her special care. Moufang would depend more on the State than on the Church. All were awake to the evils of the workmen's position as described by the Socialists of the ordinary type, and they were anxious that the Catholic Church should not leave the work of curing those evils to be done without her sjrmpathy and aid. Ketteler died in 1877; and the Pope's Encychcal of 28th December 1878 bore no trace of his influence, mixing up as it did Socialists, Nihilists, and Communists in one common condemnation. The Encyclical De conditione opificum of 1891 showed that the views of the Catholic Sociahsts had penetrated to headquarters ; but the Encychcal on Christian Denw- cracy (January 1901) betrayed no sympathy with them. The Protestant Church in Germany has been hampered by fear of offending the Government. But it contains a vigorous, if tiny, body of Christian Socialists. Rudolf Todt, a country pastor, was the prophet of their move- ment ; his book on Radical Oerman Socialism and Christian Society, written in 1878, led Dr Strieker, the Court chaplain, to found an organization for " Social Reform on Christian Principles." This was denounced rather unfairly by politicians of all ranks. Socialist and otherwise, as an organized h3rpocrisy. For

whatever reason, its influence was shortlived, and its successor, the Social Monarchical Union (1890), shared in the un- popularity of Stocker, its founder. Even the Socialists of the chair, middle-class Protestants as they often were, would have nothing to say to it, but preferred to go a way of their own.

'There had existed in Germany since 1858 a league of economLsts and statesmen called the "Economic Con- gress " (Volkswirthschaftlicher Congress), bearing a general

resemblance to the Cobden Club, though its chief object was to bring about free trade among German states in particular. After the Empire, its work seemed finished; and some statesmen and economists formed a new society the "Union for a PoHcy of Social Reform" (Verein fiir Socialpolitik). Professors SchmoUer, Roscher, Hildebrand, Wagner, Brentano, the statistician Engel, and others met at Halle in June 1872, and a meeting of their supporters was held at Eisenach in October of that year. These academic Sociahsts, or Socialists of the Chair, agrfeed with the ordinary Socialists in recognizing the existence of the "social question," the problem of how to make the labourer's bad condition better. The orthodox economists saw no problem there for legislation ; competition was sup- posed to solve its own problems. But, while the ordinary Socialists looked for Social Revolution, the academic Socialists were content to strive after Social Reform on the basis of the existing system of private property and rights. This social reform, however, was to be actively furthered by the State, without regard to the scruples of the Jlanchester School. The State was re- garded as a "great moral institution for the education of the race." Bismarck is said to have declared in 1876 that if he only had time he, too, would' join the union. It was, in fact, a union of moderate State Socialists, Sociahsts who rehed on the State, and the State as it then was, for social reform. The Government Insurance Acts owed not a httle to the labours of these men, who gave their services freely for the necessary preliminary investigations. The union, as a rule, met once in two years at some German town.

The German people have been prepared for State Socialism by the efliciency of the German bureaucratic Government, made so manifest in

the wars of 1866 and 1870. If the insurance laws are successfully carried out, the confidence of the people in the Government, and in the State as it is, may be so strongly confirmed as to put any idea of a complete revolution out of their thoughts. It can hardly be said that this idea is absent now ; but the attitude of the Social Democratic party is at least less uncompromising than it was in the beginning. Since they regained their hberty in 1890, they have been weU kept in hand by their leaders, -^heir journal, Vonodrts, is conducted with remarkable abihty. Their agitation has been as peaceful as that of trade unionists or co-operators in England. They have ceased to de- nounce the Churches. They have tried to gain converts and sympathizers by showing themselves ready to take up the cause of any specially distressed class of workers, and press their special claims on the State. From a necessary evil or mere stop-gap, the present State has become to them gradually, and perhaps unconsciously, their own State. The Anarchists had been diso'svned and expelled as early as 1880. The Socialists who demanded return to the old uncompromising tactics, were cast out at Erfurt in 1891, and exist as "Independent" Socialists. The con- troversies between the advocates and the opponents of Socialism still go on in learned circles, and produce a prodigious quantity of literature year by year ; but the Social Democracy, which Schaffle the academic Socialist regarded in 1885 as "without prospects," would deserve less severe treatment now than it received from him then. Though the programme adopted at Gotha in 1875 stands almost unaltered, the parts due to Lassalle have fallen into the background. For many years Marx has been the chief economic authority of the party. Marx died in 1883, but remained an oracle till 1894 when (just before his own death in 1895) Engels published the last volume of his friend's book on " Capital." This volume was ex- pected to solve certain serious logical difficulties in the

system ; and instead of tMs it caused a feeling of disappoint- ment, which can be traced even in the JVezte 2eit, the literary and scientific organ of the party, as the Vorwdrts is the popular. Many, Uke Bebel and

Kautsky, keep up the old adoration of Marx; but the younger, like Bernstein, have rightly felt that to give up Marx is not to give up Socialism, any more than to give up Genesis is to give up theology. Bernstein has openly proposed in Congress that the old doctrines and policy of the party, involving as they do despair of Reform and insistence on Revolution, shall now be dropped. Though he has not yet carried his point, his opponents have not suc- ceeded in expelling him from the party. The death of Liebknecht (August 1900) removed not only an almost heroic figure from the ranks of the Social Democrats, but an old-fashioned Socialist who was a serious obstacle to any change of front. Yet Liebknecht himself, though he once thundered against the Bavarian von VoUmar for pro- posing a truce (1891), had latterly been drifting in this very direction. It was impossible for a man of his practical wisdom to close his eyes to what the State had done for the German workman. It was also impossible to ignore the great progress that Germany had made in wealth and industry since the creation of the Empire in 1871. Germany has been fast becoming a manufacturing instead of a merely agricultural country ; and, though the rise of large manufacturing towns in the Rhine valley and elsewhere has multipUed Socialists, whose numbers are chiefly recruited from the towns, it has added to the income of the ordinary German workman. He is farther from poverty and distress than he was a generation ago ; and his Socialism is an endeavour after a larger life, not, as formerly, a mere struggle against starvation. It is hkely, therefore, to have less and less of mere blindness and violence in it.

The condition and prospects of the working man in Germany are fast becoming those that have prevailed in England since the repeal of the Corn Laws in 1846. They fall far short of perfection, but also of hopelessness. The German Corn Laws must pass away like the English, and for the same reasons. In 1902 the Social Democrats threw their weight on the side of repeal.

England, which sheltered Marx and Engels, has never itself been a soil very favourable to Socialism ; but in the last quarter of the 19th century, in the poorer BMaln districts of our large towns, the Secularism of, say, 1875, has been supplanted by Sociahsm. Certainly among all classes there are more Socialists in England now than formerly ; and it is more easy to

say when than why the change has occurred. In 1879 Mill's essays on Socialism were pubhshed. The writings of Henry George (1880) and his lecturing tour (1881-82) in Great Britain revived interest in the claim for the nationalizing of the land, a form of Socialism endemic in England for more than a hundred years. It had been taught by Thomas Spence (1775), James Mill (1821), Dove <1850), Herbert Spencer (1851), and A. R. Wallace (1882). The Irish Land League included advocates of it ; but Gladstone's Land Act of 1881, though it was an interfer- ence with private bargaining and in many ways approached Socialism, settled the main question of ownership entirely in an individualistic sense. The English Land Restoration League makes way very slowly. Socialists pointed out that George's single tax on rents was illogical ; he would take away all the surplus value secured by the landlord, but would leave aU the surplus value secured by the employer and capitalist. The more logical Socialists had formed, in 1880, the Democratic (called afterwards, in 1883, the Social Democratic) Federation, of which the two principal leaders were WiUiam Morris, "poet and paper-

hanger," and H. M. Hyndman, journalist and stockbroker. Its weekly organ, Justice, is stO pubhshed. In 1884 William Morris seceded, and with Aveling (son-in-law of Marx) and Mr BeHort Bax estabhshed the Socialist League, with its organ. The Commonweal. Morris abandoned the League in 1890, though he held to the end, if somewhat vaguely, his belief in Socialism. Bellamy's book. Looking Backward (1888), made some impression in England; and a greater was produced by Merrie England, written in 1894 by Thomas Blatchford, editor of a Socialist newspaper, the Clarion. But there was still no sign of a strong party such as we have found in Germany. Socialists in England have been forced to adopt the ordinary English methods for the redress of grievances, finding their best opportunities, very naturally, in times of a general depression in trade (as in 1887). Nevertheless a change has come over the spirit of politics in England, in the direction they desire, though hardly through any efibrts of theirs. It is the change deplored by Herbert Spencer 'in his Man versus the State (1885), though it is neither sudden nor wonderful, but, in the Hght of events, inevitable. The period had passed when extension of the suffrage and free trade, and, generally, the removal of obstacles, could be considered panaceas. There was now a general

feeling, seldom ex- pressed in formulas, that there should be secured to all citizens the conditions under which a civUized life was possible. Hence there was a demand for greater stringency of Factory Acts and their administration. Increased attention was paid to elementary education and sanitary requirements. It is significant that the movement in favour of the better housing of the poor began in a speech of John Bright, an individualist of the old school (Glasgow, 1884). Sir William Harcourt said (1888), "We are all Socialists now," when he really meant that we were all social reformers, who .would use the help of Parliament without scruple. The English people have neither set themselves against Sociahsm nor pronounced in its favour. Except in the sohtary case of free trade in foreign imports, they are indifferent to general principles, and pride them- selves on judging each case on its merits, as if no general principle affected the merits.

The Enghsh poor law is frankly socialistic ; but the amount of its Socialism varies according to the administra- tion of it in the several localities. In this matter the English have aU been Socialists since the Act of Ehzabeth, and have not gone either backwards or forwards on purely logical grounds. Of recent years the State has taken more care than formerly to preserve common lands. No general scruples have prevented interference with individual freedom in the matter of education (1870), vaccination, the labour of children and young persons in factories and workshops, the regulation of railways, the compensation of workmen for injuries (1897), to say nothing of sanitary requirements. Little of all this is socialistic in the strictest sense of the word. The workmen's compensation is not out of pubhc funds. Where education is " free," or grants are made " in aid of rates," or the income tax and death duties are progressive, there is, perhaps, such an inroad on the revenue of one class for a real or supposed general benefit as would justify the term. But regulation, not initiative, is still the prevailing feature of the proceedings of the State in Great Britain. The railways are stiU in private hands. The Post Office, the telegraphs, the Post Ofiice Savings Banks, are a group by themselves, and the first, at least, existed before there was any thought of Socialism.

The lesser central authorities have been much more in- ' clined to conduct business for themselves. The supply of gas, water, and (more

recently) electric light, the mainten- ance of docks and tramways, the acquisition not only of parks but of house property ??? all these symptoms of

municipal Socialism, some of them a generation or more old, have increased and multiplied in recent years, and perhaps most conspicuously in towns (like Glasgow, Birmingham, Bristol, Manchester, Liverpool, Leeds, Bradford, Hudders- field) where poUtical Socialism has feeblest hold.i The passing of the Local Government Acts (1888, 1894), and the new interest aroused in municipal politics, throughout London in particular, by the establishment of its County Council and Borough Councils, may seem to have provided ready tools for municipal Sociahsm. But the actual achievements of London have certainly not surpassed those of the provincial cities, except in greatness of scale. It is the demand persistently made for permission to tax ground-rents and " unearned increment " that points to State Socialism, for such permission must sooner or later lead to State taxes of the kind described.

Pubhc men and journalists deplore or defend the exten- sion of municipal trading; meanwhile the trading goes quietly on, with the connivance of the classes most likely to suffer from a really socialistic or levelling policy. It may be that the middle classes have learned from Kuskin and Tolstoy some sympathy for the aims of Sociahsm ; and a few of them have become avowed converts. Anarchist colonies have been founded at Burleigh, Essex (1897), and at Sheepscombe, Gloucester, on the principles of Tolstoy. A band of Christian Sociahsts has gathered together, and news of foreign agitations (as of Bellamy and Henry George) and colonial experiments has not been without interest ; but the strongest movements in England are stiU such as LassaUe ridiculed as " self-help." English pubhc opinion was sceptical when the Trades Union Congresses declared themselves powerless to establish an eight hours' working day without the help of the State {e.g., Congresses of 1891, 1892). Resolutions in favour of the nationalizing of the land and of the other means- of production have been passed at most of the meetings since 1888, first on

the ground that only by these means could the unemployed be effectually helped, afterwards for more general reasons. The programme proposed on such occasions is always bolder than the policy eventually adopted. Mr John Burns, for example, said at Cardiff in 1895 : "The Eight Hours Bill, the Miners' Eight Hours Bill, the Eailway Hours Act (which had given employment to 10,000 men), higher wages and eight hours for Government workmen ??? all these things were in the direction of helping the un- employed. ... He had endeavoured to get the imme- diately possible, and in doing so he believed he was bring- ing about the social revolution."

The agitation on behalf of the unemployed had led to disturbances in London in February 1886 and November 1887. With the return of brisk trade the problem de- parted for the time. Depression is always the Socialists' best opportunity. They can hope to impress their views on the unemployed masses, and profit by the fear of the trade unionists that the competition of the unemployed will I endanger the position of the trades societies. In the last quarter of the 1 9th century a new unionism grew up. It is less aristocratic than the old, aiming at the inclusion of the comparatively unskilled labourers (as the dock labourers, formed into a union in London in 1889) ; and it seeks the federation of all trades societies, with a view to joint action. Moreover, within the separate unions the old government

' The subject of municipal ownership and municipal enterprise has come more and more to the front in England in late years. Curiously enough, in the United States the opposite tendency was shown, the experience of a preceding generation having caused a reaction. Eefer- euce should be made to Sir Henry Fowler's paper on "Municipal Finance " [Jov/rnal of Statistical Society, vol. Ixiii., 1900), and to the remarkable series of articles in TM Times on "Municipal Socialism," which appeared during the autumn of 1902.

by mass meetings of aU the members has given place to a government by representatives, and administration by permanent paid officials. This seems to lead not to democracy, but to bureaucracy; but it serves as some preparation for the Democratic Socialism held out by some of the leaders

as the ideal. A better preparation, because in the way of actual business, is given by the co-operative, societies, whose members are nearly as numerous as thosd of the trades societies, and more especially by the co-J partnerships of Leicester and Northampton, &c. But! these last are a very small body; and even the trade unions had in 1898 only about 1,644,000 members, or about one-eighth of the estimated number of the working classes. A decision of the highest Court (in the case of the Taff Vale Railway Co. v. The Amalgamated Society of Eailway Servants, 1901) gave to the trade unions, in place of the privileges of a club, the liability of a corpora- tion to be sued as a whole. The financial dangers of this position are fully understood by trade unionists. The ultimate results cannot be foreseen. The immediate effect is to drive the men into more earnest political action.

Attempts had been made to influence politics directly by means of an Independent Labour Party (founded at Bradford in January 1893 by Mr Keir Hardie), which bound itself to support only candidates of sound socialistic views. This was a sectional effort, which, except in municipal politics, had scant success. In municipal poHtics, again, especially in London, the Fabian Society, founded in 1 884 by a group of young literary men, had exercised some influence ; but, if we compare the " Fabian Essays " of 1889 with the later utterances of their writers, it becomes clear that these Socialists have become for the most part hearty Radical politicians, energetic in municipal work beyond their fellows, but hardly otherwise to be distinguished from them. They " do not suggest that the State should monopolize industry, as against private enter- prise or individual initiative, further than may be necessary to make the livelihood of the people and their access to the sources of production completely independent of both " {Fabian Tracts, No. 70, 1896). The reservation is wide; but fortunately it is added : " they accept the conditions imposed by human nature, and by the national character and political circumstances of the English people." The course of events has reconciled Socialism with political reform. In Germany itself (at the Congress held at Mainz in September 1900), the proposal of Bebel, that Democrats be allowed on occasion to ally themselves with ordinary political parties, was accepted, under qualifica- tions that are likely to disappear.

Marx said that nothing great could be done even in Germany for revolution without the aid of England. But he had also said that there must be ” the crowing of the Gallic cock.” French passion ia as indispensable as German reason. The enthusiasm for revolution is rather latent than wanting in France. The country population, with their small properties, vsill not favour revolution ; but the working ??? classes in the large towns are almost to a man Socialists or Anarchists in sentiment. They lack only opportunity and organization to be formidable. Something like a general movement towards organized Socialism began, on the return of some prominent leaders of the Commune of 1871 from exile. A Congress was held at Havre in 1880, which, under the leadership of Guesde and Ferroul, adopted a Social Democratic or ” Collectivist ” programme. In the following years a minority of the party, under Brousse and Joffrin, broke away from the main body and stood out for municipal Socialism, decentralization, and (in 1887) “self-governing workshops” aided by public money. Co-operative workshops are already helped

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forward in France by public funds, preferences in public ???works, and other privileges, without striking results. The Brousdstes are also called Possibilistes, content with such Socialism as is immediately practicable. They support, for example, agrarian reform on the present basis of private property (Marseilles, 1892). After several un- successful attempts, the amalgamation of the Collectivists, Possibilists, and Extreme Revolutionaries {Blamquutes) was accomplished in 1899. But this body has not the cohesion of the German party. Though the Socialists in the French Chamber act more or less loyally together, they are not so directly under the orders of the organiza- tion outside. M. Millerand’s acceptance of the ministry of commerce caused some misgivings among his fellow Socialists (Congress at Paris, September 1900). The Revue Socialiste, founded by Malon in 1893, has not the same standing as the German Vorwdrts. The wayward guerilla warfare of the French Socialists is a contrast to the disciplined strategy of the Germans, perhaps because

political liberty is greater in France. The intervention of the French Socialists at Carmaux (Toulouse) in the dispute between the Glass Company and the workers was ill-managed (August to October 1892), and we may contrast with it the part taken by Socialist leaders in stopping riots in Berlin (February 1892).

In France the State has been always more ready than in England to interfere with the course of competitive trade, and to take the initiative on itself. Besides having control of the Bank of France, it owns most of the railways, administering them with tolerable success. It controls secondary as well as primary education. After the disturbances at Carmaux, it proposed to take over the mines. There is still no general poor law; and old age pensions are not yet fully organized, though they are on the way, and workmen's compensation has already come (1888). State Socialism would probably have gone farther if the French bureaucracy had not proved less efficient than the German. There is little academic Socialism. The bulk of French economists stand somewhat stiffly by the economic policy of J. B. Say ; but men like Laveleye (who died in 1892), Gide among the younger economists, and the School of Le Play, at least acknowledged the existence of a "social question." There are also literary men of economic training (like Naquet) who advocate mild forms of Socialism. But the " Gallic cock " is not likely to crow at the bidding of Germany.

German Social Democracy found easier access to Belgium and Holland, and these countries have been a Belzium fa-'^ourite meeting-place for Congresses of all Holland', denominations of Socialists. Crowded manu-Swiuer- facturing Belgium had in 1876 two socialistic land. parties ❓❓❓ the Flemish, led by Dr de Paepe, an

ardent disciple of Marx, and the Brabantine or Walloon. They united in 1879, and helped the Liberals in 1893 to procure a much wider suffrage. The flourishing co-opera- tive societies, the Vooruit in Ghent, and the Maison du Peuple of the Brussels bakers, are the work of their members. The Belgian Professor Colins has been an eloquent advocate of the nationalizing of the land. Belgium adopted Old Age Pensions for the Poor in 1900.

In Holland, which is still an agricultural and pastoral country. Socialism has not a strong foothold, though the Socialist leader Nieuwenhuis succeeded (1889) in bring- ing his party into Une with German Social Democracy. The Dutch are active social reformers. They have had a Factory Act since 1889, and they passed an Act for Insurance of Workmen against Accidents in 1900. Reform is preferred to revolution.

Switzerland, for generations a refuge of exiles, usually shows them hospitality without sharing their views.

The Confederation has not gone so far as compulsory insurance against sickness and accident (rejected on Referendum, May 1900), but it has a legal working day (of 11 hours). There is most Socialism in the German cantons. Scandinavia stands apart by its situation. In Denmark, especially in Copenhagen, German Socialism has had some influence. The trade unions are largely socialistic, and some converts have been made among the farm labourers. Denmark, in turn, has influenced Norway and Sweden, the latter with greater success than the former. But in neither is Social Democracy a political power.

Where, then, are we to look for the spread of the Social Democratic gospel 1 In Austria it has taken root among the German population, quietly and in face of severg measures of repression. In the Eeichsrath of 1897 the party secured 12 out of 353 elected members. But if it had conquered all German Austria, there would still be Hungary and Bohemia to overcome ; and political disunion tells against it.

If it is true that where there is poverty there will be Sociahsm, no country should be more socialistic than Italy, whic^ has been described as "all proletariate." But the very wretchedness and ignorance of the masses, both on the land and in the cities, fitted them better for Anarchism than Socialism. Since 1882 there has been a Social Democratic organization, which has gradually drawn into itself the previously existing socialistic bodies. It was founded by Andrea Costa, and its most notable men now are perhaps Turati and De Amicis. In spite of the Government and the Anarchists, it has fought a good fight for the extension of the suffrage. In 1895 it returned 15 members to the Italian Parlia- ment. Milan has been the real capital of the movement. Laveleye had the curious idea that the

prospects of revolu- tion were hopeless in Italy because malaria made Rome uninhabitable every summer. But Social Democracy, in its native country, does not stand or fall with Berlin. The truth seems to be that Italy, especially southern Italy, must go farther in industrial and political development before it is ripe for the reception of the new ideas, and still farther before it outgrows them. In too many parts of Italy the taxes and local rates are in no ordinary sense a heavy burden, and the people revolt from sheer despair. At the end of 1893 there was a formidable out- break in Sicily, really against the tax-gatherer. The socialistic clubs called Fasci dei lavoratori actively aided the people ; and though the rising was put down by military force, some lightening of taxation followed, and there was a general sympathy with the rebels. But the policy of the Government has been mainly repressive. It tried to suppress the Socialist Union, and (in October 1894) it put down 271 workmen's associations as social- istic. The State Socialism of the Italian Government of 1902 was not of a kind to compensate for this repression. The railways, owned by Government and leased to com- panies, are not well administered, and the management of the Bank of Rome in 1892 received a damaging exposure. There are as yet no effective Factory Acts. Professor Loria of Padua describes the labour law as " still mediaeval." The professors in Italy are in advance of the statesmen in enlightenment if not in public spirit.

Social Democracy might be expected to find disciples in Spain, as there is discontent in that country both among artisans and country labourers. Paradoxical as it may seem, the converts are chiefly country Spain. labourers, the working men of the cities (when they are not Anarchists) trusting more to their trade unions and other forms of self-help. Its weakness in the great northern nation, Russia, is due to entirely

different causes. The principal is the strength of its rival, Anarchism, though the strength of the Imperial Govern- ment would by itself be enough to drive both of them underground. As Germany is the classical ground of Social Democracy, Russia is so of Anarchism ; and in the history of revolutionary parties in Russia the Social Democrats have only

a subordinate place. The Russian Sociahsts have many of them propounded a view which seems hard to reconcile with the " scientific " SociaKsm of Marx. They think that Russia might pass straight from its mediaeval system of village communities to a system of Collectivism, without passing through the stage of modern Capitalism. They are unwilling to countenance the destruction of the village communities by modern industry. Yet Marx had laid it down that progress was necessarily from feudalism and a patriarchal system, through Capitalism, to Collectivism, Capitalism forming the necessary preparation (of materials and methods and men) for its successor. When Marx was directly challenged by his Russian friends (1877), he made the unexpected statement that the course of development need not be in that precise order unless the country itself so willed it. However, since 1877 the development of industry in Russia has made straigljt for Capitalism, and there wiU soon be no temptation for other Socialists to fall into the heresy, such as it was.

If Scientific Socialism requires for the final revolution only the full development of modem industry, enterprise, and invention, nowhere should we expect to find it so near the goal as in America or the British colonies. In the latter, it is true, there is little of the Socialism due to poverty ; but there is much that is due (a) to the imperfect development of a new country, where there is a want of the accumulated capital utilized in the mother country by companies ; and (b) to the greater power of the working classes, and the intelligent consciousness of that power.

Australia is the land of democracy, and even of social- istic democracy, of a certain kind. There is manhood suffrage ; members of Parliament are paid (except in West Australia) ; the railways belong to the State ; there is free education of the poor, when not of aU and sundry. In South Australia women have the suffrage. In New South Wales the State owns the tramways, the water-supply, and the sewage works, and it gives subsidies to municipalities. The States of the Commonwealth are ceasing to pay settlers for coming to them; but they all (except New South Wales) keep up the imperfect Socialism of a protective tariff. Crown lands and mines are a chief source of revenue and expenditure. In 1897-98 more than one-half of the revenue of New South Wales was drawn from public

works and services, more than one-fifth from lands, about one-fourth from taxation. In the case of England the proportions are (for 1899) about one-sixth from works and five-sixths from taxation, the income from lands being negligible (about one-two-hundredth).

But the young state of New Zealand, with a population of 800,000, shut off from Australia by 1200 miles of sea, and from the world in general by protective duties, is in some respects more like the " cloned State " of the Socialist philosopher Fichte than any other State in the civilized world. Besides owning the railways, its Government is the largest land-owner and rent-receiver in the islands, possessing two-thirds of the whole acreage, and letting it on long leases. It limits the estate that can be held by any one individual, and has a right of compulsory repurchase. In 1893 it purchased the Cheviot projierty of 84,000 acres and divided the land into farms, now sup- porting about 900 i)rosperous tenants. The colonies for the unemployed, begun by Ballance in 1886, were less brilliantly successful ; but about 5000 farmers, holding 20

to 50 acres on perpetual lease, are the result. The policy is that of the nationalizing not of rack rents, but of fixed ground rents. Of the State's intervention in other direc- tions there is no lack. The working men of New Zealand drew together into strong organizations in the year 1890, their " maritime strike " following close on the London Dock strike of 1889. Ballance became the head of a Labour Party in Parhament, and eventually prime minister in January 1891. The result of the pressure of this new political party was a progressive income tax and land tax, an extension of the taxing powers of municipalities and local bodies, local option in regard to liquor (1893), a system of advances to settlers (1894), the adoption of the principle " one man one vote," the admission of women to the franchise (1892). The labour laws were extended and reformed on Enghsh hues as to Truck and Factory regu- lations and freedom of combination. A Department of Labour was created in 1891, and a scheme of compulsory arbitration in industrial disputes was passed in 1895. In Government works the "direct employment" of work- men, without a contractor, is the rule. In 1898 an Act was passed providing old age pensions of a shilling a day, under strict conditions of race, character, and income. Besides conducting the usual Post Office Savings Bank, the

Government, since the crisis of 1894, has had control of the Bank of New Zealand; since 1871 it has conducted life insurance ; it appoints a public trustee, who cares for the interests not only of widows and orphans, but of the Maoris ; it does most of the conveyancing of land, though, as in insurance, without exclusion of private competitors. "The State, without being in any way a monopolist," says the Hon. W. P. Reeves, "is a large and active competitor in many fields of industry."

This tentative Sociahsm, in a colony unusually free from foreign elements, proves that a certain kind of Socialism is not un-English. It has stiU, for the most part, to abide the test of time. It is acknowledged that the railways of Austraha and New Zealand, though efiaciently worked, are not remunerative in the sense in which competitive railways running through similar districts in the United States are made to be so. They are often laid down by the Governments in advance of the demand for them, to attract settlers for the Crown lands. When allowance is made for this motive, the experiment may be said to prove, as it has done in very different circumstances in Prussia, that Government can manage a railway almost as well as a controlled i)rivate company. In regard to the Crown lands, it is clear that a new colony starts with an advant- age that an old country could hardly recover, without un- reasonable outlay ; but, given the recovery, the machinery of administration might move as smoothly in the old country as in the new. But the Pensions and Arbitration Acts are unfinished experiments. The denser and more largely urban character of the English population, and the greater complication of industries, would prevent us from too readily drawing conclusions, even from the finished experiment ; and it is significant that the birth-rate is declining in New Zealand much faster than in England. Politically there was centralization when the present state replaced the local governments in 1876. But the policy most nearly justified by success in the new state is rather that of drastic democratic regulation of Capitalism than the substitution for it of Collectivism. The Govern- ment tenants are allowed to keep nearly as much of the unearned increment as tenants elsewhere ; the Maoris in the Reserve are allowed to become great landowners. No attempt is made to abolish competition in general business, but only so to regulate it as to secure healthy conditions of

labour, and something like equal oppor- tunities for the leading of a decent human life. Xo fear

of Collectivism need prevent a nation from trying to secure these benefits for its subjects in its own way, even if they are the benefits declared by the Collectivists to be only obtainable in their way.

The self-governing British colonies in the Antipodes have thus furnished valuable experiments in the direction of State Socialism. The paternal government of a dependency like India is less instructive, as being for the people, not by the people. America is in this respect a land of greater promise. Canada has paid members of Parliament, free education. Crown forests, and a Department of Labour ; but is following England, not leading her, in social policy. It is not so across the border. Yet though the United States is a world by itself, it is entirely English in its attitude to Socialism. Like Great Britain, it is not fond of general principles of policy. But, unlike Great Britain, it has in its large continent a wide room for experiments. Though it sounds a paradox, its numerous experiments in Communism belong to Individualism ; none are made by Govern- ments, but by groups of individuals already under protection of Government. But the opening up of the West ❓❓❓ Ohio, Indiana, Illinois, Missouri ❓❓❓ was assisted actively by the Governments, which made grants in aid of roads, canals, and railways, and lent capital to settlers, or promoted banks for such loans. This eagerness to quicken the pace of industrial progress, in the United States as in the Australian states, is the mark of an irreflective State Socialism, hardly to be ranked with the State Socialism of old countries. At present the socialistic experiments go on more slowly ; but they are nearly as various as there are states in the Union. Many states have a usury law, as once in England, fixing the maximum rate of interest on loans. Many states exempt homesteads from seizure for debt, an exemption extended in Texas to nearly all the customary goods and chattels of the settler. Wyoming and three other states claim control over all water ; Indiana controls the use of natural gas; Maine, not to mention other states, forbids the sale of

intoxicating liquors. These are only a few instances out of many.i The rail- ways are not owned by the states, and the legislatures of the states are the scene of constant attacks on the railway companies. Decisions of the Federal Court in 1876 estab- lished the right of a state to a control over undertakings of the nature of monopolies. In 1887 the Federal Government itself, by the enactment of the Inter-State Commerce Law, exercised public control over railways running beyond one state into another.

This is State Eegulation, not State Socialism ; and the same is true of the attempts under the Sherman Anti- Trust Law of 1890 and the numerous attempts of the legislatures of the individual states to deal with the great corporate combinations such as those formed to forestall and engross the supply of sugar, tobacco, soda, wall-paper, coal, indiarubber ??? to say nothing of the monopoly of oil under the Standard Oil Trust, and of steel under the Steel Trust of 1901. Trusts were thought to be specially dangerous in the case of articles deemed necessaries. Socialists of the modern scientific school have always regarded them as inevitable results of competitive trading, paving the way for the engrossment of all large industries by the State. But in America the mischiefs do not seem to be leading to the socialistic consummation. Trusts are seen to cure the evils of fluctuation, speculation, and wasteful overlapping. The people would prefer to see trusts controlled by Government rather than swallowed up in a Government trust.

??? For a longer list, see Bryce, American Omnmonwealth, part v. ch. xov., ed. 1895.

From various causes trade unionism is not even now so weU organized in the United States as in Great Britain. With the formation of the Knights of Labour (1878) under Stevens and Powderly, there seemed to be growing up a new power in the country ; but Powderly attempted impossibilities, trying to unite workmen generaUy, without regard to divisions of locaUty, or allowance for diflference of skill or for rivalry between trade and trade. The Federation of Labour goes more vnsely to work, dealing with particular grievances of particular trades, and pressing for redress of flagrant grievances. Appeal is made to the State mainly when the

Federation has failed ; action through the State is the second resource, not the first. The Convention of 1892 demanded Collectivism; the Convention of 1893 retracted the demand. Yet Socialism makes its converts, even in the New England states, and not simply among German immigrants. Henry George, on his return from England in 1883, formed the United Labour Party, to spread his views of the righteousness of a single tax on land rents, to displace all other State revenues. Henry George has been often hailed as an Individualist, and his "nationalizing of the land" stops far short of Social Democracy ??? the Social Demo- crats were expelled from the United Labour Party in 1887. But George's programme included more State intervention than is involved in the single tax. Almost the entire body of Socialists of all denominations sup- ported his (unsuccessful) candidature for the mayoralty of New York City in 1886, when he received 68,000 votes. A village in Maryland tried (though in vain) to get legal powers to adopt->his single tax (1893). Having made a convert of Father M 'Glynn in New York, he imagined that the Pope's EncycKcal, De conditione opiflcum, was aimed entirely at him ; and he wrote an open letter to the Pope in reply (1892). George's death (during his second candidature for the mayoralty of New York, October 1897) did not end his influence, in some respects a very healthy one.

The Social Democrats have been represented since 1877 by the Socialistic Labouj Party, consisting mainly of Germans. The aim of Edward Bellamy's Looking Back- ward (1888) was " to nationalize the functions of production and distribution," converting the United States into a gigan- tic industrial army under the generalship of the President, and so abolishing the evils of trusts and corners and modem competition generally. The Nationalist Magazine appeared in 1889 to advocate at first full-formed Nationalism, and afterwards, when the times seemed less ripe, experiments like Robert Owen's in the way of socialistic colonies. But the magazine died from lack of support in 1892.

Almost simultaneously with Nationalism, the People's Party, or Populism, sprang into being, at a convention of the Farmers' Alliances, Knights of Labour, and other organizations (1889). Its programme included (with some vacillation) abolition of the present banks, taxation for revenue

only. Government ownership of railways and canals, free coinage of sUver. This party was one of the chief supports of Mr Bryan in his unsuccessful campaign for the Presidency in 1896. It has taken its place as one of the fighting political parties ; and it is hardly to be reckoned, except incidentally, a socialistic body. It has been well said that a Socialism which proposes, like Bellamy's, to abolish the separate states of the American Union, is therein attempting quite as hard a feat as the abolition of private property. The Populist Party is not fully committed to either attempt. Its members have little devotion to general principles, and would probably accept social reform with or without Socialism. Accom- modation to altered circumstances is being forced on Sociahsts by experience, in America as elsewhere ; and in

the experience of modern nations centralization is possible without Social Democracy, and decentralization without Anarchism.

Since the knowledge of opposites is one, to understand modern Socialism we must know something of Anarchism, Anarchism ^^'-^ haunts it like its shadow, and resembles and the it Only (though that is much) in attacking the Inter- system of private property as it now is. In national, j^jj^erica the Socialistic Labour Party is con- fronted with the Anarchist International Working People's Association. Anarchism has proved to be more truly international than Socialism. Social Democracy itself was felt by Marx and his disciples to be comparatively feeble unless international. Like modern Bimetallism, without an international agreement it may be crippled by the proceedings of nations that do not adopt it. The Inter- national Working Men's Association, founded by Marx in May 1864, was the practical scheme into which he threw himself heart and soul. He lived to see the International feared by all Governments on the continent of Europe. Its motto was that of the Communistic Manifesto of Marx (1848): "Proletariate of all countries, unite!" It held congresses at Geneva, Lausanne, Brussels, Basel, but survived the Paris Commune little more than a year ; and after meeting in London (1871) held its last meet- ing at The Hague in 1872, when it expelled the Anarchists. A new International

met at Geneva in 1873; and though from time to time International con- gresses have been held at the usual centres, the control of the International, in the narrower sense, had passed, from that year onwards, into the hands of the Anarchists. The old International had been ???successful in planting the ideas of Social Democracy over all the countries of the Continent ; it had not succeeded in bringing about united action of the proletariate of all countries for the ends of Social Democracy. At the Ghent Congress of September 1877 the differences between the sections of the party led to sharp contentions. Many delegates declared themselves Anarchists : " Com- munism, 'they said,' is community and government; we desire Anarchism, which is community and anarchy." By "communism" they here understand Social Democracy, the communism of the Communistic Manifesto of 1848. This Manifesto, as compared with the contem- porary plans of Louis Blanc for self-governing associations, seems to the Anarchists entirely retrograde. They dread the prospect of a government of industry after a military pattern ; a strong centralized government is certain, they say, to be a tyranny. The most scholarly writers of the Anarchist Party (like Kropotkin, Elis^e Reclus, and Tcher- kesoff) consider that the pretensions of Marx to having founded a Scientific Socialism are unjustified historically, and that the Socialism itself is unjustified logically. They desire the abolition of all great central governments, and the establishment, in p^ace of the present system of things, of groups of autonomous small communities, in which the individual man shall support himself according to his wants and capacities. But the Anarchist benefits us more by his keen criticism of defects than by his plans for re- formation. Even in the soberest sections of the party it is hard to find men who reason out the way to their ideal.

We might divide Anarchists, very roughly, into three classes. There are, first, those who use the Universal Negative : they feel sure that political government as it is, is bad, and they would destroy all government ; they are Nihilists. This is the class associated with deeds of violence. There are, next, those who would have ComniuniHm established without a central political government, but under a public control, exercised by local councils till the time come when public opinion will be a

sufficient control by itself. WiUiam Godwin taught a similar doctrine in 1793. William Morris, when he left the Social Democrats, was drifting in this direction. There are, finally, the extreme Individualists, described in Carlyle's words as content with "Anarchy plus the street constable," and regarding the intervention of the State as a necessary evil, to be reduced to the smallest possible dimensions. These views are represented by Mr Herbert Spencer and Mr Auberon Herbert. They regard private property as the stronghold of individual liberty. They are rather an academic than a popular party. The really powerful party among the Anarchists is the middle party, disowning mere violence, and yet refusing to work in parliamentary harness, seeing no virtue in political government, even when representative. There is now a Parliamentary Socialism; there cannot logically be a Parliamentary Anarchism. Such a return to nature as is involved in successful Anarchism would be truly a revolu- tion. The whole course of civilization hitherto has been hand in hand with law. The Anarchists would persuade us that there can be order ???without law, and a better order than with the best laws. But when they propose practical schemes, these are found to involve laws on a small scale, the laws laid down by the autonomous groups into which the Anarchists would break up present states. That such groups can live and work under the segis of a State has been proved possible, but not that they can take the place of a State. Before the group could be secure against disturbance from without, it must either be under the shelter of a powerful military State, or rest assured that there is nothing but peaceable groups of like mind all around it. This last alternative would demand an inter- national agreement, and a moral change in average human beings of a far more sweeping., character than is required even for Social Democracy. If men cannot be made virtuous by Act of Parliament, neither are they so virtuous, or wise, or well-instructed as to dispense with Acts of Parliament. Anarchism, in short, seems, like the doctrines of the Society of Friends, on the whole too high for human nature, as we know it ; and no convincing proof is given by the Anarchists that human nature is changing in the right direction so rapidly as to justify their aspirations. Moreover, if the change did take place, the world would probably have thereby become a tolerable world for us all even under the present system.

Both Socialists and Anarchists have claimed that the theory of Evolution, especially in the form founded by Darwin, tells in their favour. Mr Herbert Spencer has found it necessary to disclaim the socialistic conclusion in his own case. Evolution, in his interpretation, tends to Anarchism. But all the Scientific Socialists see in it the contrary tendency, with at least equal reason. Strictly speaking, the school of Marx and Engels- ought to abstain from prediction altogether, and rest content with the reflec- tion " 'What must be, shall be." The rest of the world, believing that human affairs are not fatally determined by purely economical causes, may criticize Social Demo- cracy as an ideal, which it is perhaps in men's power to realize.

The Anarchists seem to be right in thinking that a strong central government, to which all power was given over , industry as well as over all other departments of human life, would be contrary to liberty. Supervision would necessarily become more and more importunate, and great powers would mean great temptations to abuse of power, if men remain as we know them to be in all present kinds of government, bureaucratic, aristocratic, and demo- cratic. The objection is not weakened if we take seriously the claims made by the old-fashioned Social Democrats for the supremacy of the working classes in the narrow sense

of the word. There is no reason to believe that working men are either better or worse than men of the other classes, and that they would behave differently under like temptation. Apart from actual tyranny of such a collect- ivist government, there might be a danger that individual initiative, however encouraged in theory, might be dis- couraged in practice. In fact, many of the objections found in old text-books of Political Economy have truth in them, and the Social Democrats show by their changed policy that they are well aware of this. It is true, how- ever, that the objection from population applies to social reform generally, and not to Socialism in particular ; and it is true that the objection from natural indolence applies less to Socialism than to Anarchism; Socialism

would probably give not too much but too little indulgence to what it considered laziness.

The Anarchists, again, seem to be right in thinking that their rivals have misread the signs of the times in modern industry, and that the tendency towards con- centration, both of businesses and incomes in fewer hands, is not the general rule. Gas and electricity seem likely to revive domestic and local industries. Great companies with some thousands of shareholders are be- coming commoner than businesses held by single persons or families.

Even if all were tending to concentration, it is not easy to see how all is tending to prepare the bulk of the people for the revolution that is supposed to follow the concentration. Without more knowledge, self-control, and habits of business than they have now, the great world of the employed would not be fit to direct the course of industry and of their own employment. Without an industrial and moral preparation, therefore, Collect- ivism could not be a temperate and wise and permanent government. Yet the old – fashioned Social Democrats delighted in telling us that Capitalism made and kept men unfit for the higher functions of a human life by the bad social conditions it created. If the change is not to be sudden (and the modern Social Democrat usually admits this), then the necessary discipline must go on now, even under CapitaUsm ; and it will fit men to use even their present opportunities better than formerly. Till they are capable of co-operation they are not ready for Socialism. The improvement of the workman is more important for the future of society than the improvement of the millionaire. There are signs that both are advancing together ; and the result may well be that when men are

ripe for Social Democracy, they will find Social Democracy superfluous.

Half a century's experience of Scientific Socialism seems to have served the cause of progress, though not in a way expected either by the Socialists or by their opponents. The programme of the Manifesto of 1848 has not been accomphshed. The proletariate of all countries knows each other better, but the nationalities have not disappeared. Achievements in State Socialism have been carried out by the several states, each one for itself, modified sometimes , by a common understanding, which is far

from being united action. . While the Social Demo- crats have gone the way of Marx, Germany, since German unity, has in one sense gone the way of LassaUe. The old fear of Socialism, as a sort of unknown force for evil, has given place to a familiarity which has bred deference, if not compliance. In Great Britain and America, Socialism has helped to popularize the serious study of industrial and social questions, where too many persons had been content with mother-wit and tradition. SoeiaUsm, by teaching that competition in industry is all evil, has taught many to distinguish between the good and the evil of it. Instead of kilUng Political Economy, it has caused a healthy revival of it. Politically, the old-fashioned Social Democrats insisted too abstractly on the all-pervading power of the State, as Lf that could replace the laborious ant-Uke efforts of its millions of subjects. But it helped to remind rulers that government is founded on opinion, and that the best way to avoid the need of the Social Democratic revolution is to make the govern- ment really democratic. At first the appeal to force was met by force ; both parties have needed to learn that force without opinion makes no permanent institutions.

Authorities. ??? The list of these would be too long to quote in full. The German bibliography of Stammhammer, the handbook of Stegman and Hugo, and Warschauer's History of Socialism give endless references. Sehmole and Kulemann give the history of German trade unions. For the latest aspect of German contro- versies, see E. Bernstein's Voraussetzungen der Sozialdemokratie, 1899. For the general history, see Eae's Contemporary Socialism, 2nd ed., 1891 ; for that of America, see Ely's Recent American Socialiim, 1885 ; and of New Zealand, Reeves' LoTig White Cloud, 2nd ed., 1899. For Anarchist criticism of Marx, see W. Tcher- kesoffs " Pages d'histoire Socialiste : Doctrines et Actes de la Social Democratic " (from the Temps Nouveaux of 1896). For general references, historical, biographical, bibliograpliical, see the files of the Economic Journal (London), the Quarterly Journal of Economics (Harvard), and the Political Science Quarterly (New York). (j. B.)*

SOCIAL PROGRESS IN GREAT BRITAIN.

Balldlag.

I’S common use the phrase Social Progress refers especially to the conditions under which the mass of the people lives rather than to changes which take place among the rich, and it is in this sense that it is used to cover the sub- jects dealt with in this article. Building is the most evident sign of development, and in the last twenty years of the 1 9th century the amount of building was remarkable. Great towns are now generally sur- rounded by new suburbs inhabited mostly by people with incomes under ►►300 a year. These suburbs have busy thoroughfares lined by shops, and long, straight roads, where each house has a little garden and some attempt at ornamentation. The number of houses in Great Britain of the annual value of ►►20 and upwards in 1878 was I8‘9 of the total; in 1900 the number had become 22”3. The growth of such suburbs is, however, matched by that of others occupied by city merchants and rich people, whose houses are almost mansions, and stand in their own

grounds. In 1900 there were 23,120 dwelling-houses in Great Britain assessed to house duty at an annual value exceeding ►►200 a year, as compared with 18,108 in 1878. But perhaps the most conspicuous house-building of the period is that at holiday resorts. Whole towns have been built by the seaside, and places which, in the early ‘eighties, were hardly knovni as villages have now a large popula- tion of residents retired from business, besides accommo-, dation for thousands of visitors during the summer who have both time and money to take holiday. Within the great towns themselves the builders have not been idle. Slum dwellings have been cleared under Cross’s Acts, 1 87.5- 82, and the Housing of the Working Classes Act, 1890; and on the spaces so cleared, as well as on others privately acquired, block dwellings have been erected. The character of neighbourhoods in the heart of great tovms has thus been much changed. Instead of small tenement houses ►►► buUt originally for the occupation of one family, but used

Legisla- tion.

sometimes for as many families as there are rooms ??? there are now in the industrial quarters great barrack-like build- ings four or five storeys high, with sets of rooms each fitted for the a-ccommodation of a family. But much remains undone. There are still in every town houses unfit for habitation. There are stUl people so ignorant and so careless as to render abortive any attempts to house them decently. There is increase of overcrowding as slums are destroyed and as towns attract large immi- gration from the country. The improvement, however, is marked. Public buildings, as well as private dwellings, have been raised in character. . On all sides schools have been built ; and instead of hiding behind churches, as in former times, they have come to the front as the chief feature in the street. Public libraries, generally housed in handsome buildings, have become common. Baths are to be found in most neighbourhoods. Hospitals have been built or enlarged, and poor-law establishments extended. The development of municipal life is expressed in the town halls or board offices in which the work of administration is carried on. The change is most noticeable in towns, but is also to bp seen in the country districts. In many villages institutes have been opened, cottages have been improved, factories moved from the towns have been established, and institutions have been set up for the care of the sick, the insane, the orphans, or the poor.

If the observer turns to the legislation of the period which has most directly affected social relations, he dis- covers the Housing and Building Acts, the laws which have created county and parish councils and established technical education boards, the Criminal Law Amendment Act, the extension of the fran- chise, the Allotments Act, Compensation for Injuries Act, and Kobson's Act for raising the working age of children (1899). But greater in importance than anyof these has been the continued progress of education under the Act of 1870. Great numbers of new schools have been built, and old ones have been almost everywhere improved. The system, too, has been changed, so that teachers have more freedom to develop the capacities of the children without so much regard to the results, which can be tested at inspection. In towns higher-grade schools have been started, and some attempts are made to interest as well

as to occupy the children's minds. In the country the difficulties are greater and the improvement is not so marked. The technical education boards have increased the attractions for adult education. Young men and women are coming in increasing numbers either to learn the secrets of skill in their own trade or to fit themselves better for the daily duties of life. The Society for the Extension of University Teaching, starting in 1873, has also promoted the move- ment to higher education, and has led to the establishment in some towns of university colleges. The great London polytechnics have become centres in which adult teaching of every kind has been associated with social life.

The establishment of county councils, and in a less degree that of parish councils, has aroused interest in local government. People have become more conscious of the power of common action, and in some cases have gained a sense of local jiride. There is greater attention to administration, a more general care for improvement, and a stronger inducement to collective enterprises. Munici- palities have taken up the business of trading on their own account. They have built houses, opened lodgings, bought up water, gas, and tramway companies ; and there are many proposals for enlarging their operations in this direction. Municipal indebtedness in conse(|uence rose from ££75,404,447 in 1878 to ££172,647,320 in 1899. This sum £££ representing ;in increase of 100 millions in twenty-four years £££ does not include the debts of urban

district authorities, burial and harbour boards, &c. The local debts of England and Wales for all purposes were in 1890 ££198,671,312, and in 1899 ££276,229,048, in- cluding debts for trading undertakings which, of course, often return adequate interest. The local debt of Scotland is ££32,496,766, and of Ireland ££5,091,960.

The Franchise Act, working with other causes, has enlarged the electorate. In 1881 the total number of electors was 3,077,000, in 1895 the number had risen to 6,732,613 £££ that is to say, 161 in the thousand of the population now have votes, against 88 who had votes formerly. The Allotments Act, making it possible for labourers to work the land for their own profit, has created another interest to occupy men's minds.

But the attraction of town life, which continually draws to itself the more energetic and the adventurous spirits, together with the reduced prices of country pro- duce resulting from improved means of transit from distant lands rich in corn and meat, has produced the phenomenon known as agricultural depression. Land has fallen in value ; persons and corporations depending on rents drawn from farms have been crippled, and farms have in many cases been given up. There are, indeed, at the end of the period signs of improvement. Efforts are being made to induce farmers to co-operate, as in Denmark, and to give more attention to the growth of vegetables and poultry, which the towns demand ; but the depression stiU exists, and men anxious to attain a better position flock into the great centres of population. Between 1881 and 1891 the returns show that there was in England and Wales a decrease among agricultural labourers of 173 per 10,000 of the male population, in Scotland of 109, and in Ireland of 140.

The other social legislation of the period to which reference has been made marks increased desire to protect the weak ??? women from the abuse of men, workpeople from the overpressure of work, the injured from the effects of their injuries, and children from the greed which would yoke their youth to labour. Such legislation is still on its trial ; its failure is in many directions manifest, but its existence is a proof that a new force is recognized in social relations. The doctrine that each individual must stand by himself no longer holds. The many have become responsible for the one, and society interferes when, on account of sex, or poverty, or age, the individual is too weak to make equal terms with his neighbour. In 1893 the amount of damages awarded under the Employers' Liability Act (1880) was ??9418 ; in 1900 the amount was ??11,990. In 1897 there were 1998 prosecutions under the Factory and Workshops Act, and the fines and penalties were ??3609. In 1900 there were 1869 prosecutions, and the fines imposed amounted to ??3971. Under the Work- men's Compensation Acts 1942 cases were heard during 1900. The result was in 1050 cases in favour of the applicants. The lump sum awarded was ??50,778, and weekly payments amounting to ??356. There is no record of the number of cases settled by agreement or informal arbitration.

No less important than legislation m affecting social relations is philanthropy, the spontaneous goodwill which leads to beneficent action. The growth of such goodvidll has influenced the treatment of the

Pbltan- tbropy.

poor, of criminals, and of children. The guardians acting under the Poor Law have improved their infirmaries by introducing trained nurses, humanized the workhouses by some classification of inmates, and set before themselves the duty of keeping the children apart from degrading associations. Charitable people, dire ? ?tly through the agency of the Charity Organiza- tion Society, or indirectly by acting on the principles it

represents, have aimed at giving permanent rather than temporary relief. Charity is more far-sighted and kinder than it was. Pensions have in some degree taken the place of doles, and givers show more regard for the self-respect of recipients. Personal service is more common, so that men and women become the almoners of their own gifts, and, serving on public boards, consider the needs of individuals. Some have adopted the principle of living among the poor in what are now called "Settlements." Associations of men and women have banded themselves together, especially in the service of children, representing the growing consideration of the needs of the young and the recognition of the fact that it is by friendship and not by machinery that good can be done. Keligious bodies have increasingly become centres of social activity. Churches and chapels have their missions, their clubs, and their entertainments. Sermons have almost changed their character, and are often appeals to people to work rather than to think. The Christian Social Union represents the activity of a large number of Churchmen concerned to bring higher principles into the common relations of buyer and seller, master and servant. The Salvation Army, which began as a purely preaching organization, has now a "social side," and is active in providing " shelters " and " work " in industry or on the land. The same humane feel- ing accounts for the growth in the number of institutions.

Every year societies are formed or buildings erected to meet needs which sympathy has discovered. Most marked, but still insufficient among such institutions, are those provided for the sick. The prince of Wales's (now King Edward's) Hospital Fund has gathered in enormous, yet inadequate, sums. Old hospitals have been extended and new ones founded. Nursing homes have been established and resorts for the convalescent provided. Every discovery of medical science is brought within reach of the poor, and the development of the nursing art has revolutionized their treatment in sickness. The means of convalescence in small country homes, in great institutions, and in villagers' cottages, have been so increased as to be within almost any one's reach. Children's holiday funds now send thousands of children yearly from the towns for a fort- night's holiday. The Charities Register, published by the Charity Organization Society, is instructive reading, as showing what is being done by the rich for the poor. If the register of l882 be compared with that of 1901, the change both in the quantity and quality of charity will be obvious. Philanthropy, however, cannot be measured by its own works. The rule of the spirit of goodwill is most powerful in the ordinary relations of life ??? in the treatment of tenants, workpeople, women, and children.

It is impossible to glance over our period of social history and take no notice of the agitations about the The ua- " ^^nemployed," which culminated in riots in employed Trafalgar Square, and caused the formation of and the a Mansion House relief fund, which was itself '"??"??? a fruitful source of discontent, and ended in a controversy as to the causes and remedies which has not yet ceased. The very fact of industrial progress tends to throw out of work those unfitted by health, education, or character to reach the high level required ; and one sign of the times is the congestion, in certain quarters, of men who cannot or will not earn a living. Many schemes have been suggested, such as that carried out by the Salvation Army, for giving such men work in a labour colony ; but as yet no scheme offers a solution. The unemployed are always with us, subsisting on the charity of free meals, shelters, and casual wards, for which they feel no gratitude, and ready at any time of pressure to become the centre of an agitation.

The demand for a check upon the immigration of aliens

grows in volume, but has not borne fruit, though it has been fostered with vigour. As a matter of fact, England has fewer aliens than any other nation. In France 2 ‘7 per cent, of the population are foreigners, in Switzerland 9 “6 per cent., but in England only 0‘68 per cent. In 1899 the excess of emigration from the United Kingdom over immigration into the kingdom was 21,925, and in 1894 it was 28,016.

From another side has gone up a cry for old-age pensions. The inquiries of Mr Charles Booth, which brought out many unknown facts as to the life and labour of the people, showed that in 1890 there were 218,743 persons over sixty in receipt of poor relief. The im- port of his figures has been questioned, but his conten- tion that the needs of the old should be met by a pension of 5s. a week given to every person over sixty-five years of age has met much support. There have been three Royal Commissions on the subject and various schemes have been proposed, the chief result of which has been to draw increased attention to the difficulties involved.

Among the lower classes generally the signs of progress in what used to be called the ” condition of the people ” question are evident. As has just been noted, people go about the streets better clothed, with ”[illegible]”’”’”<"' regard both to comfort and to taste. Eags are [illegible]pjg^ less common than they were in the 'eighties ; boots [illegible] partly through increased cheapness [illegible] are almost universal ; the shops offer a greater choice of dress in material and colour, while the effect of teaching in dress- cutting is seen in the improved style adopted. The artistic movement associated with the names of Ruskin and William Morris has extended from the top to the bottom of society. Furniture and wall-papers, as well as dresses, have another character. Rooms may still be over full of furniture, but prosperity has now its signs of beauty other than the vase of wax flowers or loud-toned wool samplers. The people at the same time seem better fed : there are few in a crowd who could be said to be starved, while many have the appearance of good living. Food is cheaper. Wages have gone up. The dock strike of 1889 made 6d. instead of 4d. an hour the regular wage for unskilled labour, and the wages of skilled labour have risen in greater proportion. The resources of the working classes, made larger by the decreased price of food and dress and by the increased rate of wages, have been further strengthened in provincial towns by the

growth of the co-operative principle of trading. In 1882 the total capital of co-operative societies in the United Kingdom was ►►8,736,380, and the cash received for goods sold was ►►25,598,088. In 1899 the capital had risen to ►►26,362,126, and the cash taken to ►►67,914,520. The result of their improved conditions is to be seen in the savings of the people. There is now in the Post Ofiice Savings Bank ►►130,118,605 belonging to 8,046,680 depositors, against ►►28,740,757 in 1877 belonging to 1,791,240 depositors. There is also ►►7,462,134 now held for depositors in Government stocks in addition to ordinary deposits. The friendly societies are 29,985 in number, with more than 1 1 millions of members and more than 37 millions sterling of funds. Building societies, on account of the failure of the Liberator and other societies, have not increased. There were 2079 societies in 1887, with liabilities of 52 millions, and only 2325 in 1899, with liabilities of 45 millions. By their means, how- ever, an unknown number of people have become owners of their houses. Life assurance has marvellously increased. In 1871 there were 107 companies holding 87 millions, in 1891 there were 89 companies holding 165 millions, whereas in 1901 the oflSces were possessed of 250 millions. The rate of increase, that is to say, has been

mucli more rapid in the second period. Along witli better dressing and better feeding has come a greater sense of self-respect. People as a rule are more polite, if not more considerate ; there is not the same horse-play on holidays ; and notwithstanding outbreaks of "Hooliganism" ►►► i.e., riotous and brutal conduct by boys in the streets ►►► ^people are more courteous, if not more gentle. Better health equally with better education has secured this result, and this is largely due to the development of sanitary science. Towns are more adequately lighted and cleansed, houses are fitted with more scientific appliances, and if water is still somewhat sparingly supplied, it is of decidedly better quality. The lighting of towns and villages has been im- proved. The standard of cleanliness in streets has been raised. The number of official inspectors has been doubled, often quadrupled, so that dirt is continually limited, de-

fective drainage remedied, and foul places made sweeter. The sick of infectious diseases are immediately removed in public ambulances to a hospital situated in good air, provided with every appliance which skill and money can reach ; and there they are nursed till they can be restored well and free of infection. In 1893 there were 587 local authorities in England and Wales who had provided accom- modation for infectious diseases. Since that date, under the pressure of the Local Government Board, great strides have been made. There are now many more such hospitals. The healthy have the advantage of enjoying the open spaces, small and large, which have been made available. During 1898 the sum of ??786,233 was expended on open spaces by various municipal authorities; in 1899, the sum of ??805,.592. Churchyards in crowded neighbourhoods have by this means been laid out so as to afford quiet places to sit and rest, and parks have been provided for the recreation of those who would enjoy the pleasure of walking amid the flowers, listening to music, or the vigorous pastimes of football or cricket.

An observer suddenly lifted from 1880 and planted in a town of to-day would perhaps first of all be struck by the pace at which things are done. Railway passenger traffic has greatly increased, electric trains and trams have been started, people run to and fro about the country and travel daily to their homes. It is computed by Sir J. Wolfe Barry that 1,000,000 persons enter and leave London daily by railways alone. In one hour 1228 vehicles and 5660 pedestrians pass through the Strand. In 1879 the metropolitan tram-cars ran 7,701,999 miles and carried 56,041,767 passengers. In 1900 they ran 31,679,397 miles and carried 337,058,869 passengers. It is impossible to show the absolute growth in London local raUway traffic, as the great railways do not furnish returns for their sub-urban trafBc separately from their main line and provincial traffic, but the distinctively metropolitan railways in 1879 carried 112,801,531 passengers, and in 1900 they carried 192,437,707 passengers. In 1882 there were 7,987,877 workmen's tickets issued by railways having London termini, and in 1899 there were 41,831,657 so issued, i.e., a daily average of 134,507. The London General Omnibus Company carried 135,131,902 passengers in 1894, and 195,692,126 in 1899; the Eoad Car Company carried 44,610,320 in 1894 and 65,326,150 in 1899. The I\Iotropolitan Police in 1881 issued licences for 5800 two-wheel cabs and 3847 four-

wheel cabs, and in 1900 for 7531 two-wheel and 3721 four-wheel cabs. Work is everywhere done at increased speed, and the cost of such speed is to be found in the terrible death-roll of industry. It is stated in the report of the Royal Commission on Accidents to Railway Servants that in 1898, 542 servants were killed on the railways and 12,979 disabled ; the proportion who suffer in mines is about the same. The total number of workpeople killed by industrial accidents in

1900 is reported as 4785 ??? 434 more than in 1896; and the total number injured was 104,464 ??? 46,982 more than in 1896.

Sunday is less quiet than it used to be. People wanting something to do get out of town by cycles or by trains ; they go to concerts or picture galleries ; they visit their friends and entertain parties. The Sunday League organizes gigantic excursions from town to town or from town to the seaside, the profits of which are spent in providing free or very cheap concerts of high-class music. The Sunday Society's long agitation for the opening of museums and picture galleries was crowned with success in 1896, when Parliament resolved that institutions under their control should be opened. The use made of the opportunity is at present not great. People are not sufficiently educated, and the numbers who visit the National Gallery show little yearly increase. The municipalities, vdth some notable exceptions, open the public libraries, and in many towns lectures are given.

Work is done and life is lived under greater pressure, but at the same time more leisure has been secured. A half holiday in the week is general, and the provision for week-end excursions is being developed ; many trades have secured a nine hours' and some an eight hours' day. The leisure so gained is used largely in the enjoyment of sport, actively by some, and by a larger number as spectators Schools are valued for their games as much as for their teaching ; a hero of the football or cricket club is more honoured than a scholar, and nations hang on the issue of international contests. All classes seem equally to delight in the development and use of physical strength. Every town, almost every parish, has an athletic club, and every indi- vidual is interested in its success. A football match easily draws 50,000 spectators, sometimes 100,000, and every year the language

is enlarged, if not enriched, and the thoughts of people modified, from the vocabulary of games. The development of athletics is matched by the increase of popular literature. In 1870 the total number of London newspapers filed at the British Museum was 224, provincial 667, Scotland 136, Ireland 154. In 1900 the London newspapers were 1226, provincial 1664, Scotland 282, and Ireland 222. Halfpenny papers have been started, and although no special returns are available, it is computed that every town of 45,000 inhabitants has such a paper. The number of periodicals is constantly increasing, and is now roughly computed at 21,000 per annum. The char- acteristic of both popular journals and magazines is news and stories shortly told. They seem meant for readers in a hurry who have no time to think, and they appeal to the more sensational side of human nature. The expiration of the copyright of many standard authors has thrown on to the bookstalls an abundance of good literature which finds a ready sale. Sport and newspapers together have opened greater facilities for the gambling which now takes a place near drunkenness as a cause of crime. Matches are got up not only for the sake of the show of skill, but to give opportunities for bets, and many newspapers obtain a large sale by supplying food for the gambling appetite. The statistics of drunkenness and of the efforts to control the drink traffic are given in the special sections below ; but, speaking generally, the habit of getting drunk seems to have decreased and the habit of taking drink to have increased. The character of popular pleasure is what might be expected to follow an education which leaves the mind untrained to think and a life strained and hurried. People demand excitement at the least cost of mental effort. They like, therefore, as well as gambling and drinking, sports and sensational literature, exciting plays and songs. There has been a marked increase in the pro- vision of theatres and music-halls. There is also a much

more widely spread desire to attract attention and to appear in print. Hence the growth of " personal " journalism. The question whether, with the love of excite- ment, sensuality has also increased cannot be answered

by statistics ; but judging from observation, from the tone of talk in clubs, and from the number of persons who require medical care in the infirmaries, it would seem as if less self-restraint were exercised. The occupation of their leisure by the people remains somewhat of a mystery. There are many trades which in winter leave off work at four o'clock. Some of the men so released may be found in continuation schools and libraries, some may frequent public-houses and places of amusement, but the greater number remain unaccounted for, and it seems fair to assume that they return to the homes they have built up by thrift, and spend the evening with their families reading, talking, doing odd jobs, or sleeping.

There has during ??? the period been much more talk of religion, matched by a show of greater respect for religious agencies ; but whether this means that the sanctions of religion are more powerful to inspire and restrain conduct, or to give peace and comfort, is a question not easily settled. Statistics would probably show that in every denomination there has been an increase of church membership, but the increase may be due either to the development of party feeling, which leads to zeal for opinion rather than for god- liness, or to the interest in the social work undertaken by churches ??? and this is not necessarily a religious interest. The answer to the question can only be an individual opinion, but the opinion of the writers is that religion is less powerful than it was, say, in the 'seventies. It may be that then religion was more mingled vnth superstition, but it had a power to restrain and to give peace which it does not at present generally exercise over people whose thoughts have been widened with the process of the suns. Keligion lies in a lower intellectual atmosphere than that which is commonly breathed, and does not therefore so deeply affect life. It has not kept pace with the general advance, and thus it is that people are not under authority ; they are not bound to certain courses at the cost of profit or life, and they are not at peace when their world is turned upside down. The demand for excitement, the indulgence of vanity, the hurry of life and the absence of control have increased the tendency to mental disease, and one of the problems of the immediate future is the treatment of insanity. In 1881 there were in Great Britain less than 2 per 1000 of the population insane, and at the census of 1891 the ratio exceeded 3 per 1000.

The signs of the period which can be measured leave the inquirer seeking the spirit which lies behind. Perhaps it may be best described as an increased sense of individu- ality ??? a greater consciousness of a right to be. This spirit should show itself in attempts to realize the highest individual existence ; but because a class of people who have few responsibilities to workmen, or tenants, or neigh- bours, and indulge themselves as they like, now occupy

public attention and the most honourable places ideaT "" ^^ society, it tends to show itself in a desire

to escape toil and to reach a life as easy as that of the millionaires. Prosperity has increased the attraction of material comfort. The ideal of the individual is freedom from trammels and mastery over others. There is thus a widely-spread determination to have a good time while it lasts, and there is a growing impatience of control, whether it be that of authority, of public opinion, or even of responsibility for the future. One outcome of this dis- position and this aim is to be seen in the spread of socialistic theory. Socialism seems to promise security to the individual to enjoy his life. It promises this result at once without the fatigue of thought, the exercise of

responsibility, or the weariness of waiting. It offers to remove the pressure of work, to rescue the individual who is being crushed by competition, and to give to each the means of material enjoyment. There may be some signs of a disposition to "think in conununities " and of a tendency to subordinate the present to the future, but as yet the most powerful motive is the individual's longing to do the best for himself in his own time. Another out- come of this development of the sense of individualism is to be found in the prevalence of a more arrogant or insolent tone. There is thus at one and the same time a demand for the stricter enforcement of law to secure rights, and a defiance of the laws which are in existence. The " haves " incline to assume, and the " have-nots " incline to rebel. They who are strong tend to show their strength. Hence come some of the extravagances of fashion, the lawlessness in high places and low places, the impatience of reforms whose fruits are in the future. The prevalence of this sense of "a right to be" is not incon- sistent with the increased care

for others which is shown in legislation, in charity, and in the administration of law. Succes oblige. People who have a high sense of their own claims recognize the claims of their neighbours ; and there is undoubtedly, alongside the increased demand for more of the good things of this world, an increased goodwill to grant such things. The conqueror is often kind, and there is a certain pleasant pride in being generous. Much has been done ; the progress of a generation measured by figures is immense ; but there are stiU many old ills of society waiting a remedy ??? poverty, ignorance, and suffering. There are other ills ??? vanity, love of mastership, and the desire for pleasure ??? which seem to be taking a deeper root. (s. a. b. ; h. o. b.)

Baths.

It was not till 1846 that it was deemed advisable, for the " health, comfort, and welfare " of the inhabitants of towns and populous districts, to encourage the establish- ment therein of baths by the local authority acting through commissioners. A series of statutes, known collectively as " The Baths and Wash-houses Acts, 1846 to 1896," followed. By the Public Health Act, 1875, the urban authority was declared to be the authority having power to adopt and proceed under the previous Acts, and in 1878 provision was for the first time expressly made for the establishment of swimming baths, which might be used during the winter as gymnasia. By the Local Govern- ment Act, 1894, it was provided that the parish meeting should be the authority having exclusive power of adopt- ing the Baths and Wash-houses Acts in rural districts, which should, if adopted, be carried iato effect by the parish council. Up to 1865 it seems as if only twenty- five boroughs had cared to provide bathing accommodation for their inhabitants. There is no complete information as to the number of authorities who have adopted the Acts since 1865, but a return of reproductive under- takings presented to the House of Commons in 1899 shows that 110 local authorities outside the metropolis applied for power to raise loans to provide baths, of whom 48 applied before 1875 and 62 after 1875. In 1900 the loans sanctioned for the purpose amounted to ??83,294. No loan at all has been raised by any parish council for baths, and the total receipts for the year to 31st March 1899 of such councils under the Baths and Wash- houses Acts was

127. In the metropolis, by the Local Government Act of 1894, the power of working the Act was given to vestries, and by the Act of 1899 this power was transferred to the borough councils. There are 35 parishes in London in which the Acts have been adopted, all of which except 11 have taken

action since 1875. These establishments, according to the return made in 1899, provided 2539 private baths and 85 swimming baths. The maximum charge for a second-class cold bath is Id., for a hot bath 2d. In 1897-98 the number of bathers was 4,463,109, of whom 2,347,958 were bathers in second-class private baths and 2,115,151 bathers in second and third class swimming baths. In the previous year the gross total had been only 2,000,000. In cases where the propor- tion between the sexes has been worked out, it is found that only 18 per cent, of the users of private baths, and 10 per cent, of the users of the swimming baths, are females. In 1898 the School Board was authorized to pay the fees for children using the baths if instruction in swimming were provided, and in 1898 the privilege was used by 444,111 children. The cost of this public pro- vision in London largely on account of the high rate charged for water (12,522 was paid in 1897-98) is over 80,000 a year, which has to be paid by the ratepayers. No account can be given of the numbers using the ponds and lakes in the parks and open spaces, but it is computed that on a hot Sunday 25,000 people bathe in Victoria Park, London, some of the bathers starting as early as four o'clock in the morning. These returns show how great is the increase of the habit of bathing, but they also show how even now the habit is limited to a comparatively small part of the population. People require to be tempted to the use of water, at any rate at the beginning. There are still authorities in London responsible for 800,000 persons who have provided no baths, and those who have made provision have not always done so in a sufficiently liberal and tempting way. The comparison between English great towns and those of the Continent is not in favour of the former, but the growth has begun, and promises to go on. Swimming clubs have

become common ; the contests awake much interest, and the demand for more accom- modation is likely to be heard. (s. a. b. ; h. o. b.)

Clubs.

Workmen's clubs are a product of the last twenty years of the 19th century. The first were institutes, and liquor was not introduced till 1868. They can be regis- tered under the Friendly Societies Act, but as there is no obligation to do so, the return of 802 registered clubs in England and Wales is no evidence as to their number. In 1900 there were 54 workmen's clubs registered, and at the same time "an enormous grovrth of dubious clubs." The Working Men's Club and Institute Union has collected ~. returns, and gave evidence before the Licensing Commission, presided over by Lord Peel, that in 1896 there were 3991 clubs in which intoxicants were sold. Of this number 660 were in London, 1583 in English counties, 1291 in English boroughs, 122 in Wales, 157 in Scotland, and 178 in Ireland; 313 are returned as proprietary clubs, but these cannot represent the real number. As regards subscriptions, 1098 have an annual subscription of ??1 and over, 1158 from 5s. to ??1, 1405 from 2s. to 5s., and 329 stand at 2s. or under. Bather more than one-half the clubs open on Sunday, with a large proportion in Wales and Ireland. On week-days 1582 are open after 11 p.m., or in London after 12.30 a.m.

There is no available record showing the increase of clubs ; but it is known that, of the 3991 existing in 1896, there were only 2160 in 1887. According to the returns of the Union, it seems that in 1890 there were 328 clubs affiliated, and in 1900 there were 708. The secretary reports that of these 650 have been started since 1882. The clubs are social or political, drinking or teetotal. The drinking clubs are entirely self- su]i])ort- ing, and sometimes own the buildings they occupy ;

the teetotal clubs are generally subsidized. In the drinking clubs the average spent per week on drink is one shilling and a farthing per member. There are various opinions as to the object and use of clubs. On one hand it is contended that they exist to provide means of drinking when the public-houses are closed, that they are a fruitful cause of drunkenness, that the spirit of gambling is promoted, and that the

entertainments are often of a low character. It is reported that during ten years 352 clubs were closed by the police or the excise. On the other hand it is urged that the clubs against which such charges hold are few in number, and such as should be restricted by police action ; that they have been generally formed to promote good fellowship ; and that in most of them there is a development of a higher taste and a sense of social duty. In support of the latter opinion the Union offers evidence as to the increased use made of libraries, as to the number of club members holding office on local governing bodies (2320 in 1901), and of the ever-widen- ing interest taken by members in the affairs of the world. The Union, however, acknowledges an in- creased love of pleasure compared with the increased love of knowledge. The number of clubs having Sunday lectures has decreased, while those having Sunday entertain-ments and games have increased. The proportion, too, of political to social clubs goes on decreasing. On the whole it may be said that the clubs accurately enough represent the features of the time ??? the improved conditions which leave men leisure, the possession of knowledge which longs to spread itself in fellowship, the love of pleasure which looks for the easiest ways of satisfaction, and the dislike of restraint which is happy in a club where no one has a master. The Licensing Commission, approving of the benefit to be derived from properly constituted clubs, unanimously recommended a system of registration under such conditions as to ownership and management as would prevent individuals benefiting by the sale of drink or the admission of persons under 18 years of age.

(s. A. B.; H. o. B.)

Housing.

The first legislation on this subject was due to Lord Shaftesbury in 1851 and to Mr Torrens in 1868, but for many reasons the laws were not effective. The principle, however, was asserted that the responsibility of maintain- ing houses in proper condition falls on the owner, and that if he fails in his duty the law is justified in stepping in and compelling him to perform it. In 1875 and 1879, when Lord Cross was Home Secretary, the Govern- ment brought in Acts, and a subsequent Act in 1882, " to deal

with the whole area where houses are in- capable of repair," giving the local authorities compulsory powers to enter as purchaser (but at the commercial and not at the housing value) and proceed to reconstruct. Something was done under the powers thus conferred, but in 1884 the public mind was deeply stirred by revelations about the condition of the poor. A pamphlet published by Mr Mearns, of the Congregational Union, entitled The Bitter Cry of Outcast London, described a state of things in which health and decency were impossible. A Eoyal Commission, of which the then prince of Wales was a member ??? " one of the most powerful commissions ever chosen" ??? was appointed in 1885 to inquire into the housing question. Its action brought many details of poor life to light, but its report was followed by the Housing of the Working Classes Act of 1890, which, however, did no more than consolidate all previous Acts.

The Housing of the Working Classes Act, 1890, is divided into three parts. Part I. deals with large areas. When twelve rate- payers call upon the medical officer to investigate a neighbourhood

in which houses exist which are regarded as unfit for habitation, or when, without such a call, the medical officer represents to the local authority that an area is unhealthy, the local authority must consider the representation, and, if satisfied, make an improvement scheme. This scheme has to be approved by the Secretary of State, who will issue a Provisional Order (afterwards to be confirmed by Act of Parliament), which the local authority must obey. Part II. applies to small unhealthy areas and also to individual houses. In the former case the local authority may prepare a scheme on its own initiative, which must be confirmed by the Local Govern- ment Board, but no Act of Parliament is necessary. In the latter case, when any house is declared unfit for habitation the local authority may obtain from the magistrate an order for closure and demolition, but the procedure to obtain these orders is beset with difficulties. Part III. gives the local authority power to acquire land

compulsorily or by agreement, and erect thereon lodging- houses, separate houses, or cottages containing several tenements.

In carrying into effect schemes under the Housing Acts the Metropolitan Board of Works from 1875 to 1889 displaced some 27,000 persons of the working class and secured the provision of accommodation for approximately the same number. Since 1889 the London County Council has, under the Act of 1890, displaced some 10,000 persons, and under various other Acts some 3000 more. In lieu of the accommodation thus destroyed the London County Council has itself erected dwellings for some 15,500 persons. The net cost of all operations carried out by the Metropolitan Board of Works and the London County Council under the Housing Acts from 1875 to 1901 amounts in round figures to ►►2,700,000, while the total cost of all works under the Acts (including the remunerative expenditure on dwellings) amounts approximately to ►►3,500,000. The London County Council has in connexion with its dwellings a rent-roll which now exceeds ►►40,000 per annum. Mr Blashill, the Council's former architect, thinks that after allowing for the street improvements involved it might be fair to say " that the net loss on the council's housing schemes amounts to ►►45, or possibly ►►50, for every person dis- placed."

In 1898 the council determined to take further steps under Part III. " with a view to the purchase of land and the erection of dwellings thereon," independently of any clearance or improvement schemes. About 40 acres at Tooting were acquired, and subsequently 225 acres at Tottenham to house 40,000 persons, and 30 acres at Woking to house 6000 persons. The borough councils, under the Act of 1899, also have power to put in force Part III. of the Housing Act. The possibilities of work are immense, in the light of the fact disclosed by the census of 1891 that 214,843 persons in London lived in tenements of one room, and 330,238 persons in tene- ments of two rooms. The census of 1901 showed, however, that progress had been made. The number of one-room tenements in London has declined, and whereas in 1891 there was 9 '2 per cent, of the population in such tene- ments, there was in 1901 only 6'7 ; whereas tenements of five rooms, which in 1891 were 32-7 per cent, of the whole, rose in 1901

to 34-1 of the whole. The rate of increase during the decade in larger tenements has been exactly double that shovrai in smaller tenements.

The Cheap Trains Act of 1883 has had a direct bearing on housing by tempting railways to provide workmen's trains. The passenger duty is reduced on condition that cheap trains are run between the hours of 6 in the evening and 8 in the morning. The Great Eastern Railway has thus issued return daily tickets at Is. a week to stations vsdthin 12 miles of London. The consequence has been the great extension of workmen's suburbs in the eastern districts. Other companies have been compelled by the Railway Commissioners to provide additional trains. The effect is shown in the decrease of the growth of population within the London area. Between 1891 and

1896 the rate of increase was 4 '8 per cent.; between 1896 and 1901 it was 2'4 per cent. In the ten years preceding 1901 the loss by migration from the county of London exceeded 180,000.

The Public Health and Building Acts have also directly or indirectly affected the housing question, rendering it more easy to condemn houses as unfit for habitation, and making it more difiicult to build houses with insufficient or ill-adapted provision for health and comfort. In 1899 the Government passed an Act by which the local authority may advance a sum not exceeding ►►250 to enable the resident or the intending resident of a house not exceeding ►►300 in value to purchase such house, but little use has been made of its provision.

Public action by Parliament and local authorities has been more than equalled by the individual work of philan- thropists, companies, and builders. The Peabody trustees (1862) and the Guinness trustees (1889) have in some in- stances bought land cleared by the public authority, but in most cases have secured sites in the open market. There are smaller trusts in some of the great towns : they all build block dwellings, and let tenements at rents which pay a small interest on the capital sum. The receipts accumulate, and are invested in further buildings. Rules are of course necessary, and criticism is sometimes provoked. It is objected (1) that the build- ings are too much in the nature of institutions ; that people need houses, not rooms in a barrack, and that a family should have a

house with easy access to the street ; (2) that the tenants who benefit by the somewhat lower rent are not the very poor, and are privileged ; (3) that the provision of houses out of charity limits provision in the way of business. But at all evpnts the houses so built have been an education both to their inhabitants and to society. Philanthropic action has not exhausted itself in founding trusts. Miss Octavia Hill has shown even a better way of meeting the housing difficulty. Before the agitation, as far back as 1864, she and Mr Ruskin, feeling that the housing of the people lay at the root of many social evUs, obtained possession of a court of low-class pro- perty. Miss Hill gathered round her a group of volunteer workers, and, by applpng character to character, en- deavoured to raise the tenants as she improved the houses. Her plan answered : the houses were made habitable ; broken woodwork was made sound ; sanitary conditions were gradually ??? too gradually, it often seemed to impatient reformers ??? put in order ; small playgrounds were secured ; and rents were so regularly paid that the owners received fair interest on their capital. By 1902 she herself con- trolled houses occupied by 1268 families, and her system of management by means of lady visitors has largely extended in London and in many English and Scottish towns. Miss Hill thus originated a way of dealing with the occupants of the lowest class of house which has largely modified the views which are taken of the problem. It is now seen that it is useless merely to put people displaced from their hovels into model dwellings. They wiU not submit to order ; they must be themselves educated, and the change must be gradual. Another result of the Royal Com- mission was the formation in London of the Mansion House Committee for Improving the Dwellings of the Poor, and of like committees in other towns. These com- mittees have done particular service in bringing public opinion ??? and sometimes the decisions of the law courts ??? to stir up inactive local bodies. There are many clauses in the Building Act and in the Riblic Health Acts which are not enforced. Local bodies have sometimes a sym- pathy for local landlords; at other times they are un- acquainted with the law. The Mansion House Committee, by means of local committees and by employing its ovm.

inspectors, has brouglit this neglect to light, and in many districts a higher standard obtains. One fact is sufficient to illustrate the progress. In 1885 there were 89 sanitary inspectors over the London area, in 1898 there were 256. In 1878 there were 930 sanitary inspectors recognized by the Local Government Board, and in 1898 the number was 1822.

The housing of the poor has also been taken up on purely " business " principles. A company vrith this object was started in 1864, but the first notable success was scored by Sir Sidney Waterlow. His company has laid out ►►1,000,000, and housed over 30,000 people, and the death-rate stands at 9'95 per 1000. The Artisans', Labourers', and General Dwellings Company has invested 2 J millions. Companies on this model are now numerous in many of the great towns, and generally yield a fair dividend. Of late years, however, chiefly by reason of the increased expense of building, or in a less degree by the competition of municipal bodies, the companies have almost ceased to build. The weekly rents paid for rooms in these block dwellings in London average 2s. 6d. or 3s. a room. Private builders have in some instances erected blocks on a like plan to that adopted by the companies, but their activity has been chiefly shown in building cottages in the suburbs. They are often condemned as "jerry builders," but the condemnation is probably used in too wholesale a way ; most of the cottages and houses which are now occupied on the outskirts of towns are convenient and sufficiently substantial. In 1878 there were 17,127 new houses built in the metropolitan police district ; in 1 900 there were 25,161. If, therefore, the Royal Commission was followed by no great measure of reform, there has been decided improvement.

The improvement, however, leaves much still to be done, and it has hardly touched the country districts. The mischief is now, however, much more that of over- crowding than of uninhabitable dwellings. Many causes have in late years tended to aggravate the evil. Agri- cultural depression has impoverished country employers and prevented the building of cottages, and good trade has brought people into tovms. The high wages de- manded by trade unions have almost doubled the cost of building

the cost per room in London is now ‹‹108, against ‹‹70 in 1891 ‹‹‹ and people being better off, de- mand more room. Overcrowding, according to a London County Council report, is more excessive now than in 1891. Various solutions of the problem are urged : ‹‹‹ (1) Local authorities have been pressed to use their powers under Part III. of the Housing Act to acquire sites and build, even at a loss to the ratepayers ; and further, to obtain j)owers to borrow at an easier rate, and to purchase sites outside their own boundaries. (2) Local authorities have at the same time been advised to interfere less. They are told that their restrictions on the character of the building, and on the number of occupants of a room, are absurd, and that business])eople, who would at once supply the demand for houses, are deterred by fear of competition supported by the rates. They are warned against creating a privileged class of workmen who have better accommodation or less rents than their neighbours, and may form a constituency who vnll press their private interests so as to corrupt the governing body. (3) Parlia- ment is asked by some reformers to introduce new methods of rating to make vacant building land subject to rates, and to divide ground values from building values, so that rates may fall on the former. (4) There are others who see no remedy but in dispersion of the population ; they advocate the provision of cheap and easy methods of locomotion by means of railways or tram-cars to every part

of the circumference of great towns. They sometimes add a hope that power may be given to the local authority to acquire land on this circumference on some fair system of payment, so that sites may be available for either municipal or private building. The proposal of so many remedies shows the urgency of the question. It is long since Lord Shaftesbury first succeeded in drawing public attention to the evil of housing, but it is only since 1875 that efibrts have been really made to abate the evil. Figures quoted above indeed show that the population is already tending to move from the centre to the outskirts, and the ambition for a bit of garden or for a sight of the country is more widely expressed as hours of labour are decreased. To a certain extent a remedy is thus being found by a natural process, and it is often urged that overcrowding is due chiefly to insufficient means of locomotion.

There is one class of people outside the working class whose condition especially attracts attention. This is the class found in casual wards, shelters, and common lodgings. It includes some workmen, but derives its character from the presence of many broken-bodied and broken-hearted men and women. These people ??? ragged and starved ??? are frequently found on door-steps and under arches, and awaken general sympathy. "If," it has been thought, "there were decent lodging-houses, where health and order could be secured at a small charge, many would be comfortable who are now driven to despair by discomfort." The managers of the Victoria Homes and Lord Eowton have met this need in London by forming companies to build lodging-houses, and the London County Council has itself opened a "doss-house" on the same lines. In some of the great towns ??? notably in Glasgow, where also a Family Home has been opened ??? a like provision has been made. The contrast between the new common lodging ??? a work- man's hotel ??? and the old common lodging-house is very striking. Any man who can pay 6d. a night may be secure of privacy in his bedroom and of cleanliness in his surroundings, of a bright sitting or reading room, and perfect order in the arrangements. The only doubt which clouds the satisfaction at the change is lest such good provision for single men may lead them to prefer single life to the responsibility of a home. These model lodging-houses do not, of course, affect the great mass of the class just mentioned. These people cannot pay 6d. a night, and vsdll not endure order ; they therefore take refuge in shelters and casual wards, or go to some cheaper lodging. (s. A. B.)

Pauperism.

Pauperism, measured by figures, has greatly decreased in England and Wales. In 1870 the number of persons who received relief was 46"5, in 1850 it was 57'4, per 1000 of the population. In 1899 the number was 26'5 per 1000. In Ireland, however, there has been an increase. In 1870 there were 74,000 paupers, and in 1899 there were 103,866, with a diminished population, but between 1890 and 1901 the tendency was to a decrease in the number. In Scotland there has been com- paratively little change, but the tendency is upwards, and there were in 1899, 65,929 paupers with 33,994 dependants. At the same time the money spent on

those relieved has greatly increased. Whereas in 1 850 a mean number of 123,004 indoor paupers cost ►►914,264, or ►►7, 8s. 8d. per head, a mean number now of 216,200 indoor paupers costs no less than ►►11, Os. 7d. per head. The change is due to the improved circumstances in which people live, the larger wages, the sanitary improvements, the better education, and the opportunities of saving, but still more directly to the more considerate treatment

which has been introduced into poor-law administration. Pauperism in one sense is the creation of law, or rather of its administration. People may in time of poverty get relief, and go back again to be self-respecting wage- earners ; but those who in time of poverty learn to depend on relief grudgingly given are paupers, and the increase of pauperism is largely affected by action which encourages dependence and destroys self-respect. The more humane and thoughtful treatment which during the last twenty years of the century helped to reduce pauperism is shown ►►► (1) in the improvement of infirmaries, workhouses, and casual wards ; in the separate provision made for infectious disease, imbecility, and other forms of mental defect ; and in the impetus given to voluntary effort in developing the possibilities of malformed or deficient persons by the in- creased number of homes certified by the Local Government Board adapted to the training of difficult cases ; (2) in the provision made for children ; (3) in the attention given to the administration of out-relief (see Poor Law).

(1) The infirmaries ►►► in towns at any rate ►►► in which the sick poor are nursed are now under the care of highly- qualified medical ofiicers, with assistants, and' a full staff of trained nurses. The buildings have been altered or built to suit modern requirements, and the medical oflScer has, in practice, unlimited authority as regards the ordering of necessary "sick comforts," while increasing advantage is taken of special institutions for special diseases or special needs. In London the Metropolitan Asylums Board is a body representative of the several poor-

law divisions of London, upon whom extensive duties are imposed by the legislature. When it is observed that its expenditure during the last twenty years of the 1 9th century reached the amount of 9 1 millions, that during the year ending Michaelmas Day 1900 this body expended no less a sum than ►►832,466, that each bed has often cost ►►400 to ►►550, and that the normal accommodation of its twelve fever hospitals and its five im- becile asylums and its five institutions for ophthalmic and other children is more than 15,000 beds, the magnitude of its work will be appreciated. Apart from the provision for smallpox patients which is incumbent on the managers, it devolves upon them to provide and administer a training ship for pauper boys of the metropolis, to organize and maintain an efficient land and river ambulance service, and to provide establishments for special classes of children. In the country districts, and notably in Ireland, reform still lags, and there are many cases where the workhouse characteristics are obvious in the infirmary, where the wards are depressing, and where nursing and treatment are not at the same high standard as in London and many urban centres. By an order, however, of the Local Govern- ment Board of 6th August 1899 the employment of any pauper inmate to perform the duties of a nurse was forbidden, while the employment of a pauper inmate in any other capacity in a sick ward must have the approval of the medical officer and be subordinate to the supervision of a paid officer. There has not been the same improvement in the position of the able-bodied ; but here too, in many instances, guardians have aimed to educate rather than to deter those who seek relief. They have substituted trades for oakum – picking and stone – breaking, introduced visitors, who interest the able-bodied by talk and reading, or offer them openings and induce- ments to a working life. They have, in some instances, made it possible for men of more solid determination to get work on the land, and thus train themselves for emigration. The greatest problem has been and is to deal with the vagrant population. In 1882 legislation, follo^7ing an inquiry, made it lawful to detain people using casual wards over a clear day if they were proved habitues.

The exact terms of the law are : ►►► That a casual shall not be entitled to discharge himself from a casual ward before 9 o'clock in the morning of the second day following his admission, nor before he has

performed the task of work prescribed for him ; and where a casual pauper has been admitted on more than one occa- sion during one month, he shall not be entitled to discharge himself before 9 o'clock in the morning of the fourth day after his admis- sion. This latter regulation, however, is modified by an order of the Local Government Board of 18th December 1882, which pro- vides that a casual pauper, who has been detained for more than one night, and who represents to the master of the workhouse or superintendent of the ward that he is desirous of seeking work, shall, if he has to the best of his ability performed the jirescribed task of work, be allowed to discharge himself between Lady Day and Michaelmas Day at half-past 5 in the morning, and between Michaelmas Day and Lady Day at half-past 6 in the morning.

The same policy of restriction has been followed in the recommendation of cellular wards by the Local Govern- ment Board. Guardians have thus at great cost added a sort of prison to their establishment, in which casuals are confined sometimes for four days in solitary confinement and forced to do certain task work in oakum -picking, stone-breaking, grinding corn, or cutting wood. There is a division of opinion among poor-law administrators as regards the result of the policy. On the one hand it is contended that any failure is attributable to the absence of uniformity of treatment ; on the other, that such treatment must tend to harden in their ways the somewhat limited number of persons who prefer casual wards to common lodging-homes. In the country the habit of vagrancy does not seem to be checked, but under other influences which make lawlessness easy is even increasing. The number of vagrants relieved on 1st January 1878 was 5108, and on the same date in 1901 the number was

11,658.

(2) The greatest change has been in the treatment of children following on the interest aroused before and by the Education Act of 1870. It was felt that it was unjust and short-sighted to punish the children of paupers by shutting them up in workhouses or by giving them in- ferior education. The desirability of withdravsdng children from workhouses Was recognized by the legislature as far back as 1844. The Poor Law

Amendment Act of that year empowered the commissioners (now the Local Govern- ment Board) to combine poor-law areas into school districts for the management of any class of infant poor not above the age of 1 6 years. Separate schools were in consequence formed. The schools have been continually unproved. Village communities with cottages accommodating from 10 to 30 children have in some cases been substituted for the block buUdings, and no expense has been spared, the cost sometimes amounting to ►►190 per bed. The annual charge for each child's keep then reaches ►►32. In 1873 Mrs Nassau Senior, the first woman inspector, found the results, at any rate on girls, to be unsatisfactory. It was agreed that more individual treatment was wanted, and many improvements were made. The Metropolitan Association for Befriending Young Servants was formed for the after-care of the girls, and an impetus was given to the practice of boarding out children in the cottages of villagers. The system, however, of aggregating children in large schools continued; and as outbreaks of ophthalmia and other diseases, and disclosures of cruelty and neglect occurred, another inquiry was held, and in 1896 a depart- mental committee reported, condemning the system of aggregation. Orders were in consequence issued by the Local Government Board for the breaking-up of some of the largest establishments, and encouragement has been given for the adoption of various plans of scattered homes by which parties of children under the care of a house mother are able to join in the life of a community and profit by contact with other children. A perpetual diffi- culty in dealing with children is the prevalence of a class

of "ins and outs," i.e., of children who are dragged about by vagrant parents, and frequently come in and out of the guardians' hands. With a view to getting control of certain classes of children, a law was passed in 1889 which gives the guardians power to adopt children who may be deserted by their parents, and take upon themselves all the parental

powers, even to the extent of emigrating such children. In 1899, by the efforts of the State Children's Association, which was formed to carry into effect the recommendations of the committee of 1896, these powers were extended to include any chOd the parent of which is, in the opinion of the guardians, by reason of mental deficiency, or of vicious habits, or mode of life, unfit to have control of it.

(3) In the 'seventies social observers were struck by the misuse of charity and its competition vidth the out-relief given by the guardians. The effect was seen in the increase of dissatisfaction and of poverty. Large sums were being given, some of the recipients being drunken and others starved. An attempt was therefore made to organize charity, and to lay down some principle on which out-relief should be given or refused. Some guardians determined to stop giving out-relief altogether, and carried out that policy. There are different opinions as to the success. On one side it is urged that the people are better oif. When relief was given by no comprehensive rule, many poor persons were induced to waste time and strength and character in its pursuit. On the other side it is urged that the needs ___ especially of the old ___ cannot be met out of earnings or charity. The facts, in a union like Whitechapel, are that in 1872 there were 1000 indoor and 1568 outdoor paupers, out-relief costing __4730. In 1895 there were 1503 indoor and 5 out- door paupers, out - relief costing __29. The net result has been to put a limit on pauperism. When the policy of abolition has not been followed, there have generally been more care and more discrimination; and up to 1893 the yearly diminution was regular. In 1894 a change was made in the qualification of the guardians, and the ex-offi.cio members ___ that is, the magistrates ___ were removed, and the ofiice thrown open practically to all ratepayers, men or women. The persons thus elected have not had the same experience in administration, and have inclined to meet poverty by grants of out-relief. There has been in consequence a slight rise in the pauperism. In the country districts the boards of guardians, under the Act of 1894, have been made identical with the rural district councils. The same members have thus difi^rent interests, and it is calculated that they will be less under the sway of policies or parties or classes, and more able to follow the lines laid down by experience.

The net result of a survey of pauperism is that the number of persons in receipt of relief is reduced, and that those who enjoy relief receive it in a better way. The change is due to many causes, and it is possible that what may be called the more scientific method of administration is the cause which has least popular approval. Sentiment favours liberal giving and liberal treatment ; prosperity has made liberality possible without undue pressure on the ratepayers. Progress, therefore, does not seem to rest on a secure basis. The lavish expenditure may induce such larger numbers of the sick and afHicted to make use of the State provision for their diseases as to cause a reaction. is. a. b.)

Amusements.

Holidays imply cessation from work ; amusements imply relaxation in work. The provision of means of amusement has extended in every direction. There are more theatres, more novels, more entertainments, and more games. People

seem either to work so hard or to find work so duU that they look for amusement which wiU demand as little effort as pos- sible. The theatres thus incline to afford spectacles, and the novels to givestrong sensation. The populargame is football, which provides observers with an interest almost like that of a battle ; and people seem to be less and less inclined to join in a game at all, unless it be for the excitement of a prize or of popular notice. There is an increase of athleti- cism, but it is largely mixed with sport ; men practise to take part in contests, and there is less simple healthy pleasure in exertion. People, that is to say, depend for amusement on something outside themselves, just as the children look for toys. A striking feature in advertise- ments is the offer of aU sorts and kinds of toys. Those who are older than children look for something to stir their minds, be it a scene in a play or a contest in sport. The obvious amusement is something exciting ??? a play, a race, a contest ; but alongside there is an increase of other amusements which depend on the exertion of mind and body. There are now picture galleries in many of the great towns; sketching clubs and rambling clubs are formed among young people ; music is provided by many town councils ; and people are gradually developing a love of social meeting, as by travel and reading

they find more subjects for conversation. The period, again, is one of transition. The hard worker in his first freedom from work turns naturally to the excitements which most easily stimulate his senses ; but as with more leisure he develops the powers of his mind, he begins to find satisfaction in their use. A review of the means of amusement now provided shows how largely those which excite predominate, but closer observation shows that at the same time there is a growth of other amusements which involve the exercise of the mind and taste. (h. o. b. ; s. a. b.)

Clothing.

Observers with memories going back to the 'seventies see that people are as a rule better clad in 1902 ??? more warmly, more appropriately, and often with more taste. Many things have combined to bring about the change. There has been a rapid succession of inventions in clothing making, and especially in boot-making. Women's boots which formerly cost 9s. can be bought for 6s. ; good boots for children can be got for 3s. 6d. Xew sorts of stuffs have been made available, some of which are as serviceable as the more highly priced materials they have displaced. Methods of distribution have also been improved. Large shops or co-operative stores have lowered prices ; enterpris- ing traders quickly distribute bankrupt stocks ; and the sale and translation of second-hand clothes have been better organized. Education has at the same time developed self- respect, and people tend, therefore, to adopt the same fashions. There are few workpeople who do not appear on Sundays in the same style of dress as that worn by their employers. The clothing of the poor ??? as far, at least, as outside appearance goes ??? is always a subject of astonish- ment. The only classes which look ???wTetched are not those who earn least ??? widows and labouring families ??? but the careless and thoughtless, who often earn good wages. Students who have gone into the subject estimate that clothing costs a grown person 6d. a week and a child 5d. But such clothing, if enough for appearance, is said to be insufiicient for warmth or protection from weather.

(h. o. b. ; s. A. b.)

Crime.

During the twenty years from 1881 to 1900 there was a definite diminution of crime in England, but to estimate the amount of the decrease is a matter of some difficulty. The error has been made by some of treating as a measure

of crime the average prison population, which fell from 28,324 in 1880 to 17,435 in 1900; but prison population depends not only on the number of persons sent to gaol, but on the average length of their sentences, and the fall is one mainly due to the increasing leniency of the sentences passed by judges and magistrates. Others, again, have fallen into the opposite error of founding conclusions on the number of technically "criminal" charges, which increased from 649,811 to 770,853 ; but in this case the augmentation is due, not to any growth of crime in the proper sense of the word, but to the establishment of new municipal regulations in the interest of the public safety, health, or progress. Within the last twenty years of the 19th century the cases under the Education Acts have increased by 34,000, offences with regard to the highways by 19,000, and offences against local police bye-laws by 56,000.

The best standard ??? statistically definite and covering a wide area of serious crime ??? is to loe found in the number of indictable offences, i.e., of offences which are triable on indictment, whether actually tried on indictment at assizes and quarter sessions, or disposed of at petty sessions under the extensive summary powers which the magistrates now possess. Within this definition of crime fall not only murder and the great offences against the State, but all crimes of violence except minor assaults, all " crimes against morals," all sorts of forgery and fraud, and all larcenies except some petty thefts. Statistics are available, first of the number of such crimes known to the police, second of the number of persons tried, and third of the number of convictions. Under each of these heads the figures for the period 1880-1900 show a decrease; but the second, the number of persons tried for crimes, is generally

regarded as on the whole the best test, and under this head there has been a fall from 60,724 in 1880 to 53,628 in 1900, or, taking the proportion per 100,000 of the population, from 236 to 167.

If the view of crime is extended so as to cover every offence, indictable or otherwise, that can fairly be brought within that designation, including all assaults, all petty thefts, and all minor injuries to property, the number of persons charged fell from 183,000 to 152,500, or, taking again the proportion per 100,000 of population, from 711 to 475. All the figures quoted are those for the years 1880 and 1900. These may be taken as representative years in a progressive series, not seriously influenced by casual variations. If the averages of periods of five or ten years are taken, the results are not affected in any material point. The diminution in indictable offences amounts therefore in twenty years (taking population into account) to a little more than 25 per cent.; but this diminution does not affect all forms of crime equally. The general ratio of decrease applies with little variation to larcenies (which constitute the great bulk^more than five-sixths ??? ??? of aU indictable offences), to robbery, and to forgery. It

applies also to crimes of violence to the person, though under some of the most important heads, such as murder and manslaughter, the figures are too small to give any regular rate of progression. It does not apply completely to " crimes against morals," which show an increase chiefly in connexion with the offences created or extended in definition by the Criminal Law Amendment Act, 1885, nor to burglary and house-breaking, which on the whole tended to increase. Offences connected with the coinage, on the other hand, show a much more rapid rate of diminution, having steadily fallen from 311 to 70. Suicide, which appears among indictable offences only in the matter of the attempts, increased steadily, the proceedings for attempted suicide having risen from 74 to 192. In the same period actual suicides increased from 1930 to 2863.

These figures, which apply to England and Wales, though in Scotland and Ireland the tendencies are generally similar, have to be qualified by the consideration of various influences not capable of statistical measurement. Thus the increase in numbers and the improved efiiciency of the police, while they are probably one of the causes in the actual decrease of crime, tend to increase the statistics of persons tried by ensuring the detection and punishment of a larger proportion of the offences committed ; and the actual decrease in crime is therefore probably somewhat greater than appears from the figures quoted. Again,

the shorter sentences now passed on habitual offenders, by giving the same individual more frequent periods of liberty, and therefore more opportunities of committing crime, allow the same person to appear more frequently in the criminal records ; and if there has been a diminution in the number of crimes, there is reason to believe that the reduction of the number of persons living by crime is in a somewhat greater ratio. On the other hand, the spirit of leniency towards criminals which now prevails shows itself in a greater reluctance to prosecute for minor offences, and if this influence be taken into account, the estimate of the decrease of crime becomes less favourable.

The causes of the diminution of crime must be found partly in changes in the judicial and penal systems, partly in wider influences affecting the national morals. The gradual extension of the protection afforded by the police to life and property has already been mentioned as one of the influences which have tended to repress crime. Another influence in the same direction has been the exten- sion of the summary jurisdiction of magistrates, particularly in the Summary Jurisdiction Acts of 1879 and 1899. The first effect of the Act of 1879, which much lessened the cost and trouble of criminal proceedings, was to increase the number of prosecutions ; but in the long run the greater quickness and certainty of punishment which it secured proved a considerable influence in checking crime. Yet another very important factor was the change of prison organization effected under the Prison Act of 1877, by which the local prisons passed into the charge of a Government department and the varying local methods of treating crime were replaced by a uniform national system. The main features of this system were a severity of dis- cipline for short^sentence prisoners, which, without pretence to reforming efiicacy, acted with strong deterrent effect on the minor offenders not hardened to prison life, and the separation of prisoners by cellular confinement, which pre- vented to a great extent the contamination of first offenders by old criminals. This system has now, under the policy embodied in the Prison Act of 1898, been replaced by one which, while less severe in discipline and allowing more association of prisoners, aims at more complete classification of offenders and greater discrimination in their treatment, and seeks to give more scope to directly reformatory influences. Outside the prison system there has been

an extension of the agencies for the assistance or reform of the criminal. The establishment of discharged prisoners' aid societies has been encouraged by the Prison Commissioners, and assisted by Government funds, until their operations now extend to the whole country ; while other societies less oflacial in character have shared not less effectively in the same work. Still more important has been the part played by reformatory and industrial schools, which deal with children who are actually criminal or are living in conditions which must inevitably lead to crime. These schools were extensively established before 1880, but dealing as they do with children, they had to exercise their influence on a whole generation before its full effect could be shown in reducing the criminal population. From a vnder point of view the net result of the educative

and social influences at work has been antagonistic to crime, with an increased tendency to meet it rather by preventive reform than by severe repression. The spread of common education and the increase of wholesome literature are powerful factors in this influence, though they have to combat the counter ~~effects of the debasing literature to which the universal abUity to read now gives a wide currency. The teaching of the Churches and of other social institutions has become more practical, and therefore more efficient in the contest vdth crime, notwith~~ standing the decay in some directions of religious influences and the weakening of some of the sentiments which support the elementary moral obligations. (c e. t.)

Drunkenness.

In considering the extent to which intemperance now prevails as compared with former years, the statistics of prosecutions upon which such comparisons are usually based are far from being completely satisfactory, but, inasmuch as they constitute the only possible data for such comparisons, we are compelled to accept them. The following table gives the average number of persons per 1000 of the population

proceeded against for drunkenness in England and Wales for each quinquennial period since 1857, the first year of the Judicial Statistics :
<?>

1857-61 ....

. 4-28

1862-66 ....

. 4-78

1867-71

. 5-47

1872-76

. 7-83

1877-81

. 7-25

1882-86

. 6-90

1887-91 ....

. 6-19

1892-96 ....

. 6-84

1897-99 (3 years)

. 6-47

1899 ....

. 6-74

The figures, it will be seen, show a steady decline from 1872-76 (when the consumption of alcohol was quite abnormal) to 1892-96. Since then, however, the figures have again risen. The increase was especially marked in 1899, when a tide of exceptional prosperity was again accompanied by great drunkenness. It is also dis- quieting to discover that the average number of prosecu- tions for drunkenness in the three years 1897-99 was 51 per cent, higher than the average for 1857-61, and 35 per cent, higher than the average for 1862-66. That the increase is partly due to more efficient police administra- tion is probable, but that this is not a complete explana- tion of the figures is made evident by an analysis of the general statistics of crime during the same period, from which it may be seen that, while crime generally (exclud- ing drunkenness) has decreased 28 per cent, in England and Wales since 1857-61, drunkenness has increased 51 per cent.

Speaking generally, it may be said that drunkenness is chiefly prevalent in the seaport and mining districts. If a line be drawn from the mouth of the Severn to the Wash, it will be found that the " black " counties, without exception, lie to the north-west of this line. The worst counties in England and Wales in the matter of drunken- ness are Northumberland, Durham, and Glamorganshire, while Pembrokeshire and Lancashire follow close behind. The most sober counties, on the other hand, are Cambridge- shire, Sufi'olk, Oxfordshire, and Wiltshire. Averages based upon the returns of entire counties do not, however, afford a complete guide to the distribution of drunkenness, inas- much as offences are not equally distributed over the whole area of a county. A heavy ratio of drunkenness in a small district may often give a county an unfavourable position in the general averages, notwithstanding favourable con- ditions in the rest of its area. A better classification is

that adopted by the compiler of the Judicial (Criminal) Statistics for 1898, and represented in the following table : ???

Drunkenness

(No. of prosecutions in 1898)

per 1000 population.

Mining counties .

. 11-19

Seaports

10-20

Metropolis .

9-94

Manufacturing towns

6-58

Pleasure towns

3-87

Agricultural counties-

South-western count

es . . . 2-84

Home counties

2-63

Eastern counties

1-23

England and Wales . . . 6-98

Further analysis of the prosecutions for drunkenness shows that about 24 per cent, of the total number of offences are committed by women. In the larger towns the proportion, as a rule, is higher. In London, 38 per cent, of the drunkenness is attributable to women ; in Manchester, 36 per cent. ; in Belfast and Glasgow, 32 per cent. In Liverpool, on the other hand, the proportion is only 24 per cent. The much-controverted question as to whether intemperance is increasing among women can hardly, however, be decided by an appeal to the criminal statistics. So far as these statistics throw any light at all upon the question, they suggest important local differ- ences. A more direct clue is afforded by the Eegistrar- General's annual returns of deaths directly attributed to intemperance. The figures are given below. In order to eliminate accidental variations, the comparison is based upon the average mortality during consecutive quin- quennial periods : ???

Quinquennial

Average No.

of deaths

Males

Females

Period.

(England and Wales).

per cent.

percent.

1877-81

1071

69

31

1882-86

1320

66

34

1887-91

1710

64

36

1892-96

2044

61

39

1897-99

2577

61

39

1899

2871

60

The figures are certainly striking. They show, it will be noticed, that out of every 100 deaths from alcoholic excess in England and Wales at the present time women contribute nine more than they did in ISSO. If, instead of taking the total number of deaths, we take the ratio per million persons living, the increase is seen even more clearly : ???

Males

Females

per million living.

per million living

1877-81

60

25

1882-86

67

32

1887-91

79

42

1892-96

86

51

1897-99

103

63

1899

112

70

It appears that, while the ratio of mortality from alcoholic excess has increased 87 per cent, among males during the last twenty years of the century, among females it has increased by no less than 180 per cent.

Despite the strenuous and, in many respects, successful efforts of temperance reformers, the consumption of alcohol l>er head in the United Kingdom has, though subject to fluctuations, increased until it was greater in 1902 than it was in 1840, when the temperance reformation was in its infancy. The consumption per head of alcoholic liquor in the United Kingdom in 1840, as compared with 1900, was as follows : ___ –

ISIO 1900

(Gallons). (Gallons).

Spirits (proof) . 0-97 1-12

Wine . . . 0-25 0-39

Beer . . . 28-59 31-75

SOCIAL PROGRESS

685

of proof spirit, 1 the

Gallons.

. 3-89 . 4-40

Squivalent in

Proof Spirit

(Gallons).

3-36

. 3-58

. 375

. 3‘56

. 8-60

. 4-09

. 478

470

3-90

. 3-87

. 4-08

. 4-20

. 4-28

. 4-30

. 4-48

. 4-40

If the figures are reduced to a result is as follows : ???

1840 consumption per head

1900

To adopt a familiar method of comparison, the expendi- ture per head of the population upon alcoholic drinks was in 1840 ??2, 18s. lOd., and in 1900 ??3, 18s. 8d.

That this increase in consumption is not due to the selection of exceptional years will be seen from the sub- joined table : ???

Years.

1841-45

1846-50

1851-55

1856-60

1861-65

1866-70

1871-75

1876-80

1881-85

1886-90

1891-95

1896

1897

1898

1899

1900

It will thus be seen that the increase in the consumption of alcohol per head from 1841-45 to 1891-95 amounted to nearly three-fourths of a gallon of proof spirit. The highest figures were reached in 1876 (when the effects of the great wave of commercial prosperity which marked the 'seventies were at their height), when. the consumption per head rose to 4'89 gallons of proof spirit. With the subsidence of the commercial " boom " the consumption at once declined, but only to a point that was still slightly above what may be called the normal figures of the ante- 1870 period. During the decade 1889-99, however, they rose again steadily,

until the consumption in 1899 was higher than it had been for a period of twenty-one years.

That much of the indulgence in alcoholic drinks is excessive and wasteful is not seriously disputed. Opinions, it is true, differ as to the proportion of the total con- sumption that may be so regarded, and the amount at best can only be approximately determined, but even at the lowest computation it certainly forms a not incon- siderable proportion of the whole. Professor Leone Levi, in his evidence before the Lords' Committee in 1877, estimated the amount of intemperate consumption at one-fifth of the total consumption. Mr Dudley Baxter's estimate is very much higher than this. The figures which he gives for 1869 show that 38 per cent, of the total consumption of spirits and 32 per cent, of the total consumption of beer must in that year have represented intemperate consumption. If we make the most liberal allowance for a more general diffusion of wealth and a consequent increase in the amount of temperate consump- tion in the interval, and reduce the proportions which Mr Baxter gives to 30 per cent, and 25 per cent, respectively, it would follow that more than ??39,000,000 was spent in 1900 in intemperate and wasteful drinking.

The number of public-houses and beer-shops has, it is true, been steadily declining, no fewer than 10,000 having disappeared between 1876 and 1896 ; but this reduction in numbers has been more than out-balanced by the recon-

^ The Spirits (Strength Ascertainment) Act, 1818 (58 Geo. III. c. 28), defines " proof spirit " to be that which, at a temperature of 51??, weighs ^ parts of an equal measure of distilled water. A gallon of proof spirit contains 57 per cent, of alcohol. The calculation is made on the ordinary basis that wine contains 30 per cent, and beer 10 per cent, of proof spirit.

struction and enlargement of those that remain. The reduction in numbers has affected, for the most part, the smaller and least profitable houses only ; but these have been largely replaced by huge " gin-palaces," so that what Lord Eandolph Churchill called the " fatal facility of the public-house " has become a more serious social fact than was the

case in 1875. In important legislation the last twenty years of the 19th century showed little progress.

Important licensing proposals were made by a Conservative administration in 1888 and 1890, and by a Liberal administration in 1893 and 1895, but in each case they failed to become law. The following ia a summary of temperance legislation since 1880 : ???

1881. Welsh Sunday Closing Act.

1883. Acts prohibiting the payment of wages in public-houses,

and the use of drink-shops or refreshment-houses for parliamentary election meetings.

1884. Municipal Elections Corrupt Practices Act, prohibiting use

of public -houses and refreshment -rooms for committee purposes or meetings in connexion with municipal elections.

1886. Intoxicating Liquor (Sale to Children) Bill, prohibiting sale

of intoxicants "for his or her own consumption" to children under thirteen.

1887. Beer and Cider Truck Clause, prohibiting the furnishing of

beer, cider, &c. , to agricultural labourers as part payment of wages. Also Scottish Early Closing of Public-houses Act, giving dis- cretionary power to licensing benches outside burghs of 50,000 inhabitants to close public-houses one hour earlier on week-nights.

1888. Habitual Drunkards Act.

1894. Prevention of Ouelty to Children Act, which, inter alia, empowers magistrates to commit to inebriate homes the drunken parents of ill-used children.

1897. Licensing Amendment (Scotland) Act.

1898. Habitual Inebriates Act.

1900. Beer Retailers' and Spirit Grocers' Retail Licences (Ireland)

Act.

1901. Intoxicating Liquors (Sale to Children) Act. (a. Sh.)

Food.

The abolition of duties, the invention of cold storage, the practice of tinning meat and fruits, and improved means of transit, have enlarged the supply and changed the character of the foods of the people. Casual observa^ tion of the shops in poor neighbourhoods shows the tins of salmon, peaches, soups, as weU as of ordinary meats, piled up for sale, while on the barrows in the streets there is a plentiful supply of bananas, tomatoes, grapes, &c. Closer inquiry confirms the conclusion suggested by such observa- tion. In 1883 there was imported and retained for home consumption 0'75 B) of fresh mutton per head of the total population of the United Kingdom; in 1900 the amount had risen to 9'28 lb. The figures with regard to bacon and ham show that in 1883 there was 11 '01 B) imported for each inhabitant, while in 1900 the amount was 19 '62 1). There is a hke increase in the use of imported butter. In 1886 ??? the first year in which it was dis- tinguished??? 4-57 B) per head was imported- in 1900 the amount was 9'11 lb. In 1883 each person had for his use 26-52 imported eggs; in 1900 he had 49-48. But the most astonishing increase of aU, representing the develop- ment of the use of jam, is in sugar. In 1883 the import of sugar for home consumption per head of the population was 9-91 ib of refined sugar; in 1900 it was 52-23 ti. It is somewhat more difficult to tell by figures the de- velopment of the use of foreign fruits; they were not distinguished in the returns till 1892, but in that year the value of grapes imported was ??363,644, and in 1900 the value was ??595,000. The dried or tinned fruits imported in 1883 were of the value of ??809,938, and in 1900 the value had risen to ??1,848,872, an astonishing increase, justifying the conclusion drawn from the tins which fill so many shop -windows. It must be remembered that these figures take no account of the home produce,

which must be added to the food supply of the people. If, now, the further question be asked, whether the increased importation has been followed by a decrease in price, the answer is generally in the affirmative. A live ox which was valued at ??21-57 in 1883 is valued at ??18-19 in 1900; a sheep has gone down from 45-13 shillings in 1883 to 31-87 shillings in 1900. Flour of wheat which was 15-12 shillings per cwt. in 1883 was 9-38 shillings in 1900. Food may therefore be said to be cheaper, more plentiful, and more varied. It is also more closely protected. The Food and Drugs Act, 1875, amended in 1899, aims to protect consumers against adulteration in all its recognizable forms. The Weights and Measures Act, 1878, was amended in 1899, so that local authorities might have more power to enforce its measures. Under these Acts armies of inspectors are always at work. They every year condemn as unwholesome tons of fish, meat, and fruit, and they every week prosecute sellers whose weights and measures have been found to be short. The presence and activity of these inspectors have created a standard up to which public opinion slowly rises, so that there is now greater care on the part of purchasers to avoid bad food. The review of the food supply of the people is so far encouraging. It may be that in develop- ing foreign supplies the home supply has been neglected ; that for want of skill gardening near the great towns has not been developed, that by the monopoly of railways the transit from country districts has been made difficult ; it may be that food might be fresher and even cheaper ; but measured by any test, the advance during the period 1880-1900 was great. There is, however, another set of facts which have to be considered. Casual observers not only see loaded shops and stalls : they see also many poorly- nourished faces and poorly - developed bodies among the people who crowd the streets; they not only hear of increased imports : they also hear from doctors that the diseases of the poor are largely due to underfeeding. Students who look more closely find that for the bare support of life a man in moderate work requires daily 3500 calories of food energy, and a woman eight-tenths of this amount. It is according to this scale that the Local Government Board has framed the dietaries for use in workhouses. Careful inquiry

has shown that to provide this amount of food in the cheapest form, without regard to taste, the cost for a man per week is 3s. 3d., for a woman 2s. 9d., for children 2s. 3d. A family, therefore, of five persons would need at least an income of 22s. a week just for rent, clothing, and food, without any margin for drink, holidays, literature, or amusement. The statement of this fact is sufficient to prove that even with this supply of food there must be a large number of people stiU underfed. Mr Booth and Mr Kowntree, who have made detailed inquiries, both agree that 30 per cent, of the people live in poverty, nearly half of them because of an insufficient income, and the rest because of their ignorance, their wastefulness, or drinking habits. If in a family where the earnings are 22s. or 24s. a week the man falls ill or gets out of work, if a holiday is taken, if a treat be indulged in, if even some food be bought more appetizing but less nutritious than that which has the largest strength-giving power, if there be any change in the ordinary routine ??? then the necessary food must be reduced and the body be called on to suffer. There are notoriously many families where the income is bolow 22 s. a week ; there are at least an equal number of families where, if the earnings be somewhat larger, there is ignor- ance as to the right choice or use of food, and great waste of substance on drink and amusements.*

The conclusion of Mr Booth and Mr Rowntree is, there- fore^ 'that 30 per cent, of the population is underfed. The remedy is, first of all, an increase of wages, which means

that by intelligence and character the worker shall be worth more wages. But with increased wages there must be also increased knowledge of the value of foods and of the methods of feeding. Mothers frequently give their children meat before the appearance of teeth with which to bite it. Wives prepare their husbands' meals in such a way as to destroy much of their nourishing power. People have often altogether wrong notions as to what is strength- ening and what is not. It is something that these facts are known, and already local authorities have started lectures and cookery classes, which ought to be valuable.

(h. o. b. ; s. A. B.)

Health.

Examination of the death statistics shows a steadily increasing average length of life in England. The "ex- pectation of life" at birth, which in 1880 was calculated to be 41-35 years for males and 44-62 years for females, had increased ten years later to 43-66 years and 47-18 years respectively. Thus the average length of life in England in ten years increased by about three years, and is still increasing. We find that the decrease in the mortality is still apparent at all ages from 1 year up to 45 years among males and to 55 years among females. The mortality has increased at other ages up to 85 years, after which there is an apparent decrease. From the ages of 5 years to 30 years the decrease in the rate of mortality is relatively large, and, though less marked, the decrease is evident also in all the succeeding age-periods.

But while we recognize the general improvement in the conditions of life, further examination indicates considera- tions of a less satisfactory nature. There is still a high death-rate among infants under 1 year of age, though this decreased during the period under review. Dr Farr, whose studies of vital statistics have served ??? and still serve ??? as models for other workers in this field, mentioned the following conditions as those the influence of which on the health of a community is unquestionable : ??? (1) the physical well-being of the people as to dwellings, food, drink in excess or defect ; (2) firing ; (3) cleanliness and clothing ; (4) sewage and drainage. The relation between health and the density of population under existing sanitary conditions, and the measures taken to limit the spread of infectious diseases, have also to be taken into considera- tion. Some of these conditions are under the control of the individual, others are regulated by the State or by local authorities. There are facts to be elicited from the tables of the causes of death which appear to indicate that the improvement in the healthiness of the people is due not so much to a greater attention to health requirements by individuals, as to the sanitary improve- ments carried out by local authorities and the health regulations initiated or enforced by the State. The regulation of the conditions of labour by the Factory Acts, (fee, has tended to reduce the mortality in certain trades and occupations. Without going into detail, the general result is shown by the fact that comparison of 1891 with 1871, with regard to 76 occupation groups where such comparison is possible, shows that at the ages 25-45 (which corresponds

with the working period of life) there was decreased mortality in 63 of these groups, during the latter period, whilst in 13 groups only was there an increased mortality. The deaths from zymotic diseases show a diminution, especially in those diseases which are influenced by the sanitation of towns or districts, and those for the prevention of which special regulations are in force. Enteric fever and diarrhoea, the spread of which depends so largely upon drainage and water-supply, are credited with a decreasing death-rate. The mortality from scarlet fever shows a large diminution, and whooping

cough also is less fatal. Measles remains a frequent cause of death, and the mortality from this cause, though diminishing, fluctuated but little during the last thirty years of the 19th century. Diphtheria has increased, and shows a progressive increase in mortality. This disease is especially fatal in young children at an age when isolation is impracticable, and the mortality from this cause may be taken as to some extent a measure of the sanitation of the home as distinct from the sanitation of the locality. There is still much room for improvement in the sanitation of the homes of the poor especially, and in the care which would prevent the spread of infectious illness in the family. The diminution in the mortality from consump- tion and other tubercular diseases is one of the most noticeable and at the same time satisfactory facts which the death returns demonstrate. This decreased mortality can only be referred to an improvement in the general sanitary and hygienic condition of the people, for as yet it can hardly be said that any special preventive measures have been put in force against these diseases. The influence of overcrowding ??? the aggregation of individuals ??? in the causation of consumption is undoubted. The efforts made by the authorities in most towns to prevent the overcrowding, both of buildings on a given area and of inhabitants within the dwellings, have probably had an important influence in the decrease of consumption. But we may reasonably assume that some proportion of this decrease indicates an improvement in the dwellings of the people, and is a sign of increased prosperity. This

assumption is borne out by the fact that, although the diminution in the mortality from consumption is to be observed at all age-periods and in both sexes, it is in the earlier stages of life more especially that the reduction has taken place, and the decrease has been greater amongst females than amongst males in the later age ~~periods. We m'ay take the changes in the death~~ rate from phthisis (consumption) in children under 15 years of age, and in women, to represent the influence of the home conditions, for these are much at home, whilst the men are subject to outside influences at their work. In illustration we may take from the sixtieth report of the Kegistrar-General (1897) the following figures, which show the percentage reduction in the phthisis mortality between the period 1861-70 and that of 1891-97 : ???

Age Groups.

Reduction per cent, in 1891-97.

Males.

Females.

All ages

35

49

Under 5 yrs.

55

58

5

58

49

10

60

50

15

53

56

20

49

57

25

39

63

35

23

42

The reduction, which is considerable for both sexes up to the age of 15, becomes proportionately greater for females as compared with that of males in the succeeding age-periods.

But while we recognize with satisfaction such indications of improvement in the well-being of the people, we have on the other hand to note that the death-rates from anaemia, from rickets, and from diarrhoea show an increase. These diseases are to a large extent dependent upon the hygienic conditions of the home life. There are other considerations also

which call for serious attention as indicating evils of national importance. The high mortality of men of all ages after 25 years is especially remarkable in London, whilst the mortality of women is increased to nothing

like the same extent. Two causes appear to operate powerfully in producing this result. The first of these is referred to by Dr Farr in these words : ❓❓❓ " Not only the roughs but the intelligent artisans of London do not wash the whole of the body daily." The second cause is, in the opinion of the same authority, the greater intem- perance in regard to alcohol of the men as compared with women.

The influence of occupation is also seen to be very great, for those most exposed to temptation show the highest death-rate. Innkeepers and inn servants, and those engaged in the manufacture of alcoholic beverages, show the greatest mortality ; cab and omniVjus servants, coster- mongers, commercial travellers, come close upon these ; and butchers and bakers are also high on the list. It is a significant fact that while the drivers, &c., of cabs and omnibuses show a high mortality from intemperance, engine drivers and railway guards come low on the list of deaths from alcohol ; these men have, for the most part, respon- sible and well-paid posts, which they could not retain if they were intemperate. The death-rate from insanity and that from suicide show a progressive increase. It is notable that those occupations which show a high mortality from alcoholic excess furnish also the highest proportionate mortality from suicide. It is therefore permissible to attri- bute some portion at least of the increased mortality from insanity to the greater prevalence of intemperance. There remains the fact that the mental strain resulting from the greater competition of the present day may have some influence on this mortality from mental disease, which thus represents the price the community pays for its prosperity. The continued increase in the mortality from diabetes points also to the severity of competition, since nervous strain and worry are important factors in the causation of this disease.

The conditions of life in towns contrast most unfavour- ably with those of rural districts. The urban death-rate in 1899 was equal to 19‘2 per 1000, while the rural rate was 16‘3 per 1000. And although the urban rate was

equal to the average of the ten preceding years, the ratio of urban to rural mortality (as 118 is to 100) is higher than the average ratio during those ten years. It is abundantly evident from the returns of the Kegistrar-General that the death-rate of different districts increases according to the density of the population, i.e., the number of persona to a given area. There is a tendency for the people to leave the country districts and flock to the towns, where work is, as a rule, more highly paid and perhaps more plentiful. But though this may lead to the greater prosperity of the individuals, it has an injurious influence on health. And since it is the children who are particularly susceptible to those conditions which make the towns less healthy than the rural districts, it is evidently desirable that so far as possible the families of the town workers should be brought up in the country, or at least on the outskirts of the town rather than in its crowded centre. (j. e. s.)

Holidays.

Holidays have been greatly extended since 1875, and signs of the change are everywhere manifest. Almost all persons in regular employment now stipulate for a holiday period, and employers have to arrange accordingly. The Bank Holidays Act, 1871, expressed the tendency of the time, and gave it great impetus. People who had hitherto taken casual holidays, and perhaps felt somewhat conscience-stricken at neglecting work, now felt justified, and began to plan the use of these days. The railways . and caterers for amusement have of course risen to the occasion, and tempting advertisements crowd the walls.

The effect of the Act has been to stimulate the holiday sense and awaken the dormant curiosity of many a mental sleeper. The offer of a whole day has encouraged enter- prise in those who hitherto had spent their broken bits of holiday within a few yards of their homes, and it has led those who have learnt to enjoy one day to demand a longer season. But it is a question whether this Act has not now answered its purpose. Enormous crowds of people composed of one social class generate excitement which

is unwholesome, the great demand on space in carriages or in places of resort brings about a rise of prices, and there is often a laxity of manner and of morals, followed by incidents which are demoralizing. Many thoughtful members of the industrial classes now hold the opinion that the exist- ence of the Act makes their demand for periodical recrea- tion less effective, and has set apart days on which the lower classes revel and the upper classes remain indoors. "A chasm," they say, "has been made between classes who would have been better for taking their pleasures in relation to one another." The fact, however, remains that bank holidays, and especially the August holiday, are a great institution. They have become the centre of longer holidays, the day necessarily included in the week or fortnight. They draw out vast crowds to places of amusement or to country resorts. The tendency every year is for people to go farther afield and to make more use of the railways. The Crystal Palace, for in- stance, is more, and the Zoological Gardens less frequented. The railways and steamers are every year more largely used for excursions to more distant counties or seaside places. The habit of travelling has indeed enormously developed. In consequence, there has been a great increase of agencies and facilities, some of which are educational and some simply commercial. Of the latter Messrs Cook have been the pioneers, and now there are various firms who render travelling easy in all parts of the world, by pro- viding couriers and hotels, as well as personal conductors. Of the former the Toynbee Hall Travelling Club is the original on which many others have since been formed. In these clubs the members are instructed, before their journeys, in the history, art,

It is impossible to give any idea of the numbers who make use of either of these agencies, but the presence of English people is very evident to all travellers abroad. In the British Islands the railways and steamers have made travelling easier and cheaper. Third-class carriages are attached to express trains, and on some lines accompanied by refreshment cars. The carriages themselves have been made more comfortable, and access to distant places has been opened. In 1877 the total length of lines open in the United Kingdom was 17,077 miles. In 1900 it had increased to 21,855 miles. In the earlier year the number of passengers (exclusive of season ticket holders) carried was 549,541,325, and in 1900 the total reached was 1,142,276,686, who paid as fares ??45,383,988, against ??26,534,110

paid in 1877. The reduction in the fares by means of excursion and tourist tickets is shown by the fact that while the passenger traffic has doubled, the amount for conveying them each mile has only increased by one-eighth. Two persons could in 1902 travel for 8d. the same distance as in 1877 one person was conveyed for 7d. These increased facilities for travel have been followed by the increase of places of resort, especially on the coast. A plan for opening more remote country districts has been adopted by the railway companies, who issue at the beginning of each season lists of lodgings at farmhouses, cottages, or moorland homesteads. The children's country holiday funds, followed by the women's

and factory girls' clubs, have largely increased the summer exodus from town to the country. By means of these funds the children and the women paying some- thing for themselves are placed for a week or fortnight in country cottages. They get by this means not only change of air and food, but some experience in the habits of country people and country animals. The numbers who are thus sent from each city are very large ; 50,000 at least go annually from London in connexion with the funds, and an uncounted number who, having once been by the help of the fund, now make their private arrangements. But it is not only the railways and steamers which have enabled people to get the pleasures of change : the in- vention and the improvement of the cycle has put much new pleasure within the common reach. In 1878 the Cyclists' Touring Club was formed, with 144 members : in 1900 it had a membership of over 50,000; and, still more recently, motor-cars have offered themselves as new means of locomotion. Increased holidays constitute perhaps the most marked feature of the years since 1875. The feature is due to many causes; but it is to be noted that in 1842 the Early Closing Association commenced its agitation, and has never since ceased. Its object was a half-holiday for every person employed in shops. Its own object has not been reached, and Sir John Lubbock (Lord Avebury) has vainly striven to secure by law what the association has failed to secure by voluntary action. If, however, the association has not reached its object, its influence has undoubtedly been instrumental in educating public opinion.

A review of the whole subject is encouraging. There may still be whole classes whose holidays are uncertain ; there may be even larger classes

who can never look forward to periods longer than one or two day^ ; there may be some misuse of holidays ; but, on the whole, times of leisure are more regularly provided, and are used in getting strength and knowledge. If sometimes it seems as if love of pleasure had become excessive, and that men hurried work so as to get to play, there must be patience over times of transition. It is good that people have time to travel, to get fresh air, and to know one another ; if they do not at once use the time for the best purposes, it is something that they have the time to use.

The chief criticisms which it occurs to the writers to make are : (1) that it would be better if holidays were spread over the year, and not so generally confined to the month of August ; (2) that the practice which now holds of giving clerks a holiday of weeks should be extended to workmen who now take holidays of days, which in the year often amount to weeks ; and (3) that education should be directed to fit people to enjoy themselves in natural sur- roundings, rather than depend on getting enjoyment from excitement. (h. o. b. ; s. a. b.)

Open Spaces.

Since 1847 many Acts have been passed relating wholly or partly to the provision of open spaces, besides those which were framed to deal with special parks and recrea- tion grounds. Section 164 of the Public Health Act, 1875, provided for the acquisition of such spaces ; the Commons Acts of 1866 and 1876 secured the preservation from en- croachment of lands over which there were public rights ; the Open Spaces Acts of 1877, 1881, and 1887 gave further powers to local sanitary authorities to vitilize, acquire, and maintain recreation grounds ; and the Disused Burial Grounds Act of 1884, by making it illegal to build on any land that had been set aside for interments, assisted the movement, begun in London in 1875, to convert the old closed graveyards into public gardens. A valuable im- petus was afforded by the Corporation of London (Open

Spaces) Act, 1878, whereby the Corporation was empowered to levy a tax on grain, and to use the money for the acquisition of public land outside the metropolis, such as Epping Forest, with its area of over 5000 acres. In order to stimulate and encourage the efforts of the public bodies, and to watch the progress of open space legislation, certain useful voluntary agencies came into existence. The Com- mons Preservation Society has worked most assiduously since 1865 (see Commons). The Metropolitan Public Gardens Association, formed in 1882 by the earl of Meath, has carried through, or assisted to carry through, nearly 500 successful undertakings. Open space agencies have been started in Glasgow, Liverpool, Manchester, Norwich, and other provincial towns, in the colonies, in America, and on the Continent"; while a sub-committee of the Kyrle Society, under Miss Octavia Hill, has done very useful work. This valuable movement has also from time to time been encouraged by noble gifts of parks and other lands for the use of the public. A joint committee of representatives of the open space societies, presided over by Lord Hobhouse, urged all public governing bodies through- out the kingdom to commemorate the Diamond Jubilee by carrying out some open space scheme ; and this Queen's Commemoration Committee reported that 78 such schemes had been carried through to their knowledge, 9 being in London and the suburbs, and 69 in the provinces, resulting in a gain of 651 acres (besides trees and seats), of which 160 acres appeared to have been given and 491 purchased. By the Commons Act of 1899 the county councils acquired the same powers as had before then belonged to the urban and rural district councils, and all these bodies can now preserve, purchase, lay out, or maintain recreation grounds.

The following works on this subject will be found useful : ??? Shaw Lefevke. English Commons and Forests. ??? Sir R. Hunter. Open Spaces, Footpaths, and Rights-of- Way. ??? Mrs Basil Holmes. The London Burial-Grounds. ??? Colonel Sexby. The Municipal Parks and Gardens of London. h m. H.)

Public Libraries.

In 1875 only 82 towns or districts in the United Kingdom had adopted the Public Libraries Acts ; and in this number centres of population Kke London, Glasgow, Preston, Ports- mouth, Aberdeen, Edinburgh, Halifax, Belfast, Croydon, West Ham, and Huddersfield were unrepresented. Now every large town in the country has its public library, and not a few of the Smaller urban and rural districts. In all, 430 places had established libraries up to the end of 1901, and it is estimated that these institutions are the means of circulating about 40,000,000 volumes of carefully selected literature every year. These issues represent but a tithe of the work actually accomplished by the public libraries of the country, because the total only includes books issued for home reading and books which are referred to in reading-rooms and duly recorded. The immense number of unrecorded references made to com- mercial, technical, and literary works, which most libraries now place for free inspection on open shelves, are not counted in this estimate, nor does it include the enormous use of artistic, literary, scientific, trade, and other magazines or journals, made by all classes of people, not to speak of the newspapers and miscellanies. Other departments of work which have been undertaken by library authorities, such as lecture courses, classes, museums, juvenile and school libraries, &c., have also to be reckoned as additions to the extraordinary range of activity already indicated. In one respect the public libraries of the present day compare very favourably with those of 1875, and that is as regards general excellence of administration. Scientific methods of arranging and cataloguing books, so as to make them easily accessible to all, had not been

devised or v?idely adopted in the past ; and though a con- siderable number of libraries still lag behind as regards close classification, the cataloguing has improved greatly, and it is now very rarely that a really bad catalogue is published. In other respects improvements have mani- fested themselves. Greater freedom is now allowed to readers, and restrictive rules and regulations have been relaxed with benefit to all concerned. Some libraries have adopted, with complete success, improved methods of allowing borrowers direct access to the shelves, there to select books by actual examination and comparison in minutely classified libraries, and the result of seven years' experience has been to justify what was regarded as a somewhat dangerous departure. Mr James D.

Brown, the librarian of the Finsbury Public Libraries, was the first to initiate this system for lending libraries, and his name will ever be associated with open access to the library shelves. Other libraries, by reducing the age limits at which readers may enter, and otherwise extending the franchise, have not only increased their popularity, but largely extended their spheres of work and usefulness. The funds for carrying out the great variety of work undertaken by public libraries remain the same now as in former years, and with few exceptions no further power has been granted since the penny limit to the rate was fixed in 1855. Some few towns which have secured special legislation have been enabled to raise the amount of rate, or even to abolish the penny limitation, and have thus achieved results in advance of their neighbours. But it is quite clear that until Parlia- ment steps in and empowers local authorities to increase the library rate by a general abolition of the old limit, or fixing a new and higher one, the majority of British public libraries will have to struggle on as best they may ??? in a healthy but somewhat crippled state. The conditions under which the Acts may be adopted by a community have been greatly simplified by the Public Libraries Amendment Acts, 1893 and 1901, and the London Govern- ment Act, 1899. The power of adoption has been transferred from the ratepayers at large to the governing body of the administrative area, saving as regards parish councils, and the result of this transfer has been a large increase in the number of public libraries.

Reference may be made to some of the recent literature on the subject, which has not only improved in quality and increased in quantity since 1875, but is much better represented both in journals and books. For recent statistics, methods of work, &c., see Greenwood's iiJrari/ Year-Book, 1897andl900-l. The history of the movement is told at considerable length in Thomas Green- wood's Public Lihraries, 4th and 6th editions, and Ogle's The Free Library, 1897. Other aspects of the subject may be studied in the various volumes of The Library Series edited by Dr Garnett ; Mamiel de Biblioth4conomie, by Grabsel and Laudb, 1897 (a good general sketch of methods) ; A Library Primer, by J. 0. Dana ; the publications of the Library Association ; the Library Association Year-Book; and the current British and American journals devoted to librarianship. (x. (ju

Wages and Hours of Labour.

Since the formation of the Labour Department of the Board of Trade in 1893, the wages statistics of the country have steadily increased in value and in volume ??? but the complexity and variety of the wage-earning classes, the limited extent to which representative returns can be obtained, the irregularity of employment, the prevalence of overtime, and the differences in the methods of remunera- tion ??? all of which obscure the definiteness and detract

from the sufficiency of such returns as are available are

among the causes that make any general statement as to rates of wages and average earnings impossible. Certain general tendencies at the end of the 19th century may, however, be indicated. First, as to the distribution of the wage-earning classes. The diminishing proportion of

the population of the United Kingdom that is engaged in agriculture is one of the salient facts of the century. In 1825 the amount of agricultural and of non-agricultural labour in Great Britain was approximately equal. In 1891 the ratio was about one to five, the totals for the chief agricultural classes having fallen in England and Wales during the decade 1881-91 from about 1,135,000 to about 1,050,000, while the total population of the country was steadily increasing. The general, though by no means the unbroken, tendency has been for wages to increase since 1880, those of agricultural labour having perhaps increased most slowly, and chiefly towards the end of the period, so that the importance of the above figures becomes more manifest. The most notable increases in the occupation returns for England and Wales in the years 1881-91 are shown by coal-miners, railway and general transport employees, machine and boiler makers, and printers, their rates of increase being respectively 84, 78, 24, and 14 to every 10,000 males of ten years and upwards in the

country, and their aggregate mounting in the ten years from about 1,060,000 to about 1,400,000.

The general course of trade and employment during the last twenty years of the 19th century may be briefly described as follows. The first of the two decades opened after a period of depression (the reaction from the inflation of the years 1871-74), which had reached its lowest point in 1879. From 1880 to 1883 came a time of expanding trade, checked at the end for two or three years, but afterwards recovering and again expanding until 1891. In the period of decline which then began, 1893-94 marks the lowest point; but from that year until 1900 expansion again took place. During 1900, which had opened with employment still in full flood, and with wages stiU tending upwards, a slight reaction followed on the prosperity of the preceding six years. There was, however, no general contraction in the demand for labour, and such falling-off in wages as ensued (up to the beginning of 1902) was gradual in character and limited in scope, affecting mainly the mining and metal industries. The knowledge, however, that employment was good in certain years, or that wages tended to rise or fall in such and such a period, has little significance if we remain ignorant as to any movement that may also have taken place in the prices of those commodities on which wages are to a great extent expended : it is neces- sary to take into account the distinction between real and nominal wages. With the exception of 1889-91 and 1898-1900, the trend of wholesale prices was almost continuously downwards during the period 1880-1900. The influence of this decline upon the cost of living has been sometimes exaggerated, but at no time was there a greater variety of commodities purchasable by the masses of the people of the United Kingdom than at the close of the 19th century; and owing to the continued improvement in methods of production and in facilities for transport, although special classes of workers suffer from the changes and dislocation that even improvements bring, the general course of the markets is still in favour of the working-class consumer. The statistics of consumption of many of the necessaries of life illustrate this develop- ment, but perhaps still more significant is the gradual transition of many "luxuries" into the class of "neces- saries," due to the gradual rising of the standard of com- fort, and thus to the widening of the area of demand. It is no longer possible to find an index of well-being, even

among the poorer classes of the community, in the price of the quartern loaf. The most important item in working-class expenditure, which has neither contracted nor even remained stationary, has been house rent. In many rural districts there are well-founded complaints

of the low standard and the insufficiency of the accommo- dation available, and these complaints are echoed and emphasized in towns owing to the increasing rents that have to be paid. Although the expense of "housing" is thus often an increasing charge upon wages, the healthiness and conveniences of dwellings are also often increasing, both through the competition of owners and through the exercise of greater administrative care. It cannot, there- fore, be asserted, without qualification, that even as regards rent charges real wages are declining. In many great centres of population, moreover, the problem of hous- ing is being met to a growing and an unforeseen extent by the pfovision of greater facilities for locomotion. The census returns for London in 1901 reflected these various influences, showing as they did that the larger tenements had increased during the decade twice as quickly as the smaller ones, and that the one-room tenements had declined during the same period from 172,502 to 149,524.

Meanwhile, the population of the country has increased, the general health of the community has improved, the average age at death has risen, and there are many additional proofs that there is a considerable net increase in earnings. The following table will illustrate several of the points to which reference has been made : ???

Ml

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Prices???

Consumption per Head of Population of United Kingdom.

Post Offlce Savings Bank.

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lb.

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_?_?1000.

OOO's.

1881

1917 2

91 85

46 10

12-82

6-86

13-92

4-68

1-41

36,194

2607

1886

1617 0

72 69

37 9

1177

7-23

32-08

4-92

1-44

50,874

3731

1891

1914 0

77 72

37 10

10-70

8-66

13-11

6-36

1-61

71,608

6118

1896

18141

62 61

34 6

9-66

6-92

16-90

6-77

1-73

108,098

6862

1900

21 9 0

69 76

41 9

8-68

7-16

19-62

6-11

1-96

135,649

8439

The following table has been compiled from the 1900 report of the Labour Department on changes in rates of wages in the United Kingdom : ???

Changes in Mates of Wages.

Years.

Trades.

Gross Aggregate

Nos. of Individuals

Affected.

Total Amount of Changes per Week.

Increases. ‘ Decreases.

i

Increases.

Decreases.

1893-97

1898-1900

1893-97 1898-1900

Building

Mining and quarry- ing

Metal, engineering, and shipDuilding .

Building

Mining and quarrj—

ing . . . Metal, engineering,

and shipbuilding .

All trades i . All trades 1

269,207

441,688

469,808

210,830

2,041,912

456,768

1,840,778 3,290,418

4,646

1,006,426

181,906

8,697

4,018

10,642

1,277,937 36,007

s.

26,960 6

27,629 14

86,621 10

21,920 14

280,457 6

60,378 13

108,395 16 384,806 0

s.

273 6

89,221 19

***11,9-21 17 ***

901 4

264 6

1,202 17

100,172 5 3,712 13 ‘

1 Exclusive of agricultural labourers, railway servants, and seamen.

The net result per head of all the changes recorded in the above table in the years 1893-97 is practically nil, the figures showing a decrease of only a fraction of a penny per head per week of all persons affected. During the years 1898-1900, on the other hand, the total weekly advances were considerable, being equivalent in the aggregate, and assuming regular emplojmient, to an

increase of nearly ??20,000,000 in the yearly wages bill of the United Kingdom. During 1901 there was a slight set-back from the conditions of exceptional and in some directions inflated prosperity of the early months of 1900. f f y y

The figures relating to the hours of labour tell of a much more continuous movement than do those relating to wages, and show that for the organized trades of the country the recognized working week is getting steadily shorter. From the Parliamentary Keturn (1890) giving ” the average number of hours worked as a week’s work in the chief trade centres ” in the years 1850, 1860, 1870, 1880, and 1890, we find, on analysis of the 1121 returns (962 from employers and 159 from trade unions), that in 1890, as compared with 1880, there were only 73 cases of a lengthened working week, as compared with 363 cases in which it was shortened. Of the 73 cases, 56 are reported from various branches of the building trades. The value of these returns is considerably diminished by the omission of all numbers of those affected by the changes recorded, but

the great preponderance of the cases of a shortened working week is significant. The particulars furnished in later years by the Labour Department are much more precise, and show the follow- ing results for the years 1893-1900. By the cases of which fuU particulars have been received, again ex- clusive of agricultural labourers, railway servants, and seamen, 446,169 wage-earners were affected, and of these only 82,367 had their working day lengthened. Not only has a much larger number secured a decrease, but the gain of time per head has been much greater than the loss; for while 76,663, or nearly the whole of those whose average working week was increased, sub- mitted to an increase of less than one hour per week, the average time in each year by which the working week was shortened for the trades reported on was 2 "81 hours.

But while there is much detailed evidence of some- what greater leisure and of considerably increased wages, and still more general evidence of a rising standard of comfort, other considerations point to less satisfactory conclusions. Female labour is, it is true, being gradu- ally still further withdrawn from those occupations for which it is physically least fitted, and is widely pro- tected by legislation, especially as regards the hours of work, in ways that would be inexpedient for adult males ; but it still remains subject to many special disadvantages, both as regards conditions of employment and as regards wages. This inferiority is largely due to disorganization and to non-organization ; to the disadvantages that the woman stiU labours under of being regarded as a supple- mentary wage-earner ; and, frequently, to the aggravation of the normal sources of her economic weakness through the conditions of home employment. As regards the poorly-paid and unhappily- conditioned classes of female labour, as also of inefficient, disorganized, and degraded labour generally, both of men and women, Mr Charles Booth's conclusion has to be borne in mind, that some 30 per cent, of the people of London are to be classed as "poor," either through the lowness of the rate at which they are paid, through the irregularity of their employment, or through the general precariousness of their means of subsistence. Moreover, the figures for overcrowding for England and Wales have to be con- sidered. According to the returns for 1891, in which " ordinary tenements which have more than two occupants per room, bedrooms and sitting-rooms included," are re- garded as overcrowded, it appears that, in the urban districts,

2,572,413 persons were found to be living in one, two, three, or four rooms in such conditions, and in the rural districts, 685,631 persons ??? the two totals

representing in the aggregate more than 11 per cent, out of a total population of something over 29 millions. Many people are doubtless housed beneath their earnings, the margin saved in rent and in keeping up the home standard being diverted into other channels and often wasted. But it may be broadly stated that accommo- dation is a rough index not only to the standard of comfort of the household, but also to the economic status of the householder. The two sets of figures given above may therefore be usefuUy put side by side with the indications of progress already given, in order to indicate the serious limitations of such improvement in material conditions as has taken place.

Influence of Combination. ??? The legal position of the Trade Unions {q.v.) was settled in 1876, and since that date, in spite of some uncertainty as to the nature of lawful and unlawful picketing, and, in this connexion, as to the financial liability of the societies in the case of action- able conduct on the part of a member, they have been com- paratively free to concentrate attention upon internal management, and upon the task of making combination effective. From 1880 to 1888 a large number of new societies were started, but those in which any rapid augmentation of strength took place were excep- tional ??? for instance, among the older societies, in the Boiler Makers and, to some extent, in the Amalgamated Society of Engineers. Trade unionism still represented skill, and for the most part afforded additional protection to those classes of workers whose own economic position was aheady strong. The trade union mind of these years, when the depression and financial strain of 1879 and the immediately succeeding years had been left behind, is reflected in the first Report on Trade Unions prepared in 1887 by the Labour Correspondent of the Board of Trade. Writing of the complete emancipation in the eyes of the law that the societies had obtained, he continued : " There can be no doubt that the freedom which in this respect they now enjoy tends to make them the most con- tented industrial community in the world." At this date the total membership throughout the United Kingdom was estimated at something over 600,000. In 1889 a

great change took place. The apparently successful issue of what has come to be known as " the great dock strike " of that year in London appeared suddenly to open up a new era for trade unionism. The discovery seemed to be made, not, it is true, for the first time, that the unskilled could be organized no less than the skilled. New com- binations were formed up and down the country. Even more important than this, the older societies were led to bestir themselves more actively. The figures relat- ing to the annual Trade Union Congresses reflect the inflation and the enthusiasm of 1890. In 1889 there had been only 209 delegates present, representing 145 societies and less than 700,000 members, but in the following year there were 454 delegates, representing 268 societies and nearly 1,600,000 members. From 1891 untU 1895 the total of the trade unionists in the United Kingdom appears somewhat to have declined, mainly owing to the faUing-off in ^he membership of general labourers, agricul- tural labourers, and transport employes (other than railway men). This was the period of declining trade, and also of readjustment, following on the years of excitement that had preceded, but since 1895 a steady advance has been made. The trade unionists of the United Kingdom in 1900 were put down at 1,905,116, an increase of nearly half a million on the total given for 1895, and may be roughly estimated to include something under one in four of the class of men from whom members are drawn. The total number of unions at the end of 1900 was 1272, about 57 per cent, of which had been formed from 1880

onwards, and about 38 per cent, from 1890 onwards. A slight tendency towards consolidation is observable, but very many of the societies are stiU small, local, and unimportant, there being 815 of them with less than 300 members each, and with an average member- ship of only a little over 100. About three-fifths of the membership belong to the societies designated by the Labour Department as "the hundred principal trade unions," the position and importance of which will be best seen from the following particulars taken from the Report on Trade Unions, 1900 :

❖❖❖ Total income for the year, ❖❖1,974,611; total funds in hand,

_ ___3,766,625, equivalent to ___3, 5s. Od. per member; dispute pay, ___150,283; unemployed benefit, ___265,328; sick and accident benefit, ___323,231; superannuation, ___190,039; funeral benefit, ___98,682. From 1892-1900 these 100 societies expended upwards of 13^ million pounds, in the following proportions : ___ Dispute benefit, 20”2 per cent. ; working expenses, 19 ‘5 per cent. ; and for friendly benefits of various kinds, no less than 60‘3 per cent.

The primary object of every trade union must be a protective one, but the figures and percentages quoted above, showing the large expenditure on friendly benefits, prove the importance of the incidental benevolent work of the societies. The experience of the last decade of the 19th century, in spite of the heavy financial burden im- posed, afforded further proofs of the necessity of combining the benevolent with the more militant objects, in order that the bond of a permanent and obvious material gain to members may be provided. The usefulness of the trade unions in providing, on the side of the wage-earner, the general machinery for the maintenance of organized relationships between “capital and labour,” a machinery that is as potent in the preservation of industrial peace as it is for entering upon industrial conflict ; the statistical value of the returns of the societies, as throwing con- siderable light not only on the state of employment in particular trades, but to some extent on more general con- ditions ; and the means which the societies provide for the expression of representative working-class opinion, when this exists, are among the various advantages both to the community at large and to the wage-earning classes in particular that the stability of these organizations ensures. It must be observed, however, that the Trade Union Con- gress, the most representative organization of the trade unions, has declined in importance. This has been largely due to the division that has made itself felt on questions of political action and principle, and to the more or less veiled conflict that has arisen between the Socialistic and the non-Socialistic elements at the Congress ; while another source of weakness, to some extent arrested by recent improvements in procedure, has been the multitude of questions that are brought before the meetings. The increasing strength and scope of the employers’ associa- tions that has taken place, pari passu with the growth and consolidation of the trade unions, has been a marked and significant feature of recent years.

One of the most definite ways in which trade union influence has shown itself in recent years has been in the conditions under which labour has been employed by public authorities, and in the extent to which a " fair wages clause," in some form or another, has been inserted in public contracts. Exclusive of London, where the County Council and many of the boroughs have adopted stringent clauses, it is noteworthy that in the Govern- ment Return (1898) of Urban Sanitary Districts showing whether contracts entered into " specify any conditions as to the wages to be paid by the contractor, or other condi- tions with respect to the persons employed by him," no fewer than forty-eight of the county boroughs are found to

have adopted some such conditions, as against sixteen in which no conditions are directly enforced. The conditions specified vary considerably in stringency ; and while some deal simply with the question of competency, and a few even insist on the emplo3Tiient of local labour, the great majority enforce the payment of not less than " the current local standard rates of wages," and the observance of the hours and other conditions of emplojrment recog- nized. Inasmuch as these clauses involve the pubHc recognition of a standard and a groping after fairness, their extended adoption perhaps represents one of the most far-reaching effects of trade unionism. In general, however, it may be said that the societies are much more successful in securing the adoption of shorter hours, or of other conditions affecting the convenience, healthiness, and safety of labour, than in enforcing higher wages. They can more easily introduce a uniform wage than increase the aggregate of earnings, the amount, and even the rate, of the latter being determined by more general infiuences than the presence or absence of combination. In one special direction, namely, among workmen employed by local bodies, especially aU forms of unskilled labour (street-sweeping, &c.), the increase in wages has coincided with a rise in the standard of the requirements for what used to be regarded as the inferior services demanded by the community, employers, be they municipal or private, tending inevitably to secure the most eflBcient labour that is willing to take the wage offered. Thus the man who is handicapped in any way, be it by the infirmity of age or by any other physical cause, is finding it increasingly difficult to secure employment in directions to which, in years gone by, he had naturally

turned. Analogous effects are discernible in many fields of employment in which the trade unions have been able to enforce the payment of not less than a fixed minimum wage. This is indeed one of the difficulties that the cominunity at large is having to face at this era of partial organization, coinciding as it necessarily does with the existence of a large amount of labour that is, through lack of training, through deteriora- tion, through infirmity, or from some other cause, below the average and inefficient, and thus, though not un- employable, often unemployed. (e. a.)*

Societies, Art. See Art Societies.

Society islands. See Tahiti.

Sociology. ??? In the most inclusive sense sociology may be defined as the science of human society, in the same manner that biology may be taken to imply the science of life. The fact that sociology is treated in these new volumes of the Encyclopaedia Britannica for the first time under a separate heading is indicative of a certain tendency in the development of the subject, the bearing of which will be referred to later. The word sociology (Socioloffie) was first used by Comte in 1839 as an equi- valent of the expression social physics previously in use, and was introduced, he said, to describe by a single term that part of natural philosophy which relates to the positive study of the fundamental laws of social pheno- mena. Although the word is a hybrid, compounded from both Latin and Greek terms, its use has been defended, and is now generally accepted ; none of the terms, such as politics, social economy, social philosophy, and social science, which have been suggested instead of it having succeeded in taking its place. There has been in the past a certain hesitation, especially in England, to admit socio- logy as the title of a particular science in itself until it was made clear what the subject must be considered to cover. In certain quarters sociology is often spoken of as if it implied the practical equivalent of the science of politics. Henry Sidgwick considered the word as usually

employed in this sense, and whUe he recognized that sociology must have a wider scope than politics, he thought that in practice " the difference between the two subjects is not indeed great " {^Elements of Politics). In other quarters the word is often used as no more than a covering term for subjects which are fuUy treated in various subdivisions of social science. In others, again, a certain distinction is made, and sociology is used as an ordinal term to include the general principles of a subject of which the details are treated in subdivisions. Thus when the science of society is distinguished from the special social sciences which fall within its general purview, it may be considered, says Lester F. Ward, that " we may range the next most general departments as so many genera, each with its appropriate species. That is, the classification of the sciences may be made strictly sjmop- tical. When this is done it will be possible for philo- sophers, like good systematists, to avoid making their ordinal characters include any properly generic ones, or their generic characters include any that are only specific. Thus understood, sociology is freed from the unnecessary embarrassment of having hanging about it in more or less disorder a burden of complicated details, in a great variety of attitudes which make it next to impossible to secure due attention to the fundamental principles of so vast a science. These details are classified and assigned each to its proper place (genus or species), and the field is cleared for the calm contemplation of the central problem of determining the facts, the law, and the principles of human association " (Outlines of Sociology). This defini- tion, good as it is in many respects, does not, however, in practice make clear to the mind whether the principles of sociology involve more than the generalized total of the principles of the subordinate sciences which it is said to include. Finally, in England Herbert Spencer, who has been one of the principal writers identified with the subject in a period of transition, has placed his Principles of Sociology between his Principles of Psy- chology and Principles of Ethics. In practice, however, ethics, as Sir Frederick PoUock has pointed out, must be classed as a department of sociology. For " whatever may be thought of the existence of absolute or purely self ~~regarding duties, or of the possibility of a moral sense, arising otherwise than in society, it is understood that the great bulk of moral duties have regard to other persons " (HisU/ry of Science of Politics). Psychology, on the other hand, which Mr Spencer places before sociology, cannot nowadays be fully, or~~

even in any real sense scientifically, discussed apart from sociological principles, once it is accepted that the evolution of society is proceeding under the influence of natural selection, and that therefore the social factor is always in the ascendants ??? in the develop ment of the human mind no less than in the development of human conduct.

It would appear, therefore, that if sociology is to be admitted as a true science in itself, it must be regarded rather as a science occupied more particularly with the general fundamental principles which underlie human society considered as in a condition of change. In this sense, if its claim be established, it must be possible to show that while the conclusions of sociology cannot be fully stated in relation to the phenomena dealt with in any of the divisions of social science, they must be taken as implying more than the sum total of the results obtained in all of them, and therefore as involving governing principles to which the phenomena of aU of them stand in controlled and subordinate relationship.

The fathers of the science of society may be said to be the Greek philosophers, and in particular Plato and Aristotle. The Laws and the Republic of the former

*and the Ethics and Politics of the latter have, down to modern times, and notwithstanding the great difference in the standpoint of the world and the change in social and pohtical conditions, exercised a q ?????^' * considerable influence on the development of the theory of society. To the Greeks the science of society presented itself briefly as the science of the best method of attaining the most perfect life within the consciousness of the associated life of the State. " In this ideal of the State," says Bluntschli, " are combined and mingled all the efibrts of the Greeks in religion and in law, in morals and social life, in art and science, in the acquisition and management of wealth, in trade and industry. The individual requires the State to give him a legal existence : apart from the State he has neither safety nor freedom. The barbarian is a natural enemy, and conquered enemies become slaves. . . . The Hellenic State, Uke the ancient State in general . . . was all in alL The citizen was nothing except as a member of the State. His whole existence depended*

on and was subject to the State . . . The State knew neither moral nor legal limits to its power " {Theory of the State).

It was within the limits of this conception that most of the Greek theories of society were constructed. The fundamental conception of the Koman writers was not essentially different, although the "^^gfig ??? opportunism of the Eoman State, when it became Europe. a universal power embracing the social and religious systems of many peoples, in some degree modified it ; so that with the growth of jus gentium outside the jus civile, the later writers of the Empire brought into view an aspect of the State in which law began to be to some extent distinguished from morality. With the rise and spread of Christianity in Western Europe there commenced a stage in which the social structure, and with it the theory of society, underwent profound modifications. These changes are stiU in progress, and the period over which they extend has produced a great and increasing number of vsriters on the science of society. The con- ceptions of each period have been intimately related to the character of the influences controlling development at the time. The writers up to the 14th century are nearly all absorbed in the great controversy between the spiritual and temporal power which was defining itself during this stage in Western history. In the period of the Eenaissance and the Keformation the modern development of the theory of society may be said to begin. MachiavelLi is the first great name in this period. Bodin with other writers up to the time of Montesquieu carry the development forward in France. The Dutch writer Grotius, although chiefly recognized at the time as an authority on inter- national law, had much influence in bringing into view principles which mark more directly the transition to the modem period, his Be Jure Belli et Pads, issued in 1625, being in many respects an important contribution to the theory of society. Hobbes and Locke are the principal representatives of the influential school of writers on the principles of society which the period of the political and religious upheaval of the IVth century produced in England. The ideas of Locke, in particular, exercised a considerable influence on the subsequent development of the theory of the State in Western thought. From the 17th century forward it may be said, strictly speaking, that all the leading contributions to the general bpdy of Western philosophy have been contributions to the develop- ment of the science of society. At the time of

Locke, and to a large extent in Locke's writings, there may be distinguished three distinct tendencies in the prevailing theory of society. Each of these has since become more definite, and has progressed along a particular line of

development. There is first the empirical tendency, which is to be foUowed through the philosophy of Hume down to the present day, in what may be called ~~to borrow an idea from Huxley the physiological method in the modern study of the science of society. A second tendency which developed through the critical philosophy of Kant, the idealism of Hegel, and the historical methods of Savigny in the field of jurisprudence and of the school of SchmoUer in the domain of economics finds its current expression in the more characteristically German conception of the organic nature of the modern State. A third tendency which is to be followed through the writings of Eousseau, Diderot, d'Alembert, and the literature of the French Re~~ volution found its most influential form of expression in the 1 9th century in the theories of the English Utilitarians, from Bentham to John Stuart Mill. In this development it is a theory of the utilitarian State which is principally in view. In its latest phase it has progressed to the expression which it has reached in the theories of Marxian Socialism, in which the corresponding conception of the ascendancy of the economic factor in history may now be said to be the characteristic feature. All of these developments must be considered to have contributed towards the foundation of modern sociology. The definition of the relations to each other of the positions which they have severally brought into view is not unlikely to be the first important work of the new science.

At the period between 1830 and 1842, when Comte pubhshed the Philosophie Positive, the conditions were not

ready for a science of society to be instituted.

The Darwinian doctrine of evolution by natural selection had not yet been enunciated, and knowledge of social phenomena was limited and very imperfect. As an instance of the character of the change that has since been in progress, it may be mentioned that one of Comte's main positions ??? that, indeed, to which most of the characteristic conceptions of his system of philosophy were related ??? was that "the anatomical and physiological study of individual man " should precede the theory of the human mind and of human society. It is probable, however, that it must now be considered that no really fundamental or far-reaching principle of human development can be formulated as the result of such a position. For v?ith the application of the doctrine of evolution to society a position is becoming defined which is almost the reverse of it, namely, that the development of the individual, and to a large extent of the human mind itself, must be regarded as the correlative of the social process in evolution. The study of the principles of the process of social evolution would therefore in this sense tend to come before the complete study of the in- dividual, and even to precede the construction of a system of pyschology scientific in the highest sense. Comte, apart from his want of mastery of the historical method in deal- ing with sociological development, possessed, on the whole, little insight into the meaning of the characteristic problem in which the human mind is involved in its social evolution, and to the definition of which not only the processes of Western history, but the positions successively developed in Western thought, must all be considered as contributing. His great merit was the perception of the importance of the biological method in the science of society, the compre- hension of the fact that there can be no science of society if its divisions are studied apart from each other ; and finally, and although it led at the time to the formulation of no important principle of human development, the intuition that sociology was not simply a theory of the state, but the science of what he called the associated life of humanity.

It has to be observed, that preceding the application of the doctrine of evolution to society most of the contri-

butions to social science have a certain aspect in which they resemble each other. While in later theories society tends to be presented as

evolving inevitably, under stress of natural selection, towards efficiency, the earlier contributions tend to become theories of the meaning and object of society regarded simply as a medium for the conscious realization of human desires along the line of least eflrort in the associated state. In this presentation of the subject the influence of the Greek conception of of Greek the State upon modern sociology may be traced concep- down to the present day. At the beginning of "□□" <>' **□□ the modern period it reappears in MachiaveUi ' *' (Titus Livius, i., iii., and The Prince). It is represented in modified form in Hobbes (Leviathan), and in Locke (Two Treatises of Government), each of whom conceived man as desiring to leave the state of nature and as founding civilized society, "in order that he might obtain the benefits of government" in the associated state. It is continued in Rousseau and the writers of the French Revolution, who similarly imagined the individual volun- tarily leaving an earlier state of freedom to put "his person and his power under the direction of the general wUl" (Social Contract). It is characteristic of Jeremy Bentham (e.g.. Principles of Morals and Legislation, i.) and of J. S. Mill (e.g.. Utilitarianism and Political Economy, iv., vi.). Finally, it survives in Herbert Spencer, who in like manner sees man originating society and submitting to political subordination in the associated state " through experience of the increased satisfaction derived under it " (Data of Ethics). It continues at the present day to be characteristic of many Continental and some American writers on sociology, who have been influenced both by Spencer and the Latin theory of the State, and who there- fore, conceiving sociology not so much as a science of social evolution as a theory of association, proceed to con- sider the progress of human association as the development of a process " of catering to human desire for satisfactions of varying degrees of complexity" (Small). With the application of the theory of natural selection to human development this conception may be observed as tending to be replaced by that already mentioned, which is difierent both in character and implication. In the later view, while the positions involved in the first Result ot conception of society are not lost sight of, the gyoi□□□"ioa development of human society is regarded rather as the product of a process of stress, in which progress results from natural selection along the line, not of least effort in realizing human desire, but of the highest social efficiency in the struggle*

for existence of the materials of which society is composed. In the intensity of this pro- cess society, evolving towards higher eflSciency, tends to become increasingly organic, the distinctive feature being the growing subordination of the individual to the social process. AU the tendencies of development ??? political, ethical, and psychological ??? and the contents of the human mind itself, would therefore have to be regarded as having ultimate relations to the governing principles of the process as a whole. The science of social evolution would, in short, have to be considered, according to this view, as the science of the causes and principles subordinating the in- dividual to a process developing by inherent necessity towards social efficiency, and therefore as ultimately over- ruling all desires and interests in the individual towards the highest social potentiality of the materials of which society is composed. The conflict between these two con- ceptions may be distinguished to an increasing degree as the scope of modern sociology has gradually become de- fined ; and the opposing principles and ideas of each may be observed to be sometimes represented and blended, in varying degrees of complexity, in one and the same writer.

It was natural that one of the first ideas to be held by theorists, as soon as sociology began to make progress to the position of a real science, was that society must

be considered to be organic. An increasing Society number of writers from Comte onwards have Vrxanism. ^^^^ concerned with this aspect of the subject,

and in connexion with it there is brought into view the nature of the situation towards which the conflict referred to has gradually developed. Comte conceived social organization as more or less mechanical. Writers like Herbert Spencer (Sociology) and Schaffle, who was for a time Minister of Commerce for Austria (Ban und Leben des Socialen Korpers) have instituted lengthy com- parisons between the social organism considered as the State and the living individual organism. These efforts

may be said to have reached their most characteristic current expression in the work of the sociologists who have followed Simmel in lengthy and ingenious attempts at classifying associations, considering them " as organiza- . tions for catering to human desire." In all these attempts the Greek theory of society may be said to be still vigorously represented, although, as has been said, the old is often blended with the new in one and the same writer. In their later phases they may be recognized to be, to a considerable extent, characteristic of the work of sociologists in countries where the influence of Koman law is still strong, and where, consequently, the Latin conception of the State associated with it tends to influence aU theories of society as soon as the attempt is made to place them on a scientific basis. The sterilizing effect which the example has produced on the study of sociology in certain directions in America has, however, to be noted. It is exemplified in ingenious attempts which are made, in dealing with the principles of sociology, to construct long categories of human associations, ranging from those based on mental abnormality to those that result in joint partici- pation in choral music. There is to be distinguished an increasing conviction that none pf the comparisons of this kind that have hitherto been made have contributed in any marked degree to the elucidation of the principles of modern society. Paul Leroy Beaulieu's criticism of SchafHe's effort at comparisons ___ anatomical, physiological, biological, and psychological ___ between society and the human individual is that "the mind sinks overwhelmed under the weight of all these analogies, these endless divisions and subdivisions to which they give . rise. . . . The result is not in proportion to the effort " {L'^tat moderne et ses fonciions).

In tracing the direction of this conflict between the newer and older tendencies in modern sociology, it is

*probably in Herbert Spencer's writings that the ___**" * student will find presented in clearest definition*

the characteristic difficulty with which the old view has tended to be confronted, as the attempt has con- tinued to be made to enunciate the principles of human development from the standpoint that society is to be con- sidered as a "social organism." With the application of the doctrine

of natural selection to society considered as an organism, a position has been brought into view of considerable interest. It is evident that a fundamental principle involved in considering society as an organism, is that the efficiency of the social organism must always be taken to be greater than the sum total of the eflaciencies of all the members that comprise it, acting as individuals. The inference which follows from this, is that if natural selection is to be considered as operating in society along the line of highest efiiciency, it must reach the individual through society. That is to say, his development and his interests as an individual must be regarded as having ceased to be the controlling factor in social evolution. It

is the principles subordinating him to the efficiency of society in its corporate aspect which must ultimately con- trol both, and, therefore, all theories whatever of human association. Mr Spencer, in an elaborate comparison which he has made {Essays, vol. i., and Principles of Sociology) between the social organism and the living individual organism, has insisted on a reservation which brings into view, in connexion with this fact, a position the relation of which to present tendencies in sociology is probably funda- mental. In comparing the social with the individual organism he proceeds, after noting the various aspects in which a close analogy between the two can be established, to make, as regards modern society, an important distinction by which the nature of the difftculty in which he is in- volved is immediately made apparent. While in an individual organism, he points out, it is necessary that the Uves of all the parts should be merged in the life of the whole, because the whole has a corporate consciousness capable of happiness or misery, it is not so with society. For in society, he adds, the " living units do not and cannot lose individual consciousness, since the community as a whole has no corporate consciousness." Mr Spencer pro- ceeds, therefore, to emphasize the conclusion that "This is an everlasting reason why the welfare of citizens cannot rightly be sacrificed to some supposed benefit of the State ; but why, on the other hand, the State is to be maintained solely for the benefit of citizens. The corporate life must here be subservient to the lives of the parts, instead of the lives of the parts being subservient to the corporate life." The position to which this conception of Mr Spencer ??? in which the State is conceived to be

the ” social organism ” ??? gave rise, as the doctrine of evolution continued to be applied to society, was defined in the prefatory essay to vol. xxix. of the present edition of the Encyclopczdia Britannica. Briefiy stated, the characteristic difiiculty which presented itself was that : If natural selection is conceived as operating on society, and therefore as tend- ing to produce the highest efficiency out of the materials that comprise it, it must produce the subordination of the interests of the units to that higher efficiency of society, which is greater than the sum total of the efiiciencies of the component members. But one of only two conclusions could therefore result from Mr Spencer’s position. In regarding the “social organism” as an organism in which the corporate life must be subservient to the lives of the parts, instead of the lives of the parts being subservient to the corporate life, it must be necessary to conceive that the individual had succeeded in arresting the characteristic effects of natural selection on society. Or else, the result just mentioned being scarcely conceivable, natural selec- tion, whether the individual be conscious of it or not, must be subordinating individual interests in society to a larger meaning in the evolutionary process. Society must, in short, be subject to principles which reach farther than Mr Spencer conceived : it must be organic in some different and wider sense than he imagined, and the analogy of the ” social organism ” as confined within the consciousness of ascendant interests in the political State must be considered to be a false one.

*In the essay in question the gradual reductio ad ab- surdum which has taken place, with the application of the doctrine of evolution to society, of the conception that natural selection tends to be suspended in the ”””’**??’??? social process, was dealt with and may be there to sod- followed in detail. It remains here to consider oiogy of the relation to the position in modern sociology *** evolu- of the other alternative, namely, that society “jS^^Zi must be considered to be organic in some wider sense than the principles of the State would imply. The position reached in Mr Spencer’s sociology may be said to*

represent the science of society in a state of transition. It represents it, that is to say, in a stage at which the Greek theory of society has become influenced by the doctrine of evolution applied to modern conceptions, but while as yet no synthesis has been achieved between the conflicting and even mutually exclusive ideas which are apparently in- volved. The Greek theory of society is represented in Mr Spencer in his practical identification of " the social organism " with the State. The idea, however, which carries him beyond the principles of Greek society ––– as these principles were summarized, for instance, in the passage already quoted from Bluntschli ––– is clearly in evidence. It may be observed to be expressed in the recogni- tion of a principle resident in modern society which in some manner projects the individual's rights outside and beyond the whole theory and meaning of the State. In other words, in society as !Mr Spencer now conceives it, "the welfare of citizens cannot rightly be sacrificed to some supposed benefit of the State " ; whereas, according to the Greek theory and the theory of Roman law, "the citizen was nothing, except as a member of the State. His whole existence depended on and was subject to the State. The State knew neither moral nor legal limits to its power." If, however, it be considered that modern society has made progress beyond the Greek, and if it be accepted that the theory of evolution involves the con- clusion that society progresses towards increased efficiency in a more organic type, there follows from the foregoing an important inference. This is that it would then become the task of modern sociology, as a true science, to show that the principle in modern civilization which distinguishes it from society of the Greek period ––– namely, that principle which Mr Spencer rightly recognizes as rendering the life of the individuals as no longer subservient to the corporate life of the State ––– is itself a principle identified with the increasing subordination of the individual to a more organic type of society. It must, in short, remain for the evolutionist, working by the historical method scientifically applied, to present the intervening process in history ––– in- cluding the whole modern movement towards Hberty and enfranchisement, towards equality of conditions, of rights, and of economic opportunities ––– as a process of progress towards a more advanced and organic stage of social sub- ordination than has prevailed in the world before.

It is at this point that the wide scope of modern sociology comes into view, and that the advanced character of the studies which must form its basis may be realized. It is not, it would appear, only the facts of primitive society, the general theory of the political State, and the principles of economic society, that come within its purview. The developments of history and the positions successively defined in human thought and in human belief must, it would seem, all fall to be considered in a strictly scientific sense as constituting the phenomenology of a process in which, with the evolution of society towards higher efficiency, the individual is being gradually subordinated to principles rendering society increasingly organic.

Hitherto, in the development of sociological theory, the tendency which has led to the identification of the social organism with the State has been productive of certain more or less characteristic results. In the first place, by the considerable number of writers who have, as stated, tended to consider sociology as the study of associations for realizing human desires, beginning with those of primitive society and rising to the economic wants of the modern State, attention has necessarily been given to institutions of custom and legality, to civil and economic phenomena, and, in the study of modern society, to statistical methods and quantitive measurements in con- nexion with facts relating to such subjects as wealth, |

industry, health, crime, education, and forms of economic activity. In sociology thus considered, the legal and economic aspects of society, and the theory of the State as constituting the social organism, have tended to be kept in view. An incidental but by no means unimportant result has, however, been that, as Mr Lester Ward has pointed out, sociologists have been hitherto recruited mainly from students of economics or of subdivisions of economic science. While such studies must always continue to constitute an important part of the science of society, it must be considered that the tendency in the past to give them so prominent a place, as constituting the subject- matter of the science, has hitherto unduly restricted the outlook in sociological study. The conception of sociology as occupied with the general fundamental principles which underlie society considered in a condition of change, and therefore as

involving governing principles to which the phenomena of all departments of social science stand in controlled and subordinate relationship, renders it neces- sary that the science should cover the subjects of a wide field of advanced study. When society is considered as an organism developing under the influence of natural selection along the Une of the causes which contribute to its highest potential efficiency, and therefore tending to have the mean centre of its organic processes projected farther and farther into the future, it is evident that it must be the principles and ideas which most effectively subordinate over long periods of time the interests and the capacities of the individuals of which it is composed to the efficiency of the whole which will play the leading part in social evolution. The position of sociology, there- fore, follows, as the most advanced of all the theoretical sciences. With the application of the doctrine of evolution to the social process in history, it must necessarily be concerned with all the subjects included under the old philosophy of history ; while, on the other hand, when the contents of the individual mind are viewed as the cor- relative of the evolutionary process in society, the ultimate problems of ethics and psychology are also seen to be involved. The foundations of the science of society can- not, in short, be firmly or permanently laid with the com- paratively limited outfit with which the sociologist has often been content to work in the past.

A consideration of the general outlines of the process in which society must be considered as developing towards a higher organic efiiciency imder the operation of natural selection brings into view the scope of ❑❑❑❑❑ “‘ the studies which are thus likely to form the basis ❑❑*’”❑❑f^”’*

r . 1 ❑❑❑ ❑❑❑ /i 1 sociology.

or sociology as a science m the modern sense, while it gives at the same time some general impression of the character of the results by which it is possible that a synthesis of the later with the older views may in time be attained. Beginning with primitive society, it must be considered that the first rudiments of social organization arose, not so much from conscious regard to expediency or ” increased satisfactions,” as from fitness in the struggle for existence. ” The first organized societies must have been

developed, like any other advantage, under the sternest conditions of natural selection. In the flux and change of life the members of those groups of men which in favourable conditions first showed any tendency to social organization became possessed of a great advantage over their fellows, and these societies grew up simply because they possessed elements of strength which led to the disappearance before them of other groups of men with which they came into competition. Such societies continued to flourish, until they in their turn had to give way before other associations of men of higher social efficiency" (Social Evolution, ii.). In the social process at this stage all the customs, habits, institutions, and beliefs

contributing to produce a higher organic efficiency of society would be naturally selected, developed, and per- petuated. It is in connexion with this fact that the clue must be sought to the evolution of those institutions and beliefs of early society which have been treated of at length in researches like those of M'Lennan, Tylor, Lubbock, Waitz, Letourneau, Quatrefages, Frazer, and others of equal importance. For a long period in the first stages the highest potentiality of the social organiza- tion would be closely associated with military efficiency. For in the evolution of the social organism, as has been said, while the mean centre of the processes involving its organic identity would tend to be projected into the future, it would at the same time always be necessary to maintain efficiency in current environment in competition with rival types of lower future potentiality. Amongst primitive peoples, where a great chief, law-giver, and military leader appeared, the efficiency of organized society resting on military efficiency would, as a matter of course, make itself felt in the struggle for existence. Yet as such societies would often be resolved into their component elements on the death of the leader, the overruling im- portance ??? in the next stage of the advance towards a more organic type ??? of ideas which would permanently subordin- ate the materials of society to the efficiency of the whole would make itself felt. Social systems of the type in which authority was perpetuated by ancestor-

worship ... in which all the members were therefore held to be joined in an exclusive religious citizenship founded on blood relationship to the deities who were worshipped, and in which all outsiders were accordingly treated as natural enemies, whom it would be a kind of sacrilege to admit to the rights of the State ... would contain the elements of the highest military potentiality. The universal mark which ancestor-worship has left on human institutions in a certain stage of social development is doubtless closely associated with this fact. The new and the older tendencies in sociology are here also in contrast; for whereas Herbert Spencer has been content to explain ancestor-worship as arising from an introspective and comparatively trivial process of thought assumed to have taken place in the mind of early man in relation to a supposed belief in ghosts (Principles of Sociology, 68-207), the newer tendency is to consider science as concerned with it in its relation to the characteristic principles through which the efficiency of the social organization expressed itself in its surroundings. The social, political, and religious institutions disclosed in the study of the earliest civilizations within the purview of history must be considered to be all intimately related to the ruling prin- ciples of this military stage. The wide reach and signifi- cance of the causes governing the process of social evolution throughout the whole of this period may be gathered from treatises like Seebohm's Structure of Greek Tribal Society, Maine's Ancient Law, History of Institutions, and Early Law and Custom, Fowler's City-State of the Greeks and Romans, and in a special sense from the comparative study of Koman law, first of all as it is presented in the period of the Twelve Tables, then as the jus civile begins to be influ- enced by the jus gentium,, and lastly as its principles are contrasted with those of English common law in the modern period. In most of the philosophical writings of the Greeks, and in particular in the Ethics and Politics of Aristotle, and in many of the Dialogues of Plato, the spirit of the principles upon which society was constructed in this stage may be perceived as soon as progress has been made with comparative studies in other directions.

Where, however, all human institutions, as in this stage, rested ultimately on force ; where outsiders were regarded as natural enemies, and conquered enemies became slaves ;

where, as throughout all this phase of social evolution, a rule of religion was a rule of law identified with the principles of the State (Maine, Ancient Law) ; where the State itseK was absolute as against the individual, knowing " neither moral nor legal limits to its power " ; and where all the moral, intellectual, and industrial life of the community rested on a basis of slavery ??? the full limits of the organic principle in society would in time be reached. The conditions would be inherent in which all social institutions would tend to become closed absolutisms organized round the conception of men's desires in the present. And the highest outward expression in which the tendencies in ethics, in politics, and in religion must necessarily culminate would be the military State, bounded in its energies only by the resistance of others, necessarily acknowledging no complete end short of absolute dominion, and therefore staying its course before no ideal short of universal conquest.

As society continued to be impelled to develop towards a stiU more organic type, the greatly higher potentiality of a state of social order which, while preserving the ideal of the highly organized State and the current efficiency of society in competition with lower types, would be influenced by conceptions that would dissolve all those closed absolutisms, and release human energies into a free conflict of forces by projecting the principles of human responsibility outside the State, would be apparent. The conditions in which such a stage has in some degree tended to be attained in Western history were exemplified in the Prefatory Essay to vol. xxix. In many of the religions of the East such conceptions are to be found in all stages of development. But no Eastern people has, down to the present time, been able to provide for them the permanent military milieu in history in which alone their potentiality in the evolutionary process could be realized. The significance, therefore, of the culmination of the military epoch in the ancient classic civilizations of the Western world which preceded the opening of the era in which we are living, and of the fact that the peoples of the same descent who were destined to carry on the civilization of the existing era represent the supreme military stock by natural selection, not only of the entire world, but of the evolutionary process itself in human history, will be evident. With the spread, accordingly, amongst peoples of this origin, and in such a milieu in history, of a new conviction of responsibihty to principles

extending beyond the consciousness of the political State, there would begin a further and more organic stage of the evolutionary process in society. The gradual dis- solution in the era in which we are living of all the closed absolutisms within the State, in which human action and ideas had hitherto been confined, is apparently the characteristic phenomenon of this stage. Progress is towards such a free and tolerant, but intense and efficient, conflict of forces as was not possible in the world before. It is, it would appear, in this light that we must regard the slow dissolution of the basis of ideas upon which slavery rested ; the disintegration of the conceptions which supported the absolute position of the occupying classes in the State ; the undermining of the ideas by which opinion was supported by the civil power of the State in the religious struggles of the Middle Ages ; the growth of the conception that no power or opinion in the State can be considered as the representative of absolute truth; the consequent development of party government amongst the advanced peoples, with the acknowledgment of the right of every department of inquiry to carry results up to that utmost limit at which they are controlled only by the results obtained in other departments of activity vrith equal freedom; the growth of the conception, otherwise

absurd, of the native equality of men ; the resulting claim, otherwise similarly indefensible, of men to equal voting power irrespective of status or possessions in the State, which has been behind the movement towards political enfranchisement ; and, finally, the development of that conviction which is behind the existing challenge to all absolute tendencies in economic conditions in the modern world ??? namely, that the distribution of wealth in a well- ordered State should aim at realizing political justice. These are all the features of an integrating process in modern history. They must be considered as all related to a controlling principle which has rendered the evolu- tionary process in society more organic than in any past stage : namely, the projection of the sense of human responsibility outside the limits of all the creeds and

interests which had in previous stages embodied it in the State {Principles of Western Civilization, x., xi.).

In thus regarding the social process in Western history, the projected efficiency of which, now after many centuries of development, begins to realize itself to an increasing degree in determining competition with other types of society throughout the world, it may be observed that the results by which a synthesis of the older and later views may be attained is already in some measure in sight. It was pointed out that if the principle which Mr Spencer rightly recognized in modern society as rendering the life of the individual no longer subservient to the corporate life of the State was to be accepted as a principle of progress distinguishing modern civilization from that of the Greek period, it would be necessary for the scientific sociologist to exhibit it not as indicating the larger independence of the individual, but as a principle identified with the increasing subordination of the individual to a more organic type of society. Here, therefore, this result is apparently in process of accomplishment. The inter- vening process in history ??? including the whole modern movement towards liberty and enfranchisement, towards equality of conditions, of rights, and of economic oppor- tunities ??? is presented " as a process of progress towards a more advanced and organic stage of social subordination than has prevailed in the world before {Principles of Western Civilization, xi.). In this light, also, it may be observed how the claim of sociology to be the most advanced of aU the theoretical sciences is justified. For if the historical process in the civilization of the era in which we are living is thus to be regarded as a process implying the increasing subordination of the individual to a more organic type of society, then the study of sociology as em- bracing the principles of the process must evidently involve the perception and comparison of the meaning of the funda- mental positions disclosed in the history of political progress, of the problems with which the human mind has successively struggled in the phases of religious development, and, lastly, of the positions with which the intellect has been con- fronted as the stages of the subordinating process have gradually come to define themselves in history. The positions outlined in the developments already referred to which have come down through Hume and Huxley, through Kant and Hegel, through Grotius and Savigny,

through Koscher and Schmoller, through the expression which English utilitarianism has reached in Herbert Spencer as influenced by the English theory of the rights of the individual on the one hand, and in Marxian Socialism as influenced by the Latin conception of the omnipotence of the State on the other, have thus all their place, meaning, and scientific relations in the modern study of sociology. It must be considered that the theory of organic evolution by natural selection and the historical method will continue in an increasing degree to influence the science of society. In the future, in the study of man, to make use of words

employed by Sidgwick shortly before his death : " Owing to the overwhelming importance of the social factor [in the formation of a normal human individual], the methods of psychology and sociology blend in the inquiry, and the method of sociology dominates " {Philosophy, its Scope and Relations).

Authorities. ??? It has been one of the results of the conditions affecting sociology in the past, that many of the principal contributions to the science of society are not always included in lists of sociological references. The following are mentioned only as indicating or suggesting others in the same classes of equal or perhaps greater importance. The dates given are usually those of the first edition of a work ; ???

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S6derha.mn, a seaport town of Sweden, county of Gefleborg, on a bay of the Gulf of Bothnia, 7 1 miles north

of Gefle by rail. It has saw-mills, planing-mills, iron- works, breweries, and wood-pulp factories, and exports timber (16,500,000 cubic feet annually), with iron and wood-pulp. In 1900 the exports amounted to about ??1,000,000 in value, and the imports to ??70,000. The port is cleared by some 400 to 500 vessels of 200,000 to 300,000 tons annually. In 1897 a new fairway was opened, giving access to vessels drawing 15 feet, i.e., to the loading place at Branthall. The port is, however, usually closed for the first four months of the year. The town, a straggling place with

wide streets, was given municipal privileges by Gustavus Adolphus in 1620, and was rebuilt after fires in 1860 and 1865. Population (1880), 7937 ; (1900), 11,258.

Sddertelge, a town of Sweden, county of Stock- holm, stands on the Sodertelge canal (IJ mile long; 10 feet deep on sill at low water; opened in 1819), which connects Lake Malar with an inlet of the Baltic, 23 miles by rail west-south-west of Stockholm, of which it is indeed a suburb. It is frequented also as a summer resort, having mineral springs and baths. Its church is reputed to date from about 1100. There are engineering shops, jute spinning and weaving mills, match and joinery factories. Population (1880), 3510; (1900), 8207.

Soest, a town and episcopal see of Prussia, province of Westphalia, 33 miles by rail east of Dortmund. In front of the town hall (1701), which possesses valuable archives, stands a bronze statue of the Emperor William I. (1888). There are a teachers' seminary, a deaf and dumb and a blind asylum. Sugar is now manufactured. Popu- lation (1885), 14,846; (1900), 16,724.

Sofia, the capital of Bulgaria, finely situated on a high rolling plain 2000 feet above the sea and encom- passed by the Balkan mountains, and at the terminus of the Sofia- Varna line (325 miles) opened in 1899, 300 miles west-north-west of Constantinople by rail, 206 miles south- east of Belgrade. By a branch line from Rustchuk joining the Sofia-Varna line near Tirnovo, improved means of communication is obtained with Berlin and north-east Germany, &c. The city is lighted by electricity, and there is an electric car system. Notwithstanding the bad harvests of several years, the commercial importance of the city is steadily increasing. It has breweries, tanneries, tobacco factories, and cloth and silk factories, and exports skins, cloth, cocoons, cereals, attar of roses, dried fruit, &c. The towa was almost completely renovated during the last twenty years of the 19th century, the old town to the west, still partly inhabited by Turks, having been practi- cally rebuilt in the European fashion. The houses are mainly brick encased in stucco, and the new town to the east dates entirely from 1878. A university was founded in 1888 (409 students in 1900), and there are colleges for boys and girls, a real-schule, a military

school, and a military college. Near the cathedral in the old town is the mausoleum containing the remains of Prince Alexander of Battenberg. The Bujak-jami mosque is now occupied by the national library and the museum. Between the old and new town is the modern St Alexander Church, a magnificent structure in the Byzantine style, erected to commemorate the deliverance of Bulgaria. In the new town are the theatre, the fine university buildings, includ- ing the national printing establishment, the Chamber of Deputies, and monuments to the patriot Levski, to Eussia, and to the Emperor Alexander II. of Eussia. Popula- tion (1892), 46,593; (1900), 67,920, of whom two-thirds were Bulgarians and alsout one-sixth Jews.

SoigftlieS, a town of Belgium, in the province of Hainaut, 11 miles north- east of Mons by rail. There are important freestone quarries in its vicinity, and sugar

factories and tanneries. Population (1880), 8144 ; (1900),

10,124.

Sokota,. See Abyssinia.

SokOtO, an important native state of the Central Sudan, now included in the British protectorate of Nigeria. The kingdom of Sokoto is the remnant of the great Fulbe kingdom established early in the 19th century by the leader Othman, but it has long been losing its importance as a military power, though the industrious and enterprising habits of the Hausas, who form the great bulk of its population, render it one of the most hopeful regions for the introduction of civilizing influences by Europeans. King Omar, under whose rule the power of the empire reached its lowest level, died in 1891, and was succeeded by Abderrahman, who has done something to restore the influence of the central power, especially by the reduction of the rebellious king of Argungu ; but the once tributary states of Adamawa and Gando can no longer be considered as part of the kingdom. Adamawa itself is now split up into several quasi-independent sultan- ates, and its former capital, Yola, was taken by a British military expedition in 1 90 1 . The relations of Abderrahman with the British authorities have been somewhat doubtful, for though professing

friendship, the king has shown him- self unwilling to acknowledge the British protectorate ; and in 1900 the expedition of Bishop Tugwell, though entirely non-political, was forced to retire from the great commercial centre of Kano owing to the suspicion of the native authorities. Under the administration, however, of Sir F. Lugard, the High Commissioner of Northern Nigeria, survey expeditions under Colonel Morland and other officers have reached Zaria, a strong walled town with an estimated population of 60,000 to 70,000, ruled by one of the most powerful vassals of the Sokoto king- dom, meeting with a cordial reception. By the Anglo- French agreement of 1898 the British " sphere of influ- ence " is bounded, north of Sokoto, by a line leaving the Niger in about 11 ́́ 45' N. and following the course of the Dallol Mauri to its intersection by the arc of a circle drawn from the town of Sokoto as a centre, with a radius of 100 mUes. This is followed to its second intersection viith the parallel 14 ́́ N., which then becomes the frontier for 70 miles, the line afterwards running south to 13 ́́ 20' N. and east along this parallel for 250 miles, or beyond the limits of the Sokoto kingdom.

See MONTBIL, De Saint-Louis d Tripoli par le lac Tchad, Paris, 1895. ́́́ Lugakd. "Northern Nigeria," Colonial Reports ́́́ Annual, No. 346, 1902 ; and other works referred to under art.

NiGEElA.

Sokotra. ́́́ This island is the largest and most easterly of a small group rising from a coral bank in the North Indian Ocean, of which Abd-el-Kuri, the Brothers (Kal Far'un, Semha, and Darzi), and Saboynea are the other members. An investigation of the island was under- taken by Professor Bayley Balfour in 1880, and sub- sequent expeditions were headed by Drs Eiebeck and Schweinfurth in 1881, by Mr Theodore Bent in 1897, and by Dr H. O. Forbes and Mr Ogilvie-Grant (who also visited Abd-el-Kuri) in 1898-99. Simultaneously with the latter, a further expedition, conducted by Professor D. H. Miiller, under the auspices of the Imperial Academy of Sciences of Vienna, visited Sokotra, Abd-el-Kuri, and some of the other islets of the group specially to investigate

their geology and languages, but their report had not yet been published in 1902.

From the sea the island has an imposing appearance. The centre culminates in a series of rugged pinnacles ??? the Haghier mountains, which attain an altitude of nearly 5000 feet, rising out of and above a high (1500 feet) abutting and undulating lime- stone plateau, deeply channelled by valleys. At many parts of the

north coast the edges of this plateau reach the shore in precipitous cliffs, but in others low plains, dotted with bushes and date-palms, front the heights behind. The southern shore is bordered for nearly its entire length by a belt of drifted sand, forming the Nuget plain. Along this side of the island there are few villages and but one or two possible anchoring grounds, and these only during the north-east monsoon. On the north coast there are no harbours ; but fairly safe anchorages, even in the north-east winds, are available otf Hadibu or under Haulaf, a few miles distant, and at Eallansayia, at the north-west extremity of the island. Kallansayia, Khadup, and Hadibu, all small villages, are the only places of importance in Sokotra. The latter, the capital, is pleasantly situated amid date-palms in a semicircular plain enclosed by spurs of the Haghier mountains. As to the geology of the island, its fundamental rocks are gneisses, through which cut the felspathic granites which form the Haghier massif. Through these, again, pierce other granites in dykes or lava flows, and overlying the whole are limestones of Cretaceous and Tertiary age, themselves cut through by later volcanic eruptions. "In the Haghier hills," to quote Professor Bonney, "we have probably a fragment of a con- tinental area of great antiquity, and of a land surface which may have been an ' ark of refuge ' to a terrestrial fauna and flora from one of the very earliest periods of this world's history. "

From October to May the weather is almost rainless, except in the mountains, where there are nightly showers and heavy mists. During this season the rivers, which are roaring torrents through- out the monsoon,

are almost all lost in the drj', absorbent plains before reaching the sea. The temperature of the coastal area varies from 65 F. in the night to 85 F. in the day in the hot season it may reach 95 F. ; and on the mountains (3500 feet), from 52 F. to 72 F. In the low grounds fever of an acute and hematuric form is very prevalent.

Sokotra has claims to be reckoned one of the most ancient incense-supplying countries. Among the "harbours of incense" exploited by various Pharaohs during some twenty-five centuries, it is impossible to believe that the island could be missed by the Egyptian galleys on their way to the " Land of Punt," now identi- fied with Somaliland ; nor that, though the roadsteads of the African coast were perhaps oftener frequented, and for other freights besides myrrh and frankincense, the estuaries of Sokotra were neglected, by such ardent explorers as those, for instance, of Queen Hatasu of the 18th dynasty. They would have found on the island, which is probably referred to under the name " Terraces of Incense " (from its step-like contours), the precious " auta trees " whose divine dew, for use in the service of their gods, was their special quest in greater abundance and in o larger number of species than any other country.

The ancient tiade of Sokotra aloes, myrrh, frankincense, and dragon's-blood has greatly declined. It consists now chiefly of ghi, or clarified butter from the milk of the large herds of goats and cows domesticated all over the island. It is exported to Zanzibar, Arabia, and Bombay. With the exception of a few patches of millet, tobacco, and cotton, cultivation is unknown. The coimtry forms part of the sultanate of Kishin, in South Arabia. Its governor (usually also called sultan) exercises a, mild authority beyond collecting the revenue obtained by a tax on all products. The people live mainly on milk and dates, diversified occasionally by flesh. The population, which may (with some hesitation) be given at about 10,000, is composed of two, if not more, elements. On the coast the people are modern Arabs mixed with negro, Indian, and other blood ; in the mountains live the true Sokotri, the indigenes of the island, supposed to be originally immigrants from Arabia, who have been isolated here from time immemorial. Some of them are as light-skinned as Europeans, tall, robust, thin-lipped, straight-nosed, with straight black

hair ; others are shorter and darker in complexion, with round heads, long noses, thick lips, and scraggy limbs, indicating perhaps the commingling of more than one Semitic people. Their manner of life is rude and simple in the extreme. Their dwellings are circular, rubble-built, flat, clay-topped houses, or caves in the lime- stone rocks. They are bigoted Mahommedans, yet they rarely or never perform any devotions, and though generally harmless and inoffensive, are disinclined to have dealings with "Kaflrs." They speak a language allied to the Mahra of the opposite coast of Arabia. Both Mahra and Sokotri are, according to Dr H. Muller, daughter-tongues of the old Sabsean and Min ? ? an, standing in the same relation to the speech of the old inscrijitions as Coptic does to that of the hieroglyphics. The Sokotran tongue lias been, he believes, derived from the Mahra countries, but it has become so differentiated from the Mahra that the two peoples can understand each other only with difficulty. Sokotri is the older of the two languages, and retains the ancient form, which in the Mahran has been modified by Arabic and other influences.

The biology of Sokotra has now been sufficiently well investi- gated to give a correct idea of its relationships. The fauna con- tains no indigenous mammals. A wild ass which reams the eastern plains, perhaps its oldest denizen, is probably of Nubian

origin ; while the domestic cattle, a peculiar, unhumped, small, shapely, Alderney-like breed, may be a race gradually developed from cattle imported at a distant period from Sind or Farther India. There are 67 species of birds known from Sokotia, of which 15 are endemic ; of 22 reptiles, 3 genera and 14 species are peculiar ; and of the land and fresh-water shells, to whose distribution great importance attaches, 44 species out of 47 are confined to the island. Among the other invertebrate groups there is also a large proportion of endemic species. The flora is even more peculiar than the fauna. Aloes, dragon's-blood {Draccena), myrrh, frankincense, pomegranate, and cucumber {Dendrocycios) trees are its most famous species. The phanerogams number 570, apportioned to 314 genera, and of these over 220 species and 98 genera are unknown elsewhere. The flora and also (though to a less degree) the fauna present not only Asian and Central African affinities, but, what is more

interesting, Masoarene, South African, and Antipodean- American relationships, indicating a very different distribution of land and water and necessitating other bridges of communication than now exist. The history of Sokotra, unravelled by the study of its geology and biology, has been summarized by Professor Balfour as follows : " During the Carboniferous epoch there was in the region of Sokotra a shallow sea, in which was deposited, on the top of the funda- mental gneisses of this spot, . . . the sandstone of which we have such a large development in Nubia. . . . During the Permian Sokotra may have been a land surface, forming part of the great mass of land which probably existed in this region at that epoch, and gave the wide area for the western migration of life which presently took place, and by which the eastern aflinities in Sokotra may be explained. In early and middle Tertiary times, when the Indian peninsula was an island, and the sea which stretched into Europe washed the base of the Himalayan hills, Sokotra was in great part submerged and the great mass of limestone was de- posited ; but its higher peaks were still above water, and formed an island, peopled mainly by African species ??? the plants being the fragmentary remains of the old African flora ??? but with an admixture of eastern and other Asian forms. Thereafter it gradu- ally rose, undergoing violent volcanic disturbance. "

By this elevation "Madagascar would join the Seychelles, which in turn . . . would run into the larger Mascareue Islands. In this way, then, Africa would have an irregular coast-line, prolonged greatly south of the equator into the Indian Ocean, and running up with an advance upon the present line until it reached its north-west limit outside and south of Sokotra. Thence an advanced land surface of Asia would extend across the Arabian Sea into the Indian peninsula." Sokotra thus "again became part of the mainland, though it is likely for only a short period, and during this union the life of the adjacent continent covered its plains and filled its valleys. Subsequently it reverted to its insular condition, in which state it has remained." The Antipodean- American element in the Sokotran flora probably arrived vid the Mascareue Islands or South Africa from a former Antarctic continent.

AuTHOKiTiES. ??? James Jackson. "Sokotra: Notes Bihlio- graphiqaes," in La Revue de Giographie, Paris, 1892, gives a very

complete bibliography up to that date. ❖❖❖ Bulletin of the Liverpool Museums, vols. ii. and iii., 1899-1900. ❖❖❖ Geographical Joum., London, 1899, vol. xiii. pp. 633, 638. (h. O. F.)

Soleure, one of the Swiss cantons. Its area is 305^ square mUes. Of this, 298 square mUes are reckoned as "productive," 112^ square mUes being covered by forests, and '3 square miles by vineyards, the remaining 185 '2 square miles being arable or meadow land. The population was 80,362 in 1880 and 85,621 in 1888, while in 1900 it was 100,762. In 1900 there were 352 inhabitants per square mile. The people are mainly German-speaking, a comparatively few speaking French and still fewer Italian. Roman Catholics are in a decided majority, their proportions to Protestants being roughly as 3 to 1.

In 1897 the cantonal revenue was 2,265,087 francs (a rise of 39 per cent, since 1885) and the expenditure 2,258,339 francs (a rise of 31^ percent, since 1885), while in 1898 the surplus was 11,132 francs. In 1897 the public debt was 9,813,000 francs. The existing political constitution dates from 1887, while in 1895 proportional representation was introduced as regards the elections to the cantonal legislature. The principal changes are that the executive is now elected direct by the people, while both its members and those of the legislature hold office for four years only. The "Obligatory Referendum" and the "Initiative" as regards laws date from 1875, and the Initiative as to amendment of the cantonal constitution from 1856. The canton is divided into 5 administrative districts. In 1888 the capital, Solbuee, had 8317 inhabitants (of whom 5612 were Roman Catholics), a number

increased in 1900 to 10,095 ; while Olten in 1888 had 4899 (3009 Roman Catholics), and in 1899, 6996. In 1896 the pastures of the canton were 209, of an estimated capital value of 2,395,215 francs and capable of supporting 4179 cows.

Authorities. ??? Amiet. Das St Ursus Pfarr-Stifl d. Siadt S. 6 parts. Soleure, 1878-90. ??? Blooh. Mlder aus d. Ambassadoren- herrschafi in S. (1654-1791). Biel, 1898. ??? Schuppli. GescUchte d. Stadtverfassung von S. Basel, 1897. ??? Stbohmeier. Der Kant. 8. St Gall and Bern, 1836. ??? StrIjey. Die IVeidewirthschaft im Kant. S. Soleure, 1896. (w. a. b. c.)

Solingen, a town of Prussia, in the Ehine province, 20 miles north-north-east of Cologne by rail. It is the centre of the cutlery manufacture of Germany. Dorp was incorporated with it in 1889. Population (1885), 31,926 ;

(1900), 45,249.

Solola,, chief town of a department of Guatemala, Central America, picturesquely situated on a lofty plateau on the northern shore of Lake Atitlan, 46 miles west- north-west of Guatemala. It is the ancient capital of the Cakchiquel Indians, whose descendants are still its chief inhabitants. It has manufactures of cloth and potteries. Population, 12,000.

SOITia.lil??ind, a country of East Africa, so named from its Somal inhabitants. It is also known as the "Eastern Horn of Africa," because it projects some- what sharply eastwards into the Indian Ocean, and is the only section of the continent which can be at all spoken of as a peninsula. In general outline it presents the appearance of an irregular triangle, with apex at Cape Guardafui, which is the easternmost point of the con- tinent, and is continued seawards through a line of reefs and rocks to the island of Sokotra. From the apex the north side extends for over 600 miles along the south shore of the Gulf of Aden westwards to Tajura Bay, and the east side skirts the Indian Ocean for about 1400 miles south- westwards to the mouth of the Juba river at the equator, while the less clearly marked base merges gradually landwards in the Ethiopian uplands between the equator and Tajura Bay. The vast triangular space thus roughly outlined has a total area which is approximately estimated at over 400,000 square miles, with a population of about 1,250,000, and has

(1884-97) been partitioned by various international agreements between Great Britain, Italy, France, and Abyssinia as under : ???

Area in Square Miles.

Population.

British Somaliland :

1. North Coast Protectorate . 68,000

200,000

2. South Somaliland attached

to British East Africa . 100,000

250,000

French Somaliland . . . 50,000

100,000

Italian Somaliland . . . 100,000

400,000

Abyssinian Somaliland . . 100,000

300,000

Total . . . 418,000 1,250,000

Although the country had been visited at various points by a few travellers, such as Speke, Burton, Cruttenden, E^voil, and van der Decken, it was still practically an unknown land until the early 'eighties. But its systematic exploration, begun in 1883 by James Aylmer Physical ^^^ 'Lovt Phillips, has since made' steady pro- gress, and before the close of the 19th century the whole region had been traversed in several

directions by Bottego, Kuspoli, Swaine, Cavendish, Donaldson Smith, Parkinson, Pease, Wickenburg, and L^ontieff. Much no doubt remains to be done, and extensive tracts, especially west of the lower Juba, have not yet been even visited. But nothing of importance is left to be discovered by future travellers : the course of all the large rivers has been fairly accurately determined ; many points in the interior have been astronomically fixed, and the main

geographical features of the land clearly mapped out. From the rough surveys made in various places, it appears that the whole region is characterized by a remarkable degree of physical uniformity, and may be broadly described as a vast plateau of moderate elevation, which is enclosed westwards by the Ethiopian highlands and northwards by an inner and an outer coast range, skirting the south side of the Gulf of Aden in its entire length from the Harrar uplands to Cape Guardafui. In the interior the plateau is nowhere traversed by any great mountain ranges, and everywhere presents the same monotonous aspect of a boundless steppe clothed with a scanty vegetation of scrubby plants and herbaceous growths.

The incline is uniformly in the direction of the south- east, and apart from the few coast streams that reach the Gulf of Aden during the rains, all the running waters are collected in three fluvial arteries^the Nogal in the north, the Webi ShebeU in the centre, and the Juba in the south ❓❓❓ which have a parallel south-easterly direction towards the Indian Ocean. But so slight is the precipitation, the mean annual rainfall scarcely exceeding 8 or 10 inches, that the Juba alone has a permanent discharge seawards. The Nogal sends down a turbulent stream during the freshets, while the Shebeli, notwithstanding the far greater extent of its basin, never reaches the sea at alL At a distance of about 12 miles from the coast it is intercepted by a long line of dunes, which it fails to pierce and is thus deflected southwards, flowing in this direction for nearly 170 miles parallel with the coast, and then running out in a swampy depression before reaching the Juba estuary. The plateau appears to consist technically of a huge mass of Archaean rocks, mainly gneisses and schists, on the profoundly eroded surface of which have been deposited extensive sedimentary beds of Cainozoic age and eruptive

matter of various dates, but all post-Jurassic. Limestones and sandstones prevail in many places, and the limestones of the lower Juba valley are beheved to be part of a band which once extended from the Jurassics of British and German East Africa to those of Abyssinia. The Somali gneisses are similarly connected with the typical Archaean series of East Africa. The continuity of these geological systems was probably interrupted in Jurassic times, when the Somahland plateau, vdthout having ever been below the sea, was sufficiently depressed to allow the marine waters to penetrate, as a strait, far inland between the Eastern Horn and the Mau tableland to the south-east of Lake Rudolf. For details of cHmate, natural history, and other features, see British and Itahan SomaUlands below; and for the general characteristics and social insti- tutions of the inhabitants, see article SomAli in the ninth edition.

*From the explorations of Mr Seton-Karr and others, Soma- liland would appear to have been undoubtedly inhabited by primitive man of the early Stone period. His rude flint implements, of the same types as those occurring " " in Egypt, Mauritania, and Europe, have been found in *'*

various parts of the British protectorate, and according to some observers their manufacture has survived down to comparatively recent times. Other, but much later, remains are the round tumuli of undressed stone, generally 10 feet in circuit and 10 feet high, which are locally called "Galla graves," although also met with in the Beja country north of Abyssinia, where no Gallas are known to have ranged. "Whether the present inhabitants of the land are the direct descendants of the forgotten race by which these monuments were erected it is impossible to say. But in any ease they may claim a very long pedigree, for they have been identified beyond reasonable doubt with the people of Punt already known to the Egyptians of the early dynasties. They were in fact ethnically allied to those historic Egyptians, both being members of the vast Hamitic family, which may be regarded as the absolutely indigenous element in the whole of Africa north of the Negro domain. To- gether with the kindred GaUas, Afars (Danakil), Agaus, Bejas, and Egyptians, the Somali constitute the Eastern or Ethiopio branch of the Hamitic stock, and their binguage is shown to be a

branch of the widespread Hamitic linguistic family. (See Afeioa : Ethnology.) But the present Somali peoples are not pure Hamites ^7 any means, and the physical characters vary considerably according as the race has in course of ages been affected by contact at different points with the surrounding populations ??? Arabs, Abyssinians, Afars, Gallas, Bantus, and Negi'oes. Nevertheless, viewed as a whole, and despite a distinctly dark complexion every- where conspicuous though varying in degree, they may be fairly described as one of the very finest groups of Oaucasic man, tall of stature, with graceful pliant figures, regular and often extremely handsome features far above the average European type.

The Somali have no kind of political or even social cohesion, and are still divided into a multiplicity of rers or fakidas (tribes, clans), which are further complicated by manufactured genealogies, vague traditions, and legendary matter often inspired by the vanity or ambition of powerful chiefs. Hence all attempts at classification have hitherto failed ; and even the schemes prepared by Major Abud, although possessing semi-official sanction, are not only very incomplete, but also in places untrustworthy. Three main divisions, however, have been clearly determined, and these are important both on political and ethnical grounds ; ??? I. The HAsnfyA (Abud's Asha), with two great subdivisions : Daroda, with the powerful Mijertins, War-Sengeli, Dolbohanti, and others ; and Ishak, in-eluding the Gadibursi, Issa (Aissa), Habr-Awal, Habr-Tol, Habr- Yuni, Babilli, Bertiri. AH these claim descent from a chief "Arab" by name, a member of the Hashim branch of the Koreish (Mahommed's tribe), who came over in the 12th century and founded a powerful but evanescent empire, with capital at Meit, in the Zeila district. AU are Sunnites, and, although still speaking their Somali national tongue, betray a large infusion of Arab blood in their oval face, somewhat light skin, and remarkably regular features. Their domain comprises the whole of the British North Coast, and probably most of the Italian East Coast, Protectorates.

II. The HawIya, with numerous sub-groups, such as the Habr- Jalet, Habr-Gader, Rer-DoUol, Daji, KaranU, Badbadan Kunli, Bajimal, and Ugass-Elmi ; mostly fanatical Mahommedans forming the powerful Tarika sect, whose influence, like that of the Waha- bites formerly in Arabia, is felt throughout all the central and eastern parts of Somaliland. The Hawiya domain comprises the Ogaden plateau and the region generally between the Webi-Shebeli and Juba rivers. Here contact has been chiefly with the eastern Galla tribes, with whom political alliances have even been contracted.

III. The EahanwIn, with numerous but little known sub-groups, including, however, the powerful and warlike Abgals, Barawas, Gobrons, Tuni, Jidus, and Kalallas, occupy a vast domain extend- ing from the Juba to the Tana, where they have long been in contact, mostly hostile, with the Wa-Pokomo and other Bantu peoples of the East Africa Protectorate. Hence of all the Somali divisions the Eahanwin betray the largest infusion of negroid blood, as shown in their flat features, small nose, and very dark complexion.

Somaliland, British. ??? For some years before the MaMist revolt the whole of the North Somali coastlands had been included in the khedival possessions. Several stations, such as Zeila, Bulhar, and Berbera, as well as Harrar, at the converging point of the Abyssinian, Galla, and Somal territories, were held by Egyptian garrisons. But in 1884 all these garrisons had to be withdrawn, being needed for the defence of the Egyptian frontiers already threatened by the Mahdi's forces. It was then that Great Britain interfered, and, partly to save the country from relapsing into barbarism, partly to prevent its occupation by other Powers, by which the overland route to the East might be menaced, took possession of the vacated stations along the north coast nearly as far as Cape Guardafui. Thus was constituted the present " Somali Coast Protec- torate," which was recognized by all the other interested Powers, and delimited by various international conventions, such as the Anglo-French agreement of 1888, the Anglo- Italian treaties of 1891 and 1894, and the arrangement of 1897 with Abyssinia, full details of which are given below under French and Italian Somaliland, and also under Abyssinia. It is important to notice that under the Italian treaty of 1894 Great Britain

reserved the southern section of the Somali seaboard between the Juba and the Tana rivers, but included that region which extends inland as far as Logh on the .Juba, not in the Somali Coast Protectorate, but in the East Africa Protectorate between Uganda and the Indian Ocean. Thus is explained the

statement that the whole of the Somal territory under British rule, for which there is no collective official name, is very much larger than the northern section known as the Coast Protectorate. Before 1897 this protectorate had a total area of only 75,000 square miles, and was further reduced to 68,000 square miles when certain western tracts were ceded to Abyssinia in that year. The north-western boundary no longer reaches Gildessa, near Harrar, as formerly, but is marked in this direction by the Somadu heights, on the Anglo-French fiontier. The vast central plateau of Ogaden is also ceded to Abyssinia, which, however, has hitherto failed to maintain order amongst the fanatical Moslem natives of this region, as shown by the outbreak of 1901, which had to be suppressed by a British force ascending the river Juba from the East Africa Protectorate. On the north side the Somali Coast Pro- tectorate extends along the Gulf of Aden for a distance of about 400 miles from the Lahadu Wells, near Jibuti, in the west, to Bandar Ziyada, 4 9 E., some miles west of Cape Guardafui, and stretches from the coast inland for a mean breadth of perhaps 200 miles. A considerable number of the inhabitants (about 50,000) are settled in the coast towns, and as all the rest are pure nomads, with camping-grounds but scarcely any permanent inland stations, the total population would appear to fall short of

250,000.

Physically the protectorate has a distinctive character, and may be described as almost mountainous in contrast with the somewhat monotonous plains of the interior. Between the Han-ar pu i i plateau and Gape Guardafui the coast ranges maintain . J' '^^ a mean altitude of from 4000 to 5000 feet, and fall "" generally in steep escarpments down to the narrow strip of sandy lowlands skirting the Gulf of Aden. At some points the rugged cliff's, furrowed by deep ravines, approach close to the sea ; elsewhere the hills recede abruptly inland,*

leaving a considerable maritime plain between their base and the shore line. South of Berbera, which faces Aden on the opposite side of the gulf, are developed two ranges which run nearly parallel mth the coast, and increase in elevation landwards, culminating in the inner and loftier range in the Gan Libash ("Lion's Paw"), about 9500 feet high. Southwards the slopes fall somewhat gently towards the central plains, which are at first dotted with a few clumps of mimosa, and farther on present the aspect of an interminable treeless steppe. Eastwards the mountain system maintains the same general character as far as Bandar Gori, where the precipitous northern cliffs approach to within 200 or 300 yards of the gulf, their bare brown rocks and clays presenting the same uninviting appearance as the light brown hills skirting the Red Sea. But in the valleys between the two parallel ridges, which here stand at an altitude of from 6000 to 7000 feet, the dreary aspect of the coast scenery is succeeded by a relatively rich vegetation of bush, jungle, and herbage, with a luxuriant growth of gummiferous and aromatic plants. Low trees and jungle range to a considerable height above the valleys on the northern slopes of the inner range, which here falls in a series of terraces down to the Wady Nogal. The prevailing formations appear to be granites which are veined with white quartz, and underlie old sedimentary brown sandstone and limestone formations. There are no traces of recent igneous disturbances, but old erupted matter occurs at intervals, and the volcanic heights, as well as the general character of the ranges, resemble those of the South Arabian uplands on the opposite side of the gulf.

The climate also is much the same ❓❓❓ dry and hot, with but slight changes from season to season. Thus on the coast the winter temperature ranges from 75❓❓ to 80❓❓ F. , while that of summer rarely exceeds 86❓❓ F., the extreme deviation for the whole year being little more than about 20❓❓ F. Although the protectorate lies within the track of the north-east monsoons dominant from October to March, the currents are so frequently y"""^' deflected from their normal course by changes of baro- . '""' metric pressure or temperature that the winter rains are seldom copious. But the summer monsoons prevalent from April to July or August are often accompanied by fierce hurricanes and tremendous downpours, by which the sparse vegetation is revived, while the usually waterless wadys are for the time trans- formed to raging coast torrents.

But the mean annual rainfall, thus unevenly distributed, probably falls below 30 inches, and is also largely confined to the slopes of the ranges by which the moisture-bearing clouds are intercepted. As in South Arabia, these slopes are the proper home of the aromatic flora which yields the myrrh and frankincense of commerce, and for which these

legions have been famous throughout historic times. Highly chai'acteristio are the Olibanum, a member of the Boswellia genus, from which are obtained odoriferous resins in abundance, and the Balsamodendron Myrrha, which exudes a gum resin in round masses called "tears," varying in size from small grains to lumps as large as an egg, and of a semi-transparent reddish-brown colour. On the plains, which receive a minimum supply of moisture, little flourishes except a poor scrubby flora of thorny acacias and mimosas scattered thinly over wide areas. The coast districts have been so frequently visited by sportsmen in recent years that most of the characteristic wild fauna have withdrawn farther inland. Never- theless lions, leopards, hysenas, wild asses, gazelle and other ante- lopes, jackals, the dog-faced ape, and even elephants, are still met in the more remote districts. Hares and other rodents are common on the coastlands, which are also enlivened by the jumping-shrews, which at a little distance look exactly like diminutive kangaroos hopping about in search of the insects on which they prey. The lizard family is represented by the Agama Miippellii, which changes colour when pursued, and by the still more curious Uromaslix batilliferus, another species of Agama which disappears in the clefts of the rooks, leaving nothing to be seized except the tip of a tail bristling with sharp spines. The Somali have little knowledge of the horse, which appears to be of recent introduction, and their chief domestic animals are the camel and the ass, both of prime stock. The camels make excellent mounts, swift and hardy ; and the extensive caravan trade is everywhere carried on exclusively by means of these pack-animals, the natives being too proud to be treated as beasts of burden, like their Bantu and Negro neighbours. In the northern coastlands most of the Hashiya "sultans"

have already accepted the British protectorate, which affords them the best security for the stability of their power. They are beginning to call themselves "British subjects," and show a growing disposition to submit their incessant tribal wranglinga to the British authorities at Berbera. This place, which is said to have been founded by the Ptolemies amongst the ' ' Barbari " of the surrounding coastlands, is the capital and chief seaport of the protectorate. It is by far the largest centre of trade and population in the whole of Soraaliland, with a popu- lation in the trading season of about 30,000. Berbera stands at the head of a deep inlet, which forms the only sheltered haven on the south side of the Gulf of Aden. Recently extensive harbour works have been completed, and there are now two light- houses, piers, warehouses, a strong fort, hospital, barracks, and an aqueduct seven miles long, which supplies the town with a copious stream from the neighbouring hills. About 45 miles farther west is the exposed port of Bulbar, which, however, is conveniently situated for the caravan trade. It has a permanent population of 12,000, and the district yields an abundance of good pasture. Close to the French frontier on the same coast stands the flourishing seaport of Zeila, with a present population of 15,000. It has been proposed to constract a railway from this place, or from Bulbar, through Harrar to Abyssinia. But these projects seem to have been suspended by the rapid execution of the line running from Jibuti through French territory in the same direction.

The protectorate, which since 1884 had been attached for admin- istrative purposes to the government of Bombay, was constituted a Crown colony in October 1898. In 1900 the revenue and expen- diture were Es. 3, 85, 884 and Rs. 3, 40, 092 respectively ; the imports (Berbera and Bulbar) Rs.33,15,651, (Zeila) Rs.34,71,904 ; the exports from same places, Rs.28,71,962 and Rs.30,12,712. The imports are chiefly rice, piece-goods, shirtings, and dates ; the exports skins and hides, ostrich feathers, gums, civet, cattle, and

Cblet towns.

Authorities. ??? Prince Nicolas de Ghika. Cinq Mois au Pays des Somalis. Geneva, 1898. ??? F. B. Peakce. Sambles in Lion Land: Three Months in Somaliland. London, 1898. ??? C. V. A. Peel.

Somaliland. London, 1899. ❖❖❖ Count J. Potocki. Sport in Somaliland. (Trans, from the Polish.) London, 1899. ❖❖❖ H. G. C. SwAYNE. Seventeen Trips through Somaliland. London, 1895. (a. H. K.)

Somaliland, French, a possession of France on the Gulf of Aden, at the entrance to the Eed Sea. Its limits are Kas Doumeira, on the strait of Bab el Jlandeb, and Ras Goumarl^ between Zeila and the Gulf of Tajura. This coast is arid, and on the south is bordered with plains 500 feet high, but inland there are some cultivated spots on marshy ground. The territory is about 40 miles long and 125 broad, with a population estimated at about 22,000. The climate is very hot. The port of Obock, one of the centres of this possession, was bought from Turkey in 1855 for ❖❖2000 by II. Lambert, then French consul at Aden. The acquisition was ratified in 1861, after a journey by Admiral Fleuriot de Langle. A French

factory was erected at the port in 1881, and depots for victuals and coal for war-vessels were installed in 1883. In that year Sagallo was ceded to France ; in 1884, Tajura; and in 1885, Ambabo. In 1887 the territory was delimited by agreement with Great Britain ; and in 1888 a port was created at Jibuti, whither the administra- tive services were transferred, and the commencement of the works on the railway to Harrar conferred real import- ance on the place. The expenditure of France on the Somali coast (budget of 1900) was 337,500 francs. The local budget for 1899 balanced at 650,000 francs. The colony of Obock, together with the protectorates of other dLs- tricts, is administered by a governor, who resides at Jibuti. The centres of population are Jibuti (15,000 inhabitants, of whom 2500 are Europeans), Obock, Sagallo, Tajura (2000), Ambabo, and Gobad. The native population is either of the Danakil or of the Galla race. The produce of the soil is almost nil. On the coast, turtle and mother- of-pearl fishing are carried on. The country exports mother-of-pearl, gum, coffee, emery, hides, ivory, and gold. The prosperity of Jibuti is due to its position at the head of the best route towards Harrar and Addis Ababa, but it will not be real until the railway is completed. In January 1902 the first 125 miles of the railway from Jibuti to Harrar were open for traffic. At the distance of 340 miles north of Obock, on the Eed Sea, is the Bay of Adulis, ceded to France under the Second Empire by Tigre, but not occupied.

Authorities.- ◆◆◆ L' Annie Coloniale, 1900. ◆◆◆ Henrique. Les Colonies Fram^aises (Obock). Paris, 1889. ◆◆◆ Soleillet. Obock. Paris, 1886. ◆◆◆ De Salma. Obock. Paris, 1893. ◆◆◆ Hamy. La Mission Revoil au Pays Somali. Paris, 1882. (p. i,.)

Somaliland, Italian. ◆◆◆ By various arrangements with native sultans in 1889 the African coast as far as Cape Guardafui to the north, and as far as Bandar- Siyada (49◆◆ E.) on the Gulf of Aden, fell within the Italian sphere of influence. On 19th November 1899 the Italian Government notified the Powers that it had assumed the protectorate over the East African coast from the northern limit of the territory of Kismayu (0◆◆ 14' 30" S., 42◆◆ 38' 50" E.) to 2◆◆ 30' N. for the stretches recognized as intermediate between the stations belonging to the Sultan of Zanzibar. Finally, by a treaty dated 12th August 1892, the Sultan of Zanzibar made over to Italy for a term of fifty years, and in exchange for an annual payment of Es. 160,000 (subsequently reduced to Es. 120,000), all his rights over the ports of Barava, Marka, Mukdishu, and Warsheikh. In pursuance of this treaty and of the Anglo-Italian protocol dated 24th March 1891, the East African littoral from the Juba valley to Bandar-Siyada was recognized as an Italian sphere of influence, under the name of Itahan Somaliland. Towards the interior the boundary of this sphere followed the course of the Juba as far as 6◆◆ N., and thence coincides with that parallel as far as 35◆◆ E., and with the 35th meridian up to the point where it intersects the Blue Nile. On the Gulf of Aden the internal frontier is marked by a line which, starting from Gialdessa and proceeding towards 8◆◆ N., follows the north-eastern limits of the Girri, Bertiri, and Eea Ali territories, including in the Italian sphere the villages of Yaldessa, Darmi, Gig-Giga, and Milmil. On reaching 8◆◆ N. the line coincides with that parallel as far as 48◆◆ E., whence it turns north-east to the point of intersection of the 9th parallel N. with the 49th meridian E. and follows the latter meridian to the sea at Bandar-Siyada (Anglo-Italian protocol of 5th May 1894). By the same protocol the port of Zeila and the station and territory of Kismayu were recognized as belonging to Great Britain, but equality of rights and treatment for British and Italian subjects was established. The

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Italo-Abyssinian treaty, signed at Addis Abbaba in the summer of 1897, stipulated that the interior of Italian Somaliland should belong to Abyssinia up to -within forty miles from the coast, and that the station of Lugh should be made over to the Negus.

Information concerning the interior of Italian Somaliland is scarce and uncertain. To the north it is inhabited by the Ogaden Somali, and to the south by the Arusi and the Boran, which are moie properly classified as Galla tribes. The soil, which rises rapidly in successive plateaux from the sea, is considered especially fertile in the great valleys of the Juba (Ganana), Webbi, and Wady Nogal, which, descending from the Ethiopian Alps, traverse the country from north-west to south-east. In other districts lack of water impedes cultivation, though after the rains pasturage is abundant, and resinous plarts are so varied and numerous as to justify the ancient name. The climate on the plateaux is tem- perate and healthy, but near the streams malaria and enteric fever prevail. The temperature in the interior oscillates between 60 and 86 Fahr., but along the coast rises to 104. Con- tinual breezes, however, render this temperature tolerable for Europeans. Along the coast live a number of Arabs and several tribes of mixed Arabo-Somali blood, of which the Amaran tribe is the principal. These Arabs are a residuum of the dominion of the Imam of Muskat, which lasted from 1698 to 1856. The languages spoken in Italian Somaliland are Arab, Somali, and Suaheli. The Somali profess the Mussulman religion, but do not strictly inter- pret the injunctions of the Koran.

The chief towns of Italian Somaliland are : Brava, with about 4000 inhabitants, belonging for the most part to tribes of the interior. It was destroyed in 1840 by Ibrahim of Bardera and repeopled by Sheikh Yusuf, who in 1843 invaded Bardera, razing it to the ground and putting its inhabitants to the sword.

Marlca (Meroa), situated at 1 42' 05" N., 44 53' 50" E., with about 5000 inhabitants, and a trade from the interior in cotton, coffee, maize, butter, and skins. .

ilukdishu (Mogadishu), 2 ́ 01′ 50″ N., 45 ́ 24′ 40″ E., is formed of the villages of Shangani and Hamerain, which together number 6000 inhabitants. An ancient tower recalls Portuguese rule (1529-1698). In the neighbourhood gold and silver objects have been found, together with money and domestic utensils, which bear witness to an ancient civilization long since swept away.

Warsheikh, 2 ́ 19′ 45″ N., 45 ́ 53′ 50″ E., has about 3000 inhabitants. A natural channel allows ships of all sizes to approach to within 700 or 800 yards of the coast, but the bay is only practicable during the north-east monsoon.

Itala, a station established by Captain Filonardi, in the belief that it was a good port, but subsequently abandoned.

Obbia, 5 ́ 22′ N., 48 ́ 30′ E., residence of Sulten Yusuf Ali Yusuf, and Alula, residence of the Sultan Osman Mahmud, are two large villages, well kept, and inhabited by tribes which are distinguished from other Somalis by the mildness of their dis- position. Considerable trade in ostrich feathers is carried on.

Along the coast are to be noted the minor villages of Coriale, Gondersha, Gellib, Akari, Galwin, Gelidi, Torre, Munghia, &c., and the station of Yub (Yumbo), at the mouth of the Juba. In the interior is situated Lugh, a populous city on the left bank of the Ganana, about 240 miles from the coast ; visited for the first time by Captain Bottego in 1893. The Sultan of Lugh applied for Italian protection in June 1895, but the city and territory are still a subject of contention between Italy and Abyssinia. For the time being Italians and Abyssinians enjoy parity of treatment there.

The part of Italian Somaliland known as El Benadir (the ports), comprising Yub, Brava, Marka, JIukdishu, and Warsheikh, was ceded for three years to the Filonardi Commercial Company by way of experiment. In 1896 the Italian Benadir Trading Company Limited (SocietJi Anonima Commeroiale Italiana del Benadir), formed at Milan with ́ 40,000 capital, should have replaced the Filonardi Society in the ad- ministration of the Benadir coast ; but on 26th November 1896 the Italian consul, Captain Cecchi, who was preparing to inaugurate the new regime, was

killed in an ambush at Lafole, and the consequent disturbances hindered for a time the installation of the new company. On l.st May 1898 the Italian Government, however, concluded a convention with the Benadir Company, granting to it the administration of the Benadir pojts until 16th Jiuy 1946, with a subsidy of ►►16,000 annually for the first twelve yeara, and of ►►14,000 from 1910 until the expiry of the convention. The Government retained the option of denouncing the convention on 16th July 1921, subject to two years' notice. The company was given the right to collect taxes and customs, to exploit mines, to occupy territories in Italian possession, to obtain from Government arsenals at cost price the arms and munitions of war necessary for the safety of the colony, and to enjoy in the port of Kismayu all the facilities specified in the Anglo-Italian protocol of 24th March

Benadir Company.

1891 (Art. 3). The company, for its part, undertook to develop the colony ; to pay to the Sultan of Zanzibar an annual tribute of 120,000 rupees ; to maintain at least 600 guards for the protection of the stations ; to administer justice, respect existing laws and treaties, apply the provisions of the Berlin and Brussels Conven- tions, and to assume the postal service. The Italian Government explicitly declined to guarantee any operations of credit entered into by the company, or to consent that the convention with the company, or the privileges therein specified, be ceded to any third party. During the year 1896-97 the total value of the Benadir trade was ►►120,000, and since then it has continually increased. The chief imports are petroleum, rice, and textile fabrics ; the exports are ivory, cattle, butter, cotton, dhurra, gum, myrrh, and skins.

*See L'Omo: Viaggio di esplorazione ntlV Africa orientate, narrato da L. Vanutelli e 0. Citerni. Milan, 1899. h, jj^ *

Somersetshire, a south-western maritime county of England, is bounded on the E. by Wilts, on the N.E. by Gloucester, on the N. and N.W. by the Severn and the Bristol Channel, on the W. and S.W. by Devon, and on the S.E. by Dorset.

Area and Population. ??? The area of the ancient county is 1,043,485 acres, or 1630 square miles, with a population in 1881 of 469,109 ; in 1891 of 484,337, of whom 225,754 were males and 258,583 females ; and in 1901 of 508,104 ; the number of persons per square mile being 312, and of acres to a person 2-05. The area of the administrative county, as given in the census returns of 1891, was 1,039,106 acres, with a population of 386,866, or, including the county borough of Bath, 1,042,488 acres, with a population of 438,760 ; but since then certain changes have been made in the administrative area. In 1895 the parishes of Goathill, Poyntington, Sandford Orcas, Seaborough, and Trent were trans- ferred from Somerset to Dorset, the parts of the parishes of Maiden Bradley with Yarnfield and Stourton with Caspar in Somerset to Wilts, and the parish of Wambrook from Dorset to Somerset ; and in 1896 the parish of Church-Stanton was transferred from Devon to Somerset, and the parish of Kilmington from Somerset to Wilts. The area of the registration county is 1,061,614 acres, with a population in 1891 of 510,076, of whom 219,021 were urban and 291,055 rural, and in 1901 of 466,126, of whom 216,693 were males and 250,433 females. Within the registration area the percentage of increase between 1881 and 1891 was 3 "84. The excess of births over deaths between 1881 and 1891 was 59,729, and the actual increase of population was 18,851. The following table gives the number of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 : ???

Tear.

Marriages.

Births.

Deaths.

Illegitimate Births.

Males, j Females.

1880 1890 1898

3163 3269 3686

15,033 14,114 14,064

8935 8909 8167

359 252 225

327 265 234

In 1898 the number of marriages was 3226, of births 11,386, and of deaths 7823.

The following table gives the marriage-, birth-, and death-rates per thousand of the population, with the percentage of illegitimate births, for a series of years : ???

1S70-79.

isso.

1SS0-S9.

isoo.

18SS-97.

13-4

1S9S.

Marriage-rate

13-3

12-9

13-0

12-9

14-1

Birth-rate .

30-9

30-6

29-6

27-7

27-8

26-9

Death-rate .

19-4

18-2

17-4

17-5

16-5

15-6

Percentage of ille-

gitimacy .

4-7

4-6

4-3

3-7

3-7

3-3

The birth- and death-rates and the percentage of illegitimacy are all below the average. In 1891 there were in the county 1484 natives of Scotland, 2234 natives of Ireland, and 1049 foreigners. Constitution a-nd Government. ??? The parliamentary and judicial arrangements remain as stated in the earlier article on the county. The administrative county includes seven municipal boroughs : the city of Bath (49,817 in 1901), Bridgwater (15,209), Chard (4437), Glastonbury (4016), Taunton (21,078), Wells (4S49), and Yeovil (9838). Bath is a county borough. The following are urban districts : Burnham (2897), Clevedon (5898),

Crewkerne (4226), Frome (11,055), His;hbridge (2234), Ilminster (2287), Midsomcr Norton (5811), Minehead (2r.ll), Portishead (2544), Radstook (3365), Shepton Mallet (5238), Street (4018), Wellington (7282), Weston-super-Mare (19,047), and Wiveliscombe (1417). The ancient county, which corresponds closely with the diocese of

KJ -7 ►►H.

E R S W O R T H ►►► S 0 N D R I O

705

Bath and Wells, contains 501 ecclesiastical parishes and districts and parts of 3 others.

Education. ►►► At Wellington there is a hoard school for blind children. The total number of elementary schools in the county on 31st August 1898 was 552, of which 106 were board and 446 voluntary schools, the latter including 410 National Church uf England schools, 8 Wesleyan, 6 Roman Catholic, and 22 "British and other." The average attendance at board schools was 17,268, and at voluntary schools 46,224. The total school board receipts for the year ended 29th September 1898 were ie67,590. The income under the Agricultural Rates Act was over ►►3576.

Agriculture. ►►► Nearly five-sixths of the total area of the county is under cultivation, but about three-fourths of this is in permanent pasture, an exceptionally large number of cattle, especially cows, being kept, while many sheep are also grazed both on the lower grounds and the hill pasture, of which there are over 50,000 acres. Orchards, chiefly of apple-trees for cider, occupy 25,000 acres, and over 45,000 are under woods. The Exmoor district is still tenanted by wild deer, and there is also a special breed of ponies peculiar to the district. The acreage under corn crops has within recent years largely decreased. Wheat occupies about five-twelfths of this acreage, and barley and oats usually about one-fourth each, oats having the largest acreage of the two. Of the acreage under green crops, about one-half is occupied by turnips and swedes, about one-fourth by mangold, and about one-tenth by potatoes.

The following table gives the larger main divisions of the cultivated area at intervals from 1885 : ???

Tear.

Total Area under Cul- tivation.

Com Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1900

18S5

1890 1895

867,469 868,721 860,649 854,588

115,005

109,607

94,628

97,333

61,660 55,639 52,116 49,111

58,863 53,567 54,486 50,139

625,957 643,937 653,435 654,659

5434 5112 5045 2615

The following table gives the numbers of the principal live stock for the same years : ???

Year.

Total Horses.

Total Cattle.

Cows or Hfiifers

in Milk or in

Calf.

Sheep.

Pigs.

1885 1890 1895 1900

34,848 34,895 37,693 35,981

236,899 235,742 221,117 239,663

110,068 107,513 104,111 106,210

601,020 596,637 538,757 519,670

111,719 137,849 140,857 118,884

Industries and Trade. ??? According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 37,164, as com- pared with 34, 975 in 1896. Of these 4687 were employed in textile factories, woollen and worsted industries employing 1791, and linen, &c. (at Crewkerne, Taunton, and Shepton Mallet), 1096 ; there is now a considerable lace manufacture, chiefly at Chard. Non- textile factories employed 25,281 persons, the percentage of increase hetweenl895 and 1896 being 7-5,

while between 1896 and 1897 it was 9-2. Of these, 2770 were employed in the manufacture of paper, &c., 8324 in clothing industries, 2553 in the manufacture of machines, &o. (including carriages, agricultural implements, spades, shovels, and edge tools), 2023 in tobacco and snuff industries, 1446 in clay and stone industries (including bricks, drain tiles, and the well-known bathbrick), 1227 in wood indus- tries, and 1121 in drink industries. Of the 7196 persons employed in workshops, 3582 were employed in clothing industries. The total number of persons employed in connexion with mines and quarries in 1899 was 6864. The same year 480,158 tons of limestone were raised, 178,153 tons of clay, 58,910 tons of sand- , stone, 5970 tons of gravel and sand, 9866 tons of ochre, 5875 tons of gypsum, 1750 tons of slate, 475 tons of sulphate of strontia, and 9866 tons of manganese ore. Lead mining has now almost ceased. 921,870 tons of coal, valued at ►►464,776, were raised in 1890 ; 983,973 tons, valued at ►►541,185, in 1899.

The Bristol Channel and Bridgwater Bay abound in varieties of white and shell fish, and salmon and herring fishing are also carried on, the principal fishing stations being Porlock, Minehead, and Watchet^ but since in the return relating to sea fisheries they are not included amongst the fishing ports at which fish are landed, no statistics are available.

Authorities. ►►► Paul, jlccount of some of the Incised Slaps of Somersetshire. London, 1882. ►►► Elworthy. West Somerset Note-hook. London (Dialect Society), 1886. ►►► Roger. Myths and Worthies of Somerset. London, 1887. ►►► Weaver. Somerset In- cumbents. Bristol, 1887. ►►► Archbold. "Somerset Religious Houses," in Cambridge Historical Essays, vol. vi. 1892. ►►►

Bakrbt. Somerset Highways, Byways, and Waterways. London, 1894. ►►► Walter. Byegone Somerset. London, 1897. ►►► See also various publications by the Somerset Record Society, the Pro- ceedings of the Somerset Archceological and Natural History Society, and Somerset Notes and Queries. (t. y. h)

So mers worth, a city of Strafford county, New Hampshire, U.S.A. It is situated in the south-eastern part of the state, on Salmon Falls river,

vphich separates it from the state of Maine, and on the Boston and Maine Eailroad. It has an excellent water-power in Salmon Falls river, and this is turned to account in extensive manufactures. Population (1890), 6207 ; (1900), 7023, of whom 3166 were foreign-born.

Somerville, a city of Middlesex county, Massa- chusetts, U.S.A. It is situated in 42 ►► 22' N., 71 ►► 05' W., on the river Mystic, adjoining Boston, of which it is a suburb, and with which it is connected by many lines of steam and trolley railways. Its streets are macadamized or gravelled. It is an active manufacturing city; the census of 1900 showed that it contained 378 manufactur- ing estabhshments, with a total capital of $10,131,596. They employed 4342 hands, and the product was valued at $21,776,511. Its assessed valuation in 1900 was $52,578,200, the net debt was $1,828,000, and the rate of taxation was $16 per $1000. Population (1890), 40,152; (1900), 61,643, of whom 17,232 were foreign-born and 140 negroes. Of 18,148 males 21 years of age and over, 490 were illiterate (unable to write).

SomiTie, a department on the north coast of France, taking its name from the river running through it from south-east to north-west.

Area, 2423 square miles. The population, 550,837 in 1881, numbered only 534,101 in 1901. The births in 1899 were 11,670, of which 1715 were illegitimate ; deaths, 12,832 ; marriages, 3989. With 1437 schools accommodating 78,000 pupils, primary grade, in 1896, 5 per cent, of the population was illiterate. The land under cultivation in 1896 measured 1,411,606 acres, of which 1,143,610 acres were arable. There are no vines in the agricultural returns of this department. The soil is considerably productive. Its wheat crop of 1898 amounted to the value of ►►1,640,000 ; meslin, ►►94,000; r3-e, ►►88, 000 ; barley, ►►128,000 ; oats, ►►1,120,000; potatoes, ►►318,600 ; mangold-wurzel, ►►114,800 ; green crop (trefoil, lucern, and sainfoin), ►►401,800 ; apples, ►►43,500 ; garden- poppy, ►►43,500. Its beetroot produce was valued at ►►911,000. The live stock comprised (1899) 76,500 horses, 165,800 cattle, 380,900 sheep, 85,300 pigs, and 14,560 goats. Peat-cutting in 1898 amounted to 37,300 metric tons. The industry in metals produced only 3005 tons of iron, valued at ►►23,500.

The thriving industries are the spinning and weaving of linen, hemp, and cotton. The velvets of Amiens are in good repute. Sugar -refining yielded (1899) 2,048,000 cwt. The product of the distilleries amounted to 5,830,000 gallons of alcohol. Amiens, the capital, had (1901) 90,038 inhabitants.

Sonderburg^, a seaport and seaside resort of Prussia, province of Schleswig-Holstein, on the south-west coast of the island of Alsen, of which it is the chief town, and 17 mUes by steamboat north-east from Flensburg. There is a castle, now used as barracks. , The town, which existed in the middle of the 13th century, was burnt down in 1864 during the assault by the Prussians upon the Diippler trenches (on the mainland). Population (1900),

5522.

Sondershausen, a town of Germany, capital of principality Schwarzburg-Sondershausen, 37 miles by rail north of Erfurt. It possesses a castle, with natural history and antiquarian collections, and a parish church (restored 1891), with the mausoleum (1892) of the reigning princes. The people make pins and woollens. Population (1900) 7053. ^

Sondrio, capital of the province of Sondrio, Lom- bardy, Italy, amongst the Southern Alps, on the river Adda, 26 miles east of Lake Como, and 83 miles by rail

north-east of Milan. It is visited by tourists in spring and autumn, and tas active silk industries and manu- facture of stone pottery (lavez). There are a technical school and an industrial institute. Population (1901), 8700. In the Masino valley, 12 miles north- west of Sondrio, there are, at Ardenno, saline baths and springs, with a temperature of 86❓❓ Fahr.

Song'-Koi, or Eed Eivee. See Indo-China.

Sonneberg', a town of Germany, duchy of Saxe- Meiningen, situated in a narrow valley of the Thuringian Forest, 1 3 miles by rail north-east of Coburg. It is famous for its manufacture of toys, papier-mach6, mirrors, &c. ; it has also tanneries, dyeworks, and slate works. The town possesses a fine Gothic church, a hydropathic, and a monu- ment to the philologist Schleicher (1821 ? ? ?68). Population

(1885), 10,247 ; (1900), 13,317.

Sonnino, Sidney, Baeon (1847-

-), Italian

statesman and financier, was born at Florence on 11th March 1847. Entering the diplomatic service at an early age, he was appointed successively to the legations of iladrid, Vienna, Berlin, and Versailles, but in 1871 returned to Italy, to devote himself to political and social studies. On his own initiative he conducted exhaustive inquiries into the conditions of the Sicilian peasants and of the Tuscan metayers. In 1878 he founded a weekly economic review. La Rassegna Settima/nale, which four years later he converted into a political daily journal. Elected deputy in 1880, he distinguished himself by trenchant criticism of Magliani's finance, and upon the fall of Magliani was for some months, in 1889, Under- Secretary of State for the Treasury. In view of the severe monetary crisis of 1893, he was entrusted by Crispi with the portfolio of Finance (December 1893), and in spite of determined opposition, dealt energetically and successfully with the deficit of more than ? ?6,000,000 then existing in the exchequer. By abolishing the illusory pensions fund, by applying and amending the Bank Laws, efi'ecting economies, and increasing taxation upon corn, incomes from consolidated stock, salt, and matches, he averted national bankruptcy, and placed Italian finance upon a sounder basis than at any time since the 'fall of the Right. Though averse from the policy of unlimited colonial ex- pansion, he provided by a loan for the cost of the Abyssinian war in which the tactics of General Baratieri had involved the Crispi Cabinet, but fell vpith Crispi after the disaster at Adowa (March 1896). Assuming then the leadership of the

constitutional Opposition, he com- bated the alliance between the Rudini Cabinet and the subversive parties, criticized the financial schemes of the Treasury Minister, Luzzatti, and opposed the “demo- cratic ” finance of the first Pelloux administration as likely to endanger financial stability. After the modification of the Pelloux Cabinet (May 1899) he became leader of the ministerial majority, and bore the brunt of the struggle against Sociahst obstruction in connexion with the Public Safety Bill. Upon the formation of the Zanardelli Cabinet (February 1901) he once more became leader of the constitutional Opposition, and in the autumn of the year founded a daily organ, II Giornale d’ Italia, the better to propagate Moderate Liberal ideas.

Sonor ll, a state of Mexico, bounded on the N. by the United States, on the E. by Chihuahua, on the W. by the Gulf of California, and on the S. by Sinaloa. Area, 76,922 square miles, being only exceeded by the state of Chihuahua (87,820). Population (1879), 115,424 ; (1900), 220,553. The principal agricultural products are cereals, tobacco, cotton, sugar-cane, fruits, etc. The annual ^‘alue of the exports of minerals is from $10,000,000 to

$12,000,000 (silver). The Guaymas and Nogales Railway connects the state with the Southern Pacific Railroad. The capital, Hermosillo, has 8474 inhabitants. Other towns include Alamos (6197), Guaymas, an important commercial port connected by rail with Nogales on the United States frontier, the terminal point of the Sonora Railway, Moctezuma or Oposura, Arizpe, Ures.

Son pur, a feudatory state of India, in the Chhattis- garh division of the Central Provinces. Area, 906 square miles. Population (1881), 178,701; (1891), 195,245; (1901), 170,633, showing a decrease of 13 per cent., due to the results of famine. Estimated revenue, Rs. 1,06,000 ; tribute, Rs.9000. The chief is a rajput of the Patna hne. Rico and timber are exported, and iron ore is said to abound. The town of Sonpue is on the Mahanadi river, just above the point where it enters Orissa.

Sonthal (or Santai) Parganas, The, a

district of British India, in the Bhagalpur division of Bengal It stretches south from the Ganges at Rajmahal to Chota Nagpur, and consists mostly of a rolling, forest- clad plateau. Area, 5469 square miles. Population (1881), 1,567,966; (1891), 1,754,196, showing an increase of 12 per cent., partly due to more accurate enumeration; average density, 321 persons per square mile. In 1901 the population was 1,807.286, showing an increase of 3 per cent.

Classified according to religion, Hindus in 1891 numbered 900,399 ; Mahommedans, 121,086 ; Christians, 6943, of whom 196 were Europeans; aborigines, 726,284; "others," 484. The land revenue and rates in 1897-98 were Es. 3,31, 744; number of police, 388 ; boys at school (1896-97), 20,667, being 157 per cent, of the male population of school-going age ; registered death-rate (1897), 29 per thousand. The Sonthals, who give their name to the district, are the most numerous aborigiual tribe in Bengal, who work the coal-mines of Raniganj and Karharbari and migrate to the tea-gardens of Assam. According to the linguistic classifica- tion of the census of 1891, the total number of persons in India speaking Sontliali was 1,709,680. Tlie Church Missionary Society and the Scandinavian Sonthal Home Mission have been very successful among them, especially in promoting education. The district is traversed by both the chord and loop lines of the East Indian Railway. It comprises the old Mahommedan city of Rajmahal and the modern commei'cial mart of Sahibganj, both on the Ganges ; and also the Hindu place of pilgrimage of Deogarh, which is important enough to have a branch railway. Coal-mines yield about 1800 tons a year.

SoOChOW, or SucHAU, the capital of the province of Kiangsu, China. It was opened to foreign trade by the Japanese treaty of 1895, but the privilege has not been largely utilized. Indeed, the value of the trade has steadily declined from an aggregate of 1,473,560 H. taels in 1897 to 1,176,616 H. taels in 1900. The only import- ance of the port is as a centre of distribution for foreign goods subordinate to Shanghai, with which it is connected by a canal 80 miles in length. The trade is entirely in native hands. A cotton spinning miU and two or three silk filatures have been erected, two of the latter in native hands, the others in part under European management. ' The principal industry in Soochow is silk-

weaving. The fabrics produced are of extreme elegance and low price, and are chiefly intended for the domestic market in China; but there is a large and increasing demand for export (value of silk export in 1900, ►►72,000). In the ninth edition of this work Soochow was credited ndth a popula tion of 500,000, but a more recent estimate would give about 350,000.

Sopron (Oedenbueg), a municipal town in Hungary, capital of the county of the same name, 40 miles south by east of Vienna, vfith a population in 1891 of 29,543, and in 1901 of 33,478. It contains an evangelical school, 3 g)rmnasia, 2 upper rm/-schools, 2 training institutes for teachers, a commercial academy, several orphanages, ifcc.

Amongst its manufactures are bell-founding and machinery, besides sugar, beer, vinegar, soap, and a flourishing wine trade. The electric light and tramways are in operation.

Sora.U, a town of Prussia, on the Sorebach, near the frontier of Silesia, 55 miles south-south-east of Frankfurt- on-Oder by rail. There are 7 churches and several schools, including a technical and a weaving school. The industries include cloth and linen factories. Population (1885),

13,668; (1900), 15,945.

Sorel, a city and port of entry of Quebec, Canada, capital of RicheUeu county, 42 miles north-east of Montreal, at the confluence of the Richelieu and St Lawrence. It is a station on the Quebec Southern and South Shore railways, and is a port of call for the Montreal and Quebec river steamers. It contains iron and leather manufactories, and shipbuilding is carried on. It occupies the site of a fort built in 1665 by M. de Tracy to guard the route by way of the Richelieu to Lake Champlain and the Hudson. Population (1891), 6669 ; (1901), 7057.

Soria., a province of Spain, in Old Castile. Area, 3836 square miles. Population, 151,530 in 1887, 147,787 in 1897. The birth-rate is 3 ???84 per cent., the death-rate 3‘39 per cent., and the proportion of illegitimate births 1-29 per cent., being one of the lowest in Spain. The pro- vince is divided into five districts and 345 ayvmtamientos or parishes. Three railways run through the province. Th^ only really important industries are connected with agriculture and the rearing of cattle. The exports are mostly timber, wool, salt, leather, and cheese. About 400,000 acres of the soil, chiefly in the mountains, are covered with forest; 1,450,000 acres are cultivated, and about 350,000 are reserved for pasture. Out of the cultivated area in 1897, 103,292 acres were covered with wheat crops, 199,135 with oats, rye, barley, maize, 13,000 with pod fruit, 12,000 with vines. The live stock in 1897 consisted of 3550 horses, 16,502 mules, 11,724 asses, 16,875 cattle, 487,109 sheep, 25,395 goats, and 14,695 pigs. There are only two salt mines and one bed of asphaltic rock actuaUy worked in Soria.

Sori??i, capital of the above province, on the Douro, station at Alcuneza on the Madrid-Saragossa line. Popula- tion, 7784 in 1887, 7290 in 1897. Soria has a provincial institute, normal schools for teachers of both sexes, many primary schools, savings banks, two hospitals, barracks, a theatre, and the usual bull-ring. Near the Douro are the ruins of the old castle of Soria, and in many places the remains of the walls of the city are yet standing. The more modern streets are clean and well paved. The bridge across the Douro is a solid and massive structure, which formerly had a tower in the centre.

Soroki, a district town of South Russia, in the government of Bessarabia, 117 miles north-north-wesfc of Kishineff and 36 miles from the nearest railway station, built in a narrow ravine on the right bank of the Dnieper. It is an important river port for the export of corn, wool, fruit, wine, and cattle, and had in 1897 a population of 15,800, half of whom were Jews. Formerly it was the old Genoese colony of Olhionia, and has still the ruins of a 13th century Genoese castle. In the 1 5th century the Moldavians erected here a fort, Saraki, which the Poles took in the 1 7th century. Peter I. conquered it in 1711, but it was returned to the Turks, and was only definitely annexed to Russia in

1812.

Sothern, Edward Askew (1826-1881),

English actor, was born at Liverpool, 1st April 1826, his father being a merchant. He began acting as an amateur, and drifted into a professional engagement with a dramatic company in Jersey in 1849. Between then and 1858 he

played in various capacities with no particular success in Birmingham and in America, where he went in 1852. In 1858 Tom Taylor's Our American Cousin, a piece of no special merit, was brought out at New York, with Sothern in the small part of Lord Dundreary, a caricature of an English nobleman. He gradually worked up the humour of this part, so that in 1861, when the play was pro- duced at the Haymarket Theatre in London, he made such a " hit " that his impersonation was on everybody's lips, and the piece ran for nearly five hundred nights : the " Dundreary whiskers " became the fashion, and Dun- dreary this, that, or the other made its appearance on every side. At various times Sothern revived the character, which retained its popularity in spite of all the extrava- gances to which he developed its amusing features ; and his name will always be famous in connexion with this r61e. In T. W. Robertson's David Garrick (1864) Sothern also had a great success, his acting in the title- part, which he created, being wonderfully effective, but none of his many other parts was specially remarkable. Sothern was a born comedian, and off the stage he was a notorious practical joker. He was as much of a favourite in America as in the United Kingdom. He died in London, 21st January 1881.

Sotteville, a town, arrondissement of Rouen, depart- ment of Seine Inf 6rieure, France, one mile south of Rouen, of which it is really a suburb, continuous with Sever, on the railway from Paris to Havre. There is a chapel of the 12th and 14th centuries. Cotton-spinning and the manu- facture of calicoes are conducted on an extensive scale ; hemp-spinning, cordage, varnish, and gelatine represent other branches of industry. The Western Railway Com- pany have here an extensive group of manufacturing and repairing workshops. To the south of the town is the

departmental lunatic asylum, of Quatre Mares, attached to that of St Yon. Population (1881), 11,738; (1901), 18,535.

Soudan. See Sudan.

Soundingf (Deep Sea). ??? Wire has now entirely superseded the hemp gear formerly used for this pur- pose. Its smooth surface and minute section, reducing friction to a minimum, gives a rapidity of descent of about 100 fathoms per minute, and this velocity is not materially diminished even at great depths. Reeling in may be accomplished at nearly the same rate. Soundings are thus obtained with a degree of accuracy not formerly possible. The apparatus is light, compact, and automatic in its action. Soundings with wire can be carried out at night with the same facihty as in daytime, and in almost any circumistances of wind and weather short of a strong gale, against which the ship could not steam or face the sea. A sounding of 1000 fathoms may be obtained in twenty-five minutes from the time the weight is lowered to the time the order is given to put the ship on her course, or in half that time if sounding from astern and going ahead on getting bottom. 2000 fathoms wUl require forty-five minutes, and 3000 fathoms seventy-five minutes. Beyond that depth, much greater caution being required, the time occupied is correspondingly increased, and reeling in must then be done very deliberately. The deepest sounding hitherto obtained is 5269 fathoms. Soundings at such depths may occupy as long as five or six hours.

The latest pattern of Lucas machine carries nearly 6000 fathoms of 20-gauge wire, and is fitted with two brakes, one a screw brake for holding the reel when required, the other an automatic brake for ^^”^^y stopping the reel when the weights strike the bottom. A guider for the purpose of winding the wire uniformly on to the reel is also attached, and is worked

bring up a specimen of the bottom, and the same sinkers fit them both.

The " Driver rod " is shown in Fig. 2. ABC is a tube about 2 feet in length, fitted at the top with a flap valve D, working on a hinge at E. The lower part of the tube

by a small handle. After leaving the reel, the wire passes over a registering wheel, the dial of which indicates the amount of wire run out. Similar machines of smaller size are supplied for use in boats. The large machine is repre- sented in Fig. 1.

Heaving in is accomplished by means of a hemp "swifter" or driving belt, which conveys the motion of the drum of a donkey engine to the drum carrying the wire of the sounding machine. It being impracticable to regulate the speed of the engine by hand according to the heave of the ship, in order to obviate the sudden and excessive strains on the wire so caused an ingenious mechanical arrangement has been fitted to machines of recent pattei'n, by which frictional discs, geared by cog-wheels and capable of ad- justment, are interposed on the axle connecting the grooved wheel actuated by the hemp swifter and the revolving drum carrying the wire. By this arrangement the latter can be controlled as desired, both in speed and direction of motion, by means of a lever regulating a strap on the frictional discs, which may be set by experiment to act at any given tension of the wire. As the tension approaches this limit, the velocity of revolution of the drum is automatically checked ; and if the tension further increases, the motion of the drum is actually reversed, thus causing the wire to run out, until the tension is relieved

sufficiently to allow the frictional discs again to ___ ___, . ___ i.. ___, ___^ t.rrj i-o -s.t,, a t,,,,

i. ___ 4-1, J- 4— f 1, ___ ___ rri J I^io. 1' ___ Lucas Machine (from Wharton s Hydronravhic Surveying). A, Reel or drum: B, brake:

act m the direction of heaving m. The drum c, brake lever ; D, springs ; E, regulating screw ; F, hand wheel ; G, swivelUng frame \ may be stopped instantly by moving the lever H, measuring wheel ; J, indicator ; K, stop ; L, wire guiding roller ; M, handle for working in the proper direction to throw the apparatus roller ; N, bolt ; O, screw brake.

out of gear.

Galvanized steel wire of 20-gauge and 21-gauge is supplied on drums in lengths of 5000 fathoms. The 20-gauge wire when new has a breaking strain of 240 lb, and the smaller wire 190 Hi. The large machines now made will hold a sufficient quantity of the larger wire for the deepest soundings ; there is therefore no longer any necessity for the smaller wire, and its use is not recom- mended. The zinc wears off to a considerable extent with constant use ; it is necessary to pass the wire through an oily wad whenever soundings are suspended for a time, and the surface layers on the drum should be kept well coated with oil and covered over with oily waste. A fortnight's continuous use is about the limit to the trust- worthiness of any piece of wire ; no amount of care will prevent it from becoming brittle ; and directly it can be snapped by twisting in the hand, it should be condemned and passed on to the boats' machines. A magnifying glass will assist in examining its con- dition. Taut and even winding on the reel from the drum is most important ; otherwise, when heaving up after a sounding, the strain forces each layer as it comes in to sink down amongst the previous layers loosely reeled on, with the result that at the next sounding slack turns will suddenly develop on running out, to the great risk of the wire. The wire is liable to cut grooves in the interior of the swivelling frame ; a iile must constantly be applied to smooth them down, or they will rip the splices. A roller of hard steel, underneath which the wire passes, and placed in rear of the swivelling frame, obviates this to a great extent.

Splices are made about 5 feet in length, one wire being laid round the other in a long spiral of about one turn per inch. A seizing of fine wire is laid over each end and for two or three inches up the splice, no end being allowed to project, and solder is then applied the whole length of the splice. Three more seizings should be placed at intervals. Splices are the weakest parts of the wire, and their multiplication is to be avoided. They should be frequently examined and their position noted, so that in heaving in they may be eased round the wheel with the guider nearly in the centre, to avoid tearing.

Under 1000 fathoms a lead of 30 to 40 lb weight can

be recovered, and no detaching rod is necessary. At a

little risk to the wire, when sounding from astern

Soundlag ^^j, q j-jjg– depth, the ship may go ahead directly

sinkers.

bottom is struck, increasing speed as the wire comes in ; the great saving in time thus effected will often justify tlie increased risli of parting the wire. For greater depths the ” Driver rod ” is the best detaching apparatus for slipping the sinkers ; its construction is easier than that of the ” Baillie rod,” and with a piece of gas piping cat to the proper length the ship’s Ijlacksmith can make one in a day. Both rods are fitted with tubes to

C screws on and oflf, and contains a double flap valve to retain the bottom specimen. The sinkers WW, each 25 tt) in weight, conical in form, and pierced with a cylindrical hole through which .the Driver rod passes loosely, are slung by wire or cod line secured to a flat ring or grum- met shown at L and passing over the stud G. A stud K on each side of the tube fits loosely into the slot H in the lower part of the slipping lever MH. The weight of the apparatus being taken by the sounding wire, the sinkers remain suspended; but on striking the bottom, the wire slackens, and the weight of the sinkers drags the slipping lever down till the stud K bears against the upper part of the slot H. By this action the point]\I of the slipping lever is brought to bear against the upper end of the standard EF, being tliercl>y forced out- wards sufiiciently to ensure that the weight acting at the point G will tilt the slipping lever right over, and thus disengage the sling. The tube being tlien drawn up, the sinkers are left behind. In descending, the ‘alve.’ at top and bottom open- ing upwards, allow the water to pass through freely ; but on di-awing up they are closed, thus retaining the plug of mud with]\hich the tube is tilled. For Avater under 2000 Fio. 2. Driver Rod.

SOUNDING

fathoms two conical weights are sufficient. In deeper water a third cyUndrical weight of 20 Bb should be put between them. It is important to interpose a piece of hemp line, some ten fathoms long, between the end of the wire (into which a thimble is seized) and the lead or rod. This tends to prevent the wire kinking on the lead striking the bottom. A piece of sheet lead about 2 Bb in weight, wrapped round the hemp just below the junction, keeps the wire taut while the hemp slacks. Small brass screw stoppers, fitted with a hempen tail to secure to a cleat, hold the wire during the sounding if necessary to repair splices or clear slack turns. In heaving in, the springs are replaced with a spring balance, by which the amount of strain is seen and the deck engine worked accordingly. A system of signals is required by day and by night, by which the officer superintending the sounding can control the helm, main engines, and deck engine.

Method of Sounding. ??? The machine is placed on a projecting platform on the forecastle. An endless hemp swifter, led through blocks with large sheaves connects the sounding machine and deck engine, and when heaving in is kept taut by a snatch block set up with a jigger. As the wire runs out, the regulating screw of the brake must be gradually screwed up, so as to increase the power of the brake in proportion to the amount of wire out. The regulating screw is marked for each 500 fathoms. In fairly smooth water the brake will at once act when the weight strikes the bottom and the reel stops. Under 3000 fathoms one spring only is sufficient, but beyond that depth two springs are required. If the ship is pitching heavily, the automatic brake must be assisted by the screw brake, to ensure the reel not overmnning. The marks on the regulating screw are only intended as a guide ; the real test is that the brake is just on the balance so as to act when the strain lessens, which may be known by the swivelling frame being just lifted off the stop. As the wire weighs 7J lb for each 500 fathoms, the 500-fathoms mark on the screw should be at the position in which the screw has to be to sustain a weight of TiJ lb ; the 1000-fathoms mark, 15 lb ; and so on. This can be tested, and the marks verified.

Handling the Shi}}. ??? Sounding from forward enables the ship to be handled with greater ease to keep the wire up and down, and especially so

in a tide-way ; but in very heavy weather soundings may be obtained from a machine mounted over the stem, when it would be quite impossible to work on the forecastle. The spanker must be set with the sheet to windward, unless a strong weather tide renders it undesirable ; the ship's head must be kept in a direction which is the resultant of the direction and force of the wind and current, and this is arrived at by altering course while sounding, point by point, until the wire can be kept up and down by moving the engines slowly ahead as necessary. It should seldom, or never, be necessary to move the engines astern.

The temperature of the water is usually taken at intervals of 100 fathoms down to a depth of 1000 fathoms, Observa- ^^^ ^ closer intervals in the first 100 fathoms. tioas of If a second wire machine is available, the obser- tempera- vations may be made from aft whilst the sounding "" is being taken forward. A 30-Ib sinker is*

attached to the end of the wire, and the thermometers are secured to the wire by the metal clips at the back of the cases, at the required intervals. Care must be taken to see that the indices are down before attaching the ther- mometers. To avoid heavy loss, not more than four thermometers should be on the wire at one time. When sounding, a thermometer is usually attached to the Une a short distance above the lead.

Submarine Sentry. ??? The primary object of this machine is to supply an automatic warning of the approach of a ship to shallow water : it has been instru- mental in discovering many unsuspected banks in imper- fectly surveyed waters. By means of a single stout wire

the sinker, an inverted kite, called the " sentry," Submarine ^^^ j^g ^owed steadily for any length of time, at

any required vertical depth down to 40 fathoms with the red kite and 30 fathoms with the black kite ; should it strike the bottom, through the water shallowing

to less than the set depth, it wiU at once free itself and rise to the surface, simultaneously sounding an alarm on board, thus giving instant warning. The vertical depth at which the sentry sets itself when a given length of

wire is paid out is not changed by any variation of speed between 5 and 13 knots, and is read off on the graduated dial-plate on the winch. One set of graduations on the dial indicates the amount of wire out ; the other two sets refer to the red

Fig. 3. ??? The Submarine Sentry.

and black kites respectively, and show the depth at which the sentry is towing. By this machine, single soundings down to 40 fathoms can be taken at any time while the ship is under way, the sentry being let down slowly. The gong will indicate when the bottom is touched, and the dial corresponding to the kite used will show at once the vertical depth at the place where the sentry struck.

By removing the kite and substituting a lead, with atmospheric sounder or other automatic depth gauge, flying single soundings up to 100 fathoms can be obtained in the ordinary manner without stopping the ship.

The winch is secured to the deck a short distance from the stern ; the towing wire passes from the drum under a roller fairlead at the foot of the winch, thence through an iron block with sheave of large diameter, suspended from a short davit on the stern rail and secured to the sling of the sentry. The dial being set to zero with the sentry at the water's edge, the ship's speed is reduced to 8 or 9 knots, and the wire paid out freely until the kite is fairly in the water, when the brake should be applied steadily and without jerk- ing, veer^g slowly until the required depth is attained, when the pawl is put on the ratchet wheel and the speed increased to 12 knots if desired when using the black kite, or 10 knots with the red kite.

The kite in its position when being towed is indicated in Fig. 3. The point of the catch C, passing through a thimble M in the short leg of the sling, is slipped into the hole at the top of trigger T, which is hinged at K and kept in its place by the spring S attached to the hook H. On the trigger striking the bottom the catch is released, the short leg of the sUng slips off, and the sentry, which then rises to the surface, is left towing by the long leg. The winch is fitted with two handles for heaving in the wire ; one gives great power and slow speed, and the other, acting on the drum

spindle direct, winds in quickly. The wire supplied with the machine has a steady breaking strain of about 1000 ft. Using the black kite at a speed of 7 knots, the strain on the wire is about 150 ft, and at 10 knots about 300 ft. The red kite increases the strain largely. (^ jj j. "v*

SOUTH AFEICA.

General survey.

I. Geogeaphy and Statistics.

THE expression "Britisli South Africa" ??? which has obtained general currency, although it has no official sanction ??? came into use, or at least began to acquire a definite meaning, in the early 'eighties, when the first step towards the partition of the continent was taken by the German occupation of Nama- qualand (1884). It then became at once evident that British interests could no longer be confined to the regions south of the Orange river and east of the Drakensberg range, and that the very existence of the two long-established colonies of the Cape and Natal would be imperilled unless practical measures were taken to keep open the " English road " to the interior of the continent, which had hitherto been mainly fol- lowed by missionaries, traders, and travellers. Thus arose the imperial idea of a " British South Africa," as a political domain destined, in due course to embrace in one vast federation all existing colonies and all other settlements in process of development into free, self- governing states. But such a system must necessarily lack ideal completeness ??? such completeness as is enjoyed by the sister federations of Canada and Australia ??? so long as considerable tracts are held by foreign Powers on the western and eastern seaboards (German South- West Africa ; Portuguese South-East Africa). In the interior, however, the unity of the system has been secured by the suppression of the late Boer states, while its borders have been enlarged by the settlement of Matabele and Mashona Lands (South Rhodesia), and by the extension of British rule, directly or indirectly, over the whole of Bechuanaland. Thus the expression British South Africa now covers the whole of the continent from the Zambezi to the Cape, the specified

German and Portuguese territories alone excepted. Including these. South Africa has a total area of about 1,364,000 square miles, and a population approximately estimated (1900) at nearly 7,000,000, and is d□□vSsloas politically divided into five British colonies, two British protectorates, and two non-British colonies, with respective areas and populations as under : □□□

Political Divisions.

Area in Square Miles.

!

Population

(1891-1900).

Cape Colony, with Griqualand, South

Bechuanaland, and Pondoland, all

now incorporated

277,000

1,766,000

Bechuanaland Protectorate

213,000

200,000

Basutoland

10,000

250,000

Natal, with Zululand and South

Tongaland

50,000

1,026,000

Southern Rhodesia (Mataliele and

Mashona Lands)

17.5,000

450,000

Orange River Colony

48,000

207,000

Transvaal Colony ....

119,000

1,094,000

German South-West Africa

322,000

200,000

Portuguese territory south of the

Zambezi (Delagoa Bay, &c.) Total

150,000

1,750,000

1,364,000

6,943,000

Africa south of the Zambezi forms a vast tableland which stands at a mean elevation of about 4000 feet above

sea-level, and is buttressed seawards by a great tenures mountain system disposed in concentric ranges

roughly parallel with the contour lines of the continent, at distances of from 100 to 250 miles from the coast. The inner encircling range, which falls through

secondary parallel chains, or through steeply scarped terraces, the so-called karoos, down to the seaboard, is continuous only on the south and east sides facing the Austral and Indian Oceans, and on the west as far north as the Oliphant river. Beyond this point the system loses the aspect of an unbroken rampart, the outer scarps have been greatly eroded, the coast ranges become more fragmentary, and at last entirely disappear at the broad estuary of the Orange river. Still farther north Uttle is to be seen except low, rocky hiUs and ridges, almost lost amid the shifting dunes of the sandy Namaqualand plains. But in the direction of the east and north-east the rise is continuous through the Eoggeveld, the Nieuwveld, the Sneeuwberg, and the Stormberg round to the Quathlamba (Drakensberg) range, where the whole system culminates in peaks from 10,000 to nearly 11,000 feet high at the converging frontiers of Basutoland, Natal, and the Orange Eiver Colony. From these Alpine heights the Drakensberg is continued at a mean altitude of 8000 feet along the Natal frontier right into the Transvaal, broken only by a few difficult passes, such as Tintwa, Van Keenens, Botha's, and Lang's Nek at Majuba HilL Beyond Natal the escarpments of the plateau again fall to '5000 or 6000 feet and assume a more broken character along the Transvaal frontier, where they have been subject to much weathering and erosion, presenting in places the appearance of marine headlands, whence the term Xaap, " Cape," apphed to the cliffs in this auriferous

district. Here the Eandberg ("Border range"), as it is called, is flanked seawards by the less elevated Lobombo Coast range ; and beyond the Mauchberg, culminating point of the Transvaal (8725 feet), the whole system gradually merges in a broad expanse of moderately elevated uplands, intersected transversely to the main range by the Zoutpans- berg and Murchison Rand, between the Oliphant and Limpopo rivers. North of the Limpopo the eastern es- carpments again assume a mountainous aspect between Portuguese territory and Southern Rhodesia, broadening out northwards in the Mashona highland, and developing in Matabeleland the historical Matoppo ridge, which forms the true water-parting between the Limpopo and the Zambezi rivers.

From the inner slopes of the encircling ranges, thus roughly outlined, the great continental plateau stretches away for interminable distances through the former Boer states and Bechuanaland from the Orange northwards to the Zambezi, and through the Kalahari desert westwards to the Atlantic Ocean. It has a total area of not less than 900,000 square miles ; and the tilt of the land being westwards in the south and eastwards in the north, the drainage is almost entirely through the Orange to the Atlantic, and through the Limpopo, Sabi, Bosi, Pungwe, and Zambezi to the Indian Ocean. L3dng between the low latitudes of 16 and 35 S., while also exposed to the moist monsoons and warm marine currents of the Indian Ocean, South Africa should be distinguished by a hot, wet, tropical or subtropical climate. But these con- ditions are fully reahzed only on the eastern seaboard between the Zamliezi and the Cape, and are elsewhere ITofoundly modified by the great mean elevation of the land (4000 feet), by the cold marine and aerial currents setting from the Antarctic waters along the west coast, and by the great altitude of the eastern escarpments (Drakens- berg, Eandberg), by which, as in Australia, the raiu-bearing oceanic trade winds are intercepted, leaving but a slight preciiitation for the central and western regions. Hence in the direction of the east the

Climate.

geography]

SOUTH AFRICA

increase of the rainfall is continuous, rising from 3 or 4 inches in Namaqualand and 8 to 16 in Bechuanaland to 24 at Pretoria and Bloemfontein, and 40 or even 50 in Natal. The temperature is much more uniform, the mean for the whole year lying almost everywhere, between 60 and 70 F., while the mean of the extremes ranges from 40 to 91 at the Cape, 32 to 95 at Pietermaritzburg, 40 to 105 at Kimberley and Pretoria, 41 to 94 at Bloemfontein, and 40 to 106 at Bulawayo. But owing to the dryness of the atmosphere, this intense heat is far less oppressive than might be supposed, and many parts not only of the Cape but of the central plateau and the Ehodesian uplands are perfectly salubrious and well adapted to the European constitution. The prevailing complaints enteric fever, ague, diarrhoea, and dysentery are due either to the bad water or to long exposure and hardships, or else are confined to the low-lying swampy and riverside tracts. Elsewhere fever is almost unknown, while the Matabele and Mashona uplands, where white families are already estabhshed, are declared to be even more healthy than Natal and other parts of the long- settled seaboard. The generally salubrious nature of the climate is indeed placed beyond doubt by the persist- ence of the Boer race and of the English settlers, all noted for their longevity, robust physique, and vigorous ofispring.

On the plateau the deficient moisture is everywhere reflected in the poverty and general character of the

vegetation, marked by the absence of woodlands ftr'una*"" ^^^ ^^^ great predominance of thorny scrub and

herbaceous growths. Prickly acacias, euphorbias, and mimosas are characteristic of the high veld, where the eye sweeps over vast grassy plains or rolling steppes, and lights on nothing but a few clumps of low, shadeless trees, marking the sites of the Boer farmsteads dotted thinly over the steppe. The native grasses yield rich pasturage during the wet summer months, but mostly disappear in the dry winter season, and then the only visible vegetation is the so-called "bush," that is, the acacias,

willows, mimosas, yellow-wood, iron- wood, and wild fig, by which the watercourses are often densely fringed. On the other hand, the soil is naturally rich, and where water is available some districts yield two annual crops of cereals, especially mealies (maize) and some of the finest wheat in the world. Tobacco, the vine, and most European fruits and vegetables thrive well, while sugar, cofi^ee, cotton, and other colonial produce already grown in Natal might also be successfully cultivated in the Limpopo valley. But so far only a mere fraction of the available land has been brought under tillage ; and although its agricultural resources are bound- less, no great progress can be expected until some practical steps are taken to get rid of the locust pest and introduce the urgently-needed irrigation works in a large way. Meanwhile the boundless pastures support multitudes of horned cattle, horses, goats, merinos, and fat-tailed sheep. These more profitable domestic animals have to a large extent crowded out the beasts of prey and the game of all kinds which till recently abounded in prodigious multi- tudes. F.ormerly such characteristic members of the African fauna as the lion, leopard, hyasna, elephant, buffalo, zebra, quagga, giraffe, baboon, rhinoceros, gnu, eland, springbok, gazelle, and other antelopes in endless variety swarmed over the inland plateaux and the surrounding slopes, while the large streams were infested with the crocodile and hippopotamus. The early travellers speak of the harte- beest, gnu, and springbok scouring the plains and migrating in herds of ten or even fifteen thousand from pasture to pasture between the Cape and the then unknown northern wilderness beyond the mountains. But they are now seldom seen even in the wilderness itself, and to prevent

Inhabit- ants.

their total extinction some species are sheltered in public or private preserves in the Cape and the Transvaal The lion is said to have ceased to roar, though still lingering about the haunts of men ; the quagga and white rhinoceros seem to have died out, and the hippopotamus has dis-appeared from most of the rivers.

The same fate has overtaken nearly all the Vaalpens, Bushmen, and Hottentots, who represent the true aboriginal element south of the

*Zambezi, and are described in separate articles. All the other natives, popu- larly called " Kaffres," are members of the wide- spread Bantu family (see Bantus), of whom they here form three distinct branches : 1. The Ztdu-Xoms, origin- ally confined to the south-east seaboard between Delagoa Bay and the Great Fish river, but later (19th century) spread by conquest over Gazaland, parts of Transvaal, and Rhodesia (Matabeleland). 2. The Becfmanas, with the kindred Basutos, on the continental plateau from the Orange to the Zambezi, and ranging eastwards into the late Boer states and Basutoland, and westwards over the Kalahari desert and the Lake Ngami region. 3. The Ova-Kerero and Ova^Mpo, confined to German South-West Africa between Walfish Bay and the Cunene river. All these mixed Bantu peoples, who all speak dialects of the extinct Bantu stock language, are immigrants at various periods from beyond the Zambezi. The Bechuanas, who still occupy by far the largest domain, and alone preserve the totemic tribal system in its integrity, were probably the first arrivals from the north or the north-east coast- lands. There is reason to believe that they formed the bulk of the native populations when Austral Africa was reached, some two or three thousand years ago, by the ancient navigators who came hither, most probably ^ * "" from South Arabia, in quest of gold, and to whom ruins. the late Theodore Bent has rightly attributed the remarkable Zimbabwe monuments stLU extant near Victoria, in Southern Rhodesia (Matabeleland). These remains, with their lofty round tower, encircling walls and ramparts, all in weU-dressed stone, display remarkable constructive skiU, far beyond the power of any of the present or past rude inhabitants of the land. They comprise well-planned fortifications for the defence of the prehistoric gold mines, and temples with numerous carvings, emblems, and de- tached objects, which plainly point to ancient Semitic religious rites. No inscriptions have yet been discovered, but in the Malagasy language of the neighbouring island of Madagascar distinct elements still survive of the old Himyaritic speech which was current in South Arabia under the Sab[?]?an and Minaean empires, and is not yet quite extinct. The inference seems therefore reasonable that the Zimbabwe monuments are the work of the ancient civilized inhabitants of South Arabia, perhaps co-operating with their Phoenician kindred, who were ever exploring the eastern seas in search of the gold and other treasures reported from the " land of Ophir."*

Gold, vrith diamonds of recent discovery, stUl consti- tutes the chief mineral wealth of South Africa, which in both of these respects may be regarded as un- rivalled. Full details are given elsewhere (Cape ?'^"i Colony, Teansvaal), and here it will suffice to state that while the Kimberley output controls the diamond markets of the world, in 1898 the Transvaal gold harvest exceeded that of Australia, Siberia, and America. The diamantiferous blue clays (" pipes ") are not confined to the Cape, and rich auriferous reefs range far beyond Transvaal into Southern Rhodesia. In other respects South Africa is well mineralized, and besides iron, copper, tin, and silver extensive coal-fields occur in the Cape (Molteno district), in Natal and Zululand (Newca.stle, Nougoma), in the Orange River Colony (Kroonstad), and in various parts of

[histoey

the Transvaal and Rhodesia nearly up to the banks of the Zambezi.

In the following table are brought together a conduTon ^^^ leading data showing the economic condition (1898-1900) of the various British South African colonies for which accurate returns are available : ???

Cape.

Natal.

Orange River.

Transvaal.

Basuto- land.

Imports .

??19.207,000

5,359,000

1,191,000

13,500,000

85,600

Exports .

23.6TjO,000

1,325,000

1,924,000

134,000

Revenue

8.781.000

2,081,000

800,000

3,983,000

70,500

Expenditure .

8,190,000

1,915,000

957,000

3,971,000

60,000

Debt

31,410,000

9,019,000

30,000

2,660,000

Cattle

1,070,000

278,000

896,000

Bold.

321,000

Horses

388,000

57,000

249,000

1890.

81,000

Sheep .

1,204,000

601,000

6,620,000

1,870,000

Goats .

5,573,000

450,000

858,000

1893.

Wool crop

37 180.000 lb.

Tea.

3.480,000

Moljair .

6.707,000

1,037,000 lb.

1895.

Wheat

2,221,000 bush.

Coal.

8,670,000

Mealies .

2,858.00J ???

388,000 tons

1898

Oats

1,810,000 ???

]iarJi.

16,044,000

Ostrich feathers

278,000 lb.

??58,000

1884-98.

Wine

4,826,0)0 gals.

Sugar.

69,815,000

Brandy

1,107,000 ???

??147,000

Coal. 1,908,000 tons

Diamonds

_?_?4,135,000

_?_?1,608,000

_?_?43,700

Railways

2300 miles

591 miles

392 miles

774 miles

White population .

390,000

48,000

78,000

150,000

600

Coloured population .

1,400,000

613,000

130,000

712,000

26,000

From this table it appears that about 4000 miles of railways had been opened by 1900. In that year about 1000 additional miles were either in progress or projected ; and when these are finished, the interior will enjoy the advantage of railway access to the coast and to the Zambezi at eight different points ––– Walfish Bay, Cape Town, Port Elizabeth, East London, Durban, Delagoa Bay, Beira, and some place on the Zambezi below the Victoria Railways: Falls. The main line from Cape Town north- ibe Cape- wards has already reached Bulawayo, a distance to- Cairo of 1360 miles; and this is now regarded as scheme. j^grely the southern section of a transcontinental " Cape-to-Cairo " line, which it is proposed to construct mainly through British territory, the northern section of which is also completed from the Mediterranean to Khartum, a distance of 1350 miles. As the total distance is 6610 miles, there is still left a central section of 3900 miles to complete the system by the route originally pro- posed. But recent exploration about the White Nile headwaters shows that considerable deflections may have to be made, to avoid the almost impassable swampy tracts north of the equatorial lakes ; and there are other difficulties, which render the expectations of those who hope to see the undertaking out of hand within the first decade of the 20th century a little sanguine. But when- ever the railway is completed, the results must be far- reaching, and must tend enormously to develop the material resources of British South Africa.

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II. Modern Histoey.

For historical purposes South Africa may be taken to include that part of the African continent which lies to the south of tlie Congo State on the west and German East Africa on the east. Within it are situated Portu- guese East and West Africa, Rhodesia, German South-

West Africa, Cape Colony, Natal, Basutoland, Orange River Colony, and Transvaal. The European coloniza- tion of these territories has occurred step by step, the establishment of one colony or state leading Buropeaa on to the establishment of another. As it is fjg through the European colonists that we have ob- tained such information as we possess with regard to the native races of the country, it will be most convenient to deal with colonization first in the order of its occurrence, and to consider the native races afterwards. The relations of the white and aboriginal races in the various colonies will also be dealt vdth.

What led to the discovery of America led also to the discovery, exploitation, and colonization of South Africa. In the 15th century the great Eastern trade with Europe was carried on by the Venetian ^^^ Porta- Republic Venice was the gate from West to East, and her fleets, richly laden with goods brought down to the shores of the Mediterranean in caravans, supplied Europe with the luxuries of the Orient. It was in that century that Portugal rose to prominence as a maritime power ; and being anxious to enjoy at first hand some of the commerce which had brought such prosperity to Venice, Portugal determined to seek out an ocean jjathway to the Indies. It was with this intention that Columbus sailed westward and discovered America, and that Bartholo- mew Diaz, sailing southwards, discovered the Cape of Good Hope. The story of these early voyages is full of gallant adventure, hardihood, and romance. It is sufficient here to record that in 1-486 Diaz, having rounded the Cape, entered Algoa Bay, and landing ujjon a small

island, erected a cross as a token that he had taken possession of the country for the king of Portugal. Returning, he sighted the Cape in heavy weather, and christened it the Cape of Storms. This name was subsequently changed by the Portuguese king into that of the Cape of Good Hope. In 1500, whUe on another voyage to the Indies, the brave Portuguese explorer Diaz went down with his ship in the Atlantic. Eleven years after the first expedition of Diaz another Portuguese expedition was fitted out under Vasco de Gama. De Gama entered Table Bay, but did not land. From here he pu.shed on round the coast, landed in Mossel Bay, then sailing up the south-east coast, he sighted land again on 25th December 1497, and named it in honour of the day. Natal. Still proceeding northwards, he fell in with coast pilots, and eventually reached the coast of Malabar, in the island of Java.

For a hundred years subsequent to this date Africa represented merely an inconvenient promontory to be rounded on the voyage to the Indies. Ships stopped at different ports, or rather at such few natural harbours as the inhospitable coast offered, from time to time, but no attempt was made by the Portuguese to colonize the southern end of the continent. They did, however, in course of time establish ports, and through them small settlements, on the eastern and western sides of South Africa, and these to-day are represented by Portuguese East and West Africa.

The first Europeans to follow in the wake of the Portuguese Indian voyagers were the English. In 1601 the Engli.sh East India Company fitted out a small fleet of five vessels, which sailed from Bngiisb Torbay. After four months at sea they dropped company. their aneliors in Tablfe Bay, where they landed and remained for seven weeks before proceeding east- wards. From that time forward Table Bay was used as an occasional port of call for British ships, and in 1620 two English captains formally took possession of the Cape in the name of James I. This patriotic act

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was not, however, sufficiently appreciated by either King James I. or the English East India Company to evoke any official confirmation on their part. Mean- while the Dutch East India Company had been formed in Holland, and the Dutch had entered keenly into the competition for the glittering prizes of Eastern commerce. In 1648 one of their ships was stranded in Table Bay, and the shipwrecked crew were left to forage for themselves on shore for several months. They were so pleased with the resources of the country that on their return to Holland they represented to the directors of the company the great advantages that would accrue to the Dutch Eastern trade from a properly provided and fortified station of call at the Cape. The result was that in 1652 a fort and vegetable gardens were laid out at Table Bay by a Dutch expedition sent for the purpose under a surgeon named van Riebeek.

In 1657 a few soldiers and sailors, discharged by the Dutch East India Company, had farms allotted them, and these men constituted the first so-called Dutch "free burghers." By this step the station cVmpany became a plantation or settlement. More settlers were landed from time to time from the passing Dutch ships, and in 1688 180 French Huguenots were added to the original settlers. The little settlement grew slowly, but gradually spread eastwards until in 1778 the Great Fish river was declared the boundary of the Cape of Good Hope. All through the latter half of the 17th, and the whole of the 18th, century troubles arose from time to time between the colonists and the Government. The administration of the Dutch East India Company was of an extremely despotic char- acter. The most interesting and complete account of the company's tenure and government of the Cape was written in 1857 by Mr E. B. Watermeyer, a Cape colonist of Dutch descent residing in Cape Town. He points out that it was after failing to find a route by the north-east to China and Japan that the Dutch turned their eyes to the Cape route. The Cape of Good Hope subsequently "became not a colony of the Eepublic of the United Provinces, but a dependency of the 'Netherlands Char- tered General East India Company' for mercantile pur- poses; and to this fact principally can be traced the slow progress, in all but extension of territory, of a country which was settled by Europeans within thirty years of- the time when the Pilgrim Fathers, the founders of a mighty empire,

landed at Plymouth to plant democratic institutions and European civilization in the West."

On the settlement under van Eiebeek, and the position in it which the so-called "free burghers" enjoyed, this candid Dutch writer, whose lectures are now out of print, throws an interesting light.

"The people," he says, "who came here with Eiebeek himself were not colonists intending permanently to settle at the Cape. All were paid servants of the company : the men, in course of time, to be removed to other stations ; the officers, especially the commandant, who, after the first year, urgently pressed his claim for promotion, expecting to be transferred to more lucrative posts in India. A watering and cattle station of the company, under the charge of the servants of the company, was all that was intended by the occupation of 1652. The proposition that any freemen or burghers, not in the pay of the company, should be encouraged to cultivate the ground was first made about three years after Riebeek's arrival. Accordingly, some discharged sailors and soldiers, who received, on certain conditions, plots of ground, extending from the Fresh Eiver to the Liesbeek, were the first, free burghers of the colony. . . . Here it is sufficient to say that, generally, the term 'free burgher' was a complete misnomer. The first burghers were, in truth, a mere change from paid to unpaid servants of the company. They thought, in obtaining their discharge, that they had much improved their condition, but they soon discovered the reverse to be the fact. And hence- forward to the end of the last century, we find the constantly*

repeated and weU-founded complaint, that the company and its officers possessed every advantage, while the freemen were not allowed even the fruit of their own toil. Traffic with the natives, at first permitted on stringent conditions, was soon prohibited, lest thereby prices should become too high for the company when inclined to purchase. The ' free burghers ' might buy nothing except from the company, at the company's store and price. They wore prohibited, according to the caprice of the governors, from fishing in the bays. They might not supply strange ships, for strangers were to be discouraged. Twenty years after the establish-ment of the settlement. Commissioner Verburg examined into the state of

the colony for the information of the home authorities, and thus reports : ‘ The Dutch colonists at the Cape of Good Hope bear the name of freemen ; but they are so trammelled and confined in all things that the absence of any freedom is but too manifest. The orders and proclamations from time to time issued are .so rigid that it would be impossible to carry out the penalties therein, except with the utter I’uin of the burghers.’ The natural effect of this narrow and tyrannous rule was discontent, amounting often to disaffection. After a time every endeavour was made to escape beyond the immediate control of the authorities. Thus the ‘ trekking ‘ system, with its attendant evils, the bane of South Africa, was born. By their illiberal spirit, which sought but tem- porary commercial advantage in connexion with the Eastern trade, the Dutch authorities themselves, although generally humanely disposed towards the natives, created the system which caused their oppression and extermination. ”

When it is borne in mind that the Dutch at the Cape were for one hundred and forty-three years under the rule of the Dutch East India Company, i.e., for consider- ably more than half the period of their entire residence in that country, the importance of a correct appreciation of the nature of that rule to any student of South African history is obvious. No modern writer not even the South African historian Dr Theal approaches Watermeyer either in the completeness of his facts or the severity of his indictment. Referring to the policy of the company, Watermeyer says :

“The Dutch colonial system as exemplified at the Cape of Good Hope, or rather the system of the Dutch East India Company (for the nation should not wholly suffer under the condemnation justly incurred by a trading association that sought only pecuniary profit), was almost without one redeeming feature, and was a dis- honour to the Netherlands’ national name. In all things political, it was purely despotic ; in all things commercial, it was purely monopolist. The Dutch East India Company cared nought for the progress of the colony provided only that they had a refresh- ment station for their richly laden fleets, and that the English, French, Danes, and Portuguese had not. Whatever tended to infringe in the slightest degree on their darling monopoly was visited with the severest penalties, whether the culprit chanced to be high in rank or

low. An instance of this, ludicrous while grossly tyrannical, is preserved in the records. Commander van Quffilbergen, the third of the Dutch governors of the colony, was dismissed from the government in 1667, and expelled the seivice of the company, because he had interchanged civilities with a French governor bound eastwards, the United Provinces being then at peace with France. 'Not only,' so the despatch appointing Quaelbergen's successor complained, 'had he ventured to give the French a kindly reception ashore, but he had quitted his post in the fort, and had proceeded on board of the French ship, a most inexcusable fault, for which the Chamber of XVII. felt bound to express their grievous displeasure, as subversive of all military discipline. '

"Of this nature was the foreign policy of the Dutch company at the Cape of Good Hope ; modified, indeed, in some degree from time to time, but governed by principles of jealous, stringent monopoly until the surrender of the colony by Commissioner Sluysken in 1795. The internal government of the colonists for the entire duration of the East India Company's rule was always tyrannical, often oppressive in the extreme. With proclamations, placaats, and statutes abundantly filKng huge tomes, the caprice of the governor was in truth the law. The excesses and enormities of van der Stell at a comparatively early period of our history, of van Pletten- berg and a despotic functionary, the ' Independent Fiscal ' Boers, towards the close of the last century, and of many intervening petty tyrants, are in truth almost incredible to us, who, called freemen, enjoy the rights of freemen, and who would fain believe that those who bore this name in our country in the olden time were privileged, as we are, to know the blessings of liberty. A mockery of popular institutions, under the name of a Burgher Council, indeed existed ; but this was a' mere delusion, and must not be confounded with the system of loca^ government by means

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of district Burgher Councils whicli that most able man, Commis- sioner de Miit, sought to establish during the brief government of the Batavian Republic from 1803 to 1806, when the Dutch nation, convinced and ashamed of the false policy by which they had permitted a mere money-making association to disgrace the Batavian name, and to entail degradation on what might have been a free and prosperous colony, sought to redeem their error by making this country a national colonial possession, instead of a slavish property, to be neglected, oppressed, or ruined, as the caprice or avarice of its merchant owners might dictate."

From time to time servants in the direct employment of the company were endowed with the right of " free burghers." One of the documents conferring this privilege was brought to Hght by the researches of Watermeyer. It is a quaint instrument, and will illustrate better than anything else can the attitude of the Government to the colonists : ???

"Joachim van Plettenberg, Governor of the Cape of Good Hope and its dependencies, greeting ; "Whereas Johan Hendrik Gans; of Lippolsberg, who arrived here in the year 1770 with the ship Veldhoen, as soldier at the pay of nine guilders per month, hath by petition particularly requested of us to be discharged from the service of the Honourable Company and to be appointed (aangesteld) as burgher, having duly served the Honourable Company.

"Wherefore, we graciously grant his request to earn his liveli- hood here, or elsewhere within the colony, with his handicraft as a tailor ; but that he shall not be allowed to abandon the same, or to adopt any other mode of living, unless he shall first have obtained special permission thereto from this Council, and that he shall not petition for any grant of land from the Honourable Company, which specially reserves the right and power, at any time when it may be deemed necessary, or whenever his conduct shall not be projiur, to take him back into service in his old capacity and pay, and to transport him hence, if thought fit ; further submitting him to all such placaats as have already, or may in future be enacted regarding freemen.

"Done at the Castle of Good Hope, 5th September 1780.

‘ ‘ J. VAN Plettenberg.

“0. M. Beeg”h, Secretary.”

” This right to enforce into servitude those who might incur the displeasure of the governor or other high officers was not only exercised with reference to the individuals themselves who had received this conditional freedom ; it was claimed by the Govern- ment to be applicable likewise to the children of all such. ”

The effect of this tyranny was inevitable ; it drove men to desperation. Th^y fled from oppression ; and thus trek- king began, not in 1837, as is generally stated, Tbe Trek j^^^ ~~before the commencement of 1700. From 1720 to 1780 trekking had gone steadily for~~ wards. In 1780 van Plettenberg, the governor, proclaimed the Sneeuwbergen the boundary of the colony, expressing “the anxious hope that no more extension should take place, and with heavy penalties forbidding the rambling peasants to wander beyond.” In 1789 so strong had feeling amongst the burghers become that delegates were sent from the Cape to interview the authorities at Amsterdam. After this deputation some nominal reforms were granted ; but in 1795, after a further period of disaffection at the Cape, a number of burghers settled in the Swellendam and Graaff Reinet districts drove out the officials of the company and established independent governments. This rebellion was accompanied by an assertion of rights on the part of the burghers or freemen, and this same declaration contained the following clause, from the spirit of which the Trek Boers never really departed : ???

“That every Bushman or Hottentot, male or female, whether made prisoner by commanders or caught by individuals, as well in time jiast as in future, shall for life be the lawful property of such burghers as may possess them, and sei’ve in bondage from genera- tion to generation. And if such Hottentots should escape, the owner shall bi! entitled to follow thi:m up and to punish them, according to their merits in his disrretion.

“And as to tlie ordinary Hottentots, already in servicr, brought up at the places of Christians, the children of thiwo shall be compelled to serve

until their twenty-fifth year, and may not go into the service of any other save with their master's consent ; that

no Hottentot, in future, deserting his service shall be entitled to refuge or protection in any part of the colony, but that the authorities throughout the country shall immediately, whatever be the alleged cause of desertion, send back the fugitive to his master."

After one hundred and forty-three years the rule of the Dutch East India Company came to an end at the Cape. What its principles were we have already seen. Water- meyer recapitulates its effects as follows : ❓❓❓ ❓❓❓

"The effects of this pseudo-colonization were that the Dutch, as a commercial nation, destroyed commerce. The most industrious race of Europe, they repressed industry. One of the freest states in the world, they encouraged a despotic misrule in which falsely- called free citizens were enslaved. These men, in their turn, became tyrants. Utter anarchy was the result. Some national feeling may have lingered ; but, substantially, every man in the country, of every hue, was benefited when the incubus of the tyranny of the Dutch East India Company was removed. Since then the advancement of the colony, both under an English and a brief Dutch administration (1803 to 1806), has been as rapid as that of any in the world. So great has been the progress, so utterly dilferent is the condition of the inhabitants, so much has in the intermediate sixty years been effected, that it is with incredulity, and with some effort, that we are compelled to accept the fact that affairs within so short a period were in the state which our history describes."

To this one further note must be added. The Trek Boers of the 19th century were the lineal descendants of the Trek Boers of the 18th. What they had learnt of government from the Dutch East India Company they carried into the wilderness with them. The end of the 19th century saw a revival of this same tyrannical monopolist policy in the Transvaal. If Watermeyer's formula, " In all things political, purely despotic ; in all things commercial, purely monopolist," was true of the government of the Dutch East India Company in the 18th century, it was equally true of Mr Kruger's govern- ment in the latter part of the 19th.

*In 1806, as one of the results of war, France and Holland being united against Great Britain, the Cape was seized by a British force. In 1814, at the close of the war vdth Holland, Great Britain ?'** surrendered to her all colonies seized during the ^^^ Cape. war, with the exception of the Cape and portions of what are now British Guiana. In consideration of retaining these territories Great Britain paid to Holland ►►6,000,000. The British title to Cape Colony is thus based upon conquest, treaty, and purchase. The popula- tion at that time was estimated at 26,700 Europeans, 17,650 free Hottentots, and 29,000 slaves. We have now dealt with the introduction of Portuguese, Dutch, and British to South Africa. Germany did not enter upon the scene until 1883, when the German flag was hoisted in Damaraland, on the south-west coast.*

Before tracing the development and history of the country during the 19th century, and endeavouring to estimate the part that the European races have played, it is necessary to consider the native races of South Africa. The natives first en- couhtered by the early voyagers and the Dutch settlers at the Cape were the Hottentots. They at this time occupied the Cape peninsula and surrounding country, and in the early days of the settlement caused the colonists a con- siderable amount of trouble. An extract from the diary of van Riebeek in 1659 will best illustrate the nature of the relations existing between colonists and natives at that time : ►►►

"Srd June. ►►► Wet weather as before, to tke prevention of our operations. Our people who are out against the plundering Hottentots, can effect nothing, neither can they effect anything against us ; thus during the whole week they have been vainly trying to get at our cattle, and we have been trying vainly to get at their persons ; but we will hope that we may once fall in

Tbe native races.

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*with tliem in fine weather, and that the Lord God will be with iis.'^*

The Hottentots, like the other negroid races of Africa, lived in clans or tribes and occupied kraals or villages. Tliey tilled the soil to a limited extent, and possessed flocks and herds. A study of their ethnology, language, &(:., vdR be found under Hottentots (see also under Africa : Ethnology). Throughout Cape Colony to-day the Hottentots chiefly reside as servants on farms, although in Namaqualand the Namaquas and Korannas are both Hottentot tribes, and still live in a state of semi-tribal independence. The Bushmen resemble the Hottentots to some extent in appearance. They are a race of pigmies (see Bushmen). Between the Bushmen and Hottentots in the early days an inveterate hostility usually existed. Yet occasionally a party of Bushmen would be attached as hunters and scouts to a Hottentot tribe. For the most part, however, both among black and white races, the Bushmen's hand has been against every man and every man's hand against him. To-day the Bushmen have almost disappeared from Cape Colony, though the abundant evidence of their deserted caves and old habitations attest that they once resided there in considerable numbers. When first known to the early colonists, they were inveterate stock thieves, and were treated by the Boers as wild animals, to be shot whenever an opportunity occurred. The habitat of these pigmy races is a wide one, and extends from the Libyan deserts of Herodotus through the regions of Central Africa to the Cape. To-day such Bushmen as are left in South Africa are to be found chiefly in the deserts of the south- west. Such opposition as Hottentots and Bushmen were able to offer to colonization was not difficult to overcome. The feuds of the early days with the Hottentots soon came to an end, and the Bushmen, who lived in small communities, were hunted like wild game. The formid-able native power of the great Bantu tribes was not encountered until later in the 18th century, when the boundary of the colony was extended to the Fish river (see Bantu). The first of the Kaffre wars, of which a long series occurred in the 19th century, was in 1811, when the Kaffres crossed the Fish river and occupied neutral territory to the south of it. The Bantu, like the Europeans, were invaders of South Africa, and while the European tide of immigration flowed in from the south, the Bantu came in successive migrations from the north down the east coast of South Africa. The meeting of these rival invaders on the Kaffre frontier was the

scene of many bloody conflicts. In 1819 the Kaffres again crossed the Fish river, and, headed by Mahana, a prophet, they penetrated through the dense bush country lying to the south of the Fish river, and attacked in large numbers the fort and settlement at Grahamstown, which was defended by only 320 men. The Kaffres were finally driven off'; but this last invasion convinced Lord Charles Somerset, then governor of the colony, of the necessity

for a line of frontier forts and a more numerous British settlement of colonists. Representations on the ^ot 1820 matter in England, coupled with assurances

from Somerset as to the fertility of the district, induced the British Government to vote ►►50,000 for the purpose of sending out a number of emigrants. Applications were called for, and no less than 90,000 were received. Of these, only 4000 were selected and shipped to South Africa. They were landed in IS 20, in Algoa Bay, where they founded Port Elizabeth and the Albany settlement. Among these settlers were a number of married men with families. They were recruited from England, beland, and Scotland, and came from all grades of society. Among them were cadets of [

old families, retired officers, professional men, farmers, tradesmen, mechanics, and labourers. They encountered many difficulties and some suffering in their early days, but on the whole they throve and prospered. Their descendants, the Atherstones, Bowkers, Barbers, Woods, Whites, Turveys, and a number of other well-known frontier families, are to-day the backbone of the eastern province, and furnish the largest portion of the pro- gressive element in Cape Colony. Among them was a gifted Scotsman named Thomas Pringle. His poem entitled " Afar in the desert I love to ride " and other poems have depicted the scenes of those early days in glowing and eloquent lines. The vast spaces of the veld, the silence of the solitudes, the marvellous varied and abundant animal life, the savage half-weird character of the natives, and the wild adventure of the early colonists have been caught with a true spirit of genius. Since his day no one, unless it be Olive Schreiner in TJie Story of an African Farm, has so vividly painted the life and the atmosphere of that vast continent

lying to the south of the Zambezi. Pringle did more than ~~nTite poetry : he opposed the somewhat despotic rule of Lord Charles Somerset, and gallantly stood up for the causes of liberty of the press and education in the colony. In 1826 he returned to England and threw himself into the anti~~ slavery agitation. He became secretary of the Society for the Abolition of Slavery, and heartily co-operated in the great work it had undertaken. He was the author of the lines, at one time famous ???

‘ ‘ Oppression, I have seen thee face to face, And met thy cruel eye and clouded brow.”

In 1834 occurred another terrible Kafire invasion. Many Europeans were massacred, farmhouses burnt, and an enormous quantity of stock taken from the colonists, before the Ivaffres were eventually Emanct- driven back across the Keiskamma river. In ^^-ns ” the same year the Slave Emancipation Act, emancipating all slaves throughout the British Empire, came into force. The slaves in Cape Colony, who consisted chiefly of imported negroes from the West Coast of Africa and of Hottentots, were estimated at the time at 36,000. These slaves were valued at the Cape at ??2,000,000. The sum actually voted by the British Government to slave – owners in Cape Colony, out of a total compensation paid of ??20,000,000, was ??1,250,000. This money was unfortunately only made payable in London, and the farmers were compelled to seU their claims for compensation to agents, who frequently paid a merely nominal price for them. In many instances farmers found themselves quite unable to obtain native labour for a considerable time subsequent to the eman- cipation, and in some cases, no doubt, ruin was the result. The feeling created among the Dutch colonists was very bitter. Many of the farmers, who had parted with their claims to compensation for a trifling sum, found themselves without labour or means of paying for it. At the same time, of the soundness of the general principle of the Act of Emancipation there cannot be a shadow of question.

Quite apart from the actual tyranny exercised over the natives, from which they suffered heavily, there was a still more disastrous result of slavery in South Africa. The o^vnership of native women led to a numerous bastard offspring, some of whom were in due course

themselves sold as slaves. The influence upon the owTiers of such a practice as this was degrading to a degree. The intimate contact, lasting now for two centuries, between the Dutch and the natives, has exercised a marked influence upon Boer character. The liberation

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of the slaves doubtless diminished the evil effect of this influence, but among the Boers of the Transvaal a system of apprenticeship hardly less rigid than slavery has existed down to the present day. In justice to the Dutch, it is only fair to say that the question of the relationship between white master and black servant has always been a difficult one. The difficulties were .greatly enhanced where master and servants lived on distant farms, two or three days' journey from a magistrate or field cornet. A system of punishment applicable on the spot was a necessity, and summary justice was often administered long after slavery ceased to exist. If the Boers have erred by undue harshness to the natives, colonists of British origin must not be entirely acquitted. And the fact must not be lost sight of that the native is not infrequently a most untrustworthy and lazy servant, as well as an inveterate drunkard if he can obtain access to alcohol.

Foremost in championing the natives were the mission- aries. The missionaries have been attacked not only by

Dutch but by British colonists. Their zeal, it The mis- jg certain, has frequently outrun their discretion.

Their success in making converts, at least among the Bantu tribes, has been limited. Moreover, a longer experience of all the African negroid races has led to a con- siderable modification in the views originally held in regard to them. The black man is not simply a morally and intellectually undeveloped European, and education, except in rare instances, does not put him on a par with the European. There is a

tendency in all the negroid races for mental development to cease at a much earlier age than in the European. But after all has been said against the extreme attitude of some of the missionaries, no unprejudiced man will deny that their work on the whole has been a good one. The fair fame of Great Britain has more than once been upheld in South Africa at the instigation and by the conduct of these intrepid pioneers. Mofiat and Livingstone among the Bechuanas, Cassalis among the Basutos, Dr Stewart in Cape Colony, have all had a beneficent influence upon the natives around them. They have opposed the sale of alcohol, denounced inhumanity from the farmers, encouraged the men to labour and taught them mechanical arts. To-day technical education is still further taking the place of doctrinal discourse, and the effect is an excellent one.

In 1836 an Act was passed which set a limit to the jurisdiction of the Cape Government in South Africa. It was entitled the Cape of Good Hope Punishment Act, Limits ot ^^'^ under it the Cape colonial courts were British empowered to deal with the offences committed jurisdic- by British subjects in any part of South Africa tlon. ^p ^Q ^jjg latitude of 25 degrees. The import-

ance of the Act lies chiefly in the limit given to British powers at an early date. On the strength of it, the Boers who subsequently trekked away from the colonies

were warned that by so trekking they did not

pass out of the limits of British jurisdiction.

From 1836 to 1840 what is known as the Great Trek occurred. A number of the more turbulent spirits among the Boers, impatient of JJritisli rule, emi- grated from Caj)e Colony into the great plains beyond the Orange river, and across them again to the fast- nesses of the Zoutspanberg, in the northern part of the Transvaal. Various reasons for this trek lia-e been assigned. Among the lioers of the Graaff Ri-inet and other frontier districts the tradition of rebellion against every form of civilized government had existed since the days of their first revolt against the East India Company. They now protested against what they considered the misrepresentation by the missionaries of their attitude

towards the natives. They further objected that the wars on the Kaffre frontier were of a ruinous and disastrous character, and were not sufficiently dealt with by the Cape Government. Finally, what exasperated them beyond everything was the abolition of slavery. In relation to this trek, it is as well that the cause advanced by their leader Piet Eetief in 1837 should be put on record. The manifesto dealt with various points, but the one in reference to the abolition of slavery ran as follows : ??? " We complain of the severe losses we have been forced to sustain by the emancipation of our slaves, and the vexatious laws which have been enacted respecting them." It was estimated that during the four years in which the trek lasted no less than 7000 persons took part in it. Sir Benjamin D'Urban, who was governor at the time, desired to stop the trek, but could find no means of doing so ; and when urged by the colonial authorities to take some steps in the matter, he replied that he could see no means " of stopping the emigration except by persuasion and attention to the wants and necessities of the farmers."

At the outset misfortune appeared to dog the footsteps of these pioneers. They had no sooner crossed the Vaal river than they encountered the Matabele under Moselekatze. After an initial defeat at his hands, and the loss of much of their stock, they were eventually victorious, and in 1838 drove Moselekatze out of the country. Moselekatze having been defeated, the Boers, under Piet Ketief, turned their attention to Natal, and marched towards the coast. Under the Drakensberg, while interviewing a chief of the Zulus named Dingaan, some sixty-five Boers under Eetief were treacherously murdered by him. Other trekkers followed in the wake of Retief, and attacking Dingaan, avenged the massacre, although not before a number of Boers ??? men, women, and children ??? had been massacred by the natives at Weenen (the Place of Weeping). In July 1838 the British Government announced that they could not allow the establishment of an independent state by " any of Her Majesty's subjects, which the emigrant farmers con- tinued to be." Sir George Napier, who had then been appointed governor, issued a proclamation warning the trekkers to return to the colony, and also stating that he should take immediate possession of Natal at an early date. Meanwhile the emigrant

farmers had established what they called the Republic of Natalia, elected a Volksraad, and founded the town of Pietermaritzburg.

In 1841 the Volksraad of the "Natalia Republic" requested "that a free and independent state in the closest alliance with the British Government " might be recognized. In reply to this Sir George Napier wrote saying that " Her Majesty could not acknowledge the independence of her own subjects, but that the trade of the emigrant farmers would be placed on the same footing as that of any other British settlement upon their receiving a military force to exclude the inter- ference with or jjossession of the country by any other European Power." To this the Volksraad in Natal replied that they had asserted and maintained their independence ever since leaving the colony, and they could not surrender it. Troops were then sent to the country, and several skirmishes occurred between the Boers and the British forces. At the conclusion . of these a settlement was proposed by Mr Cloete, the British Commissioner, and eventually those Boers who had come down from beyond the Drakensberg \ithdrew, returning to their homes. Those remaining behind in the territories of Natal accei)ted the constitution of a British colony.

A feature in the policy of the British authorities at this time in South Africa, and one which arose out of the

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Native treaty states.

strong representations of the missionaries, was the estab- lishment of what were known as treaty states, in which the territory and rights of certain natives were defined. The first of these was made between Cape Colony and the chief of the Griquas, Andries Waterboer, in 1834. This treaty alleged that Waterboer was the " friend and ally " of the colony, and it also defined his boundary extending along the Orange river. It further agreed to supply him with a certain quantity of muskets and

ammunition. Waterboer was the chief of some three or four thousand Griquas, a bastard race which had sprung up from the intercourse between Boers and native (principally slave) women. In 1843 two more of these treaty states were established, one under Adam Kok and the other under Moshesh. Adam Kok had under him a small number of Griquas, who dwelt in the country east of that occupied by Waterboer. And east of this country again was a tract of territory occupied by Basutos under Moshesh. In the same way Pondoland was established as a treaty state in 1844. At a later date it was found that in the country allotted to Adam Kok and his Griquas there were settled some thousand emigrant Boers. Thus the arrangement with Adam Kok naturally gave rise to a good deal of bitterness on the part of the Boers. They said it was not their intention to drive the coloured people from their dwellings, but it was their wish that they also should have their rights respected. Skirmishing between Boers and Griquas occurred, and eventually a force of 200 Britith troops was sent to the scene of disturbance. The result of this expedition was that Kok's territory was divided into two districts, one being retained exclusively for the natives, and the other for white men as well as natives. The government of both these territories was for a time under a British Resident. From the small station, at which this agreement was drawn up the town of Bloemfontein eventually developed, and subsequently became the capital of the Free State. Difficulties arose at this time also in Basutoland with the natives, and IMajor Warden defined the Basutoland boundary. This boundary, known as the " Warden line," divided the Basutos from the emigrant Boers. Its definition did not by any means terminate the strife between Basuto and Boer.

In 1848 Sir Harry Smith proclaimed the country between the Vaal and Orange rivers British territory, under the name of the " Orange River Sovereignty." The battle of Boomplaats followed, in which Sir Harry Smith routed the Boers. Meanwhile the Boers were Orange having considerable trouble amongst themselves reigaty!"' '^ the northern side of the Transvaal, arranging for the government of their country. They eventually evolved a very unsatisfactory system, which was practically one of district governments. The result and extent of this system will be found described under Transvaal. Sir Harry Smith, who was one of the most energetic, enterprising, and brave governors that South Africa ever had,

and who had been responsible for the founding of the Orange River Sovereignty, was shortly after the establishment of the sovereignty reprimanded, and eventually recalled.

*In 1852 the Boers, claiming complete supremacy in the district, turned back an Englishman who was travel- ling through Bechuanaland towards the interior I** . (see Bechuanaland). Livingstone's protest at ' this time was an important one, and his testi- mony as to the cruelty of the Boers towards the natives is of interest. The Boers plundered his house, destroying his books and taking away his goods. In 1852 the Sand River Convention was signed, which guaranteed to the Transvaal Boers the independence of their state.*

In 1853 the Bloemfontein Convention was arranged by Sir George Russell Clark, on behalf of the British Government, with the Free State. Under this convention the Orange River Sovereignty wa.s pg^gtate handed over to delegates apjDointed to receive it. ' Both in the Sand River and Bloemfontein Con- ventions clauses were inserted stating that Great Britain had no alliance whatever with any native chiefs or tribes to the north of the Orange and Vaal rivers, with the exception of the Griqua chief Adam Kok. It was further stipulated that neither the Transvaal nor the Orange lUver Government should permit slavery or trade in slaves in their territory. Numerous protests were made at the time, from many of the inhabitants of the Orange River Sovereignty, against the abandonment of it by the British Government, but the Duke of Newcastle, who was then in office, replied that the decision was inevitable, as British responsibilities in South Africa required restrict- ing rather than extending, especially (he added) " as Cape Town and part of Table Bay were all she [England] really required in South Africa " . (see Orange River Colony). The abandonment of the Orange River Sove- reignty in the territory north of the Orange river, against the wishes at the time of many of the emigrant Boers, was the first great blunder made by the British Government in their dealings with the emigrants.

When the Great Trek occurred, two courses obviously lay before the British authorities : either to let the Trek Boers go, and give them their blessing and liberty, or to repudiate and discourage the trek from the

outset. The action taken by the British authorities was one of vacilla- tion between these two courses. In the words of Mr Paul Botha, a Boer writer, England first blew hot and then blew cold. In 1854 Sir George Grey was sent to the Cape as governor. He had no g’”” ^^’”’^^ sooner arrived than he addressed himself with energy and diligence to the great problems awaiting him. He at once resolved that in dealing with the natives the policy of continually fighting was not altogether satisfactory. Up to the time of his arrival little or nothing had been done in the matter of education, and he now determined, to the utmost of his ability, to encourage the dissemination of knowledge among the natives. He visited the kraals in British Kaffraria, and thoroughly acquainted himself with the peculiarities of the Bantu tribes. He then addressed himself to the missionaries of various denominations, and offered pecuniary aid in the establishment of large industrial schools, in which the boys should learn not only to read and write, but to work as mechanics, and where they should be trained in industrial habits These societies and schools continued for some time, but were discontinued at a later date when the grant was curtailed. The school at Lovedale, however, still exists, and has continued to do good work. The plan of technical education among the Kaffres has recently been reintro- duced, and is now received with more general favour.

In 1858 Sir George Grey, who had acquainted himself thoroughly with the South African Boers, proposed confederation between the various South African states. In making this proposition to Sir E. B. Lytton, he wrote at the time: “Experience has shown that the views which led to the dismemberment of South Africa were mistaken ones. In point of fact, her ilajesty’s possessions here are of great and yearly increasing value to the trade and commerce of Great Britain.” As if to justify the sanguine prediction of Sir George Grey, the Free State, in December of the same year, having found that independ- ence had brought numerous troubles in its train, and being weary of native wars, wrote to Sir George Grey,

conveying a resolution of their Volksraad in favour of federation with, the Cape Colony. Sir George Grey was highly pleased to receive this communication, and urged the home authorities to adopt it. Unfortunately, his views with regard to federation and the reconciliation of the Dutch at this early stage did not meet with the approval of the British Government, and the proposition fell through. Sir George Grey had the mortification of seeing nearly every proposition he made rejected. In a despatch to the Colonial Office, on the 20th July 1859, he wrote as follows : ___ "With regard to any necessity which might exist for my removal on the ground of not holding the same views upon essential points of policy as her Majesty's Government hold, I can only make the general remark that during the five years which have elapsed since I was appointed to my present office there have been at least seven Secretaries of State for the Colonial Department, each of whom held difi'erent views upon some important points of policy connected with this country."

The request of the Free State Boers for federation with Cape Colony having been rejected, the inhabitants of the two republics were now left to develop their own institutions and government to the best of their ability. The Free Staters, owing chiefly to their acquiring at an early stage a most enlightened and liberal leader in President Brand, were fairly successful. The turbulence and continued unrest of the Transvaal Boers, on the other hand, kept their country in a state bordering on chaos (see TEAl^rsvAAL). In 1877 the Transvaal once more came under British rule.

Up to the year 1870 the Dutch considerably out- numbered the British inhabitants not only in Cape Colony but throughout South Africa. At the ^'^dDt b ___^ ___^ =^ British annexation of Cape Colony the colonists were entirely of Dutch and Huguenot extraction, and although the settlers of 1820 had brought a British element among the colonists, and an element which has thriven and prospered, the Dutch continued, even after the Great Trek, to be con- siderably in a majority. The industries of the colony were almost entirely pastoral, and remained chiefly in the hands of the Dutch. Continual feuds with the KafFres, and also the continual desire to trek into new countries, aU tended to keep back farming as an industry, and the country in the years 1867 to 1870

was in a generally very depressed condition. The Zulus during these years went on foraging expeditions into the Trans- vaal, and threatened Natal. The Basutos were continually at feud with the Free State. The Kaffres had a series of wars, preceded usually by massacre, chiefly with the British colonists on the eastern frontier of Cape Colony. In 1870 a new era opened for South Africa. The era of commercial expansion began. In that year, following smaller finds of diamonds on the banks of the Vaal and Orange rivers, the diamond mines of Du Toits Pan and Baltfontein were opened up. In 1869 gold had been found in the Lydenburg and Zoutpansberg districts in the Transvaal, and diggers had resorted there from different parts of the world ; moreover, farther up the country, in the territories of]\Iashona]and, Bain)iad rejiorted discoveries of gold. Among the purely pastoral i)opula- tion ostrich-farming became a new industry, and added a considerable asset to the wealth of the colony. The revenue derived from the export of ostrich feathers in 1899 was recorded at half a million. It was, howe^-er, the mineral discoveries of diamond and gold that chiefly determined a new departure in the development of the country. Emigration, which had been going on slowly for some time past, now largely increased. Men vnxlied to the diamond fields, and in smaller numbers to the ne^'

gold fields of the Transvaal. From that time the immigration of Europeans of other than Dutch extraction wen^ steadily on. The extension of railways, the influx of capital, the providing of markets for the produce of the country, were all due to the opening up of the gold and diamond mines. As the development of these industries proceeded, the line which divided the Boers from the colonists of British extraction became more clearly marked. It was soon evident that the Boer had little faith in and less capacity for mining, either as a digger on the diamond fields or as a prospector on the new gold-fields. He remained on his farm, content to reap such benefit as might be derived from the sale of farms at greatly en- hanced prices, and also with what he could obtain in the way of cash for the small products he was able to off'er in the various mining camps. On the other hand, a large mining population soon grew up, first of all at Kimberley, afterwards in and around Lydenburg and Barberton, and finally at Johannesburg ??? a population modern in its ideas, energetic, educated, cosmopolitan, appreciating all the resources that

modern civilization had to offer them, and with a strong partiality for the life of the town or the camp rather than that of the farm and the veldt. The Boers remained very much what they had been in the 17th century. Their life of continual strife with natives continual trekking to fresh pastures, had not been con- ducive to education or the acquirement of civilization. In religion they were puritanical, fanatic, and their old traditions of iDutch East India government, together with their relation to the natives, undoubtedly developed a spirit of caste and even tyranny.

In the competition which now set in for such wealth as is won in cities, the Boer found himself hopelessly handi- capped. From Cape Town to the north of the Transvaal a considerable difference has always existed amongst the inhabitants of Dutch origin. Beginning with the Dutch of Cape Town and the Western Province, many are en- lightened gentlemen, who are well educated themselves and have sent their sons to European universities. Farther out in the GraafF Reinet and other districts of Cape Colony a more primitive life obtains among the Dutch, and in the Free State existence was of even a simpler character. Nevertheless, the history of the Free State, under the masterly presidency of Brand, shows that the Boers of that country evinced a considerable know- ledge of the advantages of civilization, and in a measure endeavoured to increase them. Farther north, again, the Boer is a wilder and more turbulent spirit, as the history of the Transvaal down to 1877 testifies, until on the northern frontier of the Transvaal are to be found some of the wildest specimens of white men anywhere extant on the face of the globe. A race of hunters, and it is to be feared of slave-owners, they respected neither the laws of their own people nor sometimes those of humanity. The Boers were a prolific race, and in spite of all their losses from war, pestilence, famine, and other causes, they continually increased in numbers, if not in civilization. This increase did not, however, keep pace with the continual inflow of immigrants which began about 1870, and in 1872 we find the European inhabitants of the diamond fields returned at 35,000.

It "\'as at this stage of affairs that responsible govern- ment was granted to Cape Colony. From that time down to the annexation of the Transvaal in 1877, sirBartie to quote once more the homely phrase of Mr Prere and Botha, Great Britain " blew hot" in South Africa, contedera- Lord

Carnarvon was Secretary of State for the "□□"" Colonies, and in 1876 he appointed Sir Bartle Frere as High Commissioner of South Africa. Sir Bartle Frere's special mission '\as to further the confederation of the

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states of South Africa, and in making the appointment Lord Carnarvon went so far as to express to Frere the hope that he would be the first governor-general of the South African Dominion. Meanwhile things had reached a critical stage in the Transvaal : the treasury was empty ; the two factions were in open feud with one another ; President Burgers was unable to raise taxes ; the Boers were threatened with invasion from the Zulus, and were unable to suppress a native rising within their own territories. Under these circumstances, on 12th April 1877 Sir Theophilus Shepstone, who had been sent to Pretoria to investigate the state of affairs, annexed the Transvaal to Great Britain. Shepstone did not take

this step until he had convinced himself that it Annexe- -^^g^ ^he only step which could save the Transvaal Transvaal, ^o□□□ ruin. His motive and the evidence which

was before him are fully discussed under Teans- VAAL. In 1880 a change occurred in the Government of Great Britain, and with it there occurred another of those alterations of policy which have been so disastrous in South Africa. Great Britain once more "blew cold." Mr Glad- stone returned to power, and with his return the hopes of the dissatisfied Boers in the Transvaal, who were already agitating for retrocession of the country, were stiU further encouraged. In 1880 the fate of Sir Harry Smith and Sir George Grey overtook Sir Bartle Frere. Frere, whose coming had been heralded with such encouraging messages, was recalled. In October 1880 he received a cablegram from Lord Kimberley that "there has been so much divergence between your views and those of her ^Majesty's present Government on South African affairs, that . . □□□. they have with regret come to the conclusion that her Majesty should be

advised to replace you by another Governor." It was such vacillation as this on the part of Home Governments which won for South Africa the title of " the grave of reputations." An article in the Nineteenth Century in 1880 by Sir Bartle Frere exactly expresses the attitude of the Transvaal Boers, and shows a true insight on the part of the writer : ???

"What the Boers individually wished for [he wrote] was individual independence of law and government generally, not of this or that foreign Government, but to obey no one by force of law ; to be far from power of compulsion ; to see, as they put it, no other man's smoke ; to be free and unfettered in the wilds. This was the object of their asjiirations. For national life and national independence they had a sentiment ; but for national liberty they were not willing to make any sacrifice of individual licence or power to refuse obedience to lawr The limits within which such freedom was possible had been reached before Mr Burgers undertook to attempt the task of governing. "

The recall of Sir Bartle Frere was followed by a rebellion among the Boers in the Transvaal. In 1881, aal ^^^^^ ^ series of severe skirmishes terminating in rebeWoa the battle of Majuba, where the Boers were and retro- entirely victorious over the British forces, a cession, ^jg^ty was signed between Sir Evelyn Wood and the Boer generals, and once more the Transvaal was recognized as an independent state. The terms on which this independence was granted were clearly defined, first of all in the Pretoria Convention of 1881, and subsequently in the London Convention of 1884. The boundaries of the Transvaal were defined in both conventions, the right of control in all foreign relations was retained by her Jlajesty's Government, and the suzerainty of the Queen was reserved. On these condi- tions the independence of the Transvaal in the ???^ conduct of its own affairs was duly recognized.

oJd'''''^ 1882 the Afrikander Bond, which had its origin at Bloemfontein and the Paarl, came into existence, and was joined by members in the Free State, Transvaal, and Cape Colony. The Capo Colony branch

of the Bond dissociated itself later from those in the repubhcs. With regard to the formation of the Bond, it is only fair to say that although the

Bond partially originated in Bloemfontein, it was strongly denounced and openly discouraged by President Brand, then ruling the Free State. From this time forth the Dutch in Soath Africa on all political questions divided into two camps. These two camps were represented by President Kruger and his intriguing following in the Transvaal, and by President Brand, with an enlightened following of Free State Boers, in the Orange Free State. In Cape Colony, on the other hand, there was Mr Hofmeyer, at the head of the Bond, with a number of followers in intimate correspondence and relationship with Jfr Kruger, while a small number of enlightened Dutchmen held aloof (see Cape Colony).

From the signing of the Pretoria Convention the Transvaal Boers, who had never respected their own laws, showed that they had very little intention of respecting conventions. They raided over yf____t, _____l^ their borders to the west, north, and east. In the east they established the " New Republic " in Zidu- land, and on the west the republics of Stellaland and Goshen in the territories of Bechuanaland. Their aggres- sive action in Bechuanaland led, in 1884, to the Warren expedition, which expelled the Boers from Bechuanaland and compelled them to rehiain within their borders. It was about this time that Mr Hofmeyer thought it expedient to modify the extreme tone of his Bond policy, and that Mr Ehodes became a factor in Cape politics. The Warren expedition was clear evidence to the Bond and the rest of South Africa that whatever else Great Britain might contemplate, she did not propose either to withdraw or give up all claims to supremacy in South Africa.

The year 1883 saw the introduction of another European Power into South Africa. The German flag was hoisted over Germany's first colony on the shores of Angra Pequeiia Bay, in Damaraland. J^"____^"^ German missionaries had been settled on this AMca. coast for some time, and had previously on more than one occasion asked both the Imperial and Cape Colony Governments for protection. In 1878 Sir Bartle Frere had urged the British Government to respond to these appeals, sa)dng that if they were neglected Germany would certainly step in. The result was the annexation to Great Britaiii at that time of Walfisli Bay, with a small strip of territory adjoining. This port was handed over to Cape Colony in 1884. Tilean- while the colonial party in Germany had used

their influence to obtain further expansion, and in August of 1884 Germany finally annexed 322,450 square miles of country, with a coast-line of 930 miles, excluding the small strip of British territory in the vicinity of Walfish Bay. The greater portion of German South-West Africa is a desert and barren country, and at the time of annexa- tion was stated to contain between 2000 and 3000 white inhabitants and about 200,000 natives, chiefly Bantu. In September of the same year a German explorer, Herr Einwald, proposed to take possession on behalf of Germany of St Lucia Bay, on the coast of Zululand. After some correspondence between Great Britain and Germany, it was eventually arranged that Germany should make no annexation on the east coast of Africa south of Delagoa Bay. The whole of Zululand is now a portion of the colony of Natal.

After the retrocession of the Transvaal in 1881, and the re-establishment of the country under British suzerainty as an independent state, the attention both of the Boers and Europe was turned to Delagoa Bay. In order to

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understand the complications which now arose with regard to this port, it will be well to review briefly the history ???, of the territories in which Portugal had from

g^y time to time maintained settlements since

the end of the 15th century. Vasco de Gama discovered Delagoa Bay in 1498, and it became the site of a small settlement similar to those estab-lished at the same time on the west coast of South Africa by the Portuguese. The history of these settle- ments since their foundation has remained, at least to the world at large, almost unknown. In 1899 investigations among various Portuguese archives at Lisbon and the British Museum in London were undertaken, on behalf of the Cape Colony Government, by Dr Theal, the well- known Cape historian, with a

view to obtaining some details as to the records of colonization in these districts. Prom these researches, and also from the interesting record of events compiled by Mr Pratt in his Leading Points of South African History, the following facts have been gathered. The voyages of the early Portuguese naviga- tors were very minutely described by Portuguese historians. They were full of adventure by sea and land. Of those who succeeded Diaz and De Gama, the most distinguished navigator and administrator was D 'Albuquerque. He reduced Goa to submission and made it the capital of Portuguese India, of which the coast of Africa formed part. Forts were established at Sofala and Kilwa. Two armed fleets were maintained to keep the seas, the one from Cape Guardafui to the Gulf of Cambay, the other from the Gulf of Cambay to Cape Comorin. This state of things did not, however, last very far into the 16th century ; and as Holland, England, and France took up the Eastern trade, that of Portugal declined, and with it also declined the settlements on the African coast. For three hundred years these Portuguese settlements remained dep6ts of trade, chiefly in gold and ivory, at times being practically abandoned, and again being used in slave traffic. In 1868 Pretorius, then President of the Trans- vaal, attempted to annex Delagoa Bay, on the pretext that it formed the natural outlet of the Transvaal to the sea. Thereupon both Portugal and Great Britain advanced claims to the port, and the whole matter was eventually referred in 1872 to the President of the French Republic for arbitration. In 1875 an award was given by the French President, Marshal MacMahon, entirely in favour of the Portuguese. While the inquiry was proceeding, an agreement had been come to between Great Britain and Portugal that whichever of them should obtain possession of the Bay, should give the right of pre-emption to the other. Previously to the arbitration the Boers had withdrawn their claim in favour of that of Portugal, on an under- standing with the Portuguese that, should the award be given in their favour, they should allow the South African Republic special facilities for the importation of goods, and allow many of them to enter the state duty free. In fulfilment of this understanding a treaty was signed between Portugal and the South African Republic in 1875 granting these privileges, and also consenting to the con- struction of a railway from the port. President Burgers endeavoured to raise the capital necessary for the building of this railway, but only succeeded in obtaining a portion in Europe, and the scheme fell

through. In 1883 an American, Colonel MacMurdo, succeeded in obtaining from the Portuguese Government a concession for the building of a railway from Delagoa Bay to the Transvaal frontier. In 1889 the Portuguese Government arbitrarily seized the railway, which was then ojion to Komati, the point contracted for and shown in the Portuguese plans, on the alleged ground that the " frontier " was really at a point five miles nearer to Pretoria. This alteration of

the boundary and seizure of the railway, it was freely stated at the time, was done at the instigation of the Transvaal. As both American and British subjects were interested in this concession, a strong protest was made to Portugal at the time by the United States and Great Britain. Again the matter was referred to arbitration, on this occasion the tribunal being appointed by the Swiss Government. After a session of no less than ten years, Portugal was, on 29th March 1900, ordered by the court to pay compensation to the holders of the MacMurdo^ concession. The, total amount disbursed was over ►►900,000. The amount awarded was less than was anticipated, but it was the award of an independent court, and at least went to show that the action of the Portuguese had been unjustifiable (see also Aebiteation, Intbknational). In 1895 the Delagoa Bay railway was extended by the Netherlands Railway Company to Pretoria. In the drama of South African history the Portuguese states have not played an important part. Boundary disputes have occurred from time to time with both their Boer and their British neighbours, but with the exception of a few skirmishes in the early days of the British South Africa Company, these have been satisfactorily settled. What interest the Portuguese colonies have aroused in modern times has been centred round Delagoa Bay. While the Transvaal retained its independence, Delagoa Bay, as a port outside British control, was a source of strength to the Boers. Both President Kruger and his Hollander and German advisers interested in the railway concentrated their efi'orts on a close relationship with Portugal. In the war which began in 1899 munitions of war and recruits for the Boers were freely passed through Delagoa Bay.

In order to pursue the course of events in South Africa, it is now necessary to return to the British colonies and the Boer republics. If the year 1870 is memorable as marking the dawn of a great commercial era

*in South Africa, so must 1881 be taken to mark the beginning of a disastrous political period. It is well that the events from 1877 (the date p**f/^^ of the British annexation of the Transvaal) isai-ST.' onwards should be clearly remembered. In the first place, the Zulu power, which had so long menaced the Transvaal, was broken in 1878 by British forces, and by the expenditure of British money to the extent of ►►6,000,000, with practically no assistance from the Boers. Within the Transvaal the Bantu tribe, under Secocoeni, another native tribe in Boer territory, was defeated by a British force under Sir Garnet Wolseley. In 1881 the Transvaal was not only again independent, but the amount of its debt was funded and advanced by Great Britain. The Afrikander Bond was founded, with the deliberate intention on the part of its Boer promoters of forming a United States of South Africa under a Dutch flag. The raiding over both east and west boundaries which the Transvaal Boers continued to carry on in the face of conventions was a part of this policy.*

The Warren expedition, which cost over ►►1,000,000, had the eff'ect of checking for a time the extreme ambi- tion of the Dutch party throughout South Africa. !Mr Hofmeyr, the leader of the Bond in Cape Colony, con- siderably moderated his attitude, and in 1887 proposed a Zollverein scheme for the whole British Empire. In the Free State President Brand continued to make his influ- ence felt \it\ the Boers of both republics, insisting upon the importance of a peaceful development of the country and friendly co-operation with the British Government. i\[r Kruger remained implacable, bigoted, avaricious, determined on a policy of isolation and exclusion. The

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old Transvaal dream whicli Brand had denounced in the early days (see Transvaal) was now revived and adopted with redoubled fervour. President Kruger would have a seaport of his own, or, if not, Delagoa Bay should have a monoplyof the trade. The Transvaal would enter into an alliance with the Free State, and British trade was to be rigidly excluded.

In 1887 a conference was held at Pretoria with delegates from the Free State. The pro- ceedings reveal the gulf existing between the adherents of Kruger and the adherents of Brand (see Cape Colony, Transvaal, and Orange Kiver Colony). On the one hand was an undying hatred of Great Britain, combined with a deep scheme of ultimate attack upon British supremacy throughout South Africa ; and on the other was a desire to work amicably with all the white races of South Africa for their mutual benefit and the prosperity of the country.

The conference was followed by a personal Visit from President Kruger to President Brand at Bloemfontein. Free State '^^ result was a complete failure to arrive at and Trans- any treaty whatever. Brand refused to be vaalcon- ensnared in the wild intriguing policy of fetence. President Kruger, and while he lived the Free State held aloof. Meanwhile the great gold-fields of Johannesburg, which had been discovered in 1886, were developing by leaps and bounds, and by 1889 the popu- lation equalled that of Kimberley. Once more there occurred that rapid increase of the British and European (other than Dutch) population in South Africa, which from the beginning of the mineral discoveries has steadily gone on. From Cape Colony railways continued to be extended towards the new centres of wealth. In 1885 Kimberley was reached, and in 1890 this line was ex- tended to Vryburg in Bechuanaland. In 1889 the Cape railway was extended to Bloemfontein, and in 1892 it reached Johannesburg.

Under the influence of a rapidly increasing revenue from the gold-fields and that system of trade monopolies which Mr Kruger had introduced, the Government of the Transvaal gradually brought into existence a large privileged class of concessionaries and office-holders, until at the outbreak of the war in 1899 one burgher out of every five in the Transvaal held some office or another. The effect of this development was the production of a body of officials in the Transvaal, partly Hollander and German, partly Boer, the majority of whom were very poorly educated, and the whole of whom were pledged supporters of Mr Kruger's Government in any policy, however extravagant, which he might choose to adopt. The Government grew narrower, more exclusive, and more entirely monopolist with every year of its existence. It would almost

appear as if Mr Kruger had deliberately set himself to copy the model of the Dutch East India Company at the Cape, of which Watermeyer wrote in 1857 that it was "in all things political, purely despotic; in all things commercial, purely monopoKst." Meanwhile at the Cape there was growing up a party of AMkaader gg^tij African Imperialists, or, as they have Ists. ' been called, Afrikander Imperialists, who came to a large extent under the influence of Mr Rhodes. Among these were Mr W. P. Schreiner and Mr J. W. Leonard, and apparently even to some extent Mr Hofmeyr. From the time of his entrance into politics Mr Ehodes endeavoured to induce the leading politicians and colonists in Cape Colony to realize that a development of the whole country could and should be accomplished by South Africans for South Africans. He fully admitted that the cry which had become so popular since 1881 of "Africa for the Afrikanders" ex- pressed a reasonable aspiration, but he constantly pointed out that its fulfilment could best and most advantageously

be sought, not, as the Kruger party and extremists of the Bond persisted in saying, by working for an independent South Africa, but by working for the general development, progress, and prosperity of South Africa on democratic, self-reliant, self-governing lines, under the constitution and beneficent shelter of British colonial rule and the British flag. An independent South Africa such as the Kruger party desired might have resulted in a so-called republic. But such a republic would have been a stranger to all true liberty and equality of rights : it would rapidly have become a prey to the same sort of faction, strife, and anarchy as had obtained in the Trans- vaal. Mr Hofmeyr's attitude became considerably modi- fied after the Warren expedition. In that year (1884), having the power in his hands at the time of the fall of the Scanlen Ministry, he put Mr Upington into office, with Sir Gordon Sprigg as his colleague. In 1886 Sir Gordon Sprigg became Premier; and in 1890 he was suc- ceeded by Mr Ehodes, who took office with the approval and support of Mr Hofmeyr. Mr Rhodes remained in office as Prime Minister until 1896. During this period of Mr Rhodes's life the part he played in the development and public life of South Africa was greater than that of any other man.

In 1888 Mr Ehodes had succeeded in inducing Sir Hercules Eobinson to send Mr Moffat, the missionary, to enter into a treaty with Lobengula, the Mata- British bele chief. Under this treaty Lobengula bound Soutb himself not to make a treaty with any other AMca foreign Power, nor to sell or in any other way ^”‘“P”’}’- dispose of any portion of his country without the sanction of the High Commissioner. By this step the country was secured from both the Portuguese and the Dutch, both of whom, more especially the latter, were already making overtures with the object of obtaining the country for themselves. This treaty was followed by the formation of the British South Africa Company, under royal charter (see Ehodesia and Chartered Companies) in 1899, and the occupation of Mashonaland by the pioneer expedition in 1890. In 1891 a skirmish was fought with Portuguese forces. In 1893 a war was fought with the Matabele by Dr Jameson, then administrator of Mashonaland, and Bulawayo was occupied. The name Ehodesia was conferred upon the whole country by general consent in 1894. During the whole of these stirring events Mr Ehodes, in addition to being Premier of Cape Colony, was also managing director of the British South Africa Company, and respon- sible for the conduct of its affairs. He further occupied’ the position of chairman of the De Beers Consolidated Mines (the great diamond mining corporation in Kimberley), and was busily engaged in developing plans, in conjunction with jNlr Alfred Beit, for an extension of the telegraph from Cape Town to Cairo, and the pushing forward of rail- way communication into the heart of Africa. The political effect of this northern movement was definitely to limit the northern boundary of the Transvaal. Living in Cape Town and at the head of the Government, Mr Ehodes used every effort in his power to demonstrate to the Cape colonists that the work he was doing in the north must eventually be to the advantage of Cape Colonists and their descendants. By this means he checked opposition to the movement which sentimental sympathy with the Transvaal Boers tended to develop under the pretext that the Transvaal, by reason of its proximity, had some sort of reversionary right to the country lying to the north. On the whole, ;\Ir Hofmeyr and his friends were well pleased at having secured the co-operation of the ” big Englander ” Ehodes, or, as he was at one time called by Mr ^lerriman the “young burgher.”

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In 1891 the Bond Congress was held at Eamberley, and harmony apj^eared to reign supreme. During his term of office Mr Rhodes addressed himself to bringing the Bond, together all interests, as far as it was practic- able to do so. He showed that his views of the situation were broad and statesmanlike. The direc- tions in which practical progress was made were the steady development of inter-state and inter-colonial rail- way systems, and the establishment, as far as possible, of common customs, tariffs, and inter-colonial free trade under a customs union. The persistent opponent to both these measures was the Transvaal. In matters of colonial domestic legislation, referring to taxation, native questions, and excise, Mr Ehodes fell in to a considerable extent with Dutch prejudices. The leaders of the Cape Dutchmen apparently thought they might some day win Mr Ehodes to independent republicanism, while, on the other hand,]Mr Rhodes endeavoured to demonstrate to the colonists, Dutch and British alike, that those very privileges which theoretically are associated with republicanism were practi- cally more fully obtainable in an enlightened self-governing British colony. Afrikander Imperialism thus became a definite and living policy, and it was about this time that the term ” progressive ” came to be associated witTi the party which supported it.

Meanwhile the Kruger faction and retrogression were rampant in the Transvaal. In 1892 there began in that Pirst country what has since come to be known as

Transvaal the first reform movement. The National reform Union was founded at Johannesburg by ex-Cape movemea . QQigj^jg^^g gf_^}jg Imperial progressive party. The first chairman was Mr Tudhope, who had held office in the Cape ^Ministry, and he was ably supported by the Hon. J. W. Leonard, at one time Cape Attorney- General, and his brother Mr Charles Leonard. For three years petitions and deputations, public meetings and newspaper articles, the efforts of the enlightened South African party at Johannesbui-g and Pretoria, were all addressed to the endeavour to induce President Kruger and his Government to give some measure of recogni- tion to the steadily increasing Uitlander population. The President remained as impenetrable as adamant. Any measures he did take were retrogressive rather than progressive, intended still further to conserve the burgher privileges and exclude the Uitlander from any part or lot in the afiairs of the State. Nine-tenths of the state revenue was contributed by the Uitlanders, yet, practically speaking, neither for them nor for their children were political privileges to be accorded. The Uitlanders had not even any municipal power. At this juncture a conspiracy was entered into between i\Ir Puhodes, Dr Jameson, and certain of the Uitlander leaders which led to the Jameson Raid. In conjunction with this con- spiracy, and in order to lay before South Africa the true position of affairs in the Transvaal, as well as to give President Kruger a final chance to meet the Uitlanders, INfr Cliarles Leonard issued a manifesto as chairman of the National Union, the terms of which are memorable both for the completeness -with which the Uitlander case was stated and for the fact that the claims adA'anced therein were those which the High Commissioner and the British Government very largely supiiortiid in 1899. This manifesto, the full text of which may be found in the appendix to]Mr Fitzpatrick's The Traiisoaal from Within, concludes as follows : ???

" We have now only two questions to consider : [n) What do we ???want? (J) How shall wi; get it ? I have stated plainly wliat cm-

grievances are, and 1 shall answer with eqiial directness tlie ques- tion "What do we want?" We want (1) the establishment of this Republic as a true Eepublic ; (2) a Grondwet or Constitution,

which shall be framed by competent persons selected by representa- tives of the whole people, and framed on lines laid down by them ??? ??? a Constitution which shall be safeguarded against hasty alteration ; (3) an equitable franchise law, and fair representation ; (4) equality of the Dutch and English languages ; (6) responsibility of the Legisla- ture to the heads of the great departments ; (6) removal of religious disabilities; (7) independence of the courts of justice, with adequate and secured remuneration of the judges ; (8) liberal and compre- hensive education ; (9) efficient civil service, with adequate jno- vision for pay and pension ; (10) free trade in South African products. That is what we want. There now remains the question which is to be put before you at the meeting of 6th January, namely, How shall we get it ? To this question I shall expect from you an answer in plain terms according to your deliberate judgment."

The conspirators believed that President Kruger and the burghers would realize the peril of further withholding redress of grievances, and be induced to do by force what he had always refused to do in deference to mere reason. The conspiracy entirely failed, and the Uitlanders were left in a worse plight than ever, although whUe Johannes- burg was partially armed Mr Kruger had promised a consideration of grievances ??? a promise which was never fulfilled (see Teansvaal). The Reform leaders, sixty-four in number, were imprisoned at Pretoria, and the Uitlanders were now deprived of their services ; for although the long terms of imprisonment were not carried out, under the agreement on which the reform prisoners were liberated in May 1896, they were bound to take no part or in any way interfere in politics for three years. Mr Rhodes's complicity in the Jameson Raid compelled him to resign his position as Premier of Cape Colony; and in 1896 he went to Rhodesia in time to take an active part in the suppression of the jNIatabele rebellion, which had occurred shortly after the surrender of Dr Jameson's force .in the Transvaal.

Sir Gordon Sprigg took office for the third time as Premier of Cape Colony, in succession to ilr Rhodes, and in 1898 he was succeeded by a Bond ministry rmder !Mr W. P. Schreiner. In 1896 and 1897 feeling ran very high throughout South Africa over the Jameson Raid con- troversy. The grievances under which the Uitlanders suffered were lost sight of ; President Kruger proceeded on his retrogressive course unchecked in the Transvaal ; while in the Free State Mr Steyn used the Raid as an elec- tioneering cry during his contest for the Presidency, to work up the race feelings of the Free State burghers. j\Ir Fi-aser, who had been born and brought up in the Free State, and who was a supporter of the more enlightened piolicy followed, while living, by President Brand, was defeated by Steyn by a lai'ge majority. In Cape Colony the cleavage between the Progressives and the Bond party, although not more real, was more openly expressed than it had ever been before. The term "Progressive" was now formally adoi)ted by the British mercantile communities in the various large towns and among the sturdy farmers of British descent in the Eastern Province. On returning to South Africa after the Raid inquiry at Westminster in 1897, Jlr Rhodes had intended to withdraw from Cape politics and devote his energies entirely for a time to the development of Rhodesia, but the pressure put upon him by a section of the British colonists was so strong that he determined to throw in his lot with them and assist the Progressive party l)y every means in his power. In 1898 the Sprigg Ministry was defeated over a Eedistribution Bill by which they hoped to secure nnore adequate representation for the Pro- gressives, and]Mr W. P. Schreiner became Prime ^linister.

In 1897 Sir Alfred]\rilner had been appointed High Commissioner of South Africa and Governor of Cape Colony, in succession to Lord Rosmcad. He at once ad- dressed himself to a careful study of the situation, visiting

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every part of the colony and obtaining a considerable command of the Cape Dutch language. In March 1898 he felt that the time had come when he should Mllaer. enter a public remonstrance with those Dutch-men in Cape Colony who avowedly encouraged President Kruger and the Transvaal Government in in- justice to the Uitlanders and hostility to Great Britain. The remonstrance was moderately stated in a speech delivered at Graaff Reinet, and was of so important a character that it is advisable to reproduce a portion of it : ???

"For my own part, I believe the whole object of the people for espousing the cause of the Transvaal is to prevent an open rupture between that country and the British Government. . . . They think that if they can only impress upon the British Government that in case of war with the Transvaal it would have a great number of its own subjects at least in sympathy against it, that is a way to prevent such a calamity. But in this they are totally wrong, for this policy rests on the assumption that Great Britain has some occult designs on the independence of the Transvaal. . . . But that assumption is the exact opposite of the truth ... it is not any aggressiveness on the part of Her Majesty's Government which now keeps up the spirit of unrest in South Africa. It is that unprogressiveness ??? I will not say retrogressiveness ??? of the Government of the Transvaal, and its deep suspicion of the inten- tion of Great Britain, which makes it devote its attention to imaginary external dangers, when every impartial observer can see perfectly well that the real dangers which threaten it arc internal. Now, I wish to be perfectly fair. Therefore let me say that this suspicion, although absolutely groundless, is not, after all that has happened, altogether unnatural. I accept the situation that at the present moment any advice that I could tender, or that any of your British fellow-citizens could tender, in that qiiarter, though it was the best advice in the world, would be instantly rejected because it was British. But the same does not apply to the Dutch citizens of this colony, and especially to those who have gone so far in the expression of their sympathy for the Transvaal as to expose them- selves to these charges of disloyalty to their own flag. Their good- will, at least, cannot be suspected across the border ; and if all they desire ??? and I believe it is what they desire ??? is to preserve the South African Eepublic and to promote good relations between it and the British colonies and Government, then let them use all

their influence, not in confirming the Transvaal in unjustified suspicions, not in encouraging its Government in obstinate resistance to all reform, but in inducing it gradually to assimilate its institutions, and ??? what is even more important than institu- tions ??? the temper and spirit of its administration, to those of the free communities of South Africa, such as this colony or the Orange Free State. That is the direction in which a iieaceful way out of these inveterate troubles, which have now plagued this country for more than thirty years, is to be found."

After this the colonists realized that in the High Commissioner they had a man of resolution, ability, and straightforwardness to dpal with. The accession to power of a Bond ^Ministry at this juncture made the High Com- missioner's position one of considerable difficulty. Affairs in the Transvaal were steadily going from bad to worse. An Industrial Commission, appointed by President Kruger in 1897 to inquire into a number of grievances affecting the gold industry, had reported in favour of certain reforms. The recommendations of the Commission, if adopted, would have done something towards relieving the tension, but President Kruger and his executive Second refused to be giiided by them. Once more the Transvaal Uitlanders determined to make a further attempt reform to obtain some redress by constitutional means, movement. ^^^ ^j^g second organized movement for reform began by the formation in 1897 of a branch of the South African League. In 1898 Dr Leyds retired from the position of State Secretary in the Transvaal, and repaired to Europe as minister at large to the South African Republic. What the precise terms of that appointment may have been is unknown to history, but they apparently included the wearing of a picturesque uniform and the administration of secret service funds, which were chiefly expended on various organs of the Continental press. Dr Leyds was succeeded as State Secretary by Mr Reitz, ex-President of the Orange Free

State. The change was certainly not for the better. Mr Reitz had ever since 1881 been one of the most pronounced anti-British Dutchmen in South Africa. He had CO – operated with Borckenliagen in founding the Afrikander Bond. When elected President of the Free State in succession to President Brand, he utterly departed from the policy to which Brand had always adhered, and instead of continuing to hold aloof from the

Transvaal, he entered into an offensive and defensive alliance with it. In him Mr Kruger found as willing, if not as skilful, an instrument as in Dr Leyds. At the end of 1898 the feehngs of the Uitlanders were wrought up to fever j)itch. The police service, which was violent where it should have been reasonable, and blind where it should have been vigilant, had long been a source of great irritation. On 18th December a Boer policeman, in pursuit of an Englishman named Edgar, whom he wished to arrest for an alleged assault on another man, entered his house and shot him dead with a revolver. The deepest indignation was aroused by this incident, and was still further increased by the trivial way in which the case was dealt with by the court. In 1899 matters reached a climax. After an ineffectual attempt to get a petition forwarded in Decem- ber of 1898, the Uitlanders handed to the High Com- missioner in ilarch 1899 a petition to her Majesty with 21,684 signatures attached to it. The petition was accepted by Sir Alfred Milner and forwarded to London. This historic document will best serve to illustrate the course of events in the Transvaal after 1896, and also to show the status the Uitlander had arrived at in 1899. It is given in full in Tlie Tinies' History of the War. The f ollovsdng extracts convey its general tenor and purport : ???

"29. The condition of Your Majesty's subjects in this Sta,te has become well-nigh intolerable.

"30. The acknowledged and admitted grievances of which Your Majesty's subjects complained prior to 1895 not only are not re- dressed, but exist to-day in an aggravated form. They are still deprived of all political rights, they are denied any voice in the government of the country, they are taxed far above the require- ments of the country, the revenue of which is misapplied and devoted to objects which keep alive a continuous and well-founded feeling of irritation, without in any way advancing the general interest of the State. Maladministration and peculation of public moneys go hand in hand, without any vigorous measures being adopted to put a stop to the scandah The education of Uitlander children is made subject to impossible conditions. The police afibrd no adequate protection to the lives and propei^ty of the inhabitants of Johannesburg ; they are rather a source of danger to the peace and safety of the Uitlander population.

“32. Wherefore YourMajesty’s humble petitioners humbly beseech Your Most Gracious Majesty to extend Your Majesty’s protection ‘to Your Majesty’s loyal subjects resident in this State, and to cause an inquiry to be made into grievances and complaints enumerated and set forth in this humble petition, and to direct Your Majesty’s representative in South Africa to take measures which will secure the speedy reform of the abuses complained of, and substantial guarantees from the Government of this State for a recognition of their rights as British subjects.”

When this document was received at the Colonial Office in London, and its contents were made public, the British nation realized that !Mr Kruger and his Government must either be mended or ended. In February 1899 Mr Kruger received a despatch from the British Secretary of State for the Colonies, Mr Chamberlain, protesting against his proposal to extend the dynamite monopoly for a further period of fifteen years, and pointing out that the monopoly was a breach of the Convention. There then followed a long series of despatches and correspondence on the various points at issue. On the dynamite question proposals were made on behalf of the Transvaal Govern- ment, through Mr Lippert, to the heads of the large mining houses in Johannesburg ; but as President Kruger coupled them with impossible conditions, nothing came of them. On 4th May 1899 Sir Alfred]Milner felt it his

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duty to report at some length by cable to Mr Chamber- lain. The concluding passages of this message sum up the ^vhole South African situation in a masterly manner, The case ^^’^ show the effect that was being produced by tor British Jlr Kruger’s attitude not only in the Transvaal Inter- among the Uitlanders, but throughout South vention. ^{Yica,. The telegram undoubtedly carried great weight in helping Jfr Chamberlain to frame his policy. The concluding passages were as follows : ???

‘ ‘ The case for intervention is overwhelming. The only at- tempted answer is that things will right themselves if left alone. But, in fact, the policy of leaving things alone has been tried for years, and it has led to their going from bad to worse. It is not true that this is owing to the Raid. They were going from bad to worse before the Raid. We were on the verge of war before the Raid, and the Transvaal was on the verge of revolution. The effect of the Raid has been to give the policy of leaving things alone a new lease of life, and with the old consequences.

” The spectacle of thousands of British subjects kept permanently in the position of helots, constantly chafing under undoubted grievances, and calling vainly to Her Majesty’s Government for redress, does steadily undermine the influence and reputation of liieat Britain, and the respect for British government. within the Queen’s dominions. A certain section of the Press, not in the Transvaal only, preaches openly and constantly the doctrine of a Republic embracing all South Africa, and supports it by menacing references to the armaments of the Transvaal, its alliance with the Orange Free State, and the active sympathy which, in case of war, it would receive from a section of Her Majesty’s subjects. I regret to say that this doctrine, supported as it is by a ceaseless .stream of malignant lies about the intentions of the British Government, is producing a great effect upon a large number of our Dutch fellow- colonists. Language is frequently used which seems to imply that the Dutch have some superior right even in this colony to their fellow-citizens of British birth. Thousands of men peaceably dis- posed and, if left alone, perfectly satisfied with their position as British subjects, are being drawn into disaffection, and there is a corresponding exasperation on the side of the British.

“I can see nothing which will put a .stop to this mischievous propaganda but some striking proof of the intention of Her Majesty’s Government not to be ousted from its position in South Africa. And the best proof alike of its power and its justice would be to obtain for the Uitlanders in the Transvaal a fair share in the government of the country which owes everything to their exertions. It could be made perfectly clear that our action was not directed against the existence of the Republic. We should only be demanding the re-establishment of rights which now exist in the

Orange Free State, and which existed in the Transvaal itself at the time of, and long after, thewithdrawal of British sovereignty. It would be no selfish demand, as other Uitlanders besides those of British birth would benefit by it. It is asking for nothing from others which we do not give ourselves. And it would certainly go to the root of the political unrest in South Africa ; and though temporarily it might aggravate, it would ultimately extinguish the race feud, which is the greatibane of the country."

On receipt of Sir Alfred Milner's message !Mr Chamber-^ lain sent, on 10th May, a full and comprehensive despatch dealing both with the Uitlander petition and the message. He concluded by suggesting a conference at Pretoria between the President and the High Commissioner.]\Iean- Bl m- while a proposal had been made, at the instance foatein of some of the Schreiner ^tlinistry, in con- conter- junction with Pre.sident Steyn of the Free eace. State, for a conference at Bloemfontein. This

was accepted. On .31st]\Iay the conference began its sittings, and it was very soon evident that Mr Kruger's object was to obtain concessions, not to make them. Sir Alfred]\Iilner practirally confined his demands to a five years' franchise, which he hoped would eiuible the Uitlander to work out his own salvation. It is neces- sary to point out that even had Sir Alfred ^Milner's]iro- position been accepted, the Uitlanders would liavo been left with a very small representation in the A'olksraad. Nevertheless, it was much too advanced a proposal for President Kruger. He had quite other ^ ? ? ?iewa. His objects were to obtain Swaziland, Zambaansland, a seaport, and an arrangement whereby all future questions which might arise with Great Britain should be settled by arbitration.

The conference broke up without any result, and the gulf seemed wider than ever. The two great parties into which South Africa had gradually been divided now made themselves heard all over the larger towns. The Imperialists held enthusiastic meetings, at which con- fidence in the High Commissioner was expressed. Th& Bond and Afrikander party openly proclaimed that Kruger had offered considerable concessions, though privately they expostulated with him. Messrs Hofmeyr and Herholt, the

one the leader of the Bond and the other the Cape Minister of Agriculture, visited Pretoria to reason with]Mr Kruger. They found him deaf to all argument, while the Transvaal Volksraad apparently regarded the whole franchise question as one which they could not be expected seriously to entertain.

In the desjjatches which followed from Pretoria, con- siderable confusion was manifest. Whether the obscurity was intentional, or whether it was the outcome of mental confusion on the part of !Mr Eeitz, whose retirement from the Presidency of the Free State had been caused by mental breakdown, it is impossible to say. But it is at any rate certain that one of the state papers purporting to contain the draft of a new franchise law was so ambiguous that it was supplemented by an explanatory memorandum from the State Attorney, and called forth the severe censure of Sir Henry de ViUiers, the Dutch Chief Justice of Cape Colony, who in writing about it observed, " Surely a law should be clear enough to speak for itself, and no government or court of law wiU be bound by the State Attorney's explanations."

The fact is that all offers of amelioration on the part of the Transvaal, subsequent to the Bloemfontein conference, were as disingenuous as they had always been before. The end was bound to come. The Boers had long before made up their minds to a trial of strength with Great Britain for supremacy in South Africa. The warning of the wiser heads in the Afrikander party was useless. President Kruger, his executive, and Tl'^Boer a certain section of young Boers had persuaded matum. themselves they could win the day in battle. On 9th October 1899 the Transvaal ultimatum waa formally handed to the British Agent at Pretoria.

This historic ultimatum was in the form of a somewhat long letter, and concluded by requesting Her Jlajesty's Government to give it the assurance

' ' (a) That all points of mutual difference shall be regulated by the friendly course of arbitration, or by whatever amicable way may be agreed upon by this Government with Her Jlajesty's Government.

” (6) That the troops on the borders of this Republic shall be instantly withdrawn.

” (c) That all reinforcements of troops which have arrived in South Africa since the 1st June 1899 shall be removed from South Africa within a reasonable time, to be agreed upon with this Government, and with a mutual assurance and guarantee on the part of this Government that no attack upon, or hostilities against, any portion of the possessions of the British Government shall be made by the Republic during further negotiations within a period of time to be subsequently agrerd upon between the Governments, and this Government will, on compliance therewith, be prepared to with- draw the armed burghers of this Republic from the borders.

” (rf) That Her Majesty’s troops which are now on the high seas shall not be landed in any port of South Africa.

‘ ‘ This Government must press for an immediate and affirmative answer to these four questions, and earnestly requests Her Majesty’s Government to return such an answer before or upon Wednesday, the 11th October 1S99, not later than 5 o’clock p.m. ; and it desires, further, to add that in the event of unexpectedly no satis- factory answer being received by it within that interval, it will with great regret be compelled to regard the action of Her Majesty’s Government as a formal declaration of war, and will not hold itself ri’sponsible for the consequences thereof ; and that in the event of any further movements of troops taking place within the above-men- tioned time iu the nearer directions of our borders, this Government ^vill be compelled to regard that also as a formal declaration of war.”

This ultimatum was cabled to London, and on the

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following day, Mr Chamberlain telegraphed as follows to Sir Alfred Milner : ???

"Her Majesty's Government have received with regret tha peremptory demands of the Government of tlie South African Eepublic conveyed in your telegram of 9th October. You will inform the Government of the South African Republic, in reply, that the conditions demanded by the South African Republic are such as Her Majesty's Government deem it impossible to discuss."

On 11th October the Free State Boers seized a Natal railway train on their borders, and on 12th October, at Kraaipan, within Cape Colony, the first shot of the greatest war in which Great Britain had been engaged for nearly a hundred years was fired. For the course of the war, see under Transvaal.

The foregoing review of the history of South Africa from the earliest days of European colonization clearly brings out certain facts of the deepest interest. Coloniza- tion in the truest sense of the word, since the days of Greece and Rome, was not understood by European nations until the end of the 18th and first half of the 19th centuries. The Portuguese colonies are lat^n "' " instance of what results from merely estab- lishing an official caste to hold some sort of nominal rule over a settlement, without endeavouring to develop a country for the advantage of all its inhabitants. The Cape under the Dutch East India Company was no better. The company ruled as absolute tyrants for one hundred and forty-three years. The so-called "free burghers " had no rights or privileges of any kind. They were little better than slaves of the company, and it was under this system that there grew up the " Trek Boer " class, who wandered like Arabs from one pasture on the frontiers to another. The habit of fljdng from all government and endeavouring to set up their own laws was thus acquired, and was never abandoned by the Trek Boers and their descendants. These men founded the Free State and Transvaal. If the laudable desire to shape their own destinies had combined with it a due appreciation of the principles of civil liberty and simple justice between man and man,it is probable that a permanent and strong independent Boer state would have grown up in South Africa, which would have

become a formidable power. But the vices under which they had suffered when subject to the Dutch East India Company left their mark. Themselves at one time little better than slaves, they now meted out to the natives similar treatment. That they should have been slave-owners when all the rest of Europe was engaged in a similar traffic is no reproach to the Boers. But the humanitarian wave of sentiment which culminated in the abolition of 'slavery never reached the remote wilds of the colonial frontier. The name of Wilberforce, the cause he championed, the iniquity of traffic in human life ??? these were things unheard of on the Orange. The native was a hewer of wood and drawer of water provided by God for the service of white men. To the Boers the liberation of slaves in Cape Colony was only one more piece of European tyranny. Thus the Trek continued and the Boer republics were founded. The vacillation in British policy which followed has been referred to. It was deplorable. But whatever errors may have been committed by Colonial Secretaries, Governors, and High Commissioners, republicanism was established and recognized. Faction, strife, anarchy, and bankruptcy under a nominal republic brought about annexation of the Transvaal in 1877. Retrocession of the country by Great Britain in 1881 gave to republicanism another lease of life. Meanwhile mineral discoveries had brought wealth to the Free State, and they now brought it to the Transvaal. In both instances the work which brought about the industrial development of these resources was done by

men not of Boer race. With wealth came still higher ambitions. The Republican Boers became divided into two camps. President Brand represented the enlightened division. They recognized the desirability of cordial co- operation with the British, who at least held the ports, constructed railways, chiefly conducted the commerce of the country, and protected the coasts. President Kruger, still cherishing the old ideals of monopoly in all things handed down through generations of trekkers from the Dutch East India Company, led the other division, an exclusive and even retrogressive party. The one hope, the one chance, for Boer republicanism was a reconciliation of these two divisions of Boerdom. The opportunities for such reconciliation were abundant. On at least three occasions after 1881 President Kruger deliberately spurned overtures which would have accomplished this object and have

established Boer independence on a constitutional and permanent basis. He rejected President Brand's scheme for federating the two republics in 1887, because the constitution suggested was a liberal and civilized one, much on the lines of the United States. He refused the overtures of the large progressive and enlightened Uit- lander section of the Transvaal inhabitants, a numerical majority, which might have been accepted at any time between 1892 and 1895, and which, while securing equal privileges to all white men, would have incorporated a progressive and wealthy element in the state. Such a combination, accepted in a liberal spirit, would have made a powerful republican state. Lastly, with the alternative of a suicidal war clearly before him, he rejected the Milner proposals at the Bloemfontein conference. If, then, republicanism failed in South Africa, the cause of its destruction cannot fairly be said to be the policy of Great Britain. The cause was the endeavour to perpetuate a system of monopoly in politics and commerce as the privilege of a class, a system which covered the Dutch East India Company with reproach and led to its dis- solution, which drove the Trek Boers into the wilderness, the Uitlanders into rebellion, and finally drove Great Britain to fight for the establishment of that civil equality, impartial justice, and commercial freedom under British supremacy which Dutch so-called republicanism had refused to grant. The Dutchmen of South Africa adopted as their cry " Africa for the Afrikanders ! " This is a cry which no Englishman need resent. But among Afrikanders should obviously, in justice, be included all British and other Europeans who have domiciled themselves in the country.

Law. ??? The basis of the common law of British South Africa is the Roman-Dutch law as it existed in Holland at the end of the 18th century. This was simply the old Roman jurisprudence embodied in the legislation of Justinian, modified by custom and legislative decrees during the course of the centuries which witnessed the growth of civilization in Europe ; and it is to all intents and purposes the jurisprudence which was the foundation of the Code Napoleon. It was in part closely akin to the "modern Roman law" which is practised widely over the continent of Europe, and even in Scotland, at the present day. The authorities upon the common law in South Africa are : the Dutch commentators upon the

civil law, the statute law of Holland, the decisions of the Dutch courts, and, failing these, the corpus juris civilis itself.

In the century which has elapsed since the establish- ment of British rule at the Cape the law has been considerably modified and altered, both by legislation and by judicial decisions, and it is not too much to say that at the present time there exists hardly any material difference in principle over the greater part of the field of juris- prudence between the law of England and the law of South Africa. The law of contracts, the law of torts, the

mercantile law, the law relating to shipping and insurance, not to mention other subjects, are practically identical ~~with those of England; and even the criminal law is virtually the same, though the greater elasticity of the civil jurisprudence allows fewer opportunities for the escape of malefactors, notably in cases of fraud or falsity in any form, than exist under the law of England. The constitution of the courts is based on the example of the English judiciary, and the rules of evidence and procedure are practically the same in both criminal and civil cases as in England. All serious cases of crime are tried before a judge and jury, with the same formali~~ ties and safeguards as in England, while minor oifences are dealt with by stipendiary magistrates possessing a limited statutory jurisdiction. In criminal cases it is necessary for the jury to find a unanimous verdict. In civil cases either party may demand a jury, a privilege which is seldom exercised ; but in a civil case the verdict of the majority of jurors prevails.

The most marked difference between the English and South African systems of law is, as might be expected, to be found in the law relating to real property. In South Africa there is a rigid and universal application of the principle of registration. The title to land is regis- tered, in all cases ; and so, with a few exceptions, is every servitude or easement, mortgage or charge, upon land. With regard to the devolution of projaerty upon death, it may be remarked that the law of intestate succession applies equally to real and personal estate, there being no law of primogeniture. The rules

of distribation in intestacy differ, however, very considerably from those established in England. There is absolute freedom of testamentary disposition in Cape Colony and in some other parts of South Africa. In some of the colonies, however, the old restrictions of the civil law as to the legitimate portion ilegitini) and kindred matters still obtain, but there is little doubt that these will soon be abolished. The eflfect of marriage upon the property of the spouses is, by the Roman-Dutch law and in the absence of any ante-nuptial contract to the contrary, to bring about a complete community of property, virtually a universal partnership between husband and wife, subject to the sole and absolute control of the husband while the marriage lasts. The courts have, however, the right to interfere for the protection of the wife in case of any flagrant abuse of the power thus vested in the husband. Ante-nuptial agreements may be of any nature the parties may choose. Such agreements must in aU cases be publicly registered. Upon the dissolution of a marriage in com- munity of property, or in the event of a judicial separa- tion a comniunione honarum, the property of the spouses is divided as upon the liquidation of a partnership. It is not necessary here to refer particularly to certain exceptions to this general rule in cases of divorce.

By the common law gifts between husband and wife daring marriage are void as against creditors. This rule cannot be evaded even by ante-nuptial agreement. By the statute law of Natal jjost-nuptial agreements between spouses are permitted under certain conditions, to which it is not jiossible now to refer at length. Divorce is granted to either spouse for either adultery or malicious desertion, the distinctions established by the English law between husband and wife in respect of divorce being disregarded.

Languaf/e. ??? The languages spoken in South Africa by the inhabitants of European descent are English and Dutch, the latter chiefly in the form of a patois collo- qijially known as the Taal. The history of the Dutch language in South Africa is intimately bound up ynth. the history of the South Afrifan Dutch people. The

basis of the language as spoken to-day is that 17th- century Dutch of Holland which the first settlers brought to the country ; and as a matter of

fact, although the Dutch of Holland and the Dutch of South Africa differ very widely to-day. Cape Dutch differs less widely from the Dutch language of the 17th century than from the modern Dutch of Holland. The tongue of the vast majority of the Dutch-speaking inhabitants may thus be said to be a degenerate dialect of the 17th-century Dutch of Holland, with a very Umited vocabulary. The limiting of the vocabulary is due to two reasons. In the first place, the early settlers were drawn principally from the peasant class, being chiefly discharged soldiers and sailors ; and, further, when once settled, the necessity for making the language intelligible to the natives, by whom the settlers were surrounded, led to a stiU further simpli- fication of speech structure and curtailment of the vocabu- lary. There thus grew up an ungrammatical dialect of Dutch, suited only to the most ordinary requirements of the everyday hfe of a rural population. It became a language with neither a syntax nor a literature. At the same time it remained in character almost entirely Dutch, no French ??? in spite of the incorporation into the population of the Huguenot emigrants ??? and only a few Malay words, finding a place in the Taal. But side by side with this language of everyday life a purer form of Dutch has continued to exist and find its uses under certain con- ditions. It must be borne in mind that the Boers of every grade have always been more or less sedulously instructed in religious subjects, at all events to the extent required to fit them for formal membership of their Church, and in all their wanderings they have usually been attended by their pastors. The Dutch Bible and Catechism are written in pure Dutch. The language of the Dutch Bible is as majestic as that of our English version. Moreover, the services of the Church have always been conducted in grammatical though simple Dutch ; and the clergy, in their intercourse with the people, have as a general rule abstained from conversing in the ordinary dialect. The Boer thus has but slight difficulty in reading and under- standing pure Dutch. Of late years strenuous efforts have been made to teach the language in the schools throughout the greater part of South Africa. In the Transvaal and Orange river repubhcs education was imparted almost exclusively in Dutch. All public business in the Govern- ment offices and law courts was conducted in the language, and the Transvaal was being gradually inundated by officials, railway servants, and others introduced from Holland, who spoke modern Dutch.

Authorities ◆◆◆ The reader is referred to the following works which have been consulted, among others, in compiling this article. With reference to the notes on law and language, the writer is much indebted to the Hon. J. "W. Leonard, K.C., late Attorney- General of Cape Colony, who has placed his unique knowledge of these subjects at the writer's disposal. E. 'Watebmeyer. The Cape of Good Hope under the Gorernmgnt of the Dutch ◆◆!ast India Companij, 1857. ◆◆◆ G. M'Call Theal. History of South Africa. ◆◆◆ Rees. Life and Times of Sir George Orey. ◆◆◆ Bilke. Problcvis of Greater Britain. ◆◆◆ Livingstone. South Africa. ◆◆◆ John Mac- kenzie. Avs/ral Africa: Losing It or Muling If. ◆◆◆ Pratt. Leading Pidnts in South African History. ◆◆◆ 'Ixm:^ Cecil Jthodes: Hix Political Life and Speeches. ◆◆◆ Van Oorht. Paul fi'ruger. ◆◆◆ Statiiam. Paul Kruger. ◆◆◆ TJie Times History of the War. ◆◆◆ Fitzpatkick. The Transvaal from Jl^ithin. ◆◆◆ HiLLlEK. South African, Studies. ◆◆◆ Van Zyl. Judicial Practice in South Africa. ◆◆◆ Cliihte. History of the Great Boer Trek. ◆◆◆ Paul Botha. From Boer to Boer and Encjlishman. ◆◆◆ Worsfold. The Story of South Africa. ◆◆◆ For Parliamentary Papers see Colonial OfBce List. The best library for reference on South African literature is that of the Royal Colonial Institute. (a. P. II.)

South Am boy, a borough and seaport of Middle- sex county. New Jersey, U.S.A. It is situated in 40◆◆ 29' N., 7-1◆◆ 17' W., at the head of Raritan Bay, in

the eastern part of the state. Its site is hilly and its plan regular. It is on the Central of New Jersey, the Penn- sylvania, and the Piaritan Kiver railways. It is an im- portant point for coal shipments, and contains asphalt works, potteries, and other manufactures. Population (1880), 3648; (1900), 6349, of whom 1700 were foreign- born.

Southampton, a seaport and municipal county, (1888), and parliamentary borough of Hampshire, England, a county in itself, at the head of

Southampton Water, 79 miles by rail south – west by west of London, on the main line of the London and South -Western Bail way. The Itchen, bounding the town on the east, is crossed by the Northam (1889), a free, and a steam floating bridge. The town now consists of 1 3 wards under a mayor, sheriff, senior and junior bailiffs, 13 aldermen, and 39 councillors. There are 19 churches and many chapels of various denominations; 19 board and 14 National schools. Modern erections include the public library, baths, and the royal pier, reconstructed in 1892. In 1891, 539 persons were engaged in the making of machinery, and 381 in iron and steel manufactures. There are 1 daily, 1 bi-weekly, and 4 weekly newspapers. Since 1892 the docks have been the property of the London and South – Western Railway Company. They accommodate vessels of over 13,000 tons burden, and measure about 250 acres, comprising extensive quays both in the Test and Itchen rivers with 28 feet of water at low water of ordinary spring tides, and 15,000 lineal feet of accommodation; the Empress dock, 18-^ acres, with a depth of 26 feet at low water spring tide; the outer dock, 16 acres, with 18 feet at low water spring tide ; and the inner dock, 10 acres. There are also two coal barge docks capable of floating 10,000 tons of coal at one time. In aU the docks con- tain about 3 miles of railway line. The five dry docks have from 29 feet to 12 feet depth of water over blocks at neaps. The Prince of Wales, or No. 5 dry dock, opened in 1895, is the largest single dock in the world; it is 750 feet long by 87|- feet wide at sill, and 112 feet at cope level. In 1888 the registered shipping was 322 vessels of 69,431 tons; in 1898, 337 of 123,406 tons. In 1888, 9690 vessels of 1,651,472 tons entered; 9478 of 1,593,780 tons cleared. In 1898, 12,347 vessels of 2,704,390 tons entered; 11,994 of 2,591,441 tons cleared. The value of the imports in 1898 amounted to , ►►12,303,103, against ►►7,182,734 in 1888. The exports in 1898 were valued at ►►8,610,265, against ►►7,407,063 in 1888. The total tonnage of the entrances in 1899 was 4,257,085, of the clearances, 4,220,847. Including coin and bullion, imports were valued at ►►34,105,645, exports at ►►19,027,624. Population of municipal and county borough (1881), 60,051 ; (1891), 65,325. In 1895 it was extended to include, among other districts, Shirley and Freemantle, an urban district with a population in 1891 of 15,898. Extended area, 5295 acres. Population (1891), 82,126; (1901), 104,911. Area of parliamentary borough, 7774 acres. Population (1891), 93,589; (1901), 120,302.

South Australia. ***(For geographical and geo- logical features, see Attsteaiia.) Each state of Australasia has depended very largely for its prosperity upon the production and export of one or two staple products. What wool has been to New South Wales and gold is to West Australia, wheat has been to South Australia. In 1885 the colony saw the end of a series of seasons eminently favourable to the growth of grain and the pro- duction of wool, and to the pastoral industry generally. In the decade 1886 to 1895 there were only two good seasons, and the condition of the state would have been seriously afi'ected were it not for the fortunate mineral***

discoveries made in Barrier District of New South Wales, the trade of which is commanded by Adelaide. The popu- lation in 1860 was 124,112, and the province was third in importance amongst the states forming the Australasian group. In 1870 the population stood at 183,797, and in 1880 at 267,573; in 1890 it was 319,414, and at the census of 1901, 362,604. These figures are inclusive of the population of the Northern Territory, the province of South Australia properly so-called containing 358,508 people and the Northern Territory 4096, the respective density of the two divisions being one person per square mile and one per 128 square miles. The number of males in 1901 was 184,422 and the females 178,182. The births during 1900 numbered 9177 and the deaths 3837, representing 25- 59 and 10'70 per thousand of population respectively. The birth-rate has declined very greatly, and births were less numerous in 1900 than in 1880, notwithstanding an increase of about 30 per cent, in the population.

Dividing the years from 1861 to 1900 into five-yearly groups, the following were the average birth-rates :

Period.

Births per

1000 of Population.

Period.

BirthB per

1000 of Population.

1861-65. 1866-70. 1871-75. 1876-80.

44-14 40-60 37-24 38-28

1881-85 . 1886-90 . 1891-95 . 1896-1900 .

38-52 34-48 31-24 26-59

Illegitimate births are less frequent in South Australia than else- where in Australia ; in the five years 1896-1900 the proportion of illegitimate to total births was 3-76 per cent.

The death-rate has always been remarkably light, not having exceeded 13 per 1000 in any year since 1886. The averages for each quinquennial period from 1861 were as follows -. ???

Period.

Deaths per

1000 of Population.

Period.

Deaths per

1000 of Population.

1861-65. 1866-70. 1871-75. 1876-80.

15-70 15-01 15-83 14-90

1881-85 . 1886-90 . 1891-95 . 1896-1900

14-71 12-55 12-08 11-93

The excess of births over deaths in 1900 was 14-89 per 1000, which is in excess of the English experience. In the following quin- quennial periods the excess was, 1881-85, 23-81 ; 1886-90, 21-93 ; 1891-95, 19-16 ; and 1896-1900, 14-66 per 1000 inhabitants. This remarkable reduction means a very serious check to the progress of the country, especially as there is very little immigration. The number of marriages celebrated during 1900 was 2313; this represents a marriage-rate of 6-45 and the number of persons married 12-9 per 1000. The number of divorces and judicial separations does not exceed seven a year, and since 1891 their number compared with the marriages in the same period has been as 1 to 300.

The people are mainly of British race ; out of 320,000 persons whose birthplace was ascertained at the census of 1891, just over 300,000 were of British or Australian parentage, 11,653 were boi-n on the continent of Europe ??? of whom 8553 were Germans and 1157 Scandinavians ??? and 4000 were Chinese. The total foreign- born element of the population numbered only 4-9 per cent. The population increased 16 per cent, between the census of 1891 and the close of 1899 ; allowing for this increase and adopting the pro- portion ascertained in 1891, there would be in 1899, 147,400 per- sons in the province following gainful pursuits, namely, 119,300 males and 28,100 females ; the same numbers are got by inde- pendent estimates. Agriculture, the main industry, provided employment for 33,430 persons, of whom 32,480 were males and 1030 females. Pastoral pursuits and dairying employed 4640 males and 1540 females, total 6180 ; and mining employed 5800. The industrial class may be divided into {a) persons engaged in manufacturing industries, 16,200 males and 6400 females; (6) persons engaged in the construction of buildings, railways, roads, &c., numbering 7900 ; and (c) persons engaged in other industrial pursuits, 12,900 ; these are chieily persons whose census descrip- tion is merely "labourer." The commercial class, including

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traders of all kinds as well as persons engaged in finance, numbered 18,900, namely, 16,700 males and 2200 females ; while the num- hers of persons engaged in transport by sea and land and in effect- ing commnnications was 11, SCO. The professional class comprised 5200 males and 3000 females, or a total of 8200; while the domestic class ___ comprising persons engaged in providing board and lodging, hotel and restaurant keepers, as well as servants ___ numbered 16,520, namely, 3550 males and 12,970 females. The foregoing classes show the distribution of employment amongst the 147,400 bread- winners ; the remainder of the population, comprising, in 1899, 223,300 persons (75,260 males and 148,040 females), were de- pendent on the breadwinners, except a small number (1700) who are what is usually termed of independent means. South Australia does not possess any towns of importance besides the metro- polis.

Adelaide was the first Australian city to acquire the right of self-government, and on the 31st October 1840 the first municipal elections in Australia were held in that city. The area uocal gov- ^j. gmj^jj Australia now under local government em- eramen . ^^.^(,^3 42,493 square miles, the local authorities being called corporations and district councils, according as they control urban or rural areas. Although a large part of the state, properly so-called (337,577 square miles), as well as the whole of the Northern Territory, are without local government, the incorporated area includes all those parts of which the development warrants the right of local government being conferred upon them. Local rates are assessed upon the assumed annual value of the properties liable to be rated, and the amount of such assessed annual value was, in 1900, ___2,576,729, and the capital value about 40 millions. The expenditure was ___346,081, of which ___190,124 was spent on works. The revenue of the various local bodies was ___348,768, of which ___233, 695 was obtained from rates and ___115,073 from Govern- ment endowment. The total debt of the local bodies at that date was ___78,400.

The South Australian system of popular education in its present form dates from 1878. It is compulsory, secular, and free. The compulsory ages are over seven and under thirteen

las rue oOygafg jjuj children who have attained a certain stand and re-’’-. –

llglon.

ard of education are exempt from compulsory attend- ance. Eeligious instruction is not allowed to be given in state schools except out of ordinary school hours. Secondary instruction is in the hands of private and denominational establish- ments, and the University of Adelaide is well endowed’and efficient. The state maintained, in 1900, 690 schools, with a gross enrolment of 62,439 pupils, and the average attendance was about 43,100. The sum expended in 1900 on public instruction was ––165,706, and of this amount ––152,239 was on account of primary instruc- tion. Although education is free, the instruction department has a small revenue; this in 1900 amounted to ––11,512, of which ––6113 was derived from rents, ––3834 from sale of books and school material, and ––1565 from fees ; the greater portion of the fees comes from the advanced school for girls, which accounted for ––1299, the remainder being paid by pupils attending classes in agriculture held in the public schools. The average cost of primary instruction to the state, including cost of school premises and maintenance, is about ––3 7s. 4d. per scholar in average attendance. The revenue of the Adelaide University in 1900 was ––19,023, of which ––6556 was obtained from the Government, ––7237 from fees, and ––5230 from other sources. The number of students attending lectures during the same year was 465, of whom 238 had matri- culated. Technical education is well advanced ; the School of Design in Adelaide had 504 students on the roll, and there were branch schools at Port Adelaide and Gawler. The School of Mines and Industries, founded in 1899, had in 1900 an enrolment of 1603 students. Private schools numbered 290, with 860 teachers and 12,322 scholars; the average attendance was about 11,300. Of the teachers, 669 were engaged in general instruction, while 191 were specially engaged in particular subjects. In state and private schools there were 74,761 scholars at all schools and about 54,400 in daily attendance. There were in 1900, 169 public libraries, with 333,000 volumes.

The peculiarity of religion is the strength of the non-Episcopal Churches. The Church of England, which includes over 40 per cent, of the population of the other Australian states, chiims only 27 per cent, in South Australia ; and the Roman Catholic Churcli, whose adherents number 22 per cent, in the other colonies, numbers about 14 per cent, in Soutli Australia. The Presbyterian Churches have also less supporters, for only 5 ‘5 per cent, of the popnlntion belong to such Churches, compared with 13 per cent, in the other colonies. To the Wcoleyan Churches 19 per cent, of the popula- tion belong, to the Congregational Clmrches 3‘7 per cent.. Bap- tists 5 ‘5 per cent., Lutherans 7 ‘5 per cent, and other Protest- ants about 8 per cent.

For the year ending June 1901 the state had a public revenue of ––2,998,231, which is equal to ––8 5s. lid. per inhabitant. This amount includes revenue received by the Commonwealth Government on behalf of the State. The principal sources of public

revenue were: import and excise duties, ––687,146; land, income, and other taxes, ––283,321 ; railways, ––1,254,598 ; posts and telegraphs, ––274,716 ; public lands, ––162,346 ; and other revenue, ––336,104. In 1871 the revenue of ^”’ ––” ––’ the province was ––778,000, or ––4 4s. 3d. per inhabitant; from that year it rose rapidly until in 1881 it stood at ––2,172,000, or ––7 16s. lOd. per head ; in 1891 it was ––2,732,000, or ––8 lis. Id. per head. The expenditure for the year ended 30th June 1901 was as follows : railway working expenses, ––747,557 ; posts and tele- graphs, ––222,995 ; public instruction, ––156,387 ; interest and charges of public debt, ––1,039,106 ; and other services, ––952,366. The debt charges amount to ––2 17s. lid. per head and absorb 34‘5 per cent, of the total revenue of the state. Against this must be placed the net return from services upon which the loan moneys were expended ; this amounts to about ––634,327, so that the real burden of the province’s debt is reduced to ––404,779 per annum. On 30th June 1901 the public debt of the state stood at ––26,423,805, which is equal to ––73 2s. 6d. per head, and the purposes for which the debt was incurred were : railway construc- tion and equipment, ––13,332,206 ; water supply and sewerage, ––4,839,140; telegraphs and telephones, ––979,758; and

other works and services not producing direct revenue, ??6,077,613. The debt has tended upwards from the time the state first commenced borrowing, but the largest commitments were between 1878 and 1889, during which period the debt was increased by ??15,000,000, and rose from ??21 to ??66 per head. The amount of the debt in ten-yearly periods commencing with 1861 vas : ???

Year.

Total Debt.

Debt per Head.

1861 .... 1871 .... 1881 .... 1891 .... 1901 ....

??

866,500

2,167,700

11,196,800

20,347,125

26,423,805

?? 8. d.

6 16 8 11 13 7 39 2 1 62 9 2 73 2 6

South Australia has a large public estate : the area alienated or in process of alienation was 14j^ million acres out of a total of 578 million acres, and under lease 265 million acres.

South Australia, on 31st December 1900, had a small defence force of 3021 men, comprising 2977 partially-paid troops and a paid staff of 44 ; but in addition to the land force there is a corps of 207 men capable of being employed on local Oetence. war vessels or as a light artillery land

force. The province main- tains a twin-screw cruiser of 920 tons, whose armament comprises one 8-inch 12-ton B.L., five 6-inch 4-ton B.L., four 3-pr. Q.F., and five Gatling machine guns, and an auxiliary gun vessel carrying two 6-inch 5-ton B.L. guns. The expenditure of the province on defence in 1900 was ––43,649; but this sum includes ––10,355 contributed towards the cost of maintaining the auxiliary squadron attached to the Imperial fleet in Australian waters. About a quarter of a million has been expended upon permanent fortifica- tions and charged to the general loans account.

*The minerals mined are copper, silver, and gold ; and of these, only copper is found in large quantities in the province proper, the bulk of the gold being won in the Northern Territory. The great copper mines at Moonta and WaUaroo are P”)””^’ still worked, but the production has greatly fallen off. **”–––*

In 1900 the value of copper raised in the province was ––386,015, and the gross production to the end of that year amounted to ––22,321,969. Gold to the value of ––82,188 was won in 1900, chiefly obtained from the Northern Territorj’. The value of minerals other than gold and copper won during 1900 was ––46,925. In 1871 the mineral production of the colony was valued at ––725,000, in 1881 at ––421,000, and in 1891 at ––365,000, and in 1900 the value was ––515,128.

The chief industry is distinctly wheat-growing, and out of 2,369,680 acres under crop in 1901, 1,913,247 acres were under wheat for grain and 341,330 wheat for hay. In some parts of South Australia very fine yields are obtained ; but taking it as a whole, the yield of the province is very light. During the ten years 1891-1900 the return per acre varied from a minimum of 17 bushels in 1897 to a maximum of 6‘1 bushels in 1893. South Australian wheat is of excellent quality and strength, and well known in European markets, to which the province has sent wheat since 1850. There has been little expansion of wheat cultivation since 1880 ; nor, indeed, has there been any material expansion in the total area under crop. Up to the year mentioned, every season showed an additional area devoted to cultivation ; but repeated failure of crops, due to want of seasonable rain, have disheartened farmers, and mutli land that was

formerly cult' fated now lies fallow. The following is a statement of the area of Ivheat harvested for grain at specified intervals from 1861:
_?_?_?_,

statistics]

SOUTH AUSTRALIA

729

Year.

Acreage under Wheat.

Production.

Averajje Yield per Acre.

Acres.

Bushels.

Bushels.

1861 .

310,636

63,410,756

11-0

1871

692,508

3,967,079

6-7

1881

1,768,781

8,087,032

4-6

1891

1,552,423

6,436,488

5-6

1899

1,778,770

8,778,900

4-9

1900

1,821,137

8,453,135

4-6

1901 . . . i 1,913,247

11,253,148

5-9

The total area under crop during the same period was : 1861, 400,717 acres; 1871, 837,730 acres; 1881, 2,156,407 acres ; 1891, 1,927,689 acres

; and 1901, 2,369,680 acres. In 1901 the principal crops grown, with their acreage, were ; wheat 1,913,247 acres, oats 27,988 acres, other grain crops 15,352 acres, hay 341,330 acres, potatoes 6628 acres, vines 20,158 acres, other crops 44,977 acres. In viticulture the province has made considerable progress, and many Germans are employed in the industry. The pro- duction of wine for the year 1900 amounted to 1,388,847 gallons, while 2607 cwt. of currants and 8151 owt. of raisins were also made. The wine made is of excellent quality, and about 400,000 gallons are exported annually to London.

The production of wool has been one of the chief industries since the foundation of the state, but of late years it has been much affected by droughts and low prices, so that the export of locally grown wool in 1901 was considerably less in quantity than in 1880, and little more than half as valuable. In 1861 the colony carried 3,038,000 sheep ; in 1871, 4,412,000 ; in 1881, 6,811,000 ; in 1891, 7,745,000 ; and in 1900, 5,283,247. The quantity of wool exported in the year last named was equal to 33,277,660 lb weighed in the grease. There was also exported about 9,592,000 lb of wool gi'own in New South "Wales. As a cattle-breeding country South Australia does not take a prominent place beside the three eastern states of Australia. The province proper depastured in 1900 only 214,761 cattle, and the Northern Territory about 257,667 ??? in all, 472,428 ; in 1891 the number was 677,000, and in 1881, 315,000. It was between 1881 and 1891 that the Northern Territory was stocked. The horses in South Australia number about 179,400, and there has been no great increase, for the number in 1881 was 159,678.

Although there are some 30,000 persons engaged in one form or other of manufacturing, only 17,659 are accounted for in the annual statistics of the state ; these hands are employed in 1036 establishments. The horse-power employed in the manufactories of the province was 10,794, and in 1900 the value of the plant was estimated at ??1,810,000.

The tonnage of shipping entering the ports in 1900 was 1,851,803, which is equal to five tons per inhabitant, a very ^ considerable ratio compared with most countries ; but

ommerce. ^^^^ tonnage is quite beyond the requirements of the province, whose trade represents only about 750,000 tons per annum, and is due to the fact that Adelaide is a place of call for all the great lines of steamships trading between Europe and Australia ; but when every allowance is made, it will be found that Adelaide is a great shipping centre and the third port of Aus- tralasia. The tonnage entering at Adelaide during 1900 was 1,335,442, and the value of imports, ––4,739,483, and of exports, ––4,363,971. At Port Pirie the value of imports was ––405,473, and of exports, ––1,666,357 ; at Wallaroo the imports were ––65,052 and the exports ––385,881 ; and at Port Augusta, ––5661 and ––146, 490 respectively. The ports command the greater part of the trade of the Broken Hill and trans-Darling districts of New South Wales, and this trade is very valuable both to the merchants and the railways of the province. The trade at the periods specified

Exports

Year.

Imports.

Exports.

Total Trade.

of Domestic Produce.

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1861 .

1,976,018

2,032,311

4,008,329

1,838,639

1871 .

2,158,022

3,582,397

5,740,419

3,289,861

1881 .

5,320,549

4,508,754

9,829,303

3,755,781

1891 .

10,051,123

10,642,416

20,693,539

4,810,512

1899 .

6,884,358

8,388,396

15,272,754

3,945,045

1900 .

8,131,782

8,122,100

16,253,882

3,770,983

The great expansion following 1881 was due to the opening up of trade with the western districts of New South Wales. The ex- ports of domestic produce, the value of which is given in the last column, when compared with the other figures in the table, show how greatly the province depends upon its re-export trade. The chief items of trade are bread-stuffs, wool, and minerals ; the export

of bread-stuffs is very variable, depending so largely upon the rain- fall, which in South Australia is extremely uncertain. In 1884 the value of wheat and flour exported was ££2,491,896, falling to ££633,426 in 1886, and rising again to ££2,197,735 m 1888. Since the year last named there have been great fluctuations : in 1898 the export fell to ££261,898, and in 1899 it was ££785,341, while in 1 900 it was ££837,642. The value of locally grown wool exported during the twenty-five years ending with 1900 varied between ££950,000 and ££2,000,000 ; the value in 1900 was ££1,003,391. 'The value of minerals exported during 1899 amounted to ££422,000, and in 1900 to ££386,000.

The first railway was opened in 1856, and connected Adelaide with its port, and the following year saw a line constructed to Gawler, 25 miles

from Adelaide. The inability of the Government to borrow money at reasonable rates greatly "vays.

retarded the construction of railways in the province, and in 1875 there wei-e still less than 200 miles of line : in the next ten years 800 miles were opened for traflic, and in 1901 there were 1736 miles in the province itself and 166 miles in the Northern Terri- tory. There were, in addition, some 14 miles of privately owned lines. The cost of constructing and equipping the state lines stood at ►►14,326,775 by the middle of the year 1901, and the net earnings ►►496,142; this represents nearly 3 '5 per cent, on the capital invested. The actual interest paid by the state upon its outstanding loans was in the same year nearly 3 '8 per cent.: there was therefore a loss of 0'3 per cent, upon the working of the lines ; but the state claims that the indirect benefits of railway construction far more than compensate for the direct loss. The gross earnings for the year ended 30th June 1901 were ►►1,250,461, and the working expenses ►►754,319 ; the former represents 5s. 8'3d. and the latter 3s. 5 ►►►2d. per train mile. In 1900 the number of passengers carried was 8,498,000 and the goods tonnage 1,628,000. South Australia has two gauges, namely, 508 miles of 5 feet 3 inches and 1393 miles of 3 feet 6 inches line. The hne joining Adelaide with the Victorian border, as well as several of the trunk lines, are on the wider gauge.

*In 1900 there were 699 post ofiices, of which 285 were also tele- graph stations. The business transacted was : letters and post- cards transmitted 20,387,301, newspapers 9,956,351, n t ^ packets 1,386,624, and telegrams 1,207,288. The total ►►'►►"" revenue from these services for the year 1900-1901 * '". was ►►181,350, and the expenditure ►►148,277 ; in these '►►►'"'- sums are included the telephone revenue and expenditure, the former amounting to about ►►16,000. These sums are exclusive of revenue received by the Commonwealth Government. The use of telephones in Adelaide is rapidly extending ; in 1900 there were 8 exchanges and 1558 telephones. There were 5742 miles of telegraph line in operation in 1900, and the state owns the principal overland line by which communication with Europe and the East is maintained.*

The assets of all the banks of issue trading in South Australia on 30th June 1901 amounted to ££6,567,776, and the liabilities to ££6, 747, 644 ; these latter comprised deposits at call

££2,608,269, deposits at interest ££3,662,127, making a

Banking,

total of ££6,270,396 ; notes and bills in circulation ££424,487 ; and other liabilities ££52,761. Amongst the assets were coin and bullion, ££1,657,972. The South Australian people are very thrifty, and thirty-one in every hundred have accounts with the savings banks. On 30th June 1901 the deposits numbered 111,537, and the amount to the credit of depositors ££3,782,575, a sum equal to ££33 18s. 3d. per depositor. Taking deposits in banks of issue and in savings banks together, the total was ££10,052,971, which is equal to ££27 14s. 6d. per inhabitant. The figures for 1900- 1901 show an increase on the total amount of deposits with banks operating in the state; in 1891 the total was ££9,992,338, which is ££60,000 less than the figures for 1900-1901. The figures of the people's banks are a better guide to the progress of savings than are the banks of issue, which have been accustomed to solicit deposits in England and elsewhere. In 1871 the savings banks held ££517,000 on deposit ; in 1881, ££1,288,450; in 1891, ££2,217,419 ; and on 30th June 1901, ££3,782,575.

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The political and social developments in South Australia have been in harmony with the far-sighted LiberaUsm

which attended the infancy of the state. On the Political attainment of autonomy Governor MacDonnell, meats. i^- closing the last session of the then partially

nominated legislature, made use of the following words ; ??? " I confidently expect that the extended political power entrusted to the people of this country, and the universal suffrage conceded by the new constitution, wiU prove in reality a safe and conservative measure; and whilst conferring the utmost possible power of self-govern- ment, will render stronger and more enduring than ever the cherished ties of affection and loyalty which link this province to the throne of our respected and beloved Sovereign." Judged from every standpoint, this

prediction appears to have been amply verified : South Australia deservedly enjoys the reputation of being one of the most progressive and at the same time one of the most stable of existing communities. From its origin as the venture of private enterprise, the state has passed through orderly stages of evolution up to the zenith of democratic government. Such alterations as have been made in the constitution have been in the direction of a still further enlargement of the franchise ; for it is recognized that, in a young country of unexplored capacity and unfathomed resources, the ever-vary- ing public problems are most likely to reach a satisfactory solution when, by means of a wide enfranchisement, the ac- tivity and intelligence of the whole community are brought to bear upon each question. Payment of members proved to be the coroUary' of manhood suffrage. It was held that an unrestricted right of selection was unavailing if the area of selection was hmited to the few who had been specially favoured by fortune. In 1887 a temporary Act was passed for the payment of ►►200 a year to each member of both Houses, and in 1890 the law was made permanent. Thus was rendered possible the direct representation of all classes. Soon afterwards the parliamentary labour party came into existence ; this forms a considerable proportion of the membership of both Houses, and includes in its ranks men of the highest intelligence, industry, and eloquence. In 1894 the principle of " one man one vote " was extended to that of " one adult one vote " by the inclusion of women as voters on terms of absolute equality with men. There is no bar to the election of women to Parliament whenever the electors think fit to be so represented. The delegates to the Federal Convention and to the Commonwealth Parliament were in South Australia elected by the combined vote of men and women. Elections were formerly held in suc- cessive batcliCH, but since 1893 they have taken place simultaneously in all the districts. Electoral expenses are rigidly Umitod, both as to objects and amount, and a declara- tion of money thus expended has to be filed by every candidate. Experience has demonstrated that, owing to the intrusion of the personal element, general elections have often failed to aff'ord conclusive evidence of the state of the popular will. Attention has therefore been directed towards the referendum as a means of obtaining an unquestionable verdict on important public issues. Al- though no general statute had been formulated on the subject up to 1902, custom has definitely established the

practice. In 1896, at the general elections, the following questions were submitted to the electors : ”Do you favour (1) the continuance of the present system of education in the state schools? (2) the introduction of scriptural in- struction in the state schools during school hours ? (3) the payment of a capitation grant to denominational schools for secular results’!” An overwhelming majority pro- nounced in favour of (1) and against (2) and (3). Again, in 1899, a direct vote was similarly taken on the question of household franchise for the Legislative CouncU. Undoubt- edly the practical application of the referendum in South Australia facilitated the adoption of this principle in the ratification and in the method of amendment of the Commonwealth Constitution. The right of the Second Chamber to suggest amendments to BUls which it has not power to amend was borrowed by the Commonwealth from the Constitution of South Australia, as also was the idea of a simultaneous dissolution of both Houses as a means of overcoming possible deadlocks between the Chambers. As one among many improvements in parliamentary procedure may be mentioned the practice of permitting BiUs lapsed owing to prorogation to be replaced on the notice paper in the ensuing session by motion without debate.

The facile but unsound method of meeting a large proportion of the current expenditure out of the proceeds of land sales has long ceased to exist in South Australia. In 1884 a land and income taxation Act was passed, and in 1894 these taxes nance. were made progressive. The land tax is Jd. in the on nidmproved land values without exemption, with an addition of another ^d. in the on land values owned by any individual in excess of 5000. An increase of 20 per cent, on the tax is levied on land held by absentees. There is an exemption of 200 on all incomes. The rate on the taxable income derived from personal exertion is 4^d. in the up to 800, and 6d. in the for every pound of income in excess of that amount. On incomes derived from property the rates are double, namely, 9d. and Is. respectively. The death duties are also graduated, and are payable not on the total estate bequeatlied, but on the amount received by each beneiiciary ; the rates range up to 10 per cent, on amounts of 200,000 and upwards. Stamp duties were imposed in 1886. In 1901 South Australian securities were made trustee stocks for British in- vestors.

In partially settled countries such as South Australia the Crown lands policy rivals finance in engrossing the attention of the legislature, but as time goes on the relative importance of these subjects varies in inverse ratio. The earlier budgets, compared witli those of later years, wlien the country had become more fully developed, might be said to resemble the finances of the nursery, whereas the initial alienations of land, comprising the most central and most valuable blocks, necessarily surpassed later transactions in significance. Many phases of public opinion as to the method of disposing of the Crown lands have been Witnessed. A general review indicates clearly that the change has been uniformly in the direction of removing impedi- ments and increasing facilities for the settlement of the people either as freeholders or state tenants, on the land. Under the auction system the land was allotted to the highest bidder, with the result that the payment of the purchase-money frequently exhausted the resources of the settler, and subsequent relief had to be afforded by relaxation of the conditions of the agreement to purchase. Eventually land boards were created to allot selections to apph- cants at low rates and deferred purchase. Perpetual leases are now taking the place of absolute alienation. The tenure is equally good for all purposes of the bond fide settler, and capital which would otherwise be sunk in acquiring the freehold is set free for making improvements, purchasing machinery, and the manifold requirements of efficient husbandry. Small blocks of 20 acres, or not exceeding ►►100 of unimproved value, can be obtained by working men in the vicinity of towns, thus on the one hand affording the necessary supply of agricultural labour during the busy seasons, and on the other hand providing a homestead which the holder can with advantage cultivate at slack times when unemployed. Provision was made, under the Closer Settlement Act of 1897, for the repurchase of large estates for agricultural purposes ; these lands are leased to farmers at an average rent of about 4-; per cent, on the value. The industry of wheat-grow- ing has received an impetus through the system of drilling in a small quantity of phosphatic manure with the seed. By this means exhausted lands have been restored almost to primitive

Crown lands.

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fertility. Vine-growing lias now become one of the staple industries, and, owing to stringent precautions, the state remains free from the scourge of phylloxera. The great bulk of the unalienated . land of South Australia is held in huge areas by iure'and "–"^ tenants, known as squatters, under pastoral water. leases, which now have a currency of 42 years, with security of tenure. In 1893, when the unemployed were very numerous, the Government established co-operative village settlements on tracts of land adjoining the river Murray. Seven of these are now in existence as irrigation colonies. The water is raised from the river by rotary pumps, and distributed by means of channels, after the plan adopted at Eenmark. By the application of water to the adjacent sun-steeped soil, miles of worthless mallee scrub have been converted into vistas of vine- yards, orange groves, and orchards. The paramount importance of water supply and conservation has received ever-increasing recogni- tion. The Beetaloo reservoir has a capacity of 800, 000, 000 gallons, and from its 695 miles of trunk mains a district of over one million acres is reticulated. The supply of Adelaide and its vicinity has been reinforced by a reservoir at Happy Valley, having a contom- of about 7i miles at high-water mark, and containing 2, 950,000,000 gallons. The reservoir was formed by the construction of an earthen embankment 2645 feet long and 72 feet high ; tliis is filled from the Onkaparinga river through half a mile of steel main 6 feet in diameter and 3J miles of tunnel. Works on a large scale have also been constructed at Bundaleer and Barossa. The custom for many years past has been to construct these and other great public works departmentally instead of by contract. Many artesian wells have been sunk on the routes for travelling stock in the interior. The bores of some of these exceed 3000 feet in depth, and the supply varies from 200,000 to 1,000,000 gallons a day. Around some of these wells in the far north plantations of date palms have yielded excellent results.

South Australia was founded when the tide of the laissez /aire regime was running high, and a patriotic bias in the customs tariff was regarded as

an unwarrantable restriction ; it is therefore not surprising that free trade should at the outset have received many adherents. There were not wanting, however, some who saw clearly that a country almost entii'ely occupied in primary production would prove but a barren field for the cultivation of the many-sided activity necessary to a complete national life. It was also maintained that if inducements were given to capital to embark in home industries, a cheapening of the product, due to approxima- tion of supply and demand, would ensue. In accordance with these views, a protective tariff was adopted in 1885. Two years later the duties were increased and extencied. The establishment of manu- factures and new industries opened a career for youths of inventive and mechanical aptitude, and in several instances the predicted reduction in price of the protected article has been strikingly manifested.

One of the most notable developments in public policy consisted in the extension of the sphere of the state so as to embrace activities formerly considered to be solely within the

overn- province of private enterprise. Railways from the

, . outset have been Government undertakings, so also ' have been water-works of any degree of magnitude ; telegraphs and telephones, taken over by the Commonwealth, have always been regarded as state monopolies. A public trustee under- takes, when desired, the administration of estates. In 1895 a state hank was established to provide farmers with the neces.sary work- ing capital at lowest current rates of interest. A state produce depot was also organized at the same time to assist farmers in placing their produce to the best advantage on the world's markets. Produce is received by the Department of Agriculture, prepared for shipment, certified as to quality, and graded. Small parcels from a number of producers are grouped together in one consignment and shipped at the lowest rates. The Government of South Australia also undertakes, if so desired, to act as agent in London for the con- signor, and to arrange for the sale of his produce ; so that a farmer who has no representative at the port of destination, but is desirous of ascertaining whether a profitable trade can be established in any class of produce, has only to send the goods to the depot, and await the arrival of a cheque when the account sales come to

hand. An advance amounting to three-fifths of the value of the produce at 5 per cent, is made if desired. Wine shipped through the produce dep6t is analysed and examined in bulk by Government experts,^ and if found to be both sound and pure, is sent to the bonded depot in London with a certificate to that effect : this is recorded on the label of the bottles in which it is retailed, under the name of the "Orion" brand. Cyanide works have been erected in various centres for treating ore raised by miners working in the neighbour- lood. State smelters for copper ore have been built at Port Augusta, but are not now in operation. There is a Factory Act permitting the establishment of wages boards, and also legislation providing for a weekly half-holiday and the early closing of shops. A compulsory conciliation Act deals with the prevention and settle- ment of industrial disputes. The Eight Hon. C. C. Kingston was

the pioneer in Australasia of legislation of this description. These measures were at first denounced by some as Socialistic, and were regarded by many as an undue interference with private enterprise. Some of the state aids were, however, speemly re- cognized as affording additional incentives to industry, and by enabling producers and workers to obtain a better return for their labour, may fairly be held to have assisted rather than to have retarded private enterprise. In 1893 a bonus on butter exported to the world's markets was successful in bringing into existence a fully equipped export trade. Public opinion in South Australia has little tolerance with laxity. Children are prevented from seDing articles in the streets after 8 p.m., and are not allowed to fetch beer from public-houses. The age of consent has been raised to 17 years. The notification by medical men of cases of pul- monary tuberculosis to the local authorities is compulsory.

No pains have been spared to keep pace with modern improve- ments m popular education as an indispensable feature in democracy. South Australia holds in reverent and loving memory the name of John Anderson Hartley, the originator of the state school system, who died in 1896, and to whose character as a man and ___. genius as an organizer the schools of South Australia "'^ "" will remain as a perennial monument. School fees for children under the compulsory age of 13 were abolished in 1891, and in 1898 the older children were also

admitted free. Students in training have now the advantage of a two-years' course at the university. Technical education has received much attention. A foundation was long ago laid in the primary schools by the inclu- sion of drawing as a compulsory subject, and by affording facilities for manual training. In 1889 the South Australian School of Mines and Industries was established, and under the presidency of Sir Langdon Bonython has proved a most valuable institution. Other technical schools are in operation in industrial and mining centres. A reserve of two acres is attached to all new country schools, and systematic lessons in practical agriculture are given by many teachers. In order to encourage tree-planting, a yearly school holiday devoted to this purpose, and known as Arbor Day, was established in 1886. With a similar object, the state has dis- tributed, free of charge, 5,030,000 forest trees to 21,000 persons. Over 1,250,000 vines have also been given away. The boys' field club, with the motto "The naturalist loves life," has since 1887, under the direction of Mr W. C. Grasby, been one of the pioneers of nature-study. A state secondary school for girls has been for many years self-supporting, and in 1897 secondary agricultural schools for boys were organized in Adelaide and other centres. Half the school hours of each day are spent in the class-room, the remainder being devoted to workshop, field, and laboratory practice. An agricultural college at Eoseworthy, 25 miles north of Adelaide, imparts a high-class theoretical and practical training in the various branches of agriculture, including viticulture and wine- making. The fee charged is ??30 a year, including board and lodging. Information as to practical and scientific husbandry is disseminated among the farmers by means of an Agricultural Bureau, with numerous branches throughout the country. A journal is published conjointly by the departments of agriculture and industry, con- taining reports of the proceedings of the bureaus, and articles by Government experts, together with industrial topics and matters of interest to artisans, and also particulars furnished by the Labour Bureau as to prospects of employment in various districts.

South Australia played a conspicuous part in the attainment of Australian Federation. The popularly-elected Convention which framed the Commonwealth Constitution Act, held in 1897 its first session in

Adelaide. The Eight Hon. C. ^‘“e□□□- C. Kingston, then Premier of South Australia, after- “”’

wards Minister for Trade and Customs in the Commonwealth, was elected president of the Convention, which subsequently met both in Sydney and Melbourne. South Australia was the first of the colonies to submit the Federal BiU to the referendum, and to pass the address to the Sovereign praying that Imperial assent might be accorded to the measure. Mr Kingston was one of the delegates who watched the passage of the Act through the British Parlia- ment. When the Commonwealth Parliament was constituted, and the Hon. Sir Eichard Baker, K.C.M.G., president of the South Australian Legislative Council, and the Hon. Sir Frederick Holder, K.C.M.G., leader of the South Australian House of Assembly, were respectively elected President and Speaker of the Federal Senate and House of Eepresentatives. South Australia was also the first Australian state to make the necessary adjustments in the local legislature consequent on some of its most important functions bein” taken over by the Federal authority. The number of members of the Legislative Council has been reduced from twenty-four to eighteen, and of the Assembly from fifty-four to forty-two, and there are now four ministers in place of the previous six.

The existence of South Australia as a colony was coterminous w ith the reign of Queen Victoria. The colony was established only a few months before the accession of that monarch, and South Australia ceased to be a colony by entering the Commonwealth as a state within a few days of the close of the Victorian Age. (j a. Co)

South Bend, a city of Indiana, U.S.A., capital of St Joseph county. It is situated in 41□□ 39′ N. and 86□□ 12′ W., on St; Joseph, river, in the northern part of the state, at an altitude of 725 feet. It has five rail- ways, the Grand Trunk, the Illinois and Iowa (including the St Joseph, South Bend, and Southern), the Lake Shore and Michigan Southern, the Michigan Central, and the Vandalia. It is an active manufacturing place ;

in 1900 there were 302 establishments, with a total capital of $18,156,638. They employed 8257 hands, and the product was valued at $14,236,331. The two principal articles of manufacture were agricultural imple- ments, with a value of $2,432,083, and carriages and waggons, value $3,494,052. The assessed valuation of real and personal property was, in 1899, $15,047,350, the net debt only $918,238, and the rate of taxation $24.50 per $1000. Population (1890), 21,819; (1900), 35,999, of whom 8601 were foreign-born and 572 negroes. Of 10,402 males 21 years of age and over, 536 were illiterate (could not write).

South Bethlehem, a borough of Northampton county, Pennsylvania, U.S.A. It is situated in 40 ́ 37′ IST. and 75 ́ 23′ W., on the south bank of the river Lehigh, in the eastern part of the state. It is on three rail- ways, the Central of New Jersey, the Lehigh VaUey, and the Philadelphia and Reading. The site of the borough is hilly; it has an excellent water-supply and sewerage. It is the seat of the famous iron-works of the Bethlehem Iron Company, with its furnaces, rolling mills, ordnance shops, and armour-plate works. Besides these it has brass and zinc works and other manufactures. It is the seat of Lehigh University, a non-sectarian institution, opened in 1866, which had in 1899 a faculty of 42 and was attended by 325 students. Population (1890),

10,302; (1900), 13,241.

South bridg^e, a town of Worcester county, Massachusetts, U.S.A. It is in the southern part of the state, bordering on Connecticut. The town has an area of 21 square miles, and contains a village bearing the same name, located on Quinebaug river and on a line of the New York, New Haven, and Hartford Railroad, at an altitude of 500 feet. It has a variety of manufactures. Population (1890), 7655; (1900), 10,025, of whom 3468 were foreign-born. ^

South Cstrolina, one of the original thirteen states of the American Union, situated on the southern Atlantic coast between North Carolina and Georgia. It was founded under royal charters of Charles II. of 1663-1665. The state was peopled first by a colony from England by way of Barbados, followed by others of Dutch from New York, Huguenots from France, Scots, Irish, and Scots-Irish, Germans, and Welsh. The colony

was planted as an outpost to assert the right of Great Britain to disputed territory, and so was warred upon by Spain and France, and suffered from Indian incursions instigated by those Powers. This circumstance, and her great dis- tance from the other colonies, led to the ‘ development of the peculiar characteristics for which the state has been noted. The great staples of rice and indigo, cultivated upon a rich virgin soil by negro slave labour, produced great wealth, in the enjoyment of which a closer inter- course with the mother country was maintained than that of other colonies : her young men were sent to the uni- versities abroad for their education, and a highly-educated, cultured, and refined society was thus formud. In conse- quence of the close ties to England, there was great opposi- tion in South Carolina to the American Revolution. Her people were divided upon the subject, and yet it was upf^a her soil that the last three years of that struggle

were waged, and in it she suffered more than any other state. Within her borders no fewer than 137 battles or affairs, great and small, were fought. Much of the history of the United States turns upon that of this httle state. She led in both the Nullification and Secession movements. Three times has the city of Charleston been besieged, i.e., by the Spaniards and French in 1706, by the British in 1780, and by the Union forces in 1861-65. Her harbour is celebrated for the victory of Fort Moultrie over the British fleet and army in 1776; for the battle of Fort Sumter on the 12th-13th April 1861, which precipitated the war between the states ; and for the defence of that fortress by the Confederate army during the years 1863-65. With a white population of but 291,300, and only 55,046 arms-bearing men, in the first year of the war she put in the field 44,000 volun- teers, and during its existence 62,838 effective men, with an enrolment, including reserves, of 71,083, of whom 22 per cent, were killed in the field or died of disease or in prison. The state suffered so terribly after the war, under the iniquitous rule of the Reconstruction Govern- ment, as to be known as “the prostrate state.” Her recovery since has been wonderful.

Population. ??? The population in 1880 was 995,677 ; in 1890, 1,151,149, an increase of 155,572, or 16 -6 per cent.; and in 1900, 1,340,316, an increase of 189,167, or 16-4 per cent. The total land surface of the state is approximately 30,170 square miles, and the average number

of persons to the square mile has increased from 38-2 in 1890 to 44-4 in 1900. In 1900 there were 16 incor- porated towns and cities which had each a population of more than 2000 and less than 6000, 4 more than 6000 and less than 10,000, and 4 more than 10,000, namely, Charleston (55,807), Columbia (21,108), Greenville (11,860), and Spartanburg (11,395). The population of Charleston increased during the decade from 1890 to 1900 only 1-6 per cent. Of the population in 1900, 664,895 were males and 675,421 females"; 1,334,788 were native- born and 5528 foreign-born ; 557,807 were whites, 782,321 negroes, 67 Chinese, and 121 Indians. Of the white male population of 21 years or over, numbering 130,375, 15,865, or 12'2 per cent., were illiterate ; of the corresponding negro population, numbering 162,860, 83,618, or 547 per cent., were illiterate.

Mnmice. ??? When the first governor imder the Reconstruction Act was inaugurated in 1868, the actual debt of the state was a little less than $5,800,000. In five years a legislature but few members of which were taxpayers, and those only to a nominal amount, had increased this to a sum estimated at ??33,900,000. Fortunately for the taxpayers, these legislators were obliged them- selves to repudiate a large part of this indebtedness. In 1876 the Democratic party rose, under the lead of Wade Hampton, and overthrew the carpet-bag rule, as it was called. One of the first measures of the restored government was the appointment in 1877 of a commission to investigate the debt of the state. Under this commission the total valid indebtedness was fixed at $6,406,606, which was funded in 1894 in bonds bearing interest at the rate of 4i per cent.

Election Legislation and the Negro Vote. ??? In order to restrict the ignorant negro vote, under which it was impossible to main- tain a decent government, the General Assembly in 1882 instituted an electoral system which enforces an educational qualification b}"" requiring the voter (who is secluded) to select his ticket himself and deposit it in the appropriate box. The system has become known as the "Eight-Box" system, and has been imitated in other states. In 1895 a convention framed a new state consti- tution, differing from the old in many important particulars. The qualifications for suffrage were extended. From the adoption of the constitution in 1896 to 1st January 1898 it was

made necessary for the voter to understand and explain any section in the constitution when read by the registration officer ; but since that day persons applyuig for registration are required {a) to read and write aiiy section of the constitution sub- mitted to them, or (h) to show that they own property in the state assessed at |300 or more, and have paid all taxes collect- able during the previous year. At the same time a system of registration, which is peculiar to South Carolina, was incorporated in the constitution. Registration is not, as elsewhere, repeated before each election, but is renewed only once in every ten years. Upon a given day in every month, however, persons coming of age, or otherwise becoming entitled to vote, may have themselves enrolled. When a voter enrolls, he is given a certificate, which he is required to present when voting, for comparison with the entry in an official book. This system was adopted to meet

the difficulty of identifying the negro by the features of the face, whose surname, adopted at random upon emancipation, is often repeatedly changed, and whose nomadic habits since emancipation permit no identification by residence. The system, of course, applies to all electors, white or black.

Dispensary Liquor System. ??? During the existence of slavery the negroes were little used to the intoxicating effect of liquor, but after their emancipation every cross-road soon had its saloon or travelling liquor waggon, and in consequence their riotous conduct threatened the peace and safety of rural communities. This led to the prohibition of the sale of liquor outside incor- porated towns, where the sale was under police regulation. Mean- while a general prohibition agitation was carried on, which re- sulted in the adoption of local prohibition laws in many towns and cities, and finally in the present dispensary system. This system is based upon that of Gothenburg, though not identical with it. By it the state becomes the sole dispenser, and under- takes to furnish to purchasers chemically pure liquors in packages of not less than one-half pint, securely sealed, the package not to be opened nor the liquor to be

drunk on tlie premises of the dispenser. The profits are appropriated to state, county, and municipal purposes, that which goes to the state being devoted to education. To carry on the system a vast machinery of officers, state and county boards, and dispensers is provided, which has opened the way to corruption and extravagance. Heretofore a large constabulary force has been employed, and the enforcement of the system has caused bitterness, strife, and bloodshed. As a vendor of liquor the state becomes interested in the profits, and has practically forced dispensaries upon localities in which absolute prohibition previously obtained. The system is now as much opposed by prohibitionists as by those who are against any inter- ference with the business of liquor-selling beyoud the necessary police regulation. It must be said, however, that the rigid en- forcement of its prohibitory features has so completely broken up the city saloons and the cross-roads liquor dealers as to recon- cile many citizens and planters who are opposed to the system on general grounds. The Constitutional Convention of 1895 incor- porated a prohibition of the saloon system into the constitution.

The Supreme Court. ??? The Constitutional Convention of 1895 provided also that the Supreme Court shall consist of four members instead of three, i.e., a chief justice and three associate justices, the concurrence of a majority of whom is necessary to reverse on appeal, thus giving weight to the circuit decision appealed from, and securing a clear preponderance of legal opinion in the decision of any question. It also extended the length of the terms of the justices of the Supreme Court to eight years, and so classified Its members that the term of one of them expires every two years. It gives to the Supreme Court power to call in all the circuit judges of the state to sit iii, banc with them in certain cases.

Divorce. ??? By virtue of an unwritten law of the state, divorces have never been granted, except during the Reconstruction period. The Convention of 1895 ordained that "divorce from the bonds of matrimony shall not be allowed in the state."

Manufactures. ??? In 1860 South Carolina raised her largest crop of cotton up to that time ??? to wit, 350,000 bales of upland cotton. It was believed then that cotton could not be raised without slave labour. In

1898-99 the crop was 1,040,000 bales, of which 400,000 bales were spun in South Carolina. In other words, the state spun more cotton of her own growth than she had raised in the year 1860, and had still for export a crop 26 per cent, larger than the whole of that of 1860. One of the happiest results of this development is that the poor white ??? forced away from the farms by competition of negro cheap laboirr ??? finds a haven in the cotton-mills villages. A family the limit of whose income was from $100 to $150 dollars a year gets at the mills from $70 to $80 per month, paid in some cases every two weeks, with entire liberty to trade at their own pleasure. The best managed of these mills have free schools, open ten months in the year, with churches and reading-rooms. The follow- ing table illustrates the extraordinary recent increase of cotton mills : ???

Year.

1820 .

Mills.

Capital.

Spindles.

Looms.

Employes.

1

588

1840.

15

$617,500

16,400

200

600

1850.

18

857,200

20,000

300

1,000

1860.

17

827,825

16,461

931

900

1870.

12

1,337,000

34,940

745

1,100

1880.

14

2,776,100

82,334

1,676

2,100

1890 .

34

11,141,833

334,476

8,546

8,200

1899 .

105

45,000,000

1,906,000

53,351

45,000

1902.

109

1,931,900

54,535

The following table shows the condition of the manufacturing and mechanical industries in 1890 and 1900 : ???

1890.

1900.

Per cent, of Increase.

1890-1900.

Number of establish- ments . Capital

Wage-earners . Value of product

2,382 129,276,261

22,748 $31,926,681

3,762 $67,356,465

48,135 158,748,731

57-9 130-1 111-6

84-0

The value of the manufactures of cotton goods was $29,723,919 in 1900 as compared with $9,800,798 in 1890. Lumber timber products rose from $2,146,750 in 1890 to $5,207,184 in 1900.

Tobacco. ??? So recently as the middle of the 'eighties, not one pound of tobacco was planted in South Carolina. According to the best estimates, there were sold in 1899 in the various markets of the state 25,500,000 tti, and shipped from the state 8,000,000 lb, making a total of tobacco raised

in the state 33,600,000 lb. The average yield per acre is 770 lb, the total acreage about 44,000. The crop averages 8 to 10 cents per lb. The crop of 1899 was valued at $2,680,000. South Carolina is now the second state to North Carolina as a producer of "bright tobacco," the whole of her crop being of that description.

The " Piivihurst" Tea Experiment. ❓❓❓ The "Pinehurst" tea experiments, begun about 1890 by Professor Charles U. Shepard, M.D., and latterly assisted pecuniarily by the U.S. Department of Agriculture, bid fair to result in the creation of a new industry. The experiments have been conducted with many varieties of seed and under different conditions of soil, and over 50 acres have been planted. To reduce the cost of labour for plucking tea-leaf, which was inordinately high as compared with the Orient, a free school was built where negro children are taught the ordinary branches, earning the money to buy food and clothing by picking tea. The yield of (dry) tea has been as follows : 1894, 83-8 lb ; 1895, 185-7 lb; 1896, 215 lb; 1897, 247-5 lb; 1898, 307-3 lb; 1899 to 15th September, 496 '1 lb. It has been shown that the yield per acre approximates that in the countries from which the plants were imported.

Phosphate. ❓❓❓ From 1867 to 1890 the state produced enough phos- phate rock to fix prices for all other varieties, and to control both foreign and domestic markets. This monopoly was ended by the discovery of phosphate rock in Florida and Tennessee. South Carolina now produces about 500,000 tons annually, Tennessee about the same, and Florida as much as both of these. In the manufacture of fertUizers, established on the basis of her phos- phate rock, the state still holds her prestige. Factories in the state can manufacture 475,000 tons of fertflizer, representing a business on manufactured goods of about $5,000,000, to which should be added $300, 000 for raw materials furnished in connexion with manufactured fertilizers. The state probably manufactures and sells more fertQizers than any other in the Union, and it is believed that the city of Charleston is the largest manufacturing centre of this class of goods in the world.

Education. ❓❓❓ One of the reasons urged for calling the Constitu- tional Convention of 1895 was that the school tax of two mills prescribed

in the constitution of 1868 should be eliminated, as the constitution was not the place for a tax levy ; the sentiment of the convention for the advancement of education was, however, so strong that the prescribed tax was not only retained, but was increased from two mills to three mills. In addition to the collegiate institutions of the state previously established, to wit, the South Carolina College at Columbia and the State Military Academy in Charleston, in 1889 the state established the Clemson Agricultural College of South Carolma at Clemson, Anderson county, S. C. , in which there are three full courses of study : agricul- tural, mechanical, and textile. In 1895 it established the "Winthrop Normal and Industrial College (female) at Eock Hill, which during the first three years of its existence received 800 students. In 1900 there were 50 graded schools in the state, the term "graded" being applied to all schools in towns which have a special tax levied for their support.

Attthoeities. ??? A Brief Description of the Province of Carolina, on the Coasts of Florida. London, 1666. ??? A71 Account of the Province of Carolina,

734

SOUTH DAKOTA

David Ramsay, M. D. History of the Revolution of South Caroliiia, &c. 2 vols. nS5 ; The Sisiory of South Carolina. 1809. ??? William MOULTKIE. Memoirs of the American Revolution, so far as it relates to the Stales of North and South Carolina and Georgia, The Collections of the Historical Society of Soiith Carolina. ??? Joseph Johnson, M.D. Traditions of the Revolution. 1851. ??? William James Riveks. A Sketch of the History of South Caroliiia to the Close of the Proprietary Government, &c. 1856. ??? Edward M'Crady. The History of South Carolina under the Proprietary Governinent, 1670-1719. 1897 ; The History of South Carolina under the Royal Governinent, 1719-76 ; The History of South Carolina in the Revolu- tion, 1775-1780. 1901 ; The History of South Carolina in the Revolution, 1780-1783. 1902. (b. M'C.)

South Dakota., one of the north-western states of the American Union, about 360 miles long, with an average width of about 225 miles ; it contains 77,850 square miles.

Geography aiid Geology. ??? The surface of the state, with the exception of the Black Hills in the south-west corner, is generally rolhng prairie. The land east of the Missouri river is fertile and well adapted to agriculture, that west of the river is drier, more broken, and well suited to stock- raising. Kg timber is found in the state outside the Black Hills, except along the banks of the rivers and streams. The Black Hills, where the timber has not been cut off, are covered with pine. The timber along the rivers and streams is ash, elm, cotton-wood, and box elder. Oak and black walnut are also found. The greater portion of the state is of Cretaceous formation, with some Tertiary deposits in the southern part. The Black Hills are a distinct formation. Discoveries are constantly being made of gold and silver iu this part of the state. In 1899, 312,962 ounces of fine gold and U5,600 ounces of silver were mined ; and mines of mica, gypsum, and bituminous coal of good quality have been also opened and developed. Natural gas has been discovered in different parts of the state, especially in Hughes, Sully, and McCook counties, and is being utilized to some extent for heating and illuminating. Quartzite sandstone and other kinds of building rock are found in abundance in various parts of the state. In 1899, 50,000 barrels of very excellent cement, equal in strength and endurance to the best Portland cement, were manufactured at Yankton from the chalk rock -and clays found in abundance along the bluffs of the Missouri river.

Agriculture. ??? Of the agricultural products, wheat is the staple crop, and has a world-wide reputation as producing the best of flour ; 41,889,380 bushels were grown in 1899, valued at $20,957,917. The yield of corn in the southern part of the state and on the Missouri bottom lands frequently averages 75 bushels to the acre ; 32,402,540 bushels were grown in 1899, valued at $7,263,127. Of oats, 19,412,490 bushels were grown, valued at .$4,114,456. Flax, barley, peas, beans, hay, and other farm products are grown every- where in the state. The grasses on the ranges are very nutritious. Timothy, alfalfa, and other grasses are cultivated successfully east of the Missouri river. Some failures of crops

have resulted from drought in the northern and north-westfrii portions of the state. An artesian basin has been developed in the central portion of the state at a depth of from 500 to 1100 feet, which is being utilized for irrigation, and in some loi^alities for manufacturing. Though there is a period of low temperature during midwinter, the climate is dry and bracing.

Education and Charities, ??? There were in 1898, 3682 common schools, with 4322 teachers and a total attendance of 77,516. The children of school age (between 6 and 20 years) numbered 96, 134, and the expenditure on coinmtm schools for that year amounted to 11,729,462. According to the census of 1900, the number of persons between 5 and 20 years of age inclusive in that year was 147,165. The percentage of illiterates is very small. Out of 112,681 males of voting age in 1900, 5442 (4-8 per cent.) were unable to write ; of these, 2234 were of foreign birth. The State University at Vermilion had 384 students for the year 1900, and

has 28 instructors. It is under the control and management of the state. There are also normal schools at Madison, Spearfish, Springfield, and Aberdeen ; an agricultural college at Brookings ; a school of mines at Rapid City ; and a school for deaf mutes at Sioux Falls. These have a total of 1420 students and 63 in- structors. There are several excellent denominational schools and colleges. The state penitentiary is at Sioux Falls, the insane asylum at Yankton ; there is a reform school at Plankinton, and a soldiers' home at Hot Springs.

Railways. ??? In 1898 there were 2797 miles of railways in opera- tion within the state, of which the principal lines in point of mileage were the Chicago, Milwaukee, and St Paul, the Chicago and North- Western, the Great Northern, the Burlington and Missouri, the Fremont, Elkhom, and Missouri Valley, and the Chicago, St Paul, Minneapolis, and Omaha.

Finance. ??? The total assessed value of property in the state in 1898 was $120,175,431, which yielded state taxes to the amount of $478,881. The state debt in 1898 (1st July) was $861,600. The state banking law is modelled after the United States Banking Act. There are 25 national

banks, with deposits of ►►5,330,951 and a capital of ►►1,460,000 ; 109 state banks, with deposits of $5,322,384 and a capital of ►►1, 245, 227 ; and 70 private banks, with deposits of $3,329,486 and a capital of $945,076.

Population. ►►► The census of 1890 gave the population of South Dakota alone as 328,808, being an increase during the preceding ten years of 234 ‘6 per cent. In 1900 the population was 401,570, an increase for the decade of 72,762, or 22‘1 per cent., approxi- mately that of the country as a whole. The average number of persons to the square mile was, in 1900, 5 ‘2, as compared with 4 ‘3 in 1890. There were, ta 1900, 134 incorporated cities, towns, and villages in South Dakota, of which 25 had more than 1000 inhabit- ants, 12 more than 2000, and only 2 more than 5000. These two were Sioux FaUs, with 10,266, and Lead City, with’ 6210 inhabit- ants. The capital, Pierre, had 2306 inhabitants. The death-rate of the entire state in 1900, on the basis of the number of deaths reported to the census enumerators in that year, was about 7 ‘7. Of the total population in 1900, 216,164 (53”8 per cent.) were males and 185,406 females; 313,062 (78 per cent.) were native- born and 88,508 foreign-born ; 380,714 (94 ‘8 per cent.) were white and 20,856 were coloured, of whom 465 were negroes, 165 Chinese, 1 Japanese, 20,225 Indians. Although there are numerous settle- ments of Scandinavians, Germans, I)utch, Bohemians, and other nationalities, the American element is being rapidly increased by the immigration of farmers from Iowa, Wisconsin, Illinois, and other states, who, having sold their farms at high prices, go west to buy equally good lands at a cheaper rate. Great numbers of Indians have abandoned their tribal relations and are taking their lands in severalty.

History and Politics. ►►► The state formed a part of the Louisiana purchase, and a portion of it was at one time included io Jlinnesota territory, and later formed a part of the territory of Nebraska. The territory of Dakota was organized in 1861, and included the present states of North and South Dakota and a large portion of Wyoming and Montana. It contained less than 5000 white inhabit- ants. In 1870 that part of the territory that is now the state of South Dakota contained 11,776, and in 1880, 98,268, an increase for the decade of 734”5 per cent.

The first constitutional convention met at Sioux Falls in October 1883, and drafted a state constitution, which was adopted by the people and presented to Congress for approval ; but no action was taken. On 22nd February 1889 Congress jiassed an Enabling Act, under which South Dakota Avas admitted as a state, 3rd November 1889. The former large Indian reservations west of the Missouri river have been subdivided and large portions thrown open to .settlement.

The state is Ilcpublican in politics, but was carried for Mr Bryan and the Populist ticket in 1896 by a majority of a few hundreds, and in 1 898 a Populist governor was elected by a small majority, though the Republican Congressmen and the balance of the state ticket were elected by a large one. In 1900 the state went Republican by a plurality of 14,986. Three important amendments to the constitution were submitted to the voters at the election of 1898. One of them, invoMng the initiative and referendum systems of legislation, was adopted by a majority of 7331 ; another, involving women's suffrage, was defeated by a majority of 3285 ; and the third, involving

the dispensary liquor system founded on that of South Carolina (see Liquor Legislation), was adopted by a majority of 1643; the Legislature of 1898-99, however, instead of enacting any legislation to put the amend- ment in force, passed a resolution submitting to the voters its repeal, which was carried in the election of 1900. The civil and penal codes, as well as civil and criminal codes of procedure, are similar to those adopted in Cali- fornia, and are founded on those favourably reported by the Code Commissioners of New York. (b. t.)

South Ea,Ston, a former borough of Northampton county, Pennsylvania, U.S.A. It is on the south bank of the river Lehigh, at its mouth, opposite Easton, on the Lehigh Valley Railroad. It is situated mainly on the summit of the river cliffs, here 100 feet pr more in height. Population (1880), 4534; (1890), 5616. In 1890 it was annexed to Easton.

Southend-On-Sea, a municipal borough (inoor porated 1892, extended 1897) and watering-place in the south-eastern parliamentary division of Essex, England, on the estuary of the Thames, 35 miles east of London by rail. A commission of the peace was granted to the borough in 1894. Modern buildings are a church, a theatre, and a large hall. There are a marine park of 26 acres, several pavilions, a revolving tower, and other attractions. Southend has considerably extended towards the west, and a new and handsome suburb, Westcliffe, now adjoins it on that side. Westcliffe has a railway station on the London and Tilbury line, several hotels, and many pretty villas, commanding delightful views of the mouth of the Thames and the opposite county of Kent. Population

(1881), 7979; (1901), 28,857.

South Framing^ham, a village in the town of Eramingham, Middlesex county, Massachusetts, U.S.A. It is in the eastern part of the state, at an altitude of 163 feet, at the intersection of the main line of the Boston and Albany with a line of the New York, New Haven, and Hartford Eailroad.

South Georgia, an uninhabited British island in the South Atlantic, about 900 miles south by east of the Falklands, 54 ̊-55 ̊ S. and 36 ̊-38 ̊ W. ; area, 1600 square miles. It is mountainous, with snowy peaks 6000 to 8000 feet high, their slopes furrowed with deep gorges filled with glaciers, which in some places descend to sea^ level. Its geological constitution [illegible] gneiss and argillaceous schists, with no trace of fossils [illegible] shows that the island is, like the Falklands, a surviving fragment of some vanished continent, most probably indicating a former seaward extension of the Andean system. At Royal Bay, on the [illegible] south-east side, was stationed the German expedition sent out to observe the transit of Venus in 1882. The slopes being covered with succulent herbage (tussock grass), the island would be well suited for cattle or sheep farming but for its damp, foggy climate, with a mean annual temperature of 34 ̊ or 35 ̊ F., seldom rising to 66 ̊, but \ \ falling in winter to 9 ̊ or 10 ̊. Yet, regard being had to the conditions, the flora is surprisingly rich, and the German naturalists were able to collect thirteen flowering plants, mostly common also to the

Falklands, but one allied to a form found in distant New Zealand. South Georgia is politically attached to the Falldands.

South ing^On, a town of Hartford county, Con- necticut, U.S.A. It is near the centre of the state, mainly in the valley of Quinnipiac river, and extending to the hills on either side. Within its area of 38 square miles is a borough of the same name, located on the river, at an altitude of 149 feet and on a line of the New York, New Haven, and Hartford Railroad. Its manufactures consist

largely of cutlery and other metal goods. Population of the town (1890), 5501; (1900), 5890; of the borough (1900), 3411, of whom 790 were foreign-born.

South McAlester, a city of the Choctaw Nation, Indian Territory, U.S.A. It is near the centre of the territory, at the intersection of the Missouri, Kansas, and Texas and the Choctaw, Oklahoma, and Gulf railways, at an altitude of 716 feet. Near it, on the east and west, are the valuable coal-mines of Indian Territory, and its prosperity is in great part due to the handling and shipping of coal. Its inhabitants consist almost entirely of whites, as the Indians remain aloof from the railroad. Population (1900), 3479, of whom 119 were foreign-born, and 621 coloured, including 592 negroes.

South Norwalk, a city and seaport of Fairfield county, Connecticut, U.S.A. It is at the mouth of the river Norwalk, and on the New York, New Haven, and Hartford Railroad, in the south-western part of the state. The site rises from the water, and beautiful villas have been built upon it. Its harbour is good, and there is regular steamer communication with New York and other Sound ports. Population (1880), 3726; (1890), 6152; (1900), 6591, of whom 1528 were foreign- born.

South Omaha, a city of Douglas county, Nebraska, U.S. A It is on the west bank of the Missouri, immediately adjoining Omaha on the south, at an altitude of 1124 feet. It is entered by seven railways. Next to Chicago and Kansas City, it is the greatest slaughtering and meat-packing centre in the United States, contain- ing several large packing-houses and immense stock-yards. In 1900 it had 109 manufacturing establishments,

with a capital of $16,471,329, employing 6606 hands, and with a product valued at $70,080,941. Of this product no less than $67,716,724 was wholesale slaughtering and meat packing. It was chartered in 1885. Population (1890), 8062 ; (1900), 26,001, of whom 5607 were foreign-born and 571 negroes. There were 8106 persons of school age (5 to 20 years). Of 9880 males 21 years of age and over, 205 were illiterate (could not write).

South Orangfe, a township and village of Essex county. New Jersey, U.S.A. It is on the river Eahway, and on the Delaware, Lackawanna, and Western Railroad, in the north-eastern part of the state, at an altitude of 142 feet. It is 15 miles west of New York City, of which it is in great measure a residential suburb. It has a beautiful situation on Orange mountain, and contains many fine residences. Population of the village (1900), 4608; of the township, exclusive of the village (1900), 1630. Of the population of the village in 1900, 1140 were foreign- born.

South port, a municipal borough and seaside resort in the Southport parliamentary division of Lancashire, England, 18i miles north of Liverpool by rail. Modern erections are the Victoria Science and Art School, an infirmary, and additions to the convalescent hospital. A marine park was laid out in 1887; a marine carriage drive and a recreation ground were provided in 1895. Area (1891), 3665 acres. Population (1891), 41,406. In 1900 the area was extended to 9093 acres. Population (1901),

48,087.

South Portland, a city of Cumberland county, Maine, U.S.A. It is on Portland harbour, and on the Boston and Maine Railroad, in the south-western part of the state. It has been formed from a part of Cape Elizabeth Town. Population (1900), 6287, of whom 763 were foreign-bom.

Southwell, a parish, city, and township in the Newark parliamentary division of Nottinghamshire, Eng- land, 14 miles north-east of Nottingham by rail. The cathedral church of St Mary, founded in 630 by the first archbishop of York, is a magnificent cruciform building, mainly Norman, but partly Early English in style, with some Perpendicular insertions. In 1882 it was thoroughly restored at an expenditure of about ??20,000. The ancient palace of the archbishops of York, now partly ruinous, adjoins the churchyard of the minster, and in 1882 its " great chamber " was restored. The episcopal see of Southwell was founded in 1884. The city has lace and silk factories. The racecourse was closed in 1898, owing to its dangerous condition. Population (1881), 2866 ;

(1891), 2831; (1901), 3160.

South -West Africa, German.

??? This

German possession covers roughly the region formerly known as Damaraland and Namaqualand. The coast in features ^^ entire length of about 800 miles has no good harbour, and those ports which exist ??? Angra Pequena, Sandwich Harbour, Walfish Bay ??? are gradually being filled with sand by the strong, cold, northerly coast current. Only Swakopmund, where prbper precautions are taken, is likely to escape this fate. The coast-line is bordered byabeltof sand-dunes and desert, which in the south is about 35 miles wide and narrows towards the north. On the east this coast belt is flanked by a mountain range, which attains its highest elevation in Mount Omatako (8500 feet). These mountains form the escarpment of the great Kalahari plateau, which, gently rising from the interior towards the coast, slopes again towards the south and north from the point of its highest elevation. The Kalahari plateau changes the undulating character which it has in the west to a perfect plain in the far east, where the habitable country, with water, merges into the sterile Kalahari desert. There are only two important rivers found in South- West Africa, which do not entirely belong to the hydrographic system of the country. The Cunene comes from the Portu- guese colony of Angola, and for a short distance forms the northern boundary of the colony ; the

Orange river, which forms the entire southern boundary, is the recipient of all the rivers of the protectorate which have a southerly direc- tion. The Cunene and Orange have water all the year round, but are not navigable. The Okovango, which comes from the north and runs into Lake Ngami, is also perennial, but, like the other two rivers, belongs only partly to the hydrographic system of the country, receiving the rivers which take a northerly course. All the other streams of the protectorate, especially those running westwards, have water only after heavy rain, and only in exceptionally rainy years do they carry it on to the ocean. It mostly disappears in the sand which fills the river-beds, and there the water may be obtained by digging. The chief rivers are the Great Fish river and the Oub and Nosob, which, together with another eastern Ijranch, form thu Malopo. Both join the Orange. The Okavango receives the Omuramba and Umatako ; the Kuisip and Swakob flow into the Atlantic. Hot springs are frequent, and it is remarkable that those of Windhoek flow more copiously during the dry than the rainy season.

On the coast the mean temperature is low, and tliere is little rainfall. The necessary moisture is supplied by dense fogs, which ___ rise almost daily. South-west winds prevail. The in-

. ” terior enjoys a luxurious climate, with bracing, clear

atmospliere. There are considerable diiferences of temperature lietween day and night, and two well-niarki’d seasons, I one cold and dry from May to Septi-nibtT, the otlier hot and rainy from October to Apiil. In winter ice frequently forms during the night on 0]ii’n water on the plateau, but it never remains all day. The yearly rainfall is not great ; there is more in tlie north than in the soutli, and in tlio east than in the west, so that the north- cast part of the protectorate is probably that “witli the most

abundant atmospheric precipitation. Only here malarial fevers sometimes occur.

The vegetation corresponds exactly with the climate. In the dry littoral region we iind plants able to exist with the minimum of moisture they derive from the daily fog ___ Amarantacea, . .

*Sarcocaula, Aloe dichotoma, Aristida suhacaulis, and , *”’ the wonderful WelwitscMa. Farther inland we can dis- tinguish between those plants which spring up and disappear with the rain and those whose roots reach permanent water. The former are chiefly grasses, the latter exist almost solely in or near river- beds. Amongst the truly fine trees often seen here, the Ana tree (Acacia albida) is the most noteworthy, its seeds being favourite fodder for all domestic animals. Acacia giraffes, Ac. horrida, Adansonia sterculia, near the Cunene the ‘Hyphceiw ventrico^a, deserve special notice. Large game, which was formerly abundant, especially pachyderms, is scarce now. Of antelopes the following species are still plentiful in parts : springbok, steenbok, kudu, rietbok, pallah ; of monkeys, the Gynocephalus porcarius is fre- quent. Various kinds of hysenas and jackals with fine fur {Canis mesomelas), also Felis caracal, abound. The spring-hare [Pedestea caffer) and rock-rabbit (Hyrax capensis) may often be observed by the traveller. Of birds there are 728 species. Crocodiles, turtles, and snakes are frequent.*

Among the coloured inhabitants of South- West Africa three classes may be distinguished. Of the Hottentot and Bushmen, the former probably came from the south, while thCp . . latter, together with the second class, the Mountain ” ??^^’

Damara, may. be looked upon as indigenous races. The third class belongs to the Bantu stock, and came from the north-east, expel- ling and enslaving the Mountain Damaras, and settling in various parts of the country under different names. The most prominent are the Herero, thorough nomads and cattle-breeders ; while the Ovambo or Ambo, in the northern part of the protectorate, are agri- culturists. The Herero waged long wars with the Hottentots, who are divided into twelve tribes under as many chiefs. One of them, Hendrik Witboy, was the inveterate enemy of the Herero ; then turned against the German administration, whose friend and ally he afterwards became. The Bastards are a small tribe originating from a mingling of Cape Boers with Hottentots. They are all Christians, able to read and write, and probably destined to play a part iu the future of the colony.

South- West Africa was annexed on 7th August 1889, when the German flag was raised in Luderitz Bay. Its northern boundary is the Cunene river and a strip of Portuguese territory, as arranged by agreement of December 1886. From """ the mouth of the Cunene the boundary goes ^^"^S^oou'lat^oa to the rapids which this river forms on cutting through the Serra Cama ; thence along the parallel of that locality until it reaches the Kubango, following this river to a spot called Andara, which remains on the German side, and thence straight to the Catima rapids of the Zambezi. The west boundary is the ocean from the mouth of the Cunene to that of the Orange river ; the territory of Walfish Bay forms a small British enclave of little im- portance. Tire south and east boundaries, according to agreement of 1st July 1890, runs as follows : ??? From the mouth of the Orange river along its northern bank to where this is struck by 20?? E. Thence along the meridian to its point of intersection with 22?? S. Along that parallel to where it cuts 21?? E. ; it follows that till it reaches 18?? S., along which it continues as far as the Chobe, following the valley of that river to its confluence with the Zambezi. The area thus enclosed measures about 322,450 square miles. The population is estimated at 200,000, 125,000 of whom are Bantu. The European population in 1900 numbered 3388, of whom 2104 were German, besides military.

German South-West Africa is divided into three districts, Keet- manshoop, Windhoek, and Otyimbingue. In each of these is a Bezirksamtmanv , with his staff' of officials and a small police force. Each district has a number of small stations, where a non-commissioned officer with a few men keeps the natives in order. In each district is a law court, to whose jurisdiction not alone the whites but also the Bastards are subject. As in all German colonies, there is a court of appeal at the residence of the governor. In Keetmanshoop there is a mining department to register claims and to grant mining licences. The armed force consists of about 1000 regular troops and a militia formed of Bastards. The Landeshauptmann is the chief adminis- trator and commander of the forces.

With the exception of the Bastards, the natives are all pagans. The Rhenish Mis.sionary Society is doing good service on eight stations and the Finnish Mission on five stations in the northern part of the country.

The revenue of South-West Africa is small, and the empire has to pay a considerable subsidy. The revenue for 1901 was 10,452,000 marks, inclusive of an imperial contribution of 9,103,000 marks; expenditure, 10,452, 000 (□□527,600). □□"□□"□□□□□ The sale of land is progressing favourably, and the growing number of European settlers causes a corresponding increase of imports.

Govern' went.

SOUTHWOLD□□□ SOVEREIGNTY

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Various taxes exist in those parts of the protectorate where Govern- ment authority has heen thoroughly established. On articles of ex- port, such as feathers and hides, 5 per cent, ad valorem duty has to be paid ; on cattle and horses, an export tax per head. The sale of spirituous liquors is subject to a licence, and travelling traders pay for each waggon, cart, or horse they employ.

There is regular steamship communication between Hamburg and Swakopmund. The Woerman line despatches a steamer once in two

. , months, which calls at Swakopmund, "Waltish Bay, and '- Liideritz Bay. A small steamer plies regularly between

the coast harbours. A sailing vessel leaves Cape Town regularly once in six weeks, and calls at Liideritz, Waliish Bay, and Swakop- mund. A small schooner sails between Cape Town and Liideritz Bay only, and a steamer calls about once a month at Waliish Bay and Liideritz Bay.

A narrow-gauge railway is in course of construction between

Swakopmund and the interior, of which about 180 miles were open

for traffic at the end of 1901. The existing roads have

*/ *’ rf been considerably improved. On several spots wells Yi ‘ <, have been dug, to enable transport riders to rest their * ??? cattle where formerly want of water made forced marches necessary. The constmction of water reservoirs or dams is progressing steadily. Across the'Awas mountains a wide road has been cut. The protectorate is within the Postal Union, and there is a post office in every larger settlement. From Warmbad runners carry mails once a fortnight to the nearest post office in Cape Colony. From Windhoek a mail cart goes to Swakopmund, and thence either vid Cape Town with the English mail or direct to Hamburg with the Woermann steamer. There is no telegraphic communication with South-West Africa. Telegrams are received at Cape Town and forwarded by ordinary mail.

The products are chiefly animal. The scarcity of water in the southern parts is not favourable for agricultural pursuits, while the good grazing lands offer splendid pasturage for cattle, TO uc- -vjrjiicli the Herero raise in numbers amounting to many . “, ‘ hundred thousands. A flourishing cattle trade with

Cape Colony existed before the rinderpest. Hides form a valuable export article ; also feathers and horns. Sheep thrive well, and are beyond doubt the stock of the future. Goats also answer well. Horses have been imported from the Cape. Un- fortunately, the climate does not suit them everywhere, and they are subject to a virulent distemper. Cattle and sheep also suffer from the diseases which are common in the Cape Colony. Camels have been imported, and are doing well. Vegetable products are scarce ; agriculture is only carried on in the north, and the products ??? maize, sorghum, &c. ??? reach the south only in small quantities ; near the coast the natives collect the kernels of the nara, a wild- growing pumpkin ; they are exported to Cape Town. Minerals, especially copper, are plentiful in the country, but cannot yet be exploited owing to want of labour, cheap means of transport, and water. Of native industry there is next to nothing. A little pottery is carried on, and the women are clever in making fur cloths. In the north the Ovambo do a little smith-work and grass-plaiting. The imports in 1900 were valued at 6,968,400 marks and exports 907,600 marks. The chief exports are guano and ostrich feathers.

When South-West Africa was annexed, only a few mission stations existed, and a few white traders and hunters wandered ... . . through its wilds. Since then a considerable number

- *’”^’ of settlements have sprung into life, of which the most important is Windhoek, the seat of the Lcmdeshauptinann, estab- lished on the old site of Jonker Afrikander’s residence ; and little Windhoek, a purely agricultural settlement, where the growth of the grape from the Cape promises every success. In the beginning the natives were hostile, and Hendrik Witboy strenuously opposed German rule. After a protracted war he was subdued, and became a firm ally of the authorities. Safety of life and property was thus secured throughout the country. Many companies, some of them British, have heen formed. Private settlers are increasing, and they are recruited mostly from the men who have served their term in the colonial force and have had every chance of judging for themselves the resources of the country. In 1895 there were 13 trading firms, in 1898, 98.*

Authorities. ... N. Schinz. Deutsch Sud- West Africa. Leipzig, 1891. ... ScHWABE. Die Verkehrs-Verhaltnissedes Deutsch Siid- West Africanischen Schwtzgebietes. Berlin, 1897.^Eehbook. Deutsch Siid - West Africa. Berlin, 1898. (j. von p.)

SOUthWOld, a municipal borougk and watering- place of Suffolk, England, in the Northern, or Lowestoft, parliamentary division, 12 miles south-south-west of Lowestoft, with a station on a single line connecting with the Great Eastern at Halesworth. The church of St Edmund’s (Perpendicular) is an ancient flint structure. Herrings, sprats, smelts, and shrimps caught here are sent

to the London market. A lighthouse was erected in 1890 on the North CHff. In 1900 a jiier 270 yards long was constructed, and serves as a calling-place for pleasure steamers, and the corporation has expended large sums in the improvement of the sea front. A fine common to the south of the town is used for golf, lawn-tennis, cricket, and other sports. Population (1891), 2311;

(1901), 2800.

SovereigTlty. ❓❓❓ The word sovereignty is said to be derived from the mediaeval word supremitas, i.e., suprema potestas. (See Skeat's Etymological Dictionary as to various forms of the word, and Meyer, Lehrbuch des Deutschen Staatsrechts, 15, as to its derivation.)

Sovereignty may be viewed in three ways : there is the historical explanation of its origin and growth, its rude beginning in the savage horde, its completion in the modern state ; there is the analytical or juridical explana- tion ; there is also what (for want of a better phrase) may be called the organic explanation of sovereignty.

The following are some of the chief stages in the history of sovereignty : ❓❓❓ While society is in a rude state or only tribally organized, there is no distinct sovereignty, no power which all persons habitually obey. Thus there is no sovereignty among wandering groups of Australian savages : each family is isolated; each horde is a loose and unstable collection. When the horde has become a tribe, there may exist no definite sovereign. Distinct in time of war, the power of the chief may be fluctuating and faint in time of peace ; even in time of war it may be subject to the authority of a council. Tribes of the same ethnic stock may form a sort of federation, permanent or temporary. "With the council of the confederacy," it has been said, " and, more generally, in the confederacy, sovereignty arises and the true political tradition is evolved " (Gid- dings. Principles of Sociology, p. 285). When the city and the State are conterminous, the seat of sovereignty becomes defined. Such was the condition of things in Greece, as considered by Aristotle in his Politics. He discusses the question what is the supreme power in the State (3. 10), which he defines as an aggregate of citizens (3. i.), and he recognizes that it rnay be lodged in one, a few, or many. In his view, the distinctive mark of the State is not so much sovereignty (7. 4) as self-sufficiency; a State is not a mei-e aggregate of persons ; it is a union of them sufficient for the purposes of life (7. 8) ; sufficiency being "to have all things and to want nothing" (7. 5. 1). The Roman jurists say little, and only incidentally, as to sovereignty. But in the Middle Ages, under the influence of the Eoman law, and with the belief in the existence of an empire entitled to universal sway, an absolutist theory of sovereignty was developed in the writings of

the jurists who revived the study of that law : the emperor was sovereign ; " quod principi placuit legis habet vigorem " (Institutes, i. 2. 6).

Those jurists often justified the plenitvdo potestatis con- ceded to the emperor by the fact that he stood at the head of Christendom. Among the theories prevalent in the Middle Ages was one that mankind formed a unity, with the pope and the emperor at the head of it : the universal Church and the universal emperor ruled the world. Even to Leibnitz, writing in the 17th century, it seemed that "totam Christianitatem unam velut Rempublicam componere, in qua Caesari auctoritas aliqua competit" {Opera, 4. 330). When the power of the emperor was weakened, and the idea of a universal ruler was gone, a new test of sovereignty was applied ??? that of external independence ; the true sovereign States were universitates superiorem non recognoscentes. There were

times and countries in the Middle Ages in which the collective power of the community was small : many of the great corporations were virtually autonomous; the central authority was weak; the matters as to which it could count upon universal obedience were few. In such circumstances the conception of sovereignty was imperfect. It has been suggested that the modern conception of it was evolved from the contest between three powers : the Church, the Eoman Empire, of which the individual States in Europe were theoretically provinces, and the great landowners and corporations. Whatever may be the truth as to this, the modern theory is first clearly stated in Jean Bodin's book On the Commonwealth (French edition, 1576; Latin version, 1586), which was the first systematic study of sovereignty. Bodin defines the State thus : " Kespubhca est familiarum rerumque inter ipsas communium, summa potestate ac ratione moderata multitudo." His theory, which corresponded on the whole to the state of things in France in the time of Louis XL, was a theory of despotism. It may be also described as a type of the mechanical or juridical theory of sovereignty. According to Bodin, there is in the State unlimited one power

: " Majestas est summa in oives ac subditos legibus- que soluta potestas " (i. p. 8). There exists a central force from which are derived all the powers which make or give effect to laws ; a power which he describes sometimes as " majestas summa potestas summum imperium." This was the conception expressed by Bossuet, " Tout I'etat est en la personne du prince," or in Louis XIV. 's saying, " LMtat c'est moi."

One favourite theory was that sovereignty originated in a social contract. It was assumed that the individual members of society, by express or implied pact, agree to obey some person or persons; sometimes it is described as an unquahfied handing over ; sometimes it is a transfer subject to qualifications, and with notice that in certain contingencies this will be vsdthdrawn. Gierke, in his book JohanTies Althusius und die Entwichelung der Naturrecht- lichen Staatstheorie, shows (p. 76) that the conception of a treaty or agreement as the basis of the State was in the Middle Ages a dogma which passed almost unchallenged, and that this theory was maintained up to a late period. It is to be found in the writings of Thomas Aquinas {de Eegimine Principwm, 266), Marsillus of Padua, Buchanan, Mariana, and Suarez. It is the kernel of the theories of Hobbes, Kousseau, Filmer, and Locke. Among the clearest and most logical exponents of this theory was Hobbes, who in his Leviathan expounded his notion of an agree- ment by which absolute power was irrevocably transferred to the ruler. Puffendorf, with some variations, states the same theory. In his view there is a pactum, unionis, followed by a pactum, subjectionis. The best-known ex- ponent of this theory of the source of sovereignty is Rousseau, who assumes the existence of a pacte social, the terms of which are : " Chacun de nous met en commun sa personne et toute sa puissance sous la supreme direction de la volont^ g^n^rale ; et nous refevons encore chaque membre comme partie indivisible de tout" (Du Contrat Social, . c. 6).

Those who distinguish society from the State, and who see in the latter only one of a group of institutions included in the former, do not regard sovereignty in any of the above lights. The tendency of students of sociology is to give little prominence to sovereignty, and to treat it as an incident of a highly organized society. Comte, Spencer, Bagehot, Durkhcim, and Giddings, for example, refer to it, if at all, only briefly and

incidentally ; they conceive society as an organism, or at all events as a growing whole, no one jiart or force being the cause of all others, and all interacting ; society is not the product

of any agreement or of force alone, but of a vast variety of interests, desires, and needs. Not the State or Govern- ment comes at a certain stage of organization : small groups are drawn together ; powerful corporations fall into line ; a national feeling develops ; eventually the State as we know it is formed. Sovereignty is a resultant of many forces. It may not exist as to some regions of conduct ; as to others it may be weak and mutable ; only in certain conditions is the sovereign power supreme as to all matters of conduct.

Among the different senses in which " sovereign " has been used are the following : ???

(a) " Sovereign " may mean titular sovereign ??? the King in the United Kingdom, the Kaiser in Germany.

(6) The legal sovereign : the person or persons who, according to the law of the land, legislate or administer the Government.

(c) The political or constitutional sovereign : the body of persons in whom the actual power at any moment or ultimately resides. Sometimes this is designated " the collective sovereignty."

(d) Sovereignty is^ also used in a wider sense as the equivalent of the power, actual or potential, of the whole nation or society (Gierke, 3. 568).

The distinction between real and nominal sovereignty was familiar to mediaeval writers, who recognized a double sovereignty, and distinguished between (1) the real or practical sovereignty resident in the people, and (2) the personal sovereignty of the ruler. (Adolf Dock, Der Souveranitdtshegriff, &c., p. 13.) By many writers sove- reignty is regarded as resident not in any one organ, but in the Gesammtperson of the community (Maitland, Political Theories of the Middle Ages, xliii.).

Sometimes sovereignty is defined as the organized or general will of the community (Combothecra, Conception Juridique de I'Etat, p. 96). " Sovereignty is the organized will of an organized independent community. . . . The Kings and Parliaments who serve, as its vehicles." " Sovereignty resides in the community " (Woodrow Wilson, p. 1448). The same theory is often expressed by saying that the majority in a community, or a particular group, in fact, rules (Guizot, Eepresentative Govern- nient, i. p. 167). This was the doctrine of the French Revolution. " Sachez que vous gtes rois et plus des rois," said a revolutionary orator cited by Taine. It was the language of the founders of the American Constitution and contemporary political wi-iters; the language, for example, of Paine : " In republics such as there are established in America the sovereign power, or the power over which there is no control and which controls all others, remains where nature placed it ??? in the people" {Dissertations on Government, i. 6).

The same theory assumes a more subtle form, especially in the writings of Hegelians. Sovereignty is with them a term descriptive of the real will of the community, which is not necessarily that of the majority. " If the sovereign power is to be understood in this fuller, less abstract sense, if we mean by it the real determinant of the habitual obedience of the people, we must look for its sources much more widely and deeply than the analytical jurists do ; it can no longer be said to reside in a deter- minate person or persons, but in that impalpable congeries of the hopes and fears of a people bound together by common interest and sympathy, which we call the common will " (Green's Works, 2. 404). " Though it may be misleading to speak of the general will as anywhere, either actually or properly, sovereign . . . yet it is true that the institutions of political society are an expression of, and are maintained by, the general \ill " (2. 409).

Sovereignty is used in a further sense when Plato and

Aristotle speak of the sovereignty of the laws (Laws, 4. V15; Politics, 4. 4; 3. 15). Thus Plato remarks: "I see that the State in which the law is above

the rulers, and the rulers are the inferiors of the law, has salvation." (See also Gierke, Genossenschaftsrecht, 3. 8.) Even in mediaeval writers such as Bracton is found the notion that the king is subject to the laws : " Bracton knows of no sovereign in the Austinian sense, and distinctly denies to the royal authority the attribute of being in- capable of legal Kmitation " (Figges, Tfie Divine Bight of Kings, p. 13). We find the same expressed by many Gerfeian jurists, i.e., the idea of a State which exists only in the law and for the law, and whose life is but by a legal order regulating public and private relationship (Gierke, iii. x.).

Among the definitions of sovereignty may be quoted these : " That which decides in questions of war and peace, and of making or dissolving alliances, Deflaltloas amj about laws and capital punishment, and reignty. exiles and fines, and audit of accounts and examinations of administrators after their term of office" (Aristotle, Politics, 4. 4. 3). "Suprematum illi tribuo qui non tantum domi subditos manu militari regit, sed et qui exercitum extra fines ducere et armis, foederibus, legationibus, ac caeteris juris gentium function- ibus aliquid momenti ad rerum Europse generalium summam conferre potest " (Leibnitz, Opera, 4. 333). " La souver- ainet^ est celle qui sert a exprimer I'independance d'un ^tat aussi bien k I'int^rieur qu'a I'extMeur " (De Martens, Traits du Droit International, translated by A. Leo, 1881, i. 378). " L'independance complete qui peut se manifester a deux points de vue; Tun extMeur, I'autre int^rieur" (M. Despagnet, Droit International Public, 1894, p. 80). " Sovereignty as applied to States imports the supreme, absolute, uncontrollable power by which any State is governed " (Cooley, Constitutional Limitations, p. 1). " Social control, manifesting itself in the authori- tative organization of society as the State, and acting through the organs of Government, is sovereignty " (Giddings, Elements of Sociology, p. 217). See the col- lection of definitions in Der Souveranitdtsbegriff im Bodin, (fee, by Dr Adolf Dock (1897), p. 6, and in La Conception Juindique de V^tat, by Combothecra, p. 90).]\Iany of these definitions describe an ideal state of things rather than realities. Some of the definitions would apply to the authority of powerful religious bodies in certain periods of history, or of illegal associations, such as the Mafia, which have terrorized the community.

Territorial sovereignty is used in a variety of senses. Often the phrase is the equivalent of sovereignty. It may mean a state of things such as existed in the Middle Ages, in which ownership and sovereignty were not clearly separated : when he who was owner had sovereign rights incident thereto, or, as it was sometimes phrased, when sovereignty inhered in the territory, when the king was the supreme landowner (Maine, Ancient Law, 106) ; when all political power exhibited proprietary traits, and was incident to the ownership of land (Maitland, Township and Borough, 31). Territorial sovereignty is thus defined by Leibnitz : " Superioritatem territorialem in summo subditos coercendi jure consistere " (Opera, 4. 358. See Laband, 1. c. 8).

Certain propositions are often stated with respect to sovereignty. One of them, stated by Rousseau (Du Gontrat Social, 2. c. 2), is that it is indivisible : Nature a proposition true in the sense that in regard to the same matters at the same time there can- not be two sovereigns, but not true in the sense in which it has often been employed, namely, that in the last analysis of society there are some persons or person

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reignty.

who controls all conduct and are habitually obeyed as to all matters. Rather we may say with ilaine, "Sove- reignty is divisible, but independence is not." A frequent deduction from the theory of the indivisibility of sove- reignty is that there cannot be double allegiance ; in other words, no one can be the subject of two States. This deduction is not in fact true. With the existing differ- ences in the laws of modern States as to nationality, persons may be, and are, subjects of two or more States. In the native states in India there may be said to be double allegiance. Mr Tupper, in his work on Indian Protectorates, refers to " the double allegiance of the subjects of native states " in India ; and he explains that the native rulers are themselves subject to the Indian Government. " For all purposes of our relation with Powers the subjects of Indian native states must be regarded as subjects of Her Majesty" (Tupper, Indian Protectorates, p. 353). Such double allegiance is apt to exist in times of transition from one sovereignty to another \ for example, in the 18th

century, in the British possessions in India, the Mogul was said to exercise a personal sovereignty. As Sir William Scott remarked in the Indian Chief, 3 C. Rob. 22, it hardly existed otherwise than as a phantom : the actual authority was exercised by the East India Company.

Another deduction from the same proposition is that any corporation or private body which appears to exercise sovereign powers together with the State does so only by delegation. This theory is thus stated by Burke (Worhs, 7. 289) with reference to the East India Company : " The East India Company itself acts under two very dissimilar sorts of power, derived from two sources very remote from each other. The first source of its power is under charters which the Crown of Great Britain was authorized by Act of Parliament to grant, the other is from several charters derived from the Emperor of the Moguls. ... As to those of the first description, it is from the British charters that they derive a capacity by which they are considered as a public body, or at all capable of any public function. . . . This being the root and origin of their power, renders them responsible to the party from whom all their immediate or consequential powers are derived."

Another proposition often stated with respect to sovereignty, is that it is unlimited : a proposition which is not true of the legal or political sovereign. In all States are limits, more or less definite, to such powers, according to the character of the subjects and the relations of the State to foreign powers. Even despotism is tem- pered by assassination and the liability of revolution (Dicey, Law of the Constitution, p. 73). A third proposi- tion often expressed with respect to sovereignty, is that it cannot be alienated : a proposition thus stated by Rousseau : "Je dis que la souverainet^ n'^tant que I'exercise de la volontd g^n^rale, ne peut jamais s'ahener" (Du Contrat Social, 2. 1).

According to one view, sovereignty is not the distinctive note of a State. Many communities usually regarded as true States do not possess it. There are sovereign and non-sovereign States ; international law recognizing both. In the view of many writers sovereignty is not a necessary- attribute of a State, but a mark of independence (Laband, Das Staatsrecht des Deutschen Reiches, 1. 87 ; Jellinek, Die Lehre von der

Staatenverbindungen, p. 37 ; ileyer, Lehrbuch des Deutschen Staatsrechtes, p. 5 ; Rehm, Allge- meine Staatslehre. See the contrary view presented by Professor Burgess, Political Science or Constitutional Law, i 52; Political Science, Quarterly, 3. 123; M. Georges Streit, Revue de Droit International, 1900, p. 14).

The phrase half sovereign States was invented by J. J. Moser to describe States possessing some of the attributes

of sovereignty. Under this class are grouped very diverse communities. There are States which possess some

attributes of sovereignty, but not others ; States Halt- possessing internal autonomy, but not exter-

^Staies ^^ '^^-'ly independent ; States v^hich are more or less

under the influence of others. There are also States which have certain of the attributes of sovereignty, but are subject to servitudes or burthens imposed by treaty, usage, or force. Feudalism had a phraseology to express the varieties of fiefs which existed under it ; modern inter- national law has no generally accepted terminology for the still greater variety of States which now exist. These varieties tend to multiply, and it is difiicult to reduce them all to a few types. The theory that States are equal, and possess all the attributes of sovereignty, was never true. It is still more at variance with the facts in these days when a few great States predominate, and when the contact of Western States with African and Asiatic States or communities gives rise to relations of dependence falling short of conquest. The division into federations, confederations, and alliances is not complete. Jellinek has suggested this classification {Die Lehre von der Staaten- verhiiidungen, p. 58) : (a) Unorganized associations, in- cluding ??? (1) treaties ; (2) occupation of the territory of one State and administration by another, as in Bosnia and Cyprus ; (3) alliances ; (4) protectorates, guarantees, per- petual

neutrality ; (5) Der StoMtenstaat, the feudal State, of which Jellinek gives the Turkish empire and the old German empire as examples, (b) Organized associations, including ___ (1) international commissions (internation- ale VerwaltvMgsvereine, such as international postal and telegraph unions, &c.) ; (2) the Staatenhund or federal State ; (3) real unions of States as distinguished from personal ; (4) the Bundesstaat. Most of the existing varieties may be conveniently ranged in the foUovnng classes : ___

(1) States which have complete independence, complete autonomy, external and internal, and which are recognized in international law as sovereign States.

(2) States which have complete external independence, bat are more or less subject permanently to other States as to their internal affairs. Of this class there are few examples. Perhaps, however, such States as permit, permanently or normally, of interference by others on behalf of certain classes of subjects may be so described. Among such are Bulgaria, Montenegro, Servia, and Rumania, as to which the Treaty of Berlin (Article 5) of 1879 stipulates for rights of members of all creeds and religious worship. The general principle is that a treaty does not detract from sovereignty. As Jellinek expresses it, " Der Staatenvertrag bindet, aber er unterwirft nicht " (Gesetz und Verordnung, p. 205) ; or as Grotius (1, c. 3, 22. 2) expresses it, "Nee regi aut populo jus demit summi imperii."

(3) States which enjoy complete autonomy as to internal affairs, but which are more or less subject to other States as to foreign relations. Some writers would place in this category all States forming part a of true confederacy. It includes States which are united temporarily ___ cases of inorganic unity, to use Jellinek's expression. It includes also permanent alliances or organic unions. These are some examples : ___ ___

(a) Protectorates and Suzerainties, The status of certain States, such as Bulgaria, Kumania, the late South African Eepublio, are jicouliar. They are undoubtedly for many purposes sovereign.

*(6) The unions between a superior and inferior State, e.g., the relations of the various States to the old German Empire ; the relations of the Ottoman Porte to its Christian provinces. In the Middle Ages the question ***was often mooted whether States subject to feudal superiors, or the States forming the German Empire, were sovereign. According to one common definition*

they were not : a true sovereign State was universitas quce non superiorem recognoscit. ‘ ‘ Celui est absolument souverain qui ne rien tient apres Dieu que de Tespee. S’il tient d’autrui 11 n’est plus souverain.” The prevalent opinion, however, was that sovereignty was compatible with rights such as were possessed by the Reich over the princes of Germany ; that there might be fiefs held in full sovereignty ; and that vassal States, when subject only to “nude vassalage,” were sovereign. That was the view of Grotius (1. 1. 0. 3, 23. 2), who holds that the nexus feudalis is consistent with summum imperium.

(4) States which have, by treaty or otherwise, parted with some portion of their sovereignty and formed new political units : what Mr Herbert Spencer calls ” compound political heads,” or, to use Austin’s expression, ” composite States.” The most important examples of this class consist of federal or composite States which by treaty or otherwise have surrendered certain of their powers, or which have created a new State (Staatenbund). For many years one of the burning questions in the pohtics of the United States was the question whether the individual States of the Union remained sovereign. According to the theory of Calhoun, the States had entered into an agreeinent from which they might withdraw if its terms were broken, and they were sovereign. According to the theory expounded in the Federalist, the individual States did not, after the formation of the constitution, remain completely sovereign : they were left in possession of certain attributes of sovereignty, while others were lodged in the Federal Government ; while there existed many States, there was but one sovereign. Even if the origin was a compact or contract, after the ” United States ” were formed by a ” Constitutional Act ” there no longer existed a mere contractual relation : there existed a State to which all were subject, and which all must obey (von Stengel, Staatenbund und Bundesstaat; Jahrbuchfiir Gesetzgebung, 1898, p. 754; Cooley, Principles of

Constitutional Law, pp. 21, 102). According to Austin: "In the case of a composite State or a supreme federal Government, the several united governments of the several united societies, together with a government common to these several societies, are jointly sovereign in each of these several societies and also in the larger society arising from the federal union, the several governments of the several united societies are jointly sovereign in each and all " (5th ed., i. 258). In point of fact, there are fields of action in which A is sovereign, others in which B is sovereign, and certain others in which A and B are jointly or alternately sovereign. To take the American Constitu- tion, for example, the States are sovereign as to some matters, the Federal Government as to others.

(5) Another division includes anomalous cases, such as Cyprus or Bosnia, in which one Government administers a country as to which another State retains certain powers, theoretically large.

(6) The territories governed or administered by chartered companies form a class by themselves. Nominally such companies are the delegates of some States ; in reality they act as if they were true sovereigns.

(7) Two other classes may be mentioned : {a) cases of real union between States, e.g., that between Austria and Hungary ; (6) personal unions, distinguished from the above-named forms ??? for example, the union of England and Hanover.

(8) A small group consists of instances of condominium or arrangements similar thereto ; for example, the arrange- ments as to the Samoa Islands from 1889 to 1899.

According to modern usage the appellation " sovereign State" belongs only to States of considerable size and population exercising without control the usual powers of a State, e.g., able to declare peace or war. Leibnitz, discuss- ing this subject in his Tractatus de Jure Supremat^is,

{Opera, 4. 362), says: “Itaque valde etiam dubito, an possit Reipublicae illi Italite, quam vocant Sancti Marini

oppidum, concedi suprematus, tametsi jure liberam ???’^* esse nemo neget,” a remark wbich. would apply

also to the Eepublic of Andorra : ” Illi tantum vocantur souverains ou potentats, qui territorium majus habent, exercitumque educere possunt ; atque hoc demum illud est, quod ego voco suprematum, et Gallos quoque arbitror, cum de rebus ad jus gentium spectantibus, pace, bello, foederibus sermo est, et ipsi aliquos vocant souve- rains, eos non de urbibus liberis loqui, nee exiguorum territoriorum, Dominisquoe facile dives Mercator sibi emere potest, sed de majoribus illis potestatibus, quae bellum inferre, bellum sustinere, propria quodammodo vi stare, fcedera pangere, rebus aliarum gentium cum auctoritate intervenire possunt ” (4. 359).

With this view may be compared that of a writer in the Law Magazine, vol. xxv., 1899, p. 30, who argues that the Eepublic of San Marino is a State in the full sense.

It is sometimes suggested tbat self-governing colonies are to be regarded as true States. Undoubtedly some

of tbem can no longer be regarded as colonies

in the old sense. The self-governing colonies forming part of the “multi-cellular British State,” as Mr Maitland describes it {Political Theories of the Middle Ages, p. x), have an essentially “State-like character.” If Liberia is a State, the same may surely be said of Canada. It is true the British colonies have not the power of declar- , ing war or peace, or regulating the foreign policy of the Empire ; and the Crown may disallow a measure passed by the Dominion Parliament (Bourinot, Constitution of Canada, 1888, p. 75 ; Lefroy, Legislative Power in Canada, 244). Colonial legislatures are said to have delegated powers. It is more accurate to say that as to certain matters the Legislature of the Canadian Dominion is sovereign, and as to certain others that it is not (Lefroy, 244; Quick and Garrad, Australian Common- wealth, 328 ; Dicey, 106) ; and as to some

matters they are in fact, if not in form, universitates superiorem non recognoscentes (Quick and Garrad, 319); or that they are States in process of making. Occasionally the expression " subject of a colony " is now used {Low v. Routledge, L.R. 1 Ch. 42 ; Lefroy, Legislative Power in Canada, 329). At all events, the self-governing colonies may be classed as "haK sovereign States" or "quasi-sovereign."

Many attempts have been made to enumerate the attributes of sovereignty, i.e., the regalia, prerogatives, &c.,

as they were called. For example, Bodin gives Attributes a list of the properties of majestas or sovereignty : "r i^"nt' (") "I'^g^m universis, ic, singulis civibus dare

posse ; {b) bellum indicere aut pacem inire ; (c) to appoint and change magistrates ; {d) power of final appeal; (e) power of pardon; (/) raising revenue; {g) coining money" {De Republica, i. c. 10). Leibnitz, with the Middle Ages in view, divides the attributes or faculties into two classes : regaha majora and regalia minora. Hobbes {Leviathan), analysing these attributes, enumer- ates twelve attributes. " These," he says, " are the marks which make the essence of sovereignty, and which are the marks whereby a man may discover in what man, or assembly of men, the sovereign power is placed or resideth." He also describes them as " inseparable rights." Bluntschli {Allgemeine Staatslehre, i. 575) enumerates these attributes : (a) right of recognition of majestas; (6) independence; (c) power to determine constitution; {d) right of legislation; (e) action through deposed organs; (/) irresponsibility. All of these enumerations are open to the objection that they merely describe the action of the State at a particu-

lar time, or indicate a theory of what an ideal State should be.

Attthoeities. ◆◆◆ The literature of the subject is immense ; every book on political science, from Sepublic of Plato and the Folitics of Aristotle, has dealt with or touched sovereignty. A few of the chief modern works are ◆◆◆ Bltjntsohh. Alhjemeine Staatslehre. 1852. ◆◆◆ Gierke. Das Deutsche Genossenschaftsrecht. 1863-81. ◆◆◆ Austin. Lectures on Jurisprvdence, 3rd ed. 1869. ◆◆◆ Maine. Minute on the Xdthidwdr Stales. 1864 (printed in Life and Speeches, p. 320); Early History of InstUul ions. 1876. ◆◆◆ Laband. Slaatsrecht des Deutschen Meiches. 1876. ◆◆◆ Von Mohl. Encyclo- pddie der Staatswissenschaf ten, 2nd ed. 1872. ◆◆◆ Gierke. Johannes Althusius. 1880. ◆◆◆ Jellinek. Die Lchre von den Siaaisverhin- dungen. 1882. ◆◆◆ Meyer. Lehrbuch des Deutschen Slaatsrecht. 1878. ◆◆◆ Rosin. Souveranitatstaat. 1883. ◆◆◆ Gakeis. AUgemeines Slaatsrecht. 1882. ◆◆◆ Cooley. Constitutional Limitations, Q\ii ^A. 1890. ◆◆◆ Jellinek. Ucher Staatsfragmente. 1896. ◆◆◆ Westerkamp. Slaatenhwnd und Bnndesstaat. 1892. ◆◆◆ Green's ITorks. 1892. ◆◆◆ Fowler. Oily State of the Greeks and Hotnans. 1893. ◆◆◆ Salomon. L'Occupalion des Territoires sans Maitres. 1896. ◆◆◆ Dicey. Law of the Constitution, 5th ed. 1897. ◆◆◆ Combothecra. La Conception Juridique de VEtat. 1899. ◆◆◆ Eehm. Allgemeine Staatslehre. 1899. ◆◆◆ GiDDlNGS. Principles of Sociology, 3rd ed. 1899. ◆◆◆ BuRSEss. Political Science and Constitutional Law. 1899. ◆◆◆ Merriam. History of the Theory of Sovereignly since Rousseau. 1900. ◆◆◆ Bryce. Stitdies on History and Jurisprudence, 2. 49. 1901. ◆◆◆ BoRNHAK. Einseitige Abhdngigkeitsverhdllnisse unter den Modemen Staaten. 1896. ◆◆◆ Willoughby'. The Nature of the State. 1896. (j. Mf.)

Sower by, a large village, Yorkshire, England, in the Sowerby parliamentary division of the West Riding, on both sides of the river Calder, 3-^ miles west-south-west of Halifax and 1-^ mile distant from Sowerby Bridge station. Since 1894 Sowerby and its neighbouring parish of Sowerby Bridge have been governed by urban district councils. At Sowerby Bridge a free public library was opened in 1893. The population of the urban districts was ◆◆◆ Sowerby, in 1891, 4051 ; in 1901, 3653 : Sowerby Bridge, in 1891 (altered area), 10,426; in 1901,

11,477.

Spa., a watering-place in the province and 21 miles south-east of the town of Liege, Belgium. The altitude of the town varies from 820 feet to 1080 feet above sea-leveL The surrounding scenery is very picturesque, consisting chiefly of low, wooded hiUs. The town has flourished since the 16th century, but attained its highest popularity in the 18th century, when it was visited by, among others, Peter the Great, Gustavus III. of Sweden^ Joseph II. of Austria and the Emperor Paul of Russia (before he ascended the throne). Altogether there are sixteen springs, the waters being chalybeate (50 Fahr.). A new parish church was built in 1884-85. The Gallery Leopold II. contains a small museum, as well as music halls, reading-rooms, &c. Like Monte Carlo and Ostend, Spa permits public gambling in its casino. The season lasts from May to October, during which period the jjlace is visited by some 17,000 persons annually. Population (1890), 7109;

(1900), 8192.

Spa.hiS (in Persian Sipari, meaning "warriors," and synonymous with Sepoy) originally denoted the holders of fiefs in Central Asia who were under an obhgation to yield personal military service to their superior chief. In process of time the term came to be applied to the soldiery whom these inferior nobles furnished in their own stead. A Hke feudal institution existed in Turkey, and the " Spahis " were the light irregular cavalry which from the time of Sultan Amurath I. (1326) down to the beginning of the 19th century formed the flower of the Turkish army ; at one period they are estimated to have numbered 130,000. "Spahis" is the term now applied to certain native cavalry regiments in Algiers and Tunis, which are officered by Frenchmen.

SPAIN.

I. Statistics.

THE present 49 provinces of Spain are subdivided into 495 districts, &%j\^ partidos judidales, and 9274 parishes Territorial ►►" dyuntamientos. A plan lias been mooted divisions for once more grouping the provinces into and popu- regional divisions, and the parishes into groups latloa. ^Ys,o, to carry out the prevalent tendency towards decentralization. In 1857 the population, according to the census, was 15,464,340; in 1877, 16,631,869; in 1887, 17,673,838; in 1897 (excluding soldiers and their families abroad), 18,226,040, of which 8,884,389 were males and 9,341,651 females. The census of 1897 shows that there were 28,460 foreigners permanent residents and 9080 foreigners temporarily resident in Spain. Only 24 '7 9 per cent, of the whole population lived in towns. The density of the population is greatest in Galicia, parts of Catalonia and the Basque provinces ; lowest in Cuenca, Teruel, and some parts of Andalucia and Aragon. The average on the whole kingdom was 90 per square mile in 1887 ; 93 in 1897. In 68 towns (in 1897) the death-rate was higher than in iladrid, and the average was in the provinces from 1"95 per cent, in Canaries to 3 '88 per cent, in Palencia; and the birth-rate ranged from 2"78 per cent, in Pontevedro to 4'36 in Palencia.

The following table shows the provinces, area, and total Spanish population in 1887 and 1897 : ►►►

*T*i"nvinf>(aa*

Area in

Population,

Population,

J- 1 l-f V ILI^CQb

Square Miles.

1887.

1897.

New CastiUe .

S8,01S

1,778,155

1,849,929

Madrid

2,997

683,484

730,807

Guadalajara

4,869

205,040

202,282

Toledo

5,586

356,398

-369,830

Cuenca

6,726

246,091

245,122

Ciudad Eeal

7,840

287,142

302,088

Old Castille .

S5,409

1,7U,301

1,784,620

Burgos

5,651

342,988

343,359

Logrono

1,945

183,430

188,620

Santander .

2,112

249,116

267,292

Avila .

2,982

195,321

201,836

Segovia

2,714

155,927

159,057

Soria .

3,836

157,008

153,522

Palencia

3,126

189,349

193,963

ValladoUd .

3,043

271,162

276,971

Asturias

4,091

615,844

622,955

Oviedo

4,091

615,844

622,955

Leon

15,:J42

984,711

996,063

Salamanca .

4,940

320,588

322,198

Zamora

4,135

274,890

278,947

Leon .

6,167

389,233

394,915

JjJsiremadura .

16,702

808,685

834,045

Badajoz

8,688

476,273

487,468

Caceres

8,014

332,412

346,577

Galicia .

11,343

1,967,239

2,020,030

Coruna

3,078

635,327

651,623

Lugo .

3,787

438,076

465,996

Orense

2,739

415,237

417,327

Pontevedro .

1,739

478,599

485,084

Andalucia

33,926

3,39 J, 681

3,433,693

Almeria

3,302

345,929

350,822

Granada

4,937

482,787

479,159

Malaga

2,824

523,915

490,331

Cordova

5,300

413,883

434,802

Jacn .

5,184

428,162

456,358

Cadiz .

2,828

423,261

429,576

Seville

5,429

535, US7

541,744

Huelva

4,122

240,067

250,901

Valnii'iii

S,897

1,461,453

1,533,024

Castellon .

2,466

292,852

307,107

Valencia

4,353

730,916

774,206

Alicante Carry forward .

2,098

437,685

451,711

143,628

12,754,089

13,074,359

Area in

Population,

Population,

Square Miles.

1887.

1897.

Brought forward .

143,628

12,754,089

13,074,359

Murcia .

10,44S

720,843

755,494

Albacete

5,972

231,073

236,345

Murcia

4,477

489,770

519,149

Catalonia

12,483

1,836,139

1,951,730

Lerida

4,775

296,609

284,693

Gerona

2,272

311,153

302,345

Barcelona .

2,985

879,771

1,028,113

Tarragona .

2,451

348,606

336,579

Aragon .

17,979

922,554

907,251

Huesca

5,878

260,585

247,317

Saragossa

6,607

415,152

412,172

Teruel

5,494

246,817

247,762

Navarra

4,046

307,994

300,381

Navarra

4,046

307,994

300,381

Basque Provinces .

2,7S3

510,194

576,358

Vizcaya

849

234,880

289,405

Guipuzcoa .

728

181,149

192,311

Alava .

1,205

94,165

94,642

Balearic Isles .

1,860

313,480

309,807

Canary Isles .

2,944

301,963

339,203

African possessions . Total .

6,582

11,270

196,171

17,673,838

19,225,853

In regard to professions, the 1897 census showed that 4,854,742 inhabitants were occupied in agricultural pur- suits, 243,876 in manufacturing and mining, 194,755 in commerce, 11,804 lawyers, 40,528 in holy orders, 28,549 nuns, 20,555 in medical professions, 97,257 public oflGlcials, 49,665 employed in railways and companies, 39,136 teachers, 16,849 artists, 423,999 servants of both sexes, 91,226 paupers and mendicants, 823,310 operatives and handicraftsmen.

In 1897 Madrid had 510,616 inhabitants, Barcelona 504,396, Valencia 203,958, SeviUe 145,728, Malaga 125,434, Murcia 108,476, Saragossa 97,433, Bilbao 74,076, Granada 74,599, Cadiz 67,987, Palma 62,626, Carthagena 86,424, VaUadolid 67,917. There were 44 towns with a population of over twenty and below sixty thousand, and 133 towns ranging from ten to twenty thousand. In the last twenty years of the 19th century there was a marked increase in the population of great towns.

The birth-rate in Spain was 37-50 per 1000 in 1861-70 and 36-20 in 1886-92. The marriage-rate was 7-60 per 1000 in 1861-70, dropping to 6-40 in 1883-85, and rising again to 7-30 per 1000 in 1886-92. The death-rate per 1000 was 30-10 in 1861-70, 33-90 in 1883-85, and 31-40 in 1886-92. The percentage of illegitimacy is S'S. The death-rate in Madrid, 32-80 per 1000, is the highest of aU European capitals.

Emigraticm and Tmmigralion. ??? From 1882 to 1890, 611,295 persons emigrated from Spain, and the immigrants were 462,893, leaving a balance against Spain of 148,402. In the years 1891-95 the emigrants were 337,106 males and 53,571 females, and the immigrants 245,048 males and 55,893 females, leaving a balance against Spain of 89,736 in all. More than half the emigrants and immigrants belong to the agricultural classes, the latter chiefly returning from Portugal and Algeria. About 66 per cent, of the emigrants went to America, about 29 per cent, to Africa, meaning Algeria, and the rest to Europe and Oceania. In these figures are included the reliefs of the colonial army, the officials and civilians going and coming from the colonies up to 1895. The average annual emigration for the years 1898-1900 was 58,808 persons.

Roman Catholicism is the established religion and State Church under the Constitution of 1876. In the budget of 1899-1900, ??1,639,262 was assigned as Church estimates under the Concordat

statistics]

SPAIN

743

iwitli Rome. Spanish codes still contain many severe penalties, including fines, correctional prison, and penal servitude, for deUots Rellnion S"???"" the State religion, as writers and journalists * * " frequently discover when they give offence to the ecclesiastical authorities. Blasphemy is punished by imprison ment. The bishops sit in the Superior Council of Education, and exercise much intiuence on tlie' programmes of public instruction. The latest education reform in 1899 obliges all boys to follow lectures on theology and religion during six out of seven years of their curriculum to obtain the B.A. degree. Canon law and Church doctrine form an obligatory part of the studies of men qualifying for the bar and magistracy. By the Constitution of 1876 non-*

' Catholics are only permitted the exercise of their form of worship on condition that they do so in private, without any public demonstration or announcement of their services. The same rule applies to their schools,

which are, however, numerously attended, in Madrid, Seville, Barcelona, and other towns, by children of Protestant families, and of many Catholics also. The Protestant cemeteries, in the few places where they exist, are respected because chiefly foreign property. Many Spanish cemeteries have a corner set apart for Protestants, Jews, and Freethinkers. At the census of 1877 the total official number of Protestants was 6654, and of Freethinkers 9645, out of 16,634,345 Spaniards. In 1887 the figures were 8000 and 11,000 out of over 17 millions; but the facts are not fully disclosed, as both Protestants and Freethinkers are known to be much more numerous, especially in the middle and lower classes. Though Wilkomm said, in the early 'eighties, that he had gi-ounds for supposing that indifferentism was then general in the upper and even in the lower classes, and fanaticism and bigotry limited to some distant provinces where the clergy had much influence on the lower orders, such was not at all the case at the close of the 19th century. With liberty of conscience during the Revolution, from 1868 to 1877, certainly ??? the Church lost ground, and in- diiferenoe, scepticism, and anti-clerical ideas "did prevail for a while in great towns, in the centres of Republicanism in Catalonia and Andalucia ; but a reaction set in with the Restoration. The Governments of the Restoration showed the Church much favour, allowed the Jesuits and religious orders of botli sexes to spread to an extent without precedent in the century, and to take hold of the education of more than half of the youth of both sexes in all classes of society. The revival of Church and monastic influence began during the reign of Alphonso XIL, 1877-85, and considerably increased afterwards under the regency of Queen Christina, during the long minority of Alphonso XIII., the godson of Pope Leo XIII. It made itself felt very visibly at court, in society, in politics, and even in legislation.

A law of 17th July 1857 made primary education compulsory on all children of school age, originally fixed at six to nine, and p made free for the poor. It proved impossible to enforce

Haacatlon. ·j^j^ statute, and the majority of Spaniards are still illiterate, though in decreasing proportion at each census. The primary schools for both sexes are kept up at the expense of the parish ; the ayuntamientos, or

municipal councils, in many provinces pay the teachers very irregularly, and often owe them arrears of several years. Tlie secondary schools are styled institutes and are mostly self-supporting, as the fees paid by the pupils for attendance at lectures and for their B.A. degrees in general cover the expenses of such establishments, which get, besides, subsidies from some of the provincial councils. Spain has ten universities : Madrid, the most numerously attended, has 14,000 students ; Salamanca, the most ancient, the alma mater of Spanish science and letters in the Middle Ages and Renaissance ; Granada, Seville, Barcelona, "Valencia, Santiago, Saragossa, Valladolid, and Oviedo. Most of the universities are self-support- ing from the fees of matriculations and of degrees. In fact, the State is in great part thus reimbursed, the ►►360,000 placed nominally on record in the annual budget for education. The primary schools were attended in 1897, by 1,168,013 boys and 1,095,184 girls, making a total of 2,263,197 children receiving education in the State municipal schools alone, exclusive of free schools and religious houses of education. The normal State schools for the training of professors contained 2041 male and 3518 female pupils. The free normal schools had 2025 male and 2219 female pupils. The secondary or higher schools of the State had 29,362 pupils, and the free schools of the same grade 6866. The universities had 91,995 students, of whom 11,947 alone belonged to the class called free students, trained in addition to the regular matriculated undergraduates. The professoriate con- sisted of 549 univer.sity professors, who mostly secured their chairs by competitive examinations, 567 professors of institutes, 617 professors in the normal schools to train teachers of primary schools, and 37,754 teachers of the primary State schools. The total number of Spaniards who could read and write in 1877 was 4,071,823 out of a population amounting to 16,631,869. In 1887, 5,004,470 Spaniards could read and write, 602,005 read only, and 11,945,875 could neither read not write, out of 17,565,632. The census of 1897 did not give the details of these three classes, as

the returns were incomplete, but it is believed there is a further progress of about 9 per cent. There are, besides the State universities, institutes, and primary schools, numerous Jesuit and other ecclesiastical schools tor boys, a Jesuit Catholic University at Deusto, near Bilbao, whose pupils have to pass their final secondary examinations and take all degrees in

the' State establishments as free scholars. The education of girls has been much developed not only in the State schools but even more so in the convents, which educate more than half the girls of the upper and middle and part of the lower classes. There are free day- schools for girls and an institute in Madrid. Many girls attend the provincial institutes, and some have successfully gone in for the B.A. degi-ees and even higher honours in the universities.

Spain is a hereditary monarchy, the Constitution of which was voted by the Cortes and became the constltu- fundamental law of 30th June 1876. The tioaand sovereign becomes of age on completing his or Oovem- her sixteenth year. The legislative authority ""' ❑❑❑ is vested in the sovereign in conjunction with the Cortes. The Cortes consist of an Upper House, styled Senate, and a Lower House, styled Congress of Deputies. Half the members of the Senate, 180, are life peers ❑❑❑ who sit as nominees of the Crown by royal decrees, or in their own right as marshals, archbishops, and car- dinals, presidents of the Council of State or Supreme Court, after holding such appointments several years ❑❑❑ and grandees. The other half of the Senate, 180, are elected three each by the 49 provinces of the kingdom, and the 'remainder by academies, universities, dioceses, and State corporations. The senatorial electors in the provinces are delegates of the communes and all the members of the provincial council, presided over by the governor. The Lower House of the Cortes were elected by a very limited franchise from 1877 to 1890, when the Cortes passed a Reform Bill that became law on 29th June 1890. This law re-established universal suffrage, that had existed during the Eevolution, from 1869 to 1877, when the first Cortes of the Eestoration replaced that electoral system by a limited franchise. Under the law of 29th June 1890 every Spaniard who is not debarred from his civil and civic rights by any legal incapacity, and has resided consecutively two years in his parish, becomes an elector on completing his twenty-fifth year. Soldiers and sailors in active service cannot vote. All Spaniards aged 25 and who are not clerks in holy orders Can be elected. The same electoral law was extended to the municipal elections.*

The executive administration is entrusted to a responsible Ministry, in which the president generally holds no portfolio, though at times some

Prime Ministers have also taken charge of one of the eight departments. The ministerial departments are : Foreign Affairs, Grace and Justice, Finance, Interior, War, Education and Fine Arts, Marine, and Public Works, which includes aU the material interests. Under the Secretary of State for the Interior the civil administration in each province is headed by a governor, who represents the central power m the provincial council, which is also elected by universal suffrage. There are 49 provincial councils, and 9274 ayuntamientos or municipal councils.

The present civil code was put into force on 1st May 1889 for the whole kingdom. The penal code dates from 1870, and was modified in 1877. The com- mercial code was put into force on 22nd August j^^i^g, 1885, the code of civil procedure, 1st April 1881, and the code of criminal procedure, 22nd June 1882. There is a court of first instance in each of the 495 partidos jvdiciaXes, or legal districts, into which the kingdom is divided. From this inferior jurisdiction the appeals go to the 15 audiencias territoriales, or courts of appeaL There is in Madrid a Supreme Court, which is modelled upon the French Cour de Cassation, to rule on points of law when appeals are made from the decisions of inferior

courts, or when conflicts arise between civil and military jurisdiction. When the law of 20th April 1888 established trial by jury for most crimes and delicts, 49 audiencias criminates, one in each province, were created; these are a sort of assizes held four times a year. The administration of justice is public. The parties to a suit must be repre- sented by counsel. The State is always represented in every court by ahogados fiscales, public prosecutors, and counsel that are nominees of the Crown.

Spanish finance passed through many vicissitudes during the 19th century. In the reigns of Ferdinand VII. and Isabella II. the creditors of the State had Finance. ^^ suffer several suspensions of payments of their dues, and reductions both of capital and interest. During the Eevolution, from 1868 to 1874, matters culminated in bankruptcy. Payments of interest were only in part resumed after the Eestoration in 1876, and in 1882 the Government of King Alphonso proposed arrangements to consolidate the floating and Treasury debts of the Peninsula in the shape of ––70,000,000 of 4 per cent, stock, redeem- able in 40 years, and to reduce and consolidate the old exterior and interior debts, then exceeding ––480,000,000, in the form of ––78,840,000 of exterior 4 per cent, debt- exempt from taxation under an agreement to that effect with the council of foreign bondholders in London on 28th June 1882 ––– and ––77,840,000 of perpetual interior 4 per cent. The colonial debts were not included in those plans ‘ of Senor Camacho. The debts of Spain were further increased in 1891 by a consolidation of ––10,000,000 of floating debt turned into 4 per cent, redeemable stock similar to that of 1882 ; and this did not prevent a fresh growth of floating debts out of annual deficits averaging two to three millions sterling during the last quarter of the 19th century. The floating debt in 1900 had swollen to ––24,243,300. The Governments of Spain having guaranteed the colonial debts of Cuba and of the Philip- pines, when those colonies were lost in 1898, at the close of the colonial and American wars, Spain was further saddled with ––46,210,000 of colonial consolidated debts, and with debts contracted to face the expense of those wars amounting, besides, to ––63,257,000. Consequently, once more the Spanish Government had to attempt to make both ends meet by asking its creditors to assent to the suppression of all the amortization of imperial and colonial debts, and to a tax of 20 per cent, on the coupons of all the debts, whilst at the same time the Cortes were asked to authorize a consolidation and liquidation of the floating and war debts and an annual increase of ––3,200,000 in already heavy taxation. Under these modifications the Spanish debt at the close of the 19th century, exclusive of ––44,000,000 of Treasury debt, consisted of ––41,750,000 of exterior debt, still temporarily exempted from taxation on the condition of being held by foreigners, of ––270,000,000 of 4 per cent, interior consols, and of ––60,000,000 of new 5 jjer cent, consols, replacing the war and floating

debts. In the budget for 1900 ??? the financial years of Spain now coinciding with the calendar years ??? the credits voted for the debts of all kinds under these consolidations and conversions amounted to ??16,742,285.

The following table shows the equivalent at par value, 25 pesetas to the pound sterling, of the lmd,i,‘et estimates since 1880-81 : ???

Revenue.

Expenditure.

1880-81 .

31,666,031

??

33,466,047

1885-86

34,900,575

35,885,869

1890-91

33,622,057

33,367,750

1895-9C

30,340,688

30,689,150

1898-99

34,632,675

34,739,176

1900 .

36,218,073

35,439,928

1902 .

38,977,510

38,847,050

The chief heads of revenue were in 1902 : direct taxation ££16,538,815, indirect taxation ££13,583,600, State monopolies and services managed by the State itself ££6,512,800, sales of and income accruing from State property ££1,176,014, Treasury ways and means ££1,167,280. The chief items of expenditure for 1900 were : civil list of the royal famOy ££376,275, public debt ££16,552,470, pensions ££2,871,220, justice and worship ££2,168,105, education ££1,734,405, army ££6,180,270, navy ££1,437,670, Home Office ££2,103,125, and public works ££2,975,035.

The Bank of Spain has a, charter which has been renewed and enlarged several times since its foundation after the Restoration, and its privileged note issue has had to be gradually and very largely increased by legislative authorizations, especially in 1891 and 1898, as its relations with the Treasuries of Spain and of her colonies increased, since nothing in the services rendered by the bank to the public would ever have justified the growth of the note issue first to thirty millions sterling in 1891, then by quick strides to fifty and over sixty-one millions sterling in 1899 and 1900. At the close of the 19th century the remodelled bank charter, which is only to expire in 1921, authorized a maximum issue of ££100,000,000, on condition that the bank keeps cash in hand, gold and silver in equal quantities, equal to a third of the notes in circulation

up to ►►60,000,000, and equal to half the amount issued above that sum. After the budget of 1900 came into force, in April the balance- sheet of the bank showed a note circulation of ►►62,324,178, and cash gold in hand ►►13,689,257, cash silver in hand ►►15,605,336. Spain still keeps up the French monetary system, francs being styled pesetas of one hundred centimes each. Gold has disappeared from business of every kind since 1881, when the premium began to. rise, and it reached a maximum of 120 per cent, during the war with America. Afterwards it dropped to about 30 in 1900. Bank notes and silver coin have been practically the currency for many years. The French metric system of weights and measures has been established since 1871, and has slowly replaced the older Castilian methods.

The Spanish army, and the navy also, are recruited by conscrip- tion. Liability to service begins with the first day of the calendar year in which the 20th year is completed. Except in extraordinary circumstances, the War Ministers have ^'

seldom called for more than forty to sixty thousand men annu- ally, and of this contingent all who can aftbrd to do so buy them- selves off from service at home by payment of ►►60, and if drafted for colonial service they can buy themselves off by payment of ►►80. The period of service for all arms is twelve years ►►► three with the colours, three in the first-class reserve, six in the second- class reserve. The AVar Ministers can, and frequently do, send on unlimited furlough, or place in the iirst-class reserve, men who have not completed their first three years, and thus a considerable saving is made. Brothers can take each other's place in the ser- vice, and eldest sons of aged parents, or sons of widows, easily get exempted. A project for obligatory service for all Spaniards, with- out tlie faculty of buying themselves off, has been drawn up. Spain is divided into eight military regions or army corps. Each army corps is commanded by a lieutenant-general, who has under his orders two or more generals of di^►►►ision and a correspondmg number of brigadier-generals. The strength of the regular army for many years varied between 85,000 and 100,000 in time of peace, and during tlie Carlist war, 1868 to 1876, Spain had 280,000 under arms, and nearly 350,000 during her more recent colonial wars. Forl899-1900thefigureswereonly 80,000. The active army

is divided into 56 regiments of the line with 2 battalions each, 20 battalions of ritles or oazadores, 4 African, 2 Baleares, 1 Melilla bat- talions of light infantry, 2 battalions of rifles in the Canaries. The cavalry inckides a squadron of royal horse guards, 28 regiments of the line, remount and depot establishments, 4 regional squadrons in Mallorca, the Canaries, Ceuta, Melilla. The artillriy comprises 13 field and 3 mountain regiments, 1 siege and 10 garrison battal- ions, and auxiliary companies. The royal engineers are 4 regiments of sappers and miners, 1 of pontooners, 1 battalion of telegraph engineers, 1 of railways with cyclists, 1 balloon corps, and 4 colonial corps. Spain has besides her regular army other permanent military forces in the shape of 1076 officers, 1604 mounted and 16,536 foot gendarmes, mostly old soldiers, and 14,156 carabineers, all of them old soldiers. The regular army, at the close of the war with the United States and with the colonies in 1898, had 26,000 officers and about 400 generals, but a law was afterAvards made to reduce their numbers by filling only one out of two death vacan- cies, with a view to roach a peace establishment of 2 marshals, 25 lieutenant-generals, 50 divisional and 140 brigadier-generals, and 15,000 officers. Spain has manufactories of arms and gun foundries at Toledo, Sevilla, Oviedo, Trubia, and Segovia. Her military academies are Toledo for infantry, Segovia for artillery, "'alladolid for cavalry, Avila for commissariat, Escorial for carabineers, Getafe for civil guards, besides a staff college styled Escuela Superior de Guerra at Madrid.

The Spanish navy had been increased from 1888 to 1897. The Cortes had assigned several millions sterling out of' the ordinary

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naval estimates for the improvement of the arsenals and dock- yards, and for shipbuilding. They had also voted extraordinary Naw credits amounting to nine millions sterling to create a

powerful squadron of battleships, cruisers, destroyers, and torpedo-boats in Europe, and credits for the naval defences of the colonies. The results of these efforts were the squadrons that were defeated by the United States in the Philippines and in Cuba during the disastrous war of 1898. Afterwards the Spanish navy was seriously reduced. The official list for 1900 showed 2 first-class ironclads and 3 third-plass, of which 2 only were avail- able for coastguard service, 4 first-class cruisers, 10 second-class, 17 gunboats, 4 destroyers, 15 torpedo boats, 3 training ships, 5 despatch vessels, and a few coastguard pontoons. The navy is recruited by conscription in the coast or maritime districts. The Peninsula is divided into three naval captain-generals' departments ??? at Ferrol, at Cadiz, and at Cartagena ??? at the head of each being a vice-admiral. In 1899 the Cortes voted credits for 3500 seamen and 2500 marines.

Cereals are the staple of cultivation ; wheat ranks first, barley, rye, maize, and oats next. , The first two are cultivated in all . parts, plains and mountains equally, rye and oats in V " poorer mountain soils, and maize mostly in North ""??? Spain. Eiee is cultivated in the finely irrigated soil of*

Valencia. In 1898 the 49 provinces of Spain drew 93,628,960 bushels of wheat alone from 7,141,452 acres, 43,590,821 bushels of barley from 3,786,142 acres. Eye gave 14,606,602 bushels from 1,783,812 acres, maize 10,208,475 bushels from 1,022,225 acres, oats 6,676,496 bushels from 942,307 acres. In all, more than nineteen million acres are devoted to cereals. The produce per acre thus indicated places Spain among the countries in which the return is least, much as her agriculturists have tried to improve their cultivation of late years in many provinces. The imports of agricultural machinery of every kind, especially from Great Britain and the United States, are steadily increasing. The cereals, and especially the wheat and flour production of the kingdom, had regularly furnished a considerable export as long as high duties in the colonial tariffs obliged the Spanish possessions beyond the seas to draw such articles of indis- pensable consumption from the mother country ; in fact, the value of the exports of cereals and similar pod stuffs averaged from three to five per cent, of all the exports from 1879 to 1895. Curiously enough, though these exports of the products of Spanish agriculture kept

steady during so many years, Spain was at the same time very frequently importing considerable quantities of foreign corn from the United States, Russia, and Turkey for her own consumption. In most years, and especially in bad ones, the value of the imports under this head greatly exceeded that of the exports. In the production of pulse and kitchen vegetables Spain is one of the foremost of European nations. The chick-pea, or garbanzo, is part of the daily food of all classes, and beans, peas, and lentils are extensively grown. Garlic, onions, tomatoes, pepper or "pimientos," are staple products. Lucern and clover are prominent in the fodder crops. No less than 410,330 acres were devoted to the chick-pea, giving 2,900,000 bushels in 1898. Taken as a whole, these minor crops yielded 14,162,900 bushels out of two million acres.

Among the fruits of Spain the olive tree stands first. It occu- pies an area almost as extensive as the vine. Its range embraces the whole of the southern provinces, some parts of the central plateau, most of the Ebro valley, and a few districts of Galicia. From the 2,731,820 acres of olive plantations in the 33 provinces where olives are cultivated, 23,796,787 bushels of olives were drawn, of which seven-tenths were used to make oil. The exports of oil amounted to 54,073 metric tons, valued at ►►2,292,030, in 1899, and the exports of olives in the same year were 4849 metric tons, worth ►►143,645. Among the fruit-trees next in importance to the olive is the orange, which cannot be grown on the central plateau, where the winters are too cold. In Andalucia and along the Mediterranean coast the orange groves thrive, and in 1897 Spain exported ►►1,876,455 worth of oranges, and ►►1,563,000 in 1898. In the same years she exported about ►►150,000 worth of lemons, that grow in her southern provinces side by side with figs, almonds, pomegranates, carobs, date palms, agaves or American aloes, bananas, and prickly pears. In the northern maritime provinces the apple is extensively cultivated, and excellent cider is made in Asturias and in the Basque provinces. At the census of 1897, 4,033,391 men and 828,541 women were stated to be employed in agricultural pursuits.

Among the natural products of the soil of Spain, in regard to quantity, wines come next to cereals, and at one tirne had taken a very rapid development. In the 'eighties, Wlaes. ~~jyiien the French vineyards suffered~~

so much from various plagues, and when Spain gave a great impetus to her foreign trade by numerous treaties of commerce, none of her pro ducts showed such an increase in exports as her wines. The vine- growing districts had been, formerly mostly in the provinces of Cadiz, Malaga, Barcelona, Aragon, and Navarre. Then the vine-

yards spread all along the Ebro valley and in the Mediterranean seaboard provinces, as well as in New and Old Castille and Estrema- dura, to such an extent that wine is now produced in all the 49 provinces of the kingdom. The average result of the vintage was estimated between 440 and 500 million gallous in 1880 to 1884, and it rose to more than double that amount towards 1890, and amounted m 1898 to 880 million gallons. The total area under the vine was 3,646,375 acres ia 1898. In the heyday of the cultivation of the vine Spain sent the bulk of her wine exports to France. The imposition of high duties in France on foreign wines in 1891 dealt an irreparable blow to the export trade in Spanish wines, as will be seen by the following figures : ??? Exports of Spanish common wines to France in 1888, ??9,106,386; in 1890, ??9,603,000; and when the denunciation of the treaties of commerce of 1891 took effect in 1892, the exports of these wines to France fell to ??3,869,937 in 1892, ??1,604,651 in 1894, and ??915,000 in 1900. The export of wines of the south of Spain ??? Jerez, Malaga, and other full- bodied wines styled generoso ??? did not suffer so much as the common wines from the effects of the protectionist policy that prevailed in Spain and in most Continental countries since 1890, and England and France continued to take much the same quantities of such wines.

The official Spanish tables distinguish the wines exported as common wines, sherry and similar wines, and generoso vino. The statistics of values in the following table speak for themselves as to the state of the wine trade : ???

Aver.

1874-78.

Aver.

1879-83.

1890.

1894.

1898.

1899.

1899.

Common wines Sherry and similar wines Otior fnll- bodled wines styled gener- oso

2,547,000 2,466,000

[470,000

7,748,000 2,137,000

879,000

_?_?_

11,037,024

1,145,000 215,696

_?_?_

2,541,712

740,637 73,020

_?_?_

5,610,426

667,231 48,100

3,806,378

225,748 83,491

r England 149,138 t France 2,726,998 r England 114,057 1 France 66,069

f England 3,465 1 France 36,259

There is also a large export of grapes and raisins, especially from the southern provinces ??? Malaga and Valencia foremost. The average quantity of the two together exported in each of the five years 1879-83 was valued at ??1,560,000. The value of raisins exported in 1898 was ??688,771, of grapes ??330,014, of which the most part went to England, France, and the United States. The Spanish vines have suffered, like those of France, from mildew and phylloxera. The latter has done most damage in the provinces of Malaga, Alicante, Catalonia, and in some parts of the Ebro valley in Navarre and Aragon.

The production of sugar from cane and beetroot had considerably developed before Spain lost her colonies, but this event naturally gave fresh impetus to the sugar industry. The pro- duction in 1887-88 amounted to 2541 metric tons of Sugar. sugar from the cane and 2407 metric tons of beetroot sugar. In 1899-1900 the figures were 29,654 metric tons of sugar from the cane and 49,024 tons of beetroot sngar. In 1901 the official statistics showed 22 sugar-cane factories and 47 beetroot factories. The Government considered that these manufacturers were making such handsome profits that the Cortes were asked to increase the tax upon native sugars, with a view to draw about one million sterling from this source of imperial revenue. The sugar- cane industry is still confined to the provinces of Almeria, Granada, Malaga, where there are, besides, a few beetroot sugar factories. The latter industry has spread to Central and North Spain, in the provinces of Madrid, Saragossa, Valladolid, Santander, Leon, Oviedo, and Pontevedra. The imports of

foreign sugars to Spain dwindled down from 18,899 tons in 1883 and 22,145 tons in 1884 to 805 tons in 1897 and 866 tons in 1898. The imports of Cnban and Porto Rico sugars, that had averaged between 72,100 tons and 40,706 tons before the loss of the colonies, dropped to 7816 tons in 1898.

Despite all the efforts of the breeders and of the Government, a decline has gone on not only in horse- rearing, but also in other classes of live stock since 1865, as the. following table shows : ???

Live stock.

1865.

1896.

Horses

680,373

397,172

Mules

1,021,512

767,928

Asses

1,298,334

753,914

Cattle

2,967,303

2,217,659

Sheep

22,468,669

13,359,473

Goats

4,531,228

2,534,219

Swine

4,357,736

1,927,864

Camels .

3104

Among the causes assigned for this decay is the fact, proved by

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detailed data in the above report, that horse, sheep, goat, and swine rearing are becoming progressively less remunerative. Heavy taxation, aggravated by a generally unequal distribution of the burden, owing to insufficient survey of the assessable property, has also contributed to the decline of this and other branches of Spanish agriculture. Besides the cattle reared throughout the kingdom for field labour and consumption, and in the north- western provinces for export, chiefly to Great Britain,

bulls are reared for the great national sport in many provinces. Goats are mostly bred in the mountainous districts all along the Spanish side of the Pyrenees from Biscay to Catalonia, and in Badajoz, Caceres, Ciudad Eea], Granada, and Leon ; swine in Badajoz, Lugo, Oviedo, Caceres, and Coruna. The richest provinces in live ??? stock of every kind in 1891 were : Badajoz with 1,302,754, Caceres with 1,038,435, Teruel with 965,327. Spanish sheep, which in former times enjoyed such reputation and formed an important part of the national wealth, lost more ground than any other branch of agriculture between 1875 and 1901, the decrease in total figures having been nearly 41 per cent, between 1865 and 1891 alone. The average quantity of wool exported in the five years 1879-83 was about 9 million lb, 29 millions in 1896, 26 millions in 1897, and 30 millions in 1898. The rearing of the silkworm is still important in the Mediterranean provinces.

The mineral resources of Spain are considerable and varied. They are not yet turned to full account, owing chiefly to lack of sufficient means of transport. Spain stands at the head Minerals. ^^ European countries in the production of copper ore, lead ore, and quioksUver. The total value of the products at the mine was ??4,057,772 in 1897 and ??7,565,500 in 1900. The total value of the products of Spanish metallurgy was ??6,639,123 in 1897 and ??8,657,870 in 1900. The number ot fabricas or works in 1898 was 126, being a decrease of 3 on the figures of 1897. The number of persons employed in the mines was 65,995 in 1897 and 89,066 in 1900, and in the works, 17,752 in 1897 and 22,613 in

1900.

The following table gives particulars regarding the production of some of the principal minerals in the year 1898 : ???

1898.

Number

oJ Pro- ductive

Mines.

Metric Tons produced.

Value,

1898.

Persons

em- ployed. ‘

1883.

1898.

Iron ore . Lead ore Argentiferous ore Silver ore Copper ore Mercury . Zinc

Common salt . Coal

Manganese Sulphur .

440

438

382

5

309

26

91

83

657

20

13

4,526,000

280,000

25,000

23,000

2,455,000 23,000 54,000 20,000

1,044,000

)j

7,197,047

150,472

244,068

767

2,302,417

31,361

99,836

479,358

2,414,127

102,228

105,757

*** ***

1,246,496

989,611

1,604,752

21,218

552,749

250,404

198,277

205,136

829,466

68,609

39,627

19,482

10,193

9,985

225

8,348

2,056

1,977

2,167

17,164

997

506

The coal-mines of Spain are yearly developing their production, these being 2,019,400 tons in 1897, 2,466,800 tons in 1898, 2,672,194 in 1899. This amount did not suffice for national consumption, and, despite high duties, Spain imported 1,772,651 tons of foreign coal and coke in 1897, 1,935,000 tons in 1898, 1,875,216 in 1899. Iron ore is drawn mostly from Biscay, Santander, Murcia, Almeria, and Seville, all producing over 300,000 tons each, and Biscay alone 5,073,338 tons in 1898 and 6,146,542 in 1899. The 'total figure was 7,197,047 tons in 1898 and 9,234,302 in 1899, of which Great Britain took 4,748,557 and 6,224,229 tons. There has not been much progress in the extraction of copper ores ??? which had risen from 246,000 tons in 1863 to 2,445,000 in 1883, dropping to 2,299,444 in 1898 and rising again to 2,626,875 in 1899 ??? in the provinces of Seville and Huelva, where the Rio Tinto mines lie, as those of several other provinces are not yet worked. Argentiferous iron ore is found in the province of Almeria, 24,190 tons in 1898 ; argentiferous lead is extracted from the provinces of Badajoz, Ciudad Real, Cordoba, Murcia, Almeria, and some others, in all 244,068 tons in 1898 ; and the Inad mines are chiefly in the provinces of Almeria, -Jaen, and Tarragona, which produced 150,472 tons in 1898 and 175,000 in 1899. The exports of copper were in 1898, 179,518 tons; in 1899, 162,131 tons. Spanish salt is partly marine, partly drawn from rook-salt and brine springs, in all 479,358 tons in 1898, 620,000 in 1899, in the provinces of Alicante, Baeeares, Cadiz, Saragossa, Murcia, and Guadalajara.

The working of the mines is carried on under State supervision. The whole kingdom is divided for this purpose into three sections. At the head of each section there is an inspector-general of miues of the first class, at the head of each division an inspector of the

second class, and in each district a Government mining engineer. Under the law of 6th July 1859 many important mines were reserved as State property, but financial necessities have compelled the Government to part with one mine after another. Some of the most important have thus passed into the hands of foreigners, like Kio Tinto, Tharsis, Linares, and Almaden.

Spanish metallurgy has much increased since 1883, when lead and mercury were the only products of any importance. The working of iron is an industry of old standing in Spain, but the total production of iron, refined and unrefined, in 1873 was only 60,000 tons; in 1883, 200,000; and already in 1898 it included 54,500 tons of Bessemer steel, 58,105 of Siemens, and 154,000 of wrought iron. The Spanish works turned out in 1898, besides, 261,790 tons of lingot or pig iron, and in 1899, 295,840 tons, of which 49,919 were exported to foreign countries. Spain produced in 1899, 68,300 tons of Bessemer steel, 54,654 tons of Siemens, 173,566 tons of wrought iron. Next in importance ranked hydraulic cement 164,862 tons^ lead 78,370 tons, zinc 6031 tons, copper 46,972 tons, sulphur 3100 tons, coke and agglomerates 369,418 tons in 1898. The following table gives particulars of the exports of the chief mineral products in 1898, in metric tons, compared with those of 1883 : ???

Minerals.

Total Exports.

1883.

1898.

Iron ore

4,226,000

6,884,583

Copper ore

.

565,000

838,956

Zinc ores, calcium .

.

30,000

15,356

,, blend

,

15,000

25,688

Manganese

,

4,500

95,756

Iron

30,000

217,545

Argentiferous lead .

51,000

6,040

Non-argentiferous lead

77,000

4,924

Lead, wrought ,, argentiferous

}

546,425

r 79,980 \ 91,796

Wrought iron

186,510

48,168

Copper .

385,551

52,265

The figures of 1899 showed more progress in the principal exports of minerals: the totals were 8,606,568 tons of iron ores, 10,353 tons of lead, 96,088 tons of zinc, 948,912 tons of copper, 139,352 tons of manganese, 331,081 tons of salt, 8073 tons of coal, 319,286 tons of iron pyrites ??? in all, 10,458,799 tons in 1899, against 8,247,816 in 1898. The exports of metals showed a decline of 252,422 tons in 1899 against 281,773 in 1898. The total value of exports of minerals and metals in 1899 was ??10,431,522, being 36 per cent, of the whole exports of Spain in that year.

At the census of 1877 about 3 per cent, of the classified popu- lation was returned as engaged in industries. The proportion had risen to 5 per cent, at the census of 1887, and over ►►|-►►►►►►►. 6 per cent, in 1897. The manufacturing industries of f►►►ctares Spain had developed in the decade 1874-84, and they continued prosperous until 1892, when the existing ultra-pro- tectionist tariif caused a much more important development, no longer confined to the maritime provinces. The principal manu- facture is still that of cotton. In 1879-83 Spain stood seventh among European nations in regard to the average import of raw cotton for home consumption, not only in amount, but in regard to population, 6 lb per head, against United Kingdom 41 '7 ft, Holland 28-6 ft, Switzerland 187, Belgium 9-9, France 8-2, and Germany 8 '2. The average impoi't of raw cotton into Spain was 79,690,000 ft in 1874-78, 100,300,000 ft in 1879-1883, 124,832,716 ft in 1896, 167,111,689 ft in 1897, and 143,616,578 in 1898. The products of this branch of industry do not yet sufiico to meet the wants of the population, and every year there is a considerable import of cotton goods ►►► in fact, the figures were ►►400,000 on an average in 1896-98. The exports of Spanish cotton goods were hardly wortli mentioning outside the colonial markets, which took an average of two millions sterling in the decade 1888-98. This outlet is now almost closed, as the new masters of Cuba, Porto Rico, and the Philippines will cease to protect Spanish imports against European and American com- petitors. The cotton industry had until late years been princi- pally centred in Catalonia, and mainly in the province and town of Barcelona, famed also for their manufactures of lace, woollen, and linen goods. The Basque provinces, especially Guipuzcoa and Biscay, Navarre and Asturias, have followed in the wake of Cata- lonia for linen and cotton industries and for paper mills. Flax- spinning is confined to Galicia. The customs statistics show that Spain hnd to import ►►12,099,813 of raw materials for her industries, including fuel, in 1896 and ►►12,693,000 in 1897, but the war with the United States and the loss of the colonies

statistics]

SPAIN

caused this class of imports to decline to ►►7,478,000 in 1898. Tlie silk industry, though inadequate to meet the home demands, is active in Valencia, Murcia, and Seville. Metal industries, at first limited to the Basque provinces, particularly around Bilbao, have spread to Asturias, Almeria, Galicia, near the great ore-beds and in the vicinity of many coal-mines. In the same Asturian districts the Government has its foundries and factories for making anns at La Trubia and Oviedo, Toledo, far south, being only now famous for its blades and decorative work. The manufacture of leather is carried on in many provinces, but the formerly celebrated Cor- dova leather is a thing of the past. Gloves are made in Seville and Madrid, shoes in the Balearic Isles, chiefly for the colonies, which used to take about a million sterling a year of these exports. The esparto is twisted into cords and ropes and the staple matting so common on the floors of Spanish houses of all classes, the estera. The refining of cane and beetroot sugar has become one of the most lucrative of Spanish industries in many provinces. Soap, chocolate, and cork are among the prosperous iudustries. The same may be said of charcoal, both for heatinc and mechanical purposes. The making of porcelain, formerly well known in Madrid, is now carried on at Seville. Olive oil is a thriving industry that exported ►►2,292,790 of its products in 1898. The war of tarifls between Prance and Spain since 1892 was an inducement for an extraordinary development in the making of brandy and Uqueurs of every kind, of fruit preserves, potted meats, and many other articles in North Spain, above all in Navarre, the Basque provinces, Catalonia, and ev.en in Valla- dolid and Andalucia. Foreign as well as native capital took an active part in the establishment of such industries. Special meutioji must be made of the manufacture of tobacco, which is a royal monopoly, farmed out for 30 years to a company that has increased the factories from 7 to 12, and which began by paying the Treasury ►►3,400,000 annuaUy, and gradually more, up to ►►4,800,000 stipulated for 1900.

The loss of all her possessions -on the American mainland in the early part of the 19th century dealt a severe blow to the foreign Commerce <"'►►►►►►►''►►►►^ ►►►f Spain, from which it only recovered about ►►► 1850, when imports and exports began to increase. The

following table shows the onward march of her trade, and the figures given include those of her exports to and imports from the colonies, Cuba, Porto Eico, and the Philippines : ???

Tear.

Imports.

Exports.

1870 . 1880 . 1885 . 1890 . 1895 .

??

20,876,464 28,481,852 30,590,306 37,645,517 33,539,796

??

15,981,888 25,998,727 27,920,001 37,510,395 32,198,084

After the restoration of the Bourbons in 1875, the first Cabinet of Alphonso XII.'s reign stopped the operation of the tariff law of the Revolution and reverted to protection. In 1882 a Liberal Cabinet not only revived the system of a gradual reduction of import duties to a fixed maximum, but made very good commercial treaties with France and several other nations, which were followed by a treaty with Great Britain in 1886. The foreign commerce of Spain rapidly developed in the decade 1882-92, Great Britain, France, and the United States figuring at the hea,d of the imports. Great Britain and France at the head of the exports on an average for 63 per cent. The rapid increase of the demands of France for Spanish wines, when the phylloxera, mildew, and other plagues had heavily reduced her vintages, caused in Spain a great development of the vineyards, and the exports of Spanish wines to France alone amounted to ??12,000,000 annually. "When France and other European nations abandoned free trade for protection towards 1890, a strong movement set in in Spain in favour of protection. In 1890 the Conservative Cabinet of Seiior Canovas raised the duties on agricultural products, in 1891 it denounced all the treaties of commerce that included

most favoured nation treatment clauses, and in 1892 a new tariff^ law established considerably higher duties than those of 1882 ??? in fact, duties ranging from 40 per cent, to 300 per cent. This tariff' is still in force, and has been slightly modified only by treaties of commerce with Holland, Sweden and Norway, and Switzerland, that were concerted on the principle of reciprocity of concessions on a very limited number of articles. Great Britain, France, Italy, Germany, Austria, Russia, and some other countries which made no treaties of commerce with Spain after 1892, negotiated simple agreements, under which their im- ports are granted the same footing as those of Switzerland, Holland, Norway and Sweden. Portugal has a special recipro- city treaty with Spain, on the understanding that the commercial and navigation regime thus created shall not be extended to other nations.

Spain very soon felt the effects of protection in the sharp decline

??l i ^ '?? "^^ ??' ??? *^^' ^^^*> "^^^^ '^^^ exports suffered more than her imports. The high duties on foreign agricultural jiroducts did not check the influx of American and Russian corn whenever the crops of the Peninsula were insufficient, as happened in four years since 1890. Economical causes of depression and of altera tions m the foreign commerce of Spain were aggravated in 1895 1896, 1897, and 1898 by the Cuban rebellion first, then by the Philippine insurrection, and by the war with the United States. 1 he total figures of exports and of imports in those years remained high m appearance, because they included the large amounts of bar sdver imported for the Treasury and for the Mint, and the bullion passing to and fro between the colonies and the Peninsula ; for instance, ??4,823,406 in silver being received from the colonies and ??6,433,237 having been sent out in 1897. In this period the figures were : ???

Year.

Imports.

Exports.

??

<u>1895 .</u>

<u>33,539,796</u>

<u>32,198,044</u>

<u>1896 .</u>

<u>36,383,570</u>

<u>40,930,098</u>

<u>1897 .</u>

<u>36,381,546</u>

<u>42,995,344</u>

<u>1898 .</u>

<u>38,937,774</u>

<u>36,757,728</u>

<u>1899 .</u>

<u>37,461,455</u>

<u>28,995,150</u>

<u>1900 .</u>

<u>34,495,865</u>

<u>28,954,715</u>

<u>During the years 1895-99 Spanish imports of manufactured goods steadily increased, whilst imports of raw materials and ‘ ‘ alimentary</u>

substances ” showed a marked decline, particularly in 1898. A bad crop in 1899 caused a great increase in imports of bread-stuflfs, especially corn, which gave an increase of ►►600,000 in the proceeds of the customs duties on foreign corn and cereals. The exports of ores of every kind and other raw materials had constantly increased from 1895 to 1898, though not so remarkably as the exports of agricultural products, chiefiy oils, oranges, and raisins. In 1899 all the exports of Spain showed a sudden and marked decline. The wine trade began to pic k up a little in 1898. The loss of the colonies in that year explains the heavy decrease in exports of manufactured goods, for which Spain virtually seemed to have no other market worth mentioning. This decrease amounted to ►►2,000,000 in 1898 alone, and in 1899 the exports of goods to the quondam colonies was insignificant. Great Britain figured in the imports of Spain in 1897 for ►►6,203,059 and in 1898 for ►►5, 682,495, and in the exports for ►►10,545,743 in 1897 and ►►10,099,973 in 1898 ►►► the first being chiefly coal and coke, iron, machinery, jute, hemp, and chemicals ; the latter comprising minerals, wines, raisins, oranges, and esparto grass. France stood next with ►►5,874,278 in the imports of 1897 and ►►4,706,445 in 1898, and ►►10,178,380 in the exports of 1897 and ►►12,870,440 in 1898►►► the first including wool and woollen goods, silks, machinery, and chemicals ; the latter mostly wines, oils, and fniits. The United States ranked third in imports, in majority, cotton and cereals. Portugal,- Germany, Italy, Russia and Belgium came some way behind the next group in imports, ranging from ►►1,600,000 to ►►1,750,000. The same countries, with Norway and Holland, ranked next to Great Britain and France in exports. The trade of Spain with the South American republics is comparatively small, though steadily increas- ing, being the 40th part of the exports and less in imports. The loss of Cuba, Porto Rico, and the Philippines very seriously affected the export trade of Spain in every respect, though the American peace treaty of December 1898 secured for Spain most favoured nation treatment in her lost possessions.

Spain has 21 seaboard provinces, with more than 120 ports of some importance. The merchant navy of Spain, far from decaying through the loss of her colonies in 1898, seems to have . . been given fresh impetus since, by firms and companies ►►►►►►►g►►► f. which bought

abroad and nationalized many English nation and French steamers for the carrying of exports and imports to foreign countries and for trade on the coast of Spain. At the close of 1899 Spain had 377 steamers of 550,887 tons, being an increase of 22 .steamers and 68,494 tons on the figures of the previous year, though 18 steamers of 31,316 tons had been lost during the year. Besides the above steamers ranging over 100 tons each, Spain had at the same date 77 steamers, each of less than 100 tons, for her coasting trade, and of 10,505 tons all told. Spain ranks sixth among the merchant navies in regard to steamships. Her sailing vessels are decreasing in numbers in the exterior trade, but not in the coasting trade, which is decidedly developing and occupying more craft. Her fishing fleet, chiefly sailing boats, is also important, and manned by a hardy and active coast population. In 1897 the total number of vessels entered with cargoes was 10,705 of 3,115,826 metric tons, and in 1900 (inclusive of coasting trade), 17,722 vessels of 14,172,872 tons. The following

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table gives an abstract of the entrance and clearance, in metric tons, under the principal flags in 1897 : ???

Steamers.

Sailing "Vessels.

Entrance.

Clearance.

Entrance.

Clearance.

National ,

753,333

1,539,184

70,629

56,913

British

1,547,371

6,578,933

19,687

49,733

French .

135,888

593,526

8,030

115,973

Norwegian

114,074

233,650

11,006

4,591

Greek

69,731

35,310

5,303

2,351

German .

67,593

226,774

1,389

430

Italian

50,361

28,402

69,536

2-3,859

Austrian .

28,361

38,295

2,284

9,133

Belgian .

25,827

132,313

Danish

25,106

23,830

1,992

3,832

Russian .

23,561

10,074

27,074

20,299

Swedish . Total .

20,037

27,694

10,353

2,015

2,877,209

9,777,361

238,617

290,877

Internal

communi'

cations.

The coasting trade of Spain is considerable. The statistics for 1897 showed that the number of vessels entered under the head of " coasting trade " was 37,875, with a total of 11,266,195 metric tons, and the number of vessels cleared was 38,572, of 11,420,028 metric tons.

At the end of December 1896 there were 20,320 miles of State roads, all well built and well kept up, and 2468 miles in course of construction. The aggregate length of the provincial roads at the same date was 4270 miles, and that of the municipal roads 12,094 miles. The length of railways open for traffic on 1st January 1898 was 8020 miles. The average annual increase in the last ten years of the 19th century was 205 miles. All the Spanish railways belong to private companies, most of which have received State subventions, and the Spanish railways will revert to the Govern- ment mostly at the end of a term of 99 years. In granting a con- cession for a new railway the practice is to give it to the company that offers to construct it with the lowest subvention. The total, amount of the subventions for railway construction up to the end of 1896 was ??30,150,960. For strategical reasons the Spanish gauge was made different from that of France. Of narrow-gauge railways in 1896 Spain had 1302 miles open to traffic, 230 in course of con- struction, and 1000 planned, under concessions duly granted. Spain has 120 miles of steam tramways, 24 miles of electric tram- ways, out of a total of 332 miles at the close of 1896. Seventy per cent, of the railways of Spain, and an even larger proportion of the tramways and narrow-gauge railways, especially in mining districts, have been constructed and worked with foreign capital.

I'elegraphs. ❓❓❓ The length of State telegraph lines increased from 6665 miles on 1st January 1883 to 19,885 at the close of 1899, and the length of wires from 16,256 miles in 1883 to 46,670 miles on 31st December 1899. The number of messages in 1899 was 5,058,104, of which 3,748,805 were inland messages and 1,123,957 from or to foreign countries. In 1897 Spain derived a revenue of ❓❓322,533 from the telegraph service. The number of telegraph offices in 1898 was 1428.

Post Office. ❓❓❓ Exclusive of official correspondence, the total number of letters and post-cards that passed through the post office in 1898 was 91,800,924 for the interior of the kingdom, 13,410,166 for letters sent to or received from foreign countries, 196,715 in transit, and 356,442 for the parcel post. The number of printed papers and samples for internal service was 95,572,000, and foreign 25,627,000. There were 3047 post offices. In 1898 there were 54 urban telephone systems and 533 inter-urban circuits ; the total length of telephone line was 5980 miles, and of wire 27,640 miles.

By the relinquishment of Cuba and the cession of Porto Eico, the Philippine and Sulu Islands, and Guam, the largest of the ❓❓❓. . . Ladrones, to the United States, as a consequence of the war of 1898, and of the remaining Ladrone or Marianne Islands, together with the Caroline and Telow Islands, to Germany by treaty of 8th February 1899, the colonial possessions of Spain were reduced to about 100,000 square miles. Ceuta, Melilla, and one w two other small states on the north coast of Morocco, are part of Spain rather than colonies. The colonies or protectorates are Rio ile Oro and about 80,000 square miles in the interior of the south of Morocco, Ifiii near Cape Nun, the islands of Fernando Po, Aunobon, Corisco, Elobey, San Juan, and a section of the mainland of West Africa between the rivers Muni 'and Carapo. By an arrangement with France in 1900, Spain agreed to forego her claim to a large portion of the Adrar interior, south of Morocco, on condition that France agreed to allow her a portion of the territory claimed by Spain on the Muni and Campo.

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The Spanish colonial possessions now stand as follows, though the areas and populations are necessarily rough estimates : ???

Colonial Possessions.

Area, Square Miles.

Population.

Rio de Oro and Adrar Ifni .... Fernando Po, Corisco,

Elobey, San Juan Muni-Campo Region

Total (about)

80,000?

27

850

10,000?

50,000?

6,000

30,000

100,000?

90,877

186,000

These traits ??v”po”er.

Rio de Oro and Adrar are under the governorship of the Canary Islands, with a sub-governor at Rio. For administrative purposes the Canary

Islands are considered part of Spain.

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n. Eecent History.

No country in Europe has had a more varied and chequered historical evolution than Spain. This evolution has exhibited throughout some remarkable and persistent traits of national character and of natural resources which inspire the recuperative power displayed after every period, long or short, of reverses, inva- Spaaisb ^ sions, decay, and depression, have existed in the races which have succes- sively peopled the soil of the Peninsula from the pre- historic ages, from the times of the autochthonal tribes that inhabited the country before the Peninsula became a battlefield for Carthaginians and Eomans down to the 19th century. A sort of fatalistic stubbornness and an indomitable spirit have made them face adversity first, and afterwards attempt to recover, with wonderful energy and not a little success, when the mistakes, errors, and

shortcomings of their rulers are taken into consideration. If these qualities had not existed, Spain could not have weathered the many vicissitudes of the past which con- stitute the stages of her historic evolution. Strangely enough, at each stage some element seems to have survived which served for the foundations of the body politic that ultimately was to grow out of the mediaeval ages later. Kome, for instance, did not write the lasting record of her conquests and of many centuries of occupation and wise, beneficial rule upon the noble ruins of cities and camps, of strategical highways and aqueducts, of villas, amphitheatres, and temples alone, but in the municipal administration, in the laws, in the habits that long pre- vailed in Visigothic Spain and through six centuries of Moorish rule down to the eve of the Kenaissance. The hardy and warlike invaders who swept over the Peninsula during the decline of Imperial Eome, and who were soon converted to early Christianity, also left much behind that was comparatively progressive and beneficial during their two and a half centuries of rule, in which the Visigothic princes with their incipient feudalism, the Church with its

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councils, its schools, its monasteries, and its civilizing influences and care for the chronicles and intellectual lore of the past, the municipalities with their still Koman organization and vitality, prepared the people for the future resistance to the passing wave of Saracenic invasion. This ivave swept over Spain in the early part of the 7th century -with, an ease and rapidity that seem to us extraordinary, but not utterly inexplicable, given the

*conditions of Spain at the time and the in- **** coherent state of her powers of resistance. It*

auista”’ cannot be denied that the Arabs and Moors

governed their conquests in a wise, far-seeing, and concihatory way that in great part explains why they were so long able to hold their own. In the begin- ning, it was chiefly owing to their own divisions and to the rivalries of their leaders that they succumbed. It would have been almost impossible otherwise for the last remnants of Visigothic and Christian Spain to effect the first part of their "Reconquista." If they had not been confronted by a sorely divided Moslem commonwealth, if that commonwealth had not allowed the vanquished to preserve much of their primitive faith, their laws, their municipal institutions, their customs in Moorish territory, the task of the Catholic princes would have been very much more difficult. Even so, the kingdoms of Asturias, Leon, Castille, Navarre, and Aragon had a long and bloody struggle before they succeeded in driving the Moors slowly southwards and eastwards, until the "Eeconquista " came to a lull that lasted a couple of centuries, more or less, after Christain Spain had in some sort been consolidated into the kingdoms of Castille and Aragon and Navarre at the close of the 13th century. During the reconquest, Spain had evolved much in her growth that resembled the rest of mediaeval Europe, and some of those essential characteristics that subsequently prevailed in her national history. Like the rest of Europe during the 10th, 11th, 12th, and 13th centuries, Spain witnessed a parallel development of powerful nobles, prosperous cities and boroughs, the Church, and religious orders of both sexes, that the sovereigns of yet incomplete and disorganized kingdoms, permanently menaced by the Saracens, could not yet dream of treating too despotically. Like the rest of Europe in the 12th and 13th centuries, the Christian states of the Peninsula had in their commons and their representative Cortes much of the spirit of self-government that could have founded quite a differ- ent state of things to that which ultimately came out of the Spanish "Eeconquista" in its last stage. Even more curious and more interesting in those dark and troublous times was the display in the ranks of the people and gentry, and even among priests, friars, and nuns, of the inclination for what was afterwards styled heterodoxy, but which really amounted to heresy much akin to the tenets of Wycliffe, the Lollards, Huss, and the early Continental reformers who heralded the dawn of Protestantism in Europe. The purely Spanish char- acteristics of these four centuries were the widespread reUgious fanaticism, the hate of the ahen, the love of adventure, the warlike instincts, the .boundless

confidence in themselves, the intolerant dispositions that contributed so much to the steady development of the power of the Church and the religious orders, though both already showed a strong inclination to help the monarchy in checking and curtailing the power and influence of the nobles and of the great military orders of Calatrava, Santiago, and Montesa, and in checking even the Cortes, which played a singularly important part in the annals of Spain in the Middle Ages.

When the "Eeconquista" culminated in the conquest of Granada, the last Moorish kingdom in the Peninsula,

by the Catholic sovereigns Ferdinand of Aragon and Isabella of Castille, the unity of Spain was realized at last, and her sovereigns, rid of foreign preoccupations, were able to turn their attention to the work of centralizing and consolidating aU the powers of the State in their own hands. At the same time they reorganized the administration and the system of taxation, and revised grants and titles of property in a way that soon provided the exchequer with a revenue twenty times greater than that which they found at their accession. Undoubtedly the system of government was an improvement in some sense, but, on the other hand, it started Spain in the direction of absolutism and religious intolerance which, under the two immediate successors of Ferdinand and Isabella ??? Charles I. and Philip II. ??? became so sweeping and so complete that useful national forces were first stunted and finally crushed. Some excellent auxiliaries of the Crown up to the 16th century were not properly husbanded and managed, as in other European countries ; the nobles were turned into courtiers, favourites, and State officials ; the commons were gradually reduced to silence and impotence in Cortes packed to suit the aims of the Crown, and finally were not even consulted about taxation decreed and levied by royal mandate. In this work of destroying pubhc liberty and popular initiative the first two princes of the House of Austria, Charles and Philip II., were constantly assisted by the Church and by the Inquisition, both naturally subservient to an autocratic rule that displayed an ever- zealous disposition to further the interests of the Vatican and of the Catholic Church, not only in Spain but in the Old and New World, by a vigorous external policy that drew its resources mainly from the Peninsula. There was so much stamina yet in

the inhabitants of Spain, so much willingness to contribute to the expenditure involved in Castilian Imperialism, that, despite the shortsighted and cruel expulsion of Jews and Moors, the country grudged no effort and no sacrifice to give both these sovereigns enough to wage yt^i in central Europe, Flanders, Italy, and France against many Powers in succession, and, with less success, to try to dispute the supremacy of the seas v?ith the England of the Tudor period, besides prose- cuting the enterprise of colonization in America. For such purposes they drained Spain of men and money, and wasted both the resources accumulated by their predecessors and the first fruits of their discoveries and conquests in Central and South America. Directly the reins of government passed from the strong hands of Charles and Philip, backed by able generals, statesmen, and Church- men, into the grasp of a brainless bigot Uke Philip III., a careless voluptuary like Philip IV., and an incapable, short-witted invalid and fanatic like Charles II., Spain sped fast on the downward incline of irremediable decay. That course was not checked by any military or diplomatic success abroad, and was hastened by many reverses in her colonies, and by the wreck of her naval power at the hands of the British and Dutch navies. The 17th century was the gloomiest epoch in Spanish annals, though some of the ministers and favourites of the three decadent kings did manifestly attempt to stem the tide of disgrace and national exhaustion. In the rarely summoned Cortes, too, the Third Estate now and then raised its voice vainly to demand redress of grievances, and to remonstrate against reckless waste ???and unproductive expenditure, showing that the old spirit of the " Communeros " of Castille still lurked in the towns of the Peninsula.

The House of Bourbon succeeded to the House of Austria in extremely difficult circumstances, and had to fight for several years in Spain itself to consolidate the throne of Philip V. at the beginning of the 18th century. It cannot be denied that the first three Bourbon kings.

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Philip v., Ferdinand VII., and above all Charles III, did their best, and not without success, to raise their adopted

country from the deplorable condition into which ❑❑❑❑❑ it had fallen at the close of the I7th cen-

*klngs. *’^’y-‘^❑❑ finances and public works received*

the special attention of these sovereigns and their able ministers Alberoni, Kipperda, Florida-Blanca, and Count Aranda. Industries, agriculture, trade, educa- tion, learned societies, and academies were promoted and received State and legislative assistance, and the relations with the colonies were developed. There was a large increase in the population. The administration was recast on French models, and the home policy of the monarchy much resembled that of the French Bourbons in its autocratic ways in regard to taxation and public liberties, and even in its dealings with the Church and Church privileges and property. Mortmain was curtailed and the Jesuits were expelled by Charles III. Unfortun- ately, just as Imperialism had been the bane of Spain under the House of Austria, so family ties and the famous pact bet’.^‘cen the two branches of the House of Bourbon, the inclination of Italian – Boui’bon queen – consorts to interfere in the affairs of Naples, Sicily, and Parma, led Spain once more into costly and useless wars that impoverished her exchequer, increased her taxation, arrested her renascent prosperity, imperilled her colonies, damaged her transoceanic trade, and undid all that the Bourbons had attempted towards making her again a naval Power. In this way, on the eve of the French Eevolution, Spain had once more, ceased to be a Great Power, and both in the Peninsula and in her vast colonial empire the signs of decay and disorder had reappeared just when Charles III.‘s death placed on the throne a weak and irresolute prince, Charles IV. Though he at first frowned upon the French Revolution and joined the Continental coalitions against the new state of things in France, Charles IV. was not a king of the stamp to prevent the Revolution exercising considerable influence upon his subjects. He displayed as little decision in checking the profligacy of his Court and of his wife and her paramour Godoy as he did in resisting the dictates of Napoleon I., into whose hands he abdicated his throne in favour of Joseph Bonaparte, without any

regard for the rights of his own son and heir, Ferdinand, Prince of the Asturias. Amidst the Napoleonic invasions, the Peninsular war, and the struggle for independence, the fortunes of Spain, but for the assistance of Wellington and his armies, would have declined even more than they did in those dark days of bankruptcy and utter disorganization. It is impossible to conceive a country where there was more justification for applying the principle of the tabula rasa than in Spain in the second decade of the 1 9th century. The ~~Cortes of Cadiz, assembled behind the last bulwark of their inde~~ pendence in 1810, had thought this possible in the teeth of foreign invaders, regardless of the persistent forces of reaction that had survived very naturally in a nation which Church and monarchy, habit and tradition, racial and historical influences had blended into the average type of Spaniard, who had little in common in thought, ideas, and aspirations with the brilliant minority that gallantly strove to take the lead from 1813 to 1868. This was the secret of the ups and downs of progress and civilization in Spain in the 19th century, and of many glaring eccentricities and contradictions, under the outward forms and phraseology of constitutional and parliamentary government, even in the last quarter of that century. This contention can best be illustrated by facts. So little was the reform movement of the Cortes of Cadiz in touch with the feelings of the majority of Spaniards, that the unscrujjulous despot and bigot, Ferdinand VII., whom

they call the worst of their modern kings, had no t';buble in setting aside the Constitution of 1812 and in restoring the old regime of absolute monarchy and religious intoler- ance, including the Inquisition, which helped him to send to the scafibld many of the heroes of the War of Independence. He persevered in his revival of the worst features of the rule of the Houses of Austria and Bourbon down to 1820, when he had to bow to a revolutionary rising which gave Spain three years of Liberal and parliamentary government, while the sovereign, behind the scenes, was conspiring with Continental Powers to secure means of revenge. The French Bourbons granted him 100,000 soldiers to carry out his policy merciles%- from 1823 to 1832, when he died.

With a view to secure the throne for his infant daughter Isabella II., Ferdinand VII. set aside the Salic law, which had been introduced by

Philip v., the first Bourbon king, and had been ^^^y' constantly afterwards the law of succession. The brother of Ferdinand, Don Carlos, at once pro- tested, and unfurled the flag of legitimacy in the north of Spain,' thus opening up the era of civil wars which so much contributed to the establishment of constitutional and parliamentary forms of government in Spain, and to the progress of Liberalism and of Democracy. All the most retrograde elements of Spanish society, chiefly rural, military, noble, political, and clerical, steadily stood by successive pretenders. On the other hand, the Liberals of 1813 and 1820 returned from exile and from native hiding-places to join the partisans of the child Queen and of the Queen-Regent, Doiia Christina. They leavened the resistance to Carlist absolutism and theocracy with English and French principles of government, reform, and toleration. The Liberal movement went so far that the religious orders were suppressed and their property confiscated. The Church property was treated in the same way, being commuted for annual credits in the budgets of Spain. Parliaments, composed of a Senate and House of Deputies, were created to vote supplies and taxation, and legislation was taken out of the hands of the sovereign. After the defeat of Carlism in 1841 and up to the end of the reign of Isabella II., Spain was, on the surface, a monarchy akin to those of France, Belgium, and Great Britain. Below the surface, as soon as the dynastic peril had sub- sided and the throne of the Queen was put on a firmer basis, the old reactionar)' undercurrent set to work. A novel and powerful instrument of reaction ??? militarism ??? appeared on the scene and made Spain sadly famous. Its interference in politics and its pronunciamientos were fatal to discipline and, what was far worse, to the sense of respect for parliamentary legality which is the corner-stone of modern institutions. It must be said that Castilian militarism somewhat atoned for its interference in politics l)y using its extraordinary influence quite as often in the cause of liberty and of progress as in defence of reaction- ary Cabinets and Palace favourites. It will suffice to say that Marshal Espartero acted thus from 1836 to 1843 to crush the first Carlist risings, and to check the caprices of the Regent Dona Christina, and then, in 1854-56, again stepped in to check another reaction. Marshal O'Donnell from 1856 to 1866 was the champion of a]\Ioderate Liber- alism which might have preserved the crown of 'Queen Isabella had she not always harboured preferences for retrograde statesmen and generals.

Marshals Prim and Serrano, too, were in the van of the Progressists and Advanced Liberals who would fain have served their Queen, but went over to revolution and conspira-cies at last in sheer disgust. Such names can well be set against those of the military champions of political reactioa

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and religious intolerance ??? Marslmla Narvaez, Cheste, Novalichea, and Calonje. Spaniards grew accustomed to think that no great party could expect to seize the reins of government or get a hearing at the Palace without the alliance of a popular and distinguished general, considering that everybody knew that elections were a farce and that the Cortes never expressed public opinion. Personal government necessarily continued under the cloak of modern institutions ; when the military did not interfere to make a Cabinet fall, a Palace intrigue was resorted to, and even stern soldiers like Narvaez or O'Donnell often left royal antechambers as crestfallen as they had walked in haughtily. The Queen, all through her reign, imposed absolute religious intolerance upon the people, though many of the enlightened and educated classes vainly jDrotested. Nevertheless, the material interests of the country progressed from 1843 to 1868, particularly foreign and home trade, public works, canals, railways, and education. The finances alone were still woefully mismanaged, with increasing expenditure always much in excess of possible revenue. The national debt was more than doubled, and the interest on the external and internal debt was several times reduced, and now and then altogether stopped.

The Kevolution of 1868 was the outcome of the unanimous conviction of the Liberals, Democrats, Eadicals,

and Eepublicans, and, indeed, of not a few ??? Moderate Conservatives, that it was hopeless to*

onsea. ”” endeavour to induce Queen Isabella and her Prince inner circle of advisers to listen to the aspira- Amadeo tions of the better and more enlightened classes. accepts the ¯^ provoked the movement by two years of

reckless and bUnd reaction, 1867 and 1868, which combined all the disaffected in sheer self-defence. Led by Marshals Prim and Serrano, the revolution began in September 1868 with a naval pronunciamiento by the fleet under Topete at Cadiz, soon followed by a military and popular rising, which proved successful after a single battle at the bridge of Alcolea, in Andalucia, where the army of Isabella II. was utterly defeated. Isabella fled to France with her children and a few courtiers. Almost immediately, it was seen that the men of the revolution did not agree about the objects to be pursued after this overthrow of the ancient monarchy and dynasty. The Republicans alone indulged in the illusion that the logic of events must make their ideal form of institutions the goal of the progressive movement that had swept away the throne of Queen Isabella IL All the others ❑❑❑ the numerous followers of Prim, Serrano, Topete, Bivero, Rios Rosas, Sagasta, Martos, and Ruiz Zorilla ❑❑❑ very soon showed that they had chiefly intended to change the dynasty only, but not to alter the traditional form of the institutions. As soon as the work of the constituent Cortes of 1869 was deemed sufficiently advanced, they looked about for a prince to place at the head of the commonwealth. As there was in their eyes no native Spanish prince eligible, and as they cared nought for the ambitious brother-in-law of the late Queen, the ever- intriguing Duke of Montpensier, German and Portuguese royal candidates were discussed until Marshal Prim mooted the idea of asking an Italian Prince, Amadeus of Savoy, a son of Victor Emmanuel, to accept the throne. No selection could have been better calculated to displease the majority of Spanish Catholics, the Church, and the religious orders, than that which made the son of the king who had just put an end to the temporal power of the Popes the ruler of the most bigoted Catholic nation in Europe. This mistake was one of the principal factors in the rapid decline of the Spanish revolution, as it was the most popular pretext of the pretender Don Carlos for

plunging Spain into a long and bloody war ; and it was also one of the favourite arguments of the partisans of his rival, the Alphonsist pretender,

the son of Isabella II. King Amadeus took a little over two years to convince himself that the Constitution of 1869 could not work, and that the generals, statesmen, and parties, ConstitutionaHsts, Radicals, and Progressists, who had invited him to come to Spain, each in turn simply wanted to make him their tool in order to govern the country for their own ends. He did not find in their ranks, any more than he did in the army and navy, the loyal and patriotic assistance necessary to cope with the Carlists in armp in a dozen provinces, with the Federal Republicans frequently rebelling in southern Spain, and with the spread of the Alphonsist propaganda and conspiracy in all classes, especially in the staff of the army. It required no great efl'ort of intellect for the Italian king to comprehend that universal suffrage was an electoral system which could only work if the Governments and authorities were allowed to manipulate the register, the polls, and the returns at discretion, and to pack the Cortes with majorities and minorities to suit their convenience and keep up the appearance of parhamentary institutions. Amadeus perceived that 80 per cent, of his subjects cared nothing for, and hardly knew how to make use of, trial by jury, liberty of the Press, nearly unlimited rights of association, meeting, and public demonstration, all the reforms made by the Constitution and laws of the revolu- tion, and, above all, liberty of conscience, which the Church denounced as the very abomination of the period. Amadeus abdicated, and his last Cortes, at the instiga- tion of their Republican minorities, proclaimed a Federal RepubHc on 11th February 1873.

The new regime, which did not last long, was marked by one long struggle against the federal and cantonal Republicans of the south and of the Mediterranean p^ociama- seaboard, and its successive Presidents, Figueras, tionofa Pi y MargaU, and Salmeron, had not a little Federal trouble in managing the unruly and revolu- '^^P"""- tionary Cortes elected in the spring of 1873. Castelar took the helm in September 1873. He displayed great energy and tact in reorganizing the army and conciliating the Church on the one hand, while on the other hand he showed equal firmness and resolution in dealing with the Carlists, and in striving to put down the disgraceful rebellions of the advanced Republicans at Cartagena, Seville, Cadiz, Malaga, and Cordova. His beneficial rule terminated with the recess. He was perfectly aware that the

Federals in the Cortes proposed to defeat him, as they did by an adverse division on 2nd January 1874, which served as the desired pretext for General Manuel Pavia to make his famous pronunciamiento at dawn on the following day. At the head of the Madrid garrison, the Captain-General of the capital turned the members of the Cortes into the streets, dismissed the Government, including the War Minister, and dissolved Parliament. He then profoundlj surprised jhis fellow-countrymen by declining to use his dictatorship as a stepping-stone to power. For the ??[rst time in Spain, the victorious leader of a. pronunciamiento invited the leaders of all parties to form a Government to restore and maintain peace. Castelar naturally dechned. Canovas del Castillo, the chief agent of the Alphonsist propaganda, held aloof because he saw that events were playing into his hands. Marshal Serrano, with Sagasta and Martos, consented to form a nameless provisional Government, which attempted for eleven months to reorganize Spain, first crushing the Republican risings in the south, and then vigorously attacking the Carlists in northern and central Spain. Serrano had gone to assume the chief command of the Liberal armies in the

Ebro valley in December 1874, ~~when the generals who had long been conspiring to restore the Alphonsist branch of the Bourbons determined to make their pronuncia~~ miento before the Marshal-President of the Executive could score a decisive victory over the Carlists. The action of Generals Martinez Campos, Jovellar, Primo de Eivero, and Laserna, at Sagunto, Valencia, Madrid, and Logrono was, in fact, the premature unmasking of a carefully worked combination of forces converging by different channels towards the same goal. Queen Isabella IT. had been wisely advised during her exile to abdicate in favour of her only son, at the time a minor, the Prince of the Asturias, afterwards Alphonso XII. He was educated partly at the Theresianum College in Vienna, and partly at the British Military Academy at Sandhurst, where he was a cadet when he issued, in 1874, the manifesto drawn up by his principal adviser, Senor

Canovas del Castillo, which was profusely distributed in Spain in order to place his programme of a limited Monarchy and Parliamentary government before his future subjects. Canovas did not recommend the publication of this document until he had nearly completed the organ- ization of the heterogeneous elements which he had skilfully united from 1870 to 1874, as fast as he perceived that the revolution was going at such a pace towards self- destruction that not a few of its soundest and most influential groups unhesitatingly went over to the Alphonsist ranks in disappointment and disgust. He endeavoured to enlist the capitalists, the great landowners and protectionists, all the bishops and clergy not too compromised in favour of Carlism, and the middle and upper classes, weary of civil wars and national bankruptcy in the wake of a general decline of trade and commerce. In short, the most eminent statesman of the revolu- tionary movement was convinced that he would be in a position to restore the monarchy and dynasty peacefully and legally, through the action of the constituent Cortes, about the time when Alphonso would come of age in 1875. It was singular that Spain's greatest soldier. Marshal Manuel Concha, Marquis del Duero, who was killed in battle by the Carlists near Estella on 27th June 1874, had also conceived the same idea as Canovas ??? the restora- tion of the Bourbons by a Parliament elected after a decisive campaign against the Carlists. It is no wonder, therefore, that Canovas and the other statesmen who were thus preparing the restoration at first expressed astonish- ment and displeasure when they heard that a then obscure general at the head of a force actually at the seat of war had made a premature pronunciamiento, more majorwm, at Sagunto on 29th December 1874.

When the prommciamiento assumed an irresistible and victorious aspect, Canovas and the Supreme Junta of

Alphonsism in Madrid immediately adhered to ^ton??Ttb ^^^ military rising and produced the instructions monarchy, entrusted to Canovas by the King himself, to

which, of course, the generals bowed. Canovas gazetted himself President of the interim Council of Ministers until the arrival of his sovereign, to whom he conveyed by telegraph the loyal congratulations of the army and

navy, and of a people who quickly and gladly submitted to the change, because all believed that a great and decisive step had thus been taken in the direction of the much-desired re-establishment of peace and regular government in Spain. The progress of the young monarch through Barcelona and Valencia, and thence all the way to Madrid, was marked by a hearty welcome on the part of all classes. The loyal demon- strations in the capital contrasted with the comparatively cold greeting extended a few years before to Amadeus of Savoy. The first act of Alphonso XII. was a royal decree

confirming the appointment of Canovas del Castillo as Prime Minister. A strong Conservative administration was formed, to which Canovas admitted some men of the old parties of Queen Isabella's reign side by side with men who had played a part in the revolution before they became his active auxiliaries in the Alphonsist propa- ganda in 1872 and 1873. This Cabinet gave its chief attention for fifteen months to the pacification of the Pen- insula, adopting a Conservative and Catholic policy which contributed quite as much as the great display of military resources to make the Pretender lose adherents and pres- tige from the moment that his cousin reached Madrid. The Church, the nobility, and the middle classes soon pronounced for the new state of things. The Alphonsist armies, led by Marshals Campos and Jovellar, swept the Carlist bands from the right bank of the Ebro to the Pyrenees, and took their last strongholds in the eastern provinces, Cantavieja and Seo de Urgel. Not a few of the Carlist leaders accepted bribes to go abroad, and others put their swords at the disposal of the Government for employment against the Cuban rebels. Then all the forces of King Alphonso under Marshal Quesada gradually closed round the remainder of the Carlist army in Navarre and in the Basque provinces at the beginning of 1876. The young King himself was present at the close of the campaign, which sent his rival a fugitive across the French frontier, with the few thousand faithful followers who had clung to his cause to the very end.

*Directly the Carlist war was over, the Government used part of the large army at its disposal to reinforce the troops which had been fighting the Cuban insurgents since 1869. Marshal Jovellar was ***"""**" sent out to Havana as governor-general, ^^tlon. Marshal Martinez Campos as*

commander-in- chief of the forces. In about eighteen months they managed to drive the rebels into the eastern districts of the island, Puerto Principe and Santiago de Cuba, where by some successful expeditions and clever parleying they induced all but a few irreconcilable chiefs to accept a convention that became famous under the name of the Peace Treaty of Zanjon. Marshal Campos, who very soon succeeded Jovellar as governor-general of Cuba, for the first time held out to the loyalists of the island the prospect of reforms, fairer treatment at the hands of the mother country, a more liberal tariff to promote their trade, and self-government as the crowning stage of the new policy.- He also agreed to respect the freedom of the maroons who had fled from their masters to join the Cubans during the ten years' war, and this led to Spain's very soon granting gradual emancipation to the remainder of the slaves who had stood by their owners. Marshal Campos was not allowed to carry out his liberal and conciliatory policy, which the reactionary party in the colony, el partido Espanol, resented as much as their allies in the Peninsula. Nevertheless, before he left Havana the seed was sown among the Creoles for the home-rule movement which developed so rapidly in the 'eighties.

Though much of his time and energies had been devoted to the re-establishment of peace at home and in the colonies from 1875 to 1880, Seiior Cano- vas had displayed considerable activity and ""'' resolution in the reorganization of the monarchy. Until he felt sure of the early termination of the struggle with the Pretender, he ruled in a dictatorial manner without the assistance of Parliament. Royal decrees simply set aside most of the legislation and reforms of the Spanish revolution. Universal suffrage alone was respected for a while, and used as the means to call into existence the first Cortes of the restoration in 1876.

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The electors proved, as usual, so docile, and they were so well handled by the authorities, that Canovas obtained a Parliament with great majorities in both Houses which voted a limited franchise to take the place of

universal suffrage. Immediately afterwards they voted the Con- stitution of 1876, which was virtually a sort of compro- mise between the Constitution of 1845 in the reign of Isabella and the principles of the Democratic Constitution of the revolution in 1869. For instance, liberty of con- science, established for the fixst time in 1869, was reduced to a minimum of toleration for Protestant worship, schools, and cemeteries, but with a strict prohibition of propaganda and outward signs of faith. Trial by jury was abolished, on the plea that it had not worked properly. Liberty of associations and all public meetings and demonstrations were kept within narrow limits and under very close surveillance of the authorities. The municipal and pro- vincial councils were kept in leash by intricate laws and regulations, much resembling those of Prance under the Second Empire. The political as well as the adminis- trative life of the country was absolutely in the hands of the wire-pullers in Madrid ; and their local agents, the governors, the mayors, and the electoral potentates styled los Caciques, were all creatures of the Home Secretary at the head of Castihan centralization. The Constitution of 1876 had created a new Senate, of which half the members were either nominees of the Crown or sat by right of office or birth, and the other half were elected by the provinces of the Peninsula and the colonies, the clergy, the universities, and the learned societies and academies. The House of Deputies, composed of 456 members, was elected by the limited franchise system in Spain and by an even more restricted franchise in the colonies, five-sixths of the colonists being deprived of representation. From the beginning of the restoration the great statesman, who was nicknamed at the time the Richelieu of Alphonso XII. 's reign, established a system of government which lasted for a quarter of a century. His idea was that the restored monarchy, much as it had retraced its steps towards the regime that existed before the revolution, must be worked on the same surface lines as in other European countries which possessed two great dynastic parties who were in a position to succeed each other in the councils of the sovereign, and who might tacitly assist each other in checking both dissen- tients from their ovra ranks and the anti-dynastic parties like the Carlists and Republicans. With a view to attain this object, in 1875, a very few months after the restora- tion, he encouraged the men of the revolution who wanted to bow to accomplished facts and make the best of the restricted amount of liberty remaining, to start afresh in national

politics as a Dynastic Liberal party. From the moment that such former revolutionists as Sagasta, Ulloa, Leon y Castillo, Camacho, Alonzo Mar- tinez, and the Marquis de la Vega de Ajmijo declared that they adhered to the restoration, Canovas did not object to their saying in the same breath ??? that they would enter the Cortes to defend as much as possible what they had achieved during the revolution, and to protest and agitate, legally and pacifically, until they succeeded in re-establishing some day all that the first Cabinet of Alphonso XII. had altered in the Constitution of 1869. The Premier not only approved Sagasta's efforts to gather round him as many Liberals and Democrats as possible, but did not even oppose the return of Emilio Castelar and a few Republicans. He also countenanced the presence in the Cortes for the first time of 15 Senators and 42 Deputies to represent Cuba and Porto Rico, including a couple of home rulers. Thus Canovas meant to keep up the appearance of a Constitutional and Par-

liamentary Government with what most Spaniards con- sidered a fair proportional representation of existing parties, except the Carlists and the most advanced Republicans, who only crept into the House of Deputies in some later Parhaments. Canovas ruled his own coa- lition of Conservatives and Catholics with an iron hand. A Cabinet Minister who had shown insubordination received the first intimation of his displeasure in the shape of the Gazette containing royal decrees dismissing him and appointing his successor. On another occasion an important group of Conservatives, headed by two prominent statesmen, Gamazo and Alonzo Martinez, were sternly requested to consider themselves expelled from the ministerial ranks because they had dissented from the Premier's views. In this way Canovas managed the affairs of Spain for six years with only two short inter- ruptions, when he stood aside for a few months, just long enough to convince the King that the Conservative party could not retain its cohesion, even under such men as Marshals Jovellar and Campos, if he did not choose to support them.

In the early years of the restoration the King and Canovas acted in concert in the two most delicate matters that required their constant attention. Young as he was, Alphonso XII. agreed with his chief counsellor as to the expediency of keeping military men away from active

politics. They were given to understand that the King could not tolerate that interference which had developed and kept up the influence of militarism during the reign of Queen Isabella and during the revolution. Canovas boldly declared in the Cortes that the era of pronvm^ ciamientos had been closed by the restoration, and the King reminded the generals more than once that he intended to be the head of the army. The King and his Prime Minister were equally agreed about the necessity of showing the Vatican and the Church sufficient favour to induce them to cease coquetting with the pretender Don Carlos, but not so much as to allow the Pope and the clergy to expect that they would tolerate any excessive Ultramontane influence in the policy of the restoration. In regard to foreign policy, the King and Canovas both inclined to assist national aspirations in Morocco, and jealously watched the relations of that empire with other European Powers. This desire to exercise a preponderant influence in the afiairs of Morocco culminated in the Madrid Conference of 1880, presided over by Canovas himself. The outcome of it was the treaty which has since regulated the consular protection extended to the subjects of his Shereeffian Majesty, and the relations generally of Morocco with foreign Powers and their sub- jects. In all other points of foreign policy Canovas advocated a policy of strict and vigilant neutrality, though his sovereign hardly concealed that he considered he had monarchical and dynastic reasons for courting, if not alliances, at least close relations with Germany, Austria, and Italy.

In 1878, in spite of the well-known hostility of his mother to the Montpensiers, and in spite of his ministers' preferences for an Austrian match. King Alfonso insisted upon marrying the third daughter of "l'""^ the Duke of Montpensier, Dona Mercedes, who ^^^ ' '"'" only survived her marriage five months. Barely seventeen months after the death of his first wife, his Majesty listened to the advice of Canovas and married, in November 1879, the Austrian Archduchess Maria Chris- tina of Hapsburg. In general matters the King allowed his ministers much liberty of action. From 1875 to 1881, when not too much engrossed in more pressing afiairs, his Governments turned their attention to the reorganization of the finances, the resumption of pa3rment*

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of part of the debt coupon, and the conaohdation of the colonial and imperial floating debts. They swerved from the mild free trade policy which was inaugurated by Sefior Figuerola and by Prim at the beginning of the revolution, and to which was due the remarkable progress of the foreign trade. This went on almost continuously as long as the regime of moderate tariifs and commercial treaties lasted, i.e., until 1890.

In 1881 the Dynastic Liberals began to show impa- tience at being kept too long in the cold shade of

Opposition. Their chief, Sagasta, had found adml^i . ^lli^s ill several Conservative and Liberal tratloas. generals ??? Campos, Jovellar, Lopez-Dominguez,

and Serrano ??? who had taken offence at the idea that Canovas wanted to monopolize power for civil politicians. These allies were said to be the dynastic and monarchical ballast, and in some sort the dynastic guarantees of Liberalism in the eyes of the Court. Canovas came to the conclusion that it v^as expedient for the restoration to give a fair trial to the quondam revolu- tionists who coalesced under Sagasta in such conditions. He arranged with the King to moot a series of financial projects the acceptance of which by his Majesty would have implied a long tenure of office for the Conservatives, and so Alphonso XII. found a pretext to dissent from the views of his Premier, who resigned on the spot, recom- mending the King to send for Sagasta. The Liberal administration which that statesman formed lasted two years and some months. The pohcy of Sagasta in domestic affairs resembled that of Canovas, as the King considered that it was too early to think of altering the Constitution and the laws made after the restoration. The Liberals had to act cautiously and slowly, because they perceived that any premature move towards reform or democratic legislation would not be welcome at Court, and might displease the generals. Sagasta and his colleagues therefore

devoted their attention chiefly to the material interests of the country. They made several treaties of commerce with European and Spanish-American Governments. They reformed the tarifi^ in harmony with the treaties, and with a view to the reduction of the import duties by quinquennial stages to a fiscal maximum of 15 per cent, ad valorem. They undertook to carry out a general conversion of the consolidated external and internal debts by a considerable reduction of capital and interest, to which the bondholders assented. They con- solidated the floating debt proper in the shape of a 4 per cent, stock redeemable in 40 years, of which ??70,000,000 was issued in 1882 by Sefior Camacho, the greatest Spanish financier of the century. Sagasta was not so fortunate in his dealings with the anti-dynastic parties, and the Republicans gave him much trouble in August 1883. The most irreconcilable Republicans knew that they could not expect much from popular risings in great towns or from the disaifected and anarchist peasan- try in Andaluoia, so they resorted to the old practice of barrack conspiracies, courting especially the non-com- missioned officers and some ambitious subalterns. The chief of the exiles, Don Manuel Ruiz ZoriUa, who had retired to Paris since the restoration, organized a military conspiracy, which was sprung upon the Madrid Govern- ment at Badajoz, at Seo de Urgel, and at Santa Domingo in the Ebro valley. This revolutionary outbreak was swiftly and severely repressed. It served, however, to weaken the prestige of Sagasta's administration just when a Dynastic Left was being formed by some discontented Liberals, headed by Marshal Serrano and his nephew, General Lopez-Dominguez. They were joined by many Democrats and Radicals, who seized this opportunity to break off aU relations with Ruiz ZorUla and to adhere

to the monarchy. After a while Sagasta resigned in order to let the King show the Dynastic Left that he had no objection to their attempting a mildly Democratic policy, on condition that the Cortes should not be dissolved and that Sagasta and his Liberal majorities in both Houses should grant their support to the Cabinet presided over by Senor Posada Herrera, a former Conservative, of which the principal members were General Lopez-Domin- guez and Seiiores Moret, Montero Rios, and Becerra. The support of Sagasta did not last long, and he managed with skill to elbow the Dynastic Left out of office, and to convince aU

dissentients and free lances that there was neither room nor prospect for third parties in the State between the two great coalitions of Liberals and Conservatives under Sagasta and Canovas. When Posada Herrera resigned, the Liberals and Sagasta did not seem much displeased at the advent to power of Canovas in 1884, and within a few months almost all the members of the Dynastic Left joined the Liberal party.

From 1881 to 1883, under the two Liberal administra- tions of Sagasta and Posada Herrera, the foreign policy of Spain was much like that of Canovas, who like- wise had had to bow to the King's very evident gJucy" inclination for closer relations with Germany, Austria, and Italy than vrith any other European Powers. Alphonso XII. found a very willing Minister for Foreign Affairs in the person of the Marquis de la Vega de Armijo, who cordially detested France and cared as httle for Great Britain. The Red-books revealed very plainly the aims of the Kang and his minister. Spanish diplomacy endeavoured to obtain the patronage of Italy and Germany with a view to secure the admission of Spain into the European Concert, and into international conferences whenever Mediterranean and North African questions should be mooted. It prepared the way for raising the rank of the representatives of Spain in Berlin, Vienna, Rome, St Petersburg, and London to that of ambassadors. In Paris the country had been represented by ambassa- dors since 1760. The Madrid Foreign Office welcomed most readily a clever move of Prince Bismarck's to estrange Spain from France and to flatter the young King of Spain. Alphonso XII. was induced to pay a visit to the old Emperor William in Germany, and during his stay there, in September 1883, he was made honorary colonel of a Uhlan regiment quartered at Strasburg. In vain did German and Spanish diplomatists and the press of both countries do their best to explain away and mini- mize the signiflcance of this appointment, and to prove that it was only a compliment usually paid to foreign sovereigns. The French people resented the act very much, and the Madrid Government was sorely embarrassed, as the King had announced his intention of visiting Paris on his way back from Germany. Nothing daunted by the ominous attacks of the French people and press. King Alphonso went to Paris. He behaved with much coolness and self-possession when he was met in the streets by a noisy and disgraceful demonstration. The President of the Republic and

his ministers had to call in person on their guest to tender an apology, which was coldly received by Alphonso and his Minister for Foreign Affairs. After this untoward event, the King naturally shortened his stay in Paris and proceeded rapidly home, where the conduct of the Parisians had made as bad an impression as it had in the rest of Europe. On his return to Madrid he was received with unprecedented enthusiasm and demonstrations of loyalty and indignant protest against the insults of the French mob, which had aroused the susceptibilities of the majority of Simniards, even of many who were not Royalists. Shortly after the King's return, the German Emperor sent his son the

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Crown Prince, the husband of the Princess Eoyal of England, with a brilliant suite, to the Spanish capital, where they were the guests of the King for several days. The Crown Prince was welcomed with many imposing demonstrations of sympathy, in which the royal family, the Court, the Government, the dynastic Opposition, the army, and all classes took part. Until the end of his reign Alj)honso XII. kept up his friendly relations with the German Imperial family and with the German Govern- ment.

The close of the reign of Alphonso XII. was marked by much trouble in domestic politics, and by some great national calamities and foreign complications, while the declining health of the monarch himself cast a gloom over the Court and governing classes. The last Conserva- tive Cabinet of this reign was neither popular nor success- ful. Canovas del Castillo did not take into consideration that though he had returned so quickly to the councils of the monarchy, chiefly through the divisions of Liberalism, it would have been wise to recollect that the men of the revolution who had gradually adhered to the restora- tion thought they had reason to compilain of the persistent favour shown to the Catholics and Conservatives. In fact, the latter ruled Spain under Alphonso XII. for eight years and a half out of the eleven years of his reign. The general

election of 1884 was conducted with such insin- cerity, such disregard for the aspirations of the Opposition, t"hat both Liberals and Kepublicans entered the Cortes in anything but a pleasant frame of mind, as the Cabinet soon discovered. Kesistance and criticism in Parliament and in the press irritated Canovas, and he fancied that he could treat the adversaries of his policy in the high-handed and arbitrary way in which he had dealt with all dis- content eight years previously at the beginning of the restoration. He did not listen to any warning, and paid no attention to the many symptoms indicating that times had changed, and that his reactionary methods only stirred up the growing resistance of Democracy and Liberalism. He committed not a few mistakes in financial and commercial questions, allowing public expenditure to increase, putting no check on the growth of the floating debt, and developing the relations of the Treasury with the Bank of Spain, thereby obliging the latter to start upon an uninterrupted increase of its note issue. When cholera appeared in France, quarantine was so rigorously enforced in the Peninsula that the external trade and railway trafiic were grievously afi'ected. On Christmas night, 1884, an earthquake caused much damage and loss of life in the provinces of Granada and Malaga. Many villages in the mountains which separate those provinces were nearly destroyed. At AUiama, in Granada, more than 1000 persons were killed and injured, several churches and convents destroyed, and 300 houses laid in ruins. King Alphonso went down to visit the district, and distributed relief to the distressed inhabitants, who ever3nvhere showed their gratitude to his Majesty, who exposed himself to fatigue and hardship in the depth of winter, despite his visibly failing health. He held on gallantly through the greater part of 1885 under great difficulties. In the Cortes the tension in the relations between the Government and the Opposition was growing daily more serious. Outside, the Republi- cans and Carlists were getting troublesome, and the tone of their press vied with that of the Liberals in their attacks on the Conservative Cabinet. Then, to make matters worse, an outbreak of cholera occurred in the eastern provinces of the kingdom. The epidemic spread rapidly over the Peninsula, causing great havoc in import- ant cities like Granada, Zaragoza, and Valencia. The authorities confessed that 105,000 persons died of cholera

in the summer and autumn of 1885, being on an average from 41 to 56 per cent, of those attacked. The epidemic was not very severe in Madrid, only ranging up to 48 deaths a day, though it lasted several weeks; but at Aranjuez, a royal seat on the banks of the Tagus, a few leagues from the capital, 2000 victims were swept off in a week. Notwithstanding the opposition of his ministers, the King insisted upon visiting Aranjuez and Murcia, where also cholera was raging. The Court left Madrid later than usual in the summer to go to the residence of the Spanish Bourbons in the hot months of the year. La Granja de San Ildefonzo, in the picturesque mountains of Segovia. During the stay of the royal family at the Castilian Versailles founded by the first Bourbon, Philip V., the King, whose health had been long undermined, got worse, and the condition of his throat and lungs made Queen Maria Christina and the ministers very anxious. The latter had adopted a system of silence and concealment of the sad reality of the situation, in which they persevered for several months. The nation was kept ill a state of ignorance of the fast approaching end of the sovereign ; a few had an inkling of the truth, which had not been kept from the members of the royal family ^^ho were abroad, nor from the Courts of Berlin and Vienna.

In September, when the King was beginning to rally from a painful crisis in his illness, a conflict arose between Spain and Germany which had an adverse effect upon his health. Prince Bismarck looked upon the rights of Spain over the Caroline Islands in the Pacific as so shadowy that he sent some German warships to take possession of a port in the largest island of the group, though the naval and colonial authorities in those distant archipelagoes at once protested. The news of this move on the part of Germany caused great indignation in Spain, and popular feeling rose so high in Madrid that imposing demonstrations were made, in which people of all classes took part. The Government got alarmed when the Madrid mob one night attacked the German embassy, tore the arms of the empire from the door of the consulate, and dragged the escutcheon to the Puerto del Sol, where it was burnt amid much uproar. The troops had to be called out to restore order, and the ministers advised the King to return to the capital. Alphonso alone remained cool, and would not listen to those who clamoured for a rupture with Germany. He told his ministers that he would not on any account plunge his country into a hopeless struggle. He

elected to trust to diplomacy ; and Spain made out such a good case for arbitration, on the ground of her ancient rights of discovery and early colonization, that the German Emperor, who had no desire to imperil the dynasty and monarchy in Spain, agreed to submit the whole affair to the Pope, who eventually gave judgment in favour of the Spanish pretensions.

After his return to Madrid the King showed himself in public less than usual ; and on his last appearance, at the autumn races in October, everybody who saw him in the paddock was unfavourably impressed with ff / ”’ his looks. A few days later it was whispered [jj] that his state of health would probably oblige him to spend the vrinter on the Spanish shores of the Mediterranean. He did not consent to do so, because he wanted to avoid creating alarm, but went to a royal seat close to Madrid, El Pardo, a sort of hunting-box in the midst of the woods, and there his complaint made rapid progress. Nevertheless, in Madrid, Canovas would not allow the press to say a word. Indeed, in the ten months before the death of Alphonso XII. the Conservative Cabinet displayed unprecedented rigour against the newspapers of every shade. The Dynastic, Liberal, and Independent press, the illustrated papers, and the satirical weeklies,

fared no better than the Republicans, Socialists, and Carlists, and in 60 days 1260 prosecutions were ordered against Madrid and provincial papers. The police chased the hawkers of papers about the streets as roughly as they had chased the students of the universities and schools, who also had incurred the displeasure of the reactionary Cabinet. At last, on 24th November, the truth had to be sprung upon the capital, where the greatest consternation reigned when it was admitted that Alphonso XII. was dying at El Pardo. The Queen, his sisters, his little daughters, and his ministers had all hurried down in consequence of the peremptory summons of the physicians and of the Lord High Chamberlain. A little after eight o’clock in the morning of 25th November 1885 the Bang

expired. Dr Camison, who attended him through- out his illness, pronounced it to be laryngeal phthisis.

Alphonso XII. was undoubtedly intelligent, anxious to play his part as King with energy and regardless of peril or personal sacrifice, as he did in the flooded districts of Murcia, in the earthquake-stricken provinces of Granada and Malaga, in the hotbeds of cholera in 1885. He always insisted on being informed of all affairs of State by his ministers and by the leading statesmen of the Opposition. He wished to be considered a ruler after modern ideas and constitutional principles of government, only the old Bourbon inclination for personal government cropped up when he overawed the too ambitious generals, when he assumed responsibility for all matters concerning the army, when he vetoed the re-establishment of universal suffrage and other democratic legislation, and when he determinedly took into his own hands the direction of the foreign policy of the country. He was a patron of arts and literature, of the turf and of the national bull-fights, and he spent much of his personal income in charities. – A sincere Catholic, he was neither a bigot nor priest-ridden. He led an active life, rising early, devoting much time to riding, driving, shooting, hunting, and walking in summer in the highlands of Segovia. He was gifted with great conversational powers ; was courteous and gallant, like his Bourbon ancestors, to the fair sex ; easily approachable by all his subjects ; and both amiable and hospitable to foreign princes and visitors, though ever kingly, with a touch of haughtiness in his manners. He had the luck to escape criticism at the hands of the dynastic Oppositions of his eleven years' reign. They invariably assailed his succes- sive Cabinets, which shielded him loyally, even when perfectly aware that they were not infrequently blamed for acts which the King had dictated in a manner that brooked no resistance or remonstrance.

When such a ruler disappeared from the scene, it was no wonder that Spaniards and foreigners should have felt

extremely anxious about the prospects of the Regeacy monarchy. Alphonso XII. left no male issue. Christina. He had two daughters, the Princess of the

Asturias, born in 1880, and the Infanta Maria Theresa, born in 1882. At the time of his death it had not been officially intimated that the Queen was enceinte. The Official Gazette did not announce that fact until three months after the demise of the sovereign, when the nation was duly informed, according to ancient usage. On 17th May 1886, six months after the death of Alphonso XII., his posthumous son, Alphonso XIII. , was born at the Palace of Madrid. Six months before this event definitely settled the question of the succession to the throne, the royal family and its councillors assembled to take very important decisions. There could be no doubt that under the Constitution of 1876 the widowed Queen was entitled to the Regency. Dona Maria Christina on this first occasion displayed her characteristic self-possession and resolution by simply acting from the beginning as if

she considered her right to govern Spain during the minority of the future sovereign to be entirely undis- putable. She calmly presided over this solemn council, listening to the advice of Marshal Campos, always con- sulted in every great crisis; of Captain-General Pavia, who answered for the loyalty of the capital and of its garrison ; of the Duke de Sexto, the chief of the household ; of Marshal Blanco, the chief of the military household; and of all the members of the Cabinet and the Presidents of the Senate and Congress assembled in the presence of the Queen, the ex-Queen Isabella, and the Infanta Isa- bella. All were deeply impressed with the gravity of the situation, and looked chiefly to Marshal Campos and Canovas del Castillo for statesmanlike and disinterested advice. The question was whether it would be expedient to continue the policy of the late King and of his last Cabinet. This would have been tantamount to ushering in a long minority and the Regency of a foreign Queen with a Conservative and reactionary policy which had much impaired the prestige and popularity of the monarchy during the last 18 months of the reign of Alphonso XII., and had so exasperated the various groups of the Opposition that their discontent constituted one of the most serious embarrassments of the situation. Canovas del Castillo assured the Queen-Regent that he was ready to undertake the task of protecting the new state of things if it was thought wise to continue the Conservative policy of the late King, but in the circum- stances created by his death, he must frankly say that he considered it advisable to send for Senor Sagasta and ask him

to take the reins of government, vidth a view to inaugurate the Regency under a Liberal, progressive, and conciliatory policy. Canovas added that if this suggestion were adopted he was in a position to promise that the new Government would not be combated or obstructed by the Conservatives, whose loyalty naturally would make them co-operate in everything calculated to consolidate the monarchy and the dynasty. Marshal Campos and General Pavia endorsed the suggestion. They were also of opinion that Sagasta would soon checkmate the intrigues of the Republicans, by proving that the Government of the Regency could perfectly carry out all the reforms advo- cated by Spanish Liberalism and by those Democrats who were not irreconcilable revolutionists. Sagasta was summoned to El Pardo, and the result of his interview with the Queen-Regent, Canovas, and the generals was the understanding ever afterwards known as the pact of El Pardo, the corner-stone of the whole policy of the Regency, and of the two great statesmen who so long led the great dynastic parties and the Governments of Dona Christina. It was agreed that during the first years of the Regency, Canovas and Sagasta would assist each other in defending the institutions and the dynasty, that they would discourage indiscipline and dissent in the ranks of the two monarchical parties, and that the Parliaments should as far as possible last their full legal term of five years, in order to avert frequent general elections and the political agitation naturally aroused by such appeals to the country. Sagasta made no secret of the fact that it was his intention to alter the laws and the Constitution of the monarchy so as to make them very much resemble the Constitution of the revolution of 1868, but he undertook to carry out his reform policy by stages, and without making too many concessions to Radicalism and Demo- ❓❓❓ cracy, so that Canovas and his Conservative and Catholic followers might bow to the necessities of modern times after a respectable show of criticism and resistance. The generals assured the Queen-Regent and the leaders of the dynastic parties that the army might be counted upon to stand by any Government which was sincerely determined

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to uphold the restoration against Kepublicans and Carlists, and that it would assist the Alphonsist officers in checking the revolutionary propaganda still visible in the barracks among the sergeants and the officers who had risen from the ranks. Sagasta left the Palace to form the first of several Cabinets over which he presided continuously for five years. He took for colleagues some of the strongest and most popular statesmen of the Liberal party, virtually representing the three important groups of men of the revolution united under his leadership ___ veteran Liberals like Camacho and Venancio Gonzalez ; Moderates like Alonzo Martinez, Gamazo, and Marshal Jovellar; and Democrats like Moret, Montero Eios, and Admiral Beranger. The new Cabinet convoked the Cortes elected under the administration of Canovas in 1884, and the Queen-Regent appeared before the Estates of the ' realm assembled in the Congress Hall, with her two little daughters and Court, all in deep mourning, and there, with her hand on the crucifix and Gospels, she took the constitutional oath. The Conservative majorities of both Houses, at the request of Canovas, behaved very loyally, voting supplies and other Bills necessary to enable the Government to be carried on until another Parliament could be elected in the following year, 1886.

*Pending the dissolution and general election, Sagasta and his colleagues paid most attention to public peace and foreign affairs. A sharp look-out was kept on the ^ndCarUst '^ ___i'g ___^ *^^ Republicans, whose arch agitator, intrigues. I^iiz Zorilla, in Paris displayed unusual activity in his endeavours to persuade the Federals, the Intransigents, and even the Opportunists of Democracy that the times were ripe for a venture. Ruiz Zorilla found no response from the Republican masses, who looked to Pi y Margall for their watchword, nor from the Republican middle classes, who shared the views of Salmeron, Azcarate, and Pedregal as to the inexpediency of revolutionary methods. Castelar, too, raised his eloquent protest against popular risings and barrack con- spiracies. The Carlists showed equal activity in propa- ganda and intrigues. They did not attempt to conceal the fact that they only awaited a signal from the pre- tender Don Carlos to rise again in their usual provincial haunts. The emissaries of the pretender were constantly passing to and fro between the*

Peninsula and the abode of the exiled representative of absolutism and religious intolerance. Sagasta derived much benefit from the divisions which made Democracy powerless ; and he was able to cope with Carlism chiefly because the efl^orts of the pretender himself abroad, and of his partisans in Spain, were first restrained and then decisively paralysed by the influence of foreign Courts and Governments, above all by the direct interference of the Vatican in favour of the Spanish Regency and of the successor of Alphonso XII. Don Carlos could not afford to incur the displeasure of the Austrian Imperial family, or of the Italian Govern- ment, which allowed him to reside unmolested in Venice, much less that of the Pope, whose mandate he knew had gone forth that the clergy, high and low, and the religious orders of both sexes, were to refrain from abetting civil war in the Peninsula. The young and most impatient adherents of Carlism vainly pleaded that such an oppor- tunity would not soon be found again, and threatened to take the law into their own hands and unfurl the flag of Dios, Patria, y Bey in Northern and Central Spain. Don Carlos once more showed his well-known lack of decision and dash, and the Carlist scare passed away. Pope Leo XIII. went even farther in his patronage, for he consented to be the godfather of the posthumous son of Alphonso XII., and he never afterwards wavered in the steady sympathy he showed to Alphonso XIII. He was

too well acquainted with the domestic politics of the Peninsula to suppose that Carlism could ever do more than disturb for a while the tranquillity of Spain. He did not wish to stake the interests of the Church on a cause which could only revive against her the old animosities of Spanish Liberalism and Democracy, so roughly displayed in 1836 and 1868. He was perfectly aware that the Church could expect even better treatment at the hands of the Austrian Archduchess who had become Queen-Regent than had been received from her late husband. Dona Christina, apart from the dictates of gratitude towards the head of her Church for the kindness shown to her son and Government, was a zealous Catholic. She proved all through her Regency that she not only relied upon the support of the Vatican and of the prelates, but that she was determined to favour the Church and the religious foundations in every possible way. Whenever she distributed bounties on royal birth- days and saints' days, the lion's share went to religious charities and institutes. Her purse was

always open to assist convents, monasteries, and religious works and societies, and the building of churches, chapels, nunneries, colleges, schools, foundling hospitals, and night refuges, as long as they were under the management of the Church and the orders. Her influence was ever exercised, in Cabinet Councils and in private conferences with her ministers, to further the views of the Church in matters of education, in questions affecting religious toleration, and even in foreign relations. Dona Christina became Regent just when Spain had felt the consequences of the expulsion of the Jesuits and other religious orders from France after the famous Jules Ferry laws, which aimed at placing these orders more under State control, to which they declined to submit. They selected Spain as an excellent field of enterprise ; and it must be said that all the Governments of the Regency showed so much indulgence towards the Catholic revival thus started, that in less than a decade the kingdom was studded vsdth more convents, monasteries, Jesuit colleges. Catholic schools, and foundations than had existed in the palmy days of the Houses of Austria and Bourbon in the 17th and 18th centuries. A wave of Clericalism and ultra- Catholic influences swept over the land, affecting the middle classes, the universities and learned societies, and making itself very perceptible also among the govern- ing classes and both dynastic parties. Liberals and Con- servatives. The Vatican was thus more than rewarded for securing the Regency twelve years' comparative truce from the Carhsts. Nevertheless, it had once more to step in to check the pretender and his partisans when the disasters of the war with the United States seemed to have furnished Don Carlos a last opportunity to become an active element in Spanish politics.

Next in importance to Papal protection was the favour- able attitude of all the European Governments towards the Queen ~~Regent and, later, towards her son. The Court and Government of Germany, despite Europe the award of the Pope in the arbitration on ^eeency the rival claims of Spain and Germany over the Caroline Islands, vied with the Austrian and Italian royal families and Governments in showing sympathy to the widow of Alphonso XII. Republican France and~~ the Tsar made as cordial demonstrations as Queen Victoria and her Government, and Switzerland, Belgium, Holland, and others followed suit. The Spanish Foreign Office received every assurance that friendly Governments would watch the

Carlists and Republicans, to prevent them from using their territories as a basis for conspiracies against the peace of Spain. The statesmen of both dynastic parties, from the beginning of the Regency, did

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not conceal from the Governments of Europe that they considered it unadvisable to continue the foreign policy of the late King. From every point of view it was better that the Regency should observe strict neutrality in European affairs, in order to avoid complications fraught with evil consequences for the monarchy and the dynasty in the unsettled state of the country. This neutrality was maintained until the close of the 19th century. It was criticized during and after the colonial wars and the war with America, which led to the loss of the colonies in 1898, when a few Conservatives like Silvela, as well as the Republicans, who were always prone to French alliances, proclaimed that presentiment and foresight had made them dissent from the policy of neutrality and isolation which prevailed from 1885 to 1898.

Sagasta conducted the first general election in 1886 much after the usual precedents. The Long Parliament of the Regency was composed of considerable Policy ot Ljjjgpa,! majorities in both Houses, though Sagasta had allowed a larger share than Cano- vas was wont to do to the minorities, so much so that on the Opposition benches the Republicans of various shades were represented by their most eminent leaders, the Carlists had a respectable group, and the Conserva- tives a strong muster, flanked by a group of dissentients. The first Cortes of the Regency in five sessions did really good and substantial work. A civil code was carefully drawn up by Senor Alonzo Martinez, in order to con- solidate the very heterogeneous ancient legislation of the monarchy and the local laws of many provinces, especially Catalonia, Aragon, Valencia, Navarre, and the Basque territory. Trial by jury was re-established for most crimes and offences. The laws regulating the rights of associa- tion and public meeting, the liberty of the press, and other rights of the subject were

reformed on liberal and more tolerant lines. Finance and trade received attention. Some commercial treaties and agreements were made, including one with Great Britain, which proved highly beneficial to home trade, and the tariff was altered, in spite of much resistance on the part of the Protec- tionists. In his progressive policy Sagasta was actively and usefully supported by the chief of the Moderate Republicans, Emilio Castelar, who not only eloquently defended all the liberal projects of the Government, but re- peatedly declared in Congress and at public meetings that Democracy had no longer any grounds for agitating the country from the moment that a Liberal administration was virtually restoring all the principal features of the Constitution of the Spanish revolution. He went so far as to recommend his partisans to vote on every division with the Liberal party, because he confessed that bitter experience had taught him that liberties and rights were better attained and made stable by pacific evolution than by revolution. He laid most stress upon this axiom when, in September 1886, Ruiz Zorilla suddenly sprang upon Sagasta a military and revolutionary movement in the streets and barracks of the capital. This failed, but it was found that the conspiracy had contaminated in the Madrid and other garrisons many regiments which did not actually break out into insurrection. The military authorities acted with vigour and promptitude, the rebels being pursued, dispersed, and arrested. General Marina and several other officers were condemned to death by court-martial, but Queen Christina commuted the sentence into penal servituilc, and the Ministers of War and Marine retired from the Cabinet in consequence. Very shortly afterwards, another War Minister, General Castillo, attempted to strike at the root of military insubordination, and simultaneously in every garrison of the kingdom the senior sergeants, more than 1000 in all, were gi\en their

discharge and ordered to start for their homes on the spot. The lesson produced a good result, as no trace of revolutionary work revealed itself among the non-com- missioned ofl&cers after 1886. As time wore on, Sagasta found it difiicult to maintain disciphne in the ranks of the Liberal party. He was obliged to reconstruct the Cabinet several times in order to get rid of troublesome colleague's like General Cassola, who wanted to make himself a sort of military dictator, and Camacho, whose financial reforms and taxation schemes made him un- popular. He had oftener to

reorganize the Government in order to find seats in the Cabinet for ambitious and impatient worthies of the Liberal party ??? not always with success, as Senor Martos, president of the Congress, and the Democrats almost brought about a political crisis in

1889. Sagasta cleverly affected to resign and stand aside, so that Senor Alonzo Martinez might vainly attempt to form an intermediary Cabinet. Canovas, who was con- sulted by the Queen when Alonzo Martinez failed, faith- fully carried out the i^act of El Pardo and advised her Majesty to send for Sagasta again, as he alone could carry out what remained to be done of the Liberal programme. Sagasta reconstructed his ministry for the last time, and announced his intention to make the re-estabhshment of universal suffrage the crowning act of the Liberal policy, knowing very well that he would thus rally round him all the Liberals, Democrats, and Republicans in the last session of the Long Parliament. The Suffrage Bill was carried through the Senate and Congress in the spring of 1890 after protracted debates, in which the Conservatives and many miHtary politicians who had previously been regarded as the allies of Sagasta did their best to obstruct the measure. Marshals Campos, JoveUar, and Novahches, and Generals Pavia, Prime de Rivera, Daban, and others, were angry with Sagasta and the Liberals not only because they deemed their policy too Democratic, but because they ventured to curb the insubordinate attitude of general officers, who shielded themselves behind the immunities of their senatorial position to write insolent letters to the War Minister on purely professional questions. Spanish generals of pronunciamiento fame thought it perfectly logical and natural that sergeants and subalterns should be shot or sent to penal servitude for acts of indiscipline, but if an insubordinate general was sent to a fortress under arrest for two months they publicly demonstrated their sympathy with the offender, made angry speeches against their hierarchical chief, the War Minister, in the Senate, and dared to call upon the Queen-Regent to make representations, which unfortunately were listened to, according to the worst precedents of the Spanish monarchy. The increasing violence of the Conservative press and Opposition, the divisions developing in the ranks of Liberalism, and the restlessness of the agricultural protectionists, led by Senor Gamazo, did not weigh so much in the balance at Court against Sagasta as the aggressive attitude of the military politicians.

Sagasta held on as long as was necessary to secure the promul- gation of the univer.^al suffrage law, but he noticed that the Queen-Regent, when he waited upon her for the despatch of public business, showed almost daily more impatience for a change of policy, until at last, in July

1890, she peremptorily told him that she considered the time had come for calling the Conservatives and their military patrons to her councils. Sagasta loyally furnished the Queen with a constitutional pretext for carrying out her desire, and tendered the resignation of the whole Cabinet, bo that lier ^tajesty might consult, as usual, the party leaders and generals on the grave question of the expediency of entrusting to new ministers or to the Liberals the mission of testing the new electoral system.

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Queen Christina on this occasion acted exactly aa she henceforth did in all ministerial crises. She slowly con- sulted the magnates of all parties with apparent imparti- ality, and finally adopted the course which it was an open secret she had decided upon in pectore beforehand. Her late husband had impressed her with the advisability of keeping ijp the outward forms of constitutional and Parliamentary government, though the total lack of sincerity at the elections made it necessary that the royal prerogative should be exercised whenever the sovereign thought such interference indispensable in the interests of the dynasty and the country. Dona Christina certainly displayed more disposition for personal government than Alphonso XII., and, singularly enough, she was more often humoured in this respect by her Liberal ministers than by haughty Canovas, who did not hesitate at times to point out to the mother of Alphonso XIII. that the monarchy, as well as the Conservatives and Catholics who were its councillors, must shape its conduct in accordance with modern ideas.

Canovas gathered round him most of the prominent Conservative and Catholic statesmen. The first step of the new Cabinet was calculated to satisfy the A protec- protectionist aspirations which had spread in the rizlme kingdom about the same time that most Con- tinental countries were remodelling and raising their tariffs. The Madrid Government used an authoriza- tion which Sagasta had allowed his Long Parliament to vote, to please Sefior Gamazo and the Liberal representa- tives of agricultural interests, empowering the Govern- ment to revise and increase all tariff duties not covered by the then existing treaties of commerce. This was the case with most of the products of agriculture and with hve stock, so Canovas and his Finance Minister made, by royal decree, an enormous increase in the duties on these classes of imports, and particularly on bread – stuffs. Then, in 1891, they denounced all the treaties of com- merce which contained clauses stipulating most-favoured- nation treatment, and they prepared and put in force in February 1892 a protectionist tariff which completely reversed the moderate free trade policy which had been so beneficial to the foreign commerce of Spain from 1868 to 1892. Not a few nations retaliated with higher duties upon Spanish exports, and France raised her wine duties to such an extent that the exports of wines to that country dropped from ►►12,500,000 before 1892 to ►►2,400,000 in 1893 and the following years. The effects of a protec- tionist policy verging upon prohibition were soon sharply felt in Spain. Foreign exchanges rose, exports decreased, the railway traflic declined, and the commercial classes and consumers of foreign goods and products were loud in their protests. Industrial interests alone benefited, and imported more raw materials, chemicals, and coal and coke, which naturally influenced the exchanges adversely. Spain only attempted to make new treaties of commerce with Holland, Norway, Sweden, Denmark, and Switzer- land. The Great Powers contented themselves with securing by agreements the same treatment for their commerce in Spain as that granted by those five treaties. The protectionists in 1893 wrecked a treaty of commerce with Germany in the Senate; and Spain subsequently persevered in her protectionist policy, vsdthout any new treaties of commerce, until the close of the 19th century, with the result that' foreign trade ceased to move for- ward with great strides, as it had done all through the 'eighties under the regime of commercial treaties and a moderate tariff. During his two and a half

years' stay in office Canovas had not so much trouble with the Opposi- tion as with the divisions which sprang up in the Con- servative ranks, though he fancied that he had managed

the general election in 1891 so aa to secure the customary docile majorities. The split in the Conservative camp originated in the rivahy between the two principal lieutenants of Canovas, Romero Robledo and Francisco Silvela. The latter and a strong and influential body of Conservatives, chiefly young politicians, dissented from the easy-going views of Romero Robledo and of Canovas on the expediency of reforms to correct the notorious and old-standing abuses and corruption of the municipali- ties, especially of Madrid. When Canovas found himself deserted on so delicate a matter by a numerous section of his party, he resigned, and advised the Queen to send for Sagasta and the Liberals. Canovas's tenure of office was marked by some occurrences worthy of notice at home and in Morocco. The Anarchists of Barcelona, on a great local fete day, threw a bomb at the feet of the Captain-General of Catalonia, Marshal Campos, which wounded several people and caused a great panic ; and a few months later another Anarchist threw a bomb, into the Liceo Theatre at Bar- celona, and more than thirty persons were killed or badly wounded. In both cases some of the authors of the outrages were apprehended, tried, and executed, and their accomplices sent to penal servitude. A terrible explosion occurred in November 1893, at Santander, on board a large Spanish steamer laden with dynamite and anchored alongside the quay. An enormous amount of damage was done to many houses, public buildings, and churches. The local authorities put down the number of victims at more than 1000, and many missing were never accounted for.

Sagasta took office very reluctantly, as he considered a change of policy premature. He conducted the general election with much regard for the wishes of the Opposition, and out of 456 seats in the Lower Difficulty House allowed them to have more than 170, the Conservatives getting nearly 100 and the Republicans 30. He had to settle some knotty questions, foremost a conflict with Morocco, which was the conse- quence of the aggression of the unruly Riff tribes upon the Spanish outposts around MeUUa, a Castilhan station on the Mediterranean coast of

Morocco. Reinforcements were tardily sent out ; and in a second attack by the Arabs the Spanish forces lost heavily, and their commander. General Margallo, was killed. Public opinion was instantly fired, and the press called so loudly for revenge that the Government sent to Melilla no less a personage than Marshal Campos, at the head of 29 generals and 25,000 men. The Sultan of Morocco lost no time in censuring the behaviour of the Riff tribes, and in promising that lie would chastise them. Marshal Campos was sent to Fez to make a treaty, in which he obtained ample redress and the promise of an indemnity of ––800,000, which Morocco punctually paid.

Colonial affairs gave Sagasta much to do. He had given seats in his Cabinet to Sefior Maura as Colonial Secretary and to Sefior Gamazo, his brother-in- law, as Finance Minister. These two Moderate ––––– Liberals acted in concert to grapple with g"gg––jg––– colonial questions, which in 1894 had assumed a very serious aspect. Spain had received many ominous warnings. Marshal Campos, on returning from Cuba in 1879, had advocated some concessions to satisfy the legiti- mate aspirations of the majority of the colonists, who wished for a less antiquated and less arbitrary rule. In 1886, in the first Parliament of the Regency, Cuban autonomist Deputies divided the House on a motion in favour of home rule and of an extension of the franchise in Cuba. This motion was negatived by all the Conserva- tives, by most of the Dynastic Liberals, and by some Repub- licans. On that occasion a prophetic warning was given

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by a Cuban home ruler, Sefior Montoro, in an eloquent speech, imploring Spain not to play into the hands of the separatists and their American patrons, who made capital out of a policy which was simply suicidal on the part of Spain. The mother country, in fact, had persisted in looking

upon the colonies as a privileged iield of enter- prise for Spanish capital, commerce, adventurers, and officials, supported in Cuba particularly by an oligarchy of reactionary colonists and Spaniards settled in the island, who were able to have entirely their own way owing to a very limited franchise. The majority of Spaniards were kept by the Government and the press quite in the dark about the growth of disaffection in Cuba, so that they were loth to listen to the few men, soldiers and civilians, courageous enough to raise the note of alarm during the ten years before the final catastrophe. For no other reason did the Minister for the Colonies, Sehor Maura, in 1894 fail to convince the Cortes, and even the Liberal party, that his very moderate Cuban Home Rule Bill was an indispensable and wise, though tardy, attempt to avert a conflict which many plain symptoms showed to be immin- ent in the West Indies. Maura was warmly supported in Congress by the Cuban home rulers and by some far- sighted Liberals and Eepublicans. Nevertheless, his Bill did not find favour with the Conservatives or the majority of the Liberals, and Sagasta, trimming according to his inveterate habit, found a pretext to get rid of Maura and Gamazo. In the place of Maura he found a more pliant Minister for the Colonies, Seilor Abarzuza, who framed a Cuban Eeform Bill so much short of what his predecessor had thought an irreducible minimum of concessions, that it was censured in Havana by all the colonial Liberals and home rulers, and by their representatives in Madrid. The latter at the last moment recorded their votes in favour of the Abarzuza Bill when they perceived that a strange sort of eleventh-hour presentiment was about to make 'all the Spanish parties vote this insufficient reform. Before it could be promulgated, the tidings came of a separatist rising in the old haunts of Creole disaffection near Santiago de Cuba. Sagasta sent about 12,000 men to re- inforce the 15,000 soldiers in Cuba under General Callaga, and was preparing more when a characteristically Spanish ministerial crisis arose. The subalterns of the Madrid garrison took offence at some articles published by Radical newspapers, and they attacked the editorial offices, mal- treated the staff, and created a scandalous disturbance. Neither the War Minister nor the commanders of the garrison chose to punish the offenders, and sooner than endorse such want of discipline, Sagasta and the Liberal party once more made way for Canovas. A very few days after he assumed office Canovas received information con- cerning the spread of the rising in

Cuba which induced him to send out Marshal Campos with 30,000 men. The Conservative Government spared no effort to provide the new governor-general with the means to cope with the ever- increasing insurrection, which swept over the island from the east to the extreme west, up to the very suburbs of Havana. Canovas allowed Marshal Campos much liberty of action, but dissented from his views on the expediency of allowing him to offer the loyalists of Cuba as much home rule as would not clash with the supremacy of Spain. The Prime Minister declared that the Cubans must submit first, and then the mother country would be generous.

Before a year had passed, in view of the signal failure of Marshal Campos, the Madrid Government decided to send out General Weyler, who had made himself famous in the Philippines and at Barcelona for his stern and cruel procedure against disaffection of every kind. He showed the same merciless spirit in dealing with the Cubans ; and

he certainly cleared two-thirds of the island of Creole bands, and stamped out disaffection by vigorous military operations and by obliging all the non-com- batants who sympathized with the rebels in arms Oeneral to elect between joining them in the bush, La ^^^'"— Manigua, or residing within the Spanish lines. This system might probably have succeeded if the United States had not countenanced the sending of supplies of every kind to the rebels, and if American diplomacy had not again and again made representations against Weyler's ruthless policy. Canovas so fully comprehended the necessity of averting American intervention that he listened to the pressing demands of Secretary Olney and of the American Minister in Madrid, Mr Taylor, and laid before the Cortes a Bill introducing home rule in Cuba on a more liberal scale than Maura, Abarzuza, and Sagasta had dared to suggest two years before. Canovas did not live to see his scheme put into practice, as he was assassin- ated by an Anarchist at the baths of Santa Agueda, in the Basque provinces, on 9th August 1897. The Queen- Regent appointed General Azcarraga, the War Minister, as successor to Canovas ; and a few weeks later President McKinley sent General Woodford as representative of the United States at the Court of Madrid. At the end of September 1897 the American Minister placed on record, in a note handed by him at San Sebastian to the

Minister for Foreign Affairs, the Duke of Tetuan, a strongly worded protest against the state of things in Cuba, and demanded in substance that a stop should be put to Weyler's pro- ceedings, and some measures taken to pacify the island and prevent the prolongation of disturbances that grievously affected American interests. Less than a fort- night after this note had been delivered, the Conservative Cabinet resigned, and the Queen-Regent asked Sagasta to form a new administration. The Liberal Government recalled Weyler, and sent out, as governor-general of Cuba Marshal Blanco, a conciliatory and prudent officer, who agreed to carry out the home rule policy which was concerted by Senor Moret and by Sagasta, with a view to obtain the goodwill of the President of the United States. If things had not already gone too far in Cuba, and if public opinion in the United States had not exercised irresistible pressure on both Congress and President, the Moret home rule project would probably have sufficed to give the Cubans a fair amount of self-government. All through the winter of 1897-98 the Madrid Government took steps to propitiate the President and his Government, even offering them a treaty of commerce which would have allowed American commerce to compete on equal terms with Spanish imports in the West Indies and defeat all European competition. But the blowing up of the American cruiser JIaine in the port of Havana added fuel to the agitation in the United States against Spanish rule in Cuba. The time had really gone by for a diplomatic settlement. When Congress met in Washington the final crisis was hurried on. Spain appealed in vain to European mediation, to the Pope, to Courts and Govern- ments. All, with the exception of Great Britain, showed sympathy for the Queen-Regent and her Government, but none were disposed to go beyond purely platonic repre- sentations in Washington.

At last, on 20th April 1898, when the Spanish Govern- ment learned that the United States Minister, General Woodford, had been instructed by telegraph to present an ultimatum demanding the cessation of Warwitb

hostilities in Cuba, with a view to prepare for the ^^ f'""""*

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evacuation oi the island by the Spanish forces,

Sagasta decided to give General Woodford his passports

and to break off official relations with the United States.

It was an open secret that this grave decision was not

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taken, at the Cabinet Council presided over by the Queen, without a solemn protest by Senor Moret and the Ministers of War and Marine that the resources of Spain were totally inadequate for a struggle with the United States. These ‘ protests were overruled by the majority of the ministers, who invoked dynastic and monarchical considerations in favour of a desperate stand, however hopeless, in defence of the last remnants of the colonial empire of Spain. Eeckless as was the course adopted, it was in touch with the feelings of the majority of a nation which had been to the very end deceived by the Government and by the press not only in regard to its own resources, but also in regard to those of the United States and of the colonists in arms in Cuba and in the Philippine Islands. The sequel is soon told. The Spanish fleet in the Far East was defeated in Manila Bay by Admiral Dewey. Admiral Cervera’s squadron was destroyed outside the Bay of Santiago de Cuba by the American fleet under Admirals Sampson and Schley. All communication between Spain and her colonies was thus cut off. An American expedition landed near Santiago, and the Spanish garrison surrendered after a fortnight’s show of resistance. Very shortly afterwards, at the end of July, Spain sued for peace through the mediation of French diplomacy, which did not obtain much from President McKinley. It was agreed that hostilities should cease on sea and land, but that Spain should evacuate Cuba and Porto Eico pending the negotiations for a peace treaty which were to begin in Paris at the end of September 1898. In the meantime Manila and its garrison had surrendered to the Americans. The agreement of 9th August, signed by M. Cambon, the French ambassador in Washington, in the name of Spain, clearly stipulated that her rule in

the New World must be considered at an end, and that the fate of the Philippines would be settled at the Paris negotiations. Unfortunately, Spain indulged in the illusion that America would perhaps respect her rights of sovereignty in the Philip- pine Islands, or pay a considerable sum for their cession and recognize the debts of Cuba and of the Philippines. The American Commission, presided over by Secretary Day in Paris, absolutely refused to admit the Spanish contention that the United States or the new administration in Cuba and the Philippines should be saddled vsdth several hundred million dollars of debts, contracted by the colonial treasuries, and guaranteed by Spain, almost entirely to maintain Spanish rule against the will of the Cubans and Filipinos. Spain could not help assenting to a treaty by which she renounced unconditionally all her rights of sovereignty over Cuba and Porto Kico and ceded the Philippine and Sulu Islands and the largest of the Marianne Islands in consideration of the payment of four millions sterling by America. Thus ended a struggle which only left Spain the Carolines and a few other islands in the Pacific, which she sold to Germany in 1899 for ►►800,000, and a couple of islands which were left out in the delimitation made by the Paris peace treaty of 12th December 1898, and for which America paid ►►20,000 in 1900.

The consequences of the war and of the loss of the colonies were very serious for Spanish finance. The P national debt, which consisted before the war

and of ►►234,866,500 of external and internal consols

political and redeemable debts and ►►24,250,000 of home reorgaa. floating debt, was increased by ►►46,210,000 of zation. Qi^ban and Philippine debts, which the Cortes had guaranteed, and by ►►60,000,000 of debts contracted at a high rate of interest, and with the national guarantee, to meet the expenses of the struggle with the colonies and of the war with the United States. These additional burdens rendered it necessary that taxation and the budget should be thoroughly reorganized. All parties

faced the problem with resignation and courage, declaring that the nation would not in any case repudiate its engagements, and intended to resort exclusively to sacri- fices which would be asked of the home bondholders and the taxpayers. Sagasta and the Liberal party would gladly have undertaken the reorganization of Spain and her finances, but the issue of the war and the unavoidable peace treaty had so evidently damaged their popularity in the country and their credit at Court, that the Government seized the pretext of an adverse division in the Senate to resign. The Liberals left office after having done aU that was morally and materially possible during the gravest crisis in the annals of Spain and her monarchy, consider- ing the extremely difficult, indeed inextricable, situation in which they found the country in October 1897. The task of reorganization was confided by the Queen-Eegent to Senor Silvela, who had been universally recognized as the leader of the Conservatives and Catholics after the death of Canovas del Castillo. Silvela endeavoured to unite in what he styled a Modern Conservative party the bulk of the followers of Canovas; the Ultramontanes, who were headed by General Polavieja and Sefior^Pidal ; the Catalan Eegionalists, whose leader, Duran y Bas, became a Cabinet Minister ; and his own personal following, of whom the most prominent were the Home Secretary, Senor Dato, and the talented and energetic Finance Minister, Senor Villaverde, upon whose shoulders rested the- heaviest part of the task of the new Cabinet. Silvela lacked the energy and decision which had been the characteristics of Canovas. He behaved constantly like a wary and cautious trimmer, avoiding all extreme measures, shaking off compromising allies like the Ultramontanes and the Eegionalists, elbowing out of the Cabinet General Polavieja when he asked for too large credits for the army, taking charge of the Ministry of Marine to carry out reforms that no admiral would have ventured to make for fear of his own comrades, and at last dispensing with the services of the ablest man in the Cabinet, the Finance Minister, Senor Villaverde, when the sweeping reforms and measures of taxation which he introduced raised a troublesome agitation among the taxpayers of all classes. Villaverde, however, had succeeded in less than eighteen months in giving a decisive and vigorous impulse to the reorganization of the budget, of taxation, and of the home and colonial debts. He created a comprehensive income tax which produced several millions sterling, thus helping the budget, which

the cost of colonial and foreign wars had swelled to more than ►►36,000,000 a year. He reduced expenditure, despite the resistance of his own colleagues in the Cabinet and of all the vested interests in the army, navy, civil service, and Church, which stiU make reforms so difficult in Spain. Villaverde did not omit a single device that could serve his purpose of increasing the revenue in order to meet the irreducible expenditure of the State. He resolutely reformed all existing taxation, as well as the system of assessment and collection, and before he left office he was able to place on record an increase of close upon three millions sterHng in the ordinary sources of revenue. His reorganization of the national debt was very complete ; in fact, he exacted even more sacrifices from the bond- holders than from other taxpayers. The amortization of the home and colonial debts was suppressed, and the redeemable debts of both classes were converted into 4 per cent, internal consols. The interest on all colonial debts ceased to be paid in gold, and was paid only in pesetas, like the rest of the internal debts, and like the external debt held by Spaniards. Alone, the external debt held by foreigners continued to enjoy exemption from taxation, under the agreement made on 28th June 1882 between the Spanish Government and the council of

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foreign bondholders, and its coupons were paid in gold. The Cortes authorized the Government to negotiate with the foreign bondholders with a view to cancel that agree- ment. This, however, they declined to do, only assenting to a conversion of the 4 per cent, external debt into a 3^ per cent, stock redeemable in sixty-one years.

After parting with ViUaverde, Silvela met with many difficulties, and had much trouble in maintaining discipline in the heterogeneous ranks of the Conservative party. He had to proclaim not only such important provinces as Barcelona, Valencia, and Bilbao, but even the capital of Spain itself, in

order to check a widespread agitation which had assumed formidable proportions under the direction of the chambers of commerce, industry, navigation, and agriculture, combined with about 300 middle-class corpora- tions and associations, and supported by the majority of the guilds and syndicates of taxpayers in Madrid and the large towns. The drastic' measures taken by the Govern- ment against the iSTational Union of Taxpayers, and against the newspapers which assisted it in advocating resistance to taxation until sweeping and proper retrench- ment had been effected in the national expenditure, checked this campaign in favour of reform and retrench- ment for a while. It had, nevertheless, stirred pubKc opinion very deeply, and aroused in the middle classes, which are the backbone of a nation, a strong and healthy disposition to revolt. Silvela's position in the country had been much damaged by the very fact of his poHcy having fallen so much short of what the nation expected in the shape of reform and retrenchment. At the eleventh hour he attempted to retrieve his mistake by vague promises of amendment, chiefly because all the Opposition groups, above all Sagasta and the Liberals, announced their intention of adopting much the same programme as the National Union. On the whole, the 19th century closed in Spain with a visible and promising awakening of forces outside the merely political and official world. The nation, conscious of its vast natural resources, undaunted by its past and recent reverses, and confident of its recuperative power, made no secret of its desire to concentrate its energies at home, and of its determination to exact from its rulers a stricter account of the affairs of the nation. There were also in the depths of Spanish society, in its working classes, in its bov/rgeoisie, and among its intellectual ^lite, many s3Tnptoms of a disposition to live henceforth more in touch with the rest of Europe as regards economic, social, scientific, and political progress.

The enthronement of the young King Alphonso on 17th May 1902 helped to clinch this reassertion of Spanish virility and self-confidence. At the opening of the new century, Spain, released from the exhausting obligations of colonial troubles, found the international situation one which promised to restore some of her weight in the councils of Europe. In the Mediterranean and in north- west Africa her influence had great possibilities, and there were obvious signs that more than one Great

Power would find the friendship of Spain of almost vital importance. (a. e. h.)

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Unchanged and apparently unchangeable in so many respects ??? religious, political, and social ??? Spain has not contrived to escape altogether from the various currents which swept through the general sea of European literature during the last decades of the 19th century. The familiar saying that Africa begins at the Pyrenees finds some slight justification in the older literature of Spain, for it has a force of its own and a peculiar savour which correspond to nothing in the rest of Europe. These qualities, innate to the Spanish genius, were developed by

isolation, but the isolation of former times is no longer possible. The acceptance of the Bourbon dynasty in- volved a certain breaking vfith the past ; intercourse with France has become closer as well as more frequent, and the literary efi'ects of this intellectual commerce are to be seen in the Spanish imitation of French classicism, French romanticism, and French naturalism. It is a question whether Spain has, from the literary point of view, lost or gained by compromising with modern ideas. The aim has been to assimilate the foreign elements and to create, as has been said, "a new literature which should be truly national and no longer a mere echo of that beyond the Pyrenees." It would be an exaggeration to say that this ambition has been realized in any large measure ; but, if the attempt has not completely succeeded, it may fairly be urged that a century and a half is but a brief space in literary history, and that Spain is at present less under French influence than she has been. Kivas, Espronceda, Zorrilla, L6pez de Ayala, Tamayo y Baus owe much more to foreign models than does Kam6n de Campoamor y Campoosorio, the Nestor of Spanish poets, in whom foreign critics are often tempted to think that they recognize a disciple of Heine. Nothing could be more erroneous, for Campoamor, though he vaguely suggests to cosmopolitan readers something of Heine's condensation and pathos, is continuing in his own semi-philosophic style a national tradition which is of immemorial antiquity ??? that tradition of expressing lyrical emotion in four or eight lines which finds its most homely, popular manifestation

in the innumerable coplas collected by Francisco Eodrlguez Marin in his five volumes entitled Cantos populares espanoles. It is true that Campoamor is distinguished for his wit, his grace, his lightness of touch, and for an attention to form which we rarely find in the anonymous copleros ; but these are not exclusively German possessions, and the analogy with Heine goes no farther. The gay, innocent scepticism of Campoamor hardens into sombre doubt in the poems of Gaspar Nilnez de Arce (b. 1834), who is no less a national poet ??? national in theme, in spirit, and in execution. In his case also foreign readers are frequently at fault and prone to under-estimate the singer. Doubtless, Nilnez de Arce is not a profoundly original thinker with a prophetic message to deliver ; but, with him as with Tennyson, though the sentiment and reflection be often commonplace, the artistry is of irreproachable finish. His most popular and prob- ably his most enduring performance is Gritos del comhate (1875), a series of impassioned lyrical exhortations to peace uttered during the last civil war, and it is not a little curious to remark an inefiectual politician deserting oratory, finding his true medium, and producing a decided, permanent, political impression with a volupie of songs. In a very different key are the unaffected simplicity of his Idilio (1878) and the minute observation conspicuous in La Pesca (1884), both of which are more valuable than the melodramatic eloquence of La ultima lamentadon de Lord Byron (1878), and than the prosodic ingenuity of La Selva oscura (1879). SUent during the closing years of the century owing to failing health and to political disappoint- ments, Nilnez de Arce found a follower of considerable accomplishment in Emilio PcSrez Ferrari (b. 1853), who in Pedro A/ie/ardo and in Dos cetros y dos almas recalls the dignity, but not the impeccable correctness, of his model. Another pupil in the same school was Jos6 Velarde (d. 1892), whose best work has been brought together in his Voces del Alma, some numbers of which indicate a dainty and interesting talent. A poet of distinct indi- viduality was Vincent Wenceslao Querol (d. 1889), a mere name to all but vigilant critics like Valera. Querol's busy commercial life did not allow him to improvise at

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ease in the exuberant fashion of his race, and, though he suffered for his frugality, he chose the better part in dis- daining popular applause. He is represented by a single volume of poems as remarkable for their self-restraint and melody as for a deep tenderness which is admirably phrased in the Cartas d Maria, in the poignant stanzas A la muerte de mi hermana Adela, and in some few Catalan verses. The temptation to sound the pathetic note so beautifully audible in Querol's subdued harmonies proved irresistible to Federico Balart (b. 1831), a critic and humorist of repute who, late in life, astonished and moved the public with a sequence of elegiacs which bear a formal resemblance to In Memoriam ; but though the fancy and fluency of Balart's Dolores are obvious enough to explain its great popularity, its sincerity is doubtful, and in Horizontes the unmistakable absence of genuine feeling results in an agreeable but effeminate prettiness. The Andantes y Allegros, the Cromos y ac-uarelas of the Andalusian poet, Manuel Keina (b. 1860), together with his dramatic monologue El dedal de plata and, his Vida Inquieta, have a delightful southern effusiveness, charm, and metrical elegance that conceal some monotony of method and frivolity of thought. An older singer, Manuel del Palacio (b. 1840), was believed at one time to have a great future, and, as he combines imagination and mordant wit with signal technical dexterity, the expecta- tion was reasonable ; but it must be definitely relin- quished, for circumstances have compelled him to write so much and so rapidly that he has frittered away his various talent, and, with the exception of a few humorous sallies and perhaps a dozen sonnets of exquisite workman- ship, he will leave no perennial memory behind him. Palacio's sonnets have, as M. Boris de Tannenberg has pointed out, some resemblance to the sonnets of the French Parnassians. This resemblance is a result less deliberate than was the attempt of Joaquin Maria Bartrina to trans- plant the pessimistic spirit of Leconte de Lisle to Spanish soil. Bartrina's crude materialism is antipathetic and has made him the object of so many unjust attacks that he barely escaped becoming the fashion for a moment ; yet his substance is less censurable than his form, which is wholly wanting in the stately impassibility of his exemplar. The school of religious, doctrinal poetry, -which continues the orthodox traditions of Luis de Le6n and St Theresa, counts numerous

pupils, and, though none of them has risen to the height of the argument, it would be unjust' to omit the name of Luis Eamlrez Martinez y Guertero (d. 1874), who, under the pseudonym of Larmig, unites the Christian ideals with a despairing melancholy which finally led him to commit suicide. Among the latest writers, Vicente Medina and Eamon D. Peres have both brought a new note into Spanish poetry. The facility with which verses and rhymes of a kind can be vwitten in Spanish has made the country a nest of singing-birds ; but the chief names have been already mentioned, and, at the risk of overlooking some youthful promise, no others need be recorded here.

Campoamor has written plays which are interesting in the study as expressions of a keen intelligence put into the shape of dialogue, and Niiiiez de Arce has collaborated with Antonio de Hurtado (1878) in pieces ??? Herir en la sombra and La jota aragonesa ??? that have met with moderate appreciation. His original efforts, Quien debe paga and El Haz de lena, are brilliant exercises in versification rather than dramatic conceptions. But, as happens with Tennyson, Niinez de Arce in the weakest of his plays remains an authentic poet. The Spanish theatre of the present day can show no name of greater importance than the successor of Tamayo y Bans, Jos6 Echegaray y Eizaguirre (b. 1832), a very learned

mathematician and apostle of free trade, who failed in politics and turned to the drama in 1874, when El Libra talonario was given under an assumed name. Since that date Echegaray has produced at least sixty pieces. It does not appear that he had ever published a line of verse before he was forty ; and yet Campoamor, who had often heard Echegaray in the tribune, had not read twenty lines of the new play before he identified Echegaray as the author. This testifies to the author's marked indi-viduality, but it does not imply the faculty of intellectual suppleness which accompanies real dramatic genius. Since 1874 Echegaray has produced plays with almost in- credible profusion : romantic pieces such as La Esposa del vengador and En el puno de la espada ; tragedies such as Cdmo empieza y cdmo acaba and 6 locura 6 santidad ; melodramatic dramas such as El gran galeoto and countless more ; comedies such as Iris de paz and Correr en pos de un ideal ; modern problem-plays such as

El Hijo de Bon Jvan, which has been followed by the more successful Mariana, by Manxha que .limpia and by the very recent El Hombre negro (1898), Silencio de muerte (1899), and El loco Dios (1900). There does not exist, indeed, any form of dramatic composition which Echegaray has not attempted during his long career, and his ambition is worthy of all respect. He is an exceedingly clever play- wright, skilful in construction, a master of stage effects ; he is not embarrassed by pedantic dramatic theories, is open to ideas, and has both imagination and intellectual curiosity. Moreover, he has laid to heart the aphorism of the manager in the prelude to Faust, "Die Masse konnt ihr nur durch Masse zwingen." It is as a literary artist that Echegaray fails to satisfy, and it ►► is precisely as a literary artist that posterity vrill judge him. He does not create character ; his verse has but slight variety of cadence and no natural magic; his prose dithyrambs are impartially allotted to all his personages ; he is, for a Spaniard, strangely wanting in humour ; and, an incurable romantic, he constantly confounds the vast with the sublime. But, numerous as are his failures, he has had the gift of inter- esting audiences and of moving them to enthusiasm, so that in Spain and out of it he' is frequently considered a great dramatist. During the last few years of the century, however, his popularity waned, and one of his latest suc- cesses, Maria Rosa, is translated direct from the Catalan of Angel GuimerA (b. 1847). To Echegaray's school belongs Eugenio Sellfe (b. 1844), whose Nudo gordiano shows so much finer a poetic talent than that of his chief, that high hopes were conceived which, save in El cielo 6 el suelo, have not been realized. His prose play. La Mujer de Loth, is a powerful dramatic study containing scenes of a refreshing originality which cannot be overlooked. A third author, whose name is habitually associated with the names of Echegaray and Selles, is Leopoldo Cano y Masas (b. 1844), a colonel on the general staff of the army, a scientific soldier, and a beau sabreur in his day. Cano's symbolism and didactic purpose are brought forward too insistently in La Mariposa and in Gloria ; but in La Pasionuria the concise dialogue makes it regrettable that an author of such individual endowment should, even for a time, have surrendered his personality to the keeping of Echegaray. Fortunately this influence diminishes as Cano's gifts develop. The Hermenegildo of Francisco SAnchez de Castro (d. 1878) is a most scholarly effort to modernize the methods of Lope de Vega, Tirso de Molina, and Calder6n :

it is no reflection on Sdnchez de Castro to say that his cause is irremediably lost, and that the most minute scholarship in the world is impotent to vivify the traditional drama of the 17 th century. Among the many authors of high or low comedies and farces it is only necessary to name Miguel Echegaray y Eizaguirre (b.

1848), whose cleverness is indisputable and whose buoyant humour is in quaint contrast with his elder brother's sepulchral gloom ; while among the hopes of the future are Vital Aza (b. 1844), Ricardo de la Vega (b. 1858), Jacinto Benavente (b. 1866), Serafin Alvarez Quintero (b. 1871) and his brother Joaquin (b. 1873) ??? all of whom excel in witty fancy.

In libros de entretenimiento Spain has always been rich, and during little more than a single century she conferred upon Europe a succession of masterpieces ??? the Celestina, Amadls de Gaula, Lazarillo de Tormes, Guzmdn de Alfarache and Don Quixote. There is nothing to match that series in modern times, but since 1850 there has been a notable renascence of the Spanish novel. The Gaviota of Fern4n Caballero (d. 1877) is a fascinating, truthful picture of Andalusian village life in the first half of the 19th century, and it happens to be exempt from the sermonizing and the tearful sensibility which make many of her latest books insufferably tedious. Yet, though the Gaviota has marked limitations, and though Ferndn Caballero expended years in composing inferior variations upon her first performance, she is entitled to a most honourable place in literary history, inasmuch as in her own modest, feminine, intuitive way she helped to revive the native realism which had been neglected during the supremacy of romanticism. In all that concerns truth, conscience, and art she is at least much superior to the once popular Manuel Fernandez y Gonzalez (d. 1888). It has been said that Spain should erect a statue to him and should burn his novels at the foot of it ; and the saying has much point. Fernandez y Gonzalez is often

called the Spanish Dumas, and he equals, if he does not excel, the French author in fecundity, in invention, and resource. Some of his tales ??? for example. El Cocinero de su Majestad, Los Minfies de las Alpujarras, and Martin Gil ??? are written with an irresistible verve which time does not stale ; but poverty drove him into becoming a mere literary hack, into working upon two or three books at a time, and into piling one absurdity upon another till at last his puerilities became intolerable. A writer who was once universally read, and who is still esteemed in his native province of Biscay, is Antonio de Trueba (d. 1889). ' He followed Fern4n Caballero in observing local customs and in poetizing them with a delicate sentimental grace which attracted local patriots and uncritical readers everywhere. Beginning with the Cuentos de color de rosa and the Cuentos campesinos, Trueba vvTote incessantly till the last months of his life. He had no gift of delineating character, and he neglected to provide himself with plots ; still he has passages of vivid landscape, and it is to his credit that, except in Las Hijas del Cid (a feeble imita- tion of Sir Walter Scott), he copies nobody, but goes independently on the road of incorrigible optimism. His contemporary Pedro Antonio de Alarc6n is responsible for El Sombrero de tres picos, a peculiarly Spanish piece of picaresque malice which its author never quite succeeded in reproducing, often as he attempted it. Unluckily, Alarc6n was led away into the region of the half -political, half-religious, entirely controversial novel, and lost a great part of the reputation which his brilliant miniature had won him : he was clearly intended to work on a small scale, and on a small scale he is a keen, swift, mischievous observer. Neither Trueba nor Alarc6n could ever, under any circumstances, have developed into great artists ; the first is too sentimental, the second is too rhetorical (save in his one most excellent tale), and both are too careless and haphazard. Trueba marred his chances by idealizing country life into a pale idyll of Arcadia, and he frowned upon one of his neighbours who preferred realism to pastoralism. The northerner, Jos6 Maria de Pereda, is the parent of

the actual, authentic, naturalistic Spanish novel, and the boldness of his experiment startled, if it did not shock, a generation of readers accustomed to Trueba's rather oily conventionalism. Moreover, the very fact that Pereda was the partisan of a lost political cause, and that he was believed, not without reason, to advocate reaction in many forms, told

heavily against him at a time when Liberal ideas and a vague expectation of the millennium were in the air. But the power which stamps his Escenas mon- tanesas was at once appreciated in the northern provinces, and, though the Madrid critics were slow of conversion, a series of great books following closely one upon the other at last compelled them to admit that their first judgment was mistaken. So long as Pereda deals with country folk, with sailors, with the aspects of land and sea, he is incom- parably excellent, for he sympathizes with the poor, understands them, and hits upon the true mean between conventional portraiture and degrading caricature. His hand is less certain when his sitters are of the city type, and his hatred and contempt for towns and townsmen often trouble his vision : it is a mistake to class him, however, as a mere provincial sea and landscape painter, for he is a creator of character, of individuals and of tjrpes, and in the common vulgar things of life his art is continually revealing points of novelty. Much as Dickens is pitted against Thackeray in England, Pereda is continually pitted against Juan Valera y Alcal4 Galiano in Spain, and in both cases the opposition or comparison seems somewhat unprofitable and even unnecessary. The systems, aims, ideals, and temperaments of the two great Spanish novelists are absolutely unlike. Pereda is realistic and he is real. Valera is not, in the restricted sense of the word, realistic ; but he is not a whit less real in his own different and much wider province, while though he has neither Pereda's sturdy energy nor his intense austerity of purpose, he has a far finer, more infallible taste and tact, a wder experience of men and women, and his gracious pagan raillery is as effective a moral commentary on the characters as is his rival's inflexible Christian pessimism. The most popular of Valera's novels are Pepita Jimenez and DoJia Lui, and with Pereda's Sotileza we have a trio of Spanish women who deserve all their fame ; but Valera's wit, subtlety, and charm of style are equally conspicuous and perhaps more mature in his shorter stories ??? in Genio y Figwa and in Jlorsamor. Pereda's is the more vigorous, full-blooded talent, as Valera's is the more enchanting and patrician, yet both of them are essentially native in the quality of their genius, phrasing, and system. At a later date, when the wave of French " naturalism " reached Spain, there arose a school of naturalists who forsook the good example of Pereda and Valera, and followed the Galilean fashion much too closely ; but before the time of that school

came, the right Spanish tradition was taken up by Benito Perez Gald6s (b. 1845), who, after publishing two novels entitled El Audaz and La Fontana de oro in 1871-72, gave a new life to the politico – historical novel in a double series of romances ??? the Episodios nacionales, thirty volumes covering the period of history between the battle of Trafalgar and the death of Ferdinand VII. The name of the Spanish series may have been suggested by the A'oiiuins nationaux of Erckmann-Chatrian, but vpith the name all resemblance ceases. The colouring of the Episodios nacionales is so brilliant, their incident is so varied and full of interest, their spirit is so manful and stirring, that it is difficult for a born Spaniard to examine them in the cold light of criticism : he is reluctant to admit their frequent prolixity, their sweeping, digressions, their insistence on minute details, their loose construc- tion, their uneven style. The fact that a volume of the Episodios nacionales appeared punctually every quarter for

many years is an explanation of these weaknesses, but, taken as a whole, the EpisocUos are a great achievement which has so completely succeeded that the author felt justified in undertaking a third series. On the other hand, there is no such unanimous approbation of the politico-religious novels ??? Dona Perfecta, Gloria, and Le6n Each ??? written by P(5rez Gald6s between 1876 and 1878 : these are discussed from a purely political point of view, praised by Liberals and censured by Conservatives, both of whom are more concerned with the thesis than with the writer's art. In these three remarkable books, P&ez Gald6s proves that he can create character and that he can subordinate his polemics to a higher, more exquisite purpose : the point may be emphasized, for P6rez Gald6s is frequently wanting in tact, as when in his prose play La de San Quintin ??? which is simply a novel in dialogue ??? he marries a duchess to the con- ventional virtuous workman. The quick response which P&ez Gald6s gives to external stimulus of any

kind, his sensitiveness to every change in the literary atmosphere, made it inevitable that he should come under the influence of French naturalism, as he does in Lo prohihido and in Realidad ; but his conversion was temporary, and he recovered his individuality in two forcible romances of contemporary social life ??? Fortvnata y Jacinta and ATigel Guerra ??? which mark the third stage in the development of an impressionable talent. The latest leader of the naturalistic school in Spain is Armando Palacio Vald^s (b. 1853), whose precise vision of the visible world and whose faculty of artistic selection were first shown in his novel El Seilorito Octavio. The surprising advance made in Marta y Maria and in La Herniana San Sulpido, where the characters are seen, observed, under- stood, and rendered with unflinching fidelity, raised hopes that, in Palacio Vald^s, Spain has discovered a novelist of the first order to succeed Pereda and Valera ; but in La Espuma and in La Fe, two social studies which caused all the more sensation that they were said to include portraits of well-knovm personages, the author followed the French lead too closely, and almost ceased to be national without becoming cosmopolitan. His latest work. La Alegria del Gapitdn Ribot (1899), shows that Palacio Valdes has recognized his danger, for herein he returns to his first and better manner of direct observation in a humbler sphere of society. Another novelist who for a time almost divided honours with Palacio Valdes as a naturalistic writer, is the Senora Quiroga(b. 1851), who published under her maiden name of Emilia Pardo Baz4n. Her great energy, courage, and versatility have led her to found a journal of literary criticism which she calls the Nuevo teatro critico in memory of her countryman, the Galician Feij6o. Here she under- takes single-handed to review the literature of Europe, and, sitting constantly at the receipt of custom, she is naturally familiar with the main currents of literary developments. But she was a novelist long before she became a critic, and her Pasc-ual Ldpez, the autobiography of a student of medicine, is a simple tale which might have been written thirty years earlier, and gives no hint of the constructive power, the outspoken reality of Los Pazos de Ulloa, nor of the emphatic animalism of La Madre Naturaleza. The strong, frank, repellent pictures of country people abandoning themselves to their primitive instincts are set off by very graphic descriptions of land- scape ; but the censures passed upon the painful theme of La Madre Naturaleza may have alarmed the writer, and induced her to choose a less

objectionable subject in TJna cristiana. Here, as in later works, there is a diminution of interest and truth, but the style of Emilia Pardo BazAn is constantly happy, and the unquenchable local patriotism which inspires Insolacidn, Morrina, and De mi tierra

secures her a high place in literature as a collector of " documents." Leopoldo Alas (1851-1901), who used the pseudonym of " Clarln," is better known as a critic than as a writer of romances ; yet one of his novels. La Regenta, is certain to live as an original psychological study of the relation between spurious mysticism and illicit passion. The author, who has made many enemies as a candid literary critic, has perhaps allowed himself to be dis- couraged by their violent attacks, and his later stories are few in number and slighter in value. Jacinto Octavio Pic6n (b. 1852), who has deserted novel-vn-iting for literary and art criticism, has displayed much insight and finesse in Ldzaro, the story of a priest who finds himself com- pelled to lay down his orders ; in Jwxn Vulgar, in some measure the Spanish equivalent of Bouvard et Pecuchet ; in El Enemigo, a spirited exposure of clerical tyranny ; and in Dulce y sabrosa, which has been vehemently denounced by the orthodox party. With these domestic quarrels and with the general thesis maintained by Pic6n, foreign readers have no concern; they may, however, join with all impartial critics in admiring the author's power of awakening sympathy and ' interest, his minute analysis of emotion, and the sustained beauty of his style. The suspicion of heterodoxy and something more than the suspicion of dealing with risky subjects attach to Palacio Vald&, Emilia Pardo BazAn, Alas, and Pic6n. Neither charge can be brought against Manuel Polo y Peyrol6n, who has written indefatigably on all manner of subjects, but whose charming story. La Ha Levitico, is a captivating and finished performance much more likely to survive than the Pequeneces of the Jesuit Luis Coloma (b. 1851), a caricaturist of society foibles, who came into notoriety with that roman a clef. Coloma's health has broken down, and he has apparently no intention of trying to repeat his ephemeral triumph. Two young writers of the richest promise died prematurely : Angel Ganivet (d. 1898), the author of a semi-philosophical romance, Los Trabajos del infatigahle creador Pio Cid, a book rich in ideas and felicitous in expression, though lacking in narrative interest; and Juan Ochoa (d. 1899), whose two short stories. El amado discipulo

and Un alma de Dios, are of the highest order. Ochoa is indeed a born teller of stories, and Un alma de Dios is a treasure of sympathetic observation. Ganivet's is the finer, more cultivated intelligence : but he appears to have used the novel without any real vocation, as a convenient vehicle for transcendental ideas which would have attracted less attention in any other form. Among the younger novelists may be mentioned Eicardo Maclas Picavea (d. 1899), author of La Tierra de Campos, and Vicente Blasco Ibdiiez, whose Flor de Mayo and Arroz y Tartana are acute and truthful pieces of impressionism.

No new Mariana is discernible among the numerous students who have applied themselves to the study of history. Modesto de Lafuente's work, useful as it is in default of anything better, is now obsolete, and ^'^J'"y the opportunity for an author capable of writing criticism. history in the modern sense is a great one ; but the tendency of Spanish historical students is rather in the direction of collecting the raw material of history than in the writing of it. Antonio CAnovas del Castillo (d. 1897) had an exact and wide knowledge of the period concerning which he wrote, and his Ensayo sobre la Casa de Austria en Espana is ample in information and impartial in judgment ; but his devotion to politics absorbed him, and possibly deprived literature of a great historical work. Aureliano Fer- nandez-Guerra y Orbe, a many-sided scholar who did good service in other fields, collaborated with a younger and more brilliant man, Eduardo de Hinojosa, in the Historia de las Visigodos, which illuminates an obscure

but important period. The veteran Francisco Cardenas, in his Historia de la propriedad territorial en Espana, and in Ms studies on the history of Spanish law, has done for Spain much that Maine did for England. Hinojosa's histories of Roman and Spanish law are authoritative in substance and elegant in manner ; Eduardo Perez Pujol's Historia de las instituciones de la Espana goda supple- ments the work of Fern^ndez-Guerra and Hinojosa ; the Jesuit Fidel Fita y Colom6 is an accomplished epi- graphist, whose name justly ranks with that of Emil Hiibner ;

Joaquin Costa's Estvdios ibericos has been acclaimed by experts for its estracfrdinary learning, but his Poesia popular espafiola y Mitologid y Literatura celto- hispanas, a brilliant effort to reconstitute literary history, is of more general interest. The monographs of Francisco Fernandez y Gonzalez, Marcos Jimenez de la Espada, Julidn Ribera, Manuel Colmeiro, Jos4 Pella, Gumersindo Azcdrate, Cesareo FernAndez Duro, and many others are valuable contributions to the still unwritten history of Spain. A, most useful beginning, on the lines of John Richard Green, has been made by Rafael Altamira y Crevea (b. 1866). Literary criticism in Spain is too often inspired by intolerant party spirit which judges authors according to their political labels, and, as most Spaniards are party men, the result is extremely depressing. Antonio Val- buena, a humorist of great gifts, finds it difficult to do justice to any writer who is an academician, an American, or a Liberal ; Leopoldo Alas was scarcely less severe in criti- cizing reactionaries, but his intention was always good, and his wide culture and insight were of inestimable worth. Emilia Pardo BazAn is encyclopaedic, and resents any de- parture from the literary standards of Castelar to which she professes, though she does not practise, an adherence. Pascual de Gayangos y Arce (d. 1897) and Manuel Mil4 y Fontanals (d. 1884) escaped from these petty quarrellings by confining themselves to the historical criticism of the literature of the past ; and Marcelino Menendez y Pelayo (b. 1858) has gained a European reputation in the same province. He has passed from the narrow view of La Ciencia Espanola to the luminous catholic tolerance which is expressed in his Historia de las ideas esteticas en Espafia, a work which is still unfinished, though its first volume appeared many years ago. Ramon Menendez Pidal, a pupil of ilenendez y Pelayo, has already produced in La Leyenda de los Infantes de Lara a distinguished piece of reconstructive criticism which has extorted the admiration of eminent experts like M. Gaston Paris and M. Alfred Morel-Fatio. A third scholar whose research and accuracy gained him a chair in the Academy at an early age is Emilio Cotarelo, whose monographs on Enrique de Villena, Villamediana, and Ram6n de la Cruz are models in their kind.

Authorities. ??? The Histoire de la littirature contemporaine en EspagTie (Paris, 1876), by M. Gustave Hubbard is now practically obsolete. An Augustinian monk, Francisco Blanco GaroIa, has published

La Literatura espanola en el siglo xix. (Madrid, 1891-96), which should be used with caution, as the writer is swayed by party spirit. The various volumes of literary criti- cism by Leopoldo Alas may be consulted with profit, and the preface to the first volume of JuAN Valera's FloriUgio de poesias castellanos del siglo xix. (Madrid, 1901-02) abounds in acute, if indulgent, criticism. M. Boris de Tannenberg's La poisie castillane contemporaine (Paris, 1889) is a slight but interesting survey. (j. F.-K.)

SpailcttO, a city of the Austrian province of Dal- matia, 200 miles south - oast of Trieste, over against (north from) the island of Brazza. Population of the town proper (1890), 15,697, and of the commune, 22,752; (1900), 27,198, chiefly Serbo-Croatian and almost ex- clunively Catholic (about 9 per cent. Italians). The harbour has been extended and improved by a dam com-

pleted in 1882. It is a station of the Austrian Lloyd, and has the largest trade of any Dalmatian town. The number of ships entering and departing annually is over 7500, with a total tonnage of about 1,355,000.

SpSLndsiU, a town of Prussia, at the confluence of the Spree and the Havel, 7|- miles west by north of Berlin by rail. The town has 4 Protestant churches a Catholic church, a gymnasium, a higher-grade, a girls', and a boys' school, and a school for musketry. The Red Tower (Julius- thurm) still contains the war chest of ►►6,000,000, reserved for military purposes from the indemnity paid by France after the war of 1870-71. The town has of recent years made marked progress, its trade being enhanced by an excellent railway service with Berlin and improved navigation on the Havel. There is a monument (1889) to Elector Joachim II., and another (1892) to the Emperor Frederick IIL Population (1885), 31,463; (1895),

55,813; (1900), 65,014.

Spanish-American War.►►► By the end of

1897 the insurrection which had existed in Cuba for three years had, according to the report to his Govern- ment of Mr Fitzhugh Lee, the United States consul- general, brought matters to an impasse, in which,

while the insurgents were powerless to eject the Spanish forces from the island, the authorities were equally helpless to put dovm the rebellion. A decree, known as the order of reconcentration, promulgated by Captain-General Weyler in the early part of 1897, had f^”^^/” caused, wherever the Spanish authority pre- vailed, the assembling of all the country people within the limits of the Spanish posts. The consequence, through the inability of the Spanish authorities to support such a multitude, was terrible distress and famine, with the final result of an appalling loss of life. Consul-General Lee cites as an instance of this mortality that of the town of Santa Clara, the capital of Santa Clara province, where in January 1897 the deaths were 78 ; the order of recon- centration went into efiect in February, and the deaths rose to 1037 in Xovember and to 1011 in December. There were in this place, of a normal population of 14,000 inhabitants, 6981 deaths during this year, chiefly of people who had been driven in from the surrounding districts. The insurgents had pursued a steady policy of destruction of projierty, as had the Spaniards one of destruction of life, and the only outcome in existing circumstances was the complete ruin of all social organization. The 12th and 13th January 1898 had been marked by serious military riots in Havana, due to the opposition of the Spaniards, both in the army and in civil life, to the new Governor-General Blanco, who came as a pacificator and with the intention of putting into effect the law signed in November 1 897 by the queen-regent, establishing a system of autonomy. This was strongly opposed by the Spanish residents, the army, and by the Cubans themselves. In view of the danger to American citizens on account of the riotous state of Havana, the battleship Maine was sent there by the United States Government, 25th January. Her presence gave great offence to the Spaniards and Spanish sympathizers, and when on 15th February the ship was destroyed by an explosion, feeling naturally arose to a warlike pitch in the United States, it being generally believed that the explosion was due to Spanish action. A board of inquiry was ordered by the United States Navy Department, of which Captain W. T. Sampson was presi- dent. After sitting more than a month, and making an extensive examination of the character of the wreck and the circumstances attending the explosion, the board decided that it was caused by an exterior mine. A chief basis of this finding was the extraordinary upheaval of the ship’s

bottom, which was lifted 34 feet at the point of greatest damage, above its normal position. The Spanish authori- ties also made an examination, but did not inspect the interior, the chief diver reporting that " the bilge and keel of the vessel throughout its entire extent were buried in the mud, but did not appear to have suffered any damage," a statement wholly contrary to the significant fact of the upheaval mentioned. The destruction of the Maine brought home to the mass of the American people the state of things in Cuba ; and the intensity of sym- pathy aroused for the suffering there, combined with the general belief in the cause of the destruction of the Maine, finally led to an ultimatum signed by President McKinley, 20th April 1898, demanding the withdrawal of Spain from Cuba. Before this could be delivered by the American minister in Madrid, the Spanish Govern- ment sent him his passports on the following day. War was formally declared by Congress, 25th April, to have existed since the 21st.

The American Government had taken precautions as early as January, looking to possible hostilities, and had telegraphed to the naval commanders-in-chief abroad to hold time-expired men. Ships on several foreign stations had been drawn nearer home, and those in China were collected at Hong Kong. The North Atlantic squadron, the only power- ful one, had been sent into the waters of Florida for manceuvres, after being held north at Hampton Roads for two years, owing to Spanish susceptibilities. After the destruction of the Maine the chief part of the ships in the Atlantic were concentrated at Key West; the battleship Oregon was ordered east from the Pacific ; fifty million dollars were voted for national defence, and steps were taken to purchase auxiliary cruisers, yachts, and tugs, which were rapidly equipped. Large supplies of ammunition were ordered, and Key West became an active base of preparation. Captain Sampson, the senior officer of the North Atlantic squadron on the retirement (26th March 1898) from ill-health of Rear-Admiral Sicard, was appointed its commander-in-chief. A flying squadron composed of the armoured cruiser Brooklyn (flag), the battleships Texas

and Massachusetts, and the fast cruisers Minneapolis and Columbia, with Commodore Schley in cqmmand, was stationed at Hampton^ Roads.

The following table shows the relative naval strength of the two Powers :
*** 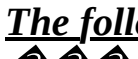 ***

Rival forces,

United States.

Spain. |

KomiDal. Effective.

NominaL

Eilective.

/ 13 13

9

4

1 4 First-class battleships.

1 First-class battleship.

Armoured ships

< 1 Second-class battleship.

2 Old ironclads (done over).

2 Armoured cruisers.

6 Armoured cruisers.

. 6 Double-turreted monitors.

Protected cruisers

/ 13 1 8

\ from 3000 to 7375 tons.

5 1 4

from 1045 to 4826 tons.

Unprotected cruisers

/ 21 1 20

\ from 839 to 2089 tons.

(-915

and guiiboats

- 2 of 3900 tons (old), others

(under 1200 tons.

Torpedo gun vessels .

1

1

11

10

Torpedo destroyers .

0

0

6

6

Torpedo-loats .

6

6

12

3

Small gunboats

0

0

84

?

from armed launches of 40

tons to gunboats of 525

tons ; all but 20 were

under 200 tons.

There were excellent judges who thought the United States, after the destruction of the Maine, was overmatched. Spain's four armoured cniisers were fine ships of great speed, against which the United States had only two. Spain's apparent show of ten torpedo-boat destroyers against her antagonist's none was also

a formidable factor to be considered. But all this was largely nominal. As we now know from documents published by Admiral Oervera, by permission of his Government, everytliing was unready, and the admiral expostulated in the strongest terms against attempting war, saying that Cuba was lost in any case, and that sending a squadron across the Atlantic was only to send it to destruction. Three torjiedo – boats and three torpedo – boat destroyers had been started trom Cadiz, 8th March, for the West Indies, under convoy of a transport, but two of the torpedo-boats had broken down after leaving the Canaries, and all had to put into the Gape Verde Islands. Cervera joined them there on 14th April, with the Maria Teresa and Cristobal Colon, and on the 19th came the Vizcaya and Almirante Cquendo from Havana. Cervera renewed his expostulations, being backed by a council of war which was of one view with himself.

On 24th April, after a consultation of all the senior officers of the navy then in Madrid, Admiral Cervera was peremptorily ordered to leave for Porto Rico, without any definite instnictions or plan of campaign. The discussion at tlie consultation refen-ed to and Cervera's correspondence reveal the state of Spain, which was in urgent need of money, lacked resources of every description, and, above all things, was deficient in sound judgment in her adminis- tration.

On the outbreak of hostilities, 21st April, Captain Sampson was appointed a rear-admiral, under a law enabling the President to select any one of command grade in time of war to command a squadron ; with this rank he Iqeeame the ranking officer in the Atlantic. Sampson left Key West early on the morning of the 22nd, and at once began the blockade of Havana and the north coast as far as Cardenas, eighty miles east, and Bahia Honda, fifty miles west He had at that time twenty-eight vessels of all kinds, of which the armoured cruiser New York (flag), the battleships Iowa and Indiana, and the monitors Puritan, Terror, and Amphi- trite, were the most important. He had six torpedo-boats. This squadron was increased to 124 vessels by 1st July, chiefly, how- ever, by the addition" of extemporized cniisers, converted yachts, armed tugs, &e.*

The flying squadron was held at Hampton Roads, partially to allay popular alarm along the coast as to the attack by Spanish ships, partially

on account of the real, though somewhat re- mote, danger of such action. Armed auxiliaries and- fast cruisers were employed patrolling the coast east of New York, which could have rendered good service elsewhere, but would have been of no use in repelling an attack by Cervera's squadron had it come that way. Popular feeling, however, was too strong to be ignored.

The joint resolution of Congress of 20th April stated the relin- quishment by Spain of authority in Cuba as the object of American action ; the struggle thus naturally centred about the island. Further, such action gave the United States a great advantage in the fact that all operations were near at hand, the real objective in Cuba, Havana, being but eighty miles distant from her excellent base. Key West. There was also a political reason for confining action to the western Atlantic : continental European sympathy was strongly pro-Spanish, and an immediate attack upon the coasts of Spain might have aroused this into much greater activity. It was, of course, expected that an American airmy would be landed in Cuba, and for this purpose the whole of the regular force ??? the only available one until war should be declared and a volunteer force author- ized??? was brought to Tampa, New Orleans, and Chickamauga ; but wisdom demanded that so long as the control of the sea was un- decided, the army should not be moved across the strait. Cervera's fleet was thus the real objective of the navy, and had to be settled with before any action could be definitely arranged.

Dewey's squadron ??? the Olympia (flag- ship), protected cruisers Baltimore, Raleigh, Boston, small unprotected cruiser Concord, gunboat Petrel, armed revenue cutter M'Culloch, with a purchased collier Kan- shan, and a purchased supply ship Zafiro ??? left Hong Kong, on account of the out- break of hostilities at the request of the governor, and went to Mirs Bay, some miles east on the Chinese coast. Receiv- ing a telegram at Hong Kong on the 25th, to commence operations, particularly against the Spanish fleet, which he was directed to capture or destroy, he left Mirs Bay 27th April, and arrived off Luzon 30th April, having ordered two ships during the afternoon to look

*into Subig Bay for the Spanish squadron. The Spanish admiral Montojo had gone with the Reina Christina, Castilla, Don Juan de Austria, Ida de Cuba, Isla de Luzon, and Marques del Duero from Manila Alanna"' *►►"^'^S On the 27th, but had returned on the 29th, not finding the guns mounted there which he expected ►►► an ignorance which in itself is a curious commentary on the conduct of Spanish affairs. He anchored in Canacao Bay, to the eastward of the spit on fwhich are the village and arsenal of Cavite, in a general east and west line, and kept his broadside to the northward. His force consisted of the ships just mentioned, of which the Castilla (an old wooden steamer) had to be towed ; the Jsla de Cuba and Isla de Luzon were protected cruisers of 1050 tons, the Don Juan de Austria, a gunboat of 1152 tons, and the Marques del Duero, of 500 tons. The Don Antonio de Ulloa, similar to the Don Juan de Austria, was added ; two of the guns of the Ulloa are stated to have been ashore. The gun- boats Velasco and General Lezo were in Bacoor Koads undergoing repair. The Elcano also seems not to have been in action. There were six guns in battery at or near Cavite, of which two were 5"87" and one 4"7" breech-loaders (from the Ulloa), and three 6 "3" muzzle-loaders. Only one of the 5 '8 7" breech-loaders seems to have looked northwards, and two of the 6 '3" muzzle-loaders. At Manila and the suburb, Ermita, there were thirty-six guns, of which four were effective 9 '45" breech-loaders, and eight breech-loaders converted from -i'i" to 5 "8 7", but all, except those at Cavite, were from 4 to 5 miles from the field of action.*

Dewey stood on during the night, and passed into the Boca Grande, which is 5 miles broad, but with a large rock, El Fraile, IJ mile from the south side. He naturally paid no attention to rumours of torpedoes in a channel so broad and deep, and at midnight passed El Fraile, on which was a battery of three 4'7" breech-loader guns, landed from the ships under repair. Two shots were fired at him, which did no damage. He headed for]\Ianila, 20 miles away, timing his speed to arrive at daybreak : he was fired at by the Cavite and one of the city batteries. Sighting the Spanish squadron to the southward, he ordered his transports and the revenue cutter M'Culloch out into the bay, and stood down in column, the

Olympia leading, followed, with 400-yard intervals, by the Balti- more, Raleigh, Petrel, Concord, and Boston. When within 5000 yards he ported his helm, and at 5.41 a.m. opened fire. He stood westwards along the Spanish line, using his port batteries, turned to starboard and stood back, gradually decreasing his distance from 5000 to 2000 yards. He passed three times to the westward and twice to the eastward. At seven the Spanish flag- ship made an ineffectual effort to come out and engage at short range, but was overwhelmed by the American fire and driven back. The Spanish squadron was now in very bad plight, but the seriousness of its condition was not as yet fully known to the American com- mander, though it was evident that it was in difficulties. At 7.~~!r) ammunition being misliikenly reported short, Dewey withdrew, gave his men breakfast, and had a con~~ sultation of commanding officers. Being reassured as to the amnmnition, he re-nigaged at 11.16. The Cristina and Castilla in the meantime had liroken into flames, so that the remainder of the action consisted in silencing the Cavite batteries and romiileting the destruction and demoralization of the smaller Spanish ships. The Petrel was ordered to send in and burn those still afloat.

The victory was complote. All the Spanish ships were sunk or destroyed, though three of the best were raised later, repaired, and added to the American navy list. In

the interval between the two parts of the action Dewey sent word to the governor of Manila that the city batteries which kept up a useless firing must cease, or he would shell the city. They thereupon ceased, and did not reopen.

Though there was a marked disparity between the two squadrons in force, it was not such as in any wise to account for the great disparity of injury. There were on the Spanish side sixty-nine guns, from 3-pounders to 6 '2", and on the American side eighty- nine, from 3-pouuders to 8". The injury done the American ships was practically nil. The Spanish lost 167 killed and 214 wounded, out of a total in their crews of 1875. The Americans had 7 slightly wounded out of 1748 men in action. Admiral Montojo has been criticized for not placing his ships under the protection of the Manila batteries. He would, however, have had to lie so far off shore on

account of shallow water, that these guns could not have afforded him any aid, and the result must have been the same. Dewey took possession of Cavite, parolled its garrison, and awaited the arrival of a land force to capture Manila.

The blockade of Havana had progressed vidthout inci- dent, beyond the capture of a number of Spanish steamers and sailing vessels, and the shelling of some new earthworks at Matanzas, 27th April ; but on 11th May an attack at Cardenas upon three Spanish gun- boats, supported by a shore battery, was made by the torpedo-boat Winslow and the revenue cutter Hudson, which was repulsed with the loss of an officer and four men killed, an officer and four men wounded, and severe injury to the torpedo-boat. The Hudson most gallantly, under a severe fire of half-an-hour, succeeded in towing the torpedo-boat out of range. Two large American gun- boats were near by, but could not come into action on account of the shallow water. The same day the Marble- head and Nashville sent in four launches, with fifty-five men, to cut the telegraph cable leading from Cienfuegos. The crews of the boats did their work under a heavy fire, cutting two cables, but failing, on account of the heavy fire at only 200 yards range, to cut a third which had been grappled. The men worked with greatest gallantry, but the boats had to retire with four men killed or mortally wounded, and an officer and five others hurt less seriously. The ships mentioned, aided 1)y the revenue cutter Windom, during this time shelled the Spanish position, with serious loss to the Spaniards, the action lasting some three hours.

Cervera had left the Cape Verde Islands, 29th April, with four armoured cruisers. Infanta Maria Teresa (flagship), Almirante Oquendo, Vizcaya, and s]gj, Cristobal Colon, and three torpedo – boat de- movemeat stroyers. Furor, Ten-or, and Pluton. On hear- across the ing, 1st jNlay, of his departure Sampson went ””- east a thousand miles to San Juan, Porto Rico, with the New Yorlc, loiva, Indiana, monitors Puritan, Terror, and Amphitrite, cruisers Montgomery and Detroit, and one torpedo-boat. He had also with him a collier. He left the monitors Puritan and Amphitrite off Havana, with several cruisers, five torpedo- boats, and a number of smaller craft. In going east he calculated on using a speed of 10 knots, which, if the Spaniards crossed the Atlantic at an*

economical speed, would enable him to reach San Juan about the time they would reach its longitude, and if they were not there, return off Havana before they could do so. It they used a speed as high as 12 knots they would certainly have to coal before reaching Havana, and the delay in so doing would also enable him to get back before their arrival. It was of very great moment that Cervera should not be able to refit at San Juan. Should he arrive there with the American squadron still at Havana, coal and get to sea, the American coast would be within easy reach. New York being only about 1400 miles away. Sampson thus felt very strongly the possi- bilities of the Spanish squadron using San Juan as a base for a raid against the United States coast, a move which might have serious moral and international consequences.

But the speed of the American squadron fell far short of the admiral's expectation, and he did not reach San Juan until the 12th, instead of upon the 8th as he expected. The monitors gave out continually, having to be tovyed a large part of the time ; and the Indiana injured her boilers through want of fresh vi^ater. Sampson arrived off San Juan early in the morning of the 12th, and at once stood in to see if Cervera Tvas in the harbour, and in doing so opened fire upon the fortifications. It soon became evident that Cervera was not present, but the attack was continued with the object of reducing the place, if it might be done with little efibrt, and thus preventing its occupation later by the enemy's squadrons. The two monitors which so seriously hampered the squadron's movements, and the large auxiliary cruiser known to be in the vicinity, could have been left in temporary effective charge. Sampson made three turns with his ships in front of the town, but the firing produced no great effect on account of the heavy rolling sea. His fire was vigorously returned without any material injury to the ships, and with the killing of one man and the wound- ing of seven on the American side. Sampson was of the opinion that there would be no real difficulty in reducing the place ; but Cervera's squadron, the real objective, was not there, and it was thus necessary to return at once to cover the entrance to Havana. He

*thus at once started back for Havana with no news of the Spaniards, who at the moment were off Martinique, with specific orders to go to San Juan, but were diverted from their course, by the news received of Sampson's presence there, to Curagoa, where they arrived 14th May, having left the broken- down torpedo-boat destroyer Terror at Martinique. Had Sampson been two days later in arriving at San Juan he would have found the Spanish squadron, and the decisive battle would have been fought there instead of at Santiago. Cervera was allowed by the Curagoa authori- ties to receive 600 tons of coal for the Maria Teresa and Vizcaya, which each needed 700. He coaled the Furor from the Colon, and left on the evening of the 15th for Santiago de Cuba, which he reached early on the 19th, not sighted en route by any of the American scouts, though several were in the vicinity. Sampson stood slowly west- wards owing to conflicting reports of the Spanish squadron's return to Spain, a basis for which existed, in that a telegram not received by Cervera had been sent, 12th May, from the Minister of Marine to Martinique, author- izing his return. In the uncertainty, and determined, in case the Spanish squadron had returned, to go back and take San Juan, Sampson stopped until he could communi- cate at Puerto Plata San Domingo by the torpedo-boat Porter, which brought the true state of the case on the night of the 15th, and also a telegram from the United States Navy Department directing him to proceed with all despatch to Key West, where the flying squadron was
 also ordered. Of the large and swift auxiliary cruisers, the Harvard was at Martinique, the St Paul directed to cruise between Jamaica and Hayti, the Yale at St Thomas. The fast cruisers Minneapolis and Columbia were also sent south as scouts. The St Louis joined the admiral on the morning of the 15th, and was sent to cut cables at Santiago and on the south side of Porto Kico. All but one of the weak squadron off Cienfuegos were ordered by the Navy Department to return to Key West. The Marblehead, Nj,shville,a,nA.Eagle were thus withdrawn. Sampson reached Key West on the afternoon of the 18th, ^ and found the flying squadron and the St Paul*

mVnt's ot in port. The St Paul left the same evening on Admiral the duty assigned her, and the flying squadron

Sampson. ^ Broohlyn (flag), Massachusetts, Texas, and

<u>[illegible]Scorpion [illegible] next morning (19th) for Cienfuegos, which was</u>

<u>regarded at the moment by the Navy Department as the certain objective of the Spanish squadron. The battle- ship Iowa, the gunboat Castine, the torpedo-boat Dupont, and the collier Merrimac sailed to join them on the 20th, thus giving Commodore Schley a force ample enough to meet Cervera. On the same day Sampson received a tele- gram from the Department that a " report of the Spanish fleet being at Santiago might very well be correct, so the Department strongly advises that you send by the Iowa to Schley to proceed off Santiago de Cuba with his whole command, leaving one small vessel off Cienfuegos." Samp- son, however, determined to hold Schley at Cienfuegos until more fully assured, but being satisfied during the same day, he directed Schley in an order dated 21st May, which was placed aboard the Marblehead, then coaling at Key West, that if he was satisfied they were not at Cien- fuegos, to proceed with all despatch to Santiago, and, if the Spanish squadron was there, to blockade it. Sampson at the same time went off Havana, and sent thence, on the evening of the 21st, by the Hawk, a fast yacht, an addi- tional memorandum impressing the necessity of movement. He then moved with the main part of his squadron into Nicholas Channel.</u>*

<u>Commodore Schley, though he could not see into Cien- fuegos, held to the opinion that Cervera was there, until Commander M'Calla, who had been off Cienfuegos previously, arrived on the morning of the 24th May in the cruiser Marblehead, and at once communicated with the insurgents some miles westwards, and found the truth. Schley moved that evening towards Santiago, 300 miles distant, but did not arrive in the vicinity until the after- noon of the 26th, having made a speed of only about 7 knots, on account of the inability of the yacht Eagle to make headway against the sea. He was then 20 miles south of the port. He sighted the scouts Yale and St Paul, which latter had captured, just outside Santiago, the Hestormel, a British collier, with coal for the Spanish squadron. Schley stood eastwards somewhat, probably with the idea of going to Hayti to coal (though Guan- t^namo was within 40 miles), but suddenly turned round, signalling " Destination Key West via Yucatan Channel," and started westwards. The Merrinuic (collier) broke down, and was taken in tow by the Yale, but great delay arose from the 'breaking of many</u>

hawsers. Early on the 27th the scout Harvard reached the squadron with a despatch vid St Nicholas Mole, Hayti, in which was expressed the Navy Department's opinion that the Spanish squadron was in Santiago, and adding, " The Department looks to you to ascertain facts, and that the enemy, if therein, does not leave without a decisive action." Commodore Schley sent a telegram, " The Brooklyn alone has more than sufficient coal to proceed to Key West ; cannot remain off Santiago present state squadron coal account . . . much to be regretted cannot obey orders of Department . . . forced to proceed for coal to Key West by way of Yucatan Passage." The statement regarding coal on hand was seriously at variance vsith the data published in official documents, which show the Iowa to have had on the day this telegram was sent 762 tons, and the Massachusetts 789 ??? sufficient to carry them three times the distance from Santiago to Key West.

Sampson had gone with the New York to Key West, where he arrived early on the 28th May, for information and coal, having first sent the New Orleans, j.. 27th May, to Schley, repeating the urgent pioitottbe orders to blockade Santiago, and also direct- "Merri- ing the Merrimac (collier) to be sunk in the '"^'???" entrance channel, which in parts has a breadth avail- able for heavy ships of less than 200 feet. Schley's telegram had much disturbed the Washington officials,

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and when forwarded to Sampson, lie telegraphed, asking to go at once to Santiago with the New York and Oregon (which had arrived 26th May in excellent con- dition after her voyage of 14,000 miles), proposing to turn back Schley's heavier ships. The permission came, and Sampson got under way, receiving, however, before starting, a telegram from Schley stating that he would remain off Santiago. He had, on the afternoon of the 28th, again turned east, and that evening arrived in sight of the port. As is now well known from the documents published by Admiral Cervera, his squadron was twice, in the interval preceding the 28th, on the point of leaving Santiago and going elsewhere. Fires were started on the 26 th with the intention of going to San Juan, but in- decision and fears for the safety of the Colon, on account of her draught, and a small shoal at the narrow entrance, which it was thought the prevailing swell made dangerous, overruled the intention. Next morning the Colon and another Spanish cruiser were seen a short distance within the entrance, and on 31st May Schley, with the Massa- chusetts, Iowa, and New Orleans, stood in and made an attack upon these and the batteries, which was naturally without result at the ranges used of. 7000 to over 10,000 yards. Sampson, leaving Key West at 11 p.m. on the 30th May, picked up the Oregon, Mayflower, and the torpedo – boat Porter in Nicholas Channel, and leaving the squadron on the north side under command of Commodore Watson, stood for Santiago at a speed of 13 knots. He arrived early on the 1st June. The Colon and Vizeaya, which were visible on his arrival, moved out of sight up the bay. Work was at once begun on the preparations for sinking the Merrimac. The prepara- tions for a quick sinking were chiefly carried out by Naval Constructor Hobson, who, on account of his zeal and the character of the work done by him, and his eagerness to go, was given command of the enterprise. As he had been educated as an officer of the combatant branch, he was fitted to handle the ship. He went in in the early morning of 3rd June, with a crew of seven men. The ship did not sink where it was intended, ovsdng to the failure of the steering gear, and drifted with the tide far up into a broad part of the channel before being sunk by her own and the Spanish torpedoes. Had she been sunk in the proper place, egress by Cervera's

squadron would have been impossible, and the main part of the American squadron would have been left for other operations, without fear of escape of the Spaniards by night, and of juncture with the Carlos V., Pelayo, and Alfonso XIII., then ex- pected by the Americans. The full extent of the inertia of the Spaniards was not yet realized, and the peculiar narrowness of the entrance precluding any attempt to pass over the torpedoes with which it was mined, the blockade of the channel in this manner was looked upon as a short and easy method of nullifying the Spanish force within ; and, as seen by Cervera's published statements, much feared by them. Cervera, in a most chivalrous spirit, sent his chief of staff, under flag of truce, to inform Sampson that Hobson and his men, who had fallen into his hands, were unhurt.

On 6th June the batteries at the entrance were bombarded and their weakness established. Sampson thcnnipon placed, every evening, a battleship (relieved every two and a half hours) close in, with a seai'ch-light turned on the channel, pi'ecluding, by Cervera's statement, any possibility of night egrrss. Guantdnamo, 40 miles east, was occupied by several ships 7th June, and a battalion of marines landed 10th June, and the port was used thereafter as a base. After some firing, with a few losses on both sides, the Spaniards retired before an expedition of the marines, 14th June, with a loss of 40 killed, leaving the Americans in undisturbed occupancy. In the meantime, Admiral Sampson per- fected his scheme of blockade, so that every night the semicircle of ships moved closer in, all pointing for the entrance ??? the search-

light battleship within the semicircle, and within her, again, three converted yachts and three steam launches as pickets.

A blockade of San Juan, Porto Rico, by one or two fast ships was kept up on account of the presence there of the destroyer Terror, but the Terror, with the gunboat Isabella II., coming out, 22nd June, to attack the auxiliary cruiser St Paul, was so badly injured by the gun-fire of the latter that she with difBculty returned to port, and was thereafter unserviceable.

On 20th June the expeditionary corps, under General Shafter, arrived off Santiago.

When war was declared the total regular army force of the United States was only 2116 ofiicers andA25,706 men, the organization comprising 25 regiments of infantry, 10 of cavalry, and 5 of artillery. -^W/teiy Two regiments of artillery were added to this "^ cu6a" by a Bill passed but a short time before, but were not organized. The adjutant-general's returns for February 1898 showed 114,602 militia enrolled in the several states, and estimated the total number of men available for military service at 10,301,339. A Bill, approved 22nd April, authorized the President to call upon the states and territories for men in proportion to their population, the regimental and company officers to be named by the governors of the States, the general and staff ofiicers by the President. On the next day a first call was made for 125,000 men. On 26th April addi- tional enlistments in the regular army were authorized up to 62,597 men ??? such an increase of force, however, to be temporary only. The quotas were filled ^A???ith extra- ordinary rapiditj', large numbers of the best classes of young men being enrolled in the volunteers, of whom there were 124,776 in May and 216,256 in August (an increase of about 5000 over those of July, and the largest number at any time on the rolls). This number about equalled the total of the Spanish forces in Cuba. The troops were concentrated chiefly at Tampa in Florida, Chickamauga in Tennessee, and at Camp Alger in Vir- ginia ; Tampa being selected as the point for the em- barkation of the expeditionary force for Cuba, though there was a strong opinion generally expressed by military authorities that no troops should be landed in Cuba until October at the earliest, on account of the unhealthiness of the summer season. Colonel W. K. Shafter, who had been made a major-general of volunteers, was given command of the expeditionary force collected at Tampa. The early successes of the navy caused a cessation of opposition to an early movement, which it was decided should take the form of reinforcements to the Cuban forces in the field. Finally, however, with the exception of scattering and un- important small expeditions, everything was delayed until control of the sea was assured, though some thirty large steamers were held m readiness near Tampa. The arrival of Cervera at Santiago, his blockade, and the request of Admiral Sampson to send a land force for co-operation, brought an end to inaction. The troops began to embark on 7th June, and were ready on the evening of 8th June, but a start was not made until 14th June, through a report from the armed yacht Eagle

that she had seen four of the Spanish ships in Nicholas Channel on the night of the 7th. The army was held back, despite a protest from Admiral Sampson, until the falsity of the alarm was made manifest. On 20th June the fleet of 32 transports, con- voyed by the battleship Indiana, the cruiser Detroit, and nine smaller armed vessels, arrived oft' Santiago. The whole force consisted of 815 officers and 16,072 enlisted men, with four light batteries of four guns each, one Hotchkiss revolving gun, one pneirmatic dynamite gun, four Catlings, four 5-inch siege rifles, four 7-inch howitzers, eight field-mortars of 3-6 inches. The total number of animals taken was 2295, with 114 six-mule waggons, 81 escort waggons, and 7 ambulances. The small number

of ambulances was due to want of transport, army waggons taking their place. Eiglity-nine war correspon- dents accompanied the expedition, and eleven foreign officers. An interview was held at once by Admiral Hampson and General Shafter with the Cuban insurgent leader Garcia, who had arrived with some 3500 men at Aserraderos, 15i nautical miles west of Santiago, and it was agreed that disembarkation should begin on 22nd June, and that Garcia's force should be transported to the point selected by the American transports.

It had been Admiral Sampson's wish to attack and to carry the batteries at the harbour entrance, so that the mines should be taken up and the fleet enter, but General Shafter selected Daiquiri, 16 nautical miles east, for the point of landing, and the harbour entrance was dis- regarded. The fleet furnished all its available boats, and the operation of landing was placed in charge of Captain Goodrich of the navy, and though on a rough coast, with scarcely any shelter from the sea or conveniences for landing, the disembarkation was practically completed on the 25th with great success ; Siboney, 7 miles nearer Santiago, being also used after the first day. The total force landed, including the 3500 Cubans from Aserraderos and two additional volunteer regiments which arrived, was about 22,000. The American force in the expedition was of remarkable quality, being composed, with the exception of two volunteer regiments (one the 1st

Volunteer Cavalry, known as the Rough Riders, of which Theodore Roosevelt, afterwards President, was lieutenant-colonel ; the other the 71st New York Volunteers), almost wholly of old and seasoned regulars, who had seen long service on the plains against the Indians. In training for such a campaign and in physique, it was an almost ideal body of men. The marksmanship, self-reliance, and powers of endurance, acquired under the burning sun of Arizona and in the winter snows of the Western plains, where campaigning was frequently carried on with the thermo-meter forty degrees below zero, were to tell successfully in the next few days against difficulties which would have demoralized men who had not become inured to extra- ordinary conditions of climate and warfare.

No opposition was made to the landing, which was covered by several ships of the navy which shelled the supposed Spanish position, though it was an Laadiag i^Q^\ one for defence. The small Spanish la ^uba contingent at Daiquiri and Siboney were with- drawn without their doing any damage to the railway equipment of the road which ran from Santiago to the iron mines at these points. Locomotives, cars, and coal were left untouched. The American troops pushed forward as soon as they landed on the only two roads, one a mere trail, and found a Spanish force, with a rapid-fire gun, entrenched 2J miles beyond Siboney, where the two roads came together at a point known as Las Guasimas. The Americans engaged with a total of 96-t men, and carried the position. Their loss was IQ killed and 52 wounded. The Spanish official reports give their force as about 500, and their loss 9 killed and 27 wounded. The Americans advanced 2 miles nearer Santiago, and by the 29th the lines were established on the east and by the 30th on the north side of the Spanish positions, the Cuban troops being on the right (north) flank, in preparation for the attack on 1st July against San Juan Hill, on the east, and the village of El Caney, to the north-east of Santiago ; the fleet at the same time bombarding the batteries at the harbour entrance. Both positions were carried by the Americans after a most gallant defence on the part of the Spaniards.

The American loss at El Caney was 88 killed and 355 wounded, out of a force of 6654 engaged ; at San Juan Hill 144 killed, 951

wounded, out of 8336, or a total of casualties of 1538 ??? slightly over 10 per cent, of the 14,990 engaged. Tlie Spanish force at El Caney was but 520, of whom 300 were killed and wounded, and 120 captured. Among the killed were the Sjjanish oflicer in com- mand, General Vara del Key, and two of his sons.

The Spanish troops in the entrenchments at San Juan are given by an excellent American authority (Lieutenant Miley, of Shaffer's staff) as 750, and behind them, close to the city, 3500 soldiers, sailors, and marines. The Spanish loss at this point is uncertain, authorities being very conflicting, but it was not large. Their commander-in-chief, Linares, however, was seriously wounded, and had to relinquish the command to General Toral ; and Captain Bustamante, Cervera's chief of staff, present with over a thousand men from his squadron, was mortally wounded. There were in the Spanish lines this day a total of about 9500 men (besides the men of the fleet), increased that night by about 1000 more under General Escario from Manzanillo, whose entry the Cubans on Shafter's right flank failed to prevent.

Though victorious, the American army was not in a pleasant situation : the men had undergone great fatigue under a tropical sun by day, and the time spared at night from digging trenches was spent on a rain-soaked ground covered with thick vegetation. With a soldier's reckless- ness, their blankets and heavy clothing had been cast aside, and thus without protection, with insufficient food ??? due to the difficulty of hauling supplies over the single road in an execrable condition leading from the base at Siboney ??? there was imminent danger of the force being weakened through sickness. Action was urgent and there was even discussion of retiring to a point nearer the supplies. Reinforcements were arriving, but they were all of volunteers not accustomed to hard service. Brisk firing was continued on the 2nd and 3rd July, with a con- siderable number of casualties to the Americans. On the morning of the 3rd a demand was sent to the Spanish commander to surrender, with the alternative of a begin- ning of a bombardment of the city on the 4th. This in effect had already begun on the 1st, when Admiral Samp- son fired a number of 8-inch shells from a point 3 miles east of the harbour entrance over the hills into the city, using a range of about 4^ land miles. The

result of this and the threat of General Shafter was an exodus of many thousands of inhabitants towards El Caney, where their support drew heavily upon the American means of supply.

Sampson by this time had begun preparation to assault the Socapa Battery at the entrance on his own account, with the marines of his fleet (amounting, with the bat- talion at Guant^namo, to about one thousand men), to countermine the channel and go in vsdth his squadron. He arranged a meeting with General Shafter with regard to the combined operations at the entrance, and on the morning of the 3rd started in his flagship, with the torpedo-boat Ericsson and the yacht Hist, for which the flagship was doing some repairs, for Siboney ??? 7 miles distant from his position, where he was intending to land and go to the front. At 9.35, when he had gone about 5 miles, the Spanish ships were seen coming out, and the New York at once turned and stood back. The ships in front of the port were the yacht gl^jf/" Gloucester, the battleships Indiana, Oregon, Iowa, Texas, armoured cruiser Brooklyn, and yacht Vixen in the order named from east to west, making a semicircle about 8 miles in length. The armed trans- port Resolute, carrying mines and a quantity of explosives which it was intended to use in clearing the entrance, was also off the port. The Massachusetts and Suwanee were coaling, at Guantanamo. The Iowa hoisted the signal "Enemy coming out," and fired a six-pounder gun. All at once stood in toward the Spanish ships, which were standing westwards along shore, and began a heavy fire, thus promptly obeying the admiral's standing order, "If the enemy tries to escape the ships must close and

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S P A N I S H-A MERICAN WAR

engage as soon as possible, and endeavour to sink Ms vessels or force them to run ashore." The Maria Teresa (flagship) had come out first, followed in order by the Vizcaya, Colon, and Oqiiendo. They were firing vigor- ously, but most of their projectiles went far beyond the American ships. The Brooklyn made a turn to star- board, thus causing the Texas to stop and back, which prob- ably gave the Colon the opportunity of passing almost unscathed. The Maria Teresa and Oqiiendo had taken fire almost

at once from the explosion of shells, and their water mains being above the protective deck, and cut, were unable to extinguish the flames : they were run ashore, 6 miles west of Santiago, burning fiercely. The Vizcaya and Colon were still standing westwards. The two torpedo-boat destroyers had come out last, with a considerable interval between them and the Oquendo, the last of the cruisers. They were received with a heavy fire from the Indiana and yacht Gloucester, which latter engaged them at close quarters. They attempted to close, with great bravery, but were cut to pieces, and one soon afterwards sank ; the other was run ashore, but later slipped off into deep water. The New York had passed and fired a few four-inch shells at the destroyer, and stood on signalling the Indiana to go back and watch the port. The torpedo-boat Ericsson and the yacht Hist were ordered to rescue the men from the two ships ashore, and the flagship, with all the others, stood on in pursuit of the two remaining ships. The Vizcaya hauled down her colours off Aserraderos, 15 nautical miles west off Santiago, and was there run ashore burning. The Iowa was ordered to stop and rescue her men, and the Oregon, Brooklyn, Texas, and the flagship settled down to the chase of the Colon, which was some 6 miles ahead of the nearest American ship. She was, how- ever slacking her speed, and at 12.40 the Oregon opened on her with her 13-inch guns at a range of 9000 yards, as did also the Brooklyn, with her 8-inch ; the latter shot fell short, however. The Oregon fired five shells, the last, at a range of 8900 yards, going over the Colon, which then hauled down her colours and was beached at the mouth of the Kio Turquino. She floated with a rising tide, but her valves had been opened, and no endeavours on the part of the Americans could save her. The shore being very steep, and the water very deep a ship's length from it, the New York pushed her in until she took the ground so that she should not sink in deep water. As she sank during the evening, however, she turned on her side, making her recovery very difiicult ; and though one effort was made some months later to lift her, it was abortive, and she was finally abandoned. Her crew was transferred to the Resolute, which had arrived with a report that another Spanish ship was off Santiago, which, however, turned out to be the Austrian armoured cruiser Maria Teresia. Admiral Cervera was taken on board the loioa, as also a large number of other officers and men, many of whom were severely wounded. The total Spanish loss was 35.') killed and 151 wounded. The Americans lost one man killed.

There was the same enormous disparity of injury in this battle as in that of Manila. The Spanish were, of course, greatly out- matched. But though they had only six 11-inch guns against the fourteen 12- and 13-inch and thirty-eight 8-inoh of the Americans, the Spanish ships had ten 6-ineh, thirty 5-ineh, and six 47-inch rapid-fire guns against the fourteen B-inch ordinary, twelve 5-inch and eighteen 4-ineh rapid-fire guns of tlie Americans, so that there was practical equality in the classi's of guns which could be looked to to do the chief work against unarmoured parts. The very great differences in damage must theri'l'ore be ascribi'd, somewhat at least, to difference of temperament, moral, and preparation. All the prisoners were on the next day transferred to the scouts Harvard and St Louis, except forty-two of the more severely wounded, who were cared for on the hospital-ship Solace. A total

of 86 ofBeers and 1615 men was taken to Portsmouth, New Hamp- shire, where the men were detained in camp, and the oiBcers, except some few left at Portsmouth, were cared for at the Naval Academy at Annapolis, Md.

The naval victory gave a new face to affairs ashore. The demand for surrender had resulted in a truce, which was renewed on the 6th, when it was arranged between Admiral Sampson and General Shaffer that an attack should be made on the batteries, and an entrance forced if the new demand in a letter sent that day to General Toral explaining fully the situation, and giving definite in- formation of the destruction of the Spanish fleet, was not acceded to. Some exchange of prisoners had taken place, among those released being Lieutenant Hobson, who was brought into the American lines on the Surrender afternoon of 6th July. On the 5th there had "gantlago been an exodus of the populations towards El Caney until many thousands were collected there under circumstances of great distress and destitution. On the 8th Toral offered to leave Santiago and retire to Holguin if unmolested, otherwise the suspension of hostihties must cease on the 9th. Shaffer forwarded the proposal to Washington, advising acceptance. The Government at once condemned the proposal, and on the 10th the bom- bardment by the fleet was renewed and continued during the morning of the 11th, when, upon a renewal of the demand to surrender, with an offer of transportation of the Spanish

troops home, negotiations were resumed, which ended with the signing of a preliminary agreement on the 15th, and the entry of the Americans into Santiago on the 17th. The surrender included all the Spanish forces in the division of Santiago de Cuba (which ex- tended to Cape Maysi), amounting to about 23,500, of whom about 10,500 were in the city of Santiago. The total number finally embarked for Spain, including the wives and children of officers and the priests and sisters of charity who had served in the hospitals, was 22,864 ; the cost of the service was 8513,860. The surrender came none too soon, the exposure of the campaign having begun to tell in the sickness of the Americans. Yellow fever broke out to some extent, and not less than 50 per cent, were attacked by the milder forms of malarial fever. The army was so weakened by illness that the general officers united in urging its removal from Cuba. General Miles had arrived with reinforcements on the 12 th of July, but the majority of these men were retained on board ship.

The fleet and the army gathered in Guantanamo Bay, the former with a view to the preparation of a powerful squadron, pai't of which, under Commodore Watson, was destined for the Philippines to proceed by way of the Mediterranean, accompanied by a covering squadron under Admiral Sampson, as far as the Suez Canal. This action was due to the divereion of a Spanish reserve squadron (so-called) composed of the Carlos V., Pelayo, TiloHa, destroyers Osado, Aiida:, and Proserpina, the fast pui'chased Ger- man ??? renamed ??? liners Rapido and Patriota, and several transports and colliers, which had been formed toward the end of May with the intention of sending it on to the eastern coast of the United States, and thence to Cuba. Ordei-s had been issued to this effect, but the whole force was diverted toward the Philippines, and left Cadiz, 16th June, for the East. The main part of the force, after difficulties regarding coaling, passed thi-ough the Suez Canal, 5th and 6th July, but turned back on the 8th on account of the news of the Spanish defeat at Santiago, and of the fear of the advent on the Spanish coasts of the American ships now free to act aln-oad. The whole reserve squadron was back home by the middle of July, and nothing came of it but a great and useless expense to Spain, which, besides the ordinary expenses of such a, squadron, had paid Canal dues twice on all but the three torpedo- boat destroyers, which were sent back from Port Said.

On 7th May a telegram had been received from Dewey : " I control bay completely, and can take city at any time, but I have not sufficient men to hold . . . will ammu- nition be sent?" He was informed that the cruiser

Charleston would leave at once, and also the steamer Peking with ammunition, supplies, and troops. Dewey's estimate on 13th May of the number of men re- ^Maaiu "' l^red was 5000. General Miles's recommenda- tion included even less, but Major-General Merritt, to whom was assigned the command, began by requesting a force of 14,000, which was increased to 20,000. On 25th May the first of these, 2491 in number, under General Anderson, sailed in three transports from San Francisco, touched at Honolulu, and were convoyed thence by the Charleston. On 20th June possession was taken of the island of Guam, and on 30th June the ships arrived in Manila Bay. The Spaniards in Manila were besieged by the Philippine insurgents under Aguinaldo, who, leaving Hong Kong, had landed from one of the American vessels at Gavite, 19th May. On 1st July, the day of the landing of the American troops at Cavite, he had proclaimed himself president of the Philippine Republic, and instituted a civil republic in the region controlled by his forces. The political attitude which he assumed was not recognized by the American authorities. A second detachment of troops, 3586 in number, under General F. V. Greene, arrived I7th July, and on 25th July General Merritt, who had been appointed governor- general, arrived, and on the 31st the five transports with which he had left San Francisco with 4847 men, making nearly 11,000 men at Manila, with 5000 more on the way. In the earlier part of the month the known de- parture of the Spanish " reserve " squadron for the East had caused some natural anxiety to Admiral Dewey, who, short of ammunition, and with a squadron but two of which had any armour protection, could not, in ordinary circumstances, expect to meet successfully armoured ships such as the Carlos V., Pelayo, and Vitoria. He had decided, in the event of the Spanish squadron's continuing its voyage, to leave Manila Bay and go eastwards to await the arrival of the monitors Monterey and Monadnock,

and return to give battle, the army in the meanwhile to move inland and await the American squadron's return. On 22nd July, however, he received news of Camara's return to Spain, and all naval anxiety ended, particularly as the reinforcement by the Charleston, on 30th June, the Monterey, 4th August, and the Monadnock, 16th August, gave him a force equal to any probable emergency.

The American general moved his forces from Cavite, and established an entrenched line within a thousand yards of the Spanish position, from which latter, on the night of 31st July, a heavy fire of musketry and artillery was opened, causing loss to the Americans of 10 killed and 43 wounded, and for the next few days night firing was frequent from the Spanish lines. On 7th August, however. Admiral Dewey having been reinforced by the arrival of the monitor Monterey on the 4th, a joint note from Dewey and Merritt, announcing that bombard- ment might begin at any time after forty-eight hours, and afibrding opportunity for the removal of non-combatants, was sent to the captain-general, Fermin Jaudenes, who had superseded General Augustin Davila by order from Madrid of 24th July. General Jaudenes in reply stated that he was surrounded by the insurgents, and that there was no place of refuge for the sick and for the women and children. But there was no more firing until the last day of the campaign. Instead of the expected bombardment, a second joint note was sent demanding surrender, which the Spanish commander declined, but ofiered to refer to Madrid. This was refused, and preparations made for an attack. There were 13,000 troops within the city fortifications, but with the strong fleet in front, and with the beleaguering force of Americans and insurgents ashore, resistance was hopeless. This was recognized.

and when the assault came off there was no greater resistance than sufficed, in their view, to "' save the face " of the Spanish authorities. The attack was made by the fleet and army on the 13th August. There was no reply to the fire of the fleet, which began at 9.30 a.m. and continued for three-quarters of an hour against Fort Antonio. The army then advanced, meeting an opposition at various points which continued for some time even after the white flag had been hoisted at eleven in token of surrender, and from which the Americans lost 5 killed and 44 wounded. An

agreement was signed during the afternoon of a rough draft of the articles of capitu- lation, which was drawn in a more formal manner and signed again the next day, 14th August. The troops capitulated with "all the honours of war," and were to be regarded as prisoners of war pending the conclusion of a treaty of peace. Their arms were deposited, to be re- turned " when they evacuated the city, or when the American army evacuates." All questions as to the repatriation of the Spanish officers and men and their families were to be referred to the Government at Washington. The city, its defences, and all public pro- perty were turned over to the United States force. The total loss of the Americans during the whole campaign was 20 killed, 105 wounded.

On the 12th August, at about four o'clock P.M., the protocol of peace had heen signed by M. Cambon, French ambassador in Washington, acting for Spain, and by Mr Day, American Secretary of State. Article III. stated: "The United States will occupy and hold the city, bay, and harbour of Manila, pending the con- clusion of a treaty of peace which shall detennine the control, disposition, and government of the Philippines." This indefinite status was to be the fruitful cause of difhculty with both Spanish officials and with the Filipinos. The insurgent forces, well armed and well organized, which had with difficulty been prevented from entering the city on the 13th ??? in which case it would, no doubt, have been the scene of savage revenge and loot ??? were forced to withdraw later into the outskirts, and there began the fomentation of the native movement which was to solidify into serious and long- continued hostilities.

Immediately after the surrender of Santiago, 17th July, preparations were made for the invasion of Porto Rico with 3500 troops which had been sent as reinforcements to Santiago, but not landed. Operations They left Guantdnamo, under Major-General j^j^^ Miles, on 21st July ??? the battleship Massa- chusetts and thirteen other naval vessels taking part in the expedition. The only harbour of the island which had been blockaded was that of San Juan, which had been guarded in turn by the St Paul, Yosemite, and New Orleans. Immediately after the arrival of the St Paul, 22nd June, a sortie had been made by the small cruiser Isabel II. and the torpedo-boat destroyer Terrm\ The former kept well inshore, but the latter

*headed for the St Paul, and was struck by two 5-inch shells, which killed three men and so disabled her machinery that she was barely able to get back into port. 'The island was garrisoned by 8223 regulars and 9107 volunteers. Fajardo, at the extreme north-eastern end of the island, was given out as the objective point of the expedition, but after sailing the plans were changed, and the towns on the south side were successfully occuf)ied, practically without resistance. The attitude of the population was exceed- ingly friendly, and opposition was not met until advance was begun northward. Miles had been reinforced, on 31st July, by two regiments of infantry, a troop of cavalry, and two batteries of artillery from Tampa, and by 6000 men from Hampton Roads. The troops were divided into four columns, advancing from Guanica around the western end of the island to Mayaguez ; from Arroyo at the eastern end to meet the San Juan road at Cayey ; from Ponce by the fine military road, 70 miles^*

to San Juan ; and the fourtli column by way of Adjuntas and Utuado, midway of the island. The various move- ments involved several actions which did not rise above skirmishes, the chief opposition being met by the western column, 10th August, and by the column from Ponce on the 9th ??? in which action the Americans lost 1 killed and 22 wounded; the Spanish, 126 killed and wounded, and over 200 prisoners. A further advance on the San Juan highway would probably have developed greater resistance, but news of the suspension of hostilities came as more serious work was to begin. The total American loss had been 3 killed and 40 wounded.

On 12th August the Newark, convoying the Resolute with a battalion of marines aboard, and with several smaller vessels, bombarded Manzanillo after a demand for surrender was refused. It is probable that the place would have yielded the next day, as it had for some time been reported ready to faU on a show of force, but during the night news arrived of the signing of the peace pro- tocol, and of an armistice, of which the

Americans were informed by the Spanish commander under a flag of truce.

With the publication of the protocol the war practically ended. The Spanish had lost Cuba, Porto Eico, and the Philippines, nearly the whole of their effective navy, a very considerable part of their merchant marine, about 500 men killed afloat, and probably an equal number ashore ; 37,000 troops had been surrendered as the result of two sieges. The total American loss was ??? in the navy, 1 oiBcer, 17 men killed ; in the army, 29 oflBcers, 440 men.

The health of the American fleet was kept remarkably. Its average strength during the 114 days of hostilities was 26,102 ; the deaths from disease during this time were 56, or at the rate of 7 per 1000 per year. As nearly the whole of the service was in the tropics, and in the summer or wet season, this is a most excellent demonstration of sanitary efficiency.

The army did not fare so well, losing by disease during May, June, July, and August 67 officers and 1872 men out of an average total of 227,494. Its larger proportion of illness must of course be ascribed, in part, to its greater hardships. The navy is, at all times, unless it has landing parties on shore, under its normal conditions ; the men have their usual food and water, can change their clothing when necessary, can keep clean. An army, on the other hand, when actually campaigning, suffers from bad or in- sufficient food, bad water, difficulties of changing or renewing clothing, sleeps frequently upon the bare earth and often in mire, and undergoes every hardship of weather. Much of the sickness in the American army, however, must be laid at the door of the ignorance and thoughtlessness of the volunteers. The newly- fledged soldier is unable to look properly after himself ; if both officer and soldier are new the conditions are greatly aggravated, and this, to a large degree, was the situation in the American forces. In nothing does training, and particularly the training of the officers, tell more than in the care of the health of an army in the field. AVhen masses of newly-enlisted men are brought together they seem to lose their individuality and revert for a time to the primitive man, the care of person and clothing has apparently to be

releamed, and unless the officers enforce cleanliness and hygiene in general, widespread disease is inevitable, whether in or out of the tropics.

Among the things which stand out prominently from the naval point of view, in the war are the facts that scouts are not effective when employed in such small numbers as by the Americans, and that the effective cutting of telegraphic communication is much more difficult than was supposed. The St Louis, largely employed on this duty, did excellent work ; but, though many cables were cut, communication was not wholly interrupted until about the close of hostilities. The endurance of ships was, as a rule, excel- lent. But this would have lieen greatly increased had all been able to keep their boilers supplied with fresh water ; this was shown to be vital to good service, and ships in this regard, to be thoroughly efficient, should be self-supporting. (p. e. Ch.)

Spanish Reformed Church. ??? This body

of Spanish Episcopalians had its origin in a congregation which met for the first time, in June 1871, in the secular- ized church of San Basilio at Seville, secured for the purpose, under the leadership of the Eev. Francisco Palomares, a priest who had left the Roman communion. Before long it was joined by considerable numbers of lay people in

various centres, and several clerg3anen, including the Eev. Juan Cabrera, an ex-Roman priest, who had for some time been a Presbyterian minister. In July 1878 a memorial was presented to the Lambeth Conference {q.v.) by nine congregations in Spain and Portugal (see below) asking for the episcopate, and undertaking, in case their request were granted, to place the nomination of the bishop in the hands of Lord Plunket, then bishop of Meath and subsequently archbishop of Dublin. The reply expressed the sympathy of the bishops, but only suggested that Dr Riley, recently consecrated by the Church of the United States to minister to the reformed congregations in Mexico, should be invited to visit them and ordain and confirm for them. Archbishop Tait wrote a formal letter to Bishop Riley to this effect, and the request was complied with. A second petition for the episcopate was sent to the Irish bishops in 1879, and early in 1881, at their request, Lord Plunket paid his first visit to the Spanish Reformed Church, though nothing immediately resulted

from it. In 1880 the first " synod " of the Church was held, under the presidency of Bishop Riley ; the principles of the Church were formally laid down, Senor Cabrera was chosen bishop-elect, the pre- paration of a liturgy was begun, and the Thirty-Nine Articles of Religion, with certain modifications, were formally adopted as a standard of doctrine. Archbishop Plunket continued his efforts on their behalf ; and at length the Irish bishops, having again received from them a petition for a bishop, formally brought the matter before the Lambeth Conference of 1888. The Conference deprecated " any action that does not regard primitive and established principles of jurisdiction and the interests of the whole Anglican communion." The archbishop interpreted this as a modified consent ; but the Irish bishops understood it otherwise, and again declined to consecrate a bishop for them. Meanwhile the movement prospered, being largely helped with money from friends in England. The founda- tion-stone of a new church was laid in Madrid in 1891, on the site of the Quemadero, where the autos de fe were formerly held ; and after considerable legal and other diffi- culties, for religious toleration in Spain is still imperfect, it was dedicated and opened for service. At length, at the meeting of the Irish House of Bishops on 21st February 1894, a letter was read from the archbishop of Dublin and the bishops of Clogher (C. ^I. Stack) and Down (C. Welland), in which they declared their intention, unless a formal protest were made by the bishops, or by the General Synod, to consecrate bishops for the Reformed Churches in Spain and Portugal, subject to certain conditions being ful- filled by those churches. The bishops resolved, mdlo con- tradicente, although the bishops of Deny (W. Alexander, subsequently primate of Armagh) and Cork did not vote, that they would not regard such action as " an indefensible exercise of the powers entrusted to the episcopate " ; and the General Synod passed a resolution leaving the matter in the hands of the bishops. Accordingly, on 23rd Sep- tember 1894, the three bishops laid hands on Senor Cabrera. The matter occasioned no little stir, more especi- ally as the Old Catholic bishops (see Old Catholics) had recently refused to take any part in the matter. It called forth a letter of protest and repudiation from Lord Hali- fax, as president of the English Church Union, to Cardinal IMonescillo, archbishop of Toledo ; and this in turn evoked a letter from Cardinal Vaughan, which was widely circulated in Spain. Since then the Spanish Reformed Church has gone quietly on its

way, and the choice of Bishop Cabrera has on the whole justified itself. At the present day there are between 3000 and 4000 members, and some 11 clergy in all, six of whom were ordained in the Roman communion. The consecration of Bishop Cabrera certainly produced a somewhat anomalous state of things, and the action, or

inaction, of the Irish bishops laid them open to very just criticism from many who were not unfriendly to such movements (see, e.g.. Bishop John Wordsworth, Ministry of Grace, pp. 176-177, London, 1901). Lord Plunket did not intend to bind either the Irish Church or the Churches of the Anglican communion, nor can he be said to have done so; but his individualist action inevitably created confusion and called forth much well-grounded opposition. Objection was made to the act as contrary to Church order, and as unjustifiable in view of the nature of the Spanish Reformed Church itself. As regards the latter, it is true that the Prayer-Book of tl^e body (first made in 1881 and published in a revised form in 1889) cannot really justify the claim made on its behalf as a " revised Moz- arabic rite " : it contains indeed many beautiful prayers from the Mozarabic and other offices, but it falls short of the English Prayer-Book, for example, in its doctrinal teach- ing, although it contains little that is open to positive objection. Again, the statements that have been made as to the lax character of the body itself have not been made out. No doubt, it has been composed out of various Protestant elements which are only by degrees growing together, and like other bodies it has a loose fringe of irresponsible adherents ; but, however hasty the action of Lord Plunket and his fellow-bishops may have been, the Church has shown a capacity for quiet growth and steady development which may promise well for the future.

Lusitanian Church. ◆◆◆ A similar movement began in Lisbon in 1867, owing to the work of a Spanish priest there, Seiior Mora ; and at first its success was even greater than the movement in Spain, in spite of the fact that Portuguese priests who left the Koman communion had either to leave Portugal or to become subjects of another Power. In 1875 the

adherents of this movement threw in their lot with their Spanish brethren, and when Bishop

Eiley visited them in 1878 the Portuguese members organized themselves as the " Lusitanian Church," and the Rev. T. Godfrey Pope, D.D., the English chaplain at Lisbon, was subsequently chosen by them as president of the Synod. A request made to the Irish bishops in 1897 for the consecration of Canon Pope as their bishop led to an examination of the Lusitanian Prayer-Book, which was found to be even more defective than that of the Spanish Reformed Church. Consequently no action was taken; and the death of Archbishop Plunket in 1897, and of Canon Pope in 1902, has rendered such action more im- probable in the near future. At the present time there appear to be 5 clergy and some 500 adherents.

Authorities. ––– H. E. Noyes. Church Reform in Spain and Portugal. London, 1897. ––– F. D. How. Life of Archbishop Plunket. London, 1900. ––– A. C. Benson. Life of Archbishop Benson, vol. ii. London, 1899. ––– Officios Divinos etc. en la Iglesia Esparlola Eeformada. Madrid, 1889 (Eng. translation, Dublin, 1889 ; new ed. 1894). ––– Divine Offices and other Formularies of the Reformed Episcopal Churches of Spain and Portugal. London, \&&% ––– Church Quarterly Beview, vol. xxxviii. p. 283, July 1894, art. "The Proposed Episcopate for Spanish Protestants."

(w. E. Co.)

Spanish Town. See Jamaica.

Spartanburg, a city of South Carolina, U.S.A., capital of Spartanburg county. It is in the north- western part of the state, on the Charleston and West Carolina, the Glenn Springs, and the Southern railways, at an altitude of 680 feet. It is the seat of Woifard College, a Methodist Episcopal institution, opened in 1854, which had in 1899 a faculty of 9, and was attended by 181 students. Population (1890), 5544 ; (1900), 11,395, of whom 83 were foreign-born and 4269 negroes.

Spectacular Drama. See Stage Mechanism.

SPECTROSCOPY.

THE rapid advance of spectroscopy during the last quarter of the 1 9th century was due in large measure to the improvement of instruments and photographic plates. The characteristic which more than any other distinguishes the spectroscopy of the present day from that of the earlier period is the high degree of precision in measurement which has resulted from the improved means of research. The distribution of lines in the spectra of many elements, so far from being governed by mere chance, is now known to be defined by simple formulae, which, though purely empirical, are nevertheless profoundly significant. The wave-length of spectral lines, formerly supposed to be unchangeably fixed by nature, has been found to vary with the pressure of the gas in which they are produced, and single lines have been separated into as many as nine com- ponents by the action of a magnetic field. The displace- ment of lines due to the relative motion of the observer and the luminous source has not only been artificially produced in the laboratory, but has rendered possible the measurement of the axial rotation of the sun and some of the planets, the demonstration of the meteoritic constitution of Saturn's rings, and the determination of the velocity of, stars in the line of sight. Through the use of improved instruments and methods, the science of spectroscopy has now attained results not inferior in precision to the most refined determinations of physics or astronomy. Indeed, an intimate relationship between these two subjects has grown out of their common use of the spectroscope, and is one of the significant- advances of the period. In astronomy the spectroscope has become hardly less im- portant than the telescope, and every advance in the study

of radiation is speedily applied to the solution of cosmical problems. In physics, on the other hand, the necessary limitations of laboratory practice make an appeal to stellar conditions more and more essential to progress. In many instances, of which the history of the hydrogen spectrum affords a striking example, the dependence of each subject upon the other is clearly manifest. As the union of the observatory and the physical laboratory becomes more complete, the science of astrophysics increases in scope and power. It will be advantageous to open this brief

account of recent advances with a consideration of certain questions relating to instruments.

The efficiency of a spectroscope in general depends upon its resolving power, or capacity for separating lines which differ but little in wave-length. Schuster (Ency. Brit. vol. xxii. p. 374) has defined the purity, p, of a spectrum by the formula

where s is the slit-width, i/c the angular aperture of the collimator lens, and r the theoretical resolving power of the spectroscope, i.e., the resolving power for an infinitely narrow slit and for monochromatic fight. This formula is based on the assumption that two wide lines can just be separated when the angular distance between their adjoin- ing edges is equal to the resolving power of the aperture employed in observing them. Wadsworth has recently shown this assumption to be incorrect (Phil. Mag. vol. xliii., 1897, p. 317). The modified formula for purity (wide-slit and monochromatic radiations) becomes

p=-

>A + ;

(2)

Hence wlieii the slit is widened, the purity of the speotmm, instead of diminishing, really increases, until

5

The theoretical resolving power of the instrument is still

realized whensi/r = -A; beyond this point the purity z

diminishes. Schuster (foe. ci'fc) states that for the condi- tion of maximum illumination, when stj/ \ (monochro- matic source),

only 50 per cent, of the theoretical resolv- ing power is realized. The new formula shows that this should be 75 per cent. In practice the source is never strictly monochromatic, and the formula for E, the limiting resolving power in any actual case, i.e., with infinitely narrow slit and with lines of finite width, becomes

7 rAA.-1-X

where A^ is the physical width of the line.

For wide slits the expression for practical purity takes the form

P = ^

sf+.

<9

2sf+X-

E

(4)

E

Bcbelon spectro- scope.

This formula, which is not restricted to monochromatic radiations or infinitely narrow slits, is the one to be employed in actual work with the spectroscope. When the factor

Tj-, the presence of which distinguishes (4) from (2), is unity,

P =p, or for monochromatic light the practical and theoreti- cal purity are equal. In the article referred to, Wadsworth gives tables which show that while for narrow lines and small resolving powers the ratio r/E is very nearly unity, this is far from true for wide lines and large resolving

powers. In an extreme case the value of the ratio exceeds 100 (when A^=l-00, r= 1,000,000, E = 9600).

The largest gratings hitherto ruled contain about one hundred thousand lines, and consequently the highest resolving power that can be obtained with their aid (as higher orders than the fourth are not ordinarily useful) hardly exceeds 400,000. It was formerly supposed that interference would no longer be possible after a retardation of over 50,000 wave – lengths, and that consequently a resolving power of 100,000would suffice for the resolution of the closest lines in the spectrum. As a matter of fact, how-ever, Michelson has been able with his interferometer to separate lines less than 0-01 tenth- meter apart, which appear single with the most powerful gratings, while Perot and Fabry have observed interference with the green mercury line at a difference of path of 790,000 wave-

i

1 1

a

c 1

b

d

1

1 1

1 1

1 1 1 !

The Echelon.

lengths. The reaUzation of great resolving powers by the use of very high orders of spectra has hitherto failed in the case of the grating, but

Michelson accomplished this result in a novel and ingenious way through his invention of the echelon in 1898. This consists of a pile of plane – parallel glass plates, of precisely equal thickness, arranged as shown in the diagram. If parallel rays pass through such a pile of plates in the direction of the arrow, the successive pencils undergo retardations proportional to the number of plates traversed. The theory of the instrument is given by Michelson {Proc. Artier. Acad. Arts and Sci. vol. xxxv. p. Ill, 1899) as follows : ???

Let db=s, the width of each pencil of rays ; l)d=t, the tHck- ness of each plate ; B, the angle of diffraction ; m, the number of waves of length X corresponding to the difference of path in each plate. The common diflference of path is ,

=ld-t cos S + s sin 8, or, since 0 is always very small,

m\={iJ.-\)t + se (5)

To find the dispersion and the angular separation of the spectra, differentiate (5) with respect to X and m.

... (6)

dk s^ d

*d0^*

dm s

(7)

J

Substituting in (6) the approximate value of m=(^-l)r-, we obtain

de

d\~ X

[(-^^-Si

s

(8)

which measures the dispersion of the echelon.

From this we can easily obtain an expression for the resolving

power. Let e = ??? for the limit. The maximum resolving power is

X assumed not to exceed that of the observing telescope, whose effective aperture is evidently ns, where n is the number of elements in the echelon. We may therefore substitute X/??s for de, whence we obtain

X

e=- ??? ont

For the angular separation of the spectra, substituting

in (7), we have

de.J^.

s

The corresponding value of ??? =E is found by substituting this

X value of dS in (8), whence

As the distance between the spectra is thus only n times as great as the hmit of resolution, the use of the echelon is restricted to the study of narrow lines. With plates 7 mm. thick it is impossible to examine lines whose width is greater than one-fourteenth of the distance between the D hnes. Moreover, as the resolving power,

= ???, is proportional to nt, and as experience has shown that e X

the number of plates is limited to from 20 to 35, on account of the loss of light by successive reflections, it will be difficult to construct an echelon which combines very great resolving power with any considerable separation of the spectra. However, by im- mersing the echelon in some fluid such as water, the distance between the spectra will be increased, and the resolving power diminished in the same ratio. But the loss by reflection will be so much re- duced that more plates can be employed to restore the resolving power to its former value. The expression for the distribution of intensities in the successive spectra shows that in general there are two spectra visible, one of which can be made to disappear by sUghtly inclining the echelon.

When in use, the echelon is mounted between a colli- mator and observing telescope of the ordinary form. A direct vision prism is usually interposed, for the purpose of cutting out all radiations except those under observation. The instrument has hitherto found its principal application in Michelson's important studies of the Zeeman effect {Astrophys. Jomrn. vol. viii. p. 37, 1898). Michelson has also constructed several reflecting echelons, but theis adjustment is so troublesome that high resolving powers have not yet been obtained with their aid.

SPECTROSCOPY

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A most valuable adjunct to tHe spectroscope, wMcli affords the best known means of measuring absolute wave- lengths, is the interferential refractometer or otnete^' interferometer. Four forms of this instrument are in use at the present time, those of Michelson, Perot and Fabry, Hamy, and Lummer (for a description of Lummer's interference spectroscope, see Arch. Neerlan- daises des Sciences, 1901). The first of these has already been described and illustrated in the article Light (vol. XXX.). When sodium light is observed with this instrument, it is found that the clearness or visibility of the interference fringes varies vidth the difference of path. This is due to the presence of two sets of fringes, which give maximum visibility when exactly superposed, and minimum visibility when the bright fringes of one set fall upon the dark intervals of the other. It is only necessary to know the difference of path corresponding to these

maxima and minima in order to calculate the differ- ence in wave-length of the two components of the sodium line. The complete theory of the interferometer, and the method of reducing observations of visibility in the case of complex radiations, are given by Michelson in his memoir : Determination Exp^rimentale de la Valeur du Metre en Longueurs d'Ondes Lumineuses, Paris, 1894, or Phil. Mag. (5), xiii. p. 236, 1882. Michelson has deter- mined the absolute wave-lengths of the red, green, and blue cadmium lines by counting the number of fringes (twice the number of wave-lengths) corresponding to the length of the standard metre at the Bureau International des Poids et Mesures. The uncertainty of his value of the wave-length in terms of tenth-metres is probably only a few units in the thousandths place, and his results are thus more accurate than the best determinations of absolute wave-length made with gratings.

The interference spectroscope of Perot and Fabry is even simpler than Michelson's interferometer. It consists of two half-silvered plane parallel mirrors, mounted with the silvered sides parallel to and facing each other. The distance between the mirrors can be varied from zero to several centimetres by means of a micrometer screw. The effect of the thin silver films is to make the fringes ob- served by transmission much narrower and sharper than those given by unsilvered plates. If two radiations are under examination, there will be two distinct systems of fringes, one corresponding to each line. Starting from zero difference of path, the two systems of fringes, red and yellow, for example, gradually separate, until a yellow fringe falls about half-way between two red ones. They then come together again, until finally two consecutive red fringes embrace two yellow fringes. Such a coin- cidence is followed by separation,

In Hamy's interference spectroscope, which is similar to Ebert's {Wied. Ann. xxxii. p. 337, 1887), a half-silvered collimating lens of long focus is used with a heavily silvered plane mirror, and the fringes are observed by reflection. A useful adjunct, which permits radiations differing but slightly in wave-length to be observed sepa- rately, is Hamy's wave-separator {Comptes Bendus, vol. cxxv. p. 1092, and cxxviii. p. 1380). The wave-lengths of a number of standard hues in the spectrum, referred to Michelson's absolute values for the cadmium lines,

have been measured by Perot and Fabry with great accuracy.

The principal lines in the infra-red prismatic spectra of the alkali metals were mapped with a bolometer by Snow in 1892 {Phys. Rev. vol. i. pp. 28, 221). More accurate wave-length determinations in the infra- '^f ff '□□□ red spectra of lithium, sodium, strontium, calcium, elements. silver, and thallium have since been obtained by Lewis {Astrophys. Jomrn. vol. ii. pp. 1, 106) with a radiomicrometer and concave grating spectroscope. Bolometric investigations of the infra-red spectra of flames, of absorption spectra, &c., have also been made by Eubens, Paschen, Julius, E. von Helmholtz, Nichols, and others. The radiometer, in the form used by Nichols for the exploration of the remote infra-red, possesses many advantages over most other heat-measuring instru- ments, and is certain to find many apphcations in spectro- scopy. The long-standing lack of accurate wave-length determinations of lines in the visible and ultra-violet spectra of the elements has been in large degree over- come. Most of the elements whose spectra have been investigated by Kayser, Eunge, and Paschen are enumer- ated in another section of this article. Eowland and his assistants (Ibid. vols. i. to vii.) have measured the lines in photographs of the arc-spectra of boron, beryllium, germanium, platinum, osmium, rhodium, ruthenium, palladium, vanadium, zirconium, and lanthanum. Hassel- berg's valuable tables of wave-lengths (Mim. de I' Acad. imp. Sci. de St Pitershowrg ; K. Svenska Vetenshaps-Akademiens Handlingar) include the spectra of oxygen, chlorine, hydrogen (second spectrum), sulphur, carbon hydride, nitrogen peroxide, iodine (absorption), bromine (absorp- tion), aluminium oxide, chromium, titanium, cobalt, nickel, vanadium, and manganese. Liveing and Dewar, Eder and Valenta, Exner and Haschek, Hartley and Adeney, Trowbridge, Ames, Lockyer, Deslandres, Lohse, and others have also published tables of wave-lengths, most of which may be found in Watts's Index of Spectra. McClean {Com- parative Photographic Spectra of the Sun and Metals, ser. i. and ii., London, 1891) and Crew {Photographic Maps of Metallic Spectra, Evanston, III, 1895) have issued photographic reproductions of the spark- and arc- spectra of various elements, and the memoirs of Eder and Valenta and of Hartley contain many excellent illustra- tions from their photographs. Kayser has published a valuable table of standard hues in the arc-spectrum of iron {Ann. der Phys. (4), vol. iii., 1900). Gramont

has given special attention to the spectra of the minerals. Many of these investigations extend far into the ultra- violet, but a limit is finally set by the absorption of even a few centimetres of air. Schumann {Sitz. K. Akad. d. Wissens. in Wien, cii. Abth. 2, 1893) has, however, succeeded in photographing the ultra-violet spectra of hydrogen and various metals out to a point near A.1000, by the use of a vacuum spectrograph and sensitive plates prepared by himself, without gelatine films. The principal recent determinations of absolute wave-length are those of Bell {Amer. Journ. Sci. vol. xxxiii., March 1887) and Thalen {Nova Acta Reg. Soc. Sc. Ups. ser. iii., 1898), by the grating method, and those of Michelson, by the inter- ference method. Eowland's Table of Solar Spectrum Wave-Lengths is based on Bell's values. (For a discussion of methods of determining wave-lengths, see Perot and Fabry, loc. cit., and Bell, Astrophys. Journ. vol. xv. p. 157,

1902.)

The most important advance in spectroscopy during the period under consideration is undoubtedly the dis- covery of orderly series of lines in the spectra of many of the elements. Prior to this period Palmer's formula for the series of lines in the spectrum of hydrogen, and the

known presence of numerous triplets in the spectra of zinc, calcium, and magnesium, constituted almost the whole sum of knowledge on the subject. The important iia'soVctra investigations of Kayser and Kunge (Abha-nd. ' d. K. Preuss. Akad. d. Wiss., BerHn, 1887-93) were entered upon in 1887. In order to secure wave- length determinations of accuracy sufficient for their purpose, they found it necessary to remeasure the lines in the spectra of all the elements studied. As evidences of orderly arrangement presented themselves at the very outset, they endeavoured to find a formula which would fairly represent the lines in spectral series. After some experimenting they selected the expression

where A, B, and C are constants, and n takes the succes- sive values 3, 4, 5, 6 ... . On comparing the wave- lengths of the lithium lines computed from this formula with their observed values, the agreement is found to be very satisfactory for most of them, but for w = 3 the difference is 108 tenth-metres. Kayser and Runge conclude that terms containing higher negative powers of n are needed to complete their formula, but on account of the uncertainty which already exists regarding the coefficient of w^, they consider that it would be useless to introduce an additional term.

In the spectra of all the elements of MendeWefFs first two groups (excepting gold and barium) series of lines were found which are accurately represented by the above formula. From the positions of these series the elements may be grouped as follows : ???

(A) Li, Na, K, Rb, Cs.

(B) Cu, Ag, Au.

(C) Mg, Ca, Sr.

(D) Zn, Cd, Hg.

(E) Al, In, Tl.

The metals of group A apparently have three series ??? a principal series, composed of the strongest and most easily reversible lines, and two subordinate series, the first composed of strong, diffuse lines, the second (found for Rb and Cs by Ramage, Proc. Roy. Sac, vol. Ixx. p. 303, 1902) made up of much fainter but sharper lines. The lines are doublets, the frequency-difference being constant in the subordinate series, but varjring inversely as the fourth power of n in the principal series. In group B two subordinate series of doublets with constant frequency-difference were found for Cu and Ag, but not for Au. A very strong reversed doublet occurs in the ultra-violet spectrum of each element, which may possibly be a part of a principal series. The two subordinate series which constitute the spectra of the elements of group C are made up of triplets. The frequency-difference between the first and second and

the second and third lines in each triplet is constant for each element, as Hartley and Ames had previously found. Barium gives no series. The elements of group D also have two subordinate series of triplets, and are characterized by the presence in the ultra-violet of a very strong reversed line, discovered by Ames (Phil. Mag,, July 1890). This peculiarity is shared by Mg. The two subordinate series in the spectra of the elements of group D are made up of doublets. The elements Sn and Pb in Mendel^eif's fourth column, and As, Sb, Bi in the fifth column, have related lines in their spectra, but no series similar to those in the above groups. It would be difficult to overestimate the importance of this spectroscopic grouping of the elements, which agrees so closely with that based upon their chemical properties. As the atomic weight increascn, the series for the elements in a given group move toward the red, but the end of the series advances steadily towards the ultra-violet in

going from group A to group E. The constant frequency- difference of doublets or triplets for each element in a group is proportional to the square of the atomic weight. The impossibility of resolving some spectra into series is probably due to the high temperature required. In general, the higher the melting-point of a substance the smaller is the percentage of lines in its spectrum that can be attributed to series.

The constant B in Kayser and Runge's formula varies but little for different elements, and differs only slightly from the corresponding constant used in Balmer's formula for the hydrogen spectrum. Seven triplets of constant frequency-difference, discovered by Runge and Paschen {Wied. Ann., 1897, p. 641) in the "compound line spectrum " of oxygen, together with six triplets previously found by Piazzi Smyth, constitute two series ending at the same point in the spectrum, thus corresponding with Kayser and Runge's subordinate series. Contemporane- ously with Kayser and Runge's investigation Rydberg {Kongl. Svensha Vetensk. Akad. Handlingar, 23, 1891) made a study of spectral series, which led to numerous results of great importance. Rydberg's formula for spectral series is

A.-i = A-B(n-f/.)-2; it differs from Kayser and Runge's in the fact that the same value of B is used for all the elements. This expression represents

the lines in the second subordinate series of oxygen better than the formula used by Runge and Paschen. Two triplets belonging to the first principal series, and two lines which perhaps represent a second principal series in the spectrum of oxygen, were found by Runge and Paschen through the apphcation of Rydberg's rule, independently discovered by Schuster : ??? The difference between the common limit of the nebulous (first subordinate) and the sharp (second subordinate) series and the limit of the corresponding principal series gives the wave-number of the common first term of the sharp and the principal series. The two subordinate series which accompany the second principal series are apparently composed of double lines. Sulphur and selenium have spectra similar to that of oxygen, though in both the second pair of subordinate series is lacking. Helium has two principal and two subordinate series, and before the similar series of oxygen were discovered it was supposed to consist of two gases, called helium and parhelium (Runge and Paschen, Astrophys. Journ. vol. iii. p. 4). One principal and two subordinate series of helium consist of doublets, many of which have been observed in the spectrum of the solar chromosphere and in certain of the white stars. Rydberg has established certain relationships among the lines of argon, but no definite arrangement of these lines in series has yet been accomphshed. In 1897 a new series of lines was dis- covered by Pickering [Astrophys. Jo-urn. voL v. p. 92) in the spectrum of the star ^ Puppis. This was soon found to be one of the subordinate series of hydrogen, produced under physical conditions not hitherto realized in the laboratory. The other subordinate series comprises the lines represented by Balmer's law. Having these data Rydberg {Ibid- vol. vi. p. 233) applied his rule and found that a strong line, the first member of the principal series, should fall at X4687-88, the remaining lines being beyond the range of possible (astronomical) observation in the extreme ultra-violet. By far the strongest bright line in the spectra of certain stars is at X4G 88, and there is a line at A4687 in the spectra of several nebulae.

In the great majority of the elements the series hitherto discovered comprise only a small percentage of the total number of lines. Rydberg {Ibid. vol. vi. p. 239) has found in the spectrum of copper a large number of triplets

of constant frequency-difference, whicli he was unable to arrange in series. Triplets had previously been recognized only in the spectra of biatomic elements. The strongest evidence may be adduced to show that the selection of lines to form series has not been the result of chance. Infra-red lines predicted by Kayser and Runge were found by Snow with the bolometer. Humphrey's studies of the effect of pressure on wave-length show that lines belonging to different series are shifted by different amounts. Finally, Preston {Phil. Mag., 1899, p. 165) found that corresponding lines of the same series in the spectra of magnesium, cadmium, and zinc behave similarly in a magnetic field, and Runge and Paschen {Astrophys. Journ. vol. XV. p. 333, 1902) have obtained similar results with these and other metals.

" Banded " spectra, in contradistinction to mopt line spectra, offer evidence to even the most casual observer of the existence of a law governing the arrangement of the Unes in the bands. In 1883 Alexander Herschel {Micro- metrical Measures of Gaseous Spectra, C. Piazzi Smyth, Edinburgh, 1884) noticed that the lines in Piazzi Smyth's map of the green band of carbon monoxide form an ap- proximate arithmetical progression. Deslandres {Gomptes Rendus, 1886) subsequently found a similar relation in the nitrogen band A3914'6 and in other bands. Kayser and Runge obtained an expression that represents the distri- bution of lines in one of the cyanogen bands, but they finally concluded that no simple and accurate formula can be deduced from observation. Thiele {Astrophys. Journ. vol. vi. p. 65), whose general formula for all spectral series is of the form A =/[(□□. -l-c)^], has resolved into series the complex green band in the spectrum of carbon monoxide. The expression necessary for this purpose is a cumbersome one, however, and is hardly adapted for general use.

Several attempts have been made to treat the question of spectral series from a purely theoretical standpoint. Julius {K. Akad. van Wetenschappen, Amsterdam, 1888) has sought for lines with frequencies equal to the sum or difference of the frequencies of other lines, thus

corre- sponding to the combinational tones of acoustics, and discovered more coincidences than would be probable on the assumption of a chance distribution of lines. But Ames {Phil. Mag., July 1890) was unable to find com- binational lines corresponding to some very strong ‘ lines in the spectrum of calcium. Stoney {Trans. Roy. Soc. Dub., 1891) has sought to explain multiple lines on dynamical grounds. He considers the motion of a point in an orbit described under the action of one or more dominant forces, and subjected to perturbations which gradually change the position and form of the orbit. The dominant orbit, however complex, can be resolved into a number of elliptic orbits, the “partials,” each of which would represent a single line in the spectrum if the moving point actually followed the dominant orbit. But in the intervals between successive encounters of the molecule the motion is constantly under the influence of disturbing forces, the effects of which may be predicted from the well-known perturbations in the solar system. Double lines would result from apsidal motion, triple lines from processional motion, vidnged lines from periodic changes in the inclination of the ellipse, pairs of equal lines from periodic changes in the ellipticity, diffuse lines from periodic oscillation in any of the perturbations (nutation). Stoney then goes on to show that the con- clusions dravm from this dynamical investigation may also be considered valid under the electromagnetic theory of light. This theory receives support from Preston’s observations of the Zeeman effect {Phil. Mag. vol. xlvii., 1899, p. 176). Kovesligethy’s discussion of the theory of continuous and line spectra, in the course of which he

derives a formula for spectral series similar to Balmer’s, may be found in his Grundzuge einer tlt^oretischen Spec- tralanalyse (Halle, 1890). This theory leads to the important law that the wave-length of the point of maximum energy in the spectrum of a black body is to a very close approximation inversely proportional to the absolute temperature, now established on a firm experimental basis through the investigations of Paschen {Astrophys. Jowrn. vol. ii. p. 202) and others. (See also the extensive theoretical investigations of Wien, Planck, and others.)

One of the most promising means of ascertaining the structure of the molecule, and of supplying data requisite for the interpretation of stellar and nebular ^ffg^t of spectra, is the investigation of the spectra of

physical substances subjected to widely different physical conill- conditions. A brief reference may be made to """s- some of the more important phenomena that have been observed in this extensive field. Remarkable effects have been observed in vacuum tubes under different con- ditions of the electrical discharge. In his important studies of electrolysis in gases J. J. Thomson {Proc. Roy. Soc, 1895, p. 244) found that at the positive electrode of a hydrogen tube the red line {Ha) was brighter than the green line {S/3), while at the negative electrode the relative intensities of the lines were reversed. On reversing the coil the effect was reversed gradually. Thomson considers the difference in the spectra to be due in part to the preponderance of positively and negatively charged atoms at the opposite electrodes. Eder and Valenta have found that argon gives three distinct spectra under different electrical conditions. In passing from the "blue" to the "white" spectrum some of the lines undergo displacements toward the red of from one-half to one tenth-metre, which are not considered to be due to unsymmetrical broadening. The details of this and many other important investigations may be found in Eder and Valenta's papers in the Denhsehriften of the Vienna Academy of Sciences. From their studies of the multiple spectra of argon and other gases, Trowbridge and Richards {Amer. Journ. Sci., 1897, pp. 15 and 117) con- clude that, in general, the oscillatory discharge produces line spectra, while the dead-beat discharge gives fluted spectra. Schuster and Hemsalech {Phil. Trans., 1899, p. 189) have pointed out that the introduction of self- induction into the secondary circuit of an induction coil eliminates the air lines from the spark discharge in air. Hemsalech {Journ. de Phys., Dec. 1889) attributes the effect to a lowering of the temperature in the oscillatory discharge. The same authors find in certain cases that different lines of the same element may be due to different particles, which move vidth different velocities in the electric spark. Two hues of equal intensity are not neces- sarily due to vibrations of equal intensity, as an intense vibration of brief duration may affect the eye or plate no more than a weak vibration which persists longer. For a full account of Hemsalech's recent work, see his Recherehes expiriTnentales sur les Spectres d'^tincelles, Paris, 1901.

Lockyer {Proc. Roy. Soc, 1897, p. 441) has made numerous investigations of " enhanced " lines, i.e., lines whose intensity increases in passing from

the arc to the spark. Crew {Astrophys. Journ. vol xii. p. 167) has observed that those lines in the arc which are either enhanced or diminished when the arc is surrounded with hydrogen, in all cases occur in the spark spectrum. Lines belonging to series are not affected at all. Lewis {Ibid. vol. X. p. 137) finds that minute traces of impurities may effect great changes in the spectra of gases, even though they be chemically inactive. Reduction of the tempera- ture of hydrogen gas to -200 C. has been shown by

Scheiner {Ibid. vol. vii. p. 231) to tave no effect on its spectrum. In the spark spectrum of liquid oxygen Liveing and Dewar (Phil. Mag., Aug. 1894) observed a line at A5572 ; this may perhaps coincide with the aurora line (A5571-6) which must be produced under somewhat similar conditions of temperature and pressure. An investigation which may have a bearing on solar phenomena is that of Wiedemann and Schmidt {Astrophys. Journ. vol. iii. p. 207), who have found that when sodium and potassium vapours are exposed to concentrated sun- light they fluoresce brightly, sodium with a green, potas- sium with a red colour. The sodium spectrum contains continuous and fluted bands, also the yellow sodium line. The recent work of Julius {Ibid. vol. xii. p. 185, vol. xv. p. 28) and Wood {Ibid. vol. xiii. p. 63 ; Phil. Mag. ser. vi. vol. iii. p. 128) on the anomalous dispersion of sodium and other vapours may perhaps aid in explaining certain pecuharities in the spectrum of the chromosphere.

While measuring Rowland's concave grating photographs of the solar spectrum, Jewell noticed that the arc lines of the comparison spectrum in many cases did not Pressure exactly coincide with the corresponding Fraun- /wijrJfi"'' liofsr lines. This led to the investigations of Humphreys and Mohler {Astrophys. Journ. vol. vi. p. 169), on the spectrum of an enclosed arc under pressures varying from one to fifteen atmospheres. From measure- ments of the spectra of fifty-three elements it was found that all isolated lines are shifted by pressure towards the red end of the spectrum. The amount of the shift is directly proportional to the increase of pressure ; it depends upon the total pressure, not upon the*

partial pressure of the vapour or gas producing the lines, and it is apparently independent of temperature. Lines in bands (of cyanogen and aluminium oxide) are not appreciably shifted. For a given element the shifts of similar lines are propor- tional to their wave-lengths. Lines belonging to different series are shifted by different amounts, the ratios of the reduced shifts for the principal, first subordinate, and second subordinate series being approximately as 1:2:4 respectively. For the same element lines of similar char- acter are shifted equally. For different elements the shifts of similar lines are ordinarily in the inverse ratio of the absolute temperature of the melting-points, and also are to each other as the products of the coefficients of linear expansion and the cube roots of the atomic volumes of the respective elements. The shifts of similar lines of elements belonging to the same half of a Men- deMeflf group are proportional to the cube roots of their respective atomic weights. The shifts are greatest for substances whose coefficients of linear expansion are greatest. For similar lines of difierent elements the shift is a periodic function of atomic weight.

In Lommel's theory of absorption the following theorem appears ; " An increase in the density or the pressure of a radiating gas causes a broadening of the bright lines in its spectrum, and at the same time displaces them toward the red." After a discussion of this theory Wil- sing {Ibid. vol. vii. p. 317) concludes that it agrees with observation in so far as it requires a displacement toward the red to result from increased damping. At the same time, however, observation shows no such great increase in the width of the lines as the theory demands. Taking into account Bessel's extension of the theory of damped vibrations, Wilsing is able to show that Humphrey's and Mohler's observations can be fully explained as resulting from a damping of the vibrations, if the quantity which expresses the damping may be regarded as a function of the pressure which is constant for a given series of vibrations of the same gas, but which varies for different series and different gases.

From measurements of the displacements of lines in the solar spectrum, Jewell, Humphreys, and Mohler {Astrophys. Journ. vol. iii. p. 138) have found the pressure in the Sun's reversing layer to vary from two to seven atmospheres, the observed pressure depending upon the height of the

absorb- ing vapour above the photosphere. Thus the lines in the spectra of stars of the solar type may have an average displacement of about 0‘02 tenth-metres, which at X4000 corresponds to a velocity of 1 ‘5 kilometres per second in the line of sight. As this is not far from the limiting accuracy attained in the best line of sight work, it is probable that pressure displacements can at present have no important effect in velocity determinations, at least in the case of stars whose atmospheric pressure is not much greater than that of the Sun.

The spectrum of the spark between iron poles in water and other liquids has recently been investigated by Hale {Ibid. vol. XV. p. 132, 1902). By varying the length of spark, capacity of the condenser, &c., or by replacing the water by a salt solution, he found that the spectrum can be changed by successive steps from a bright-line spectrum to one consisting almost wholly of dark lines. Wilsing, who was the first to make a serious study of the spectrum of the spark in water, has pointed out {Ibid. voL x. p. 113) that the composite dark and bright hues thus obtained resemble the lines which are characteristic of the spectra of temporary stars. In the spectrum of hydrogen, obtained by passing a spark between carbon poles moistened with water, Wilsing {Ibid. vol. x. p. 269) finds the line H/3 to be displaced about LI tenth-metres toward the red and greatly widened. Mohler’s {Ibid. vol. x. p. 202) observed displace- ments of the cadmium lines produced by a spark discharge at atmospheric pressure vary from 0‘026 to 0‘088 tenth- metres, increasing with the capacity in the circuit. The corresponding pressures produced by the discharge itself range from 3^ to 11 atmospheres. The much higher pressures deduced by Haschek and Mache {Ibid. vol. xii. p. 50) are ascribed by them to the difi’erent electrical conditions under which their spark was produced. The great displacements of certain lines of argon and sulphur, observed by Eder and Valenta {loc. cit.) in vacuum tubes at pressures of about 20 mm., and the displacements observed by Ebert in flames, are probably not to be attributed to the direct effect of pressure. Ebert considers his results as due to unsymmetrical widening toward the red. For a discussion of the effect of a magnetic field in breaking up spectral lines into several components (Zeeman effect) see Magneto-Optics.

Lockyer maintains that at stellar temperatures the elements no longer exist as we know them on the Earth, but are broken up into finer forms of matter. Much of the evidence adduced by him in favour Olssocla- of this view has proved to be untrustworthy, but several recent investigations point to the possibility that the chemical atom consists of many parts, which may not always be associated in the same way. Some of the principal arguments which favour this view may be sum- marized as follows : ???

1. There is reason to suppose that under certain con- ditions the different particles whose vibrations produce the different series of lines in the spectrum of a single element may exist independently of one another. For example, the series of hydrogen lines in the star ^ Puppis has not yet been produced in the laboratory. The H and K lines of calcium are observed at the highest elevations reached by solar prominences, where their only associates are the lines of the very light gases helium and hydrogen. Huggins has shown that if the density of calcium vapour is low, the H and K lines may appear without the blue line at X4226‘9, but in the Bunsen flame, where the blue

line is strong, the H and K lines cannot be produced, no matter how dense the vapour.

2. The velocity of metallic vapours, projected from the poles in the electric spark (Schuster), and occasionally that of iron in solar phenomena, is not the same for all lines of the spectrum.

3. The relationship between different elements sug- gested by the periodic law is emphasized by the law of spectral series. Lines in the same series are equally dis- placed by pressure, but, as stated above, lines in different series are differently displaced. By a given pressure the calcium line at X4226-9 is displaced twice as much as H and K.

4. For corresponding lines in the second subordinate series of cadmium and magnesium, zinc and mercury, &c., observed simultaneously in a magnetic field, the distances of corresponding components on the scale of vibration- frequency are the same. From this, Preston {Nature, vol. Ix. p. 165) and Runge and Paschen {Astrophys. Journ. vol. XV. p. 336, 1902) think it possible that atoms of related elements are composed of the same kind of ions, and that the properties of these elements are determined by the arrangement of the ions in the atom.

5. Thomson's work on gaseous discharges at low pres- sure has led him to conclude that the negative electrifica- tion is carried by "corpuscles" which are the same for different elements, and the mass of which is about one one-thousandth of that of the hydrogen atom. In his opinion the simplest way of accounting for the facts is based on the view that the atoms of the chemical elements are different aggregations of the same kind of particles {Phil. Mag. vol. xliv. p. 311, 1897).

Although this array of evidence seems to make out a fairly strong case in favour of some form of dissociation, it would be wise to defer a final conclusion until further investigations have been made. Crew has studied the spectrum of a spark-discharge through vapours intensely heated by an electric arc, and in these circumstances he finds the H and K lines of calcium to be very faint, while the line at A4226'9 is greatly enhanced {Astrophys. Journ., September 1902). Again, Schuster has pointed out that as the density of any substance cannot be increased by pressure much beyond its density when in a liquid state, and as the density of liquid hydrogen is only about one-fifteenth of the average density of the Sun, the interior of the Sun cannot be composed of hydrogen or of any constituent of hydrogen. So far as its density goes, the interior of the Sun might well be composed of the elements as we know them on the Earth ("The Evolution of Solar Stars," Proc. R. Phil. Sac. Glasgow, 1901-02).

The infra-red solar spectrum has been mapped by Abney to ~~.27,000, by Becquerel, by Lommel to A9500, and by Langley to A53,386 {Publ. Smithsonian Astro~~ f phys. Observ. vol. i.). Higgs's photographic map of the solar spectrum {The Photographic Nor- mal Solar Spectrum, Liverpool, 1896) extends from A2988 in the ultra-violet to X8346 in the

infra-red. Abney used a special emulsion of silver bromide and collodion, while Becquerel and Lommel employed phosphorescent screens. Lommel's map is from a photograph made by placing a sensitive plate in contact with a phosphorescent screen after the latter had been exposed to the spectrum. Langley's map, which contains 740 lines between X7601 and A53,386, is now the chief source of our knowledge of this region. It was made from "holographs," obtained by causing the spectrum to move at a uniform rate across a fixed bolometer, the spot of light reflected from the galvanometer mirror being simultaneously photographed upon a moving plate. Rowland's great

Photographic Map of ike Normal Solar Spectrum (Balti- more, 1888), made with a powerful concave grating spectro- scope, and extending from X3000 to A6950, and his Table of Solar Spectrum Wave-Lengths (Chicago, 1898), which contains accurate measures of some twenty thousand lines, have been accepted by common consent as standards of reference. Miiller and Kempf's map, drawn from an excel- lent series of wave-length determinations, is not commonly used, as it does not possess the advantages of a photograph. The accuracy of Rowland's determinations of relative wave-length is due to his employment of the method of coincidences. This method depends upon an exceptional quality of the concave grating, which permits two over- lapping spectra of different orders to be photographed side by side on the same plate without change of focus. Then if the absolute wave-length of a hne in one of the spectra is known, the wave-length of a coincident line in the other spectrum follows at once from the relation

X =

J n

where \ is a known wave-length of order n^. Michelson s determinations of absolute wave-length indicate that the system on which Rowland's Table is based could be improved, and many of the wave-lengths also require correction because the shifts due to pressure in the solar atmosphere were neglected. But these corrections would be slight, and the table is so much superior to any other that it is likely to remain the standard for some years to come.

Maps of the telluric lines, due to the absorption of the Earth's atmosphere, have been pubKshed by Cornu, ThoUon, Becker, McClean, Miiller, and Sp{5e. ThoUon's map {Ann. de I'Obseru. de Nice, 1890), unfinished on account of his death, but completed by Sp^e {Region, b.-f. du Spectre Solaire, Bruxelles, 1899), was drawn from visual observations, with a large spectroscope containing carbon disulphide prisms. Unfortunately it is not provided with the scale of wave-lengths indispensable for convenient use. Becker's and Midler's maps {Trans. Roy. Soc. Ed. vol. xzxvi. part 1 ; Potsdam Publicationen, vol. viii.) are also drawn from visual observations, but McClean's {Comparative Spectra of the High and Low Sun, London, 1890) is photographic. Many of the maps of the solar spectrum extend far into the ultra-violet, but a limit is finally set by the general absorption of the Earth's atmo- sphere. Cornu's determination of this limiting wave- length, made from photographs of the solar spectrum taken by Simony at an altitude of 3700 m., is A2922 {Comptes Rendus, 1890). Beyond this point the ultra-violet rays seem to be completely absorbed by the upper regions of the atmosphere. At the elevation of London Huggins found the photographic spectrum of Vega to terminate at A2970.

Spectroscopes intended for use in connexion with a telescope for observing the spectra of solar phenomena usually consist of a collimator and observing telescope, fixed at an angle of about 25 ??, with Solar a plane Rowland grating mounted at the point ??p'-'- ??? - of intersection of their optical axes. Different orders of spectra are brought into the field by rotating the grating. In order to get the best results, the spectroscope should be used with a telescope giving the largest possible image of the Sun, since the spectra of the gases and vapours lying at the base of the chromosphere, and the minute details in the structure of prominences, can be observed only when a large solar image is employed. With the 40-inch Yerkes telescope, which gives a 17'5 cm. image of the Sun, it is possible to observe on any good day the bright bands due to a layer of carbon vapour only

about one second of arc (0‘09 mm.) in thickness at the base of the chromosphere (Hale, Astrophys. Journ. vol. x. p. 287).

For observations of a total solar eclipse the objective prism, objective grating, or direct concave grating spectro- scope may be used with advantage. In all of these instruments the collimator and image-forming lens are dispensed with, the parallel rays from the chromosphere or corona being permitted to fall directly upon the prism or grating. In the two former instruments the object- ive, before which the prism or grating stands, forms upon the photographic plate a series of monochromatic images of the chromosphere or corona corresponding to the lines in their spectra. The concave grating accom- plishes the same result without the aid of an objective, and is thus of special service in the ultra-violet spectrum. Such photographs have the advantage over those made with slit spectroscopes of showing not only the spectrum, but also the distribution of the elements at various eleva- tions above the photosphere. (For the results of solar spectroscopic observations see Sun and Eclipse.)

The principle of the spectroheliograph, an instrument devised by Hale for photographing the Sun in mono- chromatic light, is described under Sun. In the b^ll’ e►►aab spectroheliograph first used at the Kenwood Observatory in 1892, the only moving parts were the first and second slits, which were mounted at the ends of the collimator and observing telescope of a large grating spectroscope attached to a 12-inch equa- torial telescope. Photographs of prominences made vpith such an instrument are hardly surpassed in delicacy of detail by the best results obtained during total eclipses. In another form of the instrument a spectroscope with two slits is moved as a whole, the solar image and plate being stationary (see Astron. and Astrophys. vol. xii. p. 241). A simple modification of the instrument permits photographs to be made simultaneously in any two lines of the spectrum. Thus, if H/S and K are used, the distribution of hydrogen gas and calcium vapour in a prominence can be learned from a comparison of the resulting photographs.

Various other forms of spectroheliographs have been devised by Hale {Astrophys. Journ. vol. x. p. 287), Deslandres, who obtained good results

with a spectro- heliograph in 1893 {L' Astronomie, June 1894), Wadsworth {Astrophys. Journ. vol i. p. 244), and Evershed. Miohelson {Ibid. vol. i. p. 1) has shown theoretically that the efficiency of a spectroheliograph increases with the dispersion up to a certain point, beyond which it is not desirable to go.

For the study of stellar spectra two principal types of spectroscopes are used at the present time ??? the objective prism and the slit spectrograph. The former. Stellar employed by Fraunhofer and Secchi for visual spec ro- observations and adapted for photographic work by Pickering, consists of a large prism mounted in front of the object-glass of an equatorial telescope, with its refracting edge parallel to the diurnal motion. On a photographic plate at the focal plane of the telescope the light from each star in the field is drawn out into a spectrum. In order to give the spectra width the rate of the driving clock is retarded, so as to cause the images to drift slowly in a direction parallel to the lines. The principal advantages of the objective prism are the bright- ness of the spectrum (no slit being required) and the large number of stellar spectra that can be photographed simultaneously. Unfortunately, however, no satisfactory method of supplying a comparison spectrum has been ???devised, and consequently the objective prism can be employed for radial velocity determinations only in the case of the few binary stars whose lines are periodically

double. Its systematic use at Harvard College Obser- vatory has resulted in the discovery of a large number of stars having remarkable spectra (see Annals, Harvard College Observatory). The slit spectrograph generally consists of a spectroscope containing from one to four prisms, provided with arrangements for photographing spectra, and attached to an equatorial telescope. It is used for researches on the spectra of individual stars, and for the measurement of their motions toward or away from the Earth. At present photographic methods are almost invariably employed for the study of stellar spectra.

According to Doppler's principle, the lines in the spectrum of a luminous source will be displaced toward the red if the distance between the source and the observer is increasing, toward the violet if the distance is decreas-

ing. Although the principle has not yet received ex- haustive theoretical treatment, its vaUdity may be con- sidered to be firmly established by the results of such investigations as those of Dun& on the rotation period of the Sun, of Keeler on the rotation period of Saturn's rings, and of Vogel on the motion of Algol (see Astronomy). In addition we now have the direct experimental proof of Belopolsky {Astrophys. Journ., December 1900), who has observed the displacement of lines produced by a system of mirrors moving at high velocity. Keeler's proof {Ibid. vol. i. p. 416) that the rings of Saturn are composed of discrete particles is a beautiful appUcation of Doppler's principle. In a photograph of the spectrum of Saturn, taken with the slit placed parallel to the equator, the lines, though straight, are slightly inclined to their normal position, on account of the displacement due to the velocity of axial rotation, which increases uniformly from the centre to the edge of the disc. If the rings were solid, forming a continuous mass with the ball of the planet, the Hues on the rings would be direct extensions of those due to the disc. But Keeler found from a study of his photographs that the lines in the spectrum of the rings are not only displaced as a whole, but inclined in the opposite direction. In other words, it appeared that the velocity of rotation of the inner edge of the ring is greater than that of the outer edge, a result evidently incompatible with the exist- ence of a solid ring, but in perfect harmony vsdth Maxwell's mathematical proof that the rings consist of separate particles. ^Measurements of the inclination of spectral lines have also been employed in determinations of the rotation periods of other planets.

Huggins was the first to apply Doppler's principle to the measurement of stellar motions in the hue of sight. But through the inadequacy of the instruments then available, his experiments in 1868 and those of Vogel in 1871 were hardly conclusive, and no accurate results were obtained before the introduction of photographic methods by Vogel in 1887. Keeler's measurements of the velocities of stars and nebulae in 1890 {Puhl. Lick Observ. vol. iii.) remain as the only accurate results derived from visual observations. The first systematic use of the photographic method, made at Potsdam during the years 1888-1891, yielded the velocities of 47 stars, and e.stablished a pro- c'cdure which has not been greatly modified by subsequent observers. {Potsdam Publicationen, vol. vii. part i.)

The ??? optical principles which govern the efficiency of stellar spectrographs have been stated by Hastings, Keeler {Sidereal Messenger, vol. x. p. 433), and Wadsworth {Astrophys. Journ. vol iii. p. 321). Hartmann {Ibid. vol. xi. p. 400 ; vol. xii. p. 30) has described the methods employed in adjusting the new Potsdam spectrographs. The Mills spectrograph, which in the hands of Campbell {Ibid. vol. viii. p. 123) has yielded very accurate velocity determinations, consists essentially of a collimator of

1^ inches aperture and 28J inches focal length, and a shorter camera, rigidly mounted with their axes parallel The light of the star, after entering the slit in the focal plane of the telescope, is dispersed by a train of three 60?? prisma of dense flint, rigidly clamped at a minimum devia- tion of 180?? corresponding to the Hy line. Throughout the exposure any irregularities in the motion of the telescope are corrected by the observer, who watches an image of the star within the slit obtained with light reflected from the face of the first prism. Before and after the exposure of the star, which may continue from one minute up to two hours, depending upon its brightness, the light of a spark passing between iron electrodes is admitted to the slit on both sides of the central portion, which is covered during these exposures. The resulting photographs show the narrow spectrum of the star lying between two iron comparison spectra, the lines of which serve as standards of reference in measurements of the displacements of the stellar lines. Provision is made for maintaining the spectrograph at a constant temperature during a prolonged exposure, as changes in the temperature of the prisms would shift the lines and impair the definition of the photographs.

Improvements are constantly being made in spectrographs and auxiliary apparatus. Keeler was the first to use a train of three simple prisms giving 180?? deviation, now almost universally employed. Campbell {loc. cit.) has devised a method of guiding for use with large visual telescopes. Huggins's reflecting slit-jaws (Publ. Tulse Hill Observ. vol. i., 1899)

permit the star image to be seen on the slit, and are preferred by many observers to other guiding devices. A correcting lens (Keeler, Astrophys. Journ. vol. i. p. 101), placed near the focal plane of a visual telescope for the purpose of uniting the more re- frangible rays, has proved to be of great service. The automatic heating apparatus of the new Potsdam spectro- graph has been described by Hartmann (Zeitschrift fur Instmmentenkunde, December 1901). Wright's apparatus {Astrophys. Journ. vol. xii., 1900) permits the comparison spectrum to be photographed while the exposure for the star is in progress. The Bruce spectrograph of the Yerkes Observatory embodies many important improvements (Frost, Ibid. vol. xv. p. 1, 1902).

In reducing the photographs the following procedure may be employed. The displacements with reference to the comparison lines of from one to thirty known star lines are measured under a microscope. After corrections have been applied for curvature of the lines, wave-lengths are obtained by the aid of the Cornu-Hartmann (Ibid. vol. viii. p. 218) interpolation formula

^ S-So

where Xo, c, and So are constants and s is the scale-reading of the line whose wave-length is desired. The velocity in kilometres per second corresponding to a displacement AA. is given by the expression

.. = ^^^, X '

where Vs is the desired velocity of the star and V^ the

velocity of light in kilometres. The velocity thus obtained

must finally be " reduced to the Sun " by correcting for

the axial and orbital motions of the Earth. To determine

the absolute velocity of the star in space an additional

correction arising from the motion of the solar system in

space would be required. (See Campbell, loc. cit. ; Frost,

loc. cit; Hartmann, Astronom. JVachr. Nos. 3702, 3703,

3704; 1901.)

The periodic doubling of lines in the spectrum of ^

Ursse Majoris led Pickering to the conclusion that the

star is binary, the separation occurring when the orbital motions of the components as observed from the Earth are in the line of sight. In another class of spectroscopic binaries the hues move to and fro in the spectrum, but are not doubled, as the spectrum of the fainter component is not visible. At present 52 spectroscopic binaries are known, vnth periods ranging from a few days to two and one-quarter years. For further details regarding such stars, see Astronomy.

In 1862, only three years after Kirchhoff and Bunsen's application of the spectroscope to the study of the Sun, Huggins measured the position of the lines in ciassittca- the spectra of about forty stars, with a small slit tion ot spectroscope attached to an 8-inch telescope, stellar In 1876 he successfully applied photography to ”””””” ??? a study of the ultra-violet region of stellar spectra, and in 1879 published his paper "On the Photographic Spectra of Stars" {Phiz. Trans., 1880, p. 669). The results were arranged and discussed with reference to their bearing on stellar evolution. In the classification adopted Sirius was placed first in the order of development, the Sun at the middle of the series, and Betelgeux last. In An Atlas of Bepresentative Stellar Spectra, by Sir William and Lady Huggins (London, 1899), which is superbly illus- trated with plates, this classification is retained, but the so-called ” Orion ” stars, whose spectra are characterized by the helium lines, are made to precede stars like Sirius. This classification is confined to the stars investigated by Huggins, and does not include stars of Vogel's Class UK.

Secchi's observations of stellar spectra were contempor- aneous with the early work of Huggins. His purely empirical classification, based upon an examination of the spectra of 4000 stars, comprises the following types :

I. White stars, whose spectra contain only a few broad hydrogen lines. II. Yellow stars, whose spectra resemble that of the Sun. Ill, Red stars, whose spectra contain solar lines and dark bands, sharply bounded on the violet side. IV. Red stars, with spectra characterized by dark bands due to compounds of carbon. V. Stars whose spectra contain bright hydrogen lines. The order is essentially the same as that of Huggins's first classification.

Vogel's classification (1874), which is more generally used than any other, is briefly as follows : Class I. Spectra strong in more refrangible region, metallic lines faint. lal. Broad hydrogen lines only. Ia2. Lines of hydrogen and fainter lines of several metals ; no helium fines. Ia3. Metallic lines stronger, K about equal to hydrogen lines. 16. HeHum lines, with strong hydrogen lines, and a few lines of Ca, Mg, Na, and Fe. Icl. Bright hydrogen lines. Ic2. Bright lines of hydrogen, helium, and a few metals. Class II. More refrangible region fainter, metallic lines strong, hydrogen no longer predominant, H and K very broad. Ha, Numerous metallic lines, particularly in yellow and green. Hydrogen lines usually intense, but less so than in Class la. lib. Bright and dark lines and faint bands (including WoH-Rayet stars). Class III. More refrangible region very faint, dark bands and lines present. Ilia. Dark lines, and dark bands sharply defined on more refrangible edge. III6. Dark lines and dark bands, due to carbon compounds, sharply defined on less refrangible edge. Vogel's classification, Hke that of Huggins, was in- tended to represent stages in stellar evolution, following a line of descending temperature. Thus his first class includes white stars like Sirius, whose temperature is so high that the metalHc vapours in their atmospheres were supposed to be unable to produce marked absorption. His second class includes yellow stars like the Sun, whose tempera- ture is lower; while his third class contains two divi- sions corresponding to the two types of red stars, whose

temperature is supposed to be low enougli to permit chemical compounds to exist in their atmospheres.

In Lockyer's classification {Phil. Trans, vol. clxxxiv. A, pp. 675-726, 1893) the principal groups are as follows : ??? I. Nebulae and bright-line stars. Radiation lines and flutings predominant. II. (Vogel's Class Ilia.) Mixed fluting radiation and absorption predominant. III. Stars like a Tauri, y Cygni, and p Orionis. Line absorption predominant, with increasing temperature. IV. Stars like /8 Persei, a Andromedse, and Sirius. Simplest line absorp- tion predominant, hydrogen lines very broad. V. Stars like /8 Arietis, Procyon, and Capella. Line absorption predominant, with decreasing temperature. VI. (Vogel's Class III6.) Carbon absorption predominant. Lockyer's classification is based upon his hypothesis that stars are formed from the condensation of swarms of meteorites. The experimental basis of the hypothesis rests on Lockyer's identification of hydrogen lines, bright carbon bands, and a fluting of magnesium oxide observed in the spectra of meteorites heated in a vacuum, with lines and bands in the spectra of nebulae. The universally distributed gas hydrogen is present in nebulae, but most spectroscopists see no indications of carbon bands in nebular spectra, while Keeler has conclusively proved (Publ. Lick Observa- tory, vol. iii. p. 221) that the chief nebular line agrees neither in position nor character with the head of the magnesium oxide fluting. Eed stars of Lockyer's Group II. (Vogel's Illa.) are considered by him to be partially condensed swarms of meteorites ; but Hale's recent in- vestigations (Astrophys. Journ. vol. ix. p. 273 ; details in Publ. Terkes Observatory, voL ii.) indicate their close relationship with stars of Lockyer's Class VI. (Vogel's III6.), and confirm the common view that the two classes of red stars are to be regarded as co-ordinate branches, representing a stage of development later than that reached by the Sun.

In the Draper Catalogue of the spectra of 10,351 stars photographed at the Harvard Observatory with an ob- jective prism {Harvard Annals, vol. xxvii.) Mrs Fleming employs an empirical classification, the relationship of which to the more recent classification of Miss Maury ("Spectra of Bright Stars photographed with the 11-inch Draper Telescope," Harvard Annals, vol. xxviii. parti.) wiU now be indicated. The essential features of Miss Maury's classification are as follows : ??? Groups I.-V. {Draper Catalorjue, B and AB ; Vogel's lb.) Stars of Orion type. VI. {D.C., AB.) Stars intermediate between the Orion stars and Secchi's first type. VII. -

XL {D.G., A, AF, F) Stars of Secchi's first type. XII. {D.C., FG) Stars intermediate between Secchi's first and second types. XIII.-XVI. {D.C., G, K) Stars of Secchi's second type. XVII.~~XX. {D.G., Ma, Mh, Ud) Stars of Secchi's third type. XXI. {D.C., Na) Stars of Secchi's fourth type. XXII {D.G., O) Stars of Secchi's fifth type. With the exception of Group XXII, which for some reason is placed at the end rather than at the beginning of this series, the classification is considered to represent suc~~ cessive stages in stellar evolution, although this is not insisted upon in the discussion.

McClean's classification, which is amply illustrated by reproductions of a large number of photographs of stellar spectra taken in both hemispheres (" Comparative Photo- graphic Spectra of Stars to 3 1-2 Magnitude," Phil. Trans. A, vol. cxoi. pp. 127-138, 1898; Spectra of Soutlwrn Stars, London, 1898), involves a subdivision of Secchi's first type, and makes divisions IV., V., and VI. correspond to Secchi's types II., III., and IV. The numerous photo- graphs in these volumes are very valuable for reference. In the second memoir an account is given of the discovery of the presence of oxygen in the spectrum of /3 Crucis.

Laplace's nebular hypothesis in its original form is open to serious objections of a dynamical nature, but it is almost universally held that stars are evolved from nebulae through the long-continued action of gravitation. In any system of classifying spectra we should accordingly expect to find nebul ranked first in order of development. The following classification of stellar spectra would appear to correspond most closely with current views : I. Nebulae. II. Helium stars. III. Stars of Secchi's first type. IV. Stars of Secchi's second type. Va. and V6. Stars of Secchi's third and fourth types. There is still much uncertainty as to the classification of the bright-hne stars, and it is indeed a question whether it will be possible to include all types of spectra in a single unbroken series. Schuster has alluded (" The Evolution of Solar Stars," Proc. Phil. Soc. Glasgmv, 1901-02) to the doubtful validity of arguments based on the so-called law of uni- formity ; and the possibility must be admitted that in different regions of space, or through the action of different physical conditions, the path of evolution need not be precisely the same in all cases. The remarkable stars of the Wolf-Rayet type all of which, with the exception of a few found in the Magellanic clouds,

occur in the Milky Way ◆◆◆ are probably in an early stage of development.

This is not the place for a discussion of the question of stellar evolution. In the paper just alluded to, Schuster makes many novel and valuable suggestions bearing upon this problem ; and in their Atlas of Bepresentative Stellar Spectra, Sir William and Lady Huggins interpret the long series of stellar spectra obtained in the course of their investigations. According to them the highest tenapera- tures are attained in stars like the Sun, though Schuster and most other spectroscopists believe that the temperature of stars at the stage of development represented by Sirius is still higher.

Various special investigations of stellar spectra remain to be mentioned. The Publicationen des Astrophysihali- schen Observatoriums zu Potsdam contain several important memoirs by the Potsdam observers. A visual spectroscopic survey with small dispersion of stars to the 7 '5 magnitude in the zone ◆◆◆1◆◆ to -1-20◆◆, by Vogel and Miiller (vol. iii. part iii.), has been followed by a photographic study with a single prism spectrograph of 528 stars of Vogel's Class I. (Vogel and Wilsing, vol. xii. part i.). In 1883 Vogel observed visually with the Vienna refractor the spectra of certain stars of Classes Ic, lib., IIIo.., and 111b. (vol. iv. part i.). The spectra of some of the brighter stars photographed by Vogel in his investigations of motion in the line of sight were subsequently studied in detail by Scheiner (vol. vii. part ii.), ilany other valuable papers by Vogel, Scheiner, Wilsing, Hartmann, and other Potsdam observers have been published in the Sitzungsberichte of the Prussian Academy, the Astronomische Xachrichten, and the Astrojjhysical Journal. Some of the extensive investigations made with the objective prism under Picker- ing's direction have already been alluded to. The prepara- tion and discussion by Mrs Fleming of the Draper Gatalogue of the spectra of 10,351 stars forms vol. xxvi. part i. of the Harmird Annals. In addition to Miss ^laury's dis- cussion of the spectra of bright stars (vol. xxviii. part i.), a study of the spectra of bright southern stars by Miss Cannon has appeared (vol. xxviii. part ii.). Numerous papers by Pickering may be found in the Harvard GircularS and the various journals. Campbell's important papers, which cover a wide range, including the spectra of

Wolf-Rayet stars, temporary stars, planets, dtc, are published in Astrovomy ami Astrophysics, the Astrophysical ??? hiirnal, and the Lick Observatory BuHefins. Dun^r's memoir, " Snr les Efoiles a Spectres de la Troisibne Glasse," contains the results of a visual spectroscopic survey of the

red stars and a discussion of their evolution. Many valuable papers have also been published by Newall, Belopolaky, Deslandres, Sidgreaves, Espin, and others. The literature of the spectra of temporary stars is too extensive to be given here.

The principal investigations of the spectra of nebulae are those of Huggins {loe. cit.), whose discovery of bright lines in their spectra demonstrated their gaseous nature ; Keeler ("On the Spectra of the Orion Nebula and the Orion Stars," Astron. and Astrophys. vol. xiii. p. 476, 1894); Lockyer (" On the Photographic Spectrum of the Great Nebula in Orion," Phil. Trans, vol. clxxxvi. p. 73, 1895); von Gothard ("Studies on the Photographic Spectra of the Planetary Nebulae," Astron. and Astrophys. vol. xii. p. 51, 1893); Campbell, ~~who discovered differ~~ ences in the relative intensities of the lines in different parts of the Orion nebula, and mapped the spectra of other nebulae {Astron. and Astrophys. vol. xiii. pp. 384, 494); and Wright {Lick Observatory Bulletin, .TSo. 19). Of the nineteen lines measured by Wright, six are due to hydrogen and three to helium. For information regarding the spectra of planets, comets, meteors, lightning, the aurora, &c., reference must be made to the technical journals and the proceedings of societies.

A comprehensive treatise on Spectroscopy, designed to cover the whole subject, is Kayser's Handbuch der iSpectroscopie, two volumes of which have been published. Reference may also be made to Scheiner's Astronomical Spectroscopy (translated by Frost), and to the journals mentioned in this article. (g. e. jj_)

Speculum Perfectionis. ❓❓❓ Recent years have seen so great an increase of our knowledge of St Francis of Assisi and his disciples that it amounts practically to a rediscovery. This has been the result of the publication of original documents by various scholars : by the Roman canon Amoni (uncritical as most of his work is), by the Franciscans of Quaracchi (near Florence) and else- where, above all by M. Paul Sabatier, to whom belongs the credit not only of having written by far the best life of St Francis of Assisi in existence, but of having shown marvellous insight and skill in the discovery of long-lost documents. M. Sabatier has taken the lead in every- thing connected with the study of St Francis and his com- panions, and in 1902 founded a "Socidt^ Internationale d'Etudes Franciscaines " at Assisi, with the object of band- ing together those who are engaged in these studies. Among the documents which have already been recovered the following may be mentioned : the ancient Rule {circ. A.D. 1228) of the Third Order of St Francis, the Tractatus de Indulgeniia S. Marice de Portiuncula (which may perhaps prove, as M. Sabatier holds that it does, the genuineness of the Indulgence), the original Latin basis of the Fioretti di san Francesco, a number of fragments of various kinds ; above all, the Speculum Perfectionis, which is the work, for the most part at any rate, of Brother Leo of Assisi. This is beyond all doubt the oldest of the various accounts of the saint's hfe, having been finished, according to the colophon, on 11th May, in the year 1228 (according to the Pisan reckoning, i.e., 1227 according to ours) ; so that it was completely written many months before the first life by Thomas of Celaus was begun. Its value is great, not only on account of its extreme vigour and freshness, but as giving us the impres- sion of a disciple who stood nearest to Francis, and who had watched with a somewhat jealous eye the development of a quasi-monastic order out of what had at first been a popular religious movement. It is indeed the work of a man who writes with a definite purpose, namely, to vindi- cate the intentions of his dead master against tendencies which are all the other way ; and this fact must of course be borne in mind in reading it. But the presentment is

as essentially true as it is beautiful. St Francis was primarily the simple follower of Christ who desired to lead other simple men in the same way, not the founder of a monastic order; what was subsequently known as the

Third Order was not an after-thought but of the very essence of his work. Although the fact was studiously glossed over in the later lives, there can be no question that Francis stood aloof from the formal development of the Minorite Order after 1221, and he appears to have been very little in sjonpathy with it. This fact is care-fully and increasingly ignored in the later lives ; and the Speculum Perfectionis is the starting-point of a series of legenda, ever becoming more formal and more conventional, which ends vpith the authorized life of the founder of the Order by St Bonaventura. Regarded, then, from the point of view of the hght which it throws upon the relations between St Francis and the society which bears its name, the value of the Speculum is, and must remain, unequalled.

Authorities. P. Sabatier. Collection d'itudes et de docu- ments pour Vhistoire du Moyen Age (especially vol. i., SiKCulum Perfectionis). Sebastian Evans. The Mirror of Perfection (Eng. trans.). London, 1898. P. Sabatier. Vie de S. Frangois d' Assise. Paris, 1894 (Eng. trans, by Harwood, London, 1894), Analecta Franciscana, Quaracchi (Ad Claras Aquas), 1885. (w. E. CO.)

Spencer, a town of Worcester county, Massachu- setts, U.S.A. It is situated in the central part of the state, a few miles west of Worcester, and contains an area of 34 square miles of hilly country, diversified with lakes and ponds. The principal village, bearing the same name as the town, is on the Boston and Albany Railroad, and has an altitude of 812 feet. Its principal industries are shoe and wire making. Population of the town (1900), 7627, of whom 1614 were foreign-born.

Spencer, Herbert (1820), English philo- sopher, was born at Derby on 27th April 1820. His father, William George Spencer, was a schoolmaster, and his parents' religious convictions familiarized him with the doctrines of the Methodists and Quakers. He declined an offer from his uncle, the Rev. Thomas Spencer, to send him to Cambridge, and so was practically self-taught. During 1837-46 he was employed as a railway engineer; 1848-53 as sub-editor of the Economist. From about this time to 1860 he contributed a large number of articles to the Westminster Beview, which contain the first sketches of his philosophic doctrines. He also published two larger works, Social Statics in 1850, and Principles of Psychology in

1855. In 1860 he sent out the syllabus of his Synthetic Philosophy in ten volumes, and in spite of frequent ill-health had the satisfaction of completing it in 1896 with the third volume of the Principles of Sociology. Herbert Spencer's significance in the history of English thought depends on his position as the philosopher of the great scientific movement of the second half of the 19th century, and on the friendship and admiration with which he was regarded by men like Darwin, G. H. Lewes, and Huxley. Spencer tries to express in a sweeping general formula the belief in progress which pervaded his age, and to erect it into the supreme law of the universe as a whole. His labours coincided in time with the great development of biology under the stimulus of the Darwinian theory, and the sympathizers with the new views, feeling the need of a comprehensive survey of the world as a whole, very widely accepted Spencer's philosophy at its own valuation, both in England and stiU more, in America. In spite of this, however, his heroic attempt at a synthesis of aU scientific knowledge could not but fall short of its aim. Living at the com- mencement of an epoch of unparalleled scientific activity

Spencer could not possibly sum up and estimate its total production. To the specialists in sciences which were advancing rapidly and in divergent directions to results which often reacted on and transformed their initial assumptions, Spencer has often appeared too much of a philosopher and defective in specialist knowledge. To the technical philosophers, who strictly confine themselves to the logical collation and criticism of scientific methods, he has contrariwise not seemed philosophic enough. Hence his doctrines were open to damaging attacks from both sides, the more so as he always stood aloof from the academic spirit and its representatives. It seems unlikely therefore that as a system the Synthetic Philosophy will prove long-lived ; but this hardly detracts from its fruit- fulness as a source of sugges- tion, or from the historic influence of many of its con- ceptions on the culture of the age.

This estimate of Spencer- ian philosophy may be sub- stantiated by a brief survey of its origin and leading char- acteristics. Spencer claims, with some reason, that he was always an evolutionist. But his notions of what " evolution " is developed quite gradually. At first he seems to have meant by the word only the belief that pro- gress is real, and that the existing order of nature is the result of a gradual process and not of a " special creation." In Social Statics (1850) he stUl regards the process teleo- logically, and argues after the fashion of Paley that " the greatest happiness is the pur- pose of creation " (chap. iii. ►► 1), and that to "gag the moral sentiment " is " to balk creative design " (ch. xxxii. ►► 7). But this phraseology soon disappears, without his considering how, in default of some sort of teleology, it is legitimate to treat the world's history as a process. In The Development Hypothesis (1852) he objects strongly to the incredibility of the special creation of the myriad forms of life, without, however, suggesting howdevelopment has been effected. InProgress, its Laio and Cause (1857) he adopted von Baer's law, that the development of the individual proceeds from the homo- geneous to the heterogeneous. This is at once connected with the nebular hypothesis, and subsequently "deduced" from the ultimate law of the "persistence of force," and finally supi>lemented by a counter-process of dissolution, all of which appears to Spencer only as "the addition of von Baer's law to a number of ideas that were in harmony with it." It is clear, however, that Spencer's ideas as to the nature of Evolution were already pretty definite when Darwin's Orif/in of Species (1859) revolutionized the sub- ject of organic evolution by adding natural selection to the direct adaptation by use and disuse, and so suggesting an intelligible method of producing modifications in the forms of life. Spencer welcomed the Darwinian theory, and enriched it with the phrase " survival of the fittest " ; but he did not give up the (Lamarckian) belief in the hereditary transmission of the modifications of organisms

Herbert Spencer. (From a photograph hy Elliott and Fry, London.'}

by the exercise of function. Shortly afterwards (1860) he sent out the prospectus of a systematic exposition of his Synthetic Philosophy, of which the first volume, First Principles, appeared in 1862. This work is divided into two parts ; the first intended to show that while ultimate

metaphysical questions are insoluble they compel to a recognition of an inscrutable Power behind phenomena which is called the Unknowable ; the second devoted to the formulation and illustration of the Law of Evolution. In the first part Spencer's argument rests on Mansel's Limits of Religious Thought and Hamilton's " philosophy of the conditioned" (and so ultimately on Kant), and tries to show that alike in scientific and religious thought the ultimate terms are " inconceivable " (not by him dis- tinguished from "unimagin- able"). In science the more we know the more extensive " the contact with surrounding nescience." In religion the really vital and constant ele- II nt is the sense of mystery. 1 1 lis is illustrated by the difii- iilties inherent in the concep- 11 n of Cause, Space, Time, ^1 itter. Motion, the Infinite, mi the Absolute, and by the I elativity of knowledge," 1 ich precludes knowledge of 1 ! Unknowable, since "all 1 nking is relationing." Yet ll I Unknowable may exist, 1 we may even have an ddefinite knowledge " of it, iitive, though vague and ;ralogical. Hence both 3nce and religion must come recognize as the "most tain of aU facts that the wer which the Universe nifests to us is utterly crutable." Thus to be ried side by side in the iknowable constitutes their final reconciliation, as it is the refutation of irreligion, which consists of "a lurking doubt whether the Incompre- hensible is really incomprehensible."

Such are the foundations of Spencer's metaphysic of the Unknowable, to which he resorts in all the fundamental difficulties which he subsequently encounters. Whatever its affinities with that version of " faith " which regards it as antagonistic to knowledge, it can hardly be deemed philosophically satisfactory. A failure to solve the prob- lems of metaphysics must always remain a failure, in spite of all protestations that it was ine'^dtable ; and it in no wise justifies an advance to so self-contradictory an asylum ignorantice as the Unknowable. In the edition of his First Principles published in 1900, Spencer adds a " jiostscript " which shows some consciousness of the contra- diction involved in his knowledge of the Unknowable, and finally contends that his account of the Knowable in part ii. will stand even if part i. be rejected. Even this, how- ever, understates the case, seeing that a really inscrutable Unknowable would destroy all confidence in the order of nature and render all knowledge entirely precarious.

In part ii. Spencer recognizes successively likenesses and unlikenesses among phenomena (the effects of the Unknow- able), which are segregated into manifestations, vivid (object, non-ego) or faint (subject, ego), and then into

space and time, matter and motion and force, of which the last is symbolized for us by the experience of resist- ance, and is that out of which our ideas of matter and motion are built. Hence the Persistence of Force is the idtimate basis of knowledge. From it Spencer proceeds to deduce the indestructibility of matter and energy, the equivalence and transformation of forces, the necessity of a rhythm, of Evolution {i.e., integration of matter with concomitant, dissipation of motion) and Dissolution, and finally reaches the statement of the Law of Evolution as " an integration of matter and concomitant dissipation of motion, during which the matter passes from an indefinite incoherent homogeneity to a definite coherent heterogeneity, and during which the retained motion undergoes a parallel transformation." This process of Evolution is due to "the instability of the homogeneous," the "multiplication of efiects " and their " segregation," continuing until it ceases in complete " equilibration." Sooner or later, how- ever, the reverse process of Dissolution, with its absorption of motion and disintegration of matter, which indeed has always been going on to some extent, must prevail, and these oscillations of the cosmic process will continue with- out end.

It appears, therefore, that Spencer ultimately describes the Knowable in terms of the mechanical conceptions of matter and motion, and that this must give a materialistic colouring to his philosophy. There are, however, other flaws also in his procedure. The Persistence of Force, i.e., his version of the methodological assumption of constancy in the quantitative aspects of phenomena, seems a very unsuitable basis for a philosophy of progress. To such a philosophy a consideration of the conditions, if any, under which progress can be conceived as ultimately real, seems a necessary preliminary, which Spencer omits. He also assumes that " Evolution " is a real, nay an ultimate, law of nature, but his evidence only

goes to show that it is a result, in some cases, of the complex interaction of laws, which like Khythm, Segregation, (fee, are in their turn only tendencies, and may be, and often are, counteracted. By the after-thought of a " dissolution " process (2nd ed. of First Principles) Spencer in a way admits this, but intro- duces fresh difficulties as to its relation to " evolution." If the two processes go on together, both are tendencies, and whether there is on the whole progress or not will depend on their relative strength ; neither can be universal, nor the " law " of cosmic existence, unless its co-existing rival is regarded as essentially secondary. But if so, it ceases to be available as evidence of a coming reversal of the dominant process. If, on the other hand, the processes are strictly alternative, a world which ex hypothesi exem- plifies the one can never justify us in inferring the other. Spencer appeals alternately to the " instability of the homogeneous " and the impossibility of complete equili- bration to keep up the cosmic see-saw, but he can do so only by confining himself to a part of the universe. A world wholly homogeneous or equilibrated could no longer change, while so long as a part only is in process, the process can not be represented as universal. Again, an infinite world cannot be wholly engaged either in evolution or in dissolution, so that it is really unmeaning to discuss the universality of the cosmic process until it is settled that we have a universe at all, capable of being considered as a whole. In the last resort, therefore, Spencer fails to deduce philosophically not only the necessity of progress, but also its compatibility with the evolution-dissolution oscillation, and even the general possibility of conceiving the world as a process. In other words, in spite of his intentions he does not succeed in giving a metaphysic of evolutionism.

In the Principles of Biology the most notable points

are the definition of life as the continuous adjustment of internal to external relations, and the consistent emphasis on the need of adapting the organism to its environment. This exaggerates the passivity of life, and does not sufiB- ciently recognize that the higher organisms largely adjust external to internal relations and. adapt their environment to their needs. His universal process of Evolution seems to give Spencer a criterion of " higher " and " lower," " progression " and " degeneration,"

independent of the accidents of actual history, and unattainable by strictly Darwinian methods. The higher (at least in times of " evolution ") is the more complex and differentiated, whether it invariably survives or not. On the other hand, he advances too easily from the maxim that func- tion is prior to, and makes, structure to the conclusion that the results of use and disuse are therefore immediately incarnated in structural adaptations capable of hereditary transmission. This inference has involved him in much controversy with the ultra-Darwinians of Weismann's school, who deny the possibility of the inheritance of acquired characteristics altogether. And though Spencer's general position, that it is absurd to suppose that organisms after being modified by their life should give birth to oflF- spring showing no traces of such modifications, seems the more philosophic, yet it does not dispose of the facts which go to show that most of the evidence for the direct transmission of adaptations is illusory, and that beings are organized to minimize the effects of life on the reproductive tissues so that the transmission of the efiects of use and disuse, if it occurs, must be both difiicult and rare ??? far more so than is convenient for Spencer's psychology.

In his Principles of Psychology Spencer advocates the genetic explanation of the phenomena of the adult human mind by reference to its infant and animal ancestry. On the fundamental question, however, of the psychophysical connexion and the derivation of mind from matter, his utterances are neither clear nor consistent. On the one hand his whole formulation of Evolution in mechanical terms urges him in the direction of materialism, and he attempts to compose the mind out of homogeneous units of consciousness (or "feeling") "similar in nature to those which we know as nervous shocks ; each of which is the correlative of a rhythmical motion of a material unit or group of such units " (?? 62). On the other hand, when pressed by his disciple, Fiske {Outlines of Cosmic Philo- sophy, ii. p. 444), he is ready to amend nervous into psychical shocks, which is no doubt what he ought to have meant but could not say without ruining the illusory bridge between the psychical and the phj'siological which is suggested in the phrase " nervous shock." And he admits (?? 63) that if we were compelled to choose between translating mental phenomena into physical and its con- verse, the latter would be preferable, seeing that the ideas of matter and motion, merely symbolic of

unknowable realities, are complex states of consciousness built out of units of feeling. But easiest of all is it to leave the relation of the unknowable "substance of Mind " to the unknowable "substance of Matter " (substance he through- out conceives as the unknowable substrate of phenomena) to the Unknowable, as he finally does. To the theory of knowledge Spencer contributes a " transfigured realism," to mediate between realism and idealism, and the doctrine that "necessary truths," acquired in experience and con- genitally transmitted, are a priori to the individual, though a posteriori to the race, to mediate between empiricism and apriorism. It has abeady been explained, however, that the biological foundations of the latter doctrine are questionable.

In the Principles of Sociology Spencer's most influen- tial ideas have been that of the social organism, of the

origination of religion out of the worship of ancestral ghosts, of the natural antagonism between nutrition and reproduc- tion, industrialism and warfare. Politically, Spencer is an individualist of an extreme laissezfaire type, and it is in his political attitude that the consequences of his pre- Darwinian conception of Evolution are most manifest. But for this he would hardly have established so absolute an antithesis between industrial and military competition, and have shown himself readier to recognize that the law of the struggle for existence, just because it is universal and equally (though differently) operative in every form of society, cannot be appealed to for guidance in deciding between the respective merits of an industrial or military and of an individualist or socialist organization of society. In the Frinciples of Ethics Spencer, though relying mainly on the objective order of nature and the intrinsic consequences of actions for the guidance of conduct, con- ceives the ethical end in a manner intermediate between the hedonist and the evolutionist. The transition from the evolutionist criterion of survival, which in itself it is difficult to regard as anything but non-moral, to the criterion of happiness, is effected by means of the psycho- logical

argument that pleasure promotes function and that living beings must, upon pain of extinction, sooner or later take pleasure in actions which are conducive to their survival. Hence pleasure is, on the whole, good, and asceticism reprehensible, although in man's case there has arisen (owing to the rapidity of evolution) a certain de- rangement and divergence between the pleasant and the salutary (□□ 39). Nevertheless pleasure forms an " inex- pugnable element" of the moral aim (□□ 16). Conduct being the adjustment of acts to ends, and good conduct that which is conducive to the preservation of a pleasurable life in a society so adjusted that each attains his happiness without impeding that of others, life can be considered valuable only if it conduces to happiness. On the other hand, life must in the long run so conduce, whatever its present value may appear to be, because a constant process of adjustment is going on which is bound sooner or later to lead to a complete adjustment which will be perfect happiness. This is the refutation of pessimism, which ultimately agrees with optimism in making pleasure the standard of value. In this reasoning Spencer appears to have overlooked the possibility of an expansion of the ethical environment. If this is as rapid as (or more rapid than) the rate of adaptation, there will be no actual growth of adaptation and so no moral progress. Complete adapta- tion to an infinitely-receding ideal is impossible, and relative adaptation depends on the distance between the actual and the ideal. Spencer, however, considers that he can not only anticipate such a state of complete adjustment, but even lay down the rules obtaining in it, which will constitute the code of "Absolute Ethics" and the standard for discerning the "least wrong" actions of relative ethics. He conceives it as a state of social harmony so complete that in it even the antagonism between altruism and egoism will have been overcome. Both of these are original and indispensable, but egoism has the priority, since there must lie egoistic pleasure somewhere before there can be altruistic sympathy with it. And so in the ideal state every one will derive egoistic pleasure from doing such altruistic acts as may still be needed. In it, too, the sense of duty will have become otiose and have disappeared, being essentially a relic of the history of the moral cf)iiscionsness. Originally the socially salutary action was in the main that which was enjoined on the individual by his political and religious superiors and by social sentiment ; it was also in the main that to which

his higher, more complex and re-representa- tive feelings prompted. Hence the fear with which the

political, religious, and social controls were regarded came to be associated also with the specifically moral control of lower by higher feelings, and engendered the coercive element in the feeling of obligation. Its authoritativeness depends on the intrinsic salutariness of self-control, and must cease to be felt as the resistance of the lower feelings relaxes. Hence Spencer concludes that the sense of duty is transitory and must diminish as moralization increases. In the preface to the last part of his Ethics (1893) Spencer regrets that " the Doctrine of Evolution has not furnished guidance to the extent he had hoped," but his contributions to ethics are not unlikely to be the most permanently valuable part of his philosophy.

After completing Ha system (1896) Spencer continued to revise it, and brought out new editions of tlie Biology (1898-99) and First Principles (1900). The dates of his chief works are as follows : ❓❓❓ 1842, Letters to the Noneon^ormist, " The Proper Sphere of Government." 1850, Social Statics. 1852, The Theory of Popu- lation (cf. part vi. of Biology) ; The Development Hypothesis (in Essays, vol. i.). 1853, IVie Universal Postulate (cf. Psychology, part vii.). 1854, The Genesis of Science (in Essays, vol. ii.). 1855, Principles of Psychology (1 vol.). 1857, Progress, its Law ami Cause (Essays, vol. i.). 1868, Essays (containing most of his contributions to the Westminster Meview ; vol. ii., 1863; vol. iii., 1885). 1S61, Ediu:ation : Intellectual, 3foral, Physical. 1862, First Principles (2nd ed. 1867, 6th 1900). 1864-67, Principles of Biology (2 vols.). 1872, Principles of Psychology (2nd ed., in 2 vols.). 1873, T/ie Study of Sociology. 1876, vol. i. of The Prin- ciples of Sociology ; vol. ii., Cerem/m/ial Institutions, 1879, Political Institutions, 1882 ; vol. iii., Ecclesiastical Institutions, 1885, com- pleted 1896. 1879, The Data of Ethics (part i. of Principles of Ethics in 2 vols. ; part iv., Justice, 1891 ; parts ii. and iii., Inductions of Ethics and Ethics of Individual Life, 1892 ; parts v. and vi., Negative and Positive Beneficence, 1893). 1884, Man versus the State. 1886, Factors of Organic Evolution. 1893, Inadequacy of Natural Selection. 1894, A Rejoinder to Professor Weismann and Weismannism once more. 1897, Fragments. 1902, Facts and Comments.

For a full bibliography of his works see W. H. Hudson's Introduction to the Philosophy of Herbert Spencer (up to 1895) ; and for a useful summary of his chief doctrines by Spencer himself, his preface to CoLLlNs's Epitome of the Synthetic Pliilosophy. He also supervised the compilation of a Descriptive Sociology, of which eight parts were published.

SpGnnymOOr, a market town and railway station, Durham, England, in the Bishop Auckland parliamentary division of the county, 6 miles south of Durham. Victoria Park, 10 acres in extent, was opened in 1889. In 1894 the urban district was extended (16,300 acres) to include several neighbouring parishes. Population (1S91), 16,353;

(1901), 16,661.

Spezia, an Italian city, and the greatest maritime arsenal in the realm, situated in the province of Genoa, at the extremity of the Riviera diLevante, 56 miles south-east of Genoa by rail. The Bay of Spezia is sheltered from all except southerly winds, and on its western shore are numerous openings, which afford perfectly safe anchorage in all weathers. The arsenal consists of three departments, the princii>al of which is 3937 feet long, with an average width of 2460 feet. The chief basin is 23 acres in extent, and the second ___ connected with the first by a recently- completed canal 91 feet wide ___ 36 acres. Both basins ha'e an a\erage depth of between 33 and 3-5 feet. The second basin gives access to the docks, of which there are six ; two 390 feet long, two 420 feet long, one 500 feet long, and one 650 feet long. The establishment of San Vito is devoted entirely to the production of artillery ; that of San Rartolomeo is now exclusively used for electri- cal M'cirl^s and the manufacture of submarine weapons. The opening of a railway across the Apennines, placing Spezia in communication with Parma ami the most fertile regions of the Po valley, has so stimulated commerce that a now port to the east of the city has had to be built. This harbour consists of a broad quay with 657 feet of wharfage, and of a mole 1639 feet long with 984 feet of

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wharfage. The basin of the harbour is about 26 feet deep. A branch railway connects the wharves directly with the main line. Since the opening of the new port the traffic has considerably increased, the figures for 1899 being 753 Italian vessels (574 sailing vessels, 179 steamers), and 232 foreign steamers of an aggregate tonnage of 228,257 tons displacement. Several important industrial establishments lie along the bay, including large lead and silver works at Pertusola, submarine cable works, and a shipyard for the construction of mercantile vessels. Worthy of notice in the neighbourhood are the picturesque Portovenere, with its Grotto Arpaia, also known as Byron's Grotto, from the tradition that Byron drew from it inspiration for his poem " The Corsair " ; Lerici and its castle, where Francis I. of France was imprisoned after the battle of Pa via ; and San Terenzo, a residence of Shelley and the place of his death. Population (communal) (1890), 44,342 ; (1900), 63,163.

Spheres of Influence. "Spheres of in- fluence," "spheres of action," " spheres of interest," " zones of influence," "field of operations," "Machtsphare," "In- teressensphare," are phrases which have come into use to describe regions as to which nations have agreed that one or more of them shall have exclusive liberty of action. These phrases became common after 1882, when the "scramble for Africa" began, to describe diplomatic arrangements vnth respect to it. Some definitions may be quoted : When secretary of state for the Defini- Colonies, Lord Knutsford, replying to a depu- tation in 1890, said: "'Sphere of action' is a term I do not wish to define now ; but it amounts to this : we should not allow the Portuguese, Germans, or any foreign nation or republic to settle down and annex the territory " (quoted in Keane's Compendium, of Geography, i. 21). "The term 'sphere of influence' implies an en- gagement between two states that one of them will abstain from interfering or exercising influences within certain territories which, as between the contracting parties, are reserved for the operation of the other " (Ilbert, Govern- ment of India, 431 n.). "Unter ' Interessensphare ' oder ' Machtsphare ' versteht man namlich das auf Grund von Vereinbarungen unter den betheiligten Kolonialstaaten abgegrenzte Gebiet, innerhalb dessen ein Staat aus- schliesslich

berechtigt ist, seine koloniale Herrschaft durch Besitzergreifung oder Abschluss vor Protectorats- vertragen zu begriinden oder doch einen fiir die in diesem Gebiete vorhandenen Volkerschaften massgebenden poli- tischen Einfluss auszuiiben " (Stengel, Die deutschen Schutzgebiete, p. 18). "The term 'sphere of influence or sphere of interest' has been given an extended meaning by recent developments. Formerly it was used to signify a region wherein a nation, through its citizens, had acquired commercial or industrial interests with- out having asserted any political protectorate or suze- rainty. To-day, as used in China and elsewhere, the term applies rather to a region pre-empted for further exploitation and possibly for political control " (Dr Reinisch's Politics, pp. 60, 61). "A portion of a non- Christian or uncivilized country which is the subject of diplomatic arrangements between European States, but has not yet developed into a protectorate" (Jenkyn's British Rule and Jurisdiction beyond the Seas). See also Hall, 4th ed. 134.

The reasons for making these arrangements are to be explained partly by reference to the history of international ^ law as to occupation. The Eoman jurists recog- d/feorerer nized certain "natural modes" of acquiring aadoccu- property, in particular traditio and occupatio. pation. rpjjg doctrines which the Roman jurists had worked out as to acquisition of private property by

occupation were applied to the appropriation by states or their subjects of vacant lands (res nullius), including lands in the possession of barbarous tribes. " Quod enim nullius est, id ratione naturali occupanti conceditur" (^Insti- tutes, ii. 1-12). The Roman law required the animus domini ??? there must be seizure for and on behalf of the owner. There must be " apprehensio. Apiscimur posses- sionem corpore et animo, neque per se animo aut per se corpore" {Dig. 41, 2-3). Professing to act on these doc- trines, and relying also on an assumed right on the part of Christian nations to subdue obdurate non-Christian com- munities, the navigators and explorers of the 15th and 16th centuries made exorbitant claims. Having occupied certain points on the coast-line, they claimed to have occupied a whole island or continent (De Martens, 1, 462). They made vast claims under Papal bulls ; for example, under the bull of Nicholas V. of 1454, and the bull of Alexander VI. of 1494, which assigned to the

Portuguese the empire of Guinea just discovered. It was one of Grotius's services to diSiise sounder ideas, and to point out that Roman law gave no support to these pretensions : " Invenire non illud est oculis usurpare, sed apprehendere " (Mare Liberumi, c. 2). He insisted that " occupatio autem publica eodem modo fit quo privata territoria sunt ex occupationibus populorum ut privata dominia ex occupationibus singulorum." In recent times the old doctrine that discovery without occupation confers an independent right to the land so discovered of any extent is discredited. The tendency is to insist on actual occupation as a condition of legitimate possession or sovereignty (see correspondence between Great Britain and Portugal, State Papers, 79, p. 1062), and to treat the discoverer's right as merely inchoate. Thus, in opening the Conference at Berlin in 1884, Prince Bismarck said : " Pour qu'une occupation soit consider^e comme efifective, il est, de plus, a desirer que I'acquereur manifeste, dans delai raisonnable, par des institutions positives, la volont^ et le pouvoir d'y exercer ses droits et de remplir les devoirs qui en resultent." This doctrine is recognized in Articles 34 and 35 of the General Act of Berlin, the former of which states that " any Power which hence- forth takes possession of a tract of Wd on the coast of the African continent outside its possessions, or which being hitherto without such possessions shall acquire them, as well as the Power which assumes a protectorate, shall accompany the respective act vrith a notification thereof, addressed to the other Signatory Powers of the present Act, in order to enable them, if need be, to make good any claim of their own." To a similar effect wrote Lord Salisbury in 1887 with reference to the claims of Portugal in East Africa. " Great Britain considers that it has been admitted in principle by all the parties to the Act of Berlin that a claim of sovereignty in Africa can only be maintained by real occupation of the territory claimed ; and that the doctrine has been practically applied in the recent Zambezi delimitation (State Papers, 79, 1063). No paper annexation of territory can pretend to validity as a bar to the enterprise of other nations." At ite session at Lausanne, in 1889, the Institut de Droit Inter- national adopted the following principles : ??? ???

"Article 1. ??? L'occupation d'un territoire "k titre de souverainete ne pomra etre reconnue oomme effective que si elle r^imit les conditions suivantes : 1?? La prise de possession d'un territoire enferme dans

certaines limites, faite au nom du gouvemement. 2" La notification ofEcielle de la prise de possession. La prise de possession s'aceeptit par I'etablissement d'un pouvoir local responsable, pourvn de moyens suiEsants pour maintenir I'ordre et pour assurer I'exercice reguKer de son autorite dans les limites du territoire oocupe. Cea moyens pourront etre emprientes \ des institutions existantes dans le pays occupe. La notification de la prise de possession de fait, soit pour la publication dans la forme qui, dans ohaque ^tat, est en usage pour la notification des aotes

officiels soit par la voie diplomatique. Elle oontiendra la deter- mination approximative des limites du territoire occupe" {Annuaire

10, 201).

This development of international law naturally led to arrangements as to " spheres of influence." Nations which had not yet settled or occupied, or established protectorates, in regions contiguous to their existing possessions, were desirous to retain a hold over the former, and proceeded to enter into treaties defining the spheres of influence.

The following are some of the chief treaties by which such spheres are defined : ???

Great Britain and Portugal as to Africa, 20tli August 1890, 14th November 1890, and 11th June 1891. Great Britain and France as to Upper Niger, 20th January 1891 ; 15th November 1893, as to Lake Chad. Great Britain and France as to Siam, 15th January 1896. The two Governments engage to one another "that neither of them will, without the consent of the other in any case or under any pretext, advance their armed forces into the regions, &c. " They also engage not to acquire within this region any special privilege or advantage which shall not be enjoyed in common, or equally open to Great Britain and France or their nationals and dependants. Great Britain and Italy as to Africa, 15th April 1891 ; 6th May 1894, as to region of the Gulf of Aden. Congo and

Portugal, 25th May 1891, as to "spheres de souve- rainete et d'influenoe " in the region of Luuda. Great Britain, Belgium, and Congo, 12th May 1894, as to the sphere of influence of the independent Congo State. Great Britain and Germany, 1st July 1890 and 15th November 1893, as to East and Central Africa. Great Britain and Russia as to the spheres of influence to the east of Lake Victoria in the region of the Pamirs, 11th March 1895.

As an example of the promises or engagements in such treaties may be quoted that between Great Britain and Portugal of the 20th August 1890. Portugal engages that the territory of which the limits are defined in Article 3 shall not, without the consent of Great Britain, be transferred to any other Power. In the treaty between the same Powers of 14th November 1890 it is stipulated that neither Power wiU make, tender, accept protectorates, or exercise any act of sovereignty, &c. Sometimes a treaty defining spheres of influence declares that such and such territory shall be neutral.

Being the result of treaties, arrangements as to spheres of influence bind only the parties thereto. As Mr Olney, in his correspondence with Lord Salisbury in regard to Venezuela, remarked : " Arrangements as to spheres of influence are new departures, which certain great European Powers have found necessary and convenient in the course of their division among themselves of great tracts of the continent of Africa, and which find their sanction solely in their reciprocal obligations " (United States, No. 2, 1896, p. 27).

Some treaties expressly declare that the arrangement shall not afiect the rights of other Powers (Stoerck, Bectieil, 16, p. 932). No doubt, however, the tendency is for spheres of influence to become protectorates. It may be mentioned that Germany and Holland have concluded a treaty (21st December 1897) by which the latter agrees to extradite German criminals in spheres of influence. By an agreement of 12th May 1894 between Great Britain and the Congo State, the former granted to the latter a lease of territories comprised within the sphere of influence laid down in the Anglo-German agreement of Ist July 1890 (19 liertslet, p. 179).

Somewhat akin to the rights of a State in a sphere of influence are those possessed by Germany in the zone surrounding the protectorate of Kiaochow under the treaty of 6th March 1898, and the rights obtained under treaties with China that certain provinces shall not be alienated.

Somewhat similar arrangements as to ports of the sea are not unknown. Grotius in his Mare Libervmi says : " lUud interim fatemur, potuisse inter gentes aliquas con-

venire, ut capti in maris hac vel ilia parte, hujus aut Ulius reipublicae judicium subirent, atque ita ad commodi- tatem distinguendae jurisdictionis in mari fines describi, quod ipsos quidem eam sibi legem ferentes obligat, at alios populos non item ; neque locum cujus proprium facit, sed in persona contrahentium jus constituit " (c. 5).

The best known example of a claim to a sphere of influence, which is not the result of any treaty, is the Monroe doctrine, flrst broached by President Monroe in 1823. The Komans had their equivalent to the Monroe doctrine; they forbade any Asiatic king enter- ing Europe and conquering any part of it ; the breach of this rule was their chief grievance against Mithradates (Montesquieu, De la Graruleur et de la Decadence des Romains, c. 6).

*Claims somewhat similar to those relating to spheres of influence have been put forward as against the whole world, in virtue of the right of continuity or the doctrine of the hinterland. Sometimes it is called / ******j*"" the " Doctrine of Contiguity," or " Droit de Vicinity, de priority de preemption, ou d'enclave." He who occupies a part of a well-defined close or fundus, a parcel of land with artificial or natural boundaries, which enables him to control the whole area, may be said to occupy it. He need not be present everywhere, or enter on every part of it : " Sufficit quamlibet partem ejus fundi introire, dum mente et cogitatione hac sit, uti totum fundum usque ad terminum velit possidere " {Dig. 41, 2, 3). In virtue of a supposed analogy to such occupation, it has been said that the occupation of the mouth of a river is constructive occupation of all its basin and tributaries, and that the occupation of part of a territory extends to all the country of which it forms physically a part. A State, having actually occupied the coast, may claim to reserve to itself the right*

of occupying from time to time territory lying inland (hinterland). In the discussions as to the western boundary of Louisiana between the Commissions of the United States and Spain, as to Oregon, as to the claims of the Portuguese in East Africa, and as to the boundaries of Venezuela, the question of the extent of the rights of the discoverer and occupier came up. Portugal actually claimed all territory lying between her African possessions. It has been urged that the subsequent settlement within a reasonable time of the mouth of a river, " particularly if none' of its branches had been explored prior to such dis- covery, gave the right of occupation, and ultimately of sovereignty, to the whole country drained by such river and its several branches." Another form of the same doctrine is, that the occupier of a part of the sea-coast thereby acquires rights "extending into the interior of the country to the sources of the rivers emptying within that coast, to all their branches, and the country they cover" (Twiss, Laws of Nations in Time of Peace, 170; Twiss, Oregon Question, 245 ; Bluntschli, s. 282 ; Philli- more. Commentaries, 236 ; Westlake, International Law

166).

Lord Salisbury has referred to " the modern doctrine of hinterland with its inevitable contradictions " (United States, No. 2, 1896, p. 12). Certainly it is inconsistent with the doctrine, more and more received in recent times, that effective possession is necessary to found a title to sovereignty or control. It is akin to the extravagant claims of the early Portuguese and Spanish navigators to territory on which they had never set foot or eyes. The doctrine of the hinterland is likely to become less im- portant, now that Africa has been parcelled out.

Authorities. ??? Twiss. Laws of Nations in Time of Peace. 1855. ??? Phillimore. Oommcntaries on International Law, s. 236. ??? Salomon. L'Occupaiion des TerrUoires sans Maitre, 1889.

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Correspondence as to Delagoa Bay (Portugal, No. 1, 1875 p 191) BrUish Counter Case, Venezuela, No. 2, 1899, p. 135. Annuaire de I'Institut de Droit International, 9, 243 ; 10 173 Revue de Droit International, 17, 113; 18, 483; 19, 371. Venezuelan Papers, No. 4, 1896. (j_jf|_)

Spherical Harmonics are certain functions of fundamental importance in the mathematical theories of Gravitation, Electricity, Hydrodynamics, and in other branches of Physics. The term " spherical harmonic " is due to Lord Kelvin, and is primarily employed to denote either a rational integral homogeneous function of three variables x, y, z, which satisfies the differential equation

. ❑❑❑❑❑❑❑ a^v a^v 32V ❑❑❑❑

known as Laplace's equation, or a function which satisfies the differential equation, and becomes a rational integral homogeneous function when multiplied by a power of (a;2 + y2 + ^2)__Qf all particular integrals of Laplace's equation, these are of the greatest importance in respect of their applications, and were the only ones considered by the earlier investigators ; the solutions of potential problems in which the bounding surfaces are exactly or approximately spherical, are usually expressed as series in which the terms are these spherical harmonics. In the wider sense of the term, a spherical harmonic is any homogeneous function of the variables which satisfies Laplace's equation, the degree of the function being not necessarily integral or real, and the functions are not necessarily rational in x, y, z, or single-valued ; when the term spherical harmonic is used in the narrower sense, the functions may, when necessary, be termed ordinary spherical harmonics. For the treatment of potential problems which relate to spaces bounded by special kinds of surfaces, solutions of Laplace's equation are required which are adapted to the particular boundaries, and various classes of such solutions have thus been introduced into analysis. Such functions are usually of a more com- plicated structure than ordinary spherical harmonics, although they possess analogous properties. As examples we may cite Bessel's functions in connexion with circular cylinders, Lamp's functions in connexion with ellipsoids, and toroidal functions for anchor rings. The theory of such functions may be regarded as embraced under the general term

Harmonic analysis. The present article contains an account of the principal properties of ordinary spherical harmonics, and some indications of the nature and properties of the more important of the other classes of functions which occur in harmonic analysis. Spherical and other harmonic functions are of additional importance in view of the fact that they are largely employed in the treatment of the partial differential equations of physics, other than Laplace's equation ; as examples of this, we may

refer to the equation -^ = M%, which is fundamental in

the theory of conduction of heat and electricity, also to

the equation 4^ = M^m, which occurs in the theory of the

propagation of aerial and electromagnetic waves. The integration under given conditions of more complicated equations which occur in the theories of hydrodynamics and elasticity, can in certain cases be effected by the use of the functions employed in harmonic analysis.

Relation between Spherical Harmonies of Positive and Negative Degrees. ******

derived by dividing V❓❓❓ by r’”’+’. All spherical harmonics of negative integral degree are obtainable in this way from those of positive integral degree. This theorem is a particular case of the more general inversion theorem that if F(a!, y, z) is any function which satisfies the equation (1), the function

r Xr^‘i^‘r^J also satisfies the equation.

The ordinary spherical harmonics of positive integral degree n are those which are rational integral functions of x, y, z. The most general rational integral function of degree n in three letters

contains ^(?i-l-l)(❓❓ + 2) coefficients ; if the expression be substituted

in (1), we have on equating the coefficients separately to zero

to be satisfied ; the most general spherical

❓❓❓M{n ❓❓❓\) relations

1,

harmonic of the prescribed type therefore contains ^(❓❓ + !)(❓❓ + 2)

-=❓❓(❓❓-l), OT 2n + \ independent constants. There exists, there- fore, 2❓❓,-l-l independent ordinary harmonics of degree n, and corresponding to each of these there is a negative harmonic of degree ~n\ obtained by dividing by r^+’. The three inde- pendent harmonics of degree 1 are x,y,z; the five of degree 2 are y^ – z^, z^ – ofi, yz, zx, xy. Every harmonic of degree m is a linear function of 2n. ~ 1 independent harmonics of the degree ; we pro- ceed, therefore, to find the latter.

Determination of Harmonics of given Degree. ❓❓❓ It is clear that a function /(aa!-f 62/ + c❓❓) satisfies the equation (1), ii a, b, c are constants which satisfy the condition a^+b’^ + e^=() ; in particular the equation is satisfied by (z + lx cos a + iy sin a)”. Taking n to be a positive integer, we proceed to expand this expression in a series of cosines and

sines of multiples of a ; each term will then satisfy (1) separately. Denoting ____’” by Ic, and y + ix by t, we have

~Wt)

which may be written as {2kt)-“{{z + kt)’-r^ ; on expansion by Taylor’s theorem this becomes

(s + a cos a + iy sin 0)”= (

+i‘+-2ir

(2M)-

{z’-T^Y

the differentiation applying to z only as it occurs explicitly ; the terms involving cos ma, sin jna in this expansion are

1 liy + ixy -cosmaj^?

1 . (

gn+m

+ m)! 3z____+”’ (y + ix)”’ 3”-H____

(s2-r2) t .(z2-,

n {y + ix)-’” 3”-”

(n + m)\ ds”” (y + ix)”’ 3”””

.(z^-r^rj z’-r^)’^}

2____ l(____-l-m)!3z”+____^ ” ‘ {n-m)[d^-^”’

where m = l,2,..,n, and the term independent of a is

1 3”/ 2 2%”

2”ji! 32”^ ‘ ’

On writing

(y + ia;)”’=i”r”(cos to0 – 1 sin m4>) sin “‘0, {y + 130)’

- i‘“r(cos m(p + i sin ni0) sin -‘^0

and observing that in the expansion of (z + la; cos a + 11/ sin a) , the expressions coa ina, sin ma can only occur in the combination cos m((^ – a), we see that the relation

sin ““9 3”+”

(z^-^f + l

ng gn-

(z2-0 =0

must hold identically, and thus that the terms in the expansion reduce to

cos ma cos m0 sm “ffg j^(a” – r) gn+m*

*{n + m)\ 2 - 1 i”**

‘ sm ma sin nuf) sin 9g

*-J.^*

*/ r. n 1' Oiii #*tU, 0 1X /*I/W DiAA U j l-*

{n + m)\ 2^^ 3z”+*

We thus see that the spherical harmonics of degree n are of the form

where /t denotes cos B ; by giving m the values 0, 1, 2 ...m we thus have the 2n + l functions required. On carrying out the differentiations we see that the required functions are of the form

A[(a: + ly)[illegible] [illegible](x- cyn^z”-’” – ([illegible]>){ [illegible] l)^-m-2(a^ + 2/^ + ^2) , (n – m){n – m – iXn ~ m ~ 2){n – m ~ S) [illegible] .,

-L fn [illegible]m [illegible](j*

2. 4. 2[illegible] – 1. 2)1 – 3

V + 2/2 + 22)

(2)

>

where m = 0, 1, 2, 3, ...?i.

Zonal, Tesseral, and Sectorial Harmonics. [illegible] Of the system of 271 + 1 harmonics of degree n, only one is symmetrical about the z axis ; this is

writing

‘[illegible]M=2i!|r>-i)”

we observe that P,j(ja) has [illegible] zeroes all lying between +1, consequently the locus of points on a sphere r=a, for which F [illegible]{/jl) vanishes is n circles all parallel to the meridian plane : these circles divide the sphere into zones, thus P [illegible](/i) is called the zonal surface harmonic of degree n, and r”Pn(/u.), r-”-^P [illegible](/i) are the solid zonal harmonics of degrees n and n. The locus of points

on a sphere for which ⬚^ m0. sin’^0^ ⬚;;;g^(ji?~~‘i.) vanishes con~~ sists of ⬚ – m circles parallel to the meridian plane, and m great circles through the poles ; these circles divide the spherical surface into quadrilaterals or rea-a-epa, except when n = m, in which case the surface is divided into sectors, and the harmonics are therefore called tesseral, except those for which m=n, which are called

sectorial. Denoting {l-fj?)

}mrf“‘P⬚(/x) dfj.’”

by P^(m), the tesseral

surface harmonics are g;⬚m0. P⬚(cos 9), where m = l, 2, ...n-1, and the sectorial harmonics are 3⬚^ nip. P^(cos 8). The functions ^tiCm)) Pji (j”) denote the expressions ⬚, , (2n)\ f n(n~l)

2^ni.n\ I

l.2⬚- {2n)\

n{n-l){n-2){n-3) ^ 2.i.2n,-1.2n-S ‘^

⬚}(3)

#-m’

I, in* f

2“TO!(7j-m)r

(⬚,-m)(⬚.-m-l) \ .^.

2.2n-l ^ J ^ ‘

KM =

J2n^ 2”n\ni.

(l-^r

Every ordinary harmonic of degree n is expressible as a linear func- tion of the system of 2n. ŧ 1 zonal, tesseral, and sectorial harmonics of degree n, thus the general form of the surface harmonic is n ___oP)iW + ^(___mOOsm0-l-6mSinm0)P____(/i) . . (5). m=l In the present notation we have

(z + ia;eosa ± ij/sina)" = r^-! P,i(m) ± '&i"'-, ____ r;I' ____(M)cosTO(

if we put a = 0, we thus have

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(cos fl ± 1 sin S cos 0)"= P___(cos ff) ^ ____ 2Ai

n

(n + m)

:P^ (cos 0) cos m0.

from this we obtain expressions for P____(cos 9), P^ (cos 8) as definite integrals

P____(cos S) = – / "(cos e + 1 sin 0 cos 0)"rfi/.

____ ___ rTPlf (cos 8) = – I "(cos d + ism8 cos 0)" cos mAdd) H-m)! ^ w] Q^ ''

K6).

Derivation of Sphcriccd Harmonics by Differentiation. ____ The linear character of Laplace's equation shows that, from any solution, others may be derived by differentiation with respect to the variables x, y, z, or, more generally, if

y {dx’dy’dzj denote any rational integral operator,

a solution of the equation if V satisfies it. This principle has been applied by Thomson and Tait to the derivation of the system of any integral degree, by operating upon l/r, which satisfies Laplace’s equation. The operations may be conveniently carried out by means of the following differentiation theorem. (See

papers by Hobson, in the Messenger of Mathematics, vol. xxiii. p. 115, and Proc. Lond. Math. Soc. vol. xxiv.)

*/ � � ﹍fl i ay , .U2n)\ 1 / r^A^*

yn\dx’dy’dzjr~^ ‘ 2^n\ r^^A’

2.2 ﹍﹍-l - ﹍﹍﹍﹍﹍﹍﹍﹍﹍﹍]fn{x,y,z)

2. 4. 2w- 1.2m -3 which is a particular case of the more general theorem

(7),

fihU>’={^,

*: ﹍﹍F 2^2 f^n-lF ^^*

+ –

*2 ﹍﹍-2, d-Y^^^*

jfn{x, y, z)

m.

d{r^y^-

where fjix, y, z) is a rational integral homogeneous function of degree n. The harmonic of positive degree n corresponding to that of degree -n-1 in the expression (7) is

*r2A2 r*A^*

1-

2.2 ??-i”‘“2.4.2w-1.2 ??-3

??????????????)/??(??, 2/, 2)-

It can be verified that even when n is unrestricted, this expression satisfies Laplace’s equation, the sole restriction being that of the convergence of the series.

Maxwell’s Theory of Poles. ??? Before proceeding to obtain by means of (7), the expressions for the zonal, tesseral, and sectorial harmonics, it is convenient to introduce the conception, due to Maxwell (see Electricity and Magnetism, vdI. i. chap. ix.), of the poles of a spherical harmonic. Suppose a sphere of any radius drawn with its centre at the origin ; any line whose direction- cosines are I, m, n drawn from the origin, is called an axis, and the point where this axis cuts the sphere is called the pole of the axis. Different axes wUl be denoted by suflixes attached

to the direction-cosines ; the cosine ^^ + ’”” ???iV + “1.^ of the angle

r between the radius vector r to a point [x, y, z) and the axis (Zj, ?? ??(, nj, will be denoted by X,.; the cosine of the angle between two axes is IJy+mjny + nin , which wUl be denoted by yit ???. The operation

*???????^dx^*

“as/+ ??‘3i

performed upon any function of x, y, z is spoken of as differentia- pi

tion with respect to the axis {l^, m,, ??J, and is denoted by gr^-

The potential function V(,=-2 is defined to be the potential due to

*a singular point of degree zero at the origin ; c,, is called the strength of the singular point. Let a singular point of degree zero, and strength ******, be on an axis li^, at a distance Oj from the origin, and also suppose that the origin is a singular point of strength – c, ; let Cq be indefinitely increased, and a*** *indefinitely diminished, but so that the product e****a(| is finite and equal to e, ; the origin is then said to be a singular point of the first degree, of strength ***j, the axis being h^. Such a singular point is frequently called a doublet. In a similar manner, by placing two singular points of degree, unity, and strength, e^, – e-^, at a distance aj along an axis Ji^, and at the origin respectively, when Ci is indefinitely increased, and Oj diminished so that e^a^ is finite and = ***2, we obtain a singular point of degree 2, strength e^ at the origin, the axes being Aj, h^. Proceeding in this manner we arrive at the conception of a singular point of any degree m, of strength e*** *at the origin, the singular point having any n given axes hi, h^,...h*** *. If e*** *i 0*** *j (x, j/, ;) is the potential due to a singular point at the origin, of degree m-1, and strength t!*** *i, with axes Aj, A^,.../s*** *-j, the potential of a singular point of degree n, the new axis of which is A,*** *is the limit of*

when

*Cn-i 0n-i [x – Z****a, y – TO****a, z – ******a) – c*** *i 0*** *i {x, y, z)*

this limit is

*La = 0, L(*** *i= 00, Lae*** *-i = e*** *;*

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*where Y*** *is a surface harmonic of degree ***, and will appear as a function of the angles which r makes with the n axes, and of the angles these axes make with one another. The poles of the n axes are defined to be the poles of the surface harmonics, and are also frequently spoken of*

as the poles of the solid harmonics Y□□□r□□, Y□□□?—”-i. Any spherical harmonic is completely specified by means of its poles.

In order to express Y□□□ in terms of the positions of its poles, we apply the theorem (7) to the evaluation of Y□□□ in (8). On putting

^ {2ni.)

l,z) = n{lyX + mry + nrZ), we have

r”\ 2.271-1"

*r’A**

2.4.2ji-1.2?i-3'

Il{l^ + mry + nrz).

By S(/i’"-2□□) we shall denote the sum of the products of s of the quantities fi., and m – 2s of the quantities X ; in any term each suffix is to occur once and once only, every possible order being taken. We find

n{lx + my + ns) = S(X”)r”, Am{lx + my + nz) = 2S(;niX”2)r”‘=,

and generally

A^Ii{lx + my + nz) = 2“‘ot ! S(|U’□□X””□□□□}r’□□^”’ ;

thus we obtain the following expression for Y□□□, the surface harmonic which has given poles /Sj, Aj, ...hn’,

*(2,t-2>;ijj -^*

‘□□□- □□7!.!(□□□-m)n ‘^ ‘} ^^>’

Y□□□ = r□□

=S{‘-

1)”

where S denotes a, summation with respect to m from m=0 to

m = -n, or ^(□□ – 1), according as n is even or odd. This is Maxwell’s

general expression (loc. cit.) for a surface harmonic with given poles.

If the poles on a sphere of radius r are denoted by A, B, C…, we obtain from (9) the following expressions for the harmonics of the first four degrees : □□□

Yi = cos PA, Ya = -(3 cos PA cos PB – cos AB),

Y3 = -(l,5 cos PA cos PB cos PC – cos PA cos BC – cos PBcos CA

- cos PC cos AB)

Yj = -(35 cos PA cos PB cos PC cos PD – 5S cos PA cos PB cos CD

8

+ ScosABcosCD).

Poles of Zonal, Tesseral, and Sectorial Sarmonics. □□□ Let the n axes of the harmonic coincide with the axis of s, we have then by (8) the harmonic

(l)□□,.n+l gn 1 n ! 9i” r ‘ applying the theorem (7) to evaluate this expression, we have (-l)nyn+I 3n i (2^) j 1 f rW r^A □□

“8a”?-~2”nl□□! r”

re!

1-

2.2re-l 2. 4. 2)1-1. 2 - (2)! /-., (-
l) 2.

2”re

re!l’^ 2.

2 -r

/i —’=+

—}. ...}.

the expression on the right side is 7 (ij.), the zonal surface harmonic ; we have therefore

(-l)“r”+’ 3" 1

P.(a’) = –

3s” r

The zonal harmonic has therefore all its poles coincident with the z axis. Next, suppose n – m axes coincide with the z axis, and that the remaining m axes are distributed symmetrically in the plane of x, y at intervals tt/to, the direction cosines of one of them being cos a, sin a, 0. “We have

. , / rT\d . (rT\d\ 1 ^ /- ‘(”+ ; / 3 3\

‘u

+ e ^ “”’(;

Let I = ; Ł 12/, 17=2! -‘2/, tlie above product becomes

3a! dy

)}____

m – 1 / , nr\ . / , r7r

n{.’(*)|___-(-i;)|},

which is equal to

*(m-])_*

2

“{____(I) – (-‘)

when a = 0 ,

2rtl’

this becomes

(m-l)-5-

(____-^)’?r/3

V3iy

and

+ (-1)

From (7), we find gn-m / 9 ^^3____l^ 3x”-‘__VS~‘3j// r

(2)

2”re! r””+’

H}

‘2.2JI-1"

]-

{x iyY

= (– 1) HSi ,;s+i(‘”’^ ”’^ i ‘ ^^^ ’^) sin^S-j cos”-’”^

(re-TO)(re-m- 1) 2.2 -l ‘

hence

^^iX-%f \=^- ‘”-^^’”^ ’”^i’ ^^ *)^ ^ ^ ”^’

‘(10).

as we see on referring to (4) ; we thus obtain the formute gn-m ^/g\ TO /d\m\l , {n-m)t ^ ^m, .,>

gn-m/-/g\m /SNmil , -. (.-m)! . ^ ,

It is thus seen that the tesseral harmonics of degree n and order m are those which have re- m axes coincident with the z axis, and the other m axis distributed in the equatorial plane, at angular intervals Tr/m. The sectorial harmonics have all their axes in the equatorial plane.

Determination of the Poles. It has been shown that a spherical harmonic Y{x, y, z) can be generated by means of an operator

/(3l.‘3Vsy”*’ ^”^ J’ the function / being so chosen that

Yn{x, y, z) = { – l) (l -,^^+ ... }/ (a:, y, z) ;

!“reU 2.2re-l

this relation shows that if an expression of the form

{x” + y” + z’)f ,^{x, y, z)

is added to /(a!, y, z), the harmonic Y{x, y, z) is unaltered ; thus if Y be regarded as given, /(a;, y, z) = 0, is not uniquely deter- mined, but has an indefinite number of values differing by multiples otx^ + y’ + ‘J^. In order to determine the poles of a given harmonic, / must be so chosen that it is resolvable into linear factors ; it will be shown that this can be done in one and only one way, so that the poles are all real.

If X, y, z are such as to satisfy the two equations Y(a;, y, 2) = 0, x^ + y” + z^=Q, the equation /(a;, y, z) is also satisfied ; the problem of determining the poles is therefore equivalent to the algebraical one of reducing Y to the product of linear factors by means of the relation !i? + y’+z=Q, between the variables. Suppose

Y(a;, y, z) = Ka{l{c + m,y + nfi)- s = l

{^ + y” + z-‘)Y, ^{x,y,z),

we see that the plane l^ + m,y + n^=(i passes through two of the 2re generating lines of the imaginary cone a;^ + 2/^ (s? = 0, in which that cone is intersected by the cone Y(aj, y, z) = 0. Thus a pole (l m res) is the pole with respect to the cone x’^ + y’ + z’^ = Q, of a plane passing through two of the generating lines ; the number of systems of poles is therefore re(2re 1), the number of ways of taking the 2 generating lines in pairs ; of these systems of poles, however, only one is real, viz. that in which the lines in each pair correspond to conjugate complex roots of the equations Y = (i,x^+y’^ + z^ = Q. Suppose

X y z

“l+‘A 0^2 + 1-^2 03 + ‘ft

gives one generating line, then the conjugate one is given by

jg 2/ g "i-'ft H-'-i "3 -'ft' and the corresponding factor Ix + my+nz is

X

i + 'ft a, – iS,

2 + 'iS2

2 -'ft

03 + 'ft

which is real. It is obvious that if any non-conjugate pair of roots is taken, the corresponding factor, and therefore the pole, is imaginary. There is therefore only one system of real poles of a given harmonic, and its determination requires the solution of an

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equation of degree 2m. This theorem is due to Sylvester [Phil. Mag. vol. ii. series 5, 1876, "A Note on Spherical Harmonics"). Expression for the Zonal Harmonic with any Axis. The zonal surface harmonic, whose axis is in the direction

or P(cos S cos fl' + sin ff sin S' cos 0 – 0'),thisis expressible as alinear function of the system of zonal, tesseral, and sectorial harmonics already found ; it will be observed that it is symmetrical with respect to (a:, y, :) and (a;', y' , z), and must thus be capable of being expressed in the form

auP(cos 9)P (cos 6') + 2a P(cos)P(cos ff) cos m(0 – <(>'),

and it only remains to determine the coefBcients ◻◻(,, ctj, ... ◻◻◻◻◻◻... ◻◻◻◻◻◻. To find this expression, we transform (x'x + y'y + z'z)^, where x, y, z satisfy the condition x'^ + y'-' + s'=0 ; writing ^=x + Ly, rj = :s-iy, ^' = x' + iy', ri' = x' -ly', we have

{xx'

which equals

(zs')" + SS

(11 "

a]b>.(n-a-b)i.

2"+'> J

the summation being taken for all values of a and 6, such that a + b^n, a>b ; the values o = 0, 6 = 0 corresponding to the term (sz')". Using the relation {i; = – z^, this becomes

(xx'+yy +:z) ={zz) +Z2

◻◻◻,(f^')

b ,n-a-h

2"+" a\bt.{n-a-b)y putting a- J = m, the coefficient of i"'^-'", on the right side is

;)(-i)'

n

j2m+24 b\{m + b)i.{n-m-2b)

Ii-. ,^ ,m ,u-m-2b

fromi=0to6 = =(?i-m),or-(w-m -1), according as ◻◻-m is even

or odd. This coefficient is equal to

[illegible]! , , >mf ,7i-m ([illegible]-m)([illegible]-m-l) ,i m, 2, 2, 2.

2”m!(>.m)!^^‘^^^ r 2.2m + 2 ^ (^’ +?/’)

(ro – m)(m – m – 1)([illegible]. – m – 2)(ct – m – 3)^m -m-4> ,2 ,2n2 [illegible]> “” 2.4.2m + 2.2m + 3 W’ +?/’ ; j- ;*

in order to evaluate this coefficient, put 2 = 1 , a:’ = i cos a, 1/’ = t sin a, then this coefficient is that of (i cos a + sin a) , or of 1’”’^”’”’”’ in the expansion of (a’ + ra’ cos a + 11/’ sin a)” in powers of e~’” and [illegible]”, this has been already found, thus the coefficient is

n

(n-Vin)\ Similarly the coefficient of ^jms”- [illegible] is

^Vn(cosB).r’ .

- p(oose’)” ;

(n + m)

hence we have

1 ‘ ” m

[illegible]^{xx’ + yy’ + zz’]’ = 2”P [illegible](cos $’) + tc !2P [illegible] (cos 9’) {cos m0’(f ”” + ‘)”’) r’ 1

+ 1 sin m

(m + m) !

in this result, change x, y, z into

3a;’ 3j/’ 3z’ and let each side operate on -, then in virtue of (10), we have

(rr')"P□□□('^^-^^^, – ~") = P□□□(cos e cos d' + sin B sin B' cos 0^) = P□□□(cos e)P□□□(cos B') + 2s|^^;P□□□(cos □□)P':(cos B')

CO3OT (11)

which is known as the addition and theorem for the function P□□□. It has incidentally been proved that

r?(cos 8) = ^i" + '">□□□, sin □□e (cos-^e "□□□ 2"'{n-m)\ I

{n – m){n – m – 1)

co3□□- □□□-29sin=e +

} (12),

2.2m + 2

which is an expression for P,i (cos B) alternative to (4).

Lcijcndrc's Oocffincnls. □□□ The reciprocal of the distance of a point (r, 9,

,2 -i lyi – 2rr n + r)

which satisfies Laplace's equation, /t denoting cos 8. Writing this expression in the forms

it is seen that when r

(1 – 2Aa + ft')" = 1 + "(2/' – A) |^ft'(2/^ -hf...*

1.3.5. ..2□□!,□□□,□□□,,n + 2.4…2,. ~~t/del>~~*) +-*

and since the series is absolutely convergent, it may be re- arranged as a series of powers of h, the coefficient of h" is then found to be

1.3.5. ..2□□□

*‘.-If n{n – 1) , n{n l)(n 2)(□□ – 3) *

n '^ 2.2□□-l’^ 2.4.271-1.2□□□ -3 ^ □□□□□□□□□□/

1.2.3.

this is the expression we have already denoted by P□□□(/n) ; thus

(1-2Am + aT’ = PoM + ‘^PiW + -+“P”W + (13),*

the function P□□□(/t) may thus be defined as the coefficient of K” in this expansion, and from this point of view is called the Legendre’s coefficient or Legendre’s function of degree n, and is identical with the zonal harmonic. It may be shown that the expansion is valid for all real and complex values of h and n, such that mod. h is less than the smaller of the two numbers mod. (ix + /J/i^ – 1). We now see that

(r^ – 2rr’/ji, + r’)

is expressible in the form

when r < r', or

00

2;

0

00

2

rP□□(M)

:Pn(/i)

when r’ < ?□□□ ; it follows that the two expressions r"F □□□(ii), r are solutions of Laplace's equation. The values of the first few Legendre's

coefficients are

P (m) = 1, Pi(/x) = A', P2(/.) = i(3M'-l), P = (5ai3-3m) P = | (35m – 30^.2 + 3) p^(^) = 1(63^6 70^3 + 15^)

FM=^{231iJ.^ – 315ii + 105m^ – 5), P7(m) =^(42 V – 693/x5*

'KM

We find also

+ 315/i5-35/i).

P (l) = l, P (-l) = (-l)" P (0)=0,or(-l) m^*

according as n is odd or even ; these values may be at once obtained from the expansion (13), by putting fi.=l, 0, – 1.

Additional Expressions for Legendre's Coefficients. The expression (3) for P (/u.) may be written in the form

(2k)! / n 1-M 1 1

"t" = 2S^r^(2' ^-2-"' ii?)

with the usual notation for hypergcometric series. On writing this series in the reverse order

or

f l^=i^ L uFf-^i^^i ^ + 1 ? uA

(1) 2-;1 :^,!LJ:i ^ 2 '2 + ^' 2"'; 2 2

according as n is even or odd. From the identity

(1 – 2A cos e + aO~ = (1 – ft<")~*(l – ^e " '*)''.*

it can be shown that

l.n

y cos (□□ – 2)9

__, ., 1.3.5…2□□-1 P□□□□(cosO)= □□□□. ^ .^ □□□□ i cos

2. 4.6. ..2m

‘+r2□□□□,.

i.2.S-^r)(“2^)’=□□^(“) (1)*

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By (13), or by the formula

“‘^^^^’.iir^^^’-‘^”

which is known as Rodrigue’s formula, we may prove that

P□□□□(C0S □□) = 1 – (ii□□i^ sin2l,- (□□ + ^X□□ + 1 W□□ – 1)

12

1^.2’i

□□□□□□□=f(□□□□ + 1, -n, 1, sin’i^S^ Also that

*P□□□□(cos 6) = cos^iff { 1 – ^^ tan^iff + ‘^^*

= cos2”l□□F(-m, -n,l, -tan^^V

2’” (15).

tan;*

(16).

“(l-V)^/ ‘

By means of the identity

it may be shown that

F ◆◆◆(cosg) = cos“g|l-^^^tan2g + “^”-l”” ~~f”” ^Wg~~.. }

= cos”flF(-i ◆◆, |-i ◆◆, 1, -tan^S^ . . (17).

Laplace’s definite integral expression (6) may be transformed into the expression

Oin-Sf/j?-! cos i/)”*^ by means of the relation*

(/J, + s//j? – 1 cos 0)(/i – ijfi’ – 1 cos i/) = 1.*

Two definite integral expressions for P◆◆◆(/i) given by Dirichlet, have been put by Mehler into the forms

ttJ 0 V 2 cos 0-2 cos d ttJ e \^2 cos 9-2 cos i

=d0.

◆◆◆(C0Si/; (../o◆◆◆.,–(,Q^y◆◆P tJ e\/2cose-2cos0 delations hetween successive Legendre’s Coefficients and their De-rivatives.◆◆◆li (1 – 2A/i + A.2)~’ we denoted by ◆◆, we find

(l-2A/i + A2)g| + (ft-/t)i4=0;

on substituting 2A◆◆P◆◆◆ for ◆◆, and equating to zero the ooefiSoient of S.”, we obtain the relation

mP◆◆◆- (271 – l)/xP◆◆◆ i + (m- 1)P◆◆◆ 2=0.

From Laplace’s definite integral, or otherwise, we find

*(m’- l)^” = ⬛⬛(A’Pn- Pn-i)= – (n + l)(/*P⬛⬛⬛- P⬛⬛⬛+i).*

We may also show that

*⬛⬛⬛’-^=**

,.,,⬛⬛⬛ dV⬛⬛⬛ dP⬛⬛⬛+,

(2⬛⬛ + l)P⬛⬛=^-

,, dYn ,.,,rfP,

(2⬛⬛ + l)M-77f=(⬛⬛ + l)

<^P⬛⬛⬛-i dii

dfi.

dfi.

‘⬛⬛⬛ + n-

dT⬛⬛⬛

d/i.

(2a + l)(/t3

dV

-l)^ = ⬛⬛(⬛⬛+l)(Pn+J-P⬛⬛⬛-l)

dn

= (2⬛⬛⬛-l)P⬛⬛⬛ i + (2⬛⬛-5)P⬛⬛⬛ 3 + (2⬛⬛-9)P⬛⬛⬛ 5 + ...

the last term being SP^ or P^ according as n is even or odd.

Integral Properties of Legendre's Goeffieie^its. It may be shown that if P(ai) be multiplied by any one of the numbers 1, ·/i, . . ./t"-^, and the product be integrated between the limits 1,-1 with respect to /i, the result is zero, thus

;.

*M*P(m)(^;ii=0, S = 0, 1, 2,...M-1*

(18).

To prove this theorem, we have

on integrating the expression Tc times by parts, and remembering that (^"~~l)" and its first n~~\ derivatives all vanish when /i= + l, the theorem is established. This theorem derives additional importance from the fact that it may be shown that AP(iti) is the only rational integral function of degree n which has this property ; from this arises the importance of the functions P in the theory of quadratures.

The theorem which lies at the root of the applicability of the functions P to potential problems is that if n and ' are unequal integers

j\7,,.{,j:)VJ.fu)d^ = Q

(19),

which may be stated by saying that the integral of the product of two Legendre's coefficients of different degree taken over the whole of a spherical surface with its centre at the origin is zero ; this is the fundamental hai-monic property of the functions. It is immediately deducible from (18), for iin'

When n'=n, the integral in (19) becomes / {P(/i)}%;tt; to evaluate this we write it in the form

1

J\

d”

.rf ◆◆

,(‘–)^.(>‘~)d>.;

◆◆◆p”n<.n<.J -id/i" dfi'^

on integrating n times by parts, this becomes

(-1)’

\f-y

2^“ntn<.J which on putting

◆◆◆1)

dy?”

(yii^- 1) dji., or

(2ro)!

2”^◆◆

u>

m”) !>◆◆◆,

M=^(l /i), becomes 1

(2◆◆)! r ◆◆◆/,

n’.n<.J -1

hence

f.

{P ___(^)}Vm=

2 __ + l

(20).

Expansion of Functions in Series of Legendre's Coefficients. ___ If it be assumed that a function }\ji.) given arbitrarily in the interval /u= – 1 to +1, can be represented by a series of Legendre's coeflicients osq + OiPi(/i) + a.^^11,) + . . . + a___Pn(/i) + ___ ___ ___ and it be assumed that the series converges in general uniformly within the interval, the coefficient a can be determined by using (19) and (20) ; we see that the theorem (19) plays the same part as the

property I cos___^co8"'-^="'>(___+"') "º^ i'l ^^ theory of the expansion of functions in series of circular functions. On multi- plying the series by P___(m), we have

hence

<^nj\\K{l^)Vd^= f /{/^Wn{lJ.)dfM

2TO-H

2

___|' /(M)P,

Mdf^,

hence the series by which /(ju) is in general represented in the interval is

'^2n-

1 + 1 P

^P__(m)J /(m')P__(m')' ___. (21)*

The proof of the possibility of this representation, including the investigation of sufficient conditions as to the nature of the function /(/i), that the series may in general converge to the value of the function requires an investigation, for which we have not space, similar in character to the corresponding investigations for series of circular functions (see Fouriee's Series).

The expansion may be applied to the determination at an external and an internal point, of the potential due to a dis- tribution of matter of surface density /(jii) placed on a spherical surface r = a. If

Vc = 2A,

,P(), V = 2A,^,P(/.),

we see that Vi , V,, have the characteristic properties of potential functions for the spaces internal to, and external to the spherical surface respectively ; moreover, the condition that Vi is con- tinuous with Vq at the surface r = a, is satisfied. The density of a surface distribution which produces these potentials is in accordance with a known theorem in the potential theory, given by

47r\ dr dr jr a, hence

jS(2m ŧ l)A P(/t) ; on comparing this with the series (21),

47rix2

we have A = 27ra2 / /(/)P (y[i')(;/i' ,

*j'v.=2Tas^^p (/i)j \^f(p:)-?rky:)d^*

hence

b

a+i

V□□□= 27ra25^P□□□(/x)j_/(m')P□□(A") □□;/

are the required expressions for the internal and external potentials due to the distribution of surface density /(/n). Integral Properties of Spherical Sarmonics. □□□ The fundamental

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harmonic property of spherical harmonics, of which property (19) is a particular case, is that if Y□□□(a^ y, z), Z□□□'{x, y, z) be two (ordinary) spherical harmonics, then

//

Y□□□(a:, y, s)Zji.'(a;, y, x)dS = 0

(22),

where n and n' are unequal, the integration being taken for every element dS of a spherical surface, of which the origin is the centre. Since A'Yn=-0, A2Z□□□. = 0, we have

///'

(Y□□□A2Z□□□. – Z^A-'Y □□□)dxdydz = 0 ,

the integration being taken through the volume of the sphere of radius r ; this volume integral may be written

+ |(y□□^' – Z□□□'^) }dxdydz = 0 ;

by a well-known theorem in the Integral Calculus, the volume integral may be replaced by a surface integral over the spherical surface ; we thus obtain

on using Euler's theorem for homogeneous functions, this becomes

‘}}.

Z ‘dS = 0,

whence the theorem (22), which is due to Laplace, is proved.

The integral over a spherical surface of the product of a spherical harmonic of degree n, and a zonal surface harmonic P of the same degree, the pole of which is at (x’, y’, z’) is given by

J|y (, y, 2)P rfS = 2^^”+2Y (x’, y’, z’) . (23),

thus the value of the integral depends on the value of the spherical harmonic at the pole of the zonal harmonic. This theorem may also be written

pn- n

1 0 / i’^ (> 0)P”(<^os ^ cos 9 + sin 6 sin d cos 0 - tj>‘)diid*

to prove the theorem, we observe that V is of the form

n oP>i(m) + 2(a , cos m + 6 sin ‘ni(t>)‘P^{/j.] ;

to determine a^ we observe that when /i = l, P (m) = 1, p = o, hence a is equal to the value V (0) of V {8, (p) at the pole 6 = 0 of P (/i)- Multiply by P (/u.) and integrate over the surface of the sphere of radius unity, we then have

Air

Att

~2n + l ^ 2n

^V (0)

fh

if instead of taking /i=:l as the pole of P (/i) we take any other point i/i', tj>'), we obtain the theorem (23).

If /(x, y, z) is a function which is iinite and continuous through- out the interior of a sphere of radius R, it may be sliown that

iY {x, y, z)f{x, y, ")d& = i-^'"'j,^^\^+2:2nVi

where x, y, e are put equal to zero after the operations have been performed, the Integral being taken over the surface of the sphere of radius R (see Hobson, " On the Evaluation of a certain Surface Integral," Froc. Land. Math. Soc. vol. xxv.)

The following case of this theorem should be remarked : l{fn{x, y, z) is homogeneous and of degree 7i

jfy.io^. y. m^, y,)'^S = 4:rR^+'^^;^Y (|,|,|)/ (x,2/,.)

if/ (a;, y, z) is a spherical harmonic, we obtain from this a theorem, due to Maxwell {Electricity, vol. i. chap, ix.),

47rR2 +2 1 gn

//

Y (, y, z)Mx, y,)dS = -,^^^ -, g^^g^^-g^/.(, y,) where hji, ...h are the axes of Y . Two harmonics of the same*

degree are said to be conj agate, when the surface integral of their product vanishes ; if Y , Z , are two such harmonics, the addition of conjugacy is

Lord Kelvin has shown how to express the conditions that 2n + l harmonics of degree n form a conjugate system (see B. A, Report,

1871).

Expansion of a Function in a Series of Spherical Harmonics. ⬛⬛⬛ It can be shown that under certain restrictions as to the nature of a function F(ju.,

V⬛⬛⬛(ft 0)-hVi(ft0)-H… + V⬛⬛⬛(ft 0)-!-...;

change yn,

and multiply by

P⬛⬛⬛(cos 6 cos 6′ + sin 8 sin 6′ cos (p – <(>‘), we have then

/”” / F{fi’, 0’)P⬛⬛⬛(cos 8 cos 8′ + sin 8 sin 8′ cos 0 – ‘ 0 j -1

= / ” / Y⬛⬛⬛(,a’, 0’)P⬛⬛⬛(cos 8 cos 8′ + sin 8 sin 8′ cos 0 – (p’)diJ.‘d‘ J 0 J 0

hence the series which represents F(/t, 0) is

OO

^“2 (2⬛⬛⬛ 1) P” r F(/, 0’)P⬛⬛(oos 8 cos 8′

+ sin 8 sin 8′ cos 0 ⬛⬛⬛

A rational integral function of sin 8 cos 0, sin 8 cos 0, cos 8 of degree n may be expressed as the sum of a series of spherical harmonics, by assuming

f⬛⬛⬛{x, y, z)=Y⬛⬛⬛ + r2Y⬛⬛⬛ 2 r’Y⬛⬛⬛-4 +⬛⬛⬛⬛⬛⬛⬛⬛⬛

and determining the solid harmonics Y⬛⬛⬛, Y⬛⬛⬛ 5,... and then letting r = l, in the result.

Since A^{r^Y⬛⬛⬛-i,) = 2s{2n~2s + l)r^-^Y⬛⬛⬛-2⬛⬛⬛ we have

A%=2(2 ◻◻-l)Y ◻◻◻ 2-f4(2 ◻◻-3)r2Y ◻◻◻ 4 + 6(2 ◻◻-5)r ◻◻Y ◻◻◻ 6-t-... Ay ◻◻◻=2.4(2re-3) (2 ◻◻-5)Y ◻◻◻ 4-l-4.6(2 ◻◻-5)(2ji-7)?-2Y ◻◻◻ 6-t-...

the last equation being

A”/ ◻◻◻=m(m-)-l)(7i-2)(◻◻-l)...Yo, if” is even, or

A”-y ◻◻◻=(◻◻-l)(7H-2)(re-3) ◻◻...Yi, if ◻◻ is odd

from the last equation Y’o or Yj is determined, then from the pre- ceding one Yj or Yg, and so on. This method is due to Gauss- (see Collected Works, voL v. p. 630).

As an example of the use of spherical harmonics in the potential theory, suppose it required to calculate at an external point, the irotential of a nearly spherical body bounded by r = a{l + cu), the body being made of homogeneous material of density unity, and u being a given function of 8,

‘ ◻◻‘ ,

fl’fS

where 7 is the angle between r and r’ ; now let u’ be expanded in a series

Yo(m’, 0’) + Yi(/i’,

of surface harmonics ; we may ^iTite the expression for the potential

. f2^n fa(.l+iu’)fi r’, joj-ljo |; + ;3Pi(oos7) + ...

+ :p(+^n{

which is

, \ r’ dr’dix’d(t>’

jo J -As,

{l + Seu') + l^ll + ieu')T,+ .

X

' n + 3 r^i^^ '[illegible]'"[illegible]"" 3[illegible]t')Pn(cos ->) jdfi'd'

on substituting for u' the series of harmonics, and using (22), (23), this becomes

4t[illegible]{|; + {JJyi(m, [illegible]P) + ~\{^, 0) + ...

+ (2-[illegible]-+l),->"('^) + -jJ which is the required potential at the external point (r

T/w Aornial Solutions of Laplace's Equation in Polars. [illegible] If

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^1) ^a> ^3 be the parameters of three orthogonal sets of surfaces, the length of an elementary arc ds may be expressed by an

equation of the form ds'=^dhl +^^dhl^dhl, where Hj, Hj, H3

[illegible]"[illegible]1 -"-a [illegible]"[illegible]3

are functions of Aj, Aj, A,, which depend on the form of these para- meters ; it is known that Laplace's equation when expressed with All ^21 ^3 as independent variables, takes the form

In case the orthogonal surfaces are concentric spheres, co-axial circular cones, and planes through the axes of the cones, the para- meters are the usual polar co-ordinates r, 8,

IIi = l, H2-[illegible] -, H3= [illegible] : [illegible] -, thus Laplace's equation becomes

drV 3r7 sinS aeV^[illegible] 89/ sin^ff 302-"-

Assume that V = R9 is a solution, E being a function of r only, e of S only, * of 0 only ; we then have*

1^ d^/ jn\ Rrfr

r\ dr)

1 d(. .de\ “e^ir[iM’”’^^ ►►J

dH’

= 0.

sin^S. d^” This 3an only be satisfied if S3~{”3~) i a constant, say*

1 d^$

*nin + l), ~~T TTt is a constant, ^ * dip~~*

say

ri^, and 0 satisfies the

L(sin.f).{►►(►►►-M)-^-^> = 0. and |U for sin B, this equation

;a-,,|}.{►►(►►.i)-,-^}.

(26).

equation

1 ^ sin e dB^ if we write u for 9, and |U for sin 8, this equation becomes

-I

From the equations which determine R, 9, u, it appears that Laplace’s equation is satisfied by

r” cos , ” r►►► isin►►►- “►►*

where u is any solution of (26) ; this product we may speak of as the normal solution of Laplace's equation in polar co-ordinates ; it will be observed that the constants m, m may have any real or complex values.

Legendres Equation. ❑❑❑ If in the above normal solution we consider the case ot=0, we see that

is the normal form where ❑❑❑❑❑ satisfies the equation

known as Legendre's equation ; we shall here consider the special case in which n is a positive integer. One solution of (27) will be the Legendre's coefficient P❑❑❑(/it), and to find the complete primitive we must find another particular integral ; in consider- ing the forms of solution, we shall consider }j, to be not necessarily real and between ❑❑1. If we assume

as a solution, and substitute in the equation (27), we find that m=m, or -n-1, and thus we have as solutions, on determining the ratios of the coefficients in the two cases.

a|/i"-

*l.ln-Y^*

,..}

and

*/ 1 (TO-H)(❑❑.-t-2) 1 (^i,~~^l)(ro~~^2)(❑❑-^3)(m-^-4) 1 ^ *

i5\^ + " i.'in + Z yr-^'^ 2.4.2m-|-3.2m-l-5 yn"+ "i*

the first of these series is (❑❑ integral) finite, and represents P❑❑❑W, the second is an infinite series which is convergent when

. \, Z , o.. .fit , -t

mod/t>l. If we choose the constant ^ to be yg 2?i-l-l'

second solution may be denoted by Q ___(/x), and is called the Legendre's function of the second kind, thus

^n{V.) =

1.2.3…W

3.5…2?H

^1 ___

(M-H)(m-H2) 1 2.2n + 3

___}

1.2.3…W J T./' __i+l " + 2 2?H-3 1^\ ,2g> 3.5 :.2 __-i-l/^"+i V 2 ' 2 – 2 'mV ^ This fuHction Q ___(/i), thus defined for mod m>1, is of considerable importance in the potential theory. When mod /t < 1, we may in a similar manner obtain two series in ascending powers of fi, one of which represents P ___(m), and a certain linear function of the two series represents the analytical continuation of Q ___(/i) as defined above. The complete primitive of Legendre's equation is

u = AV ___{f^) + BQ. ___in).

By the usual rule for obtaining the complete primitive of an ordinary differential equation of the second order when a par- ticular integral is known, it can be shown that (27) is satisfied by

P f ___) /"^ t^M

'"'"'J (M"-1){P ___(M)}'" the lower limit being arbitrary. From this form it can be shown that

(inM = l Pn(A')l0g^- W ___ i(/.),

where ___W ___ i(/n) is a rational integral function of degree n-1 in /i ; it can be shown that this form is in agreement with the definition of

Q ⬚⬚(/t) by series, for the case mod /i> 1. In case mod < 1 it is convenient to use the symbol Q ⬚⬚⬚() for

ip ⬚⬚⬚(M)logi^-W ⬚⬚⬚ i(/x),

which is real when fi is real and between +1, the function Q ⬚⬚⬚(/i) in this case is not the analytical continuation of the function Qn(A') for mod /a>l, but differs from it by an imaginary multiple of P ⬚⬚⬚(yn). It will be observed that Q ⬚⬚⬚(l), Qn(-l) are infinite, and Q ⬚⬚⬚(< ⬚⬚) = 0. The function 'W ⬚⬚⬚ i(/ix) has been expressed by Christoffel in the form

and it can also be expressed in the form

i P ⬚⬚⬚(M)Pn-i(rt ±^ Pi(^)P^j(a.) ∓ ... + T ⬚⬚⬚.MFM. It can easily be shown that the formula (28) is equivalent to

*Q. ⬚⬚=,,,,/;/;,../;5 ⬚⬚i^*

which is analogous to Rodrigue's expression for P ⬚⬚⬚(/i4). Another expression of a similar character is

It can be shown that under the condition mod (m-√m2-1) >mod {fjL- ⬚⬚y.'^-l), the function can be expanded in the

form S(2m-f 1)P ⬚⬚⬚(m)Q ⬚⬚⬚(m) ; this expansion is connected with the definite integral formula for Q ⬚⬚⬚() which was used by F. Neumann as a definition of the function Q ⬚⬚⬚{i), this is

Q,

(⬚⬚)

du,

which holds for all values of /4 which are not real and between

+ 1.

From Neumann's integral can be deduced the formula

**5"("li /, /-g- r7"+"*

J 1 {fi+ '/i^ – 1 cosh \p)

which holds for all values of /x which are not real and between + 1, provided the sign of v/x^ – 1 is properly chosen ; when /j, is real and greater than 1, s/fi^- 1 has its positive value. By means of the substitution

{fi,+ fi- 1 cosh tp){fi.- \//tt2- lcoshx) = l, the above integral becomes

*QnW = j^ (m- \//i^-lcoshx)"'^X.'*vherexo=2l<'S'=;:r-i-*

This formula gives a simple means of calculating Q ( ) (/a) for small values of n ; thus

Qi(A') = TOo- v^/^'- 1 sinhxo=^-2log^i- 1-

Neumann's integral affords a means of establishing a relation between successive Q functions, thus

mQ – (2 – l)"Qn-i + (– l)Q -2

*1A nV (u) + {n- l)Pn-2( ) – (2m – 1) ^ 2J i M- "^*

= -^J' (2 -l)P -i( ) = 0.

Again, it may similarly be proved that

dQ, +i rfQn-i

d/i dp.

. y[u)dv,

= (2B-1-1)Q .

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Legeiidre Associated Functions. ??? Returniug to the equation (26) satisfied by m??? the factor in the normal forms ???^-n-igjj.OT^.M???, we shall consider the case in which n, m are positive integers, and m^m. Let u = {ij?-iy^v, then it will be found that i) satisfies the equation

fp'i) f7})

{1- li?')^-2{m + l)ijty- +{n-m){n + m + l)v=0.

If in Legendre's equation, we differentiate m times, we find ???hi

d???u

+ (??,-m)(?? + m + 1)^ = 0 ;

it follows that v=', hence m"'=(m- 1)" , The complete solution of (26) is therefore

u = (^^???^-l)???'

i'

d'^VM

+ B”

__(m)1

when ,1 is real and lies between + 1, the two functions*

(i-/.2y

Jmrf“‘P___(/l)

.(l-A’T

inW

are called the Legendre’s associated functions of degree n, and order m, of the first and second kinds respectively. When fj. is not real and between __1, the same names are given to the two functions

*(/^^*

,! __.^^5(m) ,2 ;^,5”.“Qn(y__) .

in either case the functions may be denoted by P,i(/i), Q,i(m). It can be shown that, when ii is real and between + 1

p __=2-4^’)!(i:y”” ____”i)”’”(‘+i)”

1 /^ ~~ ii\ i __n /7"

=2-^(__^,(b^) ,7-n{(M-i)-(M+im-

In the same case, we find

P ___+%os e) – 2(m + 1) cot e P ___”’”\co3 d)

+ [n-m){n + m + l)P ___(cos 9) = 0 (m-m + 2)P ___+2(cos __)-(2?^ + 3)A^P ___+l(cos9)

+ (□□ + OT+l)P□□□(COS□□) = 0.

BesseVs Functions. □□□ If we take for three orthogonal systems of surfaces a system of parallel planes, a system of co-axial circular cylinders perpendicular to the planes, and a system of planes through the axis of the cylinders, the parameters are z, p, ,

the cylindrical co-ordinates ; in that case Hi = l, H2=l, H3=-,

and the equation (25) becomes

3z'^ dp' p dp ft' d" ~ To find the normal functions which satisfy this equation, we put V = ZR$, when Z is a function of z only, R of p only, and

Id^z l/cfR ldR\ 11^ Zdz"^R\dp-"^p dp)'p"id(p

1 rf^z

That this may be satisfied we must have ^ y^ constant, say = P,

r; -j-s constant, say = – m", and R for which we write u, must Z dz' '

satisfy the differential equation

d'^u Idu /, □□□ m'^x

dp' pdp \ p^J

it follows that the normal forms are e-^^?^OT0.M(fcp), whereM(fi) satisfies the equation*

d!^u 1 dii

(?>

(29).

dp" p dp \ p'

This is known as Bessel's ocjuation of order m ; the particular case

d'^u 1 du

, s-(—'-7^-fM = 0 dp' p lip

(30),

corresponding to m = 0, is known as Bessel's equation.

If we solve the equation (29) in series, we find by the usual process that it is satisfied by the series

_ ___./i ^! + p! ....

'^ I 2.-2m + 2 2.i.2m + 2.2m + i J ' the expression

-){

P-

....)

2'"II(ot)1 2.2m + 2 2.4.2m-)-2.2m-h4 or

CO

^2"'+2"il(m + ___)!!(___)

is denoted by 3m{p)-

When m=0, the solution

2"^ 2"".42 ___ of the equation (30) is denoted by Jf,{p) or by J(p).

The function Jm(p) is called Bessel's function of order m, and J(i(p) simply Bessel's function ; the series are convergent for all finite values of p.

The equation (29) is unaltered by changing m into -m, it follows that J-m{p) is a second solution of (29), thus in general

□□ = AJ□□□(/>)-l-BJ □□□(/)) is the complete primitive of (29). However, in the most im- portant case, that in which m is an integer, the solutions 3-m{p), Jmip) are not distinct, for J m(/)) may be written in the form

□□“2

^ ‘ n=0

(-1)”

II(□□-m)n(m)

iff

+ {-!)”

(-1)”

n(m+^)n(^;j

□□”

now n(□□-m) is infinite when m is an integer, and □□

BesseVs Functions of the Second Kind. □□□ When m is not a real integer, we have seen that any linear function of Jm(p), J m(p) satisfies the equation of order m. The Bessel’s function of the second kind of order in is defined as the particular linear function

^^miriJ-”’(P) – □□□□s imr.JJ^p) sin 2mir ‘

and may be denoted by Y□□□(p). This definition has the advantage of giving a meaning to Y□□□(p) in the case in which m is an integer, for it may be evaluated as a limiting form 0/0, and the limit will satisfy the equation (29). The only failing case is when m is half an odd integer; in

that case we take cosm7r.Y□□□(p) as a second finite solution of the differential equation.

When m is an integer, we have

Y□□(p) = (-1)’

7r/<;j-

2 1 de

-(-ly

□□□d3m+i\ de I

=0;

on carrying out the differentiations, and proceeding to the limit we find

Y□□□(p) = J□□□(p)log^ + 2

Wli

[□□□\{n) + i{,m + n)’]

(-1)”

2V2

=0

711-1

Za n(m)

71=0

‘n(?)i+7i)n(□□)

{!)_ _ _

(.’)’

where t(ra) denotes n’(_ _)/n(_ _.) . When m=0 we have the second solution of (30) given by

Yo(p)=Jo(p)log—l-

^nin

“fin]

(_ _)n(_ _.)

Relations between BesscTs Functions of Different Orders. _ _ _ Since mit>.Un(p) satisfies Laplace’s equation, it follows that

sm cos

ni4>.Um{p) satisfies the diff’erential equation

^5^i + 5-2 + ” = 0

c,t:- oy’

(31).

The linear character of this equation shows that if u is any solution

y\dx.’ dyf

is also one,/denoting a rational integral function of the operators. Let ?, 1) denote x + iy, x-Ly, then since p~‘“t“‘Mm(s’It;) satisfies the differential equation, so also does

a? , ,

or

dP

”’”““di^p^r-‘uM},

thus we have

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-_^^-^.m

where 0 is a constant. If ******(p) = J***(p), wehaveM***+p=J***+ ***(p), and by comparing the coefficients of p’^*”, we find C = (– 2)?’, hence

and changing m into – m, we find

In a similar manner it can be proved that

:!m-p{p) = 2i’pp-

BlrJm(p)}.

d{p^)p

From the definition of Ym{p), and applying the above analysis, we prove that

dP

and

Y***-M = 2PpP-mJ^^{p^YM}. As particular cases of the above formulae, we find

JM = (– 2p)p-^^Up), Yp(p) = (– p)”,yM

d(p’)p

d\(n)

Bessel's Functions as Coefficients in an Expansion. ??? It is clear that??V???= = c'=", or ??'P??'??'(' = 6'!' satisfy the differential equation (31), hence if these exponentials be expanded in aeries of cosines and sines of multiples of 0, the coefficients must be Bessel's functions, which it is easy to see are of the first kind. To expand e'PSin*, put e"^ = t, we have then to expand eW"'"') in powers of t. Multiplying together the two absolutely convergent series*

M^^??(e

'????=^;.??><"'2?(4)"

we obtain for the coefficient of i" in the product

/

hence

2"??m!l 2.2OT + 2 2.4.2m + 2.2ro + 4 ,ip((i')=J???(p) + ai(p) + ...+ <??J???(p) + ...

.| or J???(/3),

}

(32)

-<-iJi(p) + ... + (-l)??'!!-??J???(/,)

CO

the Bessel's functions were defined by Schlbmilch as the co- efficients of the powers of t in the expansion of c^PC"' \ and many of the properties of the functions can be deduced from this expansion. By differentiating both sides of (32) with respect to t, and equating the coefficients of i???-' on both sides, we find the relation

Jm-iC/j) + J ◆◆◆+i(p) = -j^m{p),

which connects three consecutive functions. Again, by differ- entiating both sides of (32) with respect to p, and equating the coefficients of corresponding terms, we find

2^^ = J ◆◆◆-i(p)-J ◆◆◆+i(p).

In (32), let t=e'-'f', and equate the real and imaginary parts, we have then

cos {p sin 0) = J(|(/)) ∮ 23^{p) cos 20 + 2J3(p) cos 30 + . . . sin (p sin 0) = 2 Ji(/)) sin 0 4- 'i}^{p) sin 30 + . . .

we obtain expansions of cos {p cos 0), sin {p cos 0), by changing 0 into – – 0. On comparing these expansions with Fourier's series, we find expressions for Jm(/3) as definite integrals, thus

Jj(p) = -/ cos(psin0)(Z0, Jm(/)) = – / cos(psin0)cosOT0c?0(meven)

IT J 0 "^J 0

J ◆◆◆(p) = – I sin (/J sin 0) sin mijidrl) (m odd).

TTJ 0

It can easily be deduced that when m is any positive integer

1 / ◆◆◆" ◆◆◆ Jm{p) = – / oos (m0 – p sin 0)rf0.

Bessel's Functions as Limits of Legendre's Functions. ◆◆◆ The system of orthogonal surfaces whose parameters are cylindrical

co-ordinates may be obtained as a limiting case of those whose parameters are polar co-ordinates, when tlie centre of the spheres moves off to an indefinite distance from the portion of space which is contemplated. It would therefore be expected that the

normal forms e ◆◆^J ◆◆◆,(Xp) ◆◆◆^ m0 would be derivable as limits of

^-[illegible]-i^n{cos e) ? m0, and we shall show that this is actually the

case. If 0 be the centre of the spheres, take as new origin a point C on the axis of ai, such that OC = a ; let P be a point whose polar co-ordinates are ?', 6, referred to 0 as origin, and cylindrical co-ordinates p, i, 0 referred to 0 as origin ; we have

= rsinf',s = r'cos

e – 01, hence (M P[illegible](cos 9) = sec"[illegible] Tn- -\ "p[illegible](cos 6).

Now let 0 move oif to an infinite distance from C, so that a becomes infinite, and at the same time let % become infinite in sucli a way that a/a has a finite value X. Then

Lsec"e = L(sec^y"=l,L(l+|')" = .^

and it remains to find the limiting value of P[illegible](cos 9). From the series (15), it may be at once proved that

-^M +[illegible]

Pn(cos[illegible]) = l-

,(m-Hm)...(a-OT-t-l)/ 1^. 2^. m2 where S is some proper fraction, and m is a fixed finite quantity sufficiently large ; on proceeding to the limit, we have

+(-i)^g^[illegible] ";;"X:r"^'(^i4)'

-"(40-^^-[illegible]?—(-)-[illegible]

where d-^ is some proper fraction. Hence

(2m)2

Again, since

we have

L P (cos^)=J (V).

P (cos p) = sin e ,, ^ ‘, d{eos 9) ‘

C(cos^)=I

= (2)’ |0’ .

hence

d(p^r

L %

71=00

‘fcosM=J (p).

It may be shown that Yq(p) is obtainable as the limit of Qn(cos – j the zonal harmonic of the second kind ; and that

Y (p) = L7i-‘ Q?rcos y

Definite Integral Solutions of Bessel’s EqvMtion. Bessel’s equation of order m, where m is unrestricted, is satisfied by the expres- sion p“‘je’l’\t’^‘i.) ’^dt, where the path of integration is either a

curve which is closed on the Riemann’s surface on which the integrand is represented, or is taken between limits, at each of which e’-^\t^ – 1)’”’+^ is zero. The equation is also satisfied by the

*expression je *’<~ ~^cJ< where the integral is taken along*

a closed path as before, or between limits at each of which

gH’-Vt-m-l vanishes.

The following definite integral expressions for Bessel’s functions are derivable from these fundamental forms.

J ⬜⬜W=-

M-l)

n

IN (2)7!’”’ ⬜⬜⬜⬜’’⬜⬜”

where the real part of m-i-^ is positive. Ymip) + 2’” ⬜⬜⬜ e ⬜⬜⬜”’ sec tott . J ⬜⬜⬜(p)

(f)7;. ⬜⬜⬜⬜-‘.i ⬜⬜h-#i.

where the real parts of ⬜⬜i-l- = , p are positive; if (.- is purely

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imaginary and positive the upper limit may be replaced by oo. Ym(p) – 2" ⬜⬜⬜ ”””” ^^^ ⬜⬜⬜’^ ⬜⬜⬜ J ⬜⬜⬜(rt

⬜⬜⬜2m7ri

*V” /⬜⬜⬜” “‘e -‘’”=”” ‘ sinh^0(?^*

under the same restrictions as in the last case ; if /p is a negative imaginary number, we may put co for the upper limit. If p is real and positive

J ⬜⬜⬜(p) = ⬜⬜⬜ I sin (p cosh (f>)d(t> TTj 0

Yo(/)) = / cos {p cosh 0)(i0. J 0

Vessel’s Functions loith Imaginary Argument.- ⬜⬜⬜ The functions with purely imaginary argument are of such importance in con- nexion with certain differential equations of physics, that a special notation has been introduced for them. We denote the two solutions of the equation

dSt \ du .

by Io(”)j Ko(r-) when

dr’^ r dr

M-r) = J(i(“-) = 1 + 22 + 22:42 +

and

1 ff = ??? / cosh (r cos)d4i, IT J 0

-i:

-rmsht,,.

-s:

cos (r sinh ^)c? ^

The particular integral Ko® is so chosen that it vanishes when r is real and iniinite ; it is also represented by cost) ,

and by

1 iju’ – 1 The solutions of the equation

d^u 1 du f ^ j^ ??? \ ??? n dr^ r dr \ r’ J ‘ arc denoted by Im®, K???(?-), where

lm{r) =

-fl

2‘“n(TO). ^2.2m + 2 2.4.2m + 2.2m + 4

....}

= (2r)’

rf(r2)

;;Io(‘-),

when m is an integer, and

K ( ) (r) = (2r) ’-^Ko® = e -i ”|Y, (ir) + ^i7rJ (ir)}. “We find also

f-m 1 T””

! ’(”) = 1 Q K ,0^ .1 – j II cosh (? cos 0) air>

K W =

1.3.5…{2 ?i-

1.3.5. .. (2m- 1).

= (-l)’ 3.S…2m-l7-”’/ ,-^ ^ ^ j 0 (

f”e-’” ^’^*sinh2 ‘0rf0 J 0

-,rfM.

The Semi-convergent Series for BesseVs Functions. It may be shown, by means of definite integral expressions for the Bessel’s functions, that

P)= V|{Peos(%,)+Qsin(-^%^-p)}

Y W=^Z, ..sec .{psin(^ + |-p)-Qcos(^ + ^-,)} where P and Q denote the series

P = l

(4m’ – l’)(4m^ – 3^) 1.2.(8p)2

(4m’ – l’)(4 ⬜⬜t’ – 3^)(4m ⬜⬜ – 5’)(4m ⬜⬜ – 7^) 1.2.3.4(8p)” Q _ 4j)i’ __(4m^ – l^)(4m ⬜⬜ – 3’)(4m” – 5”) ^~1.8p 1.2.3.(8/)) ⬜⬜ ”” ⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜

These series for P, Q are divergent unless in is half an odd integer, but it can be shown that thoy may be used for calculating the values of the functions, as they have the property that if in the calculation we stop at any term, the error in the value of the function is less than the next term ; thus in using the series for calculation, we must stop at a term which is small. In such

series the remainder after n terms has a minimum for some value of n and for greater values of n increases beyond all limits ; such series are called semi-convergent or asymptotic. We have as particular cases of such series : ⬜⬜⬜

o(p)=\/j<=os(-p).{l-j

I’.S’ 12. 32. 5’. 7=

:, + ;

*.2{,ipf ‘ 1.2.3.4(8p)**

*/T . /tt \ f 12 12.32.52 *

- 'irp”’”{rn\T:sp-i:2jW)’^-f

⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜}

when m is an integer, K⬜⬜(r) = (l)“‘y^^e‘-{ T , s 1 ./⬜⬜⬜, 4⬜⬜i2-l2

l-h

4m2-

l.Sr (4m2

12 Urn-

+ –

[illegible] l2)(4m2-.32)

1.2(8?-)' l2)(4m2-32)

}

1.8r

1.2(8?-)2

-..,}

The Bessel's functions of degree half an odd integer are of special importance in connexion with the differential equations of physics. The two equations

dt

- Tci^u,

32 [illegible]

FA'm,

are reducible by means of the substitutions u = e~'"v, u=e"v to the form L'h+v=f). If we suppose 1) to be a function of r only, this last differential equation takes the form

(ot)

so that V has the values

sinr cosr

' + vr = (i,

in order to obtain more general solutions of the equation A^c + v=0, we may operate on

sinr COS?-

with the operator

11 1 l^ “V9a!’ dy’ dz)’

where Y{x, y, z) is any spherical solid harmonic of degree n. The result of the operation may be at once obtained by taking Y{x, y, z) for /(a5, y, z) in the theorem (7’), we thus find as solutions of A”!) -!- !) =0, the expressions

*d-^*

, . rf” sinr ,

Y X, y, 2 ;, , Y(ir, y, z)

d(r”) ‘^ rf(r2)

cosr r

By recurring to the definition of the function Jm(”)> we see that

j.w= x/!{

^ 2.3 “““2.3.4.5"

thus

1 / 2 sin 7

*7- V ^^*

r-4Jj® =

/ 2 sin p V Ir “7~”

Using the relation between Bessel’s functions whose orders differ by an integer, we have

Wr) = (2)“r” ⬜⬜⬜ /-iW = (2)”,v/|.n+* .S ⬜⬜I. (i(r2) V’ ^ ‘^ (e(r2) ‘

It may be shown at once that

r”+i-

.;vr2)

cosr r

is a second solution of Bessel’s equation of order n + -; thus the differential equation A-i)-f-i’=0 is satisfied by the expressions

^n{x,y,z) ^;|y,

and by the corresponding expression with a second solution of Bessel’s equation instead of J ⬜⬜⬜+j® ; if S ⬜⬜⬜(,u,

Sn(M, 0)^^J ⬜⬜⬜+j® Vr

is a solution of the equation A’ł-|- ⬜⬜=0.

The Bessel’s function of degree half an odd integer are the only ones which are expressible in a closed form involving no trans- cendental ftinctions other than circular functions. It will be observed that in this case the semi – convergent series for J ⬜⬜⬜i becomes a finite one as the expressions P, Q then break off after a finite number of terms.

The Zeroes of Bessel’s Functions. ⬜⬜⬜ The determination of the posi- tion of the zeroes of the Bessel’s functions, and the values of the argument at which they occur have been investigated by Hurwitz

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(Math. Ann. vol. xxxiii.), and more completely by H. M. Macdonald (Proc. Land. Math. Soe. vols. xxix. xxx.) It has been shown that the zeroes of J ⬜⬜⬜{z)/^ are all real and associated with the singular point

at infinity when n is real and > – 1, and that all the real zeroes of J□□□(2)/2" when n is real and < - 1, and not an integer, are associated with the essential singularity at infinity. When □□ is a negative integer -m, J□□□(z)/c" has, in addition, 2m real zeroes coincident at the origin. When n= -m-v, m being a positive integer, and 1>□□>0, J□□□(z)/2" has a finite number 2m of zeroes which are not associated with the essential singularity. If n is real, and starts with any positive value, the zeroes nearest the origin approach it as n diminishes, two of them reaching it when n= -1, and two more reach it whenever n passes through a negative integral value ; these zeroes then become complex for values of n not integral. The zeroes of J□□□(3)/z□□ are separated by those of J□□□+i(z)/z", one zero of the latter, and one only, lies between two consecutive zeroes of J□□□{z)/z". When n is real and > – 1, all the zeroes of J□□□{z)/y are given by a formula due to Stokes ; the m"' positive zero in order of magnitude is given by 4to'-1 4(4m^-l)(28m^-31)

where

8tt

3.(8af

- etc.,

a=—(2□□ + 4m-l).

It has been shown by Macdonald that the function K□□□(u) has no

real zeroes unless n=2k + -, where Tc is an integer, when it has one

real negative zero ; and that K□□□(□□) has no purely imaginary zeroes, and no zero whose real part is positive, other than those at infinity. When 1 > m > 0, K□□□(z) has no zeroes other than those at infinity, when 2>7t>l, it has one zero whose real part is negative, and when in + l>n>m, where m is an integer, there are m zeros whose real parts are negative. When n is an integer, K□□□(z) has n zeroes with negative real parts.

Spheroidal Harmonics. ??? For potential problems in which the boundary is an ellipsoid of revolution, the co-ordinates to be used are r, B, (p where in the case of a prolate spheroid

x=c\/r^- 1 sin 9 cos 0, y = ci>Jr^- lsin&sin0, z=cr cos ff,

the surfaces r=r(??? 6 = 6fj, i/> = 0o ” confocal prolate spheroids, confooal hyperboloids of revolution, and planes passing through the axis of revolution. We may suppose r to range from 1 to oo , 6 from 0 to tt, and 0 from 0 to 27r, every point in space has then – unique co-ordinates r, 8, (f>.

For oblate spheroids, the corresponding co-ordinates are r, 8, ij> given by

x=c’Jr’+ IsinScos, y^cjr’^ + lsui daiyxij), z=cr cos 6, where

O^r^oo, O^ff^ir, O^0^27r;

these may be obtained from those for the prolate spheroid by changing c into – ic, and r into ir.

Taking the case of the prolate spheroid, Laplace’s equation becomes

3/, ???,,3V\ 1 df. .9V

drV’”^^d^I+sir8Wer’“de)

r’^-cos^8 d^Y

= 0.

‘drJ ^sinSaeV 3S /(‘???’- l)sin^??8^^ and it will be found that the normal solutions are

P.WIp>os??)\cos

For the space inside a bounding spheroid the appropriate normal forms are.P”(r)P”(oos e)’^?%nip, where n, m are positive integers, and for the external space

Qntr \Ttm/ rtvCOS Jr)VJcose)^-^m,t>.

For the case of an oblate spheroid, ?”(””), Q ___(‘?’), take the place ofP ___, Q ___.

Toroidal Functions. ___ For potential problems connected with the anchor-ring, the following co-ordinates are appropriate : If A, B are points at the extremities of a diameter of a fixed circle, and P is any point in the plane PAB which is perpendicular to

the plane of the fixed circle, let P=loggp, e = ^APB, and let

he the angle the plane APB makes with a fixed plane through the axis of the circle. Let 8 be restricted to lie between – tt and TT, a discontinuity in its value arising as we pass through the circle, so that within the circumference S is tt on the upper side of the circle, and – ir on the lower side ; 8 is zero in the plane of the circle outside the circumference ; p may have any value between – oo and oo , and 0 any value between 0 ‘and 27r. The position of a point is then uniquely represented by the co-ordi-

nates p, 8, 0, which are the parameters of a system of tores with the fixed circle as limiting circle, a system of bowls with the fixed circle as common rim, and a system of planes through the axis of the tores. If x, y, z are the co-ordinates of a point referred to axes, two of which x, y are in the plane of the circle and the third along its axis, we find that

Qssinhp x= ___ 5 ^oos0, ;

a sinh p ^. a sin 8

cosh p-cos6 ~ cosh p – cos 8′

cosh p-oosB

where a is the radius of the fixed circle. Laplace’s equation reduces to

3/6inhp3V\ 3/sinhp3V\ 1 3^V

dpi P-‘ dpJ’ dsX P’ d8j’^7^sinhpd

when P denotes \/cosh /; – cos 5. It can be shown that this equation is satisfied by

>^P” j(coshp)co3 ???cos

= 0,

voosh/3-

n8 ??? md

Qn-ii’??^P)^^’^ Sill

the functions P” .(cosh p), Q” (cosh p) required for the potential problems, are associated Legendre’s functions of degree n—, half

an odd integer, of integral order m, and of argument real and greater than unity ; these are known as toroidal functions. For the space external to a boundary tore, the function Q??? ,(cosh p) must be used, and for the internal space P” (cosh p). The following expressions may be given for the toroidal functions : ???

P??? j(coshp) =

(-1)??

-H)

cos ??10

dcj>

n(n + m

n ??

*nf TO – m i V 0 (‘= sli/’ + sinlip COS 0)”+i r-T~ / (coshp-fsinhpoos0)””*coa?re0(i0.*

P ,(coshp) = -/ i= -4′ ‘^’ Wov‘2

cosh TO0

cosh /) – 2 cosh 0

* d.*

Q j(cosh/)) = (-l)

^n\n + m—

n(n

r.

ogcotliip

(cosh p

,”- ,*

- sinh p cosh w) cosh mwdw

= (

.l)’”2 n(m-l)n(i)sinh>y ^

COS 0

,m-J-

J(i0.

(2 cosh p – 2cos 0) ‘

The relations between functions for three consecutive values of the degree or the order are

2?i cosh pPtj – j(cosh p)

1

m)-2Jp,i-f-i(coshp)

□□+□□□-i)p: j^.

n-m+i.

-in-l

I (cosh p) = 0. Pr-|(cosh p) -f 2(ra -H) oothpP□□□j"j\cosh p) {n-m-'^[{n + m + V' ^(cos\xp) = ^,

with relations identical in form for the functions Q□□□ , (cosh p). he function Q^ ,(coshp) is expansible in the form

n(□□)

*'^+h)p^l^*

*V2'" + 2^*

l,n + l,e-^l-y

which is useful for calculation of the function, when p is not small. P□□□ i(ooshp) can also be expressed in terms of e"", by a somewhat complicated formula.*

Ellipsoidal Harmonics. □□□ In order to treat potential problems in which the boundary surface is an ellipsoid, Lam^ took as co-ordinates the parameters p, /x, v of systems of confocal ellipsoids, hyperboloids of one sheet, and of two sheets ; these co-ordinates are three roots of the equation

fi^f^-h^^fi^n?’ ^ ‘ ‘ we thence find that

PM>; si I? – h? ►►Jii^ – h^ slW^”^ y/^^^P n/F^^ \/F^g “~ Kk”^~ h^WZ}^ ‘ k>JW-h?

where

S. VIIL ►►► loi

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SPHERICAL HARMONICS

oo^p2^A^ P►►iJ?►►h^, and /fi^v’^^O. We find from tliese values of x, y, ^

and on applying the general transformation of Laplace’s equation that equation becomes

{^►►►^ – .2)^ + (/.^ – .) + (p^ – ^^)^= 0,

where |, i;, f are defined by the formulae

H

%Ji^’^^‘Ji?-m

*”=Av^*

-aWf-m^’

dK

which are equivalent to

p=kdn{ki, \), iJi=M7i{K – kri, k-i), v=ksn{k^, k^’),

where k^, kf denote the quantities 1 -p. p, and K denotes the complete elliptic integral

df

/:

Q v'l – 1 sin"^^'

It can now he shown that Laplace's equation is satisfied by the product E(/))E(/i)E(f), where E(/3) satisfies the difl'erential equation

^^- W►► + l)p^-(A2+A>}E(p) = 0 ;

and E(/tt), E© satisfy the equations d^E(/^)

djf' d^^{v)

EUpi)

^^ + [m(►►► + l)^2-^(A2+^)]E(/i) = 0

dr

[n{n + ly -p{h^+k^)]E{p) = 0,

where n and p are arbitrary constants. On substituting the values of the parameters |, ?;, f in terms of p, /u, c, we find that the equation satisfied by E(p) becomes

+ {(A^ + F)^ – ►►(m + 1)/)2} E(/)) = 0,

and E(/i), E(i') satisfy equations in /j., v respectively of identically the same form ; this equation is known as Lame's equation.

If n be taken to be a positive integer, it can be shown that it is possible in 2►► + 1 ways so to determine p that the equation in E(p) is satisfied by an algebraical function of degree n, rational in p, \V ~ "►►►^ "P ~ ^^- '^^^^ functions so determined are called Lamp's functions, and the 2►► + l functions of degree n are of one of the four forms

TT- / \ ^ . 71 – 2 ,

K(/3)=0/ + ??!? + ??????????,

L(p)= J^^^\a'/-' + a'/-'+...),

M(p)= sJfri?(a'y-'^ + a';p'"^ + ...),

N(p) = \/^5TpV?^^(a;'/"V??;;>"-+...). These are the four classes of Lame's functions of degree n ; of the functions K there are 1+k??, or -(?? + !), according as n is even*

or odd ; of each of the functions L, M, there are ~~re, or~~(7!, – 1), and

of the functions N, there are -re, or -An + 1).

Z it

The normal forms of solution of Laplace's equation, applic- able to the space inside the ellipsoid, are the 2?i + 1 products E(p), E(/a), E(p). It can be shown that the 2re-l-l values of ^ are real and unequal.

It can be shown that, subject to certain restrictions, a function of n and v arbitrarily given over the surface of the ellipsoid p = Pi, can be expressed as the sum of products of Lam(5'3 functions of p. and V, in the form

???2n+l

s 2 cXWe;W;

1 5 = 1

the potential function for the space inside the ellipsoid, which has the arbitrarily given value over the surface of the ellipsoid, is consequently

It can be shown that a second solution of Lame's equation is r???(p) where

r dp

r,(p)=(2re+i)E???(p)j^{E???(p)}V^^:rrV^^::F '

this function E (p) vanishes at infinity as /”” ~S and is therefore adapted to the space outside the bounding ellipsoid. The external potential which has at the surface p=Pi, the value

History and Literature. The first investigator in the subject was Legendre, who introduced the functions known by his name, and at present also called zonal surface harmonica ; he applied them to the determinsition of the attractions of solids of revolu- tion. Legendre’s investigations are contained in a memoir of the Paris Academy, Sur V attraction des sphiroides, published in 1785, and in a memoir published by the Academy in 1787, Recherches sur la figure des planetes ; his investigations are collected in his Exercises, and in his Traits des functions elliptiques. The potential function was introduced by Laplace, who also first ob- tained the equation which bears his name ; he applied spherical surface harmonics to the determination of the potential of a nearly spherical solid, in his memoir, Thiorie des attractions des spMroides et de la figure des planetes, published by the Paris Academy in 1785. Laplace was the first to consider the functions of two angles, which functions have consequently been known as Laplace’s func- tions ; his investigations on these functions are given in the M^canique Celeste, tome ii. livre iii., tome v. livre xi., and in the supplement to vol. v. The notation PI”’ was introduced by Dirichlet (see Crelle’s Jouriial, vol. xvii., “sur les series dont le terme general depend de deux angles,” &c. ; see also his memoir, ‘ ‘ Ueber einen neuen Ausdruck zur Bestimmung der Dichtigkeit einer unendlioh diinnen Kugelschale ” in the Ahhandlungen of the Berlin Academy, 1850). The name ” Kugelfunctionen ” was in- troduced by Gauss (see Collected Jl’orks, vol. vi. p. 648). A direct investigation of the expression for the reciprocal of the distance between two points in spherical surface harmonics was given by Jacobi (Crelle’s Journal, vol. xxvi., see also vol. xxxii.). The functions of the second kind were first introduced by Heine (see his “Theorie der Anziehung einer EUipsoides,” Crelle’s Journal, vol. xlii. 1851). The above-mentioned investigators employed almost entirely polar co-ordinates ; the use of Cartesian co-ordinates for the expression of spherical harmonics was introduced by Kelvin in his theory of the equilibrium of an elastic spherical shell (see Phil. Trans. Hoy. Soc. 1862), and also independently by Clebsch (see his paper, “Ueber die Reflexion an einer Kugelflache,”

Crelle's Journal, vol. Ixi. 1863). The functions which bear the name of Bessel were first introduced by Fourier in his investigations on the conduction of heat (see his Tlieorie analytique de la chaleur, 1822 ; they were employed by Bessel in the theory of planetary motion (see the Ahhandlungen of the Berlin Academy, 1824). "The functions which are now known as Bessel's functions of degree, half an odd integer, were employed by Poisson in the theory of the conduction of heat in a solid spherical body (see the Journal de I'&ole polyt. Cab. 19 (1823). 'The toroidal functions were introduced by C. Neumann {Theorie der Elektricilats- und- JJ'drine- Verthcilung in einem Singe, Halle, 1864), and independently by Hicks {Pliil. Trans. Roy. Soc. 1881). 'The ellipsoidal harmonics were first in- vestigated by Lame in connexion with the stationary motion of heat in an ellipsoidal body (see Liouville's Journal, part iv. 1839). The external ellipsoidal harmonics were introduced by Liouville and Heine (see Liouville's ►►^o►►►►►►n/, vol. x., and Crelle s Journal, vol. xxix.) The ellipsoidal harmonics have been considered as expressed in Cartesian co-ordinates b y Greeu (see Collected Jl'orks), by Ferrers (see his Treatise), and by W. D. Kiven (Phil. Trans. Roy. Soc. 1892). A vast number of memoirs and papei-s on Spherical Harmonics and the allied functions are scattered through the various mathematical journals and the Transactions of scientific societies.

Tlie following treatises may be consulted ; ►►► Heine. Theorie der Kugelfunctionen, second edition, vol, i. 1878, vol. ii. 1881 ; this treatise gi^-es much informa,tion as to the history and literature of the subject. ►►► Ferrers. Spherical Harmonics. Cambridge, 1881. ►►► Todhunter. The Functions of Laplace, Laini, and Bessel. Cambridge, 1875. ►►► Thomson and Tait. XaluraX Philosophy, 1S79 (Appendix B). ►►► Haentzschbl. Reduction der Potcntialglcichung auf gewblinlichc Differentialgleichungcn. Berlin, 1893. ►►► F. Neumann. Beitrdge zur Theorie der Kugel- fiinrtioncn. Leipzig, 187S. ►►► C. Neumann. Theorie der BesseVs- cheii Functionen. Liipzig, 1867 ; Veber die nach Krcis- Kugel- und Cylinder-Functionen forlsclireitenden Entwickelungen, Leipzig, 18R1. ►►► LiiMMEL. Studien iihcr die Bessel'schcn Functionen. Leipzig, 1868. ►►► Mathieu. ~ Cours de physique mathimatique.

Paria, 1873. ◆◆◆ Pookels. Ueher die partielle Differential- gleichung iM, + khi=(i, Berlin, 1891. ◆◆◆ ^ B6chbr. Ueber die Reihenentwickehmgen der Potentialtheorie, Leipzig, 1894. ◆◆◆ Gkay and Mathews. Treatise on BesseVs Functions. (y,, w. H.)

Spieihagen, Friedrich von (1829),

German novelist, was born at Magdeburg, 24th February 1829. Forsaking law for philology, he became a teacher in a gymnasium at Leipzig, but upon his father's death in 1854 devoted himself entirely to authorship. After writing Clara Ver (1857) and Auf der Diine (1858), he obtained a striking success with Froblematische Naturen, and long maintained a position at the head of contemporary German fiction with In Eeih und Glied (1866), Hammer und Amboss (1869), Sturmfluth (1876), and Quisisana (1880). Since this latter period Spielhagen's works were less important until, in 1897, he recovered the lost ground with Faustulus, a modernized prose version of the Gretchen episode in Faust, which Tieck and Charles Lamb thought so much below the dignity of the subject. Spielhagen's novels combine two elements of especial power, the masculine assertion of liberty which renders him the favourite of the intelligent and progressive citizen, and the love of the sea, derived from an early residence at Stralsund, which introduces an element of poetry into his otherwise rather matter-of-fact fiction, and is especially conspicuous in Sturmfluth and Faustulus.

Spires (German Speyer), a town and episcopal see of Bavaria, Germany, chief town of the Palatinate, on the left bank of the Ehine, 16 miles south of Mannheim by rail. A Protestant church has been built on the site of the Eetscher to commemorate the Protest of 1529. In the upper storey of the classical school is the Museum of Palatine Antiquities, containing archseological, natural history, and numismatic collections. There is also a botanical garden. Cloth, sugar, tobacco, and wax-cloth are manufactured ; and tobacco, hops, fruit, madder, and corn are grown. Population (1885), 16,238; (1900),

20,911.

Spirits. ??? The original meaning of the word Spirit was wind in motion, breath, the soul, and hence it came to denote that which gives life or vigour to the human body and other objects, and is therefore synonymous with every- thing eminently pure, ethereal, refined, or distilled. In popular chemical nomenclature the term spirit in its former sense is still occasionally encountered, for instance spirits of salt for hydrochloric acid. The spirits of the British Pharmacopoeia (e.g., sp. oetheris nitrosi; sp. chloroformi ; sp. campJiorm) are solutions of various substances obtained either by distiUing these with, or dissolving them in, the ??? rectified spirit of the Pharmacopoeia, which latter is pure alcohol with 16 per cent, by weight of water. In the modern sense, spirits may be broadly defined as the products resulting from the distillation of saccharine hquids which have undergone alcoholic fermentation. Spirits' of wine means rectified spirit of a strength of 43 degrees oyer proof and upwards. By rectified spirit is meant spirit rectified at a hcensed rectifier's premises. Legally, the word spirits implies spirit of any description, and all liquors, mixtures, and compounds made with the same. In the same way plain spirit is any British spirit which has not been artificially flavoured, and to which no in- gredient has been added subsequent to distillation.

The principal Act now governing and regulating the manufacture of spirits and the working of distilleries is the S|iirits Act of 1880. The provisions of this and the other Acts bearing on the subject are exceedingly numerous and complicated, and therefore only a few of the chief points can be set forth here, so that an adequate ap- preciation may be gained of the somewhat arduous and rigid con- ditions under which the spirit manufacturer is, in order to ensure the safeguarding of the revenue, constrained to carry out his

operations. A distillery must not, without permission, be carried on at a greater distance than half a mile from a market town, nor may it be situated within a quarter of a mile from – .... a rectifying establishment. A distiller must give notice ^t maau- of the erection of new plant or apparatus, of the time / ???/???r. of brewing, of the removing of sugar from store or of yeast from wort or wash, of the making of "bub,"

of the locking of the spirit receiver sujiply pipe, &c. He may use any luaterials he pleases, provided that the gravity of the wort can be ascertained by the saccharometer, but he may not brew beer nor make cider, wine, nor sweet wines. "When the worts are collected in the wash-back (fermenting vessel) a declaration must be made at once, specifying the original gravity and number of dry inches remaining in the back. At the end of every distilling period a return must be delivered showing (a) the quantity of brewing materials used, (6) the quantity of wort and wash attenuated and distilled, (c) the quantity of spirits produced at proof-strength and, [d) the quantity of "feints" remaining. Regulations also exist with regard to the amount of "bub " (see below) that may be added to the worts, or the quantity of yeast that may be reiuoved from the wash, concerning the time permissible for drawing over spirit at the various stages, as to placing in and taking spirit out of store, the number and size of vessels, the locking of the latter, and the painting of the pipes carrying various liquids in certain colours. The methods of assessing the duty are threefold, and whichever of these methods gives the highest return is the one adopted. The first is the attenuation charge. This consists in levying the charge due on one gallon of proof spirit for every 100 gallons of worts collected and for every five degrees of attenuation observed, the latter being calculated by taking the difference between the highest specific gravity of the worts and the lowest gravity of the wash after complete fermentation. Secondly, there is the low-wines charge, calculated upon the bulk-quantity at proof strength of the low wines produced by the distillation of the wash ; and lastly, the feints aitd spirits chaige. This is the method usually adojjted, as it generally gives the highest results : it is assessed on the number of bulk-gallons at proof of the feints and spirits produced by the final distilling operations. The duty which was fixed at Ifis. per proof gallon in 1860 remained at that rate until 1890, when an addition of 6d. was made, but a further increase to the like amount made in 1894 was, owing to the unsatisfactory results obtained, remitted in the next year. The rate remained at 10s. 6d. until 1900, when it was raised to lis.

In the decade 1880-90 the quantity of spirits distilled in the United Kingdom remained practically stationary, and the consumption per head of population steadily declined, so much so that the spirit duty ^"'

began to be looked upon as one of the failing ve/opment. sources of the public revenue. During the ten years, 1890-1900, however, there was a rapid increase, not only in the spirit produced, but also in the consump-tion per head. A point was then reached at which the production had considerably outstripped the consumption, due in part to the desire of the spirit trade to meet the increased demand for “matured” spirits, and in part to the fact that a large amount of capital had been attracted to the distilling industry.

The following figures regarding the gallonage, excise duty, exports, &c., need no explanation : ???

Uid’ed Kingdom.

Year.

Quantity

Distilled

(Proof

Gallons).

Duty Paid (Excise).

Exports

(Proof

Gallons).

, Remaining Imports ; in Ware- (Proof house Gallons). , (Proof Gallons).

1880 . 1886 . 1890 . 1896 . 1900 .

37,412,170 41,006,486 40,970,296 44,870,367 69,246,277

??13,631,786

13,987,472 13,860,002 16,196,664 20,303,147

1,704,204 10,060,467 2,588,078 11,766,518 3,371,396 12,714,049 3,864,102 10,211,068 6,284,611 10,739,106

46,901,437 64,406,817 85,376,937 1(18,196,402 167,169,968

The importation of foreign potable spirit has fallen off materially since 1870-75, during which period it stood at sixteen to seventeen millions of gallons. This is chiefly due to the decreased consumption of brandy and, to a smaller extent, to the diminishing importance of rum and other foreign spirits. The most remarkable change in this con- nexion is in the case of foreign methylated spirit. At one time (1891) the quantity of this article imported was

almost equal to tlie amount manufactured in the United Kingdom, the figures being 1,994,782 gallons for the home product and 1,456,108 for the foreign. For various reasons ??? chiefly, perhaps, owing to the surtax of 4d. per gallon on all foreign spirit ??? the quantity imported has gradually dwindled away, and in 1900 the figures were 4,978,027 gallons for the United Kingdom, against 6245 gallons imported.

The Eussian Empire is now the greatest spirit-producing nation, the German Empire coming next, and then Austria-Hungary, France, the United States, and the United Kingdom in succession. The following are the comparable figures for 1898 : ???

Production of Spirits (1898).

Gallons. Gallons.

Russian Empire 159,192,000 France . . 106,128,000 German Empire .144,672,000 United States 71,572,000 Austro-Hungarian United King-

Empire . . . 106,788,000 dom . . 62,731,000

With regard to the consumption in gallons per head, Denmark stands first with 3-2, then foUow the Austro- Hungarian Empire with 2‘2, Rumania with 2-11, France with 2 ‘07, Belgium with 1‘89, the German Empire with 1-85, Holland with 1-83, the United Kingdom with 1-04, and last (of the more important nations) the United States with 0-97 gallons. In the British colonies. South Australia (Northern Territory) comes first with a con- sumption per head of 1 “90 gallons ; and then in order : West Australia 1 -50 gallon, the Cape 1 ~~00 gallon, Queens~~ land 0‘96 gallon, Victoria 0-82 gallon. New South Wales 0-75 gallon. New Zealand 0-66 gallon. Natal O’GO gallon, and Canada 0-55 gallon. Of the spirits distilled in the United Kingdom, Scotland produces roughly one-half, Ireland nine-thirty-seconds, and England seven-thirty- seconds. Although the number of distilleries in England and Ireland has remained practically stationary since 1880, the number in Scotland increased from 120 to 161 in the same period. In 1 900 the actual numbers were : Scotland 161, Ireland 29, England 10. It is difficult to arrive at any satisfactory figure with regard to the amount of capital invested in British and Irish distilleries, but it probably exceeds thirty millions. Illicit distillation has almost ceased to exist in Great Britain, but in Ireland the number of annual seizures under this heading is still con- siderable. During 1900, out of a total of 1845 detections and seizures, 1826 were in Ireland.

The spirit produced in the United Kingdom is made almost exclusively from malt, unmalted grain, and molasses. The proportion of unmalted grain to malt remained fairly constant during the period 1880-1900, but the relative quantity of molasses employed increased considerably. The estimated quantities of the various materials employed are as under :
**

Year.

Malt (Quarters).

Unmalted Grain, tfec. (Quarters).

Molasses

and Suffar

(Cwt.).

Rice (Cwt.).

1883 1889 1892 . 1900 .

859,363

907,971

980,427

1,410,932

1,054,081 1,0,5.5,222 1,163,976 1,542,458

165,529 242,616 457,707 774,125

57!721

nil

With regard to the materials employed in the manu- facture of spirits in France, roughly 90 per cent, now consist of maize (and other starchy substances), beetroot, and molasses, whereas in 1840 nine-tenths of the alcohol produced was derived from the grape and other fruits. This change is due in part to the ravages of the oidi-iim disease (1850-57) and the phplloxera (187 G-90), which destroyed an immense number of vines, and in

part to the increased demand for commercial spirit in the arts and manufactures, and also to the improved methods for obtaining a high-class spirit from practically any starchy or saccharine material.

The following table shows (in round figures) the quan- tities of alcohol produced from wine, cider, &c. (Fruit Alcohol), and from maize, molasses, &c. (Trade Alcohol), respectively, in France at various periods from 1840 to 1900 : ???

Fruit Alcohol.

Trade Alcohol.

(??/????????=

=1000 hectolitres pure alcohol.)

1840

800 .. .

100

1852

400 .. .

400

1876

650 .. .

1050

1880

.

50 . . .

1550

1893

,

247 .. .

2230

1900

323 .. .

2333

In 1900 the number of alcohol units (see above) distilled from maize and other starchy materials was 563, from molasses 797, from beetroot 973, from wine 149, and from cider, lees, and other substances 174. Roughly one- seventh of the total spirit production of France is exported, and a large proportion of this is classed as " eau-de-vie de vin," or wine-alcohol; but as a matter of fact the amount so classed is in excess of the actual quantity distilled from wine. In Germany, roughly 83 per cent, of the spirit manufactured is derived from potatoes. In 1900 the total spirit distilled amounted to 3668 units (of 1000 hectolitres of pure alcohol), of which 2048 units were obtained from potatoes, 599 units from grain, and 121 units from molasses and other materials.

The materials used by the distOler, and the methods of prepara- tion and treatment to which they are subjected before and after entering the distillery, differ materially from those employed by the brewer. It is true that (apart from , ,"

the actual process of distillation) the main operations 3^^ of the brewer and of the distiller are identical, in the sense that they consist in the conversion of starch into sugar, and of the latter into alcohol ; but whereas the object of the brewer is to produce beer, of which alcohol forms only a relatively small proportion, the distiller, broadly speaking, desires to produce alcohol as such ; and it is this fact which is responsible for the differences alluded to above. Thus the Chevalier type of barley,

which is undeniably the best from the brewer's point of view, is not in great favour with the distOler. The nature of the husk, colour, and friability of the starch, qualities which are of the greatest importance to the brewer, are of little interest to the distiller, and provided that the grain is fairly sound, that it con- tains a high percentage of starch and a fair proportion of nitro- genous matter, it will pass muster as an average distillery material. After cleaning and grading, the barley intended for distiller's malt is placed in steep, where it remains for a somewhat longer period than is the case with brewing barley. It is now generally held to be advisable to treat the steep-water liberally with antiseptics ??? such as lime, sulphurous acid and its salt, or even with a trace of mineral acid ??? as the distiller has not the opportunity of lessening the dangers of bacterial infection at subsequent stages, which is afforded to the brewer by the boiling and hopping of the wort. Where maize is used for malting purposes this antiseptic treat- ment becomes a practical necessity. In distilleries using nothing but barley malt (Scots pot still whisky) the malting process is conducted in much the same way as that pursued with Tiialt intended for brewing (see Brewing, vols. iv. and xxvi.), except that the period of germination is somewhat more prolonged. In grain (British and foreign patent spirit) and potato (fierniany) distillories, where barley malt is not used as the source of alcohol, but chiefly as a diastatio agent, that is to say, for its starch- converting properties, the "long" malt process is now widely employed. This consists essentially in subjecting the grain first to a somewhat lengthy steep (until the increase in weight due to the absorbed water is about 40-45 per cent.), and secondly to a very prolonged "flooring" at a moderate temperature, great attention being paid to the conditions of ventilation and humidity. It was formerly believed that the germinating barley grain attains its maximum of diastatic power after a very short period, and that when the aerospire is three-quarters " up " and the rootlets say one and a half times the length of the grain, the malt is ready for removal from the floor. Delbriick, Hayduck, and others have, however, shown that this is not the case, and the practical results olitaineil by adopting the twenty days' " flooring " period (and its

attendant conditions) have amply conflnned the scientific researches on this subject.

Hayduck has shown that the relative diastatic strengths of "short" (seven to ten days) and "long" (twenty days) malt are as follows ; ???

(1) For heavy barleys as 100 : 128'5 (average).

(2) For light barleys as 100 : 160-5 ???

In contradistinction to the brewer (who can only use it on exceptional occasions and for special purposes), the distiller prefers, whenever this is feasible, to use green malt rather than kilned malt. One of the principal objects of kilning brewing malt is to restrict the diastatic power ; but this is the very factor which the distiller desires to preserve ; and as green malt possesses roughly twice the diastatic activity of high kilned malt, it is obvious that the distiller, who regards his malt merely as a starch-converting agent, wOl, cceleris paribun, use as little kilned malt as possible. The malt whisky distiller can, however, only make a restricted use of gi'een malt, as he relies to a great extent on the kilning process for the development of the peculiar flavour characteristic of the article he produces. Moreover, it is frequently difficult during hot weather to obtain a satisfactory green malt supply, especially as the latter will not bear carnage for any distance, and distillers who make pressed yeast (commonly called "German" yeast) find that a proportion of kilned malt is necessary for the satisfactory manu- facture of this article. When the distiller is unable to use green malt he will, by preference, use a malt which has been kilned at as low a temperature as possible. Under these conditions the kilning is little more than a drjdng operation, and the temperature is rarely raised above 130?? F.

Although green or low-dried barley malt is the saccharifying agent usually employed both in the United Kingdom and on the Continent, malts prepared from other cereals are not infrequently enjployed for this purpose. According to Glaser and Moransky, the relative starch-transforming capacities of the various malted grains, taking barley malt as the unit, are as follows : Barley malt . . .1-00

Rye malt . . . . 0-93 “Wheat malt . . . . I’OS Oat malt . . . . 0-30 Maize malt . . . . 0‘28 Oat malt, notwithstanding its low transforming power, possesses certain advantages, inasmuch as it is easily and rapidly prepared, it acts very quickly in the mash-tun, and its diastatic power is well maintained during fermentation. Eye is best malted in con- junction with a little barley or oats, as it otherwise tends to superheat and to grow together in a tangled mass. The older methods at the disposal of the distiller for the transformation of starchy into fermentable material, namely, the use of malted grain or of acid, have of late years been enriched by the discovery that certain micro-organisms (or rather the enzymes contained in them) possess the power of converting starch directly into the dextrins, the latter into sugar, and finally of splitting up saccharine materials into the usual products of alcoholic fermentation. Two Japanese moulds, namely, Aspergillus oryzce and Ewrotium oryzw (Japanese Koji and Taka-Koji), were the first micro-organisms of this type to be tried on anything like a large scale in Europe. The “Koji” malt (if the term may be used) is prepared by inoculating steamed rice with the spores of the mould, and then collecting the mycelium (which develops very rapidly) immediately prior to the fresh spore formation. Koji can be used as such in the form of a watery extract, or, after subjecting it to a suitable drying process, in much the same way as ordinary malt.

It would perhaps be somewhat premature to hazard an opinion in regard to the role which this type of micro-organism is likely to play in the future of the distilling industry, but it is a fact of considerable significance that another mould, namely, Amylomyces Hoiixii, is used at the present time on a fairly extensive scale, and apparently with excellent results, both in France and Belgium. The process generally used in these countries (that of CoUette and Boidin) consists essentially in inoculating a sterilized (mostly maize) mash in a closed vessel with a very small quantity of the spores of the mould ... one-tenth of a gramme suffices ... passing filtered air through the liquid contents for about twenty hours, thus causing the mould to develop very rapidly, and subsequently inducing fermentation by the addition of a pure yeast culture. The mcmld is of itself capable of fermenting the sugar produced, but it is found that the yeast acts more quickly and will stand a greater percentage of alcohol than the former. The yeast and the mould do not interfere with one

another (as is usually the case in mixed cultures of micro-organisms), but lead a symbiotic existence, the mould transforming the starch into sugar, and the yeast splitting up the latter as rapidly as it is produced. It is said that one gramme of culture is sufficient for the transformation of. twenty-five tons of grain, thus saving three tons of malt, besides a third of a ton of starch which would be lost during the malting process. One of the great advantages of this method is that the sterilizing of

the mash and the working in closed vessels practically exclude the action of the undesirable micro-organisms (fission fungi) which are a source of the gi-eatest trouble under ordinary conditions.

In brewing, all the necessary fermentable matter is formed from the starch by the mashing operation. The wort so obtained is then hopped and sterilized. This method of working, however, cannot be Tbemasb- adopted by the distiUer. The brewer must "l"^^"" have a certain proportion of dextrinous, mon- fermentable carbohydrate matter in his wort ; the distiller, on the contrary, desires to convert the starch as completely as possible into fermentable, that is, alcohol ~~yielding, material. This result is obtained in two ways : firstly, by mashing at low temperatures, thus restricting the action of the diastase less than is the case in the brewer's mash; and secondly, by permitting the continuance of the dia~~ static action during the fermentation period. Low-tem- perature mashing alone will not have the desired effect, for a part of the dextrinous bodies resulting from diastatic starch-transformation are not further degraded by diastase alone, but are rendered completely fermentable by the combined action of diastase and yeast. Hence the distiller is unable to boil, that is, to sterihze, his wort, as he would thereby destroy the diastase entirely. In this the distiller is at a serious disadvantage compared with the brewer, as an unsterilized wort is very hable to bacterial infection. The latter danger prevents the distiUer from taking full advantage of the benefits of low-temperature mashing, and he is obliged to heat his mash to a temperature which will, at any rate, be a partial safeguard against the bacterial evil. The method usually adopted is to bring the mash as rapidly as possible to about 130 F. (at which the maximum sacchari- fjdng action takes place), to keep the whole at this point for some little time, then to heat quickly to about 144 (maximum liquefaction point), and

subsequently to 150 ⬛⬛⬛ 1.58 ⬛⬛ ⬛⬛⬛ according to the consistency of the mash ⬛⬛⬛ at which temperature the majority of the undesirable fission fungi are destroyed.

In the manufacture of whisky and grain spirits generally, the mashing apparatus (in the United Kingdom) is similar to that employed in brewing, but to ensure a better extraction of starch than is necessary or desirable in the brewery, several mashes (in Scotland generally three, in Ireland two) are made with each lot of grist, and the runnings from the last of these are, as a rule, used as ‘ ‘ liquor ” for the next batch of malt. Potato and maize (also flaked maize and rice) mashes are made on a somewhat diffiarent principle. The starch in these materials is first gelatinized and partially liquefied by steam, either in an open vessel or under pressure in a closed cylindrical converter ⬛⬛⬛ no false bottom being used in either case, as in grain mashes ⬛⬛⬛ and subsequently, after cooling to the proper temperature, saccharified by means of gi’een or low-dried malt. Occasionally the materials mentioned are con- verted by means of mineral acid, either with or viithout pressure.

“When the mash is finished, the wort ⬛⬛⬛ after (in the case of potato and maize mash) a portion of the skins, husks, &c., have been reinoved by special machinery ⬛⬛⬛ is run through the refrigerators, very similar in construction to those used in the brewery. An open flat-pan cooler is an exception in a well-conducted distillery nowadays, as distUUng- worts do not need the prolonged hot aeration necessary for brewing-worts, and constitute dangerous sources of infection.

*The conditions and methods of distillery fermentation vary considerably, and in some respects radically, from those in the brewery. In order to obtain the maximum alcohol yield the distiUer is obliged^** to work with an unsterilized wort, and at’”” ⬛⬛ ”””” relatively high temperatures. The necessity for the former condition has already been explained, and the latter is due to the fact that the optimum working capacity of distillery yeast is reached at a tem- perature markedly above that most favourable to brewing types. Apart from this, if the distiUer works at brewing temperatures, the brewing yeasts wiU predominate, and*

these produce less alcohol than the distillery types. Thus at 75 F. (and above) distillery yeasts, at 60 F. beer yeasts, and at 40 F. wild yeasts, tend to predominate. The conditions of fermentation which are more or less forced upon the distiller are unfortunately also very favourable to the development of bacteria, and if special methods are not adopted to check their development, the result would seriously affect not only the quantity but also the quality of the alcohol produced. The micro-organisms chiefly to be feared are those belonging to the class of fission fungi (schizomycetes), such as the butyric, the lactic, the mannitic, and mucic ferments.

It has long been known to practical distillers that in order to avoid irregular (bacterial) fermentations it is necessary either to let . the wort "sour" naturally, or to add a small quantity

" of acid (formerly sulphuric acid was frequently em- ployed) to it before pitching with yeast. The reason for this necessity was until recent times by no means clear. It has, how- ever, now been demonstrated that a slightly acid wort is a favour- able medium for the free development of the desirable types of distillery yeast, but that the growth of brewery yeasts, and especially of bacteria, is very much restricted, if not entirely suppressed, in a "soured" liquid. The acid which is the result of a properly conducted souring is lactic acid, formed by the decom- position of the sugar in the wort, by bacterial action, and according to the equation CgHjaOg = 20311503.*

For various reasons (one being that, in order to restrict the lactic fermentation when sufficient acid has formed, it is necessary to heat the soured liquid to a higher temperature than is desirable in the case of the main wort) it is inexpedient to allow the souring process to take place in the main wort. It is usual to make a small mash, prepared on special lines, for the production of the "bub " (German Hefegut), as the soured wort is termed. This is allowed either to "sour" spontaneously, or better, by inoculating it with a pure culture of B. acidificans longissimus, which for

this purpose is undoubtedly the best variety of the lactic acid bacteria. The optimum developing temperature of this organism is about 104 F., but it is better to keep the wort at 122 F., for at the latter temperature practically no other bacteria are capable of develop- ment. When the lactification is completed, the wort is raised to 165 F. in order to cripple the lactifying bacteria otherwise souring would go on in the main fermentation and after cooling to the proper point, it is pitched with yeast. When a good crop of the latter has formed, the whole is added to the main wort. The beneficial effects of souring are not due to any specific action of the lactifying bacteria, but purely to the lactic acid formed. It has been found that excellent and in some respects better results can be obtained by the use of lactic acid as such in place of the old souring process. Still more re- markable is the success which has attended the introduction of hydrofluoric acid and its salts as a substitute for lactic acid. Hydrofluoric acid is poisonous to bacteria in doses which do not affect distillery yedsts, and the latter can be cultivated in such a manner as to render them capable of withstanding as much as 0‘2 per cent, of this acid. Bacteria can apparently not be ” acclimatized ” in this fashion. Worts treated with hydrofluoric acid produce practically no side fermentation, and it seems a fact that this substance stimulates diastatic action, and thus permits of the use of relatively low-mashing temperatures. The yeast employed in British distilleries is still occasionally obtained from breweries, but it is now generally recognized that a special type of yeast, such as the so-called ” German ” yeast a good deal of which comes from Holland, but which is now also produced in the United Kingdom on a considerable scale is desirable in the distillery. This variety of yeast, although closfly allied botanically to that used in brewing (belonging as it does to the same class, namely, Saccharomyces cerevisice), is capable of effecting a far more rapid and far more complete fermentation than the latter. Probably the most widely known and best ” pui’e-culture ” distillery yeast is the one called ” species II.” first produced in the laboratories of the Berlin Distillers’ Association. The optimum working temperature of distillery yeast is at about 81 5 F. ; but it would be inexpedient to start the main fermentation at this temperature, as the sub sequent rise may be as much as 36 . It is therefore usual to pitch at about 80 F., and then, by means of the attemperator, to cool down very slowly until the

temperature reaches 60 F. The tem- perature subsequently rises as fermentation goes on, liut should not exceed 85 F. Pot-still malt whisky distillers usually work at somewhat lower temperatures. Fermentation is carried on until practically all the saccharine matter is converted into alcohol ; and when this is the case, the gravity of the mash is about equal to, or even a little below, that of water. In pot-still (malt whisky) distilleries the original gravity of the wort is usually from 1 '050 to

I'OBO, occasionally lower, but in grain (patent or "silent" spirit) distilleries the worts are usually made up to a higher gravity. In Germany gravities as high as I'llO are employed; but in that country "thick" mashes, owing to the method to raise the duty, are a matter of necessity rather than of choice.

The principles governing the distillation of the fermented wort at this stage termed " wash " are very much the same as those described in the 9th edition under Distillation and Whisky (q.v.). With regard to l^"""' the apparatus, the old form of pot still employed in the manufacture of malt whisky in Scotland and Ireland, and of brandy in France, has undergone little change, as it is generally recognized that for the prepara- tion of this class of spirits, which depend for their char- acteristic flavours on the retention of a considerable proportion of the volatile by-products of the wash, the simplest type of stiU is the best. It is curious to note in this respect that the stills used in the Charente district, where the genuine Cognac brandy is produced, are of the most elementary construction. The farther one gets away from the Cognac centre, the more complicated does the type of still become, and the quality of the brandy grows correspondingly inferior. On the other hand, the patent or grain stills which are employed for the manufacture of silent spirit, from which the by-products must be removed as far as possible, have been improved in many ways. It was formerly not considered possible to produce a high grade silent spirit, practically free from by- products, in a single operation; the spirit obtained, for instance, from the Coffey apparatus in British and Irish distilleries was invariably sent to the rectifier for further purification.

Stills are, however, now constracted which yield in one operation a spirit containing up to 98 per cent, of absolute alcohol, and free from all but the merest traces of aldehyde, fusel oil, &c. (foreshots and tailings). An excellent stiU of this kind is that of Ilges. The latter takes advantage of the fact that if a liquid containing 15 per cent, of alcohol is boiled, the quantity of fusel oil in the vapour is equal to the amount in the remanent fluid, and that if the percentage of alcohol is less than 15 per cent., the amount of fusel in the vapour is greater than that in the liquid. It is therefore, by working on proper lines, possible to remove the whole of the fusel from the mash by a single operation. By subjecting the vapours so obtained to a carefully regulated dephleg- mation, the fusel oil condenses, together with the steam and a certain proportion of alcohol ??? in practice 15 per cent. By further cooling the liquid so obtained, the fusel separates out and, being specifically lighter, rises to the surface of the watery spirit, and is then easily removed. This form of still is so arranged that any change from the correct temperature necessary for the adequate separation of the concentrated "feints" into two layers, is auto- matically corrected by the admission of more or less cooling liquor to the refrigerating pipe coiled round the dephlegmating column. The "foreshots" (aldehyde, &e.) are removed by submitting the alcoholic vapour passing up through the main dephlegmater to further purification. The Ilges apparatus yields three continuous streams of fine spirit, fusel oil, and foreshots respectively. Other good forms of modern ' ' patent " stills are those of Luck and Leaker, Pontifex and Wood, and Blair and Campbell.

Patent, grain or silent, spirit is principally used in the United Kingdom in the arts, for blending with malt whisky, and for the manufacture of gin, British brandy, and various liqueurs and cordials. As there are no official figures, it is impossible to state the exact amount of patent spirit which is blended with malt (pot) whisky, but the figures taken in evidence before the Select Com- mittee on British and Foreign Spirits in 1891 indicated that the total quantity of whisky which went into consumption in 1890 was roughly 22i millions of gallons, of which 16 millions represented pot and 6 J millions patent spirit. These figures, however, certainly do not represent the relative proportions of pot and patent spirits consumed as whisky at the present time. Accord- ing to a competent trade authority,

Irish whisky is now ” patent ” to the extent of at least four-fifths, and Scotch whisky to fully two-thirds, of the total amount

SPIRITS

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Various spirits.

consumed. It certainly seems that the taste for a “dry” spirit, i.e., one containing less of the malt or peat flavour characteristic of unblended whisky, is continually in- creasing.

For the production of whisky see under Whisky in vol. xxiv. (9th ed.), and under Distillation (vol. vii.); also above, and under By-Products (below).

Genuine brandy is obtained by the distillation of wine in pot stills, similar in construction to, but smaller, than those employed by Scotch malt whisky distillers. The best brandies, those of the Cognac (Charente and Charente Inf^rieure) district are made from light white wines possessing no marked “bouquet,” but which in distillation yield a spirit of a peculiarly fine and deUcate character. It is remarkable that the fuller and more aromatic wines of the Gironde and Burgundy, for instance, are not so suitable for the manufacture of brandy as the relatively poor growths of the Charente. Apart from the latter, wine-brandy is also distilled in considerable quantities in the Armagnac, Marmande, Nantes and Anjou, and several other districts. The eaux-de-vie de marc obtained (chiefly in Burgundy) from’ the pulp of skins, pips, &o. remaining dn the wine-press, by the addition of water and subsequent fermentation and distillation, are peculiarly rich in aromatic principles.

Bv/m in former times was made almost exclusively from the expressed juice of the sugar cane, but it is now largely obtained either from cane-sugar molasses or from ca,ne-meffasse, that is, the sugar-cane pulp from which the greater part of the juice has been expressed. Fictitious rums, made either wholly or in part from plain spirit and flavoured with essential oils (“rum essence “), are occasion- ally encountered, but this also apphes to other spirits, such as wine and fruit brandies.

Gin is obtained by distilling plain spirit (of varying strength) in the presence of a number of flavouring agents, the chief of which are juniper, angehca, cinnamon, coriander, and sweet fennel. Occasionally flavouring agents are added after distillation. ” Sweetened ” gin contains 3 to 5 (or even more) per cent, of sugar.

Liqueurs may be defined as flavoured spirits of varying alcoholic strength, and sweetened by the addition of cane sugar. They are made (1) by distilling plain spirit with the flavouring agents, and adding the sweetening syrup to the perfumed distillate; (2) by macerating plain spirit with various essences and extracts, filtering, and adding the sugar ; or (3) by adding alcohol and sugar to difierent fruit juices. Absinthe is a sweetened spirit containing 70 to 73 per cent, of alcohol, flavoured with wormwood, fennel, aniseed, &c., and coloured green by maceration with the leaves of the hyssop, mint, and wormwood plants. There is a popular belief to the effect that the green colour is due’ to copper, indigo, or other dye-stuffs, but in fact this is very rarely the case. Genuine Vermouth is obtained by adding an alcoholic extract of a number of flavouring and colouring agents to a fortified white wine, the whole being subsequently matured by exposure to the sun’s rays. The nature and quantities of the flavouring agents employed in the preparation of genuine Chartreuse, Benedictine, and similar Kqueurs are kept strictly secret, but numerous “recipes” may be found in special works dealing with this subject.

The main constituent of spirits is, of course, ethyhc alcohol ??? spirit of wine ??? but all spirits contain small but varying quantities of by-products, and it is by ^^J”Z^ ???, these that the character of a spirit is determined. termenta- The by-products are mamly formed during ter-tion and rnentation, but are also to a certain extent pre- distiliation. g^jg^gnt in the raw materials, or may be formed during the operations preceding and succeeding fermenta-

tion. The nature of the by-products is complex, and varies sensibly according to the raw materials employed and the methods of malting, mashing, fermentation, and distillation.

The by – products may be classified as follows : ??? (a) Higher alcohols ??? usually going under the name of fusel oil ; (6) compound ethers ; (c) fatty acids ; (d) fatty aldehydes and acetals ; (e) furfurol ; (/) terpene, terpene hydrate, and ethereal oils ; and (g) vftlatile bases. The higher alcohols. These consist of mixtures of fatty alcohols containing three or more atoms of carbon (CnH^n+iOH), in which, as a rule, amyl alcohol (CjHuOH) predominates. The fusel oil of British pot still spirits (whisky) is chiefly composed of amylio and butylic alcohols, whereas in patent spirits propylic alcohol is the preponderating factor ; that is, in the finished or fine spirit, for the fusel separated from patent spirit in the course of distillation consists mainly of amylio and butylic alcohols. Broadly speaking, the higher alcohols present in pot are of higher mole- cular weight than those in patent spirits. Potato fusel contains a high proportion of isobutylic, grain fusel of n. butylic, alcohol.

The formation of fusel oil is dependent on many conditions. It has been shown that at the commencement of fermentation, when the yeast is young and vigorous, very little, but that towards the end of this stage a relatively large quantity, is produced. Lindet found the amount formed thirty-eight hours after pitching to be 1‘78 c.c. (per 100 c.c. of alcohol), and after seventy-two hours, 14‘07 c.c. The presence of a large volume of yeast tends to check the production of fusel, probably owing to the overwhelming mass action of the yeast on the bacteria that may be present. Further, it is a fact that certain organisms form specific alcohols. Thus Perdrix has described a fission fungus which produces amyl alcohol, and Beijerinck has proved that B. granuloiacter hutylicuTii is re- sponsible for the fonnation of isobutylic alcohol. Nevertheless there is considerable evidence to prove that the tnie yeasts are under certain conditions capable of giving rise to the formation of fusel oil. The acid present in spirits is chiefly acetic acid, but small quantities of other acids are also found. The compound ethers, formed by the interaction of alcohols and acids, chiefly during the fermenting and distilling operations, consist almost entirely of fatty acid radicles in combination with ethyl and, to a minor extent, amyl alcohol. Ethyl acetate (acetic ether) is the main constituent of the compound ethers, the others being mainly valerate, butyrate, and propionate of ethyl. OEnanthic ether (pelar- gonate of ethyl) is one of the characteristic ethers of brandy.

Furfurol, the aldehyde of furfuran, one of the chief decomposition products of the pentoses ??? is invariably present in new pot, but rarely in patent, spirits, and it seems fairly certain that the pre- sence of relatively large quantities of this substance in pot-still spirits is mainly due to the charring effect of the direct action of the fire gases on the carbonaceous matter adhering to the bottom and sides of the still. Terpene and terpene hydrate are character- istic constituents of grain fusel. Although the ethereal oils appear to play an important part in determining the character of a spirit, too little is at present known of these substances to warrant any closer description.

That potable spirits (excepting, of course, pure alcohol) and wine are greatly improved by age is an undeniable fact, and one that has been recognized for many -^ effect hundreds, and even thousands, of years. Thus of matur- in the Gospel of St Luke we have the statement Ing on the "that no man having drunk old wine, straight- by-pro- way desireth new ; for he saith. The old is better." And again, in the Apocrypha, " New friends are like new wine : when it is old, thou shalt drink it with pleasure." There is Little doubt that the beneficial effect of age on the character of spirits is due to the changes effected in the character and quantity of the by-products j but the exact nature of these changes is by no means clear. Such improvement as takes place is apparently connected in some way with the free access of air to, or rather the satisfactory ventilation of, the containing vessel ; for spirits preserved entirely in glass undergo relatively httle change, either in taste or in chemical composition, whereas cask storage materially affects both these factors.

Concerning the changes in the higher alcohols, consider- able divergence of opinion exists, and it is, to say the least, doubtful whether the fusel oil, to which the baneful effects of new or raw spirits were formerly ascribed, actu- ally does decrease with age. The experience of the author is rather to the contrary. With regard to the compound ethers, the general belief up till a few years ago was that

these bodies tend to increase witli age, and it is to their development that the bouquet of spirits (as well as of wines) is mainly due. More recent investigations tend to throw doubt on this theory (although it may be true enough in particular cases). The author is inclined to favour the view that the ethers as a whole do not materi- ally increase, and that with regard to the bouquet, the ethereal oils play a part at any rate equal in importance to that of the compound ethers.

Coming next to the acids, there is a consensus of opinion that they increase with age, both in the case of whisky and of brandy; and as increased acidity implies oxidation, there is little doubt that this factor to a great extent connotes age or improved condition. The aldehydes in whisky have been little investigated, but on the whole the results obtained seem to indicate an augmentation during maturation. In the case of brandy, the published analyses show a sensible increase of aldehyde with age. From the latest investigations it appears more than prob- able that the elimination or modification of furfurol and other pyro compounds (probably of an aldehydic and creosotic or phenohc nature) formed by fire action in the pot still, plays an important part in the improvement of spirits.

The following are analyses of whiskies and brandies of various ages and conditions : ???

WhisTcies.

(Excepting the alcohols, results are expressed in inilligrammes

per 100 c.c. alcohol.)

Description and Age,

&c.

s a?

If

_?_?_?s

_?_?_?St,

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1

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-8

Scotch. All malt (un- blended). New * .

Scotch. All malb (un- blended. 4 years *

Scotch. Ordinary Com- mercial (blended). Age ?

62-22 60-45 47-66

25-4

31-1

138-7

11-4 13-6 18-4

6-6 4-3 1-7

62-2 69-4 88-2

208-9 236-6 182-6

313-6 354-8 424-6

I.

11.

III.

Brandies.

Genuine. New Genuine. 36 years . Factitious . Ordinary Commercial

67-7 47-5 47-6 44 6

60-6

202-1

50-6

83-1

6-9 48-1

0-4 11-8

1-3 1-3 0-1 1-3

168-3 133-3 25-8 129-0

151-9

346-4

10-6

273-8

367-0 730-1 87-3 499-0

IV.

V,

VI.

VII.

Physio- logical effects of spirit by- products.

*Note. ??? Analyses I. -III. and VII. by the author, Nos. IV.-VI. by Lusson. * These samples represent the same quality of spirit from one distillery, and are therefore fairly comparable.*

The nature of the physiological effects produced by the ingestion of spirits varies considerably, not only according to the class of spirit {i.e., whether whisky, brandy, rum, etc.) consumed, but also with the condition of the same (i.e., whether new or old, and so on) ; and there is no doubt that the causation of these phenomena is intimately con- nected with the nature and quantity of the by-products, to which, as has been already said, the character of the spirit is due. Commenting on a statement in Bailey's Book of Sports to the effect that wine and brandy had a tendency to make a man fall on hia side, whisky to make him fall forward, and cider and perry to make him fall on his back, Lauder Brunton {Evidence, Spirits Committee, 1891) suggests that these statements ??? if correct ??? might indicate definite injury to various parts of the cerebellum. Thus if the anterior part of the middle lobe of the cere- bellum is injured, the animal tends to fall forward ; when the posterior part is affected, the head is drawn backwards,

&c. Brunton is inclined to believe that the varying action of different spirits may be due to the specific action of specific products on the separate nerve centres. Thus the cause of the epileptic convulsions produced by the in- jection of absinthe has been traced to the specific action of the chief flavouring agent of this liqueur.

In -view of the doubt -which modern research has thro-wn on the older theories, to the effect that the improved character of a mature, as compared -with a ne-sv, spirit is due to the decrease in the quantity of the higher alcohols {i.e., the fusel oil), a discussion of the specific action and

relative toxicity of these tsodies may seem superfluous, more especially as they occur in quantities -which are apparently incapable of producing serious effects. As, however, there is considerable reason for believing that the higher alcohols do influence, at any rate, the flavour of the spirit, and the evidence as to the non-disappearance of these substances during maturing is not all on one side, a brief reference to their physiological action seems to the author not out of place. Broadly speaking, the toxicity of the fatty alcohols increases "with their molecular weight. Dujardin-Baumetz and Audig^ found that the lethal dose for dogs was 5-6 grammes per kilo-body- weight for ethyl (ordinary) alcohol; 3-75 grammes for propyl alcohol ; 1-8 grammes for butyl; and 1-5 grammes for n. amyl alcohol. It is interesting to note that the experiments of these investigators were conducted chiefly with the pig, as the digestive organs of the latter animal are very similar to those of man, and also because the pig is apparently the only animal which willingly takes alcohol with its food. With regard to the action of spirits generally, the investigators named above found that the digestive organs of pigs fed for thirty months ~~with pure alcohol alone were not affected, whereas the animals treated with similar quantities of imperfectly purified spirit (whether de~~ rived from the beet, the potato, or from grain) sufiered considerably.

Of late years the attention of pharmacologists has been directed to furfural especially, and the aldehydes gene- rally, as being, at any rate in part, the cause of the. un- pleasant after or by-effects of certain spirits. Curci and others have shown that furfurol in certain doses is poisonous to animals ; and Brunton and Tunnicliffe have demonstrated a poisonous action of this substance upon man, and have compared the after – effects upon animals of spirits containing, and freed from, aldehydes, and have found certain important physiological differ- ences between them. Guareschi and Mosso first drew attention to the fact that numerous samples of reputedly pure spirits contained small quantities of certain volatile bases of an alkaloidal nature. They apparently belong to the p3Tidine series, and have effects similar to those of strychnine. Bamberger and Einhorn have dis- covered the presence of pyridine, dimethyl pyridine, and other bodies belonging to the same series, in commercial fusel oil. It is possible that the existence of these volatile bases in spirit may have given rise to the ??? on the face of it absurd

suggestion that wood spirit and tar bases have been used as adulterants of whisky. It appears likely that the formation of the bases in question is connected ~~with the use of inferior or decaying grain or maize. Thus the spirit produced in Sweden in 1879 was particularly bad and had very curious effects, and it was found, on investi~~ gation by Husz, that it had actually been largely prepared from decomposing grain. Moreover, Lombroso discovered an alkaloidal body in decayed maize, the action of which was not unlike that of strychnine. The quantities of these bases which have been found in spirits are very small, but it must be remembered that substances are known such as abrine, for instance which have marked effects in practically unweighable quantities. It is possible that these volatile bases may be responsible for some of the effects very similar to alkaloidal poisoning produced by crude spirits such as Cape " Smoke " and the cheap Portuguese liquors.

*Having described the nature and effects of spirit by- products, and the changes occurring in them during storage, the question that arises is : How is the knowledge gained by scientific research in this direction applied in practice *

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Itjnaybesaid that the old adage "Prevention is better than cure" holds good in the spirit industry as elsewhere, and the dis- tiller, therefore, tiies as far as possible to avoid the formation of those by-products which are objectionable, or at any rate to remove them during tlie course of manufacture. These methods for obtahi- ing a satisfactory potable spirit are so far, however, only successful up to a certain point, and the distiller is therefore bound to have recourse to prolonged storage or to one of the many artificial pro- cesses of purification and maturing, the majority of which have been devised with varying success dming recent years. Refer- ring, in the first place, to what may be called the natural or "preventive " methods for the production of a weU-flavoured spirit, it is necessary (a) that the water-supply (for steeping, mash- ing,

*&c.) be a good one ; (A) that no mouldy or inferior material be used ; (c) that mashing heats be kept within reasonable limits ; (d) that refrigerators be constructed so as to avoid bacterial infec- tion ; (e) that the "souring" of the wort be conducted on proper lines ; (/) that a favourable and vigorous type of yeast be used ; {g) that the mash be cleared as far as possible of yeast, grains, &c., prior to distillation ??? stills are now constructed which automatically filter the mash ; (A) and that stills, &c., be kept perfectly clean. Coming next to the methods ordinarily or frequently employed by distillers for eliminating the undesirable by – products, which, despite all care, are found in the course of manufacture, the most important undoubtedly is purification by rational fractional dis- tillation. By properly regulating the distilling heats, by using a well-devised still, both in the first instance and also for rectifying, a product very free from fusel oil, and especially from fatty alde- hydes and volatile ethers, may be obtained. The removal of acids ??? objectionable chiefly on account of the unpleasant decomposition products which they form in still ??? is carried out by neutralizing the still contents with an alkaline medium. The alkali so used also decomposes undesirable compound ethers, and retains some of the aldehydes by converting them into non-volatile polymers. For the elimination of fusel oil, filtering through charcoal is the most common method. Luck has suggested for this purpose the passing of the alcoholic vapours through petroleum, which is said to absorb the higher alcohols much more easily than it does ordinary spirit ; and some distillers have successfully tried the method of Traube, which consists in treating the spirit with a saturated aqueous solution of various inorganic salts. This causes the formation of a supernatant layer, which is said to contain practically all the fusel oil as well as the greater part of the foreshot by-products, i.e., fatty aldehydes, &c.^*

Finally, there remain for consideration the artificial Tnaturing processes. These are exceedingly numerous, but it may be said at once that the great majority of them are hardly to be taken seriously. Thus one inventor, acting on the alleged fact that spirits are improved by lengthy journeys, suggests that a miniature railway, with numerous obstacles to augment the rolling and shaking action, be laid down in the distiller's warehouse ! Of the methods worthy of consideration may be mentioned, firstly, those

depending solely on the action of currents of air, oxygen, and ozone. They exist in numerous modifications, but the principle involved, broadly speaking, is to pass a current of hot or cold air or oxygen, or alternate currents of hot and cold air, or a current of ozonized air, through the liquid, with or without pressure, as the case may be. According to the patent of Mills and Barr, new whisky rapidly acquires the character of the mature sherry-cask stored spirit if the action of alternate hot and cold air currents be assisted by the addition of a little sherry and a minute trace of sulphuric acid, the latter being subse- quently neutralized by lime. Secondly, there are the processes wtich make direct or indirect use of the electric current. Of the indirect methods in this class may be mentioned that of Hermite, which consists essentially in adding an electrohzed solution of common salt to the spirit, and subsequently redistilling. Thirdly, the pro- cesses which rely on accelerating natural cask action by artificially reproducing the conditions attendant on the latter in a purposely exaggerated or heightened form.

1 The above applies chiefly to grain or " silent " spirit, in the manu- facture of which a product which is practically pure alcohol is desired. These methods can only be used to a hmited extent by whisky and brandy distillers, for a complete removal of by-products also entails destruction of the spirit's character.

One method strives to obtain this object by heating the spirit under pressure in an atmosphere of oxygen in a vessel containing a quantity of oak shavings. This pro- cess certainly seems calculated to remove a portion of the by-products, for the "grog" obtained in Allen's experi- ments by steaming the staves of an old whisky cask, con- tained appreciably more fusel oil and compound ethers than commercial whisky. Fourthly, we have the methods chiefly dependent on the action of cold. Pictet, by cool- ing a new brandy to – 80 ◆◆ C, is said to have obtained a Uquid which had apparently acquired the properties of a twelve-year-old spirit. Scott's process consists in energetic- ally treating spirit which has been cooled down to 0 ◆◆ C. with dry filtered air, and the operations are so conducted, it is said, that there is no loss of alcohol or of the important aromatic ethers. According to the published data, the quantity of the fusel oil is materially reduced by this method, and the quality of the spirit much

improved. None of the above processes have apparently (although in practice they may give satisfactory results) been devised with a view to effecting the direct removal of those specific substances (furfurol, other aldehydes, and volatile bases) which later research has shown to be present to a greater extent in new or inferior spirits than in the matured or superior article, and to some of which, at any rate, owing to their acknowledged toxicity in very small quanti- ties, it is more than reasonable (as Lauder Brunton and Tunnicliffe have pointed out) that at least a part of the evil effects produced by drinking new or inferior spirit may be ascribed. In this connexion a patent taken out by J. T. Hevritt is of interest, inasmuch as it deals with the problem of spirit purification on seemingly rational scientific lines. This patent takes advantage of the fact that furfurol and similar aldehydic bodies can be removed from spirits by distillation with phenyl-hydrazine- sulphonate of soda, which salt forms non-volatile products with the substances in question. (p. s.)

SpitsbergfOn (the name being Dutch is incorrectly spelled with z), an Arctic archipelago, almost midway between Greenland and Novaya Zemlya, in 76 26'- 80 50' N. and 10 20'~~32 40' E.,~~ ~~comprising the six large islands of West Spitsbergen or New Friesland,~~ ~~North~~ East Land, Edge Island, Barents Island, Prince Charles Foreland, and Wiche Islands, and many small islands divided by straits from the main group. Later ex- ploration has shown the character of the interior of West Spitsbergen. In comparatively recent geological times this, the main island, was over most of its area a high plateau covered with an ice-sheet, which has gradually been withdrawn from the west towards the east, the western region being thus cut up into deep valleys and more or less rugged mountains. Farther east the mountains are more rounded, but stiU farther east the plateau character of the land remains. At the north-west angle of the island is a region of bold peaks and large glaciers, in the midst of which is Magdalena Bay, " the pearl of Arctic scenery." Farther south come the series of glaciers called by the whalers " The Seven Icebergs," which drain a high snowfield reaching east almost to Wood Bay and south to the head of Cross Bay. On the south-east it is drained by glaciers towards or into Dickson and Ekman Bays. South of this snowfield comes the mountainous King James Land, consisting of an intricate network of craggy ridges with glaciers between. A deep north

and south depression is occupied by Wijde and Dickson Bays, bordered on the west by a range of fine mountains, a spur of which separates the two bays. East of this depression the plateau region occurs. Its edge is eaten away into deep valleys, down which the ice-sheet of

New Friesland sends glacier tongues into Wijde Bay. East of Dickson Bay the marginal valleys are larger, and no glaciers come far down them. The plateau between Dickson and Klaas Billen Bays is cut up by deep valleys such as the Kendal, Skansdal, and Mimesdal (all well known to geologists); it contains no big glaciers. Farther east is found a glaciated area called Garwood Land. The neck of West Spitsbergen is bounded on the N. by a line from near the head of Klaas Billen Bay to Wiche Bay, and on the S. by the Sassendal and the depression leading to Agardh Bay. It is a complicated area of fine craggy ridges with beautiful glaciers between. Adventure Land lies south of the neck, and is bounded on the S. by a line from the head of Van Keulen Bay to Whales Bay. It is an area of boggy valleys, rounded hills, and small glaciers, and may be described as the temperate and fertile belt, and is the only part of the island where many reindeer still linger. Near the west coast it contains some fine peaks and large glaciers. It is penetrated by the longest green valleys in Spitsbergen, e.g., from Coles Bay, Advent Bay, and Low Sound (the valley of the Shallow river). The southern division of the island is very icy. There is a high snowfield along its east side, and ranges of peaks farther west. Two parallel ranges form the backbone of the island south of Horn Sound, the higher of them containing the famous Horn Sund Tind (4560 feet). Of the remaining large islands, North-East Land is covered vrith a true ice-sheet, while the neighbouring Wiche Islands sustain no large glaciers at all. Neither Barents Land nor Edge Island carries ice-sheets, and both are practically devoid of glaciers down their western coasts, but have large glaciers reaching the sea on the east. Prince Charles Foreland consists of a range of fine moun- tains, interrupted towards the southern end of the

island by a flat plain of 50 square miles raised only a few feet above sea-level. There is a narrower depression a few miles farther north.

The nomenclature is in a state of hopeless confusion, the names given by the old explorers having been carelessly transferred from point to point, or capriciously set aside. The true names, English and Dutch, of the principal mis- named sites are here indicated in brackets after the current names : ❓❓❓ South Cape (Point Look-out), Torrel's Glacier (Slaadberg), Kecherche Bay (Joseph's Bay, Schoon- hoven). Van Keulen Bay (Lord Ellesmere Sound, Sardam- mer Rivier), Van Mayen Bay (Low Sound, Klok Piivier), Coal Bay (Coles Bay), Advent Bay (Adventure Bay), St John's Bay (Osborn's Inlet), English Bay (Cove Comfort- lesse). Foreland Sound (Sir Thomas Smith Bay, Keerwyk), Cross Bay (Close Cove), the bay called Smeerenbui'g (Fair Haven, Dutch Bay), Flat Hook (Fox Point), Biscayers' Hook (Point Welcome), Redbeach (Broad Bay), Liefde Bay (Wiche Sound), Grey Hook (Castlin's Point), Wijde Bay (Sir Thomas Smith Inlet), Verlegen Hook (Point Desire), Treurenberg Bay (Bear Bay), Agardh Bay (Foul Sound), Storfiord (Wyl)e Jans Water), North-East Land (Sir Thomas Smith Island), North Cape (Point Purchas). Stans Foreland is not the name of Edge Island, but of its south-eastern cape only.

Over 130 species of flowering plants have been found. Reindeer are ajjproaching extinction ; the theory that thry came over the ice from lands to the east is now of course abandoned. The walrus is still occasionally seen in the waters of West Spitsbergen. Birds are rapidly diminish- ing in numbers, eider ducks being noticeably fewer of late years.

History. ❓❓❓ All the purely modern expeditions ❓❓❓ Swedish (1890, 1892, 1896, 1898), German (1889, Kiikenthal ; 1891, Cremer), Frenc-li (1S92, La Manche), Austrian (1891, 1892), and British (1894, Fielding; 1895,

H. M. Training Squadron) ❓❓❓ were sailing expeditions, and confined their attentions almost entirely to the coast. In 1892 M. Rabot made the first serious attempt to penetrate the interior from the head of Ice Fiord, exploring a part of the Sassendal ; and in 1896 Sir Martin Conway led an

exijedition which crossed the island for the first time, and surveyed the region between Ice Fiord and Bell Sound on the east coast. In 1897 Conway and Garwood surveyed the glaciated area north of Ice Fiord to about 78 10′ N., and climbed Horn Sund Tind. In the same year Herr Andre made his fatal balloon ascent from Dane's Island with the intention of floating over the Pole. The first tourist trip to Spitsbergen was made by a small Hammer- fest steamer in 1871. In 1896 a weekly service of Norwegian steamers was established in summer, and a small inn was built at Advent Bay in Ice Fiord. The west coast is now frequently visited by tourist steamers during the height of summer.

Authorities. Important paperson the geology by Nordenskiold, Gregory, and Garwood will be found in the Journal of the Geological Society ; on birds in the Ibis ; on exploration in the Journal of the Royal Geographical Society ; but the chief source of scientific papers is the publications of the Swedish Vetenskaps Akademie. A few descriptive works are : W. Scoresey. Accowrd of the Arctic Regions. Edinburgh, 1820. J. Lamont. Yachting in the Arctic Seas. London, 1876. Th. v. Henglin. Reisen in 1870, 1871. Brunswick, 1872-74. W. M. Conway. First Crossing of Spits- bergen. London, 1897. Arctic Glaciers. London, 1898.

(w. M. C.)

Spoka.ne, a city of Washington, U.S.A., capital of Spokane county. It is situated in 47 40′ N., and 117 25′ W., on both sides of the river Spokane, at the falls, in the eastern part of the state, at an altitude of 1910 feet. It is regularly laid out on a level basalt plain, and has excellent water supply and sewerage systems, but few of its streets are paved. It is the chief city of eastern Washington, and the largest place between Butte, Montana, and the Pacific coast. The city is entered by the main transcontinental lines of the Northern Pacific and of the Great Northern ; it is the north-eastern terminus of the Oregon Railway and Navigation Company, and the terminus of the Spokane Falls and Northern Railway. Spokane river here falls over a succession of beds or flows of basalt, affording magnificent water-power, which has been utilized for manufactures, for operating street cars, and for electric lighting. The

possession of this power is making Spokane a manufacturing city. It has many flour mills, supplied from the great wheat fields of eastern Washington, and lumber mills, for which tribute is levied on the yellow pine forests to the north and east, and smelters for the ores of north-eastern Washington and British Columbia. In 1900 there -vxcre 213 manufacturing establishments with a capital of $2,678,823, employing 1779 hands, and having a product valued at $5,427,540. The assessed valuation of real and personal property was in 1899 $19,479,2.“i2, the net debt of the city was $2,868,977, and the rate of taxation was 837-00 per $1000. The city dates from 1S77, but in 1880 it had only 350 inhabitants. Upon the completion of the Northern Pacific Railroad in 1884 a boom commenced, resulting in a popu- lation in 1890 of 19,992. Immediately after the taking of the census in August 1890, the city was almost totally destroyed by fire. It was, however, quickly rebuilt, and in a much more substantial form. In 1900 the population was 36,.S48, of whom 7833 were foreign-born and 747 coloured, including 376 negroes. Of 14,944 males 21 years of age and over, 304 were illiterate (unable to write).

SpoletO, a town and archiepiscopal see of the pro- vince of Perugia, Umbria, Italy, 18 miles north-north-east of Terni, and 88 miles north by east of Rome by railway. Traces of the Roman theatre (375 feet in diameter) were

unearthed in 1891. The citadel, which stoutly resisted the Piedmontese in 1860, is now a convict prison. In 1892 the city was adorned with a monument to Victor Emmanuel. The principal industries are the collection of truffles and the preparation of preserved foods. Popula- tion (1881), 11,885; (1899), about 12,000.

Sponges. ??? The growth of our scientific knowledge of the phylum of the sponges has been more rapid during recent years than in the case of any other group of the animal kingdom. This statement is especially true with regard to those fundamental facts of development and life- history which are all-important for a proper understanding of the affinities of the

grou}) as a whole, and for deter- mining its natural position in the scheme of classification of animal life. Formerly there was scarcely any problem in natiu'al history more puzzUng and obscure than that of the embryonio. development of sponges, considered from the comparative stand- point. Kesearches, it may be fairly claimed, have brought order oiit of chaos, and rendered it possible to trace a common plan through the various types of sponge- development.

As may be seen by reference to the article Sponges in the 9th edition of the Encydopcedia Britannica, it seemed for- merly as if the " amphiblastula " type of development, characteristic of the greater number of Calcarea, was in contrast in essential points wiuh the "planula" or " parenchymula " type found in the great majority of sponges, even in many Cal- carea. In the development of Sycandra (loc. cit.. Fig. 25), so thoroughly investi- gated by Metschnikoff and Schulze, the ciliated cells of the larva were proved to become the collared epithelium (so-called endoderm) lining the gastral cavity of the adult. In all other sponges, however, it was alleged that the destiny of the ciliated cells of the larva was to furnish the outer or dermal layer (so-called ectoderm) of the adult. The latter notion, in spite of the many apparent instances upon which it was based, has proved to be simply an error of observation or interpretation, originating to a great extent from the assumption that in view of the great similarity between sponge-larvse and Coelenterate planute, the destiny of their component layers and their share in building up the adult body would be the same in the two phyla. As a matter of fact, however, the development of the sponge-planula proceeds in a manner precisely opposite to that of the very similar larva of Coelenterates, and agrees with the amphiblastula-type as regards the fate of the layers. It has now been shown in all sponges which have been carefully investigated, that the fate of the cili- ated cells of the larva is to become in the adult the coUar-ceUs, lining the gastral cavity or the flagellated chambers, and no other cell-elements but these. Where the remaining cells are so placed as to form the inner mass of the larva, a complete reversal of the two layers takes place at the metamorphosis. The inner mass in such cases (planula-type) passes to the exterior, on the fixation of the larva, and after surrounding the formerly external ciliated cells becomes the dermal layer of the adult. In other cases (amphiblastulartype) the cells of the future

dermal layer are placed not in the interior, but at the hinder pole of the larva as in Sycandra. The metamorphosis

is then correspondingly simpler, and the dermal cells, which usually mark the posterior non-ciliated pole of the larva, simply grow round the ciliated gastral cells, a pro- cess which may begin in Sycandra even before fixation. In Oscardla, however (and perhaps also in Plakina), the superficially placed cells of the dermal layer are also cOiated, both at the hinder pole of the larva and when forming the flat epithelium of the external surface or of the canal-system of the adult.

The most primitive type of sponge-larva is probably to be seen in the Ascons among Calcarea, or in Oscarella among Demospongia:. In the former the larva is .set free in the genus Olathrina (Fig. 1, A, B) as an oval ciliated blastula, carrying a small number of nn- diflferentiated blastomeres or archceocytes, usually marking the hinder pole, and destined to become the wandering and reproductive cells of the adult sponge. During larval life an inner mass of cells is formed by differentiation and immigration of cells from the ciliated layer. The result is a parenchymula larva, with (1) an outer layer of

, 1. ??? Types of sponge larvse (semidiagrammatic). The ciliated (gastral) cells are left blank, the dermal cells are shaded, aDd the archseocytes are gi-anulated. A, larva of Clatkrina blanca; B, of Clathrina reticulum,; C, young larva of Leucosolenm (or pseudogastrula stage of Sycrni) ; D, older larva of Leucosolenia (or newly hatched larva ol Sycon); E, larva of Oacarelta ; F, of a silicioua Monaxonld sponge (Myxilla).

ciliated cells (gastral layer), (2) an inner mass of non-ciliated rounded elements (dermal layer), and (3) the archseocytes ; the latter may be of large size and few in number, protruding from the surface at the hinder pole (Fig. 1, A), or of small size and more numerous, and lodged in the interior (Fig. 1, B). The larva fixes itself and the inner mass breaks out and surrounds the ciliated cells. Two types of parenchymula may be distinguished according as the immigra- tion takes place at any point (multipolar, Fig. 1, A) or only at the hinder pole (unipolar, Fig. 1, B). The latter condition is only possible when the archEeocytes are lodged in the

interior, as in CI. reticulum, and it leads by a simple modification to the well-known amphiblastula-larva of Leucosolenia and Sycaridra. To understand the origin of the amphiblastula it is only necessary to imagine that in a parenchymula, such as that of CI. reticulum (Fig. 1, B), the shape and disposition of the ciliated cells become such as to greatly reduce the internal cavity, so that the archseo- cytes alone suffice to fill it (Fig. 1, C). Then the dermal cells formed by modification of the ciliated cells at the hinder pole can- not pass inwards, but must remain where they are. The result is an amphiblastula-larva with an anterior ciliated pole, a posterior non-ciliated pole, and a central mass of archaeocytes (Fig. 1 D). At first the non-ciliated posterior cells are few in number or absent (so-called pseudogastrula stage), but as they are con- tinually being formed by modification of the ciliated cells at the hinder pole, the surface of the larva is ultimately made up of the two kinds of cells in approximately equal proportions. The larva

is then ready for fixation, an event preceded in Sycandra by the commencing growth of the non-ciliated cells round the others.

Oscarella (Fig. 1, E), on the other hand, has an oval blastula with a very large internal cavity. The cells at the posterior pole are all destined to become dermal cells, but for the most part retain their cilia and do not immigrate. Only a few lose their cilia and pass to the interior, representing, probably, the archseocytes and the connective-tissue layer of the adult, while those remain- ing at the surface become the ciliated dermal epithelium. Oscarella is the most primitive of the Demospongice, and its larva may be taken as the prototype of the other forms, in this group. No larvEe are known as yet in Tetradinellida, a gap in our knowledge for which it is difficult to account satisfactorily ; but in Monaxo- nida and Keratosa a type of larva occurs which may be derived from Oscarella by supposing (1) that all dermal cells are non- ciliated, as in Calcarea^ whether superficial in position or not ; (2) that the dermal cells are placed internally in the larva, either com- pletely filling up the interior, or leaving a small excentric cavity, as in Spongilla; and (3) that

the cells of this inner mass have become precociously differentiated to form the various classes of tissue cells found in the adult, so that the larva after fixation has but to rearrange its cells during the metamorphosis, and then finds itself, so to speak, in working order. It is clear that a great saving of time is effected by this precocious histogenesis, and the period of development is greatly sliortened. Two sub-types can farther be recognized in the larvje of Demospongice ; in the Keraiosa and in Spongilla the ciliated gastral layer completely surrounds the non-ciliated inner mass of dermal cells, bnt in other ilonaxonida the inner mass is exposed and protrudes at the hinder pole (Fig. 1, F). Further differentiations among Monaxonid larvae correspond in a striking way to the systematic divisions of the group.

Recent discoveries in sponge-embryology have a very considerable bearing upon the problem of the position of sponges in the animal kingdom. Although it cannot be said that any one theory of their actual place in nature is as yet definitely proved and established to the exclusion of any other, it is at least possible to narrow the con- troversy and to eliminate that view in particular which has hitherto been most dominant in zoological literature, the theory, namely, especially associated with the names of Leuokart and Haeckel, that sponges are to be included, in a phylogenetic sense, amongst the Coelentera. Any speculations as to the relations of sponges to other animals must take into consideration their larval as well as their adult structure, and from both these points of view the theory of their coelenterate affinities was formerly con- sidered to be as completely established as it now appears, with a better knowledge of the facts, to be overthrown. For if the larvae of sponges and of the Coalentera be compared, and their layers homologized in accordance with their relative positions, then the adult animals must appear totally dissimilar from the morpho- logical point of view, since the corresponding layers occupy reversed positions in the two cases. If, on the other hand, the layers composing the body of a simple sponge be homologized with the corresponding layers of a typical Coelenterate, then sponge-larvae appear altogether anomalous, since they must be regarded from this standpoint as having a ciliated enrloderm, often derived from micro- meres, surrounding partially or even com- pletely a non-ciliated ectoderm, often derived from mncromeres. It would seem, there- fore, that at the present

day only two views of the morphology and affinities of sponges are possible. On the one hand, they may be regarded as composed of the same two primary germ-layers as other Metazoa, inheriting these layers from an ancestor common both to them and to the Coelentera, and puisuing the same course of de- velopment up to the end of the larval period. From the metamorphosis onwaids, ho^^'cver, sponges go their own way, the ciliated ectoderm passing inwards to become the

gastral layer or collared epithelium, while the endoderm, usually non-ciliated, passes out to become the dermal layer, i.e., the contractile flat epithelium and the skeletogenous layer. This view, formerly put forward by Balfour, is now upheld by Maas and Delage, and is expressed by the name Enantioderma or Enantio7.oa (evavrios, inside out),

coined by the last C named for the phy-

lum. On the other hand, the anoma- lies of sponge- development, coupled with the invariable pres- ence in sponges of the peculiar collar- cells, have led many to separate them altogether from other Meta- zoa and to regard them as a group sejaarately de-

scended from the Protozoa, and in particular from the Choanojlagellata. On this hypothesis sponges must have acquired independently a mode of development by means of ova fertilized in the usual way, which segment and form an embryo with two germ-layers similar to, but not homologous with, the germ -layers of the jNletazoa sens, strict. This view was put forward by Biitschli and SoUas, and was formerly supported by Delage ; it is expressed by the term Parazoa, coined for sponges by Sollas, and signifying a group distinct from, but in many respects parallel to, the true Metazoa (see Lankester [11], pp. 1 and 158). To give a final decision between these two views is not possible in the present state of knowledge.

In many other fields our knowledge of sponges has received noteworthy extensions, to which only brief reference can here be made. The splendid monogi-aphs of Schulze [14, 15, 16] have made the Hexactinellids one of the best-known groups of sponges, save only as regards life-history and development, for the study of which their habitat in the abyssal depths of the ocean makes them inaccessible. Schulze [17] has also made known

the minute structure of the collar-cells of Hexactinellids (Fig. 2), and has thus brought them completely into line with other forms of sponges. It is, however, amongst the Calcarea that the most striking discoveries have been made. A very important type of

Fig. 2. ??? Three collar-cells of Schaudinnia arctica (Hexactinellid), after F. E. Schulze. n, nu- cleus ; Jl, flagellum ; c, collar.

p.s~

Fig. 3. ??? .t .sV/-osc/(;m ivilleyana, Lister. A, the sponge magnified about three diameters; p.s upi)er surface carrying the openings of the canal-system ; 6, base of attachment. B, sec Hon of the skeleton ; sph, spherules ; c, canals. (Drawings by Mr J. J. Lister.)

sponge has been found by Willey in the Western Pacific, and described by Lister [7] under the name of Aslrosclera mlhyana ; another specimen of it has been found by Kirkpatrick [6] in a collection from Funafuti. Astrosrlera (Fig. 3) has a calcareous skeleton, composed, howe^'cr, of aragonitc and not of calcite as in the true Calcarea. The skeleton takes the foi-m of spherules, each

of wliich is secreted in u, single cell, and grows until it fuses with other spherules to form a compact, rigid skeleton, traversed by channels and passages containing the soft tissues and canal-system. Another interesting calcareous sponge has been dtsoribed by Doderlein [2] from Japan, under the name of Petrostrovia schulzei. It represents a new sub-family of the Pharetronidce, termed the lAthonina, in which the calcareous spicules forming the main skeleton of the body are fused together to form a rigid frame- work. Hinde [5] has described other species of genuine Lithonina from the Eocene of Australia, including a new genus Pleclroninia, and Kirkpatrick [6] has discovered a species of Pleclroninia amongst a collection of recent sponges from Funafuti. In other fields the researches of Minohin [12] upon the histology and spicule – formation of Ascons

have shown the artificiality of Haeckel's system of the Calcarea and paved the way for a natural classification, while the investigations of Maas [10] upon the post- embryonic growth of Sycons have brought out clearly the important fact that the flat epithelium lining the gastral cavity and efTei'ent canal-system is derived from the dermal layer, and not in any way by modification or flattening of the collared gastral layer, as for- merly supposed on purely theoretical grounds. We also owe to this author the first accurate observations [9] upon the fertilization and m aturation of the ovum, processes which are found not to differ essentially from those typical for other ani- mals. In silicious sponges (Demospongice) the monograph by Top- sent [18] upon the sponges of the coast of France will be of the greatest value in helping to clear up the confusion of nomen- clature which has pre- vailed with regard to sponges of the British Fauna ever since the publication of Bowerbank's well-known monograph (Ray Society). In fossil forms Hinde [4] has described two remarkable extinct groups of silicious sponges which appear to be equivalent in systematic value to the Hexactindlida or Demospongice; the first, termed by him Octactinellida, has ootaotinal or 8-rayed megasoleres (Fig. 4), and contains the Silurian and Devonian genus Aslrceospongia, Roemer ; the second, termed Seteraclinellida, has polyaxon megaseleres, and contains two Carboniferous genera, Tholiasterella and Asteractinella (Fig. 5).

In the field of general morphology and histology, recent work has tended to discredit some generalizations or allegations for- merly accepted. In the first place, it is becoming increasingly

Fig. 4. ??? *Spicules of Aslrceospongia. A, oct- actine ; B, hexactine. (After Hinde.)*

pia. 6. Spicules of Heteractinellida. A, typical polyactine;

B, rosette-like form; C, D, E, nail-like forms, C and E in profile, D from below. (After Hinde.)

apparent that the term mesoderm cannot he applied with pro- priety to the skeletogenous parenchyma of sponges, and that they can no more be characterized as " Mesodermalia " than can the Alcyonarians. In the second place, the once much advertised nervous system of sponges has

become in the course of years alto- gether discredited ; and such drawings as Fig. 22 of the article Sponges in the Encydopmdia Britannica (9th edition) are now considered inaccurate or incorrect in every detail.

*Authorities. ��� [1] Delage. ” Spongiaires, ” TraiU de Zoologie Concrete, \i.. Paris, 1899. ��� [2] Doderlein. ” Ueber die Lithon- ina,” Zoul. Jahrhilcher, x. ��� [3] Evans. “The Structure and Meta- morphosis of the Larva of Spongilla lacustris,” Quart Journ. Micr. Sci., N.S., xlii. 1899. ��� [4] Hixde. A Monograph of the British Fossil Sponges. London (Palasoiitological Society). [5] Id. “Calcispoiiges from the Eocene of Victoria,” Qiiart. Journ. Geol. Soc, Ivi. 1900. ��� [6] Kirkpatrick. ” Spouges^trom Funafuti,” Ann. Mag. Nat. Hist., (7) vi. 1900. ��� [7] Lister. “Astrosolera willeyana,” Willey’s Zoological Pesulls. Cambridge, 1900. ��� [8] Maas. “Die Entwioklung der Spougien,” Zool. C’entralbl., v. 1S98. [9] Id. “Ueber Reifung und Befruchtung bei Spougien,” A���

and Whitelegge [5] enumerates the species of Australian sponges with serviceable qualities. A summary of accessions to our knowledge of sponges from the economic point of view will be found in Seurat [3j.

Practical experiments in the cultivation of bath-sponges ha^e been limited for the most part to attempts to propagato sponges by means of cuttings. A number of such trials have been made in Florida, and are summarized by Allen [1] and Whitelegge [5]. The results of these experiments were encouraging on the whole as regards the growth of the cuttings. The chisf difficulty is that of attaching the sponge-cuttings to their sujijiort ; and for the sub- sequent growth, the locality and position chosen for the cutting is all-important. Whitelegge points out that in nature the finest specimens are found on the underside of stones or rocky ledges, and suggests that an inverted position would probably be most favour- able for rapid growth of the cuttings, Wilson [6] and other writers have suggested that sponges might be grown from the "spawn," that is to say, by rearing the larvte in aquaria. There is little difficulty in getting sponge-larvse to fix themselves in captivity and to undergo their metamorphosis into tiny sponges, differing from the parent only in size and sexual immaturity ; but it appeal's to be almost impossible to get the young sponges to grow to any size, or even to increase in dimensions at all, under artificial conditions. It seems possible, however, that young sponges which have been reared in an aquarium might subsequently be placed in the sea, in situations favourable for their further growth. For this it would be necessary that the larviE should be got to fix themselves upon some suitable object, which could afterwards be placed, with the little sponge attached to it, in a favourable locality. Detailed ex- periments upon this method of culture are needed. Even a ques- tion so simple, and yet so important, as that of the time required for a young sponge to grow under natural conditions to a market- able size, is as yet unanswered.

With regard to the regulations of sjionge-fisheries, an important point to be determined is whether it is desirable that a close season should be instituted for sponges or not. A female sponge sends out at the proper season many thousands of larvse, and it is clearly contrary to the interests of the sponge-fishery that the sponge should be destroyed before it has spawned. It would, therefore, be a great gain if the sponges could be

protected until the spawning season is past. Observations are urgently needed in order to ascer- tain whether this is possible. The points upon which information is required may be illustrated by the present writer's experiences with regard to the simple calcareous sponges known as Ascons. In studying the development of this group, it was found that in the family Clathrinidce all the females of any given species were ripe at about the same time, the interval between the earliest and the latest being not much more than a fortnight. Eggs could be re- cognized in the sponges about six weeks before the larvje were emitted. In the family LeucosoUniidce, however, it was found that each species spawned throughout the warmer months of the year, and that, at any time, one specimen might be found with eggs, another with larvae, and a third empty. Clearly, therefore.

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it would be possilile by methodical observations to establish a close season for any species of Glathrinidce, but not so for Leiicosoleniidce. If the various species of commercially valuable sponges were studied carefully from this point of view, it might be found possible to in- crease the numbers of some of the species, at least, by sagacious legislation. The sponges should be protected from the time when eggs are first recognizable in them, until the larvfe have been sent out. It should be the duty of a special commissioner in each loca- lity to determine and report upon such points. There is much work of practical importance yet to be done by naturalists upon sponges.

Authorities. ??? [1] Allen. "Report upon the Sponge-Fishery of Florida and the Artificial Culture of Sponges," Jmurn. Mar. Biol. Assoc, 'R.S.,iv. 1896. ??? [2] Bidder. " Notes on Projects for the Improvement of the Sponge-Fisheries," ibid. ??? [3] Seurat. " L'Eponge," Bull. Soc. Nat. d'Acclimalaiion, 48. 1901. ??? [4] Smith. "The Florida Commercial Sponges," Bull. U.S. Fish. Comm., xvii. 1898. ??? [5] Whitelegge. "Report on Sponges from the Coastal Beaches of New South Wales," Records Austral. Mus., iv. 1901. ??? [6] Wilson.

“On the Feasibility of raising Sponges from the Egg,” Bull. U.S. Fish. Comm., xvii. 1898. The above works may be consulted for further references.

(e. a. M.)

Sporozoa,! ??? The class of Sporozoa, notable botli for the numerous forms included (nearly 600 species) and for its pathological importance, has in the last few years formed the subject of an enormous number of memoirs, which in many points have largely modified the old ideas held about these organisms. Even since the completion of the section Sporozoa in the Tierreich, which included a revision of the entire group up to the end of 1897, works have appeared which have completely changed our knowledge of the life-histories of these forms. Notable among these are the confirmation by Simond, Schaudinn, and Siedlecki of the old theory of K. and L. Pfeiffer on the dimorphism of the Coccidea ; the discovery by Eoss and Grassi of the alternation of generations in the malarial parasites (a metagenesis connected with the occurrence of intermediate hosts) ; finally, the discovery by Schaudinn and Siedlecki of a true fertilization in a certain number of Sporozoa, for which the present writer’s announcement in 1896 of the sexual dimorphism of macrosporozoites and microsporozoites prepared the way. Nevertheless, despite these new discoveries, the division of all Sporozoa into Cytosporidia and ^lyxosporidia does not yet seem to have been justified ; the names Neosporidia and Telosporidia, recently proposed by Mesnil and Schaudinn, are perhaps better, but lack priority. We shall therefore divide them into the sub-classes Cytosporidia and Myxosporidia, leaving unclassed all those forms which are still so little known as not to fall into either section.

I. Cytospokidia (Labbe). ??? Adult form generally per- manent ; usually uninucleate. There is an initial intra- cellular phase in most cases. The phase of growth always precedes the phase of sporulation. Sporulation results in a definite or indefinite number of archispores,! each of which gives rise to a spore or sporozoite. The spore has no polar capsule with evaginable filament. The sporozoite is not amceboid. There are four orders : ???

1. Gregarinida. ??? The older works have well described the life-histories of Gregarines, and later research has altered but little the knowledge which we owe to Stein, Eay Lankester, Biitschli, A. Schneider, &c. A fairly detailed account of the order will be found in Enrij. Brit., vol. xix., under the heading of Protozoa. A few new points, however, are worthy of notice here.

As regards the intracellular stage of the young Gregarine, Lc'ger and Duliosq (1899), in opposition to the received opinions, hold

^ In the present writer's nomenclature the archispore is the spore before formation of its characteristic investing case ; the " sporozoite " corresponds to the falciform body; hut while the term "falciform body" was applied originally to the ase.xual sporogonio form, sporozoite in-cludes both these and the more recently discovered macrogametes and microgametes of the schizogonic cycle.

that the sporozoites penetrate between cells, and that the intra- cellular condition is an exception ; the question cannot yet be considered as decided. We know that Gregarines, in addition to their power of association into pairs or chains, may also undergo a true copulation after encystation. Wolters (1891) noticed, in addition to typical mitoses, a nuclear copulation preceded by the expulsion of polar globules. Cuenot, Mrazek, L^ger, and Dubosq have taken up the question, but their results are so different as to lead to the opinion that the phenomena vary in difi'erent species. (The same is held of Coecidiida.) As regards sporalation, the case of Aggregata, observed by Frenzel (1883) in Crustacea, has till now remained exceptional ; in these Gregarines the archispores are transformed directly into sporozoites. Generally speaking, the archispores form spores with a double envelope containing eight, rarely four (Polyrhahdina), sporozoites. An intermediate case is furnished by Porospora of the Lobster, the spore of which is naked. Siedlecki(1900) in Monocystis ascidice, L^ger (1901) in Stylorhynchus, Cuenot (1901) in Moiioeystis, observed the interesting fact of a copu- lation of archispores inside the cyst, but it is not possible as yet to generalize from this single instance. Another point of interest

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Fig. 1. ??? Hsemosporidia ; A, two Lankesterella in the blood corpuscle of a frog ; B-H, Caryolysus, from blood corpuscles of lizards ; B, fragmenta- tion of the nucleus of the corpuscle ; C, commencement of encystation, the nucleus of the corpuscle has elongated, lying parallel to the para- site ; round the latter is a fibrillar zone, produced by disintegration of the corpuscle ; D, commencement of formation of sporozoites, the nucleus of the parasite proliferating, the corpuscle reduced to a mere sac ; E, cyst with microsporozoites ; F, cyst with macrosporozoites ; G, an isolated microsporozoite ; H, an isolated macrosporozoite ; (R, residual core). (Original.)

is that of ccelomio cysts, already attacked by A. Schneider and Leger ; how does the sporozoite penetrate from the alimentary canal into the ooelom to form ccelomic cysts ? Again, is there an endogenous reproduction among Gregarines, resulting in self- infection, as is the case in other Sporozoa ? Opinions are divided. CauUery and Mesnil, on a single inconclusive observation, believe in a direct reproduction of sporozoites in the epithelium. Cuenot saw intracellular stages in the cricket : the hypothesis of Leger and Dubosq, previously put forward by the present writer and Racovitza, of a direct passage of sporozoites across the epithelium, seems the most tenable.

The order of Gregarinida, containing nearly 70 genera and 200 species, splits quite easily into two sub-ordei-s : ??? Cephalina, which always have an apparatus for fixation, the epimerite (genera Piiruspora, Didymophies, Grcgarina, Actinocephalws, SliflorJiynchus, kv..) and Acephalina, which lack an epimerite (genera Monoq/stis, J'tcrospora, Urospora, Polyrhahdina, &c.).

2. Haemosporidiida. ??? A small group of minute forms, living in the blood corpuscles of Vertebrates, intermediate in character between Gregarines and Coccidians (Fig. 1). A small sporozoite penetrates into a blood corpuscle and there grows, assuming all the characters of a small accpha- line Gregarine. At this stage it may become free in the serum, and even undergo conjugation. Sporulation occurs in a blood corpuscle where the animal encysts. Two

forms of cysts may be distinguislied, those with macro- sporozoites are very different from those with micro- sporozoites. The present writer has been unable to detect conjugation between these two forms of sporo-zoites. It appears probable that neither an alternation of generations, such as we know in other Sporozoa which live in blood corpuscles, nor a phase in an intermediate host, occur in these forms ; it is more likely that infection occurs by the intestine directly.

These minute organisms are classed in three genera: ??? Lankesterella (Labb^), Caryolysus (Labb(5), Hfemogregarina (Danilewsky), living in the blood of Reptilia and Batrachia. This group has been attacked by numerous authors, who place its members among the Gymnosporidiida ; it is difficult to see on what grounds this is based, for both in form and life-history these organisms are very different from Gymnosporidiida. Some, such as Caryolysus in the blood of Lizards, are extremely interesting from their actions on the blood corpuscles in which they lodge : namely, the reduction and disappearance of the hsemoglobin, hypertrophy of the corpuscle, with a mechanical and chemical action on the nucleus which excites amitotic division. (Labb^, Arch. zool. exp. gen., 1894.)

3. Coccidiida. ???A group of extreme importance, owing to the diseases to which these parasites give origin ; a group on which recent researches have thrown a vivid light, showing in the life-history two distinct cycles which former writers had distinguished as two specific forms (Fig. 2). These are as follows : ???

A. Sporogonic cycle {Bauersporen of E. and L. Pfeiffer, Cycle sporuU of Simond, Sporogonie of Schaudinn). A sporozoite penetrates into an epithelial cell ; it becomes rounded, and increases in size, secreting reserve granules (coccidine). It then invests itself with a resistent capsule (sometimes provided with a micropyle), breaks away from the epithelium, and falls into some cavity of the host's body. The protoplasm . draws itself together within the capsule (oocyte of Leger and Schaudinn), the nucleus

divides by mitosis or by chromatic fragmentation, result- ing in the formation of archispores ; each archispore is then directly transformed into a spore containing 1 to ra sporozoites. A cystal residue may occur after formation of the archispores, a sporal residue after that of the sporozoites. Most often, the formation of spores is exogenous, that is to say, occurs outside the host in the faeces.

B. Schizogonic cycle. This cycle includes two phases : ◆◆◆ (a) Intracellular divisions, which may occur in the intra- cellular stage, the Coccidian dividing several times. Al- though denied by some authors, this is a very general mode of reproduction in acute cases. (6) Schizogonic

cycle proper {Schwdrmersporen of R. and L. Pfeiffer, Cycle asporale of Simond, Schizogonie of Schaudinn). A sporozoite penetrates an epithelial cell, becomes rounded, grows, and is directly transformed into sporo- zoites. This is a case of absolutely endogenous sporula- tion, occasioning self-infection. The sporozoites thus

Fio. 2. ◆◆◆ CoccidiMm; diagram ot the life-history. A, intracellular divisions in an epithelial cell ; B, formation of macrogametes ; a sporozoite pene- trates into a cell, becomes rounded and grows; granules of coccidine appear^ in it, the nucleus divides many times, and the protoplasm seg- ments into macrogametes ; C, formation of an oocyte at the expense of a macrogamete ; D, formation of a microgamete (s, a free microgamete) ; E, fertilization of an oocyte from a macrogamete (s, microgamete) ; F, sporogonic cycle, resulting from the fertilization ; a, cyst with concen- trated protoplasm ; &, division of the contents into four archispores ; c, formation of sporozoites in the spores (r, residual core of the cyst) ; d, ruptured spore, showing two sporozoites, and r, residual core of the spore.

formed are of two kinds. In 1894, the present writer discovered that in this schizogonic phase (then considered as a separate specific form) there existed cysts with macrosporozoites and others with microsporozoites, and he (like Schuberg) propounded the theory of a sexual

The old classification of Coocidia does not seem to need much recasting in the light of recent research ; it will sufiioe, therefore, to complete that

which the present writer put forward in the Tier,reich (1897-99).

Polyplastina : oocyte with an indefinite' number of archispores

Monogenica or Asporea : oocyte gives direct ori- gin to sporozoites

Digenica or Polysporea : oocyte gives indirectly origin to sporozoites The spores are

Eimeria (Schn.).

Tllments''' } Minchinia (Labb^),*

\ 2 sporozoites .

Oligoplastina: rTetrasporea, with 4 oocyte with I sporozoites a definite-] number of I archispores. \^Disporea, with 2 spores

without ments

fila-

ovoid : with

1 sporozoite, which is

valved

. 2 or 4 sporozoites

not valved

. Klossia (Schn.).

. Adelea (Schn.). I ^sSfoTh } Barroussia (Schn.). I viUoTs } Echinospora (L^ger). 1- . . Diaspora (L^ger).

. Hyaloklossia (Labb^).

f spore I midal

I ’”^ ‘ \ Crystallospora (Labb^).

“j spore ovoid, \bivalve Goussia (Labb^).

[and /non-bivalve Coccidium (Lkt.).

the sporozoites] 2 ^^I^‘P^M?”^?-];

3fg ‘^ I Diplospora (Labbd).

\n . Isospora (Schn.).

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dimorphism and of a fertilization. ??? Schaudinn and Siedlecki (1897-98) have the credit of having actually observed the fertilization of macrosporozoites by micro- sporozoites ; these elements have therefore the value of macrogametes and microgametes. Wasiliewski and Ldger have discovered locomotor cilia in the microsporozoites which give them a resemblance to zoospores. Fertiliza- tion has been seen in several cases. The microgamete may effect penetration, either before the formation of the capsule on the assumption by the macrogamete of the character of an oocyte {Adelea ovata), or after formation of the capsule [Coccidium pr opium).

The life-history of a typical Coccidian exhibits, therefore, a sporozoite which has come from a spore, and penetrates into a cell ; it then, whether after or without intracellular division, is transformed into a microgamete or macrogamete (oocyte). Schi- zogony may, like the intracellular division which is one of its phases, occur several times in succession. This constitutes the ordinary type of life-history, but there exist numerous modifications of the scheme. In Klossia Eberthi, for example, both microgametes and spores are formed, but there is no schizogonio cycle, only a sporogonic. On the other hand, there exists a whole group of

Coccidiida, the Goussia and Ooccidium of fish, of which only the sporogonic cycle is known, the microgametes being perhaps repre- sented by the old Rhabduspora (Laguesse). Finally, the old genus Eiiiwria (schizogonic cycle) has a real existence. There are therefore a certain number of obscure points in the general life- history of Coccidians, and it would be somewhat hazardous to draw too wide an inference from the development knowai in certain species. (See classification table on previous page.)

4. Gymnosporidiida. ??? This name v?as applied in 1894 by the present writer to a whole series of minute organisms then recently discovered, of extreme importance, in zoology and pathology, inhabitants of the blood corpuscles of birds and mammals. They were first discovered by Danilewsky in birds; then by Laveran (1881) in human blood, where they cause marshy fevers or malaria ; finally, the researches of Eoss and Grassi indisputably de- monstrated by experiment the occurrence of an alter- nation of generations, and opened new horizons to us. As with the Coccidians, we find in these parasites both schizogonic and sporogonic cycles, as well as a sexual reproduction ; but the cycles which in Coccidians are passed in the same host, in this case are found in different hosts. We commence our study of the life-history with the most important of these organisms, the parasite of malaria, Plasmodium malarice (Figs. 3, 4).

A. The schizogonic cycle, the only one known till recently, occurs in human blood, giving rise to malarial fever. After the discovery by Laveran of the forms presented by this parasite, the researches of Marchia- fava, Celli, Golgi, Mannaberg, and Grassi have thoroughly determined the developmental phases as occurring in man. A small sporozoite, hardly y^nnj- of a millimetre long, enters a human red blood corpuscle, grows, and becomes amoeboid, charged with pigment (melanin), at the exjjense of the hemoglobin of the corpuscle. It then becomes round, and without forming a cyst divides into a certain number of minute sporozoites.

Two other forms occur in malarial blood. The macro- gametes [formes en croissant of Laveran) are found chiefly in malignant tertian and quotidian fevers, and the summer-autumn fever of iMarchiafava ; they

are considered by Grassi the adult form of a special genus (Laverania). These macrogametes, at first intraglobular, are possibly conjugated forms (Mannaberg), and become afterwards free in the serum. The microgametes (formes jlagelMes of Laveran, Polymifim of Danilewsky) are not formed in circulating blood, a fact which gave rise to the old opinion of Grassi and Labbe, that they were forms of degenera- tion. As a matter of fact, the flagella of flagellate forms are filiform microgametes, very active and mobile, and rich in chromatin. Microgametes and macrogametes only

meet in the intestine of the second host, the mosquito, where fertilization occurs. Successive schizogonic cycles may be produced in human blood, each sporulation result- ing in an attack of fever.

B. Sporogonic cycle. The idea that mosquitos played a part in malarial fever is extremely ancient, but was first definitely formulated by Patrick Manson, who thought of the possibility of an intermediate host as the outcome of his beautiful researches on the migration of Filaria sanguinis hom,inis. Bignami and the present writer had only thought of the possibility of an inoculation by the puncture of the insect. Ronald Eoss(1897-99) succeeded in discovering in mosquitos the stages of the sporogonic cycle, while Grassi elucidated and completed these researches,

Fig. 3. ??? Plasmodium vnalarim: schizogonic cycle, in blood corpuscles ??? A, formation of macrogametes {corps en croissant) ; B, formation of sporo- zoites (asexual cycle) ; C, formation of microgametes (flagellate bodies).

and at the same time discovered the actual intermediate host. Anopheles. Nowadays, owing to the conclusive experiments of Grassi, and although some points are still obscure, we know the sporogonic life-history of Anopheles. The insect when sucking the blood of malarial patients absorbs numerous parasites, but the macrogametes and microgametes are not digested. Fertilization of the macrogametes then occurs. Each macrogamete, possibly after a reduction of the chromatin, becomes an oocyte ; this assumes a fusiform shape instead of a spherical, and, penetrating the wall of the intestine, surrounds itself with a membrane as the " Black spore " of Ross, and after growing forms an enormous

number of archispores, each of which becomes a small falciform sporozoite. At this

Fig. 4. ??? Plasmodium malarice; sporogonic cycle in Anopheles: a, free macrogamete ; a', the same spherical ; 6, microgametocyst setting free a microgamete, b' ; c, fertilization ; d, the resulting cyst (ookinete); e, proliferation of nuclei in the cyst ; /, cyst with thousands of sporozoites and with residual cores; p, isolated sporozoite.

stage the cyst breaks, and the sporozoites fall into the body cavity, whence they are carried by the circulation to cells of the salivary gland, where they remain till the mosquito, in biting, inoculates the man. To recapitulate, in Plasmodium malaria; there is an asexual schizogonic cycle in man, a sexual sporogonic cycle in Anopheles, and these form an alternation of generations as in Coccidiida, but one which occurs in different hosts. The question then arises, are there several species of parasites in malarial fever or only one with several varieties 1 Grassi

admits two different genera, Plasmodium and Laverania, with numerous species. Laveran formerly admitted but one polymorphic species ; in former works, the present writer recognized two, possibly three, varieties of the same species : ???

Var. tertiana, Golgi : inactive, slightly amoeboid, with few sporozoites, with minute microgametes ; apparently characteristic of tertian fever, developing (schizogonic cycle) in 48 hours.

Var. quartana : active, markedly amoeboid, with numerous sporozoites and large microgametes ; apparently characteristic of quartan fever, developing in 72 hours.

The quotidian form would seem to be the product of a complication of the two cycles. The malignant type would be the result of a variety immaculatimi, and a variety prcecox ??? Grassi and Feletti. The point

is highly controversial, and can only be settled by a number of new observations.

Other Gymnosporidia ai-e known besides the malarice. In birds Labb^ distinguished a genus Proteosoma {Hcevwproteus) almost comparable to Fl. malarice, with an acute and often mortal in- fection in various bii-ds ; and a genus Halteridium, distinguished by the elongation of its body, with a separate sporulation at its tffo extremities (dumbbell-shaped), which determines a chi'onic infection in birds. The schizogonic cycle alone was known. Since then MaoCallum, Opie, and Ross have demonstrated that mosquitos {Oulex pipiens), in which a sporogonic cycle occurs, inoculate the birds. These genera are the only Gymnosporidia in which the life-history is well known ; but many other similar fonns have been detected. Kossel in African monkeys, Kolb in oxen of South Africa, Dionisi in bats (Polychromophilus and Achromaticus), Smith and others in Texas fever (Piroplasma higeminum). Babes in haemoglobinuria ooases of cattle in Rumania {Babesia) have discovered parasites resembling Gymnosporidia. But our know- ledge is too inadequate to j^ermit of general conclusions.

II. Myxospoeidia. As contrasted with the Cyto- sporidia, these organisms are generally multinucleated, amoeboid, free in organic cavities or encysted in organs (muscular and connective tissues, at times in epithelia) ; their phase of growth coincides with their phase of sporula-tion ; the spore itself has polar capsules with evaginable fila- ment, and contains the single amoeboid sporozoite (Fig. 5). No case of copulation or of sexual reproduction has been

FiGt. 6. Myxospoiidiii : ", Leptotheca agUie, protoplasmic mass with two spores ; a', spore of the same, showing the two polar capsules, the line of dehiscence, of the valves, and the sporoplasm ; 6, spore of Uerme- guyia psoromermica ; c, spore of Chloromyxum quadratum in profile, and c' from above; d, spore of Ceratomyxa ; e, spore of Myxidium Lieierkuehni : /, muscle infected by a Nosema, parasite of Apus canon-formis ; f, spores of the latter, with a single polar capsule ; g, spore of Nosema bombycis. (a-e, after Thilohan ; /, /,' original.)

observed. The older works of Balbiani, Biitschli, and Thelohan, and the more recent studies of Dbflein and Cohn, have thrown light upon the group ; it is separated systema- tically by many characters from the other Sporozoa, and should be contrasted with them as certainly having a differ- ent phylogenetic origin. The life-history is as follows : ??? a

small mass of protoplasm, either parasitic in muscular and connective tissues, or free in some organic cavity, grows and becomes amoeboid, exhibiting an ectosarc, with an endosarc full of nuclei. Unlike the Cytosporidia, this present group is generally multinucleate. The stage of growth is not distinct from the stage of sporulation; a nucleus is isolated and surrounded by a small quantity of protoplasm, and becomes a sporoblast which may give rise to two or to several spores. Each spore secretes one or more polar capsules with an evaginalJe Ulament and contains a little mass of protoplasm. The structure of the polar capsules in the spore is quite comparable to that of nematocysts in Coelentera, and has been well worked out by Thelohan, whose researches marked a great advance in our knowledge. A process of endogenous reproduction exists in addition to the ordinary process of reproduction by spores.

Thelohan failed to obtain artificial infection and to discover the endogenous reprodiiotion ; as a matter of fact, the spores never hatch out in the host's body. Cohn and Doflein have dis- covered cases of plasmotomy, in which a kind of protoplasmic bud of ectosarc and endosarc containing some nuclei becomes detached ; these little masses have but to grow in order to fomi the ordinary protoplasmic masses, and one may imagine that a rapid multi- plication of the parasite within the host is the result of this unequal division. Cohn also observed reproduction by a kind of swarm spores, but Doflein and Mrazek think them not swarm spores, but accidental processes of degeneration.

We may follow Gurley in dividing Myxosporidia into two orders; (1) Phcenocystidia, and (2) Cryptocystidia = 2ficrosporiidia.

In the Phoenocyslidia the spore has 1 to 4 polar capsules always visible in the fresh state ; these are the true Myxosporidia. Some of these, the Disporea, have a single pansporoblast, which then forms two spores ; after the formation of the latter, no active nucleus remains in the residual

core. In Ceratoinyxa these spores have the shape of two hollow cones united at their bases ; in Leptotheca they are oval or subsjiherical. The remainder, the Polysporea, have always more than two sporoblasts. They include three families: the Myxidiidse {Sphoerospora, Myxidiuin, ilyxosoma, &c.), in which there is no iodophile vacuole, and the spore has two polar capsules ; the Myxobolidas (Myxoholus, Henneguya, &c.), which have an iodophile vacuole ; and the Chloromyxidse (Chloro-myxum), the spore of which has four polar capsules. The Micro-sporiidia= Cryptocystidia are incompletely known, despite their wide occurrence in the Animal Kingdom. They have a single polar capsule in a minute spore rarely larger than 2 or 3 /t. They may have numerous (Plistophora), eight (Thelohania), or four (Gurleya) spores in each pansporoblast. These organisms are very common in Insects and in the lower Crustacea ; they are also found in Batrachia, Reptiles, and Fish. The " Pebrine " of silk- wonns is due to Nosema bombycis; TMlohania octospora and Th. Giardii produce serious disease in Prawns and Shrimps ; Th. con- tejeani is possibly the cause of a jslague among Crayfish.

Saecospoeidia. ❓❓❓ Our knowledge of Sarcocystis, found in the muscular and connective tissues of numerous Mammals, Birds, and Reptiles, has made but little pro- gress. The initial stage is always in a muscle-cell ; the organism forms an elongated tube, often surrounded by a double membrane, the outer part of which is formed by apposed rods ; the interior of the cyst becomes divided into a series of chambers, in which are formed reniform or falciform sporozoites. Researches have shown that, along with this mode of development, there exist true spores, with evaginable filament but without polar capsule, each a little mononucleate mass of protoplasm. This fact approximates Sarcosporidia to Myxosporidia, from which, however, they differ in numerous other char- acters. The question of an intermediate host and alter- nation of generations has not been settled.

By the side of these larger groups we find among Sporozoa a considerable number of forms which cannot at the moment be relegated to any of them. The AMtEEOsroRiDiA (Schneider, Leger) are multinucleate and amoeboid ; they reproduce by division and sporulation after isogamic

conjugation, and form a single spore with 8 sporozoites. They are parasites of Insects (Ophryocystis, in

Blaps and Acts). The Serumsporidia (L. Pfeiffer and others) in lower Crustacea are still less known ; the Aplosporidia (Caul- lery and Mesnil), such as Bertrainia, Aplonporidium, &c., are, like Miorosporidia, without polar eajjsule. There are also numerous genera not yet classed at all : Bolellus, Ccelosporidmm, Toxo- sporidium, Metschnikovella, but little understood ; it is also pos- sible that the AvKebidiuni of Cienkowsky, in which endoparasitic forms have been described, belongs to them ; as also Siedleckia (Mesnil), a parasite of Aincebie, a very interesting form, a possible link between Gregarines and Mesozoa.

Besides the older works of Balbiani, Biitschli, Celli et San Felice, Danilewsky, Golgi, Grassi et Felitti, Laveran, Marchiafava, Ray Lankester, Rivolta, AimiJ Schneider, Stein, &c., the student should consult the following : ◆◆◆ Bertram. Zool. Jahrl. Anai., v., 1892. ◆◆◆ B. Danilewsky. Parusitoloijie comparee du sang: I. et II. Charkof, 1889. ◆◆◆ B. Grassi. ” Studi di una zoologo sulla malai-ia,” R. Ace. Lineei, ccxcvi., 214 pp., 4 PI., 1900. ◆◆◆ H. Haoenmuller. “Bibliotheca sporozoologica, ” Ann. Mas. Hist, not. Marseille, l, 232 pp., 1899. ◆◆◆A. LabbI “Eecherches zoologiques et biologiques sur les parasites endoglobulairs dii sang des Vert(5brfes ” {Areh. Zool. Exp., ser. 3, ii., 56-258, PI. 1-10, 1894). “Eecherches zoologiques, cytologiques et biplogiques sur les Coccidies” {Arch. Zool. Exp., ser. 3, iv., 517-654, PI. 12-18, 1896). “Sporozoa” {Tierreich, 6◆◆ livr., 180 pp., 196 fig., 1899). ◆◆◆ A. Laveeak. L’ Hematowaire du palvdistne. Paris, 1891 ; and numerous notes by the same author in C. R. Soc. Biol., Paris, 1890-1901, and in the Bulletin Ac. Med. Paris, 1880-1901. ◆◆◆ L. L^gbr. ” Recherches sur les Gregarines ” (Tabl. Zool., iii., 1892), and numerous notes by the same author in C. R. Ac. Sci., 1892- 1901, et G. R. Soc. Biol., 1892-1901. ◆◆◆ M. Luhe. “Ergebnisse der neueren Sporozoenforschung ” {Centralhl. Bakter., xxvii., 367 and 436, 1900).

<u>Mannaeerg. Die Malaria – Parasiten. Vienna, 1893. P. MiNGAZZlNl. ” Contribute alia conoscenza degli Sporozoi ” {Mem. Lab. Anai. Roma, 31-85, 3 PL, 1894). G. H. F. NuTTALL. “Die Mosquito-Malaria Theorie” {CentralU. Bakt., XXV., 161-170, 209-216, 245-247, 285-296, 337-346, 1899). L. Pfeiffer. Protowen als Krankheitserreger. Jena, 1891, et Supplem. 1895. R. Pfeiffer. Beitrdg. zur Proiozocnforschung Die Coccidien-Krankheit der Kaninchen. Berlin, 8vo, 1892. R. Ross. Brit. Med. Journ., 1899 and 1900. F. Sohaudinx. ‘ ‘ Ueber den Generationswechsel der Coccidien und die neuere Malariaforschung ” {Zool. Jahrb. Anat., xiii., 197-293, 3 PL, 1900). ScHUBERG. “Ueber Coccidien des Mausedarmes” {S. B. Ges. Wiirzburg, 1892). Siedlecki. Ann. Inst. Pasteur, 1898- 1900. L. SiMOND. C. R. soc. Biol, et Ann. Inst. Pasteur, 1897-98. P. Th^lohan. “Recherches sur les Myxosporidies ” {Bull, scient. Fr. Belgique, xxvi., 100-395, 3 PL, 1895). “Wasie- LEWSKY. Sporozoenkunde. Jena, 8vo, 1896. M. Wolters. “Die Conjugation und Sporenbildung bei Gregarinen ” (-4reA. mikr. Anat, 99-139, PL v.-viii., 1892).</u>

<u>It is enough to mention here the pathological intracellular produc- tions which have been noticed in a large number of human and animal diseases, and have been assigned to Sporozoa. Many writers have observed and studied these formations in cases of epithelioma, sarcoma, herpes zoster, cow-pox, smallpox. Oriental sore, &c. We have at present no certain indication whether we are to regard these as organisms in the nature of Sporozoa, or rather, as some hold, to consider them as special cases of cell-degeneration having nothing to do with parasitism. (a. L.)</u>*

<u>Spottsylvania,] capital of Spottsylvania county, Virginia, U.S.A., situated about 50 miles north of Kichmond. It was the scene in May 1864 of one of the longest and hardest fought battles of the Civil War. Early in May, General Grant, with the army of the Potomac, advanced against the Confederates under General Lee in Northern Virginia. A series of bloody battles ensued, beginning with those of the Wilderness, in which neither side was really victorious, though the Union forces constantly gained ground. Grant then made a flanking movement towards Spottsylvania Court House, 15 miles to the south-east, where fighting continued for ten</u>

days, with no decisive results, but with heavy loss on both sides. The Union losses were estimated at over 10,000 in killed and wounded ; the Confederate loss was much less, since they were fighting on the defensive, and on familiar ground.

Spree, a river of PrusKia, rising in the district of Upper Lusatia, in the kingdom of Saxony, close to the Bohemian frontier, and flowing nearly due N., past Bautzen, Spremberg, and Kottbus, dividing between the

first two towns for a time into two arms. Below Kottbus the river splits into a network of channels, and swings round in a big curve to the W., forming the peculiar marshy region (30 miles long and 3 to 6 miles wide) known as the 8preewald. Having returned to its predominant direction, it turns W.N.W., and passing Fiirstenwalde and Kopenick threads Berlin in several arms, and joins the Havel at Spandau. Its length is 227 miles, of which 112 are navigable ; the area of its drainage basin is 3660 square miles. It is connected with the Oder by the Fred- erick-William or MUllrose Canal (made in 1862-68, 17 miles long), and by the Oder-Spree Canal (made in 1887-88), and with the Havel by the Berlin-Spandau Navigation Canal (5| miles long).

SpreeW►►llcl, a marshy depression of the middle Spree, in the province of Brandenburg, Prussia, ex- tending to some 106 square miles, its length being 27 miles and its width varying from 1 to 7 miles. It owes its marshy character to the river Spree, which above Liibben splits into a network o# over two hundred arms, and in seasons of flood generally over- flows considerable portions of the region. In the parts which are especially liable to inundation, as, for example, the villages of Lehde, Leipe, and Burg, many of the homesteads are built each on a little self- contained island, approachable in summer only by boat, and in winter over the ice. In spite of its marshy char- acter the Spreewald is in part cultivated, in part con- verted into pasturage, and almost everywhere, but more especially in the lower districts, wooded in a park-like way, the predominant trees being willows. Fishing, cattle-breeding, and the growing of vegetables, more par- ticularly small pickling cucumbers, are the chief occupa- tions of the people, about 30,000 in all. In great part they are of Wendish blood, and though the majority have been

Germanized, there is a small residue who have faith- fully preserved their national speech, customs, and their own peculiar styles of dress. The attractive blending of wood and water makes the Spreewald in summer a resort of the people of the Prussian capital, which is only from 50 to 70 miles distant. The chief town is Liibben (47 miles south-east of Potsdam).

Springrfield, a city of Illinois, U.S.A., capital of Sangamon county and of the state. It is situated near the river Sangamon in the central part of the state, at an altitude of 582 feet. It is regularly laid out on a level site, is divided into seven wards, has good water supply and sewerage systems, and is well paved with brick and wooden blocks. Springfield is one of the most important railway centres in the Mississippi Valley ; it is entered by the Baltimore and Ohio South- western, the Chicago and Alton, the Chicago, Peoria and St Louis, the Illinois Central, and the Wabash. Its manufactures are not of importance commensurate vdth its railway facilities. In 1900 there were 320 manufacturing establishments, with a total capital of $5,030,438. They employed 3871 hands, and the product had a value of $6,612,286. In 1900 the assessed valuation of real and personal property was $5,594,097, a very low valuation ; the net debt of the city was $1,026,924, and the rate of taxation was $76-92 per $1000. Population (1890), 24,963; (1900), 34,159, of whom 4654 were foreign-born and 2227 negroes.

Springfield, a city of Massachusetts, U.S.A., capital of Hampden county, situated in 42 ́ 06′ N. and 72″ 35′ W., on the river Connecticut, in the southern part of the state, at an altitude of 70 feet. It is rather irregularly laid out on a level plain with broad streets.

It has three railways ́ the Boston and Albany ; the New York, New Haven, and Hartford ; and the Boston and Maine, which join in a fine new Union Dep6t. Spring- field is a manufacturing town of great prominence. In 1900 it contained 817 establishments, with a total capital of $17,105,947. They employed 10,12.3 hands, and their product was valued at $21,207,039. The principal of the varied products were

envelopes, $659,445 ; paper goods, $1,164,985; foundry and machine-shop products, $1,482,742 ; firearms, cotton goods, steam railway cars, and sewing-machines. In 1900 the assessed valuation of real and personal property was $72,358,481, the net debt was $2,181,204, and the rate of taxation was $13-80 p,er $1000. Population (1890), 44,179; (1900), 62,059, showing a rapid and sabstantial growth. Of the population in 1900 14,381 were foreign-born and 1021 negroes.

Spring^eld, a city of Missouri, U.S.A., capital of Greene county, situated in 37 ́́ 14′ N., and 93 ́́ 17′ W., on a high prairie in the south-western part of the state, at the intersection of the Kansas City, Fort Scott and Memphis, and the St Louis and San Francisco railways, at an altitude of 1350 feet. It is regularly laid out on an undulating site, and is divided into eight wards. It has good water supply and sewerage systems, and its business streets are paved with brick. In 1900 it contained 245 manufacturing establishments, with a total capital of $2,111,048. They employed 2127 hands, and their products had a value of $4,126,871. The principal of these establishments were flour mills, the product of which had a value of $985,398. The assessed valuation of real and personal property was in 1898 $8,202,546, the net debt was only $128,477, and the rate of taxation was $23‘00 per $1000. Spring- field is the site of Drury College, a Congregational institu- tion, opened in 1873, which had in 1899 a faculty of 18, and was attended by 325 students. Population (1890), 21,850; (1900), 23,267, of whom 1057 were foreign-born and 2268 negroes.

Springrfield, a city of Ohio, U.S.A., capital of Clark county, situated in 39 ́́ 54′ N., and 83 ́́ 46′ W., on the river Mad, south-west of the centre of the state, at an altitude of 988 feet. The city is well laid out, is divided into six wards, has good water supply and sewer- age systems, and is well paved, mainly with brick. It is an important railway centre, being at the intersection of four railways ́́́ the Cleveland, Cincinnati, Chicago and St Louis, the Erie, the Ohio Southern, and the Pittsburg, Cincinnati, Chicago and St Louis. Its manufactures are extensive. In 1900 there were 305 establishments, with a total capital of $14,091,175 ; they employed 6638 hands, and their products had a value of $12,777,173, of which $5,272,636, or nearly half, was agricultural implements.

Foundry and machine-shop products had a value of $3,097,910. The assessed valuation of real and personal property was in 1900 $17,894,095, the net debt of the city was 1926,186, and the rate of taxation was $23-10 per $1000. Population (1890), 31,895, of which only 3735 were of foreign birth ; (1900), 38,253, of whom 3311 were foreign- born and 4253 negroes.

Springffontein. See Orange Kivbr Colony.

Spring;' Valley, a city of Bureau county, Illinois, tr.S.A., in the northern part of the state, at the inter- section of three railways, in a coal mining region. Population (1890), 3837 ; (1900), 6214, of whom 2845 ???were foreign-born.

Spurgeon, Charles Haddon (1834-1892),

English Baptist preacher, born at Kelvedon, E.ssex, on 19th June 1834, was the grandson of an Essex pastor, and son of John Spurgeon, Independent minister at Upper Street, Islington. He became usher at a school in New- market, and joined the Baptist communion in 1851. His work at once attested his " conversion " ; he began dis- tributing tracts and visiting the poor ; joined the lay preachers' association, and gave his first sermon at Tever- sham, near Cambridge. In 1852 he became pastor of Waterbeach. He was strongly urged to enter Stepney (now Eegent's Park) College to prepare more fully for the ministry, but an appointment with Dr Angus, the tutor, having accidentally fallen through, Spurgeon interpreted the contretemps as a Divine warning against a college career. The lack of early systematic theological train irg certainly had a momentous efifect upon his development. Broad in every other respect, he retained to the last the narrow Calvinism of the early 19th century. His powers as a boy preacher became widely known, and at the close of 1853 he was "called" to New Park Street Chapel, Southwark. In a very few months' time the chapel was full to overflowing. Exeter Hall was used while a new chapel was being erected, but Exeter Hall could not contain Spurgeon's hearers. The enlarged chapel at once proved too small for the crowds, and a huge Tabernacle was projected in Newington Causeway. The preacher had recourse to the Surrey Gardens Music Hall, where his congregation numbered from seven to ten thousand. At twenty-two he was

the most popular preacher of his day. The Metropolitan Tabernacle, with a platform for the preacher and accommodation for 6000 persons, was opened for service on 25th March 1861. The cost was over ??30,000, and the debt was entirely paid off at the close of the opening services, which lasted over a month. Spurgeon preached habitually at the Tabernacle on Sundays and Thursdays. He frequently spoke for nearly an hour, and invariably from heads and subheads jotted down upon half a sheet of letter paper. His Sunday ser- mons were taken down in shorthand, corrected by him on Monday, and sold by his publishers, Messrs Passmore and Alabaster, literally by tons. Clear and forcible in style and arrangement, they are models of Puritan exposition and of appeal through the emotions to the individual con- science, illuminated by frequent flashes of spontaneous and often highly unconventional humour. In his method of employing illustration he is suggestive of Thomas Adams, Fuller, Baxter, Thomas Manton, and Bunyan. Like them, too, he excelled in his vigorous command of the vernacular. Among more recent preachers he had most afiinity with Whitefield, Eichard Cecil, and Joseph Irons. Collected as The Tabernacle Pulpit, the sermons form nearly fifty volumes. Spurgeon's Lectures, Aphorisms, Talks, and "Saplings for Sermons" were similarly steno- graphed, corrected, and circulated. He also edited a monthly magazine. The Sword and Trowel, an elaborate exposition of the Psalms in seven volumes, called The Treasury/ of David (1870-85), and a book of sayings called John Ploughman's Talks; or. Plain Advice for Plain People (1869), a kind of religious Poor Richard. In the summer of 1864 a sermon which he preached and printed on Baptismal Regeneration (a doctrine which he strenu- ously repudiated, maintaining that immersion was only an outward and visible sign of the inward conversion) led to a difference -with the bulk of the Evangelical party both Nonconformist and Anglican. Spurgeon maintained his ground, but in 1865 he withdrew from the Evangelical Alliance. Subsequently in 1887 his distrust of modern Biblical criticism led to his -svithdrawing from the Baptist Union. His powers of organization were strongly

exhibited in the Pastors' College, the Orphanage (at Stockwell), the Tabernacle Almshouses, the Colportage Association for selling religious books, and the gratuitous book fund which grew up under his care. He died at Mentone on 31st January 1892 (and was buried at Norwood Cemetery), leaving a widow with two sons, both preachers, one of whom, Thomas, succeeded him at the Tabernacle. An Autobiography, compiled by his widow and his private secretary from his diary, sermons, records, and letters, was published in 4 vols., 1897-1900.

(t. se.)

Spy (Militaey). ??? Halleck says : " Spies are persons who, in disguise, or under false pretences, insinuate them- selves among the enemy in order to discover the state of his affairs, to pry into his designs, and then to communicate to their employer the information thus obtained." Accord- ing to this definition, an officer or soldier of the British army who should give "aid and comfort" to the King's enemies could not be included in the category of spies. He is guilty of high treason, and is dealt with accordingly. It was ruled by the Brussels Conference, 1874, Art. 22, that " military men who have penetrated within the zone of operations of the enemy's army, in order to collect informa- tion, are not considered as spies, if it has been possible to recognize their military character." As Halleck points out, "it is the disguise, or false pretence, which constitutes the perfidy and forms the essential of the crime." It was perhaps superfluous of the Brussels Conference to rule that "a spy, if taken in the act, shall be tried and treated according to the laws in force in the army which cap- tures him " (Art. 20). The practice of courts-martial in sentencing spies is almost invariably founded upon the simple principle of Appian, quoted by Grotius : " It is usual to kiU them." " Spies are generally condemned to capital punishment, and with great justice," says Vattel.

Srinagfar (= city of the sun), capital of the native state of Kashmir, in Northern India, 5263 feet above the sea, on both banks of the river Jhelum, which is crossed by seven wooden bridges. Area, 3795 acres. Population (1891), 139,410, of whom 118,960 lived in the city proper; (1901), 122,536. The city is exposed to both fire and flood. In 1891 six of

the seven bridges were swejDt away. A regular water-supply has been provided. The artisans of Srinagar enjoy a high reputation. Unfortunately the historic industry of shawl-weaving is now practically extinct. The loss of the French market after the war of 1870 was followed by the famine of 1877-79, which drove many of the weavers into the Punjab, and the survivors have taken to the manufacture of carpets. In 1893-94, the export of shawls was valued at only Rs.22,850 : other industries are paper, leather, papier- mach^ silver and copper ware, wood-carving, and boat-making. The three chief routes of communication with India are : (1) along the Jhelum valley to Murree and Rawalpindi, which has been opened throughout for wheeled traffic (195 miles) ; (2) over the Banihal pass (9200 feet above the sea) to Jammu (163 miles); (3) over the Pir Panjal pass (11,400 feet) to Gujrat (180 miles).

See Walter R. La whence. The Valley of Kashmir. London, 1895. ??? M. A. Stein. Chronicle of the Kings of Kashmir. London, 1900.

Sryetensk, or Steyetensk, a Cossack village of Asiatic Russia, in the province of Transbaikalia, 245 miles by rail east of Tchita, and a terminus of the Trans-Siberian Railway. It was at one time intended to be a passing station on the way to Vladivostok, but this last city is now connected with the Trans-Siberian line at Kaidalovo, 230 miles west of Sryetensk. It is situated in a very

picturesque valley, er^closed between high mountains, on both banks of the river Shilka, and its population, which was only a few hundred persons a few years ago, has now reached 8000, and is swollen to over 10,000 during the navigation season. It has two schools, a Cossack hospital, large storehouses belonging to the Crown, a steam flour- mill, and soap works. Its trade is valued at 7,000,000 roubles annually.

Sta-fford, a parish, municipal, and parliamentary borough, market town, and county town in the western division of Staffordshire, England, on the Sow, 133 miles north-west of London by rail. Modern erections are the county council offices and the county technical institution. The brine baths have been enlarged. A theatre and several new blocks of buildings have been added to the Coton HUl institution for the insane. There are iron-works and works for the preparation of salt from brine wells in the

neigh- bourhood. The parliamentary borough was extended in 1885, and is now coextensive with the municipal borough. Area, 1084 acres. Population (1881), 19,977; (1901),

20,894.

Staffordsh i re, a west midland county of England, bounded on the S. by Worcester, on the S.E. by Warwick, on the N.E. by Derby, on the N.W. by Cheshire, and on the W. by Shropshire.

Area and Population. ??? The area of the ancient county is 749,601 acres, or 1171 square miles, with a population in 1881 of 981,009 ; in 1891 of 1,083,408, of whom 640,693 were males and 542,715 females ; and in 1901 of 1,234,382, the uumher of persons per square mile being 1054, and of acres to a person 0‘60. The arta of the administrative county as given in the census returns is 731,089 acres, with a population in 1891 of 818,290, or, including the four county boroughs, 749,713 acres, with a population of 1,087,161. Since 1891 certain changes have been made in the administrative area ; in 1895 the part of the parish of SherifT Hales in Staflbrd was transferred to Shropshire, and the parish of Upper Anley was transferred to Worcester, and to Staiford were transferred the part of the parish of Drayton Bassett in Warwick, the part of the parish of Croxall in Derby, and the part of the parish of Babbington in Shropshire ; and in 1897 part of the urban district of Sniethwick in Stafford was transferred to the county borough of West Brom- wich in Stafford. The area of the registration county is 767,102 acres, with a population in 1891 of 1,103,452, of whom 870,660 were urban and 232,792 rural ; and in 1901 of 1,251,888, of whom 622,318 were males and 629,570 females. Within the registration area the increase of population between 1881 and 1891 was 9-60 Ijcreent. The excess of births over deaths between 1881 and 1891 was 176,201, and the increase of population was 96,685.

The following table gives the numbers of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 : ???

Year.

Marriages. Birth.s.

Deaths.

Illegitimate Births. |

Male.

Females.

1880 1890 1898

7,592 38,198

9,202 37,871

10,185 1 41,663

20,686 22,293 23,399

930 819 906

970 852 856

The number of marriages in 1899 was 10,472, of births 41,715, and of deaths 23,289. The following table gives the marriage-, birth-, and death-rates per thousand of the population, with the percentage of illegitimate births, for a series of years : ???

lsro-79.

1880.

1880-89.

1890.

1888-97.

1898.

Marriage-rate

17-2

16-2

16-1

16-8

16-1

17-3

Birth-rate .

41-7

38-2

36-8

34-6

35-1

85-3

Death-rate .

22-8

20-7

19-7

20-3

19-7

19-8

Percentage of ille-

gitimate births

5-0

4-8

4-9

4-4

4-4

4-2

Both birth- and death-rates are high. In 1891 the number of Scots in the county was 3357, of Irish 9712, and of foreigners 166-1. ^

Constitution and Government. ??? The parliamentary and judicial aiTangements are stated in the earlier article on the county. There are fourteen municipal boroughs: Burslem (38,766), Burton-

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on-Trent (50,386), Hanky (61,524), Lichfield (7902), Longton (35,825), Newcastle-under-Lyme (19,914), Smethwick (54,560), Stafford (20,894), Stoke-upon-Trent (30,456), Tarnworth (7271), "Walsall (86,440), Wednesbury (26,544), West Brorawich (65,172), and Wolverhampton (94,179). Hanley, Walsall, West Bromwich, and Wolverhampton are county boroughs. The following are urban districts: Amblecote (3128), Audley (13,679), Biddulph (6247), Bilston (24,034), Brierley Hill (12,040), Browuhills (15,262), Cannock (23,992), Coseley (22,218), Darlaston (15,391), Fenton (22,742), Handsworth (52,921), Heath Town (9441), Kidsgrove (4551), Leek (15,484), Perry Barr (2348), Quarry Bank (6912),

Rowley Regis (34,669), Rugeley (4447), Sedgley (15,951), Short Heath (3531), Smallthorne (6263), Stone (5680), Tettenhall (5337), Tipton (30,543), Tunstall (19,492), Uttoxeter (5133), Wedensfield (4883), and Willenhall (18,513).

The ancient county, which is chiefly in the diocese of Lichfield, contains 320 entire ecclesiastical parishes or districts and parts of 17 others.

JSducation. ??? At Stoke-on-Trent is the North Staffordshire joint boards blind and deaf school. The total number of elementary schools in the county on 31st August 1899 was 628, of which 191 wore board and 437 voluntary schools, the latter including 349 National Church of England schools, 24 Wesleyan, 52 Roman Catholic, and 12 British and others. The average attendance at board schools was 100,377, and at voluntary schools 99,159. The total school board receipts for the year ended 29th September 1899 were ??420,300. The income under the Technical Instruction Act -was over ??972 ; that under the Agricultural Rates Act was over ^??2804.

Agriculture. ??? More than three-fourths of the total area of the county is under cultivation, and of this more than two-thirds is in permanent pasture, cattle being largely kept, and especially cows for the supply of milk to the towns. About 1200 acres are under orchards, and about 39,000 acres under wood. The acreage under corn crops is steadily diminishing, and.wheat, which formerly was the principal corn crop, is now, superseded in this respect by oats, which now occupies nearly one-half of the corn acreage, considerably more than one-third being under wheat, and more than one-fifth under barley. Turnips are grown on about half the acreage under green crops, and potatoes on only about one-fourth. The following table gives the larger main divisions of the cultivated area at intervals from 1885 : ???

Year.

Total Area under Cultiva- tion.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1886 1890 1895 1900

604,757 606,404 604,067 596,836

95,683 90,850 83,333 80,620

44,211 42,174 41,241 39,270

48,740 49,400 49,145 45,509

409,047 419,081 427,349 429,921

7074 4749 2635 1716

The following table gives particulars regarding the principal live- stock for the same years : ???

Year.

Total Horses.

Total Cattle.

Cows or Heifers

in Millt or in

Calf.

Sheep.

Pigs.

1885 1890 1895 1900

23,630 23,735 28,357 27,729

157,099 151,222 152,896 164,058

74,485 73,166 75,066 79,185

2^8,509

274,698 246,906 236,351

52,300 59,471 61,720 50,533

Indiistries and Trade. ??? According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 212,274, as com- pared with 205,969 in 1896. Of these 5211 were employed in textile factories, cotton industries employing 2317, and silk 2823. Non-textile factories employed 183,918 persons, there being an increase between 1895 and 1896 of 5-0 per cent., and between 1896 anil 1897 of 3-9. As many as 46,145 were employed in the manu- facture of machines, appliances, conveyances, and tools, &c., into the list of which bicycles especially have of late been introduced ; the total number employed in the founding and conversion of metal was 35,869 ; in the clay and stone industries (potteries, &c.) 50,613 vere engaged, and the drink industries (chiefly ale at Burton-on-Trent) employed 6954 persons, furniture making 6782, clothing industries 7497, the galvanizing and finishing of metals 2962, the extraction of metals 2315, glass manufacture 2920, manufacture of paper 3031, and the manufacture of chemicals 208;. The total number employed in workshops was 23,145, there being an increase between 1895 and 1896 of 9-4 per cent., and a decrease between 1896 and 1897 of O'O per cent., or 8 persons in all. As many as 10,015 were employed in the manufacture of machines, &c 5264 in clothing industries, 1309 in food industries, and 1122

in furniture making. The total number of persons employed in connexion with mines and quarries in 1899 was 48,162. The same year 1,790,480

tons of clay were raised, 313,731 tons of limestone, 165,529 tons of igneous rocks, and 64,057 tons of sandstone. A considerable quantity of salt is produced from brines, but the returns are now bracketed with tbose of Cheshire. In 1885 the pig iron made amounted to 545,365 tons, in 1890 to 545,426 tons, in 1895 to 459,058 tons, and in 1899 to 621,495 tons. The follow- ing table gives particulars in reference to fireclay, coal, iron ore, and gypsum for the years stated : ???

Year.

Fireclay.

Goal.

Iron.

Gypsum.

Tons.

Value.

Tons.

Value.

Tons.

Value.

Tons.

Value.

1890 1899

211,760 249,008

??56,842 ??67,880

13,773,629 13,881,220

5,128,006 4,787,013

1,224,610 1,069,768

434,737 366,770

20,583 48,998

8,600 18,000

The gypsum production is next to that of Nottingham, which however is nearly double.

AuTHOEiTiES. Langfokb. Staffordshire and Warwickshire, i vols. London, 1884. PoOLB. Customs and Legends of the County of Stafford. London, 1886. SiMS. Bibliotheca Staffordi- ensis. Lichfield, 1894. Dent. Historic Staffordshire. Bir- mingham, 1896. See also the Collections of the William Salt Archaeological Society.

Stage Mechanism and Spectacle.

A movement known as " Stage Eeform " originated in Austria about 1880, with, the primary object of encouraging the greatest possible imitation of reform. nature in the presentation of opera and drama. The rudiments of art as understood by painters, sculptors, architects, and the cultured public of the day were to be applied to the stage, and a true scenic art was to take the place of the nondescript mounting previously given. To facilitate the efforts of the scenic artist, the fullest appli- cation of modern science, notably- of mechanics and hydrauhcs, and the introduction of up-to-date methods of lighting were considered essential. The numerous fatal conflagrations which had originated on the stage caused the question of protection from fire to be closely associated with this movement, and the enterprise made great head- way, more particularly on account of the protective meas- ures against fire proposed soon after the burning of the great Court Theatre at Vienna. The

movement gradually developed throughout Austria and Germany and spread beyond the frontiers of these countries. Concurrently, independent movements originated elsewhere, and from 1885 to 1895 a transitional period may be said to have existed for the stage, both in Europe and in the United States, but by the close of the 19th century the necessity for reform was recognized in every country. During the transitional time various unsatisfactory experiments were made, some of the boldest experiments proving costly failures, yet serving, because of such features as were valuable, as a basis for further developments. England and France were almost the last countries touched by this movement, although in England throughout the 'nineties there was considerable improvement in actual scenic art and stage-mounting, as far as this could be brought about without the aid of improved stage mechanism.

Among those primarily responsible for this new epoch in scenic art in England were Sir Henry Irving and Mr Beerbohm Tree, both actor – managers, Mr Hubert von Herkomer, RA., Sir L. Ahna-Tadema, R.A., and Mr Edwin O. Sachs, architect. Although almost last in the application of stage reform in its best sense, England really completed the experimental period with the modern- ization of the Royal Opera House, Covent Garden, where, by the opening of the season of 1902, the directorate were provided with the latest improvements of mechanical skiU for the almost complete re-equipment of stage scenery. This work of remodelling was carried out by the Grand Opera Syndicate, with Mr Edwin O. Sachs as technical

adviser and architect. Modern mechanism has also been applied at the Apollo Theatre, London, where, however, the stage mechanism was bodily imported from the Con- tinent and is of German pattern.

The stage mechanism which was employed in the equipment of the Royal Opera House, Covent Garden, embodies the Sachs system of dividing the stage – floor into a few large sections and working them with the aid of electrical power, the Brandt system of counter-weighting for the suspension of all scenery from above, ~~the application of light in four colours by electricity, and the designing of all scenery to accord as much as possible with nature, the whole mount~~ ing being built up on the basis of a flat stage as distinct from the sloping stage of old. The classification of stages, whether for the production of opera or plays, should be made as follows : wood stages, wood and iron stages, and iron stages, with subdivisions according to the power chiefly employed in working the appliances. These sub- sections are : manual labour, hydraulics, and electricity. Owing to the almost entire absence of steam for motor power in connexion with stage machinery, a separate subdivision for appliances where steam is employed is not required. With the wood stage and the wood and iron stage manual labour alone is utilized. But in the iron stage manual labour, hydraulic power, and electric power are either used individually, or a combination of any two or three of these classes is applied. The first series of stages built in accordance with the principles of Stage Reform was erected on what was termed the "asphaleia" system, in which direct hydraulic power was utilized throughout. The stage-floor is divided into innumerable small sections supported on rams (some working telescopically), whilst everything suspended from above is also worked mechanically by hydraulic power. Notable examples are the Budapest Opera House and the Municipal Theatre at Halle.

The next type is that of the stage of the Court Theatre, Vienna, which, although based to a considerable extent on the " asphaleia " system, showed somewhat larger sections. These are suspended by cables and worked indirectly by small hydraulic rams placed at the side, whilst the whole of the top work is manipulated by manual labour with the partial assistance of counter-weights. The next type is the IBrandt type, where the number of divisions of the stage is further reduced to a few medium-sized sections, worked by means of a combination of a central h3'draulic ram and suspended cables duly counter-weighted. The top work in this case is entirely counter-weighted, and requires the least possible manual

labour for manipulation. An example will be found at the Wiesbaden Court Theatre. We next have the Sachs system, where electric power is substituted for hydraulic power, the number of stage divisions limited to several large sections, suspended on cables jiartly counter – weighted and partly worked by electric motors, while the whole of the top ^A ork is balanced on a system similar to that of the Brandt, with intermediate electric motors for the manipulation of particularly heavy loads. It is this last system that has been adopted at the Covent Garden Opera House, with the modification that tlie top work is entirely operated on the German Brandt system of manual labour and counter-weights. Another example of the Sachs system, as far as individual stage sections are concerned, will he found in a portion of the Theatre Royal, Drury Lane.

Regarding the question of expense and practicability, the hydraulic system has generally been found to be expensive and impracticable. The system of the Court Theatre, Vienna, though practicable, is costly both in

capital and annual outlay. The Brandt method has been found particularly suitable for medium ~~sized theatres, and not expensive. The Sachs system has been found practicable, of moderate initial cost and mini~~ mum annual outlay. The advantages of electricity over hydraulic power have been most marked both in capital and in annual expense. There is of course a far greater initial outlay required to-day than with the wooden stage of old, but the saving in staff and wear and tear of the scenery, and the absence of expensive temporary make- shifts, compensate for this by a material reduction of annual charges. The stage carpenter has long reigned supreme in England and France, although in England there are already one or two notable exceptions of men who are advancing to the position of engineers rather than carpenters. In Germany and Austria the stage carpenter is already being replaced in most theatres by men of engineering or technical training, as the more complex arrangements of a modern stage demand intelli- gent and careful control.

Regarding the actual designing and painting of the scenery, the English scene-painter may now be considered in advance of his Continental and American colleagues, although the productions of> some- pa/

During the period of interregnum in stage reform there appeared a number of faddist inventions which, while creating public interest, cannot be considered of lasting practical utility. Thus in the United /fl□□ea□□□□□□□□□□s States an attempt was made to have a large platform constructed like a lift, bodily rising and falling, with three different tiers or stages on which scenery could be mounted at different levels and then raised or lowered into position. Again, at Munich, a scheme of turn-tables based on the Japanese revolving stage was put forward, but this can only be looked upon as an interesting experi- ment of little practical value. Numerous methods of illuminating the stage have similarly been attempted, with the aid of search-lights, and proscenium-lights, or by the absence of footlights, and the like, but the general method of lighting the stage from the top with battens, from the side with wing-ladders, and from below with foot-lights, if carefully regulated and skilfully handled, produces excellent results. The lighting arrangements as practised at the Royal Ojiera House, Covent Garden, and at the Royal Theatre, ^^'iesbaden, leave nothing to be desired from an artist's point of view. The great difficulty of the light coming too strongly from below, i.e., from the foot-lights, can be overcome by the regulation and colouring of the lights.

As examples of modern mechanism, two photographs have been reproduced showing views of the electrical stage "bridges" of the Royal Opera House, Covent Garden, and of the Theatre Royal, Drury Lane, respectively, both on the Sachs system (see Plate). A small general plan and section of the Covent Garden stage are also shown (see

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Sachs' ELECTr.icAL Stage " Bridges," Royal Opera House, Covext Garden. {h'rom a Photograph hy S. B. Bolas and Co.)

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Sachs' Electjwcai, SrvnK " I1i:iih;ks," Theatkic Kdyal, Di:ruv Lane. (From a J'hnloijraj'h hy Alfred Ellis and Wnln-ii.)

STAGE MECHANISM

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Figure), and another illustration (see Plate) presents the " gridiron " at Covent Garden on the Brandt system.

The following is a detailed description of the Covent Garden installation.

The stage may be described as consisting of a series of six horizon- tal sections running parallel with the curtain line from front to back, each section being 8 feet wide, and the whole being followed by a large back or rear stage. ' The first section contains nothing but a plain "carpet cut," and openings to take the old-fashioned

for raising and lowering scenery for storage purposes. Between the various sections ot the stage, long longitudinal Haps, 2 feet wide, have been formed, which can be easily opened to allow scenery to be passed through below for transformation scenes and the like. Each section is equipped with what is termed a pair of chariots, to hold "wing" lights placed on so-called wing ladders. All the electrical bridges are worked from the "mezzanine" level and from ordinary switch-boards, and can be raised and lowered at various speeds, and take loads up to 2 tons. They can be moved without vibration or noise at a cost of about J for power on a full rise when loaded.

Above the stage level each section has its series of lines to take cloths, borders, &c. Each section has a batten, from which the electric battens are suspended, and has also a lai'ge wooden lattice girder, from which heavy pieces of scenery can be hung. There are, on the average, about ten lines for ordinary battens, a girder batten, and a light batten to each sec- tion ; besides these lines, there are the equip- ments of flying apparatus and the like, whilst in front there are, of course, the necessary lines for tableaux curtains, act-drops, and draperies. Everything that is suspended from above can be worked at stage level or at either of the gallery levels, every scene being counter-weighted to a nicety, so that one man can easily handle it. No mechanical contrivance is required, and in practice quite a number of scenes can be rapidly changed in a very short time. Through- out the structure and mechanism steel has been used, with iron pulleys and wire cable ; and the inflammable materials have been absolutely reduced to the flooring of the gridiron and galleries and the hardwood flooring of the stage and mezzanine. In other words, an absolutely

minimum of inflammable material replaces what was almost a maximum ; and seeing that the electric light has been installed, the risk of an outbreak of fire or its spread has been materially reduced.

cross sectioh thro a b. Plan and Section of Covent Garden Stage.

“grave” trap, “star” trap, or other similar contrivances. The second and third sections comprise large bridges, which can be raised 6 feet above the stage or lowered 8 feet below the stage, constructed in two levels, on the lower level of which appliances can be installed for the purpose of raising minor platforms above stage level or sinkino- traps and the like. The fourth, fifth, and sixth sections comprise large bridges running right across the stage front, which can be raised 9 feet above the stage or lowered 8 feet below it. The back stage has no openings or mechanism beyond certain trap-doors to a scenery store, and the necessary electrical mechanism

Authorities. ??? Modern Opera Houses and Theatres, 3 vols, grand folio, by Edwin 0. Sachs, 1896-99. Stage Construction, 1 vol. grand folio, by Edwin 0. Sachs, 1896. “En- gineering ” : Articles on Stage Mechanism, by Edwin 0. Sachs, 1895-97. Fires and F-uUic Entertainments, 1 vol. quarto, by Edwin 0. Sachs, 1897.. Le- Thidtre, 1 vol. oct., by Charles Garxier, 1871. Les ThMtres Ang- by Georges Bourdon, 1902. Die Theater, Wien, 2 vols, quarto, by Josee Bayer, 1894.

(e. o. S.)

Spectacle.

The appeal to the eye has been the essential feature of treatment of ” Spec- tacle ” in its many stages of development from the earliest times of the miracle plays and “moralities,” mumm.ers and morris-dancers, down through the cen- turies, in the form of masques and ballets, to the luxuriance of scenic and costume display that is lavished on the latest forms of theatrical entertainment. Considering the enormous advance that has been made in mechanical appliances, more especially in the increased powers of illumi- nation supplied by gas and electricity i as compared with oil and candles, we must acknowledge that the artistic

achieve- ment of spectacle has hardly kept pace with the times. If we may credit the veracity of contemporary chroniclers, the most elaborate effects and illusions were successfully attempted in the various courtly entertainments that are recorded under the Tudor and Stuart dynasties, and found perhaps their

^ The Savoy Theatre, London, tricity in 1882.

was first entirely lighted by eleo-

most sumptuous expression in the Courts of Louis XIV. and Louis XV. It would be a difficult task for the most experienced of modern stage managers to rival the splendours of apparel and the ingenious devices that were exploited in increasing magnificence during successive periods, as described by Froissart, Holinshed, Cavendish, Stow, Pepys, and other writers. The sums expended 'on these entertainments were prodigious, and a per- usal of the extraordinarily detailed descriptions of such lavishly appointed masques as those designed by Inigo Jones in particular renders credible the statement that a certain masque presented before Charles I. at the Inns of Court in 1633 cost ??21,000. Spectacle in its earlier phases appears to have existed chiefly in connexion with court and civic ceremonial : as evidenced in the wonder- ful pageantry of the Field of the Cloth of Gold ; in such princely entertainment as the Revels at Kenihvorth, when the Earl of Leicester welcomed Queen Elizabeth in a series of splendid fetes ; and in the more accomplished imagin- ings of Ben Jonson, decorated by Inigo Jones, such as the Inns of Court masque, already cited. The scenic effects and illusions which had evidently been brought to great perfection in these masques were not devoted to the ser- vice of the Drama in the public theatres until Davenant introduced them at the period of the Eestoration, although simple scenery, probably mere background "cloths," had been seen on the stage as early as 1605. The built-up stage pictures, familiar to us as " set-scenes," are said to owe their origin to Philip James de Loutherbourg, R.A., and to have been first used in 1777; but it is difficult to believe that some such elaborate

constructions had not already enjoyed a term of popularity in view of the contemporary paintings and engravings of the epoch of Louis XIV., who was hims elf not averse from appearing (in 16.53) as "Le Eoi Soleil" in the midst of an entourage combining much that was artistic and fanciful with the most pompous and most absurd incongruities of character and costume. A greater measure of ele- gance and refinement distinguished the spectacles of the reign of Louis XV., inspired by the delicate art of Watteau, Boucher, and Lancr'et, and preserved for our delectation in their delightful canvases. Under the French Revolution the spectacular ballet lost much of its prestige ; and its decorative features were for a time principally associated with the fetes inaugurated by the Republic, and presented in the classic costume which the severity of the new regime adopted as a reaction, or as a protest against the frivolities and furbelows of the obliterated monarchy. The Festival of the Supreme Being, decreed by the National Convention, designed by David and conducted by Robespierre, was perhaps the most impressive spectacle of the close of the 18th century.

The 19 th century saw spectacle devoted almost ex- clusively to theatrical entertainment. In Lond(jn, melo- drama, both of the romantic and domestic description, claimed its illustrative aid. At Drury Lane Theatre (which, with Covent Garden, the Adelphi, and Astley's, was first illuminated by gas in 1817-18) the "Cataract of the Ganges," with its cascade of real water and its prancing steeds, made a great sensation in IS 2:1, and the same stage in 1842, under Macready's managi'iiient, displayed the "moving wave" effect in the Sicilian views, painted by Clarkson Stanfield for " Acis and Galatea." The Lyceum Theatre, under the control of Madame Vestris and Charles Mathews in a memorable management lasting from 1847 to 1855, introduced a long series of elegant extravaganzas from the pen of J. R. Planche, elaborately illustrated]ij the scenery of William Beverly. The " Golden Branch," the " King of the Peacocks," and the

"Island of Jewels" (Christmas 1849) were the most remarkable of these productions, and were noteworthy as originating the fantastic fairy pictures that became known as "transformation scenes," and were copied and popu- larized in all directions. Beverly's skilful brush was at a later

date employed at Drury Lane to enhance the attrac- tions of a succession of spectacular, versions of Sir Walter Scott's novels, "Amy Robsart" (1870), "Rob Roy" (with a beautiful panorama of the Trossachs scenery), " Rebecca," " England in the Days of Charles II.," and others. More recently still, under the regime of Sir Augustus Harris and his immediate successors, spectacle at Drury Lane assumed even more costly proportions, and modern melodramas, representing well-kno^vn localities with extraordinary fidelity and all kinds of disasters from earthquakes to avalanches, have been alternated with sumptuously mounted pantomimes (so-called), in which the nominal fairy-tales were almost smofiered by the paraphernalir, of scenery and costume. It is remarkable that for a "run" of ten weeks only such a sum as ►►16,000 each can have been profitably expended on more than one of these productions.

London playgoers will recall the processional glories of "A Dream of Fair Women, " designed by Alfred Thompson ; ' ' The Land of Fairy Tales, " by Percy Anderson ; and ' ' The Silver Wed- ding " (Puss in Boots), "The Paradise of the Birds " (Babes in the Wood), and "The Gods and Goddesses of Olympus" (Jack and the Beanstalk), for which Mr Wilhelm was responsible. "The Armada," a liistorical drama (1888), also deserves to he remem- bered for the completeness and excellence of its spectacular features. In addition to the names of Clarkson Stanfield and Beverly, already cited as masters of scenic art, it must not be forgotten that the skill of David Roberts was also devoted to the embellishment of the stage ; and the names of Grieve, the Telbins (father and son), Halves Craven, and J. Harker have in successive years carried on the best traditions of the art. Alfred Thompson was one of the first to revise the conventionalities of fanciful stage costume, and to impart a French lightness of touch and delicacy of coloiir. A ballet, "Yolande," which he dressed for the Alhambra in the 'sixties, was the first Japanese spectacle to grace the English stage ; and he was also mainly responsible for the attractions of " Babil and Bijou," which cost upwards of ►►11,000 at Covent Garden Theatre in 1872, and was at the time considered to have surpassed all former spectacular ac- complishments. It achieved, however, merely a succes d'estime, and has bequeathed to a later generation only the recollections of its "Spring" choir of boys, and of the brilliant danseuse, Henriette d'Or, who reviyed memories of the great days of the

ballet, when Taglioni, Cerito, Elssler, Duvernay, and other “Dresses de la Danse ” appeared under Luniley’s management at Her Majesty’s Theatre in the Haymarket. Since the memorable tenancy of Sadler’s Wells Theatre by Phelps (1S44-62), Shake- speare and spectacle have been honourably associated. Charles Kean’s revivals at the Princess’s Theatre (1850-59) deservedly attracted considerable attention for the splendour and accuracy of their archaeology. Byron’s ” Sardanapalus ” was also a triumph for the same management in 1853 ; and the same theatre three decades later witnessed the production (December 1SS3) by Wilson Barrett of ” Claudian, ” a romantic poetic drama of classic days, mounted so exquisitely as to gain Kuskin’s enthusiastic praise. But undoubtedly the most notewortliy alliance of spectacle with Sliakespeare has been made by Sir Heniy Ii-ving, whose Lyceum triumphs in this connexion have been equally familiar and ap- preciated in the United States and in Great Britain. The art of Eoyal Academicians was happily enlisted to add lustre and dis- tinction to his productions. “Kavenswood” and the sumptuously presented “Henry VIII.” (1892) owed much to the co-operation of Mr Seymour Lucas. Sir Lawrence Alma-Tadema supervised “Cymbeline ” and “Coriolanus” (1901), whilst Sir Edward Burne- Jones inspired the decoration of “King Arthur” (1895). In Tennyson’s “Cup” (produced in January 1881) and in the beautiful revival of ” Romeo and Juliet ” it was felt that per- fection of stage illusion could scarcely go farther, but the next production, “Much Ado about Nothing,” with its superb church scene by Telbin, was admittedly Irving’s crowning success, alike from the artistic, the dramatic, the spectacular, and the financial standpoints. Great praise was equally won by the vei-sion of “Faust,” whicli was frankly spectacular, and by the more recent “Robespierre” by Sardou. Shakespeare and the poetic drama were also finely illustrated by Mr Beerbohm Tree, who secured Sir Lawrence Alma-Tadema’s interest for “Hypatia” at the

Haymarket, and “Julius Cseaar” at Her Majesty’s; whilst for his later productions, “King John,” “A Midsummer Night’s Dream,” ” Herod ”

(by Stephen Phillips), and "Twelfth Night" (1901), he was assisted by the designs of Percy Anderson, an ai'tist who made his mark in the costumes for a series of the operas at the Savoy Theatre, notably the 15th-eentury dresses for the "Beauty Stone."

Spectacular features of exceptional refinement distinguished the pantomime of "Cinderella," presented by Mr Oscar Barrett at the Lyceum Theatre in Christmas 1893, and designed by Mr Wilhelm. This production also enjoyed a prosperous season in New York. The system of international exchange seems to hold good in stage spectacle as in other cases, and in return for English successes that have been welcomed in America, Augustin Daly's Shakespearean productions were greatly ad-mired in London. Other entertainments of a more absolutely spectacular order found acceptance in London. In connexion with Bamum and Bailey's Hippodrome, Imre Kiralfy's show, "Nero," constituted a "mammoth combination," and attracted crowds to " Olympia " in 1890. The success of this latter spectacle of colour and movement, which was also designed by Mr "Wilhelm, induced Mr Kiralfy to produce a still more ambitious entertainment the following season, "Xenice," designed by the same artist. Aspec- tacle on these lines may be regarded as the outcome of such ballets as have long been popular on the continent of Europe ??? especially in Italy, where grace of movement and spontaneity of gesture are natural to the people, and greatly facilitate such an enterprise as the famous " Excelsior " ballet of Manzotti, which lasted a whole evening, in several acts, and required the services of hundreds of figurantes. "Excelsior" was originally produced at La Scala, Milan, in January 1881, and was subsequently given with great success at the Eden Theatre, Paris, in 1883. But at Her Majesty's Theatre, London, it obtained indifferent success. The English temperament hardly assimilates ballet in the sense in which it appeals to more Southern races, and apart from an occasional furore for a particular dancer, the success .of the ballet as an institution seems to depend rather on the brilliancy of its features than on its display of choregraphie skill. Amongst the latest compositions that occupied Sir Arthur Sullivan was a ballet, " Victoria and Merrie England," for the Alhambra Theatre.

There has been a growing tendency to abandon the romantic in favour of a more realistic and more modern element in ballet,' introducing features hitherto chiefly associated with performances of the Revue or Vaudeville description to the extent even of choruses and spoken dialogue to eke out the resource of the less fluent and less practised exponents of the art of pantomime. Even under these restricted conditions some memorable successes have been achieved, especially at the Empire Theatre, London, where the dances were long directed by Madame Katti Lanner. To quote the names of "Cleopatra," "Rose d'Amour," "Orfeo," "Faust," "Versailles," "Round the Town," "Monte Cristo," "The Press," "Alaska,"' and "Les Papillons " will suffice to show the wide range of subjects laid under contribution. "With all of these Mr "Wilhelm was closely identified as de- signer-in-chief to originate the varied schemes of colour and fancy, and the illustrative effects generally. In Paris, the birth-place of Delibes' ballets " Sylvia" and " Ooppelia," such spectacles as " La V^nus Noire " and ' ' Rothomago, " or, to name a later .example, Massenet's "Cendrillon," achieved a success to which the scenic art of Messrs Amable and Gardy, and the fantastic costumes of Grevin and Draner, largely contributed. In Vienna, also, ballet and spectacle enjoy a great popularity.

See E. 0. Sachs. Modern Opera Hmises and Theatres, 1896- 1897-98. ??? Planch^. The Ristory of Costume. ??? G. Vuilliek. A History of Daiidng. ??? E. L. Blanohard. Histories of the London, Theatres {Era Almanacs). (o. "Wi.)

Stainer, Sir John (1840-1901), Englisli com- poser and organist, was born at Soutli"wark, 6th June 1840. He was the second son of the schoolmaster of the parish school of St Thomas's, Southwark, who was enough of a musician to teach his son the organ and the art of reading music, in which he was already proficient when, in 1847, he entered the choir of St Paul's Cathedral. He remained there till 1856, and often took the organ in emergencies ; he held the post of organist of St Benet's and St Paul's, Upper Thames Street, during the last year of his choristership ; and in 1856 was given the appointment of organist to St Michael's College, Tenbury, where his musical and general education benefited greatly from the intercourse with Sir Frederick Gore Ouseley. He was

appointed to Magdalen College, Oxford, in 1860, and became university organist in the following year. While

at Oxford he did much to bring the choir of Magdalen to a remarkable state of excellence ; he took a keen interest in the foundation of various musical societies ; and as a sign of his appreciation of the value of general culture, it is worth recording that he took the degree of B.A. in 1864, that of Mus. D. 1865, and procured M.A. in 1867, being appointed a university examiner in music in the same year. In 1868 he was engaged frequently as solo organist at the Crystal Palace; and in 1872 was appointed organist of St Paul's, where he raised the standard of choral music to something very like perfection. He was professor of the organ in the National Training School of Music from 1876, and in 1881 succeeded his lifelong friend, Sullivan, as principal. In 1878 he was a juror at the Paris Exhibi- tion, and was created Chevalier of the Legion d'Honneur. In 1882 he became inspector of music in training col- leges. In 1888 he retired from the organistship of St Paul's, owing to failing eyesight, and ^^as knighted. In 1889 he succeeded Ouseley as professor of music in the University of Oxford, holding the post till 1899. Besides these official distinctions, he received a great number of honorary degrees ; he was vice-president of the Royal College of Organists, and president of the Plain-song and Medijeval Music Society, the London Gregorian Association, and the ^lusical Association. His compositions include four oratorios ❓❓❓ Gideon (1865), The Daughter of Jairus ("Worcester, 1878), St Mary Magdalen (Gloucester, 1887), Crucifixion (London, 1887) ; forty-two anthems, some of them very elaborate ; many hymn-tunes, organ pieces, madrigals, Ac. His professorial lectures were of great value, and he made many contributions to the literatui'e of music. He was a man of wide influence, with a remarkable faculty of organization, and his work in regard to the conditions of the musical profession was of considerable importance. His own music has many of the defects of Ms qualities, for his breadth of artistic views led him to admire and adopt many styles that are not always compatible with each other. He died while on a holiday at Verona, 31st March 1901. (j. a. f. m.)

Staiirses, town, railway station, and parish, Middle- sex, England, in the Uxbridge parliamentary division of the county, 6 miles south-west of

Windsor, on the Thames, at its junction with the Colne. A bridge, erected in 1832 at a cost of about ►►70,000, connects the town with Egham. The church of St Mary the Virgin, which occupies the site of a more ancient building, is in debased Gothic style, and dates from 1631. The interior was restored in 1885 and the chancel extended. St Peter's, the parish church, was erected in 1894 at a cost of ►►10,000. Breweries and mustard mills employ many hands. A rifle range for the metropolitan volunteers and others was opened in 1892. In the immediate neighbourhood, though included in the parish of Egham, is Runnymede, where, in 1215, King John signed Magna Charta. The population of the parish and urban district was in 1891, 5535 ; in

1901, 6688.

Stalybridge, parliamentary and municipal borough of Cheshire, England, 1\ miles east of Manchester by rail. The chief industries are cotton spinning and weaving. There are also iron works and machinery factories. The municipal borough was extended in 1881, the parlia- mentary borough in 1885. In 1885 the gasworks were acquired by the corporation at a cost of ►►126,000, and in the following year a large new water reservoir was con- structed at Greenfield. Sewage works were completed in 1897. The town hall was enlarged 1886, and the Astley-Cheetham Free Library opened in 1901. The population of the municipal borough was in 1881, 25,977 ; 1901,

27,674.

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STAMBOLOFF

StambOlOff, Stefan (1854-1895), Bulgarian statesman, was born on 31st January 1854 at Trnovo, the ancient Bulgarian capital, where his father kept a small inn. Under Turkish rule it was impossible to obtain a liberal education in Bulgaria, and young Stamboloif, after attending the communal school in his native town, was apprenticed to a tailor. During

the politico-religious agitation which preceded the establish- ment of the Bulgarian exarchate a number of Bulgarian youths were sent to Eussia to be educated at the expense of the Imperial Government ; among them was Stamboloff, who was entered at the seminary of Odessa in order to prepare for the priesthood. His wayward and independent nature, however, rebelled against the discipline of school life ; he was expelled from the seminary on the ground of his association with Nihil- ists, and making his way to Rumania, he entered into close relations with the Bulgarian revolutionary committees at Bucharest, Giurgevo, and Galatz. In 1875, though only twenty years of age, he led an in- surrectionary mt)vement at Nova Zagora in Bulgaria, and in the following year organized another rising at Orekhovitza. In the autumn of 1876 he took part as a volunteer in the Servian campaign against Turkey, and subsequently joined the Bulgarian irregular contin- gent with the Eussian army in the war of 1877-78. After the signature of the Berlin Treaty Stamboloif settled at Trnovo, where he set up as a lawyer, and was

soon elected deputy for his native town in the Sobranye. His force of character, his undoubted patriotism, his brilliant eloquence, and his disinclination to accept office ??? a rare characteristic in a Bulgarian politician ??? combined to render him one of the most iniluen- tial men in Bulgaria. The overthrow of the Zankoff Ministry in 1884 was largely due to his influence, and in that year he was nominated to the presidency of the Sobranye. He held this important office for the next two years, a critical period in the national history. The revolution of Philippopolis, which brought about the union of Bulgaria with Eastern Eumelia, took place on 18th September 1885, and it was largely owing to Stamboloff's advice that Prince Alexander decided to identify himself with the movement. The war with Servia followed, and Stamboloif, notwithstandini; his official position, served as an ordinary soldi(.'r in the Bulgarian army. After the abduction of Prince Alex- ander by a band of military conspirators (21st August 1886) Stamboloff, who ???\'as then at Trnovo, acted with characteristic promptitude and courage. In his capacity as President of the Sobranye he established a loyal government at Trnovo, issued a manifesto to the nation, nominated his brother-in-law. General Mutkuroff, commander-in-chief of the army, and invited the priiiec to return to Bulgaria. The consequence of these

measures was the downfall of the provisional govern- ment set up by the Eussophil party at Sofia. On the abdication of Prince Alexander (8th September) Stambo- loff became head of a council of regency, with Mutkuroff and Karaveloff as his colleagues ; the latter, however, soon made way for Jivkoff, a friend and fellow-townsman of the first Eegent. Invested with supreme power at this perilous juncture, Stamboflf displayed all the qualities of an able diplomatist and an energetic ruler. He suc- ceeded in frustrating the mission of General Kaulbars, whom the Tsar despatched as special commissioner to Bulgaria, in suppressing a rising organized by Nabokoff,

a Eussian officer, at Burgas, in quelling military revolts at Silistra and Eustchuk, in holding elections for the Grand Sobranye, despite the interdict of Eussia, and in securing eventually the elec- tion of Prince Ferdinand of Coburg to the vacant throne (7th July 1887). Under the newly-elected ruler he became prime minister and minister of the interior, and continued in office for nearly seven years (see Bulgaeia, Part II.). The aim of his foreign policy was to obtain the recognition of Prince Fer- dinand, and to ~~nin the sup~~ port of the Triple Alliance and Great Britain against Eussian interference in Bul- garia. In his deahngs with Turkey, the suzerain Power, he displayed considerable acuteness ; he gained the confidence of the sultan, wiom he flattered and occa- sionally menaced ; and aided by the ambassadors of the friendly Powers, he suc- ceeded in obtaining on two occasions important concessions for the Bulgarian episco- pate in Macedonia (see Macedonia), while securing the tacit sanction of the Porte for the technically illegal situation in the principality. With the assistance of Austria-Hungary and' Great Britainhe negotiated large foreignloans which enabled him to develop the military strength of Bulgaria. Under Prince Ferdinand he pursued the same despotic methods of government which had characterized his administration during the regency ; jNiajor Panitza, who had organized a revolutionary conspiracy, was tried by court-martial and shot at Sofia in 1890 ; four of his political opponents ??? were hanged at Sofia in the following year, and Karaveloff was sentenced to five years' imprisonment. His tyranni- cal disposition was increased by the assassination of his

colleague, Beltcheif, in 1891, and of Dr Ylkovitch, the Bulgarian representative at Constantinople, in 189‘2, and eventually proved intolerable to Prince Ferdinand, who compelled him to resign in May 1894. He was now exposed to the vengeance of his enemies, and subjected to various indignities and jiersecutions ; he was re- fused permission to lea^‘e the country, and his property was confiscated. On l.’^tli July 1895 he was attacked and barbarously mutilated by a band of IMacedonian assassins in the streets of Sofia, and succumbed to his injuries three days later. His funeral, which was at- tended by the representatives of the Powers at Sofia, was

interrupted by disgraceful riots, and an eifort was made to perpetrate an outrage on his remains. No attempt ???was made to arrest his murderers ; two persons were, iowever, arraigned for the crime in 1896, and subjected to almost nominal penalties. (j. d. b.)

StsHTlforol, a town and city of Fairfield county, Connecticut, U.S.A. The town has an area of 38 square miles of hilly country, in the south-western part of the state. The city, lying within it, is on the shore of Long Island Sound, and on the New York, New Haven and Hartford Eailroad. Its harbour is excellent, and it has steamer connexion with New York and other ports of the Sound. It received a city charter in 1893. Popu- lation of the town (1890), 15,700 ; j(1900), 18,839 ; of the city in 1900, 15,997, of whom 4078 were foreign- born and 256 negroes.

Stamp Revenue.’ ??? Stamp duties in the United Kingdom form part of the Inland Kevenue, and are placed under the control of the Commissioners of Inland Revenue. The principal Acts in force on the subject are the Stamp Act, 1891, and the Stamp Duties Management Act, 1891. Amendments of the law are also included in the Customs and Inland Eevenue Act, 1893, the Finance Acts of 1894, 1895, 1896, 1897, 1898, 1899, 1900, and 1901, and the Eevenue Act, 1898. The death duties, the corporation duty, the duties on patent medicines and playing cards, and postage duties, are also technically ” stamp duties ” ; but in ordinary

use the expression is limited to those imposed on the various classes of legal instruments, such as conveyances, leases, transfers, mortgages, bonds,

The revenue from stamp duties increased from ££5,833,341 in 1894-95 to ££7,772,423 in 1901-02. During the latter year the principal items of receipt were bills of exchange and promissory notes, ££701,223 ; companies' capital duty, ££559,091 ; receipts and drafts.

££1,478,392 ; deeds and other instruments, ££3,646,823. The last item included about ££1,407,000 charged on transfers of stock exchange securities. (g. h. m.)

Standerton. See Teansvaal.

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Stanford, Charles Villiers (1852-

Irish composer, was born in Dublin, 30th September 1852, being the only son of Mr John Stanford, examiner in the Court of Chancery (Dublin) and Clerk of the Crown, county Meath. Both parents of the composer were accomplished amateur musicians, the father being the possessor of a splendid bass voice, and the mother a very clever pianist. Under E. M. Levey (violin), Miss Meeke, Mrs Joseph Eobinson, Miss Flynn, and Michael Quarry (piano), young Stanford's musical powers were trained in the early days ; and Sir Eobert Stewart taught him com- position and organ. Various feats of precocity are recorded in an article in the Musical Times for December 1898. He came to London as a pupil of Arthur O'Leary and Ernst Pauer in 1862, and in 1870 won a scholarship at Queen's College, Cambridge, whence he migrated to Trinity College in 1873, and succeeded J. L. Hopkins as college organist, a post he held tUl 1892. His appoint- ment as conductor of the Cambridge University Musical Society gave him great opportunities, and the fame which the society soon obtained was in the main due to Stan- ford's energies. Before his time, ladies were not ad- mitted into the chorus, but during his tenure of the office of conductor many most interesting performances and revivals took place. In the years 1874 to 1877 he was given leave of

absence for a portion of each year in order to complete his studies in Germany, where he learnt from Reinecke and Kiel. He took the B.A. degree in 1874 and M.A. in 1878, and was given the honorary degree of Mus. D., at Oxford in 1883, and at Cambridge in 1888. He first came prominently before the public as a composer with his incidental music to Tennyson's Queen Mary (Lyceum, 1876); and in 1881 his first opera. The Veiled Prophet, was given at Hanover (revived at Co vent Garden, 1893) ; this was succeeded by Savonarola (Hamburg, April, and Covent Garden, July 1884), and The Canter- bury Pilgrims (Drury Lane, 1884). A long interval separates these from his later operas, Shamus O'Brien (Opera Comique, 1896) and Much Ado About Nothing (Covent Garden, 1901). For the main provincial festivals, works by Stanford were commissioned as follows : Orches- tral serenade, Birmingham, 1882 ; Elegiac Ode, Norwich, 1884; The Three Holy Children, Birmingham, 1885; The Bevenge, Leeds, 1886 ; The Voyage of Maeldune, Leeds, 1889; The Battle of the Baltic, Hereford, 1891 ; Eden, Birmingham, 1891; The Bard, Cardiff, 1895; Phaudrig Crohoore, Norwich, 1896; Requiem, Birming- ham, 1897 ; Te Deum, Leeds, 1898 ; The Last Post, Here- ford, 1900. Besides these, there are a few choral works of importance, such as The Besurrection, Cambridge, 1875; Ps. XLVL, Cambridge, 1877; Carmen Srzculare (Jubilee Ode), 1887 ; Installation Ode, Cambridge, 1892 ; East to West, London, 1893 ; Ps. CL., Manchester, 1887 ; Mass in G., Brompton Oratory, 1893. He was appointed professor of composition at the Royal College of Music, 1883 ; conductor of the Bach Choir in 1885 ; professor of music in the University of Cambridge, succeeding Sir G. A. Ma^rarren, 1887 ; conductor of the Leeds Phil- harmonic Society, 1897, and of the Leeds Festival, 1901. His instrumental works include five symphonies, many chamber compositions, among them a string quartet in D minor, played by the Joachim Quartet. He has written many songs, part-songs, madrigals, (fee, and his incidental music to The Eumenides and (Edipus Bex, as well as to Tennyson's Becket, attracted much attention.

His church music holds an honoured place among modern Anglican compositions ; he has edited numberless Irish and other traditional songs ; and has from time to time contributed articles on musical subjects to magazines,

Stanimaka., a town of Eastern Rumeha (depart- ment of Philippopolis), Bulgaria, situated on the D^rin Der^, an affluent of the Maritza, 12 miles S.S.E. of Philippopolis. It is an important seat of the wine trade, carried on by Greeks, and also possesses a distillery. A silk filature has also been established under British aus- pices, which in 1899 spun 75,000 kilogrammes of cocoons, producing 6000 kilogrammes of raw silk, all sent to the United Kingdom. To the south of the town are the ruins of the ancient castle. Under its Greek name, Steinmachos, the town is frequently mentioned in connexion with the Bulgarian wars from the 11th century onwards. Popula- tion, about 14,000, of whom about one-half- were Greeks and a third Bulgarians.

Sta.nisla.U, the chief town of the district of the same name in Galicia, Austria, 70 miles south-east of Lemberg. Population (1890), 22,391 ; (1900), including garrison of 3397 men, 29,628 (estimated at 76 per cent. Polish, 14 per cent. German, and 10 per cent. Ruthenian; 54 per cent. Jewish, 29 per cent. Catholic, 16 per cent. Greek Catholic, and 1 per cent. Protestant). A large manufactory of railway stock, tanning, dyeing, tile-making, milling, and the production of yeast, and considerable trade in agricultural produce. The town has been rebuilt since a great fire which occurred in

1868.

Stanley, Sir Henry Morton (1841-

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English explorer, was born at Denbigh in 1841, being the son of Mr J. Rowlands of that place. His extraction was therefore British, not American ; the name Stanley, how- ever, he assumed after his adopted father, a citizen of New Orleans. Stanley's public career began with the Abyssinian expedition of 1867-68, in which he acted as a newspaper

correspondent. Succeeding, by an accident, in sending the first news of the conclusion of the cam- paign to London, he made his mark with Mr James Gordon Bennett, the proprietor of the New York Herald, and received from that parent of the newer journalism a number of roving commissions. On one of these he ascended the Nile, on another he interviewed the chiefs of the Cretan Revolution 1868-69, and he was sent eventually to Spain in time to vntness the scenes that followed the departure of Queen Isabella from Madrid, and to describe the government of the triumvirs ??? Prim, Serrano, and Topete. The novelty of this subject having waned, Stanley was not surprised when, in October 11-569, he was summoned to Mr Bennett in Paris ; but he was astonished enough at the nature of the new commission then proposrd to him. Briefly, and " without much preamble," as he himself has put it, " I was commissioned to find a Dr Livingstone, who was supposed to be in Africa somewhere. Mr Bennett was sure he was alive somewhere, though

where precisely was a mere matter of detail. It would be my duty to find him and help him to the best of my ability." Stanley may have pointed out that of Living- stone he knew no more than that he was a great traveller, ranking with Burton, Grant, and Speke. Mr Bennett's orders were peremptory. The journey, which was to be kept secret to avoid exciting competition, was to begin next day. As a matter of fact the mission thus vigorously entered upon was considerably delayed. The Suez Canal was opened in November 1869, and on his way East Mr Bennett required Stanley to report the opening. " Then, as I was so near Jerusalem, perhaps it would be well to ascertain what kind of work Captain Warren was engaged in there." Other little commissions were added, and it was not tiU JanuarJ^ 1871 that Stanley reached Zanzibar. So long a time had now elapsed since October 1869 that both the proprietor of the Herald and his London agent seemed to have forgotten their explorer. There was no credit for him at Zanzibar, no one there had heard of him. However, an old letter from the Herald's London agent was produced, and through the sympathy and good- will of the American consul. Captain Webb, Stanley succeeded in obtaining supplies for the African expedition at 25 per cent, premium, i.e., for every ??75 drawn he had to pay ??100 by draft on New York. A well-kno-(vn and popular work, Hoio I Found Livingstone, made the successful issue of this expedition familiar.

Livingstone was found, and Stanley's reputation as a man of unusual determination and an explorer of promise was established. He had, however, a narrow escape from being prosecuted on the charge of obtaining on false pretences the money advanced to him at Zanzibar. By some error the drafts on New York were there protested, and the American consul and the Hindu banker at Zanzibar were up in arms. Fortunately, and before he reached the coast, letters came to Stanley making his credit at Zanzibar practically unlimited. He returned to England, bringing with him Livingstone's journals.

Stanley's next visit to Africa was in the quality of war correspondent. He accompanied Sir Garnet Wolseley's expedition to Coomassie, which he described in a volume entitled Coomassie and Magdala : Two British Campaigns. On reaching the island of St Vincent from Ashanti in 1874 he first heard that Livingstone was dead, and that the body was on its way to England. After the funeral some time was spent in negotiations for sending Stanley again to Africa, there to determine various problems of geographical interest left unsolved by the deaths of Livingstone and Speke, and the discovery by Sir Samuel Baker of Albert Nyanza, a lake then reputed to ex- tend inimitably in a southerly direction. Finally, Sir Edward Lawson, the editor and proprietor of the Daily Telegraph, and Sir Edwin Arnold of that journal, induced Mr Gordon liennett to join them in raising a fund for an Anglo-American expedition under Stanley's commard. The story of its experiences will be found in due detail in its commander's well-known work. Through the Dark Continent. It is enough to state hero that the expedition lasted from October 1874 to August 1877, and was successful in settling a number of the more interesting])rol)lcins which had puzzled geographers. The prin- cipal source of the Nile, the unity and area of Victoria Nyanza, the true h^ngth and area of the Tanganyika and the whereabouts of its outlet, the extension of Albert Nyanza. south of tlie equator, and the discovery of a new lake, and, finally, the connexion of Livingstone's Lualaba with the Congo, are some of the discoveries which resulted. The last was by far the most important, as the Aoyage down the river, from the farthest point which Livingstone had reached to the Atlantic Ocean, had revealed a magnificent

waterway riglit into the very heart of Africa. Stanley spent nearly the whole of 1878 in trying to induce Eng- lish capitalists to seize their commercial opportunities in this region. The King of the Belgians had early made overtures to him, even before his return, but had magnanimously confessed the superior claims of England to profit by such knowledge as the explorer had to com- municate and such practical service as he could give to turn that knowledge to account. It was a friendly rather than a necessary scruple. Whether or not Stanley's efforts to move the British public were always adroitly made, they were in vain. The press was sceptical if not con- temptuous, and in November 1878 Stanley crossed over to Brussels and engaged himself to prove to King Leopold that all he had written and spoken about the Congo was true. Tlie king, though he wanted nothing better, and accepted with alacrity, behaved with great consideration. Before actually sending Stanley to Africa in his service he consented to extend the date of that enlistment till Christmas 1878 that Englishmen might be convinced that England would have nothing to do with the Congo. After a last attempt, in which numbers of intelligent people helped in disseminating his views as to the pcssibility of establishing another India in Africa, Stanley gave in, and set out in January 1879 in the service of King Leopold as agent of a Comiti d!&tude ; in his own words, " to prove that the Congo natives were susceptible of civilization, and that the Congo basin was rich enough to repay exploitation." By June 1884 this had been accomplished with success and without bloodshed or any degree of unpleasantness with the often ferocious native tribes. The details of the six years' labours between 1878 and 1884 are given in the Congo and the Founding of its Free State, published in 1885. In the latter part of February 1885 a convention with the Powers had estab- lished that the major part of the Congo basin should be known henceforth as the Congo Free State, under the sove- reignty of King Leopold. The story of the Congo is im- portant by reason of its influence on African colonization. Prior to the formal foundation of the State by the Powers, and during the sittings of the Berlin Conference in 1884- 1885, Stanley had not only lectured in the capital upon the value

of Africa before the assembled ambassadors, but had made a tour of the larger cities of Germany. Alike in these as in Berlin he discovered that the Germans were much more alive than the British. Possibly not by reason of his lectures, but certainly directly after them, and dating from the doings in the Congo basin then and otherwise revealed, the struggle on the part of the Powers for the possession of African territory began.

During 1885 and 1886 Stanley was engaged with Sir William Mackinnon and Mr James F. Hatton of Man- chester in two ventures, each of potential consequence to the future of British commerce in East Africa, one of which was, however, doomed to failure. The first project after- wards developed into the British East Africa Company; the other, the Eoyal Congo Eailway Company, which in the event of its succeeding was to obtain a charter from the King of the Belgians, fell before the indiffer- ence of English capitalists, combined with a clause in the charter to which, in British interests, Stanley was unable to agree.

Stanley's last and most familiar expedition in Africa was for the ostensible purpose of succouring Emin Pacha (q.v.) from the Equatorial Provinces, where the abandon- ment of the Sudan by Egypt was supposed to have left him in danger. The story of the expedition and the results are set forth in Stanley's best-known work, Through Darkest Africa, a record of extraordinary effort

and resolution. So far as Emin was concerned, however, the expedition was undertaken on a comjjlete misunder- standing.

Keturning to England after his last expedition Stanley was received with honour, and received the degrees of D.C.L. from Oxford and of LL.D. from Cambridge. On 12 th July 1890 he married a lady whose graceful work as an artist was well known to the public. Miss Dorothy Tennant, second daughter of Mr Charles Tennant, for- merly M.P. for St Albans. In 1891-92 he visited the United States, Australia, and New Zealand on lectur- ing tours. In 1892, at the general election, he contested North Lambeth in the Liberal Unionist interest, but was defeated by a small majority. In 1895 he again stood for the same constituency, and was elected as its parlia- mentary representative, but was compelled by ill-health to resign in 1900. In 1898 Stanley visited South Africa as the guest

of the British South Africa Com- pany, and spoke at the opening of the railway from the Cape to Bulawayo. In 1899 his services in Africa were rewarded by a knighthood of the Bath. Too strong or too arbitrary a man perhaps to be invariably popular with his subordinates, too reserved to be popu- lar in the general acceptation of the word, and gifted with immovable resolution, Stanley possessed a positive genius for the handling of native races. As governor of the Congo his task in this respect v, as enormously diffi- cult, but was accomplished with great success.

Stanley, Thomas (1625-1678), poet and

philosopher, was the son of Sir Thomas Staidey of Cumberlow, in Herts, where he ???v\as born in 1625. His mother, Mary Hammond, was the cousin of Richard Lovelace, and Stanley was educated in company with the son of Edward Fairfax, the translator of Tasso. He proceeded to Cambridge in 1637, in his thirteenth year, as a gentleman commoner of Pembroke Hall. In 1641 he took his il.A. degree, but seems by that time to have proceeded to Oxford. He was wealthy, married early, and travelled much on the Continent. He was the friend and companion, and at need the helper, of many poets, and was himself both a writer and a translator of verse. His Poems appeared in 1647 ; his Europa, Cupid Cruci- fied, Venus Vigils, in 1 649 ; his Aurora, Ismenia and the Prince, in 1649; and a collection of these poems, and translations in 1651. Stanley's most serious work in life, however, was his History of Philosophy, which appeared in four successive volumes between 1655 and 1662, and again in one volume in 1687. In 1662 was issued his History of Chaldaic Philosophy. In 1663 Stanley published in folio a monumental edition of the text of ^Eschylus. He died at his lodgings in Suffolk Street, Strand, on 12th April 1678, and was buried in the church of St Martin's in the Fields. His portrait was painted by Sir Peter Lely; his wife was Dorothy, daughter and co-heir of Sir James Emyon, of Flower, in Northamptonshire. Stanley is a very interesting transi- tional figure in English literature. Born into a later generation than that of Waller and Denham, he rejected their reforms, and was the last to cling obstinately to the old prosody and the conventional forms of fancy. He is the frankest of all English poets in his preference of decadent and Alexandrine schools of imagination ; among the ancients he admired Moschus, Ausonius, and

the Per- vigilium Veneris ; among the moderns, Joannes Secundus, Gongora, and Marino. The English Metaphysical School closes in Stanley, in whom it finds its most delicate and autumnal exponent, who went on weaving his fantastic conceits in elaborately artificial measures far into the days of Dryden and Butler. When Stanley turned

to prose, however, his taste became transformed. He abandoned his decadents for the gravest masters of Hellenic thought. As an elegant scholar of the illumi- native order, he secured a very high place indeed through- out the second half of the 17th century. His History of Philosophy was long the principal authority on the progress of thought in ancient Greece. It took the form of a series of critical biographies of the philosophers, beginning with Thales ; what Stanley aimed at was the providing of necessary information concerning all " those on whom the attribute of Wise was conferred." He is particularly full on the great Attic masters, and intro- duces, " not as a comical divertisement for the reader, but as a necessary supplement to the life of Socrates," a blank verse translation of the Clouds of Aristophanes. Bentley is said to have had a very high appreciation of his scholarship, and to have made use of the poet's copious notes, still in manuscript, on Callimachus. Stanley's original poems were imperfectly reprinted in an edition of 100 copies in 1814, but never since; his " Anacreon " was issued, with the Greek text, by Mr Bullen in 1893. His prose works have not been collected. (e. g.)

StapletOn, formerly a village in Richmond county. New York, U.S.A., and since 1st January 1898 a part of Richmond borough, one of the five boroughs of which New York City is composed. It is situated on the east coast of Staten Island, just above the narrows of New York harbour. The population is not separately returned by the census.

Stdra-Zag'dra. See Eski-Zagea.

Starg^ard, a town of Prussia, in the province of Pomerania, 21 miles by rail east by south of Stettin. The walls have been for the most part

converted into promenades, though nearly all the old gates are left. The town has a memorial of the war of 1870-71. It has an active trade in agricultural produce, and carries on iron-founding, making of machinery, soap, roofing, oil and spirit-refining. Population (1885), 22,112; (1900), 26,858. Stargard is also the name of a town in the province of West Prussia, 36 miles by rail south of Dan- zig. It has a couple of churches and a synagogue, iron foundries, and snuflf factories. Population (1885), 6634 ;

(1900), 9687.

StarOCherkasskaya, a Cossack village of Russia, in the province of the Don Cossacks, on the Don, 27 miles from Novocherkassk. It was formerly the resi- dence of the Ataman of the Don Cossacks. In conse- quence, however, of the frequent inundations to which it is subject, the seat of administration was moved to Novo- cherkassk. There is a brisk trade in cattle, which are exported. Population (1897), 10,314.

Staryi Oskof, a district town of Russia, in the government and 9-! miles E.S.E. of the town of Kursk, on the Elets-Valuiki Railway and the river Oskot, in the midst of populous suburbs and villages. A fort was built here as early as the lOtli (century, but even four centuries later the region had the name of "Wild Prairie" {Dikoye Pole). In 1.S97 the population numbered 16,662, most of whom were engaged in agricultural pursuits. The only industrial establishments are a couple of toliaeco factories and some tanneries, but there is a brisk trade in animal and agricultural products.

State. ❓❓❓ As currently employed in that department of political science which concerns itself, not with the relations of separate political entities, but with the political

composition of society as a whole, the word state expresses the abstract idea of government in general, or the govern- ing authority as opposed to the governed, and is thus used by Herbert Spencer in all his discussions of government and society. Louis XIV.'s " L'Etat, c'est moi," Rousseau's theory of the "contrat social," Bas- ^*"' tiat's " Donne k I'Etat le strict necessaire et garde le reste pour toi," all imply this opposition. Hobbes

regards the state, or, as he calls it, the commonwealth, as " one person for whose acts a great multitude by mutual covenants, one with another, have made themselves every one the author, to the end he may use the means and strength of them all as he shall think expedient for their peace and common defence."

The term is also used to distinguish the civil from the ecclesiastical authority in countries where they are or have been in conflict.

A large number of definitions and classifications, accord- ing to political structure, international status, national homogeneity, (fee, have been attempted, but it is beyond the scope of a short article to do more than mention these, different senses of a word so variously employed.

In international law the term has a more precise meaning, according to which the state is the external personality or outward agency of an independent community. In its fullest form its attributes are : (a) possession of attributes sovereign power to pledge the community in its in later- relations with other similarly sovereign com- aatloaal munities, (b) independence of all external con- ^""' trol, and (c) dominion over a determinate territory. In practice, however, there are still incomplete forms of states which join in the international life of states, paramount states whose relations to subordinate parts of their empire are in a condition of uncertainty, and there is, at any rate, one body carrying on international state intercourse without dominion over any territory at all. Thus, Great Britain has diplomatic relations, purely formal though they may be, with several of the subordi- nate states forming the German empire. We saw in the Boer war the army of an annexed community wandering from place to place recognized as a belligerent with whom Great Britain had negotiated as an independent state. The Roman Catholic Church has permanent diplomatic relations as an independent state, though it has no territory against which international rights can be enforced. Egypt, while legally under the suzerainty of the Porte, is practically a British protectorate. Great Britain treats Cyprus as a dependency, though she is in mere occupation of the island for the purpose of carrying out certain reforms for the protection of Christians. Austria- Hungary considers herself in the same position, though she*

occupies Bosnia and Herzegovina " without affecting the rights of sovereignty of his Majesty the Sultan on those provinces," Though Bulgaria, by the Treaty of Berlin, is an " autonomous and tributary principality under the suzerainty of his Imperial Majesty the Sultan," Turkey did not consider her suzerainty to involve her in the war of LSS.""") lietween her vassal and Servia.

A new and somewhat shadowy form of suzerainty is growing up in the " paramountcy " first enunciated (with the concurrence of Great Britain) by the President of the United States in 1823 (see JIoneoe Doctrine), asserted with a certain measure of success against Great Britain in 1896 (see Venezuela, also Arbitration"), and proclaimed formally by the United States at The Hague conference in L'^99 (see Peace Conference) as a condition of her signa- ture of the Peace Convention. While the Spanish republics of Central and South America ^ are still recognized in

' Only Mexico was roprt-sented at the Peace Conference.

STATE

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'international law as sovereign states, they can only be said to fulfil the conditions of absolute independence subject to the limitations which the Monroe Doctrine has placed upon their treaty – making powers with Europe. 1

" In constitutional law, the state," says a leading English authority, " is the power by which rights are created and maintained, by which the acts and forbearances necessary for their maintenance are habitually enforced" (Anson, Law and Custom of the Constitution, part i. p. 2). The British definition is necessarily vague where, as in the and Coa- British empire, the state has a very complex tinentai Construction. In France, where it embraces "'"" a hierarchy of bodies and authorities cul-

cep ons. jjji^g^^^jjjg jj^ ^j^g President of the republic, whose acts are the final form of a series of incomplete acts of the members of the hierarchy, it comes nearer to the theoretical meaning of the word as

understood in international law. In Great Britain the sovereign power of the state is diffused among a number of authorities which have rights against each other and stand in inde- pendent relation towards the individual citizens. Actions can be brought by private citizens in the ordinary law courts against individual authorities, and there is no system of hierarchical responsibility which prevents a state official from being personally accountable for his administrative conduct. In Professor Dicey's admirable Introduction to the Study of the Law of the Constitution, this distinction between the French, or, as we should rather call it, Continental system of entire subordination of the organs to the state as a whole, and the less logical British system is dwelt upon. " Few things," he observes, " are more instructive than the examination of the actions which have been brought in Great Britain against officers for retaining ships about to proceed to sea. Under the Merchant Shipping Act, 1876, the Board are open to detain any ship which, from its unsafe and unseaworthy condition, is a serious danger to human life." " Most persons would suppose that the officials of the Board of Trade, so long as they ??? bond fide and without malice or corrupt motive ??? ^endeavour to carry out the provisions of the statute, would be safe from action at the hands of a shipowner. This, however, is not so. The Board and its officers have more than once been sued with success. They have never been accused of either malice or negligence, but the mere fact that the Board acts in an administrative capacity is not a pro- tection to the Board ; nor is mere obedience to the orders of the Board an answer to an action against its servants " (p. 324).

In England, we may say, the notion of state, from the constitutional point of view, is still inchoate, but the play of international intercourse seems to be gradually leading

^ Great Britain, in acceding tTo the arbitration imposed by President Cleveland, has, in the opinion of a number of American and Conti- nental publicists, recognized the Monroe Doctrine. See Chretien, PriTiaipes ; De Beaumarchai^, La Doctrine de Monroe; De Busta- mente, Le Canal de Panama el le Droit International ; De Pressens4 "La Doctrine de Monroe et le Contlit Anglo-Americain," Revue des Deux Mondes, an. 1896 ; also the writings of Ridgway, Scruggs, Sibley, and

Tucker, and the Annales de Jiirisprudencia (Columbia), June 1897 and following numbers. M. Pradier-Fodere, Professor of International Law at Lyons University, and formerly professor of the University of Lima, observes that "En declarant que la grande r^publique Araericaine consldererait comme dangereuse pour sa tranquillite et sa spourit^ toute tentative de la part des puissances Europfennes d'^tendre leur systSme politique & UTie partie q%ielconque du continent Amerioain, il (le President) s'est mgU indireotement des affaires int^rieures des rdpubliques du Nouveau Monde, autres que les liltats Unis ; il a fait de I'intervention par anticipation et au profit de rUnion ; car, c'est d'intervenir que d'interdire aux autres gouveme- ments d'intervenir."

to a clearer conception of the fact that an increasing national responsibility requires a corresponding increase in the power of co-ordinate state control. An instance of its absence is shown by the loose way in which the British Crown has granted governing powers to chartered companies (see Eaid). This uncertainty applies as much to the United States as to Great Britain. In the Louisiana lynching riots, of which some Italian citizens were the victims, it was contended that the United States Government was not responsible,' and that the responsi-bility fell upon the Government of Louisiana alone. This contention could not be pressed, and compensation was of course paid to Italy. But the subject is well known to have raised some apprehension as to the adequacy of the United States system to meet its centralized state respon-sibilities.

Another, and, in some respects, more dangerous featiu-e of the inchoate conception of state responsibility is the growing apart, so to speak, of certain British dependencies. The British state, for international purposes, is the British empire ; for domestic purposes it is the United Kingdom. Any limb of the former's huge body can have interests different from those of the United Kingdom, and involve its responsibility. A significant step towards co-ordination in the Continental sense ??? that is to say, towards the concentration of liability and control ??? was taken by the Australian colonies in the federation brought about by the Commonwealth Act of 1900. Under this Act the term state is applied to the federating colonies. Section 6 of the Act provides " The states " shall

mean such of the colonies of New South Wales, New Zealand, Queensland, Tasmania, Victoria, West Australia, and South Australia, as for the time being are parts of the Commonwealth, and such colonies or territories as may be admitted into or established by the Commonwealth as states ; and each of such parts of the Commonwealth shall be called "a state." "Original states" shall mean "such states as are parts of the Commonwealth at its establishment." Fol- lowing out this distinction between the Commonwealth and the states. Articles 106 to 124 of the Commonwealth Constitution deal with the respective positions of the Commonwealth, the original states, and the new states. Article 109 in particular provides that "When a law of a state is inconsistent with a law of the Common- wealth, the latter shall prevail, and the former shall, to the extent of the inconsistency, be invalid," thus paving the way for the ultimate consolidation of the federal power.

Much has been written on the " science " of the state, or, as we prefer to call it, " political science," and especi- ally by the Germans, among whom the subject is dealt with as an independent branch of university education. Several German universities have a Staats- wissenschaftliche Facultat, granting special de- Political grees on the subject. In consequence of the great attention paid to the subject in Germany, her state polity is largely the work of her political writers. The result has not unnaturally tended to a system bearing some resemblance to that of the Ameri- can Union, with this very important difi'erence, how- ever, that whereas in the United States the federal power . is derived from the democratic forces of the individual states, in Germany it is derived from their aristo- cratic and absolutist forces. German political thinkers, in fact, have worked out Staatsrecht as a comparative study, in which arguments in favour of absolute govern- ment have received as much careful consideration as those in favour of democratic institutions, and the German state has developed upon lines based on the best theoretical arguments of these thinkers. There is.

therefore, no anomaly in its practically absolutist Govern- ment working out the most democratic reforms as yet put into legislative form. ‘ It foUov^s, hovpever, that German theories are of little use in the consideration of the state problems vs^ith which British and American political thinkers have to deal. Anglo-Saxon institutions are following their independent development, and if the influence of foreign institutions is to be felt at all, it will probably be that of the clear logical detail and cohesion of French institutions.

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State Pensions. See Old-Age Pensions.

States of the Church, territories of Italy ruled over, down to 1860, by the Pope in his capacity as a secular sovereign. They are now comprised within the Italian provinces of Bologna, Ferrara, Forl'i, Eavenna, Pesaro and Urbino, Ancona, Macerata, Ascoli – Piceno, Perugia, Rome, and Benevento.

Staunton, a city of Virginia, U.S.A. It is situated in 38◆◆ 09′ N., and 79◆◆ 04′ W., in the upper part of the Shenandoah Valley, in the western part of the state, at the intersection of the Chesapeake and Ohio and the Valley branch of the Baltimore and Ohio railways, at an altitude of 1366 feet. Though within the limits of Augusta county, it is not subject to county government. Population (1890), 6975 ; (1900), 7289, of whom 149 were foreign-born and 18'28 negroes.

Stavang'er, a seaport town of Norway, capital of county Stavanger, standing on the south of Bukken Fjord, just under 59◆◆ N. During the last decade of the 19th century Stavanger and its environs (Sanniis, &c.) made remarkably rapid progress as a manufactur- ing centre. The industries are, however, of a varied character, and embrace factories for woollens, soap, pre- served foods (a speciality), butter and margarine, arti- ficial manure, hardware, jiotteries, bricks and tiles, linens and cottons, furniture and wooden wares, worsted yarn, iodine from seaweed, shoes, lime, potato flour, &c. ; also

two shipbuilding yards and foundries, with a repairing slip (1899). Another important industry is the catching and curing of fish ◆◆◆ herring, mackerel, sprats, cod, salmon, lobsters, anchovies. On Rennes

Island in the fjord, over against the town, there exists a (Cheviot) sheep-breeding farm under Government auspices. Stavanger is the fii ^t port of call for tourist boats from Hull, Newcastle, Grange mouth, and other British ports. The mercantile fleet numbers about 375 vessels of 162,400 tons; while the total value of the trade increased from ►►350,000 in 1885 to ►►795,700 (►►563,700 imports) in 1899. The imports consist principally of coal, salt, grain and flour, groceries, textiles, wood, and mineral oils. The most important export is fish ►►► other items being seaweed, marble, pre- served foods, butter and margarine, and infusorial earth. Down to 1895 Stavanger had a growing trade in the export of sheep to Leith. The port is entered by some 8000 vessels of a gross 325,000 tons annually, or, ex- cluding those flying the Norwegian flag, by 270 vessels of 150,000 tons. Stavanger was the birthplace of Kjelland the novelist (1849). Population (1891), 23,899 ; (1900),

30,541.

Stavropol, a government of Eus.sia, in northern Caucasia, with an area of 23,398 square miles. The climate is distinguished by rapid changes of tempera- ture. The dry east winds are sometimes very strong in the spring and early summer, blowing the seeds out of the fields, and even destroying in a few days all existing vegetation. In July and August they last for several weeks in succession, and fill the air with dust. The average temperatures at Stavropol (altitude 2000 feet) are much lower than one might expect in that latitude; that for the year is 47►► Fahr., that for January 24►►, and that for August 68►►. The rainfall is 2 8 '2 inches, but other parts of the province are much worse ofl^ in this respect, the yearly rainfall being only from 11"1 to 21 "5 inches. There is a great lack of forests, which are found only near Stavropol and along the courses of the main rivers. In the prairies, only bushes of tama- risk and a dwarf almond tree are found. Altogether, except in the hilly parts of the pro^diice, the flora and fauna of Stavropol diff'er to a great extent from the fauna and flora of other parts of the Caucasus. For both the animal and vegetable kingdoms resemble, on the one hand, those of Central Asia in such features as the pre- sence among mammals and birds of the Saiga tatarica, L., the Vulpes Corsac, Pallas, and the Ilelanocorypha tatarica. Pall., and among plants of, firstly, the Tamarix Pallasii, the iStatice

caspia, and the Stijia lessingiana (all charac- teristic of the dry prairies be3'ond the Urals), and, secondly, of species of Salsola, Salicornia, Sueda, Artemisia, Kochia, and Gamphorosma (all characteristic of the salted steppes of Asia) ; on the other hand, both flora and fauna have many features in common with the prairies of South Russia. As regards geology, the whole of the province is covered with Tertiary and post-Tertiary deposits. Lower Miocene, Middle-]Mediterranean deposits, and Sarmatian clays, limestones and sandstones crop out over nearly one-half of the surface of the province, namely, in its higher portion, while the remainder is covered with loess and various fluviatile and lacustrine deposits. A narrow zone, which now represents a low plain almost devoid of vegetation, is covered with the so-called Caspian de- posits.

The population is rapidly increasing, particularly from natural causes, and partly in consequence of immigration. In 1886 it was 702,635; in 1897, 876,298 (census popu- lation, domiciled only); and in 1898, 912,639, of whom 447,082 were women, and 51,324 lived in tovras. The

average density of the population is only 39 per square mile, but in some districts it rises to 87. Russians form 90 per cent, of the population, Kalmyks 2 per cent., Tiirkomans 3 per cent., Nogais 4 per cent., the remainder being Armenians, Georgians, Germans, Poles, ifec. More than four-fifths of the population (81 per cent.) are Russian peasants. The nomad population occupies, how- ever, more than one-third of the territory. There are four ordinary districts, the centres of administration in which are ❑❑❑ Stavropol (see below), Alexandrovsk (8708), iled-vyezhinsk (+000), and Praskoveya (9297 in 1896), the chief town of the district of Novogrigorievsk ; besides these the territory occupied by the nomads is diN-ided into three dis- tricts (pristavstvo) ❑❑❑ Bolshe-Derbetovskiy, Turkoman, and Achikulak. The standard of education is the average for Russia; in 1898 there were 578 schools, attended by 22,000 boys and 9000 girls. In 1897 the peasants owned 8,111,500 acres of land; private persons, l,2:iC, 800 acres; the Imperial Government,

304,600 acres; and the Crown, 265,000 acres. Agriculture is most successful on the wide prairie lands, and in 1900 3,295,600 acres were under cereals. The average yield in 1895-99 was: rye, 419,500 cwt. ; wheat, 7,254,000 cwt. ; oats, 1,270,000 cwt. ; barley, 2,001,000 cwt. ??? aU cereals, 11,712,000 cwt.; also about 500,000 cwt. of potatoes. Melons, water-melons, and sunflowers are widely cultivated in the fields, and so is flax. Improved agricultural implements ??? reapers, so'ning machines, steam- and horse- power threshing machines, itc. ??? are in general use. Nearly 9200 acres are under vineyards, which cover close upon 100 miles along the Kuma, and nearly 800,000 gallons of wine of an inferior quality are obtained annually. There were in 1898 199,470 horses, 760,690 horned cattle, 2,790,700 sheep, 8200 camels, and 102,000 pigs. These figures are much below those which were obtained from a census in 1896, the cause of the decrease being a very severe winter in 1898, when snowstorms destroyed in a few da-"s more than 200,000 head of cattle. The factories are limited to flour-mills, oil-mills, distilleries, tanneries, and candle works, and few domestic industries are carried on in the villages. Considerable quantities of grain, flax, wool and hides are exported however, and the fairs are very animated. An interesting feature of the village life, in some parts of the province, is the communal cultiva- tion of certain fields for the maintenance of reserve stores of grain. (p. a. k.)

Sta.VropOl, the capital of the above government, 360 miles north-west of Tiflis, and 30 miles from the nearest railway station, standing at an altitude of 2000 feet. It has flour-mills and various small 'factories, employing a few hundred workers. Of educational institutions there are gymnasia for boys and girls, and several town schools and industrial schools, showing an aggregate of 5600 jjupils. The town is well built, has several libraries and a people's palace, and is the seat of several scientific societies. Its population (mostly Russian) was 44,679 in

1897.

Stawell, borough, Victoria, Australia, in the county of Boning, 179 miles north-west of Melbom-ne. The quartz reefs of the gold district are worked at great depths, and large cyanide works are in operation. "UTieat is

extensively grown in the vicinity, and the soil is well adapted for vine-a;rowing, which has been attempted with success. Populatwn (1891), 5183 ; (1901), 5296.

Staweii, Sir William Foster (1815-1889),

British colonial statesman, was the son of Jonas Stawell of Old Court, in the county of Cork, and of Anna, daughter

of the Right Rev. William Foster, Bishop of Clogher. He was born on 27th June 1815, was educated at Trinity College, Dublin, studied law at King's Inn, Dublin, and Lincoln's Inn, and was called to the Irish bar in 1839. He practised in Ireland until 1842, and then making his home in Australia, was admitted to the Melbourne bar in 1843. He engaged exten-sively in pastoral pursuits, and had sheep stations at Natte Yallock, on ^e banks of the river Avoca, and in the neighbom-hood of Lake Wallace, near the South Australian border. For many years he enjoyed the leading practice at the local bar, and when the Port Phillip district of New South 'Wales was separated from the parent colony, and entered upon an independent ex- istence as the Colony of Victoria, Mr Stawell accepted the position of attorney-general, and became a member of the Executive and Legislative Councils. A few weeks after his appointment gold was discovered, and to Mr Stawell fell the arduous duties of creating a system of government which could cope adequately -nith the difficulties of the position. He had to establish a police force, frame regulations for the government of the gold-fields, appoint magistrates and officials of every gi-ade, and protect life and property against the attacks of the hordes of adventurers, many of desperate ehaiacter, who landed in Victoria, first from the neighboming colonies, and later from Europe and America. It was very much o\ving to the firm administration of Mi- Stawell that at a time when the Government was weak, and a large section of the new-comers impatient of control, lynch law was never resorted to. He had very little assistance for some time from any of his colleagues, and until the Executive Council was strengthened by the admission of Captain (afterwards Sir Andre-\) Clarke and ilr H. C. E. Childers, Mr StaweU was the brains as well as the body of the administration. The success of his policy was upon the whole remarkable. In the Legislature he was

sometimes opposed, and at other times assisted, by Mr (afterwards Su-John) O'Shanassy, who was the leader of the popular party, and between them they managed to pass a number of statutes which added greatly to the prosperity of the colony, ilr Stawell was indefatigable in the discharge of his duties, and extraordinary stories are told of the long journeys on horseback to visit distant outposts which he would take after being all day long in the Law Courts or the Council Chamber. Mr StaweU bore an active part in drafting the Constitution Act which gave to Victoria re-presentative institutions and a responsible Ministij", instead of an executive, appointed and removable by the governor, and a legislature in which one-thii-d of the meml eis were chosen by the Crown. At the first general election after the new Constitution in 1856, Mr StaweU was retm-ned as one of the members for ^Melbourne, and became the attorney-general of the first responsible ^linistry. In 1857, on the resignation of the chief-justice, Sir WiUiam A'Beckett, he succeeded to the vacant post, and was created a knigh1>~~bachelor. He administered the Govern~~ ment of Victoria in 1873, 1875-76, and 1884. Sir William never left Australia from his arrival in 1S43 tOl 1872, when he jpaid Short visits to the neigh-bouring colonies and New Zealand, and 1873, when he retm-ned to Europe on two years' leave of absence. He took a very deep interest in the proceedings of the Church of England, and was a memljer of the Sj-nod. On his retirement from the bench in 1886 he was created K.C.M.G. He died at Naples in 1889. In 1856 he had married Mary Frances Elizabeth, only daughter of W. P. Greene, R.N. (g. c. i.)

Steam Engines. See Exgixes.

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STEAM-SHIP LINES.

THE purpose of this article is not to trace the beginnings of steam navigation from an engineer's point of view, but to give some idea of the more im- portant of the commercial undertakings which have been organized with the object of offering facilities to mails and passengers and higher class cargo. The ship- ping company is the outcome of the

development of the steam-ship. In former days, when the packet ship was the mode of conveyance, there were combinations, such as the well-known Dramatic and Black Ball Lines, but the ships which were run in them were not necessarily ovraed by those who organized the services. The advent of the steam-ship changed all that. It was in the year 1815 that the first steam-ship began to ply between the British ports of Liverpool and Glasgow. In 1826 the United Kingdom, a "leviathan steam-ship," as she was considered at the time of her construction, was built for the London and Edinburgh trade, steam-ship facilities in the coasting trade being naturally of much greater relative importance in the days before railways. In the year 1823 the City of Dublin Steam Packet Company was inaugurated, though it was not incorporated tUl ten years later. The year 1824 saw the incorporation of the General Steam Navigation Company, which was intended not only to provide services in British waters, but also to develop trade with the Continent. The St George Steam Navigation Company and the British and Irish Steam Packet Company soon followed. The former of these was crushed in the keen competition which ensued, but it did a great work in the development of ocean travelling. Isolated voyages by vessels fitted v?ith steam engines had been made by the Savannah from the United States in 1819, and by the first Royal William from Canada in 1833, and the desirability of seriously attacking the problem of ocean navigation was apparent to the minds of shipping men in the three great British ports of London, Liverpool, and Bristol. Three companies were almost simultaneously organized : the British and American Steam Navigation Company, which made the Thames its headquarters ; the Atlantic Steam-ship Company of Liverpool ; and the Great Western Steam-ship Company of Bristol. Each company set to work to build a wooden paddle steamer in its own port. The first to be launched was the Great Western, which took the water in the Avon on 19th July 1837. On 14th October following the Liverpool was launched by Messrs Humble, Milcrest, and Co., in the port from which she was named, and in May 1838 the Thames-built British Queen was successfully floated. The Great Western was the first to be made ready for sea.

But the rival ports were determined not to be deterred by delays in getting delivery of their specially built ships. The London Company chartered the Sirius, a 7 00 -ton steam-ship from the St George Steam Packet Company,

and despatched her from London on 28th March 1838. She was thus the first to put to sea. She eventually left Cork on 4th April, and reached New York on 22nd, after a passage of 17 days. The Great Western did not leave Bristol till 8th April, but she reached New York only a few hours after the Sirius. The Liverpool people, fired by the action of the other two ports, chartered the Royal Willidm from the City of Dublin Steam Packet Company, and despatched her on the first steam voyage from the Mersey to Sandy Hook on 5th July in the same year. The Liverpool made her maiden voyage in the following October. But the British Queen did not make her initial attempt till 1st July 1839. Trouble overtook

all three of these early Atlantic lines, and they soon ceased to exist.

Perhaps the most serious factor against them was the success of Mr Samuel Cunard in obtaining the Government contract for the conveyance of the mails from Liverpool to Halifax and Boston, with a very large subsidy. The Cunard Line was enabled and indeed, by the terms of its contract, obliged, to run a regular service with a fleet of four steam- ships identical in size, power, and accommodation. It thus offered conveyance at well-ascertained times, and by vessels of known speed. The other companies, with their small fleets of isolated ships and their irregular departures, could not continue the competition. The Atlantic Steam- ship Company of Liverpool found that the port could not then maintain two steam-ship lines, and the steam-ship Liverpool, with another somewhat similar vessel which they had built, fell into the hands of the P. and O. Company. The Great Western Steam-ship Company proceeded to build the Great Britain, an iron screw steam-ship, which in every way was before her time, and were swamped by financial difficulties, their Great Western being sold to the West India Eoyal Mail Company, to whom she became a very useful servant. The Great Britain eventually drifted into the Australian trade. The London Company put a second ship, the President, on their station. She was lost vrith all hands, no authentic information as to her end ever being obtained. Her mysterious fate settled the fortunes of her owners, and the British Queen was transferred to the Belgian flag. Steam navigation across the Atlantic was now an accomplished fact. But all the three pioneers had been borne down by the

difficulties which attend the carrying out of new departures, even when the general principles are sound.

Constant improvement has been the watchword of the shipowner and the shipbuilder, and every decade has seen the ships of its predecessor become obsolete. Thus, to speak roughly, the 'fifties saw the iron screw replacing the wooden paddle steamer ; the later 'sixties brought the compound engine, which effected so great an economy in fuel that the steam -ship, previously the conveyance of mails and passengers, began to compete with the sailing vessel in the carriage of cargo for long voyages ; the 'seventies brought better accommodation for the passenger, with the midship saloon, improved state-rooms, and covered access to smoke rooms and ladies' cabins ; the early 'eighties saw steel replacing iron as. the material for shipbuilding, and before the close of that decade the introduction of the twin-screw rendered breakdowns at sea more remote than they had previously been, at the same time giving increased safety in another direction, from the fact that the duplica- tion of machinery facilitated further subdivision of hulls. Now the masts of the huge liners in vogue were no longer useful for their primary purposes, and degenerated into mere signal poles, while the introduction of boat decks gave more shelter to the promenades of the passengers, and removed the navigators from the distractions of the social side. The provision of train-to-boat facilities at Li-s-erpool and Southampton in the 'nineties did away with the inconveniences of the tender and the cab.

In the following pages some of the ships which first em- bodied these improvements are mentioned, a brief history of the principal lines is attempted, and reference is made to some of the milestones on the road of improvement. The tonnage and numbers of vessels in the fleets are, how-ever, given in a table, as this is a point on which every month leaves its mark. At the present time the notable

features would seem to be the fact that increase of size in individual ships still continues, and that owing to the great cost of constructing and

worlcing such huge craft the tendency is towards centralizing trade, and especially passenger trade, in the hands of great companies. The movement towards amalgamation among these big com- panies is also an interesting development.

The Allan Line. ❓❓❓ The story of the Allan Line is that of the enterprise of one family. Captain Alexander Allan, at the time of the Peninsular war, conveyed stores and cattle to Lisbon for Wellington's army. After 1815 he began to run his vessel between the Clyde and Canada, and as years went on he employed several vessels in the service. Till 1837 the ships ran from Greenock to Montreal, but in that year, after the Clyde was deepened, the ships went to Glasgow, as they have continued to do ever since. Captain Allan and his five sons devoted all their energies to the development of the Canadian trade, and for about forty years the line ran sailing ships only, which were greatly in request for the emigrant traffic. In 1852 the Canadian Gcnernment requested tenders for a weekly mail service between Great Britain and Canada. That of Sir Hugh Allan of Montreal, one of Captain Allan's sons, was accepted, and the Canadian mail line of steam-ships came into existence. From that time onwards the business has steadily increased, and the building of vessels to keep pace with modern demands has been proceeded with. . From the time of the Crimean war down to the South African campaign the company's vessels have been employed as transports on occasions of national emergency. It may be noted that the Allan Line in- augurated steamers of the "spar-deck" type, i.e., with a clear promenade deck above the main deck. This measure of safety was taken as a lesson to be derived from the disastrous foundering of the Australian steam-ship London in the Bay of Biscay in the year 1866. The company may claim, too, that their steam-ship Buenos Ayrean, built for them in the year 1879 by Messrs Denny of Dumbarton, was the first Atlantic steam-ship to be constructed of steel. As time went on the company's services were extended to various ports on the eastern shores of North America and in the river Plate ; and London, as well as the two strong- holds of Glasgow and Liverpool, was taken as a port of departure. In the course of its career it has absorbed the fleet of the old State Line of Glasgow and a great part of the fleet of the Roj'al Exchange Shipping Company, and of the Hill Line. Included in the latter fleet were the first twin-screw

steamers constructed for a British North Atlantic line. The largest vessel in the fleet is the Tunisian, a twin-screw vessel of 10,376 tons, launched in January 1 900 ; a sister ship, the Bavarian, carried as many as 2200 troops at once to the Cape. The principal ports served by the Allan Line are (in the United Kingdom) Glasgow, Londonderry, Belfast, Liverpool, and London ; from these their vessels ply to many places in North and South America, including Quebec, Montreal, St Johns (Newfoundland), Halifax, St John (New Bruns- wick), Portland, Boston, New York, Philadelphia, Balti- more, Monte Video, Buenos Aires, and Rosario. The finest steamers of the company are run in the mail service from Liverpool to St Lawrence ports in summer, and to Halifax in the months when that river is closed.

American Line. ??? Though the American Line, as now constituted, is of comparatively modern origin, it is the successor of several much older organizations. Of these the oldest is the In man Line last acquired by it. On 16th April 18-30 an iron screw steam-ship of 1609 tons gross register left Glasgow on her maiden trip to New York. This was the beginning of the Inman Line. After a few voyages this ship was sold to ^Messrs Richavdson, Spence and Company of Liverpool, and the sailings of

the steam-ships were thenceforth for some years between Liverpool and Philadelphia. But in 1857 New York took the place of Philadelphia as a regular terminus. Messrs Inman had taken the management of the line in 1854, and a little later the fleet of another Glasgow and New York line was absorbed. In 1859 the regular call at Queenstown was commenced by this line, which may be said to have been responsible for two other innovations in transatlantic traffic. Before 1850 practically all the steam-ships crossing the ocean, with the famous exception of the Great Britain, were paddle-boats. After the advent of the Inman liners the screw began to be every- where substituted for the paddle. In the second place, the Inman steamers were the first which regularly undertook the conveyance of third-class passengers, to the extinction of the old clipper vessels which had hitherto carried on the traffic. In 1867 the Inman Company's City of Paris (the first bearing the name) held the westward record with 8 days 4 hours, and in 1869 its City of Brussels came home in 7 days 22 hours 3

minutes. Till 1872 these records held good. The City of Brussels also had the distinction of being the first Atlantic mail steamer to be fitted with steam steering-gear. About 1875 Mr William Inman turned the concern into a limited company, and in 1886 the business was amalgamated with the International Company, and the vessels, though still flying the red ensign, became the property of a group of United States capitalists, who also acquired the old American Line which had been started in 1873 with four Philadelphia- built steamers. This company had been conducted under the auspices of the Pennsylvania Railroad. It plied between Liverpool and Philadelphia. A third constituent in the Inman and International Steam-ship Company was the Red Star Line, as the Societe Anonyme Belge-Ameri- caine was familiarly called. Its service was from Antwerp to New York. The whole was placed under the manage- ment of Messrs Richardson, Spence and Company, who thus after thirty-two years reassumed the direction of the old company. In 1887 the two ships City of A'ew York and City of Paris were built on the Clyde for the company. At the time of their construction they were the largest vessels ever built, always excepting the unlucky Great Eastern. It stands to the credit of the City of Paris that in 1889 she was the fir^t vessel to cross the Atlantic in less than six days. In these ships there was a great improvement in the whole arrangement of the water-tight compartments, more subdivisions being introduced. The City of Paris had the opportunity of demonstrating their value. In 1890 one of her engines was completely wrecked. The water flowed in and inundated the engine- rooms, yet her bulkheads kept her afloat until help came. The year 1893 was an important one in the history of the company, and indeed of the LTnited States. The two vessels above mentioned were admitted to American registry by Congress, a stipulation being made that two new ships of at least equal tonnage and speed to the pair should be ordered by the company from American firms, and that they should be capable of being employed by the United States Government as auxiliary cruisers in case of war. The American flag was hoisted over the Xew York in 1893 by President Harrison, and in the same year the British headquarters of the company were transferred from Liverpool to Southampton. In 1894 the first American-built ocean liner of the new fieet was launched, and was named the St Louis by Mrs Cleveland, the wife of the then President of the United States. In 1898 the American Line had the distinction of supplying the navy of its country

with cruisers for use in war. The St Paul, the only vessel of the four under contract in American waters at the time, was put under the command of

Captain Sigsbee, whose own battleship, the Maine, had been blown up in Havana harbour on 15th February. The other three ships were also put into commission, the Paris being temporarily renamed the Yale, and the New Yori the Harvard. Their exploits may be read in the annals of the war. Fitted up as swift cruisers they proved invaluable auxiliaries to the fleet, both as fighting vessels and in the pursuit and capture of blockade-runners. In 1902 with their twin-screw liner Kensington the American Line made the first experiments towards fitting Atlantic passenger steamers with appliances for the use of liquid fuel. The express fieet of the line consists of the four vessels, St Louis and St Paul, each of 11,600 tons, and a length of 554 feet ; and the New York and Philadelphia, each of 10,800 tons and 560 feet length. Several still larger, but less speedy steam-ships, have recently been constructed for the intermediate services of the company. In addition to the weekly express service between Southampton and New York, the American Line runs boats between New York and Antwerp, Phila- delphia, Queenstown, and Liverpool, and Philadelphia and Antwerp.

Austrian Lloyd Steam Navigation Company. ??? This company was started in 1837 at Trieste, where its head- quarters are still situated. It commenced operations with seven small wooden paddle-boats for the voyage to Con- stantinople and the Levant. The whole commercial history of that region has since then been intimately bound up with that of the Austrian Lloyd. Trieste is not only the port whence the vessels of the company start, and to which they return, but also the place where most of them are constructed. The company has there its own dockyard, where it builds and engines most of the steamers of the fleet. This yard is fitted with a dry-dock, slip, and all the most modern shipbuilding appliances. The seven small paddle-steamers of 1837 have now grown to a fleet of 69 iron and steel steam-ships, vidth a gross tonnage of 186,000 tons. Some of the most important of the later ships were constructed in Great Britain.

The actual ports served by the company are much too numerous to detail, but the whole eastern coast of the Adriatic and the Levant is visited by them with frequent services. These Adriatic, Mediterranean, and Levant ports have seven services in all, and three branch lines. .There is a line to the west as far as Brazil, and a monthly mail service between Trieste, Brindisi, and Bombay. There is also a monthly ordinary service between Trieste, Bombay, China, and Japan, and a monthly branch in connexion with it between Colombo, Madras, and Calcutta. The latest development is towards the Cape of Good Hope down the east coast of Africa.

Bihhy Ijine. ??? The name of Bibby has long been known and respected in the shipping world. The first undertaking of the family was the institution of a service from Liverpool to ^lediterraneaii ports about the middle of last century. When Mr (sul isequently Sir Edward) Harland took over the shipbuilding works at Belfast, which he afterwards made famous, Mr Bibby was one of his earliest customers. It was he who gave him practically carte hlam-lie in the way of pro- portion for the new ships built for his service, and it was from the experience acquired and the success achieved with them that the " long ships," with which the White Star Line made its name, were first brought into the region of the prartical. In this connexion it may be stated that Sir Edward Harland was born at Scarborough in 1831, his father being a medical practitioner. He learnt the science of shipbuilding in the yards of Messrs R. Stephenson and Company of Newcastle, and beeamo first a draughtsman with Messrs J. and G. Thomson, and then manager in a Newcastle yard. In 1854 he went to Belfast, first as manager to Messrs Eohiert Hickson and Company. Then

in 1858 he took over their yard. In 1859 he launched the Venetian for Mr Bibby, and in 1860 he took Mr G. W. Wolff into partnership. After a time Mr Bibby retired from the active pursuit of his business, and the line passed into the hands of one of his confidential mana,gers ??? Mr Leyland. The name was soon changed, and continuing its prosperity, and advancing into the Atlantic trade, the company eventually, in the year 1900, absorbed the highly successful West India and Pacific Company, and became one of the big lines of the country. A good deal of tonnage was, however, subsequently taken, over by its chairman, Mr J. E.

Ellerman, for the purpose of develop- ing another new company called after himself. And this line, in its turn, has since taken to itself others, notably the old-established City Line, plying from Glasgow as a headquarters to the East. But the Bibby family, though large shareholders in the White Star Line, could not remain without some active interest in seafaring matters. Hence a new Bibby Line was started. Its first vessel was the Lancashire, a single-screw steamer of 4244 torus grots register, built^as have been all this fleet ❓❓❓ by Messrs Harland and Wolff. She came out in 1889. Her sister was a similar vessel. The company engaged in the trade between Liverpool and Eangoon, where they soon made a name and were put by Government on the same terms as the P. and 0. in regard to the official recognition of their steamers as a permissible means of conveyance for officers. Five twin-screw steamers, each larger than the last, have followed the first pair, and the latest, the Warwickshire, is little short of 8000 tons gross. The service is main- tained with three-weekly sailings, and there are reserve ships which have done useful work in the Government transport service.

British India Steam Navigation Company. ❓❓❓ This Hne maintains, perhaps, a larger network of communications and serves a greater number of ports difficult of access than any in the world. The Persian Gulf, Burma, the Straits of Malacca, and the entire littoral of the East Indies, to say nothing of the east coast of Africa, are among the scenes of its enterprise. To its efforts is due in no small degree the development of Indian commerce with the ports of the neighbouring semi-barbarous countries. Though its ramifications now extend to the ports of northern Australia, the company had its origin in the Indian coasting trade. Its present designation is of comparatively recent origin, but its first operations date from 1855. A project for a mail service between Calcutta and Burma was then first set on foot by the East India Company. Early in the following year a company was formed, under the title of the Calcutta and Burma Steam Navigation Company. Two small steamers of 600 tons each were bought and despatched to India round the Cape in 1857, for a service between Calcutta, Akyab, Eangoon, and Moulmein, under a contract with the Government of India. At the outbreak of the Mutiny in 1857 the company rendered important service by bringing up to Ceylon from Calcutta the first detachment of European troops which came to the

assistance of India from outside. In 1862 a most im- portant step was taken, principally owing to the enlightened assistance rendered to the company by the Indian Govern- ment. An agreement was made between the company and the Government, by which the former agreed to convey troops and stores and to perform other services. Under this arrange- ment boats were to be despatched regularly from Calcutta to Eangoon, Moulmein, Akyab, and Singapore, and from Eangoon to the Andaman Islands. A service was also set on foot to the Persian Gulf, between Bombay and Karachi, and Madras and Eangoon. This gave an inijiulse to the business of the company, and entailed regular visits to ports which had hitherto been deemed unapproachable

for many months of the year. It also involved a great increase in the fleet. The company's connexions, too, have since 1866 embraced services to the Dutch West Indies. During the Abyssinian campaign of 1867 the company proved of the greatest assistance to the Government. The opening of the Suez Canal in 1869 produced an entire revolution in the shipping trade of India, and led to a great development of the company's fleet. The s.s. India with cargo was waiting at Suez when the canal was opened to traffic, and was the first steamer to arrive in London through the canal with an Indian cargo. In 1872 the company extended its operations to the east coast of Africa, and by an arrangement with the British Govern- ment began to run a service every four weeks between Aden and Zanzibar. Some interest attaches to the exten- sion of the British India Company's service to Delagoa Bay. The coming importance of this trade was recognized and a service inaugurated to develop it. A loss amount- ing to no less than ££40,000 per annum was, however, incurred, and the directors did not feel justified in continuing the attempt. The Germans, however, saw that the trade was worth buying, and the Imperial Government gave a new line under the German flag a subsidy, calculated on the amount lost by the British India Company, leaving its contractors, whilst probably insured against loss, to look to their owm exertions in the develop- ment of the trade for any possibilities of profit. The German Line

has proved a success as well to its share- holders as to German trade, and at a later date the British India Company again tried for the trade and entered into competition with it. The full record of this company's transport services would be a chronicle of British military operations during the second half of last century. But it may be mentioned that no less than 37 of its fleet were employed in the Chinese expedition, while 42 more were engaged in connexion with the South African war. The company's fleet comprises steam-ships of very various sizes, from a few hundred tons to several thousands. This of course is a necessity of the traffic, which compels visits to many out of the way ports which no vessels of large draught could approach. Upwards of one hundred ports are visited by the company's steamers. In all there are twenty-one lines with additional services. They may be classed roughly as those running to ports in (i.) India, Burma, and Straits Settlements ; (ii.) Straits Settlements and Philippines; (iii.) East Coast of Africa; (iv.) Persian Gulf ; (v.) Dutch East Indies and Queensland. Some of the services run from London, some from Indian ports, some are local. They are far too numerous to set out in detaO, but this summary will indicate the magnitude and complexity of the company's operations.

Canadian- Australian Line and the Empress Line. ❖❖❖ ❖❖❖ These two lines run in connexion with the Canadian-Pacific Railway ❖❖❖ the Canadian- Australian Line from Vancouver to Sydney, and the Empress Line from Vancouver to Japan and China. The vessels of the first-named line were built in 1892. The fleet of the Canadian-Australian Line con- sists of three vessels, iho Aorangi, Warrimoo, and Jliowera. Of these the Aorangi is of 4250 tons, and the other two of 3500 tons each. The Empress Line has three twin-screw steam-shij)s ❖❖❖ the Empress of China, Empress of India, and Empress of Japan ❖❖❖ each of 6000 tons and 10,000 h.p. A fourth is under construction. They are built to the requirements of the British Admiralty, for they are aU designed for use as armed cruisers in time of war, and are commanded by ofiicers of the Royal Xaval Reserve. Each line carries mails. The Canadian-Australian steamers run from Vancouver about every three weeks to Honolulu, Fiji, Brisbane, and Sydney. The Empress Line from Vancouver to Yokohama, Kobe, Nagasaki, "Woosung, and

Hong Kong, also run about every three weeks. These lines are of importance, not only as valuable factors in the development of the trade between the great British dependencies, but also because they afi'ord a connexion between England and the most distant parts of the empire, by a route which can be traversed on British steamers, and a railway running across a British colony, without touching on foreign soil or traversing the possibly dangerous straits and narrow seas which are characteristic of the alternative route vid the ilediterranean and Suez.

Castle Line (see also Union Line and Union -Castle Line). ??? The Castle Line began its career in 1S72 with the Iceland and the Gothland, both vessels of about 1400 tons. At that time the charge for carrying letters to the Cape was about Is. per half oz., and the contract time between England and the Cape thirty-seven days. The mail contracts were then in the hands of the Union Line exclusively, but in 1873 the House of Commons refused to ratify the extension of the contract signed with them by the Chancellor of the Exchequer, and their rights thus expired in 1876. Up to 1876 the Cape Parliament made an allowance to the Castle Line for the conveyance of letters, and when the postal contract was renewed in that year it was divided between the Union and the Castle Lines, an arrangement which was adhered to down to the time when the two lines united thtir fortunes. The scope of the company's energies has now been extended to all parts of South Africa. The line did great national service in carrying troops and stores to South Africa during the 1899-1902 and previous campaigns. By a resolution passed at a meeting of shareholders held on 13th February 1900 this company was amalgamated with the Union Line. The fleet had grown from two ships in 1876 to 20 ships in 1 900, and from a total tonnage of 2800 to one of about 110,000 gross register.

City of Dub/in Steam Packet Company. ??? Limitations of space forbid any detailed account of the various steam- ship services whose vessels traverse the waters of the narrow seas round Great Britain. It would be interest- ing to say something of the twin-screw fleet with which the London and jSTorth-Western Railway replaced the paddle vessels which formerly carried on its service between Holyhead and the N"orth Wall, Dublin ; of the comfortably fitted sleeping accommodation which

the vessels of the service jointly owned by the Xorth- Western and Lancashire and Yorkshire railways ofl^er to travellers on the longer night crossing from Fleetwood to Belfast ; of the Great Western Railway's service between Milford Haven and Waterf ord ; of the same company's Channel Island fieet, which makes its headquarters at Weymouth; of the lines' which, centring at Southampton, the South – Western Railway maintains with the Channel Islands and north- western French ports; of the cross – Channel services betAveen Dover and Calais, and Folkestone and Boulogne ; of the Xewhaven and Dieppe fleet of the Brighton and West of France railways ; of the excellent modern ships with which, starting from Harwich and plying to Belgian and Dutch ports, the unsubsidized Great Eastern Com- pany holds its own against the State-aided paddle fleets under the Dutch and Belgian flags ; and of the cross-Channel services of the Belfast Steamship Company and of the old-established Isle of Man Steam Packet Com- pany. But it is obviously impossible to deal exhaustively with these, or with others which might perhaps fairly be named, and so we must content ourselves with a brief reference to the City of Dublin Steam Packet Company, oldest and most noteworthy of them aU. This midertaking vies with the General Steam Naviga- tion Company in the claim for precedence on account of seniority. The General Steam was undoubtedly the first

to receive incorporation in the year 1824, but the under- takrQgs from which the City of Dublin Company sprang were at work in the years immediately prior to these dates. The facts, though they must have been well known to the general shipping public at the time, are now very difficult to trace. As far as appears, the firm of Bourne and Company ___ who fulfilled in Ireland functions for which the Messageries Imperiales in France were first formed ___ were large shareholders in two under- takings which made history in regard to the development of steam navigation. One of these companies was the Dublin and London Steam Packet Company, from which Messrs Wilcox and Anderson, the first managers of the P. and O., chartered the Royal Tar, the first steamer

they despatched to the Peninsula, and the other was the City of Dublin Company, which originally occupied itself in the maintenance of a service of steam-ships between Dublin and Liverpool. It was this company's Royal William which had the distinction of opening the Liver- pool service to New York. By absorption, too, this company represents the old St George Company, whose Sirius was the first steamer to sail from London towards New York. In the year 1838 the Admiralty, which in those days had the management of many of the mail services and continued for a time to keep the Irish day mails in its own hands, gave the City of Dublin Company the contract for the night Irish mails, which were thus despatched vid Liverpool. The name of Laird is to this day closely associated with the fortunes of the company, and even at that time a Mr Laird, grandfather of the present partners in the shipbuilding firm, was a director of the City of Dublin Company. In the year 1848 the Government with four steamers endeavoured to run the day and night mails itself vid Holyhead. But this arrangement did not work well, and two of its mail steamers were bought by the City of Dublin Company, while the two others were acquired by the Chester and Holyhead Railway. It is needless to follow the vicissi- tudes of the mail service, wavering as it did from the Admiralty to the Chester and Holyhead Railway, and then to the City of Dublin Company. Suffice it to say that in 1859 an arrangement was entered into whereby the City of Dublin Company undertook the conveyance of both day and night mails vid Holyhead, and built four ships, called after the four Irish provinces, for the service. The performances of these four paddle ships, three of which were built by Messrs Laird, were remarkable indeed. The Connaught was the first vessel to do her 18 knots. The Ulster made the best passage of them all ??? doing the journey from Holyhead and Kingston in 3 hours 18 minutes. But the Leinster was only two minutes behind her, and the Jfunster only six minutes worse than the Leinster. Taking the performances of the whole four vessels over the first fourteen years of their existence, and considering the mean of 20,440 passages made as well in winter as in summer, the average time of passage was only 3 hours 56' 1 minutes. The con- tract was renewed from time to time, that coming into operation on the 1st October 1883 being for an acceler- ated service. To enable this to be adequately performed, the last paddle ship of the fleet, the Ireland, was built by Messrs Laird, who also overhauled and improved

the machinery of the older vessels, giving them new boilers adapted for the use of forced draught. In 1895 it was felt that the mode of carrying these important mails again needed revision, and in that year the House of Commons approved of a new contract, under which four new twin-screw vessels were to be built for the service. The work of design and construction was again undertaken by Messrs Laird, and in 1897 the new fleet assumed the

duties, and indeed the names, of the vessels which 'had done such remarkable service during a period of about thirty-eight years. The contract time was now decreased by half an hour, and this meant naturally a very great increase in the speed of the vessels employed. The present ships are capable of a speed of about 24 knots ??? which is considerably in excess of that of any vessel as yet constructed for service on the Atlantic, and certainly of that of any other Channel steamers. They can thus maintain with regularity and ease the 20 to 21 knots which are sufficient for the purpose of their contract in ordinary circumstances. Besides the night and day ser- vices with the mails the company also maintains its old line between Liverpool and Dublin.

Collins Line. ??? Mention must not be omitted of the line which, although it had ceased by 1860, played a great part in the development of the passenger trade between Liverpool and New York. The American traveller has always been an important factor on the Atlantic, and in the sailing-ship days the American clippers had a great share of the better class of business. It was natural, therefore, that when the steam-ship was established in the trade the Americans should wish to have their share of the traffic. The Cunard Line soon after its start destroyed the opposition of the other existing British lines, and by 1850 was obtaining no less than ??,1, 10s. a ton for the cargo which it carried. There were thus more solid in- ducements than mere sentiment towards competition, and in 1850 Mr E. K. Collins started his line of steamers. Twenty voyages were to be made by it a year, and the subsidy payable by the American Government was to be $19,250 a voyage. It was found, however, before the ships were actually got to work that the cost both of building and running them would be higher than had been anticipated, and the Government accordingly raised its subsidy to $33,000 a trip, or

178,750 a year. Four wooden paddle steamers of about 3000 tons each were constructed in American yards, and these were soon put into the station. Their speed was good, and they accomplished faster passages than the Cunarders of their time. But the British company saw that its existence depended on the maintenance of its position, for the rate of freight promptly fell about 40 per cent. Accordingly the Persia, a beautifully-modelled iron paddle steamer, larger and faster than the American built vessels, was ordered and obtained from the yard of Jlessrs.R. Napier and Sons. To this the Americans responded with the Adriatic, the largest wooden steamship ever constructed. But there were delays over her completion, and in spite of its enormous subsidy the Collins Line was tottering to its fall. Disasters overtook it. The Arctic, one of the four original steamers, was lost by collision with a French vessel named the Vesta, and unfortunately the casualty was attended with great loss of life. Another ship, the Pacijic, was missing. These accidents do not appear to have been due to any want of care in the management of the line, but in conjunction with the heavy expenses which attended the working of the service they proved too much for the company, and the Adriatic only made one trip in the service, which was discontinued at the end of the year 1859. It had, however, left its mark in the improvements it wrung from the Cunard company, which had not only built the Persia, but had provided another larger and faster vessel named the Scotia ; this, however, did not come out till after the competition had ceased.

Comj^agnie Generale Transatlantiqiw. An undertaking known as the Compagnie Generale Maritime was founded by the French in the year 1855, to free their mercantile marine from the reproach of marked inferiority to those of the British and United States in the North Atlantic

trade, where at that time the Collins and Cunard mail steamers were engaged in their historic struggle. It owed its inception to the brothers Emile and Isaac Pereire. Services were first organized from Eouen to Algeria, between Havre and Hamburg, and between Marseilles and Antwerp, with calls at Spanish and Portuguese ports. In 1861 the

company was allowed to change its title to the more comprehensive one under which it now is known, and it then undertook its first contracts for the carriage of the French maUs to the United States, the Antilles, and Mexico. Some of the earlier vessels employed in the New York service were very fine specimens of the naval archi- tecture of their day. Among them may be instanced the great iron paddle steamer Napoleon III., built in the year 1864 by Messrs Scott and Company of Greenock, who at that time constructed most of the more important vessels for this service. This vessel with her imperially titled sisters suffered a change of name in the early 'seventies, when several of them were lengthened and altered to screws. In the year 1881, again, there was a great movement towards the acceleration and improve- ment of the New York service, and a new fleet was begun with the single-screw steamship La Normandie launched at Barrow-in-Furness in 1883. Four larger vessels of much the same class followed, three of them being constructed in the owners' own yard at Penhoet. In 1890 the first twin-screw steamer of the line appeared in La Touraiiie, and proving a success, the British-built L'Aquitaine was purchased. A new postal contract was arranged in 1898, and under its terms it became necessary for the company to build still larger and faster vessels. Eventually four such ships required to be provided, but in 1902 only two ??? La Savoie and La Lorraine ??? had been put on the station. These vessels are of 22 knots' speed ???on trial, and are among the fastest on the Atlantic. The company maintains a weekly service to New York, as well as the lines to the Antilles and Mexico in the Atlantic. There are also communications with British and Algerian ports.

Cunard Line. ??? This is the premier steam-ship company in the highly competitive New York trade. It derives its name from Samuel Cunard of Halifax, Nova Scotia, an owner of sailing vessels trading from Boston and New- foundland to Bermuda. He first conceived the idea of a regular despatch of royal mail steam-ships across the Atlantic, to take the place of the Government brigs, which often took six or seven weeks in the transport of mails. This idea he realized with the help of Mr George Burns of Glasgow and Jilr David Maclver of Liverpool. On the 4th July 1840 the first Cunarder, the Britannia, started on her voyage across the Atlantic with sixty -three passengers, landing them at Boston in a fortnight, where they received an enthusiastic welcome from the

inhabitants. It is said that Mr Cunard received 1873 invitations to ???dinner in twenty-four hours. Probably the advance in shipbuilding which has taken place since the time when the first Cunarder crossed the Atlantic is not to be measured by more striking contrast than that between the Britannia of 1840 and the Ivemia of 1900. The Britannia was a paddle steamer of 1154 tons, 207 feet length, 740 h.p. ; and her average speed was 8-5 knots, and she carried at the utmost 115 passengers. The Ivemia, launched in September 1899, is a twin-screw steamer of 14,000 tons, 10,000 h.p., 600 feet length, and 16 knots' sea-speed. She can carry 2300 passengers, ??? 200 firs1>class, 220 second, and 1900 third. She has four complete steel decks (lower, main, upper, and shelter), a steel orlop deck, extending from the boiler-room for- ward to the stem, and a bridge deck 280 feet long under the shelter deck. She can carry, compared with the

Britannia, twenty times the number of passengers and fifty times the amount of cargo. The experiment of using the screw for the Atlantic service was made by the company with several cargo steamers in the early 'fifties, and, these being proved a success, the first Cunard screw steamer for the mail line made her debllt in 1862. This was the China, and her advent marks the middle stage in the company's history. Since then the development in shipbuilding has advanced by leaps and bounds. The gross tonnage of the China was 2539, her i.h.p. 2250, and her average speed 139 knots. In 1870 the Cunard Company first fitted compound engines to their steam-ship Batavia, and in 1881 the Servia, the first steel vessel in the service, was the pioneer of the larger type which constitutes the present express fleet. The Cunard Line can boast that, though there have naturally been one or two losses of mail steamers in its long career of over sixty-three years, none of these have involved the lives of their passengers. The Campania, Lucania, Unibria, and Etruria are the express steamers at present maintaining the mail service. They run from Liverpool to New York every Saturday. The average speed of the two first-named boats is 21 to 22 knots, which they accomplish by means of engines of 30,000 h.p. The Lucania has accomplished the passage westwards in 5 days 7 hours and 23 minutes, making as much as 562 nautical miles in a single day's run. Since 1840 the Cunard Company has been under contract with the British Government for a mail service. At

the present time the contract is for a weekly mail to the United States, via Liverpool and New York. The British Post Office, however, only pays its contractors for the weight of mails actually carried, and reserves the right to send specially addressed letters by foreign ships. The company's services also include a weekly passenger line to Boston, and frequent despatches to Mediterranean and Levant ports as well as a weekly steamer to Havre. In October 1902, as a result of the formation of the Morgan Shipping Trust, the British Government made a new arrangement with the Cunard Line, involving the loan at 2 1 per cent, of the capital for building two new fast steamers, besides a yearly subsidy of ££150,000 for twenty years.

Elder, Dempster, and Company. ††† The remarkable pro- gress of this company, and of the undertakings connected with it, is largely due to the activity of Sir Alfred Jones, the present head of the business. The oldest business under its management is the African Steam-ship Com- pany, which was incorporated by royal charter in the year 1852 for the purpose of trading with West African ports. It received a subvention of ££30,000 per annum for a monthly mail to the Gold Coast, and began its work with an unambitious little fleet of four 700-ton vessels. These were at first, however, equal to all the traffic which the trade could oflfer them. As time went on the number and size of the vessels employed was increased. In 1869 such progress had been made that it appeared worth while to start an opposition line under the name of the British and African Steam Navigation Company. This was at first a Glasgow venture, much in the same way as the old concern had made its headquarters in London. But Liverpool has long been the centre of the West African trade, and both companies practically transferred then- business thither. In the year 1883 the British and African Company, which was the first of the two to fall under the management of Messrs Elder, Dempster, and Company, became a limited company, and not long after- wards the two rivals arrived at a working arrangement whereby their sailings ††† at that time about three times a fortnight ††† were worked into one another. The Canary Islands, where the West African steamers called on their

voyages, were then becoming known as a resort for tourists and invalids, and the issue of tickets available by either line was commenced for their convenience. The develop- ment of the cultivation of the banana for the English market was also begun to be encouraged by the two steam-ship companies. But it was in the month of August 1891 that the great movement by the Elder ~~Dempster Company was made public. It was then announced that the firm had assumed the management of the African Company, the quondam rival of the fleet they had them~~ selves managed. The two concerns were, and are, con- tinued as distinct organizations, but they naturally work very closely together. The African Company soon began to break fresh ground, building not only superior vessels for the improving West African service, but also construct- ing large cargo vessels for the general Atlantic trade. These were soon engaged in the trade between the Mersey and the St Lawrence on the one hand, and between Liver- pool and the southern ports of the United States on the other. Meanwhile the development of the possibilities of West Africa and of the Canary Islands was not neglected. Various undertakings, not usually considered part of a shipowner's work, were inaugurated. These included a bank, founded in 1894, for the accommodation of West African traders, oil mills in Liverpool, where the palm kernels so largely consigned from the coast might be dealt with, and a hotel at Grand Canary for the convenience of the tourist ; while, to ensure the disposal of the bananas which their companies brought to England, a fruit broker- age business was opened in Covent Garden. Having already, as has been seen, a footing in the Canadian trade, they began the restoration of the Atlantic trade to Bristol, by giving it a service of steam-ships to the St Lawrence, employing for the purpose vessels of as great size as their docks could accommodate. At the beginning of 1899 they further strengthened their connexion with the nearest British colony by the purchase, from the liquidator of the insolvent Canada Shipping Company, of the name, house- flag, and remains of the old Beaver Line. A new fleet for this service was at once put in hand, a fair representa- tive of the ships being the twin-screw Lake Erie, a vessel of 7550 tons gross register, built in 1900 by Messrs Barclay, Curie, and Company of Glasgow, which did good work ??? in common with many other

Elder-Dempster steamers ??? in the transport service during the Boer war. At the beginning of the 20th century the flrm began trading with the West Indies. The distressed state of the planters, owing to the competition of bounty-fed beet sugar with their cane produce, had moved the Colonial Office to do something for their assistance, and a Royal Commission recommended the encouragement of fruit cultivation. Mr Chamberlain found that the existing lines were not pro- vided either with the experience or the energy of the Elder-Dempster Company, and so, by arrangement with the Colonial Office, and in consideration of an annual subsidy of ??40,000, the "Direct" service of fortnightly steam-ships was started with the sailing from Avonmouth of the then newly built Pori Movant in February 1901. The four vessels built for this service run to Jamaica in about thirteen days, and after a four days' stay return with their contract consignment of not less than 20,000 bunches of bananas. A local steamer is engaged in con- nexion with them. The steam-ships of the new line have good passenger accommodation, and already two hotels have been acquired in Jamaica to provide accommoda- tion for those who visit the West Indies under the new management. This provision for tourists is a novt'l feature, and one of the most comfortably fitted ships of the Beaver Line has been set aside for public yachting tours in various quarters of the globe. The increase, at

once absolute and comparative, in the tonnage of the Elder- Dempster fleet has been very remarkable. It should be added for the sake of completeness that the vessels of the West African lines ply as well from Hamburg and other North Sea Continental ports as from Liverpool, while closely connected with the firm, though sailing its vessels under the Belgian flag, is the Compagnie Beige Maritime du Congo, which runs a service from Antwerp to West African ports.

General Steam Navigation Gorrvpany. ??? This is the oldest existing line. Its first prospectus was issued in the year 1824, and in 1831 it received its charter of incorporation. Its business was at first confined to narrow limits. It commenced with the passenger trade from London to Margate, and its operations gradually extended to the British coastwise ports and the home trade ports on the Continent. In time the company introduced a regular steam service between Edinburgh and other east

coast ports and London, Hamburg, Rotterdam, Antwerp, and Havre in the north of Europe. It gradually obtained a strong hold upon the passenger and fine goods trade to the Continent, holding the mail contracts between London and Hamburg, and London and Rotterdam. In the early 'seventies the pressure of foreign competition made itself severely felt, and in 1876 the increase of the American cattle trade told on the profits of the company ; but the difficulty was met by obtaining parliamentary leave for an increase of capital, and the company has displayed new enterprise, esjiecially in regard to its passenger facilities. It may claim to have been the pioneer in the promotion of steam-ship traffic between British home ports and the nearer ones of the Continent. The steam-ship Girafe, built in 1836, brought over the first cargo of live cattle from Rotterdam to Blackwall in 1846. The company runs steamers from London to Edinburgh, Hull, and Yarmouth, and from London to Antwerp, Amsterdam, Bordeaux, Havre, Hamburg, Oporto, Ostend, Rotterdam, Charente, and the Mediterranean ports. Vessels are also run to some of the ports above named from Hull and Southampton. There is also a passenger service between Harwich and Hamburg, and excursion services in summer to the watering-places at the mouth of the Thames and on the Kentish coast.

Guion Line. ❓❓❓ Soon after the discontinuance of the Collins Line the American Civil War broke out, and for a time the energies of the people of the United States were entirely distracted from the Atlantic. But, when peace was attained, the late Mr S. B. Guion, who had been a passenger agent to the Cunard Company, saw an opening for a new line of steamers, and, arranging to have the bulk of his capital from America, determined to inaugurate a line under the British flag. Six steam-ships were pro- vided for the service, the first being an iron screw vessel named the Manhattan. The eastward mails were soon given to the line by the United States Government. In the early 'seventies Mr Guion realized the desirability of a high speed for this trade, and arranged for two vessels of peculiar design, which he believed would accomplish his object. These were the Montana and Dakota ❓❓❓ ships of the then large size of 4321 tons ❓❓❓ to be fitted with water-tube boilers. The steamers in question were con- structed on the Tyne. Owing to the innovation in the boilers and the high steam pressures to be employed, the Board of Trade looked

somewhat askance at them, and decided that before they could be allowed their passenger certificates they must be subjected to a long experimental cruise. The first of the two accordingly put to sea, and failed to sustain the test. The iron tubes of the boilers were " set in hundreds of tons of brickwork," and the unequal expansion of the materials caused serious leakages under

I service conditions. Accordingly, without waiting for the report of the surveyors, the owner had the boilers removed and steam generators of the ordinary type substituted. These could not carry the steam pressures of the original designs, and accordingly the ships never attained the speed at which Mr Guion had aimed. After this set-back it was some years before he was enabled again to attempt the construction of a high speed vessel In 1879, however, he succeeded in obtaining from the Fairfield yard the Arizona, the fastest vessel of her day, and found from his experi- ence with her that his anticipations had been justified. She was followed at short intervals by the Alaska and Oregon, each more speedy than her predecessor. But the difficulties which he had gone through had crippled the finances of the line, and the Oregon had to be transferred to the Cunard Company. Then the fortunes of the line declined rapidly, and after a hopeless struggle the sailings were discontinued.

Hamburg-American Line. ??? The extraordinary progress of Hamburg as a seaport during the last thirty years of the 1 9th century may be held due in no small measure to the enterprise of this line, which now carries passengers not only to the two American continents, but also to the east of Asia and Africa. It was founded in May 1847. At that time, owing to the political disturbances throughout Ger- many, there was an enormous exodus of emigrants to the new world ; of this the founders took advantage, and they started a regular service of sailing ships between Hamburg and New York. The first ship they owned was the Deutschland, of 700 tons, built on the Elbe. It is interesting to note that the present Deutschland is of 16,502 tons gross register, and is of twenty-three times the capacity of her predecessor. The first saUing took place in October

1848. In 1851 the company's fleet consisted of six vessels, with an aggregate of 4000 tons. In 1856 the first screw steamer in the company's service left Ham- burg ; this was the Borussia, a vessel constructed, as were her sisters for many years, on the Clyde. From this time, when the company abandoned sailing ships and took to steam, its prosperity may be said to have dated. It is strange to note that the two first steam-ships owned by it were chartered by the British and French Governments to convey troops to the Crimea. By 1867 the company had ceased to own any sailing ships. The enormous increase of the traffic is indicated by the fact that whilst in 1856 the sailings to New York took place every fortnight, in 1881 there were two a week, and later on three. The company had also by this time considerably extended its operations from the original passage between Hamburg and New York. After the war between France and Ger- many it started a line to the West Indies, and later to Baltimore, Boston, Montreal, and other ports in North America. In 1875 it absorbed the old Eagle Company of Hamburg, which had previously been its rival, and then began to run boats to Central and South America, and later to China, Japan, and the Straits Settlements. To-day the Hamburg American Line may claim to be the largest steam-ship company in the world. There are three services at present to New York ??? an express service and a passenger service, both run by twin-screw steamers, and also a service direct ^rom Hamburg to New York by vessels carrying only one class of cabin passengers and third-class passengers. The ordinary passenger service is conducted by half-a-dozen ships all of over 12,000 tons. They call at Plymouth and Boulogne. The express service is run by the Filrst Bismarck, the Columbia, the Auguste Victoria, and the Deutschland, which call at Southampton on the outward and Plymouth on the homeward voyage. The Deutschland, which is the finest vessel of the fleet, was built at Stettin by the Vulcan Company. Her

engines develop about 33,000 horse-power, and she was the fijst Atlantic liner to exceed a speed of 23 knots at sea. The Hamburg Company has extended its influence and enlarged its fleet by purchases from and absorptions of other fleets. Thus it has acquired vessels from the Carr Line and the Hansa Line of Hambui-g, as well as from the Hamburg-South America and the Hamburg-Calcutta Companies. In conjunction with the Lloyd Line it took over the fleet of the Kinsing Line. In 1901,

with a view to the feeding of its main lines, it acquired the Atlas Line of Liverpool ??? a company which had developed the trade between New York and the West Indies. It is impossible to set out in full detail the ports of call of the line. Start- ing from Hamburg, its boats run to New York, Portland, Baltimore, Boston, Philadelphia, Galveston, and New Or- leans, and to Canadian ports. In Central and Southern America there are lines to Mexico, Venezuela, Brazil, Uru- guay, and Argentina. Then there is that to Eastern Asia. From Stettin its boats run to New York, and from New York to the Mediterranean, Brazil, and Eastern Asia. From Genoa they run to La Plata direct. It is also to be observed that this company runs large steamers at in- tervals on pleasure trips to Norway, the Mediterranean, the West Indies, and the East. For these yachting excur- sions there has been specially built the twin-screw yacht Prinzessin Victoria Luise, a vessel of 4409 tons, which in many respects follows the design of the German Emperor's yacht Iloltenzollern.

Japan Hail Steam^ship Company, Limited {Nippon Yusen Kaisha). ??? Nothing indicates in a more remarkable manner the entry of Japan on an equal footing into the life and activity of the civilized world than the extra- ordinarily rapid growth and development of this line of steam- ships, which now owns one of the principal fleets of the world, running to many of the chief jjorts in the four quarters of the globe. From an early period their insular frontiers made the Japanese a seafaring folk, but imperial policy for a long period shut them away from all intercourse with the rest of the world. It was not until about the year 1860 that the life of the West really touched Japan. In 1868 steam-ship communication was opened between Tokyo and Osaka; in 1871 the Yubin Kisen Kaisha Steam-ship Company came into existence under the control of the Imperial Bureau of Communica- tion ; and in the same year a private company, called the Mitsubishi Kaisha, was founded. This may be said to have been the beginning of all modern maritime enterprises in Japan. In 1876 the Government company gave up the contest, and its fleet passed into the hands of the private company. In 1873 the capacities of this company had been tested in the military expedition to Formosa, when its organization had been found excellent, but its fleet insufficient. The Treasury now invited the company to buy up the Yokohama-Shanghai service of the Pacific Mail Steam-ship Company. In 1876 the company

had a fieet of 42 vessels, including sailing ships. In 1882 the Government set on foot another rival line, the Kyodo Unya Kaisha, but it did not answer, and in 1885 the two were amalgamated into the present "Nippon Yusen Kaisha," or "Japan Mail Steam-ship Company." In the nine years which passed between this union and the outbreak of the war with China in 1894, the services between Japan and neighbouring countries were consoli- dated and extended, and the development of the cotton trade induced the Government to inaugurate a service between Japan and Bombay. During the war the vessels of the line were constantly used for the transport of troops, and many additional ships had to be acquired. As many as fifty were employed during the time that the war lasted, and they were nearly all officered and manned

by Japanese, while from first to last only one serious accident connected with their navigation occurred to any vessel of the fleet. The result of the war gave an enormous impulse to trade and navigation, and laws were passed giving special facilities for shipbuilding. The company de- termined to run vessels to America, Europe, and Australia. The capital was greatly increased, and orders were given for the construction of twelve twin-screw steamers of over 6000 tons each for the European line, and three of 3800 tons each for the Australian line. In 1899 the Japanese Diet resolved to grant subsidies to the company's European and American lines. All its lines therefore now, with few exceptions, run under the mail contract of the Japanese Government. There is a regular fortnightly service of twin-screw vessels between Yokohama, London, and Antwerp ; a monthly service between Yokohama and Melbourne; also between Yokohama and Victoria (B.C.). There are lines to Bombay, Shanghai, Vladivostok, New- chang, Tientsin, and many local lines, touching at all the ports of the islands of Japan.

Royal Mail Steam Packet Company. ❓❓❓ Soon after British- owned steam-ships began to run to America a company was formed by leading

business men interested in the West Indies, to carry the mails from England to that part of the world. The charter of this company, to be known as the Koyal Mail Steam Packet Company, was granted in 1839. The Government believed that the institution of a line carrying the mails regularly to British possessions in the West Indies was likely to prove of benefit to the empire, and granted it a large subsidy. The first contract with the Government was entered into in March 1841. No less than fourteen large paddle steamers capable of carrying the largest guns then used by the Royal Navy were at once ordered, and the service was opened with the Thames on 3rd January 1842, followed by other vessels in fortnightly succession. These steamers started from Falmouth and returned to Southampton, which was the company's headquarters, though it had no dock accommodation in those days. In 1846 the company began to carry the mails for places on the western coast of South America, the Pacific Steam Navigation Company re- ceiving them at Panama. In January 1851 the company, by contract with the Government, inaugurated a monthly service to Brazil and the river Plate, and new steamers were built which greatly increased the rapidity of transit. This company was therefore the first to institute direct mail com- munication by steamer between Europe and the countries of South America, as it had also been with the West Indies. The company's boatswere employed continuously during the Crimean war in the transport of troops. It is interesting to note that it was from one of the company's ships, the Trent, that Slidell and Mason, the commissioners of the Confederate States, were taken on their way to Europe by a United States man-of-war. In 1 87 2 the service to Brazil and the river Plate was doubled. During 1898-99 the mileage run by the whole of the company's fleet, including cargo boats, was 1,198,000 miles. There is at present a contract between the company and the British Government for the transit of West Indian mails, for which i??80,000 per annum is paid. The mails to Brazil and the river Plate are paid for by weight. The West India Line steamers leave Southampton for the West Indies every fortnight, and proceed direct to Barbados, thence to Jamaica and Colon, whence they proceed once in four weeks to Cartagena, Savanilla, and other local ports. From Barbados every fortnight boats on branch lines run (i.) to Demerara and Surinam ; (ii.) to St Vincent, Grenada, Trinidad, and Tobago ; (iii.) to St Lucien,

Martinique, Dominica, Guadeloupe, Montserrat, Antigua, and St Thomas. The Brazil and River Plate Line comprises a fortnightly

service of mail steamers to Pernambuco, Bahia, Rio, Monte Video, and Buenos Aires. There are also cargo ???services to the West Indies, and to the river Plate and intermediate ports. A branch service for collecting cargo from North Sea Continental ports for transhipment at Southampton has also been instituted.

Messageries Maritimes de France. ??? Originally known as the Messageries Imperiales, this company sprang from a land-transit undertaking. It received its first contract for the conveyance of over-sea mails from the French Govern- ment in the year 1851. It then extended its services to Italian, Greek, Egyptian, and Syrian ports. In the follow- ing year it included Salonica in its itinerary. The occurrence of the Crimean war gave an increase to its fleet and a stimulus to its operations. For it was not only given the task of maintaining mail communication with the French forces in the Black Sea, but was largely entrusted by the Government with the duty of transporting troops and stores to the seat of war. At that time it was a consider- able purchaser of British tonnage. In 1857 it had the French mail contract to Algiers, as well as to the Danube and Black Sea ports, whilst in the same year a new mail contract for a service between Bordeaux and Brazil and the river Plate was granted to it. By this time it had, either afloat or under construction, a fleet of no less than fifty-four steamships of 80,875 tons. In 1861 further employment was found for its vessels in the conveyance of the mail to India and China. By the year 1875 its fleet embraced 175,000 tons of shipping, and also employed a large number of chartered sailing vessels. It was at that time the largest steam shipping company in the world. It had already ceased to employ British shipbuilders, and now constructed its own tonnage in its o'mi yards. The exten- sion of, its services to Japan followed, and eventually it put forth branches which served iladagascar, Mauritius, and Zanzibar, as well as Australian ports and the French colony of New Caledonia. Some of the steamers employed in the mail services to the Far East and South are of a very fine character, especially the Athintique, a twin-screw vessel launched in 1900. She is of 6700 tons gross register, and is fitted with BellevUle boilers, as are no less than

twelve of the finest vessels in the fleet. The first of these was the Australien, built in 1890, and the experience gathered from the running of these mail steamers ???ndth this tj-pe of boiler cannot have been discouraging, or the company would scarcely have continued to fit it to its vessels. Some idea of the extent of the operations of the fleet may be gathered from the statement that in 1901 its ships per- formed 486 voyages, traversing, a total distance of 966,371 marine leagues, in respect of 405,810 of which no sub- vention from the Government was received.

Morgan Combination. ??? Under the head of the American Line it has been shown how a group of jVmerican capitalists acquired the Red Star, Innian, and American Lines, thus forming a body of shipping which embraced in the year 1901 about 167,000 tons of shipping tonnage, partly under the British and partly under the Belgian and American flags. Another company which drew its capital chiefly from the United States, though its vessels fly the red ensign, is the Atlantic Transport Company, registered under the British Limited Liability Acts in 1889. Its main service is between London and New York, and it is carried on by large and modern twin-screw steam -ships, several of which ha^???e been constructed by Messrs Harland and Wolff of Belfast. These vessels range up to nearly 14,000 tons gross register, and though they carry large quantities of cargo and of cattle on the eastward voyage, also accommodate a number of passengers in their saloons. Through the connexion of this undertaking with Messrs Harland and Wolff" as builders of their vessels, thosa

American capitalists who are interested in the extension of United States interests on the North Atlantic were brought into connexion with Mr Pirrie, the managing director of this shipbuilding firm, and through him approach was made to the managers of the White Star Line in the year 1901. An offer for the purchase of this famous British line was put forward by the American syndicate, headed by Mr J. Pierpont Morgan, the well-known New York banker. The price suggested was expressed in

terms of the earnings then made by the company's fleet, and it is not therefore possible to place it on record. But it is generally understood that it was about ten times the nominal value of the shares, though the amount was not all payable in cash. The managers of the White Star Company had not merely to consider what many experts be- lieved to be a liberal offer. There was another factor in the situation present to their mind. The New York syndicate, besides having the control of the vessels of the American lines on the Atlantic, had secured the management of the trunk lines of railway between the great producing districts of the Western states of America and the eastern seaboard. They were thus in a position to give to shippers from the United States the convenience of transit by a through bill of lading to embrace both the railway journey and the ocean voyage. There was thus ground for the belief that if competition were allowed to ensue the British steam-ship companies ??? which from the nature of things could receive no corresponding support from the railways of the United Kingdom ??? might suffer very severely. The White Star Line accordingly threw in its lot with the American and Atlantic Transport Companies, and with the White Star Line went the Dominion Company ??? a line whose fine passenger vessels were constructed by Messrs Harland and Wolff, and whose management is largely influenced by the partners in that firm. The Dominion Line has services from Liverpool to Boston, Portland (Maine), and St Lawrence ports. The amount of tonnage involved by these additions to the Morgan combination was not great as compared with the total tonnage of the British empire, being as, say, 350,000 tons to 15,000,000 tons. Yet the lines affected were of so great repute that the movement counted for more than the mere figures expressed, while it was obvious that the considerations which led the managers of these companies to give their adhesion to the syndicate might influence in a similar way the directors of other British Atlantic companies. The Norddeutscher Lloyd and the Hamburg ~~American Companies were approached by Mr Morgan with a view to their entering into the scheme ; but though a working agreement was arranged, the German lines decided to preserve their separate existence. The Morgan combination was eventually incorporated at the end of September 1902 in New Jersey as "The Inter~~ national Mercantile Marine Company," with a capital of 120,000,000 dollars; and an agreement was come to with the

British Government, by which the British character of the British ships in it would be preserved.

Navigazione Generale Italiana. ??? The union of the Florio and Rubattino Lines in the year 1882 was the origin of this company. The Rubattino Line finally made Genoa its headquarters, while the Florio Line centred its business at Palermo, and had itself been largely strengthened by the absorption of the Trinacria Company of its own port. The coasting trade of Italy and Sicily, with services to various ports of the Mediterranean and Black Sea, occupies the great part of the company's fleet. But it also runs monthly lines from Genoa through the Suez Canal to Red Sea ports, and so to India and Hong Kong. Towards the western ocean it has a service maintained in conjunction with that of another Italian company, La Veloce, to Brazil and the river Plate, whereby weekly departures are made

from Genoa. In February 1901 a new line was opened by the sailing of the Itahan Generale Company's steam-ship Liguria ??? a new Italian-built vessel of upwards of 5000 tons register ??? for New York. The object of this line, which is being maintained by three steamers of the Generale Company, aided by a similar number from the fleet of La Veloce, sailing once a week from Genoa vid Naples, is to attempt to retain in Italian hands some of the large traffic which is carried on from these ports regularly in the steamers of the Norddeutscher Lloyd, and in winter by those of the Hamburg-American Line.

New Zealand Shipping Company. ^This company was established in 1872 for the purpose of maintaining a passenger and cargo service between London and New Zealand. This was before the days when sailing vessels could be used with commercial success in the long sea trade. At first it depended on chartered vessels, but gradually it acquired a fleet of fast clipper iron sailing ships which reduced the voyage to 90 days. These vessels took out a large number of Government emigrants between 1874 and 1882. In 1881 one of these ships inaugurated the frozen meat trade from New Zealand, thus opening up a business which has since grown to colossal proportions. The trade increased so rapidly that it was found impossible to conduct it by means of sailing ships, and in January 1883

the company despatched from London the chartered steam-ship British King, of 3559 tons. This vessel ac- complished the voyage in 50 days, but it was found necessary to diminish the passage to 45 days out and 42 home. Five steamers were therefore built to fulfil the requirements of the trade. The first of these, the Tongariro, of 4163 tons, left England in October 1883. The company about this time received the contract of the New Zealand Government for a monthly mail service, with a guaranteed time of 45 days. The managers gradually eliminated all the sailing vessels from the fleet, and more recently replaced the original single -screw mail steamers with large modern twin-screws. In addition to passenger vessels the company owns several cargo boats, some of which are among the largest afloat. They will carry as many as 100,000 carcases of mutton, and a large quantity of dairy produce. The fleet consists of 15 steam-ships, of which several are over 7000 tons, the largest and most recent being of 8500 tons. The company's ships sail from London, calling at Plymouth, Teneriffe, Cape Town, Hobart, on the way out, and at Monte Video or Rio and Teneriffe on the return voyage. Communication with the different ports of New Zealand is carried out by the vessels of the Union Steamship Company of New Zealand, as well as to Australian ports.

Norddeutscher Lloyd. ??? The commanding position of this company among the great steam-ship lines of the world is a standing instance of success achieved after difficulties at first almost overwhelming. To the enterprise of certain citizens in the old commercial city of Bremen this large business owes its existence. The originator was Herr H. H. ileier, who brought into line the various shipping interests of Bremen, and induced them to amalgamate into one company. The associations thus brought together were the Weser Haute Steam-ship Company, the Unter Weser and Ober Weser Steam Tug Companies, and the Ober Weser Universal Shipping Insurance Association. The statutes of the new com- pany were approved by the senate of Bremen on 18th February 1857. The original capital was 4,000,000 thalers, but soon after the formation of the new company great depression set in, owing to the commercial crisis in North America. More than 2500 shareholders in the Lloyd forfeited their shares, but the directors were not dismayed, and had the loyal support of their fellow-

citizens. Four big ocean steamers were constructed for the American line and three for the English, and large docks for repairs were established at Bremerhaven. The first voyage was made in June 1858, when the Bremen started for New York, carrying many steerage passengers, but only one in the saloon. The second ship, the Hudson, was shortly afterwards burned while lying in harbour. At the end of the first year both lines showed a loss. At the end of the second year matters improved, the English cattle trade especially showing great progress. But the company still commanded little confidence, for the Darmstadt Bank parted with 1,000,000 thalers' worth of shares at a loss of 75 per cent. These the directors themselves took over. But the American Civil War now came to deal another severe blow at the Lloyd, just when its prospects were growing brighter, and till 1864 no dividend greater than 2|- per cent was paid to the shareholders. After the termination of the war the trade with the United States grew enormously, and the English traffic also revived in a most unexpected way. One result was the foundation of rival lines, which, however, were unable to maintain effective com- petition, and succumbed. In 1868 a new line was opened. Bremen's staple of commerce is tobacco, and the directors determined to bring their port into direct communi- cation with the tobacco-producing areas in the States ; so in that year they inaugurated their line to Baltimore. In the following year a line was started to New Orleans, another great centre of the tobacco and cotton trade. It was necessary to construct three special liners for that service, as the ordinary ships could not pass the bar of the Mississippi. In 1869 a line to Central America and the West Indies was set on foot, and new steamers were ordered to run on it. With the outbreak of the war of 1870 the company naturally had anxious times, as the French fleet blockaded the German coasts ; but its boats often ran the blockade with success. Soon after the war the West Indian service, proving unprofitable, was given up. In 1875 a new line of steamers to Brazil and Argentina was started. This was separated into two distinct services in 1878. In 1880 the approach of the great struggle for supremacy on the Atlantic made itself felt, and the company began to prepare for the contest, and ordered the

construction of the Elbe, the first of its express line of steamers. She commenced running in 1881, and was quickly followed by others. Between 1881 and 1888 an entirely new fleet was placed on the New York line. In 1 886 the Australian and East Asian Lines were founded in accord- ance with a contract with the Imperial Government. This included a monthly service to China, with branch service to Japan, and a monthly service to Australia, with a branch line to the Samoan and Tonga Islands. From that time onwards the story of the Norddeutscher Lloyd has been one of increased prosperity, keeping pace with wider developments of its activity. The company's fleet includes the two large and fast steam-ships Kaiser Wilhelm tier Grosse of 14,349 tons and 27,000 i.h.p., and Kronprinz WiJhelm of 14,800 tons and 33,000 i.h.p., both built by the Vulcan company at Stettin, while a still larger and more powerful vessel, the Kdiser WUhdin, der Zweite, will follow from the same yard. The company runs many lines from its headquarters at Bremen ; among them are those to New York ❖❖❖ a line of express steamers and a line of ordinary mail steamers, all calling at South- ampton or Cherbourg ; to Baltimore direct ; to Galveston direct ❖❖❖ there are no first-class passengers by this line ; to Brazil ; to the river Plate, calling at principal ports on the way. There are also lines of imperial mail steamers between Bremen and eastern Asia, and Bremen and Australia, and a freight line to East Asia, which runs in connexion with

the Hamburg -American Line. In pursuance of the Gei-man policy of securing the feeders to maintain traffic, the Norddeutscher Lloyd purchased the ships and business of the Kinsing Line and of the Scottish Oriental Company, when it began seriously to develop its Eastern trade. Feeling, in common with all large steam-ship companies, the difficulty of providing efficient personnel for its constantly expanding fleet, and believing in the necessity for seamen of experience in masted ships, the Lloyd has provided itself with a sea-going training ship.

Ocean Steam^ship Company. ❖❖❖ The Ocean Steam-ship Company is the successor of older steam-ship enterprises, mainly under the same management and ownership. These began in 1852 with the coasting trade, and extended in following years to French ports, and in 1855 to the West Indies. The last-named line attained some moderate importance,

comprising seven vessels ; it was sold in 1863, and eventually became the West India and Pacific Steam- ship Company, which in its turn was absorbed by the Leyland Line in 1900. The managers thereupon, seeking other trades, decided on attempting that to China, and the company under its present title was registered as unlimited in 1875. Up to this date low-pressure jet- condensing engines were alone used, burning perhaps 5 to 5^ B) of coal per indicated horse-power per hour. This rate of consumption would have been fatal to the scheme, since vessels coidd not have carried any cargo in addition to the coal necessary for so long a voyage as that viA the Cape, the Suez Canal not being opened till 1870. A small vessel, the Cleator, of which the exact speed and consump- tion with the old type of engine was well known, was therefore experimentally fitted with new machinery of the compound high-pressure (70 16), surface-condensing type. The result of the experiment was that her consumption was reduced to about 3 or 3|^ D). per i.h.p. per hour, and this warranted the construction of the Agamemnon, Ajax, and Achilles, all 309 feet long, 38 feet 6 inches broad, 28 feet 6 inches deep, fully rigged as barques, with screws outside their rudders. These rigs were subsequently altered to that of barquentines, but the relative positions of the screws and rudders were retained till they were disposed of in 1899. In these vessels the consumption �was further reduced to about 2 1 lb, which allowed margin for a reasonable cargo. The Agamemnon sailed from Liverpool in 1866 : the itinerary being Mauritius, Penang, Singapore, Hong Kong, and Shanghai, and, with similar calls, back to London. The cargoes in those days were mainly manu- factured goods outwards, and tea homewards. The average speed was perhaps 9| knots, and the consump- tion about 2H tons of Welsh coal per day. These and succeeding steamers were at that date the only vessels carrying high-pressure steam on long voyages, and they traded regularly round the Cape, being the only hne that did so. When the Suez Canal was opened in 1870 they changed the route. The trade from the United Kingdom to China has since steadily grown, and increasingly large cargoes are also procurable homewards from the Far East, in spite of the successful competition of Indian and Ceylon teas. In 1891 a service was begun from Amsterdam and Liverpool to Java, and this is maintained about once a fort- night, finding employment for about ten of the smaller ships. The vessels in this trade, which is principally between Holland and her eastern possessions, fly the

Dutch flag. A limited number of passengers were formerly carried between England and the East, but the ships now take cargo only to and from Europe, though Mahommedan pilgrims are conveyed in considerable numbers to and from Jeddah, the port for Mecca. The ships generally load at Glasgow, and occasionally at other west coast ports. They usually carry the greater part of the cargo from

Liverpool, the most important element being fine goods (manufactured cottons, &c.) from Lancashire and York- shire. Abroad the regular service has been extended to the principal Japan ports ??? Nagasaki, Kobe, and Yoko- hama. The following local services have their headquarters at Singapore : ??? (1) Singapore to West Australian ports, including Premantle. These steamers carry passengers, and bring large quantities of wool and pearl shell from Australia to Singapore for transhipment to the main line steamers bound for London. (2) Singapore to Deli (Sumatra). Three small steamers bring tobacco from Deli for transhipment to Europe. (3) Singapore and Penang to China. The great emigration of Chinese coolies to the British colony of the Straits Settlements keeps several steamers regularly em- ployed. The company is colloquially known in the shipping world as the "Blue Funnel" Line, and is also often referred to by the name of Mr Alfred Holt, who has been closely identified with it throughout its history. In 1902 the Ocean Company absorbed its younger rival, the China Mutual Steam Navigation Company, with a fleet of thirteen vessels of 106,870 tons, and shortly afterwards re-registered itself under the Limited Liability Act.

Orient Line. ??? The Orient Line of steamers between London and Australia took up the work of the Orient Line of clipper packets, which, in the days of sailing ships, used to ply between London and Adelaide. In April 1877 it was announced that " the Orient Line would sail the under-mentioned steam-ships of the Pacific Steam Navigation Company to Australia," and that connexion between the two organizations has been continued and strengthened till in 1901 the name of Orient Line was

changed to that of Orient-Pacific. In June of 1877 the Lusitania was despatched from London to Adelaide, Melbourne, and Sydney, vid the Cape of Good Hope. Other sailings followed at about two-monthly intervals. In the following year the present line came into existence. It was formed by the joint efforts of Messrs Anderson, Anderson and Co., and E. Green and Co., who are the managers of the line. When the service was begun it was intended to be run monthly, but the increase of traffic soon demonstrated that fortnightly sailings would be successful. This extension was determined on in 1880, the year following that in which the Orient, the first ship specially built for the company's trade, commenced work. Since 1888 the Orient Company has carried the mails to Australia by contract with the English Post Office once a fortnight. These despatches, alternating with those of the P. and O., give Australia a weekly mail. Several twin-screw steamers have been bailt for this service by both the Orient and the Pacific Companies. It was the Orient liner Ophir which took the place of a Koyal Yacht for the Imperial tour of the Prince and Princess of Wales in 1901. The steamers of the Orient Line call regularly at Plymouth, Gibraltar, Marseilles, Naples, Port Said, Suez, Colombo, Fremantle, Adelaide, Melbourne, and Sydney.

Pacific Steam Navigation Company. ??? This was the pioneer of the steam-trade along the western coast of South America; subsequently its operations were ex- tended to Europe, and finally, in conjunction with the Orient Steam Navigation Company, it established the Orient Line to Australia. It obtained a charter early in the year 1840, and soon sent out from England two steam-vessels, the Chili and Peru. These were paddle-boats of 710 tons and 198 feet in length. They ran along the coast from Valparaiso to Panama. The early struggles of this company are noteworthy as showing how difficulties, apparently insuperable, may be overcome, and even turned to essential advantage. The great obstacle to the success of these steamers was

the difficulty of obtaining supplies of fuel, and in the first five years of its existence no less than ??72,000 was lost, the whole capital of the company being but ??91-,000. But the difficulties were o'ercome, and all that remained in the mind of the managers was a strong feeling of the importance of economy in coal consumption. Accordingly, in conjunction

with the Fairfield firm of Eandolph, Elder and Company, they turned their attention in this direc- tion, and were sending out vessels fitted with compound engines some ten or a dozen years before the Atlantic com- panies adopted them. In 1867, under pressure from the Chilian Government, the company sought and obtained powers to extend its operations, and in the same year the Pacific of 1630 tons was constructed. She left Valparaiso for Liverpool in May 1868, the first of the new mail line. In 1870 the voyage was extended, Callao, 1 1,000 miles from Liverpool, being made the terminal port, and the sailings were increased from one 'to three a month. In 1873 a weekly service between Liverpool and Callao was instituted, and by 1874 there was a fleet of 54 steamers, with an aggregate of 120,000 tons, in commission. Owing, how- ever, to a great decrease in the South American trade the service was reduced to a fortnightly one. Several of the company's steamers now run in the service of the Orient Line. In January 1893 the company inaugurated a monthly cargo service to the Brazils, river Plate, and the West Coast. This service has been extended to Glasgow. Many ports are served. The principal are La Pallice, La Eochelle, Corunna, Carril, Vigo, Lisbon, St Vincent, Pernambuco, Bahia, Eio de Janeiro, Monte Video, Buenos Aires, Punta Arenas, and the ports of the western coast of South America, Valparaiso, and Callao.

Peninsular and Oriental. ^The story of the P. and 0. Company may be divided into two eras ??? the first reaching from its foundation to the opening of the Suez Canal; the second from that date to the present day. During almost the whole of its career the company has acted as the agent of the British Government in the conveyance of its mails, first to Mediterranean ports, and afterwards to Egypt, India, and the Far East. From time to time the Government has made efforts to procure some other means for transmitting its mails, but on every occasion it has found it advisable to return to the P. and O. In 1835 Messrs Willcox and Anderson, a firm of London merchants, began to run steamers to the principal ports of the Peninsula. Their vessels observed greater regularity than the sailing-ships then employed to carry the mails, and the first mail contract was entered into on 22nd August 1837. This was awarded to them after another company, which was unable to fulfil its obligations, had been engaged for the worTc. Messrs Willcox and Anderson had

shortly before, in concert with Captain Bourne, E.N., founded the Peninsular Company. This contract arranged for a monthly service between Falmouth and Vigo, Oporto, Lisbon, and Gibraltar. About two years later another step was taken. Hitherto the mails to Egypt and India had been conveyed by the Peninsular Company to Gibraltar, by an Admiralty packet from Gibraltar to Malta, by another Admiralty vessel from Malta to Alexandria, and from Alexandria to Bombay by one of the East India Company's steamers. It was resolved to sub- stitute for this unsatisfactory mode of conveyance a direct system of carriage by one line of steamers from London to Alexandria. The Peninsular Company again secured the contract, which was put up to public competition, and built two steamers of 1600 tons for the purpose, this being a large tonnage for those days. The annual subsidy was fixed at ►►34,000, by which the Government saved ►►10,000 of the amount formerly expended on their own inefficient means of transport. 'The company then, by a

charter of incorporation, dated December 1840, assumed tlie name by which it has ever since been known ►►► The Peninsular and Oriental Company. The charter was granted only on the onerous condition that steam com- munication with India should be established within two years. The first steamer, the Hindostan, was despatched to India via the Cape of Good Hope on 26th September 1842. She was one of a small fleet destined to ply between Calcutta, Madras, Ceylon, Aden, and Suez. It was an adventurous undertaking, for the East India Company promised no definite subsidy, only a small premium on a certain number of voyages.

The obvious advantages of a direct conveyance of mails between Suez and Bombay by a regular sufiicielit service were becoming evident, and the P. and O. Company offered to effect this at a great saving on the existing system ; but, for some reason or other, the East India Com- pany showed the greatest reluctance to allow the control of this route to pass out of their hands, in which, in fact, it remained until 18-54. Fortunately for the P. and O. Company the Government decided to establish regular monthly

steam communication between England and Ceylon, Madras, and Calcutta, and also from Ceylon, east- ward to Singapore and Hong Kong. Only the P. and O. could at that time have contemplated undertaking such a service. In 1844 the contract was signed, and by it the company was to receive a subvention of ??160,000. The Indian portion of the service opened on 1st January 1845, and during that year the extension to China was effected, and nine new steamers were put on the stocks. The organization of the overland route was due to the P. and O. Company, which brought it into regular working in order to convey its passengers from Alexandria to Suez. It was a picturesque but uncomfortable passage by canal -boat and steamer to Cairo, then by a two-wheeled omnibus for ninety miles across the desert to Suez. Even the coal for the boats at Suez had to be transported in this fashion, which was cheaper than sending it by sailing vessel round the Cape. The construction of a railway across the Isthmus in 1859 greatly simplified the transit. It may be noted that the company had to establish coaling stations between Suez and the Far East, and also dep6ts of provi- sions, a business of no less magnitude than that of the steam service itself. In 1852 the first mail service to Australia was undertaken by the company, and the same contract included an arrangement for a fortnightly service to India and China, though a service running once every two months vid Singapore and Sydney was thought sufficient for the requirements of Australia. The year 1854 saw the abolition of the East India Company's service to Bombay, the t. and 0. taking its place. This arrangement saved the country ??80,000 per annum. The Crimean war made large demands on the company's resources for the conveyance of troops, and the Australian service was for a time interrupted. By 1859 the company was in possession of all the lines of steam communication between England and the East. In 1864 the service to Australia was increased to one sailing a month, and in 1868 the Bombay mail left weekly. About the same time the fourth India and China con- tract was entered into, and at the end of 1869 the opening of the Suez Canal led to a serious crisis in the company's affairs ; and also after these difficulties had been surmounted, to a complete revolution in its methods. The ojiening of the canal led to a prolonged controversy with the Post Office, which, with true official perversity, would not allow the company to use the canal for the conveyance of its mails. A serious

falling-off of the company's revenue was the result, as the competition of the canal steamers was killing its trade. At length in

1874 a new arrangement was made by which the mails were to be carried through the canal, the subsidy granted to the company being at the same time reduced. Under these conditions, however, it was now able to construct vessels capable of competing successfully with its rivals. A prolonged dispute between Victoria and New South Wales for a long time prevented the Australian service from being as efficient as it might have been. Sydney insisted on the Pacific route being adopted. In conse-quence of this controversy the Australian headquarters of the company were for some time fixed at Melbourne, and it was not till 1888 that a general contract was entered into with the Postmaster-General, acting at last for all the Australian colonies as well as for the Imperial Government. This stipulated for an accelerated service ??? the India, China, and Australian mails being all worked from Aden in connexion with the steamer which conveyed them from Brindisi. There was for long a service between Venice, Brindisi, and Egypt, and a mail contract with the Italian Government ; but this came to an end in March 1900.

The company's first ship, the William Fawcett, built in 1829, had a gross tonnage of 206 and 60 h.p. Down to 1851 the vessels of the fleet were all constructed with paddles ; after that date the screw took their place, though for the Marseilles to Malta express service certain famous fast paddle steamers vrere subsequently constructed. A later interesting development was the abandonment of Brindisi as a port of call for the Ocean mail steamers, which reverted to Marseilles, whence they run across to Port Said direct. The mails leaving London every Friday night are despatched from Brindisi in specially- designed twin-screw vessels, which land them at Port Said little more than 96 hours after their despatch from London. On this service the Osiris and Isis are employed, and tKey have the distinction of being the only vessels in the mercantile marine which cross the seas with mails and passengers only. The company is under contract with the British Government for the conveyance of mails to India, China, and Australia. Its services are as follow : ??? India : Brindisi to Bombay, weekly. China : Brindisi to Shanghai, fortnightly. Australia : Brindisi to Sydney, fortnightly. Apart

from the mail services, the company runs independent lines to Malta, Colombo, and Calcutta ; also between Bombay, Colombo, Singapore, Hong Kong, and Shanghai ; and between Hong Kong, Nagasaki, Hiogo, and Yokohama. There is likewise a direct fortnightly service of through steamers to China and Japan at special rates. As illustrating the advances made in rapidity of mail ser^dces in twenty-five years, the following table is interesting : ???

Miles by Land and Sea.

Days occupied.

1873.

1900.

London to Bombay. ,, to Shanghai.

,, to Melbourne.

5,459 9,834

10,773

23

45

(Monthly.)

48

14

32

(Fortnightly.)

81

Russian Voluvteer Fleet. ??? Though of comparatively recent origin ??? it only sprang into being during the stress of the Russo-Turkish war of 1878 ??? this organization is important and in some respects unique. Its existence is due to the patriotism of certain Russian nobles who were anxious to aid their country in its struggle, and it thus began its career somewhat hurriedly, though under Imperial auspices. Owing to the need for immediate tonnage, its managers, in the first instance, purchased a few somewhat obsolete German liners, and one or two of the

earlier vessels constructed for the British Castle Line. But even with these ships it did useful service in the transport needed for the military operations then proceeding. The Imperial Government granted the company certain very exceptional facilities, including what amounts to a practical monopoly of the trade between Odessa and Vladivostok. Its vessels maintain the important service between these two ports, and thus form the link between European Russia and the ports on the Pacific coast of Siberia. They have the duty of taking out the troops and stores which are constantly being sent to the Far East, and they bring back, not only time-expired men, but also large quantities of such valuable freight as tea. Their profits are great, but they have been very largely applied to the improvement and extension of the fleet. At the con- clusion of the Eusso-Turkish war steamers specially suited for the peculiarities of the trade were ordered in British yards, and these, built for great speed, and fitted with twin-screws, are essentially designed for use as possible auxiliaries to the Imperial navy in case of maritime war. Some of the later of these ships have water tube boilers. Already some 17 vessels (of which six are of 20 knots' speed) have been placed in service, all being fitted to carry guns, which are kept in store for them in their terminal ports, and being officered from the Imperial Navy. So far the trade of this company has been Qonfined to voyages between Russian and Siberian ports. But in 1902 there was a movement towards extending the opera- tions of these ships to the North Atlantic, it being thought that they might find a useful opening in the trade between Italian and United States ports.

Shaw, SavilL, and Albion Company. ??? The amalgamation of the business of Messrs Shaw, Savill and Company of London and of the Albion Shipping Company of Glasgow brought this company into its present form 3t the close of the year 1882. At that time the amalgamating firms owned a larga fleet of sailing ships, and traded chiefly between this country and New Zealand. Soon after the amalga- mation the company began to acquire steam-ships, which gradually supplanted their sailing vessels. The Shaw, Savill, and Albion Company were among the first in the frozen meat trade, and their vessels are fitted to carry large numbers of carcases. With this company the White Star Line of Liverpool became associated in the year 1884, and five of their ships now run in the fleet of the Shaw, Savill, and Albion Company. At the pre- sent time the combined fleet comprises 13 steam-ships, of which the largest are three sister ships of 12,500 tons each. The total tonnage of the steam-fleet is about 72,000. There is also a fleet of sailing vessels, 10 in number, the total tonnage of which is 11,544. The route to New Zealand is by the Cape of Good Hope on the outward voyage, returning by Cape Horn, thus going completely round the globe every voyage. After leaving London the steamers call at Plymouth, Teneriffe, Cape Town, Hobart, and Wellington ; returning from New Zealand, the ports touched are Rio (sometimes Montevideo), Teneriffe, Ply- mouth, London. The Araiua, which came out in 1884, made the outward voyage in 38 days, and the run home in 35 days 4 hours steaming time ; she thus made the circuit of the world in 73 days 4 hours net time.

Union Steamship Company (see Castle Line). ??? This company first came into existence in 1853 under the name of the Union Steam Collier Company, with a capital of ^60 000. At its commencement it possessed a fleet of five ‘ small steamers with an aggregate of only 2337 tons. But by the time these boats were built the Crimean war was being actively carried on, and it was thought advisable to employ them for other purposes than those for which they were originally intended. They

ran for a time between Southampton, Constantinople, and Smyrna ; but the transport service proved more remunera- tive, and they were used for the conveyance of troops. At the close of the war the company was registered under the Limited Liability Act by its present name. It was then

determined to run the vessels between Southampton and Brazil with cargo, but this did not prove profitable, and in 1857 a notable change took place in the status of the com- pany, for in that year it took its place among the great ocean mail companies of England. In that year a contract was completed with the Government for a monthly mail service for five years to the Cape of Good Hope at an annual subsidy of ??30,000. The Dane was the first boat to leave Southampton with the mails on 15th September. In 1858 the subsidy was increased in order that the Com- pany's ships might call at St Helena and Ascension for mails on the homeward voyage. When the first contract expired the company secured another for five years. A service between the Cape and Natal, under a temporary arrangement, was inaugurated in 1862, and a seven years' mail service contract with the Natal Government was con- cluded in 1865. In 1873 the House of Commons refused to ratify a contract which the Government had entered into with the company for an extended mail service ; the company, however, carried out its intention to extend its service to Zanzibar. But in October 1876 a new mail contract with the Cape of Good Hope Government was entered into for a fortnightly service between Plymouth and Table Bay, the length of voyage not to exceed twenty- six days. During the Zulu war this company rendered considerable services to Great Britain. In 1878 three ships were employed, and after Isandula they conveyed reinforcements, the Pretoria being the only mail steamer to carry an entire regiment, the 91st Highlanders. It was on this company's s.s. Danube that the Prince Imperial sailed, whilst the old s.s. German took out the Empress Eugenie when she went to visit the scene of his death. The direct service with the Cape, Natal, and Zanzibar was in 1881 discontinued, and in February of that year operations were extended to the Continent, a service from Hamburg was commenced, running every twenty-eight days, which for a time proved highly successful. A branch service to Antwerp, begun in 1882, was discontinued for a time, but subsequently resumed. At the time of the Penjdeh scare in 1885, when hostilities were threatening with Russia, two of this company's steam-ships, the Moor and the Mexican, were selected to act as armed cruisers for the defence of South Africa. The former was the only merchant vessel on which the pennant was actually hoisted. In 1889 the company's Continental traffic increased so that it not only resumed the despatch of through steamers from Hamburg,

but made calls at Rotterdam. This service after- wards became fortnightly, calls being made at Rotterdam, Antwerp, and Hamburg. New contracts with the colonial governments were made in 1888, and in the same year Southampton took the place of Plymouth as the outward mail port, while in 1889 the homeward mails were landed at Southampton in place of Plymouth. In 1889, by the construction of the Scot, the company acquired a much larger vessel than any they had hitherto employed ; in 1895 Messrs Harland and Wolff successfully accomplished the task of lengthening this ship by cutting her in two amidships and adding 54 feet to her length and 1000 tons to her tonnage. In 1893 the company entered upon its new policy of building a large number of practically sister ships for its intermediate trade. All were built by]\Iessrs Harland and Wolff, and fitted with twin-screws. The series included ten vessels, commencing with the Gaul of 4745 tons, and ending with the Galician of 6757 tons launched in 1900. Meanwhile from the same yard the

mail steamers Nmman, Briton, and Saxon were added to the fleet. The last-named, which came out in 1899, is a vessel of 1 2, 385 tons, with a length of 570 feet. By a resolu- tion passed at a meeting of shareholders held on 13th February 1900, this company was amalgamated with the Castle Line, and thus ceased its separate existence. At the time of its absorption its fleet consisted of 20 vessels, of which 9 were over 6000 tons.

Union ~~Castle Line. ❓❓❓ The early developments of this company must be sought under the head of the Union and Castle Lines, from whose amalgamation it sprang. Public convenience has, in some directions at least, been served by the union. Previously, though practically all the steamers made their final departure from Southampton, the Union Line only made its headquarters at that port, the Castle liners coming round from London. After amal~~ gamation, the mail boats ❓❓❓ to which cargo is not of so much importance ❓❓❓ did not come to the Thames at all, the increase in their size and the neglect of the improvement of the river and of the docks by the authorities making it un- desirable that they

should do so. The cargo (intermediate) boats, on the other hand, all load in London, and many of them, before their final departure from the Thames, visit Hamburg, Antwerp, and Kotterdam, for the purpose of picking up cargo. On these North Sea trips passengers are carried, and facilities are given for their accommoda- tion on board during the calls at the various ports. The new company carries out the contracts of its two con- stituents and thus despatches every Saturday a mail steamer from Southampton vid Madeira to the Cape and Natal. An hour or so before the sailing of the mail boat' an intermediate steamer departs from the same port. Her places of call are Teneriffe or Las Palmas for certain, and possibly also Ascension and St Helena. These vessels serve the East Coast ports of Algoa Bay and East London as well as Natal. Some of them also go to Delagoa Bay. Those which do so proceed farther, going on alternate voyages thence to Beira on the main- land, and also to the island of Mauritius. Besides the two weekly vessels, however, there are despatches of extra mid- weekly intermediate steamers, and these extra sailings have recently tended to become more frequent. The com- pany's attention has for some time been directed to the trade between the United States and South Africa, and within two years after amalgamation eight new steam- ships were constructed with a view to the development of the trade between Cape ports and New York. Nor did the union of the two companies stop the improvement of the general fleet. The 10,000-ton twin-screw mail steamers Kinfauns Castle and Kildonan Castle were delivered to the Castle Company from the Fairfield yard prior to the amalgamation. Messrs Harland and Wolflf had the Saxon, 2000 tons larger than these ships, well in hand at the time. But the Walmer Castle, the largest of all and a still later addition to the fleet, embodies as far as possible the practice which from experience commended itself to both the old companies. Further important mail steamers were in 1902 under construction. In spite of the strain put on the resources of the company by the heavy work entailed by the South Africah war, both on the vessels employed in their regular service and on those especially taken up for Government transport duty, it was found possible already to discard two of their older vessels.

White Star Line. ??? Though perhaps chiefly known in the New York trade, the White Star flag was first hoisted in the middle of last century

over a fleet of clippers which sailed to Australia. In 1867 Mr Thomas Henry Ismay took it over, and two years later the great revolution in the constitution of the company took place. In was in

1869 that Mr Ismay formed the Oceanic Steam Navigation Company to run a line of steamers between Liverpool and New York. Immediately on its formation the company entered into arrangements with Messrs Harland and Wolflf of Belfast for the construction of a fleet of high- class passenger ships, and it is worthy of notice that the terms upon which Messrs Harland and Wolflf built the White Star ships were peculiar. No definite price was agreed upon, but the actual cost plus a percentage for builder's profit was charged. The first Oceanic, pioneer steam-ship of the line, was launched on 27th August 1870, and sailed for New York on 2nd March 1871. Her advent opened a new era in Atlantic travel. She introduced the midship saloon, which extended the whole width of the ship, thus giving increased light and improved ventilation, and reducing to a minimum the sensation of the vessel's motion. The arrangement thus introduced is now almost universally adopted in the con- struction of ocean liners. The Oceanic was also narrower in proportion to her length than the vessels previously designed for the transatlantic mail service. In 1877 the Britannic reduced the passage to 7 days 10 hours and 50 minutes, excelling by three hours the best previous Atlantic passage. After the year 1888 the company ceased to build single-screw steamers, all later vessels having been constructed on the twin-screw system, of which the superiority had been clearly demonstrated. About this time also the owners of the line became responsible for an important advance in steam-ship con- struction which was afterwards imitated by merchant ships of all the great maritime Powers. The Teutonic and Majestic, introduced in 1889 and 1890, were the first merchant ships constructed vrith a view to their use as possible auxiliaries to the Koyal Navy. The former was present, armed with eight quick-firing guns, at the naval inspection by the German Emperor in 1889. With the launch of the second Oceanic in January 1899 the company's record was still further enhanced. 'This gigantic ship, built by Messrs Harland and Wolff, is of 17,247 tons and 28,000 h.p., her length over all being 705 feet. She has accommodation for 350 saloon, 250 intermediate, and 1000 steerage passengers, besides a crew of 450. She also is an armed cruiser, as are the Majestic and the

Teutonic, both close upon 10,000 tons. The White Star Line was from 1877 regularly employed under contract with the British Government to carry the American mails from Liverpool and Queenstown to New York. Besides this weekly mail and passenger service, a fleet of twin-screw cargo vessels maintained a subsidiary service between Liverpool and New York. These vessels were especially designed for the conveyance of cattle and horses. The company's s.s. Celtic, a vessel of 20,880 tons, gross register, when launched (in 1901) the largest vessel afloat, was usually employed in this trade, but she also on occa- sion carried the mails. A slightly larger sister, the Cedric, was provided for the same work in 1902. After 1883 several steam-ships of the line were employed in the Shaw, Savill, and Albion service between London and New Zealand. Three of the company's ships ran in the line of the Occidental and Oriental Company between San Francisco and Yokohama and Hong Kong. The company inaugurated a service to Australia from Liver- pool in 1899. Five ships ran in it (calling at Cape Town) to Albany, Adelaide, Melbourne, and Sydney. The ports visited by their vessels in New Zealand will be found detailed under Shaw, Savill, and Albion Company. In 1902 the absorption of the White Star fleet and manage- ment in the Morgan Shipping Combine (q.v.) was arranged.

Wilson Line. ??? Thomas Wilson, Sons and Company is at

the present time the largest private ship-owning company in the world. This line traces its origin as far back as 1835. It was founded by Mr. Thomas Wilson in conjunction with Messrs Hudson and Beckington, and on the retirement of the two last-named gentlemen it acquired its present title. Early in the 'forties the firm was running three steam- ships to Gothenburg, and was engaged largely in the iron trade, importing large quantities of Swedish and Kussian iron, and running a regular line of sailing boats to Swedish ports. It also despatched a regular service to Dunkirk. Steain-ships gradually superseded the sailing vessels, and new steamers year by year were placed on the Scandinavian service. About this time the firm secured the mail contract between England and

Sweden, which it still holds. After the Crimean war it started the St Petersburg, Stettin, and Riga trade. During the Franco-German war the trade to Stettin had to be suspended ; and as a set-off the service to Trieste was inaugurated, which has developed into an independent Adriatic and Sicilian service. The Norwegian trade was then improved by the despatch of steam-ships to Bergen, Stavanger, and Trondhjem, and subsequently a service of large steamers began running to Constantinople and the Black Sea. After the opening of the Suez Canal the trade to India, which has since assumed such con-

siderable proportions, was inaugurated. In 1875 the firm launched out into a more hardy enterprise, by commencing to run steamers to America. Its boats in 1902 ran to New York regularly from Hull and the Tyne ports. The original Calcutta trade was discontinued when the New York line was started, but in 1883 a service was estab- lished between Hull and Bombay. In 1891 the firm became a private limited company, and in 1894 took over the coast- ing trade between Hull and Newcastle. The company employs a number of large and swift ships in the Norwegian passenger traffic, which in the summer season now reaches very considerable proportions. It has frequent services of passenger and cargo vessels to the ports of northern Europe, carrying passengers in the season as far north as the North Cape. Of course the winter season necessitates consider- able variation of summer services to Baltic ports. There are also boats leaving Grimsby, Manchest^, and Liverpool regularly for Scandinavian and Baltic ports ; weekly services to Ghent, Liverpool, and Newcastle ; and services to Mediterranean and Black Sea ports. Besides the New York line there are ocean services to Boston, to New Orleans, and the river Plate. There is also a weekly service to and from London and Boston in conjunction with the Eurness-Leyland Line.

Comparison of the Gross Tonnage of the Fleets of Various Important Steamship Companies

in 1901 and 1891?-

Company.

Flag.

1901.

1891.

Vessels.

Tons.

Numerical Order.

Numerical Order.

Vessels.

Tons.

Hamburg-American .

German

202

541,085

1

9

42

126,795

Norddentscher Lloyd

)}

111

454,936

2

4

70

198,723

Elder, Dempster, and Company'^

British

120

382,560

3

25

48

55,256

British-India S. N. Company

)>

120

378,770

4

1

100

234,654

Peninsular and Oriental Company

)_?_?

58

313,343

6

3

49

199,911

Messageries Maritimes

French

62

246,277

6

2

63

202,801

F. Leyland and Company ‘ .

British

55

242,781

7

23

23 .

60,511

Union-Castle Line ^ . . . .

}]

41

222,613

8

Nippon Yusen Kaisha .

Japanese

69

218,361

9

28

‘52

42,058

“White Star Line

British

25

212,403

10

17

16

84,902

General S. N. Company of Italy ,

Italian

102

205,104

11

6

106

164,062

Wilson Line

British

89

189,818

12

7

73

132,889

Compagnie Generale Transatlantique .

French

59

183,243

13

6

66

174,600

Austrian Lloyd ...

Austrian

68

169,436

14

10

76

124,435

American Line *

American

25

167,105

15

Ocean S. S. Company . . . .

British

41

165,143

16

11

44

109^000

Clan Line . . ...

”

46 ???

164,487

17

18

29

76,300

Hansa Line

German

57

157,037

18

26

26

60,413

Allan Line .....

British

36

152,367

19

13

31

106,346

Lamport and Holt . . . .

≥j

47

149,712

20

12

54

106,648

Harrison Line ....

31

146,625

21

22

27

61,643

Pacific S N. Company

)

42

138,754

22

15

36

97,793

Anchor Line

≥j

41

132,540

23

8

44

127,065

Maclay and Maclntyre

51

126,917

24

30

19

26,928

Cunard Line

”

26

126,332

25

16

22

85,104

Atlantic Transport Company

)5

17

123,593

26

32

6

18,111

Dominion Line

>)

13

105,430

27

29

8

28,696

Johnston Line

))

24

100,460

28

24

22

68,621

R. Kopner

Cia Transatlantica . . . .

36

100,426

29

21

34

62,717

Spanish

23

88,453

30

14

36

101,214

J. WestoU . . . . .

British

38

88,306

31

27

31

48,298

Royal Mail S. P. Company .

) ??

28

88,205

32

19

25

73,364

Bucknall Brothers . . . .

)j

23

83,207

33

Chargeurs R^unis . . . . Volunteer Fleet

French

26

81,149

34

20

30

70,173

Russian

16

80,424

35

31

8

23,845

Conclusion. ??? The scope of this article will not allow of any detailed reference to many of the important foreign lines which in a complete history should be mentioned.

1 This table is based on that contained in a paper on " Shippino; Subsidies, " by B. W. Ginsbnrg, jiublished in the Journal of the Royal Statistical Society, September 1901.

' Messrs Elder, Dempster, and Company now control the fleets of the African British and African and Imperial Steamship Companies, as well as that of the Beaver Line.

' The Leyland Line was formerly the Leyland Line and West India and Pacific Steam Navigation Company.

The Hansa Company of Bremen ; the Chargeurs Reunis of Havre ; the Nederland American Line, which has recently added to the fleet several fine twin-screw liners, built at

- *Formerly the Union Line and the Castle Line. In 1891 the Union Line had 23 steamers of 55,576 tons, and the Castle Line 19 steamers of 57,934 tons.*

^ Formerly known as the Florio-Rubattino Line.

‘ In 1891 the old American Line had 3 steamers of 10,166 tons; the Inman Line 6 steamers of 41,276 tons ; the International Line 4 steamers of 12.112 tons ; and the Red Star Line 9 steamers of 39,609 tons. The present American Line comprises all these fleets.

the Belfast yard ; the Compania Transatlantica of Barce- lona, which performed so great a feat in the transport of troops from Barcelona to Cuba in the latter days of Spain’s dominion over that island ; the Pacific Mail Company of the United States ; and many others might be noticed. A whole article might be devoted to the work of the lines on the North American inland waters, while there are several other English companies which might well claim attention, both from the magnitude of their opera- tions and the extent to which they have developed types of ships suitable for the peculiarities of the trades in which their vessels are engaged. The Clan Line, for example, has largely adopted the turret-decked ship, which is the design of Messrs W. Doxford and Company of Sunderland. This type of ship is intended to carry large cargoes on a small registered tonnage and a light draught, without paying for it by a sacrifice of weatherly qualities. The same object is aimed at by the design of the trunk steamers built by Messrs Eopner of Stockton. Then there are the tank steamers constructed for the carriage of oil in bulk. The largest fleet of such vessels is the Shell Line of Messrs Samuel and Company. Several of

these ships are adapted not only for the carriage of oil, but also for its consumption in their furnaces in place of coal. We have already referred to some of the vessels fitted with refrigerating apparatus for the carriage of dead meat, and to the cargo steamers of the Atlantic companies, which are supplied with conveniences for carrying valuable racehorses and cattle. The experience of many years has enabled the owners of some of these lines to exhibit a wonderfully low record of loss, the percentage of deaths at sea to numbers carried being small beyond the dreams of, say, the 'seventies. A tenth of 1 jier cent, over a somewhat extended period is not an unprecedented average.

The foregoing table shows something of the recent growths of companies, and at the same time records some of the amalgamartions which have been so frequent. It should be explained that the table^oes not pretend to be exhaustive. The fleets embraced in it are not necessarily all those whose tonnage reaches above the lower limit shown. The figures, too, are subject to certain reserva- tions. The count was not necessarily taken by the various companies at the same period of each year. Some of the figures given may include numbers and tonnages of tugs and tenders, while others may exclude them. Again, some of the companies may have returned in their fleets the vessels which they had under construction, whilst others may not have counted them. But none of these considera- tions can much affect the general significance of the figures shown. The growth in the average size of individual ships is as marked as that of the aggregate tonnage of the companies.

AuTHOKiTiKs. ❖❖❖ The following books throw much light on the history of the leading steam-ship lines : ❖❖❖ History of Merchant Ship- ping, by W. S. Lindsay. London, Sampson Low and Co. ❖❖❖ Ocean Steam-ships. London, J. Murray, 1892. ❖❖❖ A. J. Maoinnis. The Atlantic Ferry, 3rd edition. London, Whittaker and Co. ❖❖❖ E. R. Jones. The Shipping World Ycar-Book. ❖❖❖ T. Rhodes. Steam-ship Guide. London. ❖❖❖ Also see a comprehensive article on this subject in the Quarterly Jlcmew for January 1900. Perhaps the fullest information is, as a rule, to be obtained from the handbooks issued by the companies themselves. (b. W. G. ; W. B. Du.)

Stedman, Edmund Clarence (is.‘i.v

), American poet and critic, was born at Hartford,

Connecticut, 8th October 183.3. He studied two years at Yale College ; became a journalist in New “'ork, especially on the staffs of the Tribune and World, wliich latter paper he served as field correspondent during the first year’s of the Civil W^ar ; and was a broker in Wall Street from 1861 to 1899. His first book, Poems, Lyric ami Idi/Uic, appeared in 1860, followed by successive volumes of

similar character, and by collected editions of his verse in 1873 and 1884. His longer poems are Alice of Morvniouih: an Idyl of the Great War (1864); The Blam.eless Prince (1869), an allegory of good deeds, supposed to have been remotely suggested by the life of Prince Albert ; and an elaborate commemorative ode on Hawthorne, read before the Harvard Phi Beta Kappa Society in 1877. An idyllic atmosphere is the prevalent characteristic of his longer pieces, while the lyric tone is never absent from his songs, ballads, and poems of reflection or fancy. As an editor he put forth a volume of Cameos from Landor (with T. B. Aldrich, 1874) ; a large Library of (selec- tions from) American Literature (with Ellen M. Hutchin- son, 11 vols., 1888-90); a Victorian Anthology (1895) ; and an American Anthology (1900); the two last- named volumes being ancillary to a detailed and compre- hensive critical study in prose of the whole body of English poetry from 1837, and of American poetry of the 19th century. This study appeared in separate chapters in Scribner’s Monthly or the Century Magazine, and was re-issued, with enlargements, in the volumes entitled Victorian Poets (1875 ; continued to the Jubilee year in the edition of 1887), and Poets of America (1885), the two works forming the most symmetrical body of literary criticism yet published in the United States. Their value is increased by the treatise on The Nature and Elements of Poetry (1892) ___ originally delivered in the form of lectures at Johns Hopkins University ___ a work of great critical insight as well as technical knowledge.

SteelCi a town of Prussia, in the Ehine province, on the Kuhr, 4 miles by rail east of Essen. Here, as early as 938, the Emperor Otto I. held a diet of

the empire. It has coal mines, iron and steel works, and makes fireproof bricks. Population (1885),- 8237; (1900),

12,243.

Steelton, a borough of Dauphin county, Pennsyl- vania, U.S.A. It is on the river Susquehanna, and on the Pennsylvania and the Philadelphia and Beading rail- ways, south-east of the centre of the state, at an altitude of 306 feet. It contains the works of the Pennsylvania Steel Company, including blast-furnaces, rolling-mills, and bridge manufactories, besides other industrial concerns. It was chartered as a borough in 1880. Population (1880), 2447; (1890), 9250; (1900), 12,086, of whom 2300 were foreign-born and 1508 negroes.

Steeple-chasing^. See Hoese-Kacing.

Stefianie, Basso Naebor, or Chuwaha, a lake of East Africa, lying in 37 E., between 4 25' and 5 N. lat., and measuring some 40 miles by 15. It is the southernmost and lowest (1880 feet) of a series of lakes which seem to lie in a north-easterly continua- tion of the great East African rift valley, although this loses its well defined character in about 3 N. The character of the lake varies greatly according to the amount of water brought down by its principal feeder, the Sagan or Galana Amara, which enters at its north end, being there a fairly rapid stream 50 yards wide and 3i feet deep. According to Dr Donaldson tr^mith, this river is partly fed by the next lake in the series, Abaya or Chamo (3460 feet), which in turn receives the waters of a larger lake Abai, Pagade, or Eegina Mar- glierita through the river Walo, across a plain only 2 miles wide. All the lakes of the series are shut in by high mountains, those surrounding Lake Pagade, to- gether with the islands with which its surface is broken, being clothed with luxuriant vegetation. The chief feeder of Pagade i-ises in 7 30' W., beyond which are several smaller lakes unconnected with the more southerly system.

Lake Stefanie was discovered by Count Teleki in 1889, and has since, with others of the series, been explored by Donaldson Smith, Bottego, Wellby, and others. Harrison in 1899 found the lake quite dried up, and two years later Count Wickenburg found water only in the northern part.

See Geographical Journal, September 1896, September and December 1900, September 1901. ??? Vannutelli and Citerni. L'Omo. Milan, 1899.

Stellar Phototnetty. See Photometey, Stellar.

StellenbOSCh, a town of Cape Colony, a few miles south of Paarl and east of Cape Town, with which places it is connected by rail. It lies in a pleasant upland valley on the Atlantic slope of the coast range, and is, next to the capital, the oldest settlement in the colony. The Fransohe Hoek, or French Quarter, in the neigh- bouring amphitheatre of hills, still indicates the district where most of the Huguenot refugees established them- selves towards the close of the 17th century. Stellenbosoh is a busy agricultural centre, with a population of over 5000 in 1890. In the early days of the Boer war (1899- 1902) Stellenbosch was one of the British military bases, and was used as a " remount " camp ; and in consequence of officers being sent back to it when they had not dis- tinguished themselves at the front, the expression " to be Stellenbosched " came into general use ; so much so, that in similar cases officers were spoken of as " Stellenbosched " even if they were sent to some other place altogether.

Stendal, a town of Prussia, in the province of Saxony, 70 miles west of Berlin by rail. The cathedral was restored in 1893, and now shelters the natural history and archaeological collections of the Museum of the Alt-Mark. Population (1885), 16,184; (1900), 22,081.

Stephan, Heinrich von (1831-1897), Ger- man statesman, was born at Stolp, in Pomerania, on 7th January 1831. From his earliest years he showed that talent for languages to which he owed so much of his success in life, and before he went to school had acquired a con- siderable knowledge of Italian, Spanish, and English. He was educated at the grammar school of his native town, and at the age of sixteen entered the

service of the Prussian Post Office. His promotion was rapid ; he was trans- ferred to East Prussia, and thence to Cologne. Here he added to his salary by writing dramatic criticism, and here lie obtained his first acquaintance with the system, or rather lack of system, which with its complication of charges made all international postal correspondence so expensive and uncertain ??? a system which he was in later years to revolutionize. After passing the examinations which admitted him to the higher branches of the service, he was transferred to Frankfort-on-the-Oder, and in 1856 to Berlin. Many different stories are told of the manner in which his exceptional knowledge of European languages was brought to the knowledge of the Postmaster-General, who at once saw that capacity and attainments of the kind could best be used at headquarters. During the next few years he was entrusted with very important duties; he was chosen as Prussian representative when a. postal treaty was arranged with Spain and Portugal. In 1864 he was given the task of reorganizing the postal service in the conquered duchies of Schleswig-Holstein, and in 1866 it fell to his lot to extend the Prussian system to the newly annexed provinces ; he had to take over and replace the system by which for three hundred years the family of Thurn and Taxis had conducted the postal service of central Germany. He also found time to write works on the history of postal matters, viz., a

Histm'y of the Prussian Post Office (1859), and articles on the means of communication in ancient and mediaeval times, which appeared in Bawnier's Historisches Tascheiv- buck (1868). He was one of the invited guests at the opening of the Suez Canal, and in 1872 published a work on modern Egypt. In 1870, at the early age of thirty- nine, he was made Postmaster-General of the North German Confederation, and in the next year of the newly founded Empire; in 1878, at the general reorganization of the Imperial administration (see article Germany) the Post Office was made a separate department, and his title was altered to that of Secretary of State. His great powers of organization were at once shown in the arrangement of the admirable Feld Post, which during the war with France maintained communica- tion with the army in the field. In eight months 89 millions of letters, 2J million post-cards, and ??10,000,000 in money passed through the department, and it was his boast that letters were delivered to and col- lected from the soldiers with almost unfailing

regu- larity, sometimes even on the field of battle. In this way he began what was the great work of his life, that of making the Post Office in the truest sense of the word popular, and henceforth he was unremittingly occupied in devising and adopting new contrivances for the convenience and use of the people. The introduction of post-cards was his first innovation. In this he had been anticipated by Austria, but the idea was his own, and had been adopted by the Austrians in consequence of a suggestion made by him at a postal conference in 1865. The development of the parcel post and of the system of money orders was his next work, and in this he was so successful that in 1883 the German Post Office dealt with 79 million parcels, while in all the other countries of the world together only 52 million went through the post. While in this and other ways he extended the use of the Post Office at home, he gained a wider celebrity in being the chief promoter of the International Postal Union. He presided at the first conference, which met at Bern in 1874. The alacrity of his intelligence and his enthusiasm for the institution over which he presided were shown by the readiness vidth which he applied or took over all new inventions which might be of public service, such as telegraphs, tele- phones, and pneumatic tubes. His pride in the Post Office showed itself in the immediate interest which he took in the design and plan of the new offices which were erected in all parts of Germany ; it was always his atabition that the post office in each town should be the most conspicuous and the handsomest of public buildings, even at the sacrifice of economy. He warmly supported Bismarck in his policy of extending and pro- moting national industry and foreign trade, and arranged the subsidies by which a direct postal service was estab- lished between Germany and China and Australia. His national feeling also showed itself in the support which he gave to the movement for purifying the German language of foreign words ??? but he did not always succeed in avoiding the exaggeration verging on the ridiculous into which this movement so easily degenerates. While he stood aloof from ordinary party politics, he was a frequent speaker in the Reichstag on the affairs of his own department, and was a member of the Bundesrath. Though never on terms of intimate friendship with Bismarck (difference of habits arising from the different spheres in which their youth had been passed would have made this impossible), his mastery in his own department won for him the appreciation of the Chan- cellor, and he was allowed more

independence than most of the officials. By the power of working out broad and

general principles in detail and idealizing the routine ???work of administration he may fairly be placed among the great administrators by whom (far more than by statesmen and politicians) the Prussian State has been built up, and he was singularly fortunate in that his life fell at a time when by perfecting the administration of the newly founded Imperial Post he took no small part in strengthening the national idea and binding together the German nation. In 1897 blood-poisoning, arising from a wound in the foot, made amputation of the leg necessary, and he died from the effects of the operation.

See E. Kniokebeeg, H. -o. Stephan, Berlin, 1897.

(j. W. He.)

Stephen, Sir James Fitzjames, Eabt.

(1829-1894), English lawyer, judge, and publicist, was born in London on the 3rd of March 1829, the third child and second son of Sir James Stephen, for many years permanent under-secretary in the Colonial Office. Fitz- james Stephen was for three years (1842-45) at Eton, and afterwards for two years at King's College, London. In October 1847 he entered at Trinity College, Cambridge. Notwithstanding exceptional vigour of mind and body, he did not attain any of the usual scholastic or athletic dis- tinctions. The only studies then seriously prosecuted in the university course were mathematics and classics. Neither of these attracted him in their academical forms, nor did he care for competitive sport. But his Cambridge time was fruitful in other ways. He was already ac- quainted with Sir Henry Maine {q.v.), six years his senior, and then newly appointed to the chair of civil law. This acquaintance now ripened into a perfect friendship, which was continued in both private and public life with the happiest results, and ended only with Maine's death in 1888.

No two men's intellectual tempers ever presented a stronger contrast. As Stephen himself said, it took them a long time to know when they really agreed. Maine was subtle, swift, and far-reaching ; Stephen was massive, downright, indefatigable, and sincere even to unnecessary frankness. Their qualities were an almost exact comple- ment of one another, but neither of them would take opinions on trust, or acquiesce in commonplace methods of avoiding difficulties ; and it might have been said of either of them without exaggeration that, if all his tech- nical and professional acquirements could be taken away, a born man of letters would be left. By Maine's intro- duction Stephen became a member of the Cambridge society known as the Apostles, in form not very different from many other essay societies, in substance a body wifh an unformulated but most individual tradition of open- mindedness and absolute mutual tolerance in all matters of opinion. Perhaps the golden age of the society was a few years before Stephen's election, but it still contained a remarkable group of men who afterwards became emi- nent in such different ways as, for instance, Clerk-Maxwell and Sir William Harcourt. Stephen formed friendships with some of its members, resident or occasionally revisits ing Cambridge, which were as permanent, though in few cases so little subject to external interruption as his inti- macy with j\Iaine. Probably the Apostles did much to correct the formalism inevitably incident to the Evangelical traditions of the first Sir James Stephen's household.

After leaving Cambridge, Fitzjames Stephen, having practically to choose between the Churcli and the Bar, decided for the bar. He was called in 1854, after the usual haphazard preparation which then was (and still practically is) considered in this country alone, and e^ ??? on in this country for one kind of learnint; alone, a sufficient in- troduction to the duties of a learned profession. His own estimate of his strictly professional success, written down

in later years, was that in spite of such training as he could get, rather than because of it, he became a mode- rately successful advocate and a rather distinguished judge. As to the former branch of the statement, it is correct, but ambiguous to those who do not know the facts. Stephen's work was always distinguished in quality, though his amount of business

was never great in quan- tity. After his return from India and before he became a judge he had what is called a good practice, but still not a large one. In his earlier years at the bar he was attracted, like many other able young lawyers, by the stop-gap of journalism. It was no common journalism, however, that enlisted Stephen as a contributor to the Saturday Review when it was founded in 1855. He was in company with Maine, Sir William Harcourt, G. S. Venables (a writer of first-rate quality, who never set his name to anything), Bowen, Freeman, Mr Goldwin Smith, and others whose names have since become well known. Strangely enough, the first and the last books published by Stephen were selections from his papers in the Saturday Review {Essays by a Barrister, 1862, anonymous ; Horae Sahhaticae, 1892). These volumes embodied the results of his studies among publicists and theologians, chiefly English, from the 17th century onwards. They never professed to be more than the occasional products of an amateur's leisure, but they were of greater value when they were first pub- lished than is easily recognized at this day by a generation familiar with the resources of later criticism.

For exactly three years (1858-61) Stephen served as secretary to a royal commission on popular education, which was more fortunate than most commissions in having prompt effect given to its conclusions. In 1859 he was appointed recorder of Newark. In 1863 he published his General View of the Criminal Laxo of England (not altogether superseded by the second edition of 1 890, which was practically a new book). This was really the first attempt that had been made since Blackstone to explain the principles of English law and justice in a literary form, and it had a thoroughly deserved success. All this time Stephen kept up a great deal of miscellaneous writing, and the foundation of the Pall Mall Gazette in 1865 gave him a new opening. He was one of the principal con- tributors for some years, and an occasional one till he became a judge. He " seemed perfectly insensible to the labour," though he put far more individual conviction into his articles than most leader-writers do, or probably ought to do. So far he was a literary lawyer, possibly with chances (diminished by his vehement dislike for party politics) of regular professional advancement, possibly not free from the temptation to turn wholly to literature. The decisive point of his career was in the summer of 1869, when he accepted the post of Legal Member of Council in India.

Fitzjames Stephen's friend Maine was his immediate pre- decessor in this office. Guided by Maine's comprehensive genius, the Government of India had entered on a period of systematic legislation which was to last about twenty years. The materials for considerable parts of this plan had been left by]Maine in a more or less forward con- dition. Stephen had the task of working them into their definite shape and conducting the Bills through the Legislative Council. This he did Avith wonderful energy, with efficiency and workmanship adequate to the purpose, if sometimes rough according to English notions, and so as to leave his own individual mark in many places. The Native Marriages Act of 1872 was the result of deep consideration on both Maine's and Stephen's part. The Contract Act had been framed in England by a learned commission (a]iparently not having much special Indian information, or not much regarding that which it had), and the draft was materially altered in Stephen's hands

before, also in 1872, it became law. The Evidence Act of the same year was entirely Stephen's own. It not only consolidated the rules of judicial proof, but endeavoured to connect them by legislative authority with a logical theory of probability set forth in the Act itself. This part of the Act has been criticized both as to the principle (which, indeed, seems open to much doubt) and as to the success of the draftsman in applying it. At any rate it is characteristic of Stephen's anxiety never to shirk a difficulty. To some extent the Con- tract Act may be charged with similar over-ambition ; but its more practical defects are evidently due to the acceptance by the original framers of unsatisfactory statements which, coming to India with a show of authority, naturally escaped minute criticism amid the varied business of the Legislative Department. If the success of the later Anglo-Indian Codes has not been quite so complete as that of the Penal Code, they have on the whole done excellent service, and they are at least as good as any European codification prior to the very recent achievements of scientific lawyers in Italy and Germany. Besides the special work of legislation, Stephen had to attend to the current administrative business of his department, often heavy enough to occupy the whole of an ordinary

able man's attention, and he took his full share in the general deliberations of the Viceroy's Council. His last official act was the publication of a minute on the administration of justice which pointed the way to reforms not yet fully realized, and is stiU a most valu- able manual of information for every one who wishes to understand the judicial system of British India. When one considers this amount of performance, it seems hardly credible that it was compressed into half of a member of Council's usual term of office. Stephen, mainly for family reasons, came home in the spring of 1872. During the voyage he made a pastime of meditating and writing a series of articles, which took the form of his book entitled Liberty, Equality, Fraternity (1873, 1874) ??? a protest against J. S. Mill's neo-utilitarianism which was really in the nature of an appeal from the new to the old utilitarians, if any such were left, or perhaps rather to Hobbes, but was too individual to be systematic, and made no serious attempt at reconstruction. Soon after his return Stephen became a member of the Athen??um Club under the rule empowering the committee to elect a certain number of distinguished persons without ballot.

Indian experience had supplied Stephen with the motive for his next line of activity, which future historians of the common law may well regard as his most eminent title to remembrance. The Government of India had been driven by the conditions of the Indian judicial system to recast a considerable part of the. English law which had been informally imported. Criminal law, procedure, and a good deal of commercial law, had been or were being put in a shape intelligible to civilian magistrates, and fairly within the comprehension of any intelligent man who would give a moderate amount of pains to mastering the text of the new codes. The rational sub- stance of the law had been preserved, while the disorder and the excessive technicalities were removed. Why should not the same procedure be as practicable and pro- fitable in England ? It was Bentham's ideal of codification, to be put in practice with the knowledge of actual business and legal habits, the lack of which had made Bentham's plans unworkable. For the next half-dozen years Fitz- james Stephen was an ardent missionaiy in this cause. The mission failed for the time, as to the specific under- takings in which Stephen made his

experiments, but it had a large indirect success which has not yet been adequately recognized. Stephen published, by way of

private exposition, digests in code form of the law of evidence and the criminal law. There were transient hopes of an Evidence Act being brought before Parlia- ment, and in 1878 the digest of criminal law became a ministerial Bill. This was referred to a very strong judicial commission, with the addition of Stephen himself: the revised Bill was introduced in 1879 and 1880. It dealt with procedure as well as substantive law, and pro- vided for a court of criminal appeal (after several years of judicial experience, Stephen changed his mind as to the wisdom of this). However, no substantial progress was made. In 1883 the part relating to procedure was brought in separately, and went to the Grand Committee on Law, who found that there was not time to deal with it satisfactorily in the course of the session. Nothing has been done with either part of the draft code since. The historical materials which Stephen had long been collect- ing took permanent shape the same year (1883) in the History of the Criminal Law of England, which, though not free from inequalities and traces of haste, must long remain the standard work on the subject. A projected digest of the law of contract (which would have been much fuller than the Indian Code) fell through for want of time. Thus, none of Stephen's own plans of English codification took effect. Nevertheless they bore fruit in- directly. Younger men dealt with other chapters of the law in the systematic form of the Anglo-Indian Codes ; a digest of the law of partnership by the present writer, and one of the law of negotiable instruments by Mr Chalmers, who some time afterwards fUled the post of Legal Member of Council in India, became the foundation of the Bills of Exchange Act of 1882 and the Partnership Act of 1890. Lord Herschell passed a Sale of Goods Act on similar lines, also drafted by Mr Chalmers, in 1893 ; and it is understood that the law of insurance has been codified in the Parliamentary counsel's ofiice, and only awaits the time when the legislature can pay attention to it. A Marine Insurance Bill was in fact prepared by Mr Chalmers, under Lord Herschell's directions, in 1894, and has several times been brought into the House of Lords. Nothing really stands in the way of a practically complete code of maritime and commercial law for the LTnited Kingdom but the difficulty of finding time in the House of Commons for non-

contentious legislation which, however useful to the commonwealth, is devoid of partisan interest ; and whenever this is achieved, the result will in substance be largely due to Sir James Stephen's efforts. Meanwhile, in addition to his other occupations, Stephen was an active member of the Metaphysical Society (see Knowlbs), and he carried on an intimate correspondence with Lord Lytton, then Viceroy of India, during the critical period of the second Afghan war. In connexion with the jNIetaphysical Society and otherwise, Fitzjames Stephen took an active interest in many topics of current controversy. This led him to produce a great number of occasional articles, of which a list may be found at the. end of Sir Leslie Stephen's Life. The matters dealt with covered a wide field, from modern history and politics, with a predilection for India, to philosophy, but the pre- vailing mood, if one name must be assigned to it, was theologico-political. All these writings were forcible ex- positions of serious and thoroughly definite views, and therefore effective at the time and valuable even to those who least agreed with them. As to the philosophical part of them, the grounds of discussion were shifting then, and have continued to shift rapidly. Much of Stephen's vigorous polemic has already incurred the natural fate of becoming as obsolete as the arguments against which it was directed. Pure metaphysical speculation, as an intellectual exercise, had little attraction for him; and, though he

was fully capable of impartial Mstorical criticism, he seldom applied it outside the history of law.

In 1877 Stephen was made a Knight Commander of the Star of India, and in 1878 he received the honorary degree of D.C.L. at Oxford. Early in 1879 he was appointed a judge of the Queen's Bench Division. He held that office a little more than eleven years. The combination of mature intellectual patience and critical subtlety which marked the great masters of the common law was not his, and it cannot be said that he made any considerable addition to the substance of legal ideas. His mind was framed for legislation rather than for systematic interpretation and development. Therefore Ije can hardly be called a great judge, but he was

a thoroughly just and efficient one ; and if none of his judgments became land- marks of the law, very few of them were wrong. Especially in criminal jurisdiction, he was invariably anxious that moral as well as legal justice should be done. He found time, in 1885, to produce a book on the trial of Nuncomar, for the purpose of rehabilitating Sir Elijah Impey's memory against the attack made on him in Maoaulay's essay on Warren Hastings, which for most English readers is the first and last source of information on the whole matter. Mr G. W. Forrest's later research in the archives of the Government oi India has tended to confirm the judicial protest, at any rate as regards Macaulay's grosser charges.

The one thing of which Stephen was least capable ??? among things possible to a good man and a good citizen ??? was sparing himself. He had one or two warnings which a less energetic man would have taken more seri- ously. In the spring of 1891 his health broke down, the chief symptom being sudden lapses of memory of which he was himself quite unconscious. In obedience to medical advice, which he took as soon as his attention was called to the matter, he resigned his judgeship in April, and was created a baronet. He lived in retirement till his death on 11th March 1894, having filled a not very long life with a surprising amount of work, of which a large proportion was of permanent value. Perhaps the most individual part of Stephen's character was his absolute sincerity. He would not allow himself even innocent dis- simulation; and this gave to those who knew him but slightly an impression of hardness, which was entirely contrary to his real nature. Sir James Stephen married Mary Eichenda Cunningham in 1855. On his death his eldest son, Herbert, succeeded to the baronetcy. A second son, of brilliant literary promise, James Kenneth Stephen (1859-1892), died in his father's lifetime : hia principal literary achievements consisted of two small volumes of verse ??? Lapsus Calami and Quo Musa Tendis, the former of which went through five editions in a very short time. The third son, Mr H. L. Stephen, was appointed in 1901 judge of the High Court at Calcutta.

See Leslie Stephen. Life of Sir James Fitsjames Stephen (London, 1895), with bibliographical appendix, a model biography ; same author's article

in the Diet. Nat. Biog. See also Sir C. P. Ilbert, "Sir James Stephen as a Legislator," iaiw Quart. Rev., X. 222.

(f. Po.)

Stephen, Sir Leslie (18.32-

-), English

biographer and literary critic, grandson of James Stephen (1758-1832), Master in Chancery, a friend of Wilberforcc, and author of a book called /Slavery Delineated, and son of Sir James Stephen (1789-1859), Colonial Under- Secretary for many years, and author of Essays on Ecclesiastical Biography, was born at Kensington Gore on 28th November 1832. At his father's house he saw a good deal of the Abolitionists- and other members of the Clapham Sect, and the Macaulays, James Spedding, Sir Henry Taylor, and Nassau Senior were intimate friends

of his family. After education at Eton, King's College, London, and Trinity Hall, Cambridge, where he graduated B.A. 1854, M.A. 1857, Mr Stephen remained for several years a fellow and tutor of his college. He has recounted the experiences of a resident fellow at that period in a delightful chapter in his Life of Fawcett as well as in some less formal Slcetches from Cambridge : By a Don (1865). These sketches were reprinted from the Pall Mall Gazette, to the proprietor of which, George Smith, he had been introduced by his brother, (Sir) James Fitzjames Stephen. It was at Smith's house at Hamp- stead that Stephen met his first wife, Harriet Marion (died 1875), daughter of W. M. Thackeray. While still a fellow he had taken holy orders, which he relinquished immediately upon the passing of the Clerical Disabilities Act in February 1870. In the meantime he settled in London, and wrote largely, not only for the Pall Mall Gazette, but also for Eraser, Macm,illan, the Fortnightly, and other periodicals. He was already known as an ardent mountaineer, as a contributor to Peaks, Passes, and Glaciers (1862), and as one of the earliest presidents of the Alpine Club, when in 1871, as a vindication in some sort of the mountaineering mania, and as a com- memoration of his own first ascents of the Schreckhorn and Eothhorn, he published his fascinating Playground of Europe (republished with additions 1894). In

the same year he was appointed editor of the Cornhill Magazine, the reputation of which he maintained by enlisting such men as E. L. Stevenson, Thomas Hardy, W. E. Norris, Henry James, and James Pavn among his contributors. During the eleven years of his editorship, in addition to three delightful volumes of critical studies, reprinted mainly from the Cornhill under the title of Hours in a Library (1874, 1876, and 1879), and some Essays on Freethinking and Plain Speaking, which in- clude the very striking "A Bad Five Minutes in the Alps" (reprinted from Eraser and the Fortnightly in 1873), he made two valuable contributions to philosophi- cal history and theory, The History of English Thought in the Eighteenth Century (1876 and 1881) and The Science of Ethics (1882) ; the second of these was extensively adopted as a text-book on the subject. The first was generally recognized as an important addition to philo- sophical literature, and led immediately to Mr Stephen's election at the Athenaeum Club in 1877. In the autumn of 1882 he abandoned the direction of the Cornhill to James Payn, having accepted the more responsible duty of editor of the Dictionary of National Biography, for the first planning and conception of which he was largely responsible. The first volume of the Dictionary was pub- lished in January 1885, and twenty quarterly volumes followed under Mr St-ephen's sole editorship. Five volumes were then published under the joint – editorship of Mr Stephen and of Mr Sidney Lee, whom he had appointed as his assistant in ilarch 1883. Early in 1891, after eight and a half years' service, j\Ir Stephen, whose health had been somewhat impaired by the labour inseparable from the direction of such an undertaking, resigned the responsibility to his coadjutor. Fortunately for the success of the work, re-established health enabled him to remain a contributor to the Dictionary. Among his lives are those of Addison, Bolingbroke, Burns, Charlotte Bronte, Byron, Carlyle, Marlborough, Coleridge, Defoe, Dickens, Dryden, Fielding, George Eliot, Gibbon, Goldsmith, Hobbes, Hume, Johnson, Landor, Locke, Jilacaulay, the two Mills, Milton, Pope, Scott, Swift, Adam Smith, Thackeray, Warburton, Wordsworth, and Young. Most of these are characterized by felicitous phrases, by frequent flashes of insight (especially of the sardonic order), and by the good fortune which attends a consummate artist in

his special craft. His particular style of treatment is more appropriate, perhaps, to the self-complacent worthies of the 18th century than to quietists such as Law and Wordsworth ; but where space demands that a character should be inscribed upon a cherry-stone, Stephen seldom if ever failed to rise to the occasion. For the " English Men of Letters " series he wrote lives of Swift, Pope, and Johnson ??? the last well described as "the peerless model of short biographies" ??? and subsequently of George Eliot. During his tenure of the editorship of the Dictiorvary he was appointed first Clark Lecturer at Cambridge (1883), and lectured upon his favourite period ??? Berkeley, Mandeville, Warburton, and Hume; a few years later, upon one of several visits to his inti- mate friends and old correspondents, C. E. Norton and J. Eussell Lowell, he was granted a Doctor's degree by Harvard University. After Lowell's death in 1891 Mr Stephen was mainly instrumental in having a memorial window placed in Westminster Abbey. In 1885 he brought out his standard Life of Fawcett, in 1893 his Agnostic's Apology and other Essays, and in 1895 the Life of his brother, Sir James Fitzjames Stephen, which, less essayistic in manner than the Life of Fawcett, con- tains his most finished biographical work. In the same year, in succession to Lord Tennyson, Mr Stephen was elected president of the London Library, and was shortly afterwards appointed a trustee of the National Portrait Gallery. Some of his experiences as an editor were embodied in Studies of a Biographer, issued in 1898, while in 1900 appeared an important work which he had long had in preparation in continuation of his English Thofught in the Eighteenth Century, entitled The English Utilitarians, being full-length studies of Bentham and the two Mills. As a thinker Leslie Stephen showed him- self consistently a follower of Hume, Bentham, the Mills, and G. H. Lewes, but he accepted the older utilitarianism only as modified by the application of Darvrinian prin- ciples, upon lines to some extent indicated by Mr Herbert Spencer (see Ethics). The negative character of his teaching, his anti-sacerdotal bias, his continual attitude of irony, and even the very subtlety of his thought, have co-operated to retard the recognition of his value as in many respects the first of living English critics. For blowing the froth off the flagon of extravagant or inflated eulogy he certainly met no equal in his

generation. Voluminous as his work is, it is never dull. Wtile making self-deprecation a fine art, and perpetually laughing in his sleeve at the literary bias and the literary foible, he fulfilled with exceptional conscience the literary duty of never writing below his best. Besides being a member of the Metaphysical Society, he was for some years president of the Ethical Society (many of his addresses to which were published as Social Bights and Duties in 1896). In addition to his separate works, he superin- tended a large number of editions, among them Clifford's Essays. (1879), Fielding (1882), Eichardson (1883), Payn's Backwater of Life (1899), and J. E. Green's Letters (1901). In 1896 he wrote a memoir of his friend James Dykes Campbell for the second edition of Camp- bell's Coleridge, and in 1897 he contributed a preface to the English translation of The Early Life of Wordsworth, by M. Legouis. His name was included in the Corona- tion honours list of June 1902, when he was made KC.B.

Stepniak, Sergfius (1852-1895), whose real name was Seegius Michaeloyitch Kravchinski, was one of the most widely known among the Eussian exiles who aroused the sympathy of England for the advocates of Eussian freedom. He was born in South Eussia, of

parents who belonged to a noble family. He received a liberal education, and, when he left school, became an officer in the artillery ; but his sympathy with the peasants, among whom he had lived during his boyhood in the country, developed in him at first democratic and, later, revolutionary opinions. Together with a few other men of birth and education, he began secretly to sow the senti- ments of democracy among the peasants. His teaching did not long remain a secret, and in 1874 he was arrested. He succeeded in making his escape ??? possibly he was per- mitted to escape on account of his youth ??? ard immediately began a more vigorous campaign against autocracy. It was not only on logical grounds that he strove to bring about reform. His sympathetic nature was even more influenced by indignation against the brutal methods adopted towards prisoners, especially political prisoners, and by the stern measures which the Government of the Tsar felt compelled to adopt in order to repress the revolu- tionary movement. His indignation, in fact, carried him into accord for a time with those who advocated what was called the Terrorist policy. This, of course, was the policy which

aimed at attaining by violence and assassination ends for which it seemed hopeless to work upon peaceful lines. In consequence he exposed himseK to danger by remaining in Eussia, and in 1880 he ^vas obliged to leave the country. He settled for a short time in Switzerland, then a favourite resort of revolutionary leaders, and after a few years came to London. He was already known in England by his book. Underground Russia, which had been published in London in 1882. It gave a vivid and striking picture of the agitation which was going on under the surface of Eussian life, and it had a great success. He followed it up ^^^th a number of other works on the condition of the Eussian peasantry, on Nihilism, and on the conditions of life in his country which he was so anxious to see altered. His mind gradually turned from belief in the efficacy of violent measures to the acceptance of constitutional methods ; and in his last book, King Stork and King Log, he spoke with approval of the efibrts of politicians on the Liberal side to effect, by argument and peaceful agitation, a change in the attitude of the Eussian Government towards various reforms. Stepniak constantly wrote and lectured, both in Great Britain and the United States, in support of his views, and his energy, added to the interest of his personality, won him many friends. He was chiefly identified with the Socialists in England and the Social Democratic parties on the Continent ; but he was regarded by men of aU opinions as an agitator whose motives had always been pure and disinterested. Stepniak was killed by a railway engine at a level cross- ing at Bedford Park, Chiswick, where he resided, on 23rd December 1895. Before his cremation at Woking on 28th December, funeral speeches were made at Waterloo Station by well-known men of different nationalities who were in sympathy with his aims, including Mr William Morris, Prince Kropotkin, and Mr John Burns. (h. h. r.)

Steppes, GeneeaI/-Goveenoeship of, a portion of Eussian Central Asia which includes both what was formerly known as the Kirghiz Steppe and the region around Omsk which was formerly part of Western Siberia. It consists of four provinces ❓❓❓ Akmolinsk, Semipalatinsk, Turgai, and Uralsk ❓❓❓ and is bounded by the provinces of Samara and Astrakhan and the Caspian Sea on the W. ; the Transcaspian territory, Lake Aral, and SjT-dariinsk (Eussian Turkestan) on the S. ; Semirye- chensk. Lake Balkhash, the Chinese province of Chugu- chak, and Tomsk on the SE.

and E. ; and Tobolsk and Ufa on the N. The Tarbagatai mountains rise along the Chinese frontier, and send their spurs into Eussian

territory ; the parallel chains of the southern Urals cover portions of the province of Uralsk ; and the Mugojar Hills separate the Steppe rivers from the tributaries of the Caspian Sea. The remainder of the territory consists of plains rising nowhere more than a few hundred feet above sea-level, and sinking below it as they approach the Caspian. The territory is watered by the Emba and the upper courses of the Ural, the Ishim, the Tobol, and the Irtysh, also by a number of Steppe rivers ... Irghiz, Turgai, Sary-su, Nura, &c., which are lost in the Steppes or in lakes which frequently dry up. The soil is very fertile in the north, in the Ob-Irtysh basin, but becomes less and less so towards the south, where sandy deserts make their appearance. The climate is very hot in summer and cold in winter, and extremely dry, the average temperature at Omsk for the year being 32‘5 .. Fahr., for January – 2 .., for July 67 .. ; at Semipalatinsk (altitude 228 feet) the averages are : for the year 37 .., for January 0 .., for July 72 .. ; at Uralsk (altitude 367 feet) for the year 39 .., for January 8 .., for July 67 ... *Yearly rainfall 10‘6 inches. Farther east the yearly rainfall is even still smaller, being only 8 ‘8 inches at Akmolinsk and 6‘9 inches at Irghiz. The following table shows the area and population of the several provinces : ...*

Provinces.	*Area, Square Miles.*	*Population, 1897.*	*Density.*
	229,609	*184,631*	*176,219*
	139,168	*26,166*	

3

4 3 4

Akraolinsk .

Semipalatinsk

Turgai ....

Uralsk .

Lake Aral

678,957 685,197 453,123 644,001

General-Governorship of the Steppes

755,793

2,461,278

3

The capital of the territory is at Omsk (37,470 in- habitants). The other towns are Uralsk (36,597 inhabi- tants), Akmolinsk (9557), Semipalatinsk (26,353), and Irghiz (1536). For further particulars see under the separate provinces. (p. a. k.)

Sterling', a city of Whiteside county, Illinois, U.S.A. It is on the river Rock, at the intersection of branches of the Chicago and North-Western and the Chicago, Burlington, and Quincy railways, in the north- western part of the state, at an altitude of 648 feet. It has varied manufactures, among which perhaps agri- cultural implements are the most important. Population (1890), 5824; (1900), 6309, of whom 815 were foreign- born.

Sterlita.nna.k, a district town of Russia, in the government and 82 miles south of the town of Ufa, on the left bank of the river Byelaya, and on the highway to Orenburg. It dates only from 1766, but in 1897 its population

was 15,538 (partly Tatars), and it is rapidly growing. The surrounding country is very fertile, and it is a centre for trade in cattle, horses, hides, and furs im- ported from the Kirghiz Steppes. It is also an entrepot for salt raised at Iletsk.

Sternberg', a manufacturing town in the north of Moravia, Austria, 48 miles north-east of Brunn, one of the principal centres of the Moravian textile industry. Population (1890), 15,395; (1900), 15,195, almost ex- clusively German and Catholic. In addition to the staple textile industry, there is now a tobacco and a tile factory.

Stettin, a seaport town of Prussia, capital of the province of Pomerania, on the left bank of the Oder, a few miles above its entrance into the Stettiner Half. It is the chief port of Prussia, one of the principal shipbuilding

centres in Germany, and a place of very considerable industry. It is, further, the headquarters of the 2nd German Army Corps, but no longer a fortress, the fortifi- cations having been demolished in 1873. The foremost place in its chief industry, shipbuilding, is taken by the Vulcan yard, which makes warships for the German and other navies ; also locomotives, stationary engines, and boilers. The business was started in 1851, and now employs nearly 6500 men, the works extending over 68 acres and the covered workshops over 646,000 square feet. In 1897 a floating dock was fitted up capable of holding vessels of 12,000 tons. Next in importance to shipbuild- ing comes the making of ready-made clothing, giving employment to about 6500 men and the same number of women and girls. Then follow the manufacture of cement, sewing-machines and cycles, sugar, fireproof bricks, flour, chemicals, candles and soap, spirits and beer, and oil-cake ??? all on a large scale ; and to these have been added iron-smelting works. Most of these mills and factories are situated in the suburbs ??? Grabow, Bredow, Pomerens- dorf, &c. The sea-borne commerce of Stettin is scarcely of less importance than her industry. On an average the port is cleared by some 4500 vessels of 1,400,000 tons annually (4530 vessels of 1,465,116 tons in 1900). A further impulse to the trade was given by the opening in 1898 of a free harbour to the east of the Lastadie suburb on the east bank of the Oder,

which embraces a total area of 150 acres and a quayage length of 14,270 feet. The construction of this new harbour, of which only one basin (37 J acres) was finished in 1900, with the necessary accompaniment of cranes, dock sheds, storehouses, &c., and the deepening of the river Oder from Stettin to the Haff to 24 feet (see further under Swinemunde), had up to 1899 cost ►►1,530,000. With the view of still further increasing the commercial importance of Stettin, it is proposed to construct a ship canal giving the town direct communication with Berlin. The mercantile fleet of this port numbered 128 vessels of 58,275 tons in 1900. Modern public buildings include the Roman Catholic church (1890), the Luther church (1893), and the St Gertrude church (1896) ; also a fine monumental fountain (1898) in front of the town hall. The church of St James's was restored in 1897. The town also possesses a technical school (1898) for architects and builders, and an equestrian statue of the Emperor WiUiam I. Population (1890), 116,228 ; (1895), 140,724 ;

(1900), 210,680.

Steubenvilie, a city of Ohio, U.S.A., capital of Jefferson county. It is situated in 40►►25' N., and 88►►41' W., on the river Ohio, in the eastern part of the state, at an altitude of 662 feet. It is regularly laid out on a bench in the bottom lands of the river, above the reach of floods. It has a water-supply pumped from the river, is well sewered, and is paved with brick. It has three railways ►►► the Pennsylvania; the Pittsburg, Cin- cinnati, Chicago, and St Louis ; and the Wheeling and Lake Erie. Steubenvilie is in a region of coal and natural gas, and has extensive manufactures of iron and glass. It contains furnaces, rolling-mills, nail factories foundries, &c. Population (1890), 13,394; (1900)| 14,349, of whom 1815 were foreign-born and 736 negroes'.

Stevens, Alfred (1828), Belgian painter,

was born in Brussels, 11th May 1828. His father, an old officer in the service of William I., king of the Netherlands was passionately fond of pictures, and readily allowed his son to draw in the studio of Frangois Navez, director of the Brussels Academy. In 1844 Stevens went to Paris

and worked under the instruction of Camille Eoqueplan, a friend of his father's ; he also attended the classes at the Ecole

"La m-i-E A DoN-UiKi:." By A. Stevkns. Mmh tie ISrvxrllcr. (From a I'hotogrnpl, !,;, tmihiin-AlkniU,; Bnmels.)

des Beaux Arts, where Ingres was then professor. In 1849 he painted at Brussels his first picture, " A Soldier in Trouble," and in the same year went back to Paris, where he definitely settled, and exhibited in the Salons. He then painted " Ash- Wednesday Morning," " Burghers and Country People finding at Daybreak the Body of a Mur- dered Gentleman," "An Artist in Despair," and "The Love of Gold." In 1855 he exhibited at the Antwerp Salon a little picture called "At Home," which showed the painter's bent towards depicting ladies of fashion. At the Great Exhibition in Paris, 1855, his contributions were remarkable, but in 1857 he returned to graceful female subjects, and his path thenceforth was clear before him. At the Great Exhibition of 1867 he was seen in a brilliant variety of works in the manner he had made his own, sending eighteen exquisite paintings ; among them were the "Lady in Pink" (in the Brussels Gallery), "Consolation," " Every Good Fortune," "Miss Fauvette," " Ophelia," and " India in Paris." At the Paris Inter- national Exhibitions of 1878 and 1889, and at the His- torical Exhibition of Belgian Art, Brussels, 1880, he exhibited "The Four Seasons" (in the Palace at Brus- sels), " The Parisian Sphinx," " The Japanese Mask," " The Japanese Robe," and " The Lady Bird " (Brussels Gallery, see Plate). "Alfred Stevens is one of the race. of great painters," wrote Camille Lemonnier, " and like them he takes immense pains ^nth the execution of his work." The example of his finished technique was salutary, not merely to his brethren in Belgium, but to many foreign painters who received encouragement from the study of his method. The brother of Alfred Stevens, Joseph Stevens, was a great painter of dogs and dog life.

See J. DU Jardin. L'Art Flairumd. ??? Camille Lemonnier. Histoire des Beaux Arts eii Belgique.

Stevenson, Adlai Ewing^ (1835-

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Vice-President of the United States, 1893-97, was born in Kentucky in 1835. At the age of seventeen he removed to Bloomington, 111. After a college education he was admitted to the bar in 1857. A Democrat in politics, he was elected to Congress in 1875, and again in 1879. In President Cleveland's first administration he was first assistant postmaster-general, and he removed so many postmasters for party reasons that " Adlai's Axe " became a subject of journalistic jest. He led the Illinois dele- gation in the Democratic Convention of 1892, and after the nomination of Cleveland for the Presidency, Mr Stevenson, as representative of the Western and bimetallist wing of the party, was named for the second place. After serving his term as Vice-President, President McKinley appointed him a member of the commission to pro- mote the cause of international bimetallism. In 1900 the Democratic National Convention nominated him for Vice-President with Mr Bryan, but the ticket met with an overwhelming defeat.

Stevenson, Robert Lewis Balfour

(1850-1894), British poet, essayist, and novelist, was the only child of Thomas Stevenson, civil engineer, and his wife, Margaret Isabella Balfour. He was b-^m at 8 Howard Place, Edinburgh, on the 13th of November 1850. He suffered from infancy from great fragility of health, and nearly died in 1858 of gastric fever, which left much constitutional weakness behind it. From the age of six he showed a disposition to write. He went to school, mainly in Edinburgh, from 1858 to 1867, but his ill-health prevented his learning much, and his teachers, as his mother afterwards said, " liked talking to him better than teaching him." He often accompanied his father on his official visits to the lighthouses of the Scottish coast, and on longer journeys, thus early accustom-

ing himself to travel. As his health improved, it was hoi)ed that he would be able to adopt the family profession of civil engineering, and in 1868 he went to Anstruther and then to Wick as a pupil engineer. In 1871 he had so far advanced as to receive the silver medal of the Edin- burgh Society

of Arts for a paper suggesting improvements in lighthouse apjjaratus. But long before this he had started as an author. His earliest publication, the anony- mous pamphlet of The Pentland Rising, had appeared in 1866, and The Charity Bazaar, a trifle in which his future manner is happily displayed, in 1868. From about the age of eighteen he dropped his baptismal names of Lewis Bal- four and called himself Robert Louis, but was mostly known to his relatives and intimate friends as ” Louis.” Although he greatly enjoyed the outdoor business of the engineer’s life, it strained his physical” endurance too much, and in 1871 was reluctantly exchanged for study at the Edinburgh bar, to which he was called in 1875. In 1873 he first met Mr Sidney Colvin, who was to prove the closest of his friends, and at last the loyal and admirable editor of his works and his correspondence ; and to this time are attributed several of the most valuable friendships of Stevenson’s life.

He was now labouring, with extreme assiduity, to ground himself in the forms and habits of literary style. In 1875 appeared, anonymously, his Appeal to the Clergy of the Church of Scotland, and in that year he made the first of many visits to the forest of Fontainebleau. Mean- while at Mentone in the winter of 1873-74 he had grown in mind under the shadow of extreme physical weakness, and in the following spring began to contribute essays of high originality to one or two periodicals, of which the Cornhill, then edited by Sir Leslie Stephen, was at first the most im- portant. In 1875 Stevenson passed for the bar, as has been said ; but he made no attempt to jjractise, and the next years were spent in wanderings in France, Germany, and Scotland. Records of these journeys, and of the innocent adventures which they encouraged, were given to the world as An Inland Voyage in 1878, and as Travels with a Donkey in 1879. During these four y[illegible]ars Stevenson’s health, which was always bettered by life out of doOrs, gave him little trouble. It was now recognized that he was to be an author, and he contributed many essays, tales, and fantasies to various journals and magazines. At Fontaine- bleau in 1876 Stevenson had met Mrs Osbourne, the lady who afterwards became his wife; she returned to her home in California in 1878, and in August of the following year, alarmed at news of her health, Stevenson hurriedly crossed the Atlantic. He travelled, from lack of means, as a steerage passenger and then as an emigrant, and in December, after hardships

which seriously affected his health, he arrived in San Francisco. In May 1880 he married, and moved to the desolate mining-camp which he has described in The Silverado Squatters. As Mr Colvin has well said, these months in the west of Am'erica were spent " under a heavy combined strain of personal anxiety and literary effort." Some of his most poignant and most enchanting letters were written during this romantic period of his life. In the autumn of 1880 he returned to Scot- land, with his wife and stepson, who were received at once into the Edinburgh household of his parents. But the condition of his health continued to be very alarming, and they went almost immediately to Davos, where he remained untD. the spring of 1881. In this year was published Virginihus Puerisque, the earliest collection of Stevenson's essays. He spent the summer months in Scotland, writing articles, poems, and above all his first romance, The Sea-Cook, afterwards known as Treasure Island ; but he was driven back to Davos in October. In 1882 appeared Familiar Studies of Men and Books and New Arabian Nights. His two winters at Davos had

done him some good, but his summers in Scotland invari- ably undid the benefit. He therefore determined to reside wholly in the south of Europe, and in the autumn of 1882 he settled near Marseilles. This did not suit him, but from March 1883 to July 1884 he was at home at a charming house called La Solitude, above Hyferes ; this was in many ways to be the happiest station in the painful and hurrying pilgrimage of Stevenson's life. The Silverado Squatters was published in 1 883, and also the more important Treasure Island, which made Stevenson for the first time a popular writer. He planned a vast amount of work, but his schemes were all frustrated in January 1884 by the most serious illness from which he had yet suffered. He was just pulled through, but the attack was followed by long prostrEi- tion and incapacity for work, and by continued relapses. In July he was brought back to England, and from this time until August 1887 Stevenson's home was at Bournemouth. In 1885 he published, after long indeci- sion, his volume of poems, A Child's Garden, an inferior

story. The Body Snalcher, and that admirable romance. Prince Otto, in which the peculiar quality of Steven- son's style was displayed at its highest. Early in 1886 he struck the public taste with precision in his vtild symbolic tale of Tlie Strange Case of Dr Jekyll and Mr Hyde. In the summer of the same year he published Kidnapped, which had been written at Bournemouth.

This, however, was a period of great physical prostration, so that 1886 and 1887 were, perforce, among the least productive years of Steven- son's life. In the early months of 1887 Stevenson

was particularly ill, and he was further prostrated by being summoned in May to the deathbed of his father, who had just returned to Edinburgh from the south. He printed privately as a pamphlet, in June 1887, a brief and touching sketch of his father. In July he published his volume of lyrical poems called Underivood.s. The ties which bound him to England were now severed, and his health was broken to such a discouraging degree that he determined to remove to another hemisphere. Accordingly, having disposed of Skerryvore, his hoase at Bournemouth, he sailed from London, with his wife, mother, and stepson, for New York on the 21st of August 1887. He never set foot in Europe again. His memoir of his friend Professor Fleeming Jenkin was publislied soon after his departure. After resting at Newport, he went for the winter to be under the care of a physician at Saranac Lake in the Adirondacks for the winter. Here he was very quiet, and steadily active with his pen, writing both the greater part of The Master of Ballantrae and many of his finest later essays. He had undertaken, for a regular payment greatly in excess of anything which he had hitherto received, to contribute a monthly essay to Scribner's Magazine, and these essays, twelve in number, were published continuously throughout the

RoBEBT Lotris Stevenson. {From a photograph hy Bartlett F. Kenney^ Boston, Mass.)

year 1888. Early in that year was begun The Wrong Box, a farcical romance in which Mr Lloyd Osbourne participated ; Stevenson also began a romance about the Indian Mutiny, which he abandoned. His attitude about this time to life and experience is reflected in Fulvis et

Umbra, one of the noblest of all his essays. In April 1888 he was at the coast of New Jersey for some weeks, and in June started for San Francisco, where he had ordered a schooner, the Casco, to be ready to receive him. On the 28th of the month he started, as Mr Colvin has said, " on what was only intended to be a pleasure excursion . but turned into a voluntary exile prolonged until the hour of his death " : he never again left the waters of the Pacific. The Casco proceeded first to the Marquesas,

and south and east to Tahiti, passing before Christmas northwards to Honolulu, where Stevenson spent six months, and finished The Master of Ballantrae and The Wrong Box. It was during this time that he paid his famous visit to the leper settlement at Molokai. In

1889, "on a certain bright June day," the Stevensons sailed for the Gilbert Islands, and after six months' cruis- ing found themselves at Samoa, where he landed for the first time about Christmas Day 1889. On this occasion, however, though strongly drawn to the beautiful is- land, he stayed not longer than six weeks, and proceeded to Sydney, where, early in

1890, he published, in a blaze of righteous anger, his Letter to Dr Hyde in vindication of the memory of Father Damien and his work among the lepers of the Pacific. At Sydney he was very ill again : it was now obvious that his only chance of health lay within the

tropics. For nearly the whole of the year 1890 the Stevensons were cruising through unfamiliar archipelagos on board a little trading steamer, the Janet Nicoll. Mean- while his volume of Ballads was published in London.

The last four years of his unquiet life were spent at Samoa, in circumstances of such health and vigour as he had never previously enjoyed, and in surroundings singularly picturesque. It was in November 1890 that he made his abode at Vailima, where he took a small barrack of a wooden box 600 feet above the sea, and began to build himself a large house close by. His char- acter developed unanticipated strength on the practical side ; he became a vigorous employer of labour, an active planter, above all a powerful and benignant island chieftain. He gathered

by degrees around him “a kind of feudal clan of servants and retainers,” and he plunged, with more generous ardour than coolness of judgment, into the troubled politics of the country. He took up the cause of the deposed king Mataafa with extreme ardour, and he wrote a book, A Footnote to History (1892), in the en- deavour to win over British sympathy to his native friends. In the autumn of this year he received a visit at Vailima from the Countess of Jersey, in company with whom, and some others, he wrote the burlesque extravagance

in prose and verse, called An Object of Pity, privately printed in 1893 at Sydney. Whenever the cultivation of his estate and the vigorous championship of his Samoan retainers gave him the leisure, Stevenson was during these years almost vi’hoUy occupied in writing romances of Scot- tish life. The Wrecker, an adventurous tale of American life, which mainly belonged to an earlier time, was finally published in 1892 ; and towards the close of that very eventful and busy year he began The Justice Clerk, after- wards Weir of Hermiston. A portion of the old record of emigrant experiences in 1879, long suppressed for private reasons, also appeared in book form in 1892. In 1893 Stevenson published the important Scottish romance of Catriona and the four tales illustrative of Pacific Ocean character. Island Nights’ Entertainments. But in 1893 the uniform good fortune which had attended the Stevensons since their settlement in Samoa began to be disturbed. The whole family at Vailima became ill, and the final subjugation of his protege Mataafa, and the destruction of his party in Samoan politics, deeply distressed and discouraged Stevenson. In the autumn of that year he went for a change of scene to the Sandwich Islands, but was taken ill there, and was only too glad to return to Samoa. In 1894 he was greatly cheered by the plan, suggested by friends in England and carried out by them with the greatest energy, of the noble collection of his works in twenty ~~eight volumes, since known as the Edinburgh edition. In September 1894 was published The Ebb-Tide, the latest of his books which he saw through the press. Of Stevenson’s daily avocations, and of the temper of his mind through these~~

years of romantic exile, a clear idea may be obtained by the posthumous Vailima Letters, edited by Mr Colvin in 1895. Through 1894 he was engaged in composing two romances, neither of which he lived to complete. He was dictating. Weir of Hermiston, apparently in his usual health, on the day he died. This was the 3rd of December 1894 ; he was gaily talking on the ver andah of his house at Vailima, when he had a stroke of apoplexy, from which he never recovered consciousness, and passed away painlessly in the course of the evening His body was carried next day by sixty sturdy Samoans, who acknowledged Stevenson as their chief, to the summit of the precipitous peak of Yaea, where he had wished to be buried, and where they left him to rest for ever with the Pacific Ocean at his feet.

The charm of the personal character of Stevenson and the romantic vicissitudes of his life are so predominant in the minds of all who knew him, or lived within earshot of his legend, that they make the ultimate position which he vdW take in the history of English literature somewhat difficult to decide. That he was the most attractive figure of a man of letters in his generation is admitted ; and the acknowledged fascination of his character was deepened, and was extended over an extremely wide circle of readers, by the publication in 1899 of his Letters, which have subdued even those who were rebellious to the enter- tainment of his books. It is therefore from the point of view of its " charm " that the genius of Stevenson must be approached, and in this respect there was between himself and his books, his manners and his style, his practice and his theory, a very unusual harmony. Very few authors of so high a class have been so consistent, or have made their conduct so close a reflection of their philosophy. This unity of the man in his work makes it difficult, for one who knew him, to be sure that one rightly gauges the purelj" literary significance of the latter. There are some living who still hear in every page of Stevenson the voice of the man himself, and see in every turn of his language his flashing smile. So far, however, as it is possible to disengage one's self from this captivation, it may be said

that the mingling of distinct and original vision with a singularly conscientious handling of the English language, in the sincere and wholesome self consciousness of the strenuous artist, seems to be the

~~central feature of Steven~~ son as a writer by profession. He was always assiduously graceful, always desiring to present his idea, his image, his rhapsody, in as persuasive a light as possible, and, particularly, with as much harmony as possible. He had mastered his manner and, as one may say, learned his trade, in the exercise of criticism and the reflective parts of literature, before he surrendered himself to that powerful creative impulse which had long been tempting him, so that when, in mature life, he essayed the portraiture of invented character, he came to it unhampered by any imperfection of language. This distinguished mastery of style, and love of it for its own sake within the bounds of good sense and literary decorum, gave him a pre-eminence among the story-tellers of his time. No doubt it is still by his romances that Stevenson keeps the wider circle of his readers. But many hold that his letters and essays are finer contributions to pure literature, and that on these exquisite mixtures of wisdom, pathos, melody, and humour his fame is likely to be ultimately based. In verse he had a touch far less sure than in prose. Here we find less evidence of sedulous workmanship, yet not unfrequently a piercing sweetness, a depth of emotion, a sincere and spontaneous loveableness, which are irresistibly touching and inspiring.

The personal appearance of Stevenson has often been described : he was tall, extremely thin, dark-haired, restless, compelling attention with the lustre of his wonderful brown eyes. In the existing portraits of him those who never saw him are apt to discover a strangeness which seems to them sinister or even aflfected. This is a consequence of the false stability of portraiture, since in life the unceasing movement of light in the eyes, the mobility of the mouth, and the sjrmpathy and sweetness which radiated from all the features, precluded the faintest notion of want of sincerity. Whatever may be the ulti- mate order of reputation among his various books, or whatever posterity may ultimately see fit to ordain as regards the popularity of any of them, it is difficult to believe that the time ll ever come in which Stevenson vrHl not be remembered as the most beloved of the writers of that age which he did so much to cheer and stimulate by his example. (e. g.)

Stevens Point, a city of Wisconsin, U.S.A., capital of Portage county. It is situated in 44 31' X., and 89 33' W., on the river Wisconsin, and

on the Wis- consin Central and the Green Bay and "\Vestern rail- ways, in the central part of the state, at an altitude of 1089 feet. Situated on the border of the pine timber region, it has large lumber interests, which are aided by ample water-power in the river. It has many saw and shingle mills, railway repair shops, and flour mills. Population (1880), 4449; (1890), 7896; (1900), 9524, of whom 2205 were foreign-born.

Stevenston, a town of Ayrshire, Scotland, about a mile from the coast, 29 miles south-west of Glasgow by rail. There are coal mines, four iron-works ??? one is among the largest in Scotland ??? and in the sandhills along the coast large explosives works. Population (1891),

4263; (1901), 6797.

Stewart, Balfour (1828-1887), Scottish physi= cist, was born in Edinburgh on the 1st of November 1828, and was educated at the university of that city. The son of a tea merchant, he was intended for' a mercantile career, and for some time was actually engaged in business in

Leith. and in Australia, but tlie attractions of physical science ultimately became too strong for him. Returning to his studies at Edinburgh, he became assistant to Forbes in 1856, and his association with that physicist had an important share in determining the course of his scientific life. Forbes was especially interested in questions of heat, meteorology, and terrestrial magnetism, and it was to these that Stewart also mainly devoted himself. Radiant heat iirs.t claimed his attention, and by 1858 he completed his first investigations into the subject. These yielded a remarkable extension of Pre vest's "Law of Exchanges," and enabled him to establish the fact that radiation is not a surface phenomenon, but takes place throughout the Interior of the radiating body, and that the radiative and absorptive powers of a substance must be equal, not only for the radiation as a whole, but also for every constituent of it. In recognition of this work he received in 1868 the Rumford medal of the Royal Society, into which he had been elected six years before. Of other papers in which

he dealt with this and kindred branches of physics may be mentioned " Observations with a Rigid Spectroscope," " Heating of a Disc by Rapid Motion in Vacuo," " Thermal Equilibrium in an Enclosure contain- ing Matter in Visible Motion," and " Internal Radiation in Uniaxal Crystals." In 1859 he was appointed director of Kew Observatory, and there naturally became in- terested in problems of meteorology and terrestrial mag- netism. In 1870, the year in which he was very seriously injured in a railway accident, he was elected professor of physics at Owens College, Manchester, and retained that chair until his death, which happened near Drogheda, in Ireland, on the 19th of December 1887. In addition to papers communicated to learned societies, he was the author of several successful text-books of science, and also of the article on "Terrestrial Magnetism" in the ninth edition of this Encyclopedia. In conjunction with Professor Tait he wrote The Unseen Universe, at first published anony- mously, which was intended to combat the common notion of the incompatibility of science and religion.

Stewart, Sir Donald Martin (1824-1900),

British field-marshal, son of Robert Stewart of Forres, Elginshire, was born at Mount Pleasant, near Forres, on the 1st March 1824. Educated at schools at Findhorn, Duff- town, and Elgin, and at Aberdeen University, he entered the Bengal army in 1840, and served in 1854 and 1855 in the frontier expeditions against the Mohmands, and Aka and Bari-Khels (medal and clasp). In the Indian Mutiny in 1857 Stewart, after his famous ride from Agra to Delhi with despatches, served on the staff at the siege and capture of Delhi and of Lucknow, and afterwards through the campaign in Rohilkhand (medal and two clasps, and brevet-major and lieutenant-colonel). For nine years he was assistant and deputy-adjutant-general of the Bengal army, commanded the Bengal brigade in the Abyssinian expedition in 1867 (medal and C.B.), and became a major- . general in 1868. He reorganized the penal settlement of the Andaman Islands, where he was commandant when Lord Mayo was assassinated, and, after holding the Lahore command, was promoted lieutenant-general in 1877, and commanded the Kandahar field force in the Afghan war in 1878 (K.C.B. and thanks of Parliament). In 1880 he made his difficult and memorable march from Kandahar to Kabul, fighting the

victorious battles of Ahmed Khel and Urzu on the way, and held supreme military and civil com- mand in northern Afghanistan. On hearing of the Mai- wand disaster, he despatched Sir Frederick Roberts with a division on his celebrated march from Kabul to Kandahar, and himself led the rest of the army back to India by the Khaibar Pass (medal with clasp, G.C.B., CLE., baronetcy.

and thanks of Parliament). Promoted general in 1881, he was for five years commander-in-chief in India, and after- wards member of Council of the Secretary of State for India until his death. He was made G.C.S.I. in 1885, promoted to be field-marshal in 1894, and appointed governor of Chelsea Hospital in 1895. He died at Algiers on 26th March 1900. (e. h. v.)

Stewart, Sir Herbert (1843-1885), British

soldier, eldest son of the Rev. Edward Stewart, was born 30th June 1843 at Sparsholt, Hampshire. He was edu- cated at Winchester and entered the army in 1863. He went out to India, and was aide-de-camp to Major-General Beatson, commanding the Allahabad division, until Novem- ber 1870. It was during an outbreak of cholera in the summer of that year that Stewart gained the commendation of Lord Napier, the Commander-in-chief, by his judgment and promptitude, and he was then employed in the quarter- master-general's department, and engaged in explorations, on the north-western frontier until 1873, when he returned to England. In 1878 he was sent out to South Africa. From February to May 1880 he was military secretary to Lord Wolseley. As chief staff officer under C'clley he was present at Majuba HUl, 27th February 1881, where he was made prisoner by a Boer patrol and detained until the end of March. In August 1882 he was placed in command of a cavalry division in Egypt. After Tel-el- Kebir, 13th September 1882, he headed a brilliant advance upon Cairo, and took possessicn of the town and citadel. Again, in January 1884 he was sent to Suakin in command of the cavalry under Sir Gerald Graham, and took part as brigadier in the actions from El Teb to the advance on Tamanib. His services were recognized by the honour of K.C.B., and he was assistant adjutant and quartermaster-general in the south-eastern district in England from April to Sep- tember 1884. He then

joined the expedition for the relief of Khartum, and in December, when news from Gordon decided Lord Wolseley to send a column across the desert of Metemmeh, Iilajor-General Stewart was entrusted with the command. He was appointed brigadier on 24th November, and reached Korti on 15th December. A fortnight later he reached Jakdul with the camel corps, and, after some unavoidable delay, set out for Metemmeh on the 14th January 1885. On the 16th he found the enemy in force near the wells of Abu Klea, and brilliantly repulsed their fierce charge on the following morning. Leaving the wounded under guard at Abu Klea, the column again moved forward on the 18th through bushy country towards Metemmeh, 23 miles off. Meanwhile the enemy continued their attacks, and on the morning of the 19th Stewart was wounded and obliged to hand over the command to Sir Charles Wilson. He lingered for nearly a month, and died on the way back from Khartum to Korti on 16th February, and was buried near the wells of Gakdul. In the telegram reporting his death Lord Wolseley summed up his character and career in the words, " No braver soldier or more brilliant leader of men ever wore the Queen's uniform." (g. f. b.)

Steyn, IVIartinus Theunis (1857-),

last President of the Orange Free State, was born at Winburg on 2nd October 1857. His father was a waggon- maker, an able man, who attained the position of a member of the Executive Council. His mother, a woman of decided character, was the daughter of one of the leaders of the Great Trek of 1836. Their son was educated at the Grey College at Bloemfontein, and at the age of sixteen became manager of a farm belonging to his father. But he was

not content with the prospect of a farmer's life, and soon obtained j)ermission to study law in Europe. He was a student first in Holland and later in England at the Inner Temple, and was called to the English bar in November 1882. After his return to South Africa he practised as a barrister at Bloemfontein, and made such rapid progress in his profession

that in his thirty- second year he was appointed State Attorney of the Orange Free State. A few months afterwards he became second puisne judge, and in 1893 first puisne judge of the High Court. His decisions won him a reputation for ability and sound judgment, and in 1895, upon the resig- nation of Mr Keitz, Steyn's position had become strong enough to make him a candidate for the Presidency. He had married, soon after he returned from England, a daughter of the Eev. Colin Eraser, a clergyman of the Dutch Keformed Church. His wife's uncle, Mr J. G. Eraser, was chairman of the Free State Volksraad, and he now became Mr Steyn's principal opponent in the Presidential election. Mr Eraser's sympathies were dis- tinctly British ; he advocated an alliance between the Free State and Great Britain. Mr Steyn was the candi- date of the Dutch party. In 1895 this party was in the as- cendant. At the preliminary ballot Mr Steyn received forty- one votes to Mr Eraser's twenty. Sir Henry de Villiers, Chief Justice of Cape Colony, finding ten supporters, and ilr Hofmeyr, leader of the Dutch party at the Cape, five. The final voting early in 1896 resulted in a decisive victory for Mr Steyn. If there had been any doubt about his success, the Jameson Raid would certainly have turned the scale in his favour. He had been placed in power by the advocates of a Dutch South Africa, and he immediately began to cultivate closer relations with the Transvaal. There already existed between the two re- publics a defensive alliance, which bound each state to assist the other in the event of an unjust attack. being made upon either. Early in 1898 a treaty of closer union was concluded. At the same time steps were taken to strengthen the armaments of the Orange Free State. Yet the sympathies of the Free State burghers were by no means unanimous on the Transvaal side. It may have been the knowledge of this fact, or it may have been a genuine desire for the maintenance of peace, that led President Steyn to propose a conference at Bloemfontein in May 1899 between President Kruger and Sir Alfred (after-\'ards Lord)]Milner, the British High Commissioner. This conference failed to bring about any agreement between Great Britain and the Transvaal; but even after its failure the attitude which the Orange Free State would take up in the event cf war was by no means certain. During the summer of 1899 the two Presidents were in close touch. When it became clear that war could not be avoided, President Steyn made an efi'ort to throw upon Great Britain the responsibility for the calling to arms of the Free State burghers. He urged

the British Government to stop the movements of its troops and to explain its proposals for a settlement, which he professed himself anxious to promote. At last, on 11th October, the day which the Transvaal Govern- ment had named as the latest on which they could accept an answer to its ultimatum, Steyn telegraphed to Sir Alfred Milner that "the high-handed and unjustifiable conduct " of the British Government had determined the Free State to throw in its lot with the Transvaal. Thus the two republics began the war fighting side by side. The early successes of the Boers in Cape Colony enabled President Steyn, who had not in the first instance taken the field himself, to issue proclamations annexing portions of British territory to his own republic. But the tide cf ???war soon turned. After the surrender of Cronje's force

at Paardeberg on 27th February 1900 Bloemfontein was at the mercy of Lord' Roberts. It was occupiied on 13th March, by which date the President had already taken flight. The annexation of the Orange Free State ??? now the Orange River Colony ??? followed on 28th May. During the whole after course of the war Steyn wan- dered about South Africa, carrying on a semblance of government, and on occasion actually taking charge of military operations. More than once he narro\ly escaped capture. He was regarded as one of the most irreconcilable of the Boer leaders, and in August 1901 he justified this view by declaring, with Botha and De Wet, that he intended to carry on the war as long as possible. He took part, however, in the preliminary peace negotiations at Klerksdorp in April 1902, but was prevented by illness from signing the instrument of surrender at Pretoria on 31st May. At that date he was stated to be suffering from locomot(r ataxy, brought on in all probabiHty by his constant exertions and the nervous strain to which he had been subjected by the war. He sailed for Europe in July, and took up his residence in Holland.

Steyr, or Steiee, an industrial town in Upper Austria, on the river Enns, 18 miles S.S.E. of Linz. Population (1890), 21,499; (1900), 17,592, chiefly German and Catholic (estimated to have 5 per cent. Czech and 1 per cent. Protestants and Jews). In addition to its important iron and steel industry, there is a paper manu- factory, together ^\ith cotton-printing, dyeing, bell-found- ing, and brewing industries. The well-known small-arms

factory now produces bicycles, electrical plant, lic, in addition to its staple products.

Stillman, William James (1828-1901),

American painter, journalist, consul, and for many years a special correspondent of The Times, was born at Schenec- tady, New York state, on 1st June 1828. Both his parents were rather remarkable people of Puritan lean- ings. The religion in which the boy was brought up was of a repressive character. It tended to a morbid anxiety of soul rather than to joy and spiritual peace. But it continued to influence Stillman all through his life. He went through various developments of belief, but never lost his firm trust in the help and guidance of a beneficent Ruler of the Universe. He was sent to school in New York, and graduated at Union College, Schenectady. His desire was to be a painter. His family opposed the wish, but he managed to overcome their opposition, and early in 1850 came to England. He made the acquaintance of Ruskin ; was introduced to Turner, for whose works he had unbounded admiration ; and fell so much under the influence of Rossetti and Millais, that on his return home he speedily became known as the "American Pre-Raphaelite." He did not stay at home long. In 1851 Kossuth, the Hungarian patriot, made a tour through the United States. Still- man was one of the young people who were most deeply impressed by his oratory. He at once offered his ser- vices to the cause of Hungarian liberation, and before long his offer was accepted. He was invited to go to Hungary to dig up the Crown jewels, which had been buried secretly during the insurrection of 1848-49. But the fellow-conspirator whom he was to meet at Budapest could not be found. Kossuth had planned the errand in a characteristically casual way, and Stillman returned without the Crown jewels, glad enough to have escaped the active Austrian police. '\^Tiile he was awaiting a projected rising in Milan, Stillman studied art in Paris, and then, since the rising did not take place, he returned to the United States ard once more devoted himself to

landscape painting. He found time not only to play a considerable part in the spiritualist movement, but also to start a journal, called The Crayon, in New York. It numbered Lowell among its contributors, and when it failed for want of funds, Stillman went to live near Lowell at Cambridge, Mass. Here he had also for neigh- bours Emerson, Longfellow, Agassiz, and other famous writers. He induced many of them to join the Adiron- dack Club, which used to make expeditions into the mountains. One such expedition has its record in a poem by Emerson. In this particular excursion Long- fellow refused to take part. He was stUl doubting when he heard that Emerson intended to take a gun. " Then," he said at once, "somebody will be shot," and hesitated no longer. Stillman passed several years at Cambridge in quiet satisfaction with his surroundings, but a fit of restlessness started him oflf once more to England. He begin to paint in London, renewed his friendship with Ruskin, and went with him to Switzerland to paint and draw in the Alps. Here Stillman worked so assiduously that his eyesight was affected. This did not prevent him, however, from undertaking the responsibilities of marriage. He was in Normandy with his wife, a daughter of Dr David Mack of Cambridge, Mass.,' when the American Civil War broke out. He made more than one attempt to serve in the Northern ranks, but his health was too weak. " We have riot seen the enemy yet," said a colonel, to whom he offered himself as a volunteer, " but we have buried all the men like you already." His country, however, found emjjloyment for his services in another direction. In 1861 he was ap- pointed United States consul in Rome. A dispute with his Government soon led to resignation, but shortly afterwards (in 1865) he was appointed to Crete, where he immediately became an avowed champion of the Christians in the island and of Cretan independence. He was naturally regarded with hostility both by the Mussul- man population and by the Turkish authorities, and in September 1868 he found the strain upon his nerves too great to be borne any longer. He resigned and went to Athens, where his first wife died. In 1871 he married again in England, his second wife being a daughter of Mr Spartali, Greek consul- general in London. He had now given up painting and was following the career of a writer for newspapers and magazines. When the in- surrection of 1875 broke out in Herzegovina he went there as a volunteer correspondent of The Times. His letters from the Balkans aroused so much interest that the British Government was induced to lend its counte-

nance to Montenegrin aspirations. The Turks tried to blacken his character, but without success. Mr Glad- stone, who had been inclined to put faith in their fables, was soon convinced of their untruth, and offered Mr Stillman a handsome apology. When the war ended in 1877 Stillman passed some months in Italy before he was appointed correspondent of The Times in Athens. In 1886 he became representative of that journal both in Italy and in Greece, with permanent residence in Rome. From 1890 until]KOS ho was correspondent for Italy alone. He was a severe critic of Italian statesmen, and embroiled himself at various times with various politicians, from Crispi downwards. After his retirement he lived in Surrey, still keeping up a keen interest in all the subjects that had claimed his energies durinji; his long and interesting life. He died on 6th July 1901. Stillman left a number of books, rtcrirding the different phases of his active career and discussing the

(h. h. f.)

Stillwa.ter, a city of Minnesota, U.S.A., capital of Washington county, near the head of St Croix Lake, at. an altitude of 694 feet. It has three railways ??? the Chicago and North- Western ; the Chicago, Milwaukee, and St Paul ; and the Chicago, St Paul, Minneapolis, and Omaha, which, with boats on the river, which is navigable to this point, give it a large trade. The industries are chiefly connected with the lumber trade and manufactures^ It has many large saw, planing, and shingle mills. It contains also flour mills and grain elevators, waggon factories and agricultural implement works. Population (1890), 11,260; (1900), 12,318, of whom 4021 were foreign-born.

Stirling', a royal and parliamentary burgh (Stirling group), important railway centre, and county town of Stirlingshire, Scotland, overlooking the Forth, 36 miles W.N.W. of Edinburgh, and 30 miles N.N.E. of Glasgow by rail. A steamer runs from Leith (45 miles), but the navigation of the river between Alloa and Stirling is almost wholly dependent on the tide. The famous " links of the Forth " occur between the towns named, and make the distance between them almost twice what it is by land. At Causewayhead, about \^ mile from Stirling, rises the Abbey Craig, an outlying spur of the Ochils, upon the summit of which stands the Wallace

Monument, which serves as a landmark for many miles around. Trams connect Stirling and Bridge of Allan. Tweed is no longer manufactured, but industrial features include furniture factories, a cooperage, and large rubber works. The water-supply has been supplemented and electric light introduced. A new post ofiice and free library have been built. The High School has an organized science and art school attached. Population (1891), 16,776; (1901),

18,403.

Stirlingshire, a midland county of Scotland, bounded on the N. by Perth, on the N.E. by Clackmannan and the Firth of Forth, on the S.E. by Linlithgowshire, on the S. by Lanarkshire and a detached portion of Dumbartonshire, and on the S.W. and S. by Dumbarton- shire.

Area and Population. ??? In 1891 the parish of Stirling was placed wholly ill Stirling, and Alva transferred to Clackmannan ; Logie was placed wholly in Stirling, Lecropt wholly in Perth, and Kippen wholly in Stirling. Tlae area is 296,928 acres, or about 466 square miles. The population was, in 1891, 125,608 ; in 1891, oil the above area, 118,021 ; and in 1901 it was 142,338, of whom 72,697 were males and 69,641 females. On the area given above, the number of persons to the square mile in 1901 was 305, and the number of acres to the person 2-8. The following table gives par- ticulars of births, deaths, and marriages : ???

Year.

Deaths.

Marriages.

Births.

Percentage of Illegitimacy.

1880 1890 1899

2076 2386 2369

701

770

1010

4008 3790 4445

6-9

6-31

5-1

The following table gives the birth-rate, death-rate, and marriage- rate per thousand of the population for a series of years : ???

Birth-rate . Death-rate . llarriage-rate

1880.

1881-90.

1890.

1891-98.

1899.

37-87

19-62

6-62

33-57

18-23

6-35

32-06

20-18

6-51

34-42

18-58 6-99

34-52

18-32

7-84

In 1891 thei-e were 1794 Gaelic-speaking persons in the county, and 408 foreigners. Valuation in 1889-90, ►►567,037 ; 1899-1900, ►►623,748.

.-Idmiinstration. ►►► The county returns a member to Parliament. Stirling (18,403) is n royal and parliamentary burgh of the Stirling group, Falkirk (29,'27l) is a parliamentary burgh (Falkirk group), Kilsyth (7331) is a police burgh and burgh of barony, and Bridge of Allan (3240), Denny and Dunipaoe (5158), and Grangemouth

8T0CKBRID GE ►►► STOCKHOLM

863

(7968) are police burghs. Alva and Milngavie were cut off from the county in 1891. Five other towns have more than 2000 inhabitants, and six more over 1000. There are 23 civil parishes, and the number of paupers aud dependents in September 1899 was 2821. Stirlingshire forms a sheriffdom with Dumbarton and Clackmannan, and there are two resident sheriffs-substitute, one at Stirling and one at Falkirk.

Education. ??? Twenty-six school boards manage 78 schools, which had an average attendance of 21,591 in 1898-99, and 12 voluntary schools (8 Roman Catholic and 2 Episcopal) had 1665. There are 2 secondary schools, one at Stirling and the other at Falkirk, and each of these places has a science and art school, while 20 public schools in the county earned grants in 1898 for giving higher education. The county council does little or nothing for technical education, but Stirling and Kilsyth town councils subsidize science and art and manual instruction classes, and Denny and Dunipace supports a mining instruction class.

Agriculture. ??? The percentage of cultivated area in 1898 was 39 '9. Oats are the staple crop, the barley acreage is about a third of that under oats, and some 2000 acres are under wheat. Of the 1545 holdings in 1895 the average size was 77 acres. The per- centage under 5 acres was 14 '95, between 5 and 50 acres 33'01, and over 50 acres 52'04. The number of farms between 50 and 100 acres was 370, between 100 and 300, 393, between 300 and 500, 35, and over 500 acres, 6. The following table gives the principal acreages at intervals of five years from 1885 : ???

Year.

Area under Crops.

Corn Crops.

29,031 27,324 26,780 25,819

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1885 1890 1895 1899

115,058 119,138 118,794 118,676

8708 8434 8732 8071

28,206 36,531 32,671 31,541

47,702 45,106 49,362 52,017

1400 1630 1111 1087

The following table gives particulars of the live-stock during the same years : ???

Year.

Total; Horses.

Total Cattle.

Cows or

Heifers in

Milk or Calf.

Sheep.

Pigs.

1885 1890 1895 1899

4541 4635 6173 4772

31,275 31,106 32,889 33,902

10,966 11,074 11,744 12,181

115,766 120,531 128,734 122,584

1975 2188 2677 2096

At the census of 1891 the number of persons returned as being engaged in agriculture was 3983 men and 774 women. There were 14,920 acres under wood in 1895, of which 693 had been planted since 1881.

Industries and Trade. ??? Coal-mining is the staple industry. The following table shows the output of minerals in 1890 and 1899 : ???

Year.

Coal.

Iron Ore.

Sandstone.

Fire-clay. 1

Tons.

Value.

Tons.

Value.

Tons.

Value.

Tons.

Value.

1890 1899

1,498,086 2,269,992

??536,549 ??880,661

38,283 3,012

22,910 1,129

52,‘376

12.‘rOT

54,449 79,992

9,551 11,999

There were also obtained in 1899, 19,518 tons of limestone valued at 3904, and 2288 tons of oil-shale valued at 672. Falkirk is the headquarters of the light lounding industry, which developed largely during the last quarter of the^ 19th century ; chemical works, woollen manufacture, calico-printing and bleaching are also important. The industrial population numbered, in 1891, 26,244 men and 5664 women, of whom 13.191 men and 237 women were engaged in the working of minerals, and 1666 men and 1862 women in textiles. About 30 miles were added to the railway mileage of the county during the period 1875-1900.

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StOCkbridge, a town of Berkshire county, Massachusetts, U.S.A. It comprises an area of 24 square miles of picturesque valley and hill country, situated in the western part of the state. The principal village bears the same name as the town, and is situated on the river Housatonic, and on a branch of the New York, New Haven, and Hartford Eailroad. Stockbridge is well known as a place of summer resort for New York people, whose country houses are scattered through it. Population (1880), 2357; (1890), 2132; (1900),

2081.

StOCkera.U, a market town in the government district of Korneuburg, Lower Austria, situated on an arm of the Danube and on the North-Western Railway, about 16 miles from Vienna. It is one of the largest of the Austrian corn-markets, and has a considerable trade in timber. Soap, candles, perfumery, felt goods, &c., are manufactured. Population (1890), with incorporated village of Grafendorf, 8393 ; (1900), 10,213.

Stockholm, the capital of Sweden, beautifully situ- ated, in part on a cluster of islands, between the eastern extremity of Lake Malar and the Saltsjo, an inlet of the Baltic (40 miles long, thickly studded with rocky, wooded islands), in 59 20′ 34″ N. and 18 3′ 32″ E. Stockholm is traversed from south to north by the main railway line from Malmo to the north and west of Sweden, which has a commodious and handsome station on the Wasagatan. With this are linked three local lines. There is also a well-arranged tramway system. Since 1875 the city has grown with much rapidity, the expansion being greatest on the northern outskirts, that is, beyond Norrmalm. But the population has since 1895 increased faster than the city has expanded, and the want of houses, more particularly smaller houses at moderate rentals, became very acute in 1897, and continued to be so on to 1902. Population (1880), 168,775; (1890), 246,454; (1900), 300,624. The death-rate diminished from 25-7 per 1000 for the quinquennial period 1876-80 to 19‘5 in 1891-95. On the island of the Holy Spirit (Helgeands- holm) there are new Houses of Parliament and premises for the Bank of Sweden. On Riddarholm there were built, in 1887-90, fine archives offices; and in the yard of the palace of nobility (Riddarliunt) a statue to the Swedish chancellor. Axel

Oxenstjerna, by Borjeson, was unveiled (1890). In front of the church of St Nicholas' there was unveiled, in 1898, a statue to Olaus Petri, the reformer, by Lundberg. The exterior of the royal palace was restored, 1898-1901, and many ornamental details, planned by the architect, were executed by the muni- ficence of King Oscar II. ; what was formerly the royal library in the north-east wing of the palace is now the royal armoury, conta,ining among other objects the relics of Sweden's most famous kings, Gustavus Adolphus and Charles XII. The principal modern edifices in the Norr- malm quarter are the opera house (1891-98), the academy of fine arts (1897), and the church of St John's (1890). In this quarter two parks have been opened ??? Vanadis Park in 1886-96 and Tegner Park in 1891-93 ; and a statue to Nils Ericsson, the railway engineer, by Borjeson, was unveiled in 1893. To the east of Norrmalm stretches the handsome residential quarter of Ostermalm, with fine promenades and broad boulevards, where have been built large barracks (1888, 1890, and 1897) for the Swedish Guards Corps. Monuments to Linn??us (1885) and Seheele (1892) have been .set up in Humle-g.lrden (the Hop Garden). In 1897 the royal library pos- sessed some 300,000 volumes, 10,000 MSS., and 14,000 portfolios of pamphlets, ic. The peninsula of Blasie- holm, which juts out south-east from Norrmalm, contains

several palace-like private houses. Various hospitals, asylums, and barracks have been erected on Kungsholm (King's Island) to the west of Norrmalm. The Caroline medical institute (1815), which (since 1874) has the same rights as the universities to hold medical examinations and to confer the degree of M.D., had about 40 instructors and 282 students in 1899. In Sodermalm, which rises to 184 feet above sea-level, there are, it should be men- tioned, St Catherine's church (1656 ; restored 1891). In the same quarter there are the Roman Catholic chapel of St Erik (1892) and two parks ??? Tanto (1885-96) and White Hill (1895-96). On Djurgftrden (the Deer Park), the playground and favourite summer resort of the Stockholm people, great alterations have been made. In 1893 a

biological museum was built; in 1897 a bridge to connect the island vidth Ostermalm ; and in 1898-99 a beginning was made with an imposing pile destined to contain the northern (Scandinavian) museum, collected mainly through the instrumentality of Dr A. Hazelius. In 1891 there was organized within the enclosure of Skansen (the Redoubt) the open-air historical museum of Swedish life, which serves to illustrate the collections of the northern museum. On this same island (Djurgftrden) are a deaf and dumb asylum, several restaurants and theatres, and a bust of Bellman, whose day (26th July) is celebrated annually with great fes- tivities. Education stands at a high level in Stockholm, the city being exceptionally well endowed with academies, museums, and other adjuncts of higher culture. In 1897 there were 61 '8 telephones for every 1000 inhabitants, as compared with 40'1 in Christiania, 37 1 at Helsingfors, and 2 '3 in London. The industries of Stockholm are, generally speaking, of a miscellaneous character. It has no staples, like Norrkoping or Jonkoping. The most important are those producing commodities for human consumption, and next after them, iron and steel in- dustries. Altogether, in point of value of output, Stockholm is accredited with 25 per cent, of the in- dustry of all Sweden. In 1896 she had a total of 606 factories, employing 21,400 workpeople, with output valued at ►►4,711,000; as compared with 275 factories, 9810 workpeople, and ►►1,797,500 output in 1884. Stockholm is the first import town in Sweden, but with regard to exports she is surpassed by both Gothenburg and ilalmd. During 1891-94 inclusive lier imports averaged ►►5,821,600 and her exports ►►1,343,300 per annum; but in 1897 the imports were ►►6,805,600, or 30 per cent, of the total imports of the kingdom, and the exports ►►1,783,300, or only about 9 per cent. In 1900 the port was entered by 2255 vessels of 964,367 tons, of which 459 of 428,292 tons were British, as compared with 1746 vessels of 611,650 tons (241 of 178,500 tons British) in 1888. In 1899 Stockholm owned a mercantile navy of 205 vessels of 70,870 tons, ranking in this respect next after Gothenburg. There are three navigable approaches to the city through the SkargArd ►►► (i.) the northern, vid Furusund, 75 miles from the Baltic; (ii.) the eastern, vicl Sandhamn, 40 miles; and (iii.) the southern, vid Landsort, 87 miles. From 1885 to 1890 inclusive the port was closed by ice on an axcrage 81 days in the year, but during the period 1890-95 the average was only 25 days. Since 1896 an ire-breaker of 1000

horse-power has been employed to keep the approaches and the harbour open in winter. With the view of still further facilitating the commerce of the port, large quantities of iron, timber, and coal have since 1H79-86 been shi})ped and un- shipped at the new out-port of Viirtan, immediately north- east of the city, where there is a harbour, 14 acres in extent, with 6340 feet length of quayage. In Stockholm itself the depth beside the larger quays is 20 feet at low

water, beside the smaller quays, 1 2 feet ; the general depth of the harbour and waterways being elsewhere 100 to 105 feet, except in Norrstrom (the connexion vnth. Lake Malar), where it is only 7^ feet. Mean temperature of Stockholm (1859-94), 41-7 Fahr. ; January, 26-6; July, 61-5. Rainfall (1860-94), 17 inches ; snow falls on an average on 58 days in the year.

AuTHOKiTiBS. Of the more recent books upon Stockholm, the first place belongs to the profusely illustrated work, written by a number of authorities, edited by B. W. Dahlgren, and published under the auspices of the city executive, Stockholm, Sveriges Hufvudatad, 3 vols. (1897). See also A. Stkindbekg and C. J. LUNDIN", Gamla Stockholm (1882) ; and C. J. LuNDiN, Kya Stock- holm (1887-90) ; G. Nokdensvan, Malarens DroUmng (1896-97) ; Urkuiider till Stockholm^ historia, ed. by Karl Hildebrand (1900) ; Berdttelser angacnde Stockholms kommunal – fbrvaltning (annual reports s.nce 1868) ; and K. Ket-Aeekg, Af Stockholms Stadsfull- maktige beslutad Unders6kningafArbetarnesBosladsforliAlla7xdeni Stockholm (1897). (j. T. Be.)

Stock Ma.rketS> Since the ninth edition of the Encyclopaedia Britannica was published the volume of transactions in interest-bearing securities has grown enormously in all the great cities of the world. In London the membership of the Stock Exchange, the number of securities quoted in the Official List, and the number of securities dealt in, have expanded greatly, and the markets in New York and Paris, espe- cially the former, have acquired enhanced importance. The Berlin Bourse, the business of which was steadily growing during the 'eighties and early 'nineties, was checked in its expansion after 1896 by drastic legislation

passed in July of that year against bargains for future delivery, and the business of German speculators was being done (1896-1902) in other exchanges, especially London, Amsterdam, and Brussels. Telegrajshic com- munication between the various great cities of the world is much closer than it was in 1885, what is known as arbitrage business having attained very large pro- portions. This class of business consists in watching closely the fluctuations in certain securities which are dealt in in two big markets, and simultaneously selling in one and buying in the other when opportunity offers. Previous to 1884 and 1885 it was chiefly confined to operations between London and Paris, the difference in the times of Loudon and New York having up till then prevented the growth of a similar business between those cities, as New York morning prices do not reach London till about 3.30 p.m., and the London Stock Exchange is shut at 4 P.M. But in London, about the middle of the 'eighties, the practice of staying in " the street," after the Stock Exchange was shut, to deal in " Americans " began to become common, though many old-fashioned brokers who were rich enough not to be eager to make more money set their faces against it. It is worth noting that in most of the foreign cities there has always been more disposition to stay late than in London, where it was formerly the rule to cease business definitely at a more or less fixed hour. Since 1885 there has been more laxity in this respect, but it is not even yet the practice to do business in the evening. In Paris, dealing " on the Boulevard " goes on intermittently in summer as late as 9 P.M. when trade is active.

London. ??? The value of the securities quoted in the Official List of the Stock Exchange, deducting foreign stocks (coupons payable abroad), the exact amounts of \yhich are not ascertainable, was ^t"stock on 31st December 1891 ??4,562,438,154; at Bxcbange the end of 1901 it was ??6,795,548,291. The business List itself has been increased in size several '" ^??'"'??"- times. It formerly consisted of four pages, and in 1902 sixteen. The first great expansion in the- number of

securities took place in the years 1888-90, when, following the example of Messrs Guinness, many brewery and other firms turned themselves into limited liability companies. During the 'nineties the conversion of private concerns into companies proceeded at an ever-increasing pace, attaining its maximum in the year 1896, vi'hen 309 millions of capital of all kinds were registered. The greatest single year on record was, however, 1888, when 353 millions of capital was registered.

*The market for mining shares had, up to about 1888, held a very small place in the business of the Stock Exchange, but the discovery of an extensive ^^"i gold-field on the Witwatersrand in the Transvaal wining *^ – – market. produced a great change. At first, although the transactions in the new group of securities were very large, and enormous sums of money were won and lost in them, the "KafFre circus," as it was called, was regarded with contempt by the older habitues of the Stock Exchange, and it was not until the winter of 1894-1895, when the number of brokers engaged in the new market had become greater than those in any other, that special recognition was given to the mining department, by a rule that the arrangements for carrying over bargains in mining shares should begin the day before the regular settlement commenced (see Account). Even with these new facilities the*

Stock Exchange Clearing House found it diffi- cult to cope with the huge mass of work thrown on it in 1 895, and once or twice it broke down temporarily. Much of the trouble to all concerned arose from the fact that mining shares, like nearly all securities dealt in in London, were "registered" and not "to bearer." The offices of the companies were naturally not equipped with the staffs that would have enabled them to furnish certificates promptly in the enormous quantities unexpectedly re- quired : it must be remembered that the preparation of a certificate for 50 or 100 shares of ►►1 each is just as troublesome as the preparation of one for 500 or 1000. The new feature, which upset all calculations, was the extraordinary number of small speculative investors who bought and paid for their shares, very often to their subsequent regret. If the shares had been "to bearer," the work could have been done with comparative ease.

Another remarkable feature of the "boom," to use the slang which came into general use during the great specu- ►►►. . lative mania for South African shares in 1895,

shares not was the fact that of the 200 or 300 shares dealt quoted in, less than a dozen were officially quoted. As officially. ^ Yole no quotation was asked for, though a "special settlement" was obtained. Most of the com- panies concerned had been registered under the laws of the then existing South African Kepublic. After the Jameson Raid business in the South African market slackened somewhat, and there were few new " Kaffre " companies introduced; but the volume of mining transactions was kept up by the discovery of the Coolgardie gold-fields of West Austraha, which led to the creation of a great number of companies, whose shares were "introduced" in London from 1895 onwards. Very few of these also were, or are, quoted in the Official List. A minor "boom" occurred in the winter of 1900-1901 in AVest African shares, but although it created a good deal of noise, it was not to be compared in magnitude to the South African and West Australian movements. The West African gold-fields are expected by the best authori- ties to be very productive eventually, but are at present at an early stage of development and receive little attention, partly because the market was " manipulated " and a certain number of people lost money when they expected to gain it.

The American department of the Stock Exchange has diminished considerably in importance since 1885, owing chiefly to the great distrust which the silver policy of the United States, not finally aban- ‘”’‘7”’” doned until 1893, created. This policy and the Venezuela Message of President Cleveland in Decem- ber 1895 caused British holders to sell steadily. On the other hand, the United States continued to grow in wealth, and the American people bought back from Europe enormous masses of American railway bonds and shares. The London Stock Exchange took comiiaratively little part in the wonderful upward movement in American prices which began in 1897 and, after two partial checks, was still proceeding in 1902. The second check took place in May 1901, when two great^oups of American railroad magnates unintentionally produced a “corner” (see Maekets) in Northern Pacific Eailroad shares. The American public took fright at this apparent evidence of the recommencement of hostilities between great financiers who were believed to have ” buried the hatchet ” ; the dispute, however, was soon arranged, as the two parties had no desire to fight, but the public was only beginning to recover its confidence more than a year afterwards. The ” corner ” in Northern Pacific common shares produced one remarkable result in L(jndon, namely, the suspension for two or three weeks of the ” buying in ” rule : if that rule had been enforced against people who were, in most cases, involuntary ” bears ” of Northern Pacific, several leading firms of brokers would have been ruined.

Since the conversion of the British 3 per cents, in 1888, and creation of local loans stock (to provide^ money to be lent by the Public Works L^ian Commissioners to local authorities), no important Oovem- addition to the list of high-class investment ggcuritles. securities was made until 1900, when the Boer war necessitated special finance, consisting in the creation and issue of the national war loan for 30 millions (1900), 92 millions of Consols, in two issues, of 60 millions (April 1901) and 32 millions (April 1902); there were also minor issues of three and five year Exchequer bonds and Treasury bills. These issues of Consols greatly broadened the market for them, which for many years after the con- version of 1888 had been very narrow, owing to a large proportion of the total being in the hands of Government departments. The Government’s borrowing operations were sufficiently big to reduce the value of the whole mass of

Stock Exchange securities, except Canadian and American railway issues, which increased in value owing to causes peculiarly affecting them, and certain securities which were also influenced by special forces, such as Argentine, Spanish, and other foreign bonds. The interest taken by British investors and speculators in foreign Government bonds generally has decreased considerably, and, on the other hand, foreign speculators, and to some extent foreign investors, have operated more freely on the London Stock Exchange. The smooth working of the finance of the Boer war was greatly facili- tated by the employment of the funds of French financial institutions in British Treasury biUs and Exchequer bonds, and to some extent in Consols.

Various minor alterations in the working of the Stock Exchange occurred between 1888 and 1902. Telephonic communication has become much more general, and extends over longer distances ; for instance, ”””” conversations between men in Paris and London are daily incidents of the business of many firms. The relations between the Stock Exchange and the money market have become closer : banks lend more freely than they used to, on a wider range of securities ; but they also

lend more often direct to tiie holder of the securities borrowed on, and not through a member of the Stock Exchange. Formerly the usual practice of those banks which had considerable business with the Stock Exchange was to lend large sums on high-class stocks to wealthy brokers,^ who employed the money inside the ” House ” in carrying over the accounts of their clients, or to other brokers whom they trusted. This class of business is still very large, but wealthy clients are not now always satis- fied to borrow through their brokers ; they not unfre- quently go direct to banks and borrow from them. This practice has its inconveniences : formerly it was possible for the jobbers in aU important markets on the Stock Exchange to form a good idea, by comparing notes in each settlement, of what the condition of the speculative account really was, but it is less easy

to do so now, because so much stock is " pawned " with banks that the conclusions arrived at by the jobbers from examining only what they are carrying over themselves are liable to be falsified through finding (a) that the account is either lighter than they expected, stock having been taken off the market tem- porarily by banks ; or (b) that it is much heavier than they were prepared for, the banks having suddenly refused to lend any longer on a mass of stock they had hitherto been carrying. Banks are apt to be more capricious in their action as regards this class of business than the big "money brokers"; they cannot so well feel the pulse of the market, and are therefore liable to sudden fits of alarm, and also to hurried changes of policy on the part of their boards, which may be, and usually are, based on sound principles, but are not unfrequently carried out , without sufficient regard to the circumstances existing at the moment chosen for putting them in practice.

Paris. ??? The Paris Bourse is an institution of enormous strength, but it plays a smaller part in international busi- ness than might be expected, owing to the deep-rooted conservatism and caution of the French people in money matters. It is true that they are liable to occasional outbursts of imprudence, such as led to the loss of great sums in the Panama Canal Company ; but, as a rule, it is difficult to induce the average Frenchman to place his money in anything which he does not think a safe interest- yielding security under French law : he almost always wants to invest, not to speculate. In Great Britain and America the distinction between the two is too fre- quently forgotten. Since the Panama collapse in 1894 the French investor ??? that is, the bulk of the French nation ??? has been very prudent. The French have gone on saving money, and have been very difficult to satisfy in the matter of the securities ofi'ered to them. Appeals to patriotism have drawn from some French capitalists a considerable amount of money from time to time for Russian Government loans, but these appeals were backed by assurances given by large banking institutions like the Credit Lyonnais, the Comptoir d'Escompte, and the Soci^t^ G^n^rale, in addition to the Bank of France, that the interest was secure. As a rule, however, invest- ments outside France are not popular with the French peasantry and middle classes ; but there has always been a minority who were ready to speculate from time to time, besides the body of professional operators on

the Bourse. The dimensions of this minority increased during the last eight or ten years of the 19th century, owing to the attractions presented by the South African gold-fields. Operators and speculative investors in France were large holders of South African mining shares when the Boer war broke out in 1899, and though they sold them freely in consequence of the war, they did so with the intention of " coming in " again, and on more than one occasion made tentative purchases. The great banking firms and

institutions of Paris have been occupied a good deal vpith the finances of Spain, Portugal, Turkey, and other minor countries, and last, but not least, they were large purchasers of British Treasury biUs, which dur- ing the first two years of the war afforded an extra- ordinary opportunity to the investor, it being possible to buy them at prices yielding a rate equal to 3| per cent, per annum during the currency of the bills.

JVew York. ??? The movements on the New York Stock Exchange during the last ten or twelve years of the 19th century were so gigantic and surprising, that it is difficult to realize their meaning. Naturally the earlier events of the period are comprehensible to some extent : the collapse of prices in 1893, owing chiefly to the prolonged resistance of the Senate to the repeal of the Sherman Silver Act of 1890 ; the semi-panic of December 1895, caused by the Venezuela Message of President Cleveland; the partial revival in 1897 and relapse in 1898, owing to the war with Spain. Opinions as to the real character of the colossal upward movement which began in the autumn of 1900 differ. Certain things, however, are worth mentioning : (a) that the United States is now the largest holder of its own shares as well as bonds ; (b) that the position is much complicated by the growth of gigantic industrial combinations (see Trusts), which, according to some of the best judges, are over- capitalized ; (c) that although the United States has bought back such huge quantities of American shares and bonds from Europe, and has " participated " in various loan operations in Europe, including the issues of Consols, there is very strong evidence that this has been done in part by borrowing largely in Europe " on short term," and by selling the securities, taken up in Europe soon after their issue, or "pawning" them. It was difficult to accoimt in any other way for the movements of gold

from New York to Europe which took place from time to time in 1901-02. (w. Ho.)

Stockport, a market town, municipal, county (1888), and parliamentary borough, mainly in Cheshire but partly in Lancashire, where is part of the suburb of Heaton Norris, 6 miles from Manchester, with which it is connected by railway and tramway. The site of the town is hilly, and it stands on the Mersey where the Tame and Goyt join. The area of the county borough is 2200 acres ; its rateable value is ££286,655 ; and the population at the census of 1891 was 70,263, and at that of 1901, 78,871. Stockport is a town of varied industries, but the most important are the woollen manufacture and hat making. It was enfranchised under the Eeform Act of 1832, and its most distinguished re[iresentative was Richard Cobden, of wliom the town has a statue. As a municipal borough it dates from 1835, and the cor- poration control the gas and water supply. From the gas-works there is an annual profit of about ££10,000. The penny-in-the-slot system is increasingly used. The market rights were bought from Lord Vernon in 1847 for ££22,500. By this arrangement the corporation secured the site of the present Vernon Park, in which stands a museum presented by Mr James Kershaw, M.P., and Mr John Benjamin Smith, M.P. There are six other parks and recreation grounds. A free library was opened in 1875. In 1889 Stockport became a county borough. The municipal authorities maintain a technical and art school. The architect was Mr G. Sedger, and the cost ££20,000. Of this ££5000 was given by the Whitworth legatees, who also gave ££5000 for scholarships. There are also public baths, &c. A characteristic institution is the Stockport Sunday school, which dates from 1784, and is the largest in England. The mother church of St

Mary's was restored in 1882. The registers date from 1584. The borough contains various other Anglican, Eoman Catholic, and Nonconformist places of worship. Stockport has a grammar school founded in 1487 by

Sir Edmond Shaa, Lord Mayor of London. There are also many charitable and other public institutions.

Authorities. ††† Edward Hull and A. H. Green. Geology of the Country rownd Stockport, &c. (Geological Survey, 1866). ††† ††† Henry Hbginbotham. Stockport, Ancient and Modem, 2 vols, folio. London, 1882. ††† Alfred Burton. Annals of Stockport (part of the Burton MSS. in the Manchester Free Library). ††† George Ormerod. History of Cheshire, by Helaby. London, 1878-79. ††† J. P. Earwaker. JUast Cheshire. London, 1877-80.

Stockton, a city of California, U.S.A., the capital of San Joaquin county. It is situated in 37†† 57′ N. and 121†† 15′ W., on the Stockton slough of the San Joaquin river, and on the San Francisco and San Joaquin Valley, and on branches of the Southern Pacific Railroad, in the central part of the state. It has a perfectly level site and a regular plan, with broad streets, a water- supply from artesian wells, good sewerage, and natural gas. It is in the midst of the great valley of California, the granary of the Pacific coast, and is one of the largest grain markets of the West. It has extensive manufactures of flour, lumber, agricultural implements, and other articles. Population (1890), 14,424; (1900), 17,506, of whom 4057 were foreign-born and 846 coloured, including 213 negroes.

Stockton-on-Tees, a municipal and parlia- mentary borough, seaport, and market town, Durham, England, 20 miles south-south-east of Durham by raU. The iron bridge which spans the Tees and connects the town with Thornaby was erected at a cost of about ††65,000. The corporation baths and wash-houses have been reconstructed. The improvement of the port of Stockton has cost over ††200,000, of which the Government has advanced ††80,000 on loan to the commissioners. The construction of the North Gare breakwater on the Durham side has been in progress about ten years. Vessels drawing 20 feet come lip to the town at high-water spring tides. In 1901, 571 vessels entered with 208,131 tons, and 618 cleared with 231,048 tons. The registered shipping consisted of 30 vessels of 22,164 tons. In 1900 the total value of imports was ††280,371, and of exports, ††435,439. There is a well-known

racecourse in the vicinity of the town. Ropner Park was opened in 1893. The population of the municipal borough was in 1891, 49,708; in 1901, 51,476 : of the parliamentary borough (which includes Thornaby) in 1891, 68,875; in 1901, 71,812.

Stoke-on-Trent, a parish, municipal and par- liamentary borough, and market town of Staffordshire, England, 17 miles N. by E. of Stafford. Four large firms manufacturing every variety of art china and earthenware alone employ over 5000 hands. Coal mining and iron and machine manufactures are also carried on. Area of municipal borough, 1882 acres. Population (1891),

24,027; (1901), 30,458.

Stokes, Sir Georg-e Gabriel, Baet. (1819-

-), British mathematician and physicist, was the

youngest son of the Rev. Gabriel Stokes, rector of Skreen, CO. Sligo, where he was born on the 13th of August 1819. After attending Dr "Wahl's school in Dublin and Bristol College, he matriculated in 1837 at Pembroke College, Cambridge, where four years later, on graduating as senior wrangler and first Smith's prizeman, he was elected to a fellowship. This he had to vacate by the statutes of that society when he married in 1857, but twelve years later, under new statutes, he was re-elected, and retained his place on the foundation until 1902, when, on the day

before he entered on his eighty-fourth year, he was elected to the mastership. In 1849 he was appointed to the Lucasian professorship of mathematics in the University, and on the 1st of June 1899 the jubilee of his appoint- ment was celebrated at Cambridge in a brilliant cere- monial, which was attended by numerous delegates from European and American universities. On that occasion a commemorative gold medal was presented to him by the Chancellor of the University, and marble busts of him by Hamo Thornycroft were formally offered to Pembroke College and to the University by Lord Kelvin. Sir George Stokes, who was created a baronet in 1889, further served his University by representing it in

Parliament from 1887 to 1892. During a portion of this period (1885-90) he was president of the Royal Society, of which he had been one of the secretaries since 1854, and thus, being at the same time Lucasian professor, he united in himself three offices which had only once before been held by one man. Sir Isaac Newton, who, however, did not hold all three simultaneously.

Stokes was the oldest of the trio of natural philosophers, Clerk-Maxwell and Lord Kelvin being the other two, who especially contributed to the fame of the Cambridge school of mathematical physics in the latter part of the 19 th century. His original work began about 1840, and from that date onwards the great extent of his output was only less remarkable than the brilliance of its quality. The Royal Society's catalogue of scientific papers, which does not extend beyond 1883, gives the titles of over a hundred memoirs by him published down to that year. Some of these are only brief notes, others are short controversial or corrective statements, but many are really long and elaborate treatises, as may be judged from the fact that his scientific writings for the eleven years 1842-52 (all that up to 1902 had appeared in a collected form) alone fill three volumes, the smallest of which contains 326 pages and the largest 413. In matter his work is distinguished by a certain definiteness and finality, and even of problems that when he attacked them were scarcely thought amenable to mathematical analysis, he has in many cases given solutions which once and for all settle the main principles. This result must be ascribed to his extra- ordinary combination of mathematical power with experi- mental skill, for with him, from the time when about 1840 he fitted up some simple physical apparatus in his rooms in Pembroke College, mathematics and experiment have ever gone hand in hand, aiding and checking each other. In scope his work covers a ???vdde range of physical inquiry, but, as Cornu remarked in his Rede lecture of 1899, the greater part of it is concerned with waves and the transformations imposed on them during their passage through various media. His first published papers, which appeared in 1842 and 1843, were on the steady motion of incompressible fluids and some cases of fluid motion ; this was followed in 1845 by one on the friction of fluids in motion and the equilibrium and motion of elastic solids, and in 1850 by another on the effects of the internal fric- tion of fluids on the motion of pendulums. To

the theory of sound he made several contributions, including a dis- cussion of the effect of wind on the intensity of sound and an explanation of how the intensity is influenced by the nature of the gas in which the sound is produced. These inquiries together put the science of hydrodynamics on a new footing, and provided a key not only to the explana- tion of many natural phenomena, such as the suspension of clouds in air, and the subsidence of ripples and waves in water, but also to the solution of practical problems, such as the flow of water in rivers and channels, and the skin resistance of ships. But perhaps his best known researches are those which deal with the undulatory theory

of light. Their significance and importance may be gauged by a reference to the article Wave Theory in vol. xxiv. of this Encyclopaidia, where Stokes's authority is re- peatedly appealed to. His optical ~~*nork began at an early period in his scientific career. His first papers, en the aberration of light, appeared in 1845 and 1846, and were followed in 1848 by one on the theory of certain bands seen in the spectrum. In 1849 he published a long paper on the dynamical theory of diffraction, in which he showed that the plane of polarization must be perpendicular to the direction of vibration. Two years later he discussed the colours of thick plates ; and in 1852, in his famous paper on the change of refrangibility of light, he described the phenomenon of fluorescence, as exhibited by fluorspar and uranium glass, materials which he viewed as having the power to convert in*~~ *visible ultra-violet rays into rays of lower periods which are visible. A mechanical model, illustrating the dy- namical principle of Stokes's explanation, was shown in 1883, during a lecture at the Royal Institution, by Lord Kelvin, who said he had heard an account of it from Stokes many years before, and had repeatedly but vainly begged him to pub- lish it. In the same year, 1852, there appeared the paper on the composition and resolution of streams of polarized light from different sources, and in 1853 an in- vestigation of the metallic reflection exhibited by cer- tain non-metallic substances. About 1860 he was engaged in an inquiry on the inten- sity of light reflected from, or transmitted through, a pile of plates;*

and in 1862 he prepared for the British As- sociation a valuable report on double refraction, which marks a period in the history

of the subject in England. A paper on the long spectrum of the electric light bears the same date, and was followed by an inquiry into the absorption spectrum of blood. The discrimination of organic bodies by their optical properties was treated in 1864 ; and later, in conjunction with the Rev. W. Vernon Harcourt, he investigated the relation between the chemical constitution and the optical pro- perties of various glasses, with reference to tlie conditions of transparency and the improvement of achroniiitic telescopes. A still later pajier connected with the re in- struction of optical instruments discussed the theoretical limits to the aperture of microscopical obji.'eti-\(^s. In other departments of physics may be mentioned his paper on the conduction of heat in crystals (1851), and his inquiries in connexion with the radiometer ; his explana- tion of the light border frequently noticed in photographs just outside the outline of a dark body seen against the sky (1883) ; and, still later, his theory of the" Rontgen rays, which he suggested might be transverse waves travelling as innumerable solitary A\aves, not in regular trains. Two long papers puljlished in 1849 ??? one on

Sir g, g. Stokes, Bart. (From a photograph by Elliott and Fry, London.)

attractions and Clairaut's theorem, and the other on the variation of gravity at the surface of tlie earth ??? also demand notice, as also do his mathematical memoirs on the critical values of the sums of periodic series (1847) and on the numerical calculation of a class of definite integrals and infinite series (1850), and his discussion of a differential equation relating to the breaking of railway bridges (1849).

But large as is the tale of Stokes's published work, it by no means represents the whole of his services in the advancement of science. Many of his discoveries have not been published, cr at least have only been touched uptn in the c(urse of his oral lectures. An excellent instance is afforded by his work in the theory of spectrum

analysis. In his presidential address to the British As- sociation in 1871, Lord Kelvin (Sir William Thom- son, as he was then) stated his belief that

the applica- tion of the jJrismatic analysis of light to solar and stellar chemistry had never been suggested directly or indi- rectly by any other savant when Stokes taught it to him in Cambridge some time prior to the summer of 1652, and he set forth the conclu- sions, theoretical and practi- cal, which he learnt from Stokes at that time, and which he afterwards gave re- gularly in his public lectures at Glasgow. These statt- ments, containing as they do the physical basis on which spectrum analysis rests, and the mode in which it is ap- plicable to the identification of substances existirg in the sun and stars, make it ap- pear that Stukes anticipated Kirchhoff by at least seven or eight years. Stokes, how- ever, in a letter published some years after the delivery of this address, stated that he had failed to take one essen- tial step in the argument (not perceiving that emission of light of definite refrangibility not merely permitted, but necessitated, absorption of light of the same refrangibility), and modestly disclaimed "any part of Kirclihoff's admir- able discovery," addiig that he felt some of his friends had bren over-zealous in his cause. It must be said, however, that English men of science have not accepted this disclaimer in all its fulness, ard still attribute to Stokes the credit of having first enunciated the funda- mental principles of spectrum analysis. In another way, too, Stokes did much for the progress of mathematical physics. S(on after he was elected to the Lucasian chair lie announced that he regarded it as part of his professorial duties to help any member of the University in difficulties ho might encounter in his mathematical studies, and the assistance rerdercd was so real that piupils were glad to consult him, e'on after they had become colleagues, on mathematical and physical problems in which they found themselves at a loss. Then during the thirty years he acted as secretary of the Royal Society he exercised an enormous if inconspicuous influence on the advancement

of mathematical and physical science, not only directly by his own investigations, but indirectly by suggesting problems for inquiry and inciting men to attack them, and by his unfailing readiness to give encouragement and help.

Several of the honours enjoyed by Sir George Stokes have already been enumerated. In addition, it may be mentioned that from the Eoyal Society, of which he became a fellow in 1851, he received the Rumford medal in 1852 in recognition of his inquiries into the refrangi- bility of light, and later, in 1893, the Copley medal. In 1869 he presided over the Exeter meeting of the British Association. From 1883 to 1885 "he was Burnett lecturer at Aberdeen, his lectures on Light, which were published in 1887, dealing with its nature, its use as a means of investigation, and it.s beneficial effects. In 1891, as Giflford lecturer, he published a volume on Natural Theology. His academical distinctions included honorary degrees from many universities, together with the knighthood of the Prussian Order Pour le Merite.

Stone, Edward James (1831-1897), British

astronomer, was born in London on 28th February 1831. He was educated at the City of London School and at King's College, London, and in 1856 he obtained a scholarship at Queen's College, Cambridge, where he graduated as fifth wrangler in 1859, and was imme- diately elected fellow of his college. The following year he succeeded the Rev. R. Main as chief assistant at the Royal Observatory, Greenwich. The question most prominently before the attention of astronomers at that time was the determination of the exact value of the sun's mean parallax. Up to about the year 1854 astronomers had been inclined to adopt as final the value (8'57") found by Encke from the transits of Venus of 1761 and 1769. It had, however, been shown by Hansen in 185-4 and Le Verrier in 1861 that this value was probably too small by about one-thirtieth part. From a discussion of the observations of Mars made in 1860 and 1862 at Greenwich and Williamstown (near Melbourne), Stone deduced a value of 8-932" {Mon. Not. ofB.A.S., vol. xxiii. p. 183), and in a further investigation, in which he included the olaservations made in 1862 at the Cape of Good Hope, he obtained 8-945" (J/em.qfi?.^.;S'., vol. xxxiii.). The evidence thus afforded in favour of the larger value led him to undertake a fresh discussion of the observations of the transit of Venus of 1769, from which he deduced the value 8-91" {Mon. Not. of E.A.S., vol. xxviii. p. 255). In 1865 he contributed a memoir to the B.A.S. on the constant of lunar parallax. He also determined the mass of the moon, and

from a discussion of the Greenwich transit circle observations between 1851 and 1865 he found for the constant of nutation the value 9-134". Nor were his labours confined to one branch of astronomy only. From 1866 to 1870 he was secretary of the Royal Astronomical Society, and many important papers from his pen appeared in its publications during that period. On the resignation of Sir Thomas Maclear in 1870 he was appointed her JIajesty's astronomer at the Cape. His first task on taking up this post was the reduction and publication of a large mass of observations left by his predecessor. Rejecting the earlier observations made before the transit circle had been brought into regular use, he reduced and pub- lished the observations for 1856-1860, and compiled a catalogue of 1159 stars from these observations, within the space of four years. His principal work at the Cape was, however, his great catalogue of 12,441 stars, containing all stars do-wn to the 7th magni- tude between the South Pole and 25►► S. declination,

which was practically finished by the end of 1878. Meanwhile the post of Eadcliife Observer at Oxford had become vacant by the death of Main on 9th May 1878, and Stone had been appointed ,to succeed him, with per- mission to remain a year longer"^^ the Cape in order to complete his work there. The final reduction and pre- paration of the catalogue for the press occupied most of his time at Oxford until its publication in 1881, but in 1880 the Oxford transit circle was thoroughly examined and preparations made for extending the observations of stars to the 7th magnitude from 25►► S. declination to the equator. The results of these observations were col- lected in the Raxicliffe Catalogue for 1890, which contains the places of 6424 stars to the 7th magnitude. Shortly after his return to England, Stone was elected president of the Royal Astronomical Society (1882-84), and during his occupancy of the post of Radclifife Observer he was a frequent contribut'.r to its publications, several of his contributions being of a controversial character, and relating to his supposed explanation of the errors in the position of the moon as deduced from Hansen's Tables. He was the first to recognize the importance of the old observations accumulated at the Eadclifi'e Observatory by Hornsby, Robertson, and Rigaud, and in a paper {Mon. Not. ofB.A.S., vol. Iv.) on Hornsby's zenith-sector obser- vations of y Draconis (1788-91) he showed the excellent quality of these old and hitherto unpublished observations.

He also commenced shortly before his death a reduction of the immense mass of observations made between 1774 and 1839 with the transit instrument and fine mural quadrants of the Radcliffe Observatory.

Although not himself famous as an observer, he directed and supervised the observations of his assistants with eminent ability and success. He was indefatigable in the examination and discussion of the observations, and was never so happy as when dealing wit|i great masses of figures. The number of his astronomical publications exceeds 150, but his reputation as an astronomer -will rest mainly on his earlier work at Greenwich and his two great star catalogues ??? the Cape Catalogue for 1880 and the Radcliffe Catalogue for 1890. He died at the Radclifi'e Observatory, after a few days' illness, on the 9th !May

1897.

(a. a. e*.)

S-fconeham, a town of Middlesex county, Massa- chusetts, U.S.A. It is in the north-eastern part of the state, 12 miles nearly north of Boston, on a line of the Boston and Maine Railroad. It has extensive manu- factures of boots, shoes, and leather. Stoneham was incorporated as a town in 1725. Population (1880), 4890; (1890), 6155; (1900), 6197, of whom 1254 were foreign-born.

Stonehaven, a police burgh, seaport, favourite watering resort, and county town of Kincardineshire, Scot- land, 1 6 miles south-south-west of Aberdeen by rail. There is a town hall, and a new railway station was built in 1 900. A water-supply has been introduced and the drainage improved. The harbour is being extended ; the town is an important centre of the fishing industry. Tanning and distilling are the principal industries. Population (1891),

4500; (1901), 4665.

Stoneheng^e. ??? On the evening of 31st December 1900 one of the outer trilithons (22 on Plan), with its lintel, was blown down in the course of a severe storm, this being the first collapse since 3rd January {not

June) 1797, when one of the fine trilithons (57, 58) of the horse- shoe fell. This catastrophe attracted renewed attention to the state of Stonehenge, and much discussion took place as to the taking of precautions against further decay.

The annexed Plan, which is that of Professor Flinders Petrie, shows the state of Stonehenge at the moment preceding the fall of the trilithon on 31st December 1900. Within a circular earth- work, 300 feet in diameter, is an outer circle of trilithons (100 feet in diameter) formed by great monoliths (sarsens), originally thirty in number, with large lintel stones. Within this circle is another formed of smaller ‘ ‘ blue stones, ” only a few of which remain in situ ; within that was a horse-shoe of lire huge trilithons, with ten monoliths (sarsens) ; and within the horse-shoe was an inner horse-shoe of ” blue-stones.” The open part of the horse-shoe ex- actly faces the sunrise at the summer solstice. Beyond the outer circle (not shown on Plan), a great monolith ??? the Sun Stone ??? standing on the axis of the horse-shoe, marks the point where o. spectator, centrally placed within the horse-shoe, would see the sun rise on the horizon at the solstice. On the circumference of the earlier circle (not shown on Plan), which is here intentionally

broken, a great recumbent stone ??? the Slaughter Stone ??? lies along the axis ; and across the axis, near the central curve of the inner horse-shoe, lies a iine recumbent stone, the Altar Stone.

Only half tlie outer circle sarsens now remained upright, three on the west, thirteen on the east ; and this indicated the effect of the prevalent west wind. The fall of triU thon 22 and its lintel opened a larger path to the wind, and added to the danger of further destruction. More- over, the narrow passages between the eastern monoliths had become worn by use into hollows which threatened their foundations. The acquisition of Salisbury Plain by the War Office for military purposes seemed likely, again, to add to the risk of harm from thoughtless visitors. For

Stale oj’

TFeet

W^ Stones standing on 30’^December 1900 ^^^ ◆◆)j5 tones recumbent on same date.

all reasons, an attempt to preserve Stonehenge was de- sirable ; and the owner, Sir Edmund Antrobus, was wilKng, on certain conditions as to limitations of access, to co- operate with the Society of Antiquaries, Wiltshire Archseo- logical Society, and Society for the Preservation of Ancient Monuments, in taking such steps as might be necessary to prevent more stones from falling, and even (if possiljlc) to set up some which had fallen. The societies advised that trilithon 6, 7, with lintel ◆◆◆ which had slewed round ◆◆◆ and trilithon 56, which was leaning at a dangerous angle, should be examined with a view to replacement with as little excavation as possible ; that the monolith and lintel 22 be replaced, and its companion sarsen (21) secured ; and that trilithons 57,58, should be re-erected in its place, which was exactly known. Steps were taken to place the matter in the hands of engineering experts. On 19th September 1901 trilithon 56 was successfully raised to a perpendicular position. It then presented an impoHing appearance, standing 2 1 feet above ground ; its total length was

found to be 29 feet 6 inches, and its weightabout 30 tons. The excavations were carried to a depth of 8 feet 3 inches below the datum line, and many objects were found, in- cluding chippings and lumps of the stones, stone tools, bones, and (in the upper strata) coins and fragments of pottery. Nearly 100 implements belonging to the Neolithic age were excavated ◆◆◆ axes, hammer axes, stone hammers and mauls ◆◆◆ which, according to Dr W. Gowland, who superintended the work, had been used not only for breaking the rude blocks into regular forms, but also for working down their faces to a level or- curved surface. No light was thrown, however, on the trans- port of the blocks.

Authorities. ◆◆◆ W. Boyd Dawkins. Early Man in Britain. 1880. ◆◆◆ W. M. Flindehs Petrie. .Stunrhcngc : Plans, Descriptions, and

Theories. 1880. ??? E.T.Stevens. Jvllings on Stonehenge. 1882. ??? Edgar Barplay. Stonehenge and its Earth Works. 1895. ??? Tlie Times, 9th April 1901.

Stonehouse. See Plymouth.

STONINGTON ??? STOWE

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Stoning;1:on, a town of New London county, Connecticut, U.S.A. It contains an area of 42 square miles of rolling country, situated in the south-eastern part of the state. It contains Stonington borough, besides several villages and a rural jjopulation. Stonington borough is situated on the shore of Long Island Sound, on a good harbour, and has daily steamer connexion with New York. It is also on the main line of the New York, New Haven, and Hartford Eailroad. Its manu- factures are varied, and include machinery and textile goods. Population of the town (1890), 7184; (1900), 8540 ; of the borough (1900), 2278. Of the population of the town in 1900, 1968 were foreign-born and 141 negroes.

Stony Point, a town and village in Eockland county. New York, U.S.A. It is on a rocky promontory, on the west shore of the river Hudson, about 42 miles north of New York City, and is traversed by three rail- ways ??? the New Jersey and New York ; the New York, Ontario, and Western ; and the West Shore. During the Revolutionary War it was fortified by the Americans, captured by the British, and retaken by the Americans. About six miles below the town, on the river, is the spot where the conspirators Arnold and Andr6 held their secret conference to arrange for the surrender of West Point. Population of the town (1880), 3308 ;

(1890), 4614; (1900), 4161.

Stornow ??iy, a burgh of barony, police burgh, and seaport of the island of Lewis, Ross-shire, Scotland. The sum of ??75,000 has been spent in improving the harbour. There is regular steamer communication with the mainland. In 1888, 1268 vessels of 187,385 tons entered; in 1898, 1576 vessels of 269,943 tons. Exports (chiefly fish) were valued at ??98,023

in 1888 and ??150,669 in 1898. During the herring fishing season the population is increased to 10,000. Stornoway is one of the chief kippering districts in the United Kingdom. There is a court-house, a naval reserve station at which some 2200 men are trained annually, a public library, and a public school with a secondary department ; also a female industrial school. Population (1891), 3386 ;

(1901), 3711.

Story, William Wetmore (1819-1895),

American poet and sculptor, the son of the jurist Joseph Story, was born at Salem, Massachusetts, 12th February 1819. He graduated at Harvard College in 1838, and two years later at the Harvard Law School, and was admitted to the bar, but followed the law only five years. In 1848 he went to Italy, made it his home for the rest of his life, and devoted himself entirely to art and literature. As a sculptor he is perhaps best known for his statues of Cleopatra, Josiah Quincy, Edward Everett, and George Peabody, the last of which was erected in London in 1869. Among his longer poems are ” A Roman Lawyer in Jerusalem ” (a ” rehabilitation ” of Judas Iscariot), “A Jewish Rabbi in Rome,” “The Tragedy of Nero ” (a separate volume), and ” Ginevra di Siena.” The last named poem and “Cleopatra” ??? one of the most striking of his shorter productions ??? are included in Graffiti d’ Italia, a collection published in 1868, of which ” all the poems are intended to be dramatic in their character.” His collected poems were published in two volumes in 1885. His prose works comprise The Life and Letters of Joseph Story; Roba di Roma ; or, Walks and Talks about Rome ; Vallombrosa ; Fiammetta (a. novel); Conversations in a Studio ; and Exowrsions in Art and Letters. Of these Roba di Roma is the most widely read and most likely to endure. Story was an intimate friend

of the Brownings in Italy, and his treatment of certain themes often brings their works to mind. He died at Vallombrosa, 7th October 1895. A fragmentary account of his life is given in Mary E. Phillips’s Reminiscences of William Wetmore Story.

Stourbridg'e, a market town of Worcestershire, England, in the Droitwich parliamentary division, 10 miles west of Birmingham by rail. Since 1894 it has been governed by an urban district council. Electric tramcars connect it with Brierley'Hill and Dudley. A town hall was built in 1887, and the Corbett Hospital at Amblecote, founded in 1892, was enlarged in 1895. Population of the urban district (which includes the town- ships of Upper Swinford and Wollaston) in 1891, 14,891 ; in 1901, 16,302.

Stowe, Harriet Elizabeth (Beecher)

(1811-1896), American writer and philanthropist, seventh child of Lyman and Roxana (Foote) Beecher, was born at Litchfield, Connecticut, U.S.A., 14th June 1811. Her father (the Congregational minister of the town) and her mother were both descended from members of the company that, under John Davenport, founded New

Harriet Beeoher Stowe. {From a photograph by Sarany, Sew York.)

Haven in 1638; and the community in which she spent her childhood was one of the most intellectual in New England. At her mother's death in 1815, she came most directly =under the influence of her eldest sister Catherine, eleven years her senior, a woman of keen intellect, who a few years later set up a school in Hartford to which Harriet went, first as a pupO, afterwards as teacher. The society about her, both in Litchfield and Hartford, was one in which the supremacy of religion in the training of the young was fuUy recognized, and her ardent, imagina- tive nature was deeply stirred by the problems of personal religion. In 1832 her father, who had for six years

been the pastor of a churcli in Boston, accepted the presidejicy of the newly founded Lane Theological Seminary at Cincinnati. Catherine Beecher, who was eager to establish what should be in effect a pioneer college for women, accompanied him ; and with her went Harriet as an assistant, taking an active part in the literary and school life, contributing

stories and sketches to local journals, and compiling a school geography. She was married, 6th January 1836, to one of the professors in the seminary, Calvin Ellis Stowe. In the midst of privation and anxiety, due largely to her husband's precarious health, she wrote continually, and in 1843 published The Mayfloiver, a collection of tales and sketches. Mrs Stowe passed eighteen years in Cincinnati under conditions which constantly thrust the problem of human slavery upon her attention. A river only separated Ohio from a slave- holding community. Slaves were continually escaping from ??? their masters, and were harboured, on their way to Canada, by the circle in which Mrs Stowe lived. In the practical questions which arose, and in the great debate which was political, economical, and moral, she took a very active part. When, therefore, in 1850, Mr Stowe was elected to a professorship in Bowdoin College, Bruns- wick, Maine, and removed his family thither, Mrs Stowe was prepared for the great work which came to her, bit by bit, as a religious message which she must deliver. In the quiet of a country town, far removed from actual contact with painful scenes, but on the edge of the whirlwind raised by the Fugitive Slave Bill, memory and imagination had full scope, and she wrote for serial publication in the The National Era, an anti-slavery paper of Washington, D.C., the story of Uncle Tom's Cabin ; or, Life among the Loiuly. The publication in book form, 20th March 1852, was a factor which must be reckoned in summing up the moving causes of the war for the Union. The book sprang into unexampled popularity, and was translated into at least twenty-three tongues. Mrs Stowe used the reputation thus won in promoting a moral and religious enmity to slavery. She reinforced her story with A Key to Uncle Tom's Cabin, in which she accumulated a large number of documents and testimonies against the great evil; and in 1853 she made a journey to Europe, devoting herself especially to creating an*

entente cordiale between Englishwomen and Americans on the question of the day. In 1856 she published Dred ; a Tale of the Dismal Swamp, in which she threw the weight of her argument on the deterioration of a society resting on a slave basis. The establishment of The Atlantic Monthly in 1857 gave her a constant vehicle for her writings, as did also The Independent of New York, and later The Christian Union, of each of which papers successively her brother, Henry Ward Beecher, was one of

the editors. From this time forth she led the life of a woman of letters, writing novels, of which The Minister's Wooing is best known, and many studies of social life in the form both of fiction and essay. She published also a small volume of religious poems, and towards the end of her career gave some public readings from her writings. In 1852 Professor Stowe accepted a professorship in the Theological Seminary at Andover, Massachusetts, and the family made its home there till 1863, when he retired wholly from professional life and removed to Hartford. After the close of the war for the Union, Mrs Stowe bought an estate in Florida, chiefly in hope of restoring the health of her son, Captain Frederick Beecher Stowe, who had been wounded in the war, and in this Southern home she spent many winters. After the death of her husband in 1886, she passed the rest of her life in the seclusion of her Hartford home, where she died 1st July 1896. She is buried by the side of her husband at Andover.

See Life of Harriet Beecher Stmm, compiled from her letters and journals by her son, Charles Edwakd Stowe (Boston, 1890). Life and Letters of Harriet Beecher Stowe, edited by Annie Fields (Boston, 1898). (h. e. S.)*

StOWmarket, a market town and urban district, Suffolk, England, in the Stowmarket parliamentary division of the county, 12 miles north-west of Ipswich by rail. The church of SS. Peter and Mary is in the Decorated and Early English styles. Its spire contains eight bells, re-hung in 1894. A fever hospital was opened in 1896. The town has an extensive chemical manufactory, iron foundry, and factories for the manufacture of gun-cotton, agricultural implements, and compressed leather. There is also considerable trade in corn, malt, coal, slate, and timber. Population (1891), 4339; (1901), 4162.

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URUGUAY. The Hon. W. W. Rockiiill, I. P. A. Renwick, and C. E. Akers.

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VACCINATION. S. Monckton Copeman, M.D., Medical In- spector, Local Government Board.

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VARIATION AND SELECTION. W. F. R. Weldon, D.Sc, F.R.S., Professor of Comparative Anatomy, Oxford.

VARIATION OF AN INTEGRAL. A. E. H. Love, F.R.S., Professor of Natural Philosophy, Oxford.

VATICANISM. Dr F. X. Kraus (the late), Professor of Ecclesiastical History, University of Freiburg im Breisgau.

VEGETARIANISM. Josiah Oldfield, D.C.L.

VENTILATION. Francis Fox, M.Inst.C.E.

VERDI. R. A. Streatfield, Author of ” Masters of Italian Music. ‘ ‘

VERMONT. Professor J. E. Goodrich, University of Vermont.

VICTORIA. G. C. Levey, C.M.G., and T. A. Coghlan, Government Statistician of New South Wales.

VIENNA. M. O'Neill.

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VIRGINIA. Professor R. Heath Dabney, Ph.D., University of Virginia.

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WESTCOTT, BISHOP. The Right Rev. H. E. Ryle, D.D., Lord Bishop of Exeter.

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WISCONSIN. F. J. Turner, Ph.D., Professor of American History, University of Wisconsin.

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WOMEN. Lady Jeune.

WOOLNER, THOMAS. F. G. Stephens, Author of “Artists at Home, ” ” French and Flemish Pictures,” &c.

WORM. Oligochmta, F. E. Beddard, F.R.S., Prosector of Zoological Society of England ; Polychceta, E. S. Good- rich, M.A., Demonstrator of Anatomy, University Museum, Oxford.

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WRITING. Peter Giles, M.A., Reader in Comparative Phil- ology, Cambridge University.

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ZINC. F. L. Clero, M. Amer. Soc. of Mining Engineers.

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ZOOLOGICAL DISTRIBUTION. Marine, G. H. Fowler, Ph.D., F.Z.S. ; Terrestrial, Richard Lydekker, F.R.S., F.Z.S.

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PREFATORY ESSAY.

METHODS AND RESULTS IN MODERN THEOLOGY. By the Rev. W. E. Collins, M.A.

FROFESSOK OF ECCLESIASTICAL HISTOKY AT KING’S COLLEGE, LONDON.

AT the present day there is no special tendency to make a confusion between religion and theology ; on the contrary, it would seem that we are almost too ready to conclude that they may be re- garded as entirely distinct. From one point of view religion has recently been defined, by Professor William James, as ” the feelings, acts, and experiences of individual men in their solitude so far as they

apprehend themselves to stand in relation to whatever they may consider the Divine.” and From a rather different standpoint, Matthew Arnold has defined it as “morality touched

by emotion”: a definition which is felt to be unsatisfactory unless it denotes morality, in the largest sense of that much misused word, as traced back to and springing from the motive power which gives it birth, viz., the devotion of a personal being to that which is recognized as the end of conduct and the goal of aspiration. Theology, on the other hand, is the study which deals with what is known, or assumed to be known, of that end and goal, both in its essential nature and in all its relations with conduct and being ; in a word, it is the science of the Divine. Religion and theology differ, therefore, both in idea and in scope. It may indeed be questioned whether they ever are or can be entirely separable : many would contend that a theology of some kind, more or less definite or indefinite, is presupposed in all religion, at any rate implicitly. But those who repudiate the one would resent, and not unnaturally, any assertion or implication that they had thereby abandoned the other ; and although it is possible that the tendency of to-day is to separate them overmuch, at least it is clear ■ that they can in no sense be identified.

But there is another distinction which must not be lost sight of ; viz., the distinction between theology in a narrower and theology in a wider sense ; or better perhaps between the faith itself and

its intellectual embodiment in a theology. The faith itself declares the relations existing and (or believed to exist) between religious people and the object or objects of their religion.

eo ogy. g^ £ke jluman min(j is such that these relations must inevitably find their expression in certain statements or propositions, which in turn must

take their place side by side with the remainder of our intellectual stock in trade. Hence arises a developed theology. The Christian faith, to which from this point we confine ourselves, represents certain truths in the spiritual universe and states certain historic facts, or what are believed to be such ; theology endeavours to correlate these with our other knowledge. The faith itself is common to simple and learned ; theology is primarily a domain of the intellect. The faith cannot be said to change, generally speaking, excepting in so far as its adherents enter in course of time more or less fully into the depths of its meaning ; there is a sense in

which it must be said that theology, like natural science, is always changing. For theology is the attempt to express this unchanging faith in the terms of philosophy and to embody it in a historical and logical system ; to correlate it with the facts of life and the highest knowledge and thought of the day ; to apply it afresh to the satisfaction of human aspirations in the light of ever-varying circum- stances. To accomplish this end, it becomes of necessity subject to the dominant intellectual methods and processes of the day, and it absorbs or makes use of such material as is current in its day. By applying itself to the resolution of problems which are always changing, it systematizes itself in a shape which has reference to circumstances which are merely transitory. By bracing itself to meet new modes of thought which would cut away the ground beneath its feet, or discoveries which threaten to demolish its former presuppositions, it learns to breathe more freely and to accommodate itself to ampler quarters, only to find in time that these likewise must be vacated, and that there is yet more beyond. The theological difficulties of one generation furnish the theological armoury of the next : the apologetic of one age is the basis of the scepticism of the age that follows.

Theology must then of its very nature be constantly modifying its affirmations, constantly shifting its ground and changing its centre of gravity. It thrives by submitting to new laws. It grows by the accumulation of new facts, by the assimilation of ways of thought at first strange to itself,

by ever the development of its latent power and the manifestation of its inherent truth under the

c a 8 ‘ pressure of new necessities. It is preserved from stagnation and death by the confession, or at least the repudiation, of its own mistakes ; by the rejection of ways of thought which have grown old, of antiquated theories and exploded facts which it once accepted in common with every form of human thought ; by the retracing, sometimes frankly acknowledged, more often concealed and disguised or not even recognized, of its own footsteps. Above all, it lives and flourishes whenever, and in pro- portion as, it learns to enter afresh into the meaning of some element of the Christian faith : whenever, in the words of the Master, some ” scribe instructed unto the kingdom of heaven ” is enabled to ” bring forth out of his treasure things new and old.” Christian theology, in a word, seems always to be on the losing side, and yet it always comes out without loss in the long run. That this is so is the result of the fact that there is in it one element which is always dying, and one which never dies. For, as Dr George Salmon has said : “Every union of philosophy and religion is the marriage of a mortal with an immortal ; the religion lives ; the philosophy grows old and dies. When the philosophic element of a religious system becomes antiquated, its explanations which contented one age become unsatisfactory to the next, and there ensues what is spoken of as a conflict between religion and science ; whereas, in reality, it is a conflict between the science of one generation and that of the succeeding one.”

That such a change is continually going on in the theological thought of every age is a matter of constant observation. It is impossible to glance through any substantial theological writing of a former century, say the fourth, or the sixteenth, or the eighteenth, without finding that, although there may be much that at once appeals to the modern mind, there is even more which no longer does so. Of the latter, there may indeed be some elements which would be useful as correctives, simply because they deal, from a point of view other than our own, with that which is common to us and to them. But there will prob- ably be much more which, owing to the fact that it is moulded in accordance with the presuppositions and the theories of a former day, has now come to be evacuated of all possible meaning for us. In fact, its analogies with the philosophical and other

writings of its own day, even with those which are non- religious, or even sceptical in tone, are in some respects closer than with those of modern theological writings. Theology has shifted its ground : it has given way on all hands. Again and again it has renounced pretensions which were once made on fts behalf with the utmost boldness ; and it has been content to learn its own lesson at the feet of philosophy and natural science. And yet few thoughtful men would say that theology has become enfeebled as the result of the process. It has learned to submit to certain limitations indeed, but limitation is not always loss. The theologian may claim that, in the process of restriction within the modified intellectual content of the age, theology is continually being maintained in its proper sphere, as supplying the clue to all life and being — that clue which alone gives meaning and purpose to a world which would otherwise be without any real significance.

PREFATORY ESSAY IX

Causes of the Change which has come over Modern Theology.

Seldom, if ever, has a greater change come over the theology of any age than that which was observed in the last sixty or seventy years of the nineteenth century. Ai the beginning of that period, as Dr J. B. Mayor has said, ” Theology was the repetition of the formulas of the fourth and sixteenth centuries ; every word of the Bible was divinely dictated, equally important and equally infallible ; human reason was out of place in the sphere of religion, which consisted mainly in emotional utterance or ritual observance ; the operation of Divine grace was limited by the recognition of the three Orders and of Apostolical Succession, or else by the assurance of conversion on the part of the individual ; art, science, politics, and social life belonged to the world, which was either forbidden ground, or at least so full of snares as to make it hazardous for the ordinary Christian to venture upon.” As late as 1848, when Robertson of Brighton said that one of the duties of the library committee of a Working Men’s Society was to furnish books of amusement, he was greatly sneered at. “Many well-meaning and religious persons said I had forgotten my place as a clergyman in speaking of works of fiction as fit for labouring men. They were shocked and startled that I dared to reckon it a matter of rejoicing that there is a moral tone in that well-known publication which is dedicated to wit and humour, or that I

even named it.” Many changes, both religious and theological, have come about since then. Old land- marks have been removed entirely ; phrases formerly all-powerful have ceased to have any meaning for us ; old watchwords, such as verbal inspiration, substitution, experimental religion, and the like, have been evacuated of much of their force. On the one hand, there has sprung up a widespread feeling which is not so much anti-religious as unreligious, but which is at any rate frankly untheological ; and its results are to be seen on all sides, in the decay of church-going, the decrease of Bible-reading, the non-observance of Sunday, and the like. On the other hand, there has been, not only in the British Isles but on the mainland of Europe, a decided increase of religious earnestness, which has shown itself especially in the direction of a very notable “Catholic revival.” Meanwhile, the conflict between religion and science has gone on, and neither has been a loser by it. One thing after another has been denounced as absolutely contrary to the Christian faith: in course of time it has come to be a house- hold word to us, and yet the faith is none the worse for it. Nevertheless, it would be hard to imagine a change more far-reaching.

The causes which have led to this change are not far to seek ; nor have they influenced theology alone. For it is in fact part and parcel of the change which has come over all human life and thought; and the causes which have revolutionized every other activity of the human mind have not left theology untouched. An attempt must be made to summarize them here, difficult though it is, or impossible, to summarize them completely.

(a) First in order must be placed the widespread Romantic Movement which, seeking its inspiration in the art and literature and the ideals of the Middle Ages, has recovered and recreated for us conceptions of beauty, truth, and fellowship which had almost died out of our conscious life. At times it has been erratic and extravagant; it has degenerated at times into the barrenness Romantic of a mere mediaeval eclecticism. But nothing could have been, further from its normal character than this. As a whole it has been eminently sane and clear-sighted; and Coleridge and Shelley, Scott and Southey, Blake and Ruskin in England, not to speak of even greater leaders elsewhere, gave a new tone and a new direction to men’s thoughts. Its influence has by no means passed away yet. Nowhere has it been more conspicuously felt than in theology; and the Oxford Movement, with its

watchword ” Hear the Church,” was but an exemplification, though by far the most conspicuous and fruitful one, of a process which infused new life into the Catholicism of France, which for a time deeply affected the Lutheranism of Germany and Denmark, and which even touched orthodox Russia in the persons of Khomiakoff and others.

(5) Hardly less important in its influence upon theology has been the great social movement of modern days, which has altogether inverted, so far at least as words are concerned, our sense of the relative importance of the individual and the society; which has given us both the conception

of “solidarity” and the word by which to express it; which has deepened our sense of the corporate life of the State, and enabled us once more to speak the language of Aristotle’s Politics. It is easy

to exaggerate the permanent, or even the temporary, effects of such a movement as this ; social and nothing is more certain than that human nature does not change itself when it adopts a

new form of speech. But the fact remains that human life is largely dominated by great ideas; and, however transitory the victory may prove to be, modern political history is, more largely than anything else, a record of the triumphs of the new social creed in a succession of peaceful conflicts. Here again theology has been largely influenced by what it at first regarded with the greatest suspicion, and indeed has found in it a revelation of its own teaching ; for the conception of the relation between the society and the individual finds at once its source and its most complete fulfilment in that of the Body and its members. The results are to be seen in the liberal movement in France which centres round Lamennais and his friends, and in that which for a moment seemed likely to place Pope Pius IX. at the head of a united Italy. They are to be seen in the early Christian Socialist movement which had Maurice and Kingsley and Ludlow for its leaders, and in the more developed movements of later days ; in the zeal for social work which has taken hold of all the churches ; in the remarkable revival of devotion to

the ideals of St Francis of Assisi in our own day, the full results of which are perhaps still to be seen. Above all, they have left their record, and find their inspiration, in the larger realization of the fellowship of God and men in the Body of Christ which runs through modern theology. One striking instance of the change may be given. Cardinal Newman has declared in the Apologia that from his earliest days he had never had any conviction so strong as “the thought of two, and two only, supreme and luminously self-evident beings, myself and my Creator.” In The G-ospel of Life and elsewhere the late Bishop Westcott, with the words of Newman in this mind, has expressed his firm conviction that they do not exhaust the truth, and that man is or may be conscious of three self-evident final existences, Self, the World, and God. Perhaps each writer may be held to have expressed accurately the view most generally current in the period during which he wrote.

(c) Still more profound and far-reaching has been the change which has come over all human thought as the result of the bursting of the bonds of eighteenth-century philosophy on the one hand, and

the great discoveries of modern science on the other. As regards the former, thought has sophy and been delivered from the deadlock of a method which in reality involved the denial of the

possibility of affirming even phenomena; thus the way was opened for a new philosophy, which was given to the world by Kant in his Transcendental Idealism. As regards the latter, partly by its actual discoveries and still more by its majestic inductions, it has altogether overturned our preconceived ideas of the life-history of the world, and placed before us a larger and more unitary con- ception of it than had been possible since the revival of learning. After years of repudiation or jealous suspicion, both philosophy and science have at length been allowed to deliver their message for the theologian. Hegel, Lotze, T. H. Green, and James Martineau have remodelled our religious philosophy, Coleridge and Maurice have linked it with history and brought it into contact with practical religion ; and if for a time theories based on the metaphysics of Sir William Hamilton, such as those of Mansel, still prevailed and were made use of as a valuable bulwark of a traditional theology, further consideration

has made it plain that their basis and their inevitable outcome is what is now known as agnosticism. Again, thoughts derived from natural science have been introduced into theology, to the great benefit of the latter. The ideas of evolution and development have been found to acquire an even fuller meaning when viewed in the light of the New Testament, e.g., in the light of the teaching of St Paul as to the destiny of “the whole creation.” Little by little they have permeated all theology, delivered it from some of the survivals of eighteenth-century deism, and given form and life to much that was otherwise mechanical and shapeless.

(<2) Nevertheless, the new ideas seemed at first sight only to emphasize a divorce between "pro- fane " and " sacred " learning which had already become apparent. On the one hand, conflict could only be avoided by keeping the two carefully separated; on the other, physical science was rapidly enlarging its ground. Moreover, such a segregation of sacred learning could only mean stagnation and ever-

increasing unreality. Against this the protests have been almost incessant ; in fact, one of the most salient features of the theology of the nineteenth century has been its constant effort after reality and entire intellectual sincerity. It is this absolutely fearless honesty and freedom in dealing with the Bible which made Maurice’s Patriarchs and Lawgivers (1851) and Prophets and(

(e) This temper of free and candid examination has gone hand in hand with one of rigorous analysis. That this should have been so was but natural. When the bases of our knowledge in other spheres were being tested and overhauled, theology could not reasonably be held exempt from the same process. Nor could a merely ecclesiastical disintegration and reconstruction be judged twc sufficient. It was not enough that theology should overhaul its own fabric and reshape itself in accordance with its own presuppositions : its historical bases must be tested by the same rigorous methods which were employed elsewhere. And this is precisely what was done. The Bible, the creeds, and the institutions of the Church were placed on their trial ; the accretions of ages were torn away, with more or less of skill and discrimination as the case might be. Christianity itself was cast into the

crucible, and this not at the hands of indifferent or hostile unbelief but, on the whole, of precise and rigorous scientific scholarship. So much at least is clear to us now, for we are far enough away to see things in their true proportions. If there was much a priori reasoning, if many of the negative conclusions which were arrived at were inevitable in view of the assumed premisses upon which they really rested, there was surprisingly little of definite or conscious bias against the Christian faith, ready as people were to think otherwise at the time. Even when the conflict waxed fiercest, defenders and assailants of the received views were alike fellow-students ; and Bishop Westcott has left it on record that he had often learned more from those with whom he disagreed most fundamentally than from those with whom _he found himself in agreement. The methods adopted were those of rigorous analysis, which only became more exact and more scientific as time went on, and as the principles of historical and textual criticism came to be better understood. Moreover, the very eagerness with which the evidence was scanned led to the discovery of fresh evidence, which has often served to clinch the matter in dispute. The scholars of many nations have contributed their quota ; and if it be allowed that Germany has done the lion's share of the Work, exhibiting the most searching analysis and the most brilliant conjecture, it may fairly be claimed that the best British scholarship excels in soberness of judg- ment and scholarly completeness. The period of conflict has been prolonged and arduous. Little by

little the inquiry may be said in a measure to have worked itself out. Not, indeed, that finality has been reached upon all or even upon most of the points involved ; but, at least, certain tangible objects have been compassed, and certain tangible results have been obtained. Theological science would appear to have reached its limits for the present in certain directions, and to be tending towards fresh develop- ments in others. It may therefore be possible to take stock of some elements of our progress as it would hardly have been some twenty years ago, and also to note and record the character which has been impressed upon the theology of the present day itself, as tbe result of this period of disintegration and growth.

The Characteristic Form of Modern Theology.

To speak first of the latter. Briefly, the great change which has come over theology itself, during

the period under review, may be summed up in the formula, ” Back to history.” Theology has become

historical. Its chief evidences are, and must ever be, those which appeal to the conscience ;

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historical but it has become historical in such a sense that it can be both studied and taught historically by students of varying faiths, as is at the present time the case in the new University of London. It has become historical in its methods to a quite unprecedented degree. That this should be so is inevitable in an age which has so greatly enlarged our knowledge of the past, and has poured forth upon the theologian a continual stream of new documents and other evidence, which could only be interpreted, or correlated with our existing materials, by historical methods, and which reflect back a flood of light upon those materials in the process. In these circumstances, theology has of necessity become largely historical in its methods ; to such an extent indeed that almost all the more notable theological literature of recent ‘years has partaken largely of that character. It would not of course be true to say that a priori arguments have altogether lost their ground, or that deductive reasoning has no longer any place in theology ; such a thing would obviously be impossible in a subject which deals so largely with matters which depend in the main upon the testimony of the individual consciousness, and which are not capable of immediate verification by actual experiment. But the fact remains that in theology, as distinguished from religion, the inductive method has come to precede and to underlie all else ; and, so far as theology is concerned, the inductive method is the historical method. Here, at any rate, there would seem to be true and, it is to be hoped, permanent progress, and not merely a temporary phase of evolution. Most of the mistakes of theology in the past have resulted from a rooted habit of building hypotheses upon insufficient or unverified premisses, of failing to test alleged developments rigorously

enough by a reference to the foundations upon which they profess to be based. The time has come for theorizing to give place to careful inquiry. The facts must be made to yield up their own evidence, and they will only do so as we learn to study and to interrogate them aright. In other words, the historical method is the proper and scientific method in theological study. And regarded from this point of view, our progress in theology falls into line with progress in other studies. Sir Frederick Pollock has pointed out, in his History of the Science of Politics, that in the century which has passed away, progress in physics, indeed in natural science generally, meant a fuller realization of the great principles first enunciated by Newton ; that progress in philosophy meant ” Back to Kant,” and in politics “Back to Aristotle.” In like manner it may be said that progress in theology means “Back to history.”

But it is not only as a method of accurate analysis that the theologian has recourse to the historical method. He does indeed make use of it in this way, as a means of delivering himself from the futility of baseless theorizing. He avails himself of every means at his command — exact linguistic hiftow.” and textual study, the method of survivals, and the comparative method— he seeks every „ sidelight that is offered by archaeology or political history, by ethnology or physical geography, in order that he may get at the actual facts. But that is not all. History means more to the theologian than it did. It is more to him than a kind of prolegomena to a religious philosophy ; it is more than the determination of a basis for sound reasoning or unassailable generalization. To the theologian of to-day history is, as Dr Fairbairn has said, ” a continued creative process due to the continued, though conditioned, activity of the original creative Mind.” To him the facts of life are not something

extraneous which must be stripped off before he can penetrate to certain divine realities ; they are in themselves a revelation of those realities. To him religion finds its highest expression not in human thought, but in human life.

This new reverence for human life, and for life in all its forms, is of course based upon a theological motive. It is the outcome of a fresh realization of

the cosmic significance of Christianity itself, as being in its essence, in Bishop Westcott's words, neither a philosophy nor a law, but a Person and a Life. " Christianity announces in the plainest terms a vital union of the finite and the infinite as the funda- mental Gospel. In the brief phrase, ' The Word became flesh,' the opposition and the reconciliation, the difference and the union in one Person, of Being eternal and temporal is set forth not as a speculation or as a thought, but as a historic event." From this point of view Christianity claims to be historical in an unique sense. " It was prepared for by a long national development, into which the typical elements of the ancient world entered as contributory forces. It is summed up in the facts of a divine- human life. It has been, and still is being, wrought out in the slow and unreturning life of a society." In other words, from the standpoint of to-day the Christian religion centres more than ever in the Person, rather than in the teaching of its Founder, and Christian theology centres in the Incarnation (which potentially includes all else) rather than in the Atonement. That this is so will not be doubted by any one who will consider the general character of the theological literature of the last forty or fifty years. It is concerned with the history and the Person of Christ to an extraordinary degree. Never before, as has been pointed out by Dr A. J. Mason, were there published so many professed Lives of Our Lord and books bearing immediately on that subject ; never since the days of the great Greek fathers was the Incarnation, both in itself and in its bearing on life and conduct, the subject of so much thought and study. The problem of the Synoptic Gospels and their relation to St John, upon which so much excellent work has been done in recent years, derives its whole interest and importance from the fact that it aims at bringing us into an even closer contact with Him. And thus it may be said that the theological watchword, "Back to history," really amounts to "Back to Christ."

Some Elements of Theological Progress in Recent Years.

We turn now to the consideration of some particular elements of the theological progress of recent years. Here again our examination can only be partial and fragmentary; we can do no more than attempt to indicate results in outline, the full nature of which must be sought elsewhere.

1. Christianity and other Religions. — The time has long passed away when it was possible for the theologian either to disregard every other religion but that of the Hebrews, or to regard them simply as so many forms of error. A faith which demanded for itself exceptional treatment or exclusive consideration would have thereby put itself out of court, so far as scientific inquiry is con- ‘iaauyiuid cerned. Such a thing would indeed have been impossible at the present day, when the researches ^efigioas. of such scholars as Tiele, de la Saussaye, Waitz, Max Miiller, Ratzel, de Quatrefages, Tyler, and Frazer have practically opened to us a wholly new world of religious knowledge. Modern Christian apologetic is based in this respect not upon the ignoring of other religions, but upon a presentment of them in their right relation with Christianity. In this view, they are so many partial and typical representations of the truth, whilst Christianity, which is ” the Absolute Religion,” alone fully satisfies the craving to which they all bear witness. It has been drawn out by many writers, but nowhere more ably than by the most recent of all, Dr A. M. Fairbairn. In his Philosophy of the Christian Religion (1902) he has endeavoured to show that ” the conception of Christ stands related to history as the idea of God is related to nature, i.e., each is in its own sphere the factor of order, or the constitutive condition of a rational system ” ; and that ” the Son of God holds in his pierced hands the keys of all the religions, explains all the factors of their being and all the persons through whom they have been realized.” Nor is this relation between Christianity and other religions to be discerned only in their general character ; it may be seen also in particular institutions. Of these there is none which so well illustrates this fundamental solidarity of religion as that of sacrifice, the full significance of which was first set forth by the late Professor Robertson Smith. It was, he showed, the life, not the death of the victim that was

signified by its immolation ; and this immolation was always accompanied by a sacrificial feast, in which others partook besides the offerer. In, fact so essential was this participation that even a private sacrifice was not complete without guests, and the surplus of sacrificial flesh was not sold but distributed freely. Thus ” every act of sacrifice expressed the idea that man does not live for himself only but for his fellows,” and the fundamental idea

of the sacrifice itself is that of “communion between the god and his worshippers by the joint participation in the living flesh and blood of a sacrificial victim.” Dr F. B. Jevons can hardly be said to have over-estimated the significance of these facts when he sum- marizes them as follows : ” The whole human race for thousands of years has been educated to the con- ception that it was only through a divine sacrifice that perfect union with God was possible for man. . . . Of all the great religions of the world it is the Christian Church alone which is so far heir of all the ages as to fulfil the dumb, dim expectation of mankind ; in it alone the sacramental meal commemorates by ordinance of its founder the divine sacrifice which is a propitiation for the sins of mankind.”

2. The Doctrine of God. — The change which has come over modern theological thought in this respect is most marked. It has been pointed out by Mr A. W. Robinson that the dominant conception of

theology was until quite recently, as it had been since the early part of the eighteenth century, Doctrine the Moral Government of God. To this all else was subsidiary, and the attributes of God

which were most dwelt upon were such as were most directly connected with it. Law was the expression of his will : reverent submission and obedience were the right attitude of human beings towards him, and all else drew down upon itself the inevitable penalties due to a broken law and an .outraged holy will. Now all this is altered: theology has rediscovered the great cardinal truth of the Fatherhood of God, and learned to see in it that upon which all else depends. This of course is pure gain; but it has not been achieved without loss. Our age has seen at the same time “a widespread weakening of the meaning of Law.” We have a much greater realization of the universality of its operation, but have largely lost the thought of a personal Will behind its manifestations ; and law has come to be interpreted to us as only the inevitable sequence of events. This has greatly weakened the sense of sin amongst us, a fact which may be discerned in the absence of the note of severity in most of our moral teaching. Thus the thought of fatherly love has often been eviscerated, by the annihilation of those elements of moral uprightness and holy sternness which are really essential

to it. And thus the idea of the Fatherhood of God has been whittled away into one of mere good nature.

3. The Doctrine of Jesus Christ. — The fresh realization of the Fatherhood of God has brought with it a fresh realization of the meaning of the Incarnation. It was not arbitrary. There was already in

human nature something cognate to the divine, of which the Son of God could take hold; of Jesus and in doing so, he was fulfilling that which was foreshadowed for man from the first.

Accordingly, as has been said already, the Incarnation has once more taken its place as being, rather than the Atonement, the central point of Christian doctrine. In fact, although there has been a constant development of thought and not in any sense a mere retrogression, that development has manifested itself in a return from the characteristic standpoint of Latin theology (i.e., that which had its first home in Roman Africa) towards that of the Greek fathers. The former was largely man-centred, the latter God-centred. The former started from the point of view of human duty, and concerned itself too exclusively with the problems of man's nature and destiny; the latter started from the primary revelation of God's relation to man, as made known in concrete facts and witnessed to by every human aspiration. There can be no doubt that Christian theology in the West, where alone it has been a vital force in modern days, has been largely moulded by the former ; and not less so in the North than in the churches of the Roman obedience. We have suffered not a little from what Bishop Westcott called " the evils of that Africanism which has been dominant in Europe since the time of Augustine " ; and its one-sidedness has been the basis of not a few current misunderstandings of Christian doctrine, and of many of the objections which have been brought against it. " One of the most influential and rigorous philosophers of modern times," he says, "said not long ago with a voice from the grave [i.e., John Stuart Mill] that the sufferings and disparities of life, the contrasts of the Law and the Gospel point to the action of rival spiritual powers or to a Creator limited by something external to himself, Not so,

was Origen’s reply : they simply reveal [the fact] that what we see is a fragment of a vast system in which we can do no more than trace tendencies, convergences, signs, and rest upon the historic fact of the Incarnation.” Thus the new standpoint in theology has had no little effect, both in illuminating faith and in removing current misunderstandings with regard to it. But it has done more than this. It has caused more stress than ever to be laid upon the reality of the Incarnation, and in particular upon the actuality of the Lord’s human life upon earth. Upon this, it has been perceived, depends both the completeness of his fellowship with the human race and the truth of his human example. Accordingly, recent theological writers (the best known of whom in England is perhaps Dr Gore, Bishop of Worcester) have emphasized strongly the reality of the ” self -emptying ” (jeevtoaiM, Phil. ii. 6/.) of the Lord. They have taught that in assuming human nature, he vouchsafed to lay aside the exercise of all powers which would have rendered a true human life impossible; that he submitted himself to be recipient of the Holy Spirit and to learn by human processes as we do ; and that he so truly accepted and so consistently maintained these voluntary limitations throughout his human life that he was ” in all things made like unto his brethren,” sin only excepted. Naturally, these conclusions have not been received without considerable dissent, for it has been fully recognized by those who have put them forward that they are not in accordance with the bulk of past teaching on the subject. But in reply to this it is urged with great force that St Cyril of Alexandria, whose influence on the other side has been the strongest, undoubtedly j^oes too far, and ” lays himself open to the charge of minimizing the significance of our Lord’s humanity ” ; tnat the theological writers of former days have as a rule made no attempt to investigate the entire teaching of the New Testament on the subject ; and above all, that this teaching itself, when so investigated, is quite unmistakably clear.

4. The Christian Church. — Of course, this is not the place in which to speak in detail of the particular advances which have been made as the result of the historical study of the faith and institu- tions of the Church. Excellent work has been done in Gebhardt and Harnack’s Texte und

4. The

Untersuchungen, the Cambridge Texts and Studies, and other similar collections ; by Lightfoot, christian

Churchi

Zahn, Harnack, Hilgenfeld, Langen, Duchesne, Hatch, and many more. It must suffice to summarize it shortly under three heads, and to say a few words on each, (a) Mention has been made already of the very numerous theological and other writings which have been discovered or first made available in our own day, and which have so largely widened the horizon of the student. Naturally, they are of very different character for different periods : great collections of state papers and confidential correspondence in later mediaeval and modern days; chronicles, letters, liturgical books, theological treatises in the earlier mediaeval period ; earlier still, fragments of all sorts on a much smaller scale, but of even greater interest, coming as they often do from Armenia and other hitherto little-ransacked mines in the East. Two classes of documents of great value may be named in this last-mentioned period ; the Church Orders, and the ” heterodox ” documents of early date. The former have already added much to our knowledge of the institutions of the Church, and will add yet more as they are more thoroughly studied. As regards the latter, writings which were thrown aside and forgotten in the post- Nicene period because of their theological vagaries are of course of the greatest value to-day in helping us to determine the true character of an age or the history of a doctrine. (5) Excellent work has been done, again, in the historical study of the development of dogma, which has found its chief home in Germany. Much excellent study has been given to the tracing back of theological watchwords to their earliest sources, and above all to the investigation of the relation between Christian ideas and the terms of Greek thought in which they have been expressed. And the result is to be found in a clearer recognition of the fact that, in Dr Sanday’s words, ” All doctrine is relative — relative in the first instance to the age in which it was drawn up, and relative at all times to the limitations of our human faculties aiming at that which is infinite and divine.” (c) Not less notable is the work which has been done in the study of Christian institutions and the like, in their origin and development ; with the general result that we are beginning to learn that in almost every case what is to be looked for is not some definite creation of

a developed institution, but a growth from very insignificant and often chaotic beginnings.

5. The Old Testament. — In no department of theology has there been so great a change as that which has come over the study of the Old Testament since about 1870. In a word, these years have

seen the triumph of the Higher Criticism; i.e., that criticism which deals not merely with resfcwnenl textual an(l documentary data, but which submits the documents themselves to analysis and

reconstructs the history which they embody, by the consideration of the spirit which underlies them, the whole atmosphere which they exhale, and all the knowledge that we can derive from external sources ; in other words, that very historical criticism which has given us such large results in other fields of study. In the later volumes of the ninth edition of the Encyclopaedia Britannica, published under the editorship of Professor Robertson Smith, that great scholar was instrumental in making known to English readers, almost for the first time, many of the chief results of the Higher Criticism ; and, so far as assured and accepted results are concerned, there is little to be added from later sources to the articles therein contained. The change is rather in the way in which the Higher Criticism is now regarded. Its main results, or rather its main principles, are now accepted on all hands amongst scholars ; for even the French Catholics, as M. Houtin has reminded us in his Question Biblique chez les Catholiques de France (1902), are now accepting them freely, and have given to the world one Old Testament scholar at least who enjoys an European reputation, in the person of M. Loisy. It is agreed that the Prophets, not the Law, -must be the starting-point of all our study of the history of Israel, and that the Hexateuch must be recognized as a compilation of late date, the chief constituent elements of which have been distinguished and identified ; that the early parts of Genesis, down to the call of Abraham, are great religious prose poems, based upon the folk-lore which the early Israelites had inherited in common with their neighbours, and that the story of the Patriarchal period has reached us as recorded by much later generations, though it is probably based, to a large extent, upon genuine historical

tradition ; that much of the contents of the book of Judges is authentic ; and that with the books of Samuel we enter upon real and authentic history, a history which is retold from a later and biassed point of view in the Chronicles ; lastly, that the whole Levitical system was the result of a late growth, of which we can trace the stages with more or less of clearness. So far there is agreement ; and indeed it cannot be doubted that results have been reached which, so far as they go, are assured. For if it be asked, as it has been, whether the present critical ” results ” of Old Testament study may not prove to be as entirely nugatory as many of those obtained in the New Testament by the scholars of the Tubingen school, the answer is that the methods of the two are entirely different. The results of modern Old Testament study have been obtained by the use of the very same historical method which has in our own day demolished many of the conclusions of the Tubingen school. ” The Tubingen theories,” writes Professor George Adam Smith, ” were largely deductions from the principles of a certain philosophy of history. But the proofs of Old Testament criticism are not a priori : the argument is inductive, and the facts are furnished by the Old Testament itself.” Although there will doubtless be much to learn and to unlearn in the future, much at any rate is certain. Recently (1902), however, an attempt has been made by Dr Cheyne in the Encyclopaedia Biblica to use an analogous method to that of the Tubingen school, and to reconstruct the whole text of the Old Testament by a bold system of conjectural emendation, based upon what is largely an a priori assumption as to the whole course of the history of the Hebrew people. Briefly, his view is that the Hebrew people had really to do, not with Egypt and Syria, Babylon and Assyria, but with certain obscure tribes of North Arabia ; and he has amended the text of the Old Testament throughout with a view to substantiating this hypothesis. No more need be said here than that these views do not find support amongst Old Testament scholars at large ; nor would experience of the results of wholesale conjectural emendation in other fields of study (especially when made to support a preconceived idea) lead us to expect many permanent results here.

6. The New Testament.— It has been intimated already, and the fact is now generally acknow- ledged, that the result of modern critical work on the New Testament books has been to invalidate the objections which have been brought against their genuineness, and to substantiate in a remarkable

degree the view which has always been held in the Church as to their age and character. Dr Adolf Harnack has recognized this plainly, in words to which Professor Sanday has more than once called

attention : ” There was a time — the great mass of the public is still living in that time — when people felt obliged to regard the oldest Christian literature, including of course the New Testament, as a tissue of deceptions and falsifications. That time is past. For Science it was an episode in which she has learned much, and after which she has much to forget. . . . The oldest xkstomeirfT literature of the Church is in the main points and in most of its details trustworthy. In the whole New Testament there is probably but a single writing which can be called, in the strictest sense of the word, pseudonymous, the second Epistle of Peter. . . . Moreover, the number of writings inter- polated in the second century (like the Pauline epistles) is very slight, and most of the interpolations are as harmless as the interpolations of our hymn-books and catechisms. . . . Baur and his school believed themselves able to sketch an intelligible and trustworthy picture of the development of primitive Christianity only by throwing over . . . the testimony of the writings themselves . . . and by bringing down the date of composition several decades. On the assumption from which they started, that Jewish Christianity and Gentile Christianity (which they called Paulinism) were the ruling factors of the development until far beyond the middle of the second century, there was nothing for them to do but to place most of the writings late, and to look in the rest for traces (it was impossible to find more than traces) of the gradually slackening conflict. . . . The assumptions of Baur’s school are now, one may say, generally abandoned.” And he adds: “A time will come, it is already drawing near, in which men will not trouble themselves much more about the working out of problems of literary history in the region of primitive Christianity, because whatever can be made out about that will have acquired a general assent, viz., the essential accuracy of tradition with but a few unimportant exceptions. It will be recognized that in part even before the destruction of Jerusalem, in part by the time of Trajan, all the fundamental expressions of Christian traditions, doctrines, preachings, and even ordinances, were essentially complete.” No doubt this remarkable declaration would not be endorsed in

every detail by all theological scholars either in England or abroad. Indeed a Dutch scholar, Professor van Manen of Leyden, has recently denied the genuineness of all St Paul's Epistles. But he appears to stand alone, and it is quite indubitable that the great stream of critical opinion runs in this direction, and that the assured results of New Testament study are very different from what people would have expected them to be thirty years ago. Dr Rendel Harris has truly said that " Catholic traditions have a remarkable way of vindicating themselves." Before leaving the subject of the New Testament, a few words must be said with regard to the problem of the Synoptic Gospels. Upon this subject much valuable work has been done, especially in England, and its results have been to throw no little light upon the subject of their origin and relation to one another. The theory that they represent inde- synoptic pendent forms of a common oral tradition, for instance, must now be given up. Material which had been orally conveyed may no doubt underlie them, but the problem is really one of the relation of written documents. Scholars are now practically agreed that we have to do with three distinct sources : one document in Greek, containing the recollections of St Peter, which corresponds closely with our St Mark, and was used by the writers of the First and Third Gospels ; a second, also in Greek, containing discourses and very little narrative, which was also used by these two writers ; and a third " special source," whether written or unwritten, which is to be found in the Third Gospel alone. This in turn was probably written by the writer of the Acts, who was also the companion of St Paul. Dr Armitage Robinson, the Dean of Westminster, goes further ; he holds that " our St Mark " was used by the writers of both the other Synoptic Gospels, and that the Marcan and Lucan authorship of the Gospels which bear their names is practically certain, as also the Lucan authorship of the Acts. As to dates, he places St Mark about a.d. 65 (Harnack, 65-70) ; St Luke shortly after A.D. 70 (Harnack, 78-93) ; whilst he does not at present attempt to determine the date or authorship of the First Gospel with certainty (Harnack probably 70-75, except certain later additions).

7. The Outlook. — It must of course be remembered, however, that this tendency towards agreement as to the genuineness of the New Testament records does not necessarily indicate acceptance of the traditional faith : quite the reverse. It rather indicates, as was stated above, that theological

inquiry has come to a natural end in one respect and has taken a fresh direction. Dr Harnack himself goes

on to say, after the passage quoted above, that the problem of the interpretation of the documents yet remains. And since then he has given us an indication of his own solution of the problem in his

brilliant course of lectures delivered in the University of Berlin in the winter term, outfooi. 1899-1900, and subsequently published under the title Das Wesen des Christenthums. In

attempting to sum up the teaching of this book very tersely, it may not be inaccurate to say that Dr Harnack finds the essence of Christianity rather in the teaching than in the -Person of Christ, and indeed in his teaching as apart from what he said or implied of himself. He holds, in fact, that Christianity as such has no Christology : just as elsewhere he has said that the history of dogma, ” by laying before us the process of the origin and development of dogma, offers the most appropriate means for delivering the Church from dogmatic Christianity.” That this tendency is at variance with the tendency which has been predominant in theology during recent years is indubitable ; and as little can it be doubted that it is at the present time very strong. There are not a few things which tend in the same direction. There is a widespread feeling of hesitation as to the Virgin Birth of our Lord, based not so much upon any intellectual difficulty as to Incarnation itself as upon the scientific difficulty of conceiving of such a breach of the order of nature. There are difficulties as to the Gospel miracles, as to the nature of Christ’s offering for sin, and the like. There are, in brief, all the difficulties which arise from the fact that, in Sir Oliver Lodge’s words, ” Orthodox modern science shows us a self-contained and self-sufficient universe, not in touch with anything beyond or above itself — the general trend and outline of it known — nothing supernatural or miraculous, no intervention of beings other than ourselves being conceived possible.”

It would be at once fallacious and useless to endeavour to forecast in detail the probable course or the exact outcome of this new direction of theological speculation. But the theologian, with the experience of the past behind him, has no need to face the future with apprehension. He may easily be proved wrong : he knows, in fact, that his own partial view of Truth must fail, but not the Truth itself. Dr J. R. Illingworth has given expression as follows to the theologian's standpoint in the matter : " If we look back on the years that are past, we see that men have often thought the Christian Faith to be on its trial, when they, in fact, themselves were being tried by the Faith. It has remained, whether they in their brief lifetime kept or lost it, to test their sons, as; it had tested them. Celsus would have been unknown to us but for Origen, and Julian but for Cyril ; in each case it was the Christian who survived. And we may be sure that the same will be the case in the end with the various problems of the present day. Minds may doubt, and hearts may fail, when called to face new modes of thought, or points of view ; but the time must come when what is false in all these things will fade, and what is true will no more seem strange ; and we shall then see that the fears to which they once gave ~ise were but phases, that were soon to pass, in the age-long life of the great religion of the Incarnation.''

ENCYCLOPAEDIA BRITANMCA.

(NEW VOLUMES.)

STRACHEY-STRACHEY

Strachey, Sir John (1823), British Indian

civilian, fifth son of Edward Strachey, was born in Lon- don on 5th June 1823. After passing through Hailey- buiy, Strachey entered the Bengal civil service in 1842, and served in the North-Western Provinces until 1861, occupying many important positions. In 1861 Lord Canning appointed him president of a commission to investigate the great cholera epidemic of that year. In 1862. he became Judicial Commissioner in the Central Provinces. In 1864, after the report of the Royal Com- mission on the sanitary condition of the army, a perma- nent Sanitary Commission was established in India, and Lord Lawrence appointed Strachey as president. In 1866 he

became Chief Commissioner of Oudh, having been chosen by Lord Lawrence to remedy as far as pos- sible the injustice done after the Mutiny by the confisca- tion of the” rights of tenants and small proprietors of land, maintaining at the same time the rights of the Talukdars. As member of the Legislative Council he introduced several Bills for that purpose, which, with the full ap- proval of the Talukdars, passed into law. In 1868 he became member of the Governor-General’s Council, and on the assassination of Lord Mayo in 1872 he acted tem- porarily as Viceroy. In 1874 he was appointed Lieuten- ant-Governor of the North-Western Provinces. In 1876, by request of Lord Lytton and the Secretary of State, he consented to relinquish that office, and returned to the Governor-General’s Council as financial minister, which post he retained until 1880. During this time, while Lord Lytton was Viceroy, important reforms were carried out. The measures for decentralizing financial adminis- tration, initiated under Lord Mayo, were practically com- pleted. The salt duties were reduced, and the system under which they were levied was altered, and that op- probrium of our administration, the inland customs duties, were abolished. The removal of all import duties, in- cluding those on English cotton goods, and the establish- ment of complete free trade, was declared to be the fixed policy of the Government, and this was in great measure carried into effect before 1880, when Strachey left India.

The defective system on which the military accounts were kept occasioned a very erroneous estimate of the cost of the Afghan war o”f 1878-80. For this error Strachey was technically responsible, and it was made the occasion of a violent party attack which resulted in his resignation. The fact that almost the entire cost of the war was paid for out of revenue is a conclusive proof of the state of financial prosperity to which India attained as the result of his administration. From 1885 to 1895 Strachey was a member of the Council of the Secretary of State for India. He is joint author with Sir Richard Strachey of The Finances and Public Works of India (1882), besides writing India (2nd ed., 1894), and Hastings and the Rohilla War (1892).

See also the article India : Recent History.

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Strachey, Sir Richard (1817- dier, Indian administrator, third son of Edward Strachey, was born 24th July 1817, at Sutton Court, Somersetshire. From Addiscombe he passed into the East India Com- pany's Engineers in 1836, and was employed for some years on irrigation works in the North-Western Provinces. He served in the Sutlej campaign of 1845-46, and was at the battles of Aliwal (where he served on Sir ' Harry Smith's staff) and Sobraon, was mentioned in despatches, and received a brevet-majority. During the Mutiny of 1857 he served under Sir John Peter Grant as secretary to the government of the Central Provinces during the six months this government lasted. From 1858 to 1865 he was chiefly employed in the Public Works Department, either as acting or permanent secretary to the Government of India, and from 1867 to 1871 he filled the post of Director-General of Irrigation, then specially created. During this period the entire administration of public works was reorganized to adapt it to the increasing magnitude of the interests with which this department has had to deal since its establishment by Lord Dalhousie in 1854. For this reorganization, under which the accounts were placed on a proper footing and the forest administration greatly developed, Strachey was chiefly

responsible. He also initiated the policy of constructing public works on a large scale by direct State agency with borrowed funds. Under his supervision plans were drawn up and the first steps taken for the systematic develop- ment by this means of irrigation canals and railways over the whole of India. Eichard Strachey's work in con- nexion with Indian finance was important. In 1867 he prepared a scheme in considerable detail for decentraliz- ing the financial administration of India, which formed the basis of the policy afterwards carried into effect by Sir John Strachey under Lord Mayo and Lord Lytton. He left India in 1871, but in 1877 he was sent there to confer with the Government on the purchase of the East Indian railway, and was then selected as president of the commission of inquiry into Indian famines. In 1878 he was appointed to act for six months as financial member of the Governor- General's Council, when he made proposals for meeting the difficulties arising from the depreciation of the

rupee, then just beginning to be serious. These proposals did not meet with the support of the Secretary of State. From that time he continued to take an active part in the efforts made to bring the currencies of India and England into harmony, until in 1892 he was appointed a member of Lord Herschell's committee, which arrived at conclusions in accordance with the views put forward by him in 1878. He attended in 1892 the International Monetary Conference at Brussels as delegate for British India. Strachey was a member of the Council of the Secretary of State for India from 1875 to 1889, when he resigned his seat in order to accept the post of chairman of the East Indian Railway Company. Strachey's scientific labours in connexion with the geology, botany, and physical geography of the Himalaya were considerable. He devoted much time'to meteorological research, was largely instrumental in the formation of the

Indian Meteorological Department, and became chairman of the Meteorological Council of the Royal Society in 1883. Prom 1888 to 1890 he was president of the Royal Geographical Society. In 1897 he was awarded one of the Royal medals of the ^Royal Society, of which he has been a fellow since 1854.

Straits Settlements, the collective name given to the British possessions on or adjacent to the main- land of the Malay Peninsula, as opposed to the Federated Malay States, the , British protectorates in the same region. The Straits Settlements consist of the island of Singapore, the town and territory of Malacca, the islands and territory of the Dindings, the island of Penang, sometimes called Prince of Wales Island, and Province Wellesley. The Cocos or Keeling Islands, which have been settled and are still owned by a Scotch family named Ross, and Christmas Islands were formerly attached to Ceylon, but in 1886 the care of these islands was transferred to the Straits Settlements. The Governor of the Straits Settlements is also High Commissioner for the Federated Malay States of the Peninsula and for Borneo. Resident councillors are stationed at Penang and Malacca. British Residents control the native states of Perak, SSlangor, Pahang, and the NSgri S6mbilan, but since 1st July 1896, when the states were federated, a Resident- General, responsible to the High Commissioner, has been placed in supreme charge of all the protectorates of the Peninsula. The work of administration, both in the colony and in the Federated Malay States, is

carried cfn by means of a civil service which is recruited by com- petitive examinations held annually for the purpose in , London.

The following are the areaand population, with details of race distribution, of the colony of the Straits Settlements : —

Area in Square Miles.

Population in 1891.

Population in 1901.

Total.

Euro- peans.

Eura- sians.

Chinese.

Malays.

Indians.

Other Nationali- ties.

Singapore

Penang, Province Wellesley, \ and Dindings . . . / Malacca ....

206 381 659

184,554

235,618

92,170

228,555

248,207

95,487

3824

1160

74

4120 1945 1598

164,041 98,424 19,468

36,080

106,000

72,978

17,823

38,051

1,276

2667

2627

93

Total

1246

512,342

572,249

5058

7663

281,933

215,058

57,150

5387

The population, which was 306,775 in 1871, and 423,384 in 1881, had in 1901 reached a total of 572,249. As in former years, the increase is solely due to immigration, more especially of Chinese, though a considerable number of Tamils and other natives of India annually settle in the Straits Settlements. The total number of births registered in the colony during the year 1900 was 14,814, and the ratio per 1000 of the population during 1896, 1897, and 1898 respectively was 22-18, 20-82, and 21-57 ; while the number of registered deaths for the years 1896-1900 gave a ratio per 1000 of 42-21, 36-90, 30-43, 31-66, and 36-25 respect- ively, the number of deaths registered during 1900 being 23,385. The cause to which the excess of deaths over • births is to be attributed is to be found in the fact that the Chinese and Indian population, which numbers 339,083, or over 59 per cent, of the whole, is composed of 261,412 males and 77,671 females, and only a small number of the latter are married women and mothers of families. The male Europeans also outnumber the females by about two to one ; and among the Malays and Eurasians, who alone have a fair proportion of both sexes, the infant mortality is always excessive, this being due to early marriages and other well- known causes. In 1898, 133,558 Chinese immigrants landed in the Straits ; in 1899 the number reached 149,697, and in 1900, 200,947. Of the immigrants in 1898, 106,983 landed in Singapore, the total number of males being 90,321, of females 6192, and of children 4470. The immigrants to Penang in 1898 numbered 25,939, 21,227 being males, 2939 being females, and 1770 being children. The immigrants to Malacca numbered 636 — Viz., 612 men, 12 women, and 12 children. The number of Indian immigrants from Madras ports during 1898 was 18,814, in 1899, 19,519, and in 1900, 41,707.

In 1867, the date of the transfer of the colony to the Crown, the total population was estimated at 283,384.

The revenue, which in 1868 only amounted to $1,301,843, had risen in 1900 to $5,386,927. Of this sum $3,317,698 was derived from duties on opium and spirits, $288,540 from land revenue, $235,405 from postal revenue, and $199,552 from port and harbour dues. The expenditure, which in 1868 amounted to $1,197,177, had risen in 1900 to $6,037,084. The total cost of administrative establishments amounted to $1,775,771, the military expenditure to $956,051, public works to $1,814,621, while $110,675 were ex- pended on education.

The ports of the colony are all free. In 1867 the total burden was 1,237,700 tons of shipping entering and leaving the ports of the colony, as against 17,440 ships in 1900, with an aggregate tonnage of 14,469,400. This is exclusive of 33,941 native craft of a gross 1,445,548 tons entering and clearing. The total value of the united imports and exports in 1807 was only £14,040,000, as against £52,500,000 in 1900, exclusive of treasure. The imports for 1900 were valued at £28,250,000, and the exports at £24,250,000. The imports from the United Kingdom for 1900 were valued at close upon 3J millions. Tin ore to the value of £6,076,760 was exported from the colony during 1900, but none of this is produced in the colony itself, almost the whole of it being brought from the Feder- ated Malay States.

Malacca, the Malay States (Federated)— comprising Perak, Selangor, the Negri SSmbilan— and Pahang, Prince of Wales Island or Penang, and Singapore are treated of in separate articles.

The Dindings belonged originally to Pgrak, and was ceded to

the British Government under the treaty of Pangkor in 1874. Hopes were entertained that its excellent natural harbour would be utilized, but these have been doomed to disappointment, and the islands, which are sparsely inhabited and altogether unimportant both politically and financially, are now administered by the gov- ernment of PSrak.

Province Wellesley, which lies opposite to Penang, was ceded to Great Britain by the sultan of KSdah in 1798. It marches with Pgrak on the south. The boundary was rectified by treaty with Siam in 1867. It is administered by a District Officer, who is responsible to the Resident Councillor of Penang. The country consists for the most part of a fertile plain, thickly populated by Malays, and occupied in some parts by sugar-planters employing Tamil and Chinese labour. About an eleventh of the whole area is covered by low hills thickly wooded. Large quantities of rice are grown by the Malay inhabitants. A railway to Batu Kawan, opposite to Penang, is now (1902) in course of construction in con- junction with the line being built through the Federated Malay States, and when completed this will establish communication by rail between Penang and Malacca.

See Straits Settlements Blue-Books, Annual Reports, 1897 and 1898. Singapore, 1898 and 1899. — Journal Straits Branch of the Boyal Asiatic Society. Singapore. — Sir Frederick Weld, “Straits Settlements,” and Sir William Maxwell, “Straits Settlements,” Journal of Boyal Colonial Institute. London, 1884 and 1892. — Henry Norman. The Far East. London, 1894. — The Straits Directory. Singapore, 1900. — The annual summaries contained in the issues of the Straits Times and Singapore Free Press, published on 2nd January of each year. — Life of Sir Stamford Baffles. London, 1856. — Life of Sir Stamford Baffles. London, 1898. (H. cl.)

Strakonitz, the chief town of a government dis- trict in southern Bohemia, Austria, at the confluence of the Wolinka with the Wottawa river, 33 miles north-west of Budweis. Considerable textile industry, comprising the manufacture of the red Turkish fez, cloth and woollen stuffs, hosiery, hats, soap, perfumes, and soda-water ; and trade in corn, pigs, timber, and industrial products. Population (1890), 5419 ; (1900), 5501, Czech. The ad- joining commune of Neu-Strakonitz has 2002 inhabitants, also Czech.

Stralsund, a seaport town of Prussia, in the pro- vince of Pomerania, on the west side of Strelasund, the channel which separates Rligen from the mainland, and 139 miles by rail north of Berlin. A steam railway ferry connects it with Riigen. In the town hall, restored in 1882, are preserved the provincial antiquarian museum and the town library (70,000 vols.). There is

a fine monument (52 feet high) of the war of 1870-71 (1886), and another (1862) to the local patriot Schill, who was killed here in 1809 ; also a school of navigation and a deaf and dumb asylum. Population (1885), 28,984 ; (1900), 31,083.

Strangford, Percy Ellen Frederick William Smythe, 8th Viscount in the peerage of Ireland, and 3rd Baron Penshtjest of the United Kingdom (1826-1869), was the youngest son of the 6th Viscount, who served long in the diplomatic service, rising to be ambas- sador in Russia and Turkey. He was born at St Peters- burg, 26th November 1826. During all his earlier years Percy Smythe was nearly blind, in consequence, it was believed, of his mother having suffered very great hard- ships on a journey up the Baltic in wintry weather shortly before his birth. His health through life was very deli- cate, but did not prevent his showing quite early most remarkable powers of mind. His education was begun at Harrow, whence he went as a “postmaster” to Merton. From the very first he gave proofs of extraordinary ability as a linguist, and was nominated by the vice-chancellor of Oxford in 1845 a student-attache at Constantinople. A very interesting account of his colleagues, more especially of Mr Almerick Wood, who was a man of phenomenal capacity, was written by him later in life, and is to be found in the two volumes of his collected essays pub- lished by his widow. While at Constantinople, where

he served under Lord Stratford de Redcliffe, Percy Smythe gained a mastery not only of Turkish and its dia- lects, but of almost every form of modern Greek, from the language of the literati of Athens to the least Hellenized Romaic. Before he went to the East he had a large know- ledge both of Persian and Arabic, but until his duties led him to study the past, present, and future of the sul- tan’s empire he had given no attention to the tongues which he well described as those of the international rubble in and around the Balkan peninsula. He made, while in the East, a careful study of these, and was the first Englishman to see that the Bulgarians were much more likely than the Servians to come to the front as the Ottoman power declined. He avowed himself a Liberal in English politics, and those with whom he chiefly lived were Liberals ; but he was not an anti-Turk, as so many Liberals afterwards became. In 1857 the brilliant but erratic 7th Lord Strangford, better known as George Smythe, ended his unfortunate career,

and Percy succeeded to the peerage. He did not, however, abandon the East, but lived on at Constantinople for several years, immersed in Oriental studies. At length, however, he returned to England and began to write a great deal, sometimes in the Saturday Review, sometimes in the Quarterly, and much in the Pall Mall Gazette. A rather severe review in the first of these organs of Miss Beaufort's Egyptian Sepulchres and Syrian Shrines led to a result not very usual — the marriage of the reviewer and of the authoress. One of the most interesting papers Lord Strangford ever wrote was the last chapter in his wife's book on the Eastern Shores of the Adriatic. That chapter was en- titled "Chaos," and was the first of his writings which made him widely known amongst careful students of foreign politics. From that time forward everything that he wrote was watched with intense interest, and even when it was anonymous there was not the slightest difficulty in recognizing his style, for it was unlike any other. Many able men were writing for the press during the 'sixties, but Strangford, alike in his knowledge and his way of putting it, was unique. He did not get stronger as his life advanced, and when a slight chill, one January morning, put an end to his fragile existence, he left no one who could guide his countrymen so well as he could through the labyrinth of the twenty different questions of which he used to say that the "Eastern Question" was composed.

A selection from the writings of Viscount Strangford on political, geographical, and social subjects, in two volumes, was edited by the Viscountess Strangford (Bentley, 1868). His letters and papers upon philological and kindred subjects were also edited by the Viscountess Strangford (Trubner, 1878). (m. g. d.)

Stranraer, a royal burgh of Wigtownshire, Scotland, at the head of Loch Ryan, about 50 miles south-south-west of Ayr by rail. There are" two large dairy implement factories and creameries. In 1888, 770 vessels of 101,745 tons entered ; in 1898, 828 vessels of 183,297 tons. The east pier has been extended, a new station built, and a cottage hospital opened. There is an academy under the school board. Population (1891), 6193 ; (1901), 6009.

Strasburg (German, Strassburg), a town and first- class fortress of Germany, capital of Alsace-Lorraine, stands 2 miles from the left bank of the Rhine,

88 miles by rail north of Basel. It is the see of a Roman Catholic bishop and the headquarters of the 15th German Army Corps, with a garrison of 15,000 men. With the exception of Berlin, there is perhaps no town in Germany which can show so many handsome new public buildings as Stras- burg. These are for the most part connected with the re- suscitated university of 1872, and are almost entirely in the Renaissance style of architecture. The lecture halls are

contained in a building (1877-84) which is adorned by statues, frescoes, &c, by modern German artists, and has near it the chemical, physical, botanical, geological, and zoological institutes, also the observatory, all designed by H. Eggert, and built between 1877 and 1888. On the south of the old town are, further, the various schools, laborato- ries, and hospitals of the medical faculty, all built since 1877. In the same quarter as the university — namely, on the north-east of the old town — are the imperial palace (1883-89), designed by Eggert in the Elorentine Renais- sance style, crowned by a cupola 115 feet high, and richly ornamented. The provincial and university library (1889-94) and the hall of the provincial government (Landesausschuss), built in 1888-92, both of Pf alzbur g white sandstone, in the Italian Renaissance style, occupy the opposite side of the Emperor Square, and behind the latter is the large new post office. A little behind the imperial palace stands the Young St Peter (Roman Catholic) church (1889-93), with a conspicuous cupola. Between the university and the library is the Evangelical garrison church (1892-97), built of reddish sandstone in the early Gothic style. The castle, in the Minster Square1, after being used for university purposes from 1871 to 1895, was in 1898 converted into the town art museum (a picture gallery). A new synagogue was completed in 1898. The viceregal palace was entirely rebuilt in 1872-74. In addition, there may be mentioned the new law courts, the Roman Catholic garrison church, the iron bridge across the Rhine to KeKl, built in 1897, the fountain (1895) in the Wine Market, the conservatory of music, industrial art school and museum, botanical garden, seminaries for teachers (both sexes) and for theological students, and a deaf and dumb asylum. In 1900 the university, which has four faculties, was attended by 1145 students and had 129 professors. Since 1870 the trade of the town has grown very considerably,

and has been promoted by a new port of 250 acres extent, with quays and wharves on the Rhine, constructed since 1891. Strasburg is not an industrial town of any magnitude. Population

(1890), 123,500 ; (1900), 150,268.

See Dacheux. Das Munstervon Strassburg (60plates, 2nded.). Strasburg, 1898. — Eheberg. Verfassungs, &c. Geschichte der Stadt Strassburg bis 1681. Strasburg, 1899, et seq.

Strategy.1 — The exact meaning of the word ” strategy ” is as generally misunderstood as the study of the art it describes is generally neglected. By Definition eiv^ians it is continually confounded with ” tactics ” (q.v.), and it would seem that even soldiers are not always quite clear as to the essential distinction between the two main branches of their pro- fession. Yet such confusion is not due to the want of definition. Almost every military writer of repute has tried his hand at it, and the only embarrassment is to choose the best. The last perhaps will serve our purpose as well as any other. Strategy, according to the official text-book of the British infantry, is the art of bringing the enemy to battle, while tactics are the methods by which a commander seeks to overwhelm him when battle is joined. It will thus be seen that strategy leads up to the actual fighting — that is, to the tactical decision; but that while the two armies are seeking to destroy each other it remains in abeyance, to spring once more into operation as soon as the issue is decided. It will also be observed that the end of strategy is the pitched battle ; and it is hardly necessary to point out that the encounter at which the strategist aims at is one in which every possible advantage of numbers, ground, sup- plies, and moral shall be secured to himself, and which shall end in his enemy’s annihilation.

1 This article deals with strategy in the field. For strategy as connected with preparation for war, see the article on War.

The means by which this desirable consummation is attained are many, but the guiding principle is generally the same, and may be summed up in Napoleon’s dictum, ” The secret of war lies in the communications.” The line of supply may be said to be as vital to the existence of an army as the heart to the life of Stfamtoie. a human being. Just as the duellist who findg

his adversary’s point menacing him with certain death, and his own guard astray, is compelled to conform to his adversary’s movements, and to content himself with warding off his thrusts, so the commander whose communications are suddenly threatened finds himself in a false position, and he will be fortunate if he has not to change all his plans, to split up his force into more or less isolated detachments, and to fight with inferior numbers on ground which he has not had time to pre- pare, and where defeat will not be an ordinary failure, but will entail the ruin or the surrender of his whole army.

This great principle is common both to the offensive and the defensive. In the first case, the strategist is generally confronted with the following problem : The enemy holds a strong position ; how is he to p^bfems be forced out of it ? In the second, the difficulty may be stated thus : The enemy is advancing in superior numbers; how is he to be checked? The answers are identical : By threatening or cutting his line of communications; and so reducing him to the situation described in the preceding paragraph. It is evident, however, that so vulnerable a point will be most carefully guarded ; and, also, that the application of the principle is complicated by the fact that it is two-edged, or, to put it in plainer words, that a general in seeking to reach his adversary’s heart may expose his own. In short, to place a force in such a position that it either threatens or severs the enemy’s line of supply is not only a difficult but a hazardous operation which, unless the force is overwhelm- ingly superior, and can push its way through all obstacles by sheer weight of numbers, can never be carried out except by stratagem and manoeuvre.

The scope and nature of such expedients must to a great extent depend upon the circumstances of the particular case. There are certain principles, _ . _ however, which serve as guides ; and it will be tion of seen that they are all accessory to # rule of superior strategy which is intimately connected with /oree- that which bids us strike at the enemy’s communications, viz., the concentration of superior strength, physical and moral, on the field of battle.

” How often,” says Napier, ” have we not heard the genius of Buonaparte slighted, and his victories talked of as destitute of merit, because at the point of attack he was superior in number to his enemies ! This very fact,

which has so often been converted into a sort of reproach, constitutes his greatest and truest praise. He so directed his attack as at once to divide his enemy and to fall with the mass of his own forces upon a point where their divi- sion, or the distribution of their troops, left them unable to resist him. It is not in man to defeat armies by the breath of his mouth; nor is Buonaparte commissioned, like Gideon, to confound and destroy a fort with 300 men. He knew that everything depended ultimately upon physical superiority ; his genius is shown in this, that although outnumbered on the whole, he was always superior to his enemies at the decisive point.”

We will now take the case of an army superior in numbers, and note down in succession the methods by which those numbers may be reduced by an Metnods t adversary who is operating against its commu- overcoming nications : — (a) If the superior army is not superior yet concentrated, or is so distributed that the numbers- different parts cannot readily support each otherl it may be defeated in detail, (b) If the superior army is con- centrated, its commander, by one means or another, may be induced to make detachments, and thus be weak everywhere.

STRATEGY

To accomplish (a) the means are : — 1. More rapid mobi- lization. 2. Surprises, effected by hard marching, secrecy, feints, and the adoption of an unexpected line of opera- tions.

To accomplish (&) : — 1. The skilful use of detached forces, threatening points which the enemy is bound to protect, such as his immediate base of operations, or his line of supply. 2. Concealment, begetting uncertainty and apprehension. 3. Drawing the enemy forward into ” a zone of manoeuvre ” where topographical obstacles, the difficulties of supply, or judicious feints, will compel him to split up his army.

In addition to these shifts of war, which are more or less aimed at the hostile army, there are others which are aimed almost exclusively at the hostile general. The moral equilibrium of the commander is often of even greater importance than the spirit of his trdops. If that equilib- rium can be upset, or his imagination so played upon that he gives way to recklessness, over-

confidence, or de- spair, victory should be very near. The methods which may be employed are numerous : —

1. Drawing the enemy into a trap by an apparent dis-

persion of the forces against him.

2. Feigned retreat, inducing the enemy to pursue need-

lessly, and so commit mistakes.

3. Spreading false information.

4. Changing the base, and adopting a new and unex-

pected line of operations. This is one of the

most effective weapons in the armoury of the

strategist, who thereby not only secures great

freedom of manoeuvre, but may completely baffle

his adversary's penetration.

Lastly, there are two great principles which are the.

foundation and the crown of all strategical methods, and

which strike heavily and directly at the moral both of

the hostile commander and of the troops he commands.

They have been defined for us by Stonewall Jackson: —

1. Always mystify, mislead, and surprise the enemy.

2. Never give up the pursuit so long as your men have

strength to follow, for an army routed, if hotly pur- sued, becomes panic-stricken, and can be defeated by half their numbers. To move swiftly, strike vigor- ously, and secure all the fruits of victory is the secret of successful war. It will be noted that some of those principles are to a certain extent conflicting. The concentration of the whole army in one body is undoubtedly a rule which is not to be infringed with impunity, and yet pr™c%te7 the use of detached forces is continually re- noi to be commended as the surest means of making the pedantic- ellemv disperse his troops or commit other mis- a”yapp”e “• takes. The fact is, however, that strategical principles are neither to be rigidly applied nor overscru- pulously respected. They are to be obeyed rather in the spirit than the letter; and the strategist, to be successful, must know exactly how far he can go in disregarding or in modifying them, and be ingenious enough to bring those into adjustment which are apparently irrecon- cilable. For instance, a superior army may derive the greatest advantage from a breach of the rule of con- centration. If it divides at the outset into two wings, each approaching the enemy on a different line, and pos- sibly supplied from a different base, it may not only cause the enemy the very greatest embarrassment, but eventually crush him between them, as Napoleon was crushed between the English and the Prussians at Water- loo, or Benedek between the Crown Prince and Prince Frederick Charles at Koniggratz, or Hooker between Lee and Jackson at Chancellorsville. It is to be observed, however, that the breach of rule is more apparent than real, in that concentration is merely deferred to the field

of battle instead of taking place before the troops march against the enemy. Thus, although the letter is in- fringed, the spirit is respected.

But because a partial application, or even an absolute disregard, of the principles of strategy does not neces- sarily spell disaster, it is not to be assumed that they are merely theoretical and pedantic formulae. A But also general who was an absolute slave to them — not to be who obstinately refused, for example, to make a safety detachment — would probably fail to achieve te°ored- decisive success ; but a general who acted in defiance of them would, to put it in the mildest form, run enormous risk. This is well shown by the campaign of Waterloo. Wellington and Blucher, at the outset, were not concen- trated, and despite the fact that they had 210,000 men

against Napoleon’s 130,000, they had certainly the worst of it in the opening operations. Two days after their retreat from the line Quatre Bras-Ligny they retrieved the situation at Waterloo, concentrating successfully on the field of battle ; but even on 18th June, with all their numerical superiority, there were times when victory hung in the balance. It is thus quite clear that de- parture- from the established principles involves great dangers, and it is therefore impossible to deny that those principles are no dry-as-dust apothegms, but living forces, permeating the whole art of strategy and exerting absolute control over the issue of a cam- paign.

The array of principles, as set out above, is by no means formidable, yet it contains all those that are abso- lutely essential in the field; and it might be imagined, therefore, that the practice of strategy is exceedingly easy. The exact contrary, however, is the case ; and this arises mainly from the fact that the operations of war are carried out in such obscurity, that Tbe dlftl, it is always difficult for a general to see cutties of his way to the application of the ruling prin- strategy. ciples. It is on this point that soldiers have such deep distrust of civilian critics. The latter, as a very general rule, judge after the event. Ignorant of the practical difficulty, not to say the impossibility, of obtaining accu- rate information, and oblivious of the fact that so long as troops are mobile the military situation may be entirely changed in the course of a few hours, they almost invari- ably assume that the general, when he made his plans, must have been acquainted with the exact condition of affairs within the hostile lines.

The soldier, on the other hand, is aware that full knowledge on any one point connected with the enemy is very seldom forthcoming ; that the data of the prob- lems to be solved are never clear ; that the condition of affairs has always to be more or less inferred; and that almost every operation is so involved in uncertainty, from beginning to end, that success is invariably a matter of doubt. ” I have fought,” said Wellington, ” a sufficient number of battles to know that the result is never certain, even with the best arrangements ” ; and it is within the experience of all those who have had to do with strategy in the field that the density of the “fog of war” is almost appalling. For example, it would surely be imagined that a commander would have no difficulty whatever in ascertaining the direction of his adversary’s line of communications. In practice, however, especially where

comparatively small forces are concerned, this is exceedingly difficult ; and there is always the embarrassing feeling that the enemy may have estab- lished a secondary line of supply, to which he may transfer his forces at any given moment. Again, a fortress or extended camp has, in theory, what may be called a fixed value ; that is, it may be expected to hold out for a certain definite period. In war, however, the

possibilities of accident invariably appear, and often are in reality, so numerous, that calculations which are based on the strength of the garrison and the works lose all their weight ; and thus, when a fortified town is beleaguered, operations for its immediate relief become almost im- peratively necessary. It is true that operations for this end may often be strategically unsound, and that the general should consider probabilities of the case rather than the possibilities. But human nature asserts itself in war as strongly as elsewhere. It is as constant and as important a factor as the difficulty of procuring informa- tion; and it is the recognition of these elemental facts which is the great point of difference between practical and theoretical strategy.

War is assuredly no mechanical art. Broadly speaking, it is a war between the brains and the grit of the two commanders, in which each strives to outwit and outlast the other ; a conflict in which accident plays so prominent a part that mistakes, in one form or another, are abso- lutely unavoidable. It is thus pre-eminently the art of the man who dares take the risk ; of the man who thinks deeply and thinks clearly; of the man who importance ~~^hen accident intervenes is not thereby cast to tactics, down, but changes his plans and his disposi~~ tions with the readiness of a resolute and reflective mind, which, so far as is possible, has foreseen v and provided against mischance. Particularly is this the case with strategy. The tactical errors of a commander have often been redeemed by the skill and courage of his troops, but it is seldom indeed, against a vigilant enemy, that a strategical blunder does not carry its own punishment. Defeat, indeed, is far more often due to bad strategy than to bad tactics. An army may even be almost uniformly victorious in battle, and yet ultimately be compelled to

yield. So the Confederates in 1861-65, the Turks in 1877-78, the Boers in 1899-1902, despite their numerous successes, were beaten in the end ; but in each case the same strategical faults were conspicuous — the failure to concentrate in sufficient numbers to reap the fruits of victory, the unnecessary dispersion of the troops, and the deliberate disregard of the great end of strategy, viz., the annihilation of the enemy's fighting men, and the destruction of his material resources. To bring a stubborn enemy to his knees the war, like that of Borne against Carthage> "must be carried into Africa."

Strategy, then, is an art which almost more than any other is concerned with the fate of nations. Its study should be as assiduous as its practice should be learn "and correct ; and we now come to the questions, By how to whom should it be learned, and how should it be taught ? It has been the fashion to assert that strategy is the province of the few, tactics of the many ; that only those who are destined to or ambitious of high command need trouble about what is perhaps the most important branch of the art of war, and that it is therefore to be taught to staff officers alone. The fallacy of this most preposterous argument, if argument it may be called, is glaring. What soldier can possibly say that he will never be called upon to exercise an important command ? Ambitious or not, he can no more foresee the responsibilities a campaign may force upon him than he can make sure, at the critical moment, of having a trained staff officer at his elbow to suggest the right course of action. But there is more to be said than this. If only the few are possessed of a knowledge of strategy, what terribly one-sided creatures must be the remainder ! Imagine an officer being asked some question as to Wellington or Napoleon, and being compelled to confess that he knew nothing whatever of their achievements, or of the methods by which they had

teach strategy.

won so many victories ! Could a man who thus admitted that he despised the experience and the teaching of the greatest and most successful masters of his profession by any conceivable stretch of courtesy be rightly called a professional soldier ? If so, then a doctrine is applied to the profession of arms that is repudiated by every other profession, by every trade, and by

every sport, in the wide world. What would be said of a man without , the slightest knowledge of the habits of his quarry, of the importance of wind, of background, of silence, and of invisibility, who started off unaccompanied to shoot red deer in a Scotch forest ? He might be a first-rate rifle-shot, but even if he got within sight of the herd it is in the last degree impossible that he would bring back a head. He would be looked upon by the commonest gillie as the most ignorant of novices, and most assuredly he would never be called a sportsman. And yet it is openly asserted that men who may one day become generals need no more knowledge of strategy — the art of approaching the quarry — than the cockney has of forest-craft ! Is it possible to hold any other opinion than that this extraordinary doctrine is either a most impudent excuse for idleness, or an abject admission that the more intellectual branch of the art military is utterly beyond the capacity of the ordinary soldier? Yet what can be more humiliating to the great body of officers than the reflection that only a few of their number are considered capable of wielding the weapons of the great captains ; and that these few have to be bribed by high pay and good appointments to undergo the necessary study !

Nor is there any truth in the idea that the prac- tice of strategy in the field can be confined to the higher ranks. Every officer in charge of a detached force or flying column, every officer who for the time being has to act independently, every officer in charge of a patrol, is constantly brought face to face with strategical con- siderations ; and success or failure, even where the force is insignificant, will often depend upon his familiarity with strategical principles. The tide of warfare ebbs and flows on an ocean which is studded with strategical objectives. Positions, bridges, road and railway junctions, towns and villages, are always of the utmost importance to the accomplishment of a plan of campaign. Their occupation leads up, as it were by stepping-stones, to the attainment of the ultimate objective, that is, to the destruction of the enemy’s army ; and a quick recognition of their bearing on the course of operations, perhaps on the part of a very junior officer commanding a small column or conducting a reconnaissance, may go far towards the achievement of a decisive success. We accordingly arrive at the conclusion that every officer of every grade should, if it is deemed necessary that they should be professional soldiers — and it is for this that

they are paid — be thoroughly familiar with strategical principles. Let us now consider how that familiarity is to be acquired.

We have not far to go to find the whole case put before us in a nutshell. ” The only right way of learning the science of war is to read and re-read the cam- paigns of the great captains.” Such is the The lessons opinion of Napoleon ; and he is a bold man °ene^er ‘ who dares set himself in opposition to the great Corsican, who if not the finest soldier that ever lived, was at least one of the most sagacious of men. What could be more beneficial to the soldier than that the atmosphere he breathes from the first hour he determines on the pro- fession of arms should be purely military ; that the tradi- tions of the army should be constantly before him, the campaigns of great generals the groundwork of his daily study, and famous marches or manoeuvres the common- places of his ordinary knowledge ?

STRATFORD— STRATHNAIRN

It has been objected that pure theory can never be a substitute for practice, and that therefore what Napoleon intended to convey was, that the study of mili- ™

But we cannot admit that Napoleon meant anything but what he said. In the first place, it can scarcely be denied that an intimate acquaintance with the processes of war, even though it should be purely theoretical, is as useful to the young officer as a knowledge of common law to the newly-called barrister. In the second place, military history offers amore comprehensive view of those processes than even active service : the platform is loftier, and every phase of warfare, from the marches of great armies to the forays of the guerilla, comes under observation. In the third place, the art of war, as we have already seen, is crystallized in a few great principles ; and it is the study of military history alone that makes such principles so familiar that to apply them, or at all events to respect them, becomes a matter of instinct. It is not sufficient, any more than in the study of any other business, merely to place before the tyro a general summary of the maxims by which he is to be guided. He must convince himself of their scope and value by constant reference to apt illustrations. His study of the campaigns of his famous predecessors must be active and not passive; he must put himself in their place, not content with merely reading a lively narrative, but working out

every step of the operation with map and compass ; investigat- ing the reason’s of each movement; tracing cause and effect, ascertaining the relative importance of the moral and the physical, and deducing for himself the principles on which the generals acted. It is probable that he will only discover what has been discovered already. But the value of the discovery will not be in the smallest degree diminished. Far from it, for knowledge that is gained by hard labour and independent effort is of higher worth, and much more likely to be permanently absorbed, than that which comes in by the ear.

Can the truth of this be questioned ? . In every human transaction the most fruitful cause of failure and of error is the imperfect comprehension or the negMjgfc of principle. He who invariably sees the rignTTPtajtese to be Knowledge pUrsuea [s the man of ability, endwed with military that clearness of perception which may some- htstory times be a natural gift, but is more often the essential. pr0(juct 0f sound training; he who follows that course, come what may, is the man of high character, of resolution, and of genius. If men fail to do what they ought to do, it is, more often than not, because on their horizon the true principles of conduct do not stand out above the mists of passion and minor issues as beacon lights, for the one reason that the mind’s eye has not been trained to see them ; or, in other words, that they have not, by study and reflection, realized the paramount importance of these ” living oracles.” We may take it that in soldiering there is more to be

learned from the history of great campaigns .than from the manoeuvres of the training-ground. For instance, a man thoroughly penetrated with the spirit of Napoleon’s warfare would hardly fail, in all circumstances, to make his enemy’s communications his first objective; and if Wellington’s tactical methods had become a second nature to him, it would be strange indeed if he were seduced into delivering a purely frontal attack. More- over, although genius and resolution are no artificial products, there can’ be no doubt but that a man who is aware that a commander cannot hope for success without running risks, that he must be prepared to act on very meagre information, and that he will often have to decide quickly under most disturbing conditions, is more likely to do well in war than the leader who has no idea of the magnitude of the personal responsibility inseparable

from command against the enemy. Again, the study of military history results in the accumulation of a mass of facts. Now the knowledge of facts, however it may be acquired, constitutes experience; and the product of experience is habit, which, as being all-powerful in moments of excitement or danger, plays an even more important part in warfare than in any other phase of human affairs.

Lastly, a knowledge of military history not only supplies a touchstone by which actual experience, whether of peace manoeuvres or field service, may be tested, mistakes discovered, and reflection justified, but gives life and vigour to all instruction, and in the long years of peace the chief work of every officer, no matter how low or how high his rank, is the instruction of his subordinates. In every respect, then, it is absolutely clear that a knowledge of military history is an essential ingredient in the making of a really useful soldier ; and that any system of military training or education which leaves strategy untouched, except by the few, is not only an insult to the officers of the army, but a danger to the State.

(g. f. e. h.)

Stratford, a city and port of entry of Ontario, Canada, and capital of Perth county, situated 83 miles west-south-west of Toronto by rail, on the Avon river. Railway shops, flour-, saw-, and woollen-mills, engine and agricultural implement works are the principal industries. A large export trade in cheese and other dairy and farm produce is carried on. Exports for the year 1898-99 $1,954,575, and imports f 914,722. Population (1881),

8239 ; (1891), 9501 ; (1901), 9959.

, Stratford-on-Avon, a municipal borough and market town in the Stratford-on-Avon parliamentary divi- sion of Warwickshire, England, 110 miles north-west of London by rail. In the church of the Holy Trinity, which has been restored, a memorial window has been placed to thelate J. O.Halliwell-Phillipps, the Shakespearean scholar; and another window, illustrating scenes of the Incarnation, and containing figures from English and American history, has been presented by American visitors. Recreation grounds have been laid out. Recent erection s are a lecture room opposite the Shakespeare memorial, a drinking foun- tain with a clock tower, given

by an American visitor, the Shakespeare monument (1888), a hospital for infectious diseases, and a new post office. Anne Hathaway's cottage was purchased for the nation in 1892. Area, 4012 acres. Population (1891), 8318 ; (1901), 8310.

Strathnairn, Hugh Henry Rose, 1st Baron (1801-1885), British field-marshal, third son of the Right Hon. Sir George Henry Rose of Sandhills, Christ- church, Hampshire (Minister Plenipotentiary at the Prussian Court), was born at Berlin on 6th April 1801. He was educated at Berlin, and received military instruc- tion at the Cadet School. He entered the 93rd Sutherland

Highlanders as an ensign on the 8th June 1820, but was transferred to the 19th Foot, then quartered in Ireland, and took part in preserving order during the "Ribbon" outrages. He was promoted rapidly, to a lieutenancy in 1821, a captaincy in 1824, and an un- attached majority at the end of 1826. He was brought into the 92nd Highlanders as a regimental major in 1829, and the following year was appointed equerry to H.R.H. the Duke of Cambridge. The 92nd Highlanders were in Ireland, and Rose again found himself employed in maintaining law and order. He rendered important services in suppressing disaffected meetings, but his conduct was so courteous to the ringleaders that he incurred no personal hostility. In 1833 he accompanied his regiment to Gibraltar, and three years later to Malta, where he exerted himself with so much zeal during a serious outbreak of cholera in attending to the sick soldiers that his conduct elicited an official approval from the governor and commander-in-chief. In 1839 he was promoted, by purchase, to an unattached lieutenant-colonelcy. In the following year Rose was selected, with other officers and detachments of Royal Artillery and Royal Engineers, for special service in Syria under the orders of the Foreign Office. They were to co-operate on shore, under Brigadier-General Michell, R. A. — in conjunction with the Turkish troops — with the British fleet on the coast, for the expulsion of Mehemet Ali's Egyptian army from Syria. Sir Stratford Canning sent Rose from Constantinople on a diplomatic mission to Ibrahim Pasha, commanding the

Egyptian army in Syria, and after its execution he was attached, as deputy adjutant-general, to the staff of Omar Pasha, who landed at Jaffa with a large Turkish force from the British fleet. Rose distinguished himself in several en- gagements,' and was twice wounded at El Mesden in January 1841. He was mentioned in despatches, and received from the sultan the order of Nishan Iftihar in diamonds, the war medal, and a sabre of honour. The King of Prussia sent him the order of St John, and expressed his pleasure that " an early acquaintance " had so gallantly distinguished himself. Shortly after he suc- ceeded to the command of the British detachment in Syria with the local rank of colonel, and in April 1841 he was appointed British Consul-General for Syria. For seven years, amidst political complications and intrigues, Rose, by his energy and force of character, did much to arrest the horrors of civil war, to prevent the feuds between the Maronites and Druses coming to a head, and to administer justice impartially. In the first year of his appointment his action saved the lives of several hundred Christians at Deir el Khama, in,the Lebanon, and his services were warmly recognized by Lord Aberdeen in the House of Lords, and he was made OB. In 1845, by his promptness and energy, at great personal risk, he rescued 600 Christians belonging to the American mission at Abaye, in the Lebanon, from the hands of the Druses, and brought them to Beyrout. In 1848, during the out- break of cholera at Beyrout, he was most devoted in his attention to the sick and dying.

At the end of this year he left Syria on leave of absence, and did not return, as Lord Palmerston appointed him secretary of embassy at Constantinople in January 1851. In the following year he was chargd d'affaires in the absence of Sir Stratford Canning during the crisis of the question of the "holy places," and he so strengthened the hands of the Porte by his determined action that the Russian attempt to force a secret treaty upon Turkey was foiled. During the war with Russia in 1854-56 Rose was the British commissioner at the headquarters of the French army, with the local rank of brigadier-general. At Varna he succeeded in quenching a fire which threatened the

French small-arm ammunition stores, and received the thanks of Marshal St Arnaud, who recommended him for the Legion of Honour. He was present at the battle of the Alma, and was wounded on the following day. At

Inkerman he reconnoitred the ground between the Brit- ish and French armies with great sang froid under a withering fire from the Russian pickets, and his horse was shot under him. He distinguished himself on several other occasions in maintaining verbal communi- cation between the allied forces, and by his tact and judgment contributed to the good feeling that existed between the two armies. His services were brought to notice by the commanders-in-chief of both armies, and he received the medal with three clasps and the thanks of Parliament, was promoted to be major-general, and was made K.C.B. and commander of the Legion of Honour. On the outbreak of the Indian Mutiny in 1857 Rose was given command of the Poona division. He arrived in September, and shortly after took com- mand of the Central India force. In January 1858 he marched from Mau, captured Rathgarh after a short siege, and defeated the raja of Banpur near Barodia, in the same month. He then relieved Sagar, captured Garakhot and the fort of Barodia, and early in March defeated the rebels in the Madanpur Pass and cap- tured Madanpur, Narut, Sorai, and Chandairi, when the district was evacuated by the mutineers. He arrived before Jhansi on the 20th March, and during its invest- ment defeated a relieving force under Tantia Topi at the Betwa on 1st April. Jhansi was stormed and the greater part of the city taken on the 3rd, and the rest the follow- ing day, and the fort occupied on the 5th. Kunch was captured after severe fighting, in a temperature of 110° Fahr. in the shade, on the 7th May. Rose was only able to hold out by medical treatment, and many casualties occurred from the great heat. Under the same conditions the march was made on Kalpi. The rebels came out in multitudes on 22nd May to attack his small force, ex- hausted by hard marching and weakened by sickness, and after a severe fight under a burning sun, and in a sufft> eating hot wind, were utterly routed and Kalpi occupied the following day. Having completed his programme, Rose obtained sick leave, and Sir Robert Napier (.) was appointed to succeed him, when news came;of the* defection of Sindia’s troops and the occupation of Gwalior by Tantia Topi. Rose at once resumed command, and moved on Gwalior by forced marches, and on 16th June won the battle of Morar. Leaving Napier thei%, he attacked Gwalior on the 19th, when the city was captured. The fortress was stormed and won the following day, and Napier gained a signal victory over the flying enemy at Jaora-Alipur on the 22nd. Rose then made over the com- mand to Napier and returned to Poona. For his services he received the medal with clasp, the thanks of both Houses

of Parliament, the regimental colonelcy of the 45th Foot, and was creattgpG.C.B. By a legal quibble the Central India fo*M^^fc|.protracted litigation, was not allowed its shareWprizelnoney, a loss to Rose of £30,000. Rose was prom oted lieutenant-general for his ” eminent services ” in February I860, and the next month was appointed commander-in-chief of the Bombay army, and on the departure of Lord Clyde from India in the following June he succeeded him as commander-in-chief in India. Duringhis tenure of the commander-in-chief Rose improved the discipline of the army, while his powerful assistance enabled the changes consequent upon the amalgamation of the East India Company’s army with the Queen’s army to be carried out without friction. He was created K.S.I, in 1861 and G.C.S.I. on the enlargement of the order. On his return home he was made an honorary D.C.L. of Oxford University.

Rose held the Irish command from 1865 until 1870, was raised to the peerage in 1866 as Baron Strathnaim of Strathnaim and Jhansi, transferred to the colonelcy of the 92nd Foot, and appointed president of the Army Transp’ort Committee. By a good organization and dis- position of the troops under Ms command in 1866 and 1867 he enabled the Irish Government to deal success- fully with the Fenian conspiracy. He was promoted general in 1867. On relinquishing the Irish command he was made an honorary LL.D. of Trinity College, Dublin. . For the rest of his days he lived generally in London. He was gazetted to the colonelcy of the Royal Horse Guards in 1869, and promoted to be field-marshal in June 1877. He died in Paris on the 16th October 1885, and was buried with military honours in the grave- yard of the Priory Church, Christchurch, Hampshire. An equestrian bronze statue, by E. Onslow Ford, E.A., was erected to his memory at Knightsbridge, London. He was never married. (k. h. v.)

Strath peffer, a village and spa of Scotland, in the county of Ross and Cromarty, scattered over the sides of a Highland valley, 5 miles west from Dingwall. It is sheltered on the west and north, and has a relatively dry, warm climate. The waters are sulphurous and chalybeate, the former being of especial strength and the latter effer- vescent. Here also there is a peat

bath, like those of Franzensbad in Bohemia. There are four springs, a pump-room, a pavilion and reading-room, Established and United Free churches, an Episcopalian chapel, and a golf- course. The neighbourhood boasts of a vitrified fort (at Knockfarrel), and an old building known as Castle Leod. Population (1901), 354.

Straus, Ludwig (1835-1899), Austrian violinist, was born at Pressburg, 28th March 1835, and was a pupil

at the Vienna Conservatorium from 1843 to 1848, as a pupil of Bohm ; made his first appearance in 1850, and five years afterwards made a tour in Italy ; in 1857 he became acquainted with his lifelong friend Piatti, and toured with him in Germany and Sweden. From 1860 to 1864 he was concert-meister at Frankfort, and during these years he visited England frequently, in the year 1864 taking up his residence there. He was for many years leader of Halle's orchestra in Manchester, and a familiar figure at the Popular Concerts in London. He was first violin in the Queen's Band. He retired, owing to ill-health, in 1893, and from that time till his death, 23rd October 1899, lived at Cambridge. His playing, whether of violin or viola, had very great qualities ; he was perfect in ensemble, and his power of self-effacement was of a piece with his gentle disposition and with the pure love of art which distinguished him through life. A more lovable nature never existed, and his quiet influence on the art of his time was very great. (j. a. f. m.)

Streator, a city of Lasalle county, Illinois, U.S.A. It is on the Vermilion river, toward the northern part of the state, at an altitude of 625 feet. It is on the river bluffs, has a regular plan, good water supply and sewer- age system. It has five railways — the Atchison, Topeka, and Santa Fe'; the Chicago, Burlington, and Quincy ; the Chicago and Alton ; the Indiana, Illinois, afid Iowa ; and the Wabash, giving it much importance • as a railway centre. It is in a coal region, and clay for brick and tile is abundant in its vicinity. Its industries include brick- yards, sewer-pipe, and tile factories, glass factories, and flour and planing mills. Population (1880), 5157; (1890), 11,414; (1900), { 14,079, of whom 3740 were foreign-born and 100 negroes.

Street Railways. See Railways.

STRENGTH OF MATERIALS.

IN the article which appeared under this title in the earlier volumes (ninth edition) of this Encyclopedia some account was given of methods usually followed in the testing of materials, and of the general results of such tests. Most of the forms of testing machine’ which were there

shortly described remain typical of the machines machines *n Present use- In English practice no form of

testing machine is more common than the single- lever machine of Mr Wicksteed, in which the specimen stands in a vertical position, suspended from the short end of a long horizontal lever above it. This lever forms a weigh-beam to measure the force used in the test. Pull is applied to the lower end of the specimen by a hydraulic cylinder beneath it, and the amount of pull is measured by a travelling poise which is run out along the lever to the position necessary to balance the puU| The test is carried out by gradually increasing thV f^U^^d at the same time moving the poise out so th^|theTiH|: is kept from touching either of the stops between whicn it floats. The general arrangement of a machinWof this class for applying pull up to 30 tons was illustrated in the article referred to. More commonly, for purposes of .commercial testing, the capacity of the machine is 50 or 100 tons, and supplementary arrangements are provided to allow tests in compression or in bending to be made. For this purpose a small platform is suspended like a stirrup by four rods from the weigh-beam, and hangs below the cross-head, which is pulled down when the hydraulic cylinder is put in action. The arrangement is that of two stirrups linked with one another, so that when the two pull against each other a block of material placed

between them becomes compressed. For tests in bend- ing one of the stirrups, namely, the platform which hangs from the weigh-beam, is made some 4 or 5 feet long, and carries two knife-edge supports at its’ ends on which the ends of the piece that is to be bent rest, while the cross- head presses down upon the middle of the piece. In both cases the force which is exerted is measured by means of the weigh-beam and travelling weight, just as in the tension tests. To apply this force continuously, without shock, and either quickly or slowly at will, a very con- venient plan is to u3e a hydraulic intensifier, consisting of a large hydraulic piston operating a much smaller one. By gradually admitting water to the large piston from any convenient source under moderate pressure, such as the town water mains, a progressively increased pressure is produced in the fluid on which the small piston acts, and this fluid is admitted to the straining cylinder of the

machine. One of the advantages of the vertical type of machine, with its single horizontal lever, is the facility with which the correctness of its readings may be verified. The two points to be .tested are (1) the distance between the knife-edges, one of which forms the fulcrum of the weigh-beam and from the other of which the shackle holding the upper end of the specimen is hung, and (2) the weight of the travelling poise. The weight of the poise is readily ascertained by using a supplementary known weight to apply a known moment to the beam, and measuring how far the poise has to be moved to restore equilibrium. The distance between the knife-edges is then found by hanging a known heavy weight from the shackle, and again observing how far the poise has to be moved.

When specimens of considerable length have to be dealt with a machine which gives the specimen a horizontal position is generally preferred. In such cases a bell-crank lever is generally used to pass from the horizontal direc- tion in which the pull is applied to the vertical direction in which it is measured by means of a travelling poise. In machines of large power the transmis- sion of the stresses through a lever or system of levers becomes increasingly difficult, and accord- ingly, in some cases where the forces to be dealt with reach 600 and even 1200 tons, the use of levers has been abandoned and recourse has been had to the simpler plan of estimating the force applied to the specimen from observation of the hydraulic pressure in the straining ram. This process is at the best unsatisfactory, for the fric- tion of the hydraulic packing is uncertain. In such cases the plan might with great advantage be followed of transmitting the stress directly through a steel bar or group of bars, forming a part of the machine, which would be elastically strained, and inferring the stress from measurements of their elastic strain. Such measurements carf be readily carried out by means of an extensometer in one of the forms de- scribed below. The elastic bars would virtually form springs whose elastic quality could be relied on to re- main constant. This method of measuring the forces which act on the specimen on testing machines, though carried out on a small sca)e by Kennedy,1

Martens,2 the present writer, and others, does not appear to have yet been applied to the type of machines for which it is par- ticularly suited, namely, those in which the forces to be measured are so great as to make the use of levers unduly cumbrous and .costly.

Much attention has been paid to the design of extenso- meters, or apparatus for observing the small deformation which a test-piece in tension or compression undergoes before its limit of elasticity is reached. Such observations afford the most direct means of measuring the modulus of longitudinal elasticity of the material, and they serve also to deter- mine the limits within which the material is elastic, a matter not merely of physical interest, but of great prac- tical consequence when alternating loads have to be borne. In such a material as wrought iron the whole amount of elastic extension amounts to only about

Extensa meters.

of the length under observation; with a length of 8 inches, which is usual in tensile tests, it is desirable to read the extension to, say, goooo inch if the modulus of elasticity is to be found with fair accuracy, and if the limits of proportionality between strain to stress are under examination. Measurements taken between marks on one side of the bar only are liable to be affected by bending of the piece, and it is essential either to make independent measurements on both sides or to measure the displacement between two pieces which are attached to the bar in such a manner as to share equally the strain on both sides.

In the extensive series of experiments carried out by Bauschinger, independent measurements of the strains on both sides of the bar have been made by using mirror micrometers of the type illustrated diagrammatically in Fig. 1. Two clips a and 6 clasp the test-piece at the place between which the extension is to be measured. The clip b carries two small rollers di di which are free to rotate on centres fixed in the clip. These rollers press on two plane strips Ci c2 attached to the other clip. When the specimen is stretched the rollers consequently turn through angles proportional to the

i”The Use and Equipment of Engineering Laboratories,” Proc. Inst. C.E., 1886.

2 Handbook of Testing Materials, translated by 6. C. Henning. This book should be referred to for detailed accounts of many forms of test- ing machines.

strain, and the amount of turning is read by means of small mirrors g1 and g2 fixed to the rollers, which reflect the divisions of a fixed scale /into the reading telescopes ei e2. In Martens's extensometer each of the rollers is replaced by a rhombic piece of steel with sharp edges, one of which bears against the test-piece, while the other rests in a groove formed in the spring projecting parallel to the

Kg. 1. (From Unwin's Testing of Materials.)

test-piece from the distant clip. Much excellent work has been done by extensometers of this class, but in point of convenience of manipulation it is of great advantage to have the apparatus self- contained, and patterns having this characteristic have been devised by Unwin and others.3 The present writer has introduced a microscope extensometer of the self-contained type which has been used in a number of recent researches, and has proved convenient. This instrument is shown in Fig. 2 ; its action will be seen by refer- ence to the diagram Fig. 3. Two clips B and C are secured on the bar, each by means of a pair of opposed set-screws. Between the

Fig. 2. (From Ewlng's Strength of Materials.)

two is a rod B' which is hinged to B and has a blunt pointed upper end which makes a. ball-and-socket joint with C and P. Another bar R nangsfroJB, an<* can'ies a mark which is read by a micro- scope att^Mjp^U^ Hence, when the specimen stretches, the length of ^pbeing Wed, the bar R is pulled up relatively to the microscope, and the amount of the movement is measured by a micrometer scale in She eye-piece. A screw at P serves to bring the mark on R into the field of view, and also to calibrate the readings of the micrometer scale. The scale allows readings to be taken to ^^ inch, by estimating tenths of the actual divisions. The arms C P and C Q are equal, and hence the move- ment of Q represents twice the extension of the bar under test. Fig. 4 shows another form of the instrument, as adapted to the compression of short blocks. In this case the arm C Q is

nine times the length of C P, and consequently there is a mechanical magnification of ten besides the magnification afforded by the microscope.

8 Descriptions of various forms of extensometer will be found in Martens's book, cited above.

When the behaviour of specimens of iron, steel, or other materials possessing plasticity, is watched by means of a sensitive extensometer during the progress of a tensile test, it is in general observed that a very close proportionality between the load and the extension holds

during the first stages of the loading, and that during these stages there is little or no " creeping " or supplementary extension when any particular load is left in action for a long time. The strain is a linear function of the stress, almost exactly, and disappears when the stress is removed. In other words, the material obeys Hooke's law. This is the stage of approximately perfect elasticity, and the elastic limit is the point, rather vaguely defined by observations of the strain, at which a tendency to creep is

Fig. 3.

(From Ewing's Strength of Materials.)

first seen, or a want of propor- tionality between strain and stress. As the load is further augmented, there is in general a clearly marked yield-point, at which a sudden large exten- sion ensues. In metals which have been annealed or in any way brought into a condition which is independent of the effects of earlier applications of stress, this elastic stage is well marked, and the limit of elasticity is as a rule sharply defined. But if the metal has been previ- ously overstrained, without having had its elasticity restored by annealing or other appropriate treatment, a , , very different behaviour is exhibited. The yield-point may be raised, as, for instance, in wire which has been hardened by stretching, but the elasticity is much impairedMand it is only within very narrow limits, if at all, that proportionality between stress

and strained is found. Subsequent prolonged rest gradually restores the elasticity, and after a sufficient number of

J. Muir 2 that the rate at which this recovery of elas- ticity occurs depends on the, temperature at which the piece is kept, and that complete recovery may be produced in iron or steel by exposure of the overstrained specimen for a few minutes to the temperature of boiling water. Figs. 5, 6, and 7 illustrate interesting points in Mr Muir's experiments. In these figures the geometrical device is adopted of shearing back the curves which show extension in relation to load by

Tig. 4.

(From Ewing's Strength of Materials.)

weeks or months the metal is found to be elastic up to a point which may be much higher than the original elastic limit.1 It has recently been shown by Mr

1 See experiments by Bauschinger, Mittli. aus demmech-tech. Lab. in Miinchen, 1886, and by the writer, Proc. Roy. Soc, vol. xlviii., 1895. A summary of Bauschinger's conclusions will be found in Martens's book, cited above, and in Unwin's Testing of Materials.

Tig. 5. (From Ewing's Strength of Materials.)

reducing each of the observed extensions by an amount proportional to the load, namely, by one unit of extension for each 4 tons per square inch of load. The effect is to contract the width of the diagrams, ' and to make any want of straightness in the curves more evident than it would otherwise be. To escape confusion, curves showing successive operations are drawn from sep- arate origins. In the experiment of Figs. 5 and 6 the material under test was a medium steel, containing about 0*4 per cent, of carbon, which when tested in the usual way showed a breaking strength of 39 tons per square inch, with a well-marked elastic limit at about 22 tons. In Fig. 5 the line A relates to a test of this material in its primitive condition ; the loading was raised to 35 tons so as to produce a condi- tion of severe overstrain. The load was then removed, and in a few minutes it was reapplied. The line B

exhibits the effect of this application. Its curved form shows plainly that all approach to perfect elasticity has disappeared, as a consequence of the overstrain- ing. There is now no elastic limit, no range of stress within which Hooke's law applies. With the lapse of

2 Muir, "On the Recovery of Iron from Overstrain," Phil. Trans. Boy. Soc, A, vol. 193, 1900.

time the curve gradually recovers its straightness, and the material, if kept at ordinary atmospheric temperature, would show almost complete recovery in a month or two. But in this instance the recovery was hastened by immersing the piece for four minutes in boiling water, and line C shows that this treatment restored practically perfect elasticity up to a limit as high as the load by which the previous overstraining had been effected. The loading in C was continued past a new yield-point ; this

W Tons per sq. inch.

Fig. 6. (From Ewing's Strength of Materials.)

made the elasticity again disappear, but it was restored in the same way as before, namely, by a few minutes' exposure to 100° C, and the line D shows the final test, in which the elastic limit has been raised in this manner to 45 tons. Other tests have shown that a temperature

A. Primary test.

B. 10 minutes after A .

C. 16 honrs after A . V. 10 minutes after C E. After 4 minutes

exposure to 100° Cent.

1'ig. 7. (From Ewing's Strength of Materials.)

of even 50° C. has a considerable influence in hastening the recovery of elasticity after overstrain.

In the non-elastic condition which follows immediately on overstrain the metal shows much hysteresis in the relation of strain to stress during any cyclic repetition of a process of loading. This is illustrated in Fig. 6, where the arrows indicate the sequence of the operations. Fig. 7 relates to tests of wrought iron, a material in which the recovery through lapse of time is more rapid than it is in steel. There the first overstraining A brings about the

non-elastic condition B, but a rest during sixteen hours suffices to restore nearly perfect elasticity, with the result that the next loading gives line C with a raised elastic limit. This loading was carried far enough to overstrain the piece a second time, and line D then shows that a non-elastic condition has reappeared. Finally line E shows the recovery which is brought about by immersion in boiling water.

When a piece of iron or steel which has been over- strained in tension is submitted to compression, it shows, as might be expected, no approach to conformity with Hooke's law until recovery has been brought about either , by prolonged rest at ordinary temperature or by exposure for a short time to some higher temperature. After re- covery has taken place the elastic limit in compression is found to have been lowered ; that is to say, it occurs at a lower load than in a normal piece of the same metal. But it appears from Mr Muir's experiments that the amount of this lowering is not at all equal to the amount by which the elastic limit has been raised in tension. In other words, the general effect of hardening.by overstrain, followed by recovery of elasticity, is to widen the range within which a practically complete proportionality be- tween strain and stress holds good.

Of all recent aids to a knowledge of the structure of metals, and of their behaviour under stress, perhaps the most important is microscopic examination. The micro- scopic study of metals was initiated by Sorby as early as 1864 (see Brit. Assoc. Report for that year). After a period of neglect, it has been pursued with much energy by a large number of observers, and has yielded results which are of fundamental importance in relation to the strength of materials. For the purpose of microscopic examination it is usually necessary to bring a small piece of the metal to a

state of high surface polish, the final stage of which is performed by rubbing on a surface of wash-leather charged with a thin paste of rouge and water. The specimen is then lightly etched in dilute acid or treated with a staining medium, such as liquorice or cocoa, to make the structure visible. When the surface is examined under a lens of suitable power it is seen to be made up of irregular areas with well-defined boundaries. A characteristic example is given in Fig. 9 (see Plate), which is a microphotograph of wrought iron Tinder a magnification of 200, normally illuminated by light which is condensed on the field by means of the objective itself. The areas into which the surface is divided differ in ap- parent texture, and when illuminated obliquely it is found that some of them shine out brightly while others are dark ; by changing the direction of the incident light other areas become bright and those previously bright become dark. These areas are the sections of crystalline grains which constitute the mass of the metal. Each grain is a crystal, the elementary portions of which are all oriented one way, but the orientation changes as we pass from grain to grain. The irregular boundaries are the chance surfaces in which one grain meets another during the progress of its crystalline growth. Etching a polished surface develops a multitude of facets which have the same orientation over any one grain, and there- fore give it a uniform texture and a uniform brightness in reflecting light of any particular crystalline incidence. The size of the grains depends very *£%%£. much upon the previous thermal treatment to which the metal has been subjected. Sudden cooling from a high temperature tends to make the grains small, slow cooling tends to keep them large ; and pro- tracted exposure to moderately high temperature has been observed in some cases to favour the growth of very large grains.

When the metal is strained in any manner beyond its

STRENGTH OF MATERIALS.

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Fig. 10.

(From ” Phil. Trans. Kmj. Soc, ‘ J, I’m?. 193.)

limit of elasticity the grains are found to have altered their shape, becoming lengthened in the direction in which stretch has occurred. Subsequent exposure to a temperature which is high enough to remove the mechanical hardness produced by overstraining is found to bring about a reconstruction of the grains ; the origi- nal pattern is not reproduced, but the reformed grains show no direction of predominating length. Researches by Mr W. Eosenhain and the present writer have been directed to examining the manner in which the grains change their shape during straining, and also the changes in structure which subsequently take place. (See ” The Crystalline Structure of Metals” (two papers), Phil. Trans., 1900.) These researches have shown that metals retain their crystalline character even when so severely strained as to exhibit qualities of plasticity which are at first sight inconsistent with the idea of crystalline struc- ture. The manner in which a metal yields under severe strain is by slips which occur in the cleavage or ” gliding ” planes of the individual crystals. These slips are seen under the microscope as sharply defined lines which ap- pear on the polished surface of each grain as soon as the yield-point in any process of straining has been reached. Seen under normal illumination the lines are dark ; seen under oblique illumination they may be made to appear as bright lines on a dark ground. The appearance of each line shows that it is a narrow step produced by the slipping of one part of the crystalline grain over another part. The diagram Fig. 8 represents a section between two contiguous surface grains, having cleavage or gliding

c

‘*>,’,, >. i. in,’, i,’, ‘, v,V^v\\^>\U^

Before straining.

After straining. Fig. 8.

(From Phil. Trans. Roy. Soa., A, vol. 198.)

planes as indicated by the dotted lines, A B being a part of the polished surface. When straining beyond the elastic limit takes place, as by a pull in the direction of the arrows, yielding occurs by finite amounts of slip at a limited number of places, as at a. b, c, d, e. This exposes short steps, which are portions of cleavage surfaces, and which, when viewed under normally incident light, ap- pear black' because they return no light to the micro- scope. They consequently appear as dark lines or narrow bands extending over the polished surface in directions which depend on the intersection of that sur- face with the planes of slip. Many such lines appear as the process of straining goes on ; they are spaced at more or less regular intervals, and in general three sys- tems of them may be observed intersecting one another. The general appearance of these slip-lines is illustrated in Fig. 10 (see Plate), which is a comparatively low- power microphotograph of the surface of several grains in a piece of strained lead. – Fig. 11 (see Plate), which is part of the same surface under a much higher power, shows the intersections of slips along three or four different planes. With three independent systems of slips it is clear that the grain may take any shape in the process of straining ; in many cases four systems of slips are seen. In this way severe deformations occur without

affecting the crystalline character of the structure, al- though the shape of each crystal undergoes much change. A bar of iron which has been rolled cold from a large to a small section shows, when it is polished and etched, a structure in which each grain has all the characteristics of a crystal, although the grains have been distorted into forms very different from those which are found in bars which are rolled at a red heat or are annealed after roll- ing. It is clear that the process of straining has occurred through movements which preserve the parallelism of all the portions of each individual grain so long as continuity of the parts of the grain is preserved. In many metals, however, a further effect of severe strain is to develop twin crystals, and this implies a rotation of one group of elements through a definite angle with respect to the other elements of the same grain. Excessively severe straining, as, for instance, the squeezing of a block of lead into a thin flat plate, is found to produce a crystal- line structure in which the grains have a greatly reduced size ; the slips have in that case gone so far as to cause divisions and interpenetrations of the crystals.

Microscopic examination further shows that after severe straining the structure of a metal is far from stable, a fact which connects itself with what is ob- served in respect to mechanical quality. In ^Ssfa.”’ some metals at least, and notably in lead, severe straining is followed, even at atmospheric tem- peratures, by a protracted crystalline growth which re- sults in the formation of crystals which are relatively very large. A piece of ordinary sheet lead shows the effects of this growth well ; it will be found, when etched, to consist in general of crystals enormously larger than any that could have survived the process of manufacture by rolling. A similar growth may readily be traced from day ‘to day or week to week in a piece of lead which is kept under observation after being severely strained. The process of growth is greatly accelerated by raising the temperature. That some process more or less analo- gous to this goes on in iron and steel during the change which occurs when elastic recovery takes place after overstraining may be conjectured, though there is as yet no direct evidence on the point. The growth of large crystals which is seen to occur in lead at very moderate temperatures has perhaps a more direct relation to the changes which occur in iron at temperatures high enough to produce annealing. In the second of the two papers referred to above a theory of the growth of crystals in solid metal is suggested, according to which the film of eutectic alloy, which forms a cement between one crystal grain and another, acts as a solvent on one grain and deposits metal on* the neighbouring grain, by a process which is probably electrolytic. Most specimens of metal may be expected to contain enough impurity to furnish material for an intergranular cement.

It is impossible in a short article to give any account of what has been done, largely by microscopic examina- tion, in studying the constitution and properties of alloys. Eeference should be made to the researches of Heycock and Neville (Phil. Trans., 1900), and to the valuable reports of the Alloys Eesearch Committee made by Sir W. Eoberts- Austen to the Institution of Mechanical Engineers (Proc. Inst. Mech. Eixg., 1891, 1893, 1895, 1897, 1899), which not only contain much original work, but give a useful summary of the researches of others. The structure of steel in particular has attracted much attention, notably at the hands of Osmond (Journ. Iron and Steel Inst., 1890) and Arnold (Proc. Inst. C. E. vol. cxxiii.). Microscopic examination of the low or medium carbon steel used for

structural purposes shows it to con- sist of grains of iron (ferrite), interspersed with grains

which have in general a laminated structure and are com- posed of alternate bands of two constituents, namely, iron and carbide of iron (Fe3C). To these laminated grains the name of pearlite has been given. In steel such as is used for rails, containing about 0-4 or 0-5 per cent, of carbon, the grains of pearlite occupy about as large a volume of the specimen as the grains of unlaminated f errite ; but when the proportion of carbon is increased to about 0-9 per cent, the whole is a mass of pearlite having an exceedingly intimate mixture of the two constituents. This appears to be a eutectic alloy, and the same inti- mately blended structure is characteristic of eutectic alloys generally. Important variations in the visible struc- ture result from quenching, annealing, and other varieties of thermal treatment, as well as from the presence of other constituents in the steel. The microscope may be said to serve the part of a detective in determining whether the treatment has been normal or has involved features which would prejudice the quality of the finished product. It is a well-known characteristic of metals that small quantities of foreign matter may produce an altogether

disproportionately large influence on their me- infiuence chanical and other properties. The effect of matter?” small quantities of carbon in iron, of nickel in

iron, of aluminium in copper, are important practical instances where a highly beneficial effect, in respect of strength and ductility, is produced. The wide and varied range of qualities possessed in steel from pure iron at one end to tool-steel at the other is due to quantities of carbon which lie, for the most part, under 1 per cent. The addition of about 3 per cent, of nickel to mild steel has given an important new structural material possessing increased strength and increased capacity for plastic strain. The presence Of manganese in small quantities is known to be an essential condition of strength in mild steel. By adding nickel or manganese in large quantities

various interesting products are ob- tained, one of which has the remarkable property of being almost destitute of magnetic quality (see papers by Mr

R. A. Hadfield, Journ. Iron and Steel Inst., 1888, 1889, 1890, 1892, 1894; Proc. Inst. C. E., vols. ciii. and cxxxviii.). The microscope goes far to make intelligible such instances of large effects following on apparently small causes. It also throws light on the important practical question of the influence of certain impurities in causing weakness. It has long been known that sulphur, for example, is a dangerous constituent of iron or steel, its presence even in small quantities being apt to cause brittleness. Under the microscope it may be seen that sulphur tends to segregate into pockets or webs between the crystalline grains of the metal. The cohesion is destroyed, or greatly weakened, where these incipient flaws occur, and a state of stress which would be uniform in homogeneous metal become! far from uniform in the immediate neighbourhood of the flaw. An alternating stress, for example, which would be well within the elastic limit if it were uniformly distributed may much exceed that limit locally round the edges of the flaw. Hence the material there may be , periodically overstrained, and may give way much as a rod gives way when it is bent backwards and forwards beyond its elastic limits, with the result that the flaw gradually spreads and the mischief becomes more and more serious until the piece as a whole breaks. It is not unlikely that many of the sudden failures of propeller-shafts #nd rails are due to some such cause. The experiments of Wohler, showing that repeated stresses can produce fracture, although the load is kept within limits which are apparently narrow enough to avoid producing cumulative plastic strains, are difficult to understand in relation to a strictly homogeneous material. They become more readily intelligible when it is recog- nized that the metals with which the engineer has to deal are far from homogeneous, but consist of aggregates of granules, each of which is a crystal, united by films of cementing material whose properties are not only different from those of the granules themselves, but probably not constant from place to place throughout the substance of the piece. (j. a. e.)

STRIKES AND LOCK-OUTS.

A STRIKE is a stoppage of work by common agreement on the part of a body of work-people for the purpose of obtaining or resisting a change in

the conditions of em- ployment. The body of work-people may be large or small, and the cessation of work- may be simultaneous or gradual ; e.g., if the notices to cease work happen to expire at different dates, the cessation may nevertheless be a strike, provided it takes place as the result of a common agreement. It will be seen from the above definition that a strike, though the immediate result of an agreement, formal or tacit, on the part of work-people to withhold their labour, may originate in a demand on the part of the employer as well as on the part of the employe's. In the former case the stoppage is often (though loosely) termed a " lock-out." It is obvious, however, that to distinguish stoppages as strikes or lock-outs according to the source of the original demand for a change of conditions would lead to a very arbitrary and misleading classification. Frequently it is not easy to say which side made the original demand to which the dispute is to be attributed, and frequently a stoppage is the result of a break-down of negotiations in the course of which demands have been made by both sides. Moreover, in so far as the distinction can be drawn, it would lead to the result that in almost all cases a dispute in times of improving trade would be termed a strike, and in times of declining trade

a lock-out. It is not possible to frame an entirely satis- factory definition of a lock-out which shall enable it always to be discriminated from a strike. It may be noticed that the attempt to make this distinction has been abandoned in the Board of Trade statistics since 1894, both kinds of stoppages being now included under the comprehensive title of " trade disputes."

The only basis of distinction between a " strike " and a " lock-out," which is sufficiently definite for •precise or statistical purposes, is the source from which the actual notice to cease work emanates, cessations resulting from notices given by the employers being termed " lock-outs," while those which either result from notices given by the men, or from their withdrawal from work without notice, woul d be termed " strikes." But whether the term " lock- out " be restricted as above, or applied, as in the popular use of the term, to any dispute in which the employers appear to be the aggressors, the distinction does not afford a sound basis for the statistical classification of disputes. The source of the actual notices to leave work is often quite an unimportant matter ; while, on the other hand, if the ordinary current use of the terms be followed, there will be many disputes which, according to the

workmen’s view, should be termed lock-outs, and, according to the employers, should be termed strikes— a difficulty which was well illustrated in the controversy as to whether the

” Strike Clauses ” in Admiralty contracts could be in- voked in the case of work stopped through the engineer- ing dispute of 1897 described below (p. 24). In the present article, therefore, no distinction is drawn for statistical purposes between a strike and a lock-out.

Another distinction, perhaps of greater importance than the above, but which in practice it is sometimes difficult to draw, is between a stoppage in pursuance of a trade dispute, and a stoppage due to a bond fide dismissal or change of employment arising from the intention of an employer to cease to employ a particular set of men, or of a group of workmen to cease to work for a particular employer. Generally speaking, a stoppage may rightly be termed a trade dispute if there be an intention on the part of both parties (at least at the beginning) to resume the relations of employer and employed on the satisfaction of certain specified conditions. Where the willingness to resume this relation exists on one side only the question is more difficult, and accordingly it is not uncommon for an employer to deny the existence of a trade dispute, although the men formerly in his employ may be actually drawing ” strike pay ” from their unions, and ” picketing ” his works to prevent their places being filled. Such cases sometimes arise when the workmen consider that the dismissal of some of their colleagues is due not to personal faults or slackness of employment, but to some collective action which they have taken, or to their membership of some organization. Broadly speaking, however, the distinction is that a trade dispute is a temporary stoppage entered into to obtain or to resist a change of conditions of employment.

The essence of a strike or lock-out is a refusal on the part of a number of workmen collectively or of an em- ployer to renew contracts of employment except on cer- tain changed conditions. This simple situation may be complicated by actual breaches of contract, as when a body of

work-people leave work without notice, or by at- tempts on their part to prevent other persons from enter- ing into contracts of service, or to persuade other persons to terminate or break their contracts. But such features as these, though common to many strikes, are not essen- tial. The question of the legal position of strikes, and of the methods adopted for the conduct of strikes, is dis- cussed below. Here it is only necessary to point out that strikes, as such, are incidents arising out of the modern

relationship of free contract as between employers and workmen, and have little real analogy with the revolts of servile or semi-servile labour in ancient or mediaeval times.

Trade Disputes in the United Kingdom.

Since 1888 the Board of Trade have kept a record of strikes and lock-outs in the United Kingdom, and the following table, based on the official returns published by that department for the last ten years, shows the num- ber and importance of these stoppages in the United Kingdom : —

Tear.

Number

of Disputes.

Number of Work-people affected.

Aggregate

Duration in

Working Days.

Directly.

Indirectly.

Total.

1891 1892 1893 1894 1895 1896 1897 1898 1899 1900

906 700 783 929 745 926 864 711 719 648

203,571 316,136 598,534 257,314 207,239 147,950 167,453 200,769 138,058 136,145

63,889 40,663 37,852 67,934 55,884 50,240 62,814 53,138 42,159 53,393

267,460 356,799 636,386 325,248 263,123 198,190 230,267 253,907 180,217 188,538

6,809,371

17,381,936

31,205,062

9,529,010

5,724,670

3,746,368

10,345,523

15,289,478

2,516,416

3,152,694

A comparison of the figures for particular years is sub- ject to some qualifications, owing on the one hand to the increasing completeness of the Board of Trade returns, and on the other hand to the fact that from 1894 very small disputes have been excluded. There have also been some changes in the method of computing ” aggregate duration.? On these points reference should be made to the reports themselves. The figures stated above give, however, a fair idea of the magnitude and fluctuations of trade

disputes in recent years. It should be noted that by ” indirectly affected ” are meant the work-people employed in the same establishments as those on strike, who are thrown out of employment owing to the strike, but are not themselves engaged in it. The Board of Trade statistics do not take into account the persons employed in kindred trades who are indirectly affected.

The most important thing to note about the above statistics is that in most years they are dominated by one or two large disputes. This is seen most clearly from the following table : —

Tear.

Principal Disputes of the Year.

All other Disputes.

3 Trade and Locality.

Number of

Work-people

affected.

Aggregate

Duration in

Working Days.

Number

of Disputes.

Number of

Work-people

affected.

Aggregate

Duration in

Working Days.

1891 1892

1893

1894 1895 1896 1897

1898

1899 1900

(No very large dispute) f Coal Miners (Durham) \ Textile Operatives (Lancashire ar / Coal Miners (Federated Districts; \ Coal Miners (South Wales)

Coal Miners (Scotland)

Boot and Shoe Operatives .

(No very large dispute)

Engineers .... / Engineers — continued . 1 Coal Miners (South Wales)

(No very large dispute)

(No very large dispute)

id Cheshire)

75,000 50,000 300,000 90,000 70,000 46,000

47,500 100,000

4,275,000 \ 5,950,000 } 23,700,000 \

2,340,000/ 5,600,000 1,564,000

f 5,731,000 1 1,118,000 \

11,650,000 /

906 698

781

928 744 ‘926 863

710

719 648

267,460 231,799

246,386

255,248 217,123 198,190 182,767

153,907

180,217 188,538

6,809,371 7,156,936

5,165,062

3,929,010 4,160,670 3,746,368 4,614,523

2,521,478

2,516,416 3,152,694

From the above figures it appears that of the 7931 disputes recorded in the past decade, nearly 60 per cent, of the total magnitude as measured by aggregate duration in ~~working days was accounted for by eight large dis~~

putes. The great majority of the disputes were very trivial affairs. Thus in 1900, 488 of the recorded disputes (or about three-quarters of the whole number) accounted for only 9 per cent, of the total time lbs't, and this, it is

to be remembered, is after the very small disputes have been excluded.

By " aggregate duration " or " time lost " is meant the product of the number affected multiplied by the duration of the dispute in working days, with (in recent years) some allowance for those who have found work elsewhere or been replaced by others. Though this figure is the best general index of the importance of the disputes of

each year, it is but a rough, approximation to the time actually lost through disputes.

For example, if a strike cause a postponement or accu- mulation of work, the extra demand for labour, and the overtime worked after its conclusion, may partially com- pensate for the stoppage. On the other hand, if a dis- pute should drive away trade or cause the closing of works, it may lessen the field of employment for a long period after its termination, and such lost time cannot be taken into account in the estimates of "aggregate duration."

For these reasons all estimates of wages lost through disputes are somewhat fallacious. The real importance of strikes lies less in the value of the actual time consumed by their duration, than in their indirect effects on the organization and effectiveness of the industry, and on the relations of employer to employed, and also in their reaction on the conditions of allied trades. The compara- tive insignificance of the actual loss to production owing to the mere loss of time caused by strikes will be seen from the fact that the total duration of strikes during the past seven years, if spread over the entire adult male working population, would be equivalent to less than the loss of one day per head per annum. As a matter of fact, however, the loss owing to strikes is very unequally distributed over the industrial population. In large groups of industries, e.g., agriculture, strikes are of rare

occurrence. In others, such as the building trades, they are frequent, but mostly small and local ; while in mining they are not only frequent and often prolonged, but in many cases they involve large numbers of persons and extend over wide areas. Thus on an average of the seven years 1894-1900 there were 169 disputes annually in the building trades, and 156 in mining and quarrying, but the latter disputes have involved more than five times as many persons, and had an aggregate duration nearly six times as great. Intermediate between these groups of trades is the metal, engineering, and shipbuilding group, in which, more perhaps than in any other group, the importance of disputes varies according to the state of trade.

The principal facts relating to the distribution of trade disputes among the more important groups of trades are given in the following table for the mean of the seven years 1894-1900 :—

Groups of Trades.

Number of Dis- putes.

Number of Work-people

affected (directly and

indirectly).

Aggregate Duration

in

Working

Days.

Percent- age of Total Number employed who were affected

by Disputes.

Percent- age of Aggregate Working

Time occupied

by Disputes,

Building .

Mining and 1 Quarrying J

Metal, Engineer-] ing, and Ship- > building . J

Textile .

Clothing .

Transport (Bock,] Harbour, Bail- > way, *fcc.) . J

Miscellaneous . . Employes of Pub- 1 lie Authorities |

169 166

174

126 48

88

74

7

19,688 102,408

40,394

40,778 10,658

10,102

9,716 574

590,639 8,445,124

1,826,869

608,588 826,988

116,858

267,994 8,748

2-4 122

8-7

8‘8 1-9

1-0

0-4 0-6

0-24

T87

0-55

0-16 0-19

0-04

0-08

O’Ol

All Trades, except ‘ Agricultural La- bourers, Sea- men, Fisher- men, and Do- mestic Service

284,218

7,186,808

2-8

0-29

It is not easy from the statistics available to trace a definite relation between the prevalence of trade disputes and the general state of employment, both because of

the comparatively short period over which the records extend, and of the dominating effect of a few gigantic stoppages. If, however, these great labour wars be excluded, it will be found that the statistics of the remaining disputes show a certain degree of stability, the annual numbers affected varying roughly in the years 1890-1900 from 150,000 to 260,000. The range of variation of the aggregate duration has been greater, viz., from about 2\ to 7 million working days a year, the average being about half a day for each adult workman belonging to the classes who are affected by strikes. This is the measure of the time actually consumed by trade disputes other than the great conflicts which attract public attention. It would be natural to expect that these trade disputes would be most prevalent at or just after, a turn in the tide of employment, when there is most room for bond Jide disagreement as to the conditions of the labour market. These are undoubtedly the most critical times in the relations of employers and employed, but the disturbing influence of accidental causes is too great to enable any regular law of variations in disputes to be established by statistical evidence. It is to be remem- bered that in recent years there has been a great develop- ment in the means available for avoiding stoppages by conciliatory action (see Arbitkation and Conciliation), and this of itself would greatly complicate the task of tracing any correspondence between the prevalence of actual stoppages and the state of employment. Broadly it may be said that the great majority of upward and downward changes of wages are settled nowadays without strikes, and in many trades actual stoppages, instead of being a normal feature in the relations between employer and employed, are rather to be looked on as cases of accidental breakdown of the recognized machinery of negotiation.

The. causes of disputes are of course very varied, embracing all the matters relating to conditions of employ- ment on which differences may arise between employers and employed. Experience shows, “uses.

however, that the great bulk of disputes relate to questions of wages, a much smaller proportion to hours of labour, and the balance to a large number of miscellaneous questions, of which perhaps the most frequently occurring is the employment of persons or classes obnoxious to the strikers on the ground that they do not belong to their union, or have worked against its interests, or because they are held to have no ” right ” to the particular occupation on which they are employed, either on account of not having gone through the recognized training or of belonging to another trade. Among this class of strikes are to be included the so-called “demarcation” disputes between two bodies of workmen as to the limits of their trades, which frequently cause suspension of work by both groups, to the great inconvenience of the employer. Strikes are also not uncommon on the question of trade- unionism pure and simple — i.e., to obtain or defend free- dom to belong to a union, or to act through its agency in negotiations with employers. This question enters more or less as a factor into a large number of disputes, most usually, however, as a secondary cause or object, so that it hardly appears so prominently as it deserves in the tabulation of causes in the Board of Trade statistics, which is based on principal causes only. Thus the formulated demands of the strikers are usually for improved conditions of work, the question of ” recognition ” of the trade union only arising incidentally when the parties attempt to negotiate as to these demands. The following table, showing the principal causes of disputes for the past five years, is based on the official statistics : —

Principal Cause.

Percentage of Work -people directly affected by Disputes in

Meau

of 5

Years.

1896.

189T.

1898.

1899.

1900.

Questions of wages .

Questions of hours .

Employment of par-“) ticular classes or j- persons . j

” Trade unionism ” . (see above)

Other causes .

64-9 1-6

15-4

3-6

14-5

44-1 23-4

8-9

3-8

19-8

87-9 0-4

4-6

1-1

6-0

68-6

2-8

5-9

3-7

19-0

61-4 0-5

7-7

14-5

15-9

65-4 5 -7

8-5

5-3

15-1

The results of trade disputes are as varied as their causes. Sometimes a strike goes on until the employer Results *s ruine(l or retires from business, and is only- ended by the permanent closing^of the works; sometimes, especially when trade is slack, the places of the men are almost immediately filled, and the only economic result of the strike is to replace one body of men by another without perceptible interruption of business. There have been frequent cases of this kind in strikes of unskilled labourers. Sometimes, on the other hand, the demand for labour is so active that ,the whole of the strikers immediately find work elsewhere, and the only

economic result is to transfer a body of men from one set of employers to another with little or no interrup- tion of their employment. Of late years the building trades have afforded several examples of this issue of a trade dispute. In other cases, after a more or less pro- longed stoppage, the disputes end by the permanent ” blocking ” of an employer’s establishment by a union, or the permanent refusal of the employer to take back any of his former employes. All these, however, are extreme, and on the ~~whole exceptional cases. The vast majority of trade disputes are settled by mutual arrange~~ ment, and whether such arrangement is wholly in favour of one or other party, or involves a compromise, its terms provide that the whole or part of the body of work-people whose labour was withheld or excluded shall return on agreed conditions to their former employment. Thus in 1900, of 188,538 persons involved in 648 disputes, only 8895, involved in 45 disputes, returned to work on their employers’ terms without negotiation of any kind, while 71 disputes, involving 4918 persons, were ended by replace- ment of men ; 4, involving 300, by the closing of works, and 9, involving 3689 work-people, were settled by in- definite means, or remained unsettled. All the remaining disputes, 519 in number, involving 170,736 persons, were concluded by negotiation, either with, or more usually without, the aid of an outside mediator or arbitrator.

The following figures show the comparative results of trade disputes. The percentages refer to the proportion of work-people involved in disputes which resulted in the manner indicated. (From 1896 onward only the work-people directly affected are included.)

In favour

In favour

Compro-

Tear.

of Work-

of

Indefinite.

Total.

people.

Employers.

Per cent.

Per cent.

Per cent.

Per cent.

Per cent.

1891

25-6

34-8

36-7

2-9

100 0

1892

27-5

19-9

51-4

1-2

100-0

1893

62-9

12-1

24-7

0-3

100-0

1894

22-1

42-1

34-2

1-6

100 0

1895

24-1

27-9

47-1

0-9

100 0

1896

43-5

28-0

28-3

0-2

100-0

1897

24-2

40-7

34-0

1-1

100 0

1898

22-6

60-1

17-2

0-1

100-0

1899

26-7

43-7

29-1

0-5

100 0

1900

30-1

24-8

41-7

3-4

100-0

Decennial Average

| 30-9

33-4

34-5

1-2

100-0

As regards the results of disputes in different groups of trades, it is to be observed that in recent years workmen in the building trades have had more than the average degree of success, while in the textile trades the balance has been in favour of the employers.

It is, of course, to be understood that the figures in the above table only relate to the immediate results, as determined by the relative extent to which one or other of the parties succeed in enforcing their demands. The question

of the ultimate effect of the stoppages on the welfare of the parties or of the community generally, is an entirely different question (see below, p. 20).

Organization of Strikes and Lock-Outs.

In the great majority of cases strikes are organized and controlled by trade unions. It does not, however, follow from this that the growth of trade unionism has always fostered and encouraged strikes, there being evidence that in many trades the strengthening of organization has had the effect not only of restraining ill-considered, partial stoppages, but also of preventing more serious dislocations of industry by providing a channel influence for the expression of grievances and a recognized unions0. means of negotiating with employers. Much of the evidence given before the Royal Commission on Labour (1891-94) tended to show that the growth of trade unions has the effect on the whole of lessening the frequency though of widening the area of disputes. The Commission, moreover, laid down that the stage of in- dustry in which disputes are likely to be most frequent and bitter is that in which it is emerging from the ” patriarchal ” condition, in which each employer governs his establishment and deals with his own men with no outside interference, but has not fully entered into that other condition in which transactions take place between strong associations fully recognizing each other. In this state of industrial organization bitterness is often caused by the insistence of the work-people on the “recognition” of their unions, and by the treatment of these unions by the employers as outside parties inter- fering and causing estrangement between them and the work-people actually in their employ.

Probably next to the patriarchal stage, in which each factory is a happy family, the industrial conditions most favourable to peace are when a powerful trade union is face to face with a representative employers’ association — both under the guidance of strong but moderate leaders, and neither feeling it beneath its dignity to treat on equal terms with the other. When, on the other hand, some or all of these conditions are absent, the growth of combina- tions may tend to war rather than peace.

Whether, however, trade unionism tends generally to encourage or to restrain strikes, the organization and policy of all trade unions, as at present constituted, are based on the possibility of a collective withdrawal from

work in the last resort. Dispute pay is conse- quently the one universal form of trade union benefit. Though, however, in most of the disputes recorded the strikers are financially supported by some trade union, this is by no means universally the case. Many strikes have been entirely .carried out without the instrumen- tality of a permanent combination, the work-people affected belonging to no union, and merely improvising a more or less representative strike committee to control the movement. It is not uncommon, however, for a per- manent union to originate in a strike of non-unionists. In other cases (e.g., in the London dock strike of 1889) an insignificant trade union may initiate a strike movement involving several thousands of labourers outside its membership. In the case quoted the membership of the Dockers' Union rose during the few weeks of strike from

800 to over 20,000. The most conspicuous recent case of a "widespread strike of workmen not belonging to a trade union was the South Wales coal-miners' dispute of 1898. Of the 100,000 men affected, probably not more than 12,000 belonged at the time to any trade union, but the workmen's representatives on the committee of the sliding scale (against which the movement was directed) formed the nucleus of a strike committee, and one result of the strike was the formation of the "South Wales Miners' Federation," affiliated to the Miners' Federation, and numbering at the end of 1900 no less than 128,000 members. In the case of strikes of non-unionists, the strikers, of course, have to depend for their maintenance on their own resources or on the proceeds of public sub- scriptions. Frequently grants are made in their aid by sympathetic trade unions, and in the case of the South Wales dispute above referred to, several boards of guardians gave out-door relief to strikers who had ex- hausted their resources. This action, however, has been held to be illegal.

The majority of strikers, however, belong to trade unions and receive " dispute benefit," which usually con- sists of a weekly payment of .from 10s.

to 15s. In 1900 the sum expended by 100 of the “principal trade unions in support of men engaged in disputes was £150,283. In some recent years it has largely exceeded this sum. Thus in 1897, the year of the great engineering dispute, the amount so expended by trade unions was no less than £633,347.

Although most strikes are controlled by trade unions, cases are comparatively rare in this country in which the central committee of a trade union takes the initiative and directs its members to cease work. More usually a local strike movement is initiated by the local work- men, and the central committee is generally empowered by the rules to refuse its sanction to a strike and to close it at its discretion, but has no authority to order it. In many unions a ballot is taken of the members of the districts affected before a strike is authorized, and a two-thirds (or even greater) majority, either of members or of branches, in favour of a stoppage may be required before the sanction of the central executive is granted. Some unions in their rules draw a distinction between strikes to enforce new conditions {e.g., a rise of wages, a restriction of hours or of overtime) and strikes to oppose the introduction of new conditions by the employers, greater freedom being allowed to the local members in the case of ” defensive ” than of ” offensive ” strikes.

Sometimes also the executive committee, while refus- ing their official sanction to a strike, and declining to allow the funds of the society to be used to support the strikers, may tacitly permit a local committee to take what action it pleases and to collect funds for the pur- pose. Some strong unions, however, especially those which have entered into general agreements with em- ployers’ associations, not only refuse financial support to an unauthorized strike, but even expel from their society strikers who refuse to obey their order to return to work. The Boilermakers’ and Iron Shipbuilders’ Union has more than once taken drastic action of this kind, even to the extent of fining or superseding recalcitrant members and officials. In 1899 the Na- tional Union of Boot and Shoe Operatives, which is a party to an agreement with the Employers’ Federation (known as the ” Terms of Settlement “) was fined £300 by the umpire under that agreement for failing to expel or to induce to return to work certain of their members who took part in a strike contrary to the provisions of the agreement. It

sometimes happens, however, that the central committee of a trade union is not strong enough

to withhold financial support even from an unauthorized strike.

When a strike has been authorized by the executive, the conduct of it is frequently entrusted to a “strike committee,” appointed ad hoc, one reason being that a strike of any considerable dimensions often affects members of several unions, so that the common action necessary in a conflict with employers can only be attained by a committee representing all the societies involved. Thus the great engineering dispute of 1897 began with a purely London movement for an eight hours’ day, and was conducted by a committee repre- senting the London districts of several societies. A strike committee has often no power to draw on the funds of the unions represented, each of which pays dis- pute pay in accordance with its rules to its own members, the financial power of the strike committee being limited to the support of non-unionists out of any funds availa- ble for the purpose, or the collection and administration of funds in case of the exhaustion of the resources of any of the unions represented.

The financial support of a local or sectional strike imposes but little strain on the resources of a large society, but where a considerable proportion of the mem- bers are affected it is usual for a union to replenish its funds by imposing a ” levy ” or special contribution on members remaining at work. During the engineering dispute of 1897-98 the levies imposed by the Amalga- mated Society of Engineers rose to 2s. 6d. per week, and one of the main objects of the federated employers was to diminish the revenue obtained from this source by enlarging the area of the dispute.

When there is no regular provision for the financial support of strikers, or when this provision is exhausted, the strike leaders have a much more difficult task in preventing the return to work of some of their fol- lowers ; and it is in these cases that intimidation and violence are most to be apprehended. In all strikes, however, except in thesfew cases in which the whole of the workmen in the trade are in the union, and the skill required is such that no new labour can enter the trade during the dispute, there is the possibility of the strikers being replaced by other labour, and the efforts of the strike organizers are largely directed to the prevention of this by all

means in their power. The chief method employed has generally been that known as ” picket- ing,” viz., the placing of members of the union to watch the approaches to the works or factories affected, to give information as to the strike to any workmen who at- tempt to enter, and to endeavour to dissuade them from accepting employment. The state of the law as regards picketing is described on the next page. In practice the line between giving information and peacefully per- suading, or again between peacefully persuading and intimidating, is often so fine that the most divergent views may be taken, especially in the excitement of a contest as to what has really occurred in any given case. Other methods of preventing workmen from taking the place of strikers may also be adopted or attempted, ranging from the publication of information in leaflets or otherwise as to the existence of a dispute, or appeals to workmen to avoid the works affected, to systematic annoyance or intimidation of workmen who take or retain employment during a stoppage by threats or by actual violence and outrage.

The methods adopted by strikers and strike organizers naturally suggest the counter measures adopted by em- ployers. To break down the resistance of a body of work-people supplied with a weekly strike allowance by a powerful trade union employers sometimes have recourse to some method of mutual indemnification by which the

Free labour.

financially weaker pf their number are temporarily sub- sidized by the stronger, whether through the machinery of a permanent employers’ association or of an emergency committee. Employers’ associations being usually com- posed of much smaller numbers than trade unions, are, as a rule, able to act in concert with greater secrecy and less formality than is possible in a workmen’s union. Apart from any financial support which employers may guarantee their colleagues when attacked by a trade union, they have in some cases formed or aided organizations for the systematic provision of a reserve of ” free labourers ” available to replace men on strike. By ” free labourers ” is meant not necessarily non-unionists, but

labourers pledged to work amicably with others whether members of a union or not. The Shipping Federation, an organization of ship- owners and shipowners' associations which was formed in 1890 to combat the strikes then prevalent among seamen, arranged a system of shipping offices at which seamen could be engaged who were prepared to give a pledge that they would work with non- unionists. They also opened similar offices for shore labourers in some ports. Other independent agencies exist for supplying employers with labour during a dispute. It is not uncommon, in disputes in which there is any apprehension of intimidation or violence, for employers to board and lodge the imported work-people. Another method on which employers have recently shown' an increased tendency to rely is the institution of legal proceedings to restrain individual strikers or the union to which, they belong from taking wrongful action injurious to their business. There has, however, been no attempt to induce the courts to restrain bodies of work-people from striking by injunction, as has been frequently done in American strikes affecting inter- state commerce. In many disputes the attitude of pub- lic opinion is of some importance in determining the results, and accordingly both sides frequently issue state- ments or manifestoes giving their versions of the differ- ence, and in other ways (e.g., by an offer of arbitration) one party or the other endeavours to enlist public opinion on its side.

Public Action with regard to Strikes and Lock-Outs.

Though the majority of labour disputes have little importance for third parties, stoppages of this kind some- times acquire a special interest for the general public either by reason of the large number of labourers whose livelihood is affected, or of their indirect effects on employ- ment in kindred trades, or of the danger and inconvenience that may be caused to the public, or of the fear that industry may be diverted abroad, or that a breach of the peace may be caused by attempts on the part of the strikers to coerce persons outside their combinations. For these and other reasons, strikes and lock-outs are usually regarded as a class of disputes in which legislative interference has more justification than in the case of other kinds of industrial and commercial differences.

Legislative action, with the view of providing alterna- tive methods of adjusting labour difficulties, is discussed in the article Arbitration and Conciliation. Jt is there shown that only in New Zealand and New South Wales have these alternative methods been made compul- sory, and there are indications that the great majority of em- ployers and workmen in Great Britain would not be pre- pared for such a measure, involving as it would the legal fixing of wages and conditions of employment, and the surrender by those directly concerned of their freedom to arrange these matters by voluntary agreement or by a trial of strength. Without the provision of some alter- native by the State, it would be impossible in a free country to prohibit altogether the termination of labour

contracts by collective agreement among work-people or employers.

The law, however, may and does restrict or prohibit the use of some of the methods of promoting or carrying on strikes which interfere with the liberty of other labourers, or inflict a wrong on employers, or injuriously affect the public interest.

The present relation of the law in the United Kingdom to strikes and lock-outs is briefly as follows. Since the legislation of 1871 and 1875 there has been no question of th6 legality of a strike as such, viz., of a combined ab- Law of the stention from work in order to influence the conditions ^?**? of employment, but the method in which the strike is *‘“Zdom carried out may subject the strikers either to criminal ^fth”g or civil liabilities. In this connexion the chief ques- strikes. tions of interest relate to the limits within which strikers may lawfully act for the purpose of inducing other per- sons not to take their places, and for the purpose of bringing in- direct pressure to bear upon the employer by influencing others not to work for or deal with him ; and, on the other hand, the limits within which employers may act in inducing other employers to abstain from employing workmen or members- of a trade union with whom they have a dispute.

Strikers are necessarily liable to the general criminal law, but the Conspiracy and Protection of Property Act, 1875, enacted that an agreement or combination by two or more persons to do, or procure to be done, any act in contemplation or furtherance of a trade dispute between employers and workmen shall not be in- dictable as a conspiracy if such act if committed

by one person would not be punishable as a crime, namely, on indictment or on summary conviction with the statutory liability of imprisonment either absolutely or alternatively for some other punishment. The Act does not affect any conspiracy punishable by statute nor the law relating to riot, unlawful assembly, breach of the peace, or sedition, or any offence against the State or sovereign. The Act also does not apply to seamen, or to apprentices to the sea service.

Sudden breach of contract of service in gas and water under- takings, or under circumstances likely to endanger human life or cause serious bodily injury, or expose valuable property to destruction or serious injury, are made punishable offences by special sections, but the miscellaneous provisions of the Act are the most important in trade disputes. These provisions subject to a penalty of fine or imprisonment every person who, with a view to compel any other person to abstain from doing, or to do any act which such other person has a legal right to do or abstain from doing, wrongfully and without legal authority.

(1) Uses violence to or intimidates such other person, or his wife, or children, or injures his property ; or

(2) Persistently follows such other person about from place to place ; or

(3) Hides any tools, clothes, or other property owned or used by such other person, or deprives him of or hinders him in the use thereof ; or

(4) Watches or besets the house or other place where such person resides, or works, or carries on business, or happens to be, or the approach to such house or place ; or

(5) Follows such other person with two or more other persons in a disorderly manner in or through any street or road.

Attending at or near the house or place where a person resides, or works, or carries on business, or happens to be, or the approach to such house or place, in order merely to obtain or communicate information, shall not be deemed a watching or besetting within the meaning of the Act.

As interpreted by the courts in recent years, in a series of cases, of which Lyons v. Wilkins (1896 and 1899) is the most important, the above provisions render illegal all picketing except such as is merely for the purpose of giving or obtaining information. Attending in order to persuade was held not to be within the exemption, and it was pointed out that the Act applies to all the King's subjects, and did not legalize acts in themselves unlawful at common law. Until these cases, it was generally supposed that picketing for the purpose of peaceably, and without threats or in- timidation, persuading persons not to work or to cease work for an employer was lawful. But it is now clear that this is not the law. It has been held that the compulsion aimed at is not limited to direct coercion, but includes such compulsion as is exercised upon an employer by inducing others not to work for him, that the place beset is not limited to the works of the employer, but extends to any place where men who do or may work for him happen to be, and that the besetting need not be persistent, but may be on a single occasion. To beset any place where men happen to be who do or may work for the employer in order to persuade them not to work, if it be done with the view of compelling the employer to concede the strikers' demands, is within the section.

For damages flowing from any of these criminal acts, as from any actionable wrong not amounting to a crime, the strikers guilty of them will be civilly liable at the suit of the employer or other person injured. And employers have in recent years frequently had recourse to injunction as a ready remedy to restrain strikers, especially in order to stop illegal picketing. The extent to which strikers may render themselves liable to an action for damages by conduct aimed at bringing indirect pressure to bear upon the employer has been the subject of judicial consideration in several recent cases, and the law cannot yet be regarded as settled in any very definite manner. Picketing, except for the very limited purpose allowed by the Act of 1875, and the other acts aimed at by that Act are means of such pressure which clearly give a cause of action to the party, wronged. But apart from the statute, there are many forms of coercion which are

actionable because a wrongful infringement of the liberty of others. The general principle is that every one, employer or workman, has a right to deal with other persons who are willing to deal with him, and that no one may interfere with that right by any form of coercion. What is% coercion must depend upon the circumstances, but, when many men are acting in concert, conduct may be coercive in them all which would not be coercive in one. Picketing is thus, apart from the statute, an actionable wrong. The publication of black lists is the same. To call out men who are willing to work for an employer is an infringement of the right of the employer and of the men. If the members of a trade union, in order to bring pressure to bear upon employer A, threaten employer B that unless he ceases to deal with A- the union will call out B's men, it is a wrongful infringement of the right of A and B to deal with one another. All such forms of coercion, if they directly cause damage, will amount to actionable wrongs. An illustration may be seen in the case of Quinn v. Leathern in 1901. At one time the case of Allen v. Plood in the House of Lbrds (1898)' seemed to place some important limitations on the civil liability of strikers. But the only general principle decided by that case was that an act lawful in itself is not converted by a malicious or bad motive into an unlawful act so as to make the doer of the act liable to a civil action. The question to be determined in every case will be not whether the strikers acted out of spite, but whether they infringed any legal right of the party complaining of their action. Wherever a legal right is infringed and damage follows, the motive of the act is immaterial except in so far as it may help to show that the damage caused was the natural result of the act done, and therefore not too remote to be actionable.

Until recently it was supposed that for wrongs committed in strikes only the individual wrongdoers could be made responsible. But the decision of the House of Lords in the Taff Vale Railway case (1901") has shown that a trade union can be sued in tort for acts done by its agents within the scope of their authority, and may be sued in its collective capacity, and execution of any damages recovered may be enforced against its general funds (see Tkade Unions) .

Economic Effects.

The question of the effectiveness or otherwise of strikes and lock-outs for the purpose of influencing the condi- tions of employment is part of the wider question of the economic effect of combinations, the strike or lock-out being only one of many methods adopted by combinations of workmen or employers to enforce their demands. (This matter is discussed in the article Trade Unions.) Apart, however, from the question of the extent of the immediate advantage, if any, which one party or the other is able to obtain from a stoppage, we have to consider generally the economic effects of strikes and lock-outs to the community as a whole. Stoppages of work are in their nature wasteful. Time, which might be employed in work yielding wages to the work-people and profits to the employers, is lost never to be recovered, while many forms of fixed capital deteriorate during idleness. In attempting, however, to estimate the utility or disadvantage of strikes and lock-outs, whether to the parties themselves or to the industrial community as a whole, it is insufficient to take into account the value of the wages and profits foregone during the stoppage, and to balance these against the gains made by one party or the other. Attempts have often been made to measure the loss or gain due to strikes in this way, but even as applied to particular stoppages, looked at purely from the point of view of one or other

of the parties involved, the method is unsatisfactory. On the one hand, the time and work apparently lost may be afterwards partially recouped by overtime, or some of the strikers may be replaced by others, or may them-selves find work elsewhere, so that the actual interrup- tion of production may be less than would appear from the magnitude of the dispute. On the other hand, the total loss due to the stoppage may be augmented by the diversion of trade for a longer or shorter period after the resumption of work. Again, the ultimate effect of the forced concession of excessive demands may be damaging instead of advantageous to the nominal victors, by contracting the field of employment or by lowering the efficiency of the labour. If, however, the arithmetical computation of the value of the time lost compared with the value of the terms gained is an unsatisfactory test of the benefit or disadvantage of a particular strike to the parties concerned, it is wholly fallacious as a method of estimating the social utility or otherwise of strikes and lock-outs as instruments for effecting changes in the condition of employment. For any satisfactory consideration of this wider

question we must look not merely to the actual strike, but to the whole process of free bargaining between employers and organized bodies of work-people, of which, as already shown, the strike may be regarded as merely an untoward incident. The actual cessation of work is a symptom that for the time there is a deadlock, and frequency of such cessations in any trade is a sign of the imperfection of means of negotiation. In many trades in which both employers and workmen are strongly organized various forms of machinery have been brought into existence for the purpose of minimizing the chance of stoppages (see Arbitration and Concilia- tion). But wherever there is free combined negotiation, there is always in the background the possibility of combined stoppage. This being understood, the question of the utility of strikes as an industrial method resolves itself into the questions: (1) Whether the process of settling the terms of employment by agreements affect- ing considerable bodies of work-people and employers is superior to the method of individual settlements of labour contracts, or, at least, whether its advantages are sufficient to outweigh the cost of strikes and lock-outs ; (2) whether free collective negotiation could be replaced with advan- tage by any other method of settling the conditions of employment of bodies of work-people, which would dis- pense with the necessity of testing the labour market by a suspension of work.

(1) The first of these questions is virtually the ques- tion of the advantages and disadvantages to the com- munity of combinations of workmen and employers, which is discussed at length in the article Trade Unions. As regards the question of the direct cost of strikes and lock-outs, it is proper to remember that individual bar- gaining does not do away with stoppages ; in fact, the aggregate amount of time lost in the process of adjusting ten thousand separate labour contracts may be considera- ble— possibly not less than that consumed on an average in effecting a single agreement involving the whole body, even if the chance of a collective stoppage of work occur- ring during the process of combined bargaining be taken into account.

While, then, the strikes and lock-outs which accom- pany the system of combined bargaining are rightly to be described as wasteful, this is not so much because of the excessive amount of working time which they con- sume, as because of the disturbance and damage done to industry by the

violent breach of continuity — a breach which may dislocate trade to an extent quite dispropor- tionate to the actual loss of time involved, and the fear of

which undoubtedly affects the minds of possible customers, and hampers enterprise on the part of employers. The extent of the injury directly inflicted on the consuming public by a strike varies greatly in different cases, being at its maximum in the case of industries having the total or partial monopoly of supplying some commodity or service of prime necessity, e.g., gas-works, water-works, railway or tramway service ; and least in the case of a local stoppage in some widely-spread manufacturing or constructive industry open to active competition from other districts.

In speaking above of the loss occasioned by strikes and lock-outs attention has only been paid to the effects of the actual stoppage as such, and not to the particular methods adopted by the strikers to make the stoppage effective. The evils arising from the practice of intimidation or violence towards other workmen, or from the increase of class-hatred and bitterness engendered by the strife be- tween employer and employed, are patent to all, though they cannot be estimated from an economic point of view.

(2) As to the second question, viz., the possibility of maintaining combined negotiation, but of substituting some better method than strikes of resolving a deadlock, it is hardly necessary to say that so far as such substitu- tion can be voluntarily carried out with the assent of both parties, whether by the establishment of wages boards or joint-committees, or by agreements to refer differences to third parties, the result is an economic as well as a moral advantage.

But the increasing adoption of these voluntary ex- pedients for diminishing the chance of , industrial friction lends ttio countenance to the expectation that a satisfac- tory universal substitute for strikes and lock-outs can be devised except at the price of economic liberty. Com- pulsory reference of

disputes to a State tribunal cannot be reconciled with freedom of voluntary negotiations.

Unless, then, we are prepared for a scheme of com- pulsory regulation of industry by the State, strikes and lock-outs must be accepted as necessary evils, but their frequency may be greatly diminished with the improve- ment of means of information as to the true condition of the labour market, and the influences by which it is determined. Many disputes arising purely from" mis- management and misunderstanding are wholly avoid- able. While there is no warrant for expecting the total abolition of strikes and lock-outs, it is not unreasonable to hope that the spread of education and the means of rapidly obtaining information, the improvement of class relations, and the adoption, where practicable, of con- ciliatory methods, may gradually tend to confine actual stoppages to the comparatively few cases in which there is a genuine and serious difference of principle between the parties.

Important Strikes and Lock-Outs.

Some of the more important labour disputes which have occurred in various groups of trades in the United Kingdom are noted briefly below. With regard to the statistics given, it may here be noted that although for the sake of brevity it is stated in some places that a certain number of men were idle for a specified number of days, it must not be supposed that in all cases the whole number affected were idle for the whole number of days.

Coal Mining is an industry which has always been more convulsed by labour disputes than any other, prob- ably owing to the violent oscillations of prices and wages, and to the varied and ever-changing conditions under which work is carried on. Several of the earliest recorded

disputes among coal-miners, however, referred to the term of engagement rather than the rate of wages. In 1765 the Northumberland miners struck for several weeks unsuccessfully against the system of a yearly bond of service, which was then prevalent. In 181Q a strike of seven weeks in the same district against a variation of the yearly bond ended in a compromise. Turbulent strikes in Northumberland and Durham are also recorded in 1831 and 1832, the former, in which the men were successful, for a general

removal of grievances, and the latter, in which they were defeated, for the maintenance of the union. These strikes were attended with, violence and destruction of property. In 1844 still another prolonged strike took place in the north of England to enforce alterations in the terms of the yearly bond. From 30,000 to 40,000 men were out for 18 weeks. New men, however, were obtained, and there were many evictions. In 1864 widespread strikes took place in South York- shire and South Staffordshire, the one for an advance and the other against a reduction of wages. The York- shire strike is said to have affected 37,000 men, and the Staffordshire strike 20,000. The latter lasted over four months.

The rapid fall in the price of coal after the abnormal inflation in 1871-72 produced a series of obstinate strikes and lock-outs arising out of reductions of wages, in which the men were usually defeated. The South Wales miners, to the number of 70,000, were out for eleven weeks in 1873 and for 19 weeks in 1875, the latter dispute being a com- bined strike and lock-out, and leading to the formation of the first of the series of sliding scales under which the industry in South Wales has since been regulated. In 1877 the West Lancashire miners (30,000) were out for 6 weeks, and the Northumberland men (14,000) for 8 weeks. The last-mentioned dispute was terminated by an arbitration award in the miners' favour. In 1879, 70,000 Durham men were out for 6 weeks, the dispute being terminated by an arbitration award giving half the re- duction claimed by the coal-owners. The introduction of sliding scales in Durham and Northumberland in 1877 and 1879 did something to preserve peace in those dis- tricts, though the Durham scale did not prevent the dispute of 1879 mentioned above. Both scales, however, were terminated by the men in 1889 and 1887 respec- tively. In 1880-81 the Lancashire coal-mining industry was stopped for 7 weeks by a strike of 50,000 to 60,000 men against " contracting out" of the Employers' Liabil- ity Act of 1880.

The fall of prices after 1890 led to a renewal of dis- putes. Iu 1892 there was a prolonged stoppage in the Durham coalfield, 75,000 men being out for about 11 weeks.

In 1893 the' greatest dispute took place that has ever been recorded in the coal-mining industry, a body of miners, which at its maximum reached the

huge total of 300,000 men in Yorkshire, Lancashire, and the Midlands, being out for 16 weeks against a proposed reduction of 25 per cent, on the ” standard ” rate of wages. This dis- pute is described in detail on page 23. The conference at the Foreign Office at which it was adjusted led to the formation of a Conciliation Board, which, with some interruption, has since regulated the rate of wages and prevented general stoppages in these districts. During the summer of 1893 there was also a strike of about 90,000 men in South Wales, which lasted nearly a month. The next year, 1894, saw a prolonged dispute in the Scottish coal-mining industry, the men vainly attempting to resist the fall of wages which followed the fall of coal prices from the abnormal level to which they had risen during the English stoppage of the previous year ; 70,000 men were out from 15 to 16 weeks. In 1898 there was a

stoppage lasting 25 weeks in South Wales and Monmouth affecting 100,000 men, for the abolition or amendment of the sliding scale agreement, in which the men were un- successful.

The record of strikes and lock-outs in the Cotton Trade goes back to a time before the repeal of the Combination Laws. Thus the year 1810 was marked by lock-outs of spinners in Lancashire and Glasgow, the former caused by a strike in the Stalybridge district to enforce Man- chester rates of wages, and the latter having for its ob- ject the break-up of the men’s union. In both cases the employers were successful. Two years later there was a stoppage of 40,000 looms in Scotland for some weeks, arising out of a wages dispute, in which the men were beaten, their union broken up, and their leaders im- prisoned. Another unsuccessful strike attended with imprisonment of the men’s leaders took place among the Manchester spinners in 1818, when 20,000 to 30,000 men were out for three or four months to obtain an advance of wages and reduction of hours. In 1830 there was a strike of spinners in Ashton and Stalybridge. The year 1853 was one of great disturbance in the Lanca- shire cotton-spinning trade. For seven months 20,000 to 30,000 spinners in the Preston district were engaged in an unsuccessful strike for an advance of wages, and in the same year there was

a stoppage of 65,000 spinners in Lancashire generally. The period of bad trade cul- minating in 1879 was marked by bitter disputes in the cotton trade generally, the men vainly trying to resist the reductions of wages which marked that period. Par- tial disputes at Bolton in 1877 (10,000 to 12,000′ persons for 8 weeks), and Oldham in 1878 (6000 persons for 5 weeks) were followed in the latter year by a general stoppage in North and North-east Lancashire affecting 70,000 persons for 9 weeks. The general dispute was attended with violent riots, and 68 persons were tried and convicted. The next important dispute was a strike of 18,000 weavers in North-east Lancashire in 1884 against a reduction of wages, which encLed after 8 weeks in a compromise. Next year there was a strike at Old- ham against a reduction of wages affecting 24,000 per- sons in the spinning and weaving branches. The dispute ended in a compromise, half the proposed reduction of 10 per cent, being agreed to. In 1892-93 the last great dispute in the cotton-spinning trade took place, 50,000 persons in the Oldham and surrounding districts being out for 20 weeks_ against a proposed reduction of 5 per cent. The dispute was ended by the so-called “Brooklands Agreement,” which provided for a reduc- tion of about 3 per cent., and also contained rules for the settlement of future disputes by conciliatory methods.

The Building Trades have in most years been charac- terized by a large number of local and sectional disputes sometimes affecting comparatively small bodies of men. Often, however, all branches of building trades in a given district have been stopped simultaneously, but few of the building trade stoppages have affected a sufficiently large body of men to be- noticed here as important disputes except in London. The years 1810 and 1816 were marked by strikes on the part of the London carpenters, the first being a successful attempt to obtain a rise in wages, the second an unsuccessful resistance to a fall. In 1833 an important dispute laid idle the building trades of Liverpool and Manchester. The dispute arose out of the objection of the men to the contract system, and led to a general lock-out to compel the men to leave their unions, in which the employers were generally success- ful. In 1859-60 a partial strike in London against the discharge of a delegate led to a lock-out of 25,000 building operatives for 7 months, and in 1861-62 a re-

newed strike for a reduction of hours resulted in a com- promise. In 1872 there was a successful strike of 10,000 London building operatives for a rise of wages, a shorten- ing of hours being also obtained. In 1891 there was an unsuccessful strike of carpenters in London for a rise in wages, affecting 9000 men and lasting 24 weeks.

Engineering, Shipbuilding, and Metal Trades. — Among the most noteworthy disputes in the engineering trade was that in 1852, soon after the formation*of the Amal- gamated Society of Engineers by the fusion of a number of local and sectional societies. The dispute originated in Lancashire, and turned on demands from the men for the abolition of piecework and overtime, the dispute being further complicated by questions relating to the employment of labourers in working machines. The men ceased working overtime, and were locked out to the num- ber of over 13,000 for periods ranging from three to nine months. The men were completely beaten, and many engineering1 shops required the men to leave the union before resuming work. In 1871 a strike of 8000 to 9000 men in the North of England for a reduction of hours from 59 to 54 was successful after a stoppage of 20 weeks, and led to the general introduction of the nine hours' day throughout the country. In 1897-98 there was a wide- spread and prolonged dispute turning on questions of hours and of freedom of management of works, which lasted 29 weeks and affected 47,500 men. This dispute, which resulted in the defeat of the men, is described in detail below (p. 24).

In 1866 a strike of 3000 shipwrights on the Clyde led to a general lock-out of shipbuilders in the district. In 1877, 25,000 iron shipbuilders on the, Clyde struck for 23 weeks for an advance of wages, the dispute being settled by arbitration.

In 1891 a prolonged dispute took place between the plumbers and engineers engaged in shipyards on the Tyne as to " demarcation " ; 2460 men were idle from 7 to 8 weeks, the result being the drawing up of an elaborate' list of apportionment applicable to the Tyne and Wear. The shipbuilding trades have from early times been marked by numerous "demarcation" dis- putes, mostly of a local character, as to the limits of the work of the various bodies of work-people — e.g., between shipwrights and boatbuilders ; shipwrights

and joiners; shipwrights and boilermakers ; joiners and cabinetmakers ; boilermakers and engineers ; engineers and plumbers ; engineers and brassfinishers. Some of these matters are now dealt with by joint trade boards (see Arbitration and Conciliation).

Among the more important disputes in the iron trade are to be mentioned a strike and lock-out of 30,000 ironworkers in Staffordshire in 1865, in which the men were beaten after a costly stoppage of 18 weeks; an unsuccessful strike of 12,000 ironworkers in Middlesbrough for 18 weeks in 1866; and an unsuccessful strike of 20,000 ironworkers in Staf- fordshire for 4 weeks in 1883 against a reduction of wages, attended by rioting and destruction of plant.

The nailmakers in the Dudley district were engaged in widespread disputes in 1840, 1881, and 1887, the first being an unsuccessful strike of 20,000 men attended by rioting, to resist a reduction; and the two last being strikes for advance of wages ; resulting, the first wholly and the second partially, in favour of the work- people.

Other Trades. — Among other noteworthy disputes are to be mentioned —

(1) A successful strike of 14,000 persons in the Leices- ter hosiery trade in 1819 for an advance in wages.

(2) An unsuccessful strike of 13,000 or more tailors

in London in 1834 for a rise of wages and reduction of hours, lasting several months.

(3) A dispute among the pottery workmen in the Midlands in 1836 against the terms of yearly hiring, leading to a general lock-out of over 15,000 men for 10 weeks, which ended in the defeat of the men.

(4) A series of disputes among agricultural labourers in 1872-74 for increases of wages and other improve- ments in the conditions of employment, in which the men were mostly successful. These disputes, which are almost the only widespread disputes recorded in agriculture, evoked much public interest.

(5) In 1889 there was a prolonged strike of dock and waterside labourers in London for a rise in wages and other alterations in conditions of employment, which was successful, mainly through the financial support received from the Australian trade unions and from the general public (see below).

(6) The organization of labour at the principal ports which foil-owed this dispute led to a series of struggles between the new unions and the shipowners, who formed an organization called the Shipping Federation Limited, and successfully established their right to employ ” free labour” in opposition to the unions of seamen and other bodies of labourers. The last of these disputes on a large scale occurred at Hull in 1893, and ended in the defeat of the dock labourers after a stoppage affecting 11,000 men for 6 weeks.

(7) In 1895 a general stoppage of 46,000 boot and shoe operatives was terminated, after a stoppage of 6 weeks, by a settlement effected through the Board of Trade. The issues of this dispute were of interest as involving the scope and limits of the functions of trade union action and of arbitration in relation to the management of busi- ness. The terms of settlement, which were of an elab- orate character, are still in operation.

(8) Two prolonged disputes at Lord Penrhyn’s slate quarries in North Wales in 1896 and 1900 attracted pub- lic notice from the obstinacy with which the contests were conducted on both sides. About 2500 work-people were affected, and the questions at issue were the recognition of the men’s combination and the remedy of a number of alleged grievances, including the abolition of the contract system. After 48 weeks’ stoppage, during which the Board of Trade vainly tried to mediate, the first dispute was ended by a compromise ; but in 1900 another struggle began which, after more than a year’s continuance, is still persisted in by many of the men, though a considerable body of workmen are now (March 1902) at work.

Historic Strikes of Recent Years.

A few of the strikes referred to above appear to deserve a more detailed account.

The London dock strike of 1889 was notable, both as the most noteworthy example of a widespread and determined strike of unskilled and previously unorganized labourers, and for the amount of public sympathy shown for the men, -and London for tne fjnanciai aid rendered by their Australian t ik sympathizers. It began on 13th August with a small

1889 l°ca* dispute at the West India Docks about the

wages earned for discharging a certain cargo, but spread rapidly among all classes of dock labourers in the port, who took the opportunity of demanding an increase in the rate of pay for time work from 6d. to 6d., the abolition of contract and piece- work, and the remedy of other grievances. They were joined by the stevedores and lightermen, who came out “in sympathy,” though the latter class of men soon formulated a set of demands of their own. Employment was brisk, the weather fine, and the public sympathetic, and in a few days’ time not less than 16,000 men were idle. For the most part they were unconnected with trade unions which could give them strike pay, but during the month that the strike lasted the public at home and abroad sub- scribed nearly £50,000 in support of the strikers. Of this total over £30,000 came from Australia, where from 29th August

onwards a series of meetings were held for the purpose of raising funds to assist the London labourers. The Australian subscrip- tions practically decided the issue of the contest. On the very- day on which the first Australian meeting was held at Brisbane the leaders of the strike attempted by means of a “no-work manifesto” to widen the area of the dispute and cause a general stoppage of industry. Though this attempt was soon abandoned, it caused considerable alarm and threatened to alienate public sympathy from the men. Early in September many of the wharfingers made separate settlements with the strikers, and the shipowners attempted to put pressure on the dock companies to allow them to employ labour direct within the docks. The appre- hensions of the public led to’ the formation of a Conciliation Committee at the Mansion House, including the Lord Mayor,

the Bishop of London, Cardinal Manning, Sir John Lubbock (now Lord Avebury), and others, who mediated between the strikers and the dock directors, with the result that after one abortive attempt at a settlement, the terms of which were rejected by the men, an agreement was arrived at on 14th September, under which the dock labourers obtained the greater part of their demands. From 4th November the rate of hourly wages for time work was raised to 6d. , with 8d. overtime ; contract work was converted into piecework, with a minimum rate of 6d., and other points in dispute were settled. Though during the strike cases of intimida- tion and violence on the part of pickets were by no means absent, the police court charges arising out of the dispute were remarkably few. By the end of the year the Dock Labourers' Union (which had previously been known as the Tea Operatives and General Labourers' Union, and at the beginning of the dispute numbered about 800 members) had increased its membership in London to over 20,000 — a number which was afterwards further increased by the formation of provincial branches. In London, however, the membership rapidly declined during the following years of depres- sion of trade. The stevedores, who, as above remarked, came out "in sympathy" with the dock labourers, returned to work as soon as the latter were satisfied, but the lightermen's demands were adjusted by an award of Lord Brassey before they returned to work.

The coal-miners' dispute of 1893, whether measured by the number of men involved or by its aggregate duration in working days, was the greatest labour dispute yet recorded jn this country. Both prices and wages in the coal- Coal- mining industry are subject to rapid fluctuations, ™ Iners' according to the general state of trade, and in most /sjij" e' districts the principle has been explicitly or tacitly recognized that wages ought to follow the course of prices. In some districts an automatic connexion between wages and prices has been established by a "sliding scale," and in other districts where there is no sliding scale the average prices of coal have usually practically determined the rates of wages. The period 1879-87 was one of low prices and wages, but the revival of prices in 1888-90 led to a rapid rise of miners' wages, which in the latter year stood generally 40 per cent, higher than in 1888 throughout the principal districts embraced by the Miners' Federation, viz., Yorkshire, Lancashire and Cheshire, and the Midlands. During the years 1891 and 1892 prices again fell, and most of the districts outside the above area submitted to reduc- tions of wages varying from 15 per cent, off the standard in Dur- ham, to 42J per cent, in South Wales and 50 per cent, in Scotland, where the previous rise had been greatest. The Miners' Federation, however, refused to recognize the principle that wages should follow prices, and put forward instead the theory that a minimum or " living wage " should be fixed, and prices left to adjust them- selves to this rate. They declined altogether to agree to any reduction, and so strong was their combination that the coal- owners deferred any definite action until the middle of 1893, when they considered that some reduction was absolutely necessary to enable the trade to be carried on. On 30th June they passed a resolution, after a conference with the men, demanding a reduc- tion of 25 per cent, off the "standard" (equivalent to about 18 per cent, off current rates of wages), and offered arbitration as an alternative ; but the Federation absolutely refused any reduction, and the contest began. Shortly before the beginning of the dispute Northumberland and Durham had become affiliated to the Fed- eration, but these districts were not threatened by a reduction, and they seceded from the Federation sooner than strike, as demanded by that body to obtain the return of the reductions sustained since 1891. These districts consequently remained at work throughout the dispute, as well as Scotland and (except for a part of August and September) South Wales, reaping the

advantage of the in- creased prices and wages resulting from the restriction of produc- tion due to the stoppage. Within the Federation districts proper there were some localities in which no notices of reduction were posted, but the policy of the Miners' Federation was to make the stoppage as universal as possible, and all its members were re- quired to leave work. The Cumberland miners, however, though members of the Federation, were for special reasons permitted to

continue at work. By the middle of August nearly 300,000 men were idle, or nearly half the total number of coal-miners in the United Kingdom. The early stages of the dispute were uneventful, but as the funds of the unions affiliated to the Federation became ex- hausted, and the pinch of distress was felt, feeling ran' high, and in some districts deplorable acts of violence were committed. At Feather- stone, in Yorkshire, an attack was made on a colliery, in the course of which the military fired on the rioters, two of whom were killed.

The decision of the Federation requiring all its members to leave work, whether under notice of reduction or not, had from the beginning met with considerable opposition in certain districts, and this opposition naturally .grew stronger as the distress caused by the stoppage increased. At. the end of August a ballot' on the question showed a small majority still in favour of a universal stoppage, but the experience of another month led to a formal reversal of policy in this respect, a meeting of the Federation at Chesterfield on 29th September deciding to allow all men to return to work who could do so at the old rates of pay, such men to pay a levy of Is. a day in aid of those still on strike. Up to October no step was taken towards a settlement beyond an offer on the part of the miners on the 22nd August to pledge themselves not to ask for an advance until prices reached the 1890 level, and also to assist the employers to prevent underselling — an offer which was rejected by the coal-owners. On 9th October a meeting of the representa- tives of the parties was held at Sheffield, at the invitation of the mayors of six important towns affected, but without definite result, beyond leading to an amended proposal on the part of the coal- owners for an

immediate 15 per cent, reduction, and the regulation of future changes in wages by a Conciliation Board. The men, however, still refused all reduction, and during October a number of coal-owners, especially in the Midlands, threw open their pits at the old rate of wages.

A further advance towards a compromise was made by the owners on 25th October, when they offered that the proposed 15 per cent, reduction should be returned to the men in the event of the Concil- iation Board (with an independent chairman) deciding in their favour. In consequence of this offer a meeting was held between the representatives of the owners and the men in London on 3rd and 4th November, but without arriving at a settlement. Matters had now reached a deadlock, and accordingly, on 13th November, the Government addressed an invitation to both parties to be repre- sented at a conference under the presidency (without a casting vote) of Lord Rosebery, who was then Foreign Secretary. The confer- ence took place at the Foreign Office on 17th November, and resulted ■in a settlement, the men to resume work at once at the old rate of wageSj to be continued until 1st February 1894, from which date wages were to be regulated by a Conciliation Board, consisting of fourteen representatives of the coal-owners' and miners' federa- tions respectively, with a chairman mutually elected, or in default nominated by the Speaker of the House of Commons, the chairman to have a casting vote.

This agreement terminated the dispute. The Speaker appointed Lord Shand as Chairman of the Board. In the middle of the fol- lowing year, by mutual arrangement, the constitution of the Con- ciliation Board was modified so as to provide for limits below and above which wages should not move during a definite period. These limits have since been modified from time to time, but (with a gap from July 1896 to January 1899) the Conciliation Board has con- tinued to regulate miners' wages in the federated districts up to the present, and its formation has been followed by the institution of Conciliation Boards in most of the other important centres of the mining industry, except in South Wales.

The engineering dispute of 1897-98 was in some respects the most remarkable dispute of recent times, both on account of the nature and importance of the issues involved and of the Engineer- tenacity with which

the contest was conducted. The immediate occasion of the stoppage was a demand on the part of the men for an eight hour day in London workshops, but this issue was soon overshadowed in importance by other questions relating to the freedom of employers from interference by the unions in the management of their busi- ness, especially in such matters as piecework, overtime, selection and training of workmen to work machines, employment of unionists and non-unionists, and other matters affecting the relations of employer and employed generally throughout the United Kingdom. For some time previous to the general dispute there had been a growing dissatisfaction on the part of the employers with the encroachments of the Amalgamated Society of Engineers and other societies in kindred trades on matters affecting the management of business, which the employers con- sidered to be outside the legitimate functions of trade unions. In the absence of any general combination of employers, the unions were able to bring their whole force to bear on employers in particular localities, with the result that the stringency of the conditions and restrictions enforced varied very greatly in different districts, according to the comparative strength of the unions

dispute.

1897-98,

in those districts. Employers complained of being subject to vexatious restrictions not imposed on their competitors, and they declared that they were severely handicapped as compared with America and other countries, where engineering employers had much more complete control over the management of their busi- ness . In 1895 was formed the Federation of Engineering Employers by the coalition of the local associations on the Clyde and in Bel- fast, and this Federation gradually spread to other districts until it finally embraced the United Kingdom generally. The policy of the Federation was to defeat the attempts of the unions to put pressure on particular individuals or localities, by the counter threat of a general lock-out of trade unionists over a wide area in support of the employers thus attacked. The lock-out notices were framed in such a way that 25 per cent, of the trade unionists employed were to be discharged at the end of each week until the whole were locked out. Lock-out notices of this kind were

twice posted — in August of 1896 and in the spring of 1897 — before the general dis- pute, but in each case the dispute was tided over before the notices took effect. But the conferences which took place in April 1897 be- tween the representatives of employers and unions led to no agree- ment except on comparatively unimportant points. When, there- fore, in June 1897 the London employers, threatened with a strike for an eight hour day, put their case in the hands of the Employers' Federation, and the Federation determined to support them by a general lock-out, it was understood that this lock-out was enforced, not only in order to resist the reduction of hours in London, but to obtain a settlement of all the important questions at issue between the Federation and the unions as a whole.

The engineers replied to the notices of a gradual lock-out by withdrawing the whole of their members from work in federated workshops. At first the lock-out affected some 25,000 men employed in 250 establishments, but by the close of the dispute the number of employers involved had risen to 702, and of work-people to 47,500.

Until November no meeting between the parties took place, but on 24th November and following days a conference was held in pursuance of negotiations with the parties by the Board of Trade, each side having its own chairman. The main point for which the employers contended was freedom on the part of each employer to introduce into his workshop any condition of labour under which any members of the trade unions were working in any of the federated workshops at the beginning of the dispute, except as regards rates of wages and hours of labour. Arising out of this general principle of freedom of management, a number of special points were discussed, and subsequently embodied in separate articles of the provisional agreement, and a system of local and general conferences for the settlement and avoidance of future disputes was also included therein. The employers absolutely declined to grant any reduction of hours of labour. The negotia- tions dragged on for a considerable time, and were at one time broken off owing to the refusal of the men to ratify the provisional agreement. By the end of the year, however, it was evident that the position of the men was very much weakened owing to the depletion of their funds, while that of the employers was stronger than ever. On 13th January the London demand for an eight hours' day was formally withdrawn, and after

some further nego- tiation, and the embodiment in the agreement of the notes and ex- planations published by the employers, a settlement was arrived at and ratified by more than a two-thirds majority of the men, the final agreement being signed on 28th January.

The victory of the employers was complete, but the use since made of it has been moderate, and the relations between employers and workmen in the engineering trades seem, on the whole, to have been improved, all matters likely to cause dispute being now amicably discussed between the representatives of the respective associations.

Countries other than the United Kingdom.

_ It is not possible within the limits of this article to give a detailed account of the strikes and lock-outs in all the principal foreign countries. Strikes in the United States are dealt wtith in a separate section. Below is given a brief account of the most recent strike statis- tics and of some of the chief recent disputes in Prance and Germany, together with notices of a few of the most important recent labour disputes in other Continental countries.

France. — Detailed statistics of strikes and lock-outs in France have been published annually since 1890 by the French Office du Travail. The figures show great varia- ‘ tions from year to year, as appears from the following summary for eight years : —

STRIKES AND LOCK-OUTS

25

Year.

Number of Disputes.

Number of “Work- people directly affected.

Aggregate Dura- tion in Working Days.

1893 1894 1895 1896 1897 1898 1899 1900

634 391 406 476 356 368 744 903

170,123 54,576 45,809 49,851 68,875 82,065 177,081 222,769

3,174,000

1,062,480

617,669

644,168

780,944

1,216,306

3,550,734

3,761,227

Average of 1 eight years /

535

108,894

1,850,941

These figures show that the importance of strikes in France, both as regards numbers involved and duration, is in ordinary years much less than in the United Kingdom, but in exceptional years {e.g., 1893, 1899, and 1900) the figures approach those of an average year in the latter country. In two of the eight years (1899 and 1900) more time was lost through disputes in France than in the United Kingdom. In five out of the eight years (1894, -5, -6, -9, and 1900) the trades most largely affected were the textile group. This was especially the case in 1899 and 1900, when this group accounted for about half the total time lost. In 1893 half the total time lost was accounted for by mining disputes, and in 1897 and 1898 the building trades held the first place.

In the French statistics of causes of disputes, a dis- pute due to several causes is entered several times, and not merely under its principal cause, as in the United Kingdom. In 1900, when 222,769 persons were affected, 178,912 were involved in strikes for advance of wages, and about 40,920 in disputes as to other wages questions. Strikes for decrease of hours affected 78,512, those relating to employment of particular classes or persons 44,192, and those relating to working arrangements 57,226. As regards results, the percentages of work-people involved in disputes resulting in various ways are as follows (average of eight years) : in favour of work-people, 19 ; in favour of employers, 35 ; compromised, 46.

Some of the most notable of the Trench strikes in recent years have taken place in the coal-mining industry, namely in the Nord and Pas-de-Calais departments.

In 1884 the miners of Anzin and the neighbouring district struck against certain proposed alterations in the working condi- tions, including the letting of the work by contract to the gang making the lowest tender. After a stoppage of fifty-six days work was resumed, substantially on the company's conditions, on Caal VWn. April. The number affected is stated to have

been about 30,000. In 1889 a strike affecting 15,000 men, for an increase of wages, resulted in an increase of 10 per cent, after a short stoppage, and in the autumn of 1891 a strike in the same districts, involving nearly 40,000 men, for a more equitable distribution of wages and the reorganization of benefit funds, was settled by arbitration, the result being a compromise. In the following year a prolonged dispute took place among the miners at Carmaux, in the Tarn department, which, though not involving a very large body of workmen, attracted great public attention, and was marked by violence and disturbance. The cause of the strike was the dismissal of a miner who had been elected mayor. The strike broke out on 15th August, and on 26th October M. Loubet, as arbitrator, decided that the mayor should be reinstated, but given leave of absence during his mayoralty. He also decided that there was no ground for the removal of the director to whom the men objected. The men rejected the award because it did not provide for the reinstatement of the men convicted of violence, and ultimately the

Government remitted the penalty of those convicted on condition that the miners resumed work. The men accepted these terms, and the director resigned.

The year 1890 in France, as in England, was marked by a wide- spread agitation for an eight hours' day, which led to numerous strikes in different trades and districts.

In 1893 a general strike took place among the miners of the Pas-de-Calais and Nord departments for a 10 per cent, increase of wages and other demands, about 42,000 men being affected. The Anzin miners, however, held aloof. An invitation to both sides to submit the dispute to arbitration, under the law of 1892, met with

no response from either party, and during October, in the course of which month the number of strikers gradually diminished, the strike was attended with a good deal of disorder. The strike gradually crumbled away, and early in November those who re- mained out decided to resume work.

On 25th October 1900 a strike for increased wages and other demands took place among the Pas-de-Calais miners, 20,000 men being affected. A compromise, however, was arrived at after a fortnight's stoppage, through the intervention of a member of the Chamber of Deputies.

At the end of 1900 and beginning of 1901 a series of strikes took place among the miners in the Sa&ne-et-Loire department, the most important being a dispute affecting 12,000 miners at Montceau-les- Mines, the matters in dispute including wages and the reinstate- ment of men dismissed on account of a previous strike. Eventually the men resumed work without securing their demands.

Among the more important textile trade disputes in recent years was a strike of spinners, weavers, and dyers in the Roubaix district in 1890, the number affected being about 22,000. The demands were for a reduction of hours and rise of wages, Ie*UIes- but the work-people were all unsuccessful. In 1893 a number of disputes took place as the result of the application of the law of 1892 regulating the hours of women and children in factories, the employers endeavouring to compensate themselves for the reduction of

hours by a proportionate decrease of wages. For example, at Lille in the textile factories, where men and women work side by side, the reduction of hours necessarily affected men as well as women, and the employers attempted to reduce the wages of both by one hour's pay. A strike of men and women ensued, which resulted in the restoration of the old rate of pay on condition that the hands should stand by the frames without interruption during the whole time that the machinery was in motion. Other strikes arising out of the application of the law took place at Paris, Mar- seilles, Rheims, and elsewhere. Similarly in 1900, the application of the law of 30th March 1900, regulating the hours of women and children, led to a strike of 12,000 laundry workers in Paris against a threatened reduction of wages. After a week the dispute ended in a compromise. On 12th November 1900 a strike of lace and tulle workers at Calais took place in opposition to the enforcement of the system of workhy quarter days. The strikers demanded also an in- crease of 20 per cent, in wages. Though only between one and two thousand persons were onstrike, 14,000 or 15,000 women, youths, and girls were thrown out work. The dispute was complicated by a dis- cussion as to the interpretation of the Factory Law of 1900. A good deal of assistance was given to the strikers by English trade unions, but, after lasting till February 1901, the strike ended in the defeat of the operatives.

The summer of 1900 was marked by a general outbreak of strikes among seamen and various classes of waterside labourers at several French ports. The strikes resulted in the first instance from a difference as to the interpretation of the agree- Waterside ment under which the seamen worked in the port of 'a*our- Havre. In the course of a strike of coalies the crew of a ship were ordered to take the coal on board. They refused, contending that this unusual work could be asked from them only during a voyage. The Tribunal Maritime decided that the men were in the wrong, and condemned 51 of them to 15 days' imprisonment. A strike followed, and the work- people belonging to the various mari- time trades at once demanded an increase of wages, which they obtained after eight days. The strike movement then spread rapidly to the chief ports of the Channel, Atlantic, and Medi- terranean coasts ; from Dunkirk to Bayonne, from Port-Vendres to Nice, and from Oran to B6ne. After the seamen and dock labourers had struck the dispute spread to many other trades. In most cases the labourers, aided by the active state of employment at the time, secured a complete or

partial victory. At Marseilles, where the strikes affected 8000 labourers of various classes during August, the strikes of stokers, coal-heavers, and sailors were ended by the concession of considerable advances of wages by the shipowners on the mediation of Admiral Besson. Other classes of labourers remained out until they could secure satisfactory concessions ; and the strike movement also spread to various classes of non-maritime labour, e.g., engineering works, oil-mills, bakers, &c. The agree- ment arrived, at through Admiral Besson's intervention did not prevent a fresh strike at the end of February 1901, the dock labourers demanding an eight hours' day for six francs. The strike, however, ended on 9th April in the defeat of the men.

Germany. — Before 1899 there were no official statistics of strikes and lock-outs throughout the German Empire, but certain figures were collected and published by the committee of the " Gewerkschaften " or Social Democratic trade unions in their Correspondenzblatt. These figures, however, were admittedly incomplete. For 1899 and 1900, however, statistics have been published by the German

Imperial Statistical Office for strikes and lock-outs other than in agriculture. The figures for 1900 show that 1468 disputes occurred (or rather were terminated) in that year, involving 141,121 persons, of whom 131,888 were directly and 9233 indirectly affected. A large proportion of the work-people (40,044) were in the building trades, 23,431 in wood-working trades, 15,366 in mining and smelting industries, and the rest in various miscellaneous indus- tries. It is noteworthy that in the printing and allied trades, which (see Trade Unions) are the most effec- tively organized as regards trade unions, only 324 persons were affected by strikes in this year. In 1899, 1311 dis- putes were recorded involving 116,486 work-people. ISTo fewer than 1166 of the disputes in 1900 were due to demands for advances of wages. A considerable number (444) were for decreased hours of labour. (In the Ger- man statistics of causes a dispute arising from more

than one class of cause is counted under more than one head.) About 19 per cent, of the disputes were settled in favour of the work-people (compared with 26 per cent, in 1899), 45 per cent, in favour of the employers (compared with 41 per cent.), and 36 per cent, were compromised (compared with 33 per cent.).

The most extensive dispute among German coal-miners in recent years was the great strike of 1889. The dispute began on 3rd ‘ May as a local strike at a single colliery in Gelsenkir- chen, “Westphalia, but rapidly spread throughout the mining districts of Westphalia, Rhine Provinces, Lorraine, the Palatinate, Upper and Lower Silesia, and Saxony. Altogether about 144,000 miners were involved. The demands were for a rise of 15 per cent, in wages, an eight hours’ shift from bank to bank, the payment of wages twice a month, and other concessions. On 18th May the Coal Association at Essen agreed to an eight hours’ day ” at the face,” with certain exceptions, and made other concessions as to minor matters, the settlement being partly due to the action of the Emperor, who received a deputation from the men on 14th May and from the employers two days later. Owing to some misunderstanding, however, work was not generally resumed until the end of the month.

On 29th December 1892 a strike broke out among the men em- ployed in the State mines in the Saar district against the introduc- tion of a new code of regulations under the Prussian Mining Law of 1892. Many other miners came out in sympathy, including 13,000 “Westphalian miners, so that by the middle of January 34,000 men were affected. At the end of January the miners had to give way, and a large number of dismissals followed.

In 1891 a general strike took place in the German printing trade, 10,000 men being affected. The object was to secure a nine

... hours’ working day and an advance of 10 per cent, in

r ” agm the wages scale. Most parts of Germany were affected. Before a stoppage took place the dispute was submitted to the Wages Board at Leipzig, but employers would only agree to a 1\ per cent, advance. The strike began on 24th October, and lasted until the middle of January 1892, when the men resumed on the old conditions. In Stettin and Breslau,

however, the stoppage had terminated at an earlier date on the exhaustion of the- strikers' funds. The collapse of the strike was hastened by the action of the Prussian and Wurtemberg Governments in preventing support being given to the strikers out of certain benefit funds in posses- sion of the union.

In the spring of 1896 a widespread strike took place in the German tailoring trade, mainly affecting women. The work- _ people's demands included the recognition of price

Tailoring. ystg^ erection of suitable workshops, weekly payment of wages, and appointment of a joint-committee to deal with dis- putes. In Berlin, where, as in several other districts, the strike began on 10th February, 20,000 to 30,000 persons were affected. The dispute was a three-cornered one, affecting the interests alike of the manufacturers and the contractors as well as the work- people.

In Berlin a speedy resumption of work took place, terms of settlement being arranged on 19th February, partly through the Berlin Industrial Court, by which various increases of wages were conceded, and a Conciliation Board was empowered to arrange a minimum price list. Wages were to be paid weekly, but the de- mand for workshops was withdrawn. Partial concessions were also secured by the strikers in the chief provincial centres, and the strike came to an end. Friction, however, subsequently occurred between the manufacturers and contractors, and when the mini- mum price list was fixed in July it met with approval from none of the parties.

In the winter of 1896 a stoppage took place among the steve- dores, dock labourers, and other waterside labourers at the port of Hamburg, the men demanding a rise in wages, with Waters!de higher rates for overtime, night, and Sunday work. /a6our_ The strike began among the stevedores on 21st November, and spread until at least 15,000 men were affected. The shipowners refused to submit the dispute to the Industrial Court. The Senate promised an inquiry into the conditions of labour at the docks if the men would resume work, but this they refused to do. On 16th January a meeting between represen- tatives of the parties took place at the Chamber of Commerce, but broke down over the men's demand for the dismissal of labourers who had been engaged during the dispute. Ulti- mately on 6th February the men resolved to return to work unconditionally.

On 19th February 1900 the Berlin cabinetmakers ‘struck to the number of 6000 to obtain uniform piece wages and a minimum of 24s. per week. The dispute extended until a consider- ably larger number were affected. The dispute was]£gjtj.„ settled by the intervention of the Berlin Industrial Court acting as a board of conciliation, a minimum of 24s. being guaranteed to workmen of average efficiency. The strike ended on 27th March.

Among the more important labour disputes of recent date in other Continental countries are the following: —

Austrian Coal Miners (1900).— The greatest strike recorded in Austria took place early in 1900, in the coal-mining industry. Originating in a strike on a small scale, for an increase of wages, at certain pits on the borders of Moravia and Silesia, it spread until 90,000 miners out of a total of 110,000 in Austria were involved. The men’s demands, in their final shape, included an eight-hours’ day from bank to bank, a minimum wage, weekly wages settlements, free light, and an increase of wages. The Boards of Conciliation constituted under the law of 1896 failed to effect a settlement, and the endeavour of the Government to in- duce the strikers to return to work on the promise of introducing a Bill for the reduction of hours in coal mines was also of no avail, the men pointing out that there was no guarantee of such a Bill passing. The strike gave rise to debates in the Beichsrath, and the whole question of miners’ hours.was referred to a committee, which prepared a draft Bill. It became evident, however, by the middle of March that no legislation could be introduced until after the Easter recess, on which the miners of northern and western Bohemia, followed gradually by those in other districts, resumed work with concessions (offered five weeks before) as regards wages, free light and fuel, and the regular settlement of wage accounts, but without securing an eight-hours’ day or minimum wage. The whole stoppage lasted eleven weeks.

Danish Building Trades (1899).— The most important labour dispute recorded in Denmark was the lock-out in the building and kindred trades in 1899. The dispute began with a demand from 300 joiners in Jutland for an advance of wages. At a conference between the central unions of employers and employed at Copen- hagen it was agreed that the men should remain at

work for a month on certain terms, while an endeavour should be made to arrange a compromise. The local unions rejected these terms, whereupon the employers gave notice of a lock-out ; and on the men offering to accept the terms previously rejected, the em- ployers declared that they were withdrawn, and that a general lock-out would take place throughout the building trades of Denmark unless the men resumed work on the old conditions. The lock-out which followed on 24th May threw 30,000 men idle, and the number was subsequently increased to 50,000 by the adhesion of employers in the wood-working, metal, and other trades, including the tailors and paviors, with a view of cutting off the support given to the men by members of these- industries. The employers also contrived to stop the supply of building materials, so as to prevent the locked-out men from setting up business for themselves. The struggle mainly turned on the freedom of the employers to manage their business, and on the enforcement of the responsibility of the central trade union for the acts of the local affiliated unions. The dispute was eventually terminated by an agreement between the ” Danish Employers’ and Masters’ Association ” and the ” Associated Trade Unions,” which laid down in detail the conditions under which alone strikes and lock-outs might be declared, or supported, and explicitly recognized the freedom of employers in the organization of their business, and the responsibilities of the central organi- zation for the fulfilment of agreements by their members and branches. (A translation of the full text is published in the Labour Gazette for October 1899.)

Italian Straw-plaiters (1896 and 1897). — Among the. more im- portant of recent disputes in Italy were two strikes of the women straw-plaiters in 1896 and 1897. The women affected were em- ployed in the villages to the south and east of Florence. The

object of the dispute in 1896 was to obtain a rise of wages which were extremely low, owing, among other causes, to the competition of Chinese and Japanese straw-plait. The number affected was 40,950 and the dispute lasted ten days, during which serious riots and conflicts with the soldiers took place. On 27th May the strike was settled in favour of the work-people

through the mediation of the local Chamber of Commerce and Labour Chamber. In 1897 another outbreak, stated to affect 41,550 persons, took place, and was ended by a compromise.

Belgian Coal-Miners (1899). — A widespread stoppage of Belgian coal-miners took place in the spring of 1899, arising from a demand for a 20 per cent, rise of wages put forward by a meeting of the National Federation of Belgian Miners at Charleroi on 17th April. The number affected rose to 60,000 ; but from 3rd May the number fell off. As soon as the strike began the Government convened the coal-mining sections of all the Councils of Industry and Labour to meet on 23rd April and inquire into the wages of coal-miners. Adjourned meetings were also summoned to enable the workmen to submit data rebutting the figures produced by the employers to show that wages had risen with the price of coal. On 15th May the committee of the Miners' Federation declared the suspension of the strike, to be resumed if the employers failed to raise wages. This was at once followed by a general resumption of work.

The British Colonies.

The only labour disputes in the British colonies which require special mention are the series of widespread con- flicts which took place in various parts of Australia during the years 1890-92. These disputes were remarkable in many ways. They turned to a large extent on the attempt

of labour unions to secure a monopoly of em- Austraiiaa ployment ; they all ended in the defeat of the Si890-92. work-people, and led to a weakening of trade

unionism ; and in the course of them intimida- tion and violence were carried to a point rarely known in the history of strikes and lock-outs, some of the conflicts almost resembling armed insurrections rather than peace-ful differences between employers and employed.

The great dispute of 1890 originated in a difference between the pastoralists and shearers, which caused a deadlock between the Pastoralists' Association and the Shearers' Union, and the con- sequent engagement of a number of non-union shearers for the season. Thereupon the Wharf

Labourers' Union refused to handle wool shorn by non-unionists, and a strike was announced for 18th August. Independently of the shearers' dispute, the maritime labourers were ready for a strike, owing to the refusal in June of the employers to confer with the marine officers with regard to their grievances unless they broke off all connexion with the Trades Councils of Melbourne and Sydney. This requirement was stated to be necessary in the interests of discipline ; but the officers and labourers alike regarded it as an attack on their organizations ; and in August the marine officers, wharf labourers, seamen, and other bodies of men ceased work. The strike began in Victoria, but spread to New South Wales, Queensland, and even New Zealand. The Newcastle coal-miners refused to hew coal intended for employers involved in the dispute, and were locked out ; and in September the shearers also ceased work. In Queensland the shearers resumed work after a week, the Labour Federation ordering the execution of existing contracts ; but in New South Wales and Victoria the struggle was of an obstinate kind, and paralysed industry from August to October. Extensive picketing was resorted to, and assaults were made on gangs of non-unionists engaged in loading and unloading cargoes, or in carting wool through the streets. The disorders culminated in an attack on 19th September on nine trolleys which were being escorted from the Darling Harbour yards by mounted troopers and police, and this necessitated the reading of the Riot Act and the dispersal of the crowd by armed force. After this incident the disturbances gradually ceased, and the strike collapsed in October through the replacement of the strikers by non-union labour.

The difficulties, however, between the shearers and the pas- toralists were not ended by this dispute, and at the beginning of the following year an agreement drawn up by the newly- formed Federation of Pastoralists' Unions was rejected by the shearers' unions. This caused a prolonged stoppage of work in Queensland ; and in June the shearers of New South Wales (where the season is later) resolved to cease work on the refusal of the pastoralists to dispense with free labour. Victoria and South Australia were unaffected. The Queensland shearers formed camps in the bush ; incendiarism was advocated and practised ; and violent measures of various kinds were adopted to prevent the importation of non-unionists. Volunteers were called out, and

troops drafted into the disturbed districts, shearing being mean- while carried on by free labour, until on 15th June, the strikers' funds being exhausted, the dispute was declared at an end. The strikers in New South Wales were also defeated by the employment of non-union labour.

In July 1892 a strike took place among the silver-miners at Broken Hill in New South Wales, caused by the attempt of the management to substitute a contract system for day payments. An extensive system of picketing was resorted to, and the directors refused to meet the strike leaders until the pickets were withdrawn. After some weeks the company began to import labour under a strong police escort. The first contin- gent, which arrived from Adelaide by special train on 11th Sep- tember, was attacked with stones, and a few shots were fired. Subsequent contingents, however, were unmolested, and by November the strike had entirely collapsed. During the strike six of the leaders were tried and sentenced to various terms of imprisonment for inciting to riot ; and a night attack by the miners on non-unionists and the police, which followed the news * of the sentences, led to more arrests. The men were completely defeated, and a large number were left out of employment at the end of the dispute.

In the above disputes the employers were greatly strengthened by the presence of a large and increasing reserve of unemployed labour, owing to the depression of trade, which was gradually becoming more intense throughout Australia.

Authorities. — The following are among the more important official publications on strikes and lock-outs : Reports of the Chief Labour Correspondent of the Board of Trade on Strikes and Lock- outs (annually from 1888). — Labour Gazette (Board of Trade, monthly, from May 1893). — Reports of Royal Commission on Labour (1891-94). — Second Abstract of Foreign Labour Statistics (Board of Trade, 1901 — section on trade disputes). — Statistique des Grives, &e. (French Labour Department, annually from 1890). — Streiks unci Aussperrungen (German Imperial Statistical Office, annually from 1899). See also list of authorities on Trade Unions and Arbitration and Conciliation. (x.)

United States.

The first recourse to a strike in the United States occurred in 1740 or 1741, when a combined strike of journeymen bakers occurred in New York City. An information was filed in 1741 against the strikers for conspiracy not to bake until their wages were raised. On this they were tried and convicted, but it does not appear that any sentence was ever passed. In May 1796 an association of journeymen shoemakers in Philadelphia ordered a “turn-out” or strike to secure an increase of wages, and again in 1798, for the same purpose, both strikes being successful. In 1799 the shoemakers of Philadelphia struck against a reduction of wages, the strike lasting about 10 weeks, and being only partially successful. These four are the only strikes to which any reference can be found that occurred in the United States prior to the 19th century. The condition of industry generally during the colonial days was not conducive to strikes. The factory system had not taken deep root, masters and men worked together, and so there was no opportunity for concerted action.

The first notable American strike occurred in Novem- ber 1803, in the city of New York, and is commonly known as the ” sailors’ strike.” The sailors in New York had been receiving $10 per month. Notable They demanded an increase to f 14. In carry- ^ikes. ing out their purpose they formed in a body, marched through the city, and compelled other seamen who were employed at the old rates to leave their ships and join the strike. The strikers were pursued and dispersed by the constables, who arrested their leader and lodged him in gaol, the strike thus terminating unsuc- cessfully. In 1805 the Journeymen Shoemakers’ Associ- ation of Philadelphia again turned out for an increase of wages. The demands ranged from 25 to 75 cents per pair increase. This strike lasted six or seven weeks, and was unsuccessful. The strikers were tried for con- spiracy, the result of the trial being published in a pam- phlet which appeared in 1806. An account of this trial

may be found in the United States Supreme Court Library. In November 1809 a strike among the cord- wainers occurred in the city of New York. The pro- prietors quietly took their work to other shops, and by this stratagem defeated the strikers ; but the action being discovered, a general

turn-out was ordered by the Journey- men Cordwainers' Association against all the master workmen of the city, nearly 200 men being engaged in the strike. At that time a stoppage of work in one shop by the journeymen was called a "strike"; a general stoppage in all shops in a trade was known as a " general turn-out." A member of a journeymen's association who did not keep his obligations to the organization was denominated a " scab."

. In 1815 some of the journeymen cordwainers of Pitts- burg, Pa., were tried for conspiracy on account of their connexion with a strike, and were convicted. In 1817 a peculiar labour difficulty occurred at Medford, Mass. Thacher Magoun, a shipbuilder of that town, determined to abolish the grog privilege customary at that time. Mr Magoun gave notice to his people that no liquor should be used in his shipyard, and the words "No rum ! " " No rum ! " were written on the clapboards of the workshop and on the timbers in the yard. Some of Mr Magoun's men refused to work ; but they finally surrendered, and a ship was built without the use of liquor in any form.

The period from 1821 to 1834 witnessed several strikes, but rarely more than one or two in each year. These strikes occurred among the compositors, hatters, ship carpenters and caulkers, journeymen tailors, labourers on the Chesapeake and Ohio canal, the building trades, factory workers, shoemakers, and others. One of the most notable of these, for its influence upon succeeding labour movements, occurred in 1834, in the city of Lynn, Mass. Daring the latter part of the preceding year the female shoebinders of that town began to agitate the question of an increase of wages. The women engaged in this work usually took the materials to their homes. The manufacturers were unwilling to increase the prices paid, so a meeting for consultation was held by more than one thousand binders. This was on 1st January 1834. The binders resolved to take out no more work unless the increase was granted. The employers, however, steadily refused to accede to the demands, as they found no diffi- culty in having their work done in neighbouring towns at their own prices. The strike, after three or four weeks, came to an unsuccessful termination. In February of the same year a disturbance of short duration occurred at Lowell, Mass., among the female factory operatives. Their strike was to prevent a reduction of wages. During the year 1835 there was a large number of strikes throughout the country, instigated by both men and women. The number of strikes by

dissatisfied employes had at this time become so numerous as to call forth protests from the public press, the New York Daily Advertiser of 6th June 1835 declaring that ” strikes are all the fashion,” and suggesting that it was “an excel- lent time for the journeymen to come from the country to the city.”

The United States Government, through the Census Office and the Department of Labour, has investigated the question of strikes, the result being a fairly iavestiga- continuous record from 1880 to 31st December 1900 inclusive. In 1880, according to the tenth census, there were 610 strikes, but the number of estab- lishments involved in them was not reported ; the record must therefore commence with 1881, and since then the facts have been continuously and uniformly reported by the Department of Labour. This record, so far as numbers are concerned, is shown in the following table : —

Tear.

Strikes.

Lock-outs.

Number of

Establish- ments

O +J

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lV-i

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ft CI o

Strikes.

involved.

S£ a

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en

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SH

1881

471

2,928

129,521

9

655

1882

454

2,105

154,671

42

4,131

1883

478

2,759

149,763

117

20,512

1884

443

2,367

147,054

354

18,121

1885

645

2,284

242,705

183

15,424

1886

1,432

10,053

508,044

1509

101,980

1887

1,436

6,589

379,676

1281

59,630

1888

906

3,506

147,704

180

15,176

1889

1,075

3,786

249,559

132

10,731

1890

1,833

9,424

351,944

324

21,555

1891

1,717

8,116

298,939

546

31,014

1892

1,298

5,540

206,671

716

32,014

1893

1,305

4,555

265,914

305

21,842

1894

1,349

8,196

660,425

875

29,619

1895

1,215

6,973

392,403

370

14,785

1896

1,026

5,462

241,170

51

7,668

1897

1,078

8,492

408,391

171

7,763

1898

1,056

3,809

249,002

164

14,217

1899

1,797

11,317

417,072

323

14,817

1900

1,779

9,248

505,066

2281

62,653

Total .

22,793

117,509

6,105,694

9933

504,307

Statistics of Strikes. — Out of the total of 117,509 estab- lishments at which strikes took place during the period named, 41,910 were in building trades, 14,575 in coal and coke, 6153 in tobacco, 19,695 in clothing, 5126 in food preparations, 4652 in metals and metallic goods, 3436 in transportation, 3583 in stone quarrying and cutting, 1264 in boots and shoes, 1108 in furniture, 1193 in brick-making, 1723 in printing and publishing, and 891 in cooperage. These thirteen industries stipplied 105,309, or 89-61 per cent, of

the whole number of establishments in which strikes occurred during the twenty years. In the lock-outs occurring during the same time six industries bore a very large proportion of the burden, involving 8754, or 88-13 per cent, of the whole number of establishments, which was 9933. The industries affected were — building trades, 5001 ; clothing, 2034; stone quarrying and cutting, 516; boots and shoes, 292 ; tobacco, 339 ; metals and metallic goods, 272. The whole number of persons thrown out of employment by strikes was 6,105,694, of whom 90 per cent, were males and 10 per cent, were females; and the total number thrown out of employment by lock-outs during the same period was 504,307, of whom 80-24 per cent, were males and 19-76 per cent, were females. About 64 per cent, of the whole number of strikes were ordered by labour organizations ; and of the number so ordered (14,457) 52-86 per cent, succeeded, 13-60 per cent, succeeded partly, and 33 54 per cent, failed. Of the whole number of strikes, 50-77 per cent, suc- ceeded, 13-04 per cent, succeeded partly, and 36-19 per cent, failed. Of the lock-outs, 50-79 per cent, succeeded, 6-28 per cent, succeeded partly, and 42-93 per cent, failed. The average • duration of the strikes for the whole period was 23-8 days, and of the lock- outs 97-1 days. Strikes are principally undertaken on account of wages, either for an increase or against a reduction, or in relation to the hours of labour. These leading causes covered 76-86 per cent, of the strikes occurring in the period from 1st January 1881 to 31st December 1900.

It is difficult to ascertain exactly the losses of employes and employers resulting from strikes and lock- £.osses outs. Differences may counterbalance each from other, so that the following results, taken from strikes. the report of the United States Government, may be considered as fairly accurate : —

STRIKES AND LOC K-0 UTS

29

Str.kes.

Lock-Outs.

To Date when Strikers were re-

To Date when Employes locked

Tear.

employed or employed elsewhere.

Loss of

out were re-employed or employed elsewhere.

Loss of Employers.

Assistance to

Employers.

Assistance to

Wage-loss of

Employes by Labour

‘

Wage-loss of

Employes by

Employes.

Employes.

Labour

Organizations.

Organizations.

1881

‘$3,372,578

|287,999

11,919,483

$18,519

$3,100

$6,960

1882

9,804,228

734,339

4,269,094

466,345

47,668

112,382

1883

6,274,480

461,233

4,696,027

1,069,212

102,253

297,097

1884

7,666,717

407,871

3,393,073

1,421,410

314,027

640,847

1885

10,663,248

465,827

4,388,893

901,173

89,488

455,477

1886

14,992,453

1,122,130

12,357,808

4,281,058

549,452

1,949,498

1887

16,560,534

1,121,554

6,698,495

4,233,700

155,846

2,819,736

1888

6,377,749

1,752,668

6,509,017

1,100,057

85,931

1,217,199

1889

10,409,686

592,017

2,936,752

1,379,722

115,389

307,125

1890

13,875,338

910,285

5,135,404

957,966

77,210

486,258

1891

14,801,505

1,132,567

6,176,688

883,709

50,195

616,888

1892

10,772,622

833,874

5,145,691

2,856,013

537,684

1,695,080

1893

9,938,048

563,183

‘ 3,406,195

6,659,401

364,268

1,034,420

1894

37,145,502

931,052

18,982,129

2,022,769

160,244

982,584

1895

13,044,830

559,165

5,072,282

791,703

67,701

584,155

1896

11,098,207

462,165

‘ 5,304,235

690,945

61,355

357,535

1897

17,468,904

721,164

4,868,687

583,606

47,326

298,044

1898

10,037,284

585,228

4,596,462

880,461

47,098

239,403

1899

15,157,965

1,096,030

7,443,407

1,485,174

126,957

379,365

1900

18,341,570

1,434,452

9,431,299

16,136,802

448,219

5,447,930

Total

257,863,478

16,174,793

122,731,121

, 48,819,745

3,451,461

19,927,983

The total loss to employes and employers alike in the establishments in which strikes and lock-outs occurred, for the period of twenty years, was thus $468,968,581. The number of establishments involved in strikes during this period was 117,509, making an average wage-loss of $2194 to employes in each establishment in which strikes occurred. The number of persons thrown out of employ- ment by reason of strikes was 6,105,694, making an aver- age loss of $42 to each person involved. The number of establishments involved in lock-outs was 9933, making an average loss of $4915 to employe's in each establishment in which lock-outs occurred, while the number of em- ployes thrown out was 504,307, making an average loss of $97 to each person involved. Combining the figures for strikes and lock-outs, it is seen that the number of establishments involved was 127,442, while 6,610,001 persons were thrown out of employment. These figures show an average wage-loss of $2406 to the employes in each establishment, and an average loss of $46 to each person involved. The assistance given to strikers by labour organizations during the period was $16,174,793 ; to those involved in* lock-outs, $3,451,461, or a total of $19,626,254. This sum represents but 6-40 per cent, of the total wage-loss incurred in strikes and lock-outs, and is probably too low. Much assistance was also furnished by outside sympathizers, the amount of which cannot be readily ascertained. The total loss to the establishments or firms involved in strikes and lock-outs during this period was $142,659,104.

The states of Illinois, Massachusetts, New York, Ohio, and Pennsylvania, being the leading manufacturing states, necessarily experienced the largest number of strikes. Out of 117,509 establishments having strikes during the

period named, 87,878, or 74-78 per cent, of the whole, were in these five states ; and out of 9933 establishments having lock-outs, 8424, or 84-81 per cent., were in these states. In 1900 these states contained 45-02 per cent, of all the manufacturing establishments in the United States, and employed 55-15 per cent, of the entire capital invested in mechanical industries.

The figures given relate to all strikes, of whatever magnitude, occurring in the United States from 1881 to 31st December 1900 inclusive. Among them have occurred what may be called historic strikes, the first of which was in 1877, though of course

Historic strikes.

many very severe strikes had taken place prior to that year. The great railway strikes of 1877 began on the Baltimore and Ohio railroad at Martinsburg, W. Va., the immediate cause of the first strike being a 10 per cent, reduction of wages of all employes. This, however, was but one of many grievances. There was irregular employment. Men with families were permitted to work only three or four days per week, the remainder of the time being forced to spend away from home at their own expense, leaving them but little money for domestic use. Wages, payable monthly, were often retained several months. The tonnage of trains was increased, and the men were paid only for the number of miles run, irrespective of the time consumed. So there were many alleged causes for the great strikes of 1877. Riot, destruction of property, and loss of life occurred at Martinsburg, Baltimore, and various places in Pennsylvania. The state militia' at Martinsburg and Pittsburg sympathized with the strikers, affiliated with them, and refused to fire upon them. United States troops were ordered from Eastern garrisons, and they dispersed the mobs. In Cincinnati, Toledo, and St Louis mobs of roughs and tramps collected, and succeeded in closing most of the shops, fac- tories, and rolling-mills in those cities. There were also formidable demonstrations in Chicago, as well as in Syracuse, Buffalo, West Albany, and Hornellsville, New York, where mobs were dispersed by the state militia without violence or destruction of property.

The Pennsylvania railroad also had a memorable strike, accom- panied by riots and much violence and destruction of property, during the same year, the strike being ordered on account of a general reduction in wages and

some other causes which came in to create the difficulty. The complete story of this strike is too long to relate here, but from the beginning the strikers had the active sympathy of a large proportion of the people of Pittsburg, where the chief movements occurred. The actual loss of the Pennsylvania Company, not including freight, has been estimated at $2,000,000, while the loss of property and loss of business at Pittsburg amounted to $5,000,000. Claims were presented before the courts in Allegheny county to the amount of over $3,500,000, while the actual amount paid by compromise and judgments was over $2,750,000.

The next great strike was that of the telegraphists, which occurred in the year 1883. This strike was inaugurated to secure the abolition of Sunday work without extra pay, the reduction of day turns to eight hours, and the equalization of pay between the sexes for the same kind of work. Universal increase of wages was also demanded. The strike commenced 19th July and ended 23rd August 1883, although it was declared off on the 17th of the latter month. It was unsuccessful, the employes losing $250,000 and expending $62,000 in assistance to destitute fellow-operators. The employers lost nearly $1,000,000.

Another historic strike was that on the South- Western or Gould system of railways in the years 1885-86, but the most prominent labour controversies in the 19th century were those at Home- stead, Pa., in July 1892, and at Chicago in 1894, concerning which a more detailed account is given below. Other great labour con- vulsions have occurred which help to identify the decade beginning

1890 with the great strike era of the century. Among them may he named the Lehigh Valley railroad strike in December 1893, the American Railway Union strike on the Great Northern railway in April 1894 ; the great coal strike, which occurred in the same month ; the difficulties at Lattimer, Pa. ; and those in the Cceur d’Alene district of Idaho.

In July 1892 there occurred a most serious affair between the Carnegie Steel Company and its employes at what is known as the Homestead Works, near Pittsburg, growing out of a Homestead disagreement in the previous month in regard to wages. riot °r ^e Parties were unable to come to an agreement, and the company closed its works on the 30th of June and discharged its men. Only a small portion of the men were affected by the proposed adjustment of wages. The larger portion of them, who were members of the Amalgamated Association of Iron and Steel Workers, were not affected at all, nor was the large force of employe's, some three thousand in number, who were not mem- bers of that association. The company refused to recognize the association as an organization, or to hold any conference with its representatives. Upon the failure to arrive at an adjustment of the wage difficulty, the company proposed to operate its works by the employment of non-union men. The 'men, who could not secure recognition, refused to accept the reduced rates of wages, and also came to the determination that they would resist the com- pany in every attempt to secure non-union workers.

The history of the events at Homestead shows that the lodges composing the Amalgamated Association proceeded to organize what was styled an "advisory committee " to take charge of affairs for the strikers. All employes of the company were directed to break their contracts and to refuse to work until the Amalgamated Association was recognized and its terms agreed to. The works were shut down two days prior to the time provided by the con- tract under which the men were working, and, as alleged, because the workmen had seen fit to hang the president of the company in effigy. On 4th July the officers of the company asked the sheriff of the county to appoint deputies to protect the works while they carried out their intention of making repairs. The employes, on their part, organized themselves to defend the works against what they called encroachments or demands to enter ; in fact, they took possession of the Homestead Steel Works. When the sheriff's men approached, the workmen, who were assembled in force, noti- fied them to leave the place, as they did not intend to create any disorder, and would not allow any damage to be done to the prop- erty of the company. They further offered to act as deputies, an offer which was declined. The advisory committee, which had been able to preserve the peace thus far, dissolved on the rejection of their offer to serve

as deputies and conservators of the peace, and all of their records were destroyed. The immediate cause of the fighting which subsequently took place at Homestead was the approach of a body of Pinkerton's detectives, who were gathered in two barges on the Ohio river, some miles below the works. When the Pinkertons arrived the workmen broke through the mill fence, entrenching themselves behind the steel billets, and made all preparations to resist the approach of the Pinkerton barges ; and they resisted all attempts to land, the result being a fierce bat- tle, brought on by a heavy volley of shots from the strikers. The Pinkertons were armed with Winchesters, but they were obliged to land and ascend the embankment single file, and so were soon driven back to the boats, suffering severely from the fire of the strikers. Many efforts were made to land, but the position of the men they were attacking, behind their breastworks of steel rails and billets, was very strong, and from this place of safe refuge the detectives were subjected to a galling fire. This opening battle took place on the 5th of July, about four o'clock in the morning, and was continued in a desultory way during the day. It was re- newed the following day. A brass ten-pound cannon had been secured by the strikers, and planted so as to command the barges moored at the banks of the river. Another force of one thousand men had taken up a position on the opposite side of the river, where they protected themselves and a cannon which they had obtained by a breastwork of railway ties. A little before nine o'clock a bombardment commenced, the cannon being turned on the boats, and the firing was kept up for several hours. The boats were protected by heavy steel plates inside, so efforts were made to fire them. Hose was procured and oil sprayed on the decks and sides, and at the same time many barrels of oil were emptied into the river above the mooring place, the purpose being to ignite it and then allow it to float against the boats. Under these combined movements the Pinkertons were obliged to throw out a flag of truce, but it was not recognized by the strikers. The officers of the Amalgamated Association, however, interfered, and a surren- der of the detectives was arranged. It was agreed that they should be safely guarded, under condition that they left their arms and ammunition ; and having no alternative, they accepted the terms. Seven had been killed and twenty or thirty wounded. On the 10th of July, after several days' correspondence with the state authorities, the governor sent the entire force of the militia of the

state to Homestead. On the 12th the troops arrived, the town was placed under martial law, and order was restored. There had been much looting, clubbing, and stoning, and as the detectives, after surrender, passed through the streets they were treated with great abuse. Eleven workmen and spectators were killed in the rights.

Congress made an investigation of this strike, but no legislative action was ever taken. Some indictments were made and lawsuits ensued.. The mills were gradually supplied with new people, but the strike was not declared off until 20th November 1892. The Homestead strike must be considered as the bitterest labour war in the United States prior to the Chicago strike in 1894.

Probably the most expensive and far-reaching labour controversy which can properly be classed among the historic controversies of this generation was the Chicago strike of June and „, July 1894. Beginning with a private strike at the Chicago or works of Pullman's Palace Car Company at Pullman, a puuman suburb of Chicago, it ended with a practical insurrec- strike. tion of the labour employed on the principal railways radiating from Chicago and some of their affiliated lines, paralysing internal commerce, putting the public to great inconvenience, delaying the mails, and in general demoralizing business. Its influences were felt all over the country, to a greater or less extent, according to the lines of traffic and the courses of trade. The contest was not limited to the parties with whom it originated, for soon there were brought into it two other factors or forces. The original strike grew out of a demand of certain employes of the Pullman Company in May 1894 for a restoration of the wages paid during the previous year. The company claimed that the reduc- tion in the volume of business, owing to business depression, did not warrant the payment of the old wages. On account of the increased production of rolling-stock to meet the traffic incident to the World's Fair in 1893, orders for building cars were not easily obtainable, a large portion of the business of the Pullman Company being contract business in the way of building cars for railway companies generally. This state of affairs resulted in a partial cessation of car-building everywhere in the country, the Pullman Company suffering with all others. The demand of the employes therefore was not acceded to, and on 11th May 1894 a strike was ordered. Several minor grievances were claimed to

have existed and to have led to the action of the strikers, who had joined the American Railway Union, an association of railway employes which had achieved a partial success in a contest with the Great Northern railway a few weeks previous to the Pullman strike. The Railway Union espoused the cause of the Pullman employes on the ground that they were members thereof. This union was said to number about 150,000 members. It undertook to force the Pullman Company to accede to the demands of its employes by boycotting Pullman cars ; that is to say, they declared that they would not handle Pullman cars on the railways unless the Pullman Company would accede to the demands made upon it. The imme- diate antagonist of the Pullman Company in the extended contro- versy was therefore the American Railway Union.

Another force was soon involved in the strike, which was, very naturally, an ally of the Pullman Company. This was the General Managers' Association, a body of railway men representing all the roads, twenty-four in number, radiating from Chicago, and it was said to be the necessity of protecting the traffic of its lines that brought about its struggle with the American Railway Union. These roads represented a combined 'capital of more than 12,000,000,000, and they employed more than one-fourth of all the railway employes in the United States. These three great forces, therefore, were engaged in a battle for supremacy, and that rivalry alone, without reference to the conditions and circumstances attending the strike or accompanying it, makes this one of the historic strikes of the period.

According to the testimony of the officials of the railways in- volved, they lost in property destroyed, hire of United States deputy marshals, and other incidental expenses, at least $685,308. The loss of earnings of these roads on account of the strike is esti- mated at nearly $6,000,000. About 3100 employe's at Pullman lost in wages, as estimated, probably $350,000. About 100,000 em- ployes upon the twenty-four railways radiating from Chicago, all of which were more or less involved in the strike, lost in wages, as estimated, nearly $1,400,000. Beyond these amounts very great losses, widely distributed, were suffered incidentally throughout the country. The suspension of transportation at Chicago para- lysed a vast distributive centre, and imposed many hardships and much loss upon the great number of people whose manufacturing and business operations,

employment, travel, and necessary sup- plies depend upon and demand regular transportation to, from, and through Chicago. The losses to the country at large are estimated by Bradstreets to be in the vicinity of $80,000,000. Whatever they are, whether more or less, they teach the necessity of preventing such disasters, and the strike illustrates how a small local disturbance, arising from the complaints of a few people, can affect a whole country. When the American Railway Union took

up the cudgels for the Pullman strikers and declared their boycott against Pullman cars, and the General Managers' Association took every means to protect their interests and prevent the stoppage of transportation, the sympathies and antagonisms of the whole country were aroused. An unsuccessful attempt was made to in- duce all trades in Chicago to join in a great sympathetic strike.

The inevitable accompaniments of a great strike were brought into play at Chicago. Riots, intimidations, assaults, murder, arson, and burglary, with lesser crimes, attended the strike. In this, as in some of the other historic strikes, troops were engaged. The city police, the county sheriffs, the state militia, United States deputy marshals, and regulars from the United States army were all brought into the controversy. The United States troops were sent to Chicago to protect Federal property and to prevent obstruc- tion in the carrying of the mails, to prevent interference with inter-state commerce, and to enforce the decrees and mandates of the Federal courts. They took no part in any attempt to suppress the strike, nor could they, as such matters belong to the city and state authorities. The police of the city were vised to suppress riots and protect the property of citizens, and the state militia was called in for the same service. The total of these forces employed during the strike was 14,186.

Many indictments and law-suits originated in the difficulties occurring in Chicago. But all the attending circumstances of the strike point to one conclusion — that a share of the responsibility for bringing it on belongs in some degree to each and every party involved. The strike generated a vast

deal of bitter feeling — so bitter that neither party was ready to consider the rights of the other. The attacking parties claimed that their grievances war- ranted them in adopting any means in their power to force con- cessions. This is the attitude of all strikers. The other parties, on the other hand, claimed that they were justified in adopting any means in their power to resist the demands of the attacking party. The probability is that neither recognized the rights of the public to such an extent as to induce them to forbear bringing inconvenience and disturbance to it. It was the most suggestive strike that has ever occurred in the United States, and if it only proves a lesson sufficiently severe to teach the public its rights in such matters, and to teach it to adopt measures to preserve these rights, it will be worth all it cost.

The so-called steel strike of the year 1901 was a contest between the Amalgamated Association of Iron, Steel, and Tin “Workers and the United States Steel Corporation. It began on the The steel grst ,jay 0f juiVj ana lasted until 15th September 1901, /oa’/*’ when work was resumed in accordance with an adjust-

ment agreed to on the 13th of the latter month. The difficulty grew out of an attempt to adjust a sliding scale of wages with some of the constituent companies of the United States Steel Cor- poration, a new company having 11,404,000,000 capitalization. This corporation was perfected after the difficulties really began, so the Amalgamated Association ultimately had to confront the new power- ful corporation. The real nut of the difficulty was not a question of wages, hours of labour, or rules or conditions of work, but a contest for recognition of the right of the association to demand the unioniz- ing of mills, a demand, of course, which was positively refused by the Un ited States Steel Corporation. There were no grievances, as inti- mated ; it was clearly and solely a conflict on the demand for recogni- tion in the trade-union sense, and it was the first great struggle in the United States that was conducted solely on this issue. This issue has been contested many times, but usually in conjunction with some grievance or complicated with some demand as to wages or other eco- nomic conditions. The result was that the Amalgamated Association did not secure the terms demanded ; and it lost further, because some of the mills which were subject to the union’s rules were taken out and made non-union mills. . The strike was

conducted without any of the dramatic and tragic circumstances which attended the Home- stead affair in 1892, in which the Amalgamated Association was one of the parties. In the contest of 1901 the association did not have the hearty endorsement of a large number of workmen, as it was not a movement to redress any grievance. It was fought for a principle, but the movers did not consider the power against which they were obliged to contend. Officers of the Amalgamated Asso- ciation estimated that the number of men out of employment dur- ing the strike averaged 30,000 per day. At a conservative estimate there must have been a loss of more than $4,000,000 in wages. The steel company through its officers claimed that it experienced no great loss as the result of the strike.

A strike affecting more individual interests than any preceding it was the anthracite coal strike of 1902, which formally began on 12th May. It was ordered at a convention held at Coal Hazleton, Pennsylvania, 15th May, by a vote of 461

strike, t0 349 The leaders of the miners, with one or two

1902′ exceptions, opposed the strike. It ,was therefore a

strike of the workers themselves. Grievances had existed in the anthracite coal region for many years, but more especially since the strike of 1900. An attempt was made in 1901 to secure some

concessions, but the operating railways declined even to enter into a conference. This, of course, caused irritation, and constant appeals were made to the officers of the union to make new demands, and failing to secure concessions, to organize a strike. The demands of the miners were as follows : (1) An increase of 20 per cent, to those miners who are paid by the ton ; (2) a reduction of 20 per cent, in the time of per diem employes ; (3) that 2240 lb constitute the ton on which payment is made for coal mined by weight. No grievances were presented. The powder question was practically settled in 1900. The miners’ demands being rejected by the operators, the demands were subse- quently reduced one-half ; i.e., 10 per cent, increase per ton where mining is paid by the ton, and 10 per cent, decrease in the working day. The miners also voted to leave the whole matter to arbi- tration and investigation, and to accept the results. They were willing to

make a three years’ contract on the terms proposed. The fundamental difficulty on the part of the operators related to efforts to secure and preserve discipline. They claimed that every concession already made had defeated this. The strike involved nearly 150,000 employes, and affected the consumers of anthracite coal throughout the Eastern states.

Authorities. — U.S. Department of Labour, Sixteenth Annual Report, 1902 ; reports of various State Bureaus of Labour Statistics ; Pennsylvania Bureau of Industrial Statistics, Twentieth Annual Report, 1892; U.S. House of Representatives, “Employment of Pinkerton Detectives at Homestead, Pa.,” Report No. 2447, 52nd Congress, 2nd Session, 1892 ; United States Strike Commission, Report on Chicago Strike, Senate Ex. Doc. No. 7, 53rd Congress, 3rd Session, 1894 ; ” The Amalgamated Association of Iron and Steel Workers,” Quarterly Eeport of Economics for November 1901.

(c. D. w.)

Strood . See Rochesteb.

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Strossmayer, Joseph George (1815- Roman Catholic theologian, was born at Essek, in Slavonia, 4th February 1815. He studied theology at Pesth. After his ordination to the priesthood in 1838 he became a professor in the. seminary at Diakovar. He next was made chaplain to the emperor of Austria, and at a later period director of the Augustinian body at Rome. In 1849 he was consecrated bishop of Bosnia. From that time he became, by his ability, force of char- acter, and strong national sentiments, a recognized leader of the Slavonians of eastern Austria. He created a national party in Austrian Slavonia, and stimulated Slavonic national feeling by establishing national schools and by publishing collections of Croatian songs and ” Volksbueher.” He eagerly advocated the use of the vernacular in the Roman Catholic services, so as to bring over the Slavonians of the Greek Church to the Roman obedience. His fervid advocacy of the Slav cause drew upon him the displeasure of the emperor. But he still persevered in his efforts to fan the- flame of Slav national feeling. Among other steps in this direction, and in that of Romanizing the Slavs, he founded a seminary in Aus- tria for the Slavs of Bosnia. With the assistance of Theiner, the librarian at the

Vatican, he compiled his Vetera Monumenta Meridionalium Slavorum Mstoriam illustrantia, which was published at Rome in 1863. When the Infallibility question arose in 1870, he was one of the most energetic and outspoken opponents of the decrees, and for years he refused to send in his sub- mission to them. But the difficulty was finally surmounted by an informal submission, and in 1881 and 1888 he headed a pilgrimage of Slavs to Rome. In spite of his opposition to the decrees of the Vatican Council, he succeeded in obtaining from the Pope the concession he had so long advocated, that the vernacular should be retained in the South Slavonian liturgy. Strossmayer retired from active political life in consequence of a rebuke administered to him by the emperor of Austria, as king of Hungary, who charged him with stirring up strife between Croats and Hungarians. In consequence of this reproof, and of his advancing age, little was heard in late years of a man who once wielded an altogether exceptional influence in southern Slavonia. •

Stroud, a parish and market town in the Stroud parliamentary division of Gloucestershire, England, on the Frorne, 10 miles south of Gloucester by rail. Recent erec- tions are a free library and a school of art. There are foundries, and umbrella and walking-stick factories. Area of urban district, 1169 acres. Population (1891), 9818 ;

(1901), 9188.

Stryj, or Stet, a town in Galicia, Austria, 40 miles S. by W. of Lemberg. Population (1890), 16,515 ; (1900), estimated at 23,673 (70 per cent. Polish, 26 per cent. Ruthenian, 4 per cent. German ; 40 per cent. Jewish, 30 per cent. Catholic, 27 per cent. Greek Catholic, and 3 per cent. Protestant). Its chief industries are tanning and the manufacture of lucifer matches, but it is also an important cattle market. Iron ore is mined in the adjoining district.

Stubbs, William (1825-1901), English historian and bishop of Oxford, son of William Morley Stubbs, solicitor, of Knaresborough, Yorkshire, was born on 21st June 1825, and was educated at the Ripon grammar school and

Christ Church, Oxford, where he graduated in 1848, obtaining a first-class in classics and a third in mathematics. He was elected a fellow of Trinity Col- lege, and held the college living of Navestock, Essex, from 1850 to 1866. He was librarian at Lambeth, and in 1863 was an unsuccessful candidate for the regius pro- fessorship of ecclesiastical history at Oxford. In 1866 he was appointed regius professor of modern history at Oxford, and held the chair until 1884. His lectures were thinly attended, and he found them grievous in- terruptions to his historical work. Some of his statutory lectures are published in his Lectures on Mediaeval and Modem History. He was rector of Cholderton, Wiltshire, from 1875 to 1879, when he was appointed a canon of St Paul's. He served on the Ecclesiastical Courts Commis- sion of 1881-83, and wrote the weighty appendices to the report. On 25th April 1884 he was consecrated bishop of Chester, and in 1889 was translated to the see of Oxford.

Until Bishop Stubbs found it necessary to devote all his time to his episcopal duties, he pursued historical study with unremitting diligence. He rejected the theory of the unity and continuity of history so far as it would obliterate distinctions between ancient and modern history, holding that, though work on ancient history is a useful preparation for the study of modern history, either may advantageously be studied apart. He urged that history is not to be treated as an exact science, and that the effects of individual character and the operations of the human will necessarily render generalizations vague and conse- quently useless. While pointing out that history has a utility as a mental discipline and a part of a liberal educa- tion, he recommended its study chiefly for its own sake, for the truth's sake, and for the pleasure which it brings. It was in this spirit that he worked; and his intellectual character was peculiarly fitted for his work, for he was largely endowed with the faculty of judgment and with a genius for minute and critical investigation. He was eminent alike in ecclesiastical history, as an editor of texts, and as the historian of the ^English constitution. His right to be held as an authority on ecclesiastical history was proved in 1858 by his Registrwm Sacrum Anglicanum, which sets forth episcopal succession in England, by many other later works, and particularly by his share in Councils and Ecclesiastical Documents, edited in co-operation with the Rev. A. W. Haddan, for the third volume of which he was specially responsible. His place as a master in critical scholarship and historical

exposition is decided beyond debate by the nineteen volumes which he edited for the Rolls series of Chronicles and Memorials. It is, however, by his Constitutional History of England that he is most

widely known as a historian. The appearance of this book, which traces the development of the English con- stitution from the Teutonic invasions of Britain till 1485, marks a distinct step in the advance of English historical learning. Specialists may here and there improve on a statement or a theory, but it will always remain a great authority, a monument of patient and exhaustive re- search, of intellectual power, and of ripe and disciplined judgment. Its companion volume of Select Charters and other Illustrations of English Constitutional History, admirable in itself, has a special importance in that its plan has been imitated with good results both in England and the United States.

Bishop Stubbs belongs to the front rank of historical scholars both as an author and a critic. Among English- men at least he excels all others as a master of every department of the historian's work, from the discovery of materials to the elaboration of well-founded theories and literary production. He was a good palaeographer, and excelled in textual criticism, in examination of authorship, and other such matters, while his vast erudition and retentive memory made him second to none in interpretation and exposition. His carefulness was exemplary, and his references are always exact. His merits as an author are often judged solely by his Con- stitutional History. The learning and insight which this book displays are unquestionable: it is well planned, and its contents are well arranged ; but constitutional history is not a lively subject, and, in spite of the skill with which Stubbs handled it and the genius displayed in his narrative chapters, the book does not afford an adequate idea of his place as a writer of history. What that is cannot be determined without taking into account the prefaces to some of the volumes which he edited for the Rolls series. Several of them contain monographs on parts, or the whole, of the author's work, written with remarkable literary skill. In these his language is vigorous and dignified : he states the results of his labour and thought with freshness and lucidity; tells numberless stories in a most delightful manner, and exhibits a wonderful talent for the representation of personal character ; the many portraits of historic per- sons of all orders which he draws in these prefaces

are as brilliant in execution as they are exact and convincing. Among the most notable examples of his work for the Rolls series are the prefaces to Roger of Hoveden, the Gesta Begum of William of Malmesbury, the Gesta Hen- rici II, and the Memorials of St Dunstan. Both in England and America Bishop Stubbs was universally acknowledged as the head of all English historical scholars, and no English historian of his time was held in equal honour in European countries. Among his many distinctions he was an hon. D.C.L. of Oxford, LL.D. of Cambridge, Edinburgh, and Dublin, and hon. . Doctor in utroque jure of Heidelberg ; an hon. mem- ber of the University of Kief, and of the Prussian, Bavarian, and Danish Academies ; he received the Prus- sian order Pour le mirite, and was corresponding member of the Acad&mie des Sciences Morales et Politiques of the French Institute.

Stubbs was a High Churchman whose doctrines and practice were grounded on learning and a veneration for antiquity. His opinions were received with marked respect by his brother prelates, and he acted as an assessor to the archbishop in the trial of the bishop of Lincoln. Much of his work as bishop must have been uncongenial to him, for his tastes were those of a student, and he did not disguise his dislike of public functions and the con- stant little journeys which take up so much of a bishop’s time. Nevertheless he fulfilled all his episcopal duties with diligence, and threw all his heart into the performance of

those of a specially spiritual nature, such as his addresses at confirmations and to those on whom he conferred orders. As a ruler of the Church he showed wisdom and courage, and contemptuously disregarded any effort to influence his policy by clamour. In personal character he was modest, kind, and sympathetic, ever ready to help and encourage serious students, generous in his judgment of the works of others, a most cheery companion, full of wit and humour. His wit was often used as a weapon of defence against those who annoyed or bored him, for he did not suffer fools gladly. An attack of illness in November 1900 seriously impaired his health. He was able, how- ever, to attend the funeral of Queen Victoria on 2nd

February 1901, and preached a remarkable sermon before the King and the German Emperor on the following day. His illness became critical on 20th April, and he died on the 22nd. In 1859 he had married Catherine, daughter of John Dollar of Navestock, and had a numerous family.

(w. Hu.)

Stuttgart, the capital of Wurtemberg, Germany, stands in a basin surrounded by vine-clad hills, 1£ miles from the left bank of the Neckar. The beauty of the situation and the educational advantages attract several foreign residents, more particularly British and Americans. The more important of the recent erections are the Queen Olga Buildings, in the Eenaissance style, put up in 1893- 95, on the north side of the Castle Square ; the National Industrial Museum (1890-96), in the Late Renaissance style, flanked by a couple of cupola-crowned corner towers, and richly decorated with medallions of famous Swabians, &c. ; the Liederhalle, With one of the largest halls in Germany ; the new town hall ; the Peace church (1893), the Roman Catholic church of St Nicholas (1896), three other churches, large swimming baths (1888-89), a new railway viaduct across the valley of the Neckar, 738 yards long ; a bronze statue of Duke Christopher (1889) in the principal square ; a monument to the Emperor William I. (1898) near the old castle ; an equestrian statue of King William I. (1884), by Hofer, in the court of the Museum of the Plastic Arts ; and a large monumental fountain on the Eugensplatte. The Hof-theater was burned down in 1902. The royal library contains about 500,000 volumes, 3800 MSS., and a collection of some 7300 Bibles. There is a rapidly growing trade, and important cloth, horse, and hop markets. The art and educational institutions embrace the industrial exhibition, the state archives, numismatic, art, and antiquarian collections, zoological and botanical gardens, an excellent conservatory of music, a chemical laboratory, an art academy, higher commercial institute, a commercial improvement school, and school of the building trades. The technical high school was attended by 1033 students in 1900, and the veterinary high school by about 100 students in the same year. The latter institution was raised to academic (” high “) rank in 1890 ; and the same status is also enjoyed by the school of art. In 1899 the right to confer the degree of doctor of engineering was conferred upon the technical high school. Stuttgart is not only a residential town ; it is also the seat of

considerable industries, especially the weaving of cottons, publishing, the manufacture of furniture, piano- fortes, chemicals, confectionery, paper, leather, clothing, colours, carriages, &c. At Berg, beside the Neckar, there are saline springs. Population (1885), 125,901; (1890),

139,817; (1895), 158,321; (1900), 176,318.

Styria (German, Steiermark), a duchy and crown- land in the Cisleithan part of the Austro-Hungarian Monarchy. Population in 1880, 1,213,597; in 1890, 1,282,708; and in 1900, ‘ 1,356,058, which is equivalent to 156-7 inhabitants per square mile. Proportion of females to males, 1017 to 1000 ; 67-8 per cent. German,

32-2 per cent. Slovene; 99 per cent. Roman Catholic, the remainder consisting of 10,556 Protestants and 1979 Jews. In 1897 the marriage-rate was 6-99; the birth- rate, 31-15, or excluding still-births 29-94; and the death-rate, 24-02. Of the births 23-10 per cent, were illegitimate, a declining ratio.

Styria sends 27 members to the Reichsrath, 4 of whom are returned by the new general suffrage curia. In the Diet there are 55 Germans and 8 Slovenes. Owing to the steady increase of the industrial population and the chronic irritation produced by the nationality struggle, Styria has become one of the most Radical and strongly German Nationalist provinces of Austria. This applies even to a considerable and growing minority of the agri- cultural population. Indeed, in its Pan-Germanic leanings it approaches the German districts on the Bohemian frontier. Socialism is widely prevalent in the industrial districts, and more particularly at Gratz, although, owing to the restricted suffrage and large rural population, it is but slightly represented.

In addition to the University (1306 students in 1901), the Polytechnic (373 students), and an Academy of Commerce at Gratz, the province has over 100 other educational institutions. There are 12 intermediate and 860 elementary schools. Of the latter, 568 are German, 212 Slovene, and 40 bilingual. In 1890 the illiterates amounted to 20 per cent, of the population, an improve- ment of 7-8 per cent, on 1880.

Notwithstanding its mountainous character, Styria is excep- tionally well cultivated, and in addition is one of the principal pastoral regions of Austria. The principal crops are oats, maize, buckwheat, and turnips, but considerable quantities of wheat, rye, millet, legumes, and fodder plants are also grown. In 1899 515,181 hectolitres of wine were produced. Fruit culture and poultry are also of some importance. In 1890 there were 66,871 horses, 700,012 horned cattle, 162,416 sheep, 42,238 goats, 637,607 pigs, and 100,573 bee-hives. In 1899 the total yield of the mines in lignite and a small quantity of coal, in iron, lead, zinc, man- ganese, and graphite, amounted in value to £853,911, to which should be added salt recovered at Aussee to the value of £151,700. The value of the furnace products (iron and zinc) was £758,552. The manufacture of iron and steel wares (including small-arms, bicycles, machinery, railway material, agricultural implements, &c), glass, celluloid, paper and tobacco comes next in importance. These articles, together with cattle, timber, lignite, fruit, andwine, constitute the principal part of the exports.

In 1899 Styria had 1283 kilometres of railway, 4958 kilometres of roads, and 538 kilometres of waterway, of which 413 were only available for floating timber. There were 422 post and 209 tele- graph offices, with 2237 kilometres “of line and 8258 kilometres of wire.

Authorities. — Mitteilungen des historischen Vereinsfur Steier- mark (Gratz, 1850, &c), and other publications of the same society ; together with histories and descriptive works by Goth, Muchar, Kohl, Hlubek, Gebler, Zahn, Stur, Janisch, Schlossar, and Kosegger. (^;. 0’n.)

Suakin, a town and seaport on the west side of the Red Sea, at the point where the conventional line laid down in 1899 between Upper Egypt and Anglo-Egyptian Sudan reaches the coast. This part of the seaboard is thickly studded with reefs, and Suakin itself stands on a coralline islet connected with the suburb of El-Kef on the mainland by an embankment, and since 1884 by a railway viaduct. Access is gained to the harbour, which is the safest in the Red Sea, through a winding passage over 2 miles long, terminating in a deep oval-shaped basin several acres in extent, and completely sheltered from all winds. Suakin is of great importance both as the outlet of much of the produce of eastern Sudan and more especially as

the place where a large number of Moslem pilgrims embark for Jedda, the port of Mecca on the opposite side of the Red Sea, here about 20 miles wide. Hence after the Mahdist revolt it was occupied in force by the British in

1883, to prevent the contagion from spreading from Africa through this channel to the whole of the Mahommedan world (see Sudan, Anglo-Egyptian). It is still held by an Anglo-Egyptian garrison, and it is proposed to improve its strategical and commercial position by extending the railway begun in 1884 up the Khor Baraka valley to Kassala and Khartum, and also across the steppe, here 260 miles wide to Berber on the eastern bend of the Nile where it approaches nearest to the Red Sea. Since the overthrow of the Mahdist power, the trade of Suakin has revived and even increased, the imports having advanced from about £170,000 in 1880 before the war to £180,000 in 1899. They consist chiefly of textiles, flour, spirits, cutlery, preserves, dyes, and drugs, while the chief exports (£66,000 in 1899) are gums, mother-of-pearl, ivory, and tobacco. In the same year the entries, mostly British, were 37 ships of 29,000 tons, much less than formerly (758 vessels of 172,000 tons in 1880), the falling off being due to the total suppression of the slave trade, in which large numbers of Arab dhows were engaged before the British occupation. (a. h. k.)

Submarine Boats. See Ship.

Submarine Mines. — (1) General Considera- tions, and British Practice. The employment of floating or submerged mines for defensive purposes has long been an attractive subject for study and experiment. Unseen dangers appeal powerfully to the imagination, and the fact that ships may be and have been sunk by mines has caused extravagant claims to be advanced by the advocates of this adjunct of defence.. Mines capable of being exploded if struck by a vessel were employed by the Russians in the Crimean war without effect. In the American Civil War they were largely used by the Confederates, who were driven to adopt all possible expedients ; and as several ships were thus destroyed, the system was afterwards greatly de-

veloped and widely adopted by great and small Powers. Submarine mines have in recent years usurped a posi- tion in national defence which they are quite unfit to fill, and a modification of views which have been upheld by electrical experts who ignored the experience of war is to be expected. The conditions of the American contest were special and peculiar. The Confederate states had no sea-going navy, and the naval operations were practi- cally limited to interior waters. Provided that means existed for the entry of blockade-runners into a few Southern ports, obstruction of waterways could be accepted to- any extent. The exigencies of the war stimulated in- vention, and submarine mines afforded a cheap and ready method of defending channels. The essential conditions of the British Empire being in every respect absolutely different from those of the Southern states, the war pro- vided no lessons in harbour defence for our guidance. In the Franco-German war the small Prussian navy was powerless. Keil, Wilhelmshaven, and other ports were defended by mines which were not required, as the French fleet was effectually prevented, on other grounds, from attacks on the Prussian littoral. The only effect of the mines was to impede the entry of German ships into their own ports, and thus to bring about several captures, while the subsequent removal of the mine-fields led to a fatal accident. That the prevailing views of mine defence were hopelessly confused is shown by the fact that the French spent three months in installing the mine-field at Toulon, and failed to complete that at Cherbourg before the con- clusion of the war. As the Prussian squadron was unable to approach a French port, the futility of their proceedings could not have been surpassed. The Paraguayans are said to have employed submarine mines in the Parana

river during the irregular warfare which was carried on by Brazil for nearly six years ; but the operations were not thereby affected. In 1866 the Austrians appear to have laid out mine-fields at Pola and Venice, which events proved to be superfluous ; while a powerful Italian fleet was repulsed at Lina without any assistance from this adjunct. A little Turkish river gun-boat was sunk in •the Danube by an electro-mechanical mine in October 1887. The Peruvians are reputed to have laid mines during the war of 1879-81, which, if they existed, effected nothing. The Egyptians had provided themselves with an expensive equipment of submarine mines, which were found in store at Meks after the British occupation of

Alexandria in 1882. The Chinese were rumoured to have laid mines in the Min river in 1884; but, after careful search, the French squadron could not discover anything except fishermen's buoys. At Tamsui the river was obstructed by sunken junks and mines ; but as Admiral Leipes had only one gun-boat in his squadron which could have ascended the river, the exclusion of this craft is all that can be claimed for the mine-field. As, further, the French landing party was repulsed with heavy loss, it is clear that mines were not required by the Chinese. There is no war experience which justifies either the claims of the extreme advocates of submarine mines, or the immense expenditure to which Great Britain has been committed in providing defence of this nature.

Submarine mines may be roughly divided into three classes : (1) Mechanical mines, which, once laid, are uncontrollable, and are fired automatically if struck by any passing vessel. (2) Electrically- controlled mines, connected by cables with the shore, and capable of being rendered active when struck. (3) Observation mines laid on the ground or at depths greater than a' ship's draught, and fired electrically from an observatory station when a hostile vessel is ascertained to be within their sphere of action.

The first class are so dangerous as to be inadmissible except in cases where it is desired to close a channel alike to friend and foe.

The second necessarily constitutes an obstruction to waterways, and involves special pilotage arrangements and delay to maritime traffic. Moreover, no mine which contains its own means of igni- tion is entirely free from danger ; and there is no evidence that such mines, even when nominally inactive, might not be fired if cut through by a ship's screw.

The third class is open to no objection on the ground of physical obstruction to waterways ; but, unless the identification of an enemy's vessels can be absolutely guaranteed, it evidently involves great danger ; and in any case it breaks down altogether as a pro- tection in thick weather.

Wet gun-cotton, on account of its safety in storage, has been adopted for the charges of submarine mines in this country. Data as to the destructive radius of mines upon the hulls of modern ships are far from complete ; but the

formulae given (see United States below) embody the experience gained by such practical trials as have at present been carried out. The careful inquiry into the destruction of the Maine in 1898 led the United States officers to the conclusion that a mine had been fired close to her bottom. In this case the vessel sank rapidly ; but there was no means of ascertaining the amount of explosive employed.

The fact that the whole question of submarine mine defence has been allowed to remain in the hands of experts, who ignored naval requirements and the practical conditions of war, accounts for much misdirected energy and some evident danger. During the Spanish-American war mine-fields were laid in the approaches to New York, Philadelphia, and Boston, in obedience to the dictates of a humiliating and wholly superfluous scare which arose along the Atlantic sea-board when Admiral Cervera was believed to be contemplating a descent. The result was an almost intolerable hindrance to traffic, which would have greatly facilitated the operations of a Spanish com- merce destroyer, if such a vessel had been able to maintain herself off these ports.

The general principles which should guide and limit the employment of submarine mines may be briefly stated. In the first place, it is clearly superfluous to mine channels

~~which an enemy's vessels could not be expected to enter. The considerable expense incurred by a now abandoned project for thus defending the Liffey was therefore wholly unjustifiable. It may safely be assumed that hostile vessels will not enter cramped interior waters under effective fire, and the provision of a few guns in such cases is far more economical than an equipment of sub~~ marine mines. In any case the latter afford no protection against torpedo craft. Most British ports are in the category of those which no ship of war would enter if effective fire is brought to bear upon their waters. In war the free entry of British ships into all the Imperial ports is a condition of primary importance, and restric- tions entailing delay would frequently be dangerous. Observation mines can be employed, provided

they are always under the control of responsible officers capable of identifying with certainty an enemy's armed vessels. They have also the advantage that they can be laid down at any time without offering any hindrance to navigation. Contact mines are generally unsuitable for British requirements. Powers which contemplate the cessation of their commerce and naval inaction during war can employ mines of any form in profusion without disadvantage. As, however, artillery fire is usually re- quired for objects which no amount of mines may be able to secure, it is evidently desirable to consider in each case whether the one form of defence will not include the other. The submarine mine is thus an adjunct of little importance to Great Britain ; but, if judiciously employed, it may serve the purposes of a weak naval Power when confronted wjth a fleet too strong to be opposed on the seas. If ever the conditions of the American Civil War or of the fighting on the Parana are repeated, and naval action is limited to interior waters, the perfected sub- marine mine of the present day will play an effective rdle. As peculiar moral value has always been claimed for this form of defence, the mining of channels will generally be proclaimed whether it has been carried out or not.

(g. s. c.)

(2) United States.

Mines were planted in large numbers during the Spanish- American war of 1898. In the waters of Cuba, Puerto Bico, and Manilla the Spaniards used observation, electro- contact, and mechanical mines, ground and buoyant, with charges of gun-cotton as large as 500 lb in the former and 120 ft> in the latter. Ground mines were planted in depths of water as great as 66 feet; buoyant were submerged about 11 feet. Mechanical mines were placed in advance of electro-contact mines at Santiago; 48 mines were planted in Guantanamo Bay.

The United States had the revision of its submarine mining system under study for two years prior to the war, and had adopted many improvements in details of materials and in the operation of the system. The system involves the use of seven- cored cable, each core of which is connected through disconnectors to three single-cored cables ; at the end of each single core is a mine, either buoyant or ground. Each main group therefore

consists of twenty-one mines. Buoyant mines contain a circuit-closer and a circuit-regulator ; the latter contains a coil of 4500 ohms resistance, with a magnetic device for cutting out this resistance. Skirmish mines are not provided with circuit-regulators, and are electro- contact mines.' Mines can be fired automatically on contact with a vessel, or at will, either with or without prior contact. Contact serves to notify the observer of the mine struck. The explosive used is chiefly dynamite ; forcite gelatine has also been used. Charges are fired either by storage or Leclanche" batteries. When planted, mines are subject to frequent tests to determine their condition. Buoyed channels were provided, which vessels drawing over 3 feet were directed to follow in their passage through mine-fields ; but trespassing beyond these channels was frequent. Mines are prepared and planted by trained soldiers of the engineer battalion, assisted by skilled civilians from private corporations, boatmen, and labourers. Cable tanks are used for the storage of the submarine

cable. The Americans planted over 1500 mines, operated from forty-four mining casemates in twenty-eight harbours — 210 in Boston harbour, about 250 in the entrances to New York harbour, and 108 in Hampton Roads. The cost of all the mine-fields was #2,390,749. It is officially reported that the system fully realized all expectations, and that changes were contemplated only in a few minor details. Prior to the destruction of Admiral Cervera's fleet the Americans contemplated countermining at Santiago Bay by the method described under Tobpedoes. Though, they had a vessel equipped with dynamite guns, it was not used in counter- mining.

The Spanish-American war furnished arguments against (a) the use of certain forms of contact mines ; (6) firing mines at will with- out utilizing the circuit-closer to announce the vicinity of the enemy; and (c) the use of gun-cotton ; and in favour (d) of lightning arresters, (a) The Americans removed forty-eight mines from Guan- tanamo Bay, after having entered without precautionary measures regarding mines. An outer row of contact mines in Santiago harbour was of doubtful value. Marine growth rapidly accumulates on mine cases and prevents the action of exterior movable parts. All mechanism for firing contact mines should be covered ; plungers, by thin metal caps. (B) Two mines were prematurely fired without injury to vessels in Manilla Bay. Tables of destruc- tive ranges of mines given below

show the need of great accuracy in the determination of the position of a vessel if it is intended to fire an observation mine in the vicinity. The horizontal destructive range of a mine charged with even 2001b of gun-cotton is comparatively small, (c) In Santiago harbour half of the gun-cotton charge of a mine was found burned without explosion, (d) American mines were exploded by lightning on the Mississippi and Potomac rivers.

Destructive Range. — Two formulae, A and B, have been advanced for determining the pressure due to varying charges of explosives at varying distances ; A, by General Henry L. Abbot, a retired officer of the Corps of Engineers, U.S. Army, and B, by Lieutenant- Colonel John Townsend Bucknill, late Major B.E. A is for explosive compounds only ; B, for both explosive mixtures and explosive compounds. The general use of explosive compounds makes it unnecessary to quote Abbot's formula for mixtures. A is based upon recorded pressures obtained by its author while firing a large number of charges, mostly of 5 lb or under, the formula having been afterwards checked by recorded pressures of larger charges, some as great as 200 lb of 75 per cent, dynamite exploded under wooden and iron targets. B is based upon a number of American and British experiments. Both authors had knowledge of the experiments of the Royal Engineers and the British Torpedo Commission, 1874-76, with the steamer Oberon, to determine the destructive range of large submarine mines. This steamer, with sides adapted to be about equal in strength to those of H.M.S. Hercules, had a total weight of about 1000 tons. Charges of 500 lb of gun-cotton were fired. Widely divergent conclusions were reached as to the pressure necessary to destroy a modern first-class battleship, General Abbot deeming an instan- taneous pressure of 6500 ft> per square inch sufficient; Colonel Bucknill, one of 12,000 lb.

The following are the formulae above referred to : —

°lr6636(a+E)C-| *L (D+0-01)2-1 J 90°

p=»f(1+|)(1+

90

*m)

A. B.

P=pressure in pounds per square inch of surface exposed to the shock.

o= angle with the vertical passing through the centre of the charge, made by a line drawn from that point to the exposed surface, measured from the nadir and expressed in degrees.

E=the relative intensity of action of the explosive. Its values, determined by firing charges of 5 R> or less, are — for dynamite, 186 ; gun-cotton, 135 ; extra No. 1 forcite gelatine, 333 ; blasting gelatine, 375.

C= weight of explosive in pounds.

D= distance in feet from centre of charge to exposed surface.

I = relative intensity of -action of explosive in a horizontal direction.

e=a percentage, used for the several explosives.

The values taken fori and e are : —

1.

e.

Blasting gelatine Eorcite gelatine, extra No. 1 . Dynamite No. 1 . . . Gun-cotton .... Gunpowder ....

142 133 100 100

25

12 14 20 20 35

36

SUC ZAf A-S U D A N

With these formulse have heen computed the following ranges in feet of suhmarine mines charged with No. 1 dynamite at which a modern “battleship would be destroyed : —

Charge.

Horizontal Range.

Vertical Kange.

A.

B.

A.

B.

100 lb 200 a

500 ft)

16-3 22-6 35-0

9-5 16-5 38-2

18 ‘6 25-9 40-0

11-0 19 ‘0 45-6

After the conclusion of trials in 1875 a French High Com- mission adopted rules regulating the charges of ground mines as below : in the columns A and B are given the extreme destructive ranges of the gun-cotton charges computed by the corresponding formulse : —

Depth of Water.

A.

B.

Gun-cotton.

Gunpowder.

Feet

Feet.

Feet.

lb.

lb.

26 to 36 .

39-4

50

550

2200

50 ...

42-6

60

660

3300

60 ... .

48-8

79-5

880

4400

67 ...

54-3

99-2

1100

73 ... .

59-2

118-9

1320

80 . .

63-7

138-7

1540

(j. G. D. K.)

Suczawa (Rumanian, Suceava), the chief town of a government district in Bukovina, Austria, situated on the river of the same name, which there forms the boundary between the crownland and Moldavia. It is the last Austrian station. One of its numerous churches contains the grave of the patron-saint of Bukovina. Its principal industry is the tanning and leather trade, particularly of the finer qualities, and the manufacture of colored linen and cotton stuffs, &c. It was at one time the residence of the

Moldavian princes, and in 1675 was besieged by Sobieski and plundered by the Turks. Population (1890), 10,221; (1900), 10,946, more than one-fifth Rumanian, the remainder mostly German-speaking.

Sudan. — According to present usage, this term is extended to the whole region in Africa which is bounded by the Sahara on the north and southwards by the Nile- Congo and Congo-Chad water-partings, and stretches from the Atlantic Ocean to the Red Sea, mainly between 4°-18° 1ST. It thus corresponds in great measure to what may be called the "Black Zone," that section of the African continent which is regarded by many anthropolo- gists as the true home of the negro race, and is largely inhabited by full-blood Negro populations, as distinguished from the Negroid Bantu peoples whose domain comprises most of the southern section of the continent south of Sudan. But the recent explorations of Baumann, Johns- ton, Dybowski, Clozel, and others about the borderlands of the conterminous territories show that there are many overlappings, and that the Bantus range northwards into the Chad basin and some other parts of Sudan proper, while the Sudanese Negroes have penetrated far into Bantuland on both sides of the equatorial lakes, as in Kavirondo and the Semliki valley. The expression Sudan is thus seen to differ considerably, according as it is regarded from the geographical or the ethnical points of view. Politically it may now be described as a de- pendency of Europe, at least from the international standpoint. No doubt some of the former native states, such as Sokoto, Bornu, Baghirmi, and Wadai, continue to enjoy a measure of independence ; but all except Wadai have by numerous treaties recognized the overlordship of one or other of the three European powers— Great Britain, France, and Germany — amongst whom the whole region has now been definitely partitioned.

To Great Britain has been assigned the greater and by

far the most valuable portion of Central Sudan, comprising the three administrative divisions of Lagos, Northern and Southern Nigritia, and including the greater part of the empire of Sokoto and of the ancient kingdom of Bornu: But the northern districts of Damerghu and Kanem— dependent the one on Sokoto, the other on Bornu — are included in the Erench sphere, which also extends east to Wadai and south-east to

Baghirmi; while to Germany are awarded the southern districts of Bornu (Logon, Mosgu), together with nearly the whole of Adamawa, which was formerly attached to Sokoto. The result of this disposi- tion of Central Sudan is that all three Powers have direct access to Lake Chad — Great Britain from the Gulf of Guinea through Nigritia to the west side ; Germany also from the Gulf of Guinea through Cameroon and Adamawa to the south side; Erance both from Erench Congo and Erench Sudan to the north and east sides.

With the exception of the German enclave of Togoland, the old British colonies of the Gold Coast, Sierra Leone, and Gambia, the Portuguese territory Guinea, and the independent state of Liberia, the whole of West Sudan from the Niger to the Atlantic belongs to Erance. But ” Erench Sudan,” as it was officially designated till the year 1900, is now decomposed into the separate but conter- minous colonies of Senegal, French Guinea, Ivory Coast, Dahomey and Military Territories. In one or other of these divisions are absorbed the former empires of Samory, of Tieba, and Ahmadu, the states of Massina, Kaarta, Bambara, and Kong, the kingdoms of Mossi, Gurma, and Borgu, and the district of Timbuktu.

Since the overthrow of Mahdism, East (formerly Egyp- tian) Sudan has practically become British territory. All the shadowy claims of Turkey to this region are tacitly set aside by the Anglo-French agreement of March 1899 determining its western frontiers towards the Erench spheres of influence, and by the Anglo-Egyptian agree- ment of January, 1899, under which East Sudan is constituted an Anglo-Egyptian condominium, with effec- tive British control. Anglo-Egyptian Sudan, as it may now be called (see below), is rearranged in four first-class and three second-class districts, comprising the former provinces of Dongola, Khartum, Suakin, Sennaar, Kor- dofan, Dar-Eur, and the Equatorial Province, with Eazogli and Bahr-el-Ghazal. All the other outlying territories — – Massawa, Harrar, Berbera — which were formerly included for administrative purposes in Egyptian Sudan, have been ceded absolutely to Italy, Abyssinia, and Great Britain respectively.

Excluding the insignificant districts of Portuguese Guinea and Liberia, Sudan, taken in its widest Areas ^d sense, thus comprises three great

political popuia- domains, with approximate areas and popuia- thms. tions (1900) as under: —

Area in Square Miles.

Population.

British, (West, Central, and

East)

French (West and Central)] German (West and Central, with

Total .

1 1,516,000

620,000

| 224,000

42,000,000 9,000,000 6,000,000

2,360,000

57,000,000

The Anglo-Egyptian Sudan. — The region which before the rise of the Mahdi was known as Egyptian Sudan, and comprised the whole of the Khedive’s possessions beyond Egypt proper, has, since 4”*’<>- their recovery by the Anglo-Egyptian ex- fSof” pedition of 1897-98, been reorganized under the joint control of Great Britain and Egypt. This

territory has, in fact, become a condominium, in which Great Britain is the dominant partner. It is not, how- ever, quite coincident with the Egyptian

Sudan of the pre-Mahdi period, several of the outlying districts having been permanently ceded either to Italy, Abyssinia, or Great Britain. A strip of territory along the left bank of the Bahr-el-Jebel (Upper Nile), from below Lado south to Da- file, has also been temporarily leased by the agreement of May 1894 to King Leopold, as sovereign of the Congo Free State, while Prance acquires by the agreement of March 1899 certain commercial rights at a few, not yet defined, points on the White Nile and its affluents. Moreover, the Egyptian frontier has, by the Anglo-Egyptian agree- ment of January 1899, been advanced from Assuan at. the First Cataract to Wadi Haifa at the Second Cataract, which henceforth marks the northern boundary of the condominium.

As thus delimited, Anglo-Egyptian Sudan forms a compact territory which, being conterminous southwards with the British Uganda Protectorate, brings the whole of the Nile valley from the equatorial lakes to the Mediter- ranean under the direct control of Great Britain. The eastern frontiers towards Abyssinia and the Italian colony of Eritrea, as determined by the international conventions of 1891, 1895, 1897, and 1898, coincide for the most part with the meridian of 35° E. Gr., but beyond 13° N. follow an irregular line, which runs from Sennaar north-eastwards to the Red Sea at Cape Kasar (18° 2′ N.). Westwards the frontiers, as laid down by the Anglo-German agreement of November 1893 and the Anglo-French agreement of March 1899, follow an irregular north-westerly line, which is drawn from 5° N. and 27° 30′ E. to the Tropic of Cancer at 16° E., in such a way as to include the whole of the Bahr-el-Ghazal, Dar-Fertit, and Dar-Fur within the British sphere. The boundary thus mainly coincides in the south with the low Nile-Congo water-parting, is conterminous in the west with the French Sudan and French Sahara (Wadai, Ennedi, Borku, Tibesti), and merges beyond Dar- Fur and Kordofan northwards in the uninhabitable Libyan Desert. Here the boundary is necessarily undefined, although vaguely indicated by the line which, according to the Turkish firman of 1814, describes a semicircle from the Siwa Oasis to Wadai, . approaching very near the left bank of the Nile between the Second and Third Cataracts. But by an informal Franco-Italian agree- ment (1901) France withdraws from the hinterland of Tripolitana in favour of Italy, in the event of that Power occupying the Turkish possessions between Tunis and Egypt.

Speaking generally, the condominium constitutes two distinct physical areas — an arid, hot zone of steppes and deserts in the north and west ; a moist, hot zone of super- abundantly watered alluvial tracts in the south and south-east. In the dry zone are comprised the whole of Lower Nubia, Kordofan, and Dar-Fur; that is, everything on both sides of the Nile between Egypt and Khartum, to- gether with the region above Khartum which extends from the White Nile westwards to Wadai. In the moist zone are comprised Upper Nubia, Sennaar, the Sobat and Bahr-el-Ghazal basins ; that is, everything above Khartum between the White Nile and Abyssinia, together with the whole region on both sides of the Upper Nile from about the Sobat confluence to the Nile-Congo water-parting and to the Uganda Protectorate.

The dry zone, which occupies perhaps two-thirds of the condominium, is far from destitute of economic value, and besides gums, cattle, hides and skins, and ostrich feathers, here is great store of gold, iron, and copper. For ages gold-dust has been sent down the Nile from Kor- dofan ; iron ores abound especially in the eastern parts

of the same region and in Dar-Fur ; while extremely rich copper-beds occur in the hilly Tagala district, and especially at Hofrah, on the banks of the Bahr-el-Fertit affluent of the Bahr-el-Arab. It was these Hofrah mines, which have been famous throughout Central Africa from remote times, that first attracted the attention of the Egyptians to Dar-Fur, and led to the conquest of the country in 1875. Gold is also widely distributed in the Sobat valley and some other parts of the moist zone. But here the chief resources are pastoral and agricultural. Magnificent herds of horned cattle are owned especially by the Dinka people ; heavy crops of durra and other cereals are raised in the well-watered Bahr-el-Ghazal province ; and many valuable kinds of timber abound on the eastern slopes about the headwaters of the Sobat and Atbara, and along the banks of the Blue Nile. But the climate is either too hot or too moist for colonization, and, with the doubtful exception of the Marrah uplands in Dar-Fur, there appear to be no districts in Anglo-Egyptian Sudan suitable for permanent European settle- ment. Experience, however, shows that with due pre- cautions Etiropeans may reside in the country for a limited period with impunity.

Recent History. — It was probably no mere coincidence that the revolt of Arabi Pashi against the Khedivial Government in Egypt occurred in the same year, 1881, as the revolt of Mohammed Ahmed, the Mahdi (” Guided “) against the same Government in Sudan. One took the form of a military outbreak, the other of a religious revival. But both were inspired by the same motives, even if they were not promoted by the same secret agencies. In any case, the Mahdist rising, by which Egypt was deprived of her Sudanese domain for sixteen years (1882-98), was admittedly a protest against the growth of European influences, by which the Mahom- medan power in North-East Africa was being rapidly transformed to a civilized state based on liberal institu- tions, and not on the Moslem system of domestic slavery. By administrators such as Gordon, Lupton, and Gessi a deadly blow was being struck at the slave trade itself, in the maintenance of which the ” Khartumers,” that is, the Arabo-Nubian commercial classes, were deeply interested on mercenary even more than on religious grounds. But the astonishing success of the religious upheaval was also largely due both to the fanaticism of the Baggara and other Arab tribesmen, commonly called ” Dervishes,” and to the indifference and even open hostility of those half- subdued Nilotic Negro populations, such as the Shilluks, the Bari, and the Dinkas, who had suffered beyond endurance from the tyranny and exactions of the Egyptian officials, covert allies if not open abettors of the Arabo- Nubian slave dealers and raiders. The history of the military operations from 1881 to 1899, when the Anglo- Egyptian forces once more recovered the Sudan from the power of barbarism, is told under Egypt, and it is not necessary here to repeat it.

After the reoccupation of Khartum, which was again made the seat of government, a proposal to raise £100,000 for the purpose of erecting a memorial to its heroic defender, General Gordon, on the spot, met with an enthusiastic response in England. It took the practical form of an educational establishment for the Sudanese natives, and the foundation stone of the Gordon College was laid by Lord Cromer in January 1900. At the same time provision was made for the future administration of the country by the agreement of 19th January 1899, which stipulates that a governor-general shall be appointed by Egypt with the assent of Great Britain. It was also stipulated that the British and Egyptian flggs are to be used together, while special provision is made

for the final suppression of the slave trade, and for the exclusion of arms, ammunition, and spirits from Anglo- Egyptian Sudan.

For administrative purposes the reconstituted territory is divided into four first-class districts — Omdurman, Sennaar, Kassala, and Eashoda ; and three second-class districts — Assuan, Wady Haifa, and Suakin. These districts replace the former provinces of Dongola, Khar- tum, Suakin, Sennaar, Kordofan, Dar-Eur, Bahr-el-Ghazal, and the Equatorial Province with Fazogli. They have a collective area of 1,000,000 square miles, with a ^popula- tion reduced from about 10,000,000 before the Mahdist revolt to probably not more than 7,000,000 in 1900. Lord Kitchener was appointed first Governor-General in January 1899, and when summoned next year to co- operate with Eield Marshal Lord Roberts in the war against the Boer States, was succeeded by the Sirdar, Colonel Sir Reginald Wingate. Henceforth the consuls appointed by foreign Powers are accredited to the British Government, which implies the abolition of the capitula- tions (local consular courts of justice) and the full recog- nition of the British suzerainty over the newly constituted dominion of Anglo-Egyptian Sudan.

Khartum, the restored capital, is now in railway and telegraphic communication with Cairo, from which it is distant about 1300 miles. Before the revolt it was the most flourishing city in North-East Africa south of Cairo, with a population estimated in 1884 at 70,000. Erom this point, at the confluence of the two Niles some distance above the Sixth Cataract, there is a clear water- way navigable by steamers of some size all the way to Dufle, some miles below Lake Albert, where the river is again obstructed by insurmountable rocky barriers. But the sudd, or floating masses of vegetation, by which the upper reaches about and above the Sobat confluence have been frequently blocked, was entirely cleared away after many months of hard work in 1900, and steps taken to prevent it from again accumulating. To the old caravan routes have thus been added two main lines of communication — the waterway from the Equa- tor Co the Mediterranean, and the railway from Egypt to Khartum, to be continued to the Great Lakes as the northern section of the already pro- i jected Cape-to-

Cairo trunk line, running mainly through British territory in a north to south direction across the continent.

Authorities. — Lt.~~Col. Wingate. Mahdism and the Egyptian Sudan. London, 1891. — F. Ohrwalder. Ten Years‘1 Captivity in the MahdVs Camp. Wingate’s English Ed. London, 1892. — R. Slatin Pasha. Fire and Sword in the Sudan. London, 1896. — Count Gleichen. Handbook of the Sudan, compiled in the Intelligence Division of the War Office. London, 1898. — H. S. Alford and W. D. Sword. Tlie Egyptian Soudan, its Loss and Recovery. London, 1898. — P. Paolo Rosignoli. I mili dodici anni di prigionia in mezzo ai dervice del Sudan. Mondovi, 1898. — L. Deherain. Le Soudan Egyptien. Paris, 1898. — R. de Caix. Eashoda, la France et V Angleterre. Paris, 1899. — C. Neufeldt. A Prisoner of the Khaleefa. London, 1899. — Bennett Bur~~ leigh. Khartoum Campaign, 1898. London, 1899. — W. S. Churchill. The River War : Reconquest of the Sudan. London, 1899. (A. h. k.)

The French Sudan, since the decree of 18th October 1899, has been only a geographical expression, indi- cating a region whose outlines are not every-Sudaa where clearly traced. By that decree the region was, in fact, divided among the three colonies of Senegal, the Ivory Coast, and Guinea. Separate existence remains only to two military commands, in- tended to check the populations, but in this article the name recently in use is retained, that the geography and history of the whole country, which long had a distinct individuality, may be presented in one connected view.

It was bounded on the west by Senegal, on the south-west by the Euta Jallon, on the south by British Guinea, the republic of Liberia, the Erench colony of the Ivory Coast, the British Gold Coast, and the hinterland of Dahomey. On the east it extended beyond the Niger and, in the region of Lake Chad, joined the Erench portion of the Congo basin. The Erench Sudan is, in short, the link connecting all the African possessions of the Third Republic. Its area is estimated at 400,000 square miles, but is probably greater. No trustworthy estimate of the numbers of the black population has been formed.

The territory, as a whole, consists of a great plateau of granite and sandstone, rarely more than 1600 feet high, and in its northern part, the

Kaarta, assuming a desert aspect. No interesting orographic feature is presented. Hydrographically the western porton (Bambouk) belongs to the basin of the Senegal ; the central, to that of the Niger, which is divided into three reaches — the upper Niger from Kardamania to the frontier of the Euta Jallon as far as Bammako, the middle Niger from Bammako to Bussa, and the lower Niger beyond Bussa. The points situated on the river are Komussa, Siguiri, Bammako, Segu Sikoro, Sansanding, Kabara, Sinder, Say, and Fort Archinard. At Mopti the Niger receives the Mahel Babrel, which drains the country of Kong, and whose numerous arms uniting with offshoots from the Niger form in the flood season an immense lake. The lakes or widenings of the Niger itself occupy vast expanses of ground ; Lake Deboe, the Lake of Hero, the Lake of Daouna, the Lake of Tole are all to the south or west of Timbuktu, and are permanent. The eastern part of the Sudan slopes towards the hollow of Lake Chad.

History. — The first French expedition into the heart of the country was undertaken in 1860, when General Faidherbe sent Lieutenant Maze and Dr Quintin to explore the zone to the east of the Senegal. The two travellers pushed on as far as Segu Sikoro, then the capital of the sultanate of Ahmadu. In 1878 Soleillet renewed the visit. In 1879 Colonel Briere de l'Isle appointed two officers, Gallieni and Derrien, to investigate the route for a railway, and at the same time the post of Bafoulabe was constructed. The armed conquest began in 1880, and for more than fifteen years was carried on by Borgnise Desbordes, Gallieni, Erey, Archinard, Combes, and Bonnier. In 1881 the Niger was reached ; the fort of Kita was erected to the east of Medine, to watch the region between the Senegal and the Joliba ; the fort of Bammako above the latter river was built in 1883 ; a road was made, 400 miles of telegraph line laid down, and the work of railway construction began. The revolted population was crushed ; Mahmadu Lamine was overthrown, while Ahmadu in the north of the Sudan and Samory in the south acknowledged the French protectorate, and Lieutenant Caron in a gunboat de- scended as far as Timbuktu (1886-89) . The struggle was resumed in 1890 : Ahmadu lost Segu Sikoro and Konio Kary ; then Nioro lost his capital of Kaarta (1891), 150 miles north of the Senegal ; Jenne", near Mahel Babrel was taken in 1893. The war was prosecuted also in the south against Samory, who multiplied pretences, tried negotiation for the purpose of breaking his promises, shifted his empire to the states of Kong,

and after numberless encounters was finally defeated on the Conally, to the north of Liberia, and was taken prisoner in September 1898. Timbuktu was occupied in 1894; Colonel Bonnier perished beneath its walls. In the meantime France had signed with Great Britain the con- vention of 5th August 1890, which bounded the French possessions on the south by a line running from Say on

the Niger to Barrawa on Lake Chad ; and this convention was supplemented by another on 14th June 1898 (see also Nigeria).

Trade, &c. — Gum is produced in the northern districts, including Kaarta ; the quantity dealt with at Timbuktu, Medine, and Nioro in 1898 exceeded 2000 tons. Gold is found in the basin of the Faleme” and of the Tan- kisso. Caoutchouc is produced in the bend of the Niger and in the Wassulu. Bissandugu is the centre of its ex- ploitation. The natives cultivate millet, rice, and wheat ; the earth-nut is grown round Kayes. In 1898 the com- merce reached £580,000 sterling, of which £432,000 was for imports. The imports from France amounted to about £160,000, chiefly for cotton goods, which form also the base of the import trade from India. The trade routes run westwards through Senegal, north- wards through Taoudeni and Morocco, by In Salah and El Golea, southwards through French and British Guinea.

The railway from Kayes to Bammako, begun in 1881, has only reached a length of 110 miles, and will scarcely be finished before 1906. The Sudan hitherto has been set down in the budget of France for about £300,000 a year. The troops in the colony in 1898 were 154 officers and 3410 men.

The centres of population are Kayes (8000), on the Senegal, 560 miles from St Louis, the capital of the col- ony up to 1899 ; Bafulabe”, at the confluence of the Dak- har and the Bating (2900 inhabitants) ; Bammako, on the Niger; Bissandugu, formerly Samory’s capital, a military station with 20,000 inhabitants; Kankan, a military station (3000), 36 miles north of Bissandugu; Kita (3000), a station on the track from Kayes to the Niger;

Jenne” (8000); Medine (1500), connected by railway with Kayes ; Segu Sikoro ; Timbuktu (12,000), an important market, and the head of the caravan line.

See Gatfarel. , Senegal et Soudan Francois. Paris, 1890. — Gallieni. Deux Campagnes au Soudan. Paris, 1890.— Mounier. La France Noire. Paris, 1894. — Binger. Les Boutes Commer- ciales du Soudan. (p. l/\

Sudd is the name given to the vegetable obstruction which has at various dates closed the upper waters of the Nile to navigation. It seems to have stopped the Roman centurions whom Nero sent to explore the Nile. In modern times attention was first drawn to its existence by Sir Samuel Baker, who found his efforts to suppress the slave trade in the Sudan seriously hampered by the impossibility of maintaining a service of steamers between Gondokoro and Khartum (see Ency. Brit.’, vol. xvii. p. 506). Down to 1863 the two branches of the White Nile, the Bahr al-Jebel and the Bahr al-Zer£f, had been navigable within the memory of man. But in that year both were blocked above their junction at Lake No by an accumulation of vegetable flotsam. When Baker proceeded to Gondokoro in 1870 he thus described the increase that neglect had caused in the obstruction: — “The immense number of floating islands that were constantly passing down the stream of the White Nile had no exit ; thus they were sucked under the original obstruction by the force of the stream, which passed through some mysterious chan- nel, until the subterranean passage became choked with a wondrous accumulation of vegetable matter. The entire river became a marsh, through which, by the great pressure of water, the stream oozed through innumerable small channels. In fact, the White Nile had disappeared.” Baker, who had to cut through fifty miles of sudd in his passage to Gondokoro, urged the Khedive to reopen the Nile. This work was efficiently done by Ismail Ayub Pasha, and the White Nile was clear for large vessels

when Gordon reached Khartum in 1874. The importance of the work was clear : ” It would be quite useless to an- nex and attempt to civilize Central Africa,” wrote Baker, “unless a free communication existed with the outer world by which a commercial channel could be opened.” But the obstruction was always ready to reappear. In 1878 Emin Pasha was unable

to ascend the Bahr al-Jebel from the south on account of the sudd. It was cleared in 1879- 80 by an Italian in the Egyptian service, but had again accumulated in 1884. The rise of Mahdism and the con- sequent closing of the Sudan caused the river to be com- pletely neglected, and in 1895 the Egyptian Intelligence Department received a report that the White Nile was completely blocked above Lake No. This proved to be the case. The closing of the upper waters of the Nile not only hampered communication with Central Africa ; it was also believed to diminish the supply of fertilizing water on which the whole life of Egypt depended. The unprecedented failure of the Nile flood in 1899-1900 drew general attention to the sudd, which was thought by some to be responsible for it, and in the former year £(E) 10,000 were placed at the disposal of the Governor- General of the Sudan for the purpose of reopening the White Nile, by removing the great mass of weed which blocked the Bahr al-Jebel almost from Lake No to Sham- beh. The work was begun, under the direction of Sir William Garstin, in December 1899. ” The primary object of this measure,” he wrote, ” is to open the Bahr al-Jebel to navigation, and to permit an examination of the river and the surrounding swamps. When this ex- amination has been made, it will be possible to study the feasibility of closing off all the spill-channels which wander through the marshes, and, by confining the river in one single stream, preventthe present ruinous waste of water.” Little or nothing was then known of the real effect of the sudd on the discharge of the Lower Nile. In 1900 the greater part of the sudd was successfully removed by the exertions of Maj or Peake, and navigation was reopened from Khartum to Bejaf. Some of the blocks of sudd removed were a mile long and 15 to 20 feet thick ; underneath them the river passed with a high velocity. The work was harder than had been expected : ” Instead of the sudd being, as had been supposed, a tangle of weed floating on the water and descending a few feet below the surface, it proved in most cases to be a mass of decayed vegetation, papyrus roots, and earth, much resembling peat in its consistency, and compressed into such solidity by the force of the cur- rent that men could walk over it everywhere, and even elephants could in places cross it without danger.” The surface was first burnt ; then trenches were cut dividing the sudd into blocks 10 feet square, and each of these was hauled out with wire hawsers and chains by gunboats working from below. Two portions of the Bahr al-Jebel, which were still blocked in 1900, were cleared in 1901-02 at an additional expense of £

(E)4000, and the sudd is now practically abolished on the whole course of the White Nile. In some parts of the channel constant patrolling and inspection will be necessary to prevent it from accumulating again, and the permanent maintenance of the channel by piling, planting willows, &c, requires very serious study. The pressure of the sudd on vessels enclosed within it has been compared, both by Sir Samuel Baker and Sir William Garstin, to what Arctic travellers relate of “the motion of the ice-floes when the pack is break- ing up.” It is mainly caused by large masses of papyrus and omm suf reeds, which are loosened by storms, and drift down until they lodge on some obstruction and form a dam across the channel, rapidly converted by fresh arrivals into a block that may be as much” as 25 miles in length. In time the whole river is blotted out, as Baker found it. It is still doubtful whether the removal of

the sudd has been of any practical benefit to the Egyptian cultivator ; but Sir William Garstin is of opinion, from personal observation of the sudd, ” that its removal un- doubtedly cheeked the fall in the river levels which would otherwise have taken place, owing to the extra supply brought down by the removal of each successive block.” However that may be, the removal of the sudd, by open- ing up the water-way to the equatorial provinces, is certainly not among the least benefits which British en- terprise has already brought to the Sudan.

See Ismailia, by Sir Samuel W. Baker (1874).— Parliamen- tary Papers: Egypt, No. 5 (1899); Egypt, No. 1 (1900); Egypt, Nos. 1 and 2 (1901); Egypt, No. 1 (1902).

(w. B. G. F.)

Sudja, a district town of Russia, in the government of Kursk, connected by a narrow-gauge railway (40 miles) with the main railway system at Eylsk. It was founded in the 17th century, and had in 1897 12,856 inhabitants. It has several potteries and a few tanneries, and does a considerable trade in grain, horses, cattle, and wooden

Sueca, a town of Spain, in the province of Valencia, on the left bank of the river Yucar, near the sea, to the west of the sierra of Cullera. It has a station on the Silla-Cullera railway. Its population was 13,613 in 1887, and 13,949 in 1897. The town has regular, modern streets, with fine houses and large squares well paved. The most remarkable buildings are the town hall, theatre, hospital, parish church, and some hermitages. It is in a well-watered, fertile district, of which the fruit and agricultural products form the almost exclusive staple of the trade of Sueca.

Suffolk, one of the eastern counties of England, bounded on the E. by the North Sea, on the S. by Essex, on the W. by Cambridgeshire, and on the N. by Norfolk.

Area and Population. — In 1901 the area of the ancient (geographical) county was 952,709 acres, and in 1891 the population was 371,235, of whom 180,441 were males and 190,794 females, and in 1901, 384,198, showing an increase of 12,963 since 1891, or at the rate of 3-5 per cent, between 1891 and 1901, as compared with an increase of 3-7 per cent, during the ten years 1881-91 and an increase of 5-8 per cent, during 1871-81. The 1901 returns give 0-4 persons to an acre and 2-58 acres to a person. In 1891 the area of the registration county was 931,134 acres, and the population 353,758, of whom 172,067 were males and 181,691 females, and in 1901 was 361,856. Particulars of the birth-rate, death-rate, and the number of persons married per 1000 inhabitants, as well as the percentage of illegitimate births, are given in the accompanying table :: —

1871-80.

1831-90.

1889-98.

1899.

Birth-rate . Death-rate . Illegitimacy-rate . Marriage-rate

32-1

18-8

62

13-8

31-1

17-3

57

13-0

28-3

16-7

65

13-3

26-5

16-1

59

14-2

In 1891 the county contained 1001 persons of Scottish birth, 934 of Irish birth, and 474 foreigners. At the same date there were 356 blind, 196 deaf and dumb, and 1266 insane.

Government, &c. — Eor parliamentary purposes the ancient county is divided into five divisions, each return- ing one member (Northern or Lowestoft, North-Eastern or Eye, North-Western or Stowmarket, South or Sudbury, South-Eastern or Woodbridge), the borough of Bury St

Edmunds, returning one member; the borough of Ipswich, returning two members ; and part of the borough of Great Yarmouth. Eor administration purposes Suffolk is divided into the two counties East Suffolk and West Suffolk, together with the county borough of Ipswich and part of the county borough of Great Yarmouth. The administrative counties embrace the eight municipal boroughs of Aldeburgh, Beccles, Bury St Edmunds, Eye, Ipswich, Lowestoft, Southwold, and Sudbury. There is one court of quarter sessions for the two ad- ministrative counties, which is usually held at Ipswich for East Suffolk, and then by adjournment at Bury St Edmunds for West Suffolk. East Suffolk is divided into eleven and West Suffolk into nine petty sessional divisions. The boroughs of Bury St Edmunds, Ipswich, Sudbury, Eye, and Southwold have separate commis- sions of the peace, and the three first-named have also separate courts of quarter sessions. The administra- tive county of East Suffolk contains 318, that of West Suffolk 176, and the county borough 14, entire civil parishes ; there are besides 6 parishes which are partly in the county borough and partly in the administrative county of East Suffolk, and 6 which are partly in West Suffolk and other administrative counties. The ancient county of Suffolk contains 448 entire ecclesiastical parishes and districts, and parts of 15 others ; it is sit- uated partly in the diocese of Ely and partly in the diocese of Norwich.

Education. — On 31st August 1900 the number of elementary schools was 424, namely, 103 board schools and 321 voluntary schools ; the latter including 309 National Church of England schools, 1 Wesleyan, 3 Roman Catholic, and 11 “British and other.” The average attendance during the year was 47,136 out of a total of 56,719 on the register. The total school board receipts during the year were £77,862, of which £248 were earnings under the Technical Instruction Act and £2394 earnings under the Agri- cultural Rates Act.

Agriculture. — Erom 1885 to 1895 the general tendency was towards a decrease in the area of corn crops and green crops, with an increase in the area of pasture and hay, but since 1895 there has been a reversal of the process. In 1889, 594,491 acres were farmed by tenants, in 1895, 576,255 acres, and in 1900, 581,266 acres ; the areas farmed by owners were 179,079 acres in 1900, 192,882 in 1895, and 184,605 in 1889. The annual

rainfall averages 23 inches only ; that is, 13 inches less than the average for all England.

The table immediately following’ shows the areas under the different kinds of crops at the periods named : —

Year.

1885 1890 1895 1900

Area in Cultiva- tion.

781,860 777,370 769,137 760,345

Area under Corn Crops. ;

369,931 359,510 330,459 337,438

Area under Green Crops.

124,684 111,737 104,494 114,012

Area of

Bare Fallow.

28,151 32,625 34,720 20,463

Area under

Permanent

Grass.

171,727 181,451 188,020 180,712

The next table shows the number’ of the live-stock at the periods named : —

Tear.

Cows and Heifers.

Other Cattle.

Total Cattle.

Horses.

Sheep.

Pigs.

1885 1890 1895 1900

22,805 22,802 22,631 25,530

47,302 . 47,624 43,871 62,896

70,107 70,420 66,502 78,426

42,807 41,248 42,259 42,101

447,058 427,750 387,590 433,013

135,525 147,543 167,521 149,030

Industries. — In the year 1897, 22,794 persons were employed in the factories and workshops of the county, 6004 being employed in the clothing trades, 6279 in making machinery, implements, &c, 1355 in the paper and printing trades, and 1281 in the wood indus- tries. Fishing at Lowestoft is growing in importance. The chief quarry products are clay and chalk ; of the former 67,249 tons were extracted in 1900, and of the latter 14,366 tons.

Authorities.— H. W. Aldred. History of Suffolk. London, 1888. — Rev. A. Jessopp. Arcady. London, 1887! — P. H. Emer- son. Pictures of East Anglian Life, London (1888), and other works ; and the works of the poet Crabbe.

SUGAR, AND SUGAR MANUFACTURE.

THE value of sugar-canes at a given plantation or cen- tral factory would at first sight appear to vary- directly as the amount of saccharine contained in the juice expressed from them varies, and if canes with juice indicating 9° Beaume” be made a basis of value or worth, say at 10s. per ton, then canes with juice indicating

Com- mercial value of sugar- canes.

10°

in degrees Beaume1 and containing in

sugar .... 18-05% would be worth per

ton 11/1J

16-23% 10/-

14-42% 8/10*

7°

12-61%

7/»l

10-80% 6/8

But this is not an accurate statement of the commercial value of sugar-canes — that is, of their value for the pro- duction of sugar to the planter or manufacturer — because a properly equipped and balanced factory, capable of making 100 tons of sugar per day, for 100 days’ crop, from canes giving juice of 9° B., or say 10,000 tons of sugar, at an aggregate expenditure for manufacture (i.e., the annual cost of running the factory) of £3 per ton, or £30,000 per annum, will not be able to make as much sugar per day with

canes giving juice of 8° B., and will make still less if they yield juice of only 6° B. In practice, the expenses of upkeep for the year and of manufacturing the crop remain the same whether the canes are rich or poor and whether the crop is good or bad, the power of the fac- tory being limited by its power of evaporation. For ex- ample, a factory able to evaporate 622 tons of water in 24 hours could treat 1000 tons of canes yielding juice of 9° B., and make therefrom 100 tons of sugar in that time ; but this same factory, if supplied with canes giving juice of 6° B., could not treat more than 935 tons of canes in 24 hours, and would only make therefrom 62-2 tons of sugar.

The following table may be useful to planters and central factory owners. It shows the comparative results of working with juice of the degrees of density mentioned above, under the conditions described, for one day of 24 hours, and the real value, as raw material for manufacture, of cane giving juice of 6° B. to 10° B., with their apparent value based solely on the percentage of sugar in the juice. The canes in each case are assumed to contain 88 per cent, of juice and 12 per cent, of fibre, and the extraction by milling to be 75 per cent, of the weight of canes — the evaporative power of the factory being equal to 622 tons per 24 hours. The factory expenses are taken at £30,000 per annum, or £3 per ton on a crop of 10,000 tons (the sugar to cost £8 per ton all told at the

Degrees Beaume\

6°

7°

8°

9°

10°

Tons of canes

crushed per day

935-6

956-2

977-4

1000

1023-8

Tons of juice ex-

pressed . . .

701-7

717-2

733-1

750

767-9

Tons of water

evaporated . .

622

622

622

622

622

Tons of 1st Mas-

secuite . . .

79-7

95-2

11-11

128

145-9

Tons sugar of

all classes re-

covered . . .

62-2

74-3

86-7

100

114-0

Total output of

sugar in 100

days. Tons .

6220

7430

8670

10,000

11,400

Total value of all

sugars per day

at £8 per ton .

£497, 6/-

£594, 4/-

£693, 6/-

£800

£912

Less factory ex-

penses per day .

£300

£300

£300

£300

£300

Leaves for canes

crushed . . .

£197,6/-

£294, 4/-

£393, 6/-

£500

£612

Real value of

canes per ton .

4/2|

6/2

8/-

10/-

ll/llj

Apparent value

(see preceding

Table) . . .

6/8

7/9J

8/101

10/-

11/1*

Extraction by pres- sure.

factory) — equivalent to £300 per day for the 100 working days of crop time. But it is obvious that it would not pay a planter to sell, canes at 4s. 2|d. a ton instead of at 10s. a ton, any more than it would pay a factory to make only 62-2 tons of sugar in 24 hours, or 6220 tons in the crop of 100 days, instead of 10,000 tons. Hence arises the imperative necessity of good cultivation by the planter, and of circumspection in the purchase and acceptance of Canes on the part of the manufacturer.

The details of manufacture of sugar from canes and of sugar fr6m beetroots differ, but there are five operations in the produc- tion of the sugar of commerce from either material which are com- mon to both processes. These are : —

1. The extraction of the juice.

2. The purification or defecation of the juice.

3. The evaporation of the juice to syrup point.

4. The concentration and crystallization of the syrup.

5. The curing or preparation of the crystals for the market by

separating the molasses from them.

Cane Sugar Manufacture.

Extraction of Juice. — The juice is extracted from canes by squeezing them between rollers, i.e., by crushing and pressure. In India at the present day there are thousands of small mills worked by hand, through which the peasant culti- vators pass their canes two or three at a time, squeez- ing them a little, and extracting perhaps a fourth of their weight in juice, from which they make a substance resembling a dirty sweetmeat rather than sugar. In Barbados there are still many estates making good Mascabado sugar ; but as the juice is extracted from the canes by windmills, and then concentrated in open kettles heated by direct fire, the financial results are disastrous, since nearly half the yield obtainable from the canes is lost. In the “best organized modern cane sugar estates as much as 12J per cent, of

the weight of the canes treated is obtained in crystal sugar of high polarizing power, although in Louisiana, where cultivation and manufacture are alike most carefully and admirably earned out, the yield in sugar is only about 7 per cent, of the weight of the canes, and sometimes, but seldom, as much as 9 per cent. This is due to conditions of climate, which are much less favour- able for the formation of saccharine in the canes than in Cuba. The protection afforded to the planters by their Government, how- ever, enables them to pursue the industry with considerable profit, notwithstanding the poor return for their labour in saleable pro- duce. As an instance of the influence of climatic conditions com- bined with high cultivation the cane lands of the Sandwich Islands may be cited? Here the tropical heat is tempered by constant trade winds, there is perfect immunity from hurricanes, the soil is peculiarly suited for cane-growing, and by the use of specially- prepared fertilizers and an ample supply of water at command for irrigation the land yields from 50 to 90 tons of canes per acre, from which from 12 to 14 per cent, of sugar is produced. To secure this marvellous return, with an annual rainfall of 26 inches, as much as 52,000,000 gallons of water are pumped per 24 hours from artesian wells on one estate alone. When the great dam at Assuan is completed and an inexhaustible supply of irrigation water obtainable, there is no reason why the lands in Upper Egypt, if scientifically cultivated and managed, should not yield as abundantly as those in the Sandwich Islands.

In the Paris Exhibition of 1900 a cane-crushing mill was shown with three rollers 32 inches in diameter by 60 inches long. It is driven by a powerful engine through triple gearing of 42 to 1, and speeded to have a surface velocity of rollers of 15 feet 9 inches per minute. This mill is guaranteed to crush thoroughly and efficiently from 250 to 300 tons of canes in 24 hours. In Louisiana two mills, set one behind the other, each with three rollers 32 inches in diam- eter by 78 inches long, and driven by one engine through gearing of 15 to 1, are speeded to have a surface velocity of rollers of 25 feet 6 inches per minute (or 60 per cent, more than that of the French mill described above), and they are efficiently crushing 900 to 1200 tons of canes in 24 hours. In Australia, Demerara, Cuba, Java, and Peru double crushing and maceration (first used on a commercial scale in Demerara by the late Hon. William Russell) have been generally adopted; and in many places, especially in the Sandwich Islands, triple crushing (i.e., passing the

canes through three consecutive sets of rollers, in order to extract everything possible of extraction by pressure) is employed. In the south of Spain, in some favoured spots where sugar-canes can be grown, they are submitted even to four successive crushings.

It has been found in practice advantageous to prepare the canes for crushing in the mills, as above described, by passing them through a pair of preparing rolls which are grooved or indented in such manner as to draw in and flatten down the canes, no matter

in which -way they are thrown or heaped upon the cane-carrier, and thus prepare them for feeding the first mill of the series ; thus the work of crushing is carried on uninterruptedly and without constant stoppages from the mills choking, as is often the case when the feed is heavy and the canes are not prepared.

Although it cannot be said that any one system of extraction is the best for all places, yet the following considerations are of general application : —

(a) Whatever pressure be brought to bear upon it, the vegetable or woody fibre of crushed sugar-canes will hold and retain for the Yield from mom?nt a quantity of moisture equal to its own weight, crushing an(* *n Practi°e 10 per cent, more than its own weight ; or in other words, 100 lb of the best crushed megass will consist of 47-62 a of fibre and 52-38 lb of moisture—that is, water with sugar in solution, or juice.

(6) Canes vary very much in respect of the quality and also as to the quantity of the juice they contain. The quantity of the juice is the test to which recourse must be had in “judging the efficiency of the extraction,

while the quality is the main factor to be taken into account with regard to the results of subsequent manufacture.

For the application of the foregoing considerations to practice, the subjoined table has been prepared. It shows the greatest quantity of juice that may be expressed from canes, according to the different proportions of fibre they contain, but without em- ploying maceration or imbibition, to which processes reference is made hereafter. The percentages are percentages of the original weight of the uncrushed canes.

Per

Per

Per

Per

Per

Per

Cent.

Cent.

Cent.

Cent.

Cent.

Cent.

Percentage of fibre

in canes . . .

10

11

12

13

14

15

Percentage of juice

in canes . . .

90

89 ‘

88

87

86

85

Percentage of juice

retained in

megass ....

10

11

12

13

14

15

Percentage of maxi-

mum expression .

80

78

76

74

72

70

Percentage of best

average expres-

sion, in practice .

79

76-9

74-9

72-9

70-6

68-5

Percentage of

juice left in me-

gass, in practice .

11

12-1

13-2

14-3

15-4

16-5

The British Guiana Planters' Association appointed a sub-com- mittee to report to the West India Commission on the manufacture of sugar, who stated the following : —

With canes containing 12 per cent, fibre the following per- centages of sugar are extracted from the canes in the form of juice : —

Single crushing 76 per cent.

Double crushing ... 85 „

Double crushing with 12 % dilution . 88 ,,

Triple crushing with 10 % dilution . . 90 ,,

Diffusion with 25 % dilution . . . 94 „

These results are equivalent to 66-88 % extraction for single crushing. 74-80% ,, „ double crushing.

77-44% ,, ,, double crushing with 12 % dilution.

79-20 % „ „ triple „ „ 10 % „

82-72% „ •„ diffusion with „ 25% „

To prevent the serious loss of juice left in the megass by even the best double and triple crushing, maceration or imbibition was introduced. The megass coming from the first mill Macera- was saturated with steam and water, in weight equal i’°fcifc;y; t0 between 20 per cent, and 30 per cent, and up to immmuon. 4Q per ognt_ of the original weignt of the uncrushed

canes. Consequently, after the last crushing the mixture retained by the residual megass was not juice, as was the case when crush- ing was employed without maceration, but juice mixed with water ; and it was found that the loss in juice was reduced by one-half. A further saving of juice was sometimes possible if the market prices of sugar were such as to compensate for the cost of evaporat- ing an increased quantity of added water, but a limit was imposed by the fact that water might be used in excess. Hence in the latest designs for large factories it has been proposed that as much normal juice as can be extracted by double crushing only shall be treated by itself, and that the megass shall then be soused with twice as much water as there is juice remaining in it ; after which, on being subjected to a third crushing, it will yield a degraded juice, which would also be treated by itself. It is found that in

reducing the juice of these two qualities to syrup, fit to pass to the vacuum pans for cooking to crystals, the total amount of evaporation from the degraded juice is about half that required from the normal juice produced by double crushing.

Great improvements have been made in the means of feeding the mills with canes by doing away with hand labour and sub- stituting mechanical feeders or rakes, which by means Mechaalcal of a simple steam-driven mechanism will rake _ the improvem canes from the cane waggons on to the cane-carriers. me„ts. By the adoption of this system in one large plantation in the West Indies, crushing upwards of 1200 tons of canes per day, the labour of sixty-four hands was dispensed with, and was thus made available for employment in the fields. In Louisiana the use of mechanical feeders is almost universal.

With a view of safeguarding themselves from breakdowns caused by the inequality of feeding, or by the action of malicious persons introducing foreign substances, subh as crowbars, bolts, &c, among the canes, and so into the mills, many planters have adopted so- called hydraulic attachments, applied either to the megass roll or the top roll bearings. These attachments, first invented by Jeremiah Howard, and described in the United States Patent Journal in 1858, are simply hydraulic rams fitted into the side or top caps of the mill, and pressing against the side or top brasses in such a manner as to allow the side or top roll to move away from the other rolls, while an accumulator, weighted to any desired extent, keeps a constant pressure on each of the rams. An objection to the top cap arrangement is, that if the volume or feed is large enough to lift the top roll from the cane roll, it will simultaneously lift it from the megass roll, so that the megass will not be as well pressed as it ought to be ; and an objection to the side cap arrangement on the megass roll as well as to the top cap arrangement is, that in case more canes are fed in at one end of the rolls than at the other, the roll will be pushed out farther at one end than at the other ; and though it may thus avoid a breakdown of the rolls, it is apt, in so doing, to break the ends off the teeth of the crown wheels by putting them out of line with one another. The toggle-joint attachment, which is an extremely ingenious way of attaining the same end as the hydraulic attachments, is open to the same objections.

Extraction of cane juice by diffusion (a process more fully de- scribed under the head of beetroot sugar manufacture) is adopted in a few plantations in Java and Cuba, in Louisiana and the Sandwich Islands, and in one or two factories f^™’ in Egypt ; but hitherto, except under exceptional con- diffusion. ditions (as at Aska, in the Madras Presidency, where the local price for sugar is three or four times the London price), it would not seem to offer any substantial advantage over double or triple crushing. With the latter system practically as much sugar is obtained from thS canes as by diffusion, and the resulting megass furnishes, in a well-appointed factory, sufficient fuel for the crop. With diffusion, however, in addition to the strict scientific control necessary to secure the benefits of the process, fuel — that is, coal or ■wood — has to be provided for the working off of the crop, since the spent chips or slices from the diffusers are useless for this purpose ; although it is true that in some plantations the spent chips have to a certain

extent been utilized as fuel by mixing them with a portion of the molasses, which otherwise would have been sold or converted into rum. The best results from extraction by diffusion have been obtained in Java, where there is an abundance of clear, good water ; but in the Sandwich Islands, and in Cuba and Demerara, diffusion has been abandoned on several well mounted estates and replaced by double and triple crushing ; and it is not likely to be resorted to again, as the extra cost of working is not compensated by the slight increase of sugar produced. In Louisiana diffusion is successfully worked on two or three large estates ; but the general body of planters are shy of using it, although there is no lack of water, the Mississippi being near at hand.

Purification. — The second operation is the coagulation of the albumen, and the separation of it with other impurities from the juice which holds them in suspension or solution. The moment the juice is expelled from the cells of the canes chemical inversion commences, and the sooner it is stopped the better. This is effected by the addition of lime to neutralize the free acid. As cold juice has a greater affinity for lime than hot juice, it is best to treat the juice with lime when cold. This is easily done in liming or measuring tanks of known capacity, into which the juice is run from the mill. The requisite amount of milk of lime set up at 10° Beaume' is then added. Cream of lime of 17° Beaumfe is sometimes used, but the weaker solution is preferable, since the proper proportion is more easily adjusted. In Demerara and other places the juice is then heated under pressure up to 220° P. to 250° F. for a few moments, on its way to a steam and juice separator, where the steam due to the superheated juice flashes off, and is either utilized for aiding the steam supplied to . . the multiple effect evaporators, or for heating cold juice jJJJjjts "X on its way to the main heater, or it is allowed to escape into the atmosphere. The boiling juice is run down into subsiding

cane]

S U G A E

tanks, where it cools, and at the same time the albumen, which has been suddenly coagulated by momentary exposure to high temperature, falls to the bottom of the tank, carrying with it the vegetable and other matters which were in suspension in the juice. After reposing some time, the clear juice is carefully decanted by means of a pipe fixed by a swivel joint to an outlet in the bottom of the tank, the upper end of the pipe being always kept at the surface of the liquor by a float attached to it. Thus clear liquor alone is run off, and the mud and cloudy liquor at the bottom of the tank are left undisturbed, and discharged separately as required.

In Australia a continuous juice separator is generally used, and preferred to ordinary subsiding or filtering tanks. It is a cylin- drical vessel about 6 feet deep, fitted with a conical Continuous t,ottom 0f afoout fae same depth. Such a vessel is rafcu-SePS" conveniently made of a diameter which will give the cylindrical portion sufficient capacity to hold the juice expressed from the cane-mill in one hour. The hot liquor is con- ducted downwards in a continuous steady stream by a central pipe to eight horizontal branches, from which it issues into the sepa- rator at the level of the junction of the cylindrical and conical portions of the vessel. Since the specific gravity of hot liquor is less than that of cold liquor, and since the specific gravity of the scum and particles of solid matter in suspension varies so slightly with the temperature that practically it remains constant, the hot liquor rises to the top of the vessel, and the scums and particles of solid matter in suspension separate themselves from it and fall to the bottom. By the mode of admission the hot liquor at its entry is distributed over a large area relatively to its volume, and while this is necessarily effected with but little disturbance to the con- tents of the vessel, a very slow velocity is ensured for the current of ascending juice. In a continuous separator, of which the cylin- drical portion measures 13 feet in diameter and 6 feet deep (a suit- able size for treating a juice supply of 4000 to 4500 gallons per hour), the upward current will have at velocity of about 1 inch per minute, and it is found that all the impurities have thus ample time to separate themselves. The clear juice when it arrives at the top of the separator flows slowly over the level edges of a cross canal and passes in a continuous stream to the service tanks of the evapo- rators or vacuum pan. The sloping sides of the conical bottom can be freed from the coating of scum which forms upon them every two or three hours by two rotatory scrapers, formed of L-irons,

which can be slowly turned by an attendant by means of a central shaft provided with a suitable handle. The scums then settle down to the bottom of the cone, whence they are run off to the scum tank. Every twenty-four hours or so the flow of juice may be conveniently stopped, and, after all the impurities have subsided, the superincumbent clear liquor may be decanted by a cock placed at the side of the cone for the purpose, and the vessel may be washed out. These separators are carefully protected by non-con- ducting cement and wood lagging, and are closed at the top to pre- vent loss of heat ; and they will run for many hours without requiring to be changed, the duration of the run depending on the quality of the liquor treated and amount of impurities therein. Smaller separators of the same construction are used for the treat- ment of syrup.

In Cuba, Martinique, Peru, and elsewhere the old-fashioned double-bottomed defecator is used, into which the juice is run direct, and there limed and heated. This defecator is Double- made with a hemispherical copper bottom, placed in an bottomed outer cast-iron casing, which forms a steam jacket, and defecators. jg fitted wjth a oyimdrical curb or breast above the bot- tom. If double-bottomed defecators are used in sufficient number to allow an hour and a half to two hours for making each defect tion, and if they are of a size which permits any one of them to be filled up by the cane-mill with juice in ten to twelve minutes, they , will make as perfect a defecation as is obtainable by any known system ; but their employment involves the expenditure of much high-pressure steam (as exhaust steam will not heat the juice quickly enough through the small surface of the hemispherical inner bottom), and also the use of filter presses for treating the scums. A great deal of skilled superintendence is also required, and first cost is comparatively large. When a sufficient number are not available for a two hours' defecation, it is the practice in some factories to skim off the scums that rise to the top, and then boil up the juice for a few minutes and skim again, and, after repeating the operation once or twice, to run off the juice to sepa- rators or subsiders of any of the kinds previously described. In. Java and Mauritius, where very clean canes are grown, double- bottomed defecators are generally used, and to them, perhaps as much as to the quality of the canes, may be attributed the very strong, fine sugars made in those islands. They are also employed in Egypt,

being remnants of the plant used in the days when the juice passed through bone-black before going to the evaporators.

A modification of the system of double-bottom defecators has lately been introduced with considerable success in St Domingo

and in Cuba, by which a continuous and steady discharge of clear defecated juice is obtained on the one hand, and on the other a comparatively hard dry cake of scum or cachaza, and without the use of filter presses. These results are fon” brought about by adding to the cold juice as it comes d”f°“f,n„ from the mill the proper proportion of milk of lime oereca”an- set up at 8° B., and then delivering the limed juice in a constant steady stream as near the bottom of the defecator as possible ; it is thus brought into immediate contact with the heating surface, and heated once for all before it ascends, with the result of avoiding the disturbance caused in the ordinary defecator by pouring cold juice from above on to the surface of the heated juice, and so establishing down-currents of cold juice and up-currents of hot juice. In the centre of the defecator an open-topped cylindrical vessel is placed, with its bottom about 6 inches above the bottom of the defecator and its top about 12 inches below the top of the defecator. In this vessel is placed the short leg of a draw-off syphon, reaching to nearly the bottom. The action of the moderate heat, 210° P., on the limed juice causes the albumen in it to coagulate ; this rising to the surface collects the cachazas, which form and float thereon. The clear juice in the meantime flows over the edge of the cylindri- cal vessel without disturbance and finds its way out by the short leg of the syphon, and so passes to the canal for collecting the de- fecated juice. The admission of steam must be regulated with the greatest nicety, so as to maintain an equable temperature, 208° to 210° F., hot enough to act upon the albumen and yet not enough to cause ebullition or disturbance in the juice, and so prevent a proper separation of the cachazas. This is attained by the aid of a copper pipe, 4 inches in diameter, which follows the curve of the hemi- spherical bottom, and is fitted from one side to the other of the defecator ; one end is entirely closed, and the other is connected by a small pipe to a shallow circular vessel outside the defecator, covered with an indiarubber diaphragm, to the centre of which is attached a light rod actuating a steam throttle-valve, and capable of being adjusted as to length, &c. The copper pipe and circular vessel are filled with cold water, which on

becoming heated by the surrounding juice expands, and so forces up the indiarubber dia- phragm and shuts off the steam. By adjusting the length of the connecting rod and the amount of water in the vessel, the amount of steam admitted can be regulated to a nicety. To make this apparatus more perfectly automatic, an arrangement for continu- ally adding to and mixing with the juice the proper proportion of milk of lime has been adapted to it ; and although it may be ob- jected that once the proportion has been determined no allowance is made for the variation in the quality of the juice coming from the mill owing to the variations that may occur in the canes fed into the mills, it is obviously as easy to vary the proportion with the automatic arrangement from time to time as it is to vary it in each separate defecation, if the man in charge will take the trouble to do so, which he very seldom does with the ordinary defecators, satisfying himself with testing the juice once or twice in a watch. The scums forming on the top of the continuous defecator become so hard and dry that they have to be removed from time to time with a specially constructed instrument like a flat spade with three flat prongs in front. These scums are not worth passing through the filter presses, and are sent to the fields direct as manure.

The scums separated from the juice by ordinary defecation entangle and carry away with them a certain amount of the juice with its contained saccharine. In some factories they are collected in suitable tanks, and steam is blown hi to T^eftment them, which further coagulates the albuminous par- °cunfs tides. These in their upward passage to the top, where they float, free themselves from the juice, which they leave below them comparatively clear. The juice is then drawn off and pumped up to one of the double-bottomed defecators and redefecated, or, where juice-heaters have been used instead of defecators, the scums from the separators or subsiders are heated and forced through filter presses, the juice expressed going to the evaporators and the scum cakes formed in the filter presses to the fields as manure.

In diffusion plants the milk of lime is added, in proper propor- tion, in the cells of the diffusion battery, and the chips or slices themselves act as a mechanical filter for the juice ; while in the Sandwich Islands coral-sand filters have been employed for some years, in addition to the chips, to free the juice from impurities held in mechanical suspension. In Germany very

similar filters have also been used, pearl-quartz gravel taking the place of coral sand, which it closely resembles. In Mexico filters filled with dry powdered megass have been found very efficient for removing the large quantity of impurities contained in the juice expressed from the very vigorous but rank canes grown in that wonderfully fertile country, but unless constant care is taken in managing them, and in changing them at the proper time, there is great risk of inversion taking place, with consequent loss of sugar.

After the juice has been defecated or purified by any of the means above mentioned it is sent to the evaporating apparatus, hereinafter described, where it is concentrated to 26° or 28°

Beaumg, and is then conducted in a continuous stream either into the service tanks of the vacuum pan, if dark sugars are required, or, if a better colour is wanted, into clarifiers. The latter are cir- cular or rectangular vessels, holding from 500 to 1500 gallons each, according to the capacity of the factory, and fitted with steam coils at the bottom and skimming troughs at the top. In them the syrup is quickly brought up to the boil and skimmed for about five min- utes, when it is run off to the service tanks of the vacuum pans. The heat at which the syrup boils in the clarifiers, 220° F., has the property of separating^ great deal of the gum still remaining in it, and thus cleansing the solution of sugar and water for crystalliza- tion in the vacuum pans ; and if after skimming the syrup is run into separators or subsiders of any description, and allowed to settle down and cool before being drawn into the vacuum pan for crystallization, this cleansing process will be more thorough, and the quality of the final product will be improved. Whether the improvement will be profitable or not to the planter or manufac- turer depends on the market for the sugar, and on the conditions of foreign tariffs, which are not infrequently hostile.

Evaporation of the Juice to Syrup. — The third operation is the concentration of the approximately pure, but thin and watery, juice to syrup point, by driving off a portion of the water in vapour through some system of heating and evaporation. Since on an average 70 per cent, by measurement of the normal defecated cane juice has to be evaporated in order to reduce it to syrup ready for final concentration and crystallization in the vacuum pan, and since to attain the same end as much as 90 to 95 per cent, of the volume of mixed juices has to be evaporated, when maceration or imbibition is employed, it is clear that some more economical mode of evaporation is necessary in large estates than the open fire batteries still common in Barbados and some of the West Indian islands, and in small haciendas in Central America and Brazil, but seldom seen elsewhere. With open fire batteries for making the syrup, which was afterwards finished in the vacuum pan, very good sugar was produced, but at a cost that would be ruinous in to-day's markets.

In the best days of the so-called Jamaica Trains in Demerara, three-quarters of a ton of coal in addition to the megass was burned per ton of sugar made, and with this for many years planters were content, because they pointed to the fact that in the central factories, then working in Martinique and Guadeloupe with charcoal filters and triple effect evaporation, 750 kilos of coal in addition to the megass were consumed to make 1000 kilos of sugar. All this has now been changed. It is unquestionably better and easier to evaporate in vacuo than in an open pan, and with a better system of firing, a more liberal provision of steam generators, and multiple effect evaporators of improved construction, a far larger yield of sugar is obtained from the juice than was possible of attainment in those days, and the megass often suffices as fuel for the crop.

The multiple effect evaporator, originally invented and con- structed by Norberto Rilleux in New Orleans in 1840, has under- gone many changes in design and construction since Multiple (j^t; year. The growing demand for this system of evaporation for application in many other industries besides that of sugar has brought to the front a large number of inventors. Forgetful or ignorant of the great principle announced and established by Rilleux, they have mostly devoted their energies and ingenuity to contriving all sorts of complicated arrangements to give the juice the density required, by

passing and repassing it over the heating surface of the apparatus, the saving of a few square feet of which would seem to have been their main object. In some instances the result has been an additional and unnecessary expenditure of high-pressure steam, and in all the well-known fact — of the highest importance in this connexion — appears to have been disregarded, that the shorter the time the juice is exposed to heat the less inversion will take place in it, and therefore the less will be the loss of sugar. But this competition among inventors, whatever the incentive, has not been without benefit, because to-day, by means of very simple improvements in details, such as the addition of circulators and increased area of connexions, what may be taken to be the standard type of multiple effect evaporator (that is to say, vertical vacuum pans fitted with vertical heating tubes, through which passes the liquor to be treated, and outside of which the steam or vapour circulates) evaporates nearly double the quantity of water per square foot of heating surface per hour which was evaporated by apparatus in use so recently as 1885 — and this without any increase in the steam pressure. That evaporation in vacuo, in a multiple effect evaporator, is advantageous by reason of the increased amount of sugar obtained from a given quantity of juice, and by reason of economy of fuel, there is no doubt, but whether such an apparatus should be of double, triple, quadruple, or quintuple effect will depend very much on the amount of juice to be treated per day, and the cost of fuel. Thus, supposing that 1000 lb of coal were required to work a single vacuum pan,

effect evapo- rators.

evaporating say, 6000 lb of water in a given time, then 500 lb of coal would be required for a double effect apparatus to do the same work, 333 lb for a triple effect, 250 for a quadruple effect, and 200 lb for a quintuple effect. In some places where coal costs 60s. a ton, and where steam is raised by coal, as in a beetroot factory, it might pay to adopt a quintuple effect apparatus, but on a cane sugar estate, where the steam necessary for the evaporator is raised by burning the megass as fuel, and is first used in the engines working the mills, the exhaust alone passing to the evaporator, there would be very little, if any, advantage in employing a quadruple effect instead of a triple effect, and practically none at all in having a quintuple effect

apparatus, for the interest and sinking fund on the extra cost would more than counterbalance the saving in fuel.

With the juice of some canes considerable difficulty is encountered in keeping the heating surfaces of the evaporators clean and free from incrustations, and cleaning by the use of acid has to be resorted to. In places where work is carried on day and night throughout the week, the standard type of evaporator lends itself more readily to cleaning operations than any other. It is obviously easier to brush out and clean vertical tubes open at both ends, and about 6 feet long, on which the scale has already been loosened by the aid of boiling with dilute muriatic acid or a weak solution of caustic soda in water, than it is to clean either the inside or the out- side of horizontal tubes more than double the length. This consid- eration should be carefully remembered in the future by the planter who may require an evaporator and by the engineer who may be called upon to design or construct it, and more especially by a constructor without practical experience of the working of his constructions.

Concentration and Crystallization. — The defecated cane juice, having lost about 70 per cent, of its bulk by evaporation in the mul- tiple effect evaporator, is now syrup, and ready to enter the vacuum pan for further concentration and crystallization. In a patent (No. 3607, 1812) granted to E. C. Howard it is stated, among other things, that “water dissolves the most C™^™5 uncrystallizable in preference to that which is most an^ crystallizable sugar, ‘ ‘ and the patentee speaks of ” a dis- covery I have made that no solution unless highly concentrated of sugar in water can without material injury to its colouring and crystallizing power, or to both, be exposed to its boiling tempera- ture during the period required to evaporate such solution to the crystallizing point.” He stated that “he had made a magma of sugar and water at atmospheric temperature, and heated the same to 190° or 200° F. in a water or steam bath, and then added more sugar or a thinner magma, and the whole being then in a state of imperfect fluidity, but so as to close readily behind the stirrer, was filled into moulds and purged ” (drained). ” fdo further declare,” he added, ” that although in the application of heat to the refining of sugar in my said invention or process I have stated and mentioned the tem- perature of about 200° F. scale as the heat most proper to be used and applied in order to secure and

preserve the colour and crystal- lizability of the sugars, and most easily to be obtained with preci- sion and uniformity by means of the water bath and steam bath, yet when circumstances or choice may render the same desirable I do make use of higher temperatures, although less beneficial.’ ‘ Howard at any rate saw clearly what was one of the indispensable requisites for the economical manufacture of fine crystal sugar of good colour — the treatment of saccharine solutions at temperatures very con- siderably lower than 212° F., which is the temperature of water boiling at normal atmospheric pressure. Nor was he long in provid- ing means for securing these lower temperatures. His patent (No. 3754 of 1813) describes the closed vacuum pan and the air pump with condenser for steam by injection, the use of a thermometer immersed in the solution in the pan, and a method of ascertaining the density of the solution with a proof stick, and by observations of the temperature at which, while fluid and not containing grain, it could be kept boiling under different pressures shown by a vacuum gauge. A table is also given of boiling points from 115° F. to 175° F., corresponding to decimal parts of an inch of mercury of the vacuum gauge. Since Howard published his invention the vacuum pan has been greatly improved and altered in shape and power, and especially of recent years, and the advantages of concen- trating in vacuo having been acknowledged, the system has been adopted in many other industries, and crowds of inventors have turned their attention to the principle. In endeavouring to make a pan of less power do as much and as good work as one of greater power, they have imagined many ingenious mechanical contriv- ances, such as currents produced mechanically to promote evapora- tion and crystallization, feeding the pan from many points in order to spread the feed equally throughout the mass of sugar being cooked, and so on. All their endeavours have obtained at best but a doubtful success, for they have overlooked the fact, that to evaporate a given weight of water from the syrup in a vacuum pan at least an equal weight (or in practice about 15 per cent, more) of steam must be condensed, and the first cost of mechanical agitators, together with the expenditure they involve for motive

power and maintenance, must be put against the slight saving in the heating surface effected by their employment. On the other hand, the advocates of admitting the feed into a vacuum pan in many minute streams appeal rather to the ignorant and incom- petent sugar-boiler than to a man who, knowing his business thoroughly, will boil 150 tons of hot raw sugar in a pan in a few hours, feeding it through a single pipe and valve 10 inches in diameter. Nevertheless it has been found in practice, when syrups with low quotient of purity and high quotient of impurity are being treated, injecting the feed at a number of different points in the pan does reduce the time required to boil the pan, though of no practical advantage with syrups of high quotient of purity and free from the viscosity which impedes circulation and therefore quick boiling. Watt, when he invented the steam engine, laid down the principles on which it is based, and they hold good to the present day. So also the principles laid down by Howard with respect tp the vacuum pan hold good to-day: larger pans have been made and their heating surface has been increased, but it has been found by practice now, as it was found then, that an ordinary worm or coil 4 inches in diameter and 50 feet long will be far more efficient per square foot of surface than a similar coil 100 feet long. Thus the most efficient vacuum pans of the present day are those which have their coils so arranged that no portion of them exceeds 50 or 60 feet in length ; with such coils, and a sufficient annular space in the pan free from obstruction, in order to allow a natural down-current of the cooking mass, while an up-current all round is also naturally produced by the action of the heated worms or coils, rapid evapo- ration and crystallization can be obtained, without any mechanical adjuncts to require attention or afford excuse for negligence.

The choice of the size of the crystals to be produced in a given pan depends upon the market for which they are intended. It is of course presupposed that the juice has been properly defecated, because without this no amount of skill and knowledge in cooking in the pan will avail ; the sugar resulting must be bad, either in colour or grain, or both, and certainly in polarizing power. If a very large firm grain like sugar-candy is required the syrup when first brought into the pan must be of low density, say 20° to 21° Beaum§, but if a smaller grain be wanted it can easily be obtained from

syrup of 27° to 28° Beaume\ On some plantations making sugar for particular markets and use in refineries it is the custom to make only one class of sugar, by boiling the molasses produced by the purging of one strike with the sugar in the next strike. On other estates the second sugars-, or sugars produced from boiling molasses alone, are not purged to dryness, but when sufficiently separated from their mother-liquor are mixed with the defecated juice, thereby increasing its saccharine richness, and after being converted into syrup in the usual manner are treated in the vacuum pan as first sugars, which in fact they really are.

In certain districts, notably in the Straits Settlements, syrup is prepared as described above for crystallization in a vacuum pan, but instead of being cooked in vacuo, it is slowly boiled up in open double-bottom pans. These pans are sometimes heated by boiling oil, with the idea that under such conditions the sugar which is kept stirred all the time as it thickens cannot be burnt or cara- melized ; but the same object can be attained more economically with steam of a given pressure by utilizing its latent heat. The sugar thus produced, by constant stirring and evaporation almost to dryness, forms a species of small-grained concrete. It is called ” Basket Sugar,” and mee^s with a brisk sale, at remunerative prices, among the Chinese coolies ; and as the sugar as soon as cooled is packed ready for market, without losing any weight by draining, this branch of sugar-making is a most lucrative one wherever there is sufficient local demand. Very similar kinds of sugar are also produced for local consumption in Central America and in Mexico, under the names of “Panela” and “Chancaca,” but in those countries the sugar is generally boiled in pans placed over special fire-places, and the factories making it are on a com- paratively small scale, whereas in the Straits Settlements the “Basket Sugar” factories are of considerable importance, and are fitted with the most approved machinery.

Curing or Preparation of Crystals for the Market. — The crystal- lized sugar from the vacuum pan has now to be separated from the molasses or mother-liquor surrounding the crystals. In some parts of Mexico and Central America this separation is still effected by running the sugar into conical moulds, and placing on the top a layer of moist clay or earth which has been kneaded in a mill into a stiff paste. The moisture from the clay, percolating through the mass of sugar, washes away the adhering molasses and leaves

the crystals comparatively free and clear. It may be noted that sugar that will not purge elasily and freely with clay will not purge easily and freely in centrifugals. But for all practical purposes the system of claying sugar is a thing of the past, and the bulk of the sugar of commerce is now purged in centrifugals, as indeed it has been for many years. The reason is obvious. The claying system involved the expense of large curing houses and the employ- ment of many hands, and forty days at least were required for

completing the operation and making the sugar fit for the market, whereas with centrifugals sugar cooked to-day can go to market to-morrow, and the labour employed is reduced to a minimum.

When Cuba was the chief sugar-producing country making clayed sugars, it was the custom (followed in refineries, and found advan- tageous in general practice) to discharge the strike of crystallized sugar from the vacuum pan into a receiver heated below by steam, and to stir the mass for a certain time, and then distribute it into the moulds in which it was afterwards clayed. When centrifugals were adopted for purging the whole crop (they had long been used for curing the second or third sugars), the system then obtaining of running the sugar into waggons or coolers, which was necessary for the second and third sugars cooked only to string point, was continued, but latterly ” crystallization in movement,” a develop- ment of the system which existed in refineries and in Cuba forty years ago or more, has come into general use, and with great ad- vantage, especially where proprietors have been able to erect appropriate buildings and machinery for carrying out the system efficiently. The vacuum pan is erected at a height which commands the crystallizers, each of which will, as in days gone by in Cuba, hold the contents of the pan, and these in their turn are set high enough to allow the charge to fall into the feeding-trough of the centrifugals, thus obviating the necessity of any labour to remove the raw sugar from the time it leaves the vacuum pan to the time it falls into the centrifugals. For this reason alone, and without taking into consideration any increase in the yield of sugar brought about by “crystallization in movement,” the system is worthy of adoption in all sugar factories making crystal sugar.

The crystallizers are long, horizontal, cylindrical or semi-cylin- drical vessels, fitted with a strong horizontal shaft running from end to end, which is kept slowly revolving. The shaft carries arms and blades fixed in such a manner that Crystal' the mass of sugar is quietly but thoroughly moved, '»ers- while at the same time a gentle but sustained evaporation is pro- duced by the continuous exposure of successive portions of the mass to the action of the atmosphere. Thus also the crystals already formed come in contact with fresh mother-liquor, and so go on adding to their size. Some crystallizers are made entirely cylindrical, and are connected to the condenser of the vacuum pan ; in order to maintain a partial vacuum in them, some are fitted with cold water pipes to cool them, and with steam pipes to heat them, and some are left open to the atmosphere at the top. But the efficiency of all depends on the process of almost imperceptible yet continuous evaporation and the methodical addition of syrup, and not on the idiosyncrasies of the experts who manage them ; and there is no doubt that in large commercial processes of manu- facture, the simpler the apparatus used for obtaining a desired result, and the more easily it is understood, the better it will be for the manufacturer. The sugar made from the first syrups does not require a crystallizer in movement to prepare it for purging in the centrifugals, but it is convenient to run the strike into the crystallizer, and so empty the pan at once and leave it ready to commence another strike, while the second sugars will be better for twenty-four hours' stirring and the third sugars for forty-eight hours' stirring before going to the centrifugals. To drive these machines electricity has been applied, with indifferent success, but they have been very efficiently driven, each independently of the others in the set, by means of a modification of a Pelton wheel, supplied with water under pressure from a pumping engine. A comparatively small stream strikes the wheel with a pressure equivalent to a great head, say 300 feet, and as the quantity of water and number of jets striking the wheel can be regulated with the greatest ease and nicety, each machine can without danger be quickly brought up to its full speed when purging high-class sugars, or allowed to run slowly when purging low-class sugars, until the heavy, gummy molasses has been expelled ; and it can then be brought up to its full speed for finally drying the sugar in the basket, a boon which all practical sugar makers will appreciate. The water forced by the force-pump against the Pelton wheels returns by a waste-pipe to the tank, from which the force-pump takes it again.

Beetroot Sugar Manufacture.

About 1760 the Berlin apothecary Marggraff obtained in his laboratory, by means of alcohol, 6-2 per cent, of sugar from a white variety of beet and 4-5 per cent, from a red variety. At the present day, thanks to the careful study of many years, the improvements of cultivation, the careful selection of seed, and suitable manuring, especially with nitrate of soda, the average beet worked up contains 7 per cent, of fibre and 93 per cent, of juice, and yields in Germany 12-79 per cent, and in France 11-6 per cent, of its weight in sugar. In Great Britain the experiments

in the cultivation of sugar beets on Lord Denbigh's estates at Newnharu Paddox, in Warwickshire, in 1900, produced excellent results, both in respect of the weight of the beets per acre and of the saccharine value and purity of the juice. The average weight per acre was over 25^ tons, and the mean percentage of pure sugar in the juice exceeded 15^. The roots were grown under exactly the same cultivation and conditions as a crop of mangel wurzel — that is to say, they had the ordinary cultivation and manuring of the usual root crops. The weight per acre, the saccharine contents of the juice, and the quo- tient of purity compare favourably with the best results obtained in Germany or France, and with those described in the ninth edition of the Encyclopaedia Britannica, vol. i. p. 382, as achieved by the Suffolk farmers, who between 1868 and 1872 supplied Mr Duncan's beetroot sugar factory at Lavenham ; for the weight qf their roots rarely reached 15 tons per acre, and the percentage of sugar in the juice appears to have varied between 10 and 12. On the best equipped and most skilfully managed cane sugar estates, where the climate is favour- able for maturing the cane, a similar return is obtained. Therefore, roughly speaking, one ton of beetroot may be considered to-day as of the same value as one ton of canes ; the value of the refuse chips in one case, as food for cattle, being put against the value of the refuse me- gass, as fuel, in the other. Before beetroot had been brought to its present state of perfection, and while the factories for its manipulation were worked with hydraulic presses for squeezing the juice out of the pulp produced in the raperies, the cane sugar planter in the West Indies could easily hold his own, notwithstanding the artificial competition created and maintained by sugar bounties. But now that so great a degree of perfection in the culti- vation of the roots and their subsequent manipulation has been reached, and has been supplemented with Gov- ernment subsidies, a most serious crisis has come about, and it remains to be seen whether the British Government will, like that of the United States, put on countervailing duties to protect their own people from ruin, or be able to persuade the Continental Governments to abandon the sugar bounties. The immediate effect would be to double the consumption of sugar in the bounty-paying countries, as a consequence of reducing the price by more than one- half, and at the same time English planters and refiners would be relieved from an unfair and almost fatal com- petition, dependent both for its existence and intensity not on anything in nature or

on any permanent conditions of national life, but on the merest expedients of a time- serving and indefensible policy.

In beetroot sugar manufacture the operations are washing, slicing, diffusing, saturating, sulphuring, evaporation, concentration, and curing.

Slic ing.— The roots are brought from the fields by carts, canals, and railways. They are weighed and then dumped into a washing machine, consisting of a large horizontal cage, submerged in water, in which revolves a horizontal shaft carrying arms. .The arms are set in a spiral form, so that in revolving they not only stir the roots causing them to rub against each other, but also force them forward from the receiving end of the cage to the other end. Here they are discharged (washed and freed from any adherent soil) into an elevator, which carries them up to the top of the building and delivers them into a hopper feeding the slicer. Slicers used to be constructed with iron discs about 33 to 40 inches diameter, which were fitted with knives and made 140 to 150 revolutions per minute, under the hopper which received the roots. This hopper was divided into two parts by vertical division plates, against the bottom edge of which the knives in the disc forced the roots, and sliced and pulped them. Such machines were good enough when the juice was expelled from the small and, so to speak, chopped slices and pulp by means of hydraulic presses. But hydraulic presses have now been abandoned, for the juice is universally obtained by diffusion, and the small slicers have gone out of use, because the large amount of pulp they produced in proportion to slices is not suitable for the diffusion process in

which evenly cut slices are required, which present a much greater surface with far less resistance to the diffusion water. Instead of the small slicers, machines made on the same principle, but with discs 7 feet and upwards in diameter, are used. Knives are arranged around their circumference in such a way that the hopper feeding them presents an annular opening to the disc, say 7 feet outside diameter and 5 feet inside, with the necessary division plates for the knives to cut against, and instead of making 140 to 150 revolutions, the discs revolve only 60 to 70 times per minute. Such a slicer is capable of efficiently slicing 300,000 kilos of roots in twenty-four hours, the knives being changed four times in that period, or oftener if required,

for it is necessary to change tbem the moment the slices show by their rough appearance that the knives are losing their cutting edges.

Diffusion.— ~~The diffusion cells are closed, vertical, cylindrical vessels, holding generally 60 hectolitres or 1320 gallons, and are arranged in batteries of 12 to 14. Sometimes the cells are erected in a circle, so that the spout below the slicing machine revolving above them with a corresponding radius can discharge the slices into the centre of any of the cells. In other factories the cells are arranged in lines, and are charged from the slicer by suitable tele~~ scopic pipes or other convenient means. A circular disposition of the cells facilitates charging by the use of a pipe rotating above them, but it renders the disposal of the hot spent slices somewhat difficult and inconvenient. The erection of the cells in _ straight lines may cause some little complication in charging, but it allows the hot spent slices to be discharged upon a travelling band which takes them to an elevator, an arrangement simpler than any which is practicable when the cells are disposed in a circle. Recently, however, a well-known sugar maker in Germany has altered his battery in such manner that instead of having to open a large door below the cells in order to discharge them promptly, he opens a comparatively small valve, and applying compressed air at the top of the cell, blows the whole contents of spent slices up a pipe to the drying apparatus, thus saving not only a great deal of time but also a great deal of labour of a kind which is both arduous and painful, especially during cold weather. The slices so blown up, or elevated, are passed through a mill which expels the surplus water, and are then pressed into cakes and dried until they hold about 12 per cent, of water and 88 per cent, of beet fibre. These cakes, sold as food for cattle, fetch as much as £4 per ton in Rumania, .where four or five beetroot factories are now at work. A cell when filled with fresh slices becomes the head of the battery, and where skilled scientific control can be relied upon to regulate the process, the best and most economical way of heating the slices, previous to admitting the hot liquor from the next cell, is by direct steam ; but as the slightest inattention or carelessness in the admission of direct steam might have the effect of inverting sugar, and thereby causing the loss of some portion of saccharine in the slices, water heaters are generally used, through which water is passed and heated up previous to admission to the freshly- filled cell. When once a cell is filled up and the slices are warmed through, the

liquor from the adjoining cell, which hitherto has been running out of it to the saturators, is turned into the new cell, and beginning to displace the juice from the fresh slices, runs thence to the saturators. When the new cell comes into operation and becomes the head of the battery, the first or tail cell is thrown out, and number two becomes the tail cell, and so the rounds are repeated ; one cell is always being emptied and one filled or charged with slices and heated up, the latter becoming the head of the battery as soon as it is ready.

Saturation. — The juice, previously treated with lime in the diffu- sion battery, flows thence into a saturator. This is a closed vessel, into which carbonic acid gas (produced as described hereafter) is forced, and combining with the lime in the juice forms carbonate of lime. The whole is then passed through filter presses, the clear juice being run off for further treatment, while the carbonate of lime is obtained in cakes which are taken to the ‘fields as manure. The principal improvement made of recent years in this portion of the process has been the construction of pipes through which the carbonic acid gas is injected into the juice in such a manner that they can be easily withdrawn, and a clean set substituted. The filter presses remain substantially unchanged, although many ingenious but slight alterations have been made in their details. The juice, which has now become comparatively clear, is again treated with lime, and again passed through a saturator and filter presses, and comes out still clearer than before. It is then treated with sulphurous acid gas, for the purpose of decolorization, again limed to neutralize the acid, and then passed through a third saturator wherein all traces of lime and sulphur are removed.

A process for purifying and decolorizing the juice expressed from beetroots by the addition of a small quantity of manganate of lime (20 to 50 grammes per hectolitre of juice) under the influence of an electric current, was worked with considerable success in a sugar factory in the department of Seine-et-Marne in the year 1900-01. A saving of 40 per cent, is stated to be effected in lime.

refining]

SUGAE

The use of sulphurous acid gas is entirely abandoned, and instead of three carbonatations with corresponding labour and plant only one is required. The coefficient of purity is increased, and the viscosity of the juice diminished. The total saving effected is stated to be equivalent to 3 francs per ton of beetroot worked up. This system is also being tried on a small scale with sugar-cane juice in the West Indies. If by this process a more perfect defecation and purification of the juice is obtained, it will no doubt be highly beneficial to the cane planter, though no great economy in lime can be effected, because but very little is used in a cane factory in comparison with the amount used in a beet factory.

Evaporation and Crystallization. — The clear juice thus obtained is evaporated in a multiple effect evaporator and crystallized in a vacuum pan, and the sugar is purged in centrifugals. From the centrifugal the sugar is either turned out without washing as raw sugar, only fit for the refinery, or else it is well washed with a spray of water and air until white and dry, and it is then offered in the market as refined sugar, although it has never passed through animal charcoal (bone-black). The processes of evaporation and concentration are carried on as they are in a cane sugar factory, but with this advantage, that the beet solutions are freer from gum and glucose than those obtained from sugar-canes, and are therefore easier to cook.

Curing. — There are various systems of purging refined, or so- called refined, sugar in centrifugals, all designed with a view of obtaining the sugar in lumps or tablets, so as to appear as if it had been turned out from moulds and not from centrifugals, and great ingenuity and large sums of money have Been spent in perfecting these different systems, with more or less happy results. But the great achievement, of recent manufacture is the production, with- out the use of animal charcoal, of a cheaper, but good and whole- some, article, in appearance equal to refined sugar for all intents and purposes, except for making preserves of fruits in the old- fashioned way. The wholesale jam manufacturers of the present day use this sugar ; they boil the jam in vacuo, and secure a product that will last a long time without deteriorating, but it lacks the delicacy and distinctive flavour of fruit

preserved by a careful housekeeper, who boils it in an open pan with cane sugar to a less density, though exposed for a short time to a greater heat.

Carbonatation. — The carbonic acid gas injected into the highly- limed juice in the saturators is made by the calcination of limestone in a kiln provided with three cleaning doors, so arranged as to allow the lime to be removed simultaneously from them every six hours. The gas generated in the kiln is taken off at the top by a pipe to a gas-washer. In this it passes through four sheets of water, by which it is not only freed from any dust and dirt that may have come over with it from the kiln, but is also cooled to a temperature which permits an air-pump to withdraw the gas from the kiln, through the gas-washer, and force it into the saturators, without overheating. In some factories for refining sugar made from beet or canes this system of carbonatation is used, and enables the refiner to work with syrups distinctly alkaline, and to economize a notable amount of animal charcoal.

Refining.

Briefly, sugar-refining consists of melting raw or un- refined sugar with water into a syrup of 27° to 28° Beaume", or 1230 specific gravity, passing it through filtering cloth to remove the sand and other matters in mechanical suspension, and then through animal charcoal to remove all traces of colouring matter and lime, thus producing a perfectly clear white syrup, which, cooked in the vacuum pan and crystallized, becomes the refined sugar of commerce.

Melting Pans. — The melting pans are generally circular vessels, fitted with a perforated false bottom, on which the sugar to be melted is dumped. The pans are provided with steam worms to keep the mass hot as required, and with mechanical stirrers to keep it in movement and thoroughly mixed with the water and sweet water which are added to the sugar to obtain a solution of the specific gravity desired. Any sand or heavy matter in suspension is allowed to fall to the bottom of the pan into the " sand box " before the melted sugar is run off to the cloth filters. In a process employed with great success in some refineries the raw sugars are washed before being melted, and thus a purer article is obtained for subsequent treatment. In this process the raw sugar is mixed with a small amount of syrup so as to form a suitable magma, and is then run into a continuous centrifugal, where it is sufficiently

washed, and from which it runs out, com- paratively clean, into the melting pans described above.

Miters.— Taylor bag filters are generally used for clearing the melted liquor of its mechanical impurities. They were introduced years ago by the man whose name they still retain, but they are

very different in construction to-day from what they were when first employed. They consist of tanks or cisterns fitted with “heads” from which a number of bags of specially woven cloth are suspended in a suitable manner, and into which the melted sugar or liquor to be filtered flows from the melting pans. The bags, though 60 inches or more in circumference, are folded up in such a way that a sheath about 15 inches in circumference can be passed over them. Thus a maximum of filtering surface with a minimum of liquor in each bag is obtained, and a far greater num- ber of bags are got into a given area than would otherwise be possible, while the danger of bursting the bags by leaving them unsupported is avoided. As the liquor goes on filtering through the bags they gradually get filled up with slime and sludge, and the clear liquor ceases to run. Steam is then turned on to the outside of the bags and sheaths, and hot water is run through them to wash out all the sweets they contain. Large doors at the side of the cistern are then opened, and as soon as the bags are cool enough they are removed at the expense of very exacting labour and considerable time, and fresh bags and sheaths are fixed in their places ready for filtering fresh liquor. The dirty bags and sheaths are then washed, mangled, and dried, and made ready for use again. In a refinery in Nova Scotia a system has been introduced by which a travelling crane above the bag filters lifts up any head bodily with all its bags attached, and runs it to the mud and washing tanks at the end of the battery, while another similar crane drops another head, fitted with fresh bags, into the place of the one just removed. The whole operation of thus changing a filter occupies about ten minutes, and there is no need for any one to enter the hot cistern to detach the bags, which are removed in the open air above the mud tank. By this arrange- ment the work of a refinery can be carried on with about one-half the cisterns otherwise required, because, although it does not re- duce the number of bags required per day for a given amount of work, it enables the refiner to use one cistern twice a day with fresh bags, instead of only once

as heretofore. In some refineries the travelling cranes are now run by electricity, which still further facilitates the work. Another method of enabling more work to be done in a given time in a given cistern is the use of a bag twice the ordinary length, open at both ends. This being folded and placed in its sheath is attached by both ends to the head, so that the melted liquor runs into both openings at the same time. The mud collects at the bottom of the U, and allows the upper part of the bag to filter for a longer time than would be the case if the bottom end were closed and if the bag hung straight like the letter |.

The clear, bright syrup coming from the bag filters passes to the charcoal cisterns or filters. These are large cylindrical vessels from 20 to 50 feet high, and of such diameter as to hold a given quantity of animal charcoal (also called ‘ ‘ bone-black ‘ ‘ and ‘ ‘ char ‘ ‘) in proportion to the contemplated output of the refinery. A very usual size of cistern forming a convenient unit is one that will hold 20 tons of char. Each cistern is fitted with a perforated false bottom, on which a blanket or specially woven cloth is placed, to receive the char which is poured in from the top, and packed as evenly as possible, until the cistern is filled. The char is then ” settled” by water being slowly run on to it, in order to prevent the syrup making channels for itself and not permeating the whole mass evenly. The cistern being thus packed and settled is closed, and the syrup from the bag filters, heated up to nearly boiling-point, is admitted at the top until the cistern is quite full. A small pipe entering below the false bottom allows the air in the cistern to escape as it is displaced by the water or syrup. In some refineries this pipe, which is carried up to a higher level than the top of the cistern, is fitted with a whistle which sounds as long as the air escapes. When the sound ceases the cistern is known to be full, and the entrance of further water or syrup is stopped. The syrup in the cistern is allowed to remain for about twelve hours, by which time the char will have absorbed all the colouring matter in it, as well as the lime. A cistern well packed with 20 tons of char will hold, in addition, about 10 tons of syrup, and after settling, this can be pressed out by allowing second quality syrup, also heated to nearly boiling-point, to enter the cistern slowly from the top, or it may be pressed out by boiling water. By carefully watching the flow from the discharge cock of the cistern the change from the first/ liquor to the next is easily de- tected, and the discharge is diverted from the canal for the first

liquor to the canal for the second liquor, and when required, to the canals for the third and fourth liquors. Finally, boiling water is admitted and forces out all the last liquor, and then continues to run and wash out the sweets until only a trace remains. This weak /solution, called ” sweet water,” is sometimes used for melt- ing the raw sugar, or it is evaporated in a multiple effect apparatus to 27° Beaum£ density, passed through the char filter, and cooked in the vacuum pan like the other liquors. After the sweets have come away, cold water is passed through the char until no trace of lime or sulphate of lime is found in it ; then a] large manhole at the bottom of the cistern is opened, and the washed and spent

char is removed. In most modern refineries the cisterns are so arranged that the spent char falls on to a travelling band, and is conducted to an elevator - which carries it up to the drying floor of the charcoal kiln.

Betorts for Beburning Char. — The kilns are made with either fixed or revolving retorts. The former perhaps produce a little better char, but the latter, working almost automatically, require less labour and attention for an equal amount of work, and on the whole have proved very satisfactory. From the drying floor on which the spent char is heaped up it falls by gravitation into the retorts. These are set in a kiln or oven, and are kept at as even a temperature as possible, corresponding to a dull cherry-red. Below each retort, and attached to it, is a cooler formed of thin sheet-iron, which receives the hot char as it passes from the retort, and at the bottom of the cooler is an arrangement of valves which permits a certain amount of char to drop out and no more. With the fixed retorts these valves are worked from time to time by the attendant, but with revolving retorts they are worked continuously and auto- matically, and allow from sixteen to twenty-four ounces of char to escape per minute from each cooler, and so make room in the retort above for a corresponding quantity to enter from the drying floor. The reburnt and cooled char is collected and sent back to the char cisterns. In the best appointed refineries the whole of the work in

connexion with the char is performed mechanically, with the exception of packing the filter cisterns with fresh char and emptying the spent and washed char on to the carrying bands. In former days, when refining sugar or “sugar baking ” was supposed to be a mystery only understood by a few of the initiated, there was a place in the refinery called the “Secret Room,” and this name is still used in some refineries, where, however, it applies not to any room, but to a small copper cistern, constructed with five or six or more divisions or small canals, into which all the charcoal cisterns discharge their liquors by pipes led up from them to the top of the cistern. Each pipe is fitted with a cock and swivel, in such a manner that the liquor from the cistern can be turned into the proper division according to its quality.

Vacuum Pans and Beceivers. — The filtered liquors being col- lected in the various service tanks according to their qualities, are drawn up into the vacuum pans and boiled to crystals. These are then discharged into large receivers, which are generally fitted with stirrers, and from the receivers the cooked mass passes to the centrifugal machines. As in the beetroot factories, these machines work on different systems, but nearly all are arranged to turn out sugar in lumps or tablets presenting an appearance similar to that of loaf sugar made in moulds, as this kind of sugar meets with the greatest demand. Granulated sugar, so called, is made by passing the crystals, after leaving the centrifugals, through a large and slightly inclined revolving cylinder with a smaller one inside heated by steam. The sugar fed into the upper end of the cylinder gradually works its way down to the lower, showering itself upon the heated central cylinder. A fan blast enters the lower end, and passing out at the upper end, carries off the vapour produced by the drying of the sugar, and at the same time assists the evaporation. The dry sugar then passes into a rotating screen fitted with two meshes, so that three grades of sugar are obtained, the coarsest being that which falls out at the lower end of the revolving screen.

Becent Improvements. — Systematic feeding for the vacuum pan and systematic washing of the massecuite have been recently intro- duced not only into refineries, but also into sugar houses or factories on plantations of both cane and beetroot, and great advantages have resulted from their employment. The first-mentioned process consists of charging and feeding

the vacuum pan with the richest syrup, and then as the crystals form and this syrup becomes thereby less rich the pan is fed with syrup of lower richness, but still of a richness equal to that of the mother-liquor to which it is added, and so on until but little mother-liquor is left, and that of the poorest quality. The systematic washing of the massecuite is the reverse of this process. When the massecuite, well pugged and prepared for purging, is in the centrifugals, it is first washed with syrup of low density, to assist the separation of mother-liquor of similar quality, this washing being supplemented by the injection of pure syrup of high density, or ” clairce,” when very white sugar is required. The manufacturers who have adopted this system assert that, as compared with other methods, not only do they obtain an increased yield of sugar of better quality, but that they do so at a less cost for running their machines, and with a reduced expenditure in sugar and “clairce.” “Clairce” is the French term for syrup of 27° to 30° Beaume’ specially prepared from the purest sugar. _ (a. ch.)

Statistics.

The foregoing sketch, of the principal processes em- ployed in making sugar from canes and beetroot, and in refining the raw sugar produced from both of these sugar-

bearing plants, may be conveniently supplemented by a brief review of the progress made by the sugar industry since 1887 and its state at the present time, showing the importance and magnitude of the trade interests involved, and the serious extent to which these interests and those of the public at large in all countries are affected by the incidence of the sugar bounties.

Tables are annexed containing statistical statements relating to the production of sugar and the sugar trade.

Commerce.

Since the article on sugar in the earlier volume of the Encyclopaedia Britannica (ninth edition) was written, the sugar trade of the world has grown considerably in volume. The system of protection then existent in European coun- tries producing beet sugar offered and paid bounties, directly or indirectly, to manufacturers and refiners on their exports, and to

growers on their crops ; and until quite lately it successfully withstood all attempts to upset it. Under this system the production of sugar in bounty-paying countries has been encouraged and pushed far beyond the limits it could have reached without State aid. At the same time the consumption of sugar among the mass of their populations has been greatly restricted owing to the clearness of the commodity, caused by heavy excise duties imposed mainly to pro- vide for the payment of the bounties. The very large quantity of output made available for export under these exceptional conditions has brought about the flooding of the British and other markets with sugars at depressed prices, not unfrequently below the prime cost of pro- duction, to the harassment of important industries carried on by British refiners and sugar-growing colonies. In these circumstances, the British Government sent out invitations on the 2nd July 1887 for an International Conference to meet in London. The conference met, and on the 30th August 1888 a convention was signed by all the Powers represented except France — namely, by Austria, Belgium, Germany, Great Britain, Italy, the Netherlands, Russia, and Spain. France withdrew because the United States was not a party to it. The first article declared that ” The High Contracting Parties engage to take such measures as shall constitute an absolute and complete guarantee that no open or dis- guised bounty shall be granted on the manufacture or exportation of sugar.” The seventh article provided that bountied sugars {meres prime’s) must be excluded from import into the territories of the signatory Powers, by absolute prohibition of entry or by levying thereon a special duty in excess of the amount of the bounties, from which duty sugars coming from the contracting countries, and not bounty-fed, must be free. The convention was to be ratified on the 1st August 1890, and was to be put in force on the 1st September

1891.

The convention of 1888 was never ratified, and it is doubtful whether its ratification was urged, for a Bill introduced by the British Government in 1889 to give it effect was not pressed, and it was manifest that there was hesitation — which presently became refusal — to uphold the policy of the penalties on the importation of bountied sugar imposed by the seventh article, without which the convention would be so much waste paper.

Eight years later, on 1st August 1896, the bounties offered by the Governments of Germany and Austria- Hungary were approximately doubled, and France had a Bill in preparation to increase hers correspondingly, although it was computed that they were even then equivalent to a grant of £3, 5s. per ton. So wrote Mr Chamberlain, the Colonial Secretary, on the 9th Novem- ber following, to the Treasury, The minute plainly

stated that it had become a question whether the con- tinued enjoyment of advantages resulting from the importation of cheap bounty-fed sugar to some British industries did not involve the ruin of the British sugar-producing colonies; and that he was not prepared, as Secretary of State for the Colonies, to accept the re- sponsibility of allowing matters to take their course, and to acquiesce in the policy of non-intervention hitherto pursued in regard to the bounties without having satisfied himself as to what such a policy might entail as regarded both the colonies and the Exchequer ; nor would he think it right that the Government should adhere to their then attitude on the question, without knowing as clearly as possible its cost to the welfare and stability of an im- portant part of the Empire and to industries in which English capital was largely invested. Mr Chamberlain concluded by asking whether the Treasury would consent to sending a Royal Commission to the West Indies to inquire into the effect of the foreign sugar bounties on their principal industry.

Here were plain words, and they expressed a plain purpose. The Treasury without delay accepted the pro- posal, and a Boyal Commission proceeded to the West Indies in December 1896, and reported a few months later in 1897. Only one commissioner, however, denounced the bounties as the real cause of the utter breakdown of trade and of the grievous distress which all three had wit- nessed and fully acknowledged. But the minute and Commission were not barren of result. A fresh Con- ference of the Powers assembled at Brussels, on the invitation of the Belgian Government, on the

7th June 1898 ; and although the British delegates were not em- powered to consent to a penal clause imposing counter- vailing duties on bountied sugar, the Belgian Premier who presided, was able to assure them that if Great Britain would agree to such a clause, he could guarantee the accession of the Governments of Germany, Austria, Holland, and his own. [Mr Ozanne to the Revenue Secretary, India Office, 18th June 1898 (East India Sugar [C. 9287], 1899, p. 17).] The representative of India added, “It is certain that neither Prance nor Russia could afford to remain outside, and it is probable they will readily join.” He was, however, mistaken. A few days later the Conference met for its seventh and final sitting. Of all the countries represented — Ger- many, Austria-Hungary, Belgium, Spain, Prance, Great Britain, the Netherlands, Russia, and Sweden — only one, namely Prance, was opposed to the complete sup- pression of all export bounties, direct’ or indirect ;’ and Russia declined to discuss the question of her internal legislation, contending that her system did not amount to a bounty on exportation. [The British Dele- gates to Lord Salisbury, 27th June 1898 [C. 8938], 1898, p. 3.]

Apart from the proceedings at the sittings, much of the actual work of the Conference was done by informal dis- cussion, undertaken to discover some means of arriving at a common understanding. Was a compromise possible which would bring about a satisfactory settlement ? The British delegates wrote that it appeared that there were at that time but two methods of securing the suppression of the bounty system — an arrangement for limitation of the French and Russian bounties acceptable to the other sugar-producing States, in return for the total abolition of their bounties ; or, a convention between a certain number of these States, providing for the total suppression of their bounties, and for the prohibition of entry into their terri- tory of bounty-fed sugars, or countervailing duties pro- hibiting importation. The United States, they said, had closed her markets by these means ; and now England and India were become essential to the bounty-paying

countries; and should their markets also be closed, the speedy abolition of the bounty system, which was felt to press heavily on the States having re-course to it, must follow; while if these markets were left open, a worse

state of things might result, by the increase of the bounties in various countries. [Ibid., p. 4.]

The Belgian Government thought a compromise might be possible. A proposal was annexed to the prods-verbal of the final sitting, and the president closed the first session of the Conference on the 25th June 1898 with the expression of a hope that the delegates would soon reassemble. [Ibid., pp. 56, 57.]

The annual aggregate output of cane and date sugar in India was short of 4,000,000 tons. Exportation had long ceased, partly owing to the bountied competition of beet sugar, and partly because the people had become able to afford the consumption of a greater quantity than they produced; and German and Austrian sugars were pour- ing into the country to supply the deficiency. But the importation of foreign sugar, cheapened by foreign State aid to a price which materially reduced the fair and reasonable profit of native cultivators, and with that profit their ability to meet canal charges and pay the legitimate return on public funds invested in irrigation works, was a state of things the Indian Government could not accept, and no time was lost in following the example set by America. On the 20th March 1899 an Act, authorizing the imposition of countervailing duties on bounty-fed articles at the port of importation, was passed by the Council of India, and received the assent of the Governor- General. [East Indiar (Sugar) [C. 9287], 1899, pp. 19 and 89.]

This decisive step was not long in making itself felt in the chanceries of Europe. In October 1900 a conditional agreement for the reduction of the bounties was made at Paris between Prance, Germany, and Austria-Hungary ; in February 1901 the Belgian Government proposed a new session of the Conference of 1898, and on the 16th December following Brussels welcomed once more the delegates of all the Powers, with the exception of Russia, to the eighth European Sugar Bounty Conference since that of Paris in 1862. The discussion lasted over eight sittings, but the Conference, to which the British dele- gates had come with powers to assent to a penal clause, arrived at an understanding, and a convention was signed in March 1902.

The full text in French, with an English translation, of the Sugar Convention, signed at Brussels on the 5th March 1902 by the pleni-potentiaries of the Governments of Germany, Austria-Hungary, Belgium, Spain, France, Great Britain, Italy, the Netherlands, and Sweden, will be found in a return presented to Parliament in April 1902 (Miscellaneous No. 5, 1902, Cd. 1013).

The following is a summary : —

Article 1. — The High Contracting Parties agree, from the date of putting in force this present Convention, to suppress the direct and indirect Bounties which might benefit the production or export of Sugar, and not to establish Bounties of this kind during the whole duration of the Convention. The agreement applies to confec- tionery, chocolate, and all analogous products containing sugar artificially incorporated in a notable proportion ; and ‘to all advantages, resulting directly or indirectly for producers, from fiscal legislation, including : (a) Direct Bounties granted to exports ; (6) and to production ; (c) total or partial exemption from taxa- tion as to any part of the output ; (d) advantages derived from excess of yield ; (e) and from the exaggeration of drawback ; (/) and from any Surtax in excess of the rate fixed by Article 3.

Article 2. — Sugar factories and refineries of all kinds are to be placed in bond, and worked under the continuous supervision of revenue officers ; and finished sugars are to be stored in bonded warehouses.

Article 3. — The Surtax is limited to a maximum of 6 francs per 100 kilogrammes (=2s. 5Jd. per cwt., or £2, 8s. 9d. per ton) for refined and assimilable sugars ; and of 5 francs 50 centimes per 100 kilogrammes (=2s. 2-8d. per cwt., or £2, 4s. 8$d. per ton) for other sugars.

The Surtax is the difference between the rate of duty imposed on imported foreign sugar and the rate of duty or tax imposed on the home product. The provisions of this article do not apply to import duties on sugar imposed by countries that do not produce sugar, nor to the by-products of sugar manufacture or of refining.

Article 4. — The High Contracting Parties agree to impose a special duty on the importation into their respective territories of sugars from countries that grant Bounties either on production or export. This duty shall not be less than the amount of the Bounties direct or indirect granted in the country of origin ; and each of the parties reserves the right to prohibit the importation of bountied sugars (mere primes).

In order to compute the advantage which may be derived by the imposition of an excessive Surtax as specified in paragraph / of Article 1, the Surtax, at the agreed rate fixed by Article 3, is deducted from such excessive Surtax, and the half of the difference is considered to represent Bounty. A Permanent Commission, instituted by Article 7, will have the right, on the demand of a Contracting Party, to revise the rate imposed in excess.

Article 5. — The High Contracting Parties agree to admit, at the lowest rate of import duty, sugars of any of the contracting countries, or of any Colonies or Possessions belonging to them that do not grant Bounties, and to which the obligations imposed by Article 8 apply.

Cane and beet sugars shall not be subjected to different rates of duties.

Article 6. — Spain, Italy, and Sweden are exempt from the obligations of Articles 1, 2, and 3 so long as they do not export sugars ; but they agree to make their sugar legislation conform to the provisions of this Convention, within a year, or earlier if possible, from the time when the Permanent Commission gives notice that the above-mentioned condition has ceased to exist.

Article 7. — The High Contracting Parties agree to establish a Permanent Commission to watch the execution of the provisions of this Convention.

This Commission shall be composed of the Delegates of the Contracting Powers, and a Permanent Bureau will be connected with it. It will elect its President, and it will sit at Brussels, and assemble at the summons of the President.

The duties of the Delegates will be :■ —

(a) To ascertain whether in the Contracting States any Bounty, direct or indirect, is granted on production or export of sugar ;

(b) “Whether the States named? in Article 6 continue to conform to the conditions of that Article ;

(c) Whether any Bounties exist in non-signatory States, and to estimate their amount for the purposes of Article 4 ;

(d) To pronounce an opinion on contested points (questions

(e) To consider requests for admission to the Union made by non-signatory States.

The Permanent Bureau shall collect, translate, arrange, and publish information of all kinds respecting legislation on, and statistics of, sugar, not only in contracting countries, but in all other countries.

The High Contracting Parties shall transmit to the Belgian Government, which shall forward them to the Commission, all laws, regulations, &c, and full statistical information respecting sugar in their countries.

Austria and Hungary shall be considered separately as Con- tracting Parties.

The first meeting of the Commission shall be held in Brussels, under the auspices of the Belgian Government, at least three months before the present Convention comes into force.

The Commission shall onlyl have the duty of examination and report. It shall forward the Report to the Belgian Government, which will communicate with the Powers interested, and at the request of any one of

them shall convoke a conference to take decisions and measures, as circumstances may demand.

The Examinations and Valuations referred to in paragraphs b and c will be binding on the Contracting Powers, and will take effect in two months' time, at the latest, after being determined by a majority vote, each Contracting Party having one vote. An appeal is to lie to a fresh meeting of the Commission.

The expenses of the establishment and working of the Permanent Bureau and Commission, the salaries of the Delegates excepted, shall be borne by all the Contracting States, subject to equitable division of the same.

Article 8. — The Parties agree for themselves, their Colonies and Possessions — an exception being made for the self-governing Colonies of Great Britain and the British East Indies — to pre- vent Bounty-fed sugar, which has traversed territory of a con- tracting State, from enjoying the advantages of this Convention in the market of destination.

Article 9. — States not parties to this Convention will, on request, and after approval by the Permanent Commission, be admitted to it.

Article 10.— The Convention will come int>_ force on 1st Sep- tember 1903, and remain in force five years from that date ; and thenceforward, in case no State denounces it twelve months before the 1st September 1908, it will remain in force for a year, and so on from year to year. The denunciation will only have effect on the party making it.

Article 11. — The provisions of the Convention apply to the over-sea Colonies and Possessions of the parties, those of the Netherlands and Great Britain excepted, save as regards the pro- visions of Articles 5 and 8.

Article 12. — The Convention shall be ratified at Brussels on or before 1st February 1903.

The Plenipotentiaries, having signed this Convention, agreed to a Final Protocol.

As regards Article 3, they agreed that the object of the Surtax is the efficacious protection of the market of each producing country, and that it might be increased in respect of sugars coming from any State in excessive quantity, and so invading a home market, not as the result of a factitious increase of price by agreement between producers, but as the consequence of actual economic inferiority.

The Permanent Commission will decide the question by a majority vote, and the increase of the Surtax is limited to 1 franc per 100 kilogrammes (= 4‘875d. per cwt., or 8s. IJd. per ton).

As regards Article 11, the Governments of Great Britain and the Netherlands ageeed that, during the existence of the Convention, no Bounty, direct or indirect, or preference as against foreign sugars, shall be given to sugars of their Colonies, in their respective countries.

The Brussels Convention of 1902 — if it be ratified — will put an end to a costly system, mischievous in prin- ciple, which has benefited a comparatively small number of people at the expense of unmerited and wholly un- necessary privation to the greater part of the population of the Continent ; and it will constitute international legislation of a novel type which may prove beneficial to the world at large, for it will be a veritable organic law ruling a great trade under the common sanction of the leading European Powers.

The rates of the bounties it will remove are given in the subjoined table : —

Table I.

Amounts (reduced to English money per cwt. avoirdupois) of the total net sugar bounties granted by European Powers, according to the computation issued by the Secretary of the United States Treasury on the 12th December 1898. This forms the basis on which the United States countervailing duties are now being levied (July 1902) on all sugars imported from the countries specified : —

Sugars polarizing

From . . To . . .

75° 88°

88° 93°

65° 1 90° 98° | 98°

88° 99°

93°

99F

98°

994=

98° 100°

99° 100°

994° 100°

Bounties (per cwt.)

s. d.

s. d.

s. d.

s.d.

s. d.

s. d.

1 3

s.d.

s. d.

8. d.

s. d.

Countries — Russia Austria- j Hungary j France . Crystals Refined Germany .

2 3-3

1 2

4 4|

1 3

2 11-1

1 6

4 6J

4104

3 4-65

19-3 1 9-3

Sugars classed as (per act.)

Raw Sugar.

Refined Sugar.

Countries —

s. d.

1 10

s. d. 2 2J

0 7-6

Sugars analysing in pure sugar (per cwt.)

Hard Dry Refined.

Less than . . Country — Holland . .

98%

a. d.

1 10-8

98% and over.

s. d.

1 6

(Additional)

s. d.

0 3

statistics]

The following table does not give the Production of in the world, but only the quantities of sugar dealt with in

SUGAR

the sugar trade, included : —

The production of India, for instance, is not

Table II.

The world’s trade in cane and beet sugar in tons avoirdupois at decennial period? from 1840 to 1870 inclusive, and yearly from 1871 to 1901 inclusive, with the percentage of beet sugar and the average price per cwt. in shillings and pence.

Tons avoirdupois of 2240 pounds=1016 kilogrammes.

Year.

Cane.

Beet.

Total.

Per Cent. Beet.

Average

Price per Cwt.

Year.

Cane.

Beet.

Total.

Per Cent. Beet.

Average

Price per Cwt.

1840

1,000,000

50,000

1,150,000

4-35

s.

48

d.

0

1884-85 .

2,351,000

2,545,000

4,896,000

51-98

s. d.

12 4

1850

1,200,000

200,000

1,400,000

14-29

40

0

1885-86

2,339,000

2,223,000

4,562,000

48-72

13 1

1860

1,510,000

389,000

1,899,000

20-43

35

0

1886-87

2,345,000

2,733,000

5,078,000

53-82

11 9

1870

1,585,000

831,000

2,416,000

34-40

32

0

1887-88

2,465,000

2,451,000

4,916,000

49-85

12 9

1871-72

1,599,000

1,070,000

2,619,000

38-95

24

9

1888-89

2,263,000

2,725,000

4,988,000

54-63

14 10

1872-73

1,793,000

1,210,000

3,003,000

40-29

24

8

1889-90

2,069,000

3,633,000

5,702,000

63-71

15 1

1873-74

1,840,000

1,288,000

3,128,000

41-17

22

10

1890-91

2,555,000

3,710,000

6,265,000

59-21

14 0

1874-75

1,712,000

1,219,000

2,931,000

41-59

20

1

1891-92

2,852,000

3,501,000

6,353,000

55-10

13 6

1875-76

1,590,000

1,343,000

2,933,000

45-78

18

1

1892-93

3,045,000

3,428,000

6,473,000

52-95

14 3

1876-77

1,673,000

1,045,000

2,718,000

38-44

22

8

1893-94

3,490,000

3,890,000

7,380,000

52-71

13 5

1877-78

1,825,000

1,419,000

3,244,000

43-74

23

0

1894-95

3,530,000

4,792,000

8,322,000

57-75

9 11

1878-79

2,010,000

1,571,000

3,581,000

4Sf-89

19

2

1895-96

2,830,000

4,315,000

7,155,000

50-30

10 7

1879-80

1,852,000

1,402,000

3,244,000

43-21

19

3

1896-97

2,864,000

4,954,000

8,818,000

56-18

9 3

1880-81

1,911,000

1,748,000

3,659,000

46-13

20

4

1897-98

2,898,000

4,872,000

7,770,000

62-70

11 9

1881-82

2,060,000

1,782,000

3,842,000

46-38

20

4

1898-99

2,995,000

4,977,000

7,937,000

62-70

11 9

1882-83

2,107,000

2,147,000

4,254,000

50-47

20

2

1899-1900

2,904,000

5,510,000

8,414,000

65-48

11 6

1883-84

2,323,000

2,361,000

4,684,000

50-40

16

8

1900-1901

2,850,000

5,950,000

8,800,000

67-61

11 6

The quantities of cane sugar are based on the trade circulars of Messrs Willett & Gray of New York ; those of beet sugar on the trade circulars of Messrs. F. O. Licht of Magdeburg ; and the prices are obtained, from statements supplied by im- porters into the United States of the cost in foreign countries

of the sugars which they import. The table has been adapted from the Monthly Summary of Commerce and Finance of the United States, January 1902, prepared in the Bureau of Statis- tics, Treasury Department, Washington Government Printing Office, 1902.

Table III.

Quantities of raw and refined cane and beet sugar in tons avoirdupois, imported into the United Kingdom in 1870 and in 1875, and yearly from 1880 to 1901 inclusive, with the consumption per head of the population in pounds, and the price per cwt. of raw and refined sugar.

Raw Beet.

Refined Cane.

Refined Beet.

Total

Consumption per Head.

Price per Cwt.

Eaw.

Refined.

Raw.

Refined.

Tons.

Tons.

Tons.

Tons.

Tons.

Pounds.

Pounds.

Pounds.

b. d.

s. d.

1870

556,000

84,000

3,000

82,000

725,000

1875

705,000

107,000

16,000

128,000

956,000

50

64

8

88

59-52

21 2

30 4

1880

590,000

260,000

11,000

140,000

1,001,000

51

09

9

46

60-55

21 9

29 5

1881

623,000

310,000

5,000

135,000

1,071,000

56

01

8

44

64-45

21 9

28 11

1882

726,000

265,000

6,000

133,000

1,130,000

58

78

8

38

67-16

21 1

28 8

1883

597,000

420,000

7,000

157,000

1,183,000

58

73

\9

87

68-10

20 1

27 2

1884

582,000

399,000

53,000

160,000

1,194,000

55

57

12

58

68-15

15 6

28 11

1885

561,000

410,000

114,000

152,000

1.237,000

55

46

15

75

71-21

13 10

18 2

1886

468,000

339,000

71,000

247,000

1,125,000

44

61

, 18

75

63-36

13 0

16 8

1887

439,000

461,000

39,000

311,000

1,250,000

50

80

20

25

71-05

12 1

15 8

1888

574,000

319,000

2,000

342,000

1,237,000

47

97

19

99

67-96

13 5

17 8

1889

470,000

407,000

1,000

448,000

1,326,000

48

38

26

54

74-92

15 5

19 8

1890

283,000

503,000

15,000

484,000

1,285,000

42

87

28

22

71-09

12 6

16 4

1891

349,000

461;000

27,000

540,000

1,377,000

45

08

32

94

78-02

12 10

16 6

1892

386,000

429,000

2,000

529,000

1,346,000

44

58

30

63

75-21

13 0

17 1

1893

368,000

434,000

2,000

575,000

1,379,000

42

41

33

17

75-58

14 2

18 4

1894

324,000

391,000

1,000

696,000

1,412,000

37

18

39

90

77-08

11 5

15 6

1895

388,000

463,000

1,000

706,000

1,558,000

45

28

40

10

85-38

9 7

13 4

1896

381,000

406,000

1,000

738,000

1,526,000

40

94

41

53

82-47

10 5

13 7

1897

242,000

434,000

1,000

793,000

1,469,000

34

52

43

92

78-44

9 0

12 3

1898

.286,000

478,000

1,000

825,000

1,560,000

39

89

45

29

85-18

9 8

12 5

1899

186,000

469,000

1,000

889,000

1,545,000

35

63

48

68

84-31

10 6

12 7

1900

150,000

512,000

1,00Q

961,000

1,624,000

35

48

52

23

87-71

10 5

12 10

1901

178,472

526,451

1,000

,1,079,553

1,785,476

36-8

56-4

93-2

10 6

12 0

This table has been compiled from the Board of Trade Returns. The population of the United Kingdom in 1901 has been estimated at 41,605,220. In 1870 Mr Lowe, in Mr Gladstone's first ad- ministration, reduced the sugar duties to 6s. per cwt. on refined sugar and 4s. 2d. on raw sugar ; and he further reduced these rates in 1873 to 3s. and 2s. In 1874 all duties on sugar were repealed by Sir Stafford Northcote's budget, in Mr Disraeli's second administration. In 1901 Sir Michael Hicks Beach, in Lord

Salisbury’s third administration, to meet extraordinary war expenditure imposed a duty of 4s. 2d. on refined sugar polarizing 98° to 100°, and on lower qualities at lower rates, down to 2s. on sugar not exceeding 76° polarization ; and duties on molasses and sweetened goods on a scale adjusted to the percentage of the sweetening matter. [Regulations, Customs

Bill of Entry Bill, B, 6th August 1901.] In the six months ending 30th June 1902, 959,142 tons of sugar have been im- ported, viz.: — Raw cane, 132,351 tons; raw beet, 284,055 tons; refined cane, 500 tons ; refined beet, 542,236 tons. (Board of Trade Returns, July 1902.) In. the statements for 1901 and 1902 the quantities of raw cane sugar include molasses — 40 per cent, of the weight of the molasses as given in the returns being taken as raw sugar.

The following table gives the world’s production of sugar for the seven years ending 1901-1902. It must be borne in mind that the figures obtainable in many cases do not in fact include the sugar consumed in the country ;i.e., they represent the quantities brought to market in the country, but not the whole crop. In other cases they represent the whole crop.

[statistics

Table IV.

The eane and beet sugar crops of the world for 1901-1902, with the average of the crops for the seven preceding years from

1894-1895, in tons of 2240 lb. (A) Cane Sugar. (Compiled from the United States Monthly Summary of Commerce and Finance, January 1902.)

Country.

Africa — Egypt Mauritius Reunion Natal

Total in Africa .

America —

Argentina ....

Brazil ....

British Colonies — Trinidad Barbados Jamaica.

Antigua and St Kitts Demerara Lesser Antilles

Total in British Colonies

Costa Rica

Cuba. ....

Danish Colony, St Croix .

Dutch Colony, Surinam

French Colonies — Martinique Guadeloupe .

Total in French Colonies Ecuador .... Guatemala

Haiti and St Domingo Mexico .... Nicaragua ....

Peru

Salvador ....

Crop

1901-1902.

Tons.

95,000

145,000

35,000

26,000

301,000

115,000

215,000.

50,000 60,000 30,000 25,000 95,000 8,000

268,000

1,500

875,000

13,000

;,ooo

32,000 35,000

67,000

7,000

9,000 45,000

95,000

3,500

105,000

27,000

Average Crop for 7 years

ending

1900-1901.

Tons.

91,898

150,449

37,764

20,745

300,856

_110,394 206,028

52,153 47,992 29,143 23,386 94,826 8,000

255,500

565

443,309

11,151

6,000

32,519 40,342

72,861

6,000

7,000

46,400

32,715

82,927

22,000

Country.

America (continued) — United States — Louisiana

Hawaiian Islands . Porto Rico

Total in United States Venezuela ....

Total in America

Asia —

British India and Dependencies

China ....

Dutch Colony, Java .

Japan and Formosa .

Siam …..

United States Possession — Philippine Islands .

Total in Asia Australia and Polynesia — ■ British Colonies — Fiji Islands . New South “Wales . Queensland .

Total in Australia

Europe — Spain : Total in Europe

Summary —

Africa

America

Asia ....

Australia and Polynesia

Europe

Total Production of Canel Sugar in the World J

Crop

1901-1902.

290,000 300,000 100,000

690,000

3,000

2,653,000

3,250,000

1,000,000

765,000

93,000

7,000

70,000

5,185,000

33,000

19,000

117,000

169,000

33,000

301,000 2,631,000 5,185,000

169,000 33,000

8,341,000

Average Crop for 7 years

ending

1900-1901.

Tons.

257,142

227,839

54,761

539,742

715

1,795,743

3,500,000

1,000,000

612,905

87,768

7,000

129,683

5,337,306

30,715

27,072

106,498

164,285

21,030

300,856 1,776,743 5,337,306

164,285 21,030

7,618,820

(B) Beet Sugak.

Country.

1894-1895.

1895-1896.

1896-1897.

1897-1898.

1898-1899.

1899-1900.

190O-19O1.

1901-1902.

Average of

7 years

(1894-1901).

Tons.

Tons.

Tons.

Tons.

Tons.

Tons.

Tons.

Tons.

Tons.

Tons.

Austria-Hungary .

1,039,145

778,926

919,256

818,532

1,034,686

l,090,-509

1,076,764

1,299,154

822,545

Belgium

240,103

232,070

283,460

261,206

240,163

298,083

327,858

344,472

268,992

Denmark

48,155

47,887

52,422

38,661

43,215

54,757

49,676

56,861

47,826

France .

779,994

675,305

740,203

808,264

817,021

962,406

1,151,851

1,181,050

845,292

Germany Holland

1,815,452

1,589 602

1,807,529

1,823,592

1,694,525

1,770,223

1,952,846

2,263,670

1,779,110

83,260

101 142

171,455

123,674

147,398

168,328

175,268

196,841

139,218

Italy .

2,057

2,605

2,263

3,816

5,878

22,746

59,175

79,721

14,077

Russia .

605,337

700,849

717,158

727,057

763,809

891,431

904,325

1,082,630

758,566

United States

30,000

40,000

39,684

34,453

62,826

82,736

124,859

180,000

59,222

Other Countries

103,334

103,378

145,099

150,669

156,719

178,794

253,257

257,100

155,893 5,033,312

Total Crop of the World

4,746,837

4,257,764

4,878,529

4,789,924

4,966,240

5,520,013

6,075,879

6,941,499

Summary.

Crop, 1901-1902.

Average of 7 years

(1894-1901).

I Tons. Cane Sugar. . . . 8,341,000 Beet Sugar . . . | 6,941,499

Tons.

7,618,820 5,033,312

Total Cane and Beet Sugar |

Crop of the World . .• ■ 15,282,499

12,652,132

Table B is compiled from data furnished by Messrs F. O. Licht, 7 and 8 Westendstrasse, Magdeburg, through Mr C. Czarnikow of London. The data for the Italian crop and the Danish crop are taken from official returns.

SUICIDE

53

Table V.

Consumption per head of the population of nineteen principal countries for the year ending 21st August 1900, according to F. 0. Licht of Magdeburg, with prices of sugar :—

Consumption

Prices of Sugar per

Country.

per Head in Founds.

Raw.

Refined.

d.

d.

United Kingdom .

91 ‘6

2‘0

2125

United States

65-2

2-03

2-5

Switzerland .

60-3

2‘0

2-176

Denmark

54-8

1-57

2-42

Sweden and Norway

38-2

3-35

4‘2

France

37-0

3-90

4-57

Germany

33-9

3‘0

3-4

Netherlands

32-5 ‘

4-53

5”0

Belgium

23-3

3-7

4-35

Austria- Hungary .

17-6

3-5

3”85

Portugal

14-6

4-14

5-27

Russia .

14 ‘0

3-4

4-27

Spain .

10-6

4-0

4-64

Turkey

8-0

27

3-0

Rumania

7-8 ■[

none consumed

} 5‘5

Greece .

7-2 i

none consumed

| 3‘7

Bulgaria

6-7 {

none consumed

} 3-4

Italy . . .

6-0

63

> 6-85

Servia .

5-3 {

none consumed

} 3-5

Beet sugar costs about £9, 6s. 8d. per ton — one .penny per pound — to produce, and cane sugar a little less, and nearly all countries can produce one or the other. Yet for years past over 100 millions of people in Europe have been deprived of a sufficiency of most wholesome and desirable food, which would have been within their reach had not its production and consumption been hampered by vicious fiscal legislation. If the Brussels Convention end this state of things, much will be done for the comfort and comity of nations throughout the world. (v. w. Ch.)

Suicide. — It is within comparatively recent years that the study of suicide- by means of the vital statistics of various countries has demonstrated that while the act may be regarded as a purely voluntary one, yet that suicide as a whole is a phenomenon in the sociological history of every community which conforms to certain general laws, and which is influenced by conditions other than mere individual circumstances or surroundings. Thus it can be shown that each country has a different suicide-rate, and that while the rate for each country may fluctuate from year to year, yet it maintains practi- cally the same relative proportions to the rates of other countries. The following table shows the suicide-rate for various countries (Bertillon) : —

Table 1

Annual Number

Country.

Period of ■

of Suicides

Observation.

per Million

Inhabitants.

Saxony

1878-82

392

Denmark

1880-82

251

Switzerland .

1878-82

239

Baden .

198

Wiirtemberg

1877-81

189

France .

1878-82

180

Prussia .

166

Belgium

100

Sweden

92

England and Wales

75

Norway

69

Scotland

1877-81

49

Ireland

1878-82

XI

In addition to furnishing materials for an approximately accurate estimate of the number of suicides which will occur in any country in a year, statistics have demonstrated that the proportion of male to female suicides is prac- tically the same from year to year, viz., 3 or 4 males to 1

female ; that it is possible to predict the month of greatest prevalence, the modes of death adopted by men on the one hand and women on the other, and even the relative frequency of suicide amongst persons following different professions and employments ; and that in most of the countries of

Europe the suicide-rate is increasing. In England and Wales the annual death-rate per million from suicide has steadily advanced, as is shown by the following figures for six quinquennia : —

65 per million living.

1861-65

. 65

1866-70

. 66

1871-75

. 66

1876-80

. 74

1881-85

. 75

1886-90

. 79

The next table illustrates the continued increase in recent years, and at the same time shows the total number and the number of male and female suicides each year from 1888 to 1897 :—

Table II. — Total Suicides — Male and Female — in England and Wales, 1888-97, together with the annual rate per million living (Registrar-General’s Reports).

Suicide-rate

Year.

Male.

female.

Total.

per Million Living.

1888

1,732

576

2,308

81

1889

1,626

544

2,170

77

1890

1,635

570

.2,205

79

1891

1,863

620

2,483

85

1892

1,907

676

2,583

87

1893

1,940

659

2,599

87

1894

2,052

677

2,729

91

1895

2,071

726

2,797

92

1896

1,979

677

2,656

86

1897

2,090

702

2,792

90

Total

18,895

6427

25,322

...

The reason of the high suicide-rate in some countries as compared with others, and the causes of its progressive increase, are not easily determined. Various explanations have been offered, such as the influence of climate, the comparative prevalence of insanity, and the proportionate consumption of alcoholic drinks, but none satisfactorily accounts for the facts. It may, however, be remarked that suicide is much more common amongst Protestant than amongst Roman Catholic communities, while Jews have a smaller suicide-rate than Eoman Catholics. A point of considerable interest is the increase of suicide in relation to the advance of elementary education. Ogle states that suicide is more common among the educated than the illiterate classes. It is also more prevalent in urban than in rural districts. A curious feature in large towns is the sudden outbreak of self-destruction which sometimes occurs, and which has led to its being described as epidemic. In such cases force of example and imita- tion undoubtedly play a considerable part, as it is well recognized that both these forces exert an influence not only in causing suicide, but also in suggesting the method, time, and place for the act. No age above five years is exempted from furnishing its quota of suicidal deaths, although self-destruction between five and ten years is very rare. Above this age the proportion of suicides in- creases at each period, the maximum being reached between fifty-five and sixty-five. Among females there is a greater relative prevalence at earlier age periods than among males. The modes of suicide are found to vary very slightly in different countries. Hanging is most common amongst males ; then drowning, injuries from fire- arms, stabs and cuts, poison, and precipitation from heights. Amongst females, drowning comes first, while poison and hanging are more frequent than other methods entailing effusion of blood and disfigurement of the person. The

methods %ised in England and Wales by suicides during 1888-97, and in Scotland during the, years 1881-97, are given in the following table : —

> Table III. Modes of Suicide in England and Wales, 1888-97.

Order of Frequency.

Males.

Females.

Both Sexes.

Mode.

Num- ber.

Mode.

Num- ber.

Mode.

Num- ber.

1 2 3 4 5 6

Hanging

Stab-cut

Drowning

Poison

Firearms

Otherwise

5,669 3,594 3,443 2,264 2,152 1,773

Drowning

Poison

Hanging

Stab-out

Firearms

Otherwise

2089 1652 1336

771 52

527

Hanging

Drowning

Stab-out

Poison

Firearms •

Otherwise

7,005 5,532 4,365 3,916 2,204 2,300

Total

18,895

Total

6427

Total

25,322

Modes of Suicide in Scotland, 1881-97.

Order of Frequency.

Males.

Females.

Both Sexes.

Mode.

Num- ber.

Mode.

Num- ber.

Mode.

Num- ber.

1 2 3 4 5 6

Hanging

Drowning

Stab-cut

Poison

Firearms

Otherwise

741 630 556 257 245 207

Drowning

Hanging

Poison

Stab-cut

Firearms

Otherwise

• 430

257 145 144 6 100

Drowning

Hanging

Stab-cut

Poison

Firearms

Otherwise

1060 998 700 402 251 307

Total

2636

Total

1082

Total

3718

The season of the year influences suicide practically uniformly in all European countries, the number increas- ing from the commencement of the

year to a maximum in May or June, and then declining again to a minimum in ~~winter. Morselli attempts to account for this greater prevalence during what may well be called the most beautiful months ,of the year, by attributing it to the influence of increased temperature upon the organism, while Durkheim suggests that the determining factor is more probably to be found in the length of the day and the effect of a longer period of daily activity. The suicide~~ rate is higher in certain male occupations and professions than in others (Ogle). Thus it is high amongst soldiers, doctors, innkeepers, and chemists, and low for clergy, bargemen, railway drivers and stokers. The suicide-rate is twice as great for unoccupied males as for occupied males.

Authorities. — Morselli. IlSuicidio. Milan, 1879. — Legott. Le Suicide ancien et modern. Paris, 1881. — Westcott. Suicide, its History, Literature, die. London, 1885. — Ogle. ” Suicides in Eng- land and Wales, in relation to Age, Sex, Season, and Occupation, ” Journal of the Statistical Society, vol. xlix. 1886. — Strahan. Suicide and Insanity. London, 1893. — Mayr. “Selbstmord statistik,” in Handwbrterbuch der Staatswissenschaften. Jena, 1895. — Durkheim. Le Suicide. Paris, 1897. (h. h. L.)

Suidun (Chinese, Sui-din-chen), a town of China, and capital of the Kulja province. It is the ■ residence of the governor-general, and was founded in 1762 during the Mussulman uprising, and rebuilt in 1883. It is a military town, witli little trade, which has military pro- vision stores, an arsenal, and an arms workshop. Its walls are armed with steel guns.

Sukhum-Kale, a seaport and district town in the province of< Kutais, Caucasia, Eussia. It is the best roadstead on the eastern coast of the Black Sea, being fairly well sheltered and never freezing, and in spite of the difficulties of communication with the interior and the malarial marshes which surround the town, it has lately become an important port for the export of grain (chiefly Indian corn), and has begun rapidly to develop. In 1897 its population was 7809. It was formerly the seat of ancient Dioskuria and of a Turkish fortress.

Sukkur, or Sakhab, a town of British India, in the Shikarpur district of Sind, Bombay, on the right bank of the Indus, 24 miles north-west of Shikarpur town. Population, (1881), 27,389; (1891), 28,935; (1901), 31,316. Sukkur

owes its importance to its position on a limestone ridge running down to the Indus, opposite the island of Bukkur. It has always commanded the trade of Sind, and the river is now crossed by a cantilever bridge carrying the North-Western Eailway to Kotri. There is an industrial school.

SuSeimanieh, the chief town of a sanjak of the same name in the Mosul vilayet of Asiatic Turkey, and a military station, altitude 2550 feet, situated in a bare, treeless plain near the Persian frontier. It commands several routes to Persia, and is sometimes called the capital of southern Kurdistan. Population, Kurds 10,000, Christians 150, Jews 850.

Sulina, a town in Bumania, situated at the mouth of the Sulina branch of the Danube. It is the only free port on the Danube, and is much used for the tranship- ment into sea-going vessels of grain which is brought down the river in large lighters. No grain or other kind of agricultural produce is grown in its neighbourhood, owing to the dense reed-covered swamps with which it is surrounded. It is the headquarters of the technical department of the European Commission of the Danube. Large steamers navigate up to Galatz and Braila. In 1901, 1411 steamers and sailing craft aggregating 1,830,000 tons register cleared from Sulina for European ports carry- ing, besides other merchandise, nearly thirteen million quarters of grain. Owing to the improvements effected by the European Commission, there is now a depth of 24 feet of water on the bar. The town is dirty and insanitary. It contains a pretty little English church, the only one existing in Rumania. Population (1895),

5000; (1900), 5611.

Sullivan, Sir Arthur Seymour (1842-

1900), English musical composer, was born in London 13th May 1842, being the younger of the two sons of Thomas Sullivan, a cultivated Irish musician who was bandmaster at the Royal Military College, Sandhurst, from 1845 to 1856, and taught at the Military School of Music at Kneller Hall from 1857 till his death in 1866. His mother, nee Mary Coghlan (1811-1882), had Italian blood in her veins. Arthur Sullivan was brought up to music from boyhood, and he had learnt to play every wind instrument in his father’s band by the age of eight. He was sent to school at Bayswater till he

was twelve, and then, through Sir George Smart, he was, at his own persistent request, made a Chapel Royal chorister, and entered Mr Helmore's school for Chapel Royal boys in Cheyne Walk. He had a fine treble voice, and sang with exceptional taste. In 1856 the Mendelssohn Scholar- ship at the Royal Academy of Music was thrown open for the first time for competition, and was won by Sullivan, his nearest rival being Joseph Barnby. At the Academy he studied under Sterndale Bennett, Arthur O'Leary, and John Goss, and did so well that he was given an exten- sion of his scholarship for two years in succession. In] 858, his voice having broken, he was enabled by means of his scholarship to go to study at the Conservatorium of Leipzig. There he had for teachers Moscheles and Plaidy for^ pianoforte, Hauptmann for counterpoint, Rietz and Reinecke for composition, and F. David for orchestral playing and conducting. Among his fellow-students were Grieg, Carl Rosa, Walter Bache, J. F. Barnett, and Edward Dannreuther. Instead of the Mendelssohn cultus which represented orthodoxy in London, German musical

interest at this period centred in Schumann, Schubert, and the growing reputation of Wagner, while Liszt and Von Biilow were the celebrities of the day. Sullivan thus became acquainted for the first time with masterpieces which were then practically ignored in England. He entered enthusiastically into the spirit of the place, and after two years' hard study returned to London in April 1861. Before doing so, however, he had composed his incidental music for The Tempest, which he had begun as a sort of diploma work. Sullivan set himself to find converts in London to the enthusiasms he had imbibed at Leipzig. He became ac- quainted with George Grove, then secretary of the Crystal Palace, and August Manns, the conductor there ; and at his instigation Schumann's First Symphony was intro- duced at one of the winter concerts. Early in 1862 Sullivan showed Grove and Manns his Tempest music, and on 5th April it was per- formed at the Crystal Palace. The production was an un- mixed triumph, and Sullivan's exceptional gifts as a com- poser were generally recog- nized from that moment. He had hitherto been occupy- ing himself with teaching, and he continued for some

years to act as organist at St Michael's, Chester Square, but henceforth he devoted most of his time to composi- tion. By 1864 he had pro- duced his " Kenil worth " cantata (remembered chiefly for the lovely duet, " How sweet the Moonlight"), the " Sapphire Necklace " over- ture, and the five beautiful songs from Shakespeare, which include " Orpheus with his lute," " Oh Mistress Mine," and " The Willow Song." His attractive personality, combined with his undoubted genius and brilliant promise, brought him many friends. Costa, who was conductor at Covent Garden, gave him the post of organist, and in 1864 he produced there his Vile Enchantie ballet. Some of his spare time was spent in Ireland, where in 1863 he began the composition of his ("Irish") Symphony in E, which was produced at the Crystal Palace in 1866. The most important event, how- ever, at this period, as bearing upon his later successes, was his co-operation with F. C. Burnand in the musical extravaganza Cox and Box, which first showed his capa- city for musical drollery. This -was acted privately in 1866, and was completed for public performance in 1867, in which year Sullivan again co-operated with Burnand in Contrabandists. Meanwhile he was in request as a conductor, and was made professor of composition at the Academy. His father's sudden death in 1866 inspired him to write the fine "In Memoriam" overture, which was produced at the Norwich Festival. In 1867, besides producing his "Marmion" overture, he and Grove did a great service to their art by bringing^ to light at Vienna a number of lost Schubert MSS., including the Eosamunde music. About this time Sullivan induced

Snt Akthur Sdllivan.

(From a photograph by Walker & Cpckerell of the painting by Sir John Millais in the National Portrait Gallery.)

Tennyson to write his song-cycle " The Window," to be illustrated by Millais, with music by himself. But Millais abandoned the task, and Tennyson was not happy about his share ; and the series, published in 1871, never became popular, in spite of Sullivan's dainty setting. In 1869 he brought out his oratorio "The Prodigal Son " at Worcester, and in 1870 his overture "Di Ballo" at Birmingham.

In 1871 Sullivan had become acquainted with W. S. Gilbert (q.v.), and in 1872 they collaborated in a piece

for the Gaiety Theatre, called Thespis; or, The Gods Grown Old, which was a great success in spite of the limited vocal resources of the performers. In 1875 Mr D'Oyly Carte, then acting as manager for Selina Dolaro at the Royalty, approached Gilbert with a view to his collaborating with Sullivan in a piece for that theatre. Gilbert had already suggested to Sullivan an operetta with its scene in a law court, and within three weeks of his completing the libretto of Trial by Jury the music was written. The pie,ce succeeded beyond all expectation ; and on the strength of its promise of further successes Mr D'Oyly Carte formed his Comedy Opera Company and took the Opera Comique Theatre. There in 1877 The Sorcerer was produced, Mr George Grossmith and Mr Eutland Barrington being in the bast. In 1878 H.M.S. Pinafore was brought out at the Opera Comique. At first it did not attract large audiences, but eventuallyit becamea popular success, and ran for 700 nights. In America it was enthusiasti- cally received, and the two authors, with Mr D'Oyly Carte, went over to the States in 1879, with a company of their own, in order to produce it in New York. To secure the American rights for their next opera, they brought out The Pirates of Penzance first at New York in 1879. In 1880, in London, it ran for nearly 400 nights. In 1881 Patience was produced at the Opera Comique, and was transferred later in the year to the Savey Theatre. There all the later operas came out : Iolanthe (1882), Princess Ida (1884), The Mikado — perhaps the most charming of all — (1885), Ruddigore (1887), The Yeomen of the Guard (1888), The Gondoliers (1889). This succession of pieces by Gilbert and Sullivan had made their united names stand for a new type of light opera. Its vogue owed something to such admir- able performers as Mr George Grossmith — famous for his " patter songs " — Mr Rutland Barrington, Miss Jessie Bond, Miss Brandram, and later Mr W. H. Denny and Mr Walter Passmore ; but these artistes only took ad- vantage of the opportunities provided by the two authors. In place of the old adaptations of French opera bouffe they had substituted a genuinely English product, humorous and delightful, without a tinge of vulgarity or the commonplace. But disagreements now arose

between them which caused a dissolution of partnership. Sullivan's next Savoy opera, Haddon Hall (1892), had a libretto by Mr Sydney Grundy; and the resumption of Mr Gilbert's collaboration in 1893 in Utopia, Limited, and again in 1896 in The Grand Duke, was not as successful as before. Sullivan's music, however, still showed its characteristic qualities in TJie Chieftain (1894) — largely, an adaptation of Contrabandista ; TJie Beauty Stone (1898), with a libretto by Mr Pinero and Mr Comyns Carr ; and particularly in The Hose of Persia (1900), with Captain Basil Hood.

In the public' mind Sir Arthur Sullivan (who was knighted in 1883) had during these years become princi- pally associated with the enormous success of the Savoy operas ; but these by no means exhausted his musical energies. In 1872 his " Te Deum " for the recovery of the Prince of Wales was performed at the Crystal Palace. In 1873 he produced at the Birmingham Musical Festival his oratorio " The Light of the World," in 1877 he wrote his incidental music to Henry VIIL, in 1880 his sacred cantata "The Martyr of Antioch," and in 1886 his master- piece, "The Golden Legend," was brought out at the Leeds Festival. "The Golden Legend" satisfied the most exacting critics that for • originality of conception and grandeur of execution English music possessed in Sullivan a composer of the highest calibre. In 1891, for the opening of Mr D'Oyly Carte's new English opera-house in Shaftesbury Avenue he wrote his "grand opera" Ivanhoe to a libretto by Julian Sturgis. The attempt to put an English opera on the stage for a long run was doomed to failure, but Ivanhoe was full of fine things. In 1892 he. composed incidental music to Tennyson's Foresters. In 1897 he wrote a ballet for the Alhambra, called Victoria and Merrie England. Among his numerous songs, a conspicuous merit of which is their admirable vocal quality, the best known are " If Doughty Deeds" (1866), "The Sailor's Grave" (1872), "Thou'rt Passing Hence" (1875), "I would I were a King" (1878), "King Henry's Song" (1878), and "The Lost Chord" (1877). This last, hackneyed as it became, was probably the most successful English song of the 19th century. It was written in 1877, during the fatal illness of Sullivan's brother Frederic, who, originally an architect, had become an actor, and by means of his fine voice and powers as a comedian (best shown as the Judge in Trial by Jury) had won considerable success. Among Sullivan's many hymn tunes, the stirring " Onward, Christian Soldiers ! " (1872) is a permanent addition to Church

music. In 1876 he accepted the principalship of the National Training School of Music, which he held for six years ; this was the germ of the subsequent Boyal College. He re- ceived the honorary degree of Mus. Doc. from both Oxford (1879) and Cambridge (1876). In 1878 he was a member of the Eoyal Commission for the Paris Exhibition. He was conductor of the Leeds Festivals from 1879 to 1898, besides being conductor of the Phil- harmonic Society in 1885. Apart from his broad sym- pathy and his practical knowledge of instruments, his work as a conductor must always be associated with his efforts to raise the standard of orchestral playing in England and his unwearying exertions on behalf of British music and British musicians. Sullivan liked to be associated in the public mind with patriotic objects, and his setting of Mr Kipling's " Absent-minded Beggar" song, at the opening of the Boer war in 1899, was, with the exception of The Rose of Persia, the last of his compositions brought out in his lifetime. He died some- what suddenly of heart failure on 22nd November 1900, and his burial in St Paul's Cathedral was the occasion of a remarkable demonstration of public sorrow. He left

unpublished a "Te Deum" written for performance at the end of the Boer war, and an unfinished Savoy opera for a libretto by Captain Hood, which, completed by Mr E. German, was produced in 1901 as Tlie Emerald Isle.

Sullivan was the one really popular English com- poser of any artistic standing in his time; and his celebrity as a public man still somewhat interferes with a definite judgment as to his place in the his- tory of English music. One of the most agreeable companions, broad-minded, and free from all affecta- tion, he was intensely admired and loved in all circles of society; and though his health was not robust, for he suffered during many years at intervals from a painful ailment, he was a man of the world who enjoyed the life which his success opened out to him without being spoilt by it. He was always a devoted and an industrious musician, and from the day he left Leipzig his influence was powerfully exerted in favour of a wider and fuller recognition of musical culture. He was accused in some quarters of being unsympathetic towards Wagner and the post-Wagnerians, yet he had been one of the first to introduce Wagner's music to English audiences. He was keenly appreciative of new talent, but his tastes were too eclectic to satisfy the enthusiasts for any particular school ; he certainly had no liking for what

he considered uninspired academic writing. Serious critics deplored, with more justification, that he should have devoted so much of his great natural gift not merely to light comic opera, but to the production of a number of songs which, though always musicianly, were really of the nature of ” pot-boiling.” Sullivan was an extremely rapid worker, and his fertility in melody made it easy for him to produce what would please a large public. Moreover, it must be admitted that his great social success, so early achieved, was not calculated to nourish a rigidly artistic ideal. But when all is said, his genius remains undisputed. His Church music alone would entitle him to a high place among composers ; and ” The Golden Legend,” Ivanhoe, the ” In Memoriam ” overture, the ” Irish ” symphony, and the charming ” inci- dental music” to The Tempest and to Henry VIIL form a splendid legacy of creative effort, characterized by the highest scholarly qualities in addition to those beauties which appeal to every ear. Whether his memory will be chiefly associated with these works, or rather with the world-wide popularity of some of his songs and comic operas, time alone can tell. The Savoy operas did not aim at intellectual or emotional grandeur, but at provid- ing innocent and wholesome pleasure; and in giving musical form to Gilbert’s witty librettos Sullivan showed once for all what light opera may be when treated by the hand of a master. His scores are as humorous and fanciful qud music as Gilbert’s verses are qud dramatic literature. Bubbling melody, consummate orchestration, lovely songs and concerted pieces (notably the famous vocal quintets) flowed from his pen in unexhausted and inimitable profusion. If he had written nothing else, his unique success in this field would have been a solid title to fame. As it was,’ it is Sir Arthur Sullivan’s special distinction not only to have been prolific in music which went straight to the hearts of the people, but to have en- riched the English repertoire with acknowledged master- pieces, which are no less remarkable for their technical accomplishment.

The only regular biography is Sir Arthur Sullivan : Life-story, Letters, and Reminiscences. By Akthur Lawrence. London: Bowden, 1899. Besides being largely autobiographical, this volume contains a complete list of Sullivan’s works, compiled by Mr Wilfrid Bendall, who’ for many years acted as Sir Arthur’s private seoretary. (H. CH \

Sully, James (1842), English psychologist,

■was bom 3rd March 1842, at Bridgewater, and was educated at the Independent College, Taunton, the Eegent's Park College, and Gottingen. He was origin- ally destined for the Nonconformist ministry, but in 1871 adopted a literary and philosophic career. In 1892 he was appointed professor of the philosophy of mind at University College, London. His published books are entitled Sensation and Intuition (1874), Pessimism (1877), Illusions (1883), Outlines of Psychology (1884), Teacher's Handbook of Psychology (1886), The Human Mind (1892), Studies of Childhood (1895), and Children's Ways (1897). Professor Sully is an adherent of the associationist school of psychology, and his views have great affinity with those of professor Bain. Without making very striking advances, his monographs, as that on pessimism, have been always ably and brightly written, and his textbooks, of which The Human Mind is the most important, are models of sound exposition.

Sully – Prudhomme, Rene Francois Ar-

mand Prudhomme (1839), French poet, was

born in Paris on the 16th of March 1839. He was edu- cated at the Lycee Bonaparte, where after a time he de- voted himself entirely to the study of science, and took his degree as Bachelier es Sciences. An attack of ophthal- mia then interrupted his studies and necessitated an entire change in the course of his career. The scientific « habit of mind, however, which he had derived from these years of technical study never left him ; and it is in the combination of this scientific bent, with a soul aspiring .towards what lies above and beyond science, and a conscience perpetually in agitation, that the striking originality of Sully-Prudhomme's 'character is to be found. He found employment for a time in the Schneider factory at Creuzot, but he soon abandoned an occupation to which he was eminently unsuited. He subsequently decided to read law, and entered a notary's office at Paris. It was during this period that he com- posed those early poems which were not long in acquiring celebrity among an ever-widening circle of friends. In 1865 he published his first volume of poems, which had for sub-title

Stances et Poemes. This volume attracted considerable attention in the literary world, and was favourably noticed by Sainte-Beuve. It was at this moment that the small circle of which Leconte de Lisle was the centre were preparing the Parnasse, to which Sully-Prudhomme contributed several pieces. In 1866 Lemerre published a new edition of the Stances et Po&mes and a collection of sonnets entitled Les Epreuves (1866). From this time forward Sully-Prudhomme devoted his life entirely to poetry. It was in the volume of Les Epreuves that the note of melancholy which was to dominate through the whole work of his life was first clearly discernible. In 1869 he published a translation of the first book of Lucretius with a preface, and Les Solitudes. In 1870 a series of domestic bereavements and a serious paralytic illness resulting from the strain and fatigue of the winter of 1870, during which he served in the Garde Mobile, shattered his health in a way which made an entire recovery impossible. In 1872 he published Les Ecuries d'Augias, Croquis Italiens, Impressions de la Guerre (1866-72) and Les Destins, La Bivolte des Heurs in 1874, in 1875 Les Vaines Tendresses, in 1878 La Justice, in 1886 Le Prisme, and in 1888 Le Bonheur. All these poems were collected and republished under the title of Poesies, 1879-86. He also published two volumes of prose criticism, U Expression dans les Beaux Arts (1884) and Reflexions sur I'Art des Vers (1692). Various monographs by him appeared from time to time in the philosophical reviews, and among them a

remarkable series of essays x on Pascal. After 1870 there are no remarkable incidents to chronicle in the life of Sully-Prudhomme save his election to the Academy, 8th December 1881, and the award to him by the Swedish Academy on 10th December 1901 of the Nobel prize of 200,000 francs for literature. During later years he lived at Aulnay in great isolation, a victim of per- petual ill-health, mainly occupied with a great work on Pascal.

What strikes the reader of Sully-Prudhomme's poetry first and foremost is the fact that he is a thinker ; and moreover a poet who thinks, and not a thinker who turns to rhyme for recreation. The most strikingly original portion of his work is to be found in his philosophic and scientific poetry. If he has not the scientific genius of Pascal, he has at least the scientific habit of mind and a delight in mathematic certainties. In attempting to interpret the universe as science reveals it to us he has created a new form of poetry

which is not lacking in a certain grandeur. One of his most beautiful poems, ” L’Ideal ” (Stances et Poemes), is inspired by the thought, which is due to scientific calculations, of stars so remote from our planet that their light has been on its way to us since thousands of centuries and will one day be visible to the eyes of a future generation. The second chief characteristic of Sully-Prudhomme’s poetry is the ex- treme sensibility of soul, the profoundly melancholy note which we find in his love lyrics and his meditations. Sully-Prudhomme is above all things introspective: he penetrates into the hidden corners of his heart ; he lays bare the subtle torments of his conscience, the shifting currents of his hopes and fears, belief and disbelief in face of the riddle of the universe to an extent so poig- nant as to be sometimes almost painful. And to render the fugitive phases and tremulous adventures of his spirit he finds incomparably delicate shades of expres- sion, an exquisite and sensitive diction. We are struck in reading his poems by the nobility of his ideas, by a religious elevation like that of Pascal ; for there is in his work something both of Lucretius and of Pascal. Yet he is far from being either an Epicurean or a Jansenist ; he is rather a Stoic to whom the deceptions of life have brought pity instead of bitterness.

As an artist Sully-Prudhomme is remarkable for the entire absence of oratorical effort ; for the extreme sim- plicity and fastidious precision of his diction. Other poets have been endowed with a more glowing imagina- tion ; his poetry is neither exuberant in colour nor rich in sonorous harmonies of rhyme. The grace of his verse is a grace of outline and not of colour, his melody one of subtle rhythm ; his verse is as if carved in ivory, his music like that of a perfect unison of stringed instru- ments. His imagination is inseparable from his ideas, and this is the reason of the extraordinary perspicuity of his poetic style. He extends poetry to two extreme limits ; on the. one hand to the borderland of the unreal and the dreamlike, as in a poem such as ” Le Rendezvous ” (Vaines Tendresses), in which he seems to express the in- expressible in precise language ; on the other hand, in his scientific poems he encroaches on the province of prose. His poetry is plastic in the creation of forms which fit- tingly express his fugitive emotions and his elevated ideas. Both by the charm of his pure and perfect phrase, by his consummate art, and the dignity which informs all his work,

Sully-Prudhomme deserves rank among the foremost of contemporary poets.

Sultanpur, a town and district of British India, in the Fyzabad district of Oudh. The town is on the right bank of the river Gumti, half-way between Benares

1 Revue des Deux Mondes, 15th October to 15th November 1890.

and Lucknow. Population (1881), 9374 ; (1891), 8751 ; municipal income (1897-98) Es.14,494, less than half from octroi; incidence of taxation, 13 annas per head. It is no longer a military cantonment. There is a printing-press and a literary institute.

The district of Sultanpur has an area of 1710 square miles; population (1881), 957,912; (1891), 1,075,851, showing an increase of 12 per cent., compared with a decrease of 8 per cent, in the previous twelve years ; average density, 629 persons per square mile. In 1901 the population was 1,084,115, showing an increase of less than 1 per cent. Land revenue and rates, Es.13,59,371, the incidence of taxation Being B.l.3.2 per acre; cultivated area (1896-97), 596,042 acres, of which 273,848 were irrigated from wells, tanks, &c. ; number of police, 2383 ; vernacular schools 120, with 5809 pupils ; registered death-rate (1897) 40-75 per 1000. The principal crops are rice, y)ulse, wheat, barley, sugar-cane, and a little opium. The main line of the Oudh and Eohilkhand railway just touches the eastern corner of the district.

Sumatra, the westernmost and, next to Borneo, the largest of the Great Sunda islands comprised in the East Indian Archipelago, stretching N.W. to S.E. from Malacca Passage to Sunda Strait, between 5° 40′ 1ST. and 5° 59′ S. and 95° 16′ and 106° 3′ 45″ E., with an area, including the neighbouring islands, all but Banka and Billiton, of 178,338 square miles.

Geology. — Dutch mining engineers and the Austrian geologists Professors Suess and Neumayr all concur in the opinion that the mountain-chain of Arakan, dipping under sea-level and following, as a submarine chain, the direction of the Cocos, Andaman, and Nicobar islands, re-emerges in Sumatra, while the parallel chain of Burma, making its submarine passage in the direction of the Mergui Archipelago and Malacca, rises above the water again in the Eiouw group, Banka, and Billiton. The same sandstone, slate, older and younger Tertiary forma- tions, volcanoes, beds of petroleum, and the same direction in the folds, characterize both chains alike, which in Sumatra become united. Dr Verbeek has elucidated the folding undergone by the strata of Sumatra in several geological periods. This folding induced oscillations, and hence cleavages and ruptures, through which burst the eruptive rocks, whose differences of altitude register differ- ences of level at different parts of th6 island in the various geological periods. In the lines of those cleavages, longi- tudinal and transverse, as in Java, lie the volcanoes of Sumatra, as also lakes like Toba, and Singkara, which had their origin in the breaking down of the edges of craters, mostly in the direction of the longitudinal line. In the same direction lie also the succession of valleys, overspread with fertile pumice-stone, on which the popula- tion is most concentrated. Everywhere in Sumatra slate, •sandstone, and limestone are found, constituting, with the older eruptive rocks, the Palaeozoic chains and ranges which run through the island in a N.W. to S.E. direction. Eocks of the Mesozoic period very rarely crop out on the surface, and refer to a period during which Sumatra was elevated above the sea ; Dr Volz has discovered indications of them near Toba Lake. The higher plateaux and valleys are formed of Tertiary rocks and diluvial tuffs ; the lower plains, of the alluvium of sea and rivers. As in Java, the younger volcanoes have largely covered the old rocks with their scoriae, dammed the lakes, diverted the course of rivers, and closed in valleys. According to the W. to E. profiles from the hand of Dr Verbeek, the coast and lower plains of alluvium, here and there of higher diluvium, are succeeded by chains of Palaeozoic rocks, known as the Barisan or ” Chain,” often forming the watershed, which consists of granite and the primary rocks already referred to.

Next in order come the tuff plateaux or valleys, deeply eroded by rivers flowing in and out of the crater-formed lakes. Occasionally there are two or

three valleys spreading out parallel to one another, hemmed in on both sides by the older chains, varying in height, but declining towards the east from 4000 to 3000 and to 2500 feet, and closed in on the N. and S. by the colossal mass of the higher volcanoes.

Orography. — In order to an appreciation of the orography of the island, the following sections of Sumatra should he well dis- criminated from one another : — 1st. The valley of the Atjeh or Achin or Acheen river. 2nd. The plains around the lake of Toba of varied level and physical character. Those on the S. and N. are higher, 4000 feet high, having the character of steppes, with scantier forest-cover, and, save in the narrow valleys and river-courses, properly available for cattle-rearing. The plains on the E. and W. are of a lower level, eroded by larger rivers, clothed with forest, showing more sawahs and ladangs, or dry rice-fields, and, near the rivers, planted with jagong (maize), coffee, and fruits. Unless on the S.E., where the Asahan flows away to the east coast, Toba Lake is surrounded by steep shores. According to Verbeek, van Dyk, Hagen, and Volz, the lake had its origin in the collapse of a volcano. 3rd. The valley of the Batang Toru, with the plateau of Sipirok in the E. and the mountain-chain of Tapanuli in the “W. On the S. and S.E. the valley is bounded by two volcanoes, Lubuk Raja and Si Buwal Buwali, whence were derived the volcanic tuffs of the valley and of the plateau of Sipirok, with their lakes drained by the Batang Toru and its affluents. The valley is in the N. nearly 3000 feet high, in the S. 1150 feet, and varies in breadth from 5^ miles to half a mile and less. Flowing in a deep bed cut in the tuff strata, the river is not navigable. 4th. The longitudinal valley of Batang Gadis, with its affluent the Angkola, and in the S. the valley of the Sumpur, the upper coast of the Rocan, between the Lubuk Raja in the N. and the Merapi Mount in the S. This valley is 64 miles long, with a mean breadth of 4 to 5 miles. All the rivers of this valley, flowing in deep beds of eroded diluvial tuffs, with a fall as much sometimes as 330 to 660 feet a mile (or a little more), are unnavigable. The valley is bounded on the W. and the E. sides by chains of slate and Palaeozoic rocks. The bottom is in many parts the diluvium of lakes drained by the rivers. 5th. The section of middle Sumatra between a line on the N. side of the three volcanoes, viz., Singalang-Tandikat, Merapi, and Sago, and the line on the S. formed by the three mountains Patah Sembilan, Peak of Korintyi, and Tujuh. This section is divided by the Middengebergte or middle chain into a

northern half watered by the Ombilin or Upper Indragiri with its affluents, and a southern half traversed by the Batang Hari or Upper Jambi. To the N. of the volcanoes, which rise to 9500 feet or more, this section is occupied by a high plateau of volcanic formation, whose elevation declines in a direction from W. to E. from 2950 to 1640 feet, with the lake of Maninyu (about 40 square miles in area) filling the hollow of an old volcano, and with rivers which have eroded their beds in the tuffs to a depth of 300 feet and more. South of the volcanoes the northern affluents of the Ombilin — Sumpur, Sello, and Sinamar — flow through valleys parallel to one another in a N.W. to S.E. direction. Here, too, are found fertile tuffs, and the valleys are densely populated. The rivers, however, are, like those already characterized, and for the same reason, not available as waterways. Singkara Lake (44 square miles) is of origin similar to that of Maninyu. The Ombilin, issuing out of the lake on the east side and flowing through a plateau of Eocene sandstone, has on its banks the coalfields of Sungei Durian, &c, but is not serviceable as a waterway for that part of Sumatra. The coal has to be transported by railway over Solok to Padang (Emmahaven), a seaport on the west coast. Solok lies on the Sumami, which, flowing from the S. to the lake of Singkara, prolongs the valley of the Sumpur to the Middengebergte. Unlike the northern, the southern affluents of the Ombilin do not rejoice in longitudinal valleys hemmed in by the Barisan and ranges of slate, limestone, and sandstone. Here prevailing granite and diabase give rise to a complicated mountain system through which the rivers cleave their way in a curved and irregular course. South of the Middengebergte, however, the northern affluents of the Batang Hari, the Seliti, Gumanti, Si Potar, Mamun, and Pangean, at least those in the W., again run in longitudinal valleys. As shown by the reports of” the Sumatra Expedition, these affluents and the Batang Hari itself (except the part at the mouth, Mamun-Simalidu) are navigable only by praus drawing not more than 12 inches. 6th. South Sumatra, so far as known, presents everywhere in its valleys the same character as that of Batang Toru, Batang Gadis, Sumpur, &c. Its eastern valleys, howdSrer, are not so high and continuous as its western. They also are closed in on the N. and S. by volcanoes whioh here produced the same masses of tuff, with lakes and rivers of the

same formation as in the N. Such are the valley of Korintyi with the river of the same name, between the Peak of Korintyi and the Raja Mount ; the valleys of Serampei and Sungei Tenang (as imperfectly known as that of the Korintyi), in which are to be sought the sources of the Tambesi and Asei, both affluents of the Jambi ; the longitudinal valley of Ketaun, in Lebong, flowing to the west coast, and of the Upper Musi flowing to the east coast ; the valleys of Makakau and Selabung or the Upper Komering, an affluent of the Musi, between Sebelat and Kaba. The Makakan and Selabung drain into Lake Ranau, which on the south side is dammed by the volcano Seminung. The southernmost valley of Sumatra is that of the Semangka flowing into the bay of the same name. All these valleys, with their rivers, lakes, and volcanoes, are of a like nature with that of those already described. Generally the lower val\eys of the rivers have a relief of 600 to 1000 feet ; the higher valleys occupy heights of from 2500 to 3000 feet; the moun- tain chains rise to 5500 feet ; the volcanoes tower up from 6500 to nearly 10,000 feet. 7th. The section of south Sumatra between the eastern chain of old rocks and the east coast with its numerous river mouths. This section is formed of the alluvium of sea and rivers. In the river-beds, however, and at some distance from the sea, older strata and eruptive rocks underlie the alluvium. The strata near the mountain chains and volcanoes consist of diluvial tuffs, which, though not reaching the height of the western half of the island, indicate considerable elevation also on that side. The eastern plain increases from N. to S.

Bivers. — The middle and lower courses of the larger rivers — the Musi, Jambi, Indragiri, Kampar, Siak, Rocan, Panei, and Bila, and Asahan — all flowing eastwards, along with many of their affluents are navigable over considerable stretches for craft drawing 6 to 10 feet. The Musi and Jambi are navigable for 372 and 497 miles respectively. As waterways, all the rivers labour under the drawbacks of rapids, mudbanks at their mouths, banks overgrown with forest, sparse population, and currents liable to serious varia- tions due to irregularity of supply from the mountains and sudden rainfalls.

Climate. — As throughout the whole of the Malayan Archipelago, so also in Sumatra, which lies about equally balanced on both sides of the Equator, the temperature stands at a high level sub- ” ject to but slight variations. The monthly temperature mounts only from 77° Fahr. in February to 80-6° Fahr. in May, August, and November. In the distribution of the rainfall as dependent on the direction of the winds, the following parts of Sumatra must be distinguished : — 1st. S.E. Sumatra, on which, as on Banka and Billiton, the heaviest rainfall occurs during the N.W. monsoon, the annual volume of rainfall increasingfrom 98-4 inches in the E. to 139 inches in the W. Of the 139 inches yearly rainfall, 91-7 inches are brought by the N.W. and 47-3 inches by the S.E. mon- soon. 2nd. The west coast. Here the rainfall for the year in- creases from the S. and the N. ends towards the middle. Ben- kulen, e.g., gets 126 inches ; Singkel (2° 15′ N.), 172 inches; and Padang, 184 inches in the year. Here too the prevailing rain- fall is Drought by the N.W. monsoon, but in this belt its prev- alence is not so pronounced, Padang getting 94 inches of rain during the N.W. monsoon against 90 inches during the S.E. The mountain chain immediately overhanging it, the high temper- ature of the sea washing it, the frequent thunder-storms to which it is subject, the moist atmosphere of its equatorial sit- uation, and the snorter regime of the dry S.E. wind are the principal causes of the heavier rainfall on the • west coast. The higher stations of middle Sumatra, on the lee side of the western mountain chain, get off with only a yearly drenching of 78-7 inches. 3rd. The N. and N.E. parts of Sumatra. These are swept By a variety of winds. The S.E. wind, however, predominates. Blowing overland, and in the direction of the longitudinal valleys, the S.E. wind brings so much less rain, and thus favours the for- mation of steppes in the N, such as the Toba plains. The N.E.

and S.W. winds, on the other hand, licking up the moisture of the sea, bring rain if they blow for any length of time.

Area and Population. — The following table gives particulars as to the area and population of the several political divisions of Su- matra and of the island as a whole : —

‘ Division.

Area in square Miles.

Population in 189T.

Density per square Mile.

Sumatra, West Coast

Sumatra, East Coast

Benkulen

Lampongs

Palembang

Atjeh ....

31,649 35,312 9,399 11,284 53,497 20,471

1,353,515 335,432 158,767 137,501 692,317 531,705

42-8 9-5 16-9 12-2 12-9 26-0

Total ....

161,612

3,209,237

19-85

Of the total population, 5015 were Europeans, 92,716 Chinese, 2478 Arabs, 7133 foreigners of other nations, and the rest natives.

In the west coast lands European influence, fertile soil, com- paratively good roads, agriculture, timber, and coalfields have created populous settlements on the coast at Padang (the capital of the west coast, with 35,158 inhabitants in 1897, of whom 1640 were Europeans), Priaman, Natal, Ayer Bangis, Sibogha, Singkel, and also on the plateaux at Fort de Kock, Payokombo, &c. In the east coast lands it is only at the mouths of

rivers — Palembang at the mouth of the Musi with 53,000 inhabitants, and Medan in Deli, the residence of the highest civil and military officials of the east coast, in which a splendid government house is (1900) being erected — that considerable centres of population are to be found. Nine-tenths of the natives of Sumatra live by agriculture, the rest by cattle-rearing, fishing, navigation, and, last but not least, from the products of the forests ; they are therefore little concentrated in towns.

Beligion and Instruction. — The natives professing Christianity numbered in 1897 about 32,000 in the west coast division of the island, and about 250 in all other parts. The number of Christian missionaries was 61, of whom 42 belonged to the Rheinische Mis- sionsgesellschaft. The number of schools, Government and private, on the west coast was 260, with 19,226 pupils. In Benkulen there were 9 schools with 1241 pupils ; in Lampong district, 4 schools* with 638 pupils ; in Palembang, 8 with 658 pupils ; on the east coast, 2 with 145 pupils ; in Acheen and dependencies, 2 with 375 pupils.

Productions and Industry. — Forests and natural vegetation cover a much larger part of Sumatra than of Java. Whereas in Java tall timber on the mountains keeps to altitudes of not less than 3000 feet, the tall timber on the mountains of Sumatra descends to below 1000 feet, to 650 feet, and in many cases right down to the coast. In Sumatra, as in Java, the vegetation of the lowlands up to nearly 1000 feet is distinct from the vegetation of the moun- tain slopes and plateaux from that elevation up to 4000 feet and over. In addition to the 134 plantations of 46,825 acres farmed out by the princes to the planters of Deli, only 38 plantations of 13,823 acres are farmed out by the Government to private persons. For the European market there are grown coffee, tobacco, nutmeg, mace, Depper, &c. The production of coffee cultivated by the Government in Upper Padang varied from 82,233 piculs (each’ 133J lb avoir.) in 1888 to 19,000 piculs in 1894 ; in Tapanuli from 12,698 piculs in 1888 to 5192 piculs in 1894 ; in Lower Padang from 4176 piculs in 1888 to 912 piculs in 1894 ; and in the whole island from 175,000 piculs in 1877 to 26,000 piculs in 1894. On private lands the production increased from 1000 piculs in 1877 to 16,000 piculs in 1899.

The following table shows the number of tobacco plantations and the amount of tobacco produced on’ the east coast of Sumatra in 1899:—

, Deli and Dependencies.

Lang-Teat.

Serdahg.

Batu Baru.

Other Establishments (Asahan, Bila, Siak).

Total.

Establish- ments.

Production (in kilog-s.)

Establish- ments.

Production (in kilogs.)

Establish- ments.

Production (in kilogs.)

Establish- ments.

Produc- tion.

Establish- ments.

Produc- tion (in kilogs.)

Establish- ments.

Production

(in kilogs.)

59 .

12,141,707

36

6,802,864

23

3,305,828

6

478,022

5

921,150

130

23,958,369

Minerals. — The production of the Ombilin coalfields increased from 1758 metric tons in 1892 to 181,325 metric tons in 1899. The production of petroleum on the Lepan river in Langkat mounted from 362,880 gallons in 1891 to 20,141,000 gallons in 1899. Palem- bang, at Muara Enim, also produces petroleum, the amount not pub- lished. Perlak, formerly a tributary state of Acheen, and now a political division of the Acheen Government, has become one of the chief centres of the petroleum industry. The crude oil is con- veyed in pipes to Aroo Bay, on the east coast, and refined in the island of Sembilan. There is no gold production.

Exports. — The principal exports from all the regencies alike are black and white pepper, bamboo (rotan), gums, caoutchouc, copra, nutmegs, mace, and gambir. From the west coast and Palembang coffee is also exported, and from Deli, tobacco.

Boads and Bailways. — In the western half of Sumatra, with its long line of coast and numerous valleys, the transport of coffee has, owing to the want of navigable rivers, induced the construc- tion of very good roads as far as the lake of Toba. In the west coast, under the Dutch Government, there is a railway connecting not only the coalfields of the Ombilin valley with Padang, but

also the Ombilin river and the lake of Singkara with the most productive and densely populated plateaux and valleys, N. and S. of the line of volcanoes (Singalang, Merapi, and Sago). A second railway in the district of Deli connects the inland plantations with the coast. Good roads traverse also the broad plains of Benkulen, Palembang, and the Lampong districts ; altogether there are in Sumatra (1900) 194 miles of railway. (See also Malay Archi- pelago : Dutch East Indies, for general information as to Govern- ment, Finance, Defence, &c.)

Authorities. — (For geology and orography) Fennema. “Geolo- gische Besehrijving van .het Noordelijk Deel der Padangsche Bovenlanden,” Jaarb. v. het Mijnwezen, 1887.— Vekbeek. Topo- graphische en Geologische Besehrijving van een Deel van Sumatra’s Westkust, with atlas. Batavia, 1883 ; similar work dealing with S. Sumatra, Jaarb. v. het Mijnwezen, 1881, and Supplement, 1887. * — Hoekstra. Die Oro- und Hydrographie Sumatra’s. Gronin- gen, 1893. — Veth. Midden Sumatra, II., Aardrijksk. Besehrijving, with atlas. Leyden, 1882. — Yzerman, &c. Dioars door Sumatra, Tocht van Padang naar Siak. Haarlem, 1895.— (For rivers of the east coast) Tijdschr. Aardr. Gen., III., map 16, and 1890, maps 7 and 8; Tijdschr. Bat. Gen., 1881 and, 1883, and Jaarb. v. het Mijnwezen, 1874; Tijdschr. Aardr. Gen., III. and VI., and Bijdr. v. het Inst, voor Taal-, Land-, en Volk., 1884 ; Tijdschr. Aardr. Gen., 1886. — (Rivers of middle Sumatra) Proceedings of the B. G. Society and Petermann’s Mitteil., 1880. — (Climate) Van der Stok. Begenwaarnemingen, and Atlas of Wind and Weather. Batavia, 1897. — (Statistics) Jaarcijfers, 1901, and Koloniale Verslagen, 1900 and 1901. — (History) Kielstra. On the history of Palembang, west coast, and the war in Acheen, in Indisch Militair Tijdschrift, 1886-89 ; Tijdschr. Bat. Gen. , 1887-92. (c. M. K.)

Becent History. — From 1883 to 1894 the Dutch Government, with the help of missionaries, extended its authority over the lands to the S.E. and S.W., and also over some of the lands to the E. and N. of Toba Lake, including the districts of Toba, Silindong, and Tanah Jawa. In 1895 the authority of Holland was extended over the southern part of the island of

Samosir in Toba Lake. Its jurisdiction was also extended over Tamiang, till then the northern . frontier of the Dutch east coast of Sumatra. By military expedi- tions (1890-95) the Dutch influence on the Batang Hari, or Upper Jambi, was increased ; as also in 1899 in the Lima Kotas in cen- tral Sumatra, included within the territory of Siak. It is expected that the new extension will comprise in it mines of tin and gold. Historically, Sumatra has proved to be perhaps the most interesting among the Dutch-Indian possessions in the Malay Archipelago (q.v.). The war in Acheen did not materially retard the development of Sumatra, and although the titular Sultan of Acheen has continued a desultory guerilla warfare against the Dutch in the mountainous woodlands of the interior, the almost inaccessible Pasci country, so called, really active warfare has long ceased. All along the main coasts of the former sultanate of Acheen military posts have been established, and military roads are being constructed ; even in Pedir, on the north coast, until 1899 the most actively turbulent centre of resistance of the Sultan party, and even in 1902 only pacified in parts, Dutch engineers are building a highway to connect the west with the east coast ; and a railway is running in the north from Olehleh, the new capital of the Government of Acheen, a good, free port, with an active trade, carried on by numerous steamers, both Dutch and foreign. A similar state’of things has been in existence at Edi on the north- east coast, the harbour capital of a sultanate which formerly owed allegiance to the Sultan of Acheen, but which since 1889, in which year an armed expedition restored order, forms a political division of the Government of Acheen. Edi has become one of the centres of the still extensive pepper trade, carried on mainly with the Chinese at Singapore and Penang, which island faces Edi. South- west of Singapore the archipelago of Riow forms a separate resi- dency, with an assistant-resident at Lingga, to which belongs the island of Singkep, where extensive tin deposits have been dis- covered, which are being worked by a Dutch company under an exclusive concession, similar to the existing tin concessions for the islands of Banka and Blitong (Billiton). In Singkep the tin output for the ten years ending 1st June 1900 reached 81,000 piculs. The residency of Riow, which embraces many hundreds of islands, big and small, also includes a portion of the Sumatra mainland, be- tween the residencies of Palembang to the south and the east coast of Sumatra to the north. To the latter belong perhaps the richest and best developed districts of northern Sumatra, namely, Deli (with an assistant-resident), Langkat,

Serdang, &c. — districts little known in 1875, but by 1902 famous among the largest tobacco countries in the world. Belawan is the harbour to Deli, but the capital is Medan, where the Sultan and the Dutch Resident reside. Belawan is connected with Medan by a railway, constructed before 1890 by a private company, almost entirely dependent for its earnings upon the numerous tobacco plantations,

several of which belong to English corporations. The plantation labourers are almost entirely alien coolies, largely Chinese, and the Malays are comparatively few in number. The tobacco plantations of British North Borneo have nearly all been started by planters from Deli. Between the mainland dependency of the Riow resi- dency and the residency of Palembang lies Djambi, an extensive sultanate, which is still in a state of transition ; a portion belongs to the residency of Palembang as a protectorate, the Sultan having in his capital (also called Djambi) a Dutch ” comptroller,” who represents the resident of Palembang ; another portion is claimed by a quasi-independent sultan who reigns in the interior. Of this interior very little was known until the scientific expedition despatched by the Dutch Royal Geographical Society towards the end of the ‘seventies, but in 1901 an armed Dutch expedition, necessitated by frequent disturbances, penetrated right into the Jambi hinterland, the so-called Gajoo districts, where until then no European had ever trod. Otherwise there is little of a historical or political character to chronicle of Palembang, beyond the fact that many petroleum wells have been started in the interior, and that it is now possible to travel by road from Palembang to Ben- kulen, on the west coast. The same remark applies to the resi- dency of Banka Island, which includes Billiton Island, with an assistant-resident, and to the residency of the Lampong districts, adjoining the Palembang residency, and comprising the southern- most portion of Sumatra.

The west coast of Sumatra is administered upon lines somewhat approaching those of the east coast. There is a government in the north adjoining that of Acheen, and comprising the two residencies of Padang, the Highlands residency and the Lowlands residency ; further, the residency of Tapanuly. All have several assistant- residencies. The residency of Benkulen is interposed between the west coast government and the residency of the Lampongs above mentioned. Of the recent history of the

former, all that need be stated here is that the settlement of the Padang highlands and of Tapanuly, which, from the point of view of the picturesque alone, are among the most beautiful upland countries anywhere to be found, is of much later date than that of the Padang lowlands. Still, up to 1900 a great deal had been done to develop the long- neglected interior, a development to which the geological survey expeditions, under the lead of that eminent engineer, Mr Verbeek, to whom we owe not only the best maps of Sumatra but also the most comprehensive study of the Krakatao cataclysm, have so powerfully contributed. A state railway now runs from Padang town into the interior as far as the immense Ombilin coalfields, which are worked by a private company.

A brief mention should be made of the island of Nias, which forms a political division of the residency of Tapanuly on the west coast. Nias has excited a good deal of interest among scientists on account of its remarkable population, whose origin is still in doubt, Junghuhn's surmise that they are Battaks not having met with general acceptance. The Nias natives are a distinct race. Cannibalism seems unknown among them, but slavery is still rampant, and especially head-hunting, despite the persistent efforts against it made by the Dutch and German missionary societies, which are strongly represented in Nias. A peculiar feature of the population is the large number of albinos which it comprises.

From the above outlines it would appear that the government of Sumatra was still in 1902 in an essentially transitory condition. For recent literature consult the works mentioned under Java and Malay Archipelago ; also Schuiling's Nederland tusschen de Tropen ("Tropical Holland," 1889), and Prof. Van der Lith's Netherlands-India (2nd edition, 1892). (h. ti.)

Sumbawa, one of the Little Sunda islands in the East Indian Archipelago east of Lombok, measuring, according to Zollinger, 4300 square miles, or, including the neighbouring islands, 5240 square miles. Four mountain chains cross the island in common with the Western Sunda islands in a west to east direction. The northern, as in Bali and Lombok, is of volcanic origin. In the southern chain is found a limestone formation analogous to that in Bali, Lombok, and Java. Between these two chains are round hills consisting of lavas, some- times of volcanic tuffs, covered with the silvery

and long grass which also clothes vast prairies in Java and Sumatra. The natives live solely by agriculture. But out of a total population of about 75,000 there are 11,000 foreigners, living mostly by trade and naviga- tion (Ligtvoet). Politically, Sumbawa, with its four independent states, belongs to the confederated states of the ” Government of Celebes and its dependencies ” (see

Celebes), a situation to be explained by the fact of the old supremacy of the Makassaresi over Sumbawa, Plores, and Sumba.

Zollinger. “Soembawa,” in Verhandelingen van het Batav. Genootschap, xxiii. — Ligtvoet. ” Anteekeningen betreffende den Economischen Toestand en de Ethnographie van Soembawa,” in Tijdschr. Bat. Gen. xxiii.

Summit, a city of Union county, New Jersey, U.S.A. It is on the Delaware, Lackawanna, and Western railroad, in the north-eastern part of the state. It was formerly Summit township. Population (1900), 5302, of whom 1397 were foreign-born and 129 negroes.

Sumter, a city of South Carolina, U.S.A., the cap- ital of Sumter county. It is a little east of the centre of the state, on the Atlantic Coast Line and the South- ern railway, and is an important shipping point for the products of the surrounding agricultural region. Population (1890), 3865 ; (1900), 5673, of whom 58 were foreign-born and 3160 negroes.

Sun. — The sun maybe described in the most com- prehensive way as a globe of matter so intensely hot that all the substances composing its interior are vaporized and dissociated, so that any chemical combination is prevented among them, and so massive that the gases which form it are compressed by the mutual attraction of their parts to a density exceeding in the mean that of water, and possibly, near the centre, as great as that of metals. The following numerical particulars will be con- venient for reference. The bases of some of them will be found in Part II. of the article Astronomy in vol. xxv. of this work : —

Angular semi-diameter at mean distance Density (earth’s density=l) . ,, (water=l)

‘ 959-63″ 0 ‘25538 1-41151

The value of the equatorial horizontal parallax of the sun at the earth’s mean distance, as now adopted in all the astronomical ephemerides, is 8-80”, but the most recent investigations indicate a somewhat smaller value, probably 8-78”, and a correspondingly greater distance. The distance, linear diameter, mass, and attraction depend in their determination upon the parallax, and are therefore given for the two values of this quantity just mentioned : —

Equatorial horizontal parallax . . . 8-80″ 8-78″

Mean distance (kilometres) . . . 149,501,000 149,841,000

(miles) 92,896,000 93,108,000

Linear diameter (kilometres) . . 1,391,080 1,394,240

(miles) . . . 864,372 866,340

„ (earth’s eq. diam. = l) . 109-05 109-30

Mass (earth’s mass=l) 332,297 334,512

Gravity at surface(metres) . . . 273-82 274-42

„ (0gr=l) . . 27-88 27-95 According to Sporer’s determinations from 1861 to 1866, the position of the solar equator referred to the ecliptic is Longitude of ascending node .... Inclination to the ecliptic .... The most recent determination of the period of the 11*-13±0’-02.

A fundamental constant of solar physics is the rate at which the sun radiates heat. The measure of this radiation, called the solar constant, is the amount by which a sheet of water 1 centimetre thick, exposed per- pendicularly to the sun’s rays at the earth’s mean distance, would rise in temperature in one minute if it absorbed all the rays and lost no heat. The determination, being necessarily made at the earth’s surface, requires a know- ledge of the

absorption of the sun’s heat in passing through our atmosphere. The selective character of this absorp- tion renders its determination difficult, and, as was pointed out by Langley, has led to the result being raueh too small. The most elaborate determination at command is that of Langley, made on the summit of Mount

74-2°

. 6-6

solar spots is

Whitney, at an elevation of about 14,000 feet. The value which he reached was 3-0° C. per minute, with a fair probability of its being as great as 3-5°. Angstrom places the value at the yet higher point of 4°. We may assume the most probable value to lie between 3-0° and 3-5°. This result may be expressed by saying that if the sun were surrounded by a spherical shell of water 1 centimetre thick, having a radius equal to that of the earth’s orbit, the heat radiated would raise its temperature at the rate of about 3-0° or 3-5° C. per minute (5-4° to 6-3° Pahr.). Computing the volume and mass of this shell, we may deter- mine the number of units of heat necessary to warm it at this rate, which would be the rate at which the sun lost energy; The following are the common logarithms of the amount of energy radiated per minute and per day, assuming the two values just given for the constant. We remark that the C.G.S. unit of heat is that which will raise the temperature of 1 cubic centimetre of water 1° C. ; the calorie is the amount which would raise one kilogramme 1°, while the erg is the C.G.S. unit of mechanical work.

Per Minute. Per Day.

Constant 3-0 3-5 3-0 3-5

Log C.G.S 27-927 27-994 31 086 31-153

„ Calories 24-927 24-994 28-086 28-153

„ Ergs 35-560 36-627 38-718 38-785

Assuming the mean specific heat of the materials compos- ing the sun to be the same as that of water, the loss of energy would be equivalent to a lowering of the tempera- ture at the rate of about 4° Pahr. per annum. Assuming the sun to be of uniform density in its interior, and to contract uniformly throughout its mass when cooling, the number of ergs of work done by a contraction of this mass through u centimetres is, when a coefficient is expressed by its logarithm, (37-515)w. The annual contraction which would then generate an energy equal to that radiated is 6790 centimetres or 225 feet. In deriving this result no allowance is made

The interior of the solar globe is invisible to us, so that its constitution must be entirely a matter of inference. Its surface, the photosphere, is all we see under ordinary circumstances. Immediately outside of it, and lying upon it, is a layer of self-luminous gases, red in colour, forming the chromosphere. Outside of this is an irregular col- lection of matter of extreme tenuity, the corona. Both chromosphere and corona are, under ordinary circum- stances, invisible to direct vision ; the chromosphere can be detected by the aid of the spectroscope, but the corona is visible only during total eclipses of the sun.

The number of terrestrial elements whose spectral lines can be detected in the solar spectrum has been increased by Rowland's researches with the aid of photography. The question whether oxygen is in the list has long been an open one, and cannot yet be regarded as decisively settled. Its difficulty arises largely from the fact that we necessarily see the solar spectrum after the light has passed through the oxygen of the earth's atmosphere. Investigations by Eunge, make it at least highly probable that a triplet of lines in the extreme red, W. L. 7772-2, 7774-4, and 7775-6, belong to the. spectrum of oxygen, and are also true solar lines. This evidence will be the more easily accepted that the absence from the sun of an element so abundant on the earth does not seem probable.

That the photosphere cannot be a continuous solid or ordinary liquid, like molten metal, is shown by the fact that, if it were, its enormous radiation would result in its being cooled down almost instantly. Even were the

Photo- sphere

liquid as transparent as water, all the heat radiated at any moment would come from within a few yards of its surface, which would cool down in a few min- utes or hours. Indeed, whatever constitution we assign to the photosphere, the matter com- posing it would cool off at a rate of several thousand de- grees in a day if it remained in situ. The radiating matter must therefore be continuously renewed by con- vection currents. Great mobility is therefore a neces- sary characteristic of its constitution. The combination of the required mobility and radiating power is best obtained by supposing that the more refractory sub- stances in a rising mass of vapour, carbon for example, condense when they reach a certain level, and then fall rapidly back into the interior, to be there revaporized. But it does not seem absolutely necessary to suppose any condensation, because the principles of thermodynamics show that a stratum of gas so thick as to be opaque to radiation will radiate like a solid. Further inferences as to the nature of the photosphere may be drawn by start- ing from the envelope of hydrogen which rests upon it, and assuming that chromosphere and photosphere have a temperature corresponding to convective equilibrium. The latter will occur when the temperature in going downward increases at such a rate that a descending current, continually growing hotter by the work of com- pressing it, shall always have the same temperature as the surrounding mass. In this case the temperature will increase with the depth at a uniform rate, if the change in the gravity in going downward be neglected. In the case of hydrogen the rate is about 15° C. per kilometre, and in the case of air about twenty times more rapid. Assigning to the chromosphere a depth of 5000 kilome- tres, the temperature at the base would be some 75,000° higher than at the surface, whatever the temperature of the latter might be. This result, however, is excessive, because based on the hypothesis of no radiation. The effect of the radiation from the photosphere is to elevate the temperature of the outer parts of the chromosphere, the base of which must, under all circumstances, be at least as cool as the photosphere on which it rests. In the general average every concentric shell of the sun’s mass must be hotter as we go downward, since below the region from which radiation is received a condition ap- proaching to that of convective equilibrium must

hold. The increase of temperature in this case would admit of being computed by the laws of Boyle and Gay-Lussac, did we know the physical constants of the vapours com- posing the sun. But we must speedily reach a point of temperature and condensation at which these laws cease to hold, and there is also a tendency towards equality of temperature through interior radiation. We cannot therefore say what either the temperature or density may be at a great depth.

Defining the photosphere as the totality of all matter which radiates an appreciable amount of energy into outer space, we see that it cannot be a surface, but rather a stratum, of which the probable depth is several hun- dred, and may be several thousand, kilometres. The best estimates of its temperature range from 5000° C. to ten, fifteen, or even twenty thousand. Really, however, no definite temperature can be assigned to it, owing to the rapid increase of temperature with the depth.

The reversing layer of Young may be regarded as con- necting the chromosphere and photosphere, being at once the base of the former and the extreme outer surface of the latter. Its duration during total eclipses of the sun, and the circumstances of its visibility on such occasions, seem to show its thickness to be a considerable fraction of 1”, say 500 kilometres. Its bright line spectrum shows that a ray of light from the earth would pass

through and through it and suffer only selective absorp- tion. The path of such a ray within the layer would be some 30,000 kilometres if it went in a straight course, and yet more if it underwent refraction. Being trans- parent through such a length, the tenuity of the layer must be extreme. Were its density not much less than that of our atmosphere, a ray of light could not pass through it without being refracted from its course toward the interior, and no bright line spectrum would then be visible. This result is totally at variance with the infer- ences of Jewell and Humphreys from the character of the spectrum — that the pressure upon it is equal to several terrestrial atmospheres. But the writer considers that an inference from these data can be little more than a conjecture. The probable law of the increase of temper- ature from the inner regions of the sun outward is shown in Kg. 1. Here C is the centre of the sun ; p is the region of the photosphere, a shell between the surface S S, which is the innermost one that radiates heat into

S R T

Fig. 1. — Temperature Gradient of the Sun.

outer space, and B B, the very thin shell of the reversing layer; h, between R B and T T, is the region of the chromosphere ; ordinates parallel to C A, terminating in the upper curve of the figure, would represent the diminishing temperature. Brom the centre C A to the surface S S the law of diminution is that of convective equilibrium. The dotted curve outside of S is a contin- uation of this curve, showing the temperature as it would be were there no radiation. But owing to the radiation by the photosphere there is a rapid drop of temperature through the latter, while outside of it, the radiation being absorbed by the chromosphere increases the temperature of the outer surface of the latter. The result is a rapid fall through the photosphere, while in the chromosphere the change may be quite small, the whole being shown by the continuous curved line.

One of the most curious phenomena connected with the sun is the rotation of its equatorial regions in less time than those nearer the pole, the difference being about ld-5 between the equator and the ^tatton limits of the spotted zone. The question would naturally arise whether this might not be due to a motion of the spots in longitude unaccompanied by a motion of the matter of the photosphere around them, much as a whirlwind might change its position without a continuous translation of the air. On tnis supposition a spot would be in the nature of a disturbance, which might be propa- gated from point to point independent of the matter dis- turbed. There are, however, other tests. The motions of the “faculae admit of being followed like those of a spot, though not so easily. The results from facnlse have not been conclusive, but the preponderance of evidence is that

they follow the same anomalous law as the spots. The most conclusive test is that afforded by the spectroscopic comparison of velocities to and from the earth at the opposite limbs of the sun. Very careful comparisons of this sort were made by Crew and Duner, the latter of whom seems to have

reached a high degree of precision in his work : his general conclusion is that the angular mo- tion in question actually grows slower towards the poles not only within the zone of sun spots, but to at least ± 60° of latitude. What makes the phenomenon seem anomalous is that, in the case of a revolving fluid body the particles of which constantly change their positions relatively to each other, the most rapid angular motion should be near the axis of rotation, where it might become so great that a vortex would form. Several recent writers have, however, constructed hydrodynamic theories of the processes going on in a rotating mass of gas at a high temperature, leading to a law of rotation similar to that observed in the present case. The subject is most thoroughly worked out in a memoir by Professor E. A. Sampson (Mem. E.A.S., vol. li.), but it is impracticable to condense this or any other mathematical theory of the subject within our present limits. We must therefore confine ourselves to a brief statement of the probable conditions existing and processes going on in the sun's interior. The result of the convection currents must be a continuous increase in the angular speed of rotation from the surface towards the centre. The law of this increase cannot be rigorously determined. It seems to the writer that, passing inward from any point of the sun's equa- torial region, there could at first be no diminution of the linear speed; that is, the angular speed should increase at least inversely as the distance from the centre. Sampson's theory, however, makes the increase in angular speed slower than this (loc. tit., pp. 175, 176). The effect of the increasing pressure and temperature is to increase the viscosity towards the centre, so that the central core may behave like a solid. It would also have a higher angular speed of rotation than any point of the surface.

An important recent paper on the subject is by Emden (Sitzungsber, Munich Akad., July 1901, pp. 339-363). The greater speed of the equatorial rotation is here connected with a theoretically higher temperature of the photosphere at the poles than at the equator, a condition not yet confirmed by observation.

Several theories of their mode of production have been propounded, of which that of E. von Oppolzer (Vienna, Schwingsbet., 3rd March 1893) has received most So,ar attention ; but the conditions are not yet ripe

spots. £Qr formlliaf;ing any theory of the subject. We

shall therefore confine ourselves to the general laws of the phenomenon brought out by recent investigations, and to deductions from observed facts.

In going through the eleven-year cycle of change the rise from minimum to maximum of spottedness takes place more rapidly than the reverse, the two partial periods being from minimum to maximum, 47-62, and from maximum to' minimum, 6y-51. The degree of spottedness at any one phase of the cycle is quite irregular, being • sometimes greater or less than the average for a period of a year or more. The spots in one hemisphere sometimes reach a given phase, say that of maximum, a year or even more in advance of those in the other hemisphere. Sporer from a number of observations inferred that the southern cycle was generally in advance of the northern one ; this, however, is not justified by more recent comparisons, which show that, in the general mean, the spottedness of the two solar hemispheres goes through its phases simultaneously. Accurate observations of the spottedness of the two hemispheres of the sun separately

commenced with Carrington's work in 1856. During the four cycles which have since elapsed the spottedness of the southern hemisphere has in the general average exceeded that of the northern in a ratio of about 6 : 5. This excess is greater than the probable result of chance irregularities, but its permanence cannot yet be regarded as established. A most important question connected with the length of the period is whether the cycle is fundamentally a perfectly regular one. Are the observed irregularities in the degree of spottedness superposed upon an invisible cycle of change of invariable length on which they fundamentally depend, or is the cycle itself an irregular one? In the former case the times of any one phase through long periods will, in the general average, be equidistant; in the latter case the irregularities will constantly tend to accumulate, so that the deviation from the results of uniformity may increase to any extent. Wolf, from records beginning with Galileo, derived the time of every maximum and minimum since 1610. Including the phases up to 1895, it is found that there is no evidence of any accumulated deviation, but the differences between the observed epochs and those com- puted on the supposition of a uniform period seem to be accidental all the way through. The probability is

therefore that the unknown cycle of change in the interior of the sun on which the degree of spottedness depends is quite uniform. No cause external to the sun having the period in question is known to exist. The period of Jupiter, lly-86, comes nearest, but differs so much as to preclude the hypothesis of coincidence. E. W. Brown (Mon. Not. B.A.S., October 1900) discusses the question whether the combined tide-producing forces of Jupiter and Saturn might not represent the changes in spottedness, but reaches no definite conclusion. We must therefore seek for the cause of the cycle in operations going on within the body of the sun itself. It is remarkable that the phases of increase and decrease during the cycle follow very different laws in different solar latitudes. About the time of maximum there is a fairly definite law of distribution of spots in latitude. There are very few at or near the solar equator. The number increases up to about 15° heliocentric latitude, where it reaches a maxi- mum. Erom this point it falls off slowly at first, then more rapidly to 30° of latitude. Beyond this limit a spot is only occasionally seen. The number of spots in belts of latitude 5° wide during 1894, just after a maximum, was as follows: —

Mid. of t>elt+30°

3 spots

25

• 13 „

20

. 36 „

15

. 51 „

10

• 75 „

5

• 41 „

0

• 11 „

- 5

• 46 „

-10

. 75 „

-15

. 88 „

-20

. 49 „

-25

• 16 „

-30

■ 5 „

The Wilsonian theory, that the spots are depressions in the photosphere, rested upon a supposed effect of perspec- tive, the pneumbra which surrounds the dark nucleus of each spot being supposed to be broader on the exterior edge of the spot on the sun’s limb than on the interior edge. But the breadth of the pneumbra is extremely irregular and variable, and it is now found that there is no such systematic difference, nor any other evidence of a depression. The question of the exact location of a sun spot is necessarily somewhat indefinite, because what we have to do with is a phenomenon, and

not merely an object. It may be that the cause of the phenomenon extends through the entire thickness of the photospheric stratum.

The fundamental facts, relating to the radiation of the spots, which modern investigation has brought out are these : — By the aid of a thermopile it was long since found by Henry and Secchi that a spot radiates not only less light but less heat than the rest of the photosphere. The radiation from the photosphere is weaker the nearer we approach the limb of the sun. The question whether the radiation of the spot diminishes in the same degree has been investigated by Langley and Frost. It is found that this is not the case, and that in the general average the diminution of radiation from the spots is less than that from the photosphere as the latter approach the sun's limb. This lends colour to the view that the spot is high up in the photospheric stratum. The spectro- scope shows that the darkness of the spots, especially of the umbra, is due entirely to an absorption of light by gases denser than those which produce the lines of the solar spectrum. The entire spectrum seems to be darkened to a greater or less extent, but in an irregular way. Young and Duner have resolved the dark regions into great numbers of fine lines. Another remarkable phenomenon is the broadening of most of the spectral lines. In addition to this, a line is frequently reversed — that is, seen as bright instead of dark. Frequently a bright line appears without the broadened dark line having disappeared. The reversed line is also frequently curved or displaced, showing rapid vertical motion in the gases which produce it. The reversed lines are generally those of calcium, hydrogen, and iron. It is remarkable that the lines even of the same substance are not broadened equally. This, however, is only one of the many irregularities in the behaviour of the spectral lines of a substance under various conditions. The behaviour of the spectral lines seems best explained by supposing absorption by a dense layer of cool gases with another of hotter gases above it.

Intimately associated with the spots are the faculas and prominences. The former are subject to the same period as the spots and, like them, are mostly within Facuix 3q° 0f ye equator, but they are found occasion- aiineaces.

alty> though rarely, even in the polar regions. The prominences are also found all over the sun, but are more frequent in the spotted latitudes. It is not established that the spots have any well marked motion in latitude, though a tendency has been suspected in those of high latitudes to move toward the pole.

The most hopeful source of conclusions respecting the surface of the sun seems to be offered by Hale's method of photographing it by monochromatic light, which is based on an idea originally suggested by Janssen. By it a photograph is made in which all the light but that of one particular spectral ray is cut off. The essen- tial principle of the apparatus by which this is done is this. Let A be an image of the sun formed in the focus of a telescope. To fix the ideas, let us suppose this image formed of monochromatic light, that of the calcium line K for example. If this light is passed through a spectroscope, whether prism or grating, it, being monochromatic, suffers no dispersion. B may then represent the second image formed in the focus of the spectroscope. Then let S S be a slit through a frame which cuts off all the light but a narrow line. The image will then be reduced to the line S' S', which will simply be the spectral line K. Suppose S S to move vertically across the disc ; the line S' S' will then seem to move in like manner across the image B, only instead of an actual motion of the spectrum it will be a moving impression of the K-light from the different parts

of the sun. Actually, the light not being monochromatic, the entire spectrum of the sun will fall upon the plane of the image B. To obtain the photograph by the K-light an actual slit S' S' is made to move over the image B in coincidence with the K-image of the slit S S. Thus a photograph of the entire sun is obtained in which only K-light is allowed to fall on the plate. The most remark- able results obtained with this instrument concern the faculas. The ordinary visual spectrum of these objects shows the H and K bands of calcium reversed by a thin bright line running down the middle of each, thus indi- cating the presence of calcium vapour at a higher tempera- ture than the surface below. The reversal is often double,

Fio. 2.— Principle of Hale's Spectroheliograph.

a very thin dark line running down the middle portions of the somewhat broader bright line. This indicates the presence of a stratum of cooler calcium vapour above the hotter one. In some cases the bright line on one side of the dark one disappears, showing the double reversal to be unsymmetrical. Distortions in these reversed lines are rare. The bright H line is sometimes accompanied by the neighbouring He line due to hydrogen. No bright lines more refrangible than those of calcium are ordinarily seen in either the faculse or the spots. Photographs of the whole surface by the spectroheliograph show that this reversal of the K line is only an extreme case of a phenomenon present here and there over a large portion of the solar disc, especially the middle latitude belts of greatest spottedness, and comprising a regular gradation in the behaviour of the K line. Commencing at one extreme with the normal darkness usually shown in the visual spectrum of the sun, this line may, in special regions, be less dark to any extent, then gradually reversed, first by the narrowest possible line, and then by one of increasing brightness, which at length changes into a double reversal. Regions where this gradation is found to begin are irregularly scattered over a considerable portion of the sun's disc, but the brightening is farthest advanced in the two zones of greatest spot activity, where they sometimes cover widely extended regions, with scarcely a break, though with varying intensity. Besides these bright areas, the photographs show a fainter reticulated structure extending from pole to pole. The brighter regions increase and decrease in number and intensity with the spots, but the reticula- tion persists throughout the entire sun-spot period. On rare occasions the photographs show remarkable eruptive phenomena, which break out near sun spots and rise as immense clouds of calcium vapour, obscuring m the photo- graphs the underlying regions of the photosphere. Such eruptions are, however, quite invisible either by direct, vision or on photographs of the sun taken in the ordinary way. The photographs which may be taken with the instrument are not confined to the photosphere, but may include the chromosphere with its prominences. When taken by the light of the K line, these objects have the sharpness of outline of the best eclipse photographs.

One of the most remarkable constituents of the chromo- sphere and protuberances is helium. When the spectrum of the objects in question was

first studied, a bright line, W.L. 5876, was found to be present, not known to exist

among the dark lines of the solar spectrum. Being near the two D lines of sodium, it received the designation D3. Its origin remained a mystery until it was sphere?’ found Dy Ramsay that this line was emitted by a hitherto unknown substance in clevite, a rare Norwegian mineral. To this new element the name helium was therefore given. Besides the helium line, the H and K lines of calcium are also found in the chromosphere. Hydrogen, helium, and calcium are therefore the three elements the evidence of whose existence is most uniformly shown. But besides these, the lines of many other metals, especially iron, magnesium, and sodium, are found, with greater or less frequency. It is curious that they are present mainly in the eruptive protuberances, never in the cloud-forms. This fact is susceptible of the very rational explanation, that after being thrown up from the sun, they rapidly condense and fall back, while the lighter gases of the other elements remain. At the station on Mount Sherman Young catalogued 273 lines which were seen with greater or less frequency in the spectrum of the chromosphere. This list has since been considerably extended.

An outline of the observations made on the corona during total eclipses will be found in the article Eclipses c roaa (®nc2/ JBrit., vol. xxvii.). At present we con- fine ourselves to certain phenomena and conclu- sions of a general nature. In interpreting the apparent form of this curious effulgence, it must be remembered that we see only a projection, as it were, of the real corona. The latter surrounds the sun on all sides, towards us and away from us as well as laterally. What we really see at each apparent point is not the corona as it is at that point, but the combined effect of all the matter lying along the line of sight from our eye to the corona. This makes the seeming diversity of structure more remarkable, since the diversity must be lessened by the effect of perspective.

Considering, first, the visual aspect of the corona, the most striking feature is found to be its radial structure. It is not merely a soft effulgence, but a

complex com- bination of rays, frequently with dark rifts between them. The appearance of these rays is much like what we should expect to see if the equatorial regions of the sun were dotted over with hundreds of search-lights sending out their light through a thin fog. Yet there can be nothing of this kind, because every point of the corona must be equally exposed to the light of the sun. There is a remarkable difference in the radial structure in the equatorial and polar regions. A peculiarity of the latter is the curved rays which bend away from the axial line on all sides. There is a curious resemblance between this curvature and that of the lines of magnetic force as they would be were the sun a magnet. This arrange- ment does not, however, extend around the equatorial region as it should, if the rays always coincided with lines of magnetic force.

The spectrum of the corona is found to be a faint, con- tinuous one, crossed with a small number of bright lines, which form its characteristic spectrum. Of these lines the strongest is one in the green, long supposed to be identical with 1474 of Kirchhoff's scale, of which the wave- length is 5317. At recent eclipses Lockyer found the wave-length to be 5303, which does not coincide with any line present either in the spectrum of the sun or in that of any known substance. The lines next in brightness are near wave-lengths 4230 and 4290. A number of others have been recorded, some of which belong to hy- drogen, calcium, and helium, but the existence of these as belonging to the corona has been questioned.

The question whether, the continuous spectrum of the corona has any dark lines, as should be the case were it

reflected sunlight, is still an open one, with a large pre- ponderance of evidence in the negative. Only Janssen has ever been able to see such lines, and it seems likely that Campbell and others who have failed to see them en- joyed rather better conditions for doing so than did Jans- sen. However this may be, a rational interpretation of the spectrum seems easy. Scheiner has shown that any substance, especially if composed of solid particles, must in the neighbourhood of the sun be heated to incandes- cence by the sun's rays, and must therefore be self- luminous. In addition to this, it would reflect more or less sunlight, according to its degree of blackness. Only when perfectly black would it have no power to reflect ; if belonging

to the whiter class of substances, it might reflect more light than it emitted. Even if gaseous, a faint continuous spectrum formed by its own radiation would not be out of the question, because a gaseous body really emits light of all wave-lengths, though the quantity not belonging to its characteristic lines is extremely minute. We may therefore regard the light of the corona as a mixture of its own light with reflected sunlight, the latter being in an unknown but probably small proportion. The result of observations showing that the coronal matter is as bright in the rifts of the corona as in its brightest por- tions still lacks decisive confirmation. Granting it, the corona would seem to be in some sort duplex in structure, consisting of an extremely tenuous atmosphere of the un- known substance coronium surrounding the sun, in which are suspended minute particles partly or wholly vaporized by the sun's heat. All views of the corona as incandes- cent matter are at variance with the measures of its heat with the bolometer made by Abbot of the Smithsonian In- stitution during the eclipse of 1900. These, as interpreted by Abbot, would show that no obscure heat is radiated by the corona, a result which cannot be accepted without fur- ther investigation.

An interesting question is whether the coronal matter does or does not rotate with the sun. Three states of things are possible : it may remain at rest as the sun rotates, or rotate with the sun, or, like a mass of meteoric matter, might be revolving around the sun in orbits under the influences of gravitation. The latter would imply a vastly more rapid rotation than that of the sun itself. Campbell has investigated this question by comparing the spectra of the lines at the two edges of the sun. The re- sult is conclusive against the motion of the coronal matter in an orbit around the sun, but is indicative of a motion corresponding to that of the sun's rotation. The effect is, however, too minute to be quite conclusive.

It has been shown by Arrhenius (Physikalische Zeit- schrift, Nov. 1900) that a minute impulsive force of the sun's rays, pointed out by Maxwell in his development of the electromagnetic theory of light (Electricity and Magnetism, vol. ii.), affords a remarkably plausible ex- planation of the tails of comets, the floating prominences, and the solar corona. It results from this theory that this action upon particles of matter of dimensions of about 0-001 mm., and of density unity, will be equal to their gravity

towards the sun. Particles smaller and rarer will be driven off against the sun's gravity. We have there- fore only to suppose the solar corona to be composed of particles like this, to account for its seeming suspension about the sun. (s. n.)

Sun bury, a borough of Pennsylvania, U.S.A., the capital of Northumberland county. It is situated in lat. 40° 52', long. 76° 47', on the eastern bank of the Sus- quehanna river, at the junction of its north and west branches. Its site is level, and the borough is laid out with great regularity. It has three railways — the Penn- sylvania, the Northern Central, and the Philadelphia and

Reading. Sunbury contains the repairing works of the Pennsylvania railroad, and varied manufactures. It was settled in 1772. Population (1880), 4077; (1890), 5930; (1900), 9810, of whom 1970 were foreign-born.

Sundarbans, The, a tract of waste country in British India, forming the seaward fringe of the Gangetic delta. It has never been surveyed, nor has the census been extended to it. It stretches for about 165 miles, from the mouth of the Hooghly to the mouth of the Meghna, and is bordered inland by the three settled dis- tricts of the Twenty-four Parganas, Khulna, and Backer- gunge. The total area (including water) is estimated at about 5500 square miles. The whole is a water-logged tract, overgrown with impenetrable jungle, in which tigers and other wild beasts abound. Attempts at reclamation have not been very successful. The forest department realized in 1897-98 a net revenue of Rs.4,00,000, chiefly by tolls on produce removed. The characteristic tree is the sundri (Heritiera littoralis), from which the name of the tract has been derived. It yields a hard wood, used for building purposes, and for making boats, furniture, &e. The Sundarbans are everywhere intersected by river channels and creeks, some of which afford the recognized means of water communication between Calcutta and the Brahmaputra valley, both for steamers and for native boats. Down to 1897-98 the total capital expenditure on the Calcutta and Eastern canal was Rs. 63,00,000. The gross revenue from tolls in that year was

Rs.4,26,203, and the net revenue Rs.2,24,798. The tonnage of boats was 1,016,657, with cargoes valued at Rs.5,90,14,426, or about four millions sterling.

Sunday. — There has not since 1887 been any legis- lation directly affecting the observance of Sunday in the United Kingdom, or the lawfulness of carrying on any trade on that day. But a good many Acts have been introduced with respect to Sunday trading. Most have been directed to the closing of public-houses on that day ; but the Shop Hours Bills introduced in 1901 contained clauses for closing shops on Sunday, with the exception of certain specified trades. In the administration of the law, however, there has been a distinct disposition to refrain from enforcing the strict letter of the older law, and to permit the latitude of what is described as the ” Continental Sunday,” except in the case of businesses carried on so as to interfere with the public comfort.

The result of the Acts of 1871 and 1875 in London has been in substance to make the Lord’s Day Acts a dead letter as to Sunday trading. The Commissioner of Police rarely if ever allows a prosecution for Sunday trading. Sunday markets are usual in all the poorer districts, and shopkeepers and hawkers are allowed freely to ply their trades for the sale of eatables, temperance drinks, and tobacco. But the conditions of licences for the sale of intoxicants and for refreshment houses are strictly en- forced with respect to Sunday. In districts where the town councils have control of the police, prosecutions for Sunday trading are not infrequent ; but they seem to be instituted rather from objection to the annoyance caused by street traders than from religious scruples. The lim- itation of the time for prosecution to ten days, and the necessity of the previous consent of the chief constable, have a great effect in restricting prosecutions. This liber- ality in administration has progressed pari passu with a change in public opinion as to the uses to which Sunday may properly be put ; it is becoming less of a holy day and more of a holiday.

There has been great activity among those interested ‘in different theories as to the proper use of Sundays. On the one side, Lord’s Day observance societies and the or- ganizations concerned in the promotion of “temperance”

(or of abstinence from alcoholic drinks) have been ex- tremely anxious to enforce the existing law against Sunday trading, and against the sale of intoxicants to persons other than bond fide travellers, and to obtain legislation against the sale of any alcohol on Sundays. On the other side, the Sunday League and other like organizations have been active to organize lectures and concerts and excursions on Sundays, and to promote so far as possible variety of recreation other than attendance at the exercises' of any religious body. The lessees of certain places of public resort in London have in some cases obtained their licences from the London County Council on condition that they do not hold Sunday con- certs, and the recent policy of the Council has been not to interfere with or restrict the giving of Sunday concerts unless they are given for private gain or by way of trade. The Council has no legal authority to- dispense with observance of the Lord's Day Act of 1781 (21 Geo. III. c. 49), which enforces penalties on giving entertainments to which persons are admitted by payment of money or by tickets sold for money. The law has been judicially interpreted, however, to mean that charges for reserved seats are not incompatible with free admission. In con- sequence of this ruling Sunday concerts have been reg- ularly given at the Albert Hall, which is not under the licensing jurisdiction of the London County Council, and at the Queen's Hall and other places within that jurisdiction. No charge is made for admission, but those who wish for seats must pay for them, and the pro- ceeds of the concerts are not made the subject of profit. At the licensing sessions conflicts have annually arisen on this subject between the advocates and opponents of Sunday music.

Travelling and boating on Sunday are now freely resorted to, regardless of any restrictions in the old Acts, and railway companies run their trains at all hours, those in the metropolis, however, limiting their trains during the hours of morning service. The running of tramcars on Sundays has been recently introduced in Scotland, but its legality is the subject of litigation. Refreshment houses are freely open even in the Royal Gardens at Kew, and bands play in the public parks. An attempt was made in 1897 to enforce the Act 1 Chas. I. c. 1, forbidding the playing of Sunday games out of the player's parish, by prosecuting some lads for playing football in an adjoining parish, but the justices dismissed the charge, treating the Act as

obsolete ; and to a great extent the aim of the Book of Sports has, after two centuries, been attained.

The operation of the Lord's Day Acts has to* some ex- tent been restricted by two recent decisions. In 1900 it was decided that a barber was not a tradesman, artificer, work- man, or labourer, or other person whatsoever within the Act of Charles II., and that he could lawfully shave his customers on Sunday. Under the Scots Act of 1579, c. 8, which prohibits "handy labouring or working" being used on Sunday, the House of Lords had in 1837 held that it was illegal for barbers to shave their customers on Sun- days, although the deprivation of a shave might prevent decently disposed men from attending religious worship, or associating in a becoming manner with their families and friends through want of personal cleanliness.

British Colonies. — The English law as to Sunday observance was the original law of the colonies acquired by settlement, and in many of them is left to operate without colonial legislation. In other colonies it is sup- plemented or superseded by colonial Acts. Ontario has a law (Rev. Statutes, c. 246) which, besides the matters included in the Act of Charles II., prohibits political meetings, noisy games, shooting, fishing, and excursions, and to some extent the running of street railways. The

Indians of the province are exempt from the Act. In New Zealand an Act of 1884 (c. 24, § 16) prohibits the carrying on on Sunday of any trade or calling, but the exceptions are numerous, and, besides works of necessity or charity, include driving live stock, sale of medicines, sale or delivery of milk, hairdressing or shaving before 9 a.m., driving public or private carriages, keeping livery stables, working railways, ships and boats, and letting boats for hire, and work in connexion with post offices and telegraphs, and with daily newspapers.

United States. — The early legislation in the Eastern, and particularly in the New England states, prohibited business, travelling, and work of all kinds except of ab- solute necessity or of religious or charitable purpose.

Unsuccessful attempts have been made to have the Sunday laws declared unconstitutional and invalid as interfering with the liberty of conscience and worship and the rights of property guaranteed by the Federal and State constitutions. But legislation has resulted in considerable relaxation from the old Puritan strictness. In Massachusetts, which may be fairly taken as repre- senting the Eastern states, public service corporations, . such as railway, street railway, steamboat, telegraph, telephone, electric lighting, water and gas companies, are permitted to serve the public in the usual manner. Public parks and baths are open. Tobacco may be sold by licensed innholders, common victuallers, druggists, and newsdealers. Bake shops may be open during cer- tain hours. All other shops must be closed. Saloons are closed, and liquor can be served only to the guests of licensed innholders. Horses, carriages, boats, and yachts may be let for hire. All games and entertainments, except licensed sacred concerts, are prohibited. In Connecticut Sunday recreation is still prohibited, but electric and steam cars are now allowed to run. Sunday is a close time for game and birds (1899). In many of the Western states base-ball games and various enter- tainments for pay are permitted, and in some saloons are open. In many but not all the states such persons as by their religion are accustomed to observe Saturday are allowed to pursue their ordinary business on Sunday. In Delaware and Illinois barbers may not shave custom- ers on Sundays; and in Georgia guns and pistols may not be fired (1898). In North Dakota the fines for Sabbath-breaking have been raised. Statutory provision has lately been made in Minnesota (1899) for investiga- tion by the labour bureaux into Sunday labour ; while in New York City the population of European origin have been much vexed by the enforcement of the Sunday laws.

Europe. — On the continent of Europe there is a dis- tinct tendency to restrict Sunday labour, not on reli- gious grounds, but in the interests of the industrial classes. In France a law of 13th June 1896 regulates le repos hebdomadaire, and M. Baudry d'Asson in that year introduced a Bill proposing to prohibit Sunday labour, but this was reported against and rejected. In Austria in the first half of the 19th century Sunday labour was prohibited on religious considerations. In 1884 legislation was passed with reference to factory workers, and after divers amendments and much discus- sion, comprehensive laws were passed in 1895. These laws prohibit factory work on Sundays, with certain specified exceptions corresponding

to those of the English Factory Acts, and subject to the right of the Minister of Commerce to except works of a character which renders Sunday labour inevitable. Commercial enterprise or labour in shops, offices, &c, and hawking is allowed on Sundays for not more than six hours. The hours during which Sunday opening is permissible are settled by a form of local option. (w. f. c.)

Sunderland, a seaport and municipal (extended 1895), county (1888), and parliamentary borough, Durham county, England, at the mouth of the Wear, 269 miles north by west of London by rail. Recent buildings in- clude the town hall, the museum and library, and other public institutions. Electric lighting is supplied by the corporation, which also owns a system of electric tram- ways. Two new piers, 2790 and 2844 feet long respec- tively, have been built, so as to form a harbour about 150 acres in area. There are two other piers at the south entrance to the south dock. – The docks already opened accommodate many hundreds of vessels, and an under- taking is in hand to make the port adequate to the entry and exit of vessels of any size at any time. Besides the other docks there are two graving docks respectively 441 and 356 feet long. There are over a dozen shipbuilding yards. A large park at Boker and two smaller parks have been opened. In 1891, 6336 persons were employed in shipbuilding, 2057 in iron and steel manufactures, 2580 in the making of machines, and 1225 in mining. There are four daily newspapers. At this port 318 vessels of 229,081 tons were registered in 1888 ; in 1898, 252 of 266,211 tons. Vessels entered in 1888, 8473 of 2,719,256 tons ; cleared, 8376 of 2,772,837 tons ; in 1900, entered 6377 of 2,453,883 tons ; cleared, 6487 of 2,559,025 tons. The value of the imports in 1900 was £695,350, against £583,561 in 1888. The value of the exports in 1900 was £2,320,200, against £583,561 in 1888. Area of municipal and county borough in 1891, 2868 acres ; popu- lation in 1881, 116,526 ; in 1891, 131,015. The extended area (3739 acres) is coextensive with that of the newly- constituted parish of Sunderland, which includes the- old parishes of Sunderland, Bishopwearmouth Panns, and almost the entire part of Bishopwearmouth on the south bank of the river ; also Monkwearmouth and Monk- wearmouth Shore on its north bank. The population on this area in 1891 was 131,686; in 1901, 146,565.

Sundsvall, a seaport town of Sweden, Vesternorr- land county, on the east coast, on a wide bay of the Baltic, 117 miles north from Gefle, and connected by a branch line (70 miles) with the Stockholm-Trondhjem railway at Ange (301 miles from Stockholm). Having been rebuilt in brick and stone since a destructive fire of 1888, it is one of the best built towns in Sweden, with a fine Gothic church, handsome schools, slojd school, town hall, theatre (1894), &c. It possesses about forty steam saw- mills, besides wood-pulp factories, steel-works, brick- works, engineering shops, breweries, and joineries, but owes its chief importance to its export trade in timber (6 to 7 million cubic feet annually), the bulk of which goes to Germany, France, and Great Britain. It also exports wood-pulp, and a little iron and fish. There is a special trade with Finland. The harbour, which is usually- closed by ice from about the middle of December to the second week in May, is sheltered against the east winds by a group of islands. In 1900 the port was cleared by 1033 vessels of 559,500 tons. Population (1900), 14,831.

Superior, a city of Wisconsin, U.S.A., the capital of Douglas county. It is situated in lat. 46° 42’, long. 92° 02’, at the head of Lake Superior, opposite Duluth, Min- nesota, in the north-westei^i part of the state, and at an altitude of 641 feet. The city is laid out with great regularity on a level plain, with broad streets, well paved mainly with wooden blocks, has an excellent water-supply drawn from Lake Superior, and is well sewered. It has an excellent harbour, shared with Duluth, and formed by Minnesota and Wisconsin Points, which, projecting at right angles from the north and south shores respectively, nearly close in the upper end of the

lake. It has an immense lake traffic, consisting largely of wheat, coal, and lumber. It has four railways — the Chicago, St Paul, Minneapolis, and Omaha ; the Duluth, South Shore, and Atlantic ; the Great Northern ; and the Northern Pacific, which add greatly to the city’s traffic. The manufactures of the city are large and are rapidly increasing. They consist mainly of flour, lumber and lum- ber products, and iron and woollen goods. In ltlOO the city contained 185 manufacturing establishments, with a

capital of $5,882,562, employing 1958 hands and having a product valued at $7,527,703. There are many grain elevators, coal docks, and shipyards. The assessed valua- tion of real and personal property in 1899 was $10,604,151, the net debt of the city was $1,356,241, and the rate of taxation was $40”50 per $1000. The rate of assessment was very low. Superior was originally a trading post of the Hudson Bay Company. The city was founded in 1855, but no settlement followed, and it was not until 1885, thirty years later, that the present city commenced its rapid growth. Population (1890), 11,983; (1900), 31,091, of whom 11,419 were foreign-born and 186 negroes.

Suppe, Franz VOn (1820-1895), Austrian musical composer, whose real name was Francesco Ezechiele Ermenegildo Suppe-Demelli, was born at Spalato, in Dalmatia, in 1820, and died at Vienna in 1895. Originally he studied philosophy at the Uni- versity of Padua, but on the death of his father devoted himself to music, studying at the Vienna Conservatoire under Sechter and Seyfried. He began his musical career as a conductor in one of the smaller Viennese theatres, and gradually worked his way up to be one of the most popular composers of light opera of the day. Outside Vienna his works have never won much success. Only two of his sixty comic operas have ever found their way to London. Of these Fatinitza (Vienna, 1876 ; London, 1878) was the most successful. Boccaccio (Vienna, 1879 ; London, 1882) only enjoyed a moderate amount of favour. It would be useless to attempt a catalogue of Suppe’s comic operas, which are of the most ephemeral character, and only at their very best can pretend to something of the charm of Strauss. Suppers overture to Dichter und Bauer is his most successful orchestral work. He also wrote some Church music.

Sural, a city and district of British India, in the Gujarat division of Bombay. The city is situated on the left bank of the river Tapti, 14 miles from its mouth; railway station, 167 miles north of Bombay. Population

(1881), 109,844; (1891), 109,229; (1901), 118,364.

The modern city is well laid out, with roads and markets. The most interesting monuments are the tombs of English and Dutch merchants of the 17th century. The military cantonment lies to the west. Surat is still a centre of trade and manufacture, though some of its former industries, such as

shipbuilding, are now extinct. There are three cotton mills, with 181 looms and 45,000 spindles, employing 1550 hands ; twenty factories for ginning and pressing cotton ; a rice- cleaning mill ; and a paper mill. Fine cotton goods are woven in handlooms, and there are special manufactures of silk brocade and embroidery. The chief trades are or- ganized in guilds. There are many wealthy Parsi, Hindu, and Mahommedan merchants. There are three high schools, of which one is supported by the Government, one by a mission, and one by a Hindu association ; total pupils (1896-97), 1124; also a municipal industrial school. The city has twelve printing-presses, issuing several vernacular newspapers.

The district has an area of 1662 square miles. Population (1881), 614,198; (1891), 649,989, showing

an increase of 6 per cent. ; average density, 391 persons per square mile, being the second highest in the province. In 1901 the population was 636,602, showing a decrease of 2 per cent. Land revenue and rates, Rs.29, 76,000, the incidence of assessment being Rs. 3-5-7 per acre. Cultivated area (1897-98), 481,531 acres, of which 10,256 were irrigated from wells, &c. Number of police, 833 ; children at school (1897-98), 25,306, being 4‘4 per cent, of the total population ; registered death-rate (1897), 33‘48 per 1000. The principal crops are millet, rice, pulse, and cotton. After Surat city, the chief centre of trade is Bulsar. The district is traversed for 74 miles by the main line of the Bombay and Baroda Railway, with 15 stations ; and a branch is now being constructed along the Tapti valley to join the Great Indian Peninsula in Khandeish.

The Surat Agency consists of three native states — Dharampur, Bansda, and Sachin. Total area, 1051 square miles ; population (1891), 181,208 ; (1901), 161,010, showing a decrease of 11 per cent. Dharam- pur has an estimated revenue of Rs. 4, 13,000; tribute, Rs.9000. Bansda: revenue, Rs.3,33,000; tribute, Rs. 154. Sachin : revenue, Rs.2,08,500 ; no tribute. The chiefs of the two former are Rajputs ; the last is a Mahommedan.

Surbiton, a civil parish and town of England, on the Thames, in the ancient parish of Kingston, 12 miles south-west of London, and in the Kingston parliamentary division of Surrey. Station on the London and South- Western Railway. Population of urban district in 1881, 9406; in 1901, 15,019.

Surface. — Most of the results briefly outlined in the following article depend upon the method of treat- ment of the geometry of surfaces founded on the con- sideration of the expression of the lineal element in terms of two parameters, u, v,

ds2 = Edu2 + 2Ydudv + Gdv2, u = const, v = const, being thus systems of curves traced on the surface. This method has the great advantage of dealing in the most natural way with all questions con- nected with geodetics, geodetic curvature, geodetic circles, &c. — in fact, all relations of lines on a surface which can be formulated without reference to anything external to the surface. All such relations when deduced for any particular surface can be at once generalized in their application, holding good for any other surface which has the same expression for its lineal element ; e.g., relations involving great circles and small circles on a sphere furnish us with corresponding relations for geodetics and geodetic circles on any synclastic surface of constant specific curvature. The study of surfaces from this point of view may be said to have been inaugurated by Gauss in his classical paper published in 1828, Disquisitiones generales circa superficies curvas. He begins by intro- ducing the conception of the integral curvature (” curvatura integra “) of any portion of a surface. This he defines to be the area of the corresponding portion of a sphere of unit radius, traced out by a radius drawn parallel to the

normal at each point of the surface; i.e., it is fl— ,

J J RR

where R, R’ are the principal radii of curvature. The

quotient obtained by dividing the integral curvature of a

small portion of the surface round a point by the area of

that portion, that is g-g„ he naturally calls the measure of curvature or the specific curvature at the point in question. He proceeds to establish his leading proposi- tion, that this specific curvature at any point is expressible in terms of the E, F, and G which enter into the equation for the lineal

element, together with their differential co- efficients with respect to the variables, u and v.

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It is desirable to make clear the exact significance of

this theorem. Of course, for any particular surface, the

curvature can be expressed in an indefinite variety of

ways. The speciality of the Gaussian expression is that

it is deduced in such a manner as to hold good for all

surfaces which have the same expression for the lineal

element. The expression for the specific curvature, which

is in general somewhat elaborate, assumes a very simple

form when a system of geodetics and the system of their

orthogonal trajectories are chosen for the parameter curves,

the parameter u being made the length of the arc of the

geodetic, measured from the curve, w = 0 selected as the

standard. If this be done the equation for the lineal

element becomes ds1 — du2 + P2dv2, and that for the specific

1 1 d?P

curvature -^g, = ~ p-j-i- By means of this last expression

Gauss then proves that the integral curvature of a triangle formed by three geodetics on the surface can be expressed in terms of its angles, and is equal to A + B + C — 7r, a theorem he, with natural satisfaction, calls ” elegantissinvwm.”

This theorem may be more generally stated.

The integral curvature of any portion of a surface = 2?r — Idi round the contour of’ this portion . . . (A), where di denotes the angle of geodetic contingence of the boundary curve. The angle of geodetic contingence of a curve traced on a surface may be defined as the angle of intersection of two geodetic tangents drawn at the extremities of an element of arc, an angle which may be easily proved to be the same as the projection on the tangent plane of the ordinary angle of contingence.

The geodetic curvature, which we shall denote by -, is

thus equal to the ordinary curvature multiplied by -cos , being the angle the osculating plane of the curve makes with the tangent plane.

The theorem (A), discovered by Gauss by Ms E, F, G analysis, may be established geometrically in the following simpie manner : — ■

If we draw successive tangent planes along the curve, these will intersect in a system of lines, termed the conjugate tangents, forming a developable surface. If we unroll this developable it appears at once that di=d8-df, where di is the angle of geodetic contingence, dB the angle between two consecutive conjugate tangents, \p the angle the conjugate tangent makes with the curve. Therefore, as f returns to its original value when we integrate round the curve, we have 2di=2d0. This equation holds for both the curve on the given surface and the representative curve on the sphere. But the tangent planes along these curves being always parallel, their successive inter- sections are so also ; therefore 2d0 is the same for both ; conse- quently Xdi for the curve on the surface = 2di for the repre- sentative curve on the sphere. Hence integral curvature of curve of surface = area of representative curve on sphere,

=2tt – ‘Zdi on sphere by spherical geometry, = 2w – ~Zdi for curve on surface.

A useful expression for the geodetic curvature of one of the curves, v = const, can be obtained. If a curve receive a small displacement on any surface, so that the displace- ments of its two extremities are normal to the curve, it follows, from the Calculus of Variations, that the variation

/a 1

— ds where – is the geodetic

curvature, and 8n the normal component of the displace- ment at each point. Applying this formula to one of the v curves, we find

sfFdv=fd^ Sudv = S length of curve = A UVdv,

and as Su is the same for all points of the curve, – = j, — .

We can deduce immediately from this expression Gauss’s value for the specific curvature. For applying theorem (A) to the quadrilateral formed by the curves u, ult v, vlt and remembering that Jidi along a geodetic vanishes, we have

f [Vdudv

I I t, p, – = – 2rfi for curve BC — Zdi for curve DA,

= – X-ds for curve BC + 2,-ds for curve AD, P P

= -/p au?dv for curve Bc+ fp Tmv for cury0 AD’

/{©..(f).}-

P (PP

therefore passing to the limit tn>/= – -j-2.

Gauss then proceeds to consider what the result will be if a surface be deformed in such a way that no lineal element is altered. It is easily seen that this involves that the angle at which two curves on the surface intersect is unaltered by this deformation ; and since obviously geodetics remain geodetics, the angle of geodetic contingence and consequently the geodetic curvature are also unaltered. It therefore follows from theorem (A) that the integral curvature of any portion of a surface and the specific curvature at any point are unaltered by non-extensional deformation.

Geodetics and Geodetic Circles.

For the definition of a geodetic and its fundamental pro- perties see article Surface, vol. xxii. It is also explained in that article within what range a gebdetic possesses the property of being the shortest path between two of its points. The determination of the geodetics on a given surface depends upon the solution of a differential equation of the second order. The first integral of this equation when it can be found for any given class of surfaces gives us the characteristic property of the geodetics on such surfaces. The following are some of the well- known classes for which this integral has been obtained : 1. Quadrics ; 2. Developable surfaces ; 3. Surfaces of revolution.

1. Quadrics. — Several leading mathematicians about the middle of last century made a special study of the geometry of the lines of curvature and the geodetics on quadrics, and were rewarded by the discovery of many wonderfully simple and elegant analogies between their properties and those of a system of confocal conies and their tangents in piano. As explained in the article on Surfaces, the lines of curvature on a quadric are the systems of orthogonal curves formed by its intersection with the two systems of confocal quadrics. Joachimstal showed that the interpretation of the first integral of the equation for geodetics on a central quadric is, that along a geodetic pD = constant (C), p denoting the perpendicular let fall from the centre on the tangent plane, and D the semidiameter drawn parallel to the element of the geodetic, the envelope of all geodetics having the same C being a line of curvature. In particular, all geodetics passing through one of the real umbilics (the four points where the indicatrix is a circle) have the same C.

Michael Eoberts pointed out that it is an immediate consequence of the equation pD = C, that if two umbilics, A and B (selecting two not diametrically opposite), be joined by geodetics to any point P on a given line of curvature, they make equal angles with such line of curvature, and consequently that, as P moves along a line of curvature, either PA + PB or PA – PB remains constant. Or, conversely, that the locus of a point P on the surface, for which the sum or difference of the geodetic distances PA and PB is constant, is a line of curvature. It follows that if the ends of a string be fastened at the two umbilics of a central quadric, and a style move over the surface keeping the string always stretched, it will describe a line of curvature.

Another striking analogue is the following : — As piano, if a variable point or an ellipse be joined to the two foci S and H, tan gPSH tan ^PB.S = const, and

for the hyperbola tan gPSH/ tan gPHS = const, so for a

line of curvature on a central quadric, if P be joined to two umbilics S and H by geodetics, either the product or the

ratio of the tangents of ^PSH and -PHS will be const.

Chasles proved that if an ellipse be intersected in the point A by a confocal hyperbola, and from any point P on the hyperbola tangents PT, PT’ be drawn to the ellipse, then the difference of the arcs of the ellipse TA, T’A = the difference of the tangents PT, PT’ ; and subsequently, Graves showed that if from any point P on the outer of two confocal ellipses tangents be drawn to the inner, then the excess of the sum of the tangents PT, PT’ over the intercepted arc TT’ is constant. Precisely the same theorems hold for a quadric replacing the confocals by lines of curvature and the rectilineal tangents by geodetic tangents. Hart still further developed the analogies with confocal conies, and established the following : — If a geodetic polygon circumscribe a line of curvature, and all its vertices but one move

on lines of curvature, this vertex will also describe a line of curvature, and when the lines of curvature all belong to the same system, the perimeter of the polygon will be constant.

2. Geodetics on Developable Surfaces. — On these the geodetics are the curves which become right lines when the surface is unrolled into a plane. From this property a first integral can be immediately deduced.

3. Geodetics on Surfaces of Revolution. — In all such the geodetics are the curves given by the equation, r sin = const, r being the perpendicular on the axis of revolution, 4> the angle at which the curve crosses the meridian.

The general problem of the determination of geodetics on any surface may be advantageously treated in con- nexion with that of ” parallel ” curves. By ” parallel ” curves are meant curves whose geodetic distances from one another are constant — in other words, the orthogonal trajectories of a system of geodetics. In applying this method the determination of a system of parallel curves comes first, and the determination of the geodetics to which they are orthogonal follows as a deduction. If (u, v) = const be a system of parallel curves, it is shown that (j> must satisfy the partial differential equation

^)2-2F(g)(g)+G(|r)2=EG-F,

If (u, v, a) = const be a system of parallel curves

satisfying this equation, then {£,)= const is proved to

represent the orthogonal geodetics. The same method enables us to establish a result first arrived at by Jacobi, that whenever a first integral of the differential equation for geodetics can be found, the final integral is always reducible to quadratures. In this method corresponds to the characteristic function in the Hamiltonian dynamics, the geodetics being the paths of a particle confined to the surface when no extraneous forces are in action. See Mechanics.

The expression for the lineal element on a quadric in elliptic co-ordinates suggested to Liouville the considera- tion of the class of surfaces for which

this equation takes the more general form rfs2 = (U – Y)(U*du* + Yfdv*), where U, Uj are functions of u, and V, V1 functions of v, and shows that, for this class, the first integral of the equation of the parallels is immediately obtainable, and hence that of the corresponding geodetics. It is to be

remarked that for this more general class of surfaces the theorems of Chasles and Graves given above will also hold good.

Geodetics on a surface corresponding to right lines on a plane, the question arises what curves on a surface should be considered to correspond to plane circles. There are two claimants for the position : first, the curves described by a point whose geodetic distance from a given point is constant; and, second, the curves of constant geodetic curvature.

On certain surfaces the curves which satisfy one of these conditions also satisfy the other, but in general the two curves must be carefully distinguishe'd. The property involved in the second definition is more intrinsic, and we shall therefore, following Liouville, call the curves possess- ing it geodetic circles. It may be noted that geodetic circles, except on surfaces of constant specific curvature, do not return back upon themselves like circles in piano. As a particular instance, a geodetic on an ellipsoid (which is, of course, a geodetic circle of zero curvature), starting from an umbilic, when it returns again, as it does to that umbilic, makes a finite angle with its original starting position. As to the curve described by a point whose geodetic distance from a given centre is constant, Gauss showed from the fundamental property of a geodetic that this curve resembles the plane circle in being everywhere perpendicular to its radius. In the same way it holds that the curve described by a point the sum (or difference) of whose geodetic distances from two given points (foci) is constant, resembles the plane ellipse (or hyperbola) in the property that it bisects at every point the external (or internal) angle between the geodetic focal radii, and, as a consequence, that the curves on any surface answering to confocal ellipses and hyperbolas intersect at right angles. The equation for the lineal element enables us to discuss geodetic circles on surfaces of constant specific curva- ture ; for we have seen that if we choose as parameters, geodetics and their orthogonal trajectories, the equation

becomes ds2 = du2 + ~22du2 ; and since ^^ = — _- -7-2, and

KR1

P du»

here ^j = + – it follows P = A cos – + B sin – .

or P = A cosh — h B sinh ~~, according as the sur~~ face is synclastic or anticlastic. If a geodetic circle

\yX

Fig. 1.

(curvature v) be chosen for the starting curve w = 0,

and if v be made the length of the arc OY, intercepted on this circle by the curve v = const (see Fig. 1), then A and B can be proved to be independent of u and P =

cos – + T sin – for a synclastic surface, P = cosh – + % sinh – u. k a J aha

for an anticlastic surface. It follows from the expression for the geodetic curvature – = ^ • j that in both classes of surfaces all the other orthogonal curves u = const will be

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geodetic circles. It also appears that on a synclastic surface of constant specific curvature all the geodetics normal to a geodetic circle converge to a point on either

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Fig. 2.

side as on a sphere, and can be described with a stretched string taking either of these points as centre, the length

of the string being a tan ~’(? J (see Fig. 2). These normals

will be all cut orthogonally by an equator, that is, by a geodetic circle of zero curvature.

For anticlastic surfaces, however, we must distinguish

two cases. If the curvature r of the geodetic circle

> – the geodetic normals meet in a point on the concave

side of the geodetic circle, and can be described as on the synclastic by a stretched string, the length of the

string being a tanh -1(t)> but in this case the geodetic

normals have no equator (see Fig. 3). If on the other

Fig. 3.

hand the curvature of the geodetic circle be <- the

normals do not meet on either side, but do possess an equator, and at this equator the geodetic normals come nearer together than they do anywhere else (see Fig. 4).

On a synclastic surface of constant specific curvature -j

two near geodetics proceeding from a point always meet again at the geodetic distance ira ; and more generally for

Fig. 4. any synclastic surface whose specific curvature at every point lies between the limits ~~5 and A, two near geodetics pro~~ ceeding from a point always meet again at a geodetic distance intermediate in value between ira and irb. On an anticlastic surface two near geodetics proceeding from a point never meet again.

Representation of Figures on a Surface by Corresponding Figures on a Plane ; Theory of Maps.

The most valuable methods of effecting such representa- tion are those in which small figures are identical in shape with the figures which they represent. This property is known to belong to the representation of a spherical surface by Mercator's method as well as to the representa- tion by stereographic projection. The problem of effecting this "conformable" representation is' easily seen to be equivalent to that of throwing the expression for the lineal element into what is known in the theory of heat-conduction as the isothermal form ds2 = \{du2 + dv2), for we have then only to choose for the representative point on the plane that whose rectangular co-ordinates are x=u, y = v. A curious investigation has been made by Beltrami — when is it possible to represent a surface on a plane in such a way that the geodetics on the surface shall correspond to the right lines on the plane (as, for example, holds true when a spherical surface is projected on a plane by lines through its centre) ? He has proved that the only class of surface for which such representation is possible is the class of uniform specific curvature.

Just as the intrinsic properties of a synclastic surface of uniform specific curvature are reducible to those of a par- ticular surface of this type, i.e., the sphere, so we can deal with an anticlastic surface of constant specific curvature, and reduce its properties to a particular anticlastic surface. A convenient surface to study for this purpose is that known as the Pseudosphere, formed by the revolution of the tractrix (an involute of the catenary) round its base (see Fig. 5).

Its equations are r — a sin <£, 2 = a(cos <£ + log tan^). This surface can be conformably represented as a plane map by

axis of revolution.

Fig. 5.

choosing x — is the longitude of the point and

y =

sin0

It will then be found that

ads’ — — — , where

d s = lineal element on the surface, ds’ = same on the map. It easily appears that geodetic circles on the surface are represented by circles on the map, the angle \p at Y

which these circles cut the base depending only upon the

curvature of the geodetic circle, cos \b being equal to -. As

P a particular case it follows that the geodetics on the surface are represented by those special circles on the map whose centres lie on the base (see Fig. 6). The geodetic distance between two points P and Q on the surface is represented by the logarithm of the anharmonic function AP’BQ’, where P’Q’ are the representing points on the map, A B the points in which the circle on the map which passes through P’ and Q’ and has its centre on the base cuts the base. The

perimeter (/) of a geodetic circle of curvature – turns out

p

to be — ~~a —~~, and its area (– – 2ir)a2. The geometry of

coaxal circles in piano accordingly enables us to demon- strate anew by means of the pseudosphere the properties which we have shown to hold good in all anticlastic sur- faces of constant curvature. Thus the system of geodetics cutting orthogonally a geodetic circle C will be represented on the map by circles having their centres on the base, and cutting a given circle C orthogonally, i.e., by a coaxal system of circles. We know that the other orthogonal trajectories of this last system are another coaxal system, and therefore, going back to the pseudosphere, we learn that if a system of geodetics be drawn normal to a geodetic circle, all the orthogonals to this

system are geodetic circles. It is to be noted that while every point on the surface has its representative on the map, the converse does not hold. It is only points lying above the line y’ = a which have their prototypes on the surface, the portion of the plane below this line not answering to any real part of the surface. If we take any curve C on the map crossing this line, the part of the curve above this line has as its prototype a curve on the surface. When C reaches this line, C reaches the circular base of the pseudosphere, and there terminates abruptly. The distinction between the two cases of a geodetic circle with curvature greater and one with curva- ture less than – also comes out clearly. For if curvature a

of C > – the map circle C lies entirely above the base, and a

the coaxal system cutting C orthogonally passes through a

real point ; therefore C has a centre. If curvature of

C<- the map circle C intersects the base, the coaxal a

system cutting C orthogonally does not intersect in a real

point, and C has accordingly no centre. It is of interest

to examine in what way a pseudosphere differs from a plane as regards the behaviour of parallel lines. If on a plane a geodetic AB (i.e., a right line) be taken, and another geodetic constantly pass through a point P and revolve round P, it will always meet AB in the point except in the particular position. On the pseudosphere, if we carry out the corresponding construction, the position of the non-intersecting geodetic is not unique, but all geodetics drawn within a certain angle fail to meet the geodetic AB. See Geometry, Non-Euclidean.

Minimal Surfaces.

For the definition of these surfaces and their partial differential equations, see Surfaces. From this defini- tion readily follows the well – known property of these surfaces — that the two principal curvatures are at every point of such a surface equal and opposite. For familiar instances of the

class we have the surface formed by the revolution of a catenary round its base called by French mathematicians the alysseide, and the right

conoid, z = a tan v~, “formed by the successive edges of the

steps of a spiral staircase. Monge succeeded in expressing the co-ordinates of the most general minimal surface in two parameters, and in a form in which the variables are separated. The separation of the variables in the expres- sion signifies that every minimal surface belongs to the class of surfaces which can be generated by a movement of translation of a curve. Enneper has thrown the expres- sion for the co-ordinates into the following convenient forms —

*=J/(1 – «2)/W^’+ 1/(1 ” v^(v)dv,

9 = |/(1 + «’)/(«)** – 1/(1 + v2)4>(v)dv,

z = juf(u)du+ Iv4>(y)dv.

It is noteworthy that the expression for the lineal element on a minimal surface assumes the isothermal form ds2 = X(du2 + dv2), (1) when the curves u = const, v = const are so chosen as to be the lines of curvature ; and (2) when they are chosen to be the lines in which the surface is intersected by a system of parallel planes and the orthogonal trajectories of these lines. It is easily proved that a minimal surface possesses the property of being con- formable to its spherical representation. For since the indicatrix at every point is a rectangular hyperbola, the angle between the elements of two intersecting curves = angle between their conjugate tangents; but this = angle between conjugate tangents to representative curves on sphere = angle between these curves themselves.

The problem of finding a minimal surface to pass through a given curve in space, known as Plateau’s problem, possesses an exceptional interest from the circum- stance that it can be always exhibited to the eye in the following way by an actual physical experiment. Dip a wire having the form of the given curve in a soap-bubble solution, and the film adhering to the wire when it is withdrawn is the surface required. This is evident, since from the theory of surface-tension we know that a very thin film must assume that

form for which the area of its surface is the least possible. The same theory also furnishes us with an elementary proof of the characteristic property that the sum of the curvatures is everywhere zero, inas- much as the normal pressure on the film, here zero, is known to be proportional to the surface-tension multiplied by the sum of the curvatures.

Riemann, adopting a method depending upon the use of the complex variable, has succeeded in solving Plateau's problem for several interesting cases, e.g.,

1° when the contour consists of three infinite right lines; 2° when it consists of a gauche quadrilateral; and 3° when it consists of any two circles situated in parallel planes. For Lie's investigations in this domain, see Groups, Theory of Continuous.

Non-exten&ional Deformation.

We have already explained what is meant by this term. It is a subject to which much study has been devoted, connecting itself, as it does, with the work of Gauss in pure geometry on the one hand, and with the theory of elasticity on the other. Several questions have been opened up : — (1) What are the conditions which must be fulfilled by two surfaces such that one can be " deformed " so as to fit on the other? (2) What instances have we of known surfaces applicable to one another? (3) What surfaces are applicable to themselves? (4) In regard to infinitely small deformations, what are the differential equations which must be satisfied by the displacements ? (5) Under what circumstances can a surface not be deformed? Can a closed surface ever be deformed ?

1. Of course if two surfaces are applicable, we must be able to get two systems of parameter curves u = const, v = const, on the first surface, and two systems on the second, such that the equation for the lineal element, when re- ferred to these, may have an identical form for the two sur- faces. The problem is now to select these corresponding systems. We may

conveniently take for the co-ordinate u the specific curvature on each surface, and choose for v the

function -^ which denotes the rate of increase of u along

dn °

a direction normal to the curve u = const. Then, since at corresponding points both u and v will be the same for one surface as for the other, if the surfaces are applicable, E, F, and G, in the equation, ds2 = Edw2 + 2Fdudv + Gdv2 must be identical for the two surfaces. Clerk-Maxwell has put the geometrical relation which exists between two applicable surfaces in the following way : — If we take any two corresponding points P and P' on two such surfaces, it is always possible to draw two elements through P parallel to conjugate semi-diameters of the indicatrix at P, such that the corresponding elements through P' shall be parallel to conjugate semi-diameters of the indicatrix at P'. The curves made up of all these elements will divide the two surfaces into small parallelograms, the four parallelo-grams having P as common vertex being identical in size and shape with the four having P' as vertex. Maxwell regards the surfaces as made up in the limit of these small parallelo- grams. Now, in order to render these surfaces ready for application, the first step would be to alter the angle between two of the planes of the parallelograms at P, so as to make it equal to that between the corresponding planes at P'. If this be done it is readily seen that all the angles between the other planes at P and P', and at all other corresponding points, will become equal also. The curves which thus belong to the conjugate systems common to the two surfaces may be regarded as lines of bending.

2. Any surface of uniform specific curvature, whether positive or negative, is applicable to another surface of the same uniform specific curvature, in an infinite variety of ways. For if we arbitrarily choose two points, 0 and O', one on each surface, and two elements, one through each point, we can apply the surfaces, making 0 and O' cor- responding points and the elements corresponding ele- ments. This follows from the form of the equation of the lineal element, which is for synclastic surfaces ds2 = du2 +

a2 sin2(- W, and for anticlastic, ds2 = du2 + a?smh2(-\dv2,

and is therefore identical for the two surfaces in question. Again, a ruled surface may evidently be deformed by first rotating round a generator, the portion of the surface lying to one side of this generator, then round the consecutive generator, the portion of the surface lying beyond this again, and so on. It is clear that in such deformation the rectilinear generators in the old sur- face remain the rectilinear generators in the new ; but it is interesting to note that two ruled surfaces can be constructed which shall be applicable, yet so that the generators will not correspond. For, deform a hyperboloid of one sheet in the manner described, turning the portions of the surface round the consecutive gene- rators of one system, and then deform the hyperboloid, using the generators of the other system. The two sur- faces so obtained are, of course, applicable to one another, yet so that their generators do not now correspond. Con- versely Bonnet has shown that, whenever two ruled surfaces are thus applicable, without correspondence of generators, they must be both applicable to the same hyperboloid of one sheet. The alysselde is a good example of a surface of revolution applicable to a ruled surface, in this case the right circular conoid, the generators of the conoid coincid- ing with the meridians of the alysseide.

3. As instances of surfaces applicable to themselves, we may take surfaces of uniform specific curvature, as obviously follows from the reasoning already given ; also surfaces of revolution, inasmuch as any such surface can be turned round its axis and still fit upon its old position. . Again, helicoidal surfaces possess this property. A helicoidal surface means that traced out by a rigid wire, which is given a screw motion round a fixed axis, or, which comes to the same thing, the surface made up of a system of helices starting from the points of a given curve, all having the same axis and the same interval between the successive threads. The applicability of such a surface to itself if given a screw motion round the axis, is evident from the law of its formation.

4. The possible small variations £, 17, £ of the points of a surface when it is subject to a small inextensional deformation are conditioned by the equation dxd% + dydrj + dzd£= 0, or making x and y the independent variables,

«(i+*£W(I^4+‘I)

From this it follows that the three equations must sepa- rately hold

d£ df . dtdr, , dt d{ . dv di „

Accordingly, the determination of a possible small defor- mation of a given surface is reduced to the analytical problem of finding three functions £, 17, (of the variables x and y to satisfy these equations. Changing the co-ordinates to a and /? where a = const, /S = const, are the curves of inflexion on the surface, the solution of the equations can be shown to depend upon that of the equation

j-t-„ = ku>, where A is a function of a and /? depending on

the form of the surface. The last equation can be in- tegrated, and the possible deformation determined in the case of a spherical surface, or of any surface of uniform specific curvature. It is easily shown that if we have determined the displacements for any surface 8 we can do so for any surface obtained from S by a linear trans- formation of the variables. For let

x’ = a1x + b1y + c1z + d1, y = a2x + b2y + eg + d2, z’ = a$c + bzy + c3z + ds,

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then .the displacements

? = Aij- + B^ + Cai-, V = A2f+B2l, + C2f, r = A3f + B3^ + C3f, where Aj B2 &c. are the minors of the determinant [ax b2 c3], will evidently satisfy the equation

dx’dg + dy’drj + dz’dg = 0. Accordingly the known solution for a sphere furnishes us with a solution for any quadric. M. Moutard has pointed out a

curious connexion between the problem of small deformation and that of the applicability of two finitely different surfaces.

For if dxd£ + dydt] + dzd£= 0, it follows that if Tc be any constant,

{d(x + k£)/**strong**≥**{d(z + k£)}* = {d{x-k^+{d{y-h-n)}^+{d{z-ki)**
Consequently, if we take two surfaces such that for the first

X=x + k£, Y =y + krj, Z = z + k£, and for the second

X' = x – &£, Y' = y – krj, Z = z – &£, then

dX2 + dY2 + dIL2 = dX'2 + dY'2 + dZ'2,

and therefore the new surfaces are applicable.

5. Jellett and Clerk-Maxwell have shown by different methods that, if a curve on a surface be held fixed, there can be no small deformation, except this curve be a curve of inflexion. This may be also proved thus : — There can be no displacement of the tangent planes along the fixed curve, for, at any point of the curve the geodetic curvature cannot alter ; but in present case the ordinary curvature of the curve is also fixed, therefore their ratio is constant, so that 8 (cos 6) = – sin 6W = 0, where 6 is the angle which the osculating plane makes with the tangent plane ; there- fore unless sin 6 = 0, as it is along a curve of inflexion, 86 = 0, and therefore the tangent plane at each point is unaltered. Hence it can be shown that along the given curve not only £, -q, (vanish, but also their differential coefficients of all orders, and therefore no displacement is possible.

The question has been much discussed, Can a closed synclastic surface be deformed ? There seems to be a prevalent opinion amongst mathematicians that such de- formation is always impossible, but we do not think any unimpeachable demonstration of this has yet been given. It is certain that a complete spherical surface does not admit of inextensive deformation, for if it did it would follow from Gauss's theorem that the new surface would have a uniform specific curvature. Now, it is not difficult

to prove that the only closed surface possessing this pro- perty is the sphere itself, provided that the surfaces in question be such that all their tangent planes lie entirely outside them. We can then, by the method of linear transformation already given, extend the theorem of the impossibility of deformation to any ellipsoid.

The theorem, that a sphere is the only closed surface of constant specific curvature, may, we suggest, be established by means of the following two propositions, which hold for integration on any closed surface, p being the perpendicular from the origin on the tangent plane —

(i)

both sides of the first equat rtract the second, and we get-

(2)

Now multiply both sides of the first equation by the constant VRR', and subtract the second, and we get-

which is impossible unless R' = R everywhere, since in accordance with the proviso^) is everywhere positive.

Theorems (1) and (2) are deduced by Jellett by means of the Calculus of Variations in his treatise on that subject. They may also be very simply proved thus : Draw normals to the surface along the contours of the small squares formed by lines of curvature, and let these meet successive parallel surfaces at distances dn, then the volume bounded by two parallel surfaces

=/WH;;s)(1+£)

but taking origin inside, the perpendiculars let fall from 0 on a tangent plane to the outer surface =p + n on account of the parallelism of the surfaces. Also dS for outer surface

=dS(1 + b-)(1 + d7J > therefore volume in question

=i//<*+*)(1+1)(1+f>s-J//^s

Hence equating coefficients of the powers of n —

and //*«=//(i + i)*

References to the original memoirs will be found in Salmon's Analytical Geometry of Three Dimensions, Fkost's Solid Geometry, and, more completely, in Darboux's Lecons sur la theorie ginirale des surfaces. (j. Pu. ; P. Pu.)

SUEGEET.

SINCE the year 1887, when the earlier volume of this Encyclopaedia was published, the science and practice of surgery have been steadily advancing. It is the object of this article to show in what respects the advances have been most marked. Surgical explorers and pioneers have been bold and enterprising to an extraordinary extent, so that regions and tracts which hitherto had only by acci- dent or good fortune, as it were, been entered, have now been systematically surveyed and annexed. But not- withstanding the extraordinary aggressiveness of- modern surgery, the results and statistics of operative work are steadily improving, and it has been truly said that the mortality from surgical operations has been reduced to a point never dreamt of by the last generations of surgeons.1 Surgery is every day becoming more successful and more responsible, but it is not, nor can it ever be, an exact science, for no two cases are ever precisely alike. The surgeon of to-day deems it an essential part of his duties to study the general condition of his patient, and,

1 The Lancet, 1891, vol. ii. p. 1447.

so far as practicable, his moral and physical environment, before urging the performance of a serious operation. The dashing operator who played so bold and useful a part before the days of anaesthetics and of asepticism would at the present time be hopelessly out of place, when each of the many details of the preparation for the operation, of the operation itself, and of the after-treat- ment, has to be a matter of

the most careful consideration. When the ninth edition of this Encyclopaedia was going through the press, the carbolic acid spray, which to some practitioners had apparently been the embodi- ment of the Listerian theory and practice, was ^.™£“c beginning to pass into desuetude, though for a good many years after that time certain surgeons con- tinued to employ it during operation and during the subsequent dressings of the wound. Surgeons who, having had practical experience of the unhappy course which their operation cases had been apt to run in the pre- Listerian days, and of the vast improvements which ensued on their adoption of the spray-and-gauze treatment

in its entirety, were, not unnaturally, reluctant to operate except in a cloud of carbolic vapour. So, even after Lister himself had given up the spray, its use was con- tinued by many of his disciples. It was in the course of 1888 that operating surgeons began to neglect the letter of the antiseptic treatment and to bring themselves more under the broadening influence of its spirit. Certain adventurous and partially unconvinced surgeons began to give up the carbolic spray gradually, by importing a smaller percentage of carbolic acid to the vapour, until at last the antiseptic disappeared altogether, apparently without detriment to the excellence of the results obtained. But while some surgeons were thus ceasing to apply the antiseptic spray to the wound during operation, others were pouring mild carbolic lotion, or a very weak solution of corrosive sublimate (an extremely potent germicide) over the freshly-cut surfaces. These measures were in turn given up, to the advantage of the patient; for it was hardly to be expected that a chemical agent which was strong enough to destroy or render inert septic micro- organisms in and about a wound, would fail to injure exposed and living tissues. Eventually it became gene- rally admitted that if a surgeon was going to operate upon the depths of an open abdomen for an hour or more, the chilling and the chemical influences of the spray must certainly lower the vitality of the parts exposed, as well as interfere with the prompt healing of the wounded surfaces.

With the spray went also the “protective,” the paraffin gauze, and the mackintosh sheeting which enveloped the bulky dressing.

Years before this happened, in the address on Surgery given at the Cork meeting of the British Medical Associa- tion, Sir William (then Mr) Savory had somewhat severely criticized the rigid exclusiveness of the members of the spray-and-gauze school : the sum and substance of the address wasj that every careful surgeon Aseptic wag an antiSeptic surgeon, and that the success of the Listerian surgeon did not depend upon the spray or the gauze, or the two together, but upon cleanliness — that the surgeon’s fingers and instruments and the area operated on must be surgically clean. Though careful experiment shows that it is impossible for the surgeon to remove every trace of septicity from his own hands and from the skin of his patient, still with nail-brush, soap, and water, and alcohol or turpentine, with possibly the help of some mercuric germicide, he can, for all practical purposes, render his hands safe. Eecognizing this difficulty, some surgeons prefer to operate in thin rubber or white cotton gloves which can, for certain, by boiling, be rendered free of all germs ; but this refinement does not seem to be generally acceptable, whilst the results of practice show that it is by no means necessary. The careful, the antiseptic surgeon of 1885 is to-day represented by the careful, the aseptic surgeon. The antiseptic surgeon was waging a constant warfare against germs which his creed told him were on his hands, in the wound, in the air, everywhere ; and these he attacked with potent chemicals which beyond question often did real damage to the healthy tissues laid bare during the operation. If, as was frequently the case, his own hands became sore and rough from contact with the antiseptics he employed, it is not to be wondered at if a peritoneal surface or an incised tissue became more seriously affected. The surgeon of to-day has much less commerce with antiseptics : he operates with hands which, for all practical purposes, may be considered as germless ; he uses instruments which are certainly germless, for they have just been boiled for twenty minutes in water, to which a little common soda has been added to prevent tarnishing of the steel, and he operates on tissues which

have been duly made clean in a surgical sense. If he were asked what he considers the chief essentials for securing success in his operative practice, he would pro- bably reply, “Soap and water and a nail-brush.” He uses no antiseptics during the operations, he keeps the wound dry by gently swabbing it with aseptic, absorbent cotton-wool, and he dresses it with a pad of aseptic gauze. This is the simple aseptic method which has been gradually evolved from the Listerian antiseptic system.

A great change has taken place in connexion with the use of soft indiarubber drainage-tubes. In former years most surgeons placed one or more of these in the dependent parts of the area of operation, so Dr*!aa«e- that the blood or serum oozing from the injured tissues might find a ready escape. But to-day, except in dealing with a large abscess or some other septic cavity, many surgeons make no provision for drainage, but, bandaging the part beneath a pad of aseptic wool, put on so much pressure that any little leakage into the tissues is quickly absorbed. If a drainage-tube can be dispensed with, so much the better, for if it is not actually needed its presence keeps up irritation and delays prompt healing. But inasmuch as a tube if rightly placed in a deep wound is an insurance against the occurrence of ” tension,” and as it can easily be withdrawn at the end of twenty-four hours (even if it has served no useful purpose), it is im- probable that the practice of drainage of freshly made cavities will ever be entirely given up. If the tube is removed after twenty-four hours its presence can have done no harm, and sometimes the large amount of fluid which it has drained from the wound affords clear evidence that its use has saved the patient much dis- comfort, and has probably expedited his recovery. For septic cavities drainage-tubes are still used, but it must be remembered that they cannot remain long in position without causing and keeping up irritation ; hence, even in septic cases, the modern surgeon discards the tube at the earliest possible moment. If after he has taken it out septic fluids collect, and the patient’s temperature rises, it can easily be reinserted. But it is better to take out the tube too soon than to leave it in too long : this remark applies with special force to the treatment of abscess of the pleural cavity (empyema), in the treatment of which a drainage-tube has been resorted to.

Poultices are now never used : they were apt to be foul and offensive, and were certainly septic and dangerous. If moisture and warmth are needed for a wound they can be obtained ,by the use of, a fold of clean lint, or by some aseptic wool which has been wrung out in a hot solution of boracic or carbolic acid, and applied under some waterproof material, which effectually prevents eva- poration and chilling. There was no special virtue in poultices made of linseed meal or even of scraped carrot : they simply stored up the moisture and heat. They possessed no possible advantage over the modern boracic fomentation under oil-silk.

A severe surgical or other serious injury, or a furious attack of bleeding, produces a lowered condition of the individual which is known as shock or collapse, the heart being unablg to pump blood to the brain in sufficient amount. In recent years many in- dividuals have been saved from a fatal collapse by the timely injection into their veins (or even into the loose tissue of the body) of several pints of boiled water which has been cooled to 105° F., and made somewhat to resemble blood-serum by having dissolved in each pint 60 grains of table salt. Other measures which are now also resorted to for warding off shock are the injection deeply into the tissues of brandy, ether, or of a solution of strychnia.

Much less is heard now of so-called" bloodless "operations.

The bloodlessness was secured by the part to be operated on — an arm, for ihstance — being raised and compressed from the fingers to the shoulder by successive turns of an indiarubber roller-bandage (Esmarch's), the operattoas. main artery of tlie limb being then compressed ' by the application of an elastic cord above the highest turn of the bandage. The bandage being removed, the operation was performed through bloodless tissues. But when it was completed and the elastic cord removed from around the upper part of the limb, a reactionary flow of blood took place into every small vessel which had

been previously squeezed empty, so that though the operation itself had actually been bloodless, the wound could not be closed because of the occurrence of unusually free haemorrhage or troublesome oozing. A still further objection to the application of such an elastic roller-bandage was that septic or tuberculous material might by chance be squeezed from the tissues in which it was perhaps harmlessly lying, forced into the blood-vessels, and so widely disseminated through the body. Esmarch's bandage is therefore but little used now in operative surg- ery. Instead each bleeding point at an operationis promptly secured by a small pair of nickel-plated clip-forceps, which generally have the effect, after being left on for a few minutes, of completely and permanently arresting the bleeding. These clips were specially introduced into practice by Sir Spencer Wells, and it is no unusual thing for a surgeon to have twenty or thirty pairs of them at hand during an extensive operation. Seeing how con- venient, not to say indispensable, they are in such cir- cumstances, the surgeon of to-day wonders how he for- merly managed to get on at all without them.

By means of the Bontgen or X-rays the surgeon is able to procure a distinct shadow-portrait of deeply-placed bones, so that he can be assured as to the presence or raysfea absence of fracture or dislocation, or of out- growth of bone, or of bone-containing' tumours. By this means also he is able to locate with absolute pre- cision the situation of a foreign body in the tissues — of a coin in the windpipe or gullet, of a broken piece of a needle in the hand, of a splinter of glass in the foot, or of a bullet deeply embedded in soft tissues or bone. This effect may be obtained upon a fluorescent screen, or printed in a permanent form upon glass or paper. The shadow is cast by a 10- or 12-inch spark from a Crookes vacuum tube. The rays of Bontgen find their way through dead and living tissues which are far beyond the reach of the rays of ordinary light, and they are thus able even to reveal changes in the deeply placed hip-joint which have been produced by tuberculous disease. In examining an injured limb it is not neces- sary to take off wooden splints or bandages except in cases where the latter have been treated with plaster-of- Paris, lime-salts obstructing the rays and throwing a shadow. Thus the rays pass through an ordinary uric acid calculus in the kidney or bladder ; but if it contain salts of lime, as does

the mulberry calculus (oxalate of lime), a definite shadow is cast upon the screen. The value of the X-rays is not limited to the elucidation of obscure problems such as those jupt indicated : they are also of therapeutic value ; for, example, in the treatment of certain forms of skin disease, as well as of cancer.

Injection Treatment of Sarcoma. — Sarcomata are growths of new tissue of an embryonic type ; the more elementary the cells of which they are built up the more rapid their growth and the greater their malignancy. In inoperable cases a treatment has recently been introduced by Coley, which consists of repeated injections of a sterilized culture of septic micro-organisms. The injections, though not necessarily made into the tumour itself, are supposed to act through the blood, causing fatty degeneration and absorption of the ill-organized cells of the tumour. The injection of such a potent fluid should not be undertaken without a clear appreciation

of the risks run, nor must too much be expected of it. It is sup- posed to be most efficacious in those tumours in which the cellular elements are spindle-shaped ; but at the time of writing there is no clear evidence that, in England at least, any unmistakably sarco- matous tumour has been cured by the treatment.

Carbuncle has been shown to be an intense local inflammation caused by septic germs which have in some manner found their way to the part. The attack ends in mortification of the affected tissue, and, after much suffering, the "core" or mortified part slowly comes away. The modern treatment consists in cutting into the inflamed area, scraping out the germ-laden core at the earliest pos- sible moment, and applying germicides. This method relieves the pain at once, materially diminishes the risk of blood-poisoning, and hastens convalescence.

Aneurysms are now being dealt with in a more direct manner. Without resorting to the speculative and somewhat dangerous method of treatment by compression, or to the application of an indiarubber bandage, the surgeon now without loss of time cuts down upon the artery, and applies an aseptic ligature close above the dilatation. Experience has shown that this method of treatment possesses many

advantages, and that (provided the wound be kept aseptic) it has none of the disadvantages which only recently were generally supposed to attend it. Saccular dilatations of arteries which are the result of cuts or other injuries are treated by legation of the vessel above and below, and by dissecting out the aneurysm. Popliteal, carotid, and other aneurysms, which are not of traumatic origin, are sometimes most successfully dealt with on this plan, which is the old ” Method of Antyllus ” under the influence of asepticism.

Treatment of Tuberculous Lesions. — It has now been settled beyond dispute that tuberculous lesions are due to the growth in the affected tissue of specific micro-organisms which, from their resemblance to minute rods, are called bacilli. They seize upon a tissue the vitality of which has been lowered by malnutrition, injury, or some such cause, and, undergoing proliferation, deter- mine the growth of an unhealthy material which rapidly breaks down. Tuberculous lesions may be found in many other tissues than the lungs, where it is called phthisis. It is specially prone to attack the spongy bone-tissue, joints, skin (lupus), and lymphatic glands — especially those of the neck. Recognizing the infective nature of the disease, and knowing that from one focus the germs may be taken by the blood-stream to other parts of the body, and so cause a general tuberculosis, the surgeon is anxious, by removing the primary lesion, to cut short the disease and promote immediate and permanent convalescence. Experience has shown him that medicines and sea-air cannot be depended upon to cure the disease, any more than could the much- vaunted and disappointing injection of Koch’s tuberculin. Cod-liver oil and sea-air are useful only in so far as they improve the general health and nutrition of the in- dividual, and enable his tissues to wage a more successful warfare against the bacilli. Thus, in the early stage of tuberculous disease of the glands of the neck, for instance, these measures may ren- der excellent service, but when the disease has got a firm hold, nothing short of removal of the glands by surgical operation is likely to be of any avail. The results of this modern treatment of tuberculous disease of the skin, and of the lymphatic glands, has been highly gratifying, for not only has the infected tissue been com- pletely removed, but the resulting scars have been far less notice- able than they would have been had less

radical measures been employed. One rarely sees now a network of scars down the neck of a child, showing how a chain of tuberculous glands had been allowed to work out their own cure. A few years ago, however, such conditions were by no means unusual.

Cancer of the Tongue is now operated on in advanced cases such as in former years would scarcely have been dealt with by a radical operation. An incision is made beneath the jaw and through the floor of the mouth, by which the tongue is drawn out and rendered easily accessible, the arteries being leisurely secured as the tissues are cut across. The upper part of the gullet is plugged by a sponge so that- no bleeding can enter the lungs, and unimpeded respiration is provided for by the preliminary introduction of a tube into the windpipe. Through the incision which is made below the jaw the infected lymphatic glands are removed. To Dr Kocher of Berne the profession and the public are indebted for this important advance in the treatment of this disease.

Intra-Cranial Surgery. — Chronic discharge of matter from the external ear is associated with septic disease of the middle ear, or drum, and as the inflammation is liable to spread to the adjacent structures, abscess is very likely to form in or about the contiguous part of the brain, and a foul clot is apt to plug the large venous channel inside the skull and at its base. If these conditions are allowed to run their course uninterfered with, fatal consequences, chiefly from blood-poisoning, not infrequently ensue. Amongst the most important advances of modern surgery is that of making an aperture into the skull behind the ear and opening up, gently irrigating, and draining an intra-cranial abscess. The septic clot is also turned out from the (lateral) venous sinus, and if the large vein of the neck (internal jugular) is found also to be plugged, it

is exposed and tied in the neck, cleaned of its clot, and, together with the lateral sinus (which communicates with it), is syringed out with an

antiseptic lotion. The result of this treatment is often extremely gratifying. The situation of tumours inside the skull can now be defined with precision, and their removal is sometimes effected with complete success. But inasmuch as such growths are often of a malignant nature, the successful accomplishment of their extirpation is not seldom impracticable. In certain cases of intractable neuralgia of the face the skull is now opened for the removal of a large ganglionic swelling (Gasserian ganglion) through which courses the trunk of the fifth, the tri-facial nerve. The re- sults of this formidable operation are sometimes most successful.

Surgery of the Spine. — Being deeply placed amongst the mass of the muscles of the back, and, moreover, being jealously locked within the bony canal of the vertebral column, the spinal marrow or spinal cord was, until the last few years, generally considered to be beyond the reach even of the most enterprising surgeon. Still, like other tissues, it was liable to diseases and injuries. The exact situation of a tumour pressing upon the spinal cord can be located with great precision by noting the areas of pain and numb- ness, and the height in the limbs or trunk to which loss of power of voluntary movement ascends, and by noting also whether these effects are symmetrical upon the two sides or appear more upon one side than on the other. By cutting away the posterior parts of certain segments- of the vertebral column, tumours of various sorts have been successfully removed from the interior of the canal. Displaced fragments of bone in tuberculous affection of the spine, abscess-contents, and inflammatory tissue have also been similarly dealt with. Macewen of Glasgow and Horsley of London have been pioneers in this development of surgery. In cases of fracture of the spine, with displacement of the vertebra and compression of the spinal cord, surgeons have also been trying what relief can be afforded by the adoption of bold operative measures, but as in most of these cases of fracture-dislocation the spinal cord is torn right across or crushed beyond hope of repair, active measures f cannot be undertaken with much prospect of success.

In the last few years the treatment of spinal abscess has under- gone a ~~great improvement. In the first place, surgeons have re~~ cognized the

fact that the collection of broken-down tuberculous material or fluid is not an abscess in the usual sense, for it does not contain “pus” or “matter.” A spinal abscess is therefore no longer drained : it is incised, scraped, washed out, and swabbed dry, the opening being carefully and permanently sewn up. In this way septic germs are effectually excluded from the cavity, and the patient is spared the depressing and tedious discharging of the cavity which so often followed the old methods of treatment. It must be clearly understood, however, that every spinal abscess does not undergo cure after being subjected to the evacuation and closure treatment mentioned above, but that the surgeon is sometimes compelled to use irrigation and drainage.

In the year 1897 Dr Calot of Berk-sur-Mer introduced the method of straightening out the hump of the back, so often left after disease of the spine, by stretching the child on a flat table and dealing with the hump, under chloroform, with what is com- monly known as ” brute force.” A considerable number of hump- backed children on the Continent as well as in England and America were thus dealt with, but it is doubtful whether the records of those cases, could they all be collected and published, would be found entirely to justify the enthusiasm and publicity with which the method was inaugurated and its details were spread abroad. It is scarcely necessary to say that the forcible straighten- ing of a spine which has developed a hump because tuberculous disease has wrecked the front of the vertebral segments is in no sense a curative operation. Diminishing the size of the projection does not cure the tuberculous ulceration of the bones ; indeed, it may increase the ulcerative process or determine a scattering of the germs of tubercle throughout the body. Still there may be a certain small proportion of cases in which a resort to such rough and speculative measures may possibly be deemed expedient. The operation has not been generally accepted by British and American surgeons. In the practice of the foreign surgeon death ensued in three cases out of thirteen that were operated on, and an English surgeon reported fourteen cases ” in all of which the deformity had recurred although the spines had been fixed in plaster-of-Paris after the straightening.” At present the method— which is not a new one — is on its trial, but it does not look as if it would come through it with triumph.

In cases of advanced tuberculous disease of the spine, in which the spinal cord is compressed within its bony canal either by the posterior parts of the vertebral bodies or by inflammatory products, or in which, after severe injury, the cord is pressed upon by a dis- placed piece of bone, the surgeon may think it expedient to open the spinal canal from behind, removing in the procedure the posterior arches (laminas) of the vertebrae. The operation is called by the hybrid word laminectomy. Sometimes in the case of tuber- culous disease, where the propriety of resorting to the operation is

being discussed, the symptoms of the compression begin to clear off and the child makes a complete recovery without being operated on. When the operation is performed for a crushed cord, the outlook is, as might be expected, very cheerless. Still, there are a certain small number of cases in which it may be given a trial.

Adenoids ; Post-Nasal Vegetations. — A general impression exists that in the last few years a new disease has been invented by surgeons ; the fact is that, thanks to the teaching of Meyer of Copenhagen, surgeons have somewhat recently been shown how they may recognize the existence of a mass of soft spongy tissue between the back of the nose and throat, which, blocking the air-way, pre- vents the due inflation of the lungs and the proper development of the chest. The growths are apt to keep up a constant catarrh near the orifice of the tubes which pass from the throat to the ear, and so render the child dull of hearing or even deaf. They also give rise to asthma, and, like enlarged tonsils — with which they are often associated — they impart to the child a vacant expression, and hinder his physical and intellectual development. Though, except in the case of a cleft palate, they cannot be seen with the naked eye, they are often accompanied by a very visible and suggestive granular condition of the wall of the back of the throat. Their presence may easily and confidently be determined by gently hooking the end of the index-finger round the back of the soft palate. Though the disease is » comparatively recent discovery, it has probably existed as long as tuberculosis itself, with which affection it is somewhat distantly connected. In the unenlightened days many children must have got well of adenoids without opera- tion, and even

at the present time it by no means follows that because a child has these vegetations he must forthwith be operated on. The condition is very similar to that of enlarged tonsils, where with time, patience, and attention to general measures, operation is often rendered unnecessary. But if the child continues to breathe with his mouth open and to snore at night, if he remains deaf and dull and is troubled with a chronic " cold in his head," the question of thorough exploration of the naso-pharynx and of operation should be most certainly considered.

Cleft Palate. — Operations for closing a congenital cleft in the roof of the mouth are now performed much earlier than was customary a few years ago. If the infant be in a satisfactory state of health, the operation may be undertaken within a few weeks of birth. However wide a cleft of the hard and soft palate may be, it is now the custom to deal with it in its entirety at the one operation, rather than to divide the operation into two parts — one for closing the cleft in the soft, and the other for closing that in the hard, palate. In many cases it is better to operate on the cleft palate before dealing with an accompanying hare-lip, and even a few weeks after birth the infant bears the shock of the operation extremely well.

Abscesses in the Lungs are treated by resection of a piece of rib, stitching the lung to the opening in the chest thus made, and, after a few days, when adhesions have formed, opening and drain- ing the cavity. So, also, suppurating bronchiectatic cavities are dealt with, to the great relief of the patient. Portions of the lungs, especially the apex, have been removed by operation in the hope of curing malignant or tuberculous disease, but the treatment has not met, nor is likely to meet, with much success, for if a part of a lung is affected with malignant disease an attempted removal of the implicated tissue is almost certain to leave some outlying patches of disease, whilst if a tuberculous inflammatory patch is so limited in extent as to lend itself to incision, it is more than likely that the area would completely clear up under medical and general treatment without operation. If foreign bodies which have been carried in by the air-stream — such as beads, buttons, or fragments of bone — can be located by the Rontgen rays, they should be re- moved, if be need by operation through the side of

the chest, for if they are allowed to remain embedded in the lung they are very likely to set up inflammatory changes ending in abscess, blood- poisoning, or phthisis.

Afections of the Heart. — It has somewhat recently been proved that incised wounds of the heart may be successfully dealt with by cutting through the ribs and turning up a large flap of the chest wall so as to make a window through which effused blood may be wiped out and the wound of the heart deliberately stitched up. When the presence of abscess in the pericardium has been demon- strated by aspiration, modern experience has shown that the most successful treatment consists in dividing the fourth and fifth costal cartilages of the left side, and incising and draining the suppurating heart-sac.

Cancer of the Breast. — Highly important advances have been made in connexion with the operative treatment of cancer of the breast, and the results of this radical treatment have emboldened surgeons to undertake the removal of cancerous masses which a few years ago they would have considered to be hopelessly beyond their reach. The advances consist in a free and fearless attack, the skin being widely removed with the cancer, and the large muscles of the side of the chest stripped bare of fascia as the mass

is lifted up. The latter is a very important matter, as tlie lym- phatic duets from the breast are now known to be in eonimunica- tion with lymph-spaces over the muscle. The lymphatic ducts running from the breast to the glands in the arm-pit are also taken away, together with the infected glands in the arm-pit. Inasmuch as the operator cannot know what glands are actually infected, he takes them all away so as to make his operation secure. If the muscles of the chest are invaded, he removes them also. In cases where a considerable amount of integument is taken away with the breast, he endeavours to bring the edges of the wound together by freely detaching the skin from the side of the chest so as to obtain loose available flaps whose edges can be

adjusted and secured by sutures without tension. Experience has shown that in the case of re- turn of cancerous growth, repeated operations may be advantageously resorted to. The surgeon therefore keeps the patient under regular supervision, and on the appearance of any fresh nodules of cancer at or near the scar, promptly and thoroughly removes them. In the meanwhile the health and comfort of the patient have often greatly improved, and the secondary operations being, as a rule, far from serious, are submitted to cheerfully and hopefully. Lastly, in those sad cases in which, from obstruction of the lymph-channels and veins in the neighbourhood of the arm-pit, the hand and arm are swollen, heavy, and useless, and cancerous pressure on the nerves is causing terrible neuralgias, which dart down to the elbow or even into the fingers, the expediency of resorting to- Paul Berger's operation may be considered. This operation consists in the removal of the outer part of the collar-bone, the entire shoulder- blade, and the whole of the upper extremity, together with tissue of doubtful integrity in the arm-pit and on the upper part of the chest. Though obviously a- very severe undertaking, Berger's operation does not, as a rule, cause a large amount of shock, whilst the relief which the unhappy patient experiences from it may be lasting and immense. In the case of inoperable cancer of the breast the administration of thyroid extract sometimes proves helpful, but experience does not seem to show that the removal of the ovaries has much influence in checking the growth of the disease. Nevertheless, so many cases have been reported in which real improvement has followed their removal, that the method may still be regarded as worthy of favourable consideration.

Exploratory Laparotomy. — In many cases of serious intra-ab-dominal disease it is impossible for the surgeon to say exactly what is wrong without making an incision and introducing his finger, or, if need be, his hand among the intestines. With due care this is not a perilous or serious procedure, and the great ad- vantage appertaining to it is daily being more fully recognized. It was Dr Oliver "Wendell Holmes, the American physiologist and poet, who remarked that one cannot say of what wood a table is made without lifting up the cloth ; so also it is often impossible to say what is wrong inside the abdomen without making an opening into it. When an opening is made in such

circumstances — provided only it is done soon enough — the successful treatment of the case often becomes a simple matter. An exploratory operation, there- fore, should be promptly resorted to as a means of diagnosis, and not left as a last resource till the outlook is well-nigh hopeless.

A great impetus was given to the surgery of severed intestines by the introduction from Chicago of an ingenious contrivance named, after the inventor, Murphy's button. This consists of a short nickel-plated tube in two pieces which are rapidly secured in the divided ends of the bowel, and in such a manner that when the pieces are subsequently " married " the adjusted ends of the bowel are securely fixed together and the canal rendered practi- cable. In the course of time the button loosens itself into the interior of the bowel and comes away with the alvine evacuation. In many other cases the use of the button has proved convenient and successful, as in the establishment of a permanent communica- tion between the stomach and the small intestine when the ordinary gateway between these parts of the alimentary canal is obstructed by an irremovable malignant growth ; between two parts of the small intestine so that some obstruction may be passed ; or between small and large intestine. The operative procedure goes by the name of shorP-sArcuiting ; it enables the contents of the bowel to get beyond an obstruction. In this way also a permanent working communication can be set up between the gall-bladder, or a dilated bile-duct, and the neighbouring small intestine — the last-named operation bears the precise but impossible name of choledocoduo- denostomy. By the use of Murphy's ingenious apparatus the communication of two parts can be secured in the shortest possible space of time, and this, in many of the circumstances in which it is resorted to, is of the greatest importance. But there is this against the method — that sometimes ulceration occurs around the rim of the metal button, whilst at others the loosened metal causes annoyance in its passage along the alimentary canal. Some surgeons therefore prefer to use a bobbin of decalcified bone or similar soft material, while others rely upon direct suturing of the parts. The last-named method is gradually increasing in popularity, and of course, when time and circumstances permit,

it is the ideal method of treatment. The cause of death in the case of intestinal obstruction is usually poisoning by the absorption of the products of decomposition of the fluid contents of the bowel above the obstruction. It is now becoming the custom, therefore, for the surgeon to complete his operation for the relief of obstruc- tion by drawing out a loop of the distended bowel, incising and evacuating it, and then carefully suturing and returning it.

Gunshot Wounds and Stabs of the Abdomen. — If a revolver bullet passes through the abdomen, the coils of intestine are likely to be traversed by it in several places. If the bullet be small and, by chance, surgically clean, it is possible that the openings may tightly close up behind it so that no leakage takes place into the general peritoneal cavity. If increasing collapse suggests that serious bleeding is taking place within the abdomen, the cavity should be opened forthwith and a thorough exploration made. When it is uncertain if the bowel has been traversed or not, it is well to wait before opening the abdomen, due preparation being made for- performing that operation on the first appearance of symptoms indicative of perforation having occurred. Small per- forating wounds of the bowel are treated by such suturing as the circumstances may suggest, the interior of the abdominal cavity being rendered as free from septic micro-organisms as possible, for it is by the malign influence of such germs that a fatal issue is determined in the case of an abdominal wound, whether inflicted by firearms or by a pointed weapon. If aseptic procedure can be promptly resorted to and thoroughly carried out, abdominal wounds do well, but the recent campaign in South Africa showed that these essentials cannot be obtained upon the field of battle. When after an action wounded men come pouring into the field-hospital, the many cannot be kept waiting whilst prepara- tions are being made for the thorough carrying out of a prolonged aseptic abdominal operation upon a solitary case. Experience showed that Mauser bullets could pierce coils of intestine and leave the unfortunate soldiers in such a condition that, if treated by mere ” expectancy,” more than 50 per cent, of them re- covered, whereas if operations were resorted to fatal septic peritonitis was likely to ensue. Erom a surgical point of view, this was the great lesson of the Boer war, and probably in all future wars experience will show that in

the close proximity of the fight, where time, assistants, pure water, towels, lotions, and others necessaries for carrying out a thoroughly aseptic operation cannot be forthcoming, gunshot wounds of the abdomen had best not be interfered with.

Gastric Ulcer. — Among the complications of the chronic forms of dyspepsia met with, especially in youngish women, is an inflamed spot upon the wall of the stomach, which ulcerates, and not infrequently perforates, the wall, allowing the contents of the stomach to escape into the abdominal cavity. Without operation, such cases almost invariably end fatally, but in recent years it has become a matter of custom for the physician to call in the aid of a surgeon the instant that pain and collapse indicate that per- foration has taken place. The abdomen being promptly opened, the ulcer excised, and the inflamed area turned into the stomach and secured by suturing, the surgeon cleans out the abdomen and puts in a gauze drain. A large proportion of cases of perforated gastric ulcer thus treated recover. Sometimes the physician and surgeon arrange to deal with the ulcerated patch of the stomach before perforation has taken place — a plan of treatment which gives still better results. Reports are accumulating of cases of typhoid fever with perforation of the bowel, which have been successfully dealt with by opening the abdomen, stitching up the ulcer, and washing out or merely wiping out the abdominal cavity.

Tuberculous Peritonitis. — Ithas long been known that inflamma- tion of the peritoneal cavity is frequently met with in tuberculous subjects, and especially amongst children and young adults, and that medical and general treatment is incapable of diverting its downward course. Almost by accident it was discovered, however, that if an incision be made into the abdomen and the tension be relieved by the letting out of some of the tuberculous fluid, the remainder is likely to undergo spontaneous absorption and the peritonitis entirely to clear away. The surgical treatment of tuberculous peritonitis has thus become one of the most remark- able advances of late years ; but the explanation of the improve- ment which follows the simple operation has yet to be discovered.

Liver and Gall-bladder. — Much advance has been made in the treatment of injuries and diseases of the liver and gall-bladder. The liver being a large and friable gland, is not seldom ruptured in the case of severe blows upon the abdomen. Collapse of the patient, and other signs of rupture and haemorrhage, are now taken by the surgeon as a clear indication that the abdomen should be immediately opened and the liver examined and dealt with ; by this means patients have been snatched from death. Liver abscesses are also successfully evacuated by direct incision (through the chest, if need be) instead of by blind and speculative explora- tion through the abdominal wall. Gall-stones lodged in the gall- bladder, impacted in the biliary ducts or, as sometimes happens,

obstructing the small intestine, are successfully operated on through an abdominal incision. Rupture of the gall-bladder has been happily dealt with by opening the abdomen, suturing the rent, and cleansing the peritoneal cavity. Cases of rupture of the liver, spleen, intestine, and kidney which have been successfully treated by bold operative measures are of diminishing rarity.

Pyloroplasty. — Simple fibrous narrowing of the gateway of the stomach or of the intestine is dealt with by divi'ding it longitudi- nally and then suturing the edges of the wound transversely. This ingenious operation widens the track at the expense of an unim- portant fraction of its length. In cases of great dilatation of the stomach with no obstruction to the outlet the slack of the walls may be gathered up by pleating, and so permanently secured by suturing. Loreta's operation for dilatation of the outlet of the stomach is now rarely performed.

Intussusception. — That terribly fatal disease of infants and chil- dren, in which a piece of bowel slips into a piece next below it, is being dealt with on more progressive lines, and therefore is giving promise of a diminished mortality. Hitherto it had generally been the custom to endeavour to reduce the invagination by passing air or water up the

rectum under pressure — a speculative method of treatment which sometimes ended in a fatal rupture of the distended bowel, and often — one might almost say generally — failed to do what was expected of it. The teaching of modern surgery is that a small incision into the abdomen and a prompt withdrawal of the invaginated piece of bowel can be trusted to do all that, and more than, injection can effect, without blindly risking a rupture of the bowel. It is certain that when the surgeon is unable to unravel the bowel with his fingers gently applied to the parts themselves, no speculative distention of the bowel could have been effective. But the outlook in these distressing cases, even when the operation is promptly resorted to, is extremely grave, because of the intensity of the shock which the intussusception and resulting strangulation entail.

Cancer of the Stomach. — In more than one instance the entire stomach has been successfully removed for cancer, the end of the gullet being "married" to the beginning of the small intestine. Partial resection of the stomach is also resorted to from time to time. When the ninth edition of this work was in preparation the operative treatment for cancer of the large intestine chiefly con- sisted in arranging for the escape of the fasces which had accumu- lated above the obstruction by making an opening in the right or left loin, as the case might demand. The great advantage of this operation was that the interior of the bowel was reached without traversing, and without risking injury to, the peritoneum. But with the introduction of aseptic methods of operating it was found that the surgeon could reach the bowel through the peritoneum easily and safely. With the peritoneum opened, moreover, the surgeon can explore the diseased bowel and deal with it as circumstances suggest. If the cancerous mass is fairly movable the affected piece of bowel is excised and the cut ends are spliced together, and the continuity of the alimentary canal is permanently re-established. Thus in the case of cancer of the large intestine which is not too far advanced, the surgeon expects to be able not only to relieve the obstruction of the bowel, but actually to cure the patient of his disease. When the lowest part of the bowel was found to be occu- pied by a cancerous obstruction, the surgeon, as already remarked, used formerly to secure an easy escape for the contents of the bowel by

making an opening into the colon in the left loin. But in recent years this operation of lumbar colotomy has been almost entirely replaced by opening the colon in the left groin. This operation of inguinal colotomy is usually divided into two stages : a loop of the large intestine is first drawn out through the abdomi- nal wound and secured by stitches, and a few days afterwards, when it is firmly glued in place by adhesive inflammation, it is cut across, so that subsequently none of the motions find their way into the bowel below the artificial anus. If at the first stage of the operation symptoms of obstruction are urgent, one of the ingenious glass tubes which Mr Paul has recently invented may be forthwith introduced into the distended bowel, so that the contents may be allowed to escape without fear of soiling the peritoneum or even the surface-wound.

Cases of malignant disease of the rectum are now radically and successfully dealt with, which, a few years ago, no surgeon would have felt justified in attacking. Por this important advance sur- geons are indebted to Professor Kraske of Freiburg. In order to secure the entire removal of the cancerous piece of bowel, the-coc- cyx and a considerable portion of the sacrum may have to be re- moved ; and the rapid and complete recovery of the patient after so serious an operation is often a matter of surprise even to the surgeon.

Inflammation of the Appendix. — Attached to the large intestine (near the right groin) is a slender, worm-like process about as large in circumference as an ordinary penholder, and 3 or 4 inches long. It is hollow, and it communicates with the interior of the bowel by a small valvular opening. When the secretion of this vermiform process, or appendix, is prevented from finding its way into the

intestine by a kink, or by any other form of obstruction, local pain and tenderness and great constitutional disturbance are apt to result; Inflammation of the appendix has been compared to the behaviour of the obsolete percussion-cap under the hammer of the gun : sometimes the hammer striking the cap gave absolutely no result, sometimes it merely “snapped” the cap, and sometimes it exploded the charge of powder. Sometimes the attack of inflam- mation of the appendix is

slight and transitory, sometimes it passes off after giving rise to considerable local and general disturbance, and sometimes it determines the formation of an acute septic abscess, which suddenly and without definite warning bursts into the general peritoneal cavity with, probably, a fatal result. –

In recent years surgeons have fully recognized the advantage of interfering in the course of a large proportion of these cases, rather than allowing them to drift on as blind chance may direct. It is a feature of the disease that though it may subside after running a subacute course, it is apt to recur, especially after severe exer- cise, or cold, or after an indigestible meal. These recurrent attacks are often met with in young adults who, but for this weakness, are in perfect health, but who during the attacks are compelled to lead a life of helpless inactivity or invalidism. Modern surgery has shown that on the subsidence of one of these attacks the appendix can be safely removed, and the individual restored 'to robust and permanent health. During the progress of an acute attack of appendicular inflammation, when the local tension and pain are great, and the patient is disturbed by the absorption of septic material which is set free in the formation of a local abscess, the surgeon cuts down into the inflamed mass of tissues so as to provide for the easy escape of matter to the surface which might otherwise burst into the general peritoneal cavity. By this rational treatment many a life is saved. If in the course of the operation the inflamed appendix presents itself in the abscess- cavity the surgeon does well to resect it, but otherwise it is not always advisable for him to disturb the tissues in searching for it, lest by breaking down barriers of adhesions he should render the abscess diffuse. Lastly, in those sad cases in which an inflamed appendix has suddenly burst into the peritoneum and amongst the coils of intestine, the patient being in a state of serious collapse, the surgeon hastens to offer the only chance left, by opening the abdominal cavity, wiping out the interior, and affording full pro- vision for drainage.

Hernia. — Great advance has been made and success secured in the treatment of reducible hernia. Without tiresome delay, and the tedious and sometimes disappointing application of trusses, the weak spot in

the abdominal wall is exposed, the sac of the hernia tied and removed, and the canal by which the rupture descended blockaded by buried suturus. Thus the patient's worries become a thing of the past, and he is rendered a fit and normal member of society. The results of the treatment of strangulated hernia also show steady improvement, for the simple reason that the condition is now more promptly dealt with by operation, "radical cure" being aimed at at the same time.

Surgery of the Kidney. — During the past decade the surgery of the kidney has been steadily advancing : movable kidneys are now stitched securely in their bed, with great relief to the patients ; the presence of a renal calculus is sometimes clearly located by the Ebntgen-rays and the stone extracted ; abscesses are drained, and kidneys hopelessly diseased are removed with the greatest possible advantage. Calculi which have become impacted in their course down to the bladder are also searched for and extracted.

To Brigade-Surgeon Lieutenant-Colonel Keegan, of the Indian Medical Service, is due the fact that the operation of crushing and promptly removing all fragments of a vesical calculus — litholapaxy — is as well suited for boys as for men. In entire opposition to old European prejudices, Keegan's operation is now firmly and permanently established. The old operation (Cheselden's) of cutting a stone out through the bottom of a boy's bladder is now very rarely resorted to, and if a stone in a boy is found too large or too hard to lend itself to Keegan's crushing operation, it is now removed by a vertical incision through the lower part of the anterior wall of the abdomen. For the successful performance of the crushing operation in a boy a small lithotrite has, of course, to be used, and it must be of the very best English make : the bend- ing of a "cheap" lithotrite in a boy's bladder would be a terrible predicament. The operation has to be done with the utmost gentleness and thoroughness, "not a particle of the crushed stone being left in the bladder.

Ligation of Iliac Arteries. — In the case of aneurysmal or other pulsating tumour of the buttock, or of iliac aneurysm in which it is desirable to place a ligature upon the internal or upon the com- mon

iliac artery, the surgeon now finds it convenient and expedient to expose the main trunk by cutting across the peritoneal cavity. In the pre-aseptic days such an operation could scarcely have been thought of, as the risk of the patient dying from infective peri- tonitis would have been very great.

Senile Enlargement of the Prostate. — Enlargement of the prostate

gland in old men is being somewhat widely treated by removal of the testes, or by the enucleation of the masses themselves through a supra-pubic incision, after the manner of McGill of Leeds or Fuller of New York.

Fractures. — The treatment of fractures has undergone consider- able improvement of late. Simple fractures are not kept so long at rest fixed in splints, but are constantly ” taken down ” in order that massage and passive movements of the limb may be resorted to. This, of course, is done with the utmost gentleness, and with the result that swelling, pain, and other evidences of the serious injury quickly disappear, whilst a more rapid and complete recovery is insured. Stiff hands and feet after fracture are very much less constantly met with. By the aid of the X-rays it is now easy for the surgeon to assure himself that fractured surfaces have been well adjusted and are in close apposition. But if they are not well in position, and it be found impracticable to assure their close adjustment by ordinary methods, the surgeon now, without undue loss of time, cuts down upon the broken ends and fixes them together by a strong wire suture, which remains per- manently in the tissues. If the fracture be associated with an open wound of the part (compound fracture), and the broken ends are found incapable of easy adjustment, immediate wiring together of the fragments is now considered to be a necessary part of the primary treatment.

Congenital Dislocation at the Hip. — Possibly as the result of faulty position of the subject during intra-uterine life, the head of the thigh-

bone leaves, or fails throughout to occupy, its normal situation on the haunch-bone. The defect, which is a very serious one, is probably not discovered until the child begins to walk, when1 its peculiar rolling gait attracts attention. 'The want of fixation at the joint permits of the surgeon thrusting up the thigh-bone, or drawing it down in a painless, characteristic manner.

The first thing to be done is to find out by means of the X-rays whether a socket exists into which, under an anaasthetic, the surgeon may fortunately be enabled to lodge the end- of the thigh- bone. If this offers no prospect of success, there are three courses open : First, to try under an anaesthetic to manipulate the limb until the head of the thigh-bone rests in its normal position, and then to endeavour to fix it there by splints, weights, and bandaging until a new joint is formed ; second, to cut down upon the site of the joint, to scoop out a new socket in the haunch- bone, and thrust the end of the thigh-bone into it, keeping it fixed there as just described ; and third, to allow the child to run about as it pleases, merely raising the sole of the foot of the short leg by a thick boot, so as to keep the lower part of the trunk fairly level, lest secondary curvature of the spine ensue. The first and second methods demand many months of careful treatment in bed, and the ultimate result of the second is so often disappoint- ing that, except in certain rare instances, the surgeon is loth to recommend it.

Fracture of Patella. — There is still a great difference of opinion as to the most satisfactory method of treating a recent fracture of the patella. Some surgeons are still content to follow the old plan of fixing the limb on a back-splint, or in plaster-of-Paris splints, and awaiting the result.

It is beyond question that a large percentage of these cases recovered with a useful limb — especially if the fibrous bond of union between the pieces of the broken knee-cap was not stretched, by bending the leg, at too early a date. But a certain propor- tion of the cases gave a very imperfect result, the fragments remaining permanently wide apart, and the patient being left with a more or less enfeebled limb. Still, at any rate, this line of treatment was unassociated with risk. But after Lister showed (1883) that with due care and cleanliness the knee-joint could

be opened, and the fragments of the broken patella secured in close apposition by a stout wire suture, the treatment of the injury underwent considerable change. The great advantage of Lister's treatment was that the fragments, being fixed close together by the wire stitch, became solidly united by bone, and the joint became as sound as it was before. Some surgeons, however, objected to the operation — in spite of the excellence of the results obtainable by it — because of the risk which it entailed of the joint becoming invaded by septic micro-organisms. As a sort of compromise, Barker introduced the method of holding the fragments close together by means of a strong silver wire which he passed round them vertically by a large needle without laying open the joint. But experience has shown that in the hands of skilful surgeons Lister's operation of openly wiring the frag- ments gives a perfect result with a comparatively small amount of risk.. Other surgeons secure the fragments in close contact for bony union by passing a silk or metal suture around them circumferentially. Many years ago Lister remarked that the careful selection of one's patients is an antiseptic measure — by which he meant that if a surgeon intended to get the most per- fect results for his operative work, he must carefully consider

whether any individual patient is physically adapted for the performance upon him of any particular operation. From this aphorism it is evident that not every patient with a broken knee- cap is suited for the opening of his knee-joint, or even for the subcutaneous adjustment of the broken fragments. An operative procedure which is admirably suited for one patient might result in disaster when adopted in another case, and it is an important part of the surgeon's business to know exactly what to advise in an individual case.

Infantile Paralysis. — In cases of infantile paralysis of the leg and foot, groups of muscles supplied by certain nerves are left seriously affected, and in many instances great improvement results from grafting the tendons of the paralysed muscles upon the tendons of muscles which remain strong and vigorous. The operation, which was recently designed by Dr Nicoladoni, is a very ingenious one, and it is steadily making its way into general recognition. In cases in which the paralysis

has left a useless flail-joint in a limb, considerable strength may be imparted to the limb by opening the joint and scraping it out so as to render it permanently rigid.

Club-foot. — In the treatment of congenital club-foot great advances have been made. Parents as well as surgeons have come to recognize the value of the adoption of corrective measures in the very earliest days of infancy. The monthly nurse is now instructed in the art of manipulating the deformed foot and of gently but firmly holding it in the corrected position ; and in slight cases these simple measures when begun thus early are sufficient. At any rate, they are to have a fair trial, and should they fail, a simple subcutaneous division of tendon or tendons, in the earliest weeks of infancy, may suffice. Much of the great advance which has recently been made in dealing with obstinate cases of deformity has been the result of Phelps's teaching. Dr Phelps is an orthopaedic surgeon of New York, and he has shown that in cases which are not remediable by simple measures, an immediate correction of the deformity may safely be obtained by freely dividing the skin and "all the resisting tissues by a vertical incision straight across the middle of the foot. By this "open method" the surgeon sees exactly what structures are at fault and in need of division — skin, fasciaa, tendons, ligaments ; everything, in short, which prevented the easy rectification of the deformity. After the operation, the foot is fixed, without any strain in an over-corrected position, between plaster-of-Paris splints. By the adoption of this method the old instrument of torture known as " Scarpa's shoe" has become obsolete, as have also some of those operations which effected improvement of the foot by the removal of portions of the bony arch. Phelps's operation removes the deformity by increas- ing the length of the concave border of the foot rather than by shortening the convex borders ; it is a levelling up, not a levelling down.

Morton's Disease. — There is a painful neuralgic condition of flat feet which has recently been described by Dr Morton and named after him. It is apparently due to the nerves of the toes (which come from the sole of the foot) being pressed upon by the rounded ends of the long bones of the foot near the web of the toes. It does not generally yield to palliative measures (though rest of the foot is helpful), and the only

effectual remedy for it seems to be resection of the head of one of the metatarsal bones.

**Hammer-toe. — That painful condition in which a toe is rigidly bent and the salient angle on its upper aspect is constantly irri- tated by the boot, is no longer treated by amputation of the toe, but the toe is made permanently to lie flat by the simple excision of the small digital joint. Even in extremely bad cases of hammer- toe the operation of resection of the head of the metatarsal phalanx is to be recommended rather than amputation. (E, 0# **

Surgical Instruments and Appliances.

— The purpose of this article is to give an account of the more important surgical instruments that are at this time in general use, and to show by what modifi- cations, and from what discoveries in science, the present methods of an operation have come to be what they are. A new catalogue of surgical instruments suggests at first sight that the surgeon must be hindered rather than helped by the bewildering number and variety of instruments that he is supposed to use, one and all of them, with equal ease and familiarity. The array of instruments is of amazing length: for example, in one instance the list of needle-holders extends from No. 845 to No. 887, with twenty-five illustrations. Yet in many cases the finger and thumb are a sufficient needle-holder, and for cases where the depth of the tissues, or the special nature of the operation, require a needle-holder, there are a few simple forms of the instrument, and no need for

these many sub-species. The good surgeon is careful to use the right sort and pattern of instrument, but is not concerned to try all the twenty-five different kinds of needle-holder; one might as well expect an artist to have twenty-five palettes. But, though the mere multiplicity of

Fig. 1.— Needle-holders— A, Hagedorn's ; B, Macphail's ; and C, Allen and Hanburys', for Hagedorn or ordinary needles.

catalogued instruments is not an exact measure of the excellence of surgery, yet the chief fact about the surgery of the present day, that it is aseptic or antiseptic, is recorded in the make of surgical instruments and in all the installation of an operating-theatre. Take, for in- stance, a scalpel and a saw that are figured in Ambroise

Pare's (1510-1590) surgical writings. The scalpel folds into a handle like an ordinary pocket- knife, which alone was enough in those days to keep it from being aseptic. The handle is most ele- gantly adorned with a little winged fe- male figure, but it does not commend itself as likely to be surgically clean. The saw, after • the same fashion, has a richly-chased metal frame, and, at the end of the handle, a lion's head in bold relief, with a ring through its mouth to hang it up by. It may be admirable art, but it would harbour all sorts of germs. If one contrasts with these artistic weapons the instruments of 1850, one finds no such

Fig. 2,— Combination knife containing finger- knife, finger-saw, gnm lancet, Liston's naevus needle, Syme's abscess knife, tenotomy knife, probe and grooved director.

Fig. 8.— Tenotomy knives forged in one piece.

adornment, and for general finish Savigny's instruments would be hard to beat ; but the wooden or ivory handles, cut with finely scored lines like the cross-hatching of an engraving, are not more likely to be aseptic than the handles of Pare's instruments. At the present time, in-stead of such handles as these, with blades riveted into

them, scalpels are forged out of one piece of steel, their handles are nickel-plated and'perfectly smooth, that they may afford no crevices, and may be boiled and immersed in carbolic lotion without tarnishing or rusting ; the scal- pel has become just a single, smooth, plain piece of metal, having this one purpose, that it shall make an aseptic wound. In the same way the saw is made in one piece, if this be possible ; anyhow, it must be, so far as possible, a simple, smooth, unrusting metal

instrument, that can be boiled and laid in lotion; it is a foreign body that must be introduced into tissues susceptible of infection, and it must not carry infection with it.

Or we may take, at different periods of surgery, the various kinds of ligature for the arrest of bleeding from a divided blood-vessel. In Pare's time (he was the first to use the ligature in amputation, but the existence of some sort of ligature is as old as Galen) the ligature was a double thread, bon fil qui soil en double; and he em- ployed a forceps to draw forward the cut end of the ves- sel to be ligatured. From the time of Ambroise Pare to the time of Lord Lister no great improvement was made. In the middle of last century it was no uncommon thing for the house-surgeon at an operation to hang a leash of

Fig. 4. — Amputating saws.

waxed threads, silk or flax, through his button-hole, that they might be handy during the operation. Then came Lord Lister's work on the absorbable ligature ; and out of this and much other experimental work has come the present use of the ligature in its utmost perfection — a thread that can be tied, cut short, and left in the depth of the wound, with absolute certainty that the wound may at once be closed from end to end and nothing more will ever be heard of the ligatures left buried in the tissues. The choice of materials for the ligature is wide. Some sur- geons prefer catgut, variously prepared; others prefer silk; for certain purposes, as for the obliteration of a vessel not divided but tied in its course for the cure of aneurysm, use is made of kangaroo-tendon, or some other animal sub- stance. But whatever is chosen, is made aseptic by boil- ing, and is guarded vigilantly from contamination on its way from the sterilizer into the body of the patient. The old ligatures were a common cause of suppuration. There- fore the wound was not closed along its whole length, but the ligatures were left long, hanging out of one end of the wound, and from clay to day were gently pulled until they came away. Certainly they served thus .to drain the wound, but they were themselves a chief cause of the suppuration that required drainage.

Sutures, like ligatures, were a common cause of sup- puration in or around the edges of the wound. Therefore,

in the hope of avoiding this trouble, they were made of silver wire, which was inconvenient to handle, and gave pain at the time of removal of the sutures. At the present time they are of silkworm-gut, catgut, silk, or horsehair ; they are made aseptic by boiling, and can be left any number of days without causing suppuration, and can then be removed without pain.

Next may come the consideration of surgical dressings. In the days when inflammation and suppuration were almost inevitable, the dressings were usually something very simple, that could be easily and frequently changed— ointment, or wet compresses, to begin with, and poultices when suppuration was established. It is reported of the great Sir William Pergusson that he once told his students, ” You may say what you like, gentlemen, but after all, there’s no better dressing than cold water.” This is not the place to try to tell the long history of the quest after a perfect surgical dressing, and the advance that was begun when Lord Lister invented his carbolic paste. The work was done slowly in the international unity of science during many years. The perfect anti- septic dressing must fulfil many requirements : it must be absorbent, yet not let its medicament be too quickly soaked out of it ; and it must be antiseptic, yet not viru- lent or poisonous. Of the many gauzes now available, that which is chiefly used is one impregnated with a double cyanide of zinc and mercury. Its pleasant amethys- tine tint has no healing virtue, but is used to distinguish it from other gauzes — carbolized gauze, tinted straw- colour ; iodoform gauze, tinted yellow ; sublimate, blue ; chinosol, green. The chinosol gauze is especially used in ophthalmic surgery ; for general surgery the cyanide gauze is chiefly employed. The various preparations of absorbent wool (i.e., wool that has been freed of its grease,

custeo -\^ ‘{

A B *■

Fig. 5.— Surgical needles— A, ordinary ; B, Hagedorn’s.

so that it readily takes up moisture) are used not only for outside dressings, but also as sponges at the time of operation, and have to a great extent done away with the use of real sponges. The gauzes in most cases are used not dry, but just wrung out of carbolic lotion, that their antiseptic influence may act at once.

The whole subject of surgical instruments may be con- sidered in more ways than one. It may be well, for the sake of clearing the ground, to take first some of the more common instruments of general surgery, and then to note the working out, in the operations of surgery, of the three great principles — the use of anaesthetics, the use of antiseptic or aseptic methods, and the surgical uses of electricity.

Of the essential instruments that are common to all operations, we may well believe that they have now become, by gradual development, perfect. Take, for in- stance, the ordinary surgical needle. In the older forms the eye was slit-shaped, not easily threaded, and the needle was often made of a triangular outline, like a miniature bayonet. At the present time the needles used in general surgery are mostly Hagedorn’s, which have a full-sized round eye, easy for threading, are flat for their

whole length, and have a fine cutting edge on one side, near the point. Thus they enter the skin very easily, like a miniature knife, and the minute wound they make is not a hole, but a tiny slit that is at once drawn together and, as-it were, obliterated by the tying of the suture. Or, for another simple instrument in universal use, take the catch-forceps that is used for taking hold

Fig. 6.— Artery-forcepB— A, Pean’s ; B, Spencer Wells’.

of a bleeding point till it is ligatured. This forceps is as old as the time of Pare, but he made use of a very heavy and clumsy pattern. Up to the last few years, the artery-forceps was made with broad, curved, fenestrated blades, with the catch set close to the blades. At the present time the forceps in general use, named after Dr Pean in-Prance and after Sir Spencer Wells in England,

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Fig. 7.— Retractors.

is made with very narrow grooved blades, and the catch is placed not near the blades, but near the handles: thus it takes a surer hold, and can be set free when the ligature is tied by a moment's extra pressure on the handles.

Among other instruments in universal use are divers forms of retractors, for holding gently the edges of a wound : the larger patterns are made with broad, slightly-concave, highly-polished surfaces, that they may,

so far as possible, reflect light into the wound. Among tourniquets, the old and elaborate Petit's tourniquet, which was a band carrying a pad screwed down over the main artery of the limb, has given place to the elastic tourniquet with Esmarch's bandage. For example, in an amputation, or in an operation on a joint or on a

Fig. 8.— Tourniquet (Esmarch's).

vessel or a nerve in a limb, the limb is raised, and the Esmarch's elastic bandage is applied from below upward till "it has reached a point well above the site of the operation; then an elastic tourniquet is wound round the limb at this point, the bandage is removed, and the limb is thus kept almost bloodless during the operation.

Fig. 9.— Lithotrite (Blgelow's).

It is not possible to describe here the many forms of other ordinary instruments of general surgery — probes, directors, scissors, forcipes, and many more — nor those that are used in operations on the bones. Nor again can the numerous instruments used in special depart- ments of surgery be discussed in detail. But, with

Fig. 10.— Tonsillotomo (Mathieu's).

regard to the special surgery of the eye, and of the throat and ear, it is to be noted that the chief advance in treatment arose from the invention of the present instruments of diagnosis, and that these are of com- paratively recent date. The ophthalmoscope was the work of Helmholtz. The inventor of the laryngoscope, Signor

Fig. 11.— Ophthalmoscope (Lnndolt's)

Manuel Garcia, was still living at the beginning of this century ; and the use of a frontal mirror, for focussing a strong light' on the membrana tympani, in the ex- amination of the ear, was then scarcely fifty years old. Before the ophthalmoscope, it was impossible to study the internal diseases of the eye; before the laryngoscope, the diseases of the larynx were invisible, and were mainly a matter of guess-work, and of vague and often futile

treatment. Before the use of the frontal mirror, the diseases of the ear were hardly studied, in that sense in which they are studied now. The wonderful advance of the special departments of surgery was, of course, the result of many forces, but one of the chief of these forces was the invention of proper instruments of diagnosis. The text-books that were written immediately before those instruments became available were not far in advance of Ambroise Pare, so far as these special de- partments are concerned.

It may be well next to consider in what ways the con- duct of an operation is influenced by those two great discoveries, the discovery of anaesthetics, and the more

I'ig. 12. — Laryngoscope (Lennox Browne's).

gradual development of the principles of antiseptic and aseptic surgery ; with especial reference to the use of the instruments of surgery. The jubilee year of anaesthesia was 1896 ; the first use of nitrous oxide was on 11th December 1844 ; the first operation under ether was on 30th September 1846 ; the first use of chloroform was on 4th November

1847. The choice of the anaesthetic, or of some combination of anaesthetics, that is best suited to each particular case, is a matter of careful considera- tion ; but, on the whole, the tendency in England is to keep to the via media between the more general use of chloroform in Scotland and the more general use of ether in the United States. Of the methods of administering

Fig. 18. — Inhaler (Junker's).

chloroform there is no need to say much ; no instrument is used save a fold of lint or some such stuff, or a piece of flannel made into a sort of cone or mask. But, for operations on the face or on the mouth, where a piece of lint would be in the way, use is generally made of a " Junker's inhaler," whereby the vapour of chloroform is administered by means of a hand-ball through a fine, soft tube held at one corner of the mouth, out of the way of the surgeon. For the administration of ether, some form of Clover's inhaler is generally used, whereby the ether in a small metal chamber passes as vapour into an indiarubber bag, and there is combined with the patient's breath in proportions determined by the anaesthetist throughout the operation. The metal chamber is so designed that by turning it the exact proportion of ether

to air is fixed in accordance with the requirements of the case. Of late years, by the use of an iron cylinder of nitrous oxide, connected by a tube with a Clover's in- haler, it is possible to begin with nitrous oxide, and to go on, without interruption, with ether. More recently, an admirable method has been devised of administering nitrous oxide with the admixture of air or of oxygen in such a way that the anaesthesia produced by the gas may

Fig. 14. — Gas and ether apparatus (Hewitt's).

be maintained for time enough to allow of an operation of some length.

The series of discoveries which, in its application to surgery, has brought about the present antiseptic and aseptic methods of operation, is concerned both with the shape or use of the instruments of surgery and with their preparation for use. The mere sterilization, by boiling or by steaming, of all instruments and dressings, is enough to ensure their freedom from the ordinary micro-organisms of suppuration ; but the surgeon cannot

boil or steam either him- self or his patient. The preparation, therefore, of the surgeon's hands, and of the skin over the area of operation, is made not only by scrubbing with soap and hot water, but by careful use of anti- septic lotions. Again, ligatures and sutures, which must be kept in stock ready for use, are kept, after careful steri- lization, in antiseptic lotion, or are again sterilized immediately before an operation. Again, all towels used at an operation must be prepared, either by sterilization or by immersion in anti- septic lotion.

The sterilization of all instruments and dressings is a simple matter : the usual sterilizer is a vessel like a fish- kettle, with a perforated metal tray in it, so that the instruments can be immersed in boiling water, and can be lifted on the tray and transferred straight from the sterilizer into vessels containing sterilized water or antiseptic lotion. For the sterilization of dressings, an upper vessel is fitted to the sterilizer, so that the steam may permeate the dressings placed in it. In hospital practice it is usual also to sterilize all towels,

Fig. 35. — Instrument sterilizer.

aprons, and the like in a large cylindrical vessel. Sterili- zation by boiling or steaming, together with the use of antiseptic lotions, or of water that has been boiled, for all such things as cannot be boiled or steamed, is the essential principle of the surgery of the present day ; and practically the antiseptic method and the aseptic method have become one, varying a little this way or that accord- ing to the nature and circumstances of the case.

Beside anaesthetics and antiseptics, there is a third series of discoveries that has profoundly influenced surgery — the use of the forces of

electricity. The uses of electricity are fivefold.

(1) The Galvano- Cautery. — The ori- ginal form of the cautery, the fer ar- dent of Pare's time, for the arrest of haemorrhage after amputation, was a terrible affair. Happily for man- kind, his invention of the ligature put an end to this use of the cautery, but it was still used in a small number of other cases. Subsequently Paquelin invented a very ingenious form of cautery, a series of metal blades or points of different shapes and sizes, that could be fitted to a handle: these points were hollow inside, and were filled with fine platinum gauze, and, by means of a bottle and hand-bellows, they could be kept heated with benzine-vapour. Thus, when they had once

Fig. 16. — Portable sterilizer.

Fig. 17. — Galvano-cautery set.

been raised to a glowing heat by holding them over a spirit-lamp, they could be kept at any desired heat. This instrument is still in use for a few cases where very- rapid and extensive cauterization is necessary. But for all finer use of actual heat the galvano-cautery alone is used — a series of very minute points of platinum, with a suitable trigger-handle, connected with a battery or (by means of a converter) with the ordinary house supply of electricity. In this way it is pos- sible to apply a glowing point with a fineness and ac- curacy of adjust- ment that were wholly impossible with Paquelin's cautery.

}Tiq, 18. — Electrolysis needle-holders.

(2) Electrolysis. — This method is of great value, in suitable cases, for the arrest or obliteration of small growths. The passage of the electric current between needles introduced into or under the skin brings about a gradual shrinking or cicatrization of the tissues subjected to it, without the production of any unsightly scar.

(3) Electro-Motor Power. — During the last few years the use of a small electro-motor machine has come into

the practice of surgery for certain operations on the bones ; especially for the operation for disease involving the mastoid bone. It is, of course, a better method for the use of a fine drill or burr, for example, than the ” dental engine,” where the power is generated by a pedal turning a wheel, and it will probably come into wide use both for dental surgery and for those operations of general surgery that require very gradual and delicate removal of small circumscribed areas of bone, especially of the cranial bones.

(4) The X-Rays. — This, the most unexpected and, as it were, the most sensational discovery that has been bestowed on physicians and surgeons since the dis- covery of anaesthetics, is now used over a very wide and varied field of practice. Its value does not stop at the detection and localization of foreign bodies ; indeed, this is but a small part of its work. It is used constantly for cases of actual or suspected fracture or dislocation ; for cases of congenital or acquired deformity ; for cases involving difficulties of diagnosis between a swelling of the bone due to inflammation and a swelling due to a tumour ; and for obscure cases of spinal disease, hip-dis- ease, and the like. Moreover, it has lately been found possible, by Dr Hugh Walsham and others, to obtain pictures of the thoracic organs that are a very valuable guide in many obscure cases of disease of the lungs or of the pleura, and in many cases of thoracic aneurysm or of intra-thoracic tumour. Every year the number and the range of the cases where the X-rays are helpful for diag- nosis, and for treatment, become greater ; and it is impos- sible to say at what point the surgical value of this discovery will find its limit. Beyond these uses, it is probable that the X-rays will maintain and extend the importance that they already have in the direct treatment of certain cases of disease of the skin.

(5) The Electric Light. — Beside the general superiority of this light to other lights for the routine work of surgery,

Fia. 19.— Cyatosoope (Nitze’s).

there are several special uses for it. Of these, the most important is the cystoscope, a long narrow tube, shaped and curved somewhat like a catheter, and having at its end a very minute glow-lamp and reflector, and a small

Fig. 20.— Urethroscope (Fenwick's), also used for ear, nose, throat, &c.

window. Its other end is fitted with a lens, and is con- nected by a switch with the main current. With this instrument, in skilled hands, it is possible to inspect the interior of the bladder, and in many cases to make an exact diagnosis under circumstances where otherwise

it would be impossible. Another instance of the value of the electric lamp in diagnosis is given by the trans-illu- mination of the facial bones in cases of suspected disease of the central cavity of the superior maxillary bone. A small glow-lamp is held in the closed mouth, in a dark- ened room, and by a comparison of the shadows on the two sides of the face, thus trans-illuminated, an exact diagnosis can often be obtained as to the presence or ab- sence of pus in this central cavity. Again, a small glow- lamp, duly sterilized, is often of great value in deep operations on the abdominal cavity.

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Surrey, an inland county of England. It is bounded on the N. by the Thames, which separates it from Berks and Middlesex, on the E. by Kent, on the S. by Sussex, and on the W. by Hampshire.

Area and Population. — The area of the ancient county as given in the census returns is 485,128 acres, or 758 square miles, with a population in 1881 of 1,436,899, in 1891 of 1,731,343, and in 1901 of 2,008,923. In 1891, 820,993 were males and 910,350 females, the number of persons per square mile being 2284, and of acres to a person 0‘28. The area of the administrative county, exclusive of the county borough of Croydon, is 452,218 acres, with a population of 418,856, and including the county borough the area is 461,230, with a population in 1901 of 653,406. Under thg^provisions of the Local Government Act, 1888, 23,898 acres

of the ancient county were transferred to the county of London. The area of the registration county is 452,733 acres, with a population in 1891 of 572,092, of whom 175,307 were urban and 396,785 rural. Within this area the increase of population between 1881 and 1891 was 24-09 per cent. The excess of births over deaths between 1881 and 1891 was 67,873.

The following table gives the number of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1899:—

Year.

Marriages.

Births.

Deaths.

Illegitimate Births.

1880 1890 1899

2956 3605 5001

13,907 14,534 16,843

7,550

8,645

10,268

Males.

264 273 312

Females.

267 281 297

The following table shows the marriage-, birth-, and death-rates per 1000 of the population, with the percentage of illegitimate births, for a series of years : —

1870-79.

1S80.

1880-89.

1890.

1S89-98.

1899.

Marriage-rate

12-7

13-0

12-5

12-8

13-0

14-7

Birth-rate

31-5

30-6

29-2

25-8

25-3

24-8

Death-rate

17-3

16-6

15-6

15-4

14-6

15-1

Illegitimate births .

}

3-8

3-8

4-1

3-8

40

3-6

Both the birth-rate and death-rate were below the average for England. The number of Scots in the county in 1891 was 4621, of Irish, 5291, and of foreigners 3388.

Administration. — The ancient county is divided into six parliamentary divisions, and it also includes the parliamentary borough of Croydon. The administrative county includes five municipal boroughs, exclusive of the county borough of Croydon (133,885), viz., Godalming (8748), Guildford (15,937), Kingston (34,375), Eeigate (25,993), Richmond (31,677). The following are urban districts— Barnes (17,822), Carshalton (6745), Caterham (9486), Chertsey (12,762), Dorking (7670), East and West Molesey (5937), Epsom (10,915), Esher and The Dittons (9489), Farn- ham (6124), Frimley (8409), Ham (1460), Leatherhead (4694), Maidens (The) and Coombe (6232), Penge (22,468), Reigate (25,903), Surbiton (15,019), Sutton (17,224), Walton-on-Thames (10,329), Weybridge (5329), Wimbledon (41,604), Woking (16,223). Surrey is in the south-eastern or home circuit, and assizes are held at Guildford. The administrative county has_ one court of quarter sessions, and is divided into eleven petty sessional divisions. The boroughs of Croydon, Godalming, Guildford, Kings- ton-upon-Thames, and Reigate have separate commissions of the peace, and Croydon and Guildford have in addition separate courts of quarter sessions. The Central Criminal Court has jurisdiction over certain parishes adjacent to London. All those civil parishes within the county of Surrey, of which any part is within 12 miles of, or of which no part is more- than 15 miles from, Charing Cross, are in the metropolitan police district. The administrative

county contains 133 entire civil parishes, and the county borough of Croydon one entire civil parish. The ancient county of Surrey (exclusive of the parishes now in the county of London) contains 210 entire ecclesiastical parishes or districts, and parts of six others, situated in the dioceses of Rochester, Winchester, Canter- bury, Oxford, and Chichester.

Education. — The number of elementary schools in the county on 31st August 1899 was 287, of which 67 were board and 220 were voluntary schools, the latter including 190 National Church of England schools, 3 Wesleyan, 13 Roman Catholic, and 14 ” British and other.” The average attendance at board schools was 16,645, and at voluntary schools 41,925. The total school board receipts for the year ended 29th September 1898 were over £135,392. The income under the Agricultural Rates Act was over £1303. The South-Eastern Agricultural College, Wye, Kent, is under the control of the county councils of Surrey and Kent. In 1899 there were three reformatory and industrial schools in the county.

Agriculture. — About two-thirds of the area of the county is under cultivation, and of this about five-ninths is in permanent pasture. In 1899, 1313 acres were devoted to the cultivation of hops, and 1537 acres to that of small fruit ; 54,437 acres are under wood, and 11,221 acres are heathlands used for grazing. The following table gives the main divisions of the cultivated area at intervals from 1880 :—

Tear.

Total Area under Cul- tivation.

Corn Crops.

Green Crops.

Clover.

Per- manent Pasture.

Fallow.

1880 1890 1899

299,315 295,920 280,027

86,649 72,627 57,128

42,528 39,062 34,364

28,848 24,724 23,305

122,793 147,655 155,948

16,169 9,110 6,578

The following table gives particulars regarding the principal live stock during the same years: —

Tear.

Total Horses»

Total Cattle.

Cows or

Heifers in

milk or in

calf.

Sheep.

Pigs.

1880 1890 1899

13,947 12,606 12,535

45,475 46,071 45,021

23,286 23,152 22,633

79,848 80,575 72,630

25,937 27,822 21,943

Industries and Trade. — The total number of persons employed in factories and workshops in 1897 was 15,996, as compared with 13,701 in 1896. Textile factories employed only 82. In non- textile factories 9599 persons were employed, as compared with 8591 in 1896. Of the 6315 persons employed in workshops, 3081 were employed in the clothing industries. Gloves and hosiery are made at Godalming. Euller's-earth is excavated at Nutfield and Reigate. There are oil, paper, and sheet-iron mills on the rivers Mole and Wandle. Other industries are brush and broom making, brick-making, glass-working, cement-working, and pottery.

Authorities. — Manning and Brat. History and Antiquities of Surrey, 3 vols. London, 1804-14. — Brayley. Topographical History of Surrey, 5 vols. London, 1841-48. Another edition, revised by E. Walford, London, 1878. — Topley. Geology of the Weald (Memoirs of the Geological Survey). London, 1875. — Archaeological Collections (Surrey Archaeological Society). London, from 1858.

(h. b. w*.)

SURVEYING.

I. Methods and Instruments.

SURVEYING is the art of determining the relative positions of prominent points and other objects on the surface of the ground, and recording them in such a manner that graphical determination of the included area may be made, and the areas of the whole, or of defined portions, may be calculated from the observed data. All surveys rest primarily on linear measurements, which are frequently, and when a long distance has to be covered invariably, supplemented by angular measurements. From the latter are formed triangles, whose sides can be calculated from the original measured base and whose apices are known and fixed points, from which other triangles may be observed and evaluated, and from which direct linear measurements may be made. The simplest form of surveying is that in which the chain, rod, and staff are the only instruments employed. The chain in use in England for land survey- ing is 66 feet long and is divided into 100

links. The length of 66 feet is arrived at by the relation of this unit of measurement to the mile and the acre, there being 80 chains in a mile of 1760 yards, and 10 square chains to one acre of 43,560 feet. With the metrical system the chains are 20 metres, or approximately 65-62 feet, in length. Until recently the chain was constructed of 100 short bars of iron or steel hooked at the ends and connected together by three rings between each pair of links, the end links being provided with brass handles and each ten links marked with a distinctive brass label. Such chains as these are heavy, and the hooks and intermediate links collect sticks, grass, weeds, and mud, and offer considerable resistance to traction, causing them to stretch, and necessi- tating frequent adjustment by reducing the length of the shorter links with the hammer or by the removal of one or more of the rings. In modern practice a continuous steel band of nearly oval section, about ^ of an inch deep by 4 of an inch thick, is substituted for the built-up chain. Such a band does not stretch in itself, does not offer much resistance to traction, and is of small weight; but the brass swivel handles used for dragging it are liable to extension,

and the points of measurement should be marked on the band itself and should not include the handles. To obtain the most accurate measurements the steel band is suspended horizontally with a given tension, one end being made to coincide with a given mark, and the mark at the other end transferred to a nail driven into a peg or to some other record by means of a plumb-line, or, better, of the theodolite. When used in this manner the band must be 66 feet in length between marks ; and as this is the case at one par- ticular temperature only (generally 52° F.), temperature observations should be made simultaneously with each measurement, so that the true length passed over may be corrected by calculation. The rate of expansion of steel is 1 in 927, from 32° to 212° F., and is nearly constant within these limits.

In surveying with the chain, rod, and staff, straight lines are measured horizontally along the surface of the ground. The primary base line is of the greatest practicable length, and from it other lines are measured in such manner as c*a'° to form triangles and polygons, each side of each figure mf^re" being the subject of direct measurement, and the

posi- m tion of every three sides being further defined by a check measure- ment, generally made in a direction nearly perpendicular to the base of the particular figure under consideration to its apex. Where, as in European countries, the land is divided up into fields by walls, ditches, or hedges, the subsidiary figures are generally made to follow as closely as is convenient the lines of division between enclosures, and the distance of the boundary from the survey line is measured from recorded points on the chain by offsets or short lines drawn perpendicularly from the chain to the boundary. Where the length of the offset is short, the offset staff, a pole of ten links in length, can be used, and this rod may be laid at right angles to the chain by eye ; but if the length of the offset is greater, its direction must be laid perpendicular to the chain by means of some instrument, such as the cross staff, the optical square, or the box sextant. Where offsets are greater than 60 links in length, they should be obtained by making two measure- ments from different points in the base line. Great care must be taken to ensure the straightness of each line, especially in the case of the primary or base line, which is probably that of greatest length. The success of the operation depends on placing poles in the ground one in front of another by eye ; hence considerable care and judgment must be used, and before the survey is commenced it is necessary to traverse the greater part of the ground, selecting a route for the primary line that is not obstructed by some obstacle

which would render the continuity of the base difficult or impos- sible. Obstacles — such as buildings, ponds, and rivers — have to be surmounted in most surveys. Where, as in the case of a building, the obstacle obstructs both the sight and the measurement, a common practice is to measure off in two places from the main line a distance suf- ficient to clear the obstacle, to run through the points measured a line parallel to the main line until the obstacle is passed, and to return into the main line again by a repetition of the former measurements

(Fig. 1). When the line of sight is not ob- structed, the survey line may be continued by methods such as are shown in Figs. 2 and 3. The whole of the measurements, the number of each line, its general direc- tion with regard to the line from which it originates and to any other which it may cross or with which it may connect, its reference number and any measurements along it and from it which it is necessary to record, are entered in a field book, from which the survey may be transferred to paper and the areas of enclosures calculated. The amount of error permissible in chain- ing with the link chain is 1 in 1000, and considerable care is necessary to secure this degree of accuracy : with the band chain used as an instrument of precision there is little difficulty, however, in measuring to 1 in 20,000 ; and if the measurement be of sufficient importance to warrant the delay, much greater accuracy than this, probably ,1 in 60,000, may be obtained without any special apparatus beyond that already de- scribed. Although the use of the chain lies at the foundation of all surveying, the addition to the surveyor's apparatus of some optical instrument for measuring angles facilitates his operations greatly, and is recognizable in the use of the oross staff for setting offsets perpendicularly to the chain line. In the accurate survey of a long length of line or a considerable tract of country the use of an optical instrument becomes a necessity : the instrument best adapted for this purpose is the theodolite, although the work of the surveyor may be

much assisted by the use of the prismatic compass and the pocket sextant, and either or both of these instruments may be used with advantage, in conjunction with the theodolite, for obtaining the direction of the less important and shorter lines.

If to the chain, cross staff, tape, offset staff, and lining rods, which form the equipment of the surveyor under

Fig. I.

Fig 3

elementary conditions, some instrument for measuring angles, such as a prismatic compass, a more advanced form of cross staff, a box

sextant, or (in large surveys) a

theodolite, be added, and if the optical square be substi- tuted for the cross staff, the rapidity of the survey may be increased. The direction of each survey line with reference to the primary or base line or to magnetic north can be recorded in the field book, and accuracy in the measurements of each triangle is secured apart from the tie line or fourth element, which is employed for this purpose in surveying with the chain alone, but which should not be omitted even when angular observations are made. In a survey with the chain alone it is possible to plot the triangle without any manifest error although the length of a side is inaccurately measured. The measurements must therefore be checked by a fourth dimension, generally drawn from the apex of the trian- gle perpendicularly, or nearly so, to the base. The triangle, however, may still be plotted with its apex in the wrong direction without falsifying any measurement. But none of these errors can take effect if the bearing or direction of each line with regard to magnetic north be recorded, as, should there be inaccuracy in reading the angles or in measuring the lengths of the sides, the trian- gle could not be constructed.

When no local attraction exists to affect the magnetic needle, the prismatic compass is the most convenient instrument for taking the bearings of the several survey lines and the direction of straight pieces of fencing, whereby the measurement of many offsets and frequently of subsidiary triangles rendered necessary in a chain sur- vey in order to obtain short offset measurements may be avoided. Failing the prismatic compass, the cross staff is more convenient than the sextant, because its construction permits of angles the apices of which are at varying levels being read in the horizontal plane, and because it is free from parallax, except when the observed point is very close to the instrument. The cross staff can also be used to read bearings from magnetic north on the angle inter- cepted between two lines, but it is a heavier and more cumbersome instrument than either the prismatic compass or the pocket sextant. Owing, however, to the fact that it must be supported on a leg or staff forced into the ground, or on a tripod, the angles taken may be re- corded to something like 10′ of arc, while neither the sextant

nor the prismatic compass can be relied on to read more closely than to half degrees. In surveys of large extent it is preferable to lay out the main lines, and especially the base or primary line of the survey, with the theodolite. By this instrument a given straight line may be continued for any convenient distance with a degree of accuracy to be measured only by the care taken in observing, and the angles of the principal triangles can be read to any desired degree of nicety up to 1″ of arc. Minor triangles may be filled in with the prismatic com- pass, cross staff, or sextant. The length measurements may be made with the chain, the tacheometer (see Tacheometky), or by means of a succession of triangles built up on the base line, the sides of which are calcu- lated trigonometrically.

Traversing is a system of surveying dependent, for its accuracy on an exact measurement of a system of main survey lines laid out in succession, and of the angle which each line makes _ with the last, with the primary line, with true Travers‘“g- meridian, or with magnetic north. Traverse surveys are of two kinds, closed and open. A closed traverse is one where the terminal point coincides with the commencing station on the sur- vey, and the lines when drawn in plan form one or more polygons. In an open traverse the terminal station does not coincide with any other point on the survey ; if it did, or if any line on the traverse intersected or coincided with any other line previously surveyed, the traverse would be partly closed and partly open. A traverse closed or open may be surveyed with the chain and poles only, in the following manner: The direction of the primary line having been poled out, its length is measured with the Chain. Where it is desirable to deflect the survey from the original straight line, a line in a new direction is poled out, preferably from a chain

end, so that the measuiement may be continuous. A measurement of a convenient number of chains is then made in the reverse direction, and

the distance which separates the terminal distance measured in a backward direction from the corresponding point on the primary line is measured as carefully as possible, not with the chain, but with a steel tape, or with a stick cut to the required length, preserved for reference and numbered ; the traverse line is then continued forward until it is desired again to deflect its direction, when the same process is repeated. In plotting the survey lines it is desirable that the dimensions of the tie lines should be multiplied three .or more times, or that the angle of deflection from the straight should be calculated in order to obtain greater accuracy. This system, which, however, is not to be recommended, may be used for recording the position of an out- lying piece of property which is only conveniently accessible along a road, or for the delimitation of the boundaries of a wood through which it would be impossible to lay out lines without cutting the timber, when instruments for measuring angles are not available.

Traverse surveying by chain or tacheometric observations for length measurements with the assistance of an instrument for meas- uring angles is a most important branch of the art, and is particularly applicable to the delineation of the shore line of an island or lake when the traverse is closed, or to that of a length of coastline^ a road, or railway, where the traverse is open. When, as in laying out roads or railways, the absolute direction of the several lines is a matter of minor importance, and it is sufficient as a rule to know that a line can be laid out with given radii of curves, the prismatic com- pass may be used ; but much greater accuracy may be obtained by employing the theodolite to measure the angle which each line makes with the preceding one, or with a meridian. In a closed traverse

(Fig. 4), the first lines AB, BC, being set out and measured, the theodolite may be placed at B with the verniers reading zero and the telescope directed to A and clamped. The upper circle is then un- damped, the telescope directed to C, the circle reclamped, and the angle ABC read by means of the verniers. In the same manner the sides CD, DE, E A may be set out and measured, and the angles BCD, CDE, DEA, and EAB read with the theodolite. The angles recorded being exterior angles, and the sum of the exterior angles of a polygon,

diminished by four right angles, being equal to twice as many right angles as the figure has sides, in the five-sided figure illustrated they should be equal to 14 right angles or 1260° ; and the interior angles, which can be found in each case by subtracting the observed angle from 360°, should be equal to six right angles or 540°. If the observed angles together differ from 1260° by more than the permissible error (which, for single observations with a small instru- ment, may be taken at 30″ for each angle), they should be observed a second time, the final error being evenly divided between them. Should the lines when plotted with a protractor fail to close, the measurements must be inaccurate and should be repeated. The polygon illustrated forms the base of the survey, and must be filled in with the chain and other instruments by the introduction of sub- sidiary lines or triangles with offsets in the manner described under the head of chain surveying.

Plotting the polygon or other figure on paper with protractor and scale is an untrustworthy method. • Hence, when the survey

is of any considerable size, plotting by co-ordinates is !° preferable, and may even become obligatory. In this

system every angle is referred, where the compass is used, to magnetic north and south, or in important surveys with the theodolite to a true meridian ; and the position of each point is cal- culated trigonometrically with reference to its distance east or west, north or south, of the starting-point of the survey. The distance from point to point, measured along or parallel to the meridian, is

called the difference of latitude of these two points, or northing or southing, and the distance from point to point in a direction per- pendicular to the meridian is called the departure of these points, or easting or westing. In a closed traverse the sum of the northings is equal to the sum of the southings, and the sum of the eastings is equal to the sum of the westings. The angle which any line makes with a true meridian is called its ‘ ‘ azimuth,” with any other merid- ian its ‘ ‘ bearing.’ ‘ The length of a line and its bearing being known, the difference of latitude of its extremities can be calculated trigo- nometrically. Thus in Fig. 5 the triangle ABC is right-angled, the angle

at B being the right angle. Then AB, the difference of latitude between A and C, = AC x cos < BAC, and BC, the departure of C from A =AC x sin <BAC.

In modern theodolites the circle is divided from 0° to 360°, reading clockwise ; the method of whole circle readings is there- fore adopted, though reference is made to that of reading by quadrants which obtained in older instruments. The whole circle system agrees with the graduation of the compass, and the angle suffices to determine the bearing. Unfortunately, most trigono- metrical tables only give functions of angles from 0° to 90°, Shortrede's tables (which are scarce) being, it is believed, the only ones which give augments from zero to 360°. Consequently, with ordinary tables, to ob- tain the sine or cosine of an angle greater than 90° a preliminary calculation has to be made, which is an objection to the use of whole circle readings. The arrangement of the first quadrant agrees with the whole circle readings ; in the second quadrant, between east and south, 0° corresponds with 90°, and 90° with 180° on the whole circle ; in the third, from south to west, 0° corresponds with 180°, and 90° with 270° ; and in the fourth, from west to north, 90° corresponds with 270°, and 0° with 360°. When using ordinary trigonometrical tables for bearings less than 90°, enter tables with bearing direct ; for bearings greater than 90° but less than 180°, with 180°— bearing ; for those greater than 180° but less than 270°, with bearing— 180° ; and for those greater than 270° but less than 360°, with 360° -bearing. The calculation of differences of latitude and departures greatly facilitates plotting ; it obviates the use of the protractor, since the points can be projected with scale, T-square, and set-square, and the work can be set out more accurately than with any protractor.

In the observation of the angles it is desirable to follow a regular routine, in order that addition and subtraction of figures (especially the latter) in the field may be avoided as far as is possible. Several systems may be adopted, but the following seem to commend themselves most : — (1) Let the theodolite be set up at A (Fig. 4), the telescope being clamped at zero and directed along the merid- ian towards the north. Then, after reading and booking the bearing of the magnetic needle,

unclamp the upper plate, direct the telescope to B, and read and book the angle NAB and the magnetic bearing. If the angle recorded is less than 90°, no correc- tion is necessary ; if it be larger, deduct it from 180° and book as a reduced angle ; if larger than 180°, deduct 180° from it ; if in excess of 270°, deduct it from 360° and book both the whole circle and the quadrant readings. The theodolite is next moved to B and the vernier set to the same number of degrees, minutes, and seconds as was observed for the last angle, but deducted from 360° ; thus, when brought to zero the telescope should be parallel to the meridian, and the magnetic reading should be constant in this position, serving as a check throughout on the accuracy of the readings to the nearest degree. The telescope is then directed to C ; the angle ABC and the magnetic bearing read and booked. The same process is repeated at D, E, and A. It is obvious that the same result may be obtained if the first position of the tele- scope be along the line AE or AB, the direction of the meridian being taken as an intermediate bearing, and the telescope at each setting up of the instrument being clamped at zero and directed backwards along the last line observed ; but the number of the calculations to be made is greater and the automatic check on the accuracy of each reading less than where the telescope is made to stand parallel to the meridian when brought to zero. (2) The same process may be carried on automatically. Place the theodo- lite at A (Fig. 6), clamp the telescope at zero, direct it in a northerly direction along the meridian, and read the position of the magnetic needle. Then unclamp the telescope, direct it to B, and book the angle recorded and the bearing of the magnetic needle. Next, keeping the telescope clamped, remove the instru- ment to B, transit the telescope, unclamp the lower plate, and direct the telescope to A. Then retransit the telescope, reclamp

Observa- tion of angles.

methods]

the lower and unclamp the upper plate, and bring the telescope to zero ; there it should be parallel to the meridian, the magnetic bearing being the same as for the previous reading at zero, and serving as a check on its position. Now direct the telescope to C and read. *

With the telescope still clamped, but with the lower plate un- damped, remove the instrument to C, transit the telescope, direct it to B, retransit and bring the vernier to zero ; then read the bearing of the magnetic needle and see that it remains the same, direct the telescope to D, and book both the angle and magnetic bearing. The process is to be repeated until the traverse is com- pleted. By this method all the angles recorded are true bearings

ZTO

‘Iff 90

N.

F‘9 «■ 6 s,

^Erom the meridian used, and should differ by the same number of degrees in all cases from the magnetic bearings. The possible sources of error are two : the telescope may be slightly moved during transit of the instrument from one station to another, and the omission to transit the telescope may lead to there being a mistake of 180° in the readings. The first is easily obviated by checking the reading of the vernier at each change of position, and the second by comparing the readings with the magnetic bearings when the vernier is at zero. To facilitate accuracy the primary vernier should be marked A, and be under the eye-piece of the telescope when at zero.

The advantage of this system over others is that it is largely mechanical. It should be remembered that the surveyor is more usefully employed in selecting the best route for the survey, and in other matters in the field, than in attending to the instrument, which can be manipulated .by almost any man who has had a moderate training in its use, and who can give his whole attention to accuracy of

position, to careful reading, and booking ; who, moreover, has no thought beyond his instrument, and is not dis- tracted by the multifarious duties of the surveyor in charge of a large survey. Some surveyors prefer not to transit the telescope, but to read alternately the true bearing and the true bearing + 180° ; the results obtained are the same, but the method is less mechanical than the other. The effect of defective centring of the instrument and incorrect bisection of the object viewed is common to all the systems referred to, which, however, eliminate gradua- tion and reading errors to a great extent. These are limited to a single observation, whereas if each angle were read separately any error in reading would be carried forward and could not be located.

From the angles or bearings and the distances the traverse sheet is compiled, and then the latitudes and departures are computed by multiplying the cosine of the reduced bearing by the distance for latitude, and by the sine of the distance for departure. In an ideal polygon the sum of the northings will equal the sum of the southings, and the sum of the eastings the sum of the westings. In an open traverse no such check on the accuracy of the readings and measurements can be obtained ; the utmost care is therefore necessary both in observation and measurement, and angles should be taken to distant objects, which are visible from as many stations as may be, which will serve as checks on the accuracy of both the angular and linear measurements. The computation of latitudes and departures may be facilitated by the use of traverse tables, which are tables of natural sines and cosines multiplied by 10 or 100, addition being substituted for multiplication. Full directions for use are given in the introduction to these tables, and they need not be described. The most complete tables are, it is believed, made out for centesimal degrees. The next step is to calculate the co-ordinates or meridional distances and perpendiculars from a common point of origin, which in polygons is conveniently taken at some place approximating to the centre of the figure. Through A the point of origin in an open traverse, or through a point at

some convenient distance from it near the centre of the figure in the case of a closed traverse, draw a vertical line, NS, piattiar to represent

the meridian, or NS, a line parallel to the meridian, and through the same point draw a line at right angles to the meridian. On the second line the departures must be measured, and through each point so obtained a perpendicular should be drawn and the meridional distance measured along it. If the several points so obtained be connected by straight lines, then length measurements AB, BC, CD, &c. (Fig. 4) will agree approxi- mately with the distances measured on the ground. As the paper on which the plot is drawn expands and contracts irregularly, it will be found, if the distances be continuously laid off by scale, that one sheet will not agree with another, nor the earlier measure- ments with the later. It is therefore desirable at the commence- ment of operations to draw a horizontal and a vertical scale on each sheet, and to divide the paper into squares not larger than about 3. inches across, the sides of which represent a given number of feet, links, or other unit, on the scale : in this way the measure- ments by scale can be limited to a length which cannot be greater than half the side of a single square, and the relation of every part of the plot to the scale inscribed on the paper is maintained throughout, notwithstanding a material alteration in the size and shape of the sheet. The squares must be set out with the greatest accuracy, their dimensions, parallelism, and verticality being checked with all care ; they should be ruled in faint carmine in preference to pencil, any line which may be inaccurate being easily removed with chloride of lime. The deformation in each square is probably less than the smallest amount which can be measured with an ordinary scale, and is insignificant when com- pared with the distortion of the whole sheet. Should the, sheet be exposed to the sun in the field, and become, from this or any other cause, seriously distorted, the squares can be accurately redrawn on a new sheet of paper, and the details filled in. By this system the measurement of the areas surveyed can be taken out with facility, and long distances determined by the addition of squares with greater accuracy than is possible with the short scale inscribed on the plan. To take out an area, count the number of squares which approximately coincide with the figure, measure the frac- tional parts of squares, add the excess and deduct the deficiency, and the desired area is then determined. The areas of the squares themselves are independent of contraction or expansion, and the only part liable to

error is the small portion of the whole area com- prised in the fractional parts of the squares.

Absolute accuracy is unattainable, and the degree to be aimed at bears relation to the use to which the work when executed is to be put. Thus the accuracy to be aimed at in the jec„rac„ measurement of a base line from which a large trigono- metrical survey is to be laid out should be the greatest possible ; but with regard to the work to which this article refers a lower standard may be adopted, which has direct reference, except where the measurements are to be used for the purpose of calculating the areas measured, to the scale to be used in plotting. It may be assumed that the limit of accuracy in plotting is T^ of 1 inch. Taking the scales in most common use in England, j^ of 1 inch is equal in each to the following dimensions, in feet or links : —

1 chain to 1 inch (yM =1 link.

2 chains to 1 „ (tj£j) =2 links.

10 feet to 1 inch (T^) =■& ft. i! (ysr)=Tff i!

» (r^nr)— j- » ‘i CijVt)= * ”

11 \¥fGTS’= * ii

20

30

40

100

200

400

Ordnance Scales.

1 mile to 1 inch or 6yJ^j=52-8 feet or 80 links. £ mile to 1 inch or ^{4}=8-8 feet or 13-33 links. 1 mile to 2-112 feet or j5'jnT=2'0833 feet or 3'15 links- 41-667 feet to 1 inch, ^=-41700 or -631 link. 40 feet to 1 inch, ^=-400 or -606 link.

Thus it appears that with a scale of 1 mile to 1 inch an error of 52-8 feet, T^ of a mile, will leave no sign of its presence, while with a»scale of 10 feet to 1 inch the permissible error is -fa of a foot.

Traverse surveys may be plotted direct from the field book by means of a protractor. An efficient protractor is illustrated in Fig. 7, or- one 18 inches in diameter made of clear parchment paper with the angles printed thereon may be used. When the former instrument is employed it is usual to lay the lower edge against a vertical or horizontal line, or against a parallel ruler placed parallel to one of these lines, to move the arm until the proper bearing is secured, and to draw a line along its bevelled edge. To use the second, or any other circular protractor, the line intersect- ing zero and 180° is laid on the meridian, or on a line parallel to it, and on the circle are marked off all the angles required for one

sheet in direct bearing, and the same + 180°. The protractor is then removed, the marks joined, and the several lines transferred into their proper places on the plan with the parallel ruler. Card- board protractors 12 inches in diameter internally, the interior portion being cut out, can be advantageously employed, especially where the traverse is a closed one : the survey is plotted to a small scale, so that the whole or the greater number of the survey lines fall within the 12-inch circle, and the lines can be laid down on the paper without moving the protractor. Cardboard protractors are

Fig 7

generally accurate, and are little liable to distortion through changes of temperature and damp ; this is not, however, invariably the case, and it is well to check a new cardboard protractor before using it. Good work can be done with the protractor in careful and competent hands, but it cannot be safely trusted to an ordinary draughtsman. Should any error occur, it can only be discovered by going over the whole work again. In extensive surveys, when really accurate work is desired, the method of co-ordinates is greatly to be preferred, as it admits of positive check at every stage of the work. Surveys should not be plotted on papermounted on a board, but the sheets should, previously to use, be damped, mounted sev- eral together on a board, cut off before they are quite dry, and stacked together for some weeks in order that they may become flat and take up the surrounding hygrometric conditions. The filling in of subsidiary lines should be done with the protractor, which may also be used with advantage in laying out a preliminary plot of the work to a small scale.

It being accepted that the permissible error in chaining between two points, the distance apart of which is known, is ± 1 per 1000, the permissible difference, i.e., the difference between two measurements of the same distance with the same instruments, should not exceed half the above amount. In the same manner, it being accepted that, using a 5-inch theodolite and single read- ings, the total error, including those due to imperfect centring of the instrument and. bisection of the object, does not exceed 30 seconds of arc (which is a very liberal allowance), the linear error will be ± -29 foot per 1000. In other words, in a square the sides of which are 1000 feet in length the linear measurements at the first angle will be within a square the sides of which are 2 feet in length, and the angular measurement within a square the sides of which are -58 foot in length. Neither the linear nor the angular errors are necessarily cumulative, but being some+, some—, they have a tendency to correct themselves. The linear and angular errors may be in the same or in opposite directions. Probably, as in other matters of measurement, the error will increase in proportion to the square root of the number of sides. Thus in a figure with nine sides, each 1000 feet in

length, the closing error for linear measurements would amount to 12″ x -jS=W, and the angular error to 30″ x ~~1/9=1′ 30”. The final error may be corrected by an addition to or deduction from the several sides of the figure, the corrections being proportioned to the length to which they apply. If greater accuracy is requisite, the following rule (due to Bowditch) may be observed : “As the sum of all the distances is to each dis~~ tance, so is the total error in departure to the correction for the corresponding departure, each correction being applied so as to diminish the whole error or departure.” The same procedure is applied for correction in latitude. In all surveys of importance, the principal stations should be permanently marked, preferably by pillars of stone or concrete, or by holes drilled in a rock, the actual position of the instrument being indicated by a copper bolt into which a centre punch mark is made, or on which intersecting lines are drawn.

In extensive surveys made with the chain and compass it is necessary to bear in mind that the direction of the magnetic needle is not constant, but varies throughout the globe, and from year to year, or even during one day, in the same locality. In 1663 the magnetic needle pointed due north in Paris, while in 1895 it was 15° west, decreasing about V annually, while the needle pointed due north at St Petersburg. In a distance of 360 miles, from Dover to the west coast of Ireland, the compass varies from 10° to 23° west,

or 7° in 360 miles, or at the rate of 1′ 10″ per nautical mile. Dr Carl Bamf ried gives the following daily variations : St Helena, in summer, 0° 4-06’; winter, 0° 3-03’. At Greenwich, in summer, 0° 8-16′ ; in winter, 0° 7-02’. At Munich, in summer, 0° 10-77’; in winter, 0° 6-64’. The same authority states that near Munich the maximum deviation to the east occurs at 8 a.m., and the maxi- mum westerly at 2 p.m. Lastly, the needle is affected by magnetic storms and by local attractions. It is clear, therefore, that the compass cannot be accepted as an instrument of precision ; but for exploratory work, and for filling in details of surveys where only a moderate degree of accuracy is required, it is invaluable. If it should be desirable to determine the variation of the compass, this must be done by astronomical observations on the spot, and not by reference to any fixed north and south line, however

accurate, situated at another place and observed only at a particular time, where the variation will almost certainly be different from what it is when used.

Although the effect of the spherical form of the earth is practi- cally ignored in this article, it will not be out of place to introduce a few words indicating the point at which it becomes necessary to consider the earth as a sphere and to what extent a survey may be carried without consideration of the spherical form. In Rankine's Civil Engineering the following dimensions are given : —

Earth's mean radius

Arc subtended by 1°

" " " 1′

20,889,000 feet. 364,582 „ 6076-36 „

From these figures it may be deduced that in working from a fixed meridian, when the departures east or west have summed up to 6076 feet, or to a nautical mile, the direction of the meridian will be inaccurate to the extent of 1', and ought to be inclined to the meridian of origin by that amount.

In minor triangulation, which deals with triangles the sides of which are comparatively short, and which are used for the purpose of filling in between the sides of larger triangles, or as the bases of construction of independent surveys, an 8″ uj|f!?f S" theodolite is as a rule the largest employed, and good a "'

results may be obtained with smaller instruments. The spherical form of the earth is neglected. Only one side of the triangle nee.d be measured, although it is desirable to measure the side of rome adjacent triangle as a check, since the lengths of the other sides are found by calculation. Although, if accuracy is required, the three angles of every triangle should be measured with the theo- dolite, if two be known the third can be found, since the three together are always equal to 180°. In

a triangle ABC let the sides subtending the several angles be called a, b, c If c be the

base, the length of a=csm A, and of b=c sm B. If, as should

sin C sin C

be done, all three angles are observed, they will not in all proba- bility sum up to 180° ; but the summation error should not exceed ± 52”, even with the smallest instrument and without repetition. In a single triangle this error may be divided by 3 ; but when several triangles form part of the survey and together form a polygon, the corrections become much more difficult and tedious. In order to simplify the process as much as possible, it is desirable to correct the interior angles at the outside of the polygon first, remembering that their summation should be equal to twice as many right angles as the figure has sides, less four right angles, and to go on correcting to- wards the centre. It is assumed that the correction may be equally distributed between the several angles, although if the polygon be built up of many triangles this system is insufficient, as the surveyor would find out when, the outer angles being fixed, he approached the centre of the polygon and discovered, as he probably would, an ever-increasing distortion in a particular direction. A right angle is the angle least liable to error, but the error tends to increase slowly as the angle becomes more obtuse, and more rapidly as it becomes more acute. For this reason the angles of every triangle should be as regular as possible ; none should be less than 30°, and each should approximate as nearly as may be to 60°. With angles ranging from 26° to 155°, the rate of error is always less than lper 1000, which may be taken as the error of good ordinary chaining. If only two angles be measured and the third calculated from the difference between the two which have been observed and 180°, the limiting error in the third will be 1′ instead of 30”.

In one or more polygons built up from several triangles (Fig. 8), if the interior angles at A, B, C, D, E, F, G, H, I, J,X L, M, N, and O be added together, and the difference between the sum of these angles and 2340° be divided over all the angles, the form of the polygon will be fixed. As each of the interior angles of the polygon is made up of two or more

angles, these must be made to agree with the interior angles, but should be corrected in proportion to the angle, the smaller angle receiving the larger correction. Thus the angles O A a, a A 6, b A B, 6 B C, &c, will be fixed. By the same operation the angles A 6 B, B 6 C, C c D, &c., the apices of which are opposite to a side of the

instruments]

polygon, are also fixed, as is one angle of each of the triangles whose apices are towards the outside of the polygon. The polygon a, 6, c, d, e, /, g, h, i, j, may now be treated in the same way, except that the correction is made previously in the exterior angles, the interior angles being deduced from the corrected

Fig 8.

exterior ones. In the. figures which go to make up the exterior angles of this polygon, the triangles A B 6, B C 6, C D c, D E c, E E d, F G e, G H e, H I /, I J /, J K g, K L h, L M i, M N j, N O j, 0 A o, are known and fixed, as are the angles a A 6, b C c, c E d, d E e, e H /, J ‘3 g, g K h, h L i, i M j, j 0 a ; and the whole of the correction must be divided between the remaining angles of the triangles of which the angles a A 6, 6 C c, &c, form part. Should the result of these corrections be to distort the triangles a A 6, 6 C c, &c, materially in one direction, it is desirable to correct the second polygon a to j in the same manner as the figure A to O, and then to redistribute the corrections back- wards. If the angles have been carefully observed, no material distortion should be possible. When the exterior angles of the second polygon have been fixed, the interior angles are corrected from the exterior ones in the manner already described for the outer polygon. Alternately, the outer polygon may be treated as a traverse, and corrected by Bowditch’s method. The subsequent procedure may be as before, or the following precept may be adopted : In any closed polygon, composed of triangles, the con-

tinued product of the log sines of the right-hand angles is equal to the con- E

tinuous product of the log sines of the left-hand angles. When all the angles have been fixed, the remaining sides may be calculated from the side A B, or other known base, and should be invariable whether the calculations be made to the right or left, or through any other set of triangles.

As the accuracy of the figure is dependent on the accuracy of the base, the latter must be Base line. carelully measured, if pos- sible, on a flat and unbroken country. A base line may be measured with rapidity and fair accuracy along the rails of a straight portion of railway, and experience proves that it is better to use a short base line, carefully measured, than to employ a longer one which has to pass over broken country, and which may not be laid out with the same care. The base line may be extended in the direction required by the triangulation in the manner shown in Eig. 9, where A B is the measured and E F the extended base line. A system of comparatively small triangles is useful in surveying, as affording fixed points and measured bases from which chain measurements may be carried in any convenient direction ; and should'the error

fig 9.

in the base line measurement be 1 in 2500 — and it is not difficult to measure to 1 in 40,000 — the survey will still be within the per- missible limit of error. The selection of points, always laborious, on account of the difficulty of determining from one or two stations whether or no it is possible for all the other stations required for the triangulation to be seen, is a matter of such importance that it should be done by the chief surveyor. The observation of the angles, as has already been pointed out, may be reduced to a mat- ter of routine. Survey points should, where possible, be marked in a permanent manner for future reference.

The size of the triangles to be employed must depend on the scale and on plotting, the length measured with the chain not exceeding that which can be detected in plotting. With a scale of y^nr it has already

been shown that 2\ feet is the smallest dimension which can be plotted, and as the probable chainage error is 1 per 1000, the length to be chained within any triangle should not exceed 2600 feet. With a scale of y^^ the length to be chained might be increased to 10,000 feet without detectable error in plotting.

In order that the angles recorded may be observed with the greatest accuracy, it is necessary that a method of repetition or reiteration should be employed. With the upper plate and the theodolite clamped at zero, direct the telescope to Observa- the first object to be sighted, clamp the lower plate, “nzles and bisect the object by means of the lower tangent screw ; read all the verniers, unclamp the upper plate, and bisect the right-hand signal. The reading of the verniers will give the desired angle. Next unclamp the lower plate and bisect the first object, unclamp the upper plate and direct the telescope to the right-hand station, bisect the signal, and again read the verniers, which should record twice the first angle. The operation should be repeated at least once around the circle. Then the telescope must be transited, and the whole operation gone over again. This system of repetition (invented by Borda) reduces the error of reading and bisection to some extent ; it is, however, laborious and tedious. Reiteration, which, if carried to its fullest extent, is both laborious and tedious, consists in clamping the upper plate at zero of the A vernier, directing the telescope at a selected signal, bisect- ing it, reading all the verniers, unclamping the upper plate, bisect- ing each of the signals in succession, and returning to the selected signal, the angles recorded by each vernier being read in each case. Second, if there be two or four verniers make the A vernier read 90°, if three verniers make it read 120°, and repeat the operation ; similarly with the A vernier at 180° and 270° when the instrument has two or four verniers, or at 240° when it has three. Next the telescope must be transited, and the whole process repeated. This system may be further elaborated by bringing each of the verniers to zero successively. Except in extreme cases, these methods for the purposes of a minor triangulation are unnecessary, and it is sufficient that two readings of each object should be recorded, one being taken “face right,” that is to say with the vertical circle to the right of the observer, and one “face left,” with the vertical circle to the

left of the observer. It is well to turn the instrument to the right for one set of readings, and to the left for the other.

The Plane Table. — This instrument in its simple form consists of a board about 1 foot 6 inches or 2 feet square, supported on a light tripod stand, on which it can revolve in a horizontal plane, a central screw being provided to clamp it in any desired position. The paper on which the survey is to be drawn is laid on the top of the table and held in position by eight clamps. The adjuncts to the plane table are : a sighting rule, made in the form of a parallel ruler ; a plumb line attached to a long clip, which can be passed over the edge of the board ; a compass, generally of the box form ; and a level. To use the instrument, set it up with the table horizontal, and bring the plumb line over the starting-point of the survey ; direct the sighting rule along the line of survey, beginning over the plumb line measure the line with the chain, draw it in, and with a scale mark off its length ; next, direct the rule to any prominent objects, and draw rays to them, marking each in succession. Before leaving the first station, place the compass on the paper, direct the needle to magnetic north, and draw a pencil line carefully round the compass box, indicating at the same time the northern direction. The table is now moved and set up over the second station. With the compass the table is brought into the same direction as at the previous station, and the plumb line moved to the end of the survey line is brought over the station, and the sighting rule is laid alongside the line drawn on the paper from station to station, and should, when sighted through, bisect the last station ; if it does not do so, the magnetic needle must have deviated from its position or the line drawn round it must be inaccurate. A new line is now laid out and measured with the chain and on the paper, and rays are again drawn to the principal objects and numbered as before, the intersection of the rays giving the position of each object. Three rays from three separate stations should be drawn to each object in order to ensure accurate work. In this way the survey

[instruments

of a plot of ground, a traverse, or a triangulation may be drawn on the plane table. If to the instrument described above be added an arrangement for levelling the table and a slow-motion screw

Fig. 10.

for turning it on its vertical axis, while for the simple sighting rule an alidade provided with a telescope fitted with subtense hairs for measuring distances by the interception of units on a staff, be substituted, the use of the chain becomes unnecessary ; the staff may be held at any point the position of which it is desired to record, and the point at which it is held can be plotted directly on the sheet, and checked by a second and third observa- tion from other stations, and by rays drawn through it. With these adjuncts and under suitable conditions of climate, the plane table becomes an instrument of precision, and extensive surveys can be carried out with it alone (Fig. 10). To the telescope of

Fig. II.

the alidade is attached a graduated circle for reading vertical angles (Fig. 11), the use of which is necessary for reducing the distance measured to the horizontal, and which enables the points observed to be levelled. Good millboard is preferable to paper for plotting, and should be pale drab, green, or pale slate colour, rather than white. The preliminary survey of the St Gothard railway was made with the plane table, and very extensive surveys have been made in America with this instrument alone ; it must be remem- bered, however, that there is no record of the survey except that contained in the sheets of paper themselves.

Tlie Theodolite. — This, the most perfect portable instrument for measuring angles in azimuth and altitude, is made in three forms — the Y pattern, the Everest, and the transit. Certain parts are common to all the forms in use and to the level. The stand is generally made circular in sec- tion (Fig. 12) , each of the three legs being shod at the lower

extremity with steel. Their upper ends are hinged to a flat plate provided with a screwed collar of large diameter (Fig. 13). The hinge bolts should not be less in length than the width of one leg. The tripods are sometimes made like those of a camera ; but though lighter for equal stiffness than those of circular section, they are inconvenient to .carry, a matter of importance to the surveyor. To the legs is screwed a

Fig 12.

plate 0 0 (Fig. 13), which supports the lower side of the plate P P. This receives the ends of the screws S S by which the in- strument is levelled, its annular portion being larger than the collar in 0 0, so that, until clamped by the screwed plate above it, the whole of the instru- ment except the legs can be moved horizontally in any direction to the extent of about J inch. This materially facilitates centring over a point. The upper plate P P is bored centrally to receive a parallel or conical pillar which supports the lower circle of the theodolite or the arm of the level which carries the telescope. In the theodo- lite the edge of the plate r r is bevelled and di- vided into 360 or 400 degrees, and to half degrees, or to 20 minutes or 10 minutes, according to the size of the instrument. A collar is provided, which when tightened on the vertical axis, otherwise free to move, holds it rigidly in posi- tion with respect to the plate P P. To this collar is attached a slow-motion screw, working against a reaction spring, by which the plate r r can be rotated through a small arc. The upper plate carrying two, three, or four verniers v v is attached to a vertical coned pillar passing through the centre of the large pillar and rotating in it ; this plate can be clamped to the lower plate by means of the screw C, and can be rotated with respect to it by the slow- motion screw d. On the upper plate are placed two

Fig. 13-

geographical]

small levelling bubbles, and two standards 1 1 are attached to ^the upper side of the plate for supporting the trunnions of the telescope T. The bearings for receiving these trunnions are V-shaped; the V on one side is fixed, while the other is cut through and can be narrowed or made wider, thus lifting or lowering the trunnion by means of two capstan- headed screws. To the telescope the vertical circle for reading angles in altitude is fixed, and rotates with it ; both can be ^clamped to the standard, and motion can be given by a suitable double-ended motion screw. The verniers are attached to arms u u bearing on an enlargement of one trunnion of the telescope, one arm projecting downwards and embracing a projection on the standard t. To the same frame is attached a bubble, which should be parallel with the centre line of the verniers. The diagonal telescope n n is provided with cross hairs, and is used for the final centring of the instrument over an object. The use of aluminium in the construction of the instrument for all parts not liable to much wear is to be commended, since by the employment of that metal the weight which the surveyor has to carry is greatly reduced. A five-inch instrument made entirely of brass or gun-metal will weigh 28 lb, while a similar instrument in the construction of which aluminium is used will weigh only 17 ft. The Y theodolite differs from the transit in that the supports for the telescope are low, that the telescope rests in a cradle the trunnions of which rest on the supports, and that a segment of a circle attached to the cradle replaces the vertical circle. When it is desired to read a line in the reverse direction the telescope is lifted out of the cradle, turned end “for end, and re-placed in the Y bearings of the cradle again. In the Everest theodolite the sup- ports are low and the tele- scope cannot be transited. The instrument is similar to that described above, except that the vertical circle is not continuous, but is formed of two arcs.

The Level. — To the upper side of the parallel plates the level is similar in construction to the theodolite. No pro- vision is made for centring over a point. The upper plate is bored through the centre and carries a conical pillar, which rotates freely in it and supports a horizontal plate, to the extreme ends of which are attached, by means of capstan screws

or otherwise, two vertical supports, on which the telescope, which is constructed to be perpendicular to the vertical axis of the instrument, rests and rotates with it. The level bubble (Fig. 14), by which the instrument is brought into a position at right angles to the axis of the earth, is generally placed on the top of the telescope. In the best telescopes, whether for theodolite or level, the diaphragm on which the image is formed is made of glass, and the cross hairs are engraved thereon. In the level the eye-piece and object-glass are interchangeable, to facilitate adjustment for collimation.

(b. B. m.)

II. Geographical Surveying.

The introduction by mechanical means of superior graduation in instruments of the smaller class has lately- placed it within the reach of surveyors to effect equally good results more rapidly in these days, and with less expenditure on equipment and on the staff necessary for transport in the field, than was formerly considered necessary. The 12-inch theodolite of the present day, with micrometer adjust- ments to assist in the reading of minute subdivisions of angular graduation, is found to be equal to the old 24-inch or even to the 36-inch instruments of thirty years ago. New methods have been adopted for the measurement of bases which promise largely to super- sede the laborious process of measurement by the alignment of ” compensation ” bars, . although they cannot at present be said to be entirely independent of them. The Jaderin apparatus, which consists of a wire 25 metres in length stretched along a series of cradles or supports, is undoubtedly the simplest means of measur- ing a base which has yet been devised ; and experiments

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measure- ments.

which have been carried out with it at the Pulkova obser- vatory show it to be capable of producing most accurate results. But there is still a measurable defect in the apparatus, owing to the liability of the wires to

change in length under variable conditions of temperature. It is therefore still considered necessary, where base meas- urements for geodetic purposes are to made with scien- tific exactness, that the Jaderin wires should be compared before and after use with a standard measurement — and this standard is best attained by the use of the Brunner, or Colby, bars. There is also a general consensus of opinion amongst experts that the direct process of meas- urement need not be extended to such lengths as formerly, but that from the ends of a shorter line, the length of which has been exactly. determined, the base may be extended by a process of triangulation.

The elaborate processes of first-class or ” geodetic ” triangulation have hitherto been held to be essential for two distinct purposes. One is the purely . scientific object to be attained by an exact geodetic determination of the figure of the earth and of trianguia- its dimensions. The other is the more practi- tion’ cal issue which is gained by a rigidly accurate series, or backbone, of fixed points on which to base all subsequent survey operations ; and it must be con- ceded in these practical days that it is the latter rather than the former aim which justifies the great cost and the time demanded by the process. In countries which are highly cultivated and parcelled out into more or less minute subdivisions for fiscal and political purposes — such countries as the great European states, Egypt, India, or Ceylon (where a single cocoa-nut tree may be the subject of endless litigation), where the necessity for cadastral (or field) surveys is paramount, and the political divisions between rival states must be demarcated with minute accuracy — it is obvious that the triangulation on which the whole system of sur- veys depends must be itself as perfect as it can be made, and the ” value ” of points fixed thereby must be beyond dispute or discussion. Here that class of triangulation which is termed ” geodetic,” extended from a base which has been measured with all the refinements which modern science can apply, is a paramount necessity. Expense and labour are fully justified in its attainment, because the expense (and possible danger) of disputes and litiga- tion, arising from inaccurate boundary definition both of states and estates, will in the end be vastly greater than the initial outlay. Numerous instances in

recent history could be cited in support of the statement did space permit.

It would, of course, be better that the whole habitable world should be surveyed on the system which inculcates the strictest accuracy in survey method; but „_ this is impossible. There are vast spaces in it graphical” which at present exhibit no prospect of rapid trianguia- development in civilization, but which are tion’ nevertheless of great importance in the future economy of nations, and of which it is most desirable that we should rapidly acquire such an accurate geographical knowledge as will enable us to lay down political boundaries, to project roads and railways, to formulate sound schemes of military strategy, and to attain such exact knowledge of special localities as will further military ends. Such surveys are called by various names — military surveys, first surveys, geographical surveys, &c; but, inasmuch as they are all undertaken with the same end in view, i.e., the acquisition of a sound topo- graphical map on various scales, and as that end serves civil purposes quite as much as military, it seems appro- priate to adhere to the latter term and to designate them geographical surveys only.

[geographical

phlcal surveys

It is within this region of geographical surveying that the greatest advance has been made in recent years.

The governing principles of geographical surveys are rapidity and economy. Accuracy is of course a recognized

necessity, but the term must admit of a certain wMch“‘eS elasticity in geographical work which is quite govern inadmissible in geodetic or

cadastral functions. geogra- It is obviously foolish to expend as much money

over the elaboration of topography in the vast

silent sand wastes which border the Nile valley, for instance (albeit those deserts may be full of topo- graphical detail), as in the valley itself — the great centre of Egyptian cultivation, the great military highway of northern Africa. On the other hand, the most careful accuracy attainable in the art of topographical delineation is requisite in illustrating the nature of a district which immediately surrounds what may prove hereafter to be an important military position. And. this, again, implies a class of technical accuracy which is quite apart from the rigid attention to detail of a cadastral survey, and de- mands a much higher intelligence to compass.

The technical principles of procedure are, however, the same in geographical as in other surveys. A geographical

survey must equally start from a base and be of survey supported by triangulation, or at least by some

process analogous to triangulation, which will furnish the necessary skeleton on which to adjust the topography so as to ensure a complete and homogeneous map.

This base may be found in a variety of ways. If geodetic triangulation exists in the country, that triangu- _. . lation should of course include a wide extent of

secondary determinations, the fixing of peaks and points in the landscape far away to either flank, which will either give the data for further extension of geographical' triangulation, or which may even serve the purposes of the map-maker without any such extension at all. In this manner the Indus valley series of the great triangulation of India has furnished the basis for surveys across Afghanistan and Baluchistan to the Oxus and Persia.

Should, however, no such preliminary determinations of the value of one or two starting-points be available, and it becomes necessary to measure a base and to work ctb initio, there can be little hesitation in adopting the Jaderin wire apparatus for the purpose. It is cheap (cost about £50), and far more accurate than the process of measuring either by any known "subtense" system (in which the distance is computed from the angle subtended by a bar of given length) or by measurement with a steel chain. This latter method may, however, be adopted with great success so long as the base can be levelled, repeated measurements obtained, and the chain be com- pared with a standard steel tape before and after use.

The initial data on which to start a comprehensive scheme of triangulation for a geographical survey are — (1) Latitude ; (2) longi- tude; (3) azimuth; and (4) altitude, and this data should, if possible, be obtained pari passu with the measurement of the base. A 6-inch transit theodolite, fitted with a micrometer eye-piece and extra vertical wires, is the instrument par excellence for work of this nature ; and it possesses the advantages of portability and comparative cheapness.

The method of using it for the purposes of determining values for (1) and (3), i.e., for ascertaining the latitude of one end of the base and the azimuth of the other end from it, are Latitude fuiiy explained in Major Talbot's paper on " Military tzimuth Surveying in the Field ' ' (J. Mackay and Co. , Chatham, 1889), which is not a theoretical treatise, but a prac- tical illustration of methods employed successfully in the geo- graphical survey of a very large area of the Indian transfrontier districts. Recapitulation here would occupy too much space. But it should be noted that these observations are not merely of an initial character. They should be constantly repeated as the

Initial data.

survey advances, and under certain circumstances (referred to sub- sequently) they require daily repetition.

The problems connected with the determination of (2) longi- tude have of late years occupied much of the attention of scien- tific surveyors. No

system of absolute determination is accurate enough for combination with triangula- °“s ” tion, as affording a check on the accuracy of the latter, and the spaces in the world across which geographical surveying has yet to be carried are rapidly becoming too restricted to admit of any liability to error so great as is invariably involved in such determinations. It is true that absolute values derived from the observation of lunar distances, or occultations, have often proved to be of the highest value ; but there remains a degree of un- certainty (possibly due to the want of exact knowledge of the moon’s position at any instant of time), even when observations have been taken with all the advantages of the most elaborate arrangements and the most scientific manipulation, which renders the roughest form of triangulation more trustworthy for ascertain- ing differential longitude than any comparison between the absolute determination of any two points. Consequently, if an absolute de- termination is necessary it should be made once, with all possible care, and the value obtained should be carried through the whole scheme of triangulation. It rests with the surveyor to decide at what point of the general survey this value can best be introduced, provided he can estimate the probable longitudinal value of his initial base within a few minutes of the truth. A final correction in longitude is constant, and can easily be applied. With reference to such absolute determinations of longitude, Major S. Grant’s “Diagram for determining the parallaxes in declination and right ascension of a heavenly body and its application to the prediction of occultations” (S.G.S. Journal for June 1896) will afford the observer valuable assistance.

But the recognized method of obtaining a longitude value in recent geographical fields is by means of .the telegraph — a method so simple and so accurate that it may be applied with advantage even to the checking of long lines of tri- Telegraph angulation. No effort should be spared to introduce a jLi„Tltlons telegraphic longitude value into any scheme of geo- graphical survey. It involves a clear line and an instructed ob- server at each end, but, given these desiderata, the interchange of time signals sufficient for an accurate record only requires a night or two of clear weather. But inasmuch as rigorous accuracy in the observations for time is necessary, it would be well for

the surveyor in the field to be provided with a sidereal chronometer. Under all other circumstances demanding time observations (and they are an essential supplement to every class of astronomical determination) , an ordinary mean time watch is sufficient.

With reference to altitude determinations, there has lately been observable amongst surveyors a growing distrust of barometric results and a reaction in favour of direct levelling, or of differ- ential results derived from direct observation with the e'

theodolite (or clinometer) rather than from comparison of those determined by aneroid or hypermeter. It is indeed impossible to eliminate the uncertainties due to the variable atmospheric pressure introduced by " weather " changes from any barometric record. A mercurial barometer advantageously placed and carefully observed at fixed diurnal intervals throughout a comparatively long period may give fairly trustworthy results if a constant comparison can be maintained throughout that period with similar records at sea- level, or at any fixed altitude. Yet observations extending over several months have been found to yield results which compare most unfavourably with those attained during the process of trian- gulation by continued lines of vertical observations from point to point, even when the uncertainties of the correction for refraction are taken into account. Errors introduced into vertical observa- tions by refraction are readily ascertainable and comparatively un- important in their effect. Those due to variable atmospheric conditions on barometric records are still indefinite, and are likely to remain so. The result has been that the latter have been rele- gated to purely local conditions of survey, and that whenever practicable the former are combined with the general process of triangulation.

The conditions under which geographical surveys can be carried out are of infinite variety, but these conditions are rare which absolutely preclude the possi- conditions bility of any such surveys at all. Perfect under freedom of action, and the recognition of such wh,c^i^' work as a public benefit, are not often attain- surveys able. Par more frequently the opportunity are carried offers itself to the surveyor with the

progress out of a political mission or the advance of an army in the field. It cannot be too strongly insisted on that geo- graphical surveys are functions of both civil and military

geogkaphical]

SURVEYING

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operations. Very much of such work is also possible where a country lies open to exploration, not actively hostile, but yet unsettled and adverse to strangers. The geographical surveyor, has to fit himself to all such conditions, and it may happen that a continuous, com- prehensive scheme of triangulation as a map basis is im- possible. Under such circumstances other expedients must be adopted to ensure that accuracy of position which cannot be attained by the topographer unaided.

During a long-continued march extending through a line of

country generally favourable for survey purposes — a condition

which frequently occurs — when forward movement is a

reviax neoessitv! and an average of 10 to 15 miles of daily su v y g. pr0gress ;s maintained, one officer and an assistant can measure a daily base, obtain the necessary astronomical determina- tions, triangulate from both ends so as to fix the azimuth and distance from the base of points passed yesterday and those to be passed to-morrow ; project those points on to the topographer's plane-table to be ready for the next day's work, and check each day's record by latitude ; whilst a second assistant runs the topo- graphy through the route, basing his work on points so fixed, on the scale of 2 or 4 miles to the inch, according to the amount of detail. Occasionally a hill can be reached in the course of the day's march, or during a day's halt, which will materially assist to consolidate and strengthen the series.

It may, however, frequently be impossible to maintain a con- sistent series of triangulation for the “control”, (to use an Ameri- can expression) of the topography, even when the Trlaagu- configuration of the land surface is favourable. In latioa or 8U0n ciroumstances the method of observing azimuths coa ° ‘ to points situated approximately near to the probable route in advance, and of determining the exact position of those points in latitude as one by one they are passed by the moving force, has been found to yield results which are quite sufficiently accurate to ensure the final adjustment of the entire route geography to any subsequent system of triangulation which may be extended through the country traversed, without serious discrepancies in compilation. It is, however, obvious that as accuracy depends greatly on the exact determination of absolute latitude values, this method is best adapted to a route running approximately parallel to a meridian, and is at complete disadvantage in one running east and west. Where the conditions are favourable to its application, it has been adopted with most satisfactory results ; as, for instance, on the route between Sistan and Herat, where the initial data for the Russo-Afghan boundary delimitation was secured by this means, and more recently on the boundary surveys of western Abyssinia.

When an active enemy is in the field, and topographical opera- tions are consequently restricted, it is usually possible to obtain the necessary “control” (i.e., a few well ~~fixed points rwhv determined by triangulation) for topography in advance geograpny. Qf a p0sition securciy held. With a very little assist~~ ance from the triangulator an experienced topographer will be able to sketch a field of action with far more certainty and rapidity than can be attained by the ordinary so-called “military surveyor,” and he may, in favourable circumstances, combine his work with that of the military balloonist in such a way as to represent every feature of importance, even in a widely extended position held by the enemy. The application of the camera and of tele-photography to the evolution of a map of the enemy’s position is well understood in France {vide Colonel Laussedat’s treatise on ” The History of Topography “), as it is in Russia, and we must in future expect that all advantages of an expert and professional map of the whole theatre of a campaign will lie in the hands of the general who is

best supplied with professional experts to com- pass them. Geographical surveying and military surveying are con- vertible terms, and it is important to note that both equally require the services of a highly trained staff of professional topographers. Twenty-five years ago, during the war between Russia and Turkey, . upwards of a hundred professional geographical surveyors were pressed into military service, besides the regular survey staff which is attached to every army corps. Triangulation was carried across the Balkans by eight different series ; every pass and every notable feature of the Balkans and Rhodope mountains was accurately surveyed, as well as the plains intervening between the Balkans and Constantinople. Surveys on a scale which averaged about 1 mile = 1 inch were carried up to the very gates of the city.

The use of the camera as an accessory to the plane-table (i.e., the art of photo-topography) is a recent innovation in survey processes which has received much attention in Italy Photo- an(j m Canada, where it has been applied almost ex-

topo- clusively to geographical or exploratory surveys. The

graphy; camera is specially prepared, resting on a graduated

horizontal plate which is read with verniers, and with a small telescope and vertical arc attached. Cross wires are fixed in the focal plane of the camera, which is also fitted with a magnetic needle and a scale so placed that the magnetic declination, the scale, and the intersection of the cross wires are all photographed on the plate containing the view. A panoramic group of views (slightly overlapping each other) is taken at each station, and the angular distance between each is measured on the horizontal circle. The process of constructing the horizontal projection from these perspective views involves plotting the skeleton triangulation, as ob- tained from the primary triangulation, with the theodolite (which precedes the photo-topographical survey), or from the horizontal plate of the camera. With several stations so plotted, the view from each of them of a certain portion of the country may be projected on the plane of the map, and salient points seen in perspective may be fixed by intersection.

The field work of a photo-topographic party consists primarily in execution of a triangulation by the usual methods which would be adapted to any ordinary topographical survey. To this is added a secondary triangulation, which is executed pari passu with the pho- tography for the purpose of fixing the position of the camera sta- tions. From such stations alone the topographical details are finally secured with the aid of the photographs. Great care is necessary in the selection of stations that will be suitable both for the exten- sion of triangulation and the purposes of closely overlooking topo- graphical details. In order to obtain means for correctly orienting the photographic views when plotting the map from them, it is usual, whilst making the exposures, to observe two or three points in each view with the altazimuth attached to the camera, in order to ascertain the horizontal and vertical angles between them. It is also advisable to keep an outline sketch of the landscape for the purpose of recording names of roads, buildings, &c.

The process of projecting the map from the photographs involves the use of two drawing-boards, on one of which the graphical determination of the points is made, and on the other the details of the final topography are drawn. The principal trigonometrical points are plotted on both these boards by their co-ordinates, and the camera stations either by their co-ordinate values or by intersection. Intermediate points, selected as appearing on two or more negatives, are then projected by intersection. The hori- zontal projection of a panorama consisting of any given number of plates is a regular geometrical figure of as many sides as there are plates, enclosing an inscribed circle whose radius is the focal length of the camera. Having correctly plotted the position of one plate, or view, with reference to the projected camera station by means of the angle observed to some known point within it, it is possible to plot the position of the rest of the series, with reference to the camera station and the orienting triangulation point, by the angular differences which are dependent on the number of photo- graphs forming the sides of the geometrical figure. Having secured the correct orientation of the horizontal plan, direction lines are drawn from the plotted camera station to points

photographed, and the position of topographical features is fixed fey intersection from two or more camera stations. -^

The difficulty of fitting in topographical detail from photographs taken from several points of view and in varying Kghts is very con- siderable; and leads to a generalizing of minor features which would be inadmissible in the Ordinary plane-tabling. Thus the opinion of Canadian experts appears to he that "a map made from photo- graphs and constructed in the office on a drawing-board, much on the same principle that a map is made on a plane-table board on the field, is less accurate and less satisfactory than the latter." x On the other hand, "considerable outlay is saved in photo-survey- ing by drafting the map in office, at the expense of only the indi- vidual draughtsman ; moreover, under advantageous conditions of light, photo-surveying field operations can be conducted more rapidly than plane-table surveys." These conclusions accord with those arrived at by surveyors in India who have recently tested this method of geographical surveying. In their opinion the camera may be accepted as a useful auxiliary to the plane-table, especially in high altitudes where, owing to the varying atmospheric conditions, only limited opportunities are available of observing peaks, snow-fields, and glaciers j but that for all ordinary conditions of geographical topography it can never supersede a plane-table survey. As an adjunct to military topographical equipment there can be no doubt about its value.

The plane-table is the instrument, par excellence, on which the geographical surveyor must depend for the final mapping of the physical features of the country under survey. It is piane. employed almost exclusively by members of the topo- table.' graphical staff in India, Russia, America, and France, and it is unlikely that the art of photo-topography will finally supersede it in Canada. But the art of plane-tabling is not an easy art to acquire. To be effective it must be adopted as a

1 Vide Wilson's Topographic Surveying. Wiley and Sons, New York.

[nautical

profession, and it is unfortunate that England offers no oppor- tunity for such professional training as is to be gained in the vast plains and mountains of Asia or America. The methods of adapt- ing the plane-table to geographical requirements differ with those varying climatic conditions which affect its construction. In the comparatively drjr climate of Asiatic Russia or of the United States, where errors arising from the unequal expansion of the plane-table board are insignificant, the plane-table is largely made use of as a triangulating instrument, and is fitted with slow-motion screws and with other appliances for increasing the certainty and the accuracy of observations. Such an adaptation of the plane-table is found to be impossible in India, where the great alternations of temperature, no less than of atmospheric humidity, tend to vitiate the accuracy of the projections on the surface of the board by the unequal effects of expansion in the material of which it is composed. The Indian plane-table is of the simplest possible construction, and it is never used in connexion with the stadia for ascertaining the distances of points and features of the ground (as is the case in America) ; and in place of the complicated Amer- ican alidade, with its telescope and vertical arc, a simple sight rule is used, and a chirometer for the measurement of vertical angles. The Indian plane-table approximates very closely in general con- struction to the ” Gannet ” pattern of America, which is specially constructed for exploratory surveys.

The scale on which geographical surveys are conducted is neces- sarily small. It may be reckoned at from 1 : 500000 to 1 : 125000, s . or from 1 inch=8 miles to 1 inch=2 miles. The 1 inch

=1 mile scale is the normal scale for rigorous topogra- phy, and although it is impossible to fix a definite line beyond which geographical scales merge into topographical (for instance, the 1-inch scale is classed as geographical in America whenever the continuous line contour system of ground representation gives place to hachuring) ,

it is convenient to assume generally that geo- graphical scales of mapping are smaller than the 1-inch scale.

On the smaller scales of 1 : 500000 or 1 : 250000 an experienced geographical surveyor will, in favourable country, complete an area of mapping from day to day which will practically cover Oat-tarn, nearly all that falls within his range of vision ; and he will, in the course of five or six months of continuous travelling (especially if provided with the necessary "control " in the shape of triangulated points at suitable intervals) cover an area of geographi- cal mapping illustrating all important topographical features re- presentable on the small scale of his survey, which may be reckoned at tens of thousands of square miles. But inasmuch as everything depends upon his range of vision, and the constant occurrence of suitable features from which to extend it, there is obviously no guiding rule by which to reckon his probable out-turn.

The same uncertainty which exists about " out-turn " manifestly exists about " cost." The normal cost of the 1-inch rigorous topographical survey in India, when carried over dis- Cos'- tricts which present an average of hills, plains, and

forests, may be estimated as between 25 and 30 rupees a square mile. This compares favourably with the rates which obtain in America over districts which probably present far more facilities for surveying than India does, but where cheap native labour is unknown. The geographical surveyor is simply a topographer employed on a smaller scale survey. His equipment and staff are somewhat less, but, on the other hand, his travelling expenses are greater. It is found that, on the whole, a fair average for the cost of geographical work may be struck by applying the square of the unit of scale as a factor to 1-inch survey rates; thus a quarter-inch scale survey (i.e., 4 miles to the inch) should be one-sixteenth of the cost per mile of the 1-inch survey over similar ground. A geographical reconnaissance on the scale of 1 : 500000 (8 miles = 1 inch) should be one-sixty-fourth of the square-mile cost of the 1-inch survey, &c. This is, indeed, a close approxima- tion to the results obtained on the Indian transfrontier, and would probably be found to hold good for British colonial possessions. In processes of map

reproduction a recent invention by Mr Vandyke (patented in India) for the reproduction of auction”1″ drawmgs by a method of direct printing on zinc with- out the intervention of a negative promises to be of great value. A new section has already been formed in the Calcutta printing office, which has already turned out a considerable quan- tity of work in much less time and at a much lower cost than would be involved by any process of photo-zincography or lithography. A large number of cadastral maps have been reproduced at about one-ninth of the ordinary cadastral rate.

For the rapid reproduction of geographical maps in the field in order to meet the requirements of a general conducting a campaign, or of a political officer on a boundary mission, no better method has lately been evolved than that which is known as the ferro- type process, by which blue prints can be secured in a few hours from a drawing of the original on tracing-cloth. The sensitized paper and printing-frame are far more portable than any photo- lithographic apparatus. Sketches illustrative of a field of action

may be placed in the hands of the general commanding on the day following the action, if the weather conditions are favourable for their development. The necessity for darkness whilst dealing with the sensitized material is a drawback, but it may usually be arranged with blankets and waterproof sheets when a tent is not available.

Nothing is more important to the geographical surveyor than a well-tried and well-considered equipment. For this he must be referred to the Mathematical Instrument Department, Calcutta, where “mobilization” equipment is retained, ready for issue for military purposes, and is carefully packed for mule or camel transport. It is equally well suited to the civil or military geographer.

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III. Nautical Surveying.

The great majority of nautical surveys are carried out by H.M. surveying vessels under the orders of the Hydro- grapher of the Admiralty. Plans of harbours and anchor- ages are also received from H.M. ships in commission on foreign stations, but surveys of an extended nature can hardly be executed except by a ship specially fitted and carrying a trained staff of officers. The introduction of steam placed means at the disposal of nautical surveyors which largely modified the conditions under which they had to work in the earlier days of sailing vessels, and it has enabled the ship to be used in various ways previously impracticable. The heavy draught of ships in the present day, the growing increase of ocean and coasting traffic all over the world, coupled with the desire to save distance by rounding points of land and other dangers as closely as possible, demand surveys on larger scales and in greater detail than was formerly necessary ; and to meet these modern requirements re-surveys of many parts of the world are continually being called for. Great Britain is, of all countries, most concerned in these matters, but the present expenditure for the purpose appears to be in- sufficient to keep pace with the demand, and it seems as if charts will get farther and farther behind the necessities of the case as years go on. Nautical surveys vary much in character according to the nature of the work, its im- portance to navigation, and the time available. The elaborate methods and rigid accuracy of a triangulation for geodetic purposes on shore are quite unnecessary, and are not attempted ; astronomical observation spots at intervals in an extended

survey prevent any serious accumulation of errors consequent upon a triangulation which is usually carried out with instruments, of which an 8-inch theodolite is the largest size used, whilst 5-inch theodolites generally suffice, and the sextant is largely employed for the minor triangulation. The scales upon which nautical surveys are plotted range from \ inch to 2 or 3 inches to the sea-mile in coast surveys for the ordinary purposes of navigation, according to the require- ments; for detailed surveys of harbours or anchorages a scale of from 6 to 12 inches is usually adopted, but in special cases scales as large as 60 inches to the mile are used. The general operations of a survey will be,

nautical]

Instru- ments.

described in the following pages, but space precludes the possibility of entering into many of the details which are necessary in practice, and for these the standard works on the subject must be consulted. For the execution of marine surveys no abstruse mathematical training is re- quired. Success depends chiefly upon the skill exercised by the officer in command in economizing the time at his disposal, or his judgment in evading the difficulties caused by contrary winds, bad weather, strong tides, an inhospitable population, and the natural features of the coast; and upon the concentrated attention given by himself and his assistants to a multitude of small details.

The following are the principal instruments required for use in the field : Theodolite, 5-inch, fitted with large telescope of high power, with coloured shades to the eye-piece for observ- ing the sun for true bearings. Sextant, 8-inch observing, stand and artificial horizon. Chronometers, eight box, and two or three pocket, are usually supplied to surveying vessels. Sounding Sextants, differing from ordinary sextants in being ■lighter and handier. The arc is cut only to minutes, reading to large angles of as much as 140°, and fitted with a tube of bell

shape so as to include a large field in the telescope which is of high power. Measuring chain 100 feet in length. Ten-foot pole for coast-lining, is a light pole carrying two oblong frames, 18 inches by 24 inches, covered with canvas painted white, with a broad vertical black stripe in the centre and fixed on the pole 10 feet apart. Station-pointer, an instrument in constant requisition either for sounding, coast-lining, or topographical plotting, which enables an observer's position to be fixed by taking two angles between three objects suitably situated. The movable legs being set to the ob- served angles, and placed on the plotting sheet, the chamfered edges » of the three legs are brought to pass through the points observed. The centre of the instrument then indicates the observer's position, Heliostats, for reflecting the rays of the sun from distant stations to indicate their position, are invaluable. The most convenient form is Galton's sun signal ; but an ordinary swing mirror, mounted to turn horizontally, will answer the purpose, the flash being directed from a hole in the centre of the mirror. Pocket Aneroid Barometer, required for topographical purposes. Prismatic Compass, Patent Logs (taffrail and harpoon), Lucas Wire Sounding Machine (large and small size), and James's Submarine Sentry are also required. For chart-room use are provided a graduated brass scale, steel straight-edges, and beam compasses of different lengths, rectangular vulcanite or ivory protractors of 6-inch and 12-inch length, and semi-circular brass protractors of 10-inch radius, a box of good mathematical drawing instruments, lead weights, drawing boards, and mounted paper.

Every survey must have fixed objects which are first plotted on the sheet, and technically known as " points." A keen eye is re- „ . quired for natural marks of all kinds, but these must

narks and 0ften ^e supplemented by whitewash marks, cairns, eacons. tripoaSj or bushes covered with white canvas or calico, and flags, white or black according to background. On low coasts, flagstaffe upwards of 80 feet high must sometimes be erected in order to get the necessary range of vision, and thereby avoid the evil of small triangles, in working through which errors accumulate so rapidly. A barling spar 35 feet in length, securely stayed and carrying as a topmast (with proper

guys) a somewhat lighter spar, lengthened by a long bamboo, will give the required height. A fixed beacon can be erected in shallow water, 2 to 3 fathoms in depth, by constructing a tripod of spars about 45 feet long. . The heads of two of them are lashed together, and the heels kept open at a fixed distance by a plank about 27 feet long, nailed on at about 5 feet above the heels of the spars. These are taken out by three boats, and the third tripod leg lashed in position on the1 boats, the heel in the opposite direction to the other two. The first two legs, weighted, are let go together ; using the third leg as a prop, the tripod is hauled into position and secured by guys to anchors, and by additional weights slipped down the legs. A vertical pole with bamboo can now be added, its weighted heel being on the ground and lashed to the fork. On this a flag 14 feet square may be hoisted. Floating beacons can be made by filling up flush the heads of two 27-gallon casks, connected by nailing a piece of thick plank at top and bottom. A barling spar passing through holes cut in the planks between the casts, pro- jecting at least 20 feet below and about 10 feet above them, is toggled securely by iron pins above the upper and below the lower plank. To the upper part of the spar is lashed a bamboo, 30 to 35 feet long, carrying a black flag 12 to 16 feet square, which will be visible from the ship 10 miles in clear weather. The ends of a span of J-inch chain are secured round the spar above and below ‘ the casks with a long link travelling upon it, to which the cable

is attached by a slip, the end being carried up and lightly stopped to the bamboo below the flag. A wire strop, kept open by its own stiffness, is fitted to the casks for convenience in slipping and picking up. The beacon is moored with chain and rope half as long again as the depth of water. Beacons have been moored by sounding line in as great depth as 3000 fathoms with a weight of 100 1b.

There is nothing in a nautical survey which requires more attention than the “fix”; a knowledge of the principles involved is essential in order to select properly situated objects. The method “p,xlnz-” of fixing by two angles between three fixed points is generally known as the “two-circle method,” but there are really three circles involved. The ” station-pointer ” is the instrument used for plotting fixes. Its

construction depends upon the fact that angles subtended by the chord of a segment of a circle measured from any point in its circumference are equal. The lines joining three fixed points form the chords of segments of three circles, each of which passes through the observer's position and two of the fixed points. The more rectangular the angle at which the circles intersect each other, and the more sensi- tive they are, the better will be the fix ; one condition is useless without the other. A circle is "sensitive" when the angle between the two objects responds readily to any small movement of the observer towards or away from the centre of the circle passing through the observer's position and the objects. This is most markedly the case when one object is very close to the observer and the other very distant, but not so when both objects are distant. Speak- ing generally, the sensibility of angles depends upon the relative distance of the two objects from the observer, as well as the absolute distance of the nearer of the two.

Fig. 1.

In the accompanying diagram A, B, C are the objects, and X the observer. Fig. 1 shows the circle passing through C, B, and X, cutting the circle ABX at a good angle, and therefore fixing X independently of the circle CAX, which is less sensitive than either of the other two. In Fig. 2 the two first circles are very, sensitive, but being nearly tangential they give no cut with each other. The third circle cuts both at right angles ; it is, however, far less sensitive, and for that reason if the right and left hand objects are both distant the fix must be bad. In such a case as this, because the angles CXB, BXA are both so sensitive, and the accuracy of the fix depends on the precision with which the angle CXA is measured,

that angle should be observed direct, together with one of the other angles composing it. Fig. 3 represents a case where the points are badly disposed, approaching the condition known as “on the circle,” passing through the three points. All three circles cut one another at such a fine angle as to give a very poor fix. The centre

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Pig. 2.

of the station-pointer could be moved considerably without materially affecting the coincidence of the legs with the three points. To avoid a bad fix the following rules are safe : —

1. Never observe objects of which the central is the furthest unless it is very distant relatively to the other two, in which case the fix is admissible, but must be used with caution.

2. Choose objects disposed as follows : (a) One out- side object distant and the other two near, the angle between the two near objects being not less than 30° or more than 140°. The amount of the angle between the middle and distant object is immaterial. (&) The three objects nearly in a straight line, the angle between any two being not less than 30°. (c) The observer’s position being inside the triangle formed by the objects.

A fix on the line of two points in transit, with an angle to a third point, becomes more sensitive as the distance

\ C

Fig. 8,

between the transit points increases relatively to the dis- tance between the front transit point and the observer ; the more nearly the angle to the third point approaches a right angle, and the nearer it is situated to the observer, the better the fix. If the third point is at a long dis- tance,

small errors either of observation or plotting affect the result largely. A good practical test for a fix is

afforded by noticing whether a very slight movement of the centre of the station-pointer will throw one or more of the points away from the leg. If it can be moved with- out appreciably disturbing the coincidence of the leg and all three points, the fix is bad.

Tracing-paper answers exactly the same purpose as the station-pointer. The angles are laid off , from a centre representing the position, and the lines brought to pass through the points as before. This entails more time, and the angles are not so accurately measured with a small protractor. Never- theless this has often to be used, as when points are close together on a small scale the central part of the station-pointer will often hide them and prevent the use of the instrument. The use of tracing-paper permits any number of angles to different points to be laid down on it, which under certain conditions of fixing is sometimes a great advantage. Although marine surveys are in reality founded upon triangulation and measured bases of some description, yet when plotted irregularly the system of triangles is not always apparent. The triangulation ranges from the rough triangle of a running survey to the carefully formed triangles of detailed surveys. The measured base for an extended survey is provisional only, the scale resting ultimately mainly upon the astronomical positions observed at its extremes. In the case of a plan the base is absolute. The main triangulation, of which the first triangle contains the measured base as its known side, establishes a series of points known as main stations, from which and to which angles are taken to fix other stations. A sufficiency of secondary stations and marks enables the detail of the chart to be filled in between them. The points, embracing the area to be worked on, having been plotted, are transferred to field boards, upon which the detail of the work in the field is plotted; when complete the work is traced and re-transferred to the plotting-sheet, which is then inked in as the finished chart, and if of large extent it is graduated on the gnomonic projection on the astro- nomical positions of two points situated near opposite corners of the chart.

The kind of base ordinarily used is one measured by chain on flat ground, of £ to 1$- miles in length, between two points visible from one another, and so situated that a triangulation can be readily extended from them to em- brace other points in the survey, forming well-conditioned triangles. The error of the chain is noted before leaving the ship, and again on returning, by comparing its length with the standard length of 100 feet marked on the ship's deck. The correction so found is applied to obtain the final result. If by reason of water intervening between the base stations it is impossible to measure the direct distance between them, it is permissible to deduce it by traversing.

A Masthead Arigle Base is useful for small plans of harbours, &c. , when circumstances do not permit of a base being measured on shore. The ship at anchor nearly midway between two base stations is the most favourable condition for employing this method. Theodolite reading of the masthead with its elevation by sextant observed simultaneously at each base station (the mean of several observations being employed) give the necessary data to calculate the distance between the base stations from the two dis- tances resulting from the elevation of the masthead and the simul- taneous theodolite-angles between the masthead and the base stations. The height of the masthead may be temporarily in- creased by securing a spar to extend 30 feet or so above it, and the exact height from truck to netting is found by tricing up the end of the measuring chain. The angle of elevation should not be diminished below about 1° from either station. Base by Sottud. — The interval in seconds between the flash and

report of a gun, carefully noted by counting the beats of a watch or pocket chronometer, multiplied by the rate per second at which sound travels (corrected for temperature), supplies a means of ob- taining a base which is sometimes of great use when other methods are not available. Three miles is a suitable distance for such a base, and guns or

small brass Cohom mortars are fired alternately from either end, and repeated several times. The arithmetical mean is not strictly correct, owing to the retardation of the sound against the wind exceeding the acceleration when travelling with

it ; the formula used is therefore T=

2tt' t+t1

where T is the mean in- terval required, { the interval observed one way, t' the interval the other way. The method is not a very accurate one, but is suffi- ciently so when the scale is finally determined by astronomical observations, or for sketch surveys. The measurement should be across the wind if possible, especially if guns can only be fired from one end of the base. Sound travels about 1090 feet per second at a temperature of 32° F, and increases at the rate of 1-16 foot for each degree above that temperature, decreasing in the same propor- tion for temperatures below 32°.

Base by Angle of Short Measured Length. — An angle measured by sextant between two well-defined marks at a carefully measured distance apart, placed at right angles to the required base, will give a base for a small plan.

Astronomical Base. — The difference of latitude between two stations visible from each other and nearly in the same meridian, combined with their true bearings, gives an excellent base for an extended triangulation ; the only drawback to it is the effect of local attraction of masses of land in the vicinity on the pendulum, or in other words, on the mercury in the artificial horizon. The base stations should be as far apart as possible, in order to mini- mize the effect of any error in the astronomical observations. The observation spots would not necessarily be actually at the base stations, which would probably be situated on summits at some little distance in order to command distant views. In such cases each observation spot would be connected with its corresponding base station by a subsidiary triangulation, a short base being mea- sured for the purpose. The ship at anchor off the observation spot frequently affords a convenient means of effecting the

con- nexion by a masthead angle base and simultaneous angles. If possible, the observation spots should be east or west of the moun- tain stations from which the true bearings are observed.

If the base stations A and B are so situated that by reason of distance or of high land intervening they are invisible from one another, but both visible from some main station C between them, when the main triangulation is completed, the ratio of the sides AC, BC can be determined. From this ratio and the observed angle ACB, the angles-ABC, BAC can be found. The true bearing of the lines AC or BC being known, the true bearing of the base stations A and B can be deduced.

Extension of Base. — A base of any description is seldom long enough to plot from directly, and in order to diminish errors of plotting, it is necessary to begin on the longest side possible so as to work inwards. A short base measured on flat ground will give a better result than a longer one measured over inequalities, provided that the triangulation is carefully extended by means of judiciously selected triangles, great care being taken to plumb the centre of each station. To facilitate the extension of the base in as few triangles as possible, the base should be placed so that there are two stations, one on each side of it, subtending angles at them of from 30° to 40°, and the distances between which, on being calculated in the triangles of the quadrilateral so formed, will constitute the first extension of the base. Similarly, two other stations placed one on each side of the last two, will form another quadrilateral, giving a yet longer side, and so on.

The angles to be used in the main triangulation scheme must be very carefully observed and the theodolite placed exactly over the centre of the station. Main Main angles are usually repeated several times by

won?”” resetting the vernier at intervals equidistant along the arc, in order to eliminate instrumental errors as well as errors of observation. The selection of an object suitable for a zero is important. It should, if possible, be another main station at some distance, but not so far or so high as to be easily obscured, well defined, and likely to be permanent. Angles to secondary stations and other marks need not be repeated so many times as the more important angles, but it is well to check all

angles once at least. Rough sketches from all stations are of great assistance in identifying objects from differ- ent points of view, the angles being entered against each in the sketch.

False Station. — When the theodolite cannot for any reason be placed over the centre of a station, if the distance be measured, and the theodolite reading of it be noted, the observed angles may be reduced to what they would be at the centre of the station. False stations have frequently to be made in practice ; a simple rule to meet all cases is of great assistance to avoid the possibility of error in applying the correction with its proper sign. This may very easily be found as follows, without having to bestow a moment's thought beyond applying the rule, which is a matter of no small gain in time when a large number of angles have to be corrected.

Bule. — Put down the theodolite reading which it is required to correct (increased if necessary by 360°), and from it subtract the theodolite reading of the centre of the station. Call this remainder 6. o

With 6 as a "course" and the num- i

ber of feet from the theodolite to 4/5 iff? ~~45′ the station as a "distance," enter the traverse table and take out the greater increment if 8 lies between 45° and 135°, or between 225° and »r6a^r 315°, and the lesser increment for Increment/ other angles. The accompanying diagram (Fig. 4) will assist the memory. Refer this increment to the " table of subtended angles by **^ various lengths at different dis~~ tances" (using the distance of the object observed) and find the corre- sponding correction in arc, which mark -f or — according as 0 is under or over 180°. Apply this correction to the observed theodolite angle. A "table of subtended angles" is unnecessary if the formula

Fig. 4.

Angle in seconds =

number of feet subtended x 34

be used instead.

distance of object in sea-miles Convergent/ of Meridians. — The difference of the reciprocal true bearings between two, stations is •called the ” convergency.” The formula for calculating it is : Conv. in minutes = dist. in sea- miles x sin. Merc, bearing x tan. mid. lat. Whenever true bear- ings are used in triangulation, the effect of convergency must be considered and applied. In north latitudes the southerly bearing is the greater of the two, and in south latitudes the northerly bearing. The Mercatorial bearing between two stations is the mean of their reciprocal true bearings.

After a preliminary run over the ground to note suitable positions for main and secondary stations on prominent headlands, islands, and summits not too far back from the coast, and, if no former survey exists, iatedZ”~ to make at the same time a rough plot of them coast by compass and patent log, a scheme must be survey- formed for the main triangulation with the object of enclosing the whole survey in as few triangles as possible, regard being paid to the limit of vision of each station due to its height, to the existing meteorological conditions, to the limitations imposed by higher land intervening, and to its accessibility. The tringles decided upon should be well-conditioned, taking care not to introduce an angle of less than 30° to 35°, which is only permissible when the two longer sides of such a triangle are of nearly equal length, and when in the calculation that will follow one of these sides shall be derived from the other and not from the short side. In open country the selection of stations is comparatively an easy matter, but in country densely wooded the time occupied by a triangulation is mainly governed by the judicious selection of stations quickly reached, sufficiently elevated to command distant views, and situated on summits capable of being readily cleared of trees in the required direction, an all-round view being, of course, desirable but not always attainable. The positions of secondary stations will also generally be de- cided upon during the preliminary reconnaissance. The object of these stations is to break up the large primary triangles into triangles of smaller size, dividing up the distances between the primary stations into suitable lengths ; they are selected with a view to greater accessi-

bility than the latter, and should therefore usually be near the coast and at no great elevation. Upon shots from these will depend the position of the greater number of the

coast-line marks to be erected and fixed as the detailed survey of each section of the coast is taken in hand in regular order. The nature of the base to be used, and its position in order to fulfil the conditions specified under the head of ” Bases,” must be considered, the base when ex- tended forming a side of one of the main triangles. It is immaterial at what part of the survey the base is situated, but if it is near one end, a very satisfactory check on the accuracy of the triangulation is obtained by comparing the length of a side at the other extreme of the survey, derived by calculation through the whole system of tri- angles, with its length deduced from a check base measured in its vicinity. It is generally a saving of time to measure the base at some anchorage or harbour that requires a large scale plan. The triangulation involved in extend- ing the base to connect it with the main triangulation scheme can thus be utilized for both purposes, and whilst the triangulation is being calculated and plotted, the survey of the plan can be proceeded with. True bearings are observed at both ends of the survey, and the results subsequently compared. Astronomical observations for latitude are obtained at observation spots near the ex- tremes of the survey and the meridian distance run between them, the observation spots being connected with the pri- mary triangulation ; they are usually disposed at intervals of from 100 to 150 miles, and thus errors due to a trian- gulation carried out with theodolites of moderate diameter do not accumulate to any serious extent. If the survey is a very extended one, intermediate observation spots afford a satisfactory check, by comparing the positions as calculated in the triangulation with those obtained by direct observation.

Calculating the Triangulation. — The triangles as observed being tabulated, the angles of each triangle are corrected to bring their sum to exactly 180°. We must expect to find errors in the triangles of as much as one minute, but under favourable conditions they may be much less. In distributing the errors we must consider the general skill of the observer, the size of his theodolite relatively to the others, and the conditions under which his angles were observed ; failing any particular reason to assign a larger error to one angle than to another, the error must be divided equally, bearing in mind that an alteration in the small angle will make more difference in the resulting position than in either of the other two, and as it approaches 30° (the limit of a receiving angle) it is well to change it but very slightly in the absence of any strong reason to the contrary. The length of base being determined, the sides of all the triangles involved are calculated by the ordinary rules of trigonometry. Starting from the true bearing observed at one end of the survey, the bearing of the side of each triangle that forms the immediate line of junction from one to the other is found by applying the angles necessary for the purpose in the respective triangles, not forgetting to apply the convergency be- tween each pair of stations when reversing the bearings. The bearing of the final side is then compared with the bearing ob- tained by direct observation at that end of the survey. The difference is principally due to accumulated errors in the triangula- tion ; half of the difference is then applied to the bearing of each side. Convert these true bearings into Mercatorial bearings by applying half the convergency between each pair of stations. With the lengths of the connecting sides found from the measured base and their Mercatorial bearing, the Mercatorial bearing of one observation spot from the other is found by middle latitude sailing. Taking the observed astronomical positions of the observation spots and first reducing their true difference longi- tude to departure, as measured on a spheroid from the formula -^ ™ ^ , no. ft. in 1 mile long. , . . ,

Dep. =T. D. long. . — n — j-p^-, then with the d. lat.

r ° no. ft. in 1 mile of lat.

and dep. the Mercatorial true bearing and distance between the observation spots is calculated by middle latitude sailing, and compared with that by triangulation and measured base. To adjust any discrepancy, it is necessary to consider the probable error of the observations for latitude and meridian distance ; within those limits the astronomical positions may safely be altered in order to harmonize the results ; it is more important to bring the bearings into close agreement than the distance. From the amended astronomical positions the Mercatorial true bearings and distance between them are re-calculated. The difference be- tween this Mercatorial bearing and that found from the triangulation and measured base must be applied to the bearing of each side to

get the final corrected bearings, and to the logarithm of each side of the triangulation as originally calculated must be added or subtracted the difference between the logarithms of the distance of the amended positions of the observation spots and the same dis- tance by triangulation.

Calculating Intermediate Astronomical Positions. — The latitude and longitude of any intermediate main station may now be calculated from the finally corrected Mercatorial true bearings and lengths of sides. The difference longitude so found is what it would be if measured on a true sphere, whereas we require it as measured on a spheroid, which is slightly less. The correction

, , cos2 mid. lat. = d. long. r-rjr — — must therefore be subtracted ; or the

true difference longitude may be found direct from the formula , no. ft. in 1 mile of lat. _, ,

dep. j—. — z — – — j-^ From the foregoing it is seen

no. ft. in 1 mile of long. & &

that in a triangulation for hydrographical purposes both the bearings of the sides and their lengths ultimately depend almost entirely upon

the astronomical observations at the extremes of the survey ; the observed true bearings and measured base are con- sequently more in the nature of checks than anything else. It is obvious, therefore, that the nearer together the observation spots, the greater effect will a given error in the astronomical positions have upon the length and direction of the sides of the triangula- tion, and in such cases the bearings as actually observed must not be altered to any large extent when a trifling change in the astro- nomical positions might perhaps effect the required harmony. For the reasons given under "Astronomical Bases," high land near observation spots may cause very false results, which may often account for discrepancies when situated on opposite sides of a mountainous country.

Great care is requisite in projecting on paper the points of a survey. The paper should be allowed to stretch and shrink as it pleases until it comes to a stand, being exposed to the air for four or five hours ° °s' daily, and finally well flattened out by being placed on a table with drawing boards placed over it heavily weighted. If the triangulation has been calculated beforehand throughout, and the lengths of all the different sides have been found, it is more advantageous to begin plotting by distances rather than by chords. The main stations are thus got down in less time and with less trouble, but these are only a small proportion of the points to be plotted, and long lines must be ruled- between the stations as zeros for plotting other points by chords. In ruling these lines care must be taken to draw them exactly through the centre of the pricks denoting the stations, but however carefully drawn, there is liability to slight error in 'any line projected to a point lying beyond the distance of the stations between which the zero line is drawn. In plot- ting by distances, therefore, all points that will subse- quently have to be plotted by chords should lie well within the area covered by the main triangulation. Three distances must be measured to obtain an intersection of the arcs cutting each other at a sufficiently broad angle ; the plotting of the main stations once begun must be completed before distortion of the paper can occur from change in the humidity of the atmosphere. Plotting, whether by distance or by chords, must be begun on as long a side as possible, so as to plot inwards, or with decreasing distances. In plotting by chords it is

import- ant to remember in the selection of lines of reference (or zero lines), that that should be preferred which makes the smallest angle with the line to be projected from it, and of the angular points those nearest to the object to be projected from them.

Irregular Methods of Plotting.— In surveys for the ordinary purposesof navigation, it frequently happens that a regular sys- tem of triangulation cannot be carried out, and recourse must be had to a variety of devices ; the judicious use of the ship in such cases is often essential, and with proper care excellent results may be obtained. A few examples will best illustrate some of the methods used, but circumstances vary so much in every survey, that it is only possible to meet them properly by studying each case as it arises, and to improvise methods. Fixing a position by means of the "back-angle" is one of the most ordinary expedients. Angles having been observed at A, to the station B, and certain other fixed points of the survey, C and D for instance : if A is

shot up from B, at which station angles to the same fixed points have been observed, then it is not necessary to visit those points to fix A. For instance, in the triangle ABC, two of the angles have been observed, and therefore the third angle at C is known (the three angles of a triangle being equal to 180°), and it is called the " calculated or back-angle from C." A necessary condi- tion is that the receiving angle at A, between any two lines (direct or calculated), must be sufficiently broad to give a good cut ; also the points from which the "back-angles" are calculated should not be situated at too great distances from A, relatively to the distance between A and B. A station may be plotted by laying down the line to it from some other station, and then placing on tracing-paper a number of the angles taken at it, includ- ing the angle to the station from which it has been shot up. If the points to which angles are taken are well situated, a good position is obtained, its

accuracy being much strengthened by being able to plot on a line to it, which, moreover, forms a good zero line for laying off other angles from the station when plotted. Sometimes the main stations must be carried on with a point plotted by only two angles. An effort must be made to check this subsequently by getting an ” angle back ” from stations dependent upon it to some old well-fixed point; failing this, two stations being plotted with two angles, pricking one and laying down the line to the other will afford a check. A well-defined mountain peak, far inland and never visited, when once it is well -fixed is often invaluable in carrying on an irregular triangulation, as it may remain visible when all other original points of the survey have disappeared, and ” back-angles ” from it may be continually obtained, or it may be used for plotting on true bearing lines of it. In plotting the true bearing of such a peak, the convergency must be found and applied to get the reversed bearing, which is

Fig. 5.

then laid down from a meridian drawn through it; or the re- versed bearing of any other line already drawn through the peak being known, it may simply be laid down with that as a zero. A rough position of the spot from which the true bearing was taken must be assumed in order to calculate the convergency. Fig. 5 will illustrate the foregoing remarks. A and B are astronomical observation spots at the extremes of a survey, from both of which the high, inaccessible peak C is visible. D, E, F are intermediate stations ; A and D, D and E, E and F, F and B being respectively visible from each other. G is visible from A and D, and C is visible from all stations. The latitudes of A and B and meridian distance between them being determined, and the true bearing of C being observed from both observation spots, angles are observed at all the stations. Calculating the spheroidal correction (from

the formula, correction=d. long.-2 — —^ -] and adding it to

the true (or chronometric) difference longitude between A and B to obtain the spherical d. long. ; with this spherical d. long, and the d. lat., the Mercatorial true bearing and distance is found by middle latitude sailing (which is an equally correct but shorter method than by

spherical trigonometry, and may be safely used when dealing with the distances usual between observation spots in nautical surveys) . The convergency is also calculated, and the true bearing of A from B and B from A are thus determined. In the plane triangle ABC, the angle A is the difference between the calculated bearing of B and the observed bearing of C from A ; similarly angle B is the difference-between calculated bearing of A and observed bearing of C from B. The distance AB having been also calculated, the side AC is found. Laying down AC on the paper on the required scale, D is plotted on its direct shot from A, and on the angle back from C, calculated in the triangle

ACD. G is plotted on the direct shots from A and D, and on the angle back from C, calculated either in the triangle ACG or GCD. The perfect intersection of the three lines at G assures these four points being correct. E, F, and B are plotted in a similar manner. The points are now all plotted, but they depend on calculated angles, and except for the first four points we have no check whatever either on the accuracy of the angles ob- served in the field or on the plotting. Another well-defined object in such a position, for instance as Z, visible from three or more stations, would afford the necessary check, if lines laid off to it from as many stations as possible gave a good intersection. If no such point, however, exists, a certain degree of check on the angles observed is derived by applying the sum of all the calculated angles at C to the true bearing of A from C (found by reversing observed bearing of C from A with convergency applied), which will give the bearing of B from C. Reverse this bearing with con- vergency applied, and compare it with the observed bearing of C from B. If the discrepancy is but small, it will be a strong pre- sumption in favour of the substantial accuracy of the work. If the calculated true bearing of B from A be now laid down, it is very unlikely that the line will pass through B, but this is due to the discrepancy which must always be expected between astronomical positions and triangulation. If some of the stations between A and B require to be placed somewhat closely to one another, it may be desirable to obtain fresh true bearings of C instead of carrying on the original bearing by means of the calculated angle. In all cases of irregular plotting the ship is very useful, especially

if she is moored taut without the swivel, and angles are observed from the bow. Floating beacons may also assist an irregular triangulation.

Surveys of various degrees of accuracy are included among sketch surveys. The roughest description is the ordinary running survey, when the work is done by the ship steaming along the coast, fixing f„^yS points, and sketching in the coast-line by bear- ings and angles, relying for her position upon her courses and distances as registered by patent log, necessarily regardless of the effect of wind and current and errors of steerage. At the other extreme comes the modified running survey, which in point of practical accuracy falls little short of that attained by irregular triangulation. Some of these modifications will be briefly noticed. A running survey of a coast-line between two harbours, that have been s ur veyed independently and astronomically fixed, may often be carried out by fixing the ship on the points already laid down on the harbour surveys and shooting up prominent intermediate natural objects, assisted possibly by theodolite lines from the shore stations. Theodolite lines to the ship at any of her positions are particularly valuable, and floating beacons suitably placed materially increase the value of any such work. A sketch survey of a coast upon which it is impossible to land may be well carried out by dropping beacons at intervals of about ten miles, well out from the land and placed abreast prominent natural objects called the ” breastmarks,” which must be capable of recognition from the beacons anchored off the next ” breastmark ” on either side. The distance between the beacons is found by running a patent log both ways, noting the time occupied by each run ; if the current has remained constant, a tolerably good result can be ob- tained. At the first beacon, angles are observed between the second beacon and the two ” breastmarks,” an ” inter- mediate ” mark, and any other natural object which will serve as “points.” At the second beacon, angles are observed between the first beacon and the same objects as before. Plotting on the line of the two beacons as a base, all the points observed can be pricked in on two shots. At a position about midway between the beacons, simultaneous angles are observed to all the points, and laid off on tracing-paper, which will afford the necessary check, and the foundation is thus laid for filling in the detail of coast-line, topography, and soundings off this

particular stretch of coast in any detail desired. Each section of coast is complete in itself on its own base ; the weak point lies in the junction of the different sections, as the patent log bases can hardly be expected to agree

precisely, and the scales of adjacent sections may thus be slightly different. This is obviated, as' far as possible, by fixing on the points of one section and shooting up those of another, which will check any great irregularity of scale creeping in. The bearing is preserved by getting occa- sional true bearing lines at the beacons of the most distant point visible. Space does not here permit of dwelling upon the details of the various precautions that are neces- sary to secure the best results the method is capable of ; it can only be stated generally that in all cases of using angles from the ship under weigh, several assistants are necessary, so that the principal angles may be taken simultaneously, the remainder being connected immediately afterwards with zeros involving the smallest possible error due to the ship not being absolutely stationary, these zeros being included amongst the primary angles. When close to a beacon, if its bearing is noted and the distance in feet obtained from its elevation, the angles are readily reduced to the beacon itself. Astronomical positions by twilight stars keep a check upon the work.

Sketch Surveys by Compass Bearings and Vertical Angles. — In the case of an island culminating in a high, well-defined summit visible from all directions, a useful and accurate method is to steam round it at a sufficient distance to obtain a true horizon, stopping to make as many stations as may be desirable, and fixing by compass bearing of the summit and ■'its vertical angle. The height is roughly obtained by shooting in the summit, from two positions on a patent log base whilst approaching it. With this approximate height and Lecky's vertical danger angle tables, each station may be plotted on its bearing of the

summit. From these stations the island is shot in by angles between its tangents and the summit, and angles to any other natural features, plotting the work as we go on any convenient scale which must be considered only as provisional. On completing the circuit of the island, the true scale is found by measuring the total distance in inches on the plotting-sheet from the first to the last station, and dividing it by the distance in miles between them as shown by patent log. The final height of the summit bears to the rough height used in plotting the direct proportion of the provisional scale to the true scale. This method may be utilized for the sketch survey of a coast where there are well-defined peaks of suf- ficient height at convenient intervals, and would be superior to an ordinary running survey. From positions of the ship fixed by bearings and elevations of one peak, another farther along the coast is shot in and its height determined ; this second peak is then used in its turn to fix a third, and so on. The smaller the vertical angle the more liability there is to error, but a glance at Lecky's tables will show what effect an error of say 1′ in altitude will pro- duce for any given height and distance, and the limits of distance must depend upon this consideration.

Surveys of Banks out of Sight of Land. — On striking shoal soundings unexpectedly, the ship may either be anchored at once, and the shoal sounded out by boats starring round her, using pris- matic compass and masthead angle ; or if the shoal is of large ' extent and may be prudently crossed in the ship, it is a good plan to get two beacons laid down on a bearing from one another and patent log distance of 4 or 5 miles. With another beacon (or mark-boat, carrying a large black flag on a bamboo 30 feet high) fixed on this base, forming an equilateral triangle, and the ship anchored as a fourth point, soundings may be carried out by the boats fixing by station-pointer. The ship's position is determined by observations of twilight stars.

In a detailed survey the coast is sketched in by walk- ing along it, fixing by theodolite or sextant angles, and plotting by tracing-paper or station-pointer. A sufficient number of fixed marks along the shore afford a constant check on the minor coast-line stations, which should be plotted on, or checked by, lines from one to the other wherever

possible to do so. When impracticable to fix in the ordinary way, the ten-foot pole may be used to traverse from one fixed point to another. With a coast fronted by broad drying coral reef or flats over which it is possible to walk, the dis- tance between any two coast-line stations may be found by measuring at one of them the angle subtended by a known length placed at right angles to the line joining the stations. There is far less liability to error if the

Coast- lining.

work is plotted at once on the spot on a field board with the fixed points pricked through and circled in upon it ; but if circumstances render it necessary, the angles. being registered and sketches made of the bits of coast between the fixes on a scale larger than that of the chart, they may be plotted afterwards ; to do this satisfactorily, how- ever, requires the surveyor to appreciate instinctively exactly what angles are necessary at the time. It is with the high-water line that the coast-liner is concerned, de- lineating its character according to the Admiralty symbols. The officer sounding off the coast is responsible for the position of the dry line at low-water, and on large scales this would be sketched in from a small boat at low-water springs. Heights of cliffs, rocks, islets, &c, must be inserted, either from measurement or from the formula,

. . angle of elevation in seconds x distance in miles height in feet= — =j
>

and details of topography close to the coast, including roads, houses, and enclosures, must be shown by the coast- liner. Eocks above water or breaking should be fixed on passing them. Coast-line may be sketched from a boat pulling along the shore, fixing and shooting up any natural objects on the beach from positions at anchor.

The most important feature of a chart is the complete- ness with which it is sounded. Small scale surveys on anything less than one inch to the mile are apt to be very misleading ; such a survey may 0OJ““1,& appear to have been closely sounded, but in reality the lines are so far apart that they often fail to disclose indications of shoal-water. The

work of sounding may be proceeded with as soon as sufficient points for fixing are plotted; but off an intricate coast, it is better to get the coast-line done first. The lines of soundings are run by the boats parallel to one another and perpendicu- lar to the coast at a distance apart which is governed by the scale ; five lines to the inch is about as close as they can be run without overcrowding; if closer lines are required the scale must generally be increased. The distance apart will vary with the depth of water and the nature of the coast ; a rocky coast with shallow water off it and projecting points will need much closer examina- tion than a steep-to coast, for instance. The line of pro- longation of a point under water will require special care to ensure the fathom lines being drawn correctly. If the soundings begin to decrease when pulling off-shore it is evidence of something suspicious, and intermediate lines of soundings or lines at right angles to those pre- viously run should be obtained. Whenever possible lines of soundings should be run on transit lines ; these may often be picked up by fixing when on the required line, noting the angle on the protractor between the line and some fixed mark on the field board, and then placing the angle on the sextant, reflecting the mark and noting what objects are in line at that angle. On large scale surveys whitewash marks or flags should mark the ends of the lines, and for the back transit marks natural objects may perhaps be picked up ; if not, they must be placed in the required positions. The boat is fixed by two angles, with an occasional third angle as a check ; the distance between the fixes is dependent upon the scale of the chart and the rapidity with which the depth alters ; the 3, 5, and 10 fathom lines should always be fixed, allowing roughly for the tidal reduction. The nature of the bottom must be taken every few casts, and recorded. It is best to plot each fix on the sounding board at once, joining the fixes by straight lines and numbering them for identification. The tidal reduction being oh tained, the reduced soundings are written in the field- book in red underneath each sounding as originally noted ; they are then placed in their proper position on the board

between the fixes. Suspicious ground should be closely examined; a small nun buoy anchored on the shoal is useful to guide the boat while trying for the least depth. Sweeping for a reported pinnacle rock may be resorted to when sounding fails to discover it. Local information from fishermen and others is often most valuable as to the existence of dangers. Up to depths of about 15 fathoms the hand lead line is used from the boats, but beyond that depth the small Lucas machine for wire effects a great saving of time and labour. The deeper soundings of a survey are usually obtained from the ship, but steamboats with wire rounding machines may assist very materially. By the aid of a steam winch, which by means of an endless rounding line hauls a 100-ib lead forward to the end of the lower boom rigged out, from which it is dropped by a slipping apparatus which acts on striking the water, soundings of 40 fathoms may be picked up from the sounding platform aft, whilst going at a speed of 4£ knots. In deeper water it is quicker to stop the ship and sound from aft with the wire sound- ing machine. In running long lines of soundings on and off shore, it is very essential to be able to fix as far from the land as possible. Angles will be taken from aloft for this purpose, and a few floating beacons dropped in judi- ciously-chosen positions will often well repay the trouble. A single fixed point on the land used in conjunction with two beacons suitably placed will give an admirable fix. A line to the ship or her smoke from one or two theodo- * lite stations on shore is often invaluable ; if watches are compared, observations may be made at stated times and plotted afterwards. True bearings of a distant fixed ob- ject cutting the line of position derived from an altitude of the sun is another means of fixing a position, and after dark the true bearing of a light may be obtained by the time azimuth and angular distance of a star near the prime vertical, or by the angular distance of Polaris in the northern hemisphere.

A very large percentage of the bugbears to navigation denoted by vigias on the charts eventually turn out to have no existence, but before it is possible to expunge them a large area has to be examined. No bottom soundings are but little use, but the evidence of positive soundings should be conclusive. Submarine banks rising from great depths

necessarily stand on bases many square miles in area. Of recent years our knowledge of the angle of slope that may be expected to occur at different depths has been much extended. From depths of upwards of 2000 fathoms the slope is so gradual that a bank could hardly approach the surface in less than 7 miles from such a sounding ; therefore any- where within an area of at least 150 square miles all round a bank rising from- these depths, a sounding must show some decided indications of a rise in the bottom. Under such circumstances, soundings at intervals of 7 miles, and run in parallel lines 7 miles apart, enclosing areas of only 50 square miles between any four adjacent soundings, should effectually clear up the ground and lead to the discovery of any shoal ; and in fact the sound- ings might even be more widely spaced. From depths of 1500 and 1000 fathoms, shoals can scarcely occur within 31- miles and 2 miles respectively ; but as the depth de- creases the angle of slope rapidly increases, and a shoal might occur within three-quarters of a mile or even half a mile of such a sounding as 500 fathoms. A full appre- ciation of these facts will indicate the distance apart at which it is proper to place soundings in squares suitable to the general depth of water. Contour lines will soon show in whteh direction to prosecute the search if any irregularity of depth is manifested. When once a decided indication is found, it is not difficult to follow it up by paying attention to the contour lines as developed by suc-

cessive soundings. Discoloured water, ripplings, fish jumping, or birds hovering about may assist in locating a shoal, but the submarine sentry towed at a depth of 40 fathoms is here invaluable, and may save hours of hunting. Eeports being more liable to errors of longi- tude than of latitude, a greater margin is necessary in that direction. Long parallel lines east and west are prefer- able, but the necessity of turning the ship more or less head to wind at every sounding makes it desirable to run the lines with the wind abeam, which tends to dis- turb the dead reckoning least. A good idea of the cur- rent may be obtained from the general direction of the ship's head whilst sounding considered with reference to the strength and direction of the wind, and it should be allowed for in shaping the course to preserve the paral- lelism of the lines, but the less frequently the course is altered the better. A good

position in the morning should be obtained by pairs of stars on opposite bear- ings, the lines of position of one pair cutting those of another pair nearly at right angles. The dead reckoning should be checked by lines of position from observations of the sun about every two hours throughout the day, preferably whilst a sounding is being obtained and the ship stationary. Evening twilight stars give another position.

Tides. — The datum for reduction of soundings is low-water ordi- nary springs, the level of which is referred to a permanent bench mark in order that future surveys may be reduced to the same datum level. Whilst sounding is going on the height of the water above this level is observed by a tide gauge. The time of high-water at full and change, called the ” establishment,” and the heights to which spring and neap tides respectively rise above the datum are also required. It is seldom that a sufficiently long series of obser- vations can be obtained for their discussion by harmonic analysis, and therefore the graphical method is preferred ; an abstract form provides for the projection of high and low waters, lunitidal inter- vals, moon’s meridian passage, declination of sun and moon, apogee and perigee, and mean time of high-water following supe- rior transit, and of the highest tide in the twenty-four hours. A good portable automatic tide gauge suitable for all requirements is much to be desired. A pneumatic gauge seems now to be perfected, but it has yet to be tried under practical conditions of service.

Tidal Streams and Surface Currents are observed from the ship or boats at anchor in different positions, by means of a current log ; or the course of a buoy drifted by the current may be followed by a boat fixing at regular intervals. Tidal streams often run for some hours after high and low water by the shore ; it is important to find out whether the change of stream occurs at a regular time of the tide. Undercurrents are of importance from a scientific point of view. A deep-sea current meter, devised (1876) by Lieu- tenant Pillsbury, U.S.N., has, with several modifications, been used with success on many occasions, notably by the U.S. Coast and Geo- detic Survey steamer Blake in the investigation of the Gulf Stream. The instrument is first lowered to the required depth, and when ready is put into action by

means of a heavy weight, or messenger, travelling down the supporting line and ^umnt3 striking on a metal plate, thus closing the jaws of the m|ifcj, levers and enabling the instrument to begin working. The rudder is then free to revolve inside the framework and take up the direction of the current ; the small cones can revolve on their axis and register the number of revolutions, while the com- pass needle is released and free to take up the north and south line. ,On the despatch of a second messenger, which strikes on top of the first and fixes the jaws of the levers open, every part of the machine is simultaneously locked. Having noted the exact time of.starting each of the messengers, the time during which the in- strument has been working at the required depth is known, and from this the velocity of the current can be calculated, the num- ber of revolutions having been recorded, while the direction is shown by the angle between the compass needle and the direction of the rudder.

The instrument is shown in Fig. 6. A A are the jaws of the levers through which the first messenger passes and strikes on the metal plate B. The force of the blow is sufficient to press B down, thus bringing the jaws as close together as possible, and putting the meter into action. The second messenger falling on the first opens the levers again and prevents their closing, thus keeping all parts of the machine locked. C is the rudder which takes up the direction of the current when the levers

are unlocked. D is a set of small levers on the rudder in con- nexion with A A. The outer end on the tail of the rudder fits into the notches on the outer ring of the frame when the machine is locked and thus keeps the rudder fixed, but when the first mes- senger has started the machine by pressing down B and opening the levers A A, this small lever is raised and the rudder can revolve freely. E E are four small

cones which revolve on their axis in a vertical plane, similar to an anemometer ; the axis is connected by

a worm screw to geared wheels which register the number of revolutions up to 5000, corre- sponding to about 4 nautical miles. There is a small lever in connexion with A A which prevents the cones revolving when the machine is locked, but allows them to revolve freely when the machine is in action. Below the rudder- post is a compass-bowl F, which is hung in gimbals and capable of removal. The needle is so arranged that it can be lifted off the pivot by means of a lever in con-nexion with A A ; when the meter is in action the needle swings freely on its pivot, but when the levers are locked it is raised off its pivot by the in- verted cup-piece K

Fig. 6. — Deep-sea Current Meter.

placed inside the triple claws on the top of the compass and screwed to the lever, thus locking the needle without chance of moving. The compass- bowl should be filled with fresh water before lower- ing the instrument into the sea, and the top screwed home tightly. The needle should be removed and carefully dried after use, to prevent corrosion. The long arm G is to keep the machine steady in one direction ; it works up and down a jackstay which passes between two sheaves at the extremity of the long arm. This also assists to keep the machine in as upright a position as possible, and prevents it from being drifted astern with the current. A weight of as much as 8 or 10 cwt. is required at the bottom of the jackstay in a very strong current. An elongated weight of from 60 to 80 H> must be suspended from the eye at the bottom of the meter to help to keep it as vertical as possible. On the outer part of the horizontal notched ring forming the frame, and placed on the side of the machine opposite to the projecting arm G, it has been found necessary to bolt a short arm supported by stays from above, from which is suspended a leaden counterpoise weight to assist in keeping the apparatus upright. This additional fitting is not shown in Fig. 6. A f-inch phosphor-bronze wire rope is used for lowering the machine ; it is rove through a metal sheave H and indiarubber washer, and spliced round a heart which is attached to metal plate B. The messengers are

fitted with a hinged joint to enable them to be placed round the wire rope, and, secured with a screw bolt. To obtain the exact value of a revolution of the small cones it is necessary to make experiments when the actual speed of the current is known, by immersing the meter just below the surface and taking careful observations of the surface-current by means of a current log or weighted pole. From the number of revolutions registered by the meter in a certain number of minutes, and taking the mean of several observations, a very fair value for

a revolution can be deduced. On every occasion of using the meter for under-current observations the value of a revolution should be re-determined, as it is apt to vary owing to small differences in the friction caused by want of oil or the presence of dust or grit ; while the force of the current is probably another important factor in influencing the number of revolutions recorded.

The features of the country should generally be de- lineated as far back as the skyline viewed from seaward, in order to assist the navigator to recognize the land. The summits of hills and conspicuous gra°phy. spurs are fixed either by lines to, or by angles at them ; their heights are determined by theodolite eleva- tions or depressions to or from stations whose height above high-water is known. As much of the ground as possible is walked over, and its shape is delineated by contour lines sketched by eye, assisted by an aneroid barometer. In wooded country much of the topography- may have to be shotin from the ship ; sketches made from different positions at anchor along the coast with angles to all prominent features, valleys, ravines, spurs of hills, &c, will give a very fair idea of the general lie of the country. Circum-meridian altitudes of stars on opposite sides of the zenith observed by sextant in the artificial horizon is the method adopted wherever possible for Latitudes observations for latitudes. Arranged in pairs of nearly the same altitude north and south of zenith, the mean of each pair should give a result from which instru- mental and personal errors and errors due to atmospheric conditions are altogether eliminated. The mean of several such pairs should have a probable error of not more than ± 1”- As a rule the observations of each star should be confined to within 5 or 6 minutes on either side of the

meridian, which will allow of from fifteen to twenty observations. Two stars selected to "pair" should pass the meridian within an hour of each other, and should not differ in altitude more than 2° or 3°. Artificial horizon roof i!L error is eliminated by always keep- ing the same end of the roof towards the observer ; when observing a single object, as the sun, the roof must be reversed when half way through the observations. The observations are reduced to the meridian by Eaper's method. When pairs of stars are not observed, circum-meridian altitudes of the sun alone must be resorted to, but being observed on one, side of thd zenith only, none of the errors to which all observations are liable can be eliminated.

Sets of equal altitudes of- sun or stars by sextant and artificial horizon are usually employed to discover chrono- meter errors. Six sets of eleven observations, a.m. and p.m., observing both limbs of the sun, chrono- should give a result which, under favourable errors. conditions of latitude and declination, might be expected to vary less than two-tenths of a second from the normal personal equation of the observer. Stars give equally good results. In high latitudes sextant observa- tions diminish in value owing to the slower movement in altitude. In the case of the sun all the chronometers are compared with the " standard " at apparent noon ; the comparisons with the chronometer used for the ob-servations on each occasion of landing and returning to the ship are worked up to noon. In the case of stars, the chronometer comparisons on leaving and again on returning are worked up to an intermediate time. A convenient system, which retains the advantage of the equal altitude method, whilst avoiding the necessity of waiting some hours for the p.m. observation, is to observe two stars at equal altitudes on opposite sides of the meridian, and combining the observations, treat them as relating to an imaginary star having the mean R.A. and mean declination of the two stars selected, which should

have nearly the same declination, and should differ from 4h to 8h in R.A.

The error of chronometer on mean time of place being obtained, the local time is transferred from one observa- tion spot to another by the ship carrying usually distances eignt box chronometers. The best results are found by using travelling rates, which are de- duced from the difference of the errors found on leaving an observation spot and returning to it ; from this differ- ence is eliminated that portion which may have accumu- lated during an interval between two determinations of error at the other, or any intermediate, observation spot. A travelling rate may also be obtained from observations at two places, the meridian distance between which is known; this rate may then be used for the meridian distance between places observed at during the passage. Failing travelling rates, the mean of the harbour rates at either end must be used. The same observer, using the same instrument, must be employed throughout the observations of a meridian distance.

If the telegraph is available, it should of course be used. The error on local time at each end of the wire is obtained, and a number of telegraphic signals are exchanged between the observers, an equal number being transmitted and received at either end. The local time of sending a signal from orie place being known and the local time of its reception being noted, the difference is the meridian distance. The retardation due to the time occupied by the current in travelling along the wire is * eliminated by sending signals in both directions. The relative personal equations of the observers at either end, both in their observations for time, and also in receiving and transmitting signals, is eliminated by changing ends and repeating the operations. If this is impracticable, the personal equations should be determined and applied to the results. Chronometers keeping solar time at one end of the wire, and sidereal time at the other end, materially increase the accuracy with which signals can be exchanged, for the same reason that comparisons between sidereal clocks at an observatory are made through the medium of a solar clock. Time by means of the sextant can be so readily obtained, and within such small limits of error, by skilled observers, that in hydrographic surveys it is usually employed ; but if tran- sit instruments are available, and sufficient time can be devoted

to erecting them properly, the value of the work is greatly enhanced in high latitudes.

True bearings are obtained on shore by observing with theodolite the horizontal angle between the object selected as the zero and the sun, taking the latter in bearin s eaclx

At sea, true bearings are obtained by measuring with a sextant the angle between the sun and some distant well-defined object making an angle of from 100° to 120°, and observing the altitude of the sun at the same time, together with that of the terrestrial object. The sun's altitude should be low to get the best results, and both limbs should be observed. The sun's true bearing is

calculated from its altitude, the latitude, and its declina- tion ; the horizontal angle is applied to obtain the true bearing of the zero. On shore the theodolite gives the horizontal angle direct, but with sextant observations it must be deduced from the angular distance and the elevation.

For further information see Wharton, Hydrogmphical Surveying (London, 1898) ; Shorti-and, Nautical Surveying (London, 1890).

(A. M. F*.)

Sus, an important province of southern Morocco' (g.v.), once an independent kingdom, and still too unruly to be opened to Europeans, who have nevertheless for centuries past made repeated attempts, official and private, to secure admission or a foothold. Its principal towns are Tarudant, High (the old capital), and Glimin on the Wad Nun. Ports might be opened at Agadir Ighir (once the Santa Cruz of the Portuguese), Massa, Ifni, Arksis, and Assaka, at the mouth of the Nun. As a coveted district, all descriptions of natural riches are attributed to Sus, but in the present state of ignorance it may safely be assumed that they are much exaggerated. Europeans land at their peril, since the coast as far as Cape Bojador, 26° N., is recognized as Moorish territory, and as such it is by imperial order closed to trade, no custom-houses being provided. The inhabitants and language of Sus are

principally Berber, but the Arabs and their tongue predominate in the extreme south.

Susquehanna, a river whose course for the most part is through Pennsylvania, U.S.A., rises in two branches, the North Branch, whose source is in southern New York, and the West Branch, whose source is in north-western Pennsylvania. The two branches, after tortuous courses among the ridges and valleys of the Appalachians, unite at Sunbury, Pennsylvania, and the river thence pursues a nearly straight course in a direc- tion a little east of south to its mouth at the head of Chesapeake Bay. Its total length, following the North Branch, is 422 miles, and it drains an area of 27,655 square miles. The course of the river is shallow and rapid, and it is therefore of no value for purposes of navigation. Its valley and that of its main tributary, the Juniata, are, however, of the utmost importance in affording easy routes for railways.

Sussex, a southern and maritime county of England,' is bounded W. by Hampshire, N. by Surrey, N.E. by Kent, and S. by the English Channel.

Area and Population. — The area of the ancient county is 933,269 acres or 1458 square miles, with a population in 1881 of 490,505, in 1891 of 550,446, of whom 253,438 were males and 297,008 females, and in 1901 of 605,052, the number of persons per square mile being 415, and of acres to a person 1-54. The area of the administrative county of East Sussex, including Brighton and Hastings, is 530,255 acres, with a population in 1901 of 450,697 ; and West Sussex an area of 402,478 acres, with a population of 151,541. Since 1891, however, various changes in the administrative area have been made : in 1895 the part of the parish of Broomhill in Kent was transferred to East Sussex, and the parts of the parishes of Horsemonden and Lamberhurst in East Sussex were transferred to Kent ; in the same year the part of the parish of Bramshott in West Sussex was transferred to South- ampton, and the parish of Crawley in East Sussex to West Sussex ; and in 1897 the parts of the parishes of Eairlight, Hollington, Ore, and St Matthews were transferred from East Sussex to the county borough of Hastings. The area of the regis- tration county is 938,630 acres, with a population in

1891 of 554,542, of which 324,363 were urban and 230,179 rural ; and in 1901 of 605,763. Within the registration area the increase of population between 1881 and 1891 was 12-20 per cent., and between 1891 and 1901, 9-2 per cent. The excess of births over deaths between 1881 and 1891 was 63,018, and the actual increase of population was 60,304. The following table gives the numbers of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 :—

Year.

Marriages.

Births.

Deaths.

Illegitimate Births.

Males.

Females.

1880 1890 1898

3326 3522 4173

14,942

13,472 13,756

8277 8541 8663

359 405 362

359 343 388

The number of marriages in 1899 was 4223, of births 13,861, and of deaths 9595.

The following table gives the marriage-, birth-, and death-rates per thousand of the population, with the percentage of illegiti- mate births, for a series of years : —

1870-79.

1880.

... 1880-89.

i

1890.

1888-97.

1898.

Marriage-rate

14-0

13-6

12-7

12-8

13-1

13-9

Birth-rate

30-2

30-5

28-4

24-8

24-7

22-9

Death-rate .

17-5

16-9

15-9

15-5

lo-l

14-4

Percentage of ille-

gitimacy .

5-2

4-8

5-3

5-6

5-4

5-5

Both the birth-rate and the death-rate are a good deal below the average. In 1891 the number of Scots in the county was 3493, of Irish 3963, and of foreigners 3551.

Constitution and Government. — The parliamentary and judicial arrangements are stated in the original article on the county. Tor administrative purposes Sussex is divided into two counties, East and West Sussex, and it also includes the county boroughs of Brighton and Hastings. East Sussex contains six municipal boroughs: Brighton (123,478), Eastbourne (43,337), Hastings (65,528), Hove (36,542), Lewes (11,249), and Eye (3900). The urban districts in this division are Battle (2996), Bexhill (12,210), Burgess Hill (4888), Cuckfield (1813), East Grinstead (6094), Haywards Heath (3717), Newhaven (6772), Portslade-by-Sea (5217), Seaford (3355), and Uekfield (2895). In West Sussex there are three municipal boroughs: Arundel (2738), Chichester (12,241), and Worthing (20,006). The urban districts are Bognor (6180), Horsham (9446), Littlehampton (7363), and New Shore- ham (3837). The ancient county, which is almost entirely in the diocese of Chichester, contains 393 entire ecclesiastical parishes or districts, and parts of eight others.

Education. — At Brighton there is a residential training college (Chichester Diocesan) for schoolmistresses, and there is another at Chichester (Bishop Otter's Memorial). In Brighton there are a home blind school, a deaf and dumb institution, and an asylum for the blind. The total number of elementary schools in the county on 31st August 1899 was 439, of which 106 were board and 333 voluntary schools, the latter including 302 National Church of England schools, 1 Wesleyan, 23 Roman Catholic, and 8 "British and other." The average attendance at board schools was 42,307, and at voluntary schools 52,674. The total school board receipts for the year ended 29th September 1898 were over £150,214. The income under the Technical Instruction Act was over £1072, and that under the Agricultural Bates Act was over £2133. There is an important high-class school at Brighton, and many private educational establishments there and at other towns on the coast.

Agriculture. — About three-fourths of the total area of the county is under cultivation, and of this nearly three-fifths is in permanent pasture. There are also over 17,000 acres in hill pasture, over 3000 acres under orchards, and about 125,000 acres under woods. Within the last twenty years the acreage under corn crops has decreased by

about a third, the decrease being chiefly in the acreage under wheat, which is now rather surpassed by that under oats, the two together occupying eleven- twelfths of the whole. Potatoes are not much grown, the acre- age under green crops being devoted mainly to turnips and other food for cattle, and the supply of the usual varieties of vegetables for the London market. Many cattle are kept both for breeding and dairy purposes. The acreage under hops has within the last fifteen years decreased 50 per cent., and is now only about 5000 acres, or about 2000 acres less than Hereford, and only about a sixth of the hop acreage of Kent. Small fruit occupies over 1100 acres. The following table gives the larger main divisions of the cultivated area at intervals from 1885 : —

Tear.

Total Area under Cul- tivation.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture.

Fallow.

1885 1890 1895 1900

680,943 684,786 678,559 666,292

176,516 169,505 144,872 135,950

76,467 67,350 62,163 58,740

65,542 64,857 61,306 61,148

333,653 358,250 381 ,‘146 392,340

18,039 17,236 20,071 12,044

The following table gives particulars regarding the principal live- stock for the same years : —

1885 1890 1895 1900

Total •> Horses.

25,017 25,217 25,552 24,421

Total. Cattle.

113,153 110,717 103,883 115,877

Cows or Heifers

in Milk or in

Calf.

39,707 42,570 43,168 49,551

Sheep.

537,837 503,829 446,416 434,236

Pigs.

42,873 46,822 48,048 38,781

Industries and Trade— -The total number of persons employed in factories and workshops in 1897 was 14,344, as compared with 12,900 in 1896. Non-textile industries employed 8533 persons, of whom 2694 were employed in the manufacture of machines, appliances, conveyances, and tools (many of them in the works of the London, Brighton, and South Coast Railway Company at Brighton), 1184 in drink industries, and 1437 in the manufac- ture of paper, &c. Of the 5764 persons employed in workshops, 3028 were employed in clothing

industries. In 1899, 218,468 tons of chalk were raised, 54,994 tons of clay, 18,630 of gravel and sand, and 10,923 tons of chert and flint. The only valuable mineral is gypsum, of which in 1899, 18,454 tons were raised, valued at £6229. The development of what promised to be an extensive natural gas field was begun at Heathfield by a private company in 1901. The fisheries are of great importance, including cod, herrings, mackerel, sprats, plaice, soles, turbot, shrimps, crabs, lobsters, oysters, mussels, cockles, whelks, and periwinkles. In 1899, 70,745 cwt. of fish, valued at £57,567, was landed at the several fishing stations in the county. Shell-fish was further valued at £8907.

Bibliography. — Among later works are — Sawyer. Sussex Natural History and Folklore. Brighton, 1883 ; Sussex Dialect. Brighton, 1884; and Sussex Songs and Music. Brighton, 1885. —Ellis. Parks and Forests of Sussex. ‘ Lewes, 1885. — Egerton. Sussex Folks and Sussex Ways. London, 1892. — Hare. , Sussex. London, 1894. — Anon. Byegone Sussex. London, 1897.— See also “The Climate of the South-Eastern Counties,” in Climates of Great Britain. London, 1895. (t. F. H.)

Sutherlandshire, a northern maritime county of Scotland, is bounded E. by Caithness, S.E. by the Moray Firth, S. and S.W. by Eoss and Cromarty, and N. and W. by the Atlantic and the North Sea.

Area and Population — According to the latest official estimate, the area of the county (foreshore excluded) is 1,345,480 acres, or 2102 square miles. The population was, in 1881, 23,370 ; 1891, 21,896 ; in 1901, 21,550, of whom 10,550 were males and 11,000 females. Taking the land area only (1,197,848 acres of land or 2027-9 square miles), the number of persons to the square mile in 1901 was 10-6 and the number of acres to the person 55-5, the county being the most sparsely populated’in Scotland. Between 1881 and 1891 the population decreased by 6-35 per cent. Between 1881 and 1891 the excess of births over deaths was 1455, and the decrease of the resident population 1474. The following table gives particulars of the births, deaths, and marriages, with the percentage of illegitimacy in 1880, 1890, and 1899 : —

.Year.

Deaths.

Marriages.

Births.

Percentage of Illegitimates.

1880 1890 1899

260 378 370

85 84 91

518

445 465

6-5

6-97

4-5

The following table gives the birth-rate, death-rate, and marriage- rate per thousand of the population for a series of years : —

1S80.

1831-90.

1S90.

1891-98.

1899.

Birth-rate . Death-rate . Marriage-rate

23-08

16-04

3-79

22-94

16-22

319

21-08

17-91

3-98

21-82

16-55

3-24

22-48

17-89

4-40

In 1891 the number of Gaelic-speaking persons in the county was 14,786, of whom 1115 spoke Gaelic only, and there was one foreigner. Valuation in 1889-90, £94,320 ; 1899-1900, £93,594.

Administration. — The county returns a member to Parliament, and Dornoch (624), the county town, is one of the Wick group of parliamentary burghs, and the only royal burgh. There are 13 . oivil parishes, which form a poor-law combination ; the number of paupers and dependents at September 1899 was 991. Sutherland is embraced in

the same sheriffdom with Ross and Cromarty, and there is a resident sheriff -substitute in the county town.

Education. — Thirteen school boards manage 43 schools, which

had an average attendance of 2803 in 1898-99, while one private school had 38. Eight schools give higher education, and the ” residue ” grant is expended in bursaries.

Agriculture.— In 1898 only 2-4 per cent, of the area was under cultivation, the county ranking lowest in Scotland in this regard. The great mass is grazing ground and forest. In 1895 there were 19,641 acres under wood, 302 of which had heen planted since 1881. An attempt is being made to repeople Strathnaver, one of the glens depopulated in the famous Sutherland clearances of the second decade of the 19th century. Of the 2600 holdings in 1895, the date of the last return, the average size was 12 acres; 64-92 per cent., the highest proportion in Scotland, were under 5 acres ; 31-23 were between 6 and 50 acres, and only 3-85 over 50. Forty-three were between 50 and 100 acres, 44 between 100 and 300, and only 12 over 300. The following table gives the principal acreages at intervals of five years from 1885 : —

Year.

Area under Crops.

Corn Crops.

Green Crops.

Clover.

Permanent Pasture,

Fallow.

1885 1890 1895 1899

40,058 31,078 31,816

32,884

10,424 9,767 9,622 9,386

5190 4831 4857 4805

7856 8089 8207 9062

9260 8043 9078 9530

7328

342

47

100

The following table gives particulars of the live-stock during the same years : —

Tear.

Total Horses.

Total Cattle.

Cows or

Heifers in

Milk or Calf.

Sheep.

Pigs.

1885 1890 1895 1899

2641 2495 2678 2685

12,569 10,814 12,002 12,051

5469 5293 5536 5814

214,303 202,931 203,681 208,540

1248

1028

955

815

In the period 1886-98 the Crofters' Commission disposed of 2562 applications in the county to fix fair rents, and reduced an aggregate rental of £7952 to £7253, wipiug off £1647 out of arrears amounting to £6172. In the same period 822 applications for enlargement of holdings were dealt with, and 25,802 acres were added to existing holdings. At the census of 1891, 3170 men and 650 women were returned as being engaged in agriculture.

Industries and Trade. — At Helmsdale (1323), the only port of any consequence, a new harbour 3 acres in extent, with a break- water 700 feet long, has been built in recent years, and several small harbour works have been undertaken by the county council with the help of Treasury grants. Nine Sutherland ports are included in the Lochbroom fishery district, the statistics of which will be found under Boss and Cromarty ; and six of the eight ports in the Helmsdale district belong to Sutherland. The county ports of both districts had, in 1899, 279 boats of 2372 tons, 691 resident fishermen and boys, and the- fish landed was valued at £16,069. The following table gives comparative statistics for the Helmsdale district alone : —

Year.

Boats.

Value of Gear.

Resident Fishermen and Boys.

Total Value ofaUHsh.

No.

Tons.

Value.

1890 1898 1899

191 198 197

1843 2221 2172

£7750 £7335 £7137

£8666 £9803 £9838

641 414 413

£16,204 £17,100 £14,301

Of the total value of fish caught in 1899, £8861 was the value of herrings only. The number of persons employed in the district at the various branches of the sea fisheries was 1143. A light railway 7 J miles long is being built from Mound to Dornoch.

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(w. WA.)

Sutton, a town in the Epsom parliamentary division of Surrey, England, 11 miles by rail from London (Vic- toria). Among the buildings are the parish church of

St Barnabas, a technical institute, and a Masonic hall. A cemetery was opened in 1890. Population of the urban district and parish (1891), 13,977 ; (1901), 17,224.

Sutton-in-Ashfield, a parish, town, and railway station in the Mansfield parliamentary division of Notting- hamshire, England, 3 miles west-south-west of Mansfield. Recent erections are a town hall, a public hall, and a free library . Area of township (an urban district), 4879 acres. Population (1881), 8523; (1891), 10,562; (1901), 14,862.

Suwatki, a government in the extreme north-east of Russian Poland, bordering on Prussia. It has an area of 4846 square miles, and a domiciled population which numbered 606,573 in 1883, and 738,632 in 1899, when there were 371,609 women, and the urban population numbered 69,834. The majority (389,424) of the in- habitants are Lithuanians, mostly found in the north ; there are 159,427 Poles (and Mazurs), chiefly occupying the towns ; 118,712 Jews ; 39,107 Germans ; and 31,026 Russians. The chief towns of the seven districts into which the government is divided are Suwatki (22,646 inhabitants), Augustowo (12,746), Kalwarya (8420), Mariampol (6298), Seiny (3771), Wilkowiszki or Volko- vyshki (9101), and Wiadistawow (3988). The standard of education is about the average in Poland ; in 1898 there w^re 189 primary schools attended by 7603 boys and 2544 girls. A good feature of these schools was that no less than 150 village schools

had gardens for teaching gardening, and bees were kept in 13 schools. No less than 856,410 acres were under crops in 1900. The aver- age yield in 1895-99 was : rye, 2,580,000 cwt. ; wheat, 534,000 cwt.; oats, 1,220,000 cwt.; barley, 659,000 cwt. — all cereals, 5,270,000 cwt. ; also potatoes, which are largely grown for distilleries, 5,179,000 cwt. There were, in the province in 1897 114,030 horses, 181,700 horned cattle, 341,640 sheep, and 165,450 pigs. Bee 'culture is widely spread, and about 40,000 ft of honey are obtained every year. The weaving of linen and plain woollen cloth and fishing-nets is extensively carried on in the villages as a domestic industry, and in 1899 there were, too, 631 factories, but most of them were small, and their aggregate returns did not total more than 3,000,000 roubles. Thus a great number of the inhabit- ants are still compelled to seek work in winter in the other provinces. The felling of timber, which is floated down the Nyeman, gives occupation to large numbers. The Nyeman is navigated by steamers between Grovno and Kovno.

Suwaiki, the capital of the above government, is situated 75 miles north-west of Grodno. It is well built, and one of the best kept towns in Poland. Its tradei is chiefly in timber, grain, woollen cloth, and other manu- factured goods. Its population in 1899 was 27,165.

Suzerainty. — "Suzerain," a term of feudal law, is now used to describe persons or states in positions of superiority to others. Its etymology, according to Professor Skeat (Etymological Dictionary), is e " oa' as follows : " A coined word ; made from French sus, Latin susum or sursum, above, in the same way as sovereign is made from Latin super; it corresponds to a low Latin type suseranus." Another form of the word is souseran (Godefroy, De I'Ancienne Langue Francaise). Suzeran has been defined as "Qui possede un fief dont d'autres fiefs relevent (Littri and Dictionnaire de I'Academie Francaise). Loyseau, in his Traiti des Seig- neuries (1610, 3rd ed., p. 14), explains that there are two kinds of public seigneuries, that is, sovereign seigneurs, possessing summum imperium, and suzerains, "Les suze- raines sont celles qui ont puissance superieure mais non supreme." Elsewhere he says that suzerainty is a form

Modern usage.

of public seigneuries which has been “usurpee par les particuliers pour laquelle exprimer il qous a fallu forger un mot express, et l’appeller suzerainete, mot qui est aussi etrange comme celle especе de seigneuries est absurde ” (p. 11). Loyseau adds, ” Seigneurie suzeraine est dignite d’un fief ayant justice ” (p. 38). Bousquet {Nouveau Dictionnaire de Droit) defines suzerain as “superieur, celui dont un fief relevait” ; Rogulau (Glossaire du Droit Frangois), ” superieur en quelque charge ou dignite autre que le roy.” The name does not occur in the Consue- tudines Feudorum, or in Hotoman’s De Verbis Feudalibus Commentarius. It was rare in feudal times in England. But it was used in France to describe a feudal lord, the supreme suzerain being the king. Merlin, under ” suze- rainete,” shows that the word was not used by all feudal writers in the same sense. (See also Butler’s note to Coke on Litt., 191 a.)

In modern times the term has come to be used as descriptive of relations, ill-defined and vague, which exist

between powerful and dependent states; its

very indefiniteness being its recommendation.

According to feudal law the vassal owed certain duties to the lord ; he promised fidelity and service ; and the lord was bound to perform reciprocal duties, not very clearly defined, to the vassal — Dominus vassallo conjux et amicus dicitur. The relation between^a lord and his vassals, implied in the oath of fealty, has been extended to states of unequal power ; it has been found convenient to designate certain states as vassal states, and their superiors as suzerains. Originally and pro- perly applicable to a status recognized by feudalism, the term vassal state has been used to describe the subordinate position of certain states once parts of the Ottoman Empire, and still loosely

connected there- with. Such are Egypt and Bulgaria. Rumania, Servia, and Montenegro, once vassal states, may now be regarded as independent. The relations of these states to the Otto- man Porte are very varied. Egypt has been variously described as a vassal state or as a protectorate. But all of these pay tribute' to the Sultan, or in some way acknow- ledge his supremacy (Ullmann, Volkerrecht, s. 16) ; M. de Martens (Traiti de Droit International, 1883, i. 333, n.) thus defines the term : " La suzerainete est la souverainete limited exercee par le pouvoir supreme d'un etat sur un gouvernment mi-souverain," a definition applicable to protectorates, with which it is often confounded. Thus Mommsen {History of Rome) indiscriminately describes the supremacy of Rome over Armenia as " suzerainty " or "protectorate." To illustrate the vague use of the word in modern diplomacy may be quoted the descrip- tion of suzerainty given by Lord Kimberley, which Mr Chamberlain in the correspondence as to South Africa mentioned with approval : " Superiority over a state pos- sessing independent rights of government subject to reser- vations with reference to certain specified matters " (1899 [O, 9057], p. 28).

M. Gairal {Le Protectorat International) distinguishes suzerainty from protectorate in these respects : (a) suze-

rainty proceeds from a concession on the part rates and °f *ne suzerain (p. 112) ; {b) the vassal state is suze- bound to perform specific services ; and (c) the

rainty. vassal state has larger powers of action than those belonging to a protected state ; (d) there is recipro- city of obligation. According to M. Despagnet, the term suzerain is applicable to a case in which a state concedes a fief, in virtue of its sovereignty {Essai sur le Pro- tectorat International, p. 46), reserving to itself certain rights as the author of this concession.

Another writer draws these distinctions: (a) a state connected by protectorship with another previously en- joyed autonomy; the vassal state did not; (&) the

protected state retains its nationality and its internal administration; the vassal state acquires a distinct na- tionality ; (c) the establishment of a protectorate modi- fies few of the institutions of the protectorate state except as to foreign relations ; the establishment of a suzerainty changes the institutions of the vassal state ; {d) the pro- tected state exercises its internal sovereignty a pen, pres pleinement; the vassal state remains subordinate in sev- eral respects ; (e) while the protected state has the right to be assisted in case of war by the protecting state, but is not bound to defend the latter, the vassal state is bound to aid its suzerain (Tchomacoff, De la Souverainete", p. 53). See also Hachenburger, De la Nature Juridique du Protectorat.

Hall thus defines vassal states : " States under the suzerainty of others are portions of the latter which during a process of gradual disruption or by the grace of the sovereign have acquired certain of the powers of an independent community, such as that of making com- mercial conventions or of conferring their exequatur on foreign consuls. Their position differs from that of the foregoing varieties of states (protectorates, &c), in that a presumption exists against the possession by them of any given international capacity {International Law, 4th ed., p. 31).

Another suggested distinction is this: Suzerainty is title without corresponding power ; protectorate is power without corresponding title (Professor Ereund, Political Science Quarterly, p. 28, 1899).

On the whole, usage seems to favour this distinction : while a protectorate flows from, or is a reduction of, the sovereignty of the protected state, suzerainty is conceived as derived from, and a reduction of, the sovereignty of the dominant state.

As to the power of making treaties, a vassal state cannot, as a rule, conclude them ; such power does not exist unless it is specially given. On the other hand, a protected state, unless the contrary is stipulated, retains the power of concluding treaties (Bry, p. 294).

There is one practical difference between the two re- lations : while the protecting and protected states tend to draw nearer, the reverse is true

of the suzerain and vassal states ; a protectorate is generally the preliminary to incorporation, suzerainty to separation. Sometimes it is said that the territory of the vassal state forms part of the territory of the suzerain ; a proposition which is true for some purposes, but not for all.

All definitions of suzerainty are of little use. Each instrument in which the word is used must be studied in order to ascertain its significance. Even in feudal times suzerainty might be merely nominal, an instance in point being the suzerainty or over-lordship of the Papacy over Naples. In some cases it may be said that suzerainty brings no practical advantages and implies no serious obligations. Among the instances in which the term is actually used in treaties instances are these : the General Treaty, Peace of Paris, rainty*. 1856 (Article 21 and 22), recognized the suze- rainty of Turkey over the Danubian Principalities, Mol- davia and Wallachia, modifying the "sovereignty" of Turkey recognized by the Treaty of Adrianople. " Les Principaut^s de Valachie et de Moldavia continueront a jouir, sous la suzerainete de la Porte et sous la ga- rantie des Puissances contractantes, des privileges et des immunite's dont elles sont en possession." The convention of 19th August 1858 (Hertslet, x. 1052) organized the then Principalities "under the suzerainty of the Sultan " (Article 1). The internal government was to be exercised by a Hospodar, who received his investiture from the Sultan, the sign of vassalship, it has been said (Tchomacoff, p. 45). The autonomy of these

vassal states has been fully recognized by the Treaty of Berlin of 1878 (Article 1). In the Interpretation Act, 1889, s. 18 (5), "suzerainty" is used to describe the authority of the sovereign over native princes.

The word suzerain is used in the Pretoria Convention of 3rd August 1881 between the British Government and the late South African Republic. The convention (by its preamble) granted to the inhabitants complete self-govern- ment, "subject to the suzerainty of her Majesty,"

and this suzerainty was reaffirmed in the articles. Even when the convention was being negotiated doubts arose as to its meaning, and legal authorities were divided as to its effect (see speech of Lord Cairns, Hansard, 269, p. 261 ; Lord Selborne, 260, p. 309 ; answer of Attorney-General, 260, 1534). It was doubtful whether territory could be ceded by the Crown of its own authority ; and if the power existed the cession could, it was said, be made only by virtue of clear words. Prom the articles substituted in the London Convention of 27th February 1884 for those of 1881, the word ” suzerainty ” was omitted. Fresh doubts arose as to the effect of this omission ; and a correspondence on the subject took place between the British Government and the Government of the Republic before the outbreak of hostilities in South Africa, the former maintaining that the preamble of 1881, by which alone any self-government was granted, was still in force, and therefore that the suzerainty— whatever it involved — remained; the Transvaal Government, on the other hand, contending that the suzerainty had been abolished by the substitution of the 1884 convention for that of 1881. Writers on international law differ greatly as to the exact position of the South African Republic under the later convention. Some considered it an independent sovereign state. Mr Taylor (A Treatise of International Public Law, p. 174) treats the Transvaal after the convention of 1884 as a “neutralized state only part sover- eign.” Other writers describe the relation as that of a protectorate (see Professor Westlake, Revue de Droit International, 1896, p. 268 et seq.). Professor de Louter defines it as ” une servitude du droit des gens (servitus juris gentium), et qui differe de la servitude du droit prive en ce qu’elle ne constitue pas un droit reel (jus in re aliena) mais un droit entre deux per- sonnes de droit International (subjecta juris gentium) {Revue de Droit International, 1899, p. 330). Dr Von Liszt (Das VolJcerrecht, p. 331) treats the South Afri- can Republic as an example of a half sovereign state. M. Gairal describes it as a vassal state. Probably the soundest opinion is that the British Crown reserved no other rights than those expressly stated in the conven- tion of 1884.

See Stubbs. “Suzerainty, or the Rights and Duties of Suzerain and Vassal States,” 1882, Revue de Droit International, 1896, pp. 39, 278.— Westlake. ” L’Angleterre et le Republique Sud- Africaine,” Bevue de

Droit International, 1896, p. 268.— Bornhak. Einseitige Abhangigskeitsverhaltnisse unter den modern Staaten, 1896.— Dr XJllmann. Volkerrecht, s. 16 (1898).— Tchomacoff. De la Souverainete, 1901.— Jellinek. Die Lehre von den Staat- ■ enverbindungen, 1882. — Correspondence Selating to South African Republic, 1899 [C, 9507].— Law Magazine, p. 413, 1900; Law Quarterly Review, p. 122, 1896 ; Journal of Comparative Legisla- tion, I., N.S., 432. (j. Mj\)

Svea, or Svealand, the middle of the three great territorial divisions of Sweden, embraces the counties of Stockholm, Upsala, Sodermanland, Vermland, Orebro, Vestmanland, Kopparberg, and the county of the city of Stockholm, with a combined area of 32,589 square miles, and population (1880), 1,343,305; (1890), 1,445,744; and (1900), 1,579,954. This is the region of lakes and islands, forests and mines, embracing Lakes Malar and Hjelmar, Siljan, the upper portion of Wener, and a multitude of smaller sheets of water.

Svendborg, a seaport town of Denmark, capital of Svendborg county, on the south shore of the island of Etinen, 29 miles by rail south from Odense, a pictur- esque old place, possessed of importance in the 13th century. The harbour is accessible to vessels drawing 20 feet. Svendborg manufactures tobacco and earthen- ware, and has boatbuilding yards and distilleries. The harbour is entered and cleared by some 5500 vessels of 250,000 tons annually, butter being the principal export, and petroleum, coal, and iron the chief imports. Popula- tion (1870), 7184 ; (1890), 8755; (1900), 11,543.

Svendsen, Johann Severin (1840 — —), Nor- wegian composer. Born in Christiania, 30th September 1840, Svendsen learnt the elements of music and violin- playing from his father, and after serving for some time in the army, and later touring as violinist with a wandering troup of instrumentalists, he entered the Conservatorium at Leipzig through the aid of the king of Sweden. There David, Dreyschock, Haupt- mann, and Richter were his masters. After another tour, which extended to the British Isles, Svendsen spent a year in Paris, and in 1871-72 was leader of the once famous Euterpe Concerts in Leipzig. In 1871 he married an American, and from 1872 to 1877 he con- ducted the

Christiania Musical Society, while in 1877- 78-79 he lived in Rome, London, and Paris. Since 1883 Svensden has been Court Capellmeister at Copenhagen. Probably we have to go back to Schubert to find a com- poser whose Opus 1 has attained the wide popularity of Svensden's A minor string quartet, while his Opus 3, the beautiful octet, carried his name almost at once the wide world over. Though Svendsen was at one time intimate with Wagner, the latter does not seem to have influenced his music, which includes two symphonies, an excellent violin concerto, and a hackneyed ro- mance for violin, as well as a number of orchestral rhapsodies.

Swan, Joseph Wilson (1828-

-), English

physicist and electrician, was born at Sunderland on 31st October 1828. After serving his apprenticeship with a chemist in his native town, he became first assistant and later partner in a firm of manufacturing chemists in Newcastle. Among its operations this firm included the manufacture of photographic plates, and thus Swan was led to one of the advances in photography with which his name is associated — the production of extremely rapid dry plates, which were the outcome of an original observa- tion made by him on the effect of heat in increasing the sensitiveness of a gelatine-bromide of silver emulsion. In 1862 he patented the first commercially practicableprocess for carbon printing in photography. This depended on the fact that when gelatine is exposed to light in the presence of bichromate salts, it is rendered insoluble and non-absorbent of water. Swan took a surface of gelatine, dusted over with lampblack and sensitized with bichro- mate of ammonium, and expoced it to light below a photo- graphic negative; the result was to make the gelatine from the surface downwards insoluble to a depth depending on the intensity, and therefore penetration, of the light which had reached it through the negative. In this operation the surface of the gelatine was also rendered insoluble, and it therefore became necessary to get at its back in order to be able to wash away the portions that still remained soluble ; this was effected by cementing the insoluble surface to a fresh

sheet of paper by means of indiarubber solution, and then detaching the original support. It thus became possible to reach the soluble portions with water and to obtain a representation of the picture, though reversed as to right and left, in relief on the pigmented gelatine. This process has been

simplified and improved by subsequent workers, but in its essential features it forms the basis of some of the methods of photographic reproduction most widely used at the present day. But Swan's name deserves remembrance even more in connexion with the invention of the incan- descent electric lamp than with improvements in photo- graphic technique. He was one of the first to undertake the production of an electric lamp in which, as in the glow lamp of to-day, the light should be produced by the passage of an electric current through a carbon filament, and he was almost certainly far ahead, in point of time, of any other worker in the same field in realizing the conditions to be met and the difficulties to be overcome. So far back as 1860 he constructed an electric lamp with a carbon filament, which was formed by packing pieces of paper or card with charcoal powder in a crucible and subjecting the whole to a high temperature. The carbon- ized paper thus obtained he mounted in the form of a fine strip in a vacuous glass vessel and connected it with a "battery of Grove's cells, which though not strong enough to raise it to complete incandescence, were sufficient to make it red-hot. This was substantially the method adopted by Edison nearly .twenty years later, after various fruitless efforts to make a practical lamp with a filament of platinum or a platinum alloy had convinced him of the unsuitability of that metal for the purpose — a conclusion which Swan had reasoned out for himself many years before. By the time Edison had hit upon the idea of carbonizing paper or bamboo by heat to form the filament, Swan had devised the further improvement of using cotton thread " parchmentized " by the action of sulphuric acid, and it was by the aid of such carbon filaments that on 20th October 1880 he gave at New-

castle the first public exhibition on a large scale of electric lighting by means of glow lamps practically identical with those now in universal use. In another method devised by him for the manufacture of filaments, collodion was squirted into a coagulating solution and the tough threads thus obtained carbonized by heat. Dr Swan has also devoted attention to apparatus for measur- ing electric currents, to the improvement of accumulators, and to the conditions governing the electro-deposition of metals. He was elected a fellow of the Royal Society in 1894, and served as president of the Institution of Electrical Engineers in 1898-99 and of the Society of Chemical Industry in 1901. In the last-named year he received the honorary degree of D.Se. from Durham University.

Swanage, an urban district and watering-place, Dorsetshire, England, in the Eastern parliamentary division of the county, 10 miles south-east of Wareham by rail. The pier, built in 1896, cost £10,000. The neighbourhood is a beautiful one. Corfe Castle lies 10 miles north-west of the town. Purbeck stone is largely exported. Population (altered area), (1891), 2631;

(1901), 3384.

Swansea, a seaport and municipal (extended 1889), county (1888), and parliamentary borough, Glamorgan- shire, Wales, at the mouth of the Tawe, on Swansea Bay, 202 miles by rail west of London. The seat of a suffragan' bishop since 1890, Swansea is divided into 10 wards under a mayor, 10 aldermen, and 30 councillors. In 1885 the parliamentary representation was increased to 2 members. There are 25 churches, 2 Catholic churches, and over 60 Dissenting chapels ; also a female training college, inter- mediate and technical instruction schools, museums, art galleries, public libraries, and many board and National schools. The market has been rebuilt at a cost of

£26,000. Victoria Park (16 acres) was opened in 1887, and there are several other parks and pleasure-grounds. In 1891, 3442 persons were engaged in the manufacture of tin and tin goods, about three-quarters of the whole British output of tin-plate being manufactured within a dozen miles of the port; 1192 in the manufacture of copper and copper

goods, 1731 in iron and steel manufac- tures, 341 in the manufacture of zinc and zinc goods, and 831 in mining. There are 3 daily newspapers. In con- nexion with the docks, covering over 60 acres, there are 30 hydraulic lifts (shipping up to 10 tons of coal a minute) and 62 hydraulic cranes. In 1888 the tonnage of the vessels registered was 59,565 tons ; in 1898, 46,985 tons; in 1900, 56,090 tons. In 1890, 4778 vessels of 1,499,529 tons entered and 4593 of 1,464,587 tons cleared ; in 1900, 5042 vessels of 2,048,002 tons entered and 5004 of 2,053,116 tons cleared. The total value of the imports of foreign and colonial merchandise in 1900 was £4,682,400, against £2,724,572 in ,1888. The total value of the exports in 1900 was £5,951,000, against £3,445,367 in 1888. Area of municipal and county borough, 5963 acres ; population (1881), 76,430 ; (1891), 90,349; (1901), 94,514. The parliamentary representa- tion is divided between Swansea town and Swansea dis- trict, which latter includes part of Swansea borough, with the boroughs of Aberavon, Kenfig, Loughnor, and Neath. Area of Swansea town, 4863 acres; population (1881), 50,043; (1891), 57,492. Area of 'Swansea district, 10,719 acres ; population (1881), 50,547 ; (1891), 59,875.

Swanwick, Anna (1813-1899), English writer and philanthropist, was the youngest daughter of John Swanwick of Liverpool, and was born on the 22nd June 1813. She was educated partly at hpme and partly at one of the fashionable boarding-schools of the day, where she received the usual education of accomplish- ments. Dissatisfied with her own intellectual attain- ments she went in 1839 to Berlin, where she took lessons in German, Greek, and Hebrew. On her return to London she continued these pursuits, along with the study of mathematics. In 1843 appeared her first volume of translations, Selections from the Dramas of Goethe and Schiller. In 1847 she published a translation of Schiller's Jungfrau von Orleans ; this was followed in 1850 by Faust, Tasso, Iphigenie, and Egmont. In 1878 she published a complete translation of both parts of Faust, which appeared with Eetsch's illustrations. It passed through several editions, was included in Bohn's series of translations, and ranks as a standard work. It was at the suggestion of Baron Bunsen that she first tried her hand at translation from the Greek. In 1865 she pub- lished a blank verse translation of iEschylus's Trilogy, and in 1873 a complete edition of iEschylus, which, appeared

with Elaxman's illustrations. Miss Swanwick is chiefly known by her translations, but she also published some original work. In 1886 appeared Books, our Best Friends and Deadliest Foes; in 1888, An Utopian Dream and How it may be Realized; in 1892, Poets, the Interpre- ters of their Age; and in 1894, Evolution and the Religion of the Future. Miss Swanwick was interested in many of the sooial and philanthropic movements of her day. In 1861 she signed John Stuart Mill's petition to Parlia- ment for the political enfranchisement of women. She helped in the higher education movement, took part in the foundation of Queen's and Bedford Colleges, and continued to take a sympathetic interest in the movement which led to the opening of the universities to women. Her work was acknowledged by the University of Aber- deen, which bestowed on her the degree of LL.D. She died in November 1899. (a. z.)

Swat is the territory on the north-west frontier of India which is comprised in the Swat valley, and does not include that which is drained by its great affluent the Panjkora. The Swat river rises on the southern slopes of the Hindu Koh or Dave! mountains, not far from the sources of the Gilgit river, and it joins the Kabul between Michni and Naoshera. Only that portion of the valley which lies beyond the Peshawar frontier hills, and which is reached by the Malakand, the Shahkot, and other passes from the south, is Swat. To the east are the independent hill provinces of Tangir, Kohistan, and Buner, all bordering the Indus, and to the west are Dir and Bajaor, which absorb the Panjkora.

Swat was better known to the ancients, and to the warriors of Baba's time, than it was to us until the frontier risings of 1895- 1896 gave our surveyors the opportunity of visiting the country. The ancient name of the river was Suastos, and that of the Panj- kora, Ghoura, under which names they figure in the history of Alexander's campaign. The site of the city Massaga, the capital of the Assakeni, is supposed to be near the modern Manglaor. But since the adoption of the Khaibar as the main

high road from Kabul to India the Swat routes had passed into oblivion. Only the lower portion of the Swat valley, where the river intervenes between Malakand and the passes leading to Dir from the Panj- kora, is of military significance. The upper valley is closely gripped between mountain spurs stretching southwards from the Hindu Koh, rising to 15,000 feet on one side and 19,000 on the other, leaving but a narrow space between their rugged summits and the banks of the river. The valley, narrow though it is, and traversed by the worst conceivable type of hill tracks, contains many villages or hamlets, and is pretty thickly populated.

The dominating race in Swat is the Yusufzai, an Afghan people who migrated hither from the Kandahar country within historic periods. They are a fine, manly race, living under tribal laws which encourage activity and independence. There are many Yusufzais in the pay of the Indian Government, and they are reck- oned amongst the best of Government servants. Hidden amongst the valleys of the higher mountain slopes there are still to be found a remnant of the old Buddhist population, a people allied to the Tibetans, about whom very little is at present known. Beyond the post of Malakand, the chief point of importance to us is Chak- dana, where a fort has been built to protect the bridge across the Swat river. Chakdana maintained a gallant defence against the tribespeople in 1897 when Malakand was attacked.

The relative distances to Chitral by the Gilgit route and by Swat may be estimated as follows : — Rail-head at Rawal Pindi to Gilgit about 400 miles ; Gilgit to Chitral, 200 miles ; total, 600. From the railway at Dargai (to which point the line will ultimately reach), at the southern foot of the Malakand Pass, to Chitral, about 150 miles, or one-fourth of the Gilgit route distance.

The Government of India's political and survey reports for 1896- 1897, and Bellew's report on the Yusufzais, are the best recent authorities on the subject of Swat. (t. h. h*.)

SwatOW, a treaty port in the province of Kwang- tung, China. The trade has shown a reasonable devel- opment, the total value in 1899

having been H. taels 44,030,750 (£6,834,000) as compared with H. taels 21,176,000 (£5,838,000) in 1880, the silver valuation (taels), however, more nearly representing the volume ; that is to say, while the tael valuation shows an increase of 107 per cent., the pound sterling valuation shows an increase of not more than 17 per cent. Of the imports (£4,794,000 in 1900), consisting principally of cotton goods and opium (each to the extent of over half a million sterling), with kerosene oil, tin, flour, fish, and rice, some 59 per cent, ranks as native Chinese trade and 41 per cent, as international trade. Sugar (£843,750 in 1900) is the principal export ; other articles being paper, cloth, tobacco, fruit, beans, and bean cake and bean oil. The shipping which entered in 1900 amounted to 2127 vessels of 2,185,550 tons The former turbulent and anti-foreign character of the people has much toned down of late years. There are now numerous missionary sta- tions within the district.

Swazieland, a mountainous country of British South Africa, about 3000 square miles in area. Lying on the eastern border of the Transvaal, between the

Drakensberg and Lobombo ranges, it is separated from the Indian Ocean by a strip of territory known as Ton- galand, recently incorporated with Zululand (Natal). The Swazies are a branch of the Bantu family, and are a comparatively industrious and intelligent moun- tain tribe. They are closely allied to the Zulus, whom they resemble in appearance, and they possess equally fine physique. Swazieland was first constituted a petty native state in 1843, when the Barabuza people under their chief, Swaze, rose against their Zulu op- pressors, and according to custom took their name from the founder of their chieftaincy." In 1855 the Swazies, in order to get a strip of territory between themselves and the Zulus, ceded to the Transvaal a narrow piece of land on the Pongola. Ten years later, in response to the demands of the Zulus, this boundary was again altered.

In the Pretoria Convention, which came into existence between Great Britain and the Transvaal after the retro- cession of the Transvaal in 1881, the following clause was inserted especially dealing with the Swazies : " The inde- pendence of the Swazies within the boundary line

of Swazieland, as indicated in the first article of the Convention, will be fully recognized." A similar provi- sion was also made in the London Convention of 1884, when a new set of articles was substituted for those of the Convention of 1881. Neither of these charters of freedom proved of much value to the Swazies. In 1886 the governor of Natal received a paper from Urn- bandine, the chief of the Swazies, stating that Piet Joubert had called on. him and requested him to sign a paper saying that "he and all the Swazies agreed to go over and recognize the authority of the Boer Govern- ment, and have nothing more to do with the English." On his refusal the Boers replied to him, " Why do you refuse to sign the paper? You know we defeated the English at Majuba." The Boers further added that if the Swazies were relying on the British, they were leaning on a broken reed, and would find themselves left in the lurch. Subsequently to this incident Umbandine ap- plied to the Colonial Office for British protection, but without result. Later on, in 1887, both Boers and gold prospectors of all nationalities were overrunning his country, and Umbandine asked for a British resident. This request was also refused. The Boers now deter- mined to adopt towards Swazieland the policy which had proved so successful in Zululand. A colony of Boers settled within the Swazie territories and proclaimed "The Little Eree State." Umbandine was then at length induced to ask the Transvaal for annexation. The Transvaal applied in 1889 to Great Britain for permis- sion to accede to this request, but the British Government replied that the only intervention to which they could consent must be a dual one. Consequently a joint com- mission was appointed to visit Swazieland and report on the condition of things there. Sir Erancis de Winton, the English commissioner, who was accompanied by Generals Joubert and Smit on behalf of the Transvaal, reported that Umbandine had already granted concessions, such as " postal, telegraphic, banking, customs," &c, to the Trans- vaal,' and concessions of mining and grazing rights to various adventurers. He therefore considered a British Protectorate inadvisable and impracticable, and recom- mended that the South African Republic should be allowed access through the country to the sea, provided (1st) that England should have the first right to such port if the Transvaal ever gave it up, and (2nd) that the Transvaal should join the Customs Union. This offer, although ratified by a Convention

in 1890, when the dual control on the part of Great Britain and the Transvaal over Swazie- land was arranged, was not finally accepted by the

Transvaal, as they objected to the clause about the Cus- toms Union. In 1893 a further conference on the Swazie question took place between Sir Henry Loch and Presi- dent Kruger, the result of which was that the adminis- tration of Swazieland, with certain reservations as to the rights of the natives, was practically made over to the South African Republic. The Swazies at this time were governed by a queen regent, who bitterly resented the arrangement come to between Sir H. Loch and President Kruger, and refused to sign the agreement. In the fol- lowing year six Swazie envoys visited England for the purpose of asking the Queen to take Swazieland under her protection. In view, however, of the arrangement come to, this petition had to be refused. In 1894 a Con- vention was formally signed between England and the Transvaal, and the Boers, in spite of the Swazie opposition, assumed administration of the country. Ubanu was in- stalled by them as paramount chief.

The Boers' object in intriguing to acquire Swazieland was not merely that of extending their territories. They cherished above all things the idea of getting a road through the country to a seaport of their own — Kosi Bay, from which a railway has now been projected to Standerton on the Durban-Pretoria line. But inasmuch as their acquisition of Swazieland was profoundly dis- tasteful to the Swazies themselves, and was at variance with the whole spirit, of both conventions, England was justified in deciding that this policy of expansion could not be tolerated indefinitely, and after strong representations from Sir Henry Loch she declared a protectorate over Tongaland, thus blocking the Boers' farther progress towards the sea. In 1898 the Boer ad- ministration of Swazieland again called for a protest from the British Government, who pointed out that the Boers were not fulfilling the terms of the Convention of 1894, which reserved certain privileges and rights of

self- government to the natives. The war of 1899 diverted attention from the Swazies, but after the flight of the sanguinary King Ubanu in 1898, a provisional govern- ment was carried on at the chief kraal by the queen regent ; and in the absence – of any white control a good many excesses were committed. Under the Boer regime "concessions" of various public interests were acquired by the Transvaal Government, and various other concessions were granted to private individuals, including "banking."

In 1899 the European inhabitants of Swazieland were estimated by Mr Allister M. Miller, for several years a resident in the country, at about 1600. The natives are estimated at between 70,000 and 80,000. The imports are valued at £90,000; exports, £26,000. This dis- crepancy is due to the fact that the larger mining and land companies with auriferous and other mineral areas have hitherto spent a good deal more on their mines than they have been able to recover. Under more favourable auspices the auriferous belt, stated to be about 250 square miles in extent, might prove to contain payable mines. In addition to gold, tin, copper, and coal are said to be among the mineral resources of the country. Swazieland offers decided inducements to the stock farmer and agriculturist. Water is plenti- ful, and the general character of the country is much like that of Natal. It is believed that out of the five million acres which the country contains, at least two millions are adapted to the requirements of the small agriculturist. The soil is in many parts rich, and the climate is genial and healthy, except in some of the deeper valleys.

Theal. History of South Africa. — Miller. " Swazieland," Journal Eoyal Colonial Institute. — Pratt. Leading Points in South African History. (a., p. h. ; A. u. it.)

Sweating System.— The "sweating system" is a term loosely used in connexion with oppressive industrial conditions in certain trades. This " system " originated early in the 19th century, when it was known as "the contract system." Contractors supplying the Government with clothing for the army and navy got the work done by giving it out to sub-contractors, who in some cases made the garments or boots

themselves with the assistance of other workmen, and in others sublet their sub-contracts to men who carried them out with similar help. Afterwards this plan was adopted in the manufacture of ready-made clothing for civilian use, and of "bespoke" garments (made to the order of the customer). Previously the practice had been for coats, &c, to be made up by workmen employed on the premises of the master tailor or working together in common workshops, but in either case directly employed by the master tailor. The new plan brought a large number of workpeople possessing little skill and belonging to a very needy class into competition with the regular craftsmen; and in consequence a fall in wages took place, which affected, to a greater or less extent, the whole body of workmen in the tailoring trade. The work was done in overcrowded and insanitary rooms, and the earnings of the workers were extremely low. In 1850 a vigorous agitation against " the sweating system " was commenced, based mainly upon a series of articles in the Morning Chronicle, which were followed by a pam- phlet,' GJteap Clothes and Nasty, written by Charles Kingsley under the name of " Parson Lot," and by his novel Alton Locke. Kingsley and his friends, the Christian Socialists, proposed to combat the evils of the sweating system by promoting the formation of co-operative work- shops ; and several experiments of this nature were made, which, however, met with little success. Except that in 1876-77 the outcry against the sweating system was renewed (principally on the ground of the risk of infection from garments made up in insanitary surround- ings), the matter attracted little public notice until 1887, when the system again came into prominence in con- nexion with the immigration of poor foreigners into East London, where large numbers of these people were em- ployed in various trades, especially in the tailoring, boot- making, and cabinet-making industries, under conditions generally similar to those complained of in the earlier agitations. In 1888 a Select Committee of the House of Lords was appointed to inquire into the subject; and after a lengthy investigation — in the course of which evidence was given by 291 witnesses in relation to tailor- ing, boot-making, furriery, shirt-making, mantle-making, cabinet-making and upholstery, cutlery and hardware manufacture, chain and nail making, military accoutre- ments, saddlery and harness-making, and dock labour — this committee presented its final report in April 1890. The

committee found themselves unable to assign an exact meaning to the term “sweating,” but enumerated the following conditions as those to which that name was applied : — ” (1) A rate of wages inadequate to the neces- sities of the workers or disproportionate to the work done ; (2) excessive hours of labour ; (3) the insanitary state of the houses in which the work is carried on.” They stated that, ” as a rule, the observations made with respect to sweating apply, in the main, to unskilled or only partially skilled workers, as the thoroughly skilled workers can almost always obtain adequate wages.” With regard to the sweating system, the committee declared that this cannot be regarded as responsible for the, industrial condi- tions described ; for ” the middleman is the consequence, not the cause of the evil ; the instrument, not the hand which gives motion to the instrument, which does the mischief. Moreover, the middleman is found to be absent

in many cases in which the evils complained of abound.” While, on the one hand, we find, as pointed out by this committee, that ” sweating ” exists without the presence of the “middleman” (the fact being that many grossly underpaid workpeople are in the direct employment of large firms), it is, on the other hand, no less true that the “middleman” (i.e., subordinate employer) is common in numerous trades in which there is no trace of any such oppression of the workpeople employed by the sub-con- tractors as is denoted by the term ” sweating.” Thus, for example, in shipbuilding in many cases men work in squads, the leading workmen employing their own helpers ; in the cotton trade the mule-minders engage and pay their own piecers, and the weavers their own tenters ; in the manufactured iron trade, in mining, &c, a good deal of work is done under sub-employers employing their own assistants, none of these sub-contractors being alleged to ” sweat ” their helpers. There is, in short, no system of employment which can properly be called ” the sweating system.” At the same time, wherever workers possessing a small degree of skill and deficient in organization

are employed under a number of small masters, there ” sweating ” is likely to obtain.

The common idea, that the ” sweater ” is, an unscrupu- lous tyrant, who fulfils no useful function, and who makes enormous profits, has no counterpart in fact. Whatever may have been the case in earlier days, before the inter- necine competition of the ” middlemen ” had time to produce its inevitable effects upon the position of these sub-employers, it may now be considered to be beyond dispute that the small master (” sub-contractor,” ” garret- master,” ” f ogger,” &c.) usually works at least as hard as his employes, and that his gains are, as a rule, no more than a fair return for the work which he performs — work which in many instances consists in doing some difficult part of the job, and in all cases in organizing the labour engaged. So far as concerns the “manufacturer,” by whom the ” sweater ” is employed, and who is clearly the causa causans of “the sweating system,” for him the practice of getting his work done in outside workshops is undoubtedly convenient, especially in localities where rent is high, because he is saved the expense of providing accommodation for those who do his work. He is also free from restrictions as to the subdivision of labour and the employment of a certain class of workpeople which the sentiment of the regular factory workers would impose upon him. The regular tailor, for example, thinks that no one who has not, by a lengthy period of tuition, acquired the capacity to make a coat “right out” ought to be allowed to enter the tailoring trade. But in the workshop of the sub-contractor the work is split up into fractions, each of which is soon learned, so that it becomes possible to introduce into the trade persons possessing no previous training, and generally willing to work for wages far lower than those to which the regular tailors

consider themselves entitled, and which, so long as they are not exposed to the competition of these outsiders, they are usually able to secure. On the other hand, while it may suit the manufacturer, anxious to keep down the cost of production, to give his work out to middlemen, it is beyond question that any form of the ” small master ” system is necessarily liable to abuse in many directions. Among these small masters the eagerness to secure employment is usually so keen, that the

work is often taken at a price too low for it to be possible for these sub-employers to pay to their workpeople wages adequate to provide the reasonable requirements of working-class life. The workshops of the middlemen are scattered over large districts, and these little masters frequently remove their business from one house to another. Both of these are circumstances which tend strongly to make efficient regulation by the factory and the sanitary inspectors very difficult. Not seldom, especially when trade is brisk, these work-places are overcrowded in a manner injurious to health, and in not a few cases their sanitary condition is defective. It will readily be understood that combine tion among the people employed in these numerous small isolated work-places is much less easy than among the compact bodies of workers employed in large factories, so that any attempt to resist oppressive conditions of em- ployment by trade union organization meets with serious obstacles. But perhaps the worst of all the features which this method of manufacture presents is the absence of motor power and machinery. The fact that a manu- facturer has laid out a large sum in plant, thus entailing a heavy expenditure in "standing charges," necessarily induces him to do his best to make employment regular. In the little outside workshop, on the other hand, lengthy spells of enforced idleness are followed" by short periods of most severe toil, during which the hours of daily labour are prolonged to an inhuman extent. At the same time, the workpeople employed in the ill-equipped workshop of the little master are competing with the much more efficient production of the factory provided with labour-saving machinery driven by steam or other mechanical power ; and in many cases their only chance of retaining the work under these circumstances is to take it at starvation prices. But the progress of invention moves fast, and antiquated methods of production are gradually being abandoned. Already, in many of the trades in which the sweating system has hitherto largely prevailed, especially in the tailoring, the boot-making, the cabinet-making, and the nail-making industries, the factory system is coming so far to the front in the race for cheapness of production that, although in certain industrial centres, in which the rents of factories are high and a specially abundant supply of needy and unskilled workpeople is available, a good deal of work is still given

out to small outside masters, the proportion of the total output manufactured in this manner is day by day diminishing. (d. sch.)

SWEDEE

I. Geography and Statistics.

SWEDEN forms the eastern and larger portion of the Scandinavian peninsula, extending from 69° 3′ 21″ to 55° 20′ 18″ N. It is separated from Norway on the W. by the Kolen mountains, and from Finland, on the N.E., by the Tornea Elf, together with its tributary the Muonio Elf. On the E. and S. its shores are washed by the Baltic Sea, and on the S.W. by the Sound and the Cattegat, which separate it from Denmark.

Area and Population. — Eor administrative purposes the kingdom is divided into 24 governments (Ian) besides the capital; their respective areas and populations at the end of 1901 are given in the table on the following page.

An older division of the country that still maintains itself, being based on the physical features, is that into provinces. Of these Skane embraces governments Nos. 11-12 in the following table, Smaland (and Oland), Nos. 6-8, &c. The largest of the provinces is Lapland, which consists of the inland districts of governments 24 arid 25, and has an area of about 45,000 square miles, with a population of 61,234. Only 6,000 of these, however, are Lapps.

S.IX.— is

[statistics

Lan.

Square miles.

Population.

Population per sq. mile.

1. Stockholm (city) .

13

303,356

23,351-1

2. Stockholm (rural) .

3,015

176,281

58-5

3. Upsala ....

2,051

125,043

61-0

4. Sodermanland

. 2,631

167,888

63-8

5. Ostergotland .

4,264

281,657

66-1

6. Jonkbping

4,447

203,746

45-8

7. Kronoberg

3,825

159,266

41-6

8. Kalmar .

4,456

• 228,177

51-2

9. Gotland .

1,219

52,828

43-3

10. Blekinge

1,164

146,787

126-1

11. Kristianstad .

2,488

219,459

88-2

12. Malmohus

1,864

413,421

221-8

13. Halland ....

1,900

141,344

74-4

14. Gbteborg and Bohus

1,948

340,402

174-7

15. Elfsborg

4,912

280,101

57-0

16. Skaraborg

3,273

240,907

73-6

17. Vermland

7,459

254,975

34-2

18. Orebro ....

3,511

196,462

56-0

19. Vestmanland .

2,612

149,332

57-2

20. Kopparberg .

11,522

220,116

191

21. Gefleborg

7,613

241,420

31-7

22. Vesternorrland

9,856

234,968

23-8

23. Jemtland

19,675

112,761

5-7

24. Vesterbotten .

22,771

145,961

6-4

25. Norrbotten

40,870

138,630

3-4

The four great lakes Total

3,516

172,875

5,175,228

29-9

In 1870 the number of inhabitants was 4,168,525 ; in 1900 (the last census), 5,136,441. In 1901 the 5,175,228 inhabitants comprised 2,526,179 males and 2,649,049 females. The greatest increase of the population during the last twenty years of the 19th century took place in Norrland. As regards the rest of the kingdom, the rural population during that period in general remained stationary or decreased, whereas the urban population increased very greatly. In 1870 the town population formed 12-9 per cent, of the whole ; in 1890, 18-8 per cent. ; and in 1901, 21-7 per cent. The populations of the principal towns at the end of 1901 were: — Stock- holm, 303,356 ; Goteborg (Gothenburg), 132,111 ; Malmo, 62,954; Norrkoping, 41,549 ; Gefle, 30,146 ; Helsingborg, 25,164; Karlskrona, 24,607 ; Upsala, 23,802 ; Jonkoping, 23,519; Orebro, 22,807; Lund, 16,493; Boras, 16,004; Halmstad, 15,567 ; Sundsvall, 15,087.

Movement of Population. — The average number per annum of marriages, living births, and deaths per 1000 inhabitants in the years stated were : —

Tears.

Marriages.

Living Births.

Deaths.

1871-80 1891-95 1896-98 1899

6-81 5-76 6-01 6-24

30-5 27-4 26-8 26-2

18-3 16-6 15-9 17-6

The figures for the years 1891-95 were lower than those for any other European country, with the exception of the birth-rate for Trance. The rate of mortality more especially decreased in towns, falling fromr24-l per 1000 inhabitants in 1871-80 to 18-0 in 1891-95. During the same period the rate among children in the first year of life decreased from 129-9 to 104-0 per 1000 children born living. About 10 per cent, of the births are illegitimate. The censuses of 1870-90 showed that the several classes of occupation engaged the following percentages of the population : —

Class of Occupation.

1870.

1880.

1S90.

Agriculture .... Mining and manufactures . Commerce and transport Public services, &c.

71-87

14-71

5-06

8-36

67-42

17-75 7-14 7-69

60-92

22-72

8-92

7-44

Consequently the number of persons employed in agri- cultural pursuits formed even in 1890 more than three- fifths of the total population ; but as the development of the country since that date has proceeded continuously, the ratio has steadily decreased, the number of those engaged in manufactures having greatly risen.

Religion. — The census of 1890 registered only 49,763 adherents of creeds other than the Lutheran. These were for the most part Baptists and Methodists; there were 1390 Roman Catholics and 3402 Jews.

Education. — During recent years the Swedish system of instruction in sloyd has particularly attracted attention. The education in primary or national schools has been gratuitous and compulsory for sixty years, and hence it is now rare to come across any adult who is unable to read and write. The cost of maintaining the primary schools is little more than a million sterling, of which the State contributes about one-fourth and the local districts the remainder. There were 11,981 primary schools in 1901, with 833,601 pupils and 5367 male and 10,257 female teachers. There are, furthermore, the specifically Scandi- navian institutions called peasant high schools, for the further education of the rural population, 29 in number, with 1510 pupils. Secondary instruction is provided for boys at 75 public schools entirely maintained by the State, with 18,085 pupils. Education of a similar standard is provided for girls at some 120 private schools (about 13,000 pupils), supported in part by grants from the State and the local districts. The State universities at Upsala and Lund now have 1546 and 693 students

respectively. The medical college at Stockholm has about 300 students. Private subscriptions have enabled two in- dependent universities to be founded, one at Stockholm and the other at Gothenburg. In addition to a large number of technical, forestry, and agricultural schools of a lower grade, there are, for more advanced teaching, the technical high school at Stockholm (428 students), Chalmer's College at Gothenburg, the college of forestry at Stockholm, the agricultural colleges at Ultuna and Alnarp, and the dairy college at Alnarp. At Stockholm, too, is the gymnastic central institute, where the teachers of the Swedish system of gymnastics receive their training. Among the scientific and literary societies are noted the Swedish Academy, consisting of 18 members, which was instituted in 1786 by Gustavus III., after the pattern of the Academie Eranqaise, for the cultivation of the Swedish language and literature, and the Academy of Science, founded in 1739 by Linnaeus and others for the promotion of the natural sciences. Among other things, the former distributes one and the latter two of the prizes of the Nobel Institution. A fourth prize is distributed by the Medical College at Stockholm.

Finance. — The revenue and expenditure were estimated in the national budget for 1903 at £9,497,000. The sources of income were principally : Customs, £2,671,000 ; excise on Swedish brandy, £1,074,000 ; on Swedish sugar, £578,000 ; income from State rail- ways (net), £385,000 ; from domains, £501,000 ; income and pro- perty tax (to be paid in 1903), £889,000; surplus from 1901, £876,000. This surplus has been constant during recent times. On the expenditure side the following items appeared • Army £2,832,000 ; navy, £988,000 ; education, £992,000 ; interest and amortization of debt, £659,000 ; railway rolling stock and railway construction, £339,000. To these items must be added an additional sum of £312,000 for railway construction to be covered by loans. The national debt, the existence of which is almost exclusively due to railway construction, amounted on 31st December 1900 to £18,607,214. To balance it were the following : Funds, £14,295,154 • railways, £21,254,544 ; real estate, £13,964,648 (whereof domains, £7,657,400) ; to these may be added the funds of the Riksbank. The communal revenues amounted in 1899 to £4,772,045 ; then- expenditure to £5,636,948. On the revenue side may be mentioned

the following items : Income and property tax, £2,251,306 ; proceeds of the sale of spirits (the “Gothenburg system is generally intro- duced), £425,483 ; contribution from the Treasury, £333,721. On the expenditure side : Primary schools, £1,064,141 ; administration

of the poor laws, £760,141 ; Church purposes, £625,007. The liabilities of the communes in 1875 were £3,262,512, and in 1899 £12,478,470 ; their assets, £20,699,511 in 1899.

Army and Navy. — General military service was introduced in 1885. The standing army is divided into two classes : there are the Varfvade, almost all garrisoned on a two to three years’ service system, and there are .the so-called Indelta, to which body belong the majority of the infantry and about half the cavalry. These latter are drawn from the peasantry. They serve a considerable number of years, and live, as a rule, scattered over the country districts, some of them in small cottages placed at their disposal. After their recruit period is over, they are drilled twenty-two or twenty-three days annually. Besides the standing army there is the Varnpligtige, or the conscripts, to which every Swedish man belongs from the age of 21 to 40. For the first twelve years he is one of the Bevdring, who are apportioned among the regiments and corps of the army and the different branches of the navy ; for the last eight years the Varnpligtige are numbered in the Land-storm, intended solely for local defence on shore. The conscripts were formerly trained for ninety days, but according to the law of 1901 the conscript is bound to serve in time of peace — in the in- fantry, position artillery, fortress artillery, fortress engineers, and the army service corps a total of 240 days ; and in the cavalry, field artillery, field engineers, and field telegraph corps a total of 365 days. The Indelta, on the other hand, are gradually to be abandoned, and the Varfvade, now 39,000 men, to be brought down to about 21,500 men (2293 officers, 557 officer-aspirants, 1805 non- commissioned officers, 6857 corporals,

836 civilian officers, &c). During the years 1902-07 all conscripts are to be trained for only 172 days. The Bevdring of the first year consists of about 29,000 men, of the twelve years of about 255,000 ; the Landstorm (of the eight years) of about 205,000 men. The organization of the army in time of peace is as follows : 82 battalions of infantry (28 regi- ments), 50 squadrons of cavalry, 71 field artillery and 7 position artillery batteries, 10 fortress artillery, 16 engineer, and 18 army service corps companies. The men in the navy consist partly of enlisted and partly of Varnpligtige sailors ; of the former there are 4100, of the latter about 17,000. The conscripts are to be trained 300 days (in 1902-07 only 172 days). The fleet includes 11 iron- clads of 3100 to 3650 tons and 4 of 1500 to 1600 tons, 5 .torpedo- cruisers, 1 destroyer, 15 torpedo-boats of 67 to 90 tons, and 11 of 40 to 58 tons, &c. To the navy department belong furthermore the two coast artillery regiments, which complete will consist of 1568 men without the conscripts. The naval stations are Karlskrona (the head station) and Stockholm. Fortresses : Karlsborg, at the LakeWettern; Boden (in course of construction), at the railway Lulea-Gellivara, Karlskrona, Vaxholm, and Oskar-Fredriksborg, at the entrance of Stockholm, and some forts at Gothenburg (in construction) and on the island of Gotland.

Mining. — The copper and silver mines at Falun and Sala, that were formerly of such great importance, are now of but little note. The iron mines, on the other hand, continue to be of great import- ance. The best iron ore is found mainly within a belt which extends from the southern parts of ,the Bothnian Gulf to the districts north of Lake Venern. In the extreme north of the country also there are considerable iron ore deposits, some of which are among the largest and richest in the world ; such are those at Gellivara, Kirunnavara, Luossavara, and Ruotlvara. Until lately these deposits have been unworked, partly on account of bad communications, partly owing to the high percentage of phosphorus and titanium in them. During the last decade, how- ever, a railway has been opened from Gellivara to Lulea, on the Gulf of Bothnia ; but the harbour there is inaccessible for half the. year on account of ice. A railway has been constructed by the State from Gellivara, past Kirunnavara and Luossavara, to the Norwegian boundary, with a projected continuation from there to the Ofoten

Fjord, where there is always open water. The amount of iron ore obtained in 1891 was 976,544 tons, and with a con- stantly increasing production this became in 1901, 2,795,160 tons, 1,076,564 tons being from Gellivara. (See Commerce.) In 1901, 48,630 tons of zinc ore and 23,660 tons of copper ore were mined. In the same year 271,509 tons of coal were obtained from the isolated field in Malmohus Lan. The number of miners employed in 1901 was 14,583. In consequence of the great supply of iron ores containing but little phosphorus, and of the immense forests and numerous waterfalls, the iron trade attained great prosperity during the 17th and 18th centuries, and down to about the year 1790 the production of pig-iron was greater in Sweden than in Great Britain ; but subsequent to the successful introduction of the use of coal in the iron trade, this state of things was soon changed. Now the production of pig-iron in Sweden, though doubled during the last thirty years, and 528,375 tons in 1901, is, however, not 1J per cent, of the production of the world. Owing to its excellent quality, Swedish iron is often preferred to other varieties for special purposes. The amount of wrought iron and steel produced in 1901 was 434,046 tons, and this also shows a very

appreciable increase. There were 16,008 workmen employed in iron-works in 1901.

Agriculture.— The number of petty landowners has always been great. In 1900, 288,000 farmers owned the land they cultivated, and only 50,400 were tenants. 93,023 acres (2-47 acres=one har or hectare) were occupied by orchards and market-gardens in 1900 ; 8,693,906 acres were arable land, and 3,607,445 acres natural meadows. The acreage devoted to orchards and gardens had in- creased since 1870 by 28,000 acres ; 2,400,000 acres had been added to the arable land, while meadow land had decreased by 1,300,000 acres. The increase in arable land goes on steadily, and is partly due to the decrease in meadow land, partly to the transformation of fens and marshes into fertile soil. The extent of these fens and marshes capable of cultivation is so great that the total acreage of arable land at the present time would be more than doubled if they were brought into a cultivable condition. 2-2 per cent, of the arable land produced wheat, 11-7 per cent, rye, 6-2 per cent,

barley, 23‘4 per cent, oats, 3-7 per cent, mixed crops, 1-3 per cent, other corn crops, 4-4 per cent, potatoes, 1 ‘4 per cent, sugar-beet and other root crops, 29 -2 per cent, clover and grass, 0 -1 per cent, flax, tobacco, &c. ; 4-6 per cent, is devoted to pasturage, and 11-8 percent, lies fallow. The section lying fallow is decreased year by year (in 1870, 15-2 per cent.). The average value of the harvests yielded by arable and meadow land is £28,750,000, £16,400,600 of it being for corn, £2,630,000 for roots, and £9,720,000 for hay. During the last few decades an increasing proportion of field land has been set aside for the cultivation of those cereals used as fodder, owing to the great advance made in cattle-rearing and in dairy farming. The culti- vation of sugar-beet has advanced since 1890 with such strides that the produce is sufficient to supply the whole demand of the country. The consumption of wheat per inhabitant is double what it was in 1880, and is now half that of rye. The wheat produced in the country supplies not half the demand ; the rye, six-sevenths. The export of oats, in former times very considerable, has greatly dimin- ished, owing to their more extensive use at home. The export of butter has become so large that it counterbalances the diminution in the export of grain, and the country still produces a sufficient supply of food for the needs of its inhabitants. The live stock in- cluded, at the end of 1900, 533,050 horses, 2,582,555 horned cattle, 1,261,493 sheep, 79,826 goats, 805,805 pigs, and 231,960 reindeer. Since 1870 the number of horses has increased by 100,000, of horned cattle by over 600,000, of pigs by 450,000 ; the number of sheep has diminished by 330,000, of goats by 45,000.

Forests. — These cover 51,150,000 acres, and provide fuel both for household purposes and for the numerous iron-works, besides affording an article of export in such large quantities that the quantity of timber exported from Sweden is greater than from any other country. The public forests form about a third of the whole. At the saw-mills, situated for the most part on the Gulf of Bothnia, 43,312 workmen are employed.

Fisheries. — By reason of unsuccessful fishing, the export trade in herrings sank to 30,000 tons annually in 1897-1900.

Manufactures. — In spite of the fact that Sweden has but in-considerable deposits of coal, and wholly lacks colonial possessions, it possesses important mechanical industries, which have made great strides, especially during the last few years. In 1900 machine shops employed 20,681 hands ; factories for iron and steel manu- factured goods, 19,146 ; mills for weaving woollen and other materials, 14,730; stone-cutting works, 11,697; brickyards, 10,337 ; spinning-mills, 10,255 ; furniture factories, 10,103 ; charcoal works, sugar factories, wood-pulp factories, paper mills, breweries, match factories, glass factories, printing nouses, and. shipyards, each class between 5000 and 7700. The number- of workmen engaged in practical trades is 87,322. The productions of the Swedish factories are disposed of for the most part in the country itself, though a not inconsiderable amount is sent abroad. The industries connected with wood-pulp, sugar, machinery, shoes, and electricity have made the greatest advances in recent years.

Commerce. — The aggregate value of the foreign trade of Sweden in 1870 was estimated at £16,199,780 (imports £7,802,093, exports £8,397,687), and in 1900 at £51,006,007 (imports £29,456,780, exports £21,549,227). The principal articles of import in 1900 were: Coal and coke, £4,682,052; grain, £2,462,263; coffee, £1,490,588; machines and implements, £1,270,179; yarn and thread, £854,824 ; cotton, £790,198 ; hides and skins, £779,619 ; woollen woven goods, £726,976 ; fish, £725,800 ; petroleum, £602,000; wool, £542,898. The coal and coke imported forms more than 90 per cent, of the total supply, and amounted in 1900 to 3,130,000 tons. The principal articles of export were: Wood (not worked, sawn, or cut), £8,466,409 ; iron and steel, £2,747,942; butter, £2,026,021; wood-pulp, £1,471,794; iron ore, £718,965 ; paper, £683,467 ; machines and implements, £637,655; carpentry work, £598,446; stone, £571,993; iron and steel goods, £545,624; matches, £465,896. The exporta- tion of iron ore has increased remarkably ; in 1891 only 172,232

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tons, in 1901 it was 1,761,000 tons : Germany takes most of the supply. The value of the (direct) imports from and exports to non-European countries was in 1900 but £662,930 and £476,487 respectively. Trade was principally with the following countries : —

United Kingdom.

Germany.

Denmark.

Imports .... Exports ....

£9,719,383

9,319,824

£10,346,806

3,592,786

£3,443,007

2,625,661

Shipping and Navigation. — In 1900 there were 2076 sailing vessels of 288,687 tons, and 911 steamers of 325,105 tons ; total, 2987 vessels of 613,792 tons. Of these only 10 sailing vessels and 90 steamers were of 1000 tons or more, and the largest was of only 3377 tons. In 1870 the aggregate tonnage was 350,200 tons (sail- ing vessels 319,300, steamers 30,900).

Bailways, Posts, Telegraphs, and Telephones. — Sweden has more miles of railway in proportion to population than any other Euro- pean country. The first line was open for traffic in 1856. In 1870 the total length was 1060 miles (State railroads 366, private 694), which had increased to 4979 miles in 1890 and to 7217 at the close of 1901, when 2392 miles belonged to the State and 4825 to private companies, while about 800 miles was in course of construction. The line from Gellivara

to the Norwegian frontier is the most im- portant recently under construction ; it is the most northerly rail- way in the world. The State railways yielded a profit of 3-73 per cent, in 1899 and 3-06 per cent, in 1900 ; the private lines, on an average, one of 5-62 per cent, in 1898 and 5-24 per cent, in 1899. The total number of letters, parcels, &c. , transmitted through the post in 1900 amounted to 123,261,253, without counting newspapers and journals ; the number of telegrams despatched was 2,749,483. In 1870 the corresponding numbers were 13,360,440 and 738,000. The telephone system has been more speedily developed than per- haps in any other country. It is now largely in the hands of the State. The total number of telephones at the close of 1901 was about 95,000, of which about 33,000 were in Stockholm alone.

Banks. — The Riksbank or National Bank of Sweden is the principal and oldest bank in the kingdom, and the first in the world from which notes were issued. Founded as a private con- cern, it was taken over in 1668 by the State, to which it belongs entirely. It is managed by directors who, with the exception of the president, are elected for three years by the Diet ; the president is appointed by the king. Other banks are of two categories : private banks with solidary responsibility, which alone, along with the Eiksbank, possess the right of issuing notes ; and joint^stock banks, with limited responsibility and not possessing the right to issue notes. At the close of 1901 the value of all notes in circulation was £8,625,616, those of the Riksbank amounting to £5,560,724, and of the private banks to £3,064,892. At the close of 1903 private banks will forfeit the right of issuing notes, that right from thence- forward belonging to the Riksbank alone. The capital and the reserve funds, besides funds to further disposition (after distri- bution of the year's profits) at the end of 1901, were as follows : the Riksbank, £3,887,589 ; private banks, £7,006,760 ; joint-stock banks, £6,482,600. In 1900 there were 388 savings banks in exist- ence. At the close of the year the deposits in these amounted to £24,085,416 (in 1870, £3,155,386), and in the Post Office Savings Bank in 1901 to £2,986,959.

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II. Becejstt Histoet.

The economic condition of Sweden, owing to the progress in material prosperity which had taken, place in the country as the result of the Franco-German war, was at the accession of Oscar II. to the throne on the 18th September 1872 fairly satisfactory.

Politically, however, the outlook was not so favourable. In their results, the reforms inaugurated 'during the preceding reign did not answer expectations. Within three years of the introduction of the new electoral laws, De Geer's g^s„f ministry had forfeited much of its former popularity, oscarll. and had been forced to resign. In the vital matter of national defence no common understanding had been arrived at, and during the conflicts which had raged round this question, the two Chambers had come into frequent collision and paralysed the action of the Government. The peasant proprietors, who, under the name of the " Landtmanna party," 1 formed a compact majority in the Second Chamber, pursued a consistent policy of class interests in the matter of the taxes and burdens that had, as they urged, so long oppressed the Swedish peasantry ; and consequently, when a Bill was introduced for

superseding the old system of army organization by general compulsory service, they demanded as a condition of its acceptance that the military burdens should be more evenly distributed in the country, and that the land taxes, which they regarded as a burden under which they had wrongfully groaned for centuries, should be abolished. In these circumstances, the "Landtmanna" party in the Riksdag, who desired the lightening of the military burden, joined those who desired the abolition of landlordism, and formed a compact and predominant majority in the Second Chamber, while the burgher and Liberal parties were reduced to an impotent "intelligence" minority. This majority in the Lower Chamber was at once attacked by another compact majority in the Upper, who on their side maintained that the hated land taxes were only a kind of rent-charge on land, were incidental to it and in no way weighed upon the owners, and, moreover, that its abolition would be quite unwarrantable, as it was one of the surest sources of revenue to the State. On the other hand, the First Chamber refused to listen to any abolition of the old military system, so long as the defence of the country had not been placed upon a secure basis by the adoption of general compulsory military service. The Govern- ment stood midway between these conflicting majorities in the Cham- bers, unable to find support in either.

Such was the state of affairs when Oscar II., surrounded by his late brother's advisers, began his reign. One of his first cares was to increase the strength of his navy, but in consequence of the continued antagonism of the political parties, he was unable to effect much. In the first Riksdag, however, the so- called "compromise," which afterwards played such The party an important part in Swedish political life, came into ™^T existence. It originated in the small " Scania " party is74. in the Upper House, and was devised to establish a modus Vivendi between the conflicting parties, i.e., the champions of national defence, and those who demanded a lightening of the burdens of taxation. The king himself perceived in the compro- mise a means of solving the conflicting questions, and warmly ap- proved it. He persuaded his ministers to constitute a special inquiry into the proposed abolition of land taxes, and in the address with which he opened the Riksdag of 1875 laid particular stress upon the necessity of giving attention to the

settlement of these two burning questions, and in 1880 again came forward with a new proposal for increasing the number of years of service with the militia. This motion having been rejected, De Geer resigned, and was succeeded by Count Arvid Posse. The new prime minister endeavoured to solve the question of defence in accordance with the views of the ” Landtmanna ” party. Three parliamentary committees had prepared schemes for a remission of the land taxes, for a new system of taxation, for a reorganization of the army based on a stammtrupp (regular army), by the enlistment of hired soldiers, and for naval reforms. In this last connexion the most suitable types of vessels for coast defence as for offence were determined upon. But Count Posse, deserted by his own party over the Army Bill, resigned, and was succeeded on 16th May 1884 by Oscar Themptauder, who had been minister of finance in the previous Cabinet. The new premier succeeded in persuading the Riksdag to pass a Bill, increasing the period of service with the colours in the army to six years and that in the militia to forty-two days, and as a set-off a remission of 30 per cent, on the land taxes.

Influenced by the economic reaction which took place in 1879 in consequence of the state of affairs in Germany, where Prince Bismarck had introduced the protectionist system, a protectionist party had been formed, which tried to gain adherents in the

1 The Swedish “Landtmanna” party was formed in 1867. It con- sisted mostly of the larger and smaller peasant proprietors, who at the time of the old ” Standers Riksdag ” were always opposed to the nobility and the clergy. The object of the party was to bring about a fusion between the representatives of the large landed proprietors and the regular peasant proprietors, to support the interests of landed pro- prietors in general against those of the town representatives, and to resist Crown interference in the administration of local affairs.

Riksdag. It is true that in the Riksdag of 1882 the commercial treaty with France was renewed, but since 1885 the protectionist party was prepared to begin the combat, and a duty tlisi on corni which had been proposed in the Riksdag of movement *e same year, was rejected by only a slight majority. During the period of the unusually low price of corn of 1886, which greatly affected the Swedish farmers, protection gained ground to such an extent that its final triumph was con- sidered as certain within a short time. During the Riksdag of the same year, however, the premier, Themptauder, emphatically declared himself against the protectionist party, and while the parties in the Second Chamber were equal in number, the pro- posed tax on corn was rejected in the First Chamber. In the Riksdag of 1887 there was a majority for protection in the Second Chamber, and in the first the majority against the tax was so small that the tax on corn would have triumphed in a combined meeting of the two Chambers. The Government, availing itself of its formal right not to dissolve the Chamber in which it had the support of a majority, therefore dissolved only the Second Chamber (March 1887).

The new Riksdag assembled in May with a free trade major- ity in the Second Chamber, but nothing in connexion with the great question of customs was settled. In the meantime, the powerful majority in the Second Chamber split into two groups — the new "Landtmanna" party, which approved protec- tion in the interests of agricultural classes; and a somewhat smaller group, the old "Landtmanna" party, which favoured free trade.

The victory of the free traders was not, however, destined to be of long duration, as the protectionists obtained a majority in both Chambers in the next Riksdag (1888). To the First Chamber pro- tectionists were almost exclusively elected, and in the Second all the twenty-two members for Stockholm were disqualified, owing to one of their number not having paid his taxes a few years previously, which prevented his being eligible. Instead, then, of twenty-two free traders representing the majority of the Stock- holm electors, twenty-two protectionists, representing the min- ority, were elected, and Stockholm was thus represented in the Riksdag by the choice of a minority in the

capital. This singular way of electing members for the principal city in the kingdom could not fail further to irritate the parties. One result of the Stockholm election came at a convenient time for the Themptauder ministry. The financial affairs of the country were found to be in a most unsatisfactory state. In spite of reduced expenses, a highly estimated revenue, and the contemplated raising of taxes, there was a deficit, for the payment or discharge of which the Government would be obliged to demand supplementary supplies. The Themptauder ministry resigned. The king retained, how- ever, for a time several members of the ministry, but it was difficult to find a premier who would be able, during the transition from one system to another, to command sufficient authority to control the parties. At last Baron Gillis Bildt, who, while Swedish ambassador in Berlin, had witnessed the introduction by Prince Bismarck of the agrarian protectionist system in Germany, accepted the premiership, and it was under his ‘ auspices that the two Chambers imposed a series of duties or necessaries of life. The new taxes, together with an increase of the excise duty on spirits, soon brought a surplus into the State coffers. At a Council of State (12th October 1888) the king declared his wishes as to the way in which this surplus should be used. He desired that it should be applied to a fund for insurance and old-age pensions for workmen and old people, to the lightening of the municipal taxes by State contributions to the schools and workhouses, to the abolition of the land taxes and of the obligation of keeping a horse and man for military service, and, lastly, to the improvement of the shipping trade ; but the Riksdag decided to devote it to other objects, such as the payment of the deficit in the Budget, the building of railways and augmentation of their material, as well as to improvements in the defences of the country.

Baron Bildt resigned as soon as the new system seemed settled, making room for Baron Gustav Akerhjelm. The latter, however, also soon resigned, and was succeeded on 10th July 1891 by Erik Gustav Bostrom, a landed proprietor. The protectionist system gained in favour on the expiry of the commercial treaty with France in 1892, as it could now be extended to articles of industry. The elections of 1890, when the metropolis returned free traders and Liberals to the Second Chamber, certainly effected a change in the latter, as the

representatives of the towns and the old “Landtmanna” party joined issue and established a free- trade majority in the Chamber, but in the combined meetings of the two Chambers the compact protectionist majority in the First Chamber turned the scale. The customs duties were, however, altered several times in accordance with market prices and ruling circumstances. Thus in ,1892, when the import duty on unground corn was reduced from 2s. lOd. to Is. 5d., and that on ground corn from 4s. 9d. to 2s. lOd. for 100 kilogrammes, the same duties

were also retained for the following year. They were also retained for 1894 at the request of the Government, which desired to keep faith with their promise that while the new organization of the army was going on no increase of duties on the necessaries of life should take place. This measure caused much dissatisfaction, and gave rise to a strong agrarian movement, in consequence of which the Government, in the beginning of 1895, before the assembling of the Riksdag, made use of its right of raising the two duties on corn just referred to, to 3s. 7d. and 7s. 2d., which were afterwards somewhat reduced as far as seed corn for sowing purposes was concerned.

The question of customs duties now settled, that of national defence was taken up afresh, and in the following year the Government produced a complete scheme for the aboli- tion of the land tax in the course of ten years, in National exchange for a compensation of ninety days’ drill for defence. those liable to military service, proposed to retain the old mili- tary system of the country and to strengthen the defences of Norrland, and the Government Bill for a reorganization of the army was accepted by the Riksdag in an extraordinary session. But it was soon perceived that the new plan was unsatisfactory and required recasting, upon which the minister of war, Baron Rappe, resigned, “and was succeeded by Colonel von Crustebjorn, who immediately set to work to prepare a complete reorganization of the army, with an increase of the time of active service on the lines of general compulsory service. The Riksdag of 1900, in addi- tion to grants for the fortifications at Boden, in the province of Norr- botten, on the Russian border, and other military objects, voted a considerable grant for an experimental mobilization, which fully exposed the defects

and faults of the old system. In the Riksdag of 1901 E. G. Bostrom resigned, and was succeeded by Admiral F. W. von Otter, who introduced a new Bill for the army re- organization, the most important item of which was the increase of the period of training to 365 days. The cost in connexion with the new scheme was expected to amount to 22 millions of kronor. The Riksdag, however, did not accept the new plan in its full extent. The time of drilling was reduced to 240 days for the infantry, to 300 days for the navy, while for the cavalry and artillery the time fixed was 365 days. The plan, thus modified, was then accepted by the Government.

After the elections in 1890, the alliance already mentioned between the old "Landtmanna" party and the representatives of the towns had the result that the Liberals in the Second Chamber, to whom the representatives of the j^ftirin Se towns mostly belonged, were now in a position to decide the policy which the two united parties should follow. In order to prevent this, it was proposed to readjust the number of the members of the Riksdag. The question was only settled in 1894, when a Bill was passed fixing the number of the members of the Riksdag in the First Chamber at 150, and in the Second at 230, of which 150 should represent the country districts and 80 the towns. The question of protection being now considered settled, there was no longer any reason for the con- tinued separation of the two "Landtmanna" parties, who at the beginning of the Riksdag of 1895 joined issue and became once more a compact majority in the Second Chamber, as they had been up to the Riksdag of May 1887. The influence of the country representatives was thus re-established in the Second Chamber, but now the demands for the extension of the franchise came more and more to the front, and the premier, Bostrom, at last felt bound to do something to meet these demands. He accordingly introduced in the Riksdag of 1896 a very moderate Bill for the extension of the franchise, which was, nevertheless, rejected by both Chambers, all similar proposals by private members meeting the same fate. When at last the Bill for the reorganization of the army, together with a considerably increased taxation, was accepted by the Riksdag of 1901, it was generally acknowledged that, in return for the increased taxation, it would only be just to extend the right of taking part in the political life

and the legislative work of the country to those of the population who hitherto had been excluded from it. The Government event- ually laid a proposal for the extension of the franchise before the Riksdag of 1902, the chief feature of which was that the elector should be twenty-five years of age, and that married men over forty years should be entitled to two votes. The Riksdag, however, finally agreed to a proposal by Bishop Billing, a member of the First Chamber, that an address should be presented to the king asking for a full inquiry into the question of extending the franchise for the election of members to the Second Chamber.

In 1897 the Riksdag had received among its members the first socialistic representative in the person of R. H. Brauting, the leader of the Swedish Social Democrats. The Socialists, who had formerly confined their activity Q^en*. to questions affecting the working classes and their wages, took, however, in 1902 an active part in the agitation for the extension of the franchise. Processions of many thousands

of workmen were organized^ in Stockholm and in other towns of the kingdom, just before the Riksdag began the discus- sion on the above-mentioned Bill of the Government, and when the Bill was introduced in the Chambers a general and well- organized strike took place, and continued during the three days the debate on the Bill lasted. As this strike was of an exclusively political kind, and was intended to put pressure on the Chambers, it was generally disapproved, and failed in its object.. The prime minister, Admiral von Otter, resigned shortly after the end of the session, and was succeeded by Bostrom, the ex-premier, who at the request of the king again assumed office.

The relations with Norway during King Oscar’s reign had great influence on political life in Sweden, and at times it even seemed as if the union between the two countries was Relations on the point of being

wrecked. The dissensions chiefly Nrwa ka<* tne'r or'gin in the demand by Norway for separate

y’ consuls and foreign ministers, to which reference is made under Norway. At last, after vain negotiations and dis- cussions, the Swedish Government in 1895 gave notice to Norway that the commercial treaty which, till then, had existed between the two countries, and would lapse in July 1897, would, according to a decision in the Riksdag, cease, and as Norway at the time had raised the customs duties, a considerable diminution in the exports of Sweden to Norway took place. The Swedish minister of foreign affairs, Count Lewenhaupt, who was considered as too friendly disposed towards the Norwegians, resigned, and was replaced by Count Ludvig Douglas, who represented the opinion of the majority in the First Chamber. When, however, the Norwegian Storthing, for the third time, passed a Bill for a national or “pure” flag, which King Oscar eventually sanctioned. Count Douglas resigned in his turn, and was succeeded by the Swedish minister at Berlin, Lagerheim, who managed to pilot the ques- tions of the Union into more quiet waters. He succeeded all the better as the new elections to the Eiksdag of 1900 showed clearly that the Swedish people was not inclined to follow the ultra- conservative or so-called ‘ ‘ patriotic ” party, which resulted in the resignation of the two leaders of that party, Professer Oscar Alin and Court Marschal Patrick Reutersvard as members of the First Chamber. On the other hand, ex-Professor E. Carlson, of the High School of Gothenburg, succeeded in forming a party of Liberals and Radicals to the number of about 90 members, who, besides being in favour of the extension of the franchise, advocated the full equality of Norway with Sweden in the management of foreign affairs.

During King Oscar’s reign many important ^social reforms have been carried out by the legislature. The statistics show in a very striking manner how the country has developed in all directions. In the Riksdag of 1884 a new patent law was adopted, the age at which women should be held to attain their majority was fixed at twenty-one years, and the barbarous prison punishment of “bread and water” abolished. In order to meet the cost of the new army organization, the Riksdag of 1902

increased the revenue by progressive taxation, but only for one year. Bills for the improvement of the social conditions of the people and in the interests of the working classes have also been passed. During the five years 1884-89 a committee was occupied with the question of workmen's insurance, and thrice the Government made proposals for its settlement, on the last occasion adopting the principle of invalidity as a common basis for insurance against accidents, illness, or old age. The Riksdag, however, delayed coming to a decision, and contented itself by earmarking money for an insurance fund. At last the Riksdag of 1901 accepted a Bill for insurance against accidents which also extended to agricultural labourers, in connexion with the estab- lishment of a State institution for insurance. The Bill for pro- tection against accidents, as well as for the limitation of working hours for women and children, was passed, together with one for the appointment of special factory inspectors.

The so-called "Nobel Gift" has given Sweden an important r61e in the history of culture, which is quite unique. Alfred Nobel, a civil engineer, in 1896 left the whole of his immense property, amounting to over one and three-quarter million pounds, to a fund, the yearly income of which was to be divided between those who, in the course of the current year, had rendered the greatest service to mankind in various branches of science, in literature, and in the cause of peace. The prizes for 1901 were distributed as follows: Professor Rontgen (natural philosophy), Professor Van't Hoff (chemistry), Professor Behriz (medicine), and Sully Prudhomme (literature). These prizes were adjudged by the Swedish Academy ; while the prize for services rendered in the cause of peace is, in accordance with the testator's will, left in the hands of the Norwegian Storthing to distribute. The prize for 1901 was divided between Henri Drenant, the founder of the Red Cross, and Frederic Passy, the secretary of the Peace Congresses. Each prize amounts to about £8300, and will be distributed yearly.

When in 1897 King Oscar celebrated his jubilee of twenty-five years as king, the exhibition which had been organized in Stock- holm offered a convincing proof of the progress the country had made in every direction, while the thousands of provincial visitors who flocked to the

metropolis took the opportunity to attest their respect and loyalty to the king and the royal family. The amount collected all over the country on the occasion of the jubilee as a gift to the king, amounting to £140,000, was, accord- ing to His Majesty's wishes, applied to the building of sanatoria for sufferers from consumption. (x.)

III. LlTEEATUBE SINCE 1885.

The serenity of Swedish literature was rudely shaken about 1884 by an incursion of realism and by a stream of novel and violent imaginative impulse. The controversy between the old and the new schools raged so fiercely, and the victory has remained so obviously in the hands of the latter, that it is difficult, especially for a foreigner, to hold the balance perfectly even. It will therefore be best in this brief sketch to say that the leader of the elder school was Viktor Eydberg (1828-1895) (q.v.), and that he was ably supported by Carl Snoilsky (b. 1841) (q.v.), who in 1902 was the principal living poet of the bygone generation in Sweden. Snoilsky is prominent for the richness of his lyrical style, his cosmopolitan interests, and his great width of culture. Carl David af Wirsen (b. 1842) has dis- tinguished himself, and made himself very unhappy, by his dogged resistance to every species of renaissance in Swedish thought, or art, or literature. A man of great talent, he was a violent reactionary, and suffered from the conse- quences of an attitude so unpopular. Of less importance were Karl Herman Satherberg. (1812-1897), a romantic poet who was also a practising physician of distinction ; the elegiac poet Johan Nybom (1815-1889) ; and the poet, novelist, and dramatist Frans Hedberg (b. 1828), who in his old age made many concessions to the modern taste. Two exceedingly popular novelists of the preceding age, Emilie Flygare-Carlen (1807-1892) and K. A. Wetter- bergh (" Onkel Adam ") (1804-1889), survived into the period we are now considering. The posthumous poems of the Bishop of Strangnas, Adam Teodor Stromberg (1820- 1889) were collected by Wirsen, and created some sensa- tion. A typical academician was the poet, antiquary, and connoisseur Nils Fredrik Sander (1828-1900). The im- provisator of Gluntarne, Gunner Wennerberg (1817-1901) (q.v.), was a romantic figure of the past, surviving through nearly the whole of this period. Still older was the poetess Wilhelmina Nordstrom (1815-

1902), long a schoolmistress in Finland. The aesthetic critic and poet, Carl Eupert Nyblom (b. 1832), continued the studies, translations, and original pieces which had created him a reputation as one of the 'most accomplished general writers of Sweden. King Oscar II. (b. 1829) (q.v.) did not add any work of importance to his poetical repertory after 1885. Professor Gustaf Ljunggren (b. 1825) con- tinued his valuable researches into the early history of Swedish literature. A. T. G- ellerstedt (b. 1836), an architect of position, has written poems of small range but of very fine quality. The dramatist, Thure August Safstrom (b. 1813), had in 1902 been silent for nearly forty years. Among writers of a still earlier generation who survived into our period were Achatius Johan Kahl (1794-1888), the biographer of Tegne"r, and Per Erik Bergfalk (1798-1890), the critic and supporter of Geijer. The distinguished historian and academician, Karl Johan Schlyter (1795-1889), was another silent nonogenarian. Other historical writers were Frederik Ferdinand Carlson (1811-1887), Vilhelm Erik Svedelius (1816-1889), and Martin Weibull (1835-1902). It is perhaps not neces- sary to mention any more of the veteran reputations of this period, for our interest certainly centres in their successors.

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Four influences may be mentioned as having acted upon young Sweden, and as having combined to release its literature from the old hard-bound conventions. These are English philosophy in the writings of Mr Herbert Spencer, French realism in the practice and the preaching of M. Zola, Norwegian drama mainly through Ibsen, and Danish criticism in the essays and mono- graphs of Georg Brandes. Unquestionably the greatest name in Swedish literature during twenty years after 1882 was that of Johan August Strindberg (b. 1849). His drama of Master Olof in 1878 began the revolution- ary movement. It was the sensation caused in 1884 by the lawsuit brought against Strindberg's Married (a col- lection of short stories dealing realistically with some of the seamy sides of marriage) which brought to a head the

rebellion against the elegant and superficial conventions which were strangling Swedish literature. It was not the first occasion on which Strindberg's works had caused a scandal. His early dramas had been looked at askance, and his sketches of low life in the capital, entitled Tlie Bed Boom (1879), had introduced naturalism into Sweden, and made the author notorious if not famous. In 1882 he found the restraint of life in Stockholm intolera- ble, and he exiled himself to Paris. When he came back to defend Married, he received from- his followers an ova- tion which turned into a frenzy of joy when he won his case. Strindberg's career is a very curious one. He affronts every canon of taste, more by a radical absence, it would seem, of the sense of proportion than by any de- sire to shock. His diatribes against woman suggest a touch of madness, and he was in fact at one time seized with an attack of insanity. He writes like a man whose view is distorted by physical or mental pain. His phraseo- logy and his turns of invention are too empirically pseudo- scientific for the simplicity of nature. With all these faults, and in spite of a terrible vulgarity of mind, an absence of humour, and a boundless confidence in the philosophy of Nietzsche, Strindberg is a writer of very remarkable power and unquestionable originality. His mind has undergone singular transformations. After de- voting himself wholly to realism of the coarsest kind, he began in 1889 his series of mystico-pathological novels about life in the archipelago of Stockholm. This led him to a culte du moi, of which the strangest result was an autobiography of crude invective, A Fool's Confession (1893), the printing of which in Swedish was forbidden. He rapidly passed on, through books like Inferno (1897), the diary of a semilunatic, up into the sheer mysticism of In Damascus (1898), where he reconciles himself at last to Christianity. His best work is classic in its breadth of style, exquisite in local colour and fidelity to the national characteristics of. Sweden. Strindberg's latest productions have been a series of historical dramas, four of which, Gustavus Wasa, Erik XIV., Gustavus Adol- phus, and Carol XII., appeared between 1899 and 1902. He was then engaged in pouring forth these dramas of national history in quick succession. The future of Strindberg stimulates and baffles curiosity.

A curious antidote to the harsh pessimism of Strind- berg was offered by the delicate and fantastic tempera- ment of Ola Hansson (b. 1860), whose poems came prominently before the public in 1884, and who, in Sensitiva Amorosa (1887), preached a gospel of austere self-restraint. Hansson has been as ardent in the idola- try of woman as Strindberg has been in his hostility to the sex. He has since exiled himself to Germany. Of those who have worked side by side with Strindberg, the most prominent and active has been Gustaf af Geijerstam (b. 1858), in his curious and severely realistic studies of country life. A melancholy interest surrounds the name of Victoria Benedictsson ("Ernst Ahlgren") (1850-

1889), who committed suicide in Copenhagen in the midst of a highly successful career as a novelist. Her biography, a most affecting narrative, was published by Ellen Key, and her autobiography by Axel Lundegard (b. 1861), who, after some miscellaneous writing, pro- duced in 1889 a curious novel of analysis called The Bed Prince, and who, becoming a devout clerical, has since published a number of popular stories in a neo-romantic manner. A historical novelist of unequal powers, but great occasional merit, is Matilda Mailing (b. 1864), whose romance about Napoleon (1894) enjoyed a huge success. Tor Hedberg (b. 1861) also began as a decided realist, and has turned to a more psychological and idealist treatment of life. His most striking work was Judas (1886) ; he has written some excellent dramas. The latest successes in the novel have been those of Hilma Angered-Strandberg (On the Prairie, 1898) and Gustaf Janson (Paradise, 1900). The most remarkable of the novelists of the latest group is Selraa Lagerlof (b. 1858), who, when a schoolmistress in Landskrona, published Gosta Berling's Saga in 1891-92, and achieved an immense success. A later romance, The Miracles of Antichrist (1898), still further established the fame of this lady, who is certainly in the front rank of living Swedish writers. In 1901 she published Jerusalem, a novel describing a religious revival in the country. She employs the Swedish language with an extraor- dinary richness and variety. After 1897, entirely de- voted to literature, Miss Lagerlof resided in Fahluu. But perhaps the greatest recent novelist of Sweden is Per Hallstrom (b. 1866), who spent much of his youth in America, and appeared as an

imaginative writer first in 1891. He has published volumes of ballads, short stories and sketches, fantastic and humoristic, all admira- ble in style.

Among the recent lyrical poets of Sweden, the first to adopt the naturalistic manner was Albert Ulrik Baath (b. 1853), whose earliest poems appeared in 1879. In his rebellion against the sweetness of Swedish con- vention he proved himself somewhat indifferent to beauty of form, returned to ” early national ” types «of versification, and concentrated his attention on dismal and distressing conditions of life. He is a resolute, but harsh and rocky writer. From 1882 onwards Baath was steadily productive. Karl Alfred Melin (b. 1849) has described in verse the life in the islands of the Stockholm archipelago. Among lyrists who have at- tracted attention in their various fields are Oskar Levertin (b. 1862) and Emil Kleen (1868-1898). Of these Levertin is the more highly coloured and perfumed, with an almost Oriental richness ; Kleen has not been surpassed in the velvety softness of his language. But by far the most original and enjoyable lyrical genius of the period is that of Gustaf Froding (b. 1860), whose collection of poems, called Guitar and Accordion, humorous, amatory, and pathetic, produced a great sensation in 1891. Three other volumes followed in 1894, 1895, and 1897, each displaying to further ad- vantage the versatility and sensuous splendour of Froding’s talent, as well as its somewhat scandalous recklessness. In 1897 he was struck down with insan- ity, and after three months’ confinement in the asylum at Upsala, although he recovered his senses, all his joyousness and wildness had left him. He became gloomily religious, and in a new volume of poems he denounced all that he valued and enjoyed before his conversion. The youngest poet who has appeared in Sweden is K. G. Ossian-Nilssen (b. 1875), the author of two volumes of vigorous dramatic and satiric

verse.

The writer who was exercising most influence in Sweden

at the opening of the 20th century was Verner von Heidenstam (b. 1859). He only started authorship in 1888, after which time he led a reaction against realism and pessimism, and has turned back to a rich romantic idealism in his novels of Endymion (1889) and Hans Alienus (1892), and in his stories (1897) of the time of Charles XII. His latest work is The Pilgrimage of St Bridget (1901). Heidenstam has also published interest- ing volumes of literary criticism. Miss Ellen Key (b. 1849), a secularist lecturer of great fervour, has lately become an author in biographical and critical studies of remarkable originality. She is distinguished from Selma Lagerlof, who is simply an artist, by her exercise of pure intellect; she is a moral leader; she has been called ” the Pallas of Sweden.” She published in 1897 a biography of the Swedish author, Almqvist ; in 1899 she collected her finest essays in the volume called Thought Pictures; in 1900 appeared, under the title Human Beings, studies of the Brownings and of Goethe ; but the finest of Ellen Key’s books is The Century of Childhood (1901), a philosophical survey of the progress of element- ary education in the last hundred years. She exercises a very remarkable power over the minds of the latest generation in Sweden. A polemical essayist of elaborate delicacy of style is Hjalmar Soderberg (b. 1869), who has been influenced by Strindberg and by Anatole Erance. His ironic romance, Martin BircWs Youth, created a sensation in 1901. Karl Johan Warburg (b. 1852), has done good work both as an essayist and as a historian of literature. But in this latter field by far the most eminent recent name in Swedish literature is that of Professor Johan Henrik Schuck (b. 1855), who has made great discoveries in the 16th and 17th centuries, and who has published, besides a good book about Shakespeare, studies in which a profound learning is relieved by elegance of delivery. Warburg and Schuck have written an excellent history of Swedish literature down to 1888. The poet Levertin, who is also a distinguished critic, has written a good book about the Swedish theatre. Drama has rarely flourished in Sweden, but several of the poets mentioned above have written important plays, and, somewhat earlier, the socialistic problem-pieces of A. C. Edgren-Leffler, duchess of Cajanello (1849-1893), possessed considerable dramatic talent, working under a direct im- pulse from Ibsen ; but her greatest gift was as a novelist. The plays of Harald Johann Molander (b. 1858) have

been popular in the theatres of Sweden and Finland since his first success with Rococo in 1880. These brief remarks do little justice to the remarkable revival of belles-lettres in Sweden which has taken place, after a long period of inertness and conventionality, during the last fifteen years. It is regrettable, for its own sake, that the Swedish Academy, which in earlier generations had identified itself with the manifestations of original literary genius, has closed its doors to the new writers with an almost vindictive pertinacity. Not one indi- vidual identified with the revival of taste has been admitted to the Swedish Academy, whose latest mem- bers (June 1902) were the diplomatist, Baron Bildt, and Professor M. G. Retzius (b. 1842), the histologist and craniologist. But the new movement, the manifestations of which are still! imperfect, but which is connected with a return to the study of national history, will probably attract much attention from the future historian of liter- ature, (e. g.)

Swellendam, a town of Cape Colony, on the left bank of the Breede river, and one of the oldest Dutch settlements in the colony, dating from about the middle of the 18th century. It is a thriving agricultural and trading centre, with a population which increased from

about 3000 in 1887 to 3300 in 1890. Swellendam is memorable in the colonial records as the place where the burghers first raised the standard of revolt against the Dutch authorities and established a national party shortly before the arrival of the English.

Swimming. — During the last fifteen years of the 19th century much attention was paid to swimming in Great Britain. Its great development is largely due to the Amateur Swimming Association, which from small beginnings has grown into a strong and powerful body, and has been the means of founding kindred associations in Scotland, Ireland, and Wales. It is also due to the vast increase in the bathing accommodation provided by municipalities throughout the kingdom. ^ With baths brought almost to their very doors, swimmers have been able to practice more frequently than their predecessors, to study more carefully the relative value of the various strokes, to eradicate that which was bad and to develop that which was good. Speed rates have

been revo- lutionized, and times which were once considered good enough to win championships are now not even fast enough for standard certificates. Much of this im- provement dates from 1886, when Joseph Nuttall, the greatest swimmer of his age, won the hundred yards championship of England. His wonderful leg kick and extraordinary speed powers astonished every one, and swimmers were not slow in taking advantage of the object-lesson afforded them, and soon learnt to adopt his style. A peculiar screw movement of the leg is the distinctive feature of it. Suppose the swimmer to be lying on his right side at rest, the legs one above the other. The under leg is bent double and the left leg pushed slightly forward, and bent a little at the knee. Then the left leg is straightened with force, and the right simultaneously swirled rapidly to it, the foot of the right leg swinging as on a hinge. The lower arm is pulled down towards the hips, then the hand is turned quickly thumb upwards, so that together with the lower part of the arm it cuts the water, the arm at this stage being bent almost double. As the arm is shot forward the hand is gradually turned palm down- ward, and is hollowed for the next sweep downwards. The upper arm used to be fully extended beyond the head, but now it is customary to bring it only a foot in front of the face, then pull it through the water towards the waist and recover close to the body, the arm straightening as it leaves the water. When the under arm is in position for its stroke, the upper arm should have completed its sweep and the legs be extended ready for the kick. Breathing should be regular and timed with the stroke. It is carried on principally through the nose, and after a time a swimmer learns to inhale naturally during the recovery of the upper arm.

Another method of swimming which has helped to increase speed rates, especially over short distances, is that known as the ” Trudgen,” or double over-arm stroke. It is a modification of a style peculiar to Indians and those who get their living on surf -beaten shores, and was first brought into special prominence in England by an amateur named Trudgen in 1873. It was, however, not until water polo made headway that the study of the stroke became general. Since then it has become highly popular and been greatly improved. Each arm is in turn thrown out of the water beyond the head, and swept round through the water

to the side. The leg kick is the same as in the ordinary over-arm stroke. When the kick is taken the body is on its side, and as the legs are widened out, one arm is being brought into position out of the water while the other is (finishing its stroke, and

the body then turns on the breast. By this action a water polo player is able to get a good view of the field of play, and as it is a very fast stroke, it is extremely useful when racing for, or dribbling, the ball.

Water polo has also been one of the factors in the advance of swimming. It appears to have been played first in the 'seventies, but it was not until the ^J0f institution of the English Championship in 1888 that swimmers began to take much interest in Jhe game. Its growth was, however, rapid, for in 1889 a big London League was formed ; on 26th July 1890 the first county match was played, and two days later England and Scotland met at Kensington. There is now a regular County Championship, and a series of annual interna- tional matches between England, Scotland, Ireland, and Wales. The teams consist of seven a side, and the game is played in a bath or open water not more than 30 yards or less than 19 yards in length, while the width must not be more than 20 yards and the depth not less than 3 feet. The goal posts are 10 feet apart, with cross bar 3 feet above the surface when the water is 5 feet and over in depth, or 8 feet from the bottom when the water is less than 5 feet in depth. An ordinary Football Asso- ciation match ball is used, and when playing it the men are not allowed to touch it with both hands, or take it under water. Neither must they stand on the bottom when playing it, duck an opponent (unless he is in pos- session of the ball), retain possession of the ball when ducked, interfere with or impede an opponent unless he is holding the ball, or jump from the bottom, Or push off from the side, in order to play the ball or duck an opponent. There are also numerous rules as to penalties for fouls, &c. From the mere scramble which the game was in 1888, water polo has now become a scientific exposition of skill in the water. Its great use to swim- mers has been the development of staying power.

Since 1891 scientific swimming and diving have made great advances. A knowledge of floating is of vital Pi ti necessity before one can become an expert in oa ng' the higher branches of swimming, and the ability to float properly in fresh water can only be acquired by long practice. The relative buoyancy of each individual varies, and as a consequence a position which would suit one man would send another to the bottom. The best way to learn is to stand on the bottom of the bath and gradually let the head back until all of it except the face is immersed, the arms meanwhile being carried slowly back until they are in a line with the rest of the body (as you would hold your arms above your head if on dry land). Keep the legs together, and then, after taking a good inspiration, push gently away from the bottom. If the balance has been correctly gauged the legs will rise slowly to the surface. Probably the water will wash over the face, but this must not make the learner give up, as that inconvenience will in all likelihood be only temporary. Above all things, the beginner must not try to see whether he is floating, i.e., lift up his head to see if the legs are on the surface. This is a common fault, and as it upsets the balance at once, the learner often gives up the attempt to float in despair. Once floating has been mastered, the smart feats of the experts may be gradually acquired by careful study. A system of back swimming which is of excel- lent service in saving life has been perfected by the officers of the Life Saving Society. When carrying a person, if the ordinary back stroke kick were made, the rescuer, as well as the person being rescued, would at intervals sink below the surface, and it is therefore essential that the legs should be inclined towards the bottom at a greater angle, and that progression should be made by semicircular sweeps of the legs from the

knees downwards. Another service to English swim- ming rendered by the Life Saving Society was its invitation to the expert amateur divers of owing. Sweden to give a demonstration of their skill at the Diamond Jubilee Gala in the West India Docks, at which the Prince and Princess of Wales were present. Nothing like their display had ever before been seen in this country, but since then their styles have been copied, and great improvement has taken place in the form of English divers. The Swedes are wonderfully skilful and graceful in dives from great heights. Forward and backward headers, backward springs, somersaults, and swallow-like dives are mere child's-play to them, and 60 feet is a common drop. The "swallow" is one of the most thrilling dives. The Swede will stand on a plat- form 60 feet above the surface, make a run, and then spring out into the air. His head is then at once thrown backwards, the back hollowed, the arms flung out hori- zontally and at right angles to the body, and the legs straightened and closed. He falls in this position until some 8 feet from the water, when suddenly the arms close, the head falls between them, and the body comes into the correct and usual position for entering the water.

Swimming Records, 1902. — 100 yards, 1 minute £ second, by J. H. Derbyshire, Manchester Osborne, at Manchester, 23rd Novem- ber 1898 ; 160 yards, 1 minute 38$ seconds, by J. H. Derbyshire, Manchester Osborne, at Burslem, 8th June 1899 ; 220 yards 2 minutes 34$ seconds, by J. H. Derbyshire, Manchester Osborne, at Burslem, 8th June 1899 ; 220 yards, 2 minutes 34$ seconds, by J. H. Derbyshire, Manchester Osborne, and P. C. V. Lane, New South Wales (dead heated), at Birmingham, 17th September 1900 ; 300 yards, 3 minutes 47$ seconds, by P. C. V. Lane, New South Wales, at Blackpool, 11th September 1899 ; 440 yards, 5 minutes 52f seconds, by J. A. Jarvis of Leicester, at Bacup, 27th October 1900; 500 yards, 6 minutes 42f seconds, by J. A. Jarvis of Leicester, at Sunderland, 4th October 1899 ; 880 yards, 12 minutes 29 seconds, by J. A. Jarvis of Leicester, at" Leicester, 8th August 1899 ; 1000 yards, 14 minutes 10 seconds, by J. A. Jarvis of Leicester, at Walsall, 15th July 1899 ; 1 mile, 25 minutes 13f seconds, by J. A. Jarvis of Leicester, at Leicester, 8th August 1899.

Plunging Records. — With time -limit of 60 seconds, 78 feet 9 inches, by W. Taylor of Bootle, at Bootle, 14th September 1899. Without time-limit, 82 feet, by W. Taylor of Bootle, at Bootle, 6th September 1899.

M. A. Holbein swam from Blackwall to Gravesend Town Pier, a distance of about 20 miles, on 29th June 1900, in 4 hours 43 minutes 6 seconds. Captain Webb swam the same distance in July 1875, in 4 hours 52 minutes 44 seconds. M. A. Holbein swam from Blackwall to 2 miles beyond Gravesend Town Pier and back to within a mile of his starting-point on 25th July 1899, in 12 hours 27 minutes 42| seconds, the distance covered being about 43 miles. M. A. Holbein swam for 12 hours in Spithead and the Solent, on 14th August 1899, and in that time it was computed that he covered between 46 and 47 miles. He was quite fresh, and his body warm when he left the water, and, but for darkness coming on, would have gone farther. On 27th August 1902, Holbein almost succeeded in swimming the Channel from Cape Grisnez to Dover, being taken out of the water a mile from land owing to the adverse tide. P. Holmes, of Birmingham, swam 14 miles in 4 hours and 45 minutes, on 24th July 1900, in an attempt to swim the English Channel from Dover to Calais. Madame Isacescu, an Austrian lady, swam nearly 20 miles in 10 hours, on 5th September 1900, in an attempt to swim the English Channel from Calais to Dover. (s. h*.)

Swinburne, Algernon Charles (1837- –

),

English poet and critic, was born in Chapel Street, Bel- gravia, 5th April 1837. He was the son of Admiral Charles Henry Swinburne (of an old Northumbrian family) and of Lady Jane Henrietta, a daughter of George, third earl of Ashburnham. It may almost be said to have been by accident that Mr Swinburne owed London for his birthplace, since he was removed from it immediately, and always felt a cordial dislike for the surroundings and influences of life in the heart of a great city. His own childhood was spent in a very different environment. His grandfather, Sir John Edward Swinburne, Bart., owned

an estate in Northumberland, and his father, the Ad- miral, bought a beautiful spot between Ventnor and Niton in the Isle of Wight, called East Dene, together with a strip of undercliff known as the Landslip. The two homes were in a sense amalgamated. Sir Edward used to spend half the year in the Isle of Wight, and the Admiral's family shared his northern home for the other half ; so that the poet's earliest recollections took the form of strangely contrasted emotions, inspired on the one hand by the bleak north, and on the other by the luxuriant and tepid south. Of the two, the influences of the island are, perhaps naturally, the stronger in his poetry; and many of his most beautiful pieces were actually written at the Orchard, an exquisite spot by Niton Bay, which belonged to relatives of the poet, and at which he was a constant visitor. After some years of private tuition, Mr Swin- burne was sent to Eton, where he remained for five years, proceeding to Balliol College, Oxford, in 1857. He was three years at the University, but left without taking a degree. Clearly he must have culti- vated while there his passion- ate and altogether unacademic love for the literature of Greece; but his undergradu- ate career was unattended by university successes, beyond the Taylorian Prize for French and Italian, which he gained in 1858. He contributed to the "Undergraduate Papers," published during his first year, under the editorship of John Nichol, and he wrote a good deal of poetry from time to time, but his name was pro- bably regarded without much favour by the college authori- ties. He took a second class in classical moderations in 1858, but his name does not occur in any of the "Final" honour schools. He left Ox- ford in 1860, and in the same year published those remark- able dramas, Tlie Queen Mother and Rosamond, which, despite a certain rigidity of style, must be considered a wonderful performance for so young a poet, being fuller of dramatic energy than most of his later plays, and rich in really magnificent blank verse. The volume was scarcely noticed at the time, but it attracted the attention of one or two literary judges, and was by them regarded as a first appearance of uncommon promise.

It is a mistake to say, as most biographers do, that Mr Swinburne, after leaving Oxford, spent some time in Italy with Walter Savage Landor. The facts are quite other- wise. The Swinburne family went for a few weeks to Italy, where the poet's mother, Lady Jane, had been educated, and among other places they visited Fiesole, where Landor was then living in the house that had been arranged for him by the kindness of the Brownings. Swin- burne was a great admirer of Landor, and, knowing that he was likely to be in the same town with him, had pro- vided himself with an introduction from his friend, Richard Monckton Milnes. Landor and Swinburne met and conversed, with great interest and mutual esteem ; but the meetings were not for more than an hour at a time, nor did they exceed four or five in number. Mr

Algernon Charles Swinburne. {From a photograph oy Elliott and Fry, London.)

Swinburne never lived in Italy for any length of time. In 1865 appeared the lyrical tragedy of Atalanta in Calydon, followed in. the next year by the famous Poems and Bal- lads, and with them the poet took the public gaze, and began to enjoy at once a vogue that may almost be lik- ened to the vogue of Byron. His sudden and imperative attraction did not, it is true, extend, like Byron's, to the unliterary ; but among lovers of poetry it was sweeping, permeating, and sincere. The Poems and Ballads were vehemently attacked, but Dolores and Faustine were on every one's lips : as a poet of the time has said, " We all went about chanting to one another these new, astonishing melodies." Chastelard, which appeared between Atalanta and Poems and Ballads, enjoyed perhaps less unstinted attention ; but it is not too much to say that by the close of his thirtieth year, in spite of hostility and detraction,

Mr Swinburne had not only placed himself in the highest rank of contemporary poets, but had even established him- self as leader of a choir of singers to whom he was at once master and prophet.

Meanwhile, his private life was disturbed by troublous influences. A favourite sister died at East Dene, and was buried in the little shady churchyard of Bonehurch. Her loss overwhelmed the poet's father with grief, and he could no longer tolerate the house that was so full of

tender memories. So the family moved to Holmwood, in the Thames valley, near Reading, and the poet, being now within sound of the London literary world, grew anx- ious to mix in the company of the small body of men who shared his sympathies and tastes. Rooms were found for him in North Crescent, off Oxford Street, and he was drawn into the vortex of Lon- don life. The Pre-Raphaelite movement was in full swing, and for the next few years he was involved in a rush of fresh emotions and rapidly-changing loyalties. It is in- deed necessary to any appreciation of Mr Swinburne's genius that one should understand that his inspiration has been almost invariably derivative. His first book is deliberately Shakespearian in design and expression ; the Atalanta, of course, is equally deliberate in its pursuit of the Hellenic spirit. Then, with a wider swing of the pendulum, he recedes, in Poems and Ballads, to the ex- ample of Baudelaire and of the Pre-Raphaelites them- selves; with the Song of Italy (1867) he is drawing towards the revolt of Mazzini ; by the time Songs before Sunrise are completed (in 1871) he is altogether under the influence of Victor Hugo, while Rome has become to him " first name of the world's names." But, if Mr Swinburne's inspiration was derivative, his manner was in no sense imitative ; he brought to poetry a spirit entirely his own, and a method even more individual than his spirit. In summing up his work we shall seek to indicate wherein his^ originality and his service to poetry has lain ; mean- while, it is well to distinguish clearly between the influences which touched him and the original, personal fashion in which he assumed those influences, and made them his own.

The spirit of Mr Swinburne's muse has always been a spirit of revolution. In Poems and Ballads the revolt is against moral conventions and restraints; in. Songs before Sunrise the arena of the contest is no longer the sensual sphere, but the political and the ecclesiastical. The de- testation of kings and priests, which marked so much of the work of his' maturity, is now in full wing, and Mr Swinburne's language is sometimes tinged with extrava- gance and an

almost virulent animosity. With Bothwell (1874) he returned to drama and the story of Mary Stuart. The play has fine scenes and is burning with poetry, but its length not only precludes patient enjoyment, but tran- scends all possibilities of harmonious unity. Erechtheus (1876) was a return to the Greek inspiration of Atalanta ; and then in the second series of Poems and Ballads (1878) the French influence is seen to be at work, and Victor Hugo begins to hold alone the place possessed, at different times, by Baudelaire and Mazzini. At this time Mr Swinburne's energy was at fever height ; in 1879 he pub- lished his eloquent Study of Shakespeare, and in 1880 no fewer than three volumes, The Modem Heptalogia, a brilliant anonymous essay in parody, Songs of the Spring- tides, and Studies in Song. It was shortly after this date that Mr Swinburne's friendship for Mr Theodore Watts-Dunton (then Mr Theodore Watts) grew into one of almost more than brotherly intimacy. After 1880 Mr Swinburne's life remained without disturbing event, de- voted entirely to the pursuit of literature in peace and leisure. The conclusion of the Elizabethan trilogy, Mary Stuart, was published in 1881, and in the following year Tristram of Lyonesse, a wonderfully individual contribu- tion to the modern treatment of the Arthurian legend, in which the heroic couplet is made to assume opu- lent, romantic cadences of which it had hitherto seemed incapable. Among the publications of the next few years must be mentioned A Century of Roundels, 1883 ; A Midsummer Holiday, 1884 ; and Miscellanies, 1886. The current of his poetry, indeed, continued un- checked ; and though it would be vain to pretend that he added greatly either to the range of his subjects or to the fecundity of his versification during the twenty years 'from 1882 to 1902, it is at least true that his melody was unbroken, and his magnificent torrent of words inexhaustible. His Marino Faliero (1885) and Locrine (1887) have passages of power and intensity unsurpassed in any of his earlier work, and the rich metrical effects of Astrophel (1894) and The Tale of Balin (1896) are inferior in music and range to none but his own masterpieces.

Besides this wealth of poetry, Mr Swinburne was active as a critic, and several volumes of fine impassioned prose testify to the variety and fluctuation of his literary alle- giances. His Note on CJiarlotte Bronte

(1877) must be read by every student of its subject ; the Study of Shake- speare (1880) is full of vigorous and arresting thought, and many of his scattered essays are rich in suggestion and appreciation. His studies of Elizabethan literature are, indeed, full of "the noble tribute of praise," and no con- temporary critic has done so much to revive an interest in that wonderful period of dramatic recrudescence, the side- issues of which have been generally somewhat obscured by the pervading and dominating genius of Shakespeare. Where his enthusiasm is heart-whole, Mr Swinburne's appreciation is stimulating and infectious, but the very qualities which give his poetry its unique charm and char- acter are antipathetic to his success as a critic. He has very little capacity for cool and reasoned judgment, and his criticism is often a tangled thicket of prejudices and predilections. He is, of course, a master of the phrase ; and it never happens that he touches a subject without illuminating it with some lightning-flash of genius, some

vivid penetrating suggestion that outflames its shadowy and confused environment. But no one of his studies is satisfactory as a whole ; the faculty for sustained exercise of 'the judgment is denied him, and even his best apprecia- tions are disfigured by error in taste and proportion. On the other hand, when he is aroused to literary indignation the avalanche of his invective sweeps before it judgment, taste, and dignity. His dislikes have all the violence of his affections, and while both alike present points of great interest to the analyst, revealing as they do a rich, varied, and fearless individuality, the criticism which his hatreds evoke is seldom a safe guide.

But whatever may be said in criticism of his prose, there is at least no question of the quality of his poetry, or of its important position in the evolution of English literary form. To treat, first of its technique, it may" safely be said to have revolutionized the whole system of metrical expression. It found English poetry bound in the bondage of the iambic ; it left it revelling in the freedom of the choriambus, the dactyl, and the anapaest. Entirely new effects ; a richness of orchestration resem- bling the harmoily of a band of many instruments ; the thunder of the waves, and the lisp of leaves in the wind ; these, and a score other astonishing poetic developments were allied in his poetry to a mastery of language

and an overwhelming impulse towards beauty of form and ex- quisiteness of imagination. In Tristram of Lyonesse the heroic couplet underwent a complete metamorphosis. No longer wedded to antithesis and a sharp caesura, it grew into a rich melodious measure, capable of an infinite variety of notes and harmonies, palpitating, intense. The service which Mr Swinburne rendered to the English language as a vehicle for lyrical effect is simply incalculable. He revolutionized the entire scheme of English prosody. Nor was his singular vogue due only to this extraordinary metrical ingenuity. The effect of his artistic personality was in itself intoxicating, even delirious. He was the poet of youth insurgent against all the restraints of con- ventionality and custom. The young lover of poetry, when first he encounters Mr Swinburne's influence, is almost bound to be swept away by it ; the wild, extrava- gant licence, the apparent sincerity, the vigour and the verve, cry directly to the aspirations of youth like a clarion in the wilderness. But, while this is inevitable, it is also true that the critical lover of poetry outgrows an un- questioning allegiance to the Swinbumian mood more quickly than any other of the diverse emotions aroused by the study of the great poets. It is not that what has been called his " pan-anthropism " — his universal wor- ship of the holy spirit of man — is in itself an unsound philosophy; there have been many creeds founded on such a basis which have impregnably withstood the attacks of criticism. But the unsoundness of Mr Swin- burne's philosophy lies in the fact that it celebrates the spirit of man engaged in a defiant rebellion that leads nowhere; and that as a "criticism of life" it has neither finality nor a sufficiently high seriousness of purpose. Walt Whitman preaches very much the same gospel of the "body electric" and the glory of human nature ; but Whitman's attitude is far saner, far more satisfying than Mr Swinburne's. .Eor it is concerned with the human spirit realizing itself in ac- cordance with the unchangeable laws of nature ; while Mr Swinburne's enthusiasm is, more often than not, directed to a spiritual revolution which sets the laws of nature at defiance. It is impossible to acquit his poetry of the charge of an animalism which wars against the higher issues of the spirit — an animalism sometimes of love, sometimes of hatred, but, in both extremes, out of centre and harmony.

Yet, when everything has been said that can be said

against the unsesthetic violences of the poet's excesses, his service to contemporary poetry outweighs all disadvantages. No one has done more to free English literature from the shackles of formalism ; no one, among our contemporaries, has pursued the poetic calling with so sincere and re- splendent an allegiance to the claims of absolute and unadulterated poetry. Some of our poets have ' turned preachers ; others have been seduced by the attractions of philosophy ; but Mr Swinburne has always remained an artist absorbed in a lyrical ecstasy, a singer and not a seer. When the history of Victorian poetry comes to be written, it will be found that his personality has been among the most potent of his time ; and, as an artistic influence, it will be pronounced both inspiring and bene- ficent. The topics that he has touched are often ephe- meral ; the causes that he celebrated will, many of them, wither and desiccate ; but the magnificent freedom and lyrical resource which he introduced into the language will enlarge its borders and extend its sway so long as English poetry survives.

Swindon, a municipal borough (1900) and import- ant railway junction in the Cricklade parliamentary divi- sion of Wiltshire, England, 77 miles west of London. The Great Western Kailway works employ about 11,000 hands. Numerous churches and Nonconformist chapels have arisen. Other recent erections are a market, a central club and institute, a theatre, a Victoria Hospital, the Great Western

Medical Fund Society's building, and an isolation hospital. A recreation ground of 30 acres is connected with the Great Western Kailway Mechanics' Institute, which has been enlarged, as has also the accident hospital. The Wilts and Berks canal has been dredged and repaired, and three bridges have been built over it. Area, 4246 acres. Popu- lation (1851), 4876; (1881), 19,904; (1891), 33,001;

(1901), 44,996.

Swinemiinde, a seaport town and seaside resort of Prussia, province of Pomerania, situated at the east extremity of the island of Usedom, and on the left bank of the river Swine, which connects the Stettiner Haff with the Baltic, serves as the outer port of Stettin (q.v.), from which it is 42 miles distant by water. The entrance to the Swine is protected by two breakwaters, 3600 feet and 5250 feet long respectively; and in 1897 the river continuation of the Kaiserfahrt, known as the cut through the Mellin, was opened to navigation. Further, the waterway between the Haff and the Baltic was deepened to 24 feet in 1900- 1901, and in other ways improved. The connexion be- tween Swinemiinde and Stettin is kept open in winter by ice-breakers. This port was cleared by 4967 vessels of 1,706,488 tons in 1899, the bulk of them having previ- ously cleared from Stettin. The industries are principally connected with shipping. A monument to the Emperor William I. was unveiled in 1895. Population (1777),

1804; (1895), 9391; (1900), 10,251.

SWITZERLAND.

I. Geography and Statistics.

IN 1902 the area of Switzerland was officially estimated at 15,990 square miles. Of this 71-6 per cent., or 11,461 square miles, were classed as "productive," 3250 square miles being covered by forests and 127 square miles by vineyards. Of the "unproductive" 4529 square miles (28-4 per cent, of the total area), 710 square miles were covered by glaciers, 518 square miles by lakes, 129 square miles by the beds of rivers and streams, and 66 square miles by towns, villages, and buildings. The Grisons, Bern, and the Valais occupy together 7456 square miles, while if we add the next three in size (Vaud, Ticino, and St Gall) the amount is raised to 10,570 square miles. The three smallest (whole) cantons are Schaffhausen(113| square miles), Geneva (107 square miles), and Zug (92-3 square miles).

The following table gives the (1902) official details as regards the fifteen principal Swiss lakes : —

Name of Lake.

Area in Square Miles.

Mean Height

above

Sea-Level

in Feet

Greatest

Depth in

Feet.

1. Geneva

223-0

1230J

1014

2. Constance

207 ‘8

1309

827

3. Neuchatel

92-4

1420J

505

4. Maggiore

82-7

646*

1197

5. Lucerne

44-5

1434

702

6. Zurich

33-8

1342

469

7. Lugano

19-4

‘ 899

945

8. Thun

18-4

1837J

712

9. Bienne

16-2

14174

246

10. Zug .

14-7

1368

649

11. Brienz

11-5

1857

853

12. Morat

10-5

1420J

151

13. Walensee

8 ‘9

1388

495

14. Sempaeh

5-5

16634

285

15. Hallwyl .

3-9

1483

157

(4 -7 square miles), the rest (83 -2 square miles) belonging to France. Constance is partly in Thurgau (59 -7) and St Gall (21£), but mostly belongs to Wiirtemberg, Bavaria, Baden, and Austria. Neuchdtel is owned by Neuchatel (36£), Vaud (33-1), Fribourg (20-7), and Bern (2). Mag- giore is in Ticino for part of its area (16‘2) only, the rest (66|) belonging to Italy. Lucerne is much divided, as Lucerne has 15£ square miles, Nidwalden 12‘9, Uri 7‘6, Schwyz 7J-, and Obwalden ‘9, so that this lake is rightly named the ” Lake of the Four Forest Cantons.” Zurich is owned by Zurich (20”9), Schwyz (8 -8), and St Gall (4-l) ; but of Lugano, Ticino has 7 J square miles only, the rest (11 ‘9) being Italian. Bienne is divided between Bern (15-8) and Neuchatel (-4), Zug between Zug (10-1), Schwyz (3-7), and Lucerne (‘9), and Morat between Fri- bourg (6-8) and Vaud (3-6). The Walensee is owned jointly by St Gall (7‘1) and Glarus (1-8), and Hallwyl by Aargau (3‘3) and Lucerne (-6). The .following are the dates at which steamers first plied on the twelve principal Swiss lakes:— 1823 (Geneva), 1824 (Constance), 1826 (Maggiore), 1827 (Neuchatel, Bienne, and Morat), 1835 (Thun, Lucerne, and Zurich), 1839 (Brienz), 1852 (Zug), and 1856 (Lugano).

The following is the number of the resident inhabitants in Switzer- land according to the various censuses : — ■

1850.

1860.

1870.

1880.

1888.

1900.

2,392,740

2,510,494

2,655,001

2,831,787

2,917,754

3,315,443

Of these lakes Geneva is divided between Vaud (123£ square miles), Geneva (11| square miles), and the Valais

According to the census of 1888, the rate of density in Switzer- land's 219 inhabitants to each square mile of dry land (i.e., ex- cluding from the total area of Switzerland all lakes of over 1 square kilometre ('3 square miles) in extent. In 1888 Lucerne and the Valais both had 101 males to 100 females, while Obwalden had 100 of each, though in Geneva there were but 87 males to 100 females, in urban Basel but 83, and in Ticino but 79, these three cantons showing the lowest proportion of males to females. As regards ages per 1000 of the total Swiss population, the figures for 1888 are respectively 322 (under 15), 584

(15-59), and 94 (60 and upwards). Though, as pointed out above, there are so many more females

STATISTICS

]

SWITZERLAND

125

than males in Switzerland (in 1888 there were 1,002,144 females of marriageable age, and but 864,076 males), yet the proportion of marriages in each sex is almost the same — of 1000 persons of mar- riageable age in 1888, 609 males and 607 females were actually married. The annual average number of divorces (almost wholly

1880, 927 between 1881 and 1885, and 882 between 1886 and 1890 ; in 1895 there were 897, and in 1899, 1091. The number of ille- gitimate births between 1886 and 1890 was 4009 a year, fell to 3855 in 1890, but in 1895 was again 4009, and in 1899 it rose to 4518 ; in every year the male children so bora exceeded the female children.

in the Protestant cantons of course) was 994 between 1876 and

Table showing Principal Changes since the Earlier Article was compiled.

‘Same of Canton.

1. Grisons .

2. Bern .

3. Valais .

4. Vaud .

5. Ticino .

6. St Gall.

7. Ziirieh .

8. Fribourg

9. Lucerne

10. Aargau .

11. Uri

12. Thurgau

13. Schwyz.

14. Neuchatel

15. Soleure . Unterwalden —

16. Obwalden

17. Nidwalden .

18. Glarus . Basely—

19. Urban . >20. Rural .

21. Outer

22. Inner

23. Schaffhausen

24. Geneva .

25. Zug

Total

Date of Present Cantonal

Constitution.

1892

1893

1875

1885

1892

1890

1869

1857

1875

1885

1888

1869 1876 (1898)

1858 1887 (1895)

1867 1877 1887

1889 1892

1876 1872 1876 1847 1894

Area in English Square Miles.

2,773-3

2,657-3

2,025-3

1,247-6

1,087-9

779-3

665-2

646-2

579-3

541-9

415-3

387-8

350-6

311-8

305-5

183-2 112-1

13-8 163-8

100-5

61-3

113-5

106-9

92-3

Population (Resident).

1888 (Census). 1900 (Census).

15,978-5

94,810 536,679 101,985 247,655 126,751 228,174 337,183 119,155 135,360 193,580.

17,249 104,678

50,307 108,153

85,621

15,043 12,538 33,825

73,749 61,941

54,109 12,888 37,783 105,509 23,029

2,917,754

Density

per Square

English Mile

(1900).

104,520 589,433 114,438 281,379 138,638 250,385 431,036 127,951 146,519 206,498

19,706 113,221

55,385 126,279 100,762

15,260 13,070 32,349

112,227 68,497

55,281 13,499 41,514 132,609 25,093

3,315,817

222 56 228 127 322 649 198 254 381 47 292 158 405 329

83 116 121

8063 418

548

221

365

1247

274

208

Cantonal Capitals.

Coire Bern Sion

Lausanne Bellinzona St Gall . Zurich . Fribourg . Lucerne . Aargau . Altdorf . Frauenfeld Schwyz . Neuehatel Soleure .

Sarnen . Stans Glarus .

Basel Liestal .

Herisau . Appenzell Schaffhausen Geneva . Zug

Population

of Cantonal

Capitals

(1900).

11,513

63,994

6,059

46,407

5,047

33,087

150,703

15,766

29,203

7,824

3,134

7,735

7,398

20,781

10,053

3,950 2,794 4,896

109,169 5,390

13,491 4,569

15,286

105,517

6,471

The following table gives by periods of five years the average number of marriages, births, and deaths per each 1000 inhabitants of the total population : —

Yeara

Marriages.

Births.

Deaths.

1881-95 . 1886-90 . 1891-95 .

6-9

7-1

7-4

30-0 28-8 29-2

21-4 20-5 20-1

Between 1871 and 1890, in Switzerland, the average number of marriages per 1000 inhabitants was 7 ~~4 (the rate for Great Britain and Ireland being 7‘2), of births was 29‘4 (Great Britain and Ire~~ land, 32-6), and of deaths 22-1 (Great Britain and Ireland, 19-9).

The numbers of non-Swiss residents in the Confederation was 229,650, according to the census returns of 1888 (392,896 in 1900). By

nationality they were principally distributed as follows in 1888 : natives of Germany, 112,342 (including 6814 from Alsace- Lorraine) ; Austria, 13,737 (and also 444 Hungarians) ; Italy, 41,881 ; France, 53,627; Great Britain and Ireland, 2577; Russia, 1354 ; United States of America, 986.
_ >

Emigration. — The following numbers show that the tide of emigration from Switzerland to lands over the seas has, with some slight fluctuations, greatly decreased. In 1888 there were 8346 emigrants, in 1893, 6177 ; in 1895, 4268 ; in 1897, 2508 ; in 1898, 2288 ; in 1899, 2493 ; but in 1900 there were 3816. By far the great majority find their way to the United States of America.

Civic and Rural Population. — Of the 3185 "political communes " existing in Switzerland in 1888, only 18 had a population above 10,000, 36 between 5000 and 10,000, and 24 between 4000 and 5000 — in all 78 with populations exceeding 4000 ; and there were 428 with populations between 1000 and 2000. Of these 3185 "communes" 50 are above 1500 metres (4931 feet in altitude). The lowest "commune" in Switzerland is that of Ascona, 202 metres (663 feet) on the Lago Maggiore, and the highest, Avers, 1949 metres (6395 feet)— herein is Juf, 2133 metres (6998 feet), the highest permanently inhabited village not merely in Switzerland, but in the entire chain of the Alps.

Religion.— The figures for 1888 are : — 1,716,548 Protestants (58-8 per cent.), 1,183,828 Roman Catholics (40-6 per cent.), 8069 Jews (~~3 per cent.), and 9309 (3 per cent.) miscellaneous or un~~ known. The following cantons in 1888 had more Protestants than Roman Catholics: — Zurich, Bern, Glarus, Outer Rhodes of

Appenzell, the Grisons, Aargau, Thurgau, Vaud, and Neuchatel — in all 8J. The other 16J had a Roman Catholic majority, and among these was in 1888 that of Geneva. The Jews are most numer- ous in Zurich (1349), Bern (1195), and urban Basel (1051), no- where else exceeding 740 (Neuchatel). In 1900 there were (among the actual as opposed to the resident population) 1,918,197 Protestants, 1,383,135 Roman Catholics, and 12,551 Jews.

Languages. — By the Federal Constitutions of 1848 and 1874, French, German, and Italian are formally recognized as “national languages,” so that debates in the Federal Parliament may be carried on in any of the three indifferently, while all laws and Federal Acts appear in three versions. The old historical dialect of the Romonsch or Ladin (nearly confined to the Grisons, q.v.) enjoys no political recognition, and is largely maintained by artifi- cial means in the shape of special societies for its preservation. In 1900 German was spoken by 2,319,105, French by 733,220, Italian by 222,247, Romonsch by 38,677. The first linguistic censuses of individuals were those of 1880 and 1888, as shown in the following table : —

German.

French.

Italian.

Romonsch.

1880.

1888.

1880.

1888.

1880.

1888.

1880.

1888.

2,030,792 (71-3)

2,083,097 (71-4)

608,007 (21-4)

634,613 (21-8)

161,923 (5 3)

156,130 (5-7)

38,705 (1-4)

38,357 (1-3)

In 1880 there were 6675 (2 per cent), and in 1888 6557 (2 per cent.) persons in Switzerland whose mother-tongue was other than the four mentioned above, Vaud, Geneva, and Zurich heading the list in this respect. For fuller details see the various can- tons. Here it need only be noted that there is a German- speaking majority in all the cantons save five, thus showing that historically the Swiss Confederation is a German-speaking state with which have been united fragments of lands speaking other tongues, these, however, having no political rights till after the French Revolution. Of the non -German-speaking five cantons, four (Fribourg, Vaud, the Valais, and Geneva) had a French-speaking and one (Ticino) an Italian-speaking majority. Of the Romonsch- speaking inhabitants there were in the Grisons 37,794 out of 38,705 in 1880, and 37,036 out of 38,357 in 1888 ; in no other canton were there in either year over 97, save in St Gall (239 in 1880, and 392 in 1888) and Zurich (150 and 217 respectively). Climate. — The minimum rainfall between 1864 and 1893 was

at Sierre in the canton of the Valais (per year 565 millimetres, or 22J inches), while the maximum (certainly over 74 feet) occurs in the higher parts of the alps of Bern, Uri, Ticino, and the Grisons.

Mineral Products. — The output of salt from the five salt-mines of Switzerland increased about 20 per cent, between 1882 and 1896.

Animals. — As regards game, the extent of the “district francs ” or ” Bannbezirke ” in 1896 was 1887 square kilometres. The most extensive district is that in the Titlis range (195 square kilo- metres), taking in parts of Uri and Unterwalden, followed by that of the Faulhorn range in the canton of Bern (172 square kilo- metres), while the smallest (11 square kilometres) is near Thusis in the Grisons. Yet there is a great deal of unlawful hunting in these districts, as the game licences are very expensive.

In 1899-1900 there were 150 fish hatcheries, in which all the can- tons shared save Uri and the Inner Rhodes of Appenzell. From these hatcheries in the year quoted 33 millions of fish were placed in lakes and rivers. The old Federal law of 1875 was re- placed in 1888 by a stricter code.

In live stock the following table contains the definitive results of the censuses of live stock taken in 1886, 1896, and 1901 : —

1886.

. 1896.

1901.

1. Total number o

n

owners of liv

s V 289,274

287,430

Not given.

stock of all kind

ij

2. Cattle1

1,212,538

1,306,696

1,340,375

3. Swine .

394,917

566,974

555,261

4. Goats .

416,323

415,817

354,634

5. Sheep .

341,804

271,901

219,438

6. Horses

98,622

108,969

124,896

7. Mules.

2,742

3,125

3,077

8. Asses .

2,046

1,740

1,789

9. Beehives

207,384

254,109

242,544

Alpine Pastures. — The “alps” are the high mountain pastures used by cattle during the summer, and are held as common pro- perty by different communes (33 per cent.), or else by individuals (54 per cent.), or by one and the other or by ” corporations ” jointly (12 per cent.), or finally by the State or monasteries (1 per cent.). It has been estimated that there are in all 4778 different “alps,” capable of supporting 270,389 cows, and of an estimated capital value of 814 million francs. Bern (836), the Grisons (646), and Ticino (435) have the greatest number of “alps,” while Neuch&tel has but 245. In view, however, of returns now in course of publi- cation, these figures must be accepted with some reserve.

Forests. — The Federal Constitution of 1874 gave to the Federal Government the right of supervision, &c, over forests and the damming of torrents only in the high mountains. But in 1897 an amendment struck out this limitation, so that all torrents and forests are now cared for by the Federal Forest Department.

Industries. — The following table gives the round value (in millions of francs) of the products of the three chief Swiss indus- tries exported between 1898 and 1900

1898.

1899.

1900.

1. Embroideries.

2. Silk (raw)

3. Watches and clocks

83-6 99-7 108

108-7 109-2 112-6

119 110 123

The cheese industry (save as regards Germany, France, and Russia) has decreased of late years, while the condensed milk industry has risen but slightly, and that chiefly as regards Eng- land. The production of beer has enormously increased, but only a very small quantity is exported.

Commerce. — The following table shows the round value (in mil- lions of francs, the figures in parentheses giving the percentage of the total import, or export, trade in 1898) of the trade of Switzer- land, with its principal customers, between 1896 and 1898 : —

Imports into Switzer-

Exports from Switzer-

land.

land.

1896.

1897.

1898.

1896.

1897.

1898.

1. Germany .

305

3064

192}

314} (29})

172J

176} 83}

194 (26-8)

2. France

177}

204 (191)

166} (14 -6) 66} (6-2)

81

83} (11})

3. Italy

137}

149}

39}

39

38} (6 -3)

4. Austria-Hungary .

71}

66i

40} 24}

411

24}

42 (6‘8)

5. Russia

66} 61}

67

61 (67)

30} (4.2)

6. Great Britain .

54

61 (4 -7)

147

146

148} (20-4)

7. Belgium .

24

24}

261(2-4)

1H

13

12} (1-7)

Total Europe .

876} 15}

897}

911} (85})

561}

660}

686} (81) 6} (-8)

Total Africa

13

13} (1-2)

6}

6

Total Asia .

31}

38}

36} (3-4)

81?

30

321 (4‘4)

United States

391

51}

73 (6 -8)

70} 93}

71

78} (10-1) 92} (12-7)

Total America .

65J

77

98 (9-2)

90}

Total Australia .

4}

6

6 (-5)

2}

3

31(4)

Grand total .

993}

1031}

1066}

688

693}

723J

1 Of which 663,102 were cows.

688,052, and 739,922 in the respective years

The grand totals for 1899 were :— Imports, 1160 ; exports, 796 ; and for 1900— imports, 1111 ; exports, 836.

The next table shows the trade between Great Britain and Switzerland, the figures, as before, denoting round millions of francs : —

Year.

Imports into

Exports from

Switzerland.

Switzerland.

1894

43

117J

1895

474

130

1896

51j

147

1897-

54

146

1898

51

148J

1899

564

166

1900

62J

1754

In 1900 the principal articles imported from Great Britain, with their value in round millions of francs, were : cotton goods (264), woollen goods (84), and sheet iron (12) and machines (2) ; while in the same year the chief exports to Great Britain were : woven silk goods (48£), ribbons (21), embroideries (30J), watches and clocks (24f), and condensed milk (174). I* i8 explained below (in the sketch of modern Swiss history) how Switzerland, though by nature a free-trade country, has become for the present a pro- tectionist country, the customs duties having been raised very much of recent years. In 1850 the import duties amounted only to 3,613,763 francs, and even as lately as 1870 were but 8,111,349 francs. But in the next twenty years the rise was rapid : in 1875 to 16,622,254, in 1880 to 16,535,907, in 1885 to 20,792,905, and in 1890 to 30,816,425. The figures for the next few years are in- structive: 1891, 31,114,059; 1892, 35,589,858; 1893, 37,927,974;

1894, 40,752,543 ; 1895, 42,838,518 ; 1896, 45,817,457 ; 1897, 47,434,151; 1898, 48,314,099; 1899, 50,578,684; 1900,47,491,704;

and 1901, 46,472,000.

Sealth Stations. — Almost every little mountain village now calls itselfa ” health resort ” or “air cure.” As far hack as 1880 it was reckoned that there then existed in Switzerland 1002 inns built expressly for visitors, containing 58,137 beds, and of an estimated capital value of 320 million francs. Of these inns 283 were situated above 3400 feet, while 14 stood at a height of above 6562 feet. In 1894 the number of such inns had risen to 1693 (with 88,634 beds) and in 1899 to 1896 (with 104,876 beds), while then- capital value was respectively 519 and 5504 millions of francs.

Finances. — The following table gives (in francs) the revenue, expenditure, and public debt of the Swiss Confederation at the periods stated : —

Year.

Revenue.

Expenditure.

Public Debt.

1880

42,511,848

41,038,227

37,442,029

1885

48,392,697

46,278,686

35,713,485

1890

67,621,251

66,688,381

71,112,031

1895

81,005,586

70,402,631

83,889,439

1896

87,262,389

79,559,657

80,870,764

1897

91,556,543

87,317,364

83,891,688

1898

95,277,453

94,109,942

84,392,065

1899

100,476,336

98,052,644

1900

101,033,716

102,757,837

1901

101,924,682

105,533,089

The figures last given show a great advance upon the first budget (1848) of the infant Confederation, which showed a revenue of 4,770,000 francs and an expenditure of 4,822,000. The finances of the cantons are of more or less local interest, but the state revenues of all the cantons together rose from (round) 65 million francs in 1885 to 105| million francs in 1897, or nearly 63 per cent., and the total cantonal state expenditure from 66 millions in 1885 to 105 millions in 1897 (a rise of 59 per cent.), while the state cantonal debts rose from 247| million francs in 1885 to nearly 344 million francs in 1897.

Education. — There is now a movement in favour of making the primary schools financially dependent on the Confederation only, but this idea is strenuously opposed by those who desire to retain some shadow of cantonal sovereignty. In 1896 there were 671 (759 in 1899) "kindergarten" schools, with an attendance of 32,419 (in 1899, 38,918) children and 914 (in 1899, 955) mistresses. The primary schools in 1896 were 4396 (in 1899, 4643) in number, and were attended by 236,792 (in

1899, 235,277) boys and 233,985 (in 1899, 237,481) girls, in all 470,677 (in 1899, 473,058) ; the male teachers in that year numbering 6359 (in 1899, 6439) and the female teachers 3305 (in 1899, 3667). The expense of maintaining these schools was in 1896, 25,895,054 francs — per scholar, 55 francs —(in 1897, 30,036,338 and 63 francs), of which 17,190,764 francs (in 1899, 19,059,672 francs) were paid by the "communes" and 8,704,290 francs (in 1899, 10,978,666 francs) by the respective cantons. In 1896 the secondary schools numbered 484 (in 1899, 523), and had an attendance of 18,501 boys (in 1899, 19,396) and 14,950 (in 1899, 15,532) girls, in all 33,451 (in 1899, 34,928),

with 1108 (in 1899, 1238) male and 185 (in 1899, 163) female teachers. The expense in 1896 of maintaining the secondary schools amounted to 4,788,794 francs (in 1899, 5,261,122 francs), of which 2,267,279 francs (in 1899, 2,373,684 francs) fell on the "communes" and 2,521,515 francs (in 1899, 2,887,438 francs) on the respective cantons. In 1896 the "continuation schools" had 71,069 (in 1898, 76,859) scholars, private schools 14,393 (in 1898, 16,277), and "gymnasiums" 7611 (in 1899, 5788), while the 38 "nor- mal schools " (30 — 29 in 1899 — supported by the State, the others private enterprises) had 2453 (in 1897, 2339) pupils. There are also a considerable number of special schools, e.g., industrial, com- mercial, agricultural, technical, veterinary, &c. It was estimated that in 1896 the cantons spent 18,925,875 francs (in 1899, 23,196,482 francs), and the "communes" 21,665,274 francs (in 1899, 20,924,570 francs) for educational purposes, or 13 '9 francs (in 1899, 14"8 francs) per head of the population. In the same year the ' ' subventions " granted by the Confederation for education amounted to 1,939,927 francs (in 1897, 2,410,531 francs), this sum including as its largest item 922,598 francs (in 1899, 987,172 francs) for the Federal Polytechnic School at Zurich. Besides the four universities named, there are two new ones at Lausanne and Fribourg, as well as an " Academic " at Neuch&tel.

Army. — The Swiss army (which, save in the ease of officers, is a militia, as Article 13 of the Federal Constitution of 1874 forbids the existence of a standing army) consists of three main sections — the "Auszug" or "Elite" (men between 20 and 32), the "Landwehr" or "first reserve" (men between 32 and 44), and the "Landstunn" or "second reserve" (men above 44). These three sections numbered on 1st January 1901, 152,122 Auszug 88,126 Landwehr, and 278,556 Landstunn men, in all 502,254. Railway, steamboat, postal, and telegraph officials are exempt from military service while holding those posts. But these, as well as other men disqualified for physical reasons, are bound to pay a special tax yearly, this tax amounting to 6 francs a man, plus a variable sum based on his private means. In 1897, 35,889 (in 1901, 33,116) young men were medically examined to ascertain if they were physically fit to serve in person as,recruits ; of this number 18,740 (in 1901, 16,234), or 52'2 per cent, (in 1901, 40 per cent.), were passed, while 7116 (in 1901, 5717) were remanded for one or two years, and 10,033 (in 1901, 11,155) absolutely rejected. Owing to cantonal jealousy, the Confederation remains responsible for the arming and instruction of the soldiers, while the cantons pay all charges (recouped ultimately by the Confederation) of clothing and equipping their respective contingents. Yet the Federal military expenditure in 1897 amounted to (round) 241 million francs (in 1900 to 27j millions), this heavy burden being greatly resented by the people, while vast sums have been spent on fortifying the St Gothard Pass and the defile of St Maurice, as well as the Furka Pass leading from the one to the other.

Railways. — The first Swiss railway was the Swiss bit of the line from Strasburg to Basel, comprising but 1* mile, which was opened in 1844 ; but the first line in the interior of Switzerland was that from Zurich to Baden (141 miles), opened in 1847. At the beginning of 1901 the total length of all lines open in Switzerland

, was 2484 miles. Of recent years the light mountain railways have greatly increased in number, and one was in 1901 being built to the summit of the Jungfrau. The St Gothard Railway — one of the grandest triumphs of man over Nature — was opened in 1882, while the piercing of the Simplon and Albula tunnels is now nearly

completed. Railway politics have loomed large in Switzerland of recent years, and Winterthur (q.v.) has greatly suffered thereby, while the land has been overbuilt with railways, so that many failures have occurred. ‘ From 1852 to 1872 the cantons granted, concessions for the building of railways to private companies ; from 1872 to 1898 these concessions were granted on other conditions, and under Federal supervision ; while in 1898 by a popular vote it was decided to purchase for the Confederation the five chief lines, this decision to take effect in 1903, but in 1909 only for the St Gothard line. The problem of finding the money wherewith to meet this tremendous expenditure (estimated at a thousand million francs, or 40 million pounds sterling) is the chief thing that now engages the attention of Swiss financiers.

Roads. — Among the most remarkable of the newer roads over mountain passes are those over the Grimsel Pass (opened in 1895) and the Umbrail Pass, 8242 feet, the highest carriage road in the country (opened in 1901), one of the latest of a series of engineer- ing triumphs that began with the road over the Simplon (made in

. 1801-07). The Gemmi track of 1740-41 was simply an improvement of a much older path in the same spot.

Telegraphs and Telephones. — The public telegraph service dates from 1852, and that of the telephone from 1881. In 1900 the tele- graph lines were 42881 miles in length (wire 12,531 j miles), the number of offices 2108 (with 2981 officials), while the home telegrams numbered 1,577,974, and the foreign telegrams (sent and received) 1,694,371, besides 677,817 despatches that passed through Switzerland on the way elsewhere. In 1900 the receipts of the telegraph service were 3,031,583 francs, and the expenses

3,044,952 francs. In 1900 the figures for the telephone service were : length of lines 82,3924 miles, number of stations 41,801, ? „! Jo bsoribers 37,761. The purely local traffic amounted to 20, 878, 866 messages, and that between different towns to 4,511 753, while 232,275 telegrams were transmitted by the telephone. The receipts in 1900 of the telephone service were 6,229,857 francs, the capital expenditure and all other expenses 7,115,206 francs. r

Post Office.— The postal administration is most admirably organized in Switzerland, but its work increases very rapidly as is shown by the following table : —

In round millions.

1885.

1890.

1895.

1900.

1. No. of Letters (home) .

2. No. of Letters (foreign)

3. Postcards (home)

4. Postcards .

5. Parcels

6. Net profits .

521 12

8J

3

81

XI

62|

13

13

4

111

2*

83* 16* 16

5* 15

11

99*

21

38|

94 19*

2|

Banks. — In 1891 the Swiss people accepted the principle of a State bank with a monopoly of note issue, but as yet no scheme for organizing such a bank has succeeded in securing popular assent. In 1899 there were 35 legalized banks of issue in Switzer- land ; the average circulation of notes rose from 152 1 million franos in 1890 to 179* millions in 1895, and 216J millions in 1900. The note issue of seven banks has been called in since 1896. At the end of 1900 the 35 banks of issue had the right of issuing 2291 million francs of notes, all of which, save 435,000 francs, was actually in circulation. In 1896 th'ere were 377 (in 1897, 373) savings banks proper with 2081 million (in 1897, 214,158,532) francs deposits in that year. There were also 153 (in 1897, 157) school savings banks with 164,241 (in 1897, 153,244) francs de- posits in 1896, and 36 (in 1897, 34) factory savings banks with 210,315 (in 1897, 280,116) francs deposits in 1896. In all these 566 (in 1897, 564) institutions there were in 1896, 1,254,355 (in 1897, 1,311,946)

depositors, 3274 (in 1897, 3574) of whom were in the factory savings banks and 11,038 (in 1897, 17,867) in the school savings banks.

, Authorities. — Official publications of the Swiss Government, e.g., the annual reports of the Agricultural, Commercial, &c, Departments, the detailed censuses from 1850 to 1888, and official periodicals, such as the Statistisches Jahrbuch d. Schweiz (from 1891), the Jahrbuch d. Unterrichtswesen in der Schweiz (from 1887), the Zeitschrift f. schweiz. Statistic (from 1865), the Land- wirthschaftliches Jahrb. d. Schweiz, and Die schweiz. Alpenpdsse, 1893. Consult also Alpstatistik, Schweiz (Soleure, in course of publication since 1894). — Felix Andeeegg. Illustriertes Lehr- buch f. das gesamie schweiz. Alpwirthschaft. Bern, 1897-98. — John Ball. Hints and Notes for Travellers in the Alps. London, 1899. — F. Beeghoff-Ising. Die sozialistische Arbeiter-bewegung in d. Schweiz. Leipzig, 1895. — H. A. Berlepsch. Schweizerkunde. 2nd edition, Brunswick, 1875. — G. Beendt. Der Fohn, 2nd edition, Gbttingen, 1896. — A. Buekli – Meter. Die Geschichte d. ziircher. Seidenindustrie. Zurich, 1884. — W. H. Dawson. Social Switzerland. London, 1897. Finanz-Jahrbuch, Schweiz (from 1899). Bern. — A. Furrer. Volkswirthschafts- Lexikon d. Schweiz, 3 vols. Bern, 1885-92. — T. Geering and R. Hotz. Wirthschaftskvmde d. Schweiz (with full bibliography). Zurich, 1902. — Die mdustrielle urnd kommerzielle Schweiz beim Mntritt ins xx. Jahrhundert (monographs on chief Swiss industrial establishments), in parts from 1900. Zurich. — J. Hann. Mnfilhrung in die Meteorologie der Alpen. Vienna, 1882. — A. LE Cointe. Inventaire des institutions economiques et sociales de la Suisse a la fin du 19”»« siicle. Geneva, 1900. — A. VON Miaskowski. Die schweizerische Allmend (Leipzig, 1879) and Die Verfassung der Land-, Alpen-, und Forstwirthscha/t d. deutschen Schweiz (Basel, 1878). — G. Sohanz. Die Steuern der Schweiz (historical), 5 vols. Stuttgart, 1890. — R. Sohatzmann. Alp- wirthschaftliche Volksschriften. New edition, 2 vols. Aarau, 1887. — Max Wirth. Allgemeine Beschreibung und Statistik der Schweiz, 6 parts. Zurich, 1870-73.— F. von Wtss. Abhandlungen zitr Geschichte des schweiz. offentlichen Rechts. Zurich, 1892. — Emil Hofmann. Die Schweiz als Lndustriestaat. Ziirich,

1902.

II. History and Politics, 1874-1900. The late M. Numa Droz (who was for seventeen years — 1876 to 1892 — a member of the federal executive, arid twice president of the Swiss Confederation) expressed the opinion shortly before Ms death in December 1899, that while the dominant note of Swiss politics from 1848 to 1874 was the establishment of a federal state, that of the period extending from 1874 to 1899 was the

direct rule of the people, as distinguished from govern- ment by elected representatives. Whether this distinction be just or not, it is certain that this advance towards democracy in its true sense is due indirectly to the mono- poly of political power in the federal Government enjoyed by the Eadical party from 1848 onwards: many were willing to go with it some part of the way, but its success in maintaining its close monopoly has provoked a reaction against it on the part of those who desire to see the Con- federation remain a Confederation, and not become a strongly centralized state, contrary to its past history and genius. Hence after 1874 we find that democratic meas- ures are not advocated as we should expect by the Radicals, but by all the other political parties with a view of breaking down this Radical monopoly, for it is a strange fact that the people elect and retain Radical representa- tives, though they reject the measures laid before them for their approval by the said Radical representatives. For these reasons the struggle between Federalists and Centralists (the two permanent political parties in Switzerland), which up to 1874 resulted in favour of the Centralists, is turning more and more in favour of the Federalists, and that because of the adoption of such democratic institutions as the Referendum and the Initia- tive. Such are the general lines on which Swiss politics ran during the last quarter of the 19th century. The details may be most conveniently summarized under three headings — the working of the

political machinery, the principal political events, and then the chief economical and financial features of the period since 1874. But it must be always borne in mind that all the following remarks relate only to federal politics, those of the several cantons being much more intricate, and of course turning more on purely local differences of opinion.

1. Political Machinery. — The federal constitution of 1848 set up a permanent federal executive, legislature, and tribunal, each and all quite distinct from and inde- pendent of any cantonal government. This system was a modified revival of the state of things that had pre- vailed from 1798 to 1803, and was an imitation of the political changes that had taken place in the cantonal constitutions after 1830. Both were victories of the Centralist or Radical party, and it was therefore but natural that this party should be called upon to under- take the federal government under the new constitution, a supremacy that it has kept ever since. To the Cen- tralists the Council of States (two members from each canton, however large or small) has always been a stumbling-block, and they have mockingly nicknamed it ” the fifth wheel of the coach.” In the other house of the federal legislature, the National Council (one member per 20,000, or fraction of over 10,000 of the entire population), the Radicals have always since its creation in 1848 had a majority. Hence, in the Congress formed by both houses sitting together, the Radicals have had it all their own way. This is particularly important as regards the election of the seven members of the federal executive which is made by such a Congress. Now the federal executive (Federal Council) is in no sense a cabinet, i.e., a committee of the party in the majority in the legisla- ture for the time being. In the Swiss federal constitution the cabinet has no place at all. Each member of the federal executive is elected by a separate ballot, and holds office for the fixed term of three years, during which he cannot be turned out of office, while as yet but a single instance has occurred of the rejection of a federal councillor who offered himself for re-election. Further, none of the members of the federal executive can hold a seat in either house of the federal legislature, though they may appear and speak (but not vote) in either,

while the Federal Council as such has not necessarily any common policy, and never expresses its views on the general situation (though it does as regards particular legislative and administrative measures) in anything resembling the ” speech from the Throne ” in England. Thus it seems clear that the federal executive was intended by the federal constitution of 1848 (and in this respect that of 1874 made no change) to be a standing committee of the legislature as a whole, but not of a single party in the legislature, or a “cabinet,” even though it had the majority. Yet this rule of a single political party is just what has taken place. Between 1848 and the end of 1899, 36 federal councillors were elected (23 from German-speaking, 11 from French- speaking, and 2 from Italian-speaking Switzerland, the canton of Vaud heading the list with 7). Now of these 36 two only were not Radicals, viz., M. Ceresole (1870-75) of Vaud, who was a Protestant Liberal-Conservative, and Herr Zemp (elected in 1891), a Romanist Conservative ; yet the Conservative minority is a large one, while the Romanists form about two-fifths of the popidation of Switzerland. But despite this predominance of a single party in the Federal Council, no true cabinet system has come into existence in Switzerland, as members of the council’do not resign even when their personal policy is condemned by a popular vote, so that the resignation of Herr Welti (a member of the Federal Council from 1866 to 1891), in consequence of the rejection by the people of his railway policy, caused the greatest amazement and consternation in Switzerland.

The chief political parties in the federal legislature are the Right, or Conservatives (whether Romanists or Protestants), the Centre (now often called ” Liberals,” but rather answering to the Whigs of English political language), the Left (or Radicals), and the Extreme Left (or the Socialists). In the Council of States there is always a federalist majority, since in this house the smaller cantons are on an equality with the greater ones, each indifferently having two members. But in the National Council (147 elected members) there has always been a Radical majority over all other parties, the num- bers of the various parties after the triennial elections of 1899 being roughly as follows : — Radicals, 86 ; Socialists, 9 ; Centre, 19 ; and the Right, 33. The Socialists long worked under the wing of the Radicals, but now in every

canton (save Geneva) the two parties have quarrelled, the Socialist vote having largely increased. In the country the anti-Radical opposition is made up of the Conservatives, who are strongest in the Romanist, and especially the Forest cantons, and of the ” Federalists ” of French-speaking Switzerland. There is no doubt that the people are really anti-Radical, though occasionally led away by the experiments made recently (see 2 below) in the domain of State socialism : they elect, indeed, a Radical majority, but very frequently reject the bills laid before them by their elected representatives. The follow- ing table shows what a curious state of things is revealed by all the popular votes that have taken place between 1874 and 1899 in federal matters : —

Accepted.

Rejected.

Total.

1. Amendments to the Federal Con-

stitution (Obligatory Referen- dum)

2. Federal Laws (Facultative Refer-

endum at the demand of 30,000

3. Initiative (at the demand of

50,000 citizens)

9

8

1

5

17 2

14

25 3

18

24

42

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2. Politics. — The cantons had led the way before 1848, and they continued to do so after that date, gradually introducing reforms all of which tended to give the direct rule to the people. The Confederation was bound to follow this example. Hence, in 1872 a new federal constitution was drafted, but was rejected on a popular vote by a small majority, as it was thought to go too far in a centralizing direction, and so encountered the com- bined opposition of th e Conservatives and of the Federalists of French-speaking Switzerland. The last-named party was won over by means of concessions as to military matters and the proposed unification of cantonal laws, civil and criminal, and especially by strong provisions as to religious freedom, since the ” Kulturkampf ” was then raging in French-speaking Switzerland. Hence a revised draft was accepted in 1874 by a considerable popular majority, and this is the existing federal constitution. But it bears marks of its origin as a compromise, and no one party has ever been very eager to support it as a whole. At first all went smoothly, and various very useful laws carrying out in detail the new provisions of the constitution were drafted and accepted. But divisions of opinion arose when it was proposed to reform the military system at a very great expenditure, and also as to the question of the limitation of the right to issue bank-notes, while (as will be seen under 3 below) just at this time grave financial difficulties arose with regard to the Swiss railways, and in consequence

of Prince Bis- marck's anti-free-trade policy, which threatened the prosperity of Switzerland as an exporting country. Further, the disturbed political state of the canton of Ticino (or Tessin) became more or less acute from 1873 onwards. There the Radicals and the Conservatives are nearly equally balanced. In 1872 the Conservatives obtained the majority of this canton, and tried to assure it by some certainly questionable means. The Radicals repeatedly appealed to the federal Government to obtain its armed intervention, but in vain. In 1876 the Conser- vatives at a rifle match at Stabio fired on the Radicals, but' in 1880 the accused persons were acquitted. The long-desired detachment of Ticino from the jurisdiction of the foreign dioceses of Como and Milan was effected in 1888 by the erection of a see at Lugano, but this event caused the Radicals to fear an increase of clerical influ- ence. Growing impatient, they finally took matters in their own hands, and in September 1890 brought about a bloody revolution. The partial conduct of the Radical federal commissioner was much blamed, but after a State trial at Zurich in 1891 the revolutionists were acquitted, although they loudly boasted of their share in this use of force in political matters.

From 1885 onwards Switzerland had some troubles with foreign powers owing to her defence of the right of asylum for fugitive German Socialists, despite the threats of Prince Bismarck, who maintained a secret police in Switzerland, one member of which, Wohlgemuth, was expelled in 1889, to the Prince's huge but useless indig- nation. From about 1890, as the above troubles within and without gradually subsided, the agitation in the country against the centralizing policy of the Radicals became more and more strongly marked. By the united exertions of all the opposition parties, and against the steady resistance of the Radicals, an amendment was introduced in 1891 into the federal constitution, by which 50,000 Swiss citizens can by the " Initiative " compel the federal legislature and executive to take into considera- tion some point in the federal constitution which, in the opinion of the petitioners, requires reform, and to prepare a Bill dealing with it which must be submitted to a pop- ular vote. Great hopes and fears were entertained at the time as to the working of this new institution, but both

have been falsified, for the Initiative has as yet only succeeded in inserting (in 1893) in the federal constitu- tion a provision by which the Jewish method of killing animals is forbidden. On the other hand, it has failed (in 1894) to secure the adoption of a Socialist scheme by which the State was bound to provide work for every able-bodied man in the country, and (also in 1894) to carry a proposal to give to the cantons a bonus of two francs per head of the population out of the rapidly grow- ing returns of the customs duties.

The great rise in the productiveness of these duties (see 3 below) has tempted the Swiss people of late years to embark on a course of State socialism, which may be also described as a series of measures tending to give more and more power to the central federal Government at the expense of the cantons. So in 1890 the principle of compulsory universal insurance against sickness and accidents was accepted by a popular vote, in 1891 like- wise that of a State or Federal bank, and in 1898 that of the unification of the cantonal laws, civil and criminal, into a set of federal codes. In each case the federal Government and legislature were charged with the pre- paration of laws carrying out in detail these general principles. But in 1897- their proposals as to a federal bank were rejected by the people, while at the beginning of 1900 the suspicion felt as to the insurance proposals elaborated by the federal authorities was so keen that a popular demand for a popular vote was signed by 115,000 Swiss citizens, the legal minimum being only 30,000: they were rejected (20th May 1900) on a popular vote by a two to one majority. The preparation of the federal codes has progressed quietly, drafts being framed by experts and then submitted for criticism to special com- missions and public opinion. But this method, though the true one to secure the evolving of order out of chaos, takes time. By a popular vote in 1887 the federal authorities were given a monopoly of alcohol, but a propo- sal to deal similarly with tobacco has been very ill received (though such a monopoly would undoubtedly produce a large amount), and would pretty certainly be refused by the people if a popular vote were ever taken upon it. In 1895 the people declined to sanction a State monopoly of matches, even though the unhealthy nature of the work was strongly urged, and have also resolutely refused on several occasions to accept any projects for the

central- izing of the various branches of military administration, &c. Among other reforms which have recently been much discussed in Switzerland are the introduction of the obligatory Referendum (which hitherto has applied only to amendments to the federal constitution) and the Initia- tive (now limited to piecemeal revision of the federal con- stitution) to all federal laws, &c, and the making large federal money grants to the primary schools (managed by the several cantons). The former scheme is an attempt to restrain important centralizing measures from being presented as laws (and as such exempt from the compulsory referendum), and not as amendments to the federal constitution, while the proposed school grant is part of the Radical policy of buying support for unpop- ular measures by lavish federal subventions, which it is hoped will outweigh the dislike of the cantons to divest themselves of any remaining fragments of their sovereignty.

Besides the insurance project mentioned above, two great political questions have recently engaged the attention of the Swiss people.

(a) State Purchase of the Railways. — In 1891 the purchase of the Central railway was rejected by a popular vote, but in 1898, by the aid of various baits thrown out, the people were induced to accept the principle of the purchase by the Confederation of the five great Swiss railway lines — four in 1903, viz. the Central, the North-Eastern, the Jura-Simplon, and the United Swiss lines,

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and one (the Gothard line) in 1809, this delay being due to international conventions that still have some years to run. It was estimated that the debt thus incurred might be paid off in 1960, but the price of purchase — to be fixed partly by agreement, partly by the federal tribunal— seems likely far to exceed the original estimates, and to mount up to at

least a milliard of francs, or £40,000,000. Further, very important economical consequences, e. g. , as to strikes, may be expected to result from the transformation of all railway officials of whatever grade into State servants, who may naturally be expected to vote (as in other cases) for their employers, and so greatly increase the strength of the Centralist political party.

(6) The '■'■Double Initiative.'"1 — This phrase denotes two purely political reforms that have been coupled together, though in reality they are by no means inseparable. One is the introduction of proportional representation into the elections for the National Council of the federal Parliament, the object being thus to secure for several large minorities a number of M.P.'smore in accordance with the size of those minorities in the country than is now possible under the regime of pure majorities : naturally these minorities would then receive a proper share of political power in the senate house, instead of merely exerting great political influence in the country, while if they were thus strengthened in the legislature they would soon be able to claim the right of naming several members of the federal executive, thus making both legislature and executive a mirror of the actual political situation of the country, instead of the preserve of one political party. The other reform is the election of the members of the federal executive by popular vote, the whole body of voters voting, not by cantons, but as a single electoral constituency. This would put an end to the " lobbying " that goes on previously to the election of a member of the executive by the two houses of the federal Parliament sitting jointly in Congress ; but, on the other hand, it might stereotype the present system of electing members of the executive by the majority system, and so reduce large minorities to political impotence. The " double initiative " scheme was launched in the beginning of 1899, and by the beginning of the following July secured more than the requisite number of signa- tures (50,000), the first-named item having been supported by 65,000 citizens, and the second item by 56,000. Hence the federal Parliament was bound to take these two reforms into formal con- sideration, but in June 1900 it rejected both.

This notice of the recent legislation or political agitations in Switzerland will show that the struggle between the Centralists and the Federalists still goes on, and that the latter are (as before observed) inclined to ” dish ” their opponents by themselves supporting thorough democratic reforms with the intention of arousing the innate conser- vatism of the Swiss people in order to oppose the trans- formation of the Confederation into an ordinary centralized state. It should also never be forgotten that two steady and permanent characteristics of Swiss voters are a deep- seated dislike of a ” bureaucracy,” or army of State officials, and a notion that, if they can only manage their own affairs directly and not through representatives, this hated class will disappear. At all events, it is certain that the more business is heaped upon the federal or central authorises the larger must be the number of the “per- manent officials ” and the amount of ” red tape.”

3. Economics and Finance. — Soon after the adoption of the federal constitution of 1874 the economical and financial state of the Confederation became very unsatis- factory. The great financial crisis in Vienna in 1873 was a severe blow to Swiss commerce, which had taken a very great start after the Franco-German war of 1870-71. In the later ‘seventies, too, the financial position of some of the great Swiss railway lines was very unfavourable: the bankruptcy of the National line ruined for the time (till a federal loan at a very low rate of interest was forced upon them) the four Swiss towns which were its guarantors ; the North-Eastern line had to beg for a ” moratorium ” (a legal delay of the period at which it had to pay its debts) from the federal Government ; the Bern-Lucerne line was actually put up to auction, and was bought by the canton of Bern. Further, the expenses of construct- ing the Gothard railway vastly exceeded all estimates, and in 1876 over 100 million francs more were re- quired. Hence the subventions already granted had to be

increased. Germany (which gave originally 20 million francs) and Italy (original contribution 45 million francs) each promised 10 million francs more, and the two Swiss railway lines interested (Central and North-Eastern) added 1^- millions to the 20 millions they had already agreed to give jointly with the cantons interested in the completion of

this great undertaking. But these latter refused to add anything to their previous contributions, so that finally the federal Government proposed that it should itself pay the 6£ million francs most urgently required. This proposal aroused great anger in east and west Switzer- land, but the matter was ultimately settled by the Confederation paying 4A million francs and the interested cantons 2 millions, the latter gift being made dependent on a grant of 4£ million francs by the federal Govern- ment for new tunnels through the Alps in east and west Switzerland, and of 2 millions more for the Monte Ceneri tunnel between Bellinzona and Lugano. This solution of a most thorny question was approved by a popular vote in 1879, and the Gothard line was success- fully completed in 1882. Gradually, too, the other Swiss railway lines attained a state of financial equi- librium, owing to the more careful management of new directors and managers.

Switzerland, by reason of natural conditions, is properly a free trade country, for it exports far more than it imports in order to supply the demand for objects that it cannot itself produce. But Prince Bismarck's protec- tionist policy in 1879 was imitated by France, Austria, and Italy, so that Switzerland was gradually shut in by a high wall of tariffs. Hence in 1891 the Swiss people approved, in sheer self-defence, a great increase of the customs duties. In 1880 these produced 17^ million francs, in 1885, 2\ millions, in 1890, Sl\ millions, and in 1891, 31^- millions ; then came a rapid rise to 36 millions in 1892, 43^ millions in 1895, nearly 49 millions in 1897, and 51 millions in 1899. (A truce was made with France in 1895, while the revision of other commercial treaties is to take place in 1903.) This huge increase in revenue naturally led to increased expenditure, which took the form of lavish subventions to all sorts of cantonal objects, magnificent federal buildings, most useful improvements in the post and telegraph services, and extensive and lamentable construction of military fortifications in Uri and the Valais against some unknown foe. In 1894 it was pro- posed to distribute part of this new wealth in giving a bonus to the cantons at the rate of 2 francs per head of the population, but this extravagant proposal (nicknamed the " Beutezug ") was rejected, owing to the cool common sense of the Swiss people, by a majority of over two to one. These prosperous circumstances, however, contributed mainly to the

adoption or suggestion of various measures of State socialism, e.g., compulsory insurance, federal subvention to primary schools, purchase of the five great Swiss railway lines, giving a right to every able-bodied man to have work at the expense of the State, &c. All these schemes would cost money. It is estimated that the insurance scheme, if adopted, would cost 10 million francs a year, and the subvention to the primary schools 2 or 3 million francs a year, while the purchase of the railways will absorb at least 1000 million francs of capital, and no one dares to fix a limit to the wasteful military expenditure insisted on by the military caste. Add the yearly increasing subventions to cantonal objects, and it will be seen that the expenditure, actual and prospective, advances by huge leaps and bounds. As yet, it is true, there have been few deficits in the federal budget, but this is mainly due to the extraordinary elasticity of the customs revenue. But it is now generally allowed that, unless the duties themselves are increased, this elasticity has reached its highest point, while new sources of revenue

are far to seek. Practically speaking, it would be im- possible to increase the customs duties without doing harm to Swiss commerce, while the proposed most pro- ductive tobacco monopoly would certainly be rejected by a popular vote. Then, too, there is the enormous sum which must soon be obtained for the purchase of the rail- ways, while the credit of the federal Government does not now stand as high as it did a few years ago. In section I. of this article a table is given in which are set down the revenue, expenditure, and public debt of the Swiss Confederation since its foundation in 1848. Here it may suffice to say that, while between 1885 and 1900 the revenue rose from 48£ million francs to 1021 millions, and the expenditure from 46^ millions to 103 millions, the public debt leaped from 35§ millions in 1885 to 84^ millions in 1898, and has been since much increased. The balance of trade is more and more against Switzerland every year (181 million francs in 1893, and 341 million francs in 1898).

The clearest and most complete account of the history of Switzer- land during the 19th century is that written by the late M. Numa Droz in vol. i. (1899) of Die Schweiz im ldten Jahrhundert (also in French, published at Lausanne and Bern). Professor Hilty's Politisches Jahrbuch d. Schweizerischen Eidgenossenschaft (pub- lished annually at Bern since 1886), and many official publications of the federal Government, should also be consulted by any one desiring to obtain more detailed information.

Owing to the very local character of Swiss history, especially in the early days of the Confederation, many most valuable articles and essays appear in periodicals which often quite escape the notice of those to whom they would prove of great service. Hence every one interested in Swiss history hajled with joy the publication (at Basel in 1892) of Herr J. L. Brandstetter's Repertorium uber die in Zeit- und Sammelschriften der Jahre 1812-1890 enthaltenen Aufsatze und Mittheilungen schweizergeschichtlichen Inhaltes. This is an admirably arranged list of all such articles as have been published in any periodical between 1812 and 1890 relating to Swiss history, and is thus indispensable to all students of that department of history. Among important articles dealing with constitutional Swiss history two in particular by Professor CEchsli deserve special attention, as well as the same writer's epoch- making work on the early history of the Confederation up to 1316. The posthumously published book by Professor G. von Wyss, entitled Geschichted. Historiographie in der Schweiz (Zurich, 1895), gives a most excellent account of all the original sources (chronicles, &c.) for Swiss history from the earliest times to the present day, and is a most useful supplement to Wattenbach's1 Deutschlands Geschichtsquellen, which takes in the whole of Ger- many. Amid the mass of recent essays and articles relating to the very early history of the Swiss Confederation three cannot be passed over here. One is by Professor H. Bresslau, and appeared under the title of "Das alteste Bundniss der Schweizer Urkantone" in vol. xx. (1895) of the Jahrbuch f. Schweizerische Geschichte. It shows most conclusively, by a careful examination of surviving documents, that the "antiqua confoederatio " mentioned in the League of 1291 cannot possibly refer to the events of 1245 sqq. , for

the simple reason that at that time Uri, Schwyz, and Unter- walden took different sides in the great strife between Pope and Emperor, Schwyz and Obwalden supporting the Emperor, while Uri and Nidwalden stood by the Pope. It is further shown that the "antiqua confoederatio " was not formed against the Habsburgs, but was simply an ordinary agreement to preserve peace and quiet in that particular district, having probably been made during the interregnum in the empire (1254-1273), and that it is possible in the existing text of the League of 1291 to distinguish the main features of the old League as well as the additions made in 1291. The second noteworthy publication is an essay (Zug, 1895) by Herr Burkli, which proves decisively that the battle of Morgarten took place not in the gorge of Schornen, but on the south-east shore of the lake of jEgeri. Dr Th. von Liebenau has also shown (in an article reprinted from the Katholische Schweizerblatter in the Bollettino Storico delta Svizzera Italiana for 1899) that in 1283 the Emperor Rudolf of Habsbuvg gave the right of receiving the tolls for escort over the St Gothard Pass to his sons, the dukes of Austria. The levying of these tolls gave rise to various disputes between the men of Uri and the bailiffs of the dukes of Austria, and by 1319 (if not already in 1309) the claim to levy them was silently given up. But these facts show (what could not hitherto be proved) that at the time when legend places the rising of Uri, Tell exploit, &c, the dukes of Austria really had disputes with Uri. The note on p. 795 requires correction. At present (1900)

in the twenty-five whole or half cantons the two members of the "Standerath" are elected by the people in sixteen, and by the cantonal legislature in nine. The terms of office vary from one year (in twelve) to two (valais), three (in eleven), and even four (Zug) years, the matter being entirely in the hands of the cantons themselves.

III. Literature.

After the death of Gottfried Keller in 1890, the chief literary figure in German-speaking Switzerland was for some years Conrad Ferdinand Meyer (1825-1898), a member of an old Zurich family : in his early days he was a poet, Huttens Letzte Tage being his masterpiece, while

later he wrote many historical novels relating to St Thomas a Becket, George Jenatsch, Pescara; and Jakob Frey (1824-1874) of Aargau wrote tales of peasant life like those of Bitzius. Of living Swiss writers the chief are J. V. Widmann, a poet and litterateur (in charge of the literary department of the Bund, one of the principal Swiss newspapers), Adolf Frey the poet, Isabella Kaiser, poetess and writer of stories, and Arnold Ott the dramatist. Among historical writers G. von Wyss (died 1893), Karl Dandliker, Wilhelm CEchsli, G. Meyer von Knonau, E. Bloseh (died 1900), Paul Schweizer, Johannes Dierauer, P. C. von Planta, Hermann Wart- mann, Rudolf Hoppeler deserve to be "named, as well as Eudolf Maag, who died in 1899 at an early age. J. R. Rahn and H. Angst represent the history of art, while Andreas Heusler, L. R. von Salis, and F. von Wyss have devoted themselves to more severe studies in the history of institutions. Among the poets of the Suisse Romande, Juste Olivier (1807-1876), specially in his Chansons Lointaines (1855), is generally given the first place. But to the outer world the name of the phi- losopher Amiel and his Journal Intime are far better known. Eugene Rambert (1830-1886) in his Alpes Suisses (1868), and Emile Javelle (1847-1883) in his Souvenirs d'un Alpiniste (1886), did much by their writings to make known the beauties of the Alps, while Felix Bovet described admirably his journey to the Holy Land, and Marc Monnier represented modern cosmopolitanism. Among novelists Urbain Olivier, Auguste Bachelin, " T. Combe" (the "nomdeguerre" of Mile Adele Huguenin), Samuel Cornut, and Edouard Rod are the best known ; the latter writer is, indeed, since the death of V. Cherbuliez (1899), the most prominent literary figure in the Suisse Romande. Louis Duchosal, Philippe Godet, and Virgile Rossel represent poetry and literary history, while among historical writers we may name B. van Muyden, P. Vaucher (died in 1898), Edouard Rott, B. de Mandrot, and above all J. Gremaud (died 1897), one of the most learned men that Switzerland has ever produced. The chief literary organ of the Suisse Romande is the Bibliotheque Uhiver- selle, founded in 1816.

Italian Switzerland is best known by its artists, while its literature naturally is rather Italian than Swiss. Stefano Franscini (1796-1857) in history and statistics, Luigi Lavizzari as a writer of travel sketches,

Angelo Baroffio and Emilio Motta, both historians, are perhaps the best known names. There is a swarm of poets, such as Pietro Peri, J. B. Buzzi, Giovanni Airoldi, and Carlo Cioccari, while two younger men are F. Chiesa and M. A. Nessi. The art of novel writing does not flourish in Ticino. The Bollettino Storico della Svizzera Italiana (from 1879 onwards), though mainly historical, devotes a good deal of space to literary and artistic matters. In the canton of the Grisons alone does Romonsch, the laggard sister of the other Romance tongues, still linger, though it can scarcely be said to flourish, despite attempts by the Societad Rhseto-Romanscha in the Engadine and the Romania in the Vorder Rhine valley to infuse into it an artificial vitality. It is called "Romansch" in the " Bilndner Oberland," or Vorder valley of the Rhine, and

"Ladin" in the Engadine, these being the two chief dialects. The first poem (by Johann v. Travers) known to have been written in this quaint language dates from 1527, though not published till 1865: the first book printed in it was issued in 1552, and the next a trans- lation of the Bible in 1560. Most of the works in Eomansch and Ladin are translations of religious or scholastic works. But Theodor v. Castelberg, Cadisch, Huonder, and Muoth have written in Eomansch both poems and novels, while in Ladin we have the poems of Flugi, Valentin, Juvalta, and especially Caderas. Zac- charias Pallioppi, besides poems, compiled an excellent Ladin dictionary, published (after his death) in 1895.

The above summary has been mainly based on the sections of chap. iv. (dealing with literature) in vol. ii. (1899-1900) of Die Schweiz im 19Jera Jahrhundert, each chapter being written by a distinguished specialist. Consult also J. Bachtold. Ge- schichte d. deutschen Litteratur in d. Schweiz. Frauenfeld, 1892. — P. Godet. Historie litteraire de la Suisse Bomande. Neuchatel and Paris, 2nd edition, 1895. — F. Rausch. Geschichte d. Litteratur d. Bhdto-Bomanischen Volkes. Frankfort-on-

the-Main, 1870. — Virgile Rossel. Histoire litteraire de la Suisse Bomande, 2 vols. Geneva and Paris, 1889-91. (w. A. B. C.)

Swords. — In the article Swords in the earlier volumes of this “work (ninth edition) the subject has been generally treated. It is only proposed in the following article to deal with the sword as at present used in most

o

Length of

Blade from

Hilt to Point.

Weight

without

Scabbard.

Material

of Scabbard.

Fig.

1 2 3

4

r>

6

French cavalry sword (men), pattern 1898

German „ 1889

British „ „ (officers) „ „ „ (men), „ 1S99 „ infantry „ (officers) . „ general officers1 sword

Inches.

85

82J

85 881 82* 82$

lb oz.

2 6 2 81 2 0

2 10J

2 8 1 12

Steel

with

wood

lining.

For figures 8. 5. and 6 the writer is indebted to Messrs Wilkinson and Co.

European countries, to touch briefly on the causes which lead to the adoption of particular forms, and to give a short description of the method of manufacture now in common use. The present military swords are descended from the straight ” back-sword ” and the Eastern scimitar or tulwar. The difference between the curved “sabre” and straight “sword” has been preserved abroad, not only in fact but in name (e.g., in German Degen stands for the straight, and Sabel for the curved, sword), though in English the single word ” sword ” covers both varieties. The shape of the sword has varied considerably at

differ- ent times ; this is due to the fact that it is practically impossible to decide by trial whether a straight or a curved sword is the better under all circumstances. The trooper can use his sword in three different ways — to cut, to guard, and to point ; and his success depends upon the training of his horse, his skill in horsemanship, and, above all, upon the dexterity and methods of his adversary. Thus the effect the cavalryman can produce in combat depends upon much besides his arm or arms, and those other conditions cannot be reproduced accurately enough to make trustworthy tests. The result is that changes have often been made in cavalry armament under the erroneous impression that the arm used has been the main cause of success. The Ottoman cavalry up to the end of the 18th century was regarded as one of the best in Europe, and so much was it t-, dreaded that the Eussians in their • wars ~-^ with Turkey at one time carried ” chevaux- de-frise” to protect their infantry against these redoubtable horsemen. The curved European cavalry sabre so long in use may undoubtedly be traced to this cause, the superiority of the Turks being put down to their curved scimitars, though there can be no doubt that horsemanship and dash were really the dominating factors. The Turkish cavalry of the 19th century, trained on Western models, is an inferior force.

The shape of the sword to be chosen depends obviously on the purpose for which it is mainly intended. If for cutting a curved blade, and for thrusting a straight and pointed one, will be adopted. The question naturally arises as to which is the better plan to adopt, and it is improbable that a definite answer can ever be given to it. The French, for instance, in 1822 adopted a curved blade for a short time for all their cavalry, and in 1882 again for. a short time a straight blade, and in 1898 again a straight blade. In this much-debated matter the facts appear to be as follows : — A deter- mined thrust, especially when delivered by a horse- man at full speed, is difficult to parry : if it gets home, it will probably kill the recipient outright or disable him for the rest of the campaign. That this is the case is borne out by the very large proportion of killed as compared with wounded in the British cavalry when engaged with that of the French in the Peninsular war, the French making much use of the point, and their heavy cavalry being

armed with a long straight sword. On the other hand, to deliver a bold thrust, while disre- garding the uplifted sword of the adversary,' and leaving one's own body and head open to an impending blow, demands complete confidence that the thrust will get home before the blow can descend, or that the adversary's cut will probably be weakened by a momentary uncertainty as to whether it would not be better to convert the intended cut into a parry. Such confidence, it is argued with much truth, can only be the fruit of long training, especially as it is the natural ten- dency of all men to cut when excited ; therefore, as the trooper in modern armies will often be a reservist who has not been able to keep up his swordsman- ship, or a young soldier liable to lose his head and forget the lessons of peace in the excitement

of the mSlee, it is considered by many most unwise to adopt a sword with which a powerful cut cannot be delivered as well as an effective thrust. The swords recently adopted by most nations have repre- sented a compromise. They have blades which are nearly straight, but of sufficient weight towards their points to enable an efficient cut to be delivered with them. France alone in 1898 decided on a long straight sword designed wholly for thrusting (see Kg. 1).

As regards the swords worn by officers and men of corps other than cavalry, no remarks are necessary. As long as they are worn they should be efficient ; but with the officer the sword is largely a badge of rank, and, in the opinion of many, should only be used for ceremonial purposes ; while with certain corps, notably the Horse Artillery, it is difficult to see on what grounds a sword is carried by the men at all.

A good sword should be elastic, so as to stand bending or a heavy blow without breaking or permanent deformation, and yet stiff enough to deliver a powerful thrust without yielding too readily from the straight ; it must also be as light as is possible consistently with strength, and well balanced. All four desiderata are met in the main by the use of a suitable steel, properly treated and disposed, but balance is also

dependent on the weight and form of the hilt. As regards the effect of disposition, grooving or “fullering” the flats of the blade reduces weight without impair- ing strength, and is now very largely adopted.

The operations of manufacture, as carried out at the Koyal Smalls Arms Factory at Enfield, are briefly as follows : — The steel “blank” (about 17”xl£“xi” in the case of the cavalry sword, pattern 1899) is heated and drawn out to about double its length under a mechanical hammer. It is then re-heated and rolled out between rolls suitably shaped, and the “fullers” formed. The “tang,” to which the hilt and “grips” are ultimately attached, is then formed by stamping under a machine hammer, and the blade cut to length and roughly pointed. The blade, which, though approximately in its finished form, is still straight, is now heated for hardening, and, when hot, set by pressure to the required curve, and immediately all except the tang plunged into, and well stirred in, a bath of oil kept cool by a water-jacket. On removal from the bath the blade is “dead hard,” and so brittle that it can be broken by a light blow, and consequently has to be ” let down ” by tempering. This is accomplished by heating it in a bath of molten lead until the steel assumes a particular colour ; if now removed from the bath and allowed to cool slowly it is known by experience that the blade will have the correct temper and possess the requisite combination of stiffness and elas- ticity. While still hot from tempering the blade is ” set ” by hand, the processes of hardening and tempering altering the curve and frequently the straightness of the blade. It is now ground to size, and the tang, which though not hardened purposely (see above), is harder than is desirable for machining, is softened by annealing — that is, by heating in the lead bath and then slow cooling — and machined to the required form. The blade is then ” finish ground,” finally set, polished, and completed by the attachment of the hilt and grips of compressed leather roughened by “chequers” to afford a firm hold. During, and at the com- pletion of, manufacture the blade is tested as follows : — When tempered and set before polishing, it is fixed in a machine and caused to strike an oak block with a blow of 120 lb with both its edge and back, and similar blows, but with a force of 60 lb, with both flats. These tests detect flaws, and over or under tempering, by the breakage or distortion of the blade, the blows by the flats being

particularly searching tests. If the blade passes the above tests, it is then placed vertically in a machine and shortened one inch by bending. It must recover perfect straightness, and at the same time raise a weight of 35 lb bearing on its tang. This tests the stiffness of the blade. Passing this test, it is next twice shortened 5 inches by bending towards each flat and must recover perfect straightness. This tests the elasticity of the blade. After polishing it is again tested for stiffness as above, and must recover perfect straightness, but only under 321b, and for elasticity by a further shortening by 5 inches, but towards one flat only. The complete sword is tested for firmness of hilting by two blows on an oak block, one by the edge and the other by the back, delivered by hand. The weight, balance, &c. , are also tested. To arrive at the tests described above, a number of swords are made to meet the conditions required on service, and then handed over to the troops for practical tests. If the swords prove satisfactory, the mechanical tests to which further supplies must conform are based on those which the experimental swords have passed.

The introduction of the system of manufacture described above has greatly simplified, cheapened, and raised the average excellence of manufacture, while the severe and certain tests by mechanical means have increased the standard of efficiency of the swords in the hands of the troops. It is certainly true that excellent blades were occasionally turned out by hand, but they were exceedingly costly, and the average merit of sword blades when turned out in numbers by hand was poor. It must not, however, be supposed

that the regular methods described have eliminated the necessity for personal skill. The steel can still be spoilt by over or under- heating, whether for rolling or hardening ; tempering and setting require much experience and skill, and blades can be easily injured both in form and temper by unskilful grinding. Sword-making, therefore, though not the somewhat uncertain art it once was, still requires skilled craftsmen for its successful accomplishment.

(h. w. b.)

Sybel, Heinrich von (1817-1895), German his- torian, sprang from a Protestant family which had long been established at Soest, in Westphalia. He was born on 2nd December 1817 at Diisseldorf, where his father held important posts in the public service both under the French and the Prussians ; in 1831 he had been raised to the hereditary nobility. His home was one of the centres for the vigorous literary and artistic life for which at that time Diisseldorf was renowned. Sybel was educated at the gymnasium of his native town, and then at the University of Berlin, where he came under the influence of Savigny and Ranke, whose most distinguished pupil he was to become. After taking his degree he settled down as privat-docent in history at the University of Bonn. He had already made himself known by critical studies on the history of the Middle Ages, of which the most important was his History of the First Crusade (1841), a work which, besides its merit as a valuable piece of historical investigation, according to the critical methods which he had learnt from Ranke, was also of some significance as a protest against the vaguely enthusiastic attitude towards the Middle Ages encouraged by the Romantic school. Lady Duff Gordon published in 1861 an English translation of part of this book, to which are added lectures on the Crusades delivered in Munich in 1858, under the title History and Literature of the Crusades. This was followed by a study on the Growth of German Kingship (1844), after which he was appointed supernumerary professor. In the same year he came forward prominently as an opponent of the Ultra- montane party. The exhibition of the Holy Coat at Treves had attracted enormous numbers of pilgrims. Indignant at what appeared to him an imposture, with Gildemeister, his colleague, he published an investigation into the authenticity of the celebrated relic, TJie Holy Coat of Treves and the Twenty other Holy Seamless Coats (1844). Prom this time he began to take an active part in contemporary politics and controversy, as a strong though moderate Liberal. In 1846 he was appointed professor at Marburg, and though the small university (there were only 200 students) offered little scope to his activities as a teacher, a seat in the Hessian Land- tag gave him his first experience of political affairs. In 1848 he was present at the Vor-Parliament in Prankfort, but did not succeed in winning a seat for the National Assembly; his opposition to the extreme democratic and' revolutionary party made him un-

popular with the mob, who broke his windows, as his Liberalism made him suspected at Court. He sat in the Erfurt Parliament of 1850, and was attached to the Gotha party, who hoped for the regeneration of Ger- many by the ascendancy of Prussia. During the years that followed all political activity was impossible ; but he was fully occupied with his great work, Tlie History of the Period of the French Bevolution, for which he had made prolonged studies in the archives of Paris and other countries. (Vols, i.-iii., 1855-60; vol. iv., 1870-71; vol. v., 1874-77. The later editions of the earlier volumes are much enlarged and altered. English translation of vols, i.-iii., 1867-69 : Murray.) In this work he for the first time showed the close connexion between the internal and external history of France; he was also the first, by a systematic study of the records, to check and

correct the traditional account of many episodes in the internal history. His demonstration that letters attri- buted to Marie Antoinette were not genuine roused much interest in France. For the history of German thought it was of the greatest importance that a well- known Liberal from the Rhine, by a systematic history of the Revolution, attempted to overthrow the influence which the Revolutionary legend, as expounded by French writers, had acquired over the German mind, and the book was an essential part of the influences which led to the formation of a National Liberal school of thought. He had been much influenced by Burke, on whom he had published two essays. The work was in fact the first attempt to substitute for the popular representations of Thiers and Lamartine the critical investigation which has been carried on with such brilliance by Taine and Sorel. In 1856, at the recommendation of Ranke, he accepted the post of professor at Munich, where King Maximilian, a wise and generous patron of learning, hoped to estab- lish a school of history. He found here a fruitful field for his activity. Besides continuing his work on the Revolu- tion and on the Middle Ages, he was occupied with the Historical Seminar which he instituted, in the newly established Historical Commission, and in the Historische

Zeitschrift which he founded, the original and model of the numerous technical historical publications which now exist. Political differences soon interfered with his work ; as an adherent of Prussia and a Protestant, especially as a militant champion against the Ultramontanes, he was from the first an object of suspicion to the Clerical party. In the political excitement which followed the war of 1859 he found that he could not hope for the unreserved support of the king, and therefore in 1861 he accepted a professorship at Bonn, which he held till 1875. He was at once elected member of the Prussian Lower House, and during the next three years was one of the most active members of that assembly : in several important debates he led the attack on the Government, and opposed the policy of Bismarck, not only on the budget, but also on the Polish and Danish affairs. In 1864 he did not stand for re-election, owing to an affection of the eyes, but in 1866 he was one of the first to point out the way to a recon- ciliation between Bismarck and his former opponents. He had a seat in the Constituent Assembly of 1867, and while he joined the National Liberals, distinguished himself by his opposition to the introduction of uni- versal suffrage, the effects of which he, as did many other Liberals, much distrusted. In 1874 he again accepted a seat in the Prussian Parliament, in order to support the Government in their conflict with the Clericals, and after 1878 with the Socialists. In two pamphlets, by an analysis of the teaching of the Social- ists and a survey of Clerical policy during the 19th century, he explained and justified his opinions. In 1880 he retired, like so many other Liberals, disheartened by the change in political life, which he attributed to uni- versal suffrage.

In 1875 he had been appointed by Bismarck to the post of Director of the Prussian Archives. Under his superintendence was begun the great series of Publications from the Prussian Archives, besides that of the Corre- spondence of Frederick the Great, in the editing of which he himself took part. His last years were occupied on his great work, The Foundation of the German Empire (5 vols., 1889 ; vols, vi.-vii., 1894 : there is an English translation, published in America, of vols, i.-iii.), a work of great importance, for he" was allowed to use the Prussian State papers, and was therefore enabled to write a history of the greatest events of his own time with full access to the most secret sources of

information. As a history of Prussian policy from 1860 to 1866 it is therefore of

incomparable value. After the fall of Bismarck the per- mission to use the secret papers was withdrawn, and therefore vols. vi. and vii., which deal with the years 1866 to 1870, are of less importance. He did not live to write the account of the war with France, dying on 1st August 1895.

Sybel left two sons, one of whom is an officer in the Prussian army ; the other, Ltjdwig von Steel, professor of archaeology in the University of Marburg, is the author of several works dealing with Greek archaeology. Some of Sybel's numerous historical and political essays have been collected in Eleine Historische Schriften, (3 vols., 1863, 1869, 1880) ; Vortrdge und Aufsatze (1874) ; and Vortrtige und Abhandlungen, published after his death with a biographical introduction by C. Varrentrapp (1897).

(j. w. HE.)

Sydney, the capital of New South Wales, and the principal seaport of Australia. It is situated on the east coast of the Island Continent, in 33° 51′ 41″ S., and 151° 12′ 23″ (10h- 4m- 49-553) E., and lies on the southern shore of the magnificent harbour of Port Jackson, on the South Head of which stands a splendid light- house, fitted with a powerful revolving electric arc light, visible for 25 miles at sea. The harbour proper has an area of water surface of 15 square miles, and the shore line is 165 miles in circuit. The private wharves on the east side of Darling Harbour were resumed by the State in 1900, and the Government thus acquired the control of wharfage amounting to 12,000 feet. The total wharfage in Port Jackson belonging to the Government is about 30,000 feet, and has connected with it shipping appliances and many stores. Sydney Cove is still the busiest of the bays as far as shipping is concerned, and besides the ferry traffic running to North Sydney, Mosman's Bay, Neutral Bay, Manly Beach, Watson's Bay, &c., the four great deep-sea mail steamship companies bring their vessels up to the wharves. From the city area proper largely popu- lated suburbs have spread away in all directions, and are connected with the city by railways, cable, electric or steam trams. The old system of steam

trams has been superseded by electric trams, on the overhead wire system. From North Sydney a line of railway recently built has brought into existence a series of northern sub- urbs, named respectively Chatswood, Lindfield, Gordon, Pymble, Wahroonga, and Hornsby. In a southerly direction are the important suburbs of Darlington, Redfern, Alexandria, Waterloo, and Botany, the latter situated on the shores of Botany Bay. The prin- cipal streets are George Street, Pitt Street, running parallel, and King Street, running at right angles to those two streets. As an example of modern efforts in the direction of widening thoroughfares, Sydney has only Moore Street, which was created under statutory powers out of a narrow slum lane, the open space in front of the General Post Office being extended as far as Castlereagh Street at a uniform width of 100 feet. The public buildings and principal business places, warehouses, churches, &c, are built of Pyrmont freestone. This supplies an admirable building material, being easily worked, and hardening by exposure to the air.

In view of the enormous growth of the city and suburbs, and the increase of population, the residents may congratulate themselves upon the situation and extent of the city parks and open spaces. No other city can boast such advantages in proportion to population. First comes the harbour, which, being situated in the very midst of the city, which has spread on both the north and south shores, may be regarded as the principal open space. Next comes Hyde Park, which was the original racecourse of the city, about 40 acres in extent. As adjuncts to this fine park there are two small parks — Cook Park and Phillip Park — of about 7 acres, and then the Domain,

which extends to the shores of Woolloomooloo Bay and Farm Cove, and has an inner botanic garden, running down to a semicircular sandstone sea wall on the shores

of the harbour. These, together with the Government House grounds, contain about 150 acres. Belmore Park occupies 10 acres. Wynyard

Square is a small garden on

Walker & Cockerel! su

Map of Sydney.

a hill in York Street, and on the Flagstaff Hill, where the Astronomical Observatory is situated, there is a picturesque little public garden. Moore Park, lying to the south-east of the city, is about 378 acres in extent. On it are the

rifle range, the Agricultural Society's show ground, and the Association Cricket Ground, where the principal cricket matches are played. Prince Alfred Park is another fine open space of 18 acres. Grose Farm, on the south-west

of the city, was the site of one of the earliest attempts at Government farming. It is an undulating and elevated piece of land, and is divided amongst the university and the affiliated colleges of St Paul, St John, and St Andrew, the Prince Alfred Hospital, and Victoria Park. The latest addition to the open spaces is that magnificent expanse of land of 530 acres, now called the Centennial Park, which was formerly used in connexion with the water supply. Pine drives, riding and bicycle tracks have been made, and it is now one of the finest parks in the world. The citizens owe this great gift to the late Sir Henry Parkes, who, while Premier of the colony, conceived and carried out the idea of converting the old water reserve into a park.

Sydney is municipally governed by a city council and a large number of municipal councils. Por municipal purposes .the city proper is divided into twelve wards, each returning two aldermen. It is behind many cities of Europe and the other colonies in its municipal development. Powers which are usually retained and exercised by municipal bodies have been parted with in Sydney, or never acquired. The control of

traffic is handed over to the police. The administration of the water and sewerage department, the parks, and city im- provement have been handed over to boards and trusts. The council has no control over wharves or police, and the tramways belong to and are managed by the State Government. The gas supply is in the hands of a private company, which pays nothing for the use of the streets. Electric lighting is passing into the hands of private firms, and already several blocks of city streets are lighted by such companies. A movement is on foot for the establish- ment of one central council to manage the municipal des- tinies of Greater Sydney, but so far little progress has been made. This movement may be hastened by the plague, which broke out in Sydney early in 1900 and again in 1902.

The population has increased with marvellous rapidity. In 1861 it was (city and suburbs inclusive) 95,000 ; in 1881, 237,300; in 1891, 399,270; and in 1901,487,900. The proportion of city dwellers to suburban is as fol- lows : in 1901— city, 112,137 ; suburbs, 369,693 ; total, 487,900. The incorporated area of the metropolitan dis- trict is about 142 square miles, or 91,220 acres, so that the average density of population was 5-35 persons per acre, some of the more immediate suburbs being more densely populated than the city itself.

The suburbs comprise forty -one distinct municipalities, of which the populations at the census of 1901 were as follows : — ~~Alexandria, 9341 ; Annandale, 8349 ; Ashfield, 14,329 ; Balmain, 30,076 ; Bexley, 3079 ; Botany, 3383 ; North Botany, 3772 ; Burwood, 7521 ; Camperdown, 7931 ; Canterbury, 4226 ; Concord, 2818 ; Darlington, 3784 ; Drummoyne, 2843 ; Enfield, 2497"; Erskineville, 60.7,1 ; Five Dock, 1401 ; Glebe, 19,220 ; Hunter's Hill, 4232 ; Hurstville, 4019 ; Kogarah, 3892 ; Lane Cove, 1918 ; Leichhardt, 17,454 ; Manly, 5035 ; Marrickville, 18,775 ; Marsfield, 713 ; Mosman, 5691; Newtown, 22,598; North Sydney, 22,040; Paddington, 21,984 ; Petersham, 15,307 ; Randwick, 9753 ; Red~~ fern, 24.219 ; Rochdale, 7857 ; Ryde, 3222 ; St Peters, 5906 ; Strathfleld, 2991 ; Vaucluse, 1152 ; Waterloo, 9609 ; Waverley, 12,342 ; Willoughby, 6004 ; Wollahra, 12,351.

For parliamentary purposes the city was formerly divided into three electorates — ~~East, West, and South, returning four members each. Since the Parliamentary Electorates and Elections Act of 1893, these large electorates have been divided into four small elec~~ torates, returning a single member each. The principal suburbs are nearly all electorates for parliamentary purposes.

Sydney is now supplied with water by the ” Upper Nepean scheme.” By this scheme the water is brought from the sources of supply, a distance of 40 miles, to Prospect Reservoir, and from thence to Sydney and suburbs, over 20 miles farther. The average daily consumption of water during the year ended June 1901 was 21,583,000 gallons. The cost of this scheme was about four millions sterling.

The new scheme of drainage is nearly completed. The works will drain the northern slopes of the city and suburbs into the Pacific Ocean ; and the drainage of the southern slopes will be dis- charged at a sewage farm on the shores of Botany Bay.

” Sydney,” says the Government Statistician of New South Wales, “now stands as the second city of the British Empire, as estimated by the annual value of its rateable property.” The total value of all rateable property in the whole metropolitan area in 1902 was £90,060,600. In trade Sydney is in a most important position, the tonnage entered and cleared in the year 1900 being 6,569,824 tons, and the value £42,695,771. “The comparative importance of the trade of Sydney may be realized,” says the authority above quoted, “by viewing it in connexion with the trade of the chief ports of the United Kingdom. In absolute tonnage Sydney is surpassed by only five English ports — London, Liverpool, Cardiff, Hull, and New- castle ; though in point of value the trade of Sydney exceeds that of any port in Great Britain, London, Liverpool, and Hull excepted.”

The jurisdiction of the port was until 1899 in the hands of a Marine Board, of which three members were elected by the ship- ping interest, and three others and the president were nominated by the Government. But by the Act No. 32 of 1899 the Marine Board was abolished, and the various powers and duties of the board are transferred to an officer

called the Superintendent of the Department of Navigation, acting under the control of the Colonial Treasurer. A court of marine inquiry is created, consisting of one or more district court judges, assisted by the assessors. This new authority will have control of the pilot service, which is en- tirely a Government department. Port Jackson is the headquarters of the naval squadron in Australasia, the residence of the Admiral of the Australian station, and the chief Imperial naval depot in these seas. With respect to dock accommodation, Sydney is well off, having three graving docks, five floating docks, and three patent slips, with all necessary machinery.

Sydney has many public institutions, including the university and affiliated colleges ; deaf and dumb asylum, three lunatic asylums, a free public library and reading room, with a lending branch ; a technical college, three large hospitals, besides cottage hospitals in various suburbs; a benevolent asylum, an institute for destitute children at Randwick, a training ship for boys, two soup kitchens and refuges ; a bacteriological experimental institute at Rose Bay, a school of arts with library and class-rooms, a Government astronomical observatory, a museum, an art gallery, &c; and a leper lazarette at Little Bay. A women's college was opened in 1892 in connexion with the university. There were at the university in 1901 62 professors and lecturers and 657 students (573 male and 84 female). The revenue in that year was £35,766, of which £9800 represented Government aid. Many donations have been made to the university ; one of £180,000 has been increased to £250,000, and the present capital value of all donations is probably not less than £460,000. The technical college is not connected with the university. There were in 1899 7647 students attending the college and its branches, and the State expenditure on technical instruction was £19,218.

None of the public institutions mentioned above, though situated in and around Sydney, are under the control of the municipal council. They are controlled by the State Government. Of insti- tutions purely municipal there are several, such as the central markets, a pretentious building in George and York Streets, the fish-market, and the large markets at the Haymarket, known as the Belmore Market. In the

metropolitan area there are sixty- four licensed slaughter-houses for the supply of beef to the inhabit- ants. The principal slaughter-houses are the abbatoirs, Glebe Island ; they are under the supervision of the Board of Health.

Sydney has several public monuments and statues. The prin- cipal statues are those of Queen Victoria, at the top of King Street, and Prince Albert, at the gate of Ilvde Park ; Captain Cook and the Right Hon. W.” P. Dalley, P. C., in Hyde Park ; Governor Phillip, in the Palace Gardens, Domain ; Governor Richard Bourke, at the Domain gates ; Mr Mort, in Macquarie Place ; and the Rev. Dr Lang, in Wynyard Square Gardens.

The National Art Gallery is situated in the Outer Domain, and the building is at yet incomplete. It contains a splendid collection of pictures by the greatest modern artists, some statuary, and a number of artistic pottery, medallions, and a fine Chinese tapestry. It is open on Sundays (as is also the free public library), and is a very popular resort, the average Sunday attendance being 1773, and on week days 675.

Sydney possesses several fine theatres, viz., the Theatre Royal, the Lyceum Theatre, Her Majesty’s Theatre, the Criterion Theatre, the Opera House, the Palace Theatre, and the Tivoli Music Hall.

There are innumerable places of resort for the citizens. Many of the bays in the harbour are largely visited on Sundays and holidays. The most popular resorts are Manly Beach, Chowder Bay, and Watson’s Bay, in the harbour ; Cabarita, on the Parra- matta river ; Middle Harbour ; and Coogee Bay and Bondi, on the ocean beach ; Botany, Lady Robinson’s Beach, Sandringham, and Sans Souci on Botany Bay. Besides these there are two splendid

national reserves, an hour’s rido by rail from Sydney, viz., National Park, comprising an area of 36,810 acres, surrounding the pic-

turesque bay of Port Hacking ; and Kurringai Chase, with an area of 35,800 acres.

The two principal cemeteries are at Waverley and Rookwood. The former is most picturesquely situated on the cliff overlooking the Pacific Ocean. The latter is on the Western railway line. Both contain many fine monuments.

Amongst the principal public buildings are the Law Courts, though these are not important from an architectural standpoint. They are nearly all situated at the top of King Street. In one building there are comprised the Banco Court, the Divorce Court, and various Jury Courts. Towards Macquarie Street, in King Street, are the Equity Court, the District Court, and the Probate Offices. The Central Criminal Court is a massive stone building in Darlinghurst, in proximity to the gaol.

As a manufacturing centre Sydney occupies a fairly important position. Those industries which are peculiar to a great seaport exist, with the notable exception of shipbuilding, which at one period was assuming flourishing proportions, but has fallen away to nothing. Ship-repairing, however, could hardly fail in such a favourable position to assume large proportions, and it has. Large numbers of hands are employed in the Government railway work- shops, where the locomotives and rolling stock for the Government railways are manufactured. There are several large tobacco factories, boot factories, flour-mills, a large sugar refinery, tanneries, boiling- down works, glue and kerosene oil factories, and a large English firm have established a branch of a soap manufactory. There are also clothing factories, tweed factories, and a great number of minor industries. The number of hands employed in the metro- politan district in 1900 was 38,668. Towards the close of 1901 Coal of excellent quality was struck near the shore of the harbour.

The mean temperature is 62-9°, and corresponds with that of Barcelona in Spain and of Toulon in France. The mean summer temperature is slightly under 71°, and that of winter 66°. The range is thus 15° Fahrenheit, while the mean yearly average for a period of thirty-eight years was 63°. The greatest temperature ever experienced

was 108-5° in the shade in 1896, and the lowest winter was 36-9°, giving a range of 72 ‘6°. The average rainfall is 49-66 inches. (j. d. F.)

Sydney, the chief town of Cape Breton county, Nova Scotia, on a good harbour, the eastern terminus of the Intercolonial railway, 285 miles north-east of Hal- ifax. The town contains many fine buildings, among which are seven churches, an academy, court house and post office, and custom house. The Dominion Iron and Steel Company have built immense works for the manu- facture of iron and steel, in consequence of which the population has more than doubled. For 1901 the exports were f 1,262,903 and the imports $2,850,607. Population

(1901), 9909.

Sylhet, a town and district of British India, in the Surma Valley division of Assam. The town is on the right bank of the river Surma. Population (1881), 14,407; (1891), 14,027; municipal income (1897-98), Rs.33,650. There are manufactures of mats, carved ivory and shells, and furniture. An unaided college, founded in 1892, and mainly supported by a native gentleman, had 27 students in 1896-97; two high schools had 608 pupils. There are two dispensaries and an English church. The great earthquake of 12th June 1897 de- stroyed every substantial building, but caused very little loss of life.

The district of Sylhet has an area of 6414 square miles ; popula- tion (1881), 1,969,009; (1891), 2,154,693, showing an increase of 9 per cent. ; average density, 398 persons per square mile, com- paring with 112 for the province generally. Classified according to religion, Hindus in 1891 numbered 1,016,134 ; Mahommedans, 1,123,984; Christians, 643, of whom 277 were Europeans; hill tribes, 13,818 ; ” others,” 14. In 1901 the population was 2,238,892, showing a further increase of 4 per cent. Land revenue, Rs.7,66,638, the incidence of assessment per acre being R.0.2.5 on the per- manently settled and R.0.10.7 on the temporarily settled tract; number of police, 547 ; number of boys at school (1896-97), 39,077, being 23-66 per cent, of the male population of school-going age ; number of girls at school, 3690, being 2-33 per cent. ; regis- tered death-rate (1897), 62-93 per 1000. Tea cultivation is a flourishing industry in the southern hills. In 1897 the number of gardens was 137,

with 70,200 acres under tea, employing 145,804 persons, of whom 13,116 had been imported under contract, and

yielding more than 26 million lb, or 474 tb per acre, by far the highest rate in the province. There are two printing-presses, issuing a fortnightly newspaper in Bengali. The Assam-Bengal railway now runs through the district, but trade is still largely river-borne. Great damage was done by the earthquake of June

1897.

Sylvester, James Joseph (1814-1897), English mathematician, was born in London on 3rd September 1814. He went to school first at Highgate and then at Liverpool, and in 1831 entered St John's College, Cambridge. In his Tripos examination, which through illness he was prevented from taking till 1837, he was placed as second wrangler, but being a Jew and unwilling to sign the Thirty-nine Articles, he could not compete for one of the Smith's prizes and was ineligible for a fellowship, nor could he even take a degree : this last, however, he obtained at Trinity College, Dublin, where religious re- strictions were no longer in force. After leaving Cam- bridge he was appointed to the chair of natural philos- ophy at University College, London, where his friend De Morgan was one of his colleagues, but he resigned in 1840 in order to become professor of mathematics in the University of Virginia. There, however, he remained only six months, for certain views on slavery, strongly held and injudiciously expressed, entailed unpleasant consequences, and necessitated his return to England, where he obtained in 1844 the post of actuary to the Legal and Equitable Life Assurance Company. In the course of the ensuing ten years he published a large amount of original work, much of it dealing with the theory of invariants, which marked him as one of the foremost mathematicians of the time. Still, his reputa- tion among those competent to judge of his attainments did not extend to the dispensers of academic patronage, and he failed to obtain either of two posts — the profes- sorships of mathematics at the Royal Military Academy and of geometry in Gresham College — for which he ap- plied in 1854, though he was elected to the former in the following year on the death

of his successful com- petitor. At Woolwich he remained until 1870, and although he was not a great success as an elementary teacher, that period of his life was very rich in mathe- matical work, which included remarkable advances in the theory of the partition of numbers and further con- tributions to that of invariants, together with an import- ant research which yielded a proof, hitherto lacking, of Newton's rule for the discovery of imaginary roots for alge- braical equations up to and including the fifth degree. In 1874 he produced several papers suggested by Peaucel- lier's discovery of the straight line link motion associated with his name, and he also invented the skew pejntagraph. Three years later he was appointed professor of mathe- matics in the Johns Hopkins University, Baltimore, stip- ulating for an annual salary of 5000 dollars, to be paid in gold. At Baltimore he gave an enormous impetus to the study of the higher mathematics in America, and during the time he was there he contributed to the American Journal of Mathematics, of which he was the first editor, no less than thirty papers, some of great length, dealing mainly with modern algebra, the theory of numbers, the- ory of partitions, and universal algebra. In 1883 he was chosen to succeed Professor Henry Smith in the Savilian chair of geometry at Oxford, and there he produced his theory of reciprocants, largely by the aid of his " method of infinitesimal variation." In 1893 loss of health and failing eyesight obliged him to give up the active duties of his chair, and a deputy professor being appointed, he went to live in London, where he died on 15th March 1897. Sylvester's work .suffered from a certain lack of steadiness and method in his character. For long periods he was mathematically unproductive, but then

sudden inspiration would come upon him and his ideas and theories poured forth far more quickly than he could record them. All the same his output of work was as large as it was valuable. The scope of his researches was described by Cayley, his friend and fellow-worker, in

the following words : ” They relate chiefly to finite analysis, and cover by their subjects a large part of it — algebra, determinants, elimination, the theory of equations, par- titions, tactic, the theory of forms, matrices, recipro- cants, the Hamiltonian numbers, &c. ; analytical and pure geometry occupy a less prominent position ; and mechanics, optics, and astronomy are not absent.” Syl- vester was a good linguist, and a diligent composer of verse, both in English and Latin, but the opinion he cherished that his poems were on a level with his mathematical achievements has not met with general acceptance.

Symonds, John Addington (1840-1893), Eng- lish critic and poet, was born at Bristol, 5th October 1840, the only son of John Addington Symonds, M.D., and Harriet, eldest daughter of James Sykes of Leatherhead. He was a delicate boy, and at Harrow, where he was entered in 1854, took no part in school games and showed no particular promise as a scholar. In 1858 he proceeded to Balliol as a commoner, but was elected to an exhibition in the following year. The Oxford training and associa- tion with the brilliant set of men then at Balliol called out the latent faculties in Symonds, and his university career was one of continual distinction. In 1860 he took a first in ” Mods,” and won the Newdigate with a poem on The JEscorial; in 1862 he was placed in the first class in Literae Humaniores, and in the following year was winner of the Chancellor’s English Essay. In 1862 he had been elected to an open fellowship at Magdalen. The strain of study unfortunately proved too great for him, and, immediately after his election to a fellowship, his health broke down, and he was obliged to seek rest in Switzerland. There he met Janet Catherine North, whom, after a romantic betrothal in the mountains, he married at Hastings 10th November 1864. He then at- tempted to settle in London and study law, but his health again broke down and obliged him to travel. Returning to Clifton, he lectured there, both at the college and to ladies’ schools, and the fruits of his work in this direction remain in his Introduction to the, Study of Dante (1872) and his admirably vivid Studies of the Greek Poets (1873- 76). Meanwhile he was occupied upon the work to which his talents and sympathies were especially attracted, his Renaissance in Italy, which appeared in seven volumes at intervals between 1875 and 1886. The Renaissance had been the subject of

Symonds's prize essay at Oxford, and the study which he had then given to the theme aroused in him a desire to produce something like a complete picture of the reawakening of art and literature in Europe. His work, however, was again interrupted by illness, and this time in a more serious form. In 1877 his life was in acute danger, and upon his removal to Davos Platz and subsequent recovery there, it was felt that this was the only place where he was likely to be able to enjoy life. Erom that time onward he practically made his home at Davos, and a charming picture of his life there will be found in Our Life in the Swiss Highlands (1891). Symonds, indeed, became in no common sense a citizen of the town ; he took part in its municipal business, made friends with the peasants, and shared their interests. There he wrote most of his books — biographies of Shelley (1878), Sidney (1878), Ben Jonson (1886), and Michelan- gelo (1893), several volumes of poetry and of essays, and a fine translation of the Autobiography of Benvenuto Cel- lini (1887). ^There, too, he completed his study of the Renaissance, the work by which he will be longest re-

membered. He was assiduously, feverishly active through- out the whole of his life, and the amount of work which he achieved was wonderful when the uncertainty of his health is remembered. He had a passion for Italy, and for many years resided during the autumn in the house of his friend, and ultimately biographer (1895), Mr Horatio E. Brown, on the Zattare, in Venice. He died at Rome, 19th April 1893, and was buried close to Shelley. Two works from his pen, a volume of essays, In the Key of Blue, and a monograph on Walt Whitman, were pub- lished in the year of his death. His activity was unbroken to the last. In life Symonds was morbidly introspective, a Hamlet among modern men of letters, but with a ca- pacity for action which Hamlet was denied. Robert Louis Stevenson described him, in the Opalstein of Talks and Talkers, as "the best of talkers, singing the praises of the earth and the arts, flowers and jewels, wine and music, in a moonlight, serenading manner, as to the light guitar." But under his excellent good-fellowship lurked a haunting melancholy. Eull of ardour and ambition, sympathy and desire, he was perpetually tormented by the riddles of ex- istence ; through life he was always a seeker, ardent but unsatisfied. This side of his nature stands revealed in his gnomic poetry,

and particularly in the sonnets of his Animi Figura, where he has portrayed his own character very subtilly. His poetry is perhaps rather that of the student than of the inspired singer, but it has moments of deep thought and emotion. It is, indeed, in passages and extracts that Symonds appears at his best. Rich in description, full of ” purple patches,” his work has not that harmony and unity that are essential to the conduct of philosophical argument. He saw the part more clearly than the whole ; but his view, if partial, is always vivid and concentrated. His translations are among the finest in the language ; here his subject was found for him, and he was able to lavish on it the wealth of colour and quick sympathy which were his characteristics. He was a lover of beauty, a poet and a philosopher ; but in his life and his work alike he missed that absolute harmony of conviction and concentration under which alone the highest kind of literature is produced. (a.wa.)

Symons, George James (1838-1900), English meteorologist, was born in Pimlico, London, on 6th August 1838. In 1860 he obtained a post in the meteo- rological department of the Board of Trade under Ad- miral Eitzroy, who was then deeply interested in the subject of storm-warnings, and in the same year he pub- lished the first annual volume of British Rainfall which contained records from 168 stations in England and Wales, but none from Scotland or Ireland. Three years later he resigned his appointment at the Board of Trade, where his rainfall inquiries were not appreciated, at least not as a prior study to storm-warnings, and devoted his whole energies to the organization of his wonderful band of volunteer observers for the collection of particulars of rainfall throughout the British Isles. So successful was he in this object that by 1866 he was able to show results which gave a fair representation of the distribution of rainfall, and the number of recorders gradually increased until the last volume of British Rainfall which he lived to edit (that for 1899) contained figures from 3528 stations— 2894 in England and Wales, 446 in Scotland, and 188 in Ireland. Apart from their scientific interest, these annual reports are of great practical importance, since they afford engineers and others engaged in water supply much-needed data for their calculations, the former absence of which had on some occasions given rise to grave

mistakes. Symons himself devoted special study not only to rainfall, but also to the evaporation and per- colation of water as affecting underground streams, and

his extensive knowledge rendered him a valuable witness before parliamentary committees. In other branches of meteorology also he took a keen interest, and he was particularly indefatigable, though consistently unsuccess- ful, in the quest of a genuine thunderbolt. The history of the science too attracted his attention, and he possessed a fine library of meteorological works, which passed to the Meteorological Society at his death. Of that society he became a member when only eighteen, and he retained his connexion with it in various official capacities up to the end of his life. He served as its president in 1880, and in view of the celebration of its jubilee was re-elected to that office in 1900, but the illness that caused his death prevented him from acting. He died in London on 10th March 1900.

Syra, or Hbrmoupolis, the principal seaport of the Greek (Jyclades, on the east side of the island of Syros, nearly midway between Piraeus and Samos. It is con- veniently situated as a port of call, and for coaling, for vessels going to and from Constantinople and the Black Sea. But since the energetic development of Piraeus, Syra has ceased to be the chief commercial entrepot and distributing centre of this part of the Levant, and con- sequently its trade has seriously declined. Whereas in 1890 the foreign commerce was valued at £1,313,730, in 1900 it only amounted to £408,350. Coal, textiles, and iron and steel goods figure prominently amongst the im- ports, and emery, leather, lemons, sponges, flour, valonea, and iron ore amongst the exports. Syra is the seat of several industries, as tanneries, flour and cotton mills, rope- walks, factories for confectionery (” Turkish delight “), hats, kerchiefs, furniture, pottery, and distilleries. The port is entered and cleared by some 900,000 tons of shipping annually. The harbour, which is protected by a breakwater 273 yards long, has a uniform depth of 25 feet, diminishing to 12 feet. Population (1896),

17,894.

Syracuse (Italian, Siracusa), a city of Italy, on the east coast of Sicily, capital of the province of Syracuse, 80 miles south ~~by w;est of Messina, occupying a small island (Ortygia) which projects south towards the pen~~ insula of Massolivieri. There is a trade averaging in the aggregate £274,000 per annum — exports, £130,000; imports, £144,000. The principal exports are olive oil, oranges and lemons, including peel, wine, rock asphalt, locust beans,1 linseed, almonds, &c. In 1899 the port was entered by 782 vessels of 404,100 tons. Population (1881),

21,739; (1900), 32,074.

Syracuse, a city of New York, U.S.A., capital of Onondaga county. It is situated in lat. 43° 02', long. 76° 14', near the south end of Onondaga Lake, on the Erie Canal, and on the Delaware, Lackawanna and Western, the New York Central and Hudson River, and the West Shore railways, in the central part of the state, at an altitude of 400 feet. It has a level site, a somewhat irregular street plan, and is divided into nineteen wards. It has an excellent water-supply drawn from Skaneateles Lake, the works being owned by the city, and is well sewered. Its streets are well paved, mainly with asphalt and brick. There is a city library of nearly 30,000 volumes, and many fine public buildings, among which are the United States Building, the Court House, and the City Hall. The city contains many charitable and educational institutions. Among the latter is Syracuse University, which in 1899 had a faculty of 109 professors and instructors, and was attended by 770 students, in- cluding 219 women. . Syracuse is a manufacturing city of importance. In 1900 it contained 1383 establish- ments, with a total capital of $31,358,055. They em- ployed 14,917 hands, and the product had a value of

$ 31,948,055. The principal articles of manufacture were clothing, carriages and waggons, chemicals, foundry and machine-shop products, iron and steel, bicycles, boots and shoes, furniture, hosiery, and malt liquors. Salt, formerly the principal product, is now of little importance, having been driven out of the market by the competition of that of Michigan. In 1899 the assessed valuation of real and personal

property was $80,759,234, the net debt of the city was $7,379,329, and the rate of taxation was $19.33 per $1000. The total income of the city from all sources, exclusive of loans, was $2,239,035, and the ex- penditure for maintenance and operation was $1,745,014. Population (1890), 88,143; (1900), 108,374, of whom 23,757 were foreign-born and 1034 negroes. Of 32,499 males 21 years of age and over, 1071 were illiterate (unable to write).

Syria. — The Tell el-'Amarna letters show that in the 14th century b.c. all Syria belonged to Egypt, and they describe in some detail the breaking up of the Egyptian power in the reign of Akhenaten and the progress of the conquering Amorites and Hittites (Khita). The German excavations at Sinjerli, east of the Giaour Dagh, have made known the existence of a principality in that dis- trict, Samal, which was ruled in the 8th century b.c. by dynasts named Panammu, and was absorbed in the fol- lowing century by the growing power of Tiglath Pileser III. In the same place was found a stele recording the victories of Esarhaddon over Egypt and Tyre. Interesting results, not yet published, have also been obtained by the German excavations at Baalbek. The railroad from Beirut to Damascus has already been noticed (see Lebanon), and at the end of 1901 about 180 miles of the Damascus- Mecca railway were completed. There are good roads from Beirut to Damascus, Beirut to Tripoli, Tripoli to Hums and Baalbek, and from Alexandretta to Aleppo, on which wheeled transport is used ; but the volume of trade has not greatly increased. The total trade by sea amounts from six to seven millions sterling. In 1900 the imports, which embrace cottons and woollens, sugar, leather, timber, petroleum, silks, glass, rice, fezzes, &c, were valued at £4,000,000 ; and the exports, the chief items of which were silk thread, &c, cocoons, lemons, oranges, and other fruit, wool, cereals, and sponges, at £2,655,000. There are no accurate returns of the popu- lation, but for the whole of Syria, including Lebanon and Palestine, it may be roughly estimated at about 3^ millions, of whom about one-third are Christians.

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Vom Mittelmeer zum Persischen Golf. 1900. — Petkie. Syria and Egypt from the Tell el-Amarna Letters. 1898. — Sachau. Am Euphrat und Tigris. 1900. — Von Luschan. Ausgrabungen in Sendjerli. — Baedeker-Socin. Handbook to Syria and Palestine. — Murray's Handbook to Asia Minor, &c. — Post. Flora of Syria and Palestine.

Syriac Gospels.— The most important and far- reaching discovery of recent times in regard to the text of the Gospels is undoubtedly the Syriac palimpsest, which was unearthed on Mount Sinai by Mrs Lewis and her sister, Mrs Gibson, in the year 1892. The upper writing of this MS. is a collection of lives of women saints, made by a monk in the monastery of Beth Mari, in the town of Mearath Mezrin, near Antioch, as its colo- phons show, and written towards the end of the 8th century: a collection of small literary value, unless it should be for the fact that it Contains a new Syriac text of the story of Susanna. The erased underwriting is, however, some four centuries earlier, and contains a text whose critical worth for the student of the Gospels is wellnigh inestimable. When the volume first came under Mrs Lewis's notice the pages were compacted together,

through age and disuse, so that the steam from a kettle had to be used to separate them : finding that the erased text was very ancient and contained the Gospels, Mrs Lewis photographed the whole of the MS. and brought the results back to Cambridge, where her suspicions as to the antiquity of the text were speedily confirmed by Professor Bensly and Mr Burkitt, who recognized the characteristic traits of the old Syriac version, hitherto only known by the imperfect recension that bears the name of Cureton. In the year 1893 Mrs Lewis and her sister returned to the convent on Mount Sinai, bringing with them three transcribers for the text, Professor Bensly, Mr Burkitt, and Dr J. Bendel Harris. Prom 8th February to 20th March they laboured on the transcription, and brought the results back to Cambridge for publica- tion. Professor Bensly, however, did not live to take part in this work, but died almost immediately upon his return. His transcripts were

placed in the hands of Mr Burkitt, and the text, so far as recovered, was published, with a preface by Mrs Lewis, by the Syndics of the University Press.1

For further details as to the discovery and transcription of the text, see Mrs Gibson's How the Codex was Found and Mrs Lewis's A Translation of the Four Gospels from the Syriac of the Sinaitic Palimpsest. The account attached to Merx's German translation of the Syriac Gospels is not always trustworthy.

When the transcribers left Sinai, they imagined that the work had been done with tolerable completeness, and had expressed themselves to the effect that they had not left much for the Germans ; but palimpsest reading is rarely final, and in 1895 Mrs Lewis and her sister were again at Sinai, where they revised the text in doubtful places, re-read the codex from end to end, and, by a com- bined result of the fresh scrutiny with the further judicious use of the chemical reagent which had been employed in 1893, succeeded in adding nearly a fifth to the already published matter — a critical triumph that can hardly be paralleled in the history of palimpsest reading. As a result of this visit, Mrs Lewis published a re- transcription 2 of a number of pages of the Syriac text, and re-edited her first translation of the text, under the title, Some Pages of the Four Gospels re-transcribed from the Sinaitic Palimpsest with a Translation of the Whole Text, by Agnes Smith Lewis (London, C. J. Clay and Sons, 1896). A fourth visit to the convent made in 1897 enabled the untiring sisters to examine a number of doubtful passages, and to add a few further readings to the total result. These will be found in the pages of the Expositor for 1897 (pp. 111-119 ; see also p. 472).

It should be observed that the discovery of the original home of the MS., before it came into the possession of the Sinai monks (see Mrs Lewis in Expositor for 1900, pp. 415-421 3), has rendered the title " Sinaitic Syriac " no longer suitable. It must be called " Antiochene Syriac," or, following the analogy of the Cureton text, the "Lewis Syriac." Probably the latter is the better term, as we do not know

whether “Antiochene” may not have to be further replaced by ” Edessan.”

There can be no doubt that these arduous labours on the part of the discoverers and transcribers of the text have been abundantly justified by the published results, for the recovered text is in some respects superior to any- thing that had hitherto been known of the text of the Gospels, and gives us frequent vistas over the untravelled country that lies between our most ancient uncial texts and the Gospel archetypes. It is not only free from- those expansions which critical science has already condemned in the Textus Beceptus, and from most of its conflations

1 This may be quoted as the Syndics’ edition.

2 This may be quoted as Mrs Lewis’s edition. The parts added by Mrs Lewis are printed in blue ink.

8 The colophon which betrayed the secret to Mrs Lewis had been read by Professor Bensly, as appears from a transcript since found amongst his papers.

of contending types of text, but it is also singularly free from those expansions which do so much to discredit the so-called Western text, with which it is otherwise in sub- stantial agreement ; and generally speaking, its brevity appears to be defensible, not only in such cases as the Pericope de Adultera (John vii. 53-viii. 11) and the last twelve verses of Mark, but in a number of less conspicu- ous places, where it betrays to us the fact that the Gospels have come down to us through a long sequence of editorial revisions, of which accretion is certainly one conspicuous feature. Even the order of the text, where apparent displacements occur, can frequently be justified, e.g., Mark xvi. 4, where the words, “For it was very great,” used of the stone at the sepulchre, are carried back to their right place in Mark xvi. 3, and the trans- position is further verified by the fact that the same order is given in the Gospel of Peter. At other times the relative displacement of passages in the Lewis text is a key to the finding of the shorter text which under- lies all existing copies, as in Luke xxii. 17-20, where all

texts are in excess and the removal of the accretions had already been commenced by Westcott and Hort. Criti- cally the Lewis text must be described as Western, but it is Western of great antiquity and purity, and the com- bination of this text with earlier evidence of the same kind from the old Latin versions is one that it will he difficult to resist.

Of the innumerable questions that have arisen with regard to the new text, the two that have provoked most interest are (a) the relation of the new Gospel to the Diatessaron of Tatian ; (6) its theological orthodoxy or unorthodoxy.

With regard to (a) no final agreement has yet been reached, though there is a strong phalanx of experts for the opinion that the Lewis Gospels represent a Syriac text which antedates Tatian. There are traces of a Jewish hand in the translation, as when the temple is called the Holy House (John x. 22), or when the phylac- teries are called by their Jewish name of Tephillin (Matt, xxiii. 5). On the other hand, there are slight suggestions of Encratism (Matt. xxii. 4, Luke ii. 36), as well as a number of harmonistic touches which seem to recall Tatian. And between the Separated Gospels or Gospels of the Mepharrashe, as they call themselves, and the Combined Gospels or Gospels of the Mehallete, there is some nexus that is not yet perfectly explored. We incline to the belief that the Lewis text is not the daughter of the Tatian Harmony, but its parent, and that traces of the latter in the former are due to textual contamination.

With regard to (6), the orthodoxy of the codex has been im- pugned on account of an extraordinary reading in the genealogy of Matthew, which appears to make Joseph the direct parent of Jesus [Matt. i. 16, Joseph, to whom the Virgin Mary was espoused, begat Jesus]. There are also traces of what may perhaps best be described as a recrudescence of Adoptionist Theology. Notably, there are singular cases of the tendency to call Christ the Elect of God, a title which, as a result of editorial revision, had almost disappeared from the New Testament, but which is now to be read in Luke ix. 35, 'Luke xxiii. 35, John i. 34, John iii. 18 (as recently verified for the Lewis text by Mr Burkitt), and perhaps elsewhere. The reading, whether we choose to

call it Adoptionist or not, is certainly pre-Catholic, as may be conclusively shown from Justin, Trypho, § 67, where Trypho argues, against the Catholic position of Justin, that Jesus became the Christ, by election, as a result of his perfect obedience and life (Ka.Ti)£iwtr9ai tov bfreyTjvai eh xPl

It is probable that the genealogy in Matthew, while restored to a more early form by the Lewis MS. than is found in the edited texts, is not yet in its final shape. And it is certain that both it and the account of the birth of Christ which follows it have under- gone revision with a view to the avoiding of misunderstanding. In any case the evidence of this MS. is of the first importance for both the critic and the theologian.

Authorities. — The Four Gospels in Syriac, transcribed from the Sinaitic Palimpsest. By the late Robert L. Bbnsly, M.A.,

J. Kendel Harms, M.A., and F. Crawford Burkitt, M.A., with an introduction by Agnes Smith Lewis. Cambridge, at the University Press, 1894. — How the Codex was Found. By Mar- garet D. Gibson. Macmillan, 1893. — A Translation of the Four Gospels from the Syriac of the Sinaitie Palimpsest. By Agnes S. Lewis. Macmillan, 1894.— Some Pages of the Four Gospels re- transcribed from the Sinaitie Palimpsest, with a Translation of the Whole Text. By Agnes Smith Lewis. London, C. J. Clay and Sons, 1896.— ” The New Syriac Gospels” by J. Rendel Harris in Contemporary Beview, 1894 ; Hie Academy for November and December 1894 and for January 1895 ; The Guardian for 31st October 1894 (F. C. Burkitt). — Collatio Codicis Lewisiani. By Albert Bonus. — Die vier Kanonischen Fvangelien (trans, by Merx from the Sinai palimpsest, Berlin, 1897). — Die altsyrische Eoangelieniibersetzung. By Hjelt (Leipzig, 1901). (j. r. ha.)

Szabadka (Maria-Theresiopel), a municipal town of Hungary, in the county of Bacs-Bodrog, 25 miles south- west of Szegedin, with 73,526 inhabitants in 1891 and 82,122 in 1901. To its territory belongs Lake

Palics, a favourite watering-place and summer establishment. It contains a burgher school for boys and girls, public hos- pital, almshouse, municipal music school. Its inhabitants are mostly engaged in agriculture ; there is no important industry. The town has an immense territory (369 square miles). Its fruit trade and turkey breeding are considerable; the latter is the most important in the country. In 1889 the honvid commemorative monument was inaugurated. ,

Szalay, Ladislas (1813-1864), Hungarian histo- rian, was born in 1813. After the completion of legal and historical studies, he took part in the great revolution of 1848^49, and was obliged to seek refuge in Switzer- land, where, at Rorschach, on the Lake of Constance, he wrote his Magyarorszdg toHinete (History of Hungary). It extends to 1707 and, in six volumes, tells chiefly the constitutional history of Hungary and her dependencies. Szalay himself admitted that he could not claim for his work the merits of thorough and original research in all its parts ; it was meant as a great political programme, enlightening the nation about their historical rights against the pretensions of the Habsburgs. The style of the work is somewhat rigid, but thoughtful ; a manly and profound conviction of Hungary's historical vocation ani- mates its every page. Szalay also wrote remarkable studies on Pitt, Fox, Mirabeau, and other statesmen, and contributed very considerably to the codification of Magyar law.

See Joseph Szinnyei in the Magyar Helikon of 1886, and Alexander Flegler, Szalay Laszld, a biography (in Olcsd Konyvtdr, 1878).

Szamos-Ujvar (Gherla), a corporate town of HuDgary, in the county of Szolnok-Doboka, 23 miles north-east of Klausenburg, with 5798 inhabitants in 1891 and 6363 in 1901. Its ancient fort now serves for a prison. It is the seat of a Greek Catholic bishopric, and has a seminary for Greek Catholic priests, a State upper gymnasium, an orphanage, a Franciscan convent, and a distillery. It was founded by the Armenians, who are known as skilful and wealthy traders. There is a fine Armenian cathedral, with an altar-picture by Rubens.

Szawly (Russian, Schavli), a district town of Russia, in the government and 77 miles jST.N.W. of the town of Kovno on the railway from Vilna to Libau. It has several distilleries, flour-mills, and tobacco factories, and carries on a brisk trade with Libau (105 miles) in grain and linseed. Its population in 1897 was 15,914 (nearly 22,000 with the suburbs).

Szeged , a municipal town of Hungary, on the right bank of the Theiss, just below the confluence of the Maros, 100 miles south-east of Budapest. Population 87,410 in 1891, and 102,991 in 1901. Centre of the commerce and industry of the great Hungarian Alfold, this town has recently developed considerably and has been much improved, so that now it is one of the finest cities of Hungary. There are many educational establish- ments. In tL898 a State gymnasium was opened. It con- tains a training institute for teachers and several special industrial schools. Among its industrial establishments may be mentioned saw-mills, match, sausage, red pepper {paprika), leather, and spirit factories, an iron-foundry, &c. Several statues adorn the town, among which is the monument of the Hungarian poet, Andreas Dugonics.

Szegzard, chief town of the county of Tolna, near the right bank of the Danube, 80 miles S. by W. of Budapest, Hungary, with 14,325 inhabitants in 1891 and 13,895 in 1901. Its most important buildings are the county hall, the castle of Baron Augusz, the Roman Catholic church, and the hospital. There are a rich county museum and the central inspectorship of silk- production. Its inhabitants are largely engaged in pro- ducing silk and fruits. In its vicinity is produced the celebrated red wine of Szegzard.

Szekesfchervar, a municipal town of Hungary, capital of the county of Fejer, 37 /niles south-west of Budapest, with 28,942 inhabitants in 1891 and 32,167 in 1901. Besides the administrative offices of the county, there are a county and a district court of justice, a chamber of advocates, a large episcopal library, a museum, a theatre, an archaeological association, a hospital, and nu- merous other public institutions. It is an important centre of national horse-breeding. It is

one of the oldest towns of Hungary, founded by St Stephen, first king of Hungary.

Szerencs, an old Hungarian market-town in the county of Zemplen, in the vicinity of the hills of Tokaj, 125 miles north-east of Budapest, with 4339 inhabitants in 1891 and 5272 in 1901. It is an important railway junction, and contains the largest sugar-refinery of Hun- gary, in which 1350 workmen are employed, and which produces yearly above 10,000 tons of fine sugar.

Szombathely (Steinamanger), a corporate town of Hungary, capital of the county of Vasvar (Eisenburg), 68 miles south of Pozsony (Pressburg), with 17,270 inhabit- ants in 1891 and 24,751 in 1901. It is an important rail- way and industrial centre, having a State rail way workshop, two manufactories of agricultural machinery, a foundry, a steam mill, &c. On its site stood the Roman Sabaria. Numerous remains of these are in the civic museum.

Taaffe, Eduard Francis Joseph von, Count [11th Viscount Taaffe and Baron of Ballymote, in the peerage of Ireland] (1833-18‘95), Austrian statesman, was born at Vienna on 24th February 1833. He was the second son of Count Ludwig Taaffe (1791-1855), a distinguished public man who was minister of justice in 1848 and president of the court of appeal. As a child Taaffe was one of the chosen companions of the young archduke, afterwards emperor, Francis Joseph. In 1852 he entered the public service ; in 1867 he was Statthalter

of Upper Austria, and the emperor offered him the post of minister of the interior in Beust’s administration. In June he became vice-president of the ministry, and at the end of the year he entered the first ministry of the newly organized Austrian portion of the monarchy. For the next three years he took a very important part in the confused political changes, and probably more than any other politician represented the wishes of the emperor. He had entered the ministry as a German Liberal, but he soon took an intermediate position between the Liberal

majority of the Berger ministry and the party which desired a federalists amendment of the constitution and which was strongly supported at Court. From September 1868 to January 1870, after the retirement of Auersperg, he was president of the cabinet. In 1870 the Govern- ment broke up on the question of the revision of the con- stitution : Taaff e with Potocki and Berger wished to make some concessions to the Federalists ; the Liberal majority wished to preserve undiminished the authority of the Reichsrath. The two parties presented memoranda to the emperor, each defending their view, and offering their resignation : after some hesitation the emperor accepted the policy of the majority, and Taaff e with his friends resigned. The Liberals, however, failed to carry on the Government, as the representatives of most of the terri- tories refused to appear in the Reichsrath : they resigned, and in the month of April Potocki and Taaffe returned to office. The latter failed, however, in the attempt to come to some understanding with the Czechs, and in their turn had to make way for the Clerical and Federalist cabinet of Hohenwart. Taaffe now became Statthalter of Tirol, but once more on the breakdown of the Liberal Govern- ment in 1879 he was called to office. At first he at- tempted to carry on the Government without change of principles, but he soon found it necessary to come to an understanding with the Feudal and Federal parties, and he was responsible for the conduct of the negotiations which in the elections of this year gave a majority to the dif- ferent groups of the National and Clerical opposition. In July he became minister president : at first he still con- tinued to govern with the Liberals, but this was soon made impossible, and he was obliged to turn for support to the Conservatives. It was his great achievement that he persuaded the Czechs to abandon the policy of absten- tion and to take pa>rt in the Parliament. It was on the support’ of them, the Poles, and the Clericals that his majority depended. His avowed intention was to unite the nationalities of Austria : Germans and Slavs were, as he said, equally integral parts of Austria ; neither must be oppressed ; both must unite to form an Austrian Parliament. Notwithstanding the growing opposition of the German Liberals, who refused to accept the equality of the nationalities, he kept his position for thirteen years. Not

a great creative statesman, he had singular capacity for managing men ; a very poor orator, he had in private intercourse an urbanity and quickness of humour which showed his Irish ancestry. The history of his administration will be found in the article on Austria. Beneath an apparent cynicism and frivolity Taaffe hid a strong feeling of patriotism to his country and loyalty to the emperor. It was no small service to both that for so long, during very critical years in Euro- pean history, he maintained harmony between the two parts of the monarchy and preserved constitutional government in Austria. The necessities of the parlia- mentary situation compelled him sometimes to go farther in meeting the demands of the Conservatives and Czechs than he would probably have wished, but he was essen- tially an opportunist : in no way a party man, he recog- nized that the Government must be carried on, and he cared little by the aid of what party the necessary majority was maintained. In 1893 he was defeated on a proposal for the revision of the franchise, and resigned. He retired into private life, and died two years later at his country residence, Ellerschau, in Bohemia, on 29th November 1895.

By the death of his elder brother Charles (1823-1873), a colonel in the Austrian army, Taaffe succeeded to the Austrian and Irish titles. He married in 1802 Countess Irma Tsaky, by whom he left four daughters and one son, Henry. The family history presents points of unusual interest. From the 13th century the Taaffes

had been one of the leading families in the north of Ireland. In 1628 Sir John Taaffe was raised to the peerage as Baron Ballymote and Viscount Taaffe of Corven. He left fifteen children, of whom the eldest, Theobald, took a prominent part in the Civil War, accompanied Charles II. in exile, and on the Restoration was created earl of Carlingford. He was sent on missions to the duke of Lorraine and to the emperor, by which was established the con- nexion of his family with Hapsburg and Lorraine, which has con- tinued to this day. His eldest son was killed in the Turkish wars. He was succeeded in the title by his second son Nicholas, who had served in the Spanish wars and was killed at the Boyne. The next brother Francis, the third earl, was one of the most cele- brated men of his time : he was brought up at

Olmiitz, at the imperial court, and in the service of Duke Charles of Lorraine, whose most intimate friend he became. He rose to the highest rank in the Austrian army, having greatly distinguished himself at the siege of Vienna and in the other Turkish campaigns, and was a member of the Order of the Golden Fleece. He was sent on many important diplomatic missions, and at the end of his life was chancellor and chief minister to the duke of Lorraine. Not- withstanding the Jacobite connexions of his family, his title to the earldom of Carlingford was confirmed by William III., and the attainder and forfeiture of the estates incurred by his brother was repealed. This favour he owed to his position at the court of the emperor, William's most important ally. On his death the title and estates went to his nephew Theobald, whose father had fallen during the siege of Derry, and who himself had served with dis- tinction in the Austrian army. On his death the title of earl of Carlingford became extinct ; both the Austrian and Irish estates as well as the Irish viscountcy went to a cousin Nicholas (1677- 1769). Like so many of his family, he was brought up in Lorraine and passed into the Austrian army ; he fought in the Silesian war, rose to be field-marshal, and was made a count of the empire. His Irish estates were, however, elaimed under the Act of 1703 by a Protestant heir : a lawsuit followed, which was ended by a com- promise embodied in a private Act of Parliament, by which the estates were sold and one-third of the value given to him. With the money he acquired the castle of Ellerschau, in Bohemia ; he had also inherited other property in the Austrian dominions. He was naturalized in Bohemia, and left on record that the reason for this step was that he did not wish his descendants to be exposed to the temptation of becoming Protestants so as to avoid the operation of the penal laws. His great-grandson was the father of the subject of this article. A Committee of Privileges of the House of Lords in 1860 recognized the right of the family to hold the Irish title.

See Wurzbach, Biographisches Lexicon Oesterreichs. Memoirs of the Family of Taaffe. Vienna, 1856. Privately printed. — Article in the Contemporary Beview, 1893, by E. B. Lanin.

(j. W. He.)

Taal, a town in the province of Batangas, Luzon, Philippine Islands, on the narrow neck of land which separates Bombon Lake from the Gulf of Balayan. It was formerly a beautiful town, noted for its fine houses and well-kept streets, but it was badly damaged by fire in 1900. It has a cool and very healthy climate. Extensive agricultural lands in its vicinity produce rice, Indian corn, pepper, cacao, and cotton, but the great coffee plantations which were formerly to be seen in its vicinity have been destroyed by an insect pest. Its inhab- itants raise cattle and horses in considerable numbers. Taal is the only town in the Philippines where effective efforts have been made to exclude the Chinese. The hostility of the inhabitants towards them was such that none succeeded in establishing a residence there until the latter days of the revolution against the American Govern- ment. The language is Tagalog. Population, 33,000.

Tabasco, a state of Mexico, bounded on the N. by the Gulf of Mexico, on the E. by Campeche, on the S. by Chiapas, on the S.E. by Guatemala, and on the W. by Vera Cruz. Area, 10,075 square miles. Population, (1879), 104,747 ; (1900), 158,107. This state possesses the best hydrographic system of the republic. The climate is hot, the temperature ranging from about 62° to 80° F. The agricultural products are valued at about $8,000,000 (silver) a year. The leading products are cacao, sugar-cane, coffee, tobacco, maize, rice, fruits, rubber, pepper, vanilla, logwood, cedar, mahogany, dye- woods, and cabinet woods. There is little mineral Wealth and no railways. The capital, San Juan Bautista, has

9604 inhabitants, and amongst the chief towns are Fron- tera, Balancan, Cardenas, Jalapa, Thapa, La Ermita, and Carrizal.

Tabor, the chief town of a government district in Bohemia, Austria, situated on an eminence between the Luschnitz, a tributary of the Moldau, and the Jordanteich, a small lake, 31 miles N.N.E. of Budweis. The town, which occupies the site of an ancient fortress of Kotnow,

owes its origin to the Hussites, who constructed a forti- fied camp on the spot in 1420. It contains, both in its ancient buildings and in the municipal museum, numerous memorials of the Hussite period. The Late Gothic Eathhaus (1521) bears the city arms in a framework which includes statuettes of Ziska, Procopius, Huss, and Jerome of Prague, together with a group of Adamites. The Gothic Decanalkirche (1516) contains an interest- ing zinc baptismal font (1472), and on the ring is one of the stone tables at which the Taborites used to partake in the open air of the communion in both kinds. In the immediate vicinity is the ruined castle of Kotnow, and also a mineral spring and baths. The industries include the manufacture of cigars and tobacco in the State factory, and of mother-of-pearl buttons, cloth, cotton goods, machine embroidery, tanning, brewing, and the production of malt and corn-milling. It has also an important trade in corn. Population (1890), 8440 ; (1900), 10,692, all Czech ; about 95 per cent. Catholic and 5 per cent. Jewish.

Tabrir, the capital of Azerbaijan, one of the five great provinces of Persia, situated at an elevation of 4420 feet in 38° 4′ N. and 46° 18′ E. In 1881 its popu- lation was estimated at 165,000, and is now said to be close upon 200,000.

The popular etymology of the name Tabriz, from tab= fever, Hz=pourer away (verb, rikhtan =pou.r away, flow), hence “fever-destroying,” is erroneous, and was invented in modern times. It is related that Zobeideh, the wife of Hariin ar-Rashid, founded the town in 791 after recovering there from fever, but the name Tabriz was known many centuries before her. In 1842 Hammer Purg- stall correctly explained the name as meaning the ” warm-flowing ” (

Tabriz was for many years the emporium for the trade of Persia on the west, but since the opening of the rail- way through the Caucasus and greater facilities for trans- port on the Caspian, much of its trade with Eussia has been diverted to Astara and Eesht, while the insecurity on the Tabriz-Trebizond route since 1878 has diverted much commerce to the Baghdad road. During the years 1867-73 the average value of the exports and imports which passed through the Tabriz custom-house in

a year was £593,800 and £1,226,660 (total value per annum £1,820,460); in the year 1877-78 (Eusso-Turkish war) the value of the exports was only £270,900, and that of the imports £525,500 (total £796,400). The following table gives the exports and imports for later years : —

Tear.

Exports.

Imports.

Total.

1893-94

£199,617

£411,541

£611,158

1894-95

162,808

350,339

513,147

1895-96

256,720

524,820

781,540

1896-97

227,630

648,920

876,450

1897-98

210,700

649,200

859,900

1898-99

219,930

682,330

. 902,260

There are reasons for believing that these values are considerably understated. For the year 1898-99 the writer obtained figures directly from the books kept by the custom-house official at Tabriz, and although, as

this officer informed him, some important items had not been entered at all, the value of the exports and imports shown in the books exceeded that of the consular report by about 10 per cent. The figures in the books were : Exports, 59,975£ bales or packages, value £227,492; imports, 101,748^- bales, &c, value £766,394; total value of exports and imports 1898-99 £993,886; total of customs levied £30,846 (average 3TV per cent). British, Eussian, French, Turkish, and Austrian consul- ates and a few European commercial firms are established at Tabriz, and the Imperial Bank of Persia has a branch there. (a. h.-s.)

Tacheometry, or rapid measuring, is the term given to a modern system of surveying by which the positions, both horizontal and vertical, of

points on the earth's surface relatively to one another are determined without the necessity of chain or tape measurements and without the use of a separate levelling instrument. Until recent times, the usual instrumental methodof determining the position of one point with respect to another was to centre a theodolite over one of the points and to read the horizontal angle to a pole at the other point from some zero of azimuth, such as the direction of a point already determined on a traverse line or some other known direc- tion. The horizontal distance from one of the points to the other was measured directly by a chain or tape. These two measurements sufficed to locate one point with refer- ence to the other on the plan, and the difference of height between the two was determined by a separate operation of levelling with a separate instrument. This method is fairly satisfactory when the ground is pretty clear of obstructions and not very precipitous, but it becomes extremely cumbrous when the ground is much covered with bush, or broken up by ravines— conditions which commonly have to be faced in new countries when it is desired to construct a railway or some other engineering work. Chain measurements are then both slow and liable to considerable error ; the levelling, too, is carried on at great disadvantage in point of speed, though without serious loss of accuracy.

These difficulties led to the introduction of tacheometry, in which, instead of the pole formerly employed to mark a point, a staff similar to a level staff is used. This- is marked with heights from the foot, and is graduated according to the requirements of the special form of tacheometer in use. The azimuth angle is determined as formerly. The hori- zontal distance is inferred either from the vertical angle included between two well-defined points on the staff and the known distance between them, or by readings of the staff indicated by two fixed wires in the diaphragm of the telescope. The difference of height is computed from the angle of depression or elevation of a fixed point on the staff and the horizontal distance already obtained. Thus all the measurements requisite to locate a point both verti- cally and horizontally with reference to the point where the tacheometer is centred are determined by an observer at the instrument without any assistance beyond that of a man to hold the staff. In this way a survey is effected in a rough country much more cheaply, more expeditiously,

and more accurately than by the old method, and many points are included in the survey which would have been neglected formerly by reason of the extreme labour and difficulty of the measurements.

The simplest system of tacheometry is that in which the instru- ment used is a theodolite without additions of any kind, and the horizontal and vertical distances are obtained from the angles of depression or elevation of two well-defined Subtense points on a staff at known heights from the foot, the method. staff being held vertically. In Fig. 1 let T be the tele- scope of a theodolite which is centred over the point C, and let AB be the staff, which is held truly vertical on the ground at A. Let

P and P’ be the two well-defined marks on the face of the staff, both of them at known heights above A, and enclosing a distance PP’=s between them. Let (o) and (/3) be the measured angles of

7^

m^wwm>im77n0Wrfjm’c

Fig. l.

elevation of P and P’, and let (d) be the horizontal distance TM of the staff from the theodolite, and (A) the height PM of P above T. Then P’M =

S = P’M – PM = d{ta.n £ – tan o).

.-. d=

h =

tan § – tan o s . tan a

tan p – tan a

If TO be the height of the rotation axis of the telescope above the ground, and TC=q, and if AP=p, then the height of A above C is h-p + q. If, as is usually the case, a number of points are determined from one station of the theodolite, and hlt A2> hs, &e., be the values of (A) for the different points Aj, A2, A3, &c, then the difference of level of A1 and A2 will be A2-fti, that of Aj and A3 will be h3 — klt and so on. To ensure the essential condition that the staff is held vertical, it is usually provided with a small circular spirit-level, and the staff-holder must always keep the bubble in the centre of its run. No graduation of the staff is required beyond two well-defined black lines across the white face at P and P', but the marks can be very usefully supplemented by wings fastened on the two sides of the staff, having their tops at right angles to the staff, at the same height as the points P and P', and forming a continuation of the black lines. A convenient length for the staff is 12 feet, with the

point P 2 feet from the foot, and the point P' at the

top of the staff, so that s=10 feet.

With the above arrangement the staff can easily be read with the telescope of a 5-inch theodolite at half a mile distance. But while it is frequently very useful to determine approximately points a long way off, the determinations will not be nearly so accurate as those of near points. Thus suppose that the distance of

amount to about 20 seconds of arc. At a quarter of a mile excel- lent work can be done. In carrying on a traverse line by this method with stations 10 or 12 chains apart, the theodolite being set up at points about midway between the stations, the probable distance error in a mile is about 3§ feet, and the probable level error about 4 inches. In 25 miles these probable errors would correspond to about 18 feet and 20 inches respectively. This system of tacheometry is well adapted for distant readings, and from the great simplicity of the observations there is little likeli- hood of errors in the field. But the reduction work is rather heavier than is the case with some of the tacheometers to be described presently. Since the accuracy of the method depends entirely upon the accuracy with which the vertical angles are measured, it is advisable that the vertical circle should be as large as possible, very finely and accurately divided, and fitted with good verniers and microscopes.

In Eckhold's omnimeter, described in the 9th ed. of the Ency. Brit. (vol. xxii. p. 719), the vertical circle of the theodolite is dis- pensed with, and a saving of reduction work is effected by reading, not the vertical angles themselves, but the tangents of the angles.

In the Ziegler-Hager tacheograph the tangents are read not horizontally but vertically, and the arrangement (which has been very carefully thought out) is as follows : — In Fig. 3 0 is the axis of rotation of the telescope ; mm, is the axial line of a steel bolt, which carries on its top a knife-edge, on which the telescope rests by means of an agate plate. The bolt is carried by a slide in which it can be raised or lowered

by a micrometer screw which is fitted witb a graduated head. The slide plays between the vertical

Fig. 2.

the staff is (d), and the intercept on the staff is (s), as in the annexed diagram (Fig. 2), and suppose that all the uncertainties of adjusting and reading, both personal and instrumental, amount to a small angle error (So) (o being the angle subtended by s at the telescope) ; then since

d(d)_ s 1 + tana a

“tana’ da~ sin2 a- ‘ tan2 a ‘

d=.

d(d)_ da

1 +

P=-){s*+cP).

d?

Therefore Sd, the distance error, is given by the equation Sd— – 8a. -(s2+rf2). But at distances of 5 chains or more (s2)

will be very small compared with (d”) and may be neglected, so

d2 that Sd = – da . — . And since 8a may be considered as constant

for all distances where the staff can be distinctly viewed and read, the distance error increases as the square of the distance, and will be four times as groat at half a mile as at a quarter of a mile. With small theodolites, where special care has not been given to the graduating and reading of the vertical circle, 5a will probably

Fig. 3.

cheeks of a standard rigidly attached to the frame of the instrument, and it can be raised or lowered by a rack and pinion movement. The telescope, which rests on the knife-edge, follows the movement of the bolt. The slide carries on one side a vernier by which to read the divisions on a scale fixed to one of the vertical legs of the standard, and the zero point (o) of the scale is the point where the horizontal plane through 0 cuts the scale when the plane-table or upper plate of the theodolite is truly level. The scale is graduated in divisions, each of which is the rMh part of the distance Oo, or (ft). The head of the micrometer screw which raises or lowers the steel bolt in the slide is graduated with a zero mark and with marks corresponding to a vertical

movement of the knife-edge of — , — ,

&c. The instrument

is used as follows :— Let AB be the surface of the ground, and BC a staff held vertically at B, and let CB be produced to meet the horizontal line through 0 in M. Let the head of the micrometer screw be turned till the zero division is exactly under the pointer. Let (p) be the zero division on the staff, and let the slide and bolt be raised by the rack and pinion movement till the optical axis of the telescope is directed towards (p). Let (v) be the point where the line Op cuts mm, and let the tangent reading ov be taken on the scale. Then let the telescope be lowered by the micrometer screw in the slide till the division on the head of the screw marked 1 is exactly under the pointer ; the knife-edge of the bolt

has then been lowered through «. distance vt equal to — •

Let (q) be the point on the staff where the line Ot cuts it, and let the reading at (q) be taken. Then since the triangles between 0 and mn and 0 and CM are_ similar to each other, and vi is rJ-^th of Oo, therefore pq will be y^th of OM, or OM = 100xpj. This gives the horizontal distance of the staff from 0, and the vertical distance ^>M of (p) above 0 is

OM tan M0p=0Mxg-‘ and since ov has been read in parts-

of which Oo contains 100, the

obtained. Suppose for example

in centimetres. Let the reading

26*4

= “264, and let the reading

distance pHL is readily

the staff is graduated

w=26”4, so that tan tlLOp

., and let the reading at (q) he 112 “5, so that

5^=112-5 centimetres. Then OM=100 x 112-5 = 112‘5 metres, andpM = 112‘5x -264=297 metres. If the difference of elevation of B and A be required, the height^M must be reduced by pB and increased by OA, both known quantities. By this arrangement the reduction work of the observations is rendered extremely simple, and can readily be performed in the field. The instrument is frequently used in connexion with the plane-table, for which purpose it is well adapted.

Tacheometers in which the horizontal distance of the staff from the telescope is deduced from the readings of the staff indicated by two fixed wires in the diaphragm of the telescope will now be considered. In Fig. 4 BC is a

Stadia method.

diaphragm fixed in a tube having fine horizontal ■wires at B and C. Let the end E of the tube be closed by a disc whioh has a minute hole at

E, to which the eye can be applied. If P*and D be the points on a vertical staff at which the lines EB and EC are observed to cut the staff, so that the intercept PD is known, then from similar triangles

ED = =5. PD, and since EC and BC are constant, ED varies as PD.

BC If for instance PD has a certain observed value when the staff is

Fig. 4.

held at a certain distance ED, and has exactly half that value

when the staff is held at-another distance ED', it would be at once

inferred that the distance ED' is one-half of the distance ED, and

so on in proportion. The distance ED can be instantly inferred

from the readings of the staff, if the latter be suitably graduated

for the desired unit of measurement. If, for example, it be desired

to know the distance ED in yards, and by construction the

Ff* proportion ===50, then the intercept on the staff at 1 yard from

E would be -^th of a yard, or 72 inch, the intercept at 2 yards from E would be 2 x 72 inches, and so on. If therefore the staff be graduated with divisions of 72 inch, and the intercept be 45 of such divisions, it would be inferred that the distance of the staff

FP from E was 45 yards. The constant proportion -^p can be easily

checked by measuring 100 yards from E and observing whether the intercept is exactly 100 divisions or not. If it is not, the wire diaphragm must be shifted in the tube until it is. In Figs. 4, 5, 6, and 7 the distances are deduced from the readings of a central wire in the optical axis of the telescope and of a wire above it, for the

inferred from the readings given by the corresponding wires above and below the central wire.

The foregoing elementary form of tacheometer has been given as illustrating the general principle of the class of tacheometers now under consideration, and as leading up to the practical form, in which the staff is viewed with ». telescope mounted in the manner of a theodolite. The simplest form is that of Reichen- bach's tacheometer, which may be investigated as follows : — In Fig. 5 let A be the object glass by which an image of the staff ST is formed at HK. The wire diaphragm is moved in the tube so as to coincide with the image, and the image and wires are viewed with an eye-piece (not shown) in the usual way. Let O be the point where the vertical axis of the instrument cuts the axis of the telescope, the instrument being centred over a peg, from which the distance to the staff is required. The object glass (of focal length =/) is at a distance (c) from O. Let AT=« and AH = ti, and the angle SAT = HAK = 0. Then if (i) be the height of the image HK,

i=v. tan 8.

+=■55 whence v= — .,

V u /' u-f

u-f Let F be some point on AT such that AF=a! and FT=«'.

And

■ tan 0.

let the angle SFT=0. Then u=u’+x and tan 6=

_(u’+x).f u’

■ tan =

f-W u’ + x-f

u’ + x tan .

And

tan (p.

u’+x-f u’ + x

And, if x=f, i=f. tan 4>.

If therefore the point F be taken at a distance (/) from the object glass, every intercept of the staff for positions between T and F, such as ST, S’T”, &c, which are bounded by the line FS, and for which consequently (

&

•mm>niif>M/>i//i/i>m

Kg. S.

Bake of simplicity. The usual arrangement is to fit the diaphragm with a central wire and with one or two wires above and below it at equal distances from the central wire. The vertical angle of depression or elevation is fixed by directing the central wire to a well-defined division on the staff, and the distance of the staff is

Fig. 6.

one-half of ST, and therefore if the reading on the staff indicated by the wire in question be one-half of ST, it may be inferred that the position of the staff is half-way between F and T, and similarly for other distances. If the distance of ST from O is required, as is usually the case, a quantity f+c must be added to every dis- tance from F determined as above. It is of course very seldom that the line of sight AT of the tele- scope is at right angles to the staff. In general it is more or less inclined to the staff, which is almost always held vertical, and the horizontal and vertical distances of the staff from the axis of rotation of the telescope are found thus : — In Fig. 6 let ST be the observed intercept on the staff when the telescope is in- clined at an angle (o) to the horizontal. Draw TS' at right angles to OT. The angle TS'S will be very nearly a right angle, and STS' may be taken as equal to (a). If there were (ri) gradua- tions (each corresponding to 1 yard in distance) in ST, there would be n . cos a graduations in S'T, and therefore the distance of the staff from F, as inferred from the observed number of graduations in ST, must be multiplied by cos o to give the true distance FT. Again FN = FT . cos o, so that the distance inferred from the observed number of graduations

in ST must be multiplied by cos2 a to give the horizontal distance of F from T. To this must be added the distance OL=OFcos a — (f+c) cos a to get the horizontal distance, OM, of 0 (the vertical axis of the instrument) from T. This value of OM must be multiplied by tan a to obtain the value of (h) the vertical distance of T from 0. Tables of the value of cos a, cos2 a, and tan a are necessary to facilitate these calculations.

The trouble caused by the fact that in the tacheometer last described the distances as inferred from the readings of the staff are the distances of the staff from F and not from 0 rendered it desirable to improve the instrument in this respect. This was done by M. Porro, who added a

lens (called the anallattic lens) to the telescope, which has the desired effect. The arrangement of the telescope, as manufactured by Messrs Troughton and Simms, is as follows : — In Fig. 7 0 is the point where the vertical axis of the instrument cuts the axis of the telescope. The object glass is

Ur—C-

Kg. 7.

fixed at a distance (c) from O, and the anallattic lens at a distance (d) from the object glass. The distances (c) and (d) are chosen to suit the constructive conveniences of the instrument. The diaphragm at K is movable so that it can be made to coincide with the image of the staff. The focal length (/a) of the object glass is fixed arbitrarily, and the focal length (/a) of the anallattic lens is determined from an equation of condition between c, d, fi , and/2, as will be seen presently. The image of the staff ST would be formed by the object glass at H, at a distance («j) from the object glass, were it not that the rays, after passing through the object glass, are received by the anallattic lens and the image of the staff is formed at K on the wire diaphragm, which is slid in the tube till it coincides with the position of the image. The image at K is viewed by an eye-piece in the usual way. Let T be the point where the image of the staff is cut by the central wire of the diaphragm, and S the point where the image is cut by one of the outer wires of the diaphragm. If (8) and (0) be the angles subtended by ST at the object glass and at the point 0 respect- ively, and if (») be the height of the image at K, and (h) the height of the virtual image at H, then

~~/strong>~~,; .-.,= |=3%. tan 9. h v-d vl-d vx-d

Again from optical considerations :

vi «A v% fA^-d)

1 1

— + –

vx ■u

1

~fx

1

“2

1

vl-d

1

A;

rf

JV«i

-d)

5f : u>=-

“A

/g(«i-

d)

l-rf+/2

“A i-<+/s «i-<*

tan 8 =

“AA

(«-/i)K-d+/a)

tan 8.

-„.„ j , f _ “A d>f-y-fi-(d -A) (” -A)

“AA

■ tan 8.

«A-(<2-A)(»-A)

Let OT=m’. Then u’=u + c, and u=u’-c. And u’ tan

= (m’~~c) tan 8, and tan 8~~

■ tan 0

(“■’-“ViA

(«’ – c)fi – {d -f2) (it’ – c -/j) u’-o

“A A

tan 0

tan 0

«’(A – d +A) – {A – (e +A) (d -A)} Let (A) be made suon that A – (c +A) (d ~~A) = °~~ Then

rf-A=^V,and/2=^+^-<*

And «=7-4×7 • tan *=>%&&=& • tan

Therefore all the readings of the staff which would be given by

the outer wire of the diaphragm will lie on the line OS (for all of which ((p) is the same), and the distance from 0 along OT will be proportional

to the reading on the staff. Thus if the staff be suitably graduated, the distance from 0 can be immediately de- duced from the reading. Also, as before, if the telescope be inclined at an angle (a) to the horizontal, the distance OT interred from the number of graduations in ST must be multiplied by cos2 a to give the horizontal distance of 0 from T, and the hori- zontal distance so obtained must be multiplied by tan a to obtain the vertical distance of T from 0.

The inconvenience of the reduction work necessary to obtain the horizontal and vertical distances produced the Wagner-Feunel tacheometer, by which the distances can be read directly from the instrument. As is seen from Fig. 8, three scales are provided to measure the inclined distance, the horizontal distance, and the vertical distance respectively. All three are arranged in a plane parallel to the plane in which the telescope turns. The inclined scale is attached to the telescope exactly parallel to its line of collimation, and moves with it. The horizontal scale is fixed to the upper horizontal plate of the theodolite. The vertical scale is on th£ vertical edge of a right-angled triangle, which can be slid along on the top of the horizontal scale. The in- clined scale carries a slide which is provided with two verniers. One of these is parallel to the inclined scale, and is for the purpose of setting- off on the scale (in terms of the divisions on the scale) the inclined distance of the staff from the axis of rotation of the telescope. The other turns on a pivot whose centre is accurately in the edge of the inclined scale at the point where the zero division of the inclined .vernier cuts the edge, and is for the purpose of reading the vertical scale ; it can be turned on its pivot so as to be vertical whatever may be the inclination of the telescope. Moreover, since the distance from the centre of the pivot to the zero of the vernier is always constant and known, the vertical scale can be gradu- ated so that the reading of the vernier gives the height (in terms of the division on the scale) of the staff above the axis of rotation of the telescope. The horizontal scale attached to the horizontal plate of the theodolite is read by means of a vernier carried by the triangle. To ascertain the horizontal and vertical distances of the point on the staff which is cut by the middle wire in the diaphragm of the telescope from the rotation axis of the

Fig. 8.

telescope, the inclined distance of the point on the staff is read by means of the wires, as in Porro's tacheometer. This distance (in terms of the divisions) is then set off on the inclined scale by means of the inclined vernier, and the vertical scale on the triangle is moved up to the vertical vernier, which is adjusted to its edge. With proper graduation of the horizontal and vertical scales the horizontal and vertical distances can be at once read off on the scales. This method, however, requires that the staff be held so that its face is perpendicular to the line of sight, which is more troublesome than holding the staff vertical.

Photographic surveying is used in Canada and elsewhere for filling in details after a number of points have been determined trigonometrically. To do this a special camera

is used which is provided with a telescope for sighting, as shown in Fig. 9. The camera being centred over one Photo- of the given points and set truly horizontal, graphic photographs of the country are taken in different surveying, directions, which are defined by the azimuth angles from the direction of another of the given points. The camera is then removed to another of the given points, and a set of photographs is obtained as before. All the salient points which are common to both stations are sought out and marked on the photographs. The locating of these common points on the plan is done in the office. The azimuth angles of the salient points right or left of the vertical centre line on a photograph from the centre of

Fig. 9.

the lens will be the same as the azimuth angles of the points themselves on the ground from the centre of the lens. Therefore to plot the directions of the salient points on the plan, a line is drawn from the station point in the exact direction in which the camera faced when one of the photographs was taken. Then the photograph is placed on edge at right angles to the lines so drawn at a distance from the station point equal to the known distance of the centre of the lens from the photograph at the time when it was taken. The directions of the salient points on the plan will be the azimuthal directions of the same points on the photograph, and lines can be drawn on the plan accordingly. In practice the distances of the salient points right and left of the centre line on the photograph are copied on the edge of a slip of paper which is placed flat

on the plan in the position of the photograph, and is used instead of it to facilitate the drawing of the lines. In the same manner the direction lines of the same salient points (or as many of them as can be recognized) are plotted from a photograph taken from another of the station points. The intersections of these lines give the positions on plan of the salient points. Some information regarding the contour of the ground can also be obtained by noting where the horizon lines on the different photographs cut the hill slopes, &c. This method of surveying has the advantage that it does not require continuously fine weather to the same extent as surveying by the plane-table.

All the instruments that have been described have advantages peculiar to each, and, speaking generally, one is preferable to another only in consideration of the circum- stances in which it is to be employed. The advantage of a light instrument over a heavy one is very great in the field, and tacheometers that depend upon the accurate reading of divisions on a staff require a larger telescope and a heavier construction than those in which the observation merely consists in bisecting a broad and well- defined mark on the face of a staff. It must be remembered too that the reduction work of the observations, if it is mainly effected, as in some of the tacheometers, by in- genious mechanical contrivances attached to the instrument, introduces delicate parts and delicate adjustments which require special care.

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(w. Ay.)

Tachien-lu. See Tibet.

Ta.cn a, or San Pedeo de Tacna, a town of Chile, capital of the province and department of the same name. Population (1895), 9418. By the treaty of peace of 20th October 1883 with Peru, Chile came into possession of the territories of Tacna and Arica for a term of years, after which a plebiscite was to decide the final ownership of the country. In 1902 this had not yet been done (see Chile, Peru). The Chilian Government by the law of 31st October 1884 organized the country temporarily as a province. Tacna is in communication with Arica by a railway. The province has an area of 8688 square miles, and population (1900), 25,031.

Tacoma, a city and seaport of Washington, U.S.A., capital of Pierce county, on Commencement Bay, at the head of Puget Sound, in the western part of the state. The business part of the city is situated on the steep face of bluffs rising some 200 feet from the water, while the residence part spreads over the rolling summit. It is regularly laid out, with broad streets, which are paved in the business quarter. It is divided into eight wards, has ample water-supply, and is well sewered. Among its fine buildings are the court house, city hall, chamber of commerce, Tacoma Hotel, and many business blocks. Tacoma is the principal western terminus of the Northern Pacific Bailway, whence branches run to Seattle and Portland, and with its excellent harbour it is probably the chief commercial port on Puget Sound, excelling Seattle

in foreign trade. Its exports consist in great part of wheat, flour, and lumber, and its imports, which are inconsiderable, of tea from China and Japan. In 1900 it contained 381 manufacturing establishments, with, a total

capital of $8,146,691. They employed 4347 hands, and the product was valued at $12,029,497. Of this $2,721,006 was the value of lumber manufactures, which was the largest item. It is the site of Puget Sound University, a Methodist Episcopal institution, opened in 1890. The assessed valuation of real and personal pro- perty was in 1900 $20,023,955, the net debt was $4,340,096, and the rate of taxation was $29 per

$1000. Tacoma was laid out in 1863. In 1873 it was adopted as the terminus of the Northern Pacific railway. In 1880 it had a population of 720, but upon the com- pletion of this railway a boom commenced, which in- creased the population to 36,006 in 1890 ; since which time the city has made but little growth, having in 1900 37,714 inhabitants, of whom 11,032 were foreign-born and 1244 coloured, including 307 negroes.

TACTICS.

I. Artillery.

THE objects of artillery are primarily to commence an action by firing on the enemy at long ranges before the infantry comes into play, to break down and Objects. sukdue *ne nre of the enemy's artillery by

concentrating on it the largest number of guns available as early as possible, so as to prepare the way for the infantry attack, and then to support the latter by firing upon the enemy's infantry. To attain these objects, massing the guns in position as soon as the enemy comes within range is the principal aim of artillery tactics. The enemy will of course

endeavour to do the same thing so that it must be sought to establish a superiority of guns from the earliest moment. To enable artillery to be thus employed it should march as closely as possible to the heads of the columns of troops and on the best roads, care being taken that there is always a sufficient force in front to protect it from attacks. When on the march, artillery will be protected by the troops marching with it, but the officer commanding should always employ his own scouts to ascertain that the front and flanks are clear of the enemy. Artillery while on the march is helpless, and at the mercy of even small bodies of cavalry and infantry. In addition to these scouts, it is most desirable to send out a specially selected officer with some non-commissioned officers or gunners to reconnoitre the ground. This officer and his party will march with the leading portion of the advanced guard. They should reconnoitre the ground so as to be able to select an artillery position as soon as the march of the advanced guard is checked and it has been decided to accept battle or to await the enemy's attack. The artil- lery commander, when he comes up, ought thus to have all information regarding the position and the objective. In a European theatre of war the great range and ac- curacy of modern guns render the combined action of a

group of batteries far more effective than was un«.'Ca/ formerly the case, and this tends to increase the

size of the tactical unit. Whereas formerly this tactical unit was the battery, now the brigade division, consisting of two batteries in the horse and three in the iield artillery, under the command of a lieutenant-colonel, is the tactical unit in peace and in war ; and this unit should as far as possible be always kept together in quarters and cantonments, on the march and on the battlefield. It will, however, nearly always be neces- sary, except in very open ground, for the batteries of a brigade division to move into position independently after the lieutenant-colonel has pointed out to the battery commander the position selected. The advance into action should, when possible, be continuous and simul- taneous after the position and the objective have been

decided on. The general officer commanding Cos!th>af *^e armv decides upon the plan of action, and

therefore broadly on the position for the artillery. The choice oJi the actual position depends principally

on tactical considerations, but there are also many technical objects to be regarded, such as a position diffi- cult for the enemy to range on, no woods or folds in the ground either in the front or on the flanks, which would conceal an enemy and enable him to creep up unperceived There should also be cover for the waggons, limbers, and spare horses within a convenient distance of say not more than 400 yards in rear, and natural cover for the guns is also an obvious advantage. An ideal position should have command over the surrounding country and a clear view of all possible lines of advance of the enemy. There should be a gentle slope to the rear so as to allow of the guns being placed as far as possible out of sight, or en- tirely withdrawn under cover, in case they be temporarily overpowered by those of the enemy. There should be no obstacles to advance or retirement. The flanks should rest on natural obstacles such as a lake or river. The position for his guns having been selected by the artil- lery commander, the lieutenant-colonel fixes on Advance the exact spot for his brigade division, which he position. either brings up himself or directs his adjutant to bring up from the ” covered ” or ” rendezvous ” position in which it has been waiting and preparing for an imme- diate advance into action. From this point the advance into action should be made continuously, and at as rapid a pace as is consistent with steadiness and the nature of the ground.

It may, however, sometimes be desirable to bring up the guns under cover by means of the horses, then un- limbering them and running them up by the gunners into the exact position selected for them. In the early phases of a battle, especially on the defensive, when time is avail- able and the ground favourable, every possible means of concealing the guns and deceiving the enemy should be adopted. This deliberate or ” creeping ” method, as it has been called, is then suitable. But subsequently, when it is necessary to move in, to the support of infantry

or to sub- due the enemy's guns, the direct or " continuous " method is the only one by which to come into action. It is in the majority of cases the best method, and it is certainly the most in consonance with the traditions of the British artillery. When once the guns are in action they should so remain until it is necessary for them, through being marked or being unable to see the target, to take up a new position. Unless in imminent danger of being lost, guns in action should not be withdrawn without the consent of the officer commanding the force, as the re- tirement of guns has a bad effect on the morale of other . troops.

As soon as a fresh advance becomes desirable, the com- manding officer must ride rapidly forward and select another position which may possibly have been partially reconnoitred already. Before the brigade division moves, however, the new position and its approaches must be thoroughly. scouted, and this duty should on no account be entrusted to the cavalry or infantry escort alone, but must be carried out by trained artillery scouts, or preferably

cavalry]

by an officer. When a second position is taken up, the objective will usually be the enemy's attacking infantry, but the artillery commander must be prepared at any moment to renew the artillery duel and to maintain his superiority. He will, as soon as the enemy's artillery fire is subdued, turn his attention again to their infantry and cavalry. Should a counter attack be ordered, the artillery will usually advance with the force detailed for the purpose, giving it moral and physical support, and not shunning the closest ranges.

The war in South Africa has shown that in open coun- try artillery cannot now approach within 2000 yards of unbroken infantry, which is not engaged with other troops, without suffering very severely in men

and horses. During the decisive phase of a battle, however, the effec- tive zone of infantry fire cannot be shirked, and regardless of risk and losses, artillery must go into close range and support the other arms up to the moment when success is practically assured. If, however, a retirement becomes necessary, and the army is driven back, the r61e of artillery becomes most important, but at the same time difficult and dangerous.

The general principle of the employment of artillery in retreat is to take up successive positions and delay the advance of the pursuing troops. In the case where the artillery finds an exceptionally strong position with the flanks secure from a turning movement, the rearguard need not confine itself to merely showing fight, but may resist an attack to the utmost of its ability. The artillery commander should, however, remember that the army is constantly retiring, and he should see that his guns do not remain in action so long as to endanger their capture.

Horse artillery with cavalry will often be employed to cover the retreat of a beaten army, and their mobility points them out as specially adapted for this duty. The action of a rearguard is one of the most difficult opera- tions of war, especially when covering the retreat of a beaten army. The artillery of a rearguard should be very active, and have a large supply of ammunition. An ad- vanced guard fights under favourable moral conditions, knowing that it can constantly expect reinforcements ; orders need not be waited for, and risks may be freely incurred. A rearguard, on the other hand, knows that every moment the main body is marching away from it, that no reinforcements can come up, and that if it remains too long in position it is likely to be overwhelmed and its flanks turned. Cavalry and horse artillery are equally useful in the pursuit of a beaten enemy.

Artillery is seldom employed in the front line of out- posts, except when a defile or important approach has to be defended, or when the front line of outposts is on the line of resistance. Its place will generally be with the reserve of outposts, and special precautions should be taken to guard against guns on outpost duty being sud- denly rushed. If the outposts are intended to retire and not to hold their ground, any guns

should be withdrawn before they are exposed to infantry fire. To extricate them might otherwise embarrass the action of the main force.

Wars with savages and with partly disciplined troops differ very much from each other and from campaigns in Europe ; it is therefore necessary to adapt our war/a” equipment and our tactics to the customs of the enemy, and to the nature of the country in which operations are being carried on. If scouting and reconnaissance are necessary in presence of a European enemy, they are even more important, as was learnt by bitter experience, when dealing with the crafty hill-tribes of India and the rapidly-moving and artful Boers. The importance of taking proper precautions against surprise

is obvious, and yet instances occur in almost every campaign of culpable neglect of this essential military requirement. As artillery is at the mercy of a sudden rush of savages or mounted irregular troops while on the march, it should never move until its intended route has been thoroughly reconnoitred.

The war in South Africa has demonstrated that forces acting on the defensive in a friendly country, and having a line of railway communicating with their base, v f can employ in the field much heavier guns than heavy guns had been contemplated. The conditions of this ’” the war were, however, somewhat exceptional, and fleId’ it is doubtful whether these long high-velocity guns with flat trajectory are so generally effective as the lighter howitzers which fire a heavier shell with a high explosive at larger angles of elevation. Most Powers have decided that a few howitzer batteries should always accompany their armies in the field. The British 5-inch howitzer, throwing a 50-ft> shell filled with lyddite, seems well adapted to dislodge troops from natural or artificial cover or villages, &c. (a. h. c. p.)

II. Cavalry.

In what manner the cavalry of the 20th century will differ from the hussars and cuirassiers of the 19th is undoubtedly, from a military point of view, one of the most interesting and most momentous questions of the day. Of the three arms, cavalry has undergone the least

change since the introduction of gunpowder. The load upon the horse has been gradually lightened, but defensive armour has not yet been altogether discarded ; and although the carbine and revolver have been added to the equipment of the trooper, there are armies in which weight, of both man and horse, is reckoned a more important attribute than either marks- manship or activity. Shock-tactics, the charge, and the hand-to-hand encounter are still the one ideal of cavalry action; and the power of manoeuvring in great masses, maintaining an absolute uniformity of pace and formation, and moving at the highest speed with accurately dressed ranks, is the criterion of excellence. To such an extent has this teaching been carried that the efficiency of the individual, especially in those duties which are carried out by single men or by small parties, cannot fairly be said to have received due attention. When cavalry held the pride of place upon the battlefield, as in feudal times and even later, the mastery of both horse and weapons by the individual officer and trooper was the predominant factor. In the English Civil War, for instance, the horseman- ship and skill at fence of both Cavalier and Roundhead were remarkable; and their encounters were far more hotly contested and much more bloody than any which have since been seen. That the Parliamentarians, after the first year or so of the war, were generally successful, is to be ascribed to Cromwell's introduction of a severer discipline in the ranks of the Ironsides, no less than to his admirable leading. His troopers were taught the value of co-operation; and the means of ensuring co-operation, i.e., uniformity of pace and precision of move- ment when in mass, were constantly practised upon the training-grounds. Nor are we to suppose that Cromwell was blind to a further advantage derived from the capacity for manoeuvring at speed. He had seen too much of cavalry fighting, at the time he first took over the command and training of a considerable force, not to understand the great moral effect of large bodies of horse- men, wheeling and forming with mechanical smoothness, covering the ground at a speed that almost made each attack a surprise, and charging in lines whose unbroken front produced a most powerful impression of solidity and

resolution. He saw, as Rupert never saw, that the power of swift movement in mass conferred upon the troops pos- sessing it the enormous advantage of tactical mobility ; and the readiness with which his regiments and brigades were transferred from one quarter of the battlefield to the other, throwing in their whole weight, time afte,r time, at the point where their presence was decisive, in contra- distinction to the reckless and ill-managed onsets of the Royalists, which ended, as a rule, in a confusion which it took hours to abate, show that he had fully realized the practical value of steady and continuous drill. It is to be noted, however, that Cromwell built up his cavalry on a foundation of high individual efficiency.

As time went on and armies became larger, and skill at arms, as a national characteristic, rarer, drill, disci- pline, manoeuvres in mass, and a high degree of mobility came to outweigh all other considerations ; and when the necessity of arming the nations brought about short ser- vice, the training of the individual, in any other branch of his business than that of riding boot to boot and of rendering instant obedience to the word or signal of his superior, fell more and more into abeyance. Shock- tactics filled the entire bill, and the cavalry of Europe, admirably trained to manoeuvre and to attack, whether by the squadron of 150 sabres or the division of 3000 or 4000, was practically unfitted for any other duty. The climax of incompetency may be said to have been reached during that cycle of European warfare which began with the Crimea and ended with the Russo- Turkish conflict of 1877-78. The old spirit of dash and daring under fire was still conspicuous. Discipline and mobility were never higher. The regiments manoeu- vred with admirable precision at the highest speed, and never had great masses of horsemen been more easily controlled. And yet, in the whole history of war, ifmay be doubted whether the record of the cavalry was ever more meagre. It is true that in the course of the cam- paign of 1870-71 the German cavalry learned something of scouting, and that, owing to the utter supineness of the enemy, it obtained a large amount

of valuable infor- mation. But its failures in this respect, especially at the outset, were very many ; and it is not too much to say that, so fap as peace training is concerned, it was little, if at all, superior to the cavalry of any other European Power. Moreover, when called upon to act dismounted, and to meet the enemy with fire instead of with I'arme blanclie, it proved absolutely useless. The carbine was a popgun ; the troopers knew nothing whatever of fighting on foot ; their movements were impeded by their equip- ment ; and a few francs-tireurs, armed with the chasse- pot, were enough to paralyse a whole brigade. That the cavalry so far screened the march of the armies in the rear that the French could obtain no information of the various movements is not to be gainsaid ; but the efforts of the Erench to pierce the screen were feeble in the extreme, and there is no proof whatever that against a more active adversary the same result would have been achieved. In fact, to the student who follows out the operations of the cavalry of 1870-71 step by step, and who bears in mind its deficiencies in armament and train- ing, it will appear very doubtful whether a strong body of mounted riflemen, of the same type as the Boers, or, better still, as Sheridan's or Stuart's cavalry in the last years of the War of Secession, would not have held the German horsemen at bay from the first moment they crossed the frontier.

Had the successes gained by shock-tactics been very numerous, it might possibly be argued that the sacrifice of efficiency in detached and dis- mounted duties, as well as the training of the individual, was fully justified. But what are the facts ?

Shock tactics

The successes gained by shock-tactics, where anything larger than a regiment was engaged, are confined to the following : —

1. The victory of the British Heavy Brigade at Bala- klava.

2. The charges of some twenty squadrons at Custozza, manoeuvring by brigades, which checked and partially routed three divisions of most indifferent infantry.

3. The charges of the Austrian cavalry at Koniggratz, which drove back the Prussian horse and enabled Bene- dek's defeated troops to get away in safety.

4. The charge of six squadrons at Mars-la-Tour, which went through a French army corps, largely composed of recruits.

5. The defeat of 2500 French horsemen, also at Mars- la-Tour, by about the same number of Germans.

6. The charge of the 11th and 17th German Hussars, near Vionville, against retreating infantry.

7. The charge of the German Brigade at Loigny- Poupry, when a small brigade charged down on the flank of a large body of half-trained French infantry and put them out of action for about three-quarters of an hour.

Such is the record : one great tactical success gained at Custozza; a retreating army saved from annihilation at Koniggratz , and five minor successes, which may or may not have influenced the ultimate issue; not one single instance of an effective and sustained pursuit; not one single instance, except Custozza, and there the infantry was armed with muzzle-loaders, of a charge decisive of the battle; not one single instance of infantry being scattered and cut down in panic flight; not one single instance of a force larger than a brigade inter- vening at a critical moment. And how many the fail- ures ! How often did the cavalry dash vainly in reckless gallantry against the hail of a thin line of rifles ! How often were great masses held back inactive, without drawing a sabre or firing a shot, while the battle was decided by the infantry and the guns ! How few the enterprises against the enemy's communications ! How few men killed or disabled, even when cavalry met cav- alry in the melee ! Can it be said, in face of these facts, that the devotion to shock-tactics, the constant practice in massed movements, the discouragement of individual- ism, both in leaders and men, was repaid by results ? Does it not rather appear that there was some factor present on the modern battlefield which prevented the cavalry, trained to a pitch hitherto unknown, from escap- ing the same harvest as the

horsemen of previous eras ? Was not the attempt to apply the same principles to the battle of the breech-loader and the rifled cannon, as had been applied successfully to the battles of the smooth- bore, a mistake from beginning to end; and should not the cavalry, confronted by new and revolutionary condi- tions, have sought new means of giving full effect to the mobility which makes it formidable ?

The answer comes from across the Atlantic. It was as much the length of the War of Secession as native ingenuity which enabled the Americans to work out so many military problems to their logical ^j^JSJI. conclusion. Their cavalry, in the beginning, was formed, so far as possible, on the European model. But before long it became a new type. It could manoeuvre sufficiently well for all practical purposes. It was exceedingly mobile. It could charge home with the sabre or the revolver. In addition, it was so equipped that it could fight on foot as readily as in the saddle, and it was so armed and trained that when dismounted it was but little inferior to the infantry. Environment undoubtedly had much to do with its evolution. In the forests of the South there was seldom space for the manoeuvres of a mass of horsemen, and obstacles were so

numerous that a few men, armed with rifles, were gene- rally able to beat back the charge of many squadrons. Nevertheless, the ground was not so cramped and difficult that shock-tactics were out of the question. Great cavalry combats, in which both sides rode at each other, were far more frequent than in any of the European campaigns referred to above ; and the instances of cavalry charging infantry are so numerous as completely to disprove the common belief that the American horsemen were merely mounted infantry. The truth is that the Americans struck the true balance between shock and dismounted tactics. They were prepared for both, as the ground and the situa- tion demanded ; and, more than this, they used fire and Varme blanche in

the closest and most effective combina- tion, against both cavalry and infantry. Due respect was paid to individualism. The veteran trooper, when in the last years of the war he attained the proficiency at which his great leaders had always aimed, was a good shot, a skilful skirmisher, a good horseman, and a useful swords- man. He could charge home, either mounted or dis- mounted. He had learned to scout, both in the saddle or on foot. His individualism was carefully cultivated; and if, for the purpose of manoeuvring in large bodies, he was less well drilled than his European contemporary, as a fighting man, trained to all the exigencies of war, he was very much his superior. So brilliant were the achieve- ments of the cavalry, Federal and Confederate, that in the minds of military students they have tended, in a certain measure, to obscure the work of the other arms. Space forbids an enumeration of even its most considerable successes. But it may be said that there is no finer in- stance of a pursuit than that of Lee's army by Sheridan in 1865 ; none of a screen impenetrable, even by a vigor- ous enemy, than that formed by Stuart in 1863-64; none of a well-contested cavalry battle than that near Brandy Station, 9th June 1863; none of cavalry on the defen- sive than the resistance of the Confederate horsemen before Spottsylvania on 8th May 1864, or of the Federals near Hawes' Shop, six weeks later; none of effective intervention on the field of battle than Sheridan's hand- ling of his divisions, an incident most unaccountably overlooked by European tacticians, when Early's army was broken into fragments, principally by the vigour of the cavalry, in the valley of the Shenandoah.

Nor are these all. Continental writers have persistently decried the value of the so-called raids, in which whole divisions of cavalry rode boldly round the hostile army, crossing his communications, and spreading panic and embarrassment far and wide ; and doubtless, in several in- stances, the results were hardly worth the risks involved. But many of these enterprises were much more than forays or reconnaissances. Large bodies of cavalry, accompanied by horse artillery, and stripped of everything which would impede their mobility, operated for weeks, and even months, as detached forces, with specific strategical mis- sions, and the value of their work cannot be overrated. " The secret of war," said Napoleon, " lies in the commu-

nications.” The profound wisdom of this remark has never been more forcibly illustrated than in the great American conflict. The lines of supply and of retreat were the first pre-occupation of every leader of an army ; their importance is continually impressed on even the casual student of the several campaigns; and they ap- pear to have played a far more prominent part than is usually the case. To a certain extent the character of the theatre of war was accountable; but the strategical use of a well-organized, well-trained, and well-led cavalry had even more to say to it. If the chief difficulty of the American generals was the maintenance of their commu- nications, it was because these communications were attacked with a method and a persistence which had

been hitherto unknown in warfare. The operations of Forrest, of Grainger, of Wilson, of Earl van Porn, of Sheridan, and of Hampton are brilliant examples of the great strategical value of a cavalry which is perfectly independent of the foot soldier, and which at the same time is in the highest degree mobile. Those who have never had to deal with the communications of an army may be unable to realize the effect that may and has been produced by such a force ; but no one with the least prac- tical experience of the responsibilities which devolve upon a commander-in-chief will venture to abate one jot from the enormous strategical value assigned to it by American soldiers. It may, however, be unhesitatingly admitted that no cavalry of the 19th century, except the American, could have achieved the same results ; and, as these results were far greater than those produced by any other cavalry since the advent of the breech-loader, it may be just as unhesitatingly declared that the horse- man of the American war is the model of the efficient cavalryman.

The evolution of the American trooper is due, in the main, to new tactical conditions. In 1861 fire had already become the predominant factor in battle. In range and accuracy the rifle so far surpassed the musket that the infantry was more formidable than ever; and even small forces, unless taken at disadvantage, had very little to fear from a much larger number of cavalry armed with lance or sabre. In order, then, to avoid being brought to a standstill at every turn by a few

riflemen, the cavalry leaders soon found it necessary that at least a portion of their command should be equipped with fire- arms. A trial was given to the carbine, but despite its handiness, it was soon discarded in favour of the long rifle ; and it was not long before the whole of the cavalry, with the exception of those regiments which carried breech-loading carbines, were armed, in addition to the sabre, or to the sabre and the revolver, with the same weapon as the infantry. It may fairly be asked whether a European cavalry, in ease of war, would not be com- pelled, and compelled with even greater force, to follow precisely the same course as the Americans of 1861-65, substituting the rifle for the carbine, and modifying its tactics to meet the conditions of modern battle ?

Let us consider the duties which cavalry is called upon to perform. In the first place, it is required to cover the front and flanks of the army to which it is attached, securing it from surprises, and en- ^vairy1 abling it to carry out movements of concentra- tion or other strategical manoeuvres unobserved. In the second place, it is required to burst through the screen which covers the movements and manoeuvres of the opposing army, and to obtain the information which is absolutely essential to the commander-in-chief. Its action is thus twofold, protecting and at the same time aggressive ; but its immediate enemy being the same in both cases, the enemy's mounted troops, it is evident that a bold offensive, which succeeds in sweeping away the hostile squadrons, is the readiest means of accomplishing the double duty. Attack, therefore, would seem to be imposed upon the cavalry so long as the armies are manoeuvring ; and the collision of large masses of horsemen, both seeking the encounter, a necessary preliminary to the meeting of armies on a decisive field. Now, when two bodies of cavalry meet in conflict, shock-tactics and Varme blanche are unquestionably the speediest, the traditional, and the most natural method of deciding the issue. Thus shock- tactics, until one or other of the opposing bodies has been reduced to impotency, have been generally assumed to be the usual method by which cavalry will seek to attain its object. This conclusion, however, will not stand the test of examination. In the first place, the action of the

covering cavalry cannot be entirely aggressive. While the main body is moving to seek the enemy, there will be points, such as roads, bridges, fords, and the like, which, in the interests of the duty of protection, as well as to give the cavalry itself due freedom of manoeuvre, will be economically and effectively held by riflemen. In the second place, fire, both before and during an encounter, has always been easily a most valuable auxiliary, as is proved by the existence of horse artillery. Thus in this phase also the presence of a body of riflemen, accompanied by machine-guns, will confer the greatest freedom of manoeuvre on the force to which they belong, embarrassing the enemy, covering the line of retreat, and relieving the cavalry commander of all anxiety for the safety of his waggons and the security of his communica- tion. In the third place, it is exceedingly improbable that in one quarter or other of the theatre of the cavalry operations the ground will not be of such a character as to favour dismounted tactics. It is evident therefore that cavalry, even when confronted only by mounted troops, cannot rely on shock-tactics only to achieve its object, and that the rifle is an absolutely indispensable auxiliary.

Arising out of these considerations two most important questions present themselves : — ■

(1) Are shock-tactics any longer possible against a

force which is endowed with a high degree of fire-power ?

(2) Should the fire-power which has been shown to be

essential to the free and effective working of cavalry be supplied by the cavalry itself, or by highly mobile infantry ? A force endowed with a large degree of fire-power possesses the most formidable attribute of infantry, and not even the most vehement partisan of I’arme blanche

denies that against infantry, unless surprised, shock-tactics have the very smallest chance of success. But troops who dismount to make use of their rifles have two great disadvantages to contend with. The led horses are a source of weakness, physical and moral. They form a most sensitive and most vulnerable point. It is not always easy to place them in security ; and the fact that they constitute the sole means of retreat renders them a source of continual anxiety both to officer and man. The former is preoccu- pied with providing for the safe cover of a crowd of ani- mals ; the latter, fully realizing his helplessness and discomfort if deprived of his mount, is never quite happy when there is the slightest chance that they may become separated. In consequence there is always a tendency on the part of dismounted men to think more of getting safely into the saddle than of offering a protracted resist- ance ; they are thus less stubborn in defence than in- fantry, and more inclined to give way when there is a danger of their being outflanked. Now, there can be no doubt, when led horses and a safe retreat are concerned, that shock-tactics, which are the essence of rapidity and surprise, are far more to be feared than the slower pro- cess of an attack on foot. It is beyond question, there- fore, that in dealing with a dismounted force, whatever may be the degree of fire- power with which it is endowed, shock-tactics may play a most important part. The opportunities of effective outflanking or of surprise may possibly be few ; but the very fact that the enemy has both the power and the will to seek out such opportuni- ties and to charge home, is bound to hamper the move- ments and to affect the moral of any force of horsemen which depends on fire alone. Such a force, even if it could hold on to its position, would be unable, except under favourable conditions of ground, to make any for- ward progress, for directly it mounted it would be at the mercy of its antagonist, and it would thus be absolutely I

prevented from bursting through the hostile cavalry and of acquiring the information which it is its main object to obtain. In the valley of the Shenandoah, in 1864, the Confederate squadrons were armed only with rifles, while the Federals, under Sheridan, were trained both to fire and to charge. The result is significant. The Southern- ers, though admirable horsemen, were worsted at every turn, and their

commander had at last to report that his mounted infantry were absolutely useless against the Union cavalry. At the same time, in consequence of the increased range, accuracy, and rapidity of both gun and rifle, the opportunities for charging will undoubtedly be fewer than before, and with every improvement of the fire- arm they must necessarily become more rare. A force while looking for an opportunity must keep at such a distance from its objective that when the moment comes a surprise will not be easy to effect ; and it would seem that small bodies, of the size of a squadron or so, which can make good use of even insignificant cover and creep up where a heavier column would be at once detected, are far more likely to bring about success than large. What is required, therefore, for shock-tactics against cavalry en-dowed with fire-power — and, as we have seen, all cavalry comes under this designation — is great independence and skilled leading on the part of individual squadrons, and, on the part of the commander of the whole force, a judicious distribution and handling of his troops, part making use of their rifles to hold the enemy's attention, while the remainder, moving at the will of their immediate leaders, seek for openings to ride home with lance or sabre.

The second question that arises, viz., whether the neces- sary fire-power should be supplied by the cavalry itself, or by a body of mounted riflemen attached to the brigade or the division, is intimately connected with psychological considerations, and it is from the standpoint of the indi- vidual horseman that it must be discussed. Let us see what peculiar qualities are required from the trooper in the charge, that is, in the operation which differentiates him from his comrades of the other arms. In the first place, there is resolution ; in the second, a certain eagerness for battle ; and in the third, the quick decision which seizes an opportunity the instant it offers.i The sum of these three qualities is dash, and it is above all things important that dash, the most precious possession of the cavalry soldier, should never be tampered with, either in training or in war. A cavalry without the true cavalry spirit, lacking all spark of chivalry, and jibbing at the prospect of self-sacrifice, would be of small value in shock-tactics ; yet if this spirit is not to disappear, it must be sedulously fostered. The cavalry soldier must be taught to consider himself as, first and foremost, the soldier of

the charge and of the melee. It is this that he must be led to look upon, as the consummation of his training, the justification of his existence, as well as the finest, the most manful act of war. Now, if the cavalry soldier is called a mounted rifleman ; if he is told that it is more useful to be a good shot than a good swordsman ; if he is continually dismounted in preference to risking something by advancing ; if he is not sometimes allowed to lose himself in the exhilaration of a charge, his dash invariably deteriorates. So, while it is absolutely essential that the trooper should be a good skirmisher and a good marksman, it is undoubtedly good policy to relieve him, so far as possible, of the necessity of fighting on foot.

Furthermore, from the psychological point of view, it is exceedingly desirable that for certain duties a force should be available which has adifferent training, different

1 It is true that the quality of quick decision is more necessary to the leaders than to the men ; but it is much to be doubted whether any body of cavalry could really be called efficient of which both leaders and men were not of the same temper.

traditions, and a different ideal of the supreme incident of battle than the lancer or hussar. The mounted troops of an army, if they are handled as effectively as in the War of Secession, will often be called upon to capture and to hold localities and posts which are of strategic or tactical importance; and for the thorough fulfilment of their mission it is essential that they should be capable of carrying out, dismounted, an attack which culminates in an assault, as well as of defending a hastily occupied position against a hot counter-attack. Now, an attack on foot, culminating in an assault with the bayonet, demands in the troops who make it the same concentra- tion of will and aspiration, the same exclusive training, and the same confidence in the weapon, which,

as already shown, give shock-tactics their best chance of success. Dismounted cavalry, disposed as skirmishers, can render great assistance during the progress of an attack, holding the enemy to his ground, threatening him, and feinting ; but the assault, that is, the actual storming of the posi- tion, will be most effectively carried out by a force which, while for purposes of mobility it has been trained to ride, for purposes of fighting has been trained as infantry. So, too, on the defensive. The cavalry trooper, regard- ing himself and his horse as inseparable, habituated to constant movement, and but little concerned with the occupation of positions, is not likely to offer so stout or so skilful a resistance as the soldier to whom the horse is but a secondary consideration, a stubborn defence the highest point of honour, and familiarity with the use of cover one of the chief ends of all instruction.

The need, then, of attaching some sort of special force to the cavalry brigades and divisions, from the psycho- logical point of view, is clearly demonstrated ; and it has now to be decided whether this force should be a perma- nent organization, forming an integral part of the cavalry brigades and divisions, or whether the work can be done by a body of infantry organized on the spot, who have had sufficient practice in equitation to enable them to sit in their saddles and to groom their horses. Broadly speaking, and putting aside the question of expense, there can be little question but that the first suggestion is the better. A permanent force would be accustomed to work with the cavalry. The men would be better horse- masters, a most important consideration, both as regards mobility and the waste of horse-flesh. They could be trusted to act as scouts and take their share of recon- naissance work ; and furthermore, it would be possible to give them sufficient instruction in the use of the sabre to enable them to have recourse to shock-tactics when these were the only means of defence, or in a pursuit or a mSlee when it was useless to fire. The fear that such a force might degenerate into indifferent cavalry cannot be accepted as a valid reason against its formation. Much, naturally, must depend upon the officers, more perhaps upon the system of inspection ; but in a body of troops armed with the bayonet, and encouraged to prove them- selves equal, if not superior, to the best infantry at purely infantry work, the

cultivation of a healthy and distinctive esprit de corps should not, be an insurmount- able difficulty.

The formation, however, of a permanent force of mounted riflemen is a counsel of perfection; and, in default, a mobile infantry, mounted on cobs, cycles, or even in light carts, is the only alternative. Such infantry, if well trained and well officered, is capable of excellent work in conjunction with cavalry, and is a source of strength with which it would be simply pedantic to dispense.

It has been shown in the preceding pages that when acting against mounted troops the following are the fundamental principles of cavalry tactics : —

(1) The combination, in the conflict, of shock and fire.

Funda- mental

(2) The fire of the dismounted portion of the force, as well as of the guns, to be utilized as a pivot of manoeuvres.1

(3) The line of retreat to be secured by dis- mounted riflemen.

(4) Independence of regimental and squadron leaders.

(5) An incessant watchfulness for opportunities of sur- prise.

(6) Skilful use of cover by regiments and squadrons, so as to take advantage of those opportunities by an unexpected charge.

(7) Protection of led horses is often only to be secured by shock.

So far as the details of shock action are concerned, such as formation in one, two, or three lines, the move- ment and position of the horse artillery batteries, it is quite useless to lay down hard and fast rules. Four principles are to be observed : —

1) The enemy’s line should always be outflanked.

‘2) A reserve should always be retained in the hand of the commander.

(3) The guns should, if possible, accompany the cavalry when it advances with the view of charging, and by secur- ing one of the flanks form a pivot of manoeuvre.

(4) If the enemy is surprised, or attacked while he is manoeuvring, success will be best assured. Beyond this it is unnecessary to go. Everything must depend on the readiness of the commander to adapt himself to the needs of the situation, to the quickness of his sub-ordinates in apprehending and executing his instructions, and to the drill, training, and condition of both men and horses.

We now come to the employment of cavalry on the field of battle in conjunction with the other arms, and we have to note that with a certain school of tacticians the intervention of a vast mass of horsemen at J^™*’”” the moment the defender is forced to evacuate his position is still as ever a pious expectation. The direction of the charge is presumably to be round the flank of the defeated army, and it appears to be anticipated that the cavalry, if led with sufficient boldness, and thundering forward in a close succession of steel-tipped lines, will have the supreme satisfaction of riding down a mob of panic- stricken fugitives, whose bandoliers are empty, or who are so paralysed by terror as to be incapable of using their rifles. To this picture two objections may be taken. First, it is only exceedingly bad troops that have ever been reduced to such a prostrate condition as, for the application of their theory, the advocates of the cavalry torrent are compelled to postulate ; and even bad troops in the present firearm possess a power of resistance, derived as much from confidence in the magazine as from magazine-fire, against which the flood will break in vain. Even if some portion of the retreating troops be surprised, it is unlikely in the extreme that the panic will spread far. The great extent of the battlefield is against it; the troops not immediately attacked will have ample warn- ing, and the artillery and machine-guns have time to occupy positions. Moreover, it is exceedingly improbable that any army whatsoever will not have made adequate arrangements for an organized and deliberate retreat. Again, it is quite a delusion to expect

that when a position is carried the defending troops will dissolve into an un- controllable and terrified mob. Men are not cattle ;. a few cool and intelligent riflemen, especially if favoured by the ground, can easily hold at bay a far larger number of mounted troopers ; ana it is not to be expected, even in an indifferent army, that such men will be lacking. So,

1 A pivot of manoeuvre is a force, a fortress, or natural obstacle, which secures a flank.

even where the character of the country facilitates the deployment and the approach of a large force of cavalry, and makes surprise a possibility, the action of a mass of brigades or divisions will not penetrate beyond the fringe of battle ; and it may be confidently expected that against guns and infantry, even if defeated and retreating, shock-tactics will be confined to regiments and squadrons acting independently and content with small captures. Whether such action will be worth while, whether it would not be better policy to concentrate the whole of the cavalry, and to occupy positions which will block, or at least flank, the lines of retreat, must be determined by the commander in accordance with the circumstances of the particular case.

The second objection is that if the cavalry is armed with a rifle it will be simply a waste of fire-power to hold it in reserve for an opportunity which may never offer. The regiments must be dismounted and take part in the general attack, working, for preference, on the extreme flanks, or assailing posts and localities which cover the line of retreat. It is true that if it is to keep up a sustained pursuit when the enemy retreats, the cavalry must be nursed so long as he holds his position.

But this applies rather to the horses than the men; and while the latter are fighting on foot, the former are getting quite as much rest as if the regiments were kept back in reserve. It may be urged, however, that in case of the failure of the attack, the cavalry, if it has been kept back, will be available to cover the retreat. The answer is simple. If the cavalry is employed in the attack, reinforcing the efforts of the infantry by an appreciable accession of fire-power, the possibilities of retreat will be much reduced ; while the mobility of the arm, on the emergency arising, should enable it to with- draw from the line of battle in time to protect the guns against counter-attack, and to give the infantry the opportunity of rallying, re-forming, and occupying a defensive position.1

What cavalry will have to apprehend during a pitched battle is that it will be constantly engaged with the cavalry of the enemy. The mass of the horsemen on both sides will be found far out on the flanks, striving to put mobility to the best use, threatening whatever is in rear of the hostile front, and at the same time protecting whatever is in rear of their own. But it is not therefore to be anticipated that the charge and countercharge of all the available sabres on either side will be a feature of the great combats of cavalry that are bound to occur. It will very seldom be the case that the two sides will be so equally matched as to be equally prepared to risk the issue on the chances of a gigantic melee. One side must be the weaker, morally, numerically, or both, and it will certainly make the best use of the fire-power at its dis- posal, while at the same time it is in the highest degree unlikely that the stronger side will care to dispense with so valuable an auxiliary. These conflicts of cavalry will therefore take the form already indicated, even in the case when one army has been decisively defeated and its horsemen have the task of covering the retreat. Eire is a far better means of keeping the foe at a distance and of gaining time than shock ; and a retreat from position to position, making full use of the rifle and the machine- gun, may be less glorious but much more effective than the supreme self-sacrifice of a desperate onslaught on the masses of a victorious enemy at the very moment of his triumph.

The principles of cavalry tactics in conjunction with the other arms may now be summarized : —

1 This does not mean that a portion of the cavalry should not be attached to the general reserve.

(1) Action on the flanks, protecting and aggressive

,m S^taneOUSly. Summary.

(2) Posts and localities covering the lines oi

retreat and communication the proper objective.

(3) Action against infantry confined to surprises ef-

fected by bodies not larger than regiments or squadrons.

(4) The main object in pursuit to occupy position

having or flanking the line of retreat.

(5) The main object in retreat to occupy a succession of

positions, and so hold the pursuers at a distance, and gain time.

The question of armament can hardly be excluded from a dissertation on cavalry tactics. We have seen that a rifle is indispensable. A sword, it is generally Armameat admitted, must be carried by every mounted man as the best means of protection against a sudden charge ; and the rifleman is useless without his bayonet. Controversy is thus confined to the lance, and it may be said at once that the lance is undoubtedly a far more formidable weapon, even if it is not in reality more deadly, than the sabre or the revolver. Although there are many objections to it, such as its weight, its in- convenience in scouting and detached duties, the time taken up in mastering it, its uselessness in the melee or in the hands of a second or reinforcing rank, and the fact that its killing power depends altogether on the momentum of the horse, its moral effect is so great that a force carrying it is irresistible in the shock. So

much is this the case, that it may be doubted whether a cavalry armed only with swords and revolvers, if opposed by one armed with lances, would not absolutely decline to cross weapons in the saddle. If, then, mounted troops are to meet lancers in the field, they must either be able to oppose them with the same arm, or they must be restricted to the tactics of mounted riflemen, and condemned to comparative immobility. But no army, except one whose only mission is the defence of a mountainous or forest country, dare make the smallest sacrifice of mobility; and there is no escaping the conclusion that a really good cavalry must be trained to use the lance as well as the sabre and the rifle.2

It may be said, in conclusion, that the trooper of the 20th century, if he is to fulfil the conditions of efficiency laid down in this article, must not only be a picked man, but that his facilities for training must be ample, his education a protracted process, and his instructors and leaders men of exceptional capacity. But when it is to be remembered that the cavalry is par excellence the strategical arm, that it depends on the cavalry, and on the cavalry alone, whether the commander of an army marches blindfold through the ” fog of war,” or whether it is the opposing general who is reduced to that disas- trous plight, it will be admitted that to spare trouble or expense in the training and organization of the mounted branch is as unpardonable a mistake as to adhere to obsolete traditions.

There are still other points that deserve attention. Entrenchments play as great a part in modern campaigns as in those of 1861-65 or of 1877-78, and entrenchments are all in favour of the force that awaits attack. But, as suggested above, antidotes exist, such as surprise, the sudden seizure of tactical points which have been left unoccupied, outflanking manoeuvres, and movements against the line of retreat. Now the effect of each of these operations depends, broadly speaking, on rapidity

2 As has been suggested, however, the nature of the country in which the army is likely to be engaged has much to say to this ques- tion. There are theatres of war, such as the greater part of America, Great

Britain, Switzerland, Sweden, all mountainous countries, where the lance would be an intolerable encumbrance.

infantry]

and secrecy ; and, for reasons already alluded to, cavalry is the arm which best fulfils the required conditions. The principle of combination, however, demands that cavalry should always be supported in battle, directly or indirectly, by the other arms; or, to put it in another form, that the artillery and infantry should be so mobile as to be always within supporting distance when the cavalry comes into action. So far as the guns are con- cerned, there is no great difficulty; with the slow-moving foot-soldiers it is quite another matter. Much, however, may be done by constant training in combined manoeuvres ; much by sound administration, and by due regard for the physical condition of man and horse; more still — and here we touch the secret of all tactical as well as strate- gical success — by a thoroughly efficient staff. It is im- possible to lay too much stress on this most powerful auxiliary.

Take any army of the 19th century famous for the

excellence of its grand tactics : Napoleon's army of

1805-06-07; Wellington's army of 1813-14;

rtth£bM Lee's army of 1864~65 ! Grant's, Sherman's, and Johnston's armies of the same period; Moltke's army of 1870 : the staff of each one of them had been welded by years of experience and the teaching of a great soldier into a magnificent instrument of war. They were not composed only of administrative officers, concerned with supply, organization, quartering, and discipline, but of tacticians and strategists of no mean order. Combinations in war too often "gang agley" from the neglect of some trifling precaution, some vagueness or

omission in orders; and in the excitement of battle, or of approaching battle, when arrangements have to be made, possibly on the spur of the moment, for the co-operation of large bodies, unless he has been so trained that the measures necessary to ensure simultaneous and harmonious action occur to him instinctively, it is an exceedingly easy matter for even an able and experienced soldier to make the most deplorable mistakes. The practice of the staff in peace should not be less constant, to say the very least, than that of the units whose co-operation, as the only road to victory, it is the business of the staff to ensure. (g. f. k. h.)

III. Infantry.

The employment of infantry in action may be divided into two separate branches — attack and defence : in order to complete a satisfactory analysis of either, both must be studied, as the action of the one greatly influences the performance of the other. The principle is universally accepted that superiority in numbers, armament, position, or moral, are conditions indispensable, in a military sense, to justify attack. If the commander in the field commits himself to an attack, he delivers a frontal attack, a flank Atta k attack, or both in combination. A frontal attack, pure and simple, deprives the assailant of the opportunity of using his superiority by establishing a fighting line longer than that of the defending force; therefore it is undertaken only if natural obstacles pre- clude any overlapping extension to either flank. Still rarer are pure flank attacks, because the enemy, on seeing only his flank threatened, will naturally alter Ms front so as to face his opponent, whose contemplated flank attack thus becomes a frontal one. It follows that pure flank attacks must possess the character of surprise, and cannot be effected against a watchful enemy. Such attacks are occasionally initiated in order to compel the defender to quit a strong position, but in this case the enemy is merely out-manoeuvred, and for his defeat an action is still required. By far the most usual form of attack is to combine the advance against the enemy's front with an assault against one, possibly both, of his flanks. In this

case the task of the direct attack is to tie the enemy to his ground, so as to prevent him from changing his front. This very object makes it evident that a mere demonstration by a small number of troops is by no means sufficient, as it leaves the adversary free to assume the offensive against them, and then to con- form to the assailant's flank attack. A further reason why the front attack should be made strong is the fact that the more vigorously it is executed the more troops the enemy needs for holding his own front, and the fewer he will have left for opposing the flank attack. It thus becomes evident that the success of the latter in a large measure depends on the energy with which the adversary's front is assailed, and also that the front attack must precede the advance against the enemy's flank. In order to ensure for the latter the character of a surprise, the assailant endeavours to conceal the move- ments of the troops detailed for it ; the chances of attain- ing this object, however, are the slenderest when dealing with a watchful opponent, who, on detecting such move- ments, will take the counter-measure of facing it by deploying part of his main reserve. Obviously, then, the flank of the enemy, can be gained, if at all, only at the end of a struggle. A flank attack usually resolves itself, therefore, into a fight which draws out the enemy's reserves and compels them to come into action on a line forming an angle with the original front, a procedure which confers the following advantages on the assailant —

(1) the defender is compelled to expose himself to eon- verging fire, the effect of which increases with the sharp- ness of the angle which his flank forms with his front :

(2) the reserves moved out for opposing the flank attack have little or no time for throwing up entrenchments, and thus lose the chief advantage characteristic of the defen- sive; (3) if the defender is considerably inferior, he is compelled to oppose the flank attack by an attenuated line which obviously incurs the risk of being penetrated; (4) the doubled-back flank of the defender materially hampers his mobility.

The battalion in European armies, being the organized body for disciplinary command, is also the fighting unit, and for the attack it is

divided into firing line, supports, and reserve. The firing line invariably moves in extended order, while supports and reserves adopt this formation only if exposed to effective fire ; otherwise they are kept in closer order, and furnish the means by which the firing line is fed and pushed closer to the enemy's position. It is impossible to lay down hard and fast rules as to how many companies should be retained in JJj* firing reserve, and how many should be used for the firing line and supports ; that depends entirely upon the conditions, but for general guidance the following rules may be formulated : — A battalion must retain strong reserves, (1) if its flanks are unprotected; (2) if the fight is likely to last long; (3) if the enemy's dispositions are insufficiently known. A battalion may develop a strong fighting line (1) when its flanks are protected, (2) when its object is to gain an advantage over the enemy in a short time. The reinforcements which are sent forward from the supports and from the reserve give successive impulses for further advances; but this system will stand the test of war only if it is so thoroughly practised in peace time that it becomes a habit to the men, and if the conditions of real warfare are taken into consideration. The first check a firing line experiences is when it is fired at by an enemy who cannot be seen, an occurrence which will lose some of its novelty if imitated at manoeuvres. The advance against a hostile position is admittedly a task that requires hours for its execution; this, too, should be imitated in peace time. The men should be taught to halt and to fire for long periods, making only short advances. During the latter it is not

necessary to keep a strict alignment ; on the contrary, if part of the firing line sees cover a short distance in front, it is justified in rushing to it, while the remainder seek to come gradually abreast of their comrades. During the halt it is the duty of subalterns to see that the privates have got the right range, and that they take careful and steady aim. Intelligent questions should compel the men to use their own

judgment as to the enemy's disposition, so as to enable them to direct their fire upon targets which are of tactical importance, as, for instance, sup- ports moving into the hostile firing line. These objects can be attained only if those who lead and direct a firing line have sufficient power of imagination, and a suf- ficiently serious conception of their responsibility, to put the stamp of reality even upon a sham fight. Experi- ence has shown that if once a firing line is seriously engaged it is impossible to send orders to its leaders, who must rely upon their own resources ; hence arises the difficulty of bringing their conceptions into line with the general plan of battle. The only means of attaining this end is to make junior officers acquainted with the principles underlying the leading of larger bodies of troops, so as to enable them to appreciate the intentions of their generals. This training would not, however, supply a sufficiently secure foundation upon which a commander could base his plans, were'it not for the exist- ence of another factor which is entirely of a psychical character. When the men get within effective rifle range they become convinced of the fact that retirement would mean annihilation ; this knowledge causes anger, which is increased by the sight of the wounded and dead of their own, and awakens the spirit of retaliation. This desire is the chief motive which prompts the men to rush closer to the enemy's position whenever an opportunity offers, and on it are based two important tactical principles — namely, that troops which are within an effective zone of fire can neither be withdrawn nor moved towards a flank. It also explains the fact that the fighting capabili- ties of the average man are little influenced by the cause for which a war is waged, and lastly, it is the reason of the initiative for the final assault often coming from the firing line. The strength of the main reserve depends on the strength of the force engaged and on the knowledge of the enemy's dispositions. The bigger a force is, the longer the fight lasts ; consequently the reserves retained are not only meant to carry out the final assault and to start the pursuit, but in addition to this they form the reservoirs from, which such parts of the first line as have become absorbed or paralysed during the course of the action are replaced. Moreover, reserves furnish the means by which a general influences the course of an action ; consequently, when the enemy's dispositions are insuffi- ciently known, it is imperative to have a relatively weak first line and to

retain strong reserves. The first line reconnoitres, so to speak, the enemy's position, and upon its experience the general must base his final decision in regard to the use of his reserves. The attempt to lay down on paper definite objects for reserves, and to formulate rules for their approximate strength, is of little assistance to a commander on the field of battle, where adaptation to varying conditions, which makes war an art, must dominate all theoretical considerations.

In the defence the battalion also forms the fighting unit, and usually retains half its strength in reserve, while the other half furnishes the supports and the firing line. Supports and reserve keep the firing line at its most efficient strength, and should be posted as close as possible behind it, to avoid heavy losses during the process of reinforcement. The defence has profited more than the attack by the recent improvements of firearms. The absence of smoke compels the assailant to

advance for at least 1000 yards, and possibly much more, under fire, before his opponent's position becomes dis- closed to him; of this advantage the defender should make full use by placing his troops as far as possible behind cover that conceals them from view. Moreover, it has become easy for the defender to prolong the pre- liminary stages of the attack by occupying a series of advanced posts, which the enemy must make dispositions for attacking, and by quitting them as soon as such dis- positions are completed. Naturally the troops occupying such posts must take care to retire in good time, lest they should be caught at a disadvantage by a rapidly advancing enemy. Strategical necessity limits the choice of defensive positions to narrowly confined areas ; there- fore, instead of simply choosing the best ground, it is generally necessary to make the most of the conditions as they exist. The choice of too strong a position is not always advantageous, since the assailant, instead of en- tering upon a hopeless task, may force the defender to quit his ground by turning his occupied position and threatening his lines of communication. Besides, the occupation of a position depends so much upon the direc- tion of the enemy's advance, that in the majority of cases the defender has to adopt a waiting attitude till the ad- versary's intentions become known ; and this uncer- tainty, with its

concomitant danger of acting either too soon or too late, is the chief disadvantage of the defence. When the flanks of a defensive position do not rest on natural obstacles they must be protected by reserves, which eventually oppose the enemy's flank attack by meeting it with a newly-deployed front taken up in pro- longation of the first line. Should, however, the ground not lend itself to that course, it is advisable to use weak bodies for opposing the hostile flank attack, to allow the latter to develop, and then to threaten counter-attack on the enemy's flank by a force of all arms previously echeloned for that purpose. This procedure is somewhat dangerous, as the force so detailed lays itself open to being cut off from the main body, as the adversary can hardly fail to discover its presence. Small bodies of infantry employed in this manner have chances of success, because not only is there a likelihood of their remaining concealed, but owing to the absence of smoke they can enfilade the adversary's lines for a considerable time before being dis-covered. At the end of the action, when all attempts of the assailant to carry the position have been foiled by the stubbornness of the defence, a vigorous counter-attack, which drives the enemy in disorder from the battlefield, alone entitles the defender to claim a victory ; therefore, when a position is occupied with a view to inflict a decisive reverse upon the adversary, a reserve should always be retained for the purpose of assuming the final offensive. The method of defence adopted by a rearguard differs from that above described. Its principal object is to delay the enemy, and as this object is best attained by compelling the enemy to deploy as many of his troops as possible, thereby causing him a corresponding loss of time, it is evident that a rearguard must endeavour to show as broad a front as possible to the assailant. It is not necessary in this case to pay excessive attention to the security of the flanks, because a flank attack invariably requires time; therefore, should it be initiated by the pursuing force, the latter will play into the hands of the defence. Modern weapons have largely facilitated the work of a rearguard, because not only will the .adversary's cavalry require much longer time for ascertaining the extent of front occupied, but the enemy will be compelled to deploy at ranges hitherto unknown. Yet, as a rearguard must avoid becoming seriously engaged, it must retire before the hostile infantry comes within a range that is likely to cause even slight losses.

An advanced guard when coming in contact with the enemy acts on the same principles followed in the attack or defence, but must modify them when com- guZrd™ Pelled to do so by its relations to the main body. For instance, an inferior enemy being met with, he should be driven in, to prevent the march of the main body from being interrupted ; and as in this case quick- ness is the essence of the fight, the advanced guard must at once bring all its available forces into action. Similarly, when holding a superior hostile force in check to gain time for the main body to come up, no hesitation should be felt by the commander of an advance guard to use every man in the front line.

The use of smokeless powder favours the detachment of small bodies of troops to occupy folds of the ground,

t t &c, whence they can enfilade the adversary's lines without disclosing their own position. This possibility necessitates, in the attack as well as in the defence, the employment of patrols, who reconnoitre to the right and left of the fighting force and carefully examine all ground affording concealment to the enemy. As the presence of small hostile bodies on the flank ceases to be a danger as soon as they are discovered, it is not advisable to make such patrols too strong, because the stronger a patrol the stronger is its inclination to fight. A few privates led by an intelligent man are well suited for this purpose. (j. be.)

IV. Engineers.

The employment of engineers in the field is as ancient as history. The military operations of the Persians, Greeks, and Carthaginians would have been impossible without field engineers; and the engineers of Xerxes, Alexander, and Hannibal must have been remarkably proficient. From time immemorial the attacks on Pri 1 1 strongholds and fortresses of great strength depended upon the skill of the

engineers to execute works in the field. History teaches us that, from the siege of Troy to modern times, the field army has, with few exceptions, eventually overcome the re- sistance of the strongest fortresses ; in other words, the attacking engineer has almost invariably beaten the de- fending engineer. The primary objective of all military operations is to secure possession of certain positions which are of decisive importance, and victory in battle is the only means by which this end can be attained. A battle is an encounter between bodies of men armed, equipped, and organized for war ; and the means by which a commander endeavours to attain his end — that is, victory — should be by a strict observance of the principle of being stronger than the enemy at a decisive point. This principle is not always observed, but where it is followed on one side and neglected on the other, the result is generally a decided victory for the former. The same principle should be observed on all occasions, whether the encounter is between large forces or is merely a small affair between detachments. A modern army is an exceedingly compli- cated organization, and a general requires much know- ledge, skill, and experience, and many high moral and physical qualities, if he is to handle the troops with full command and power. He should never lose sight of the fact that the cavalry, artillery, and engineers exist mainly to support and assist the infantry — this arm being para- mount in battle. The usefulness of the subsidiary arms is therefore proportionate to the extent to which they devote themselves to furthering the requirements of the infantry. But they are more than adjuncts to the infan- try, being essentially part of the army, and quite indis- pensable if decisive results are to be expected.

From the earliest times engineers have been employed at sieges, and on field defences to protect the besiegers against relieving

In the field.

armies. But sieges are outside the scope of this article, and we have now to consider how the engineers should be employed in the field so as to assist towards a victory on the field of battle. Napoleon knew the true value of engineers, but on some notable occasions he suffered from having neglected to apply his knowledge in practice ; for example, at

the Beresina, at Leipzig, and during the campaign of 1814 in France. He said that “those who proscribe the use of defensive lines, and the support that the art of the engineer can give, gratuitously de- prive themselves of a power and an auxiliary that are never hurt- ful, nearly always useful, and often indispensable. However, the uses of field fortification require reconsideration ; this important part of the art of war has made no progress since the time of the ancients — it is even behind what it was two thousand years ago. We must therefore encourage officers of the engineers to improve this part of their art and bring it up to a level with the rest.” There is no evidence that the art of employing the engineers as an auxiliary force has been exercised to the fullest advantage in the great battles that have been fought since Napoleon summed up the situation. At Plevna the Turkish engineers were employed to the fullest advantage at first, but this was only as long as it was good strategy to hold Plevna. After the defensive works had ful- filled their object, they ought to have been abandoned ; instead of this, the mistake was made of holding on to them, and they thus became a snare and delusion, and were entirely responsible for the loss of an army that might have been employed with advantage elsewhere in the theatre of war. The earliest instance of the systematic employment of field works was the Roman fortified camp, from which the troops sallied out and formed up in battle array — the Roman custom and tradition being to take the offensive — but the fortified camp was close at hand as a place of refuge in case of a reverse, and a safe place in which to leave the sick, non- combatants, and baggage. All the infantry were employed in making the defences of the camp. Many centuries later we find armies again making an extensive use of the spade, though instead of enclosed camps they made great lines of works adapted for de- fence by firearms. But, unlike the Romans, the troops on both sides placed more reliance on the cover from fire and the impedi- ment to the assailants afforded by the parapets, ditches, and ob- stacles, than upon the skilful manoeuvring of a mobile army operating outside the protection of the field defences. The brill- iant generalship and strategy of Marlborough brought into discredit this misuse of field fortification. It was another of Napoleon’s maxims that ” field fortifications are useful, never harmful, when they are well understood.‘1‘1 The qualifying clause is at the root of the whole question of the employment

of engineers. Frederick the Great was also sound in his views when he insisted that it was better to have too few than too many field works, because it is not the works that stop the enemy, but the troops that defend them. We may go back farther, to Lycurgus, who refused to enclose Sparta with walls because "that city is well fortified which has a wall of men instead of brick." It is one of the great errors made in the use of field works to imagine that fortifications can be made a substitute for men. In only a restricted sense is the statement true ; if a position is fortified so that the defenders can inflict heavier losses than they suffer, it requires, of course, fewer men to defend than to attack. The error pointed out has led many to overlook the fact that decisive victory cannot be expected from mere defensive resistance, though the object in view may be best furthered, for the time being, by defensive action, as at Torres Vedras in 1811. Although it is dangerous to regard field fortifica- tions as a substitute for men, they are a means by which the enemy may be delayed, and thereby time saved, pending the arrival of reinforcements or the decisive action of that part of the army which is makingan offensive movement elsewhere. If time and opportunity offer, arear guard may gain time by means of the protection afforded by field works ; and siege works enable an investing army to hold its positions with far fewer men than would otherwise be possible.

The use of field works is frequently wrong in principle, owing to the general not taking a sufficiently broad view of the situa- tion, and making the troops subservient to the field _. . works instead of the works being subordinated to the Works. requirements of the troops. The only correct procedure is to choose the best position for the troops, with due regard to the weapons in use and to the tactical situation, and then to consider in what way the troops may be aided in their defence by the use of field works. This is the only way to ensure that the tactical relation between the troops and the ground is correctly observed. It is wrong in principle to select sites because they are the easiest to strengthen with works, and then to dispose the troops to defend these fortified localities. In other words, fortification should not govern the situation, but the -military situation should indicate where fortifications may be of value. No doubt in many cases the best positions for the troops will also happen to be those easiest to

strengthen with works ; but to regard a position from a purely fortification point of view would

[combined akms

often lead to error, because due consideration should first be given to the troops available, and the composition and quality of those troops, and the tactical conditions generally. The use of field works in the attack has never been fully developed, and there are many difficulties in the way, the most important being the absence of entrenching tools. That infantry on a large scale should be burdened with these implements has been advocated, but fortunately in vain , since the extra weight would militate much against mobility, and it would be only on exceptional occasions that the tools would be required. It is far better to have great mobility, and to rely upon the natural features of the ground. It is doubtful if many tools will ever be available for the attacking troops on the eve of a great battle, so as to enable them to make any very extensive use of field fortifications, except in so far as existing banks, walls, and hedges can be improved as cover for those troops that are to hold certain defensive positions as pivots of manoeuvre for the remainder. The engineers, supplemented by the other troops, should make every effort to render defensive positions as strong as possible, working throughout the night if need be ; but whether the most important work will be clearing the field of fire, preparing cover, or making obstacles, will depend upon circumstances. In any case, it must be carefully borne in mind that invisibility of the defences has become of the utmost importance since the intro- duction of accurate long-ranging and rapid-firing weapons and smokeless powder, since it is impossible to produce good results unless the targets and the effects of fire can be observed. In many cases the engineers can be most profitably employed in opening up communications for the free movements of the troops. After a position is taken it should not be retaken through the neglect of the engineers to strengthen its natural defences. Prom this captured position a further offensive movement may be contemplated.

Engineers are employed in the field, especially on the lines of communication, in connexion with railways, roads, telegraphs, water-supply, balloons, mines, bridges, embarkations Duties. an(j ^embarkations, demolitions, and the fortification of entrenched camps and positions. The frequent adoption of new and complicated

inventions for war purposes demands an increase of skilled labour which can only be performed by trained specialists, and the conditions of modern warfare have given rise to fresh developments in the methods of attack and defence requiring the closest reflection if engineers are to be employed in the field so as to co-operate according to the changing conditions. For field works to be useful they must be in the right place, and, above all things, at the right time ; in other words, there must be a close tactical connexion between the works and the troops.

There is a moral side to the question of the use of field works, which is, that troops who seek shelter in works lose all mobility and fitness for offensive operations, and may be regarded as Moral. ka|j, Deaten The results of defensive action are gene-

rally merely local and rarely decisive ; and the theoretical idea of vigorous offensive action, after an attack has failed, has rarely had any application in practice. If the defenders really contemplate a serious counter-attack, it must be deliberately prepared before- hand in the way Napoleon did at Austerlitz ; he invited attack, and then met it half way. It may be that the troops are so wanting in training, moral, or organization as to be unfit for active operations, or that the general, having no confidence in his skill to handle troops, finds his task simplified by having a clearly defined line on which to dispose his army for defence. In any case, the very fact of acting on the defensive is an admission of weakness. With the greatly increased mobility of armies, due to improvements in communication, the advantages to be derived from an extensive use of field works in modern battles are not always commensurate with the disadvantages. But if the officer in command of the engineers has a sound knowledge of the art of war, and possesses initiative and self-reliance, he will be able, in all kinds of battles, to employ the engineers as a powerful auxiliary that is always useful, and often indispensable, if worked in co- operation with the other arms and in subservience to the general object in view. (k. c. h.)

V. Combined Arms.

Strategy is the art of bringing the enemy to battle. Combined, or, to use the phraseology of the Napoleonic era, ” grand ” tactics are the methods employed for his destruction by a force composed of all arms, that is, of infantry, artillery, and cavalry. Each of these possesses a power peculiar to itself, yet is dependent, for the full development of its power, to a greater or lesser degree upon the aid and co-operation of the rest. Infantry and artillery, unaccompanied by cavalry, if opposed by a force complete in all arms, are practically helpless, always

liable to surprise, and whether attacking or defending, hampered by ignorance of the enemy’s movements and bewildered by uncertainty. Cavalry trained to fight as infantry, and carrying a magazine rifle, is the ideal arm. But without artillery the most mobile cavalry cannot be expected, in ordinary circumstances, either to hold or to storm a position; and, when fighting dis- mounted, the necessity of protecting the horses so cramps its freedom of movement that it is less effective than infantry.

It is essential, then, for decisive success that every force which takes the field against an organized enemy should be composed of the three arms. Their Pnportk)n relative proportions in the armies of the great „fthe

Powers Stand as follows : — three arms.

5 to 6 guns per 1000 infantry soldiers ; 1 cavalry trooper per 6 infantry soldiers.

These proportions have undergone a marked change during the past hundred years. The number of guns has been very largely increased, while that of the cavalry has been slightly diminished. It is probable, however, that the proportion of the latter will soon be restored to the old standard, and in small armies will very greatly exceed it. The reason for these disturbances is not far to seek. Before the introduction of the breechloader and the rifled cannon, the three arms of the service employed very different methods of combat. The infantry depended principally on the bayonet; the cavalry on the lance or sabre ; the artillery on fire. Since the advent of the small-bore rifle and the quick-

firing gun there is practi- cally but one method, common to all arms. The bayonet and the sabre still have their part to play ; but in almost every phase of the combat both infantry and cavalry, as well as the artillery, must rely on fire, and on fire alone, to compass the enemy's overthrow. All move- ments and all manoeuvres have but one end in view, the development of fire in greater volume and more effectively directed than that of the opposing force ; and it is " superiority of fire," to ' use the technical term, that decides the conflict.

For the attainment of this superiority no further rule can be laid down than that the three arms must com- bine. In war every situation differs. Moral, _ ground, numbers are never identical, and it is uoaot these considerations that form the basis of the the three problems with which a general has to deal. Of arms' all errors in the conduct of war, none is more pernicious than the attempt to fight battles according to a sealed pattern. Even the formations in which troops approach the enemy, or occupy a position, must vary with the circumstances. In like manner, it is impossible to dic- tate a normal procedure for the combination of the three arms. Certain principles demand respect, for to infringe them generally spells disaster. But even this rule is not absolute. Great victories have been won not merely in spite of great principles being disregarded, but because they have been disregarded ; and those are the greatest generals who have known when and where to discard the accepted maxims of war. Yet it would be very far from the truth to say that they did so because the principles embodied in those maxims had no weight with them. On the contrary, Napoleon, for instance, unfolded much of his practice of the art of war in a series of maxims, and the volume containing this series was Stonewall Jackson's constant companion in the field. We are not, however, to conclude that these great soldiers invariably shaped their conduct in accordance with the precepts they so diligently studied. They looked on them as warn- I ings of the dangers that generally follow certain courses

of action, rather than as finger-posts showing the path to be pursued. When they formed their plans for defeat- ing the enemy they undoubtedly weighed these warnings, instinctively, perhaps, rather than deliberately; but whether they obeyed them or rejected them was a ques- tion of judgment. They were in no way bound by them. Far from it. They would have no fetters cramping their intelligence and common-sense, for it was on their intelligence and common-sense, and on no normal pro- cedure and hard and fast rules, that they relied to solve the problems of war. And herein is the key to successful combinations on the battlefield : the habit of using the wits, of subordinating the rules of theory to the needs of the moment, and if necessary discarding them in toto; the habit of improvising stratagems, of inventing on the spot new methods of attack and de- fence. Habit is all-powerful in war, especially under the excitement generated by the near presence of the enemy ; and it is undeniably the case that when conflict is immi- nent the average officer will act exactly as he has been accustomed to on the manoeuvre-grounds of peace. If he has been accustomed to stereotyped proceedings ; to a perfunctory reconnaissance of the enemy and of the ground; to beginning the fight with the whole of his guns massed in a central position; to handling his infantry in one invariable formation ; to using his cav- alry without regard for their horses, he will probably do the same in action. The danger is great. A slavish adherence to set form and inelastic regulations had much to do with the destruction of the Prussians at Jena and Auerstadt, of the Austrians in 1866, and of the French in 1870; and if ill-organized and half- trained levies have sometimes triumphed over highly- educated and well-disciplined soldiers, it is because the latter have come to look on war as a- mechanical rather than an intellectual art, and have lacked all power of originality and resource in dealing with tactical difficulties.

As we have already implied, the first principle of grand tactics is co-operation, i.e., the full development of Modern *ne f°rce inherent in each arm at the right conditions place and the right time ; and before discussing 1*thj>.. .. the methods of producing this development it will be well to describe the conditions which affect it. The flat trajectory of the magazine rifle, smoke- less powder, and the quick-firing field gun,

have wrought a greater change in tactics than did the substitution of the breechloader for the musket and of the rifled cannon for the smoothbore. With the older rifle, deadly as it was, the ground in front of a position was not thoroughly covered by bullets for more than 500 yards at most. Beyond that range, owing to the elevation of the tra- jectory, a great many bullets flew high over the heads of men even in an upright position. Nowadays, the ground for 900 yards in front of a strong line of in- fantry, provided that the rifles are held a few inches above the level, is so closely swept by the sheet of lead as to be practically impassable by men standing upright or even crouching. The long deadly zone of this hori- zontal fire, which every improvement in the firearm tends to increase, is the most potent factor in modern battle. Of little less importance is smokeless powder. The ab- solute invisibility of a skilful enemy renders reconnais- sance tenfold more difficult than heretofore. Smoke betrayed not only the position but the strength of the troops who held it; the new powder tells nothing. Moreover, the rattle of rapid fire is most deceptive, for a few riflemen, or a few guns, firing at their utmost speed, give the idea of far larger numbers than are actually present. Again, at the crisis of the conflict the quick- firing field-piece is far more effective than the gun it

superseded. On troops whose power of resistance is already strained to the utmost, on masses of men and horses, on crowds breaking to the rear, on a line sud- denly assailed in flank, the constant hail of shells, even if less devastating than might be imagined, is terribly demoralizing. Nor is greater range and greater accu- racy without influence on morale. Enfilade fire, the most telling of all, is more easily brought to bear, and more deadly; while the knowledge that, if once they are outflanked, they can no longer reckon, owing to the range of the enemy's projectiles, on a secure line of retreat, tends to shake the nerves of the most stubborn fighters.

Such are the conditions of modern battle, and it is often urged that they are distinctly in favour of de- fensive tactics ; in other words, that the force which awaits attack can develop the full force The gala of each arm with more facility than that which defence. delivers it. The contention may be true ; but it is not always realized that anything

which gives new strength to the defence at the same time adds something to the advantages of the army which attacks. The net outcome of the improvements in rifles, guns, and powder is that far fewer men are required to hold a posi- tion than of old. A direct (or frontal) attack against good troops well-posted, always a desperate undertaking, has now become suicidal. To a certain extent this favours the defence. A much larger number than formerly can be set free to act in reserve, and to deliver the counter- stroke ; i.e., a much larger number than formerly can be employed by the defenders in attack. This is to the good. But the assailant profits in an almost equal ratio. His strength has always lain in his power of manoeuvring, of hiding his movements, and of massing suddenly against some weak point. To-day his power of manoeuvring is greater than before. The increased strength of the defence renders it comparatively easy for him to form with a part of his force an impenetrable barrier behind which the remainder can move unobserved. He needs far fewer men and guns to cover his communications ; and a general counter-attack, delivered, like those of Wellington, of the French in 1870, of Osman at Plevna, direct to the front, is very little to be dreaded. More- over, the object of the assailant's manoeuvres will be to place portions of his force on the flank or flanks of the position he is attacking. If he can accomplish this, the effect, moral and physical, of the enfilade fire he brings to bear upon the enemy's front will be far greater than that which attended a similar operation when fire was of less account. In short, the process of envelopment is easier than it used to be ; and envelopment, which means that the enemy is under fire from several directions, is much more effective than in the past.

It does not appear, then, that the new conditions are altogether in favour of the defender. To win a decisive victory and annihilate the enemy he must, at some time or another, leave his position and Thegain attack. But the time, if not the place, must Attack. depend on his adversary's movements, and will only be disclosed during the progress of the battle. What time will be given the defender for the long preliminaries which attack against even a shaken force demands, for the preparation by artillery, for the massing of the infantry, for their deployment in line of battle, for the issue of adequate orders ?

Tacticians have long been puzzled over the rarity and ineffectiveness of the counter-stroke in modern campaigns. The reason lies in the increased power of the local defensive, even with the needle-gun and the slow-firing cannon. With the newer weapons this power is trebled. The counter-stroke, therefore, is more difficult than ever ; and this, difficulty,

[combined arms

combined with the greatly enhanced effect of envelop- ment fire, gives a marked advantage to the assailant. Resistance is more protracted than heretofore, but de- fence, as a method of giving battle, is no stronger.

The question will probably suggest itself, Why should envelopment be the monopoly of the advancing army ? The reply is easy. Save in exceptional circumstances, the force that surrenders the initiative and stands still in position will be too weak for far-reaching manoeuvres. Envelopment requires a numerical superiority or a vastly higher moral ; and an army possessing these advantages must needs seek out its adversary and attack him, for the very simple reason that not otherwise can he be brought to battle. Yet it is not to be understood that the numerically inferior army is debarred from attack- ing ; but it may be taken for granted that it will not do so until it sees the opportunity — the fruit, as a rule, of more skilful strategy — of falling on an isolated portion of the enemy's forces.

It would seem, however, that under the new conditions an army can split up into detachments with greater impunity than heretofore. Some of the most The remarkable victories in history — Vittoria, Baut-

attack. zen, Waterloo, the First and Second Manassas, Chancellorsville, Koniggratz — have been won by two distinct forces, operating from different bases, or approaching the field of battle from different direc- tions, and crushing the enemy between them. This " sweep of the

dragon's wings " is by no means an easy operation to put into successful practice. Von Moltke, indeed, has laid it down that the junction of, two pre- viously separated forces on the field of battle is the highest triumph of generalship ; and Napoleon, although on more than one occasion he availed himself of the expedient, was never weary of pointing out the risk. It cannot, therefore, be questioned that separation has hitherto involved great dangers. Unless the separated forces acted in perfect unison, unless their leaders dis- played the utmost activity and resolution, it was always to be apprehended that the one might be attacked and defeated before the other could intervene. At Waterloo, for instance, some of the Prussian generals, when they reached the neighbourhood of the field, and saw, as they believed, the British retreating, were for turning back immediately. Again, the timidity of Ney in find- ing himself separated from the main army made Bautzen a barren victory ; and if there is one thing more con- clusively proved by military history than another, it is that without determined, energetic, and skilful leaders, without superiority of moral, or great superiority of numbers, movements entailing separation were, under past conditions, very likely to end in disaster. To a certain extent this still holds good, for human nature, in war, recoils from nothing so much as from isolation. Nevertheless, the use of the field telegraph has done much to modify the risks that were formerly attendant on such manoeuvres, and the increased strength of the local defensive has brought them within the scope of everyday tactics. It may be assumed, therefore, that the directors of future campaigns will have always in view the advantages to be derived from hurling a fresh force, whose approach, if possible, has been concealed until it opens fire, against the enemy's flank and rear; and the sudden onset of Blucher at Water- loo, of Lee at the Second Manassas, of Stonewall Jackson at Chancellorsville, of the Crown Prince of Prussia at Koniggratz, will be the ideal of the decisive act of battle.

It is to be observed, however, that successful concentric movements have been carried out more frequently by a force acting on the offensive than the defensive. In the

first place, as has been said above, an army which adopts the offensive has usually the superior numbers or the superior moral, and it consequently incurs less risk from separation. In the second place, it is usually superior in cavalry, and is thus able to prevent all knowledge of the separation from reaching the enemy, as well as to conceal the march of the outflanking column. We may conclude, therefore, that it is only when the defender has the more powerful cavalry, and is at least equal to his adversary in numbers and in moral, that he will dare to deliver a concentric counter-stroke.

The army, then, which assumes the strategical offen- sive has, as a general rule, the best chance of employing this most effective manoeuvre; but much de- pends on the quality and handling of the import- cavalry. If the cavalry is so armed and tH^iry. trained that it is capable of holding off the enemy's scouts and patrols, a tactical surprise may be effected, and surprise is far more than half the battle. And surprise is not only of the very greatest importance in offensive operations fromdifferent bases, but in every species of attack. An ordinary enveloping movement for which a portion of the main army is detached after it reaches the vicinity of the battlefield, is much more likely to be effective if the troops making it are protected from observation up to the last moment. Cavalry, then, sharing the enormous defensive power conferred by a low trajectory and rapidity of fire, play a role in grand tactics of which the importance can hardly be over-estimated. They make it possible for a general to adopt the most brilliant of all manoeuvres, the concentric attack, and to make that attack, as indeed all other attacks, more or less of a surprise.

But to protect the troops in rear from observation is not the only duty of cavalry. Eeconnaissance of the enemy's position is the foremost of its functions, and the occupation of points of tactical vantage, such as hills, woods, villages, &c, behind which the main army can deploy in security, or the outflanking columns march un- observed, is not far behind. The pursuit, too, falls upon the mounted arm, the destruction of the enemy's trains, the capture of his guns, the spreading of demoralization far and wide. But most important, perhaps, of all its functions are the manoeuvres which so threaten the enemy's line of

retreat that he is compelled to evacuate his position, and those which cut off his last avenue of escape. A cavalry skilfully handled, as at Appomattox or Paardeberg, may bring about the crowning triumph of grand tactics, viz., the hemming in of a force so closely that it has either to attack at a disadvantage or to surrender.

The cavalry attached to an army on the defensive acts on much the same lines, furnishing a large proportion of the outpost or advanced troops, and making use of its mobility to prolong the line of battle when a flank is threatened, and of its power of defence to hold back any force which may attempt to work round in rear. In a word, the cavalry of the defence endeavours to obstruct that process of envelopment which the cavalry of the attack endeavours to complete.

It has long been understood that to attain the superior- ity of fire over a vigilant enemy in a strong position, a heavy artillery bombardment is as absolutely essential a preliminary as a thorough reconnais- {JoitE/™" sance. It has not, however, been always realized artillery that unless the infantry co-operate, the artillery and is not likely to produce the slightest result. If 'nlantry- the infantry is kept behind the guns, or at such a distance from the position that it cannot pass quickly to the assault, the enemy during the cannonade will keep his troops un- der cover, perhaps leaving his trenches unoccupied, and

thus present no target to the guns. It is an important principle, therefore, of combined tactics that the infantry- should co-operate with the artillery in the preliminary bombardment, for by this means only will the enemy be compelled to man his defences, to show himself above his parapets, and thus expose himself to the demoralizing effect of shrapnel.

Again, however thorough the artillery preparation may have been, it is not likely to have caused such losses that the defender's fire will be altogether innocuous when the attacking infantry advances. In fact, the assailant will probably suffer very heavily, for infantry advancing to the attack — that is, before it has established a strong firing line at decisive range (within 800 yards) from the enemy's position — can do nothing towards attaining the superiority of fire. Over 800 yards, if the enemy is well covered, its fire will be practically harmless, for the very good reason that the men will see no target at which to aim. But if the artillery co-operate by pouring a heavy and concentrated fire on the defender's lines, and, if necessary, by pushing forward batteries or guns to the most effective range, it will so disturb the aim of his riflemen as to secure the attacking troops from very heavy loss. We deduce, therefore, another princi- ple : superiority of fire can only be gained by the close co- operation of the artillery and infantry at every stage of the attack.

Nor is it the guns alone that should cover the infantry advance. Where the ground permits, a portion of the infantry should be detailed for this purpose before the remainder move forward. At 2000 yards telescopes and strong glasses can be used to locate the exact position of the enemy's trenches ; the range, by means of mechani- cal appliances, can be accurately measured ; and the fire of the companies can be controlled with the same ease as that of the machine-guns. Such fire is little less effective than that of field or horse artillery. It may be less de-moralizing ; but, if the exact range can be ascertained, it will be more accurate, for infantry has not to contend with the technical difficulties, fuzes, the errors of the day, &c, of the sister arm. Especially will it be effective when it enfilades, or strikes at an oblique angle, the front of the defence. We are justified, therefore, in laying down the secondary principle that long-range rifle fire is an important auxiliary to the artillery in covering the advance of attacking infantry.

It cannot escape notice that the application of these principles is intimately connected with the use of ground. If there are favourable positions for the artillery, • „fgn°ad or localities adapted to the development of long- range rifle fire ; if the enemy's line is so exposed

and well-marked that the guns can fire over the heads of the attacking infantry until the very moment of assault ; or if it is open to enfilade, the co-operation of infantry and artillery should be comparatively easy. But it is no simple matter, without constant practice, to recognize at a glance the capabilities of the ground, and the manner in which the various physical features, hills, knolls, ridges, woods, should be employed in order to attain the superiority of fire.

If we look back on history, we cannot but be struck by the exceedingly important part that the appreciation or neglect of the capacities of the ground have played in every campaign. The most brilliant victories have been won by manoeuvres which, if not suggested by the physi- cal features of the battlefield, were at least deprived by the nature of the ground of half their risk. Bosbach, Leuthen, Austerlitz, Friedland, Dresden, Vittoria, Orthez, Chancellorsville, the Green Hills at Plevna, are examples. Nor can we fail to notice that the object of the great masters of tactics in carefully reconnoitring the enemy

was to discover the key point or points of his position, and to judge for themselves how each separate locality, wood, village, farm, or hill, might be turned to account and fitted into the plan of battle. In short, we see in many most successful battles an almost methodical pro- gression from point to point, each successive capture weakening the enemy's position, and paving the way for a further and more decisive advance; and the method pursued seems to have been in every case the same. " By threatening the village on the left, and seizing the wood in rear of it, I shall attract the enemy's atten- tion, and perhaps his reserves. As soon as I have succeeded in doing this, I shall attack the hill on his right, and having captured this, bring every available gun to bear upon the central ridge, and attack, under cover of their fire, in full strength." This, or something very like it, appears to have been the ordinary mental process of such leaders as Frederick, Wellington, Napo- leon, and Lee, and in many respects it is still eminently adapted to the field of battle. The difficulty of recon- naissance, the increased power of the defence against direct attack, the difficulty, owing to the wide front occu- pied by a defending force, of developing flank attacks, the general use of entrenchments, will make the fight for each locality

long and exhausting ; and it will con- sequently be necessary for a general to proceed with the utmost caution, and to make certain of securing one point of vantage before he attacks the next. The attack, moreover, of each point will consume far more troops in proportion to the strength of the army than heretofore. The whole army, indeed, may be employed in mastering one single point, part keeping the enemy employed elsewhere, the remainder combining for the decisive attack. The battle, more often than not, will thus resolve itself into a distinct series of engagements, each raging round a different locality and each protracted over many hours.

A systematic attack, wresting point after point, in the order of their importance, from the enemy's possession, is not, however, the only expedient by which the defensive may be overcome. Surprise may be called into play. Manoeuvring, which has been described as the " antidote to entrenchments," is likely to be a conspicuous feature in all skilful tactical operations. Feints will seldom be neglected ; and night marches, preparatory to an attack at dawn from an unexpected direction, will be constantly resorted to. With the exception of the first, each one of these is made easier by the increased power of the local defensive, and by the enhanced difficulty of reconnaissance. A screen, behind which troops moving to a flank or making a night march will be secure from observation or inter- ference, can be established in any ordinary country without much difficulty and maintained by comparatively small numbers ; while no better means of deceiving the enemy, or of making feints effective, could have been invented than the magazine rifle, the quick-firing gun, and smoke- less powder.

But while the latest productions of mechanical invention have done much to help the general offensive, they have by no means made combination .easier, and the success of the attack, as a rule, has always depended on the combination between the units, be they battalions, brigades, or divisions, of which an army is composed. To secure such combination has therefore been the constant aim of all tacticians. The ideal of many has been a simultaneous attack against the front and flank, or front and flanks, made on a uniform system, with all the troops disposed in a uniform J^c^°r

that accidents of ground1, even if utilized by the enemy, would never produce a serious check ; in fact, that the effect of physical features might be ignored, and each separate attack from left, right, and centre might be expected to reach close quarters at approximately the same time. On the other hand, there are those who have taken into account both the ground and the flat trajectory, and who have taught that the normal, simul- taneous system, described above, is far less practical than a system which gives to each unit its specific task, which allots that task in accordance with the ground, and which arranges for combination by instructions which differ for every unit. In this system there is no uni- formity, and it is therefore less simple than the other; but it is founded on sound principles. It does not, in- deed, ensure combination. But inasmuch as it takes each physical difficulty into consideration, and recog- nizes that battle is a succession of efforts, not one con- tinuous rush, it is likely to come much nearer than the other. It is not a popular system. It is more compli- cated than the almost mechanical manoeuvres of the first ; it is less easy to practise in peace ; owing to the lack of uniformity, it is much less picturesque ; and it makes large demands on the intelligence of all ranks. An officer commanding several units, if he wishes to make such use of the ground that each unit may sup- port the others, and if he determines to allot to each its specific task, must not only make a careful recon- naissance and think out a definite plan of action, but he must issue such clear and comprehensive orders that every subordinate commander will thoroughly un- derstand the general design, the part he has himself to play, and the manner in which he is to co-operate with others. By this means only can he ensure intelli- gent combination and resolute action; but it is hardly necessary to say that to frame adequate orders to this end requires a sustained intellectual effort, plenty of previous practice, a cool brain, a mind which knows exactly what it wants to do and how

it is to be done. Moreover, unless the commanders of units and those under them are well trained, even the clearest and most comprehensive orders will probably fail to produce the desired results.

There is one more point connected with the attack which demands notice. It should always be the aim of a general, even when in command of a much superior force, to destroy his enemy with as little loss as possible to himself. Napoleon prided himself on winning his great triumph at Ulm with "the legs of his soldiers," and Moltke's stupendous victory at Sedan, where 104,000 Frenchmen laid down their arms, with an additional loss in killed and wounded of 18,000, cost the Germans no more than 2800 lives. At first sight, then, it would appear that an attack on a strong position, especially if entrenched and prepared, should be consistently avoided, and the enemy manoeuvred out of it. And no doubt this is an excellent rule. Nevertheless, strategical reasons often forbid delay ; and therefore, when time presses, it may happen that the attack has to be delivered then and there, and the > consequent sacrifice of life deliberately accepted. But it is worth noting that the necessity of taking time by the forelock is apt to produce undue haste, disregard of ordinary precautions, and the neglect of essential preliminaries, such as reconnaissance, the con- ception of a comprehensive plan of battle, and the issue of clear orders. Furthermore, a reluctance to incur losses often leads to a small portion only of the force being employed in the attack, and the remainder being either kept in reserve, or so timidly handled as to lend no assist- ance whatever to the assaulting troops. Such half-hearted tactics bring with them their own punishment. Even if

the battle be won, the losses of the troops actually under fire are generally heavier than would have fallen on the whole army had it been resolutely engaged ; while it is exceedingly unlikely that the victory will be decisive. To take a strong position without suffering enormous losses demands the very closest co-operation of every element of force which the commander has at his disposal. What should be the object of such co-operation is a question of much interest. Under the old conditions the general idea of offensive tactics was by feints and secondary attacks to draw off the defender's attention, and, if possible, his reserves, from

the weakest point of the position, and then to attack that point with an over- whelming mass of men and guns. It would be too much to say that this principle is no longer applicable, for it will always be necessary that the full weight of the artillery, when once the battle has become general, should be directed against some particular portion of the defender's line; but envelopment, and the capture of good "fire-positions," especially of localities which favour enfilade or oblique fire, are a far surer and much less costly means, against good troops, of attaining that superiority of fire which decides the victory.

The grand tactics of the defence, of which the soul is the counter-stroke, are in many respects similar to those of the attack. The assailant at the outset occupies certain localities, and so long as he defence. holds out he covers his communications, and the greater part of the force is available for active opera- tions. The defender acts in much the same fashion. He occupies a position which protects his communications, and if possible threatens the communications of his adversary, and, using this position as a pivot of manoeu- vre, he keeps a large force in hand for the counter-stroke. It is in the employment of the force in hand that the great difference arises between an active and a passive attitude. The defender can seldom decide, when he takes up his position, at what moment and at what place he will let this force slip ; his adversary, on the other hand, can determine the exact role of every unit before a shot is fired. It is most important, therefore, that the force detailed for the counter-stroke should be kept abso- lutely distinct from the garrison of the pivot of manoeuvre, that it should be in every respect mobile, and be used for no other purpose than delivering a vigorous attack at the place and at the time a good opportunity offers. Whether it should be tied down to one particular spot is a debateable question. Some part of the battlefield may be more favourable to counter-attack than another, and it is of course desirable, when the blow is struck, to aim at the enemy's line of communication and his strategic flank. But the opening for the counter-stroke is more often offered by the enemy's mistakes than by the ground, and it is impossible to predict where mistakes are likely to be made. We might say, then, that the force set aside for the counter-stroke, unless it come from a dis- tance, like Blucher's army at Waterloo, should be posted where it can rapidly intervene on any part

of the battle- field. Yet in conflicts fought over a very wide front this would manifestly be impossible ; ‘and, as a matter of fact, the whole question is so dependent on local circum- stances that no rule can be laid down. It is clear, how- ever, that the value of mounted troops in this respect is very great.

It has been suggested that the attack will draw more advantage from feigned attacks than heretofore ; but it is not the attack alone that will derive benefit „ PaIse from the power of deception that lies in quick- fronts” firing weapons. By detaching small mobile and “false forces to tactical points beyond the flanks, and f,aaks’ by pushing them forward in advance of the main line of

defence, the difficulties of reconnaissance on the part of the assailant will be largely increased; and it will be always on the cards that uncertainty and the loss of time may betray him into undue extension, dissipation of strength, and purely frontal attacks on the strongest points of the position. In ordinary country, where troops can manoeuvre with facility, a few quick-firing guns, constantly changing their position, will add enor- mously*to the effect of these ” false fronts ” and ” false flanks,” and it may here be stated that the mobility of field and horse artillery confers a great advantage on the defender. In ordinary circumstances, that is, when he is outnumbered in guns, it is questionable whether he is likely to gain anything by accepting a duel with the opposing batteries. His heavy artillery should be suffi- cient to protect the front and flanks of the central for- tress— his pivot of manoeuvre — leaving the remainder available to prevent the assailant from securing strong tactical points and to prepare the counter-stroke. Espe- cially will it be important for the artillery to keep down enfilade and oblique fire, and cover should always be provided whence guns can sweep with shrapnel the hills or ridges which lie beyond the flanks, but within range. The artillery of the defence, in fact, should be handled on the same principles as the light artillery which forms part of the armament of a fortress, and it should only be concentrated when it is

clear that the enemy is about to deliver a resolute attack against some one point of the position, or just previous to the counter-stroke. In both cases as many guns as possible should co-operate. The assailant will endeavour to cover the advance of his infantry by overwhelming the entrenchments with the fire of a mass of guns, and this the defender's artillery must do its best to render inaccurate and harmless, leaving the enemy's infantry alone until it is clear that the advance is progressing, and that the attack is gain- ing the upper hand. For the counter-stroke, concentra- tion is even more important. As a rule, the time for preparation will be short, and yet preparation is as essen- tial as in the attack ; the more guns, therefore, that can be brought into action, the less likelihood of failure. It is true that the counter-stroke, as a rule, will only have to deal with troops shaken by long fighting or by re- pulse ; but behind them will be the batteries, undemor- alized, probably superior in numbers, and maintaining an iron grip on the ground already won. The combinar tion, then, of infantry, cavalry, and artillery should be as carefully planned in the counter-stroke as in the attack. Superiority of fire must be attained by a skilful use of the ground, by enveloping and ^enfilading the point of attack. (g. f. k. h.)

Tafaila, a town of Spain, in the province of Navarra, south of Pamplona, on the river Cidacos, with a station on the railway from Saragossa to Alsasua. Population (1887), 6496; (1897), 5758. The surrounding country is hilly and well cultivated, producing much wheat, good wine, olives, fruit, and vegetables. There are in the town saw-mills, manufactures of alcohol and brandies. The old walls with a few towers and a citadel on a hill outside are still standing. In the parish church of Santa Maria and San Pedro there are some fine bas-reliefs and a Greco-Boman altar front. There is a modern town hall on a large square. There is an old palace of Carlos el Noble now in ruins, and some convents are worthy of notice. Tafaila is an ancient city, first mentioned in the historical documents of Navarre in 1040. It played a conspicuous part in me- diaeval wars between Navarre, Aragon, and France even. It was often besieged and taken by the kings of Navarre and their rebel vassals. In 1512 it passed into the

hands of the kings of Castille with the rest of Spanish Navarre.

Taftlalt {i.e., “The Country of the Filali,” as its in- habitants are called because descended from the Arabian tribe of Hilal, settled here in the 11th century), formerly known as Sajilinasa, the most important oasis of the Moroccan Sahara, ten days’ journey south of Fez, across the Atlas. It is celebrated for its large and luscious dates, to the successful cultivation of which, soon after the arrival of an ancestor of the reigning dynasty of Mo- rocco (hence called the Filali Shareefs, i.e., descendants of Mohammed), circ. a.d. 1250, this dynasty owes its rise to power. Instead of living in towns, its bellicose inhabi- tants occupy fortified buildings and are constantly at war.

Tahiti. — The French establishments in Oceania con- stitute a colonial government embracing the Society Archipelago, with Tahiti, the most important of the Windward Islands, the Leeward Islands, the Marquesas, the Tuamotu Islands, the Gambier group, the Tubuai Islands, Bavavae, and Bapa. These groups are widely scattered, the Marquesas being 720 miles north-east of Tahiti; the nearest of the Leeward Islands, 60 miles north-west, and the Gambier Islands 850 miles south- east. The Tuamotu Islands are spread over an area of 700 miles from north-west to south-east. The island of Tahiti was transferred to the Government of France by Pomare on 29th June 1880; the Marquesas were annexed in 1842; the Gambier Islands in 1894; Bapa in 1867 ; the Leeward Islands in March 1888, in accord- ance with an arrangement made two years earlier by the cabinets of Great Britain and France; the Tubuai Islands in 1889. The establishments have altogether an area of 1520 square miles, with a population of about 29,000. They are administered by a governor who resides at Papeete in Tahiti, and is assisted by a director of the interior, a judicial head, and a privy council. In 1885 an elective general council was created, consisting of 18 members, 10 for Tahiti, 2 for the Marquesas, 4 for Tuamotu, 1 for the Gambier Islands, 1 for Tubuai and Bapa. The tribunals (superior, first instance, and justices of peace) are now all French, the native courts having been suppressed under a convention of 1887. Schools are in general in the hands of religious orders, in par- ticular that of St Joseph of Cluny for girls’ schools. The local budget balanced in 1900 at 1,237,456 francs ; the expenditure of France amounts to about 800,000 francs yearly.

Tahiti has an area of 600 square miles, with magnificent vegeta- tion and picturesque scenery. The fertile lands have an area of about 25 square miles, but only 2 or 3 square miles are under cultivation, the crops being cocoanuts, oranges, sugar, and vanilla. Cotton, coffee, and tobacco growing have been abandoned. From the cocoanut copra and flour are made, and from the sugar-cane both sugar and rum. For some years the orange crop has steadily increased. Cattle are scarce ; the industries comprise sugar works, brick works, and printing-offices, and the Tahitians prepare flour and make straw hats. The natives, however, are not fond of work, and this fact accounts for the backward condition of agriculture. In 1900 Tahiti had a population of 10,750, of whom 4282 were at Papeete, the capital-; of these 2490 were French or the descendants of French. The trade of this port amounts to about £240,000 a year, of which about half is for exports. The staple exports are copra, 40 per cent. ; mother-of-pearl, 30 per cent. ; vanilla, 17 percent.; cocoanuts, oranges; while the imports are tissues, 27 per cent. ; farinaceous foods, 12 per cent. ; wines, 6 per cent. The United States send to the port goods to the value of £52,000 per annum ; France, £28,000 ; New Zealand, £20,000 ; Great Britain, £3200. The shipping, exceeding 80,000 tons, derives its import- ance from the situation of Papeete in the Pacific. The port has a slip for repairing and a coal dep6t. Tahiti is connected by a weekly service with Moorea, and by other services with other French establishments. It has communication also with San Francisco, Noumea, and Auckland. Moorea has an area of 50 square miles, of which 13 are cultivable. The coffee and cotton

area descends low. The island contains 1596 inhabitants grouped around Papetoai, the capital. The chief produce of the Windward Islands is copra. Raiatea and Tahaa have 2300 inhabitants; Huahine, 1300 ; Bora Bora, which arose in 1890, 800.

The Tubuai or Austral Islands are all very small, their total area being under 100 square miles, but they bristle with mountains, reaching at Rouroutore a height of 1300 feet. They contain 2300 inhabitants, and

are rich in cocoanut trees and ironwood. The seat of administration is Rotoava.

Bapa (15 square miles) is an old crater, 2000 feet high. It has 192 inhabitants, and possesses a coal mine.

The Tuamotu Islands or Low Archipelago produce cocoanuts, mother-of-pearl, and pearls. The population exceeds 7000.

The Gambier Islands, with an area of 6 square miles and a popu- lation of 460, yield annually about £16,000 worth of mother-of- pearl.

The Marquesas have 5246 inhabitants, and produce oranges, cocoanuts, and yams. Cattle are comparatively numerous, over 2000 ; and the natives are skilful in the construction of whale- boats. The commerce exceeds £20,000. The capital, Taiohae, has 493 inhabitants.

See Haukigot. Utablissements Francais en Oceanie. Paris, 1887. — Le Chartier. Tahiti. Paris, 1887. V Annee Coloniale,

1900.

Tain, a royal and parliamentary burgh of Ross and Cromarty, Scotland, near the Dornoch Firth, 44 miles N.N.E. of Inverness by rail. The shrine of St Duthus is a roofless ruin, and the collegiate church of St Duthus dates from about 1360. The public buildings are of considerable architectural merit, notably a court house, a public hall, and the endowed academy. The industries include distilling and the manufacture of aerated waters. The town has a valuable ” common good ” in the shape of lands and fishings. The rainfall is one of the lowest in the kingdom. Population (1881), 2221 ; (1901), 1645.

Taine, Hippolyte Adolphe (1828-1893), French critic and historian, the son of Jean Baptiste Taine, an attorney, was born at Vouziers on the 21st of April 1828. He remained with his father until his eleventh year, receiving instruction from him, aud attending at the same time a small school which was under the direction of M. Pierson. In 1839, owing to the serious illness of his father, he was sent to an ecclesiastical pension

at Rethel, where he remained eighteen months. J. B. Taine died on the 8th of September 1840, leaving a moderate competence to his widow, his two daughters, and his son. In the spring of 1841 Taine was sent to Paris, and entered as a boarder at the Institution Mathd, where the pupils attended the classes of the College Bourbon. Madame Taine followed her son to Paris. Taine was not slow to distinguish him- self at school. When he was but fourteen years old he had already drawn up a systematic scheme of study, from which he never deviated. He allowed himself twenty minutes' playtime in the afternoon and an hour's music after dinner; the rest of the day was spent in work. His efforts met with brilliant success and prompt reward. In 1847, as v6tiran de rhitorique, he carried off six first prizes in the general competition, the prize of honour, and three accessits ; he won all the first school prizes, the three science prizes, as well as two prizes for disserta- tion. It was at the College Bourbon that he formed lifelong friendships with several of his schoolfellows who afterwards were to exercise a lasting influence upon him : among these were Prevost-Paradol, for many years his most intimate friend ; Planat, the future " Marcelin " of the Vie Parisienne ; and Cornells de Witt, who introduced him to Guizot when the latter returned from England in

1846.

Public education was the career which seemed to lie open to Taine after his remarkable school successes. In 1848 he accordingly took both his baccalauriat degrees, in science and letters, and passed first into the iScole

Normale; among his rivals, whopassed in at the same time, were About, Sarcey, Libert, and Suckau. This was a brilliant epoch in the annals of the lScole Normale ; among those of Taine's fellow-students who afterwards made a name in teaching, letters, journalism, the theatre and politics, &c, were Challemel-Lacour, Chassang, Aube, Perraud, Ferry, Weiss, Yung, Gaucher, Greard, Prevost- Paradol, and Levasseur. Taine made his influence felt among them at once ; he amazed everybody not only by his erudition, but by his indefatigable energy ; and not only by his prodigious industry, but by his facility both in

French and Latin, in verse as well as in prose. Taine enjoyed this period of his life to the full ; he revelled in the stimulating pleasure of feeling himself surrounded by young, keen, and audacious minds. His reading was immense. He devoured Plato, Aristotle, the Fathers of the Church, and he analysed and classified all that he read. He already knew English, and set himself to master German in order to read Hegel in the original. The brief leisure he allowed himself was devoted to music. The rare quality of Taine's intellect and his extraordinary industry placed him beyond the range of rivalry. The teachers of his second and third years, Deschanel, Geruzez, Berger, Havet, Filon, Saisset, and Simon, were unanimous in praising the nobility of his character, the vigour and the fertility of his intellect, the distinction of style with which his work was always stamped ; they were equally unanimous in finding fault with his un- measured taste for classification, abstraction, and formula. The director of studies, M. Vacherot, gauged his capacity at the end of his second year with prophetic insight. He prophesied that Taine would be a great savant, add- ing that he was not of this world, and that Spinoza's motto, " Vivre pour penser," would also be his. In the month of August 1851 he came forward as a candidate for the fellowship in philosophy (agre'gation de philoso- phie) in company with his friends Suckau and Cambier. The jury was presided over by M. Portalis, and con- sisted of MM. Benard, Franck, Garnier, Gibon, and l'Abbe Noirot. Taine was declared to be admissible, together with five other candidates; but in the end only two candidates were admitted, his friend Suckau and Aube. This decision created almost a scandal. Taine's reputation had already spread beyond the college. Everybody had taken for granted that he would be admitted first. The fact was that his examin- ers sincerely considered his ideas to be absurd, his style and method of handling a subject dry and tiresome ; they declared that he was incapable of teaching philoso- phy, and an unlikely candidate ever to succeed in a competition for a fellowship. Four years later this fellowship was abolished.

The Minister of Public Instruction, however, judged Taine less severely, and appointed him provisionally to the chair of philosophy at the college of Toulon on 6th October 1851 ; but he never entered upon his duties, as he did not wish to be so far from his mother, and on 13th

October he was transferred to Nevers as a substitute. Two months later, on the 27th December, occurred the coup d'&at, after which every university professor was regarded with sus- picion ; many were suspended, others resigned. In Taine's opinion it was the duty of every man, after the plebiscite of the 10th December, to accept the new state of affairs in silence ; but the universities were not only asked for their submission, but also for their approbation. At Nevers they were requested to sign a declaration express- ing their gratitude towards the President of the Republic for the measures he had taken. Taine was the only one to refuse his endorsement. He was at once marked down as a revolutionary, and in spite of his success as a teacher and of his popularity among his pupils, he was

transferred on 29th March 1852 to the lycee of Poitiers as professor of rhetoric, with a sharp warning to be careful for the future. Here, in spite of an abject com- pliance with the stringent rules imposed upon him, he remained in disfavour, and on 25th September 1852 he was appointed assistant professor of the sixth class at the lyce"e of Besancon. This time he could bear it no longer, and he applied for leave, which was readily granted him on 9th October 1852, and renewed every year till his decennial appointment came to an end. It was in this painful year, during which Taine worked harder than ever, that the fellowship of philosophy was abolished. As soon as Taine heard of this he at once began to prepare himself for the fellowship in letters, and to work hard at Latin and Greek themes. On 10th April 1852 a decree was published by which three years of preliminary study were necessary before a can- didate could compete for the fellowship, but by which a doctor's degree in letters counted as two years. Taine immediately set to work at his dissertations for the doc- tor's degree ; on the 8th June (1852) they were finished and 150 pages of French prose on the Sensations and a Latin essay were sent to Paris. On the 15th July 'he was informed that the tendency of his Essay on the Sensations made it impos- sible for the Sorbonne to accept it, so for the

moment he laid this work aside, and on 1st August he began an essay on La Fontaine. He then started for Paris, where an appointment which was equivalent to a suspension awaited him. His university career was over, and he was obliged to devote himself to letters as a profession. In a few months his two dis- sertations, De personis Platonicis and the essay on La Fontaine's fables were finished, and on 30th May 1853 he took his doctor's degree. This was the last act of his university career; his life as a man of letters was now to begin.

No sooner had he deposited his dissertations at the Sorbonne than he began to write an essay on Livy for one of the competitions set by the Academy ; in this work he displayed a new side of his extensive erudition. Here again the moral tendency of his work excited lively opposition, and after much discussion the com- petition was postponed till 1855 ; Taine toned down some of the censured passages, and the work was crowned by the Academy in 1855. The essay on Livy was published in 1856 with the addition of a preface setting forth determinist doctrines, much to the disgust of the Academy. In the beginning of 1854 Taine, after six years of uninterrupted efforts, broke down and was obliged to rest ; but he found a way of utilizing his en- forced leisure : he let himself be read to, and for the first time his attention was attracted to the French Revolution ; he acquired also a knowledge of physiology in follow-

HlPPOLTTE ADOLPHB TAINK.

{From a photograph by Bra/wi, Cldmmt el Cie., Paris.)

ing a course of medicine. In 1854 he was ordered for his health to the Pyrenees, and Hachette, the publisher, asked him to write a guide-book of the Pyrenees. Taine's book bore little resemblance to a guide-book. It was a collection of vivid descriptions of nature, historical anec- dotes, graphic sketches, satirical notes on the society which frequents watering-places, and underlying the whole book was a vein of stern philosophy ; it was published in

1855.

The year 1854 was an important one in the life of Taine. His enforced leisure, the necessity of mixing with his fellow-men, and of travelling, tore him from his cloistered existence and brought him into more direct contact with reality. His method of expounding philo- sophy underwent a change. Instead of employing the method of deduction, of starting with the most ab- stract idea and following it step by step to its concrete realization, henceforward he starts from the concrete reality and proceeds through a succession of facts until he arrives at the central idea. His style also became vivid and full of colour ; he shows that he is acutely sensible to the outward manifestations of things and depicts them in all their relief. Simul- taneously with this change in his works his life became less self-centred and solitary. He lived with his mother in the Isle Saint-Louis, and now he once more associated with his old friends, Planat, Prevost-Paradol, and About. He made the acquaintance of Penan, and through Penan that of Sainte-Beuve, and he renewed friendly relations with M. Havet, who for three months had been his teacher at the l£cole Normale. These years (1855-56) were Taine's periods of greatest activity and happiness in production. On 1st February 1855 he published an article on La Bruyere in the Bevue de V Instruction Publique. In the same year he published seventeen articles in this review and twenty in 1856 on the most diverse subjects, ranging from Menander to Macaulay. On 1st August 1855 he published a short article in the Revue des Deux Mondes on Jean Reynaud. On 3rd July 1856 appeared his first article in the Debats on Saint-Simon, and from 1857 onwards he was a constant contributor to that journal. But he was seeking for a larger field, which would afford scope for the development of his theory on race, period, environment, and the dominating faculty. On 17th January 1856 his history of English literature was announced, and from 14th January 1855 to 9th October 1856 he published in the Revue de V Instruction Publique a series of articles on the French philosophers of the 19th century, which appeared in a volume at the beginning of 1857. In this volume he energetically attacked the principles which underlie the philosophy of Victor Cousin and his school with an irony which amounts at times to irreverence.

The book closes ~~with, the sketch of a system in which the methods of the exact sciences are applied to psycho~~ logical and metaphysical research. The work itself met with instantaneous success, and Taine became famous. Up till that moment the only important articles on his work were an article by About on the Voyage aux Pyrenees,1 and two articles by Guizot on his Livy.2 After the publication of Les Philosophes Francais, the articles of Sainte-Beuve in the Moniteur (9th and 16th March 1856), of Sherer8 in the Bibliotheque Universelle (1858), and of Planche in the Revue des Deux Mondes (1st April 1857) show that from this moment he had taken a place in the front rank of the new generation of men of letters. Caro published an attack on Taine and Renan, called "L'Idee de Dieu dans une Jeune lScole," in the Revue Contemporaine of 15th June 1857. Taine answered all attacks by publishing new books. In 1858 appeared a volume of Essais de Critique et d'His- toire ; in 1860 La Fontaine et ses Fables, and a second edition of his Philosophes Francais. During all this time he was persevering at his history of English litera- ture up to the time of Byron. It was from that moment that Taine's influence began to be felt ; he was in con- stant intercourse with B-enan, Sainte-Beuve, Sherer, Gau- tier, Flaubert, Saint-Victor, and the Goncourts, and gave up a little of his time to his friends and to the calls of society. A more liberal atmosphere was abroad, and in 1862 Taine came forward as a candidate for the chair of literature at the Polytechnic School, but M. de Lomenie was elected in his place.

The following year, however, in March, Marshal Randon, Minister of War, appointed him examiner in history and German to the military academy of Saint Cyr, and on 26th October 1864 he succeeded Viollet- le-Duc as professor of the history of art and aesthetics at the Ecole des Beaux Arts. He was to meet, never- theless, with renewed opposition. Benan's appointment at the College de France and Taine's candidature for the Polytechnic School had alarmed Mgr. Dupanloup, who in 1863 issued an Avertissement d la Jeunesse et aux Pdres de Famille, which consisted of a violent attack upon Taine, Renan, and Littre: Renan was suspended, and Taine's appointment to Saint Cyr would have been

cancelled but for the intervention of the Princess Mathilde. In December 1863 his Histoire de la Litera- ture Anglaise was published, prefaced by an introduction in which Taine's determinist views were developed in the most uncompromising fashion. In 1864 Taine sent this work to the Academy to compete for the Prix Bordin. M. de Falloux and Mgr. Dupanloup attacked Taine with violence; he was warmly defended by Guizot: finally, after three days of discussion, it was decided that as the prize could not be awarded to Taine, it should not be awarded at all. This was the last time Taine sought the suffrages of the Academy save as a candidate, in which quality he appeared once in 1874 and failed to be elected, Mfeieres, Caro, and Dumas being the rival candidates ; and twice in 1878, when, after having failed in May, H. Mar- tin being chosen, he was at last elected in November in place of M. Lomenie. In 1866 he received the Legion of Honour, and five years later (October 1871), on the con- clusion of his lectures in Oxford on Corneille and Racine, the University conferred upon him its degree of D.C.L.

The period from 1864 to 1870 was perhaps the happi- est of Taine's life. He derived pleasure from his employ- ment at the Beaux Arts and Saint Cyr, which occupied but a limited portion of his time and left ample leisure

1 Revue de I' Instruction Publique, 29th May 1856.

2 Debats, 26th and 27th January 1857.

8 Reprinted in Melanges de Critique Religieuse.

for travel and research. In 1864 he spent three months (February to May) in Italy, which furnished him with several articles for the Revue des Deux Mondes from December 1864 to May 1866. In 1865 appeared La Phil- osophie de VArt, in 1867 L'Idial dans VArt, followed by essays on the philosophy of art in the Netherlands (1868), in Greece (1869), all of which short works were repub- lished later (in 1880) as a work on the philosophy of art. In 1865 he published his Nouveaux Fssais de Critique et d'Histoire ; from 1863 to 1865 appeared in La Vie Parisi- enne the notes he had taken for the past two years on Paris and on

French society under the sub-title, of ” Vie et Opinions de Thomas Frederic Graindorge,” published in a volume in 1867, the most personal of his books, and an epitome of his ideas. In 1867 appeared a supplemen- tary volume to his history of English literature, and in January 1870 his Thiorie de V Intelligence. During these last years his life had undergone another change ; in 1868 he married Mademoiselle Denuelle, the daughter of a distinguished architect, and from that time his life was lightened of half its cares.

He had made a long stay in England in 1858, and had brought back copious notes, which, after a second journey in 1871, he published in 1872 under the title of Notes sur V Angleterre. On 28th June 1870 he started to visit Germany, but his journey was abruptly interrupted by the outbreak of the war ; his project had to be abandoned, and Taine, deeply shaken by the events of 1870, felt that it was the duty of every Frenchman to work solely in the interests of France. On 9th October 1870 he published an article on ” L’Opinion en Allemagne et les Conditions de la Paix,” and in 1871 a pamphlet on Le Suffrage Universel ; and it was about this time also that the more or less vague ideas which he had entertained of writing on the French Revolution returned in a new and definite shape. He determined to trace in the Revolution of 1789 the reason of the political instability from which modern France was suffering. From the autumn of 1871 to the end of his life his great work, Les Origines de la France Contemporaine, occupied all his time, and in 1884 he gave up his professorship in order to devote himself wholly to his task; but he succumbed before it was finished, dying in Paris on 5th March 1893. In the portion of the work which remained to be finished Taine had intended to draw a picture of French society and of the French family, and to trace the development of science and the scientific spirit in the 19th century. He had also planned a complementary volume to his Thiorie de I’ Intelligence, to be entitled Un Traite” de la VolontL

The Origines de la France Contemporaine, Taine’s monumental achievement, stands apart from the rest of his work. His object was to explain the existing consti- tution of France by studying the more immediate causes of the present state of affairs — the last years of what

is called the Ancien Regime, the Revolution and the begin- ning of the 19th century, to each of which several volumes were assigned. He also had another object, although he was perhaps hardly conscious of it, which was to study man in one of his pathological crises ; for Taine makes an investigation into human nature, and the historian checks and endorses the pessimism and misanthropy of Graindorge. The problem which Taine set himself was, to inquire why the centralization of modern France is so great that all individual initiative is practically non- existent, and why the central power, whether it be in the hands of a man or of an assembly, is the sole and only power ; also to expose the error underlying two prevalent ideas: — (1) That the Revolution destroyed absolutism and set up liberty ; the Revolution, he points out, merely caused absolutism to change hands. (2) That the Revo- lution destroyed liberty instead of establishing it; that

France was less centralized before 1789 than after 1800. This also he shows to be untrue. The centralization was as great before 1789 as after 1800. France was already a centralized country before 1789, and grew rapidly more and more so from the time of Louis XIV. onwards. The Revolution was the last step, completing what had already been done. The Revolution neither destroyed nor created despotism ; it merely gave it a new form.

The Origines differ from the rest of Taine's work in that, although he applies to a period of history the method which he had already applied to literature and the arts, he is unable to approach his subject in the same spirit: he loses his philosophic calm; he cannot help writing as a man and a Frenchman, and he lets his feelings have p"lay; but what the work loses thus in impartiality it gains in life. The most important part of this great work is the deductive part, in which Taine traces step by step by what succession of facts and ideas, converted into facts later, ancient France developed into modern France. According to Taine, the chief causes of the French Revolution were the crying abuses of the

Ancien Rigime, the stupendous waste of the State revenue, and the conversion of the French esprit classique into abstract idealism.

Taine was the philosopher of the epoch which suc- ceeded the era of romanticism in France. The romantic era had lasted from 1820 to 1850. It had been the result of a reaction against the classical school, or rather against the conventionality and lifeless rules of this school in its decadence. The romantic school introduced the principle of individual liberty both as regards matter and style; it was a brilliant epoch, rich in men of genius and fruit- ful of beautiful work, but towards 1850 it had reached its decline, and a young generation, tired in turn of its conventions, its hollow rhetoric, its pose of melancholy, arose, armed with new principles and fresh ideals. Their ideal was truth; their watchword liberty; to get as near as possible to scientific truth became their object. We can trace their efforts in all the branches of art, in the pictures of Meissonier, Millet, and Bastien- Lepage ; in the poetry of Leconte de Lisle and of Sully- Prudhomme; in the historical works of Renan; in the- fiction of Flaubert, Zola, and Maupassant. Taine was the mouthpiece of this period, or rather one of its most authoritative spokesmen.

Many attempts have been made to apply one of Taine's favourite theories to himself, and to define his predomi- nant and preponderant faculty. Some critics have held that it was the power of logic, a power which was at the same time the source of his weakness and of his strength. He had a passion for abstraction. " Every man and every book," he said, " can be summed up in three pages, and those three pages can be summed up in three lines." He considers everything as a mathematical problem, whether it be the universe or a work of art : " C'est beau comme un syllogisme," he said of a sonata of Beethoven's. Taine's theory of the universe, his doctrine, his method of writing criticism and history, his philosophical system, are all the result of this logical gift, this passion for reasoning, classification, and abstraction. But Taine's imaginative quality was as remarkable as his power of logic; hence the most satisfactory definition of Taine's predominating faculty would be one which comprehended the two gifts. M. Lemaitre gave us this definition when he called Taine a poete-logicien ; M.

Bourget likewise when he spoke of Taine's imagination philosophique, and M. Barres when he said that Taine had the power of dramatizing abstractions. For Taine was a poet as well as a logician ; and it is possible that the portion of his work which is due to his poetic and imaginative gift may prove the most lasting.

Taine's doctrine consisted in an inexorable determinism, a negation of metaphysics; as a philosopher he was a positivist. Enamoured as he was of the precise and the definite, the spiritualist philosophy in vogue in 1845 posi- tively maddened him. He returned to the philosophy of the 18th century, especially to Condillac and to the theory of transformed sensation. Man knows nothing save through sensations, which are transformed in him into ideas by means of the faculty of abstraction. Sen- sations grouping themselves represent phenomena, and abstract ideas are significative of the constant relations between phenomena, or laws ; and since to abstract and to generalize is all that man can do, his whole knowledge is limited to phenomena and the laws of phenomena. He can never arrive at the knowledge of a cause — the domain of metaphysics; but he can get to know more and more about, although he can never attain to, the knowledge of the how — the domain of science. Meta- physics does not exist ; but science exists ; therefore, philosophy to be a science must stop short on the threshold of metaphysics. Taine presented this philoso- phy in a vivid, vigorous, and polemical form, and in con- crete and coloured language which made his works more easily accessible, and consequently more influential, than those of Auguste Comte. Hence to the men of 1860 Taine was the true representative of positivism.

Taine's critical work is considerable ; but all his works of criticism are works of history. Hitherto history had been to criticism as the frame is to the picture; Taine reversed the process, and studied literary personages merely as specimens and productions of a certain epoch. He started with the axiom that the complete expression of a society is to be found in its literature, and that the way to obtain an idea of a society is to study its litera- ture. The great writer is not an isolated being ; he is the result of a thousand causes; firstly, of his race; secondly, of his environment; thirdly, of the circum- stances in which he was placed

while his talents were developing. Hence Race, Environment, Time — these are the three things to be studied before the man is taken into consideration. Taine completed this theory : by another, that of predominating faculty, the faculti, maltresse. This consists in believing that every man, and especially every great man, is dominated by one faculty so strong as to subordinate all others to it, which is the centre of the man's activity and leads him into one particular channel. It is this theory, obviously the result of his love of abstraction, which is the secret of Taine's power and of his deficiencies. He always looked for this salient quality, this particular channel, and when he had once made up his mind what it was, he massed up all the evidence which went to corroborate and to illustrate this one quality, and necessarily omit- ted all conflicting evidences. The result was an inclina- tion to lay stress on one side of a character or a question to the exclusion of all others. Consequently, in his study of man and history he did what he blamed the classical authors of the 18th century in France for doing. These authors saw and portrayed the type exclu- sively, and entirely neglected the individual. Taine generalized in the same manner. Hence the one-sided character of his work.

Taine served science unfalteringly, without looking forward to any possible fruits or result. In his work we find neither enthusiasm nor bitterness, neither hope nor yet despair; merely a hopeless resignation. The study of mankind was Taine's incessant preoccupation, and he followed the method already described. He made a searching investigation into humanity, and his verdict was one of unqualified condemnation. In Thomas Graindorge we see him aghast at the spectacle of man's brutality and

woman's folly. In man he sees the primeval savage, the gorilla, the carnivorous and lascivious animal, or else the maniac with diseased body and disordered mind, to whom health, either of mind or body, is but an accident. Taine is appalled by the Mte humaine; and in all his works we are conscious, as in the case of Voltaire, of the terror with

**which the possibilities of human folly inspire him. It may be doubted whether Taine's system, to which he attached so much importance, is really the most lasting part of his work, just as it may be doubted whether a sonata of Beethoven's bears any resemblance to a syllogism. For Taine was an artist as well as a logician, an artist who saw and depicted what he saw in vital and glowing language. From the artist we get his essay on La Fontaine, his articles on Balzac and Bacine, and the passages on Voltaire and Bousseau in the ~~4wcien Rigime. Moreover, not only was Taine an artist who had not escaped from the influence of the romantic tradition, but he was by his very method and style a romanticist. His emotions were deep if not violent, his vision at times almost lurid. He sees everything in startling re~~ lief and sometimes in exaggerated outline, as did Bal- zac and Victor Hugo. Hence his predilection for exuberance, strength, and splendour ; his love of Shake- speare, Titian, and Rubens ; his delight in bold, highly-coloured themes. Thus we have the curious spectacle of a man who combats and attacks the classical spirit with all his might, and yet passes his life in generalizing ; of a man who comes to supplant romanticism, and yet affords us one of the most striking examples of the ro- mantic style and method. **

Taine's influence was great, and twofold. On his own generation it was considerable ; during the epoch in which he lived, while a wave of pessimism was sweeping over French literature, he was the high priest of the cult of misanthropy, in which even science was held to be but an idol, worthy of respect and devotional service, but not of faith. In its turn came the reaction against positivism and pessimism, and an attempt at spiritual renascence. Around a man so remarkable as Taine a school is certain to form itself ; Taine's school, which was one of positivist doctrines, rigid systems, and resigned hopelessness, was equally certain to produce at some time or another a school of determined opponents to its doctrines and system. If, therefore, the tone which pervades the works of Zola, Bourget, and Maupassant can be immediately attributed to the influence we call Taine's, it is also the influence of Taine which is one of the ultimate causes of the protest embodied in the subsequent reaction.

(m. ba.)

Tait, Archibald Campbell (1811-1882), Arch- bishop of Canterbury, the son of Craufurd Tait and his wife Susan, daughter of Sir Hay Campbell, was born at Edinburgh on 21st December 1811. His parents being Presbyterians, he was baptized (10th February 1812) by Dr Thomas MacKnight of St Giles's, Edinburgh ; but he early turned towards the Scottish Episcopal Church, and was confirmed in his first year at Oxford, having entered Balliol College in October 1830 as a Snell exhibitioner from the University of Glasgow. He won an open scholarship, took his degree with a first-class in Uteris humanioribus (1833), and became fellow and tutor of Balliol ; he was also ordained deacon (1836) and priest (1838), and served the curacy of Baldon. Bapid changes amongst the fellows found him at the age of twenty-six "the senior and most responsible of the four Balliol tutors." The experience, gained during this period stood him in good stead afterwards as a member of the first Oxford University Commission (1850-52), in which he took a prominent part. But he cannot be said to have

left any permanent effect on the university. He never sympathized with the principles of the Tractarian move- ment, and on the appearance of Tract XC. in 1841 he drafted the famous protest of the " Four Tutors " against it ; but this was his only important contribution to the controversy. On the other hand, although his sympathies were on the whole with the liberal movement in the university, he never took a lead in the matter. In 1842 he became an undistinguished but useful suc- cessor to Arnold as headmaster of Bugby ; and a serious illness in 1848, the first of many from which he suffered, led him to welcome the comparative leisure which fol- lowed upon his appointment to the deanery of Carlisle in 1849. His life there, however, was one of no little ac- tivity ; he served on the University Commission already mentioned, he restored his cathedral, and did much ex- cellent pastoral work. There too he suffered the great sorrow of his life. He had married Catharine Spooner at Bugby in 1843 ; in the spring of 1856, within five weeks, five of their children were carried off by virulent scarlet fever. Not long afterwards he entered upon his real life-work, being

consecrated bishop of London on 22nd November 1856, as successor to C. J. Blomfield. He at once took a leading part in all ecclesiastical affairs, and never ceased to do so. His translation to Canterbury in 1868 (he had refused the archbishopric of York in 1862) constituted indeed a recognition of his work, but made no break in it. His latter days were interrupted by illness and saddened by the death in 1878 of his only son Craufurd (whom he had ordained priest three years before) and of his wife ; but although his activity was thus lessened, his influence grew steadily down to his death.

If Blomfield had almost remodelled the idea of a bishop's work, his successor surpassed him. Tait had all Blomfield's earnestness and his powers of work, with far wider interests. Blomfield had given himself zealously to the work of church-building ; Tait followed in his steps by inaugurating (1863) the Bishop of London's Fund. He realized too that the obtaining of funds was not enough, and that the real problem was the far larger one of getting hold of the people. He spent a large part of his time at London in actual evangelistic work ; and to the end his interest in the pastoral side of the work of the clergy was greater than anything else. With his wife, he was instrumental in organizing women's work upon a sound basis, and he did not a little for the healthful regulation of Anglican sisterhoods during the formative period in which this was particularly necessary. Nor was he less successful in the larger matters of administration and organization, which brought into play his sound practical judgment and strong common-sense. He was constant in his attendance in Parliament, and spared no pains in pressing on measures of practical utility. The modification of the terms of clerical subscription (1865), the new lectionary (1871), the Burials Act (1880) were largely owing to him ; for all of them, and especially the last, he incurred much obloquy at the time, but it would be generally agreed at the present day that he was right. The Boyal Commissions on Bitual (1867) and on the Ecclesiastical Courts (1881) were due to him, and he took a large part in the deliberations of both. Probably his successor (see Benson, E. W.) was brought into closer relations with the colonial churches than Tait was ; but the healthy development of the Lambeth Conferences on the lines of mutual counsel rather than of a hasty quasi-synodic action was

largely due to him ; and many pitfalls which might have endangered the orderly growth of the Anglican Communion, especially as regards South Africa and India, were avoided owing to his practical clear-sightedness.

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T A I T

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On the other hand, Tait -was greatly at fault in dealing with matters which called for the higher gifts of a ruler, and especially in his relations with (a) the liberal trend in modern thought, and (6) the Catholic revival, (a) As regards the former, he was himself not a little in sympathy with it. But although a very well-read man, he was no scholar in the true sense of the word, and had neither the knowledge to feel sure of his ground nor the theological insight to perceive the real point at issue. His object in dealing with questions of faith, as in dealing with the ritual ques- tion, was primarily a prac- tical one : he wished to secure peace, and obedience to the law as he saw it. Consequently, after his sym- pathies had led him to express himself favourably towards some movement, he frequently found himself compelled to draw back. He expressed a qualified sympathy with some of the writers of Essays and Re- views, and then joined in the censure of it by the bishops (1861). The same kind of apparent vacillation was found in his action in other cases ; e.g., in the Colenso case (1863), and in the con- troversy as to the use or disuse of the Athanasian symbol (1872). It was nat- urally and widely misunder- stood. Some who did not know him thought, or pre- tended to think, that he was a Socinian or a free- thinker. The world at large knew better ; but even Dr Temple warned him, in the case of Essays and Reviews, ” You will not keep

friends if you compel them to feel that in every crisis of life they must be on their guard against trusting you.” (6) As regards the second point, Tait was concerned with it during the whole of his episcopate, and above all on the side of ritual, on which it naturally came into most direct conflict with the recognized ecclesiastical practice of the day. He

had to deal with the St George's-in-the-East riots in 1859, and the troubles at St Alban's, Holborn, in their earlier stages (1867) ; he took part as assessor in the Privy Council judgment in the Eidsdale case (1877) ; he was more closely concerned than any other bishop with the agitation against confession in 1858, and again in 1877. His method throughout was the same : he endeavoured to obtain a compliance to the law as declared by the courts ; failing this, he made the most earnest efforts to secure obedience to the ruling of the Ordinary for the sake of the peace of the Church; after this, he could do nothing. He did not perceive how much of reason the " ritualists " had on their side ; that they were fighting in some cases for practices (such as confession) which had been widely used in England since the Reformation ; in other cases for what, as they contended, and not altogether unreasonably, were covered by the letter of the rubric ; and that at any rate, where rubrics were notoriously disregarded on all hands, it was not fair to proceed against one class of delinquent only. In fact, it is not too much to say that, if others

Archbishop Tait. (From a photograph by Bawano, London.)

were inclined to ignore it altogether, Tait could hardly realize anything but the connexion between the English Church and the State. From such a position there seemed to be no escape but in legislation for the depriva- tion of the recalcitrant clergy ; and the Public Worship Regulation Act (1874) was the result. For this Tait was by no means responsible as a whole : some of the provisions which proved most irksome were the result of amendments by Lord Shaftesbury which the bishops were unable to resist; and it must be borne

in mind that the most disastrous results of the measure were not contem- plated by those who were instrumental in passing it. The results followed inevi- tably : clergy were cited before a new tribunal, and not only deprived but im- prisoned. A widespread feel- ing of indignation spread not only among High Churchmen, but among many who cared little or nothing for the ritual prac- tices involved; and it seemed impossible to fore- tell what the outcome would be. But the aged arch- bishop was moved as much as anybody, and tried hard to

mitigate such a state of things. At len gth, when the Rev. A. H. Mackonochie was on the point of being de- prived of his benefice of St Alban's, Holborn, for contu- macy, the archbishop, then on his deathbed at Adding- ton, took steps which re- sulted in the carrying out of an exchange of benefices (which had already been pro- jected), which removed—him from the jurisdiction of the court. This proved to be the turning-point; and although the ritual difficulty by no means ceased, itwas afterwards dealt with from a different point of view, and the Public Worship Regulation Act became practically obsolete. The archbishop died on Advent Sunday 1882, leaving a legacy of peace to the Church.

Tait was a Churchman by conviction ; but although the work of his life was all done in England, he remained a Scotsman to the end. It was the opinion of some that he never really understood the historical position of the English Church and took no pains to learn. Tillotson was a favourite hero of his, and in some ways the two men resembled one another. But Tait had none of Tillotson's gentleness, and he rode roughshod over the obstacles in his way. To say that he was a great ecclesi- astical statesman is misleading, for he could not discern the signs of the times ; and, well though he administered his office, his work was in many ways a failure. On the other hand, he was undoubtedly one of the foremost public men of his day. But he was more : he was a man of great devotion and beauty of character ; and his face grew steadily in power and nobility to the day of his death.

Authorities. — Bishop R. T. Davidson and W. Benham. Life of Archbishop Tait, 2 vols. London, 1891. — A. C. Tait. Catharine and Craufurd Tait. London, 1880. — Dictionary of National Bio- graphy, article "A. C. Tait," by W. H. Fremantle. (w. e. Co.)

Tait, Peter Cuthrie (1831-1901), Scottish physi- cist, was born at Dalkeith, on 28th April 1831. After attending the Academy at Edinburgh and spending a session at the University, he went up to Cambridge as a member of Peterhouse, and graduated as senior wrangler and first Smith's prizeman in 1852. As a fellow and lecturer of his college he remained in Cambridge for two years longer, and then left to take up the professorship of mathematics at Queen's College, Belfast. There he made the acquaintance of Andrews, whom he joined in researches on the density of ozone and on the electrolytic conden- sation of mixed oxygen and hydrogen, and by whom he was introduced to Hamilton and quaternions. In 1860 he was chosen to succeed his old master, Forbes, as pro- fessor of natural philosophy at Edinburgh, and this chair he occupied till within a few months of his death, which occurred on 4th July 1901, at Edinburgh. The first scientific paper that appears under Tait's name only was published in 1860. His earliest work dealt mainly with mathematical subjects, and especially with quaternions, of which he may be regarded as the leading exponent after their originator, Hamilton. He was the author of two text-books on them — one an Elementary Treatise on Quaternions (1867), written with the advice of Hamilton, though not published till after his death, and the other an Introduction to Quaternions (1873), in which he was aided by Professor Kelland, who had been one of his teachers at Edinburgh. In addition, quaternions was one of the themes of his address as president of the mathematical section of the British Association in 1871. But he did not long confine himself to pure mathe- matics, and soon began to produce original work in mathe- matical and experimental physics. In 1864 he published a short paper on thermodynamics, and from that time his contributions to that and kindred departments of science became frequent and important. In 1871 he emphasized the significance and promise of the principle of the dissipation of energy. In 1873 he took thermo- electricity for the subject of his discourse as Rede lecturer at Cambridge, and in the same year he presented the first sketch of his well-known thermoelectric diagram before the Royal Society of Edinburgh. Two years later researches on "Charcoal Vacua" with Dewar led him to see the true dynamical explanation of the Crookes radiometer in the largeness of the free path of the mole- cule of the highly rarefied air. From 1879 to 1888 he was

engaged on a long and difficult series of experi- mental investigations, which began with an inquiry into the corrections required, owing to the great pressures to which the instruments had been subjected, in the readings of the thermometers employed by the Challenger expedition for observing deep-sea temperatures, and which were extended to include the compressibility of water, glass, and mercury. Between 1886 and 1892 he published a series of papers on the foundations of the kinetic theory of gases, the fourth of which contained what is, according to Lord Kelvin, the first proof ever given of the Waterston-Maxwell theorem of the average equal partition of energy in a mixture of two different gases ; and about the same time he carried out investi- gations into impact and its duration. Many other in- quiries conducted by him might be mentioned, and some idea may be gained of his scientific activity from the fact that a selection only from his papers, published by the Cambridge University Press, fills three large volumes. This mass of work, it must be remembered, was done in the time he could spare from his profes- sorial teaching in the university, which he always re- garded as his primary duty. In addition, he was the author of a number of books and articles. Of the former, the first, published in 1896, was on the dynamics of a

particle ; and afterwards there followed a number of concise treatises on thermodynamics, heat, light, pro- perties of matter, and dynamics, together with an admirably lucid volume of popular lectures on Recent Advances in Physical Science. With Lord Kelvin he collaborated in writing the well-known Treatise on Natural Philosophy. “Thomson and Tait,” as it is familiarly called (” T and T’ ” was the authors’ own formula), was planned soon after Lord Kelvin became acquainted with Tait, on the latter’s appointment to his professorship in Edinburgh, and it was intended to be an all-compre- hensive treatise on physical science, the foundations being laid in kinematics and dynamics, and the structure completed with the properties of matter, heat, light, electricity, and magnetism. But the literary partnership ceased in about eighteen years, when only the first por- tion of the plan had been completed, because each of the members felt he could work to better advantage separately than jointly. The friendship, however, endured for the twenty-three years which yet remained of Tait’s life. Tait also

collaborated with Balfour Stewart in the Unseen Universe, which was followed by Pargdoxical Philosophy. Among his articles may be mentioned those which he wrote for the ninth edition of this Encyclopaedia on Light, Mechanics, Quaternions, Radiation, and Thermodynamics, besides the biographical notices of Hamilton and Clerk-Maxwell. The article on Halos in the tenth edition (vol. xxix.) is also from his pen.

(h. m. e.)

Takazze. See Abyssinia.

Takhtsingjee (1858-1896), Mahraja of Bhavnagar, was a raj put chief of the Gohel clan, and the ruler of a considerable territory in western India. He was born in 1858, and succeeded to the throne of Bhavnagar at the age of twelve, on the death of his father, Jaswantsingjee, in 1870. During his minority, which ended in 1878, the education of the chief was directed and controlled by the joint administration of Mr E. H. Percival, a member of the British Civil Service, and Azam Gavrishankar Oodeyshankar, C.S.I., one of the foremost native statesmen of India, who had served the state in various capacities and finally as minister since 1822. This system of joint administration under the direction of the paramount Power, in cases where the succession to the gadee of large native states on the death of the ruling chiefs devolved upon minors, was the evolution of much experience and serious consideration on the part of the local government. It was tried for the first time in the case of the Bhavnagar state, and resulted in such conspicuous success that it is now the recognized mode of, administration during periods of minority. The training of the youthful chief and the conduct of the state's affairs under his guardians prospered, and at the age of twenty Takhtsingjee found himself the independent ruler of a territory nearly 3000 square miles in extent, of a highly productive character, and with a population of over 400,000, embracing large mercantile and agricultural com- munities. His early education, the administrative training he had undergone during the latter years of his minority, and above all his suavity of manner and sympathy with his people, soon won for him the recognition both of the British

Government and his own subjects as “a model ruler of a model state.” His first public act was the sanctioning of the line of railway connecting his territory with one of the main trunk lines. It was the first enter- prise of its kind on the part of a native raja in western, if not in all, India, and many were the misgivings expressed by the old school of Indian politicians ; but the enterprise was so fully justified by results that before long other native chiefs followed his example. The commerce and

trade, and the economic and even social development of the state, which came in the wake of this railway, con- firmed Takhtsingjee in a policy of progressive adminis- tration under which educational establishments, hospitals and dispensaries, trunk roads, bridges, and handsome edifices and other public works grew apace. In 1886 he inaugurated a system of constitutional rule, by placing several departments of his government in the hands of four indepenent members of a Council of State under his own presidency. This innovation, which had the warm support of the then governor of Bombay, Lord Reay, provoked a most virulent attack upon the chief, who brought his defamers to trial in the High Court of Bombay. The punishment of the ring- leaders broke up a system of blackmailing to which the native rajas used to be regularly exposed, and the public spirit of Takhtsingjee in freeing his brother chiefs from this evil was widely acknowledged throughout India, as well as by the British authorities. The most conspicuous traits in the Mahraja’s, character were unstinted be- nignity and an unflinching attachment J;o British rule. In 1893 he took the occasion of the opening of the Imperial Institute by Queen Victoria to visit England in order to pay personal homage to the sovereign of the British Empire. His cordial reception on that occasion was a matter of the highest pride to him to the day of his death, which occurred in 1896. His eventful career was several times recognized by the British Government, which, for the first time in the history of Kathiawar, elevated the chiefs of that province in the person

of Takhtsingjee to a status of equality with the highest class of native princes by enrolling him in the first rank of the Order of the Star of India, and augmenting his title of ” Thakore ” to that of ” Mahraja.” During his visit to England in 1893, the University of Cambridge conferred on him the degree of LL.D. in recognition of his en- couragement of learning in his own state and of his munificent gifts to educational bodies out of it.

The Mahraja Takhtsingjee could trace his descent from a long line of progenitors, whose origin, according to the chronicles of Hindu mythology, was derived from the sun. Many of his actual ancestors were distinguished for their prowess in the battlefield against their foreign invaders, and in holding their own in inter- necine conflicts. The most remarkable of these was Sejukji, who was the virtual founder of the state, while of those who consoli- dated the kingdom and laid the foundation of its future commer- cial development was Bhavsingjee, who ruled long and wisely from 1723 to 1764. Takhtsingjee’s own father, Jaswantsingjee, was one of the staunchest allies that Great Britain had throughout the troublous days of the Mutiny. (m. jj. bh.)

Talavera de la Re in a, a town of Spain, province of Toledo, on the Tagus, 40 miles W. by N. of Toledo. It stands in the midst of a fertile, well-irrigated country, producing abundantly wheat, pod fruit, wine, olives, and vegetables. It has fine squares and streets, well lighted by electricity. Population (1897), 10,544.

Talca, a town of Chile, capital of a province and department of the same name, 156 miles south of Santiago by rail. Population (1890), 33,232 ; (1900), 40,987. It is an important commercial centre, and carries on a large business through the port of Constitucion (distant 5 miles) by the Rio Maule, .and with the countries north and south of it by the Central railway.

Talcahuano, or Talcaguano, a town of Chile, in the province of Concepeion. Population (1895), 10,431; (19Q0), 15,376. It is the terminus of a rail- way communicating with Concepeion, Santiago, and Valparaiso. It is the most important port in southern Chile, so far as

foreign trade is concerned, and is steadily increasing in importance. The value of its

imports increased from £477,784 in 1890 to £954,770 in 1898. In 1900 the imports were valued at £1,242,757, the exports at £156,428. The movement of foreign shipping was in 1897 — entries (from abroad), 126 ships of 284,973 tons; clearances, 42 ships of 95,743 tons; coastwise, 415 entries with 497,683 tons ; clearances, 498 with 716,270 tons. In 1900 the entries from abroad and coastwise were 525 ships of 832,843 tons, and clearances the same. The Chilian Government opened a dry dock at this port in 1895. It is the finest on the west coast of South America, over 650 feet long by 70 broad. It is principally used in docking the Chilian men-of-war, and is also the principal naval depot of the republic.

Talienwan, an open bay or roadstead on the east side of the Liaotung peninsula, in the province of Man- churia, China. It was leased to Russia by the Chinese Government in 1898 along with the naval fortress of Port Arthur, from which it is distant 40 miles. A portion of the bay, namely, that on the west side known as Port Victoria, was intended to be opened to foreign trade as soon as the railway was finished. Being ice-free all the year round, it has an advantage over the treaty port of Newchwang, which isfrozen up for four months in the year. On the other hand, Newchwang lies much nearer to the great producing and consuming districts of Manchuria, and it remains to be seen how far trade will be attracted to the newer port. The railway from Port Arthur to the Russian main line in north Manchuria touches at Talienwan. The eastern part of the bay is to be retained as a Russian naval dep6t, where already a number of buildings have been erected' for barracks, store-houses, &c. Talienwan was the rendezvous of the British fleet during the Anglo- China war of 1860, whence the names Port Arthur and Port Victoria.

Talmage, Thomas De Witt (1832-1902), American Presbyterian preacher, was born at Bound Brook, New Jersey, 7th January 1832. He was educated at the University of the City of New York, and at the theological seminary at New Brunswick, N.J. In 1856 he became pastor

of a church at Belleville, N.J. In 1859 he removed, to Syracuse, N.Y., in 1862 to Philadelphia, and in 1869 to the Central Presbyterian Church in Brooklyn, later known as the Tabernacle. In 1872 the church was burned down. A larger one, holding 5000 persons, was built for him, but even this could not contain the crowds attracted by his eloquence. In 1889 this church also was burned to the ground, only to be succeeded by another and larger church, which again in its turn was burned. Shortly afterwards (1894) he moved to Washington. During the last years of his life Dr Talmage ceased to preach, and devoted himself to editing. At different periods he was editor of the Christian at Work, the Advance, Frank Leslie's Sunday Magazine, and the Christian Herald. For years his sermons were published regularly in about 3000 journals, reaching it is said, 25,000,000 readers. His books also have had large circulations. His eloquence, while sensational, was real and striking ; and his fluency and the picturesqueness of his language and imagery were remarkable. He died at Washington, 13th April 1902.

Tamaqua, a borough of Schuylkill county, Penn- sylvania, U.S.A., on the Schuylkill river, in a gap in Nesquehoning Mountain, on the Central of New Jersey, and the Philadelphia and Reading railways, in the eastern part of the state, at an altitude of 787 feet. Its site is uneven and its plan irregular. It is divided into east, north, south, and middle' wards, and has a water-supply by gravity. It is surrounded by anthracite coal mines,

and its chief industries consist in mining, handling, and shipping coal. Population (1890), 6054; (1900), 7267, of whom 625 were foreign-born.

Tamatave, the chief seaport of Madagascar, situated nearly on the centre of the eastern coast in 18° 10′ S., 39° 5′ E. It owes its importance to the existence of a coral reef, which forms a spacious and fairly commodious harbour, entered by two openings. The town is built on a sandy peninsula which projects at right angles from the general coast-line. On this are crowded together a considerable number of houses,

with good shops and merchants' offices in the main thoroughfares. Tamatave is the seat of several foreign consuls, as well as of numerous French officials, and is the chief port for the capital and the interior. In 1901 the imports, consisting principally of piece-goods, farinaceous foods, and iron and steel goods, amounted to £663,925 ; and the exports, chiefly gold dust (£122,150), but embracing also raffia, hides, caoutchouc, and live animals, amounted to £182,400. Regular communication with Europe is maintained by steamers of the Messageries Maritimes and two other French companies, as well as by the English Castle line. Of the whole foreign trade of Madagascar, 46 per cent, is through Tamatave. Small wharves and jetties have been constructed, and other works for the improvement of the port are in progress. A short line of railway con- ' nects with Hurondrona, a village 5 miles to the south, and will ultimately run to Antananarivo. There are Anglican, Congregational, and Roman Catholic churches. Owing to the character of the soil and the formerly crowded native population, the town is not healthy, and has often been attacked by epidemic disease : the plague broke out in 1898, and again in 1900. Since 1895 the native population has been removed from the town and settled in a new village to the north-west. An electric telegraph, 180 miles in length, connects Tamatave with the capital. Population about 8000. (j. si*.)

Tamaulipas, a state of Mexico, bounded on the 1ST. by Texas, on the N.W. by Coahuila, on the W. by Nuevo Leon, on the S. by San Luis Potosi, on the S.E. by Vera Cruz, and on the E. by the Gulf of Mexico. Area, 32,585 square miles. Population (1879), 140,137 ; (1895), 206,502. The commercial future of the state is assured by .reason of its excellent ports (Matamoros, Tampico), its proximity to the United States, its railways, and its mineral and agricultural wealth. Three railways traverse the state — the Mexican National, the Monterey and Gulf, and the Mexican Central. The capital, Ciudad Victoria (14,774 inhabitants), is 475 miles from Mexico by rail. It has fine public buildings, tramways, and other modern improvements. Amongst other towns may be mentioned Tula, handsomely laid out (19,421), Matamoros (17,564), Tampico (11,912), Jaumave (9220), Santa Barbara (9079), Villagran (7400), Mier (7114), Loreto (7022), San Carlos (6871), Camargo (6815),

Reynosa (6137), Guerrero (5664), San Fernando (5383), Bustamante (5260).

Tamayo y Baus, Manuel (1829-1898), was born at Madrid in 1829. He came of a family connected with the theatre, his mother being the eminent actress Joaquina Baus. It is interesting to note that she appeared as Genevieve de Brabant in an arrangement from the French made by Tamayo when he was in his tenth year. Through the influence of his uncle, Antonio Gil y Zarate, minister of education, Tamayo's inde- pendence was secured by his nomination to a post in a Government office. The earliest of his printed pieces Juana de Arco (1847), is an arrangement from Schiller and Una Aventura de Richelieu, which the author has

not cared to preserve, is said to be an imitation of Alexandre Dumas. The general idea of his Angela (1852) was derived from Schiller's Kabale und Liebe, but the atmosphere is Spanish, the situations are original, and the phrasing is Tamayo's own. His first great success was Virginia (1853), a dramatic essay in Alfieri's manner, remarkable for its ingenuity and noble diction. In 1854 Tamayo was expelled from his post by the new Liberal Government, but was fortunately restored before long by Candido Nocedal, a minister who had been struck by the young man's talent. Next year he joined with Aureliano Fernandez-Guerra y Orbe in writing La Rica- hembra, a historical drama which recalls the vigour of Lope de Vega. La Locura de Amor (1855), in which Juana la loca, the passionate, love-sick daughter of Isabel the Catholic, figures as the chief personage, established Tamayo's reputation as Spain's leading playwright. La Hija y Madre (1855) is a failure, and Bola de Nieve (1856) is notable solely for its excellent workmanship. It is unfortunate that Tamayo's straitened means forced him to put original work aside and to adapt pieces from the French. Examples of this sort are fairly numerous. Lo Positivo (1862), imitated from Adrien-Augustin-Leon Laya's Due Job, is well-nigh forgotten, though the Spanish version is a dexterous piece of stagecraft and contains some elements of original value. Del dicho al hecho (1864) is from La Pierre de touche of Jules Sandeau and Emile Augier, and a pleasing proverb, Mds vale Mana que Fuerza (1866) is a great improvement upon Mme

Caroline Berton's Diplomatie du Manage. The revolution of 1868, which cost Tamayo his post at the San Isidro Library, is indirectly responsible for No hay mal quepor Men no venga (1868), a clever arrangement of Le Feu au Convent, by Henri Murger's friend, Theodore Barriere. During these seven years Tamayo produced only one original piece, Lances de Honor (1863), which turned upon the immorality of duelling, and led to a warm discussion among the public. Written in prose, the piece is inspired by a breath of mediaeval piety which had not been felt in the Spanish theatre since the 17th century. This renascence of an old-world motive has induced many critics to consider Lances de Honor as Tamayo's best work, but that distinction should be accorded rather to Un Drama nuevo (1867), a play in which the author has ventured to place Shakespeare and Yorick upon the scene. Los Hombres dc Men (1870) was Tamayo's final contribution to the Spanish stage. His last years were spent in recasting his Virginia, and the result of his efforts may be read in the posthumous edition of his Obras (Madrid, 1898-99). In 1859 Tamayo was elected a member of the Spanish Academy, to which he afterwards became permanent secretary ; and in 1874 the Conservative minister, Alejandro Pidal y Mon, appointed him director of the National Library. He died in 1898. At his best Tamayo is the most accom- plished and most rational dramatist that Spain has pro- duced since 1850. He was not, however, altogether happy in his period. The rage for romanticism was over; the taste for the old classic — that is to say, for the ancient romantic — drama had not yet reached the Madrid public ; and the audacities of a later time would not have been endured. Yet Tamayo's qualities are of a very high order. His ambition was great, his scrupu- lousness was admirable; his origin and early training gave him an intimate knowledge of theatrical possi- bilities ; and, though he was a born poet, his prose is not inferior to his verse. Some of his characters, such as Juana la loca, are drawn with exceptional skill ; and, as he is rich in the eloquent declamation which characterizes the national theatre, his dramas will constantly be read though they may not be played. (j. f.-k.)

Tamboff, a government of central Russia, lying to the south-east of Tula and Ryazan, with an area of 25,710 square miles. Population (1883), 2,519,660; (1897) 2,715,453 (domiciled only), of whom 1,385,100 were women ; average density 105 per square mile, and urban population 224,697. The government is divided into twelve districts, the chief towns of which are Tamboff (48,134 inhabitants), Borisoglyebsk (22,370), Elatma (4533), Kirsanoff (10,677), Kozloff (40,347), Lebedyan (13,352), Lipetsk (20,323), Morshansk (27,756), Shatsk (13,928), Spassk (6024), Temnikoff (5737), and Usman (9843). In 1897 there were 1944 schools, attended by 85,500 boys and 22,400 girls. Agriculture, the chief industry, has greatly developed, machinery being largely used on the wide prairies. Of forests there remained in 1900 only 1,224,900 acres, while 5,760,200 acres were under cereal crops. The average yield of cereals in 1895- 1899 was: rye, 20,194,000 cwt. ; wheat, 494,000 cwt. ; oats, 9,401,000 cwt. ; and barley, 12,250 cwt. ; all cereals, 32,346,000 cwt. ; also potatoes, 13,445,000 cwt. Good breeds of horses and horned cattle are raised, and there were in 1897 494,100 horses, 321,800 horned cattle, 1,121,710 sheep, and 128,770 pigs. Manufactures are still backward, the chief factories being flour-mills, distilleries, sugar works, and tallow works, whose aggre- gate returns in 1897 amounted to only about 16,000,000 roubles.

Tamboff, the capital of the above government, on the Tsna river, 300 miles south-east of Moscow by rail. It is a prairie town, the merchants of which carry on a considerable trade in grain and cattle. Population (1897),

48,134.

Tamise, a town of Belgium, in the province of East Flanders, 25 miles east of Ghent, on the Scheldt, with a station on the line from Malines to Saint Nicolas. Its manufactures include lace, cotton and woollen fabrics, and soap. Jute yarns and tissues are also produced. Population (communal, 1880), 9943; (1890), 11,039;

(1900), 12,348.

Tammany Hall, a political organization in the city of New York, U.S.A., claiming to be the regular representative of the Democratic party in that city. It takes its name from a sachem or chief of the Delaware Indians, Tamanend or Tammany, the name itself meaning ” the Affable.” In May 1789 the ” Tammany Society or Columbian Order” was founded in New York City as a patriotic, benevolent, and non-political organization, and with the intent to counteract the influence of what was believed to be the aristocratic Order of the Cincinnati. In 1805 it was incorporated, in 1811 it built its first hall in Frankfort Street near the City Hall, and in 1867 it moved to its present hall in Fourteenth Street. The society was a secret organization, divided into tribes, with sachems (the most important being the Grand Sachem) as the chief officials, and with a ritual of supposedly Indian character. This ” Tammany Society ” is not itself the well-known political organization, but rents its hall to the Tammany Hall General Committee, the ” Tammany Hall ” of political notoriety : the leading members, how- ever, of the ” Society ” and of the ” Hall ” are identical, so that the difference between the two is little more than nominal. Almost from the beginning Tammany has been actively engaged in politics, being part of, and during the greater period of its existence actually represent- ing in New York City, the Democratic party. It has had local rivals at different times, but these, though successful for a while, have not lived long; on the other hand, the Hall has not generally been regarded with favour by the Democratic party throughout the

country at large. In 1800 it worked for the election of Jefferson as President, and by 181.2 had become an important force in New York City politics. Its power grew steadily with the growth of the city, with the increase of the ignorant immigrant vote, and with the introduction of the spoils system. It reached its height of power under the leadership of William M. Tweed about 1870. In the mayoralty and the other adminis- trative offices and in the common council of the city, in the chair of the governor of the state, and even in some of the judges’ seats, Tweed had placed or had secured the election of accomplices or tools. A system of official plunder then began that has had few parallels in modern times. How much was actually stolen can never be known ; but the bonded debt of the city, which was $36,000,000 at the beginning of

1869, was $97,000,000 in September 1871, an increase of $61,000,000 in two years and eight months : nor was this all, for within the same period a floating debt of $20,000,000 was incurred, making a total of $81,000,000, or over £16,000,000. For this vast sum the city had something to show, but very far from what it should have had. The method of plunder was the presentation of excessive bills for work done, especially in connexion with the new court house then being erected. The bills were ostensibly paid in full, but in reality only in part, the rest being retained by Tweed, and divided amongst his followers in pro- portion to their importance. The total cost of the court house to the city was about $13,000,000 — many times the actual cost of construction. Later investiga- tions showed that $404,347 was paid for safes, and $7500 for thermometers to be used in this building. The amount paid in these two years for the city print- ing and stationery was nearly $3,000,000. The end came through a petty quarrel over the division of the spoils. One of the plunderers, dissatisfied with the office he had received, gave to the New York Times a copy of certain swollen accounts which showed conclusively the stealing that had been going on. The better classes were now thoroughly aroused, and with Mr Samuel J. Tilden, afterwards governor of the state, at their head, com- pletely overthrew the ring and rescued the city. Tweed was tried and convicted, but afterwards released on a technicality of law ; .he was re- arrested, but managed to escape and fled to Spain ; was identified and brought back to gaol, where he died in 1876. The rest of the gang fared little better. Tammany itself, however, was not killed, but scotched. Within a few years and under a new leader, ” Boss ” Kelly, it was again in control of the city. Kelly was succeeded after his death in 1886 by Richard Croker, a former saloon-keeper, who became absolute master of Tammany. During the years 1881 to 1902 Tammany was in virtual control of the city government about half the time, a Tammany and a reform mayor often alternating. The two most conspicuous overthrows of Tammany since the days of Tweed were in 1894 and in 1901, the latter being the more important, in that practi- cally the whole reform ticket from mayor to alderman was elected. The grosser forms of corrupting that prevailed under Tweed did not as a rule prevail in later years. Instead, the money raised by and for the Hall and its leaders has come from the blackmailing of corporations, which find it easier to buy

peace than to fight for their rights ; from corporations which desire concessions from the city, or which do not wish to be interfered with in encroachments on public rights ; from contributions of the liquor-dealers, whose licences are more or less at the mercy of an unscrupulous party in power ; from contribu- tions of other dealers, especially in the poorer parts of the city, whose business can be hampered by the police ; from contributions of office-holders and candidates for office ;

and, lastly, from contributions, obtained indirectly through corrupt police officials, of the criminal classes and gambling establishments in return for non-inter- vention on the part of the police. The power of Tammany Hall is the natural result of the well-regu- lated machine which it has built up throughout the city, directed by an omnipotent "boss." Each of the "assembly districts" into which the city is divided sends a certain number of representatives to the General Committee of Tammany Hall. Each district also has a " boss " or leader and a committee, and these leaders form the Executive Committee of the Hall. There is also a " captain " for each of the voting precincts, over 1000 in number, into which the city is divided. The patronage of the city niters down from the real " boss " of the Hall to the local precinct leader, the latter often having one or more small municipal offices at his disposal; he also handles the election money spent in his precinct. The party headquarters in the different assembly districts are largely in the nature of social clubs, and it is in consider- able degree through social means that the control of the Hall over the poorer classes is maintained. The head- quarters are generally over or near a saloon, and the saloon-keepers through the city belong as a rule to the Hall — in fact, are its most effective allies or members. It should be remembered too that the Hall, is not subject to divided counsels, but is ruled by one man, a " boss " who has risen to his position by sheer force of ability, and in whose hands rest the finances of the Hall, for which he is accountable to no one. The incorporation of Brooklyn in the city of New York had

not up to 1902 led to the extension of Tammany into the former city. (See New York City.) (f. h. h.)

Tammerfors, a town in the grand duchy of Fin- land, capital of the government of Tavastehus, on the rapids connecting Lakes Nasi-jarvi and Pyha-jarvi, 125 miles by rail N.W. of Helsingfors. Tavastehus being the chief industrial province of Finland, 14,000 workers are employed in factories, the yearly returns of which amount to 43,100,000 marks, including textiles, 20,540,000 marks ; paper, 7,460,000 marks; timber and wood, 6,226,000 marks. Tammerfors is an important centre for the manu- facture of and trade in cotton, linea, and woollen goods, leather, and paper. Population (1875), 8443; (1898),

28,725.

Tampa, a city and seaport of Florida, U.S.A., capital of Hillsboro county, on Tampa Bay, on the west side of the peninsula, on the Plant and the Florida Central and Peninsula railways. It is a favourite winter resort, with magnificent hotels, good water-supply, and sewerage system. The harbour is excellent, with ample depth of water, and the city has regular steamer communi- cation with the principal ports of the Atlantic and Gulf coasts. It has a large commerce in lumber, phosphates, and cigars. The chief industry is the manufacture of cigars from Cuban tobacco, an industry which for some time increased rapidly, as indicated by the following figures of population : (1880), 720 ; (1890), 5532 ; (1900), 15,839, of whom 5085 were foreign-born and 4382 negroes.

Tanega-shima, an island 36£ miles long and 7\ broad at its widest part, lying to the south of Kiushiu, Japan, in 30° 50′ N. and 131° E. It is a long low stretch of land, carefully cultivated, and celebrated as the place where Mendez Pinto landed when he found his way to Japan in 1543. Until modern times firearms were colloquially known in Japan as "Tanega-shima," in allusion to the fact that they were introduced by Pinto.

The distance from Misaki, the most northerly point of Tanega-shima, to Satonomisaki, the most southerly point of Kiushiu, is 23 miles.

Tanganyika, a vast lake in East Central Africa, the longest freshwater lake in the world, measuring just over 400 miles, with a general breadth varying from 30 to 45 miles, and an area of about 12,700 square miles. It occupies the southern end of the great central rift valley, which terminates suddenly at its southern point, the line of depression being represented farther south by the more easterly trough of Lakes Nyasa and Rukwa, from which Tanganyika is separated by the Fipa plateau, composed of old granitoid rocks; though even here traces of old valley-walls are said by Dr Kohlschiitter to exist. North of Tanganyika the valley is suddenly interrupted by a line of ancient eruptive ridges, which dam back the waters of Lake Kivu (q.v.), but have been recently cut through by the outlet of that lake, the Eusizi, which enters Tanganyika by several mouths at its northern end. The flat plain traversed by the lower Eusizi was evidently once a portion of the lake floor. Tanganyika has been formed by the sub- sidence of a long narrow tract of country relatively to the surrounding plateaux, which fall to the lake in abrupt cliffs, some thousands of feet high in places. The geologi- cal formations thus exposed show that the plateaux are com- posed of a base of eruptive material, overlaid by enormous deposits of reddish sandstones, conglomerates, and quartz- ites, exposed in parts to a depth of 2000 feet. Besides the plain to the north, a considerable area to the west, near the Lukuga outlet (see below), shows signs of having been once covered by the lake, and it is the opinion of Mr J. E. Moore that the sandstone ridges which here bound the trough have been recently elevated, and have been cut through by the Lukuga during the process. The past history of the lake is still a disputed question, Mr Moore's view that it represents an old Jurassic arm of the sea being contested by Dr Stromer. The mapping of Tanganyika, which long rested on the surveys of Mr E. C. Hore, published in 1882, has received considerable modi- ficationfrom the work of Fergusson, Lemaire, Kohlschiitter, and Gibbons, who have shown that while the general out- line of the coasts has been- drawn fairly correctly, the whole central portion, and to a lesser degree the northern, must be shifted a considerable distance to the west. At Mtowa, in 5° ,43′ S., the amount of shifting of the west coast is about 30 miles. At Ujiji, on the east coast, the longi- tude is given by Fergusson

and Kohlschiitter respectively as 29° 42′ 0″ E. and 29° 42′ 38″ E.,1 as compared with 30° 4′ 30″ E. of Cameron, a difference of some 25 miles.

Recent investigations have shown that the Mlagarazi, perhaps the largest river that enters the lake, derives most of its water from the rainy districts east of the strip of high ground which shuts in the lake on the north-east. The main stream, in fact, has a nearly circular course, rising in 4° 40′ S., only some 10 miles from the lake shore and less than 40 miles from its mouth, though its length is at least 220 miles. The other branches of the Mlagarazi, which traverse the somewhat arid granite plateaux between the lake and 33° E., bring comparatively little water to the main stream. In its lower course the river is a rapid stream flowing between steep jungle-clad hills, with one fall of 60 feet, and is of little use for navigation. The various channels of its delta are also obstructed with sand-banks in the dry season. The Rusizi, the next (or perhaps equal) in importance among the feeders of the lake, has already been spoken of. It receives many tributaries from the sides of the rift valley, and is navigable for canoes. The outlet of the lake to the Congo (q.v.), after running strongly for some years, has shown signs of ceasing to flow. This is due to the gradual fall of the lake level, which was in pro- gress from about 1880 to 1890 or later, and which was estimated by Wissmann at 2 feet annually. In 1896 Captain Ramsay found

1 So given iu a letter to Mr Fergusson ; the final result, published in 1902, is 29° 40-2’, but it is not clear whether the figures refer to the same point of observation.

that a wide level plain, which had before been covered by water, intervened between Ujiji and the lake, but stated that no farther sinking had taken place during the two previous years. Near Tembwe head Mr L. A. Wallace found recent beaches 16 feet above the present level. Further fluctuations have since taken place, for whereas the Lukuga was reported blocked by a bar about 1897, a certain amount of

water was found flowing down by Mr Moore in 1899 ; while in 1901 Mr Codrington found the level 4 or 5 feet higher than in 1900, the outlet having again silted up. In any case, the alterations in level appear to be merely periodic, and due to fluctuations in rainfall, and do not point, as some have supposed, to a secular drying up of the lake.

In the partition of Africa among the European Powers, the shores of Tanganyika have been shared by the Congo State, Great Britain, and Germany, Great Britain holding the southern ex- tremity, Germany the east, and the Congo State the west. Stations have been established on the lake by all three Powers, the principal being — German: Bismarckburg in the south and Ujiji1 in the north ; British : Sumbu and Kasakalawe, on Cameron Bay ; Belgian : Mtowa or Albertville in 6° S. Missionaries, especially the Catholic "White Fathers," are also active on its shores. A small steamer, the Good News, was placed on the lake by the London Missionary Society in 1884, but is now owned by the African Lakes Corporation ; a larger steamer, the Hedwig von Wissmann, carrying a quick-firing Krupp gun, was launched in 1900 by a German expedition under Lieutenant Schloifer ; and two others are owned by the "Tanganyika Concessions" and Katanga companies. The greater part of the trade with Tangan- yika is done by the African Lakes Corporation by the Shire-Nyasa route, but the Germans have been active in opening up overland routes from Dar-es-Salaam.

Authorities. — Moore, in Geogr. Journal, September 1897 and January 1901 ; To the Mountains of the Moon, London, 1901. — Wallaoe, Geogr. Journal, June 1899. — Ramsay, in Verhandl, d. Gesell. fur Erdkunde Berlin, No. 7, 1898. — Glauning and Kohlschuttee, in Mitt, aus den Deutschen Schutzgebieten, Nos. 1 and 2, 1900. — Kohlschutter, in Verhandl. 13 Deutsch. Geogra- phentages, 1901.— Fergusson, in Geol. Mag., August, 1901. — Stromer, in Fetermanns Mitteil., December 1901. — Codrington, in Geogr. Journal, May 1902. (e. he.)

Tangermunde, a town of Prussia, province of Saxony, on the Elbe, 43 miles north-north-east from Magdeburg by rail vid Stendal. It has numerous buildings of the 14th and 15th centuries, including the turreted walls, the church of St Stephen (1376), and the town hall. The

castle, built in the 14th century, was the chief resi- dence of the Margraves of Brandenburg. There is a school of navigation ; and the manufactures include sugar, oil, shot, and brewing, and there is a trade in corn. Population (1885), 5852 ; (1895), 9059; (1900), 11,524.

Tangier (improperly Tangiers, locally Tanjdh), a seaport of Morocco, situated on the Strait of Gibraltar. It is the only town in the empire in which the effects of progress are marked. As the seaport nearest to Europe it has been for over a century the diplomatic headquarters, since the Court divides its time between the three metro- politan cities — Eez, Marrakesh, and Mequinez — and cam- paigns for the chastisement of unruly tribes. The nucleus of a cosmopolitan society thus formed has expanded into a most powerful community, enjoying privileges and immunities unknown to natives who do not receive its protection. Not only has the steadily increasing number of visitors induced the opening of first-class hotels, but extensive building operations have been necessitated, resulting in the immigration of some thousands of artisans, chiefly Spanish. Several printing-presses have been estab- lished, and newspapers appear in Spanish, Prench, and English. Among the more apparent signs of development are the European shops, which are replacing the pictur- esque native cupboards ; the drinking dens, which have sprung up at every corner ; telephone wires, and electric light ; while for corn-mills, &c, European machinery has been introduced. Elsewhere these details might seem trivial, but in so conservative a land as Morocco they are

1 The transference of the German station from Ujiji, 7 miles north-west, to Kajoma Bay — a better harbour— is meditated.

signs of the times which did not fail to arouse the alarm and disgust of the late sultan on his only visit to the city ” devoted to dogs.” The Europeans number perhaps 6000 in an estimated population of 25,000, the Jewish element forming a somewhat larger proportion. Tangier is the headquarters of the Pranciscans, the North Africa Mission, and the Gospel Union of Kansas. Of the annual imports, which average about £300,000 in value, but were £427,750 in 1899 and £488,670 in 1900, about two-fifths come from or through Great Britain and Gibraltar,

and nearly one-fourth from France. About one-half of the total value represents cottons. But for increased facilities for reaching Pez and Mequinez by way of Laraiche and Rabat, the imports by way of Tangier would be much greater. The exports average only about £260,000 in value, though in 1900 they rose to £386,270, so that there is a constant drain of specie, made up for, however, at some of the other ports. The principal items under this head are : Oxen, £75,700 in 1900 (chiefly to Spain) ; slippers, £62,000 ; wax, £46,200 ; woollens (to the East), £41,200; eggs, £78,000 (chiefly to Spain); and goat- skins, £40,500, the agricultural produce finding but a slight outlet at this port. Shipping entered (1896), 324,183 tons; (1898), 391,517 tons; (1900), 423,900 tons. (b. m*.)

Tanjore, a city and district of British India, in the Madras Presidency. The city is situated on the right bank of the Cauvery ; an important junction on the South Indian railway, 218 miles south of Madras. Population (1881), 54,745 ; (1891), 54,390 ; (1901), 57,605. Municipal income (1897-98), Rs.94,920. Tanjore is a great centre of Brahmans and of Sanskrit literature. There are Roman Catholic and S.P.G. missions. St Peter's College had 126 students in 1896-97, the three high schools 541 pupils, and the Prince of Wales medical school 25 students and an endowment of Rs.1,00,000. There are five printing-presses, issuing one vernacular newspaper. Though the city makes specialities of jewellery, carpets, modelling in pith, &c, it has no large industries.

The district of Tanjore has an area of 3709 square miles ; popu- lation (1881), 2,131,019; (1891), 2,228,114, showing an increase of nearly 5 per cent. ; average density, 601 persons per square mile, compared with 252 for the province generally. In 1901 the population was 2,246,361, showing an increase of less than 1 per cent. The land revenue and rates in 1897-98 were Rs.67,26,484, the incidence of assessment being Bs.5 per acre, compared with R. 1.2.0 for the province generally ; cultivated area, 1,273,606 acres, of which 957,814 were irrigated, including 827,994 from Government canals ; number of police, 1238 ; boys at school (1896-97), 52,965, being 33 per cent, of the male population of school-going age; girls at school, 7116, being 4 per cent.; regis- tered death-rate (1897), 27-4 per 1000. The one staple crop is rice, which is

grown on 85 per cent, of the total cultivated area. The chief irrigation work is the Cauvery delta system, upon which the capital outlay has been Rs.19,94,978. In 1897-98 the irrigated area was 989,808 acres, and the net profit was 41 per cent. The district is traversed by several branches of the South Indian rail- way, running to Mayaveram, Karikal, Negapatam, and Muttupet. The district board has undertaken to extend the last-named branch to Avadaiyarkovil. There are no large industries, except one rice- cleaning mill. The chief seaport is Negapatam. In 1897-98 the total sea-borne trade was valued at Rs.l, 94,29,666, chiefly exports of rice to Ceylon.

Tank Ships. See Petroleum and Shipbuilding.

Tann-Rathsamhausen, Ludwig Samson,

Baron von und zu der (1815-1881), Bavarian general, was born at Darmstadt on the 18th of June 1815, the scion of an old Alsatian family. Entering the army as ensign of artillery in 1833, he soon afterwards, in quest of adventure, joined a French military expedition operat- ing in Algiers against the Tunisian frontier. In 1849 von der Tann took part in the Danish war, and especially

distinguished himself at the lines of Diippel. Becoming lieutenant-general in 1850, he was placed in command of a division. In the war of 1866 he was chief of the staff to Prince Charles of Bavaria, who commanded the South G-erman contingents. Although vehemently at- tacked in the Ultramontane press for the unsuccessful issue of this campaign, he continued to enjoy the favour of the king, and received promotion, being appointed in 1869 commandant of Munich. In the Franco-German war he commanded the 1st Bavarian corps, and fought with great gallantry at Worth and Sedan, being in the latter battle prominently concerned in the attack upon Bazeilles. Transferred in the autumn to an independent command on the Loire, he conducted the operations against Aurelle de Paladines, at first with marked suc-

cess, and forced the surrender of Orleans. He had, however, at Coulmiers to give way before a numerically larger French force ; but reinforced, he fought several successful engagements under the Grand Duke of Meck- lenburg near Orleans. On the termination of the war he was appointed commander-in-chief of the 1st Bavarian corps, a post which he held until his death at Meran on the 26th of April 1881.

Tantah, a town of Lower Egypt, in a central position nearly midway between the two main branches of the Delta, and converging-point of several railways travers- ing the Delta in all directions. It is the capital of the rich province of Gharbieh, and is noted for the fairs and Moslem festivals, which are held three times a year in honour of the renowned saint, Seyyid el-Bedawi, and are sometimes attended by 200,000 pilgrims and traders. There are a large railway station, a very fine mosque (restored), and a palace of the Khedive. Population

(1900), 35,000.

Tapajos. See Amazon.

Tapestry. See Textiles.

Tara, a district town of Bussia, western Siberia, in the government of Tobolsk, 201 miles N.N.E. of the Trans- Siberian railway at Omsk, on the left bank of the Irtysh river, 35 miles below its junction with the river Tara. It has a distillery and several tanneries, and the surround- ing country is beginning to be thickly populated with Russian immigrants. Population (1897), 7226.

Tarai, or Terai (= moist land), the name of the sub- montane strip of marshy jungle stretching along beneath the lower ranges of the Himalaya in northern India. This strip extends roughly from the Jumna river on the west to the Brahmaputra on the east. Everywhere it is most unhealthy, and inhabited only by tribes who seem to be proof against malaria. A large portion lies within Nepal. The part below the Kumaun hills used to form a district of the North-Western Provinces, called Tarai, now combined with Naini Tal. Area, 963 square miles ;

population (1891), 210,568, showing a density of 219 persons per square mile.

Tara neon, a town of Spain, province of Cuenca, with a station on the railway from Aranjuez to Cuenca. Population (1887), 5066; (1897), 5316. It is situated in a plain watered by the river Bianzares, and the prin- cipal products of the district are wheat, wine, oil, and fruit. The town has some manufactories of linen goods, distilleries of alcohol, and saw-mills. The streets are regular, and contain many good modern houses, including the palace of the Duke of Rianzares, who became the morganatic husband of the Queen Begent Christina of Bourbon, widow of Ferdinand VII. and mother of Isabella II. He built this palace and gardens, and restored the convent of our Lady of Bianzares. Tarancon has a few old churches and convents.

TarantO, a seaport of southern Italy, on the gulf of the same name on the Ionian Sea. In 1861 the mili- tary importance of Taranto, which Napoleon I. had fore- told, was recognized by the Italian Government, and in 1864 a Naval Commission designated it as third maritime arsenal, after Spezia and Venice. In 1882 it was declared the seat of the second maritime department in place of Naples, but the declaration was afterwards withdrawn out of regard for Neapolitan susceptibilities. Nevertheless, the arsenal must in time take precedence over that of Naples, which will then be given over to private industry. Work was begun on the arsenal in 1883, and continued as the finances of the State permitted, and already it is capable of turning out new war-vessels and of executing repairs of all kinds for the Mediterranean Squadron. The arsenal extends for a mile and a half on the southern coast of the Mare Piccolo, which constitutes its chief basin. The receiving dock and the anchorage for tor- pedo-boats, with a wide landing-stage, form dependencies. The arsenal proper faces north-east, and has an area of 2,564,000 square metres. Its dock is 220 metres long, 38 metres wide, and 11-50 metres deep. The dock is divisi- ble into two compartments, each capable of containing a full-sized battleship. It holds 70,000 metres of water, which can be drawn off in eight hours by two 600-h.p. steam pumps. The equipment of the arsenal comprises cranes up to 100 tons' lifting power, eight workshops, sup- ply magazines, a coalyard of

85,000 tons' capacity, three- quarters of a mile of wharves, two moles 100 and 180 metres long, complete railway communication between all points of the workshops and yards, and an aqueduct supplying 1000 cubic metres of water a day to two reser- voirs of the capacity of 200 and 2000 cubic metres. In addition there are other naval dependencies, barracks for marines, and an ammunition depot. The Mare Grande is connected with the Mare Piccolo by a channel 800 metres long, constructed at a cost of £120,000, and suffi- ciently capacious to permit the passage of the largest battleships. In its present form it provides well-sheltered anchorage, 11 metres deep and 6325 acres in extent. Taranto as a port is therefore superior to Spezia, Toulon, Marseilles, and Cherbourg. The channel was bridged in 1887 by an iron swivel-bridge, which when open leaves a passage-way 60 metres broad. In consequence of the establishment of the arsenal the importance of Taranto is steadily increasing. The citadel built in 1404 has been demolished. Large new buildings and wide streets have been constructed. The city is the seat of an arch- bishopric and a sub-prefecture, and also includes 23 asso- ciations, several of which are mutual benefit societies, four charitable institutions, and well-kept municipal and i Government schools. The chief industry is the cultiva- tion of oysters, the Ostrea Tarantina being a variety of the Ostrea edulis. The oyster parks are four in number, and yield an annual total of 27,000,000 oysters, worth £10,000. Besides oysters, Taranto carries on a large trade in cozze, a species of large black mussel of pleasant flavour, which is packed in barrels with a special sauce. The other chief trades are barrel-making, oil-making, soap-making, and a mother-of-pearl button factory. Corn, honey, and fruit are largely exported from the district. Population (1881), 26,000 ; (1901), 53,000.

Tarapaca, a province in the north of Chile, situated between 18° 30′ and 21° 40′ S. and 68° 20′ and 70° 15′ W. It is bounded on the N. by the province of Tacna, on the E. by Bolivia, on the S. by Antofagasta, and on the W. by the Pacific. Area 19,300 square miles, divided into two departments. It was ceded to Chile by Peru, and organized as a province in 1884. In 1898 the marriages were 426; births, 2665; deaths, 2712. The capital is Iquique. Population of province (1900), 98,769.

Tarascha, a district town of Bussia, in the govern- ment of Kieff, 12 miles from Olshanitsa station of the South- Western railway. There are large flour-mills and sugar works in the district, and a brisk trade in flour, spirits, and sugar (exported) is carried on. Population

(1897), 11,452.

Tarazona, a town of Spain, province

(1897), 8470.

Tarentum, a borough of Allegheny county, Penn- sylvania, U.S.A., on the Allegheny river, and the Alle- gheny Valley and Pennsylvania railways, in the western part of the state. Population (1890) 4627; (1900), 5472, of whom 1173 were foreign-born.

Targul Ocna, a small town of Moldavia, Eumania, on the left bank of the river Trotus, 80 miles south-west of Jassy. It lies on a series of bare hills formed of enormous deposits of rock-salt, which are worked for the benefit of the state. It was only in 1870, however, that the state undertook the working of the mines, where prisoners condemned to penal servitude are em- ployed. The depth of the layer of salt is unknown, boring for 600 feet having been made without the bottom being reached. The annual production from the mines is from 10,000 to 12,000 tons. Between the salt mines and the town is the prison, consisting of large buildings surrounded by high walls. This is the largest penal establishment in Eumania. There are three churches, the most important being that of Eaducanu, built in 1762. Population

(1900), 8033.

Tarifa, a seaport of Spain, province of Cadiz, on the strait, and 21 miles W.S.W. of Gibraltar. Population (1877), 12,134; (1897), 11,699. A new lighthouse has been constructed on the southern part of the island in

front of the town. The trade is not very important, except in fresh and salted fish and live stock.

Tariffs. — Eesort is made to tariffs, or duties on imports, partly to secure revenue, partly to affect the course of industry within a country. Strictly speaking, these two objects are inconsistent with each other; since a customs duty, in so far as it causes a domestic industry rather than a foreign to supply the market, ceases to be a source of revenue. But in a great number of cases the imposition of a duty causes only a partial displacement of the foreign supply, and hence brings some revenue from that which remains. This circumstance strengthens the hold of the protective system, especially in countries where customs duties are an important source of rev- enue, the combination of fiscal convenience and of pro- tection to home industry being a highly attractive one. Where tariff duties are imposed solely for revenue, an equivalent excise tax is imposed within the country, so as to put the domestic producer precisely on the

footing of his foreign competitor; and tariffs so main- tained are in complete conformity with the principle of free trade.

Great Britain. — Between the close of the Napoleonic wars of 1815 and the year 1860, the tariff system of Great Britain was changed from elaborate protection to practi- cally complete free trade. An attempt had indeed been made in 1786 to modify the rigidly protective legislation of the 18th century. In that year Pitt concluded a commercial treaty with France, providing for large reductions of duties in both countries. But the treaty was swept away with the outbreak of the wars with France, and accordingly the old system was still in force in 1815. The first important step, and in some respects the decisive step, towards modifying it was taken in 1824, under the policy of Huskisson. In that year, and again in 1825, great reduc- tions were made in the duties on raw materials, especially on wool, raw silk, flax, and iron, while considerable reduc- tions were also made in the duties on manufactured goods. The most sharply contested of the changes was in regard to silks, which had been completely prohibited, and were now admitted at a duty of 30 per cent. A considerable breach was thus made

in the protective system ; and some further changes in the same direction were made in the next decade, especially under Lord Althorp in 1833. But in the decade from 1830 to 1840 the Corn Laws were the chief subject of contention. The great increase in population since the middle of the 18th century had made England a corn-importing country, especially with the rapid growth of manufactures in the early years of the 19th century. The first systematic Corn Laws imposing duties on grain had been passed in 1773. From 1816 onwards a series of measures were passed, all designed to maintain the high price, of grain. The Act of 1816 pro- hibited the importation of wheat when the price was less than 80s. a quarter (=$2.50 a bushel). In 1822 the pro- hibitive point was lowered to 70s. In 1828 the sliding scale was introduced, under which the duty went up and down as the price of grain went down and up; and it was against this form of the Corn Law that the great agitation led by Cobden and Bright was directed after 1830. For a long time the anti-Corn Law agitation seemed to have no effect, although conducted with extraordinaiy skill and enthusiasm. In 1842, however, Sir Eobert Peel made the first important concession, by modifying the sliding scale, his opponent, Lord John Eussell, having proposed in the previous year a fixed duty of 8s. a quar- ter. In view of the bad harvest of 1845—46, and the famine in Ireland in 1846, Peel surrendered, and proposed in 1846 the admission of grain f°r”jfjrs with only a fixed duty of Is. a quarter as a regis- m%* e ‘ tration fee. This change was carried, but Peel, being able to carry only a fraction of his party with him, was compelled shortly afterwards to resign. The Corn Laws had great political strength, serving as they did the interests of the landowners, whose hold on Parliament was still very strong ; but the general economic situation in Great Britain, from the rapid growth of the manufacturing population and the imperative need of more food, made their abolition inevitable. After having been maintained till the middle of the century, apparently with irresistible support, they suddenly collapsed under the strain of a season of exceptionally short crops. Both their continued maintenance and their final sudden abolition are in some respects divergent from the general course of British tariff history.

The remodelling of the tariff system in the direction of free trade went on, little retarded by the main- tenance of the Corn Laws and not much accelerated by their abolition. In 1842 great reductions of duty were made on a large number of articles ; in 1846 still

further reductions of duty were made ; another series of changes came in 1853 ; and finally, in 1860, the last rem- nant of protective duties disappeared. The four General Acts of 1842, 1846, 1853, 1860— the first two Ci842^60.‘a un(ier Peel’s leadership, the second two under Gladstone’s guidance — thus carried out gradu- ally the policy of free trade in regard to other articles than grain. The first of them, in 1842, was signalized by the introduction of the Income Tax as a means of raising revenue to replace that lost by the diminished import duties. The last of them, in 1860, was largely influenced by the great commercial treaty with France. In that treaty the concessions made to Prance were the reduction by Great Britain of duties on wines and spirits, and the admission, free of duty, of some important French products, notably silk manufactures, gloves, and other products in which the French had superiority. Great Britain, instead of limiting the con- cessions to France, in 1860 made them applicable to all the world. The silk manufacture, as to which the first great changes had been made in 1824, and on whose products the duties had been kept higher in previous Acts than on other manufactures, was thus compelled, notwithstanding violent opposition, to face unfettered foreign competition.

Two general features should be noted in regard to the tariff history of Great Britain. In the first place, most of the reductions of duty on manufactured articles were of little practical significance. The great mass of manufactured commodities were produced in the United Kingdom more cheaply than in foreign countries, and would not have been imported, with duty or without, except in sporadic amounts for

some special qualities. The changes hence involved little real readjustment of industry. There is thus some ground for the assertion that the policy of free trade was not adopted by the United Kingdom until its industries had reached the stage of being independent of protection. But this does not hold good of some manufactures ; especially not of the silk industry, and some parts of the woollen and linen trades. Still less does it hold good of raw materials, many of which have been really affected by the duties, and were largely imported after their aboli- tion. Such was the case not only with some metals, such as lead, zinc, copper, but still more strikingly with textile materials such as wool, flax, and the like, and most of all with agricultural products such as grain, meat and meat products, timber. In regard to all these, the abolition of protection meant a real sacrifice to domestic industries. The second feature to be noted is the simplification which resulted in the administrative features of the English tariff. A great number of articles had been enumerated in the earlier tariff Acts, each of which was imported in very small quantity and yielded an insignificant revenue. The nature of the changes made between 1842 and 1860 is indicated by the following tabular statement : —

Duties reduced.

Duties abolished.

1842-46 1846 1853 1860

503 112

390

64

123

371

After 1860 only forty-eight articles remained subject to duty, a number which has been still further reduced, the most notable change having

been free admission of sugar in 1872. Since that date the English customs tariff has been simplicity itself. A very few articles (spirits, beer, wine, tobacco, tea, coffee, cocoa) yield practi- cally all of the customs revenue, and so far as these

articles are produced within the country, they are subject to an excise duty, an internal tax precisely equal to the import duty. In 1901, to aid in meeting the expenses of the South African war, a moderate revenue duty was again imposed on sugar.

France. — The tariff history of France in the 19th century divides itself into three periods : one of com- plete prohibition, lasting till I860; second, of liberal legislation, from 1860 to 1881; third, of reversion to protection after 1881.

(1) During the first period the prohibitive legislation of the 18th century was retained, largely in consequence of the Napoleonic wars. The commercial treaty of 1786 between Great Britain and France has already been referred to as making a breach in the restrictive system of the 18th century ; and in the early years of the French Revolution a similar wave of liberal policy is to be seen. But the great wars led to the complete prohibition of the importation of manufactures, reaching its climax in Napoleon's Continental system. The system of prohi- bition thus instituted, while aimed at Great Britain, was made general in its terms. Hence the importation into France of virtually all manufactured articles from foreign countries was completely interdicted ; and such was the legislation' in force when peace came in 1815. This system doubtless was not expected to last after the wars had ceased, but, as it happened, it did last until 1860. Successive Governments in France made endeavours to break with the prohibitive system, but naturally met with strong opposition from the manufacturing interests, not prepared to meet the competition of Great Britain, whose industries had made, and were continually making, rapid strides. The political position of the Governments of the Restoration and of Louis Philippe was such that they were unwilling to forfeit support by pushing mea- sures in which, after all, they were not themselves deeply interested.

(2) It was not until Napoleon III. believed it to be to his political advantage to strengthen friendly relations with Great Britain by the moderation of the import duties that the change was finally made; ?£ %%? ot while the despotic character of his government enabled him, when once the new policy was entered on, to bring about a radical change. After some secret negotiations, in which the English Corn Law agitator, Cobden, and the French eponomist, Cherbuliez, took an active part, Napoleon was persuaded to enter on the famous commercial treaty of 1860, and virtually to force its acceptance by the French legislature. In the treaty as finally framed duties on most manufactured commodi- ties were reduced to a range of 10 or 15 per cent., some iron manufactures, however, being left at slightly higher rates. Before the treaty, all woollen and cotton manu- factures, all manufactures of leather, of hardware, pottery, all glass ware, had been prohibited, while raw materials and such manufactures as were not prohibited had been subjected to heavy duties. The treaty thus made a radical change, revolutionizing the tariff system of France. It did so with relation not only to the United Kingdom, but, in its after effects, to the world at large. The French Government at once set to work to enter into similar arrangements with other countries, and treaties were successively concluded in 1860-66 with Belgium, with the Zollverein (Germany), Italy, Switzerland, Swe- den and Norway, Holland, Spain, Austria. All these countries made reductions of duty on French products, while France admitted other products at the rates of the British treaty tariff. Thus a network of treaties was spread over Europe, leading to much greater free- dom of trade and opening an era of freer international exchange.

(3) This more liberal policy, however, probably never had deep root in French public opinion. It received a

check from the Franco-German War of 1870- s%?e’°880. 1871- The treaty of Frankfort in 1871 contained,

in ‘place of the previous detailed commercial treaty with Germany, the simple ” most favoured nation” proviso. The guarantee which each country thus gave to the other of treatment as favourable as that given elsewhere became irksome to France, sore after her defeat in the war. More important, however, in under- mining the liberal system, was the change in agricultural conditions which began to set in in the decade of 1878-88. Then the great improvements in transp6rtation caused competition in agricultural products to be felt, especially from the United States. Agricultural prices declined; agricultural depression set in. The agricultural interest in France, hitherto indifferent about duties, now began to demand protection against competition from beyond the sea. To this factor was added the revival of national feeling and prejudice, with growing political complica- tions and jealousies. Hence, by gradual steps, the cus- toms policy of France has become more and more strongly restrictive. The first important step was taken in 1881, when a new general tariff was established, in which specific duties replaced the ad valorem duties chiefly applied in the treaty tariffs of 1860-66. The new rates were supposed to be no more than equivalent to those replaced by them, but in fact were in some cases higher. New treaty tariffs, less liberal than the earlier ones, were concluded with Belgium, Switzerland, and Spain ; while with other countries {e.g., Great Britain) a ” most favoured nation” arrangement was substituted for the previous treaty regime. These new treaty arrangements expired in 1892 : even before that date, duties had been

raised on grain and meats ; and finally, in 1892,

a new and more highly protective general tariff

was established on the recommendation of M. Meline, with high duties on agricultural products and raw materials as well as on manufactures, and with pro- visions for limited domestic bounties on silk, hemp, and flax. Nevertheless, some provision was made for nego- tiations with foreign countries by establishing a mini- mum tariff, with rates lower than those of the general or maximum tariff, the rates of this minimum tariff being applicable to countries which might make conces- sions to France. As a rule the minimum tariff has been applied, after

negotiation, and thus is the tariff in practical effect ; yet its rates are still high, and, most significant of all, agricultural products are granted no reductions whatever as compared with the maximum tariff, there being heavy and unrelaxed duties upon grain, animals, meats, and the like.

Germany. — The tariff history of Germany, up to the foundation of the German Empire, is the history of the

Zollverein or German customs union ; and this Zollverein *n *urn *s cl°sety connected with the tariff his- 1834. ‘ tory of Prussia. In 1818 Prussia adopted a

tariff with much reduced duties, under the in- fluence of the Liberal statesmen then still powerful in the Prussian Government. The excitement and opposi- tion in Germany to the Prussian tariff led to customs legislation by the other German states, some smaller states joining Prussia, while the southern states endeavoured to form independent customs unions. Finally, by gradual steps between 1831 and 1834, the complete Zollverein was formed, notwithstanding popular opposition. All the German states formed a customs union, with free trade between them, except so far as differing internal taxes in the several states made some modifications necessary. The customs revenue was divided among the several states in proportion to population. The tariff of the Zollverein

Tariff of

1892.

was, in essentials, the Prussian tariff of 1818, and was moderate as compared with most of the separate tariffs previously existing. Within the Zollverein, after 1834, there was an almost unceasing struggle between the Pro- tectionist and Free Trade parties, Prussia supporting in the main a Liberal policy, while the South German states supported a Protectionist policy. The trend of the tariff policy of the Zollverein for some time after 1834 was towards protection ; partly because the specific duties of 1818 became proportionately heavier as

manufactured commodities fell in price, partly because some actual changes in rates were made in response to the demands of the Protectionist states. In 1853 a treaty between the Zollverein and Austria brought about reciprocal reductions of duty between these two parties. After 1860 a change towards a more liberal policy was brought about by the efforts of Prussia, which concluded inde- pendently a commercial treaty with France, forcing on the other members of the Zollverein the alternative of either parting company with Prussia or of join- prench ing her in her relations with France. The treaty and second alternative was accepted, largely be- low tariff, cause Austria did not vigorously support the South German states, and in 1865 the Zollverein as a whole concluded a commercial treaty with France, bring- ing about important reductions of duty. The regime of comparatively free trade thus established lasted for about fifteen years. After the foundation of the Ger- man Empire, the duties of the Zollverein became those of Germany, and for a time the liberal regime was main- tained and extended, with respect to the tariff as with respect to other matters. But in Germany, as in France, a combination of political and of economic forces led before long to a reaction towards protection. Bismarck broke with the National Liberals, who were the cham- pions of free trade;- at the same time the agricultural depression set in, and the agricultural interest demanded protection against American and other foreign competi- tion. The manufacturers, especially of iron, also ma- noeuvred for protection. The reaction came in 1879, when duties were increased on manufactured articles as well as on agricultural articles. Other advances of duty were made in later years, especially on Pr?ie’?’?n. grain ; and thus the policy of Germany has be- ‘1879. ‘ come distinctly Protectionist, though not to the same degree as in France. In 1892, however, the precise year in which France gave up her system of commercial treaties, some moderation was brought about in Germany’s protective system by commercial treaties with Austria, Italy, Belgium, Switzerland, and shortly afterwards with Russia. These treaties provided for reductions of duties in all directions, the most important concessions being on certain agricultural products. Thus the duty on wheat, which had been gradually raised as high as 5 marks per hundred kilogrammes (roughly Is. 3d., or about 30 c. a bushel) was reduced to 3-50 marks by the

treaties. The rates of these treaties were extended to a number of other countries having ” most favoured nation ” relations with Germany. The tariff system of Germany, however, at the close of the 19th century, remained Protectionist, and the controversy on protection and free trade has not reached an end.

In other important countries changes in policy have taken place similar to those noted in Germany and in Prance. The era of mode- rated tariffs, which began with the’ great treaty o£ 1860, lasted for about twenty years, and has been followed in Italy, Austria, Bel- gium, Switzerland, and Spain by a reversion to protection, although usually to a less high system of protection than had prevailed before 1860. The United Kingdom and Holland alone have held consistently and unfalteringly to the principle of free trade. The factors which have brought about this reaction nave been, as was already noted, partly economic, partly political : on the one hand,

the pressure of competition from distant countries in agricultural products, a consequence chiefly of improved transportation ; on the other hand, the revival of national sentiment and prejudice.

The United States. — The tariff history of the United States,, like that of European countries, divides itself into two great periods, before and after the year 1860. But it is no more than an accident that this year constitutes the dividing line in both cases, the change in the United States being due to the Civil War, which so profoundly influenced the fiscal, economic, and political history of the country in all directions. The period before 1860 may again be divided into three sub-periods, the first extending from 1789 to 1816, the second from 1816 to about 1846, the third from 1846 to 1860.

(1) The Tariff Act of 1789 was the first legislative measure passed by the United States. The Protectionists

have pointed to it as showing the disposition of ‘ the first Congress to adopt at once a policy of protection ; the Tree Traders have pointed to it similarly as showing a predilection for their policy. Each had some ground for the claim. The duties of the Act of 1789 were very moderate, and, as compared with those which the United States has had under any subsequent legislation, may be described as free trade duties. On the other hand, the spirit of the Act of 1789 was protec- tive. It had been the design of Madison, and of other . firm supporters of the new constitution, to adopt in 1789 a very simple measure, designed solely to secure revenue. But the pressure from the representatives of some of the states, notably Pennsylvania and Massachusetts, com- pelled him to incorporate in the Tariff Act certain specific duties borrowed from the Tariff Acts then in force in these states, which had a distinctly protective aim. Thus the Act of 1789, although the duties levied by it were moderate, yet had a protective intent. Such in the main remained the situation until 1816, duties being indeed raised from time to time in order to secure more revenue, but the arrangement and the general rate of the duties not being sensibly modified. There was not at this time any considerable public feeling on the subject of protection, chiefly because during most of the years of this period the Eastern states, and especially New Eng- land, where manufactures might be expected to develop first, were profitably engaged in an extensive export and carrying trade.

(2) After the close of the war of 1812, however, a new spirit and a new policy developed. With the end of the

Napoleonic wars, the opportunities for American commerce became less, while at the same time the expanding population necessarily led to diversified interests at home. A demand arose for two closely con- nected measures : protection to domestic manufactures, and internal improvements. Protection was demanded as a means both of aiding young industries and of foster- ing a home market for agricultural products. The chief spokesman of the new movement was Henry Clay, who remained throughout his life the consistent advocate of this so- called ” American system.” Some disposition in this direction showed itself as early as 1816, when tariff duties were raised. Still greater

changes were made in 1824, 1828, and 1832. In 1824 duties were considerably raised ; and thereafter the New England states, which so far had been lukewarm in supporting the movement, joined in it unreservedly. The tariff of 1828 was affected by some political manipulation, which caused it to contain objectionable provisions, and to be dubbed "the tariff of abominations." But the so-called abominations were re- moved in 1832, when the protective system was delibe- rately and carefully rearranged. By this time, however, the opposition to it in the South had reached a pitch so intense that concessions had to be made. As a planting

and slave-owning region, the South inevitably had no manufactures : it felt that its cotton was sure to find a foreign market, and would gain little from the establish- ment of a domestic cotton manufacture within the country ; and it judged, rightly, that the protective sys- tem brought it only burden and no benefit. The extent of the burden was greatly exaggerated by the leaders of the South, especially in the heat of partisan controversy ; and the subject was closely connected with the con- troversy as to the rights of the states, and the endeavour of South Carolina, under the influence of Calhoun, to nullify the Tariff Act of 1832. The nullification move- ment led in 1833 to the well-known compromise, by which the rates of duty as established by the Act of 1832 were to be gradually reduced, reaching in 1842 a general level of 20 per cent. The compromise served its term in allay- ing political bitterness and staving off a direct conflict between the United States and South Carolina. But the reductions of duty made under it were never effectively carried out. In 1842, when the final 20 per cent, rate was to have gone into effect, the Protectionists again had control of Congress, and after a brief period of two months, during which this 20 per cent, rate was in force, passed the Tariff Act of 1842, which once more restored the protective system in a form not much less extreme than that of 1832.

(3) Four years later, however, in 1846, a very consider- able change was secured by the South, and a new era was entered on. The Democratic party now was in controlof legislation, and in the Tariff Act of 1846 '846~60- established a system of moderate and purely ad valorem

duties, in which the protected articles were subjected, as a rule, to a rate of 30 per cent., in some cases to rates of 25 and 20 per cent. The system then established has often been spoken of as a free trade system, but was in reality only a system of moderated protection. In 1857 duties were still further reduced, the rate on most pro- tected commodities going down to 24 per cent., and remaining at this comparatively low level until the out- break of the Civil War.

The second great period in the tariff history of the United States opens with the Civil War. It is true that the first steps towards a policy of higher protection were taken just before the war began. In the session of 1860- 1861, immediately preceding the outbreak of the conflict, the Morrill Tariff Act was passed by the Bepublican party, then in control because the defection of Southern members of Congress had already begun. It substituted specific duties for the ad valorem duties of 1846 and 1857, and made some other changes of significance, as in the higher duties upon iron and steel. Nevertheless, the advances then made were of little importance as compared with the far-reaching increases of duty during the Civil War. These formed part of the general resort to every possible fiscal device. The great struggle com- The war pelled every resource to be strained to the t^I64, utmost: the issue of long-time bonds, continual borrowing in very large amounts on short-time incon- vertible paper money, an elaborate and all-pervading system of internal taxes, and, finally, heavy import duties. The internal taxes of the war were applied not only in the form of income taxes, stamp taxes, licence and gross receipts taxes, but also as direct excise taxes on many commodities. The import duties were correspondingly raised, partly by way of off-set to the internal taxes, partly as a means of getting additional revenue, and finally in some degree because of a disposition to protect domestic industries. The most important Acts were the great revenue Acts of 1862 and 1864. Some further changes were made in 1865, and the close of the war thus left the United States with a complicated system of very

high taxes both on imported duties and on domestic products.

The main features of the tariff history of the United States since the Civil War have been that the internal taxes have been almost entirely swept away, the import duties on purely revenue articles similarly abolished, while those import duties that operated to protect domes- tic industries have been maintained, and indeed in many cases increased. The situation has had some analogy to that of France from 1815 to 1860, when similarly a highly restrictive system established during a period of war was unexpectedly retained long after peace had been established. This result in the United States came about by gradual steps and without premeditation. After the close of the war efforts were first directed to clearing the financial situation by funding the floating debt, and taking steps (never fully consummated) towards contracting the currency. Next the internal taxes were gradually done away with, until nothing was left except the excise on beer, spirits, and tobacco. No further resort was made to internal taxes until the revenue Act of 1898 was passed, at the outbreak of the Spanish War. Efforts were made also to reduce the tariff duties, but these naturally came last : they met with strong opposition, and in the end they were almost completely frustrated, thus leaving as the basis of the tariff the rates which had been levied in the course of the war. In 1870 some rearrangements were made, the duties on iron arad”fL an(^ on some other articles being reduced. In CUoa°ot war 1872 a more general reduction was carried out, duties. strongly resisted by the Protectionists, and finally ending in a uniform cutting off of 10 per cent, from all the import protective duties. In 1875, however, when the revenue had become deficient after the crisis of 1873, the 10 per cent, reduction was re- pealed, and duties restored to their previous amounts. It deserves to be noted that in 1872 an important step was also taken towards removing entirely the duties on purely revenue articles, tea and coffee being then admitted free of duty. On the other hand, the maintenance of the protective duties, and the gradual consolidation of feeling in favour of a permanent policy of strong protection, led to other revisions and rearrangements in the direction of protection. In 1867 an important Act on wool and wool- lens was passed, largely increasing the duties on both. In 1869 the duty on copper was raised. In 1870, while some duties were lowered, others

were raised, as, for in- stance, those on steel rails and on marble. Thus the ten years immediately following the close of the war brought about the gradual transformation of the high duties levied on all commodities for revenue purposes into a system of high duties almost wholly on protective commodities. This transformation met with much opposition, not less in the Republican party than in the Democratic party. While the feeling in the Eepublican party had been from the outset in favour of protection, so high a range of duties met with much opposition. This opposition led to an important general revision in 1883, largely influenced by the recommendations of a special Tariff Commission which. Congress created in 1882. The Act of 1883 was passed

in the main as a party measure by the Repub- onasl" licans, and on the whole served rather to put in

order the protective system as it stood than to make any change of policy. Certain duties were reduced (though in no case greatly reduced) such as those upon wool, some woollens, cheaper grades of cotton cloths, iron, steel rails, copper. On the other hand, on many articles duties already high, but believed to be insufficient for the effective pro- tection of the domestic producer, were raised; e.g., on finer woollens and cottons, on some iron and steel manufactures.

The tariff system as revised and codified in 1883 would probably have remained unchanged for many years had it not been for the turn taken by political and financial history. The decade from 1880 to 1890 was one of great prosperity, consequently of rising imports, consequently of swelling customs revenue. In the second half of the decade a continuous large surplus in the Treasury neces- sarily directed attention to the state of the revenue, and gave strength to the protests against excessive taxation. In addition, the Democratic party, which had long been committed, though in a half-hearted way, against the policy of high protection, was brought to a vigorous and uncompromising attack on it through the leadership of President Cleveland. In his Presidential Message of December 1887 he attacked the protective system in un- qualified terms; and in the session of 1887-88 the Democratic majority

in the House of Representatives prepared a Bill providing for great reductions. The con- trol of the Senate by the Republicans- prevented any legislation. But the Republicans, as is almost inev- itable under a party system, championed the policy opposed by the other side, and declared themselves not only in favour of the maintenance of existing duties, but of the consistent and unqualified further application of protection. The protection question thus became the main issue in the Presidential election of 1888, which resulted in the defeat of the Democrats. In the next ensuing session of Congress, in 1889-90, the Republicans passed a new tariff Act, known as the McKinley Tariff Act, because Mr McKinley was then chairman of the House Committee in charge of the Bill. "c"J[a'*j!r It advanced duties materially on a considerable M90_ number of commodities, both raw materials and manufactured articles. The duties on wool were raised, corresponding changes made on woollen goods, the duties on cottons, linens, some silks, and velvets considerably raised. A further step towards consolidating the protec- tive system was taken by abolishing the duty on sugar, mainly a revenue duty. The necessity for reducing the revenue and cutting down the continued surplus was met in this way rather than by lowering the protective duties. For consistency in maintaining the protective principle a direct bounty was given to the domestic producers of sugar in Louisiana. A turn in the political wheel brought an abrupt change four years liter, in 1894. The tariff question was again the issue in 1892 : President Cleve- land, defeated four years before, was now again elected, and the Democratic party came into power, pledged to change the tariff system. Accordingly in the first ensu- ing session of the Congress elected in 1892 the tariff Act of 1894 was passed, known as the um" Wilson Tariff, bringing about considerable re- I894_ ductions of duty. The measure, however, was less incisive than its chief sponsors had planned, because of the narrow majority commanded by the Democrats in the Senate. Some of the Democratic senators were luke- warm in their support of the party policy of tariff reduc- tion, and joined with the Republicans in mitigating the changes. Nevertheless some crucial changes were made. The duty on wool, typical among the duties on raw ma- terials, was completely abolished, and with this change came a great reduction in the duties upon woollen goods. Changes, but of less importance, were

made on other textile goods. The House had proposed to remove also the duties, on coal and on iron ore, but the Sen- ate permitted only a reduction in these. A duty was reimposed on sugar, chiefly as a means of securing needed revenue, but at a less rate than had existed before 1890. At the same time the differential duty on refined sugar, which operated as protection to the sugar trust, was not abol- ished, as the ardent tariff reformers had proposed, but

kept in substance not greatly changed. This circum- stance, as well as the failure to make other desired reduc- tions, caused the ardent tariff reformers to be greatly disappointed with the Act of 1894 as finally passed, and led President Cleveland to permit it to become law with- out its endorsement by his signature. The next election in 1896 brought still another turn in the political wheel, the Republicans being once more brought into power under the leadership of President McKinley. The cur- rency issue had been foremost in the campaign, but the Republicans had also proclaimed themselves in favour of a return to the unqualified protective system. At the extra session which President McKinley called in 1897, almost the sole measure considered was the tl”meyt tariff. Act, known (again from the name of the !S97. chairman of the House Committee) as the Ding-

ley Act. This reimposed the duties upon wool, on most qualities at the precise rates of 1890, on some qualities at even higher rates. Necessarily the duties on woollens were correspondingly raised, and here again made even higher than they had been in 1890. On other textiles, particularly on silks and linens, similar advances were made. As a rule, the duties of 1890 were either retained or somewhat advanced. To this policy, how- ever, there was a significant exception in the iron and steel schedule, where the reduced duties of 1894 were left mainly unchanged. The iron industry in the United States had made extraordinary advances, and confessedly was not in need of greater protection than had been given in 1894. Some provisions for reciprocity arrange- ments with other countries, opening the way for possible reductions of duty

by treaty arrangement, were also in- corporated in the Act of 1897, though with limitations which made it improbable that any considerable changes would ensue from this policy. Some such provisions had also been contained in the Act of 1890, but here also without important results. The tariff system of the United States at the close of the 19th century thus re- mained rigidly and unqualifiedly protective, with rates higher than those of even the most restrictive tariffs of the countries of the European continent.

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Tarija, a city of Bolivia, capital of the depart- ment of the same name. It was founded in 1577 by .Luis de Fuertes. Population (1898) about 24,000, mostly of Spanish descent. The most important build- ing in the city is the convent founded in 1574 by the Jesuits, but belonging since their expulsion in 1769 to the Franciscans.

Tarn, a department of the south of France, traversed by the Cevennes (Montagne Noir), and watered by the Tarn, the Agout, and the Aveyron.

Area, 2232 square miles. The population, 358,757 in 1886, de- clined to 326,396 in 1901. The births in 1899 were 6462, of which 208 were

illegitimate ; deaths, 7201 ; marriages, 2484. There were in 1896, 959 schools, with 45,000 pupils, 4 per cent, of the popula-

tion being illiterate. Out of 1,217,710 acres of land cultivated in 1896, 807,690 acres were plough-land and 37,050 acres in vines. The wheat raised in 1899 was valued at £1,064,000 ; rye, £157,000 ; oats, £182,000 ; maize, £149,000 ; potatoes, £133,500 ; chestnuts, £9400 ; vines, £393,000. The live stock includes (1899) 16,320 horses, 1820 mules, 4100 asses, 173,200 cattle, 368,500 sheep, and 100,900 pigs. Mining in 1898 turned out 552,000 metric tons of coal, valued at £297,000, at Carmaux ; 8443 tons of iron, and 279 tons of other metals. The industry in metals in 1898 produced 6753 tons of cast-iron, 3540 tons of iron, and 2927 tons of steel, of the total value of £126,000. Albi, the capital (22,571), and Castres (24,120) do much work in glass-making, leather-dressing, and the manufacture of coverlets. Mazamet (13,700) is the centre for the weaving of woollen stuffs.

Tar n-et- Garonne, a department of the south- west of France, watered by the two rivers naming it.

Area, 1440 square miles. The population decreased from 214,046 in 1886 to 194,458 in 1901. The births in 1899 were 3204, of which 111 were illegitimate ; deaths, 4751 ; marriages, 1326. The primary schools in 1896 numbered 551, with 22,000 pupils, 5 per cent, of the population being illiterate. The area under cultivation in 1898 comprised 832,390 acres ; 590,330 acres in plough-land and 56,810 acres in vines. In 1899 the depart- ment raised wheat valued at £723,000 ; rye, £120,000 ; oats, £124,000; maize, £192,000; potatoes, £86,200; plums, £26,800; vines, £411,000. In 1899 horses numbered 16,660 ; asses, 1710; cattle, 84,200; sheep, 126,320; pigs, 33,900. In the absence of minerals, metallurgy has made little progress. The industries are tanning, weaving of coarse cloths, and silk manufacture. Montauban, the capital, had in 1901, 24,979 inhabitants.

Tarnopol, market-town and seat of a government district in Galicia, Austria, 75 miles E.S.E. of Lemberg. Population (1890), 27,405; (1900), 30,368, including garrison of 1724 men (estimated at 73 per cent. Poles, 19 per cent. Ruthenians, and 8 per cent. Germans ; 51 per cent. Jewish,

24 per cent. Roman Catholic, and 25 per cent. Greek Catholic). There is a Jesuit college and two Polish gymnasia. Industry consists chiefly in corn- milling and the preparation of wax and honey. The principal trade is in horses, corn and other agricultural produce, and spirits.

Tar now, the chief town of a government district in Galicia, Austria, and seat of a Catholic bishop, 46 miles east of Lemberg. It is situated on the river Biala, at its junction with the Dunajec, and is a station on the rail- way between Cracow and Lemberg. Population (1890), 27,574; (1900), 31,548, including garrison of 2426 men, almost exclusively Polish (57 per cent. Catholic, and 43 per cent. Jewish). The industry consists in the manu- facture of agricultural implements, glass, and chicory ; steam corn and saw mills. It has a trade in corn, leather, rape-seed, timber, and linen.

Tarom, a district of Persia, situated on the borders of Gilah, north-west of Kazvin. It is divided into upper and lower Tarom ; the former, on the right bank of the Kizil Uzain river, is held in fief by the minister of Crown domains ; the latter, on the left bank, forms part of the province of Kazvin. It produces much cotton and fruit, and derives a considerable revenue from its alum mines at Zajkamn. Most of the alum is exported to Russia. It also has a few olive groves.

Tarragona, a maritime province of Spain, on the Mediterranean. Area, 2451 square miles. Population (1887), 348,579; (1897), 336,579. The birth-rate is 3-38 per cent. ; the death-rate, 2-74 per cent. ; the propor- tion of illegitimate births 1-37 per cent. It is divided into 8 districts and 185 parishes. There are 250 miles of railway. It is one of the most industrious provinces in Spain, and its manufacturing interests have grown apace with its vineyards and agriculture. Its industries include silk, cotton, linen, woollen, velvet, felt, leather, alcohol, pottery, and paper, and vie with those of Barcelona. Its

fisheries produce more than £20,000 yearly. Its exports exceed £560,000 a year. The climate is temperate on the coast and in the centre, cold in the highlands, very warm and damp in the valleys and in the lowlands on the banks of the rivers as they near the sea. It is an important vine-growing district. In 1898 36,000 acres were covered with fruit; 29,410 acres were devoted to wheat crops ; 110,150 acres to rye, oats, barley, maize, and other cereals ; 10,000 acres to pod fruit ; 273,375 acres to vines ; and 146,760 to olives. There were 1878 horses, 14,161 mules, 14,914 * asses, 628 cattle, 47,398 sheep, 15,681 goats, 9659 pigs.

Tarragona, capital of the above province, a seaport on the Mediterranean coast, with a station on the rail- way from Valencia to Barcelona. Population (1887), 27,225 ; (1897), 25,358. It is the seat of an active trade in the agricultural products of the surrounding districts. The local industries include alcohols, liqueurs, chocolate, soap, flour, iron, paper, pipes, and salted fish. The town contains many modern public buildings, like its institute, normal training schools for teachers and primary schools for both sexes, archaeological museum, seminary, tribu- nals, and several hospitals. Though it is still styled a fortified city, most of its fortifications, old and new, are ruinous. The port has been improved since 1892. In 1898, 843 vessels of 514,377 tons, mostly Spanish and French, entered and cleared the port. Total value of imports in 1898, £190,161, of which £32,954 was British ; exports, £1,320,959 in 1898, of which £248,910 went to Great Britain, £719,449 to France, £201,663 to Italy.

Tar rasa, a towU of Spain, province of Barcelona, W.N.W. of Sabadell, on the railway from Barcelona to Saragossa, in a plain surrounded with mountains. The principal agricultural products of the district are wine, oil, cereals, and fruit. Tarrasa has a model establish- ment founded in 1885 for experiments in the cultivation

of vines. It was a Roman municipality, §, bishopric from the 5th century to the invasion of the Arabs, and was razed by them and rebuilt later by the Christians. The three principal churches date from the Christian restora- tion. It is now mostly a modern city, with fine public buildings, including the royal college, built in 1864 for 450

students besides day scholars, the school of arts and handicrafts, the industrial institute, chamber of com- merce, hospitals, town hall, several clubs and two theatres. It is above all an industrial town, with splendid factories employing several thousands of men and women. Some of the establishments are quite mon- umental structures. Population (1887), 13,182 ; (1897),

15,423.

Tarsus. — The ruins of ancient Tarsus are covered with silt brought down by the Cydnus. The modern town is connected by road and railway with Adana and Mersina, and is surrounded by gardens in which oranges, lemons, and citron are grown. The remarkable monument, Dunuk Tash, called the ” Tomb of Sardanapalus,” is supposed to be the substructure of a Soman or Grasco-Roman temple. The population, about 25,000, includes Moslems, Arme- nians, Greeks, Persians, Afghans, Ansariyeh, and Hindus.

Tashilunpo. See Tibet.

Tashkend, or Tashkent, the capital of the general- governorship of Russian Turkestan, situated in 41° 20′ N. and 69° 18′ B., at an altitude of 1480 feet, connected by rail with the Caspian Sea at Krasnovodsk, and with Khojent and Andijan, whilst in 1901 a railway was begun to connect it with Orenburg. Since the lines join- ing it with these places have been laid down it has begun to regain its former commercial importance, carrying on a considerable trade with Bokhara, Kashgaria, Persia, Kashmir, and Russia. In 1897 the total population was 156,414. The Russian town is rapidly growing, and its population is now over 15,000.

TASMANIA.

History.

TASMANIA, or, as it was originally called, Van Die- men’s Land, was discovered on 16th August 1642 by the Dutch navigator Tasman, who landed at Frederick Hendrik Bay near Hobart, and named the

territory, which he believed to form portion of the Great South Land, after his patron, Van Diemen, the governor of the Netherland East Indies. The island was subsequently visited in 1772 by a French naval officer, Captain Marion du Fresne ; in 1773 by Captain Furneaux, of the British man-of-war Adventurer; in 1777 by the great cir- cumnavigator Captain Cook ; by Bligh in 1788, and again in 1792, when he planted fruit trees. In the same year the French navigator D'Entreeasteaux visited the south portion of the island and surveyed the coast. In 1798 Bass sailed through the strait which now bears his name, and discovered that Van Diemen's Land was an island. In 1800 the French explorer Baudin, in command of the ships Oiographe and Naturaliste, surveyed the south of the island, and reports of his proceedings having reached the British officials at Sydney, they determined to fore- stall the French and take possession of Van Diemen's Land, which, not forming part of the mainland of Australia, had not become British by the occupation of Port Jackson.

In 1802 the Cumberland, a small schooner, landed at King's Island, in Bass Strait, and in 1803 Lieutenant

Bowen was sent by Governor King of New South Wales to form a settlement on the south coast of Van Diemen's Land. He had aboard his two ships, the Lady Nelson of 60 tons, and the whaler Albion of 306 tons, three officials, a lance-corporal and seven privates of the New South Wales corps, six free men and twenty-five convicts, together with an adequate supply of live stock, and landed at Risdon, near Hobart, where he was joined shortly after- wards by fifteen soldiers and forty-two convicts* In 1807 Colonel Paterson occupied Port Dalrymple on the north side of the island. During the same year Colonel Collins, who had failed in an attempt to colonize the shores of Port Phillip, transferred his soldiers, convicts, and officials to the neighbourhood of Hobart, and was appointed com- mandant of the infant settlement. Provisions were scarce and dear, communication with the rest of the world was infrequent, and in 1807 the community was threatened with starvation, and flour was sold at £200 per ton. The difficulties of the settlers were increased by the determined hostility of the aborigines, who, although of the same race as the "blacks" of Australia, appear to

have been more ferocious and more warlike. The first collision took place at Risdon, a few days after the land- ing of Lieutenant Bowen's expedition, and from 1802 till 1830, when an unsuccessful attempt was made to drive the natives to one corner of the island, they were always at war with the settlers. In 1831, when Mr. George Robinson induced the remnant of the blacks to leave

their natiye land and take refuge, first in South Bruni and subsequently in Flinders Island, their numbers had diminished from 5000, the original estimate of the aboriginal population, to 203. In 1842 there were only 44, in 1854 they had diminished to 16, and the last pure-blooded Tasmanian died in 1876, at the age of seventy-six. There are, however, a few persons possessing more or less aboriginal blood in some of the islands of Bass Strait.

Some persons who had settled at Norfolk Island when that island became a penal depot were transferred to Van Diemen's Land in 1805. But the growth of popula- tion was extremely slow, and in 1818 a census showed that there were only 3240 people on the island, including officials, military, and convicts. Whatever prosperity was enjoyed by the free inhabitants 'had arisen from the ex- penditure by the Imperial Government upon the convict establishment. But in that year settlers began to arrive. Every free immigrant was presented with a tract of land in proportion to the amount of capital brought by him to the colony^ — 640 acres for every £500 — and he was allowed to include in the estimate of his capital the passage money of himself and family, as well as the value of his furniture, his farming implements, and any live animals that he brought with him. The result was that no men took up land unless they were possessed of some means, and they were not compelled to part with a large proportion of it to pay for their farms, with the almost invariable result that they would be compelled to have recourse to the local banks or other financial institutions. Every free

settler was allowed the services of a number of convicts, termed locally assigned servants, proportionate to the size of his holding. These men and women were fed and clothed by the settler in return for their labour, and the Government was relieved from the expense of their support and supervision. The assignment system was eventually abandoned, in consequence of the evil moral result of what was practically slavery, but it cer- tainly increased the prosperity of the community. In 1821, when the next census was taken, the population had grown to 7400 ; the sheep numbered 128,468, the cattle 34,790, horses 550, and 14,940 acres of land were under crops.

Up to this date Van Diemen's Land had been adminis- tered as a penal settlement, but the settlers and eman- cipists agitated for a free press and for trial by jury, and their requests were gradually granted. Courts of justice were substituted in 1822 for courts-martial ; and in 1825 the colony was made independent of New South Wales, and Colonel Arthur was appointed governor. In 1828 t the Van Diemen's Land Company commenced sheep farming on a large scale in the north-west district of the island under a charter granted three years before, and in '1829 the Van Diemen's Land Establishment obtained a grant of 40,000 acres at Norfolk Plains for agriculture and grazing. In 1834 Portland Bay, on the mainland of Australia, was occupied by settlers from Van Diemen's Land, and in 1835 there was a migration, large when compared with the population of the island, to the shores of Port Phillip, now Victoria. At that date the popula- tion was 40,172, a large proportion being convicts, for in four years 15,000 prisoners had been sent out. The colony was prosperous, but the free settlers were not at all satisfied with the system of government, and an agi- tation commenced in Van Diemen's Land, as well as in New South Wales, for the introduction of representative institutions and the abolition of transportation. This system was abolished in New South Wales in 1840, after which date the island was the receptacle for all convicts not only from the United Kingdom, but from India and the colonies.

Gold was discovered in Victoria in 1851, and trans- portation to Van Diemen's Land finally ceased in 1853 ; in the same year representative institutions were intro- duced and the name of the colony was changed

to Tas- mania, but it was not till 1856 that it obtained respon- sible government.

The discovery of gold in Victoria produced a very remarkable effect upon Tasmania. All kinds of produce brought fabulous prices, and were exported to Victoria in such quantities that they rose from a value of £665,790 in 1851 to £1,509,883 in 1852, and £1,756,316 in 1853, while the population diminished in an equal ratio. It was estimated that in 1842 there were 38,000 adult males in the colony, but in 1854 their numbers had diminished to 22,261. For many years the island was inhabited by grey-beards and children ; the young men and women of all classes, so soon as they had reached manhood and womanhood, crossed Bass Strait and entered upon the wider life and the more brilliant prospects which first Victoria and subsequently New South Wales and Queensland afforded them. But even in its darkest days the fine climate of the island induced a steady immigration of retired officers, civil and military, from India, while the more wealthy inhabitants of the mainland of Australia spent a portion of their summers in the cool and exhilarating atmosphere of the island. It was not till the 'sixties that Tasmania embarked upon a new lease of prosperity. In the early days little or nothing was known about the western half of the island. The lake and mountain country was covered with forests, which rendered it almost worthless for agricultural and pastoral purposes ; except in the immediate neighbourhood of the navigable rivers — the Mersey, the Forth, and the Leven — the timber had no commercial value, and the land would not pay for clearing. The mineral wealth of this large district was not suspected, although coal off air quality had been found between the Dee and the Mersey rivers in 1850, and gold had been discovered in two or three local- ities during 1852. In 1860 two expeditions were equipped by the Government for a search for gold and other minerals, and although it was some years before there was any important result, the dis- coveries of these explorers directed attention to the mineral wealth of the island. In 1869 the mining industries were so unimportant that they were not even mentioned in the colonial statistics. In the following year an export of gold was noted of 2141 oz., valued at £7475. Since that date the gold industry has attained important dimensions. No tin was raised in 1872,

but in 1873 four tons of tin ore, valued at £220, were exported, and in 1879 the renowned Mount Bischoff on the north-west coast was discovered. Silver, bismuth, and copper have also been discovered, and Mount Lyell, where the ore contains gold, silver, and copper, promises to rival Mount Bischoff in profitable richness.

The development of the mining, agricultural, fruit-growing, and pastpral industries has withdrawn the attention of the colonists from other sources of wealth. No country in the world possesses more magnificent forests, and considerable quantities of black- wood and Huon pine have been exported to Australia, while the blue and red gum have been largely employed in building houses, jetties, and wharves in Victoria and New South Wales, and more recently in South Africa and at the Dover harbour works. There is no reason why the ornamental woods which abound should not he made up in the state and an export trade in furniture created. The fisheries are comparatively neglected. In the early days a large sec- tion of the community was employed in the pursuit and capture of the whale. For many years shore whaling was carried on at many places on the coast ; the pursuit was exciting, profitable, and popular. But by degrees the female cetaceans abandoned their old breeding- grounds, and the occupation came to an end. Deep-sea whaling was carried on very extensively. In 1838 the produce of the fisheries was valued at £137,000 ; in 1848 38 whalers, with a tonnage of 7260 tons and with crews of 1100 men, sailed from Hobart. The discovery of gold, by increasing wages, checked the industry, and in 1862 the export of sperm and black oil had de- clined to £59,210, in 1872 to £47,574, and in 1886 to £9463. . It is generally supposed that the whale of the Southern seas is nearly extinct, but there is apparently no very valid reason for the belief. There is little or no attempt at deep-sea fishing. The fish are far superior in flavour to those which inhabit the warmer water surrounding the Australian continent. The trumpeter, trevally, rock-cod, and king-fish are equal to the best fish found in the northern hemisphere ; the flounder is a formidable rival to the sole, and the crayfish to the lobster. The salmon-trout and trout have been thoroughly acclimatized in the rivers and lakes, but no attempt has been made to secure the harvest with which the shores abound. Nor has Tasmania taken full advantage of the difference in the

seasons between the southern and the northern hemisphere. Apples and pears shipped in the Tasmanian autumn arrive in England in March, April, and May, at the period when the European and American varieties have become tasteless

through having been stocked since September. But the colonists have allowed the dairy farmers of Victoria and New South Wales almost to monopolize the butter and poultry trades, in which a similar advantage may be taken of the difference in the seasons.

Tasmania possesses one great advantage over her neighbours through her temperate and salubrious climate. The death-rate is only 14-10 per thousand. The mean temperature of the year, as estimated from observations extending from 1841 to 1879, is about 50-10°. The mean af Hobart was 64 -4°, at Launceston 56 -6°, and at Oatlands, which is in the centre of the island and 1400 feet above sea-level, was 51 -76°. The mean number of days on which rain fell was 61, and the average annual fall 18‘45 inches. Snow is rarely seen, except in the mountains. The average temperature at Hobart of January, the hottest month, is 63°, and of July, which is mid-winter, 45°.

The first sod of the railway which was to connect Launceston with Deloraine was turned by the late Duke of Edinburgh in 1868, and the line was opened for traffic in 1871. Originally constructed by a private company, it fell into the hands of the Government, which has since become the owner of all the’ railways in the island, with the exception of that between Emu Bay and Bischoff, 48 miles, and the Mount Lyell, 15 miles. The gauge is 3 feet 6 inches, the total mileage 488 miles, and the cost of construction about £4,000,000.

The political history of the colony since the inaugura- tion of responsible government, until it became one of the states of Federated

Australasia, was not important. State aid to religion, which was given to any denomina- tion which would receive it, was abolished ; local self-government was extended to the rural as well as to the urban districts; a policy of semi-protection was intro- duced ; the island was connected by a submarine cable to 1 the mainland of Australia, and thence to the rest of the civilized world; and the population, which was only 99,328 in 1870, was nearly doubled. Like her neighbours, Tasmania organized a defence force, and was able to send a contingent to South Africa in 1900.

As one of the states of Australia, Tasmania returns six senators and five representatives to the Federal Parlia- ment. The local constitution resembles that of the other Australasian states, inasmuch as the executive govern- ment of four ministers is responsible to the legislature, which consists of a Legislative Council and House of Assembly. The former is composed of eighteen members, elected for six years by all natural-born or naturalized subjects of the Crown who possess either a freehold worth £20 a year or a leasehold worth £80, all barristers and solicitors on the roll of the Supreme Court, all duly qualified medical practitioners, and all British subjects holding a commission or possessing a degree. The House of Assembly is elected by owners or occupiers of property, or adult males who are in the receipt of £60 per annum as income and have resided in the colony for three years.

Geography.

The general physical features of Tasmania were most graphically described by Count Paul de Strzelecki in his work, Physical Description of New South Wales and Tas- mania (London, 1845), and soon afterwards many of its geological features were again briefly sketched by J. Beete Jukes (A Sketch of the Physical Structure of Australia : London). Although the researches of many local ob- servers have since added to our knowledge of the physical details, the descriptions of the main features as recorded by these two accomplished observers are wonderfully accurate, and even as regards local details are still, so far as they extend, most valuable sources of reference. The main axis of the

Great Cordillera, — so termed origi- nally by Sir Roderick Murchison — bordering the eastern coast-line of Australia, may be traced across Bass Strait in the chain of islands forming the Furneaux and Kents Group, which almost continuously link Tasmania with Wilson's Promontory, the nearest and most southerly part of the Australian mainland. Tasmania is wholly occupied

by the ramifications of this chain, and in itself may be said to embrace one and all of its characteristic features.

If we take our stand near Lake Fergus, to the east of Lake St Clair, we find that we are situated nearly in the centre of an exten- sive plateau — a smaller Tasmania — with an elevation, especially on the northern side, of between three and five thousand feet above the sea-level. This elevated plateau extends from Dry's Bluff in the north to the Denison Range in the south-west, and although often receding at points adjacent to the sources of the principal rivers, invariably presents a bold crested front to the north, west, and east. At its greatest elevation it is comparatively level, and contains many extensive fresh-water basins, such as Lake Augusta, Lake St Clair, Lake Sorell, Lake Echo, Lake Crescent, Arthur's Lake, and the Great Lake. The last is estimated to be about 90 miles in circumference. The marginal crests of this mountain table-land, together with its upper surface, composed principally of diabase, are known locally as "Tiers," and have a very com- manding aspect in the neighbourhood of Longford, Westbury, Delo- raine, and Chudleigh. The extent of the principal elevated plateau is best appreciated when we consider that it maintains its general altitude in a westerly direction from Dry's Bluff (4257 feet) on the north to Cradle Mountain (5069 feet) in the north-west, a distance of nearly 50 miles ; from Dry's Bluff in a south-westerly direction to Denison Range, a distance of over 60 miles ; and from Dry's Bluff to Table Mountain in a southerly direction, a distance of above 43 miles. This plateau itself again rests upon a more extended table-land, composed mainly of metamorphic schists or slates. The level of this table-land stretches westwards, and, including the Middlesex Plains, the Hampshire Hills, and the Emu Plains, maintains an altitude of 1200 to 2000 feet. Its limits follow the coast-line more or less closely, the

space between it and the sea often broadening out into low-lying tracts not much raised above the sea-level. Here and there, rising abruptly from its surface, are to be seen isolated peaks, chiefly of schistose forma- tion, the most characteristic of which are Valentine's Peak (3637 feet) and Mount Pearse. Ridges and plateaux of a similar char- acter, but more or less isolated, such as Ben Lomond (5010 feet) and Mount Wellington (4166 feet), are to he found in the north- east and south-west of the island. Towards the extreme west and south, granites, metamorphic mica, and quartzose schists, with overlying slates, grits, and limestone of Cambro-Silurian age, reappear again and again in anticlinal and synclinal ridges, which trend north and south, the most characteristic being the Huxley, Owen, Sedgwick, Pranklin, and Arthur Ranges. These rocks may also be seen following the south coast, and evidently occu- pying nearly all that extensive mountain region to the south of the river Huon. Settlement of population has taken place principally among the plains and lower levels of the north-western, midland, and south-eastern parts of the island, following in the main the rocks of Tertiary and Mesozoic age. In the Recent Tertiary period the soils of these plains and valleys have been greatly enriched by extensive outbursts of basalt- with accompanying tuffs. These comparatively level sheets of basalt are often of great extent in the midland, north-western, and north-eastern districts, and there is ample evidence to show that, as in France and other parts of the world, they are invariably intimately associated with the ancient Tertiary lake systems. These basalts produce a very rich chocolate soil, and were it not for their influence, the greater part of what is now the most fertile part of the island would have been comparatively poor or altogether sterile.

The appearance of the island throughout is wonderfully beautiful, with its open plains, bordered by far-extending precipitous mountain tiers, its isolated shaggy peaks and wooded ranges, and its many noble rivers and lakes. Its coasts for the most part, especially towards the south, are bold, and frequently indented with splendid bays and harbours (such as the Derwent where Hobart, the capital, is situated), affording ample shelter- and safe anchorage for ships. On the western side one is reminded of scenes in the highlands of Boss- shire and Inverness-shire

in Scotland, from the pictu- resque character of the blue, white, and pinkish crystalline peaks and the fantastic outlines of the mountain ranges which rise abruptly to a height of from 2000 to nearly 3000 feet above the Button Grass Plains. The vegeta- tion which prevails among the older schistose rocks of the west and extreme south presents a totally different appearance to that which occurs in the more settled districts of the east. The western vegeta- tion, as compared with that of the east, presents as

marked a contrast as do the prevailing rocks upon which it flourishes. The characteristic trees and shrubs of the west include the following genera, viz. : Fagus, Genar- rhenes, Anodopetalum, Eucryphia, Bauera, Boronia, Agas- tachys, Riohea, Telopea, Grevillea, Orites, Athrotaxis, Dacrydium, Phyllocladus. On the eastern side the plains and rocky ridges, where not artificially cleared, are occupied by shaggy and often sombre forests mainly composed of the-f ollowing genera : Eucalyptus (gum tree), Gasuarina, Bursaria, Acacia, Leptospermum, Drimys, Melaleuca, Dodonea, Notolea, Exocarpus, Hakea, Epacris, Xanthorrhcea, Frenela. The mountain slopes and ravines of the east have a well-marked vegetation. In character it is more akin to, and in many cases identical with, that of the west. The tree fern (Dicksonia antarctica) in the mountain ravines is especially remarkable. The following genera are also found in such positions in great luxuriance, viz. : Fagus, Anopterus, Phebalium, Eucalyptus, Richea, Cyathodes, Pomaderris, Prostanthera, Boronia, Gaultheria, Correa, Bedfordia, Aster, Archeria, Atherosperma, &c. In the extreme west the trees and larger shrubs do not appear to ascend the schistose rocky mountain slopes of the central and eastern parts. The flora and fauna as a whole are almost identical with the flora and fauna of the continent of Australia, and there is, even now, sufficient evidence to show that both

have been derived immediately from ancestors which at least had established themselves in Australia and Tasmania during, and possibly even prior to, the dawn of the Tertiary period.

Geology.

Distribution of the Principal Bock Systems. — In a general way- it may be stated broadly that the bldest rocks (in which the pre- cious metals usually occur), ranging from the Pre- Oeology. Cambrian to the Devonian, are largely represented in Tasmania, forming, with the associated granites, gabbros, and porphyries, remarkably rugged ranges in the north-eastern part of the island in the vicinity of the gold and tin mining centres, as at Asbestos Eanges, Beaeonsfield, Lefroy, Branxholm, Gladstone, Gould's Country, George's Bay, and Schouten and Maria Islands. In the north they occur in the vicinity of Chudleigh, Mount Roland, Mount Claude, and Latrobe. In the western highlands — the region of the famous tin, silver, copper, lead, gold, and other mining centres — these older and richly metalliferous formations occupy a broad marginal strip nearly 200 miles in length and 50 miles in width.

Pre- Cambrian. — The rocks of Pre-Cambrian age consist mainly of highly crystalline schists, gneissoid micaceous schists, and quartz- ites. Rocks of this age are found in the neighbourhood of Port Davey, Davey river, Arthur, Frankland, and Wilmot Ranges, the western border of Macquarie Harbour, Mount Heemskirk, Parson's Hood, Mount Roland, Latrobe, and the Asbestos Ranges.

Cambrian. — Rocks determined to be of Cambrian age are found associated with gneissoid mica-schists at Caroline Creek near Latrobe. They consist mainly of rusty tilted sandstones, thinly bedded.

Silurian (Lower and Upper). — The Silurian consist mainly of hydro-mica schists, clay, slates, sandstones, grits, conglomerates, and fine-grained, massive blue, grey, and white limestones. The rocks of the Lower Silurian division, so far as known, have been divided into two groups. These are, in ascending order : —

(1) Auriferous Slate Group, consisting mainly of dark blue clay slates very much tilted and folded, and frequently penetrated in their faultings and dislocations by quartz reefs and veins.

(2) Cordon Limestone Series. — The rocks of this group consist mainly of massive cave limestones and conglomerates, as at Ilfra- combe, Chudleigh, Ida Bay, Florentine, Franklin, and Gordon rivers, with numerous corals and shells.

The rocks of the Upper Silurian division are generally divided into three groups, in ascending order, as follows : —

(1) Hydro-mica Schist Group, consisting of the prevailing silvery hydro-mica schists and associated conglomerates, as at Mount Lyell, Honeysuckle Hill, and elsewhere.

(2) Brachiopod Sandstone Series, consisting mainly of red and whitish highly-tilted sandstones, rich in various forms of Brachio- pods, notably Pentamerus and Orthis, as at Queen River and Heazlewood.

(3) Eldon Valley and Zeehan Clay Slate Series, consisting of a series of highly contorted or tilted clay slates, schists, and thin bands

of limestone, containing Calymene and other trilobites, also Spirifers and Brachiopods. The rocks of this division are frequently pene- trated by dykes, lodes, and veins containing gold, silver, copper, lead, and other valuable metals.

Devonian. — It is doubtful if the rocks referred to this system can be permanently retained, and whether it may not be found necessary, as originally suggested by Mr Jukes, to abolish this system in classi- fication, and to class part of the series with the Silurian, and class part of the uppermost series with the Permo-Carboniferous system.

Permo-Carboniferous. — The characteristic rocks of Permo-Car- boniferous age chiefly consist of thin regular horizontal bands of silicious conglomerates and grits, blue slaty shales, limestones, argillo- arenaceous and argillo-calcareous mudstone rocks of a yellow or

whitish appearance, with intercalated beds near its upper limits in some places, composed of white, red, and yellow sandstones, fine greyish laminated friable shales, and occasionally thin coal seams. The members are, for the most part, extremely rich in fossils. These rocks are mainly deposited throughout the eastern and midland parts of the island, and are found fringing the whole of the great central plateau of greenstone. There exists also a not- able patch, more recently discovered, near the mouth of the Henty river. The typical remains of this period are two species of a genus of Conifera (Naiggerathiopsis) ; characteristic net-veined ferns (Gangamopteris, Glossopteris) ; lycopods (Tasmanites, Schizo- neura). The remains of the oldest known Tasmanian insect— a species of some form of Neuroptera — has been found associated with these plant remains in the Mersey Coal Measures. The fossils of the marine beds of the system are very numerous, but the characteristic forms, consisting of large-winged Spirifers and abundant lace-like Fenestellse, alone enable any one easily to identify the rocks in which they are found.

Mesozoic Period. — The rocks of Mesozoic age consist mainly of variegated sandstones regularly or falsely bedded, shales, and blue and white clays. These members are often of great thickness, and extend throughout the midland, southern, and south-eastern dis- tricts. They frequently contain seams of coal of considerable thick- ness and of fair quality, as in the Fingal district, where the output is about 40,000 tons yearly. The beds of the system are, as a rule, distributed in district basins, often greatly concealed, altered, and otherwise disturbed by the more recent intrusions of the diabasic greenstones. On this account, and because of the great sameness of the fossil plant remains, there is great difficulty in attempting to separate the various members of the period, or system, into distinct subdivisions. The formations, as a whole, probably cover the whole period from the close of the Permo-Carboniferous age to the beginning of the Tertiary period. The marine cretaceous rocks, such. as the Rolling Downs and Desert Sandstones of Australia, are nowhere represented in Tasmania.

Cainozoic Period (Tertiary System). — Taken as a whole, the general features of the Tertiary system in Tasmania correspond with those of

the same system in the mainland of Australia. The rock formation may be conveniently divided into two principal divisions and four groups, in descending order, as follows: —

Neogene —

(1) Older raised terrace drifts, often overlying the immediately preceding widespread extrusions of olivine basalt.

Palmogene —

(2) Basaltic sheets and associated tuffs overspreading the Tertiary marine and lacustrine formations.

(3) Lacustrine deposits of great thickness and extent, com- posed of sands, clays, lignites, travertines, and sometimes including auriferous and stanniferous drifts ; contains the remains of a rich and varied flora.

(4) Marine deposits at Heathy Valley, Flinders Island, and fringing the sea at Table Cape and Cape Grim.

Palmogene Epoch. — Middle and Lower Tertiary.

Marine Formations. — The marine formations occur in isolated patches fringing the north-western coast and the Islands nf Bass Strait, notably near Cape Grim, Table Cape, and Heathy Valley, Flinders Island. From the character of the molluscs and the small percentage of species having living representatives (not exceeding 2 per cent.), it is clear that these marine beds must be placed at the base of the Palteogene group, i.e., equivalent to the early Eocene of other countries.

Lacustrine Formations. — The more important lacustrine forma- tions, as might be expected, are mainly found in the original valleys and eroded basins of the earlier rocks, and generally consist of regular or irregular bands of white, grey, or ferruginous sand- stones, alternating with grits ; blue, white, yellow, or blackish clays ; lignites ; and sometimes, in the neighbourhood of the old slates and crystalline rocks,

the ancient channels formed in them contain drifts of a richly auriferous or stanniferous character. Many of the formations are found along the course of existing rivers and watercourses in the form of raised bordering terraces. In other places, as in the Launceston Tertiary Basin, they occupy the floor of broad undulating plains, covering an area of not less

than 600 square miles, and ranging from 400 to 1000 feet in thick- ness. Being comparatively of a loose and incoherent nature, the beds are unable to resist the eroding influences of air and water, and are therefore greatly denuded along the course of existing rivers and their tributaries. The clays and ferruginous sandstones are in most places replete with the remains of a luxuriant vegeta- tion, among which the leaf impressions of forms more allied to the existing European flora are especially noticeable, such as those belonging to certain extinct species of the oak, elm, beech, laurel, willow, and elder. With these occur ancestral forms of banksia, lomatia, eucalyptus, pittosporum, cinnamon, fig, araucaria, and other conifers. It is of especial interest to note that the ancestral forms of the existing floras of the world had already attained a very high state of development and specialization into well-known generic types, which were then worldwide in distribution and not, as at present, restricted to particular widely separated regions. The mixture in Tertiary formations of the elements of the exist- ing floras of Europe and Australia is of the greatest interest, and has been ably investigated by the late Professor Von Ettingshausen.

Fedlspathic Basalts and Tuffs. — One of the most remarkable fea- tures of theTertiary period throughout Australia and Tasmania mark- ing the close of the Palaeogene epoch, is the eruption of extensive sheets, flows, and accumulations of feldspar basalts, with their asso- ciated tuffs. It is evident that great volcanic activity prevailed gen-

erally at this time, especially in the neighbourhood of ancient lakes, estuaries, and. river systems. Considerable areas in such places are covered by repeated flows or sheets of basalt or scoriae — overwhelming ancient Tertiary forests, and filling ancient valleys, lakes, estuaries, and river beds. In the tuffs, overlaid by overflows of basalt, at Breadalbane, Cora Linn, Geilston, One Tree Point, and Little Badger Corner, there have been discovered silicious and calcareous trunks of fossil woods of banksia, araucaria, and other extinct forms of coni- fers, together with fossil bones and teeth of extinct forms of mar- supials allied to the existing Hypsiprymnus and Phalascomys.

Upper Tertiary (Neogene Epoch). — In Tasmania a series of deposits occur, generally resting either upon the Palaeogene basalts or the lacustrine or marine beds. These deposits consist mainly of clays of various shades of colour, ferruginous sands, coarse and fine, and more conspicuously of gravels and pebbles frequently con- glomerated, among which in many localities, as at Longford, occurs a wonderful abundance of water-worn pebbles derived from the silicified stems and branches of conifers and other fossil trees. The apparent absence of marine formations and of the newer basalts, so common in Victoria, renders it difficult to mark the upper limits of this division with any degree of satisfaction. As regards the principal divisions of this epoch, there is good reason for the belief that the paucity of life and the enormous denudation are in a large measure due to a growing refrigeration of the climate, and to a much greater rainfall than at present. Whether this supposed change in the direction of a colder climate became sufficiently intense within the period to produce local ice- sheets and glaciers — of the former existence of which there is abundant evidence in the valleys and sub-alps of the Western Highlands, notably along the deeply-cut ravines of the Mackintosh, Franklin, King, and Henty rivers — it is difficult to determine, although local geologists are inclined to this view.

Post-Tertiary Period. -r-The nature of the Post-Tertiary rock formations and of their principal divisions may be ascertained from the following summary, arranged in descending order : —

Human Period —

(1) Alluvium of recent rivers, lagoons, lakes, seas, &c. ; peat;

unconsolidated sands along the coasts ; native shell- mounds, with burnt embers and rudely-chipped flint implements belonging to the extinct Tasmanian race, all around the coast-line, especially noticeable along the commanding headlands of the estuaries of the Derwent and Tamar rivers ; talus-drifts on slopes, and at base of mountains, cliffs, &c.

(2) Consolidated sand-dunes, such as the Helicidse sandstone,

Flinders Island, associated with and including the raised-beach terraces on Flinders, Cape Barren, Badger, King and Kent Group islands, and along certain parts of the northern coast. The only example known of a raised sea-beach in the southern part of Tasmania occurs in one of the minor bays inside the heads at Blackman's Bay on Forestier's Peninsula.

Pleistocene Period —

(1) Cave deposits, with bone-breccia underlying stalagmitic

floor, as at Chudleigh, from which bones of animals still living were obtained.

(2) Esker drifts, as at Pig Island, Newnham, Stevenson's Bend,

and Invermay, on the Tamar, consisting of irregular beds of water-worn pebbles; pebbles of silicified and ferru- ginous fossil pine and other woods, including fossiliferous fragments of Palaeogene leaf-beds, &c.

(3) Lower terrace drifts, belonging to the later pluvial period, at successive levels in the main valleys of the North Esk and other rivers.

It is very probable, during the earlier Cretaceous period, that Tasmania was separated from the southern spur of the continental

portion of the Australian cordillera by a narrow strait, as at present ; but there is good evidence at Table Cape, Flinders Island, and Kent Group that when the bed of the Cretaceous (or perhaps Eocene) sea was Anally elevated on the mainland, the floor of Bass Strait partook in the general movement, thus forming a biological bridge, for a time connecting Tasmania and Australia, and per- mitting the migration of plants and animals heretofore isolated in terrestrial provinces of narrower limits. The smaller, and perhaps more local, depression which again severed Tasmania from the mainland probably occurred towards the close of the Tertiary period, prior to the evolutional development of the giant mar- supials of the mainland, viz., Diprotodon, Nototherium, and Mar- supial Lion (Thylacoleo), &c. ; and this may account for the fact that no remains of these giant marsupials have been discovered in Tasmanian rocks. It is most probable, therefore, that the destruc- tion of the connecting-link of the previously upheaved Tertiary marine beds in the region of Bass Strait was accompanied by a local subsidence of the land, perhaps during the earlier Pleistocene period, of which there is also some evidence along the western and southern coast-line of Tasmania. The fact that the older lacustrine leaf-beds of Tertiary age, in the Launceston, Derwent, and Mac- quarie harbour basins, are now found at a considerable depth below the existing sea-level (proved to a depth of from 300 to 400 feet below sea-level in some places) is in harmony with this view. The very much more recent elevation of the land on the north-east coast and the islands of Bass Strait during the recent or human period, as evidenced by the raised sea-beaches containing shell remains in all respects identical with the living species in the same localities, is quite local in character, as there is no evidence of this final movement southwards. It was also certainly a much more limited vertical oscillation, as it failed to reconnect com- pletely the island of Tasmania with the Australian mainland.

The western prevailing winds — particularly the north-western — carry the rain-bearing clouds. It altogether depends upon the directness of the exposure of the land surface of the various parts of its mountainous and other exposed ana. regions to these western winds what the magnitude of its rain- fall may be. The elevation-divide between the western and eastern parts of the island rises generally to a

height of between 3000 and 5000 feet, and consequently the parts to the east of such rain-draining heights are more or less robbed of the prevailing rainfall of the western border. This is clearly revealed by the following analysis for the year 1900 : —

District.

Altitude.

Average Rainfall.

f Great Lake

N.W., average 39-88 -(Glengarry.

(, Waratah .

Feet.

3700

51

2000

Inches.

33-65 38-04 79-02

C Mount Lyell S.W., average 33-24 \ Cape Sorell (Glenora

1230

40

1.75

115-6 42-82 22-79

f Boobyalla . N.E., average 22-63 I Cullenswood (. Mathinna .

15 900

25-74 25-55 30-81

(Apslawn .

S.E., average 21-68 | Bothwell .

(Oatlands .

30 1400

30 06 23-45 20-95

The general average for the eastern district over a period of years was 22-07 inches ; for the western, 37 -55 inches; and for Tasmania, 26-69 inches.

Statistics.

In 1901 the state contained 174,230 people, viz., 90,265 males and 83,965 females, giving a density of 6-6 persons per square mile. The population in 1870 was 100,765, but the discovery of Jjb^”” Mount Bischoff two years later, though it greatly stimulated speculation and induced a large influx of immigrants, did not put a stop to the outflow, for in 1878 the population did not number 110,000. In 1880 the population was 114,762, and in 1890, 145,290.

Like all the Australian colonies, Tasmania shows a decline in the birth-rate ; in 1901 the births were 4930, which is smaller than the number recorded ten years previously, and

[statistics

much below the ratio per thousand then recorded. Prom 1870 onwards the average birth-rate per 1000 in five-yearly periods was : —

Periods.

Births per 1000 of Population.

Periods.

Births per 1000 of Population.

1871-75 1876-80 1881-85

29-72 31-54 35-02

1886-90

1891-95

1896-1901

34-59 32-18 28-29

The number of illegitimate children born in 1901 was 193, which gives a ratio of somewhat over 3-9 per cent, of all births, and this may be taken as the present average, compared with 3-8 prior to 1890. The climate is probably more healthy than that of any of the Australian states, although, owing to the large number of old people in the colony, the death-rate would appear to put Tasmania on a par with New South Wales and South Australia. Grouping the deaths in five-yearly periods, the following results are attained : —

Periods.

Deaths per 1000 of Population.

Periods.

Deaths per 1000 of Population.

1871-75 1876-80 1881-85

15-64 16-52 16-00

1886-90

1891-95 .

1896-1901

15-16 13-14 12-00

There has therefore been a gradual and substantial improvement in the health conditions of the state. The annual marriage-rate is about 6-9 per 1000 persons, which is considerably below the average of Australia generally, and is accounted for by the con- tinued emigration of men unmarried and of marriageable ages ; this emigration had ceased in 1900, and the marriage-rate may be expected to rise. For 1901 the rate was 7-71 per 1000. The chief towns are Hobart (population 34,682) and Launceston (population

21,220).

Half the population are adherents of the Church of England, and about 18 per cent. Eoman Catholics ; Wesleyans number nearly 16 per cent., and Presbyterians about 6 J per cent. In- Educatioa. struoti0n is compulsory upon children over six years of age and under thirteen years in the towns of Hobart and Launces- ton, but not in the rural districts. Special religious instruction is allowed to be given after school hours by teachers duly authorized by the various religious denominations, and this privilege is some- what extensively used by the Church of England. The schools are not free, as small fees are charged ; but these are not enforced where parents can reasonably plead poverty. At the beginning of 1901 there were 327 state schools, with 18,693 pupils on the roll, and administered by 603 teachers ; there were also 243 private schools, with 525 teachers, and an enrolment of 11,940 scholars ; there were therefore 30,633 children receiving instruction, out of about 40,000 children of school age. The expenditure in 1901

upon primary instruction was £59,618, but in addition to this sum £8143 was expended upon school premises, while the revenue from fees in the same year was £10,945. The net cost, excluding expenditure on school premises, was £3 8s. 3d., and including that expenditure £3 19s. 8d. per scholar in average attendance. The University of Tasmania has an endowment of £4000, and a revenue of £748 from fees and £968 from other sources, making a total of £5716. The students attending lectures in 1901 were 49, of whom 45 matriculated, and the number of degrees conferred to the close of that year was 146 ; the great .majority of these degrees were granted ad eundem gradum.

The revenue is 'chiefly obtained through the custom-house, but the Federal tariff has had the effect of considerably reducing the receipts from this source. In 1900 the state raised Finance. £1,054,980 on account of the public revenue, which is equal to £6 2s. 3d. per inhabitant ; of this sum £490,916 was obtained from import and excise duties, and £153,594 from other taxation ; the railways returned £202,075, and the posts and tele- graphs £97,393, while from public lands was obtained £67,498, and from other sources £43,504. The expenditure was £923,731, thus distributed : railway working expenses, £160,674 ; posts and telegraphs, £84,539 ; public instruction, £52,614 ; interest and charges upon debt, including sinking funds, £320,151 ; and other services, £305,853. The interest and other debt charges come to £1 17s. Id. per inhabitant, and represent from 31 to 43 per cent, of the expenditure of the state. The public debt in 1900 was £8,511,005, which sum is equal to £49 6s. 2d. per inhabitant. In 1871 it was £1,315,200, in 1881 £2,003,000, and in 1891 £7,110,290. The debt was represented by debentures and in- scribed stock to the amount of £7,690,000, and local inscribed stock, £821,005. The expenditure upon works may be divided into that on revenue-yielding works, viz., railways, £3,910,229, and telegraphs, £130,197 ; and that on works not yielding

revenue, £4,205,732. For local government purposes Tasmania is divided into municipalities, town boards, and road trusts. The rates are assessed on an assumed annual value, which in 1900 was £1,417,547, corresponding to a capital value of upwards of £28,000,000. The bulk of the revenue of the local government bodies is obtained from rates. The

sources of revenue in 1900 were : Government endowment, £23,537 ; general rates, £84,564 ; special rates, £6796 ; and other sources, £41,867. The outstand- ing loans of municipalities amount to £516,952, of which £234,100 is owing by Hobart and £281,152 by Launceston; the latter has accumulated a sinking fund of £32,390 against its indebt- edness.

Tasmania has a partially-paid force of 255, and a volunteer force of 2257, and a paid staff of 42 • the cost of defence is £17,990 per annum, but of this sum £4998 represents uet™ce. Tasmania's contribution to the maintenance of the Australian auxiliary squadron.

Mining is now the foremost industry, the exports of minerals amounting in 1900 to £1,638,672, compared with pastoral produce exported valued at £391,918, agricultural produce and fruit, £478,678. Tasmania produces gold, tin, silver, Mining. and copper, and in 1900 the production of these minerals was valued atw gold, £316,220 ; tin, £270,998 ; silver, £252,080 ; and copper, £901,660. Beaconsfleld is the chief goldfield, 26 miles north-west of Launceston. There are about 1500 persons employed mining for gold on the various fields. The Mount Zeehan and Dundas districts produce almost the whole of the silver at the present time, and most of the ore is sold to agents of the Australian and German smelting works. Tasmania is the largest producer of tin in Australasia, and a very large proportion of the tin hitherto produced has been obtained from alluvial deposits, the lodes, except at Mount Bischoff, having, comparatively speaking, been neglected. The Mount Biscnoff mine, which is worked as an open quarry, is the largest producer of tin, and (with an original capital of £30,000) has paid £1,732,500 in dividends. The num- ber of tin miners in the state is about 1170. The production in

1900 was £270,998, which represents about four-fifths the value of what was obtained ten years previously. Tasmania takes the lead amongst the states in copper production : in 1896 there was a small export of £1659 ; in 1897 the export grew to £317,437, in 1898 to £378,565, in 1899 to £761,880, and in 1900 to £901,660. This expansion was chiefly due to the enterprise of the Mount Lyell Mining and Railway Company, whose

mine is situated at Gor- manston. A sum of £400,000 was expended by the company on construction and development works before any return was received from the mine, but up to the end of 1900 £670,000 had been paid in dividends. “Up to the 28th December 1900, 863,061 tons of material had been dealt with, the quantity of gold won being 97,854 ounces, silver 2,443,901 ounces, and copper 27,155 tons. Coal-mining is carried on in various districts in the island, but the principal mines are at Mount Nicholas and Cornwall, in the Mount Nicholas Range ; the output of the field is increasing, but no export trade is at present possible, the mines being situated too far from the sea-board.. The number of men em- ployed in coal-mining is 150, and the output about 46,000 tons per annum.

Manufactures are on a very small scale, the number of estab- lishments being about 260, and the hands employed 3800.

After being much neglected, agriculture received renewed atten- tion in 1890, the area of land under wheat being increased from 32,452 acres in 1890 to 51,825 acres in 1901, and under oats from 20,740 acres to 45,073 acres, the total A&“cu<- area being advanced from 157,376 acres to 224,352 re-

acres. The area under crop, at intervals of ten years, was as follows: 1861, 163,385 acres; 1871, 165,046 acres; 1887,148,494 acres; 1891, 168,121 acres; and 1901, 224,352 acres. Wheat is the principal crop, and the yield is larger per acre and less variable than that of the Australian states : for the ten years ending with

1901 the average yield was 18-9 bushels per acre, ranging between 15 bushels in 1894 and 27 bushels in 1899. The oat crop is also much above the Australian average, and during the ten years’ ending 1901 the yield ranged between 22 bushels in 1897 and 38 bushels in 1899. Tasmania is renowned for its fruit crops, and now that this fruit has found an opening in the British market, renewed attention is being directed to the industry. In 1901 there were 7888 acres of apples, 1053 acres of pears, 766 acres of apricots, 826 acres of plums, 531 acres of cherries, 354 acres of peaches, 1755 acres of strawberries, gooseberries, and raspberries, and 979 acres of currants. The crop for the same year

included 551,251 bushels of apples, 59,480 bushels of pears, and nearly 60,000 bush- els of other fruit. Tasmania finds its best markets for fruits in New South Wales and in Great Britain. The total value of the produce of Tasmanian farms now exceeds £1,020,000, which is equivalent to £4 lis. per acre cultivated and £5 18s. per inhab- itant. The areas devoted to the principal descriptions of crops in 1901 were : —

T A S T E — T ATE

189

Acres.

Acres.

Wheat .

51,825

Potatoes .

23,068

Barley

4,502

Grass for seed .

2,302

Oats

45,073

Hay ....

61,541

Peas

9,824

Green crops

3,749

Turnips .

4,743

Gardens and orchards

13,001

Tasmania shows a decline in sheep-breeding, yet the state is singularly well adapted for sheep-raising, and its stud flocks are Live stock we^’ known an<* annually drawn upon to improve the ' breed in the other states. Nor have the other branches of the pastoral industry shown much expansion, as the following table will show : —

Tear.

Sheep.

Horned Cattle.

Horses.

Swine.

1861 1871 1881 1891 1901

1,714,498 1,305,489 1,847,479 1,662,801 1,683,956

87,114 101,540 130,526 167,666 165,516

22,118 23,054 25,607 31,262 31,607

40,841 52,863 49,660 73,520 68,291

The shipping increased considerably during the ten years pre- ceding 1900 ; in 1888 the tonnage inwards was 385,650, and in 1900, 618,963. Hobart is now a place of call for several of Commerce. tjje Eur0pean steamship lines, and the state is becom- ing increasingly popular as a summer resort for the residents of Mel- bourne and Sydney. The growth of the shipping trade will be seen in the following table, which also gives the imports and exports at ten-yearly intervals ; it is not necessary to give the tonnage of ship- ping leaving, which is practically the same as that entering: —

Year.

Shipping entered.

Imports.

Exports.

1861 1871 1881 1891 1900

Tons.

113,610 107,271 192,024 514,706 618,963

£

954,517

778,087

1,431,144

2,051,964

2,073,657

£

905,463

740,638

1,555,576

1,440,818

2,610,617

Tasmania does a large trade with Victoria, the imports in 1900 being valued at £908,722, and the exports at £388,913 ; with Great Britain the trade was, imports, £628,663, and exports, £688,600 ; and with New South Wales, imports, £337,672, and exports, £613,161. A considerable portion of the goods from both New South Wales and Victoria are of British origin. The principal exports in 1900, and their values, were : fruit, preserved and green, £279,988 ; oats, £39,901 ; potatoes, £103,223 ; hops, £19,870 ; hides, £67,941 ; wool, £261,214 ; bark, £29,405 ; timber, £42,213 ; silver ore, £252,080 ; copper, £901,660 ; tin, £270,998 ; and sheep, £51,092. The imports represent £12 and the exports £15 2s. per inhabitant. The chief ports of the colony are Hobart, imports in 1900, £776,918, and exports, £755,470 ; Launceston, imports, £808,326, and exports, £707,053 ; and Strahan, imports, £287,995, and exports, £868,239.

The railways open for traffic in 1900 had a length of 594 miles, of which 439 were Government lines ; there were also 18 miles in course of construction, making the total mileage of the Hallways. gtate g12 ^he progress of railway construction will be seen from the following figures: open for traffic, 1871, 45 miles; 1881, 168 miles; 1891, 425 miles ; and 1900, 594 miles. The rail- ways, both State and private, are of 3 feet 6 inch gauge. The capital expended on Government lines up to 1900 was £3,659,069, and the gross earnings in that year £202,959, and the working expenses £160,487, leaving £42,472 as the net earnings. This last-mentioned sum is equal to 1”16 per cent, on the capital ex- penditure ; and as the average interest upon outstanding loans is 3-73 per cent., the railways are carried on at a loss of 2-57 per cent. On the other hand, the private railways show excellent returns ; the Emu Bay and Mount Bischoff line, 98 miles in length, con- structed at a cost of £396,796, returned in 1900 about 3 per cent., and the Mount Lyell Company’s railway, 22 miles long, costing £220,333, returned over 8 per cent.

The roads maintained by the road trusts and boards of the colony extend over 6368 miles, of which 2987 miles were macadamized ; the annual expenditure thereon is over £25,000.

There were 371 post offices and receiving offices in 1900, and there were also 322 telegraphic stations. The postal officials numbered 828, and 317,000 postcards, 10,590,000 Posts and ietterSi 1,900,000 packets, and 6,637,000 newspapers telegraphs. were rece;ve(j an^ despatched. The postal revenue amounted to £99,864, and the expenditure to £84,539 ; these

sums include telegraph and telephone business. The telegraph messages sent numbered 370,225. The telephone system is being rapidly extended, and at the beginning of 1901, 1194 miles of line were being worked.

There are four banks of issue, of which two are local institu- tions ; their united assets amounted in June 1901 to £3,315,120, and their liabilities to £3,353,863. The note circula- tion was £151,340, and the deposits £3,178,846, of Banking. which £1,759,292 bore interest. The coin reserve and till money amounted to £577,689. Post office and trustee savings banks are working side by side. Sums of one shilling and upwards may be deposited, and interest is allowed on sums under £150 at the rate of 3 per cent, per annum. The following table shows the progress of the savings banks since 1871, the number of accounts open at Hobart and Launceston being almost the same : —

Tear.

Depositors.

Amount at Credit.

1871 1881 1891 1901

8,500 14,728 26,916 42,509

£217,413

369,278 554,417

1,009,098

Authorities. — J. Bonwick. Daily Life and Origin of the Tas- manians. London, 1870. — J. Fenton. A History of Tasmania. Hobart, 1884. — Sir Joseph Dalton Hooker. On the Flora of Australia : its Origin, Affinities, and Distributions. An Intro- ductory Essay to the Flora of Tasmania. London, 1859. — R. M. Johnston. Handbook of Tasmania ; a Systematic Account of the Geology of Tasmania. — T. C. Just. Tasmaniana ; a Description of the Island and its Resources. Launceston, 1879. — J. L. Gerard Krefft. Notes on the Fauna of Tasmania. Sydney, 1868. — George Thomas Lloyd. Thirty-three Years in Tasmania and Victoria. London, 1862. — Mrs Louisa Anne Meredith. My Home in Tasmania; or, Nine Tears in Australia. New York, 1853. Tasmanian Friends and Foes — Feathered, Furred, and Finned. Hobart, 1881. — Royal Society of Tasmania, Papers and Proceedings. Hobart. — H. Ling Roth and M. E. Butler. The Aborigines of Tasmania, 2nd ed. Halifax, 1899.

(g. c. l. ; t. A. c.)

Taste. See Physiology : Special Senses.

Tata (Totis), a market-town of Hungary, 57 miles west of Budapest. Near the town is a romantic lake, on the shore of which stands the old castle of the Counts Eszterhazy, with a rich picture gallery and other collec- tions, and a park of 140 hectares, much frequented by the citizens of Budapest. Population (1891), 6925;

(1901), 7220.

Tatar Bazardjik, or Tatar Pazardjik, chief town of a department in eastern Rumelia, Bulgaria, on the Upper Maritza, and on the Sofia-Constantinople rail- way, 74 miles E.S.E. of Sofia and 23 miles W. of Philip- popolis. Situated at the junction of several roads, it began to acquire importance in the 15th century, when it was known as the small Tataren Markt, and also as Pazar of the ” Markt.” Occupying a low situation, it is rather subject to flooding in winter. The railway station on the opposite side of the river is reached by a wooden bridge resting on sixteen stone pillars. The town is an important centre of the rice trade, which has much in- creased, and it has also some trade in

cocoons. Popula- tion (1892), 16,343. Though originally almost wholly Turkish, the inhabitants are now mainly Bulgarian, the Turks numbering less than one-tenth.

Tate, Sir Henry, Bart. (1819-1899), English mer- chant and founder of the National Gallery of British Art, was born at Chorley, Lancashire, in 1819. His father, a minister of religion, put him into business in Liverpool. He became a prosperous sugar-broker, and about 1874 removed to London, where he greatly increased the operations of his firm and made ” Tate’s Cube Sugar ” known all over the world. He had early in his career begun to devote large sums of money to philanthropic and educational purposes. He gave

£42,000 to the Liverpool University College, founded in 1881 ; and a still larger sum to the Liverpool hospitals. Then, when he came to London, he presented four free public libraries to the parish of Lambeth. His interest in art came with later years. He was at first merely a regular buyer of pictures, for which he built a large private gallery in his house at Streatham. He was also the friend of many painters and others interested in art, and every year he invited them to a large dinner-party just before the opening of the Royal Academy exhibition. Gradually his gallery came to contain one of the best private collections of modern pictures in England, and the owner naturally began to consider what should be done with it after his death. It had always been his intention to leave it to the nation, but in the way of carrying out this generous desire there stood several obstacles. The National Gallery could not have accepted more than a selection from Tate’s pictures, which were not all up to the standard of Trafalgar Square ; and even when he offered to build a new gallery for them, it was found difficult to secure a suitable site. What Tate offered was to spend £80,000 upon a building if the Govern- ment would provide the ground. This proposal was made to Mr Goschen, while he was Chancellor of the Exchequer, through the good offices of Mr Humphry Ward. But it was not until Sir William Harcourt had succeeded to the

Chancellorship in 1892 that Tate's offer was finally accepted. One possible site at Black- friars was refused by the City Corporation ; another at South Kensington was found to be already allotted to the future College and Museum of Science. However, the demolition of Millbank Prison left a large plot of ground vacant upon the Embankment at the Middlesex end of Vauxhall Bridge, and this Sir William Harcourt presented to Mr Tate, on condition that the control of the new building should be placed in the hands of the Trustees of the National Gallery, of whom Mr Tate himself was one at the time. The total sum spent upon construction was much more than £80,000 ; in fact, it was said to approach a figure twice as large. The gallery was opened by the Prince of Wales on 21st July 1897, and a large addition to it was completed just before the donor died. It contained sixty-five pictures presented by him ; nearly all the Eng- lish pictures from the National Gallery painted within the previous eighty years ; the pictures purchased by the Royal Academy under the Chantrey Bequest, which had previously hung in South Kensington Museum ; and seventeen large works given to the nation by Mr G. F. Watts, R. A. Mr Tate was created a baronet in the year after the Tate Gallery, as it became the custom to call it in order to avoid confusion between it and the National Gallery, had been opened. He died at Streatham on 5th December 1899.

Tatian, Diatessaron of. — Since the appearance of the article on Tatian in the ninth edition of this work (vol. xxiii. p. 80 f.) an Arabic version of the Diatessa- ron has been published at Rome by Agostino Ciasca from two MSS., together with a Latin translation ; the Latin was afterwards rendered into English by J. Ham- lyn Hill, and the Arabic by Hope W. Hogg. Of the two manuscripts, one, now in the Vatican library, is of about the 12th century; it was brought from the East in 1719 by S. Assemani, and its existence had long been known to scholars, although it had not been examined in detail. The other, now in the Borgian Museum, was sent from Egypt as a present to the Pope in 1886 by a Uniat Copt named Halim Dos Ghall, and is of a somewhat later date, although it contains, on the whole, a purer text. The two MSS. are derived from a common source, which, as we learn from the introduction and colophon to the

Borgian MS., was a version made by Ibn-at-Tayyib (died 1043), a Nestorian monk who was secretary to Elias I., patriarch of Nisibis, from a Syriac MS. of the Diatessaron which was in the handwriting of one Ibn-‘Ali, who appears to have flourished circ. a.d. 900. Each of the MSS. states, either in the introduction or the colophon, that what it contains is the Diatessaron compiled from the four Gospels by Tatianus (Borg. MS., coloph. Tatianus) ; in each case, however, the text shows signs of many accretions, which appear to be drawn from the ordinary text of the [Arabic] gospels.

We have therefore atthe presenttime three main streams of evidence for the study of the Diatessaron of Tatian, viz., the Arabic version from the Syriac ; the Armenian version of Ephraem’s gospel commentary in Syriac, which has the Diatessaron for its basis ; and the so-called Codex Fuldensis (edited by Ernestus Ranke in 1868), in which the text of the Vulgate has be,en introduced into an arrangement of the Gospel narrative which is that of the Diatessaron. It is upon these, in the main, that the study of the work must be based ; unless, indeed, a Syriac or Greek text should be discovered. The whole matter is still under study, but the opinion of scholars seems to be in favour of a Syriac rather than a Greek original for the work. It has been snggested by Mr Rendel Harris, with no little plausibility, that the Diatessaron shows signs of being based in part upon one or more already existing compilations. On the other hand, it is clear that it depends ultimately upon the four Gospels as we know them, and no others ; and these substantially in their present forms, including, for example, the con- cluding verses of St Mark. As to the history of the Diatessaron itself, it is summed up as follows by Mr Hope W. Hogg : ” It would seem that at a quite early stage the Diatessaron was very widely if not universally read in the Syriac churches, and commented on by scholars as the Gospel ; that in time it fell under the condemnation of some at least of the Church leaders pheodoret, Rabbula] , who made violent efforts to suppress it ; that it could not be suppressed ; that a commentary on it was (perhaps in the 5th century) translated into Armenian ; that it was still discussed by commentators, and new Syriac MSS. of it made in the 9th century, and thought worth the labour of reproduction in Arabic in the beginning of the 11th century ; that MSS. of the Armenian volume

continued to be made down to the very end of the 12th century, and of the Arabic edition down to the 14th century ; but that this long life was secured at the expense of a more or less rapid assimilation of the text to that of the great Syriac Bible, which from the 4th century onwards became more and more ex- clusively used — the Peshitta."

**Authorities. — A. Ciasca. Tatiani evangeliorum harmonics, arabice. Rome, 1888.— H. W. Hogg. The Diatessaron of Tatian, in T. and T. Clark's Ante-Nicene Christian Library, additional volume. Edinburgh, 1897.— J. Hamlyn Hill. Tlie Earliest Life of Christ. Edinburgh, 1894.— Th. Zahn. Forschungen zur Geschichte des neutestamentlichen Kanons, iv. Erlangen, 1891. — J. Rendel Harris. The Diatessaron of Tatian, London, 1890 ; and Fragments of the Commentary of Ephr. Syr. on the Diatessa- ron. London, 1895. (w. E co **

Tatraf ii red (German, Schmecks), a famous spa and summer resort of Hungary, fti the Tatra Mountains, 3330 feet above sea-level, in the midst of wild, romantic scenery. Although the first house was built here in 1797, the place only came into repute about 1870. It consists chiefly of three large establishments and several hotels.

Taunton, a municipal and parliamentary borough and market town, Somersetshire, England, in the Welling-

ton parliamentary division of the county, 45 miles south- south-west of Bristol, on the river Tone and the Great Western railway. A bridge was erected in 1895 across the river, connecting the town proper with its northern part. Vivary Park was laid out in 1896. A recreation ground was opened in 1895, and in 1897 the corporation commenced a scheme for connecting the Parade with Park Street. Population (1881), 16,614 ; (1891), 18,961 ;

(1901), 21,078.

Taunton, a city of Massachusetts, U.S.A., capital of Bristol county, in the south-eastern part of the state, at an altitude of 40 feet. The city has an irregular plan, is divided into eight wards, has a good water-supply by pumping, and is well sewered. It has extensive and varied manufactures ; in 1900 there were 284 establish- ments, with a total capital of $11,737,399, employing 2102 hands, and having a product valued at $12,594,- 814. The principal items of manufacture were cotton goods, value $4,593,466 ; foundry and machine-shop products, $2,636,390. In 1900 the assessed valuation of real and personal property was $19,885,835, the net debt was $1,424,573, and the rate of taxation $18.60 per $1000. Population (1890), 25,448; (1900), 31,036, of whom 9140 were foreign-born and 226 negroes.

Taunus, a wooded,, hilly district in the Prussian province of Hesse-Nassau and the grand-duchy of Hesse- Darmstadt. It lies between the Bhine and the Main on the south and the Lahn on the north, and stretches some 55 miles east and west. But while its southern slopes stand 5 to 10 miles back from the Main, they leave only a very narrow strip of low ground alongside the Rhine, between Biebrich and Bingen ; and after the Bhine turns at Bingen, they overhang it as precipitous crags, many of which are crowned with picturesque feudal ruins. The range or system has an average elevation of 1500 feet, but the individual summits are some 1000 to 1300 feet higher. The loftiest peaks occur in the east, where the imposing cluster of Grosser Feldberg (2890 feet) Kleiner Feldberg (2715 feet), and Altkonig (2620 feet), dominate the Wetterau and the valley of the Main. Above the Bheingau, or the slopes which stretch down to the Bhine between Biebrich and Bingen, the altitude averages 1500 to 1700 feet. The geological core of the system con- sists of primitive argillaceous schists, capped by quartzite and broken through in places by basalt. On the northern side, which sinks on the whole gently towards the Lahn, the grey wacke formation attains a considerable develop- ment. The hills are almost everywhere well wooded, the predominant trees being firs and beeches. The lower slopes are, wherever possible, planted with vineyards, orchards, and chestnut and almond groves. The vineyards of the Bheingau are specially famous, and yield brands of wine — e.g., Johannisberger, Steinberger, Rildesheimer,

Marcobrunner,Hochheimer,Rauenthaler,Assmannshauser, and others — which enjoy the highest reputation amongst the vintages of Germany. The Taunus is also famous for the number and efficacy of its mineral springs, which annually attract thousands of visitors to the celebrated spas of Wiesbaden, Homburg, Ems, Schlangenbad,Schwalbach, Soden, and Nauheim, whilst the waters of Selters and other springs are exported in vast quantity. The sheltered position and warm climate have led also to the establishment of the health resorts of Falkenstein (1875) and Schmitten, and to other places, such as Konigstein, Cronberg, and Oberursel, being much frequented by pleasure-seekers in summer. And the attractions of the climate are supplemented by the natural scenery, as well as by historical associations. Above Falkenstein stand the ruins of the ancestral castle of Kuno, the power-

ful archbishop of Treves ; above Konigstein are the re- mains of the former fortress of that name belonging to the Electors of Mainz, and destroyed by the French in 1796 ; on Altkonig, two concentric fortified lines, 4557 and 2982 feet in circumference, date from ante-Boman times ; the family seats of Eppstein, Katzenelnbogen, and Scharfenstein are famous ; there are also the once cele- brated Cistercian abbey of Eberbach, founded in 1116, and the former pilgrimage resort of Kiedrich. Eltville, at one time the chief town of the Rheingau, and frequently the residence, in the 14th and 15th centuries, of the archbishops of Mainz, is associated with Gutenberg and the earliest years of the art of printing. But perhaps the most interesting of the historical memories of this region are the traces of the ancient Eoman palisaded moat, or fortified boundary of the empire (limes), which stretched from the Rhine at Bheinbrohl (below Coblenz) along the summit of the Taunus to the Main at Miltenberg, and was indeed carried on to the Danube. On the southern or Boman side this fortified line was backed by several castles, one of which, the Saalburg, survives in part, and, after being restored to its original appearance, was in 1901 converted into a national (German) museum, one of the most instructive historical memorials of ancient Boman life to be found north of the Alps. The original edifice, or rather edifices, for there seem to have been at least three successive forts built on the same site, were con- structed in the 1st and 2nd centuries of our era. In this same region, though 40 miles to

the west of the Saalburg (which crowns the crest of the Taunus, 4 miles north-west of Homburg), there is a modern national monument, the colossal figure of Germania, which stands on a bold spur of the Taunus 740 feet above the Bhine. It was erected in 1883 to commemorate the war of 1870-71 and the re-creation of the German empire in the latter year. The steep crags of the western end of the Taunus, where they abut upon the Bhine, are rich in the romantic associations of the great river. Here are the rock of the siren Lurlei or Lorelei ; the old castles of Stahleck and Pfalz, which belonged to the Counts Palatine of the Rhine ; and the quaint mediae- val towns of Kaub and Sankt Goarshausen. Yet an- other, though a sorrowful, association clings to the Taunus, in Schloss Friedrichshof, at the foot of the Feldberg and Altkonig, immediately north of Cronberg, built in 1889-97 for the Empress Frederick, and the place where she died in 1901. In addition to Frank- fort, Bockenheim, Hochst, and Biebrich are centres of manufacturing industry.

Tail rid a, a government of South Russia, includ- ing the peninsula of Crimea and a tract of the main- land. It has an area of 24,540 square miles, of which 6990 square miles belong to Crimea. This peninsula continues to afford afavourite fieldfor geological research. Its south-eastern coast is occupied by mountains, while the remainder consists of a plateau of dry prairie land (steppe), which attains its highest level of about 700 feet at the north-western foot of the mountains, and gently slopes towards the north-west. A secondary plateau, Eupatoria Plateau, shoots off to the western extremity of the peninsula. The mountains which fringe the south- east coast consist of several parallel chains separated by longitudinal valleys. The main chain begins, in the south, at Cape Fiolent, where the cliffs rise sheer from the sea for from 2000 to 2500 feet. Farther eastwards the range slightly retreats from the coast inland, its highest summit, Tchatyr-dagh, lying 8 miles from the sea.. The main range has on its summit a succession of flat surfaces (yailas), which might well be compared to the Alpine meadows but for their much poorer vegetation.

Several mountain passes (bogaz) intersect these plateaux, but only six of them are available for carriage roads. The highest summits of the main range, rising from 4000 feet to 5000 feet, are found in its middle section, the principal peaks being Tchatyr-dagh, or Ekliz-Burun (5005 feet), Eoman-hosh (5061 feet), Kemaligherek (5012 feet), and Western Karadagh (3731 feet). Geologically the main range consists of clay slates — very capriciously bent in all directions, but having a general dip towards north-west — intersected by veins of marble and quartz, and covered with sandstones, conglomerates, and lime- stones. They belong to the Titanic division of the Jurassic age, "which is intermediate between Jurassic and Chalk, and masses of trachitic and crystalline rocks protrude from beneath them. The second chain consists of conglomerates, sandstones, marls, and limestones, belonging to the Chalk, also dipping north-west, and falling towards the south-east in steep crags, in which thousands of small caverns probably inhabited in pre- historic times by Tauro-Scythians, are excavated. The Chalk deposits are covered with the oldest Tertiary num- mulitic sandstones. The highest summits of this second chain rise from 1550 to 1900 feet. A valley from 10 to 13 miles wide separates it from the main chain, and several rivers pierce it in delightfully picturesque gorges. A second valley 2 or 3 miles wide, which is followed by the railway from Simferopol to Sebastopol, separates the second chain from a third, which is only from 500 to 850 feet high, and consists of Middle Tertiary clays and sand- stones belonging .to the Mediterranean and Sarmatic divisions, which also dip north-westwards, but only by three or four degrees. This range is limited to the south- western part of the peninsula. A fourth range composed of younger Tertiary deposits may be traced in the southern parts of Crimea. The peninsula is badly watered on both the south-east and the north-west slopes of the mountains. The short rivers of the former carry considerable quanti- ties of water, but they dry up in the summer. In the steppes, indeed, which cover the largest portion of the peninsula, water can only be obtained from wells, which have to be dug from 200 to 280- feet deep ; but artesian wells have begun to be made, and there are now several dozens of them, supplying large quantities of water. The character of

the climate can best be judged by com- paring the following observations taken at three different stations : — At Melitopol, in the steppe region, the average temperature for the year is 48° F., for January 20°, and for July 74° ; at Simferopol, in the mountain region, the average temperature for the year is 50° F., for January 31°, and for July 70° ; on the south coast, at Yalta, the average temperature for the year is 56° F , for January 39°, and for July 75°. As a rule the thermometer seldom falls on the south coast below 17 or 20 degrees. The yearly rainfall is small everywhere, being on an average only 13-8 inches in the steppes, 17-5 inches at Simferopol, and 18-8 inches at Yalta. It varies greatly, however, from year to year, so that Simferopol experiences such extremes as 7-5 inches and 26-4 inches. The vege- tation widely differs, of course, in the steppe region and on the south coast. In the steppe region the prairies are covered in early spring with a great variety of grasses and Liliacese, growing very thickly, but in July and August the prairies are so parched by the sun that everything but the common desert plants die off, while the air is filled with clouds of dust; parts of the steppes, too, are im- pregnated with salt, and are covered only with the usual Salsolaceee and Artemisise. The mountains, on the con- trary, are covered with beautiful forests of beech, oak, “and elm, mixed with the northern fir and thickly inter- woven with the ivy and the vine. As to the flora of the southern coast, it has a great number of acclimatized

plants, and bears a great resemblance to the vegetation of Tuscany.

The population of the peninsula in 1897 was only 853,900 (domiciled only), of whom nearly 150,000 lived in towns. Though large numbers of Tatars left Crimea after the war, the race still forms the main element in the population, but there are also numbers of Germans, Bulgarians, Czechs, Esthonians, Greeks, Jews — who have acquired the habits of the Tatars — Karaites, and Tziganes. The prairies are chiefly owned by private persons, the descendants of the Tatar beys. Cattle-breeding, which was formerly the chief occupation of the people, is on the decline ; large areas have been and are being turned into fields, and there are now in Crimea only 66,000 horses, 150,000 cattle, and less than 1,000,000 sheep. No less than 1,080,000 acres are now under crops in

Crimea, chiefly wheat and barley. There are also numerous plantations of tobacco, and gardening is rapidly spreading, its returns being estimated in 1899 at 2,000,000 roubles. Nearly 19,000 acresvare under vineyards, and 3| million gallons of wine are obtained annually. Salt is extracted to the amount of nearly 200,000 tons per annum. Industries are represented by ship- building, flour-mills, iron works, jam and pickle factories, soap works, and tanneries. The Tatar population excels in a great variety of domestic industries, and especially in the working of leather, wool, and metal.

The mainland part of Taurida consists of prairies, less than 150 feet high, and sometimes sandy and waterless in the south-west, and from 150 to 400 feet high in the north-east. It had in 1897, 904,673 inhabitants, chiefly Great and Little Russians, but includ- ing nearly 50,000 Germans and 25,000 Bulgarians and Jews. The chief occupation of the people is agriculture, and every available patch of land has been brought under the plough. The increase in the area under all crops in the ten years 1889-99 was fully 39 per cent, for the whole province, which had in 1900 no less than 6,755,200 acres under cereal crops alone. The average annual yield in 1895-99 for the whole of the province was, rye 2,178,000 cwt., wheat 9,698,000 cwt., oats 1,431,000 cwt., barley 8,749,000 cwt. — all cereals, 25,535,000 cwt. ; also 2,053,000 cwt. of potatoes. There were further, in 1899, 7680 tobacco plantations, covering over 8150 acres, and 32,300 acres under vineyards (crop over 600,000 cwt.), while gardens covered about 15,500 acres in Crimea alone, the average annual export of fruit in 1895-99 being 300,000 cwt. Cattle-breeding is extensively engaged in, there being in 1897 in the whole province 341,000 horses, 414,000 horned cattle, 2,226,000 sheep, aud 172,000 swine. Salt, of which about 210,000 tons are obtained annually, is the only mineral raised in the province, but the iron industry, and especially the manu- facture of agricultural machinery, has greatly developed, Berdyansk, on the Sea of Azov, being now perhaps the first town in Europe for agricultural machinery. The export trade is considerable, the chief ports being Sebastopol, Eupatoria, Theodosia, and Yalta on the Black Sea, and Azov and Berd- yansk on the Sea of Azov. In the foreign trade all ports were visited in 1899 by 541 ships, the exports amounting to 596,500 tons and the

imports to 71,000 tons ; but in the coasting trade they were visited in 1898 by 10,360 ships of 5,935,480 tons. The traffic on the railways is also very great, the yearly imports by railway being 822,000 tons, and the exports 677,000 tons. The government is divided into eight districts, the chief towns of which are Simferopol (48,821), which is also the capital of the government; Eupatoria (17,915), and Theodosia (27,238), in Crimea; and Aleshki (9119), Berdyansk (27,279), Melitopol (15,120), Perekop (5285), and Yalta (13,269), inland. Sebastopol and Kerch-Yenikale are separate townships (gradonachalstvo) under military governors ; and there are several villages, such as Bolshoy, Tokmak, Andreevka, and Mikhailovka, with a population of over 7000. (p. a. K.)

Taus (Czech, Domazlice), the chief town of a govern- ment district of Bohemia, on the border of the Bohemian Forest, 29 miles south-west of Pilsen. The manufactures comprise ribbons, hosiery, machinery, sugar, pottery, glass and mirrors, beer, &c, and there is some trade in corn and timber. Taus was the scene of a Hussite victory on the 14th August 1431, and some interesting MSS. of that period are preserved in the Eathhaus. Population (1890), 7703 ; (1900), 7555, chiefly Czech. ,

Tavistock, ancient parish, market town, and rail- way station, Devonshire, England, in the Tavistock parlia- mentary division of the county, ISmiles north of Plymouth, in the valley of the Tavy. The copper-mining industry is in a depressed condition, but there is a trade in arsenic.

which is extracted from the copper ore. A cottage hos- pital and dispensary was erected at Spring Hill in 1896. Population (1891), 5043; (1901), 4728.

Tavoy, a district in the Tenasserim division of Lower Burma, lying between the Bay of Bengal and Siam. Population (1881), 84,988; (1891), 94,92J; (1901), 109,131. In 1891 92,556 were Buddhists and Jains, 796

Mahommedans, 326 Hindus, 94 aborigines (mostly Karens), and 1149 Christians, of whom 1039 were natives, chiefly Karens.

Area, 5308 square miles; 303 villages in 1898-99, paying a revenue of Ks.306,673. The total acreage of the district is 3,397,120 acres, and of this 358,400 are under forests, 1,876,035 are uncultivable, 1,044,612 are available for cultivation, and 111,285 were cultivated in 1898-99. There were 6788 acres of fallow. The rainfall in 1898-99 was 197-26 inches. The great bulk of the cultivation is rice, but there are many orchards. The town of Tavoy, standing on the river of that name, had a population of 15,099 in 1891. A considerable amount of coasting trade is carried on with the other parts of Burma and the Straits Settlements.

Taxation is that part of the revenue of a state which is obtained by compulsory dues and charges upon its subjects. The state may have revenue from property of its own. In past times one of the principal sources of the revenue of the sovereign was in fact property of some sort, of which the Crown lands in Great Britain, still administered by the Government, are a remnant. In other countries, even at the present time, there is a large

» public domain yielding revenue. Local authorities also largely own property from which a revenue is obtained. But as a rule, and in spite of what has often been the practice in the past, and of exceptions which may still exist in some countries, a Government obtains the money required for its expenses by means of taxation. Some of the apparent exceptions, moreover, appear to be only exceptions in name. It is contended, for instance, that the revenue from land obtained by the Government of India is in reality of the nature of a land rent — a species of property owned by the Government. But the fact of a Government levying so general a charge may be held ipso facto to convert the charge into a tax, having much the same economic effects and consequences as a tax. When, moreover, a state receives a revenue from property, some of the economic consequences may be the same as if it received the money by means of a tax. In both cases there is absorption and administration by the state of so much of the income of the community, and it may be a question whether the private

ownership of the property would not be more expedient both for the state and its subjects than state ownership is, in spite of the apparent advantage to all concerned in the state getting so much of its income without the compulsion of a tax.

Tlie Different Kinds of Taxes. — In the economic develop- ment of states taxes have come to be grouped in different ways, according to variations in the method of levying them or the means of enforcing compulsion or other differences. One of the most usual divisions is into direct and indirect taxes. Taxes are distinguished as direct, because they are charged directly upon the tax- payer from whose income they are supposed to be taken. Indirect taxes are those where it is recognized from the beginning that the individual who pays in the first in- stance usually passes on the charge to some one else, who may again pass it on until it finally reaches the subject who bears the burden. The income tax, a direct charge upon all incomes above a certain limit, is the principal type in the United Kingdom of a direct tax. In France there is a group of taxes known by that name — a land tax, a personal and furniture tax, a door and window

tax, and a trade licence tax. In the United States there

are mainly assessments of the capital value of property, usually for state and local purposes only, and not for the central Government. Among the indirect taxes the most important are excise and customs duties (see Excise Revenue) upon articles of general consumption, the principal articles almost everywhere being spirits, beer, and tobacco. Sugar, tea, coffee, and cocoa are also among the articles commonly selected. In essential character there is no difference between excise and customs duties, except that excise duties are levied upon articles of home production, and customs upon articles imported from abroad, or brought into one part of a country or empire from another part; but excise duties on the whole are considered more likely to interfere with trade, in con- sequence of the necessity of supervising the production of the articles affected. Next in importance to excise and customs we have duties levied by means of stamps upon documents (see Stamp Revenues), or by charges at the time of registering deeds to which

registration is necessary for the purpose of being valid. The charge in one case upon the article at a certain stage of its production, and in the other upon a transac- tion, is supposed to be passed on by the first payer to others. With these have been usually classed in the United Kingdom certain licence taxes upon traders, although such licences in Prance are reckoned direct taxes.

This division into direct and indirect is, however, far from logical. To take first the direct taxes. The income tax itself is not, in all cases, really paid to the state directly by the person out of whose income it comes. It is paid, in the first instance, in the case of land or houses, by the occupier, and where the occupier is a tenant it is recovered by him from the owner. In the case of joint stock companies the company pays the state, and deducts the amount from the individual owners of stocks and shares out of whose incomes the amount comes. The ultimate payer in these cases is no doubt reached without delay or many steps, but the process is not quite direct. It is the same with rates. A householder is assessed as occupier, but he may be "compounded for," and really know nothing of the payment, though it is supposed to come out of his income. In the cage, again, of a long established land tax or rate many questions may arise as to whether the person who is considered to bear the bur- den in the first instance really bears it in the end. It is contended by some that the tax becomes in the nature of a rent-charge upon the property affected, and that the state really acts as landowner in levying the charge just as it does in receiving the rent of Crown lands, and with simi- lar economic incidents and consequences. Thus the direct taxes so called may frequently be no more direct than any others.

As regards indirect taxes, again, there appear to be some cases at least where it is by no means certain that the charge is passed on; stamp duties, for instance, espe- cially where moderate in amount, may have the effect of diminishing pro tanto the profits in business of the person paying them, or the income which he enjoys. Where they are heavy, as, for instance, with the Prench regis- tration duties on the transfer of property, there appears to be little doubt that they constitute a deduction from the price which a seller receives, and thus they are

direct enough. Sometimes also, when a charge upon a com- modity is not of such a figure as to be easily divisible among the ordinary units of retail consumption, so that it can be passed on to a consumer of the articles in the form of an increased price, it may remain fixed upon those who first pay it, at least for a time. This is supposed to have actually happened with the increase of the beer duty in the British budget of 1894 by 6d. per barrel — a

sum which would not when divided by the pints in a barrel amount to the smallest coin in the realm. When the multure tax, a tax upon milling grain, was imposed in Italy many years ago, it was found that no corresponding increase took place in the price of flour and bread. The trade fell into the hands of the millers on a large scale, who paid the tax out of their increased profits from larger business, while the smaller millers were crushed out; so that this was manifestly the case of a tax, so called in- direct, where the whole burden really fell on those who paid the charge in the first instance, and who in theory were supposed to pass it on to others. Even in the case of indirect taxes, therefore, there are important exceptions to the rule that they are indirect.

The division of taxes into direct and indirect is thus based on no real intrinsic difference. It is a classification for convenience' sake, adopted upon a rough observation of conspicuous, or apparently conspicuous, differences in the mode of levying taxes, and nothing more. The divi- sion, nevertheless, cannot be passed over without mention, as it is not only a common one in economic writing, but it figures largely in budget statements, financial accounts, and finance ministers' speeches — especially in the United Kingdom and France. In the United Kingdom the distinction has been made familiar by free-trade discus- sions. Direct taxation in the shape of income tax was substituted for indirect taxation previously levied, in order to relieve trade from the shackles of

duties and charges which had become all-embracing. In France the direct taxes above referred to are described officially as direct, having been originally, there is little doubt, the main sources of Government income ; and there is equally an official designation of certain heads of revenue as ” con- tributions et taxes indirectes.” Quite lately in budget debates in England there has been much comparison of the amounts yielded at different times by direct and indirect taxes respectively.

Other general classifications of taxes have also been attempted, as, for instance, taxes upon real property, and taxes upon personal property, and so on. Classification is indeed only too easy. Applying a characteristic com- mon to some taxes, we can make a group of them, and set them against a»group of all the other taxes lumped together. Such classifications are, however, uninstruc- tive, and it has been found practically necessary in financial writing to take the principal taxes by name, or by such a general grouping as that of import or stamp duties, and then describe their nature, character- istics, and incidence. In this way each country has a grouping of its own, though there is a common likeness, and the experience and practice of one country assist the financial study of another. As Adam Smith re- marks, there is nothing in which Governments have been so ready to learn of one another as in the matter of new taxes.

Descriptions of Taxes. — Following the practice of authors on finance, we may give a short account of the principal taxes in the United Kingdom, with references in passing to points of comparison or contrast with the taxes of other countries.

The income tax (g.v.) for many years has been the most prominent, and latterly it has been the most pro- ductive, single tax. At the war rate of Is. 2d. per £, which was fixed in 1901, the annual yield in a complete year is the very large sum of £35,000,000, or about one- fourth of the total revenue raised by the Imperial Govern- ment. Its technical name is the Property and Income Tax, but it is essentially a charge upon all incomes or profits, whether arising from property, or from the re- muneration of personal services, or from annuities, income being applied with the widest possible meaning. As

originally instituted in April 1798, during the great war with France, under the name of a “triplicate assessment,” it was rather a consolidation of various assessed taxes levied upon the luxuries of the rich and upon property, than a wholly new tax. In December of the same year this impost was repealed, and a true income tax of 10 per cent, established on all incomes, over £60, with abatements between £60 and £200. It was intended as a temporary tax for war purposes only, and was repealed in 1802, but was reimposed when the war recommenced in 1803, with the limit of abatement reduced to £150. So odious was it that Parliament in 1815, when the war came to an end, ordered the destruction of the documents relating to it. Its efficiency as an instrument of. producing revenue was, however, so great as to lead to its revival in 1843, when Sir Eobert Peel inaugurated his great free-trade reform and swept away duties on exports, duties on imported raw material, and other imposts hampering the trade of the country. The intention again was that the tax should be temporary, but although the free-trade work was practically completed in the early ‘sixties, and Mr Gladstone went so far as to dissolve Parliament in 1874 with a promise that he would abolish the tax if his party were returned to power, it has become a permanent impost. The reasons are that with the tax at a low rate it has been found much less intolerable than during the war, when it was at the rate of 10 per cent., while the pressure of the tax has also been greatly mitigated by placing very high the minimum income subject to it, and giving abatements upon the lower taxable incomes. These expedients have since been carried much farther, till now the minimum income subject to charge is £160 per annum, as compared with £60 when an income tax was first imposed in 1798, £50 in 1806, and £150 when it was revived in 1843, while abatements are given upon incomes above the minimum and under £700. Since these changes there has been a feeling among public men, and men of business generally, that the tax, with all its drawbacks, if usually kept at a low rate, fulfils a useful function as a revenue reserve for emergencies, on account of the ease with which it can be put up and down without disturbing trade. The tax, nevertheless, at the rate of Is. 2d. per £, again gave rise to loud complaints. As regards this tax at least there is no question of its “directness” in a sense, as it is so contrived that it can hardly be passed on by those who are struck at, though they are not always the

same as those who pay in the first instance, as has already been pointed out. There have been great complaints also of injustice by the possessors of temporary and precarious incomes, who have to pay the same rate of tax as the owners of permanent incomes from property, although these complaints have been diminished to some small extent by the raising of the minimum limit of the income assessed and the increase of the abatements on incomes under £700.

The varieties of income charged being very great, and special claims for consideration having been set up at different times, the result has been the formation of an Income Tax Code, defining the methods and rules for assessing the different classes of profits and income, and prescribing the way in which abatements and exemptions are to be obtained. A leading peculiarity is the avoidance of special inquisition into the aggregate of individual incomes. Although it is called a direct tax, the method of levy, as far as property is concerned, is upon the profits at their source, and not as they are distributed among the receivers. The question of the amount of individual incomes only comes before the authorities when claims for exemption and abatement are made. The character of the tax is accordingly much less odious than it would be if an account of individual incomes were

invariably demanded, as was the case in the United States during the Civil War, when an income tax existed for a short time.

Other taxes grouped with the income tax by the authorities are house duty and land tax, but they are unimportant by comparison. The house duty replaced a window tax and other charges which were formerly not unimportant, especially in the interval between 1815 and 1843, when there was no income tax. It is a charge upon the occupiers of houses, mainly dwelling-houses, according to the amount of rent, the rate (1901) upon dwelling-houses being 9d. per £, and the yield to the state being about £1,750,000 per annum, as compared with £35,000,000 of income tax at Is. 2d. The incidence is probably much the same as that

of the income tax itself, though there are curious questions as to the ultimate incidence as between owners and occupiers of houses. The land tax is quite unimportant, being an ancient tax upon an old assessment which has long be- come obsolete, and it interests economists most of all by the illustration it furnishes of what may be called a rent- charge tax — a tax, that is, which has been so long in exist- ence and so fixed in its basis that it becomes in reality a charge upon the property, and not a direct burden upon the person who pays it, as the income tax is upon the person who pays it or for whom it is paid. In 1897 the basis of the tax was varied, but not in any way to affect the principle pst stated.

The next great group of taxes is that of the excise (q.v.) and customs duties upon commodities. Excise duties are charges upon commodities produced at home on their way to the consumer, and customs duties in the United King- dom, with an exception to be noticed, are charges upon commodities brought into the country from abroad ; and they are of essentially the same nature. Not only so, but excise duties and customs duties are in some cases sup- plementary to each other, like articles being produced at home and imported from abroad, so that for the sake of the revenue they have both to be taxed alike. Of this in the British system spirits are the best instance.

The total yield of customs and excise in the United Kingdom in 1901 was about £67,000,000 (including the duties imposed up to that date), and the amount from the principal articles was as follows : Spirits, £24,000,000 ; beer, £13,500,000; tobacco, &c, £13,000,000; tea, £6,300,000; sugar, £6,300,000; wine, £1,500,000, besides minor amounts from a few other articles. With these should also be included a small export duty of Is. per ton on coal, levied by the machinery of the customs, though its incidence cannot be precisely the same as that of the import duties with which it is classed.

Export duties, it may be observed, are not important in systems of taxation generally, as there are few articles where the charge will not really fall on the wages of labour and profits of capital within the country imposing them ; but opium grown in India is a well-known

excep- tion, and in the West Indies export duties on principal articles of production, in spite of their incidence, have been found a convenient source of revenue.

The list of commodities selected for taxation, it will be observed, is very small. This restriction to a few articles is obviously a great advantage to trade, but the number could be added to and still remain a small one. Eew countries have so short a list of import duties at least as that of the United Kingdom, and in most the number is still so large as to be burdensome and harassing to trade, quite apart from the design to give protection, which raises totally different questions from those of revenue.

One consequence of having few articles is that the duty charged is very high ad valorem of the commodities concerned. On spirits the rate is 10s. per gallon, or

rather more, on a commodity which costs no more on the average than Is. to 3s. per gallon to produce. On to- bacco the charge is 3s. 4d. per lb on an article costing no more, when imported, than about 7d. per lb ; on beer 8s. per barrel, costing perhaps not more on the average than 30s. per barrel ; on sugar ^d. per ft> on an article costing Id. to l|d. per lb ; on tea, 6d. per ft on an article cost- ing 8id. per lb ; and so on. Experience has proved that such high charges on a few articles are better on the whole than lower ad valorem charges on many articles ; but there may be doubts whether the charges in some cases are not higher than is quite expedient.

Included with the excise duties are a railway passenger duty and certain licence taxes. The latter are not strictly of the general character above described as charges upon commodities, but they are of too small amount to deserve further discussion in connexion with Imperial finance, though the licences, as we shall see, bulk more largely in the question of taxation for behoof of local authorities.

The next large group of taxes is that of the stamp duties (q.v.), which bring in about £8,000,000 per annum. The principal items are about £1,500,000, derived from a stamp of Id. upon each cheque or receipt for

money paid, and about £5,000,000 derived from a variety of charges on deeds and other instruments, but principally a charge of 10s. per cent, ad valorem on the price paid for the transfer of real property and of stocks and shares, and 5s. per cent, ad valorem on mortgages. Included are various charges on foreign bonds to bearer, to compensate for the advantage they have in escaping the transfer duty on deeds, through their passing on sale or mortgage from hand to hand. The essence of the compulsion in the case of stamp duties is the in- validity of the documents in courts of law unless the stamp is affixed, besides liability to penalties for not affixing the proper stamps. As things go in matters of taxation, English stamp duties are now very low. In France, besides the stamp duties, there are charges on the transfer of real property amounting to about 6 per cent, on the official registration of the transfer which is necessary to make it effective.

We come next, in dealing with taxation, to a group of charges about which the question has been raised as to whether they are, properly speaking, taxes or not. These are the Post Office charges, yielding about £14,000,000 per annum, and the charges for telegraph service, including telephones, yielding £3,500,000. In the classification of the revenue in English budgets and in official returns * these charges are deliberately separated from the above sources of the revenue described as taxes, and classed with "revenue derived from other sources." The correctness of this procedure is questionable. According to old usage, the Post Office was made a state monopoly for the express purpose of levying taxation by means of it. In Prance the postage on letters is still called the taxe des lettres. There is no doubt also, that when postage on letters is charged at the rate of Id. each, where the cost of col- lection and delivery, as in the metropolis, is perhaps not more than a tenth of a penny, it is difficult to distinguish the levy from that of any other tax. The excuse, as a rule, may hold good, that the postal charge is only a reasonable one for services rendered, so that the net income of the Post Office really resembles the profit of a business, but the element of taxation appears undoubtedly to enter. The same remark would apply to the charges for passenger conveyance and goods freight made by Governments which carry on railway business, as in Prussia, India, and the Australian states. In strict theory, where the

1 See Statistical Abstract of the United Kingdom, for 1900, pp. 8, 9.

Government makes a charge, it levies a tax. The reason- ableness of the charge in a given case is to its credit, but the features of monopoly and compulsion on the tax-payer make the charges difficult to distinguish logically from other taxes. The facts are not in dispute, however they may be described. If the Government derived a large income from post office and telegraph service in excess of the amount expended, the whole income would be generally, and not improperly, described as taxation, but consideration, of course, must be given to the difference made by the working of the service generally for the public advantage rather than for purposes of revenue.

Another source of revenue in British imperial finance is that from fees in courts of justice, patent stamps and the like, which is usually classified, like the income of the Post Office, as revenue derived from other sources than taxes. The amount is not large, though unfortunately it is not exactly known, owing to the fees being treated in many cases as extra receipts, and deducted from the ex- penditure of the departments by which they are received, so that this part of the national expenditure is not shown in the accounts at all. The proceeding appears to be quite incorrect, whatever excuse there may be for treat- ing revenue like that of the Post Office as non-tax revenue. Fees levied on proceedings in courts of justice are not only taxes, but taxes of the worst sort. They received the special condemnation of Jeremy Bentham. It is a blot on British finance, therefore, that this part of the taxa- tion is treated as if it were not taxation at all, and largely concealed from view in the way described.

Last of all, we have to notice among the Imperial taxes the. estate (q.v.) or death duties, as they are called — the charges made by Government on the transfer of property from the dead to the living. These have been considerably increased in amount, and the Imperial Government derives in all about £14,000,000 a year from them. Various interesting

questions arise regarding them. Logically they are apparently taxes upon the dead, as they limit the area of bequest, but they are felt by the living who receive the estate as if the burden of taxation fell on them. Practically, when a stranger receives the estate of a deceased man, the proper way of viewing the tax would appear to be that it is a share of property claimed by the state against a stranger who has no right in the matter except that which the state gives him, so that it is hardly a tax at all, as the word is usually understood ; but when the estate is received by the near relatives of the deceased who were subsisting upon it even before his death, it is undoubtedly felt as a tax by them, and operates as a tax. It is even at times a very burdensome tax, falling upon a family when its sources of income are otherwise dimi- nished, while it has the demerit of striking a small number annually instead of being diffused equally. Death duties also raise the question as to their being taxes upon capital. They are of large amount, even at the lowest rates of 1 to 4 per cent, upon the capital charged, and they have to be paid at such times as to cause their being paid out of capital and not out of income, so that their tendency is to diminish the capital available for productive enter- prise. This last feature has not until lately been material in British finance, the income from death duties being less than the amount annually applied to the reduction of the National Debt, while accumulations of capital otherwise were on an enormous scale ; but when the yield is so large as £14,000,000 annually, besides £4,132,000 levied for local authorities (see infra), and the reduction of the debt is suspended, the tendency of death duties to become serious taxes on capital may perhaps require consideration.

Local Taxation. — ~~Besides the above revenue from taxa~~ tion for Imperial purposes, large amounts are raised for

local purposes. The local authorities derive a large income from private property, and from monopolies such as water, gas, electric light, telephones, and tramway ser- vice, which they carry on, and on which the same observa- tions may be made as on the post office and telegraph services; but in addition there is a large amount of taxation, nearly the half of the annual total of local expenditure in the United Kingdom, amounting to about £112,000,000 (1898-99), being probably

so derived. The principal portion of this taxation consists of rates, that is, a direct charge upon the income or rental of real property, such as lands, houses, railways, and mines, but mainly lands and houses. In England, in the year re- ferred to, the amount received from rates was £38,000,000, and in Scotland £4,000,000, while in Ireland, although no distinct separation is made in the accounts be- tween rates and income from gas and water undertak- ings, the amount may be estimated at about £3,000,000, which would give a total of about £45,000,000 as the amount received in the United Kingdom. Kates are thus even a more important factor in taxation than the income tax, and they have given rise to even greater complaints and discussion. Some years ago a special Royal Commission was appointed, under the chairman- ship of Lord Balfour of Burleigh, to consider the problems of the rates, and after making one elaborate report this Commission was still sitting in 1902. The most im- portant questions raised in a scientific view appear to be the misconception of the whole problem of local taxation by Governments. Bates were originally imposed, there is little question, when the intention was to tax all local incomes equally, and this is still the intention in the local taxation of the United States as well as the United Kingdom. Rates were imposed, therefore, on all kinds of property and the income arising from them, just as they are imposed in the United States on the capital of the property itself. But it has been found in practice that for various reasons only real property, which is visibly local and cannot be moved away, can be assessed and made to pay. The owners of real property, however, continually urge that they are unfairly treated, and that other property should be rated. Next there has been misconception, arising from the same cause, in the con- stant attempt to charge the occupier of lands and houses with rates, although the real effect of the rates must be, as a rule, to diminish the value of the property affected like an old-established land-tax, so that rates, properly speaking, do not fall upon either owner or occupier. It would be hard, however, to persuade the mass of occupiers in England that they do not pay the rates, so that the expedient of dividing the rates between owner and occupier, though it cannot affect their real incidence to a substantial extent, constantly finds favour. The con- fusion has been further increased of late years by attempts, as far as towns are concerned, to find a new subject of taxation in what are

called site values, as if rates them- selves were not in reality an appropriation by the stale of a portion of the whole value of the property, subject to which all the other interests exist. It would be im- possible here even to state all the questions that have arisen about rates ; but the essential confusion caused by the neglect of practical men to study the natural history of taxation, as it may be called, must be obvious to every student. The frank recognition that local income taxes are impossible, and that taxation on property for local purposes can only be applied to real property, where it becomes, usually or frequently, in the nature of a rent- charge, would have saved the legislature and the public an infinity of laborious discussion.

Other taxes for local purposes comprise dues and tolls, such as harbour dues, where the money is required for

such a definite purpose as a harbour, maintained at the expense of the traffic accommodated. Here again the question arises as to whether the tax is a mere compul- sory charge or payment for a service rendered. Such tolls and dues in the British system of local taxation amount to about £8,000,000 a year. Among these may perhaps be included some charges in the nature of octroi dues, imposed on commodities entering a town, but not to a great extent. Such dues, in the nature of customs, are very common in Continental cities, and yield large revenue to the local authorities, although they have been very generally, if not quite universally, abolished in the United Kingdom. They have been regarded with much dislike by most economists, and some dues of the kind which existed in London, viz., dues on coal and wine im- ported, and metage dues on grain, were much opposed until their final abolition in recent years. When of moderate amount, however, dues of this sort appear no more objectionable than harbour dues already mentioned, or any other moderate charges on transactions. If of large amount and very numerous, they hamper trade, as all taxation tends to do, but that is no reason for con- demning them specially when the choice lies between them and other forms of taxation.

In addition, we have to notice taxes yielding about £10,000,000 a year, which are levied by the British Gov- ernment and distributed to the local authorities, just as in Prance the Government levies certain direct taxes, or centimes additionnelles, added to its own direct taxes for the benefit of the local authorities. These taxes in the year 1900-01 were as follows : Additional beer and spirit dues (customs and excise), £1,586,000; excise licences, £3,886,000; and share of probate and estate duty, £4,132,000. The remarks already made on the corresponding taxes levied for imperial purposes of course apply to these. Exceptionally, it may be added, as regards the licence taxes, which occupy quite an inferior place in the British system of taxation for imperial purposes, that the question whether some of them are not really direct in their incidence on the first person charged may also be raised, although they are classed with indirect taxes. Many of the licences are those of brewers, distillers, and publicans, and others in trade, and are paid out of the general profits of the busi- ness, so that they can hardly be passed on to the consumers, while other licences are for shooting, for employing car- riages and men-servants, and for similar objects, where the charge on the payer is direct. This may be the place to mention that in other countries, as in France, the licence duties on traders are more general than in the United Kingdom, and are levied on an elaborate scale, according to the size of population of the town where the business is carried on, and the rent paid for the premises. They take the place, to some extent, of the income tax, and are usually classed with the direct taxes.

The peculiarity of taxes which are levied by the imperial authority and distributed among the local authorities for disbursement deserves notice. There must be a general cause for such an arrangement when we find it to have been in existence in France and other countries,- and to have been introduced into the United Kingdom. And this cause no doubt is the need of the local authorities, and the difficulty of letting them have taxes of their own to levy which do not interfere with the imperial monopoly. The arrangement is obviously objectionable on the score of its conducing to local extravagance, as local authori- ties are not likely to be so economical with money that comes to them from the

outside, as it were, as they would be with money directly taken from their own pockets. Local authorities receive other subventions

and aids from the central Government besides the pro- ceeds of these taxes, so that their appropriation for local needs is related to a large question which belongs, how- ever, to the general subject of local government, and not so much to the special subject of taxation.

Incidence of Taxation. — In describing the principal taxes which are employed in the United Kingdom to provide for the national expenditure, observations have necessarily been made upon the incidence, probable or assumed, upon the tax-payer, and on the question how far they may fall equally on the whole community with- out any special incidence being traceable. The incidence of taxation is, however, a special subject for discussion, and is connected with various large issues, such as that of Free Trade, which are of deep interest to economic students.

The starting-point of discussions as to incidence of taxation is a classical passage in Adam ‘ Smith’s Wealth of Nations (book v. chap, ii.), where he lays down the following maxims with regard to taxes in general : 1. The subjects of every state ought to contribute towards the support of the Government, as nearly as possible, in pro- portion to their respective abilities ; that is, in proportion to the revenue which they respectively enjoy under the protection of the state. 2. The tax which each individual is bound to pay ought to be certain and not arbitrary.

3. Every tax ought to be levied at the time or in the manner in which it is most likely to be convenient for the contributor to pay it. [Adam Smith specially praises indirect taxes on commodities under this head, because the consumer ” pays them by little and little as he buys the goods,” and ” it must be his own fault if he ever suffers any considerable in conveniency from such taxes.”]

4. Every tax ought to be so contrived as both to take out and keep out of the pockets of the people as little as possible over and above what it brings into the public treasury of the state. [This last passage is

specially directed against taxes which are expensive to collect, or discourage trade, or offer temptation to smuggling, or subject people to frequent visits of the tax-gatherer.] These maxims have commanded universal assent, as they are obviously the common-sense of the subject.

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It may be observed, however, that while general maxims are easy, the application presents difficulties, and since Adam Smith wrote, and especially in modern times, new questions of some interest have been raised. Adam Smith does not go minutely into the incidence of taxation. Taxes in his view must come out of rent, or profit, or the wages of labour ; and he observes that every tax which falls finally upon one only of the three sorts of revenue ” is necessarily unequal in so far as it does not affect the other two,” and in examining different taxes he disregards as a rule this sort of inequality, and confines his observations “to that inequality which is occasioned by a particular tax falling unequally upon that particular sort of private revenue which is affected by it.” Eecent discussion, however, has gone rather to the point which Adam Smith neglected, that of inequality generally, not merely as between different sorts of income, but as be- tween individuals and classes. The whole burden of taxation, it is maintained, should fall equally upon classes and individuals as far as possible, and, if necessary, taxes falling equally upon special sources of private revenue should be balanced against each other in order to obtain the desired result. Along with this view has arisen the question whether the burden of taxation should not be progressive — the proportion of the sum taken by the state from the tax-payers increasing with the wealth of the individual ; because ability to pay taxes is assumed to be not in proportion to, but to increase with the size of, the income.

What opinion should be held regarding this modern view as to equality in taxation, which differs so widely from anything countenanced by Adam Smith, though his language is echoed in it ? The answer must be that, however sound, the view is for the most part far too ambitious.

One difficulty is caused by the large pro- portion of the taxes in almost every system of taxation, and at any rate in the British system, where the exact incidence is in no way traceable, or where there is no sort of general agreement as to the incidence. Out of about 140 millions of revenue for Imperial purposes above dealt with, the whole of the British revenue from post office and telegraph service, and the whole of the stamp revenue, amounting together to over £25,000,000, are derived from charges whose exact incidence cannot be traced. We have seen, indeed, that doubt is even felt as to whether post office and telegraph charges can be treated as taxes at all. To remove nearly one-fifth of the taxation in question from the calculation manifestly goes far to destroy the possibility of answering the question as to the distribution of the whole burden of taxation. However right one may be as to the four- fifths, the answer to the whole might be quite different if we only knew the facts as to the unknowable remain- der of the four-fifths. Again, a considerable portion, the death duties, is in a category of its own, these duties falling each year not on a particular class of the com- munity, or a particular kind of property, but on a few individuals only, who are in some cases treated severely, while others may have no cause of complaint. In the course of fifty years, it may be said, the balance will be rectified, and the whole class to which the individuals belong, and the property they own, will be visited in turn, so that this taxation should be credited to them in an account of the incidence of taxes generally ; but fifty years is altogether too long a period for such adjustments to be made. Adding the death duties, then, to the post office revenue and stamp revenue, we have a total of about £40,000,000, or nearly a third of the total revenue of about £140,000,000 which cannot be made available for an account showing the incidence of taxation. There remain principally the income tax and one or two minor "direct" taxes yielding just under £40,000,000, and the customs and excise duties yielding about £67,000,000. These, it is said, can be distributed among different classes of tax-payers, because the income tax falls on the owners of incomes of all kinds of property subject to the duty, if their incomes are above a certain limit, while the incidence of customs and excise duties can be ascertained by inquiries as to the consumption of dutiable articles by different classes. Even here, however, formidable diffi- culties are presented. The payers of income

tax, unfor- tunately, are not one class but many, and although the rate of duty is the same, the definition of income seems imperfect, so that many pay on a much larger assess- ment of income than seems fair in comparison with other incomes of nominally the same amount, but really of much greater value when all deductions from the gross sum are fairly reckoned. If all who pay income tax are lumped together and contrasted with those who do not pay, then there is a false division to begin with, and there is so far no means of establishing equality or in- equality. As regards indirect taxes, again, there appears no small difficulty in ascertaining the relative consump- tion of different classes, for the simple reason that in the same class so called the habits of consumption differ widely. It is only by a wide extension of the term ” working man,” for instance, that a class which includes a steady mechanic earning 30s. to £2 a week, who is frequently a total abstainer, and a labourer of inferior capacity and character earning 15s. to 20s. a week, and

who is not a total abstainer, can be spoken of as one, and credit given to the one class for so much taxation on spirits, beer, tobacco, wine, tea, and sugar. There are also geographical differences of a serious kind. On the other hand, the consumption by the income tax paying classes of customs and excise articles must vary indefi- nitely amongst themselves, according to personal habits, size of families, and even their geographical distribution. A further difficulty is furnished by a question as to whether the employer of domestic servants who gives them their board does or does not bear the burden of the duties on the articles which they consume, and which he buys for their use. Theoretically the burden falls on them as consumers. They would have more real wages, it is said, if the price of the articles they con- sume was not raised by taxation. But practically most employers are convinced that they pay the taxes for their servants. To establish, therefore, any fair account of the incidence of indirect taxes on different classes of the community, real classes being distinguished, and not a mere rough grouping into so-called classes of units who are altogether heterogeneous, is probably beyond the skill of man.

All this is evident on a view of imperial taxation alone. In studying equality, moreover, local taxation must be brought into view, with even more impracticable differ- ences of opinion as to the real incidence of the taxation. The moment rates are brought into question it is seen at once how impossible it would be to establish equality among tax-payers, when owners on one side and occupiers on the other claim that they each bear the burden of the same taxes, and economists favour the opinion that much of the burden is in the nature of a rent-charge on the property, and in any case is equally diffused over the whole community.

Adam Smith was thus not altogether badly advised in not carrying his investigations into the equality of taxa- tion farther than he did. There was another reason for his so doing in the heaviness of the burden of taxation at the time he wrote, Governments exacting as much as they could, and being only desirous of finding the easiest means of doing so. It is the very lightness of taxation in recent years which has suggested the possibility of comparing the relative burdens of different classes, which would have seemed quite hopeless with a high taxation and an immense variety of high taxes. The conclusion that with good taxes long established the burden of taxation tends to become equal over the whole community was certainly not ill founded in the circumstances of former times, and may be accepted as true even in the present day.

As to progressive taxation based on the assumption that equality requires a larger proportionate charge upon a big income than on one of a smaller amount, the prac- tical application of the principle, if true, would be im- possible. A great deal more would need to be known than is now known as to the effect of taxes on different classes, and the aggregate amount of different incomes before such a task could be undertaken. If there is a greater proportionate charge already on the larger in- comes, nothing more need be done, and we cannot know that there is not. As to the justice of such a progressive tax, there is a common opinion in its favour among econo- mists, at least to the extent of exempting a certain minimum of subsistence from taxation ; but the pres- ent writer, after accepting this view in early life on the authority of Mill, must now express the greatest doubt. The ideal is equality, and no measure of a minimum of subsistence can really be devised.

Of course there may be single taxes which are progressive in form, such as the licence tax in France, or the income

tax in Great Britain, where progression is established by abatements, or the death duties, where progression by- scale is very common. But such progression may arise in a different way and on different principles from those proposed in defence of a general system of progressive taxation. It may be expedient for balancing taxation and roughly redressing palpable inequalities, and may be adopted for that purpose and no other.

Statistical inquiries as to the incidence of taxation or of particular taxes, though ideal or even approximate equality of a palpable arithmetical kind is practically unattainable by Governments, are not altogether to be put aside. The information thus obtainable may be useful as far as it goes, indicating the directions in which the burden of taxation may press, and forming a guide of some utility when changes of taxation are con- templated. Calculations, for instance, as to what people at the lower levels of the income tax must pay because they happen to be struck by every sort of tax as no other class is, and calculations as to the freedom from taxation of large numbers of other classes whose habits of con- sumption and living enable them to escape the tax- gatherer as the class to which they belong cannot generally do, may help a finance minister in the selection of taxes to be repealed or reduced or tp be newly imposed. With every effort after equality he must fail to satisfy all, but friction may be diminished and the work of carrying on government quietly and steadily facilitated.

Taxes and Free Trade. — Taxation ought not to inter- fere with trade if possible, and the object of Adam Smith's maxims, as we have seen, was largely to erect sign-posts warning finance ministers against the kind of taxes likely to harass traders. There has been much discussion, however, on free trade since Adam Smith's time, and the far-reaching nature of his warnings is not even yet generally understood. There will

probably be general agreement as to the wisdom of avoiding taxes which are uncertain and arbitrary, or which involve fre- quent visits of the tax-gatherer ; but so far from there being a general assent in all countries to his maxims as to the expediency of avoiding taxation which takes more from the tax-payer than what comes into the hands of the Government, this is the very characteristic of duties deliberately imposed by most Governments for the purpose of interfering with trade, and frequently called for even in the United Kingdom with a similar object. In a question of taxation, however, for the pur- pose of meeting the expenses of the Government, all such duties must be ruled out. Taxes, as instruments for advancing the prosperity of a country, are things un- known to the study of ” taxation ” in the proper sense of the word. The only proper object of taxation is to meet the expenses of the state, and when taxes are used primarily or mainly for some other object they can only be justified by political and economic reasons of a different order from anything that has been under discussion.

On this ground, in an account of taxation proper, one might avoid discussing altogether the question of irregu- lar or illegitimate taxation. But the subject is too popu- lar, perhaps, to be passed over altogether. Generally, then, it may be affirmed that taxation in its essential nature cannot be thought of as a good instrument for pro- moting trade and the advancement of a country. So far as it operates at all, it operates by diverting trade from the channels in which it would naturally flow into other channels, and this diversion of industry, so far as it goes, must involve loss. People are induced to do things they would otherwise leave alone, or to leave alone what they would otherwise do, because money is given to them out

of the pockets of the tax-payers to make it worth their while to do so ; but there is palpably loss and not profit in the proceeding. It is urged that in time industries are set up that would not otherwise have existed, and population thereby attracted, this being especially the argument for protective duties in new countries; but even so, there is loss to set against the final gain, if any, and we have not yet had an account in which a balance of loss and gain is attempted. The presumption is that on balance there is loss. In new countries especially the diversion of

industry from its natural development cannot but be mischievous, wrong manufactures and industries being set up at the expense of the whole community, instead of those manufactures and industries which would be most profitable.

There is more to be said for the political argument which induced Adam Smith to favour navigation laws, giving a preference to national shipping in national waters, and for a similar political argument in favour of duties on agricultural produce imported into the country, on the ground, as regards navigation, that the prosperity of the shipping industry in particular was essential to the safety of the country, and on the ground, as regards duties on agricultural produce, that the maintenance of a larger rural population and of a larger agricultural production than would exist under natural conditions of perfect free trade was essential to the welfare of the state and even to its very existence in the possible event of a temporary defeat at sea and a partial blockade of the coasts. This is not the place to discuss such political problems, but there is no question of free trade theory involved if the cost to the community of any such taxation is frankly acknowledged,

Sir John A. Macdonald, the great protectionist Prime Minister of Canada, in a conversation with the present writer in 1882, avowed without hesitation that protec- tionist taxation in Canada was indefensible on economic grounds, and he defended it exclusively for political reasons. Politically one might differ from him, but economists as such must either be silent when political reasons are alleged for taxes that are against fundamental maxims, or must be content to point out the cost of the taxes in order that the communities concerned may decide whether the object in view is obtainable by means of the taxation, and is worth the price.

A great deal has been said as to taxes termed ” coun- tervailing duties,” which are called for in order to defend free trade itself against the protectionist bounties of foreign Governments. Such duties are obviously taxes outside the limits to be considered in a question of taxa- tion proper. They are to be imposed for other purposes than revenue.

As to the claim for them that they will restore free trade conditions by nullifying the foreign bounties which have caused a disturbance of trade, this is really in the nature of a political reason. A country which is so devoted to free trade that it not only practises free trade itself but endeavours to convert others by nullifying their protectionist measures as far as it can, even with immediate loss to itself, departs from the guid- ance of self-interest so far ; but its political action may be justifiable in the long run by other considerations. It seems right to point out, however, that countervailing duties, which are really differential duties of a special kind, are not the good expedient they are supposed to be for nullifying foreign bounties ; that experience of differential duties in former times is altogether against them ; and that they cannot be enforced without certificates of origin and other causes of harassment and confusion in the conduct of trade.

The extent of the interference with trade, in regard to particular taxes, is also a matter of importance. A

particular tax is not necessarily to be condemned because it takes a little more out of the pockets of the people than what the Government receives. Such a defect is a ground for consideration in -weighing a particular tax against others, but it is only one inconvenience among many incidental to all taxes.

Some applications of free trade theory in our times in the matter of import duties have been pedantic — the abolition of the shilling corn duty in 1870 by Mr Lowe being typical of this pedantry, though it is not the only instance. No doubt, in theory, this duty, being levied on the import only and not on the home production of corn, took from the tax-payer a shilling on every quarter of grain produced at home which did not go into the ex- chequer. Per contra the tax was wholly unfelt, a shilling a quarter only affecting an average family of four persons to the extent of three shillings per annum, or about three farthings a week, while it was paid little by little, as Adam Smith explains with

regard to indirect taxes in general. The amount yielded, moreover, was considerable, being equal to a penny on the income tax, which it is desirable to maintain as a reserve of taxation. When we balance advantages and disadvantages, therefore, the re- peal of the corn duty and similar measures would appear to have been sacrifices of revenue without adequate reason.

Rates of Taxation. — Apart from the merits or demerits of particular taxes or groups of taxes, and the questions as to inequality, injury to trade, and the like already discussed, the aggregate of taxation, or rather revenue, of a state may be considered in the most general way, having regard to the proportion appropriated by the State of the total income of the community, and the return made by the state therefor. Here there are the greatest varia- tions. At one time, for instance, during the great wars at the beginning of the 19th century, it was calculated that the British Government expenditure, and the corre- sponding revenue, mostly raised by taxation, were each equal to about one-third of the aggregate of individual incomes— that is, as £90,000,000 to about £270,000,000. Proportions even higher have not been unknown in history, and it is probable that in Russia, India, Egypt, and in other countries at this moment, in time of peace, the proportion may amount to one-fourth or one-fifth. On the other hand, some years ago in the United King- dom, before the high expenditure on army and navy began, and before the South African war, it is probable that with an outlay of less than £100,000,000 by the central Government, the proportion of this outlay to the aggregate income of the people was not higher than one- fourteenth. At the beginning of 1902, when the South African war was closing, the normal peace expenditure, even reckoned at £160,000,000, did not exceed one-tenth, while even peace and war expenditure together in 1901, taking them as close on £200,000,000, did not exceed one- eighth. These varying proportions, however, mean different things economically, and it is of obvious interest that, besides questions as to particular taxes, the broad effect of the whole burden of taxation should also be discussed.

The important points in this connexion appear to be : (1) Very large appropriations can be made by the state from the revenue of its

subjects without permanent injury. The community thereby suffers, but the land and fixed capital remain, and when the high Government expendi- ture ceases individuals at once have the benefit, subject to possible disturbance at the moment of transition, when many persons employed by the state return to private employment. (2) A state which in ordinary times appro- priates one-tenth or some less proportion of aggregate individual incomes is much stronger relatively than a state absorbing one-fourth, one-third, or even ahigher proportion. It has much larger resources, which would be available if

time were given to develop them. (3) When the propor- tion becomes one-tenth or less it is doubtful whether the state can do best for its subjects by making the proportion still lower, that is, by abandoning one tax after another, or whether equal or greater advantage would not be gained by using the revenue for wise purposes under the direction of the state, such as great works of sanitation, or water supply, or public defence. In other words, when taxes are very moderate and the revenue appropriated by the state is a small part only of the aggregate of individual incomes, it seems possible that individuals in a rich country may waste individually resources which the state could apply to very profitable purposes. The state, for instance, could perhaps more usefully engage in some great works, such as establishing reservoirs of water for the use of town populations on a systematic plan, or making a tunnel under one of the channels between Ireland and Great Britain, or a sea-canal across Scotland between the Clyde and the Forth, or purchasing land from Irish landlords and transferring it to tenants, than allow money to fructify or not fructify, as the case may be, in the pockets of individuals. Probably there are no works more beneficial to a community in the long run than those like a tunnel between Ireland and Great Britain, which open an entirely new means of communi- cation of strategical as well as commercial value, but are not likely to pay the individual entrepreneur within a short period of time.

Authorities. — The following short list of authors may be useful to the student : — Adam Smith. Wealth of Nations. — Ricardo – M'Culloch. Principles of Taxation. — Mill. Prin- ciples of Political Economy. — Bastable. Public Finance. — Garnier. Traite de Finances. — Cohn.

System der National- Okonomie. — Wasner. Finanzwissenschaft. — Roscher. System der Finanzwissenschaft. (n. Gn.)

Tayabas, the capital of the province of the same name in Luzon, Philippine Islands, until 1901, when the capital was removed to Lucena. It is picturesquely situated on the slopes of the extinct volcano Banajao, and commands a magnificent view of the surrounding country, which is extremely fertile, and is planted in rice and cocoanuts. Its climate, although cool, is very unhealthy, malignant malarial fevers causing a high death-rate. It has a church and convent of large size and massive con- struction. During the revolt of 1896 a Spanish garrison occupying these buildings was able to withstand a siege of fifty-eight days, at the end of which time it was forced to surrender by lack of food. Tagalog and Bicol are the languages spoken. Population, 15,000.

Taylor, a city of Williamson county, Texas, U.S.A., about 30 miles north-east of Austin, the state capital, on the Missouri, Kansas and Texas, and the International and Great Northern railways, at an altitude of 556 feet. It is in a cotton region, contains gins, oil-mills, and compresses, and handles the cotton crop of the surrounding region. Population (1890), 2584; (1900), 4211, of whom 530 were foreign-born and 1260 negroes.

Taylor, Isaac (1829-1901), English philologist, born at Stanford Rivers, 2nd May 1829, was the eldest son of Isaac Taylor, author of the Natural History of En- thusiasm. He was educated at Trinity College, Cam- bridge, and graduated as a wrangler in 1853. His interests, however, were linguistic rather than mathe- matical, and his earliest publication was a translation from the German of Becker's Charicles. Though of Nonconformist stock, Isaac Taylor joined the Church of England, and in 1857 was ordained to a country curacy. In 1860 he published Tlie Liturgy of the Dissenters, an appeal for the revision of the Book of Common Prayer

” on Protestant lines ” ” as expedient for the material interests of the Church, and as an act of plain justice to the Dissenters.” He was next appointed to a London curacy, and at this time began his studies in local etymology, which he continued at intervals all his life. Words and Places in Etymological Illustration of History, Ethnology, and Geography appeared in 1864. Between 1865 and 1869, when he was in charge of a Bethnal Green parish, these pursuits were laid aside, and he published only T7te Burden of the Poor and the Family Pen, a record of the literary work of his own family, the Taylors of Norwich. In 1869 he became incumbent of a church at Twickenham, and here he continued his philological researches. The result was a volume of Etruscan studies, published in 1874, in which he con- tended powerfully for the Ugrian origin of the Etruscan language. Next year he was presented to the rectory of Settrington, Yorkshire, and began his systematic re- searches into the origin of the alphabet. This led him to the study of runes, of which he suggested an entirely new interpretation, viz., that they were derived from Greek sources. His Greeks and Goths (1879) led to a good deal of controversy, and called attention to the author, who received an honorary degree from Edinburgh. In 1883 appeared his great work Tlie Alphabet, an Account of the Origin and Development of Letters. Taylor points out that alphabetical changes are the result of evolution taking place in accordance with fixed laws. ” Epigraphy and palaeography may claim, no less than philology or biology, to be ranked among the inductive sciences.” He was largely indebted to the Egyptian researches of Bouge, which it has now become necessary to reconsider in the light of discoveries in Crete. In 1885 Taylor became canon of York, and two years later dean. His paper on the Origin of the Aryans, read at the British Association in 1887, was afterwards expanded into a book. In the following winter he visited Egypt, and his letters from there, when collected under the title Leaves from an Egyptian Notebook, aroused considerable controversy from the extremely favourable view he took of the Mahommedan religion. In 1888 three of his essays appeared in the memorial volume of Domesday studies. He also contributed to a good many learned periodicals. A new and revised edition of his great work on the alphabet appeared in 1899. For the last few years of his life

he suffered from ill health, and was laid aside from active work for some time before his death in October 1901. ‘(a. z.)

Tayug, a town near the eastern boundary of the province of Pangasinan, Luzon, Philippine Islands. The Agno river furnishes water for irrigating the low fields in its vicinity. Its inhabitants are agriculturists, and rice is their principal crop. Pangasinan and Ilocano are the languages spoken. Population, 19,000.

Tchad, Lake. See Chad.

Tchebicheff, Pafnutij Lvovitch (1821-1894), Bussian mathematician, was born at Borovsk on 26th May 1821. He was educated at the University of Moscow, and in 1859 became professor of mathematics in the University of St Petersburg, a position from which he retired in 1880. He was chosen a correspondent of the Institute of France in 1860, and succeeded to the high honour of associi itranger in 1874. He was also a foreign member of the Boyal Society of London. After Lobat-chewsky he probably ranks as the most distinguished mathematician Bussia has produced. Among the best known of his papers, and also among the earliest, are several dealing with prime numbers, in one of which he established the existence of limits within which must be comprised the sum of the logarithms of the primes

inferior to a given number. Another question to which he devoted much attention ~~was that of obtaining recti~~ linear motion by linkage. The parallel motion known by his name is a three-bar linkage, which gives a very close approximation to exact rectilinear motion, but in spite of all his efforts he failed to devise one that produced abso- lutely true rectilinear motion. At last, indeed, he came to the conclusion that to do so was impossible, and in that conviction set to work to find a rigorous proof of the impossibility. While he was engaged on this task the desired linkage, which moved the highest admiration of Sylvester, was discovered and exhibited to him by one of his pupils, named Lipkin, who, however, it was after- wards found, had been anticipated by Peaucellier. Tchebicheff further constructed an instrument for draw-ing large circles, and an arithmetical machine with continuous motion. His mathematical writings, which account for some forty entries in the

Royal Society's catalogue of scientific papers, cover a wide range of subjects, such as the theory of probabilities, the theory of consequences, quadratic forms, integration of irra- tional differentials, gearings, the construction of geographical maps, &c. He died at St Petersburg on 8th December 1894.

Tchelyabinsk. See Chelyabinsk.

Tchernaieff, Michael Gregorovitch (1828-

1898), Bussian general, of a noble family, was born on 24th October 1828. Educated at the General Staff Academy at Nikolaieff, he entered the army in 1847. He distinguished himself in the Crimean war, and attained the rank of major-general. After serving as divisional chief of the staff in Poland, he went to Orenburg in 1858 as Aide du Chef de la Ligne du Syr-Daria, and the following year commanded an expedition to support the Kirghiz tribes on the borders of the Sea of Aral against the Khivans. He did duty on the staff of the army of the Caucasus for a time, and returned to Orenburg as chief of the staff. In 1864, in command of a force of 1000 men, he made his famous march across the steppes of , Turkestan .to Chimkent in Khokand, to meet another Bussian column from Semipalatinsk, in eastern Siberia, under Colonel Verefkur, in conjunction with which he successfully stormed Chimkent, and then unsuccessfully attacked Tashkend, 80 miles farther south. Wintering at Chimkent, he captured Tashkend the following year. This was contrary to his instruc- tions, and although he was received in St Petersburg with enthusiasm, and presented with a sword of honour by the emperor, he was not again employed in the military service, and retired from it in July 1874. He bought, and edited with great success, the Buski Mir in Slavonic interests, devoting himself to the Panslavie idea. In the summer of 1876 he was appointed commander-in-chief of the Servian army, but on entering Turkey was driven back by Osman Pasha, who followed him into Servia, defeating him at Saitchar and Yavor in July, and the campaign in Servia proved disastrous. He rashly pro- claimed Milan king of Servia in September, and in October Alexinatz and Deligrad were in the hands of the Turks, and the road open to Belgrade. An armistice was concluded, and Tchernaieff

resigned his command. In 1879 he organized a Bulgarian rising, but was arrested at Adrianople and sent back to Bussia. He succeeded Kaufmann as governor of Turkestan in 1882, but his aggressive policy led to his recall two years later, when he was appointed a member of the Council of War at St Petersburg. In 1886 his opposition to the Central Asian Military railway caused him to lose his seat in the Council. He died on 16th August 1898, at his country seat in the province of Mohileff. (r. h. v.)

Tchimkent. See Chimkent.

Tchorlau, or.CHOBLu, chief town of a sanjak in the vilayet of Rodosto, European Turkey, situated on an eminence on the right bank of a small tributary of the Erghene, about 2 miles from the station on the Constantinople-Adrianople railway, 20 miles north-east of Rodosto. It possesses three mosques and several Christian churches. It has manufactures of woollen cloth (chayak) and native carpets, and exports cereals, oil-cloth, carpets, cattle, poultry, fresh meat, game, fruits, wine, alcohol, hides, and bones. Population, 11,500, of whom about one-half are Greeks, one-third Turks, and the remainder Armenians and Jews.

Tchugueff, a town of Russia, in the government and 33 miles by rail E.S.E. of the town of Kharkoff, on the right bank of Northern Donets. It is a great military camp, and had in 1897 a population of 11,877.

Teaching of the Apostles. — The DidacM, or Teaching of the Apostles, is the most important of the recent recoveries in the region of early Christian literature. It was known to us by name from lists of canonical and extra-canonical books compiled by Euse- bius and other writers. Moreover, it had come to be suspected by several scholars that a lost book, variously entitled The Two Ways or The Judgment of Peter, had been freely used in a number of works, of which mention must

presently be made. In 1882 a critical reconstruc- tion of this book was made by Krawutzky with marvel- lous accuracy, as was shown when in the very next year the Greek bishop Bryennios published The Teaching of the Twelve Apostles from the same manuscript from which he had previously given us the complete form of the Epistle of Clement. The Teaching, as we now have it in the Greek, falls into two marked divisions : (a) a book of moral precepts, opening with the words, ” There are two ways ” ; (&) a manual of church ordinances, linked on to the foregoing by the words, ” Having first said all these things, baptize, &c.” Each of these must be con- sidered separately before we approach the question of the locality and date of the whole book in its present form.

1. The Two Ways. — The author of the Teaching, as we now have it, has modified the original Two Ways by inserting near the beginning a considerable section con- taining, among other matter, passages from the Sermon on the Mount, in which the language of St Matthew’s Gospel is blended with that of St Luke’s. He has also added at the close a few sentences, beginning, ” If thou canst not bear the whole yoke of the Lord, bear what thou canst”; and among minor changes he has introduced a passing reference to “the church.” No part of this matter is to be found in the following documents, which present us in varying degrees of accuracy with the Two Ways : (i.) the Epistle of Barnabas (in which the order of the book has been much broken up, and a good deal has been omitted) ; (ii.) the so-called Apostolic Church Order, a book which presents a parallel to our Teaching, in so far as it consists first of a form of the Two Ways, and secondly of a number of church ordinances (here, how- ever, various sections are ascribed to individual apostles, e.g., ” John said, There are two ways,” &c.) ; (iii.) a discourse of the Egyptian monk Schnudi (d. 451), pre- served in Arabic (see Iselin, Texte u. Unters. 1895) ; (iv.) a Latin version, of which a fragment was published by Gebhardt in 1884, and the whole by Schlecht in 1900. When by the aid of this evidence the Two Ways is restored to us free of glosses, it has the appearance of being a Jewish manual which has been carried over into the use of the Christian Church. The recent recovery of the Latin version is of singular interest, as showing that,

even without the Christian additions and interpolations which our full form of the Teaching presents, it was circulating under the title Doctrina apostolorum.

2. The second part of our Teaching consists of precepts relating to church life; these are couched in the second person plural, whereas the Two Ways used throughout the second person singular. Its chief features only can be noted here. It orders baptism in the threefold name, making a distinction as to waters which has Jewish parallels, and permitting a threefold pouring on the head, if sufficient water for immersion cannot be had. It prescribes a fast before baptism for the baptizer as well as the candidate. Easts are to be kept on Wed- nesday and Friday, not Monday and Thursday, which are the fast days of "the hypocrites," i.e., by a per- version of the Lord's words, the Jews. " Neither pray ye as the hypocrites ; but as the Lord commanded in His Gospel." Then follows the Lord's Prayer, almost exactly as in St Matthew, with a brief doxology — " for Thine is the power and the glory for ever." This is to be said three times a day. Next come three eucharistic prayers, the language of which is clearly marked off from that of the rest of the book, and shows parallels with the diction of St John's Gospel. They • are prob- ably founded on Jewish thanksgivings, and it is of interest to note that a portion of them is prescribed as a grace before meat in (pseudo-) Athanasius ' de Virginitate. A trace of them is found in one of the liturgical prayers of Serapion, bishop of Thmui, in Egypt, but they have left little mark on the liturgies of the Church. As in Ignatius and other early writers, the eucharist is re- garded as producing immortality (ef. " spiritual food and drink and eternal life"). None are to partake of it save those who have been " baptized in the name of the Lord" (an expression which is of interest in a docu- ment which prescribes the threefold formula). The prophets are not to be confined to these forms, but may "give thanks as much as they will." This appears to show that a prophet, if present, would naturally pre- side over the eucharist. Hereupon follows a section upon apostles and prophets. An apostle is to be "re- ceived as the Lord " ; but he must follow the Gospel pre- cepts, stay but one or two days, and take no money, but only bread enough for a day's journey. Here we have that wider use of the term " apostle " to which Light- foot had already

drawn attention. A prophet, on the contrary, may settle if he chooses, and in that case he is to receive tithes and first-fruits: “for they are your high priests.” If he be once approved as a true prophet, his words and acts are not to be criticized ; for this is the sin that shall not be forgiven. The eucharist is to be cele- brated every Lord’s Day, and preceded by confession of sins, “that your sacrifice may be pure . . . for this is that sacrifice which was spoken of by the Lord, In every place and time to offer unto Me a pure sacrifice.” So far we have had no reference to a permanent local ministry ; but we now read, ” Appoint therefore unto yourselves bishops and deacons, worthy of the Lord, men meek and un- covetous, and true and approved; for they also minister unto you the ministration of the prophets and teachers. Therefore despise them not ; for they are your honoured ones, together with the prophets and teachers.” The book closes with exhortations to steadfastness in the last days, and to the coming of ” the world-deceiver ” or Antichrist, which will precede the coming of the Lord.

3. It will now be clear that indications of the locality and date of our present Teaching must be sought for only in the second part, and in the Christian interpolations in the first part. We have no ground for thinking that the second part ever existed independently as a separate book. The whole work was in the hands of the writer of the

seventh book of the Apostolic Constitutions, who embodies almost every sentence of it, interspersing it with pas- sages of Scripture, and modifying its precepts to suit a later age (4th century) ; this writer was also the t inter- polator of the Epistles of Ignatius, and belonged to the Syrian Church. Whether the second part was known to the writer of the Apostolic Church Order is not clear, as his only quotation of it comes from one of the eucharistic prayers. Egypt is the country to which we are chiefly pointed by the quotations and allusions of early writers ; but their references are mostly to the first part, so that we must be careful how we argue from them as to the provenance of the book as a whole ; very little caution has hitherto been exercised in this

matter. Against Egypt has been urged the allusion to “corn upon the mountains ” ; but this occurs in one of the eucharistic prayers, and these are certainly not composed by the writer of the present book. The anti-Jewish tone of the second part suggests the neighbourhood of Jews, from whom the Christians were to be sharply distinguished. This might point to Palestine, but the conditions might also be found in Egypt. All that we can safely say as to locality is that the community here represented seems to have been isolated, and out of touch with the larger centres of Christian life.

This last consideration helps us in discussing the ques- tion of date. For such an isolated community may have preserved primative customs for some time after they had generally disappeared. Certainly the stage of de- velopment is an early one, as is shown, e.g., by the prom- inence of prophets, and the need that was felt for the vindication of the position of the bishops and deacons . (there is no mention at all of presbyters) ; moreover, there is no reference to a canon of Scripture (though the written Gospel is expressly mentioned) or to a creed. On the other hand, the ” apostles ” of the second part are ob- viously not ” the twelve apostles ” of the title ; and the prophets seem in some instances to have proved unworthy of their high position. The ministry of enthusiasm which they represent is about to give way to the ministry of office. Three of the Gospels have clearly been for some time in circulation ; St Matthew’s is used several times, and there are phrases which occur only in St Luke’s, while St John’s Gospel lies behind the eucharis- tic prayers which the writer has embodied in his work. There are no indications of any form of doctrinal heresy as needing rebuke ; the warnings against false teaching are quite general. On the whole, it seems wisest not to place the complete work earlier than a.d. 130, and this judgment has the support of Harnack, who has given special attention to the matter.

A large literature has sprung up round the Teaching since 1884. Harnaek’s edition in Texte u. Tlnters. vol. ii. (1884), is indispensable to the student; and his discussions in AUchristl. Litteratur and Chronologie give clear summaries of his work. Pr C. Taylor in 1886 drew attention to some important parallels in Jewish literature ; his

edition contains an English translation. Prof. Eendel Harris published in 1887 a complete facsimile, and gathered a great store of patristic illustration. Text and transla- tion will also be found in Lightfoot's Apostolic Fathers (ed. min.). Other references to the literature may be found by consulting Har- naek's AUchristl. Litteratur. The relation of the information derived from the Didache (in regard to apostle, prophet, baptism, and eucharist) to other evidence is discussed in the articles so named in the Encyclopedia Biblica. (j. a. e.)

Tea no, a town of the province of Caserta, Cam- pania, Italy, 14 miles north-west of Capua by rail, forming conjointly with Calvi an episcopal see. It stands at the foot of an extinct volcano, Eocca Monfina (3412 feet), and possesses numerous small remains of the ancient Teanum Sidicinum, one of the most important towns of

Campania. The chief institutions are a cathedral, a technical school, and a mineral spring. Population

(1881), 12,993 ; (1900), 14,500.

Technical Education.— The meaning, methods, and purpose of technical education are set forth in the article in vol. xxiii. of the ninth edition of this work. The organization of technical instruction in the United Kingdom is mainly the work of the years from 1890. The experience acquired during this period has been utilized in building up a system of technical education adapted to the different needs of various classes of work- ers, based on the general principles laid down in the article just mentioned, to which the reader is referred. A definition of technical instruction applicable to' the varied teaching of the United Kingdom has been fixed by Act of Parliament. The term includes instruction in science, art, and technology, and also manual training ; and by technology is understood the practical application of different kinds of knowledge to a particular trade, or industry, or employment. The following article will be limited to (1) a short statement of the successive legisla- tive efforts which have led to the organization of tech- nical education in the United Kingdom, and (2) a brief exposition of the changes in the conception of technical education due to the practice and experience of recent years.

1. Since 1890 the progress of technical education has been very much helped by the ” National Association for the Promotion of Technical Education,” which was inaugurated at a meeting held on 1st July /ie*,s/aL_ 1887. The general objects of the Association meats. were, and still are, to promote and watch legis- lation, to spread information, and to discuss and assist in giving effect to the recommendations of Eoyal Commis- sions appointed to inquire into educational methods and organization. To its activity the development of tech- nical education in England has been largely due. The first legislative effort to give effect to the recommenda- tions of Eoyal Commission on Technical Instruction, whose report was published in 1884, was a Bill intro- duced into Parliament in July 1887.. The purpose of this Bill was to enable school boards and local authori- ties to provide out of the rates technical schools, or to contribute to their support. A special provision of the Bill was that a poll might be demanded by fifty ratepay- ers before any action could be taken under the powers it conferred. Technical instruction was so defined as to in- clude subjects aided or sanctioned by the Science and Art Department. The Bill was read a second time on 9th August 1887, but never reached the committee stage. In the following March a new Bill was introduced on be- half of the “National Association.” It empowered school boards to provide technical instruction in schools under their management, and to contribute to the main- tenance of higher technical institutes. The definition of technical instruction was widened so as to include the use of tools, commercial subjects, modern languages, and any subjects sanctioned by the Education and Science and Art Departments jointly. The Bill gave very extensive powers to school boards. It was withdrawn without a second reading, in view of the avowed intention of the Government to deal with the subject. On 17th May 1888 the Government Bill was introduced. It contained sev- eral new features which pointed in the direction of sub- sequent legislation. Whilst school boards were again empowered to provide technical instruction in their own schools, they were also required, under ^888?* certain conditions, to aid in the supply of tech- nical and manual training in voluntary schools. At the same time the control of secondary technical instruction

was placed in the hands of a separate authority, viz., the ” authority empowered to carry out the Public Libraries Acts.” Additional rates, limited in each case to Id. in the £, might be levied. The Bill bristled with difficulties. It aimed at placing voluntary schools, as regards technical instruction, under the control of school boards, but set up a new authority for the control of technical instruction higher than elementary. There was a growing belief, however, that school boards were not the most suitable bodies for the direction or control of technical education, which arose from the difficulty of devising means for securing equal advantages to both classes of elementary schools, and from the general unwillingness to extend school board authority beyond the limits of elementary instruction.

No reference was made to technical education in the Queen’s Speech in opening the Parliamentary session of 1889, but the subject had been fully discussed during the recess. The difficulties in the way of legislation on the lines previously attempted were now clearly understood, and it was recognized that separate and distinct measures would have to be adopted for providing technical instruc- tion in elementary schools and in schools of a higher grade. During the year 1889 three Bills were introduced by private members. Two only of these Bills were con- sidered, the one dealing with elementary education, and enabling school boards to give technical teaching in schools under their management ; the other enabling local authorities to establish or contribute to technical schools and classes. The former Bill was fully discussed, but in the absence of any practical settlement of the voluntary school difficulty, the Government withdrew its support, and the Bill was dropped. About this time the passing of another legislative measure helped very con- siderably towards the solution of the difficulty. The Local Government Bill, which became law in the year 1888, enacted that ” a council shall be established in every administrative county . . . and be entrusted with the management of the administrative and financial business of that county.” A number of new representative bodies , / known as county councils were thus created, with

Govern- powers similar in character to those possessedby meat Act, the old boroughs. To these newly constituted t888m bodies were transferred all business previously

conducted by the quarter sessions. The Act conferred similar powers on certain boroughs, according to their population, which were known as county boroughs. By utilizing these county municipal bodies for educational purposes, the necessity of entrusting technical instruction to school boards was avoided ; and accordingly, on 24th July 1889, the Government introduced into the House of Commons a Bill conferring upon county and county borough councils, and also upon urban sanitary autho- rities, the power to levy a rate, not exceeding Id. in the £, for the purpose of promoting technical and manual instruction in their district. This Bill met with serious opposition from school board authorities and their friends, who resented the limitations it imposed on their educa- tional aspirations ; but the Government was resolved to pass it, and after much obstruction it became law on 19th August 1889, having passed through all its stages in the House of Lords in a single sitting. The Bill marked an epoch in the history of education, being the first legislative enactment dealing with technical instruction in England.

The Act, which, with slight modification, is still opera- tive, provides that : —

The expression, ” Technical Instruction,” shall mean instruction in the principles of science and art applicable to industries, and in the application of special branches of science and art to specific industries or employments. It shall not include teaching the

practice of any trade or industry or employment, but, save as aforesaid, shall include instruction in the branches of science and art with respect to which grants are for the time being made by the Department of Science and Art, and any other form of instruction (including modern languages and commercial and agricultural subjects), which may for the time being be sanctioned by that Department by a minute laid before Parliament, and made on the representation of a local authority

that such a form of instruction is required by the circumstances of its district.

Although at first received with no great favour, the Act has proved useful, and is important as representing the outcome of a number of abortive attempts at legisla- tion, occupying three years, and intended to give practical effect to some of the recommendations of the Royal Com- mission of 1884. The Act definitely settled the question as to the local authority for technical instruction, and decided it against the school board. It contained no provision, however, for the supply of technical instruction to children in either voluntary or board schools, and even expressly excluded from any share in its benefits all scholars receiving instruction in the obligatory or standard subjects. A way was soon found, however, of providing for technical instruction in elementary schools without any fresh Act of Parliament, and the difficulty of recon- ciling the interests of voluntary and board schools, which had impeded previous attempts at legislation, was thus avoided.

Early in the year 1886 the School Board for London, finding that it was unable to expend on technical instruc- tion any part of the school board rate, applied to the City and Guilds of London Institute for school" financial help. The application was favourably Board received, and in the following year a joint- "J?"""" committee was formed, consisting of represen- m^e. tatives of the Board, of the Institute, and of the Drapers' Company. With the funds supplied by the Com- pany and the Institute, the committee were enabled to try some interesting educational experiments. Six centres for workshop instruction were equipped, and children were received into the classes from voluntary and board schools. A scheme of instruction was prepared with the object of bringing into prominence the disciplinary character of the teaching, and of distinguishing it from the rule-of-thumb methods adopted in the workshop of commerce ; and the experience of foreign schools, especially those in France, was utilized. The fears of trade unions lest the action of the school board would have the effect of increasing the number of trade carpenters were minimized, and the real value of manual training as a part of general education was for the first time illustrated. The experiment proved so successful that H.M.

inspectors reported most favour- ably on the usefulness of the teaching, and on the value of the instruction in improving the general intelligence of the pupils, and particularly in rendering them more skil- ful and observant. Indeed, it was found that their pro- gress in ordinary school studies was quickened by the practical training of the shop. As the result of these experiments the ” use of tools ” was recognized, in the Government Code of 1890, as a subject of school instruc- tion on which grants were to be paid, and towards the cost of which the school board rate was applicable. Later, following further experiments by the joint-committee, laundry work and housewifery were included in the curri- culum, and the problem of introducing so-called technical teaching into elementary schools was solved without any special legislation. Since 1890, manual training has formed a part of the elementary school system. The instruction includes the use of wood-working and metal-working tools, but stops short of teaching any particular trade, and is thus differentiated from the teaching given in the municipal schools of Paris. The new Code also

provided for a more rational system of object-lessons and of rudimentary science teaching, encouraging practical exercises and experiments to be worked by the pupils themselves. The joint-committee having completed its work, ceased to exist in 1900.

The Act of 1889 and the Code of 1890 enabled local authorities and school boards to provide out of the rates technical instruction for the working classes. The rate available under the Act was limited to one penny in the pound, and very gradually, and with some hesitation, certain local authorities put the Act in force. The motive power required for promoting technical instruction, other than that in elementary schools, was, however, still wanting, and might have remained so for some time longer if it had not been for the accident that in the following year, during the discussion in Parliament of the question of compensation relating to public-houses, the residue of the beer and spirit duty was found to be unappropriated, and was allocated

to county and county borough councils and made available for the purposes of technical education.

The Local Taxation (Customs and Excise) Act, Taxation wnicn became law on the 18th August 1890, Act, 1890. was “an -A-ct for the distribution and application

of certain duties of customs and excise,” and it provided that the residue of the English share of these duties should be distributed between county and county borough funds, and made applicable “for the purposes of technical education within the meaning of the Technical Instruction Act, 1889.” By the express terms of this Act, this disposition of the residue, which then amounted to £743,000 for England and Wales, was revocable by Parliament, and the allocation of the fund to education was left to the discretion of the local authorities. The grant accordingly was not generally regarded as permanent, and local authorities hesitated to commit themselves to any definite educational schemes. Indeed, it was seriously doubted whether such a windfall was likely to be made a permanent annual contribution from the State to the purposes of technical education. But gradually small sums were provisionally voted in aid of existing schools ; and when the then Chancellor of the Exchequer declared that, if the money were found to be well and carefully expended, no future Chancellor would be able to divert it to any other purpose, local authorities began to consider how the money that had fallen into their hands might be best employed to meet local educational needs. Special committees were ac- cordingly formed, consisting in many cases not only of members of the county or county borough council, but also of other persons versed in educational matters, to Technical w^om the preparation of schemes of instruc- instruc- tion suitable to the several districts was referred. tioo com- xhe committees so constituted, known as tech- mittees. nicaj instruction committees, were established in all parts of the country, and to these bodies was dele- gated, subject to periodic reports to the council, the responsibility of dealing with the moneys at their dis- posal. The technical instruction committees proceeded in nearly all cases to elect as secretary a gentleman of scholarly attainments and educational experience, capable of advising as to the organization of schools and

classes in accordance with the terms of the Act, and the special requirements of the district. The number of such organizing secretaries in England alone is seventy. As a result of the Acts of 1889 and 1890, local educational authorities, altogether distinct from school boards, have come into existence, each with a secretary acting as educational officer for the district. The creation of these educa- tional authorities, with functions, however, limited to technical instruction, marks the most important step in

the organization of .education since the establishment of school boards.

By special minutes of the Science and Art Department, new subjects were from time to time included under the term ” technical,” and the definition of technical education was gradually widened. Among the Cur.ri~ subjects first added to the list were those in- ”” “m’ eluded in the ” programme of technological examinations ” of the City and Guilds of London Institute, and the teaching of technology, as distinct from science, was thus for the first time officially recognized and aided by grants from public funds. Later, commercial subjects and modem languages, the theory and practice of agri- culture, and the arts and crafts underlying various cottage industries were accepted as branches of technical instruc- tion ; and whilst, on the one hand, the definition was so widened as to include nearly all that is comprised in the curriculum of a secondary school, the teaching of certain technological subjects approached so near to trade teaching that the provision excluding “the practice of any trade or industry or employment ” from the teaching sanctioned by the Act appeared likely to be overlooked. Practical instruction in engineering, weaving, printing, photography, plumbing, carpentry, brickwork, bookbind- ing, and other subjects was encouraged by the City and Guilds Institute, acting as a central authority for educa- tion of a, distinctly technological character ; but notwith- standing the continued increase in the number of practical classes in different branches of technology, the teaching of technology as distinct from that of science and art has received no direct support, by means of grants in aid, from the State. Under the new conditions, however, of assessing the Government grant, introduced into the

Directory of 1901-02, instruction in technology received some form of recognition.

The county of London remained for some time behind other counties in utilizing the provisions of the Technical Instruction Act of 1889, by devoting to educa- tional purposes the funds placed at its disposal schemes by the Local Taxation (Customs and Excise) London. Act, 1890. These funds, which in the first in- stance amounted to about £163,000, but now reach a total of nearly £200,000, were wholly employed for a period of two years in relief of the rates. The wants of London were not at first understood ; and it was thought that sufficient funds for educational purposes might be obtained from other sources. A scheme for the utilization of a fairly large income arising from the City parochial charities had been under the consideration of the Charity Com- missioners. It was first published in 1888, and, after some discussion and modification, was sanctioned by Parliament. According to this scheme, a capital sum of about £150,000, supplemented by a like amount ob- tained from the City companies and other sources, was made available for the building of technical and recreative institutions for the poorer classes of the work- ing population of London, similar to the newly organized Polytechnic in Regent Street and the People's Palace in Mile End Road. The scheme created a central gov- erning body for the general supervision of these institu- tions, and placed at its disposal an income of about £50,000 available for educational purposes, which, with the falling-in of leases, was certain to increase. Pro- vision for the endowment of eight polytechnics and of other educational institutions was made in the scheme, and the Goldsmiths' Company undertook to erect and maintain from its corporate funds a ninth. Since then other similar but somewhat smaller institutions have been established.

Before the erection of these new institutions was com- pleted, it was ascertained that the annual income at the

disposal of the trustees for the purposes of maintenance and equipment was altogether inadequate ; and a com- mittee of inquiry having been appointed by the London County Council, an exhaustive report on the educational needs of the metropolis was prepared, which led to the formation of a Technical Education Board, consisting of members of the County Council, who formed the majority of the board, and also of representatives of the City Parochial Trustees, of the City and Guilds Institute, of the School Board, and of other bodies ; and to the board so constituted the council entrusted the spending of the funds available under the Local Taxation Act, 1890. The

board held its first meeting on 28th April 1893. board!1 Since then, with the assistance of its organizing

secretary, the board has arranged a comprehen- sive and varied scheme of scholarships, which, among other benefits, enables children from the elementary schools to continue their education in intermediate schools, and to pass on to the higher technical institutes and universities. It has supplemented by large grants the income of the polytechnic institutions ; it has established or assisted in establishing new trade schools ; it has pro- vided laboratories, and aided in the teaching of practical science in a large number of secondary schools ; it has encouraged the teaching of modern languages and com- mercial subjects ; it has founded a school of economics, which has become a constituent part of the new University of London, and has utilized, in nearly all instances with the best possible results, the large annual income, now amounting to £180,000, allocated by the County Council to technical education.

The close connexion between technical and secondary education was clearly indicated in the comprehensive

definition of the former term given in the Act. with But it soon became manifest that no great

secondary progress could be made in technical education education. uniess farther provision were made for secondary education and some improvement effected in the methods adopted in secondary schools.

The cry of Matthew Arnold for the better organization of secondary education had, so far, met with no adequate response. There was still an insufficient supply of secondary schools, and a complete absence of advice or control by any central authority. The urgency of this need was recognized by the "National Association for the Promotion of Technical Education," which, at a meeting held in July 1889, resolved to alter its title by the addition of the words " and Secondary " after " Technical." This verbal alteration represented a widespread conviction that tech- nical and secondary education are of necessity closely associated, and that future efforts should be directed towards the improvement and organization of secondary education and the union of different grades and branches of education under a single Government department. That the Technical Instruction Act would need to be followed by a Secondary Education Act was generally recognized. Accordingly, after much discussion, the Government in the year 1896 introduced into Parliament a comprehensive measure dealing with education as a whole and embodying the principal recommendation of the Royal Commission on Secondary Education. The Bill was well received, and, if the Government had persevered with it, would have passed into law, and the question would have been settled for a generation. It was wrecked owing to the difficulty of satisfying the aspirations of the smaller boroughs to be constituted as local education authorities. No further action was taken till 1898, when a new Bill was introduced by the Government, creating a Board of Education, and com- bining under one department the functions of the Education Department at Whitehall and of the Science

and Art Department at South Kensington, with certain powers relating to the educational work of the Charity Commissioners. The Bill was fully discussed during the recess, and in a slightly altered form it became law in the early part of the year 1899, and came into operation in April 1900. The Board of Education called into existence by the Act was intended to become a central authority for elementary, secondary, and technological instruction. It is assisted in its work by a consultative committee of educational experts appointed by the president, whose special duty it is to prepare and keep a register of all qualified teachers. As now constituted, the board consists of the secretary, who is

resi3onsible to the president for the administration of both primary and secondary edu- cation, of two principal assistant secretaries, and of subordinate officers. There is an assistant secretary for secondary and another for technological instruction, both under the direction of the principal assistant secretary at the South Kensington branch. With a view of co- ordinating the technological instruction to be carried on by the board with that undertaken by the City and Guilds of London Institute and other bodies, a depart- mental committee was appointed in November 1900 on which those bodies were represented. As a result of the recommendations of this committee, arrangements were made for co-ordinating to some extent the work of the City and Guilds Institute with that of the Board of Education. In the regulations issued in 1902 for assessing the amount of State aid to he given by way of grants to technical schools, it was provided that the whole instruction given in any school, in technology as well as in science and art, should be considered ; formal recognition was given to the certificates issued by the Institute, and the Examination Board of the Institute was strengthened by the addition of four members nominated by the Board of Education. The teaching of science and art, as applied to specific trades and industries, was thus brought under the direct super- vision of the central educational authority.

The foregoing statements refer more particularly to England and Wales. In Scotland and in Ireland the organization of technical instruction has pro- ceeded on different Mnes. A Technical Schools Act, applicable to Scotland only, was passed in 1887. This Act enabled school boards by means of the school funds to provide and maintain technical schools. The Act has proved to be practically inoperative. In Scot- land, however, school boards have been entrusted with much larger powers, and possess greater influence, than in England. Many of the secondary schools of Scotland are under the direction and control of school board authorities. The residue of the beer and spirits duties, under the Local Taxation Act, applicable to Scotland was much less, even relatively to the population, than in England, and was, moreover, divided directly among so many different authorities as to be in most cases of little or no real value for educational purposes. Recently attempts have been made to combine the funds distributed among

different neighbouring authorities, so as to bring them under the control of a single body for the benefit of a larger area. In the year 1896-97 the Education Department of Scot- land was entirely separated from that of England, and there was a consequent transfer of functions and grants from the latter to the former. By the passing of the Local Taxation (Scotland) Act, 1898, the residue grant was relieved of certain charges, and additional funds thus became available for technical education. No grants for science or art instruction are made to Scottish schools from the English Board of Education ; but several of the technical schools avail themselves of the examinations of the board, and also of those of the City and Guilds

of London Institute. Among the equipped technical colleges in Scotland may be mentioned the Heriot- Watt College of Edinburgh, the Glasgow and West of Scotland Technical College, Glasgow, the Eobert Gordon College, Aberdeen, and the Technical College, Dundee. These do not differ in any essential points from corresponding schools in England. The system of instruc- tion is very similar, and among the subjects taught will be found most of those included in the Science and Art Directory and in the programme of the City and Guilds of London Institute. Special attention is given in some of these schools to the teaching of the principles and practice of the different branches of textile manufacture. Manual training forms an important part of the curriculum of primary and secondary schools, and the instructions to inspectors on science teaching issued by the Scottish Education Department show a just recognition by tb^e department of the proper methods to be adopted in the teaching of science as a part of general education. Under the Scottish system, leaving certificates are awarded on the results of examinations held at the close of the ordi- nary school course. These examinations cause the mini- mum of interference with the ordinary school work. At the universities of Edinburgh, Glasgow, and Aberdeen the higher technical instruction in such subjects as engi- neering and naval architecture is well developed.

Ireland is still behind Great Britain as regards facili- ties for technical education. Although the Technical Instruction Act (1889) applies to Ireland as well as to England and Wales, very little use has hitherto been made of its provisions. Moreover, the Irish share of the funds available under the Local Taxation Act is definitely allocated to intermediate education. A committee known as the Recess Committee published in 1896 some valuable and important recom- mendations, which led to the passing of the Agriculture and Technical Instruction (Ireland) Act of 1899. The reports of two commissions, one on manual and practical instruction in primary schools, and the other on inter- mediate education, contain suggestions which will give encouragement to the practical teaching of technology and will help to promote a better system of instruction in Irish schools.

The work was successfully commenced under the direc- tion of the newly-constituted Department of Agriculture and Technical Education consisting of an Agricultural Board, a Board of Technical Instruction, a Council of Agriculture, and a Consultative Committee of Education. The department has an endowment of £166,000 a year, which is distributed among the several branches. It has taken over the duties of several other administrative bodies, and the grant for science and art for Ireland, and the grant in aid of technical instruction in Ireland as defined by the Technical Instruction Act of 1889, hith- erto administered from South Kensington, have been transferred to the new department. Among the indus- tries for which the department is now occupied in organ- izing courses of instruction are engineering, textiles (particularly linen manufacture), shipbuilding, agricul- ture, and the fisheries. The operations of the depart- ment extend to all grades of schools, from the Eoyal College of Science, Dublin, organized as a Central Tech- nical College, to the elementary and secondary schools which the department enters for the administration of the science and art grants to the evening technical classes conducted by local authorities. The first annual report of the department, published November 1901, showed that successful efforts had been made to improve science teaching as a part of general education, and to develop on correct lines manual training and technologi- cal instruction.

2. Experience has helped to establish certain princi- ples as applicable to technical education. It is now gen- erally admitted, that whilst the age at which the ordinary school training should cease, and ci””>fse* technical or professional education should com- ‘Za’cepUon mence, must vary for different classes of work- of what ers, the teaching special to any industry or te3hn>^ln employment should supplement, and not form %ho5idbe. part of, general education. The subjects enter- ing into the school curriculum may be, and in certain cases should be, selected with reference to their applica- bility to certain callings, but they should be so taught as to become instrumental in the formation of mental habits and the development of character, the mere knowledge or skill acquired being of secondary importance. In the teaching of science there has been, during the last few years, a marked change in method. Eormerly the use- fulness of the knowledge to be derived from the study of nature gave to physical science its chief claim to a place in the school curriculum, but it is now held that the real value of the study consists in the opportunities it affords of exercising the pupil in accurate observation, and of developing resourcefulness and powers of independent thought and reasoning. Whilst the opinion in favour of postponing as long as circumstances permit all specialized instruction has become of late years more pronounced, there has been a growing tendency, not only in England but also on the Continent and in the United States, to associate technical teaching more closely with workshop practice. The professional or trade teaching, which is supplementary to primary or secondary education, is more practical and less easily distinguishable by the or- dinary observer from the training of the factory or workshop. This tendency is shown in all grades of tech- nical education. The technical institutes established in London and in the large English manufacturing towns, attended mainly by evening students, are provided not only with expensive laboratory apparatus for the teach- ing of applied science, but also with tools and machines for the teaching of technology ; and some of the depart- ments of these schools are equipped so as to resemble a small factory. This is the case in the departments de- voted to the teaching of mechanical and electrical engi- neering, weaving and spinning, watch and clock making, boot and shoe manufacture, and the different branches of the building and printing trades.

So far, however, no attempt has been made to teach the practice of any special trade. The teaching of tech- nology is distinct from trade teaching. In all the technical institutes of London, and in most of those of other towns, none but persons actually engaged in the industry, the technology of which they are desirous of studying, are admitted to the workshop classes. The instruction given in such classes is very different as regards method, and also in its aim sand objects, from the training of apprentices in the factory or trade shop. The tools and appliances are the same, but they are used rather as a help to the teachers in illustrating principles than as a means of enabling the student to acquire that dexterity and skill which constant practice can alone secure. With the general cessation of apprenticeship, as formerly under- stood, it is only in the school workshop that the young artisan has any opportunity of learning the use, and the principles underlying the use, of the instruments and ap- pliances connected with his trade ; and in those industries in which automatic machinery is gradually displacing hand labour he is altogether dependent upon school teaching for any knowledge he may wish to acquire of the processes involved in the particular manufacture, in some small section of which he is exclusively engaged. Modern technological teaching is essentially practical, but

it is nevertheless different in kind from the mechanical and sectional practice of the factory of commerce ; and Relations excePt in some few, mainly artistic, crafts, there with is no entrance to a trade through the door of the

practical school workshop. In other countries, particu- larly in France, the case is different. The school, in many branches of industry, is accepted as a substitute for the shop, and the lad is so trained that he acquires in the school not only a knowledge of the prin- ciples of the trade, but sufficient dexterity and skill to enable him, on leaving school, to take his place among wage-earning operatives. It is only in day schools, in which the pupils spend the greater part of their time in

workshop exercises, that trade teaching can be so devel- oped. There are schools in England in which manual training in wood and metal work is carried beyond the limits of mere educational discipline ; but even in those schools no special trades are taught, and the experience of recent years has only tended to emphasize the prin- ciple, that the education given in the ordinary day schools, whether primary or secondary, should be forma- tive and general, rather than technical or professional.

Owing partly to climatic conditions, and partly to the fact that the hours of labour are somewhat shorter in England than abroad, evening schools of technology are likely to occupy a permanent place in the English system of technical education. In these schools all grades of workmen will continue to receive their special supple- • mentary instruction ; and it is from among the workmen so trained that foremen and works managers will gener- ally be selected. Some intermediate teaching, however, is necessary between that of the elementary school and the technical class as a preparation for technological in- struction. A knowledge of workshop arithmetic and geometrical drawing is indispensable, and it is in the evening continuation classes that such knowledge may be best acquired. These classes therefore supply the teach- ing which may be regarded as the connecting link between elementary and technological instruction.

By means of scholarships a large number of children from the elementary schools are now enabled to continue and complete their general education in day schools of a higher grade. Nearly every county has its scheme of scholarships, providing facilities for the further education of children who show special abilities and aptitudes. These scholarships are in many cases awarded on the results of examinations conducted by the Joint Scholar- ships Board, which consists of representatives of local educational authorities, of the associations of head- masters and headmistresses, of the universities, and other bodies. Pupils from the higher-grade schools enter industrial life at a later age than those from the elemen- tary schools, and, by reason of the more advanced in- struction they have received, are at once qualified to enter classes in technology. In these schools practical teaching is further

developed, both in the laboratory and workshop, but as a part only of the ordinary school course; and it would be incorrect to describe such schools as technical in the strict sense of the term. The position of these higher-grade schools in the general educational scheme was the subject of an important action (Rex v. Cockerton, 1901) in which it was decided by the law courts that the school board was unable to apply the rates to the support of such schools. They were accordingly withdrawn from the sphere of elemen- tary education, and will in future be treated as schools of a secondary type. The judgment on appeal was con- clusive, that the school board rates can be employed only for the provision of elementary education for children, whether in the day or evening.

As regards secondary schools proper, in their relation to

technical education, it is all important that the curriculum of such schools should be sufficiently varied to afford a sound liberal and preparatory training for the different branches of professional work. At least three types or departments of schools are needed — (a) the classical, (6) the mathematical, and (c) the modern language type; and each of these divisions might contain sub-depart- ments. The first of these varieties would be available for 'the general training of students wishing to enter the legal, theological, or literary professions; the second for those preparing for engineering, manufac- turing, or agricultural pursuits; and the third- would be found best fitted as a preparation for a commercial calling. These schools would correspond to some ex- tent to the three kinds of secondary schools found in Germany, and would be available for students preparing to enter one or other of the faculties of a modern university.

The demand for technical education, which originally led to the formation of the City and Guilds of London Institute, directed attention to the methods of teaching science, drawing, and other subjects, and to the necessity of including science in the curriculum of all grades of schools. The methods of science teaching have been greatly improved. Experimental work has become es- sential, and methods of investigation and research have been applied to the teaching of a number of subjects to which formerly they would have seemed

inapplicable. A close connexion has thus been established between the workshop and the classroom, and practical instruction is now regarded as a necessary part of general education, and as no less disciplinary than the merely literary and oral teaching it has partly superseded. This change in the school curriculum, and in the methods of instruction, has narrowed the true significance of the term ” technical ” as applied to education. By the term ” technical ” as commonly used is now understood “technological” or ” professional,” and whilst technological instruction may supplement either primary or secondary education, it is necessarily distinct from either.

The conviction has been steadily gaining, ground that success in manufacturing industry, in the higher walks of commerce, and in every pursuit requiring technical know- ledge, depends very largely upon the thorough and com- plete training of those who are charged with the control of the different kinds of work in which the army of opera- tives are engaged. Intelligent and highly skilled work- ers are indispensable; but unless they are properly directed by efficient and expert officers they can effect but little. It is undoubtedly due to the careful training of the masters and leaders of industry sample. that the Germans have achieved so large a mea- sure of success in different technical pursuits. The recog- nition of this fact is slowly but surely influencing educational thought and action in Great Britain ; but Ger- many is still far ahead in the facilities afforded for higher education, and in the advantage taken of the facilities that exist. The number of students in the universities of Ger- many exceeds 31,000, whilst in the technical high schools, which are of university rank, there are about 10,000. In England and in Wales there are not more than 13,000 students receiving an equally systematic training ; and if we include Scotland the number does not exceed 18,000. Germany has relaxed none of her former efforts, but has been steadily occupied in the enlargement and improvement of her educational institutions. New schools have been erected, wherever and for whatever purpose they are needed, equipped with every modern appliance for scientific investigation and research. Each professional career has its corresponding high school or university department. The economy of a wise and

liberal expenditure on higher education is a recognized fact in German statecraft.

For those who are intended to occupy the highest posts in industrial life, a sound secondary education, supplemented by appropriate university training, is the best preparation. It is only in the university or tertiary grade of education that specialized or technological training for the higher industrial posts should com- mence. At this stage of education, general and pro- fessional teaching are more closely associated, and the names of the faculties of the new universities in the United Kingdom will in future indicate the several branches of professional work to which the different courses of university study are intended to lead. Of late there has been a marked development of distinctly technical instruction in connexion with the colleges of university rank. The error of restricting university studies to a certain limited range of subjects, which led in Germany to the establishment of technical high schools as institutions distinct from the universities, has been avoided. Engineering, in the broadest sense of the term, has been recognized as a branch of univer- sity education of the same order as medicine or law. Laboratories and workshops have for many years formed part of the equipment of the principal university col- leges. In the statutes of the new University of London a separate faculty is assigned to engineering, and part of the work of the polytechnic institutes is correlated with that of the reconstituted University. In Germany a new Doctorate in Engineering has been created, to be conferred by the professors of the technical high schools. A survey of the field of education shows that whilst the difference between technical and general education is well marked in the primary and secondary stages, it is the function of the university to liberalize professional teaching, and to afford opportunities for specialized study and research in the higher branches of knowledge applica- ble to the practical work of industrial life. (p. m*.)

United States.*— The line between technical education and other forms of advanced training is not so clearly drawn in the United States as in most parts of Europe. There is not in the United States that sharp separation in personnel or in methods between the university, the military school, and the technical school which exists in the United Kingdom, and especially on the European Continent. The schools of

law and medicine in many an American university approach more nearly in their require- ments and their methods of instruction to the technical schools of Europe than to the traditional characteristics of a legal or medical faculty. The American universities include in their programmes courses in applied science which would be regarded in Europe as belonging exclu- sively to a polytechnic institute. Much of the training of engineers and chemical experts has been accomplished in colleges which were established for other purposes, rather than in distinctively technical schools. In this matter West Point set an honourable example. Its courses of instruc- tion in military engineering gradually developed such a high degree of efficiency that they became an admirable means for training civil engineers also. What was true of West Point was equally true at a later date of Annapolis. In like manner the Sheffield Scientific School at Yale, and the Lawrence Scientific School at Harvard; both founded in 1847 as places for the teaching of theory, became by force of circumstances schools of practitioners also. Of a similar character were the School of Mines at Columbia and the scientific schools at Princeton and Dartmouth. The Morrill Act of 1861, for the encourage- ment of colleges of agriculture and the mechanic arts, caused a large number of other institutions whose work

was collegiate rather than technical in its character, especially among the state universities, to establish scientific courses, sometimes of a high degree of merit, in order to secure the income to be obtained by compli- ance with its general provisions. These scientific schools, private or public, are something peculiar to America. They differ from the colleges of England, or the depart- ments of philosophy in the universities of the Continent, in basing their course predominantly on the study of natural science. They differ on the other hand from the technological schools, in teaching theory rather than practice, in reducing shop work to a minimum — in short, in not endeavouring to anticipate the kind of things that the student will need to learn afterwards, but in teaching him the things which he otherwise would not learn at all.

Passing to the more distinctively technical schools of <»the country, which emphasize shop and field work and the more practical side of scientific training, we shall find it convenient to group them under four heads : first, schools of engineering and applied chemistry — technological schools in the old sense; second, schools of agriculture and forestry ; third, schools of the arts of design ; fourth, schools for the teaching of trades.

The earliest, institution of the first group, and for more than a generation the only one of this distinctive character, was the Rensselaer Polytechnic Institute, established at Troy in 1824. The next, and in some respects the most important of all, was the Massachusetts Institute of Technology, established in 1861, but not actually placed in operation until 1865. In all branches of engineering, as well as in metallurgy and lapplied chemistry, and even in biological study, it has maintained a high rank. The Worcester Polytechnic was established at about the same time, and it was a little later that the Packer endowment formed the basis of an excellent technical school at South Bethlehem, Pa., known by the name of Lehigh University. The Stevens Institute of Technology at Hoboken was established in 1871. Among the many other foundations of a later date the Case School of Applied Science at Cleveland, and the Sibley College at Cornell, deserve special mention for the work which they have accomplished ; nor should we omit to name institutes like those of Armour at Chicago, or Carnegie at Pittsburg.

The colleges of agriculture did not develop either so quickly or so independently as the colleges of engineering and applied chemistry. The technical training under this head in most of the states was given by adding special courses to institutions established for other purposes. Perhaps the most important practical effect of these agri- cultural courses has been the establishment of experiment stations, not so much for the training of experts as for giving to the world the results of expert work. Schools of forestry represent a more recent development, in which Cornell took the initiative, and which Yale has carried out to the highest degree of efficiency.

The courses of study in the two groups thus far described are intended to be collegiate in their grade ; that is, those who desire to enter upon these courses are expected to have a knowledge of mathematics and natural science not inferior to that required in the classical colleges, and to present a more or less adequate equiva- lent in modern languages in place of the Greek or Latin requirement. In such circumstances, .these institutions give degrees intended to be in a general way co-ordinate with the bachelorship of arts. In the two following groups there is no such general standard of requirement. In fact, each institution has arranged its demands to suit itself, so that there is no American system of technical education, but only a number of isolated institutions.

Of the schools of design in the United States, some are connected with universities, like the Yale School of the Pine Arts. Especially is this true of the architec- tural courses; for instance, at Cornell, Columbia, and Harvard. Others are connected with academies of de- sign. But a much larger number were established by- private endowment in the various cities, of which the Cooper Union in New York has probably the best-known history and the largest field of usefulness.

The fourth group, of trade schools, may be said to bear the same relation to the high school system of the coun- try that the schools of engineering bear to the colleges or universities. Taking their pupils with comparatively small preliminary requirements, they give a surprisingly good training in the principles necessary for the intelli- gent exercise of various trades, for the simpler arts of design and construction, and for household economy. Most conspicuous in this group is the Pratt Institute of Brooklyn, founded in 1887. In the number of its pupils it equals the very largest universities of the country, and it has shown the utmost activity and success in developing the study of library

management and other lines of work outside of the traditional conception of a trade school. .

The movement to introduce manual training into the American high schools, which has been during the last few years extremely successful, is often regarded as the equivalent of the establishment of a system of technical education on the lower secondary grade. This idea is not justified. By those who have been most successful in its use, manual training is made to be what its name implies — a training for the hand, rather than a prepara- tion for particular lines of industrial activity. In other words, they value it for the education which it gives to the powers of perception and muscular control, rather than for any specific results which it teaches the child to achieve. It is perhaps fair to say that the traditional high school, the manual training school, and the trade school may in the future bear the same relation to one another which is now held by the college, the scientific school, and the institute of technology.

The best summary of the work of various technological schools in America is found in the second volume of monographs on edu- cation in the UDited States, edited by Nicholas Murray Butler for the United States Educational Exhibit at the Paris Exposition of 1900. Especially valuable is the chapter on scientific, technical, and engineering education, by T. C. Mendenhall, president of the Technological Institute, Worcester, Mass. (a. t. h.)

TecucT, chief town of the district of the same name, Rumania, picturesquely situated on the right bank of the river Berlad, 40 miles north-west of Galatz. The neigh- bourhood of Tecuci was the scene of a fierce battle in 1476 between Stephen the Great and the Turks. Popu- lation (1895), 11,000 ; (1900), 13,405.

Teddington, a parish and village in the Uxbridge parliamentary division of Middlesex, England, 12 miles from Hyde Park Corner (London), close to the Thames, with a station on the Kingston line in connexion with the North London and London and South-Western rail- ways. Two bridges were erected in 1889, one for foot passengers only. Since 1894 Teddington has been gov- erned by an urban district

council. The parish church of St Alban's, still incomplete, has already cost nearly £30,000. The church of St Mary's was renovated in 1898. The National Physical Laboratory was opened in Bushey House here in March 1902. Population (1881),

6599; (1891), 10,052; (1901), 14,029.

Tegetthoff, Wilhelm von, Baron (1827-1871), Austrian admiral, son of Lieutenant-Colonel Karl von Tegetthoff, was born at Marburg, in Styria, on 23rd

December 1827. After passing through the naval col- lege at Venice, he first served afloat in 1845, and in 1848 was made an ensign. In 1849 he was present at the blockade of Venice, resulting in its surrender. In 1852 he was promoted to be a lieutenant, and during the Crimean war was employed on a sort of police duty at the Sulina mouth of the Danube, which brought him to the favourable notice of the Archduke Maximilian, who in 1854 had been appointed head of the navy with the style of rear-admiral. After some time in a semi-official scientific expedition in Egypt, Arabia, and the Red Sea down to the island of Socotra, Tegetthoff was promoted to the rank of captain of the third class, and in 1858 he commanded the corvette Erzherzog Friedrich on the coast of Morocco, then in a very disturbed state. The cor- vette returned to Trieste on the imminence of the war with Prance; but during 1859 the French fleet com- manded the Adriatic in vastly superior force, against which the Austrians were powerless. After the peace Tegetthoff made a voyage to Brazil as aide-de-camp to Maximilian, and in 1860-63 commanded a large frigate in the Levant during the disturbances in Syria, and on the coast of Greece or in the Piraeus at the time of the Greek revolution. In the end of 1863 he was sent to the North Sea as commodore in command of two frigates, with which, together with three small Prussian gunboats, he fought an action with the Danish squadron, and though without any decisive success, succeeded in raising the blockade of the mouths of the Elbe and Weser. The Austrian emperor answered Tegetthoff' s telegraphic despatch by another promoting him to be rear-admiral, and conferring on him the Order of the Iron Crown. In 1865 he commanded a small

squadron in the Mediter- ranean, and in the war of 1866 was placed in command of the whole effective force of the Austrian navy. With all his efforts, however, this was markedly inferior to the Italian force opposed to it, and when the two fleets met off Lissa on 20th July, the decisive victory of the Austrians was entirely due to the personal superiority of Tegetthoff and the officers whom he in-great measure had trained. In numbers, in ships, and in armament the Italians were much the more powerful, but they had neither a capable chief nor efficient officers. Tegetthoff was immediately promoted, by telegraph, to the rank of vice-admiral, and among the many decorations conferred on him was one from his former commander, the unfortu- nate Maximilian, at this time emperor of Mexico, whose body was in the following year brought home by Tegetthoff. In March 1868 he was appointed head of the naval sec- tion of the War Office and commander-in-chief of the navy, which offices he held till his death at Vienna, after a very short illness, on 7th April 1871 — in the words of the semi-official notice — "zu friih fur Oesterreich."

(j. K. L.)

Tegucigalpa, capital of the republic of Hon- duras, Central America, situated in 14° 08′ N. and 87° 15′ W., at an altitude of 3200 feet above sea-level, on the eastern bank of the Choluteca river, about 75 miles in a direct line from the Pacific coast. It is the largest and finest city of the republic, with a population of about 18,000. Until 1880 the seat of government of the republic was alternately Comayagua and Tegucigalpa, but since that date the capital has remained in the latter city. It is tolerably well laid out, has some fine public buildings, good waterworks, and other modern improvements. The principal church, called the Parroquia, is, with the exception of the cathedral of Comayagua, the largest and handsomest church in the republic. The city is united to Comaya- guela or Concepcion, on the other bank of the Choluteca,

by a fine bridge. The latter town is administratively a part of Tegucigalpa. There are in the city a university, national institute, colleges, national library, high school for girls, school of arts and manufactures, a- fine national printing office, and other public buildings.

Tehran, or Teheran (the former the true Persian pronunciation, the latter due to Turkish influence), a province of Persia, with capital of same name (which is also the capital of the Persian empire). It pays a yearly revenue of about £100,000, and comprises the districts of Saujbul^gh, Shahri^r, Feshaviyeh, Shimran, Kasran, and Veramin. The first three, situated north-west, west, and south of the city of Tehran, are very fertile, and supply the capital, principally with fruit, but also' with grain. Shimran, the district north of the city, and on the slopes of the Elburz (rising to an elevation of 12,600 feet) has 63 villages (one, Tajrish, the seat of the governor, with a population of over 3000), which are much frequented during the summer months by the inhabitants of the city seeking relief from the great heat. One of the villages, Gulhek or Gulahek, but correctly Kulhek (with a guttural K, and meaning a small, reedy mere), situated 800 feet above the city of Tehran and 6^- miles from it, was given in fief to the British Government by Path Ali Shah about 1830 for the summer quarters of the British Legation. Zer- gendeh, a village adjoining Gulhek, is held in a similar manner by the Russian Government, and the Russian Legation stays there during the summer. Kasran is a hilly district north-east of Tehran, with numerous coal mines (inferior coal of the Jurassic period) and streams abounding with salmon trout. The Veramin district, south-east of Tehran city, has 123 villages, and supplies the city and surrounding districts with wheat, barley, and rice. It is watered by the Ja^jrud river, and is considered one of the most fertile districts of Persia.

Tehran, or Teheran, the capital of Persia, about 70 miles due south of the central point of the southern shore of the Caspian Sea. It is situated on the immense gravel deposit which slopes down, with an average fall of about 115 feet per mile, from the foot of the Elburz, 8 or 9 miles north of the city, and extends for 16 miles to near Shah-Abdul-Azim,

5$- miles south of it. In 1869 the Shah decided upon enlarging the city : the old embattled mud wall, flanked by a number of round towers, was demolished, the dry ditch filled up, and an enceinte, consisting of a ditch and fifty-eight unequal bastions, according to Vauban's first system, was constructed and completed in 1874. The city then took the shape of an irregular octagon, and its circumference (a line drawn through the salient angles of the bastions) measures 19,596 metres, or 12-18 miles. The area within the bastions is about 7$ square miles. There are twelve gates, which are closed from two hours after sunset to half-an-hour before sunrise. According to observations taken in 1895 by British officers in connexion with determining the longitude of Madras, the longitude of Tehran (British Legation in the northern part of the city) is 51° 25′ 2-8″ E. The latitude of the old telegraph office is 35° 41′ 6-83″ N., and its elevation 3810 feet. The northern gates of the city are 282 feet above the southern ones. Tehran has 6-^ miles of tramways (single lines), and is connected with Shah-Abdul-Azim by a single line of railway of one-metre gauge. To the countries mentioned in the ninth edition of this work as being represented at Tehran by legations, Belgium and Italy have since then been added. The water supply is from about thirty underground canals (kanats) led from the slopes of the northern hills, and running 5 to 10 miles at considerable depths below the surface, and would be

ample for the requirements of the population if it could be regularly and equally distributed ; but the supply in the months of October and November is only about one-half of that during March, and much water is lost through open ditches and by leakage. The distribution therefore is irregular : in winter and early spring, when the gardens require very little water from the canals, the supply is too great, and in summer it is too little. It has been calcu- lated that the mean water supply amounts to the enor- mous quantity of 921,000 gallons per hour all the year round, but that, after deducting the quantity wasted in distribution, irrigation of gardens, filling tanks and baths, watering streets, &c, there remain forty-two gallons per head daily during the month of April, seventeen during July, August, and September, and ten during October and November. Even the last quantity would suffice if evenly distributed, but as most of the canals are private property and

independent of Government or municipal control, the distribution is unequal, and it frequently happens that when some parts of the city have water in abundance others have hardly any. Population about 250,000, including 500 Europeans, 4000 Armenians, a like number of Jews, 150 to 200 Zoroastrians, and a military garrison of 5000 to 6000. (a. h.-s.)

Teignmouth, seaport and market-town, Devon- shire, England, in the Ashburton parliamentary division of the county, 14 miles south of Exeter by rail. In 1897 the harbour commissioners commenced improvements to the navigable channel at the entrance to the harbour. In 1901, 1224 vessels entered with 172,924 tons cargo, and 1212 vessels cleared with 171,744 tons. A western tower was added to the church of St Michael's, East Teignmouth, in 1889. Racing and cruising yachts are built here. Population (1881), 8496 ; (1891), 8292 ; (1901), 8636.

Telav, a district town of Russia, Transcaucasia, in the government and 63 miles E.N.E. of the town of Tiflis. It stands at an altitude of 2240 feet. It is a very old town, founded in 893, and until 1797 was the capital of Kahetia, and has several ruins of old forts. In the neighbourhood are the Ikaltoi monastery (6th century), the Shuanty monastery (16th century), and the famous Alaverd church, visited by many pilgrims. Wine is exported. In 1897 its population was 11,810, chiefly Armenians (9000) and Georgians (2000).

Telegony. — Telegony is the name now given to the hypothesis that offspring sometimes inherit characters from a previous mate of their dam. Until recent years the supposed inheritance of characters acquired by a dam from one or more of her former mates was usually designated by breeders " throwing back " ; by physiologists, " infection of the germ," or simply " infection." The doctrine of " in- fection," like the somewhat allied doctrine of " maternal impressions," seems to be alike ancient and widespread. Evidence of the antiquity of the belief in "maternal impres- sions " we have in Jacob placing peeled rods before Laban's cattle to induce them to bring forth " ring-straked speckled and spotted " offspring ; evidence of the antiquity of the " infection " doctrine we have, accbrding to some writers, in the practice amongst

the Israelites of requiring the childless widow to marry her deceased husband's brother, that he might " raise up seed to his brother." Whatever may have been the views of stockowners in the remote past, it is certain that during the Middle Ages the belief in " infection " was common amongst breeders, and that during the last two centuries it met with the general approval of naturalists, English breeders being especially satisfied of the fact that the offspring frequently inherited some of their characters from a former mate of the dam, while both English and Continental naturalists (apparently

without putting the assertions of breeders to the test of experiment) accounted for the "throwing back" by- saying the germ cells of the dam had been directly or indirectly " infected " by a former mate. It is noteworthy that Agassiz, Darwin, Carpenter, and Romanes were all more or less firm believers in the doctrine of infection, and that a few years ago, with the exception of Professor Weismann, all the leading biologists had either subscribed to the telegony doctrine or admitted that " infection of the germ " was well within the bounds of possibilities. Even Professor Weismann did not deny the possi- bility of the offspring throwing back to a previous mate. The widespread belief, he admitted, "may be justifi- able and founded on fact," but he was careful to add that " only the confirmation of the tradition by methodical investigation, in this case by experiment, could raise telegony to the rank of a fact." In assuming this attitude Professor Weismann decidedly differed from Mr Herbert Spencer, who some years ago mentioned that he had evidence "enough to prove the fact of a previous sire asserting his influence on a subsequent progeny."

The importance of determining whether there is such a thing as telegony is sufficiently evident. If a mare or other female animal is liable to be " infected " by her first or by subsequent mates, telegony will rank as a cause of variation, and breeders will be justified in believing (1) that pure-bred females are liable to be " corrupted " when mated with sires of a different breed ; and (2) that inferior or cross-

bred females, if first mated with a high-class sire, will thereafter produce superior offspring, however inferior or cross-bred her subsequent mates. If, on the other hand, ” infection of the germ ” is impossible, telegony will not count as a factor in variation, and breeders will no longer be either justified in regarding mares and other female animals as liable to be ” corrupted ” by ill-assorted unions, or benefited by first having offspring to a high-class, or it may be more vigorous, mate. Though, according to breeders, evidence of telegony has been found in nearly all the different kinds of domestic mammals and birds, most stress has been laid on instances of “infection” in the horse and dog families.

Telegony in the Horse Family. — Beecher at the end of the 17th century pointed out that “when a mare has had a mule by an ass and afterwards a foal by a horse, there are evident marks on the foal of the mother having retained some ideas of her former paramour, the ass.” That mares used in mule breeding are liable to be infected is still widely believed, but irrefragable evidence of the influence of the ass persisting, as Agassiz assumed, is conspicuous by its absence. Darwin says, ” It is worth notice that farmers in south Brazil . . . are convinced that mares which have once borne mules when subsequently put to horses are extremely liable to produce colts striped like a mule ” {Animals and Pbmts, vol. i. p. 436). Baron de Parana, on the other hand, says, “I have many relatives and friends who have large establishments for the rearing of mules, where they obtain from 400 to 1000 mules in a year. In all these establishments, after two or three crossings of the mare and ass, the breeders cause the mare to be put to a horse ; yet a pure-bred foal has never been produced resembling either an ass or a mule.”

The prevalence of the belief in telegony at the present day is largely due to a case of supposed infection reported to the Royal Society in 1820 by Lord Morton. A chest- nut mare, after having a hybrid by a quagga, produced to a black Arabian horse three foals showing a number of stripes — in one more stripes were present than in the quagga hybrid. The more, however, the case so intimately associated with the name of Lord Morton is

considered, the less convincing is the evidence it affords in favour of " infection." Stripes are frequently seen in high-caste Arab horses, and cross-bred colts out of Arab mares sometimes present far more distinct bars across the legs and other zebra-like markings than characterized the subsequent offspring of Lord Morton's seven-eighths Arabian mare. In the absence of control experiments there is therefore no reason for assuming Lord Morton's chestnut mare would have produced less striped offspring had she been mated with the black Arabian before giv- ing birth to a quagga hybrid. To account for the stripes on the subsequent foals, it is only necessary (now that the principles of cross-breeding are better understood) to assume that in the cross-bred chestnut mare there lay latent the characteristics of the Kattiawar or other Indian breeds, in which stripes commonly occur. Dar- win and others having regarded Lord Morton's mare as affording very strong evidence in support of the infec- tion hypothesis, it was considered some years ago desira- ble to repeat Lord Morton's experiment as accurately as possible. The quagga having become extinct, a number of mares were put to a richly striped Burchell zebra, and subsequently bred with Arab, thorough-bred, and cross-bred sires. Other mares were used for control experiments. Thirty mares put to a Burchell zebra produced seventeen hybrids, and subsequently twenty pure-bred foals. The mares used for control experiments, produced ten pure-bred foals. Unlike Lord Morton's quagga hybrids, all the zebra hybrids were richly, and sometimes very distinctly, striped, some of them having far more stripes than their zebra parent. Of the subse- quent foals, three out of Highland mares presented in- distinct markings at birth. But as equally distinct markings occurred on two pure-bred Highland foals out of mares which had never seen a zebra, it was impos- sible to ascribe the stripes on the foals born after zebra hybrids to infection of their respective dams. Further, the subsequent foals afforded no evidence of infection, either in the mane, tail, hoofs, or disposition. Of the pure-bred foals, i.e., the foals by pure-bred sires out of mares which had never been mated with a zebra, two were striped at birth and one acquired stripes later — they were revealed as the foal's coat was shed. Moreover, while the faint markings on the foals born after hybrids completely disappeared with the foals' coat, the stripes on the three pure-bred colts persisted. One of the per-

manently striped colts, a bay, was out of a black Shetland mare by a black Shetland sire, one was by a dun Norwegian pony out of a roan-coloured Arab mare, while the third was by a Norwegian pony out of a half-bred bay Arab mare. It has been asserted by believers in telegony that evidence of infection may appear in the second though not present in the first generation. By way of testing this assump- tion, a bay filly, the half-sister of a richly striped hybrid, was put to a cross-bred Highland pony, and a Highland mare, while nursing her hybrid foal, was put to a colt the half-brother of a hybrid. The result was two fillies which in no single point either suggest a zebra or a zebra- hybrid. Similar results having been obtained with horses and asses, there is no escape from the conclusion that the telegony tradition is not confirmed by such methodical investigations as were suggested some years ago by Pro- fessor Weismann. (See Cossar Ewaet, The Penycuik Experiments, 1899.)

Telegony in Dogs. — Breeders of dogs are, if possible, more thoroughly convinced of the fact of telegony than breeders of horses. Nevertheless, Sir Everett Millais, a recognized authority, has boldly asserted that after nearly thirty years' experience, during which he made all sorts of experiments, he had never seen a case of telegony. Recent experiments support Millais's conclusion. Two of

the purest breeds at the present day are the Scottish deerhound and the Dalmatian (spotted carriage-dog). A deerhound after having seven pups to a Dalmatian was put to a dog of her own breed. The result was five pups, which have grown into handsome hounds without the remotest suggestion of the previous Dalma- tian mate of their dam. A similar result was obtained with a deerhound first mated with a retriever. Many accidental experiments on telegony are made annually with dogs. Two such experiments may be mentioned. A black-brindled Scottish terrier belonging to a famous breed had first a litter of pups to

a curly-haired liver- and-white cocker-spaniel. The pups were spaniel-like in build, and of a brown-and-white colour. Subse- quently this terrier had pups to a black-brindled ter- rier. All the pure-bred pups were typical terriers, and evidence of their dam having escaped infection, is the fact that three of them proved noted prize- winners. The subject of the second undesigned ex- periment was a wire-haired fox-terrier. In this case the first sire was a white Pomeranian, the second a cross-bred Irish terrier. Having had ample opportunity of being "corrupted," the fox-terrier was mated with a prize dog of her own strain. The result was three pups, all in make and markings pure terriers, and one of the three was regarded as an unusually good specimen of the breed.

Experiments with cats, rabbits, mice, with sheep and cattle, with fowls and pigeons, like the experiments with horses and dogs, fail to afford any evidence that offspring inherit any of their characters from previous mates of the dam ; i.e., they entirely fail to prove that a female animal is liable to be so influenced by her first mate that,

however subsequently mated, the offspring will either in structure or disposition give some hint of the previous mate. In considering telegony it should perhaps be mentioned that some breeders not only believe the dam is liable to be "infected" by the sire, but also that the sire may acquire some of the characteristics of his mates. This belief ' seems to be especially prevalent amongst breeders of cattle ; but how, for example, a long-horned Highland bull, used for crossing with black hornless Galloway cows, could subsequently get Galloway-like calves out of pure Highland heifers it is impossible to imagine.

In conclusion, it may be pointed out that it was only natural for breeders and physiologists in bye- gone days to account for some of their results by the " infection " hypothesis. Even now we know surpris- ingly little about the causes of variation, and not many years ago it was frequently asserted that there was no such thing as reversion or throwing back to an ancestor. But even were the laws of heredity and variation better understood, the fact remains that we know little of the origin of the majority of our domestic animals. On the other hand,

from the experi- ments of Mendel and others, we now know that cross-bred animals and plants may present all the characters of one of their pure-bred parents, and we also know that the offspring of what are regarded as pure-bred parents sometimes revert to remote, it may be quite different, ancestors. The better we understand the laws of heredity and variation, and the more we learn of the history of the germ cells, the less need will there be to seek for explanations from telegony and other like doctrines. (j. c. e.)

TELEGRAPHY.

MANY improvements have been effected in the art of electric telegraphy since the article on Tele- graphy was written for the ninth edition of this Encyclo- paedia (see volume xxiii. p. 112). Considerable progress has been made towards an understanding of the nature of the physical operations accompanying the propagation of an electric current along a conductor, and much has been done in making practical applications of electrical dis- coveries in telegraphy. These will be briefly discussed under four headings : (i.) Theory, (ii.) Land Telegraphy, (iii.) Submarine Telegraphy, (iv.) Wireless Telegraphy.

I. Theory.

The theory of the electric telegraph enunciated by W. Thomson (Lord Kelvin) in 1855, which has been of great importance in Atlantic and cable telegraphy gene- rally, has how become merged in a wider theory of which it forms an extreme case. This wider theory is founded upon Maxwell's theory of electromagnetic radiation, and may be accordingly termed the radiational theory. The latest type of electric telegraphy, usually termed " wire- less," which has been developed from Hertz's experi- mental researches, also comes under the wider theory. The principal difficulties are concerning the various functions of wires. The fundamental radiational part is comparatively easy. Electric telegraphy is done by means of electromagnetic waves through the ether differing in no essential respect from radiation from the sun. This in- volves a flux of energy through the ether, travelling at the enormous speed of 30 earth quadrants, or 3xl010 centi- metres per second, which speed will

be denoted here by v. The energy arriving at the earth's surface may be measured by its heating effect, but in transit it is

measured by the product of the density of the energy into its speed, that is, by 2Tu, if 2T is the density. In Maxwell's theory of light it is half electric energy, say TJ=£cE2, half magnetic energy, T=|y/.H2. Here E and H are the intensities of the electric and magnetic forces, and /jl c are etherial constants. It is a general property of elastic waves that, to be transmitted without reflection in transit, the two energies concerned should be equal. In this case, therefore, /xH2=cE2, and E=(/u,/c)*H. The ratio (ju./c)4 is the same as (iv, as may be proved by adjusting the vectors E and H so that the two circuital laws of electromagnetics shall be simultaneously obeyed. To secure this result, E=///uH, and E and H must be per- pendicular to one another and to the direction of propaga- tion. If a watch indicates three o'clock, and the big hand stands for E and the small hand for H, then the flux of energy is straight through the watch from front to back. These properties hold good in all parts of plane waves. It is convenient to think of a slab wave. Let the ether between two parallel planes be the seat of uniform E and uniform H, related as above, and in the plane of the slab. This being the state of things at a given moment, electro- magnetics asserts that the slab of E and H will move through the ether (when stationary) perpendicular to itself at speed v, unchanged, and carrying all its proper- ties with it. It is not known what ft. and c are separately, but ju.cd2=1 connects them. Also the product pv is known in terms of resistance, being an impedance equivalent to 30 ohms ; and cv is the equivalent conductance. The electric displacement is D=cE, and the magnetic induction is B=,uH.

A little later the concrete forms of these equations will be wanted. If a condenser of permittance S has a charge Q

under the voltage V, then Q = SV. This is the concrete form of D = cE for a unit cube, for Q is the total displace- ment through the condenser, and V the line integral of E, which is therefore the voltivity, whilst c, corresponding to S, is the permitivity. The energy of the condenser is |SV2. This is the space integral of |cE2. Similarly, if P is the total induction through a coil of inductance L under the gaussage C, then P = LC. This is the concrete form of B = /aH. So ju. is the inductivity, and H the gaussivity, C being the line integral of H. The energy of the coil is JLC2, which is the space integral of |^H2. It is important to bear in mind these relations of the concrete and the specific, for they appear frequently in telegraphic theory.

There may be any number of slabs of the above kind, separated, or in contact, of any depths and any strengths. But if E = /rwH in all, they will all behave alike, indepen- dently of one another. This is expressed by

E=HvK=f(t-xlv), (1)

where f(t) expresses the state at the plane x = 0. If E and H do not change in direction from one slab to another, the radiation is plane-polarized ; the plane of polariza- tion is the plane of H. But the direction of E (and with it that of H) may vary from slab to slab in any way we like. Then the radiation is circularly, or elliptically, or heterogeneously polarized, the last being, in the average, equivalent to no polarization. In all cases the behaviour of individual slabs is the same. The disturbance is vibratory in solar radiation, but in telegraphy this is not necessary. We may have waves in which E and H do not change at all. It is the progression through the ether that is the wave, not accidental vibration. There is, it may be noted, no change from electric to magnetic energy anywhere in this sort of radiation.

We can make an immediate application to telegraphy. The slab was above considered to extend indefinitely. But let the tubes of displacement be confined between a pair of parallel perfectly-conducting plates upon which they terminate perpendicularly. The tubes of induction •are unchanged. One plate is positively, the other nega- tively, electrified to surface density D. In virtue of the perfect

conductivity, this terminated plane slab will behave exactly like the complete one ; that is, we may send any radiation we like along between the plates, unchanged in transit. This is a rudimentary case of distortionless tele- graphy along a pair of conductors. But the plates need not be infinitely extended, nor need they be flat. They may become a pair of cylinders of any form of section. The three most important cases are : (1) a pair of parallel wires ; (2) a wire suspended parallel to a flat conductor, the earth ; (3) a wire inside a cylinder surrounding it. In all cases the displacement goes from one conductor to the other through the ether between them, leaving one and reaching the other perpendicularly, and its distribution is to be calculated as in two-dimensional electrostatics. In all cases the lines of H cut the lines of E perpendicularly. They therefore make complete circuits round one or other conductor. In all cases E = fivH.

If we consider only a unit tube of flux of energy (a beam) there is no difference from the radiational case first considered. The complications due to the varied distri- butions of E and H in their plane are avoided by express- ing results in terms of the concrete V and C. The line integral of E in any wave plane from one conductor to the other is V, the line integral of H in a circuit of magnetic force is C. Then we have

V = ~LvC = V(l-xlv); (2)

C = Si>V; LSu2=l; JSV2=iLOs. (3)

The additional L and S are the inductance and per-

mittance per unit depth of the wave, or per unit length of the conductors.

The use* of conductors will now be seen partly. They serve to guide a wave along from place to place without loss, and with a limited amount of energy. Without them, the complete plane wave would be required. If not complete, it will spread out over all space. This is, in fact, what occurs with solar radiation. Although the small curvature makes the radiation practically plane waves, yet they are really expanding spherical waves. The energy is conserved, and therefore its density

varies inversely as the square of the distance from the sun's centre, whilst E and H vary inversely as the distance. This is the attenuation.

The transition from plane to spherical waves is shown by the theory of waves along conical conductors. Let there be two coaxial conical conductors with a common apex O. Let the semi-vertical angles be dx and 62. The displacement is to go from the inner cone to the outer symmetrically in spherical sheets centred at O. The induction as usual is to be perpendicular to the dis- placement, therefore in circles round the inner cone. As before, make E = ij.v£L. Then the wave will run along between the cones at speed v, attenuating in transit like solar radiation. We may vary the angles of the two cones as we please. An important case is got by making one angle 61 = 0, the other 6t = \ir ; this gives the case of a flat plane with a vertical wire projecting from it at O, and the waves are hemispherical. The displacement goes from the wire to the plane in quadrantal sectors. This gives " wireless " telegraphy, like that of Lodge and Marconi, though more perfect, having ideal conditions. Signals made at O will be sent out in hemispherical waves quite undistorted, though attenuating as they ex- pand. They are guided by the wire and by the plane representing the surface of the sea. If the wire is of finite length reflected pulses are generated ; the waves sent out then become vibratory, of a frequency and wave length determined by the length of the wire. If the angle of one cone is 6l = 0, and of the other 6„ = tt, we get complete spherical waves upon a wire, generated at O. If the wire is of finite length the terminal reflec- tions make it become a sort of Hertzian vibrator.

Comparing the case of the cylindrical wires with the so-called "wireless" case, though there is little difference in theory, there is great difference in practice. Using wires, we can send radiation anywhere we like in small quantities without loss. One wire and earth is enough, but two parallel wires are preferable, to avoid certain interferences. Were it not for the resistance of the wires, and a little disturbance and loss in turning corners (for the wires need not be straight), telegraphy with wires would be perfect, by any path to any distance. But in " wireless telegraphy," though no expensive connecting wires are required, which gives a remarkable freedom in certain ways, there is enormous loss,

and enormous power is required to send workable signals across the Atlantic, since they are being sent simultaneously everywhere. But for this loss by expansion and by resistance, and possible unsettled interferences, there is no reason to limit the distance. The course of a wave round the earth can be easily followed graphically.

When a wave sent along wires comes to a sharp bend in the circuit, a new wave is generated at the bend. This, combined with the old wave, forms the wave after passing the bend. There is a rapid accommodation of the wave round the wire to the new direction. But if the bending is continuous, instead of abrupt, the accommoda- tion goes on continuously also. The reason is that the electrification cannot leave the wires, so the wave in close

proximity must accommodate itself to them. A part of the wave, however, really does go off into space with some loss of energy »at a sharp corner by its own natural tendency to keep going, but the wire serves to guide the disturbance round the corner as a whole, by holding on to the tubes of displacement by their ends. This guidance is obviously a most important property of wires.

There is something similar in ” wireless ” telegraphy. Sea water, though transparent to light, has quite enough conductivity to make it behave as a conductor for Hertzian waves, and the same is true in a more imperfect manner of the earth. Hence the waves accommodate themselves to the surface of the sea, in the same way as waves follow wires. The irregularities make confusion, no doubt, but the main waves are pulled round by the curvature of the earth, and do not jump off. There is another considera- tion. There may possibly be a sufficiently conducting layer in the upper air. If so, the waves will, so to speak, catch on to it more or less. Then the guidance will be by the sea on one side and the upper layer on the other. But obstructions, on land

especially, may not be con- ducting enough to make waves go round them fairly. Then waves will go partly through them.

The effects of the resistance of the guides are very complicated in general, and only elementary cases can be considered here. Considering the transmission of plane waves in the ether bounded by parallel cylinders ; first imagine the ether to be electrically conducting. Then

- =1E+C or

dx at

expresses the first circuital law, and

–

dx dt'

dx dt

_dV = ldC dx dt'

(4)

(5)

expresses the second. The additional quantities here are Tc the conductivity, and K the conductance per unit length along the wires. The effect is to waste energy at the rate &E2 per unit volume, or KV2 per unit length. It is wasted in heating the medium or matter in it, according to Joule's law. Two other effects occur, viz. , attenuation of the wave in transit, and distortion, or change of shape, due to reflection in transit. The attenuation cannot be prevented, but the distortion can. _ For let the medium be conducting magnetically, so that (/H3 is' the waste per unit volume, and RC2 the corresponding waste per unit length. This g is analogous to k, and R to K. Then instead of (5) above, we shall have

-cl3 = H+ — dx dt

-^Rc+ii?.

dx dt

(6)

These are of the same form as (4). So, if there be no electric conductance, but only the new magnetic conductance, the wave of H will be distorted in the same way as that of E was before, and the wave of E in the same way as that of H was before, and there will be attenuation similarly. But if the two conductivities coexist, though the attenuations are additive the distortions are combative, and may therefore destroy one another. This occurs when R/L = K/S, or g/fi=k/c. The solution expressing the trans- mission of a plane wave is now

,E = /i«H=e-«'/((-it/«), (7)

or

V = Li)C = e-B*L F(t – x/v). (8)

The meaning is that signals are transmitted absolutely without distortion, every slab independently of the rest, but with attenua- tion in transit according to the time factor

This would be very curious, even if it could only be imagined to be done by means of the imaginary magnetic conductivity. What is even more remarkable, however, is that it can be closely imitated by means of the real electric resistance, not of the medium outside the wires, but of the wires themselves. Abolish g altogether, but keep in R, which is to mean the steady resistance of the conducting guides per unit length, previously taken as zero. Then

dx dt

and

.^ = RC + li° dx at

0)

are still the proper equations in certain circumstances, to be mentioned later. Thus equation (8) is still the result, i.e., distor- tionless propagation along wires. The waste RC2′ is now in the wires, instead of outside. It equals the other waste KV2. It follows that any ordinary telegraph circuit may be made approxi- mately distortionless by adding a certain amount of leakance, or

leakage conductance ; for it has L, S, and R already, and a little K. Increase K until K/S = R/L. Then the distortion, which may be excessive at first, will gradually disappear, and the signals will be restored to their proper shape, but at the expense of increased attenuation. If K be increased further, distortion will come on again, of the other kind ; for at first R was in excess, but now K is. For example, if R is 1 ohm per kilom., and L» = 600 ohms, then

This is the insulation resistance required. Also, the attenuation in the distance x is e-Rwi* or e-*wx> ; that is, from ltoe”1 in 600 kilom. to e~2 in 1200 kilom., and so on.

To understand the reason of the disappearance of the distortion : concentrate the resistance of the wire in detached lumps, with no resistance between them. Let each resistance be r. Similarly concentrate the leakance, each leak being k. Then, between the r’s and h’a there is natural unattenuated distortionless propaga- tion ; so we have only to examine what happens to a slab wave in passing by one of the r’a, or one of the k’a, to see the likeness and difference of their effects on V and C. First let a positive wave be passing r. Let Vj, V2, V3 be corresponding elements in the incident, reflected, and transmitted waves. Then the conditions are

V1 + Vs = Vs + rC3) 01 + C!=C,, (10)

and, since Vi = LdC1(V2 = -Li)C2, V3=LdC3, we have the results

V3

V1 = V2 + V3.

(11)

Vj l+r/2W

The second of these equations shows that the electrification (and displacement) is conserved. The first shows the ratio of the transmitted to the incident wave. The incident element, on arriving at r, divides into two, both of the same sign as regards V; one V3 goes forwards, the other V2 backwards, increasing the elec- trification behind. Now suppose a slab wave passes by n resistances in succession in the" distance x, such that mr = Rr, then the attenua- tion produced in the distance x is the n"1 power of VsIVly and in the limit, when u is made =», it becomes e-Rs/SL". This is when there is no leakage.

Next consider the effect of a single leak. The conditions are

C1 + C2 = C3 + 7<.-V3, and the results are

V1 + V2=V3,

C^Ca + Oj.

(12)

(13)

Vi l + k/28v

Here the second result shows that the induction is conserved, instead of the displacement. A part of Cx is thrown back and increases C behind the leak. The complete attenuation in the distance x, by similar reasoning to the above, is e-K*/2S»j when there is leakage without resistance in the wires.

To compare the two cases ; in the first, part of V[is reflected positively and part of Cj negatively, in passing a resistance ; and in the seconcL part of Vj is reflected negatively and part of C1 positively. 'THe effects

are opposite. So if the resistance and the leak coexist, there is partial cancellation of the reflection. This compensation becomes perfect when r and Tc are infinitely small and in the proper ratio. Then there is no reflection, though increased attenuation. So with R and K uniformly distributed there is no reflection in transit anywhere, provided R/L = K/S. The attenuation in the distance x is now e-k*/!^

If the circuit stops anywhere, what happens to the wave depends upon the electrical conditions at the terminus. If it is a short circuit, then the resultant V = 0 is imposed. This causes complete positive reflection of incident V, and negative of C. If insulated, then the resultant C = 0, and there is positive reflection of incident C and negative of V. A remarkable case is that of a terminal resistance, say Ri. Then

V1=LbCi, V2=-Li;C2, V1 + V2=R1(C1 + C2) (14) are the conditions. So the reflected wave is given by

Va_Ri-L« ,lg>

Vj^Ri + Lu' v '

V is reflected positively when Ri > I/», and negatively when < Lv. If Rl = Lu, there is no reflection. The energy of the wave is absorbed by the resistance. So we attain not only perfect trans- mission, but also perfect reception of signals.

The above method of treating resistance and leakance by isolated resistances and leaks may be applied to find out what in general happens when there is either no leakage or else no resistance in a continuous circuit. Suppose, for example, there is no leakage. Given a charge anywhere, initially without current, how will it behave ? If there were no resistance, it would immediately split into two ; one with positive magnetic force would move to the right, the other with negative magnetic force would move to the left, both at speed v. Now this is also exactly what happens in a resisting circuit at the first mmoent, namely, the generation of a

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pair of oppositely travelling pure electromagnetic slab waves. But this state does not continue, because the resistance causes a con- tinuous partial reflection of the two waves. This may be studied in detail by easy numerical operations when we concentrate the resistance of the circuit at a number of equidistant points. The result is as follows : — Let Vo be the original state of V of depth a. Then at a certain time t the distribution consists first of two heads at distance Ivt apart. These are two pure electromagnetic waves, of depth a, travelling at speed v. They are the attenuated remains of the initial waves iVo=V = Lt>C, and £Vo = V= ~~Li)C. Between them is the rest of V0, cast behind by reflection as the two waves progress. In time the heads attenuate to insignifi~~ cance, and there is left the widespread diffused state of V, having a maximum at the centre. It then tends to obey the Fourier law of diffusion.

If, on the other hand, there is no resistance, then the effect of the leakance alters the nature of the disturbance between the heads. V is positive in the heads, which are nearly as before, but negative in the intervening space. Now in the former case the charge or integral of SV was conserved. Suppose Q was the original charge. Then £Qf-R”2:L is the amount in each head, and the rest of Q is diffused between them. But in the second case the chargo in each head is iQe”2”23, and the total charge at the same moment is Qe_K”s. So we know the amount of negative charge between the two heads.

If the initial state is a pure slab wave V0 = Lf C0, it goes on moving as a pure wave, but attenuating, and casting a tail behind it, the tip of which travels backwards at speed v. The tail of V is everywhere positive, and the tail of C is everywhere negative at first and until the head has attenuated very considerably, when bv diffusion in the tail itself and attenuation it becomes positive, first near the head and later all the way to the middle. The ultimate result^ is a widely diffused state of V symmetrical with respect to the origin, where V is a maximum and 0 zero, whilst elsewhere C is all posi- tive on the right side and negative on the left, in accordance with the diffusion law.

It is now necessary to consider what K, the resistance, means in the above theory. The remarkable property of guidance has been noticed, and also that E in the wires acts oppositely to K outside in reflective power, so that they may neutralize. But there is another remarkable property of wires to be mentioned. They are conductors truly, but it is for conduction or guidance of the wave outside them, in effect, in all the above. Do they con- duct the wave similarly inside ? Not at all. So far from doing that, they obstruct it. If a plane wave strikes flush against a perfect conductor it is wholly reflected, and with any good conductor it is mostly reflected. When a wave is sent along a wire, a purely superficial conduction is first of all concerned. The boundary of the wire is exposed to magnetic force tangenti'ally. Now, suppose the wire is really a conducting dielectric, like the medium outside it in cases before considered. Then the magnetic force impressed upon its boundary will send an electromagnetic wave inwards. This wave will be nearly of the same type as the plane wave in the medium outside, when there is electric conductivity there, if the conductor has a plane boundary. If it is a wire, the wave will be cylindrical, with complications accordingly. But there is no difference in principle. So the transit of the plane wave along the wire out- side it causes the transmission perpendicularly into the wire of another wave, and just as the former suffers positive reflection of H and negative of E in transit, so does the secondary wave which, so to speak, leaks into the wire and converges to its axis.

But though there is no difference in principle, there is a very great difference in practice. The external con- ductivity is usually very small, and a wave can go a long way with little change. But the internal conductivity is relatively very large indeed. Hence if an impulsive wave enters the wire at its boundary, its " head," in the sense used above, attenuates to nothing almost at once, and the wave becomes of the diffusive kind. The magnetic induc- tion therefore diffuses into the wire according to Fourier's law of diffusion. The time interval needed to effect any operation varies as the product [ika?, where /j. is the

inductivity, k the conductivity, and a the radius of the wire. This diffusion is nothing like the elastic wave outside from which it results. It is to, be regarded, in the main, as a purely local phenomenon. The

electric force in this transverse wave is axial, or parallel to the axis of the wire. Energy is wasted in the wire at the rate £E2 per unit vol. The transverse wave has no direct action upon the main wave outside the wire from which it is derived, but its indirect action may in time become very great, namely, the distortion and attenuation of the main wave before considered.

Metals vary considerably in the facility with which they are penetrated. Iron and copper are typical examples. Although k is six times as great in copper as in iron, yet /* is 100 or 200 times as great (for small H) in iron as in copper. So iron is much more difficult to penetrate than copper ; and it takes a far longer time to set up the state of steady current in iron if the wires are of the same size. When it is reached the steady current in iron is only one-sixth of that in copper, if the impressed voltage be the same. It follows that under the action of an alternating voltage the wave-train enter- ing the iron will attenuate much faster than that entering the copper. In either case, increasing the frequency of alternation removes the current from the interior towards the boundary, shortening the wave-length. The tendency is towards skin conduction. The attenua- tion is so rapid in going inwards that only one wave- length in the wire itself need be considered. This may be confined within a mere skin. Then the interior might be all scooped out without making any sensible difference. With Hertzian waves a mere film may be sufficient. These waves (outside) may be of the order of a few metres long, and the derived wave inside of microscopic length. With telephonic waves, on the other hand, there is very good penetration in the usual copper wires, except at the higher frequencies. On the other hand, if the wires are iron there is bad penetration.

Wires have really no definite resistances as a whole when waves are ‘sent along them. The resistance per unit length will vary according to the amount of penetra- tion at the place. The least resistance is when there is complete penetration. It is then the steady resistance measured by the Christie balance. But if the impressed alternations are simply periodic, and the resultant alter- nating state is allowed to be assumed, then a definite meaning can be given to the “effective resistance” (Kayleigh). If it is called B,’ it will be such that B’C2 is the average rate

of generation of heat, C3 meaning the mean square of the current. The more the current is concentrated, the greater the resistance. Thus with Hertzian waves the resistance is largely multiplied (compared with the steady resistance), for it is the resist- ance of a thin skin. It is also easy to multiply the resistance three times or so with telephonic currents in iron wires, but in copper wires there is little increase.

In skin conduction the resistance depends upon the area of the surface of the conductor. The amount per unit area is the same for a round wire as for a plane boundary when the surface state is the same. But, as before mentioned, the displacement between a pair of parallel cylinders distributes itself (in electromagnetic waves) according to two-dimensional electrostatics, and the magnetic force lines are perpendicular to the displace- ment. It follows that in such very rapid alternations as lead to skin conduction, the skin current concentrates itself where the displacement is strongest, usually the parts of the two conductors which are nearest together.

The penetration of the magnetic force also increases the inductance L. This increase is a trifling matter in copper,

theory]

but in iron, since it becomes magnetized, it is a large effect with good penetration, though insignificant when there is skin conduction.

The way the current “rises ” in a wire under impressed surface action may be visualized by comparing it with water in a pipe, originally at rest, subjected to surface traction upon its boundary acting longitudinally. The traction will at first only drag along the outermost layer of water. But if the traction continues to act steadily, viscosity will gradually cause similar motion to penetrate inwards, and to any depth. On the other hand, if the traction alternates in direction, not too slowly, only the outer layer will be sensibly moved to and fro.

It may become possible to convert this analogy into something more than an analogy by regarding the surface traction as that exerted by the longitudinal electric force on electrification in the wire, and supposing that the interior electrification (half positive, half negative) is somehow controlled in its average motion by the diffusion law. It has always been difficult to reconcile metallic conduction with electrolytic. There is a slow drift of ions in electrolysis, carrying electric charges. But there is no sign of ionic electrolysis in metallic conductors. Again, regarding metals as polarizable, Maxwell's idea that conduction consisted in a break- down of the electric displacement does not go far in explaining the nature of the intermolecular discharge. Yet the possibility of a convective explanation of metallic conduction in harmony with Maxwell's theory became obvious when it was established that a moving charge in that theory was magnetically the same thing as a "current element," both in itself and under external magnetic force. Only quite lately, however, has it been possible to carry out this notion even tentatively. This has come about by the experimental researches which appear to establish the individuality of electrons of astonishing smallness and mobility. It is now believed by many that the conduction current inside a wire con- sists of a slow drift of electrons. Naturally, in the present state of ignorance about atoms and molecules, the theory is in an experimental stage. But it does not come into the telegraphic theory sensibly, since the electronic drift is a local phenomenon. It is stationary compared with the wave outside a wire. It may be noted that it is'not necessary to consider the electronic drift to be the cause of the electromagnetic wave which has the drift for an after effect.

The resistance of the sea to Hertzian waves in " wire- less telegraphy " comes under the same principles, and may be calculated by the same formula as the skin resistance of wires. But this is only a rough beginning, for a reason to be seen presently. Going back to equa- tions (9), consider that R originally meant magnetic con- ductance outside the wires. The theory was then an exact one ; but when R means the resistance of the wires, the theory cannot be exact, because R is not in the right place. It is outside the wave. The theory is now only true, as regards R, for long waves. A long wave-length may be considered to be

one which is a large multiple of the distance apart of the wires, though there is really no distinct limitation. Telegraphic and telephonic waves are long, of course. So may Hertzian waves be, though, on the other hand, as these waves may be made only a few centimetres in length, such waves might require serious correction in the theory. Even when they are many metres long and the wires only a few centimetres apart, although there may be little distortion in transit, the estimation of attenuation may be considerably upset. As for light-waves, obviously they are very much too short for the theory. The application of these remarks to waves over the sea is obvious. The waves in the air are too short for the influence of the resistance of the sea to operate on them in so simple a way as in the wire theory. The air itself also may be feebly conductive, generally or locally.

Understanding, then, confinement to long waves, equa- tions (9) will apply when the circumstances allow R to be considered fairly constant. This may happen when the conductors are thin sheets of metal permitting very rapid penetration. It may also happen with wires, as

when the frequency of the waves is not so great as to increase the resistance greatly ; for example, in telephony along copper wires of low resistance. But a consider- able extension of the use of equations (9) may be made. Let it be a simply periodic train of waves that is in question, and let R stand for the effective resistance, which becomes definite at a definite frequency. Also make the corresponding change in L, if desired. Then it is a consequence of the general theory of wires that equations (9) are still true in the circumstances. The fundamental solution is

V = V0

due to V0 sin nt impressed at x = 0, where P and Q are given by

P + Q»= J(B, + loii)(K + 8ni) ; (17)

that is

P or Q=a)i{(E2 + LV)}(K2 + SV)i±(RK-LS?!.2)}}. (18)

Valuable information may be obtained from this equation, by varying the frequency and other constants. In an extreme case when R and S are paramount,

P = Q = (£RS»)i. (19)

This applies to signals received at the end of a long submarine cable, slowly worked. They start as electro- magnetic waves, and degenerate to diffusive waves. This is the reason why Lord Kelvin's (W. Thomson's) theory of 1855 applies pretty closely to the reception of signals.

In contrast with this, R/L = K/S produces distortionless transmission, with P = R/L«, Q = n/v. This v is defined by LS«2= 1, and is usually smaller than v in ether. Again, if R/L?i and K/Sm are both small, we get approximately R K

P 2Ld + 2Su'

Q = '-

(20)

This is practically very important in telephony. We can have a near approach to distortionless transmission. It is easy to make K/Sre small, because it is naturally small. We may in fact put K = 0 in effect. So if R/L?i is small, there is little distortion in transit. Observe, too, that the attenuation in the distance x is only e-2*/81* instead of e-'BalLv, which is important. The proper leakage to remove the distortion entirely would cure the evil also when R/Lra. is big ; any value, in fact. Now in telephony we are not concerned with very low frequencies, but only with those beginning with the lowest tone of the human voice. If R/Lm is small for this, it is small for all higher tones, therefore first-rate telephony. Even if R/Lm is 1 for the lowest tone, it will be \, \, \, &c, for the octaves. Then P and Q in (16) will each not vary much in the upper tones, and there can be good transmission.

There are other ways of approximating to the distortion- less state than by leakage. In the first example given, p. 215, no leakage would be wanted, because there would be so little distortion in thousands of miles without the leak- age.' Other examples relating to telephony have been given. Considering the matter more generally, let there be a circuit in which R/L is far greater than K/S, K being small and to be kept small, preferably, to avoid attenuation by leakage. Then we may tend to equalize R/L and K/S in several ways. First, by reducing S. This is well known. It means with air wires, separating them as much as possible. With cables it means reducing the "specific inductive capacity " principally, by air or paper insulation. But this reduction of S is not nearly enough. Another way is to reduce R. This is well known, and is very important. It can be carried a long way. Cable companies have been much too economical in the matter of copper, in the past especially. A third way is to increase L. Inductance causes im- pedance in general. But this way is proper, and is powerful. If we can increase the L of a circuit, without

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any change at all in R, S, we can approximate to dis- tortionless transmission as much as we please, and with as little attenuation as we please. That is, the effect of increasing L is advantageous in a double sense, for it lessens the attenuation and the distortion simultaneously. To illustrate, if it were possible for L to be zero on say 100 miles of cable of Atlantic type (which it is not), telephony would be very bad indeed or impossible, because there would be such a wide difference in the attenuation produced on tones of different frequencies. The formula (16) above may be used, with L=0, K=0. But even if L is increased only from 0 to the small value 2 (cm. per cm., B.A. abs. units), the formula will show a remarkable improvement ; and if L is increased to 10, the results are excellent. What happens is simply this,

that self-induction imparts momentum to the waves, and this carries them on. The formula will show that further increase in L will carry waves across the Atlantic with little loss. But the L needed is exceedingly great. Any increase of L does good, provided it be unaccompanied by increased resistance or other evils to destroy the benefit. It is therefore very important to know how to increase L, and to find out what can be made of the principle concerned in practice. Now there is some practice in it already. Telephone wires in air, for long distance telephony, should be, and are in some places, put up in such a way as to make L as large as possible, although some electricians have maintained that L should be as small as possible. The difference between L=2 and L=20 or 30, which is produced by separating wires, is enormous, and largely multiplies the distance over which telephonic waves can be carried.

But it is the improvement of signalling through cables that is most important, if it can be done. The most effective way of obtaining self-induction is by the use of iron, suitably arranged and divided ; not iron for the guides, but outside or inside them. There is plenty of iron put round cables now, but it is for protection, and is not at all suitably arranged for the purpose required. It is not unlikely that a new type of cable can be designed in which iron can be brought into use to increase the self-induction largely and in a uniform manner. The writer invented a way of carrying out the principle other than uniformly, and recommended it for trial ; viz., by the insertion of inductance coils in the main circuit at regular intervals, say one per mile, according to circumstances. The time constants of these coils should be as large as possible, so that the average inductance may be largely in- creased without a large increase in the average resistance per mile. The action of the coils is similar to that of small detached loads placed upon a string to give it inertia, and enable it to carry waves farther. If we wish to imitate a curve containing bends of various sizes by means of dots, it is obviously necessary to have several dots in every bend. So, in the substitution of detached inductances for uniform inductance, we need to have several coils in every bend of the electrical wave. It is easy to say that so many coils will be wanted in such a length, in telephony, for example, if we can fix upon the shortest wave-length, by using the

known formula for the wave-length. One could do that without being considered to make a new discovery. But this does not answer the question how few the coils may be for telephony through a cable. Theoretically we want an infinite number, i.e., uniform inductance. We must sacrifice something. The shortest telephonic wave-length necessary to be considered is a doubtful element, and there are unmentioned inter- ferences to be allowed for. Hence experiment alone can decide how few the coils need be for telephony through a distance far exceeding that possible without the coils. Nothing particular has been done in Great Britain to

carry out the writer's invention, but in America some progress has been made by Dr Pupin, who has described an experiment supporting its practicability ; the length telephoned through was increased five times by inserting the coils.

The above radiational theory of telegraphy founded upon Maxwell's theory of light has been proved in all essential points and in various details by important experiments of Hughes, Lodge, Hertz, and others, to say nothing of long- distance telephony in America, or the more recent spherical telegraphy. But quite different views have been main- tained by the electricians of the British Post Office, under the guidance of Sir W. H. Preece. It is only fair to put on record here his leading articles of faith. The information is derived from his papers. Self-induction is harmful to telephony, and is to be avoided and minimized. Nevertheless, experiments upon the Post Office wires showed that though self-induction is sensible in iron wire circuits, it is quite insensible in copper circuits. That is why copper wire is so successful, and iron wire a failure. Also the capacity of circuits (their permittance) is reckoned in a peculiar manner. What controls telephony is " the KE law." If K is the total capacity of a circuit in micro- farads, and B its total resistance in ohms, the product KE fixes over what distance telephony can be carried on. It must not exceed 2000 because of the KE law, the speed of the current varying as the square of the length of the line. Finally, Sir W. H. Preece has a special invention aiming at Atlantic telephony. Imagine a round wire to be slit in two, and the halves to be slightly separated for insulation, say by a piece of paper. The two halves

form the circuit, and it was supposed by the inventor that by the close approximation of the flat surfaces the electro- static and electromagnetic inductions would neutralize one another.

For additional information the reader is referred to the following works : — Lord Kelvin. Mathematical and Physical Papers, vol. ii. Cambridge, 1884.— Clerk-Maxwell. Treatise on Electricity and Magnetism, vol. ii. Oxford, 1881 J. J. Thom- son. Recent Researches in Electricity and Magnetism. — Oliver Heaviside. Electrical Papers. London, 1892 ; and Electromag- netic Theory. London, 1893. (o. he.)

II. Land Telegraphy.

The improvements introduced in land telegraphy within the last two decades of the 19th century re- lated almost entirely to line construction and instrument design. No striking novelties were devised, and such inventions as could be claimed as new have not, so far, been developed to the extent necessary to make them practical successes. Nevertheless very real progress was made, though it was practically in the direction of the better adaptation of old principles to modern require- ments. Almost all the general types of apparatus which were in use at the beginning of the period named are still employed, and have proved themselves capable of fully meeting modern necessities. In determining what are real improvements, it is especially necessary to consider what are the working conditions involved in practical telegraphy. Exaggerated importance has been attached to certain systems of rapid and multiple telegraphy, which, although they are capable under favourable conditions (seldom met with in practice) of transmitting a large amount of message work, are yet of little value, from the fact that the received and recorded signals cannot be handled and transcribed to commercial advantage at a correspondingly high speed. In illustration of this it may be stated that it is found in practice that more message work can be transmitted and dealt with by means of the ” Wheatstone Automatic ” apparatus when running at a moderate speed, than when running (as it

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is quite capable of doing) at a speed of from 400 to 600 words per minute. Methods therefore (among others) which claim to be able to transmit at speeds which have not hitherto been attained are not necessarily ” improvements.”

In the aerial or overground system of land telegraphs the use of copper wire has become very general. The advantage of the high conducting power which Over- copper possesses is of especial value in moist

Yin””? climates (like that of the United Kingdom), since the effect of leakage over the surface of the damp insulators is much less noticeable when the conducting power of the wire is high than when it is low, especially when the line is a long one. Copper is not yet universally employed, price being the governing factor in its employment ; moreover, the conducting quality of the iron used for telegraphic purposes has of late years been very greatly improved.

In the British Postal Telegraph system five sizes of iron wire are in general use, weighing respectively 200, 400, 450, 600, and 8001b per statute mile, and having electrical resistances (at 60° F.) of 26-64, 13-32, 11 ‘84, 8-88, and 6-66 standard ohms per statute mile respectively. The sizes of copper wire employed have weights of 100, 150, 200, and 400 lb per statute mile, and have electrical resistances (at 60° F.) of 8 782, 5-855, 4-391, and 2-195 standard ohms respectively. Copper wire weighing 600 and 800 lb per mile has also been used to some extent. The copper is ” hard drawn,” and has a breaking strain as high as 28 tons per square inch ; the test strain required for the iron wire is about 22J tons. The particular sizes and descriptions of wires used are dependent upon the character of the ” circuits,” the longer and more important circuits requiring the heavier wire.

Practically one form of ” insulator ” is in general use on the postal lines, viz., the ” Cordeaux screw ” ; but the ” Varley double cup ” (see Ency. Brit., vol. xxiii. p. 114) is still employed, especially by the railway

companies, and is a very serviceable pattern, though possessing the defect that the porcelain cup is not re- movable from the iron bolt on which it is mounted. The Cordeaux insulator (Fig. 1) is made in one piece. A coarse screw-thread is formed in the upper part of the inner cup, and this screws on to the end of the iron bolt by which it is supported. Between a shoulder, a, in the iron bolt and a shoulder in the porce- lain cup c is placed an indiarubber ring, which forms a yielding washer and enables the cup to be screwed firmly to the bolt, while preventing the abrasion of the por- celain against the iron. The advantage of the arrangement is that the cup can at any time be readily removed from the

bolt. At the termination of a line a _ . ~

large insulator (Fig. 2), mounted on a deatix Insulator strong steel bolt having a broad base flange, is employed. Connexion is made into the office (or to the underground system, as is often the case) from the aerial wire by means of a copper conductor, insulated with gutta-percha, which passes through a ” leading in ” cup, whereby leakage is prevented between the wire and the pole. The insulators are planted on creosoted oak arms, 2\ inches square and varying in length from 24 to 48 inches, the 24 and 33 inch arms taking two, and the 48-inch four, insulators. The unequal lengths of the 24 and 33 inch arms are adopted for the purpose of allowing one wire to fall clear of that beneath it, in the case of an insulator breaking or the securing binder giving way. The poles are of red fir, creosoted, this method of preservation being the only one now used for this purpose in the United Kingdom. The number of poles varies from about 15 to 22 per mile

of line ; they are planted to a depth of from 2 to 4 feet

For protection from lightning each has wire” running from the top down to the

in the ground an ” earth base.

Gutta-percha-covered copper wires are largely used for the purpose of underground lines, the copper conductor weighing 401b per statute

mile, and the gutta-‘ percha covering 501b (901b total). The con-
Under- ductor has an electrical resistance (at 60° F.) ground of 22-66 standard ohms, and an electrostatic “*”’

capacity of 0-270 microfarad, per statute mile. The insulated wires are enclosed in cast iron pipes which are

Fig. 2 — Terminal Insulator.

buried at a depth of about 18 inches beneath the foot- divided ways and contain sometimes as many as 70 wires. In London alone the buried wires exceed 20,000 miles in length. At every 400 yards along the line of pipes are placed “flush” boxes, i.e., cast iron boxes with stone covers, which are flush with the surface of the ground ; at these boxes the wires are jointed. Other flush boxes are also provided where there are no joints, but where the wires are drawn into the pipe in lengths of 400 yards, half being taken to either side of the box. Paper cables, i.e., copper wires insulated with carefully dried paper of a special quality, are now very largely used. A number of the wires, each enveloped in a loose covering of well-dried paper, are loosely laid up together with a slight spiral ” lay ” in a bundle, and the whole is enclosed in a stout lead pipe. It is essential that the paper covering be loose, so as to ensure that each wire is enclosed in . a coating not of paper only, but also of air ; the wires in fact are really insulated from each other by the dry air, the loose paper acting merely as a separator to prevent them from coming into contact. The great advantage of this air insulation is that the electrostatic capacity of the wires is low (about one-third of that which would be obtained with gutta-percha insulation), which is of the utmost importance for high speed working or for long-distance telephonic communication. As many as 400 wires are enclosed in one lead pipe.

Between London and Birmingham a paper cable 116 miles long and consisting of 72 copper conductors, each weighing 150ft> per statute mile, was laid in 1900. The conductors are enclosed in a lead pipe, 2J inches in outside diameter and \ inch thick, which itself is enclosed in cast iron spigot-ended pipes, 3 inches in inter- nal diameter, and buried 2 feet below the surface of the roadway. At intervals of 2 miles ” test pillars ” are placed for the purpose of enabling possible faults to be

accurately located. Each con- ductor has a resistance (at 60° F.) of 5-74 ohms per statute mile, and an average electrostatic capacity per mile between adjacent wires of 0-06 microfarad, or between wire and earth of 0-1 microfarad ; the insulation resistance of each wire is about 5000 megohms per mile.

The one disadvantage of paper cables is the fact that any injury to the lead covering which allows moisture to penetrate causes telegraphic interruption to the whole of the enclosed wires, whereas if the wires are each individu-

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ally coated with gutta-percha, the presence of moisture can only affect those wires whose covering is defective. There is no reason for doubting, however, that, provided the lead covering remains intact, the paper insulation is imperishable ; this is not the case with gutta-percha-covered wires.

In order to maintain the system of telegraph lines in good

working condition, daily tests are essential. In the British

Postal Telegraph Department all the most im-

“*’ portant wires are tested every morning between

7.30 and 7.45 a.m., in sections of about 200 miles. The

method adopted consists in looping the wires in pairs

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Fig. 3. — Method of testing circuits.

between two testing offices, A and B (Fig. 3) ; a current is sent from a battery, E, through one coil of a galvano- meter, g, through a high resistance, r, through one of the wires, 1, and thence back from office B (at which the wires are looped), through wire 2, through another high resistance, r’, through a second coil on the galvanometer, g, and thence to earth. If the looped lines are both in good condition and free from leakage, the current sent out on line 1 will be exactly equal to the current received back on line 2 ; and as these currents will have equal but opposite effects on the galvanometer needle, no deflection of the latter will be produced. If, however, there is leakage, the current received on the galvanometer will be less than the current sent out, and the result will be a deflection of the needle proportional to the amount of leakage.

The galvanometer being so adjusted that a current of definite strength through one of the coils gives a definite deflection of the needle, the amount of leakage expressed in terms of the insulation resistance of the wires is given by the formula

Total insulation “) resistance of [■ — looped lines j ^ V

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in which R is the total resistance of the looped wires, including the resistance of the two coils of the galvanometer, of the battery, and of the two resistance coils r and r’ (inserted for the purpose of causing the leakage on the lines to have a maximum effect on the galvanometer deflections). In practice the resistances r, r’ are of 10,000 ohms each. The deflection observed on the galvanometer when the lines are leaky is d, while D is the deflection obtained through one coil of the galvanometer with all the other resistances in circuit ; and assuming that no leakage exists on the lines, this deflection is calculated from the

“constant” of the instrument, i.e., from the known deflection obtained with a definite current. For the purpose of avoiding calculation, tables are provided showing the values of the total insulation according to the formula, corresponding to various values of d. If the insulation per mile, i.e., the total insulation multiplied by the mileage of the wire loop is found to be less than 200,000 ohms, the wire is considered to be faulty. The climatic conditions in the British Islands are such that it is not possible to maintain, in unfavourable weather, a higher standard than that named, which is the insulation ob- tained when all the insulators are in perfect condition and only the normal leakage, due to moisture, is present.

There are three kinds of batteries in general use in the British Postal Telegraph Department, viz., the Daniell, the bichromate, and the Leclanche. The Daniell Batteries. type consists 0f a teak trough divided into five cells by slate partitions coated with marine glue. In each cell is placed a porous chamber containing sulphate of copper crystals and a copper plate ; the cell also contains a zinc plate immersed in a solution of sulphate of zinc. The electromotive force of each cell is 1-07 volts, and the resistance 3 ohms. The Fuller bichromate battery

consists of an outer jar containing a bichromate of potash and sulphuric acid solution, in which a plate of hard carbon is immersed; in the jar there is also a porous pot containing dilute sulphuric acid and a small quantity (2 oz.) of mercury, in which stands a stout zinc rod. The electromotive force of each cell is 2.14 volts, and the resistance 4 ohms. The Le- clanche” is of the ordinary type, and each cell has an electromotive force of 1-64 volts and a resistance of 3 to 5 ohms (according to the size of the complete cell, of which there are three sizes in use). Dry cells, i.e., cells containing no free liquid, but a chemical paste, are also largely employed; they have the advantage of great portability.

The adoption of improved forms of batteries, and, of recent years, the introduction of accumulators for tele- graphic purposes, has resulted in the very general application of the principal of working universal a number of instruments off one set of batteries, working. The batteries

must be of low resistance, other- wise great variation in the strengths of the currents passing out to the lines takes place when a number of instruments are being worked. In practice, when primary batteries are used for the purpose, not more than five or six circuits can be worked satisfactorily together, but by using accumulators as many as 300 can be grouped on one set of cells. So satisfactory has been the use of accumulators that they have entirely replaced ordinary batteries at large offices. The force of the set of ac- cumulator cells provided is such as to give sufficient power for the longest circuit to be worked, the shorter circuits being brought up approximately to a level, as regards resistance, by the insertion of resistance coils in the circuit of the transmitting apparatus of each shorter line. A spare set of accumulators is provided for every group of instruments in case of the failure of the working set. For working ” double current,” two sets of accumulators are provided, one set to send the positive and the other set the negative currents ; that is to say, when, for example, a double current Morse key is pressed down it sends, say, a positive current from one set, but when it is allowed to rise to its normal position then a negative current is transmitted from the second set of accumulators. It is not possible to work double current from one set alone, as in this case, if one key of a group of instruments is up and another is down, the battery would be short- circuited and no current would flow to line.

At small country towns or villages, where the message traffic is light, the Wheatstone ” ABC ” instrumentisused. In this apparatus electric currents are generated by turning a handle (placed in front of the ^JJT instrument), which is geared, in the instruments of the most recent pattern, to a Siemens shuttle armature placed between the two arms of a powerful horse-shoe per- manent magnet. When one of a series of keys (each corresponding to a letter) arranged around a pointer is depressed, the motion of the pointer, which is geared to the shuttle armature, is arrested on coming opposite that particular key, and the transmission of the currents to line is stopped, though the armature itself can continue to rotate. The depression of a second key causes the first key to be raised. The currents actuate a ratchet-wheel mechanism at the receiving station, whereby the hand on a small dial is moved on letter by letter. A noticeable feature in the modern ABC indicator, as

well as in all modern forms of telegraph instruments, is the adoption of ” induced ” magnets in the moving portion of the apparatus. A small permanent magnet is always liable to become demagnetized, or have its polarity reversed by the action of lightning. This liability is overcome by making the movable parts which require to

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be magnetic, of soft iron, and magnetizing them by the inducing action of a strong permanent magnet.

At offices where the work is heavier than can be dealt with by the A B 0 apparatus, the ” Single Needle ” instru- ment is very largely used ; it has the advantage of slight liability to derangement, and of requiring very little adjustment. A fairly skilled operator can signal with it at the rate of 20 words per minute. The needle (in the modern pattern) is of soft iron, and is kept magnetized inductively by the action of two permanent steel magnets. The coils are wound with copper wire (covered with silk), 10 mils1 in diameter, to a total resistance of 200 ohms. The actual current required to work the instrument is 3‘3 milliamperes (equivalent approximately to the current given by 1 Daniell cell through 3300 ohms), but in practice a current of 10 milliamperes is allowed. A simple, but im- portant, addition to enable the reading from the instrument to be effected by sound is shown in Fig. 4. In this arrangement the needle strikes against small tubes formed of tin-plate. Fig. 5 shows the modern pattern of

(Sounder ” as used by the British Post Office. The magnet is wound to a resistance of 40 ohms (or 900 ohms when worked from accumulators),

Fie. 4. — Single Needle with sounding arrangement.

Fig. 5. — Modern “Sounder.”

and the instrument is worked with a current of 400 milliamperes (25 milliamperes with accumulators). Direct, or single, current working is employed only for

very short lines ; for long lines, relays are invariably used. Fig. 6 shows the most modern pattern of relay used by the British Post Office, known as the ” Post Office Standard Belay.” In this instrument there are two soft iron tongues, n, s, fixed upon and at right angles to an axle a, which works on pivots at its ends. These tongues are magnetized by the inducing action of a strong horse-shoe permanent magnet, S N, which is made in a curved shape for the sake of compactness. The tongue plays between the poles of two straight electro- magnets. The coils of the electromagnets are differen- tially wound with silk-covered wire, 4 mils in diameter,

1 1 mil = m’oD inch.

Fig. 6.-

-Post Office Standard Relay.

to a total resistance of 400 ohms. This differential winding enables the instrument to be used for ” duplex ” working, but the connexions of the wires to the terminal screws are such that the relay can be used for ordinary single working. Although the relay is a “polarized” one, so that it can be used for “double current” working, it is equally suitable for ” single current ” purposes, as the tongue can be given a bias over to the ” spacing ” side, i.e., to the side on which no current passes through the local circuit. The standard relay will work single current with a current of 3 milliamperes, though in prac- tice about 10 would be used. Worked double current — that is, with the tongue set neutral, having no bias either to the spacing or marking side — the relay will give good signals with 11 milliampere of current, though in prac- tice 10 milliamperes are provided. The lightness of the moving parts enables great rapidity of action to be obtained, which for automatic fast speed working is very essential. When a local instrument such as a sounder (Fig. 5) is worked from a relay, the dying away of the magnetism in the iron cores of the electromagnet, when the relay

tongue moves from the marking to the spacing side, i.e., when the local battery is cut off, sets up an induced current of high tension, which causes a spark to jump across the contact points of the relay, and by oxi- dizing them makes it necessary for them to be frequently cleaned. In order to avoid this sparking, every local instrument in the British Postal Telegraph Department has a “spark” coil connected across the terminals of the electromagnet. The sj>ark coil has a resistance about ten times as great as that of the electromagnet it shunts, and the wire of which it is composed is double wound so as to have no retarding effect on the induced current, which circulates through the spark coil instead of jump- ing in the form of a spark across the contact points. The device is a most effectual one, and a very important improvement.

” Single current ” working by means of a non-polarized relay, although general in America, is not adopted in England. In the latter .country, when such working is

Fig. 7. — Connexions for Double Current working.

resorted to, a polarized relay with a bias is used, but on all important lines worked by sounders, the ” Double Current ” system is employed. In this the tongue of the relay is kept over to the spacing side by means of a current flowing in one direction, but on the depression of the signalling key the current is reversed, moving the relay tongue over to the marking side. The relay tongue being perfectly free to move, can be actuated by a com- paratively weak current, and, moreover, requires but little

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adjustment. Normally a switch attached to the key cuts the battery off, and connects the line direct through the receiving relay ; this switch is turned to ” send ” when transmission commences, and is moved back to “receive” when it ceases : this movement is done quite mechani- cally by the telegraphist, and as it is practically never forgotten, automatic devices to effect the turning are wholly unnecessary. Fig. 7 shows the general arrange- ment of the connexions for double current working; the galvanometer G- is used for the purpose of indicating whether a station is calling, in case the relay sticks or is out of adjustment.

The ” Multiplex ” system devised by Delaney, which has been adopted to a limited extent in Great Britain, enables

a large amount of work to be done on one wire. Jj2j° The general arrangement of the apparatus is

shown by Fig. 8. Arms a and b, one at each station A and B, are connected to the line wire, and are made to rotate simultaneously over metallic segments, 1,

Line

Fig. 8. — Multiplex working. 2, 3, 4, and 1’, 2’, 3’, 4’, at the two stations, so that when the arm a is on segment 1 at A, then b is on segment V at B, and so on. At each station sets of telegraph apparatus are connected to the segments, so that when the arms are kept rotating the set connected to 1 becomes periodically connected to the set connected to 1’, the set connected to 2 to the set connected to 2’, and so on. In practice the number of segments actually employed is much greater than that indicated on the figure, and the segments are arranged in a number of groups, as shown by Fig. 9, all the seg- ments 1 being connected together, all the segments 2, all the segments 3, and all the segments 4. To each group is connected a set of apparatus ;

hence during a com- plete revolution of the arms a pair of instruments (at

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Line

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Fig. 9. — Grouping of Segments in Multiplex System.

station A and station B) will be in communication four times, and the intervals during which any particular set of instruments at the two stations are not in connexion with each other become much smaller than in the case of Fig. 8. In practice this subdivision of the segments is so far extended that the intervals of disconnexion become extremely small, and each set of apparatus works as if it were alone connected to the line. As many as 162 segments in eight groups are practically used. The arm which moves round over the segments rotates at the rate of three revolutions per second, and is kept in motion by means of an iron toothed wheel, the rim of which is set in close proximity to the poles of an electromagnet. Through this electromagnet pass impulses of current re- gulated in frequency by a tuning-fork contact breaker; these impulses, acting on the teeth of the iron wheel, by a series of pulls keep it in uniform rotation. If the rates of vibration of the two tuning-forks at the two stations could be maintained precisely the same, the two arms would rotate in synchronism, but as this uniform vibra- tion cannot be exactly preserved for any length of time, a means is provided whereby the rate of vibration of either of the forks can be slowed down, so as to

retard the rate of rotation of one or other of the arms. This is effected by means of ” correcting ” seg- ments, of which there are six sets containing three each. Should the rotating arms fail to pass over these

correcting segments at their synchronous positions, cor- recting currents pass to a relay which cuts off momen- tarily the current actuating the tuning-fork, thereby altering the rate of vibration of the latter until the arms once more run together uniformly. The actual number of sets of apparatus it is possible to work multiplex depends upon the length of the line, for if the latter is long, retardation-effects modify the work- ing conditions. Thus between London and Manchester only four sets of apparatus can be worked, but between London and Birmingham, a shorter distance, six sets (the maximum for which the system is adapted) may be used.

The Wheatstone automatic apparatus, as described in Ency. Brit., vol. xxiii. p. 120, although in general prin- ciple unaltered, has undergone several important wheaU modifications which well illustrate the result of stone experience. In the older form of instrument automatic {ibid., p. 120, Fig. 18) the automatic contacts system- were made through the medium of the crank-levers A B and the pins p p on the rocking-bar E ; in the most recent arrangement, Fig. 10, the crank-levers A A' and the pins PP'on the rocking-bar Y are used solely for the purpose

Perforated Slip

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Fig. 10. — Wheatstone Automatic Transmitter.

of regulating the automatic contacts, which are wholly made by the rocking-lever L. This arrangement in fact corresponds to the double current key of the " Double Current " system, the key action being regulated by the movements of the levers A and A', which, as in the

older arrangement, are controlled by the vertical rods S M, which pass through the perforations in the paper slip. It is found that this modified arrangement gives great certainty of action, a point of great importance with the mechanism running at a very high speed. Although it is quite possible to obtain good signals at a rate corresponding to 600 letters per minute, in practice it is found that such a high speed is not advisable, as it is difficult or impossible for even the most skilled operators properly to handle and transcribe from the ” slip ” on which the signals are recorded.

In the l’ollak-Virag system the sending is automatically carried out by means of a paper ribbon resembling in many respects that used for the Wheatstone apparatus. The ribbon carries two series of ^?’/fl*” perforations, one (on one side of the ribbon) system. representing the dashes of the Morse alphabet, and the other series (on the other side) representing the dots. The reception is effected by means of a telephone disc which is connected by a multiplying movement to a small mirror. This mirror directs a light-ray upon sensitized paper, and imprints a line which alternately rises and falls in waves ; the waves above a central line

represent the dashes, and those below, the dots. The perforated ribbon is prepared by an apparatus which closely resembles that used for perforating Wheatstone ribbon. It is inserted in an automatic transmitter, of which the essential sending parts are extremely simple. The slip passes over a metal cylinder and beneath two metal brushes, so placed as to correspond exactly in position with the two lines of perforations. In this way the passage of a perforation allows one or other of the brushes to fall and come in contact with the metal cylinder beneath. The brush which corresponds to the upper series of perforations is joined to the positive pole of the battery, while the brush which corresponds to the lower series of perforations is connected with

the nega- tive pole. The metal cylinder is joined to the line. The battery is joined to earth or to a return line. It will thus happen that when a perforation of the upper series, corresponding to the dashes of the Morse alpha- bet, passes under the brush of the transmitter, the brush comes in contact with the metal cylinder and joins the positive pole of the battery to line, while if a perforation of the lower, or dot, series passes, the corre- sponding brush will come into contact with the cylinder, and the negative pole of the battery will be joined to line. By this arrangement (which, however, is not novel) currents of differing direction are sent into the receiving apparatus. Through an aerial line 650 kilo- metres long the system has worked at a speed of over 1600 words per minute with a battery power of 20 volts only (see Electrical Review, 16th and 23rd March

1900).

In Squier and Crehore's " Synchronograph" system " sine waves " of current, instead of sharp " makes and breaks," or sharp reversals, are employed for Squier and transmitting signals, the waves being produced system. by an alternating-current dynamo, and regu- lated by means of a perforated paper ribbon, as in the Wheatstone automatic system. The arrange- ment has been found under certain conditions to give better results than those obtained with sharp reversals, but the apparatus for the purpose is (as at present ar- ranged) too bulky for general use, and cannot yet be con- sidered practicable (see Electrical Review, 7th May 1897). The Hughes apparatus has remained substantially un- altered in general arrangement. It i^ still ex- Type clusively used in England for working the

telegraphs, circuits to the Continent, but in many of the instruments the driving is effected by a small electromotor instead of by a weight.

Several new and interesting features have been intro- duced in the Eowland multiple method of telegraphic working. The transmitter consists of a mechanical key- board provided with a series of levers, which effect certain combinations of positive and negative currents for each letter. These currents are furnished by an alternator which transmits sine currents over the line and operates a motor at the distant

end of the line, both machines running in synchronism. At the receiving end of the circuit a shaft is coupled to the motor ; this is provided with gearing which rotates four combining commutators and four type wheels, which print the letters on the band of paper. There are four transmitters and four receivers, which are operated independently by means of an adapta- tion of the multiplex system of working, and each circuit is provided with a number of segments set apart for its own use. Each transmitter is therefore able to transmit a separate series of positive and negative currents in diffe- rent combinations; these are distributed, by suitably arranged distributors and relays at the receiving end of the line, into their respective receivers. The function of the ” combiner ” in each receiving instrument is so to

group the received combination of positive and negative currents that they operate polarized relays in such a manner that the position of the tongues corresponds with the operation of the levers on the transmitter. Since each letter is represented by a specific combination of positive and negative currents, it is possible, by means of the combinations, to close a local circuit at any given interval, and so cause the paper to be pressed against the periphery of the type wheel at the time when the letter required is opposite. The paper is also caused to advance automatically for each letter, start a fresh line, and also to commence a fresh form at the completion of each message.

On long circuits worked by the Wheatstone fast-speed apparatus, and especially on those in which a sub- marine cable is included, it is found neces- sary to introduce “repeaters” half way, in l?e“eaters- order to enable a high speed to be maintained. The speed at which a circuit can be worked depends upon what is known as the “KR” of the line, i.e., the product of the total capacity and the total resistance, both the capacity and the resistance having a re- tarding effect on the signals. By dividing a line into two halves the working speed will be dependent upon the KR of the longest half, and as both K and R are directly proportional to the length of the line, the KR product for the half of a circuit is but one quarter that of the whole length of the circuit, and the retardation is correspondingly small. Thus the speed on a line at which the repeater is situated exactly midway will be four times that of the

line worked direct. Repeaters (or translators, as they are sometimes termed) are in Great Britian only used on fast-speed circuits ; they are in no case found necessary on circuits worked by hand, or at ” key speed ” as it is called.

Authorities. — Preece and Sivewright’s Telegraphy ; Houston and Kennelly’s Electric Telegraphy (American) ; Montillot’s Telegraphie (French) ; Kempe’s Handbook of Electri- cal Testing. (h. b. k.)

III. Submarine Telegraphy.

The system of submarine cables originated in the mid- dle of last century by Great Britain has continued to develop in her hands until the world has been DeveI _. covered with a veritable network of cables, meat of which has hitherto done much to prevent the ble decline of her commercial supremacy, the pos- eaterPrise- session of so comprehensive a system of rapid communi- cation radiating in all directions having assisted in keeping London the centre of the world’s trade. Dur- ing the last few years, however, other maritime nations in Europe have begun to realize the importance of sub- marine cable enterprise in this respect, and France and Germany have made some progress towards freeing themselves from the British monopoly. Both are now connected to America by cables which are owned in their respective countries, though their manufacture and submergence was effected by an English company. This spread of the cable system has naturally followed trade routes, and thus, with the exception of the cables to America, their trend has been eastwards as far as Australia and Japan ; and now the circuit of the globe by British-owned cables is on the eve of completion, as the long-projected Pacific cable, connecting Vancouver with Australia, in course of manufacture, will be laid before the close of 1902.

In 1887 Sir C. Bright stated in his Presidential Address to the Society of Telegraph Engineers that 107,000 miles of submarine cable had been, up to that time, manufactured and laid, and that the capital invested therein was esti- mated at about £37,000,000, while in 1897, as stated by

Sir H. Mance (Presidential Address to the Institution of Electrical Engineers), 1300 cables were in existence, of an aggregate total of 162,000 nautical miles, varying in length from a quarter of a mile to 2600 miles, and repre- senting a total capital of £40,000,000 sterling, 75 per cent, of which had been provided by England. It was undoubtedly Sir J. Pender who contributed most, from a business point of view, to the development of this colossal industry, and to his unfailing faith in their ulti- mate realization may be ascribed the completion of the first successful Atlantic cables. At the present day (1902) the total length of submarine cable laid in the world amounts to about 200,000 miles, 20,000 being the property of Government administrations. Nearly the whole of these cables have been manufactured on the Thames, for it is only within the last few years that in Italy at Spezia, in France at Calais, and in Germany at Norden- ham, works of sufficient magnitude to turn out long sub- marine cables have been established, and even this has only been effected by the aid of more or less financial support from the respective Governments.

The principles underlying the design of a submarine cable ‘are so well established, that of recent years there has been little alteration except in the direc- faSare. t*ori °f improvement in materials and in the application of more rigorous tests. To secure immunity from the ravages of submarine boring animals, e.g., teredo navalis, it has been found necessary, for depths not exceeding 300 fathoms, to protect the core with a thin layer of brass tape, while the subjection of the core to a hydraulic pressure of four tons to the square inch and an electric pressure of 5000 volts from an alternating-current transformer has been adopted, by one manufacturer at least, to secure the detection of masked faults which might develop themselves after submergence. The deep- sea portion is sheathed with tempered galvanized steel wires, offering a breaking strain of rather over eighty tons per square inch, with an elongation of at least 5 per cent., the separate wires being first covered with a firm coating of tape and compound, or compound alone.

The open type of sheathing, where each wire was served with manila, adopted in the early transatlantic cables, has been abandoned. The costly experiment of insert- ing in one of the Atlantic cables 300 miles of the light cable proposed by Captain Trot and Mr. Hamilton had very unfortunate results, and may be deemed to have decided once and for ever against the use of any such type.

The cost of the cable before laying depends on the dimensions of its core, the gutta-percha, which still forms the only trustworthy insulator, constituting the principal item of the expense ; for an Atlantic cable of the most recent construction the cost may be taken at £250 to £300 per nautical mile.

The use, during the laying of the cable, of the mea- suring wire for determining the ship's speed has been further improved by Messrs Siemens Brothers foWqff. an<^ ^°-' so ^a a eontinuous indication and record of the actual slack paid out is secured. The instrument by which this is effected, termed a " Slack In- dicator " (Fig. 11), consists of a long screw spindle, coupled by suitable gearing with the cable drum, and thus rotating at the speed of the outgoing cable ; on this screw works a nut which forms the centre of a thin circular disc, the edge of which is pressed against the surface of a right circular cone, the line of contact, as the nut moves along the screw, being parallel to the axis of the latter. This cone is driven by gearing from the wire drum, so that it rotates at the speed of the outgoing wire, the direction of rotation being such as to cause the nut to travel towards the smaller end of the cone. If both nut and

screw are rotating at the same speed, the position of the former will remain fixed; and as the nut is driven by friction from the surfaoe of the cone, this equality of speed will obtain only when the product of the diameter (d) of the cone at that position multiplied into its speed of rotation (n) equals the product of the diameter (a) of the disc multiplied into the speed of rotation (jV) of the screw, or N/n = d/a, and thus the ratio of cable paid out to that of wire paid out is continuously given by a pointer controlled by the disc, for any difference in speed between

Fig. 11.— Slack Indicator.

nut and screw will cause the nut to move along the screw until the diameter of the cone is reached which fulfils the above conditions for equality in speed. In Fig. 11 the edge of the disc serves as the pointer and the scale gives the percentage of slack, or (N—n)/n. The wire being paid out without slack measures the actual distance and speed over the ground, and the engineer in charge is relieved of all anxiety in estimating the depth from the scattered soundings of the preliminary survey, or in calculating the retarding strain required to produce the specified slack, since the brakesman merely has to follow the indications of the instrument and regulate the strain so as to keep the pointer at the figure re- quired— an easy task, seeing that the ratio of speed of wire and cable is not affected by the motion of the ship, whatever be the state of the sea, whereas the strain will in heavy weather be varying 50 per cent, or more on each side of the mean value. Further, the preliminary survey over the proposed route, necessary

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Fig. 12.— Records of strain and depths.

for deciding the length and types of cable required, can afford merely an approximation to the depth in which the cable actually lies, since accidents of wind and weather, or lack of observations for determining the po- sition, cause deviations, often of considerable importance, from the proposed route. From the continuous records of slack and strain combined with the weight of the cable it is a simple matter to calculate and plot the depths along the whole route of the cable as actually laid. The above diagram (Fig. 12) is compiled from the actual records obtained during the laying of the Canso-Fayal section of the Commercial Cable Company’s system, and shows by the full line the actual strain recorded which secured the even distribution of 8 per cent, of slack, and by the dotted line the strain that would have been

applied if the soundings taken during the preliminary survey had been the only source available, although the conditions of sea and weather favoured close adherence to the proposed route. The ordinates of the curve give the strain in cwts., and the abscissae the distance in miles measured from the Canso end; as the strain is propor- tional to the depth, 18 cwts. corresponding to 1000 fathoms, the black line represents to an exaggerated scale the contour of the sea bed.

Owing to the experience gained with many thousands of miles of cable in all depths and under varying conditions Repairing. °^ weather and climate, the risk, and conse- quently the cost, of laying has been greatly reduced. But the cost of effecting a repair still remains a very uncertain quantity, success being dependent on quiet conditions of sea and weather. The modus operandi is briefly as follows : — The position of the fracture is determined by electrical tests from both ends, with more or less accuracy, depending on the nature of the fracture, but with a probable error not exceeding a few miles. The steamer on reaching the given position lowers one, or perhaps two, mark buoys, mooring them by mush- room anchor, chain, and rope. Using these buoys to guide the direction of tow, a grapnel, a species of five- pronged anchor, attached to a strong compound rope formed of strands of steel and manila, is lowered to the bottom and dragged at a. slow speed, as it were ploughing a furrow in the sea bottom, in a line at right angles to the cable route, until the behaviour of the dynamometer shows that the cable is hooked. The ship is then stopped, and the cable gradually hove up towards the surface ; but in deep water, unless it has been caught near a loose end, the cable will break on the grapnel before it reaches the surface, as the catenary strain on the bight will be greater than it will stand. Another buoy is put down marking this position, fixing at the same time the actual line of the cable. Grappling will be recommenced so as to hook the cable near enough to the end to allow of its being hove to the surface. When this has been done an electrical test

is applied, and if the original fracture is between ship and shore the heaving in of cable will continue until the end comes on board. Another buoy is then lowered to mark this spot, and the cable on the other side of the fracture grappled for, brought to the surface, and, if communication is found perfect with the shore, buoyed with sufficient chain and rope attached to allow of the cable itself reaching the bottom. The ship now returns to the position of original attack, and by similar operations brings on board the end which secures communication with the other shore. The gap between the two ends has now to be closed by splicing on new cable and paying out until the buoyed end is reached, which is then hove up and brought on board. After the ” final splice,” as it is termed, between these ends has been made, the bight, made fast to a slip rope, is lowered overboard, the slip rope cut, and the oable allowed to sink by its own weight to its resting place on the sea bed. The repair being thus completed, the various mark buoys are picked up, and the ship returns to her usual station.

The grappling of the cable and raising it to the surface from a depth of 2000 fathoms seldom occupy less than twenty-four hours, and since any extra strain due to the pitching of the vessel must be avoided, it is clear that the state of the sea and weather is the predominating factor in the time necessary for effecting the long series of operations which, under the most favourable circum- stances, are required for a repair. In addition, the intervention of very heavy weather may mar all the work already accomplished, and require the whole series of operations to be undertaken de novo. As to cost, one

transatlantic cable repair cost £75,000; the repair of the Aden-Bombay cable, broken in a depth of 1900 fathoms, was effected with the expenditure of 176 miles of new cable, and after a lapse of 251 days, 103 being spent in actual work, which for the remainder of the time was interrupted by the monsoon; a repair of the Lisbon-Porthcurnow cable, broken in the Bay of Bis- cay in 2700 fathoms, 11 years after the cable was laid, took 215 days, with an expenditure of 300 miles of cable. All interruptions are not. so costly, for in shallower waters, with favourable conditions of weather, a repair may be only a matter of a few hours, and it is in such waters that the majority of breaks occur, but still a

large reserve fund must be laid aside for this purpose. As an ofdinary instance, it has been stated that the cost of repairing the Direct United States cable up to 1900 from its submergence in 1874 averages £8000 per annum. Nearly all the cable companies possess their own steamers, of sufficient dimensions and specially equipped for making ordinary repairs; but for exceptional cases, where a considerable quantity of new cable may have to be inserted, it may be necessary to charter the services of one of the larger vessels owned by a cable-manufacturing company, at a certain sum per day, which may well reach £200 to £300. This fleet of cable ships now numbers over forty, ranging in size from vessels of 300 tons to 10,000 tons carrying capacity.

The life of a cable is usually considered to continue until it is no longer capable of being lifted for repair, but in some cases the duration and frequency of interruptions as affecting public convenience, with the loss of revenue and cost of repairs, must together decide the question of either making very extensive re- newals or even abandoning the whole cable. The possi- bility of repair is affected by so many circumstances due to the environment of the cable, that not even an approximate term of years has yet been authoritatively fixed. It is a well-ascertained fact that the insulator, gutta-percha, is, when kept under water, practically imperishable, so that it is only the original strength of the sheathing wires and the deterioration allowable in them that have to be con- sidered. Cables have frequently been picked up showing after many years of submergence no appreciable deteriora- tion in this respect, while in other cases ends have been picked up which in the course of twelve years had been corroded to needle points, the result probably of metal- liferous deposits in the locality. It is scarcely possible from the preliminary survey, with soundings several miles apart, to obtain more than a general idea as to the average depth along the route, while the nature of the constituents of the sea bed can only be revealed by a few small specimens brought up at isolated spots, though fortunately the globigerine ooze which covers the bottom at all the greater ocean depths forms an ideal bed for the cable. The experience gained in the earlier days of ocean telegraphy, from the failure and abandonment of nearly 50 per cent, of the deep-sea cables within the first twelve years, placed the probable life of a cable as low as fifteen years, but the

weeding out of unserviceable types of construction, and the general improvement in materials, have by degrees extended that first estimate, until now the limit may be safely placed at not less than forty years. In depths beyond the reach of wave motion, and apart from suspension across a submarine gully, which will sooner or later result in a rupture of the cable, the most frequent cause of interruption is seismic or other shifting of the ocean bed, while in shallower waters and near the shore the dragging of anchors or fishing trawls has been mostly responsible. Since by inter- national agreement the wilful damage of a cable ha3

been constituted a criminal offence, and the cable com- panies have avoided crossing the fishing banks, or have adopted the wise policy of refunding the value of anchors lost on their cables, the number of such fractures has greatly diminished.

The theory of the transmission of signals on any elec- trical circuit has been mathematically developed, at great

length, by 0. Heaviside (Electrical Papers, Trfas,' f London, 1892), who starting from Maxwell's signals. fundamental equations of the propagation of

electrical waves (see Electricity, Ency. Brit., vol. viii.) shows that if the term involving the self-induc- tion of the circuit be introduced, the " KR " formula, i.e., that the speed of signalling on a cable is inversely pro- portional to the product of its resistance into its capacity, enunciated by Sir W. Thomson (Lord Kelvin), does not completely determine the solution of the problem. As- suming certain relations between the values of resistance, capacity, inductance, and insulation per unit length, it is shown than an ideal distortionless circuit is the

result, such that the curve connecting current and time at the receiving end is an exact copy in attenuated form of that originated at the sending end. The theory of the effect of terminal apparatus by their introduction of extra resistance, &c, into the circuit has also been fully dis- cussed by the same author, as well as the effect of de- parture from the values required for the ideal circuit. Various proposals have been made for carrying out these theoretical conclusions in the realm of practical cable work, but in no case with any such probability of success as to warrant the costly experiment of laying an actual cable embodying such qualities ; in fact, the increase of capacity and attenuation of current resulting from the materials proposed, or connexions introduced, while the voltage applied must be kept within finite limits, would be such as to reduce the current far below that required to give legible signals on any receiving instruments hith- erto in use. In actual practice, therefore, the KR for- mula still governs the size of the core of a submarine cable, and to arrive at the best results for a given first cost, the tendency in the latest instances of important cables has been to increase the weight of the conductor and diminish that of the dielectric, so as to allow the latter merely the thickness required by mechanical considera- tions in manufacture. Thus in the two transatlantic cables laid in 1894 by Messrs Siemens Brothers and Co. and the Telegraph Construction and Maintenance Co. re- spectively, the core of the former consisted of 500 lb copper and 320 ft gutta-percha per nautical mile (2029 yards), while of the latter the amounts were 650 ft and 400 ft respectively; in the similarly situated cable laid in 1866 the figures were 300 ft copper and 400 ft gutta-percha. Natural gutta-percha is still the only insulator possessing the requisite qualities for durability, and though its price is increasing year by year at a rapid rate, no other material has been found to replace it with any satisfactory result.

The mirror instrument has been completely ousted by the siphon recorder, various minor improvements to which have recently been introduced, principally in the adoption of permanent steel magnets to form the field in which the suspended coil moves, and in the substi- tution of mechanical vibration of the siphon in place of electrification of the ink, so as to eliminate the ef- fect of atmospheric conditions which

frequently caused discontinuity in the flow of ink. As the earth is used for completing the electric circuit, the signals received on such sensitive instruments as these are liable to be disturbed by the return currents of other systems in their immediate neighbourhood, which also use the earth as return, when such are of the magnitude generated

by the working of electric tramways or similar under- takings, and to obviate this it is necessary to form the ” earth ” for the cable a few miles out at sea and make connexion thereto by an insulated return wire, which is enclosed in the same sheathing as the core of the main cable.

The heavier cores, with the consequent advance in speed of working attainable, have necessitated the introduction of automatic sending, the instruments adopted being in general a modification of the Wheatstone transmitter adapted to the form of cable signals, while the regularity of transmission thus secured has caused its introduction even on circuits where the speed cannot exceed that of the ordinary operator’s hand signalling. The actual speed, or rate of signalling depends to a great extent on the ex- perience and ability of the operators, but an average value furnished by the results of various recent cables (see Report Pacific Cable Committee, London, 1899) is given by the formula, S=120/ (KR), where S is the number of words per minute, R the total resistance of the conductor in ohms, and K the total capacity in farads. About 50 per cent, increase may be obtained by the use of automatic curb sending. The speed of a cable is given in words per minute, the conventional number of five letters per word being understood, though in actual practice, owing to the extensive use of special codes, the number of letters per word is really between eight and nine ; and this forms a considerable factor in lowering the earning capacity of a cable.

A relay capable of working at the end of a long cable has long been a desideratum. The difficulty experienced is that of securing a good electrical contact under the very slight pressure obtainable from an instrument excited by attenuated arrival-currents. In an instrument invented by Mr S. G. Brown (Brit. Pat. 1434 of 1899) it is sought to overcome this difficulty by causing the point of a contact- arm,

representing the siphon in the ordinary form of recorder, to traverse the cylindrical surface of a rapidly rotating drum. This surface is divided into two parallel halves by a short insulating space on which the arm normally rests, so that two separate conducting surfaces are provided, with either one of which the arm will make contact in its excursions in one direction or the other from the central position, the direction and duration of contact being governed by the motion of the suspended coil. The great reduction in friction and in electrical resistance of the contact thus effected between the recurved end of the arm and the rotating surface secures the trans- mission of signals at such a high rate of speed that the combination of this relay with a special form of curb sender allows of the re-transmission of signals into a second cable at a speed not less than that of the siphon recorder worked in the usual way. The special form of curb sender mentioned, termed the ” Interpolator,” has been devised so as to secure the correct re-transmission of any given number of consecutive elements of a letter which are of the same sign, for when signals are received at the end of a long cable the relay arm will not return to its zero position between consecutive elements of the same sign, but will remain on the respective contact surface during the whole time occupied by such consecu- tive elements. The instrument consists of two cams, the form of which regulates the components of the curbed signal, one cam being for the dot element and the other for the dash element, which by their sequence give the letter signals ; these cams, by means of clutches controlled by the relay, are mechanically rotated by clockwork, the speed of rotation being approximately adjusted to the rate of transmission of a single element, so that the req- uisite number of consecutive elements is transmitted corresponding to the duration of contact of the relay arm

with the side controlling that particular element. By a modification of this apparatus the message, instead of heing immediately re-

transmitted into the second cable, can be punched on a paper slip, which can be inserted in the usual way into an automatic transmitter, so as to send

A

\ >.* rXt\n

'r

B

:V v

D

‘V^r^A^,/^^/\^^^A^A/V/VVV

v v’ v » v\< vv vV V V V

Fig. 13. — Taylor and Dearlove’s Interpolator with Brown’s Improvements.

A, Blip as received on recorder, using ordinary relays for translating on to second cable ; B, Blip as received on recorder, when interpolator is used at intermediate Btation, for sending on to second cable ; C (four cells through a line, KR=8‘6), signals -with recorder under ordinary conditions ; D, all conditions the same as in C, but magnifying relay inserted between the end of the line and the recorder.

either cable or Morse signals. Fig 13 shows the effect of the interpolator in dissecting the consecutive elements of any letter combination. Another instrument (see Brit. Pat. No. 18,261 of 1898) is what may be termed, a mag- nifier, since signals so small as to be almost unreadable on direct record are rendered perfectly legible. The recorder coil is connected mechanically to a second similar coil, which is suspended between the poles of a laminated magnet, so that the motions of the two are similar. This magnet is excited by an alternating current, and the current induced in the second coil is after rectification sent through an

ordinary siphon recorder. As the direc- tion and intensity of this induced current are a function of the position of the second recoil in its field, and as this position is determined by its mechanical connexion with the recorder coil, it is evident that, by a suitable choice of the electrical elements of the second coil and its alter- nating field, the indications on the siphon recorder can be magnified to any reasonable extent. (See Fig. 13.)

For further information the reader is referred to the following works : — E. AVunschendorff. Traite de Telegraphic Sous- marine. Paris, 1888. — C. Bright. Submarine Telegraphs. London, 1898. — 0. Heaviside. Electro-magnetic Theory. London, 1893. — H. D. Wilkinson. Submarine Cable Laying and Bepair- ing. London, 1896. (f. Ja.)

IV. Wireless Telegraphy. The suggestion that it might be possible to effect electric telegraphy between places not connected by a continuous metallic conductor was made very early in the development of the art of employing the electric current for telegraphic purposes. Hence it may be said that the so-called wireless telegraphy and telegraphy with wires originated contemporaneously. The earliest practical attempts to establish electric telegraphy (see Tele- graphy, JEncy. Brit., vol. xxiii. p. 112) showed the necessity for a complete conducting circuit. Steinheil

of Munich, acting on a suggestion given by Gauss, made in 1838 the important discovery that half of the circuit might be formed of the conducting earth, and so dis- covered the use of the earth return, since then an essential feature of nearly every telegraphic circuit. Encouraged by this success, he even made the further suggestion that the remaining metallic portion of the circuit might per- haps some day be abolished and a system of wireless telegraphy established.

Morse showed, by experiments made in 1842 on a canal at Washington, that it was possible to interrupt the metallic electric circuit in two places and yet retain power of electric „

communication. (See Fahie, History of Wireless Tele- morse- graphy, p. 10.) His plan, which has been imitated by numerous other experimentalists, was as follows : — On each side of the canal, at a

considerable distance apart, metal plates e, e (Fig. 14) were sunk in the water ; the pair on one side were connected by a battery B, and the pair on the other by a galvanometer or tele- graphic receiver R. Under these circumstances a small portion of the current from the battery is shunted through the galvanometer circuit, and can be used to make electric signals. Morse and Gale, who assisted him, found, however, that the distance of the plates up and down the canal must be at least three or four times

RIVER ^m>-

B

Fig 14. — Morse's Conduction Method.

the width of the canal to obtain successful results. Numerous investigators followed in Morse's footsteps. James Bowman Lindsay of Dundee between 1845 and 1854 reinvented and even patented Morse's method, and practically put the plan into opera- tion for experimental purposes across the river Tay. J. W. Wilkins in 1849, and H. Highton in experiments described in 1872, also revived the same suggestion for wireless telegraphy.

The invention of the magneto-telephone put into the hands of electricians a new instrument of extraordinary sensitiveness for the detection of feeble interrupted, or alternating, cur- rents, and by its aid Professor J. Trowbridge in 1880, V^T" in the United States, made a very elaborate investiga- bridge. tion of the propagation of electric currents through the earth, either soil or water. (See " The Earth as a Conductor of Electri- city," Amer. Acad. Arts and Sci., 1880.) He found, as others have done, that if a battery, dynamo, or induction coil has its terminals connected to the earth at two distant places, a system of electric currents flows between these points through the crust of the earth. If the current is interrupted or alternating, and if a telephone receiver has its terminals connected to a separate metallic circuit joined by earth plates at two other places to the earth, not on the same equipotential surface of the first circuit, sounds will be heard in the telephone due to a current passing through it. Hence, by inserting a

break-and-make key in the circuit of the battery, coil, or dynamo, the uniform noise or hum in the telephone can be cut up into periods of long and short noises, which can be made to yield the signals of the Morse alphabet. In this manner Trowbridge showed that signalling might be carried on over considerable distances by electric conduction through the earth or water between places not metallically connected. He even placed again in view the idea, which Lindsay had originally put out in another form, that it might be possible to signal in this manner by conduction currents through the Atlantic Ocean from the United States to Europe. He and others also suggested the applicability of the method to the inter-com-

munication of ships at sea. He proposed that one ship should be provided with the means of making an interrupted current in a circuit formed partly of an insulated metallic wire connected with the sea at both ends by plates, and partly of the unlimited ocean. Such an arrangement would distribute a system of flow lines of current through the sea, and these might be detected by any other ships furnished with two plates dipping into the sea at stem and stern, and connected by a wire having a telephone in its circuit, provided that the two plates were not placed on the same equipo- tential surface of the original current flow lines. Experiments of this kind were actually tried by Graham Bell in 1882, with boats on the Potomac river, and signals were detected at a distance of a mile and a half.

At a later date, 1891, Trowbridge discussed another method of effecting communication at a distance, viz., by means of magnetic induction between two separate and completely insulated circuits. If a primary circuit, consisting of a large coil of wire P (Fig. 15), has in circuit a battery B and an interrupter I, and at some

Pig. 15.-

-Magneto-Induction Method.

distance and parallel to this primary circuit is placed a secondary circuit S, having a telephone T included in it, the interruptions or reversals of the current in the primary circuit will give rise to a varying magnetic field round that circuit which will induce secondary currents in the other circuit and affect the telephone receiver. “Willoughby Smith found that it was not necessary even to connect the tele- phone to a secondary circuit, but that it would be affected and give out sounds merely by being held in the variable magnetic field of a primary circuit. By the use of a key in the battery circuit as well as an interrupter or current reverser, signals can be given by breaking up the continuous hum in the telephone into long and short periods. This method of communication by magnetic induction through space establishes, therefore, a second method of wireless telegraphy which is quite independent of and different from that due to con- duction through earth or water.

Sir W. H. Preece, who took up the subject about the same time as Prof. Trowbridge, obtained improved practical results by combining together methods of induction and con- Preece. duction. His first publication of results was in 1882 {Brit. Assoc. Beport) , when he drew attention to the considerable distance over which inductive effects occurred between parallel wires forming portions of telephonic and telegraphic circuits. Fol- lowing on this he made an interesting experiment, using Morse’s method, to connect the Isle of Wight telegraphically with the mainland, by conduction across the Solent in two places, during a temporary failure of the submarine cable in 1882 in that channel. In subsequent years numerous experiments were carried out by him in various parts of Great Britain, in some cases with circuits earthed at both ends, and in other cases with completely insulated circuits, which showed that conductive effects could be detected at distances of many miles, and also that inductive effects could take place even between circuits separated by solid earth and by considerable distances. Mr A. W. Heaviside in 1887 succeeded in

communi- cating by telephonic speech between the surface of the earth and the subterranean galleries of the Broomhill collieries, 350 feet

deep, by laying above and below ground two complete metallic circuits, each about 2J miles in length and parallel to each other. At a later date other experimentalists found, however, that an equal thickness of sea-water interposed between a primary and secondary circuit completely prevented similar inductive intercom- munication. In 1885 Preece and Heaviside proved by experiments made at Newcastle that if two completely insulated circuits of square form, each side being 440 yards, were placed a quarter of a mile apart, telephonic speech was conveyed from one to the other by induction, and signals could be perceived even when they were separated by 1000 yards. The method of induction between an insulated primary and secondary circuits laid out flat on the surface of the earth proves to be of limited application, and in his later experiments Preece returned to a method which unites both conduction and induction as the means of affecting one circuit by a current in another. In 1892, on the Bristol Channel, he estab- lished communication between Lavernock Point and an island called Flat Holme in that channel by placing at these positions insulated single-wire circuits, earthed at both ends and laid as far as possible parallel to each other, the distance between them being 3-3 miles. The shore wire was 1267 yards long, and that on the island 600 yards. An interrupted current having a frequency of about 400 was used in the primary circuit, and a telephone was employed as a receiver in the secondary circuit. Other experi- ments in inductive telegraphy were made by Preece, aided by the officials of the British Postal Telegraph Service, in Glamorganshire in 1887 ; at Lock Ness in Scotland in 1892 ; on Conway Sands in 1893 ; and at Frodsham, on the Dee, in 1894. (See Proc. Inst. Elec. Eng., vol. xxvii. p. 869.) In 1899 experiments were made at Menai Straits to put the lighthouse at the Skerries into com- munication with the coastguard station at Cemlyn. A wire 750 yards in length was erected along the Skerries, and on the main- land one of 3J miles long, starting from a point opposite the Skerries, to Cemlyn. Each line terminated in an earth plate placed in the sea. The average perpendicular distance between the two lines, which are roughly parallel, is 2-8 miles. Telephonic speech between these two circuits was

found possible and good, the com- munication between the circuits taking place partly by induction, and no doubt partly by conduction. On the question of how far the effects are due to conduction between the earth plates, and how far to true electromagnetic induction, authorities differ, some being of opinion that the two effects are in operation together. A similar installation of inductive telephony, in which telephone currents in one line were made to create others in a nearly parallel and distant line, was established in 1899 between Rathlin Island on the north coast of Ireland and the mainland. The shortest distance between the two places is 4 miles. By stretching on the island ana main- land parallel wire circuits earthed at each end, good telephonic communication over an average distance of 6J miles was established between these independent circuits.

The difficulty of connecting lightships and isolated lighthouses to the mainland by submarine cables, owing to the destructive action of the tides and waves on rocky coasts on the . .

shore ends, led many inventors to look for a way out Sm^s y of the difficulty by the adoption of some form of inductive or conductive telegraphy not necessitating a continuous cable. Mr Willoughby S. Smith and Mr W. P. Granville put into practice between Alum Bay in the Isle of Wight and the Needles lighthouse a method which depends upon conduction through sea-water. (See Proc. Inst. Elec. Eng., vol. xxvii. p. 938.) It may be explained as follows : — Suppose a battery on shore to have one pole earthed and the other connected to an insulated sub- marine cable, the distant end of which was also earthed ; if now a galvanometer is inserted anywhere in the cable, a current will be found flowing through the cable and returning by various paths through the sea. If we suppose the cable interrupted at any place, and both sides of the gap earthed by connexion to plates, then the same conditions will still hold. Communication was established by this method in the year 1895 with the lighthouse on the Fastnet.1 A cable is carried out from the mainland at Crook- haven for seven miles, and the outer end earthed by connexion with a copper mushroom anchor. Another earthed cable starts from a similar anchor about 100 feet away near the shore line of the Fastnet rock, crosses the rock, and is again earthed in

the sea at the distant end. If a battery on the mainland is connected through a key with the shore end of the main cable, and a speak- ing galvanometer is in circuit with the short cable crossing the Fastnet rock, then closing or opening the battery connexion will create a deflection of the galvanometer. A very ingenious call-bell arrangement was devised, capable of responding only to regularly reversed battery currents, but not to stray ” earth currents,” and very good signalling was established between the mainland and the

1 See Fahie, History of Wireless Telegraphy, p. 170 ; also 6th Report (1897) of the Royal Commission on Electrical Communication with Lightships and Lighthouses.

rock. Owing to the rough seas sweeping over the Fastnet, the conditions are such that any ordinary submarine cable would be broken by the wearing action of the waves at the rock boundary in a very short time. Another worker in this department of research was Mr C. A. Stevenson, who in 1892 advocated the use of the inductive system pure and simple for communication between the mainland and isolated lighthouses or islands. He proposed to employ two large flat coils of wire laid horizontally on the ground, that on the mainland having in circuit a battery, interrupter, and key, and that on the island a telephone. His proposals had special reference to the necessity for connecting a lighthouse on Muckle Flugga, in the Shetlands, and the mainland, but were not carried into effect. Professor E. Rathenau of Berlin made many experi- ments in 1894 in which, by means of a conductive system of wire- less telegraphy, he signalled through three miles of water.

Sir 0. J. Lodge in 1898 theoretically examined the inductive system of space telegraphy. (See Proc. Inst. Elec. Eng., vol. , . xxvii. p. 799.) He advocated and put in practice

g ‘ experimentally a system by which the primary and secondary circuits were “tuned” or syntonized by including con- densers in the circuits. He proved that when so syntonized the circuits are inductively respondent to each other with a much less power expenditure in the primary circuit than without the syntony. He also devised a ” call ” or arrangement for actuating an ordinary electric bell by the accumulated effect of the properly tuned induc- tive impulses falling on the secondary circuit. A very ingenious call-bell or annunciator for use with inductive or conductive sys- tems of wireless telegraphy was invented and described in 1898 by Mr S. Evershed, and has been practically adopted at Lavernock and Flat Holme. (Id., vol. xxvii. p. 852.)

In addition to the systems of wireless or space telegraphy depend- ing upon conduction through earth or water, and the inductive _.. system based upon the power of a magnetic field created

so ‘ round one circuit to induce, when varied, a secondary current in another circuit, there have been certain attempts to utilize what may best be described as electrostatic induction. In 1885 Mr Edison, in conjunction with Messrs Gilliland, Phelps, and W. Smith, worked out a system of communicating between railway stations and moving trains. At each signalling station was erected an insulated metallic surface facing and near to the ordinary tele- graph wires. On one or more of the carriages of the trains were placed also insulated metallic sheets, which were in connexion through a telephone and the secondary circuit of an induction coil with the earth or rails. In the primary circuit of the induction coil was an arrangement for rapidly intermitting the current and a key for short-circuiting this primary circuit. The telephone used was Edison’s chalk cylinder or electromotograph type of telephone. Hence, when the coil at one fixed station was in action it generated high frequency alternating currents, which were propagated across the air gap between the ordinary telegraph wires and the metallic surfaces attached to one secondary terminal of the induction coil, and conveyed along the ordinary telegraph wires between station and moving train. Thus, in the case of one station and one mov- ing railway carriage, there is a circuit consisting partly of the earth, partly of the ordinary

telegraph wires at the side of the track, and partly of the circuits of the telephone receiver at one place and the secondary of the induction coil at the other, two air gaps existing in this circuit. The electromotive force of the coil is, however, great enough to create in these air gaps displacement currents which are of magnitude sufficient to be equivalent to the conduction current required to actuate a telephone. This current may be taken to be of the order of two or three micro-amperes. The signals were sent by cutting up the continuous hum in the telephone into long and short periods in accordance with the Morse code by manipulating the key in the primary circuit. The system was put into practical operation in 1887 on the Lehigh Valley railroad in the United States, and worked well, but was abandoned because it apparently fulfilled no real public want. Edison also patented (U.S. Patent No. 465971, 14th May 1885) a plan for establishing at distant places two insulated elevated plates. One of these was to be connected to the earth through a telephone receiver, and the other through the secondary circuit of an induction coil in the primary circuit of which was a key. The idea was that variations of the primary current would create electromotive force in the secondary circuit which would act through the air condenser formed by the two plates. The results, however, did not come up to expectation.

A very similar system of wireless telegraphy was patented by Professor A. E. Dolbear in 1886 (U.S. Patent No. 350299), in which he proposed to employ two batteries at two places to affect the potential of the earth at those places. At the sending station one battery was to have its positive pole connected to the earth and its negative pole to an insulated condenser. In circuit with this battery was placed the secondary circuit of an induction coil, the primary circuit of which contained a telephone transmitter or microphone interrupter. At the receiving station a telephone

receiver was placed in series with another insulated battery, the negative terminal of which was to be in connexion with the earth. It is, however, perfectly certain that the method proposed could not effect the transmission of speech or signals between stations separated by any distance. Many other more or less imperfect devices— such as those of

Mahlon Loomis, put forward in 1872 and 1877, and Kitsee in 1895— for wireless telegraphy were not within the region of practically realizable schemes.

Space Telegraphy by Hertzian Waves. — Up to 1895 or 1896 the suggestions for wireless telegraphy which had been publicly announced or tried can thus be classified under three or four divisions, based respectively upon electrical conduction through the soil or sea, magnetic induction through space, combinations of the two fore- going, and lastly, electrostatic induction. But a more suitable system for long distance working has been de- veloped out of the modern researches on the production of electric waves. Before the classical researches of Hertz in 1886 and 1887, many observers had noticed curious effects due to electric sparks produced at a distance which were commonly ascribed to ordinary electrostatic or electro-magnetic induction. Thus Joseph Henry (Scien- tific Writings, vol. i. p. 203) noticed that a single electric spark about an inch long thrown on to a circuit of wire in an upper room could magnetize steel needles included in a parallel circuit of wire placed in a cellar 30 feet be- low with two floors intervening. Some curious distance phenomena connected with electric sparks were observed in 1875 by Edison (who referred them to a supposed new ” etheric force “), and confirmed by Beard, S. P. Thomp- son, E. J. Houston, and others.1 Professor D. E. Hughes made some remarkable observations and experiments in or between the years 1879 and 1886. He discovered a fact subsequently rediscovered by others, that a tube of metallic filings, loosely packed, was sensitive to electric sparks made in its vicinity, its electrical resistance being reduced, and he was able to detect effects on such a tube connected to a battery and telephone at a distance of 500 yards.2

These distance effects were not understood at the time, or else were referred simply to ordinary induction. Hertz, however, made known in 1887 the experimental proofs that the discharge of a condenser produces an electric spark which under proper conditions creates an effect pro- pagated out into space as an electric wave. He employed as a detector of this wave a simple, nearly closed circuit of wire called a Hertz resonator, but it was subsequently discovered that the metallic

microphone of D. E. Hughes was a far more sensitive detector. The peculiar action of electric sparks and waves in reducing the resistance of discontinuous conductors was rediscovered and investi- gated by Calzecchi Onesti,3 and by Branly,4 Dawson Turner," Lodge,6 and many others. Lodge particularly studied the action of electric waves in reducing the re- sistance of the contact between two metallic surfaces such as a plate and a point, or two balls, and named the device a " coherer." He constructed one form of his coherer of a glass tube a few, inches long filled with iron borings or brass filings, having contact plates or pins at the end. When such a tube is inserted in series with a single voltaic cell and galvanometer it is found that the resistance of

1 See Telegraphic Journal of London, vol. iv. pp. 29, 46, 61 ; Proc. Phys. Soc. Land., vol. ii. p. 103.

2 See Fahie, History of Wireless Telegraphy, p. 289 ; also an im- portant letter by Professor D. E. Hughes himself in the Electrician of London, vol. xliii. p. 40.

8 Nuovo Cimento, series iii. vol. xvii.

4 Comptes Rendus, vols. cxi. , cxii. ; see also the Electrician, vol. xl. pp. 87, 91, 166, 235, 333, and 397; vol. xli. p. 487; vol. xlii. pp. 46 and 527 ; and vol. xliii. p. 277.

6 Report Brit. Assoc, 1892.

B Lodge, Signalling through Space without Wires, 3rd ed., p. 73,

1899.

the tube is nearly infinite, provided the filings are .not too tightly squeezed. On creating an electric spark or wave in the neighbourhood

of the tube the resistance suddenly falls to a few ohms and the cell sends a current through it. By shaking or tapping the tube the original high resistance is restored. In 1894 he exhibited at Oxford apparatus of this kind in which the tapping back of the tube of filings was effected automatically. He ascribed the reduction of resistance of the mass to a ~~welding or cohering action taking place between the metallic par~~ ticles, hence the name coherer. But it has since been discovered that it is not universally true that the action of an electric wave is to reduce the resistance of a tube of powdered metal (see below).

Between 1894 and 1896 Gr. Marconi gave great atten- tion to the improvement of devices for the detection of electric waves. He made his sensitive tube, or arcon . improved. coherer, as follows : — A glass tube having an internal diameter of about 4 millimetres has sealed into it two silver plugs PP by means of platinum

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Fig. 16. — Marconi Form of Coherer.

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wires WW (Fig. 16) ; the opposed faces of these plugs are perfectly smooth, and are placed within a millimetre of each other. The interspace is filled with a very small quantity of nickel and silver filings, about 95 per cent, nickel and 5 per cent, silver, sufficient to fill loosely about half the cavity between the plugs, which fit tightly into

IB

Fig. 17. — Transmitter and Eeceiver, later Marconi System

the tube. The tube is then exhausted of its air, and attached to a bone or glass rod as a holder. Marconi employed this device as a very sensitive relay to set in operation ordinary telegraphic apparatus. The arrange- ments of his receiver as subsequently modified are as follows: — The plugs of the sensitive tube T (Fig. 17) are joined to the terminals of the secondary circuit S'S'

of a small transformer, called a "jigger," which has its secondary circuit cut in the centre and a small condenser C inserted. The terminals of the condenser are also connected to a relay B and single voltaic cell B through two coils of high inductance KK; the relay actuates a Morse printer or other telegraphic receiver through a local battery in the ordinary manner. One terminal of the primary circuit P' of the jigger is connected to the earth E, and the other to an elevated conductor A or nearly vertical wire otherwise insulated. The great improve- ment introduced by Marconi was the employment of this vertical air-wire, aerial, antenna, or elevated conductor, as it is variously called, in combination with the earth con- nexion at both the receiving and transmitting stations ; this aerial being used as a Hertz oscillator or radiator, and also as an electric wave absorber. A simple coherer, however sensitive, is not affected by an oscil- latory spark at any very great distance, the reason being that the coherer is a small object and offers little surface to be acted upon by the electric wave, and therefore gathers up little wave energy. Minchin is said to have used collecting wires in connexion with photo-electric cells used as electric wave detectors (Elec- trician, vol. xxxix. pp. 832, 869). In 1895 it occurred to Popoff, a Bussian physicist (see Proc. Physico- Chemical Society of Russia, vol. xxviii. p. 18), to connect a coherer to a lightning conductor, and using in connexion with it a relay, automatic tapper after the manner of Lodge, and Morse printer, he obtained records on the tele- graphic tape due to atmospheric electric discharges at a distance. This, however, was not telegraphy, and there does not appear to be any evidence that any communication by Hertz waves of the nature of intelli- gible signals was achieved until Marconi in 1896 em- ployed an aerial or air-wire, or elevated conductor, in connexion with the one secondary terminal of the trans- mitting induction coil, in the primary circuit of which he placed a signalling key, and also with one terminal

of the receiving coherer, the other ends of both appliances being connected to the earth.1 This use of an aerial at each place made all the difference between mere laboratory experiments and telegraphy in any proper sense of the word. It was soon found that the distance at which the effects of the oscillatory spark could be perceived by the aid of the coherer was closely connected with the height of this air-wire or aerial connected to the spark balls and coherer. Marconi then adopted the plan of erecting tall masts at the two stations between which wireless telegraphy was to be accomplished, and suspending from the top of each an aerial in the form of a long insulated copper wire. The opera- tion of the receiver is as follows : — When electric waves created by a distant oscilla- tory spark, or rapid train of oscillatory sparks, the magnetic flux component of which is parallel to the earth's surface, fall on the aerial they set up in the primary cir- cuit of the receiving induction coil or jigger electrical oscillations which induce other oscillations in the secondary circuit. These secondary oscil- lations break down the resistance of the tube and render it conductive; the single cell then sends a current through the

1 Captain H. B. Jacksou, R.N., has stated (Proc. Roy. Soc, May 1902) that in 1805 he hegan systematic experiments with Hertz waves for the purposes of navy signalling.

coherer and causes the relay to operate, thus working the telegraphic instrument — generally a Morse printer — con- nected to the relay work. The receiver has a tapper or electromagnetic hammer in connexion with it which is set in operation by the current passing through the Morse printer; hence when the local battery actuates the printer the same current is used to administer small regulated taps or shocks to the tube, which bring it back to a non- conductive condition. By suitably adjusting the strength of these taps matters can be arranged so that a short train of oscillations causes a dot to be

registered on the Morse tape, while a longer train registers a dash. In certain cases another condenser C ” (Fig. 17) is joined in across the terminals of the sensitive tube.

The transmitter used with the arrangement consists (Fig. 17) in one form, of a large induction sparking coil I, the secondary of which is connected to an adjustable spark ball discharger Sp. To the two spark balls are connected the terminals of a circuit consisting of a con- denser C or series of Leyden jars arranged either in parallel or in series, and the primary circuit P of another air-core induction coil consisting of very few turns. The secondary circuits of this last induction coil have one terminal connected to the earth E, and the other to an elevated and insulated conductor A. In the original Marconi system the transmitter consisted solely of the induction coil I, generally a 10-inch spark coil, having

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X

K R

Fio. 18,— Transmitter and Receiver, original Marconi System.

one secondary terminal connected to the earth and the other to an elevated conductor A, often 150 feet long (Fig. 18). Similarly at the receiving end the terminal of the coherer T was connected directly to the aerial A, while the other was put to earth, the tube being also in circuit with a relay R and a cell B through impedance with KK. Subsequently, however, it was found by F. Braun and by Marconi that a greatly increased distance could be covered in signalling by the use of the second interposed induction coil PS and condenser C placed between the primary coil and the circuit of the elevated conductor (Fig. 17). In this last arrangement the oscillations are induced in the aerial by others in a cir- cuit of larger capacity and therefore greater energy-storing power. Further, Marconi discovered that by suit- ably bringing

into resonance, or tuning, the four circuits composing the primary and secondary of the receiving jigger, and this last-mentioned oscillation transformer or induction coil, the primary of which takes the discharge of the condenser, the receiver so tuned could be prevented from responding to irregular waves sent out from other non-resonant exciters. On these principles he elaborated between 1896 and 1900 a system of electric wave or spark

telegraphy (German, Funken Telegraphie), in which each receiver was tuned to a particular wave frequency and responded only to that one frequency, or to a not very high harmonic.

At one time Marconi experimented with simple Hertz trans- mitters or wave producers placed in the focus of parabolic mirrors, and by this means was able to effect signalling up to a distance of a couple of miles. In some of the early experiments a Rhigi transmitter was employed, sparks being taken between brass balls immersed in oil, but he afterwards found that the wave production was more energetic if an ordinary 10-inch spark coil was used to produce sparks between brass balls in air 1 inch in diameter, placed 1 centimetre apart. Each of these sparks is a series of oscillatory discharges taking place between the earth and the elevated insulated conductor, or of electrical oscillations induced in the aerial, and each oscillation creates an electro-magnetic impulse or electric wave, or train of waves, which is propa- gated out into space over the surface of the sea or earth and affects the distant coherer. Owing to the high radiative power of the vertical wire, each oscillatory discharge gives rise only to a very brief train of electric waves, perhaps only a single impulse, but these impulses follow each other at a rate depending upon the vibration rate of the contact breaker of the induction coil. When the waves reach the receiver they act, as above explained, in setting the telegraphic printer in operation.

Marconi made his earliest demonstrations in Italy, and followed with others in England between Lavernock and Elat Holme, and Lavernoek and Bream Down, near Bristol, in May 1897. Early in 1898 permanent stations were established between Alum Bay and Bournemouth, a distance of i\ miles, where successful results were obtained. Later the

Bournemouth station was removed to Poole Harbour, and the Alum Bay station to Niton in the Isle of Wight, the distance being thus increased to 30 miles. In December 1898 communication was established by the Marconi method between the East Goodwin lightship and the South Foreland lighthouse ; and this installation was maintained for up- wards of a year, during which it was the means of saving both life and property. In March 1899 communication was effected by his system between England (South Foreland lighthouse) and France (Wimereux, near Boulogne), a distance of 30 miles. He kept up the communication for six months, in all weathers, and found that ordinary commercial messages could be transmitted at the rate of 15 to 20 words a minute. In January 1901 he established communication by his system between the Lizard in Cornwall and Niton in the Isle of Wight, a distance of 200 miles. A full account of the development of his system was given by him in an article published in the Fortnightly Meview for June 1902. Wire- less telegraphy by electric waves, though by no means in every case with apparatus made by Marconi, has been largely adopted by the British and other navies and in the mercantile marine, and has proved to be of great utility in ordinary marine signalling between ship and ship and ship and shore.

The method of Hertzian wave telegraphy described above labours under the disadvantage that several trans- mitters and receivers in the same region affect each other equally. A transmitter consisting Marconi's of a simple aerial or insulated conductor con- %"^J.C nected as described to the secondary terminal of an induction coil, the other terminal of which is earthed (see Fig. 5), affects within a certain radius all simple coherers or other receivers alike. Great attention has therefore been directed to the consideration of syntonic receivers and transmitters which can be " tuned," so that the tuned pair alone affect each other, but do not affect, and are not influenced by, other similar apparatus not tuned to sympathy with them. The improvements which have been made depend upon the fact that every circuit possessing inductance and capacity has a natural free time-period of electrical vibration. Thus if a condenser of capacity C is joined in series with a coil of inductance L, and a sudden impulsive electromotive force is applied to the circuit and then withdrawn, an electrical oscillation or

rapidly alternating electric current will be created in the circuit, the frequency of which is equal to 1/2-n- VLC.

Circuits are, however, broadly divided into good and bad radiators. In the first, an electrical oscillation when set up gives rise to the production of an electric wave or very short wave train in the surrounding ether (see

Electricity : Electric Waves, vol. xxviii.), and the oscilla- tions are rapidly damped out. In the second the oscilla- tions persist in the circuit, and do not give rise to radiated wave energy to anything like the same extent. Examples of radiative circuits are the ordinary Hertz radiator or a simple Marconi vertical insulated wire. Instances of non-radiative circuits are a Hertz resonator, or a coil and Leyden jar connected in series with a small spark gap in one place. There can be no effective syntony or tun- ing between very radiative circuits. Thus in the case of the Marconi simple vertical wire or transmitter the effect sent out at each spark can hardly be called a train of electric waves, but is merely a single impulse, or at most one or two vibrations. The energy stored up in the aerial is radiated, as it were, in one explosion. On the other hand, non-radiative circuits, though susceptible of being tuned, and able to affect each other by electro- magnetic induction at small distances, cannot send out wave energy enough to affect each other at great dis- tances. Marconi has, however, ingeniously combined the two forms of circuit (see British Patent Spec. No. 7777 of 1900), and by connecting a condenser placed in series with the primary coil of an oscillation transformer to the spark gap of an induction coil, and one terminal of the secondary circuit of the oscillation transformer to an aerial, the other terminal being connected to the earth, has made a transmitter capable of sending out trains of electric waves of definite wave length, provided that the two circuits of the oscillation transformer are tuned together. In other words, he associates a pair of

syn- tonic circuits inductively, one being a good radiator and the other a persistent oscillator (Fig. 17). In the same way, at the receiving end he constructs a compound receiver consisting of an aerial wire earthed through the primary of an oscillation transformer, which is in syn- tony with a secondary circuit consisting of a coil and condenser. A receiving circuit of this kind responds only to its proper transmitter, and not to any simple Hertz wave producer. Using this device, Marconi was able in September 1900 to show the simultaneous send- ing and reception of two different Hertz wave telegraphic messages on the same aerial; and in 1900 and 1901 he elaborated a number of different forms of transmit- ters or' radiating circuits, and a complete system of independent Hertz wave telegraphy, so arranged that syntonized receivers and transmitters alone re- sponded, and were not affected by ordinary non- tuned apparatus (see Journal Society of Arts, vol. xlix. p. 505).

Other workers in the same field have been Sir O. J. Lodge, who in conjunction with Dr A. Muirhead patented

various devices for syntonic Hertz wave tele- fyttemArC° graphy (British Patent Spec. No. 18644 of

1897), and Slaby in Germany, who in co-opera- tion with Count von Arco worked out a similar system. The Slaby-Areo arrangement consists at the transmitting end of an inductance coil elevated above the ground; one end of this coil is connected to the earth by a wire and the other end to a condenser, the opposite terminal of which is connected to one secondary terminal of an induction coil, the other terminal of this induction coil being earthed. The Slaby-Arco receiving arrangement in one form consists of an aerial wire which may be earthed, and from the lower end of which proceeds a straight or loosely coiled wire of the same length as the aerial. The coherer, or detector, is inserted be- tween the earth and the outer end of this last wire (see Pig. 20). The vertical aerial wire responds to electromagnetic waves having a wave length of four times its own length, and the outer end of the attached bottom wire experiences variations of potential similar

to that of the top of the aerial wire. By this arrange- ment a receiving circuit is made having a selective power, and an exhibition of duplex wireless telegraphy was given with it in December 1900 by Slaby, which, however, did not anticipate Marconi's work. Other workers who have given attention to syntonic wireless telegraphy are Blondel, Ducretet, and Tissot in Prance, Popoff in Eussia, and Braun in Germany. Braun sug- gested the employment of an oscillation transformer for inducing the oscillations in the aerial, but did not appre- ciate at first the importance of having the transformer circuits in tune with each other.

The essential difference between a tuned or syntonic receiver and one not tuned may be likened to the effects of surface waves on water when acting on various forms of floating bodies. A cork floating on the surface is caused to bob up and down by surface waves of any period. If, however, a heavy log of wood be tethered to the bottom of the sea by a spiral spring the arrangement would have a definite natural period of vibration, and would only be set in oscillation by surface waves of like periodicity. Similarly a simple coherer attached in series with an aerial and the earth is affected by any electric wave of any kind ; but if the arrangements de- vised by Marconi are made, the receiver becomes in- sensitive to electric waves of any frequency except those to which it is tuned.

The true function of the various elements in Marconi's system of electric wave telegraphy can hardly yet be said to have been determined. The earth connexion at both receiving and sending end is essential for long-distance work. Signals may be sent over a few miles with apparatus insulated at both ends, but for tele- graphy over any distance, such as 100 or 200 miles or more, a good earth connexion is essential. The signals are better transmitted over water, especially sea-water, than over land, and over moist land than dry land. Coupled with the fact of the known opacity of water for short electric waves, this seems to point to a greater absorption of energy by dry earth than by water. As regards the effect of rotundity of the earth, in which the popular mind has professed to see a reason for a limitation of long-distance work, there is no evidence yet that it is effective. Although no

accurate measurements have yet been made of the wave length usual in practice, theory points out that the fundamental wave length will probably be about four times the length of the aerial or antenna employed. Hence, with 200-feet masts the wave length is nearly one-sixth of a mile. Diffraction effects must therefore be present in any moderate terrestrial distances, and the earth curva- ture is not an effective screen even for distances of 1000 miles or so. The importance of the earth connexion may arise from the wave being thus compelled to expend itself wholly in the space between the receiver and transmitter.

There is some evidence that the function of the aerial in receiv- ing is not the same as in sending. In sending it acts as a capacity. What is then required is means for storing up a sufficient quantity of electric energy which can be discharged as an electric wave or wave train. Accordingly, metallic cylinders or surfaces only slightly elevated can be used as transmitters. In the reception of effects a certain height of aerial is essential. The function of the aerial may then be, as suggested by J. A. Fleming, to integrate the electric force distributed through space into electromotive force, and for this purpose a length of metallic conductor is neces- sary. Marconi has enunciated the law that, other things being equal, two similar aerials will respond at distances varying as the square of their height. When the principal of tuning or resonance is made use of it is remarkable how small an initial expenditure of energy will, with the proper aerial, affect a receiver at very great distances. Thus, with masts 150 feet high, Marconi has worked between the Isle of Wight and Cornwall, a distance of 200 miles, the spark energy in this case being a 7-millimetre spark, equivalent to about 20,000 volts, charging a capacity of about 1/100 of a microfarad. Each discharge therefore represents the dissipation of energy equal to 2 joules or about 1J foot- pounds. Probably only a portion of this is really employed in wave-making, yet the effects can be detected everywhere on the circumference of a circle 200 miles in radius described on an ocean surface. This sensibility can, however, only be obtained by the most careful syntonization of the transmitter and receiver, but when syntony and large wave-making energy are combined electric wave wireless telegraphy over very long distances can be accomplished.

In creating powerful electric waves for communication over long distances it is necessary to employ an alter- nating current transformer (see Transformers) distance supplied with alternating currents from a low wireless frequency alternator D driven by an engine telegraphy. (Fig 19) The transformer T, has its secondary or high-pressure terminals connected to spark balls Si, which are also connected by a circuit consisting of a large glass plate condenser Cj and the primary circuit of an

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Fio. 19.— Alternate Current Transformer System. (Fleming.)

air-core transformer T2 called an oscillation transformer. The secondary circuit of this last is either connected in between an aerial A and the earth E, or it may be again in turn connected to a second pair of spark balls S2, and these again to a second condenser C2, oscillation transformer T2, and the aerial A. In order to produce electric oscillations in the system, the first or alternating current transformer must charge the condenser connected to its secondary terminals, but must not produce a per- manent electric arc between the balls. Various devices have been suggested for extinguishing the arc and yet allowing the condenser oscillatory discharge to take place. Tesla effected this purpose by placing the spark balls transversely in a powerful magnetic field. Elihu Thomson blows on the spark balls with a powerful jet of air. D'Arsonval causes the spark balls to revolve rapidly, and the draught of air acts in the same manner. J. A. Fleming devised a method which has practical advantages in both preventing the arc and permitting the oscillatory currents to be controlled so as to make electric wave signals. He inserts in the primary circuit of the alter- nating current transformers one or more choking or im- pedance coils Ej, E2 (Fig. 19), called "chokers," which are capable, one or all, of

being short-circuited by keys Kj, K2. The impedance of the primary or alternator circuit is so adjusted that when both the chokers are in circuit the current flowing is not sufficient to charge the condensers; but when one choker is short-circuited the impedance is reduced so that the condenser is charged, but the alternating arc is not formed. In addition it is necessary to adjust the frequency so that it has the value of the normal time period of the circuit formed of the condenser and transformer secondary circuit, and thus it is possible to obtain condenser oscillatory discharges free from any admixture with alternating current arc. In this manner the condenser discharge can be started or stopped at pleasure, and long and short discharges made in accordance with the signals of the Morse alphabet by manipulating the short-cir- cuiting key of one of the choking coils (see British Patent Specs. Nos. 18865, 20576, and 22126 of 1900, and 3481 of 1901). Another method suggested by Fleming by which the necessary control can be obtained for signalling is to construct the alternator with a field-magnet entirely of laminated iron, and then to open and close the exciting circuit by a suitable key. This then controls the condenser discharges and the pro- duction of the waves.

Availing himself of a suitable transformer plant for the production of powerful trains of electric waves, Marconi was able to produce and receive signals across Trans. the Atlantic Ocean between Cornwall in Eng- atiantio land and St Johns in Newfoundland on 12th wireless December 1901. A station was erected at ielesr*Pt'y- Poldhu near Mullion in Cornwall, in which was established an alternating current transformer plant. The general design and engineering arrangements for this first " aether wave power station " were made by the writer of this article. Condenser discharges were employed to create powerful electric oscillations in an aerial consisting of about 50 wires 150 feet long upheld in a fan form between two masts, the lower end of the aerial being connected through an oscillation transformer with the earth. Subsequently this aerial was enlarged, and now consists of 400 wires, upheld by four wooden towers each 215 feet high. At St Johns in Newfoundland Marconi elevated a wire 400 feet long by means of a kite, and, using a receiving jigger and various very sensitive electric wave detectors in connexion with a telephone and battery, was able to

hear sounds corresponding to condenser dis- charges in Cornwall - repeated rapidly three times (three dots) making the letter S in the Morse alphabet. These S signals were repeated regularly at intervals in accordance with a pre-arranged programme, so as to leave no doubt that they were really due to electric waves generated at the Cornwall station and propagated across the Atlantic Ocean a distance of 1800 miles. This experiment proved that the rotundity of the earth, amounting to an elevation of 110 miles in the 2000 miles, did not altogether inter- cept the electric waves. In a repetition of this experiment at the end of February 1902, Mr Marconi, on board the s.s. Philadelphia, received wireless messages printed down on the ordinary Morse tape at a distance of 1557 miles from the sending station at Poldhu, in Cornwall, England. He also received the letter S at a distance of 2099 miles from the same place. In the course of this voyage he noticed that the signals were better received during the night than the daytime, and that legible messages were received only 700 miles by day, but 1500 by night.

So long as a receiver consisting of metallic filings is used as a detector of electric waves, it has to be tapped and reset between each signal automatically in the manner suggested by Lodge and Popoff. This limits the rate at which the Llmlta- coherer can be worked in receiving signals on the *‘ons an« Morse alphabet system. Attempts have therefore been menu6″ made to obtain a self-adjusting receiver which shall work more rapidly. D. E. Hughes found in 1879 that a loose or microphonic contact of two metals was reduced in electrical resistance when an electric spark was made near it, and he dis- covered (see Electrician, 5th May 1899) that a carbon-steel micro- phonic contact is self-setting and requires no tapping back to cause it to regain its original resistance. It has since been found that an exceedingly sensitive electric wave detector which is self- recovering can be made by including a globule of mercury between an iron and a carbon rod placed as plugs in a glass tube. This microphonic receiver in connexion with a telephone and battery forms a very sensitive receiver for wireless telegraphy, and in one form, the invention of which has been claimed by Lieut. Solari, this receiver was used by Marconi in the first trans- atlantic wireless transmission (see V Elettricista, May 1902, p.

118 ; also the Electrician, vol. xlix. p. 477, 1902, where the inventor is, however, stated to be P. Castelli, a petty officer in the Italian navy) . Schafer has devised a receiver, which he calls an ” anti-coherer,” by depositing silver upon glass and then scratching the deposit across with a diamond. If the gap is about 30 mm. long, then the resistance between the two sides is not infinite, but about 40 ohms. If electric waves fall on this receiver its resistance in- creases about threefold, and falls again when the waves cease. This receiver can therefore be used in connexion with a telephone and battery and interrupter to receive Morse signals by ear. Neugschwender (Wied. Ann., vol. lxviii. p. 92) found that if a similar cut across a deposit of silver upon glass was breathed upon the film of moisture transmitted a small current electrolytically, but the impact of electric waves stopped this current. In one case the impact of waves on a cut 20 mm. long and 0-5 mm.

wide caused the resistance to rise from 50 ohms to 90,000. J. C. Bose (Proc. Roy. Soc, vol. lxv. p. 171) found that a receiver made of fragments of potassium in kerosene increased in resistance when electric waves fell on it, and spontaneously recovered its former conductivity when the waves ceased. Up to the present time (1902), however, no one has succeeded in making a practical self-restoring electric wave detector for wireless telegraphy which can be used in conjunction with a relay to work a Morse printer, except the self-tapping metallic filings coherer as employed by Lodge, Marconi, Slaby, and others.

The actions taking place in the filings coherer when submitted to electric radiation have been studied by many physicists. Blondel and Dobkevitch (Comptes Rendus, 23rd April 1900) have stated that when such a tube is submitted to gradually increasing E.M.F. there is a

certain critical voltage at which it passes sud- denly from a non-conducting to a conducting condition. But W. H. Eccles (Electrician, vol. xlvii. p. 682) has denied this, and states from an extensive experience that a degree of coherence is produced by any E.M.F., and that its detection is merely a question of delicacy of instrument. A considerable amount of knowledge and skill is required to make a properly sensitive metallic filings coherer (Ger. Fritter) . The general experience is that tubes made exclusively with non-oxidizable metals, e.g., gold, silver, or plati- num filings, are too sensitive, while those made exclusively with very oxidizable metals, e.g., iron, copper, &c, are too insensitive and uncertain for telegraphic work. Marconi has obtained his best results with receivers in which nickel mixed with a small percentage of silver filings is used in a good vacuum between silver terminals. Even then to work well the tube must not have currents exceeding one-tenth of a milliampere sent through it, and

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Fig. 20.— Slaby-Arco System.

Ihe tapping back must be very gentle. So far all that can be said is that the making of a good metallic filings coherer tube is a matter of skill rather than science. M. Blondel and also Sir O. J. Lodge have designed forms of sealed tube with a pocket to hold a store of filings so that the working mass can be changed, but experience is wanting to show how far this is an advantage in practice.

The mode in which the sensitive tube should be connected to the aerial and the form of the latter have been the subject of much investigation. Slaby has contended that the coherer should not be connected between the aerial and the earth, because the latter place is a point of zero potential, and the amplitude of potential variation due to oscillations in the aerial is small near the base of the latter. He has therefore, in conjunction with Count Von Arco, devised arrangements for which he claims an advantage. At the transmitting end the aerial A (Fig. 20), which may consist of a lightning conductor, has a loop at its lower end

connected with one secondary terminal of the induction coil. One secondary spark ball of the induction coil I is connected to this loop, and the other to a condenser C in series with an earthed inductance coil L. At the receiving end a similar lightning conductor A has its loop connected to a very open spiral wire V, the length of which is equal to the height of the aerial, and the outer end of this coil is connected through another coil M, called a multi- plicator, to the coherer F. The coherer is earthed through a condenser C, which is shunted by a relay K and one dry cell B ; according to Slaby, the receiver and transmitter can be so "tuned" that the receiver does not respond to electric waves

of any length, but only to those proceeding from the proper transmitter. In a demonstration given in December 1900 he exhibited the apparatus in action, and showed that two receivers tuned to different wave lengths could be connected to the same lightning rod and that each would only respond to its own proper transmitter (see Electrical Review, London, 28th December 1900 ; or Engineer- ing, 8th February 1901). The difficulty, however, has hitherto been to prevent even a so-called " tuned " receiver from responding to any electric wave if the latter is sufficiently vigorous.

In 1896 E. Rutherford (see Proc. Roy. Soc, vol. lx. p. 184, June 1896) described " A Magnetic Detector of Electric Waves and some of its Applications." This detector consisted of a bundle of very fine steel wires which were surrounded by a coil of wire. The steel was magnetized, and it was found that when the above coil was placed in series with a receiving circuit the oscillations set up in the latter demagnetized the steel. The effect was produced at dis- tances of half a mile. More recently Marconi (see Proc. Roy. Soc, 12th June 1902) discovered that if a bundle of iron wires is carried slowly through a magnetic cycle by being rotated in a magnetic field so as to magnetize it first in one direction and then in the other, it becomes very sensitive, to the magnetizing action of electric oscillations. When a bundle of iron wires is thus carried through a cycle of magnetic operations the magnetization lags behind the magnetizing force in consequence of hysteresis (see Magnetism, vol. xxx.). If this bundle of iron wires is sur- rounded by two coils, of insulated wire, one of which is in circuit with a

telephone and the other is in inductive connexion with an aerial wire, then when an electric oscillation is set up in the aerial by an arriving electric wave these oscillations cause the magnetization of the iron core suddenly to come up into step with its external magnetizing force. This gives rise to a secondary current, and this is heard as a ” tick ” in the telephone. Marconi has in this manner con- structed an improved magnetic detector of electric waves which is exceedingly sensitive and more cer- tain than the coherer, with which it has nothing in common. This receiver, from its constant resistance, admits of being employed with great advantage in a syntonic system of wireless telegraphy. In July 1902, using this receiver, he received “wireless” messages on board the Italian flagship Carlo Alberto sent out from Poldhu, the vessel being then in Cron- stadt harbour and the signals crossing England, the North Sea, Denmark, and the Baltic.

Marconi has described several interesting forms of transmitter and syntonic receiver arrangements (see Journ. Soc. Arts, London, vol. xlix. p. 506). One of these, the transmitter, consists of two concentric metal cylinders or a length of concentric cable. The inner cylinder is connected to earth and to one spark ball of an induction coil. The outer cylinder is con- nected to the other spark ball through an inductance. The improvement thus effected consists in giving the aerial a larger capacity, and enabling it to store up more electric energy. The radiation thus consists of a greater train of waves. The ordinary simple or plain insulated aerial used as a transmitter on Marconi’s first plan has a very small capacity. Measurements show that a single aerial consisting of a 7/20 copper wire 200 feet in length, suspended vertically, has a capacity of 0-0004 microfarad, whilst 25 such wires arranged 3 inches apart, parallel to each other, have a capacity of 0-0016 microfarad. There is a limit to the length of oscillatory spark which can be obtained on such a single wire aerial with an ordinary 10-inch induction coil, usually employed, which may perhaps be taken at 2 centimetres, representing a potential of about 60,000 volts. Hence, for a single aerial as above, the stored-up energy before discharge amounts to I x -0004 x (60,000)2=0-72 joule, or about 1^ foot-pound. Not all this energy, however, is available for wave making, as some is dissipated as heat. Moreover, this small amount of energy is almost all discharged in the first half

vibration, so that no true train of waves is radiated, but merely an impulse given to the ether. Large capacity as well as large surface in the aerial is essential for the achievement of long-distance wireless telegraphy, especially if the latter is to be syntonic. This can only be accom- plished by storing up a large amount of energy in a condenser and releasing it into a non-radiative circuit which is inductively connected with the radiative circuit. The radiative and storage power of the combination can be adjusted so as to radiate a con- siderable train of energetic electric waves.

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Telephone. — The electric speaking telephone was invented by Alexander Graham Bell, who first proposed to transmit speech electrically by the employment of electric undulations similar in form to the sound waves which characterize the words spoken. The apparatus- constructed by him for the purpose of putting this con- ception into a practical form was the so-called magneto- telephone, in which a thin iron diaphragm is placed opposite a pole-piece constituting the end of a permanent magnet, around which pole-piece is wound a coil of in- sulated wire. The iron disc is enclosed in a suitable box, and the instrument is furnished with a mouth-piece. The transmitter and the receiver are alike. On speaking into the transmitter the air waves produced by the voice act to set the iron diaphragm into a corresponding condi- tion of vibration. This, by its inductive action upon the magnet and coil, generates an undulatory current in the line which copies, as it were, the characteristics of the sound waves. The passage of this undulatory current through the coil of the receiving instrument varies the strength of the pole of its magnet and thus attracts the iron diaphragm more or less strongly, so that this enters into vibration and acquires motion of a character corre- sponding to and determined by the undulatory current. These vibrations of the receiver diaphragm produce air- waves which are necessarily similar in all their character- istics to those produced by the voice at the transmitter. Hence the sound heard at the receiver is a reproduction of that spoken into the transmitter.

Microphone. — The magneto-receiver has been univer- sally used in practical telephony. But the magneto- transmitter was soon superseded by the microphone- transmitter, originally invented by ISinile Berliner, which produces much louder effects. In this instrument an application is made of the principle that the transition resistance, as it has been called, which exists at the sur- face of contact of two separate conductors or electrodes, through which a current is passing, is varied in magnitude with changes in the pressure between them, becoming less

as the pressure is greater. This change is particularly marked when one or both of the electrodes are of carbon. The form of microphone which until recently has been the standard type in the United States and to a large extent in other countries is the Blake transmitter, in which the electrodes are of platinum and hard carbon respectively. These are suspended from springs, and press lightly against one another. The platinum electrode is small, approxi- mately ellipsoidal in shape, and rests in contact with the diaphragm. The carbon electrode is of large mass, and has spun around it a button of brass, still further in- creasing its inertia. When the diaphragm is set into vibration by the voice, its motions are communicated to the platinum " hammer electrode." This presses more or less closely against the "anvil electrode" of

carbon, which on account of its large mass does not readily enter into motion; and there is thus brought about a variation in the transition resistance existing at the surface of contact of the two electrodes. The electrodes being in circuit with a battery and the re- ceiving instrument, undulations will be produced in this circuit in consequence of the variation in transi- tion resistance referred to, and these undulations will be of the same character as the sound waves which actu- ate the transmitter, and will thus cause a reproduction of speech at the receiver. Ordinarily the battery and microphone are put in circuit with the primary of an induction coil, in the secondary of which are placed the line and the receiver, in order to give better conditions for overcoming the necessarily large line resistance.

Another type of microphone which has been used in Europe much more than in the United States is the multiple-contact instrument. In this several microphonic joints are employed. Thus, in the Crossley transmitter four hard carbon pencils are arranged in a lozenge-shaped figure, the ends of each pencil resting loosely in a small carbon block. These blocks are fastened to a diaphragm of wood. The circuit connexions are such that two adjacent sides of the lozenge are in parallel and two in series. In the Ader transmitter as many as twelve carbon pencils are employed, arranged in a series of two groups with six pencils in parallel in each group. These are supported at their ends in parallel carbon bars, which are carried by a nearly horizontal

wooden diaphragm. Such multiple-electrode transmitters give a loud although some- what harsh sound, and will bear being spoken to very strongly without breaking the circuit.

A type of transmitter which has come to be invaluable in connexion with long-distance telephony, and which is superseding all other forms, is the granular carbon trans- mitter. The earliest instrument of this kind was the Hunnings transmitter. This was constructed of a shallow box placed in a vertical position, with metallic front and back and insulating sides. The front face was of thin metal, and served as a diaphragm. The box was filled nearly but not quite full of granulated hard carbon. The current from the battery used passed from the diaphragm through the granulated carbon to the metallic back of the box. When spoken to, the diaphragm vi- brated, and thus set the carbon granules into vigorous vibration. The vast number of microphonic contacts present give rise to very strong electrical undulations, and hence to a loud sound.

The chief difficulty with this transmitter, and with various others of later date based upon it, has been the frequent packing of the carbon granules, which renders the instrument inoperative. The difficulty was first satisfactorily overcome in the long-distance transmitter,' invented by A. C. White in the laboratory of the Ameri- can Bell Telephone Company, and commonly known as the " solid back transmitter."

The microphonic portion of the transmitter is contained in a thin cylindrical box or case of brass, the inner curved surface of which is covered with an insulating layer of paper. The case is firmly fixed to a "bridge" with its back or bottom in a vertical position. To the brass bottom of the case is attached a thin disc of polished hard carbon which is slightly less in diameter than the brass bottom, so that the carbon disc almost entirely covers this brass back, leaving only a slight annular space around its edge. The front or cover of the case is a similar button of hard polished carbon, also slightly smaller in diameter than the cylindrical wall of the box. It is attached to a brass disc, which is fastened to the centre of the diaphragm by mean of a rivet, and is capable of moving to and fro like a plunger when the dia,phragm

vibrates. A washer of thin flexible mica concentric with the carbon button is carried by the brass disc, and projecting over the edge of this, is held firmly against the rim of the cylin- drical wall of the case by an annular brass collar, which is screwed upon the outer curved surface of this wall. The box is thus

entirely closed at the front, while the front carbon disc, which constitutes an electrode, is perfectly free to follow the motions of the diaphragm. The space enclosed between the front and rear faces of the box is filled about three-quarters full of finely granu- lated hard carbon, which therefore lies in contact with the front and rear carbon discs of the apparatus, and also fills up the space lying between the lower edge of these discs and the curved surface of the case. The current from the battery passes from one of the carbon discs to the other through the particles of granulated carbon which fill the space between them.

The discs and granules constitute a very powerful microphone. The motions impressed upon the carbon granules are very vigorous, and this together with the particular arrangement of the parts of the instrument is effectual in obviating the difficulty from packing which attended the use of earlier forms of granulated carbon transmitters. For long-distance telephony this instrument is used exclusively by the American Bell Telephone Company, and it is rapidly displacing all other forms of transmitter for local work.

On long lines there is frequently used with this transmitter a more sensitive form of magneto-receiver than the usual one. The magnet of this is of horse-shoe type, with the two legs parallel and close together.. The pole-pieces are very small and of elongated cross-section. The diaphragm is also somewhat less rigid than that of the ordinary instrument. The whole is enclosed in a rubber case resembling the usual one.

Circuit Arrangements. — In the early days of telephony, when circuits were not long, and before electricity had come to be used extensively for purposes of lighting and power distribution, grounded circuits like those used in telegraphy were almost exclusively employed. They were, however, subject to serious disturbances' from the induction caused by currents in neighbouring telegraph and electric light wires, from leakage, and from the vary- ing potential of the earth due to natural or artificial causes. . The introduction of electric street railways caused an enormous increase in disturbances of this class. It was early recognized that a complete metallic circuit would obviate troubles from varying potential of the earth, and that if the outgoing and incoming branches of this circuit were parallel, and kept by transposition, spiralling, or otherwise at equal distances from the disturbing wire, induction effects would likewise be removed. The greater cost of such all-metallic circuits and certain incidental complications of the- switchboards then employed at the central stations were objections to the general introduc- tion of such a system. It has, however, proved to be a necessity with long-distance lines, and is very largely used for local service. It has also been found, as was suggested by the writer prior to its observance in prac- tice, that to secure freedom from inductive disturbance the line must be " balanced," that is, the two branches must be substantially alike in their electric constitution. If, for example, one branch possesses a considerably greater capacity than the other, the line will be subject to disturbance. An all-metallic line which, being balanced, is free from inductive disturbance may become noisy if placed in continuous circuit with a grounded line which is itself silent from the absence of disturbing causes. For this reason, in connecting all-wire long-distance circuits with local grounded circuits, the connexion is not made directly, but translation is secured by means of an induc- tion coil known as a " repeating coil." This has a ring- shaped core of an oval form, being in fact a closed circuit transformer, with the primary and secondary coils wound one upon each of the longer sides of the core. One of these coils is connected in circuit with the long-distance lines, and the other with the local grounded circuit.

Ordinary galvanized iron or steel telegraph wire is still used upon short lines for local service. But for long- distance telephony it is

unsatisfactory, on account of its high impedance. The introduction in 1883 of the hard- drawn copper-wire of high conductivity, invented in 1877 by Mr T. B. Doolittle, was of the greatest importance in rendering the use of long lines practicable, and it is

universally employed for such service. The gauge gen- erally used is No. 12 standard gauge (104 mils), having a resistance of 5-2 ohms per mile. The New York-Chicago line, 950 miles in length, built in 1892, uses wire 165 mils in diameter (No. 8, Birmingham), weighing 435 lb per mile, and with a resistance of 2-05 ohms per mile.

The rapid increase in the use of the telephone and the constant multiplication of electric service wires have caused the use of underground cables to be imperative in cities. These are generally laid in conduits made up of iron pipes with manholes at intervals to allow of the drawing in of the cable. Their high electrostatic capac- ity is, of course, objectionable, as it greatly limits the range of clear articulation. In the systems of cable that were first used, the wires, usually with a cotton insula- tion, were drawn into lead tubes, and the tubes filled with paraffin or other similar compound, which kept the wires from the injurious effects of any moisture that might penetrate the lead tube. This form of cable has been superseded by a type with paper insulation. The separate wires are surrounded only with a loose covering of soft paper, which furnishes abundant insulation. About them is moulded a lead tube, which is carefully made so as to be free from ” pinholes,” thus avoiding any penetra- tion of water. The dielectric of the cable is practically air, and the specific inductive capacity is therefore ex- tremely low, from which follows a corresponding increase of the range of communication. Such a cable is very compact, a tube 2| inches in diameter containing 800 or more wires.

As no practical process of telephonic relaying has been devised, it is extremely important that the character of the line should be such as to favour the preservation of the strength and form of the telephonic current. The latter element is the more important, since upon it clear- ness depends, while an extremely minute current is capable of giving audible speech. At one time it was believed by many that the same law

held for the tele- phonic transmission of speech as for the transmission of ordinary slow telegraphic signals, viz., that the limiting range of intelligible conversation was inversely as the product of the resistance of the line by its capacity — forgetful of the fact that in the deduction of this law the only variables are supposed to be the two mentioned. This is practically true in cable signalling, but with the rapidly-varying electric undulations of the telephone, inductance plays an all-important part.

As long-distance telephone lines came to be extended it was soon found that conversation could be carried on over a much greater distance than would be inferred from the "KR law," as it was called. Furthermore, O. Heaviside showed mathematically that uniformly-distributed inductance in a telephone line is a distinct aid in preserving the strength of the electric undulations, thus preventing " attenuation " of the articulating cur- rent. Indistinctness of speech upon long telephone lines results from the distortion of the electric waves, which is due to the unequal attenuation of the undulations corre- sponding to the various partial tones of speech, the atte- nuation being greater as the frequency is higher. Hence the effect of high inductance in reducing attenuation is likewise to produce a distortionless circuit, as was also pointed out by Heaviside. (See Telegraphy : Theory.) It has not proved feasible in practice to construct a uniform conductor of high inductance, but Professor M. I.. Pupin has shown that it is practically possible to diminish the attenuation of a current by the use of a non-uniform " loaded " conductor with inductance coils separated by definite intervals, which must be less than half the length of the shortest component wave to be transmitted.

Speech has been habitually transmitted for business purposes over a distance of 1542-3 miles, viz., over the lines of the Long Distance Telephone Company, from Omaha to Boston. Conversation has been carried on over 2200 miles of No. 8 line.

Exchanges.

Switchboard. — In commercial telephony switchboards are an evident necessity as a means of putting into con- nexion subscribers who are desirous of communicating with one another. Where the number of wires entering the station is small the problem is a very simple' one, since all that is necessary for the operator to do upon receiving a signal from the subscriber calling is to connect his wire in closed-circuit with the wire running to the person with whom he wishes to speak, of course at the same time -opening both circuits at the station, where they were previously closed, since this condition would otherwise short-circuit the speaking current. A flexible cord, terminating in plugs which are slipped into "spring- jacks" as they are called, serves to accomplish the desired result. The spring-jack is a form of switch with two contact springs which press against each other, and close the circuit with the wires of which they are connected. When the plug is inserted this circuit is opened and a connexion is made with that circuit to which the wire running from the plug is joined. The plugs at the ends of the cords are inserted into those spring-jacks which are respectively in connexion with the wires of the calling and the called subscriber, thus putting these into communication with each other. The operator at the exchange by the use of a key can throw her own telephone into the circuit, and ascertain whether con- versation is established and continued. A simple sys- tem of annunciator ("calling drops") actuated by the calling current of the magneto-bell shows the operator who it is that is calling, so that she may make inquiry as to the person with whom he wishes to speak. A sep- arate drop-magnet ("clearing-out drop") is so arranged as to be inserted into the circuit at the same time that communication is established between the two subscribers. When the conversation is finished a ring upon the call- bell (" ring off ") causes the drop to fall, and the operator thus notified of the fact removes the plugs and discon- tinues the connexion. This form of switchboard, usually called the " standard board," has proved satisfactory for small exchanges of fr.om fifty up to five hundred sub- scribers. For the larger boards two operators are re- quired.

In a more extensive exchange a number of operators are necessary to attend to calls. Several single switch- boards like that described may be employed, each devoted to a certain section of the subscribers, and placed in care of an operator. In these circumstances, when, as frequently will be the ease, the person calling desires to be put in communication with a subscriber who belongs to another section, connexions must be established in the office between the two sections, which necessitates additional switchboard arrangements and also increases the time required to put subscribers in •communication with one another.

This difficulty is obviated by the use of the "multiple- switchboard," which is divided into a series of panels, each containing a set of spring-jacks connected with every subscriber's line, so that all subscribers can be reached from any section. A certain moderate number of incoming lines also terminate in each section of the multiple-switchboard, and are placed in the care of the operator assigned to that section. Hence this operator, when signalled in the usual manner, can put any one

of these subscribers in connexion with any other sub- scriber whatever, without the necessity of calling upon another operator to make connexions. The objection to such a switchboard is the complicated wiring, be- cause of the multiplication of spring-jacks that is re- quired. Thus the 6000-wire switchboard in New York has 44 panels, and consequently 44×6000=264,000 jacks. Besides this, additional multiplication of wires arises from the necessity of providing for the "busy test," as with a multiple-switchboard it is impossible for any one operator to know that the line of the, person called for is not already occupied. Hence special test- wires have to be arranged to meet this difficulty. Notwithstanding these objections, this form of switch- board has proved the most satisfactory that has been devised.

Party Lines. — An important improvement has been introduced into local telephone service by the use of the bridging bell of J. J. Carty, whereby a number of subscribers can be placed upon a single circuit or " party line," as it is called. The former practice was to place the calling apparatus in series. This was found to be objectionable on account of the effect of the large im- pedance introduced by the electro-magnets of the call- bells, so that not more than two or three persons could be placed upon a single circuit without seriously im- pairing conversation. The bells as now used are placed in bridges in parallel circuit between the go-and-return wires, or between the wire and the earth, according as a metallic or a grounded circuit is employed. The electro-magnets of the call-bells are so wound as to possess very high inductance. For this reason, although they are constantly in circuit, bridging across the lines, they will not interfere with telephonic transmission through the receiver at any station, since the rapidly- varying telephonic currents will be prevented from traversing the bell-magnets on account of the " throt- tling " action of these, while they freely traverse the re- ceiver, which is of low inductance. Hence there is no sensible loss of the telephonic current through the sev- eral bridging bells. The armatures of the generators of the several call-bells are out of circuit except when one is operating to transmit a call, when it is automatically thrown in. On the other hand, the frequency of the al- ternating current produced by the call-bell is so low that these undulations easily traverse the

electro-magnets of all the bells, their throttling action not being sufficient to prevent this. The current furnished by the rotating armature of the generator of the call-bell is of sufficient strength to actuate all of the bells between which, be- cause of their parallel arrangement, it is divided. Hence every bell responds to the call. It is possible to operate . twenty or more bells thus, and as many as ten are fre- quently used at present. The fact that every bell responds to each call, of itself makes a limitation of the party line to a moderate number of subscribers desirable. This difficultymayberemovedby selective signalling. Methods for doing this have been proposed, among others one of great interest based upon an electrical tuning of the re- ceiving apparatus at each station, so as to respond by electric resonance to a call of one particular frequency. Selective signalling has not, however, as yet been much utilized in practice, chiefly because the large number of subscribers on the party line would keep it too busy for their convenience.

Common Battery System. — Until recently it has been customary to place a local battery with each subscriber to actuate his transmitter. This method is simple, but is open to serious objection because of the large number of separate cells needed, the space occupied by them, and the expense of proper inspection. For this reason much

thought has been given to the perfecting of a system in which a single large battery at the central office may be used. The “common battery system,” as it is called, which in its present form is the invention of H. V. Hayes, has already come into use to a very considerable extent, and is now almost universally employed in newly estab- lished stations. The battery at the central station, com- posed of a number of storage cells, is situated in a bridge between the two sides of the circuits of the sub- scribers when these are connected for conversation. The accompanying diagram represents the essential portions of the apparatus as it stands after such connex-

Diagram of Central Battery System.

ion has been made. Each pole of the battery B is con- nected with one end of a repeating coil, Cx Cu C2 C2, having two windings with a common point at the battery terminal. One of the free ends of the wires of each repeating coil goes to subscriber S, the other to subscriber S'. In these circumstances a current flows from the central main battery through one of the windings of the repeating coil Cx through the circuit to subscriber S, traversing the receiver R and the microphone M, back to B through one of the windings of C2. Likewise a current from B flows through the second winding of the repeating coil CL through the circuit to subscriber S', traversing the receiver R', the microphone M', and thence back to B through the second set of windings of C2. The trans- mitters are therefore in direct circuit with the battery, no local induction coil being used. Assuming the circuit connexions to be made as shown in the diagram, then if subscriber S speaks into the transmitter M, the un- dulatory current thus produced traverses the circuit Cx R M C2 B2. The inductive action of the one set of windings of the repeating coils Cx C2 upon the other set causes a similar undulatory current to traverse the cir- cuit Ci B' M' C2 B, and thus to convey the message to the subscriber at S'. In this explanation the circuit between the two subscribers is supposed to have been closed. In practice, of course, this is only the case when both sub- scribers have removed their receivers from the suspending hooks. Hence suitable arrangements have to be made whereby the calling subscriber may notify the central station operator, and the operator may call up the sub- scriber who is wanted.

For this purpose the calling system has been very conveniently modified. The magneto-bell previously used by the subscriber to call the operator is done away with, as are also the drop magnets at the station. For these last as a signalling device there is substituted a small incandescent electric lamp. This is normally dark, but by a simple arrangement of circuits, when a sub- scriber, wishing to call up the exchange, removes his re- ceiver from the hook by which it hangs, the hook, which as usual constitutes a switch, closes a circuit containing a battery and a relay. The relay, thus actuated, closes in its turn at the

station a circuit through the incandescent lamp, the glowing of which apprises the operator of the call.

In order that the operator at the central station may be able to call up subscriber wanted (S'), a condenser (not shown in the diagram) is permanently bridged around

the cut-off switch of each subscriber, a call-bell being inserted in the condenser circuit. Hence the calling current from an alternating current generator at the station will ring up the desired subscriber through his condenser on throwing his line into the circuit ; while, of course, no current from the main battery can traverse the condenser.

In recent practice several improvements in details have been introduced. Instead of allowing the signal lamp to glow as long as conversation is continued and show by its going out when this is finished, the operator in the act of answering the call throws this lamp out of gear, and in completing the connexion between the two subscribers two auxiliary incandescent lamps (" supervisory lamps ") are introduced in such a way that, so long as the receivers of both subscribers are removed from the hooks, the lights do not glow, a relay keeping them shunted out of circuit ; but when either of the subscribers puts his re- ceiver on the hook, the corresponding lamp glows. When both lamps glow the operator knows that the conversation is finished and removes all connexions between the two subscribers. No local induction coil was originally used in this system, but more recently it has been found ad- vantageous to employ one.

Automatic Systems. — Many attempts have been made to do away with operators at the central station by making the circuit connexions between different sub- scribers automatically. These automatic systems are very complicated, but have nevertheless been'used with as many as 2000 subscribers. The lines from every sub- scriber enter the central office, and conductors connected with them are placed in parallel with one another, so that if proper cross-connexions are made the circuit between two subscribers is completed as desired. The cross-con- nexion is accomplished by a series of shafts carrying projecting circuit-connecting arms set spirally, and sus- ceptible of both rotation and

lateral displacement, so that one or another pair of conductors will be connected according to the position of the shaft. This is moved into the proper position by means of a step-by-step mech- anism actuated from the transmitting station by a key. The energy necessary to operate the mechanism is derived from a battery at the central station. (c. e. cr.)

Telescope. — The principal advances made in con- nexion with the telescope in the last two decades of the 19th century consisted in the construction of several re- fractors of much greater size than had ever before been attempted, and in the development of the photographic telescope with comparatively short focus and large field, of the ” equatorial coude” ” of Loewy, and of the fixed horizontal telescope, in which the object is viewed by reflection in a mirror.

Before the size of the refracting telescope could be increased, ii was necessary to command masses of optical glass larger than manufacturers had previously found it practicable to nut mould. Up to 1880, Feil of Paris, successor and son- %„ in-law of Guinand, had been among the most sue- cessful makers, and his greatest improvement was to increase the possible size of the flint discs. Formerly these were more difficult to make than discs of crown, owing to the tendency of the heavier portions, especially the lead, to sink to the bottom of the pot. It is believed that the principal improvement made by Feil, by which this difficulty was surmounted, consisted simply in constantly stirring the melted glass in the pot. However this may be, very large flint discs are now more easily made than those of crown. About the end of 1883 Feil’s factory fell into the hands of Mantois (died 1900), who soon proved himself the most success- ful maker of great discs that has ever appeared. His first large discs were made for the 36- inch equatorial of the Lick Observatory in California, the glasses for which were figured by Alvan Clark and Sons, the mounting being made by Warner and Swasey of Cleve- land. This telescope, which was completed and erected at Mount Hamilton early in 1888, offers no radically new features in construc- tion. A few years later was mounted the great Yerkes telescope of the

University of Chicago, having an aperture of 40 inches, which, with the other large telescopes of recent construction, is described else- where (see Observatory).

In the usual form of refracting telescope the instrument is pointed directly at the object to be observed, the diurnal motion 6f which it must follow. The longer the instru- ment, the more massive must be its mounting and the greater the mechanical difficulties encountered, both in construction and management. Especially inconvenient is the continual motion of the eye-piece, which the ob- server must follow in order that he may look into the telescope. The idea of surmounting these difficulties by keeping the telescope fixed in position, and throwing the rays of the body to be observed into it by reflection from a plane mirror, was worked out by Eoucault, and such a mirror, with its mountings, was called by him a sidero- stat, a term which is sometimes applied to the entire instrument, telescope included. A construction of this sort, in which the telescope is pointed towards the de- pressed pole, so that the eye-piece must be fixed in an elevated position while the observer looks down into it, is described in the Encyclopaedia Britannica, vol. xxiii. p. 152, but it is so far from being a convenient form of mounting that little or no use has ever been made of it.

In the form now preferred the telescope is fixed in a horizontal position, an arrangement that offers every ad- vantage of the other form, except that the Fixed motion of the mirror requires a more complex telescopes, mechanism, owing to the variation of the angle of reflection with the diurnal motion. The reduction of the observations is more simple when the telescope is in the line of the meridian ; this position is therefore generally preferred. The principal advantages of this form are : (1) There is mechanically no limit to the length of the telescope, so that, with any diameter of object-glass, the telescope may be lengthened so as to obtain an image of any required size. This is especially important in photography. (2) The clockwork and other appliances required to move the siderostat are lighter and smaller than those required to move a large telescope. (3) The observer remains in a

fixed position so long as he chooses to observe any one object. (4) If a photographic plate be exposed in the focus, the linear distance corresponding to one second of arc can be ac- curately determined by measuring the distance between the principal point of the objective and the photographic plate. The position angle can also be obtained by photo- graphing a fine silver plumb line upon the plate, though it should be remarked that this determination of the position angle is subject to the important limitation that the time of exposure must be short. The most serious inconvenience of this form is that the image formed in the focal plane undergoes a diurnal rotation around the axis of the instrument. It follows that in long exposures the eye-piece or photographic plate must itself rotate. Such a movement involves no mechanical difficulty, but it interferes with the photographing of the plumb line. This drawback disappears in the case of a photograph of the sun, which is necessarily instantaneous ; this form is therefore preferable to all others as a photoheliograph. An additional advantage, where simplicity and cheapness are an object, is that the rudest form of clockwork may be used in moving the mirror ; in fact, no mechanical motion whatever is necessary in an instantaneous photograph like that of the sun, since it is only necessary to move the mirror by hand to such a position as to bring the image upon the photographic plate. The operation is, however, facilitated by a rude form of clockwork, which will keep the image approximately in the right position, an exact adjustment being made by hand.

The greatest refracting telescope, and the longest telescope of any, constructed by Gautier for the Paris Exposition of 1900, is arranged on this plan. The objective of this instrument is 1 ~~25 metres (49 inches) in diameter, and has a focal Pe .greM length of 60 metres, or nearly 200 feet. Two object~~ ^“fcooe. glasses are provided, one for visual, the other for photo- graphic purposes. These are of the ordinary curves, the flint nearly plano-concave, and the crown double convex. With such a focal length a moderate magnifying power and a large angular field of view are scarcely possible. Without any eye-piece an ordinary eye capable of being accommodated on objects at a dis- tance of 7 or 8 inches would secure a magnifying power of 300 times by simply looking at the image in the air, and the only difficulty in doing this would be that the

apparent diameter of the field of view would be that of the object-glass, and the actual diameter in arc only about twelve seconds. The field of an eye- piece 6 inches in diameter would be only about eight minutes. The field of view that could be advantageously included on a photographic plate would be small in proportion. This would, however, be an advantage where a great enlargement of a minute object was required, as in the case of star clusters and satellites of the outer planets. Up to the time of writing, the qualities of the object-glass and the reflector as regards perfection of images have not, so far as known, been subjected to any severe test, and the question of what this instrument can do is therefore still unsettled. Of its theoretical practicability there seems to be no doubt, and its success is mainly a matter of mechanical skill.

To the devices for photographing objects by reflecting their rays into the object-glass of a telescope, a new one has been added, termed the coelostat. This is a plain mirror turning on an axis parallel to itself and to the axis of the earth. The The normal to such a mirror as the latter rotates is coelostat. always directed towards some point of the celestial equator. It is made to revolve with one-half the apparent diurnal motion of the stars. The image of the celestial sphere, reflected from such a moving mirror, remains at rest at every point. Its drawbacks are the obliquity of the angle of reflection, which can never be less than that of the declination of the star, and may be greater to any extent. It is necessary that the telescope receiving the ray shall be directed towards a point having the same declination as that of the star to be photographed, so that a fixed telescope cannot be used.

Equatorial telescopes of the new and ingenious con- struction designed by M. Loewy (see Ency. Brit, vol. xxiii. pp. 152, 153) have, up to the present time, been mounted for the most part only at ^jS,, some French observatories, notably those of Paris and Nice. The great advantage of the instrument is the rapidity and convenience with which it may be manipulated. The observer is always seated in a fixed and comfortable position at the eye-piece, and the mount- ing is such that from this point he can read both the hour circle and the declination circle. The position of the eye-piece remains invariable, whatever the object at

which the instrument may be pointed. The eye-piece is shel- tered by a building which has a movable sliding wing whereby the lower part of the instrument, including the object-glass, maybe sheltered from the weather when not in use. The main building in which the observer is seated may be warmed in winter without seriously affect- ing vision through the telescope. The result of these arrangements is that all the ordinary observations, es- pecially those involving the use of a micrometer, may be carried on much more effectively than with the ordinary construction, in which the observer is obliged to follow the eye-piece at various heights round the interior of the dome. The drawbacks of the instrument are those arising out of the double reflection, the result of which is that to any possible defects of the object-glass are added those of the form of the mirrors. There is necessarily a cer- tain amount of light lost in two reflections — how much will depend largely on the condition of the silvered surfaces. The Messrs Henry, who have, we believe, figured the mirrors for such of these instruments as have yet been made, have been remarkably successful in their work, not only as regards the flatness of the reflecting sur- faces, but in mounting the mirrors so as to keep them free from flexure in the various positions of the instrument.

The most serious defect of the refracting telescope arises from the secondary chromatic aberration, due to the so-called irrationality between the respec- alerratiaa **ve dispersive powers of flint and crown glass. This irrationality consists in the fact that the ratio of the dispersive power of flint glass to that of crown glass continually increases as we pass from the red to the violet end of the spectrum ; consequently, if we arrange a combination of flint and crown lenses so as to bring all the light in some one region of the spectrum, say the yellow, to the same focus, the light of all other colours will be brought to a more distant focus. It is remarkable that this defect remains unchanged whatever combinations of the various sorts of crown and flint glass we may choose. Its exact nature and amount may be defined

thus : Choose any part of the spectrum, say that near wave-length 540, the light of which is to be con- centrated to a point at the focus. Imagine a plane, the ” focal-plane,” passing through this focus at right angles to the axis of the objective. Then the light of every other wave-length, coming as it does to a more distant focus, will meet the focal plane in a circle. This is the “circle of aberration” for that light, and is of course larger the more the wave-length deviates from 540. Let us take as a standard of comparison the circle of aberra- tion in which falls the light of some other assumed wave- length, say 440, as that by which we are to measure the aberration. We then have these propositions : —

I. The radius of the circle of aberration is a certain invariable fraction of the aperture of the objective, and is independent of its focal length.

IL This fraction is the same whatever combination of crown and flint glass is used,1 and varies but little with the figures of the lenses, provided that the condition of correcting the spherical aberration is satisfied.

III. It follows from I. that when the radius of the circle of aberration is reduced to arc by dividing it by the focal length, it varies directly as the aperture and inversely as the focal distance of the objective; that is, it varies as the ratio A : L where A is the aperture and L the focal distance. Hence, if we use a given magnifying power upon any num- ber of telescopes for which A:L is the same, the apparent diameter of the circle of aberration will be the same in all.

To give a definite numerical form to these propositions we put p., the index of refraction of the glass of a lens for any ray ; c, the curvature of a lens, that is, the sum of the reciprocals of its radii of curvature, these being taken as positive when convex, negative when concave ; s, the reciprocal of the focal distance of a lens ; a, the radius of its aperture ; and k=/*- 1.

The simplest theory of the subject, which it is not necessary to develop here, shows that the focal length of a lens for light of refractive index p. is given by the equation 8={fi-l)c=vc.

Let us represent by vi and c2 the values of v for the two rays to be brought together in an achromatic combination, and represent by dashed letters the quantities relating to the flint lens. If we then put k for the ratio of dispersions of the two glasses, or

k= r>

»r»i

we must have between the curvatures of the lenses the relation

c’ + ka=0. The reciprocal of the focal length of the combination will then be given by any one of the equations

s = v-fi + v\c’ — Vtf + v’&’ = (vi – kv‘1)c={v2 – kv’^c.

1 This proposition is at variance with statements sometimes made by experts, and based on wave-lengths measured by Fraunhofer and others. But the writer has found it quite true for all combinations of glass for which he has been able to procure accurate data, and is not aware that it has been disproved by any actual experiment. He believes the error to have arisen from the circumstance that what were formerly called the Fraunhofer lines are really groups of lines where the position measured will depend on the power used.

Now let us consider any third ray whose values of v are vs and v’y If all these rays passing through the objective of radius a fall on a perpendicular plane at the distance D from the objective, they will form a circle whose radius p is

p = a{l – D(v3c + y’sc’)}. If we take for D the focal distance for the first two rays, or -,

p will be the radius of the circle of aberration for the third ray, and we shall have

a ~ s

(H“‘3-“‘i) + “i->‘s)e ,^>

Were the ratio of dispersion of the two glasses the same through the entire spectrum, we should have

n-“i=k(i“3-y’i), and therefore p=0. But owing to the irrationality just described, this is never the case with the usual flint and crown glasses. To find the value of p/a for these glasses in some concrete cases, we take the indices of refraction found by Miiller for a crown and three kinds of flint. (Publicationen des Astrophysikalischen Observe/.- toriums eu Potsdam, Bd. IV., Th. 1.) The results for the rays C, D, F, and H7 were : —

Ray.

Crown.

Flint.

(1)

Hint.

(2)

Flint.

(3)

0

D

F

1-51509 1-51767 1-52383 1-52880

1-57590 1-57992 1-58991 1-59832

1-61974 1-62462 1-63685 1-64727

1-64586 1-65131 1-66509 1-67691

Let us suppose that the combination is to unite the rays D and F, which would be the case with the somewhat “under-corrected” objectives of Schroeder. Taking the combinations of the crown glass with the several flints in the table, we have

^=0-51767; y2=0‘52383;

y’i= 0-57992; 0-62462; 0-65131;

i>‘2= 0 -58991 ; 0-63685; 0-66509;

&=0-6165; 0-5038; 0-4470;

s=0-1601c; 0-2031c; 0-2265c.

These numbers all refer to the united rays D and F. From the formula (A) we now find, for the radii on the focal plane formed by the rays C and H7 respectively,

EayC, p= -0006a; -0006a; -0007a; Kay H7, p= -0014a; -0014a; -0014a.

The minute differences in the case of ray C doubtless arise from’ the omitted decimals, so that we may regard the three results as identical. Our conclusion is : In the focus of an ordinary achro- inatic telescope, the light of ray C is spread out in a circle whose diameter is -0006 of the aperture of the objective, and that of ray ffy in a circle of “0014 of the aperture. It follows that if the ratio of focus to aperture is the very common one of 15 : 1, the diameters of these circles of aberration expressed in arc will be 9″ and 19”.

In the mathematical theory of the problem a second approximation to perfect achromatism can be reached by combining three glasses of different dispersive powers in the various parts of the spectrum. The required combina- tion depends upon the solution of three equations for the three rays that are to be combined. It happens, however, that the usual forms of crown and flint glass form a series, such that no

advantage can be gained in this way. The coefficients of the three equations to be solved are the refractive indices for the three rays to be combined in the case of the three different kinds of glass, but in the kinds of glass alluded to, however varied may be these indices, their determinant vanishes. The result is that every triple combination will be equivalent to some combination of two kinds of glass, and no advantage can be gained by the addition of the third lens. If success is to be reached in this way, we must find glasses not belonging to the usual series. The problem has therefore been attacked on another side by seeking for new kinds of glass, the dispersions of which would not be affected by the irrationality of flint and crown glass. The best known of the efforts in this direction are those of Schott and Co. of Jena. This firm has succeeded in producing

combinations said to be nearly free from the defect in question. It is necessary that the glass should admit of being made in large and at the same time homogeneous masses, and that it should not deteriorate with time, the importance of the first requirement arising from the circumstance that it is only with large telescopes that the secondary aberration becomes a serious fault. The astronomer, therefore, will not regard the problem as solved until telescopes of large size can be made with glass of the required quality. It does not appear that this practical solution of the problem has yet been reached.

In the Royal Astronomical Society's Journal for March 1894 Mr H. Denis Taylor described a perfectly achromatic refractor which may be made of three different kinds of Jena glass, but it does not appear that Mr Taylor's conception has yet been realized by the construc- tion of any telescope of considerable size. The astro- nomical work of the world, visual as well as photographic, is therefore mainly carried on with object-glasses of the traditional construction affected by the defect in question.

The question has sometimes been considered whether the secondary aberration cannot be diminished by giving suitable curves to the lenses of the objective. The writer, however, has not been able to find that any material diminution can be brought about in this way, and the defect must therefore be regarded as inherent in the refracting telescope, and, so long as any combination of ordinary flint and crown glass is used for the lenses, incapable of material diminution except by increasing the focal length of the instrument.

In the circumstances it might be expected that re- newed attention would be devoted to the possibility of improving the reflecting telescope. It is there- Refiecting ^ore a curjous fact that no serious attempt has

yet been made to construct such an instrument equal in size to the celebrated reflector of Lord Eosse, made in 1845. The aperture of this instrument is 6 feet, while 4 feet seems to have been the practical limit in the case of any reflecting telescope in actual use. So far as the writer is aware, the most successful constructor has been Dr A. A. Common. To the practical difficulties connected with the management of such an instrument must be added that of so supporting the mirror that it shall preserve its figure in all positions. The great foe to the effectiveness of the mirror is the action of gravity upon it, producing a flexure which is fatal to the quality of the images. Although the problem of overcoming this difficulty is a purely mechanical one, a satisfactory solution has not been reached in the case of any mirror more than 4 feet in diameter. An additional defect in the reflector has been pointed out by Mr Schaeberle in papers published in the Astronomical Journal, vols, xviii. and xix. He shows that, while a parabolic mirror will form in its focus a perfect image of an object in the axis of the paraboloid, yet the image deteriorates rapidly when the object does not lie in that axis. This general fact is an obvious result of theory, but, until Schaeberle investigated this sub- ject, no one had any conception of the rapidity with which the image might deteriorate towards the margin of the field of view. It follows from Schaeberle's results that, in the parabolic reflector, the deterioration begins a very few minutes away from the centre of the field and increases with great rapidity. It ought to be

added that, in practice, it does not seem that the image deteriorates so rapidly as might be inferred from the theory. In any case, the effectiveness of the reflector for photographing nebulae has been demonstrated by Keeler with the Crossley reflector of the Lick Observatory. Reference has been made in

the article Astkonomy (vol. xxv.) to the extraordinary number of nebulae found with this instrument. / The absence of a secondary spectrum seems to be an ad- vantage which compensates very serious defects in the geometrical quality of the focal image.

In the article Telescope, in the ninth edition of this work, it was shown how, owing to the irrationality of the dispersions of flint and crown glass, a telescope achromatized for visual purposes is not suitable pb°to- for photographing the heavenly bodies. For the fe^opes latter purpose the flint lenses must be relatively less curved than for a visual instrument, the object being to bring the photographic rays as nearly as possible to the same focus. With this exception, the main features of the two telescopes, especially in their mounting, are similar. An accurate clock-motion is essential in the photographic instrument. In some of the first efforts to photograph the heavenly bodies with a telescope the focal image was enlarged by an eye-piece, but this practice has been aban- doned, owing to the distortion of the image to which it gave rise, and photographs are now made by exposing the sensitized plate in the photographic focus of the instrument. From what we have said of the secondary aberration, it will be seen that, in theory, its amount in a photographic telescope of given aperture should be independent of the focal length. It would follow that, in photographing the stars for the purpose of measurement, the longer the focus the better, so long as the plate remains of manageable size, because we then have the heavens pictured on a larger scale, while the images of the stars remain un- changed in magnitude. Moreover, the quantity of light being the same with a given aperture whether the focus be long or short, a photograph should be taken in the same time with the short telescope as with the long one. In practice, however, this is not found to be the case, and the image is impressed more quickly on a plate in the focus of a short telescope than of a long one of the same aperture. This

is probably due to the effect of atmo- spheric undulations upon the images of the stars. In using a visual telescope the observer can always choose moments when the images are exceptionally good ; but the photographic plate can make no such choice, and must receive the impressed image with all the undulations the latter happens to have during the time of exposure. The effect of this cause increases in direct proportion to the length of the telescope. Practically, therefore, no advantage seems to be gained by greatly increasing the focal length of the photographic instrument for astro- nomical purposes. Some points of interest brought out by the use of such an instrument are these : (a) Objects can be photographed which are too faint to be visually perceptible with a telescope of the same size. This is especially the case with faint nebulae, which are discovered by photography though entirely invisible to the eye. (b) The impression made by a star is not proportional to the product of the brightness into the time of exposure. For example, a star half as bright as another must be exposed more than twice as long to produce an equal photographic effect. The law of intensity of impression as a function of the brightness and time of exposure is not yet precisely established.

A new method of photographing with a telescope cor- rected for the visual rays only has been devised by Mr Ritchie of the Yerkes Observatory, and put into successful operation in connexion with the 40-inch telescope there. The method depends on three conditions : first, the use of the Cramer isochromatic photographic plates, having the property that, although the sensitiveness diminishes from the violet rays towards the green in the usual way, there is an increase of sensitiveness in the region of the

lower green’ and yellow ; second, this region is that in which the rays are most concentrated in the visual tele- scope ; third, a colour screen is made of a collodion film of a greenish yellow tint, which cuts off all the

light except that near the region of greatest concentration. The result is that the moon and star-clusters are photo- graphed with a sharpness equal to that of the axial image in the best reflector, and of a breadth of field which the latter does not admit of. The drawback is the loss by absorption of the photographic energy of the blue rays, but this is of no importance where the faintest possible objects do not have to be pictured.

Photography is now being applied to the accurate measurement of small areas in the heavens, the method being to measure the linear distances and position- angles of the images on the photographic plates. If the distance is considerable, a degree or more, the most difficult problem that arises is to determine the value in arc of the unit of length, say one millimetre, on the plate. There are two ways of doing this. One is to measure the linear distance between two stars of which the angular distance is accurately known, and the other to compute the required factor from the measured focal length and other constants pertaining to the instrument. The solution of the problem in geometrical optics thus involved does not present serious difficulties. In photo- graphing the heavens on an extended scale, a larger field of view is required than in the case of a visual telescope. The necessity of securing this result without distorting the images of stars near the edge of the field has led to the invention of several forms of objectives materially different from those of the visual telescope, and similar to those of the ordinary camera. The end has generally been reached by a combination of two objectives, sepa- rated by a greater or less interval ; each being an achro- matic combination, there are four glasses in all. Mr H. D. Taylor has proposed a triple combination which is said to admit of photographing a field 30° in diameter ; it is composed of a double concave flint between two convex crown glasses, the glasses being separated by considerable intervals. Whether a combination of three or four lenses be used, it is certain that there is, in each case that may be presented, a system of curves of the lenses which will make the distortion a mathematical minimum ; but the problem of determining these curves rigorously is so complicated that no general solution has yet been reached. (s. n.)

Tell, William. — The setting up in 1895 in the market-place in Altdorf of a fine statue of Tell and his son, and the opening in 1899 just outside Altdorf of a perma- nent theatre, wherein Schiller's play is to be represented every Sunday during the summer months, show that the popular belief in the Tell legend is still strong, despite its utter demolition at the hands of a succession of scientific Swiss historians during the 19th century. Professor Gisler of Altdorf (in his book, Die Tettfrage, Bern, 1895) has also made an attempt to rehabilitate it from the purely historical point of view. He is well acquainted with all the researches that have been made, but tries to save Tell's refusal to do reverence to the hat, his leap from the boat on the lake, and his slaying of the bailiff in the " Hollow Way." To effect the rescue of these incidents, he boldly admits the forgeries in the registers, abandons all the traditional dates, throws over Tschudi's account, and regards the shooting by Tell of the apple from his son's head as an "ornamental addition" to the tale. Save a mention of the Tell chapel on " Tellsplatte " in 1504 (the first known before was that by Tschudi in 1572), and a proof that the pilgrimages to Btirglen and Steinen had nothing to do with " St Kummerniss," as her images are

preserved in the parish churches of those villages, whereas the pilgrims go to the chapels therein, he brings forward no new evidence. His book is a striking proof that the popular Tell legend cannot claim the support of authentic history, while his attempt to find room for the atrocities of the wicked bailiffs elsewhere than at Altdorf consists only in suggesting an intricate series of possibilities, none of which are supported by any positive evidence. In a pamphlet (Die Sagen v. Tell u. Stauffacher, Basel, 1899) Herr August Bernouilli has applied the same sort of method to all the legends relating to the origin of the Swiss Confederation, but despite his exceeding ingenuity and zeal in spinning theories (for he has no new evidence whatsoever to bring forward), he cannot be said to have succeeded in vindicating any kernel of historical truth in these legends, even by his desperate plan of first eliminat- ing all their characteristic features. (w. a. b. c.)

Tellicherry, a seaport town of British India, in the Malabar district of Madras, between Cannanore and the French settlement of Mahe.

Population (1891), 27,196; municipal income (1897-98), Rs.48,450. The old fort still stands. The town is now a busy centre of export trade in coffee, cocoanut produce, spices, and sandal-wood. In 1897-98, 10 vessels entered and cleared for foreign trade, with an aggregate burthen of 17,171 tons. The Basel Protestant mission has a station here. The municipality manages the Brennen College, with 42 students in 1896-97, in which year also the two high schools had 473 pupils.

Tembuland. See Kaffraria.

Temesvar, a municipal town and capital of the county of Temes, Hungary, 160 miles south-east of Budapest. It is the most important centre of traffic and industry of south Hungary. Among its educational establishments are the Roman Catholic Institute, two upper gymnasia, a ?-eaZ-school, an infantry cadet school, two training institutes for teachers, two upper girls' schools, an upper commercial school, several special industrial schools, &c. Its industrial establishments in- clude factories for tobacco, safes, cloth, matches, artificial manure and felt, besides breweries and distilleries. There is an electrical tramway for local traffic. Population

(1891), 43,438; (1901), 53,033.

Temple, a city of Bell county, Texas, U.S.A., 36 miles south-west of Waco, at the intersection of lines of the Gulf, Colorado and Santa Pe and the Missouri, Kansas, and Texas railways, at an altitude of 698 feet. It is in a cotton region, and contains compresses, gins, oil- mills, and agricultural implement works. Its principal industry is in handling the cotton crop of the surround- ing country. It was settled in 1882. Population (1890), 4047 ; (1900), 7065, of whom 360 were foreign-born and 1425 negroes.

Temple, Frederick (1821), Archbishop of

Canterbury/was born in the island of Santa Maura, 30th November 1821, being the son of Major Octavius Tem- ple, governor of Sierra Leone. He was educated at Blundell's School, Tiverton, and Balliol, Oxford, where he took a double first in 1842. At first he had to struggle

with very narrow means, but as soon as he had passed through his university course, fortune smiled upon him. He became fellow and mathematical lecturer of his college, was ordained in 1846, and was appointed principal of Kneller Hall Training College in 1848. In 1858, after having been for some time a Government in- spector of schools, he was elected headmaster of Rugby

School, in succession to Dr Goulburn, afterwards dean of Norwich. He also became chaplain to Queen Victoria. In 1860 the famous Essays and Reviews was published. The first essay in that volume, Tlie Education of the World, was by Dr Temple, and though its contents were almost universally admitted to be unobjectionable, he was involved in the criticism bestowed on the rest, in spite of the fact that it was expressly stated that the responsi- bility of each author was limited to his own essay. Dr Temple's firmness, impartiality, and strict justice gained for him the respect and affection of his pupils, and ren- dered his administration of Rugby most successful. In 1869 Dr Temple, who had supported the disestablishment

Archbishop Temple. {From a photograph by J. Burnett and Sons, London.)

of the Irish Church and was known as a Liberal, was offered the bishopric of Exeter by Mr Gladstone. The appointment raised a storm in both the High and the Low Church camps. The old controversy in reference to the Essays and Reviews was revived, and the opposition was carried to the extent of a public protest against Dr Temple's appointment. At the confirmation of his elec- tion at St Mary-le-Bow, Cheapside, counsel were in- structed to object to it, but ultimately their objections were overruled, and Dr Temple was duly consecrated on 21st December. During the sixteen years of Dr Temple's tenure of the see of Exeter, his firm and vigorous, as well as kindly rule, coupled with indisputable soundness, availed to dissipate all prejudices against him ; and when, on the death of Dr Jackson in 1885, he was translated to

London, the appointment gave general satisfaction. Dr Temple displayed the same vigour, firmness, and impar- tiality in his administration of the see of London as he had done at Exeter ; and onthe sudden death of Arch- bishop Benson in 1896, Dr Temple was appointed to the see of Canterbury. Dr Temple's archiepiscopal career has not been without its noteworthy features. He has presided over the Lambeth Conference of the bishops and

archbishops of the Anglican Communion, which, usually held every ten years, was fixed for 1897 as the thirteenth centenary of the founding of the see of Canterbury by Augustine. In the same year Dr Temple and his brother archbishop issued an able reply to an encyclical of the Pope denying the validity of Anglican orders. The pronouncement of the Pope was drawn from him in con- sequence of negotiations which had been entered into by the Abbe" Portal and the Abbe" Duchesne on the side of the Eoman Church, and by Lord Halifax, Eather Puller, and others on the side of the Anglicans, with the view of bringing about the reunion of the two Churches on the basis of the recognition of the validity of Anglican orders. A publication called the Revue Anglo-Romaine, which contained communications from Eoman and Anglican divines, was started in support of this movement. The project was, however, ultimately condemned by the Pope in the encyclical referred to. To this encyclical the re- ply of the two archbishops, which was published in Latin and English, was regarded on the Anglican side as a dignified and satisfactory answer. In 1900 the two arch- bishops were once more called upon for united action on behalf of the Anglican Church. The complaints against recent innovations in ritual having become very serious, and having given rise to some animated debates in Par- liament, the united episcopate resolved, in accordance with the directions in the Book of Common Prayer, to refer the vexed questions of the use of incense in divine service, and the practice of reservation of the elements in the Lord's Supper, to the archbishops for their decision. After the matter had been fully argued out before them, the archbishops pronounced against the practices in question. Dr Temple's energy and industry in the performance of his archiepiscopal func- tions at his advanced age commanded general admira- tion. In 1902 he

discharged the important duties of his office at the solemn coronation of King Edward VII. in Westminster Abbey.

Temple, Sir Richard, Bart. (1826-1902), Eng- lish administrator, a descendant in the female line of the Temples of Stowe, was born 8th March 1826, and after being educated at Rugby and Haileybury, joined the Bengal Civil Service. His industry and ready pen soon obtained appreciation, and after acting as private secretary for some years to John Lawrence in the Pun- jab, and gaining useful financial experience under James Wilson, he was appointed Resident at Haidarabad. In 1867 he was made K.C.S.I. In 1868 he became a mem- ber of the central Government, first as foreign secretary and then as finance minister ; and he did admirable work during the famine of 1874, in the course of which he was made lieutenant-governor of Bengal. His services were recognized by the bestowal of a baronetcy in 1876. In 1877 he was made governor of Bombay, and his activ- ity during the Afghan war of 1878-80 was untiring. In 1880 he left India to enter on a political career in England, but it was not till 1885 that he was returned as a Conservative for the Evesham division. Meanwhile he produced several books on Indian subjects. In Par- liament he was assiduous in his attendance, and he spoke on Indian subjects with admitted authority; but he was not otherwise a parliamentary success, and to the public he was best known by the caricatures in Punch, which exaggerated his physical peculiarities and made him look like a lean and hungry Indian tiger. In 1885 he became vice-chairman of the London School Board, and as chairman of its finance committee he did use- ful and congenial work. In 1892 he changed his constituency for the Kingston division, but in 1895 he retired from Parliament, being in 1896 made a

Privy Councillor. He had kept a careful journal of his parliamentary experiences, intended for posthumous pub- lication; and he himself published a short volume of reminiscences. On 15th March 1902 he died at Hamp- stead. He was twice married, and left a daughter and

three sons, all of the latter distinguishing themselves in the public service.

Temryuk, a district town and seaport ‘of Eussia, northern Caucasia, in the government of Kuban, on the Sea of Azov, 48 miles north-north-west of Krymskaya station on the North Caucasian railway. It was the seat of a Turkish fortress, Abass, till 1774, and is now a growing seaport for the export of grain, and has many flour-mills in its neighbourhood. It is in regular com- munication by steamer with Ekaterinodar. Population

(1897), 14,476.

Tenasserim, a division of Lower Burma, bor- dering on Siam, 36,086 square miles, divided into six districts — Toungoo, Salwen, Thaton, Amherst, Tavoy, and Mergui. Population (1891), 912,051, living in 3603 villages; (1900), 1,137,776. They paid a revenue in 1898-99 of Ks.34,87,686.

The population consisted of 763,771 Buddhists and Jains, 53,677 aborigines (chiefly Karens), 30,351 Hindus, 28,799 Mahommedans, 17 Parsis, and 35,536 Christians, the great majority of whom were Karens. The total area of the division is 23,085,040 acres, of which in 1898-99 the area cultivated was 1,249,695 acres ; there were 2,151,066 acres under forests, 13,388,842 acres were uncul- tivable, and 6,255,286 acres were available for cultivation, besides 40,151 acres of current fallow. This division and that of Arakan are the oldest British possessions in Burma. The headquarters of the Commissioner are at Moulmein.

Ten Brink, Bernhard Egidius Conrad (1841- 1892), German philologist, of Dutch origin, was born at Amsterdam on 12th January 1841, but was sent to school at Diisseldorf, and afterwards studied at Miinster, and later under Diez and Delius at Bonn. In 1866 he began to lecture at the Miinster Academy on the philology of the English and Romance languages. In 1870 he became professor of modern languages at Marburg, and after the reconstitution of Strasburg Univer- sity he was appointed English professor there. In 1874 he began to edit, in conjunction with Scherer, E. Malim, and E. Schmidt, Quellen und

Forschungen zur Sprache und Kulturgeschichte der germanischen Volker. He devoted himself for many years to the study of Chaucer. In 1877 he published Chaucer-Studien zur Geschichte seiner Entwickelung und zur Ohronologie seiner Schriften; in 1884, Chaucer's Sprache und VersJcunst. He also pub- lished critical editions of the Prologue and the Com- pleynte to Piti. Ten Brink's work in this direction stimulated a revival of Chaucer study in the United Kingdom as well as in Germany, and to him was in- directly due the foundation of the English Chaucer Society. He was a great teacher as well as an accurate and brilliant writer, and from many countries students nocked to his lecture-room. His Studies in Beowulf proved a valuable contribution to the study of Early English, and he contributed to Paul's Qrundriss der germanischen Philologie an important article on Early English literature. Perhaps his best known work is his History of English Literature, which was unfortunately never completed, and broke off just before the Elizabethan period. Ten Brink, therefore, never made any important contribution to Shakespeare literature, though it was his intense admiration of this poet that first attracted him to the study of English. Eive lectures on Shakespeare de- livered at Erankfort were published after his death, and show his contempt for the Baconian theory and his

thorough appreciation and grasp of his subject. His History of English Literature and his work on Chaucer's language and versification were translated into English.

(A. Z.)

Ten Kate, Jan Jacob Lodewijk (1819-1889), Dutch divine, prose writer, and poet, was born at The Hague, 23rd December 1819. He started in life as a solicitor's clerk. It was his friend, Dr Heldring, pastor at Hemmen, in Gelderland, who, discovering in Ten Kate the germs of poetical genius, enabled him to study theology at the University of Utrecht (1838-43). Having completed his studies, Ten Kate became pastor at Middel- burg, Amsterdam, and other places, meanwhile develop- ing well-nigh ceaseless activity, both in prose and lyric poetry. Among his prose works may be mentioned the travel papers (Rhine,

1861 ; Italy, 1857-62), Christelijke Overdenkingen (” Thoughts of a Christian,” 1849-52), and other religious studies. His early poetry was in the main original. The best known of his poems were — Ahasverus op de Orimsel (“Ahasuerus on the Grimsel,” 1840) ; Zangen des Tijds (” Songs of the Times,” 1841) ; Legenden en Mengelpoezie (” Legends and Detached Poems,” 1846) ; In den Bloemhof (“In the Elower Garden,” 1851); De Schepping (” The Creation,” 1866) ; De Planeten (” The Planets,” 1869) ; De Jaargetijden (” The Seasons,” 1871) ; De Psalmen (” The Psalms,” 1874) ; De Vrouw in het Nederlandsch Lied (“Woman in Dutch Song,” 1882); Palmtakken en Dichtbloemen (“Palm-branches and Elowers of Poesy,” 1884). Ten Kate reached the pinnacle of his poetic fame in Tlie Creation, The Planets, and TJie Seasons. These poems certainly show a masterly grasp of his mother tongue and a wonderful facility of expression, coupled with graceful vigour and fertile fancy. These qualities he also plentifully displayed in the innumerable transla- tions he made of many of the masterpieces of foreign poetry in nearly every European language. He had not only an extraordinary aptitude for learning alien idioms, but also the gift ‘of translating foreign lyrics into clear, fluent, and beautiful Dutch verse. Ten Kate’s versatility in this respect has never been equalled ; it extended from Tasso and Andersen to Dante, Schiller, Victor Hugo, Milton, Tennyson, and Longfellow. Ten Kate died at Amsterdam, 24th December 1889. His complete Poetic Works were published after his death in 12 volumes (Leyden, 1891). (h.ti.)

Tennessee, one of the south central states of the United States of America. It extends from the Ap- palachian mountains on the E. to the Mississippi river on the W., and lies between 35° and 36° 36′ N. and 81° 37′ and 90° 28′ W. Its area is 42,050 square miles, only 300 square miles of which is water surface. The popu- lation in 1900 was 2,020,616, as against 1,767,518 in 1890— an increase of 253,098, or 14-3 per cent. Ever since 1830 the increase has been continuous and without marked fluctuations except between 1870 and 1880, when it was 22-6 per cent. The average number of persons to the square mile was, in 1890, 42-3; in 1900, 48-4. Of the total population in 1900, 1,021,224 were males and 999,392 were females. Only 17,746 (less than 1 per cent.) were foreign-born. The negroes numbered 430,678 in 1890 and 480,243 in 1900, an

increase during the decade of 11 ‘5, as compared with an increase of 15-2 among the white population. Among 375,046 adult white males, 52,418, or 13-9 per cent., were illiterate (unable to write) ; among 112,236 negro males of like age, 53,396, or 47-6 per cent., were illiterate. The principal cities, and the only ones having over 10,000 in population in 1900, were Memphis, on the Mississippi (102,320) ; Nashville, the capital (80,865); Knoxville (32,637),

Chattanooga (30,154), and Jackson (14,511). The popu- lation is chiefly rural ; of 104 incorporated towns only 29 had in 1900 a population of more than 2000, and of these 21 had less than 5000, and only three had more than 5000 and less than 10,000. The urban population, including under this head all persons in places of more than 4000 inhabitants, increased from 11-4 per cent, of the total population in 1890 to 13-4 per cent, in

1900.

Education. — In 1900 the school population— between the ages of six and twenty-one years— was 768,843 (whites, 573,287; coloured, 195,556). The total actual enrolment in the public schools was 485,354, or only three-fifths of the school population, partly to be explained by the fact that the limits of school ages are so wide, few going to school under eight years and most leaving before seventeen. The total average daily attendance was 338,566 (whites 270,662 ; coloured, 67,904). The country schools are of two kinds — primary schools with six grades, and secondary schools with two additional grades. There are 5262 primary and 940 secondary schools for whites, and 1558 primary and 53 secondary schools for coloured. There are thus 6202 schools for white and 1611 for coloured children, with 8239 teachers. In the secondary schools there are only 18,443 pupils. There are, in addition, about 1000 private schools with an enrolment of 50,000 pupils. The schools in the towns and cities have from ten to twelve grades, and are divided into primary schools and high schools. There are 79 town

schools for whites and 50 for coloured, with 956 teachers. The total number of public schools is 7954, with 9195 teachers, of whom 1834 are coloured. The total value of schoolhouses and other school property is $3,063,567. The total amount expended for the country schools in 1900 was $1,751,047, and for city schools $597,006— total $2,348,053. The average salary of teachers in country schools is $31.16 a month, in city schools $53.31. The average cost of tuition per pupil in country schools is $1.07 a month for less than five months, in city schools $1.87 a month for eight and a half months. The State University, at Knoxville, was chartered in 1794 by the first General Assembly of the territory, and was the first distinctly non-sectarian college established in America, and the second one to be opened west of the Alleghanies. It receives the appropriations of the national Government for agri- cultural and mechanical colleges and for agricultural experiment stations. The university includes a college with departments of agriculture, engineering and mechanics, and the arts ; a graduate department; and schools of law, medicine, dentistry, and engineering. It occupies sixteen large brick and stone buildings, situated in beautiful grounds of thirty-eight acres, 1000 feet above the sea. The value of its buildings and grounds in 1900 was $462,566, of its invested funds $425,000, of its equipment $112,500. Its library numbers 22,426 volumes. In 1900 its total income (not including professional schools) was $83,859. The university had in 1900 750 students and 90 professors and in- structors. The Vanderbilt University at Nashville, the property of the Methodist Episcopal Church South, was endowed chiefly by the elder Cornelius Vanderbilt of New York. It is organized in seven departments : arts, theology, law, medicine, pharmacy, dentistry, and engineering. Its property was in 1900 valued at $850,000, and it had 777 students and 89 instructors. The Peabody Normal College at Nashville is managed by the Pea- body Board of Education. It uses the buildings and property of the University of Nashville, which has also a medical de- partment, a college of music, a model school, and an academy. The Normal College in 1900 had 28 instructors and 602 students ; the medical department 25 instructors and 210 students. The Peabody Board supports 200 scholarships in the Normal College, which are given to students from the Southern states. The University of the South, controlled by the episcopal dioceses of ten Southern states, is situated at

Sewanee, the South-western Presbyterian University at Clarksville, and the South-western Baptist University at Jackson. The Eisk University in Nash- ville is an institution for coloured persons.

Charities. — The school for the blind at Nashville has three buildings, ten acres of land, and other property, aggregating in all $220,000 in value, with 185 pupils, at an annual cost of $76,881. The school for the deaf and dumb at Knoxville has five buildings and twelve acres, valued at $185,000, and 227 pupils, at an annual cost of $82,081. The industrial school at Nashville has five buildings and 92 acres, worth $150,784. It costs $130,528 a year to maintain this school for 600 pupils. There are three asylums for the insane. The Eastern Hospital at Knoxville has three build- ings and a large farm, which cost $292,800 ; the Central Hospital near Nashville has seventeen buildings and 460 acres, valued at $426,500 ; and the Western Hospital at Bolivar has one building and 300 acres, valued at $393,350. In the three hospitals are

1280 patients at a cost of $375,401, or $140 per patient per annum. The state maintains also a home for disabled soldiers of the Civil War, which has five buildings and 450 acres, valued at $57,500, with 120 beneficiaries, at a cost of $19,000 a year. The total investment in charitable and educational institutions is $1,725,934, and the total annual charge for their 2396 pupils and inmates is $683,810.

Prisons. — In his biennial message to the General Assembly of 8th January 1901 the Governor says : ” The penitentiary has not only been made self-sustaining, but has been so successfully worked that the labour of the convicts is utilized to reimburse the state for the’ money expended in their conviction. Most of the money thus realized comes from the [state] coal mines. The present system is far preferable to that formerly prevailing, whereby the convicts were leased to contractors.” On 1st December 1900 there were 1744 convicts — 544 whites and 1200 negroes. In the main prison at Nashville were 1110, including the women and delicate, whose net earnings in 1900 were $125,000. At the state mines were 634 able-bodied men and a few women, whose net earnings averaged $62,000 a year.

Railways. — The principal railways are the Southern, with 561 miles and a total valuation of $10,241,142; the Nashville, Chattanooga, and St Louis, with 879 miles and a total valuation of $14,061,470 ; the Louisville and Nashville, with 525 miles and a total valuation of $13,305,650; and the Illinois Central, with 266 miles and a total valuation of $8,137,834. The total mileage of railways on 1st July 1899 was 3129 ; number of miles of lines per 100 square miles of territory, 7 ‘5 ; number of miles per 10,000 inhabitants, 15. The assessed valuation of the property of the rail- ways distributable throughout the counties is $52,943,494, and of their localized property $2,352,918 — total value $55,296,412 ; aver- age value per mile on the distributable property in Tennessee, $17,623. The total state tax per annum on railways is $201,410 ; county tax, $474,144 ; municipal, $73,452. The railways pay over one-sixth of the taxes collected by assessment of property.

Taxation.— The total valuation of land in 1900 was $171,527,025, or $6.61 an acre; the total valuation of town lots was $120,338,355, and of other property, $48,493,768 ; or, adding the railway, telegraph, and telephone property, the total valua- tion of all taxable real property is $387,050,050. The rate of taxation for state purposes is 35 cents per $100. Real property bears nearly the entire burden of taxation. In 1899, when the as- sessed value of real property (excluding railways) was $271,021,726, the assessed valuation of personal property, excluding railway property, was only $37,693,230, or 12-2 per cent, of the whole. The ratio in neighbouring states with similar industries ran from 30 to 50 per cent., showing that 15 to 30 per cent, of personal property escaped. The state tax on real property yielded in 1900, net $1,022,029. Clerks of courts paid in certain fees, which brought the total returns from counties up to $1,556,989. Many privileges are taxed, amounting in 1900 to $417,199. Other sources of state revenue are : fees for charters, building and loan associations, insurance, and coal oil inspection. The total receipts for 1900 were $6,120,231 ; total disbursements, $6,095,299. The total bonded indebtedness is $16,953,266. Since 1899 10 per cent, of the gross receipts is carried to a sinking fund.

Miscellaneous. — There were 207 banks in 1900 — national 48, state and private 159 — with a total paid-up capital and surplus of $17,370,662, and deposits of $45,686,251. The number of news- papers and periodicals was 306. There are 27 cotton and 21 woollen-mills. The value of the annual production of flour is $13,000,000, of lumber $6,000,000, of leather $2,400,000; of cottonseed oil there are produced 3,200,000 gallons, and of distilled spirits 1,100,000 gallons. The largest churches are the following : the Methodist Episcopal Church South has 132,000 members ; the Baptist has 115,000 white members, 62,000 coloured members ; Cumberland Presbyterian, 43,000 ; Presbyterian, 18,300 ; Roman Catholic, 18,000 ; and Protestant Episcopal, 6000 members.

Agriculture. — Possessing many kinds of soils, spread out at all altitudes from 6000 feet down to 300 feet above sea-level, with a climate varying from the semi-tropical on the Mississippi river in the west, to the boreal on the mountain plateaus of the east, Tennessee has the greatest variety of agricultural and horticultural products. It has something in every column of the census of agriculture. Wheat, oats, rye, and barley mature well in the valleys of the eastern' and central districts; maize is a great crop in all parts ; tobacco is produced in nearly all quarters ; and cotton is at home in the south-western corner of the state. Potatoes, sorghum, broom-corn, and peanuts are important crops also in the middle and west. Small fruits and vegetables are produced in large quantities for the great cities. The eastern section is well adapted to large fruits, and the grape' does well all over the state. Nutritious grasses grow well, and stock-raising and dairying are great industries in the central and eastern portion. The following table shows the acreage, production and value of the principal crops in 1899 : —

Acreage.

Production.

Farm Value.

Acres.

Bushels.

Dollars.

Corn (maize)

• 3,374,574

67,307,390

28,059,608

Wheat

1,426,112

11,924,010

7,882,697

Oats .

235,313

2,725,330

887,940

Potatoes .

27,103

1,404,097

817,419

Sweet potatoes .

23,374

1,571,575

883,620

Orchard fruits

208,625

1,479,915

Hay .

645,617

802,720 (tons) 234,592 (bales)

6,811,577

Cotton

623,137

8,192,642

Tobacco .

71,849

49,157,550 (lb)

2,748,495

In 1899 Tennessee had 309,000 horses, of an average value of $43 per head ; 140,000 mules, of an average value of $48 ; 240,000 milch cows, of an average value of $24 ; 287,000 other cattle, of an average value of

§19 ; and 252,000 sheep, of an average value of $2.37. The poultry industry is a considerable one in the central and eastern parts.

Mining. — The chief mineral productions in 1900 were coal, 3,904,048 short tons ; coke, 494,438 short tons ; iron ore, 700,000 long tons ; copper, 116,000 long tons ; and zinc, 3968 short tons. Phosphate mining is a new and great industry in middle Tennessee.. In 1900 450,556 short tons of phosphate were pro- duced, valued at $1,352,568 at the mines. The total number of persons employed in mining industries was in 1900 as follows : in coal mining 9181, in iron ore mining 1082, in copper mining and smelting 886, in phosphate mining 3000. Including some other small mines, the total was 15,000.

Administration. — The state government has the usual depart- ments, legislative, executive, and judicial. The legislature has two chambers, the house and the senate ; its members are elected for two years, and their sessions are limited to ninety days. The governor is elected for two years. In case of vacancy the speaker of the senate succeeds him. The legislature elects the secretary of state, the comptroller, and the treasurer ; the gov- ernor appoints, subjected to confirmation by the senate, the super- intendent of public instruction, the superintendent of prisons, the commissioner of agriculture, and the commissioner of labour and mines. The Supreme Court consists of five judges, elected for eight years. There are also chancery courts, circuit courts, and a court of chancery appeals. The large counties have separate criminal courts. The affairs of the counties are ad- ministered by the justices of the peace, elected two or more from each civil district, which is the smallest unit of government. The magistrates have both legislative and judicial powers. Each county has a sheriff, a trustee (collector of taxes and treasurer) , a register, and clerks of courts. Towns and cities are incorporated by special Act of the legislature, and usually have a, mayor and common council, with the ordinary municipal offices. Suffrage is free to male citizens of the United States who have been one year in the state and six months in the county. The Australian ballot system is in use in the larger towns and counties.

Political Changes. — During the last part of the decade from 1880 to 1890 an agrarian movement swept over the southern and western states, resulting in the organization of farmers in various societies called “granges,” “wheels,” &c, which were finally all united in a national ‘ ‘ farmers’ Alliance.” These organizations were naturally strong in Tennessee, an agricultural state, and for a time exerted a great influence in politics. They captured the Democratic party, which of recent years has controlled the state, and elected their nominee for governor in 1890 upon a platform which proposed many changes looking to the restriction of the business of the professional and commercial classes, especially the so-called ‘ ‘ middle- men ” who dealt in agricultural products or supplies, and to the advancement of the agricultural industries. The new governor was a farmer and the leading spirit in the Alliance, but his constituents were disappointed in their expectation of unreason- able and impossible changes. The most serious event during this administration was a miners’ war, which grew out of the peni- tentiary lease system. Tennessee had had the lease system since 1867. The able-bodied convicts, a large majority of whom were young negro men, were leased to companies, who used them in manufacturing shoes and waggons, and in working marble quarries and coal mines. Under this system the people were relieved of the burden of supporting the convicts, who were made to bring the state a revenue of more than one hundred thousand dollars a year. Great discontent grew up, however, among the labourers, especially the miners. Free men could not get work at the coal mines, and the people living in the mining districts objected to having large todies of convicts among them. The trouble began in July 1891, and continued at intervals until the autumn of 1892. The miners attacked the prisons and set the convicts at liberty at many places. They openly defied state authorities, and over- powered the first militia that was sent against them. The authori- ties did not get control until a considerable force of reorganized

militia had been put in the field. Judge Peter Turney, an old- time Democrat, chief justice of the Supreme Court of the state, was nominated by the Democrats and elected governor in 1892 as a protest against the rather weak measures of the state government in the

miners' war. These disturbances were soon brought to an end. Governor Turney advocated the abolition of the penitentiary lease system, the erection of a new large penitentiary, and the working of convicts in coal mines owned by the state. These measures were all carried out. Convicts are employed in various manufactures in the prison, in raising field and garden crops for their own use, and the more able-bodied ones are utilized in mining coal, upon property owned by the state, to be used in the capitol, asylums, and other state institutions. Governor Turney was a candidate for re-election in 1894, and the Republicans nominated Mr H. Clay Evans. At the close of the election both candidates claimed the office. The matter was carried before the legislature for investigation and settlement, and resulted in a bitter contest. The laws of Tennessee require that every citizen between 21 and 50 years of age shall pay a poll-tax every year or forfeit his right to vote. The legislative investigation showed that many men had voted who had not paid their poll-tax, and that in counties where this occurred Mr Evans had received his largest majorities. He was therefore declared not legally elected, and Governor Turney was inaugurated and served the full term. The chief legislative act of later years was the adoption of a " uniform text-book law,'.' which provided a commission to select tax-books to be used in the public schools and to make contracts with publishers for supply- ing them at moderate and uniform prices. This Act went into effect 1st July 1899, with a contract which was to continue in force for a period of five years. (c. W. D.)

Tennessee River, the longest and most important branch of Ohio river, U.S.A. It takes its source in numerous streams in the Appalachian valley in south- western Virginia and east Tennessee, and in the moun- tains of western North Carolina. Among these head- waters are the Holston, Clinch, and Powell rivers of east Tennessee and the Nolichucky, Big Pigeon, French Broad, and Little Tennessee of North Carolina. The Tennessee is popularly regarded as commencing at the junction of the Holston and French Broad, near Knoxville, Tennessee. Thence it flows south-westwards through the Appalachian valley into Alabama, where it turns to west-north-west and, just touching Mississippi, returns into Tennessee. It crosses that state and also Kentucky, flowing nearly north to its mouth at Paducah. Its length

from its mouth to Knoxville is 639 miles, and, following up the Holston to its source, 782 miles. Its drainage basin comprises 43,897 square miles. It is navigable from its mouth to Muscle Shoals in Alabama, and thence, by slack water navigation, to Knoxville.

Tenniel, Sir John (1820— — —), English humor- ous and satirical artist — specially identified with Punch — was born in London in 1820. He educated himself for his career, and although he became a probationer, and then a student, of the Koyal Academy, he soon left the schools, where at that time there was little teaching. In 1836 he sent his first picture to the exhibition of the Society of British Artists, and in 1845 contributed a 16-feet cartoon, ” An Allegory of Justice,” to the competition, held in that year, of designs for the mural decoration of the new Palace of Westminster. For this he received a £200 premium and a commission to paint a fresco in the Upper “Waiting Hall (or ” Hall of Poets “) in the House of Lords. In spite of his tendency towards ” high art,” he was already known and appreciated as a humorist, and his early companion- ship with Charles Keen fostered and developed his talent for scholarly caricature. At Christmas time 1850 he was invited by Mark Lemon to fill the position of joint car- toonist (with John Leech) on Punch, from which Richard Doyle, offended by the attitude adopted by the paper towards the Papal see at the time of the so-called ” aggres- sion,” had suddenly resigned. On the strength of his remarkable illustrations to iEsop’s Fables, in which artistic power, humour of observation, and knowledge of animal life were equally apparent, Tenniel was selected on Douglas

“Ill:

M’I’im: tiik Pilot.” By Sir J,„„n Tknniel. (/■’;/ permission of the Proprietors of Vuneh”)

Jerrold’s initiative, to fill the breach, and he contributed his first drawing in the initial letter appearing on p. 224, vol. xix. His first ”

cartoon ” was ” Lord Jack the Giant Killer ” : it showed Lord John Russell, whose letter, on the “aggression” had recently been published, valiantly assail- ing with the sword of truth and liberty Cardinal Wiseman, armed with a crozier. In 1852 we have Tenniel’s first superb lion, and his first obituary cartoon (q.v. under Caricature). Gradually he took over altogether the weekly drawing of the political ” big cut,” which John Leech was happy to resign into his hands in order to restrict himself to his pictures of life and character. Leech’s work consisted for the most part of farce ; Ten- niel’s was high comedy, and not infrequently tragedy ; and the freedom of the humorist heightened the severer beauties of the satirist. When Leech died his friend continued his work alone, and except in 1864, 1868, and 1875-6-7-8, during short spells of illness or holiday, he did not miss a single week. About 2300 cartoons, innumerable minor drawings, double-page cartoons for Punch’s Almanac and other special numbers, and 250 designs for Punch’s Pocket-books, comprise the sum of Sir John Tenniel’s work for the periodical in the service of which he spent the greater portion of his life. When Tenniel retired from the service of Punch in January 1901 he received the honour of a farewell banquet (12th June), at which Mr A. J. Balfour, then leader of the House of Commons, presided and was supported by distinguished representatives of all that was best in English life. On that occasion Mr Balfour’s description of Tenniel as ” a great artist and a great gentleman ” was applauded by the press of the whole country.

The main quality of Sir John Tenniel’s work is accuracy of drawing, precision of touch, grace and dignity of conception, and — so far as such things can be compatible — geniality of satire. Tenniel raised the political cartoon into a) classic composition, from which a sense of nobility is rarely absent. The beauty and st ituesqueness of his ideal figures recall the influence, perhaps, of Cornelius and Overbeck — that German manner which was charac- teristic of many of our finer draughtsmen upon wood at the middle of the 19th century. But Tenniel’s work is always original, un- forced, and fresh ; and it never suggests, what is the fact, that the artist’s work is drawn exclusively from memory, and never from the model. It may be mentioned that Tenniel’s wonderful observation has been conducted, and his

knowledge accumulated, literally through a single eye, the other having been lost during a ~~fencing bout in his youth. It was in recognition not only of his ability as an artist in black and white, but of his service in in~~ fusing good humour and good taste into one phase of political life, that a knighthood was conferred upon him on Mr Gladstone's recommendation in 1893. Without pronounced political opinions of his own, Sir John Tenniel adopted in his work those of his paper, of which the Whig proclivities were to some degree softened by his pencil. The political history not of England only, but to some extent of the world, of half a century appears in Sir John Tenniel's weekly cartoons, which are dignified by a number of types in- vented by the artist, the classic beauty of which may be looked for in vain in kindred work by any previous cartoonist. (Take, for example, Sir John's famous picture of " Dropping the Pilot " [see Plate], which appeared in Punch on 20th March 1890, vol. xcviii. pp. 150-51.) Two public exhibitions of Sir John Ten- niel's work have" been held, one in 1895 and the other in 1900. Sir John Tenniel is also the author of one of the mosaics, "Leonardo da Vinci," in the South Court in the Victoria and Albert Museum ; while his highly stippled water-colour drawings have appeared from time to time in the exhibitions of the Royal Institute of Painters in Water Colours, of which society he was elected a member in 1874. As an illustrator on the wood-block he stands very high ; his "Lalla Rookh" is perhaps the finest of all his work in point of conception, refinement, power, and tech- nical excellence.

Works Illustrated — (1) Juvenile Verse and Picture Book, 1846 ; (2) Undine, 1846; (3) jEsop's Fables, 100 drawings, 1848 ; (4) Blair's Grave, 1858 ; (5) Shirley Brooks's The Qordian Knot, 1860, and (6) The Silver Cord, 1861 ; (7) Moore's Lalla Rookh, 69 drawings, 1861 ; (8) Lewis Carroll's Alice's Adventures in Wonderland, 1866; (9) The Mirage of Life, 1867; (10) Carroll's Through the Looking-Glass, 1870 ; and the following in col-

laboration: (ll)Pollok's Course of Time, 1857; (12) Poets of the Nineteenth Century, 1857 ; (13) Poe's Works, 1857 ; (14) Home Affections, 1858 ; (15) Cholmondeley Pennell's Puck on Pegasus, 1863 ; (16) The Arabian Nights, 1863 ; (17) English Sacred Poetry, 1864 ; (18)

Legends and Lyrics, 1865 ; (19) Tupper's Proverbial Philosophy; (20) Barry Cornwall's Poems, and other books. He also contributed to Once a Week, the Art Union publications, &c.

Tennyson, Alfred Tennyson, 1st Baron (1809-1892), English poet, was the fourth of the twelve children of the Rev. George Clayton Tennyson (1778- 1831) and his wife Elizabeth Fytche (1781-1865). The Tennysons were an old Lincolnshire family settled at Bayou's Manor, where the poet's grandfather, Mr George Tennyson, M.P., resided, while the father was settled hard by in the rectory of Somersby. Here Alfred was born on the 6th of August 1809. The rich pastoral scenery of this part of Lincolnshire influenced the imagination of the boy, and is plainly reflected in all his early poetry, although it is now stated with authority that the local- ities of his subject-poems, which had been ingeniously identified with real brooks and granges, were wholly imaginary. At a very early age he began to write in prose and verse. At Christmas 1815 he was sent to the grammar school at Louth, his mother having kept up a connexion with this typical Lincolnshire borough, of which her father, the Rev. Stephen Fytche, had been vicar. Tennyson was at this school for five years, and then returned to Somersby to be trained by his father. In the rectory the boys had the run of an excellent library, and here the young poet based his wide knowledge of the English classics. The news of Byron's death (19th April 1824) made a deep impression on him : it was a day, he said, " when the whole world seemed to be darkened for me " ; he went out into the woods and carved " Byron is dead " upon a rock. Ten- nyson was already writing copiously — " an epic of 6000 lines" at twelve, a drama in blank verse at fourteen, and so on : these exercises have, very properly, not been printed, but the poet said of them at the close of his life, "It seems to me, I wrote them all in perfect metre." The family was in the habit of spending the summer holidays at the coast of the county, commonly at Mablethorpe, and here Tennyson gained his impressions of the vastness of the sea. EitzGerald very justly attributed the landscape character of Tennyson's genius to the impress left on his imagination by " old Lincoln- shire, where there were not only such good seas, but also such fine hill and dale among the wolds."

_ In 1827 Frederick Tennyson (1807-1898), the eldest sur- viving brother, uniting with his younger brothers Charles (1808-1879) and Alfred, published at Louth an anonymous collection of Poems by Two Brothers. The ” two ” were Charges and Alfred (whose contributions predominated), and who shared the surprising profits, £20. On the 20th February 1828 Charles and Alfred matriculated at Trinity College, Cambridge, where Frederick was already a scholar. The poet told the writer of these lines that his father would not let him leave Somersby till, on successive days, he had recited from memory the whole of the odes of Horace. The brothers took rooms at 12 Rose Crescent, and after- wards moved into Trumpington Street (now 157 Corpus Buildings). They were shy, and made at first few friends ; but they gradually gathered selected associates around them, and Alfred grew to be looked up to at Cambridge ” as to a great poet and an elder brother ” by a group which included Trench, Monckton Milnes, Spedding, Thompson, FitzGerald, Brookfield, and, most of all, A. H. Hallam (1811-1833). In June 1829 Tennyson won the Chancel- lor’s prize medal for his poem called ” Timbuctoo.” With great imperfections, this study in Miltonic blank verse displays the genius of a poet, in spite of a curious obscurity both of thought and style. Here are already

both richness and power, although their expression is not yet clarified by taste. But by this time Tennyson was writing lyrics of still higher promise, and, as Arthur Hallam early perceived, with an extraordinary earnest- ness in the worship of beauty. The results of this en- thusiasm and this labour of the artist appeared in the volume of Poems, chiefly Lyrical, published in 1830. This book would have been astonishing as the production of a youth of twenty-one, even if, since the death of Byron six years before, there had not been a singular dearth of good poetry in England. Here at least, in the slender volume of 1830, was a new writer revealed, and in “Mariana,” “The Poet,” “Love and Death,” and ” Oriana,” a singer of wonderful though still unchastened melody. Through these, and through less perfect examples, was exhibited an

amazing magnificence of fancy, at present insufficiently under control, and a volup- tuous pomp of imagery, tending to an over-sweetness. The veteran S. T. Coleridge, praising the genius in the book, blamed the metrical imperfection of it. For this criticism he has himself constantly been reproved, and Tennyson (whose impatience of anything like censure was phenomenal) continued to resent it to the end of his life. Yet Coleridge was perfectly just in his remark; and the metrical anarchy of the "Madelines" and "Adelines" of the 1830 volume showed that Tennyson, with all his delicacy of modulation, had not yet mastered the arts of verse.

In the summer of 1830 Tennyson and Hallam volun- teered in the army of the Spanish insurgent Torrijos, and marched about a little in the Pyrenees, without meeting with an enemy. He came back to find his father ailing, and in February 1831 he left Cambridge for Somersby, where a few days later Dr George Tennyson died. The new incumbent was willing that the Tennysons should continue to live in the rectory, out of which they did not turn until six years later. Arthur Hallam was now betrothed to Emily Tennyson (afterwards Mrs Jesse, 1811-1889), and stayed frequently at Somersby. This was a very happy time, and one of great physical develop- ment on Alfred's part. He took his share in all kinds of athletic exercises, and it was now that Brookfield said, " It is not fair that you should be Hercules as well as Apollo." This high physical zest in life seems to have declined after 1831, when his eyes began to trouble him, and he became liable to depression. The poetical work of these three years, mainly spent at Somersby, was given to the world in the volume of Poems which appeared at the end of 1832. This was one of the most astonishing revelations of finished genius ever produced, certainly by a young man of less than four-and-twenty. Here were to be read " The Lady of Shalott," " The Dream of Fair Women," " CEnone," "The Lotos-Eaters," "The Palace of Art," and " The Miller's Daughter," with a score of other lyrics, delicious and divine. The advance in crafts- manship and command over the matiriel of verse shown since the volume of ,1830 is absolutely astounding. If Tennyson had died of the savage article which presently appeared in the Quarterly Beview, literature would have sustained terrible losses, but his name would have lived for ever among those of the great

English poets. Indeed, it may be doubted whether, in several directions, he ever surpassed the glorious things to be found in this most exquisite and most precious book. It was well that its publication was completed before the blow fell upon Tennyson which took for a while all the light out of his life. In August 1833 Arthur Hallam started with his father, the great historian, for Tirol. They went no farther than Vienna, where Mr Hallam, returning to the hotel on the 15th September 1833, found his son lying dead on a sofa : a blood-vessel had broken in his brain. His body

was brought back to England, and buried at Clevedon on the 3rd January 1834. These events affected Tennyson extremely. He grew less than ever willing to come for- ward and face the world ; his health became ” variable and his spirits indifferent.” The earliest effect of Hallam’s death upon his friend’s art was the composition, in the summer of 1834, of TJie Two Voices; and to the same period belong the beginnings of the Idylls of the King and of In Memoriam, over both of which he meditated long. In 1835 he visited the Lakes, and saw much of Hartley Coleridge, but would not ” obtrude on the great man at Bydal,” although “Wordsworth was hospitably disposed.” Careless alike of fame and of influence, Tennyson spent these years mainly at Somersby, in a uniform devotion of his whole soul to the art of poetry. In 1837, to their great distress, the Tennysons were turned out of the Lincolnshire rectory where they had lived so long. They moved to High Beech, in Epping Forest, which was their home until 1840. The poet was already engaged, or ” quasi-betrothed,” to Emily Sell wood, but ten years more had to pass before they could afford to marry. At Torquay, in 1838, he wrote Audley Court on one of his rare excursions, for he had no money for touring, nor did he wish for change: he wrote at this time, ” I require quiet, and myself to myself, more than any man when I write.” In 1840 the Tennysons moved to Tunbridge Wells, and a year later to Boxley, near Maidstone, to be close to Edmund Lushington, who had now married Cecilia Tennyson. _ “Alfred was from this time more and more frequently a visitor in London.

In 1842 the two-volumes edition of his Poems broke the ten years’ silence which he had enforced himself to keep. Here, with many pieces

already known to all lovers of modern verse, were found rich and copious additions to his work. These he had originally intended to publish alone, and an earlier privately-printed Morte oV 'Arthur, Dora, and other Idylls, of 1842, is the despair of book-collectors. Most of those studies of home-life in England, which formed so highly popular a section of Tennyson's work — such as "The Gardener's Daughter," "Walking to the Mail," and " The Lord of Burleigh " — were now first issued, and, in what we have grown to consider a much higher order, " Locksley Hall," " Ulysses," and " Sir Galahad." To the older and more luxurious lyrics, as reprinted in 1842, Tennyson did not spare the curbing and pruning hand, and in some cases went too far in restraining the wanton spirit of beauty in its youthful impulse. It is from 1842 that the universal fame of Tennyson must be dated; from the time of the publication of the two volumes he ceased to be a curiosity, or the darling of an advanced clique, and took his place as the leading poet of his age in England. Among the friends whom he now made, or for the first time cultivated, were Carlyle, Eogers, Dickens, and Elizabeth Barrett. Material diffi- culties now, however, for the first time intruded on his path. He became the victim of a certain "earnest-frothy" speculator, who induced him to sell his little Lincolnshire estate at Grasby, and to invest the proceeds, with all his other money, and part of that of his brothers and sisters, in a " Patent Decorative Carving Company " : in a few months the whole scheme collapsed, and Tenny- son was left penniless. He was attacked by so over- whelming a hypochondria that his life was despaired of, and he was placed for some time under the charge of a hydropathic physician at Cheltenham, where absolute rest and isolation gradually brought him round to health again. The state of utter indigence to which Tennyson was reduced greatly exercised his friends, and in September 1845, at the suggestion of Henry Hallam, Sir Eobert Peel was induced to bestow on the poet a pension of £200 a year. Never was public money expended in a more

patriotic fashion. Tennyson's health slowly became re- stored, and in 1846 he was hard at work on Tlie Princess ; in the autumn of this year he took a tour in Switzerland, and saw great mountains and such " state- liest bits of landskip " for the first time. In 1847 nervous prostration again obliged him to undergo treatment atPrestbury: "They tell me not to read, not to think; but they might as well tell me not to live." Dr Gully's water-cure was tried, with success. The Princess was was now published, in a form afterwards considerably modified and added to. Car- lyle and FitzGerald " gave up all hopes of him after The Princess," or pretended that they did. It was true that the bent of his genius was slightly altered, in a direc- tion which seemed less purely and austerely that of the highest art; but his con- cessions to public taste vastly added to the width of the circle he now addressed. The home of the Tennysons was now at Cheltenham : on his occasional visits to London he was in the habit of seeing Thackeray, Coven- try Patmore, Browning, and Macready, as well as older friends, but he avoided "society." In 1848, while making a tour in Cornwall, Tennyson met Hawker of Morwenstow, with whom he seems — but the evidence is uncertain — to have talked about King Arthur, and 1jo have resumed his intention of writing an epic on that theme. In his absent-minded way Tennyson was very apt to mislay objects; in ear- lier life he had lost the MS. of Poems, chiefly Lyrical, and had been obliged to re-store the whole from scraps and memory. Now a worse thing befell him, for in Feb- ruary 1850, having collected into one " long ledger-like book " all the elegies on Arthur Hallam which he had been composing at intervals since 1833, he left this only MS. in the cupboard of some lodgings in Mornington Place, Hampstead Road. By extraordinary good chance it had been overlooked by the landlady, and Coventry Patmore was able to recover it. In this way In Memoriam was dragged back from the very verge of destruction, and could be published, in its original anonymous form, in May 1850. The public was at first greatly mystified by the nature and object of this poem, which was not merely a chronicle of Tenny- son's emotions under bereavement, nor even a statement of his philosophical and religious beliefs, but, as he long afterwards explained, a sort of Divina Commedia, ending with happiness in the marriage of his youngest sister, Cecilia Lushington. In fact, the great blemishes of In Memoriam, its redundancy and the

dislocation of its parts, were largely due to the desultory manner of its composition. The poet wrote the sections as they occurred to him, and did not think of weaving them together into a single poem until it was too late to give them real

Alfred Tennybon. {From a photograph by Elliott and Fry, London.)

coherency. The metre, which by a curious naivete" Tennyson long believed that he had invented, served by its happy peculiarity to bind the sections together, and even to give an illusion of connected movement to the thought.

The sale of Tennyson's poems now made it safe for him to settle, and on the 13th June 1850 he was married at Shiplake to Emily Sarah Sellwood (1813- 1896). Of this union no more need be said than was recorded long afterwards by the poet himself, "The

peace of God came into my life before the altar when I wedded her." Every species of good fortune was now to descend on the path of the man who had struggled against ill luck so long. Wordsworth died, and on the 19th November 1850 Queen Victoria appointed Tennyson Poet Laureate. The salary connected with the post was very small, but it had a secondary value in greatly stimulating the sale of his books, which was his main source of income. The young couple took a house at Warning- lid, in Sussex, which did not suit them, and then one in Montpelier Row, Twickenham, which did bet- ter. In . April 1851 their first child was born dead. At this time Tennyson was brooding much upon the ancient world, and reading little but Milton, Homer, and Virgil. This condition was elegantly defined by Carlyle as "sitting on a dungheap among innumer- able dead dogs." In the summer of 1851 was made the tour in Italy, of which Tlie Daisy is the immortal record. Of 1852 the prin- cipal events of his eldest Lord Tennyson, in August, and in publication of the Ode on the Death Wellington. In the winter of 1853 Tennyson entered into possession of a little house and farm called Farring- ford, near Freshwater, in the Isle of Wight, which he leased at first, and afterwards bought : this beautiful place, ringed round with ilexes and cedars, entered into his life and coloured it with its delicate enchantment. In 1854 he published The Charge of the Light Brigade,

and was busy composing Maud and its accompanying lyrics ; and this volume was published in July 1855, just after he was made D.C.L. at Oxford : he was received on this occasion, which may be considered his first public appearance, with a ” tremendous ovation.” The reception of Maud from the critics, however, was the worst trial to his equanimity which Tennyson had ever had to endure, nor had the future anything like it in store for him. He had risen in Maud far above his ordinary serenity of style, to ecstasies of passion and audacities of expression which were scarcely intelligible to his readers, and certainly not welcome. It is odd that this irregular poem, with its copious and varied music, its

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splendid sweep of emotion, its unfailing richness of texture — this poem in which Tennyson rises to heights of human sympathy and intuition which he reached nowhere else, should have been received with bitter hostility, have been styled ” the dead level of prose run mad,” and have been reproved more absurdly still for its ” rampant and rabid bloodthirstiness of soul.” There came a reaction of taste and sense, but the delicate spirit of Tennyson had been wounded. For some years the world heard nothing from him ; he was at Farringf ord, busying himself with the Arthurian traditions. He had now become an object of boundless personal curiosity, being already difficult to find, and the centre of amusing legends. It was in 1857 that Bayard Taylor saw him, and carried away the impression of a man, ” tall and broad-

shouldered as a son of Anak, with hair, beard, and eyes of southern darkness.” This period of somewhat mysterious withdrawal from the world embraced a tour in Wales in 1857, a visit to Norway in 1858, and a journey through Portugal in 1859. In 1857 two Arthurian poems had been tentatively and privately printed, as Enid and Nimue, or the True and the False, to see how the idyllic form would be liked by the inner circle of Tennyson’s friends. In the summer of 1859 the first series of Idylls of the King was at length given to the world, and achieved a popular success far beyond anything experienced before by any English poets, save perhaps Byron and Scott. Within a month of publication, 10,000 copies had been sold. The idyls were four in number, “Enid,” “Vivien” (no longer called “Nimue”), “Elaine,” and ” Guinevere.” These were fragments of the epic of the fall of King Arthur and the Table Bound which Tennyson was so long preparing, and which he can hardly be said to have ever completed, although nearly thirty years later he closed it. The public and the critics alike were entranced with the ” sweetness” and the “purity” of the treatment. A few, like Buskin, were doubtful about ” that increased quietness of style ” ; one or two already suspected that the ” sweetness ” was obtained at some sacrifice of force, and that the ” purity ” involved a concession to Victorian conventionality. It was not perceived at the time that the four idyls were parts of a great historical or mystical poem, and they were welcomed as four polished studies of typical women: it must be confessed that in this light their even perfection of work- manship appeared to greater advantage than it eventually did in the general texture of the so-called ” epic.” In 1859 ” Boadicea ” was written, and ” Riflemen, Form ! ” published in The Times. Urged by the Duke of Argyll, Tennyson now turned his attention to the theme of the Holy G-rail, though he progressed with it but fitfully and slowly. In 1861 he travelled in Auvergne and the Pyrenees, with Clough, who was to die a few months later ; to this year belong ” Helen’s Tower ” and the ” Dedication ” of the Idylls to the Prince Consort, ” These to his Memory.” The latter led to Tennyson’s presentation in April 1862 to the Queen, who ” stood pale and statue-like before him, in a kind of stately innocence,” which greatly moved his admiring homage. From this time forth the poet enjoyed the constant favour of the Sovereign, though he could never be moulded into a con- ventional courtier. He

now put the Arthurian legends aside for a time, and devoted himself to the composition, in 1862, of ” Enoch Arden,” which, however, did not appear until 1864, and then in a volume which also con- tained ” Sea Dreams,” ” Aylmer’s Field,” and, above all, ” The Northern Farmer,” the first and finest of Tennyson’s remarkable studies in dialect. In April of this year Garibaldi visited Farringford ; in February 1865 Tenny- son’s mother died at Hampstead in her eighty -fifth year ; in the ensuing summer he travelled in Germany. The

time slipped by with incidents but few and slight, Tenny- son’s popularity in Great Britain growing all the time to an extent unparalleled in the whole annals of English poetry. This universality of fame led to considerable practical discomfort ; he was besieged by sight-seers, and his nervous trepidation led him perhaps to exaggerate the intensity of the infliction. In 1867 he determined to make for himself a haven of refuge against the invad- ing Philistine, and bought some land on Blackdown, above Haslemere, then a remote corner of England; here Mr James Knowles began to build him a house, ultimately named Aldworth. This is the time of two of his rare, privately printed pamphlets, Tlie Window ; or, the Loves of the Wrens (1867), and The Victim (1868). The noble poem Lucretius, one of the greatest of Tenny- son’s versified monographs, appeared in May 1868, and in this year Tlie Holy Grail was at last finished; it was published in 1869, together with three other idyls belong- ing to the Arthurian epic, and various miscellaneous lyrics, besides Lucretius. The reception of this volume was cardial, but not so universally respectful as Tennyson had grown to expect from his adoring public. The fact was that the heightened reputation of Browning, and still more the sudden vogue of Swinburne, Morris, and Bos- setti (1866-1870), considerably disturbed the minds of Tennyson’s most ardent readers, and exposed himself to a severer criticism than he had lately been accustomed to endure. He went on quite calmly, however, sure of his mission and of his music. His next volume (1872), Gareth and Lynette and The Last Tournament, continued and, as he then supposed, concluded the Idylls of the King, to the great satisfaction of the poet, who had found much difficulty in rounding off the last sections of the poem. Nor, as he was to find, was the poem yet completed, but for the time being he dismissed it from his

mind. In 1873 he was offered a baronetcy by Gladstone, and again by Disraeli in 1874 ; in each case the honour was grace- fully declined. Believing that his work with the roman- tic Arthurian epics was concluded, Tennyson now turned his attention to a department of poetry which had long attracted him, but which he had never seriously attempted — the drama. He put before him a scheme, which he cannot be said to have carried far, that of illustrating ” the making of England ” by a series of great historical tragedies. His Queen Mary, the first of these chronicle- plays, was published in 1875, and played by Mr Irving at the Lyceum in 1876. Although it was full of admir- ably dramatic writing, it was not theatrically well com- posed, and it failed on the stage. Extremely pertinacious in this respect, the poet went on attempting to storm the theatre with assault upon assault, all practically failures until the seventh and last, which was unfortunately post- humous. To have really succeeded on the stage would have given Tennyson more gratification than anything else, but he was not permitted to live long enough to see this blossom also added to the heavy garland of his glory. Meanwhile Harold, a tragedy of doom, was published in 1876 ; but, though perhaps the finest of its author’s dramas, it has never been acted. During these years Tennyson’s thoughts were largely occupied with the building of Aldworth. His few lyrics were spirited ballads of adventure, inspired by an exalted patriotism— ” The Bevenge” (1878), “The De- fence of Lucknow ” (1879) — but he reprinted and finally published his old suppressed poem, Tlie Lover’s Tale, and a little play of his, Tlie Falcon, versified out of Boccaccio, was produced by the Kendals at their theatre in the last days of 1879. Tennyson had reached the limits of the three- score years and ten, and it was tacitly taken for granted that he would now retire into dignified repose. In point of fact, he now started on a new lease of poetical activity.

In 1880 he published the earliest of six important collec- tions of lyrics, this being entitled Ballads and other Poems, and containing the sombre

and magnificent ” Bizpah.” In 1881 Tlie Cup and in 1882 Tlie Promise of May, two little plays, were produced without substantial success in London theatres : the second of these is perhaps the least successful of all the poet’s longer writings, but its failure annoyed him unreasonably. This determination to be a working playwright, pushed on in the face of critical hostility and popular indifference, is a very curi- ous trait in the character of Tennyson. In September 1883 Tennyson and Gladstone set out on a voyage round the north of Scotland, to Orkney, and across the ocean to Norway and Denmark. At Copenhagen they were enter- tained by the king and queen, and after much fgting, returned to Gravesend: this adventure served to cheer the poet, who had been in low spirits since the death of his favourite brother Charles, and who now entered upon a phase of admirable vigour. During the voyage Glad- stone had determined to offer Tennyson a peerage. Af- ter some demur, the poet consented to accept it, but added, “For my own part, I shall regret my simple name all my life.” On the 11th March 1884 he took his seat in the House of Lords as Baron Tennyson of Aid- worth and Farringford. He voted twice, but never spoke in the House. In the autumn of this year his tragedy of Becket was published, but the poet at last despaired of the stage, and disclaimed any hope of ” meeting the exi- gencies of our modern theatre.” Curiously enough, after his death Becket was the one of all his plays which enjoyed a great success on the boards. In 1885 was pub- lished another interesting miscellany, Tiresias and other Poems, with a posthumous dedication to Edward Fitz-Gerald. In this volume, it should be noted, The Idylls of the King was completed at last by the publication of ” Balin and Balan ” ; it contained also the superb address ” To Virgil.” In April 1886 Tennyson suffered the loss of his second son, Lionel, who died in the Bed Sea on his return from India. The untiring old poet was stead- ily writing on, and by 1886 he had another collection of lyrics ready, Locksley Hall Sixty Tears After, &c. ; his eyes troubled him, but his memory and his intellectual curiosity were as vivid as ever. Late in 1888 he had a dangerous attack of rheumatic gout, from which it seemed in December that he could scarcely hope to rally, but his magnificent constitution pulled him through. He was past eighty when he published the collection of new verses entitled Demeter and other Poems (1889), which appeared almost simultaneously with the death of Browning, an

event which left Tennyson a solitary figure indeed in poetic literature. In 1891 it was ob- served that he had wonderfully recovered the high spirits of youth, and even a remarkable portion of physi- cal strength. His latest drama, TJie Foresters, now received his attention, and in March 1892 was produced at New York, with Miss Ada Behan as Maid Marian. During this year Tennyson was steadily engaged on poetical composition, finishing ” Akbar’s Dream,” ” Kapi- olani,” and other contents of the posthumous volume called The Death of GEnone, 1892. In the summer he took a voyage to the Channel Islands and Devonshire ; and even this was not his latest excursion from home, for in July 1892 he went up for a visit to London. Soon after entering his eighty-fourth year, however, symptoms of weakness set in, and early in September his condition began to give alarm. He retained his intellectual lucidity and an absolute command of his faculties to the last, reading Shakespeare with obvious appreciation until within a few hours of his death. With the splendour of the full moon falling upon him, Ms hand clasping his Shakespeare, and looking, as we are told, almost un-

earthly in the majestic beauty of his old age, Tennyson passed away at Aldworth on the night of the 6th October 1892. Cymbeline, the play he had been reading on the last afternoon, was laid in his coffin, and on the 12th he was publicly buried with great solemnity in Westminster Abbey. Of the twelve eminent men who supported the coffin, seven had already followed him in 1902 — Argyll, Dufferin, Selborne, Jowett, Froude, Lowell, and Paget. Lady Tennyson survived until she reached the age of her husband when he died, and was buried at Freshwater in August 1896.

The physical appearance of Tennyson was very remark- able. Of his figure at the age of thirty -three Carlyle has left a superb portrait: “One of the finest-looking men in the world. A great shock of rough, dusky, dark hair ; bright, laughing, hazel eyes ; massive aquiline face, most massive yet most delicate ; of sallow brown complexion, almost Indian-looking, clothes cynically loose, free-and- easy, smokes infinite tobacco. His voice is musical, me- tallic, fit for loud laughter and piercing wail, and all that may lie between ; speech and speculation free and plen- teous ; I do not meet in these late decades such company over

a pipe.” He was unusually tall, and possessed in advanced years a strange and rather terrifying air of sombre majesty. But he was, in fact, of a great sim- plicity in temperament, affectionate, shy, still exquisitely sensitive in extreme old. age to the influences of beauty, melancholy, and sweetness. Although exceedingly near- sighted, Tennyson was a very close observer of nature, and at the age of eighty his dark and glowing eyes, which were still strong, continued to permit him to enjoy the delicate features of country life around him, both at Aid- worth and in the Isle of Wight. His Life was published, with admirable piety and taste, in two volumes, by his son, Hallam, second Lord Tennyson, in 1897.

At the time of his death, and for some time after it, the enthusiastic recognition of the genius of Tennyson took popular forms which were excessive and which it was obvious could not be enduring. We are now feeling the reaction against this extravagance, and criticism has of late been little occupied with the poet. The reason of this is easy to find. For an unusually long period this particular poetry had occupied public and professional opinion, and all the commonplace things about it had been said and re-said to satiety. It lacks for the moment the interest of freshness ; it is like a wonderful picture seen so constantly that it fails any longer to concentrate attention. For a final estimate of Tennyson we must ‘ wait until a generation arises which is not under the spell of the overwhelming personal prestige which his sixty years of unceasing production gave him among his younger contemporaries. No poet has ever held England, no poet but Victor Hugo has probably ever held any country, quite so long under his unbroken sway as Ten- nyson did. As he recedes from us, however, we begin to see that he has much closer a relation to the great Georgian writers than we used to be willing to admit. The distance between the generation of Wordsworth and Coleridge and that of Byron and Shelley is not less — it is even probably greater — than that which divides Keats from Tennyson, and he is more the last of that great school than the first of any new one. The qualities in which he seems to surpass his immediate predecessors are exactly those which should be the gift of one who sums up the labours of a mighty line of artists. He is remarkable among them for the breadth, the richness, the substantial accomplishment of his touch;

he has something of all these his elders, and goes farther along the road of technical perfection than any of them. We still look to the earlier masters for supreme excellence in particular directions : to Wordsworth for sublime philosophy, to

Coleridge for ethereal magic, to Byron for passion, to Shelley for lyric intensity, to Keats for richness. Tenny- son does not excel each of these in his own special field, but he is often nearer to the particular man in his particular mastery than any one else can be said to be, and he has in addition his own field of supremacy. What this is cannot easily be defined ; it consists, perhaps, in the beauty of the atmosphere which Tennyson contrives to cast around his work, moulding it in the blue mystery of twilight, in the opaline haze of sunset : this atmosphere, suffused over his poetry with inestimable skill and with a tact very rarely at fault, produces an almost unfailing illusion or mirage of loveliness, so that, even where (as must sometimes be the case with every poet) the thought and the imagery have little value in themselves, the Active aura of beauty broods over the otherwise undis- tinguished verse. Hence, among all the English poets, it is Tennyson who presents the least percentage of en- tirely unattractive poetry. In his luminous subtlety and his broad undulating sweetness, his relationship with Virgil has long been manifest ; he was himself aware of it. But he was also conscious that his exquisite devotion to mere lucidity and beauty might be a snare to him, and a happy instinct was always driving him to a study of mankind as well as of inanimate nature. Few English writers have known so adroitly as Tennyson how to bend the study of Shakespeare to the enrichment of their per- sonal style. It should be added that he was a very deep and original student of literature of every description, and that the comparatively few specimens which have been preserved of his conversation contain some of the finest fragments of modern appreciation of the great poets which we possess. This is worthy of consideration in any attempt made to sketch the mind of a man who was above all other masters of recent literature an artist,

and who must be studied in the vast and orbic ful- ness of his accomplishment in order to be appreciated at all. (e. g.)

Tenterden, a municipal borough and market town of Kent, England, in the Ashf ord parliamentary division of the county, 18 miles south-east of Maidstone, on the South-Eastern and Chatham railway. The town received incorporation charters from Henry VI. and Elizabeth. The church (Perpendicular), with its famous steeple, is well known for the legend connecting it with Goodwin Sands. The story is that the Abbot of St Augustine, Canterbury, diverted the funds by which the sea-wall pro- tecting Earl Godwin's island Louisa was kept up, for the purpose of building Tenterden steeple, the consequence being that in 1099 an inundation took place and "Tenterden steeple was the cause of the Goodwin Sands." Population (1881), 3620 ; (1901), 3243.

Topic, a territory of the Mexican Republic, bounded on the N. by the states of Sinaloa and Durango, on the S. by Jalisco, on the E. by Zacatecas and Jalisco, and on the W. by the Pacific. Area, 11,279 square miles. Popula- tion (1895), 148,776 ; (1900), 149,677. The territory is divided politically into six partidos. The value of the agricultural products in 1896 was $6,990,622. The mining interests are also important. The capital, Tepic, has a population of 14,560, fine public buildings, and considerable manufacturing interests, which would be largely increased with better transportation facilities, but there are no railways in the territory. San Bias is the principal port, and does a large business with the entire Pacific coast. It is connected with Tepic by a fairly good waggon road.

Teplitz, or Toplitz (Czech, Teplice, which signifies " warm bath "), a town and watering-place in Bohemia, 47

miles north-west of Prague. Population (1890), 20,262 ; (1900), 24,110, mostly German and Catholic. In 1895 the village of Schonau was incorporated with the town, which now bears the official name of Teplitz-Schbnau. In addition to its textile, chemical, and hardware industries, Teplitz now manufactures machinery and metal goods, glass, imitation jewellery, hosiery and knitted goods, stoneware, and

sugar, besides carrying on dyeing and calico-printing. The patients now number nearly 6000, and the passing visitors over 23,000.

Terek (Bussian, Terskaya Oblast), a province of north Caucasia, Russia, bordering on the Caspian Sea. It has an area of 23,548 square miles, and its population, which was 615,660 in 1884, numbered 933,485 (domiciled only) in 1897, when the female population numbered 445,996, and the urban population 115,179. According to Dr Pantukhoff's researches, malaria is prevalent everywhere except at the foot of the mountains, and is especially deadly along the Caspian shore. Notwithstand- ing this, however, there has been a steady flow of Russian immigration into the province, the Russian population now forming considerably more than a third of the whole; in 1895 there were 312,443 Russians out of a total population of 871,148. In the same year the numbers of the inhabitants of other nationality were (approximately) : Ossets, 90,000 ; Kabardians, 80,000 ; eastern mountaineers (Tchetchens, Ingushes), 316,500 ; Kumyk Tatars, 31,500; Armenians, 13,700; the re- mainder being — Georgians (4500), Germans (8440), and Persians (2400). The province is divided into seven dis- tricts, the chief towns of which are Vladikavkaz (43,843), which is also the capital of the province, Groznyi (15,599), Kizlyar (7324), Nalchik (2571), Pyatigorsk (18,638), Sunzhinsk and Khasavyurt, the two last being mere nomad centres of administration. Other towns are Georgievsk (11,532) and Mozdok (14,583). Agriculture has developed greatly on the prairies, and in 1900 the total area under cereal crops was 1,336,900 acres, while the average yield in 1895-99 was: Rye, 786,000 cwt. ; wheat, 1,525,000 cwt. ; oats, 256,000 cwt. ; and barley, 411,000 cwt.— all cereals, 8,273,000 cwt. ; also potatoes, 1,172,000 cwt. The vine is very extensively cultivated, especially in the districts of Kizlyar and Pyatigorsk, where no less than 1,500,000 gallons of wine are made annually. Improved agricultural machinery is coming more and more into general use. Cattle-breeding is widely engaged in, and fishing is a valuable source of income, especially at the mouth of the Terek, where nearly 2000 tons of fish are obtained and 2770 cwt. of caviare made every year. Bees are generally kept, there being in the province over 200,000 hives, which yield every year about 4,000,000 roubles worth of honey and wax. Melons, cucumbers,

sunflowers, &c, are extensively grown. Manufactur- ing industry is still in its infancy, and in 1898 the aggregate returns of all factories only amounted to a little over 4,000,000 roubles. Mining is also insigni- ficant in character, only 106 lb of silver (Sadonsk) and 1890 cwt. of lead being produced in 1889. Naphtha, however, is obtained in large and growing quantities (390,500 tons in 1899) at Groznyi. Some salt is also obtained. The railway, which formerly stopped at Vladikavkaz, on the northern slope of the Caucasus, has now been continued from the Beslan station, near Vladikavkaz, to Petrovsk on the Caspian Sea, and thence to Baku, where it joins the trans-Caucasian line from Batum to Baku. There were in 1898, 15 middle schools for boys and girls, and 389 primary schools (15,445 boys and 5118 girls). No less than 115 had school gardens, while sericulture was taught in 40 primary schools and bee-keeping in 16.

Tergovista, the chief town of the district of Dambovitza, Rumania, picturesquely situated at the foot of the Carpathians, on the right bank of the Jalomitza, 48 miles N.N.W. of Bucharest. Population (1900), 9398. Formerly it was the capital of Wallachia, and in the 16th century had a population of 60,000, and contained 70 churches and 40 convents within its strongly fortified enceinte. In 1515 Neagru Bassaraba, the founder of the cathedral of Curtea d'Argesh, constructed the metropolitan church at Tergovista, one of the finest in the country, which with several others is still existent.

Tergu Jiu, chief town of the district of Gorj, Rumania, 60 miles N.N.W. of Craiova and near the Transylvanian Alps. It is the seat of the court of first instance, and has five churches. The annual fair is held on 15th August. Anthracite coal is found in the neigh- bourhood. Population (1895), 5400 ; (1900), 6634.

Terim. See Arabia.

Termini, a seaport town of the province of Palermo, Sicily, Italy, on the north coast, 23 miles east-south-east of Palermo by rail. It has an archaeological collection, a picture gallery, a technical school, and a navigation school, and produces macaroni (a speciality), olive oil, wine, liquorice, sulphur, and lime. It has also tunny- fishing, and trade in sulphur, fish, fruits, &c. The harbour is 12 to 25 feet deep. In 1897 it was cleared by 276 vessels of 82,398 tons. There is a hydropathic attached to the baths. Population (1881), 22,861 ; (1899), about

32,000.

Termites are insects with four wings which are developed outside the body (a large proportion of the individuals become adult, however, without wings appear- ing at all). The wings are of nearly one size, of long, narrow form, of paper-like consistence, and in repose are placed flat on the back of the insect so that only one wing shows. After a short time the wings are shed, and only small stumps remain as evidence of the individual being a winged form. The mouth has strong mandibles. For- merly Termites were classed as a part of the Order Neuroptera, but more recently they have been separated by certain zoologists from the true Neuroptera, and asso- ciated with some other forms as an Order Corrodentia. By Packard they have been associated with Mallophaga, and called Platyptera. They are, however, really an isolated form as much allied to Orthoptera as to Neuro- ptera, and now constitute by themselves the Order Isoptera, of which about 300 species are known. There is no great structural diversity in the Order, all the species being referred to the single family Termitidse, which is therefore synonymous with the Order Isoptera. Termites are more widely known as White Ants, but as they are extremely different from true ants, and as they are rarely white, this designation is very deceptive, and should be abandoned.

Termites are found only in warm climates, where they are sometimes very destructive. They are vegetarian, but occasionally eat, or destroy, dry animal matter. The basis of their alimentary regimen is woody matter. Some of them make use of fungi growing in their abodes as food ; some cut and store grass ; others prepare a peculiar kind of food,

which is stored in a tough, dry form, so that it has to be moistened before it can be eaten. Termites are social insects ; many of them construct large edifices called termitaria and often spoken of as nests. A termit- arium frequently contains an enormous number of indi- viduals forming the society or colony. Termites are totally different in structure and development from all other social insects, but their social existence exhibits

numerous analogies with that of the ants and other social Hymenoptera. The most remarkable of these analogies is that the reproduction of the species in each com- munity is confined to a single pair, or to a very limited

number of indi- viduals. The mem- bers of one society or colony, however numerous or dis- similar they may be, are the descen- dants of a single pair. The colony is — so far as is known, and on this, as well as on many other points, authentic informa- tion is scanty — first started by a pair of winged individuals that cast their wings, secrete them- selves in a suitable place, and produce young; the colony,

Fig. 1.— A, newly hatched termite ; B, worker termite ; Termes nernorosus.

however huge, being subsequently developed by the extreme fertility of the reproductive pair. Very little is known as to how long a colony endures, and, as there is greaty variety in the social condi- tions of different kinds of Termites, it is probable that there is considerable difference as to the point in question. As a rule a family or colony has only a single termit- arium, but there are cases in which a single family has several separate abodes, though usually only one of them is a real home containing reproductive indi- viduals. The social life in Termites, as well as in all other social insects, is clearly a develop- ment of the family life. It is accom- panied by extra- ordinary modifica- tions of the forms of the individuals constituting the society, and by a great division of labour. As regards the forms, or castes, Termites differ to- tally from other social insects ; in the latter case there are great differences between the males and females, and the whole of the castes are of the female sex, whereas in Termites the males and

Fig. 2. — A, manditralate soldier of Termes nernorosus ; B, nasute soldier of T. hospitalis.

females are extremely similar, and the castes are in no way correlative with sex. As the Termite life is a family life, and as there is normally only a single pair of repro- ductive individuals in each community, it is easily com- prehensible that if anything goes wrong with this pair, the community is at once thrown into a state of complete disorganization. But this misfortune is mitigated by a method which Termites have of keeping individuals in an undifferentiated state, and of turning some of them speedily into reproductive individuals, whereby the com- munity is restored to something like a natural condition of activity and growth.

Apart from the forms that are merely juvenile, the fol- lowing kinds of adults are normally present in a colony ; (1) workers, (2) soldiers, (3) winged individuals ready to leave the nest, (4) king and queen.

(1) The worker Termite resembles the young in general appear- ance, and, like the young, has no trace of wings (Fig. 1). The two segments behind the head are more contracted, so that head, thorax, and abdomen are more differentiated than they are in the young. The colour too is different, the young being milky- white, whereas the adult worker is variously pigmented according to its species, but is never milky -white. The worker is generally blind, and in only a few species does it possess rudimentary eyes. The species of the group Calotermitides have no workers. In the other species the workers look after the eggs and young, and perform most, if not all, the industrial work of the community. They are also, in some cases, effective combatants, though quite destitute of any special structures to suit them for this purpose. The sexual organs do not undergo development, but it has been satisfactorily ascertained that both sexes are represented amongst the workers. In certain species the workers seem to be dimorphic, so far as size is concerned, but this point has apparently been only very inadequately considered. Workers form a very large but variable proportion of the members of a community.

(2) The soldier Termite is the most extraordinary feature of Termitid biology. It is more varied than any of the other castes, so that most of the species of Termites can be best distinguished by their soldiers. The chief feature of the soldier is an extraordinary development of the h.ead, or of the head and mandibles. There are two very distinct kinds of soldiers : (a) the flat-headed or mandibulate soldier, and (6) the nasute or rostrate soldier (Fig. 2). In the first kind the head is usually developed out of all proportion to the rest of the body ; the mandibles are frequently enormous, and, being in many cases asymmetric, give the appearance of de- formity. In the nasute soldier the head is thick or convex, and may be described as unicorn — that is to say, it is prolonged in the middle so as to form a single pointed horn ; the mandibles are never largely developed. No species of Termite has both mandibulate and nasute soldiers, although the reverse is sometimes still stated in books. The soldiers of some species are, however, dimorphic to the extent that larger and smaller forms occur in the same nest without intermediates. In other cases soldiers of simply variable size exist. The soldier is blind and wingless, though in a few soldiers minute wing-

rudiments can be detected. As in the worker, the development of the sex organs is arrested, but both sexes are represented. The function of the soldiers is probably, as stated by Haviland, defence. The mandibulate soldiers use their heads as blocks to stop gaps in the nests, and employ terrifying but some- what theatrical devices, making threatening motions and producing noises by movements of the head and thorax. The nasute soldiers emit a fluid from the tip of the rostrum, and dab it upon their enemies with some skill. Soldiers are present in all species of Termites except the South American genus Anoplotermes. It is a remarkable fact that in the group Calotermitides soldiers exist although there are no workers, but in this case the function of the soldier seems to be very much that of a worker. Grassi says that in Calotermes flavinollis all the individuals of a community work for the common welfare. Moreover, in the Calotermitides no very great development of the heads or mandibles occurs.

(3) Adult or Winged Termite. — Such of the young as do not become workers or soldiers grow and develop after the fashion usual in exopterygote insects. Moults take place, the wing-pads gradually increase in size, eyes appear, and finally pigmentation takes place, and the winged insect is perfected at the last moult (Fig. 3). In prosperous colonies these winged insects are produced in large numbers and emerge at intervals as swarms. They have extremely feeble powers of flight, and apparently scarcely any other capability. They are a favourite food of a large number of animals, including even man. They have well-developed eyes and ocelli, and differ from all the other forms by their greater pigmentation. The func- tion of these adults is to diffuse the species, and to favour crossing outside the family circle. Attainment of this second end is, in

some cases, favoured by the fact that the whole of the individuals constituting a swarm consist of one sex only. This extraordinary fact is attested by Grassi, but has not yet received the attention it merits. If a Termite colony be compared with a tree or plant, the winged forms, it is clear, functionally correspond to the flowers and seeds of the tree ; indeed, Fritz Muller and Grassi go further,

Fig. 3. — Adult “Winged Termite : T. nemoro- sus ; wings of the right-hand side ex- panded.

and conclude that the modes of diffu- sion and reproduction of Termites are analogous to the modes of plants of continuing the species by means of cleistogamic as well as ordin ary flowers. The force of this comparison will be better appreciated after the reader has made himself acquainted with the facts connected with the neoteinic forms of Termites.

(4) King and Queen. — As a rule each community includes only a single pair of individuals apt for reproduction ; these are the royal pair, or king and queen (Fig. 4). They are adult Ter- mites that have shed the wings they formerly possessed. The queen usually undergoes an extraordinary increase in the size of the abdomen, which may be distended to many hundred times its original capacity (Fig. 4, A). In many species the king and queen are confined in a royal cell, out of which they cannot move, though the workers, owing to their smaller size, can get in and out to tend them. In other cases the queen only

is so imprisoned, the king being able to leave the cell. In still other cases neither king nor queen is effectually imprisoned. Much discrepancy of opinion exisjts as to the invariable pre- sence of a king in each nest ; this, how- ever, is explained by Haviland’s observa- tion that the king is active and timid, and when a nest is opened seeks safety by running away and concealing himself, so that he is some- times only discov- ered when the very last fragment of the nestisbroughtunder scrutiny. Another point on which ex- tremely diverse opinions are ex- pressed is the copula

of the sexes. It is Fig. 4.-A, queen; B.king: T. nemorosus. usuaUy stated that

the swarming of Termites is analogous to that of bees and ants, in which groups of insects the conjunction of the sexes takes place at this period, and at this period only. In the Termites the reverse is the case. The swarming is not at all a nuptial flight ; indeed, at that time the sexes are not apt for reproduction. Copulation only takes place after a

pair have cast their wings and have established .themselves together. It is repeated at intervals, and is thus quite dissimilar from the corresponding phenomenon in Hymenoptera. The male has no intromittent organs, so that

copula during flight is impossible. Grassi has actually witnessed the act in subsequent life. Haviland is of opinion that in some cases the male fertilizes the eggs without connexion with the female.

(5) Neoteinic and Substitution Forms.— When a colony of Ter- mites is deprived of king and queen it can replace them by forms specially prepared. These substitution forms are of two kinds — (a) normal adult individuals, and (6) neoteinic forms. The latter may be described as unnatural kings and queens possessing re- productive powers, though the wings have never been developed and some other parts of the body have not taken on the fully adult state. Haviland removed the royal pairs from nests of Termes malayanus, and after three or four months again examined the nests : in three out of the five cases substitution pairs exactly resembling the original ones, with well-formed wing-stumps, were present ; in the other two cases he failed to find the royal cell, and believes that the loss had not been repaired. In other species the bereavement is made good by means of neoteinic instead of normal individuals, and in certain species neoteinic forms are abundantly found. In the case of substitution forms there is usually more than one pair present in a colony, and sometimes numerous pairs exist. Grassi says that in Sicily the colonies of Termes lucifugus are kept up entirely by neoteinic kings and queens; in other words, the swarms are nearly or quite useless. The neoteinic forms are compared to cleistogamous flowers ; and this curious case is parallel with that of a species of plant whose re- production should be accomplished entirely by its cleistogamous flowers, though at the same time it produced perfect flowers in abundance. The condition recorded by Grassi is probably ex- tremely exceptional. Fritz Muller found once a colony in

which a true king was acting as con- sort to a considerable number of neoteinic queens, no true queen being present.

In order to understand the curious phenomena presented by the castes and variety of forms of a single species of Termite, it is necessary to be- come acquainted with their food-habits, which are very peculiar and may be described as com- munistic. Termites have the habit of eating their cast skins and even their dead companions, and in fact their system of keeping the , nest clean seems to be that of eating the refuse of their own bodies till it no longer contains any digestible matter. This cannibalism is the more remarkable, as they will not eat other Termites. The most curious part of their dietary is their complex system of feeding from the matters con- tained in the alimentary systems of their fellows. When a Termite wishes food it strokes the body of another individual with its antennae, and the specimen thus caressed exudes from the posterior or from the anterior part of the body a drop of matter, which is eaten by the hungry one. The matter exuded from the posterior part of the body appears to be very different from that yielded by the mouth, so that there are at least two kinds of this excretory food. The proctodaeal food (that which comes from the posterior part of the body) is in great favour with adult Termites, but so far as is known it is not used for feeding the newly born young, which are believed to be fed on matter elaborated in the bodies of the adult workers and communicated by their mouths. Subse- quently the young take also proctodaeal food, and triturated vege- table matter.

Origin of the Castes. — When Termites are hatched from the eggs none of the remarkable differences that are manifested in the individuals in subsequent life can be detected. The sexes are in Termites extremely simi- lar in external characters. When the young are hatched they all appear nearly exactly alike, though on careful examination the sexes can be distinguished. But no other difference than that of sex can be detected. In the article on Ant in vol. ii. of the Encyclopaedia Britannica it was stated (p. 99) that "the distinction between soldier and worker can be easily seen in the egg." This is con- tradicted by all modern observations, and is certainly erro- neous. It is true that considerable difference of opinion exists as to when the distinction

between soldier and worker first becomes evident, but all are agreed that it is not till after the growth is to some extent accomplished. The discrepancy that exists in opinions on this point is

due to the facts: (1) that different species have been under observation ; and (2) that the modification of the larva to form a soldier may commence at more than one period of the development even in the same species. It being ascertained that all Termites commence as undiffer- entiated larvae, the question arises as to what causes the differentiation into castes. This question is the more im- portant as two of the castes (the worker and soldier) do not at all resemble their parents. Grassi, from an ex- amination of the individuals of a large number of nests of Termes lucifugus, arrived at the conclusion that all start as undifferentiated larvae, and that the regular de- velopment of Termes up to the perfect insect may undergo a deviation at various periods of life leading to the forma- tion of workers, of neoteinic forms, or of soldiers, the last passing through the stadium of the young worker. He

Fig. 5. — Termitarium of Termes malayanus : f, fungus-chamber ; c, royal cell.

attributes this deviation, which may take place at various periods, to the influence of food, and attaches special im- portance to the salivary food. The soldiers have no wings; nevertheless a larva, or young nymph that has the rudiments of wings, can be made into a soldier. Grassi has found juvenile specimens that have already assumed the soldier form, although they possess the rudiments of wings. It appears from his observations that the worker may be considered as a form with arrested development, and the soldier as a form with arrested and much diverted development, while the neoteinic forms are individuals in which the reproductive organs are perfectly developed, while some of the bodily structures have suffered arrest of development and even some amount of atrophy.

The soldier form of Termite presents most difficult questions to the biologist, its special structures bearing no approximation to any characters possessed by the parents. Various theories have been

proposed to account for this fact, but they are mere guesses. We may, how- ever, mention that it is possible that soldiers and workers occasionally produce young. This has never been actually observed, but specimens have been found with the sexual organs partially developed, and Silvestri has recorded the occurrence of workers with some of the characters of the females, in South America, in a nest of Termes strunchii.

Termitaria. — There is nothing in which Termites dis- play more variety than in their dwellings. These are sometimes not constructions at all. The primitive Calo- termesflavicollis — in which there is no worker — frequently

inhabits rotten places in trees ; at most it increases these a little by excavation, and modifies the passages by slight and imperfect barricades. In the case of this species the community never attains a greater number than one thousand individuals, and even this is comparatively rare. On the other hand we have the huge solid structures, 10 or 12 feet high, delineated by Smeathman with cattle standing on their summits. Saville Kent has observed termitaria in Australia 18 feet high. As a rule large termitaria do not occur in considerable numbers in a restricted area, but there are exceptions even to this. At Somerset, Cape York, there is one of the most remarkable Termite cities of the world. Viewed from the sea, it appears as if the plain for a mile or more in extent were covered with pointed pillars varying, according to different accounts, from 6 to 13 feet in height, broad at the base and tapering to the summit, forming regular symmetrical pyramids. In this part of Australia there is also found the "compass," "magnetic," or "meridian" Termite, the mounds of which have somewhat the shape of a tomb- stone, and have always the same orientation, the wider face of the structure always extending north to south. It has been suggested that this is connected with the necessity of regulating the temperature or the amount of desiccation of the nest, but there is no evidence whatever on the point. A termitarium on being

opened displays a vast number of irregular chambers separated by thin partitions (Fig. 5,f), the royal cell being placed in the middle (Fig. 5, c). The material used is of an earthy na'ture, but the interiors of many earthy termitaria are largely composed of woody fibre, the refuse proceeding from the alimentary canals of the insects being used for this purpose. A considerable number of the larger Termites use fungi for their food-stuff. There are special chambers where these are cultivated, the matter on which the fungus is grown being of a woody nature and sponge- like in its structure. The fungi make their appearance as small globules. Probably the spores or mycelium are placed in the mass when it is formed by the Termites ; but very little is yet known as to this fungus and its mode of treatment by them.

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Tern ate, one of the two Dutch residencies in the East Indian Archipelago, exercising authority over the area of the ancient kingdoms of Ternate and Tidor (see AMBOYNAand Moluccas). The residency consists of the following groups of islands: the Gilolo or Halmaheira group, the Bachian and the Obi group, the Sula islands, the islands near the western half of New Guinea (Gebeh, Vaigeu, Saluwatti, Misol), the western half of New Guinea as far as 141° E., with the islands in Geelvink Gulf on the north coast of New Guinea, along with others on the south coast. To this residency also belong the state of Banggaai and the Banggaai group in East Celebes. The residency stretches from 2°

43′ to 8° 45′ S., and 121° to 141° E., with an area of 155,800 square miles. The Dutch Government exercises direct authority only over parts of Ternate, Halmaheira, Bachian, and Obi islands. Its rule over the other groups it carries on through the sultans of Ternate and Tidor. The island of Ternate, near the west

coast of Gilolo, its volcano, products, &c, were fully described by the Resident De Clercq, who visited the different groups of the residency, more especially the western half of New Guinea. Both the island and town of Ternate suffer from their isolation, and have never regained the importance they had in former centuries. Ternate is a little town, and, in spite of its good harbour, carries on no considerable trade or shipping, number- ing only 3000 inhabitants. The density of population throughout the whole residency is calculated at from 0-5 to 1 per square kilometre.

Recent History. — The breaking up of the old Government of the Moluccas has not only not injured Ternate, it has tended to make it perhaps the most important Dutch-Indian political centre of the archipelago east of Celebes. Nominally the sultan is still ruler, but virtually his powers were greatly curtailed by his conventions with the Dutch-Indian Government, under which he surrendered, with the concurrence of his grandees, many of his former rights to the Dutch Resident, who has become the de facto governor of the easternmost colonial possessions of Holland, especially since the transfer of Dutch New Guinea in 1901. To the same residency also belongs Tidor, which, however, still has its own sultan, whose dominion likewise extends to other islands, Bachian, Buru, &c. Among the rights surrendered by the sultan of Ternate to the Dutch were those of granting monopolies and mining concessions, now vested in the Dutch Resident. The island of Bachian is being worked by a kind of chartered company. For surrendered rights and privileges the sultan and his grandees received monetary com- pensations in the shape of annual subventions, and these are also being paid for the losses formerly incurred by the wilful destruc- tion of the nutmeg plantations. The restrictions in the growing of nutmegs have long since been removed, and many nutmeg plantations, with free labour, have been started in Ternate since 1885.

In fact, experts now believe that Ternate, and not Banda, was originally the centre of nutmeg-growing. It is a curious fact that Christianity has declined in Ternate latterly, though formerly it was an early stronghold and the number of Europeans settled there has materially increased. (m. k. : H. Ti.)

Terni, a town and episcopal see of Perugia, Umbria, Italy, amongst the Apennines, 70 miles north by east of Rome by rail. It has important iron and steel works and iron foundries, at which armour-plates, guns, and projectiles are made for the Italian navy, also steel castings, machinery, and rails, a royal arms factory, and lignite mining. There is a school of industry. Population (1900), 11,000.

Terracina, a town and episcopal see of the province of B-ome, Italy, on the Mediterranean coast, 18 miles west- north-west of Gaeta. Excavations made in 1894 on the site of the reputed palace of Theodoric prove it to have been a magnificent temple of Venus, 111^- feet long by 651- feet wide. Population (1900), 6500.

Terre Haute, a city of Indiana, U.S.A., capital of Vigo county, on the Wabash river, in the western part of the state. It is regularly laid out, divided into ten wards, has a good water-supply, is sewered, and well paved with bricks and granite blocks. Five lines of railway meet here — the Chicago and Eastern Illinois; the Cleveland, Cincinnati, Chicago, and St Louis ; the Evansville and Indianapolis ; the Evansville and Terre Haute ; and the Vandalia. It is in a coal and natural gas region. In 1900 it contained 429 manufacturing establishments, with a total capital of $8,938,107. They employed 5427 hands, and the product had a value of $27,784,619. The leading articles of manufacture were distilled liquors with a value of $16,041,747, flour with a value of $1,363,338, and clothing with a value of $826,000. In 1900 the assessed valuation of real and personal property was $20,414,090, the net debt was $392,455, and the tax-rate was $25.20 per $1000. Terre Haute contains a number of educational institutions, among them the Rose Polytechnic Institute, a technical school opened in 1883. In 1899 the faculty numbered 20, and the attendance was 103. Population (1890),

30,217 ; (1900), 36,673, of whom 2952 were foreign- born and 1520 negroes.

Terrell, a city of Kaufman county, Texas, U.S.A., on the Texas Pacific and the Texas Midland railways, in the north-eastern part of the state, in the cotton and timber region. Population (1890), 2988; (1900), 6330, of whom 211 were foreign-born and 1517 negroes.

Terriss, William [William Charles James Lewin] (1847-1897), English actor, was born in London, 20th February 1847. After trying the merchant service, medicine, sheep-farming in the Falkland Isles, and tea- planting in Bengal, in 1867 he definitely took to the professional stage, for which his handsome presence, fine voice, and gallant bearing eminently fitted him. He quickly came into favour in ” hero ” parts, and appeared at the principal London theatres from 1868 onwards. In 1880 he joined Irving’s company at the Lyceum, playing such parts as Cassio and Mercutio, and in 1885 he acted there with Mary Anderson, as Borneo to her Juliet, &c. He was then engaged to take the leading parts in Adelphi melodrama, and it was in this capacity that for the rest of his career he was best known, though he occasionally acted elsewhere, notably with Irving at the Lyceum in Ravenswood, Henry VIII., Faust, and Becket. No more popular stage hero ever trod the boards, and his robust method was particularly effective in naval or military parts. On 16th December 1897, as he was entering the Adelphi Theatre, he was stabbed to death by a madman, Richard Archer Prince.

Terry, Ellen Alicia (1848), English actress,

was born at Coventry, 27th February 1848. Her parents were both in the theatrical profession, as also have been her sisters Kate, Marion, and Florence, and her brother Fred. Ellen Terry’s first appearance was made at the age of eight, under the Keans’ management, as the child Mamilius in The Winter’s Tale, at the Princess’s Theatre, London. This

was followed by her appearance as Puck at the same theatre. Two years later she played the part of Prince Arthur in King John with such artless grace as to win high praise. From 1860 to 1863 and again from 1867 to 1868 she acted with various ” stock companies,” amassing valuable experience. During this period she acted, in 1867, for the first time with Henry Irving, playing Katherine to his Petruchio in Tlie Taming of the Shrew at the Queen’s Theatre. When quite a girl she married G. F. Watts the painter, but the marriage was dissolved at an early date. Between 1868 and 1874 she was again absent from the stage (having married Mr E. A. Wardell, an actor whose professional name was Kelly), but she reappeared in leading parts at the Queen’s Theatre under Charles Reade’s management. In 1875 came an event which set the seal of popular approval on her fame as an actress, in the shape of an engagement to play Portia in an elaborate revival of The Merchant of Venice under the Bancrofts’ management at the old Prince of Wales’s Theatre. Her performance was, indeed, the one bright spot in what proved otherwise an un- expected-failure. This was followed by a succession of smaller triumphs at the Court Theatre, culminating in her beautiful impersonation of Olivia (in W. G. Wills’s play of that name) in 1878, the result of which was her engagement by Henry Irving as his ” leading lady ” for the Lyceum Theatre and the beginning of a long artistic partnership. Her Shakespearian impersonations at the Lyceum have been Ophelia in 1878, Portia in 1879, Desdemona in 1881, Juliet and Beatrice in 1882, Viola in 1884, Lady Macbeth in 1888, Katherine (in Henry VIII.) and Cordelia in 1892, Imogen in 1896, and Volumnia (in Coriolanus) in 1901. Of these Portia and Beatrice were most entirely suited to her method and temperament. Some of Ellen Terry’s other most notable

performances were as the Queen in Wills’s Charles I. in 1879, Camma in Tennyson’s TJie Cup in 1881, and Margaret in Wills’s Faust in 1885. With the Lyceum company she several times visited the United States. In 1902, while still acting with Sir Henry Irving, she appeared with Mrs Kendal in Mr Beerbohm Tree’s re- vival of Tlie Merry Wives of Windsor at Her Majesty’s Theatre.

Teruel, a province of Spain, area 2363 square miles. Population (1887), 241,865; (1897), 247,762. The birth-rate is 3-99 per cent., the proportion of illegitimates being 2-11 per cent. ; the death-rate is 3-55 per cent. Education is in a very backward state. The industries are comparatively unimportant. Much land is devoted to pasture that could be cultivated. Extensive forests with fine timber are as neglected as some impor- tant coal-beds in the eastern districts. Several hundred thousand acres are devoted to pasture, and forests cover about 600,000 acres.

Teruel, capital of the above province, on the Guadalaviar. Population (1887), 9423; (1897), 9938. Three suburbs have sprung up outside the walls, with broader, well-built streets. Teruel has several good hospi- tals and asylums for the aged and children, an institute, a normal training school, primary schools, a public library, an athenaeum, a meteorological station, a large prison, and eleven churches, besides the handsome cathedral. The town hall is a solid modern building, and the bull-ring is also modern.

Teschen (Czech, Tevin ; Polish, Cieszyn), the chief town of a government district in Austrian Silesia, formerly the capital of the duchy of Teschen, 65 miles south-west of Cracow. Population (1890), 15,220 ; (1900), 19,142 (estimated at 53 per cent. German, 43 per cent. Polish, and 4 per cent. Czech). It has a museum and four high schools. Its industries have received an important addi- tion in the State printing and lithographic works, and the manufacture of small arms, vehicles, leather, and cloth, together with large saw-mills. There is a consider- able trade in spirits, beer, and liqueurs, iron wares, furniture, and timber, cheese, lard, &c.

Testa me ntum Domini (“Testament of ouk Lord “). — Extracts from the book which bears this title, contained in an 8th-century MS. at Paris, were published by Lagarde in 1856 (Reliquiae iuris ecclesiastici anti- quissimae 80-89) ; and a Latin fragment, edited by Dr Montague James, appeared in 1893 (Texts and Studies, i. 154). The whole book was first published in Syriac in 1899, with a Latin translation by Mgr Bahmani, the Uniat Syrian Patriarch of Antioch. His text is that of a

17th-century MS. at Mosul, the colophon of which says that the Syriac text was translated from the original Greek ” a Jacobo paupere,” evidently James of Edessa, in a.d. 687 ; but he makes use of other material, including an Arabic version made from a Coptic copy written in a.d. 927. The Mosul MS. contains the whole Bible in the Peshitto version, followed by the Syrian “Clementine Octateuch,” i.e., the collection of ecclesi- astical law, in eight books, which was used by the Nestorians and Jacobites. Of this the Testament forms the first two books; and according to the title (which, apparently by an error, is made to apply to the whole eight books) it contains the ” testament, or words which our Lord spake to His holy Apostles when He rose from the dead.” Plainly, it is one of that series of writings, claiming to embody the fundamental rules of the Church, which culminates in the Apostolical Constitutions (q.v.). It falls into three distinct parts : an apocalyptic

introduction (book i. chapters 1-18; the division into books, however, is clearly not original); a “church order” proper (i. 19-ii. 24); and a conclusion (ii. 25-27) of the same apocalyptic character as the intro- duction, (a) The Introduction professes to contain the record of the revelation of Himself by the Lord to His Apostles, with whom are Martha, Mary, and Salome, on the evening after His resurrection. He is represented as unfolding to them, at their request, the signs of the end, and giving them instruction on various other topics. Incidentally, the fact becomes plain that this section is composed from the standpoint of Asia Minor and Syria, that it dates from soon after the time of Maximin (235-38) and Decius (249-51), and that it springs from a Christian community of a strictly puritan type. (6) The Church Order follows the general lines of the Canons of Hippolytus and similar documents. It describes the Church and its buildings (i. 19) ; the office of the bishop and his functions (i. 19-27) ; the mystagogic instruction (i. 28) common to this and the Arabic Didascalia, where it occurs in an

earlier form, and based in part upon the Gnostic “Acts of Peter”; the presbyter (i. 29-32); the deacon (i. 33-38) ; confessors (i. 39) ; the ” widows who have precedence in sitting” (i. 40-43), apparently the same persons who are spoken of elsewhere as ” pres- byteresses ” (i. 35, ii. 19) ; the subdeacon (i. 44) and the reader (i. 45), the order of whose offices seems to have been inverted ; virgins of both sexes (i. 46) ; and those who possess charismata or spiritual gifts (i. 47). Next come the regulations for the laity, including the whole course of preparation for and admission to baptism (ii. 1-8), confirmation (ii. 9), and the eucharist (ii. 10) ; after which there follows a series of miscellaneous regu- lations for Easter and Pentecost (ii. 11-12), the agape (ii. 13), the funds of the Church (ii. 17-20), the visita- tion of the sick (ii. 21), the use of psalmody (ii. 22), the burial of the dead (ii. 23), and the hours of prayer (ii. 24). (c) The Conclusion (ii. 25-27) brings us back to the injunctions of the Lord as to the keeping of these precepts, a special charge to John, Andrew, and Peter, and a statement that copies of the Testament were made by John, Peter, and Matthew, and sent to Jeru- salem by the hands of Dosithaeus, Sillas, Magnus, and Aquila.

In all this there is much that is peculiar to or charac- teristic of the Testament. First and foremost is its ascription to the Lord Himself, which we can hardly be mistaken in regarding as an attempt to claim yet higher sanction than was claimed by the various compilations which were styled ” apostolic.” This fact alone would lead us to infer the pre-existence of certain of the latter. Again, the whole tone of the Testamentum is one of highly strung asceticism, and the regulations are such as point by their severity to a small and strictly organized body. They are “the wise,” “the perfect,” ” sons of light ” ; but this somewhat Gnostic phraseology is not accompanied with any signs of Gnostic doctrine, and the work as a whole is orthodox in tone. They are set in the midst of “wolves,” despised and slighted by the careless and worldly : there is frequent mention of ” the persecuted,” and of the duty of ” bearing the cross.” There appears to be no locus poenitentiae for serious sins excepting in the case of catechumens, and there is a notable “perfectionist” tone in many of the prayers. Cfiarismata, and above all exorcisms, occupy a very important place : there is a vivid realization of the ministry of angels, and the angelic hierarchy is very

complete. Great stress is laid upon virginity (although there is not a sign of monasticism), upon fasting (especially for the bishop), upon the regular attendance of the whole clerical body and the ” more perfect ” of the laity at the hours of prayer. The church

buildings are very elaborate, and the baptistery is oblong, a form found apparently only here and in the Arabic Didascalia. Amongst the festivals mentioned are the Epiphany, Easter, and Pentecost. With regard to the prayers, they are based upon forms common to this and other Church orders, but have many lengthy interpolations of an inflated and rhapsodic kind. The bishop appears to rank far above the presbyters (more conspicuously so, for example, than in the Canons of Hippolytus), and the presbyters are still divided into two classes, those who are more learned and those who are of mature age. The deacons have functions in the Eucharist and about the altar which point to an early date ; they have also much administrative work of an important kind, and especial provisions are made for the care of the sick and the dead, and the burial of those who perish by shipwreck. One of the deacons is to be chosen as ” chief deacon ” (proto- diaconus i. 19, cf. i. 34), and is charged with the care of pilgrims. There are no doorkeepers or singers, who begin to appear circ. a.d. 340. The honour given to confessors is very conspicuous, and points back to an early date. But remarkable above all is the position given to women. We have “widows having precedence” or presbyteresses, three in number, deaconesses, virgins, and widows who are in receipt of the alms of the Church ; and the first named occupy a place of very great dignity, which is almost un- equalled elsewhere (excepting in the earlier form of the apocryphal and Montanistic Acts and Martyrdom of Mat- thew, where the relation of the TrpeafivTi and deaconess corresponds with that of the Testament), and which was formally condemned by the Council of Laodicea in Phrygia.

What conclusion is to be drawn, then, as to the age and character of the Testament ? Mgr Rahmani’s view, that it is a work of the 2nd century, is univer- sally discredited; nor has Dr Punk’s contention found acceptance, that it and the Canons of Hippolytus are alike derived ultimately from the eighth book of the Apostolic Constitutions. It is

now generally agreed that the Apocalypse at the beginning is pre-Nicene (a.d. 250- 325), and that it originates from Asia Minor, probably from Montanistic circles. On its first appearance, how- ever, Dr Harnack contended that this, was an indepen- dent work, upon which the Church Order had been grafted, and that as a whole it dated from circ. a.d. 400. To this it must be replied that the unity of thought and atmosphere is such as to show that the work is one whole (subject no doubt to a certain amount of redaction and interpolation), and that the apocalyptic part was com- posed as an introduction to the rest. As to the central portion (i. 19-ii. 24) it is a Church Order of the same kind as the Canons of Hippolytus and the Egyptian Church Order, standing nearer to the latter than the former, and especially to the latter in the Latin form published in 1900 by Dr Hauler. The precise relation in which these three stand to one another still remains in a measure doubtful, but it seems probable that they are based upon a lost Church Order, to which the Canons of Hippolytus stands nearest. If this be the case, the Testamentum would seem to date from the latter part of the 3rd century, and to emanate from some Mon- tanistic or semi-Montanistic community ; and such is Mr Eackham's conclusion. With this agree most of the indications given above, especially that from the position of women in the Testament; and there is nothing which points strongly to a later date for the whole work.

On the other hand, it shows signs of later redaction, as was indeed inevitable in ' the case of work which has had a living history as part of a codex of Church law. Such signs may be discerned in the interpolations

in the prayers; possibly in the reference to the chief deacon, for elsewhere no single deacon is distinguished by name until the close of the 4th century ; in the refer- ence to the Epiphany, which is first heard of elsewhere at the beginning of the 4th century. They probably point, as Bishop J. Wordsworth has suggested, to a re- daction on a large scale about a.d. 400 ; but the evidence seems scarcely sufficient to justify the

conclusion that this revision was due to the school of Apollinaris of Laodicea (died circ. a.d. 390).

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Tetschen, the chief town of the government dis- trict of the same name in north Bohemia, near the Saxon frontier, 20 miles E.N.E. of Teplitz. It is situated at the confluence of the Polzen with the Elbe, on the right bank of the latter river opposite Bodenbach, with which it is connected by a chain bridge (1855) and two rail- way bridges. It is the seat of an Austrian custom-house. The handsome chateau of the Thun family (built in 1667-73), which occupies a rocky height above the town, was at one time fortified, and was a place of some im- portance during the Seven Years' War. The shipping amounts to an annual total of over 4000 vessels. In addition to being the principal emporium for the Aus- trian traffic on the Elbe, Tetschen has a considerable industry, its products comprising chemicals, oil, soap, cotton stuffs, plaster of Paris, glazed and coloured paper, cellulose, beer, flour, preserved fish, &c. Population

(1890), 7299; (1900), 9692.

Tetuan (Tettdwan), the only open port of Morocco on the Mediterranean, a few miles south of the Strait of Gibraltar, and about 40 miles east-south-east of Tangier. It contains many fine residences of Moorish families ex- pelled from Spain. Exports : annual average of the years 1896 to 1900 inclusive, £5746 ; imports, £36,609. The shipping

entered and cleared in 1899 and 1900 averaged 22,900 tons annually. Population about 25,000.

Teutoburger Wald, a mountain range of Ger- many, stretching north-west to south-east, along the borders of the Prussian provinces of Hanover and AVestphalia and the principality of Lippe, for a distance of 70 miles, but with a width of only 1£ to 3 miles. There is a well-marked main chain, accompanied, espe- cially in the middle, by smaller subsidiary chains. The highest elevation is Volmerstod, 1535 feet, near the east end; but the height diminishes gradually towards the west. The main chain is pierced by several deep gaps or ” doors,” through some of which important railways have been carried; e.g., the line connecting Paderborn and Hanover, and that connecting Herford and Hamm. The chief geological formations belong to the Cretaceous system, backed towards the north and east by Jurassic and Triassic formations. The entire range is for the most part well wooded. The name is first found in Tacitus, but it is uncertain which mountain range he intended to indicate; consequently it is still a matter of dispute amongst scholars where the famous battle in the Teutoburger Wald was actually fought in which

Arminius, in the year a.d. 9, at the head of the Germanic tribes annihilated the legions of Varus. Mommsen con- siders it to have been fought near the source of the Hunte, north of Osnabruck, and beyond (north of) the range alto- gether. Nevertheless the Grotenburg (1275 feet), 2\ miles south-west from Detmold, is crowned with a heroic monument to Hermann (Arminius), the Cheruscan chief, erected in 1838-46 and 1875, at a cost of £13,500, the battlefield having been placed by some scholars at the south-west foot of that hill. The work, which was de- signed by E. von Bandel, consists of a gigantic statue of the chieftain, 56£ feet high, standing on an arched pediment 100 feet high. The materials employed are copper and iron.

Tewfik Mohammed (1852-1892), Khedive of Egypt, son of the Khedive Ismail, was born on 15th November 1852. Although the eldest son, he was not sent to Europe to be educated, like his younger brothers, but was left to grow up in his native country. In 1866 Ismail succeeded in

his endeavour to alter the order of succession to the Khediviate. The title, instead of passing to the eldest living male descendant of Mehemet Ali, was now to descend from father to son. Ismail sought this alteration mainly because he disliked his uncle, Halim Pasha, who was his heir-presumptive, and he is supposed to have imagined that he would be able to select whichever of his sons he pleased for his successor. But he found, after the change had been made, that the Powers interpreted the new arrangement as applying strictly to the eldest son. Tewfik there- fore became heir-apparent. He was given a palace near Cairo to live in, and for twelve years he passed an uneventful life, farming, and establishing a reputation for good sense and fair dealing with his fellah tenants. In 1878 he was appointed President of the Council after the dismissal of Nubar Pasha. He held this office only for a few months ; but this was long enough to show that, if he was unambitious and not particularly intelli- gent or energetic, he had the wisdom to refrain from tak- ing a part in the intrigues which then formed the chief part of political life in Egypt. He went back to his es- tate, and settled down once more, with the single wife to whom he was devoted, to a quiet country life. He was not left undisturbed for long. On 26th June 1879 Ismail was deposed by the Sultan, who sent orders at the same time that Tewfik should be proclaimed Khedive. The new Viceroy was so little pleased by the news of his ac- cession that he soundly boxed the ears of the servant who first brought it to him. For some months the country passed through troubled times. Tewfik's people were dis- satisfied, his army disaffected ; his advisers were nearly all of the adventurer class, with their own ends to gain ; and he himself had neither the character of a strong ruler nor the experience that would have enabled him to secure an orderly administration of affairs. Disorder prevailed until November 1879, when the Dual Control was re- established by the Governments of Great Britain and France. Eor nearly three years Major Baring (after- wards Lord Cromer), Mr (afterwards Sir) Auckland Col- vin, and M. de Blignieres practically governed the country. During all this time the disaffection in the Egyptian army was increasing. Tewfik has been blamed for his failure to take a firm line with the rebels, but his attitude was governed by his relations with Great Britain and France, and it was his endeavour to carry out suggestions which constantly

varied that finally led to the outbreak of Arabi Pasha's armed rebellion. In July 1882 the atti- tude of Arabi, who was carrying out defensive works on a large scale, made it necessary for the British Admiral (Sir Beauchamp Seymour, afterwards Lord Alcester) to

declare that he would bombard the forts of Alexandria unless they were handed over to him. Before the bom- bardment began it was suggested to Tewfik that he should leave the city and embark either upon a man-of-war belonging to one of the neutral Powers, or in his own yacht, or in a mail steamer which was then in the port. His answer was, " I am still Khedive, and I remain with my people in the hour of their danger." At his palace of Eamleh, 3 miles from the town, he was beyond reach of the shells, but his life was nevertheless imperilled. When the rebel soldiers attacked the palace he managed to make his escape and to reach another palace after pass- ing through the burning streets of Alexandria. Here he was obliged to agree that a guard of British blue-jackets should protect him from further risk. He showed his courage equally during the cholera epidemic at Alexan- dria in 1883. He had gone back to Cairo after the battle of Tel-el-Kebir, had consented to the reforms insisted upon by Great Britain, and had resumed the functions of a constitutional ruler under the guidance of Lord Duf- ferin, the British Special Commissioner. When the cholera broke out, he insisted upon going to Alexandria. His wife accompanied him, and he went round the hos- pitals setting an excellent example to the authorities of the city, and encouraging the patients by kind and hope- ful words. In 1884 Sir Evelyn Baring went back to Egypt as diplomatic agent and consul-general of Great Britain. His first task was to demand that Tewfik should abandon the Sudan. Tewfik gave his consent with natu- ral reluctance, but, having consented, he did everything he could to insure the success of the policy which Baring had been sent to carry out. He behaved with equal pro- priety during the negotiations between Sir H. Drummond Wolff and the Turkish envoy, Mukhtar Pasha, in 1886. His position was not a dignified one—

that of a titular ruler compelled to stand by while others discussed and managed the affairs of his country. The Sultan was his suzerain ; in Great Britain he recognized his protector : to the representative of each he endeavoured to show friendliness and esteem. As time went on his confi- dence in Baring increased, until at last he deferred to the strong mind of the British agent in almost everything. He had, like most weak men, occasional outbursts of activity, occasional impulses to act upon his own initiative. For instance, he dismissed Nubar Pasha at a moment when Baring was not in Egypt; and Biaz Pasha was also dismissed in his turn without any consultation between the Khedive and the British agent. Baring encouraged him to show his activity in matters of administration, and he took a strong interest in all matters connected with irrigation, education, and justice. He was not a strong man either in mind or in character, but he showed a genuine desire to govern his country for its own benefit. He understood the import- ance to Egypt of British assistance and support: his natural shrewdness made him accept the British con- ditions ; his natural good feeling kept him from any inclination to intrigue. In private life he was courteous and amiable. He had no desire to keep up the unap- proachable state of an Oriental ruler. Indeed, in many ways his manners and habits were less Oriental than European. He died on 7th January 1892, at the Helouan Palace near Cairo, and was succeeded by his eldest son, Abbas Pasha, born in 1874. (h. h. f.)

Texarkana, a city lying in the two states of Texas and Arkansas, the state line passing down the middle of the main street. The portion on either side of the line is, of course, a separate municipal corporation. Texarkana, Arkansas, is the capital of Miller county, and Texarkana, Texas, is in Bowie county. The altitude is

295 feet. It is regularly laid out on a level site, and is an important railway centre, no fewer than six railways intersecting here. It is situated in a timber and cotton region, contains cotton-gins, compresses, and oil-mills, and ships large quantities of cotton. It has lumber-mills and car shops. Population (1880), Texarkana, Ark., 1390; Texarkana, Texas, 1833— total, 3223; (1890), Texarkana, Ark., 3528; Texarkana, Texas, 2852 — total, 6380 ; (1900), Texarkana, Ark., 4914 ;

Texarkana, Texas, 5256 — total, 10,170. Of the population of Texarkana, Ark., in 1900, 120 were foreign-born and 2078 negroes ; of that of Texarkana, Texas, 192 were foreign-born and 1964 negroes.

Texas, the largest state of the American Union, situated on the south central border. In the closing decades of the 19th century it made great strides in its material welfare. In 1880 the state was still lavishly distributing its public domain to settlers, educational institutions, railways, and as rewards for services. Im- migration was invited, and there was little thought of the vast landed legacy being exhausted. There were no railways except in the eastern third, aggregating hardly 500 miles. There were practically no constructed public highways, or laws for making them. Although ordinarily considered a prairie state, Texas possessed the largest area of woodland (64,000 square miles) of any American commonwealth, but the modern lumbering in- dustry was unknown. Mining and manufacturing were undeveloped. The school system was in a primordial condition ; there was no county superintendence and no system of instruction, the scholastic year was of only four months' duration, and the attendance limited to pupils between eight and fourteen years of age. The university and other institutions of higher education had not been organized. Since 1880 the population has steadily grown in number and density, although it is still the least densely settled of all the American states east of the Boeky Mountains, with the exception of Florida and the Dakotas, and has not attained one-half the average den- sity (25-6) of population of the entire Union. In 1900 the public domain theoretically had been entirely expended, but in fact fully 40,000,000 acres were still owned by the commonwealth in trust for the public schools, university, and other state institutions. In 1880 the total population was 1,591,749, or 6-1 persons to the square mile ; in 1890 it was 2,235,523, or 8-5 to the square mile; in 1900 it was 3,048,710, or 11-6 to the square mile. The increase in population from 1880 to 1890 was 40-4 per cent., and from 1890 to 1900 36-4 per cent. In 1900 there were 46 incorporated cities and towns having more than 2000 and less than 5000 inhabitants ; 16 having more than 5000 and less than 10,000; 6 of more than 10,000 and less than 25,000 ; and 5 with more than 25,000, namely, San Antonio (53,321); Houston (44,633); Dallas (42,638); Galveston (37,789); and

Fort Worth (26,688). The urban population (classing as such all persons living in places of more than 4000 inhabitants) was 13 per cent, of the total population in 1890, and 14-9 per cent, in 1900. Of the total population in 1900, 1,578,900 4 were males and 1,469,810 were females. The foreign-born numbered 179,357 and the negroes 620,722, being respectively 5-9 per cent, and 20-3 per cent, of the total population. The illiterate adult males (unable to write) numbered : native white, 30,017, out of 514,188 ; foreign-born white, 21,773, out of 85,773 ; negroes, 61,744, out of 136,875.

Agriculture and Forestry. — Since 1880 the state has become the largest cotton-producing state or country in the world. Texas also ranks first in the Union in the production of cattle and horses. There were in the state, according to the census of 1900, 362,190 farms, with an acreage of 126,807,017, of which 19,576,076 acres were improved, and 106,230,041 unimproved ; 286,664 farms were

owned by white persons, 65,536 by coloured. The total value of farm property was estimated at $962,476,273, and the value of the farm products at $239,823,244. The lumbering interest has grown to a vast industry, and its product has been distributed by rail over Mexico, the eastern Rocky Mountain states, and by ship to all the West Indian and South American ports. Other forest products of a local character, for which no statistics are obtain- able, have also developed enormously. It is estimated that 500,000,000 feet of lumber are produced annually.

Mining and Manufactures. — It was not until 1889 that Texas finally passed a law permitting mineral claims upon the public lands by individuals ; hence the development of its mineral re- sources has been backward. In 1898 the gold product was valued at $300, and the silver at $611,426. Coal mining has steadily increased ; 686,734 short tons were produced in 1898, valued at $1,139,763. Lignite, vast beds of which formerly remained unused, is also mined in quantities. Salt, which used to be entirely derived from Europe, is now exported, the

yield for 1898 being 254,284 barrels, valued at $119,700. The extensive beds of gypsum in the north-west are being worked ; in 1898, 34,215 short tons were produced, valued at $58,130. Rich fields of cin- nabar have been opened in Trans-Pecos province ; 1000 flasks were produced in the state in 1900, valued at $50,000. Building materials, such as granites, sandstone, limestone, marbles, and cement, are growing in importance. In 1898 101,590,000 bricks were produced, valued at $602,988. Oil fields have been opened ; 546,070 barrels of crude petroleum were produced, valued at $277,135, or seven times the amount produced in the previous year. There were 12,289 manufacturing establishments in 1900, an increase of 133‘3 per cent, for the decade, with a capital of $90,433,882 and a product valued at $119,414,982.

Education. — Since 1880 the public schools have been organized upon a model system ; state, county, and municipal superinten- dence has been provided ; the standard and pay of teachers raised ; the public school fund augmented, and vacation* normal institu- tions established. The school age has been extended, and the number of teachers employed greatly increased. The permanent school fund consists of 30,000,000 acres of land, and cash and bonds. The latter in 1894 was $2,162,600 ; in 1899 it had in- creased to $6,447,247. The available annual school fund, the revenues from taxes and sale and lease of lands, in 1899 amounted to $3,232,624. In 1895-96 616,568 children were enrolled in the public schools, or 20-7 per cent, of the population. The number of teachers employed was 13,217. Of the children in- structed in 1894, 472,963 were white and 157,340 coloured. The State University was not organized until 1884. It is under the control of a board of regents nominated by the governor. The main institution, situated at Austin, is the head of the state public school system, and admits students without entrance examinations from approved state high schools, the state normal school, and the agricultural and mechanical colleges, both sexes being admitted on equal terms. In 1899 there were 150 affiliated schools throughout the state, which, after thorough examination by a committee of the university faculty, sent graduates to the university without entrance examination. The income of the university is derived from bonds, the

leases of lands belonging to the university (2,500,000 acres), and annual appropriations from the state. The total expenses for 1899- 1900 were $155,366. In addition to the main university at Austin, there is a medical branch at Galveston, which requires a four years' course. The expenses of the medical department for 1899-1900 were $59,919. In 1897-98 the university had a total enrolment of 812 students.

Penal and Charitable Institutions. — The prison system has been placed entirely under state control, and its affairs are conducted upon a more humane and more economic basis. An institution for coloured dependents at Austin, a reformatory for youthful penal offenders at Gatesville, and a new and third insane asylum near San Antonio have been provided. A home for dependent Confederate soldiers has been established at Austin, in which about 100 un- fortunates took refuge. By a legislative Act of 1899 a biennial appropriation of $250,000 was made for the relief of other indigent Confederate soldiers, which, distributed among 5000 applicants, gave a relief of $1.66 per month.

Finances and Banks. — The total valuation of the assessed property for 1886 was $630,591,029. In 1891 it was $856,202,283 ; in 1899 it was $921,927,231. Taxation is limited by the constitution to 35 cents on the $100 ad valorem, and the county and city taxes to 25 cents. Notwithstanding the enormous growth of wealth and popu- lation, the taxes and cost of administration have not increased. The revenues in 1886 from all sources were $2,916,488, and in 1899, $2,700,000. In 1899 there was a cash balance of $1,092,807 in the treasury above all expenses. In 1894 Texas had a bonded debt of $3,992,030. Of this sum $1,405,610 was held as a fund for its various institutions, only $756,990 beingin the hands of individuals. Inl899 the debt was $3,989,445. The contract rate of interest has been re- duced from a maximum of 12 to 10 per cent, and the legal rate from

8 to 6 per cent. In 1899 there were 194 national banks, which on 20th September of that year had loans and discounts amounting to

$46,024,782.

Hallways and Commerce. — The railways have increased in length since 1880 from less than 1000 to nearly 10,000 miles in 1900, a mileage exceeded only by Illinois. In 1880 vast trunk lines were initiated to connect the state with the north and east, and to cross the western half to the Rocky Mountains region and the Pacific Ocean. Bight trunk lines of the first and three of the second char- acter now exist. Meanwhile additional railways were constructed in the eastern half. The total of miles in 1899 was 9702. The average indebtedness per mile was $38,267. The total earnings were $45,334,191 ; the working expenses were 71-73 per cent., or $32,518,118, and the net earnings 3-48 per cent. The national Government, by the expenditure of $6,000,000 upon a system of jetties in the harbour at Galveston, has increased the depth from 13 to 26 feet. The imports have increased from $1,157,370 in 1885 to $3,000,000 in 1899, and the exports from $12,680,000 in 1885 to $78,480,000 in 1899. Four hundred and sixty-eight steam vessels, with an aggregate of 833,497 tons, cleared from Galveston for foreign ports in the year ending 30th June 1899.

Recent History. — The governor is chosen for two years, and by popular custom is usually elected for two terms. There is practi- cally but one party in Texas — the Democratic — and all questions are in reality determined by the popular primaries and state conven- tions. With the exhaustion of its public domain, the introduction of steam transportation, and the closer competition resulting from readjusted sound conditions, many large corporations began opera- tions in Texas, for the rights and practices of which as public franchises there existed no adequate legislation. This legislation, and the discussion incident thereto, created a period of violent poli- tical antagonism, and resulted in a long struggle carried out upon the political rostrum, in the legislative halls, and in the state and Federal courts. Many laws were enacted, especially those regulat- ing railways, and against alien ownership of lands and trusts. Suits were instituted in the courts to recover property illegally held by corporations, and in some instances millions of dollars reverted to the state treasury. The “Free Grass” movement was organized to express discontent at the introduction of barbed wire fences. The rural and pastoral population had held that all unfenced land was public commons. With the coming of the barbed

wire all the previously open lands were rapidly enclosed, and thousands of settlers found themselves without pasturage. This feeling gave way to violence, and lawless mobs known as ” Fence Cutters ” destroyed thousands of miles offence. Order was restored by the executive, and many just laws enacted pro- tecting public rights.

The Farmers‘1 Alliance. — The unusual interest in politics among the farmers and other labouring classes resulted in several organiza- tions. Among these was a secret society known as the Farmers’ Alliance, which originated in a meeting of a few neighbours in Pleasant Valley, Lampasas county, in February 1878. In 1886 this organization had grown to a membership of from 75,000 to 100,000 in Texas and 1,000,000 in the United States. The Farmers’ Alliance manifested great interest in politics, due to the general belief that the railway charges for freight were exorbitant, and antagonism towards the railway interests was intensified. The movement, however, largely died out before 1900.

State Megulation of Railways. — By 1890 an amendment to the Constitution providing for a State Railway Commission was passed. The Commission had general powers for the regulation of railways in the state by prescribing rates of freight, and was a tribunal to hear complaints made by both parties. Through a series of suits in the Federal courts, railways were compelled to make restitution for past offences. Companies were compelled to bring back their principal offices and officers into the state from foreign states to which they had been removed. Other suits broke up pooling, and recovered for the state land which had been illegally obtained. By these suits 1,437,000 acres of land were restored to the public domain. Over $3,000,000 was saved to the producers from traffic taxation alone, without diminishing the receipts of the companies.

Alien Land Laws. — An Alien Land Law, passed by the legisla- ture, was declared illegal by the Supreme Court of the United States. The legislature then passed a modified Alien Land Act, providing that no private corporation whose main purpose was ownership of land should hereafter be allowed to acquire land in the state, and requiring that all such corporations then owning land should sell it within fifteen years.

Special Incidents. — The twenty-first legislature passed an Act to define and punish conspiracies against trade, popularly known as the Anti-Trust laws. Suits were instituted against illegal insurance companies, and stopped their business in the state. In August 1887 the state was convulsed by the so-called Prohibition campaign, when an amendment to the constitution was submitted to the people prohibiting the manufacture and sale of liquors in the state except for mechanical and scientific purposes. The proposition

■was defeated by a vote of 220,627 against 129,270. The new state capitol building, commenced in March 1885, was dedicated on 16th May 1888. Parts of Texas have suffered many great natural disasters, such as droughts, storms, floods, and hurricanes. In May 1899 the Brazos river flooded the vast area of agricultural lands bordering it throughout the region of the coastal plain. In 1900 a sudden rise of the Colorado caused the breaking of a dam which the citizens of Austin had erected at a cost of more than a million dollars. On 8th September 1900 a hurricane struck Galveston, causing a loss of life estimated at 3000 and of property at twenty to thirty million dollars. The wind, which reached a maximum velocity of 96 miles an hour, piled the water of the Gulf upon the city to such an extent that every building on the sea front and for three blocks inland was destroyed, and all communication cut off.

A special session of the twenty-second legislature passed an election law providing for the registration of voters in cities of 10,000 population, known as the Australian ballot system. For years Texas had claimed jurisdiction over a tract lying in the south-west corner of Indian Territory between the forks of Red river, and had issued patents to the land therein, organized courts, and constructed school-houses and other public improvements. The Supreme Court decided that this area, known as Greer county, belonged to the United States. (k. t. h.)

Textiles. — In connexion ~~with the history of tex~~ tiles, much interest attaches to the considerable quanti- ties of hand-woven textiles -which have been discovered in Egypto-Greek, Eoman, and Coptic cemeteries since 1885, and are now exhibited in many important European museums, particularly in the Victoria and Albert Museum at South Kensington. They illustrate varieties of weaving in linen and worsted threads such as were in general use amongst Greeks and Romans from the 1st and 2nd centuries before Christ up to the 8th and 9th centuries a.d., and elucidate many of those references to ancient woven fabrics which are quoted in the article on textiles in the ninth edition of this work. It is well to note that silken fabrics were practically unknown in Europe before the 1st century a.d., and anything approaching to a Western counterpart of the traditional Chinese silk manufactures, which are re- ported to have flourished 2000 B.C., cannot be said to have sprung into existence until the 6th or 7th centuries a.d. ; after this period their development was due principally to Mahommedans or Saracens, who con- quered, over-ran, and settled in many places about the Mediterranean during the 7th to the 11th centuries of our era.

The present article, however, deals with stuffs made with linen and worsted threads found in the above- mentioned cemeteries, the sites of which have been laid bare at spots adjacent to the Nile, between the district of Fayiim on the north and the town of Assuan on the south, the more notable of them being Akhmim (or Panopolis of the Greeks) and Antinoe (or Antinopolis, founded by the Roman Emperor Hadrian). Amongst the stuffs are simple shuttle-woven fabrics, the back and front of which are alike, weft and warp threads being equally visible, as in ordinary modern sailcloths and linens of different qualities. The plain stuff of the tunic in Eig. 5 (see Plate), and the material about the angel in Fig. 2, are samples of this simple weaving. There are also materials similarly woven with woollen threads, resembling flannels. Besides these, another distinctive class of textile is that in which its back and front, and more generally the front, only are woven with loops, giving a shaggy texture, as in modern bath or Turkish towels. Indications of this are seen in the outer margins of the square (Fig. 3), and on a reduced scale in Fig. 1. This shaggy-faced material was known to the Greeks under the names of kaunakes or persis. The ancient village of Thymetes

in Greece was noted in the days of Aristophanes for its manufacture of such shaggy stuffs. Hesychius writes of kaunakes as being etero-malla, or shaggy on one side only. But in Roman times Pliny ” recollects the amphi-malla [a textile

with each side shaggy] and the long shaggy apron being introduced.” The main parts of the large specimen (Fig. 1) are of such shaggy material. It dates from about the 3rd or 4th century, and was probably a covering to a couch or pall. The dark ornamental portions are of compact series of worsted tufts or loops, the texture of which is kindred to that of certain carpets. Finer and similar shaggy linen-faced material was also used for tunics.

The ornamental and decorative features which abound in these different linen textiles were almost invariably made with coloured threads of linen and wool by a simple inweaving process, the method and implements of which are identical with those of tapestry-weaving by hand. The largest and most complete tapestry-weavings are the great textile pictures or storied wall-hangings of the 15th and 16th centuries made in France and Flanders (e.g., Arras, Brussels), and of the 17th and 18th centuries in France (e.g., Gobelins, Beauvais tapestries). Now this tapestry-weaving method of producing intricate textile ornament, but on a far smaller scale, seems to have been used by all kinds of people, and as a method was certainly much earlier in the chronology of weaving than that of figured shuttle-weaving in a loom. The widespread range of its practice amongst various people is demonstrated by specimens made by natives of Borneo, by hill tribes of India, such as the Todas, by ancient dwellers in Peru, who may have been Toltecs and Aztecs, by nomad Turcoman tribes, by Scandinavians, by Greeks of the 5th century B.C., and of course by Romans. Ovid (Metamorphoses, vi., 55-69) gives a remarkable and minute description of this inweaving or tapestry-weaving method ; and Martial appears to be referring to work of this character when he writes that the ” Babylonian needle is now surpassed by the comb of the Nile,” a small comb, to press down the inwoven wefts compactly between the warp threads, being a necessary implement in this ornamental thread work. Pliny notes that “a garment when it has been worn for some time is

often embel- lished with wool from Egypt ” ; and Flavius Vopiscus in the 3rd century a.d. makes mention of the “linen cloths from Egypt . . . prized on account of their laboured embroidery ” : these references are particularly interesting when read in connexion with the specimens which have been collected from the cemeteries above mentioned. The greater number of these textiles proves the prevalence during the earlier centuries a.d. of the tapestry-weaving process for decorating costume as well as other articles, such as hangings and cover- ings. The angel or winged figure (Fig. 2) bearing the segment of a wreathed cross is 2 feet 3 inches in length, and is one of a confronted pair of such figures which ornamented a cloth or hanging at least 5 feet wide. The decorative device of confronted angels occurs in large and small sculptured reliefs and other decorative work of the 1st century a.d., and prevails for many centuries later; this tapestry -woven version of it is probably of the 4th century. Of corresponding date is the panel from a shaggy-faced linen (Fig. 3). The symmetrical arrangement of the circular and curved hands marking the plan of the entire pattern is fre- quent in patterns of Roman mosaics. The symbols in the four outside circles are those of the Evangelists, adapted in their forms from Gnostic emblems, and possess peculiar interest as early devices of Christian iconography. Possibly of the 2nd or 3rd century a.d. is the tree and vase ornament (Fig. 4), also from a cloth. The vase is designed in a characteristic Roman style. The formal arrange- ment of the branches and leaves, however, reflects a con- ventional treatment which is met with in Egyptian wall paintings 2000 b.c. Fig. 5 gives part of an elaborately

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Fig. 4. — Tapestry woven orna- ment for a linen cloth. 2nd or 3rd century a.d. (Egypto-Roman.)

Fig. 1.— Covering for a conch, or a funeral pall. 3rd or

4th century a.d. (Egypto-Roman.)

Fin. 7. — Square panel oi fine coloured flax thread tapestry weaving. 2nd or 3rd century a.d. (Egypto-Roman.)

Fio. 5. — Half of a linen tunic with ornamental bands, etc., of tapestry weaving. 3rd century a.d. (Egypto-Roman.)

Fig. 2.— Figure of coloured tapestry weaving for a linen hangi; 4th century a.d. (Egypto-Roman.)

Fig. e —Wide-sleeved linen tunic with broad bands of tapestry weaving. Probably 3rd century a.d. (Egypto-Roman.)

Fig. 3.— Ornamental square panel of tapestry weaving 4th century a.d. (Egypto-Roman.)

Fio. 8.— Net of flax threads. 2nd or 3rd century a.d. (Egypto-Roman.)

ornamented tunic, probably of the 3rd century a.d. The double bands to the sleeve, a narrow band along the length of the tunic, square panels on the shoulder and the lower part of the skirt, and a breast enrichment are all of well-designed devices wrought in tapestry-weaving. The wide-sleeved tunic (Fig. 6), decorated with broad bands of simpler ornament, is probably of 3rd-century work. The small square (Fig. 7) is of the daintiest texture, in fine flax thread tapestry-weaving, more delicate than any later work of this character, including even fine silk tapestry-weaving from China and Japan. It is possibly of 2nd or 3rd century work, and came from a child's tunic. The colours of this, as indeed of most of the tapestry-weavings in question, are bright and fresh. Passing to quite another class of textiles, an interesting example of variegated netting as made in the 2nd or 3rd century is given in Fig. 8, which is a prototype of lace made thirteen or fourteen hundred years later. In this and other specimens of similar nettings are

forestalled those varieties of meshes formed by twisting and plaiting threads which, fourteen hundred years later, became the characteristic of the grounds or riseaux of Brussels, Valenciennes, Mechlin, Lille, and Buckinghamshire pil- low-made laces.

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(a. s. C.)

Thale, a town of Prussia, province of Saxony, on the north side of the Harz Mountains, 8 miles by rail south-west of Quedlinburg, in the picturesque valley of the Bode, and in the immediate vicinity of the Bosstrappe, the Hexentanz, and other notable spots in the Harz. It has an idiot asylum, an epileptic home, and the saline springs of Hubertusbad, and there are manufactures of enamelled wares and machinery, ironworks, and brew- eries. Population (1885), 4498 ; (1900), 9467.

Thames, the chief river of Great Britain, taking its rise in several small streams on the eastern borders of the counties of Gloucester and Wilts. Its source is generally held to be at a place known as Thames Head, in the parish of Coates, 3 miles south-west of Cirencester ; but claims have also been advanced on behalf of the Seven Springs, the headwaters of the river Churn, 5 miles south of Cheltenham. The Thames leaves the Gloucester and Wilts borders near Lechlade, after which it separates successively Berks and Oxford, Berks and Bucks, Middle- sex and Surrey, and finally, at its estuary, Essex and Kent. Between Lechlade and Oxford it has a winding course, passing near Faringdon and Bampton. The Windrush flows into it at New Bridge, the Evenlode at Eynsham, and the Cherwell at Oxford. It then flows in a southerly direction nearly as far as Reading, receiving on the right the Ock at Abingdon, the Pang at Pang- bourne, and the Kennet at Beading; on the left, at

Dorchester, the Thame. After passing Beading it bends northwards to Henley, eastwards to Great Marlow, and southwards to Maidenhead, receiving the Loddon near Henley. Winding in a south-easterly direction, it passes Eton, Windsor, Datchet, Staines, Chertsey, Shepperton, and Sunbury, then receiving the Colne from the left at Staines, and the Wey from the right at Shepperton. Flowing past Hampton Court, opposite to which it re- ceives the Mole, and past Kingston, it reaches Teddington, and at the latter place its bulk is increased by the tidal wave. At Kew the outskirts of London are reached, and it flows through the metropolis and its suburbs for a dis- tance of about 25 miles, till it has passed Woolwich. Gravesend, the principal town below Woolwich, is 26 miles from London, and the Medway flows into the Thames estuary at Sheerness, 45 miles from London. The estuary extends to the North Foreland at Margate. In the tideway the principal affluents of the Thames are the Brent at Brentford, the Wandle at Wandsworth, the Ravensbourne at Deptford, the Lea at Blackwall, the Darenth just below Erith, and the Ingreburn at Bain- ham.

The length of the river from Thames Head Bridge to London Bridge is 161^ miles, and from London Bridge to the Nore, 47f miles, a total of

209 miles. The width at Oxford, is about 150 feet, at Teddington 250 feet, at London Bridge 750 feet, at Gravesend 2100 feet, and at the Nore 3 miles. The height of Thames Head above ordnance datum, or average sea-level, is 356 feet, and that of the river at Lechlade 237 feet, the average fall between Lechlade and London, 143 miles, being 20 inches per mile. The watershed area of the Thames is about 6000 square miles ; this does not include that of the Medway, which can hardly be considered a tributary of the river.

The Thames is navigable for rowing-boats as far up- wards as Cricklade, except in dry seasons, and for barges at all times as far as Lechlade, 18 miles below Thames Head. At Inglesham, three-quarters of a mile above Lech- lade, the Thames and Severn Canal has its junction with the Thames. This canal is the necessary link between the two great rivers from which it takes its name, or, in other words, between the east and west of England. It was abandoned for years, but owing to the exertions of a joint- committee of the counties and other interests concerned, powers were obtained from Parliament for its restora- tion, and the works needful for its reopening have been carried out. Concurrently with the repair of the canal, the navigation works on the Thames were remodelled at a large cost, and barges drawing 3 feet 6 inches can now, even in the summer season, navigate from London to Inglesham.

Although the Thames, as one of the ” great rivers of England,” was always a navigable river, that is to say, one over which the public had the right of navigation, it was not until the last quarter of the 18th century that any systematic regulation of its flow in the upper reaches was attempted. Complaints of the obstructions in it are not uncommon, and early in the 17th century Taylor, the Water Poet, in a poem commemorating a voyage from Oxford to London, bewails the difficulties he found on the passage. No substantial measures to remedy this state of things were adopted till the year 1771, when an Act of Parliament was passed authorizing the construction of pound locks on the Thames above Maidenhead Bridge. In pursuance of the powers thus granted, the Thames Commissioners of that day caused locks to be built at various points above Maidenhead, and between 1810 and 1815

the Corporation of London carried out river works on the same lines as far down the river as Teddington. The character of these works is so well known that it is hardly necessary to explain that whilst they maintain an efficient head of water during the drier seasons of the year, they facilitate the escape of winter floods.

The canals communicating with the Thames, in addition to the Thames and Severn Canal already spoken of, are the Oxford Canal, the Wilts and Berks at Abingdon, the Kennet and Avon Canal at Reading, the Wey and Basingstoke Canals at Weybridge, the Grand Junction at Brentford, the Regent's Canal at Limehouse,

and the Grand Surrey Canal at Rotherhithe. There is also a canal at Gravesend, but this is little, if at all, used. By means of these canals, and especially by means of the Grand Junction and Oxford Canals, constant communication is maintained between the Thames and the great industrial centres of England. The importance of the merchandise traffic on the upper Thames may be estimated from the fact that in the year 1900 the sum of £10,700 was paid for tolls on barges carrying goods on that part of the river.

But considerable as is the part the river thus plays in the national economy in distribution, its usefulness is greater still in the opportunities for exercise and recreation which it affords to the public, especially to Londoners. The scene at Henley at regatta time, or on any part of the river on public holidays, and on Satur- days and Sundays during the summer, would be sufficient to show how it contributes to the public enjoyment. But a further proof is in the fact that in the year 1900 as many as 11,284 rowing-boats, 541 steam launches, and 162 houseboats were registered for use on the Thames. It is only since about 1870 that this popularity has grown up. Ten years earlier even rowing-boats were but few and far between, excepting, of course, at Oxford, at Henley in regatta time, and at Putney on the tideway. Steam launches did not exist on the river before 1866 or 1867, and houseboats only in

the form of college barges at Oxford. But by the year 1884 there were 217 launches ; in 1887 they had increased to 268, and in 1900 there were 541. Houseboats increased from 98 in 1887 to 162 in 1900, and rowing-boats from 8926 in 1888, the first year of regis- tration, to 11,284 in 1900. The growth of the popularity of river sports, as shown by these figures, has been encouraged by the facilities given by the Great Western railway and the London and South- Western railway for reaching stations on the river, as well as by the fact that the works carried out on the river since the year 1867 by the Conservators of the Thames have much improved the navigation for pleasure purposes as well as those of business. During the season regattas of importance take place at most of the towns and larger villages. Of these Henley Royal Regatta is pre- eminent by the number and importance of the entries, and by its comparative antiquity. The regattas at Molesey, Kingston, Reading, Marlow, and Oxford, as well as many others, attract numerous competitors and spectators.

The Thames is a favourite stream for the angler — indeed, up to 1860 the angler had comparatively undisturbed enjoyment of his sport. The introduction of steam launches and the growth of traffic generally have interfered with his pursuit, but there is no reason to apprehend that, as has often been alleged, the fishery has been injured. Indeed, in the opinion of those qualified to speak, the river has as good a supply as formerly of coarse fish such as pike, perch, roach, dace, and barbel. Of trout there are many fine specimens, especially at the weirs. Salmon are known to have existed at Maidenhead so recently as 1812, but they dis- appeared soon after that date. An association has been formed, under the presidency of Mr W. H. Grenfell, M.P., with the object of re- introducing this fish into the river, and in April 1901 a num- ber of young salmon were placed at Teddington by way of experi- ment. The right of the public to take fish has been frequently in dispute, but a committee of the House of Commons, which took much evidence on the question in the year 1884, came to the con- clusion that ” it is impossible to recognize anything like a general public right to take fish as now existing.” They added “that the public at large have only to know that their rights are imaginary to induce them also to be content with the extant system under which permission is very freely granted

by owners of fisheries to the public for angling on the more frequented parts of the Thames." These conclusions are interesting in face of the fact that the ques- tion has arisen from time to time since 1884.

The fisheries are under the regulation of bye-laws made by the Conservators of the Thames, and apply to the riparian owners as well as to the public generally. These bye-laws are carried into effect by officers of the Conservators, assisted by the river keepers of the various fishing associations. The principal associations are those at Oxford, Reading, Henley, Maidenhead, and Windsor, and last but not least, the Thames Angling Preservation Society, whose district is from Staines to Brentford.

The Thames is the principal source of the water supply of London, and the water companies of the metropolis take in the summer, the season of their greatest requirements, as much as 130,000,000 gallons a day, under the statutory powers granted them by Parliament. The companies authorized to draw water from the Thames are the Chelsea, the East London, the Grand Junction, the Lambeth, the Southwark and Vauxhall, and West Middlesex, all of which have intakes at Hampton or in its imme- diate vicinity. In addition to these companies, there is a joint- committee of the New River Company, the Grand Junction Company, and the West Middlesex Company, which have power to draw water when the river is above a certain level. This committee is now constructing huge storage reservoirs at Staines Moor.. Outside of London the corporation of Oxford and two

small companies in the Staines district have power to draw water from the river, but not in any large quantities.

The flow of the Thames varies greatly, according to the season of the year. The average gaugings at Teddington for the summer months of the years 1883 to 1900 were in July 413,000,000 gallons a day, in August 39-3,000,000 gallons, and in September 375,000,000 gallons. At present the normal natural flow in ordinary summer weather is about 350,000,000 gallons a day, and of this, after the companies have taken 130,000,000, only 220,000,000 gallons are left to pass over Teddington Weir. After a long period of dry weather the natural flow has been

known to fall to considerably below 200,000,000 gallons, whilst, on the other hand, in the rainy winter season, the flow in 1894 rose for a short time to as high a figure as 20,000,000,000 gallons, and the ordinary flow in winter months may be put down as 3,000,000,000 gallons. The importance of storage reservoirs, such as those at Staines, is manifest under such conditions of flow, especially bearing in mind the probable growth of population in the London district and of its increasing needs.

Whilst the flow of the river requires the most careful observation and regulation, as well in the interest of the traffic as of the water supply itself, the preservation of the purity of the stream calls for even more assiduous attention. Throughout the whole of the Thames watershed, and especially in the 3800 square miles above the intakes of the water companies, the Conservators have enforced the requirements of Parliament that no sewage or other pollution shall be allowed to pass into the Thames, into its tributary streams, or even into any water communicating with them. There is a large staff of inspectors constantly visiting the various parts of the watershed, and in spite of many difficulties arising from vested interests, the work of purification is attaining completion, with a correspondingly great improvement in the quality of the river water. So recently as 1890 the state of the river below London was such as to be dangerous to the public health. The metropoli- tan sewage was discharged untreated into the river, and the heavier solids deposited over the river-bed, while the lighter parts flowed backwards and forwards on the tide. The London County Coun- cil, directly after its establishment, took means to remedy this evil, and the solids are now separated from the sewage and taken to sea in large steam hoppers. The liquid effluent passed into the river does not now give rise to complaints, but the Council are, notwithstanding, carrying out works of magnitude to secure that the effluent shall be above suspicion.

While the points already dealt with are of very great interest, nothing has been said of the trade which constitutes the real im- portance of the Thames. Early in the 16th century the opulence of London, and the extent of the trade on the Thames, evoked the ad- miration of the ambassadors of Venice, and the port continued to hold its position in

the following centuries. At the end of the 18th century the business of the port received a considerable impetus, due doubtless to the marked superiority of Great Britain at sea. The House of Commons in 1796 considered the growth of the trade in the port of London of such importance as to call for the appointment of a strong committee of the House to deal with the question of im- provements to be made, and of this committee Mr Pitt, Mr Fox, and Mr Sheridan were members. Yet it is probable that at that date the trade of the port did not exceed 1,500,000 tons a year. The total foreign inward and outward trade of the port in the year 1816 amounted to only 1,240,000 tons ; if to this be added as much again forecasting trade, we have a total trade of 2,500,000 tons. In 1850 the total trade, foreign and coasting, had grown to 7,494,815 tons; in 1870 to 11,169,746 tons; in 1890 to 20,962,334 tons ; and in 1900 it approximated to 30,000,000 tons.

The greater part of this trade proceeds up the river to the various docks, of which the most important are the Tilbury Dock, the Albert Dock, and the Victoria Dock belonging to the London and India Docks Company, the Surrey Dock and the Commercial Dock, both belonging to the Surrey Commercial Dock Company, and the Millwall Docks. Ships of the largest draught can be docked in the Albert and Victoria Docks, in which the steamers belonging to the Peninsular and Oriental Companies, the Union- Castle Company, and other great lines load and discharge. The Surrey and Commercial Docks are mostly used for the timber and corn trades. The use of the river and the docks by the great ocean-going steamers has given rise to discussion as to the depth of the river and the necessity of dredging to a much greater extent than in the past. The river has been deepened to 26 feet up to Gravesend, and dredging to 22 feet is being carried out up to the Albert Docks. These depths are considered by the owners of large steamers to be insufficient, and they maintain that a depth of 30 feet at low water to Gravesend and of 20 feet to the Albert Dock is the least that should be afforded.

The regulation of the traffic below London is under the control of harbour-masters appointed by the Conservators, and it is part of their

duty to see that the laws relating to explosives and to petroleum are duly observed. An important detail of the work in

the river is the removal from the stream of sunken vessels. Of these forty or fifty are generally dealt with every year, many of them being large steamers. In most cases they are delivered to their owners on payment of the comparatively small expense incurred in raising.

There has existed from early times a special authority f<5r the government of the Thames. A statute as far back as 1393, the 17th Richard II., cap. 9, recites that it had been granted to the citi- zens of London by the king's progenitors to remove all the weirs on the waters of Thames, and to leave the punishment thereof relating to the king, and it then grants to the Lord Mayor the enforcement of the particular provisions of the statute itself. The Lord Mayor for the next four centuries after the date of the statute enforced his powers through the medium of bis water bailiffs, till, in 1771, a committee of the Corporation of London took under their charge the details of the work. This system continued till 1857, when an Act of Parliament was passed establishing the Thames Conservancy Board. The powers of this body have been enlarged by subsequent Acts of Parliament, and its constitution was varied in 1864 and 1866, and again in 1894, when it was greatly increased in numbers and placed on a more popular basis. The jurisdiction of the river above Staines was formerly under a very numerous body of commissioners, and was only transferred to the Conservancy Board in the year 1866.

A word should be added on the name of the Thames. Camden gave currency to the derivation of the word from the combination of the names Thame and Isis. Now it can be shown conclusively that the river has borne its present designation from the earliest times. We have the testimony of Csesar (B.G., v. 11) who says that at the time of his invasion of Britain it was called Tamesis. Dion Cassius (xl. 3) and Tacitus (Ann. xiv. 32) both call it Tamesa, and in no early authority is

the name Isis used. In early Saxon times the river was called Thamis, as may be seen in a grant before A.D. 675 to Chertsey Abbey by the sub-king Frithwald. In the first statute passed for improving the navigation of the river near Oxford (21 Jac. I.) it is called the river of Thames, and it was only in a statute of George II. (1751) that the word Isis appears. The name Isis has indeed the authority of Spenser as applied to the Thames in its course above Dorchester (Faerie Queen, Bk. iv. canto xi. stanza 24), but there is ample evidence to show that long before his time the name of the river throughout its course was not Isis but Thames. The word Isis is probably an academic rendering of Ouse or Isca, a common British river name, but there is no reason to suppose that it ever had much vogue except in poetry or in the immediate neighbourhood of Oxford.

See Ordnance Survey of England for physical features ; Report of the Select Committee of the House of Commons on Thames River Preservation, 1884 ; Reports of Royal Commissions of 1892 and 1898-99 on Metropolitan Water Supply ; Evidence given before the Royal Commission on the Port of London, 1900 ; ‘ Annual Reports of the Conservators of the River Thames ; Minutes of the London County Council. (j. h. go.)

Thana, or Tanna (=a fort, or police-station), a town and district of British India, in the Konkan division of Bombay. The town is on the west of the Salsette creek or Thana river, just where the Great Indian Peninsula railway crosses to the mainland, 21 miles from Bombay city. Population (1881), 14,456 ; (1891), 17,455 ; (1901),

16,011.

The district of Thana, since the census of 1891, has been dimin- ished by the transfer of about 200 villages to Kolaba. Present area, 3578 square miles ; population, 819,680, showing an average density of 229 persons per square mile. In 1901 the population was 809,361, showing a decrease of 1 per cent. The land revenue and rates are Rs. 15,08,077, the incidence of assessment being R.l.4.10 per acre; number of police, 1052; children at school (1897-98), 15,046, being 1-98 per cent, of the total population; registered death-rate (1897), 37-10 per 1000.

Cultivated area (1897-98), 453,684 acres, of which 4593 were irrigated from wells. The staple crop is rice. Fishing supports many of the people, and the forests yield timber and other produce. Salt is largely manu- factured by evaporation along the coast. At Kurla, in Salsette Island, there are 2 cotton mills, with 915 looms and 54,000 spindles, employing 4370 hands ; 4 rice mills ; 4 printing-presses, issuing 4 vernacular newspapers. The district is traversed throughout its length by the Bombay and Baroda railway, and also crossed by the two branches of the Great Indian Peninsula line.

Thann, a town of Germany, in Alsace-Lorraine, district of Upper Alsace, 16 miles by rail west-north-west of Mulhausen. It is the seat of cotton, calico, silk, machinery, and other industries. An excellent wine is

made. The (Roman Catholic) church of St Theobald (1351) is an elegant specimen of the Gothic, and has a remarkably fine tower (1450-1516), 266 feet high. Above the town are the ruins of the castle of Engelburg, destroyed by Turenne in 1675. The town existed in the 10th century. Population (1885), 7464 ; (1900), 7618.

Thar and Parkar, a district of British India, in the Sind province of Bombay. Area, 2729 square miles ; population (1881), 203,344 ; (1891), 298,203, showing an increase of 47 per cent., due to the extension of irriga- tion ; average density, 23 persons per square mile, com- pared with 60 for Sind generally. In 1901 the population was 364,168, showing a further increase of 22 per cent.

The land revenue in 1897-98 was Rs.8,33,038, the incidence of assessment being R. 1.7.3 per acre; cultivated area, 767,786 acres, of which 320,538 were irrigated from Government canals ; number of police, 515 ; children at school, 3123, being 1-1 per cent, of the population; registered death-rate (1897), 19-54 per 1000. The principal crops are millet, rice, oil-seeds, and cotton. Cultivation largely depends upon the control of the water which comes down the canals and occasionally causes flood. Salt is found in two or three places. The western border of the district is entered by the railway from Haidarabad to Shadipalli, connected with the North- western main line

by a bridge across the Indus at Kotri, and with the Rajputana system at Jodhpur.

Umarkot, the administrative headquarters of the district, is on the edge of the desert. Population (1881), 2828; (1891), 3702. Historically interesting as the birthplace of the emperor Akbar in 1642, it is now a station on the railway from Haidarabad to Jodhpur, which has brought central India into direct connexion with the seaport of Karachi.

Tharandt, a town of Germany, romantically situated on the Wilde Weisseritz, 8f miles S.W. of Dresden, kingdom of Saxony, on the Dresden-Reichenbach railway. It has a Protestant church, a higher-grade girls' school, and the oldest academy of forestry in Germany, with about 90 students. Tharandt is a favourite summer resort of the Dresdeners, one of its principal charms being the magnificent beech woods which surround the little town. Population (1900), 2822.

Tharrawaddy, a district of the Pegu division of Lower Burma, lying to the north of Rangoon. Area, 2851 square miles ; population (1891), 339,240, living in 1458 villages ; (1901), 395,870. They paid in 1898-99 a revenue of Rs.13,15,648.

Of the population in 1891, 329,688 were Buddhists and Jains, 2843 were Hindus, 1674 Mahommedans, 1877 aborigines, mostly Karens, and 3158 Christians, 2722 of whom were natives, most of them Karens. Of the total area of 1,824,640 acres, 402,222 acres were cultivated in 1898-99. The remainder was made up of forest land, 616,669 acres ; land not available for cultivation, 243,421 acres ; cultivable waste, 644,918 acres ; and current fallow, 17,410 acres. The rainfall in 1898-99 was 81-61 inches. The railway runs through the centre of the district, and there are ten railway stations. The chief villages, with their population in 1891, are Zigon, 1256 ; Gyobingauk, 2960 ; Thonze, 1653 ; Letpadan, 1575. The great bulk of the cultivation is rice.

Thaton, a district in ,the Tenasserim division of Lower Burma. Area, 5089 square miles; population (1891), 266,620 ; (1901), 340,355. It was formerly a sub- division of the Amherst district, but was formed out of part of that and of the Shwegyin district which has now ceased to exist.

There were 922 villages in 1898-99, and they paid a revenue of Rs.15,36,381.

The population was made up in 1891 of Buddhists and Jains, 247,662 ; aborigines, mostly Karens, 7338 ; Hindus, 6092 ; Mahom- medans, 3814 ; and Christians, 1714, most of them natives. Of the total area of 3,256,890 acres, 529,826 acres were cultivated in 1898-99. Of the remainder 152,031 acres were forests, 1,750,703 were uncultivable, 811,590 were available for cultivation, and there were 12,740 acres of current fallow. The rainfall in 1898-99 was 181-84 inches. The headquarters town That6n had a population of 9683 in 1891. The great bulk of the cultivation is rice, but a good deal of tobacco also is grown.

T H A X T E E — T HEISS

Thajcter, Celia (1836-1894), American poet, was born at Portsmouth, Nvew Hampshire, 29th June 1836. Her father, Thomas B. Laighton, became offended with some of his associates in state politics, and retired to the barren and isolated Isles of Shoals (ten miles off Ports- mouth), where he was keeper of the lighthouse; and his daughter's girlhood was therefore spent in marine surroundings, which gave character to the best of the verse she afterwards wrote. Her poems, mainly in lyrical form, deal with the beacon-light, the sea-storm, the glint of sails, the sandpiper, the flower among the rocks, &c, in characteristic and sympathetic fidelity, constituting an interesting addition to American place literature. She wrote prose sketches of life and scenery, Among the Isles of SJioals (1873), stories and poems for children, and letters ; but her best work is that described above, and contained in the complete (1896) edition of her poems, edited by Sarah Orne Jewett. She married Levi L. Thaxter, an interpreter of Browning's poetry, in 1851, spent most of her life on Appledore, one of the Isles of Shoals, and died 26th August 1894.

Thayetmyo, a district in the Minbu division of Upper Burma. It was formerly in the Irrawaddy division of Lower Burma, but was transferred to Upper Burma for administrative purposes in 1896. Area, 4750 square miles ; population (1891), 250,161, living in 939 villages, and paying a revenue of Rs.4,03,504 ; (1901), 239,877.

The population was made up in 1891 of Buddhists and Jains, 226,732 ; aboriginal tribes, mostly Chins, 17,291 ; Hindus, 2524 ; Mahommedans, 2149 ; and Christians, 1465, of whom 545 were natives. The area is 1,534,080 acres. Of this in 1898-99 only 112,146 acres were cultivated, 296,320 acres were under forests, 564,928 acres were not available for cultivation, 544,535 acres were cultivable, and there were 16,151 acres of current fallow. The total rainfall in 1898-99 was 26‘3 inches. The chief towns are Thayetmyo and Allanmyo, on opposite banks of the Irrawaddy. In 1891 Thayetmyo had 17,101 inhabitants, and Allanmyo 9012. There is now only a wing of a British regiment stationed here. There is a central gaol capable of containing 1214 prisoners. The bulk of the cultivation is rice, but in 1898-99 there were 3935 acres under tobacco. There are 256,256 acres of reserved forest. Three oil-wells were sunk in 1883 at Pedaukpin, but they were found unprofitable and abandoned.

Theinni, called by the Shans Hsenwi, and also officially so designated, but better known by the Bur- manized name of Theinni. It was by far the largest of the cis-Salween Shan states, and at one time included not only all the territory of the present states of North and South Hsenwi, but also Kehsi Mansam, Mong Hsu, Mong Sang, and Mong Nawng, besides having a sort of protectorate over Mang Lon and other Wa states east of the Salween. These had, however, fallen away in Bur- mese times, and at the period before the British annexa- tion Theinni was divided into five parts by name ; but there was no central authority, and the whole state was in hopeless disorder. This continued until the appear- ance of British troops in March 1888, when it was divided into two states — North Theinni, which was assigned to a successful adventurer, Khun Hsang, of Ton Hong, and South Theinni, which went to Nawmong, of the old Shan ruling house. North Theinni has an approximate area of 6330 square miles, and a population

estimated at 118,000 persons, living in 1500 villages, divided among 76 districts. South Theinni has an approximate area of 5000 square miles, and a population estimated in 1897 at

57,223.

The northern part of North Theinni is a mass of hills affected by the geological fault which has produced the rift that forms the Nam Tu or Myit-nge valley, and has thrown up a series of parallel ranges which extend northwards to the Shweli (Lung Kiang), without altogether destroying the north and south trend which is the characteristic of the Shan hills as a whole. In the valleys be-

tween these hills are numerous tracts under rice cultivation, some circular or oval, some mere ribands along the river banks. The southern portion has much more flat land, along the line of the Nam Tu, its tributaries the Nam Yao and the Nam Nim, and the Nam Yek flowing into the Salween. This was formerly thickly populated, and still remains the most valuable portion of the state. A range run- ning westwards from the Salween, and marking the southern border of the rift in the hills, divides North from South Theinni. Both north and south of the Nam Tu there are many peaks which rise to 6000 feet, and several over 7000 feet. The northern portion is almost con- sistent enough in its altitude of about 4000 feet to be called a plateau. It has large, grassy, upland downs. This part of the state has fallen almost entirely into the hands of the Kachins. The Shans are found in the Nam Mao (Shweli or Lung Kiang) valley, and in the NamTu and other valleys in the southern part of the state. The line of the Nam Mao is the lowest portion of North Theinni, being little over 2000 feet above sea-level. The southern valleys are about 500 or more feet higher. South Theinni is practically bisected by the huge mass of Loi Ling, nearly 9000 feet above sea-level, and by the spurs which that peak sends north and south. Apart from this it consists of broken hill-country of no great height, or open rolling downs, the latter chiefly in the eastern half of the state. It is watered by numerous streams, of which the chief is the Nam Pang, an affluent of the Salween. The chief river in the northern state, apart from the Salween, is the Nam Tu or Myit-nge, which rises

on the Irrawaddy-Salween watershed, not far from the latter river, and flows westwards through the state into Taungbaing or Thebaw, and eventually into the Irrawaddy at Amarapura. The Nam Mao or Shweli only skirts the state, but it receives a con- siderable tributary, the Nam Paw, which has its entire course in Theinni territory, and is large enough to be barely fordable in the dry weather, and only passable by boats in the rains. The deforestation caused by years of upland cultivation has dried up many of the springs, but as a whole North Theinni is very well watered. Considerable deposits of coal, or rather of lignite, exist in both North and South Theinni, but do not appear to be of high quality. Gold is washed in many of the streams in a fitful way. Limestone exists in large quantities. No valuable timber exists to any considerable extent. There is some teak in the Nam Yao val- ley, and scattered wood-oil trees exist. Pine forests cover some of the ranges, but, as elsewhere in the Shan states, varieties of the oak and chestnut are the commonest forest trees. The climate of the state as a whole is temperate. In the plains of the uplands there are yearly frosts in January, February, and March, but in the greater part of the state the thermometer rarely falls to freezing- point, and in the hot weather does not exceed ninety degrees for any length of time. The average rainfall seems to be about 60 inches yearly. After the disruption of the ancient Shan empire at Tali by Kublai Khan, Theinni seems to have been the centre of the independent Shan kingdom, with various capitals in the Shweli and Nam Tu valleys. This kingdom of Kawsampi was ended by the Burmese about 1738, and the country was divided into various states, with appointment orders from Ava. Numerous rebellions and civil wars have reduced Theinni from its position as the most powerful and populous Shan state to a condition of fearful desolation. It has regained much population since the British occupation in 1888, but is still far from its old prosperity. Much may be expected from the cart roads that have been made, and from the Mandalay-Kun L6ng railway.

Hsenwi, the capital of North Theinni, contained 150 houses in 1898, with a population of about 800. It stands near the north bank of the Nam Tu. The ruins of the old capital he at a short distance, and show it to have been a large and well-built town, with a number of houses variously estimated at from three to ten thousand. Mong Yai is the

capital of South Theinni. It num- bered 481 houses in 1897, with about 2000 inhabitants in the town and suburbs. Lashio, the headquarters of the Superintendent of the Northern Shan State, is in North Theinni. The races found in Theinni comprise Shans, Kachins, Chinese, Burmese, Lihsaws, Wa, Palaungs, and Yanglam. The Shans and Kachins vastly pre- dominate, and are nearly equal in numbers. (j. q. gc.)

Theiss (Hungarian, Tisza), a large affluent of the Danube, next to which it is the greatest river of Hungary. It springs in the north-eastern part of the Carpathian Mountains, in the county of Maramaros, at a height of above 2000 metres. By a quick fall it soon reaches the great Hungarian plain (Alfold), where it becomes slow, some- what muddy, and very tortuous. It flows into the Danube near Titel. Its length from source to mouth is, as the crow flies, only 455 kilometres, but its windings make its course about 1000 kilometres long. The floods formerly spread far and wide and caused immense damage; and in 1879 the town of Szegedin was almost destroyed by

an inundation. Therefore the river is now strongly dammed. Formerly the Tisza and its tributaries were fabulously rich in fish, but these have considerably diminished. There are numerous water-mills on the stream, which is navigable for rafts almost everywhere, but for steamers only downwards from Szolnok for a length of 338 kilometres. Its chief tributaries are the Szamos, Koros, Maros, Latorcza, and the Saj<5. In its lower course it is joined to the Danube by the Francis-Joseph canal crossing the county of Bacs-Bodrog. A canal connecting Budapest with the Tisza is projected. As a purely Hungarian river, having its entire course within the frontiers of the country, the Tisza plays a

considerable part in Hungarian literature and popular poetry.

Theodosia (formerly Kaffa), a seaport and water- ing-place of Russia, on the south-east coast of Crimea, 75 miles by branch line from Jankoi junction on the Sebastopol railway, and 181 miles from Sebastopol. Its roadstead is the best in Crimea after Sebastopol, and very seldom freezes in winter. It has gained much of the trade of Sebastopol since that town was made a military port in 1894, and the value of its exports, principally grain and animal products, is increasing year by year. Population

(1897), 27,238.

THERAPEUTICS.

THEEAPEUTICS is that branch of medicine which deals with the means employed to cure disease if possible, or to control and lessen its evil results when a cure is impossible. The cure which is sought for may either be symptomatic or radical. Various morbid condi- tions of the body generally may give rise to different symptoms. Thus a gouty condition may manifest itself in one man as eczema of the skin, giving rise to redness and intense itching ; in another as neuralgia, causing most severe pain ; in a third as bronchitis, producing a dis- tressing cough ; in a fourth as dyspepsia, giving rise to flatulence and intestinal disturbance ; and in a fifth as inflammation of the great toe, accompanied by redness, swelling, and pain. The therapeutic measures employed in these different cases maybe directed towards alleviating the symptoms, such as itching, pain, cough, and swelling, in which case the treatment will be merely symptomatic; or they may be directed towards removing the root of the disease, viz., the gouty condition underlying them all, and thus effecting a radical cure. It very frequently happens that we do not know what the underlying condition is, and we are forced simply to relieve as best we can the most prominent and most distressing symptoms. In symptom- atic treatment we are frequently obliged to use remedies Empirical simPty because we know they have done good and before in similar cases, and we expect them to

Rational

treatment, j^ they &Qt Thug ^ ^^ gQut ^ mogt

common and most trusted remedy for removing the pain is colchicum, but at present we do not know what action it has upon the system, or why it gives so much ease in the pain of gout while it has comparatively little effect upon pain due to other causes. This plan of treatment is termed empirical. It is a useful method, and is often very satisfactory, but it has the disadvantage that it admits of but little progress, and when a trusted empirical remedy fails we do not know precisely in what direction to look for a substitute. In contradistinction to empirical we have rational therapeutics, by which we mean the application of a remedy whose mode of action we know more or less perfectly in diseased conditions, the nature of which we also understand more or less fully. As an example may be taken the use of nitrite of amyl in angina pectoris. It has been found that in many cases of this disease the pressure of blood within the arteries becomes increased, probably from spasmodic contraction of the arteries themselves. Nitrite of amyl has the power of dilating the arteries ; it has consequently been employed with much success in lowering the blood pressure and removing the pain in angina pectoris. But such rational knowledge as this not only enables us to remove pain at the time, but helps us to prevent its recurrence. For

on the one hand knowledge of the fact that nitrite of amyl lessens blood pressure has led to the successful employment of other nitrites and bodies having a similar action, and on the other the knowledge that increased blood pressure tends to cause anginal pain leads to the prohibition of any strain, any food, any exposure to cold, and also of any medicines which would unduly raise the blood pressure. Here we notice one of the greatest advantages of rational over empirical therapeutics. In cases of angina, while the resistance opposed to the action of the heart by spasm in the vessels may be great, the heart itself may be feeble, and it may therefore be necessary to give some remedy which will increase the power of the heart. But if such a remedy were given alone it might, and probably would, act on the arteries as well as the heart, and by causing the contraction of the vessels do more harm than good. But if we know what remedies will increase the power of the

heart and what will lessen resistance in the vessels, we may combine them and thus obtain the objects we desired, viz., removal of the pain, better action of the heart, and more perfect circulation.

The testing of ideas by observation and experiment which was begun in anatomy by Vesalius, and by Harvey in physiology, was applied by Morgagni to alterations in the organs produced by disease, Successors. by Bichat to the tissues, and by Virchow to the cell. The study of disease in the living body may be said to have been begun by John Hunter (Ency. Brit., 9th edition, i. p. 815, xii. p. 385, xv. p. 816, xxii. p. 676), developed by Magendie, Claude Bernard, Brown-Sequard, and others. Of late years enormous impulse has been given to our knowledge of the causation of disease by microbes, through the works of Gaspard, who injected putrid matter into the veins of aliving animal; by Villemin,who discovered that tuberculosis is infective ; by Davaine ; and especially by Pasteur, Koch, and others too numerous to mention, who have worked, and are still working, at the microbic causa- tion of disease with marvellous success. The natural end of life is that all the organs should become old and gradu- ally decay at the same time, so that at the last the indi- vidual should become less and less active, weaker and weaker, and finally die without any definite disease, without pain and without struggle. But this is excep- tional, and generally one part gives way before another, either on account of one part being naturally weaker or of one part having been overtaxed or more severely attacked by some injurious external influence, or by some undue preponderance of another part of the body itself. For health consists in a due proportion between the action of all the different parts of the body, and if one part be unnaturally strong it may lead to injury or death. Thus

a very strong heart, although it may be useful to its possessor for many years, driving the blood rapidly through the vessels, and supplying all his tissues with such abundant nutriment as to enable him to endure great exertion, mental or bodily, may in the end cause death by

bursting a vessel in the brain, which might have resisted the pressure of a feebler circulation for years

longer. On the other hand, a heart that is too fttbkaess feeble may cause its owner's death by its in- orexces- ability to carry on the circulation against in- sive action creased resistance. This may occur suddenly, oftbebody. as wnen tne resistance is increased in the arterial

system by a sudden exertion or strain, and more slowly when the resistance is increased in the pulmonary circulation by inflammation of the respiratory passages. The thyroid gland, which is situated in front of the neck, yields a secretion which passes into the blood and there tends to maintain a state of moderate dilatation in the blood-vessels and of oxidization in the tissues, so. that the circulation remains good and the body-heat and muscular activity remain well maintained. When this gland becomes enlarged, and its secretion consequently increases, the vessels dilate, the heart beats more rapidly, the skin becomes too hot, the nervous system becomes irritable, and tremors occur in the limbs. On the other hand, when it becomes atrophied the circulation becomes feeble, the face heavy and dull, the patient suffers from cold, the features grow lumpish, mental processes become sluggish, and bodily vigour diminishes.

Disease of the whole body may thus be produced by over-action or under-action of some part of it, but such causes of disease are slight as compared with the effect of external noxious influences, and more especially the effect of microbes. These enter the body through various channels, and once they have effected a lodgment they grow, multiply, and give rise to various poisons which attack and injure or destroy different tissues or organs in the body. Various safeguards are provided by Nature to prevent their entrance. On the skin we have a thick

epidermis through which microbes cannot pass, cro es. aJ^.j10Ugn ^ an entrance is obtained for them

by a prick or cut they may readily grow in the tissues below and spread from them throughout the whole body. They pass more readily through mucous mem- branes, but almost every one of these is provided not

only with a coating of mucus, which obstructs their pas- sage, but with some reflex mechanism which tends to remove them. Thus irritation of the eye causes wink- ing and secretion of tears, by which the irritant is re- moved ; irritation of the nose causes sneezing ; of the air-passages, coughing ; of the stomach, vomiting ; and of the intestines, diarrhoea. Even when they have passed through the mucous membranes and enter the blood they are met, in some instances, by a toxic action of the blood itself upon them ; and in others they are attacked by the white corpuscles, which destroy them, eat them up, and digest them, the process being known as phagocytosis. Moreover, the products of microbic secretion tend to produce fever. The high temperature characteristic of this condition is no doubt injurious to the body itself, but it is frequently more so to the microbe which has invaded the organism ; and thus fever, instead of now being regarded -as a morbid condition to be suppressed by every means in our power, is considered to be a reaction of the organism tending to protect it by destroying the infection. But it must be kept within limits, lest it should of itself cause death, and here again we see the difference between empirical and rational medicine.

Fever is not to be looked upon as an unmitigated evil, to be removed if possible, but rather as a defensive

mechanism by which the organism may prevent invasion from noxious microbes. Nevertheless, as in a campaign the general's plan may be spoiled by too hasty or too eager action on the part of some of his troops, so the de- fensive arrangement carried to excess may prove injurious or fatal to the organism. Thus too great a rise of tem- perature in fever may kill the patient ; and the aim of therapeutics is to restrain the temperature within proper limits, neither allowing it to rise too high nor to fall too low. The old plan of lowering it by means of cold baths was known to Musa, the physician of Augustus, and by it he saved the emperor's life ; but the same treatment killed the emperor's nephew.

The introduction of the clinical thermometer, which allows us to ascertain exactly the amount to which the temperature rises in fever or

to which it is reduced by antipyretic measures, is to the physician like the com- pass to the sailor, and allows him to steer safely between two extremes (Hydropathy, Ency. Brit., 9th edition, vol. xii.). After the struggle between the organism and the microbes is over, even when it has ended victoriously for the former, injuries are left behind which require repair. Every one has noticed after prolonged fever how thin and weak the patient is, and both the muscular and nervous power throughout the whole body are sadly in want of repair. Where there has been local mischief due to inflammation the dead leucocytes must be removed, and this is done either by their being converted into pus in one mass (Pathology, vol. xviii. pp. 365 and 400), and making their way through the tissues to the nearest surface, whether of skin or mucous membrane, from which it can be discharged, or they may undergo a process of fatty degeneration and absorption, leaving behind in some eases cheesy matter, in others hard con- nective tissue. *

Poisons formed by microbes are partly eliminated by the kidneys, partly by the mucous membrane of the stomach and intestines, and possibly also by the skin. In days of old free elimination by these channels was looked upon as a sign of returning health, and was termed a ” critical ” diuresis, diarrhoea, or sweating, according to the channel through which the eliminative act had occurred.

By therapeutic measures we strive to limit as far as possible the entry of injurious microbes into the organism, to expel or destroy them and their harmful products, and to maintain the strength of the organism itself. One of the influences which is most injurious to the body, and favours most the invasion of microbes, is chill. So much is this the case that some diseases which are now known to be due to infection were formerly attributed entirely to the effect of cold. Thus pneumonia is now known to be due to the diplococcus pneumonia}, and yet its invasion occurs so frequently after a chill that it is almost impossible not to look upon chill and pneumonia as cause and effect. The reason of this appears to be that the diplococcus is fre- quently present in the mouth or air-passages without giving rise to any symptoms; but when the patient is exposed to chill, and the tissues of the respiratory passages are thereby weakened, the diplococcus grows, multiplies, and

gives rise to inflammation of the lungs. Even what are known as common colds are probably due chiefly to microbic infection aided by a chill, just like pneumonia. Therapeutic measures which are commonly adopted in the treatment of a cold have for their object to destroy the microbes before they penetrate fairly into the organism, and to restore the balance of the circulation and increase the strength of the invaded parts. Thus carbolic acid or carbolized ammonia are sniffed into the nose to destroy the microbes there, or the nose is washed out by an anti- septic solution as a nasal douche ; bismuth or morphine are insufflated, or zino ointment is applied, to cover the

mucous membrane, and protect it from further irrita- tion ; and various antiseptic gargles, paints, and powders applied to the pharynx in order to prevent the microbic inflammation from extending to the pharynx and down the trachea and bronchi, for many a severe bronchitis be- gins first by sneezing ~~and nasal irritation. Sometimes the patient is put to bed and the circulation is encour~~ aged, especially on the surface of the body, by the use of hot spirits and water, or opium and ipecacuanha (Dia- phoretics, Ency. Brit., 9th edition, vol. vii.), while the out- side of the nose is protected to a certain extent from loss of heat, and consequent irritation, by smearing it with a tallow candle or rubbing some ointment over the skin. At the same time, if the throat has begun to show signs of being involved, a hot poultice or wet pack is applied to the neck.

Both inflammation and fever are protective processes calculated to defend the organism against the attacks of microbes. But protective processes misdirected or carried to excess may become injurious or even dangerous to the organism. As an instance of misdirection, we may take the irritation which remains in the eye after a par- ticle of dust has been removed, or the itching of the skin which occurs in eczema. The irritation of the conjunc- tiva caused by dust leads to winking of the eyelids, lachrymation, and rubbing, which tend to remove it ; but after the dust has been removed violent rubbing tends

rather to keep up the irritation ; and sometimes, if the particle of dust remains under the eyelid and is sharp and angular, the process of rubbing may cause it to in- jure the conjunctiva much more than if it were left alone. In the same way itching is often caused by the presence of insects or other irritants upon the skin, and it tends reflexly to cause rubbing, which is useful by removing the irritant. But when the irritation is situated in the skin itself, as in eczema, the scratching tends to increase inflammation, and makes the irritation worse. In the same way, the reflex act of coughing is useful in remov- ing either foreign bodies or excessive secretion from the air-passages ; but when the mucous membrane of the res- piratory tract is irritated and inflamed, it produces a feeling of tickling and a desire to cough sometimes very violently ; yet the coughing simply tends to exhaust the patient, because there is really little or nothing to bring up. The same is the case in inflammation of the lung sub- stance itself. As an example of excessive action we may take sneezing, which is calculated to remove irritants from the nose, but when too powerful may cause the pa- tient to burst a blood-vessel. In phthisis also, although there may be some expectoration to bring up, yet a good deal of the irritation is in the lung substance, and the efforts of coughing are far greater and more continuous than are required for the removal of expectoration, and they simply exhaust the patient. In inflammation of the stomach also such continuous vomiting occasionally oc- curs that the patient's life is in danger by his inability to retain food ; and similar danger also occurs from in- flammation of the intestines and consequent diarrhoea.

We will next take the various parts of the body, and

consider more in detail the therapeutic measures most

commonly employed in the treatment of their

^fHHall? diseases. The defensive powers of the body

measures. . . , . , n •

against microbes, when actually on or in it, may be classed as means (1) of passive defence, (2) of active defence, and (3) of repair. Besides these,

how- ever, we must consider the protection of the whole body from injury caused by (a) inaction, (6) or over-action, or (c) weakness of any one of its parts. The means of passive and active defence are sometimes so closely associated that it is difficult to distinguish between them. Thus if a little diphtheritic sputum were coughed into a

person's eye, or some blood containing anthrax bacilli were to touch a raw spot upon the hand, the removal of microbes in either case by washing with simple water might be regarded as a means of passive defence, whilst washing them away with an antiseptic lotion might be regarded as active defence, because the antiseptic would tend not only to remove but to destroy the microbes. In the same way, washing the skin with spirit would tend to harden the epidermis and thus prevent the entrance of microbes; and the application of an oint- ment to an abrasion would have a similar action. But by the addition of some antiseptic to the ointment its defensive action would be converted from passive to active, and its power to prevent infection would become greater ; and if inflammation had already set up in the skin, the addition of opium, belladonna, or cocaine would lessen local pain ; and an astringent, either metallic or organic, would restrain inflammation and accelerate repair. The thickening of the epidermis in the hands and feet, which occurs from constant use, is Nature's provision for meeting the extra wear to which these parts are subjected by much use ; but pressure is apt to cause the defensive process to be carried too far, and to lead to corns, which give rise to much pain and annoyance. To remove these salicylic acid dissolved in flexible collodion is now generally employed. When this is painted upon the part the corn usually peels off in a day or two, and the patient is cured.

' But the object of therapeutics is not merely to cure. It is, in the words of the old formula, "Curare, cito, tuto et jucunde," to cure quickly, safely, and pleas- antly. There are therefore in most prescrip- tions (1) a basis or chief ingredient intended to ^'"^eles cure {curare), (2) an adjuvant to assist its action and make it cure quickly (cito), (3) a corrective to pre- vent or lessen any undesirable effect (tuto), and (4) a vehicle or excipient to make it suitable for administra- tion and pleasant to the patient (jucunde). In the remedy just mentioned the

salicylic acid forms the basis ; but sometimes chloride of zinc or lactic acid is added to it to make it act more quickly, and these are the adjuvants. Extract of belladonna is added to lessen the pain which might occur during the removal of the corn, and this acts as a corrective, while the flexible collodion forms a means of applying it conveniently, and constitutes the vehicle.

The surface of the skin may be invaded by parasitic organisms and may exhibit spots, which are removed by something which will destroy the parasite, such as oint- ments containing mercurial salts. In psoriasis the epider- mis separates in flakes at various spots which have not been subjected to pressure, and to cure '^i^Tn it ointment containing tar or other products of the dry distillation of wood is employed. When the true skin is inflamed various appearances may arise, according to the intensity and extent of the inflammation, and the eruption may be papular, vesicular, pustular, tubercular, bulbous, or ulcerative. To lessen irritation the skin is protected by dusting powders, such as oxide of zinc, starch, fuller's earth, &c, or by ointments. Irritation is lessened by lotions containing substances that will diminish irritability of the nerve-endings and skin, such as carbolic acid, hydrocyanic acid, morphine or opium, cocaine, belladonna or atropine. Where the surface is ulcerated it may be protected from external violence and placed under favourable conditions for healing by covering it with lint moistened with water and with oil-silk over it to prevent evaporation. If the granulations tend to become too abundant, some astringent, such as sulphate of copper or sidphate of zinc, is added to the water. On the other hand, when the ulceration is old and the circulation

through it poor, the aim of the therapeutist is to reawaken the normal reparative process, to bring ~~about increased circulation and increased tissue change, and thereby in~~ sure healing. For this reason a blister is placed upon the callous ulcer, which heals with the fresh inflammation thus excited.

The treatment of inflammation of mucous membrane is based upon the same principles as inflammation of the skin, and there too we usually associate means (1) for re- moving microbes, (2) for destroying them, (3) for lessen- ing the irritation they produce, and (4) for repairing any mischief they have done. Thus in the eye and ear, lo- tions containing an antiseptic, a sedative, and an astrin- gent are very generally used. For inflammation of the mouth a similar combination is used as a mouth wash, in the throat as a gargle, and in the nose as a wash and sometimes as an ointment or spray, the ointment possess- ing the advantage of protecting the delicate nasal mucous membrane from irritation by stopping the entrance of irritant dust into the nasal cavities. In the stomach we aid the vomiting by which microbes or the products of decomposition of food are usually eliminated by giving to the patient repeated draughts of hot water so as to wash the stomach clean. Frequently this is sufficient; but if the stomach refuses to eject its objectionable contents, we may either give an emetic or wash it out by means of a stomach pump or syphon. Similar procedures are used for the intestine, and one of the best methods of treating the diarrhoea consequent upon the presence of irritating substances in the intestinal canal is to give a dose of castor-oil together with a few drops of laudanum. By means of the castor-oil the irritating substances are re- moved, and the laudanum which is mixed with the purgative soothes the intestine. Even in cases of very acute intestinal diseases similar treatment is now pur- sued, and instead of treating dysentery simply by seda- tives or astringents, an eliminative treatment by means of sulphate of magnesia is largely employed. After the irritant has been removed either from the stomach or intestine, a feeling of irritation of the mucous mem- brane may remain, and sickness, diarrhoea, or pain may continue in the stomach and intestine although the ir- ritant is no longer present within them, just as the flow of tears and desire to rub may remain in the eye after the piece of grit which has occasioned it may have been removed. The condition which remains after the ir- ritant has been removed is one of inflammation more or less intense. The process of inflammation is a de- fensive one, but if carried too far may prove injurious.

For the purpose of checking the inflammatory pro- cesses and lessening discharge from mucous membranes astringents are employed. Some of these are of mineral and some of vegetable origin, but they almost all possess one chemical property in common, namely, they precipi- tate albumin. This power is possessed alike by a glass of brandy, by solution of lime, soluble salts of zinc, copper, or silver, by tannic and gallic acids, as well as vegetable juices and extracts which contain them. The strength of the astringent application and the mode of its administration are varied according to the delicacy and position of the mucous membrane affected. Thus to the eye we may use a solution of sulphate of zinc of half a grain to the ounce, while to the ear, urethra, or vagina a solution of four to eight grains or even more may be applied. For the stomach and intestines we employ the same drug in the form of a pill ; and when it is desired to act especially upon the intestines, the pills are made of a harder consistence or less soluble preparation, or are covered with keratin, so that they may not act much, if at all, upon the stomach while passing through it before reaching the intestines. The

heat which occurs in inflamed parts is chiefly due to the larger amount of blood circulating in the part on account of the dilatation of the vessels. The pain is due to stretching of the nerve fibrils or compression of them by the turgid vessels in the swollen tissues. This latter cause is chiefly observed when the tissues are of a very unyielding character ; for example, when the inflamma- tion occurs in a bone or under a thick fibrous and un- yielding membrane. The swelling, heat, and pain may sometimes be relieved by mere change of position alter- ing the flow of blood to the inflamed part. Thus when inflammation occurs in the finger, as in a whitlow, the pain is not only constantly severe, but it is increased by every pulsation of the heart, and thus has a throbbing character. By raising the hand nearly to a level with the head both the constant pain and the severity of the throbs may be relieved, as the blood is not sent with such great force into the arteries and returns more readily through the veins. In other parts of the body the same relief may be obtained by raising the inflamed part as high as possible. Belief is frequently given also both by heat and cold, and at first sight it seems strange that agents having such an opposite action should each

produce a similar effect. The reason probably is that the application of cold causes contraction of the arteries leading to the inflamed part, while heat by dilating the vessels around forms a side channel through which the blood passes, the tension in the seat of inflammation be- ing thus lessened in both cases. When the inflammation occurs in soft parts where the surrounding vessels can be readily dilated, heat often affords more relief to the pain than cold, but when the inflammation is in a bone or in unyielding fibrous tissues, cold generally gives more relief. For example, the pain of a gum-boil is gen- erally relieved more by warmth, because the yielding tissues of the gum, mouth, and cheek can be readily re- laxed by heat and their vessels dilated ; but when the pain is dependent upon inflammation in the hard un- yielding socket of a tooth, cold generally gives greater relief. The removal of blood, either by incision or by the application of leeches, sometimes gives considerable relief to the pain and tension of inflamed parts. Blisters applied at some distance from inflamed parts are also sometimes useful ; and probably they produce this good effect by causing a reflex contraction of the arteries in the inflamed part, and thus acting like a cold application. Certain drugs have the power of relieving inflammation by slowing the heart and rendering its impulse more feeble. Amongst those are to be classed small doses of aconite and colchicum ; the former especially tends to lessen the process of inflammation generally, when it is not too severe. There can- be little doubt that the inten- sity of inflammation frequently depends very much on the condition of the blood, and that by altering the blood inflammation may be lessened. Thus free purgation, and especially purgation by cholagogues and salines, has long been recognized as a useful means of reducing the inflam- matory process. For example, a mercurial pill at night, followed by salts and senna in the morning, will often re- lieve the pain in toothache or gum-boil, and lessen in- flammation not only in the mouth, but other parts of the body as well. Such remedies are termed antiphlogistic. Venesection at one time was highly esteemed as an antiphlogistic measure, and while it is possible that it has not fallen too much into disuse, there can be no doubt that at one time it was very greatly abused, and was carried to such an excess as to kill many patients who would have recovered perfectly had they been let alone. Although the high temperature in an inflamed part is

chiefly due to the increased circulation of blood in it, yet the presence of inflammation appears to

cause increased formation of heat either in the inflamed part itself or in the body generally, because we rarely find inflammation exist to any extent without the tem- perature of the body being raised and a febrile condition produced. (See Fever.)

Two very old remedies for fever are acetate of ammo- nia and nitrous ether. These were formerly given em- pirically, simply because they had been found to do good. Now we can see the reason for their administration, because the nitrous ether, consisting chiefly of ethyl nitrite, dilates the superficial vessels and thus allows greater escape of heat from the surface ; while acetate of ammonia, by acting as a diaphoretic and stimulating the secretion of sweat, increases the loss of heat by evaporation. When a patient is covered with several blankets, loss of heat from the surface both by radiation and evaporation is to a great extent prevented, but if a cradle be placed over him, so as to raise the bed- clothes and allow of free circulation of air around his body, both radiation and evaporation will be increased and the temperature consequently lowered. If his body be left uncovered except by the sheet or blanket thrown over the cradle, the loss of heat is ‘still greater, and it may be much increased by sponging the surface with either hot or cold water so as to leave it slightly moist and increase evaporation. The temperature may be still further reduced by placing vessels fiWed with ice inside the cradle. When the patient is very restless, so that cradling is impossible, a wet pack may be employed, a sheet wrung out of cold water being wrapped round him, and over this a blanket. The pack has the double effect of restraining his movements and thus lessening the pro- duction of heat, while at the same time it dilates the vessels of the skin and produces loss of heat. The re- straint which it imposes and the equal distribution of heat over the surface frequently cause sleep

quickly in patients who have previously been wildly delirious and entirely sleepless. When the temperature continues to rise in spite of wet sponging and cradling, recourse must be had to the cold bath. The bath should be brought to the bedside and the patient, wrapped in a sheet, should be lifted into it by two attendants. The water should be at the temperature of 90° and gradually reduced by the re- moval of hot water and displacement by cold, until the temperature of the patient as taken in the mouth is re- duced to about 99£° or 99°. After this the patient should be taken out and again put into bed. It is inadvisable to lower the temperature quite to the normal while the patient is in the bath, as frequently it falls after his removal, and may fall so far as to induce collapse. In cases where no bath is available a large mackintosh sheet may be spread upon the bed under the patient, the sides and top may be raised by pillows, and cold water may be applied to the surface of the body with large sponges. The mackintosh sheet forms a shallow bath, and the water may afterwards be run off from it at the lower end of the bed. Another way of applying cold is to dip an ordinary sheet into cold water, apply it for three or four minutes to the surface of the body, then remove it and replace it by another sheet while the first one is being dipped in water. By the alternate use of the two sheets, or by the use of one quickly wrung out of cold water as soon as it becomes warm, the patient's temperature may be rapidly reduced.

There are a number of drugs which have a very power- ful action in lowering temperature. Most of these belong to the aromatic group of bodies, although one of them, antipyrin, belongs rather to the furf urol group. Carbolic acid has an antipyretic action, but on account of its poisonous properties it cannot be employed as an anti- pyretic. Salicylic acid has a strong antipyretic action,

and is most commonly used in the form of its sodium salt, which is much more soluble than the acid itself. Amongst other antipyretics, the most important are quinine, phenacetin, and antifebrin. These probably lessen fever by their action upon the nerve centres which regulate the temperature of the body, and partly by their peripheral action in causing the secretion of sweat. Very high fever in itself will cause death, the fatal temperature in rabbits being 114.6°. Before death

occurs the pulse and respiration become ex- ceedingly rapid and weak, and complete unconscious- ness sets in. That these symptoms are simply due to heat is shown by the fact that if the temperature be quickly reduced by the application of cold the symptoms at once subside. But the delirium which is common in fever, although it may be partly due to rise of temper- ature, is very often due to poisons in the blood, for in some cases it occurs with quite a low temperature, 101° or 102°, whereas in others the temperature rises to 104° and 105° with no delirium whatever. The presence of toxins in the blood not only affects the brain, causing de- lirium, but also other organs, the, heart and lung, and may cause fatal syncope or respiratory failure.

Many years ago Dr S. L. Mitchell, father of the well- known neurologist, Dr Weir Mitchell, pointed out the close resemblance which exists between symp- toms of poisoning by snake venom and infec- ^ad ««?* tive fevers.1 Weir Mitchell and others have serums. shown that serpent venom consists chiefly of albumoses, and the toxins formed by infective bacilli have a somewhat similar chemical nature. Calmette and Fraser found that when small doses of snake venom, insufficient to cause death, are injected into an animal, temporary disturbance is produced ; but after a few days the animal recovers, and a larger dose is then required to produce any symptoms. By gradually increasing the dose the animal becomes more and more resistant, until at last a dose fifty times as great as that which would at first have produced immediate death can be injected without doing the animal any harm. If a horse be chosen for the experiment, a considerable quantity of blood may be withdrawn without injuring the animal. When this is clotted the serum is found to act as an anti-venin, so that when mixed with the venom of a snake it renders it harmless. Although this result is best obtained when the venom and serum are mixed in a glass before injection, yet if they be in- jected at the same time in different parts of the body the animal will still be protected and the poison will not produce its usual deadly results. What occurs with snake venom takes place also when the toxins are formed by microbes, and a new method of treatment by anti-toxic serums has been introduced of late years with great suc- cess. This is most commonly and successfully used in the treatment of diphtheria. This disease depends upon the presence of a

bacillus which grows rapidly at the back of the throat and in the air-passages of children, causing the formation of a membrane which, by plugging the windpipe, causes suffocation and death. At the same time it produces a poison which causes inflammation of the nerves, leading to paralysis, which sometimes proves fatal. By growing this bacillus in broth a toxin is formed which remains in solution and can be separated from the bacilli themselves by filtration. This toxin-containing broth is injected into a horse in increasing doses, just as in the case of the serpent venom, and after the resistance of the horse has been much increased it is bled into ster- ilized vessels and the blood is allowed to coagulate. The serum is then removed and its anti-toxic power tested by

1 Quoted by Weir Mitchell, ” Researches on the Venom of the Rattlesnake,” Smithsonian, Contributions, 1860, p. 97.

ascertaining the amount necessary to counteract a given amount of active toxin in a guinea-pig of a certain size, the standard weight being three hundred grammes. The serum, the strength of which has thus been ascer- tained, is distributed in bottles and injected in the proper quantity under the skin of children suffering from diph- theria. If used at an early stage of the disease, ai\d in sufficient quantity, the results are wonderful. The same method of serum therapeutics has been used in other infective diseases, but not with the same success.

Another therapeutic method which is historically much older than that of serum therapeutics is that of inocula- tion. The virulence of infective diseases varies i?°a“‘a” *n different epidemics, and at different times in the same epidemic. It had been noted that many infective diseases did not attack an individual a second time, the first attack appearing to protect from subsequent ones. The idea of inoculation, therefore, was to infect an individual with a mild form of the dis- ease, so that he should escape infection by a more viru- lent one. This was tried largely in the case of smallpox, and once at least by Dr Erasmus Darwin in the case of scarlet fever. The worst of this method was that the disease thus

inoculated did not always prove of a mild character, and in the case of Dr Erasmus Darwin's son the scarlet fever was exceedingly severe and very nearly proved fatal. To Jenner we owe the discovery that vaccination protects against smallpox, and it is now gen- erally acknowledged that smallpox and vaccine are probably the same disease, the virus of which is modified and its virulence lessened by passing through the body of the cow. Pasteur found that the germs of anthrax could be cultivated outside the body and their virulence weakened either by growing them at too high a tem- perature or in an unsuitable medium. By inoculating first with a weak virus and then with others which were stronger and stronger, he was able completely to pro- tect oxen either from the effects of inoculation with the strongest virus or from infection through contact with other animals suffering from the disorder. On the other hand, he found the weakened virus could be again strengthened by inoculating a feeble animal such as a guinea-pig a day or two old with it, and then inoculating stronger and stronger animals : an increase in strength was gained with each inoculation, until at last the virus could attack the strongest. A similar increase in viru- lence appears to occur in plague, where animals, especially rats and mice, seem to be affected before human beings, and not only increase the virulence of the mi- crobes, but convey the infection. Two methods of protective inoculation have been used. In one, Haffkine employs the toxins obtained by growing plague bacilli in broth for five or six weeks, and then heating the whole to 65° or 70° C. so as to destroy the bacilli. This preparation is prophylactic, but does not seem to be curative. Yersin has prepared a serum from horses in the same way as diphtheria anti-toxin, and this is said to have a curative action during the attack. In the same way sterilized cultures of typhoid bacilli have been used to protect against attacks of typhoid fever, and an anti-typhoid serum has been employed with intent to cure. Protection does seem to be afforded, but the curative action of the serum is still somewhat doubtful. Although the anti-toxins which are used in the cure of infective diseases are not danger- ous to life, yet they sometimes cause unpleasant con- sequences, more especially an urticarial eruption almost exactly like that which follows eating mussels or other shell-fish. Sometimes the swelling of the skin is much more general, so that the

whole body may be so swollen and puffy as exactly to resemble that of a person

suffering from advanced kidney disease. These disa- greeable results, however, are not to be compared with the benefits obtained by the injection of anti-toxic serum, and this method of treatment is likely to maintain its place in therapeutics.

For many years pepsine has been used as a remedy in dyspepsia to supplement the deficiency of digestive juice in the stomach, and it has been used popularly in dyspepsia for a still longer period. Prom Organo- time immemorial savages have been accustomed pemics. to eat the hearts of lions and other wild animals, under the belief that they will thereby obtain courage and strength like that of the animal from which the heart had been taken, but in 1889 Brown-Sequard pro- posed to use testicular juice as a general tonic and stimulant. Observations were made on the connexion between thyroid gland and myxoedema, which appeared to show that this disease was dependent upon atrophy of the gland. Accordingly the liquid extracts of the gland, or the gland substance itself compressed into tablets, have become largely used in the treatment of the disorder. The success which has been achieved has led to the use of many other organs in a raw or compressed form, or as extracts, in other diseases ; e.g., of suprarenal capsule in Addison's disease, of bone marrow in perni- cious anaemia, of thymus and suprarenal capsule in ex- ophthalmic goitre,* of kidney in renal disease, and of pituitary body in acromegaly. To this method of treat- ment the name of organo-therapeutics has been given. The first scientific attempt to employ portions of raw organs in the treatment of disease was made by Lauder Brunton in diabetes in 1873, sixteen years before Brown- Sequard's paper on the effect of testicular juice. From considering the nature of diabetes, he had come to the .conclusion that many cases were due to imperfect oxidation of sugar in the body ; that this oxidation was normally carried out by a ferment in the muscles, and that probably the disease was in some cases depend- ent upon absence of the ferment. He tried to supply this by giving raw meat and glycerine extract of meat, but although he seemed to get some benefit from the treatment, it was not sufficiently marked to attract general

attention. His attempts to isolate a glycolytic ferment from flesh were also only partially success- ful. One of the great difficulties in the way of apply- ing this treatment is that in all probability many of the ferments or enzymes are altered during the process of absorption in the same way as the normal ferments of digestion, and unless the tissue enzymes can be isolated and injected subcutaneously the desired results will not be obtained. The most striking of all the results of organo-therapy are those obtained in myxoedema. In this disease the face is heavy, puffy, and expressionless, the lips thick, the speech slow, the hands shapeless and spade-like, the patient apathetic, the circulation slow, and the extremities cold. Under the influence of thyroid gland these symptoms all disappear, and the patient is frequently restored to a normal condition. When the thyroid gland is absent in children, not only is the ex- pression of the face dull and heavy as in the adult, but the growth both of body and mind is arrested, and the child remains a stunted idiot. The effect of thyroid gland in such cases is marvellous, the child growing in body and becoming healthy and intelligent. In the case of the thyroid the function of the gland appears to be to prepare a secretion which is poured out into the blood and alters tissue-change. When the thyroid tablets or extract of thyroid are given in too large quantities to patients suffering from myxoedema, the symptoms of myxoedema disappear, but in their place appear others indi- cative of increased metabolism and accelerated circulation.

The pulse-rate becomes very rapid, the extremities become warm, so that the patient is obliged to wear few clothes, the temper becomes irritable, the patient nervous, and a fine tremor is observed in the hands. On stopping the administration of thyroid these symptoms again dis- appear. When the thyroid is hypertrophied, as in Graves's disease, the same symptoms are observed, and these are probably due to increased secretion from the thyroid. At the same time other symptoms, such as exophthalmos, may appear, which have an independent origin and are not due to the secretion of the gland. The

whole of the secretion here is poured into the blood and not at all on to a mucous surface, and herein the thyroid gland differs largely from such glands as the pancreas or peptic and intestinal glands. But it seems now probable that all glands which have what may be termed an external secretion like the pancreas, stomach, intestine, skin, and kidneys have also an internal secretion, so that while they are pouring out one secretion from the ducts into the intestine or external air, they are also pouring into the lymphatics, and thus into the blood, an internal secretion. In fact, a splitting appears to take place in the process of secretion somewhat resembling that which takes place in the formation of a toxin and anti-toxin. The secretion of some digestive glands would prove poisonous if absorbed unchanged. For example, the trypsin of the pancreas (vide Digestive Organs) digests albuminous bodies in neutral or alcoholic solution, and if the whole of that which is secreted in the pancreas for the digestion of meat in the intestine were absorbed unchanged into the circulation, it would digest the body itself and quickly cause death. The secretion of trypsin by the pancreas may therefore be looked upon as the formation of a toxin. We do not know at present if any corresponding anti-toxin or anti-trypsin, as we may term it, is returned into the lymphatics or blood from the gland, but the pancreas, which in addition to secreting trypsin secretes a diastatic ferment forming sugar from starch, pours this into the intestine and secretes at the same time a glycolytic ferment which breaks up sugar, and this latter passes into the blood by way of the lymphatics. Thus the gland not only breaks up starch into sugar in the intestine, but breaks up the sugar thus formed after it has been absorbed into the blood. It is by no means improbable that all glands have a double function, and that sometimes the external may be even less important than the internal secretion. On this point, however, we have but little definite knowledge, and a great field is open for future research. At the same time, there are many indications of the importance of an internal secre- tion in popular treatment. For example, there are many people who feel very much better after profuse perspira- tion, and as sweat appears to contain little but water and a few salts, it is not improbable that the improve- ment in their condition is due rather to the internal secretion from the skin than to the elimination effected by the sweat. It is probable that the kidneys also have an internal secretion, and that the

great oedema some- times found in kidney disease (vide Kidneys) is rather due to the action of some proteid body resembling in its effects the streptococcus anti-toxin, rather than to accumulation of water due to imperfect action of the kidney. Similarly the beneficial effects of purgation may be due not only to the elimination which takes place through the bowel, but also to the internal secretion from the intestinal glands.

The health of the body depends upon the proper kind and supply of food, upon its proper digestion and ab- sorption, on the proper metabolism or tissue-change in the body, and the proper excretion of waste. We have considered how these may be disturbed by microbes from

without and from within. We have also considered in a general way the treatment of local diseases by a passive protection, active protection, and repair of waste; but both maintenance of health and repair of waste depend very largely upon the condition of the blood. When this is healthy the attacks of microbes are resisted, wounds heal readily, and patients recover from serious diseases which in persons of debilitated constitution would prove fatal. In order to keep the blood in a satisfactory condition it must be well supplied with fresh nutriment, and the products of waste N”trition freely eliminated. The food required for the l”^”™1′ body may be divided into five kinds (vide Dietetics) — carbohydrates, such as starches and sugars ; fats ; proteids, such as meat and eggs ; salts ; and last, but not least, water. Water forms almost three-fifths of the weight of the body, so that it amounts to more than all the other constituents put together. Without it life would be impossible, and it is well recognized that death from thirst is more awful than death from hunger. The healthy organism can adapt itself to great varieties both in regard to the quality and quantity of food; but when health begins to fail much care may be required, and many ailments arise from dys- pepsia. Imperfect digestion is very often caused by detective teeth or by undue haste in eating, so that the food is bolted instead of being sufficiently masticated and insalivated (vide Digestive Organs). The food thus reaches the stomach in large lumps which cannot be readily digested, and either remain there till they

decompose and give rise to irritation in the stomach itself, or pass on to the intestine, where digestion is likewise incomplete, and the food is ejected without the proper amount of nourishment having been extracted from it; while at the same time the products of its decomposition may have been absorbed and acted as poisons, -giving rise to lassitude, discomfort, headache, or perhaps "even to irritablility and sleeplessness. Much dyspepsm-JVould be avoided by attention to the con- dition ofe 5YJS teeth, by artificial teeth when the natural ones are defective, and by obedience to one or two simple rules : (1) to eat slowly ; (2) to masticate thoroughly ; (3) to take no liquid with meals excepting breakfast, but sip half a pint of hot water on rising in the morning, on going to bed at night, and again about an hour before luncheon and dinner. The object of taking no liquid with meals is that it ensures mastication being more complete, because persons cannot wash the unmasticated food down by drinking, and it prevents the gastric juice from being greatly diluted, and so allows it to digest more rapidly. Should these rules be insufficient, then (4) proteid and farinaceous food should be taken in separate meals — farinaceous food at breakfast, proteid alone at lunch; farinaceous in the afternoon, and proteid again in the evening. The reason for this is that farinaceous foods are digested in the intestine and not in the stomach, where they may undergo fermentation, whereas proteid foods are to a great extent digested in the stomach. When the secre- tion of gastric juice is deficient it may be excited by gastric tonics, such as ten grains of bicarbonate of soda and a drachm of compound tincture of gentian in water shortly before meals, and may be supplemented by the administration of pepsin and hydrochloric acid after meals. When the nervous system is below par, and both secretion and movements are deficient in the stomach, nervine tonics, such as nux vomica or strychnine, are most useful.

High tension in the arteries is often associated with sleeplessness, the pressure of blood being such that the circulation in the brain is constantly maintained at a high

rate of speed and the brain is unable to obtain rest. The means of producing sleep may be divided into two classes : those (1) which lessen the circulation, Tefs.‘eSS” and. wnich (2) diminish the excitability of the brain cells. The circulation in the brain may be lessened by warmth to the feet, cold to the head, warm food in the stomach, warm poultices or compresses to the abdomen, antipyretics, which reduce the temperature and consequently slow the beats of the heart in fever, and cardiac or vascular tonics, which slow the heart and tend to restore tone to the blood-vessels, so that the circulation in the brain may be more efficiently regu- lated. Amongst those which lessen excitability of the brain-cells, areopium, morphine, hyoscyamus, chloral, sul- phonal,trional, paraldehyde, chloralamide, chloralose, hop, and many others. A combination of the two kinds of remedy is sometimes useful, and chloral sometimes suc- ceeds when other things fail, because it depresses the circulation as well as lessens the activity of the brain-cells.

Irritation of sensory nerves tends to cause contraction of the vessels and to raise the blood pressure, and where p la pain is present opium or morphine is the most

efficient sedative. The sensation of pain is felt in the brain, and the cause of it may be in the sensory centres of the brain alone, as in cases of hysterical pain, with no lesion to cause it. Ordinarily, however, it is due to some peripheral irritation which is conducted by sensory nerves to the spinal cord and thence up to the sensory centre in the brain. Pain may be stopped by removing the cause of irritation, as, for example, by the extraction of a carious tooth or by rendering the nerve- endings insensitive to irritation, as by the application of cocaine ; by preventing its transmission along the spinal cord by antipyrin, phenacetin, acetanilide, cocaine, &c. ; or by dulling the perceptive centre in the brain by means of opium or its alkaloids, by anaesthetics, and probably also, to a certain extent, by antipyrin, and its congeners.

Deficient nervous action also leads to defective secre- tion and movement in the intestine, sometimes with _, . , flatulent accumulation and sometimes with

Flatulence. ,. ,. T ,

constipation. In sucn cases nux vomica or strychnine is useful. Flatulent distension in the stomach or bowels is partly due to air which has been swallowed and partly to gas which has been formed by the de- composition of food. The stomach may become dis- tended with gas on account of acid fermentation leading to the frequent swallowing of saliva, and both this form of flatulence and that caused by the actual formation of gas are much diminished by such drugs as tend to prevent fermentation. Amongst the best of these are carbolic acid in doses of one or two grains, creosote in one or two .drops, and sulpho-carbolate of soda in doses of ten grains. Others which may be mentioned are salicylate of bismuth, salol, /J-naphthol, and naphthalene. By preventing fermentation in the intestine these also tend to prevent or check diarrhoea, and they may do good after the irritant has been removed by castor oil. After the irritant has been removed and fermentation stopped, the irritation still remaining in the intestinal wall may be soothed by chalk mixture and bismuth, to which if necessary small quantities of opium may be added. In cases where diarrhoea is very obstinate and lasts for weeks, sulphuric acid is sometimes more effica- cious than alkalis ; and in chronic colics it may be nec- essary to treat the mucous membrane by local application of astringent solutions. For this purpose solutions of sulphate of copper or of nitrate of silver may be gently introduced into the bowel in quantities of a quart at a time. It is essential that a large quantity should be

used, as otherwise the seat of irritation may not be reached by the astringent.

Constipation is so common that it may be almost looked upon as the normal condition in civilized coun- tries. Two of its chief causes probably are (1) improvement in cookery, whereby the harder ^nstlpa' and more irritating parts of the food are soft- ened or removed ; and (2) improvement in grinding ma- chinery, whereby the harder and

more stimulating parts of the grain are separated from the finer flour which is used for bread. In consequence of the absence of me- chanical stimulant the bowels act more slowly, and constipation is the result. It may be considerably diminished by a return to a more natural system of feed- ing, as by using brown bread instead of white, by taking oatmeal porridge, and by eating raw or cooked fruits, such as apples, oranges, prunes, and figs, or preserves made of fruit, such as raspberry and strawberry jam, marmalade, &c, or by vegetables. Should these means fail, aperients may be used. The commonest are senna in the form of compound liquorice powder, sulphur in the form of lozenges, cascara sagrada, either in tablets or in the form of liquid or dry extract, rhubarb, colocynth, and especially aloes. The last acts chiefly upon the lower bowel, and forms a constituent of nearly every purgative pill. The medicines above mentioned may be taken either in a moderate dose at bedtime or in the form of a dinner pill, or they may be taken in small doses three times a day just before or after meals. Some suf- ferers from constipation find that they get greater relief from salts dissolved in water, or from natural aperient water taken on rising in the morning, and others again find that the best way of opening the bowels is to inject one or two drachms of glycerine into the rectum, or use it as a suppository. If these means fail, exercise, mas- sage, and electricity may help a cure.

The most common diseases of malassimilation are gout, rheumatism, and diabetes. In health most of the nitrogenous waste in the body is eliminated as urea, but in gout uric acid is either formed in Diseases too great quantity or too little is eliminated, so simiiation. that it tends to be deposited as urate of soda in the joints and other tissues. Two means of treating it by diet have been proposed. One is to put the patient on an almost complete vegetarian diet, so as to limit both the amount of uric acid introduced into the body as well as its formation in the body. The other plan is to use an exclusively meat diet, combined with the ingestion of a large quantity of hot water, so as to cause free elimination. Where neither method is strictly pursued it is usual to forbid to gouty patients sugar, pastry, and pickles, and to forbid heavy wines, espe- cially Burgundy and port. During an attack of acute gout nothing relieves so much as colchicum, but during the intervals potash

or lithia salts taken in water are advisable, as tending to prevent the deposits of urate of soda. In true diabetes, which probably originates in the central nervous system, as well as in the gly- cosuria common in gouty patients, sugar in every form should be entirely forbidden, and starchy food restricted to within narrow limits. The remedy most trusted to in this disease is opium and its alkaloids, morphine and codeine. In acute attacks of rheumatism the remedy par excellence is salicylate of soda, which reduces the temperature, relieves the pain, and removes the swellings from the joints. Rest in bed should be insisted upon for a longer time than appears actually required, because acute rheumatism tends to bring on cardiac changes, and is more likely to do this when the heart is excited than when the patient is kept at rest. In chronic rheu- matism the chief remedies are salicylate of soda, iodide

of potassium, guaiacum, and sulphur, while massage, lin- iments, and baths are beneficial as local applications.

Elimination of waste-products is one of the most important points in regard to health, and when this is interfered with by disease of the kidneys, the life of the patient is rendered more or less uncertain and the health frequently seriously impaired. In some cases of chronic inflammation of the kidneys, where the disease is not extensive, the patient may continue in fair health for a number of years, provided attention be paid to the following rules : — (1) The body must be kept warm, and chills must be scrupulously avoided ; (2) the digestion must be attended to carefully, so that no excess of poisonous bodies is formed in the intestine or ab- sorbed from it; (3) eliminating channels such as the skin and bowel must be kept active. It is usual to reduce the quantity of proteid food to a minimum, in order to lessen the amount of nitrogenous waste to be excreted by the kidneys. Sometimes an entirely milk diet is useful, but in others it does not agree, and a more liberal diet is essential. Alcohol should be avoided as much as possible. The small contracted kidney, which is so common in elderly gouty people, is usually associated with a very large secretion of urine containing only a

minute trace of albumin. The ten- sion within the blood-vessels is generally high, and the patients run a risk of anginal attacks or of apoplexy. A nearly vegetarian diet and a complete abstinence from alcoholic stimulants is the ideal in such cases, but it must be modified to suit individuals, as sometimes very strict limitations prove injurious. The daily use of • potash, and especially nitrate of potash, tends to reduce the tension and increase the patients' safety, but if pushed too far may sometimes render them very weak and depressed.

It has already been mentioned that water is absolutely necessary for the body : by taking it hot it does not lie

like a weight on the stomach, and by taking "'cures"" ** an k°ur before meals it washes out the

remnants of the previous meal; and being absorbed into the blood, it probably renders the secretion of gastric juice freer and accelerates digestion, instead of diluting it and interfering with the digestive processes. Where the stomach and bowels are irritable, all food likely to cause mechanical irritation should be avoided, such as skins, bones, fibres, and seeds. In some cases of diarrhoea an entirely milk diet has to be prescribed, and in the diarrhoea of children it is sometimes necessary to alternate a diet of barley water with one of beef juice or white of egg and water, or to give whey instead of milk. The drinking of large quantities of whey is used as a means of cure for dyspepsia in adults, and also in cases of chronic bronchitis. The whey is drunk warm, and for this cure it is usual to go to some Alpine resort where pasturage is abundant and fresh milk can be had at all times of the day. The cure is greatly helped by the fresh air and sunshine of such places, among which are Gais, Heiden, Interlaken, Rorschach, Eigi-Scheideck, and Weggis in Switzerland; Ischl and Meran in Austria; Harzburg, Kreuth, Partenkirchen, Eehburg, Eeichenhall, Sankt Blasien, Salzbrunn, and Streitberg in Germany. Another therapeutic method is the so-called "grape cure," in which, along with a regulated diet, five or" six pounds of grapes are eaten daily. As the grapes eon- tain a quantity of water and of salts, they tend to lessen the amount of food taken, to increase the action of the bowels, and to stimulate the kidneys.

The ” grape cure ” is used both in chronic disease of the stomach and intes- tines with or without constipation, and also in cases of gout or ailments depending upon a gouty constitution. The chief places where it is carried on are in the neigh-

bourhood of the Ehine, on the Lake of Geneva, and in the Tirol. Amongst places in the Ehine and its vicinity may be mentioned Cannstadt, Dtirkheim, Gleisweiler, Kreuznach, Neustadt, Eiidesheim, St Goar, and Wein- heim ;’ on the Lake of Geneva are Montreux and Vevey ; and in the Tirol Gries and Meran. The so-called ” Salisbury ” cure consists of living entirely upon minced beef and hot water. It sometimes answers very well in persons troubled with flatulence, since meat does not give rise to the same amount of gas in the intestines as carbohydrates. During its continuance fat is absorbed from the subcutaneous tissue, and patients become very- much thinner, so that it not only lessens flatulence, but reduces obesity. It is, in fact, very much the same sys- tem as that proposed a number of years ago by Banting. It is very important for those who are trying this diet to bear in mind the necessity of abundance of water, because sometimes they may be tempted to lessen the water on account of the inconvenience produced either by frequent micturition or too profuse sweats. If the meat diet be continued with too small a proportion of water, a gouty condition may be brought on. This diet has been recommended in gout, and no doubt the essential part of it is the hot water, but there can be little doubt that in fat gouty people it is often useful. An entirely opposite dietary is that in which butcher’s meat is com- pletely excluded and proteids reduced to a minimum, as advocated by Dr Haig. This dietary also is very useful in gout, but it answers better in thin gouty people than in fat ones.

The dietaries already mentioned, the whey cure, the grape cure, the meat cure, and the vegetarian cure, are all more or less systems of starvation, one or other article of ordinary diet being either reduced to a minimum or omitted altogether. In three of them at least — the whey cure, the grape cure, and the meat cure — a diminution in one or other of the solid constituents of food is associated with the ingestion of an unusually large quantity of water. In visiting the most famous watering-places, it is curious to note how one finds, in the various

waters, here some chloride, there some sulphate, here some potash, there some magnesium, but in all of them we find water. In watching the troops of patients who go to the wells we notice that most of them do more early rising, take more regular exercise, and drink more water in the course of a month at the well than they would do in the rest of the year at home. The watering-places divide them- selves, according to the temperature of the waters, into cold and thermal, and according to the composition of the waters, into purgative saline, indifferent saline, sul- phur, and iron. Amongst the most celebrated saline wa- ters are those of Carlsbad, which contain sulphate of soda and bicarbonate of soda. These salts crystallize out when the water is partially evaporated and may be used with hot water at home, the best imitation of the Carlsbad water be- ing obtained by mixing with hot water the powdered Carls- bad salts (pulverformig), which contain all the constitu- ents of the natural water. Where it is impossible for the pa- tient to visit Carlsbad, half a teaspoonful or a teaspoonful of salts may be taken in a large tumbler of hot water on rising every morning ; but when taken at home the treat- ment is not so effective as at Carlsbad, because at the wells sipping water is associated with early rising, considerable exercise, and a very carefully regulated diet. It is, indeed, the care with which the diet of patients is regulated and the difficulty that patients find in obtaining forbidden foods at hotels and restaurants, that make Carlsbad better for the liver than any other watering-place. Amongst other places having a similar action are Marienbad, Franzens- bad, and Tarasp. The waters just mentioned contain free alkali as well as sulphates, and are employed more

especially in cases of hepatic disorder, such as congestion of the liver, jaundice, gall-stone, and diabetes. A num- ber of other waters containing sulphides and chlorides are powerfully purgative, and are more often drunk at home than at the springs. Amongst these are the’ Hun- garian waters, iEsculap, Apenta, Franz Josef, and Hun- yadi Janos ; and the Rubinat and Condal waters of Spain. Waters which

have a similar composition are drunk at the springs of Leamington and Cheltenham in England, Brides Salins and St Gervais in France, for chronic con- stipation, dyspepsia, gout, and hepatic disorders of a milder character than those usually treated at Carlsbad. The waters in which chlorides form the purgative princi- ple are those of Homburg, Kissingen, Wiesbaden, and Baden Baden in Germany, and Bridge of Allan in Scot- land. Similar waters, but much weaker, are found at Innerleithen and Pitkeithly. Sulphur waters are chiefly used for painful and stiff joints, chronic skin disease, and chronic catarrhal affections. The most important are Aix-les-Bains, and a number of springs in the Pyrenees in France, Aachen in Germany, Harrogate in England, Strathpeffer and Moffat in Scotland. Iron waters are used in ansemia and the affections which are frequently associated with it. The most important are Spa in Bel- gium, Schwalbach in Germany, St Moritz and Tarasp in Switzerland. Iron waters are, however, common, and are generally found at all those places which have sulphur waters. Simple alkaline waters, containing carbonates, chiefly of sodium along with some magnesium and cal- cium, are drunk for their utility in gastric and intestinal disorders as well as in rheumatism and gout. They are also employed locally as sprays and douches to the nose, throat, vagina, and rectum, for catarrhal conditions of the mucous membranes. The most important are Vichy and Vals in France and Neuenahr in Germany. Alkaline waters, containing a little common salt, are perhaps even more important than the pure alkaline, as the salt lessens the depressing effect of the alkali. They are therefore used largely in chronic gout, rheumatism, and in calcu- lous affections of the kidney. Amongst the most impor- tant are Ems and Wildungen in Germany, Contrexeville and Royat in France.

Simple thermal waters are those which contain only a very small quantity of solids, and owe their efficacy chiefly to their temperature. They are used partly for drinking, but even more so for baths. Bath, Buxton, and Matlock in England ; Mallow in Ireland ; Wildbad, Schlangenbad, and Badenweiler in Germany; Gastein and Teplitz in Austria; Ragatz and Senkerbad in Switzerland; Plom- bieres and Dax in France ; and Bormio in Italy are amongst the best known. When water is dashed against the body with more or less violence, its effects

are more powerful than when the body is simply im- Batbs. mersed in it. Thus the stimulating effect of searbathing is more marked than simple salt-water baths, for in addition to the effect upon the skin produced by the salt and by the temperature of the water, we have the quicker removal of heat by the continual renewal of the water as the waves dash over the body, and mechanical stimulus from its weight and impetus. Somewhat similar effects are produced by so-called wave-baths, and at Nau- heim, although the fresh movement of the water against the surface of the body is much less than in the sea, yet its stimulating effect is greatly increased by the presence of carbonic acid in it. Douches have a still more power- ful action than waves. They are generally given in the air, but at Plombieres very simple douches are given under water. These form a more powerful wave-bath, and are used very successfully for the treatment of ab- dominal disorders. Douches to the spine are much em- ployed for nervous debility, and good effects are also

obtained in such cases from the so-called needle-bath, where small streams of water at high pressure are driven against the whole surface of the body. In the treatment of stiffened joints, massage under water is very service- able, and in the so-called Aix douche a nozzle from which water continuously streams is fastened to the wrist of the masseur, so that a current of water is constantly playing upon the joint which he is rubbing. While water con- taining much saline matter, and more especially water containing free carbonic acid, has a very stimulating action upon the skin, mud has a sedative effect, so that in a mud-bath one feels a pleasant soothing sensation as if bathing in cream. These mud-baths are chiefly employed at Marienbad, Franzensbad, and Homburg. Sulphur- baths and sulphur waters are chiefly used in combination for rheumatism and gout, and massage, especially under water, is frequently combined most advantageously with baths and drinking water to effect a cure.

Exercises, passive and active, are also used in diseases of the joints, as well as massage and baths, but exercises and training are even more important in cases of cardiac disease. In very bad cases of heart xerc se' disease, where the patient is unable to go about, the best plan of

treatment usually is to make him stay abso- lutely quiet in bed and have massage, which aids the circulation, tends to remove waste, and increases the appetite.- To this is added gentle exercise, beginning with the fingers at first. At MeTan walks have been arranged according to Oertel's system, and at Llangam- march in Wales both Oertel's and Schotfs systems are employed, and baths according to the Nauheim system are also to be found in London, Sidmouth, Leamington, Buxton, Strathpeffer, &c. Many people who have seden- tary employments are unable to get as much exercise as they require because they have not either the time or the opportunity. Such persons may sometimes get a good deal of exercise in a short time by the use of dumb-bells, of elastic cords, or of cords running over pulleys and weighted at one end. The whole system of methodical exercises was started by Ling in Sweden, but it has been developed to a large extent for the pur- pose of increasing muscular strength by the professional athlete Sandow. Fencing, boxing, wrestling, and the use of a punching-ball may also be resorted to. Walk- ing on the flat is of comparatively little rise as a mode of exercise, and has become supplanted to a considerable extent by bicycling. Ascending mountains, however, is very different, because in walking up a steep ascent all the muscles of the body are thrown into action, and not only those of the legs. In addition the purer and rare- fied air of the Swiss mountains seems to produce a sense of exhilaration which is not felt nearer the searlevel. For those who suffer from nervous depression, exercise in the Swiss mountains is useful, and even living at a height of about 6000 feet above the seaJevel seems to have an exhilarating influence. The nature of this is not very easy to analyse, but as mental depression is closely associated with irritation of the vagus nerve and weaken- ing of the circulation, it seems not at all unlikely that mountain air acts by accelerating the pulse and quicken- ing the circulation, and thus creating a sense of well- being. Indeed many patients liken its effect to that of drinking champagne. In some persons rarefied air is too stimulating, so that they find difficulty in sleeping, and for those who suffer from insomnia a warm moist air nearer the searlevel is preferable.

It sometimes happens, however, that people cannot sleep at the seaside itself, although they do so perfectly well a mile or two inland. Where

the nervous system is exhausted, such warm and moist climates as Malaga, Ma- deira, Tenerife, and Grand Canary are suitable. In these

Health resorts,

places not only is the air moist, but the temperature is particularly equable, and they are therefore suitable places also for persons suffering from kidney disease. Many such persons also do well in dry, ~~warm places, such as the higher reaches of the Nile, Egypt, Mentone, St Raphael, and other sheltered places on the Riviera. The places mentioned are all suit~~ able for persons suffering from chronic bronchitis, who should avoid any irritation of the larynx, trachea, or bronchi by air which is too dry or which is liable to great changes of temperature. Some cases of phthisis, there- fore, do better in warmer and moist climates, and especially those where the larynx has become affected by the disease. Such patients are apt to suffer much from cough and laryngeal irritation in the cold, dry air of the Alps, whereas they live in comparative comfort on the Riviera, in the Canary Islands, Madeira, or at Capri. But warm, moist climates rather favour sedentary habits and tend to lessen appetite, so that the nutrition of the patient is apt to suffer ; and although phthisical patients may live in comparative comfort in such climates, their tendency to recovery in them is small. At the Swiss health resorts, on the contrary, during the winter the air is very pure, and has just sufficient coldness to make exercise agreeable to patients. They are thus induced to be out the whole day, and to take food with an appetite which greatly improves their nutrition and aids their restoration to health. The best-known Alpine health re- sorts are St Moritz and Davos, to which lately Grindel- wald has been added. St Moritz is, upon the whole, better for less advanced cases, while Davos is more sheltered and better for cases which are severe. It is a mistake, however, to send those in whom the disease is very far advanced away from home and friends, be- cause when there is no hope of cure it is better for them to die in comfort at home. At the health resorts just mentioned the amount of food taken is regulated by the appetite of the patient himself, but a system of cure

has been inaugurated by Dr Brehmer at Gorbers- dorf, by Dr Dettweiler at Falkenstein, and by Dr Walther at Nordrach, in the Black Forest. The most important point in this treatment consists in forced feeding, the want of appetite which is so prominent in many cases of phthisis being regarded as an abnormal sensation not to be regarded ; and under the forced feeding, combined with open-air life, many marvellous recoveries are recorded. Numerous other institutions have been started in imitation of Dr Walther' s, but their success or failure must depend very much on the doctor who directs them. In the well-known "rest" cure, which we owe to Weir Mitchell, forced feeding takes a prominent part. The essence of this cure is to give to the patient rest, bodily and mental, by confinement to bed and isolation from the outside world. While this treatment by itself would aid recovery from nervous exhaustion, it would lessen appetite and thus interfere with nervous repair ; but the want of exertion is supplied by means of massage, which stimulates the circulation and increases the appetite, so that the patient gets all the benefit of exercise without any exhaustion. Where nerv- ous exhaustion is less marked and the Weir Mitchell treat-ment is not appropriate — for example, in men who are simply overworked or broken down by anxiety or sorrow — a sea voyage is often a satisfactory form of " rest " cure. The lack of posts and telegrams prevents much of the excitement which they would have upon shore, the space for exercise is limited, food is abundant and appetite is supplied by the stimulus of constant exposure in the open air. In order that the voyage should be satisfactory, however, it must be sufficiently long, and the weather must be sufficiently warm to allow the patient

to stay in the open air the whole day long. During the heat of summer voyages to the North Cape are suitable, and during the spring and autumn to the Mediterranean, but in the colder months of the year the West Indies, India, Cape Town, Australia, or New Zealand forms the best objective. (t. l. b.)

Theresienstadt (Czech, Tereziri), a royal free town and important garrison in the government district of Leitmeritz, Bohemia, Austria, situated on the Eger river, near its confluence with the Elbe, in a

district known as the ” Bohemian Paradise,” from its wealth of fruit trees. The fortress erected here by the Empress Maria Theresa in 1780 was abandoned in 1882 ; but the place remains one of considerable strategic importance, owing to its position on both banks of the Eger in the midst of a broad plain. It lies on the- border between the Czech and German portions of Bohemia, and its in- habitants belong to both nationalities. The basaltic cones of the Mittelgebirge are visible from the town. Population (1890), 7215 ; (1900), 7046, including garri- son of 3998 men.

Therezina, a town of Brazil, and capital of the state of Piauhy. It was formerly called Chapada do Co- risco, and has several fine churches and public buildings. Among the manufacturing industries are a large factory for making cotton and thread, an iron foundry, a soap factory, and machines for assorting and pressing cotton. Population, 22,000.

Thermochemistry. — Thermochemistry is a branch of Energetics, and treats of the thermal phenom- ena which are associated with chemical change.

§ 1. That vigorous chemical action is accompanied by a brisk evolution of heat is evident from such familiar examples as the combustion of fuel or the explosion of gunpowder. The heat attendant on these actions, and on the vital processes of the animal organism, naturally first attracted attention. Boyle, Crawford, Lavoisier and Laplace, Dulong, Davy, Rumf ord, all concerned themselves with therinochemical investigations of such processes. Their quantitative experiments were, however, too rough to permit of accurate generalization ; and although Lavoisier and Laplace stated the principle that the same amount of heat must be supplied to decompose a com- pound as would be produced on its formation, the state- ment was not based on exact experiment, and only received experimental confirmation much later.

The beginnings of modern thermochemistry, though made independently of the doctrine of the Conservation of Energy, are practically contemporaneous with the recognition of that law, and without it the science could scarcely have reached the degree of development which it rapidly attained. Thomas Andrews and,

especially, G. H. Hess (1840) were the first who systematically investigated thermochemical effects in solution, and arrived at conclusions from their experimental data which still possess validity. Andrews, for example, found that when a series of acids were under similar conditions used to neutralize a given amount of a base, the quantity of heat evolved on the neutralization was the same in all cases. Hess, from his work, arrived at the converse conclusion, that when a series of bases were used to neutralize a given amount of an acid, the heat of neutralization was always the same. Both of these statements are correct when the powerful mineral acid and bases are considered, exceptions only arising when weak acids and bases are employed. Again, Andrews discovered that when one metal displaces another from solution of its salts (e.g., zinc with solutions of copper salts), the thermal effect is practically independent of the nature of the acid radical in the salt employed. Andrews

likewise found that when the heat evolved on the dis- placement from its salts of a metal M' by a metal M is added to the heat of displacement of another metal M" by M', the sum is equal to the heat which is evolved on the direct displacement of M" from its salts by M. This affords' an example of a principle which had been stated by Hess in a very general form under the name of the Law of Constant Heat Sums — namely, that the thermal effect of a given chemical action is the same, independently of the character and number of the stages in which it takes place. Thus, in the above example, it is immaterial whether M displaces M" from its salt directly, or whether M first displaces M', which is then used to displace M". This important principle is a direct consequence of the Law of the Conservation of Energy, but was discovered independently by Hess from accurate experiment.

Hess employed this principle to determine indirectly the heat of formation of compounds from their elements, when this magnitude, as is generally the case, was in- accessible to direct measurement. Thus the

heat of for- mation of anhydrous zinc sulphate, ZnS04, which cannot be determined directly, may be arrived at by summation (in Hess's units) as follows : —

Oxidation of Zn to ZnO 6291 units

S „ S03 .... *. 6384 „

Dissolution of SO3 in much water . . . 2566 „

„ ZnO in the resulting aqueous H2SO4 1609 „

Deduct heat of dissolution of anhydrous ZnS04

15850 1193

Heat of formation of ZnS04 from Zn, S, and 40 = 14657 „ Heats of formation are still determined for the most part in a precisely similar manner.

' Hess also stated another principle on empirical grounds, which, although admitting of many exceptions, is of considerable utility and significance. It had been known long before his time that when solutions of neutral salts were mixed, and no precipitate resulted, the mixed solution was also neutral. Hess now ob- served that in the process of mixing such neutral solutions no thermal effect was produced — that is, neutral salts in aqueous solution could apparently interchange their radicals without evolution or ab- sorption of heat. These experimental results were generalized by him under the title of the Law of Thermoneutrality.

After the investigations of Hess and Andrews, a great deal of excellent experimental work was performed by Favre and Silbermann, whose chief theoretical achieve- ment was the recognition that the heat of neutralization of acids and bases was additively composed of two con- stants, one determined by the acid and the other by the base. This deduction harmonized the observations of Andrews and of Hess

previously alluded to, and also accounted satisfactorily for the Law of Thermoneutrality.

The Danish chemist, Julius Thomsen (born 1826), was the first investigator who deliberately adopted the prin- ciple of the Conservation of Energy as the basis of a thermochemical system. His thermochemical work was begun in 1853, but most of his experiments were per- formed in the years 1869-82, the whole being published collectively, under the title T/iermochemische Untersuch- ungen, in four volumes. Somewhat later than Thomsen, the distinguished French chemist, Marcellin Berthelot, began (in 1873) a series of thermochemical determinations, which by the hands of himself and his pupils have been continued to the present day (1902). It is to these two investigators that most of our exact thermochemical data are due.

Thomsen and Berthelot independently enunciated a

generalization (commonly known as Berthelot's Third Principle, or Principle of Maximum Work), which may be stated in brief as follows : — Every pure chemical reaction is accompanied by evolution of heat. Whilst this principle is undoubtedly applicable to the great majority of chemical actions under ordinary conditions, it is subject to numer- ous exceptions, and cannot therefore be taken (as its authors originally intended) as a secure basis for theoreti- cal reasoning on the connexion between thermal effect and chemical affinity. The existence of reactions which are reversible on slight alteration of conditions at once invali- dates the principle, for if the action proceeding in one direction evolves heat, it must absorb heat when proceed- ing in the reverse direction. As the principle has now been abandoned even by its authors, it is at the present time only of historical importance, although for many years it exerted considerable influence on thermochemical research.

§ 2. From the standpoint of the Law of the Conserva- tion of Energy, the relation between chemical and ther- mochemical action bears the following aspect : — A given amount of any substance under given conditions possesses a perfectly definite amount of intrinsic energy, and, no matter what chemical and physical transformations the substance may undergo, it will, when it returns to its original state,

possess the original amount of intrinsic energy. If we consider now the transformation of one system of chemical substances into another system under specified conditions, we shall find that in general the intrinsic energy of the second system is different from the intrinsic energy of the first. Let us assume, as is commonly the case, that the intrinsic energy of the initial system is greater than that of the final system. When the first system then is transformed into the second, the excess of energy which the former possesses must appear in the shape of heat, light, electrical energy, mechanical energy, &c. It is for the most part a simple matter to obtain the excess of energy entirely in the form of heat, the amount of which is easily susceptible of measurement, and thus the existence of thermochemistry as a practical science is rendered possible. Since the intrinsic energies of the two systems under given conditions are invariable, the difference between them is constant, so that the heat evolved when the first system is converted into the second is equal to that absorbed when the second system is re-transformed into the first (cf. Lavoisier and Laplace, ante, § 1). The total thermal effect too, which is associated with the transformation, must be the same, whether the transformation is conducted directly or indirectly (Hess's Law of Constant Heat Sums'), since the thermal effect depends only on the intrinsic energies of the initial and final systems.

Since the intrinsic energy of a substance varies with the conditions under which the substance exists, it is necessary, before proceeding to the practical application of any of the laws mentioned above, accurately to specify the con- ditions of the initial and final systems, or at least to secure that they shall not vary in the operations con- sidered. It is also a necessary condition for the applica- tion of the preceding laws that no form of energy except heat and the intrinsic energy of the substances should be ultimately involved. For example, when metallic zinc is dissolved in dilute sulphuric acid with production of zinc sulphate (in solution) and hydrogen gas, a definite quantity of heat is produced for a given amount of zinc dissolved, provided that the excess of energy in the initial system appears entirely as heat. This provision may not always be fulfilled, since by placing the zinc in electrical contact with a

piece of platinum, likewise immersed in the sulphuric acid, we can generate a current of electricity

through the solution and the metallic part of the circuit. The reaction as before is completely expressed by the chemical equation

Zn+H2S04=ZiiS04+H2,

the initial and final systems being exactly the same as in the first case ; yet the amount of heat generated by the action is much smaller, a quantity of the intrinsic energy having been converted into electrical energy. This elec- trical energy, however, is equivalent to the heat which has disappeared, for it has been shown experimentally that if it is converted into heat and added to the heat actually evolved, the total quantity of heat obtained is exactly equal to that produced by the direct dissolution of the zinc in the absence of platinum.

§ 3. The following conditions have to be considered as affecting in a greater or less degree the intrinsic energy of the initial and final systems : —

(1) 2) (3 (4) (5)

Dilution of solutions. Physical state. Change of volume. Allotropic modifications. Temperature.

(1) Generally speaking, there is a considerable thermal effect when a substance is dissolved in water, and this effect varies in magnitude according to the amount of water employed. It is only, however, when we deal with comparatively concentrated solutions that the heat-effect of diluting the solutions is at all great, the heat-change on diluting an already dilute solution being for most practi- cal purposes negligible. In dealing, therefore, with dilute solutions, it is only necessary to state that the solutions are dilute, the exact degree of dilution being unim-

portant. It occasionally happens that a change in dilu- tion affects the chemical action that occurs. Thus if concentrated instead of dilute sulphuric acid acts upon zinc, the action takes place to a great extent not accord- ing to the equation given above, but according to the equation

$$Zn+2H_2SO_4=ZnSO_4+SO_2 + 2H_2O,$$

sulphur dioxide and water being produced instead of hydrogen. Here we have a different final system with a different amount of intrinsic energy, so that the thermal effect of the action is altogether different.

(2) The physical state of the reacting substances must be considered, since comparatively large amounts of heat are absorbed on fusion and on vaporization. Thus the heat of fusion of ice (for H_2O=18 g) is 1440 cal., and the heat of vaporization of water at 100°, for the same quantity, 9670 cal.

(3) The effect of change of volume against external pressure (due to production or consumption of mechanical energy) may be neglected in the case of solids, liquids, or solutions, but must usually be taken into account when gases are dealt with. Each gramme-molecule of a gas which appears under constant pressure during a chemical action (e.g., hydrogen during the action of zinc on dilute sulphuric acid) performs work equivalent to 580 cal. at the ordinary temperature, which must be allowed for in the thermo-chemical calculation. A similar correc- tion, of opposite sign, must be made when a gramme- molecule of gas disappears during the chemical action.

(4) When a substance — e.g., carbon, phosphorus, sulphur — exists in more than one allotropic modification, the par- ticular variety employed should always be stated, as the conversion of one modification into another is frequently attended by a considerable thermal effect. Thus the con- version of yellow into red phosphorus evolves about one- sixth of the heat of combustion of the latter in oxygen,

and so the knowledge of which variety of phosphorus has been employed is of essential importance in the thermo- chemistry of that element.

(5) The influence of temperature on the thermal effect of a chemical action is sometimes considerable, but since the initial and final temperatures, which alone determine the variation in the thermal effect, are in almost all cases within the ordinary laboratory range of a few degrees, this influence may in general be neglected without serious error.

§ 4. Methods. — In order to estimate the thermal effect of any chemical process, use is made of the ordinary methods of calorimetry, the particular method being selected according to the nature of the chemical action involved. In almost every case the method of mixture (Calobimetky, Ency. Brit., vol. xxvi. p. 505) is employed, the method of fusion with Bunsen's ice- calorimeter (ibid.) being only used in special and rarely occurring circumstances.

As a very great number of important chemical actions take place on mixing solutions, the method for such cases has been thoroughly studied. When the solutions em- ployed are dilute, no water is placed in the calorimeter, the temperature-change of the solutions themselves being used to estimate the thermal effect brought about by mixing them. Known quantities of the solutions . are taken, and the temperature of each is accurately mea- sured before mixing, the solutions having been allowed as far as possible to adjust themselves to the same temperature. The change of temperature of the solu- tions after the mixing has taken place is then observed with the usual precautions. It is of course in such a case necessary to know the specific heat of the liquid in the calorimeter. Thomsen by direct experiment found that the heat-capacity of a dilute aqueous solution di- verged in general less than 1 per cent, from the heat- capacity of the water contained in it, the divergence being sometimes in one sense, sometimes in the other. He therefore abstained from determining for each case the specific heats of the solutions he employed, and contented himself with the above approximation. Berthe- lot, on the other hand, assumed that

the heat-capacity of an aqueous solution is equaL to that of an equal volume of water, and calculated his results on this assumption, which involves much the same uncertainty as that of Thomsen. Since thermochemical measure- ments of this type may be frequently performed with an error due to other causes of much less than 1 per cent., the error introduced by either of these assump- tions is the chief cause of uncertainty in the method.

The calorimeter used for solutions is usually cylindri- cal, and made of glass or a metal which is not attacked by the reacting substances. The total quantity of liquid employed need not in general exceed half a litre if a sufficiently delicate thermometer is available. The same type of calorimeter is used in determining the heat of solution of a solid or liquid in water.

Combustion calorimeters are employed for observing the heat generated by the brisk interaction of substances, one of which at least is gaseous. They are of two kinds. In the older type the combustion chamber (of metal or glass) is sunk in the calorimeter proper, tubes being pro vided for the entrance and exit of the gaseous substances involved in the action. These tubes are generally in the form of worms immersed in the water of the calorimeter. In the newer type (which was first proposed by Andrews for the combustion of gases) the chemical action takes place in a completely closed combustion chamber of sufficient strength to resist the pressure generated by the sudden action, which is often of explosive violence. The steel combustion chamber is of about 250 c.c. capacity,

and is wholly immersed in the calorimeter. To with- stand the chemical action of the gases, the ” calorimetric bomb ” is lined either with platinum, as in Berthelot’s apparatus, or with porcelain, as in Mahler’s. For or- dinary combustions compressed oxygen is used, so that the combustible substance burns almost instantaneously, the action being induced by means of some electrical de- vice which can be

controlled from without the calori- meter. The accuracy of heats of combustion determined in the closed calorimeter is in favourable cases, about one- half per cent, of the quantity estimated. *•.

§ 5. Units and Notation. — The heat-units employed in thermochemistry have varied from time to time. The following are those which have been in most general

use: —

Small calorie or gramme calorie Large or kilogramme calorie . Centuple or "rational" calorie

cal. Cal. K.

The centuple calorie is the amount of heat required to raise 1 g. of water from 0° C. to 100° C, and is approxi- mately equal to 100 cal. The large calorie is equal to 1000 cal. In view of the not very great accuracy of thermochemical measurements, the precise definition of the heat-unit employed is not a matter of special import- ance. It has lately been proposed to adopt the joule, with the symbol j, as thermochemical unit for small quantities of heat, large amounts being expressed in terms of the kilojoule, Kj=1000 j. (For the exact rela- tion between these heat-units, see Caloeimetrt, vol. xxvi. p. 509.) For ordinary thermochemical work we may adopt the relation 1 cal.=4-18 j, or 1 Cal. =4-18 Kj.

Except for technological purposes, thermochemical data are not referred to unit quantity of matter, but to chemical quantities — -i.e., to the gramme-equivalents or gramme-molecules of the reacting substances, or to some multiples of them. The notation which Julius Thomsen employed to express his thermochemical measurements is still extensively used at the present day, and is as fol- lows : — The chemical symbols of the reacting substances are written in juxtaposition and separated by commas ; the whole is then enclosed in brackets and connected by the sign of equality to the number expressing the thermal effect of the action. The chemical symbols stand for quantities measured in grammes, and heat-evolution is reckoned as positive, heat-absorption as negative. Thus

[S, 20] =71100 cal.

indicates that 71100 calories are evolved when 32 grammes of sulphur react with 2 x 16 grammes of free oxygen to form sulphur dioxide. It is of course necessary in accu- rate work to state the conditions of the reaction. In the above instance the sulphur is supposed to be in the solid rhombic modification, the oxygen and sulphur dioxide being in the gaseous state, and the initial and final systems being at the ordinary temperature. Again, the equation

[2N, 0] = – 18600 cal.

indicates that if 28 grammes of nitrogen could be made to unite directly with 16 grammes of oxygen to form nitrous oxide, the union would cause the absorption of 18500 calories. When substances in solution are dealt with, Thomsen indicates their state by affixing Aq to their symbols. Thus

[NaOH Aq, HNOsAq] =13680 cal.

represents the heat of neutralization of one gramme- equivalent of caustic soda with nitric acid, each in dilute aqueous solution before being brought into contact. One drawback of Thomsen's notation is that the nature of the final system is not indicated, although this defect in gen- eral causes no ambiguity.

Berthelot's notation defines both initial and final systems by giving the chemical equation for the reaction considered, the thermal effect being appended, and the state of the various substances being affixed to their for- mulae after brackets. Ostwald has proposed a modifica- tion of Berthelot's method which has many advantages, and is now commonly in use. Like Berthelot, he writes the chemical equation of the reaction, but in addition he considers the chemical formula of each substance to ex- press not only its material composition, but also the (un- known) value of its intrinsic energy. To the right-hand member of the equation he then adds the number express- ing the thermal effect of the reaction, heat-evolution be- ing as before counted positive, and heat-absorption

nega- tive. The mass equation then becomes an energy equation. He thus writes

$S + O_2 = SO_2 + 71100$ cal.,

which expresses the fact that the intrinsic energy of the quantities of sulphur and oxygen considered exceeds that of the sulphur dioxide derived from them by 71100 cal. when thermal units are employed. The equation

$H_2 + I_2 = 2HI - 12200$ cal.

expresses that under certain conditions the intrinsic energy of hydriodic acid is greater than the intrinsic energy of its component elements by 12200 cal., i.e., that hydriodic acid is formed from its elements with absorp- tion of this amount of heat. Energy equations, such as the above, may be operated with precisely as if they were algebraic equations, a property which is of great ad- vantage in calculation. Thus by transposition we may write the last equation as follows : —

$2HI = H_2 + I_2 + 12200$ cal.,

and thus express that hydriodic acid when decomposed into its elements evolves 12200 cal. for the quantity indi- cated by the equation.

Ostwald has made the further proposal that the formulae of solids should be printed in heavy type (or within square brackets), of liquids in ordinary type, and of gases in italics (or within curved brackets), so that the physical state of the substances might be indicated by the equa- tion itself. Thus the equation

$CZ_2 + 2KI, Aq = 2KCl, Aq + I_2 + 52400$ cal., or $(Cl_2) + 2KI, Aq = 2KCl, Aq\text{-}f [I_2] + 52400$ cal.,

would express that when gaseous chlorine acts on a solution of potassium iodide, with separation of solid iodine, 52400 calories are evolved. These suggestions have not as yet been widely adopted.

§ 6. Heat of Formation. — For thermochemical calcula- tions it is of great importance to know the heat of formation of compounds from their elements, even when the combination cannot be brought about directly. As an example of the use of Ostwald's energy-equations for the indirect determination we may take the case of carbon monoxide.

The following equations give the result of direct experi- ment : —

C + 20 = C02+ 94300 cal. CO + 0 = C02 + 68000 cal.

If now it is required to find the heat of formation of the compound CO, which cannot be directly ascertained, we have merely to subtract the second equation from the first, each symbol representing constant intrinsic energy, and thus we obtain

C+O

C + O:

-CO =26300 cal., = CO +26300 cal.,

that is, the heat of formation of a gramme-molecule of carbon monoxide is 26300 cal.

As has already been stated, the heat of formation of a compound is the amount (expressed in thermal units) by ■which its intrinsic energy exceeds or falls short of that of the elements which enter into its composition. Now of the absolute values of intrinsic energy we know nothing ; we can only estimate differences of intrinsic energy when one system is compared with another into which it may be directly or indirectly converted. But since the elements cannot under any circumstances be converted one into the other, we are absolutely without knowledge of ,the relative values of their intrinsic energy. This being the case, we are at liberty to make the assumption that the

intrinsic energy of each element (under specified conditions) is zero, without thereby introducing any risk of self-contradiction in thermochemical calculations. This assumption has the great advantage, that the intrin- sic energy of a compound relatively to its elements now appears as the heat of formation of the compound with, its sign reversed. Thus if we consider the energy equation

$C+O_2=CO_2+94300$ cal.,

and replace the symbols by the values of the intrinsic energy, viz., zero for carbon and oxygen, and x for carbon dioxide, we obtain the equation

0+0=a;+94300 cal. or x= -94300 cal.

With knowledge then of the heats of formation of the substances involved in any chemical action, we can at once calculate the thermal effect of the action, by placing for each compound in the energy-equation its heat of formation with the sign reversed, i.e., its heat of decom- position into its elements. Thus if we wish to ascer- tain the thermal effect of the action

$Mg+CaO=MgO + Ca$,

we may write, knowing the heats of formation of CaO and MgO to be 131000 and 146000 respectively,

0-131000=0-146000+a; k=15000 cal.

Since heats of formation afford such convenient data for calculation on the above method, they have been ascer- tained for as many compounds as possible.

Substances with positive heats of formation are termed exothermic; those with negative heats of formation are termed endotliermic. The latter, which are not very' numerous, give out heat on decomposition into their ele- ments, and are more or less unstable. Amongst endo-thermic compounds may be noted hydriodic acid, HI, acetylene, C_2H_2,

nitrous oxide, N20, nitric oxide, NO, azoimide, N3H, nitrogen trichloride, NC13. Some of these pass into their elements with explosive violence, owing to the heat generated by their decomposition and1 the gaseous nature of the products.

§ 7. Heat of Combustion. — The thermochemical mag- nitude which is universally determined for organic compounds is the heat of combustion, usually by means of the calorimetric bomb. The relation between the heat of combustion of a hydrocarbon and its heat of formation may be readily seen from the following example. The hydrocarbon methane, CH4, when completely burned to carbon dioxide and water, generates 213800 cal. We may therefore write

CH4+4O = CO2+2H2O + 213800.

Now we know the heats of formation of carbon dioxide (from diamond) and of liquid water to be 94300 cal. and 68300 cal. respectively. The above equation may conse- quently be written, if x is the heat of formation of methane,

-a;+0= ~~94300~~ (2 x 68300) + 213800 3=17000 cal.

This heat of formation, like that of most hydrocarbons, is comparatively small : the heat of formation of saturated hydrocarbons is always positive, but the heat of forma- tion of unsaturated hydrocarbons is frequently negative. For example, ethylene, C2H4, is formed with absorption of 16200 cal., acetylene, C2H2, with absorption of 59100 cal., and liquid benzene, C6H6, with absorption of 9100 cal. Since the heat of combustion of a hydrocarbon is equal to the heat of combustion of the carbon and hydro- gen it contains minus its heat of formation, those hydro- carbons with positive heat of formation generate less heat on burning than the elements from which they were formed, whilst those with a negative heat of formation generate more. Thus the heat generated by the combus- tion of acetylene, C2H2, is 316000 cal., whereas the heat of combustion of the carbon and hydrogen composing it is only 256900 cal., the difference being equal to the neg- ative heat of formation of the acetylene.

For substances consisting of carbon, hydrogen, and oxygen, a rule was early devised for the purpose of roughly calculating their heat of combustion (Welter's rule). The oxygen contained in the compound was deducted, together with the equivalent amount of hydro- gen, and the heat of combustion of the compound was then taken to be equal to the heats of combustion of the elements in the residue. That the rule is not very accu- rate may be seen from the following example. Cane-sugar has the formula C^H^Ou. According to Welter's rule, we deduct 11 O with the equivalent amount of hydrogen, namely, 22 H, and are left with the residue 12 C, the heat of combustion of which is 1131600 cal. The observed heat of combustion of sugar is, however, 1354000, so that the error of the rule is here 20 per cent. A much better approximation to the heat of combustion of such substances is obtained by deducting the oxygen together with the amount of carbon necessary to form C02, and then ascertaining the amount of heat produced by the residual carbon and hydrogen. In the above case we should deduct with 11 O the equivalent amount of carbon 5-5 C, thus obtaining the residue 6-5 C and 22 H. These when burnt would yield (6-5 x 94300) + (11 x68300) =1364250 cal., an amount which is less than 1 per cent, different from the observed heat of combustion of sugar. Neither of the above rules can be applied to carbon compounds containing nitrogen.

§ 8. Heat of Neutralization. — It has already been stated that the heats of neutralization of acids and bases in aqueous solution are additively composed of two terms, one being constant for a given base, the other constant for a given acid. In addition to this, the further regu- larity has been observed that when the powerful monobasic acids are neutralized by the powerful monacid bases, the heat of neutralization is in all cases the same. The following table gives the heats of neutralization of the commoner strong monobasic acids with soda : —

Hydrochloric acid

HC1 .

. 137400 cal

Hydrobromic acid

HBr .

137500 „

Hydriodic acid

HI .

. 136800 „

Nitric acid

HNO3

. 136800 „

Chloric acid .

HC103

. 137600 „

Bromic acid .

HBrOs

. 137800 „

Within the error of experiment these numbers are identical.

It was at one time thought that the greater the heat of neutralization of an acid with a given base, the greater was the strength of the acid. It is now known, however, that when weak acids or bases are used, the heat of neutralization may be either greater or less than the normal value for powerful acids and bases, so that there is no proportionality, or even parallelism,

between the strengths of acids and their heats of neutrali- zation.

§ 9. Heat of Solution.— When substances readily combine with water to form hydrates, the heat of solution in water is usually positive ; when, on the other hand, they do not readily form hydrates, or when they are already hydrated, the heat of solution is usually negative. The following examples show the effect of hydration on heat of solution in a large quantity of water : —

Heat of Solution. Heat of Hydration. I. Sodium carbonate —

NaaCOs . . +5640oal.

NajCOa, H20 . +2250,, +3390 cal.

N”a2C03, 2H20 . +20 „ +5620 „

NaaCOs, 10H2O . -16160 „ +21800 „

II. Sodium sulphate —

Na2S04 . . +460 cal.

NasS04, H20 . -1900,, +2360 cal.

Na2S04, 10H2O . -18760 „ +19200 „

§ 10. Application of the Second Law of Thermodynamics to Thermochemistry. — What is commonly understood by thermochemistry is based entirely on the first law of thermodynamics, but of recent years great progress has been made in the study of chemical equilibrium by the application of the second law. For an account of work in this direction the reader may consult the last two books given in the short bibliography subjoined.

See Julius Thomsen. Thermochemische Urvtersuchimgen. Leip- zig, 1882-86. — M. BertheHot. Mssai de MScanique Chimique fondie sur la Thermochimie, Paris, 1879 ; Thermochimie, Dannies et Lois nwmdriques, Paris, 1897. — W. Ostwald. Lehrbuch der allgemevnen Chemie, 2nd ed., vol. ii. part 1, pp. 1-517. Leipzig, 1893. — Muir and Wilson. Elements of Thermal Chemistry. London, 1885. — P. Duhem. Traiti de Micanique Chimique. Paris, 1897-99. — J. J. VAN Laar.. Lehrbuch der mathematischen Chemie. Leipzig, 1901. (jr. wal.)

Thermodynamics. — The name Thermo- dynamics is given to that branch of the general science of Energetics which deals with the relations between thermal and mechanical energy, and the transformations of heat into work, and vice versa". Other transformations of heat (see Energetics) are often included under the same title, but they cannot be considered here. A discussion of some of the fundamental principles and equations of thermo- dynamics has been given under the same title in Ency. Brit. vol. xxiii., p. 283. The object of the present article is to explain more fully the applications of the theory to imperfect gases and vapours under conditions which occur in practice, and to develop certain equations which are interesting in themselves and are required for reference in cognate subjects. (See Thermometry, Fusion, Vaporization.) An alphabetical index of the symbols employed will be found at the end of the article.

1. Introductory. — The modern science of thermo- dynamics dates from about the year 1850, in which Ranking and Clausius independently and simultaneously published the correct interpretation of Carnot's principle on the basis of the law of the conservation of energy, which had already won general acceptance through the work of Joule and Thomson and of Helmholtz. It was in the same year that Joule's principal paper on the mechanical equivalent of heat was published in the Philosophical Transactions. About the same time Thomson devised the absolute or thermodynamic scale of temperature, without which no scientific treatment of the subject was possible, and developed the fundamental equations of the subject in the most general manner. The previous work of Carnot and others had been founded on the assumption that heat, like a material substance, possessed the

property of remaining invariable in quantity through any trans- formation. Carnot, in the proof of his principle that the efficiency of a reversible heat engine is a maximum,

assumed that the case of a heat engine receiving a quantity of heat, H', from a source at a temperature, &, and giving up a quantity of heat, H", to a sink at a lower temperature, 6", was exactly analogous to that of a water engine taking water from a high level and letting it down to a lower level. In the latter case, the maximum work that could be done by any kind of water-wheel would be equal to the product of the difference of level and the weight of water transferred. This maximum output could be attained only by a perfectly reversible water-wheel, capable, if driven backwards, of restoring the water- to its original level by the expenditure of a like amount of work. For if there were any more efficient engine, A, capable of doing more work with the same quantity of water and the same difference of level, it would be possible to obtain a balance of work without any expenditure of water power by employing A to drive a reversible engine backwards and return the water to its original level. On Carnot's assumption with regard to the indestructibility of heat, it follows by exactly similar reasoning that the efficiency W/H (the ratio of work done, W, to heat trans- ferred, H) of a perfectly reversible heat engine is the maximum attainable, and cannot be exceeded by any other engine working between the same limits of tem- perature. The fallacy of Carnot's proof became evident when it was admitted that heat was a form of energy, and therefore capable of transformation. The adoption of the principle of the conservation of energy in place of that of the conservation of heat made it necessary to suppose (as was experimentally proved by Him and others at a later date) that part of the heat, H', taken from the source was transformed into work and disappeared, ceasing to exist as heat. The quantity of heat, H", given up to the sink was therefore less than H'. The simple proof given by Carnot on the basis of the conservation of heat no longer held good, and it became necessary to devise some other axiom on which to found the proof of Carnot's principle. Either of the axioms chosen for this purpose by Clausius and Thomson (Lord Kelvin) may be stated as the second law of thermodynamics, but as they are equivalent to Carnot's principle, and may be deduced from it, it is

more convenient in practice to take Carnot's principle itself as the second law.

2. Application of the First Law. — The complete trans- formation of mechanical energy into heat by friction, or some analogous process of degradation, is always possible, and is made the basis of experiments for the determina- tion of the mechanical equivalent of the heat unit. (See Calorimetry.) The converse process of the transforma- tion of heat into mechanical work or other forms of energy is subject to limitations. When a quantity of heat, H, is supplied to a body, part is expended in raising the temperature of the body, or in expanding the volume against molecular forces, and is represented by an in- crease in the total quantity of energy contained in the body, which is generally called its Intrinsic Energy, and will be denoted by the symbol E. The remainder is equivalent to the external work, W, done by the body in expanding or otherwise, which can be utilized for mechanical purposes, and ceases to exist as heat in the body. The application of the first law leads immediately to the equation,

$$H=E-E0+W, \ldots (1)$$

in which E0 represents the quantity of energy originally present in the body, and all the quantities are supposed, as usual, to be expressed in mechanical units. This equation is generally true for any series of transformations, provided that we regard H and IF as representing the algebraic sums of all the quantities of heat supplied to, and

of work done by the body, heat taken from the body or work done on the body being reckoned negative in the summation. E – Ea, then, represents the total increase of the intrinsic energy of the body in its final state, which may be determined by measuring H and W. If after any series or cycle of transformations the body is restored to its initial state, we must have E = E0, whence it follows that H= W. But this simple relation is only true of the net balances of heat and work in a

complete cyclical process, which must be adopted for theoretical purposes if we wish to eliminate the unknown changes of intrinsic energy. The balance of work obtainable in such a cycle depends on the limits of temperature in a manner which forms the subject of the second law.

3. Indicator or p.v. Diagram. — The significance of relation (1) is best appreciated by considering the graphic representation of quantities of heat and energy on a work- diagram. On the familiar indicator diagram the state

of the working sub- P '\ \ stance is represented

by the position of a point called the "state-point," defined by the values of the pressure p and volume v of unit mass, as ordinate and abscissa respectively (Fig. 1). Any line (" path " or " graph ") on the diagram, such as BCD, represents an "operation " or " pro- cess," i.e., a contin- uous series of states through which the substance may be made to pass in any transformation. It is tacitly assumed that the motion is relatively so slow that the pressure and temperature of the substance are practically uniform throughout its mass at any stage of the process. Otherwise the transformation could not be fully represented on the diagram, and would not be reversible. The area- BGDdb under the path represents the external work done by the substance in expanding from B to D, which is analytically represented by the integral of pdv taken along the given path. Any closed path or figure, such %s ABCD, represents a complete cycle or series of operations, in the course of which the substance is restored to its original state with respect to temperature, intrinsic energy, and other pro- perties. The area DABbd under the return path (v diminishing) represents work done on the substance, or against the back-pressure, and is negative. The area of the cycle, viz., that enclosed by the path BCDA, repre- sents the balance of external work done by the substance in one cycle, and is positive if the cycle is described clock- wise as indicated by the arrows. The simplest types of process or operation are: — (1), heating or cooling at constant volume, represented by vertical lines such as B6, called Isometrics, in which the pressure varies, but no external work is done.

(2) Heating or cooling at constant pressure, represented by horizontal lines such as NA, called Isopiestics, in which the external work done is the product o'f the pressure p and the expansion v" – v'. (3) Expansion or compression at constant temperature, represented by curves called Isothermals, such as BC, AD, the form of which depends on the nature of the working substance. The isothermals are approximately equilateral hyperbolas (pv = constant), with the axes of p and v for asymptotes, for a gas or unsaturated vapour, but coincide with the

Fig. 1.

isopiestics for a saturated vapour in presence of its liquid. (4) Expansion or compression under the condition of heat -insulation, represented by curves called Adiabatics, such as BAZ or CDZ', which are necessarily steeper than the isothermals.

A cycle such as ABCD enclosed by parts of two isothermals, BC, AD, and two adiabatics, AB, CD, is the simplest form of cycle for theoretical purposes, since all the heat absorbed, H', is taken in during the process represented by one isothermal at the temperature & , and all the heat rejected, H", is given out during the process represented by the other at the temperature 6". This is the cycle employed by Carnot for the establishment of his fundamental principle of reversibility as the criterion of perfect efficiency in a heat engine. The area ABCD, representing the work, W, per cycle, is the difference (H' – H") of the quantities of heat absorbed and rejected at the temperatures 8′ and 6". As the temperature 9″ is lowered, the area of the cycle increases, but since W can never exceed H', there must be a zero limit of temperature at which the pressure would vanish and the area of the cycle become equal to the whole heat absorbed at the higher temperature. Taking this ideal limit as a theoretical or absolute zero, the value of H' may be represented on the diagram by the whole area included between the two adiabatics BAZ, CDZ' down to the points where they intersect the isothermal of absolute zero, or the zero isopiestic OV asymptotically at infinity.

If the substance in any state such as B were allowed to expand adiabatically (dH= 0) down to the absolute zero, at which point it

contains no heat and exerts no pressure, the whole of its intrinsic heat energy might theoretically be recovered in the form of external work, represented on the diagram by the whole area BAZcft under the adiabatic through the state-point B, bounded by the isometric B6 and the zero isopiestic 6V. The change of the intrinsic energy in passing from one state to another, as from B to C, is represented by the addition of the heat-area H= BCZZ', and the subtraction of the work-area W— BCcb. It follows from the first law that the intrinsic energy of a substance in a given state must always be the same, or that the change of E in any transformation must depend only on the initial and final states, and not on the path or process. It will be observed that the areas representing H and W both depend on the form of the path BC, but that the difference of the areas representing the change of intrinsic energy dE is independent of BC, which is a boundary common to both ~~£Tand W. This is mathematic~~ ally expressed by the statement that dE is an exact dif- ferential of a function of the co-ordinates defining the state of the body, which can be integrated between limits without reference to the relation representing the path along which the variations are taken.

4. Application of the Second Law. — The limitations of the transformation of heat into work in a cyclical process, such as is necessarily involved in the working of any form of heat engine, form the subject of the second law, and are most conveniently stated in terms of the absolute scale of temperature devised by Lord Kelvin on the basis of Carnot's principle. Since the efficiency of all perfectly reversible engines working between the same two limits of temperature in a cycle of the kind illustrated in Fig. 1 must be the same, it follows that it can depend only on the limits of temperature, and not on the mechanism of the engine, or on the nature of the working substance employed. Any scale of temperature defined in terms of the ratios of the quantities of heat absorbed and rejected by a reversible engine will be absolute in the sense of being independent of the properties of any particular sub- stance. The scale proposed by Lord Kelvin, and now

universally adopted, is obtained by taking the ratio ffjO” of the temperatures of the source and the sink to be the same as” the ratio H’\H” of the quantities of heat absorbed and rejected at those temperatures in a simple Carnot cycle. Since H’-H”=W, we thus obtain the simple relations,

W/(9′ -$”) = &!& = H” JO” . (2)

The scale of temperature so defined leads to the simplest thermodynamical relations, and has the great advantage of being in the closest possible agreement with the scales of the mercury and gas-thermometers. The size of the degree of temperature is determined by the system of graduation employed (Centigrade, or Fahrenheit, or Keaumur) with reference to the freezing and boiling points of water, but this does not affect the ratios involved in (2), and is immaterial for theoretical purposes. Having due regard to the meaning of the symbols employed, the relations (2) may also be interpreted as the formula of the simple reversible engine, or as the symbolic statement of Carnot’s principle, since the assertion that the efficiency depends only on the temperature limits is implicitly in- volved in the form of the equations.

5. Thermodynamical Relations. — The most important and most useful of the relations between the thermodynamical properties of a substance may be very simply deduced from a considera- tion of the indicator diagram by a geometrical method, which is in many respects more instructive than the analytical method

generally employed. Re- ferring to Kg. 2, let BC be a small portion of any isothermal corresponding to the temperature 8’, and AD a neighbouring isothermal 8”. Let BE be an isometric through B meeting AD in E, and EC an isopiestic through E meeting BC in C. Let BA, CD he adiabatics through B and C meeting the isothermal 8″ in A and D. Then by relations (2) the heat, H, absorbed in the isothermal change BC, is to the work, W, done in the cycle ABCD in the ratio of 8′ to ($’-8”). If the difference of temperature (8′ -8”) is small, the figure ABCD may be regarded as a parallelogram, and its area W as equal to

the rectangle BE x EC. This is accurately true in the limit when (8′ — 8”) is infinitesimal, but in practice it is necessary to measure specific heats, &c. , over finite ranges of temperature, and the error involved is generally negligible if the range does not exceed a few degrees. BE is the increase of pressure (p’ —p”) produced by the rise of temperature {$’ – 8”) if the volume is kept constant. EC is the expansion (v” – v’) produced by the same rise of temperature if the pressure is kept constant. Substituting these symbols in the expression for the area, the relation becomes

H=8(p’-p”)(i/’-i/)l(8’-d”) . . . (3)

This relation may be interpreted in two ways, according as we require the heat absorbed in terms of the change of pressure or volume. (1) The heat, H, absorbed in isothermal expansion (latent heat of expansion) from p’ to p” is equal to the diminution of pressure (p’-p”) multiplied by the absolute temperature and by the expansion per degree («” – v’)/(8′ – 8”) at constant pressure. (2) The heat, H, absorbed in isothermal expansion from v’ to v” is equal to the increase of volume (v” – v’) multiplied by the abso- lute temperature, and by the increase of pressure per degree (p’ -p”)/(8′ – 8”), at constant volume. In the notation of the calculus the relations become

-dHldp (8 const) = 8dv/dd (p const)

1/

(4)

dH/dv (8 const) = 8dp/d8 (v const)

The negative sign is prefixed to dHldp because absorption of heat + dE corresponds to diminution of pressure – dp. The utility of these relations results from the circumstance that the pressure and expansion coefficients are familiar and easily measured, whereas the latent heat of expansion is difficult to determine.

The moat instructive example of the application of relations (1) and (2) is afforded by the change of state of a substance at

Liquid .

/ ,-*» \ Vapour

Mixture -» \ *

e>

Bl

**9′ **

C

/

e”

1

£

Fig. 3.

constant temperature and pressure. Starting with unit mass of the substance in the first state (e.g., liquid) possessing volume v’ at a temperature 8″ and pressure^” represented by the point A in Fig. 3, the heat absorbed in raising the temperature to & and the pressure to p’ without change of state may be written s’ (8′ – 8”), where s’ is the specific heat of the substance in the first state at saturation pressure. If now the substance in the state B is en- tirely converted at constant temperature and pressure into the second state (e.g., saturated vapour), in which it occupies a volume ■»”, the line BC represents the change of volume (if’ – if). The heat absorbed in this change is called the latent heat of change of state, and may be represented by the symbol L’. The substance isthen cooled to the lower tempera- ture 8″ along the path

CD, keeping it in the saturated state. The heat evolved in this process may be represented by s”(8′ – 8”), where s” is the specific heat of the substance in the second state at saturation pressure. Finally, the substance is reconverted into the first state at the temperature 8”, completing the cycle by the abstraction of a quantity of heat L”. By the application of the first law, the difference of the quantities of heat absorbed and evolved in the cycle must be equal to the work represented by the area of the cycle, which is equal to (p’ – p”)(if’ – v’) in the limit when the difference of pressure is small. By the application of the second law, relations (2), the same work area is equal to (8′ – 8”)L’/8’. Dividing by (8′ – 8”), and writing dp\d8 and dL/d8 for the limit- ing values of the ratios (p’ -p”)/^ – 8”) and (V – L”)j(8′ – 8”), we obtain the important relations

s’-s” + dLld8 = (i/’-v’)dplde=Z/8, . . . (5)

in which dp/d8 is the rate of change of pressure with temperature when the two states are in equilibrium, and not necessarily at constant volume, as in the previous example.

6. Ratio and Difference of Specific Heats. — If we take unit mass of the substance at B, Fig. 2, and cool it at constant volume to E, through an interval of temperature (8′ — 8”), the amount of heat abstracted may be written h=s(8′ — 6”), where s is the specific heat at constant volume. If, starting from E, the same amount of heat h is restored at constant pressure, we should arrive at the point F on the adiabatic through B, since the substance has been trans- formed from B to F by a reversible path without loss or gain of heat on the whole. In order to restore the substance to its original temperature 8′ at constant pressure, it would be necessary to supply a further quantity of heat, H, represented by the area between the two adiabatics from FC down to the absolute zero. This quantity of heat is the same as that already found in equa- tion (3), but for the small area BFC, which is negligibly small in the limit compared with H. The whole quantity of heat required to raise the temperature from 8″ to 8′ at constant pressure along the path EC is H+h, which is equal to S(8′ ~~8”), where ence S-s between the specific heats at constant pressure and volume is evidently H/(8′ – 8”).~~

~~Substituting for H its value from (3), and employing the notation of the calculus, we obtain the relation~~

S-s=8(dpld8)(dv/d8) (6)

in which the partial differential coefficients have the same meaning as in (4).

Since the amounts of heat supplied at constant pressure from E to F and from E to C are in the limit proportional to the ex- pansions EF and EC which they produce, the ratio S/s is equal to the ratio EC/EF. EF is the change of volume corresponding to a change of pressure BE when no heat is allowed to escape and the path is the adiabatic BF. EC is the change of volume for the same change of pressure BE when the path is the isothermal BC. These changes of volume are directly as the compressibilities, or inversely as the elasticities. If we write K for the adiabatic elasticity, and k for the isothermal elasticity, we obtain

S/s = EC/EF =K/k . . . . (7)

The value of the specific heat S at constant pressure can always be determined by experiment, and in practice is one of the most important thermodynamical properties of a substance. The value of the specific heat s at constant volume can also be

measured in a few cases, but it is generally necessary to deduce it from that at constant pressure by means of relation (6). It is often impossible to observe the pressure-coefficient dp/dd directly, but it may be deduced from the isothermal compressibility by means of the geometrically obvious relation, BE = (BE/EC) x EC. The ratio BE/EO of the diminution of pressure to the increase of volume at constant temperature, or – dp/dv, is readily observed.

The amount of heat absorbed in any small change of state, as from E to G in Fig. 2, may be found by adding to the heat required for the change of temperature at constant volume, sdd, or at constant pressure, SdB, the heat absorbed in isothermal expansion as given by relations (4). We thus obtain the ex- pressions

dH=sd8 + 8{dpld8)dv=Sd8-8(dv/dB)dp . . (8)

The first is equivalent to measuring the heat along the path EBG, the second along the path EGG. The two differ by the area BEC, which can be neglected if the change is small. For a finite change it is necessary to represent the path by a series of small steps, which is the graphic equivalent of integration along the path represented by the given relation between v and 8, or p and 8. If we put dH=0 in equations (8), we obtain the relations between dv and d8, or dp and dd, under the condition of no heat -supply, i.e., along the adiabatic, which can be integrated, giving the equations to the adiabatics, provided that the values of the specific heats and expansion-coefficients are known.

6. Intrinsic Energy. — The change of intrinsic energy E along any path is found by subtracting the work pdv from either of the expressions for dH. Since the change of energy is independent of the path, the finite change between any two given states may be found by integration along any convenient path. It is generally convenient to divide the path into two steps, isothermal and isometric, or isothermal and isopiestic, and to integrate along each separately. The change of energy at constant volume is simply sdd, the change at constant temperature is (8dpjd8 - p)dv, which may be written

dE/d8 (v const) = s, dE[dv (0 const) = 0dp/d8-p . . (9)

These must be expressed as functions of v and 8 , which is theor- etically possible if the values of #, p, and dp/d8 are known. Since the two expressions (9) are the partial differential-coefficients of a single function E of the independent variables v and 8, we shall obtain the same result, namely d2E/d8dv, if we differentiate the first with respect to v and the second with respect to 8. We tans obtain the relation

dsjdv(8 const) = 8(2^^0* (v const), . . . (10)

which is useful for calculating the variation of the specific heat s with variation of density at constant temperature. A similar expression for the variation of the specific heat S at constant pressure is obtained from the second expression in (8), by taking p and 8 as independent variables ; but it follows more directly from a consideration of the variation of the function (E+pv).

7. Total Seat.— The function F=(E+pv), like E itself, has a value depending only on the state of the body. It may con- veniently be called the Total Heat, by a slight extension of the meaning of a term which has been for a long time in use as applied to vapours (see Vaporization). Since dE=dK-pdv, we have evidently for the variation of the total heat from the second expression (8),

dF=d(E+pv)=dK+vdp=Sd0-(0dv/d0-v)dp . (11)

This expression shows that the rate of variation of the total heat with temperature at constant pressure is equal to the specific heat at constant pressure. To find the total heat of a substance in any given state defined by the values of p and 0, starting from any convenient zero of temperature, it is sufficient to measure the total heat required to raise the substance to the final temperature under a constant pressure equal to p. For instance, in the boiler of a steam engine the feed water is pumped into the boiler against the final pressure of the steam, and is heated under this constant pressure up to the temperature of the steam. The total heat with which we are actually concerned in the working of a steam engine is the total heat as here defined, and not the total heat as defined by Regnault, which, however, differs from (E+pv) only by a quantity which is inappreciable in ordinary practice.

Observing that F is a function of the co-ordinates expressing the state of the substance, we obtain for the variation of S with pressure at constant temperature

dSjdp (8 const) =

If the heat supplied to a substance which is expanding re- versibly and doing external' work, pdv, is equal to the external work done, the intrinsic energy, E, remains constant. The lines of constant energy on the diagram are called Isenergics. The equation to these lines in terms of v and 8 is obtained by inte- grating

dE=sd8 + (8dp/d0~p)dv=O . . . (13)

If, on the other hand, the heat supplied is equal to – vdp, we see from (11) that J*1 remains constant. The equation to the lines of constant total heat is found in terms of p and 0 by putting dF=0 and integrating (11).

8. Ideal Gases. — The simplest and most instructive illustration of the foregoing principles is afforded by a consideration of the properties of an ideal gas, and of the manner in which actual gases deviate from the ideal state. According to the elementary kinetic theory, an ideal monatomic gas is imagined to consist of a number of very small and perfectly elastic particles, each of mass m, moving in all directions with a velocity u, depending on the temperature. In the state of equilibrium of a mixture of different gases the mean kinetic energy »»!/2 of each kind of molecule must be the same. This mean kinetic energy is the natural measure of the temperature, since the energy is assumed to be wholly kinetic, and equal increments of heat produce equal increments of energy. The specific heat at constant volume is constant and equal to u?/20. The pressure p due to the mole- cular impacts is u2/3v. We thus obtain the ideal characteristic equation

pv=S0/M=u2/Z = 2s0/3, (14)

in which E is a constant, the same for all ideal gases, and M is the molecular weight relative to the standard for which the value of R is calculated. It is assumed in establishing these relations that the molecules themselves are so small that the space which they occupy is a negligible fraction of that occupied by the gas, and that the duration of an intermolecular collision may be neglected in comparison with the time between two consecutive encounters of the same molecule with another. It is also assumed that there are no forces of attraction or

repulsion between mole- cules, so that no work is done against molecular forces in change of volume. The change of energy in isothermal expansion is zero, and the heat absorbed is equal to the external work. ThiB assump- tion gives 0dp/d0=p, by relations (4), which are equivalent to (2). But by (14) 0dp/d0=p, hence the scale of temperature given by the ideal gas coincides with the scale defined by (2). The difference of the specific heats, (S-s)=K/M, and the ratio S/s is constant, being equal to 5/3 for a monatomic gas. The

adiabatic elasticity is Sp/s, and the adiabatic equation pv ’”= constant.

9. Deviations of Actual Gases from the Ideal State. — Since no gas is ideally perfect, it is more important for practical purposes to discuss the deviations of actual gases from the ideal state, and to consider how their properties may be thermodynamically ex- plained and defined. The most natural method of procedure is to observe the deviations from Boyle’s law by measuring the changes of pv at various constant temperatures. But this procedure in itself is not sufficient, because, although it would be highly probable that a gas obeying Boyle’s law at all temperatures was practically an ideal gas, it is evident that Boyle’s law would be satisfied by any substance having the characteristic equation pv=f{8), where f{0) is any arbitrary function of 0, and that the scale of temperatures given by such a substance would not necessarily coincide with the absolute scale. An ideal gas is often defined as one which obeys the law of Boyle, and also that of Charles. But the latter does not afford a practical test, as the gas thermometer itself is the only available standard for measur- ing . temperature. A sufficient test, in addition to Boyle’s law, is the condition dE/dv=0 at constant temperature, which is assumed in the elementary kinetic theory. This gives by equation (9) the condition 0dp/d0=p, which is satisfied by any substance possessing the characteristic equation p/0=f(v), where /(e) is any arbitrary function of v. In order that a substance of this nature may also satisfy Boyle’s law, it is necessary that its characteristic equation should be that of the ideal gas. In that case its specific heat must be constant, and its temperature scale must coincide with the absolute scale. This test was applied by Joule in the well-known experiment in which he allowed a gas to expand from one vessel to

another in a calorimeter without doing external work. Under this condition the increase of intrinsic energy would be equal to the heat absorbed, and would be indicated by fall of temperature of the calorimeter. Joule failed to observe any change of temperature in his apparatus, and was therefore justified in assuming that the increase of intrinsic energy of a gas in isothermal expansion was very small, and that the absorp- tion of heat observed in a similar experiment in which the gas was allowed to do external work by expanding against the atmospheric pressure was equivalent to the external work done. But owing to the large thermal capacity of his calorimeter, the test, though sufficient for his immediate purpose, was not delicate enough to detect and measure the small deviations which actually exist.

10. Method of Joule and Thomson. — William Thomson (Lord Kelvin), who was the first to realize the importance of the absolute scale in thermodynamics, and the inadequacy of the test afforded by Boyle's law or by experiments on the constancy of the specific

heat of gases, devised a more delicate and practical test, which he carried out successfully in conjunction with Joule. A continuous stream of gas, supplied at a constant pressure and temperature, is forced through a porous plug, from which it issues at a lower pressure through an orifice carefully surrounded with non-con- ducting material, where its temperature is measured. If we consider any short length of the stream bounded by two imaginary cross-sections A and B, unit mass of the fluid in passing A has work, p'v1 ', done on it by the fluid behind and carries its energy, E + V, with it into the space AB, where U' is the kinetic energy of flow. In passing B it does work, /*", on the fluid in front, and carries its energy, E" + U", with it out of the space AB. If there is no external loss or gain of heat through the walls of the pipe, and if the flow is steady, so that energy is not accumulating in the space AB, we must evidently have the condition E' + V +p'v' = E" + U" +p"v" at any two cross-sections of the stream. It is easy to arrange the experiment so that U is small and nearly constant. In this case the

condition of flow is simply that of constant total heat, or in symbols, d(E+pv) = 0. We have therefore, by equation (11),

SdB=(8dv/d8-v)dp, . . . (15) where dd is the fall of temperature of the fluid corresponding to a diminution of pressure dp. If there is no fall of temperature in passing the plug, d8 = 0, and we have the condition 8dvjd8 = v. The characteristic equation of the fluid must then be of the form v/B=f(p), where f(p) is any arbitrary function of p. If the fluid is a, gas also obeying Boyle's law, pv=f(8), then it must be an ideal gas. As the result of their experiments on actual gases (air, hydrogen, and C02), Joule and Thomson (Phil. Trans. 1854, 1862) found that the cooling effect, dff, was of the same order of magnitude as the deviations from Boyle's law in each case, and that it was proportional to the difference of pressure, dp, so that ddjdp was nearly constant for each gas over a range of pressure of five or six atmospheres. By experiments at different temperatures between 0° and 100° C, they found that the cooling effect per atmosphere of pressure varied inversely as the square of the absolute tempera- ture for air and C02. Putting d$/dp=A/8i in equation (15), and integrating on the assumption that the small variations of S could be neglected over the range of the experiment, they found a solution of the type, v/B=f(p)-SA/38s, in which f(p) is an arbitrary function of p. Assuming that the gas should approxi- mate indefinitely to the ideal state pv=BB at high temperatures, they put f(p)=B/p, which gives a characteristic equation of the form

v=£8lp-SA/3e*. . . . (16) An equation of a similar form had previously been employed by Rankine (Trans. Boy. Soc. Ed. 1854) to represent Regnault's experiments on the deviations of C02 from Boyle's law. This equation is practically identical for moderate pressures with that devised by Clausius (Phil. Mag. 1880) to represent the behaviour of C02 up to the critical point. Experiments by Natanson on 0O2 at 17° C. confirm those of Joule and Thomson, but show a slight increase of the ratio dB/dp at higher pressures, which is otherwise rendered probable by the form of the isothermals as determined by Andrews and Amagat. More recent experiments by Grindley (Proc. Boy. Soc. 1899) and Callendar (Proc. Boy. Soc. 1900) on steam confirm this type of

equation, but give much larger values of the cooling effect than for C02, and a more rapid rate of variation with temperature.

11. Modified Joule- Thomson Equation. — Hirn (The'orie Mec. de la Chaleur, ii. p. 211, Paris, 1869) proposed an equation of the form (p+p0)(v-b)=B8, in which the effect of the size of the molecules is represented by subtracting a quantity 6, the "covolume," from the volume occupied by the gas, and the effect of the mutual attractious of the molecules is represented by adding a quantity p0, the internal pressure, to the external pressure, p. This type of equation was more fully worked out by van der Waals, who identified the internal pressure, pa, with the capillary pressure of Laplace, and assumed that it varied directly as the square of the density, and could be written aji?. This assump- tion represents qualitatively the theoretical isothermal of James Thomson (see Vaporization) and the phenomena of the critical state (see Condensation of Gases) ; but the .numerical results to which it leads differ so widely from experiment that it is necessary to suppose the constant, a, to be a function of the temperature. Many complicated expressions have been suggested by subsequent writers in the attempt to represent the continuity of the gaseous and liquid states in a single formula, but these aro of a highly empirical nature, and beyond the scope of the present inquiry. The simplest assumption which suffices to express the small deviations of gases and vapours from the ideal state at moderate pressures is that the coefficient a in the expression for the capillary pressure varies inversely as some power of the absolute temperature. Neglecting small terms of the second order, the equation may then be written in the form

v-b = B6/p-c0(B0/&)'>=zV-c, . . (17)

in which c is a small quantity (expressing the defect from the ideal volume V—B8/p due to co-aggregation of the molecules) which varies inversely as the reth power of B, but is independent of p to a first approximation at moderate pressures. The constant c0 is the value of c at some standard temperature 0O. The value of the index, n, appears to be different for different types of molecule. For C02 at ordinary temperatures »=2, as in the Joule-Thomson equation. For steam

between 100° and 150° C. it approaches the value 3 -5. It is probably less than 2 for air and the more perfect gases. The introduction of the covolume, b, into the equation is required in order to enable it to represent the behaviour of hydrogen and other gases at high temperatures and pressures according to the experiments of Amagat. It is generally taken as constant, but its value at moderate pressures is difficult to determine. According to van der Waals, assuming spherical molecules, it should be four times ; according to O. E. Meyer, on slightly different assumptions, it should be 4 ^/2 times, the actual volume of the molecules. It appears to be a quantity of the same order as the volume of the liquid, or as the limiting volume of the gas at very high pressures. The value of the co-aggregation volume, c, at any temperature, assuming equation (17), may be found by observing the deviations from Boyle's law and by experiments on the J oule-Thomson effect. Differentiating equation (17) at constant pressure to find dv/dB, and observing that dc/d8= -nc/8, we find by substitution in (15) the following simple expression for the cooling effect dB/dp in terms of c and b,

SdB/dp = (n + l)c-b . . . (18)

Experiments at two temperatures suffice to determine both c and n if we assume that b is equal to the volume of the liquid. But it is better to apply the Boyle's law test in addition, provided that errors due to surface condensation can be avoided. The advantage of this type of equation is that c is a function of the temperature only. Other favourite types of equation for approxi- mate work are (1) p=B0/v+f(v), which makes j) a linear function' of B at constant volume, as in van der Waals's equation ; (2) v=B8/p+f(p), which makes v a linear function of 8 at constant pressure. These have their advantages in special cases as empirical formulae (e.g., Zeuner's formula for steam), but they cannot be made to represent with sufficient approximation the deviations from the ideal state at moderate pressures. In the modified Joule-Thomson equation (17), both c and n have simple theoretical interpretations, and it is possible to express the thermodynamical properties of the substance in terms of them 'by means of reasonably simple formulas.

12. Application of the Modified Equation. — We may take equa- tion (17) as a practical example of the thermodynamical principles already given. The values of the partial differential coefficients in terms of n and c are as follows —

(19) (20) (21) (22) (23)

(24) (25) (26)

cm

(28)

dv/dB (p const) = (B/p)(l + nc/V) (Pv/dB* „ = -n(n + l)c/Bi

dp/dd (v const) = (B/F)(l + nc/F) dtp/de* „ =Bnc(-n + 2nc/V)/8V*

- dpjdv (8 const) =pj V .

Substituting these values in equations already given, we find,

from (6) S-s = B(\ + nc/Vf .

„ (9) dEjdv (8 const)=ncp/F . ...

„ (U) dF/dp „ =(n + l)c-b . .

„ (10) ds/dv „ = (-n + 2nc/V)Rnc/V^

„ (12) dS/dp „ = n(n + \)e/8

In order to deduce the complete variation of the specific heats from these equations, it is necessary to make some assumption with regard to the variation of the specific heats with temperature. The assumption usually made is that the total kinetic energy of the molecules, including possible energy of rotation or vibration if the molecules consist of more than one atom, is proportional to the energy of translation in the case of an ideal gas. In the case of imperfect gases, all the available experimental evidence shows that the specific volume tends towards its

ideal value, V—B8/p, in the limit, when the pressure is indefinitely reduced and the molecules are widely separated so as to eliminate the effects of their mutual actions. We may therefore reasonably assume that the limiting values of the specific heats at zero pressure do not vary with the temperature, provided that the molecule is stable and there is no dissociation. Denoting by S0, s0, these constant limiting values at p = 0, we may obtain the values at any pressure by integrating the expressions (27) and (28) from <= to v and from 0 to p respectively. We thus obtain

S=S0 + n(n + l)pc/8 .... (29) s = SQ + (n--nc/y)ncplB . . . (30)

In working to a first approximation, the small term nc/P'may be omitted in the expression for s.

The expression for the change of intrinsic energy E between any given limits p080 to p8 is readily found by substituting these

values of the specific heats in equations (11) or (13), and integ- rating between the given limits. We thus obtain

E- E0 = s0{$ – e„) – n{pc -p0c)

(31)

The energy is less than that of an ideal gas by the term npc. If we imagine that the defect of volume c is due to the formation of molecular aggregates consisting of two or more single molecules, and if the Kinetic energy of translation of any one of these aggregates is equal to that of one of the single molecules, it is clear that some energy must be lost in co-aggregating, but that the proportion lost will be different for different types of molecules ancf also for different types of co-aggregation. If two monatomic molecules, having energy of translation only, equivalent to 3 degrees of freedom, combined to form a diatomic

molecule with 5 degrees of freedom, the energy lost would be pc/2 for co-ag- gregation, c, per unit mass. If two diatomic molecules, having each 5 degrees of freedom, combine to form a molecule with 6 degrees of freedom, we should have ra = 2, or the energy lost would be 2pc per unit mass. If the molecules and molecular aggregates were more complicated, and the number of degrees of freedom of the aggregates were limited to 6, or were the same as for single molecules, we should have n = s0/R. The loss of energy could not be greater than this on the simple kinetic theory, unless there were some evolution of latent heat of co-aggregation, due to the work done by the mutual attractions of the co- aggregating molecules.

It is not necessary to suppose that the co-aggregated molecules are permanently associated. They are continually changing partners, the ratio cjV representing approximately the ratio of the time during which any one molecule is paired to the time during which it is free. At higher densities it is probable that more complex aggregates would be formed, so that as the effect of the collisions became more important o would cease to be a function of the temperature only ; experiment, indeed, shows this to be the case.

13. Entropy. — It follows from the definition of the absolute scale of temperature, as given in relations (2), that in passing at constant temperature 0 from one adiabatic 4> (Fig- 1) to any other adiabatic “, the quotient H/6 of the heat absorbed by the temperature at which it is absorbed is the same for the same two adiabatics whatever the temperature of the isothermal path. This quotient is called the change of entropy, and may be denoted by (” –). In passing along an adiabatic there is no change of entropy, since no heat is absorbed. The adiabatics are lines of constant entropy, and are also called Isentropics. In virtue of relations (2), the change of entropy of a substance between any two states depends only on the initial and final states, and may be reckoned along any reversible path, not necessarily isothermal, by dividing each small increment of heat, dH, by the tempera- ture, 0, at which it is acquired, and taking the sum or integral of the quotients, dH/0, so obtained.

The expression for the change of entropy between any two states is found by dividing either of the expressions for dH in (8) by 6 and integrating between the given limits, since dH/0 is a perfect differential. In the case of a solid or a liquid, the latent heat of isothermal expan- sion may often be neglected, and if the specific heat, s, be also taken as constant, we have simply <£ – <£0 = s loge6/0o. If the substance at the temperature 6 undergoes a change of state, absorbing latent heat, L, we have merely to add the term LjO to the above expression. In the case of an ideal gas, dpjdO 'at constant volume = H/v, and dv/d0 at c«istant pressure = R\p ; thus we obtain the expressions for the change of entropy <£ — <£0 from the state p^rfi^ to the state pOv,

-a = s log„ 0/0» + R log6 v/v0

= S\ogeei0o-Hlogep/p<) (32)

In the case of an imperfect gas or vapour, the above expressions are frequently employed, but a more accurate ■result may be obtained by employing equation (17) with the value of the specific heat, S, from (29), which gives the expression

<£ – <£0 = £0 loge0/0o – B loge p/p0 – n(cp/0 – coPjeo) (33)

The state of a substance may be defined by means of the temperature and entropy as co-ordinates, instead of employing the pressure and volume as in the indicator diagram. This method of representation is applicable to certain kinds of problems, and has been developed by Macfarlane, Gray, and other writers in its application to the steam engine. (See Engines, vol. xxviii. p. 175 of this work ; also Ewing, Steam Engine ; Perry, Steam Engine.) Areas on the temperature-entropy or 6, diagram represent quantities of heat in the same way as areas on the indicator diagram represent quantities of work. The 0, <£ diagram is useful in the study of heat waste and condensation, but from other points of view the utility of tl\e conception of entropy as a " factor of heat " is limited by the fact that it does not correspond to any directly measurable physical property, but is merely a mathe- matical function arising from the form of the definition of absolute temperature. Changes of entropy must be calculated in terms of quantities of heat,

and must be interpreted in a similar manner. The majority of thermo-dynamical problems may be treated without any reference to entropy, but it affords a convenient method of ex- pression in abstract thermodynamics, especially in the consideration of irreversible processes and in reference to the conditions of equilibrium of heterogeneous systems.

14. Irreversible Processes. — In order that a process may be strictly reversible, it is necessary that the state of the working substance should be one of equilibrium at uniform pressure and temperature throughout. If heat passes ” of itself ” from a higher to a lower temperature by con- duction, convection, or radiation, the transfer cannot be reversed without an expenditure of work. If mechanical work or kinetic energy is directly converted into heat by friction, reversal of the motion does not restore the energy so converted. In all such cases there is necessarily, by Carnot’s principle, a loss of efficiency or available energy, accompanied by an increase of entropy, which serves as a convenient measure or criterion of the loss. A common illustration of an irreversible process is the expansion of a gas into a vacuum or against a pressure less than its own. In this case the work of expansion, pdv, is expended in the first instance in producing kinetic energy of motion of parts of the gas. If this could be co-ordinated and utilized without dissipation, the gas might conceivably be restored to its initial state ; but in practice violent local differences of pressure and temperature are produced, the kinetic energy is rapidly converted into heat by viscous eddy friction, and residual differences of temperature are equalized by diffusion throughout the mass. Even if the expansion is adiabatic, in the sense that it takes place inside a non-conducting enclosure and no heat is supplied from external sources, it will not be isentropic, since the heat supplied by internal friction must be included in reckoning the change of entropy. Assuming that no heat is supplied from external sources and no external work is done, the intrinsic energy remains constant by the first law. The final state of the substance, when equilibrium has been restored, may be deduced from this condition, if the energy can be expressed in terms of the co-ordinates. But the line of constant energy on the diagram does not represent the path of the transformation, unless it be supposed to be

effected in a series of infinitesimal steps between each of which the substance is restored to an equilibrium state. An irreversible process which permits a more complete experimental investigation is the steady flow of a fluid in a tube already referred to in section 10. If the tube is a perfect non-conductor, and if there are no eddies or frictional dissipation, the state of the substance at any point of the tube as to E\ p, and v, is represented by the adiabatic or isentropic path, dE= -pdv. As the

section of the tube varies, the change of kinetic energy of flow, dU, is represented by – vdp. The flow in this case is reversible, and. the state of the fluid is the same at points where the section of the tube is the same. In practice, however, there is always some frictional dissipa- tion, accompanied by an increase of entropy and by a fall of pressure. In the limiting case of a long fine tube, the bore of which varies in such a manner that U is constant, the state of the substance along a line of flow may be represented by the line of constant total heat, d(E+pv) = 0 ; but in the case of a porous plug or small throttling aperture, the steps of the process cannot be followed, though the final state is the same.

In any small reversible change in which the substance absorbs heat, dH, from external sources, the increase of entropy, d, must be equal to dH/6. If the change is not reversible, but the final state is the same, the change of entropy, d, is the same, but it is no longer equal to dH/6. By Carnot's principle, in all irreversible processes, dH/0 must be algebraically less than d, otherwise it would be possible to devise a cycle more efficient than a reversible cycle. This affords a useful criterion (see Energetics) between transformations which are impossible and those which are possible but irreversible. In the special case of a substance isolated from external heat supply, dH=0, the change of entropy is zero in a reversible process, but must be positive if the process is not reversible. The entropy cannot diminish. Any change involving decrease of entropy is impossible. The entropy tends to a maximum, and the state is one of stable equilibrium when the value of

the entropy is the maximum value consistent with the conditions of the problem. This is the theorem of Clausius, but it cannot be usefully applied in practice on account of the difficulty of realizing experimentally the condition of heat-isolation, and because the equations to which it leads would often be difficult or impossible of solution.

15. Heterogeneous Eqiiilibrium. — In a system, as dis- tinguished from a homogeneous substance, consisting of two or more states or phases in equilibrium, a similar condition of equilibrium applies. In any spontaneous irreversible change, if the system is heat-isolated, there must be an increase of entropy. The total entropy of the system is found by multiplying the entropy per unit mass of the substance in each state by the mass existing in that state, and adding the products so obtained. The simplest case to consider is that of equilibrium between solid and liquid, or liquid and vapour. The more general case is discussed in the article Energetics, and in the original memoirs of Willard Gibbs and others. Since "the condition of heat-isolation is impracticable, the condition of maximum entropy cannot be directly applied, and it is necessary to find a more convenient method of expression. If d W is the external work done, dH the heat absorbed from external sources, and dE the increase of intrinsic energy, we have in all cases by the first law, dH – dE = dW. Since Odcf> cannot be less than dH, the difference (6d(f> – dE) cannot be less than d W. This inequality holds in all cases, but cannot in general be applied to an irreversible change, because 9d<$> is not a perfect differential, and cannot be evaluated without a knowledge of the path or process of transformation. In the special case, however, in which the transformation is conducted in an isothermal enclosure, a common condition easily realized in practice, the temperature at the end of the transformation is re- duced to its initial value throughout the substance. The value of 8d is then the same as d(0cf>), which is a perfect differential, so that the condition may be written d(

There are two special cases of importance : — (a) If the volume is constant, or dW=0, the value of the function (64> — E) cannot diminish, or (E – 6) cannot increase, if the temperature is kept

constant. This function may be represented, for each state or phase of the system con- sidered, by an area on the indicator diagram similar to that representing the intrinsic energy, E. The product 6 may be represented at any point such as D in Fig. 1 by the whole area #"DZ'VO under the isothermal 0"D and the adiabatic DZ', bounded by the axes of pressure and volume. The intrinsic energy, E, is similarly represented by the area DZ'Yd under the adiabatic to the right of the isometric Dd. The difference 0- E is represented by the area 6"DdO to the left of the isometric Dd under the isothermal 6"D. The increment of this area (or the decrement of the negative area E – 6tf>) at constant temperature represents the external work obtainable from the substance in isothermal expansion, in the same way that the decrement of the intrinsic energy represents the work done in adiabatic expansion. The function J=E —Q4>, has been called the "free energy" of the substance by Helmholtz, and 6 the "bound energy." These functions do not, however, represent energy existing in the substance, like the intrinsic energy ; but the incre- ment of 6 represents heat supplied to, and the decre- ment of (E – 8) represents work obtainable from, the sub- stance when the temperature is kept constant. , The condition of stable equilibrium of a system at constant temperature and volume is that the total J should be a minimum. This function is also called the "thermo- dynamic potential at constant volume " from the analogy with the condition of minimum potential energy as the criterion of stable equilibrium in statics.

As an example, we may apply this condition to the case of change of state. If J', J" represent the values of the function for unit mass of the substance of specific volumes v' and j/' in the two states at temperature 6 and pressure p, and if a mass m is in the state i/, and 1 – m in the state 1/', the value of J for unit mass of the mixture is mJ + (1 – m)J". This must be a minimum in the state of equilibrium at constant temperature. Since the volume is constant, we have the condition m»' + (l ~~m)u"=con~~ stant. Since dj= —

(6) The second case, which is of greater practical utility, is that in which the external pressure, p, is kept constant. In this case dW=pdv = d(pv), a perfect differential, so that the external work done is known from the

initial and final states. In any possible transformation d(6 – E) cannot be less than d(pv), or the function (E — 6$ +pv) = G cannot increase. The condition of stable equilibrium is that G should be a minimum, for which reason it has been called the ” thermodynamic potential at constant pressure.” The product pv for any state such as D in Fig. 1 is represented by the rectangle MDdO, bounded by the isopiestic and the isometric through D. The function G is represented by the negative area #“DM under the isothermal, bounded by the isopiestic DM and the axis of pressure. The increment of 6 is always greater than that of the total heat F=E +pv, except in the special case of an equilibrium change at constant temperature and pressure, in which case both are equal to the heat absorbed in the change, and the function G remains constant. This is geometrically obvious from the form of the area representing the function on the indicator diagram, and also follows directly from the first law. The simplest application of the thermodynamic potential is to questions of change of state. If <£', E', v' ; and <£", E", v", refer to

dff’IdB (p const) = “= dJ”/d0 (v const) . dG ‘/dp (8 const) = i), dj”/dv (8 const) =p .

unit mass of the substance in the first and second states respectively in equilibrium at a temperature 8 and pressure p, the heat absorbed, L, per unit mass in a change from the first to the second state is, by definition of the entropy, equal to 6(4>” – <£'), and this by the first law is equal to the change of intrinsic energy, E" — E, plus the external work done, p(v" — v'), i.e., to the change of total heat, F" – F '. If G' and G" are the values of the function G for the two states in equilibrium at the same pressure and temperature, we must have G' = G" . Assuming the func- tion G to be expressed in terms of p and 6, this condition represents the relation between p and 6 corresponding to equilibrium between the two states, which is the solution of the relation (v" – v')dp/dd = L/6, (5). The direct integra- tion of this equation requires that L and v" — v' should be known as functions of p and 6,

and cannot generally be performed. As an example of one of the few cases where a complete solution is possible, we may take the comparatively simple case equation (17), already con- sidered, which is approximately true for the majority of vapours at moderate pressures.

Writing formulse (31) and (33) for the energy and entropy with indeterminate constants A and B, instead of taking them between limits, we obtain the following expressions for the thermodynamic functions in the case of the vapour : —

rb” = S0loge8-B\ogtp-nep/8 + A”. . . . (34)

JS”=s08-ncp + B” (35)

F” = S08-{n + l)cp + bp + B’ (36)

G” = Sl)8(-\ogee) + R8\ogep-(c-b)p-A”8 + B” . (37)

J”=s09-S081oge8 + R8\ogep-A”8 + B” . . (38)

The function J” may be expressed in terms of 0 and v by writing for p its value, namely, R8/(v+c-b). We have also in any case the relations

(39) (40)

And all the properties of the substance may be expressed in terms of 0 or J and their partial differential coefficients. The values of the corresponding functions for the liquid or solid cannot be accurately expressed, as the theoretical variation of the specific heat is unknown, but if we take the specific heat at constant pressure s’ to be approximately constant, and observe the small residual variation dh of the total heat, we may write

F=s‘8 + dh + B’ (41)

= s’ loge 8 + d<)> + A’ (42)

G’=s‘8{-\oge6) + (dh-8d)-A‘8 + B’ . . (43)

where d(j> is the corresponding residual variation of (/>', and is easily calculated from a table of values of h.

To find the border curve of equilibrium between the two states, giving the saturation pressure as a function of the temperature, we have merely to equate the values of G' and G". Rearranging the terms, and dividing throughout by 8, we obtain an equation of the form

R \ogep =A-B/8- (s' – S0) loge 8 + (c – b)p/8 + (dh/8 – d) . (44)

in which B = B' – B', and A = A" – A' + s' – S0. The value of A is determined by observing the value of 80 at some known pressure p0, e.g., at the boiling-point. The value of B is determined by observing the latent heat, L0=F"0-F'0, which gives

B=B"-B'=L0 + (s'-S0)80 + (n + l)c0p0-bp0 + dh0 . (45)

This constant may be called the absolute latent heat, as it expresses the thermal value of the change of state in a manner independent of temperature.

The term (dh/8 – d<)>) depending on the variation of the specific heat of the liquid may be made very small in the case of water by a proper choice of the constant s'. It is of the same order as the probable errors of observation, and may be neglected in practice. (See Vaporization, § 12.) The expression for iJlog^ for an im- perfect gas of this type differs from that for a perfect gas only by the addition of the term (c – b)p/8. This simple result is generally true, and the corresponding expressions for G" and J" are valid, provided that s- 6 in formula (17) is a function of the temperature only. It is not necessary to suppose that e varies inversely as the rath power of the temperature, and that b is constant, as assumed in deducing the expressions for

Although the value of G in any case cannot be found without that of , and although the consideration of the properties of the thermodynamic potential cannot in any

case lead to results which are not directly deducible from the two fundamental laws, it affords a convenient method of formal expression in abstract thermodynamics for the condition of equilibrium between different phases, or the criterion of the possibility of a transformation. For such purely abstract purposes, the possibility of numerical evaluation of the function is of secondary importance, and it is often possible to make qualitative deductions with regard to the general nature of a transformation without any knowledge of the actual form of the function. A more common method of procedure, however, is to infer the general relations of the thermodynamic potential from a consideration of the phenomena of equilibrium.

It is often possible to heat a liquid at atmospheric pressure considerably above its boiling-point, especially if it be not exposed to vapour or gas. It is similarly possible to cool a vapour considerably below its condensing- point, in the absence of nuclei, without condensation occurring. Under such conditions, boiling of the liquid or condensation of the vapour may be induced, if they are brought in contact or in various other ways, but is an irreversible process involving local differences of pressure and temperature, which cannot be fully represented on the indicator diagram, since the condition is not one of equilibrium throughout the substance. In such cases there is always dissipation of available energy in friction and diffusion before the equilibrium state is reached, and the value of the function G for the mixture is diminished. The direction of the change of state which occurs may be determined by observing whether G' is greater than G", or vice versd.

As it would be impossible within the limits of this article to illustrate or explain adequately all the applications which have been made of the principles of thermodynamics, it has been necessary to select such illustrations only as are required for other reasons, or could not be found elsewhere. For fuller details and explanations of the elements of the subject, the reader must be referred to general treatises such as Baynes's Thermodynamics (Oxford), Tait's Thermodynamics (Edinburgh), Maxwell's Theory of Seat (London), Parker's Thermodynamics (Cambridge), Clausius's Mechanical Theory of Heat

(translated by Browne, London), and Preston's Theory of Seat (London). One or two chapters on the subject are also generally included in treatises on the steam engine, or other heat engines, such as those of Rankine, Perry, or Ewing. Of greater interest, particularly from a historical point of view, are the original papers of Joule, Thomson, and Rankine, some of which have been reprinted in a collected form. A more complete and more elaborate treatment of the subject will be found in foreign treatises, such as those of Clausius, Zeuner, Duhem, Bertrand, Planck, and others.

Alphabetical Index of Symbols employed.

8, Thermodynamic or absolute temperature. , Entropy. Section 13.

b, Covolume of molecules of gas. Equation (17).

c, c0, Co-aggregation volume per unit mass. Equation (17). e, Base of Napierian logarithms.

FS, Intrinsic energy per unit mass. Section 2.

F=E+pv, Total heat. Section 7.

G, J, Thermodynamic potential functions. Section 15.

S, Quantity of heat (in mechanical units). Section 2.

K, k, Adiabatic and isothermal elasticities. Equation (7).

L, Latent heat of fusion or vaporization. Equation (5).

M, Molecular weight. Section 8.

m, Mass of substance or molecule.

n, Index in expression for c. Equation (17).

p, Pressure of fluid. p0, Initial pressure.

R=Sq-s0, Constant in gas-equation (17).

S, Specific heat of gas at constant pressure.

S0, Limiting value of S when^=0. Section 12.

x, Specific heat of gas at constant volume.

s„, Limiting value of s when p = 0. Section 12.

s , s”, Specific heat under other conditions. Equation (5).

U, Kinetic energy of flow of fluid. Section 10.

u, Mean velocity of gaseous molecules. Section 8.

V=R8/p, Ideal volume of gas per unit mass. Equation (17).

v, Specific volume of fluid, reciprocal of density.

W, External work done by fluid. (h. L. C.)

THERMOELECTRICITY

Thermoelectricity.— The account of this

subject given in the article Electricity, Ency. Brit., vol. viii. p. 94, brings our knowledge of the phenomena down to the epoch of Tait’s theory and experiments. The present article gives a summary of the results of the older work, in order to make the discussion of later theories and researches intelligible.

§ 1. Fundamental Phenomena,. — Volta (1801) showed that although a separation of the two electricities was produced by the contact of two different metals (Volta Effect), which could be detected by a sensitive

electro- meter, a continuous current of corresponding magnitude could not be produced in a purely metallic circuit without the interposition of a liquid, because the electromotive force at one junction was exactly balanced by an equal and opposite force at the other. Seebeck (1822), employ- ing a galvanometer then recently invented, which was more suited for the detection of small electromotive forces, found that a current was produced if the junctions of the two metals were at different temperatures. He ex- plained this effect by supposing that the Volta contact E.M.F. varied with the temperature, so that the exact balance was destroyed by unequal heating. The inten- sity of the current, G, for any given pair of metals was found to vary directly as the difference of temperature, t — t', between the hot and, cold junctions, and inversely as the resistance, £, of the circuit. We conclude by applying Ohm's law that the electromotive force, E, of the thermocouple may be approximately represented for small differences of temperature by the formula

E=CR=p{t-t')

(1)

•§ 2. Thermoelectric Power, Series, Inversion. — The limiting value, dE/dt, of the coefficient, p, for an infini- tesimal difference, dt, between the junctions is called the Thermoelectric Power of the couple. One metal (A) is said to be thermoelectrically positive to another (B), if positive electricity flows from A to B across the cold junction when the circuit is completed. The opposite convention is sometimes adopted, but the above is the most convenient in practice, as the circuit is generally broken at or near the cold junction for the insertion of the galvanometer. Seebeck found that the metals could be arranged in a Thermoelectric Series, in the order of their power when combined with any one metal, such that the power of any thermocouple p, composed of the metals A and B, was equal to the algebraic difference (p —p") of their powers when combined with the standard metal C. The order of the metals in this series was found to be different from that in the corresponding Volta series, and to be considerably affected by variations in purity, hard- ness, and other physical conditions.

Cumming shortly afterwards discovered the phenomenon of Thermoelectric Inversion, or the change of the order of the metals in the thermoelectric series at different temperatures. Copper, for instance, is negative to iron at ordinary temperatures, but is positive to it at 300° C. or above. The E.M.F. of a copper-iron thermocouple reaches a maximum when the temperature of the hot junction is raised to 270° O, at which temperature the thermoelectric power vanishes and the metals are said to be neutral to one another. Beyond this point the E.M.F. diminishes, vanishing and changing sign when the temperature of the hot junction is nearly as mueh above the neutral point as the tem- perature of the cold junction is below it. Similar pheno- mena occur in the case of many other couples, and it is found that the thermoelectric power p is not in general a constant, and that the simple linear formula (1) is applic- able only for small differences of temperature. More accurately it may be stated that the thermo-E.M.F. in

any given circuit containing a series of different metals is a function of the temperatures of the junctions only, and is independent of the distribution of the temperature at any intermediate points, provided that each of the metals in the series is of uniform quality. This state- ment admits of the simple mathematical expression

E= /”!’ p’dt+ f’t’ p”dt + &c.

(2);

where p’, p”, &c, are the thermoelectric powers of the metals, and t0, t’, t,” &c, the temperatures of the junctions. There are some special cases of sufficient practical im- portance to be separately stated.

§ 3. Homogeneous Circuit. Strain Hysteresis. — In a circuit consisting of a single metal, no current can be produced by variations of temperature, provided that the metal is not thereby strained or altered. This was par- ticularly demonstrated by the experiments of Magnus. The effects produced by abrupt changes of temperature or section, or by pressing together pieces of the same metal at different temperatures, are probably to be ex- plained as effects of strain. A number of

interesting effects of this nature have been investigated by Thomson, Le Eoux, Tait, and others, but the theory has not as yet been fully developed. An interesting example is fur- nished by an experiment due to Trouton (Proc. E. S. Dub., 1886). A piece of iron or steel wire in the circuit of a galvanometer is heated in a flame to bright redness at any point. No effect is noticed so long as the flame is stationary, but if the flame be moved slowly in one direc- tion a current is observed, which changes its direction with the direction of motion of the flame. The explana- tion of this phenomenon is that the metal is transformed at a red heat into another modification, as is proved by simultaneous changes in its magnetic and electrical pro- perties. The change from one state to the other takes place at a higher temperature on heating than on cooling. The junctions of the magnetic and the non-magnetic steel are therefore at different temperatures if the flame is moved, and a current is produced just as if a piece of different metal with junctions at different temperatures had been introduced into the circuit. Other effects of ” hysteresis ” occur in alloys of iron, which have been recently studied by Barrett (Trans. E. S. Bub., Jan.

1900).

§ 4. Law of Successive Temperatures. — The E.M.F. of a given couple between any temperatures t’ and t” is the algebraic sum of the E.M.F. between t’ and any other temperature t and the E.M.F. between t and t”. A useful result of this law is that it is sufficient to keep one junc- tion always at some convenient standard temperature, such as 0° O, and to tabulate only the values of the E.M.F. in the circuit corresponding to different tem- peratures of the other junction.

§ 5. Law of Intermediate Metals. — A thermoelectric circuit may be cut at any point and a wire of some other metal introduced without altering the E.M.F. in the circuit, provided that the two junctions with the metal introduced are kept at the same temperature. This law is commonly applied in connecting a thermocouple to a galvanometer with coils of copper wire, the junctions of the copper wires with the other metals being placed side by side in a vessel of water or otherwise kept at the same temperature. Another way of stating this law, which, though

apparently quite different, is really equivalent in effect, is the following. The E.M.F. of any couple, AB, for any given limits of temperature is the algebraic sum of the E.M.F.s between the same limits of temperature of the couples BC and CA formed with any other metal C. It is for this reason unnecessary to tabulate the E.M.F.s

of all possible combinations of metals, since the E.M.F. of any couple can be at once deduced by addition from the values given by its components with a single standard metal. Different observers have chosen different metals as the standard of reference. Tait and Fleming select lead on account of the smallness of the Thomson effect in it, as observed by Le Roux. Noll adopts mercury because it is easily purified, and its physical condition in the liquid state is determinate ; there is, however, a discon- tinuity involved in passing from the liquid to the solid state at a temperature of – 40° C, and it cannot be used at all with some metals, such as lead, on account of the rapidity with which it dissolves them. Both lead and mercury have the disadvantage that they cannot be employed for temperatures much above 300° C. Of all metals, copper is the most generally convenient, as it is always employed in electrical connexions and is easily obtjained in the annealed state of uniform purity. For high temperature work it is necessary to employ platinum, which would be an ideal standard for all purposes on account of its constancy and infusibility, did not the thermoelectric properties of different specimens differ considerably.

§ 6. Thermoelectric Formulae, — On the basis of the principles stated above, the most obvious method of tabulating the observa- tions would be to give the values Et of the E.M.F. between 0° C. and t for each metal against the standard. This involves no assumptions as to the law of variation of E.M.F. with temperature, but is somewhat cumbrous. In the majority of cases it is found that the observations can be represented within the limits of ex- perimental error by a fairly simple empirical formula, at least for

moderate ranges of temperature. The following formulae are some of those employed for this purpose by different observers : —

Et=bt + cP .

Et=at + bf+ct!s

log E=a + b/T+c log T

.§«_„= <:(*-«') (2*° -it+H)) Et + Ee = 10"+M + KK+w t=aE+bE2 + cE> . Ea-f) = b(t -?)*”> . E(t-f) = a{t-t’) + b(t-ff Et^-f)=inTn-mTn, Et=mt» Et=bt + clog T/273, (c=Ts.) . Et=-a + bt + cP . Et= at + cP + s°(T log eT-21S log e2‘73). (“Where s=s° + 2cT, and c is small.

(Avenarius, 1863.) (General type.) (Becquerel, 1863.) (Tait, 1870.) (Barus, 1889.) (Holborn and Wien, (Paschen, 1893.) (Steele, 1894.) (Holman, 1896.) (Stansfield, 1898.) (Holborn and Day, 1899.)

1892.)

See sec. 15.)

For moderate ranges of temperature the binomial formula of Avenarius is generally sufficient, and has been employed by many observers. It is figured by Avenarius (Pogg. Ann., 119, p. 406) as a semi-circle, but it is really a parabola with its axis parallel to the axis of E, and its vertex at the point t= -b/2c, which gives the neutral temperature. We have also the relations dE/dt = b + 2d and cPEjdp=2c. The first relation gives the thermoelectric power p at any temperature, and is probably the most convenient method of stating results in all cases in which this formula is applicable. A discussion of some of the exponential formulae ia given by Holman (Phil. Mag., 41, p. 465, June 1896).

§ 7. Experimental Results. — In the following comparative table of the results of different observers the values are referred to lead. Before the time of Tait’s researches such data were of little interest or value, on account of insufficient care in securing the purity’ of the materials

tested ; but increased facilities in this respect, com- bined with great improvements in electrical measurements, have put the question on a different footing. The comparison of in- dependent results shows in many cases a remarkable concordance, and the data are becoming of great value for the testing of various theories of the relations between heat and electricity.

Table I. — Thermoelectric power, p— dE/dt, in microvolts at 50° C. or pure metals with respect to lead. (The mean change, 2c=d2E/dP, of the thermoelectric power per degree C. over the range covered by the experiments, is added in each case.)

Metal.

Tait (0″ to 300”).

Steele (0° to 100°).

Soil (0° to 200”).

Dewar and Fleming (+100″ to -200°).

P-

2c.

P-

2c.

P-

2c.

P-

2c.

Aluminium .

-0-56

+ -0039

-0-42

+ -0021

-0-41

+ -00174

-0-394

+ -00398

Antimony

+ 42-83

+ -1450*

+ 3-210

+ -02817

Bismuth

-76-870

- -08480

Cadmium

+ 475

+ -0429

+ 4:79

+ -0389

+ 4-71

+ -0339

+ 4-792

+ -02365

Carbon .

+ 12-795

+ -03251

Copper . Cobalt .

+ l’-81*

+ -0095

+ 3:37

+ -0122

+ 3-22

+ -0080

+ 3-156

+ “00683

-19-252

- -0734

Gold .

+‘3-30

+ -oi.02

+ 8-19

+ -0131

+ 3-10

+ -0063

+ 1-161

+ -00315

Iron

+ 14-74

- -0487

+ 11-835

- -0306

+ 14-522

- -01330

Steel (piano) Steel (Mn 12

+ 9-75

- -0328

+ 9-600

- -01092

0

-5-73

- -00445

Magnesium

+‘i’-75*

<- -0095

-0-113

+ -0019

-0-126

+ -00353

Mercury

...

-4-03

- -0086

Nickel .

- 24-23*

- -0512

• ••

-20-58

- -0302

- 18-87

- -05639

Palladium

•

-8-04

- -0359

-9-100

- -04714

Platinum

-1-15*

- -0110

-‘4-09

- -0211

-4-347

- -03708

Silver .

+ 2-86

+ -0150

+ 3:07

+ -0115

+ 2-68

+ -0076

+ 3-317

+ -00714

Thallium

+ 1-76

- -0077

Tin

-0-16

+ -0055

-0-091

+ -0004

- 0-067

+ -0019

+ 0-057

+ -00021

Zinc

+ 3-51

+ -0240

+ 1-77*

+ -0195

+ 3-318

+ -0172

+ 3-233

+ -01040

Explanation of Table. — The figures marked with an asterisk represent discrepancies which are probably caused by impurities in the specimens. At the time of Tait's work in 1873 it was difficult, if not impossible, in many cases to secure pure materials. The work of the other three observers dates from 1894-95. The value of the thermoelectric power dE/dt at, 50° C. is taken as the mean value between 0° and 100° C, over which range it can be most accurately determined. The values of d?E/dfi agree as well as can be expected, considering the difference of the ranges of temperature and the great variety in the methods of observation adopted ; they are calculated assuming the parabolic formula, which is certainly in many cases inadequate. Noll's values apply to the temperature of +100° C, Dewar and Fleming's to that of ~~100° C, approxi~~ mately.

In using the above table to find the value of E or dE/dt at any temperature or between any limits, denoting by p the value of dE/dt at 50° C, and by 2c the constant value of the second coefficient, we have the following equations : —

=p + 2c (t – 50), at any temperature t, Cent.

(3), (4),

E(t-n = {t-t)(p + c{t + t’- 100)) . for the E.M.F. between any temperatures t and t’.

§8. Methods of Observation. — In Tait’s observations the E.M.F. was measured by the deflection of a mirror galvanometer, and tfie temperature by means of a mercury thermometer or an auxiliary thermocouple. He states that the deviations from the formula were ‘ ‘ quite within the limits of error introduced by the altera- tion of the resistance of the circuit with rise of temperature, the deviations of the mercury thermometers from the absolute scale, and the non-correction of the indications of the thermometer for the long column of mercury not immersed in the hot oil round the junctions.” The latter correction may amount to about 10° C. at 350°. Later observers have generally employed a balance method (some modification of the Potentiometer or Poggendorf balance) for measuring the E.M.F. The range of Steele’s observations was too small to show any certain deviation from the formula, but he

notes capricious changes attributed to change of condition of the ■wires. Noll employed mercury thermometers, but as he worked over a small range with vapour baths, it is probable that he did not experience any trouble from immersion corrections. He does not record any systematic deviations from the formula. Dewar and Fleming, working at very low temperatures, were compelled to use the platinum thermometer, and expressed their results in terms of the platinum scale. Their observations were probably free from immersion errors, but they record some deviations from the formula which they consider to be beyond the possible limits of error of their work. The writer has reduced their results to the scale of the gas thermometer, assuming the boiling-point of oxygen to be – 182-5° C.

§ 9. Peltier Effect.— The discovery by Peltier (1834) that heat is absorbed at the junction of two metals by passing a current through it in the same direction as the current produced by heating it, was recognized by Joule as affording a clue to the source of the energy of the current by the application of the principles of thermo- dynamics. Unlike the frictional generation of heat due to the resistance of the conductor, which Joule (1841) proved to be proportional to the square of the current, the Peltier effect is reversible with the current, and being directly proportional to the first power of the current, changes sign when the current is reversed. The effect is most easily shown by connecting a voltaic cell to a thermopile for a short interval, then quickly (by means of a suitable key, such as a Pohl commutator with the cross connectors removed) disconnecting the pile from the cell and connecting it to a galvanometer, which will indicate a current in the reverse direction through the pile, and approximately proportional to the original current in intensity, provided that the other conditions of the ex- periment are constant. It was by an experiment of this kind that Icilius (1853) verified the proportionality of the heat absorbed or generated to the first power of the current. It had been observed by Peltier and Becquerel that the intensity of the effect depended on the thermo- electric power of the junction and was independent of its form or dimensions. The order of the metals in respect of the Peltier effect was found to be the same as the thermoelectric series. But on account of the difficulty of the measurements involved, the verification of the accurate relation between the Peltier effect and thermoelectric power was left to more recent times. If C is the intensity of the current through a simple thermocouple, the junctions of which are at temperatures t and t', a quantity of heat, P x C, is absorbed by the passage of the current per second at the hot junction, t, and a quantity, P' x C, is evolved at the cold junction, t'. The coefficients, P and P, are called coefficients of the Peltier effect, and may be stated in calories or joules per ampere-second. The Peltier coefficient may also be expressed in volts or micro- volts, and may be regarded as the measure of an E.M.F. located at the junction, and transforming heat into elec- trical energy or vice versd. If ~~K is the whole resistance of the circuit, and E the E.M.F. of the couple, and if the flow of the current does not produce any other thermal effects in the circuit besides the Joule and Peltier~~

~~effects, we should find by applying the principle of the conserva~~ tion of energy, i.e., by equating the balance of the heat absorbed by the Peltier effects to the heat generated in the circuit by the Joule effect,

(P-F)C=C2R=EC, whence E=P-P. . (5)

If we might also regard the couple as a reversible thermo- dynamic engine for converting heat into work, and might neglect irreversible effects, such as conduction, which are independent of the current, we should expect to find the ratio of the heat absorbed at the hot junction to the heat evolved at the cold junction, namely P/P, to be the same as the ratio TJI" of the absolute temperatures of

the junctions. This would lead to the conclusion given by Clausius (1853) that the Peltier effect varied directly as the absolute temperature, and that the E.M.F. of the couple should be directly proportional to the difference of temperature between the junctions.

§ 10. Thomson Effect. — Thomson (Lord Kelvin) had already pointed out (Proc. R. S. Ed., 1851) that this con- clusion was inconsistent with the known facts of thermo- electric inversion. (1) The E.M.F. was not a linear function of the temperature difference. (2) If the Peltier effect was proportional to the thermoelectric power and changed sign with it, as all experiments appeared to indicate, there would be no absorption of heat in the circuit due to the Peltier effect, aud therefore no thermal source to account for the" energy of the current, in the case in which the hot junction was at or above the neutral tempera- ture. He there- fore predicted that there must be a reversible absorp- tion of heat in some other part of the circuit due to the flow of the cur- rent through the unequally – heated conductors. He succeeded a few years afterwards in verifying this remarkable predic- tion by the experimental demonstration that a current of positive electricity flowing from hot to cold in iron pro- duced an absorption of heat, as though it possessed negative specific heat in the metal iron. He also succeeded in show- ing that a current from hot to cold evolved heat in copper, but the effect was smaller and more difficult to observe than in iron.

The Thomson effect may be readily demonstrated as a lecture experiment by the following method (Fig. 1). A piece of wire (No. 28) about i cm. long is soldered at either end A, B to thick wires (No. 12), and is heated 100° to 150° C. by a steady current from a storage cell adjusted by a. suitable rheostat. The experi- mental wive AB is connected in parallel with about 2 metres of thicker wire (No. 22), which is not appreciably heated. A low- resistance galvanometer is connected by a very fine wire (2 to 3 mils) to the centre C of the experimental wire AB, and also to the middle point D of the parallel wire so as to form a Wheatstone bridge. The balance is adjusted by shunting either AD or BD with a box containing 20 to 100 ohms. All the wires in the quadrilateral must he of the same metal as AB, to avoid accidental 'thermoelectric effects which would obscure the result. If the current flows from A to B there will be heat absorbed in AC and evolved in CB by the Thomson effect, if the specific heat of electricity in AB is positive as in copper. When the current is reversed, the temperature of AC will be raised and that of CB lowered by the reversal of the effect. This will disturb the resist- ance balance by an amount which can be measured by the deflection of the galvanometer, or by thp change of the. shunt-box, S, required to restore the balance. Owing to the small size of the experimental wire, the method is very quick and sensitive, and the apparatus can be set up in a few minutes when once the experimental quadrilaterals have been made. It works very well with platinum, iron, and copper. It was applied with elaborate modifications by the writer in 1886 to determine the value of the Thomson effect in platinum in absolute measure, and has recently been applied with further improvements by King to measure the effect in copper.

§11. Thomson's Theory. — Taking account of the Thom- son effect, the thermodynamical theory of the couple was satisfactorily completed by Thomson (Trans. B. S. Ed.,

Fig. 1. — Diagram of Apparatus for Demon- strating the Thomson Effect.

1854). If the quantity of heat absorbed and converted into electrical energy, when unit quantity of electricity (one ampere-second) flows from cold to hot through a difference of temperature, dt, be represented by edt, the coefficient * is called the specific heat of electricity in the metal, or simply the coefficient of the Thomson effect. Like the Peltier coefficient, it may be measured in joules or calories per ampere-second per degree, or more con- veniently and simply in microvolts per degree.

Consider an elementary couple of two metals A and B for which s has the values s1 and s” respectively, with junctions at the temperatures T and T+dT (absolute), at which the coefficients of the Peltier effect are P and P+dP. Equating the quantity of heat absorbed to the quantity of electrical energy generated, we have by the first law of thermodynamics the relation

dEldT=dPjdT+{s’-s”) . .. . (6)

If we apply the second law, regarding the couple as a reversible engine, and considering only the reversible effects, we obtain

(s’-s”)IT=-d{plT)ldT . . . (7)

Eliminating {/ – s”) we find for the Peltier effect

P=TdE/dT=Tp . . . . (8)

“Whence we obtain for the difference of the specific heats

tf-s”)=-Td?EldT2=-Tdp/dT . . (9)

From these relations we o’bserve that the Peltier effect P, and the difference of the Thomson effects (s’ – s”), for any two metals are easily deduced from the tabulated values of dJZ/dt and cPEjdft respectively. The signs in the above equations are chosen on the assumption that positive electricity flows from cold to hot in the metal s1. The signs of

the Peltier and Thomson effects will be the same as the signs of the coefficients given in Table I., if we suppose the metal s' to be lead, and assume that the value of i/ may be taken as zero at all temperatures.

§ 12. Experimental Verification of Thomson's Theory. — In order to justify the assumption involved in the application of the second law of thermodynamics to the theory of the thermocouple in the manner above specified, it would be necessary and sufficient, as Thomson pointed out {Phil. Mag., December 1852), to make experiments to verify quantitatively the relation P\T=dE\dT between the Peltier effect and the thermoelectric power. A quali- tative relation was known at that time to exist, but no absolute measurements of sufficient accuracy had been made. The most accurate measurements of the heat absorption due to the Peltier effect at present available are probably those of Jahn (Wied. Ann., 34, p. 755, 1888). He enclosed various metallic junctions in a Bunsen ice calorimeter, and observed the evolution of heat per hour with a current of about 1"6 amperes in either direction. The Peltier effect was only a small fraction of the total effect, but could be separated from the Joule effect owing to the reversal of the current. The values of dE/dT for the same specimens of metal at 0° 0. were determined by experiments between +20° C. and -20° 0. The results of his observations are contained in the following table, heat absorbed being reckoned positive as in Table I.:—

Table II.

Thermo- couple.

dE/dT

P=TdE/dT

Heat calc.

Heat observ'd

Microvolts

Microvolts

Calories

Calories

per (leg.

at 0″ C.

per hour.

per hour.

Cu-Ag

+ 2-12

+ 579

+ 0-495

+ 0-413

Cu-Fe

+ 11-28

+ 3079

+ 2-640

+ 3-163

Cu-Pfc

-1-40

-382

-0-327

-0-320

Cu-Za

+ 1-51

+ 412

+ 0-353

+ 0-585

Cu-Cd

+ 2-64

+ 721

+ 0-617

+ 0-616

Cu-tfi

-20-03

-5468

-4-680

-4-362

The agreement between the observed and calculated values in the last two columns is as good as can be expected considering the great difficulty of measuring such small quantities of heat. The analogous reversible heat effects which occur at the junction of a metal and an

electrolyte were also investigated by Jahn, but he did not succeed in obtaining so complete an agreement with theory in this case.

§ 13. Tait's Hypothesis. — From general considera- tions concerning minimum dissipation of energy (Proc. B. S. Ed., 1867-68), Tait was led to the conclusion that " the thermal and electric conductivities of metals varied inversely as the absolute temperature, and that the specific heat of electricity was directly proportional to the same."

Subsequent experiments led him to doubt this conclusion as regards conductivity, but his thermoelectric experi- ments (Proc. R. S. Ed., Dec. 1870) appeared to be in good agreement with it. If we adopt this hypothesis, and substitute s = 2cT, where c is a constant, in the fundamental equation (9), we obtain at once cPE/dT2 = – 2 (c' – c"), which is immediately integrable, and gives

dE/dt=p = 2(t<,-t)(c'-c") . . (10), Et-t. = (t-q{c> ~~c")(2t0~~(t + e)} . . (11), where t0 is the temperature of the neutral point at which dE/dt = Q. This is the equation to a parabola, and is equivalent to the empirical formula of Avenarius, with this difference, that in Tait's formula the constants have all a simple and direct interpretation in relation to the theory. Tait's theory and formula were subsequently assimilated by Avenarius (Pogg. Ann., 149, p. 372, 1873), and are now generally attributed to Avenarius in foreign periodicals.

In accordance with this hypothesis, the curves repre- senting the variations of thermoelectric power, dEjdt, with temperature are straight lines, the slope of which for any couple is equal to the difference of the constants 2(c' – c"). The diagram constructed by Tait on this principle is fully explained and illustrated in the article Electricity (Ency. Brit., vol. viii. p. 97). It has since been gene- rally adopted as embodying in a simple form the funda- mental phenomena of thermoelectricity.

§ 14. Experimental Verification. — Tait's verification of this hypothesis consisted in showing that the experimental curves of E.M.F. were parabolas in most cases within the limits of error of his observations. He records, however, certain notable diver- gencies, particularly in the

case of iron and nickel, and many others have since come to light from other observations. It should also be remarked that even if the curves were not parabolas, it

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Fig. 2. — Temperature by Thermocouple. Difference from Tait’s formula.

would always be possible to draw parabolas to agree closely with the observations over a restricted range of temperature. “When the question is, tested more carefully, either by taking more accurate measurements of temperature, or by extending the observations over a wider range, it is found that there are systematic deviations from the parabola in the majority of cases, which cannot be ex- plained by errors of experiment. A more accurate verification of these relations, both at high and low extremes of temperature, has become possible of late years owing to the development of the theory and application of the platinum resistance thermometer. (See Thermometry.) The curves in Fig. 2 illustrate the differences from the parabolic formula, measuredin degrees of temperature, as observed by Tory (B. A. Report, 1897). The deviations for the copper-iron couple, and for the copper cast-iron couple over the range 0° to 200° C, appear to be of the order of 1° C., and were carefully verified by repeated and independent series of observa- tions. The deviations of the platinum and platinum-rhodium 10 per cent, couple over the range 0° to 1000° C. are shown on a

smaller scale, and are seen to be of a similar nature, but rather greater in proportion. It should be observed that these deviations are continuous, and differ in character from the abrupt changes observed by Tait in special cases. A number of similar deviations at temperatures below 0° C. were found by the writer in reducing the curves representing the observations of Dewar and Fleming (Phil. Mag., July 1895) to the normal scale of temperature from the platinum scale in which they are recorded. In many cases the deviations do not appear to favour any simple hypothesis as to the mode of variation of s with temperature, but as a rule the indica- tion is that s is nearly constant, or even diminishes with rise of temperature. It may be interesting therefore to consider the effect of one or two other simple hypotheses with regard to the mode of variation of s with T.

§ 15. Other Assumptions. — If we take the analogy of a perfect gas and assume s=s° = constant, we have

d&ldT2= – s°/T, dEldT=s° log ,T'/T . (12),

E{T-r)=s°T log eT°IT- s°T log eT°/r . (13),

where T and T are the temperatures of the junctions, and T° is the neutral temperature. These formulae are not so simple and con- venient as Tait's, though apparently founded on a more simple assumption, but they frequently represent the observations more closely. If we suppose that s is not quite constant, but increases or diminishes slightly with change of temperature according to a linear formula s=s° + 2cT (in which s° represents the constant part .of s, and c may have either sign), we obtain a more general formula which is evidently the sum of the two previous solutions and may be made to cover a greater variety of cases (see above, p. 291). Another simple and possible assumption is that made by Stansfield (Phil. Mag., July 1898), that the value of s varies inversely as the absolute temperature. Putting s=c/T, we obtain

Ew-T)=c\ogeT\r-c(T-T)\T° . . (14),

which is equivalent to the form given by Stansfield, but with the neutral temperature T° explicitly included. According to this formula, the Peltier effect is a linear function of the temperature. It may appear at first sight astonishing that it should be possible to apply so many different assumptions to the solution of one and the same problem. In many cases a formula of the last type would be quite inapplicable, as Stansfield remarks, but the differ- ence between the three is often much less than might be supposed. For instance, in the case of 10% Rh. Pt. – Pt. couple, if we cal- culate three formulae of the above types to satisfy the same pair of observations at 0″ – 445° and 0° – 1000° C, we shall find that the formula s= constant lies midway between that of Tait and that of Stansfield, but the difference between the formulae is of the same order as that between different observers. In this particular case the parabolic formula appears to be undoubtedly inadequate. The writer's observations agree more nearly with the assumption s= constant, those of Stansfield with s=c/T. Many other formulae have been suggested. Holborn and Day (Berl. ATcad., 1899) have gone back to Tait's method at high temperatures, employing arcs of parabolas for limited ranges. But since the parabolic formula is certainly erroneous at low temperatures, it can hardly be trusted for extrapolation above 1000° 0.

§ 16. Absolute Measurement of Thomson, Effect. — Another method of verifying Tait's hypothesis, of greater difficulty but of con- siderable interest, is to measure the absolute value of the heat ab- sorbed by the Thomson effect, and to observe whether or not it varies with the temperature. Le Roux (Ann. Chim. Phys. x. p. 201, 1867) made a number of relative measurements of 'the

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Fig. 3. — Thomson Effect. Batelli (Le Roux’s method).

effect in different metals, which agreed qualitatively with ob- servations of the thermoelectric power, and showed that the effect was proportional to the current for a given temperature gradient. Batelli has applied the same method (Accad. Sci. Turin, 1886) to the absolute measurement. He observed with a thermocouple the difference of temperature (about ‘01° C.) produced by the Thomson effect in twenty minutes between two mercury calori- meters, 2?i and _B2, surrounding the central portions of a pair of rods arranged as in Le Roux’s method (see Fig. 3). The value of the Thomson effect was calculated by multiplying this difference of temperature by the thermal capacity of either calorimeter, and dividing by the current, by the number of seconds in twenty minutes, and by twice the difference of temperature (about 20°)

between the ends a and b of either calorimeter. The method appears to be open to the objection that the difference of tempera; ture reached in so long an interval would be more or less inde- pendent of the thermal

capacities of the calorimeters, and would also be difficult to measure accurately with a thermocouple under the conditions described. The general results of the work ap- peared to support Tait's hypothesis that the effect was proportional to the absolute temperature, but direct thermoelectric tests do not appear to have been made on the specimens employed, which would have afforded a valuable confirmation by the comparison of the values of cPE/dT2, as in Jahn's experiments.

§ 17. King's Experiments. — The method employed by the writer, to which allusion has already been made, consisted in observing the change of distribution of temperature in terms of the resistance along a wire heated by an electric current, when the heating current was reversed. It has been fully described by King (Proc. Amer. Acad., June 1898), who applied it most successfully to the case of copper. Although the effect in copper is so small, he suc- ceeded in obtaining changes of temperature due to the Thomson effect of the order of 1° C. , which could be measured with satis- factory accuracy. He also determined the effect of change of

2000

Cd -L+47/ = £

°1 Pt T~403= £

6000

Ni -f-20S8=E

100°

Fig. 4. — Potential Diagrams of Thermocouple on the Contact Theory.

temperature distribution on the rate of generation of heat by the current, and on the external loss of heat by radiation, convection, and conduction. It is necessary to take all these conditions carefully into account in calculating the balance due to the Thomson effect. According to King's experiments, the value of the effect appears to

diminish with rise of temperature to a slight extent in copper, but the diminution is so small that he does not regard it as established with certainty. The value found at a temperature of 150° C. was + 2‘5 microjoules per ampere-second per degree, or +2-5 micro- volts per degree in the case of copper, which agrees very fairly with the value deduced from thermoelectric tests. The value found by Batelli for iron was – 5‘0 microvolts per degree at 108° C, which appears too small in comparison. These measurements, though subject to some uncertainty on account of the great ex- perimental difficulties, are a very valuable confirmation of the accuracy of Thomson’s theory, because they show that the magni- tude of the effect is of the required order, but they cannot be said to be strongly in support of Tait’s hypothesis. A comparison of the results of different observers would also suggest that the law of variation may be different in different metals, although the dif- ferences in the values of d?E/dT* may be due in part to differences of purity or errors of observation. It would appear, for instance, according to the observations of Dewar and Fleming, that the value of s for iron is positive below – 150° C, at which point it vanishes. At ordinary temperatures the value is negative, increasing rapidly in the negative direction as the temperature rises. This might be appropriately represented, as already suggested, by * linear for- mula s=s°-cT.

§ 18. Potential Diagrams on the Contact Theory. — It is instruc- tive to consider the distribution of potential in a thermoelectric

circuit, and ita relation to the resultant E.M.F. and to the Beat of the E.M.F. In Fig. 4, which is given as an illustration, the cold junctions are supposed to be at 0° C. and the hot junctions at 100° C. Noll’s values (Table I.) are taken for the E.M.F., and it is supposed that the coefficient of the Thomson effect is zero in lead, i.e. that there is no E.M.F. and that the potential is uniform throughout the length of the lead wire. Taking the lead-iron couple as an example, the value of dE/dt at the hot junction 100° C. is 10 ‘305 microvolts per degree, and the

value of the Peltier coefficient P = TdE/dT is +3844 microvolts. In other words, we may suppose that there is an E.M.F. of that magnitude situated at the junction which causes positive electricity to now from the lead to the iron. If the circuit is open, as repre- sented in the diagram, the flow will cease as soon as it has raised the potential of the iron 3844 microvolts above that of the lead. In the substance of the iron itself there is an E.M.F. due to the Thomson effect of about 10 microvolts per degree tending to drive positive electricity from hot to cold, and raising the cold end of the iron 989 microvolts in potential above the hot end on open circuit. At the cold junction the iron is supposed to be connected to a piece of lead at 0° C. , and there is a sudden drop of potential due to the Peltier effect of 3648 microvolts. If the circuit is cut at this point, there remains a difference of potential £=1184 microvolts, the resultant E.M.F. of the circuit, tending to drive positive electricity from the iron to the lead across the cold junction. If the circuit is closed, there will be a current 0=EjR, where R=R + R", the sum of the resistances of the lead and iron. The flow of the current will produce a fall of potential ER'/R in the lead from cold to hot,. and ER"IR in the iron from hot to cold, hut the potential difference due to the Peltier effect at either junction will not be affected. For simplicity in the diagram the temperature gradient has been taken as uniform, and the specific heat s= constant, but the total. P.D. would be the same whatever the gradient.

Similar diagrams are given in Fig. 4 for cadmium in which both the specific heat and the Peltier effect are positive, and also for platinum and nickel in which both coefficients are negative. The metals are supposed to be all joined together at the hot junction, and the circuit cut in the lead near the cold junction. The diagram will serve for any selected couple, such as iron-nickel, and is not restricted to combinations with lead. The following table shows the component parts of the E.M.F. in each case : —

Thermocouple.

Iron-lead Cadmium-lead Platinum-lead Nickel-lead .

Table III.

•Moo ~ “o

+ 3844 – +3648

+ 2389 – +823

-1919 – -828

-8239 – -5206

-100X0,0 = E0.100

-988 = +1184

+ 1095 = +471

-682 = -409

-975 = -2058

The components for any other combination of two are found by taking the algebraic difference of the values with respect to lead.

§ 1 9. Relation to the Volta Effect. — It is now generally conceded that the Relatively large differences of potential observable with an electrometer between metals on open circuit, as discovered by Volta, are due to the chemical affinities of the metals, and have no direct relation to thermoelectric phenomena or to the Peltier effect. The order of the metals in respect of the two effects- is quite different. The potential difference, due to the Volta effect in air, has been shown by Thomson (Lord Kelvin) and his pupils to be of the same order of magnitude, if not absolutely the same, as that produced in a dilute electro- lyte in which two metallically-connected plates (e.g., zinc and copper) are immersed. (On this hypothesis, it may be explained by regarding the air as an electrolyte of infinite specific resistance.) It is also profoundly modified by the state of the exposed surfaces, a coating of oxide on the copper greatly increasing the effect, as it would in a voltaic cell. The Peltier effect and the thermo-E.M.F., on the other hand, do not depend on the state of the surfaces, but only on the state of

the substance. An attempt has been made to explain the Volta effect as due to the affinity of the metals for each other, but that would not account for the variation of the effect with the state of the surface, except as affecting the actual surface of contact. It is equally evident that chemical affinity between the metals cannot be the explanation of the Peltier E.M.F. This would necessitate chemical action at the junction when a current passed through it, as in

an electrolytic cell, whereas the action appears to be purely thermal, and leads to a consistent theory on that hypothesis. The chemical action between metals in the solid state must be infinitesimal, and could only suffice to produce small charges analogous to those of frictional electricity ; it could not maintain a permanent difference of potential at a metallic junction through which a current was passing. Although it is possible that differences of potential larger than the Peltier effect might exist between two metals in contact on open circuit, it is certain that the only effective E.M.F. in practice is the Peltier effect, and that the difference of potential in the substance of the metals when the circuit is complete cannot be greater than the coefficient P. The Peltier effect, it may be objected, measures that part only of the potential difference which depends upon temperature, and can therefore give no information about the absolute potential difference. But the reason for concluding that there is no other effective source of potential difference at the junction besides the Peltier effect, is simply that no other appreciable action takes place at the junction when a current passes except the Peltier generation or absorption of heat.

§ 20. Convection Theory. — The idea of convection of heat by an electric current and the phrase ” specific heat of electricity” were introduced by Thomson as a con- venient mode of expressing the phenomena of the Thom- son effect. He did not intend to imply that electricity really possessed a positive or negative specific heat, but merely that a quantity of heat was absorbed in a metal when unit quantity of electricity flowed from cold to hot through a difference of temperature of 1°. The absorp- tion of heat was considered as representing an equivalent conversion of heat energy into electrical energy in the element. The element might thus be regarded as the seat

of an E.M.F., dE=sdT, where dT is the difference of temperature between its ends. The potential diagrams already given have been drawn on this assumption, that the Thomson effect is not really due to convection of heat by the current, but is the measure of an E.M.F. located in the substance of the conductor. This view with regard to the seat of the E?M.F. has been generally taken by the majority of writers on the subject. It is not, however, necessarily implied in the reasoning or in the equations given by Thomson, which are not founded on any assumptions with regard to the seat of the E.M.F., but only on the balance of heat absorbed and evolved in all the different parts of the circuit. In fact, the equations themselves are open to an entirely different interpretation in this respect from that which is generally given.

Returning again to the equations already given in § 1 1 for an elementary thermocouple, we have the following equivalent expressions for the E.M.F. dE, namely,

$$dE= dP+ (s' – s'')dT= (P/T)dT=pdT= (p'' -p')dT,$$

in which the coefficient, P, of the Peltier effect, and the thermoelectric power, p, of the couple, may be expressed in terms of the difference of the thermoelectric powers, p' and p", of the separate metals with respect to a neutral standard. So far as these equations are concerned, we might evidently regard the seat of the E.M.F. as located entirely in the conductors themselves, and not at all at the junctions, if p or (p" — p) is the difference of the E.M.F.s per degree in corresponding elements of the two metals. In this case, however, in order to account for the phenomenon of the Peltier effect at the junctions, it is necessary to suppose that there is a real convection of heat by an electric current, and that the coefficient P or pT is the difference of the quantities of heat carried by unit quantity of electricity in the two metals. On this hypothesis,

if we confine our attention to one of the two metals, say p”, in which the current is supposed to flow from hot to cold, we observe that p”dT expresses the quantity of heat converted into electrical energy per unit of electricity by an E.M.F. p” per 1° located in the element dT. It happens that the absolute magnitude of p” cannot be experimentally determined, but this is immaterial, as we are only concerned with differences. The quantity of heat liberated by convection as the current flows from hot to cold is represented in the equation by dP = d(pT). Since d(p”T) =p”dT+ Tdp”, it is clear that the balance of heat liberated in the element is only Tdp” = s”dT, namely, the Thomson effect, and is not the equivalent of the E.M.F. p”dT, because on this theory the absorption of heat is masked by the convection. If p is constant there is no Thomson effect, but it does not follow that there is no E.M.F. located in the element. The Peltier effect, on the other hand, may be ascribed entirely to convection. The quantity of heat p”T is brought up to one side of the junction per unit of electricity, and the quantity of heat p’T taken away on the other. The balance (p” —p’)T is evolved at the junction. If, therefore, we are prepared to admit that an electric current can carry heat, the exist- ence of the Peltier effect is no proof that a corresponding E.M.F. is located at the junction, or, in other words, that the conversion of heat into electrical energy occurs at this point of the circuit, or is due to the contact of dis- similar metals. On the contact theory, as generally adopted, the E.M.F. is due entirely to change of substance (dP – Tdp) ; on the convection theory, it is due entirely to change of temperature (pdT). But the two expressions are equivalent, and give the same results.

§ 21. Potential Diagrams ore Convection Theory. — The difference between the two theories is most readily appreciated by drawing the potential diagrams corresponding to the supposed locations of the E.M.F. in each case. The contact theory has been already illustrated in Fig. 4. Corresponding diagrams for the same metals on the convection theory are given in Fig. 5. In this

.Scale of Temperature Centigrade^ 200 —100 0 +100 +200 \ +300

- **Fio. 5.— Curves of Thermo-E.M.F., or Potential Diagrams, on the Convection Theory.**

diagram the metals are supposed to be all joined together and to be at the same time potential at the cold junction at 0° C. The ordinate of the curve at any temperature is the difference of potential between any point in the metal and a point in lead at the same temperature. Since there is no contact E.M.F. on this theory, the ordinates also represent the E.M.F. of a thermocouple metal-lead, in which one junction is at 0° C. and the other at f C. For this reason the potential diagrams on the convection theory are more simple and useful than those on the contact theory. The curves of E.M.F. are in fact the most natural and most convenient method of recording the numerical data, more particularly in cases where they do not admit of being adequately represented by a

formula. The line of lead is taken to be horizontal in the diagram, because the thermoelectric power, p, may be reckoned from any convenient zero. It is not intended to imply that there is no E.M.F. in the metal-lead with change of temperature, but that the value of p in this metal is nearly constant, as the Thomson effect is very small. It is very probable that the absolute values of p in different metals are of the same sign and of the same order of magnitude, being large compared with the differences observed. It would be theoretically possible to measure the absolute value in some metal by observing with an electrometer the P.D. between parts of the same metal at different temperatures, but the differ- ence would probably be of the order of only one-hundredth of a volt for a difference of 100° C. It would be sufficiently difficult to detect so small a difference under the best conditions. The difficulty would be greatly increased, if not rendered practically insuperable, by the large difference of temperature.

§ 22. Conduction Theory. — In Thomson's theory it is expressly assumed that the reversible thermal effects may be considered separately without reference to conduction. In the conduction theory of Kohlrausch (Pogg. Ann., 1875, vol. 156, p. 601), the fundamental postulate is that the thermo-E.M.F. is due to the conduction of heat in the metal, which is contrary to Thomson's theory. It is assumed that a

flow of heat Q, due to conduction, tends to carry with it a proportional electric current C=aQ. This is interpreted to mean that there is an E.M.F. dE= -akrd'T= – BdT, in each element, where k is the thermal conductivity and r the specific resistance. The "thermoelectric constant," 8, of Kohlrausch, is evidently the same as the thermoelectric power, p, in Thomson's theory. In order to explain the Peltier effect, Kohl- rausch further assumes that an electric current, C, carries a heat- flow, Q=A8C, with it, where "A is a constant which can be made equal to unity by a proper choice of units." If A and 8 are constant, the Peltier effects at the hot and cold junctions are equal and opposite, and may therefore be neglected. The combination of the two postulates leads to a complication. By the second postulate the flow of the current increases the heat-flow, and this by the first postulate increases the E.M.F., or the resistance, which therefore depends on the current. It is difficult to see how this complication can be avoided, unless the first postulate is abandoned, and the heat-flow due to conduction is assumed to be independent of the thermoelectric phenomena. By applying the. first law of thermodynamics, Kohlrausch deduces that a quantity of heat, CBdT, is absorbed in the element dT per second by the current C. He wrongly identifies this with the Thomson effect, by omitting to allow for the heat carried. He does not make any application of the second law to the theoiy. If we apply Thomson's condition P= TdE/dT= Tp, we have A = T. If we also assume the ratio of the current to the heat-flow to be the same in both postulates, we have a=l/T8, whence 62=fo-/T. This condition has recently been applied by Liebenow (Wied. Ann., 68, p. 316). It simplifies the theory, and gives a possible relation between the constants, but it does not appear to remove the complication above referred to, which seems to be inseparable from any conduction theory.

Boltzmann (Sitz. Wien. Akad., 1887, vol. 96, p. 1258) gives a theoretical discussion of all possible forms of expression for thermo- electric phenomena. Neglecting conduction, all the expressions which he gives are equivalent to the equations of Thomson. Taking conduction into account in the application of the second law of thermodynamics, he proposes to substitute the inequality, Td/dET- P&1 *JT(JYP + Vfc" r"), instead of the equation given by Thomson, namely, P= TdEjdT. Since, however, Thomson's equation has been so closely verified by

Jahn, it is probable that Boltzmann would now consider that the reversible effects might be treated independently of conduction.

§ 23. Thermoelectric Relations. — A number of sugges- tions have been made as to the possible relations between heat and electricity, and the mechanism by which an electric current might also be a carrier of heat. The simplest is probably that of Weber (Wied. Ann., 1875), who regarded electricity as consisting of atoms much smaller than those of matter, and supposed that heat was the kinetic energy of these electric atoms. If we suppose that an electric current in a metal is a flow of negative electric atoms in one direction, the positive electricity associated with the far heavier material atoms remaining practically stationary, and if the atomic heat of electricity is of the same order as that of an equivalent quantity of hydrogen or any other element, the heat carried per ampere-second at 0° C, namely P, would be of the order of ‘030 of a joule, which would be ample to account for all the observed effects on the convection theory. Others

have considered conduction in a metal to be analogous to electrolytic conduction, and the observed effects to be due to ” migration of the ions.” The majority of these theories are too vague to be profitably discussed in an article like the present, but there can be little doubt that the study of thermoelectricity affords one of the most promising roads to the discovery of the” true relations between heat and electricity.

Alphabetical Index of Symbols.

a, b, c= Numerical constants in formulae.

C= Electric Current.

_E=E.M.F. = Electromotive Force.

k = Thermal Conductivity.

P= Coefficient of Peltier Effect.

p = dEjdt = Thermoelectric Power.

Q= Heat-flow due to Conduction.

B— Electrical Resistance ; r, Specific Resistance.

s= Specific Heat, or Coefficient of Thomson Effect.

t= Temperature on the Centigrade Scale.

T= Temperature on the Absolute Scale.

(h. L. C.)

Thermometry ; Pyrometry.— A Pyrometer

is an instrument specially designed for measuring high temperatures, and differs from a thermometer in details of construction only, and not in principle, so that the two subjects may be most advantageously treated together. The theoretical principles underlying the science of ther- mometry have been ably expounded by Lord Kelvin in the article Heat (Ency. Brit., vol. xi. p. 554). The most important varieties of thermometer in common use have also been described in the articles Thermometer (Ency. Brit., vol. xxiii. p. 288) and Pyrometer (Ency. Brit., vol. xx. p. 129). The object of the present article is to describe and explain the advances which have been made in the practice of scientific thermometry or ” ther- mometry of precision,” and in the practical application of electrical methods to the accurate measurement of tempera- ture, during, the last twenty years of the 19th century.

§ 1. Temperature. — The idea of temperature or degree of hotness is a primary conception derived directly from our sensations of heat and cold, and in part from those of light and colour. For ordinary temperatures the sense of touch serves as a rough thermometer, for high tempera- tures the sense of sight as a rough pyrometer. The idea of temperature therefore requires no explanation or defini- tion. It is very

often explained as “the condition of a body considered with reference to its power of communi- cating heat to other bodies.” Similarly difference of temperature is often defined in terms of the flow of heat. Such definitions are somewhat unsatisfactory, because the “flow of heat “is really a secondary conception derived from observations of changes of state and temperature. In considering the measurement of temperature it is necessary, however, to define the scale or system on which it is to be measured.

§ 2. Zero : Fundamental Interval. — In all systems of measuring temperature it is necessary (1) to choose a zero or starting-point from which to reckon, (2) to determine the size of the degree by subdividing the interval between two selected fixed points of the scale (called the ” funda- mental interval “) into a given number of equal parts. In all systems of measurement, the fundamental interval selected is that between the temperature of melting ice and the temperature of condensing steam, under standard atmospheric pressure. On the Centigrade system, which alone need be considered here, the fundamental interval is divided into 100 parts, and the melting-point of ice is taken as the zero of the scale. , “We shall denote tempera- ture reckoned on this system by the letter t, or by affixing the letter C. It is often convenient to reckon temperature, not from the melting-point of ice, but from a theoretical

or absolute zero representing the lowest conceivable temperature. We shall denote temperature reckoned in this manner by the letter T, or 8, or by affixing the letters Abs. In practice, since the absolute zero is unattainable, the absolute temperature is deduced from the Centigrade temperature by adding a constant quantity, T0, represent- ing the interval between the absolute zero and the melting- point of ice ; thus

$$T= t + T0.$$

§ 3. Arbitrary Scales. — An arbitrary scale can be con- structed by selecting any physical property of a substance which varies regularly with the temperature, such as the volume of a liquid, or the pressure or density of a gas, or the electrical resistance of a metal. Thus if V denote the volume of a given mass at the temperature t, and if V0, F, represent

the volumes of the same mass at the tempera- tures 0° and 100° C, the size of 1° C. on the scale of this arbitrary thermometer is one hundredth part of the funda- mental interval, namely (V1- F0)/100, and the tem- perature t at volume V is the number of these degrees contained in the expansion V— V0 between 0° and t° C. We thus arrive at the formula

<=100(r-F0)/(Pi-r0) . . . (1), which is the general expression for the temperature Centi- grade on any such arbitrary scale, provided that we substitute for Fthe particular physical property selected as the basis of the scale. If we prefer to reckon tem- perature from an arbitrary zero defined by the vanishing of V, which may conveniently be called the fundamental zero of the scale considered, we have, putting V=0 in equation (1), the numerical values of the fundamental zero T0, and of the temperature T reckoned from this zero

ro=ioor0/(r1-r0), and3,= 2,or/r0=i!+n . (2).

It is frequently convenient to measure temperature in this manner when dealing with gases, or electrical resistance thermometers.

§ 4. Thermodynamical Scale. — It is possible, by refer- ence to the principles of thermodynamics, to construct scales of temperature which shall be ” absolute ” in the sense of being independent of the properties of any material substance. The thermodynamical scale generally selected is that defined by Lord Kelvin in such a manner as to coincide as closely as possible with the scale of the gas-thermometer. His definition (Proc. B. S. Ed., 1854) is as follows (see also Thermodynamics, § 4) : ” The ratio of any two temperatures on the thermodynamical scale is the ratio of the quantity of heat taken in at the higher temperature to the quantity of heat rejected at the lower temperature by a perfectly reversible thermodyna- mical engine working with a source and refrigerator at the temperatures considered.” If, when the engine is working between the temperatures 90 and 6-^ corresponding to 0° and 100° C. respectively on the thermodynamical scale, a quantity of heat H-^ is taken in at 01 for each quantity H0 rejected at 80, and if the fundamental interval is divided into 100 degrees, we have for the numerical values of the temperature

of the melting-point of ice 90 on the thermodynamic scale, and of the temperature 0 reckoned from the absolute zero,

e0=ioos'oi{J3ri-s0),a,nd.e=eoS/M0=t+e0, . (3)

where H is the quantity of heat taken in at 0 for each quantity H0 rejected at 6Q. This scale can be most nearly realized in practice by observing the temperature T on the scale of a gas-thermometer, and making special experi- ments on the gas to determine how far its scale deviates from that of the thermodynamical engine. In the case of the gases hydrogen and helium, which Can exist in the liquid state only at very low temperatures, the deviations from the thermodynamical scale at ordinary temperatures

[mercurial

are so small that they cannot be certainly determined. Thermometers containing these gases are generally taken as the ultimate standards of reference in practical ther- mometry.

Mercurial Thermometry.

§ 5. The most familiar type of thermometer depends on the apparent expansion of a liquid hermetically sealed in a glass bulb attached to a graduated stem of fine bore. Of all liquid-in-glass thermometers that containing mer- cury is almost invariably selected for scientific purposes, although at first sight mercury would appear to be the least suitable liquid, on account of its small coefficient of expansion. The smallness of the expansion necessitates an extremely fine bore for the stem, which introduces errors in consequence of the high surface tension of mercury. The considerable density of the liquid also tends to exaggerate the effects of change of position due to variation of the

pressure exerted on the interior of the hulb by the liquid column. These errors are small and fairly regular, and can be corrected within certain limits. A much more serious source of trouble, especially at high temperatures, is the imperfect elasticity of the glass, which causes more or less irregular changes in the volume of the bulb. The effect of these changes on the readings of the thermometer is enhanced by the smallness of the expansion of mercury, and might be reduced by employ- ing a more expansible liquid. It is more likely, however, that the defect will be remedied in the near future by the construction of thermometers of fused silica (Si02), which is the most perfectly elastic solid hitherto dis- covered. For work at low temperatures the range of a mercury thermometer is limited by its freezing-point (— 39° C). These are the serious disadvantages attend- ing the use of mercury, but in other respects it possesses so many advantages over alcohol or other substitutes, that it will in all probability continue to be used almost exclusively in thermometers of this type for scientific work. Among its chief advantages may be reckoned its high boiling-point (357° C), and the absence of evapora- tion from the top of the thread, which is so serious a source of error with the alcohol thermometer. With mercury the evaporation is almost inappreciable at 100° C, and can in all cases be avoided by exposing the upper parts of the emergent thread to the temperature of the air. Although an evacuated mercury thermometer cannot be safely used at temperatures over 300° C, owing to the breaking up of the thread of liquid in the stem, it has been found possible, by filling the upper part of the stem with nitrogen or carbonic acid gas under high pres- sure, to extend the range to 550° C. A more important advantage for accurate work is the fact that mercury does not wet glass, and avoids any possible errors due to adherent films of liquid on the walls of the tube. This greatly facilitates observations, and also renders it possible to ” calibrate ” the thermometer after construction, which cannot be satisfactorily accomplished with other liquids. The process of construction and calibration is further facilitated by the fact that mercury does not dissolve air to any appreciable extent. In consequence of the regularity of expansion of mercury at ordinary tem- peratures, the scale of the mercury thermometer agrees very closely with that of the gas thermometer. The liquid is very easily obtained in a high state of purity by distillation,

and has practically no chemical action on glass. In this respect it is superior to the liquid alloy of potassium and sodium, which rapidly reduces silica at high temperatures. The high conductivity and low specific heat of mercury as compared with most other liquids tend to render the thermometer quick and sensitive in action.

Its opacity considerably facilitates accurate reading, and even the smallness of its expansion has one great counter- vailing advantage, in that the correction for stem-exposure is proportionately reduced. This correction, which (even in the case of mercury) may amount to as much as 40° C. at 550° C, is far the most uncertain in its application, and is the most serious objection to the use of the liquid- in-glass thermometer at high temperatures.

§ 6. Construction. — The construction of the most accurate type of mercury thermometer has undergone some changes of detail in recent years. The range of the most accurate standards is generally restricted to the fundamental interval. The length of a degree on the stem can be increased to any extent by enlarging the bulb or diminishing the bore of the stem, but it is found in practice that there is no advantage in making the scale more open than one centimetre to the degree C. in standard instruments, or in increasing the number of divisions beyond ten or at most twenty to the degree. Enlarging the bulb makes the instrument sluggish, and exaggerates the errors due to imperfect elasticity. Diminishing the bore of the tube increases the errors due to capillary friction. Even one centimetre to the degree is an impracticable scale for thermometers graduated con- tinuously from‘0° to 100° C, owing to the excessive length of the stem. In order to secure so open a scale, it is necessary to limit the range to 35°, or at most 50°. The fixed points 0° and 100° may still be retained, for purposes of testing and reference, by the device, now commonly employed, of blowing auxiliary bulbs or ” ampoules ” on the stem, the volume of which is carefully adjusted to correspond with the number of degrees that it is desired to suppress. In the best instruments the bulb is not blown on the capillary tube itself, but is formed of a separate piece of tube fused on to the stem. It is possible in this manner to secure greater uniformity of strength and regularity of dimensions. The thickness of the glass is

generally between half a milli- metre and one millimetre. The advantage in point of quickness gained by making the glass thin is more than counterbalanced by increased fragility and liability to distortion. The best form of bulb is cylindrical, of the same external diameter as the stem. The bore of the stem should also be cylindrical, and not oval or flattened, in order to diminish errors due to capillarity, and to secure the greatest possible uniformity of section. The glass should be clear, and not backed with opal, both to admit of reading from either side, and to minimize risk of bending or distortion. In the commoner sorts of thermometers, which are intended for rough purposes and to be read without the application of minute corrections, it is not unusual to divide the tube into divisions of equal volume by a preliminary calibration. In the most accurate instruments it is preferable to divide the tube into divisions of equal length, as this can be more accurately effected. The corrections to be applied to the readings to allow for inequalities of bore can be most satisfactorily determined in the case of mercury thermometers by calibrating the tube after the instrument is completed (see Calibration, vol. xxvi.). This correction is known as the ” calibration correction.” Instead of being separately determined, it may be included in the scale correction by comparison with a standard instrument, such as a platinum-resistance thermometer.

§ 7. Corrections. — The corrections to be applied to the readings of a mercury thermometer, in addition to the cali- bration correction, may be summarized under the following heads : (i.) Zero, (ii.) Fundamental Interval, (iii.) In- ternal and External Pressure. (iv.) Stem Exposure, (v.) Scale Correction, including Poggendorf’s correction.

mbbcueial]

(I) The changes of zero are of two kinds, (a) Secular rise of zero due to gradual recovery from changes or strains acquired by the bulb during the process of manufacture. This process may be hastened and

subsequent changes practically eliminated by anneal- ing the bulb after manufacture, and before final adjustment, at a high temperature, such as that of boiling sulphur. A thermometer which has not been so treated may show a rise of zero amounting to as much as 20° or 30° when exposed for some time to a tempera- ture of 350° C. (Jo) Temporary depression of zero after each ex- posure to a high temperature, followed by a slow recovery which may last for days or weeks. The best thermometers of hard glass show a depression of zero amounting to about one-tenth of 1° C. after exposure to 100° C. In softer glass the depression is usually greater and more persistent, and may amount to half a degree after 100° 0. At higher temperatures the depression generally in- creases roughly as the square of the temperature above 0° 0. It may amount to 2° or 3° at 300° 0. The effect cannot be calculated or predicted in any series of observations, because it depends in so complicated a manner on the past history and on the time. It is a most serious difficulty in accurate mercurial thermometry, especially at high temperatures. The most satisfactory method of correction appears to be to observe the zero immediately after each reading, and to reckon the temperature from the variable zero thus observed. The rationale of this procedure is that the depression is produced at the high temperature much more rapidly than the subsequent recovery at the low temperature. The thermometer is taken from the bath and allowed- to cool rapidly by free exposure to the air. As soon as it reaches 40° or 50° C, it is plunged in the melting ice, and the lowest point reached is taken as the tem- porary zero.

The following formulae have been proposed by various observers to represent the depression of zero for different kinds of glass : —

Pernet, French cristal, &=0-0040(

Bottcher, Jena, 16, iii., d«=((7100«-8i2) 10”7 . . J

The symbol dz in these formulae stands for the depression of zero

produced by an exposure to a temperature t. The depression is about three times as large in French crystal as in English flint

flass, and varies roughly as the square of t. Verre dur and ena, 16, iii., are varieties of hard glass chosen as standards in France and Germany respectively, on account of the comparatively small depression of zero to which they are liable. At low tem- peratures, up to 50° C, the depression is very nearly proportional to t, but at temperatures above 100° C. it is necessary to adopt another formula in which the term depending upon tl is more im- portant. These formulae are useful as giving an idea of the probable size of the correction in any case, but they cannot be employed in practice except in the simplest cases arid at low temperatures. On account of these temporary changes of zero, a mercury thermometer intended for the most accurate work at ordinary temperatures (as in calorimetry) should preferably never be heated above 40° or 50° C, and certainly never above 100° C. Above 100° O. the changes of zero become more irregular and more variable, depending on the rate of cooling and on the sequence of previous observations, so that even if the method of observing the zero after each reading is adopted, the order of precision attainable rapidly diminishes.

(II) Fundamental Interval. — The thermometer to be tested is exposed to steam condensing at atmospheric pressure in an appara- tus which is often called a "hypsometer," constructed with double walls to protect the inner tube containing the thermometer from any cooling by radiation. The standard atmospheric pressure at which the temperature of the steam is by definition equal to 100° C. is equivalent to that produced by a column of mercury at 0° C. and 760 millimetres high, the force of gravitation being equal to that at sea-level in latitude 45°. The atmospheric pressure at the time of observation is reduced to these units by applying the usual corrections for temperature and gravitation. If the pressure is near 760 mm., the temperature of the steam may be deduced by assuming that it increases at the rate of 1° C. for 27'2 mm. of pressure. If the pressure is not near 760 mm., the application of the correction is less certain, but is generally taken from Regnault's tables, from which the following data are ex- tracted. Thermometers cannot be satisfactorily tested at an elevated station where the height of the barometer S is less than 700 mm., as the steam point is too uncertain.

Table I

— Temperature of Steam at pressures from

790 to 710 mm.

Pressure (corrected) . Steam temp. = 100° C. + . .

790 + 1-083

780

+ •726

770

+ •365

760 0

750

-•369

7-10

-•742

730 -1-120

720 -1-502

710 -1-888

Approximate formula dtx= ~~0367(.ff~~ 760) – ~~000020(.S”~~ 760)2

(«)

If the barometer has a brass scale correct at 0° 0., and S be the reading in millimetres, the correction for temperature is made approximately

by subtracting 0-00163 .5″ mm.

If X is the latitude and M the height of the station in metres above the sea-level, the correction for gravitation is approximately made by subtracting (0-0026 cos 2L + 0 -00000021?) S mm.

The zero of the thermometer is observed immediately after the steam point. If n be the interval in degrees of the scale between the two observations, and if t\ be the temperature of the steam, the fundamental interval of the thermometer may be taken as 100 njti, provided that h is nearly 100° C. Since all the readings of a thermometer have to be corrected for the error of the funda- mental interval, by dividing by the fundamental interval thus observed and multiplying by 100, it is a matter of some con- venience in practice to have the instrument graduated so that the difference between the readings in ice and at 100° C. is very nearly 100° of the stem. The correction can then be applied as a small percentage independently of the other corrections. The method of determining the fundamental interval above described applies to all other kinds of thermometers, except that it is not generally necessary to observe the zero after the steam point. The tempera- ture of the steam t\ should be expressed in the scale of the ther- mometer tested, if the scale differs appreciably from that of Eegnault.

(Ill) Pressure Correction. — The corrections for variations of internal and external pressure on the bulb are of some importance in accurate thermometry, but can be applied with considerable certainty at moderate temperatures. The correction for external pressure is assumed to be proportional to the change of pressure, and to be independent of the temperature. It is generally deter- mined by enclosing the thermometer to be tested in a vessel of water, and observing the change of reading on exhausting or readmitting the air. The correction is generally between one and two thousandths of a degree per centimetre of mercury change of pressure, but must be determined for each thermometer, as it depends on the nature of the glass and on the form and thickness of the walls of the bulb. The coefficient of the correction for in- ternal pressure is greater than that

for external pressure by the difference between the compressibility of mercury and that of glass, and may be calculated from it by assuming this relation. If J0, 6^

are the external and internal coefficients, expressed in degrees of temperature per centimetre of mercury, we have the relation

&i = io + 0‘00015, degrees per cm. of mercury . . (6)

The coefficient of internal pressure can also be determined by taking readings in the horizontal and vertical positions when the thermometer is at some steady temperature such as that of ice or steam. The reading of the thermometer is generally reduced to an external pressure of one standard atmosphere, and to an internal pressure corresponding to the horizontal position. It is also possible to include the internal pressure correction in the scale correction, if the thermometer is always read in the vertical posi- tion. In addition to the variations of internal pressure due to the column of mercury in the stem, there are variations due to capil- larity. The internal pressure is greater when the mercury is rising than when it is falling, and the reading is depressed to an extent depending on the fineness of the bore and the thinness of the walls of the bulb. The capillary pressure does not depend only on tho bore of the tube, but also apparently to an even greater extent on the state of the walls of the tube. The least trace of dirt on the glass or on the mercury is capable of producing capillary pressures much greater than would be calculated from the diameter of the tube. Even in the best thermometers, when there are no in- equalities of bore sufficient to account for the observed variations, it is seldom found that the mercury runs equally easily in all parts of the stem. These variations of capillary pressure are somewhat capricious, and set a limit to the order of accuracy attainable with the mercury thermometer. It appears that the difference of reading of a good thermometer Detween a rising and falling meniscus may amount to five or ten thousandths of a degree. The difference may be reduced by continuous tapping, but it is generally best to take readings always on a rising column, especially as the variations in the angle of contact, and therefore in the capillary pressure, appear to be much smaller for the rising meniscus. In

ordinary work the zero reading and the steam reading would both generally correspond to a falling meniscus ; the former necessarily, the latter on account of the phenomenon of the temporary depres- sion of zero, which causes the thermometer to read higher during the first moments of its exposure to steam than it does when the expansion of the bulb has reached its limit. It is easy to secure a

rising meniscus at the steam point by momentarily cooling the thermometer. At the zero point the meniscus generally com- mences to rise after five or ten minutes. The question, however, is not of much importance, as the error, if any, is regular, and the correction for capillarity is necessarily uncertain.

(IV) Stem-Exposure Correction. — When the bulb of a. mercury thermometer is immersed in a bath at a temperature t, and a part of the column of mercury having a length of n degrees is exposed to a lower temperature t^, the reading of the thermometer will be lower by a x n x (t – ^) degrees (nearly) than it would have been if the whole of the mercury and stem had been at the temperature t. The factor a in this expression is the apparent coefficient of expan- sion of mercury in glass, and varies from ‘000150 to •000165 for different kinds of glass. In order to apply this correction, it is usual to observe ^ by means of an auxiliary “stem-thermometer” with its bulb placed near the middle of the emergent column n. Occasionally stem-thermometers with long thin bulbs are employed to give more nearly the average temperature of the whole emergent column. Owing to conduction along the stem of the thermometer, and to heated vapours near the bath, the mean temperature deter- mined in this manner is generally too low. To allow for this empirically, an arbitrary reduction is often made in the value taken for n or a, but this cannot be regarded as satisfactory for work of precision. The only practical method of reducing the correction is to limit the number of degrees n exposed, or, in other words, to work with

thermometers of “limited range.” Each of these thermometers must theft be corrected by comparison with a standard thermometer free from stem-exposure correction, such as a platinum-resistance thermometer. To secure results of any value the correction must be determined at each point under the actual conditions of observation under which the thermometer is to be used. In work of precision it is necessary to use ten or twenty thermometers to cover a range of 300°, as this is the 6nly method of securing an open scale and reasonable accuracy as regards stem- exposure. To quote the opinion of M. Guillaume, one of the leading authorities on mercurial thermometry : ““When this correc- tion is large, it cannot generally be determined with sufficient approximation for measurements of precision. The mercury ther- mometer should then be replaced by other instruments, among which those based on the variation of the electrical resistance of metals hold the first rank.”

(V) Scale Correction. — The correction required to reduce the readings of a mercurial thermometer to the normal scale may appropriately be called the “scale correction.” One of the chief advantages of the mercurial thermometer for scientific purposes is that its scale agrees very closely with the thermodynamical scale between 0° and 200° C. The scale corrections of the standard French thermometers of verre dur have been very carefully deter- mined over the range 0° to 80° C. by M. Chappuis using a constant- volume gas thermometer containing hydrogen (at an initial pressure of one metre of mercury at 0° C.) as the representative of the normal scale. His observations between 0° and 80° C. are repre- sented by the quartic equation

tk-U=t(t- 100) (- 61-859 + 0-47351 t- 0-0011577 iP)xl0-B, (7)

in which t\ and tm represent temperature on the scales of the hydrogen and mercury thermometers respectively. The verre dur mercury thermometer reads 0-112° C. above the hydrogen thermo- meter at 40° C, where the difference of the scales is a maximum. The scale corrections of the Jena-glass thermometers, deduced by comparison with the French verre dur, appear to be practically of the same magnitude, but show differences of as much as 0‘010 C. on either side

of the mean. It may be questioned whether it is possible to construct mercury thermometers with scales agreeing more closely than this, owing to inevitable variations in the quality and treatment of the glass. According to Guillaume, the scale of a French cristal thermometer tc differs from that of the standard verre dur tm between 0° and 50° C, according to the cubic formula

tc – tm=t(l00 – 0(14-126 – 0-03110 x IO-

CS)

According to some unpublished observations made by the writer in 1893-94, the scale of an English flint-glass thermometer, tested by comparison with a platinum thermometer, does not differ from that of the constant-pressure air thermometer, by more than one or two hundredths of a degree between 0° and 100° C. But for the comparison of the scales to be of any value, it would be necessary to study a large number of such thermometers. It is possible to obtain much more consistent results if the thermometers are not heated above 50° C. i'

The comparisons of the verre dur thermometers with the normal scale at the International Bureau at Paris have not as yet extended beyond 100° C. The most important observations on the mercury thermometer above these limits appear to be those of Eegnault already given in a previous article (Heat, Ency. Brit., vol. xi. p. 554). The more recent observations of Crafts were confined to French thermometers of cristal dur {Comptes Sendus,

vol. 95, p. 863, 1882). He finds the following deviations from the hydrogen scale : —

th 150° 170° 200° 230° 250° 280° 300° 330″ th-tm +-25 +-35 +-27 —02 —26 —63 -1-21 -2-48

The correction changes sign at about 230° C, owing to the rapid increase in the expansion of mercury. Between 0° and 150° C. it would appear that the coefficient of expansion of glass increases more rapidly than that of mercury.

Poggendorf s Correction. — It should be observed that, since in the construction of a mercury thermometer the tube is divided or calibrated so as to read in divisions of equal volume when the whole of the tube is at one temperature, the degrees do not as a matter of fact correspond to equal increments of the apparent expansion of mercury. The scale does not therefore agree in practice with the theoretical formula (1) for the scale of the expansion of mercury, since the expansion is measured in a tube which itself is expanding. A similar argument applies to the method of the weight thermometer, in which the overflow is measured by weight. Even if the expansion of mercury and glass were both uniform, as measured on the thermodynamical scale, the scale of the mercury thermometer, as ordinarily calibrated, would not agree with the thermodynamical scale. The difference can be

Fig. 1. — Differences between Scales of Mercury, and Gas Thermometers and Hydrogen Scale, according to Guillaume and Chappuis.

easily calculated if the actual expansion of mercury and glass is known. The correction is known as Poggendorf s, but is generally included in the scale correction, and is not applied separately. It has the effect of making the thermometer read higher at temperatures between 0° and 100° than it would if the divisions of the stem .did not expand as the temperature rose. The amount of the correction for verre dur is given by Guillaume as

P.a=Z(100-0(23-920 + 0”0240<)xl0-6 . . (9)

The value of this correction is between -060° and -080° at 50° C. for different thermometers.

Gas Thermometry.

§ 8. The absolute or thermodynamical scale cannot be directly realized on account of the impossibility of con- structing a perfectly reversible thermodynamic engine, and of the great practical difficulties involved in the accurate measurement of quantities of heat. It is necessary, therefore, to have recourse to indirect methods. Among the most interesting of these methods are the vapour-pressure thermometers

described by Lord Kelvin (Heat, vol. xi. p. 554). These instruments have the great advantage that the pressure is a function of the temperature only, and that no measurements of the volume of the space in which the thermometric substance is enclosed are required. The temperature scale of such an instrument depends only on the substance, and not on the material of the enclosure. From a practical point of view, however, the range of each instrument is too limited, and the scales differ too widely from uniformity. Although it is theoretically possible to deduce the absolute temperature from a study of the properties of

each vapour, it is practically impossible to carry out the required measurements, such as the determination of the specific volume of the saturated vapour, with sufficient accuracy to be of value for the realization of the absolute scale. On the other hand, the second method proposed by Lord Kelvin, and carried out experimentally with the assistance of Joule, for the reduction of the indications of the gas thermometer to the absolute scale, is in itself so delicate, and the deviations of the uncorrected gas ther- mometer from the absolute scale are so small, that this instrument is now universally regarded as the ultimate standard in thermometry. It had, in fact, already been adopted for this purpose by Regnault and others, on a priori considerations, before the absolute scale itself had been invented. Although the indications of a gas thermometer are not absolutely independent of the changes of volume of the envelope or bulb in which the gas is contained, the effect of any uncertainty in this respect is minimized by the relatively large expansi- bility of the gas. The capricious changes of volume of the bulb, which are so great a difficulty in mercurial thermometry, are twenty times less important in the case of the gas thermometer. As additional reasons for the choice we have the great simplicity of the laws of gases, and the approximate equality of expansion and close agreement of the thermometric scales of all gases,

provided that they are above their critical temperatures. Subject to this condition, at moderate pressures and provided that they are not dissociated or decomposed, all gases satisfy approximately the laws of Boyle and Charles. These two laws are combined in the character- istic equation of the gaseous state, viz., pv = El\ in which p is the pressure and v the volume of unit mass of the gas in question, and R is a constant which varies inversely as the molecular weight of the gas, and is approximately equal to the difference of the specific heats. The equation in this form, without further restrictions, applies only to the ideal "perfect gas" which satisfies Boyle's law accurately, and in which the internal work of expansion is zero.

§ 9. Practical Conditions. — In practice it is not con- venient to deal with unit mass, but with an arbitrary mass M occupying a space V, so that the specific volume v = V/M. It is also necessary to measure the pressure p in terms of mercury columns, and not in absolute units. The numerical value of the constant B is adjusted to suit these conditions, but is of no consequence in thermometry, as we are concerned with ratios and differences only. The equation may still be written in the form T=pY\EM, but in order to satisfy the essential condition that T shall be a definite function of the temperature in the case of a gas which does not satisfy Boyle's law exactly, it is necessary to limit the application of the equation to special cases which lead to definite, but not necessarily identical, thermometric scales. There are three special cases of practical importance, corresponding to three essentially distinct experimental methods.

(i.) Volumetric Method (constant-pressure). — In this method V is variable and p and M are constant. This method was employed by Gay-Lussac, and is typified in the ideal thermometer with reservoir of variable capacity designed by Lord Kelvin (Ency. Brit., vol. xi. p. 575, Fig. 10). It corresponds to the method ordinarily em- ployed in the common liquid-in-glass thermometer. It is not satisfactory in practice, owing to the difficulty of making a bulb of variable and measurable volume the whole of which can be exposed to the temperature to be measured.

(ii.) Manometric Method (constant-volume or den- sity).— In this method p is variable and V and M are

constant. Variations of temperature are observed and measured by observing the corresponding variations of pressure with a mercury manometer, keeping a constant mass, M, of gas enclosed in a volume, V, which is constant except for the unavoidable but small expansion of the material of which the bulb is made.

(iii.) Gravimetric Method (constant-pressure). — In this method M is variable and p and V are constant. This method is generally confounded with (i.) under the name of the constant-pressure method, but it really corresponds to the method of the weight thermometer, or the "over- flow " method, and is quite distinct from an experimental standpoint, although it leads to the same thermometric scale. In applying this method, the weight M of the vapour itself may be measured, as in Begnault's mer- cury-vapour thermometer, or in Deville and Troost's iodine-vapour thermometer. The usual method of measur- ing ^the overflow is that of weighing mercury displaced by the gas. The mass of the overflow may also be estimated by observing its volume, or by water-displacement, but these methods are much less accurate.

In addition to the above, there are mixed methods in which both p and V or M are variable, such as those employed by Rudberg or Becquerel ; but these are unsatis- factory for precision, as not leading to a sufficiently definite thermometric scale. There is also a variation of the constant- volume method (ii.), in which the- pressure is measured by the volumetric compression of an equal mass of gas kept at a constant temperature, instead of by a manometer. This method is experimentally similar to (iii.), and gives the same equations, but a different ther- mometric scale to either (ii.) or (iii.). It will be con- sidered with method (iii.), as the apparatus required is the same, and it is useful for testing the theory of the instru- ment. We shall consider in detail methods (ii.) and (iii.) only, as they are the most important for accurate work.

§ 10. Construction of Apparatus. — The manometric or constant-volume method was selected by Regnault as the standard, and has been

most generally adopted since his time. His apparatus has not been materially modified except in points of detail. A description of his instru- ment will be found in most textbooks on heat. The improvements introduced by M. Chappuis, of the Interna- tional Bureau at Sevres, in the construction of the con- stant-volume hydrogen thermometer selected by the committee for the determination of the normal scale, are also described in some recent text-books (e.g., Watson's Physics). The most important is the combination of the manometer and the barometer into a single instrument with a single scale, thus materially reducing the number of readings required. The level of the mercury in the branch of the manometer communicating with the bulb of the gas thermometer is adjusted in the usual manner up to a fixed contact-point, so as to reduce the contained gas to a constant volume. Simultaneously the barometer branch of the manometer is adjusted so that the surface of the mercury makes contact with another point fixed in the upper end of the barometer tube. The distance between the two contact-points, giving the pressure of the gas in the thermometer, is deduced from the reading of a vernier fixed relatively to the upper contact-point. This method of reading the pressure is probably more accurate than the method of the cathetometer which is usually employed.

§ 11. Pressure Correction. — In the practical applica- tion of the manometric method there are certain correc- tions peculiar to the method, of which account must be taken in work of precision. The volume of the bulb is not accurately constant, but varies with change of pressure

[gas

and temperature. The thermal expansion of the bulb is common to all methods, and 'will be considered in detail later. The pressure correction is small, and is determined in the same manner as for a mercury thermometer. The value so determined, however, does not apply strictly

except at the temperature to which it refers. If the pressure-coefficient were constant at all temperatures and equal to e, the pressure correction, dt, at any point t of the scale would be obtainable from the simple formula

dt=epat{t-100)/T(l, . . . (10)

where p0 is the initial pressure at the temperature TQ. But as the coefficient probably varies in an unknown manner, the correction is somewhat uncertain, especially at high temperatures. Another very necessary but some- what troublesome correction is the reduction of the mano- meter readings to allow for the varying temperatures of the mercury and scale. Since it is generally impracticable to immerse the manometer in a liquid bath to secure certainty and uniformity of temperature, the temperature must be estimated from the readings of mercury thermo- meters suspended in mercury tubes or in the air near the manometer. It is therefore necessary to work in a room specially designed to secure great constancy of tem- perature, and to screen the manometer with the utmost care from the source of heat in measurements of high temperature. Eegnault considered that the limit of accuracy of correction was one-tenth of a millimetre of mercury, but it is probably possible to measure to one- hundredth as a mean of several readings under the best conditions, at ordinary temperatures.

§ 12. Stem-Exposwre. — In all gas thermometers it is necessary in practice that the part of the gas in contact with the mercury or other liquid in the manometer should not be heated, but kept at a nearly constant temperature. The space above the mercury, together with the exposed portion of the capillary tube connecting the manometer with the thermometric bulb, may be called the ” dead space.” If the volume of the dead space is kept as nearly as possible constant by adjusting the mercury always up to a fixed mark, the quantity of air in this space varies nearly in direct proportion to the pressure, i.e., in proportion to the temperature of the thermometric bulb at constant volume. This necessitates the application of a stem-exposure correction, the value of which is approximately given by the formula

dt=rt{t-100)/T2, ... (11)

where *• is the ratio of the volume of the dead space to the volume of the thermometric bulb, and T2 is the mean temperature of the dead space, which is supposed to be constant. The magnitude of the correction is propor- tional to the ratio r, and increases very rapidly at high temperatures. If the dead space is 1 per cent, of the bulb, the correction will amount to only one-tenth of a degree at 50″ C, but reaches 5° at 445° C, and 30° at 1000° C. It is for this reason important in high- tem- perature work to keep the dead space as small as possible and to know its volume accurately. With a mercury manometer, the volume is liable to a slight uncertainty on account of changes of shape in the meniscus, as it is necessary to use a wide tube in order to secure accurate measurements of pressure.

§ 1 3. Compensation Method with Oil – Gauge. — It is possible to avoid this difficulty, and to make the dead space very small, by employing oil or sulphuric acid or other non-volatile liquid to confine the gas in place of mercury (Phil. Trans., A. 1887, p. 171). The employment of a liquid which wets the tube makes it possible to use a much smaller bore, and also greatly facilitates the read- ing of small changes of pressure. At the same time the

Fig. 2.— Method of Compensation.

instrument may be arranged so that the dead space correc- tion is automatically eliminated with much greater accuracy than it can be calculated. This is effected as shown diagrammatically in Kg. 2, by placing side by side with the tube AB, connecting the bulb B to the manometer A, an exact duplicate CD, closed at the end D, and containing liquid in the limbC, which is of the same size as the branch A of the manometer and in direct com- munication with it. The tube CD, which is called the compensating tube, contains a constant mass of gas under exactly similar conditions of volume and temperature to the tube AB. If therefore the level of the liquid is always adjusted to be the same in both tubes AB and CD, the mass of gas contained in the dead space AB will also be constant, and is automati- cally eliminated from the equations, as they contain differences only.

§ 14. Gravimetric Method. — In the writer's opinion, the gravimetric or overflow method, although it has sel- dom been adopted, and is not gene- rally regarded as the most accurate, is much to be preferred to the mano- metric method, especially for work at high temperatures. It is free from the uncertain corrections above enume- rated as being peculiar to the mano- metric method. The apparatus is much simpler to manipulate and less costly to construct. If the pressure is kept constant and equal to the external atmospheric pressure, there is no strain of the bulb, which is particularly important at high temperatures. There is no dead space correction so long as the temperature of the dead space is kept constant. The troublesome opera- tion of reading and adjusting the mercury columns of the manometer is replaced by the simpler and more accurate operation of weighing the mercury displaced, which can be performed at leisure. The uncertain correction for the temperature of the mercury in the manometer is entirely avoided. The reasons which led Regnault to prefer the constant-volume thermometer are frequently quoted, and are generally accepted as entirely conclusive, but it is very easy to construct the constant-pressure or gravimetric instrument in such a manner as to escape the objections which he urges against it. Briefly stated, his objections are as follows : (1) Any error in the observation of the temperature of the gas in the overflow space produces a considerable error in the temperature deduced, when the volume of the overflow is large. This source of error is very simply avoided by keeping the whole of the overflow in melting ice, an expedient which also considerably simplifies the equations. It happened that Regnault's form of thermometer could not be treated in this manner, because he had to observe the level of the mercury in order to measure the pressure. It is much better, however, to use a separate gauge, containing oil or sulphuric acid, for this purpose. The use of ice also eliminates the correction for the variation of density of the mercury by which the overflow is measured. (2) Regnault's second objection was that an error in the measurement of the pressure, or in reading the barometer, was more serious at high temperatures in the case of the constant – pressure thermometer than in the constant-volume method. Owing to the incessant variations in the pressure of the atmosphere, and in the temperature of the mercury columns, he did not feel able to rely on the

pressure readings (depending on observations of four mercury surfaces -with the cathetometer) to less than a tenth of a millimetre of mercury, which experience showed to be about the limit of accuracy of his observations. This would be equivalent to an error of 0‘036° with the constant-volume thermometer at any point of the scale, but with the constant-pressure thermometer the error would be larger at higher temperatures, since the pressure does not increase in proportion to the temperature. This objection is really unsound, because the proportionate error dTjT, or the error considered as a fraction of the whole temperature, remains constant at constant pressure, for a given constant error in the pressure. This is the ideal condition to be aimed at.” That the pro- portionate error diminishes with rise of temperature, in the case of the constant- volume thermometer, is really of no advan- tage, because we can never hope to be able to measure high temperatures with greater proportionate accuracy than ordinary tem- peratures. The great increase of pressure at high temperatures in the manometric method is really a serious disadvantage, because it becomes necessary to work with much lower initial pressures, which implies inferior ac- curacy at ordinary temperatures and in the determination of the initial pressure and the fundamental interval.

§ 15. Compensated Differential Gas Ther- mometer.— The chief advantage of the gravi- metric method, which Regnault and others appear to have missed, is that it is possible to make the measurements altogether independent of the atmospheric pressure and of the observation of mercury columns. This is accomplished by using, as a standard of constant pressure, a bulb contain- ing a constant mass of gas in melting ice, side by side with the bulb in which the volume of the overflow is measured. The pressure in the thermometric bulb is adjusted to equality with the standard by means of a delicate oil-gauge of small bore, in which the difference of pressure is observed by means of a cathetometer microscope. This kind of gauge permits the rapid

observation of small changes of pressure, and is far more accurate and delicate than the mercury manometer. The fundamental measurement of the volume of the over- (£ ” flow in terms of the weight of mercury displaced at 0° C. involves a single weighing made at leisure, and requires no tempera- ture correction. The accuracy obtainable at ordinary temperatures in this measurement is about ten times as great as that attainable under the best conditions with the mercury manometer. At higher temperatures the relative accuracy diminishes in proportion to the absolute temperature, or the error dt increases according to the formula

$$dt/t = – (T/To)\ dw/w, \ldots (12)$$

where w is the weight of the overflow and dv> the error. This diminution of the sensitiveness of the method at high temperatures is commonly urged as a serious objec- tion to the method, but the objection is really without weight in practice, as the possible accuracy of measurement is limited by other conditions. So far as the weighing alone is concerned, the method is sensitive to one-hundredth of a degree at 1000° C, which is far beyond the order of accuracy attainable in the application of the other corrections.

§ 16. Description of Practical Form of Instrument. — A form of gas thermometer constructed on the principles above laid down,

with the addition of a duplicate aet of connecting tubes for the elimination of the stem-exposure correction by the method of automatic compensation already explained, is shown in Fig. 3. This type of instrument, designed for work of the highest precision, was described and exhibited at a meeting of the Royal Society in December 1891 (Proc. M. S., vol. 50, p. 243), but has not hitherto been figured in any publication, except in a diagrammatic form (e.g., Preston’s Heat, p. 133). The connexions of the various parts of the instrument will be better understood by reference to the diagram (Fig. 4), in which the two sides of the instrument are separated. The connecting tubes to the thermometric bulb T are compensated by a similar pair of tubes C, which are shown in the diagram on

Fig. 3. — Compensated Differential Gas Thermometer.

the extreme right, but are really in close proximity to the thermometric bulb. The taps ti h serve for cleaning and drying the apparatus, and for the introduction and removal of mercury when the bulb T is used as a weight thermometer for determining the expansion of the glass. The thermometric bulb T is connected to the "overflow" bulb M, in which the expansion is measured by the displacement of mercury. The system of tubes and taps connected to the overflow bulb serves for the introduction or removal of weighed quantities of mercury. The standard pressure- bulb S is an exactly similar bulb to the overflow bulb, and is provided with an exactly similar set of connexions. It is placed side by side with the overflow bulb in a large vessel of ice. Between the two bulbs is the oil-gauge G, in which the difference pressure is observed by a cathetometer microscope. An auxiliary mercury-gauge N is added to show when the difference of pressure is small enough to be within the range of the oil-gauge.

V

XJ

o

n

w

r

n

n

r

s

Fig. 4. — Diagram of Compensated Differential Gas Thermometer.

In setting up the instrument, after cleaning and drying and calibrating the bulbs and connecting tubes, the masses of gas on the two sides are adjusted as nearly as possible to equality, in order that any changes of temperature in the two sets of connecting tubes may compensate each other. This is effected with all the bulbs in melting ice, by adjusting the quantities of mercury in the bulbs M and S and equalizing the pressures. The bulb T is then heated in steam to determine the fundamental interval. A weight wi of mercury is removed from the overflow bulb M in order to equalize the pressures again. If W is the weight of the mercury at 0° C. which would be required to fill the bulb T at 0° C, and if W+dWi is the weight of mercury at 0° which would be required to fill a volume equal to that of the bulb in steam at h, we have the following equation for determining the coefficient of expansion a, or the fundamental zero Tm

ati = tilTl, = (w1 + dW1)l(W-w1), . . (13)

[gas

Similarly if w is the overflow when the bulb is at any other temperature t, and the expansion of the bulb is dW, we have a precisely similar equation for determining t in terms of Tm but with t and w and d W substituted for tx and w1 and dWx. In practice, if the pressures are not adjusted to exact equality, or if the volumes of the connecting tubes do not exactly compensate, it is only necessary to include in w a small correction dw, equivalent to the observed difference, which need never exceed one part in ten thousand.

It is possible to employ the same apparatus at constant volume as well as at constant pressure, but the manipulation is not quite so simple, in consequence of the change of pressure. Instead of removing mercury from the overflow bulb M in connexion with the thermometric bulb, mercury is introduced from a higher level into the standard bulb S so as to raise its pressure to equality with that of T at constant volume.

The equations of this method are precisely the same as those already given, except that w now sig- nifies the ‘ ‘ inflow ” weight introduced into the bulb S, instead of the overflow weight from M. It is necessary, however, to take account of the pressure-coefficient of the bulb T, and it is much more important to have the masses of gas on the two sides of the apparatus equal than in the other case. The thermometric scale obtained in this method differs slightly from the scale of the mano- metric method, on account of the deviation of the gas compressed at 0° C. from Boyle’s law, but it is easy to take account of this with certainty.

Another use to which the same apparatus may be put is the accurate comparison of the scales of two different gases at constant volume by a differential method. It is usual to effect this com- parison indirectly, by comparing the gas thermometers separately with a mercury thermometer, or other secondary standard. But by using a pair of bulbs like M and S simultaneously in the same bath, and measuring the small difference of pressure with an oil- gauge, a higher order of accuracy may be attained in the measure- ment of the small differences than by the method of indirect com- parison. For instance, in the curves representing the difference between the nitrogen and hydrogen scales (Fig. 1), as found by Chappuis by comparison of the nitrogen and hydrogen thermometers with the mercury thermometer, it is probable that the contrary flexure of the curve between 70° and 100° C. is due to a minute error of observation, which is quite as likely to be caused by the increasing aberrations of the mercury thermometer at these tem-

Eeratures as by the difficulties of the manometric method. It may e taken as an axiom in all such cases that it is better to measure the small difference itself directly than to deduce it from the much more laborious observations of the separate magnitudes con- cerned.

% 17. Expansion Correction. — In the use of the mercury thermometer we are content to overlook the modification of the scale due to the expansion of the envelope, which is known as Poggendorf s correction, or rather to include it in the scale correction. In the case of the gas thermometer it is necessary to determine the expansion correction separately, as our object is to arrive at the closest approximation

possible to the absolute scale. It is a common mistake to imagine that if the rate of ex- pansion of the bulb were uniform, the scale of the apparent expansion of the gas would be the same as the scale of the real expansion — in other words, that the correction for the expansion of the bulb would affect the value of the coefficient of expansion 1/T0 only, and would be without effect on the value of the temperature t deduced. A result of this kind would be produced by a constant error in the initial pressure on the manometric method, or by a constant error in the initial volume on the volumetric method, or by a constant error in the fundamental interval on any method, but not by a constant error in the co- efficient of expansion of the bulb, which would produce a modification of the scale exactly analogous to Poggen- dorf's correction. The correction to be applied to the value of t in any case to allow for any systematic error or variation in the data is easily found by differentiating the formula for t with respect to the variable considered. Another method, which is in some respects more instruc- tive, is the following : — ■

Let T be the function of the temperature which is taken as the basis of the scale considered, then we have the value of t given by the general formula (1), already quoted in §3. Let dT be the correction to be added to the observed value of T to allow for any

systematic change or error in the measurement of any of the data on which the value of T depsnds, and let dt be the corresponding correction produced in the value of t, then substituting in formula (1) we have,

t + dt = 100(T- T0+dT-dT„)HTi~ To+d^-dTt),

from which, provided that the variations considered are small, we obtain the following general expression for the correction to t,

dt=(dT-dT0) – (dTi –

(14)

It is frequently simpler to estimate the correction in this manner, rather than by differentiating the general formula.

In the special case of the gas thermometer the value of Tis given by the formula

T=pVIEM=pVIR(Mo-M2), . . (15)

where p is the observed pressure at any temperature t, V the volume of the thermometric bulb, and M the mass of gas remaining in the bulb. The quantity M cannot be directly observed, but is deduced by subtracting from the whole mass of gas M0 contained in the apparatus the mass M2 which is contained in the dead space and overflow bulb. In applying these formulae to deduce the effect of the expansion of the bulb, we s observe that if d V is the expansion from 0° C, and Vt, the volume at 0° C, we may write

y=V„ + d V. T=p{ r0+d V)\RM= (p V*\RM) (1+dF/ Vt), whence we obtain approximately

dT=Tdr/V0 .... (16)

If the coefficient of expansion of the bulb is constant and equal to the fundamental coefficient/ (the mean coefficient between 0° and 100° C.), we have simply dV/V0=ft; and if we substitute this value in the general expression (14) for it, we obtain

dt=(T- Tx)ft=fi{t- 100) . . (17)

Provided that the correction can be expressed as a rational integral function of t, it is evident that it must contain the factors t and (t – 100), since by hypothesis the scale must be correct at the fixed points 0° and 100° C., and the correction must vanish at these points. It is clear from the above that the scale of the gas thermometer is not independent of the expansion of the bulb even in the simple case where the coefficient is constant. The correction is by no means unimportant. In the case of an average glass or platinum reservoir, for which /may be taken as 0

“000025 nearly, the correction amounts to -0‘0625° at 50° C, to 3-83° at 445° C, and to 22-5° at 1000° C.

The value of the fundamental coefficient / can be determined with much greater accuracy than the coefficient over any other range of temperature. The most satisfactory method is to use the bulb itself as a mercury weight thermometer, and deduce the cubi- cal expansion of the glass from the absolute expansion of mercury as determined by fiegnault. Unfortunately the reductions of Regnault’s observations by different calculators differ considerably even for the fundamental interval. The values of the fundamental coefficient range from ~~00018153 Regnault, and “00018210 Broch, to ‘00018253 Wiillner. The extreme difference represents an un~~ certainty of about 4 per cent. (1 in 25) in the expansion of the glass. This uncertainty is about 100 times as great as the prob- able error of the weight thermometer observations. But the expansion is even less certain beyond the limits of the fundamental interval. Another method of determining the expansion of the bulb is to observe the linear expansion of a tube or rod of the same material, and deduce the cubical expansion on the assumption that the expansion is isotropic. It is probable that the uncertainty involved in this assumption is at least of the same Order as the other in the case of glass or porcelain bulbs, on account of the difficulty of perfect annealing. In the case of metallic bulbs it is probable that this assumption is more nearly correct, provided that they have been perfectly annealed.

Except for small ranges of temperature, the assumption of a constant coefficient of expansion is not sufficiently exact. It is therefore usual to assume that the coefficient is a linear function of the temperature, so that the whole expansion from 0° C. may be expressed in the form dV=t(a + bt)V0, in which case the funda- mental coefficient f=a + 100b. Making this substitution in the formula already given, we obtain the whole correction

dt=(f+bT)t(t-\00) . . . (18)

It will be observed that the term involving b becomes of consider- able importance at high temperatures. Unfortunately, it cannot be

determined with the same accuracy as/, because the conditions of observation at the fixed points are much more perfect than at other temperatures. Provided that the rauge of the observations for the determination of the expansion is coextensive with the range of the temperature measurements for which the correction is required, the uncertainty of the correction will not greatly exceed that of the expansion observed at any point of the range. It is

not unusual, however, to deduce the values of b and/ from observa- tions confined to the range 0° to 100° C, in which case an error of 1 per cent., in the observed expansion at 60° C, would mean an error of 60 per cent, at 445°, or of 360 per cent, at 1000° C. Moreover, it by no means follows that the average valne of b between 0° and 100° C. should be the same as at higher or lower temperatures. The method of extrapolation would therefore probably lead to erroneous results in many cases, even if the value could be determined with absolute precision over the fundamental interval. It is probable that this expansion correction, which cannot be reduced or eliminated like many of the other corrections which have been mentioned, is the chief source of uncertainty in the realization of the absolute scale of temperature at the present time. The uncertainty is of the order of one part in five or ten thousand on the funda- mental interval, but may reach 0*5° at 500° C, and 2° or 3° at 1000° C.

§ 18. Thermodynamical Correction. — Of greater theo- retical interest, but of less practical importance on account of its smallness, is the reduction of the scale of the gas thermometer to the thermodynamical scale. The theory of the reduction was first given by Thomson, and the requisite experimental data for air, hydrogen, and carbonic acid were subsequently obtained by Joule and Thomson in their celebrated series of experiments on the ” Thermal Effects of Fluids in Motion” {Phil. Trans., 1854, 1862). These experiments have been discussed by Thomson (Ency. Brit., vol. xi. p. 554), and more recently by a number of other writers, but little has been done in the direction of the practical application of the results to the construction of a table of corrections for the reduction of the scales of different gas thermometers. This is the more to be regretted as the original table of corrections for the air thermometer given by Joule and Thomson in their first paper (1854) was calculated from imperfect data and formulae. Unfortunately, this table has been very widely quoted, even by later authors (cf. Guillaume, Thermometry, 1889), and has given rise to the impression that the corrections calculated by the method of Thomson and Joule are of no value as compared with those obtained by direct comparison of the scales of different gases. It may therefore be of interest to give a more complete table of corrections calculated from their later experi- ments, and to explain the method of calculation and discuss its limitations.

Lord Kelvin {Ency. Brit., vol. xi. p. 554), assuming that the cooling effect in adiathermal expansion through a porous plug varies inversely as the square of the absolute temperature, and taking Regnault’s values for the coeffi- cients of expansion at constant pressure, finds the following results for the absolute zero : —

Table II. — Absolute Zero from Expansion-Coefficienti

Regnault’s

‘ V ,■ r

Gas employed .

Air.

Hydrogen.

Carb6ni6″ .Acid. , ■

Coefficient of expansion . a Fundamental zero of gas . To Correction to abs. zero 0O^ T0 Absolute zero deduced *. 0<

•0036706

272-44 + 070 273-14

■0036613

273-13

\ -0-13

273 -00

;0037100′ 269-50

+•4-4

273-90

He concludes that the absolute zero is probably within one-tenth, of a degree of 273-0, at which point it may be taken (as a round' number) .until more accurate experi- ments are forthcoming.. He does not consider the case of the pressure-coefficient at constant volume. The objec- tion has been raised to his formula, that the simple inverse square law does not represent the observed increase in the heating effect with rise of temperature in the case of hydrogen, and, that it does not satisfy the observations on carbonic acid very accurately. It appears that more consistent results might ,be- obtained by taking , account of the "covolume,"iS,1 which affords an explanation' of the heating effect for hydrogen, and by employing the

more general equation (see Theemodynamics, equation (17), § 11),

v-b=R8/p-c, ... (19)

in which J is a constant depending on the volume of the molecules themselves, and c is a term depending on the molecular co-aggregation, which may be assumed to vary inversely as the wth power of the absolute temperature. The index n is equal to 2 in the Joule-Thomson equation, but is probably different for different gases.

Calculation of Correction. — In order to calculate the value of the correction by this , equation, it is preferable to write it in the form B—pvfR+q, where q is a small quantity of the same dimensions as a temperature. Comparing this with equation (19), we have generally

q={c-b)p/R .... (20)

In using a gas thermometer we assume an equation of the form T=pv/Ri, in which T is the temperature on the scale of the gas thermometer, and R± is a constant, differing slightly from R, and depending on the method of thermometry employed. The value of J?! has to be determined by observations at the fixed points 0° and 100° C, which gives the relations

R1 = (p1v1-p)ll00), . (21)

where p0, «„, q0 are the values of p, v, q, at 0° C, and^, vi, q1 are the values at 100° C. Similarly for the value of the freezing-point of water on the absolute thermodynamical scale, we have

«o=Wo/-B+?o=2’o+?o-(?i-?oW100;. . (22)

and for the correction dt to be added to the temperature Centi- grade on the scale of the gas thermometer to reduce to tem- perature Centigrade on the thermodynamical scale, we have by formula (14),

dt=(q-q0)-{q1-ql>)t /100 . . . (23)

The values of c and b for the gas may be deduced from the observations on the cooling effect Q for a difference of pressure P in terms of the specific heat

StyP=[n + l)c-b

(24)

If, for instance, we take from the observations of Joule and Thomson on the cooling effect in the case of carbonic acid for a change of pressure P=100 inches of mercury, the values 6=4-64° C. at 0° C, and 2-15° at 95 ‘6°, assuming the index n=2, we should find c„ = 4-62 c.c. at 0° C, and 6=2-18 c.c. The specific heat S is taken as 0-85 joule, but this is a little uncertain. The value of q is easily found in terms of c and b by equation (20), but as it depends on p as well as 0, its value is different for different methods of thermometry. In the case of the constant-pressure thermometer we have p=pm the initial pressure, but for the constant- volume thermometer p =po0/0o. Thus if n = 2, substituting in (22) and (23) we have the following very simple expressions for the correction for the constant- volume thermometer : —

Zero correction (const, vol.), 8o- To = 6i6 C) Scale correction „ „ dt = Ct{t – lOO)/0)

(25)

where C is used as an abbreviation for the constant factor Copo/S7SR, which has the following values if n=2, po=760 mm. : air, C= ■00085 ; hydrogen, C- “000132 ; carbonic acid, C= ‘00650.

For the constant-pressure thermometer, the constant C has the values already given for each gas, and the corrections are as follows : —

Zero correction, 0O- ?o=846 C-bpo/R

Scale correction,

(26)

The covolume b occurs only in the zero-correction of the constant-pressure thermometer. All the corrections vary in direct propor- tion to the initial pressure po at 0° C. By assuming a standard value such as 273-0 for the absolute zero 0O, the formulae for the zero-correction will give the value of T0, the reciprocal of the fundamental expansion- or pressure – coefficient for any initial pressure ^o-

The values of the corrections given in Table IV. have been calculated by the above formulae, assuming n=2. If the correc- tions between 0° and 100° for the constant-volume thermometer are increased in the proportion of ‘4/3, to correspond with an initial pressure of 100 cms., they are found, to agree very fairly in general character and also jn magnitude with those found experimentally by Chappuis, arid illustrated in Fig. 1. The theory may also be verified by comparison with the observed Values of the pressure- coefficients.

[gas

Table III. — Absolute

Zero from Pressure-Coefficient

Observer .

Regnault, j>=76 cms.

Chappuis, #=100 cms.

Gas employed .

Air.

H2,

C02.

N2.

H2.

C02.

Coef. xlO?. Jfund. zero T° .

36650 272-85

36678 272-64

36880 271-2

36748 272-11

36626 273 03

37250 268-5

e„-T0,n=2 . Abs. zero 60

+0-56 273-41

+0-09 272-73

+4-2 275-4

+0-86 272-97

+011 273-14

+ 5-5 274-0

90-T„,n=l . Abs. zero 80

+0-83 273-68

+0-13 272-77

+6-4 277-6

+1-30 273-41

+0-17 273-20

+8-4 276-9

It is at once evident from this table that Regnault's values for the pressure-coefficients, which have been so long accepted, disagree . among themselves, and cannot be reconciled with those of Chap- puis. His values for the expansion-coefficients, on the contrary, are fairly concordant, and have been confirmed by subsequent work. This would indicate that, contrary to his own belief, the constant-pressure thermometer was more accurate in his hands than the constant – volume thermometer. Assuming that the Joule- Thomson effect for air may be applied to nitrogen, the values of 6o deduced from the observations of Chappuis on the pressure- coefficients of nitrogen and hydrogen at 100 cms. agree very fairly with those deduced by Lord Kelvin from the expansion-coefficients. For the sake of comparison, the values of the corrections have also been calculated on the assumption n = 1, which corresponds to the formula of van der Waals. It will be seen that this introduces discrepancies so large as to be practically inadmissible. It would also make the scale correction for the constant-volume thermo- meter vanish, which cannot be reconciled with Chappuis's results (Fig. 1). So far as these particular observations alone are con- cerned, it would be possible to obtain better agreement empirically by the choice of some other values for the index n, but the real difficulty lies in reconciling the results by the Joule-Thomson method with the direct observations of specific volume by Amagat and others at higher temperatures. According to Amagat, CO2 is still a notably imperfect gas (c greater than b) at 260° C. But according to the values of c and b calculated from the Joule- Thomson effect, it should become "pluperfect" (c less than 6) at 125° C. On account of the difficulty of making experiments on the cooling effect at different temperatures, the work of Joule and Thomson has not yet been

repeated, except in the case of steam, which offers special facilities. It is evident that further experi- ments are desirable, but in the meantime it appears preferable to retain the value n = 2 for the index, a3 it simplifies the formulae, and satisfies the observations within the probable limits of experi- mental error, over the range of the experiments 0° – 100° C.

Table IV. — Thermodynamical Correction of Gas Thermometers.

At Constant Volume, Initial

At Constant Pressure, v«=

t

Pressure 760 mm.

760 mm.

Cent.

Air.

H2.

C02.

Air.

H2.

C02.

-200′

(+•700)

+ •109

(+5-36) (+1-98)

(+3-77)

+ •586

(+28-8)

-150′

+ •258

+ •040

+1-02

+ 158

(+7-82)

-100°

+ ■099

+ •015

(+•75)

+ •328

+ •050

(+2-48)

-50°

+ •029

+ •005

+ •22

+ •086

+ •015

+ ■65

0°

0

0

0

0

0

O

+10″

- -0027

- -0004

- -0207

- -0073

- -0011

-•056

+20′

- -0046

- -0007

- -0356

- -0122

- -0019

-•095

+30′

- -0059

- -0009

- -0452

- ‘0155

- -0024

-119

+40″

- -0065

- -0010

- -0500

- -0169

- -0026

-130

+50″

- -0066

-•0010

- -0504

- -0170

- 0026

-‘130

+60′

- -0061

- -ooio

- -0470

- -0155

- -0025

-120

+70′

- -0052

- -0008

- -0398

- -0132

- ‘0020

-101

+80′

- -0039

- -0006

- -0295

- -0098

- -0015

-■074

+90″

- -0021

- 0003

- -0162

- -0002

- -0008

-•040

+100′

0

0

0

0

0

0

+ 150°

+ ■015

+ ■002

+ ■116

+ ‘036

+ •006

+ •274

+200°

+ ■036

+ 006

+ •276

+ •083

+ •013

+ •635

+250°

+ ■061

+ ■009

+ 466

+ 137

+ ■021

+1‘05

+300*

+ ■089

+ •014

+ ■683

+ •196

+ •031

+ 1-61

+350′

+ 119

+ ■019

+ ■913

+ ■258

+ ■040

+2 00

+403°

+ •152

+ •024

+1-16

+ •325

+ •050

+2-48

+450″

+ 186

+ •029

+1-42

+ •392

+ •061

+3 00

+ 500″

+ •220

+ •034

+1-68

+ ‘460

+ •071

+3-60

+600″

+ •293

+ •046

+2‘24

+ •60

+ ■093

+4-60

+700″

+ ‘366

+ ■057

+281

+ •73

+ 114

+ 6-66

+800″

+ •442

+ •069

+3-40

+ ■88

+ 137

+6-73

+900°

+ ■523

+ ■081

+4-00

+ 1-03

+ 169

+7-83

+ 1000″

+ •600

+ ■093

+4-60

+1-16

+ 181

+8-93

+ 1500″

+ 1-01

+ 157

+772

+1-90

+ •296

+14-5

+2000″

+ 1-42

+ ■221

+10-9

+2-62

+ •407

+20-2

+3000′

+ 2-26

+ ■352

+17 ‘3

+410

+ ■837

+31-4

§ 19. Limitations. — In the application of the gas thermometer to the measurement of high temperatures certain difficulties are encountered which materially limit the range of measurement and the degree of accuracy attainable. These may be roughly classified under the

heads — (1) changes in the volume of the bulb; (2) leakage, occlusion, and porosity; (3) chemical change and dissociation. The difficulties arise partly from de- fects in the materials available for the bulb, and partly from the small mass of gas enclosed. The troubles due to irregular changes of volume of glass bulbs, which affect the mercury thermometer at ordinary temperatures, be- come so exaggerated at higher points of _ the scale as to be a serious source of trouble in gas thermometry in spite of the twentyfold larger expansion. For instance,

the volume of a glass bulb will be diminished by from one- quarter to one-half of 1 per cent, the first time it is heated to the temperature of boiling sulphur (445° C). This would not matter so much if the volume then remained constant. Unfortunately, the volume continues to change, especially in the case of hard glass, each time it is heated, by amounts which cannot be predicted, and which are too large to neglect. The most accurate method of taking account of these variations in a series of observations, with- out recalibrating and refilling and cleaning the bulb, is to assume the known constant value of the coefficient of ex- pansion of the gas, and to calculate the volume of the bulb at any time by taking observations in ice and steam {Phil. Trans., A. 1891, vol. 182, p. 124). Similar changes take place with porcelain at higher temperatures. Metallic bulbs are far more perfect than glass bulbs in this respect. It is probable that silica bulbs would be the most perfect. The writer suggested the use of this material (in the Journal of the Iron and Steel Institute for 1892), but failed to construct bulbs of sufficient size. Mr Shenstone, however, has recently succeeded, and there seems to be a good prospect that this difficulty will soon be minimized. The difficulties of leakage and porosity occur chiefly with porcelain bulbs, especially if they are not perfectly glazed inside. A similar difficulty occurs with metallic bulbs of platinum or platinum-iridium, in the case of hydrogen, which passes freely through the metal by occlusion at high temperatures. The difficulty can be avoided by substituting either nitrogen or pre- ferably argon or helium as the thermometric material at high temperatures. With many kinds of glass and por- celain the chemical action of hydrogen begins to be ap- preciable at temperatures^as low as 200° or 300° C. In any case, if metallic bulbs are used, it is absolutely necessary to protect them from furnace gases which may contain hydrogen. This can be effected either by enclosing the bulb in a tube of porcelain, or by using some method of electric heating which cannot give rise to the presence of hydro- gen. At very high temperatures it is probable that the dissociation of diatomic gases like nitrogen might begin to be appreciable before the limit of resistance of the bulb itself was reached. It would probably be better, for this reason, to use the monatomic and extremely inert gases argon or helium.

§ 20. Other Methods. — Many attempts have been made to overcome the difficulties of gas pyrometry by adopting other methods of measurement. Among the most in- teresting may be mentioned — (i.) The variation in the wave-length of sound. The objection to this method is the difficulty of accurately observing the wave-length, and of correcting for the expansion of the material of the tubes in which it is measured. There is the further objection that the velocity varies as the square root of the absolute temperature, (ii.) A similar method, but more promising, is the variation of the refractivity of a gas, which can be measured with great accuracy by an inter- ference method. Here again there is difficulty in deter- mining the exact length of the heated column of gas, and in maintaining the temperature uniform throughout a long column at high temperatures. These difficulties have been

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ingeniously met by D. Berthelot (Comptes Rendus, 120, p. 831). But the method is not easy to apply, and the degree of accuracy attainable is probably inferior to the bulb methods, (iii.) Methods depending on the effusion and transpiration of gases through fine orifices and tubes have been put in practice by Barus and by the writer. The method of transpiration, -when the resistance of the tube through which the current of gas is passed is measured on the Wheatstone bridge principle (Nature, 23rd March 1899), is extremely delicate, and the apparatus may be made very small and sensitive, but the method cannot be used for extrapolation at high temperatures until the law of increase of resistance has been determined with certainty. This may be successfully accomplished in the near future, but the law is apparently not so simple as is usually supposed.

On account of these and similar difficulties, the limit of gas thermometry at the present time must be placed at 1200° O, or even lower, and the accuracy with which temperatures near 1000° C. are known does not probably exceed 5° C. Although measurements can be

effected with much greater consistency than this by means of electrical pyrometers, the absolute values corresponding to those tem- peratures must remain uncertain to this extent, inasmuch as they depend On observations made with the gas thermometer. Temperatures as high as 2000° C. have been determined, but only by extrapolation of empirical formulae or other methods of estimation.

Electrical Thermometry.

§ 21. The convenience of the mercurial thermometer lies in the fact that it is complete in itself, and can be read without subsidiary appliances beyond a magnifying glass. Its weakness lies in the very limited range of each single instrument, and in the troublesome and often uncertain corrections which must be applied to its readings in all work of precision. Electrical thermometers have the disadvantage of requiring auxiliary apparatus, such as galvanometers and resistances, the use of which involves some electrical training. But they far surpass the mercurial thermometer in point of range, delicacy, and adaptability, and can be applied to many investigations in which ordinary thermometers are quite useless.

There are two kinds of electrical thermometers, which depend on different effects of heat on the electrical properties of metals : (1) The Thermocouple, or Thermo- pile, which depends on the production of a thermoelectric force when the junctions of different metals in an electric circuit are at different temperatures ; and (2) the Electrical Resistance Thermometer, the action of which depends on the fact that the resistance of a pure metal to the passage of an electric current increases very considerably when the temperature is raised. The theory of the thermocouple is discussed at some length in the article Thermoelectricity, as it possesses many points of interest, and has been studied by many skilful experimentalists. The electrical resistance thermometer is of more recent origin ; but although the theory has been less fully developed, the practice of the method bids fair to surpass all others in the variety and accuracy of its applications. In order to secure the widest possible range and the greatest constancy, in either variety of electrical thermometer, advantage is taken of the great

stability and infusibility characteristic of the metals of the platinum group. Other metals are occasionally used in work at low temperatures with thermocouples for the sake of obtaining a larger electro- motive force, but the substitution is attended with loss of constancy and uncertainty of reduction, unless the range is greatly restricted.

§ 22. Applications of the Thermocouple. — The principal uses of the thermocouple in thermometry are for measur- ing high temperatures, and for measuring small differences of temperature, more particularly when the temperature is required to be measured at a point, or in a very small space. The electromotive force of the couple depends only on the temperature at the plane of junction of the two metals, which can be very exactly located. A typical instance of a measurement to which the thermocouple is peculiarly suited, is the determination of the cyclical variations of temperature at accurately measured depths from one-tenth to one-hundredth of an inch in the metal of the cylinder of a heat engine, the interior surface of which is exposed to cyclical variations of temperature in the working of the engine.1 The exact depth of the plane of junction can be measured without difficulty to the thousandth of an inch. The insertion of the wire makes the least possible disturbance of the continuity of the metal. There is no lag, as the thermometer itself is part of the metal. The instantaneous value of the temperature at any particular point of the stroke can be measured separately by setting a periodic contact to close the circuit of the galvanometer at the desired point. A further advantage is gained by measuring only the differ- ence of temperature between two junctions of a thermo- couple at different depths, instead of the whole interval from some fixed point. None of these advantages could be secured by the use of any ordinary thermometer ; some depend on the fact that the method is electrical, but some are peculiar to the thermocouple, and could not be other- wise attained.

On the other hand, the thermocouple is not well suited for thermometry of precision, on account of the smallness of the electromotive force, which is of the order of ten microvolts only per degree for the most constant couples. By the use of very delicate galvanometers it is possible to read to the hundredth or even in special

cases to the thousandth of a degree on this small difference, but unfortunately it is not possible to eliminate accidental thermal effects in other parts of the circuit due to small differences of temperature and material. These accidental effects seldom amount to less than one or two microvolts even in the best work, and limit the accuracy attainable in temperature measurement to about the tenth of a degree with a single platinum thermocouple. This limit can be surpassed by using couples of greater thermo- electric power and less permanence, or by using a pile or series of couples, but in either case it is doubtful whether the advantage gained in power is not balanced by loss of simplicity and constancy. A method of avoiding these effects, which the writer has found to be of great use in deli- cate thermoelectric researches, is to make the whole circuit, including all the terminals and even the slide-wire itself, of pure copper. Platinoid, german silver, constantan, and other alloys most commonly used for resistances and slide-wires, are particularly to be avoided, on account of their great thermoelectric power when connected to copper. Manganin and platinum-silver are the least objectionable, but the improvement effected by substitut- ing copper is very marked. It is clear that this objection to the use of the couple does not apply with the same force to high temperatures, because the electromotive force of the couple itself is greater, and the accuracy attainable is limited by other considerations.

§ 23. The Resistance Thermometer. — In practice the resistance thermometer is almost invariably made of platinum, since there is very seldom any advantage to be gained by the substitution of baser metals. The instrument

1 Hall, Tram. Amer. Inst. Meet. Eng., 1891, vol. viii. p. 226 ; Callendar and Nicolson, Proc. Inst. O. E., vol. oxxxi. p. 1.

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is for this reason often referred to simply as the “platinum thermometer.” It is important that the platinum should be pure, both for the sake of uniformity and also because the change of electrical resistance with temperature is greater the purer the metal. The observa- tion of the fundamental coefficient, which is ‘00390 (or rather larger than the coefficient of expansion of a gas) for the purest metal hitherto obtained, is one of the most delicate tests of the purity of the metaL In addition to the constancy and infusibility of the metal, a special advantage which is secured by the use of platinum is the close agreement of the thermodynamical scale with the platinum scale of temperature, as defined by the formula

pt=W0(R-It(l)/(It1-M0), . . . (27)

in which the symbol pt stands for the temperature on the platinum scale Centigrade, and R, Ev and S0 are the observed resistances of the thermometer at the tempera- tures pt, 100°, and 0° C. respectively. A platinum- thermometer is generally arranged to read directly in degrees of temperature on the platinum scale, just as a mercury thermometer is graduated in degrees of the mercury scale. The reduction to the scale of the gas thermometer is most conveniently effected by the differ- ence formula

t-pt=dt(t-WO)/W,000„ . . (28)

in which d is a constant, called the difference-coefficient, the value of which for pure platinum is about 1*50, but varies slightly for different specimens. This formula was first given by the writer as the result of a series of com- parisons of different platinum wires with each other and with other metals, and also with an air thermometer over the range 0° to 625″ C. The platinum wire in these com- parisons was enclosed inside the bulb of the air thermo- meter itself, and disposed in such a manner as to be at the mean temperature of the bulb in case the temperature were not quite uniform throughout (Phil. Trans., A. 1887, p. 161). The formula was subsequently verified by Griffiths (Phil. Trams., A. 1891), by the comparison of platinum thermometers of different construction at tem- peratures up to the boiling-point of sulphur, 445° C, and by Heycock and Neville (Jour. Chem. Soc,

February, 1895), by the observation of a number of higher points up to the freezing-point of copper at 1082° C, which they showed to agree with the most probable mean of all the best determinations by various methods of gas thermo- metry., At still higher temperatures, beyond the present range of the gas thermometer, the writer has succeeded in obtaining presumptive evidence of the validity of the same formula by comparison with the scales of the expansion and the specific heat of platinum, which appear to follow similar laws (Phil. Mag., December 1899). If we assume that the coefficient of expansion of platinum, the coefficient of increase of resistance, and the specific heat are all three linear functions of the temperature, we obtain results which are in agreement within the limits of error of observation up to the fusing point of platinum itself. Quite recently the same formula has been independently verified by the comparison of platinum thermometers with the constant-volume nitrogen thermometer by Harker and Chappuis (Phil. Trans., A. 1900), working at the International Bureau at Sevres, over the range 0° to 650° C. It has also been shown by the experiments of Fleming and others that the same formula' satisfies very closely the observations on the variation of electrical resistance of other metals over wide ranges of temperature. Although the theoretical explana- tion of the formula has not yet been given, owing to our ignorance of the true nature of electrical conduction and of the molecular constitution of metals, it may be regarded

from an empirical point of view as being one of the most accurately established of all thermometric formulae. It will be observed that it also represents the simplest possible type of divergence from the thermodynamical scale. It has for this reason been proposed to adopt a scale of temperature based on this formula as a practical standard of reference pending more accurate determina- tions of the thermodynamical scale at high temperatures. The advantage of this practical standard would be that all measurements made at the present time could be referred to it directly with much greater accuracy than they can be referred to the gas thermometer. The latter instru- ment is extremely difficult to use, especially at high temperatures, and cannot be directly applied to the majority of investigations. The order of accuracy attain- able with a platinum thermometer is at least ten times

greater than with the gas thermometer, on account of the uncertainty of the expansion of the envelope, a source of error from which the platinum thermometer is free. By adopting the platinum thermometer as a practical standard of reference, a higher order of accuracy of comparison is attainable, in addition to much greater ease and convenience of manipulation.

§ 24. Methods and Apparatus. — The methods of electri- cal thermometry may be roughly classified under two heads as (1) deflection methods, in which the temperature is deduced from the observed deflection of a galvanometer ; and (2) balance methods, in which the resistance or the electromotive force is balanced against a known adjustable resistance or potential difference. The former methods are most suitable for rough work and rapid reading, the latter for the accurate measurements. In the practice of the deflection method it is customary to use a movable- coil galvanometer, the sensitiveness of which can be varied by varying the resistance in circuit, or by varying the stiffness of the suspension. The accuracy attainable is of the order of one-half of 1 per cent, on the deflection, and is limited by variations of resistance of the galvano- meter, and by the imperfect elasticity of the suspension. In any case the scale of the galvanometer should be "calibrated" or tested for uniformity. In this kind of work the thermocouple has the advantage over the re- sistance thermometer in that the latter requires an auxiliary battery to supply the current; but in many cases this is no disadvantage, because it permits a greater latitude of adjustment^ and makes it possible to obtain greater power than with the thermocouple. For ex- ample, the electromotive force of a 10 per cent. Rh. Pt. – Pt. couple at 500° C. is only about 4 millivolts ('004 volt). To read so small a potential difference with any accuracy requires a suspended coil galvanometer with a mirror and scale. Even with the smallest resistance thermometer, with a coil containing only two inches of fine wire, it is easy to have a difference of potential of 40 or 50 millivolts at 500° Oj, which is well within the range of an ordinary portable pivoted millivoltmeter, such as is commonly used in every power station for measuring electric currents by the fall of potential method. With larger thermometers the power available would be much greater. This is most advantageous, not only for accurate

work, but also for practical applications, in which automatic records are often a great convenience. With a resistance thermometer it is easy to obtain records in pen and ink on a scale of an inch to the degree by a balance method. With a thermo- couple it is necessary to employ photography and very delicate apparatus to secure a similar scale.

In cases where it is desired to obtain greater accuracy without abandoning the quickness of reading which is the principal advantage of the deflection method; it is possible to combine the two methods by balancing part of the

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potential difference by means of a potentiometer (see Electricity : Electric Current) and using the galvano- meter for the small changes only. In cases where the greatest accuracy is required, a very sensitive galvanometer should be used, and the whole of the potential difference should be balanced as nearly as possible, leaving very little to depend on the deflection of the galvanometer. The degree of sensitiveness and accuracy obtainable depends primarily on the delicacy of the galvanometer, on the power available, and on the steadiness of the conditions of experiment. For thermometry of precision the resist- ance thermometer possesses three very great advantages over the thermocouple : (1) The power available, owing to the use of a battery, is enormously greater ; (2) it is possible completely to eliminate the errors due to acci- dental thermal effects by reversing the battery ; (3) the Wheatstone bridge method can be employed in place of the potentiometer, so that the constancy of the battery is immaterial, and it is not necessary to use a standard cell. The conditions to be satisfied in the attainment of the greatest possible accuracy in the measurement of temperature by this method differ somewhat from those which obtain in ordinary measurements of resistance, so that a special type of apparatus has been evolved for the purpose, a brief description of which will be given.

§ 25. Compensated Bridge Apparatus. — It is necessary that the thermometer should be connected to the measuring apparatus by wires or ” leads ” of considerable length, generally at least two or three metres, in order to avoid exposing the galvanometer and resistance box, or other delicate parts of the apparatus, to changes of temperature. It is also essential that the leads should not be too thick or heavy, for convenience in handling, and to prevent conduction of heat along the stem of the thermometer. The resistance of that part of the leads which is exposed to variations of temperature necessarily changes, and would give rise to serious

Rheostat

Tlterm’

Coil£.

Fig. 5. — Diagram of Compensated Bridge Method.

errors if it were not determined or compensated. The method now generally adopted in accurate work is to compensate the variations of resistance of the leads by an exactly similar pair of dummy leads called the ” compensator ” and connected as shown diagram- matically in Fig. 5. The battery, consisting of a single cell, with a rheostat and reversing key in circuit, is connected to the terminals AB of the two equal resistance coils AG, GB, which form the ratio arms of the balance. These coils must be carefully tested for equality of temperature-coefficient, and placed in close proximity to each other so as to be always at the same temperature. If they are interwound on the same reel, they must be most care- fully insulated from each other. In parallel circuit with the ratio coils are connected the compensator CC and the balancing resistances C’E, on one side of the bridge-wire EF, and the com- pensating resistances FP and the pyrometer and leads PEP’ on the other side. The galvanometer is connected to the point G between the ratio coils, and to the sliding contact D on the bridge- wire. Since the ratio coils are always equal, equal changes of resistance on either side of D are eliminated, and do not affect the balance. Thus the changes of the pyrometer leads PP’ are balanced by the equal changes

of the compensator leads CC on the other side. As a further refinement, which is of some im- portance in delicate work, the ends of the compensator leads are

connected by a short piece of the same wire as the pyrometer coil. For instance, in observing the variations of temperature of the steam in the cylinder of a steam engine at different points of the stroke with a very delicate thermometer made of wire one- thousandth of an inch in diameter (Proc. Inst. 0. E., vol. cxxxi. Fig. 16, p. 23), the ends of the fine wire attached to the thick leads could not follow the rapid variations of temperature, and it was found necessary to adopt this device to eliminate the end- effect. It is also useful in other cases to eliminate the effect of conduction along the leads in cooling the ends of the fine wire coil. The balancing resistances C'E are made of some alloy such as manganin or platinum-silver, the resistance of which varies very little with change of temperature. Platinum-silver is pro- bably the best material, as it can be perfectly annealed at a red heat without risk of burning, and is then extremely constant, whereas manganin resistances are liable to change, and require frequent recallbration. Unless the box can be kept at an absolutely constant and uniform temperature, which is not impossible but often inconvenient, it is necessary to allow for the change of resistance of the balancing coils 'C'E due to change in the tem- perature of the box. The temperature of the coils cannot be accurately determined with a mercury thermometer unless they are immersed in oil, but even in that case it is necessary to know the temperature coefficient of each individual coil. A more con- venient and accurate method, which eliminates the correction auto- matically, is to compensate each individual coil of the balancing coils C'E by a corresponding compensating coil at FP on the other side of the bridge-wire. The compensating coils are made of platinum, also annealed at a red heat, and each is placed in the box in close proximity to the coil it is intended to compensate. Each balancing coil and its compensator are tested together at various temperatures between 10° and 30° G, and are adjusted until their difference remains constant for any small variation of temperature in the neighbourhood of 20° C. This method of com- pensation was applied by the writer in 1887, but has not been generally adopted on account of the labour involved in adjusting the coils. The

absolute values of the resistances are immaterial, but it is necessary to know the relative values with the greatest possible accuracy. For this reason it is preferable to arrange the resistances in the binary scale, each resistance being equal to twice the next smaller resistance, or to the sum of all the smaller resistances, the two smallest resistances being made equal. This arrangement permits the greatest accuracy of comparison in the simplest manner with the fewest observations. The bridge-wire EF provides a continuous scale for reading small changes of resistance. Any change of resistance of the pyrometer coil necessitates the movement of the balance point D through an equivalent resistance along the bridge – wire. The equivalent resistance of the bridge-wire per unit length of the attached scale is preferably adjusted, by means of a shunt shown in parallel with it in Fig. 5, to be an exact submultiple of the smallest resistance coil. It is usual also to adjust the resistances of the thermometers so that their fundamental intervals are convenient multiples of this unit, generally either 100, 200, 500, or 1000, so that the bridge-wire may read directly in degrees of temperature on the platinum scale. It is easy to get a scale of 10 cms. or more to the degree, and it is not difficult with a suitable galvanometer to read to the ten-thousandth part of a degree. The length of the bridge-wire itself need not be more than 20 or 30 cms., as the balancing resistances enable the scale to be indefinitely extended. Thus the instrument possesses the great advantage over the mercury thermometer that the most open scale may be easily secured without unwieldy length, and without restricting the range of each thermometer.

§ 26. Errors and Corrections. — It is most instructive to consider the errors and corrections involved in platinum thermometry on the same lines as those on which the corresponding errors of the mercury thermometer have already been treated.

(I) The changes of zero of the mercury thermometer arise chiefly from the small expansibility of mercury combined with the imper- fect elasticity of the containing tube. In platinum thermometry the containing tube has nothing to do with the reading, and the effect of any possible strain of the fine wire of the coil is minimized by its small

dimensions and by the large temperature-coefficient of the increase of resistance, which is more than twenty times greater than the coefficient of apparent expansion of mercury in glass. It is not surprising, therefore, that the changes of zero of a platinum thermometer should be practically negligible; provided that the wire is not strained and contaminated with impurities. It is probable that with ordinary care the changes of zero due to exposure to any given limits of temperature are in all cases less than the limit of accuracy of observation, due to other causes at the extreme limit of the range considered.

(II) The fundamental interval of each thermometer must be determined as usual by observations in ice and steam, and a correc- tion must be applied by the method already described in the case of the mercury thermometer. The difference of the temperature of

the steam from 100° C. should be determined on the platinum scale by the approximate formula

dph=-9S5dh= ~~0362(2”~~ 760)- ■000020(5’- 760)2 . (29)

(III) Pressure Correction. — The effect of change of pressure on a platinum thermometer of the ordinary tube form is of course nothing, as the wire itself is not exposed to the pressure. Even if the wire is naked and directly exposed to large changes of pressure, the change of reading is almost inappreciable. Similarly there is no source of error analogous to the effects of capillarity, which are so troublesome with delicate mercury thermometers.

(IV) Stem Exposure. — The reading of a platinum thermometer with compensated leads depends only on the temperature of the coil of wire forming the bulb, and not on the temperature of the stem, provided that the immersion is sufficient to avoid errors due to conduction or

convection along the stem. It is desirable that the top of the bulb should be immersed to a depth equal to from three to five times the diameter of the tube, according to the size and the accuracy required.

(V) Scale Correction. — The reduction to the thermodynamical scale may be effected, within the limits of probable error of the most accurate measurements at present available, by the very simple difference formula (28) already given, over the whole range from -100° C. to +1100° C. This is in striking contrast with the mercury thermometer, which requires a cubic formula to cover the range 0° to 200° C. with equal accuracy. The value of the constant CL in the formula varies but little, provided that the wire be fairly pure and the thermometers properly constructed. In order to determine its value in any special case, it is best to take an observation at the boiling-point of sulphur (S. B. P.) for tempera- tures above 0° C. , or at that of oxygen for temperatures below 0° C. down to – 200° O. It appears probable that there is a point of inflection in the curve of resistance- variation of platinum and some other metals in the neighbourhood of -200° C, and that the formula does not apply accurately below this point. It has been the custom for several years to assume the boiling-point of sulphur (S.B.P.) under normal pressure to be 444 ‘53° C, as determined by Gallendar and Griffiths, using a constant-pressure air ther- mometer, and to take the rate of change of temperature with pressure as ‘082° per mm. from Regnault’s observations. According to experiments made at Kew Observatory with platinum ther- mometers (Chree, Proc. R. S., 1900), the rate of change is somewhat larger than that given by Regnault’s formula, namely, about “090° per mm., and it appears desirable to determine this constant with greater accuracy. The difference between the above formulae reaches a tenth of a degree if the barometer differs by 12 mm. from 760 mm. The uncertainty in the absolute boiling-point of sulphur, however, is probably somewhat greater than one-tenth of a degree, on account of the uncertainty of the expansion correction of the gas thermometer (Phil. Mag., December 1899). The thermo- dynamical correction of the gas thermometer, which amounts to half a degree, according to Table IV. above, is also to some extent uncertain, on account of the extrapolation. Provided, however, that some exact value of the S. B. P. is chosen for refer- ence,

for the reduction of observations with platinum thermo- meters, the results so reduced will be strictly comparable, and can be corrected at any subsequent time when the value of the S.B.P. is more accurately determined. The boiling-point of oxygen may be taken as – 182 ‘5° C. with sufficient approximation for a similar purpose.

(VI) Calibration Correction. — The calibration of the resistance box and the bridge-wire corresponds to the calibration of the stem of the mercury thermometer, but the process is much simpler for several reasons. It is more easy to obtain a uniform wire than a uniform tube. The scale of the wire is much more open, it corre- sponds to a very small part of the whole scale, and the process of calibration is easier. One box when calibrated will serve for any number of thermometers of different ranges and scales, and covers the whole range of temperature (see Calibration, Ency. Brit., vol. xxvi.).

§ 27. Electrical Precautions. — The platinum thermometer is so far superior to the mercury thermometer in all the points above enumerated that, if there were no other difficulties, no one would ever use a mercury thermometer for work of precision. In using a platinum thermometer, however, some electrical training is essen- tial to obtain the best results. The manipulation and adjustment of a delicate galvanometer present formidable difficulties to the non-electrical observer. Bad contacts, faulty connexions, and defective insulation are not likely to trouble the practised elec- trician, but present endless possibilities of error to the tyro. A useful discussion of these and similar details is given in the paper by Chree already referred to. Bad insulation of the pyrometer and connexions can easily be detected, in the compensated instru- ment already described, by disconnecting one of the C leads from the battery and one of the P leads from the bridge-wire. Under these conditions the galvanometer should not deflect if the insula- tion is perfect. Defective insulation is most likely to be due to

damp in the thermometer at low temperatures. This source of error is best removed by drying and hermetically sealing the ther- mometers. Trouble from bad contacts generally arises from the use of plugs for the resistance coils. If plugs are used, they must be specially designed so as

not to disturb each other, and must be well fitted and kept very clean. Mercury cups with large copper terminals, well amalgamated, as used with standard resistance coils, are probably the simplest and most satisfactory method of changing connexions. Accidental thermoelectric effects in the circuit are a possible source of error, as with the thermocouple, but they are always very small if the thermometer is properly con- structed, and are relatively unimportant owing to the large E.M.F. available. In any case they may be completely eliminated by re- versing the battery. The heating, effect of the current through the thermometer is often negligible, but should be measured and allowed for in accurate work. With a current of ‘01 ampere the rise of temperature should not exceed T^jf or xh of a degree. With a delicate galvanometer it is possible to read to the ten- thousandth of a degree with a current of only ‘002 ampere, in which case the heating effect is generally less than ttsVh °f “■ degree. It can be very easily measured in any case by changing from one cell to two, thus doubling the current in the thermometer, and quadrupling the heating effect. The correction is then applied by subtracting one-third of the difference between the readings with dne and two cells from the reading with one cell. The correction is always very small, if a reasonably sensitive galvanometer is used, and is frequently negligible, especially in differential work, which is one of the most fruitful applications of the platinum thermometer.

§ 28. Construction of Thermometers. — One of the chief advantages of the platinum thermometer for research work is the endless variety of forms in which it may be made, to suit the particular exigencies of each individual experiment. It is peculiarly suited for observing the average temperature throughout a length or space, which is so often required in physical experiments. For this pur- pose the wire may be disposed in a straight length, or in a spiral, along the space in question. Again, in observing the temperature of a gas, the naked wire, on account of its small mass and extremely low radiative power, is far superior to any mercury thermometer. The commonest form of platinum thermometer, and the most suit- able for general purposes, contains a coil from J inch to 2 inches long, wound on a cross of thin mica, and enclosed in a tube, about \ to \ inch in diameter, of glass or porcelain according to the

tempera- ture for which it is required. The pyrometer leads and the com- pensator leads are insulated and kept in place by passing through mica discs fitting the tube, which serve also to prevent convection currents up and down the tube. For temperatures above 1000° C. biscuit porcelain presents certain advantages over mica in strength and infusibility. For the highest temperatures it is proposed to use silica tubes and, silica frames, which have been successfully constructed and possess the advantage of being tougher than porcelain. The chief objections to porcelain tubes arise from the glaze, which melts at 1100° C, and is liable to stick to and injure the coils.

It would not be within the scope of the present article to attempt to describe the many ingenious varieties of electrical thermometers which have been devised for special purposes. It would also be impossible to discuss the many other methods of thermometry or pyrometry, depending on expansion, on fusion, on calorimetry, or on radiation. These methods have many useful applications, but are not in general suited for work of precision. It has been thought desirable to restrict the discussion to the most accurate types, because they are the most important for the advancement of science, and could not be adequately treated in a smaller compass. Moreover, descriptions of the commoner methods can be found in many familiar text-books, whereas ther- mometry of precision is a more recent development, of which no complete exposition is to be found in any English work at the present time. On mercurial and gas thermometry the best treatise is that of Guillaume (ThermomUrie de Precision, Paris), already referred to. On pyrometry there is » valuable report by Barus, Physical Congress, Paris, 1900 ; also a recent work by Chatelier and Boudouard (Mesure des Temperatures jtlevies, Paris), which is concerned chiefly with the thermocouple, but is well illustrated and up to date. The electrical resistance method as applied to work of precision is to be found only in a series of papers, the most important of which have been referred to.

Alphabetical Index of Symbols.

a, b = Numerical constants in expansion formulae (18).

C= Coefficient of thermodynamical correction formulse (26). ‘ c = Co-aggregation volume in formula (19). /= Fundamental coefficient of expansion of bulb. ,M= Mass of gas in bulb of gas thermometer. p= Pressure of gas in bulb of gas thermometer. i2= Constant of gas thermometer, or resistance of platinum thermometer.

r=Eatio of dead space to volume of bulb. T= Temperature by gas thermometer. t = Temperature on the Centigrade scale. 6 = Temperature on the therrnodynamical scale. v = Specific volume of gas. V= Volume of bulb of gas thermometer. W= Weight of mercury filling bulb at 0° C. w= Weight of mercury in overflow.

(h. l. c.)

Thibaw, called by the Shans, and officially, Hsipaw, and also frequently Ong Pawng (the name of an old capital), is one of the northern Shan States of Burma. It includes four states — Thibaw, the main state, and the sub-states of Mbng L5ng, Mbng Tung, and Thonze (or Hsumhsai). The whole state has an estimated area of 4524 square miles, and the population in 1897 was cal- culated to be 73,248. There were 96 circles, 1260 villages, and 19,436 households. The main state lies on the geological fault which runs east and west across the Shan States, from the Salween at Kun Long and beyond to nearly the rim of the Shan tableland at Gokteik. It is therefore broken up into a mass of not very well denned ridges and spurs, crossing and re-entering. The chief plain land is in the valley of the Nam Tu (Myit-nge), near Thibaw town, and the valley or strath of the Pyawng Kawng, Nawng Ping neighbourhood. Elsewhere the valleys are insignificant. The hills on the Mong Tung border reach their highest elevations in the peaks Loi Pan (6848 feet) and Loi Htan (6270 feet). To the north-west of Thibaw town, on the Tawng Peng border, Loi Lam rises to 6486 feet. The valley of the Nam Tu marks the lowest point in the state at Thibaw town, about 1400 feet, and rises on the east in Mong Tung to a plain level of about 2500 feet, and on ■ the west in Mbng Long to a confused mass of hills with an

average height of 4500 feet, broken up by the Nam Yawn and Nam Kaw valleys, which are about 3000 feet above mean sea-level.

The chief river is the Nam Tu or Myit-nge, also frequently called by its classical name the D&ktawadi. The main stream rises in the Salween-Irrawaddy watershed, and is enlarged by consider- able tributaries. At Thibaw town it is 250 yards wide and about 8 feet deep, with a fairly strong current. The Nam Tu is navig- able only in local stretches, and between Thonze and Lawksawk (Yatsauk) it flows through a gorge between cliffs three to four thousand feet high. At the gorge of Hokut (Ngokteik) the Nam Htang and the Nam Pase unite to form the Nam Kiit, which passes into the ground at the natural bridge where the Mandalay- Kun Long railway crosses the gorge, and reappears to join the Nam Tu. The bed of the Nam Kiit is about 1500 feet below the general level of the country. Coal is found at various places in the state, but is not of very high quality. Salt-wells are worked by the inhabitants of Mawhkio (Bawgyo) about 7 miles from Thibaw town. The average maximum temperature at the beginning of April is about 96°, and the minimum about the same period 65°. The rainfall averages about 70 inches for the year. The chief crops are rice, cotton, sesamum, tea in the hills, and thanat, the leaf of a tree used for the wrapper of the Burma, or "green" cheroot. Cotton cloth was formerly much more generally manufactured than it now is, and a coarse country paper is also made. Other industries are merely of articles for local use. The Government cart road to Lashio passes through the centre of the state, and from this various unmetalled cart roads radiate to different parts of the state and the neighbouring states. The Mandalay-Kun L6ng railway under construction will also pass through the capital. Teak forests exist along the banks of the Nam Tu and in the Mong L6ng states, but both have been practically exhausted, and will have to be closed for many years. Previous to the annexation, and in a general way still, the state is administered by the sawbwa, or chief, aided by a council of six amats or ministers. Under them are a number of ni-baings, who are in charge of circles and townships. Each ni-baing has an asiyin, or clerk, and each village has a neadman, or hin-mcm. The amats supervise the administration of a certain number of districts. The old system is now being assimilated to that followed in Burma. The revenue in 1897-98

amounted to Es.262,906, and the expendi- ture in the same year to Es.221,127.

Thomar, a town of the district of Santarem, Por- tugal, 1 2 miles north-east of Lisbon. It is chiefly famous for the magnificent convent of the Order of Christ, founded

by the Templar Knight Gualdim Paes, and greatly favoured by King Manuel ; the windows of the chapter-house are especially noteworthy. Other interesting edifices are the church of St John the Baptist and the ruins of the Templars' Castle. Paper and cottons are manufactured. Population (1890), 5816 ; (1900), 6933.

Thomas, Arthur Goring: (1850-1892), English musical composer, was the youngest son of Free- man Thomas and Amelia, daughter of Colonel Thomas Frederick. He was born at Katton Park, Sussex, 20th November 1850, and educated at Haileybury College. He was intended for the Civil Service, but delicate health interfered with his studies, and in 1873 he went to Paris to cultivate the musical talent he had displayed from an early age. Here he studied for two years with Emile Durand. In 1875 he returned to England, and in 1877 entered the Royal Academy of Music, where for three years he studied under Ebenezer Prout and Arthur Sullivan, winning twice the Lucas medal for composition. At a later period he received some instruction in orches- tration from Max Bruch. His first published composition was a song, "Le Roi Henri," which appeared in 1871. An early comic opera, Bon Braggadocio (libretto by his brother, C. I. Thomas), was apparently unfinished ; some of the music in it was afterwards used for the The Golden Web. A selection from his second opera, The Light of the Harem (libretto by Clifford Harrison), was performed at the Royal Academy of Music, 7th November 1879, with such success that Carl Rosa commissioned him to write Esmeralda (libretto by T. Marzials and A. Ran- degger), which was produced at Drury Lane, 26th March 1883. Two years later it was given (in German) at Cologne and Hamburg, and in 1890 (in French) at Covent Garden. On 16th April 1885 Rosa produced at Drury Lane Thomas's fourth and best opera, Nadeshda (libretto by Julian Sturgis), a German version of which was given at Breslau in 1890. A fifth opera,

The Golden Web (libretto by F. Corder and B. C. Stephenson), slighter than its predecessors, was produced (after the composer's death) at Liverpool, 15th February, and at the Lyric Theatre, London, 1 1th March 1893. Besides these dramatic works Thomas's chief compositions were a psalm, " Out of the Deep," for soprano solo and chorus (London, 1878) ; a choral ode, " The Sun Worshippers" (Norwich, 1881), and a suite de ballet for orchestra (Cambridge, 1887). A cantata, the Swan and the Skylark, was found in piano- forte score among his MSS. after his death : it was orchestrated by C. Villiers Stanford, and produced at the Birmingham Festival of 1894. His minor compositions include over 100 songs and duets. In 1891 Thomas became engaged to be married; shortly afterwards he showed signs of mental disease, and his career came to a tragic end on 20th March 1892. He was buried in Finchley cemetery. Thomas will always occupy a distinct place among English composers of the 19th century. His music shows traces of his early French training, but he possessed a great talent for dramatic composition and a real gift of refined and beautiful melody. He was most critical of his own work, never attempting anything for which he felt he was unfitted, and constantly revising and rewriting his compositions. Personally he was the most amiable of men : the esteem in which he was held was shown by the concert given at St James's Hall after his death with the object of founding a scholarship in his memory, at which there appeared all the chief musicians then in London, both British and foreign. (w. b. s*.)

Thomas, Charles Louis Ambroise

(181 1-1896), French musical composer, was born at Metz, 5th August 1811. He studied at the Paris Conservatoire,

and won the Grand Prix de Bome in 1832. , Five years later, in 1837, his first opera, La Double Echelle, was produced at the Opera Comique. For the next five-and-twenty years Thomas's productivity was incessant, and most of his operatic works belonging to this period enjoyed

an ephemeral popularity. A few of these have survived, and are still occasionally heard on the Continent, their names being Le Ca'id (1849), Le Songe d'une Nuit d'Eti (1850), PsycM (1857). The overture to Raymond (1851) has remained popular. So far the composer's operatic career had not been marked by any overwhelming success. He occupied a place among the recognized purveyors of operas in the French capital, but could scarcely claim to having achieved European renown. The production of Mignon at the Opera Comique in 1866, however, at once raised Am- broise Thomas to the position of one of the foremost French composers. Goethe's touching tale had very happily inspired the musician ; Madame Galli Marie, the original interpreter of the title-role, had modelled her conception of the part upon the well-known pic- ture by Ary Scheffer, and Mignon at once took the fancy of the public, its success being repeated all over the Continent. It has since remained one of the most popular operas belonging to the second half of the 19th century. Thomas now attempted to turn Shakespeare's Hamlet to operatic account. His opera of that name was produced with success at the Paris Opera in 1868, where it enjoyed a long vogue. If the music is scarcely adequate to the subject, it nevertheless con- tains some of the composer's best work. The scene of the esplanade is genuinely dramatic, the part of Ophelia is poetically conceived, and the ballet music is very brilliant. Ambroise Thomas's last opera, Fran- goise de Rimini, was. given at the Opera in 1882, but has not maintained itself in the repertoire. Seven years later La Temp&te, a ballet founded on Shake- speare, was produced at the same theatre. Ambroise Thomas succeeded Auber as director of the ' Paris Con- servatoire in 1871. If it can be said that the talent of Thomas was in its nature rather assimilative, and that it successively yielded to the various influences of the moment, yet it must be allowed that the composer of Mignon was not altogether devoid of personality. His music is often distinguished by refined touches which reveal a sensitive mind, and there is a distinct element of poetry in his Mignon and Hamlet, two operas that should suffice to keep the composer's memory green for some time to come. He died on the 12th of February 1896. (a. he.)

Thomas, George Henry (1816-1870), Ameri- can soldier, was born in Southampton county, Virginia, 31st July 1816. He graduated from West Point in 1840, and. served continuously in the army until his death in 1870, occupying every rank from second lieu- tenant to major-generaL As a young officer of artillery he served in the war against the Seminole Indians in Florida (1841), and in the Mexican war at the battles of Fort Brown, Eesaca de la Palma, Monterey, and Buena Vista, receiving three brevets for distinguished gallantry in action. In 1855 he was appointed by Jefferson Davis, then Secretary of War, junior major of the 2nd Cavalry, of which Johnston (A. S.) was colonel, Lee was lieut.- colonel, and Hardee was senior major. At the out- break of the Civil War these three officers resigned and joined the Confederate States. Thomas was in doubt as to what his duty required, but finally decided to adhere to the United States. He was promoted in rapid succession to be lieut.- colonel and colonel in the regular army, and brigadier-general of volunteers. In

command of an independent force in eastern Kentucky, on 19th January 1862, he attacked the Confederate General Zollicoffer at Mill Springs and completely routed him, gaining the first Union victory in the west. In command of an army corps, under General Buel, he was engaged in the battles of Perryville and Stone Biver. Under Bosecrans, at the battle of Chicka- mauga, 19th September 1863, he achieved great distinc- tion, his firmness on that disastrous field, where he gained the name of ” The Bock of Chickamauga,” being all that saved a terrible defeat from becoming a hopeless rout. He succeeded Bosecrans in command of the army of the Cumberland. At Chattanooga, 25th November 1863, in many respects the most brilliant battle of the war, Thomas played a most conspicuous part, his divi- sions under Sheridan, Wood, and Baird carrying Mis- sionary Bidge in superb style. In Sherman’s advance through Georgia in the spring of 1864, Thomas com- manded the army of the Cumberland, consisting of three army corps, and numbering over 60,000 men present for duty. Thomas handled these with great skill in all the engagements and flanking movements from Chattanooga to Atlanta. When Hood broke away from Atlanta in the autumn of 1864, menaced Sherman’s long line of communications and endeavoured to force Sherman to follow him,

Sherman determined to abandon his com- munications and march to the sea, leaving to Thomas the difficult task of taking care of Hood. Thomas hastened back with a comparatively small force, racing with Hood to reach Nashville where he was to receive reinforce- ments. At the battle of Franklin, 30th November 1864, a large part of Thomas's force, under command of Scho- field, checked Hood long enough to effect a concentre tion at Nashville. Here Thomas had to organize his force, which consisted largely of quartermaster's em- ployes and improvised troops. He declined to attack until his army was ready and the ice which covered the ground had melted sufficiently to enable his men to move. Grant was impatient of the delay. He sent Logan with an order to supersede Thomas, and soon afterwards left the army of the Potomac to take com- mand in person. Before either arrived Thomas made his attack, 15th and 16th December 1864, and inflicted on Hood a most crushing defeat, so absolute and com- plete that Hood's army never again appeared as a factor in the Civil War. For this brilliant victory Thomas was made a major-general in the regular army, and received the thanks of Congress. After the termination of the Civil War he served on reconstruction duty in command of military departments in Kentucky and Tennessee until 1869, when he was ordered to command the divi- sion of the Pacific with headquarters at San Francisco. He died there of apoplexy, while writing an answer to an article criticizing his military Career, 28th March

1870.

Thomas was beloved by his soldiers, for whom he always had a fatherly solicitude. He was a man of solid rather than brilliant attainments : he remained in the army all his life, and never had any ambitions outside of it ; his mind acted deliberately, and his temperament was somewhat sluggish ; but his judgment was remarkably accurate, his knowledge of his profession was complete in every detail, and when he had finally grasped a problem, and the time arrived for action, he could strike with extraordinary vigour and rapidity. The only two battles in which he had ho immediate superior — Mill Springs and Nashville, one at the beginning and the other at the end of the war — were signal victories, without defect and above criticism. His service during the intervening

three years of almost incessant conflict, and manoeuvring was marked by loyal obedience to his

superiors, skilful command of his subordinates, and successful accomplishment of every task entrusted to him. (f. v. g.)

Thomas, Theodore (1835), American

musician, was born in Esens, Germany, 11th October 1835. His early musical training -was received chiefly from his father. His career began early, for at the age of six he made his first public appearance as a violinist. Four years later he was taken to America by his parents, and when only fifteen years old (1850) was first violin in the orchestra that accompanied Jenny Lind in her American tour. From 1855 to 1869 he took part in a series of chamber music concerts in New York. In 1867 he organized the Thomas Orchestra, and it is in the capacity of orchestra conductor that he made his reputation. His orchestra made its first tour in 1869, and continued to give concerts in various American cities until it was disbanded in 1888. During most of the seasons from 1877 to 1891 he. was conductor of the New York Philharmonic Society, and from 1862 to 1891, of the Brooklyn Philharmonic Society. He was director of the Cincinnati College of Music, 1878-81, conductor of the American Opera Company, 1885-87, and for a quarter of a century (1873-98) the conductor of the biennial May festivals at Cincinnati. In 1891 he removed to Chicago, and was subsequently the conductor of the Chicago Or- chestra. In 1893 he was musical director of the Colum- bian Exposition in that city. His ability as a conductor has had an important influence in the elevation of public taste for music in America.

Thomasville, a city of Georgia, U.S.A., capital of Thomas county, in the southern part of the state, on a line of the Plant Railway system, and on the Tifton, Thomasville, and Gulf railway, at an altitude of 250 feet. It is known as a winter resort for Northern people. The surrounding

country produces much cotton and early vegetables and fruit, the latter being raised mainly for Northern markets. Population (1880), 2555; (1890), 5514 ; (1900), 5322, of whom 69 were foreign-born and 3296 negroes.

Thompson, a town of Windham county, Con- necticut, U.S.A., with an area of 50 square miles of hill country, traversed by French river, and by a line of the New York, New Haven, and Hartford railroad, in the north-eastern part of the' state. It contains several villages, among which are Thompson, West Thompson, Mechanicsville, Grosvenordale, North Grosvenordale, and Quinebaug. Population (1880), 5051; (1890), 5580; (1900), 6442, of whom 2914 were foreign-born.

Thompson, Sir Henry, Baht. (1820-

-),

English surgeon, was born at Framlingham, Suffolk, on the 6th of August 1820. His father wished him to enter business, but circumstances ultimately enabled him to follow his own desire of becoming a physician, and in 1848 he entered the medical school of University College, London. There he had a brilliant career, and obtained his degree at London University in 1851 with the high- est honours in anatomy and surgery. In 1853 he was appointed assistant surgeon at University College Hos- pital, becoming full surgeon in 1863, professor of clini- cal surgery in 1866, and consulting surgeon in 1874. In 1884 he became professor of surgery and pathology in the Royal College of Surgeons, which in 1852 had awarded him the Jacksonian prize for an essay on the Pathology and Treatment of Stricture of the Urethra, and again in 1860 for another on the Health and Morbid Anatomy of the Prostate Gland. These two memoirs in- dicate the department of medical practice to which he

devoted his main attention. Specializing in the surgery of the genito-urinary tract, and in particular in that of the bladder, he went to Paris to study under Civiale, who in the first quarter .of the 19th century proved that it is possible to crush a stone within the human bladder, and after his return he soon acquired a high reputation as a skilful

operator in that class of disease. In 1863, when the King of the Belgians was suffering from stone, he was called to Brussels to consult in the case, and after some difficulties was allowed to perform the operation of lithotrity : this was quite successful, and in recognition of his skill Thompson was appointed surgeon-extraordi- nary to the king, an appointment which was continued by Leopold II. Nearry ten years later he carried out a similar operation on the Emperor Napoleon, who, how- ever, died four days after the second crushing, not from the surgical interference, as was proved by the post- mortem examination, but from ursemic poisoning. Be- sides devising various operative) improvements in the treatment of the disorders which were his speciality, Sir Henry Thompson wrote various books and papers dealing with them, including Clinical Lectures on Dis- eases of the Urinary Organs, Practical Lithotomy and Lithotrity, Tumours of the Bladder, Suprapubic Litho- tomy, and Preventive Treatment of Calculous Disease. Among other books of a medical character that came from his pen were Food and Feeding, and Diet in Re- lation to Age and Activity, both of which passed through a number of editions. In 1874 he took a foremost part in founding the Cremation Society of England, of which he was the first president; and not only was he active in urging the advantages of cremation as a means of disposing of the body after death, but also did much towards the removal of the legal restrictions by which it was at first sought to prevent its practice in England. On various occasions he denounced the slackness and inefficiency of the methods of death-cer- tification prevalent in Great Britain, and in 1892 his agitation was instrumental in procuring the appoint- ment of a Select Committee to inquire into the mat- ter; its report, published in the following year, in great measure confirmed his criticisms and approved the remedies he suggested. But medicine and hygiene by no means exhaust the list of Sir Henry Thompson's activities. In art he is an accomplished sketcher, and, moreover, an amateur of painting whose pictures have been hung at the Royal Academy and the Paris Salon. About 1870 he began to get together his famous collection of china, in particular of old blue and white Nanking ; this in time became so large that he could no longer find room for it, and most of it was sold. A catalogue of it, illustrated by himself and Mr. James Whistler, was published in 1878. In his famous octaves he may

be said to have elevated the giving of dinner parties into a fine art. The number of courses and of guests was alike eight, and both were selected with the utmost care and discrimination to pro- mote the ” feast of reason and the flow of soul.” In literature, in addition to more serious works, he produced two novels — Charley Kingston’s Aunt (1885) and All But (1886) — which met with considerable success. In science he became a devotee of astronomy, and for a time main- tained a private observatory in his house at Molesey. He further did much to promote astronomical study in Great Britain by presenting Greenwich Observatory with some of the finest instruments now among its equipment, his gifts including a photoheliograph of 9-inch aperture, a 30- inch reflecting telescope, and a large refracting telescope having an object-glass of 26 inches diameter and a focal length of 22£ feet. The offer of the last instrument was made in 1894. Its manufacture was undertaken by Sir Howard Grubb of Dublin, and its erection was

completed in 1897. It added greatly to the instrumental resources of Greenwich, especially for photographic work, and its importance may be gauged from the fact that both in aperture and focal length it is double the size of any instrument possessed by the observatory at the time it was put in place. That Sir Henry Thompson, who was knighted in 1867, received a baronetcy in 1899 was prob- ably not unconnected with the presentation of this tele- scope to the national observatory.

Thomsen, Gnmur (1820-1896), Icelandic poet and man of letters, was born in 1820. He came in 1837 to the University of Copenhagen, where he first studied law and philology, but later, philosophy and aesthetics. He became an enthusiastic follower of the Pan-Scandinavian movement, although this was not generally favoured by his countrymen. After some years of foreign travel, in 1848 he entered the Danish diplo- matic service, and remained in it till 1851, when he re- turned to Copenhagen, where he became the chief of one of the

departments of the Danish Foreign Office. He retired in 1866, and then went back to Iceland, where he passed the rest of his life, active in the politics and the literature of his native island. He died in 1896. He is the best ballad poet Iceland has produced. His poems are unaffected and mostly free from rhetoric, the beset- ting sin of Icelandic poets. His subjects are principally taken from Icelandic or Scandinavian history and mytho- logy. He is very unlike most of his contemporaries, both in style and thought : he is Icelandic to the core, and on that account is perhaps the modern Icelandic poet most appreciated by foreigners. Besides his poems (two separate collections, Reykjavik, 1880, and Copen- hagen, 1895), he is the author of numerous critical and historical essays in Icelandic and Danish, and some larger works in Danish, of which his dissertation on Lord Byron (Copenhagen, 1845) deserves to be mentioned. Grimur Thomsen was a warm admirer of Greek literature, and translated a great number of poems from that language into Icelandic. (s. bl.)

Thomson, James (1822-1892), British physicist and engineer, was born in Belfast on the 16th of February 1822, and, like his younger brother, Lord Kelvin, at an unusually early age began to attend the classes at Glasgow University, where his father had been appointed professor of mathematics in 1832. After his graduation he decided to study civil engineering, and for that purpose became a pupil in several engineering offices and works successively; but ill-health obliged him to leave them all, and he had finally to accept the fact that an occupation involving physical exertion was out of the question. Accordingly, from about 1843, he devoted himself to theoretical work and to mechanical invention. To this period belong his well-known researches in thermodynamics, which enabled him to predict by the application of Carnot's theorem that the temperature of the freezing-point of substances which expand on solidifying must be lowered by the application of pressure, the reverse being the case with substances which contract on solidification ; and he was able to calculate the amount by which a given pressure lowers the freezing-point of water, a substance which expands on solidification. His results were experimentally verified in the physical laboratories of Glasgow University under LordKelvin's direction, and were afterwards applied

to give the explanation of regelation which is now gener- ally accepted. In 1861 he extended them in a paper on crystallization and liquefaction as influenced by stresses tending to change of form in crystals, and in other studies on the change of state he continued Andrews's work on the liquid and gaseous states of matter, constructing a thermodynamic model in three dimensions to show the

relations of pressure, volume, and temperature in a sub- stance like carbonic acid. With regard to his inventions, he devised a clever feathering mechanism for the paddles of steamboats when only a boy of sixteen, and later turned his attention to water engines. In 1850 he patented his " vortex water-wheel," and during the next three or four years carried on inquiries into the properties of " whirling fluids," which resulted in improved forms of blowing-fans and water-turbines and in the invention of a centrifugal pump. Settling in Belfast in 1851, he was selected to be the resident engineer to the Belfast Water Commissioners in 1853, and four years later became professor of civil engineering and surveying in Queen's College, Belfast. Thence he removed in 1873 to Glasgow as successor to Macquorn Rankine in the chair of engineering in the university, and retained this position until 1889, when the failure of his eyesight compelled him to resign. He died on the 8th of May 1892. Among other subjects which he worked at, in addition to those already men- tioned, were the explanation of the parallel roads of Glen Boy and of the prismatic structure seen at the Giant's Causeway ; the flow of water in rivers, in which, during 1876 and following years, he studied the origin of windings in alluvial plains and made many experiments with the aid of artificial rivers ; and the currents of atmospheric circulation, which afforded him the material for the Bakerian lecture of

1892.

Thomson, Joseph (1858-1895), African ex- plorer, was born on 14th February 1858 at Penpont, Dumfriesshire. In 1868 the family removed to Gatelaw- bridge, where young Thomson was soon attracted by the natural curiosities and historical associations of Nithsdale. In 1875 he went to Edinburgh University, where he paid particular attention to

geology and botany, and after completing his course in 1878 he was appointed geologist and naturalist to the Royal Geographical Society's expedition to East Central Africa under Keith Johnston. The latter died at Behobeho, between the coast and the north end of Lake Nyasa, 28th June 1879, and Thomson then took command. Though very young, his coolness and tact were remarkable, and he successfully conducted the expedition across the desolate region of Uhehe and Ubena to Nyasa, and then by a hitherto unexplored track to Lake Tanganyika, where he settled the moot question of the Lukuga outlet. After enduring terrible hardships among the Warua, he returned through Bagamoyo, reaching London in August 1880. In the following year he published an account of his travels, under the title To the Central African Lakes and Back. About this time the Sultan of Zanzibar, being anxious to develop certain supposed coal-beds on the river Rovuma, was advised to obtain independent expert opinion as to their value. Application was made to Thomson, who undertook to survey them, and started from Mikindani, 17th July 1881. The coal, however, turned out to be merely bituminous shale, and Thomson, on his return to Zanzibar, had to endure much delay and vexation through the sultan's chagrin. For a considerable time the explorer had directed his attention to Masai-land, that wild region occupied by a powerful tribe of intractable savages, and Gordon had already pointed out that the true route to the head-waters of the Nile lay through that territory. In 1882 the Royal Geographical Society took up the question, and requested Thomson to report on the practicability of taking a caravan through the Masai country, which no European had yet been able to penetrate beyond Mount Kilimanjaro. By undaunted courage and great resourcefulness he succeeded in cross- ing the Njiri desert and exploring the great Rift Valley.

Thence he went with a picked company through Lykipia to Mount Kenia, emerged on Lake Baringo, and shortly afterwards traversed the unknown region lying between this lake and Victoria Nyanza. The

account of this adventurous journey appeared in 1884, under the title of Through Masai-land, and it is a classic in modern travel. The hardships and anxieties attendant on such a career now began to tell upon Thomson's exceptionally hardy constitution, but he undertook an expedition to the Niger for the National African (afterwards the Royal Niger) Company, and succeeded by his energy in con- cluding valuable commercial treaties with the sultans of Sokoto and Gandu. In 1888, by way of recreation, he travelled through southern Morocco and explored a portion of the Atlas range, and published the results in the following year, under the title Travels in the Atlas and Southern Morocco. Twice again he visited Africa, proceeding in 1890-91 to the Zambezi for the British South Africa Company, on which occasion he met Mr Rhodes ; and again in 1893 to South Africa, this time in search of health. His journey in 1890-91 had proved disastrous to a constitution already undermined, and after a short sojourn he returned to London, where he died on 2nd August 1895. The accounts of his minor travels were published in magazines or in the Proceed- ings of the Royal Geographical Society. " Thomson was ' endowed with a special genius for the observation of the natural features of a country. His methods of dealing with aborigines were so gentle and persuasive that his expeditions never had recourse to arms, and he covered so much unknown ground that he will prob- ably remain the last great geographical pioneer of African exploration." (g. p. b.)

Thomson, William (1819-1890), English divine and logician, was born on 11th February 1819 at Whitehaven, in Cumberland. He was sent to Shrews- bury School, whence he proceeded to Queen's College, Oxford, of which he became a scholar. He took his B.A. degree in 1840, and was soon afterwards made fellow of his college. He was ordained in 1842, and worked as a curate at Cuddesdon, under the eye of the then bishop of Oxford. In 1847 he was made tutor of his college, and in 1853 he delivered the Bampton Lectures, his subject being "The Atoning Work of Christ viewed in Belation to some Ancient Theories." These lectures established his reputation, being thoughtful and learned, and they did much to clear the ground for the subsequent discussions on the doctrine of the Atonement, with which theologians are familiar. But Dr Thomson's activity was not confined to theology. He was made fellow of

the Royal and the Royal Geographical Societies. He was examiner in logic and mental science for the Society of Arts. He wrote a treatise on Pure and Applied Logic, which immediately became popular, and soon reached a second edition. He sided with the party at Oxford which favoured University reform, but this did not prevent him from being appointed president of his college when the post became vacant in 1855. In 1858 he was made preacher at Lincoln's Inn, and there preached some striking sermons, a volume of which he published in 1861. In the same year he edited Aids to Faith, a volume written by eminent divines iu opposition to the famous Essays and Reviews, which, with its advanced liberal sentiments, had stirred up a great storm in the Church of England. In December of that year, in recognition of the services he had rendered to the cause of orthodoxy in the Church, he was appointed to the see of Gloucester and Bristol, which had become vacant, and within a twelvemonth he was elevated to the archiepiscopal see of York. In this position Dr

Thomson, whose orthodoxy was of what may be called the Moderate type, excited the fierce indignation of the High Church party by the support he gave to the passing of the Public Worship Regulation Act, and, as president of the Northern Convocation, he came frequently .into sharp collision with the Lower House of that body. But if he incurred the hostility of the High Church party among the clergy, he was admired by the laity for his strong sense, his clear and forcible reasoning, and his wide knowledge, and he remained to the last a power in the north of England. In his later years he published an address read before the members of the Edinburgh Philosophical Institution (1868), one on Design in Nature, for the Christian Evidence So- ciety, which reached a fifth edition, various charges and pastoral addresses, and he was one of the pro- jectors of The Speaker's Commentary. He died on 25th December 1890. (j. j. L*.)

Thdngwa, a district in the Irrawaddy division of Lower Burma. It was formerly in the Pegu division, and contained 5413 square miles. Increase of population and of cultivation, however, led to its reduction in size, and a portion was taken from it in 1896 to form the district of Myaungmya. In 1898-99 the district had an area of 3470 square miles,

and a population (1891) of 333,443; (1901), 482,680. The revenue paid in 1898- 1899 by 971 villages was Rs.30,64,920. The population was made up in 1891 of 316,841 Buddhists and. Jains, 3508 Hindus, 2769 Mahommedans, 1073 aborigines (mostly Karens), and 9252 Christians, of whom 8954 were natives (mostly Karens). Of a total acreage of 2,220,800, there were 788,065 acres cultivated in 1898- 99; "651,918 acres were not available for cultivation; 34,560 acres were under forest; 685,577 acres were cultivable ; and there were 60,680 acres of current fallow. The rainfall in 1898-99, taken at Maubin, was 96-67 inches. Yandoon (20,235 inhabitants) and Maubin (5327) were the chief towns. Maubin is the headquarters of the district, and has been a municipal town since 1888, with fifteen of a committee, eleven of whom are elective. The steamers of the Irrawaddy Flotilla Company call at Maubin and Yandoon.

Thorbecke, Jan Rudolf (1798-1872), Dutch statesman, was born at Zwolle, in the province of Overij ssel, 14th January 1798. Thorbecke was of German extraction, his grandfather, Heinrich Thorbecke, having settled in Overij ssel towards the end of the 17th century. Little is known of his youth, beyond the fact that he was sent in the year of Waterloo to Amsterdam for his education. For two years he stayed with a Lutheran clergyman of the name of Sartorius, whilst attending the lectures of the AthenaBum Illustre. In 1817 he commenced his studies at Leyden University, proving a brilliant scholar, and twice obtaining a gold medal for his prize essays. In 1820 he obtained the degrees of Lit.D. and LL.D. In the following years Thorbecke undertook a journey of research and study in Germany, staying at most of her famous universities, and makingthe acquaintance of his best-known contemporaries in the Fatherland. At Giessen he lectured as an extra-ordinary professor, and at Gottingen, in 1824, published his treatise, Ueber das Wesen der Oeschichte. After his return to Amsterdam in 1824 Thorbecke wrote his first political work of any importance, Bedenkingen aangaande het Recht en den Stoat (" Objections anent Law and the State "), which by its close reasoning and its legal acumen at once drew attention to the young barrister, and pro- cured him in 1825 a chair as professor in Ghent University. Here he wrote two

pamphlets of an educational character before 1830. The Belgian revolt of that year forced

Thorbecke to resign his position at Ghent, and he subsequently went to Leyden. He did not approve of the Belgian movement, nor of the part that Europe played in it, and published his views in three pamphlets, which appeared in the years 1830 and 1831. In 1831 he was appointed professor of jurisprudence and political science at Leyden University. In that capacity, and, before his appointment at Leyden, as a lecturer on political science, history, and economics at Amsterdam, he gained great reputation as a political reformer, particularly after the publication of his standard work, Aanteekeningen op de Grondwet ("Annotations on the Constitution" 1839; second edition, Amsterdam, 1841-43), which became the text-book and the groundwork for the new Reform Party in Holland, as whose leader Thorbecke was definitively recognized. Thorbecke's political career until his death, which occurred at The Hague, 4th June 1872, has been sketched under Holland : History. Thorbecke's speeches in the Dutch Legislature were published at Deyenter in six volumes (1867-1870), to which should be added a collection of his unpublished speeches, printed at Gronin- gen in 1900. The first edition of his Historische Sdietsen (" Historical Essays ") was issued in 1860, the second in 1872. At, Amsterdam there appeared in 1873 a highly interesting Correspondence with his academy friend and lifelong political adversary Groen Van Prinsterer (q.v.), which, although dating back to the early 'thirties, throws much light on their subsequent relations and the poli- tical events that followed 1848. Of Dutch statesmen during the Napoleonic period, Thorbecke admired Ealck and Van Hogendorp most, whose principles he strove to emulate Of Van Hogendorp's Essays and Speeches, in- deed, he published a standard edition, which is still highly valued. Thorbecke's speeches form a remarkable continuation of Van Hogendorp's orations, not only in their style, but also in their train of thought. Thor- becke's funeral furnished the occasion for an imposing national demonstration, which

showed how deeply he was revered by all classes of his countrymen. In 1876 a statue of Thorbecke was unveiled in one of the squares of Amsterdam.

Thorbecke's gifts and public services as a statesman have been as fully recognized as his political genius has been. As an orator and writer his style was clear and forcible. His very dogmatism brought him many enemies, but at times, especially when he went in advance of his time, he was a much misunderstood man. These misunderstandings, frequently wilful, extended often beyond the domain of pure politics. Thus, by his enemies Thorbecke was often held up to scorn as a pure materialist, and no friend of the fine arts, because at a sitting of the States General in 1862 he had said that it is not the duty of the State, nor in the true interest of art itself, for the Government to " protect " art, since all State- aided art must be artificial, like any forced plant. This was popularly condensed into the aphorism, yet current in Holland, that "Art is not the business of the Govern- ment," and Thorbecke was condemned as the author of it. Again, his adversaries used to call him a dangerous demagogue. As a matter of fact, there was no more ardent royalist than Thorbecke. He believed in consti- tutional monarchy, as offering the best guarantees both for sovereign and people, and he was bitterly opposed to all forms of State Socialism. Long before his death he realized that he had outlived his own principles, and many of his former admirers had commenced to dub him a "rank Conservative," whose political aims and reforms were no longer adequate. But Thorbecke's life-work will endure, and the Dutch Constitution of 1887 practically embodied his principles, as laid down in the Constitution of 1848. The former is the

outcome of the latter, and could not have been made without it.

The best biographical sketch of Thorbecke we owe to the late Professor Buys, his principal scholar and devoted friend, whose biography appeared in 1876 at Tiel. Another biography which deserves mention was issued in the same year at The Hague, from the pen of Dr J. A. Levy, an Amsterdam lawyer. (h. ti.)

Thorn, a fortified town of Prussia, province of West Prussia, on the right bank of the Vistula, 87 miles by rail north-east of Posen. The new garrison church (1897), the church of St James's (1309), a good specimen (in Gothic brick) of the architecture of the Teutonic Knights; the Junkerhof, restored in 1883; the Coper- nicus monument (1853), the municipal museum in the town hall, and the synagogue are the chief architectural features. Population (1885), 23,906; (1895), 30,314;

(1900), 29,626.

Thornaby-on-Tees, a municipal borough and railway station in the Cleveland parliamentary division of the North Riding of Yorkshire, England, opposite Stock- ton-on-Tees (with which it is connected by a bridge), on the river Tees. The town was formerly known as South Stockton, and is still included in the parliamentary borough of Stockton, but was incorporated as a separate municipal borough in 1892. In the same year the town hall was completed. There are blast furnaces, iron foundries, engineering works, iron shipbuilding yards, extensive saw- mills, flour-mills, and a manufacture of " blue and white " pottery. Population (1881), 10,852; (1891), 15,637 ;

(1901), 16,053.

Thoroddsen, J6n por Sarson (1819-1868), Icelandic poet and novelist, was born in 1819, at Rey- kh61ar in western Iceland. He studied law at the Univer- sity of Copenhagen, entered the Danish army as volunteer in 1848 in the war against the insurgents of Schleswig and Holstein, who were aided by Prussia and other German states. He went back to Iceland in 1850, became sheriff (syslumaftur) of Baroastrandarsysla, and later in Borgar- f jarSars^sla, where he died in 1868. He is the first novel- writer of Iceland. J6nas Hallgrimsson had led the way by his short stories, but the earliest veritable Icelandic novel was Jon Thdroddsen's Piltur og Sttilka (" Lad and Lass "), a charming picture of Icelandic country life. Still better is MdSur og Kona (" Man and Wife "), published after his death by the Icelandic Literary Society. He had a great fund of delicate humour, and his novels are so essentially Icelandic in their character, and so true in their descriptions, that he is justly considered by most of his countrymen not only as the father of

the Icelandic novel, but as the best novelist Iceland has produced His poems, mostly satirical, are deservedly popular : he follows Jdnas Hallgrimsson closely in his style, although he cannot reach him in lyrical genius. (s. bl.)

Three Rivers, a city and port of entry of Quebec, Canada, at the confluence of the rivers St Maurice and St Lawrence. The principal development of trade has been the result of utilizing the immense water-power of the St Maurice at Shawanegan, Grand Mere, and other falls for the manufacture of wood-pulp. Population (1891), 8334 ;

(1901), 9981.

Thring, Edward (1821-1887), one of the most distinguished schoolmasters of the 19th century, was the son of John Gale Dalton Thring, rector of Alf ord, Somer- set, and was born 19th November 1821. His elder brother was Henry Thring (born 1818), the distinguished Parlia- mentary counsel (1868-1886), who was made a peer as Baron Thring in 1886. Edward was educated first at Ilminster grammar school and afterwards at Eton, where

he became head of the school, and Captain of Montem in 1841, the last occasion on which that ancient festival was celebrated. He then entered King's College, Cam- bridge, won the Porson prize for Greek, and was elected fellow. At that time King's College scholars retained the privilege of proceeding to a degree without examina- tion, but Thring thought the maintenance of this usage inexpedient in the interests of learning and wholly inde- fensible in principle, and his vigorous protest against it aroused lively academic controversy, and became effec- tive in 1851, when it was abolished. On leaving the university in 1846′ he was ordained, and served for a short time as curate in Gloucester. Here he took re- markable interest in the elementary school of the parish, and ever afterwards attributed much of his professional success and his insight into educational principles and methods to the experience he

had acquired in imparting the humble rudiments of learning to the children of the poor. After an interval of two or three years, spent partly in private tuition and partly as curate at Cook- ham Dean, he married in 1853 a daughter of Carl Koch, commissioner of customs at Bonn, and was elected to the mastership of Uppingham School, a post which he re- tained until his death in 1887. That school had been founded in 1584, was slenderly endowed, poorly housed, and little known. Thring found only twenty-five boys in it, but he succeeded in raising it both in numbers and repute to a position in the first rank among English public schools. He had a strong conviction that there should be a limit to the number of pupils entrusted to the care of one head-master, and he fixed that limit at 300, although, owing to the increasing popularity of the school, he was under strong temptation to exceed it. Little by little he surrounded himself with a loyal staff of masters, raised money for the building and equipment of a noble school-room and chapel, besides class-rooms and eleven boarding-houses. Among the distinctive features of his plans and achievements were : (l)his strong sense of the need for a closer study of the characteristics of individual boys than is generally found possible in large public schools ; (2) his resolute adherence to the disci- pline of the ancient languages, in connexion with English, as the staple of a liberal education ; (3) his careful pro- vision of a great variety of additional employments and interests, in studies and in games, to suit the aptitudes of different pupils ; (4) the value he attached to the aesthetic side of school training, as evinced in the encouragement he gave to music and to drawing, and to the artistic decora- tion of the school-rooms ; and above all (5) his rebellion against mere routine, and his constant insistence on the moral purpose of a school as a training-ground for char- acter, rather than as a place solely concerning itself with the acquisition of knowledge. The vigour and intrepidity of his character were conspicuously shown in 1875, when an outbreak of fever made Uppingham for atimeuntenable, and when, at a few days' notice, he took a disused hotel and some boarding-houses at Borth, on the Cardiganshire coast, and transported the whole 300 boys, with 30 masters and their households, to it as to a city of refuge. Here the school was carried on with undiminished and even fresh zest and

efficiency for fourteen months, during which needful sanitary measures were taken in the town.

Unlike Arnold, with whose moral earnestness and lofty educational aims he was in strong sympathy, he took little or no part in outside controversies, political or ecclesiasti- cal. All the activity of his life centred round the school. His was the first public school to establish a gymnasium, and the first to found a town mission in a district of South London, with a view to interest the boys in an effort to improve the social condition of the poor. He took the first step in 1869 in the formation of the Head Masters'

Conference, an institution which has ever since done much to suggest improvements in method and to cultivate a sense of corporate life and mutual helpfulness among the teachers in the great schools. And in 1887 he took the bold and unprecedented step of inviting the Association of Head Mistresses to Uppingham, and giving to them a sympathetic address. He also formed an association in Uppingham, with lectures, cookery classes, concerts, and other aids to the intellectual and social improvement of the residents of the little town. He gave valuable evidence before the Schools Inquiry Commission of Lord Taunton in 1866, but it was very characteristic of him that he dreaded the intrusion of public authority, whether that of royal commissioners or of the legislature, into the domain of the school, wherein he thought it indispensable that the liberty and personal inventiveness and enthusi- asm of teachers should have full scope and be hindered by no official regulations.

His contributions to literature were not numerous, but were all closely connected with his work as a school- master. They were : Thoughts on Life Science, 1869, written under the assumed name of Benjamin Place ; Education and School, 1864 ; Tlie Theory and Practice of Teaching, 1883 ; Uppingham School Sermons, 1858 ; The Cliild's Grammar, 1852; The Principles of Grammar, 1868 ; Exercises in Grammatical Analysis, 1868 ; School Songs, 1858; Borth Lyrics, poems and translations, 1887 ; and a volume of Miscellaneous Addresses, published after his death in 1887.

The fullest account of his life is that written by Professor G. B. Parkin of Canada, 1898, containing copious extracts from his diary and letters, A Memory of Edward Thring ; and Uppingham by the Sea, written by J. H. Skrine, the warden of Glenalmond, who was first a pupil and after- wards an assistant master at the school, presents a vivid and attractive picture of Thring' s active life, and an affec- tionate and yet discriminating estimate of his character. Other particulars may be found in the chapter devoted to his biography in Sir Joshua Pitch's Educational Aims and Methods, and in Edward Thring, Teacher and Poet, by Canon H. D. Bawnsley. (j. g. f.)

Thun . Hohenstein. — The family of Thun-Ho- henstein, one of the wealthiest of the Austrian nobil- ity, which has for more than 200 years settled at Tetschen, in Bohemia, has given several distinguished members to the Austrian public service. Of the three sons of Count Pranz, the eldest, Pbiedeich (1810-1881), entered the diplomatic service; after holding other posts he was in 1850 appointed president of the re- stored German Diet at Prankfurt, where he represented the anti-Prussian .policy of Schwarzenberg, and often came into conflict with Bismarck, who was Prussian envoy. He was afterwards ambassador at Berlin and St Petersburg. After his retirement from the public service in 1863 he supported in the Bohemian Land- tag and the Austrian Beichsrath the federal policy of his brother Leo. In 1879 he was made hereditary member of the House of Lords. In this position he was on his death succeeded by his eldest son Franz Anton, who was born in 1847. Like the rest of his family, he belonged to the Federalist party, and his appointment in 1889 as governor of Bohemia was the cause of grave dissatisfaction to the German Austrians. He took a leading part in the negotiation of 1890 for the Bohemian settlement, but the elections of 1891, in which the young Czechs who were opposed to the feudal party gained a decisive victory, made his position a very difficult one. Contrary to expectation, he showed great energy in suppressing disorder ; but after the proclamation of a state of siege his position became untenable, and in

1895 he had to resign. On the resignation of Badeni in 1898, he was made minister president, an office which he held for little more than a year, for, though he succeeded in bringing to a conclusion the negotiations with Hungary, the support he gave to the Czechs and Slovenians increased the opposition of the Germans to such a degree that parliamentary government became impossible, and at the end of 1899 he was dismissed.

The third son of Count Franz, Leopold or Leo (1811-1888), was one of the leading Austrian statesmen. After studying at the University of Prague, he travelled through Europe, and among other countries he visited England, where he became acquainted with James Hope (afterwards Hope-Scott) and other leaders of the Trac- tarian party. He was much affected by the romantic movement and the Ultramontane revival, and after his return home interested himself greatly in the revival of Czech language and literature and the growth of the Bohemian national feeling. He formed a personal friend- ship with Palacky and others of the Czech leaders ; he helped in the foundation of schools in which Czech should be taught, and set himself to acquire some know- ledge of the language. He was also interested in prison reform, on which he wrote, and other philanthropic work. After serving under Stadion in Galicia, he was in 1848, after the outbreak of the revolution, appointed president of the administration and acting Stadthalter in Bohemia. He had scarcely entered on his duties when the rebellion of June broke out in Prague. In order to avoid blood- shed, he went down to the insurgents on the barricade, but was seized by them, imprisoned, and for some time his life was in danger. On his release he vigorously supported Windischgratz, who was in command of the troops, in the restoration of order, but thereby lost his popularity and was superseded. He still defended the Bohemian national movement, and in one of his writings laid down the principle that nationality was one of the interests outside the control of the State. Not- withstanding this, in 1849 he accepted the office of religion and education, which he held in 1860 under the autocratic and centralizing administration of Schwar- zenberg and Bach. At first he threw himself with great energy

into the task of building up an adequate system of schools. He summoned experienced teachers, Protestant as well as Catholic, from Germany, established middle and higher schools in all parts of the empire, superseded the antiquated text-books and methods of instruction, and encouraged the formation of learned societies and the growth of a professional spirit and independence among the teachers. It is noticeable that at this time he insisted on the use of German in all schools of higher education. As minister of religion he was to a certain extent responsible for the concordat which again subjected the schools to the control of the Church : to a certain extent he thereby undid some of his work for the extension of education, and it was of him that Grillparzer said, ” I have to announce a suicide. The minister of religion has murdered the minister of education.” But during his administration the influence of the Church over the schools was really much less than, by the theory of the concordat, it would have appeared to be. The crisis of 1860, by which the office he held was abolished, was the end of his official career ; for the rest of his life he was very prominent as the leader of the Federalist party in Bohemia. His high social position, his influence at Court, his character as well as his un-doubted abilities, and learning not often in Austria found in a man of his rank, gave him great influence. He supported the claims of Bohemia to a full autonomy ; he strongly attacked both the February constitution and the ausgleich with Hungary ; what he desired was a common

parliament for the whole empire based on a settlement with each one of the territories. With the old Czechs, he refused to recognize the constitution of 1867; he helped to draft the declaration of 1868 and the funda- mental articles of 1871, and took a leading part in the negotiations during the ministry of Potocki and Hohenwart. In order to found a strong conservative party, he established a paper, the Vaterland, which was the organ of the Clerical and Federalist party. It is needless to say that he protested against the ecclesiastical legislation of 1867 and 1873. He mar- ried in 1847 the Countess Clam-Martinitz, but there was no issue of the marriage.

See the very full article by Frankfurter in the Allgemeine Deutsche Biographie, which supersedes his earlier biography.

(j. W. He.)

Thuret, Custave-Adolphe (1817-1875), French botanist, was born in Paris on 23rd May 1817. He came of an old Huguenot family, which had sought refuge for a time in Holland after the revocation of the Edict of Nantes. A trace of Dutch influence still persists in the pronunciation of the family name, in which the final t is sounded. Thuret's mother was brought up in England; English was the first language that he learnt, and he appears to have, retained strong sympathies with Great Britain throughout life. As a young man he studied for the law ; in his leisure time he was an ardent musician, and it was from a musical friend, de Villers, that he received, in 1837, his first initiation into botany. Begin- ning simply as a collector, he soon came under the in- fluence of Decaisne, whose pupil he became. It was Decaisne who first encouraged him to undertake those algological studies which were to become the chief work of his life. Thuret twice visited Constantinople in com- pany with the French ambassador, M. de Pontois, and was for a time attache to the French embassy there. His diplomatic career, though of short duration, gave him a valuable opportunity of studying the Oriental, flora. After travelling in Syria and Egypt in the autumn of 1841, he returned to France. Giving up his intention of entering the civil service, he retired to his father's country house at Eentilly, and thenceforth devoted himself to scientific research. He had already, in 1840, published his first scientific paper, " Notes sur l'anthere de Chora et les animalcules qu'elle renferme," in which he first accurately described the organs of motion of the " animal- cules " or spermatozoids of these plants. He continued his studies of the zoospores and male cells of Algae and other Cryptogams, and our exact knowledge of these remarkable motile stages in vegetable life is largely due to his labours. He spent a great part of his time, up to 1857, on the Atlantic coast of France, assiduously observ- ing the marine Algae in their natural habitat and at all seasons. In conjunction with his friend Fldouard Bornet, he became the recognized authority on this important group of plants, of which the two colleagues acquired

an unrivalled knowledge. Their work, while remarkable for taxonomic accuracy, was more especially concentrated on the natural history, development, and modes of reproduc- tion of the plants investigated. The discovery of sexual reproduction in seaweeds is almost wholly the work of these two men. The researches on the fecundation of the Fucaceas were published by Thuret in 1853 and 1855; the complicated and difficult question of the sexual re- production in Florideae was solved by the joint work of Thuret and Bornet (1867). These great discoveries — of far-reaching biological significance — stand out as the chief, but every group of marine Algae was elucidated by the researches of Thuret and his colleague. There are few scientific authors whose work has so completely stood the

test of subsequent investigation and criticism. Thuret's style in expounding his results was singularly clear and concise ; he was a man of wide education, and possessed the power of expressing his ideas with literary skill. Un- fortunately, much of his best work remained unpublished during his life. A portion of the material accumulated by himself and his colleague was embodied in two mag- nificent works published after his death — the Notes Algologiques (1876-80), and the still finer Etudes Phyco- logiques (1878). These volumes, as well as earlier mem- oirs, are illustrated by drawings of unequalled accuracy and beauty from the hand of the artist Eiocreux, whom Thuret employed. In 1857 Thuret removed to Antibes on the Mediterranean coast, where, on a once barren pro- montory, he established a botanic garden which became famous throughout the scientific world. Since his death the Antibes establishment has been placed at the dis- posal of botanical workers as an institute for research. Thuret died suddenly, while on a visit to Nice, on 10th May 1875, when he had scarcely completed > his fifty- eighth year. He was a man of considerable wealth, who devoted his money as freely as his time and labour to the advancement of science, but his high reputation rests on the brilliancy of his personal investigations.

The best and fullest account of Thuret's career is that by his friend and fellow-worker Bornet, published in the Annates des /Sciences Naturelles for 1876. An English notice of his life, by Professor W. G. Farlow, will be found in the Journal of Botany for the same year. (d. h. S.)

Thurgau, one of the Swiss cantons. Its area is 387-8 square miles. Of this 327 square miles are reckoned as " productive," 70 square miles being covered with forests, and 7 square miles with vineyards, the remaining 250 being arable or meadow land. Of the 60-8 square miles classed as " unproductive," 59-7 square miles are occupied by the Lake of Constance. The popula- tion was 104,678 in 1888, while in 1900 it was 113,221, or 346 inhabitants to the square mile. The population is almost exclusively German-speaking, as in 1888 there were but 271 Italian-speaking, 195 French-speaking, and 61 Eomonsch-speaking inhabitants. The existing can- tonal constitution is that of 1869. The canton is di- vided into 8 administrative districts. The capital is Erauenfeld. In 1897 the state revenue of Thurgau was 1,874,140 francs (a rise of 43 per cent, since 1885), and the state expenditure 1,852,891 francs (a rise of 371 per cent, since 1885), but in 1898 there was a deficit of 107,260 francs. The public debt in 1897 was 2,710,000 francs.

Thurles, an inland town and urban sanitary dis- trict in the county of Tipperary, Ireland, on the river Suir, 87 miles south-west of Dublin by rail. There is an important monthly horse fair, largely attended by English and Continental buyers. Population (1891), 4511 ; (1901),

Thurman, Allen Cranbery (1813-1895), Ameri- can jurist and statesman, was born at Lynchburg, Va., on the 13th of November 1813. He early attained dis- tinction at the Ohio bar, and was elected to the supreme bench of the state (1851). Save his one term in this position, and a term in Congress (1845-47), he avoided public office, though prominent in the Democratic party, till 1869, when he was sent to the United States Senate, serving there till 1881. He was recognized as a Demo- cratic leader in the Senate, and served as chairman of the judiciary committee, and as a member of the Elec- toral Commission of 1877. A law through which the Government secured important

advantage in its relations with the bond-aided Pacific railways was due largely to

him, and was commonly known as the Thurman Act. In the Democratic conventions from 1876 onwards he was a candidate for the Presidential nomination. In 1888 he was named for Vice-President on the ticket with Cleveland, but was defeated in the election. He died at Columbus, Ohio, 12th December 1895.

Thyrostraca. — As shown by Burmeister in his historical review (1834), these animals, comprised by Linnaeus in the genus Lepas, first received a more com- prehensive title from Cuvier, who called them Cirrho- poda, a word strictly meaning tawny-footed. Lamarck in 1809 altered this into the hybrid form Cirrhipoda, meaning curl-footed, which was subsequently improved into Cirripedia or Cirrhipedia. So long as the group was held to be a subordinate member of the Entomostraca, this term, though not the earliest, was generally accepted. The name Thyrostraca, meaning door-shells or valve- shells, is now to be preferred, as agreeing in termination with the titles of the other two divisions, the Malacos- traca and Entomostraca, from which, in the article Crus- tacea, the present group has been already distinguished. It may conveniently be arranged in two principal sec- tions— the Genuina with cirrhiform feet, and the Ano- mala without them.

Thyrostraca genuina. — It is with these that Darwin's classical and still essential treatises {Bay Soc. and Palaiont. Soc, 1861- 1854) are almost exclusively concerned. Therein an order Thora- cica comprehends the pedunculate Lepadidse, together with the operculate and sessile Balanidse and Verrucidae ; a single species without cirrhi constitutes the order Apoda, and a single species with only three pairs of cirrhi the order Abdominalia. Within the last Kochlorine (Noll, 1872) with two species, and Lithoglyptes (Aurivillius, 1892) with three species, have since been included. But H. J. Hansen {Die Cirripedien der Plankton-Expedition, 1899) states that Cryptophialus minutus, for which the order Ab- dominalia was founded, has, like Alcippe and other Genuina, its cirrhi on the thorax, not, as Darwin wrongly supposed, on the abdomen. In place, therefore, of the Abdominalia, it will be right to

accept the family Cryptophialidse, v. Martens, side by side with the Lithoglyptidse of Aurivillius and the Alcippidse of Gerstaecker. These, with Darwin's three families above mentioned, will com- plete the section of genuine cirripedes now existent. Gruvel has recently submitted to the Linnsean Society a rearrangement of the Lepadidse, unfortunately using for the first of his new families the preoccupied name Anaspidse. It is confusing, but not uninstruc- tive, to find that within the Balanid group such generic titles as Stephanolepas and Platylepas have been coined. The vernacular name barnacle, traceable to the fable of pedunculate cirripedes hatohing out into bernicle geese, has also been transferred to the sessile cirripedes, which are popularly known as acorn barnacles. The scientific student may be congratulated on the fact that a complete and luminous list of all the recent species of Thyrostraca in both sections, down to the year 1897. has been published by Weltner {Arch. Naturg., Jahr. § 63, part i., pp. 227-280, 1898). For fossil species, Woodward's Catalogue of Brit. Foss. Crust., pp. 137-144, 1877, should be consulted. Hoek {Challenger Reports, vol. viii., " Cirripedia," pp. 8-11, 1883) gives a brief geological sum- mary down to 1882. In that year J. M. Clarke {Amer. Journ. Sci. and Arts, ser. iii., vol. xxiv. p. 65) added a new species to Plumu- lites (Barrande, 1872), remarking that the species in question, P. devonicus, "is interesting in being the first representative of fossil barnacles from the Devonian, Barrande's species of Plumulites and Anatifopsis, as well as the Turrilepis of Woodward, being from the Upper and Lower Silurian, and Plumulites Jamesi (Hall and Whitf., Pal. Ohio, vol. ii.) from the Hudson River group." Since Plumulites appears to be a synonym of Turrilepas (not Turrilepis"), the species Turrilepas Wrightii, Woodward, 1865, from the Upper Silurian of Dudley, did not long enjoy its isolated eminence as the oldest known cirripede. As pointed out by Dr Bather {Geol. Mag., decade 4, vol. viii. p. 521, 1901), palaeontologists themselves have in this branch not very closely followed the progress of their own science, since Dr Ruedemann, in regard to his new Pollicipes siluricus, 1901, speaks of "the enormous gap existing between the appearance of this Lower Siluric type and the next Upper Triassic (Rhsetic) representatives of the genera Pollicipes and Scalpellurh." Many species of Scalpellum from the Wenlock shale of Gotland were described in 1892 by C. W. S. Aurivillius, who at the

same time founded the species Pollicipes signatus on an almost perfect speci- men from the Lower Ludlow of Wisby in Sweden. “Aurivillius

Fig. 1. — Brachylepas cretacea (Woodward), from Mar- gate chalk.

considered that Pollicipes signatus showed a closer approach to the Balanidse than any other of the Lepadidas, but he, too, in ignorance of the Devonian Protobalanus (Whitf.), discoursed needlessly about the gap in the distribution.” Dr Bather justifiably anticipates further discoveries, but if, already in Silurian as in modern times,

the members of these families had to pass through nauplius and cypris stages to maturity, there is one “enormous gap” between them and the common ancestor of the crustacean class that will not be very easily filled. To later phylogenetic links an addition is offered by Dr Woodward {Qeol. Mag., p. 145, 1901), who transfers his Pyrgoma cretaceum, 1865, to a new genus Brachylepas (Fig. 1), and a new family {Brachy- lepadidce, intermediate between the Rhaetic Pollicipes and the modern Balanus. Among other fossil genera of recent institu- tion, Archasolepas, Lepidocoleus, Squama, Stramentum, can only be mentioned as incentives to research. Among living forms, added since Weltner’s catalogue, may be noticed Koleolepas Willeyi, from the Loyalty Islands (Stebbing, in Willey’s Zool. Results, part v., p. 677, 1900). This was found in a Turbo shell, occupied also by a Pagurid, and coated with Actinians. The cirripede, which has an elastic peduncle, a crested capitulum, but no valves, and the first cirrhi longer than the rest, should stand near Eremolepas, the name given by Weltner in place of the preoccupied Gymnolepas (Auri- villius). In the genus Scalpellum, S. giganteum, Gruvel {Trans. Linn. Soc, 1901) disputes with S. Stearnsii . (Pig. 2), Pilsbry, 1890, which shall be ac- counted the greatest. The latter is threat- ened with a new generic name (Chun, Aus den Tiefen des Weltmeeres, p. 502, 1900).

The horizontal distribution of barnacles over all seas is fully explained by Darwin. The bathymetric range of sessile as well as pedunculate forms down to such depths as twelve or eighteen thousand feet — Verruca quadrangularis, Hoek, 1900 fathoms ; Scal- pellum regium, Wyville Thomson, 2850 fathoms— is a more recent discovery. Gru- vel {Contribution a V etude des Cirrhipedes, 1894) found that species frequenting the sea surface or shallow water, notwithstand- ing their feeble powers of vision, cannot live long when entirely debarred from light. It must therefore be supposed that abyssal forms have gradually acquired such tol- erance of darkness as makes their health independent of the sun. Among other singularities of habitats, not the least curi- ous is the freedom with which some small species, especially in the genus Dichelaspis, occupy the very jaws of large crustaceans. It is generally stated that cirripedes are confined to salt water, and, generally speaking, that is true. But Platylepas bissex-lobata (De Blainville), from the west coast of Africa, is sometimes found entirely buried, ex- cept its operculum, in the skin of the manatee. Now, since it seems this Manatus senegalensis "freely ascends the rivers, fre- quents the lagoons, and has even been captured in Lake Tchad," we may infer that its parasite travels with it. Whether the journey is in any way detrimental to the cirripede, those should determine whom opportunity favours. Studer (Crustacea of the O-azelle, 1882) records Balanus amphitrite, Darwin?, from roots and stems of mangroves in the Congo, where, he says, " it follows the mangroves as far as their vegetation extends along the stream, to six sea- miles from the mouth." Darwin notes B. improvisus as quite tolerant of water not saline. Why the Thyrostraca, so hardy, so widely dispersed and multitudinous, and with a history so pro- longed, should not have made more extended and more indepen- dent incursions into fresh water remains a problem. Though the Ornitholepas australis, Targioni Tozzetti, 1872, found on the tail feathers of a bird, represents only the cypris-larva of a cirripede, it still shows one of the many facilities for dispersion which these creatures enjoy. A striking instance of their abundance is cited by Aurivillius (1894) from a report by Captain G. C. Eckman, who late in the summer observed great masses of Lepas fascicu- laris forming broad belts in the North Sea. Aurivillius himself examined a humpback whale which had as many as fifty specimens of Coronula diadema on

each side of its head. He believes that the cetacean approaches not only rocks but ships in the hope of

Fig. 2. — Scalpellum Stearnsii.

Two-thirds nat. size.

freeing itself from its lodgers. Yet the fact that the long, soft Conchoderma auritum stands exposed on the Coronula, sometimes ten on one, indicates that the whale can have little chance of evicting its tenants, even at the expense of rubbing off the eighteen flattened horns of its own skin embedded in cavities round the domed base of the Coronula shell. The fecundity in the genus Lepas has struck many observers. Hoek {Chall. Rep., vol. x., "Cirripedia," 1884) notes that, while in Scalpellum the number of eggs may be less than a hundred, "in Lepas anatifera it amounts, on the con- trary, to many thousands and tens of thousands." In the same treatise Dr Hoek has useful chapters on the anatomy, development, and sexes of the group, with references to the important researches since Darwin by Krohn, Claus, Kossmann, and others. Francis Darwin, in the life of his father (vol. iii., p. 2, 1888), says, "Krohn stated that the structures described by my father as ovaries were in reality salivary glands, also that the oviduct runs down to the orifice described in the Monograph of the Cirripedia as the auditory meatus." Hoek, however, observes that the interpretation of the glands as salivary is not given by Krohn as his own opinion, but only quoted from Cuvier. Hoek himself proposes to call them pancreatic glands.

On the absorbing question of development, T. T. Groom {Phil. Trans., vol. clxxxv., 1894) supplies a full bibliography, beginning with the pioneers Slabber, 1778 (properly 1769), and J. Vaughan Thompson, 1830. Groom's monograph was almost immediately supplemented by Chun's chapters on the same subject {Bibliotheca Zoologica, Heft 19, Lieferung 2, 1895), to which an important discussion is contributed by H.J. Hansen (Cirripedien der Plankton Exp. , 1899) . He insists on the value of the upper lip or labrum f oi generic distinction, and as an aid in affiliating larval forms of different stages to their several species. He cites Groom's evidence that larvae obtained from the egg readily go

through one moult in the aquarium, and the known fact that the last larval stage is marked by a longitudinal series of six pairs of immovable spines or processes. He considers, then, that by a judicious comparison of larval forms with these two easily determinable stages the poverty of existing information on the subject may be gradually, if labori- ously, diminished. The large and peculiar Archizoea gigas of Dohrn must, he thinks, belong to the Lepadidse as a larva in the last stage, but not, as v. Willemoes Suhm supposed, to Lepas australis, or even to the genus Lepas at all.

Thyrostraca anomala. — This section comprises Darwin's Apoda, the footless, Lilljeborg's Suctoria, called by Fritz Muller the Rhizo- cephala, or rootlet-headed, and the group to which Lacaze-Duthiers gave the alternative names Ascothoracida, sac-bodied, or Rhizo- thoracida, rootlet-bodied. For the present these names may be dispensed with in favour of their equivalents, the three families Proteolepadidae, Sacculinidse, and Lauridse. The first is still limited to the single genus and species Proteblepas bivincta, Darwin, para- sitic within the sac of another cirripede. Nothing is certainly known of its development, except that the ova are extremely small, but H. J. Hansen {Die Cirripedien der Plankton-Exp., p. 53, 1899) argues that various nauplii of a type not previously described may probably be referred to this group or family, to which man's igno- rance rather than nature's insufficiency has hitherto given so trifling an extension. The second family, discussed by Delage, Giard, Kossmann, and others, has no dearth of genera and species, though about several of them the information is scanty enough. Almost all of them are parasitic on other crustaceans. Sphaerothylacus polycarpus, Sluiter, 1884, has an ascidian for its host. Sarcotaces (Olsson, 1872) has two species parasitic in fishes. But these excep- tional and dubious forms do not obtain nutriment by sending root- lets in a rhizocephalous manner into their patrons. The family Peltogastridse is sometimes separated from the Sacculinidaj, and sometimes made to do duty for both, the latter course being im- proper, since Sacculina (J. Vaughan Thompson, 1836), is not, as has been supposed , preoccupied, and must therefore take precedence of Peltogaster (Rathke, 1843). In the same family stands the genus Sylon, noted by KrOyer without a name in 1842, named by him

without a description in 1855, described by Michael Sars in 1869, and published by G. O. Sars in 1870. Hoek {Challenger, Rep., vol. xxiv. App. A, 1888) will orientate the English reader on this genus. For the complicated parasitism of isopods and Sacculinidae on the same hosts Giard and Bonnier {Bopyriens, p. 197, 1887) should be consulted.

The remaining family may till further knowledge be allowed to cover four remarkable species, three of them resident on Anthozoa, one on an echinoderm. Only the first, the celebrated Laura gerardim, Lacaze-Duthiers, 1865, sends such rootlets into its host as would justify the term Rhizothoracida. The small sinuous seg- mented body is enclosed, except for one small opening, in an enormous sac-like carapace, between the lamellae of which are protruded from the body the ovary and "liver," both large, bifurcate, and ramified. It is this sac-like and not valvular carapace, therefore, that justifies the term Ascothoracida. But Synagoga mira, Norman, 1888 {Brit. Assoc. Report for 1887,

has the body covered by two nearly circular valves instead of a sac. Petrarca bathyactidis, G. H. Fowler (Qtiart. Journ. Micros. Sci., vol. xxx. part ii. p. 115, 1889), has abilobed carapace, ventrally open. Dendrngastcr astericola, Knipovitch (Biologisches Centralblatt, vol. x. p. 707, 1891), is a multilobular sac, with apparently indistinct segmentation of the body proper on the dorsal side. For this highly problematic group the original authorities should by alj-ineans be consulted. The student may then be asked to compare the account of Synagoga mira both with the figure of the cypris-stage of Dendrogaster astericola and with the figure of the "indeterminate animal found on Gerardia," about which Lacaze-Duthiers asks, " Is it the cypris-stage of Laura ? " (Mem. Acad. Sci., vol. xlii. p. 160, pi. 1, fig. 102, 1883). S. mira was found, like Lmira gerardim (Fig. 3) in the Mediterranean, andfound like it attached to an antipatharian. Its six pairs of limbs are not like the bare and simple feet of the Laura, but two-branched and setose as in the ordinary cypris-stage of the cirripede. The conclusion, therefore, from these facts and from the suggested com- parisons, seems at least extremely probable that the question

A B

Fig. 3. — A, Laura Gerardice; B, carapace slit open to show the body proper.

asked by Lacaze-Duthiers should be answered in the affirmative, and that S. mira is either the cypris-stage of Laura gerardice or of some congeneric species. In Lacaze-Duthiers's highly-elaborated memoir it should be noticed that he uses the term "cirrhes" rather misleadingly, not for cirrhiform feet, but as the equivalent ■of setae. Also he gives two different reckonings of the segmenta- tion, counting first eleven body segments without the caudal furca – (p. 40), and then the caudal furca as itself the eleventh segment (p. 41). Of Petrarca the development is not yet known. The points of agreement and difference between it and Laura are care- fully drawn out in the essay by Dr Fowler, who inclines to favour a close relationship between the

Thyrostraca and Ostracoda. To the extreme development of the carapace in Laura as compared with the segmented body it would be difficult to find among crusta- ceans any analogy more striking than that of the great ovarial expan- sions in Nicothoe astaci, the little copepod parasite of the common lobster. The compactness of the class Crustacea is generally ad- mitted ; of the precise affinities of its subdivisions there is still much to learn. (t. r. k. S.)

Tiber (Italian, Tevere), a river of Italy. It traverses the Tuscan Apennines — in which it rises at a point some •5 miles north of Pieve San Stefano — in a series of picturesque ravines, skirts the west foot of the Sabine Mountains in a broad, shallow valley, then crosses the Roman Campagna, cutting its wav through Rome, and finally enters the Tyrrhenian (Mediterranean) Sea by two arms at Ostia and Fiumicino. Its principal tributaries |ire the Paglia, the Nera, and the Anio or Teverone, and it is generally navigable by boats up to the con- fluence of the Nera, a distance of 104 miles. The total length of the river is 240 miles, of which 21 miles lie between Rome and the sea. This latter portion of the river's course, although the depth varies from only 7 to .20 feet, and in places at low water does not exceed 4 feet, is nevertheless navigated by vessels up to 180 tons burden. 'The area of the river basin is 6845 square miles. The

stream is heavily charged with sedimentary matter, and from that circumstance got its ancient epithet offlavus (tawny). It does not, however, form adelta proportionate to the volume of its water. This is owing to the existence of a strong sea current flowing northwards close to the shore, to the sudden sinking of the sea to a great depth im- mediately off the mouth of the river, and possibly also to the permanent subsidence of the Italian coast from the Tiber mouth southwards to Terracina. Still it has in the course of centuries formed a small delta between its two arms, the district known to the ancients as the Isola Sacra (Sacred Island), about 3 miles across. From Rome to the sea the fall is only 6'5 : 1000. Fiumicino is connected with the river by a canal, dug by Trajan, 2\ miles long, 80 to 130 feet wide, and with a minimum depth of 5 feet. The lower course of the Tiber has from the earliest ages / been subject to frequent and severe inundations, those of 1598, 1870,

and 1900 having been especially destructive ; but since the year 1876 the municipality of Rome, assisted by the Italian Government, has taken steps to check, and possibly to prevent the occurrence of these calamities," by constructing embankments of stone, resting on caissons, for a total distance (counting in both sides of the river) of 6 miles, at a cost amounting in 1900 to a total of £5,000,000. The portion of the river thus embanked, and otherwise improved by straightening and clearing the channel near the Tiber island, is that which stretches from the new Ponte Margherita (near the Piazza del Popolo), at which point the river is 80 yards wide, to the Ponte Pala- tino, below the Tiber island, where its width increases to 113 yards and its depth is 16 to 43 feet. In December 1900 fully a quarter of a mile of the solid masonry of this new embankment (made in 1885-86), on the right bank, between the Garibaldi and the Cestio .bridges in Rome, collapsed and was swept away by the stream, while weakness and partial subsidence manifested them- selves at other points of the embankment witliin the city. (j. t. be.)

Tiberias, now Tabarieh, on the western shore of the Sea of Galilee. It is the seat of a mission of the United Free Church of Scotland with hospital and school, of a Franciscan hospice, church, and school, and of a Greek monastery and school. On a spur to the south of the town are the ruins of a fortress probably built by Herod. The population of 4000 includes about 2600 Jews.

Tibet. — The main outlines of Tibetan physiography have been so well illustrated already in the article on Tibet in vol. xxiii. (ninth edition) of this Encyclopaedia, as to leave little more to be said, in spite of the continuous activity in geographical research which has been main- tained in these regions during later years. The Indian approaches to Tibet have been systematically closed against travellers by the jealous interference of Tibetan andChinese officials, so that nearly all the fresh geographical informa- tion which has been added since 1885, or thereabouts, to our previous knowledge of the country, has been obtained by travellers who crossed the border either from Kashmir on the west or from Turkestan and China on the north and east. Although Lhasa is within 200 miles of the frontiers of Sikkim, no European has

lately succeeded in reaching that mysterious city, and our knowledge of it is still chiefly derived from native explorers. On the northern borders of the great Changtang — the central lake region which is flanked to the south and west by the Himalaya and their northern offshoots, and to the east by a vast moun- tain wilderness which contains the sources of the great rivers of Burma and China — the Kuen-lun and the second- ary mountain chains diverging therefrom have been scien- tifically explored by a series of travellers following on the footsteps of Prjevalsky ; and it is here that we have

to note certain amendments which have become necessary to our previous conceptions of Tibetan mountain configu- ration. The surveys of the Pamir Boundary Commission in 1895, followed by those of Captain Deasy, subsequently show that it is no longer correct to describe the Tibetan plateau as merging into the Pamirs on the west. No part of the Pamir region directly borders Tibet, nor can there be traced that connexion between the Kuen-lun and the mountains bordering Lake Victoria which was claimed by Stoliczka. The Kuen-lun, indeed, in its extreme north-western offshoots, abuts on what is known as the Mariom Pamir, in the basin of the Zarafshan river, but the Kuen-lun has ceased to represent the northern boundary of Tibet politically (if not geographically) long before it touches the Zarafshan, and the Mariom Pamir (if it can be recognized as a true Pamir) is separated by the whole border of the double range of the Sarikol from the ” Great ” Pamir of Lake Victoria. A northern offshoot of the giant Muztagh chain, forming an irregular transverse watershed, which connects the eastern and final buttresses of the Muztagh with the Kuen-lun in about 80° E., repre- sents the western boundary of Tibet as recognized politi- cally in the present day, although the Changtang (or tableland) to the west of it differs in no essential physical aspect from the Aksai chain to the east. The long, straight axis of the Kuen-lun, extending through 20 degrees of longitude, along the parallel of 36° N,

and denning the northern edge of the great central Tibetan upheaval as clearly as does the main snowy chain of the Himalaya on the south, is now known to be traversed by at least one important river (the Kiria), which passes from the plateau to the plains of Turkestan across the axis in about 82° E., and is finally lost on the sands of the Takhla Makan.

In the eastern section of the Kuen-lun, where the barren wind-swept solitudes of the Tsaidam stretch north- wards to the Altyn Tagh and Nan Shan ranges, our geo- graphical knowledge has been greatly extended by Russian explorations and by the researches of Sven Hedin. The absolute elevation of the Tsaidam uplands is about 9000 feet above sea, and its vast spread of desert and swamp is shown to be allied to the Tibetan tableland in con- figuration and physical aspect, and to be entirely distinct from the Turkestan depression which centres about Lob Nor to the north of it. We may therefore fairly include Tsaidam as an integral part of Tibetan geography. Such was the view taken by General Walker in the article in the ninth edition of this work, in contradistinction to later authorities, notably Mr W. Eockhill, who is disposed to regard Tsaidam politically as a sort of no man's land, because of the ethnographical and administrative dis- tinctions existing between its nomadic and marauding Mongolian and Tibetan inhabitants and the tribes and people of the south.

In eastern Tibet much advance has been made in un- ravelling the secrets of Asiatic hydrography by the identi- fication of the sources of the Yangtse, the Hoang Ho (Yellow river), the Mekong, and the Salween, all of which originate in the mountain borderland of eastern Tibet, and can now be placed with some approach to accuracy in their relative geographical positions on the map of Asia. The climate and conformation of the surface of the central tableland have also been the subject of scientific observa- tion by the many distinguished travellers who have crossed it, and much new light has been thrown on the ethnographical conditions of its nomad inhabitants.

For these and many other recent additions to our scientific knowledge of Tibet we are indebted to a number of travellers, Russian, English, French, American, Swedish, and Indian, a brief summary of whose

work is necessary in order to illustrate the gradual progress of scientific investigation.

The great Russian explorer Prjevalsky, although he was not, strictly speaking, an explorer of Tibet, did very much incidentally towards determining the conformation of its north- eastern and eastern mountain systems. His third «“ssian journey into Central Asian wilds, which lasted from exp orers- March 1879 to October 1880, included the sources of the Hoang Ho, or Yellow river, till then unmapped and unknown. His fourth journey, between November 1883 and October 1,885, covered much of northern Tibet, and established the true character of Tsaidam. It was when setting out in 1888 to, make an attempt to reach Lhasa that he died.

After Prjevalsky’s death, Roborovski, with several companions, explored the western ranges of the Kuen-lun, and crossed south- wards into Tibet, tracing the course of the Kiria river to the north- western plains of the central plateau. The distinguishing feature of these explorations, led by Russian officers, is their high scientific value, and the contributions they have offered to the botany, natural history, geology, and meteorology of the regions under investigation in addition to the actual geographical data attained. The Kuen-lun is known in their writings as the Russian Range.

Following the example of previous distinguished native explorers of the Indian Survey, Lama Ugyen gyatso, who worked in direct connexion with Sarat Chandra Das of the Bengal Edu- cational Department from 1878 to 1883, made Lhasa his Ind,aa chief objective. He was originally a teacher of Tibetan ZroJ* in a Darjiling school, and being deputed to take tribute from his monastery to Tashilunpo and Shaia, he secured permission from the Tibetan authorities for Chandra Das to visit the Tashi- lunpo monastery, where his name was entered as a student. This was the opportunity for a series of most valuable exploratory journeys through the Tibetan provinces adjoining the Indian and Nepalese frontiers, which have added greatly to our stock of in- formation about Lhasa and the districts surrounding that city. In their first journey the travellers set out from Jongu in Sikkim, and traversing the north-east

corner of Nepal, crossed into Tibet by the Chatang la, and travelled northwards to Shigatse' and Tashilunpo. They returned by much the same way to near Khamba djong, and re-entered Sikkim by the Donkhya la. The journey was fruitful of information and valuable for mapping.

After a second journey into southern Tibet, the lama undertook another journey in 1883 to complete and extend his former surveys. Travelling by way of Khamba djong directly to Gyantsfi and Shigatse^ he turned eastwards at the latter town, finished the survey of the Yamdok tso, and crossed the Himalaya into the valley of the Lobratsangpo or upper Manas river. At Shakhang djong he was arrested, and his true character discovered. He managed, nevertheless, to extricate himself, and turning north-eastwards he passed through Chetang, and reached Lhasa by way of Samye' monastery. From this city he started for Darjiling, which he reached on 15th December 1883.

Sarat Chandra Das's reports of his two journeys were published by the Indian Government, but for political reasons were until about 1889 kept strictly confidential. In 1899 they were edited, but not yet published, by the Royal Geographical Society. They contain a great amount of valuable information on the geography, ethnology, and religion of Tibet. Chandra Das also brought back from his journeys a large number of interesting books in Tibetan and Sanskrit, the most valuable of which have been edited and published by him, some with the assistance of Ugyen gyatso. As a reward for these geographical and other services Chandra Das was made CLE. and granted ajaghir.

In 1882 Mr Rockhill, an American, leaving the lamasery of Kumbum in north-western Kansu with three Chinese servants and a small caravan, proceeded round the north shore of Koko Nor, crossed eastern Tsaidam, and explored JJ'" 17… some of the rivers and lakes directly south of that j^r-89 ' region. Leaving Barong Tsaidam, he travelled south fs91-92. by way of the sources of the Yellow river, till he reached the Dr6 chu (upper Yangtse-kiang) , which he crossed to the north of the important trading centre of Gy^kundo. From this point he followed

the valley of the Dre’ chu till about lat. 30° 30’, when he passed into the basin of the Yalung river, tra- versed the Horba states, and finally reached Tachienlu by the Gi la and the valley of the Darchu.

In 1801 Mr Rockhill, starting again from Kumbum with three Chinese, passed south of Koko Nor through the country of the pastoral Panaka Tibetans, and by a very difficult pass (Wahon la/ entered again the basin of the Tsaidam. He then turned west, followed the base of the south Tsaidam range as far as the Naichi Gol, where he entered the southern mountainous region forming the northern borderland of Tibet. From this point the traveller followed a general south-westerly direction around the heads of all the feeders of the upper Dr6 chu, and thence into the lake region of northern central Tibet, crossing Bonvalot’s route south of the Chib-chang tso and that of Bower a few days farther south. Near the Namru tso his farther progress south was arrested, and he was compelled to>

Qabrlel

Boavalot

1889-90.

H. Bower,

1891-92.

take an easterly course. After making a long detour north, often crossing the roads previously travelled by Bonvalot and Bower, and passing by Riwoche, he came to Chamdo and Tachienlu. The results of Mr Rockhill’s two journeys were most valuable.

Bonvalot, aceompaoied by Father Dedeken of the Belgian Catho- lic Mission and Prince Henri d’ Orleans, left Charkalik, south-west of the

Lob Nor in November 1889, and taking a very nearly due southerly course, reached on the 13th of Feb- ruary 1890 the eastern end of the Tengri Nor. Then pushing on southwards, he crossed the Nyinchen tang la and entered the Dam district near the Lhasa-Hsining highroad. Here the party was stopped by Tibetan authorities and forced to take the tea route through Chinese Tibet (Gyade) by way of Batasumdo, Chebotenchin, Riwoche, Chamdo to Chiangka, near the upper Yangtse-kiang, whence they proceeded to Tachienlu by Batang and Litang. Bonvalot noted some extinct volcanoes in the northern Tibet desert.

Accompanied by Dr W. G. Thorold, of the India Medical Service, and a native sub-surveyor, Captain Hamilton Bower, I. S.C., set out from Leh on 1st June 1891, and crossed the Lanak la and Captain jne Ladak frontier on 3rd July. From this point the party took a general easterly direction past the Mangtza tso, Horpa tso, Charol tso, and around the northern end of the Aru tso, all important lakes, at an average altitude of about 16,500 feet. From the Aru tso the travellers took a south-easterly direction across the great northern plateau or Changtang till they reached the south-east side of the Garing tso, in about 31° 30′ N. and 89° 10′ E. At this point Bower was stopped by some of the head-men of the Tibetan pastoral tribes (here under the rule of Lhasa), and obliged to make a long circuit to the north well out of Lhasa ter- ritory, and then eastward — till he struck the road to Chamdo through Gyade or Chinese Tibet. Crossing the Hsining-Lhasa road a little south of the Dang la range, and about two days' journey north of Nagchuka, Captain Bower crossed the Su chu, and following a course parallel to the Gyama-nu chu, he made his way to Riwoche and thence to Chamdo, from which town he followed the Lhasa- Tachienlu highroad to the latter town, which he reached on 10th February 1892. The results of Captain Bower's journey were all of first-class importance.

Miss Annie R. Taylor, an Englishwoman of the China Inland Mission, started from Tao-chou (Kansu) in September 1892, ac- companied only by five Asiatics. Passing by the Miss A. R. famous lamasery of Labrang, south of the Yellow. 1892 ' nver, she crossed that river and traversed the southern part of the country inhabited by the predatory Tibetan tribes called Golok. Thence, after crossing the upper Za (or

Tsa) chu, which flows by the town of Kanze\ she pursued her journey to the upper course, of the Yangtse-kiang (Dr6 chu), crossing that river somewhere near where A. K. had crossed it in 1881 and Rock- hill in 1899, and then came to the town of Gyekundo. From this point she seems to have followed the Chamdo road to near that town, when she turned westwards and continued in that direction till she came on the highroad from Lhasa to Hsining Fu some- where north of Nagchuka. Here, like all other European travel- lers who have tried to reach Lhasa from the north, she was stopped by the Lhasan authorities. She appears to have followed about the same route on her way back to China, for she again went to Gyekundo and thence by the highroad, followed previously by A. K. and Rockliill, to Tachienlu in Szechuen, where she arrived 12th April 1893.

In 1893 Mr J. L. Dutreuil de Rhins and F. Grenard, both Frenchmen, left Cherchen, with Lhasa as their objective. After crossing the Kara muren davan in the Arka Tagh, they Dutreuil entered the lake region of north Tibet and followed a de dF>aS general southerly direction across low ranges of hills Oreaard an<^ y numerous small lakes till they arrived in 1893-94. 32° 30′ N, where they changed direction to east-south- east, passing to the north of the Chargut and Gyaring lakes. The travellers were able to push on as far as the north- eastern bank of the great Tengri Nor, which they reached 30th November 1893. Here they were finally stopped by the Tibetans, and after a delay of six wgeks passed in vain attempts to obtain permission to go to Lhasa, they were only allowed to proceed to Nagchuka on the Hsining-Lhasa road, and to continue by the Gyade route to Gyekundo, near the upper Dr6 chu, and thence to Hsining in Kansu. From Nagchuka the travellers followed a heretofore unexplored road through the Gyade country, crossing Rockhill's route in the Per-Sangyi districts near Trashiling (their Tachi gomba). The road followed by them to Gyekundo is called by Tibetans the upper road {gong lam), and had apparently been followed previously by Miss Taylor. Reaching Gye'kundo (or Giergundo) on 21st May 1894, the travellers started for the Koko Nor and Hsining on 1st June ; but the party was attacked near Tungbumdo (Tumbumdo of previous travellers), and Dutreuil de Rhins was killed on 5th June. Mr Grenard after a few days resumed his march, passed east of the Noring tso, the eastern

extremity of Tosu Nor, and thence by the south-east corner of Koko Nor to the town of Hsining Fu in Kansu. The results of this exploration have been a large number of maps and a report of great scientific importance.

Mr .Littledale, an Englishman, accompanied by his wife, left Khotan in the early part of 1895, and travelling thence to Cher- chen, he turned southwards, and following up the course of the Cherchen daria to a point near its source, he con- st George tinued in that direction between 87° and 89° E. across *• P^m". the northern plateau of Tibet till he reached the Zillang '

(or Garing) tso. Pursuing, amidst great difficulties, his southerly course, he finally reached the western hank of Tengri Nor. Push- ing rapidly on in the direction of Lhasa, when not over 50 miles away from the city (camp, 30° 12′ 12″ N.), he was finally stopped by the Lhasan authorities and obliged, in great part on account of the severe illness of Mrs Littledale, to give up the attempt to reach Sikkim, and to take a direct trail to Ladak. In the latter part of this remarkable journey Littledale's route lay parallel but to the south of the routes followed previously by Nain Sing, and more recently by Bower. Passing by Rudok, the party re-entered Ladak at the village of Shushal on 27th October 1895, and Leh on 2nd November. Mr Littledale surveyed about 1700 miles of country between Cherchen and Shushal, and brought back a valu- able collection of plants, which, added to those collected by other travellers in this part of Tibet, has enabled botanists considerably to extend their very scanty knowledge of this region.

Accompanied by Lieutenant Malcolm of the 93rd Highlanders, Captain Wellby, of the British army, left Leh on 4th May 1896. The travellers were compelled to enter Tibet by way of the Lingten tso in 35° N. From this point they turned due east, and continued, with the usual incidents experienced ^jfc3'" by all travellers in these regions — cold, storms, lack well'b of food and of grass, loss of ponies and pack animals, 1896. *' &c. — until they reached the northern branch of the Dr6 chu, the Chumar. Passing into the valley of the Nomoron Gol, south of the

Tsaidam, they made their way by Barong Tsaidam to Tankar and Hsining Fu by the highroad along the northern shore of the Koko Nor.

‘ Captain Deasy, of the British army, left Leh on 27th May 1896, and crossing the Lanak la, passed by the Mangtza tso, north of the Horpa tso, to Yeshil kul. Thence he endeavoured to proceed due east, but was obliged fp‘p by the nature of the country to turn south, crossing (?” Bower’s route on the west side of the Aru tso. He 1896^’ finally completed a valuable survey of an important part of western Tibet.

In 1896 Sven Hedin, a Scandinavian, left Kopa, a point about 100 miles south of Cherchen, and after crossing the Arka Tagh took an easterly course between that range and the western continuation of the Kokoshili range till he entered the valley of the most northerly feeders of the Dre chu, when he passed into the valley of the Naichi Gol and entered the Tsaidam. His careful observations concern- ing the meteorology of this region are of great value, and his sur- veys between Kopa and the Naichi Gol were in a country not previously explored. The country traversed, however, can hardly be considered as forming a part of Tibet, though its configuration is the same as that farther south in the great Tibetan plateau crossed by other travellers.

During his second journey in Central Asia, Sven Hedin left Charkalik in May 1901, intending to cross Tibet in a diagonal direction to the sources of the Indus. Arriving within fourteen days of Lhasa, he left the bulk of his caravan and pushed rapidly on towards that city, but was stopped when about five days from it. Rejoining his caravan he turned westwards, and passing through the country previously traversed by Bower and Littledale, he reached Leh on 20th December 1901.

In May 1900 Kozloff, in command of the Russian Geographical Society’s expedition to Central Asia and Tibet, left Barong Tsaidam, and travelling southwards, came to the Dre’ chu (his Ndu chu or Blue river), at about the same

Nyamtso, he crossed the river and reached Gye’kundo 1900- ‘ (his Jarku Lomba). One stage beyond this place he l90i_ left the route followed by former travellers and pushed northwards to near the town

of Chamdo, where after a sharp fight with the natives he turned eastwards. The winter was passed in the valley of the Ra chu, a tributary of the Chamdo chu (his Dza chu) , and excursions were made as far as Derge' droncher. In the spring of 1901 the expedition resumed its march eastwards around the Dr6chu and the Ja chu (Yalung river), followed up the left bank of the latter, and got back to Russian Lelu (Oring tso) on 30th May 1901. The scientific results of this expedition, so far as can be judged from the very meagre accounts published, appear to be important.

Hedin,

1896.

Svea

Hedin,

1901.

TIBET

Physically Tibet may be divided into two parts, the

lake region in the west and north-west, and the river

aeo ra b re9ion> which spreads out on three sides of the

eograp y. -former on ^e east; south, and west. The lake

region extends from the Pangong tso in Ladak, near the source of the Indus, to the sources of the Salween, the Mekong, and the Yangtse. This region is called the Changtang (Byang Tang) or "Northern Plateau" by the people of Tibet. It is some 700 miles broad, and covers an area about equal to that of France. From its great distance from the ocean it is extremely arid, and possesses no river outlet. The mountain ranges are spread out, rounded, disconnected, separated by flat valleys

relatively of little depth. The country is dotted over with small lakes, many salt or alkaline, and inter- sected by streams, and the soil is boggy and covered with tussocks of grass, thus resembling the Siberian tundra and the Pamirs. Its average altitude is over 16,000 feet, the northern portion of it being the highest. The southern portion, from Lake Pangong to Tengri Nor, isi inhabited by pastoral tribes of Tibetans, and possesses a few hamlets, such as Ombo, Rudok, and Sendja djong. The river region comprises the upper courses of the Brahmaputra (Yara tsangpo), the Salween (? Gyama nyul chu), the Yangtse (Dre chu), the Mekong (Nya-lung chu), and the Yellow river (Ma chu). Amidst the mountains there are many narrow valleys, partially cultivated from an altitude of 12,000 feet downwards, with here and there fine forests covering the mountain sides. Villages of high stone-built houses are to be found wherever the valley bottoms open out enough to afford a little space for agriculture. Barley and turnips are about the only products of the higher valleys; as one reaches lower levels, wheat, buckwheat, cabbages, potatoes, apricots, apples, and peaches are found, and in the so-called "hot country" (tsct-rong), in the southern part of Tibet, rice, oranges, pomegranates, and jujubes are raised successfully.

The Tibetan race, which probably belongs to the Turko- Mongolstock, is divided between thetent-dwellingTibetans of the lake region and the transition zone be- Peopie. tween it and the river region, and the sedentary population of the valleys. The tent-dwelling Tibetans are called by the Tibetans Dupa or Drupa (librog-pd), or " Steppe dwellers." They probably present the purest type of the race. An exception may be made in the case of the Tibetans of the Koko Nor region, also .called Panaka, who show a Mongolized type. The males measure about 5 feet 5 inches ; the females not appreciably less. The head is brachy cephalic ; the hair, when worn, is nearly invariably wavy ; the eyes are usually of a clear brown, in some cases even hazel ; the cheek-bones are high, but not so high as with the Mongols ; the nose is thick, sometimes depressed at the root, in other cases prominent, even aquiline, but usually narrow, though the nostrils are broad. The teeth are strong but irregular ; the ears, with tolerably large lobes, stand out from the head, but to a less degree than with the Mongols.

The mouth is broad, the lips not very full and, among the people living in the lower altitudes, decidedly thin. The beard is very sparse, and with the exception of the moustache, which is sometimes worn, especially in central Tibet, it is carefully plucked out with tweezers. The shoulders are broad, the arms round ; the legs are not well developed, the calf is especially small. The foot is large, the hand coarse. The women are usually stouter than the men, their faces much fuller. The colour of the skin of the Tibetans is a light brown, frequently nearly white, except where exposed to the weather, when it becomes a dark brown, nearly the colour of the American Indian's. Their voices are full, deep, and powerful. They can en-

dure exposure without any apparent inconvenience. Hunger they can also endure ; though the nature of the food they use is such that they cannot stand absolute privation for any considerable length of time, they can easily exist for long periods on starvation rations.

The sedentary population of Tibet has to a greater or less degree the same physical traits as the Drupa, but as one approaches China, India, or the border lands generally, one observes that the admixture . of foreign blood during many centuries has considerably modified the primitive type. Among the customs of the Tibet- ans, that which is perhaps the most peculiar is the ex- istence among them of polyandry, the brothers in a family having one wife in common. Polygamy is not unknown in Tibet, especially in the eastern parts of the country. Among the pastoral tribes monogamy seems to be the rule.

The population of Tibet has been estimated by various writers at from 3,000,000 to 8,000,000 ; the lower estimate seems the more acceptable ; and in it should be counted the Tibetans of Ladak, Sikkim, and adjacent districts under British sovereignty. The latest estimate of the population of Tibet is that made by order of the emperor of China in 1737. According to it the grand total of the population for the whole of Tibet in the middle of the 18th century, was about a million and a half. No means exist of checking these figures, but when we take into account the exist- ence of polyandry and promiscuity, the configuration of the soil, the ever-increasing number of the lamas, slavery, the

frequent terrible ravages caused by smallpox, &c. , it seems highly probable that the present population of the country, except in some highly- favoured districts, does not greatly exceed that given for 1737, at which figure it was estimated by Csoma de Koros, writing some-where about 1830. If we add the Tibetans of north-western Kansu, the Koko Nor, and adjacent districts not included by Csoma de Koros, who do not, it is believed, number over 250,000, it would certainly appear that the total Tibetan population would hardly reach 3,000,000 as a maximum.

Tibetans divide their country into five provinces. (1) Amdo, which comprises that part of the Chinese pro- vince of Kansu which is inhabited by Tibetans, and Koko Nor region, extending southwards mvfstoL to the Yellow river and westwards as far as the Tsaidam. Amdo is inhabited in its eastern part by Tibetans, called Eongwa or "agriculturists," and in the western by pastoral tribes, collectively called Panaka or Panakasum. (2) Khams or Khamdo, which includes all eastern Tibet between the Chinese provinces of Szechuen and Yunnan, and the district of Lhorong djong, which forms the eastern border of the Lhasa-governed territory. This province is divided into the five Horba tribes, the eighteen Nyarong states in the valley of the upper Nyalung, and the districts of Litang, Batang, Derge, Gartok, Chamdo, and Draya. In Khamdo, but subject to the direct rule of Lhasa, are several small districts; the principal are Nyarong, Tsarong, and Mar Khams or " Lower Khamdo." Most of these districts are governed by diba or chiefs, while a few have kings or gyalpo, the most powerful of the latter being the king of Derge and of Chagla, or, as it is better known, Taehienlu. Khamdo is under the direct rule of the Chinese provincial authori- ties of Szechuen. Some of its rulers send also tribute missions to Peking. For convenience of classification, we may include in Khamdo a long strip of country extending along the northern border of the Lhasa territory of Lhorong djong and Larego as far as Tengri Nor, and bounded to the north by the Dang-la mountains, which is designated by Tibetans as Oyade or "the Chinese province." This strip of country has its own native chiefs, but is under the control of a high Manchu officer stationed at Lhasa, known colloquially as the " Superintendent of Savage Tribes." The third

political division of Tibet is Wu (written Dbus), meaning ” Central.” It includes Lhasa, and a large number of outlying districts in south-eastern Tibet, such as Po yul, Pemakoichen, Za yul. The

pastoral or Drupa tribes, north and north-east of Tengri Nor, are also under its rule. Lhasa is colloquially de- signated as Teba gzung, ” the very centre.” The fourth and fifth divisions of Tibet, called Tsang and Nari (Mngah-ris), include, the first, all south-west Tibet as far as Lake Manasarowar ; the second, the whole country around the sources and along the upper course of the Indus and the Sutlej, and also all north-western Tibet generally. Tsang and Nari are under the rule of Lhasa, all the high civil and military authorities in these pro- vinces holding their offices from it.1

Tibet hardly possesses a town of first-class importance besides Lhasa. The monastic towns of Tashilunpo (Shigats^) and Gyantse on the Nyang chu, a The chief southern tributary of the Tsanpo, which joins Tibet. ° that river about 150 miles above Lhasa, are perhaps the best-known towns of the southern districts of Tibet. Both of them are commercial centres of some significance.

Shigatse, which is at the confluence of the Nyang chu with the Tsanpo, also called Digarcha, is a city of ahout 9000 inhabitants (exclusive of priests), about J of a mile long by £ a mile broad. About a mile from the north-east corner of the city is situated a monastery called Konkaling, whilst to the south-west is the far- famed Tashilunpo monastery, the residence of one of the great high priests of Tibet, coequal with the Dalai-Lama of Lhasa. Between the Tashilunpo monastery and the city is the Thorn or open market, where all the business of the place is daily trans- acted. A wall about a mile in circumference surrounds the Tashilunpo monastery, within which are numerous temples and houses, four of the larger temples being decorated with gilded spires. A great wealth of jewels and precious metal is said to enrich the numerous idols of Tashilunpo. The monastery main- tains 3300 priests. The city is

protected by a fort which stands on a low hill totthe north-west, and a garrison of 100 Chinese and 400 Tibetan soldiers is quartered here. The municipal government is in the hands of two dapon assisted by resident Djongpons. The soil around ShigatsS is rich and productive, the elevation being between 11,000 and 12,000 feet.

Gyantse, the mart for Bhutan, to the south-east of ShigatsS, is described by "the Pundit" as being very similar in size to ShigatsS, but the government is in the hands of one dapon only, and the fort is near the centre of the city, maintaining a force of 60 Chinese and 200 Tibetans only. At Gyantse' wheat, barley oil, radishes, peas, and ghee are said to he cheap, and the town is famous for its manufacture of various kinds of cloth and of small bells, such as are attached to caravan horses.

Janglache, on the Tsanpo (where the trade-route from Ladak crosses from the left to the right bank of the .river), is about 80 miles above Shigatsfi. Here again we meet with the usual monas- tery and fort. Janglache is between 13,000 and 14,000 feet above sea-level.

On the Kashmir (or Ladak) frontier the little town of Budok is important. Through Rudok all the trade of Tibet passes to Leh, and at Rudok is maintained the Chinese outpost which has so per- sistently interfered with all efforts at European exploration of the country. Nevertheless the political resident at Leh has already visited that town, and it may well happen that its bazaar will soon be as much traversed by Europeans as is Leh itself. Rudok is described as a small town picturesquely situated on the side of a hill standing isolated in the plain near the eastern end of Lake Pangong, across which the official boundary between Tibet and Kashmir now runs. The houses are built in tiers, whitewashed, and walled in. At the top of the hill is a large palace and several monasteries painted red. About a mile away from the foot of the hill is another monastery. Rudok is about 13,300 feet above sea- level, the height of Lhasa being 11,600 feet, and the greatest altitude on the route connecting the two, at the Mariom la (the pass which defines the water-parting between the sources of the Brahmaputra and those of the Sutlej), is 15,500 feet. It is a note-

worthy fact in respect of the winter climate of Rudok and . of all the towns of the Tsanpo basin that, owing to the intense dryness of the air and the light fall of snow, it seems to be bracing and exhilarating rather than severe. The thermometer apparently

lrThis enumeration of the political divisions of Tibet does not in- clude the elevated steppes of Tsaidam (extending between the Kuen- lun and the Altyn Tagh or Nan Shan ranges), inhabited by a mixed race of marauding people, Tunguts and Mongols. Yet Tsaidam is geographically but a northern extension of the great Tibetan plateau, and in most of its essential physical features it is more closely allied to the Changtang of the south than to the great sandy depressions of Chinese Turkestan or Mongolia on the north.

Govern- ment.

never sinks very low, and never approaches the minimum record of Puetra (in the same latitude and at half the absolute elevation), according to the observations of native surveyors.

Tachienlu (Darchendo) is on the extreme eastern boundary of Tibet, bordering the province of Szechuen in China. It is the great tea mart for Tibet, and from Tachienlu the two great trade- routes, the Gya lam anov the Chang lam, diverge, the former to Ladak and the latter to Kashgar.

In eastern Tibet another well-known trading town is Batang, about which, however, travellers have given us but meagre in- formation. It is described as a large town of 200 houses at an elevation of 8000 feet, but of little commercial importance. There are only two Chinese firms at Batang, where the trade is in the hands of the lamas, who, however, make larger profits out of the “pawnbrokers’ business” than they do by legitimate trade. Its geographical position near the Dr£ chu (Yangtse), and its com- mand of the great eastern highroad from China both to Lhasa and to Chinese Turkestan, ensure its vitality. Batang may well be a more important town in the future than it is in the present.

The chief town in the province of Khams is Chamdo, which is situated at the junction of two rivers, which are frozen in winter. Here is a large monastery with 3000 priests, and a garrison. European travellers have been jealously kept out of Chamdo lately.

Though the whole of Tibet is under the suzerainty of China, the government of the country is divided into two distinct administrations, the one under the rule of the Dalai-Lama of Lhasa, the other under local kings or chiefs,, and comprising a number of ecclesiastical fiefs. Both are directed and controlled by the high Chinese officials residing at Lhasa, Hsining Fu, and the capital of the Chinese province of Szechuen. North-eastern Tibet or Amdo, and also a portion of Khamdo, are under the supervision of a high official (Manchu) residing at Hsining Pu in Kansu, whose title is Imperial Controller-General of Koko Nor. The native chiefs of the Panaka and other Tibetan tribes of this region are styled pombo (" official " or " headman ") by both the natives and the Chinese. The region under the supervision of the Imperial Controller includes all the countries north of the upper course of the Dre chu (Yang- tse-kiang). The people pay a small poll-tax to China, and are exempted from any other impost ; they also pay a small tax in kind, sheep, butter, &c, to their chiefs. The province of Khamdo, including all eastern Tibet, is governed by local chiefs, styled gyalbo, " king," and dSba, " chief," succession to the chieftainship being usually assured to the eldest son not a lama. Each chief ap- points a certain number of civil and military officers to assist in the government of the country, and each village has its headman or besi, also a hereditary office. None of these officials receive salaries ; they are only exempt from taxation, and some have grants of land made to them. The only tax paid to China is a so-called "horse tax " of about 5d. for each family. Once in every five years the chiefs send a tribute mission to the capital of Szechuen, and once every ten years to Peking, but the tribute sent is purely nominal. The Chinese maintain a few small military posts 'with from six or eight to twenty men stationed in them ; they are under the orders of a colonel residing at Tachienlu. There are also a few lama chiefs.

The part of Tibet under the rule of Lhasa, by far the largest and wealthiest, includes the province of Wu, Tsang, Nari, and a number of large outlying districts in southern and even in eastern Tibet. The central govern- ment of this part of the country is at Lhasa ; the nominal head is the Dalai-Lama. Under him are five ministers of state (kalon or shapi), who divide among them- selves, under the immediate supervision of the two Imperial Chinese residents (or Amban), the management of all secular affairs of the country. The army is under the high command of the Chinese Amban, a Tibetan generalissimo or magpon, and six Tibetan generals or dapon. Under the dapon are six riipon or colonels, and a number of subordinate officers. The regular army consists

(in theory) of 6000 men, on active service for three years, and at home on half-pay for three years. After the six years they pass into the reserve or militia (yulmag). The taxes paid to the Lhasa Government are mostly in kind, sheep, ponies, meal, butter, wool, native cloth, &c, and the coin paid is said to be about 130,000 ounces of silver a year. Chandra Das states that the Crown revenues of Lhasa amount to about 2,000,000 rupees annually. All high Tibetan officials, whether ecclesiastics or laymen, are appointed subject to confirmation by the Chinese Govern- ment. The administrative subdivisions of the Lhasa country, of which there are fifty -three, are called djong, or " prefecture," each of which is under the rule of two djongpon, the one a lama, the other a layman. They collect all taxes, are responsible for the levy of troops, the courier service, corvees, &c, and exercise judicial functions, corresponding directly with Lhasa. There are 123 sub- prefectures under djongnyer. Under them are village headmen or tsopon, headmen or mipon, and elders or gyanpo. All are appointed for indefinite periods by the prefects. (For additional data on the administra- tion, revenues, and army see Lhasa, and for the religion see Lamaism, vol. xiv.)

But little is known of the geological structure of the central regions of Tibet. The observations of Strachey or Godwin-Austen, with the more recent observations of Griesbach and Geology other members of the Geological Survey of India, only miner / extend to the southern edge or rim of the great plateau wealth. where vast alluvial deposits in horizontal strata have been furrowed into deep ravines, whilst Russian ex- plorers have as yet but superficially.examined the mountain regions of the north and north-east. ‘

The general structure of the trans-Himalayan chains appears to indicate that the main axis of upheaval of the whole vast mass of the Tibetan highlands is to be found on two approximately parallel lines, represented the one by the Kuen-lun, and the other by a line which is more or less coincident with the watershed between India and the central lake region, extending from Lake Pangong to Tengri Nor, the plateau enclosed between the two being wrinkled by minor folds, of which the relative elevation is com- paratively low, averaging from 1000 to 1500 feet. The strike of these folds is usually east and “west and roughly parallel to the axes of elevation of the plateau. A very remarkable economic feature is the almost universal distribution of gold throughout Tibet. Gold has been worked on the plateau for numberless centuries. The gold-digging is referred to in some- what mythical terms by Herodotus. Every river which’ rises in Tibet washes down sands impregnated with gold, and it has been proved that this gold is not the product of intervening strata, but must have existed primarily in the crystalline rocks of the main axes of upheaval. In western Tibet the gold mines of Jalung have been worked since 1875. They have been visited by native explorers of the Indian Survey, who reported that much gold was produced therefrom, and that it was remitted twice a year under a Chinese guard to Peking. The Tibetan diggers collected together at the mines chiefly during the winter, when the frost assisted to bind the loose alluvial soil and render excavation easy. These mines are within 200 miles of the Ladak frontier, near the sources of the Indus, at an elevation which cannot be less than 15,000 feet above sea-level. They are said to have been lately abandoned owing to the exorbitant imposts levied on gold produc- tion by Chinese and Tibetan officials. Between the Ladak frontier and Lhasa the plateau

region teems with evidences of disused and abandoned mines, which might be counted by hundreds. These mines are excavations in the alluvial soil, never more than from 20 to 30 feet deep, and the gold produced therefrom has been sepa- rated from the soil by a process of washing so crude that a great part of it must inevitably have been lost.

The researches of Prjevalsky demonstrate that gold is plentiful in northern and eastern Tibet. Here Tungus diggers were en- countered who had extracted handfuls of gold in small nuggets from a stream bed at a depth which they stated to be no greater than 2 feet. Another scientific explorer, Mr W. Mesny, has ob- served similar evidences of the existence of gold at comparatively shallow depths in Koko Nor region, and records that he lias seen nuggets, ” varying from the size of a pea to that of a hazel- nut,” .in eastern Tibet. The gold was almost pure and perfectly malleable. The Gork goldfields, which are visible from Koko Nor, are reported to have yielded to China very considerable quantities of gold as lately as 1888. They are now deserted. Prjevalsky, indeed, predicts of northern Tibet that it will prove a

“second California” in course of time. But very little geld at present finds its way across the Tibetan passes to India, either by way of Ladak or Kumaon ; and the export to China has diminished of late years. Until the determined official opposition to exploration, which is maintained both by Chinese and Tibetan authorities, is sufficiently relaxed to admit of the presence of European experts, it will be impossible to estimate the economic value of the enormous area of the Tibetan goldfields which are already known to exist.

Iron is found in eastern Tibet in the form of pyrites, and is rudely smelted locally. Salt and borax exist in abundance in thu western lake regions. The exportation of borax to India is only limited by the comparatively small demand. Lapis-lazuli and quicksilver are amongst the minor mineral products of the country , which is, however, but very partially exploited.

The climate of Tibet varies so greatly over the enormous area and the changing altitudes of the country, that no two travellers agree precisely

in their records. Tibet is affected by the south-west monsoon, just as the Pamirs w“D”e. are affected, but in varying degrees according to geographical position. In western Tibet, bordering the Kashmir frontier, the climate differs but little from that of Ladak. Intense dryness pervades the atmosphere during nine months of the year ; but little snow falls, and the western passes are so little subject to intermittent falls of fresh snow, as frequently to be traversable during the whole year round (see Ladak). Low temperatures are prevalent throughout these western regions, whose bleak desolation is unrelieved by the existence of trees or vegetation of any size, and where the wind sweeps unchecked across vast expanses of arid plain. All the western region is but slightly affected by the mon- soon. The central lake region, extending from the Kuen-lun to the Himalaya, is also characterized by extreme dryness in autumn, winter, and spring, with an abundance of rain in summer, whilst the eastern mountain region, extending to China south of the Dang la (which, with an altitude of about 20,000 feet, stretches from 90° to 97° E. along the parallel of 33° N., and arrests the monsoon currents) , is subject to much the same climatic influences as the eastern Himalaya. The southern slopes of the Dang la are deluged with rain, hail, and snow throughout the yeajr. Northern Tibet is an arid waste, subject to intense heat in summer and intense cold in winter. In March snow still lies deep in the Tsai- dam passes, whilst Wellby found the heat oppressive in June at 16,000 feet elevation on the plateau south of the Kuen-lun, and a temperate climate prevailing about the sources of the Dre chu (Yangtse) in August.

All travellers testify to the perpetual wind currents from the west, which sweep with fierce, unremitting blasts across the salt bogs of Tsaidam (9500 feet) and through the higher valleys of eastern Tibet. Wind is a prevailing feature throughout Tibet at certain seasons of the year, as it is in the Pamirs, in Turkestan, in western Afghanistan, and in Persia. The climate of southern Tibet is, however, subject to considerable modifications from that of the northern and central regions, owing doubtless to its geographical connexion with northern India. Here, at an elevation of 15,000 feet, about the great Lake Dangra, we hear of well-built villages and of richly cultivated fields of barley, indicating a condition of climate analogous to that which

prevails in the districts south of Lhasa, and in sharp contrast to the monotonous sterility of the lake region generally and the nomadic character of its population. Recent travellers bear witness to a gradual progress of desiccation in the Tibetan uplands. Everywhere there are signs of the gradual diminution of the lakes and the recession of the water line — a phenomenon that has also been observed in the Pamirs. There are still enormous glaciers about the head of the Brahma- putra, but the glacial epoch of the Changtang highlands has passed away ; but it has passed comparatively recently, and the last evidences of its existence are to be traced in those lakes, which are now in their turn slowly disappearing. There is nothing to be found in the records of recent exploration or travel to indicate that in western, southern, or eastern Tibet the climate of the winter months is of a severity which would render it inimical to European existence.

Our knowledge of the flora of northern and central Tibet has been considerably increased by the collections of Prjevalsky, Wellby, Bower, and Littledale, and that of eastern Tibet by _.

Rockhill. These and other collections have been admirably described in W. B. Hemsley's The Flora of Tibet or High Asia. Western and southern Tibet were fairly well explored previously to the advent of these travellers. Pro- fessor Maximowicz concludes from an analysis of the Prjevalsky collection that the flora of Tibet is extremely ancient, and that it is chiefly composed of immigrants from the Himalaya and Mongolia. There is also a large percentage of endemic species. Chinese and European plants followed in the process of immigration. Those species which are distinctive of the eastern border ridges are found to reach the plateau, but do not spread westwards, so that a

botanic separation or distinction is found to exist between the true plateau of Tibet in the west and the alpine tracts of Ijhe east. Thiselton-Dyer classes the flora of Tibet on the whole as belong- ing to the Arctic-Alpine section of the great northern division, but containing a purely

endemic element. Two typical species are Lychnis apctala, which extends to Spitsbergen, and the well- known edelweiss. A single fem specimen obtained by Little- dale (Polypodium hastaium) is indicative of eastern China. Of the forty or fifty genera obtained by Littledale in central Tibet, a very large proportion are British, including many of the most characteristic mountain forms. In the higher regions of northern and western Tibet the conditions under which vegetation exists are extreme. Here there are no trees, no shrubs, nor any plants above a foot high. Wellby says he saw nothing higher than an onion. The peculiar form of tussocky grass which prevails in the Pamirs is the characteristic feature of the Tibetan Changtang of the Tsaidam plains and of the bogs north-east of Lhasa. Of grasses indeed there are many forms, some of them peculiar to Tibet, but no trees or shrubs at any elevation higher than 15,000 feet. A flowering plant {Saussurea tridactyla) was discovered by Bower at an elevation of 19,000 feet. In south-eastern Tibet, where Himalayan conditions of climate prevail, we have a completely different class of flora. Of the flora of Tibet Mr Rockhill writes: "In the 'hot lands' (tsa-rong) in southern and south-eastern Tibet, extending even to Batang, peaches, apricots, apples, plums, grapes, watermelons, &c, and even pomegranates, are raised; most of Tibet only produces a few varieties of vegetables, such as potatoes, turnips, beans, cabbages, onions, &c. The principal cereals raised are barley and buckwheat, wheat in small quantities, and a little oats. A few localities in the extreme southern portions of the country, and around Lhasa possibly, are said to produce a non- glutinous variety of rice. A variety of mountain bamboo is found in southern and parts of eastern Tibet, and is much used for basket work. Tibet produces a large number of medicinal plants much prized by the medical profession in China and Mongolia, among others the Vordyceps sinensis, the Coptis teeta, Wall., and Picko- rhiza kuwoa, Royle, &c. Rhubarb is also found in great quantities in eastern Tibet and Amdo ; it is largely exported for European use, but does not appear to be used medicinally in the country. The trees most commonly found are the plane, poplar, maple, walnut, oak, the cupressus funebris, and various varieties of the genera pinus, abies, and larix. Some valuable plants are obtained in the mountains of south and south-western Tibet, yielding the excellent yellow and red colours used to dye the native cloths."

The fauna of Tibet has been by no means exhaustively investi- gated, especially the rodents and smaller species of animals. _^ Amongst domesticated animals are to be found the

horse, male, donkey, cattle, sheep and goats, fowls and pigs, ducks and geese. Probably no country in the world, excepting perhaps inner Africa, so abounds in wild animals as the cold solitudes of the northern plateau. Here are to be found yak, wild asses {kiang), several varieties of deer, musk deer, and Tibetan antelope (pantholopo) ; also wild sheep (the burret of the Hima- laya) , Ovis ammon and possibly Ovis poli, together with wild goats, bears (in large numbers in the north-eastern districts), leopards, otter, wolves, foxes, marmots, monkeys, squirrels, and wild dogs. To this list must be added the curious Ailuropus melanoleucus. Birds are fairly numerous, and include many varieties of water- fowl, some of which (Anser indicus [the bar-headed goose] ,. for instance) breed in Tibet, whilst others are only found as birds of passage. In eastern Tibet, on the Chinese border, varieties of the pheasant tribe abound, some of which are rare. Amongst them are the "white" pheasant, the Ceriornis Temminckii, two kinds of eared pheasant, Anderson's pheasant, and the blood pheasant. The Tibetan sand-grouse is peculiar to the country, and the snow-partridge (a member of the Himalayan variety) is also occasionally met with. "Wellby mentions eagles in the north- east of the plateau, and Rockhill enumerates, on Chinese authority, storks, larks, and swallows amongst the birds of central Tibet.

The industries are confined to the manufacture of woollen cloth of various degrees of fineness and colour, and called truk, tirma, and lawa, to that of small rugs, potteiy of an inferior quality, utensils of copper and iron, some of which show considerable artistic skill in design, and to such other small trades as are necessary to supply the limited wants of the

industries antitrade.

people. The best artisans are Nepalese and Chinese, the former being the best workers in metal and dyers.

The great trade routes are, first, that which, starting from Cheng-tu, the capital of the Chinese province of Szechuen, passes by way of Tachienlu, Litang, Batang, Chamdo, Larego, Lhasa, Gyantsg, Shigatse^ reaches the Nepalese frontier at Nielam and goes thence to Khatmandu. This route is called Gya-lam, "the China road" (or "high road") ; the great bulk of Tibetan travel goes over it. Minor roads go from Hsining Fu in the Chinese province of Kansu via Tsaidam and the Dang la pass to Nagchuka and

Internal

communl'

cation.

Lhasa. This road, called the Chang-lam or "northern road," was much used by traders till the middle of the 19th century, since when the Mahommedan rebellions in north-western China have practically closed it. Another road starts from Sung-pan in north-western Szechuen, and, by way of the sources of the Yellow river, joins the Gya-lam at Chamdo ; it is but little used, as it passes through the country of the wild marauding Golok. Still another route starts from Tachienlu, and by the valley of the Yalung and the Dre" chu runs to Gyelcundo, and thence to Chamdo. Prom this point it leads to Riwoche, and then through Gyade or Chinese province to Nagchuka and Lhasa. An important trade road starts from Likiang Fu in Yunnan, and by way of Chung-tien (Guiedam of the French missionaries) joins the Gya- lam at Batang.

The latest routes adopted by travellers from Barjiling to Lhasa have been those which, avoiding the Chumbi valley, have crossed the Himalaya on the north-west rather than the north- east of Sikkim, and run most directly to Shigatse. Trade Prom Shigatse" to Lhasa the route has been the same routes' &c- as that followed by Nain Sing in earlier days, which passes by Gyantse and thence over the lofty Kharo la plateau through the lake basin of the Yamdok tso, across the Khambala range to the Nari chu (Tsanpo) . Between Shigatse' and the mouth of the Kyi chu (on which Lhasa stands) there is still no direct

communication by river. Chandra Das, travelling via Kambajong and the Kongra Lamo pass, made a twenty-eight days' journey between Shigatse" and Darjiling. The direct distance being about 160 miles, this length of time is sufficient indication of the tortuous and difficult nature of the mountain track. Prom Khatmandu, the capital of Nepal, a difficult mountain route runs by Kirong tso to the No la (lfi,600 feet), descending from which pass it strikes the Tsanpo about midway between Lhasa and Lake Mansarowar. Farther west Tibet may be reached from Kumaon by one of a group of passes (of which the best-known is the Milam) leading to Lake Man- sarowar. The lake becomes a sort of obligatory point on all routes to Tibet which lie between Ladak and Nepal. The Shipki road from Simla, which strikes the Sutlej at Totling (where there is a bridge), leads up to Mansarowar, coinciding with the great high- road (Jonglam) after passing Totling. The Jonglam (elsewhere called Gya-lam, which traverses the whole length of Tibet from Leh to China) is the route by which Chinese officials keep up com- munication with western Tibet. From Leh to Gartok (14,250 feet) it follows the upper Indus valley ; then crossing the lofty Kailas range (dividing the Indus from the Sutlej) it drops to Totling and follows the Sutlej to Mansarowar. The remarkable area of gold- mining industry which lies to the north-east of Gartok is reached by another route from Leh, which, crossing the Chang la close to Leh, passes by Rudok at the eastern extremity of Lake Pangong in a south-easterly direction, running north of the great mountain masses which crowd round the Indus sources. It continues through the central lake district of the Hor province to Tengri Nor and Lhasa.

For the money of Tibet see the article Lhasa. The weights and measures in use are practically those of China ; the dry measures, the most commonly employed, are the bre or bo of about four pints and the bchal of twenty bo; the capacity urreacy- of the bo varies according to localities. The most commonly used measures of length are the span (mto), the cubit (kru), and the arm's-length or fathom (dompa).

The principal trade with the outside world is carried on with China over the Lhasa-Tachienlu road. Mr G. L. Litton, of H.B.M. Consular Service in China, in his report on the nature and value of this trade in

1898, gives trade*” the following figures for the average value passing through Tachienlu : —

Exports from Tibet.

Value, Taela.

Total Taels.

Musk

Wool

Gold

Fox skins ....

Other skins

Rhubarb and drugs

Imports to T

Tea

Cottons

Silks and sundries ....

V

500,000

200,000

150,000

25,000

30,000

30,000

935,000

1,150,000

bet,

1,100,000 10,000 40,000

2,085,000

328

TIBE T — T ICHBOENE

The value of the Chinese tael is 1$ oz. avoirdupois of silver by treaty. The tea imported from Szechuen is for the most part of very inferior quality, estimated at 35 per cent, tea-leaves and 65 twigs and other material. It is compressed into large bricks, and costs two-thirds of a penny per pound. No Indian tea would compete with it. Tachienlu is the principal market, permits being issued each year from Peking to the traders. The trade between Sung-pan in north-west Szechuen and Tibet is estimated by the same -writer as follows : —

Imports to Tibet.

Value, Taels.

TotaJ Taels.

Tea

Cotton and woollen goods

Brass and ironware, and sundries .

Exports from

Wool

Live sheep

Sheepskins and furs Medicines and musk

760,000

15,000

5,000

780,000 800,000

Tibet.

80,000

20,000

180,000

520,000

1,580,000

The trade carried .over the Hsining-Tankar-Tsaidam route has not been large for many years, on account of the various Mahom- medan rebellions in Kansu. Probably the value of the exports and imports over it cannot .be estimated at more than 50,000 to 75,000 taels. a year, including in this the value of the Mongol trade. Trade between India and Tibet is carried on at present over the road which, starting from Darjiling, crosses the Jelap la and passes by Yatung, the Chumbi valley to Khamba djong, Shigatsl, and Lhasa. Yatung (80 miles from Darjiling) was opened 1st May 1894 to foreign trade under the regulations appended to the Sikkim-Tibet Convention of 1890, concluded between the Viceroy of India atad the Chinese Amban of Lhasa. An officer of the Chinese Maritime Customs is stationed at Yatung ; beyond this point foreigners are not allowed to proceed. The

trade over this route has steadily grown since the opening of the road. The gross value of the imports into and exports from Tibet is as follows : — •

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189T.

1898.

1899.

1900.

Imports . Exports .

Rupees.

674,139 820,300

Rupees.

718,475 817,851

Rupees.

962,637 822,760

Rupees.

730,502

710,012

Total

1,494,439

1,536,326

1,785,397

1,440,514

The total imports into British India from Tibet by all available routes are more than double the value enumerated above according to the Indian official statistics of 1898. This would allow a con- siderable margin for the trade via Ladak and across the Kumaon passes. Returns for the official year ending 31st March 1901 give the value of the trade between Bengal and Tibet as 6-20 lakhs of rupees. The exports consist mostly of wool, woollen cloths, musk, yaks' tails, skins, ponies, and mules. The imports comprise a large variety of articles, principally cotton and woollen goods, silks, metals, tobacco, umbrellas, matches, kerosene, clocks, watches, and quite a large quantity of Chinese goods shipped from China to Calcutta, and thence by rail to Darjiling. Tibetan woollen goods are also exported over this route to be taken to Peking by sea. No tea is allowed by the Chinese to be brought into Tibet over this road. The value of the trade between Bhutan and Tibet is not known. The native explorer R. N. states (in 1886) that "the exports from Tibet (into Bhutan) are chiefly salt, blankets, wool, skins, tea in bricks, musk pods, and earthern pots, of which salt and wool take the first place with regard to quantity exported. These are either sold for cash in the currency of Tibet, or are bartered for the following commodities, viz., bure (a kind of silk stuff), khamar (coloured silk), yiiltha (a cotton cloth), brass utensils, silver, jewellery, rice, and tobacco." Trustworthy statistics of the value of the trade maintained between Tibet and bordering countries are not obtain- able. Probably the trade with Bhutan does not much exceed Rs. 10,000 in value. Trade with Ladak (independent of that which passes through Leh to India) is inconsiderable, and is certainly exceeded in value by the trade with Nepal. The total foreign trade of Tibet does not probably exceed Rs. 10,000,000 a year.

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(t. h. h*. ; w. W. E.)

Tichborne Claimant, The. — Boger Charles Tichborne (1829-1854), whose family name became a household word on account of an attempt made by an impostor in 1868 to personate him and obtain his heritage, was the eldest grandson of Sir Edward Tichborne, the 9th baronet, of a very ancient Hampshire family. Sir John de Tichborne, sheriff of Southampton, was created a baronet by James I. in 1621, and from him his descend- ants inherited great wealth and the position of one of the leading Roman Catholic families in the south of England. Roger Charles, born at Paris on 5th January 1829, was the eldest son of James Francis Doughty-Tichborne (who subsequently became 10th baronet and died in 1862) by Henriette Felicite, natural daughter of Henry

Seymour of Knoyle, in Wiltshire. This lady, who hated England, was intent upon bringing up her son as a Frenchman : the result was that he hardly got any education at all until he went in 1846 to Stonyhurst, whence he pro- ceeded in 1849 to Dublin and joined the 6th Dragoon Guards. His eccentricity and his French accent made him rather a butt in his regiment, and, being disappointed of war service, he sold out in 1852, and in the following year proceeded on a trip to South America. He sailed in March 1853 from Havre for Valparaiso, whence he crossed the Andes, reaching Rio in 1854. In April of that year he sailed from Rio in the Bella and was lost at sea, the vessel foundering with all hands. His insurance was paid and his will proved in July 1855. The baronetcy and estates passed in 1862 to Roger's younger brother, Sir Alfred Joseph Doughty-Tichborne, who died in 1866. The only person unconvinced of Roger's death was his mother, the dowager Lady Tichborne, from whom every tramping sailor found an eager welcome at Tichborne Park. She advertised largely and in a highly injudicious manner for the long-lost wanderer, and in November 1865 she learnt, through an agency in Sydney, that a man " answering to the description of her son " had been found in the guise of a small butcher at Wagga Wagga, in Queensland. As a matter of fact, the supposed Sir Roger did not correspond at all to the long-lost heir, who was slim, with sharp features and straight black hair, whereas the claimant was enormously fat, with wavy, light brown hair. His first letter to Lady Tichborne was not only ignorant and illiterate to the last degree, but appealed to circumstances

(notably a birth-mark and an incident at Brighton) of which she admitted that she had no recollection. But so great was her infatuation with her fixed idea, that she soon overcame the first qualms of distrust and advanced money for the claimant to return to Europe. Like all pretenders, this one was impelled by his entourage, who regarded him strictly in the light of an investment. He himself was reluctant to move, but the credulity of persons under the influence of a romantic story

soon came to his aid. Thus an old friend of Sir James Tich- borne's at Sydney, though puzzled by the claimant's answers, was quite convinced by a resemblance to his supposed father, " especially about the mouth." At Sydney, too, he made the acquaintance of Bogle, a negro servant of a former baronet. Bogle sailed with him for Sydney in the summer of 1866, and coached him in the rudiments of the role which he was preparing to sustain. On reaching London on Christmas Day 1866 the claimant paid a flying visit to Tichborne House, near Alresford, where he was soon to obtain two highly important allies in the old family solicitor, Mr Hopkins, and a Winchester antiquary named Baigent, who was intimately acquainted with the Tichborne family history. He next went over to Paris, where in a hotel bedroom on a dark January after-noon he was promptly " recognized" by Lady Tichborne. She had formerly been a beauty, and her real son had borne a striking resemblance to her. The claimant was an unwieldy "mass of flesh," scaling nearly 25 stone, and his countenance was of a repulsive coarseness. This " recognition " naturally made an enormous impression upon the .English public, who were unaware that Lady Tichborne was a monomaniac. That such a term is no exaggeration is shown by the fact that she at once acquiesced in her supposed son's absolute ignorance of French. She allowed the claimant £1000 a year, accepted his wife, a. poor illiterate girl, whom he had married in Queensland, and handed over to him the diaries and letters written by Roger Tichborne from South America. From these documents the claimant now carefully studied his part ; he learnt much, too, from Baigent and from two carabineers of Roger's old regiment, whom he took into his service. The villagers in Hampshire, a number of the county families, and several of Tichborne's fellow- officers in the 6th Dragoons, became eager victims of the delusion. The members of the Tichborne family in England, however, were unanimous in declaring the claimant to be an impostor, and they were soon put upon the track of discoveries which revealed that Tom Castro, as the claimant had been called in Australia, was identical with Arthur Orton (born 1834), the son of a Wapping butcher, who had deserted a sailing vessel at Valparaiso in 1850, and had received much kindness at Melipilla in South America from a family named Castro, whose name he had subsequently elected to bear during his sojourn in Australia. It was

shown that the claimant, on arriving in England from Sydney in 1856, had first of all directed his steps to Wapping and inquired about the surviving members of his family. It was discovered, too, that Roger Tichborne was never at Melipilla, an assertion to which the claimant, transferring his own adventures in South America to the account of the man whom he impersonated, had com- mitted himself in an affidavit. These discoveries and the deaths of Lady Tichborne and the friendly solicitor, Hopkins, were so discouraging that the ” claimant ” would. gladly have “retired”- from the baronetage; but the pressure of his creditors, to whom he owed vast sums, was importunate. A number of ” Tichborne bonds ” to defray the expenses of litigation were taken up by the dupes of the imposture, and an ejectment action against the trustees of the Tichborne estates (to which the

heir was the present baronet, Sir Henry Alfred Joseph Doughty-Tichborne, then two years old) finally came before Chief Justice Bovill aud a special jury at the Court of Common Pleas on 11th May 1871. During a trial that lasted over one hundred days the claimant exhibited an ignorance, a cunning, and a bull-dog tenacity in brazening out the discrepancies and absurdities of his depositions, which have probably never been surpassed in the history of crime ; they may have been rivalled in the case of Titus Oates, to whom in physical constitution the claimant bore a striking resemblance. Over one hundred persons swore to the claimant’s identity, the majority of them, and they were drawn from every cla’ss, being evidently sincere in their belief in his cause. It was not until Sir John Coleridge, in a speech of unparalleled length, laid bare the whole conspiracy from its inception, that the result ceased to be doubtful. The evidence of the Tichbornes finally convinced the jury, who declared that they wanted no further evidence, and on 5th March 1872 Serjeant Ballantine, who led for the claimant, elected to be non-suited. Orton was immediately arrested on a charge of perjury, and was brought to trial at bar before Chief Justice Cockburn in 1873. The defendant showed his old qualities of impudence and endurance, but the furious indiscretion of his counsel, Edward Kenealy, the testimony of his former sweetheart, and Kenealy’s re- fusal to put the Orton sisters in the box, proved conclu- sive to the, jury, who, on the one hundred and eighty- eighth day of the trial, after half-an-hour’s

deliberation, found that the claimant was Arthur Orton. Found guilty of perjury on two counts, he was sentenced on 28th February 1874 to fourteen years' penal servitude. The cost of the two trials was estimated at something not far short of £200,000, and of this the Tichborne estates were mulcted of fully £90,000. The claimant's better-class supporters had deserted him before the second trial, but the people who had subscribed for his defence were staunch, while the populace were convinced that he was a persecuted man, and that the , Jesuits were at the bottom of a deep-laid plot for keeping him out of his own. There were symptoms of a riot in London in April 1875, when Parliament unanimously re- jected a motion (by Kenealy) for referring the Tichborne case to a royal commission, and the military had to be held in readiness. But the agitation subsided, and when Orton emerged from gaol in 1884 the fickle public took no interest in him. The sensation of ten years earlier could not be galvanized into fresh life either by his lectures or his alternate confessions of imposture and re-iterations of innocence, and Orton sank into poverty and oblivion, dying in obscure lodgings in Marylebone on 2nd April 1898. (t. se.)

Ticino, or Tessin, one of the Swiss cantons. Its area is 1087-9 square miles. Of this 725-67 square miles are "productive," forests covering 233-8 square miles, and vineyards 30-7 square miles (the greatest vine-growing area in Switzerland), the remaining 461-1 square miles being arable or meadow land. The population was 126,751 in 1888, while in 1900 it was 138,638, or 127 inhabitants per square mile. The canton is overwhelm- ingly Romanist and Italian-speaking. In 1888 the epis-copal see of Lugano was founded : it is at present held by the bishop of Basel, who names an administrator apostolic for Ticino. Bellinzona is now the only political capital, but the largest town in the canton is Lugano. In 1888 Locarno had 3142 inhabitants (3557 in 1900), Airolo 1697 (in 1900, 1629), and Mendrisio 2815 (in 1900, 3441). The canton is divided into seven administrative districts. In 1897 its state revenue was 3,891,293 francs (a rise of 63 per cent, since 1885), and the state expenditure

3,733,263 francs (a rise of 97 per cent, since 1885), but in 1898 there was a deficit of 110,102 francs. In 1897 the public debt was 13,235,208 francs.

The political troubles of Tioino were increased in 1888 by the foundation of the see of Lugano, considered by the Radicals as likely to advance Clericalism, though it freed Switzerland from foreign ecclesiastical rule. Hence in September 1890 the Radicals carried out a bloody revolution, which necessitated Federal inter- vention, but at a state trial at Zurich in July 1891 the leaders were acquitted. In 1891 proportional representation was adopted for elections for the cantonal and communal assemblies. In 1892 a new cantonal constitution was accepted, by which the executive is elected directly by the people, and proportional re- presentation is maintained, while the Facultative Referendum, especially for certain financial bills, and an initiative in legis- lative matters, are given to 5000 citizens, though 7000 are required in the case of an amendment in the cantonal constitution. In 1896, by “a strange anomaly only to be explained by the previous political history of the canton, non-resident citizens were given a vote in all cantonal and communal matters, though residence is strictly required for all voters in Federal matters. .

Authorities.- — Baroffio. Dei Paesi e delle Terre costituenti il Cantone del Ticino fino all’ anno 1798. Lugano, 1798. — Bol- lettino della Svizzera Italiana (published by the Cant. Hist. Soc). Bellinzona, from 1879. — Borrabti. II Ticino Sacro. Lugano, 1896. — Meyer. Die evangelische Gemeinde in Locarno. Zurich, 1836. — Rahn. Die Kunstdenkmaler d. Kant. Tessin. Zurich, 1893. (w. A. B. C.)

Tides.— Our knowledge of the tides has been ad- vanced in several ways since the date of the ninth edition of this Encyclopedia. From the nature of the case the following sections do not form part of a connected whole ; they are rather a collection of minor articles dealing with topics connected with the tides.

The subjects treated are : —

§ 1. Seiches, or oscillations in lakes.

§ 2. The bore in estuaries.

§ 3. The deflection of the vertical by lunar attraction.

§ 4. Tide-tables and tidal prediction.

§§ 5-10. Eecent advances in the dynamical theory of the tides.

Occasion will frequently arise to refer to the article in the ninth edition of this work (vol. xxiii. pp. 353-381) ; we shall for brevity call it Tides. Where it may be necessary to give a reference to a book entitled Tfie Tides and Kindred Phenomena in the Solar System, by G. H. Darwin (John Murray, 1898), it will be referred to as Darwin's Tides, &c.

§ 1. Seiches.

In the article Tides (p. 370) there is reproduced a portion of a tide-curve for Bombay. The object of the figure was to show the general nature of tidal irregular^ oscillations, and accordingly certain small irregu- iurves! "' larities, which probably existed in the original, were smoothed out. Such irregularities are found in most tide-curves, and the smoothing of this curve has masked an interesting phenomenon closely connected with the tides, although arising from a wholly different set of causes.

The notches which are prevalent in tide-curves indicate that the water is affected by other waves than that of the main tide. These secondary waves are observed to have periods which range from two to twenty minutes ; they thus alternate very much more rapidly than does the tide, whilst their periods are very much longer than those of the wayes which are visible on the surface of the sea. Waves of this kind have sometimes been called periodic tides — as, for example, in correspondence in Nature on 12th January and 20th April 1899 ; but

the name is altogether inappropriate, since they are not tides, and they possess the attribute of periodicity in common with all other waves.

In order to gain some insight into the nature of the

phenomenon, we must now turn our attention to certain observations which have been made on an inland lake.

It has been known for several centuries that the water of the Lake of Geneva is apt to rise and fall by a few inches, sometimes irregularly and sometimes with more or less regularity. Since the water Setcbes on ebbs and flows, these oscillations present some a^n^va. resemblance to true tides, and the phenomenon is sufficiently conspicuous to have gained from the in- habitants of the shores of the lake the name of Seiche. It was discovered during the last half of the 19th century that these waves are not peculiar to the basin of Geneva, and the name seiche has been generally adopted, whether we speak of the waters of a lake or of a land-locked arm of the sea.

In the 18th century Patio de Duillier recorded a cele- brated seiche which occurred in the year 1600 on the Lake of Geneva, when the range of the wave from lowest to highest was 5 feet 4 inches ; but the first man thoroughly to investigate the subject was Dr Forel of Lausanne.1 Between the years 1876 and 1885 he published, princi- pally in the Archives des Sciences Physiques et NatureUes of Geneva, a series of papers giving the results of his observations. An abstract of these papers, with illustra- tive diagrams, is given in Darwin's Tides, &c.

At first Dr Forel conducted his observations by means of a simple but very sensitive apparatus, called by him a plemyrameter, which was intended to detect the periodicity of the oscillations of the water with- ^fjs°^rf out reference to the heights of the waves. By analyses the observation of a light float in a horizontal Genevan glass tube, which formed portion of a pipe elcbes- connecting the water in the lake with that in a tank ashore, he was able to detect even the slightest current setting from the lake to the tank, or vice versd. Such a current was found to occur even when the difference of levels amounted to only a

fraction of a millimetre. Care was of course taken, by choking the ingress of the water into the pipe, to obliterate the effect of the visible waves and ripples on the lake, so that his at- tention was directed only to inequalities with a dura- tion of at least a minute. A description of the instru- ment and of the records derived by means of it is contained in Dr Forel's book, and in chapter ii. of Darwin's Tides, &c.

A careful study of the registrations of his instrument, taken at Morges and at other places, convinced Dr Forel that the oscillations were not irregular and capricious, as they naturally appear to the casual observer. He was able, in fact, to pick out from the complex motions several rhythms which presented themselves over and over again on many occasions. It will easily be perceived that the coexistence of several rhythmical movements, presenting themselves in various intensities and in various phases relatively to one another, suffices to explain any amount of complexity in the aggregate effect.

Dr Forel then concluded that these motions are oscil- lations dependent on the shape and depth of the whole lake, and he announced that seiches are due to " a gigan- tic impulse moving the whole liquid mass of Leman throughout its length, breadth, and depth." He adds that "it is probable that the same thing would be observed in far larger basins of water."

He concluded that the principal oscillations are of two kinds, the longitudinal and the transverse. In the seiche of longest period the water was found to rock about a line drawn transversely across the lake at its centre, so that it was high water at Villeneuve when it was low

1 His papers are collected in Le Le'man, 2 vols. (Roux, Lausanne

1892).

water at Geneva, and conversely. Such a seiche is said to be uninodal and longitudinal, because it affects the whole length of the lake, and there is at the centre anode or place at which the water is stationary as to height. He found that seventy-three minutes elapsed between successive high waters at either end of the lake, and that this period was the same whether the seiche was of visible amplitude or whether it amounted to only a fraction of a millimetre.

A crucial test of the correctness of Dr Forel's analysis is afforded by the determination of the period of oscilla- tion of water in a trough of the dimensions of the Lake of Geneva in accordance with the laws of moving liquid. Now it may be concluded from this consideration that if it were possible to tilt up one end of the lake, so as to make the water rock about a single central node, the period of the oscillation would be very nearly that which was observed. The irregularities in the bed of the lake are, of course, considerable, and the period cannot be de- termined by a priori reasoning with close accuracy, but the discussion demonstrated with certainty the nature of the motion in the case of these seichgs of longest period.

If the uninodal longitudinal seiche had been the only motion of the water, Dr Forel's task would have been a comparatively easy one, but, as has been already said, the motion is in reality exceedingly complex. He was, how- ever, also able to show the existence of the binodal seiche with a period of thirty-five minutes. In this case there are two nodes which divide the lake into three parts, of which the two terminal ones are each half as long as the central part. In this kind of seiche Loagitud- the low water occurs simultaneously at the two laai and en(js when it is high water at the centre. The Seiches. existence of multinodal longitudinal seiches was also suspected, although the complication was so great as to prohibit absolute demonstration. Besides these longitudinal oscillations, uninodal transverse seiches were picked out with certainty. In this case-the water was highest at Morges on the north when it was lowest at Evian on the south, and the period was deter- mined at. about ten minutes. It was thus established that the whole water of the lake is apt to oscillate about several fixed longitudinal or tranverse nodes, but the question remained as to the

manner in which the motions originate. Any cause which tends to heap up the water at one end or at one side of the lake, and then ceases to operate, must start an oscillation which will last for many hours, with gradually decreasing amplitude, until the motion finally dies out in consequence of friction. Dr Forel suggested that such a temporary local rise of water-level may be produced in various ways. Some, perhaps many, seiches are due to the tilting of the whole lake-bed by minute movements of the earth's surfa'ce. Modern investigations seem to show that this is probably a more fertile cause than Dr Forel was dis- posed to allow.

When the wind blows in one direction for many hours it heaps up the water to leeward, and when it drops a seiche must necessarily originate. Again, the height of the barometer will often differ slightly at different parts of the lake, and the water must respond to the atmospheric pressure at the rate of about a foot of water to an inch of mercury : we shall return to the consideration of this point hereafter. Dr Forel also suggested that a seiche was most frequently the result of a sudden squall, but we think that he much over-estimated the efficiency of this cause. It is thus possible to point out several causes competent to produce seiches, but it generally remains impossible to say how any particular seiche was started. Before leaving this subject, it may be well to mention

Their

that some observations have been made on other lakes, and we may especially refer to the observations of seiches on Lake George in New South Wales, made by Mr Rus- sell, Government Astronomer at Sydney.1

We commenced this discussion by referring to the notches on tide-curves, but these zigzags are in general too rapid to be entirely attributable to the seiches of a land-locked arm of the sea. There must, then, be other oscillations besides seiches, and Dr Forel found that this was also true of the Lake of Geneva. These oscillations resembled seiches in every respect except in the greater rapidity of their alternations. Some of them were per- haps multinodal seiches, but they

frequently only affected a portion of the lake at a time. In order to distinguish them from proper seiches, he called them “vibrations.”

In all his later work Dr Forel replaced his plemyra- meter by a very sensitive form of tide-gauge which he called a limnimeter. The trace was registered on a very open scale, so that an interval of vibrations a minute was clearly legible. This would ^‘wiad^6 not be the case with an ordinary tide-curve. He found then that, when there is much wind, vibrations make their appearance which are quite distinct from ordinary wave motion, inasmuch as their periods range from forty-five seconds to four minutes. It is probable that there is a complete gradation of waves extending from the shortest ripple up to vibrations with a period of four or five minutes. However this may be, the form of instrument adapted for the observation of short waves would be quite different from one appropriate for waves with a period a hundred times as great, and thus the con- sideration of vibrations naturally separates itself from that of waves.

Dr Forel found that the wind always produced vibra- tions, and that it was most efficient when it blew from certain definite directions ; but he also found that steamers produced movements so closely vibrations resembling those due to wind, that it was only steamers, possible to study the wind-vibrations at night, when there were no steamers plying on the lake, and the steamer-vibrations in calm weather. As a steamer is approaching the place of observation the vibrations be- come visible on the trace of the limnimeter as much as twenty-five minutes before its arrival, and they continue to be visible during two or three hours after the boat has passed. The antecedent vibrations have a shorter period of oscillation than the subsequent ones. The lengths of these waves may be concluded from their periods, and it appears that they may be from 1000 yards to a mile in length, and are therefore quite distinct from the visible waves generated by the boat as it ploughs through the water. Dr Forel gives a trace of the limni- meter as affected by these steamer-vibrations in his paper ” Les Seiches ” (Annates de CMmie et de Physique, 1876); this figure is reproduced in chapter ii. of Dar- win’s Tides, &c.

Dr Forel was aware that similar vibrations exist in the sea, and he remarks that they cannot be due to seiches if these are defined as oscillations of the whole sheet of water abou^ fixed nodes. It appears seiches to us probable, however, that true seiches do ^j'*r^e occur in land-locked harbours or estuaries, sea. since the seaward opening may often be narrow enough to make the water oscillate almost as though the mouth of the harbour were completely blocked. It seems almost certain, then, that the zigzags observable in tide- curves are due partly to seiches proper to the harbour and partly to vibrations.

There is a good deal of obscurity as to the manner in

which vibrations originate. It is obvious that they are caused by the wind and by steamers, but it is not easy to understand how such insignificant causes can produce waves of such great length. But we know that they do so, and certain considerations are adduced in chapter ii. of Darwin's Tides, &c, which show to some extent how the result may be brought about. However this may be, we shall now give some account of another investigation which may perhaps ultimately be found to throw much light on the subject.

Helmholtz has pointed out (Preuss. Ahad. der Wiss., 25th July 1889) that when a layer of one fluid flows over another the surface of separation is neces- Atl?°' sarily unstable, so that waves will be generated iravesf between them. The most familiar instance of this is to be found in the waves generated on the sea by the wind. Another but less obvious case must occur when the air aloft is blowing from a different point of the compass from that near the earth's surface. But it might appear that this should not be considered as an example of the relative motion of two fluids, since the air is all of the same kind. We shall now show, however, that it is proper to regard the atmosphere as consisting of two fluids of different kinds. If the atmo- sphere were

rigorously in that condition which is called adiabatic equilibrium,1 its temperature and its density would fall at certain definite and uniform rates as we ascend above the earth's surface. But such a uniform rate of fall of temperature and density only represents the average of what would be found to occur in many ascents, and in any individual ascent an abrupt change would occur at the moment of passing from a lower cur- rent into an upper one. Hence it follows that, from a mechanical point of view, an upper current should be re- garded as consisting of a fluid of a different density from that of the lower current. In this case the instability pointed out by Helmholtz must inevitably follow, and a series of air waves, strictly analogous to those in a rough sea, must be generated. A mackerel sky is the visible proof of the truth of this conclusion, for the moisture is condensed into cloud at the crests of the waves and re- absorbed in the hollows.

It altogether transcends the power of the mathematician to determine what length of wave will be generated by a given wind blowing on a given sheet of water of'atmo- during a given time, but we do know that like spheric circumstances produce like results, so that, for waves de example, a gale in the Atlantic always pro- ^ycom- duces waves of nearly the same length. It is par/son often found that the comparison of similar dynamical systems will lead to interesting con- clusions, even when the motion of either system presents a problem intractable by mathematical reasoning. Now, Helmholtz has shown how the waves generated in the surface separating two fluids must be dependent on their relative densities and velocities. He has in this way used the known lengths of sea-waves for obtaining a measure of the lengths of the air-waves aloft. Fairly accurate estimates have been obtained of the effective change of density' in passing from the lower to the upper of two currents in the air, and this, together with the relative velocities, affords the data needed for the comparison. In this way he showed that the lengths

with

oceanic

waves.

1 In the adiabatic expansion of a gas the pressure varies as the density raised to the power y, where y is the ratio of the two specific heats. But pressure also varies jointly as the first powers of the density and of the absolute temperature. Hence the absolute tem- perature varies as the density raised to the power v — 1. From this it easily follows that as we ascend in an atmosphere in adiabatic equilibrium the fall of temperature is proportional to the height of ascent. The law of fall "of density is easily deducible from that of the temperature.

of the air-waves must be very great, so that in a gale of wind we may expect the waves to have a period of from ten minutes to half an hour ; in the latter case the whole visible sky would be occupied by a single crest. This accords exactly with the more or less regular intermission of the furious gusts in a gale, and with the sinuous line marked by the continuous record of a barometer on these occasions.

Mr Napier Denison has sought to apply this theory to the explanation of some, or many, of the vibrations of lakes and of the sea.2 He points out that the sea must respond to the alternations of atmo- vibrations spheric pressure, and that the vibrations so p^JJJT generated, when propagated into land-locked due to bays and harbours, are in fact recorded as zig- aciioB ot zags on tide-curves. He has commenced an a^°lic extensive analysis of the vibrations of the sea waves. in comparison with the oscillations of the barometer. For this purpose he has devised a very sensitive form of barorneter which registers the varia- tions of pressure on a large and open scale. The evi- dence appears favourable to his view, and if his theory shall be ultimately confirmed we shall have obtained an interesting insight into at least one important cause of these vibrations.

At several places Mr Denison believes that the vibra- tions tend to become manifest at an earlier time than the oscillations of the barometer. If this is so, the water-waves have outrun the advancing atmospheric dis- turbance, and it thus appears not impossible that the study of vibrations may prove of service in forecasting the weather. The theory is still under trial, and it will need much patient analysis to confirm or refute this in- teresting speculation.

§ 2. The Bore in Estuaries.

In the general description of tidal phenomena in the article on Tides, it is stated that in estuaries, where large expanses of sand or mud are laid bare at low water, the rising tide sometimes advances in the form of a steep slope of water called a Bore. The rising tide acquires this remarkable shape under the influ- ence of two causes : t}ie first of these is the ^0ttrsees ot change of form to which every wave is subject as it progresses in shallow water, the advancing slope becoming steeper and the backward slope less steep. This is exemplified, but in a less exaggerated form, in the figure on p. 362 of Tides. The second cause is that the natural current of the river holds back the advancing flood until there, is a considerable head of water at the mouth of the estuary, and the equilibrium then breaks down suddenly. It does not seem possible to apportion the relative importance of these two causes in the production of the observed effect.

In order to explain more exactly how the latter cause operates, let us consider, in the first place, the tidal currents in a very sluggish river. At any point on the river bank mean water-mark is at such a height TUal cur' that the tide rises above it to the same amount estuaries. that it falls below it. Then the law governing the tidal currents is simple; it is that whenever the water stands above mean water-mark the current is up- stream, and whenever it stands lower it is down-stream. This result follows at once from the formulae (54) § 21 of the article Tides (p. 362) When the water is at mean level it is stagnant, except for the natural current of the river, which we for the moment consider to be so sluggish as to be negligible. At high water the current is most

2 Proc. Canadian Institute, 16th January and Bth February 1897 ; Canadian Engineer, October and November 1897 ; Brit. Assoc. Rep. (Dover). 1899.'

rapid up-stream, and at low water most rapid down- stream. Hence the tidal current "flows" landwards for a long time after high water, and continues to do so, but with diminishing speed, until the water has fallen to mean water-mark. Similarly, the water ebbs seawards from the moment at which the level falls be- low mean water-mark, with an increasing speed and falling level until low water is reached, and then with a diminishing speed and rising level until mean water is attained.

At a station on the open coast the water flow^ land- wards during the whole of the rise, ebbs seawaras dur- ing the whole of the fall, and is slack at mean water. The law of tidal currents on the open coast is thus very different from that which holds good in a sluggish river. Now the estuaries of actual rivers broaden and deepen as the sea is approached and a large volume of water is de- livered into the sea. Hence the currents in an actual estuary are intermediate between those which would be observed on the open coast and in a river of uniform breadth. It is, of course, to be noted that, whatever may be the state of currents due to the tides, we must super- pose on them the proper current of the river. Hence in actual rivers the resultant current continues to flow up-stream after high water is reached, with falling water- level, but ceases flowing before mean water-level is reached, and the resultant current ebbs down-stream after low water, and continues to ebb with the rising tide until mean water is reached, and usually for some time after-wards. The downward stream, in fact, lasts longer than the upward one. The moments at which the currents change will differ in each river according to the depth, the rise and fall of the tide at the mouth of the river, and the amount of water delivered by it into the sea. An obvious consequence of this is that in rivers the tide rises quicker than it falls, and this effect is accentuated by the change of form natural to all waves during their progress in shallow water.

The conditions under which the tide- wave rises and falls in an actual estuary are very complex, and it would hardly be possible to submit them to rigorous mathematical treat- ment. But this is the less to be regretted, in that the scientific results which might be attained by such treat- ment would hardly repay us for the great labour inevitable in the attempt. We may then well rest satisfied merely to point out the general

principles involved. The bore presents, however, so curious a natural phenomenon as to merit careful observation.

The tide-wave rises as a bore in the Severn, the Wye, the Seine, and the Garonne ; perhaps also in other rivers in England and France. But its appearance is capricious, and it is usually conspicuous only at spring-tides and with the wind in certain directions. There is indeed, as far as we know, only one river in which the bore occurs Bore of the at every tide without exception; that is the tang°~ Tsientang-kiang, which flows into the China Kiaag. Sea about 60 miles south of the great Yangtse-kiang. Some interesting observations of the bore in the Tsientang were made in 1888 and 1892 by Captain Moore, R.N., when in command of H.M.S. Rambler. His survey of the estuary was attended by some danger from the extreme violence of the currents — dangers which experience has taught the navigators of Chinese junks how to avoid. Captain Moore's two reports1 give many interesting details, and present a graphic descrip- tion of the bore, together with careful measurements of the rise and fall of the tide in this estuary. It may here suffice to say that the bore is from 12 feet to 15 feet in

1 The Bore of the Tsientang-kiang, 1888, and Further Report, &c, 1893. Potter, London.

height, and progresses up the estuary at a speed of about 12 knots. An abstract of these reports is given in Dar- win's Tides, &c, chapter iii., together with a reproduction of some previously unpublished photographs which were given to the author by Captain Moore himself.

Mr W. Bell Dawson has also made observations at Moncton, on the Petitcodiac river, in the Bay of Fundy, of a bore only slightly less remarkable than the Chinese example. Careful observations of the Bore of the rise of water at a fixed spot, together with P*£'ac measurements of the rate of progress of the bore up-stream, have enabled Mr Dawson to draw the profile of the tide-wave. The bore itself consists of a precipitous slope of water ; and this is succeeded by a more gradual slope, which is, however, interrupted at intervals by several steps or minor bores. An account of Mr Dawson's observations is contained in the " Report of the Tidal Department of the Survey of

Canada for 1898," and an abstract of the paper, together with a drawing of one of the profiles, is published in Nature of 15th June 1899.

§ 3. Lunar Deflection of Gravity.

Formulae were given in § 8 of Tides (p. 357) for the deflection2 from the vertical of a pendulum under the lunar attraction, and the section ended with a statement that George and Horace Darwin had made an abortive attempt to measure the lunar deflection of gravity. We shall now give a short account of some more recent in- vestigations bearing on this subject.3

It is clear that, if the earth were to yield to the tidal forces to the same degree as a fluid, the movement" of the pendulum would be masked from the observer by the simultaneous deflection of the ground on «"!!/" de/ which he stood. Hence a comparison between gravity and the observed deflection and that computed on rigidity of the hypothesis of the absolute rigidity of the eaHb' earth would afford the means of determining the amount by which the solid earth itself yields to the tidal force. The attainment of such accuracy as to furnish satisfactory numerical results by means of such a com- parison is yet distant, but something has already been done in this direction.

When a pendulum is under observation, there is nothing to tell the observer whether it has moved under changes in the direction of gravity relatively to the earth, or of the earth relatively to gravity, or whether both kinds of movement have occurred together. In the experiment referred to above, George and Horace Darwin concluded that almost the whole of the movements were due to motion of the ground. The causes of such a motion are complex ; it arises from minute earthquakes, slower earth-movements of obscure origin, the effects of changes of temperature and of the percolation of subterranean water, mixed together in indeterminate proportions. All other observers have noted similar phenomena, and their results are important in the science of seismology, but fall outside the scope of this article.

Amongst many experimenters, there is only one who has been able to adduce any good evidence in favour of the belief that a lunar periodicity can be detected amidst the wandering movements of the pen- Expert. dulum. This is Dr von Rebeur-Paschwitz, “paschwitz. whose early death was a great loss to science. Paschwitz made use of a form of instrument called a horizontal pendulum, the nature of which we will now indicate. A door swinging on an absolutely vertical door-

2 There was a mistake in that section as to the amount of deflec- tion calculated for the latitude of Cambridge. The angle 0-0216″ there given is the total range, not the semi-range as. stated.

8 For further details see Darwin’s Tides, &c, chaps, vi. and vii.

post will rest in any position, but a slight tilt to the door- post imparts to the door a definite position of rest. The mechanical principle of the horizontal pendulum is the same as that of the door ; but a horizontal boom replaces the door, and the hinges are steel points resting in agate cups. Observations of the position of rest of the boom and of its period of oscillation determine the direction and magnitude of the inclination to the vertical of the line passing through the points of the two steel pivots. It is easy to see then that movements of the bed of the instru- ment will be shown by a motion of the boom, and that a continuous record of the motion may be obtained by photo- graphy. Two horizontal pendulums in planes at right angles to one another are needed to give a complete record of the motion of the ground.

Paschwitz made prolonged observations in the prime vertical with this form of instrument at Wilhelm shaven, Potsdam, and Orotava, and in the meridian at Strasburg.1 He almost convinced himself that he could detect a lunar periodicity amidst the wanderings of the pendulum, but a more searching analysis seemed to him to leave the result open to some doubt. After Paschwitz’s death his meri- dional observations were continued at Strasburg by M. Ehlert,2 who also died young, through a

lamentable Alpine accident. The deflections of the pendulum were regis- tered by him during nine months, and the results are in close agreement with those of Paschwitz. Moreover, M. Kortazzi 3 made two series of meridional observations at Nikolaieff, the first lasting sixteen and the second nine months, and found the lunar inequalities to be very clearly marked. It now seems hardly possible to doubt the genuineness of the results of these observers.

We shall now show, however, that even if we assume the lunar periodicity to be a reality, there is still room for doubt as to the extent to which it is due to such a deflection of the vertical as is under consideration in this section.

A weight resting on a thick horizontal slab must lie in

a shallow dimple formed by the elastic yielding of the

, solid bed. The slope of this dimple must

Flexure of , . , , ■ n j t

elastic obviously decrease rapidly as we recede from

surface by the centre, and mathematical investigation

superin- proves that the slope due to pressure at a single

point diminishes inversely as the square of

the distance from the centre of the depression.

The attraction of gravity also obeys the law of the inverse

square, and therefore the slope is everywhere proportional

to the gravitational attraction. If a number of particles

be resting on the slab, each must produce its own dimple

and its own attraction, and we conclude that if any weights rest on an elastic horizontal plane, the slopes of the hills and dales into which the originally flat surface is distorted will be everywhere proportional to the attraction ; moreover, the direction of steepest slope will be that of the resultant attraction of the weights. The same will be true of weights lying on the earth's surface, because the curvature of the earth will make no material difference in the result. If the effect of weights imposed on the earth's surface is observed by means of a pendulum, it is clear that the slope of the aggregate of dimples will render itself manifest by a deflection of the pendulum. But we have seen that the gravitational attraction of the weights is

cutnbent load.

1 Paschwitz, "Das Horizontalpendel," Nova Acta Leap. Carol. Alcad. 1892, vol. lx. No. 1, p. 213 ; also Brit. Assoc. Rep. 1893 ; Beitr-'ige zwr Geophysik, 1895, vol. ii. pp. 211-536.

2 Ehlert, " Horizontalpendelbeohachtungen," Beitrdge mr Gen-physik, vol. iii. p. 1, 1896. He explains the diurnal inequality aa a thermal tide due to the expansion by heat of the half of the enrbh which is exposed to sunshine. For other references, see Darwin's Tides,

3 Isvestiya Russk. Astron, Obshtchestra. , Part iv. 1895; Part v.

proportional to the slope, and therefore attraction must produce a real deflection of the pendulum strictly pro- portional to the slope of the distorted surface. Thus the total apparent deflection of the pendulum must consist of two parts — -one due to slope, and the other to attraction ; and there is nothing in the phenomenon itself to tell us how much is produced by one cause and how much by the other. It may, however, be proved by mathematical investigation that the relative importance of the two effects depends on the degree of elasticity of the solid bed. It appears that if the bed has the same elasticity as very stiff glass, the attraction would contribute one-fifth of the whole effect, and if the glass were of the most yielding quality the fraction would be one-eighth. Most rocks are somewhat stiffer than stiff glass, and we shall probably be not far wrong in assuming that with a rock bed of average stiffness the attraction of the load would contribute one-quarter of the total apparent deflection of a pendulum.

When the tide rises and falls on the sea-coast many millions of tons of water are brought alternately nearer to and farther from the land. There is thus a shifting load which must inevitably affect eartj,-s a pendulum erected on the land, principally surface by through the bending of the rock, but partly also varying through the direct attraction of the tidal load. ‘ a ” The tide oscillates with lunar periodicity in obedience to the tidal forces, and it follows that the lunar periodicity of a pendulum should only be attributed solely to the direct lunar attraction when the observations are made at a great distance from the sea-coast.

It would be very difficult to compute the changes in the deflections on any actual coast as high and low tides alternate, even if the elasticity of rock were accurately known. It is, however, possible to rf*//™2oV formulate a problem of ideal simplicity which of pendu- may serve to give some notion as to the amount lum by of effect to be expected. From the considera- ^fPr!a.g rf tion of such an ideal case G. H. Darwin has con- cluded that at one kilometre from the sea-coast we might expect the total range of oscillation of the pendulum between low and high

water to amount to 0′15″; at 10 kilometres the computed range is 0-10”, and at 100 kilometres it is 0-05”.4 We should note, however, that it is contended by Paschwitz that this ideal problem is not truly representative of actuality. He adduces the irregularity of European coast-lines, and the differences in the time of high water and of the rise of the tide at vari- ous places, as reasons for maintaining that G. H. Darwin’s numerical estimates are untrustworthy except in close vicinity to the coast. The fact that the results at Niko- laieff present much the same character as those at Stras- burg tends to confirm his contention. M. Kortazzi adopts the view of Paschwitz, and thinks that his own observa- tions show the elastic tide of the solid earth to be of such magnitude that the actual deflection of the vertical is reduced to about one-half of the amount as computed for a perfectly rigid earth. Whatever view may ultimately prevail as the general or local character of the deflections of the vertical with lunar periodicity, there is evidence that the weight of the tidal load is responsible for some part of such deflection, at least near the coast. For M. d’Abbadie erected a special form of instrument at his chateau, about a mile from the Bay of tJons of Biscay and close to the Spanish frontier, and d’Abbadie observed that the vertical was generally de- and ot fleeted towards the sea at high water and away Pascbw,t*- from it at low water. These normal oscillations were,

4 ft. H. Darwin, .” Appendix to Second Report on the Lunar Dis- turbance of Gravity,” Brit. Assoc, Southampton, 1882 ; or reprint in Phil. Mag. Chreo, Phil. Mag. vol. xliii. 1897, pp. 173-200.

however, occasionally interrupted and even reversed, and it seems probable that they were then masked by those slower movements, analogous to earthquakes, which are occupying the attention of seismologists.1 Paschwitz also at Wilhelmshaven noted similar deflections, which were of surprising magnitude ; this may perhaps be explained by the peaty nature of the soil which prevails in that district. The earth’s surface has to bear another variable load besides that of

the tide, for every square yard has to support half a ton more when the barometer is very high than when it is very low. Paschwitz, in fact, found that the deflections of the pendulum at Wilhelmshaven showed a connexion with the oscillations of the barometer.

§ 4. Tide-Tables and the Degree of Accuracy in Tidal Prediction.

In the article on Tides, prediction was considered prin- cipally from the mathematical point of view,2 and the practical use of tide-tables aiyl the degree of their success were hardly mentioned. The latter side of the subject will be considered in the present section.

The connexion between the tides and the movements of the moon and sun is so obvious that tidal predictions were regularly made and published long before tide-tables matnematiciaQs had devoted their attention to them ; and these predictions attained consider- able success, although they were founded on empirical methods. During the 18th century, and even in the earlier part of the 19th, the art of prediction was regarded as a valuable family secret to be jealously guarded from the public. The best example of this kind of tide-table was afforded by Holden's tables for Liverpool, founded on twenty years of observation by a harbour-master named Hutchinson.3 In about the year 1832 the researches of Whewell and of Lubbock (senior) pointed the way to improvement on the empirical tables prepared by secret methods, and since that time the preparation of tide-tables has become a branch of science.

A perfect tide-table would tell the height of the water at the place of observation at every moment of the day, but such a table would be cumbrous ; it is there- Predictioa fore usuai to predict only the times and heights day.*" °^ kigh water and of low water. The best kind of tide-table contains definite forecasts for each day of a definite year, and we may describe it as a special table. Although the table is only made for one definite place, yet it is often possible to give fairly accurate predictions for neighbouring ports by the applica- tion of corrections both for time and height. These cor- rections should not be constant, but should vary according to the positions of the sun and moon. Special

tide-tables are published by all civilized countries for their most important harbours.

But there is another kind of table, which we may describe as a general one, where the heights and times are given by reference to the time at which the moon crosses the meridian. Although such a table is only applicable to a definite place, yet it holds good for all time. In this case it is necessary to refer to a nautical almanac for the time of the moon's transit, and a simple

1 D'Abbadie, " Recherches sur la verticale," Ann. de la Soc. Scient. de Bruxelles, 1881.

2 References may be given to two papers by G. H. Darwin on this subject, viz., "Tidal Prediction," Phil. Trans. Roy. Soc, A. 1891, pp. 159-229 ; and "An apparatus for facilitating the reduction of tidal observations," Proc. Roy. Soc, vol. lii. 1892. For a general account without mathematics see Darwin's Tides,

3 Whewell, History of Inductive Sciences, vol. lii. p, 248 ; Darwin's Tides, &c, chapter iv.

calculation then gives the required result. In a general tide-table the heights and rimes are tabulated according to the hour of the clock at which the moon will' cross the meridian at the place of obser- ^"nfer-" vation. Corrections have to be applied to allow eace to for the effects of the declinations of the moon time of and sun, and for the lunar parallax. Moreover, moon's at places where there is much diurnal inequality ran' ' in the tides the moon's visible transit must be treated apart from its transit be^ow the horizon. A considerable degree of elaboration has to be given to the table, in order that it may give accurate results, and it would occupy some half-dozen to a dozen pages of a book, its extension varying according to the degree of accuracy aimed at. It might occupy about five minutes to extract a prediction from the more elaborate form of such a table. There are many ports of considerable commercial im- portance where, nevertheless, it would hardly be worth while to incur the great and repeated expenditure in- volved in the publication of special tables. But this kind of elaborate

general tahle has as yet been used in very few cases,4 and the information furnished to mariners usually consists either of a full prediction for every day of a future year, or of a meagre statement as to the average rise and interval, which must generally be almost useless. The success of tidal predictions varies much according to the place of observation. In stormy regions the errors are often considerable, and the utmost that can be expected of a tide-table is that it shall be Meteoro-

correct with a steady barometer and in calm /•?lca_ s^ i -n ~~it~~ -li turbance of

weather. But such conditions are practically prediction.

non-existent, and therefore errors are inevit- able. The former of these sources of error is due to the fact that the sea responds to atmospheric pressure, falling with high pressure and rising with low pressure, at the rate of about a foot of water to an inch of mercury. As regards the second cause, a landward wind usually raises the sea-level ; in estuaries the rise is some- times very great, and even on the open coast it may be considerable. But both these effects seem to be more or less, capricious, and it seems only possible to formulate certain rules of probability, the application of which will generally lead to improvement in the prediction as to the height of the water ; occasionally, however, such em- pirical corrections will be found to augment the error.

Notwithstanding these perturbations, tide ~~tables are usually of surprising accuracy even in northern latitudes ; this may be seen from the following table show~~ ing the results of comparison between prediction Amount of and actuality at Portsmouth. The importance e^! [sa of the errors in height depends, of course, on mouth. the range of the tide; it is well, therefore, to note that the average ranges of the tide at springs and neaps are 13 feet 9 inches and 7 feet 9 inches respectively.

Prediction at such a place as Portsmouth is difficult, on account of the instability of the weather, but, on the other hand, the tides in themselves are remarkably simple in character. Let us now turn to such

Amount of a port as Aden, where the weather is very ^°„ ” uniform, but the tides very complex on account of the large diurnal inequality, which frequently ob- literates one of two successive high waters. The short series of comparisons between actuality and pre- diction which we give below may be taken as a fair example of what would hold good when a long series ia examined. The results refer to the intervals 10th March to 9th April and 12th November to 12th December 1884.

4 Darwin, ” Tidal Prediction,” quoted above. This kind of table has been applied with some success at Cairns in North Queensland, where there is a large diurnal inequality.

In these two periods there should have been 118 high waters, but’ the tide-gauge failed to register on one occasion, so that one comparison is lost. We thus have 117 cases to consider, but on one occasion the diurnal inequality obliterated a high water, leaving 116 actual comparisons. The maximum range of the tide at Aden is 8 feet 6 inches, and this serves to give a standard of importance for the errors in height.

Table of Errors in the Prediction pf High Water at Ports- mouth in the months of January, May, and September 1897.

Time.

Height.

Magnitude of Error.

Number of Cases.

Magnitude of Error.

Number of Cases.

0″ to 5″ 6″ to 10″ 11″ to 15″ 16″ to 20″ 21″ to 25″ 26″ to 30″ 31″ to 35″

52″

69

50

25

10

11

7

4

1

Inches.

0 to 6

7 to 12

13 to 18

19 to 24 .

89

58

24

6

177

Errors in Height for the year 1892, excepting part of July.

Magnitude of Error.	Number of Cases.
Inches.	
0 to 6	31
7 to 12	381
13 to 18	228
19 to 24	52
31	8
381	1
228	670

N.B. — The comparison seems to show that these predictions might be much improved, because the predicted height is nearly always above the observed height, and because the diurnal inequality has not been taken into account sufficiently, if at all.

Table of Errors of the Prediction of High Water at Aden in March-April and November-December 1884.

Time.

Height.

Magnitude of Error.

Number of Cases.

Magnitude of Error.

Number of Cases.

0″ to 5″ 5″ to 10″ 10″ to 15″ 15″ to 20″ 20″ to 25″ 26″ and 28″ 33″ and 36″ 56″ and 57″ No high water.

35

32

19

19

5

2

2

2

1

Inches.

0 1 2 3 4

No high water.

15

48 28 14 11 1

117

117

It would be natural to think that when a prediction is erroneous by as much as fifty-seven minutes it is a very bad one, but we shall show that such a conclusion may be unjust. There was one case in which the high water was completely obliterated by the diurnal inequality, but there were many others in which there was nearly complete obliteration, so that the water stood nearly stagnant for several hours. A measure of the

degree of (stagnation is afforded by the amount of rise from low to high water. Now, on examining all the eleven cases where the error of time was equal to or over twenty minutes, we find five cases in which the range from low to high water was less than 8 inches, and these include the errors of fifty-six and of fifty-seven minutes. There is one case of a rise of 13 inches with an error of thirty-six minutes ; one case of a rise of 17 inches with an error of twenty-two minutes; one of 19 inches rise with thirty-three minutes error. The remaining three cases have rises of 2 feet 10 inches, 3 feet 9 inches, 3 feet 11 inches, and errors of twenty-two, twenty-three, twenty minutes. Thus all the very large errors of time correspond with approximate stagnation, and are quite unimportant. It is fair to conclude, therefore, that the predictions as to time are very good. The predictions as to height are obviously good, for more than half were within 1 inch, and only eleven had an error of as much as 4 inches.

When it is considered that the incessant variability of the tidal forces, the complex outlines of the coast, the depth of the sea, the earth's rotation, and the perturba- tions by meteorological influences are all involved, it should be admitted that the success of tidal prediction is very remarkable. If further evidence were needed, we might appeal to tidal prediction as a convincing proof of the truth of the theory of gravitation.

Dynamical Theory of Tides.

§ 5. Oversight in the Article on ” Tides” (vol. xxiii. p. 358).

The dynamical equations for tidal oscillations are established in § 11 of the article Tides, but in the endeavour to obtain succinctness one of the steps in the proof was given without sufficient explanation.

The equations (16) purport to give the accelerations in the radial, colatitudinal, and longitudinal directions. They should have been written as follows : —

J-jjr-jiVsin8*,

at

£=-7^-2n sin2

cP?

dr

H=-j72 -2m sin 8 cos 8 -ji – n2r sin 6 cos 8,

‘dp H= sin 0 ^2 + 2m cos

dt~ dt

The oversight referred to consists in the omission of the last term in S. It is true that this term does disappear, as will be shown below, but it should not have been B9”ations omitted without further explanation.

If Q denotes the potential of the external forces under which the particle whose accelerations are R, H, H mores, but inclusive of the potential corresponding to a uniform angular velocity m, it is clear that the actual potential is SI – J mV° sin2 6. Then the

differentials — , — , of the last-named function must

dr rda rsmdd

Now Ji is the potential of the forces when the system has been rendered statical by the addition of a rotation potential, and the arguments adduced in the article show that 0= -g (t)-e) r*/a‘2. Also the radial motion, being excessively small compared with the horizontal motion, need not be considered ; thus the equations of motion have the form shown in (17) of the article in the ninth edition of this work.

As we are referring to errors in the article in the ninth edition, it may be well to note that there is a misprint on p. 368, § 30, in the formula for 2^i ; for H„, should occur in the denominator in all the terms on the right excepting the first.

§ 6. Recent Advances in the Dynamical Theory of the Tides.

In two papers contained in the second volume of Liouville’s Journal (1896) M. Voincare has considered the mathematical prin- ciples involved in the tidal problem where the ocean is interrupted by land, as in actuality. He has not sought to obtain numerical results applicable to any given configuration of land and sea, but he has rather aimed at pointing out the methods by which it may be some day possib\e to obtain such solutions. It would hardly be in place to attempt in this article to follow the details of an investigation of this character ; but we may say that it affords a conspicuous example of M. PoincarcVs power of reaching the

very heart of a difficult problem, and exhibits his consummate skill in the treatment of mathematical analysis.

We shall, however, notice in some detail two other still more recent papers ‘ by Mr S. S. Hough, in which he has carried the solution of our problem considerably farther than the point at which it was left by Laplace.

In the article on Tides we were compelled to follow Laplace in treating the ocean as deprived of the power of attracting itself, but Mr Hough has been able, by the use of spherical harmonic analysis, to include in his results the effects of the mutual gravi- tation of the water. The physical results are not profoundly affected by this addition, ancf so far the principal interest lies in the improvement of the mathematical method. But the author has also made a far more fundamental advance. In the tides, as in all other dynamical problems, the determination of the oscilla- tions which the system is capable of executing when free from the action of external causes affords the only clue whereby it is possible to discuss completely the oscillations executed under external forces. Now oceanic tides are "forced oscillations" due to the moon and sun, and although Laplace showed how such tides were determinable on an ocean-covered planet, he failed to give a complete analysis of the various modes of "free oscilla- tion." Mr Hough has now succeeded, by very skilful analysis, in finding a complete solution of the problem, and he has thus placed the theory on a far more satisfactory basis than that on which it stood before.

We shall in the following sections give Mr Hough's investiga- tion in outline, but shall confine our attention more to ' ' free " than to "forced" oscillations.

§ 7. Equation of Tidal Oscillation,

This would not be an appropriate place in which to follow the author in his careful discussion of the nature of the approxima- tions by which the problem is treated. It may suffice to say that he confirms Laplace's results, which were reproduced in § 11 of the article on Tides. It is only necessary to point out how the effects of the mutual gravitation of the ocean may be included in the equation.

We denoted the height of the dynamical tide by \j, and that of the equilibrium tide by e. These two quantities are of course functions of the co-latitude 0 and of the longitude , and may obviously be expanded in spherical harmonics, so that we may write

h = 2fj,, E = Sfi,

where each term in the series is a spherical harmonic of 0, of the order indicated by the suffix.

It is easy to prove, by a process exactly similar to that pursued

in § 6 of the article on Tides, that if the equation to

Mutual the surface of the ocean be r=o + tjf or ti, it is in equi-

attraction ijDrium under the. action of external forces of which

of water. the potential is

In this formula g is gravity,

bt=l- 3

(2» + l)8′ k ‘

where the subscript i is not to be taken as denoting a spherical harmonic. In the article on Tides we assumed bt to be unity be- cause we virtually took

be – 2J< t 4 (f»i - ti) and - ~~^L %~~ (fo – u) respectively. The

add a sin 0 d

equation of continuity (19) remains unchanged.

The next step was to assume that t, If, ? were proportional to cos {2nft + k

e = Sej = 2cj cos (2nft + k^> + a). Here ti is a spherical harmonic of order i, and 6i is the ” associated function” of co- latitude such that et gjn k

order i. It is obvious that k is the rank of the tesseral harmonic in which et is the associated function. As it has been usual to denote the rank of a tesseral harmonic by the letter s, we shall now replace k by s.

1 Phil. Trans. Roy. Soc, vol. 189 A. (1897), pp. 201-258, and vol. 191 A. (1898), pp. 139-185.

The next step was the determination of x, y (which replace {,»;) from the equations of motion ; and it is clear that in Differential the new solution x, y should be replaced by 26jx4, equation Xbiji. The substitution in the equation of continuity 0t tidal gave the equation (24), which we may now write oscillation.

1 d_ sin0d0

y (sin 0-

~~+^O30)(h~~

‘)

/2-cos20

/cos^d \,h_e) ‘\ f d0+sin0/V ‘ sin 6(f – cos2 0)

+ 4mah=0 . . (2) The only effect of the introduction of mutual gravitation will be that in the first two terms (h – e) should be replaced by 2bi(h{ – d). We may then continue to use the equation in the above form, if we bear in mind that the factors bs are to be introduced at the stage where the spherical harmonics are first used.

It will be well ‘to remind the reader of the meaning of the several symbols.

The ratio of centrifugal force at a distance equal to the earth’s radius a to gravity g is denoted by m, so that m=n2a/g.

The depth of the ocean, covering the whole planet, is y ; and, as we shall only consider the case of an ocean of uniform depth, y is a constant. The ” speed of the tide ” is 2nf, so that 2/ is the frequency of the tide in the sidereal day. The rank of the tesseral harmonic is denoted by s. Lastly, h and e are the semi-ampli- tudes of the actual and of the equilibrium tides ; they are func- tions of co-latitude 0.

§ 8. Zonal Oscillations.

We might treat the general harmonic oscillations first, and proceed to the zonal oscillations by putting s=0. These waves are, however, comparatively simple, and it is well to beg‘‘n with them. The zonal tides are those which Zo”aloacil- Laplace describes as of the first species, and are now * OBS’ more usually called the tides of long period ; they were treated in § 17, of the article on Tides.

In this case s = 0, and our equation (2) becomes „

4 (shL° T8ih-e)) + i^hsin0=O.

f V /2-cos20 / y

This may be written

d .. Nj 4m

(h-c)+ •>- — ^— — hsm0d0 + A = Q, . . (3)

d0 7 sin 0 J ‘ v ‘

where A is a constant. It must be remembered further that when the first term is expanded in spherical harmonics the term hi – et must be multiplied by the factor bt. 1

Let us assume

A = 2C,Pi, t = ZEiPi

where Pt denotes the ith zonal harmonic of cos 0. The coeffi- cients 0{ are unknown, but the Et are known because the system oscillates under the action of known forces.

If the term involving the integral in this equation were ex- pressed in terms of differentials of harmonics, we should be able to equate to zero the coefficient of each dP{ /d0 in the equation, and thus find the conditions for determining the C’s.

f2

cos2 0 f8

I Pi sin 0d0 in differentials

sin 0

The task then is to express

of zonal harmonics. It is well known that Pi satisfies the differential equation

-I d0

Therefore

/sinfl^i) +i(i + l)P,sin 0 = 0. /P,si

(4)

(Sin&Z0= ■

/”-cos2 17 sin0

‘/

Pi sin 8d0=

i(i + l)

1

sin 0 ~~jt~~, and

JPi

__!: f/2_11^±i_ t gin20— ‘

i(i + l)U ‘d0 i(i + l)am “d0-

Another well-known property of zonal harmonics is that

. /P,_»(> + l)f.

Pi-i)

If we differentiate (5) and use (4) we have

Multiplying (5) by sin0, and using (6) twice over

‘dP(+2 dP(\ , 1 fdPi

(5)

(6)

2gdPi=i(i + l)f 1 (dPw dPA d0, !M + 1\ 2i + 3\ d0 d0 J

2i-l\d0 d0)}’ S. IX. — 43

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Therefore

f2 – cos2 1

siutf

r/2-

- /.ft sir

1

dP<-

(2i-l)(2i+l) dd 2 ~~\dii+~~

dPu

\i(i + \) (2i-l)(2» + 3)/rf0 (2i + l)(2* + 3) d8 ‘ This expression, when multiplied by itna/y and by Ct and summed, is the second term of our equation.

The first term, with the introduction of the factors }*, is

In order that the equation may be satisfied, the coefficient of each dPi/dS must vanish identically. Accordingly we multiply the whole by y/ima and equate to zero the coefficient in question, and obtain

WC,-jfci) + (2i-l)(2i-3)”

>-l

i(i + l) (2i

, Ci+2

l5(2i + 3)}Ci

(2i + 3)(2i + 5)

= 0

(7)

This equation (7) is applicable for all values of i from 1 to infinity, provided that we take C0, Ed, 0_lt E_± as being zero.

The equation amongst the C’& presents a close analogy with (45) of § 18 of the article on Tides, and is treated in a similar manner. We shall not, however, pursue the investigation of the tides of long period, merely stating that Mr Hough’s results are con- firmatory of those obtained in § 18 of the article on Tides.

The free oscillations of the ocean of the zonal type may be treated by means of this equation, and since in this Free zonal Case there is no disturbing force, all the Es vanish. oscilla- if we write for brevity

tions.

the equation (7) is

i”i(i + l) + (2i-l)(2i + 3)

Cj+2

(2i + 3)(2i + 5)

-LiC,+

Ct-i

(2i-3)(2»-l)

= 0

(8)

The problem is to eliminate the Cs from an infinite series of these equations and to determine / the semi-frequency of oscil- lation. Since the dimensions and mean density of the earth, the density of sea-water, and the depth of the ocean are known, the last term in Li is known.

With respect to this result Mr Hough writes : — ” The equations divide themselves into two groups, in one of which only even suffixes, and in the others of which only odd suffixes, are involved. We conclude, therefore, that the types of oscillation divide them- selves into two classes, in the former of which the height of the surface waves will be expressible entirely by harmonics of even order, and in the latter by harmonics of odd order alone. An exactly similar treatment is applicable to each of these classes ; we shall therefore select for discussion thq former set.”

Remembering that C0 is to be regarded as zero, the first three equations of the even set are

C,Li+-£i-=0,

5.7 °iLi+n.n~0′

c4

^+I5T7=°-

It would seem at first sight that these equations would serve to determine £,, C6, C8 . . . in terms of C2, but the same difficulties arise as were found to occur in § 16 of the article on Tides’ and they are to be met in a similar manner. If we write for brevity

1

‘ (2i + l)(2i + 3)2(2i + 5)

the equation amongst the Cs may be written in the alternative forms

(2i-3)(2i-l) (2» + 3)(2i + 5)

u-

cjcu

(2i + l)(2i + 3)

=Lt-

@l/C{-2

(2*-l)(2i + l)

By successive applications of these formulae the right-hand side may, in each case, be expressed as a continued fraction.

Let us express the following continued fractions by a single symbol, and write

K{+2 =

Li+2-

Li+i —

Oi-4

i(-2~ Lt.

gj-g

Then

C-2/Cj

(2* – 3)(2i – 1)

(9)

(2i + 3)(2i + 5)~

By substitution in the equation (8) we have -as the Frequency general condition equation.

Li – -0i_2 – Ki+2 = 0.

The (7s have disappeared, and we are left with an equation for determining /, the frequency of oscillation.

The equation may be written in many other forms, but the object attained by this particular form is that a selected portion, namely, Li, stands out by itself.

The values 2, i, 6, &c, are to be attributed successively to i, and the equation solved in the manner indicated below. When the similar series of equations corresponding to the odd harmonics are solved, we shall have a systematic solution of the whole, con- taining all the possible modes of oscillation.

Reverting, however, to the even series, the solution is effected as follows : —

We first compute the numerical portion of all the X's, and obtain a series of equations such as

where A\ is a number.

As a first approximation we assume that one particular L, say Li, vanishes ; then/= *jAi. With this value of /we . ,

compute i2, Lit L6 . . . up to a pretty high order, ° " "" ' and one of the series, namely Lt, will be zero.

The continued fractions Hi-%, Aj+2 are then computed. They are so rapidly convergent that a few terms suffice to give them with all necessary accuracy. If B be the value of ^_2 + Ku.i, we shall have the function i4 – £i_2 – Kt+2 equal to – B, when / is equal to *JAi.

We next assume thatij=5, so that /= *J(Ai+i(i + l)B), and go through the same process as before, finding is – .Hi_2 – A"i+! equal, say, to + 0.

By interpolation it is easy to find the exact value of /, which causes Li – Hi-i – Ai+2 to vanish. If – B and C are found to differ too widely from one another it is, of course, easy to repeat the process of approximation.

In this way Mr Hough has found the frequencies of all the modes of oscillations expressible by the harmonics of orders 1 to 12, for depths of ocean equal to once, twice, four times, and eight times 7260 feet.

In the case of a non-rotating planet each haraionic forms a fundamental mode of oscillation capable of existing by itself, but this is not the case for a rotating planet. The next task is then to determine the nature of the waves which correspond to each of the frequencies ; this entails the determination of the Cs.

Since Aj-Sj_2=Ai+2 and Lt- A'i+2=-2«-2 the equations (9) give us

-^2 = (2i-l)(2i-3)AT<+3>

waves.

%2=(2i + 3)(2i + 5)Si_2. w

In the course of finding the frequency the H, K continued fr ictions have been determined, and therefore we can find C*_2 and Ci+2 in terms of Cs.

•‘By putting i – 2 for * in the first formula and i + 2 for i in the second, we can find d_i in terms of C-2, and thence of Ci ; also Oi+4 in terms of Cl+2 and thence »f C- By continuing this pro- cess all the Cs are determinable as multiples of d, which is the arbitrary constant of the solution

”’-* p „ J. p J. “>+

Form of

h = Ci{.

^PM+ ... }cos(2n/« + a).

It appears that when i is considerable the coefficients of the Ps on each side of Pt are not very large, so that the Ith harmonic stands out from the rest. If the planet did not rotate the cor- responding solution would be CiPiCoa (2nft+a), and Inf would not differ much in the two cases. But this is by no means the case for small values of i ; for example, when i=l and the depth, of ocean 7260 feet, the solution is

tr=C1{P1-l-5058P3+-7106i,l,—1673P,. . . } cos {Inft + o),

and the period ir\nf is 30h 29m.

But for the non-rotating globe the corresponding sojution is f) =

In the rotating planet the third harmonic has » greater co- efficient than the first, and the fifth has nearly as much import- ance. This perhaps tends to explain the great discrepancy between the periods of oscillation in the two cases.

We refer the reader to Mr Hough's first paper (Phil. Trans. A.

Steady currents of ocean.

1897, pp. 201-257) for a valuable series of numerical results illus- trative of the theory.

In the latter part of his paper Mr Hough shows that there are other solutions of the ditferential equations which do not correspond to oscillations, but to steady motions. The differential equations of motion and the equation of con- tinuity are given in (17) and (18) of § 11 of the article on Tides. If there be no disturbing force they are as follows : —

^ – 2n sine cos ed-l=-Ldl, dt1 dt a dB

sinfl

dt*

dh d (a -J. + —I 7 sin dt dey '

+ 2» cos 8 ^i = dt

d\j

1

3

dt

J d\ dt)

0.

In the previous solutions we have supposed 7 to be a function of co-latitude only, and indeed, where the solution has been con- sidered in detail, to be constant. This restriction will now be removed. Let us suppose, if possible, that there is a condition of steady motion which will satisfy these equations. Then the velocities and the elevation, of the surface are not functions of the time, so that the equations reduce to

sin0^ = . I Q

dt ‘2an cos 8 dB

if= a *,

dt Ian cos 0 sin Bdtf> Therefore the equation of continuity becomes

± (jy_ ^]\=_i (jr_ ^

dB \cos 8 d) d \cos B

The equation of continuity is satisfied if I) and 7 are functions of co-latitude only, and the first of the equations of motion then shows what velocity must be imparted to the fluid in order to give the figure of the ocean any arbitrary form, provided it is a figure of revolution. The distribution must, however, be sym- metrical with respect to the equator, for if ft were to involve any odd harmonic the necessary velocity would be infinite at the equator.

Reverting, however, to the genera] case, where the depth of the ocean may vary in longitude as well as in latitude, it is clear that if, starting from any point, we pursue a line along which ft. is constant, we must have

(ID

Therefore

dft. dB

d(f>

‘sinfl^f) SB -if (sint ^ dt) dt

) = 0.

Stream lines of ocean cur- rents.

But sin Bdri/dt is the. eastward velocity, and d%jdt is the southward velocity, so that the displacements SB, Stp indicate motion with the fluid. Hence t) is constant along a stream line, or ft is a stream function. In this statement we have omitted the attraction of the water on itself, but from what has gone before it is obvious that when the attraction is included the stream function is SJjJjj. In the same way in (11) ft, must be replaced by 2bjk)it and it follows from this equation that 7/cos 8 is constant along a stream line. Therefore the stream lines are determined by the consideration that the depth of the ocean multiplied by the secant of the co-latitude is constant. It would thus be possible to draw the stream lines for these oceanic currents on an actual chart. However, the fact that the ocean consists of fluid of slightly different densities in different places would introduce effects resulting in a total subversion of the theoretical arrange- ments of currents. The driving forces which overcome friction must be sought in precipitation, evaporation, and the wind, and the whole circumstances of the actual problem are so complex that mathematical treatment becomes almost impossible. The reader is referred to Mr Hough’s paper for further consideration of the subject.

§ 9. Tesseral Oscillations.

The oscillations which we now have to consider are those in which the form of surface is expressible by the tesseral harmonics. The results will be appli- cable to the diurnal and semidiurnal tides — Laplace’s second and third species.

If we write a = – the equation becomes

Tesseral oscilla- tions. Transfor- mation of equation.

d_ d8L

l sinB-JQ + cr cos 8 J (fc-e) (s2-

COS 9 -T3 + S2

du

cosec 8)(h-e)

j2 –

ima

ft sin 0=0.

It must be borne in mmd that when h and e are expressed in harmonics, h-e, as it occurs in the first two terms, must be replaced by SSjfA, – et), where h{, e4 are the associated functions of the co-latitude, such that h(or e, multiplied by cos «0 or sin s

are tesseral harmonics. If we write D for the operation sinfl— , the middle term may be arranged in the form

g-cot9(2? +

Therefore on multiplying by sin0 the equation becomes in ~™ofl\r(-D +

(J-“*>L t-jJee j] -(*-«) +ffiwg=o (12)**

All the terms except the last will need multiplication by bt when the attraction of the water io included.

We now introduce two auxiliary functions, such that h-e = ‘2bi (hi-ei),

= (D – -?<> cos2 8)$ . . (13) It is easy to prove that

(D + a cos B){D – a cos 8) = Z>2 -s2 + cr sin2 e + (s*-e* cos2 8) 1 „., (£-

(D + + a cos B)

~~+ 2ir2sin‘20cos0* . (15)~~

~~Now perform D +~~

~~(D + a cos 8){h – e) = (D2 – s2 + a sin2 8 + s2 –~~

~~+ (s2 –~~

~~jjjTT^-O2 -s* +~~

~~(D + cr cos 8)(h-e) s‘2 – a1 cos2 8~~

~~= ‘Jr+(2) + (!-COS0)*.~~

~~Substituting from this in (12), and using the second of (14), the function ^ disappears and the equation reduces to~~

~~‘■ – s2 –~~

~~(18)~~

~~Since by (17) – 2-s2 +~~

~~24 A – ct) = D – (£2 – s2 +~~

~~The equations (17), (18), and (19) define * and *, and furnish the equation which must be satisfied.~~

~~If we denote cos 0 by /j, the zonal harmonics are defined by~~

~~Pr-~~

~~‘-1~~

~~The following are three well-known properties of zonal har- monics—~~

~~djj.. (i+l)Pi+1-(2i + l)/i.Pi + iPt_1=0,~~

~~dPi+1 dPi-!~~

~~. (20)~~

~~• (21)~~

~~■da— d^ + W- ■ (22)~~

~~If P\ sjn s are the two tesseral harmonics of order i and rank s, it is also known that~~

~~ft'Pt •~~

~~JP;=(l-yn2)»«~~

~~dp'~~

~~(23)~~

~~Let us now assume~~

~~A=SCJfl, c = 'ZE\P\, *=2a;PJ, *=2/3;P;.~~

~~These must now be substituted in our three equations (17), (18), (19), and the result must be expressed by series of the P\ functions. It is clear then that we have to transform into P\ functions the following functions of P\, namely~~

~~rf-^±"^^)Pi, COS0PJ,~~

~~\j) — a cos 8 + i giJD2 — s2 + .~~

~~If we differentiate (20) s times, and express the result by means of the operator D, we find~~

~~(O2-s2)P! + i(i + l)P;sm20=O . . . (24)~~

~~Again, differentiating (21) s times and using (22), we find~~

~~(i-s + l)P;+i-(2i + l)cosffPj + (i + s)Pj_1 = 0 . (25) Lastly, differentiating (23) once and using (20), (22), and (25)~~

~~i(i-s + l] (i + l)(t + s)~~

~~VJfi~ 2i+\ ^+1 2i + l •/1”1~~

~~By means of (24), (25), and (26) we have~~

~~1~~

~~(26)~~

~~(Z>2-s2 +~~

~~sin2θ~~

~~(t + s)[(r + (t + l)(t + 2)]., 2(2i + l) Therefore the equations (17), (18), (19) give~~

~~-J-Pj-i.~~

~~2i + l~~

~~θ,~~

~~,}]=..~~

~~s[aS{-i(i + l) + ff}Pj + 2~~

~~s[/3;{-^+i)-~~

~~+ M^p2)Vi}_^!]=0. Since these equations must be true identically, the coefficients~~

~~of P% in each of them must vanish. Therefore~~

~~aj {~~

~~ij(Cj-£j) + ai-i~~

~~+ OJ+1~~

~~2i + 3~~

~~-/35{~~

~~(i- „)[>+(* !)(* 2)]~~

~~2(2*- 1)~~

~~(t + s + l)[cr + (t + 2)(t + 3)] 2(2i + 3)~~

~~B;s=0.J~~

~~(27)~~

~~Solution~~

~~far tssssfsl~~

~~oscilla- ^ we climinate the a's and /3's from the third equa-~~

~~tions. ti°n (27) by means of the first two, we find~~

~~ybi~~

~~where~~

~~a-2CU-Z:C;+tf+2C7;+2=i^.E»,~~

~~^-s2)[0- + (i-l)(i-2)]~~

~~(28)~~

~~(rI[l)[(r(i-l)i][~~

~~[(* + l)2-s2][ff + (* + 2)(* + 3)] 76i~~

~~[4(t>l)2-l]|>-(i + l)(i + 2)][>-H(i + l)] 4mo — (i-s)(i-s-l)~~

~~IU =~~

~~11+2 =~~

~~(2i-l)(2i-3)0-(i-l)j]'~~

~~-(t + S + l)K + 5+2)~~

~~(2i + a)(2i + 5)[o—(4 + l)(i + 2)]'~~

~~This equation amongst the C's is available for all values of i, provided that C_i, E_v CV En are regarded as being zero.~~

~~As in the case of the zonal oscillations, the equations with odd suffixes separate themselves from those with even suffixes, so that the two sets may be treated independently of one another.~~

~~The equation (28) might be treated by a process exactly parallel to that followed in § 8, but as the numerical computations would then become very laborious, it is well to adopt a modification of the procedure.~~

~~It is obvious that the function ij may be split up into partial Second fractions containing~~

~~(2i-l)[i(i-\)-c\ 2i-3 '-2+ i2 2T+1°7~~

~~f8'[t(* + l)-(T] T}t)~~

~~\~~

~~i + s + 1~~

~~/:~~

~~+ 2)-«r]\~~

~~(2t+8)[(t + l)(<~~

~~If now we write for brevity~~

~~+ s + 2 2i + 5~~

~~Cj+2 +~~

~~(i + 2^i-s + l {i + lf 2i~~

~~£«}~~

~~47TIO ”~~

~~^i = ^[* + l)-~~

~~iv”J=i(i + l)-(r, and define a new function D\ by the equation~~

~~{i + \)\i-s)~~

~~ou-im+ygpato-o.~~

~~(29)~~

~~(30)~~

~~2i-l our equation may be written |~~

~~2t-l D” M,°i+ 2i + 3 A+1~-* (4 + X) KS*~~

~~As in the case of the zonal oscillations, we shall in the first instance only consider the free oscillations. Accord- „ ingly, it will now be assumed that there is no dis- ree wayes- turbing force, so that E\ will be zero.~~

~~If for brevity we write~~

~~f{i + 2f(i + s + \){i-s + l)~~

~~aj=-~~

~~(2i + l)(2i + 3)~~

~~the equations (29) and (30) may be written in the alternative forms~~

~~{i + \)\i-s)(CUi nT DU\ 2t-l V D\ or c; /~~

~~= (iVj or Mi)~~

~~a'~~

~~{i + 2?(i-s + l) 2i + l~~

~~(m a \.~~

~~(3D~~

~~By continued application of these two formulae alternately~~

~~{i + l)*(i -s)DUi~~

~~=M-~~

~~a\~~

~~aj+i M\+i-~~

~~a'+i~~

~~2i-l C\ ' m+i- Mi+2- ^v;+3-. Again, the same two equations may be written~~

~~(32)~~

~~£(£+s + l) 2J + 3~~

~~= (NioiM<)-~~

~~a_i~~

~~■j-iy\i+s)~~

~~2i + l~~

~~7 m c;\ .~~

~~(33)~~

~~By continued application of these two formulae alternately~~

~~i2(i + s + l)Dj+1~~

~~=M~~

~~«’-i~~

~~ai-2~~

~~«i-3~~

~~(34)~~

~~2i + 3 C; ~* JVUi- Mi-i- N- But the second general equation of condition (30), with E’,=0 is (i + l)\i-~~

~~2t-l~~

~~■ s) Z)J_i i2(i + s + l) &,-i~~

~~Cj~~

~~Therefore~~

~~M-~~

~~Ni+~~

~~JVt_~~

~~2»-l aj_2~~

~~. ad inf.~~

~~= 0~~

~~Ml=0.~~

~~(35)~~

~~This is the equation from which the frequency of the oscilla- tions may be determined. It may, however, be arranged in another form, for if we had proceeded from (33) we should have obtained a formula like the foregoing in which every M would be replaced by an N, and every iVby an M.~~

~~In both of these forms the fraction with ascending suffixes ex- tends ts infinity, and that with descending suffixes ends with M] or JVJ.~~

~~For the symmetrical types of oscillation, if we use (35) we must suppose i-s to be even, whereas if we use the second form i-s must Jbe supposed odd. The reverse will of course be the case for the unsymmetrical types.~~

~~Let us write~~

~~ci =~~

~~«i-i~~

~~«!~~

~~a'+i~~

~~' M\ — JVJ+i — M\+z- ... ad inf. yj=the same with M and N interchanged.~~

~~v. <*! <*i-i «!-2~~

~~-&; = —~~

~~Frequency equation.~~

~~M- iVi-i- J/i_2-... . F' = the same with M and N interchanged. The E'i used here is merely an abbreviation for a certain continued fraction, and must not be confused with the previous E. Then the two forms of the frequency equation are~~

~~il/;2*_1/5+i=0\~~

~~iV;—E!-i-«;+i = o/ • ■ • • (36>~~

~~The periods of oscillation are determinable from either of these. As a first approximation, the E, F, e, f fractions may be taken as zero, so that M\=Q, Jtfj=0. We shall see that these two afford, in fact, first approximations to different roots of the equation.~~

~~TIDORE~~

~~341~~

~~Then, since ff=^, these approximate equations are~~

~~/,+D-g-<+i)'i&=o,'j~~

~~(37)~~

~~/"~~

~~The first is a quadratic equation, with a positive and a negative~~

~~root ; the second has the solution ^. c.~~

~~t(» + l) We now denote the "speed" of the tide by X, so that \=2nf. Then since m is n2ajg, it follows that the first of (37) may be written~~

~~i(i+l)\i-2ns-i\i + l)#^S=0. . . (38)~~

~~If, therefore, n vanishes we still have two roots, but they be- come numerically equal to one another.~~

But the second of (37) maybe written \=-rr-. — =>, and this root J *(t + l)’

vanishes with n.

Since the positive root corresponds to a westward wave, and the negative root to an eastward wave, we see that there are eastward and westward waves which tend to become identical in period as the rotation slackens. But there is also a westward wave which tends to have an infinite period when the rotation vanishes ; that is to say, it becomes a steady motion. “We have already adverted to the case of steady motion in the case of the zonal oscillations, but that steady motion differs from the one which we are now considering, in that it can subsist as such without supposing the diurnal rotation to vanish. Whon the E, F, e, f are not treated as zero, that is to say, when we go on to a second approximation, the motions are found to possess the same characteristics as in these two first approximations.

In order to find the type of motion we have the two equations (32) and (34), which may be written

(i + \f{i-s)D-i_

Form of waves.

2i-l

CJ

■-W- fhi=n-i,

i\i + s + l)DUx_M. F, fi 2i + 3 W~· Mi~F’1 *+

(39)

It is clear from the manner in which the equations (39) were derived that there are two other similar equations with the C”s in the numerators. We thus have the four equations

~~0_ 2< + l ,_(t-«)(t + l)2 \~~

~~Z>J-i (i-lf(i + s)'- C{ _ 2i + l~~

~~(2i-l)>'J_i (i + » + l)i2~~

~~■M=~~

~~~(i + 2f(i-s + l) From these it is easy to deduce~~

~~(2t'-l)(2»-S)~~

~~(2i + 3)/;+i'~~

~~Cj_2 — C\~~

~~««=«;~~

~~(2i + 3)(2i + S>)~~

~~-2«i+2^i+:~~

~~(40)~~

~~(41)~~

~~By successive applications of (41) all the Cs of the series Gi-iir, Ci+zr, may be expressed in terms of Cj, which is the arbitrary constant of the solution. It seems natural to adopt this form for the solutions corresponding to the type M't=0. It is clear that for the symmetrical oscillations i — s must be even, whilst for the unsymmetrical ones it must be odd.~~

~~If we are finding the solution of the type iVj = 0, it will be best to proceed as follows. Writing i + 1 for i in (4l), we obtain C'i-i and 01+3 in terms of C{+i.~~

~~Now~~
~~~

~~r- -p. 2*+3 ,. -p. (*-» + !)(» +2)”~~

~~C/j+i— JJi — — ci+i — Lit — ,~~

~~t2 (i + s + 1) {2i + l)F;~~

~~and therefore we may express Cf-i and C’i+3 in terms of D. Hence all the Cs of the series (7;_2r_i, C’+2r+i may be expressed as terms of D\, which is the arbitrary constant of the solution. In this case the symmetrical oscillations correspond with i – s an odd number, and the unsymmetrical with i – s an even number.~~

~~The numerical solutions obtained by Mr Hough show that for a shallow ocean and for the higher harmonics the eastward and westward wave of the first class (derived from the Mi form) have periods which tend to equality as the order of the harmonic increases. This result may be foreseen from the form of the quadratic (38), because the augmentation of i tends to make the first and last terms important compared with the middle term ; thus the increase of i gives a result similar to that due to the diminu- tion of n, and if n, the angular velocity, vanishes, the two roots become numerically identical. But for the harmonics of low order the velocities of the two waves are very different. For example, in an ocean 7260 feet deep the westward wave corre-~~

~~sponding to i=2, s=2, has a period of eighteen hours, whilst the period of the eastward wave is thirty-eight and a half hours. But the westward wave of the second” class (derived from the N\ form) has in all cases a long period, and the period increases with the order. This result is clearly in accordance with what was to be expected from the first approximation \=2ns/i(i+l). For example, for the ocean of 7260 feet in depth when » = 1, i = l, the period is one day thirteen hours, but when s=l, i=3 the period is 26£ days.~~

~~§ 10. Forced Oscillations or Tides.~~

~~We will now consider, but without going into details, the forced oscillations which correspond with the tides „ generated by the moon and sun. Forced tea-~~

~~The equation of condition amongst the Cs is given s.er., osc”m in (28), namely, latlons.~~

~~SUCS-2 – L\C\ + i)i+2tfj+2 =^-EJ,~~

~~and all the .E’s excepting, say, E’, are to be zero. Omitting the superscript s for brevity, the equations are~~

~~-L, C,+t),+1C,+2 =0,~~

~~(,0, – i,+2C,+2 + 7;,+4 C,+i = 0,~~

~~and so on ; one of the series having the zero on the right replaced ybt~~

~~by~~

~~tea~~

~~K~~

~~It follows from the same arguments as were adduced in the article on Tides, § 16, that the limit of Cj is zero when j is infinity.~~

~~The equations amongst the C’s may be written in the two forms~~

~~(42)~~

~~in every case except when j=i, and then the right-hand side of~~

~~yh Fi~~

~~each equation contains the term +~~

~~ima d~~

~~By continued application of these formulae we may write the right-hand sides in the’ form of continued fractions — say JBj-i, K}+2~~

~~Thus~~

~~!,_2 %?=£,- iT,-2,~~

~~provided that j is not equal to i.~~

~~In the particular case where j=i the right-hand side of each equation may still be expressed by the continued fractions S, K, but the additional term must be added. Thus the equation corresponding to j=i is~~

~~G,(SL1!-i1 + Jr4+s) = ^l'.~~

~~Hence d is determined, and then all the other Cs are easily determinable as multiples of it.~~

~~It follows from thisthat h, the semi-range of the Factor of ,.j .,, , " , , ybiFt kinetic aug-~~

~~tide, will have a common factor ima(Jf^,_Lt + x^; mentation.~~

~~and we see that must be regarded a coefficient~~

~~-Hi-2 – Li + iTj+2~~

~~of kinetic augmentation, so that if the period of the force coin cides with that of any one of the free oscillations the amplitude of the tide becomes infinite. We refer the reader to Mr Hough's paper for the numerical results exemplifying the lunar and solar tides in oceans of various depths. As we have already said, they do not differ more widely from those obtained in the article on Tides than was to be expected from the introduction of the attraction of the ocean on itself ; but the fact that Mr Hough's solution contains that factor of kinetic augmentation, which must occur in every complete solution of a problem involving forced oscillations, renders his solution immensely superior to the older one- (g. H. D.)~~

~~Tidore, an island of the East Indian Archipelago, situated in 0° 45′ N. and 127° 23′ E. In area, volcano, liability to earthquakes, climate, and products it resembles Ternate. By an agreement of 1879 the sultan~~

exercises authority over some parts of Jilolo, the Papoea Islands, the western half of New Guinea, and the islands in

Geelvink Gulf. The town of Tidore is the seat of the sultan and of a Dutch Controleur (Resident or Commis- sioner or Agent). The inhabitants live by agriculture (jagung, cotton, tobacco, and nutmegs) and fishing.

Tiele, Cornells Petrus (1830-1902), Dutch

theologian and scholar, was born at Leyden on the 16th of December 1830. He was educated at Amsterdam, first studying at the Athenaeum Illustre, as the communal high school of the capital was then named, and after- wards at the seminary of the Eemonstrant Brotherhood. He was destined for the pastorate in his own brother- hood, which, after steadily declining for a considerable period, increased its influence in the second half of the 19th century by widening the somewhat inelastic tenets of the original Dutch Methodists, which had caused many of the advanced clergymen of the Lutherans and Cal- vinists to secede and go over to the Remonstrants. Tiele certainly had advanced religious views himself, which he early enunciated as a Remonstrant pastor from the pulpit, both at Moordrecht (1853) and at Rotterdam (1856). His earnest eloquence and deep learning attracted attention, and upon the removal of the seminary of the brotherhood from Amsterdam to Leyden in 1873, Tiele was appointed one of its leading professors. In 1877 followed his appointment at the University of Leyden as professor of the science of religion, a chair specially created for him. Of the ‘ many learned works which have constituted Tiele one of the leading authorities in Europe upon these matters, the Vergelijkende Geschie- denis van de Egyptische en Mesopotamische Godsdiensten (” Comparative History of the Religions of Egypt and Mesopotamia,” Amsterdam, 1872), and the Geschiedenis van den Godsdienst (” History of Religion,” Amsterdam, 1876 ; new edition, Amsterdam, 1891), have been trans- lated into English, the former by James

~~Ballingall (London, 1878-1882), the latter by J. E. Carpenter (London, 1877), under the title of " Outlines of the History of Religion " (French translation, Paris, 1885 ; German translation, Gotha, 1895). A French translation of the Comparative History was published in Paris in 1882. Other works by Tiele are : — De Godsdient van Zarathustra, van het Ontstaan in Baktrie, tot den Val van het Oud-Perzische Rijk ("The Religion of Zoroaster, from its origin in Bactria to the Fall of the old Per- sian Empire," Amsterdam, 1864) [this work is now embodied, but much enlarged and improved by the latest researches of the author, in the History of Religions (vol. ii. part ii., Amsterdam, 1901), a part which appeared only a short time before the author's death] ; Die Assy- riologie und Hire Ergebnisse far die vergleichende Religions- geschichte (Leipzig, 1877) ; Babylonisch-Assyrische Ges- chichte (in two parts, Leipzig, 1886-88) ; Western Asia, according to the most Recent Discoveries (London, 1894). A volume of Tiele's sermons appeared at Haarlem in 1865, and a collection of his poems in 1863. He also edited the poems of his friend, the genial and witty de Genestet. Tiele was best known to English students by his Outlines and the Gifford Lectures " On the Elements of the Science of Religion," which he delivered in 1896-98 at Edinburgh University, and which attracted a good deal of attention at the time. They subsequently appeared simultaneously in Dutch at Amsterdam, in English in London and Edinburgh (1S97- 1899, 2 vols.). Edinburgh University in 1900 conferred upon Tiele the degree of D.D. honoris causd, an honour bestowed upon him previously by the Universities of Dublin and Bologna. He was also a fellow of at least fifteen learned societies in Holland, Belgium, France, Germany, Italy, Great Britain, and the United States. He died on 11th January 1902. In 1901 he had resigned his professorship at Leyden University. Tiele's zeal and power for work were as extraordinary as his vast know- ledge of ancient languages, peoples, and their religions, upon which his researches, according to the undisputed testimony of his lifelong friend and fellow-worker in England, Max Milller, have shed an entirely new and most vivid light. Equally remarkable were the breadth of his religious views, his command over facts, and the gift of exposition, whether writing or~~

~~speaking. With Kuenen and Scholten, amongst others, he founded the " Leyden School " of modern theology.~~

~~His brother, Pietek Anton Tiele (1834-1888) acted for many years as the librarian of Utrecht University, and distinguished himself by his bibliographical studies, more especially by his several works on the history of colonization in Asia. Among these the most noteworthy are : De Opkanst van het JSfederlandsch Gezay in Oost- Indie (" The Rise of Dutch Power in Netherlands India," 1886) ; De Vestiging der Portugeezen in Indie (" The Portuguese in India," 1873), and other books on the early colonization struggles of the Portuguese in the Malay Archipelago. (h. ti.)~~

~~Tientsin, a treaty port in the province of Chihli, China, 70 miles south-east of Peking, of which it is the port. It occupies a position of great importance as the seat of the trade of north China. The importance of this position has been enhanced by the railways con- necting it with Peking on the one hand and with Shan- haikuan and Manchuria on the other. It will be still further enhanced by the prospective opening of the main trunk line from Peking southwards. In 1899 the total trade of the port was H. taels 77,604,000 (£11,640,- 000). The native population is stated to be 950,000, but this is probably over the mark. Among local indus- tries the distillation of spirits, usually called Chinese wine, made from millet, holds a principal place, as does also the manufacture of carpets and rugs made of camels' wool. The chief exports are wool, coal, bristles, skins, furs, &c. The British concession, in which the trade centres, is situated on the right bank of the river Peiho below the native city, and occupies an area of some 200 acres. It is held on a lease in perpetuity granted by the Chinese Government to the British Crown, which sublets plots to private owners in the same way as is done at Hankow. The local manage- ment is entrusted to a municipal council organized on lines similar to those which obtain at Shanghai. Be- sides the British concession there are a French concession and a German concession, situated the one above the other below the British. The German concession was negotiated in 1895, but so far has not been utilized to any great extent. During the long period 1874-94, when Li Hung Chang was viceroy of Chihli and ex officio super- intendent of~~

trade, he made Tientsin his headquarters and the centre of his experiments in military and naval education. As a consequence the city became the chief focus of enterprise and foreign progress. Having arrogated to himself the practical control of the foreign policy of the nation, his yamen became the scene of many important negotiations, and attracted distinguished visitors from all parts of the globe. The loss of prestige conse- quent on the Japanese war brought about the retirement of Li, and with it the political importance of Tientsin ceased. Both the foreign concessions and the native city suffered severely during the hostilities resulting from the Boxer movement in June-July 1900. (For a fuller account of these events see China : History.)

Tierra del Fuego. — -The boundary between the Argentine Republic and Chile has been settled in such a manner that the Argentine holds that part of the great

island, or Tierra del Fuego properly so-called, which is situated to the east of the meridian of Cape Espiritu Santo, up to the middle of Beagle Channel ; and Chile holds all the western part of that island and the other numerous islands to the west and to the south of Beagle Channel. The archipelago to the south of Magellan Strait and to the north of Cape Horn, known by the general name of Tierra del Fuego, is controlled by both countries, the Argentine side as the Territory of Tierra del Fuego, and the Chilian as part of the Territory of Magallanes. Knowledge of these lands has increased considerably, and their reputation for dreariness has been favourably modi- fied. The climate in the eastern and southern regions is not so rigorous as was believed, there are no barren lands, the soil is fertile and can support fruitful industries, and the aborigines are far from being so dangerous as they were once generally considered to be.

The western part of the archipelago of Tierra del Fuego, i.e., to the south of Magellan Strait, constituted by the continuation to the south of the Cordillera de la Costa of Chile and of the Cordillera of the Andes,

~~has not been explored lately, and there is very little to be told concerning it. Small surveys on these fjords have shown that several of the larger islands are cut by channels which separate them into smaller ones, while in other cases the low valleys which unite the mountains and hills are only the result of post-Glacial deposits that have filled part of the former channels, these islands being only the summits of an old continuous half-submerged mountain chain. Sir Martin Conway ascended Mount Sarmiento (7200 feet) and ascertained that it is not a volcano as it is sometimes called. At Dawson Island the Chilian Govern- ment has established some settlements, and the Roman Catholic mission there tries to civilize the Alakaluf Indians by means of school and workshop.~~

~~The eastern and greater island has been better explored. In its principal extension it is formed by the continuation of the Tertiary beds of the Patagonian tableland cnt by the transversal depression of Magellan Strait and by the low land extending from Useless Bay on the west to San Sebastian Bay on the east, of so recent origin that there exist still some salt lakes, this depression being repre- sented in the old charts as an inter-oceanic passage for small boats. This tableland is covered with morainic material, and as the climate is damper here than in the northern lands of eastern Patagonia, it is more useful for colonization. However, although in 1880 numerous prospectors discovered extensive deposits of alluvial gold, its exploitation has not been generally successful, and farms have taken the place of mines. At the end of 1899 1200 square miles had been occupied by cattle and sheep on the Argentine side, and about the same extent on the Chilian. The price of land has reached £100 per square mile, the results of the first experiments on the farms showing that the cattle industry is very profitable. The gold industry is limited now to very small areas, princi- pally in the southern part of the island.~~

~~The undulating tableland has an average height of 300 feet above the sea, and its climate, however cold in winter — in 1892 and 1893 the temperature reached 12-6° F. — -allows of the cultivation of barley, oats, and occasionally potatoes, which, however, grow better in Beagle Channel. To the south the tableland is higher and more broken, being~~

~~drained by the rivers Silva and Grande, amongst other smaller ones, the Grande being navigable in some parts by small craft. To the west and south-west the general character of the land changes ; the ends of the Tertiary beds are raised in small hills and Mesozoic rocks appear, forming broken ridges of the Pre- Cordillera, a name given on the continent to the ridges which precede, to the east, the Andes. There appears the Antarctic forest in which predominates the Fagus antarctica and F. betuloides, Drymis Winteri, Berberis ilicifolia, Pernettia, Desfonteinia and Philesia buxifolia. Two lakes receive the waters of these mountains and hills, Lake Solier and Lake Fagnano. Lake Fagnano is only~~

~~180 feet above the sea, and its depth reaches 700 feet. To the south of the lake rises the south-eastern prolongation of the Cordillera of the Andes, with ridges of a uniform height of 3500 feet, in which predominate crystalline schists which do not seem to be very old. Some peaks due to Tertiary granite break the uni- formity, such as Mount Sarmiento, Mount Darwin, of which two peaks have been measured (6201 and 7054 feet), and Mount Olivaia (4324 feet). Deep valleys, which seem to be only the prolongation of fjords, penetrate into the chain in the southern slope where exist several ports in which settlements have commenced. Yendegaia, Lapatia, and Ushuaia Bays are among the larger, and present magnificent landscapes, with their glaciers and wopds. Ushuaia, being the site of the capital of the Argentine Territory, is developing rapidly, having regular communication by monthly steamers with Buenos Aires, while smaller steamers serve the different settlements along the coast. Cattle farms prosper along Beagle Channel, the timber industry is growing, lignite seams have been discovered, and alluvial gold is washed principally at Slogget Bay. These regions, as they become more known, will invite the attention of tourists by their proximity to the most sublime scenery. South of the Beagle Channel partial exploration was conducted by the French Mission du Cap Horn in 1882-83, and the geological foundations are better known, being there granite and basic volcanic rocks. Staten Island to the east of Tierra del Fuego has been settled by the Argentine Government, and there are a prison and lighthouse in St John Harbour. A first-class permanent meteorological and magnetic~~

~~station is being established there by the same Government. The aborigines are decreasing rapidly in the whole archipelago, and the Eev. Thomas Bridges, who, as missionary first and then as farmer, resided thirty years there, says that when he arrived he calculated the population to be 10,000, but in 1892 there were only about 1000 (Alakahifs, 100 ; Yagans, 320 ; Onas, 600). With the settlement of the great island, which is now generally called Onisia, leaving the name of Tierra del Fuego to the archipelago, the Onas tribe is becoming better known. Undoubtedly, however, among these Indians are many that recall some Patagonian types ; it seems that they are not the same as,the Tehuelche type generally known, but that they pertain to one of the races that in earlier times existed in Patagonia. Their language is closely allied with the one called Old Tehuelche. The Onas live only in the island of Onisia. The Yagans seem less distantly related to the Onas than has been supposed, and probably are a mixed race composed of Alakalufs and Onas. The languages of the Yagans and the Alakalufs are alike in many particulars.~~

~~Authorities. — Mission Scientifique du Cap Horn, 1882-83. Paris, 1888. — Thomas Bridges. "Notes on Tierra del Fuego," Bevista del Museo de La Plata. 1892. — Otto Nordenskjold. "Ueber die Natur der Magellanslander," Peter. Mitt., 43, 1897; L' Expedition Suedoise a la Terre de Feu, 1895-97 ; Wiss. Erg. der Schioed. Exped. nach den Magellanslandern, 1895-97, Stockholm, 1898 ; Geological Map of the Magellan Territories, Stockholm, 1899. — F. Lahille. "Fines de Verano en la Tierra del Fuego," Bevista Museo de La Plata, vol. viii. 1898. — Sir Martin Conway. Aconcagua and Tierra del Fuego, London, 1902. (y. p. m.)~~

~~Tietjens, Therese Johanne Alexandra~~

~~(1831-1877), Hungarian soprano vocalist, was born at Hamburg on 17th July 1831. Her voice was trained at Hamburg, where she made a successful ddbut in 1849 as Lucrezia Borgia in Donizetti's opera. Thence she pro- ceeded to Frankfort and Vienna. She sang for the first time in London in 1858, appearing as Valentine in Les Huguenots. Her success was so great that for the rest of her life she made England her~~

~~home, and soon gained as brilliant a reputation in concert and oratorio work as she had already won upon the stage. Her voice was a dramatic soprano of magnificent quality, and her gifts as an actress were unequalled. Her most famous parts were Fidelio, Medea (in Cherubini's opera), Donna Anna (in Don Giovanni), but she touched nothing that she did not adorn. She had endeared herself to the English people as much by her virtues as by her artistic gifts, and her death in London on 3rd October 1877 was deplored as a national calamity.~~

~~Tiffin, a city of Ohio, U.S.A., capital of Seneca county, on the Sandusky river, and the Baltimore and Ohio, the Cleveland, Cincinnati, Chicago, and St Louis, and the Pennsylvania railways, in the northern part of the state, at an altitude of 746 feet. Heidelberg~~

~~University, situated here, had in 1899 a faculty of 28 teachers, and was attended by 308 students, of whom 104 were women. Population (1890), 10,801; (1900), 10,989, of whom 1168 were foreign-born.~~

~~Tiflis, a government of Transcaucasia, Eussia, occupying the eastern portion of the great valley which stretches between the main Caucasus range and the Trans- caucasian plateau from the Mesques Mountains eastwards, comprising within its boundaries both the southern slopes of a long stretch of the Caucasus Mountains and the northern slopes of the Anti-Caucasus, which rise to from 5000 to 10,000 feet. A portion of it, namely, the district of Akhaltsykh, penetrates, indeed, right over the Trans- caucasian plateau, including the high valley of the Upper Kura, between the Wakhan Mountains and the Anti- caucasus. The land is rich in minerals, but hitherto most of them have been allowed to remain practically idle. Only copper is extracted at Alaverd and Akhtal. The government is watered by the Kura and its tributaries, Lyakhva, Aragva, Iora, and Alazan, all of whose waters are largely used for irrigation ; but in the lower parts of the great valley there are extensive waterless steppes, Shirak and Kara-ez, on the left bank of the Kura, which are chiefly inhabited by nomad Tatars. The area of the~~

~~government is 15,306 square miles (16,847 with the Zaka- taly district), and the population, which was 599,300 in 1869, numbered 1,040,943 (domiciled only) in 1897, 470,173 of whom were women, and 207,294 urban. The inhabitants are very mixed in race : the bulk of them are Georgians, whose numbers were estimated by Caucasian statisticians at 396,673 out of a total population of 808,143 in 1894-96, and to whom belong also in reality the Pshaves (9155), the Imeretians (8970), the Tushins (5624), the Khevzurs (6560), the Gurians, the Mingre- lians, &c. ; Armenians were estimated to number 193,610, Ossets 72,420, Azerbaijan Tatars 68,345, Bussians 35,750, Greeks 22,171, Germans 5066, and west and east Cau- casian mountaineers 4700. The annual birth-rate is 36 per 1000, the death-rate 23 per 1000; hence the natural increase of population is nearly 12,400 yearly. The government is divided into nine districts, the chief towns of which are : Tiflis (see below), Akhalkalaki (5443), Akhaltsykh (15,387), Dusheti (2456), Gori (10,457) Signakh (8998), and Telav (11,810). The districts of Borchala and Zioneti have no towns. Agri- culture is the main occupation of the people, and has reached a very high standard. Land is sold and rented at very high prices, such as are obtained only in the most populous parts of western Europe. The crops of 1897, which may be considered as an average year, were: wheat, 769,000 qrs. ; rye, 2600 qrs. ; oats, 11,550 qrs. ; barley, 413,000 qrs. ; millet, 18,800 qrs. ; Indian corn, 143,600 qrs. ; rice, 3900 qrs. ; various cereals, 18,700 qrs. ; also potatoes, 71,000 qrs. Large portions of the cultivated area are covered with vineyards. Cattle-breeding is exten- sively carried on in the steppes. There is a great variety of domestic industries, and the natives attain a high degree of perfection in the manufacture of leather and metallic goods, felt, woollen stuffs, and gold embroidery. Factories, however, are of little importance ; the 3800 industrial establishments employ only 7350 workers, and their aggregate yearly returns amount to little more than 10,000,000 roubles. (p. a. k.)~~

~~Tiflis, the capital of Caucasia and of the above government. It is now connected by rail with Poti and Batum (217 miles) on the Black Sea, with Baku on the Caspian Sea (341 miles), with Kars (185 miles) on the Transcaucasian plateau, and, vid Baku and Petrovsk, with the railway system of European Eussia, which it~~

~~joins at Beslan, near Vladikavkaz (723 miles). Omni- buses also run regularly across the main range to Vladi- kavkaz, which by this route is only 133 miles distant. The city has considerably developed, and had, in 1897, 160,645 inhabitants, as compared with 104,024 in 1883. The central part is well built, and contains many hand- some structures. There are monuments to the Eussian writers Griboyedoff and Lermontoff. It carries on an important trade with Eussia, Western Europe, and Persia. (See Caucasus.)~~

~~Tigre. See Abyssinia.~~

~~Tigris, a river of Turkey in Asia. Navigation is carried on by large rafts from Diarbekr to Baghdad, and below the latter city by river steamers and sailing craft. The last ascend as far as Samara, but at present no steamers run above Baghdad. The river commences to rise about the middle of November, and is highest in May and June, when its current is about four miles an hour. It is lowest in September, October, and November. Its tributaries, the Khabiir and the Lesser Zab, are navig- able for rafts over portions of their courses, and the Diala for sailing vessels as far as Bakuba. During the flood season the Shatt el-Hai canal is navigable for native boats, and the Isa canal, which runs from the Euphrates to the Tigris, for small steamers. During the time of the Abba- side khalif s the Tigris flowed down the Shatt el-Hai canal, and, below Wasit, passed through several channels to the great swamp, el-Batiha, whence its waters ran out through a canal to the Shatt el- Arab. At that period, too, a large canal on the left bank of the river, dating from the time of Chosroes, left the river at Dur, below Tekrit, and re-entered it below the site of Kut el-Amara; whilst the lands on the right bank, north of Baghdad, were irrigated by the Ishakiyeh and Dujeil canals.~~

~~Tikhvin, a district town of Eussia, in the govern- ment of Novgorod, 86 miles north-east of Chudovo station, on the St Petersburg-Moscow railway. It is the head of the Tikhvin system of canals, which connects the Volga with St Petersburg. Over 11,000 vessels, carrying goods valued at £5,000,000, pass through these canals every year, and during the summer the town becomes very animated, its population for a few~~

~~months being double its normal size. It has several flour-mills and distilleries ; also a monastery which has acquired a great reputation in northern Eussia. Population (1897),~~

~~6631.~~

~~Til burg, a town in the Dutch province of North Brabant, 13 miles east by south of Breda. A railway to 's Hertogenbosch (Bois-le-Duc) was opened in 1881, and there is railway connexion also with Nimeguen, &c, and a steam tramway to Waalwijk. The town has a cloth hall, a new Gothic church, and a higher burgher-school. There are 70 steam and 110 other factories, 80 of them woollen, and 30 leather factories. Population (1901),~~

~~41,518.~~

~~Tillicoultry, a police burgh of Clackmannanshire, Scotland, at the foot of the Ochil Hills, on the river Devon, 3| miles north-north-east of Alloa. There are about a dozen woollen factories, tweeds and shirtings being the staple product. Coal-mining and agriculture are also pursued. It has an institute and library, a session-house and hall in connexion with the parish church, an orphan- age, and a public park. Population (1891), 3939 ; (1901),~~

~~3337.~~

~~Tilsit, a town of Prussia, province of east Prussia, on the river Niemen, 57 miles by rail south-east of Memel. It has considerable trade, and manufactures of~~

~~machinery, soap, oil, vinegar, shoes, tobacco, glass, cheese, &c, besides iron foundries, tanneries, breweries, saw-mills and flour-mills. A bronze statue of the native poet Von Schenkendorf was unveiled in 1890. Population~~

~~(1885), 22,422; (1900), 34,538.~~

~~Timbuktu, chief town of the territory of Tim- buktu, southern Sahara, West Africa, on the border of the gently-rising tableland to the north of the swamps and channels connecting with the Niger, and some 9 miles north of the main stream. Its position, which was given by Caillte and Barth at 17° 29′ N. and 5° 27′ W., has been astronomically determined at 16° N. and 5° W. It was occupied by the French in December 1893, and has since formed part of their Sudanese domain. The neighbouring reaches of the Niger had already been vis'ited by 'gunboats in 1887 and 1890, and after the reduction of Segu and Massina by Colonel Archinard early in 1893, the permanent occupation of Timbuktu became inevitable. Indeed the townspeople, wearied with the internecine strife of the rival Tuareg and Fulah tribes, freely opened their gates to Lieutenant Boiteux as soon as he reached the riverside port of Kabara in command of a small flotilla on 12th December 1893. This first success was followed by some severe reverses at the hands of the' turbulent nomads ; but since February 1894 the French rule has not been seriously challenged. At that time the population, which had probably exceeded 50,000 under the Mandingan and Songhai empires, had fallen to about 8000, and even now scarcely exceeds 10,000. In 1895 the place was still described as little more than a vast ruin, but under the new order steady revival set in. The people no longer fear to repair their dilapidated dwellings ; new streets have been opened ; European schools, churches, and other establishments have sprung up ; the fortifications, including a fort at Kabara, have been greatly strengthened, and it is proposed to connect the city with the Niger by a regular canal running through the occasionally flooded backwaters of the intervening dis- trict. The local industries — cotton-weaving, earthenware, leather work, and embroidery — are of subordinate import- ance, and the great bulk of the people continue as for- merly to be occupied exclusively with trade. The whole traffic of the surrounding lands still converges on Tim- buktu, which is described as a vast " exchange " for the products of the north and south, with a transit trade estimated at over £800,000. Considerable quantities of British and German fabrics, hardware, beads, &c, are conveyed across the Sahara from Mogador (Morocco), while two great caravans of 3000~~

~~or 4000 camels are yearly charged with salt from the Taudeni district. The imports vid the Sahara average close upon £50,000 annually, and by the way of Senegal £20,000 to £25,000. From the south come cereals, gold, wax, ivory, coarse native cotton goods, now brought from the heart of Sudan by steamers plying on the Upper Niger. Cowries, the former currency (2500=5 francs), have already been generally replaced by French money, and efforts are being made to oust British and German goods by French wares introduced by the Senegal route. Since 1899 Tim- buktu has been the capital of the Territoire de Tombouc- tou (the French spelling), a very large administrative division which is organized on a military base and is directly dependent on the Governor-General of French West Africa.~~

~~Authorities. — F. Dubois. Timbuctoo the Mysterious. London, 1896. — Col. Prey. Senegal et Soudan. Paris, 1888. — Lieut. Hourst. La Mission Hourst sur le Niger et aupaysdes Touaregs. Paris, 1898. — A. Lebon. Bapport de la Mission au Senegal et au Soudan. Paris, 1898. — CommandantTouTEE. Dahorne, Niger, Touareg. Paris, 1897 ; Du Dahorne au Sahara. Paris, 1899.~~

~~(a. h. k.)~~

~~Timor, in the Malay (or Indian) Archipelago, the most easterly and the largest of the Lesser Sunda Islands, with a length of 300 miles and a fairly regular breadth of about 60 miles. Though visited by several explorers, (Beinwardt, Muller, Biedel, Forbes, and Wich- mann), its physical features are imperfectly known, and there is considerable divergence of opinion as to the character of the mountain system of the island, the existence or non-existence of volcanoes, and the geolo- gical formations. Little progress has been, or is likely to be, made in the development of the island. How much the climate militates against cultivation will be seen when it is stated that at Kupang, on the south coast, the number of rainy days per month in the six months May to October dwindles from 4 to 1, and finally 0, whilethe monthly rainfall gradually sinks from a little less than 2 inches to nil; the northern districts are somewhat better off, and might do fairly well under a vigorous rule. Though the mineral products are varied, the supply of ores has hitherto proved scanty, besides which the exploitation of the resources of the island in this respect is rendered difficult by the lack of labourers and of water and wood. The area is estimated at about 12,500 square miles, whilst the population is variously placed at 600,000 (Wagner and Supan) and more than 750,000 (Reclus and Vaquinhas). Politically the north eastern half of the island is Portuguese, as are two small enclaves in the south-western half, the remainder being Dutch.~~

~~Portuguese Timor includes the neighbouring isle of Pulo Kambing, and has an area of about 7450 square miles. Estimates of the population vary from about 300,000 to over half a million. Dilli, on the north coast, the administrative headquarters and chief settlement, is a very poor little place of some 3000 inhabitants, containing hardly any Europeans~~

apart from the official population. Macao was administratively united to Portuguese Timor till 1896, and still pays a contribution to the revenue. The estimated revenue for 1901-1902 was £25,196 (£7200 from Macao), and the estimated expenditure £36,532. Scarcely any ships visit the colony, except some of the Dutch vessels trading in the archipelago, which call regularly at Dilli. Exports (principally coffee) were valued at £110,000 in 1888, £72,000 in 1890, and £55,000 in 1897, when the imports were valued at about £70,000.

Dutch Timor has an area of a little over 5000 square miles, and a population of about 250,000. Kupang, the chief town not only in the island but in the whole residency, contains some 8000 inhabitants, of whom 145 are Europeans living in well-built houses, 594 Chinese, and 43 Arabs. In agriculture, European plants have not been successful, and of native products the supply is only sufficientforthe home consumption. The export of sandal- wood, ponies, cattle, pinang nuts, &c, amounts in a year to the value of only about £8500. Dutch Timor gives its name to a residency consisting of, besides its own territory, the small adjacent islands, Roti, Peman, &c, the Savu islands, Sumba or Sandalwood island, the Solor and the Allor group of islands, and the eastern half of Flores, the whole lying between 8° 5′ and 11° 5′ S. and 119° 3′ and 125° 15′ E., the total area being 17,698 square miles. It is divided into four administrative districts — Timor, Boti and Savu, Larantuka (eastern Flores), and Sumba. In 1897 the population was officially returned as (approxi- mately) 119,239, of whom 256 were Europeans, 1314 Chinese, and 182 Arabs ; but other estimates have placed it as high as 400,000, and even 1,800,000. The number of natives is indeed only conjectural. (See also Malay Archipelago : Dutch East Indies, for general information as to government, defence, &c.)

The Anglo-Portuguese Boundary Treaty of 1859 was replaced by one signed at Lisbon in June 1893. The old treaty had proved irksome in

many ways, especially in that it left portions of the territory belonging to protected chieftains of both Powers as enclaves within the boundaries of the Portuguese or Dutch parts of the island. This led to frequent disputes and complaints on both sides. In order to obviate such complications in the future, a mixed boundary commission was appointed under the new treaty, which commission has determined new boundaries in Timor that are more satisfactory to the contracting parties than the old ones were. The new treaty contains, moreover, the important stipula- tion (alluded to under Holland, Recent History), that all future disputes relating to the possessions of either Power in Timor, or the decisions of the International Boundary Commission, will be referred to arbitration. Equally important is the declaration, signed by the contracting parties at the same time as the Lisbon treaty, to the effect that either Power will favour the subjects of the other in granting concessions, &c, to the exclusion of all other aliens. Thus Portugal and Holland have mutually secured the exclusive possession of Timor to themselves. Both principles are new, certainly as far as the Malay Archipelago is concerned, and might be applied with advantage in other parts of the Malay Archipelago, where more than one European Power possesses terri- tories and territorial rights. Timor is no longer, connected with New Guinea (compare Ternate).

Authorities. — Prof. P. A. van dek Lith's Netherlands India (1893-94, in 2 vols.), published in Dutch at Leyden ; and H. 0. Forbes, Wanderings of a Naturalist in the Eastern Archipelago. Some of the problems connected with the physical features of Timor are discussed in Zondervan's " Timor en de Timoreezen," Tijdschr. Aardr. Gen., v., 1888 (with bibliography). — Martin and Wichmann. Sammlungen des Geologischen Beichsmuseums. Ley- den, 1881-84. — Wichmann. "Bericht tiber eine Reise nach dem Indischen Archipel.," Tijdschr. Aardr. Gen., 1890-92, with sketches of Timor, map, &c. For the remarkable flying survey of-the south coast by the commandant of the Siboga expedition, exploring the deep seas and fauna of the Archipelago, see Bulletin (No. 35) of the Maatschappij ter bevordering van het natuurkun onderzoelc der N. I. Kolonien. In the earlier maps much of the south coast is laid down too far to the south.

~~(e. de v. ; C. M. K. ; H. Tl.)~~

~~Timor Laut (in Dutch, Timor Laoet), or Tenim- bae, a group of islands in the Malay Archipelago, to the S.W. of the Aru islands, between 6° 20′ and 8° 30′ S. and 130° 40′ and 132° 5′ E. They are politically divided into two districts. One is Larat, including the inhabited islands of Larat, Vordate, Molu, and Maro, together with many other islands uninhabited ; the other is Sera, in- cluding the Sera islands, Selaru, and the southern part of Yamdena, all inhabited. Only Yamdena and Selaru are by the natives called . Timor Laut ; all the others they call Tenimbar. Vordate, Molu, and south-eastern Yam- dena have a maximum height of 820 feet ; the rest are low and flat. Eitabel in Larat is the only safe roadstead during the east and west monsoons. The population is estimated at from 12,000 to 13,000 by BAedel, and at 19,342 by Van Hoevell. The only means of subsistence is the natives' primitive agriculture on a stingy soil, turtle and trepang fishery, and cattle-rearing. The yearly export (trepang, turtle, and kamuning wood) is valued at only from £850 to £1650.~~

~~See Forbes. " Three Months' Explorations in the Tenimbar Islands," in Proceedings ofB.G.S. 1884.— Riedel. Desluiken kroesharige rassen tusschen Selebes en Papua. 188(i. — Van Hoevell. "Tanimbar en Timor Laoet-Eilanden," in Tijdschr. Bat. Gen., xxxiii. 1889.~~

~~Tin. — Since 1875 a remarkable expansion has occurred in the production and consumption of this metal, which is still the rarest of what are known as the " common " metals. In the year named the world's total production was some 40,000 tons, of which 10,000 tons were produced by Cornwall, 10,000 by the Straits Settlements, about 8000 tons by Banka and Billiton, and about 11,000 tons by Australasia, the greater portion of the latter coming from New South Wales. At present the world's annual production is about 75,000 tons, of which about 46,000 tons come from the Straits Settlements, 14,000 from the~~

~~Dutch East Indies, 5000 from Australasia (Tasmania now taking the first place among these states), 5000 tons from Cornwall, and 5000 tons from Bolivia. There are a few other places where tin is met with, but they are practically unimportant. Tinstone occurs in its matrix, either~~

~~in or closely associated with fissure veins or disseminated through rock masses. It is also found in the form of rolled lumps and grains in alluvial gravels; it need hardly be said that the latter are secondary deposits, the products of the disintegration of the first-named primary deposits. Throughout the world, primary deposits of tinstone are in or closely connected with granite or acid eruptive rocks of the same type, its mineral associates being tourmaline, fluorspar, topaz, wolfram, and arsenical pyrites, and the invariable gangue being quartz : the only exception to this mode of occurrence is to, be found in Bolivia, where the tin ore occurs intimately associated with silver ores, bismuth ores, and various sulphides, whilst the gangue includes barytes and certain carbo- nates. Over five-sixths of the world's total production is derived from secondary alluvial deposits, but all the tin obtained in Cornwall and Bolivia is from vein min- ing, while a small portion of that yielded by Australasia comes from veins, and from granitic rocks carrying dis- seminated tinstone.~~

~~Mining and Dressing. — The alluvial deposits are almost invariably worked opencast, those of the Malay Peninsula and Archipelago chiefly by Chinese labour : in a few instances hydraulic mining has been resorted to, and in other cases true underground mining is carried on ; but the latter is both exceptional and difficult. The alluvial extracted, which in the Malay Peninsula and Archipelago carries from 5 to 60 lb of tinstone (or " black tin," as it is termed by Cornish miners) to the cubic yard of gravel, is washed in various simple sluicing appliances, by which the lighter clay, sand, and stones are removed, and tinstone is left behind comparatively pure, containing usually 65 to 75 per cent, of metallic tin (chemically pure tinstone containing 78-7 per cent.). Lode tin, as tinstone derived from primary deposits is often termed, is mined in the ordinary method, the very hard gangue in which it occurs necessitating a liberal use of explosives. The veinstuff is broken small either by hand or in rock-breakers, and stamped to fine powder in stamp mills, which are practically large mechanically-worked pestles and mortars, the stamp proper weighing from 500 to 1000 lb. The mineral, crushed small enough to pass a sieve with perforations -fa inch in diameter, leaves the stamps in suspension in water, and passes through a series of troughs in which the heavier mineral is collected ;~~

this then passes through a series of washing operations, which leaves a mixture consisting chiefly of tinstone and arsenical pyrites, which is calcined and washed again, until finally black tin containing about 60 to 65 per cent, of metal is left. The crude tinstuff raised in Cornwall carries on an average a little over 2 per cent, of black tin. The Bolivian tin ore is treated by first extracting the silver by amalgamation, &c, and afterwards concentrating the residues ; there are, however, great difficulties in the way of treating the poorer of these very complex ores, and several chemical processes for extracting their metallic contents are in course of being worked out.

Smelting. — The dressed ore is smelted by one of two main methods, viz., either in the shaft furnace or the reverberatory ; the former is the better suited to stream tin, the latter to lode tin, but either ore can be smelted in either way. Shaft furnace smelting is confined to those parts of the world where charcoal can still be obtained in large quantities at moderate prices. The furnace consists of a shaft, circular (or more rarely rectangular) in plan, into which alternate layers of fuel and ore are charged, an air

blast being generally injected near to the bottom of the furnace through one or more tuyeres. This was the primitive process all over the world ; in the East, South America, and similar regions, it still holds its own. In Europe, Australasia, and one large works at Singapore it has been practically replaced by the reverberatory furnace process, first introduced into Cornwall about the year 1700. All tin, except a small quantity produced by the shaft furnace process from exceptionally pure stream tin ore, requires refining by liquation and “boiling” before it is ready for the market.

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the Vegetable Creek Tin-mining Field. Sydney, 1887. — Rolker. "The Pro- duction of Tin," U.S. Geol. Survey, 1894.— Louis. "Straits Tin," Western Daily Mercury, 1895; "The Metallurgy of Tin," The Mineral Industry, 1896. — M'Killop and Ellis. "Tin Smelt- ing at Pulo Brani, Singapore," Inst. Civil Engrs., vol. cxxx. 1895- 96. — Inoalls. "The Tin Deposits of Durango," Trans. Amer. Inst. Min. Eng., vol. xxv. 1895. — Schnabel and Louis. Hand- book of Metallurgy, vol. ii. London, 1898.— Stelzner. "Die Silber-ZinnerzlagerstattenBolivias," Zeitsch. deutsch. geoh Gesell., 1897. (h. l*.)

Tinnevelly, a town and district of British India, in the Madras Presidency. The town is on the left bank of the Tambraparni river, on the other side of which is Palamcotta, the administrative headquarters of the district. It is the terminus of a branch of the South Indian railway, 44-4 miles S.W. of Madras. Population (1881), 23,221; (1891), 24,780 ; municipal income (1897-98), Es.28,160. It has two cotton mills, with 31,740 spindles, employing 1327 hands. The two colleges, Hindu and Church Mission, had 131 students in 1896-97; the two high schools, 797 pupils. There are also five printing-presses.

The district of Tinnevelly has an area of 5.387 square miles. Population (1881), 1,699,747; (1891), 1,916,095, showing an in- crease of 13 per cent, after the famine of 1876-78 ; average density, 356 persons per square mile. In 1891 the native Christians, chiefly Protestants, numbered 145,569, or nearly 8 per cent., a far higher proportion than in any other district of India. In 1901 the popu- lation was 2,060,759, showing a further increase of nearly 8 per cent. The land revenue and rates in 1897-98 were Rs.35,69,011, the incidence of assessment being R. 1.10. 7 per acre ; cultivated area, 1,145,900 acres, of which 282,818 were irrigated from tanks, wells, &c., including 44,611 from Government canals ; number of police, 1037 ; boys at school (1896-97), 55,149, being 39-4 of the male population of school-going age, the highest proportion in the province; girls at school, 9418, being 6-4 per cent.; registered death-rate (1897), 25-2 per 1000. The principal crops are rice, millet, other food-grains, cotton, and oil-seeds, with a little tobacco. Coffee is grown on 1284 acres on the slopes of the Travancore hills. The palmyra palm, whose juice yields toddy as well as a coarse

~~sugar, flourishes in certain tracts. The Shanans, or caste of toddy-drawers, have supplied many converts to Christianity. In 1899 their treatment by the Vellalars, or cultivating caste, led to serious riots and bloodshed. The chief irrigation work is the Srivaikuntam anicut, or dam, on the Tambraparni river, on which the capital outlay has been Rs.14,71,924. In 1897-98 the area irrigated was 41,668 acres, and the net profit was Rs.25,527. The South Indian railway runs through the district, with its maritime terminus at Tuticorin, the chief seaport. In 1897-98 the total sea-borne trade was valued at Rs.3,08,03,307, being just one-tenth of the trade of the province. The chief exports are rice to Ceylon and cotton to Japan and Europe. There are thirteen factories for ginning and pressing cotton, and one rice- cleaning mill.~~

~~Tippera (Tripura), a native state and British dis- trict of India, in the north-east of Bengal. The state is known as Hill Tippera. It represents that portion of the raja's territory that was never conquered by the Mahom- medans. The dynasty, which is of great antiquity, was converted to Hinduism many centuries ago; but the people, called Tipperas, still profess an aboriginal religion, similar to the neighbouring hill tribes.~~

~~The raja owns an estate of 589 square miles in the British dis- trict, where he ranks as an ordinary zamindar. His residence is at Agartalla, just within the boundary of Hill Tippera. Area of the state, 4086 square miles; population (1881), 95,637; (1891), 137,442, showing an apparent increase of 43 per cent., due to more accurate enumeration ; average density, 34 persons per square mile. In 1901 the population was 167,441, showing, a further increase of 22 per cent. The expenditure in 1897-98 was Rs.6,87,430, of which Rs.l, 38,000 was devoted to public works. Tolls are levied upon exports of forest produce, cotton, and oil-seeds. The raja's palace and other public buildings at Agartalla were seriously damaged by the earthquake of 12th June 1897.~~

~~The British district of Tippera (the administrative headquarters are at Comilla) has an area of 2491 square miles ; population (1881), 1,514,361 ; (1891), 1,782,935, showing an increase of nearly 18 per cent., by far the highest rate of increase in Bengal ; average density, 716~~

~~persons per square mile. Classified according to religion, Mahommedans in 1891 numbered 1,224,336 ; Hindus, 557,079 ; Christians, 182, of whom 57 were Europeans ; " others," 1338. In 1901 the population was 2,124,869, showing a further increase of 19 per cent., again the highest rate in the province. The land revenue and rates in 1897-98 were Bs.ll, 77,084 ; number of police, 377 ; boys at school (1896-97), 57,435, being 4-19 per cent, of the male population of school-going age ; registered death- rate (1897), 26 per 1000. The eastern border of the district is traversed by the Assam-Bengal railway, with a cross branch from Laksam to Chandpur ; but waterways still remain the chief means of communication. The exports are mostly rice, jute, and betel- nuts.~~

~~Tipperary, an inland county of Ireland, province of Munster.~~

~~Population. — The area of the administrative county in 1900 was 1,050,130 acres, of which 246,353 were tillage, 623,874 pasture, 403 fallow, 26,469 plantation, 35,788 turf bog, 9819 marsh, 67,471 barren mountain, and 39,953 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, includes the portions of the towns of Clonmel and Carrick-on-Suir formerly situated in Waterford. The popula- tion in 1881 was 199,612 ; in 1891, 173,188 ; and in 1901, 159,754, of whom 81,075 were males and 78,679 females, divided as follows among the different religions : Roman Catholics, 149,903 ; Protes- tant Episcopalians, 8689 ; Presbyterians, 444 ; Methodists, 550 ; and other denominations, 168. The decrease of population between 1881 and 1891 was 13-24, and between 1891 and 1901, 7-7 per cent. The average number of persons to an acre in 1891 was -16, and of the total population, 133,213 persons inhabited the rural districts, being an average of 99 to each square mile under crops and pasture. The following table gives the degree of education for the principal creeds in 1891 : —~~

~~Percentage.~~

~~e~~

~~I Males.~~

~~Females.~~

~~Total.~~

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~~o «~~

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~~Una~~

~~a~~

~~Read and write .~~

~~60,684~~

~~58,092~~

~~118,776~~

~~74-5~~

~~93 -T~~

~~98*1~~

~~95-4~~

~~Read only~~

~~6,856~~

~~7,788~~

~~14,644~~

~~9-7~~

~~2-9~~

~~4-4~~

~~2‘2~~

~~Illiterate~~

~~11,077~~

~~12,630~~

~~23,707~~

~~15-8~~

~~3-4~~

~~25~~

~~U~~

~~The percentage of illiterates among Roman Catholics in 1881 was 22-7. In 1891 there were 14 superior schools with 750 pupils (Roman Catholics, 662; and Protestants, 88), and 355 primary schools with 27,469 pupils (Roman Catholics, 26,234 ; and Pro- testants, 1235). The number of pupils on the rolls of the National Schools on 31st December 1900 was 26,674, of whom 25,518 were Roman Catholics and 1156 Protestants. The following table gives the number of births, deaths, and marriages in various years : —~~

~~Year.~~

~~Birtas.~~

~~Deaths.~~

~~Marriages.~~

~~1881 1891 1900~~

~~4523 3661 3296~~

~~3428 3046 3053~~

~~708 659 612~~

~~In 1900 the birth-rate per 1000 was 20-6, and the death-rate 19-1. The rate of illegitimacy was 2-3 per cent, of the total births. The total number of emigrants who left the country between 1st May 1851 and 31st December 1900 was 206,377, of whom 106,542 were males and 99,835 females. The chief towns in the county are Clonmel, Carrick-on-Suir, Tipperary, and Nenagh.~~

~~Administration. — The county is divided into four parliamentary divisions — North; South, Mid, and East — the number of registered~~

~~electors in 1901 being respectively 5994, 5190, 6613, and 6234. The rateable value in 1900 was £686,396. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the two grand juries were transferred to two county councils (one for each Riding), urban and rural district councils were established, and under that act the county now comprises eight urban and twelve rural sanitary districts.~~

~~Agriculture. — The following tables give the acreage under crops, including meadow and clover, and the amount of live stock in 1881,~~

~~1891, 1895, and 1900. The figures for 1900 are for the new administrative county : —~~

~~Year.~~

~~Wheat.~~

~~Oats.~~

~~o~~

~~$~~

~~o~~

~~Oh~~

~~‘5~~

~~E-i~~

~~Other Green Crops.~~

~~Meadow~~

~~and Clover.~~

~~Total.~~

~~1881~~

~~1S91~~

~~1895 1900~~

~~14,658 6,275 1,914 2,938~~

~~54,348 40,888 42,547 88,699~~

~~17,490 22,038 21,181 19,114~~

~~84,480 80,316 27,195 24,834~~

~~19,892 20,189 20,654 19,789~~

~~6612 8047 8084 9466~~

~~118,371 116,673 129,191 181,513~~

~~265,801 244,426 250,716 246,858~~

~~For 1900 the total value of the cereal and other crops was estimated at £1,551,209. The number of acres under pasture in 1881 was 602,9,12 ; in 1891, 621,394 ; and in 1900, 623,874.~~

~~Tear.~~

~~Horses~~

~~and Mules.~~

~~Asses.~~

~~Cattle.~~

~~Sheep.~~

~~Pigs.~~

~~Goats.~~

~~Poultry.~~

~~1881 1891 1895 1901)~~

~~28,987 33,910 35,226 32,889~~

~~12,871 15,091 15,716 17,412~~

~~244,029 280,810 268,476 297,218~~

~~205,850 272,969 221,859 251,202~~

~~74,540 87,695 82,274 73,797~~

~~12,952 16,796 15,532 16,050~~

~~681,816 661,863 688,476 755,706~~

~~The number of milch cows in 1891 was 85,532, and in 1900, 86,505. It is estimated that the total value of cattle, sheep, and pigs for 1900 was £4,311,730, Cork being the only county with a higher figure. In 1900 the number of holdings not exceeding 1 acre was 3625 ; between 1 and 5, 2714 ; between 5 and 15, 4413 ; between 15 and 30, 4801 ; between 30 and 50, 4035 ; between 50 and 100, 3414 ; between 100 and 200, 1480 ; between 200 and 500, 507 ; and above 500, 92 ; total, 25,081. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901, was 2585, amounting to £1,152,679. The number of loans for agricultural improvements sanctioned under section 31 of the Land Act, 1881, between 1882 and 1901 was 1095, and the amount issued £77,785. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations in 1847 to 31st March 1901 was £235,249.~~

~~Tipperary, a town and urban sanitary district in the above county, 110 miles S.W. of Dublin by rail. There are condensed milk and mineral water factories. New Tipperary, which was founded outside the town by Mr William O'Brien during the Plan of Campaign on the Smith-Barry estate, is now practically deserted. Population (1891), 6391 ; (1901), 6216.~~

~~Tipton, a city of Indiana, U.S.A., capital of Tipton county, a little north of the centre of the state, on the Lake Erie and Western railroad, at an altitude of 872 feet. It is in an agricultural and natural gas region, and has considerable trade. Population (1880), 1250 ; (1890), 2697 ; (1900), 3764 ; of whom 85 were foreign-born.~~

Tirah Campaign.— The sudden outbreak in 1897 of the Afridi tribes required to be promptly met in order to avert a general conflagration on the Indian frontier. The Afridis had for sixteen years received an annual subsidy from the Indian Government for the safeguarding of the Khyber Pass, in addition to which the Government had maintained for this purpose a local regiment entirely composed of Afridis, who were sta- tioned in the pass. Suddenly, however, the tribesmen rose, captured all the posts in the Khyber held by their own countrymen, and attacked the forts on the Samana Ridge, near Peshawar, one of which, Saraghari, made a memorable defence, the entire garrison (composed of Sikhs) dying at their posts. It was estimated that the Afridis and Orakzais could, if united, bring from 40,000 to 50,000 men into the field. The preparations for the

expedition occupied some time, and meanwhile the Mohmand rising north-west of the Khyber Pass was first dealt with (see Mohmand Expedition).

The general commanding was General Sir William Lockhart (q.v.), commanding the Punjab Army Corps ; he had under him 34,882 fighting men, officers and men, British and native, in addition to 20,000 followers.

Tirah is a fertile valley about 30 miles to the south-west of Peshawar, but cut off almost entirely by ranges of mountains. The district, which no white man had penetrated, was the summer home of the Afridis, whither they retire with their flocks and herds for pasture and agriculture. The frontier post of Kohat was selected as the base of the campaign, and it was decided to advance along a single line. On 18th October the operations commenced, fighting ensuing immediately. The Dargai heights, which commanded the line of advance, were captured without difficulty, bu.t abandoned owing to the want of water. On the 20th the same positions were gallantly stormed, with a loss of 199 killed and wounded. The progress of the expedition, along a wretched track through the mountains, was obstinately contested on 29th October at the Sampagha Pass leading to the Mastura valley, and on the 31st at the Arhanga Pass from the Mas- tura to the Tirah valley. The force, in

~~detached brigades, now proceeded to traverse the Tirah district in all directions, and to destroy the walled and fortified hamlets of the Afridis. The two divisions available for this duty numbered about 20,000 men. A force about 3200 strong commanded by Brigadier-General (afterwards Major-Genera] Sir Richard) Westmacott was first employed to attack Saran Sar, which was easily carried, but during the retirement the troops were hard pressed by the enemy, and the casualties numbered sixty-four. On 11th November Saran Sar was again attacked by the brigade of Brigadier-General (afterwards Sir Alfred) Gaselee. Experience enabled better dispositions to be made, and the casualties were only three. The traversing of the valley continued, and on the 13th November Brigadier-General Kempster's brigade visited the Waran valley vid, the Tseri Kandao Pass. Little difficulty was experienced during the advance, and several villages were de- stroyed ; but on the 16th, during the return march, the rearguard was hotly engaged all day, and had to be relieved by fresh troops next morning. The casualties numbered seventy-two. Almost daily the Afridis, too wise to risk general engagements, waged a perpetual guerilla warfare, and the various bodies of troops engaged in foraging or survey duties were constantly attacked. On 21st November a brigade under Brigadier-General "Westmacott was detached to visit the Rajgul valley. The road was exceedingly difficult, and steady opposition was encountered. The objects were accomplished, and the casualties during the retirement alone numbered twenty-three. The last important work undertaken was the punishment of the Chamkannis-Mamuzais and Massozais. This was carried out by Brigadier-General Gaselee, who joined hands with the Kurram movable column ordered up for the purpose. The Mamuzais and Massozais submitted immediately, but the Chamkannis offered resistance on 1st and 2nd December, the British casualties numbering about thirty. The Kurram column then returned to its camp, and Sir \V. Lockhart prepared to evacuate Tirah, despatching his two divisions by separate routes— the 1st under Major-General W. P. Symons (d. 1899) to return vid, the Mastura valley, destroying the forts on the way, and to join at Bara, within easy march of Peshawar, the 2nd division under Major-General Yeatman Biggs (d. 1898), and, accompanied by Sir W. Lockhart, to move along the Bara valley. The base was thus to be transferred from~~

Kohat to Peshawar. The return march began on the 9th December. The cold was intense, 21 degrees of frost being registered before leaving Tirah. The movement of the 1st division though arduous was practically unopposed, but the 40 miles to be covered by the 2nd division were contested almost throughout. The actual march down the Bara valley (34 miles) commenced on the 10th, and involved four days of the hardest fighting and marching of the campaign. The road crossed and recrossed the icy stream, while snow, sleet, and rain fell constantly. On the 10th the casualties numbered about twenty. On the 11th some fifty or sixty casualties were recorded among the troops, but many followers were killed or died of exposure, and quantities of stores were lost. On the 12th the column halted for rest. On the 13th the march was resumed in improved weather, though the cold was still severe. The rearguard was heavily engaged, and the casualties numbered about sixty. On the 14th, after further fighting, a junction with the Peshawar column was effected. The 1st division, aided by the Peshawar column, now took posses- sion of the Khyber forts without opposition. Negotiations for peace were then begun with the Afridis, who under the threat of another expedition into Tirah in the spring at length agreed to pay the fines and to surrender the rifles demanded. The expeditionary force was broken up on the 4th April 1898. This

campaign was the greatest since the Indian Mutiny, not excepting the Afghan war of 1878-80. A memorable feature was the presence in the fighting line of the Imperial Service native troops under their own officers, while several of the best known of the Indian princes served gallantly on Sir W. Lockhart's staff. The total casualties were —

Killed, all ranks Wounded

British Officers in addition.

Killed "Wounded

~~Killed Wounded~~

~~Native Officers in addition.~~

~~287~~

~~853~~

~~10~~

~~23 56~~

~~4 16~~

~~besides very many followers.~~

~~(c. J. B.)~~

~~Tiraspol, a district town of Russia, in the govern- ment of Kherson, on the left bank of the Dniester, 73 miles by rail north-west of Odessa. It is surrounded by gardens, has a number of steam flour-mills and tobacco factories, and carries on a considerable trade with Eumania. Population (1897), 27,585.~~

~~Tirch, the ancient Teira, a town of Asia Minor, situated in the valley of the Kuchuk Mendere (Oaystrus) at the foot of Mount Messogis. It is connected with Smyrna by railway, and has a trade in raisins, wheat, rice, tobacco, and cotton. The population consists of 8000 Moslems and 6000 Christians.~~

~~Tirnovo (Bulgarian, Tmovo), the chief town of a department, Bulgaria, on the Jantra, an affluent of the Sistova, on the Sofia-Varna railway, at the junction of the branch line from Rustchuk, 124 miles E.N.E. of Sofia. The town consists of two divisions — the Christian quarter, situated chiefly on a high rocky plateau, and the Turkish quarter, on the lower ground. On the Tsarevetz Hill above the town are the remains of the ancient fortress. The Husardjaini mosque is now used as a military powder and dynamite factory. In the old Christian quarter there are some interesting churches of the Middle Ages. Numerous~~

~~antiquarian remains have also been discovered. There are a gymnasium and a high-class girls' school. The town possesses large dye-works, and important manufac- tures of copper utensils.~~

~~Tirnovo was the ancient capital of Bulgaria, and from 1186 until its capture by the Turks, 17th July 1394, the residence of the Bulgarian Tsars of the house of Aiden. From the beginning of the 13th century it was also the seat of the patriarchate of Bulgaria, until the suppression of the patriarchate in 1767. In 1877 it was taken from Turkey by the Russians, and in 1879 Alexander of Battenberg was there elected Prince of Bulgaria. Population~~

~~(1892), 12,858.~~

~~Tirol, a province of the Austrian Empire. It may be roughly described as the mountainous region inter- vening between Munich and Verona, so that, owing to the Brenner Pass connecting those two cities, Tirol has always been of extreme military importance. It com- prises all the highest summits of the Austrian Alps, which culminate in the Ortlerspitze (12,802 feet). The German- speaking north and central Tirol are sharply distinguished in many respects from the Italian-speaking south Tirol, the latter including the now well-known group of Dolo- mite mountains. North Tirol sends its waters to the Black Sea, while those of south Tirol flow to the Adri- atic. The area of Tirol (excluding Vorarlberg, often counted with it) is 10,300 square miles, of which about 4000 square miles are covered by forests. In 1890 the total population was 812,696, and in 1900, 850,062. The inhabitants are mostly Roman Catholic. More than one- half are German-speaking, and of the remainder the vast majority speak either Italian or the ancient and curious~~

~~Ladin dialect. Erom an administrative point of view Tirol forms twenty-one districts (Bezirke). Its capital and largest town is Innsbruck. The other most important towns are Trent (24,908 in 1900), Bozen (13,632), and Rovereto (10,180).~~

~~The mountain pastures ("Almen") are less carefully looked after than those in Switzerland, one reason being that they often belong not to the~~

~~neighbouring villages, but to far-distant places, so that those who in Switzerland would be their owners are helpless. The vine-growing area is about 40,500 acres (of which 26,750 acres are in south Tirol), of which the mean annual produce may be put at 8,360,000 gallons. The silk industry has fluctuated greatly, rising from 1,400,000 kilogrammes in 1881 to 2,150,000 kilogrammes in 1888, but falling in 1890 to 1£ million kilogrammes.~~

~~See in general vol. xiii., Tirol (Vienna, 1893), of the great official work entitled Die oeslerreichisch- Ungarische Monarchie in Wortund Slid. The following more special works may be consulted : — W. A, Baillie-Groiiman. Tirol and the Tirolese (London, 1876) ; Gaddings with a Primitive People, 2 vols. (London, 1878) ; and Sport in the Alps (London, 1896). — Miss R. H. Bosk. The Valleys of Tirol. London, 1874.— J. Egger. Geschichte Tirols, 3 vols. Innsbruck, 1872-80.- — J. Gilbert and G. C. Churchill. The Dolomite Mountains. London, 1864. — Max Haushofen. Tirol. Bielefeld and Leipzig, 1899. — Alfons Huber. Geschichte d. Vereinigung Tirols mit Oesterreich. Innsbruck, 1864. — L. Pdrt- scheller and H. Hess. Der Hochtourist in den Ostalpen, 2 vols. Leipzig and Vienna, 1894 (2nd edition in 3 vols, in 1899). — E. Riohter. Die Erschliessung der Ostalpen, 3 vols. Berlin, 1893-94. — A. Schaubach. Deutsche Alpen, 5 vols. Jena, 1865-71. — Chr. Schneller. Landeskunde von Tirol. Innsbruck, 1872. — F. A. Sinnacher. Beitrage z. Geschichte d. bischofl. Kirche Saben und Brixen (really a special territorial history of Tirol), 10 vols. Brixen, 1821-37. — I. V. Zingerle. Sagen, Marchen, und Gebrduche aus Tirol. Innsbruck, 1859. — I. V. Zingerle and K. Th. von Inama-Sternegg. Die tirolischen Weisthiimer, 4 vols. Vienna, 1875-88. (w. a. b. c.)~~

~~Tirupati, or Tripetty, a town of British India, in the North Arcot district of Madras, 84 miles north-east of Madras, with a station on the Madras railway. Population (1891), 14,238 ; municipal income (1897-98), Rs.1,84,840. It is famous for a pagoda or temple on a neighbouring hill, 2500 feet above the sea, which is one of the most frequented places of pilgrimage in southern India. Two high schools are maintained, one by a German mission, the other by the high priest of the temple.~~

~~Tisserand, Francois Felix (1845-1896), Erench astronomer, was born at Nuits-Saint-Georges, Cote-d'Or, on the 13th January 1845. In 1863 he entered the ficole Normale Superieure, where his remarkable talents were soon recognized, and on leaving he went for a month as professor at the lycee at Metz. Le Verrier, however, who had formed a just estimate of his abilities, offered him a post in the Paris Observatory, which he accordingly entered as astronome adjoint in September 1866. In 1868 he took his doctor's degree with a brill iant thesis on Delaunay's Method, which he showed to be of much wider scope than had been contemplated by its inventor. Shortly afterwards he went out to Malacca to observe the famous solar eclipse of 18th August 1868. In 1873 he was appointed director of the observatory at Toulouse, whence he published his Recueil d'exercices sur le Calcxd infinitesimal, and in 1874 became corresponding member of the Academie des Sciences. He took part in the French expeditions of 1874 to Japan and of 1882 to Martinique to observe the transits of Venus. In 1878 he was elected a member of the Academie des Sciences in succession to Le Verrier, and became a member of the Bureau des Longitudes. Tn the same year he was appointed professeur suppliant to Liou- ville, and in 1883 he succeeded Puiseux in the chair of celestial mechanics at the Sorbonne. In the midst of so many occupations Tisserand always found time to con- tinue his important researches in mathematical astronomy, and the pages of the Comptes Rendus bear witness to his~~

~~surprising activity. His writings relate to almost every branch of celestial mechanics, and are always dis- tinguished by rigour and simplicity in the solution of the most difficult problems, and by a clearness and cle- gance peculiarly French. He treated in a masterly manner {Bulletin Astronomique, 1889) the theory of the capture of comets by the larger planets, and in this con- nexion published his valuable Criterion for establishing the identity of a periodic comet, whatever may have been the perturbations brought about in its orbit, between successive appearances, by the action of a planet. His principal~~

~~work, TraiU de Mecanique celeste, is the noblest and most lasting monument to his memory, and is worthy to stand beside the Micanique cdleste of his fellow- countryman, Laplace. In this treatise, published in four quarto volumes, the last of which appeared only a few months before his death, he fused into one harmonious whole the researches of Laplace and those of other workers in the same field since his time. It furnishes a faithful and complete r&sumA of the state of knowledge in that department of astronomy at the end, as Laplace's great work did for the beginning, of the 19th century. In 1892 he succeeded Mouchez as director of the Paris Observatory, and as president of the committee of the photographic chart of the heavens he contributed largely to the success of that great project. Under his direction the revision of Lalande's catalogue was brought almost to completion, and four volumes of the Annates de V Observatoire de Paris exhibit the progress made in this important undertaking. He was also editor of the Bulletin Astronomique from the beginning, and contributed many important articles to its pages. He died suddenly, in the fulness of his power, of congestion of the brain, on 20th October 1896. (a. a. e.)~~

~~Tissot, James Joseph Jacques (1836-1902), French painter, was born at Nantes on 15th October 1836. He studied at the iScole des Beaux Arts in Paris under Ingres, Flandrin, and Lamothe, and exhibited in the Salon for the first time at the age of twenty-three. In 1861 he showed " The Meeting of Faust and Marguerite," which was purchased by the State for the Luxembourg Gallery. At this period he was a follower of the classical tradition, a careful draughtsman with a sense of composition but no particular originality of idea. His first characteristic period made him a painter of the charms of women. His models were of the worldly type — demimondaine would be more strictly accurate as a description of the series of studies which he called " La Femme a Paris." He fought in the Franco-German war, and. then, falling under suspicion as a Communist, he left Paris for London. Here he studied etching with Sir Seymour Haden, drew caricatures of public men for Vanity Fair, and painted portraits as well as genre subjects. It was many years before he turned to the chief labour of his career — the production of a series of 700 water-colour drawings to illustrate the life of Christ and the Old Testament. Some sudden shock or bereave- ment~~

~~was said to have turned his thoughts from ideals of the cafe and the boulevard into a more serious channel. He disappeared from Paris, whither he had returned after a stay of some years in England, and went to Palestine to begin the task which occupied him during the rest of his life. In 1895 the series of 350 drawings of incidents in the life of Christ was exhibited in Paris, and the follow- ing year found them on show in London. They were then published by the firm of Lemercier in Paris, who had paid him 1,100,000 francs for them. After this he turned to the scenes of the Old Testament, upon which he was still engaged at the abbey of Buillon, in the department of Doubs, France, when he died on 8th~~

~~August 1902. The merits of Tissot's Bible illustra- tions lay rather in their imaginative power and in the care with which he studied the details of scenery than in any quality of religious emotion. He seemed to aim, above all, at accuracy, and, in his figures, at a vivid realism which was far removed from the conventional treatment of sacred types. His achievement called forth admiration for his genius, but it was the genius that is an infinite capacity for taking pains, not the genius of insight and inspiration that is found in the greatest art.~~

~~Tisza, Koloman von (1830-1902), Hungarian statesman, was sprung from a noble Hungarian family whose estates were situated in the county of Bihar, and was born at Geszt on the 16th of December 1830. After studying law, in the year 1848 he received an appointment in the ministry of education under Baron Eotvos. He took no part in the revolution, retired from the public service, and for some years lived in seclusion on his estates. He first came prominently before the public notice in 1859. In this year he took the leading part in the agitation which was aroused by the attempt of the Government to interfere in the autonomy of the Hungarian Protestant Church. In 1861 he was elected a member and first vice-president of the new Diet, and from this time was leader of the Left Centre in the Lower House. While he was opposed to the demands of the extreme Kossuth and Republican party, he was not always prepared to accept all Deck's pro- posals for arranging a compromise with the emperor. The differences were however small, and in the crisis of 1865-66 he and his followers worked~~

~~in close har- mony with Deak. He was a loyal supporter of the Ausgleich, in the discussions on which he had taken a large part. He had also made himself known as a supporter of free trade and other Liberal reforms, which he advocated in the press. After 1866 he was for many years leader of the parliamentary Opposition to the admin- istration of Andrassy. After several times refusing office, he accepted the post of minister of the interior in 1875, and in the end of the same year became president of the ministry. This post he held till the year 1890. For a history of his administration the reader is referred to the article on Hungary. The strong measures which he took to further Magyar nationality in the German and Slavonic districts won him great popularity among his own countrymen, and enabled him to surmount the crisis caused by the occupation of Bosnia. In foreign policy he took little interest, but he was successful in the finan- cial administration, and did much to develop the material resources of the country. From 1887 to 1889 he was minister of finance. He resigned in March 1890 and died on 23rd March 1902. His brother Ludwig (born 1832) held many important posts in the internal admin- istration, and on two occasions, from 1871 to 1873 and from 1892 to 1894, was a member of the ministry. He received the title of count in 1883. This title descended to Stephan, the eldest son of Koloman, who became leader of the Liberal party in the Lower House of the Hungarian Parliament.~~

~~Titan Cranes. — Probably no branch of engineer- ing has developed more rapidly of recent years than that which is concerned with the design and construction of harbours. Breakwaters were in earlier days generally con- structed of masonry walls or of plain " rubble mounds," i.e., of heaps of rough large stones thrown into the sea and left to be consolidated by the action of the waves. But, owing to the increased depth of water and the more ex- posed sites in which they are now built, new methods have gradually been evolved. Amongst the most noteworthy~~

~~has been the employment of Portland cement, from which are made artificial blocks of stone that have many advantages over the natural blocks previously used. Breakwaters are now mostly built up of such concrete blocks, either directly from the bottom, or on a low rubble mound foundation, the top of which is kept such a distance below the surface as to be out of the reach of the greatest wave action. The blocks are generally of very large size, seldom weighing less than 10 tons, and often as much as 40 or 50 tons or even more.~~

~~The typical method of block-setting formerly was to construct over the whole extent of the site a timber staging, resting on heavy piles driven into the bed of the sea ; this staging supported lines of railway placed at a very wide gauge apart, and on the rails ran " travellers," spanning the whole width of the breakwater. The traveller beams carried other rails placed at right angles to the former, and these carried in their turn a powerful lifting crab, which could be traversed across from side to side. The whole machine could be moved forward on the staging as the work proceeded, and thus the whole area within the lines of staging could be perfectly com- manded for the purpose of block-setting. The concrete blocks were brought from the land along " service roads " laid along the staging; when they came under the travellers they were lifted by the crab off the railway truck, and after being travelled and traversed to the cor- rect position were lowered to the divers, who saw that they were accurately placed in their final situation. Within wide limits this method was an exceedingly con- venient one, and it is still largely made use of for certain situations, with of course the improvement of substituting steam or other motive power for hand. Certain diffi- culties, however, arise with the stagings, especially in exposed sites, for they are very expensive to construct, and very liable to damage from storms. In every break- water there must of necessity be during the period of construction an unfinished or so-called " scar end," which, with the staging around and in front of it, is particularly liable to damage by the sea, more especially in those works which can only be carried on during a fine season and have to be left during the winter in an unfinished state exposed to heavy storms. A single winter storm has often done enormous injury by washing away the greater portion of the staging and the plant carried on it, thus involving the~~

~~expenditure of very large sums for restoration and the loss of much working time. In view of these facts, it gradually came to be recognized that instead of relying on a temporary staging placed in the most exposed situation for the support of the block-setting machinery, it was quite possible to utilize the finished work itself ; and this idea, coupled with the further one of making the whole block-setting plant self-contained and portable, resulted in the introduction of the " Block-setting Titan " of the present day.~~

~~AH the early Titans were what may be called " rectangular " or " non-revolving " machines, in distinction to the latter " revolving" machines. They consist essentially of a portable structure which travels on wheels running on rails laid at a very wide gauge on the surface of the completed portion of the work, this substructure or carriage being sufficiently raised in the centre of its breadth to leave a clear passage-way beneath it for the trucks with concrete blocks to pass right up to the end of the -work. The upper part of the carriage is extended forwards in the form of two great projecting arms or cantilever girders, which reach out over the water and carry a travelling crane of similar construction to those previously used on the timber staging. The traveller is worked by a steam engine and boiler placed at the rear end. At the back of the machine is also placed the counterpoise required tcbalance the weight of the concrete block and of the traveller when they are run out over the water ; for this counterpoise a large tank filled with sea-water has often been used, though latterly blocks of concrete are more usually adopted. The driving engine is so designed that it can be dis- engaged from the shafting which actuates the traveller, and coupled to the mechanism which propels the Titan along the rails~~

~~laid on the breakwater. The operation of the Titan is very simple. The block is lifted in the blqckyard on to a truck, and run down the railway until it comes within reach of the traveller. It is then raised just sufficiently to free it from the truck and travelled forwards over the water, into which it is lowered in order that the partial buoyancy of the water may relieve the Titan of a portion of the overhanging weight. The next operation is to travel it farther forward or traverse it to either side~~

~~as far as may be neces- sary to bring it exactly over the position where it is desired to set it, and finally it is lowered until it takes a bearing on the rubble mound or on the blocks which were laid before it. All these operations are controlled by signals received from the divers who are working below the surface. When a sufficient length has emerged above high- water mark the railway is lengthened and the Titan moved forward to construct another section.~~

~~It will thus be seen that the essential features of this type of Titans are powerful lifting machinery, the capacity of running out heavy weights over the water horizontally, and portability. But while they proved very successful and useful pieces of plant, and may still be efficiently employed in places where the water is not too deep and the section of wall is suitable, they have several disadvantages or limitations. Their overhang is comparatively short, and is further reduced to a certain extent by the necessity of leaving sufficient space at the front end for the truck carrying the blocks to get within reach of the lifting gear. A still more serious objection is that they are quite unable to deal with material which, as is very often the case, has to be placed outside the line of rails on which they run. It seems to us now very simple to suggest that the whole upper part of the Titan should be made to revolve round a centre pivot, but curiously enough the machine underwent a whole series of intermediate stages before it settled down to its present form, all of which were dictated by the primary object of setting blocks outside the normal range. Special " side- setting machines " were designed with the overhanging members placed at right angles to the pier instead of parallel to it ; these followed behind the main machine, to put in the side blocks after the principal work was done. Titans were also constructed which could be twisted round bodily, the railway wheels being made to swivel like castors. Others had a superstructure which was con- nected to the under-carriage at the back end by a fixed pivot, and rested at the front on rollers running on a "roller path" of segmental shape ; these machines could be radiated through an arc of a circle sufficiently great to enable the requisite range sideways to be attained. The final step was the very obvious one of placing the pivot in the centre of the truck, and extending the roller~~

~~path until it formed a complete circle, thus producing a Titan that could be turned right round.~~

~~Local circumstances may still sometimes justify the choice of any of these types, but nearly all the later machines are made to revolve through a complete circle. This has proved to be of great practical advantage. In many cases, the breakwater to be con- structed being a detached work without any connexion with the land, it is necessary\to bring the blocks up to the work in barges. From these barges the revolving Titan, working simply as a huge crane, is able to lift the blocks and stack them on the pier at the back of the machine until wanted — an operation quite impossible with a non-revolving machine. Even when the blocks are brought forward on trucks the revolving Titan can pick them off the truck when placed in its rear, and is thus, as previously indicated, enabled to stand nearer the end. In this way the available over- hang is increased, and with the completely revolving machine the blocks can be set as far out at each side as in front. In addition, certain structural advantages are gained by the adoption of the revolving type ; e.g., considerably greater overhang with a given weight of machine. This question of overhang is one of para- mount importance to the designer both of the breakwater and of the Titan. In a regularly built' breakwater in course of con- struction, the lowest layer of blocks is always the longest, and the last cross row in this layer forms the bottom step of a great flight which rises step by step until it reaches the surface, where the top step consists of the cross row of blocks forming for the time being the end of the surface layer. Now, the deeper the water, the greater the number of steps and the greater the dis- tance of the bottom step in advance of the top one ; and it is this distance which practically settles the required overhang, though it is also to a considerable extent affected by the way in which the blocks break joint or are bonded together, and by the size of the blocks. In a pier built with a sloping bond the tiers of blocks break joint on lines placed more nearly upright than horizontal (about 60° is a usual angle), and this gives for obvious reasons a much shorter scar end, and one well suited for setting by the older type of Titan with short overhang. Taking all these points into consideration, it has been found necessary gradually to increase the oveThang beyond that which was practicable~~

~~with the older type. In the revolving machines the dimension which determines the overhang is the “radius,” or the horizontal distance from the centre pivot to the~~

~~load when travelled outwards as far as it will go. A very usual radius for an average size of Titan is now about 75 feet, but radii are found in the largest machines ranging up to as much as 100 feet. Even those not conversant with engineering matters will appreciate the enormous size and power of a machine that will pick up a block weighing 50 or 60 tons and swing it round in a circle 200 feet in diameter.~~

~~The modern Titan therefore consists of a high truck running on a wide railway and carrying on its upper side a great circular turn- table and a centre pin around which revolves a massive super- structure. The essential features of the revolving upper part are the long horizontal arm on which the load is run out, and the platform carrying the lifting machinery, engines and boiler, and also at the rear end the concrete ballast. There are two methods of supporting the horizontal arm : one is to construct it in the form of two stiff cantilever girders, either built up of solid plates~~

~~36-TON BLOCK-SETTING TITAN~~

~~Fig. 1. — 36-ton BlocK-setting Titan Crane.~~

~~of steel or of openwork lattice bracing ; and the other to erect on the superstructure a so-called ” king-post,” and to support the arm or “jib ” by tension rods in a somewhat similar manner to the rods of a suspension bridge. The former are known as ” canti- lever ” machines and the latter as ” overhead trussed ” machines. Which of these two types should be adopted in any given case is, in the writer’s opinion, very much a matter of fashion or individual preference ; but, speaking generally, it may be said that for loads over 40 tons combined with a radius of over 75 feet the cantilever type would now be the one more~~

generally adopted. Fig. 1 illus- trates the method of working with a Titan jsetting blocks with inclined bond as described above, and Fig. 2 ‘(see Plate) shows a similar machine setting apron blocks at right angles to the line of the breakwater at South Shields. Fig. 3 (see Plate) shows one of the two large cantilever machines built by Messrs Stothert and Pitt of Bath, used for the Admiralty harbour works at Gibraltar. As will be seen, they are of the cantilever type, with open lattice-work jib ; they can set blocks weighing 36 tons at a maximum radius of 75 feet. The concrete block is suspended by wire ropes from a trolley which can be moved in or out along the horizontal jib ; the ends of the lifting rope are attached to a large revolving barrel which can be set in motion by the engines, lowering out being effected by the weight of the block itself and the descent controlled by Matthew’s •hydraulic brakes, which absorb the work given out in lowering by forcing water through a narrow orifice. The illustration also shows the large circular rings with the rollers between them on which the whole upper part revolves, the turning motion being given by a steel pinion which gears into a circular fixed toothed ring attached to the lower roller path. For the travelling move- ment along the breakwater there is a shaft which passes down through the centre pin and communicates motion to the wheels on which the Titan runs. The large box or tank under the boiler contains the necessary concrete ballast, and it will be seen that the engines, boiler, and machinery are placed as far back as they conveniently can be, in order to assist the balance and to get a long straight pull for the wire ropes. The lower wheels are fitted with springs, to allow for inequalities of the railway. The break- water at Gibraltar is a detached work, which was commenced by floating out a large steel caisson and sinking it until it rested on a rubble mound. It was then filled with concrete so as to form an enormous monolith of artificial stone, on which the first Titan was erected and employed to lay blocks until a sufficient length of wall was built for it to be moved forward to make room for the erection of the second machine. The two were then set back to back, the distance between them being gradually increased as the

work proceeded. For a further description of the breakwaters and other naval works at Gibraltar the reader is referred to the article on

~~Dockyards.~~

~~The introduction of these Titans has been of enormous service to the harbour engineer. They have enabled harbours to be built in difficult situations at much less cost than by previous methods and in much less time, while a special advantage is the facility with which they can be brought up to the work and removed again, since in this way short spells of fine weather can be utilized and the risk of loss is reduced to a minimum. In many works it is a regular rule to run the setting plant back to a safe place and anchor it fast every evening after the day's work is done ; and that this is not an unnecessary precaution will be seen when it is remarked that in several instances Titans have been carried along the rails by the force of the wind and the waves and lost over the end or washed bodily into the sea.~~

~~The huge blocks which are placed in position in the sea by the Titan require elaborate machinery for their preparation. The con- crete has to be mixed out of sand, shingle, and cement, then placed in the moulds and allowed to set ; when sufficiently firm to permit of being removed, the blocks have to be stacked in the blockyard until seasoned for use, and finally they have to ' be lifted on to the heavy railway trucks which con- vey them to the Titan. All these operations involve the use of spe- cially designed plant, among which may be mentioned particularly the great Goliath cranes which span the blockyard and handle the blocks.~~

~~Little has been written on the special subject of the Titan, but a few descriptions of single machines may be found in the files of the Engineer and Engineering , and a general resume in Pitt's paper Sea-Works," Proc. Inst. C.E.,~~

~~"On Plant for Harbour vol. cxiii.~~

~~and~~

~~(w. P*.)~~

~~Tithes (England and Wales). — The payment of tithes, or the tenth part of the produce of lands, and in some cases of the profits of labour,~~

towards the maintenance of the beneficed clergy, has been known to English law since the 8th century, and was certainly established before the Norman Conquest. A full discussion of their origin and history is to be found in Lord. Selborne's Ancient Facts and Fictions concerning Churches and Tithes, and the History oj the Law of Tithes in England, by G. Edwardes Jones.

In present circumstances, the subject is perhaps best dealt with in two chronological divisions — tithes under the system existing previously to the Commutation Acts, and tithes under the system then introduced.

I. Whether or not, as it is said, before the Council of Lateran in 1180, a man could have given his tithes to any church or monastery that he pleased, at any rate since that time, with the division of dioceses ^jj^jj^! into parishes, they now of common right belong tioaActs. to the church within whose parish they arise, although by prescription they may belong elsewhere. The general rule was said to be that all lands within a parish are subject to tithes, and a layman was not allowed to prescribe generally that his lands were exempt; but he had to show a special exemption, and no length of posses- sion was regarded in law in view of the maxim nullum tempus occurrit ecclesice, although equity did take account of it. The tithes in places extra-parochial, e.g., forest lands, belong to the Crown, although by canon law they were to be disposed of by the bishop ; but by custom a parson or vicar might be entitled to them. The tithes of tithable cattle pasturing in any waste or common ground whereof the parish is not certainly known, were made

Fig. 2. — Titan Crane setting Apron Blocks at the Breakwater at South Shields.

Fig. 3.— Cantilever Type of Titan Crane used for the British Admiralty Harbour Works at Gibraltar.

~~payable to the parson of the parish where the cattle dwell, by a statute of Edward VI.~~

~~Tithes were classified according to their nature as prse- dial, or arising immediately from the ground, e.g., grain of all sorts, hay, wood, and the like ; mixed, or arising from things immediately nourished by the ground, e.g., colts, lambs, eggs, and the like ; or personal, namely, of profits arising from the honest labour and industry of man, and being the tenth part of the clear gain, e.g., fishing, mills, and the like ; or according to value, as great, e.g., corn, hay, and wood ; or little, which embraced all others. Of common right tithes were only payable of such things as yield a yearly increase by the act of God, and generally only once a year. They were not payable of the following, except by custom: things of the sub- stance of the earth, such as coals, minerals, turf, and the like ; things ferce naturae, such as fish, deer, and the like ; things tame, such as fowls, hounds, or fish kept for pleasure or curiosity; barren land, until it is con- verted into arable or meadow land, and has been so for seven years; forest land, if in the hands of the king or his lessee, unless disafforested ; a park which is dis- parked ; or glebe land in the hands of the parson or vicar, which was mutually exempted from payment by the one to the other, but not if in the hands of the vicar's lessee. Another exception to the incidence of tithes were abbey lands. These were exempted gene- rally by Pope Pascal II. while in the hands of their owners, but the privilege was restricted by Pope Adrian IV. in the time of Henry II. to the three religious orders of Cistercians, Templars, and Hospitallers (to whom the Templars' lands were given on their dissolution in 17 Edw. II.), to which Pope Innocent III. added the Prae- monstratenses. The Council of the Lateran in 1215 further restricted this exemption to lands of which these orders were in possession before that Council. A custom by the religious to obtain exemption for lands let to their tenants by means of bulls from the Pope was put an end to by a statute of Henry IV. making the acquisition or use of such bulls henceforward a praemunire. When the re- ligious houses were dissolved by Henry VIII., in the case of the greater abbeys and priories the exemptions from payment of tithes enjoyed by them passed to the Crown or the persons to whom the Crown assigned them, and thus any lands which might have been thus exempted, whether~~

~~they had been actually so or not, were presumed to be exempt ; and a further exemption was created by parsonages coming into the same hands as tithable lands, which lasted so long as such union continued.~~

~~A further exemption from tithes was given by an Act of 1832 (2 & 3 Will. IV. 100), which fixed a period of prescription against claims of tithe by laymen or cor- porations aggregate, of thirty years during which there had been no payment of tithes or a modus or composition had existed, in the absence of contrary evidence, and in any case of sixty years ; and against corporations sole, of sixty years or the tenures of two successive incumbents and three years after the entry of a third. The tithes which came into lay hands by the dissolution of the religious houses and the previous suppression of alien priories by Henry V. became in all respects incorporeal freehold property. Under the Limitation Act of 1833 twenty years of adverse possession of an estate in tithes gave a good title, except as against spiritual or eleemosynary corporations sole whose right to recover tithes was limited if at all to a period of two incumbencies and six years afterwards, or sixty years (§ 29).~~

~~Tithes were generally recovered by a writ against the owner of the tithable property usually brought in the ecclesiastical courts (questions of title to tithes being reserved to the temporal courts), the jurisdiction of which~~

~~in this respect was confirmed b/ the statutes Circumspecte agatis (13 Edw. I.), Articuli Gleri (9 Edw. II.), and others of Henry VIII. and Edward VI., and was enforced by ecclesiastical censures and the writ de excommunicato capiendo; and an Act 2 & 3 Edw. VI. made any person refusing to set out tithes liable to pay double the value in the ecclesiastical court or treble in a common law court. Tithes of small amount or due from Quakers could be recovered by summary proceedings before justices under statutes ranging from William III. to Victoria. Tithes could also be sued for in equity, especially the equity side of the Exchequer. A custom also sprang up, and was common at the time of the Commutation Acts, for a tithe-owner to accept a fixed sum of money or fixed quan- tity of the goods tithable in place of the~~

~~actual tithes, known as a modus decimandi, whether in respect of a whole parish or only of particular lands within it ; and this could be sued for in the ecclesiastical courts. Tithe- payers could also file bills in equity to establish a modus against a tithe-owner. In the City of London there were customary tithes; in other towns and places there were compositions for tithes which were confirmed by local Acts of Parliament ; and according to a return presented to the House of Commons in 1831, there were passed between 1757 and 1830 no less than 2000 local Acts containing clauses for the commutation of tithes. Enclosure Acts often gave a portion of the lands enclosed to the spiritual or lay rector, and ex- empted the rest from tithes ; and in other local Acts a corn rent or yearly money payment was substituted for tithes. Except, however, where made under par- liamentary authority, no composition for tithes, although made between the landowner and the parson or vicar with the consent of the patron and ordinary, bound a succeeding incumbent, the statute 13 Eliz. 10 prohibiting any parson or vicar from making any conveyance of (inter alia) tithes, being parcel of the possessions of their churches, to any persons, except leases for twenty-one years or three lives.~~

~~II. The principle of the Tithe Commutation Acts (1836- 1860) is to make permanent and general the system which had been only partial or temporary (in _ most cases), and to " substitute a corn rent (known as After the a tithe rent charge), permanent in quantity and tiJjj'%!ts~ payable in money, but fluctuating in value, for all tithes, whether payable under a modus or composition or not, which may have heretofore belonged either to eccle- siastical or lay persons" (Phillimore, Eccles. Law, ii. 1161).~~

~~Commissioners (now the Board of Agriculture) are appointed to execute the Acts ; a rent charge on all lands liable to tithes at the time of the passing of the first Act is substituted for those tithes, of which the gross amount is ascertained either by voluntary parochial agreement, or, failing that, by compulsory award con- firmed by the Commissioners ; and the value of the tithes is fixed in the latter case by their average value in theparticular parish during the seven years preceding Christmas 1835, without deduction for parochial or county~~

~~and other rates, charges, and assessments falling on tithes, the rent charge being liable to all the charges to which tithes were liable. The rent charge is apportioned on all the lands liable in the parish, and such apportionment may be altered or a new one made : and the value of the rent charge is fixed at the value (at the time of confirmation of the apportionment) of the number of imperial bushels and decimal parts of bushels of wheat, barley, and oats as the same would have purchased at the prices so ascertained by the advertisement (of prices of corn) to be published immediately after the passing of the Act 6 & 7 Will. IV. 71, in case one-third part of such rent charge had been invested in the purchase of wheat, one-third part in the purchase of barley, and the remaining third part in the purchase of oats ; and the respective quantities of wheat, barley, and oats so ascertained shall be stated in the draft of every apportionment. The price at which the conversion from money into corn is to be made at the time of confirmation of such apportionment, according to the provisions of the said Act, are 7s. OJd. for a bushel of wheat, 3s. ll^d. for a bushel of barley, and 2s. 9d. for a bushel of oats (7 Will. IV.~~

~~and 1 Vict. 69) ; the average price of the bushel of each grain is now computed by substituting for the " advertisement " above the statement of the septennial average price of the imperial bushel of British corn made under the Corn Returns Act, 1882 ; and thus the value of the statutory amount of corn is now fixed for each year at the beginning thereof at the average price of the three components of corn for the previous seven years. The extent of the deprecia- tion in value of tithe may be gathered from the fact that for 1902 the price of the wheat bushel is thus fixed at 3s. 5£d., that of the barley bushel at 3s. OJd., arid that of the oats bushel at 2s. Id.~~

~~As already indicated above, certain lands are exempt from pay- ment of tithes while in the occupation of their owners, either by reason of their~~

~~having been parcel of the possessions of any privileged order, or by reason of their being of the tenure of ancient demesne and exempt whilst in the tenure, occupation, or manurance of the Crown, its tenants, farmers, and lessees, or under-tenants although they are subject to tithes when aliened or occupied by subjects not being such ; and in these and in all such cases, with the consent of such owners, a fixed rent charge may be substituted for any contingent rent charge imposed on them (2 & 3 Vict. 62 ; 3 & 4 Vict. 15, now repealed except as to tithes not commuted). In certain cases where commutation of tithes for rent charge in the ordinary way was impracticable, e.g., in the case of Lammas lands or in the case of common lands, power was given to charge'a fixed sum or rate per head of the cattle there pasturing, with an exception in the case of Lammas lands which for seven years before Christmas 1835 had paid no tithe ; and also to fix a rent charge in respect of tithes of common appurtenant on the allotment made in respect of the lands to which such right of common attached (2 & 3 Vict. 62 ; 3 & 4 Vict. 15 ; 9 & 10 Vict. 73). By an Act of 1860 (23 & 24 Vict. 93) a gross rent charge can be substituted for a commutation of tithes on common rights at a fixed sum per head ; a gross rent charge made payable in respect of the tithes of a gated or stinted pasture rated to the relief of the poor may be apportioned there- upon and enforced in the method prescribed by the other Tithe Acts ; a rent charge on commons may be commuted for part of the land or redeemed, if the landowners and persons liable for tithe so agree ; and upon enclosure, a rate per head may be converted into a rent charge on the lands allotted. These rent charges are not subject to the Tithe Act of 1891. This Act of 1860 also gave power to convert the corn rents established under local Acts into rent charges.~~

~~In the case of hop-grounds, orchards, fruit-plantations, and gardens, power was given to the Commissioners to value them separately, according to the average rate of composition for the seven years preceding Christmas 1835, and to fix an ordinary and an extraordinary charge for tithes thereof, the former for such lands going out of cultivation, the latter for such as were there- after newly cultivated : lands subject to the latter were exempted during their first years of cultivation ; and such lands were only subject to it if situated in a~~

~~parish in which an extraordinary charge had been distinguished at the time of commutation (6 & 7 Will. IV. 71 ; 2 & 3 Vict. 62 ; 3 & 4 Vict. 15 ; 23 & 24 Vict. 93 ; ■ 36 & 37 Vict. 42). In 1886, however, it was enacted that no such extraordinary charge shall be levied on any such grounds so newly cultivated in future ; the capital value of the existing charges was assessed, and the payment of interest thereon was made a rent charge on the land payable in priority to all other charges until its redemption, and recoverable in the same way as ordinary rent charge and exempt from all rates, charges, and assessments: the charge was redeemable at the capital value, and saving existing contracts it was as between landlord and tenant payable by the landlord, any agreement to the contrary notwithstanding ; and it is not subject to the Tithe Act of 1891. Under the Act of 1840 (3 & 4 Vict. 15) gardens and lawns and the like, of small size, could be exempted from tithes.~~

~~Besides the tithes dealt with by local Acts as already mentioned, certain other kinds of tithes are outside the scope of the Com- mutation Acts, namely, tithes of fish and fishing, personal tithes other than tithes of mills, and mineral tithes, unless the land- owners and tithe-owners consent to make a parochial agreement for commutation before the confirmation of an apportionment after a compulsory award in such parish. As already seen, fish being feraz naturae are only tithable by custom ; but fish taken in the sea by the custom of the realm are tithable as a personal tithe, i.e., in some small sum for the net profits of the fishing, and customs for payment in kind have been upheld by the courts. Personal tithes, if not commuted or otherwise still payable, are regulated by a statute of Edward VI., which (except in the case of fishing and tithes for houses in cities and towns, which may be due by custom) restricted them to such persons exercising merchandises, bargain- ing and selling clothing, handicraft or other art or faculty in such places as had for forty years previously so used to do. Personal tithes are now rare, except of fish caught at sea, when they are payable to the church where the taker hears divine service and receives the sacraments. Tithes on houses or customary payments~~

~~in lieu of tithes have, by local Acts, in some cases been turned into church rates. Statutory provision is also made for allowing tithes and~~

~~tithe rent charge to be exchanged for land, and for the redemp- tion of rent charges made under the Acts, and also of corn rents under the local Acts. Tithe rent charge may also be merged in the land tithable, with the consent of the Tithe Commissioners and the landowner, by the legal and equitable owners of tithes in fee simple or fee tail, or persons having power to appoint the fee simple in tithes, or owners of glebes, or owners of lands and tithes settled to the same uses.~~

~~Tithe rent charge under these Acts is subject to the same liabilities and incidents as tithes, such as parlia- mentary, parochial, county, and other rates, especially the poor rate and highway rate ; but the owner of tithe rent charge attached to a benefice has been exempted by an Act of 1899 from payment of half the amount of any rate which he would be liable to pay under the Agricultural Rates Act, 1896, the other half being borne by the Inland Revenue Commissioners. The limitation of time for recovery of tithes or estates in tithes, whether between rival claimants to tithes or tithe-owners or tithe-payers, if belonging to lay individuals or lay or spiritual corporations aggregate, is a period of twelve years, as in the case of other real property (37 & 38 Vict. 57) ; and in the case of spiritual corporations sole the period of limitation of actions, if any, is governed by the Limita- tion Act, 1833, § 29, already quoted, the Act 2 & 3 Will. IV. 100 being held only to apply to demands of tithe in kind.~~

~~The method of recovering rent charge under the Com- mutation Acts was distraint where the rent charge is in arrear for twenty-one days after the half-yearly days of payment, and entry and possession with power of letting if it is in arrear for forty days, and arrears for two years are so recoverable : this power of distress and entry ex- tends to all lands occupied by the occupier of the land whose tithe is in arrear as owner or under the same land- lord ; but no action lies against the owner or occupier of the land personally. If a tenant quits leaving tithe un- paid, the landlord may pay it and recover it from him. The tithe-owner cannot recover damages from the tithe- payer for not cultivating the land. Special provision is made for the recovery of the rent charge in railway lands.~~

~~The Act of 1891 has, however, altered this method of recovering tithes, and substituted another intended to shift the burden of responsibility from the occupier to the landowner, by making the latter directly and solely responsible, but giving the remedy against the land. The landowner is made liable to pay the rent charge in spite of any contract to the contrary between him and the occupier ; the rent charge if in arrear for three months is recoverable by an order of the county court, whatever its amount may be : if the land is occupied by the owner, the order is executed by the same means as those pre- scribed in. the Tithe Acts ; but if it is not, then by a receiver being appointed for the rents and profits of the land : neither landlord nor occupier is personally liable for payment ; an appeal lies to the High Court on points of law ; and a remission of rent charge may be claimed when its amount exceeds two-thirds of the annual value of the land. The Act does not apply to' the particular kinds of rent charges mentioned above.~~

~~The Tithe Acts do not apply to the City of London, which has always had its own peculiar customary payment regulated by episcopal constitutions of 13 Hen. III. and 13 Eic. II. and statutes of Henry VIII., confirming a decree of the Privy Council, under which the rate of tithes was fixed at 16^d. for every 10s. rent, and at 2s. 9d. for every 20s. rent of houses, shops, and the like by the year. Pro- vision was made by statute after the Fire of London for certain annual tithes to be paid in parishes whose churches had been destroyed, and there have been local Acts from~~

~~time to time since with regard to particular parishes therein.~~

~~Authorities. — Phillimoke. Ecclesiastical Law. 2nd edition. London, 1895. — Cripps. Law of Church and Clergy. 6th edition. London, 1886. — Eagle. Tithes. London, 1836. (g. G. P*.)~~

~~Title Cuarantee Companies apply the princi- ple of corporate indemnity to the protection of those interested in real estate titles,~~

~~either as owners or lenders. They are of the class of indemnity companies in which technical skill and experience in investigation of risks are relied upon to protect the guarantor from loss. They are peculiar to countries where the title to real estate is a matter of public record, and where the complexity of the record and the variety of possible liens and encumbrances have made it difficult and ex- pensive to determine whether the title is good. The only country where they have reached large proportions or achieved success as independent business enter- prises is the United States. In Australia no investi- gation of a title to real estate is necessary, because before the land passed into individual ownership the Government adopted a system of State registration and guarantee of title, so that its certificate of registered title was universally accepted. In certain other countries there is neither registration of title nor recording of deeds ; the title-deeds are preserved and passed from owner to owner, and are accepted on the authority of the records and opinions of family solicitors. In the United States, however, there have been from the beginning Acts provid- ing that all deeds and mortgages be recorded, and the records, when properly made, constitute legal notice to all the world of their contents and claims. At the same time, there are other records of wills, suits, judgments, taxes, and mechanics' claims which may encumber the title. In the great cities these various records became in course of time so voluminous that the proper investi- gation of them, and the determination of the validity of the title in view of them, required the best skill of an experienced lawyer and involved very heavy expenses. On a re-sale of the property the new buyer did not rely upon the lawyer who had made the examination for the seller, but felt called upon to employ and pay his own lawyer, who had to go over the same work again, and more, for with each new transaction the history was getting longer. The delay and expense involved were great, and yet the owner had little or no protection, for a lawyer is not held to guarantee the correctness of his opinion.~~

~~The first legislative grant of corporate authority to guarantee titles to real estate was included in the charter of the New York Guaranty and Indemnity Company, a trust company incorporated in New York by Act of the Legislature in 1864 ; but the power to guarantee titles was~~

never exercised. In 1869 the Ecal Estate Assurance Company of the City of New York was chartered with the sole object of insuring the validity of titles, but was never organized. In 1871 a pamphlet was issued by a member of the New York bar, calling attention to the business carried on by the Prussian Mortgage Insurance Company of Berlin, and outlining plans very similar to those now followed by the principal title guarantee companies of the United States; but the pamphlet seems to have been forgotten. The first company actually to undertake the guarantee of real estate titles was formed in Philadelphia, Pa., in 1876. It differed from the Prussian Mort- gage Insurance Company (which guaranteed' titles merely as an incident in its business as a dealer in, and custodian and guarantor of, mortgages) in that its main business was the issue of a policy of guarantee on a transfer of title to land. The advantages of its method were immediately recognized. Corporations to carry on the' business were organized in Washington, Baltimore, Boston, and New York in the order named, and subsequently in nearly every considerable city in the. United States.

In order to be independent of the inaccurate and clumsy methods of the public record offices, title guarantee companies generally compile in their own office a copy or digest of all the real estate records of the locality in which they are established,

maintaining for this purpose a staff of skilled clerks. To make the necessary examination of a title prior to the issuing of a guarantee, they require continually a body of experienced real estate lawyers. By these means a title can be examined and guaranteed in a week, whereas thirty or forty days was formerly required. This has done much to make real estate available capital, for individual and corporate lenders on mortgage accept the guarantee of the com- panies as the best evidence of title, and loans can be had without the delay that once prevailed.

The expense of maintaining the staff of clerks and lawyers is great, amounting to half of the gross charges on titles guaranteed. Strictly speaking, the risks outstanding are also large, running up to $100,000,000 a year for a single company in New York City ; but in

~~well-managed companies the losses are very small, not exceeding 2 per cent, of the gross charges on titles guaranteed, so that the outstanding obligations should scarcely be called risks. In spite of the office expenses, the charges for first bringing a piece of land under the guarantee are no more than owners were in the habit of paying each time for examination and opinion by counsel, amount- ing to about one-half of 1 per cent, on the value of the property or on the amount of the mortgage ; and when once the guarantee has been issued, it is re-issued on a subsequent sale or mortgage on short notice and for a small fee. The largest capital employed is that of the leading company of New York City, which amounts to $2,500,000. From that it runs down to $100,000 in some of the smaller cities. (c. h. k.)~~

~~Titusville, a city of Crawford county, Pennsyl- vania, U.S.A., on Oil Creek, and on the Dunkirk, Allegheny Valley and Pittsburg, and the Western New York and Pennsylvania railways, in the north-western part of the state, at an altitude of 1181 feet. It is in the heart of the Pennsylvania oil region, and is regularly laid out on a level terrace, divided into four wards, has a good water-supply, pumped from wells, and is well sewered. The industries are chiefly connected with the refining, pumping, and transporting of petroleum. It has oil-wells, refineries, tanks, and pipe lines. Population (1890), 8073; (1900), 8244, of whom 1573 were foreign-born and 106 negroes.~~

~~Tiverton, a municipal borough, market town, and railway station in the Tiverton parliamentary division of Devonshire, England, at the confluence of the Exe and the Lowman, 14 miles north of Exeter. A canal 11 miles long connects Tiverton with the limestone quarries of Burles- combe. The system of waterworks has been improved, a public park provided, and "homes" for twenty-four inmates erected. Area, 17,680 acres. Population (18.91),~~

~~10,892; (1901), 10,382.~~

~~Tivoli, a town and episcopal see of the province of Rome, Italy, 17 miles east-north-east of Rome. Pive miles west are the sulphur baths of Acque Albule, which were known to the ancients, and are now again frequented by over 40,000 persons annually. The temperature of the~~

~~water is 75-2° Fahr. The falls in the river afford electric power for lighting Eome, as well as for driving several factories in Tivoli itself. Population (1881), 9730; (1900), about 11,500.~~

~~Tlaxcala, a state of Mexico, bounded on the N., E., and S. by Puebla, and on the W. by Mexico. Area, 1595 square miles — the smallest state in the republic. Population (1879), 138,988; (1900), 172,217. It forms a part of the central plateau, and is consequently in the cold region, its mean altitude being between 6000 and 10,000 feet. Three railways cross the state. It is essen- tially an agricultural state, cereals and pulque being the chief products. The annual value of the commerce is about $8,000,000 (silver). The capital Tlaxcala, with a population of 2847, the most important town in the state, has fine buildings, and is connected with the city of Mexico by the Santa Ana and Tlaxcala railway. The principal towns are Chiautempan (5000 inhabitants), Calpulalpan San Antonio, Tlaxco San Augustin, Huamantla, Barron- Escandon (or Apizaco).~~

~~Tlemcen, a town of Algeria and seat of a sub prefecture in the department of Oran, near the frontier of Morocco, 80 miles south-west of Oran, 2500 feet above the sea, on the north slope of mountains 4800 feet high. Its seaport is Rashgun, and it has been placed in railway-communication with Oran by way of Sidi-bel- Abbes. It is the chief town of a wide district exporting olive oil, corn and flour, wools, and onyx. Population (1900), 34,672, of whom 3812 were French.~~

~~Tobago, the most southerly of the Windward group of the British West India Islands. The products are sugar, rum, and molasses (all on the decline), and coffee, cacao, and nutmegs. But in the last year or two of the 19th century many thousands of rubber trees were planted in the island. Population (1885), 19,363 (princi- pally negroes, there being but few whites) ; (1901), 18,750. Scarborough, the capital, on the south side, had in 1891 a population of 919. The mean annual temperature at sea-level is about 81°. The average annual rainfall is 66 inches on the~~

~~windward side, the wettest months being June to December. Imports (1898) £11,657, exports £19,401. Revenue (1898) £8107, expenditure £8386. The religious denominations of Anglicans, Roman Cath- olics, Moravians, and Wesleyans maintain 25 schools, with about 2874 scholars, assisted by a Government grant of £1000. Till 1889 the island formed part of the colony of the Windward Islands, but in that year it was made part of the colony of Trinidad and Tobago, administered by a commissioner, the fiscal arrangements of the two islands being kept distinct. In 1899 it became a ward (under a warden and magistrate) of the colony, and its revenue, expenditure, and debt were merged in those of the united colony, the laws of Trinidad becoming, with some excep- tions, the laws of Tobago.~~

~~Tobolsk, a Russian government in western Siberia, extending from the steppe provinces of Akmolinsk and Semipalatinsk in the S. to the Arctic Ocean in the N., and having the provinces of Orenburg, Perm, Vologda, and Archangel on the W., and Tomsk and Yeniseisk on the E. It has an area of 539,660 square miles, and its population, which was 1,283,000 in 1882, numbered 1,438,482 (domiciled only) in 1897, of whom 726,502 were women, and 86,398 urban. In 1899 it rose to 1,474,804 (87,148 urban), of whom about 118,000 were exiles and their families. Small as this increase was, it was largely due to immigration, there having been 47,000 immigrants from 1891 to 1895, and 41,800 in 1896. At the present time it is considered that no more immigrants can be taken into the southern districts of Yalutorovsk and Kurgan ; immigration is consequently directed into the district of Ishim, and even into the woody and marshy tracts (urmans) of the districts of Tara, where some 12,600 persons settled in 1899. The population is practically all Russian, except for some 42,000 Tatars in the south, 22,500 Ostyaks, 6000 Samoyedes, and from 4500 to 6000 Voguls. There are, moreover, about 5000 Germans and Finns, some Jews in the towns, and about 1000 Tziganes. The government is divided into ten districts, the chief towns of which are : Tobolsk, Berezoff (1073)> a small town standing alone in the dreary tun- dras, Ishim (7160), Kurgan (10,579), Surgut (1120), Tara (7230), Turinsk (2940), Tyukalinsk (1180), Tyu- men (29,588), and Yalutorovsk (3450). The standard of education is still very low ; in 1897 there were only 701 schools, attended by 1400 boys and~~

girls in the mid- dle schools (7 gymnasia), 6000 in the schools in towns, and 17,340 in the village schools.

Agriculture is the chief occupation, and Tobolsk is fast becom- ing a vast granary from which corn is exported to the north-

ern provinces of European Russia. In 1896 the total cereal crop amounted to 6,548,090 quarters, but 2015 tons of hemp seed and 3100 tons of linseed were also grown. The total area under cereal crops in 1900 was 3,334,600 acres, and the average yield in 1895-99 was : rye 10,250,000 poods, wheat 22,709,000 poods, oats 22,103,000 poods, and barley 2,790,000 poods ; also potatoes 8,500,000 poods. The lack of improved agricultural im- plements places many obstacles in the way of the farmers, but efforts are being made by the local authorities to bring such im- plements into more general use. Cattle-breeding is carried on on a large scale, nearly 110,000 horned cattle and more than 150,000 sheep being killed every year within the province. There are no exact figures, owing to the difficulty of ascertaining the num ber of cattle brought for grazing from the steppe provinces. Dairy-farming has made remarkable progress since the trans- Siberian railway has been built, numbers of agents coming from European Russia and from western Europe to purchase butter, eggs, and fowls in the villages. More than 200 dairies, of which some 12 are on co-operative principles, have grown up, the aggre- gate production being estimated in 1900 at about 90,000 cwt., or 3,000,000 roubles' worth. Apiculture and fishing retain their importance. Manufacturing industries, as carried on in factories, are still insignificant ; in 1897 they employed only 7400 workers, and showed a return of only 6,287,000 roubles. Domestic indus- tries, on the contrary, are widely spread, especially carpet-weaving and the making of cheap rifles and all sorts of wooden ware. Navigation on the rivers of Tobolsk has developed considerably (see Siberia). The yearly returns of the many fairs which are held in the province are valued at 15,000,000 roubles' worth sold ; the most important is that held at Ishim. (p. a_. k.)

Tobolsk, the capital of the above province, on the right bank of the Irtysh, nearly opposite its junction with the Tobol river, 172 miles north

~~of the Tyumen railway station on the North Siberian railway. It is an out-of-the-way town, visited only by steamers during the summer. It has, however, a good archaeological and natural science museum, which issues a valuable annual report, gymnasia for boys and for girls, a theological seminary, and 17 other schools, and various educational and philanthropic institutions. Fishing is the chief occupation of the inhabitants and of its merchants, who keep their own steamers and send out fishing crews down the Ob. The merchants also carry on a considerable trade with the natives farther north, receiving fish and furs in exchange for grain, flour, salt, &c. Population (1899), 22,752.~~

~~Tocantins. See Amazon.~~

~~Todmorden, a municipal borough (since 1896) and market town, Yorkshire, England, partly in the Sowerby parliamentary division of the West Riding and partly in the Middleton parliamentary division of Lancashire, 13 miles west of Halifax, on the Calder, with a station on the Lancashire and Yorkshire railway. A new chancel was added to the church of St Mary's in 1896. Popula- tion (1891), 24,478 ; (1901), 25,419.~~

~~Togoland, a German colony in West Africa, on the Gulf of Guinea. It is a mountainous country, being situated chiefly on the southern escarpment of the Sudan plateau. Two ranges, of which one is a line of hills parallel to the plateau margin, traverse the country from south-west to north-east. The coast is a low, sandy foreland, formed of the detritus deposited by the sea current called Calema. Large coast lagoons receive the numerous rivers, the Mono, Haho, Sio Tapjie, and Volta. The last is the largest, and receives a number of affluents which rise on the plateau. In its middle part it forms the boundary of the country ; it becomes navigable at Krachi.~~

~~Bovndaries and Population. — The southern boundary is the sea. In the east the boundary between Togo and French Dahomey, by Franco-German agreement of 1897, is the middle of the river Mono as far as 7° N. and in a generally northerly direction to 11° N. The western boundary, between Togo and the British Gold Coast, was settled by Anglo-German agreement of 1890 ;~~

~~it leaves the coast near Lome and proceeds in a zigzag line to where the Deine river joins the Volta; it follows this river to its junction with the Daka, and continues from here in a manner agreed upon in 1899, so as to secure the neutral zone of Salago; this remains to be settled definitively. The area is estimated at 33,000 square miles, with 3,000,000 inhabitants.~~

~~Meteorology. — There are two wet seasons, the first lasting from March till June, the second and shorter one from September to November. The greatest heat falls in the winter months. A dry wind, called harmattan, which carries great quantities of red sand, is specially remarkable. /"~~

~~Flora and Fauna. — The lagoons on the coast are surrounded by dense belts of reeds, and the coast-land is covered with low, impene- trable bush. Large groves of oil-palms are planted. On the hills the baobab and hyphsena palm are characteristic, and on the plateau are grass and the shea butter-tree. Animal life is much the same as in the other parts of tropical Africa ; it is poor on the coast, and in the interior the influence of the Sudan steppe, is noticeable.~~

~~Ethnology. — The inhabitants are Sudan negroes. In the north they are Hausas, in the west they speak the Tchi dialect, while on the coast the Ewe" language is spoken. The Adeli and Aprosso have a dialect of their own. In the north they form small though well-organized states. The whole country is well populated ; on the coast the inhabitants are agriculturists, in the interior they raise cattle, and the Hausas are successful traders, who traverse the country in large caravans.~~

~~Government and Forces. — There are three Government stations in the interior and on the coast. Lome is the residence of the Commissioner, who is also chief justice. There is a force of 250 coloured soldiers, under one white commissioned and ten non-commissioned officers.~~

~~Meligion. — The inhabitants are partly Mahommedans, partly believers in fetish. There are four mission societies, one Roman Catholic ; they have several schools, which, however good, are not squal to the Government school in Little Popo.~~

~~Revenue, Taxation. — There is an import tax of 4 per cent, of the value on all mercantile goods. Certain exceptions are admitted. Liquors, powder, tobacco, and firearms are subject to a special tax. Trading firms have to pay a licence of £50 a year, and of £26 for each branch establishment near the coast, or of £5 in the interior. Firms which only import pay £30 per annum. The budget revenue for 1899 was 550,000~~

~~marks, the expenditure 789,000 marks ; the imperial subvention for 1900-1901 was 270,000 marks.~~

~~Shipping. — There is direct steamship communication between Togo and Hamburg ; the Woermann line sends regularly three steamers a month, and the steamers of thtee French lines and two English call at Togo ports. In 1898-99, 95 vessels of 110,241 tons entered the ports.~~

~~Boads, Post, and Telegraph.— Roads are gradually being pushed towards the interior. A short line of railway is in course of construction, and a jetty which ships can approach for loading purposes has been built. The colony belongs to the Universal Postal Union, and there are two post offices on the coast. Twice a week mails are sent by runners overland to the French and British post offices in the neighbouring colonies. The stations in the interior receive mails twice a month. There is a telegraph between Lome and Little Popo, and both places are joined on to Accra and Dahomey, and thus to the international cable system. There is a Government telephone line between Little Popo and Lome.~~

~~Productions and Industry. — The country is rich in natural products — palm oil and kernels, copra, rubber, ground nuts (arachis), shea butter of the Bassla Parkii Sapotacea, fibres of the Rwphia vinifera, the Sansevieria Guineensis, indigo, and cola nuts, ebony and other valuable wood. Minerals have not been found yet. In the interior cattle and sheep are plentiful, on the plateau horses and donkeys. The natives are good weavers. They collect and spin the indigenous cotton, and dye it with indigo or other pigments ; the country produces and manufactures very handsome shawls. Pottery and smith's-work are largely practised, and iron is being imported. Carving in wood is common, and the examples are sometimes very handsome. In 1898-99~~

~~the imports were valued at 3,029,598 marks, the exports (mainly palm kernels and palm oil) at 2,016,708 marks.~~

~~Progress since Annexation. — Since its annexation to Germany the country has been most prosperous. Trade has grown considerably. Plantations have been started, and only cocoa and tobacco have proved~~

~~a failure, there being too little rain for the one and not the right quality of soil for the other. Coffee and cocoa palms thrive well, and the produce increases from year to year. Cotton has not been cultivated with equal assiduity ; rubber promises good results. Peace and order have been established, and the good-will of the natives has been gained through- out the country.~~

~~See N. Seidel. Die Kuste und das Vorland der Togocolonie. Berlin, 1897. — R. Buttner. Die Forschungsstation Bismarckburg und Adeli. 1894 ; Das Deutsche Schutzgebiet Togo. Bremen, 1891. (J- von P.)~~

~~Tokat (Armenian, Evtoghia), the ancient Dazimon, altitude 2280 feet, chief town of a sanjak of the same name in the Sivas vilayet of Asia Minor, situated on the Sivas-Samsun chausse'e, at the mouth of a rocky glen which opens out to the broad valley of the Toranli Su, a tributary of the Yeshil Irmak. The industries are the manufacture of copper utensils and yellow leather, and stamping colours on white Man- chester cotton. Near Tokat copper pyrites, with iron and manganese, kaolin, and coal are found. In Novem- ber 1895 there was a massacre of Armenians. Popula- tion, 30,000 (Moslems 19,000, Armenians 10,000, Greeks~~

~~1000).~~

~~Tokay (Hungarian, Tokaj), a market town of Hun- gary, in the county of Zemplen. The phylloxera made enormous ravages in the famous vineyards, but by means of new plantations the wine industry is again reviving. Population (1891), 4815 ; (1901), 5110.~~

~~Tokelau. See Polynesia.~~

~~Tokoy, formerly called Ybdo, the capital of the empire of Japan, situated in 35° 41′ N. and 139° 45′ E., at the head of the bay of the same name on the south-east coast of the main island. The city stands on the banks of the river Sumida, which, although wide, is unnaviga- ble by vessels of large tonnage owing to the shallowness of its mouth, due to the silt brought down by the current. A scheme was on foot in 1902 to overcome this difficulty and thereby open the port to shipping in~~

general. Mean- while Yokohama, with which Tokyo is connected by 18 miles of railway, is practically the port of the capital.

T6kyo covers an area of about 100 square miles. Geographically, it may be divided into two parts, upland and lowland (Yama-no-te and Shitamachi), which for administrative purposes are split up into fifteen districts or Ku, of which Kojimachi, Hongo, Koishikawa, Ushigome, Yotsuya, Akasaka, Azabu, and Shiba are situated in the upland portion, while Kanda, Kiobashi, Mhonbashi, Shitaya, Asakusa, Honj6, and Eukawaga are in the lowland. Suburban T6kyo is divided into eight districts or Gun, which, with the city proper, collectively form the Tokyo-Eu (prefecture), under the general control of one governor called Eu-Chiji. Questions affecting the interests of the whole Eu come before the Fuhwai, or pre- fectural assembly, made up of representatives from both Ku and Gun, and a prefectural council, of which the governor is president; while matters concerning the city alone are discussed by a Shikwai, or muni- cipal assembly, and administered by a municipal council, of which the Shicho or mayor is the president. The population in 1898 was 1,440,121, as compared with 1,242,224 in 1894. Eor many years past it has shown a steady and substantial increase. The streets

are still in many quarters narrow and irregular, and do not permit of heavy traffic. In this direction much has been achieved, however, under the Tokyo Streets Improve- ment Act of 1888. The chief thoroughfares have been widened, and the excessive crowding in them no longer exists. All along the best streets, at regular intervals on each side, the willow, the flowering cherry, and other ornamental trees have been planted between the foot- path and the carriage-way. The 6-dori (main street) is the most important thoroughfare. It runs from the Shimbashi station to M^gane-bashi or Spectacles-bridge (so

called from its circular arches), and traverses the business quarters of Mhonbashi, Kiobashi, and Kanda. In the section of it called Ginza most

~~of the best shops and bazaars are to be found. The pavement is generally composed of pebbles held together by clay, and these, in fine weather, afford a sufficiently smooth surface. With much rain, however, the clay turns to mud. The principal streets, especially those in the business part, are lighted by electricity and gas, or by good oil lamps ; but, generally speaking, the illumination is poor, there being in some quarters no light whatever, and in these~~

~~Foreign Office~~

~~War Office~~

~~Naual Department~~

~~Department of Justice~~

~~Supreme Court~~

~~Tokyo Local Court~~

~~General Staff Office~~

~~American Legation~~

~~British Legation &. Can.~~

~~Russian Legation~~

~~Chinese Legation~~

~~Imperial University~~

~~Imperial Museum~~

~~Tokyo Library~~

~~Tokyo Observatory~~

~~Tokyo Inst, of Learned Men~~

~~Imperial Diet~~

~~Bank of Japan~~

~~Yasuktini Temple~~

~~Russian Cathedral~~

~~Temple of Huiannon~~

~~Ekoin Temple~~

~~Jbkj/6 Past & Telegraph Off.~~

~~Railways shown thus:- .... Ku Boundaries shown thus~~

~~Scale of i Mile ? i i 1~~

~~Walker&Cockerellsc.~~

~~Plan of T6kt6.~~

~~it is still necessary to carry a lantern. The jinrikisha, drawn by one or sometimes two men, forms the chief means of passenger conveyance. Horse and electric trams are used in certain parts of the town, and street railways and trams are being introduced. Lowland T6kyo, that part of the city covering the flats on both sides of the river Sumida, is intersected by a system of canals along which merchandise and tradesmen's wares are conveyed by barges. The many bridges which span these canals have always been distinctive and picturesque features of Tokyo. The Nihonbashi (Bridge of Japan), in the district of the same name, is by far the most famous. It is the central point from which all distances . in Japan are calculated. The largest bridges are those named Azuma, Umaya, Ry6goku, Shin-6, and Eitai, and these all serve to connect the districts of Pukagawa and Honjo on the eastern bank of the Sumida with the other portions of the city on the western. Shin-5 remains wooden, but the other four have been reconstructed~~

of iron. Ochanomizn-bashi, a suspension bridge con- necting Hongo with the Surugadai Hill of Kanda, is also a famous structure. On this hill stands the Russian cathedral, an imposing edifice dominating the view in the lowland district. The climate is mild and healthy, and for the greater part of the year very pleasant, the seasons of spring and autumn being more especially delightful. There is a regular water supply, the new water-works, commenced in 1892, having reached com- pletion, and water is laid on to the dwelling-houses. The reservoir at Yodobashi is capable of supplying water to all parts at a pressure varying from 80 to 100 feet, and is of such dimensions as -will enable it to meet the requirements of a population twice the size. The water is brought from the river Tama by the old, aqueduct, 27 miles in length. Hydrants are fixed in all the streets for the use of the fire brigade, whose operations have been rendered much more effective by reason of the enormous pressure and ample supply afforded by the new

system. The fire brigade has a well-disciplined and very- efficient personnel, and it does not lack opportunities for the exhibition of its skill in a town built almost entirely of wood. In 1899 there were 358 conflagrations in the T6ky6-Fu, destroying altogether 1441 buildings. The fire brigade is not yet adequately equipped with engines of European type, but the firemen, though they rely upon antiquated methods, are nevertheless highly trained, and display at all times invincible courage. On the second day of the year a public display of the fire brigade is given at theKaji-bashi ground, where the greatest excite- ment and interest are evinced by crowds of people who come from all quarters of the town to witness it. The police force is another well-trained and successful service. In 1899 its numbers were 3519 in T6ky6-Fu, or one policeman to every 543 inhabitants. Both police and fire brigade are under the command of a single Keishirsdkan (inspector-general). The postal arrangements are very satisfactory, frequent deliveries being made with the utmost despatch. Telegrams can be despatched to and from any part of the city. The telephone, too,

~~has been adopted. There are long-distance wires to Yokohama, Osaka, and other large towns, through which messages may be spoken. In 1901 there were 29 post and tele- graph offices, 23 offices for post only, and 5 offices for the despatch of telegrams only. A very complete and suc- cessful system of education exists. In 1899 there were 715 public and private elementary schools, giving employ- ment to 3053 teachers. In that year children of school age numbered 294,864, and of these 195,371 went through the course of instruction prescribed by the Ministry of Education. There are also many schools for advanced students devoted to the various branches of science, mechanics, and art, the principal of which are under direct Government supervision. Under the same control there is the Imperial University of T6ky6, which con- sists of the colleges of law, medicine, literature, science, engineering, and agriculture. There are several very good daily newspapers, as well as weekly and monthly publications of all kinds. In the suburbs there are many factories, but T6ky6 as a whole cannot be described as a manufacturing city. It has often experienced earth- quakes, and more than once has suffered from severe shocks. For this reason the number of tall substantial houses of brick and stone is limited, lest earthquakes may occasion loss of life and property through the fall of such heavy buildings. It has been suggested, however, that iron framework constructed according to scientific methods would reduce the enormous de- struction of houses from which the people suffered in past days, and it was decided to build the palace of the Crown Prince at Aoyama of that material. The Imperial Palace, which is half European and half Japanese in its style of architecture, stands on the site of the old Yedo Castle, almost in the centre of the Kojimachi-Ku. It is surrounded by moats. The Niju- bashi is the main entrance. To the east and south of the palace the neighbourhood has undergone great changes in recent years. It was here, at the Sakurada Gate, that Ii Kamon-no-Kami, Prime Minister of the Shogun's Government, and the first Japanese Progres- sive, was assassinated by the anti-foreign party in 1860. On the site of his residence a little higher up to the right of the gate now stands the War Office and the offices of the general staff. In another street, immediately facing the gate, are the Foreign Office, the Supreme Court, the Local Court, and the Departments of Justice and the Navy. The temporary buildings of the Imperial Diet, which first met in 1890,~~

~~are also in this part of the capital. Adjoin- ing the above-named buildings the new Hibiya Park~~

~~has been laid out. It is modelled attractively on public gardens of the European style. The parks have always afforded to the people their chief means of recreation. The largest and most beautiful are those in Shiba and Uyeno, the latter encircling Lake Shinobazu, so famous for its lotus flowers. In Uyeno, too, are the Imperial Museum, the Imperial Library, the Zoological Gardens, and the temples of the Shoguns. The famous temple of Kwannon, the goddess of mercy, is in the Asakusa Park, in which a permanent fair is held ; it is a great holiday resort of the middle and lower classes. Kudanzaka Park is approached by a long steep road. In its grounds is the Yasukuni Temple, consecrated to the spirits of departed heroes who gave their lives for the state. To the right of the temple is a museum of arms, where the old Jap- anese swords, and scabbards, as well as trophies from China and Korea, are exhibited. The pastimes of the people for the most part take the form of out-of-door sight-seeing, regulated by the season of the year. In the spring or cherry-blossom season many picnic excursions are made into the country. One of the greatest sights is the shell-fish gathering in April, when the tide runs out, leaving the bed of the bay accessible to thousands of gay young people, who wade out in search of bivalves. Athletic sports, once altogether ignored, have become very popular. Twice in the year, in May and January, wrestling contests take place in the enclosure of the Ekoin Temple near Ryogoku Bridge, and these evoke the great- est interest and enthusiasm. Rowing is popular with schoolboys and students. Cycling, too, is a favourite pastime, even with Japanese ladies, who are usually very conservative in their habits.**

~~T6kyd is the centre from which several railways radiate. The trains of the Tokai-do line, starting from the Shimbashi station, run westwards to K6be\ thence to Shimonoseki, the western end of the main island, a distance of 700 miles. The TJyeno station is the starting-point for trains to Aomori, a town 460 miles away, at the northern extremity of the island. (n. u.)~~

~~Toledo, a province of Spain; area, 5620 square miles ; population, 359,562 in 1887, 370,012 in 1897. The birth-rate is 4-08 per cent., the death-rate 3-36 per cent., and the proportion of illegitimate children 2-05 per cent, of the births. The province is divided into twelve dis- tricts and 206 parishes. There are 250 miles of railways. The mountainous districts were until lately the abode of brigands, who found shelter in the forest-clad sierras that were so extensively denuded of timber in the last decade of the 19th century. From the woods in the lower sierras much charcoal and firewood is yet drawn, and the commons produce £70,000 yearly in this way.~~

~~The northern part of the province is richest in agricultural pro- ducts, and the southern in wines. About three millions of acres are cultivated, 503,500 acres in 1897 being devoted to wheat crops, 263,822 to rye, oats, barley, maize ; 70,437 to pod fruit ; 109,880 to vines ; and 60,472 to olives. There are extensive pasture grounds, where much live-stock is reared and excellent breeds of bulls for their popular sport. The live-stock in 1897 included 3971 horses, 24,248 mules, 22,059 asses, 14,810 cattle, 346,228 sheep, 39,349 goats, and 21,410 pigs. There is an active trade in the products of agriculture.~~

~~Toledo, capital of the above province; population, 20,837 in 1887, and 23,465 in 1897. It is on a branch of the Southern Railway. The aspect of this ancient city has not changed, and it is still the silent old-world place that attracts natives and foreigners who desire to form an idea of a town preserving so many traits of the past in its noble churches and public buildings, its narrow streets and massive houses, its Gothic, Moorish, and old Castilian ruins and monuments intermingled. The Alcazar, so often restored after fires that caused much damage, was again much injured on the 9th January~~

~~1887. The Government spent a considerable sum in once more restoring it, and it is now the military academy for infantry. A masterpiece of Covarrubia was fortu- nately saved from all the~~

~~successive fires. Toledo has some modern buildings worthy of notice — the institute for higher education and the primary schools, the school for training teachers, courts of justice, hospitals. The arms manufactory, a mile outside the town walls, is conducted by the Government. There are many private manufactories in Toledo that rival the royal works.~~

~~Toledo, a city of Ohio, U.S.A., capital of Lucas county, on the Maumee river at its mouth, in the northern part of the state, at an altitude of 587 feet. The city is regularly laid out on a level site, covering an area of 28^ square miles, extending 8 miles along the Maumee, is divided into fifteen wards, has a good water-supply by pumping into stand-pipes, is well sewered and well paved with granite blocks, brick, wood, and asphalt. Among its fine buildings is its public library, containing 35,000 volumes. The city has a large share of the lake commerce, consisting of grain (mainly wheat), clover seed, lumber, iron ore, and coal. It is one of the most important railway centres of the country, being entered by no less than thirteen railway companies. It is also the terminus of the Miami and Eric Canal. Its manufactures are large and rapidly increasing. In 1900 there were 1050 establishments, with a total capital of $25,591,916. They employed 15,383 hands, and the product was valued at $37,372,355. The principal pro- ducts, with their values, were flouring and grist mill pro- ducts, $4,458,749 ; foundry and machine-shop products, $2,715,613; bicycles, $1,583,450; liquors, $1,458,593; tin and sheet-iron working, $1,435,089 ; petroleum refin- ing, $1,392,745 ; and lumber, $1,376,149. The assessed valuation in 1900 of real and personal property was $53,445,760, the net debt was $6,526,204, and the rate of taxation $32.60 per $1000. The total income was $2,158,872, and the total expenditure for maintenance and operation $1,484,588. Population (1890), 81,434; (1900), 131,822, showing an increase in the decade of nearly 62 per ent. Of the population in 1900, 27,822 were foreign-born and 1710 negroes.~~

~~Tolstoy, Leo (1828), Russian novelist~~

~~and social reformer, was born on the 9th September (28th August) 1828, in the home of his fathers — Yasnaya Polyana, near Toula — a~~

~~large country house (not the present one) built in a severely formal style, with Doric pillars and architraves, standing solitary in a typical Eussian landscape. The Tolstoy family, to whom it had belonged for several generations, was originally of German extraction, and had settled in Russia in the days of Peter the Great. The first ancestor of distinction was Peter Tolstoy, at one time Russian ambassador to the Sublime Porte, and ennobled in 1724. Subsequently becoming involved in a court intrigue, he forfeited his title and estates, which were not restored to him until the year 1760, in the reign of the Empress Elizabeth. Neither his son nor his grandson were men of mark, but the latter, at the conclusion of the Napoleonic wars, was made governor of Kazan. Unfortunately, his incapacity for administration soon brought the affairs of the province into confusion, and a commission was appointed to inquire into the case, with the result that the count was dismissed from office. The disgrace told upon his health, and he died soon afterwards. HIs son Nicholas (the father of the great author) was born in 1797. After serving for a short time in the army he retired in 1824, and led the life of a Russian boyar. By his marriage with the Princess Maria Volkon- sky, Count Nicholas in a great measure rebuilt the family~~

~~fortunes, which had fallen into decay during the two pre- vious decades. Count Leo Tolstoy was the youngest but one of the five children of this marriage, and lost his mother when he was barely three years old. Some six years later his father died also, at the early age of forty-one. Tolstoy has described his parents as Rostov and Maria Volkonskaya in War and Peace, but his childish recollections of them were necessarily dim and fragmentary. They are said to have been kind and good, cultured and God-fearing persons, his mother possessing the superior mind, together with a remarkable gift of story-telling. It is related of her that her girlish com- panions would often desert the dancers in the ballroom to sit listening to her fascinating tales. As a child, Tolstoy, though observant and thoughtful, showed no marked talent. In common with his elder brothers, he was fond of play and mischief, impatient of discipline, and disliking the routine of lessons. HIe was plain and very sensitive on the point, suffering keenly for want of notice and affection. This sensitiveness led him as he grew older to hide~~

himself away from his playmates and spend hours in lonely brooding. He describes in Childhood how, one day, it dawned suddenly cbiUbooa- upon his mind that Death was ever lying in wait, and that to be happy one must enjoy the present, unconcerned with the future. Whereupon the youthful Epicurean flung aside his books and pencils, and, stretched on his bed, fell to munching sweetmeats and reading romances. But Tolstoy's childhood was not without its share of whole- some pleasure. Hunting and shooting, the delight of the Russian noble, occupied much of his father's leisure, and from his earliest years the boy was wont to accom- pany his parent. At other times he was quite happy sitting beside his father's coachman on an expedition to one of the neighbouring towns, or with his brothers run- ning in and out of the stables and coach-houses. The tedium of the schoolroom, the reproofs of his tutor, made a reverse side to the picture, but did not prevent this fund of early memories from being, as he writes, " ever to be treasured, and fondled again and again, serving as a well-spring from which to draw my choicest treasures." After his father's death at Moscow in 1837, Tolstoy and his brothers were placed under the guardianship of his aunt, the Countess Osten-Sacken, and in the care of Madame Ergolskaya, a distant relative. The former died, however, in 1840, and the charge devolved on another aunt, Madame Jushkov, who lived in Kazan. Madame Jushkov was a typical Russian lady of her class. Keep- ing open house, fond of gaiety and society, her ideas on moral questions were liberal in the extreme, though not more so than those of most women of her rank and day. Religion was indeed a factor in her life, but acted rather as a stimulant to her emotions than as a guide in her daily conduct. Tolstoy was eleven years old when he became subject to her influence — an influence which he subsequently regarded as having been the reverse of beneficial. A French tutor was engaged for him and his brothers, prior to their entrance into the University of Kazan. Outside the hours of study Tolstoy spent his days either in solitary rambles, during which he reflected on the problems of life, or in violent exercise at the gymnasium (the only form of athletics enjoyed by boys of his position in Russia). Thus the physical and philosophical impulses of his nature were developed in equal measure, and these two conflicting forces began their lifelong duel. Only in later

years did the philosopher outweigh the man of action in Tolstoy's vigorous personality.

In 1843, at the age of fifteen, he entered the University of Kazan, and gaiued with his college cap and uniform what he prized most, his independence. The lax rule of the university — which was of no high scholastic repute,

giving ready admittance to the sons of the rich and noble — enabled him at the same time to enter the world of so- ciety and study its complex problems at leisure. co ege. j£azan wag ^n thogg dayS a real paradise for

such as sought happiness in social excitement, dining, and dancing. No city in Russia was so given up to the pursuit of pleasure. Among these scenes of luxury and licence the students of the university played a promi- nent part. Granted an unusual degree of liberty, to- gether with an indifferent system of education, even those who were desirous of serious study made little progress, while the greater number spent their time in parading the town and letting off their exuberant spirits in all sorts of horse-play. Belonging mostly to the families of rich landed proprietors who wintered in Kazan, they held themselves a privileged community, and the inspectors of the college were practically power- less over them. Amid such influences the boy soon ripened into the man. The constant succession of balls, picnics, and parties finally wearied and disgusted him. Over-strung nerves and irritability showed how the poison distilled from excess of pleasure had entered his system. The pages of Youth are eloquent of deadly ennui. He is for ever seeking " Her," engaged in an undefined " pursuit of the Well-beloved," with a half spiritual, half physical longing. At intervals in this quest of the unknown he devoured the novelists of his day, chiefly Dumas and Eugene Sue. He already thought deeply on the object and aim of existence ; forming new ideals, aspiring to noble deeds, seeing himself in imagina- tion by turns now a passionate lover, now a leader of men.

~~His forceful nature led him constantly to extremes. A story which, even if not true, illustrates the common opinion of Tolstoy, is told of how in his youthful pursuit of novelty he felt a longing to fly. The attempt, how- ever, brought him to the ground with an injured leg. He says of himself that he was always endeavouring to be original, and to tread unbeaten tracks. Partly in con- sequence of this feeling, _ he determined to enter the school of Eastern languages. His first attempt was un- successful, but finally passing in through the medium of a supplemental examination, he took up Arabic and Turkish. These studies, however, proved uncongenial to his versatile nature, and failing to distinguish himself in them, he turned his attention in 1845 to the school of law. Here he met with equal discouragement. The professors — all Germans, and many of them not knowing enough Russian to make themselves understood — were favourite butts for the students' wit. There was practically no serious teach- ing, nor any personal interest shown in the pupils. Tol- stoy's evil genius had once more cast him in stony places and left him to work out his own salvation. History, religion, and law now claimed his attention in his final .effort to gain the university diploma. In religion his opinions had undergone a great change. From the child's unthinking acquiescence in a hereditary faith had sprung absolute un- belief. History he held a useless form of knowledge. " Of what avail," he said, " to know what happened a thousand years ago ? " Hence he neglected the lectures on these subjects, absented himself' from the examinations, was confined in the university gaol for irregular attendance, and ended by coming out but moderately well' in the yearly examination. The conviction that he was wasting his time forced itself upon him. An idle, dissipated life had told upon his health, and early in 1847 Tolstoy asked permission to go down, "on account of ill-health and private reasons." Thus ended his college life, which from an educational point of view he had treated as a jest. Somewhat of an enigma as he was to his companions, with his alternate fits of feverish gaiety and melancholy abstraction, aristocratic hauteur and liberal views, there~~

~~was yet found a little band of students to accompany him on the first stage of his journey homewards. While probably admiring the original~~

~~bent of his mind, they little dreamed their late comrade would one day be ac- claimed as Russia's greatest thinker and novelist.~~

~~Tolstoy went back to his estates with fresh hope and energy, determined to ameliorate the condition of his peasantry and fulfil the duties of a landlord. Rumours had reached him at Kazan from time Tbe to time of the recurring famines, revolts, mis- reft.™"r. eries of the serfs. In 1847, as often before, the crops failed to suffice for the needs of the starving people, and whole districts set forth to petition the Tsar for food. Here was a vital problem requiring prompt solution. In the course of desultory reading at the university he had studied the writings of Jean Jacques Rousseau, and the Frenchman's plea for Nature, honest work, and simplicity of life had impressed him greatly. Fired with enthusiasm, he now entered heart and soul on the task of realizing this ideal. Unfortunately, he was as yet without sufficient moral stamina to withstand recurring disappointments and to combat the suspicions of the serfs. The youthful reformer lacked the patience necessary to deal with the deep-rooted mistrust en- gendered by years of oppression and neglect. After six months of struggle with this discouraging state of things he temporarily gave up the attempt, and we find him in St Petersburg taking up for a time the broken threads of his education. But with the restless- ness of transition strong upon him he soon returned to country life, and in company with his brother Ser- gius gave himself up to hunting, gambling, carousing with Zigani dancers, and throwing all serious thoughts to the winds. The Landlord's Morning may be taken as a picture of this stage of Tolstoy's life. The in- evitable reaction soon came. Oppressed by debts and difficulties, in the spring of 1851 he .betook himself to Caucasus, where his eldest brother Nicholas was stationed with his regiment. At Pyatigorsk, a small town at the foot of the mountains, he rented a cottage for about twelve shillings a month, and lived there with the utmost frugality.**

Finally his brother's persuasions, aided by the influence of relations in high places, led him to enter the army. He passed the necessary examination at Tiflis, and joined the artillery in the autumn of the g^yS ibe year. At that time Russia was much disturbed by the lawlessness of the Caucasian races. Bands of Circassians were constantly on the move,

~~plundering and looting. The punitive expeditions in which Tolstoy took part were his first taste of warfare. Neither his military duties nor his love of sport entirely absorbed him, how- ever. The great power which had hitherto lain dormant now awoke. He began to write, and within the nextlew years produced some of his finest works. Nekrassoff, the editor of the Russian Contemporary, accepted Child- hood, the young author's maiden effort. In accordance with the common practice, he received nothing for the MSS. Publication of a first attempt was considered ample payment in those days. Tolstoy was now twenty- four years of age. Childhood was followed by The Landlord's Morning, Boyhood, and Youth, in quick suc- cession. His early aspirations were revived in these pages, which reflect the doctrines of Rousseau. " You neither know what happiness is nor what life is," he writes to expostulating friends. " Once taste life in all its natural beauty, happiness will consist in being with Nature, seeing her, communing with her." His philo- sophy notwithstanding, Tolstoy felt a pardonable desire for promotion, which was slow in coming to him. Some verses ascribed to him (an authorship never denied)~~

~~The Crimea.~~

~~making fun of the general during the siege of Sebastopol, which appeared in print, may possibly have had some- thing to answer for. Be that as it may, the spirit of unrest and dissatisfaction was moving Tolstoy to return home, when rumours of hostilities arose, and the Crimean war burst into flame. He promptly volunteered for active service, and asked to be allowed to join the army on the Danube, under the command of Prince Gortschakoff.~~

~~In the early part of 1854 we find him encamped before the walls of Silistria, a town of Bulgaria, which Gorts- chakoff had invested. At the very height of the bombardment, however, Austrian inter- vention~~

~~prevailed, and the siege was raised. The din of battle was hushed, and revelry took its place. At the ball which promptly celebrated the event Tolstoy felt ill at ease. The joyous music and babel of tongues jarred on his sensitive ear, fresh from the moans of the wounded and dying. He went up to the prince and asked leave to start for Sebastopol. Permission being granted, he hastened from the ballroom, and left Silistria without delay. He now exchanged the offensive for the defensive. Shot and shell fell like hailstones on the bastions of Sebastopol. Courage, fortitude, presence of mind were at every moment demanded, while assault followed assault, until at last the overwhelming strength of the Allies compelled the Russians to retreat. Through- out that trying time Tolstoy cheered his companions, .whiling away many a weary hour with jest and story. Amid this " wrackful siege of battering days " he wrote those Tales from Sebastopol which earned him instant literary celebrity, and caused the Emperor Nicholas to issue special orders that he should be removed from a post of danger. An official despatch recounting the events of the siege was next written by Tolstoy at the command of his superior officer, and with the charge of this document he was shortly afterwards sent to St Petersburg. He was never again on the field of battle.~~

~~Tolstoy returned home filled with new impressions. Sad at heart and sick of the horrors of war, he came back with a feeling of brotherly love for the common s/ p te soldiers, whom he had seen day by day doing burg rs° quiet deeds of courage and devotion, fighting for their country without hope of reward, with- out fear of death. He contrasted them with the more self-seeking nobles, and felt their superiority. The stirring scenes through which he had passed, the simple faith of his men, all had helped to renew his belief in God. Preceded by the fame of his descriptions of Se- bastopol and the Caucasus, he arrived in St Petersburg to find himself the object of a general ovation. The Sovremennik (Contemporary), in which Tolstoy's first work, Childhood, had appeared, numbered among its contributors the foremost writers of the day. To be admitted to their ranks was considered by them an hon- our equivalent to the award of a fauleuil in the French Academy. They welcomed Tolstoy with open arms, the veteran novelist Tourguenieff in particular hastening to greet him on~~

his arrival, and begging him to make his house his home. Society was equally eager to open its doors to the young soldier-author. His vivid and dramatic pictures of the war had been widely read, and had created a profound sensation. The great official world of St Petersburg proceeded to offer him a brilliant series of entertainments in which he found himself the central figure. It is not surprising that this combined adulation from literary men and society overcame for a time the growing asceticism of his character. Yet it also in a measure hastened its development. Even while borne swiftly on the current of pleasure, his strenuous

nature gradually reasserted itself. In the pages of My Confession Tolstoy describes the phases of this mental unrest. The narrowness of a literary clique soon became irksome to his dominant, character. His passionate desire for truth brought him into frequent conflict with those who paid more regard to convention. With Tourguenieff especially he found himself constantly at variance. A friendship between natures so diametrically opposite, between two men who might be described as leaders respectively of the old and the new school of thought, could not long subsist. Mutual admiration does not imply sympathy. Tourguenieff presently wrote to a friend, " I regret I cannot draw nearer to Tolstoy, our views are so opposed, the one to the other." And these differences of opinion gradually led to a complete estrangement. On the other hand, in Pet, the poet, he found a lifelong friend. Others of his intimates were Nekrassoff, the editor of the Contemporary, already mentioned; Katkoff, the celebrated journalist; Drou- shinine, Grigorovitch, Fet, and Ostrovski, the dramatist.

While Tolstoy was thus waking to a sense of distaste for his environment, a great event was pending. With the accession of Alexander II. in 1855 a wave of progressive policy — set in motion by the #<««'*«> Tsar himself — stirred the bureaucratic circles movement of Russia, and while fiercely resisted by some of the nobility, met generally with cordial encouragement. The emancipation of the serfs became the burning question. "The People!" and "Progress!" were the cries quickly caught up by the press of Russia and of Germany also. It was in Germany, indeed, that the novel of humble life sprang into

~~being, Gotthelf leading the way with his tales Uli the Serf and Uli the Tenant. Auerbach followed with his village stories, which opened up a new world of thought ; Stifter and a host of others brought up the rear. This new impulse in literature soon spread to Russia. Tourguenieff in his Sportsman's Tales, Grigorovitch in Tlie Village and Anton Goremika, showed their sympathy with the moujik. But above all others, Tolstoy was most deeply and lastingly affected. Awakened by this echo from without of his own inmost yearnings, he realized at last the true bent of his mind. " The People " became his watchword. One increasing purpose henceforth ruled his life, and gradually brought into harmony the inequalities and contradictions of his character. Roused from the inertia which had been caused by nerves and hypochondria, he wrote Polikoushka, a painful story dealing with the ills of serfdom. His active brain then turned to considering the meaning and scope of the catchword " Progress," and fully to do this he determined to go abroad and study the educa- tional and municipal systems of other countries. After some delay he finally started for Germany in January~~

~~1857.~~

~~Tolstoy has only three times crossed the Russian fron- tier, and these journeys were all undertaken between the years 1857 and 1861. Since then he has been rooted to the soil. On this first trip, Germany ^ve?" and Italy were hurriedly visited. He also made a short stay in Paris, which had attractions for him in the society of several Russian friends, among whom were Nekrassoff and Tourguenieff. With the latter he had not yet come to open rupture. From Paris he went to Lucerne. An incident which occurred there and is reproduced in his semi-autobiographical Lucerne, shows the workings of his spirit. He tells how a wandering musician stood one day in the hotel courtyard, and after his performance asked in vain for alms from the convivial crowd assembled. Tolstoy, in the person of the hero, then indignantly came to the rescue, brought the poor minstrel into the hotel, and, moved to wrath with the churlish waiters who were~~

unwilling to serve him, ordered a private room where he himself supplied his guest's wants, and sent him away- happy with a double lining to his pockets. Of his suc- cessive journeys westwards, the third alone was of long duration and of corresponding importance in its results. Prior to this last visit to foreign parts, his time was spent between Yasnaya Polyana and Moscow, often in the company of his friend Fet. On a bear-hunt together, Tolstoy narrowly escaped death, an incident which he graphically describes in his Fourth Beading-book for Cliildren (20th ed., 1900, &c). Pet also mentions it in his Reminiscences. His departure was finally hastened by the serious illness of his brother Nicholas, who had gone to Prance to recruit his failing health. Tolstoy, after halting in Berlin and Dresden, joined him, but only to endure the grief of witnessing his end. Nicholas died on the 20th of September 1860, and Tolstoy's letters of that period show how deeply he was affected by the death of his brother. It gave a yet more serious turn to his thoughts. In a letter to Pet he reverts to his old trouble, the enigma of life. "In truth," he writes, " the position in which we stand is terrible." This mental gloom probably still hung over him during his wanderings through Italy. There is no record of his impressions of Rome, Naples, Florence. Turning his footsteps northwards, however, he began to take renewed interest in social conditions, elementary and monastic education, and the general subject of his quest. Prom Paris (where his friend spoke of him as " singular indeed, but subdued and kindly ") he went to London in 1861, no noteworthy incident marking his brief visit.

The spring of 1861 found him once more at Yasnaya Polyana, where some little time before he had forestalled

the Pmancipation Act by freeing all the serfs Educa- on th^ estate. He now began digesting the periments. mass of information he had acquired abroad,

eager to put his ideas into practice. The feel- ings with which he reviewed his experiences were largely those of disappointment. Of the educational systems of Italy, France, and Germany, that of the last-

~~named country alone earned his partial approval. While there he visited the universities, prisons, and working men's clubs. He made the acquaintance of Auerbach, and was greatly influenced by his ideas on village schools. He was also much impressed by the novel institution of the kindergarten, to which Frobel, the great educationist, was devoting all his energies. Determined to follow these lines, he sought and obtained permission to open a school. In his zeal he also started an educational journal called Yasnaya Polyana. This journal now only exists as a literary curiosity, but the essays published in it have all been reprinted in his collected works. The time for opening the school was well chosen. The liberal spirits of Russia had gained the day and won a great victory. Just two months previously the decree of emancipation (February 1861) had been sent forth. The air was rife with schemes for the betterment of the peasantry. A new era seemed to have begun. Tolstoy's school was essentially " free." " Everything that savours of compulsion is harmful," he said, " and proves either that the method is indifferent or the teaching bad." So that not only were no fees paid, but the children came and went as they pleased, learned what they pleased, and were subjected to no sort of punishment. It was the duty of the teacher to fix the pupils' atten- tion, and his the blame if they failed to learn. "The student," said Tolstoy, "must have the right to refuse those forms of education which do not satisfy his instincts. Freedom is the only criterion. We of the older generation do not and cannot know what is neces- sary for the younger." On these principles the Yasnaya~~

~~Polyana school was started in a house near that of Tolstoy. He himself taught drawing, singing, and Bible history. The Old Testament was his handbook; he held it as indispensable in any course of instruction, a model for all books. Doubts and fears sometimes as- sailed him, still for a year all went well. Other schools were opened on the same lines in the district, and suc- cess seemed assured. But the eyes of the Government inspectors had long been suspiciously fixed on them, and a correspondence on the subject presently ensued between the Ministry of Education and the Home Depart- ment. The verdict passed by the former was free from overt animus. " The activity of Count Tolstoy deserves respect, and should win co-operation from the Educational Department, although it cannot agree with all his ideas ; ideas which he~~

~~will in all probability abandon on due con- sideration" (October 1862). Yet there was a subtle threat conveyed in these last words which was probably not without effect. Signs of discouragement grew visible. * We find the enthusiast complaining that his masters desert him, his pupils fall away. The plague of inquisi- tive visitors annoys him. This venture shared the fate of early blossoms, and fell victim to a frost — the frost of opposition, active and passive. At the end of the second year the schools were closed, the journal discon- tinued, and Tolstoy, disheartened and sick, "more," as he writes, " in mind than body," betook himself to the healthful quiet of the steppes, to breathe fresh air, to drink koumiss, and to vegetate. This was the end of his educational experiment, the aim of which was rather to develop the character than to educate in the ordinary sense of the term. When later he asked leave from the authorities to reopen the schools, it was peremptorily refused.~~

~~His socialistic theories were now fully unfolded. In his view the people were everything, the higher classes nothing. The latter had misinterpreted the meaning of " progress," imagining it to be synonymous with educa- tion ; and hence compulsory teaching had been resorted to, with harmful results. Reading and writing played but a small part in forming a man's mind and fitting him for life. They merely rendered him more articulate. These questions should be left to the people themselves. Their demands were very clearly expressed. They knew what they wanted, and were thoroughly convinced that " in the great question of their spiritual development they would neither take a wrong step nor accept that which was false." Such was in substance Tolstoy's doctrine. " The people," he affirms, " are stronger, more independent, more just, more human, and above ali more necessary than the upper class. It is not they who should come to our schools; we should learn of them." This desire to subvert society is akin to the philosophy of Rousseau, as expressed in Smile (livre iv.) : —~~

~~" C'est le peuple qui compose le genre humain ; ce qui n'est pas peuple est si peu de chose, que ce n'est pas la peine de le compter. L'honime est le m§me dans tous les 6tats ; si cela est, les 6tats les plus nombreux mentent le plus de respect. Devant celui qui pense, toutes les distinctions civiles disparaissent : il voit les memes passions, les m§mes~~

sentiments dans le goujat et dans l'homme illustre ; il n'y discerne que leur langage, qu'un coloris plus ou moins appr§t& . . . ifetudiez les gens de cet ordre, vous verrez que, sous un autre langage, ils ont autant d'esprit et plus de bon sens que vous. Respectez done votre espece ; songez qu'elle est composee essentiellement de la collection des peuples ; que quand tous les rois et tous les philosophes en seraient 6tes, il u'y paraltrait guere, et que les choses n'en iraient pas plus mal."

While Tolstoy's theories were thus in course of practical solution, his literary powers suffered eclipse. Tour guenieff , who lived near him in the country, writes in disgust that he "has grown a long beard, leaves his hair to fall in curls over his ears, holds newspapers in detestation, and

has no soul for anything but his property." Indeed, his time was fully taken up, for while still occupied in supporting the school, he had allowed himself to be nominated to the position of "Arbitrator," which he held for a year and some months (1861-62).

^ttbth" ^is was an aro^uous Post;- The arbitrators peasantry, were appointed under the Law of Emanci- pation to supervise the distribution of land, to adjust the taxes, define the conditions of purchase, and decide all matters in this connexion. These duties were after his own heart, and he went to work with a will. Every day he had difficult points to deal with, deputations of peasants coming to see him, the new law and the rights it bestowed on them having to be explained. The hardest of all Tolstoy's tasks was to remove the suspicion and mistrust felt by the serf towards the landlord. On the other hand, he had to contend with the nobility of the district, who were well aware of the side on which his sympathies placed him. For a year and a half he tried energetically to do his duty, but this experience led him eventually to regard the Emancipation Law as a not unmixed blessing. It had come too soon, and .been granted unasked. The condition of the peasantry was worse than before. A noble impulse, inspired by love of

~~the people, impelled Tolstoy to become their champion and interpreter. "Generations have sinned against them," he writes, " and no one deserves to live who is not ready to bear his part in undoing the wrong." This spirit of generous enthusiasm made itself felt throughout the country. The peasants respected him, and learned to look upon him as their friend.~~

~~A tragic incident occurring about this period (1866) forcibly illustrates Tolstoy's character as a defender of the helpless. A regiment had recently been stationed near Yasnaya Polyana, in consequence of some five hundred convicts being at work upon the railway. In this regi- ment was a certain Captain N., a strict disciplinarian, who led a solitary life and was much disliked by his brother officers and his men. For trifling faults he would condemn his soldiers to unheard-of punishments. One of his orderlies in particular, a young man of some educa- tion — who had voluntarily taken the place of a comrade to free him from military service — was constantly getting into trouble, until, for some slight clerical error in a report, Captain N. ordered him to be degraded and flogged. This was too much for the poor volunteer. He followed the officer as he was leaving the orderly-room, and struck him a blow on the face. He was immediately placed under arrest, and the details of the occurrence quickly spread through the neighbouring villages. Two officers of the regiment brought the story to Tolstoy, and begged him to undertake the soldier's defence. He con- sented readily, and no opposition being made by the mili- tary authorities, at once prepared for the court-martial. A few days afterwards the court assembled. Warned by the president of the severity of military law, Tolstoy made answer that he was come to defend not a criminal ,but a man compelled to crime by force of circumstances outside his will. The plea he set up was that the prisoner was not in full possession of his senses ; but this defence was not allowed to stand. The soldier was con- demned to be shot, in spite of the utmost intercession Tolstoy could make. The emotion of the crowded assembly stirred by his appeal, the mute quiescence of the soldier (persuaded that death was better than the living agony of exile), the closing tragedy — all this, added to the many scenes of war and bloodshed which he had previously witnessed,~~

made a lasting impression, and caused him to raise his voice yet louder in the cause of universal love and peace. During the preceding

period of ethical experiment he published only two books, but these stand high among his works. They were TJiree Deaths (1859) and TJie Cossacks (1863) — the latter written ten years before, its leading idea being that culture is the enemy of happiness. At the conclusion of his arbitratorship, seeing his efforts partially nulli- fied, and feeling himself overstrained and overworked, he determined to exile himself for a time to Samara, a south-eastern province. He halted on his way in Moscow, and here one night's high play cost him the MSS. of The Cossacks, which he sold to the editor of the Russian Messenger for £100 to pay his debts of honour. A pleasanter feature of this visit to Moscow lay in the renewal of his intimacy with the Behrs family, Sophia, the younger daughter of the house, being his special attraction. He finally reached Samara in the spring of 1862, and went through a "koumiss cure," revelling in what he called "the life of a beast of the field."

By the month of July he felt completely restored to health, and returned to Yasnaya Polyana where his sister Maria and his aunt, Madame Ergolskaya, were looking after the property. The house in which he now lived was comparatively new. The one in which he was born was sold to pay some earlier gambling debts, and had been removed bodily to an estate (Dolgoe estate) some 30 .miles distant. He now felt a sense of some- thing wanting in his home — a feeling of incompleteness took possession of him. He wanted to see Sophia Behrs, and accordingly left almost immediately for Moscow. Sophia's father was a fashionable Russian doctor, born and bred in Moscow, and a graduate of that university. He had three daughters, of whom Sophia was the second. The friendship between the Behrs and the Tolstoy families was of old standing, Countess Maria Tolstoy having been a school companion of Mrs Behrs. It was now the height of summer, and every one of con- sequence was leaving the city for their country seats. The Behrs family were going on a visit to their grandfather, whose estate lay not more than 40 miles from Yasnaya Polyana. Here they accordingly broke their journey, and during the pleasant days that fol- lowed Tolstoy's attachment deepened. Not long after their departure

his impulse took shape, and mounting his horse, he set out for Twicy, where they were staying. His errand was a definite one; and he lost no time in fulfilling it. At first Dr Behrs demurred, un- willing to allow his second daughter to marry before her elder sister, but his objections were arra*e- presently overruled. On the 23rd of September 1862 the marriage took place, and Tolstoy installed his bride at Yasnaya Polyana with the conviction that calm and contentment were his at last. Two weeks later he wrote to his friend Pet, saying that he was now happy and felt quite a new man. In his Confession some years later he writes : " The new conditions of a happy family circle led me away from my researches into the meaning of life. My whole mind became concen- trated on the family — on the mother, the children, and the anxiety to provide due means of subsistence. The effort after perfection resolved itself into the effort to ensure the happiness of my offspring." Tolstoy thereupon settled down to country life, and though to the young countess this exile from her town friends and relations must have been somewhat of a trial, they remained on their estates for the following eighteen years, with very short intervals of absence. They had thirteen children, of whom the eldest was born in June 1863. In the bringing up and instruction of his family, Tolstoy con- formed in essentials to the requirements of his position. No experiments were attempted. English and German

governesses were engaged, and their educational methods followed the usual routine. Both father- and mother devoted a considerable amount of time to their children. Punishment was rare. It consisted in a strict " boycott " of the offender, which was not relaxed until a frank confession of fault was made — no light penalty to a sensitive child. The theory of free option in study was dropped by Tolstoy in the case of his children, but he was for ever joining in their games, taking them on his shooting expeditions, and sharing in their gymnastic exercises. Manual labour was always congenial to the great writer, and formed a

natural concomitant to his pastoral existence. It was a common thing for him to mow the lawns, hoe and rake the garden beds, or when out walking to take the scythe from a labourer and wield it lustily. His overpowering vitality needed more than the ordinary man's quantum of exercise, and more- over, he upheld manual work as elevating in itself — an article of faith arising from his love of the people, and adhered to unanimously by his followers. He was devotedly attached to sport, and we find him constantly hunting and shooting. He was once (at the bear hunt before alluded to) in imminent danger of his life, and again on a more recent occasion, when out shooting hares, he severely dislocated his arm.

War and Peace and Anna Karenina, Tolstoy's two most widely known and finest novels, date their com- mencement from this period. These two novels were received with scant favour by both the Liberals and Conservatives in Eussia. Katkoff, the editor who was publishing Anna Karenina in his periodical, introduced so many changes into the MSS. that the publication was not continued. It was due to N. Strachoff, the literary critic, that public opinion was brought to recognize the merits of these novels. Every day Tolstoy retired to his room for a certain number of hours, and whether in the humour or not, sat at his table and wrote. " Inspiration comes with writing," he used to say. Authorship he avowedly de- spised, yet confessed the temptation of public applause and heavy gains was too great to resist. The read- ing world has reason to be glad of this touch of in- consistency. The countess was at all times a help- meet to her husband. At midday, when he stopped work, she took over his MSS. to copy neatly and place ready for him to read over on the following morning. In the evening he would confide the plots of his stories to her, and discuss the books he had been read- ing in preparation for them. Despite his genius for characterization, the task of novel-writing cost him a severe and determined effort. The technique of literary composition irked him exceedingly. " You cannot con- ceive," he writes in 1864 to his friend Fet, "how hard is this preliminary labour of ploughing the field in which I am compelled to sow. To consider and reconsider all that may happen to all the characters beforehand, and to think over the million of possible combinations, and to choose one out of a hundred thousand,

~~is very difficult." In another letter he bemoans the shortness of life. " Ars longa, vita brevis. If one only had time to do a hun- dredth part of what one wishes, but alas ! a bare ten- thousandth part is accomplished. Nevertheless, in the feeling that I am able to do it lies the happiness of your friend."~~

~~In the course of this correspondence interesting side- lights are thrown on Tolstoy as landowner and farmer. Not long after his marriage he wrote, " I have made an important discovery, of which I hasten to tell you. Agents, stewards, and overseers are only so many hindrances to farming ! Dismiss them all and lie abed till 10 o'clock, and you will see things will certainly~~

~~go none the worse. I have made the experiment, and am quite satisfied. Now to business. When you are in Orel buy me 20 poods of various kinds of string, &c, and send them to me if it does not cost more than two roubles thirty kopecks a pood with the carriage " ; and in this vein he enters into manifold rural matters, the progress of crops, the illness of a favourite horse, or the calving of a valuable cow. Again the philosopher rises to the surface, and he questions Fet as to the workings of his mind.~~

~~"I don't mean in the Zemstvo nor in agriculture ; these are occupations for active men, with which we employ ourselves in a perfunctory fashion, much like ants engaged in hollowing out a clod of earth — work of which the result is neither good nor bad. But what are you doing with your thoughts ; how is the inner mechanism working ? Is the secret spring trying to show itself, making its presence felt ? Has it forgotten how to work ? that is the all-important question."~~

~~At another time he pays a well-earned tribute to his wife's helpful sympathy. " She is by no means a trifler," he writes, " but is an earnest helpmeet to me." In literary matters he valued above everything the opinions of Fet and of Tourguenieff (notwithstanding his saying of the latter, " the older I grow the less I love him "). Fet, on the other hand, was an intimate and devoted friend, constantly interchanging visits with the Tolstoy family. To him the scenes of War and Peace were first~~

~~unfolded as Tolstoy read them aloud in the quiet evenings, when the children were hushed in sleep.~~

~~It was at Fet's house (in 1864) that the violent quarrel took place between Tourguenieff and Tolstoy which nearly culminated ina duel. Many inaccurate accounts of it have been given, but the history of the Quarrel rupture, as recorded by Fet, may be looked on ™lth as trustworthy. It seems that Tourguenieff nlefff0*" in rather a boasting spirit was praising his daughter's English governess — how she had desired him to name the precise sum his daughter might spend in charity, and how, at her instigation, the young lady made a practice of mending the clothes of some of the poorest peasants. Tolstoy said brusquely that he thought it was artificial and theatrical, poseuse, for a daintily-dressed girl to sit sewing at filthy, evil-smelling garments in the name of charity. Tourguenieff thereupon rose, furious, from the table. " Stop saying such things ! " he cried, " or I will force you to silence, with insults if need be." Peace was with difficulty restored by M. and Madame Fet, and this factious pair were despatched on their homeward way by separate conveyances. The letters which subsequently passed between them only served to fan the flame, so that even the amiable Fet was involved in the dispute and for a short time estranged from Tolstoy. Finally, after a lengthy and acrimonious correspondence, the threatened resort to arms was averted through the interposition of friends ; but fourteen years were allowed to pass before a reconciliation took place. In 1878 Tolstoy, believing himself to be in a dying state, at length made overtures of peace to his brother author ; overtures which Tourguenieff met cordially in the following terms : —~~

~~" Deak Leo Nikolaevitch, — I received your letter to-day which you sent to me poste restante. I was delighted and much moved by it. With the greatest pleasure I am ready to renew our former friendship and to press your proffered hand. You are quite right in thinking I harbour no feelings of enmity towards you. If they ever did exist, they have long since disappeared, and no remem- brance of you now remains save that of a man to whom I am sin- cerely devoted, and of a writer whose first step it was my great privilege to be one of the earliest to welcome ; whose every new work has always aroused in me the greatest interest. I~~

rejoice from my heart that our misunderstanding has come to an end. I hope to be in the province of Orel this summer, and then we shall meet. Till then I send you my best wishes, and once more grasp your hand in friendship."

Meanwhile Tolstoy had pursued literary labours with

relentless ardour and with ever-increasing fame. Prince Andre (the hero of War and Peace) and Anna Karenina in turn occupied all his thoughts. Several years were given to the perfecting of these remarkable character- paintings. When the publication (1864-69) of War and Peace had been succeeded by that of Anna Karenina, he set himself to write yet another great novel, dealing with the times of Peter the Great, but after working at it for some months he suddenly abandoned the scheme. The public and private acts of the famous Tsar roused such indigna- tion in Tolstoy's soul that he could not go on with the subject. One of the few excursions made during these years of tranquillity was undertaken in 1866 to the battle- field of Borodino, the scene of the famous fight in 1812. For two days Tolstoy wandered over the plain, investigat- ing and taking notes, and there he drew a plan of the battle, which was afterwards published as a frontispiece to War and Peace. At this time, in the height of his powers and success, he confessed — with the unfaltering frankness that marks his utterances — that his creations were dearer to him than any living thing. But the con- tinued pressure of severe nervous and mental strain was bound to affect a man of his calibre ; health and spirits gradually sank, so, that in 1870 Countess Tolstoy induced him once more to seek the healthful air of Samara, and subject himself to the "koumiss cure" in practice there.

A strange feature of this " treatment " lay in 'samara *^e avoidance of meal and vegetables, the diet

~~being strictly confined to meat. Tolstoy pitched his tent in the village of Karalieck, where the primitive life among the Bashkir nomads exactly suited his habits and disposition. He had a faculty for making himself at home with peasant folk, and was a great favourite among them. In this district there was a large community of Molochans, a sect whose tenets differ considerably from those of the Orthodox religion of Bussia. They acknow- ledge no guide save the Bible, and reject all the rites and ceremonies of the Greek Church. Their honesty, industry, and temperance made them an example to all the country round, and caused Tolstoy to study ttiem with special interest. So delighted was the count with this visit to Samara, that he shortly afterwards purchased an estate of over 2000 acres in the district. But his pleasure was short-lived, for not long afterwards (1872-73) the crops failed and a serious famine broke out. He thereupon opened a subscription fund for the starv- ing population, and went from village to village taking a quantity of grain with him, and making what pro- vision was possible in the circumstances. He also endeavoured to arouse public sympathy by drawing a dark picture of the condition of things in an article which appeared in the leading newspaper of Moscow. In all that personal devotion could effect he left no stone unturned. His own immunity from the sufferings of the poor filled him with generous remorse. " Here we are," he writes, " seated at table. Crimson radishes, yellow butter, fresh loaves make a pleasant show on the clean cloth. The garden is green and shady, and our young maidens in their muslin frocks are rejoicing in the heat of summer. But outside the evil devil Famine is busy covering the fields with blight."~~

~~Tolstoy was now making up for lost time, learning what he had failed to learn at the university. Greek was his great attraction. " Without Greek," he exclaims, "there is no culture." He also became enamoured of the~~

~~writings of Schopenhauer, and for the greater studies part of a year (1869) devoted himself to the~~

~~study of that philosopher. "Never," he says,~~

~~“have I experienced such spiritual joys.” Enthusiastic in everything he takes up, he assures his friends that Schopenhauer is the greatest genius he has~~

~~la philo- sophy.~~

~~met with. He sets himself to translate his works, and tries to enrol Fet as a co-translator. Philosophy at this stage of his life went hand in hand with sport and agri- cultural interests. He contemplated buying an estate in the province of Penza, but on 21st October 1869 he writes : —~~

~~“The purchase of the estate in Penza has not come to anything. I have now finished the sixth volume [War and, Peace], and I hope it will be published on the 1st of November. There are a lot of snipe. I have shot four brace, and to-day found two brace and killed one bird.”~~

~~After a period of comparative rest and ease, the shadows of war and death once more encompassed Tolstoy. Two of his children died in 1873, and their loss was followed by that of his much-loved aunt, Madame Ergolskaya. ” In the death of a near and dear being,” he writes, ” there is always something novel and unique, something sudden and unlooked-for, however long expected ” ; and although he is able thus calmly to philosophize, and to say further that death comes easiest to the youngest-born, and they can best be spared, still these bereavements left an enduring sadness. A mental restlessness and uneasiness came over Tolstoy, and also a desire for the exercise of a wider philanthropy. The Busso-Turkish war put the crowning touch, to these feelings. God and death, war and the intricacies of life were now the constant subjects of his letters. ” You will not believe what joy your last letter has given me,” he writes in 1877 to his dear friend Fet. ” When you speak of the existence of the Deity, I agree with everything you say, and I would wish to write much, but time fails me and it is difficult in a letter. For the first time you write to me on the Divinity of God. I have been thinking about it for a long time. Don’t say that we must not think about it. Not only we must, but we ought. In all ages the best people, the true people, have thought about it.” Tolstoy now resumed the study of the Bible, and took special delight in the books of Ecclesiastes and Proverbs. He treats them as a new discovery, and~~

~~recommends them to his friends as having much in common with the teaching of Schopenhauer ! This revived interest in religious questions was accompanied and perhaps deepened by a state of extreme depression. He was not actually ill, but imagined himself to be a dying man. It was then he reconciled himself with Tourguenieff, and in December 1878 we find the latter staying with him on a visit of three days' duration. Tourguenieff writes that he finds him " very silent, but much developed." The count on his side feels the same want of mutual sympathy as of old, and confesses that no real friendship seems possible between them.~~

~~Tolstoy now entered on the third phase of his life. He himself thus describes the stages of his mental growth. In the first phase he lived only for his own lusts and pleasures. This came to an end at the age Religious of thirty-four. Then came the interest in the meat°P' welfare of humanity, which married life cooled and obscured for a while.. The striving for the welfare of mankind was mingled with the striving for personal well-being. But the third and highest phase was reached when the service of God became the motive power of his existence. All other aims grew subservient to this, and interest in the merely personal life had begun to disappear. He had passed through every imaginable grade of religious thought. As a child he had gone to church and confession unquestioningly. As a student and young man he had scorned and ridiculed religion. Later in life he became a pious and devoutly Orthodox Greek Churchman, until one day during the Busso- Turkish war he was filled with a spirit of revolt at hearing the priests pray for the destruction of the enemy,~~

~~beseeching the Almighty to help them to kill their hundreds and thousands. His whole being recoiled from the un-Christianity of these prayers, and he then and there renounced the Orthodox faith. For three years he had exceeded the priests themselves in the regularity of his attendance. Now he felt there was something vitally amiss, and he flung it all to the winds. Though the final step was sudden, the change~~

~~in his mind had been gradual, and may be traced throughout his works. The novelist was rapidly being hidden in the philosopher's cloak, to the dismay of literary Europe. So early as 1859 Tourguenieff had ex- claimed, "If only Tolstoy~~

~~would not philosophize, all might yet be well." As we see during the next fifteen years Tolstoy's increasing love of mysticism (taking mysticism to mean the emotional contemplation of the relations of man to the universe), we are constantly reminded of this charac- teristic. His brilliant con- temporaries, Gogol, Dostoiev- sky and others, had all in different ways been seized in turn by what may be called the fever of religion. Tolstoy was to suffer from it too. Like the flickering of a dying lamp, his imagi- nation again shone out in The Death of Ivan Ilyitch and The Power of Darkness. Since then, with rare excep- tions, his writings have been marred by his ethical reason- ings. He was now fifty. While leading a life out- wardly calm and peaceful, he had passed through in- numerable mental struggles and vicissitudes. Of these he speaks with simple can- dour in My Confession, an autobiographical sketch which appeared in print at intervals between the years 1879 and 1882. Many theories had appealed to him in turn. At one time it was his leading idea that "the object of life should be the happiness of one's family and oneself." This had failed to satisfy him. " I lived by this rule up to a few years ago," he writes. " Then a strange state of de- spair, a longing came over me. I had moments of doubt and despondency. Life as it were had come to a stand- still ; I neither knew how to live nor what to do. I wandered about aimlessly, a prey to low spirits. For a time this mood passed away, and I totok up the daily duties of life. Then again these misgivings became more frequent and more acute. The same questions were always thrusting themselves on my mind — why and wherefore ? and whither ? " In the orthodoxy of the Greek Church, with fastings, prayers, and rigid observ- ances of her rites, he vainly sought an answer to his doubts ; finally he broke away from a ceremonial which had become empty and lifeless to him, and built up a re- ligion of his own. His mind, so unhinged as to have been almost on the verge of suicide, was calmed by contemplat- ing the dumb patience of the people, " who meekly accept illness and sorrow in the steadfast~~

~~conviction that all is forthe best." Wearyof theroutineof materialprosperity,~~

~~Count Tolstoy.~~

~~of the writing of books, of the cultivation of his estates still more drawn to the study of abstract questions, he exclaims, " How often have I not envied the unlettered peasant his lack of learning ! " Impressed with the con- viction that the peasant's mental ease was the result of his life of physical toil, Tolstoy tried to adopt the same habits, and for some ten years (dating from about 1880) he renounced the life of his own class as completely as it was possible for him to do. He rose early and went to work in the fields, ploughing, cutting the corn, working for the widow and orphan, and helping them to gather in the~~

~~crops. He was often to be seen aiding a labourer, carry- ing his bundle, wheeling his barrow. He also learnt boot and shoe making, and en- joyed being praised for his skill. Thus he laboured late and early, and in these simple physical acts found the best cure for his attacks of despondency. " Simpli- city ! Simplicity ! Simpli- city ! " Tolstoy seems to re- peat the thought of Thoreau in the joy of his new-found peace —~~

~~"I say, let your affairs be as two or three, and not a hundred or a thousand. Instead of a million count half-a-dozen, and keep your accounts on your thumb nail. In the midst of this chopping sea of civilized life, such are the clouds and storms and quicksands and thousand and one items to be allowed for, that a man has to live, if he would not founder and go to the bottom and not make his port at all, by dead reckoning, and he must be a great calculator, indeed, who succeeds. Simplify, simplify. Instead of three meals a day, if it be necessary eat but one ; instead of a hundred dishes, five ; and reduce other things in pro- portion."~~

~~On this principle his food and drink, his pleasures and personal indulgences, were curtailed. Meat was given up and replaced by a vegetarian diet. Field sports — equiva- lents for cruelty and lust of blood — were abandoned, and his gun hidden away to rot and rust. Even tobacco was renounced as luxurious and unhealthy.~~

But with all his straining towards simplicity, it was in the nature of things impossible for Tolstoy absolutely to lead the life of a peasant. Labour though he might throughout the day, there was his well-appointed house to return to. He could not cut himself off from his wife and children. Friends and acquaintances could not be wholly ignored by the would-be Diogenes. Circumstances in this respect were too strong for his views and wishes. The renunciation was still only a partial one. But as the strain of a great surrender is greatest while it is still in- complete, so Tolstoy felt more and more impelled to emancipate himself from worldly concerns. The break in the long spell of country life which presently occurred only served to deepen this desire. In 1881 his eldest son went to the university, and the two next in seniority soon followed him. It became necessary for the family to be in Moscow a great deal, for the sake of the children's education. The eldest daughter had come out into society, and friends were continually calling, obliging

Tolstoy to sit and talk with them. All the elements of town life were distasteful to him. The artificiality of it ; the competition of the merchants and the employers of

labour ; the curse of inequality — one and all Renuncia- weighed heavily on him. Money was an evil property, thing in his sight, and he gave up carrying it

about with him, or even making use of it. " What makes a man good is having but few wants," he said, and he accordingly set himself to limit his wishes rigidly, and to detach his heart from all treasured objects. The year 1880 was the census year in Eussia. The Government, as usual, called for volunteers to help to carry it out. Tolstoy became one of the enumerators, whose duties afforded an excellent opportunity for seeing the conditions under which the poor lived. The misery of it made him often wish to surrender all his pro- perty and have nothing more to do with lands and money, but the Government and family circumstances prevented him. In the pamphlet, What are we to do? he

~~graphi- cally narrates his census experiences. Again and again he attempted to carry his theories into effect. At last, calling his wife into his room, he explained to her that property and many possessions had become irksome to him. Wealth he now regarded as a sin. He wished to be rid of all personal ownership. In 1888 Tolstoy re- nounced all claim to his estates ; everything was made over to his wife and children, the countess acting as trustee. True, this renunciation made little difference in his manner of life. He lived under the same roof as before, ate at the same table, wrote and read in the same study. The change was mental rather than material. He cared no longer for the growth or improvement of his estates, but gave himself up to ethical questions, and en- deavoured day by day to bind himself more closely to the people. He now began to write specially for their benefit a number of simple tales which have been widely read, tales directed mostly against crying evils — the peasants' love of vodka, and like themes. He found will- ing fellow-workers in the firm of Eussian publishers known under the name of Posrednik (V. Tchertkoff, and a group of friends). John the Fool, which was published in 1886 in the Posrednik series, is generally considered the best of these stories. The Power of Darkness (1885) also appeared in this series, and was written with the same object in view. Unfortunately, the popularity of these stories aroused the attention of the Government, and led to many of them being forbidden on account of their Socialistic tendencies.~~

~~The terrible famine of 1891-92 added fresh lustre to Tolstoy's name. He and his family worked unceasingly in soup-kitchens and barns, distributing food and clothes. No true leader lacks a following. Every oppressed sect or individual turned instinctively to Tolstoy for sympathy and support, the most important case in point being that of the sect of the Doukhobors. Early in 1891 rumours~~

~~began to reach headquarters of social and re- hobor™*' li§i°us excitement fermenting among theinhabit-~~

~~ants of the Caucasus, and especially among the Doukhobors (q.v.). This people, numbering from fifteen to sixteen thousand, shared their goods and property in common, and made laws of conduct for themselves,~~

based on a simple form of religion unobscured by ceremonies or ritual. In these matters, and especially in refusing to serve as soldiers, they defied the governors of the Cau- casian provinces, so that as their numbers and strength of opposition to authority grew formidable, severe measures were put in practice for their suppression. Several of their leaders were exiled, and in 1895 some hundred of them were condemned to be enrolled for three years in the so-called "disciplinary regiment." It was in that year that Tolstoy came in contact with them personally, and

became deeply interested in them. He promptly identified himself with the agitation in their favour, and by his endeavours aroused sympathy for them in other countries, especially in England, where the Quakers, with whom they have much in common, espoused their cause. After many rebuffs from the Government, and many unavailing efforts to reach the kindly ear of the Tsar, the persecu- tion of the Doukhobors at length ceased, and they were allowed to emigrate. With the aid of the Quakers and other sympathizers, sufficient funds were collected and a remarkable exodus began. No less than 7500 persons left Eussia for Canada. It was in aid of these people that Tolstoy wrote and published Resurrection. The attack on the Orthodox Church in this novel was probably the chief cause which led to his formal excommunication by decree dated 22nd February 1901.

His religious views are best given in his own words : " I believe in God, whom I understand to be a Spirit, to be Love itself and the Beginning of all things. I believe that the interpretation of the will of ™j!^' God is most clearly and most comprehensively given in the teachings of the man Christ. But I consider it the greatest blasphemy to think of Christ as God and to worship Him as such. I consider that the true happi- ness of man consists in fulfilling the will of God, which is that we should love each other, and act towards others as we would they should act towards us. I believe there is but one means by which to nourish the growth of love — Prayer, not public prayer in churches, which is ex- pressly forbidden by Christ (Matt. vi. 5-13), but private prayer, an example of which is given by Christ Himself."

~~Before attempting to define the powers and position of an author, it is best to pass in review the works which have led to his present reputation. Tolstoy the writer is a guide of unusual _ faithfulness to Tolstoy the man. The gradual evolu- ™^5ter** tion of the reformer and preacher out of the brilliant novelist is described in no pages so clearly as in his own. Child- hood (1852), Boyhood (1854), and Youth (1855-57) — Tolstoy's first literary efforts — may be regarded as semi-autobiographical studies; if not in detail, at least in the wider sense that all his books con- tain pictures, more or less accurate, of himself and his own ex- periences. No plot runs through them ; they simply analyse and describe with extraordinary minuteness the feelings of a nervous and morbid boy, a male Marie Bashkirtseff. They are tales rather of the development of the thoughts than of the life of a child, with a pale background of men and events. The distinct charm lies in the sincerity with which this development is repre- sented. We are introduced by the child, Nicholas Irtenyev, to a number of characters one after the other — father, mother, grand- mother, tutor, servants, and serfs ; and are led by him from the father's study tp the morning-room, and so on to the kitchen and the housekeeper's closet ; and we catch, as in a magic crystal, the lifelike scenes on his waking — in the schoolroom — at his mother's side. But the apparently unconscious change of the child's mind into that of the youth — his budding thoughts, hopes, fears— form the true drama of the story. To these essays in spiritual auto-biography My Confession (1879-82) forms a continuation. It has passages of great power and vividness, but at times the morbid brooding over the meaning of life, so frequent in these works, be- comes tedious and tiresome. Of the state of mind which Tolstoy calls "nihilism " for want of a better term he gives a faithful pic- ture. This "nihilism" is a desperate, and yet at -times merely dreamy, groping for something to satisfy the soul ; a fatalistic inertia alternating with spasms of feverish activity.~~

~~The following quotation from the Confession shows the tangle into which these gropings occasionally led: "All that men sin- cerely believe in must be true : it may be differently expressed, but it cannot be a lie ; and consequently, if it seems to me a lie, that must be because I do not understand it." We can but recall what Goethe said of the fate of the~~

Romantics : ” Am wiederkauen sitt- licher und religibser Absurditaten zu ersticken.” But in the interim between Youth and My Confession, a succession of brilliant performances had placed Tolstoy in the front rank of the novelists of the century. The Cossacks (1863), written round the theory that culture is an enemy to happiness, was followed by War and Peace (1864-69), which has been justly called a Russian epic. Within its pages Tolstoy has marshalled a panoramic array of kings, princes, and nobles, as they lived and moved during the times of the great Napoleonic wars. There are so many figures in

the picture, so much kaleidoscopic colour and movement, that the spectator often finds it difficult to follow the thread of the narra- , tive. The leading characters all belong to the highest

War ana Russian society, whose circle — with its inflexible code of laws and customs, and a vitiated moral atmosphere affecting each member of it in a greater or less degree — links them together. The interest centres not so much in any single person as in the groups formed by four leading families of the ” grand monde ” — the Rostovs, Bezouchovs, Volkonskys, and the Kour- agines — all bound together by common aims and interests. The men are eager to make a name and enjoy life ; the women seek pleasure in gossip and romance. Peter Bezouchov and Prince Andr6, with natures essentially different, but united by a love of truth, are the exceptions to this rule. Peter Bezouchov is one of Tolstoy’s finest characterizations, drawn with a masterly hand. He is the embodiment of all that is good and bad in the Russian temperament. On the one side there is the striving after an ideal and a capacity for self-sacrifice, on the other an absence of firmness and balance. Like Tolstoy himself, he is always in doubt as to what is right and what is wrong, as to the meaning of life and death, and, like him, can find no answer to these riddles. While Peter Bezouchov is a typical Russian, a very Tolstoy, Prince Andre\ if a less striking, is a more lovable personality. Upright and noble-minded, he yet is unable to cast off the chains of custom which have held him from

~~childhood. He too is constantly seeking mental rest and finding none. The love-story of Andre' and Natasha Rostov, which runs through the novel, is a poem in itself. Natasha is almost the only heroine Tolstoy has given us who wins our affections ; but even she, after many transitions, sinks to the level of the Hausfrau, with no aim beyond the propagation and nurture of the race. There is something strained and abnormal in all the characters in War and Peace; but it must be borne in mind that Tolstoy winged his shafts not at men generally, but at that particular section of society to which he himself by birth and association belonged.~~

~~A long period of silence followed the publication of this novel, during which the world heard little of him. At length in 1873 he M issued the first parts of Anna Karenina. It is without~~

~~'Anna ^ doubt his greatest production. The area of time and~~

~~aren na. Space jn ^ as jn ^e preoeding book, is large, but it has more continuity of action, and the principal characters are kept well in the foreground. It is a study of modern Russian life, in which the normal passivity of unsympathetic conjugal relations is sharply contrasted with the transient omnipotence of passion and deep love. The hero and heroine are Count Wronsky, a young soldier in a crack regiment, and Anna Karenina, the wife of an important official in the political world of St Petersburg. The parts of secondary heroine and hero are filled by Kitty Cherbatzky and her lover and ultimate husband, Levine. The central figure is of course Anna herself, an elegant and fascinating " mondaine." She is honest, frank, and well endowed by nature, and has an innate striving after truth and beauty in art and in life, but her early marriage with Karenina (who is double her age, reserved, and taciturn), while socially advantageous, has dulled and stunted her ideals. Ignorant of the meaning of love, she despises it, and it is not till she meets Wronsky that she realizes to the full the emptiness of her existence. Wronsky, young, handsome, impassioned, recognizing no principle but his own desires, offers her the rich wine of life at a draught. She tastes it, after scant hesitation ; and then, flinging away her worldly position, deserting husband and child, she drains it to the dregs, only to find that poison lies in the cup. Anna and Wronsky have~~

~~no true ideal to cling to. He, as their passion cools, finds the tie irksome and a hindrance to his career. She grieves for her lost and dearly-loved son, and frets as she sees that Wronsky's devotion is waning, recognizing too late that he loved her chiefly for vanity's sake, that they are slipping daily asunder, and growing displeasing to each other. Her past life is closed to her, the future opens like an abyss. The crisis has come, and swiftly obeying the impulse of her despair she seizes on death as her only weapon for wounding Wronsky and cutting the hopeless knot of her life. This pitiful end is led up to step by step with microscopic truth and insight into the springs of human action. In the married life of Kitty and Levine, on the other hand, Tolstoy describes a state of happiness of a material nature — disagreements easily bridged over, and mutual interest in their children and the pleasures of the country. . Levine is the Tolstoy of Action. The improvement and development of his estates, the life of a country squire, fail to satisfy him. The death of his brother, the birth of his child, awaken his mind to the problems of existence, and he is plunged in melancholy. Finally, relief comes to him with the words of a peasant who bids him " live for his soul and for his God." There- upon Levine exclaims, "I have discovered nothing. I have simply opened my eyes to what I knew already ; I have come to the recognition of that power which formerly gave me life and which renews life in me to-day. I am freed from error ; I recog-~~

~~nize my master." And the novel ends with the effacing of the intellect in a cloud of happy mysticism.~~

~~The Kreutzer Sonata, published in 1890, created a profound impression. Many who were previously unacquainted with Tolstoy's work read this story of love, jealousy, and revenge, and were dumbfounded by its boldness. It is a startling "Kre"t^,r advance upon Family Happiness, published thirty Sonata- years earlier. Society generally, and Russian society in parti- cular, is ruthlessly condemned for its views on marriage and its attitude towards the vexed question of the relations between man and woman. It is also a stern indictment of music as a debasing art. Marriage, Tolstoy says, can only be condoned if spiritual sympathy exists, and then only as the means to the~~

~~continuance of the race ; otherwise it is a breach of true morality. The " motive" of the Sonata is that the ideal we should strive after is a life where the spiritual penetrates and pervades everything and where all that is carnal is eliminated. Driven to its logical conclusion, the Sonata is the condemnation of marriage. But in the " Sequel " to the Sonata Tolstoy adds that great ideals are always unattainable, and affirms that no man can know, whilst yet striving, how nearly he approaches them. He is only con- scious of his deviations.~~

~~The views of culture forming the basis of The Cossacks are y.et further elaborated in What is Art f (1898), a sweeping criticism of the philosophy of aesthetics, to which he had devoted fifteen years of thought. The reformer's 72??*' 's conclusions condemn the art to which those very con- clusions owe their authority. He dismisses as inadequate the theories which define art as the pursuit of beauty, whether beauty be regarded with Shelley and Hegel as an approximation to arche- typal perfection, and thus allied to God and goodness, or with Kant as that which gives disinterested pleasure. Tolstoy sets forth his own view that art is a human activity which aims at the transmis- sion of emotion. He proceeds to narrow the definition by demand- ing that the emotion shall be actually felt, and shall belong to the highest feelings to which men can rise. True art must appeal to the religious perception of the brotherhood of man, and it must find universal response. He asserts that all exclusive art is bad art, and that such subjects as sexual love, patriotism, and religious devotion should be avoided. The theory postulates a universal art which shall ignore universal human nature. Tolstoy's doctrine is indeed a surprising medley of contradictions and arbitrary as- sumptions. As sincere iconoclasm the book is interesting, but can hardly be constructively helpful to the lover of art.~~

~~Toluca. See Mexico (State).~~

~~Tomaszow Mazowiecki, or Tomaszow Fabbyczny, an industrial town of Russian Poland, in the government and 41 miles N.E. of the town of Piotrkow. It has large woollen mills, steam flour-mills and mechanical works, and is rapidly developing. Popu- lation (1897), 21,041.~~

~~Tompkinsville, formerly a village of Eichmond county, New York, U.S.A., and since 1st January 1898 a part of Eichmond borough, one of the five boroughs constituting New York City. It is on the eastern shore of Staten Island, just above the Narrows of New York harbour. The population is not separately returned by the census.~~

~~Tomsk, a Eussian government in western Siberia, extending from the Chinese frontier to about 60° N., with Semipalatinsk on the S.W., Tobolsk on the N.W., and Yeniseisk on the N.E. It has an area of 331,159 square miles, including the Altai region ; and its popula- tion, which was 1,134,750 in 1882, has rapidly increased, chiefly through immigration, until in 1897 it numbered 1,929,092 (domiciled only), of whom 958,312 were women, and 128,503 lived in towns. The bulk of the population (90 per cent.) is Eussian, the remainder being Ostyaks, Mordves and Zyrianes, Tatars (mostly found in the Altai), Teleuts and Telenguts (belonging to the Mon- golian stem, also chiefly found in the Altai), and nomad Samoyedes (representing a mixture between the Samo- yedes and the Ostyaks, and found along the Ob river and its tributaries). The immigration during the years 1888 to 1896 varied from 13,000 to 34,000 per annum. Now that the Siberian railway has been built, it is on the increase.~~

~~Since the opening of a university at Tomsk education has made notable progress, and there were in 1897 1485 primary schools with 33,000 pupils, and 18 secondary or middle schools. Agriculture is the chief occupation of the people, and excellent crops are obtained in the southern portions of the province, especially in the Altai. No less than 4,033,500 acres were under cereal crops' in 1900, and the average yield in 1895-99 was 4,702,000 cwt. of rye, 10,684,000 cwt. of wheat, 7,155,000 cwt. of oats, 1,040,000 cwt. of barley— all cereal crops, 24,302,000 cwt. ; also 3,363,000 cwt. of potatoes. Kitchen gardening is well developed in the south, and some tobacco is also grown, but of~~

~~inferior quality. There is an ex- perimental farm, and the different agricultural societies are making considerable efforts to bring improved agricultural implements into more general use. Cattle-breeding is very important, and butter- making in model dairies, partly co-operative, has taken a great extension ; butter is already exported from Tomsk to western Europe. There were in the province in 1896 1,747',000 horses, 1,628,000 horned cattle, 2,227,500 sheep, 100,600 goats, and 452,000 pigs. Apiculture is very general, and it is estimated that there are more than 660,000 beehives in the province ; the export of honey and wax is considerable. An attempt to acclimatize the mulberry tree has been made at Tomsk University, and it has been found that though no fruit is obtained, the bushes are capable of being used for breeding silkworms. Hunting is common, especially in the Narym region, and the gathering of cedar-nuts is a trade of some importance (about £5000 worth a year). Fish- ing gives occupation to nearly 5000 persons, and mining to some 9000. The latter is especially developed in the Altai and in the Kuznetsk district, where gold and coal are obtained. Gold was extracted in 1897 to the amount of 2274 kilogrammes, silver 4563 kilogrammes, copper 213 tons, pig iron 1540 tons, iron-1097 tons, coal 22,440 tons, and salt 15,200 tons. Industries are be- ginning to develop, and there were in 1898 1390 factories, chiefly small, showing aggregate yearly returns of 8,442,000 roubles. The most important establishments are distilleries, breweries, tanneries, match factories, and iron-works. The Siberian rail- way has its own large carriage works on the Ob. A consider- able trade is carried on, especially in grain and animal products, and the sixty-eight annual fairs show returns above 7,000,000 roubles. The inner navigation on the Ob is very active (about 260,000 tons are carried every year), and is maintained by 120 steam- ers (7750 horse-power) and 380 barges, representing an aggregate tonnage of 274,000 tons. The exterior trade with China is on the increase and Biysk has become an important centre. The gov- ernment is divided into six districts, the chief towns of which are Tomsk, Barnaul (29,408), Biysk (17,206), Kainsk (5858), Kuznetsk (20,555), and Mariinsk (8300). The villages of Novo- Nikolaevsk (16,000) and Krivoschokovo, both near the spot where the railway crosses the Ob, have grown up with an American~~

~~rapidity ; so also have Tatarskaya, Karachi, Kainsk, Taiga, and Sudjenka, towns on the railway. (p. a. k.)~~

~~Tomsk, the capital of the above province, on the Tom river, 27 miles from its junction with the Ob. It is connected by a branch railway 54 miles long with Taiga, on the trans-Siberian railway, and is 1780 miles by rail from Samara. Its population, which was 31,380 in 1884, numbered 52,430 in 1897. It has now a university, a cathedral, a rich library, a number of lyceums for boys and girls, a theological seminary, various schools for the clergy, four professional schools, three public libraries, one of which is free, a society for popular education (established since the foundation of the university and displaying great activity"), a number of philanthropic institutions, scientific societies (naturalist, geographical, medical, musical, &c), and two newspapers. It was believed that when the trans-Siberian railway was built Tomsk would lose its importance as the great entrep&t for the storing of goods for distribution throughout Siberia. The contrary, however, has been the case. A great num- ber of important firms have opened storehouses, and the quantity of goods shipped on the Siberian rivers is stead- ily increasing. The distilleries, tanneries, candle works, match factories, &c, are insignificant, and show a yearly return of only about one million roubles; nevertheless Tomsk remains a centre for the economical, industrial, and intellectual life of western Siberia. Its activity in this respect will be increased with the extension of the university and the opening of the technical institute, veter- inary institute, mining school, and theological academy.~~

~~Tonawanda, a village of Erie county, New York, U.S.A., on the east bank of the Niagara river, at the western termination of the Erie Canal, in the western part of the state, at an altitude of 576 feet. Its site is level and its plan irregular. It has considerable manu- factures, now in course of development owing to the introduction of power from Niagara Falls. Eour rail- ways enter the city — the Erie, the Lehigh Valley, the New York Central and Hudson River, and the Wabash. Population (1880), 3864 ; (1890), 7145 ; (1900), 7421, of whom 1834 were foreign-born.~~

~~Tonga, or Friendly Islands (so named by Captain Cook, but now universally known by their native name, Tonga), lying in the South Pacific, about 350 miles S.S.W. of Samoa and 250 miles E.S.E. of Eiji. The climate is healthy for Europeans, being dry and cool as compared with that of Samoa and Fiji. A cyclone which de- vastated Vavau in April 1900 was the most destructive ever recorded in the group, but hurricanes are rare. In 1886 there was a serious volcanic eruption in the outlying island of Niua fo'ou, and at the same time Falcon Reef, normally awash at high water, discharged sufficient scoriae and pumice to form a new island 50 feet high. In 1898 the island had been washed away, but in 1900 H.M.S. Porpoise found that a solid core of black rock had been extruded 6 feet above high water. All the volcanoes in the group were then quiescent. The average rain- fall for the year is about 80 inches, the greatest rain- fall in one day being 4-56 in 1890. Earthquakes are not infrequent. The people, a branch of the Polynesian stock, are the most progressive and most intellectual in the Pacific Islands, except the Hawaiians. Their path towards political liberty has been thorny. In 1875 King George Tubou, acting on the advice of the Wes- leyan missionaries, absolved the natives from the service tenures which were the equivalent for rent for their lands, and granted a "constitution," with a triennial parlia- ment in which an equal number of hereditary chiefs and elected representatives have seats. A cabinet, a privy council, and an elaborate judicial system were established, and the cumbrous machinery was placed in the hands of a " prime minister," a retired Wesleyan missionary, who induced the king to break off his con- nexion with the Wesleyan body in Sydney, and to set up a state church. Persecution of members of the old church followed, and in 1889 the missionary-premier had to be removed from the group by the High Commissioner. He afterwards returned to initiate a new sect called the "Free Church of England," which for a time created further divisions among the people. There are now five churches in Tonga, the Free Wesleyans (14,000), Wesleyans (2000), Eoman Catholics (2731), Seventh Day Adventists (50). A few natives belong nominally to the Anglican Church. King George Tubou died in 1893, at the age of 96, and was succeeded by his great-grandson under the same title. Since the change of rulers the central Government has become perceptibly weaker, but the fear of annexation by one of the Great~~

~~Powers has hitherto prevented open resistance. The king has a bodyguard of thirty men. The abandonment of the old patriarchal form of government has not proved beneficial to the people, who, having lost respect for their chiefs, now respect no one. Unable to obtain the services of the community for building their houses, they live for the most part in wretched hovels. The population de- creased slightly during the decade 1890-1900, though the returns furnished by the native Government show it now to be increasing. Natives in 1890 num- bered 19,085 ; in 1899, 19,081, in addition to 80 Europeans and 260 " others." While under the control~~

~~of Europeans the Tongans have shown some aptitude for administration ; they fail when left to themselves. They pick up superficial and showy acquirements with astonish- ing ease, but they seem to be incapable of mastering any subject. They write shorthand, but speak no English; they have a smattering of higher mathematics, yet are ignorant of book-keeping. Their government, effective enough when dealing with natives, breaks down in all departments concerned with Europeans, and becomes the prey of designing traders. Their ambition is to rank as a civilized state, and the flattery lavished on them by their teachers has spoiled them. That they are a law- abiding and easily-governed people is shown by the fact that they pay a poll-tax of nine dollars, besides customs duties of 10 per cent, ad valorem.~~

~~Copra, bananas, and oranges are the principal exports ; the export of copra might be quadrupled were the islands systemati- cally planted with coooanut trees, but since every tax-payer holds his land at the will of the Government, there is no fixity of tenure to encourage improvements. The imports and exports fluctuate considerably, as the following table shows : —~~

~~Year.~~

~~Imports.~~

~~Exports.~~

~~1888 1890 1895 1899~~

~~£ B. d.~~

~~50,186 7 5 29,560 3 8 87,240 15 4 73,314 17 9~~

~~£ s. d.~~

~~68,337 3 8~~

~~45,492 6 2~~

~~113,279 6 4~~

~~71,315 17 5~~

~~No returns of revenue and expenditure are furnished by the Government, but the estimates provide for an annual expenditure of about £24,000, and there are neither debts nor a balance in the treasury. English, German, and American coinage is current, accounts being kept in dollars reckoned at four shillings. The wisdom of the late king in refusing to alienate an acre of land except upon lease has resulted in Tonga having been the last native state in the Pacific to lose its independence. In May 1900 the group became a British Protectorate under the native flag, the appointment of the consul and agent being transferred to the Government of New Zealand. There is a good code of law, drafted upon the model of the Indian Penal Code.~~

~~Authorities. — Cook's Voyages. — Martin. Mariner's Account of the Tonga Islands. Edinburgh, 1827. — D'Entrecasteaux. La Recherche de la Perouse. Paris, 1797. — Vason. Four Years at Tongatabu. London, 1815. Dumont D'Urville. Voyage de I 'Astrolabe. Paris, 1837. — Wilkes. Narrative of the United States Exploring Expedition. London, 1853. — Waldegrave, in B. G. S. Journal, 1850. — West. Ten Years in South Central Polynesia. London, 1856. — Palmer. Tonga and the Friendly Islands. London, 1855. — Erskine. The Islands of the Western~~

~~Pacific. London, 1853. — Russell. Polynesia. Edinburgh, 1843. — Thom- son. Diversions of a Prime Minister. London, 1894. — Reeves. Brown Men and Women. London, 1898. — Thomson. Savage Island. Loudon, 1902. (b. h. t.)~~

~~Tongking (in French, Tonquin or Tonkin), the northern division of the kingdom of Annam, forming an integral part of French Indo-China, extending 250 miles from north to south between 20° and 23° 20′ K, and 400 miles east to west between 102° and 108° E. The combined territories of Tongking and Annam form the " kingdom or empire of Annam." Actually, however,, the protectorate of Tongking approaches nearer to direct administration than that of Annam proper, where the conditions of the protectorate are more closely observed. It is the court of Hue- which appoints and recalls, subject to the approval of the governor-general, native officials, whose salaries are paid by the court. Formerly the king of Annam was re- presented in Tongking by a viceroy (kinh-luoc). Since 1897 this post has been abolished, and the Annamese officials are directly under the control of the Resident-General, who until 1891 was the chief personage of Indo- China. Cochin-China, however, held first rank for wealth and prosperity; but Tongking, with its population of about 12,000,000 and its situation on the southern frontier of China, must acquire great importance in the future. France is putting forth here her strongest effort towards colonization. The railway line from Hanoi to the Chinese frontier, vid Phu-Lang-Thuong and Langson, will terminate at the Canton river. The great bridge, about \ mile long, across the Red River at Hanoi has been completed. The Red River railway, which is to run to Yunnan, has been laid as far as Vietry, passing through Sontai. The lines from Hanoi to Haiphong and from Hanoi to Ninh-binh (to be _ prolonged to Hue) are under construction, and other lines are projected, including one from Tourane to Kwang-tri and Hue, and another between Hue and Saigon. Roads have been opened, and are maintained by the provinces through which they run; for example, those between Annam and Laos, lower Laos more especially. Important public works have been carried out, the docks at Haiphong enlarged, and canals deepened and opened. The imports of Tongking jn 1900~~

~~were valued at £2,552,000. The local budget for 1901 was estimated to balance at £4,197,950 (revenue and expenditure).~~

~~Local Administration. — Local administration on a communal basis exists. The institution of the mandarinate remains intact. The vacancies are filled on a most democratic system, by means of selection. The primary school, in which the pupils learn only Chinese writing and the precepts of Confucius, stands at the base of this system. Then succeeds a half-yearly examination, by means of which are selected those eligible for the course of higher education given at the capital of the province in a school under the direction of a doc-hoi, or inspector of studies. Finally a great triennial competition decides the elections. The' candidate whose work is notified as tres Men is admitted to the examinations of the dinh-thi — which qualifies for the title of doctor and the holding of the highest offices. The note Men against a candidate gives him a second-class certificate entitling him to nomination as phu, prefect, or huyen, sub-prefect, as vacancies occur. The education of a mandarin includes local history, cognizance of the administrative rites, customs, laws, and prescriptions of the country, the ethics of Confucius, the rules of good breeding, the ceremonial of official and social life, and the practical acquire- ments necessary to the conduct of public or private business. Annamese learning goes no farther. It includes no scientific idea, no knowledge of the natural sciences, and is characterized by the most absolute ignorance of even the most rudimentary instruction conveyed in a European education. The complications of Chinese writing greatly hamper education. The Annamese mandarin must be acquainted with Chinese, since he writes in Chinese characters. But the character being ideographic, the words which express them are dissimilar in the two languages, and official text is read in Chinese by a Chinese, in Annamese by an Annamese. The very intricacy of these institutions conduces to their persistence. Chinese writing remains the only one in practical use. In other matters the mandarins have resigned themselves to the French regime. Eor several years, apart from the commercial and industrial movement which has so greatly developed in Tongking (and which includes the manufacture of matches, glass, and furniture, the spinning of cotton and silk, mother-of-pearl inlaying, &c), a considerable agricultural~~

~~move- ment has arisen. Plantations of coffee, cocoa, cotton, mulberry, &c, are making rapid progress. The chief towns, Hanoi, Haiphong, and Ninh-binh, have increased in population and extended their bounds. (See Hanoi and Haiphong.)~~

~~The changes in Annam are in no sense as important, though Hue' has increased. The total population is estimated at over 6,000,000, but there are very few Europeans. The port of Tourane, however, has become the centre of an important com- mercial movement and the town (a municipality) has a population of 100 French, 200 Chinese, and 4000 natives. Coal is worked in the district. The king of Annam, Prince Bua-Lan, was born in 1879 and proclaimed emperor under the title of Than-Thai on 31st January 1889, after the death of the emperor Ding-Khank three days before. Very active and open-minded, he has greatly modified the old Court customs and rendered himself accessible — whereas the king of former times was only to be seen from afar, in ceremonial ritual. He even visited the governor-general at Saigon in December 1897, and the Saigonese were privileged to behold the emperor of Annam riding on a bicycle. The local budget of Annam since the creation of a budget-general of Indo- China is somewhat straitened. It was estimated for 1901 at 2,081,416 piastres, receipts and expenditure. (See also Cochin- China and Indo-China.) (j. m. A. de l.)~~

~~Tonk, a native state of India, in the Rajputana Agency. It consists of six isolated tracts, some of which are under the Central India Agency. Area in Rajputana,~~

~~1415 square miles. Population (1881), 170,179 ; (1891), 198,934, showing an increase of 17 per cent. ; average density, 141 persons per square mile. Population in Central India (1881), 167,850 ; (1891), 181,135. Popula- tion of both tracts (1901), 273,035. The gross revenue in 1896-97 amounted to Rs.17,01,237, of which Rs.3,10,000 was derived from loans. Of the expenditure, Rs.97,903 was directly devoted to famine relief, and Rs.39,000 to public works. No tribute is payable.~~

~~There were 13 schools, with 857 pupils. The chief, whose title is Nawab, is a Mahommedan of Afghan descent. The founder of the family was Amir Khan, the notorious Pindari leader at the beginning of the 19th century, who received the present territory on submitting to the British in 1817. The state is now well administered, the settlement of the land revenue and public works being each under a British official. The minister, Sahibzada Obeidullah Khan, C.S.I., was deputed on political duty to Peshawar during the Tirah campaign of 1897. A railway is now being constructed, with the help of a loan from Gwalior, in the outlying division of Chabra, on which 3740 persons obtained labour during the famine of 1896-97 ; and feeder roads are being made to railway stations in other parts of the state. Distress was again caused by drought in 1899-1900. The town of Tonk is situated 1462 feet above the sea, midway between Jaipur and Bundi, near the right bank of the river Banas. Population (1881), 40,726 ; (1891), 46,069 ; (1901), 38,641. It is surrounded by a wall, with a mud fort. It has a high school, the Walter female hospital, under a lady superintendent, and a hospital for males.~~

~~Tonnage. — The mode of ascertaining the tonnage of merchant ships is settled by the Merchant Shipping Acts. But before explaining the method by which this is computed, it is well to remark that there are several tonnages employed in different connexions. Displacement tonnage is that which is invariably used in respect of war- ships, and is the actual weight of water displaced by the vessel whose tonnage is being dealt with. Men-of-war are designed to carry all their weights, including coal, guns, ammunition, stores, and water in tanks and in boilers, at a certain draught, and the tonnage attributed to them is the weight of water which at that designed draught they actually displace. This displacement ton- nage is therefore a total made up of the actual weight of the ship's fabric and that of everything that is on board of her. It can be found by ascertaining the exact cubic space occupied by the part of her body which is immersed (including her rudder, propellers, and ex- ternal shafting) at the draught under consideration in cubic feet, and dividing this by 35, since 35 cubic feet of sea water weigh one ton. Of course there is nothing to prevent displacement tonnage from being used in describing the size of merchant ships, and indeed in regard to the performances of fast steamships on trial it is~~

usual to give their draught on the occasion when they are tested, and to state what was their actual displacement under these trial conditions. But it is obvious, from what has been said as to the components which go to make up the displacement at load draught, that this tonnage must, in respect of any individual ship, be the greatest figure which can be quoted in regard to her size. It is usual for dues to be assessed against mer- chant vessels in respect of their registered tonnage. This must therefore be fixed by authority, and at present vessels are measured by the officer of customs according to the rules laid down in the second schedule to the Merchant Shipping Act, 1894. As will be seen from the explana- tion of the method adopted, this is a somewhat arbitrary process, and even the gross registered tonnage affords little indication of the actual size of the ship, whilst the under- deck and net tonnages are still less in accord with the extreme dimensions.

As to length for tonnage, the measurements start with the tonnage deck, which in vessels with less than three decks is the upper, and in vessels of three or more

decks is the second from below. The length for ton- nage is measured in a straight line along this deck from the inside of the inner plank at the bow to the inside of the inner plank at the stern, making allowance for the rake, if any, which the midship bow and stern timbers may have in the actual deck. When this is measured it is apparent into which of five classes the ship's tonnage- length places her. If she be under 50 feet in length she falls into the first class, while if she be over 225 feet in length she falls into the fifth class, the remaining three classes being intermediate to these. Vessels of the first class are measured as in four equal sections, and vessels of the larger class as in twelve equal sections, according to their length. Then at each' of the points of division so marked off transverse areas are taken. This is done by measuring the depth in feet from a point at a distance of one-third of the round of the beam below the tonnage deck to the upper side of the floor timbers. Where the vessel has a ceiling and no water-ballast tanks at the point of measurement, 2\ inches is allowed for ceiling. But where there are such tanks the measurement is taken from the top of the tank and no allowance is made for ceiling, whether there in fact be any or not. If the

~~midship depth so found exceeds 16 feet, each depth is divided into six equal parts, and the horizontal breadths are measured at each point of divi- sion and also at the upper and lower points of the depth, extending each measurement to the average thickness of that part of the ceiling which is between the points of measurement. They are then numbered from above, and the second, fourth, and sixth multi- plied by four, whilst the third and fifth are multiplied by two. The products are then added together. To the sum are added the first and the seventh breadths. This total having been multiplied by one-third, the common interval between the breadths, the resultant is the transverse area. The transverse areas so obtained at each point of the vessel's length are numbered from the bow aft. Omitting the first and last, the second and every even area so obtained are multiplied by four, whilst the third and every odd area are multiplied by two. These products are added together, as are also those of the first and last areas if they yield anything, and the figure thus reached is multiplied by one-third of the common interval between the areas. This product is reckoned as the cubical capacity of the ship in feet. When divided by 100 the result is the registered under- deck tonnage of the ship — subject to the additions and deductions ordered by the Act. Directions of a kind similar to those already set out are given whereby the tonnage in the space enclosed between the tonnage and upper decks may be ascertained, and also for the measuring of any break, poop, or other permanent closed- in space on the upper deck available for stores, and the sum of the capacity of these must be added to the under-deck tonnage to arrive at the gross registered tonnage. But an express proviso is enacted that no addition shall be made in respect of any building erected for the shelter of .deck passengers and approved by the Board of Trade. In the process of arriving at the net tonnage the main deduction allowed from the gross tonnage is that of machinery space in steamships. The method of measurement here is similar to that by which the under- deck tonnage is reached. Where the engines and boilers are fitted in separate compartments, each compartment is measured separately, as is the screw shaft tunnel in the case of steamships propelled by screws. The tonnage of these spaces is reckoned, not from the tonnage deck, but from the crown of the space,~~

whilst if it has previously been reckoned in the gross tonnage, there may be an allowance for the space above the crown, if enclosed for

the machinery or for the admission of light and air. Allowances are only made in respect of any machinery space if it be devoted solely to machinery or to light and air. It must not be used for cargo purposes or for cabins. Further, by the Act itself in the case of paddle steam- ships, where the machinery space is above 20 per cent, and under 30 per cent, of the gross tonnage, it is allowed to be reckoned as 37 per cent, of such gross tonnage; whilst similarly, in the case of screw steamships, where such machinery space is over 13 per cent, and under 20 per cent, of the gross tonnage, it is allowed to be reckoned as 32 per cent. Further deductions are also made in respect of space used solely for the accommodation of the master and the crew, and for the chart-room and signal-room, as well as for the wheel-house and chain cable locker and for the donkey-engine and boiler, if con- nected with the main pumps of the ship, and in sailing vessels for the sail locker. The space in the double bottom and in the water-ballast tanks, if these be not available for the carriage of fuel stores or cargo, is also deducted if it has been reckoned in the gross tonnage in the first instance.

From the rules above laid down it follows that it is possible for vessels, if built with a full midship section, to have a gross registered tonnage considerably below what the actual cubical capacity of the ship would give, whilst in the case of steam tugs of high power it is not unprecedented, owing to the large allowances for machinery and crew spaces, for a vessel to have a registered net ton- nage of nil.

Suez Canal dues being charged on what is practically the registered tonnage (though all deductions permitted by the British Board of Trade are not accepted), it is usual, at all events in the British navy, for warships to be measured for what would be their registered tonnage if they were merchant ships, so that in case they may wish to pass through the Canal a scale of payment may be easily reached. But such

~~tonnage is never spoken of in considering their size relative to other vessels.~~

~~Two other tonnages are also made use of in connexion with merchant ships, especially when specifications for vessels are being made. The first of these is measurement capacity. This is found by measuring out the true cubic capacity of the holds, whereby it is found what amount of light measurement goods can be carried. The second is deadweight capacity. This is generally given as ex- cluding what is carried in the coal bunkers, and it is therefore the amount of deadweight which can be carried on the holds at load draught when the vessel is fully charged with coals and stores. (b. w. g.)~~

~~Tonnay-Charente. See Rochefort.~~

~~Tonsberg, a fortified seaport town of Norway, county of Jarlsberg and Laurvik, situated on a bay on the south coast, near the entrance to Christiania Fjord, 72 miles by rail south by west of Christiania. It is one of the most ancient towns in Norway. It is now the head- quarters of a sealing and whaling fleet (100 to 120 vessels of an aggregate of 10,000 tons), which employs approxi- mately 2000 men. The principal industries are refineries for preparing whale and seal oil, and saw-mills. There is a trade of the yearly value of about £300,000. Tonsberg possesses a mercantile fleet of close upon 224,000 tons (over 150 vessels). Population (1885), 7034; (1891),~~

~~7215 ; (1900), 8620.~~

~~Toole, John Lawrence (1832), English~~

~~actor, was born in London, 12th March 1832. His strong leanings towards the stage led him to abandon a com- mercial career when he was twenty, and to make his first public appearance at a benefit performance at the Hay-~~

~~market in July 1852. In this he was so successful that he obtained an engagement at the Queen's Theatre, Dublin, where he became popular. After other engage- ments at Belfast, Edinburgh, and Glasgow, he~~

~~appeared in London, in 1854, at the St James's Theatre, in "low comedy" characters. His reputation grew rapidly, and when Webster undertook the management of the Adelphi in 1858, Toole was engaged as his leading comedian. It was about this time that he first met Henry Irving, and began a lifelong friendship with him. Some five years at the Adelphi were followed by engagements at the Queen's Theatre (where the company included Charles Wyndham, John Clayton, Henrietta Hodson, and Henry Irving) and the Gaiety. In 1874 Toole undertook an American tour with considerable success, and reappeared at the Gaiety in 1875. In 1879 he became manager of the Folly Theatre, which he subsequently re-christened (in 1882) Toole's Theatre, and managed it until severe ill-health compelled him to retire from the stage in the autumn of 1895. In 1890 he made a most suc- cessful tour through the Australian colonies. Besides a remarkable fund of drollery, exploited to the full in such parts as Paul Pry, Spriggins in Igi On Parle Frangais, or " Chawles," Toole's powers of acting al- ways included a considerable command of pathos, as he showed in characters such as Caleb Plunimer, Michael Garner in Dearer than Life, or Uncle Dick in Uncle Dick's Darling; while those who saw him in Paw Clawdian and Stagedora will have a delightful recollection of his talent for travesty. His last public appearance was made on 28th September 1895, at his own theatre.~~

~~Toowoomba, a town of Queensland, Australia, in the county of Aubigny, 76 miles by rail west by north of Ipswich. It is the centre of population for the pastoral and agricultural district of Darling Downs, which is occupied by a desirable class of settlers. A town hall, school of arts, theatre, and library were erected in 1900 at a cost of £10,000, and waterworks have been constructed. Vineyards are cultivated in the suburbs by a German colony numbering about 1000, and large quantities of wine are made. Altitude, 1960 feet. Mean temperature, year, 61° F. ; January, 71-6° ; July, 48-2°; rainfall, 45-63 inches. Population (1891), 7007;~~

~~(1900), 9137.~~

~~Topeka, a city of Kansas, U.S.A., capital of Shawnee county and of the state, on the Kansas river, in the eastern part of the state, at an altitude of 886 feet. The city is regularly laid out on a fairly level site, is divided into six wards, has water-supply and sewerage systems, and its business streets are paved, mainly with brick and asphalt. It contains many fine buildings, among them the United States Government building, the capitol, the court-house, and several fine business blocks. There are five railways — the Atchison, Topeka and Santa Fe (which has offices and workshops here) ; the Chicago, Bock Island, and Pacific ; the Leavenworth and Topeka ; the Missouri Pacific ; and the Union Pacific — which give the city a large traffic. In 1900 there were 399 manufacturing establishments, with a capital of $3,891,531. They employed 3758 hands, and the pro- duct had a value of $9,977,605. The chief industry is flour-milling, the product of which was $2,188,034. The assessed valuation of real and personal property was in 1900 $11,728,525, indicating a very low rate of assess- ment. The net debt was $922,040, and the rate of taxation was $46.00 per $1000. Topeka is the seat of Washburn College, a Congregational institution opened in 1865, which irr 1899 had a faculty numbering 18 and~~

~~was attended by 228 students, 86 of whom were women. Population (1890), 31,007 ; (1900), 33,608, of whom 3201 were foreign-born and 4807 negroes.~~

~~Topelius, Zakris [or Zachakias] (1818-1898), after the death of Runeberg by far the most prominent writer of Finland, was born at Kuddnas, near Nykarleby, on the 14th of January 1818. He was the son of a doctor of the same name, who was distinguished as the earliest collector of Finnish folk-songs. Topelius became a student at Helsingfors in 1833, and remained connected with that university for the rest of his life, being made professor in 1863 and receiving in succession all the academic distinctions open to him. Quite early in his career, by the side of his constant tutorial and pro- fessional work, he began to distinguish himself as a lyrical poet, with the three successive~~

~~volumes of his Heather Blossoms (1845-54). The earliest of his historical romances was TJie Duchess of Finland, published in 1850. He was active in journalism also, and was editor-in-chief of the Helsingfors Gazette from 1841 to 1860. In 1878 Topelius was allowed to withdraw from his professorial duties, which he began to feel irksome, but this did not sever his connexion with the university ; it gave him, however, more leisure for his abundant and various literary enterprises. Of all the multifarious writings of Topelius, in prose and verse, that which has enjoyed the greatest popularity is his Tales of a Barber-Surgeon, episodes of historical fiction from the days of Gustavus II. Adolphus to those of Gustavus III., treated in the man- ner of Sir Walter Scott ; the five volumes of this work ap- peared at intervals between 1853 and 1867. Topelius attempted the drama also, with most success in his tragedy of Regina von Emmeritz (1854). Topelius was not an ex- quisite, but a fresh, cheerful, and wholesome writer. He aimed, with eminent but perhaps pathetic success, at the cultivation of a strong passion of patriotism in Finland, and he is to be thought happy in that he did not live to witness the oppression of the noble and long-suffering nation which he had roused by his writings. He died on the 13th of March 1898 at Helsingfors. Among his many claims on the attention of Finlanders it must be added that To- pelius was an exceptionally happy writer for children. His abundant poetry is graceful and patriotic, but does not offer any features of great originality. (e. g.)~~

~~Topete, Juan Bauptista (1821-1885), Spanish naval commander and politician, was born in Mexico, 24th May 1821. His father and grandfather were also Spanish admirals. He entered the navy at the age of seventeen, cut out a Car list vessel in 1839, became a midshipman at twenty-two, obtained the cross of naval merit for saving the life of a sailor in 1841, and became a lieutenant in 1845. He served on the West Indian station for three years, and was engaged in repressing the slave trade before he was promoted frigate captain in 1857. He was chief of staff to the fleet during the Morocco war, 1859, after which he got the crosses of San Fernando and San Hermenegildo. Having been appointed chief of the Carrara arsenal at Cadiz, he was elected deputy and joined the Union Liberal of O'Donnell and Serrano. He was sent out to the Pacific in command of the frigate Blanca, and was present at~~

~~the bombardment of Valparaiso and Callao, where he was badly wounded, and in other engagements of the war between Chile and Peru. On his return to Spain, Topete was made port captain at Cadiz, which put him into a position to take the lead of the conspiracy in the fleet against the Bourbon monarchy. He sent the steamer Buenaventura to the Canary Isles for Serrano and the other exiles; and when Prim and Sagasta~~

~~arrived from Gibraltar, the whole fleet under the influence of Topete took such an attitude that the people, garrison, and authorities of Cadiz followed suit. From that day Topete took part in all the acts of the Revolutionary Government, signed the proclamations, accepted the post of marine minister, was elected a member of the Cortes of 1869, supported the pretensions of Montpensier, op- posed the election of Amadeus, sat in several cabinets of that king's reign, was prosecuted by the federal republic of 1873, and again took charge of the marine under Serrano in 1874. After the Eestoration Topete for some years held aloof, but finally accepted the presidency of a naval board in 1877, and sat in the Senate as a life peer until his death on 29th October 1885 at Madrid, (a. b. h.)~~

~~Torda, a corporate town of Hungary, capital of the county of Torda-Aranyos, near the river Aranyos, 16 miles south-east of Kolozsvar. As a salt-producing district it was known to the Romans. It has still important salt mines and baths. It has a large public hospital, an old Unitarian church, an asylum supported by the Franciscans, and a large manufactory of cellulose. In its vicinity is the rocky formation known under the name of " Cleft of Torda," which crosses the calcareous mountain for 2 miles, presenting many romantic steep rocks and deep caves. Population (1891), 11,084 ; (1901), 12,117.~~

~~Toreno, Queipo de Llano y Cayoso de,~~

~~Count (1840-1890), Spanish politician, was born in 'Madrid in 1840, and was the son of the Count de Toreno who distinguished himself in the independence war against Napoleon, and afterwards as a historian, orator, minister, and statesman during the reigns of Ferdinand VII. and Isabella II. Young Toreno was educated at the Madrid Institute and~~

~~University, entered Parliament in 1864 as a Moderado, and sat in all the Cortes of Queen Isabella's reign as a deputy for his ancestral province, Asturias. Loyal to the Bourbons all through the revo- lution, he nevertheless became a deputy in the Cortes of 1871-73, and founded an Alphonsist paper, El Tiempo, in 1873. When the Restoration took place, its first cabinet made Count de Toreno mayor of the capital, and in 1875 minister of public works, in which capacity he improved the public libraries, museums, academies, and archives, and caused many important works to be published, in- cluding the Cartas de Indias. In 1879 he became min- ister for foreign affairs, in 1880 president of the House of Deputies, in 1884 again governor of Madrid, and in 1885 again president of the House of Deputies. During the reign of Alphonso XII. and the first years of the regency of Queen Christina, Count de Toreno was one of the most prominent Conservative leaders, and was often consulted by the Crown. He died on 31st January 1890. He was a patron of the Turf, and established a racecourse in Madrid, where the first races took place in the reign of Alphonso XII. (a. c. h.)~~

~~Torgau, a town of Prussia, province of Saxony, 48 miles by rail east by north of Halle, on the left bank of the Elbe, here crossed by two iron bridges (one a railway bridge). The fortifications were dismantled in 1889. The town hall contains a collection of Saxon antiquities. In the vicinity is the royal stud farm of Graditz. Popu- lation (1885), 10,988 ; (1900), 11,811.~~

~~Toro, a town of Spain, in the province and diocese of Zamora, on the right bank of the river Douro, 35 miles west by south of Valladolid. It has a station on the rail- way from Medina de Campo to Zamora. It has excellent and well-attended lay and ecclesiastical schools. There is a fine bridge of twenty-two arches across the Douro. The town is a picturesque assemblage of decaying palaces,~~

~~convents, narrow streets, public buildings, in part repaired in the 18th and 19th centuries. The cathedral church or abbey of Santa Maria la Mayor is considered older than, and quite as remarkable as, that of Zamora. It dates from the reigns of Alphonso VII. and Fernando el Santo. Toro has several fine parish churches and convents, palatial residences of the dukes of Alcanices, Fonsecas, Albas, and especially of the marquis of Santa Cruz, the last famous because the Cortes of 1371, 1442, 1505, that made Toro and its code of laws celebrated, were held there. Toro is first mentioned in documents of the 10th century, and its chequered history is intimately associ- ated with that of the mediaeval monarchies of Spain. Population (1897), 8421.~~

~~Torokszentmiklos, a large market town, situated on the great Alfold (plain), in the county of Jasz-Nagy- Kun-Szolnok, Hungary, 60 miles south-west of Debrec- zen. On the extensive communal territory — 81,695 acres — are produced immense quantities of wheat and other cereals. There is a large brick factory, a manufactory of ploughs, a steam-mill, and a considerable nunnery. Population (1891), 18,772; (1901), 21,881.~~

~~Toronto, the capital of the province of Ontario, and the second largest city in Canada, situated on the bay of the same name on the north shore of Lake Ontario, in 43° 39′ 25″ N. and 79° 23′ 39″ W. It is, next to Montreal, the principal railway centre in the Dominion, and has direct communication with all points of importance in British North America and the northern United States by way of the main lines and the branches (seven in number) of 'the Grand Trunk and Canadian Pacific rail- ways. An electric street railway, with a track of 87 miles within the city limits, affords rapid and easy com- munication with all parts-of the city, and, by connecting lines and extensions, with the neighbouring towns. Dur- ing the season of navigation several lines of steamers run between Toronto and the principal ports on the Great Lakes and the St Lawrence. It is the seat of the pro- vincial~~

~~government, and contains the official residence of the lieutenant-governor, the parliament and departmental building, courts of law, offices of the department of edu- cation, and Toronto University. The new parliament and departmental building is situated in the centre of a finely-wooded park of upwards of 30 acres. It is in the Neo-Greek style, with the central portion, containing the legislative chamber, standing forward, bold and massive. The city hall and court-house, completed in 1900 at a cost of upwards of $2,500,000, is one of the finest civic buildings in North America. It is in the Eomanesque style, and has a total length of 290 feet and a depth of 275 feet. It accommodates all the civic, county, police court, high court, and school board officials. Toronto is the centre of the wholesale trade of Ontario, and the seat of many flourishing industries, including extensive iron foundries, rolling mills, breweries, distillery, agricultural implement works — the largest employing 1500 men — stove, shoe, carpet, bicycle, rubber, and musical instru- ment factories, shipbuilding, &c.~~

~~The city occupies an area of 16-2 square miles, exclusive of the harbour and the island of the same name. It has 260 miles of streets, 233 miles of sewers, and 260 miles of. water-mains ; the water-supply, drawn through a conduit from an intake in deep water in Lake Ontario, is pumped by engines with a capacity to treat 42,000,000 gallons per day to a large reservoir in the northern part of the city. In 1902 there were 207 places of worship, in addition to upwards of 60 buildings and rooms used as missions ; there were 59 public schools with 682 teachers, including 126 on the kindergarten staff, attended by 34,863 pupils, and annual expenditure $539,910 ; also 21 separate Roman Catholic schools, with 103 teachers and 5227 pupils. For secondary education there were 3 collegiate institutes, with 1400 pupils. The city contains~~

~~the head offices of 9 banks— the Toronto, Commerce, Imperial, Do- minion, Nova Scotia, Ontario, Standard, Sovereign, and Traders— with an aggregate paid-up capital of more than $22,000,000 ; of 37 loan companies, with nearly $21,000,000 of paid-up capital; and of the principal trust and insurance companies doing business in the province. The exports for 1894 were §3,984,462 ; 1900, $9,506,911;~~

~~imports for 1894, $17,731,843; 1900, $31,787,053; duty paid in 1900, $5,363,816 ; bank clearings, 1892, $326,564,322 ; 1901, $625,228,306; gross assessment, 1902, $157,915,397; exemptions, $23,949,850; net assessment, $133,965,547 ; taxation, $2,612,328. The population in 1881 was 86,415; in 1883 the suburb of Yorkville was annexed, and subsequently Leslieville, Seaton, Brockton, and Parkdale were brought within the city limits; in 1891 it had increased to 181,220, and in 1901 to 208,040. The city returns four members to the Dominion House of Com- mons, and four to the provincial legislature. It is the seat of an Anglican bishop and a Roman Catholic archbishop. (j.wh*.)~~

~~Torpedo. — In 1805 Eobert Fulton demonstrated a new method of destroying ships by exploding a large charge of gunpowder against the hull under water. No doubt then remained as to the effectiveness of this form of attack when successfully applied ; it was the difficulty of getting the torpedo, as it was called, to the required position which for many years retarded its progress as a practical weapon of naval warfare. Attempts were first made to bring the explosive in contact with the vessel by allowing it to drift' down to her by the action of tide or current, and afterwards to fix it against her from some form of diving boat, but successive failures led to its restriction for a considerable period to the submarine mine, in which the explosive is stationary and takes effect only when the ship itself moves over or strikes the charge. Used in this way, it is an excellent deter- rent to hostile warships forcing a harbour.~~

~~Spar or Outrigger Torpedo. — The limitations attached to the employment of submarine mines, except for coast defence, revived the idea of taking the torpedo to the ship instead of waiting for the latter to gain some exact point which she might very possibly avoid. This first took practical shape in the spar or outrigger torpedo. If the boat using it was not discovered and disabled while approaching, the chances were favourable to success and escape afterwards. Against a vigilant enemy it was doubtless a forlorn hope, but to brave men the venture offered considerable attractions.~~

~~Frequent use of this spar or outrigger torpedo was made during the American Civil War. A notable instance was the destruction of the Confederate ironclad Albemarle at the end of October 1864. On this mission Lieutenant Cushing took a steam launch equipped with an outrigger torpedo up the Roanoke river, in which lay the Albemarle. On arriving at the ship Cushing found her surrounded by logs, but pushing his boat over them, he immersed the spar and exploded his charge in contact with the Albemarle under a heavy fire. Ship and launch sank together, but the gallant officer jumped overboard, swam away, and escaped. Submerged boats were also used, for similar service, but usually went to the bottom with their crews. During the war between France and China in 1884 the Yang Woo was attacked and destroyed by an outrigger torpedo.~~

~~Locomotive Torpedoes. — Though the spar torpedo had scored some successes, it was mainly because the means of defence against it at that time were inefficient. The ship trusted solely to her heavy gun and rifle fire to repel the attack. The noise, smoke, and difficulty of hitting a small object at night with a piece that could probably be discharged but once before the boat arrived, while rifle bullets would not stop its advance, favoured the attack. . When a number of small guns and electric lights were added to a ship's equipment, success with an outrigger torpedo became nearly, if not entirely, impossible. Attention was then turned in the direction of giving motion to the torpedo, and steering it to the required~~

~~Speeds Charge—~~

~~tveijhr—~~

~~point by electric wires worked from the shore or from an- other vessel ; or, dispensing with any such connexion, of devising a torpedo which would travel under water in a given direction by means of self-contained motive power and machinery. Of the former type are the~~

~~Lay, Sims- Edison, and Brennan torpedoes. The first two — elec- trically steered by a wire which trails behind the torpedo — have insufficient speed to be of much practical value, and hence are little used. The Brennan, since its adop- tion by the British Government for the defence of harbours and channels, has been developed and improved, especially in speed, which is now over twenty knots. Hence its superiority over other forms of controlled torpedo. It has the defect of all the species, that of possessing a very- limited effective radius — much less than the range of modern guns — which consequently confines its use to narrow waters.~~

~~Uncontrolled Torpedoes (the Howell). — The objection of naval officers to have any form of torpedo connected by wire to their ship during an action, impeding her free movement, liable to get entangled in her propellers, and perhaps exploding where not desired — disadvantages which led them to discard the Harvey towing torpedo some years ago — has hitherto prevented any navy from adopting a controlled torpedo for its sea-going fleet. The last quarter of the 19th century saw, however, great advances in the equipment of ships with locomotive torpedoes of the uncon- trolled type. The Howell may be briefly described as one of American origin, and has been placed in the armament of some of the warships of the United States : it has also a special feature of some interest. In this — as in all uncontrolled torpedoes — there is no attempt to steer it after entering the water, but the same direction is preserved throughout the run, allowance being made for the movement of the object at which it is directed. Motive power is provided in the Howell by causing a heavy steel fly-wheel inside the torpedo to revolve with great velocity previous to discharging the torpedo. This is effected by a small special engine outside operating on the axle. When sufficiently spun up, the axle of the fly-wheel is connected with the propeller shafts and screws which drive the torpedo, so that on en- tering the water it is driven ahead and continues its course until the power stored up in the fly-wheel is exhausted. The speed, therefore, is continually di- minishing, but special mechanism has been devised to enable a uniform rate of progress to be maintained. A controlling apparatus keeps the torpedo from diving or coming to the surface, thus preserving a fixed depth throughout the run. Now when a~~

~~torpedo is discharged into the sea from a ship in motion, it has a tendency to deflect owing to the action of the passing water. The angle of deflection will vary according to the speed of the ship, and is also affected by other causes, such as the position in the ship from which the torpedo is discharged, and its own angle with the line of keel. Hence arise inaccuracies of shooting ; but these do not occur with this torpedo, for the motion of the fly- wheel, acting as a gyroscope — the principle of which applied to the Whitehead torpedo is described later — keeps this torpedo on a straight course. This advantage, combined with simplicity in construction, induced the American naval authorities at one time to contemplate equipping their fleet with this torpedo, for they had not, up to within a few years ago, adopted any locomotive tor- pedo. A great improvement in the torpedo devised by Mr Whitehead led them, however, definitely to prefer the~~

~~latter, and to discontinue the further development of the Howell system.~~

~~Wliitelicad Torpedo. — Almost every year chronicles some advance in this wonderful piece of mechanism. The outward form is now somewhat different from that originally adopted. In place of a sharply pointed head — believed at one time to be necessary for speed — the fore most compartment is now made much fuller, which not only adds to the speed, but allows of double the amount of explosive being carried with the same length and diameter of torpedo. All are now made with this bluff head or nose. This modification, with increased effi- ciency in the Brotherhood three-cylinder air engine, has enabled a speed of 30 knots for a short range to be attained. This is with a torpedo of 14 inches diameter. For a longer range a larger weapon must be employed capable of carrying a greater supply of air. To obtain this, torpedoes of 18 inches diameter, involving increased length and weight, have for some time been constructed, and have taken the place of the smaller torpedo in the equipment of warships. This advance in dimensions has not only given a faster and steadier torpedo, but enabled such a heavy charge of gun-cotton to be carried that its explosion against any portion of a ship would inevitably~~

~~2$ Knars to 800 Metres. 133 Lbs wit Gun Cotton. HSOLbs.~~

~~IB INCH TORPEDO.~~

~~■■§—~~

~~Speed 30 Knots to 600 Yds.~~

~~Charge IIS Lbs of Viet Gun Cotton~~

~~Weight 706 Lbs~~

~~«r i%~~

~~14-INCH TORPEDO.~~

~~ei.~~

~~Si~~

~~Fig. 1. — Diagrams of 14 and 18 inch Torpedoes.~~

~~either sink or disable her. The dimensions, shape, &c, of the present 14 and 18 inch torpedoes are shown in Fig. 1. The defect of the Whitehead torpedo hitherto had been that a very limited range was imposed by the uncertainty of its course under water. The speed of the ship from which it was discharged, the angle with the keel at which it entered the water, and the varying velocity of impulse, tended to error of flight, such error being magnified the farther the path of the torpedo was prolonged. Hence 600 yards was considered the limit of distance within which the torpedo should be discharged at sea against an object from a ship in motion.~~

~~In these circumstances, though improvements in the manufacture of steel and engines allowed of torpedoes of far longer range being made (the fastest torpedo up to 1898 having a speed of 29 knots for 800 yards), it was of no advantage to make them, as they could not be depended upon to run in a straight line from a stationary point for more than 800 yards, while from a ship in motion good practice could only be ensured at a reduced range. It was obvious, therefore, that to increase the effective range .of the torpedo, these errors of direction~~

must be overcome by some automatic steering arrange- ment. Several inventors have turned their attention to the subject since 1885, nearly all of whom proposed to utilize the principle of the gyroscope for the purpose. The first which gave any satisfactory results was an apparatus devised by Mr Ludwig Obry — an engineer in Austria — and tried by the Italian Government about 1896. These trials demonstrated the feasibility of accurately and

automatically steering a torpedo in a direct line by this means. Messrs Whitehead and Co. of Fiumethen acquired the invention, and after exhaustive experiments produced the apparatus which is now fitted to every torpedo made. It is based on the principle that a body revolving on a free axis tends to preserve its plane of rotation. A gyroscope with plane of rotation parallel to the vertical axis of the torpedo will have an angular motion if the torpedo is diverted from its original course. This angular motion is employed to actuate the steering mechanism by operating an air motor connected with the rudders, and keeping the torpedo in the line of discharge. The apparatus consists of a fly-wheel caused to rotate by a spring, the barrel on which the latter is wound having a segmental wheel which gears into a toothed pinion spindle of the fly-wheel. Owing to the diameter of the segment being much greater than the pinion, a rapid rotatory motion is imparted. The spring is wound up by a key from outside the torpedo, and kept in tension until the projectile is discharged, when the spring is released by the air lever being thrown back, which admits air to the engine; the gyroscope is then freed and set in motion with its plane in the plane of the v'ertical axis of the torpedo as it was in the launching tube.

Assuming now that the course of the torpedo is diverted

by any cause, its axis will move or perform a certain angular motion with regard to the plane of the fly-wheel, which will have the same result as if we consider the con- ditions reversed, i.e., as if the plane of rotation of the fly- wheel were altered and that of the axis of the

torpedo remained the same. The axis of the fly-wheel performs a relative angular motion which it imparts to a crank ac- tuating a servo-motor worked by compressed air, and con- nected with the rudders of the torpedo, moving them in the opposite direction to that in which the torpedo was diverted from its original course. Thus all inaccuracies of flight due to errors of adjustment, miscalculation of deflection, or even damage to some part, are eliminated. As long as the gyroscope is in good order the torpedo is bound to run in the line it was pointing when the fly-wheel was started. But the gyroscope can do more. By suitable adjustment the torpedo can be made to turn to any given angle from the direction of discharge, and then run in a straight line. For instance, when discharged from a tube fixed right ahead, the torpedo can be made, by means of the gyroscope, to travel in a new direction on either side ; or supposing it be desired to fire ahead from a broadside tube which does not traverse sufficiently in that direction, the object can be attained by means of this apparatus. It is placed in the after body of the torpedo, as indicated in Fig. 2.

.DOOR FOR REMOVING GYROSCOPE

Fig. 2. — Arrangement of Gyroscope in Torpedo.

The efficiency of the Whitehead torpedo has thus been enormously increased, and more accurate practice can now be made at 2000 yards than was formerly possible at 800 yards. This adds considerably to the chances of torpedo-boats attacking ships, even in day- time, at sea or at anchor, and will render further pro- tection necessary against this weapon. Against a ship in motion there is still, however, the calculation as to her speed, and the distance she will travel before the torpedo reaches her. Should this be miscalculated, an increased range for torpedoes will magnify the error. For instance, a 30-knot torpedo will travel 1000 yards in a minute. If aimed at a ship on the beam assumed to be steaming 15 knots an hour, to reach her when 1000 yards distant the torpedo must be discharged at a point 500 yards ahead of her. But if the ship is actually steaming 12 knots, she will have travelled only 400 yards in the minute, and the torpedo will be 100 yards in advance of her. If discharged at a range of 500 yards, such a miscalculation causes

~~an error of only 50 yards or 150 feet. But if the object is 300 feet long, and her centre was , taken as the target, her bow would be just at the spot the torpedo would reach in thirty seconds. It would seem, therefore, that increased velocity of torpedo is necessary before the full advantages of the gyroscope can be realized. To attain this, higher pressures of air are sought, and experiments are being carried out with nickel-steel air-chambers, by which, without increasing their weight, they can safely stand a greater working pressure. Longer-range torpedoes are, however, being adopted by most nations. The following dimensions of torpedoes made by Messrs~~

~~Whitehead for Japan will show what has been done in this direction :~~

—

~~21 feet i inches.~~

~~17-7 inches.~~

~~1968 lb.~~

~~198 lb.~~

~~2250 R> on square inch.~~

~~28 knots.~~

~~31 knots.~~

~~Length~~

~~Diameter .~~

~~Weight complete~~

~~Weight of explosive~~

~~Pressure of air .~~

~~Speed for 2000 metres (2187 yards) .~~

~~Speed for 1000 metres (1094 yards) .~~

~~Torpedo Carriages and Discharge. — As no gun which is inefficiently mounted can give good results, so the best torpedo is valueless without a good carriage or system of discharge. In the early days of the White-head, discredit came upon it because the importance of this was not sufficiently realized; and an erratic course under water was in nine cases out of ten due to a crude method of discharge. A delicate piece of mechanism was dropped into the water from a height of several feet, and naturally suffered internal derange- ment. Gun-ports were then used for the purpose, but now a special orifice is made, to which the torpedo carriage is fitted with a ball-and-socket joint — forming a water-tight aperture — so that this carriage or tube may be only 2 or 3 feet above the water-line. The ball-and-socket joint enables it also to have a considerable angle of training. Originally the torpedo was pushed out by a rod acted upon by compressed air, in which case the carriage was a simple frame. The rod, pressing against the tail with some force, was apt to damage or disarrange the rudders, so the air-gun took the place of rod impulse. Here the torpedo fits closely in a tube or cylinder with an opening at the rear made air-tight when closed. At the~~

~~desired moment compressed air is admitted to the rear part of the cylinder and blows the torpedo out. Gun- powder then superseded air for this operation ; and now this has given place to a small charge of cordite, which does not leave any deposit on the inside of the cylinder. There is a double risk in the use of locomotive torpedoes from above water. (1) The charge may be exploded by hostile fire. Though mainly consisting of damp gun-cotton, which is not readily ignited, the dry primer and detonator may be struck, which would lead to a disastrous explosion. (2) The air-chamber is also a source of danger. As it con-tains air compressed to a high degree of tension, experi- ments have~~

shown that if struck by a small shell it may burst with great violence ; and as it offers a considerable mark, this is not an improbable event in an action. An instance of the danger of above-water torpedo tubes occurred in the Spanish-American war at the battle of Santiago. A shell entered the Almirante Oquendo and struck a 14-inch torpedo in the tube. The charge

detonated, causing a fearful explosion and practically wrecking that part of the vessel. The development of moderate-sized quick-firing guns has increased this risk. Hence we find the use of above-water torpedo tubes diminishing, and in time this method of discharge will probably be employed only in special torpedo craft and such vessels as afford armour defence to positions where these weapons are located.

Submerged Discharge. — The risk attached to having loaded torpedoes above the water-line — independently of the fact that to get the best result they should start in the element to which they belong — has given great impetus- to the system of submerged discharge. From the earliest days of the weapon this has been employed to some extent. But it was principally in the direction of right-ahead fire, by having an orifice in the stem of the ship under water, to which a torpedo tube was connected. The tactical idea was thus to supplement attack with the ram, so that if the vessel endeavouring to ram saw that the object would

end Torpedo ready to fire

VERTICAL SECTION.

PLAN VIEW.

Fig. 3. — Broadside submerged 18-inch Torpedo Tube.

evade this attack, she could project a torpedo ahead, which, travelling faster than the vessel, might as effectually accom- plish the required service. The stem orifice had a water- tight cover, which was removed on the torpedo being placed in the tube and the inner door closed ; then, sufficient im- pulse being imparted to eject the torpedo, and its

~~machinery being set in motion at the same time, it darted forward towards the enemy. There is, however, some risk of the ship using a torpedo in this manner striking it before the missile has gathered the necessary impetus from its pro- pellers to take it clear of the vessel. The system, moreover, has the disadvantage of weakening the ram, the construc- tion of which should be of immense strength. There is the further liability of ramming with a torpedo in the bow tube, which would be as disastrous to friend as foe. This method of submerged discharge has therefore given place to ejecting the torpedo from the broadside. Considerable difficulty attached to getting the torpedo clear of the ship from this position without injury, especially when the vessel was proceeding at speed. The natural tendency of the passing water acting on the head of the torpedo as it emerged was to give a violent wrench and crush the rear end before that portion could clear the aperture. To pre- vent this the torpedo must be held rigid in the line of pro- jection until the tail is clear of the ship. This is thus effected. Besides the tube with aperture in side of the ship under water, fitted with sluice-valve, all broadside~~

~~submerged discharge apparatus possess the following features : A shield is pushed out from the ship's side. In this shield there are grooves of some form. Guides on the torpedoes fit and run in these grooves. When discharged the torpedo is thus supported against the streams of pass- ing water, and guided so that its axis continues in the line of projection until the tail is clear of the side, the shield being of such length that this occurs at the same time that the guides on the torpedo leave the grooves in the shield. An apparatus on this principle has been fitted to a number of ships of the British navy, and gives good results at high rates of speed. It has the defect that the shield must be run out previous to the torpedo being discharged, and brought back afterwards, thus involving three separate operations, each performed by compressed air.~~

~~In the broadside submerged discharge, designed, con- structed, and supplied to many foreign navies by Messrs Armstrong of the Elswick works, the three operations are combined in one. There is an outer tube as before, but it contains an inner tube carrying the torpedo. Fixed to~~

this tube, and prolonging it, is the shield fitted with grooves. Both tubes have a door at the rear — made air- tight when closed — by which the torpedo is entered. A charge of cordite is used for ejection instead of com- pressed air, the gas from which entering the outer cylinder first forces the inner tube out, and then by means of a valve in the door of the inner tube passes in and blows out

water and torpedo together, the shield supporting the latter until the tail is clear of the ship. By this time the cordite gas has expanded and cooled so as to relieve the pressure in rear ; this causes the pressure of the water outside to push the shield and tube into the ship again, so that practically the whole operation is one motion.

Fig. 3 will further explain this apparatus. A is the outer tube ; B the inner tube ; C the shield ; D torpedo ; E explosion chamber for cordite charge placed at K; F pipe for gas to pass into outer tube ; G- and Y doors of inner and outer tube ; J the valve which opens automatically when inner tube arrives at position shown in Fig. 2 ; T and P appliance for running the tube in and out by hand when desired; 0 arrangement for bringing whole apparatus back for repair, &c. ; M and !N sluice-valve and handle ; R, r1, r2, r*, for draining tubes before torpedo is put in ; X indicator showing position of inner tube.

Torpedoes have been discharged from this apparatus with successful result from a ship steaming at 17^ knots.

The advantage of cordite over compressed air for im- pulse is that it requires no attention : when a charge is placed in the explosion chamber, and a torpedo is in the tube, all is in readiness for firing when desired, without farther attention in the torpedo-room. The cordite is . fired by electricity from the conning-tower ; the officer, therefore, having ascertained that all is ready below, has only to press a button when the object is in the required position. Automatic indications are

~~given in the conning- tower when the sluice-valve is opened and when all is in readiness for firing.~~

~~This method of discharging torpedoes from the broad- side under water eliminates the principal danger of the system, which required the shield to be put into position "beforehand. It was then liable to be struck and distorted by passing wreckage without the fact being apparent to those in the ship. On the discharge of a torpedo its course might thus be arrested, or possibly the charge be prematurely exploded in dangerous proximity to its own ship. There was a risk of getting the shield out too soon, and thereby exposing it unduly to injury, or leaving the operation until too late. The tendency of naval equipment being towards complica- tion, any readjustment which makes for simplicity can- not be otherwise than beneficial, and this feature is especially desirable in all matters connected with the use of torpedoes.~~

~~The compartment containing the broadside submerged apparatus usually extends across the ship, so as to con- tain a tube for each side. In the largest ships it is now customary to have two compartments — one forward and the other aft — for this part of the armament, with a pair of tubes in each ; while above-water tubes are being given up where interior space will admit of a submerged discharge.~~

~~Use in War. — It is difficult to say what place the Whitehead torpedo will take in the next great naval war, and whether it is destined to fulfil those expectations which' the expenditure allotted everywhere to this branch would seem to warrant. This generation believes it has found in the torpedo a most potent weapon with which the biggest vessels may be sunk, or rendered harmless, besides possessing the further great advantage that it can be taken into action on small and inexpensive con- structions. Hence the great development of the torpedo- boat all over the world. Since the locomotive torpedo was adopted as a weapon of naval warfare, however, it has scored successes only when used in connexion with craft specially constructed for its use. Though the armament of all battleships and cruisers is not considered complete without an installation of Whitehead torpedoes, there is~~

~~no instance of either suffering injury from one of their own class employing this weapon in recent wars. At the battle of Yalu, between the Chinese and Japanese fleets, torpedoes were discharged by the former, but none took effect. The Japanese trusted solely to gun-fire. In the war between Spain and the United States the inferiority of Admiral Cervera's squadron to that under Admiral Sampson might at the battle of Santiago have been to some extent counterbalanced by a skilful and vigorous use of torpedoes. If, instead of striving only to escape, a bold dash had been made for the American ships, the Spanish cruisers rapidly approaching end on to tne foe, enveloped in the smoke of their own guns, should — some at least — have got within torpedo range without fatal in- jury. Closing each other at a speed of 10 knots only, they would cover an interval of 6000 yards in 9 minutes — a short time in which to disable a ship by gun-fire under such conditions. But Cervera elected to offer a passive resistance only, and while suffering destruction wrought no material injury upon his opponents. On the other hand, there have been several instances of large warships being sunk by locomotive torpedoes discharged from small craft. During the Chilian revolutionary war of 1891, a battleship, the Blanco Encalada, of 3500 tons, was attacked in Caldera Bay by two torpedo vessels — the Lynch and Condell — of 750 tons. They entered the bay at dawn, the Condell leading. This vessel fired three torpedoes which missed the ironclad; then the Lynch, after one ineffective shot, discharged a second torpedo, which struck the Blanco on the side nearly amidships. The latter had opened fire with little result, and 'sank soon afterwards. A similar incident occurred in 1894, when the Brazilian ironclad Aquidaban was sunk in Catherina Bay by the Sampaio — a torpedo vessel of 500 tons. She entered the bay at night, and first discharged her bow torpedo at the ironclad, which missed ; she then fired a broadside torpedo, which struck and exploded against the bow of the Aquidaban. It caused a great shock on board, throwing an officer on the bridge into the water. The vessel sank soon afterwards, and the Sampaio escaped uninjured.~~

~~After the defeat of the Chinese at sea, their remaining ships took refuge in the harbour of Wei-hai-wei. Here they were blockaded by the Japanese fleet, which, having a number of torpedo-boats, made several~~

~~determined at- tacks upon the ships inside. After one or two attempts, foiled by the obstructions placed by the Chinese to bar the passage, the Japanese boats succeeded in torpedoing several ships, and thus expedited the reduction of the place.~~

~~Effect upon Naval Tactics; Blockade. — It has often been assumed that steam and the torpedo-boat will in future render blockade impossible as it was carried out in the old wars; that, no longer dependent upon the wind to allow egress from the blockaded port, a vessel using steam can emerge when she chooses, while fear of torpedo attack will deter a blockading squadron from keeping such watch as to foil the attempt. As regards the power conferred by steam, it will be no less advan- tageous to a blockading squadron, enabling it to maintain its position, whereas sailing ships were often driven by gales to leave their station and seek a port. This gave opportunities for the blockaded vessels to escape. As regards torpedo-boats, they would no doubt be a danger to a blockading squadron unprovided with a means of defence against these craft. Such defence consists in an adequate number of small vessels interposing an in-shore squadron between the port and the main body outside. Thus they perform the two-fold service of watching the enemy's movements within and frustrating a torpedo attack.~~

~~The battleships of a squadron adequately provided in this respect would not require to remain close to a port ; but, having a chain of communication with the advanced flotilla, its guard would be no less effective. As an instance of blockade under modern conditions, we have that of Admiral Sampson upon Santiago — a guard more rigidly maintained than any in the old wars. So little was he deterred by the knowledge that Admiral Cervera had two torpedo vessels in his force, that he drew his squadron closer in at night, when an attack might be expected, actually illuminating the entrance of the har- bour with his electric search-lights, so that no craft could come out unperceived. No attempt was made to dislodge him from that position, and we may~~

~~perhaps assume that blockade, if required in any scheme of naval strategy, will be carried out, whatever the weapons of warfare.~~

~~As regards the effect of torpedoes upon tactics at sea, and in general, as well as single ship, actions, they must operate against close range and employment of the ram. If it is recognized that a vessel within 800 yards — the effective radius of the torpedo — is liable to a fatal blow, she will endeavour in ordinary circumstances to keep outside that distance and rely upon gun-fire. The exception would be where she is overmatched in that respect, and hence might endeavour to restore the balance by the use of torpedoes. In a fleet action the danger of missing the foe and hitting a friend would restrict the discharge of torpedoes ; and this risk increases as forma- tions disappear. But the torpedo must be conceded a tactical superiority over the ram for the following rea- sons. A vessel to use the latter must come within tor- pedo range, while her adversary may successfully apply torpedoes without placing herself in any danger of being rammed. The ram can only be used in one direction, and a small miscalculation may cause disaster. If a ves- sel has more than one position from which torpedoes can be discharged, she is not confined as regards attack to a . single bearing or direction.~~

~~In action we may consider the speed of the torpedo as double that of the ship, and since against & moving object allowance must be made for the space traversed while ram or torpedo is travelling towards it, the faster weapon is less affected in its chance of successful impact by change of direction and speed of the object at the last moment. Lastly, with machinery disabled a ship is power- less to use the ram, but can avert a ram attack with her torpedoes. The movements of squadrons or single ships on entering an action are not likely to be influenced by any contemplated immediate use of torpedoes, for the gun must remain the primary weapon, at any rate at the first onset. Commanders would hardly risk being crushed by gun-fire before getting within torpedo range. Having faith in the efficiency of their ordnance and the gunnery skill of their crew, they would first manoeuvre to bring these into play. Tactics for torpedo attack in such circumstances have not therefore been laid down, and it is only necessary to consider the positions which are advantageous for the use of this weapon, and, conversely, what~~

~~should be avoided when a vessel, finding herself overmatched in gunnery, seeks to redress the balance with torpedoes.~~

~~Size of Target. — This, with a ship, varies in length as the torpedo approaches end on to the vessel, or at angle to the line of keel ; the greatest being when the path of both forms a right angle. Hence the object is to place your ship where it presents the former condition to the enemy, while he affords the larger target. It must be remembered that, owing to the comparatively slow velocity of the torpedo, it must be aimed not directly at a ship in motion — like a shot from a gun — but at a point ahead~~

~~which the ship will reach after the torpedo has traversed the intervening distance. Thus speed of object has to be estimated, and hence the importance of adding to the velocity of the torpedo and getting a broadside shot so as to reduce as much as possible errors of calculation. The great increase of the dimensions of warships, especially in length, which now has reached and exceeded 400 feet, adds to the chances of a successful hit with torpedoes, and will doubtless tend to diminish a desire in future naval tactics to close inside torpedo range for the pur- pose of ramming.~~

~~Range. — Though the effective range of a torpedo is fixed at 800 yards, it does not follow that ships must be within that distance of each other before this weapon comes into play. At certain bearings the object will be considerably outside this distance at the moment of dis- charge; but if approaching, and her course remain un- altered, she will reach a point within 800 yards of the spot from which the torpedo started. In the interval her enemy will also have traversed a certain distance, so that the two may never come within 1000 yards of each other. It thus follows, as stated, that a ship cannot ram without liability to torpedo attack, whereas it is possible to disable or sink with torpedo without risk of being rammed.~~

~~Taking range and size of target together, the most advantageous position is to be on the bow of the enemy while he bears abaft your beam. Thus situated, he is exposed to your broadside and quarter discharges, while by working the helm so as to turn your stern to him~~

~~you diminish his target and increase the distance his bow torpedo has to run before it can overtake you. Thus a high speed of ship enables her to attain the most ad- vantageous position, and renders more difficult the counter attack with the same weapon.~~

~~Finally, by improvements in construction and methods of discharge the torpedo has recovered the place it was rapidly losing a few years ago. As armour receives in- creased resisting power to above-water projectiles, and gets on a level again with the gun, more attention will be given to under-water attack, against which no adequate protection has yet been devised. Thus we shall probably find the torpedo taking a very prominent place in any future war between the great maritime Powers.~~

~~(s. M. E.-W.)~~

~~Torquay, a municipal borough (1892) and watering- place in the Torquay parliamentary division of Devon- shire, England, on the north side of Tor Bay, 215 miles west-south-west of London by rail. A commission of the peace was granted to the borough in 1893. The harbour has been extended by the corporation at a cost of £90,000. The drainage has been efficiently carried out at a cost of £70,000, the water-supply improved at a cost of upwards of £150,000, and electric light introduced (1898) by the corporation. Modern erections are a church and the Princess pier and groyne. The hospital has been en- larged. Area, 1465 acres. Population (1891), 25,534;~~

~~(1901), 33,625.~~

~~Torre Annunziata, a town of the province of Naples, Campania, Italy, on the east side of the Bay of Naples, and at the south foot of Mount Vesuvius, 14 miles south-east of Naples by rail. It has a royal arms factory and other iron-works, considerable manufacture of macaroni, breeding of silkworms, and some fishing and shipping. The harbour is protected by moles, and in 1897 was cleared by 1585 vessels of 194,889 tons. Population (1881), 20,829; (1900), about 26,000.~~

Torre del Creco, a town of the province of Naples, Campania, Italy, on the east shore of the Gulf of Naples, and at the south-west foot of Mount Vesuvius, 8

miles south-east of Naples by rail. It has shipbuilding yards and lava quarries. The inhabitants play a promi- nent part in the coral fishing off the African and Sicilian coasts, and coral is worked in the town, the workers being partly trained in a technical school. There is also fishing for tunny, sardines, and oysters. Further, hemp is woven and wine made. Population (1881), 21,588 ; (1900), about 25,000.

Torredonjimeno, a town of Spain, province of Jaen, to the north of Martos, on the river Salado de Por- cuna, on the railway from Puente Jenil to Linares. It has fine squares, broad streets, a large parish church, town hall, several convents, and modern schools. The neighbourhood produces good wine, oils, wheat, and fruit. Population (1887), 9399 ; (1897), 10,370.

Torrens, Sir Robert Richard (1814-1884), British colonial statesman, was born at Cork, Ireland, in 1814, and educated at Trinity College, Dublin. He went to South Australia in 1840, and was appointed collector of customs. He was in this capacity an official member of the first Legislative Council, and in 1852 filled the position of Treasurer and Eegistrar-General. When responsible government was established he was elected as a representative for Adelaide and became a member of the first Ministry. In 1857 he introduced his famous Keal Property Act, which he contended would render the transfer of land as simple in method as the transfer of vessels. The principle of the Act consists of conveyance by registration and certificate instead of deeds. The system was rapidly adopted in the other colonies and elsewhere, and was expounded by the author during a visit to the United Kingdom in 1862-64. After finally leaving South Australia, Sir E. E. Torrens repre- sented Cambridge in the House of Commons from 1868 to 1874. In 1872 he was knighted in recognition of the benefits attending the

~~operation of his Ecal Pro- perty Act wherever it had been introduced. He was the author of works on the effect of the gold discoveries on the currency, and other subjects. He died 31st August 1884.~~

~~Torrens, William Torrens M'Cullagh~~

~~(1813-1894), English politician and social reformer, son of James M'Cullagh (whose wife's maiden name, Torrens, he assumed in 1863), was born near Dublin, 13th Octo- ber 1813. He went to the bar, and in 1835 became an active member of the special commission on Irish poor- relief, which resulted in the extension of the workhouse system in Ireland in 1838. His work, which involved travelling all over the country, started him on the path of useful social reform, which he followed up by doing much to encourage the establishment of mechanics' institutes and other modes of helping popular education. In the 'forties he joined the Anti-Corn-Law League, and in 1846 published his Industrial History of Free Nations. In 1847 he was elected to Parliament for Dundalk, and sat till 1852. In 1857 he was elected as a Liberal for Yarmouth, and from 1865 to 1885 he represented Pins- bury. Torrens was a well-known man in political life, and devoted himself mainly to social questions in Parlia- ment. It was an amendment of his to the Education Bill of 1870 which established the London School Board, and his Artisans' Dwellings Bill in 1868 was an import- ant step in the direction of the clearing away of slums by local authorities : in many other ways, too, he acted as a true philanthropist. He published several books, and his Twenty Years in Parliament (1893) and History of Cabinets (1894) contain useful material. He died in London, 25th April 1894.~~

~~Torres Novas, a town of Portugal, district of San- tarem, 19 miles N.N.E. of Santarem. It has manufac- tures of cottons, linens, jute, paper, leather, and spirits. It was founded probably by Greeks, and was successively in the power of the Eomans, Goths, and Arabs, from whom it was conquered in 1148 by Affonso Henriquez. Population (1890), 9256; (1900), 10,738.~~

~~Torres Vedras, a town of Portugal, district of Lisbon, 36 miles N.N.W. of Lisbon. Here were the noted fortifications known as the " lines of~~

~~Torres Vedras," constructed by Lord Wellington in 1810. Here in 1846 the troops of General Saldanha defeated those of the Count de Bomfim, and seized the castle and town. The town possesses hot sulphur baths. Population (1890),~~

~~6022 ; (1900), 6891.~~

~~Torrevieja, a town of Spain, province of Alicante, on the southern coast, with railway to Albatera Catral, on the Alicante-Murcia line. Population (1887), 7724 ; (1897), 7833. The district is famous for its salt beds, which constitute a Government monopoly. The indus- tries are chiefly fisheries, and the making of everything connected with navigation. The roadstead affords safe anchorage for vessels of all sizes. There is an active trade in fruit and agricultural products. Great quanti- ties of salt are produced from several lagoons and smaller pans, the Laguna Grande alone yielding more than one hundred thousand tons a year.~~

~~Torrington, a town and borough of Litchfield county, Connecticut, U.S.A., in the north-western part of the state, with a large rural population. The borough is on the Naugatuck river, and on a branch of the New York, New Haven, and Hartford railroad. The river furnishes good water-power, which has been utilized in varied manufactures. The town was incorporated in 1740, the borough in 1887. John Brown, the noted Abolitionist, was born in Torrington, 9th May 1800. Population of the town (1880), 3327; (1890), 6048; (1900), 12,453; of the borough (1890), 4283; (1900), 8360, of whom 2565 were foreign-born.~~

~~Torrington, Great, a municipal borough, railway station, and market town, Devonshire, England, in the South Molton parliamentary division of the county, 7 miles south-south-east of Bideford, on the Torridge. It is finely situated on a hill 300 feet high, and the river is here crossed by three bridges. A cattle market was erected in 1893, and a cottage hospital in 1897. The town received incorporation charters from Mary, James I., and James II., but all the borough records were destroyed by fire in 1724. There is a manufacture of silk gloves. Population (1891), 3436 ; (1901), 3241.~~

~~Tortosa, a town of Spain, province of Tarragona, on the Ebro, with a station on the coast railway from Valencia to Tarragona. The surrounding country pro- duces oil, wheat, wine, fruit, and vegetables. No place in Spain for centuries has been so often seriously flooded. Many of the streets have been entirely rebuilt, and on the opposite bank of the Ebro a new suburb has sprung up, with modern buildings, squares, and better-paved streets. The fortifications are still standing, but are obsolete, the citadel being used as barracks and hospital. Population (1887), 25,192 ; (1897), 23,793.~~

~~Torts. — Tort is, in the law of England and the United States, the technical name of a civil wrong, i.e., the breach of a duty imposed by law, by which breach some person becomes entitled to sue for damages. A tort must, on the one hand, be an act which violates a general duty. The rule which it breaks must be one made by the law, not,~~

~~as in the case of a mere breach of contract, a rule which the law protects because the parties have made it for themselves. On the other hand, a tort is essentially the source of a private right of action. An offence which is punishable, but for which no one can bring a civil action, is not a tort. It is quite possible for one and the same act to be a tort and a breach of contract, or a tort and a crime; it is even possible in one class of cases for the plaintiff to have the option — for purposes of procedural advantage — of treating a real tort as a fictitious contract ; but there is no nec- essary or general connexion. Again, it is not the case that pecuniary damages are always or necessarily the only remedy for a tort; but the right to bring an action in common law jurisdiction, as distinct from equity, matrimonial, or admiralty jurisdiction, with the conse- quent right to damages, is invariably present where a tort has been committed.~~

~~This technical use of the French word tort (which at one time was nearly becoming a synonym of wrong in literary Euglish) is not very ancient, and anything like system- atic treatment of the subject as a~~

~~whole is very modern. Since about the middle of the 19th century there has been a current assumption that all civil causes of action must be founded on either contract or tort; but there is no historical foundation for this doctrine, though modified forms of the action of trespass did in practice largely supplant other more archaic forms of action by reason of their greater convenience.~~

~~The general scope of the law of torts has never been formulated by authority, the law having in fact been developed by a series of disconnected experiments with the various forms of action which seemed from time to time to promise the widest and most useful remedies. A short historical summary will be found in the article under this heading in the ninth edition of this work. But there is no doubt that the duties enforced by the English law of torts are broadly those which the Roman institu- tional writers summed up in the precept Alterum non lae- dere. Every member of a civilized commonwealth is enti- tled to require of others a certain amount of respect for his person, reputation, and property, and a certain amount of care and caution when they go about undertakings attended with risk to their neighbours. The precise amount of responsibility can be determined only by full consideration in each class of cases. It is important to observe, however, that a law of responsibility confined to a man's own personal acts and defaults would be of next to no practical use under the conditions of modern society. .What makes the law of torts really effective, especially with regard to redress for harm suffered by negligence, is the universal rule of law that every one HaMMy™' *s answeraDle for the acts and defaults of his servants (that is, all persons acting under his direction and taking their orders from him or some one representing him) in the course of their employment. The person actually in fault is not the less answerable, but the remedy against him is very commonly not worth pursuing. But for this rule corporations could not be liable for any negligence of their servants, however disas- trous to innocent persons, except so far as it might happen to constitute a breach of some express under- taking. We have spoken of the rule as universal, but, in the case of one servant of the same employer being injured by the default of another, an unfortunate aberra- tion of the courts, which started about two generations ago from small beginnings,~~

~~was pushed to extreme results, and led to great hardship. A partial remedy was applied in 1880 by the Employers' Liability Act ; and in 1897 a much bolder step was taken by the Workmen's Compen- sation Act. But, as the common law and the two Acts~~

~~(which proceed on entirely different principles) cover dif- ferent fields, with a good deal of overlapping, and the Acts are full of complicated provisoes and exceptions, and contain very special provisions as to procedure, the im- provement in substantial justice has been bought, so far, at the price of great confusion in the form of the law, and considerable difficulty in ascertaining what it is in any but the most obvious cases. The Workmen's Compensa- tion Act includes cases of pure accident, where there is no fault at all, or none that. can be proved, and therefore goes beyond the reasons of liability with which the law of torts has to do. In fact, it establishes a kind of com- pulsory insurance, which can be justified only on wider grounds of policy.~~

~~There are kinds of cases, on the other hand, in which the law, without aid from legislation, has imposed on occupiers and other persons in analogous positions a duty stricter than that of being answerable for them- selves and their servants. Duties of this kind have been called " duties of insuring safety." Generally they extend to having the building, structure, or works in such order, having regard to the nature of the case, as not to create any danger to persons lawfully frequenting, using, or passing by them, which the exercise of reasonable care and skill could have avoided; but in some cases of "extra-hazardous" risk, even proof of all possible diligence — according to Eng- lish authority, which is not unanimously accepted in America — will not suffice. There has lately been a notable tendency to extend these principles to the duties incurred towards the public by local authorities who undertake public works. Positive duties created by statute are on a similar footing, so far as the breach of them is capable of giving rise to any private right of action.~~

~~The classification of actionable wrongs is perplexing, not because it is difficult to find a scheme of division, but because it is easier to find many than to adhere to any one of them. We may start either from the~~

character of the defendant's act or omission, with regard to his know- ledge, intention, and otherwise ; or from the character of the harm suffered by the plaintiff. Whichever of these we take as the primary line of distinction, the results can seldom be worked out without calling in the other. Taking first the defendant's position, the widest governing prin- ciple is that, apart from various recognized grounds of immunity, a man is answerable for the " natural and probable " consequences of his acts ; i.e., such consequences as a reasonable man in his place should have foreseen as probable. Still more is he answerable for what he did actually foresee and intend. Knowledge of particular facts may be necessary to make particular kinds of con- duct wrongful. Such is the rule in the case of fraud and other allied wrongs, including what is rather unhappily called " slander of title," and what is coming to be known as " unfair competition " in the matter of trade names and descriptions, short of actual piracy of trade-marks. But where an absolute right to security for one's person, repu- tation, or goods is interfered with, neither knowledge nor specific intention need be proved. In these cases we trespass altogether at our peril. It is in general the habit of the law to judge acts by their apparent tendency, and not by the actor's feelings or desires. I cannot ex- cuse myself by good motives for infringing another man's rights, whatever other grounds of excuse may be avail- able ; and it is now settled conversely, though after much doubt, and not without considerable dissent, that an act not otherwise unlawful is not, as a rule, made unlawful by being done from an evil motive. This rule was known some time ago to apply to the exercise of rights of property, and such speculative doubt as remained has

lately been removed. Since the decision of the House of Lords in the leading case of Allen v. Flood (1898, A. C. 1), we know that it applies to the exercise of all common rights. The exceptions are very few, and must be ex- plained by exceptional reasons. Indeed, only two are known to the present writer — malicious prosecution, and the misuse of a

~~“privileged occasion” which would justify the communication of defamatory matter if made in good faith. In each case the wrong lies in the deliberate per- version of a right or privilege allowed for the public good, though the precise extent of the analogy is not certain at present.1 It must be remembered, however, that the presence or absence of personal ill-will, and the behaviour of the parties generally, may have an important effect, when liability is proved or admitted, in mitigating or aggravating the amount of damages awarded by juries and allowed by the court to be reasonable. It may like- wise be noted, by way of caution, that some problems of criminal law, with which we are not here concerned, re- quire more subtle consideration. However, it is hardly ever safe to assume that the bounds of civil and criminal liability will be found coextensive. Perhaps we may go so far as to say that a man is neither civilly nor crimi- nally liable for a mere omission (not being disobedience to a lawful command which he was bound to obey), un- less he has in some way assumed a special duty of doing the act omitted.~~

~~We have already had to mention the existence of grounds of immunity for acts that would otherwise be wrongful. Such grounds there must be if the law is to be enforced and justice administered at all, and if the business of life is to be carried on with any freedom. Eoughly speaking, we find in these cases one of the following conditions. Either the defendant was executing a lawful authority ; or he was justified by extraordinary necessity; or he was doing something permitted by legislation for reasons of superior utility, though it may produce damage to others, and either with or without special provisions for com- pensating damage ; or he was exercising a common right in matters open to free use and competition; or the plaintiff had, by consent or otherwise, disabled himself from having any grievance. Pure accident will hardly seem to any one who is not a lawyer to be a special ground of exemption, the question being rather how it could ever be supposed to be a ground of liability. But it was supposed so by many lawyers down to recent times; the reason lying in a history of archaic ideas too long to be traced here. Exercise of common rights is the category where most difficulty arises. Here, in fact, the point at which a man’s freedom is limited by his neighbour’s has to be fixed by a sense~~

~~of policy not capable of formal demonstration. As Chief Justice Holmes of Massachusetts has said, we allow unlimited trade competition (so long as it is without fraud) though we know that many traders must suffer, and some may be ruined by it, because we hold that free competition is worth more to society than it costs. A state with different economic foundations might have a different law on this as on many other points. This freedom extends not only to the exercise of one's calling, but to choosing with whom and under what conditions one will exercise it. Also the law will not inquire with what motives a common right is exercised ; and this applies to the ordinary rights of an owner in the use of his property~~

~~1 It was until lately supposed that an action by a party to a con- tract against a third person for procuring the other party to break his contract was within the same class, i.e., that malice must be proved. But since Allen v. Flood, and the latter decision of the House of Lords in Quinn v. Leathern (1901, A. C. 495), this view seems untenable. The ground of action is the intentional' violation of an existing legal right.~~

~~as well as to the right of every man to carry on his business.2 Owners and occupiers of immovable property are bound, indeed, to respect one another's convenience within certain limits. The maxim or precept Sic utere tuo ut alienum non laedas does not mean that I must not use my land in any way which can possibly diminish the profit or amenity of my neighbour's. That would be false. It is a warning that both his rights and mine extend beyond being free from actual unlawful entry, and that if either of us takes too literally the more popular but even less accurate maxim, " Every man may do as he will with his own," he will find that there is such" a head of the law as Nuisance.~~

~~From the point of view of the plaintiff, as regards the kind of damage suffered by him, actionable wrongs may be divided into four groups. We have some of a strictly personal kind ; some which affect ownership and rights analogous to ownership ; some which extend to the safety, convenience, and profit of life gener„"y — in short, to a man's estate in the widest sense ; and some which may, according to circumstances, result in damage to person, property, or estate, any or all of them.~~

~~Personal wrongs touching a man's body or honour are assault, false im- prisonment, seduction or " enticing away " of members of his family. Wrongs to property are trespass to land or goods, " conversion " of goods (i.e., wrongful assump- tion of dominion over them), disturbance of easements and other individual rights in property not amounting to exclusive possession. Trespass is essentially a wrong to possession ; but with the aid of actions " on the case " the ground is practically covered. Then there are in- fringements of incorporeal rights which, though not the subject of trespass proper, are exclusive rights of enjoyment and have many incidents of ownership. Actions, in some cases expressly given by statute, lie for the piracy of copyright, patents, and trade marks. Wrongs to a man's estate in the larger sense above noted are defamation (not a strictly personal wrong, because according to English common law the temporal damage, not the insult, is, rightly or wrongly, made the ground of action) ; deceit, so-called " slander of title " and fraudulent trade competition, which are really varie- ties of deceit; malicious prosecution ; and nuisance, which, though most important as affecting the enjoyment of pro- perty, is not considered in that relation only. Finally, we have the results of negligence and omission to perform special duties regarding the safety of one's neighbours or customers, or the public, which may affect person, pro- perty, or estate generally.~~

~~The law of wrongs is made to do a great deal of work which, in a system less dependent on historical conditions, we should expect to find done by the law of property. The law of negligence, with the refined discussions of the~~

~~2 The rule that a man's motives for exercising his common rights are not examinable involves the consequence that advising or pro- curing another, who is a free agent, to do an act of this kind can , a fortiori, not be an actionable wrong at the suit of a third person who is damnified by the act, and that whatever the adviser's motives may be. This appears to be included in the decision of the House of Lords in Allen v. Flood. So far as we can learn, that decision, though not binding in any American court, is in fact likely to be approved and followed in most American jurisdictions. It is otherwise where a system of coercion is~~

exercised on a man's workmen or customers in order to injure him in his business. The extension of immunity to such conduct would destroy the value of the common right which the law protects : Quinn v. Leathern. The coercion need not be physical, and the wrong as a whole may be made up of acts none of which taken alone would be a cause of action. In this point there is nothing novel, for it is so in almost every case of nuisance. Conspiracy is naturally a frequent element in such cases, but it does not appear to be necessary ; if it were, millionnaires and corporations might exceed the bounds of lawful competition with impunity whenever they were strong enough. The reasons given in Quinn v. Leathern are many and various, but the decision is quite consistent with Allen v. Flood.

test and measure of liability which it has introduced, is wholly modern; and the same may be said of the present working law of nuisance, though the term is of respectable antiquity. Most recent of all is the rubric of "unfair competition," which is fast acquiring great importance.

It will be observed that the English law of torts answers approximately in its purpose and contents to the Roman law of obligations ex delicto and quasi ex delicto. When we have allowed for the peculiar treatment of rights of property in the common law, and remembered that, according to one plausible theory, the Soman law of Possession itself is closely connected in its origin with the law of delicts, we shall find the correspondence at least as close as might be expected a priori. Nor is the correspondence to be explained by borrowing, for this branch of the common law seems to owe less to the classical Roman or mediaeval Canon law than any other. Some few misunderstood Roman maxims have done considerable harm in detail, but the principles have been worked out in all but complete independence.

A list of modern books and monographs will be found at the end of the article on "Torts" by the present writer in the Encyclopcedia of the

~~Laws of England, vol. xii. p. 195. (Pollock's Law of Torts has reached a sixth edition, 1901.) He is not aware that anything new and important has been published on the sub- ject since the date, September 1898, down to which that volume was revised. (i\ po.)~~

~~Toru. See Uganda..~~

~~Totana, a town of Spain, province of Murcia, to the S. W. of Murcia, on the river Sangonera, with a station on the line from Murcia to Lorca. The surrounding country is mountainous to the north and level to the south, generally fertile, and producing wheat, almonds, olives, oranges, and other fruit. The town consists of two parts, styled Barrios de Sevilla and Triana, and has a fine square, large town hall, parish church with three naves (Santiago Apostle). Water is brought in for the fountains by an aqueduct 7 miles long from the Sierra de Espufia to a large reservoir in* Jaspe, and a canal has been made from the Sangonera to the beach at Mazarron. Population (1887), 11,021 ; (1897), 11,634.~~

~~Totnes, a municipal borough, railway station, and market town, Devonshire, England, in the Totnes parlia- mentary division of the county, on the river Dart, 23 miles south by west of Exeter. It is connected with the suburb of Bridgetown by a stone bridge. Erom 1295 to 1867 (when it was disfranchised) the borough sent two members to parliament. The church of St Mary's (Early Perpendicular) is a fine one, with a peal of eight bells. It was reopened after restoration in 1889. A cottage hospital was built in 1901. The town was originally walled and entered by four gates; only the east and north remain. Bridgetown is now included in the muni- cipal borough. Population (1891), 4113; (1901), 4034.~~

~~Totonicapan, chief town of a department of the same name, Guatemala, Central America. It is beauti- fully situated amidst luxuriant gardens on the same high plateau as Quezaltenango, from which it is some 12 miles distant to the north-east. It is inhabited mainly by Quiche Indians, employed chiefly in the making of cloth, furniture, pottery ware, and wooden musical instruments. There are hot mineral springs in the neighbourhood. Population, 25,000.~~

~~Tottenham, a suburb of London, in the Totten- ham parliamentary division of Middlesex, 6 miles north of Liverpool Street by rail. A Roman Catholic church has been built, and Bruce Castle, an Elizabethan mansion, became public property in 1892, with its grounds of 20~~

~~acres. The Alexandra Palace is partly in this parish and partly in that of Muswell Hill. Population of the urban district (subdivided in 1888 into two districts, Tottenham and Wood Green) (1891), 71,343; (1901),~~

~~102,519.~~

~~Tottenville, formerly a village in Richmond county, New York, U.S.A., and since 1st January 1898 a part of Richmond borough, one of the five boroughs constituting New York City. It is near the south end of Staten Island, at the terminus of the Staten Island railway. The population is not separately returned by the census.~~

~~Touch. See Physiology : Special Senses.~~

~~Toil I, chief town of arrondissement, department of Meurthe-et-Moselle, Erance, 14 miles west of Nancy, on the railway from Paris to Strasbourg. On the north side of the Marne and Rhine canal is the artillery park. In the garden behind the Hotel de Ville is a statue of " France recucillie " by Maindron (1874). At Bellevue, \ mile north-west of the town, are large pottery works. The manufacture of embroidery is a local industry. Toul is now the centre of a vast entrenched camp. The hills surrounding the town are crowned with forts, constantly being strengthened, of which the highest is that of St Michel (1400 feet), whilst a series of forts, extending in echelon along the ridge bordering the Meuse, connects the fortifications with those of Verdun. Port traffic on the Canal de l'Est and Marne and Rhine amounted in 1900 to 251,561 tons. Population (1891),~~

~~8233; (1901), 9026.~~

~~Toulon, seaport and first-class fortress and torpedo station of Erance, department of Var, capital of the arron- dissement of Toulon, on the~~

~~Mediterranean, 42 miles east- south-east of Marseilles. It is the most important port in connexion with the French national military marine. It is frequently visited by foreign naval squadrons, and made the scene of friendly demonstrations not without political significance. The federation monument in com- memoration of the centenary of the French Revolution was erected in 1890 in the Place de la Liberte, the finest in the new town. In 1883-87 a handsome Renaissance building was erected to accommodate the picture gallery and the town library. The principal industries, apart from the arsenal, are ship-building, fishing, lace-making, and wine-growing. Toulon possesses an observatory and a botanical garden. The Missiessy wet dock was added in 1889 to the naval arsenal. In 1899 379 vessels of 162,707 tons entered, and 376 of 160,708 tons cleared. Population (1886), 53,941 ; (1901), 101,172. (See Dock- yards : French.)~~

~~Toulouse, chief town of the department of Haute- Garonne, on the Garonne, 443 miles from Paris by rail. In respect of population it is the sixth town of France, and is the actual metropolis of this southern district, if judged by its historic and commercial importance. The Canal du Midi (between Bordeaux and Cette) has ceased to belong to the Southern Railways Company, and the shipping trade should receive a great impetus by reason of the consequent reduction in the tariffs. The monu- ments, in which the town is so rich, are restored and kept in repair. A colonnade and front were added to Notre Dame de la Daurade between 1890 and 1895, and at the back of the Capitole a facade has been built in place of the old, incongruous buildings, of which only the keep (now the depository of the archives) has been retained. The magnificent H8tel d'Asse°zat has been bequeathed to the learned societies of Toulouse, which took possession of it in 1896 ; and the learned societies of all France, which for years had convened their annual sittings at Paris, held their congress in this building in 1899. The surplus~~

~~treasures of the rich Museum of Antiquities have been bestowed on the Musee St Raymond, in which are various archaeological, numismatic, and ethnological collections. The faculties of science, literature, law, and medicine, combined with pharmacy, were constituted a university in the year 1896. Population (1886), 123,040 ; (1901),~~

~~147,696.~~

~~Tourcoing, a town in the arrondissement of Lille, department of Nord, France, 2 miles north-west of Roubaix and 7£ miles north-east by north of Lille. A branch canal (1893) connects with the Roubaix canal. The town has extended in all directions, and many churches and public buildings have been erected, including an important school of industries and the HStel de Ville, an elegant structure in the Renaissance style, containing a museum of painting and sculpture. An abundant water-supply has been intro- duced. The industrial and commercial expansion has been very rapid, and Tourcoing now ranks as one of the fore- most manufacturing centres of France. In 1897 there were 12 combing establishments employing 4800 persons ; 58 spinning and twisting factories, with 580,000 spindles, employing 6460 persons, and producing 40,000,000 lb of yarn ; 15 cotton spinning and twisting factories, with 540,000 spindles worked by 4200 persons, and producing 27,000,000 lb of yarn. In the weaving departments 4000 machine and 1000 hand looms turn out woollen and mixed woollen and cotton fabrics to the value of £1,400,000 every year, while the production of drapery, swan-skins, « and jerseys is valued at £960,000 more. The making of velvet pile carpets has also greatly expanded, and the annual value of the output of that and allied industries now exceeds £500,000. Imports amounted in 1900 to £2,992,000, and exports to £5,164,000. The principal imports in 1898 were wool, forming 48 per cent., and flax, yarn, and hemp, together making up 20 per cent, of the total. Of the exports, combed wool, &c, accounted for nearly 70 per cent., while yarn, tissues, rags, and flax together made up nearly 16 per cent, of the total. Popula- tion (1891), 47,253 ; (1901), 78,233.~~

~~Tournai, a town of Belgium, in the province of Hainaut, 30 miles north-west of Mons, with a station at the junction of lines from Brussels to~~

~~Lille (France) and from Mons to, Courtrai. The Scheldt divides the town into two portions. Its manufacture of carpets is of ancient origin, but has declined in importance. Other industries include the manufacture of woollen and cotton goods, linen bleaching, and distilling. The public build- ings are numerous and interesting. Population (1890),~~

~~34,442 ; (1900), 35,004.~~

~~Tours, chief town of the department of Indre-et- Loire, France, 145 miles south-west of Paris, on the rail- way from Paris to Bordeaux. The basilica erected over the tomb of St Martin was discovered as the result of excavations undertaken in 1860. Statues of Balzac (1889) and General Meusnier (1888) have been added to the public monuments. The printing works now give employment to only 800 persons, but have storage accom- modation for 7 millions of books. Steel works, works for the manufacture of machinery and implements, iron foundries, and chemical works have become important industrial features. Population (1891), 54,283; (1901),~~

~~58,409.~~

~~Towanda, a borough of Pennsylvania, U.S.A., capital of Bradford county, on the North Branch of the Susquehanna river, and on the Lehigh Valley and the Barclay railways, in the north-eastern part of the state, at an altitude of 720 feet. It is in a lumber and farm- ing region, and has planing-mills, furniture factories,~~

~~and foundries. Population (1890), 4169; (1900), 4663, of whom 322 were foreign-born.~~

~~Townsville, a town, Queensland, Australia, on Cleveland Bay, about 870 miles north-west of Brisbane, in the county of Elphinstone. It has several handsome public buildings, including the Supreme Court and new custom-house. An excellent water-supply has been established. The tidal harbour is enclosed by stone breakwaters. Large vessels enter, and load frozen meat, direct from the refrigerator-cars. The port is an outlet for a wide area of pastoral country and for several gold- fields,~~

~~and has regular communication with all ports north and south by lines of steamers. The exports in 1899 were valued at over £3,000,000. The immigration barracks on Ross Island have accommodation for 500 persons. The railway station is the terminus of the Northern line, which extends 236 miles to Hughenden. Population (1891), 8564; (1901), 12,717.~~

~~Toxins and Antitoxins. See Bacteriology.~~

~~Trade, Balance of. See Balance of Trade.~~

~~Trade Marks. — This subject may conveniently be considered under the following heads : I. British Trade Marks before the Registration Acts, 1883-88 ; II. Trade Marks under the Registration Acts, 1883-88; III. "Passing off " and trade name ; IV. Merchandise Marks ; V. International and Imperial Arrangements ; VI. Foreign and Colonial Trade Mark Laws.~~

~~I. Before the Registration Acts. — A trade mark may be defined as a symbol, consisting in general of a picture, a label, or a word or words, applied or attached to a trader's goods for the purpose of distinguishing them from the similar goods of other traders, and of identify- ing them as his goods, or those of his successors in the business in which they are produced or put for- ward for sale. A trade mark differs both from a patent and from a copyright in its legal character. In the case of a trade mark the property and the right to protection are in the device or symbol which is invented and adopted to designate the goods to be sold, and not in the article which is manufactured and sold. The article is open to the whole world to manufacture and sell, and all that the owner of the trade mark is entitled to prevent is such a use of his mark by other traders as will suggest that goods which are not his actually are so. On the other hand, patent-right and copyright protect the substance of the articles ; and any unauthorized manufacture of it in the former case, or reproduction of it in the latter, while the protection lasts, is prohibited. The grounds, however, on which trade marks, patent-right, and copyright obtain legal recognition, though they are to a certain extent dissimilar, have a common element. Patent-right and copyright rest upon the view that the results of the original~~

~~labour of the inventor and the author ought, as a matter alike of justice and of public policy, to be secured against piracy ; while, as regards the proprietor of a trade mark, the question of originality, so long as the mark is sufficiently distinctive really to identify his goods (and, for purposes of registration, to satisfy the Trade Marks Acts) does not arise. But into the law of trade marks as well as into that of patents or copyright the element enters of a man's right to have the profit derivable from his own property guaranteed to him. "No man," said Lord Justice James in the case of the Singer Manufacturing Go. v. Loog (1880), defining in language that has become classic the foundation on which the law relating to trade marks rests, "is entitled to present his goods as being the goods of another man, and no man is permitted to use any mark, sign, or symbol, device or means, whereby~~

~~without making a direct false representation himself to a purchaser from him, he enables such purchaser to tell a lie or to make a false representation to somebody else who is the ultimate customer." The existing law in the United Kingdom cannot be properly appreciated unless the subject is approached in the first instance from the historical side. English trade mark law practically com- mences with the first years of the 19th century. The use of trade marks was indeed of far earlier date, for in 1742 we find Lord Hardwicke declaring that "every particular trader had some particular mark or stamp." But in the very case in which Lord Hardwicke made that statement (Blanchard v. Hill) he refused to protect the " Great Mogul " stamp on cards, being apparently under the influence of the notion that the legal recognition of trade marks would involve the creation of a new species of monopoly; and with regard to a case decided in the reign of James I. (Southern v. How), in which a clothier had applied the mark of another clothier to his own inferior goods, the reports leave it doubtful whether the action was brought by the owner of the mark, or . by a defrauded customer, in which latter event it would be merely an ordinary action~~

~~for deceit. But although the actual law of trade marks cannot be traced farther back than the beginning of the 19th century, Lord Eldon repeatedly granted injunctions to restrain one trader from fraudulently " passing off" his goods as those of another, and thus laid a foundation on which the present law has been built up. The stages through which its develop- ment passed possess considerable interest, and may be described quite briefly. The first reported case — apart from the doubtful one in the time of James I. above re- ferred to — in which the infringement of a .trade mark (a label on blacking) was restrained by the Court of Chan- cery was Day v. Day in 1816. In 1824 the common law courts, in the case of Sykes v. Sykes, established the right of the owner of an infringed trade mark to damages. In 1833 it was held by the Court of King's Bench that it was not necessary for the plaintiff in an infringe- ment action to prove that the defendant's goods were inferior to his, or that he had suffered special damage by the infringement. Later this became a rule of equity as well as of law. On another point, however, the prac- tice of the courts of common law and equity diverged, for a time. It was decided by Lord Cottenham in 1838, in the leading case of Millington v. Fox, that an injunction to restrain the infringement of a trade mark could be ob- tained, even although the defendant had acted without fraudulent intent. On the common law side, on the other hand, fraud was an essential ingredient in the cause of action, 'and remained so till the fusion of law and equity by the Judicature Acts.~~

~~The effect of Lord Cottenham's decision in the case of Millington v. Fox clearly was to recognize a right of pro- perty in trade marks, and the action for infringement became a familiar species of litigation. Under the then existing law, however, the plaintiff in such actions generally found himself in a very disadvantageous and unsatisfactory position. The basis of his action was the reputed association between his trade mark and his goods. This association the defendant — often a person of no means — would deny, and it had to be proved as a fact by witnesses at a cost which there was little hope of his recovering. Moreover, even if the trade mark proprietor secured a judgment in his favour, it carried with it no immunity from the obligation of again establishing his right to the mark against any subsequent infringer who chose to dispute it.~~

~~Thus — to take an interesting and pertinent illustration given in Kerly on Trade Marks (p. 6) — the case of Rodgersv. Nowill lasted five years and cost the plaintiff £2211, without giving him in the end~~

~~any security that he might not have to incur equal delay and expense in proving his title to the exclusive use of the trade mark in proceeding against other defendants. To complete this statement of the shortcomings of the law before the Merchandise Marks Act, 1862, it should be noted that the infringement of trade marks — except in cases where the seller of spuriously marked goods cheated the buyer — was not a criminal offence. The remedies needed obviously were the establishment of a system of registration of trade marks, which would simplify the proof of a plaintiff's title, and the creation of a criminal law of false marking. The first step in the accomplish- ment of the latter object was taken by the Merchandise Marks Act, 1862, while provision was first made for the registration of trade marks by the Trade Marks Eegistra- tion Act, 1875. That statute made registration in the register of trade marks which it established primd facie evidence of the right of the registered proprietor to the exclusive use of the trade mark in connexion with goods of the class for which it was registered and used, and enacted that it should after the expiration of five years be conclusive proof of such right, provided that the proprietor of the mark remained the owner of the good- will of the business in which it was used. The Act also provided that a person should not be entitled to institute any proceeding to prevent the infringement of trade mark until it was registered, or (a later statutory- modification) until, in the case of a mark in use before the passing of the Act of 1875, registration of the mark as a trade mark had been refused. The Trade Marks Registration Act of 1875 was a considerable success, but no provision was made under it for the registration of words unless they either were old marks, or were regis- tered in combination with one or more of the " essential particulars " prescribed by the Act, such as a distinctive device, heading, mark, label, or ticket. The Trade Marks Act, 1883, remedied this defect, besides altering the law in other important respects ; and the law and practice in regard to trade marks are now embodied in that statute, in an amending Act passed in 1888, on the recommenda- tion of a committee presided over by Lord Herschell, and~~

~~in rules made by the Board of Trade in 1890, 1897, and 1898. Further reference may be made, in regard to the subject of Trade Marks before the Registration Acts, 1883-88, to an admirable introductory chapter in Kerly on Trade Marks, pp. 1-10, and also to the report of the Merchandise Marks Committee, 1862, and the annual reports of the Commissioners and the Comp- troller-General of Patents from 1876 to 1884 (2nd Beport.)~~

~~II. Under the Acts. — The Register of Trade Marks is kept at the Patent Office, Southampton Buildings, London, and is under the charge of the Comptroller-General of Patents, Designs, and Trade Marks, who is appointed by and acts under the superintendence of the Board of Trade, and has a deputy — the Begistrar of Trade Marks. A copy of the entries relating to cotton goods is kept at Manchester ; and there is a branch registry at Sheffield containing the marks for metal goods (“Sheffield marks “) registered by residents in or within six miles of Hallam- shire. The care of this register is vested in the Cutlers’ Company, who are substituted for the Comptroller as to registration of ” Sheffield marks,” but subject to his veto, and subject also to an appeal from him to the courts. The Trade Marks Acts, 1883-88, do not affect a~~

~~the definition of a trade mark at common law, e as it has been explained in the preceeding portion of this article. A trade mark must still be a distinctive symbol, and it must also be so applied or attached to goods and ” go to market ” with them that the customer is led by the use of it to connect the goods with the proprietor~~

~~of the mark. But re-enacting and enlarging the pro- visions of the Act of 1875, they lay down ” essential particulars,” of one at least of which a trade mark must consist, in order to entitle its owner to the benefits of registration. These “essential particulars” are as fol- lows : — (a) A name of an individual or firm printed, impressed, or woven in some particular and distinctive manner. The name must be in the nominative~~

~~case. Thus it has been held that the word ” Pirie’s ” in ” Pirie’s Parchment Bank ” did not come within this clause, and ordinary printing type is not printing in a “particular” or ” distinctive ” manner ; (b) a written signature, or copy of a written signature of the individual or firm applying for registration — the signature must be the one bond fide used in business by the individual or firm, and not a fanciful or descriptive name ; (c) a device, mark, brand, heading, label, or ticket, which is “distinctive” i.e., capable both of identifying the goods as those of the trade mark proprietor, and also of distinguishing them from those of other traders (which are even new to the trade) ; (d) an invented word or invented words ; and (e) a word or words having no reference to the character or quality of the goods, and not being a geographical name. The registration of ” word marks ” was first provided for by the Trade Marks Act, 1883. In that statute, however, clause (d) read ” a fancy word or words not in common use.” The expression “fancy word” gave rise to con- siderable difference of opinion. It was interpreted by the Court of Appeal as equivalent to ” obviously mean- ingless as applied to the article in question,” or words. ” obviously rton-descriptive.” In accordance with this interpretation, the words “gem” for guns, ” melrose ” for a hair restorer, ” electric ” for vel- veteen, and “washerine” for a soap, were all held not to be registrable. On the recommendation, however, in 1887, of a committee appointed by the Board of Trade, and presided over by Lord Herschell, the expression ” invented word ” was substituted for ” fancy word ” by the Trade Marks Act, 1888. An invented word need not be wholly meaningless, nor is it disqualified because words may have suggested it. Thus ” mazawattee ” was held to be an “invented word,” although the latter part of it was a Cingalese term meaning ” estate,” and there were estates in Ceylon having names ending with ” wattee,” from which tea came ; and in a leading case on the con- struction of the clauses under consideration (Eastman Co.‘s Trade Mark, 1898, 15 Rep. Pat. Cas. 476), the word ” solio ” was held to be registrable as a trade mark for photographic printing paper under both clauses, although it was objected that “solio” was equivalent to “sunio.” Clauses (d) and (e), it should be noted, are independent : the former deals with newly-coined words, the latter with the existing words of the English language, or of~~

~~other lan- guages likely to be known to the public. A word which is really “invented” may be registered, whether it is descriptive or not.~~

~~There may be added to any one or more of the ” essential particulars ” above enumerated any letters, words, or figures, or a combination of these. But the right to the exclusive use of the added matter must be disclaimed. A man is not required, however, to disclaim his own name, or trade name, or that of his place of business, if the name appears in the mark. In the case of what are called ” old marks,” viz., those used before the Trade Marks Registration Act, 1875, there may also be added to the mark any device, mark, brand, head, label, or ticket, which, although primd facie distinctive, is really common to the trade.~~

~~Even if a trade mark satisfies the statutory conditions as to ” essential particulars,” it may still under certain circum- stances be refused registration by the Comptroller-General. Two or more persons are not allowed, unless the court~~

~~directs, to be registered as proprietors of the same trade mark with respect to the same description of goods ; if it appears that three or more traders are entitled to an old mark for the same description, the mark is treated as common to the trade. Moreover, except by the direction of the court, the Comptroller must not register a mark having such resemblance to one already registered as to be calculated to deceive. The Trade Marks Acts contain elaborate divisions of goods into different classes. But the question whether particular goods are of the same description is not determined solely by reference to the statutory classification. ” The true test,” says Kerly (Trade Marks, p. 181), “would seem to be supplied by the question, Are the two sets of goods so commonly dealt in by the same trader that his customers, knowing his mark in connexion with one set, and seeing it upon the others, would be likely to suppose that it was used upon them also to indicate that they were his goods ? ” Wine and spirits, beer, and even an aperient drink and baking powder, have been held to be ” goods of the same description.” The expression “calculated to deceive” has been considered by the courts in very many cases. It is not merely nor chiefly the retailer or dealer that has to be kept in view when the question of~~

~~the likelihood of deception is under consideration The courts have regard also, and mainly, to the ultimate purchaser whom the trade mark may reach, and careless or unwary persons are considered as well as those who are careful and intelligent. The judge's eye is the ultimate test as to the degree of resemblance that is calculated to deceive, although expert evidence on the point is admissible.~~

~~Registration of a trade mark is equivalent to public user of the mark. It is primd facie evidence, and after five years is conclusive evidence, of the registered pro- prietor's right to the exclusive use of the mark for the goods for which it is registered, so long as the mark remains on the register (for the court has power, on the application of any person aggrieved by the entry of a mark on the register, to order its removal), provided that the proprietor is the owner of the goodwill of the business in the goods upon which the mark is used. Moreover, it is a condition precedent to an action for the infringement of a trade mark that the plaintiff should be the registered proprietor of the mark at the time when the action comes on for hearing. This last provision does not apply to an action for "passing-off" (see infra).~~

~~The right to a trade mark is determined if the mark ceases to be distinctive and becomes publici juris ; if it is separated from the goodwill (a trade mark can only be assigned with the goodwill) ; if the mark is applied by the trader to spurious goods (as where boxes of cigarettes were so labelled, in conformity with an alleged custom of the trade, as to indicate that they were Russian manufacture, which was not the fact; or when the mark is abandoned (temporary disuse, however, is not abandonment unless the mark has in the mean- time become associated with the goods of another trader) ; or where, as in the " linoleum " case, it has become the name of the goods, and so merely descriptive; or after fourteen years where the trade mark fees have not been paid.~~

~~Trade mark rights may be protected and enforced by an action for infringement, which may be brought in the Chancery or King's Bench Division ; or, in the case of marks registered irpon application at the Manchester office, in the Palatine Chancery Court of Lancashire ; or,~~

where not more than £50 damages is claimed, in the county court. As above mentioned, the court has power to rectify the Register of Trade Marks on the application of any person " aggrieved " by any entry in or omission from it ; and a mark may be removed even after five years'

registration. The court may, on the application of the registered proprietor of a trade mark, give him leave to alter or add to it (e.g., a firm on becoming a limited company has been allowed to add the word " limited " to its name upon a registered mark), but no alteration will be permitted in regard to any " essential particular." An appeal lies from the refusal, or, where an application is unsuccessfully opposed, from the allowance of registra- tion of a trade mark by the ComptroHer-General, to the Board of Trade, which may and frequently does refer the question to the court. The work of the trade mark branch of the 'Patent Office has not increased at all in proportion to that of the patent branch, and indeed, as regards the number of registrations, shows a tendency to decrease (see article Patents). The number of applica- tions for trade marks in 1884 was 7104, and the number of marks registered 4523. In 1899 the corresponding figures were 8918 and 3771.

III. " Passing-off " and Trade Name. — A trader has generally numerous other symbols, which he uses as indicia of his goods, besides his trade mark, e.g., the name or title under which he himself trades, the name under which his goods are known and sold, badges of property which are termed " trade name," and the dis- tinctive "get-up" of the goods as they appear in the market. These symbols enjoy the protection of the law, under certain conditions, equally with trade marks. No trader is entitled to "pass off" his goods as those of another, and if he infringes this rule he is liable to an action for an injunction and damages. Even if the " passing-off " is done innocently it will be restrained (Millington v. Fox, 1838, 3 Mylne and Craig, 338). Although the first purchaser is not deceived, still if the article delivered to him bears words or marks such that it is " calculated to deceive " a

~~purchaser from him, the use of them is illegal. To this general rule there are several exceptions : — (1) No monopoly is allowed in names that are merely descriptive. But words which primd facie are descriptive, such as " camel-hair belt- ing," for belting, made of camel-hair (Reddaivay v. Banham, 1896, App. Cas. 199), or "Stone Ales" for ales brewed at Stone (Montgomery v. Thompson, 1891, App. Cas. 217), may be shown to have .acquired by long use "a secondary distinctive meaning," and, in fact, to mean the goods of a particular trader. And where a defendant is not selling the genuine goods indicated by the name, as where the composition of the goods is a secret, even if the name might otherwise be taken as merely that of the goods, he cannot rely on the defence that the name is descriptive (Birmingham Vinegar Co. v. Powell, 1897, App. Cas. the " Yorkshire Relish Case "). (2) A trader cannot be prevented from trading under his own name, if he is using it honestly, even though from its similarity to the name of another trader it may injure the business of the latter (Burgess v. Burgess, 1853, 3 De Gex, M. and G. 896; Turton v. Turton, 1889, 42 Ch. D. 128). But if a trader's own name has, before he entered the trade, become the trade name of some other person's goods, he might probably not be allowed to use it without taking steps to prevent deception. It is provided by the Companies Act, 1862, that no company shall be registered under a name identical with that by which a subsisting company is already registered, or so nearly resembling it as to be calculated to deceive, unless the subsisting company is in process of being wound up and consents to such registra- tion ; and provision is also made for a change of the name of any company which, through inadvertence or otherwise, is registered under a name coming within the statutory prohibition. It is to be observed (cf . Buckley, Companies Acts, 7th ed. p. 28) that (a) the Companies Act applies~~

~~only to the case of taking the name of a subsisting com- pany already registered, and not to a case where a new company proposes to register in the name of, or in a name closely resembling, the name of an old-established company, which is not registered, or of a firm or indi- vidual trader ; (6) that as soon as the new company is registered the Act ceases to apply ; and (c) that the Act forbids registration irrespectively of the question whether the business proposed to be carried on by the~~

~~new com- pany is the same as that of the subsisting company or not. But the provisions of the Companies Act on this subject are merely supplemental to the common law, and, accordingly, an injunction will be granted to restrain a company from carrying on the same trade as that of an- other company under a name so nearly resembling the name of that company as to be calculated to deceive, whether it has been registered or not, and, in the latter event, to restrain the infringing company from applying for registration of the name. A new company will not be allowed to take the whole name of a subsisting com- pany, even although that name is of a descriptive charac- ter (Manchester Brewery Co. Ltd. v. North Cheshire and Manchester Brewery Co. Ltd., 1899, App. Cas. 83).~~

~~The purchaser of the goodwill of a business has the right to use the trade name under which the business is known, and to restrain others from using it, or using such imitations of it as may mislead the public. But he is not entitled by the use of the trade name to make the vendor liable, under the doctrine of " holding out," for debts of the business incurred after the sale. And if the vendor of the goodwill gave his rlame to the business, he cannot (in the absence of any restrictive condition in the agreement for sale) be prevented from beginning to trade in his own name again, unless it be shown that in so doing he is attempting to deceive the public into the belief that he is still the owner of the old business. It may be noted that the right to be protected against " passing-off " is restricted to goods of the same descrip- tion as those upon which the trader uses the " get-up," &c, imitated.~~

~~IV. Merchandise Marks. — As has already been seen, the first attempt to make the falsification of trade marks a criminal offence was initiated by the Merchandise Marks Act, 1862. But that statute possessed numerous and serious defects. Although it provided that the forgery of a trade mark with intent to defraud, and the false applica- tion of a trade mark to goods with the like intent, should be misdemeanours, it left the burden of establishing the fraudulent intent upon the prosecutor. It contained no provision for summary prosecutions. And it did not provide for the seizure of falsely marked goods on impor tation from abroad. It was to the existence of this last defect that the~~

enactment of a more satisfactory measure was due. The International Convention for the Protection of Industrial Property, to which Great Britain acceded in 1884, contained a provision that all goods illegally bearing a trade mark or trade name maybe seized on importation into those states of the union where the mark or name has a right to legal protection, and that the seizure shall be effected at the request of either the proper public department or of the interested party, pursuant to the internal legislation of each country. The law had to be amended in order to carry out this article in the Con- vention, and the Merchandise Marks Act, 1887, was passed to carry out this object and generally to make better pro- vision for the protection of merchandise. It was sub- sequently amended in 1891. The effect of the provisions of these statutes may be briefly stated. Any person is guilty of an offence, punishable on indictment or summary conviction, by fine or imprisonment, who does any of the five following acts, unless he proves as regards the first four

of them that he acted without intent to defraud (there is a special defence to No. v. which is noted below) : — (i.) forges any trade mark, or makes, disposes of, or has in his possession for such purpose any die or instrument ; (ii.) falsely applies any trade mark or a colourable imitation of any trade mark to goods ; (iii.) applies any false trade description to goods : " trade description " is defined as any descriptive statement or other indication as to the measurement, quantity (not quality, it should be observed), or weight, place, or mode of produc- tion, or the material of the goods, or as to their being subject to an existing patent, privilege, or copyright ; con- ventional or customary descriptions lawfully in use in August 1887 to indicate that the goods are of a particular class or method of manufacture are allowedto be continued; but if they contain the name of a place and are calcu- lated to mislead as to the real place of production, the name of the latter must be added ; (iv.) causes any of the above offences to be committed ;

~~(v.) sells or exposes for sale, or has in his possession for sale, trade, or manufac- ture, any goods or things to which any forged trade mark or false trade description is applied, or any trade mark or colourable imitation of a trade mark is falsely applied, un- less the defendant proves that, having taken all reasonable precautions, he had no ground to suspect the genuineness of the mark, &c, and also that on demand he gave to the prosecutor all the information in his power as to the per- son from whom he obtained the goods, &c, or proves that he otherwise acted innocently.~~

~~There is power to forfeit the things found on a prosecu- tion for any of these offences, although no one is con- victed. If the offender is indicted (it is in his option to be tried in this way) the punishment is fine and imprison- ment, the latter not to exceed two years. On summary conviction the punishment is not to exceed, for a first offence, four months' imprisonment, with or without hard labour, and a fine of £20 ; and for any subsequent offence six months' imprisonment and a fine of £50. The im- portation is forbidden of goods by means of or in rela- tion to which an offence against the Acts has been com- mitted, and also of all goods of foreign manufacture bearing any name or trade name being or purporting to be that of a manufacturer or trader within the country, unless it be accompanied by a definite indication of the country where the goods were made or produced. There are also special provisions with regard to the marking of watch-cases. The Commissioners of Customs have power to make general orders for carrying out the Merchandise Marks Acts, and a number of such regulations have been issued. Under the Sale of Food and Drugs Act, 1899, the importation, except in containers showing their char- acter, of margarine, margarine cheese, adulterated or im- poverished butter, or condensed, separated, or skimmed milk, is penalized, and it is provided that the Com- missioners of Customs, in accordance with directions given by the Treasury after consultation with the Board of Agriculture, shall take such samples of consignments of imported articles of food as may be necessary for the enforcement of the law.~~

~~V. International and Imperial. — By the International Convention (see Patents) for the Protection of Industrial Property, which was signed at~~

~~Paris in 1883, the signatory states, a list of which is given below, agreed that the subjects or citizens of each state should, in all the other states, enjoy as regards trade marks and trade names the advantages that their respective laws then granted, or should thereafter grant, to their own subjects or citizens. So far as Great Britain is concerned, the only provision that has been made for. carrying out this convention is contained in § 103 of the Trade Marks Act, 1883. The effect of that section is to confer on an applicant for the~~

~~protection of a trade mark in one of the other contracting states a priority over other applicants for registration in the United Kingdom during the space of four months. The section does not, however, exempt the applicant from the conditions and formalities incumbent on ordinary ap- plicants for registration in Great Britain ; nor does the fact that the foreign application has been successful of itself give the applicant a right to have his mark accepted for registration. Under the Convention of Madrid, 1891 (to which, however, Great Britain has not acceded), a trade mark may be registered as the result of a single application in the countries of all the signatory Powers. The following is a list of the Orders in Council that have been issued applying the provisions of the Trade Marks Act, 1883, § 103, to foreign countries :~~

—

~~Foreign State.~~

~~Belgium~~

~~Brazil~~

~~Denmark (including the Faroe Islands) .... Dominican Republic~~

~~Ecuador~~

~~France~~

~~Greece~~

~~Italy~~

~~Japan~~

~~Mexico~~

~~Netherlands ....~~

~~,, (East Indian Colo-~~

~~nies)~~

~~, , (Curacoa and Suri-~~

~~nam) Paraguay Portugal Rumania Servia~~

~~Sweden and Norway~~

~~Switzerland .~~

~~Tunis~~

~~United States .~~

~~Uruguay .~~

~~Date of Order in Council.~~

~~June 26, 1884. June 26, 1884.~~

~~November 20, 1894. October 21, 1890. May 16, 1893. June 26, 1884. October 16, 1894. June 26, 1884. October 7, 1899. May 28, 1889. June 26, 1884.~~

~~November 17, 1888.~~

~~May 17, 1890. September 24, 1886. June 26, 1884. August 5, 1892. June 26, 1884. June 26, 1884. July 9, 1885. June 26, 1884. June 26, 1884. July 12, 1887. September 24, 1886.~~

~~In the following foreign countries penalties have been imposed under the Foreign Jurisdiction Act on British subjects committing offences against the Trade Marks Acts, 1883-88, and the Orders in Council thereunder — Africa, East Africa, Morocco, Persia, Persian Coast, Zanzibar.~~

~~By § 104 of the Trade Marks Act, 1883, the Sovereign is empowered by Order in Council to apply the provisions of, § 103, above mentioned, with such variations or addi- tions as may seem fit, to any British possession. The following is a list of the Orders in Council that have been issued : —~~

~~British Possessions.~~

~~Date of Order in Council.~~

~~New Zealand .... Queensland .... Tasmania ....~~

~~West Australia~~

~~February 8,1890. September 17, 1885. April 30, 1894. May 11, 1895.~~

~~It should be added that the protection of the Merchan- dise Marks Act, 1887, extends to any trade mark which, either with or without registration, is protected by law in any British possession or foreign state to which the pro- visions of § 103 of the Act of 1883 are, under Order in Council, for the time being applicable.~~

~~A foreigner suing in the United Kingdom for infringe- ment of a trade mark or for " passing-off " is in the same position as a subject.~~

~~VI. Foreign and Colonial. — It is impossible within the limits of this article to attempt a survey of the laws of~~

~~foreign countries or of the colonies. Valuable information with regard to the former will be found in the Transactions of the International Association for the Protection of In- dustrial Property, London, vol. i., 1897, pp. 185 (“Inter- national Eegistration “), 245 (” Indications of Origin”), 259 (” Unfair Competition”) ; vol. ii., 1898, pp. 214 (“Unfair Competition “), 250 (” Industrial Property Department “), 445 (” Descriptive Marks “). The British colonies gener- ally follow the model of the English Trade Marks Acts. The Hong-Kong Ordinance, No. 14 of 1898, is a typical instance of this. In the Isle of Man in 1898 a Merchandise Marks Act was passed which proceeds on the lines of the English Act of 1887, and contains an additional section imposing penalties on any person who falsely represents~~

~~that any goods are made by a person holding a royal warrant, or for the service of the Sovereign or any of the royal family, or any Government department. There is a similar provision in § 105 of the Patents Act, 1883.~~

~~Authorities. — Sebastian. Trade Marks, 4th ed. London, 1899 (in this work the American cases are fully dealt with). — Kerlt. Trade Marks. London, 1894. — Cartmell’s Digest. London, 1876-92. — Sebastian. Digest. London (cases down to 1879). — Gray. Merchandise Marks Act. London, 1888. — Safford. Merchandise Marks. London, 1893. — The Reports of the Departmental Committee of 1887, and of the Select Committees of the House of Commons appointed in 1887 and 1890 to consider the law with regard to merchandise marks and false marks, and the annual Reports of the Comptroller-General, throw great light on both the history and the practical working of the law. (a. w. k.)~~

~~TRADE ORGANIZATION.~~

~~THE development of commercial organization which . attended the growth of trade and industry dur- ing the 19th century has assumed two distinct phases. In the first, we see the creation of associations of persons engaged in trade and industry for the purpose of protecting their interests and of facilitating and fostering commercial relations. In the second, govern- ments elaborate departmental organizations for the super- vision of commercial matters, establish offices for the dissemination of commercial information, and utilize their consular services as means of commercial intelligence and influence.~~

~~The associations belonging to the first category may be divided into three classes : —■~~

~~(a) Those which are themselves engaged in trade, like ordinary joint-stock companies, or which result from the combination of firms or individuals in the same or con- nected trades, for the purpose of facilitating or restricting production, limiting competition, regulating prices, &c. — in a word, of working to their common benefit by the union of their property, knowledge, and energies, such as co- operative societies and trusts.~~

~~(&) Those which, without engaging in trade, aim at providing facilities for the transaction of commercial or financial operations. They chiefly take the form of exchanges, bourses, public sale rooms, &c, such as the Baltic, Lloyd's, the Stock Exchange, the Corn and Coal Exchanges, the Commercial Sale Booms, and impose upon their subscribers or members rules for the transaction of business which, in certain cases, apply not only to business transacted upon their premises, but also regulate tne manner of transacting business generally.~~

~~(c) Non-trading bodies, in the nature of public institu- tions, whose objects are to protect the interests of trade ; to advise, and if necessary to bring the weight of combined influence to bear upon governments and parliaments in commercial matters; to facilitate the obtaining of com- mercial information; to secure diplomatic intervention for the~~

~~upholding of national rights in international trade ; and, to a certain extent, to be to trade and traders, under the economic conditions of modern life, what the gilds and crafts and livery companies of former ages were to the merchants and craftsmen of their day.~~

~~This article is limited to commercial associations of the last class, and an attempt has been made to show how they arose, the rules which govern them, their sources of income, and the nature and extent of the services which they render to commerce. The systems in force in the United Kingdom and in the British colonies and India, in the United States, in France, Germany, Belgium, Austria-Hungary, Spain, Portugal, Russia, and Japan are the subjects of separate sections, in which will~~

~~also be found a summary of the steps taken by govern- ments to deal with the requirements of trade by the establishment of Ministries of Commerce, Official Com- mercial Information Bureaus, Commercial Museums, Con- sultative Committees, &c. In view of the interest attach- ing to consular action in trade matters, special attention has been paid to the instructions given to consuls on the subject.~~

~~When, at the close of the 18th century and early in the 19th, the power of the old trade gilds and corporations of merchants had been broken by the almost universal proclamation of the liberty of trade and industry, and by the abolition of compulsory apprenticeship, both govern- ments and commercial men soon realized that the ancient societies would not follow the commercial evolution, and that new organizations must be created to meet new re- quirements. Two systems were evolved, which, from their prototypes, are known as the British Brl*fi* and the French systems. In the former, trade *yStems.C organizations were left to develop themselves in their own way, and in whatever directions they might think fit, without any official interference. In the latter, on the contrary, the Government constituted itself the creator of trade organizations, which it incorporated into the administrative system of the country, and to which it gave an official status as an integral part of the machinery of the state. The former have grown chiefly into as- sociations for the promotion and defence of~~

commercial interests, whilst the latter have mainly become sources of commercial information and means of action at the disposal of the Government. While organizations on the British system are, as regards the Government, purely advisory bodies whose opinion might or might not be asked in connexion with commercial matters, and whose duties are limited to the services which they are in a position to render to their members and to commerce generally, organizations on the French system not only must be consulted, in certain specified cases, by the Government, especially in connexion with the drafting of commercial legislation and of regulations affecting trade, but they have also administrative duties to perform, such as the control of public commercial institutions, of testing, standardizing, and conditioning establishments, port and dock works, &c. The former associations are self-support- ing, their chief source of income being the annual sub-scriptionsrecciv^dfrommembers. Thelatter are provided for out of the rates, and sometimes by government or municipal subsidies. The British system obtains in the United Kingdom and the British colonies, in the United States, and in Belgium, while the French has been adopted in most Continental countries, and in Japan.

Both systems have advantages, but both have also

great drawbacks. The chief advantages of self-support- ing associations, unfettered by official trammels, are that they are free to act as they deem best in the interests of the commercial community, and, if necessary, to bring pressure upon the Government and upon Parliament; that the expression of their views is not coloured by the natural inclination to support the acts of an administra- tion of which they form part ; that they can freely join hands with other associations in the advocacy of a common cause ; and that they are at liberty, in all cases and at all times, to place their views before the Govern- ment. On the other hand, the fact that they have to •depend almost exclusively upon the subscriptions of their members often cripples them in their work, as in many places the membership is not sufficient to allow them

~~to develop as they should, and in consequence they are unable to render the services which are expected from them ; their library is incomplete, their offices and staff are not in keeping with their character. Moreover, self- supporting associations have a strong tendency to over- look that they are public bodies, with consequent public •duties : they naturally want to limit their services to their subscribers, and this gives rise to the taunt of the •outsider that they represent nobody but themselves, and that they have no claim to be regarded as public institu- tions. Great difficulty is experienced in making them truly representative, and their efficiency is not unfre- ■quently impaired by local jealousies. The fact that a particular firm or individual has become a member is often enough to prevent others from joining, and to make them look upon the institution as a mere organization of busy bodies.~~

~~The Continental system avoids the latter drawbacks. Trade organizations, as a rule, merely consist of a Board the members of which, limited in number, are periodically elected by the general body of commercial tax-payers. Serious guarantees are thus afforded for securing repre- sentative organizations. These Boards have an official status, their members take rank after the magistrates in public functions, membership of them confers a standing, and is considered as a public recognition of commercial position and credit. Election to them is in consequence highly coveted. Expenses being borne by the rates, there is no difficulty in providing proper offices, staffs, and libraries, and in maintaining the dignity and in carrying on the work of these associations in a manner suited to their position and to their objects. But, on the other hand, Government control does not go without grave dis- advantages. Organizations on the Continental system are, as a rule, so much under the hand of the State that they cannot always be trusted to express fully the views of their constituents, and even if they do express these views, they are powerless to take action to secure their enforcement. Their duties are carefully defined by law, and they have practically no initiative in commercial matters. As they lack the incentive given to associations under the British system by the necessity of continually increasing the number of their subscribers, they are apt to run in a groove, to limit themselves to what they are strictly bound to~~

~~do, to ignore questions which are diffi- cult or dangerous to deal with, and to confine themselves to matters of purely local interest.~~

~~I. Great Britain and Colonies. A. Commercial Associations. In the United Kingdom, commercial associations arose with the growth of trade, without any assistance from the State and free from all Government restriction or control. The first in point of date were the " Commercial iSocieties" which were formed, chiefly during the last quarter of the 18th century, in Birmingham, Exeter, Halifax, Leeds, Liverpool, and Manchester, and which~~

~~exercised a not unimportant influence upon commercial developments at the close of the 18th and in the early years of the 19th centuries. The modern associations which superseded these societies divided themselves into four classes, viz. : —~~

~~(a) Chambers of Commerce and Associations which aim at becoming representative of general commercial interests ;~~

~~(6) Associations or Institutes which represent particular trades or branches of trades ;~~

~~(c) Trade Protection Societies, which look after the interests of retail as well as wholesale traders, and under- take to supply them with information as to the standing and credit of firms, expose swindlers, collect debts, &c. ; and~~

~~(d) Non-representative associations rendering general commercial services.~~

~~All the representative associations are on the same plan, being composed of members who pay a yearly subscrip- tion, and as a rule elect a governing body entrusted with the management of the affairs of the society. In some cases the governing body is not elected, but co-opts members to fill vacancies, whilst in others it is partly elected and partly co-opted. This body decides upon applications for membership of the association, which is only granted after inquiries, and when applicants~~

~~have been duly proposed and seconded, and notice of their applications given.~~

~~(a) Chambers of Commerce and General Associations. — Most of the Chambers of Commerce in the United Kingdom were formed during the latter half of the 19th century, although a few were in existence much earlier. The oldest British Chamber is the Jersey Chamber, which dates from 1768. The Glasgow Chamber was founded in 1783. Dublin followed in 1785, Edinburgh in 1786, Manchester in 1794, Belfast in 1796, Birmingham in 1813, Newcastle-upon-Tyne in 1818, Liverpool in 1851, Sheffield in 1857, &c. The London Chamber was the last of the Chambers of import- ance to be established : it dates only from 1881. There are in the United Kingdom 113 Chambers of Commerce, of which ten are in Scotland and ten in Ireland. Some of the older chambers, notably the Glasgow Chamber, have been granted the status of a " body corporate and politic" by Royal Charters, which empowered them to acquire, hold, and dispose of property, and to sue and be sued in a corporate capacity, gave them a corporate seal, embodied the regulations adopted for the internal management of the Chamber, and ordained " that they and their successors in all time coming shall have perpetual succession for the purpose of better and more efficiently administering, directing, ordaining, and constituting in all matters and things" pertaining to the said Chambers and their funds. The obtainment of corporate capacity was rendered easier by the Companies Acts which have been enacted since 1862, and the practice of granting charters to Chambers of Commerce and similar associations was abandoned. Being non- trading bodies, and no part of their income being at any time payable, either directly or indirectly, to the members by way of dividend, bonus, Or otherwise, Chambers of Commerce could obtain the Board of Trade licence for incorporation as companies limited by guarantee without the addition of the word " limited." Some twenty cham- bers, including those in London, Liverpool, Sheffield, Aberdeen, &c. , availed themselves of this facility, and are known as Incorpor- ated Chambers of Commerce. Their objects and regulations are embodied in the Memorandum and Articles of Association, and alterations can be made therein in accordance with the provisions of company law. In Chartered Chambers, the rules,~~

which are recited in the charter, cannot be amended except by a supplemen- tary charter, which is a cumbrous and expensive proceeding. The vast majority of Chambers of Commerce, however, did not take the trouble to seek incorporation, and in law are governed by the rules regulating ordinary partnerships, under which the members are personally liable for the debts of the Association.

The London Chamber of Commerce, which boasts over 4000 members, is one of the most representative associations of its kind, and the organization adopted has been very effective in securing this. The Chamber has been divided into The trade sections, of which there, are at present forty -four, London and members specify the sections to which they desire Chamber. to belong. Each section has a separate organization, and is presided over by a chairman elected by itself, who may be helped by an elected committee, if found advisable. The general council of the Chamber confirms the election of chairmen of sections, and no action can be taken by the Chamber on the recommendation of a section unless the council has authorized such action. The result

is that, whilst general interests are safeguarded, particular trade interests are given opportunities of pressing themselves upon the attention of the general body. Questions are also sifted without needless loss of time, as they are in the first place submitted to those who are especially interested in them and especially com- petent to deal with them, and it is only upon their recommendation that the council is requested to take action. The Chamber has also placed itself in connexion with a number of mercantile associations which, whilst preserving their separate organizations and their independence of action, have found it advantageous to work in conjunction with it, either for general or. for particular purposes, and to have a voice in its council. They are twenty-nine in num- ber, the most important of which are the Institute of Bankers, the Institute of Chartered Accountants, the Society of Accountants and Auditors, the General Ship Owners' Society, the General Produce Brokers' Association, the Federation of

~~Grocers' Associations of the United Kingdom, the West India Committee, the Corn Trade Association, the United Planters' Association of Southern India, &c. The general council is composed of 115 members, as follows : four ex officio, viz. , the Lord Mayor, the Governor of the Bank of England, and the two members of Parliament for the City ; two nominated, one by the committee of Lloyd's and the other by the Board of Elder Brethren at Trinity House ; twenty-nine elected by the Mercantile Associations working in conjunction with the Chamber ; the forty-four chairmen of trade sections ; and thirty-six representing the general body of members of the Chamber. The latter are the successors of the original council which took charge of the Chamber at its foundation : they are not elected, but their number is kept up by co-optation as vacancies occur. Various attempts have been made by members of the Chamber to introduce the principle of election to the council, but so far unsuccessfully. An executive committee of the council transacts the general busi- ness of the Chamber. Individual members pay an entrance fee of £2, 2s. and an annual subscription of £1, Is., and may compound for life membership by a single payment of £17, 17s. ; firms or com- panies pay an entrance fee of £2, 2s. and an annual subscription of £2, 2s., and cannot compound. The yearly income of the Chamber is about £7000, and a reserve fund of £2000 has been invested.~~

~~Particular reference should also be made to the Liverpool Chamber, which, as regards division into trade sections and co- operation with independent associations, works on The similar lines to those of the London Chamber. The~~

~~Liverpool African trade section of the Liverpool Chamber has been Chamber, prominent in connexion with African questions, and since its foundation in 1884 has been the leading voice in all matters relating to West Africa ; and its action with reference to health and sanitation questions on the West Coast, and to the establishment of the School of Tropical Medicine, has been effective and beneficent. It also was chiefly instrumental in bringing about the reform of the management of the Niger territory by the Chartered Company, and has been the chief~~

~~recommendatory power in the making of roads and railways and in the provision of shipping facilities in those regions.~~

~~The Manchester Chamber of Commerce is known as the champion of free trade, as the principal exponent of the doctrines of the Manchester school, and as the opponent not only of all The attempts to introduce protective customs duties, but of~~

~~Manchester any preferential arrangement in favour of the Colonies Chamber, which would differentiate between the treatment of colonial goods and that of foreign goods. The Cham- ber may be said to have inherited its policy from the Anti-Corn Laws Agitation, and from the memorable rile which it played from 1838 onwards in the free-trade campaign. Its action in connexion with factory legislation has also been important. It is more of an economic body than any other Chamber of Commerce in the United Kingdom.~~

~~Other Chambers of Commerce follow more or less closely the organization explained in connexion with the London Chamber, with the exception that, as a rule, their governing body is elected. Subscriptions are on about the same scale everywhere, viz., ranging from £1, Is. to £2, 2s. per annum. The Glasgow Chamber has a £5, 5s. subscription.~~

~~The Association of Chambers of Commerce of the United King- dom, which was formed in 1860, contributed much to give Cham- bers of Commerce as a whole a national importance and Asaocla- a standing which enabled them in course of time to tlon of become representative of the general commercial inter- Chambers ests of the country, as distinguished from local interests. of Com- This Association, like the Chambers themselves, was of merce. course purely voluntary, and at the time of its founda-~~

~~tion only sixteen Chambers decided to join it. It was some time before the oldest and most important Chambers be- came members, as they were rather afraid of having their liberty of action tampered with, and of being compelled by the votes of other Chambers to countenance~~

~~decisions of which they did not approve. But these fears proved to be groundless, and the only~~

~~Chamber of importance which is still keeping aloof is the Glasgow Chamber. The Manchester Chamber joined in 1900. In 1902, 96 out of the 113 Chambers in the United Kingdom were members. The management is in the hands of a council composed of a presi- dent, two vice-presidents, a treasurer, two honorary secretaries, and twenty five representatives of constituent Chambers, who are elected by ballot every year at the general meeting of the association. In the proceedings of the Association, Chambers with less than 100 members have one vote ; those having from 100 to 250 members, two votes ; from 250 to 600, three votes ; over 600 and not exceeding 1000, four votes; over 1000, one additional vote per additional 500; but no Chamber can have more than six votes. The Association is kept up by an annual subscription from the constituent Chambers, which is based upon the number of members of each Chamber, and ranges from £8 for Chambers having less than 100 members to £32 for Chambers having up to 1000, and £8 additional for each further 500 members. Its income from subscriptions amounts to about £1000 perannum, and its budget from all sources to about £1500. Itwas incorporated under the Companies Acts in 1875, and its chief objects are stated to be : — To afford Chambers of Commerce opportunities of discussing matters of common interest and of deciding upon joint action in relation thereto ; to act as intermediary between the con stituent Chambers and the Government in matters in regard to which the intervention of the Association is requested ; to petition Parlia- ment, and to promote or oppose Bills affecting commercial, manu- facturing, and shipping interests, &c. It has been instrumental in passing many useful Acts of Parliament, and in otherwise influencing legislation upon commercial topics. The general meetings, which are held annually in March , in London, and at which delegates are present from all parts of the country, have come to be considered as a kind of parliament of trade, and representatives of the Board of Trade, the General Post-Office, and the Foreign and Colonial Offices are generally in attendance. Special meetings take place in September, and are held in provincial towns on the invitation of the local Chamber. During the Exhibition of 1900 the~~

special meeting for that year took place in Paris, on the invitation of the British Chamber of Commerce in that city, which is a member of the Association. The reception which was accorded to the visitors by the French Government and by the Chambers of Commerce of Paris and Calais, as well as the fact of the visit to France of such a representative body of British com- mercial men at a time when the relations between the two countries were not thought to be at their best, had a most beneficent effect both in France and in England, and opened up a vista of possibilities concerning the influence of Chambers of Commerce in international relations which had not hitherto received sufficient attention.

The Association has limited its work to the United Kingdom, and has not taken advantage of the commercial development of the Colonies to afford colonial interests an opportunity of voicing their needs in the metropolis. To supply this Congresses. need the London Chamber of Commerce organized ot Congresses of Chambers of Commerce of the Empire, of Chambers which up to 1902 four had taken place, viz., in 1886, “1 1892, 1896, and 1900. These Congresses, ‘to which all „^™eree Chambers of Commerce in the United Kingdom and in Empire. the Colonies and India were invited to send delegates resident in their district, enabled British commercial men, as well as the representatives of the Government who were invited to attend, to become acquainted with the views and needs of the outlying parts of the empire, by coming into actual contact with the colonial delegates, and discussing with them matters of common interest. Further ex- tension was given to the movement by the decision to hold some of these congresses in the colonies, the first being at Montreal in 1903.

The home organization of Chambers of Commerce is supplemented by a few British Chambers which have been established in foreign countries. These institutions are self-supporting, and not, as seems often to be thought, branches of or sub- British sidized or controlled by home Chambers. The British Chambers Chamber of Commerce in Paris, which is the oldest of abroad. them, dates from 1873, and was originally established by British merchants in Paris for the defence of their own trade interests. Its scope soon extended, however, and it

~~admitted to membership British firms trading with France although not resi- dent in France, and in course of time became representative of general British commercial interests in the French markets. It advises British firms with regard to the interpretation and applica- tion of French commercial and customs laws and regulations ; takes up their cases with the French Customs authorities when difficulties arise ; gives information as to the standing of French houses ; and defends British and colonial interests generally in France. It is kept up solely by the subscriptions of its members, those resident in Paris paying £4, and those resident abroad £2, per annum. The scanty support which the home trade has given to such institu- tions has prevented their growth in foreign countries, and whilst the French have thirty eight Chambers looking after their interests abroad, British Chambers are to be found only in Paris, Nice, Alexandria, Cairo, and Constantinople. In Brussels, an Anglo~~

~~Colonial Chambers,~~

~~American Chamber jointly represents British and American in- terests. The following countries are represented in London by Chambers of Commerce, viz., Austria-Hungary, Belgium, France, Italy, the Netherlands, and Spain. The Italian Chamber Foreign is the only one which has sought incorporation under Chambers the Companies Acts, and is also the only one which is a In England, member of the Association of Chambers of Commerce of the United Kingdom. The United States are repre- sented in England by the American Chamber of Commerce in Liver- pool (see p. 396). The foreign Chambers in London have joined in forming an Association of Foreign Chambers of Commerce which does, to a certain extent, for them what the Association of Chambers of Commerce of the United Kingdom does for the home Chambers. Commercial organization in the Colonies is very much on the same footing as it is in the United Kingdom. The most representa- tive associations are the Chambers of Commerce, whose constitution and functions are similar to those of the British Chambers.~~

~~In Canada the Chambers, which are also sometimes called Boards of Trade, after the American custom, are about sixty in number, the most important being the Montreal and Toronto Boards of Trade and the Quebec Chamber of Commerce. The Canadian Chambers have no association, but hold periodical conferences. There is, in addition, the Canadian Manufacturers' Association, with headquarters in Toronto and brariches in all the provinces, which incorporates all the associa- tions of manufacturers in the Dominion. Its meetings, which are held annually in various cities, are frequently attended by ministers and representatives of Government departments. The Australian Chambers of Commerce, which number about thirty, have joined into an association called the General Council of the Chambers of Commerce of the Commonwealth of Australia. The Australian Chambers are generally considered to represent the interests of importers and of general merchants, and to incline as a rule towards a free-trade policy. Their influence is counterbalanced by that of the Chambers of Manufactures, the most important of which are those of Adelaide, Melbourne, and Perth, to which must be added the National Agricultural and Industrial Association of Queensland, whose headquarters are at Brisbane. The Chambers of Manu- factures have been very active in the promotion of technical and commercial education, and have founded valuable libraries and museums, of which those at Adelaide are said to be the best organ- ized. In New Zealand there are some fifteen Chambers of Com- merce. At a conference held in 1902 they practically decided to form an association after the Australian model. In South Africa, Cape Town, Kimberley, Port Elizabeth, Johannesburg, Pretoria, Durban, and Bulawayo have important Chambers. The South African Chambers are joined in a Federation of Chambers of Com- merce of South Africa. In the West Indies the Jamaica and the Trinidad Chambers are the most important. The Indian Chambers of Commerce, which are not federated, are for the most part very important and influential bodies, which the Government of India often consults. The Bombay and Madras Chambers, and the Ben- gal Chamber at Calcutta, have a predominant voice in the organi- zation of Indian trade, notably in the settlement of the regulations of the cotton trade, and the first and last are intimately connected with the administration of the ports of Bombay and~~

~~Calcutta. There are Chambers at Rangoon and Karachi. The Colombo Chamber represents Ceylon trade ; there is a Chamber at Singapore for the Straits Settlements ; one at Hong-Kong ; one in Shanghai ; one in Mauritius ; one at Valetta, for Malta ; one at Gibraltar ; one in Georgetown, for British Guiana ; and four in "West Africa, viz., at Cape Coast, Accra, Sierra Leone, and Lagos.~~

~~With the exception of Australia none of the Colonies was in 1902 represented in London by Chambers of Commerce proper, and the Australian Chamber had only lately been established. The West India Committee and the Ceylon Association look after the com- mercial interests of their respective countries, whilst the United Empire Trade League, the British Empire League, and the Imperial Trade Defence League endeavour to promote inter-Imperial trade.~~

~~(6) Associations representing Particular Trades. — Associations representing particular trades are almost innumerable. Chambers of Shipping and Shipowners' Associations occupy the foremost place among them, for shipping is of such moment in the economic life of the empire that, although more representative of a particular interest than of the general commercial interests of the country, they have attained a position of influence which no other body limited to one particular trade has succeeded in obtaining. The London General Shipowners' Society, the Liverpool Shipowners' Association, the North of England Shipowners' and Steamship- Owners' Associations may be mentioned as representative. In shipping centres of secondary importance the shipping interests are taken charge of by the local Chamber of Commerce, which styles itself Chamber of Commerce and Shipping ; this is the case in Bristol, Grimsby, Hull, Ipswich, and Cork. The various Chambers of Shipping and Shipowners' Associations joined forces in 1878 in order to establish the Chamber of Shipping of the~~

~~United Kingdom, which does for them what the Association of Chambers of Commerce does for Chambers of Commerce. It is divided into two sections, viz., the Shipowners' Parliamentary Committee, which watches all public Bills affecting British merchant shipping and looks after shipping interests in Parliament, and the Documentary~~

~~Committee, which deals with charter-parties, bills of lading, berth notes, and other maritime documents, settles forms to be used, &c. The development of the mining industry led to the foundation some years ago of the London Chamber of Mines, which serves as an intermediary between mining interests on the one hand and the British commercial and financial public and the Government and Parliament on the other. This Chamber was supplemented in 1897 by the London Chamber of Rhodesia, whose membership is restricted to companies interested in the territories of the British South Africa Company, and having a working capital exceeding £20,000. It acts as the London correspondent of the Incorporated Chamber of Mines of Rhodesia, and defends and promotes Rhodesian land and mining interests. The Chambers of Mines are of colonial origin. In Australia they are to be found in Melbourne, Charters Towers, Perth, Coolgardie, and Kalgoorlie ; in South Africa, at Cape Town, Kimberley, Johannesburg, and Bulawayo ; and in Canada the Central Canada Chamber of Mines looks after mining interests. The Iron and Steel Institute affords a means of communication between members of the iron and steel trades, and its general meeting is an event of importance. This meeting is sometimes held abroad on the invitation of foreign associations, when technical papers are read, and discussions take place concerning especially processes and improvements connected with the manufacture of iron and steel. One-fourth of the members of the Institute are foreigners. Of the associations of firms con- nected with the iron trade, the British Iron Trade Association is one of the most powerful. The nature of the other associations is sufficiently indicated by their titles, and we cannot do more than give the names of very few of them. In addition to those mentioned in connexion with the London Chamber of Commerce, there are the Cotton Association, the Drapers' Chamber of Trade, the Fish Trade Association, the Sugar Refiners' Committee, various tea planters' associations, the Oil Seed Association, the Petroleum Defence Com- mittee, the Mansion House Association on Railway and Canal Traffic, &c, &c. Almost every trade has an association of its own, one of the most recently established being the Society of Motor Manufacturers and Traders, 1902. In addition to these, there are in almost every town of importance organizations known as Traders' or Tradesmen's Associations, which look after the interests of the retail trades. A~~

~~number of these associations joined in 1897 to form a central organization called the National Chamber of Trade, which has its headquarters at Hull, and comprises fifty Traders' Associations and some 300 individual members. The National Chamber federates, whenever possible, the various Traders' Asso- ciations in a town in a Chamber of Trade for the town, which is afterwards incorporated in the National Chamber.~~

~~(c) Trade Protection Societies. — These seem to be, on the whole, more ancient bodies than Chambers of Commerce. In the early part of the 19th century they were already strongly organized, especially in the West Riding of Yorkshire. Outside of that district the Dublin Society was the most important. In 1902 they numbered 115 throughout the United Kingdom.~~

~~The Manchester Guardian Society, which dates from 1826, occupies a position of special prominence in the Midlands, and may be taken as the model of such associations. Its objects are — the making of private inquiries as to the respecta- Man- bility and credit of traders ; the detection and exposure QSi% of swindlers ; the collection of debts ; the winding-up society" of insolvent estates ; the issue of notices of bills of sale, judgments, bankruptcies, &c. ; and generally the improvement of laws and regulations affecting trade. The Society charges an ordinary subscription of only 10s. per annum, which entitles members to all privileges, and to be supplied with confidential information as to the standing of firms at the rate of 6d. each for the first fifty inquiries in each year, and Is. each for inquiries above that number. The collection of debts is done without commission and for fees on a moderate scale : for debts under £-20, Is. ; above £20 and not exceeding £50, Is. 6d. ; and above £50, 2s. The Society has over 6000 members, and its usefulness may be gauged by the fact that it answers an average of 40,000 credit inquiries, represents members in over 300 bankruptcies, arrangements with creditors and liquida- tions, and is entrusted with the collection of debts amounting to about £150,000 every year.~~

~~Trade Protection Societies formed themselves, as early as 1848, into an Association, with offices at Nottingham, which was at first an~~

~~Association of Secretaries, but in 1865, when it included seventeen societies, was transformed into an Association Association of Societies. The number of affiliated pC^™fL_ bodies in 1902 was 82, their membership varying from Societies. 6000 in the largest to 25 in the smallest. The Associa- tion issues a quarterly journal called The Trade Protection Journal.~~

~~(d) Non-Representative Organizations. — Apart from representa- tive institutions, certain organizations have grown up which have proved of great value to the commercial community, owing to the means of information which they have placed at its disposal. It is sometimes difficult to draw the line between private businesses and those which, whilst remaining private corporations, perform duties and render services which in other countries are performed and rendered by public bodies.~~

~~The most noteworthy of these is the Commercial Intelligence Bureau, Limited, which was established in 1900 through the efforts of Mr Henry Sell, for the purpose of. rendering Commer- t0 British manufacturers and merchants services simi- cial Intel- jar t0 those which the Philadelphia Commercial Museum llgence wag rendering t0 American commercial men in placing Limited them in relation with likely foreign customers of stand- ing in their own trade. This Bureau is, it is true, in the nature of a private concern, conducted on ordinary business lines, and distributing dividends to its shareholders, but the public importance of the work which it is doing and the efficient state it has reached render it advisable to explain its method, which is still but imperfectly understood by the public. Its work is limited to the compilation and supplying of Index File Cabinets, which place before manufacturers and merchants seeking facilities in export a list of trustworthy foreign buyers in particular lines and vice ■versa supply foreign buyers with lists of British manufacturers. These Cabinets —~~

each of which is devoted to a particular trade or branch of trade, as the case may be — are rilled with cards, arranged alphabetically from the names of the firms inscribed on them, and giving, besides name and address, branches, and London office if any, date of establishment, amount of capital, class of business, and if buyers a detailed and accurate list of the goods bought, and if manufacturers the list of goods manufactured and supplied. Each Cabinet is also provided with an index classification by countries and one by articles bought or sold. The Bureau is not an agency to obtain information as to the standing and credit of firms, but it guarantees that only firms of recognized good standing are allowed to figure in its Cabinets, and the statements on each card are checked by the firm interested before the card is put into circulation. Thirty trades, each with its own subdivisions, are included in the collection of Cabinets. Cabinets are supplied to subscribers and kept up to date for an annual subscription which varies in accordance with the importance of the trade, but generally ranges from £5, 5s. to £10, 10s. In addition to this, the Bureau keeps collections of its Cabinets in public places of resort of merchants abroad, such as Bourses and Exchanges, Chambers of Commerce, British Consulates, &c, where they can easily be con- sulted by foreigners desirous to do business with the United King- dom. This is in imitation of the practice inaugurated by the Philadelphia Commercial Museum. The Bureau has opened a similar establishment in Paris, to do for French trade what it does for British trade.

B. State Departmental Organizations. Although the British Government allowed commercial organizations within its jurisdiction to grow independently of official control, it does not follow that it took no interest in the protection and promotion of British trade and the dissemination of commercial intelligence. As long ago as the reign of Charles II., the body which is now the British equivalent of what is known in most countries as the Ministry of Commerce, viz., the Board of Trade, was established. In addition to this, other Government depart- ments, such as the Foreign and the Colonial Offices, with- in whose purview commercial matters often came, took a fairly active interest in them. The commercial jurisdiction of the Board of Trade does not extend beyond the limits of the United Kingdom, but the

~~Foreign Office, through the negotiation of commercial treaties and by means of the consular body, came into touch with the larger inter- ests of international trade. It was frequently appealed to, both by private firms and by Chambers of Commerce and other associations, to undertake the defence of British trade abroad against injurious action of foreign govern- ments and administrations. With the development of the Colonies, the Colonial and India Offices also found them- selves called upon to act, to a certain extent, as guardians of commercial rights and channels for the dissemination of commercial intelligence. They have now departments specially entrusted with commercial affairs, but it is only within recent years that their commercial work has become~~

~~Consular service.~~

~~systematized, and that efforts have been made to render it really effective in view of the magnitude of the inter- ests involved.~~

~~So long as Great Britain enjoyed unquestioned commer- cial supremacy, things were allowed to go on without se- rious attempts being made to improve the means of official action proportionately with the extension of international trade. But when competition, especially German and American, began to displace British goods fromforeign mar- kets, and when the British trader began to realize that his supremacy was threatened, he noticed the efforts which were being made by foreign governments for the promo- tion of trade, and he came to the conclusion that the British Government was not doing anything for him. This was of course an exaggeration, but it was perhaps necessary that the outcry should be exaggerated in order to impress upon the home Government the necessity of improving its methods with the requirements of the times.~~

~~Complaints were especially loud against the Consuls, who were accused of systematically disregarding commercial interests, whilst their American, German, French, and Belgian colleagues did not consider it below their dignity to take advantage of their position in order to promote the trade of the country they represented. British Consular Reports were also un- favourably compared with those issued by~~

~~foreign consuls, notably the American, and the mode of their publication, which, at one time, consisted in waiting for all the reports to come in in order to publish them in one or two big volumes, was condemned as render- ing the information they contained practically of no value when it reached the public. The result was that, in 1886, when Lord Kose- bery was Secretary of State for Foreign Affairs, he instructed the Under-Secretary of State, JJr Bryce, to carry out, in view of the action of Chambers of Commerce, an extensive inquiry into the question of consular action in international trade, with the object of facilitating the dissemination of commercial intelligence, and of giving British consuls detailed instructions with regard to their duties in commercial matters and to the help to be given by. them to British merchants. In consequence of Mr Bryce's recommenda- tions, instructions were issued to the consular service which, for the completeness and fairness with which they deal with the sub- ject, can hardly be equalled by anything that has been published in foreign countries, and which have frequently been quoted by for- eign representatives in England as models which might advanta- geously be followed (see Parliamentary Paper, Commercial, No. 16, 1886). The preparation of Consular Reports, however, continued to be most unfavourably criticized, and frequent instructions were issued by the Foreign Office in regard to them, notably in. 1888, 1889, 1891, and 1893. In 1895, Lord Kimberley issued a further circular, embodying the recommendations of Chambers of Com- merce with regard to the kind of information to be given in Consular Reports, and the manner in which it should be set forth. The whole question was raised again in 1896, when, as the result of lengthy communications between the Foreign Office on the one hand and the Association of Chambers of Commerce and the Lon- don Chamber on the other, and under the incentive of the action which had just been taken by Mr Chamberlain as Secretary for the Colonies (see below), fresh instructions were sent to British consuls,, reiterating with especial emphasis Lord Rosebery's in- structions of 1880, and urging them to be particularly careful, not only in the preparation of their reports, but in reporting without delay, and even by telegraph, if advisable, matters which might be of interest to the British^ commercial community, and in giving to British traders~~

~~and their agents all the help and information in their power (Parliamentary Paper, Commercial, No. 5, 1897).~~

~~From a perusal of these instructions, it is plain that if the British consular body does not render commercial services equal to those rendered by the representatives of certain other nationalities, the fault does not lie in the instructions furnished to them. If the best of instructions have been ineffectual, the reason is that sufficient care has not always been exercised in the selection of British consuls, and that the following practices, among others, have too often been indulged in, viz., appointments through influence, and without regard to qualifications ; non-insistence upon commercial knowledge of a real and serious nature ; frequent selection of men who have been brought up in circles out of touch or sympathy with commercial aims and commercial men, and who* consider it below their dignity to have anything to do with trade matters ; appointment of foreigners ; too frequent appointment of unpaid trading consuls, who cannot always afford the necessary time or bring the necessary impartiality to the discharge of their functions ; and distribution of appointments without due regard to~~

~~commercial importance of districts, inland manufacturing centres being too often sacrificed to unimportant seaport towns.~~

~~The consular service has of late years been supplemented by the appointment of commercial attaches, who in 1902 were seven in~~

~~number, viz., one in Paris, for France, Belgium, and Com- Switzerland ; one in Berlin, for Germany, Denmark,~~

~~merclal Holland, and Sweden and Norway ; one in Madrid, attaches. for Spain and Portugal ; one in Constantinople, for~~

~~European and Asiatic Turkey and Bulgaria ; one in St Petersburg, for Russia and Siberia ; one in Vienna, for Austria- Hungary, Italy, and Greece ; and one at Shanghai, for China and Japan. No other country, with the exception of Russia, seems to have similar commercial representatives. The posts are of compara- tively recent creation, the first commercial attache having been the late Sir Joseph Crowe, who was appointed to Berlin and Vienna in 1880. The second post, which was to St Petersburg, was created in 1887, and the third one to Paris in 1889. The attaches' duties are to avail themselves of every possible source of information in regard to commercial questions within their jurisdiction ; to prepare an annual report, and, whenever advisable, special reports, on matters of in- terest to trade and industry ; to help consuls with advice ; to pay special attention to all tariff questions and regulations ; to follow the proceedings of legislatures within their jurisdiction, and furnish information as to any bills, or laws, or parliamentary discussions and papers affecting trade matters ; to give assistance to British merchants and to British Chambers of Commerce, and to endeavour to meet their wishes so far as they properly can, " and, although not expected to act as agents or commercial travellers for private firms, or to push their particular business, yet to render them sub- stantial assistance in the pursuance of legitimate enterprise as far as possible " ; to cultivate friendly relations with the heads of the department concerned with industry and commerce, and also with the heads of the great manufacturing or commercial firms within their jurisdiction ; and, in addition, to report upon matters con- nected with mining and industrial concessions, labour and sanitary questions, railways and canals, trade-marks and patents, bounties and subsidies, technical and commercial education, improvements in industrial methods and machinery, the state of agriculture, &c. (Instructions of 1896).~~

~~The pressure exercised by the Chambers of Commerce upon the Government led to the appointment in 1897 of a Departmental~~

~~Committee on the Dissemination of Commercial Intel- Com- ligence, which was composed of representatives of the~~

~~merclal In- Board of Trade, the Foreign, Colonial, and India Offices, telligence an(j tae Treasury, and the presidents of the Associa- tta d 'on ° Chambers of Commerce and of the London and otTralle. Manchester Chambers, and which was charged with~~

~~considering means of more adequately supplying traders with commercial information, of improving consular and colonial reports, and with reporting on the advisability of appointing com- mercial agents to the Colonies and establishing a Commercial Intel- ligence Office. The chief result of the committee's recommenda- tions was the establishment of the Commercial Intelligence branch of the Board of Trade, of which Mr T. Worthington, who had acted as special commissioner to South America, was appointed principal. This branch was entrusted with the centralization of the commercial information received by the various Government departments, and the dissemination of this intelligence. It has the power to send com- mercial missions abroad for the purpose of inquiring and reporting upon trade matters, and can order the preparation of special reports upon particular trades or industries, collects and exhibits samples and patterns whenever advisable, and supplies general information in connexion with foreign customs and shipping duties and regulations, fees, trading licences, &c. It publishes the Board of Trade Journal weekly. Attached to the branch is an Advisory Committee, com- posed of representatives of the various Government departments and of the Association of Chambers of Commerce, who meet in private once a month, andhold office for a period of five years.~~

~~The scope of 'the Commercial Intelligence branch was further increased, and its means of action strengthened, by the transfer of~~

~~the Imperial Institute to the Board of Trade, which '/""fit'f was ef£eoted in 1902 °y tne passing of a private Act of institute. Parliament. The Commercial Intelligence Department and the Colonial and Indian Sections of the Institute, with their complete and efficient organization, are now controlled by the ■ Commercial Intelligence branch of the Board of Trade, but the good work which they did when the Institute was a private cor- poration deserves special mention. They~~

~~endeavoured to develop trade with the Colonies by organizing a valuable and complete system of colonial trade information at a time when no such thing was in existence in London, and by arranging collections of raw materials and produce, which afforded a comprehensive representa- tion of natural wealth, and of its practical value and application to various arts and manufactures. The Research Department, whose duty it was to make experiments with samples of raw products in order to test their capacities and their uses, has also rendered great~~

~~services to British commerce ; as have also the expert referees, who experimented with new orlittle-known materials, and expressed com- petent opinion as to the probable demand for and marketable value of product. The Imperial Institute has two City offices— one in Cannon Street, which was opened for the purpose of affording business men general information, and of providing a proper office for the trans- lation of documents in Eastern or little-known languages ; the other in Eastcheap, for organizing exhibitions of colonial products, and for forming a Museum of Samples of Colonial and Indian Raw Materials, which could conveniently be resorted to by City men.~~

~~Official means of obtaining information in connexion with the Colonies and India are not on so satisfactory a basis as in the case of foreign countries. There are no representatives of the British Government in those parts of the empire Colonial whose duty it is to report upon trade prospects, and to and ,adlao render home manufacturers and merchants the services latel"' which are performed in connexion with foreign trade geace' by commercial attaches and by the consular service. The Colonial Office publishes occasional reports concerning the Colonies, but they can hardly be said to be even as satisfactory as the consular reports, and they are not so freely distributed as the latter. Too often the British commercial community has to go, for commercial informa- tion of any value concerning British Colonies, to the reports issued by American, French, or Belgian consuls.~~

~~The self-governing Colonies are, however, represented in London by Agents-general, whose duties are mainly of a commercial nature, and~~

who are especially entrusted with making the products of the Colonies known in England, look- Agenis- ing after the interests of the Colonies in the matter of geaera ■ shipping arrangements and rates of freight, cable communications and rates, tenders for public works, &c. Their expenses and salaries are fixed and paid by the Government of the Colony they represent. The following Colonies have Agents-general in London, viz., Canada, whose representative is styled High Commissioner ; New South Wales, Victoria, South Australia, Queensland, West Austra- lia, New Zealand, Tasmania, Cape Colony, and Natal. The Canadian provinces of Nova Scotia and New Brunswick have separate Agents-general. Canada has also commercial agents in Liverpool, Cardiff, Glasgow, and Dublin ; in Sydney, Cape Town, Kingston (Jamaica), St John (Antigua),- St Kitts, and Port of Spain ; and in Paris, Antwerp, Christiania, and Buenos Aires. The commercial interests of the Crown Colonies are in the hands of the Crown agents for the Colonies, who, Crown however, are not colonial representatives like the Agents- agents. general, but home Government officials, and whose duties are chiefly connected with the public works of the Colonies, with shipping con- tracts, port and dock regulations, and similar quasi-administrative functions. The India office looks, to a certain extent, after the commercial interests of India, but from both the British and Indian commercial point of view the system in force in 1902 was very inadequate.

When Mr Chamberlain took office for the first time as Colonial Secretary, in 1895, he was so much impressed by the results of the Congress of Chambers of Commerce of the Empire, which had taken place in the previous year, and by the statements there made as to the displacement of British goods from colonial markets, that he entered into communication with the London Chamber of Commerce, which had organized the congress, requesting it to make suggestions for the drafting of a despatch to colonial governors, asking for information as to the extent to which foreign competition displaced British goods from colonial markets, the causes of this displacement, and the means which might be adopted to induce colonial buyers to purchase British-made articles in preference to foreign manufac- tures. The despatch went most minutely into the question, and asked for specific and detailed

~~information with regard to prices and conditions of payment by British and foreign exporters, suit- ability of goods for the market, native preferences, quality, finish, packing, &c. A list of sixty-eight principal articles was appended to the despatch, with a request that particular attention should be paid to them. The governors were at the same time requested to send samples of the foreign-made articles which sold in colonial markets in preference to English-made ones, and to affix to each sample the price at which the article was retailed to the public.~~

~~The samples were sent to the London Chamber of Commerce, where they were exhibited for some time, and were subsequently sent for exhibition to various Chambers of Commerce throughout the United Kingdom. Wide publicity was at the same time given to the replies received from the governors, and leading firms in each trade were requested to send representatives to examine the samples, and to give for publication a report as to what they thought of them, of the price at which they sold, and of the means which British manu- facturers should adopt to oust them from colonial markets. The burden of the reports was typically British. There was a general consensus of opinion that the articles of which samples had been sent were, in the main, so poor that no British firm would lower~~

~~itself to manufacture them, and that if the colonials preferred them to solid and thorough and expensive British-made articles, they were not worth catering for. General surprise was, nevertheless, expressed at the excellence and marvellous cheapness of American ironmongery, and the skilful and artistic way in which foreign goods in general were packed was contrasted with the rough-and- ready manner in which British-made articles were put up.~~

~~These matters led to the conference of Colonial Premiers with the Colonial Secretary at the time of Queen "Victoria's Jubilee in 1897,~~

~~when commercial questions affecting the Colonies and the mother country were under consideration. This first interchange of opinions was followed in 1902 by another similar conference, which took place on the occasion of the visit of the Colonial Premiers for King Edward's coronation.~~

~~II. United States of America.~~

~~A. Commercial Associations.~~

~~American trade organizations have been developed mainly on the lines of the British system. Of the associations which come within the scope of this article, the most important are the Chambers of Commerce, which in certain cases are called Boards of Trade. The- oretically there is a distinction between the two, Cham- bers of Commerce being entrusted with the protection of general commercial interests, especially in connexion with foreign trade, whilst Boards of Trade look after local commercial questions. But in practice the differ- ence is of no importance, as Chambers of Commerce take cognizance of local as well as international trade matters, and the Boards of Trade in no way limit the sphere of their activity to purely American questions.~~

~~The oldest American commercial organization is the New York Chamber of Commerce, which was founded in 1768, and incor- porated by royal charter in 1770. In the words of its The charter, its object was " to carry into execution, en-~~

~~New York courage, and promote by just and lawful ways and Chamber, means such measures as will tend to promote and extend just and lawful commerce." It was the proto- type of all the other Chambers of Commerce and Boards of Trade which have since been established in the United States, and which are said to exceed 1000 in number.~~

~~American trade organizations are associated in a National Board of Trade, which corresponds to the Association of Chambers of Commerce of the United Kingdom. The objects of this institution are to secure unity and harmony of action in reference to commercial questions, and to obtain, through its representative character, more~~

~~satisfactory consideration of the matters which it brings under the notice either of the Federal Government or of the local State ad- ministrations. The expenses of the National Board of Trade are defrayed out of a fund formed by the subscriptions of the various associations belonging to it.~~

~~The Americans have a number of Chambers of Commerce estab- lished in foreign countries. They started the first institution of this kind so long ago as 1801, when the American Chamber American of Commerce in Liverpool was established. This cham- Chambers ber was in 1902 the only one representing American abroad. commercial interests in the United Kingdom, there being no association of this nature in London. The American Chamber of Commerce in Paris is one of the most active, important, and representative foreign associations on the Continent. In some places where neither the American nor the British element is strong enough to maintain separate associations (notably in Brussels), they have joined hand's to support an Anglo-American Chamber of Commerce, which is found to work fairly satisfactorily. The American Commercial Museums, although of recent founda- tion, have attracted much notice owing to the practical and busi- ness-like manner in which they are conducted, and are Com- considered to be among the best equipped institutions~~

~~merclal of this nature. They are two in number, one in Phila- museums. delphia and the other at San Francisco. The Philadel- phia Museum, which came first and is better known, was established by an ordinance of the municipality in 1894, and is sup- ported by subscriptions and by municipal subsidies, administered by a board of trustees, who are appointed for life and serve without remuneration. The work of the museum is supervised by an sfdvisory board, composed of representatives of the principal commercial or- ganizations in the United States. Its objects are to assist American manufacturers and merchants in securing wider foreign markets for their products, to aid them in forming connexions abroad, and to bring foreign buyers in touch with them. One of the chief ways in~~

~~The~~

~~which this is done is by means of an index file of foreign customers supplied to American manufacturers, and vice versa, on the princi- ple which has been put in practice in London by the Commercial Intelligence Bureau, which, by the way, is an offshoot of the Phila- delphia Museum (see p. 394). In addition to the regular service to members, the Museum also maintains abroad, in forty-five different cities, index files covering sixty American trades or trade divisions, containing the names of American manufacturers of standing, with full particulars of their various lines of manufacture. These files are generally entrusted to Chambers of Commerce, or similar commer- cial institutions, and are placed gratuitously at the disposal of foreign manufacturers and merchants. The Philadelphia Museum has also a most valuable library and a museum of samples, which it has en- deavoured to make as complete and representative as possible, and to keep strictly up to date. It seems, however, that the policy of keeping such samples is open to question. At any rate, the use which has been made of the Philadelphia collections has not been such as to warrant the expense and care which they entailed, and latterly this feature, which was at one time the most prominent, has been allowed to drop into the background, as happened also in the case of the Vienna Handelsmuseum. The energies of the institution are now especially directed to the services which it is in a position to render its members in connexion with foreign markets, by finding them desirable houses with which to do business and supplying in- formation to foreign firms desirous of doing business with America. The American Commercial Museums, in addition to the subsidies which they receive from municipalities and from commercial asso- ciations, have also subscribing members, who pay 100 dollars per annum to be entitled to all the services which the museum can render, and 25 dollars if they desire only the index file in their particular line of business.~~

~~B. State Departmental Organization.~~

~~The American state organization for dealing with com- mercial matters lacks the theoretical completeness of the organization of most~~

~~European states, but is nevertheless found to give satisfaction. Official control is exercised through various bureaus placed, for the most part, under the Treasury Department. The most important of these are : the Interstate Commerce Commission, which deals with matters affecting the inland trade; the Industrial Commission, which looks chiefly after manufacturing; and the Fishery Commission. There is no Ministry of Commerce, nor any department centralizing the commer- cial functions fulfilled in England by the Board of Trade and abroad by Ministries of Commerce. Foreign commer- cial matters come within the cognizance of the Bureau of Foreign Commerce, a section of the State Department which also controls the consular body, and sees to the publication of their reports and to the dissemination of foreign commercial intelligence. The State Department corresponds to the British Foreign Office.~~

~~An institution deserving of special mention is the Bureau of Ameri- can Republics, which was established in 1889, as a result of the Pan-American conference called together in that year by the late Mr James G. Blaine, then Secretary of State. This Bureau, which has its office in Washington, is supported by a contribution from all the republics of North, Central, and South America, which is fixed at the rate of 1000 dollars a' year per million inhabitants. Its object is the dissemination of trustworthy commercial information concern- ing the republics of the American continent, and in pursuance of this object it has issued a large variety of publications, handbooks, compilations showing the trade usages, commerce, industry, tariffs, commercial and quasi-commercial laws, &c, of eachrepublic,~~

~~The American consular service has been frequently pointed out as a model to be followed in connexion with commercial matters. America, contrary to the European practice, has no consuls de carriere. Her consular representatives are Consaur appointed for a period of as a rule, four years, and sery ' are selected in preference from commercial circles. Their work, as compared with that of British consuls, is rather limited, and they have nothing to monopolize their time like the shipping interests with which the British consular body is entrusted in most countries. They have, in consequence, more opportunities of~~

~~devoting them- selves to the purely commercial side of their duties, and as most of them are business men, it is naturally towards this side that they first turn. As a body, they have displayed a decided business instinct, which has enabled them to secure the kind of information~~

~~especially wanted by the American commercial world, and their reports have been particularly remarkable for their terseness and for the practical way in which they conveyed information. Since 1898, the Bureau of Foreign Commerce issues consular reports daily, as fast as they are received, and circulates them in advance sheets, printed on one side of the paper only, like printers' proofs. They are afterwards republished in permanent form.~~

~~Th'e American consular body, which numbers about 400 members, and is exclusively composed of American citizens, is distributed according to the commercial importance of towns. Important inland manufacturing districts are not sacrificed to more or less insignificant seaport towns, as is too often the case in the distribu- tion of the British consular body.~~

~~III. France.~~

~~A. Commercial Associations.~~

~~The French Government was the first to elaborate a~~

~~regular system of trade organizations, which it endeavoured~~

~~to make as complete as possible. This system as it exists~~

~~at present comprises : —~~

~~(a) Chambers of Commerce ;~~

~~(b) Consultative Chambers of Arts and Manufactures; and~~

~~(c) Syndical Chambers of Trade and Industry.~~

~~(a) Chambers of Commerce. — Chambers of Commerce owe their origin to the city of Marseilles, where, in 1599, the Town Council, _ . which had hitherto looked after the commercial interests~~

~~g "' of the city, found it no longer possible to combine com-~~

~~mercial with municipal functions, and established an association which it called the " Chamber of Commerce" to take up the com- mercial part of its duties. This seems to be the first time that the title was used. The new Chamber soon became a most important body, and in 1650, during the minority of Louis XIV., lettres patentes were granted to it. It settled the law merchant and the customs of the port, was entrusted with the appointment of consuls and the control of French consulates in the Levant, fitted out expeditions against corsairs, owned fleets, sent embassies to the Barbaresque countries, organized commercial missions, &c. Its ordinary budget, at one time, amounted to over one million livres. Louis XIV. conceived the idea of a system of organizations which, whilst not being allowed to become so dangerously power- ful as that of Marseilles, would nevertheless be useful in other towns, And in 1700 he caused an arrete to be published, order- ing the creation of Chambers of Commerce, which were entrusted with the nomination of deputies to the Royal Council of Commerce which had just been created in Paris. Chambers were consequently established in Lyons, Rouen, Toulouse, Montpellier, Bordeaux, La Rochelle, Lille, Bayonne, Amiens, &c. These bodies, however, did not exercise much influence under the monarchy. Including the Marseilles Chamber, they were suppressed, with all trade gilds and other trade associations, in 1789. Napoleon re- established the Chambers by decree of the 24th December 1802, and endowed them with a constitution similar, in essential par- ticulars, to the one they have at present, which has served as a model for Chambers of Commerce on the Continent, but he sub- mitted them to a uniform and narrow administrative jurisdiction which practically deprived them of all initiative, and rendered them almost useless as representative commercial associations.**

They are now regulated by the law of the 9th April 1898, which codified, altered, and completed previous legislation on the subject. Under this law, Chambers of Commerce can only be established by a decree countersigned by the Minister of Commerce, upon the advice of the Municipal Council of the place where the Chamber is to bs, of the General Council of the department, and of the existing Chambers of Commerce of the district. The members of Chambers of Commerce used to be elected by the "Notables Commercants," who were a body of com- mercial electors selected by the prefects in accordance with the provisions of the Code of Commerce. They were abolished by law in 1871, but those who were then entitled to the designation still continue to use it, which explains the words " Notable Commer- cant," so puzzling to foreigners in French commercial directories and on French business cards. At present, commercial houses pay- ing patente — which is a special tax upon people engaged in trade — elect the members of the Chamber, the number of whom is fixed for each Chamber by the Minister of Commerce. It cannot be less than nine nor more than twenty-one, except in Paris, where it may be thirty-six. Members are elected for six years and retire by thirds every two years, but are re-eligible at all times. They elect, subject to the approval of the Minister of Commerce, their officers, who cannot remain in office more than three years. Attendance at least once every six months is compulsory under penalty of expulsion. It is paid for at all times by a cachet or token, ranging in value from ten francs to twenty francs. There are 142 Chambers of Commerce in France and in the French colonies.

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tlon.

French Chambers are bound to give their services gratuitously, and their income is derived from a special addition to the patente paid yearly by commercial houses. Such other establishments as they may control have separate budgets, and these, as well as the Chambers' budgets, have to be examined and approved every year by the Minister of Commerce.

~~Their functions, which are consultative and administrative, are set out in Part II. of the Law of 1898. The Government is bound to take their opinion regarding the regulation of com- mercial usages, the establishment of public institutions Faact'ons- of a commercial or financial nature, and of tribunals of commerce, the improvement of transport and communications, the applica- tion of laws of a local character, the sale price of prison-made goods and the tariff for prison labour, and local public works, and loans or taxation in connexion therewith. On the other hand, they are allowed to submit observations to the Government, with- out being asked, on proposed changes in the commercial or economic legislation of the country ; on customs tariffs and regulations ; on railway, canal, and river rates ; and on transport regulations. As regards their administrative functions, they may be authorized to establish and administer such institutions as bonded warehouses, public sale-rooms, fire-arm testing establishments, conditioning rooms for wool, silk, textiles, paper, &c, commercial, professional, or technical schools and museums, &c. They may be granted concessions for public works, and may undertake the carrying out of public services, especially in regard to the ports, docks, canals, and navigable rivers in their district, and be authorized to issue loans for the purpose. They have to ascertain the local prices of goods for official quotation, to issue certificates of origin and com- mercial travellers' certificates, and to submit every year to the Minister of Commerce a list of names of experts to form the Board of Experts called upon to decide difficulties arising between the customs authorities and importers of foreign goods.~~

~~Previous to 1898, it was illegal for Chambers of Commerce to hold joint meetings for the discussion of matters of public interest, and they were not even allowed to correspond or consult in any way, except through the medium of the Minister of Commerce. The new law relaxed to a certain extent this prohibition, by authorizing direct correspondence and permitting Chambers in a district to meet for the joint consideration of questions affecting their district, but for no other purpose. Such a thing as an Association of Chambers of Commerce, or a general meeting of Chambers for the consideration of questions such as are raised at the general meetings of the Association of Chambers of~~

~~Commerce of the United Kingdom, has always been and is still illegal in France. Chambers of Commerce which fail to comply with the law, or which make themselves objectionable, may be dissolved by decree on the proposal of the Minister of Commerce.~~

~~When, in 1873, British merchants in Paris started a British Chamber of Commerce in the French capital, the French Govern- ment looked rather askance at the new venture, and M. Leon Say, when Minister of Commerce, even threatened French it with forcible dissolution unless the title ‘ ‘ Chamber of Chambers Commerce ” was dropped. This demand was not ulti- °mer°™~ mately pressed, and the services rendered by the British abroad. Chamber soon opened the eyes of the French Govern- ment to the advantages which they might derive from the formation of similar institutions to represent French commercial interests abroad. In 1883, the Minister of Commerce started the organization of such Chambers, which endeavoured to combine to a certain extent the French and the British systems. These Chambers, of which the French Chamber in London is the oldest and may be taken as the model, belong to the British system in so far as they are formed by the election of members who pay a yearly subscription, and are not limited in number, have no administrative duties, and are not sub- mitted to the restrictions imposed by the French law upon such bodies. They belong to the French system in so far as they receive a subvention from the French Government, as the sanction of the French Minister of Commerce is required for their establishment, and as the Government is represented upon them by the French consul of the locality, who is ex officio honorary president. The amount of the subvention depends upon the importance of each Chamber and the requirements of the locality. A sum of about 100,000 fr. is voted every year in the French budgetfor the purpose. The French Chamber in London gets between 6000 and 7000 fr., and the others in propor- tion. “There were in 1902 thirty-eight such Chambers in existence.~~

~~Foreign commercial interests are represented in Paris by seven foreign Chambers of Commerce, of which the British Chamber is the oldest. The others are the American, ^Zrelgf Austro-Hungarian, Belgian, Italian, Spanish, and o/£™„frs Russian Chambers. In 1896, these~~

Chambers formed mercein themselves into an Association of Foreign Chambers of par/s. Commerce, but the French Government gave it to be understood that, as they did not allow associations of French Chambers, they could not treat foreign bodies more favourably, and the Association had to be dissolved.

(6) Consultative Chambers of Arts and Manufactures. — These institutions, organized somewhat after the model of Chambers of Constitu Commerce, represent manufacturing and industrial Won. " interests. They were established by Napoleon I. in 1803,

and formed part of the complete system of commercial organizations which he intended to give France. They are now regulated by decrees of 1852 and 1863, and are composed of twelve members elected for six years by merchants and manufacturers inscribed upon an electoral list specially drawn up by the prefects. These Chambers, of which in 1902 there were forty eight in existence, are placed under the control of the Minister of Commerce, but instead of being kept out of the patentes, like Chambers of Commerce, they are supported by the municipality of the town where they are situ ated, which has also to provide them with offices rent free, and with clerical assistance. In addition to giving advice in connexion Functions w^t'1 manulact',armS an

to look after and report upon improvements in manu- factures and machinery, new industrial processes, &c. They are especially useful in the preparation of local and international exhibitions. They are also entrusted with the nomination of the Consultative Committee of Arts and Manufactures, a body whose functions are to advise the Ministers of Commerce and Finance, as well as those of the Interior and of Public Works, as regards the regulation of dangerous trades and industries, patents and trade marks legislation, and the interpretation of customs regulations, notably in the classification of goods not specifically mentioned in the tari Ef . This power gives them great importance from

~~*the com- mercial point of view, and brings them into daily contact with importers and foreign merchants.*~~

~~*(c) Syndical Chambers of Trade and 'Industry. — By the side of the official trade organizations, other associations have grown up, which, although regulated by law, are in the nature of voluntary and self-supporting bodies, viz., the Syndical Chambers of Trade and Industry. The repeal in 1884 of the law of 1791, which prohibited the formation of trade or professional associations, was the signal for the formation of those Chambers, which soon acquired great influence. A few Syndical Chambers existed before that date, the oldest, the Chamber of Master Builders, dating back as far as 1809, but they were only tolerated, and their existence, being illegal, was most precarious.*~~

~~*The Syndical Chambers, which are divided into Chambers of Employers and Chambers of Employed, are the official organs and*~~

~~*representatives of the trade and professional syndicates Constitu- authorized by the law of 31st March 1884, which was*~~

~~*the work of M. Waldeck-Rousseau. Each syndicate has its separate Chamber. They may be established without Government authorization, but a copy of their rules and a list of their officials must be sent to the prefect. Membership is strictly limited to persons of French nationality. The only way in which the Government can dissolve them is by application to the courts of justice for an order of dissolution on the ground of infringement of the provisions of the law. In Paris, most of the Syndical Chambers have formed themselves into an association called the Union Nationale du Commerce et de lTndustrie — Alliance des Chambres Syndi- cales, which has built a hall in the Rue de Lancry in which they are all housed, and where one common staff of officials and attend- ants does the clerical and office work of all the Chambers. Another association, intended to take up the defence of the interests and rights of Syndical Chambers, has been formed under the title of Syndicat du Commerce et de 1' Industrie — Syndicat des Chambres Syndicales. The Syndical Chambers are kept up by the subscrip- tions of their members, and have the right to hold real property, as have also the*~~

~~*Associations of Chambers, which are kept up by subscriptions from the constituent Chambers.*~~

~~*According to the law which authorized their formation, the objects of the Syndical Chambers are exclusively "the study and*~~

~~*defence of economic, industrial, commercial, and agri- Punc- cultural interests," and for this purpose they have com-*~~

~~*tions. plete freedom of intercommunication and can hold*~~

~~*congresses. They are authorized to establish for their members mutual benefit societies and pension and relief funds, to open employment agencies, to give legal advice to, and in certain cases to bring actions on behalf of their members, and to organize the settlement of disputes by arbitration. They take part in the election of judges of the Tribunals of Commerce and of the Con- seils de Prud' homines, and may be requested by the courts to make statements as to trade and industrial customs and usages. They are competent to offer advice and address representations to the Government affecting the interests which they represent, and are not compelled, like other non-official associations and private individuals, to use stamped paper for the purpose.*~~

~~*B. State Departmental Organization.*~~

~~*The State commercial departments and offices are chiefly centred round the Ministry of Commerce, to which*~~

~~*of Com- merce.*~~

~~*is assigned the commercial part of the dirties fulfilled in England by the Board of Trade. A Ministry of Com- merce existed for short periods in 1811 and in 1828, but it was ultimately suppressed in 1829, and from that date until 1886, when the department received its present form and separate existence, com- Ministry merce was only represented in the French Government by a subsidiary Bureau attached sometimes to one ministry, sometimes to another. The ministry is divided into three main Bureaus, — the first entrusted with all matters connected with the home*~~

~~*trade and industry, the second with foreign and colonial rela- tions, and the third with the compilation of statistics.*~~

~~*Attached to the Ministry of Commerce is a body called the Conseil Superieur du Commerce et de l'Industrie, which acts as an advisory council to the minister. Its origin goes back to the Council of Commerce established by Louis XIV., but it is now regulated by a decree of 1882. It is divided into two sections, a commercial and an in- dustrial one, each composed of twenty-four members, who are nominated by the President ,of the Republic on the proposal of the Minister of Commerce. The members are selected from among senators, deputies, presidents of Chambers of Commerce and of Syndical Chambers, and men of recognized standing in the financial, industrial, and commercial worlds. The council only meets when summoned by the minister.*~~

~~*The Office National du Commerce Exterieur was estab- lished by a law of the 4th March 1898, and is carried on jointly by the Ministry of Commerce and the Chamber of Commerce of Paris, the latter office tor having provided it with an installation at a cost foreign of over 1,200,000 francs. The Office, which has trade- been founded for the promotion of French trade with foreign countries and the dissemination of commercial in- telligence, fulfils duties similar to those of the Commercial Intelligence Branch of the Board of Trade (p. 395). It also publishes the weekly Moniteur Officiel du Commerce. An ingenious system .has been devised to secure for the Office the active co-operation of prominent French mer- chants residing abroad, by the creation of the title and functions of Councillor of Foreign Trade, which are con- ferred for a period of five years, by decree of the President of the Republic, upon a select number of such merchants, in return for their acting as information agents for the Office, and supplying regular reports upon the trade of the country in which they reside. The Office is governed by a council appointed partly by the Minister of Commerce and partly by the Chamber of Commerce of Paris, and its director and employes rank as civil servants.*~~

~~*The Office Colonial, whose duties are especially to furnish information concerning the French Colonies, to promote emigration thither, and to*~~

foster a demand in France for the produce of her ?£!", Colonies, was established by a decree of the 14th March 1899. It is entrusted, in addition, with a permanent exhibition of colonial produce and a museum of samples of goods supplied by or required in the Colonies. The Office is also in charge of a colonial garden at Vin- cennes, where experiments are made for the acclimatization of colonial plants and produce in France, and the cultiva- tion of French produce in the Colonies. The Office publishes a monthly bulletin of miscellaneous colonial information, and issues yearly commercial and other reports dealing with the Colonies. It is a dependency of the Ministry of the Colonies.

French consuls are instructed to transmit to their Government all information which they may consider useful for the prosperity of French trade and the development of French commercial influence abroad. It is also their duty to spread, in the country where

they reside, a knowledge of such French commercial and financial matters as they may consider most useful in the interests of their own country. The close relations which they are recommended to cultivate with the French commercial community within their jurisdiction through the local French Chamber of Commerce and the Councillors of Foreign Trade are intended to enable them to keep in better touch with commercial questions. They have had, however, to be frequently reminded of their commercial duties, and the French Chambers of Commerce have criticized them almost as much as the British Chambers have British consuls. The most important instructions issued to consuls were contained in circulars from the Minister for Foreign Affairs dated 15th March and 24th April 1883. French consuls have to make a return to their Government every fort- night — every month if the district is not of great commer- cial importance — showing, upon forms specially provided, the nature, quantity, origin, or destination, prices whole- sale and retail, and chief trademarks of the goods imported into and exported

~~*from the district, the results of public sales of produce, the conditions of transport, contemplated public works and tenders advertised, state of the labour market, artistic enterprises, commercial failures and rumours concerning important local firms, effect of foreign competition, imitation of French trade marks, &c. These returns are mostly of a confidential nature, and are not intended for publication, but whenever the minister con- siders it advisable he causes information to be conveyed through the Chambers of Commerce, or other channels, to the parties chiefly interested. The ordinary Consular Keports are published in weekly instalments in the Moniteur Offlciel du Commerce, which also contains selec- tions from foreign consular reports and the reports of commercial students sent abroad by the high schools of commerce with travelling scholarships.*~~

~~*IV. Germany. A. Commercial Associations. German trade organizations are of three kinds, viz.: — (a) Official organizations established by law, and called Handelskammern, or Chambers of Commerce ; (&) Semi-official associations; and (c) Voluntary or " Free " associations.*~~

~~*(a) Chambers of Commerce. — Contrary to the idea prevalent in England, official trade organizations in Germany are in a somewhat chaotic state. They have been established under more or less different conditions and systems in each State of the empire, and in certain districts still bear the imprint of foreign origin. They are under the control of the local State governments and lack the homogeneity and unity of direction of the French official system.*~~

~~*Before proceeding to a general examination of the German regime, special mention must be made of the Chambers of Com- merce of the old Hanseatic Confederacy which stand Hanseattc apart, and whose duties, as well as constitution, differ organlza- from those of trade organizations in the rest of Ger- tloas. many. The Chambers of Commerce in Hamburg,*~~

~~*Bremen, and Liibeck are not only the successors of, but (contrary to what happened in Germany as well as in other countries) have been evolved out of the old corporations which looked after the interests of the Hans traders in the olden days, and which, in the case of the Hamburg "Commerz-Deputation," for instance, dated as far back as 1665.*~~

~~*The Hamburg Chamber of Commerce, whose present constitution dates from 1860, is composed of twenty-four members elected for six years by the ancient " Versammlung eines ehrbaren Kaufmannes," that is to say, the merchants and commercial men whose names appear on the register of the " Honest Merchants " of the city. Its income is chiefly derived from special taxation, to which are added the proceeds of the sale of contract and transfer stamps, and also the amount paid every year for the re-registration of each " Honest Merchant." This latter source of income amounts to about 70,000 marks per annum. The Chamber has to submit its accounts for approval to the Senate of the Republic.*~~

~~*In addition to the general duties of Chambers of Commerce in connexion with trade matters, the Hamburg Chamber — the same*~~

~~*may also be said of the other Hanseatic Chambers — fumls the combined functions of a Chamber of Shipping and of a Port and Docks Board. It appoints inspectors of shipping, of sailors, of rigging and machinery, and controls the administration of the sailors' fund. It has the right of proposing judges and of nominat- ing experts attached to the courts. The exchanges and public sale rooms of the city are under its control, and it publishes the official quotations, as well as a weekly price list of goods and pro- duce at the port of Hamburg. It is entitled to elect members to the "Biirgerschaft," or Lower House of Representatives, who are especially competent to deal with trade and shipping questions, customs duties, and emigration. The Chamber must be consulted by the " Biirgerschaft " with reference to all proposals affecting trade and navigation.*~~

~~*In Bremen, the Chamber is composed of twenty-four members elected by the " Ausschuss des Kaufmanns-Konvents," which com- prises all the important commercial houses of the city. Two members go out every year, and no one can remain a member for more than eighteen years. The Bremen Chamber is intimately con- nected with the Senate of the Republic, a standing committee of both being in existence to settle questions affecting trade and navi- gation. In addition to the usual sources of income, the Bremen Chamber receives a subvention of 3500 marks from the town, and the salaries of its officials are fixed by law.*~~

~~*The Liibeck Chamber is composed of twenty members elected for six years by the associations representing the wholesale and retail trades. The president must be approved by the Senate, and is sworn in as a State official. IIe holds office for two years, and is not paid for his services, but when he goes out of office is pre- sented with a sum of money subscribed by the townspeople. The Liibeck Chamber is probably the wealthiest organization of its kind in Germany, and is entrusted with the administration of the pro- perty of the old corporation of the " Vorstand der Kaufsmann- schaft," which is very important. The Senate must consult it not only in trade and navigation matters, but also with reference to all contracts entered into on behalf of the State.*~~

~~*Chambers of Commerce in other parts of the German empire are not so important, nor are their duties so varied, as in the Hanseatic towns. The oldest ones were established by Napoleon in 1802 in Cologne, Crefeld, Aachen, Stolberg, and other Chambers towns which were then under the control of France, and of Co/n- il icy were submitted to the legislation which regulated merce. the Chambers organized in France at the same time. The model set up by the French was more or less closely followed in the subsequent establishment of institutions of this nature in other German States. There were in 1902 eighty-eight Chambers of Commerce throughout the empire, the latest one established being, curiously enough, the Berlin Chamber, which was con- stituted on the 1st April 1902. A trade corporation called the " Aelteste der Kaufmannschaft " previously fulfilled, to a certain extent, the duties of a Chamber of Commerce. The new Chamber rests on a broader basis than the old corporation, which, however, remains intact, though the sphere of its action has been restricted.*~~

~~*A detailed account of the system in force in every State of the German empire is hardly required here, and would not in any case present much interest, as the differences are mainly on points of detail. Broadly speaking, the German Chambers are elected by the registered tradespeople and merchants. In some States, e.g., Bavaria, all the people on the Commercial Register have the right to vote ; in others, e.g., Baden, this right is limited to people living in the district, and paying a certain amount of taxes. The period for which members1 are elected is not*~~

~~*uniform, but generally averages six years, one-half of the members going out every three years. Re-election is generally allowed. In Bavaria, there is a curious proviso that a person elected member of the Chamber of Commerce cannot refuse to serve, but can decline to be re-elected. Throughout the whole of Germany, Chambers are under the strict supervision of the State Minister of Commerce, and cannot be established ex- cept with his permission. He fixes the number of members as well as the amount of the State allocation to the Chamber. In Prussia and Bavaria, the Government is entitled to dissolve Chambers whenever it considers it advisable to do so, and there is always a Government commissioner in attendance at all meetings. In most cases, the local Government allows a fixed sum for the expenses of Chambers of Commerce, and if this amount is exceeded the electors who are on the Commercial Register have to make good the excess by the striking of a special rate. In some States, e.g., Brunswick, Wurtemberg, and Baden, the electors cannot be called upon to pay for deficiencies more than an amount fixed by law. In Bavaria, Chambers get a subvention from the district and central funds.*~~

~~*The duties and powers of the German Chambers are practically the same as those of the French Chambers, viz., to look after the interests of trade and industry in their respective districts, to administer stock and other exchanges, bourses, public sale rooms and warehouses, and commercial institutes, manage public*~~

~~*institutions founded for the promotion of commercial interests or commercial education, define and state rules and customs of trade, &c. In Prussia, they are, moreover, called upon to look after "the moral protection of clerks and apprentices."*~~

~~*The Prussian law of the 24th February 1870, amended by that of the 19th August 1897, regulates Chambers of Commerce and similar associations in Prussia. A Bill for the amendment of the law on the subject has been for some time under the consideration of the Reichstag, as the present*~~

~~system is very strongly criticized, and is in many quarters not considered satisfactory in view of modern trade requirements. The object of the promoters is to transform the Chambers into institutions of an imperial instead of a local character, and to enable them to be utilized more efficiently in promoting the general commercial interests of the empire.~~

~~The German Government did not, like the French, interfere with the liberty of association of Chambers of Commerce, and as a result German Chambers have united, together with other trade corpora- tions, in an association called the "Deutsche Handelstag," which was founded in 1861, and has been carried on in its present form since 1886.~~

~~The German Government is understood to be opposed to the formation of German Chambers of Commerce abroad, and as a matter of fact there are no German Chambers in Europe Chambers outside o£ Germany. The writer is informed that a abroad and *ew nave Deen established in South America, but that foreign tney are Purely voluntary associations. No foreign Chambers Chambers of Commerce are known to exist in Germany. In Steps were taken about 1898-1900 to bring about the~~

~~Germany, creation of a British Chamber in Berlin, but they do not seem to have been successful.~~

~~(6) Quasi-Official Corporations. — Besides the Chambers of Com- merce, there exist, chiefly in Prussia, various old-established and quasi-official corporations, whose views receive as careful consider- ation from the Government as do those of Chambers of Commerce. The Berliner Aelteste der Kaufmannschaft, previously mentioned, is one of the most important of these corporations, but the Gewerbekammer of Memel, the Kaufmannischen Verein of Breslau, the Vorsteher Amt der Kaufmannschaft of Koenigsberg, also de- serve mention. Others exist in Elbing, Stettin, Danzig, Tilsit, and Magdeburg. They originated for the most part in ancient guilds or associations of commercial firms, and were organized in their present form between 1820 and 1825.~~

~~(c) Voluntary Associations. — Germany possesses also a large number of influential commercial associations of a voluntary character called the " Freie Vereine," which, especially in recent years, have greatly contributed~~

~~*to the commercial development of the Empire. One of the most important of these Freie Vereine is that of Diisseldorf. Similar ones also exist in Cologne, Kiel, Essen, Frankfort, &c. Some cover trade and industry in general, while others are limited to particular trades. They are all supported by the contributions of their members, and although they have no official standing, they are frequently consulted by both the imperial and local authorities.*~~

~~*B. State Departmental Organization.*~~

~~*The German empire has no Ministry of Commerce. As in the United States, commercial matters form only a department of the Ministry of State. Most of the States of the empire have, however, their own Ministries of Commerce, the oldest being the Prussian Ministry of Commerce and Industry, which dates from 1848.*~~

~~*In Prussia, the Minister of Commerce is advised by the Volks-wirthschaftsrath, or Council of National Economy, an official body Prussian constituted in 1880 °y tne Emperor William I. The Council of funoti°ns of this council, which assembles periodi- Naiional callv un*~~

~~*Within recent years, the German Government has taken steps to facilitate the dissemination of commercial intelligence, by the establishment of Commercial Museums, which are Com- variously called "Handelsmuseen," " Ausf uhrmuster-*~~

~~*mercial lager," or " Exportmusterlager." The first of these, Museums, which are on the model of the Vienna Handelsmuseum, was opened in Berlin in 1883. Others followed in Munich, Karlsruhe, and Frankfort in 1884-85, in Cologne and*~~

~~*Dresden in 1886-88, and later in Leipzig, Weimar, &c. They perform, to a certain extent, much the same functions as those per- formed in England by the Commercial Intelligence Branch of the Board of Trade, and the commercial and colonial departments of the Imperial Institute. They are centres of commercial information, and give advice to German manufacturers and merchants in their dealings with foreign countries. They keep samples of foreign manu- factures which are competing*~~

successfully with German articles, as well as samples of goods suitable for export to certain countries. They examine and advise as to samples of raw materials and colonial produce, and endeavour to guide the German exporter in the direc- tion in which his efforts are most likely to produce satisfactory results. The museums are free public institutions.

A perusal of the instructions given to German consuls with regard to commercial matters shows that the German consular body is in this respect very much in the same position as the British consular body. If German consuls as a Consular whole have been especially active and successful in serv'ce- promoting German commercial interests, it is not on account of the nature of the instructions received from their Government, these instructions being to all intents and purposes similar to those issued to British consuls, but because particular care was taken to select consuls from a class of men imbued with the desire of increasing the greatness of their country by the promotion of German trade. Their action was prompted by their own personal feelings and business instincts and experience, and if it has been successful whilst remaining within the recognized bounds of consular work, it is because it was guided by an enlightened desire to place the general interests of the German empire before questions of personal convenience, or before the decorum of official inertia. The German consular body were not selected from a class of men trained from their early youth to look upon trade as below them, and to regard anything and anybody that " smells trade " as unworthy of their attention.

Of distinctly commercial attaches, like those of Great Britain and Russia, Germany has none ; but in addition to the consular body, she is represented in foreign countries by five attaches or experts, whose duties are to study the movements of ,7" agricultural produce, and interest themselves in agri- ^L."Ca- cultural matters generally. They cover Great Britain c es"

France, Russia, the Danube district, and the United States.

V. Belgium. A. Commercial Associations.

~~*The important place which Belgium has taken in international trade has directed much attention to her commercial organization, which comes nearer to the British model than that of any other European country. Belgian Chambers of Commerce were on the French system until 1875, when all official ties between them and the Government were broken, and full liberty was given to Com- mercial Associations to establish and govern themselves in then- own way. The Belgian Chambers have now no administrative functions of any kind, but the Belgian Government never fails to consult them in matters likely to interest the commercial com- munity. The most important Chambers are those of Antwerp, Brussels, Ghent, Liege, Charleroi, Verviers, and Namur. Mention should also be made of the Federations of Industrial and Com- mercial Associations at Antwerp and at Brussels, and of the Syndical Union of Brussels. In some places there are Liberal and Conservative Chambers of Commerce.*~~

~~*In addition to institutions representative of the general interests of commerce and industry, the principal trades have also in the larger cities separate associations or syndicates. The coal and iron trades are particularly strong in such associations, which are mostly located in Charleroi, Liege, and Namur. There are also a large number of associations for the promotion of colonial trade, which have grown up since the establishment of the Congo Free State. A number of Belgian Chambers of Commerce also exist abroad, the first of which was established in New York in 1867. Others have since come into existence, notably in London and Paris.*~~

~~*B. State Departmental Organization.*~~

~~*The Belgian Ministry of Commerce, under whose control com- mercial matters are placed, dates only from 1895, previous to which time the Department of Commerce at the Ministry for Foreign Affairs fulfilled the same functions. The Ministry has established in Brussels a Commercial Museum, similar to those of Germany and Austria, to centralize commercial intelligence and facilitate its dissemination. The Minister for Foreign Affairs, before appointing consuls requests the advice of the most important Chambers of Commerce and trade associations, and submits for their considera- tion lists of candidates upon the relative merits of*~~

~~*whom they are invited to express an opinion. The result is that the consular body is- a remarkably capable one, and that, proportionately, it probably contains a smaller number of useless members than the consular body of any other nation. Attention to commercial duties is especially insisted upon, and in taking their oath of office Belgian*~~

~~*consuls promise that they will contribute, by every means in their power, to forward the interests of Belgian commerce and navigation. Explicit instructions are given to them not only to keep them selves well informed as to the commercial conditions of the country to which they are accredited, and to transmit this information for the use of the home trade, but also to give the greatest possible assistance towards securing an increase of the nation's export*~~

~~*trade.*~~

~~*VI. Other Countries.*~~

~~*Austria- Hungary. — The control exercised by the Government over commercial organizations in Austria and in Hungary is very close. The only institutions of this kind of any importance within the dual monarchy are the Chambers of Commerce, of which there are twenty-nine. They are official bodies, regulated by the law of the 29th June 1868, which is, as regards the functions of Chambers, almost similar to the French law. But the Austrian Chambers, in certain cases, have the right to elect members of Parliament, which right depends upon taxation. A ministerial representa- tive is entitled to attend all meetings, and to take part in dis- cussions, but not to vote. The Minister of Commerce may dissolve a Chamber if it does not confine its activity within the prescribed limits, but a Chamber so dissolved must be reconstituted within three months. Chambers of Commerce are entrusted with the registration of trade marks and industrial designs. Within the Trieste district, one-third of the members of Chambers of Com- merce may be foreigners.*~~

~~*Austria and Hungary have each a Ministry of Commerce, the former since 1853 and the latter since 1867, whose jurisdiction is strictly confined to internal trade matters in each country. When- ever important questions arise affecting common interests, the Gemeinsame Zoll-Conferenz, or Common Customs Conference, is summoned. This Conference is made up of representatives of the various ministries of both countries. Matters arising out of com- mercial relations with foreign countries are under the control of the Commercial Department of the Imperial Foreign Office.*~~

~~*The Vienna Commercial Museum was the prototype of similar institutions. It was established in 1875, as a consequence of the Vienna International Exhibition of 1873, and was followed shortly afterwards by the establishment of a similar one in Budapest. These museums are under the control of the respective Ministers of Commerce, and their object is to bring together producers and consumers, and to disseminate information in connexion with foreign markets. Special attention was, for some time, paid to collections of samples, but, as in the case of the Philadelphia Museum, this feature has not been found satisfactory.*~~

~~*Italy. — The Chambers of Commerce and Arts, which are regu- lated by the law of 1862, are official bodies. They are instituted, and may be dissolved by royal decree, and their functions are almost similar to those performed by the French Chambers. They are, however, at liberty to unite for the consideration of commercial and industrial questions of common interest, and are entitled to own property and to levy taxes for their maintenance. Contrary to the practice of other nations which have official Chambers of Commerce, the membership of Italian Chambers is not limited to subjects of the country. One-third of the elected members may be foreigners. The Italian Chambers are seventy-two in number. In addition to the Chambers of Commerce, there are in most towns of importance Chambers of Trade, which are local institutions.*~~

~~*An Advisory Council is attached to the Ministry of Commerce, which dates from 1878. This Council is called upon to give an opinion with reference to all matters connected with trade and industry. It is composed of eighteen members appointed by the king, of the representatives of*~~

~~*eighteen Chambers of Commerce, of those of six other commercial corporations and of two working- men's associations, and of six ex-officio members belonging to vari- ous State Departments. There are also two commercial museums, one in Rome and one in Milan, the duties of which are similar to those performed by such associations in other European countries. Their expenses are paid by the Italian Government, under whose control they now are.*~~

~~*Spain. — Spanish Chambers of Commerce were organized by a royal decree of 1886, which places them under the control of the Ministro de Fomento. They are self-supporting bodies with un- limited membership, but have also an official standing. In order to belong to them one must be of Spanish nationality, be engaged in trade, have paid direct taxes to the State for at least five years for the business in connexion with which membership of the Cham- ber is sought, and pay annually the amount of the subscription provided by the regulations. The Government must consult Cham- bers of Commerce upon treaties of commerce and navigation, tariff changes, the creation of commercial exchanges and the organization of commercial education. The Spanish Chambers have played a prominent rdle during the last few years in con- nexion with the reform of the financial policy of the country and of taxation. The Madrid Chamber, especially, has taken a very*~~

~~*pronounced line of action in these matters, which has not always been in accordance with the views of the Government. It must not be forgotten, however, that owing to the peculiarity of their constitution, the Spanish Chambers are much more representative of the feelings of the commercial community, and much less under the strict control of the Government, than similar institutions in other Continental countries. Spain has no Ministry of Commerce proper, the duties of this office being performed by the commer- cial sub-department of the Ministro de Fomento, which dates from*~~

~~*1847.*~~

~~*Portugal. — In Portugal, the organizations corresponding to Chambers of Commerce, which are called " Commercial Associa- tions," are voluntary associations kept up by the subscriptions of their members.*~~

~~They have no official character, but cannot be established except by a royal decree approving their statutes, which approval can be withdrawn if they in any way depart from their object, or fail to send in annually their report to the Minister of Commerce, or to submit their accounts to him. These institutions, which are the only commercial associations of any kind in Portugal, are fifteen in number, including those in the adjacent islands and in the Colonies. The associations at Lisbon and Oporto are the only ones of importance.~~

~~The Portuguese Ministry of Commerce, which dates from 1852, is placed in contact with popular opinion on commercial and economic questions, by an institution called " The High Council of Commerce and Industry," which is composed of six members selected by the Government from persons whom it considers to be most competent to advise on matters connected with commerce and industry, three for each subject. The Minister of Commerce and two officials of his department are ex-officio members. The Govern- ment must consult this council with reference to customs and tariffs, railway rates, exhibitions, subsidies, banking, trade marks and patents, and labour in factories.~~

~~Russia. — Attached to the Department of Trade and Manufactures of the Ministry of Finance, which in Russia does duty for the Ministry of Commerce, there is an Official Council of Trade and Manufacturers which sits in St Petersburg, and is presided over by a representative of the ministry. It consists of . six honorary members, six ex-officio members, and twenty-four ordinary mem- bers, of whom fifteen are Russian officials and nine merchants of the first class or gild. The latter are almost all foreigners. Half the Council retire every two years, and the remaining half co-opt members to replace them. Nominations must be approved by the Minister of Finance and sanctioned by the Emperor. A similar Council of twenty-four members is also in existence at Moscow. In addition to these there are six local bodies, called the " Local Committees of Trade and Manufactures," entrusted with the care of commercial interests in Archangel, Odessa, Rostov-on-the-Don, Tver, Tikhvin, and Ivanovo-Voznesensk. At Warsaw, there is a "Committee of Manufactures" consisting of six members chosen by the Government from among the notables of the city and presided over by the Governor. The other "local~~

~~*committees" are elected as follows: the first and the second Gilds of Merchants elect by ballot a council of seventy members, and this council elects the twelve members who are to form the committee. All the committees are purely consultative bodies, but their opinion carries considerable weight, and although the Minister of Finance is perfectly free to reject it, he does not do so without good reasons. As will be gathered from the above, there is a difference between the St Petersburg and Moscow councils and the Warsaw committee on the one hand, and the local committees on the other. The former are official bodies, though merchants are represented on them, whilst the latter are almost Chambers of Commerce elected by the merchants among themselves.*~~

~~*Closer, however, to what we know as Chambers of Commerce are the institutions called ' ' Exchange Committees. ' ' They are eighteen in number, one in each of the most important cities of the empire, and their importance has greatly increased of late years. They are voluntary associations, chosen by a council elected for the purpose by the commercial community, after the principle already explained in connexion with the Local Committees of Trade and Manufactures. They generally consist of twelve members elected for five years, and the president is appointed by the Minister of Finance. Foreigners are eligible. The Committee meets once a week at the local exchange, hence its name. The opinion of the Exchange Committees is frequently taken not only by the Minister of Finance, but also by other ministers, and they have always the right to petition the Minister of Finance if they wish to draw his attention to any matter. The Minister of Finance receives the president of the St Petersburg Exchange Committee in consultation every Saturday. Two im- portant commercial societies, although unofficial, are recognized and frequently consulted by the Government, viz., the Society for the Encouragement of Russian Trade and Industry, of St Petersburg, and the Society for the Encouragement of Navigation, of Moscow.*~~

~~*The Russian Government is represented abroad by commercial*~~

~~attaches, who are known as "agents of the Russian Ministry of Finance." The duties of these attaches, who are to be found in all the important capitals, are almost similar to those of the British commercial attaches, but they are entrusted with the promotion of Russian financial as well as commercial interests in the countries where they reside. There is also a Russian Chamber of Commerce in Paris.~~

~~Japan. — Commercial matters in Japan come within the cogni- zance of the Minister of State for Agriculture and Commerce. The chief commercial associations are the Chambers of Commerce, which are under the direct control of the Minister. Since the law of the 24th May 1902 they may be described as official bodies, with a constitution somewhat resembling that of the Trench Chambers. This law, which came into force on the 1st July 1902, provides that a Chamber shall consist of not more than fifty members, who must he Japanese subjects, elected by the commercial taxpayers of the town or district in which it is situated. Only Japanese commercial men, or companies and partnerships in which more than one-half of the directors or partners are Japanese, shall be entitled to vote. Permission to promote the establishment of a Chamber in a given district must be obtained from the Minister before any steps are taken, and the Chamber comes into existence only when the Minister has approved the steps taken by the promoters, and the proposed articles of association and bye-laws. The Minister has power to cancel anything done by a Chamber which seems to him detrimental to public interests, to dismiss officers or members, and, if he thinks fit, to dissolve the Chamber. The expenditure of Chambers of Commerce is met by a special rate, which is paid by those entitled to vote for the election of members, and is fixed by the minister or his representative, according to the requirements of each district. In addition to the usual consulta- tive work of Chambers of Commerce, the Japanese Chambers may be authorized to build and manage commercial or industrial — estab- lishments. They also recommend judges and experts in commercial and industrial matters, and may be ordered by the Government to investigate commercial and industrial affairs. Chambers of Com- merce which were in existence before the passing of the above law were given until 31st March 1903 to~~

~~*dissolve or reconstruct them- selves in accordance with the new law. Since the exclusion of foreigners from the membership of Chambers of Commerce, foreign merchants resident in Japan have taken steps to establish foreign Chambers of Commerce, the chief of which are in Tokyo and in Yokohama.*~~

~~*Authorities. — Correspondence respecting Diplomatic and Con- sular Assistance to British Trade Abroad. Parliamentary Papers, No. 16, 1886, and No. 5, 1897.— Report of the Departmental Com- mittee on the Dissemination of Commercial Intelligence. 2 vols. (C. 8962 and 8963). 1898.— Reports on the Constitution and Functions of Ministries of Commerce and Analogous Branches of Foreign Administrations. Parliamentary Paper, No. 12, 1889. — Reports, Rules, Bye-laws, and Articles of Association of the Association of Chambers of Commerce ; of the London, Liverpool. Manchester, and Paris British Chambers of Commerce ; of the Association of Trade Protection Societies and of the Manchester Guardian Society ; of the Imperial Institute, British Empire League, and Commercial Intelligence Bureau ; Charters and Bye-laws of the Glasgow Chamber of Commerce, &c. — E. Helm. Chapters in the History of the Manchester Chamber of Commerce. 1902. — H. B. Adams. Monographs on American Social Economics. New York, 1900. — W. H. Schoff. American Commercial Institutions. New York, 1900. Foreign Trade Policies. American Consular Report, No. 307, 24th December 1898. — Tlie Bureau of American Republics Annual Beport. Washington, 1900. — W. Harper. The Pan- American Conference. New York, 1894. — Yves Guyot and Arthur Raffalovich. Dictionnaire du Commerce, de V Industrie et de la Banque. Paris, 1901. — Maurice Block. Dictionnaire de V ad- ministration Fran^aise. Paris, 1894.— Almanack National. 1901. — Handworterbuch der Staatswissenschaften. Leipzig, 1900-02. — Sandbuch uber den k'oniglich-preussischen Hofund Staat. Berlin, 1794-1868. — B. W. von Konig. Handbuch des deutschen Konsular- wesens. Berlin, 1875 ; Das K. K. Oesterreichische Handels-Museum, 1875-1900. Wien, 1902. — Information has also kindly been supplied by the Principal of the Commercial Intelligence Branch of the Board of Trade ; H.M. Consuls-General in Berlin and Vienna ; the Directors of the Office National du Commerce Exterieur, Paris ; and of the Commercial Museums of Philadelphia and Vienna ; the High Commissioner for*~~

~~*Canada and the Colonial Agents-General ; the Belgian Consul-General in London ; the Secretaries of the Belgian, Italian, and Austro-Hungarian Chambers of Commerce in London; of the American Chamber inLiverpool ; of the British and American Chambers in Paris ; of the Yokohama (Japanese) Chamber of Commerce ; of the London, Liverpool, Manchester, Newcastle, and Glasgow Chambers, and of the Association of Chambers of Commerce ; of the Manchester Guardian Society, and of the Association of Trade Protection Societies; of the Chamber of Shipping ; of the Imperial Institute, &c. (j, q. C.)*~~

~~*TRADE UNIONS.*~~

~~*I. The United Kingdom.*~~

~~*THE present article is supplementary to the article Trade Unions, on pp. 499-502 of vol. xxiii. of the ninth edition of this work, in conjunction with which it should be read, and to which reference should be made for a definition and general description of trade unions, and for an account of their legal position in Great Britain, and of the course of legislation concerning them. In the present, as in the former, article the term " trade union " is used mainly in its popular signification as an organization of workmen, for the purpose of improving the conditions of their employment, although legally the term is applicable also to associations of employers and to joint associations of employers and workmen.*~~

~~*So far as statute law is concerned, there has been no material change in the position of trade unions since the passage of the Trade Union Act of 1876, and for this part of the subject, therefore, the article in vol. xxiii. gives all the necessary information. The statement, however, at the end of the first paragraph, in small print (p. 500), with regard to registration, needs some qualification. The legal position of a registered trade union differs materially from that of a friendly or industrial and pro- vident society. Thus, there is no legally enforceable contract between a trade union and its members binding it to pay the stipulated benefits and to carry out the rules, since no trade union can sue its members for contribu- tions, or be sued by them for benefits ; the right of a regis- tered trade union to invest funds with the National Debt*~~

~~*Commissioners is limited, and in certain other matters it does not enjoy the same privileges as a friendly society.*~~

~~*Since the legislation of 1876 there have been import- ant decisions in the courts of law with reference to the provisions of the Conspiracy and Protection of Property Act, 1875, and the rights of trade combinations, for which see Strikes and Lock-Outs, supra, p. 19.*~~

~~*Important questions have also arisen as to the liability of individual officials of trade unions to civil actions for damages on account of recommendations they may have given to their members. The question has of course only been doubtful in case the action recom- mended is in itself lawful, but incidentally causes or is intended to cause the violation of some actionable private right. In the leading case on this point (Allen v. Flood) the delegate of the Boilermakers' Union in- formed an employer that the members of his society would give notice to leave work unless he ceased to employ two shipwrights who had given offence by working for a former employer on iron work. The employer therefore discharged the shipwrights, who brought an action against the" boilermakers' delegate. The case was carried up to the HOuse of Lords, whose final decision (14th December 1897) was in favour of the delegate, on the ground that his acts were in themselves lawful, and the action which they were intended to induce the employer to take was also lawful, and that such lawful acts would not con- stitute an actionable wrong to third parties who might incidentally be injured thereby.*~~

~~*But besides the liability ,of individual officials, it has*~~

~~*been decided in the HOuse of Lords, in the case of the Toff Vale Railway Co. v. The Amalgamated Society of Railway Servants (1901, A.C. 426), that persons acting in concert, whether combined together in a trade union or collected and united under any other form of association, were*~~

~~*as liable to be sued in respect of any damage occasioned to any other person through their act or default as any individual • person might be liable. Con- sequently, the agents of a trade union who, in furtherance of a strike sanctioned and directed by its authorized officers, committed wrongful acts were held to have rendered responsible the principals who caused them to be committed ; and it was further held that the trade union could be sued in its registered name, and would be liable for damages out of its common fund. Opinions were also expressed in the House of Lords that, whether registered or not, a trade union could be sued by its proper officers on behalf of themselves and the other members of the society, and that the judgment could be enforced against all funds forming the common fund of the society by adding the trustees if necessary.*~~

~~*Trade unions, in the sense in which the term is now understood, appear to be almost exclusively of modern growth. Though combinations among various classes of workmen to improve their position have doubtless been formed from time to time from an early period, such com- binations, up to comparatively recent years, were mostly ephemeral, almost the only class among whom permanent associations of journeymen are known to have History. existe*~~

~~*The craft gilds of the Middle Ages have sometimes been regarded as the true predecessors of trade unions, but the analogy must not be pressed too far. The struc- ture, constitution, and functions of a gild of craftsmen, aiming at the protection and regulation of the craft as a whole, were essentially different from those of a trade union, formed to protect one class of persons engaged in an industry against another. Nor is there any trace of — direct continuity between gilds and trade unions, for the claim of certain Irish trade unions to be descended from gilds will not bear scrutiny (see Webb, History of Trade Unionism, Appendix). The only true sense in which it can be said that there is a certain indirect historical filiation between gilds and trade unions is that, as pointed out by Brentano, some of the earliest trade unions had for their original object the enforcement of the decaying Elizabethan legislation, which in its turn had taken the place of the obsolete regulation of industry by the\ craft*~~

~~*gilds, so that among the rules and objects of such unions would naturally be some bearing a like- ness to gild regulations.*~~

~~*The actual way in which trade unions first came into being probably varied very greatly. In some cases, as stated above, their origin can be definitely traced to associations for enforcing the legal regulation of indus- try against the opposition of employers ; in others, the meetings of journeymen belonging to the same trade for such purposes as sick or burial clubs became naturally the nucleus of secret combinations to raise wages. The growth of the " capitalistic " system of industry, under which the workman no longer owned the materials or instruments with which he worked, was one of the most*~~

~~*potent causes of the development of workmen's combina- tions. The efforts of trade unions to revive the enforce- ment of the Elizabethan legislation not only failed, but led to its repeal (1813-14) ; but the laws against com- binations, which had been made more stringent and more general by the Acts of 1799-1800, remained unal- tered until 1824 (vol. xxiii. p. 499). In spite of these Acts, which made all combinations illegal, there is evidence that trade clubs of journeymen existed and were tolerated in many trades and districts during the first quarter of the 19th century, though they were always subject to the fear of prosecution if they took hostile action against employers ; and in many cases strikes were suppressed by the conviction of their leaders under these Acts or under the common law of conspiracy. The partial protection accorded to societies for the purpose of regulating wages and hours of labour by the law of 1825 (vol. xxiii. p. 500) led to a rapid multiplication and expansion of trade unions, and to an outburst of strikes, in which, however, partly owing to the widespread commercial depression, the workmen were mostly unsuccessful. Thus the first impetus given to trade unions by the modification of the combination laws was followed by a collapse, which in its turn was followed (in the third decade of the century) by a suc- cession of attempts on the part of workmen to establish a federal or universal combination, to embrace members not of one but of several trades. To this new form of combination, which excited a good deal of alarm among employers, the term " trades union," as distinct from trade union, was applied. All these general movements, however, proved short-lived, and*~~

~~the last and most extensive of them, the " Grand National Consolidated Trades Union," which was formed in 1834 and claimed half a million adherents, only had an active existence for a few months, its break-up being hastened by the conviction and transportation of six Dorchester labourers for the administration of unlawful oaths. In the years of depressed trade which followed, trade unionism once more declined, and the interest of workmen was largely diverted from trade combinations to more general poli- tical movements, e.g., Chartism, the Anti-Corn-Law agi- tation, and Eobert Owen's schemes of co-operation.~~

~~From 1845 we trace another revival of trade unions, the characteristic tendency of this period being the amalgamation of local trade clubs to form societies, national in scope, but confined to single or kindred trades. High rates of contribution, and the provision of friendly as well as trade benefits, were among the fea- tures of the new type of union, of which the Amal- gamated Society of Engineers, formed in 1851, was the most important example (see vol. xxiii. p. 501 for de- scription of this society). The growth of unions of the new type was followed by a development of employers' associations in the 'sixties, and by a number of wide- spread strikes and lock-outs, and also by various efforts to promote arbitration and conciliation by the establish- ment of joint boards of employers and employed (see Arbitration and Conciliation, and Strikes and Lock-Outs).~~

~~A series of outrages at Sheffield in 1865-66, in which officials of some local trade societies were implicated, led to the appointment in 1867 of a Royal Commission on Trade Unions, whose report was followed by the passage of the Trade Union Act of 1871, which as amended in 1876 now governs the legal position of trade unions (vol. xxiii. p. 500).~~

~~The period of inflated trade which began in 1871 led, as usual, to another rapid growth of trade combinations, of which the most characteristic feature was their exten- sion to agricultural and general labourers. To meet this~~

~~new development of combination, the National Federation of Associated Employers of Labour was formed in 1873. The years of depression, 1875-80, were marked by a series of unsuccessful strikes against reductions of wages, and by a general decline of trade unions, which did not again revive until nearly ten years later, when the new wave of prosperous trade brought with it an outburst of strikes, chiefly among unskilled labourers, for improved conditions, of which the most notable was the strike of the London dock labourers in 1889. These trade move- ments were accompanied by the formation of a large number of unions of a type more akin to those of 1830-34 than to the more modern trade-friendly society with its high contributions and benefits. The " new unions " were chiefly among unskilled labourers ; their rates of contribu- tions were from Id. to 3d. a week, and as a rule they only offered strike benefit. Another characteristic was the extent to which their leaders were permeated with the Socialistic doctrines which had then recently taken root in Great Britain, and which led them to advocate positive State interference with industry in the interests of the labourers (e.g., the legal limitation of hours of labour).~~

~~The reports of the Boyal Commission on Labour, which sat from 1891 to 1894, contain much valuable information on the state of facts and on the opinions of employers and workmen at this period.~~

~~From 1892 onwards the progress of trade unionism can be traced statistically (see below, p. 406). The depression of trade, 1892-95, brought with it, as usual, some decline in trade unionism; but though many of the " new unions " collapsed, some of the more important have survived to the present time. The revival of trade which began in 1896 has naturally been accompanied by an increase in the strength of trade unions; but the most marked characteristic of this period has been the extension and consolidation of employers' associations, of which perhaps the most notable is the Engineering Employers' Federation, which was originally formed on the Clyde, but gradually extended to other districts and became a national organization of great strength during its successful struggle with the Amalgamated Society of Engineers in 1897-98 (see Strikes).~~

~~*Among the other more important employers' associations and federations of a national character may be mentioned the Shipping Federation, the Federated Coal Owners, the Federation of Master Cotton-Spinners' Associations, the National Federation of Building Trade Employers, and the Incorporated Federated Associations of Boot and Shoe Manufacturers.*~~

~~*The account given in the article on Trade Unions in vol. xxiii. of the way in which the ordinary business of a trade union and its branches is conducted, applies fairly to the present state of things and need not be repeated here. As regards, however, the general structure and organization of trade unions, that article referred principally to a single important type of society, the national society, divided into districts and branches, of which the Amalgamated Society of Engineers served as an example. As a matter of fact, trade unions, both in their historical development and their present organization, present a very great variety of constitutions. The oldest type is that of the local trade club, consisting of a comparatively small number of men following the same occupation in the same locality. A large number of unions have never progressed beyond this primitive form of organization. The government is of the simplest kind, by a general assembly of all the members, while such officers as are required to carry on the necessary routine business of the society are chosen by rotation or even by lot.*~~

~~*Indisposition to concentrate power in the hands*~~

~~*Constitu tion.*~~

~~*of permanent officers and a tendency to divide the business of management equally among all the members, instead of delegating authority to a few chosen repre- sentatives, are leading characteristics of trade unions in this primitive form. The organization here described, even if adequate for ordinary current requirements, is ill suited for conducting a contest with employers, and accordingly in times of strife an improvised "strike committee" often comes into existence and practically governs the conduct of the dispute. No doubt this double constitution of the old trade club as a loosely organized friendly society, converting itself from time to time into a more or less secret strike combination ruled by an*~~

~~*irresponsible committee, is to be traced to the time when trade unions as such were illegal com- binations and had to carry out their objects under the guise of friendly societies. The Friendly Society of Ironfounders (established in 1809), though it has to a great extent outgrown its primitive constitution, retains in its name the mark of its origin, while the government of the London Society of Compositors by mass meeting of its members offers an example of the persistence of traditional methods under wholly changed conditions. The Sheffield trade clubs, responsible for the outrages which led to the appointment of the Trade Union Com- mission in 1867, and subsequently to the passage of the Trade Union Acts, conformed as a rule to the primitive type. At the present time over 850 trade unions are known to exist which are purely local in character, with no branches. The next step in trade union evolution seems to have generally been an alliance or federation of two or more local clubs belonging to the same trade. This federation would make it necessary to provide some machinery for common management, the simplest and crudest expedient being for each of the allied clubs to act in rotation as the governing branch. Thus the govern- ment of the federation or " amalgamated society " was at any given time confided to the members of a single locality, and the seat of government was periodically shifted. Some federal societies (e.g., the Mutual Associa- tion of Journeymen Coopers) still retain this primitive form of government.*~~

~~*As the tendency developed for local clubs to unite, the necessity of permanent officials to cope with the growing business of the amalgamation caused the institution of a paid secretary (usually elected by the whole body of members), and this led naturally to the fixing of the seat of administration at a particular centre instead of rotating among the branches. Some continuity of policy and of office tradition was thus made possible, but the executive committee almost invariably continued to consist of the local committee of the district where the seat of govern- ment happened to be. Thus up to 1892 the business of the Amalgamated Society of Engineers, a society with hundreds of branches all over the United Kingdom and even abroad, was conducted by a committee elected by the London branches.1 The Boilermakers continued a some- what similar form of government up to 1895 ; and many great societies, e.g., the Amalgamated Society of Carpen- ters and Joiners, continue the system to the present day.*~~

~~*The plan of entrusting the government of a national society to a local executive has obvious conveniences, where the society consists of a body of working men scattered over a large area and with no leisure for travel- ling. But the control exercised by a locally-elected committee over a general secretary deriving his autho- rity not from them but from the vote of a much wider*~~

~~*1 This arrangement was in force when the article in vol. xxiii. was*~~

~~*written.*~~

~~*constituency, could hardly be expected to be very effec- tive ; while the expedients of referring all important questions to a vote of the whole body of members, and of summoning at periodical intervals special delegate meet- ings to revise the rules, have proved in practice but clumsy*~~

~~substitutes for the permanent control and direction of the executive officers by a representative council. Quite as ineffective in some cases has been the authority of a mere local executive over the committees of other districts. Accordingly, some of the largest " amalga- mated " unions have now adopted a representative sys- tem of government. Thus in 1892 the Engineers revised their rules so as to provide for the election of the execu- tive council by vote of all the members divided into eight equal electorial districts. The members of council so elected are permanent paid officials, devoting all their time to the work of the society. The general secretary, however, continues to be chosen by the whole body of members, while the responsibility of the council is also weakened by the institution of " district delegates " nomi- nally responsible to them, but chosen by direct election in the various districts. (This division of authority and consequent weakness of responsibility was one of the causes of the state of things which led to the great engineering dispute of 1897.) The Boilermakers adopted the system of a permanent executive in 1895.~~

~~In the case of certain highly-localized industries, such as cotton and coal, the conditions have admitted of a somewhat different form of constitution from that de- scribed above. Thus the Amalgamated Association of Operative Cotton-Spinners is a federal organization, con- sisting of a number of local associations, all, however, situated within a comparatively small area. The govern- ing bodies of the association are — (1) a quarterly meeting of about a hundred representatives of the districts ; (2) an executive committee of thirteen chosen by the above representative meeting, of whom seven must be working spinners and the other six are usually permanent district officials ; (3) a sub-council to transact the ordinary daily work of the association, consisting of the six official members referred to above. The secretary is chosen by the representative meeting, and engages his own office assistants. Here we have the familiar features of rep- resentative institutions — a large legislative body, a small executive chosen by and responsible to this body, and a still smaller group of permanent officials to transact ordi- nary business.~~

~~Lastly, there are some large societies constituted not by the aggregation of local clubs or the federation of neigh- bouring associations, but originally~~

~~*founded as ” national societies ” divided into districts and branches for ad- ministrative convenience. An example is the Amalga- mated Society of Railway Servants, founded in 1872.*~~

~~*Besides the tendency of the national society with branches to swallow up the local trade club, there is a further tendency among the larger societies to form federations for certain common purposes. Such federa- tions are to be distinguished from national trade unions, inasmuch as their members are societies and not individ- uals, and as a rule their powers over their constituent organizations are limited to certain specific objects. On the other hand, they are more than merely consultative bodies (such as local trades councils).*~~

~~*Some federations consist of unions in the same industry in different districts (e.g., the Miners' Federation). ” Single trade ” federations like this have usually con- siderable powers, including that of imposing levies.*~~

~~*In the cotton trade, the trade union organization has a federal character, and the Amalgamated Association of Operative Cotton-Spinners, in spite of its name, is strictly speaking a federation.*~~

~~*Other federations (e.g., in the building trade) are formed of allied trades in the same locality, and usually have little executive power. The Federation of En- gineering and Shipbuilding Trades has among its objects the settlement of disputes between members of its con- stituent societies as to the limits of their work. Some federations aim at embracing societies in all kinds of industries, but as a rule such organizations have not proved long-lived. The most recent example is the ” General Federation of Trade Unions,” formed in 1899, and now embracing 64 societies with nearly 400,000 members.*~~

~~*Since 1866, a congress of delegates from trade unions has met annually for discussion, and a parliamentary committee elected by this congress watches over matters in which trade unions are interested during the ensuing year.*~~

~~*The principal object of every trade union is to protect the trade interests of its members, and to strengthen their position in bargaining with their*~~

~~*employers with regard to the conditions under which they work, objects The chief means by which they seek to attain "mtthods these objects (apart from political methods such as the promotion of legislation or of administrative action by public authorities) are twofold : viz., the support of members when engaged in a collective dispute with em- ployers by the payment of " dispute" benefit^ and the in- surance of members against loss from want of work by the payment of " unemployed " benefit, so as to enable them to refuse any terms of employment inferior to those recognized by the trade, union. All trade unions in one form or another provide " dispute " benefit, but a separate "unemployed" benefit is by no means universal, though, except in certain groups of trades, it is usual among more powerful and well established societies. Thus in the mining, clothing, and even many branches of the building trade, comparatively little is spent by trade unions on " unemployed " benefit, while, on the other hand, in the metal, engineering, shipbuilding, printing, and other trades a large proportion of the total expendi- ture is devoted to this object (see Statistics below). In some important societies, such as the Amalgamated So- ciety of Engineers, " unemployed " and " dispute " bene- fits are mixed up together, members engaged in a dispute receiving an addition of 5s. per week (known as " con- tingent " benefit) to the ordinary out of work pay (known as "donation").*~~

~~*Unemployed benefit may, of course, be regarded as a " friendly" benefit, i.e., a provision against one class of the casualties to which a workman is exposed — the loss of employment through slackness of trade. But in practice it also operates as a method of maintaining the " stan- dard " rate of wages, members being entitled to it who could obtain employment, but only on conditions disap- proved by the society or branch.*~~

~~*The conditions under which the members of a union are entitled to financial support in a strike vary in differ- ent societies, and are prescribed in the rules. Usually, though the initiative may come from the localities, the central executive must approve of the strike before it takes place, and may at any time declare it to be closed, though in some societies the central authority is often unwilling to take the responsibility of curbing its members by exercising its powers in this respect.*~~

~~*"Dispute" and "unemployed" benefits are the only ones which are specially characteristic of trade unions, and as regards the latter benefit, it may be said that trade unions have hitherto been the only form of organization capable of meeting the difficulties arising from " malinger- ing." Most of the more firmly established unions, how- ever, add to their trade functions those of friendly societies,*~~

~~*providing sick, accident, superannuation, and funeral benefits, or some of these. The position of a trade union, however, with regard to these benefits differs very mate- rially from that of a friendly society. As stated above, the society is under no legally enforceable contract with its members to provide the stipulated benefits : it can change their scale, or even abolish them, by vote of its members, and a member who has contributed for years in hope of receiving them has no legal redress. Again, a member excluded from the society for some "trade" reason incidentally loses all claim to friendly benefits. The funds of a trade union applicable to trade and friendly purposes are never kept distinct (in the few cases in which some distinction is attempted, the society may " borrow " from the one fund in aid of the other in case of emergency) ; and a prolonged strike or depression of trade may so deplete the funds as to make it impos- sible for the society to meet its engagements as regards sickness or superannuation. Thus the friendly society operations of trade unions have strictly no actuarial basis, and in some cases the scales of contribution and benefit have been fixed with little regard to ultimate solvency.*~~

~~*On the other hand, the power of levying and varying the scale of contributions adds to some extent to the financial stability of the funds, and the provision of " friendly " as well as " trade " benefits by a trade union undoubtedly gives strength and continuity to the society, and increases its power of discipline over its members. Societies that only provide " dispute " pay are exposed to violent oscillations of membership,*~~

~~*and also to a dangerous temptation t;o rush into an ill-con- sidered strike owing to the mere accumulation of funds which can be u^ed for no other purpose.*~~

~~*The statistics of trade union expenditure on benefits of various classes are given below. Of the 100 principal unions, all provide dispute benefit ; 78 in the year 1900 provided unemployed benefit (including in some cases travelling pay) ; 75, sick or accident benefit ; 39, super- annuation benefit ; and 89, funeral benefit.*~~

~~*One of the most important functions of trade unions in many industries is the negotiation of agreements with employers and employers' associations for the regulation of the conditions of employment in those industries. While undoubtedly the power of withdraw- ing its members from employment in the last resort adds to the power of a trade union in such negotiations, many of the most fmportant agreements by which the conditions of labour of large bodies of workmen are governed are habitually concluded, and from time to time revised, by conferences of representatives of the trade union and employers without any strike taking place. To the functions of trade unions as fighting or- ganizations and as friendly benefit societies should therefore be added that of providing the necessary machinery and basis for the conclusion of industrial agreements between bodies of work-people and their employers (see Arbitration and Conciliation, and Strikes and Lock-Outs.*~~

~~*While the broad objects of trade union policy are generally similar, their methods and features vary greatly in detail. Among the objects most frequently met with (besides those of raising wages and shortening hours, which may be said to be universal) are the enforcement of a " minimum " wage ; the limitation of overtime; the restriction of numbers in the trade through the limitation of apprentices, or the regulation of the age of entrance ; the restriction or regulation of piecework (in trades accustomed to " time " work) ; the preservation for mem- bers of the trade of the exclusive right to perform certain classes of work claimed by other trades (leading to so-called " demarcation " disputes) ; resistance to the*~~

~~*encroachment of labourers on work considered to be " skilled " (leading to disputes as to the class of persons to be employed on machines, &c.) ;*~~

~~*and the securing of a monopoly of employment for members of the union by a refusal to work with non-unionists.*~~

~~*The statistics of trade unions are very complete for recent years, but for earlier years the records are so fragmentary that it is im- possible to give exact figures showing the total growth of trade unions over a long period. The following stat,st,cs- table, based on the statistics published by the Board of Trade, shows the number and membership of trade unions in the United Kingdom for each of the nine years 1892-1900 : —*~~

~~*Number*~~

~~*Membership*~~

~~*of Unions.*~~

~~*of Unions.1*~~

~~*1892 .*~~

~~*1208*~~

~~*1,502,358*~~

~~*1893*~~

~~*1255*~~

~~*1,479,417*~~

~~*1894*~~

~~*1295*~~

~~*1,436,300*~~

~~*1895*~~

~~*1311*~~

~~*1,407,836*~~

~~*1896*~~

~~*1317*~~

~~*1,494,465*~~

~~*1897*~~

~~*1307*~~

~~*1,613,998*~~

~~*1898*~~

~~*1267*~~

~~*1,648,732*~~

~~*1899*~~

~~*1302*~~

~~*1,800,869*~~

~~*1900 .*~~

~~*1272*~~

~~*1,905,116*~~

~~*1 Includes a small number (9072 in 1900) of members abroad.*~~

~~*The fluctuations in membership correspond in the main to the oscillations of trade, membership declining in the years of depres- sion following 1892, and increasing with the revival of trade which began about 1895. The later decline in the number of separate unions is chiefly due to the growing tendency to amalgamate into large societies.*~~

~~*The following table shows the distribution of trade unions among the various groups of trades in 1900 : —*~~

~~*Groups of Trades.*~~

~~*trans-*~~

~~*Mining and quarrying .*~~

~~*Metal, engineering, and shipbuild- ing ... .*~~

~~*Building*~~

~~*Textile ....*~~

~~*Railway, dock, and other port ....*~~

~~*Clothing*~~

~~*Printing and bookbinding*~~

~~*Wood-working and furnishing*~~

~~*General labour*~~

~~*Public employment*~~

~~*All other unions*~~

~~*Total*~~

~~*Number*~~

~~*,of Unions.*~~

~~*59*~~

~~*280 131 237*~~

~~*66 48 54*~~

~~123 19 31~~

~~224~~

~~1272~~

~~Membership in 1900.~~

~~Number.~~

~~501,290~~

~~338,075 253,822 220,685~~

~~171,219 67,424 57,256 39,704~~

~~113,209 38,859~~

~~103,573~~

~~1,905,116~~

~~Percent- age of Total.~~

~~26~~

~~18 13 12~~

~~9 4~~

~~3 2 6~~

~~2 5~~

~~■100~~

~~This table shows that the strength of trade unionism lies in the four first-named groups of trades — mining, metal, engineering and shipbuilding,~~

~~building and textile, which among them account for over two-thirds of the total membership.~~

~~In agriculture, trade unionism is at present practically non- existent, but in 1876 there were important unions of agricultural labourers, though at no time did they include any considerable proportion of the total agricultural population.~~

~~Taking the men belonging to all trade unions together, we find that their number does not amount to more than about one in five of the adult men who belong to the classes from which trade uuionists are drawn. Only in a few groups do trade unionists form a high percentage of the total working population, e.g., coal- mining and cotton manufacture. The number of women belonging to trade unions at the end of 1900 was 122,047, distributed among 138 unions, of which, however, only 27, with 8974 members, con- sisted exclusively of women. The great bulk (79 per cent.) of women trade unionists are found in the cotton trade, in which they actually outnumber the male members. Of all the women employed in factories and workshops, about one in twelve belongs to a trade union.~~

~~The available statistics with regard to the financial resources of trade unions, and their expenditure on various objects, are not so complete as those of membership, as the Board of Trade figures only relate to 100 of the principal unions. As, however, these unions include nearly two-thirds of the total membership, the~~

~~figures showing their financial position may be accepted as being representative of the whole number of societies. In 1800 the in- come of these 100 societies was £1,974,611, or 34s. Id. per head ; and their expenditure £1,490,582, or 25s. 8£d. per head; and at the end of the year the funds in hand amounted to £3,766,625, or 65s. per head. Of the income, £1 10s. llj-d. per head was derived from members' contributions,~~

~~*and 3s. lfd. per head from various other sources, e.g., interest, fines, entrance fees, subscrip- tions, &c.*~~

~~*The above figures represent the average, but the actual rates of contribution vary greatly among the unions — from 7s. up to £4 per annum. Generally speaking, the highest income per member is found among the unions in the metal, engineering, and ship- building group, where in 1900 it averaged £3 Is. 3J4., while the average in the mining unions was only £1 2s. 10fd., and among dock labourers still lower. The metal trades and the textile unions appear to hold the highest amount of funds compared with their membership, the amounts at the end of 1900 being £5 0s. 6d. and £4 18s. 10£d. per head respectively in these groups, while in the clothing trade unions it was only £1 12s 7d., and in some societies of unskilled labourers far less than this.*~~

~~*The main items of expenditure of trade unions are "dispute" benefit, " unemployed " benefit, various friendly benefits (includ- ing sick and accident, superannuation, and funeral), and working expenses. The proportions of expenditure on these various objects naturally vary greatly in different groups of unions, and also in different years, some of the items being affected largely by the general state of employment, and the occurrence or absence of important disputes. On the basis, however, of an average of the nine years 1892-1900, the following analysis of the proportionate expenditure of the 100 principal unions on various classes of objects has been made : on disputes, 20 per cent. ; on unemployed, 22 per cent. ; on friendly benefits (other than "unemployed"), 38 per cent. ; on working expenses, 20 per cent. The 38 per cent, of expenditure on friendly benefits is made up of 17 per cent, on sick and accident, 10 per cent, on superannuation, and 11 per cent, on funeral and other benefits.*~~

~~*The mining unions devoted 40 per cent, of their expenditure to the support of disputes (friendly benefits in this industry being largely provided by other agencies), while the unions in the print- ing and bookbinding trades only used 6 per cent, for this object, over three-quarters of their expenditure going to unemployed or friendly benefits. As illustrations of the variation in the ex- penditure by the same group of unions on a particular object from year to year, it may be stated that*~~

~~within the nine years' period referred to the annual expenditure of the metal, engineering, and shipbuilding group on disputes varied from £12,633 in 1899 to £491,478 in 1897, the year of the great engineering dispute. Again, the expenditure of the same group of unions on un-employed benefit varied from £80,004 in 1899, a year of good trade, to £258,620 in 1894, a year of bad trade. The burden of superannuation payments by the 100 unions has steadily increased during the nine years from £102,578 in 1892 to £190,039 in~~

~~1900.~~

~~At the end of 1900 there were 110 federations, including societies with a gross membership of nearly a million and three-quarters ; but a considerable deduction must be made from this total on account of duplication. In the same year 171 " Trades Councils " were known to exist, with an affiliated membership of about~~

~~754,000.~~

~~The number of employers' associations and federations known to exist in the United Kingdom at the end of 1900 was 870, in- cluding 47 federations, and national associations. Of the total number of associations, nearly half are in the building trades.~~

~~II. Outside the United Kingdom.~~

~~Modern trade unionism has had its chief development in English-speaking countries, and especially in the United Kingdom, where the conditions necessary for its growth have been present to the fullest extent. With some exceptions, such unions as are found elsewhere are either derived or copied from English organizations, or are associations with political objects. It is therefore unnecessary to give more than a very brief summary of the position of trade unions in some of the principal countries and colonies outside the United Kingdom (for United States see p. 411). ,~~

~~Germany. — In Germany the majority of trade unions are of a political character, being closely connected with the Social Democratic party.~~

~~These Socialist trade unions, termed " Gewerkschaften," were started by a con- gress held at Berlin in 1868, under the auspices of~~

~~Fritscher and Schweitzer, two followers of Lassalle. In 1878 many of them were dissolved under the law prohibiting Socialistic organizations, but shortly after their place was taken by local unions termed "Fach-vereine," which ostensibly abstained from politics, but which in various ways succeeded in evading the law and carrying on the work of the " Gewerkschaften." In 1887 a general committee of the German Gewerkschaften was formed. The last few years of prosperous trade have been marked by a rapid growth of membership of this group of unions. According to the Correspondenzblatt, their official organ, they included in 1899 a membership of 596,419, compared with 252,044 in 1894. Of the total members in 1899, 580,473 belonged to 7623 branches affiliated to 55 central federations, the membership of non-federated local unions being returned as only 15,946.~~

~~The total income of the federated trade unions in 1899 was £384,358, or about 13s. per member. The expendi- ture on trade purposes, including strikes, was £111,605, and on other benefits, unemployed, travelling, sick, &c, £74,245, the remaining expenditure being attributed to the publication of the journal, agitation, office, and mis- cellaneous expenses.~~

~~Another group of trade unions in Germany, less im- portant as regards number and membership than the above, are the " Gewerkvereine," or non-political trade unions, sometimes known as " Hirsch-Duncker " unions, from the names of their founders. These unions were first formed in 1868, immediately after the Berlin con- gress referred to above. They were directly modelled on British trade unions. Since 1876 Social Democrats have been excluded. In their earlier years these unions suf- fered in membership from a series of unsuccessful strikes, and of late years they have been mostly benefit societies. At the end of 1899 the " Gewerkvereine " embraced 91,661 members belonging to about 1700 local unions affiliated to a central federation. Their expenditure on benefits amounted to less than £6000 a year, of which only about £600 was spent on disputes. The Christian trade unions (" Christliche Gewerkvereine ") form another group, embracing, in 1899, 111,860~~

~~*members in 36 trade unions, mainly in railway service, textile and mining industries.*~~

~~*As regards objects, methods, and organization, the National Printers' and Typefounders' Trade Union bears more resemblance to British trade unions than do any of the other German labour organizations. There seems to have been a long tradition of organization among journeymen in the German printing trade, going back to the 17th century. In 1848 the Gutenberg National Union of Printers was formed, but after an unsuccess- ful strike it broke up into local unions. The present union was formed in 1867, and became affiliated to the federation of " Gewerkschaften " in 1892. It has estab- lished a wages list, and secured other advantages for its members. It escaped the law of 1878 by changing its name. In 1899 its membership was 26,344, its income £79,000, and its funds amounted to £136,000.*~~

~~*It will be seen that German trade unions of one type or another include about 800,000 members. As regards, however, their direct influence on industrial conditions, they are not (with the exception of the printers' union) nearly so powerful as the British organizations.*~~

~~*France. — In France combinations of workmen as well as of employers were prohibited by the law of 1791, which overthrew the old gild or corporation system. They were also penalized under various articles of the Penal Code, and it was not till 1864 that the prohibition was modified by law. At present the status of trade unions in France is regulated by the law of 1884, which repealed that of 1791 and modified the articles of the*~~

~~*Penal Code so far as regards professional syndicates of employers or workmen. Since then there has been a considerable growth of workmen's unions, which in 1899 numbered 2685, with a membership of 492,647, compared with 2178 unions, with 403,440 members, five years pre-*~~

viously. Of these unions, 1199 belonged in 1899 to 73 federations, of which the total affiliated membership is returned as 432,950, though there is here some duplication owing to the fact that some unions belong to more than one federation. The distribution of these unions among trades can only be stated for the year 1897, when out of a total membership of 437,793, 160,208 belonged to the group " transport and commerce," 41,760 to mining and quarrying, 38,316 to metal trades, 35,432 to textile indus- tries, 33,795 to building trades, 27,967 to chemical trades, 20,262 to leather and skin trades (including boot, shoe, and glove trades), 18,552 to food-preparation trades, and the remainder to printing, furnishing, clothing, and other groups.

Austria-Hungary. — Apart from the Austrian gilds, membership of which is compulsory for persons engaged in non-factory handicrafts and trades (under a law of 1883) and in mining (under a law of 1896), there are a certain number of trade unions in Austria, though freedom of combined action among workmen is less com- plete than in many other European countries. Such right of combination as exists rests on the law of 1870, which removed the restrictions imposed by the Penal Code on combinations for influencing the conditions of labour. The impulse given to the formation of unions by this law, and by the advantages gained for the work- men during the years of prosperous trade that immedi- ately followed, received a severe check during the suc- ceeding depression of trade, when these advantages were mostly lost. Trade unionism did not revive until 1888, from which time the unions formed have mostly been on a Social Democratic basis, the majority being affiliated to a central organization in Vienna. In 1899, 409 trade unions and 604 " trade clubs " were known to be in exist- ence in Austria. The latter class of associations are described as educational associations possessing to a greater or less extent trade union functions. The majority of trade clubs and a few trade unions are affiliated to a federation at Prague. Returns compiled by the com- mittee of Austrian trade unions, and applicable to 391 trade unions and 492 trade clubs, showed a total member- ship of 157,773 persons in 1899 compared with 117,946 members in 313 trade unions and 527 trade clubs in 1896. Of the members in 1899, 128,504 belonged to trade unions in various groups of industries, of which the following are the principal in order of numerical importance : Metal trades, 18,374 ; transport

~~(including railway service), 16,665; mining, 13,583; printing and allied trades, 12,750 ; glass and pottery, 9688 ; textile, 9470; clothing, 9083; building, 7790; wood-working,~~

~~The total receipts and expenditure of trade unions and clubs in respect of benefits other than dispute pay were, in 1899, £85,384 and £79,585 respectively. The expen- diture on disputes was £14,977. The average annual expenditure per member of the organizations affiliated to the Vienna federation in 1899 was lis. 4d., of which the amount spent on unemployed and travelling benefit was about 2s. 3d., on sickness Is. 8-|d.., on superannuation 6|d., on funerals 4d., on trade journals Is. 7d., the remainder being accounted for by office and various miscellaneous expenses.~~

~~In Hungary trade unions are not far developed, the figures given on the authority of the Budapest Trades Council showing only 126 trade unions with 23,603 members in various industries, exclusive of unions of~~

~~agricultural labourers, which it is stated brought up the membership to 64,000 in 1898-99.~~

~~Denmark. — In Denmark there were, in 1900, 1196 trade unions with 96,359 members — a very large membership compared with the total industrial population. The principal groups of trades represented were as follows in order of membership : General labourers, 29,044 ; build- ing trades, 14,391 ; metal trades and shipbuilding, 10,954 ; transport, 8657 ; food, &c, trades, 7701 ; clothing, 6381 ; wood-working, 5520. Unemployed pay is said to be paid by 465. unions with 32,220 members, travelling benefit by 676 unions with 37,135 members, these being the most widely-spread benefits other than dispute pay. Over 80 per cent, of the members belong to unions affiliated to the General Federation of Danish Trade Unions. In 1896 unions with a membership of 63,377 had an income of £39,504 and an expenditure of £32,593.~~

~~Sweden and Norway. — In Sweden and Norway trade unions are of recent growth. There is a trade union membership of about 60,000 in~~

~~*Sweden, and of 24,000 in Norway. A National Federation of Swedish Unions was formed in 1898, and in 1900 was said to embrace 692 societies, with 39,132 members. In 1899 a federation was established in Norway.*~~

~~*Switzerland. — The only available statistics as to Swiss trade unions are the (avowedly incomplete) returns com- piled by the Swiss " Arbeiter-Sekretariat," which show for 1899 a total of 758 local unions affiliated to 39 trade unions, with a membership of 49,034, of whom 17,451 belonged to unions affiliated to the General Federation of Swiss Trade Unions. Nearly a third of the total mem- bership (16,066) is accounted for by seven trade unions of railway servants, the next largest group being Gov- ernment employes (5655), followed by metal-workers*~~

~~*(5373).*~~

~~*Holland. — In Holland in 1895 there were known to be 370 ordinary and 131 Koman Catholic trade unions, but little information is available as to membership or funds. Of the ordinary unions, 93 were in the building and kindred trades, 73 in food, drink, and tobacco trades, and 61 in transport industries. In 1893 a National Labour Sekretariat was formed, to which, in 1899, 45 societies with 13,050 members were said to be affiliated. The largest trade union in Holland was stated in 1900 to be the Diamond Workers' Federation, with 7000 members and an expenditure in 1899 of £12,260.*~~

~~*Belgium. — The status of trade unions in Belgium is regulated by the law of 1898, under which they can be incorporated, provided that their objects are non- political and are confined to the furtherance of the interests of particular trades. Belgian trade unions, nevertheless, are mostly political in character, the major- ity being connected either with the Socialist-Labour, Catholic, or Liberal parties. There are, however* a few unions (e.g., the printers') independent of these parties. There are said to be altogether about 170 unions with from 60,000 to 70,000 members, of which about 100 unions are affiliated to the Labour party. In some trades (cigar-makers, woodworkers, printers, stonework- ers, painters, miners, and metal-workers) the unions have formed themselves into federations.*~~

~~British Colonies. — Trade unionism has only developed to any important extent in a few of the industrial centres of the principal self-governing colonies. Unions in Canada are to a large extent branches of organizations having their headquarters in the United States or in England, and the purely Canadian unions do not present any features requiring special notice.~~

~~Between 1876 and 1890 all the principal Australian states passed statutes more or less resembling the Trade~~

~~Union Acts of the United Kingdom. A similar law- was passed in New Zealand in 1878, but in this colony and in New South Wales trade unions can now become incorporated and acquire a special legal status by registering as industrial unions under the laws relating to industrial conciliation and arbitration. In the years immediately preceding 1890 certain Australian unions, especially among the shearers and the seamen and wharf- labourers, acquired great strength, and their determined attempts to secure a monopoly of employment for mem- bers of their organizations led to prolonged labour disputes in 1890 and 1891 (see Strikes and Lock-Outs, p. 27), which resulted in the defeat of the unions and a conse- quent diminution of their membership and influence.~~

~~Authorities. — For statistics of recent progress of trade unions, see annual reports on trade unions published by the Board of Trade (from 1887 onwards). Much information respecting trade unions is contained in the reports of the Royal Commission on Trade Unions (1867) and of the Royal Commission on Labour (1891-94). The reports of the Chief Registrar of Friendly Societies give information with regard to trade unions registered under the Trade Union Acts. On the history and constitution of trade unions the fullest information is given in Webb's History of Trade Unionism and Industrial Democracy, both of which~~

~~*contain valuable bibliographical appendices which may be consulted as regards other sources of information respecting British trade unions.*~~

~~*On trade unions abroad (besides the reports on foreign countries and the colonies of the Royal Commission on Labour), see Kule- mann's Die Gewerkschaftsbewegung (Jena, 1900), dealing with trade unions in all countries, and the Board of Trade " Abstract of Foreign Labour Statistics" (1901) and Labour Gazette, both of which give numerous references to the foreign official sources of informa- tion on trade unions, together with a summary of the statistics which they contain.*~~

~~*III. Economic Effects of Tbade Unionism.*~~

~~*There is no general consensus of opinion as to the extent to which trade unions can attain success in achieving the objects which they set before themselves, or as to how far their action is beneficial or otherwise to the general community. One of the principal objects of trade unions being to maintain and increase the rates of wages paid to their members, the first question would be practically solved if statistical evidence were available to connect the course of wages with the action of combina- tions. Such evidence, however, is inconclusive. The period of growth of trade unionism in Great Britain has certainly been on the whole a period of rising wages. But many other causes tending to raise wages have been operative over the same period, and some of the facts might be explained as much by the tendency of rising wages to strengthen combinations as by that of combina- tions to raise wages.*~~

~~*Again, the observed fact that the rise has not been confined to industries in which organizations are strong might be explained either by the supposition that the rise brought about by trade unions has benefited a wider circle than their membership, or that the rise both within and outside the ranks of trade unions is due to causes other than their action. Perhaps the strongest statistical evidence of the power of trade unions to affect wages in particular districts is afforded by the local differences of wages in the same trade, which, it is contended, cannot be wholly explained by local differences of cost of living or industrial conditions, but which often correspond closely to differences of strength of trade*~~

~~union organiza- tion. This argument, however, does not touch the question of the effect of combination on the general level of wages.~~

~~Hardly more conclusive than the reasoning founded on statistics have been the attempts to solve the ques- tion by pure economic theory. During the prevalence of the old view of wages, known as the "wage-fund"~~

~~theory, combinations were usually held to be powerless to affect the general rate of wages, because they could not alter the proportion between capital and population, on which wages were thought to depend. The question, however, was reopened by the change in theory which led economists to regard wages as depending primarily on the productivity of industry, and secondarily (and within comparatively narrow limits) on the relative power of bargaining as between the labourers or groups of labourers and the organizers of labour. According to this view, the effect of combinations on the rate of wages will ultimately depend, so far as the first and most important factor in the problem is concerned, on their effect on the general productiveness of industry. Prima facie, we might expect that trade unionism would, on the whole, restrict productiveness, and this is undoubtedly a view widely held among employers. Strictly professional associations tend generally to become conservative so far as methods of work are concerned ; and even trade unions which may not " officially " oppose the introduction of new processes and the use of machinery may nevertheless serve to focus and make effective the hostility felt by the artizan towards methods of business organization which seem to him likely to decrease the demand for his services or to alter the conditions of work to his detriment. In some trades also trade unions are charged with encouraging or permitting their members to restrict the amount of work performed by them in a given time, with the short-sighted object of making more work for others. Many unions have attempted also with varying degrees of success to keep up the value of their labour by creating an arti- ficial scarcity by restricting the numbers entering the trade, and have in various ways sought to control the management of business to a degree which must re- strict the freedom of experiment on which the attain- ment of the maximum productiveness of industry must depend. By the resort to strikes — an essentially waste- ful method of settling differences with employers — they have also to some extent~~

~~*restricted production, though the loss directly due to this cause, is often exaggerated (see Strikes and Lock-Outs). Moreover, by their insistence on the payment to all workmen on a fixed " minimum" wage they have diminished the field for the profitable employment of the old and less capable, and may to some extent have discouraged the expert workman from earning and receiving the full reward of his extra ability.*~~

~~*On the other hand, it is claimed that trade unions have in many cases acted in the interests of industrial peace by restraining their members from ill-considered strikes, and that, by providing a recognized channel through which the workmen's grievances may find expression, they have often assisted in adjusting differences which would other- wise have led to the interruption of production. It is also claimed that by protecting the " standard of life " of their members through the policy of securing a "minimum" rate of wages, trade unions may tend in the long run to build up a physically and industrially superior class of workmen, and thus ultimately increase the efficiency of industry.*~~

~~*The comparative weight of the above considerations differs somewhat according to the point of view from which the question is regarded. At any given time an individual employer may tend to feel most strongly the dis-advantages of the restrictions under which he is placed by the action of a particular trade union, and may attach but little importance to the general effects, in the long run, on the national output of the pressure which such combina- tions exercise — which from the point of view of the general well-being of the community is the most important con- sideration. Generally speaking, any action of trade unions*~~

~~*tending to diminish the efficiency and industry of the in- dividual workman is as injurious to the community as to the individual employer,*~~

~~*except in so far as such restric- tion may conceivably affect the health of the working community from over-strain. But the policy of " levelling up" the standard rate of wages, which may mean loss or ruin to a particular employer, may nevertheless act quite otherwise with respect to the national well-being, in so far as it tends to eliminate the "unfit" employer and to concentrate the industry in the hands of the more capable and more enterprising of the employing class, and in the localities most suited for the purpose. The pressure of rising wages has undoubtedly acted as a stimulus to the invention of labour-saving devices and the adoption of economical methods, as is shown in America, where the highest wages are often seen concur- rently with the lowest labor cost. Advocates of trade unionism sometimes lay much stress on this aspect of their operation. On the other hand, it must not be for- gotten that competition, both as between different grades of employing ability and of local advantages, is now in- ternational, and that the concentration of an industry in the most suitable localities and in the hands of the most capable organizers, which is claimed as a beneficial result of trade union action, may for any particular country mean the transference of the industry abroad ; and this transference, especially in the case of industries depend- ent on export to neutral markets, may involve a consider- able national loss.*~~

~~*Apart from the effect of trade unions on the total amount of the "national dividend," their supporters claim that they are able to alter the mode of distribu- tion of this dividend. It is not usually claimed that they are able to affect the proportion of the total product which is paid as rent or interest for the use of the in- struments of production, but that they can alter the pro- portions in which the residue is shared between the organizers of labour and the manual labouring class, to the advantage of the latter. The methods by which trade unions seek to achieve this result require separate examination.*~~

~~*The first group of methods are those which aim at creating a scarcity of some particular kind of labour so as to alter the relation of demand and supply. The par- ticular methods employed for this purpose have been already sufficiently described. With regard to all of them, it may be remarked that they are ineffective as regards the raising of the general*~~

~~*rate of wages through- out the country {i.e., the average income per head of the manual labour classes), seeing that an artificial scarcity of one sort of labour implies a redundancy of some other kind. As regards the rate of wages in particular occupa- tions, there is no doubt but that at least for a time such methods may cause a considerable rise of wages, only limited at first by the imperfection of the control exer- cised by the union over the number competing in the labour market, and by the extent to which the rise in the cost of production so caused is checked by the competi- tion of goods imported from abroad, or of alternative commodities, or by the loss of foreign markets, or the diminution of home demand. But as time goes on other forces of a more subtle kind tend to come into play which further limit the power of the combination to keep up wages through restricting the supply of labour. Besides the substitution of alternative commodities, alternative processes of production may be invented, diminishing the demand for the services of the members of the exclusive trade union, while the artificial rise of wages is also likely to attract labour into the trade.*~~

~~*Generally speaking, it may be said that while the arti- ficial restriction of the supply of workmen in a trade may*~~

~~*raise wages for a time, it calls into play forces tending to restore the equilibrium of demand and supply by dimi- nishing demand, and that these forces grow progressively stronger as time goes on, while the restrictive capacity of the combination usually tends to diminish. This is apart from the fact that restriction of the supply of labour en- tering a trade almost always involves the narrowing of the field of ability from which the trade can be recruited, and thus a lowering of the general standard of efficiency.*~~

~~*The other group of trade union methods which requires examination is that which aims at strengthening the economic position of the labourer by substituting collective for individual negotiations as regards wages, supported by a common reserve fund out of which the labourer may be maintained while waiting for his terms to be accepted. Undoubtedly these methods of mutual insurance and col- lective bargaining afford a powerful instrument for pre- venting " sweating," and for enabling the*~~

~~*whole body of workmen to exact at the earliest moment and retain to the latest moment the 'full amount of the wages which a given state of trade and prices will enable the industry to support. The establishment of general working rules and standards of time or- piece wages throughout a trade or district may also serve to protect the better and more capable employers against their more inefficient or unscrupulous competitors, and thus tend towards the survival of the " fittest " among the employing class. It is always to be remembered that the effect of collective bargaining is not in the long run one-sided. Combina- tions of workmen beget counter-combinations of employers, and the conditions of important industries tend to be settled more and more by " treaties " concluded between powerful bodies of employers and employed. Were the combinations on both sides which enter into these agree- ments conterminous with the entire trades which they represent, and especially if the trades were protected from foreign competition, the interests of the general unorganized mass of consumers might conceivably suffer from these agreements. But as a general rule there has hitherto been sufficient outside competition, either within or without the country, to obviate this danger.*~~

~~*As regards the future prospects of trade unions in Great Britain, it is difficult to prophesy. The hopes of those who look for a universal expansion of these organizations so as to include the whole or the majority of the members of the manual-labour classes are certainly extravagant. Not less chimerical is the expectation of the opponents of trade unions that a few defeats at the hands of determined employers or employers' organizations will permanently cripple them and lead to their decay and extinction. Probably for many years trade unions will include, as now, in their membership a powerful minority of the working classes, wielding an influence out of all propor- tion to their actual numbers. It is to be expected that experience and the spread of education may cause them gradually to abandon the rules and methods which inter- fere most with the economical application of labour and capital to industry, while continuing to protect the inter- ests of their members in the fair distribution of the joint product of industry.*~~

~~*Lastly, it may be pointed out that trade unionism has been the result of the growth of a class of manual work- men working for wages for employers who provide the materials and instruments of industry, and into whose ranks it is relatively difficult for the average workman to rise. It is doubtful if the class feeling which enables trade unions to flourish can permanently be fostered and maintained except among workmen who expect to remain workmen most of their lives. If these conditions should be materially altered, trade unionism in its present form must decay or undergo a profound alteration. (x.)*~~

~~*IV. United States.*~~

~~*Trade unions in the United States are best treated from the broad standpoint of labour organizations generally, i.e., associations of wage-earners having for their general purpose the improvement of their members, either through a lessened working day, increased wages, or more satis- factory rules and conditions of employment. They may or may not admit employers, but as a rule they do not admit them. Sometimes they are formed for a specific pur- pose, like the Eight-Hours League, but generally they have platforms comprehending all the demands which labour usually makes. Labour organizations in the United States cannot be given a definite birthday. Prior to 1825 there were very few of them. In orgaafza- • c°l0Iual days we have hints of their existence, tioas. but their purpose was partly political, and*~~

~~*their membership often consisted of politicians. The purpose of the Caulkers' Club, in the early days of Massachusetts, was " to lay plans for introducing certain persons into places of trust and power." Tradition has it that the word " caucus " was derived from this club. It is also said that Samuel Adams's father, as early as 1724, was active in the club's work. There was pro- bably a union of journeymen bakers in the city of New York in 1741, and of shoemakers in Philadelphia in 1792. The*~~

~~*shipwrights of New York City were incor- porated 3rd April 1803, and the tailors and carpenters of that city were organized in 1806. The New York Typo- graphical Society was in existence in 1817, and was pro- bably organized in the early years of the 19th century. Peter Force was its president for a time, and Thurlow Weed was a member. A strike occurred in Mr Weed's office in 1821 on account of the employment of a non-union man, who was then designated a " rat." In 1823 was organized the Columbian Charitable Society of Ship- wrights and Caulkers of Boston and Charlestown.*~~

~~*The period from 1825 to 1860 may be called the for- mative period. About 1825, and for some years after- wards, there was a general discussion of So- Formative cialistic theories, growing out of Robert Owen's per experiments at New Lanark, in Scotland, and*~~

~~*out of his communistic attempt at New Harmony, Ind., in 1825. These experiments gave a great impetus to Pourierism, more than 200 communistic villages being founded, among them the celebrated Brook Farm, in Mas- sachusetts. A large proportion of these experiments lasted only for a few years, but their influence has not yet ceased. The wave of transcendentalism also, which swept over the country between 1825 and 1840, affected not only social but industrial life. Labour papers began to be established. The Working Man's Ad- vocate, published in New York City in 1825, was pro- bably the very first American labour journal. Soon afterwards there appeared the Daily Sentinel and Yqung America, projected by two' Englishmen, George Henry Evans and Frederick W. Evans. The chief demands advocated by these journals were the freedom of public lands, the breaking up of monopolies, the adoption of a general bankruptcy law, a lien for the labourer upon his work for his wages, the abolition of imprisonment for debt, equal rights for women with men, and the aboli- tion of chattel and wage slavery. These demands were endorsed by over 600 newspapers. In 1830 a Working- man's Convention was held in Syracuse, N.Y., the out- come of which was the nomination of Ezekiel Williams for governor. In 1832 a delegated convention which met in the State House at Boston initiated the 10-hours movement. The Tribune (New York), under the leader- ship of Horace G-reeley, was opened to the advocacy of Pourierism, and so on all hands the movement*~~

~~*towards organization was helped. In 1845 the New England Working Man's Association was organized, and such men as Charles A. Dana, George Ripley, Albert Brisbane, Wendell Phillips, William Lloyd Garrison, Theodore Parker, and others participated in its meet- ings. The first industrial congress of the United States was convened in the city of New York 12th October, 1845, but little came of it. Other and more important labour-congresses were held in that city and in Chicago in 1847 and 1850 respectively. During the latter part of the formative period, that is, from 1825 to 1860, most of the great national trades unions that are now influ- ential were projected and organized, though their great and rapid growth has been since the Civil War. The National Typographical Union was organized in 1852, its name being changed to International in 1862 in order to admit Canadian members ; the National Union of Hat Finishers in 1854; the Iron Moulders' Union of North America on 5th July 1859, and in the same year the Machinists' and Blacksmiths' Union of North Amer- ica. By 1860 the national unions already formed num- bered 26.*~~

~~*During the next few years, among other important organizations, were instituted what are known as the group of railway brotherhoods, the oldest and largest of which is the International Brother- Railway hood of Locomotive Engineers. The grand Aoodsf" division was founded at Detroit, Mich., 17th August 1863y under the name of the Brotherhood of the Footboard. The society was reorganized under its present title at Indianapolis, Ind., 17th August 1864. The second national association of railway employe's that was organized was the Conductors' Brotherhood, formed at Mendota, 111., 6th July 1868, by the conductors from various railways in the United States. This brotherhood was recognized, and a general governing board estab- lished, on 15th December of the same year. Ten years later the name of the organization was changed from the Conductors' Brotherhood to the Order of Railroad Con- ductors of America. The Brotherhood of Locomotive Firemen was organized at Port Jervis, N.Y., 1st December 1873. The Brotherhood of Railroad Trainmen was organized at Oneonta, N.Y., 23rd September 1883. It was called the Brotherhood of Railroad Brakemen until 1st January 1890, when the present name was adopted. The Brotherhood of Railroad Trackmen is one of the younger and smaller organizations. The first efforts to found it*~~

~~were made in the spring of 1887, but its per- manent organization took place a year later. The Brotherhood of Railroad Carmen of America was founded 9th September 1890, by the consolidation of the Car- men's Mutual Aid Association, the Brotherhood of Rail- road Car Repairers, the Car Inspectors, Repairers, and Oilers' Protective Association, and the Brotherhood of Railroad Carmen) of Canada. The Switchmen's Union of North America is the outgrowth df the Switchmen's Mutual Aid Association, the present organization dating from 1897. At one time the Mutual Aid Association was a large and influential body. Several of these railway brotherhoods suffered materially in their membership and influence through the organization of the American Railroad Union in 1893.~~

~~The Cigar-makers' National Union dates from 1864, the Bricklayers' and Masons' International Union from 17th October 1865, the United States Wool Hat Finishers' Association from 1869, and the ^'j1™*' National Union of Horse-shoers of the United States from 1875. The Amalgamated Association of Iron and Steel Workers resulted, as its name signifies, from the consolidation of various other orders and societies, the present order being organized at Pittsburg in August~~

~~1876. The consolidated societies were known previously to the new order of things as the United Sons of Vulcan, the Associated Brotherhood of Iron and Steel Heaters, Rollers, and Roughers of the United States, and the Iron and Steel Roll Hands' Union. The oldest of these bodies was the United Sons of Vulcan, originating in Pittsburg, 17th April 1858, and known as the Iron City Forge. The Granite Cutters' National Union was organized in~~

~~1877, the Brotherhood of Carpenters and Joiners in 1881, and the Journeymen Bakers' National Union in 1886. This ends the list of the leading trades unions of the United States. All are organized along what~~

~~*is known as trade union lines; each is devoted to its particular in- terests, and primarily has nothing to do with other unions. Many, such as the Cigar-Makers, the Carpenters, and others, have special publications relating to their particular work.*~~

~~*In sympathy each union is, of course, bound up with all unions, and there have been attempts to organize labour on a general or universal plan. The first of these was the International Association of Working-men, known as the " International," which was organized in London in the autumn of 1864. This society sought to associate working-men wherever manufacturing has been extended. The International grew for a while, but never at any time had a membership exceeding 100,000, and pro-*~~

~~*latioaaC bably never over 50>000- u did not extend to the United States with much force; certainly no large number of the working-men of the country were involved in it, and branches were not organized in the Union until 1870 or 1871. The International took part in the Parisian difficulties in the latter year, and thus lost its influence with Americans ; in fact, its experience there killed the society. Its programme and propaganda •sowed some seeds, however, through its broad foundation. Its practices were generally condemned.*~~

~~*The second attempt was the Noble Order of Knights of Labour of America, which was founded in Philadelphia on Thanksgiving Day 1869, through the efforts of Labour "' Uriah S. Stephens and six associates, all gar- ment-cutters. For several years the garment- cutters of Philadelphia had been organized as a trade union, but failed to maintain satisfactory rates of wages. Dissatisfaction prevailed, and resulted in the autumn of 1869 in the disbandment of the Union. Stephens, who was a far-seeing man, and anticipated the disruption of his union, had prepared the outlines of a plan for an organization embracing, as he said, " all branches of honourable toil." He advocated education, co-opera- tion, and an intelligent use of the ballot as the proper means for gradually abolishing the present wage-system. The Order had a varied career. Mr Stephens, himself a Mason, brought into the ritual of the new Order many of the features of speculative Masonry. The obligations were in the nature of oaths, taken with much solemnity upon the Bible, and the*~~

~~*members were sworn to the strictest secrecy. The Order was known for a long time as " Five Stars," that designa- tion being used in printing and writing. Many ex- pressions taken from Greek literature were introduced into the ceremonies. The instructions given to every person admitted into the order are perhaps the best exponent of the nature of the ritual : —*~~

~~*Labour is noble and holy. To defend it from degradation ; to divest it of the evils to body, mind, and estate which ignorance and greed have imposed ; to rescue the toiler from the grasp of the selfish — is a work worthy of the noblest and best of our race. In all the multifarious branches of trade, capital has its combina- tions ; and, whether intended or not, they crush the manly hopes of labour, and trample poor humanity in the dust. We mean no conflict with legitimate enterprise, no antagonism to necessary capital, but men, in their haste and greed, blinded by self- interests, overlook the interests of others, and sometimes violate the rights of those they deem helpless. We mean to uphold the*~~

~~*dignity of labour, to affirm the nobility of all who earn their bread by the sweat of their brows. We mean to create a healthy public opinion on the subject of labour (the only creator of values), and the justice of its receiving a full, just share of the values or capital it has created. We shall, with all our strength, support laws made to harmonize the interests of labour and capital, and also those laws which tend to lighten the exhaustiveness of toil. To pause in his toil to devote to his own interests [sic], to gather a knowledge of the world's commerce, to unite, combine, and co- operate in the great army of peace and industry, to nourish and cherish, build and develop, the temple he lives in, is the highest and noblest duty of man to himself, to his fellow-men, and to his Creator.*~~

~~*The ritual was neither printed nor written, and in all probability there is not now in existence a copy of it. So long as the utmost secrecy was retained, the Order did not grow rapidly; gradually it lost its secrecy, and worked on more general plans. From the best evidence that can be secured, it is probable that the first Local Assembly of the Knights of Labour was organized as early as 1873, in Philadelphia. Attempts at outside organization had been unsuccessful. The second Assembly consisted of ship-carpenters and caulkers employedin Cramp's shipyard.*~~

~~*After this the Order spread quite rapidly, 20 Assemblies being organized in Phila- delphia during 1873. A District Assembly, consisting of delegates from Local Assemblies in Philadelphia, met in that city on Christmas Day 1873, and organized District Assembly No. 1. The Order increased during the years following this action, and in 1877 delegates were chosen to organize a General Assembly. These delegates met at Reading, Pa., 1st January 1878, and organized the first General Assembly, Mr Stephens, the founder, presiding as temporary chairman. Seven states were represented. General Assemblies have been held each year since that time, and changes in the constitution or work of the Order have been the subject of warm discussion. At the meeting of the first General Assembly the membership must have been small, probably only a few thousand. It did not reach 50,000 till five years later. The General Assembly of 1880, at Pittsburg, denounced strikes as injurious, and not worthy of support, except in extreme cases. At the fifth session, at Detroit, in 1881, the most important actions in the history of the Order were taken, and from this session the rapid growth of the Order may be dated. The Assembly then declared that on and after 1st January 1882 the name and objects of the Order should be made public. It also declared that women should be admitted upon an equal footing with men, and a strong committee was appointed to revise the constitution and the ritual. At the next General Assem- bly, September 1882, in New York, the revised constitu- tion was adopted, as well as laws and regulations for supporting strikes. After this the Order began to grow rapidly. It antagonized the trade unions, the contention being that the Order embraced higher and grander principles than those underlying the organization of the former. The trade unions in existence at that time struggled to preserve their organizations against what they considered the encroachment of the Knights of Labour. The high-water mark of the Order was probably during 1883, 1884, 1885, and 1886, when, according to the very best information, it. numbered not less than 1,000,000 members. In 1900 its membership was estimated at about 130,000.*~~

~~*The declaration of principles of the Knights of Labour calls attention to the alleged alarming development and aggressiveness of great capitalists and corpora- tions, and makes the following specific claims Declaration or demands : To make industrial moral worth, "jphi? not wealth, the true*~~

~~*standard of individual and national greatness ; to secure to the workers the full enjoy- ment of the wealth they create ; sufficient leisure in which*~~

~~*to develop their intellectual, moral, and social faculties, and all of the benefits, recreations, and pleasures of asso- ciation. As means for securing these results, they de- mand at the hands of the State the establishment of Bureaus of Labour Statistics; that public land, the heritage of the people, be reserved for actual settlers ; the abrogation of all laws that do not bear equally upon capital and labour ; the adoption of measures providing for the health and safety of those engaged in mining, manufacturing, and building industries, and for indemni- fication for injuries received; the recognition by incorpo- ration of trade unions, orders, and such other associations as may be organized by the working masses ; the enact- ment of laws to compel corporations to pay their employes weekly, and giving mechanics and labourers a first lien upon the product of their labour to the full extent of their wages ; the abolition of the contract system on national, state, and municipal works ; the enactment of laws pro- viding for arbitration between employers and employed ; the prohibition by law of the employment of children under fifteen years of age in workshops, mines, and factories ; that the hiring out of convict labour be pro- hibited, and that a graduated income tax be levied. They demand of Congress the establishment of a national monetary system, in which a circulating medium shall issue directly to the people ; that interest-bearing bonds, bills of credit, or notes shall never be issued by the Government ; the prohibition of the importation of foreign labour under, contract ; the organization of financial ex- changes, safe deposits, &c, in connexion with the post office ; the possession by Government, by purchase, of telegraphs, telephones, and railways. The Order pledges itself, while making the foregoing demands upon the state and national governments, to endeavour to establish a co-operative institution to supersede the wage system, to secure for both sexes equal pay for equal work, to shorten the hours of labour by a general refusal to*~~

~~work for more than eight hours, and to persuade employers to agree to arbitrate all differences which may arise.~~

~~The Order of the Knights of Labour is based on the federal plan, and has a hierarchy of assemblies — the Local Assembly, the Dis- trict Assembly, the State and the General Assembly. Organi- ^ng officers of the Local Assembly consist of a Master Workman, Worthy Foreman, Venerable Sage, Recording Secretary, Financial Secretary, Treasurer, Worthy Inspector, Al- moner, Statistician, and some minor officers. These are elected semi-annually by ballot or by acclamation. The District Assembly is composed of duly accredited delegates from at least five Local Assemblies, and is the highest tribunal of the Knights of Labour within its jurisdiction under the general laws of the Order. It has the power to levy assessments for its maintenance upon all Locals, and has also the power to establish Locals in the territory governed by it. The officers and their duties are similar to those of the Local Assembly, except that the Master Workman is called the District Master Workman. The constitution of the General Assembly is a very imposing document, containing twenty articles. The Assem- bly consists of representatives chosen by the District Assemblies, and has full and final jurisdiction, being the highest tribunal of the Order. It alone possesses the power and authority to make, amend, or repeal the fundamental and general laws of the Order, to decide finally all controversies arising, and to issue charters to State, Dis- trict, and Local Assemblies. The officers are elected at each an- nual session, and their titles correspond almost completely with those of the Local and District Assemblies, with the exception that the word " General " takes the place of "District," as "General Master Workman," &c. The General Master Workmen have been Uriah S. Stephens (the founder of the Order), Terence V. Powderly, James R. Sovereign, John N. Parsons, and Henry A. Hicks, the present incumbent. The Order has a publication known as the Journal of the Knights of Labour, published at Washington, D.C.~~

~~The third attempt to bring into one order men employed in different vocations was the American Eail- B>murlcV roa<^ Union, organized in Chicago on 20th June uahm. 1893. It included all railway employe's born of white parents. It was organized for the pro- tection of members in all matters relating to wages and I~~

~~their rights as employe's, and affirmed that such employe's were entitled to a voice in fixing wages and in determining conditions of employment. The union won a great vic- tory on the North-Western railroad in April 1894, but its action in the great strikes in Chicago in 1894 cost it its life. Its membership reached at one time 150,000.~~

~~The separate unions found that the co-operation of other unions was needed to perfect and extend their work, and attempts were made from time to time to organize a federated body. The initial Pedera- steps were taken in 1866, when the trades labour! assemblies of New York City and Baltimore called a national labour congress, the 100 delegates sent by 60 secret and open organizations from different trades unions meeting on 20th August. In 1867 a second conven- tion was called to meet in Chicago, the aim being to form a Trades Union Congress like that existing in Great Britain. The National Labour Union held two conven- tions in 1868, the first in May and the other in September ; it met again in Chicago in 1869, in Boston in 1870, in Philadelphia in 1871, and in Columbus, O., in 1872. This closed the experience of the National Labour Union. During 1873, owing to the industrial depression, many of the trade unions were suspended. An Industrial Congress met in Rochester, N.Y., in April 1874, consisting of some of the leading trade unionists of the United States, and on the 14th of that month a convention was held repre- senting the Sovereigns of Industry. The expectation was that the old National Labour Union should be taken up. The Industrial Brotherhood of the United States, another secret order, partaking largely of the character of the Knights of Labour, was represented in that convention. As might have been expected, the two ideas — that on which the Knights of Labour was organized, and the trade union idea — immediately became antagonistic, yet a platform containing most of the principles of the Knights of Labour was adopted. The movement ended with the Rochester meeting. The years 1875 and 1876 saw other attempts ; but they were chiefly political in their character, and the temporary orders then organized were disbanded. Between 1876 and 1881 other attempts were made at federation. A call issued jointly by the Knights of Industry and a body known as the Amalga- mated Labour Union, consisting of some dissatisfied members of the Knights of Labour, resulted in a conven- tion held at Terre Haute, Ind., 2nd August 1881. The chief purpose was to~~

~~*supplant the Knights of Labour by the creation of a new secret order. The membership of the convention, however, had trade union proclivities, and did not believe in multiplying labour societies. The secret organization was not effected. Another convention was held in Pittsburg, 19th November 1881, as the result of the following statement : —*~~

~~*We have numberless trades unions, trades assemblies or councils, Knights of Labour, and various other local, national, and inter- national labour unions, all engaged in the noble task of elevating and improving the condition of the working classes. But great as has been the work done by these bodies, there is vastly more that can be done by a combination of all these organizations in a federa- tion of trades and labour unions.*~~

~~*It is claimed that the 107 delegates represented 262,000 workmen. Their deliberations resulted in the Federation of Organized Trades and Labour Unions of the United States and Canada. Its platform differed but very little from that of the Knights of Labour, although it was in some respects more comprehensive. It demanded eight hours as a day's work; called for national and state incorporation of trade unions ; favoured obligatory edu- cation of all children, and the prohibition of their employ- ment under the age of fourteen ; favoured the enactment of uniform apprentice laws ; opposed bitterly all contract*~~

~~*convict labour and the truck system for payment of wages ; demanded laws giving to working men a first lien on property upon which their labour had been expended; insisted upon the abrogation of all so-called conspiracy laws ; advocated the establishment of a national bureau of labour statistics ; urged the prohibition of the importation of foreign labour; opposed Government contracts on public work ; favoured the adoption by states of an Em- ployers' Liability Act ; and urged all other labour bodies to vote only for labour legislators. The second conven- tion was held at Cleveland, 0., 21st November 1882. The Federation had many*~~

very difficult problems under discussion during the next few years, among others being the attempt to include Socialism and the doctrines of Anarchists; but the Federation has always stood out against these attempts, although at one time it seemed likely that it would become a Socialistic body, in full alliance with the Socialist Labour party.

The American Federation of Labour is the largest labour organization in the United States. It was organized at Columbus, 0., 8th December 1886, under the name it now bears. In 1888 it was1 declared that it owed its existence to the Federation of Organized Trades, &c, founded in 1881 at Pittsburg, and that the American Federation meetings or conventions should date from that year; hence it is generally stated that the Federation was founded in 1881. From the start in 1881 the Federation had a constitution, but it revised it at the convention held in Baltimore, 16th December 1887, under the name of the American Federation of Labour. The order is not secret, nor do individual members, through local trades unions or otherwise, owe any allegiance to it. Its object is the encouragement and formation of local trades and labour unions, and the closer federation of such societies through the organization of central trades and labour unions in every State, and the combination of such bodies into state, territorial, or provincial organizations for the purpose of securing general harmony not only in the interests of the working masses, but of legislation. While it is a federation, it cannot be called a federal body, like the Knights of Labour, although there are local trade unions, trade assemblies in cities, and state federa- tions ; nevertheless, there is not the hierarchical character of the other body. Most of the trade unions in the United States are affiliated with the American Federation. The great railway brotherhoods are not so affiliated, ex- cept the Amalgamated Association of Railroad Employes of America, the Order of Railroad Telegraphers, and the Brotherhood of Eailroad Trackmen.

The following is a list of the principal unions affiliated : — Actors' National Protective Union ; Allied Metal Mechanics, International Union of ; Bakers and Confectioners International, Journeymen ; Barbers National, Journeymen ; Black- smiths, International Brotherhood of ; Blast Furnace "Workers and Smelters of America, International Association of ; Boiler Makers and Iron Ship Builders, Brotherhood of ;

~~*Bookbinders, International Brotherhood of ; Boot and Shoe Workers' Union ; Brewery Workers, National Union of United ; Brickmakers' National Alliance ; Bridge and Structural Iron- workers ; Broom Makers, International ; Carpenters and Joiners of America, United Brotherhood of ; Carpenters and Joiners, Amalgamated Society of ; Carriage and Wagon Makers, In- ternational ; Wood Carvers' Association of North America, International ; Cigar-Makers' International Union of America ; Clerks' International Protective Association, Retail ; Coopers' International Union of North America ; Coremakers' Inter- nationa] Union ; Curtain Operatives of America, Amalgamated Lace ; Drivers' International Union, Team ; Electrical Workers of America, National Brotherhood of ; Engineers, National Brotherhood of Coal Hoisting ; Engineers, International Union of Steam ; Engineers, Amalgamated Society of ; Engravers, In- ternational Association of Watch Case ; Firemen, Interna- tional Brotherhood of Stationary ; Fitters and Helpers, National Association of Steam and Hot Water ; Garment Workers of America, United ; Glass Bottle Blowers' Association of the*~~

~~*Affiliated unions.*~~

~~*United States and Canada ; Glass Cutters' League of America, Window ; Glass Flatteners' Association of North America, Window ; Glass Workers' Union, American Flint ; Gold Beaters' Union, National ; Granite Cutters' National Union ; Grinders' National Union, Table Knife ; Hatters of North America, United ; Horse Shoers of United States and Canada, International Union of ; Hotel and Restaurant Employes' International Alliance and Bar-tenders' International League of America ; Iron, Steel, and Tin Workers, Amalgamated Association of ; Lathers, International Union of Wood, Wire, and Metal ; Leather Workers on Horse Goods, United Brotherhood of ; Longshoremen's Association, International ; Machinists, International Association of ; Meat Cutters and Butcher Workmen of North America, Amalgamated ; Metal Polishers', Buffers', Platers', and Brass Workers' Union of North America ; Metal Workers' International Association, Amal- gamated Sheet ; Mine Workers of America, United ; Mine Workers' Progressive Union, Northern Mineral ; Moulders' Union of North America, Iron ; Musicians, American Federation of ; Oil and Gas Well Workers,*~~

~~*International Brotherhood of ; Paper Makers of America, United Brotherhood of ; Pattern Makers' League of North America ; Plumbers, Gas Fitters, Steam Fitters, and Steam Fitters Helpers, United Association of ; Plate Printers' Union of United States, National Steel and Copper ; Printing Pressmen's Union, International ; Potters, National Brotherhood of Operative ; Railroad Employes of America, Amalgamated Association of ; Railroad Telegraphers, Order of ; Railroad Track- men, Brotherhood of ; Seamen's Union, International ; Spinners' Association, Cotton Mule ; Stage Employes National Alliance, Theatrical ; Stove' Mounters, International ; Tailors' Union of America, Journeymen ; Textile Workers of America, National Union of ; Tile Layers' Union, International Mosaic and En- caustic ; Tin Plate Workers' International Protective Union of America ; Tobacco Workers' International Union ; Trunk and Bag Workers' International Union; Typographical Union, Interna- tional ; Weavers' Amalgamated Association, Elastic Web ; Wood Workers' International Union of America, Amalgamated.*~~

~~*The state branches affiliated with it are those of Alabama, California, Connecticut, Florida, Georgia, Illinois, Iowa, Kentucky, Massachusetts, Michigan, Missouri, Nebraska, New York, New Jersey, North Carolina, Ohio, South Carolina, Texas, Utah, Virginia, and Wisconsin. The central labour unions, trades assemblies, or labour councils of cities are also affiliated with the American Federation. The chief officers of the Federation are a president, first, second, third, fourth, fifth, and sixth vice- presidents, treasurer and secretary. Samuel Gompers of New York was the first president, holding that position till 1894, when he was defeated through the endeavours of the Socialist Labour party, and John M'Bride elected. At the next session, however, h« was re-elected, and has been the president ever since. The numerical strength of the American Federation of Labour is probably not far from 1,000,000. It maintains a journal called the American Federationist, published at Washington, D.C. The doctrine of the Federation relative to strikes is that each affiliated society has its own government, distinct from the government of the national convention, which has no power to order strikes, such matters being left to the affiliated societies, but is advisory, and not conclusive in its action.*~~

~~Unions are often organized for temporary purposes, their existence ceasing as soon as the purposes succeed or fail. The total number of members of all kinds of labour organizations cannot be stated, f^^^ There are many local societies and associa- tions other than those belonging to the Knights of Labour or those affiliated with the American Federa- tion of Labour, but which are distinctly labour bodies. In 1900, according to the best possible classification, there were 18,000,000 wage-earners in the United States, including men, women, and children. The most liberal estimate of the membership of all labour organizations places the total at 1,600,000. This would be about 8 per cent, of the whole body of wage-workers ; but in some occupations, like that of the printing trade, the organiza- tion probably includes from 75 to 90 per cent. ; and so of other organizations of workers found very largely in the unions. It is not safe, therefore, to make calculations from general estimates.~~

~~In the state of New York in 1901 there were known to be 1881 trade unions with 276,141 members, of which 84,401 belonged to the building trades, 41,883 to the clothing trades, 17,896 to the printing and kindred trades,~~

~~35,562 to iron and steel trades, 34,371 to railway service, and the others to various other trades and industries. In Connecticut there were, in 1900, 340 trade unions, of which 122 returned a membership of 14,244. The greater part of the expenditure appears to have been on sick and funeral benefits and management.~~

~~The law relating to trade unions varies somewhat in the different states. Both the Federal Legislature and several of the states (Massachusetts, New York, Penn- sylvania, Michigan, Maryland, Iowa, Kansas, and Louis- iana) have passed laws permitting the incorporation of unions. Michigan, Wyoming, and Nebraska have specially provided for incorporating assemblies of the Knights of Labour. Hardly any advantage, however, has been taken of these statutes. Some states have passed laws excepting trade unions from restrictions on combinations and~~

~~*conspiracies imposed by other statutes or the common law (e.g., New York), and especially from the operation of anti-trust laws (Michigan, Wisconsin, Nebraska, Montana, North Carolina, and Texas). The Texas law, however, has been held unconstitutional. A number of states have passed laws, some of doubtful validity, prohibiting employers from making it a condition of employment that labourers should not belong to a union. Most states have adopted statutes legalizing union labels to indicate the products of members of trade unions.*~~

~~*By Act of Congress, associations of the nature of labour organizations, having branches in several states or terri- tories, may, on filing articles of association for record in Washington, become corporations. American legislation generally is friendly to trade unions. Their purposes are regarded as lawful by the courts, but if they use unlawful means for their accomplishments, a remedy will be applied. Injury to property, intimidation by threats, personal violence, or boycotts enforced by ter- rorism, are such unlawful means. The liberty of action thus secured to organizations of labour is equally the right of the employer. Therefore, a statute making it an offence for one to require those whom he employs to withdraw from a trade union is unconstitutional and void (see Reports of American Bar Association, volume xxi. 367, 372).*~~

~~*Authorities. — Ely. The Labour Movement in America. New York, N.Y., 1886. — M'Neill. The Labour Movement. Boston, Mass., 1887.^- Powdeelt. Thirty Tears of Labour. Columbus, 0., 1889. — Simonds. The Story of Manual Labour in all Lands and Ages. Chicago, 1886. — Bliss. The Encyclopcedia of Social Reform. New York, 1897. — Aldrich. " The American Federa- tion of Labour," Economic Studies, August, 1898. — Wright. In- dustrial Evolution of the United States. Meadville, Pa., 1895. — " HIistorical Sketch of the Knights of Labour," Quarterly Journal of Economics, January, 1887. — " The Amalgamated Association of Iron and Steel Workers," Quarterly Journal of Economics, July 1893 and November 1901. (c. d. w.)*~~

~~*Traill, Henry Duff (1842-1900), English author and journalist, was born at Blackheath on 14th August 1842. When he left Oxford with the usual degree, he studied for the bar. HIe was called in 1868, but practised*~~

~~*scarcely at all, and in 1871 obtained a post in the Educa- tion Office. This left him leisure to cultivate the liter- ary gift which had clearly shown itself in him at Oxford, and in 1873 he became a contributor to the Pall Mall Gazette, then under the editorship of Mr Frederick Greenwood. He followed Mr Greenwood to the St James's Gazette when in 1880 the Pall Mall Gazette took for a time the Liberal side, and he continued to contribute to that paper up to 1895. In the meantime he had also joined the staff of the Saturday Review, to which he sent, amongst other writings, weekly verses upon subjects of the hour. Some of the best of these he republished in 1882 in a volume called Recaptured Rhymes, and others*~~

~~*in a later collection of Saturday Songs (1890). He was also a leader-writer on the Daily Telegraph, and acted for a time as editor of the (Sunday) Observer. In 1897 he became first editor of Literature, when that weekly journal was established by the proprietors of The Times, and directed its fortunes until his death. But it was rather as a writer than an editor that Traill excelled. He wrote best when he wrote with least sense of the burden of responsibility. His playful humour and his ready wit were only given full scope when he was writing to please himself. One of his most brilliant jeux d 'esprit was a pamphlet which was published without his name soon after he had begun to write for the newspapers. It was called TJie Canaanitish Press and the Israelitish Ques- tion. This told the story of the Exodus in articles which parodied very cleverly the style of all the leading journals of the day, and was at once recognized as the work of a born humorist. Traill sustained this reputation with The New Lucian, which appeared in 1884 (second edition with several new dialogues, 1900) ; but for the rest his labours were upon more serious lines. He directed the production of a vast work on Social England in 1893-98 ; he wrote, for several series of biographies, studies of Coleridge, Sterne, William III., Shaftesbury, Strafford, and Lord Salisbury ; he compiled a biography of Sir John Franklin, the Arctic explorer ; and after a visit to Egypt he published a volume on the country and another on Lord Cromer, the man who had done so much to bring it back to prosperity. Traill was certainly one of the most distinguished journalists of his day, and might well have left some enduring monument of his talent as a man of letters if he had not been so constantly occupied with ephemeral production. He died in London on 21st Feb- ruary 1900. (h. h. f.)*~~

~~Tralee, a maritime town, market town, and urban sanitary district in the county of Kerry, Ireland, on the river Lee,. 181^- miles W.S.W. of Dublin by rail. Large vessels discharge at Fenit, 8 miles westward, where a pier has been constructed, connected with the town by rail- way. In all 289 vessels of 1498 tons entered in 1900, and 120 of 23,459 tons cleared. Population about 9867.~~

~~Tranent, a police burgh of Haddingtonshire, Scot- land, on the highroad between Edinburgh and Hadding- ton, 9£ miles east of the former. The town thrives on the retail trade of its district and the surrounding coal mines and quarries. It has the oldest coal-mining charter (1202-18) in Great Britain. A fragment of a parish church said to have been built in the 11th century is still standing. Tranent is being largely reconstructed. There is a town hall, an Elizabethan school, and a Boman Cath- olic boarding school. Population (1881), 2235 ; (1891),~~

~~2389 ; (1901), 2584.~~

~~Tranmere. See Biekenhead.~~

~~Tranquebar, a town of British India, in the Tan- jore district of Madras, on the sea coast, 22 miles north of Negapatam. Population (1891), 5000. It lost its importance when the railway was opened to Negapatam. The Lutheran mission high school (combined with one at the village of Shiyali on the railway) had 120 pupils in 1896-97. There is a mission press, issuing a monthly periodical in the vernacular, besides a reading room and literary institute.~~

~~Transbaikalia (ZabaiJcalskaya Oblast), a province of Eastern Siberia, to the east of Lake Baikal, bounded on the W. by Irkutsk, on the N. by Yakutsk, on the E. by the province of Amur, and on the S. by Mongolia. Its area is 236,868 square miles, and its population, which was 497,760 in 1882, numbered 664,071 (domiciled only)~~

~~in 1897, of whom 325,349 were women, and 36,823 lived in towns. The province is divided into five districts, the chief towns of which are Tchita~~

~~*(11,480 inhabitants), which is also the capital of the province, Barguzin (1378), Nerchinsk (6713), Selenghinsk (1076), and Verkhneudinsk (8002). Other towns are Kyakhta (4300), Nerchinskiy Zavod, and Sryetensk. The standard of education is low, there being less than 200 schools attended by less than 10,000 scholars. Mining, and especially gold mining, is important, but the production of gold has fallen off (4451 kilogrammes in 1882, 3882 kilogrammes in 1897). Silver mines have only a very small output (925 kilo- grammes in 1897), and the production of iron is also insignificant (in 1897, 645 tons of pig iron and 532 tons of iron). Iron mining, however, is gradually developing, and explorations in connexion with the Trans-Siberian railway have led to the discovery of good coal mines, which are now being worked. Salt is raised from several lakes to the amount of about 750 tons per annum, and the extraction of Epsom salts has considerably developed, nearly 1000 tons being obtained every year. Agriculture, however, continues to remain the main occupation of the people, and the average yield of all cereals is estimated to be not less than a million quarters yearly. Cattle- breeding is also of great importance, there being in the province over 500,000 horses and an aggregate of 2,700,000 head of various cattle. Hunting for sables and (especially) squirrels, and the gathering of nuts are widely followed. Manufactures, though insignificant, have somewhat increased. Transbaikalia is crossed by the Trans-Siberian railway from Mysovaya on Lake Baikal, vid Tehita, to Sryetensk, and from Kaidalovo, near Tchita, to the Mongolian frontier ; this latter sec- tion is continued, as the main line, across Manchuria to Vladivostok and Port Arthur (see Russia and Siberia). River navigation has been improved and extended ; regu- lar steamer communication has been established along Lake Baikal, not only for the transport of passengers and goods between the two railway stations of Listvenichnaya and Mysovaya, but also with the object of developing the fishing industry, which is of great importance. Steamers ply up the Selenga river as far as the town of Selenghinsk, considerable cargoes of tea being transported along this line. (p. a. k.)*~~

~~*Trans-Caspian Territory (Zakaspiyskaya Oblast), a province of Russia to the east of the Caspian Sea, bounded by Uralsk on the N., by Khiva and Bokhara on the N.E., by Afghan Turkestan on the S.E., and by the highlands of Afghanistan and Khorassan on the S. Its area is officially*~~

~~*estimated at 220,540 square miles, but Strelbitzky reckons it to be only 214,240 square miles. In 1897 the domiciled population numbered 372,193, of whom 166,084 were women, and only 42,431 lived in towns; but, besides those of whom alone the census took account, there were about 25,000 strangers and troops. In 1895, when the population was estimated at 331,030, there were 240,200 Turcomans, 60,560 Kirghiz, 12,400 Russians (only 2174 peasants), 11,600 Persians and Tatars, 4170 Armenians, and 2100 of various nationalities. The province is divided into five districts, the chief towns of which are : Askhabad (19,428), which is also the capital of the province ; Krasnovodsk (6359) ; Fort Alexandrovskiy (882), in the district of Manghishlak, on the Caspian Sea; Merv (8727), and Tejen (382). In 1898 there were only 24 schools with 1200 pupils.*~~

~~*The land is very rich in minerals : rook-salt covers over 80 acres on the island of Cheleken, and is also found at Bala Ishem, along the Uzboi, and in many lakes ; while naphtha, ozokerite, and gyp- sum are found in several places. At the present time the chief minerals extracted are rock-salt, 18,300 tons in 1897 ; naphtha,*~~

~~*14,050 tons from Cheleken Island ; gypsum, 1240 tons ; sulphur, nearly 5000 tons. Nearly 300,000 acres are irrigated by the natives, and attempts are being made by the Government to increase the irrigated area by means of dams and new canals ; it is considered that over 5,000,000 acres of land could be rendered suitable for agriculture. Strenuous efforts are being made to in- crease the forest area ; several hundred thousand trees are planted every year, and a forest guard has been established to prevent useless destruction of the saksaul trees, which grow freely in the steppes. A model garden and a mulberry-tree plantation have been established at Askhabad in connexion with the gardening school. The land in the oases, especially those of the Atrek, is highly cultivated. In 1896, 1,300,000 cwt. of wheat and 220,000 cwt. of barley were grown, in addition to sorghum, Indian corn, rice, millet, and "kunjut " for oil. Raw cotton to the amount of nearly 3000 tons was obtained in 1896 in the Merv district, where nearly 10,000 acres were under this crop, and four factories were engaged in cotton cleaning. Gardening is well developed, and at- tempts are being made to encourage the spread of viticulture. Cattle-breeding is the chief*~~

~~occupation of the nomad Turcomans and Kirghiz. It was estimated in 1895 that there were in the pro- vince 106,000 horses, 44,000 horned cattle, 18,000 donkeys, 186,000 camels, and nearly 3,000,000 sheep and goats. Raw wool is exported to the value of 600,000 roubles per annum, as also over 60,000 hides and nearly 150,000 sheepskins. Consider- able fishing is carried on off the coasts of the Caspian Sea, and seals are killed on the Manghishlak Peninsula. The natives follow a variety of domestic trades, in which they excel, chiefly the making of carpets, travelling bags, felt goods, and embroidered leather. The Russian population is chiefly limited to the military and the towns, only eight agricultural and three fisning villages containing Russians. Wheat, flour, wool, raw cotton, and dried fruit are exported, while tea, manufactured goods, timber, sugar, iron, paraffin oil are imported, as also rice and fruit from Bokhara, Turkestan, and Persia. The Trans-Caspian railway, constructed across the province from Krasnovodsk to Merv, with a branch to Kushka, and from Merv to Bokhara and Russian Turkestan, has accomplished quite a revolution in the trade of Central Asia. The old caravan routes via Orenburg have lost their im- portance, and goods coming from India, Persia, Bokhara, and even China are now brought to different stations on the railway. The export of raw cotton from Bokhara along this line supplies the Russian cotton mills with a considerable portion of the raw material which they require, and in the year 1895 the exports of cotton, wool, dried fruit, hides, sheepskins, &c, were estimated at nearly 100,000 tons, while the imports of corn, metals, paraffin oil, and timber amounted to 613,000 tons. (For the recent history see Russia : History.)~~

~~See the researches of Andeusoff, Bogdanovitch, Konshin, Mushketoff, and Obbucheff in the Memoirs, the Bulletin (Izvestia) , and the Annuals of the Russian Geographical Society, 1890-1900. — Lessae. Vancienne junction de VOxus avec la Mer Caspienne, 1889. — Zaroudnoi (zoology) in Bulletin de la Societe des Naturalistes de Moscou, 1889 seq. — Works of the International Commission, in English and Russian. — Obzor Zakaspiyskoi Oblasti (annual reviews), published at Askhabad, since 1890. — The Geo- graphical Journal (Royal Geographical Society, London), 1893.~~

~~(P. A. K.)~~

~~*Transformers. — An electrical transformer is the name given to any device for producing by means of one electric current another of a different character. The working of such an appliance is, of course, subject to the law of conservation of energy. The resulting current represents no more (in fact, always less) power than the applied current, the difference being represented by the power dissipated in the translating process. Hence an electrical transformer corresponds to a simple machine in mechanics, both transforming power from one form into another with a certain energy-dissipation depending upon frictional losses, or something equivalent to them. Elec- trical transformers may be divided into several classes, according to the nature of the transformation effected. The first division comprises those which change the form of the power, but keep the type of the current the same ; the second, those that change the type of the current as well as the form of power. The power given up electri- cally to any circuit is measured by the product of the effective value of the current, the effective value of the dif- ference of potential between the ends of the circuit, and a factor called the power factor. In dealing with periodic*~~

~~*currents, the effective value is that called the root-mean- square value (B.M.S.), that is to say, the square root of the mean of the squares of the time equidistant in- stantaneous values during one complete period (see Electricity: Electric Current). In the case of con- tinuous currents, the power factor is unity, and the effective value of the current or voltage is the true mean value. As the electrical measure of a power is always a product involving current and voltage, we may traus- form the character of the power by increasing or diminish- ing the current with a corresponding decrease or increase of the voltage. A transformer which raises voltage is generally called a step-up transformer, and one which lowers voltage is called a step-down transformer.*~~

~~*Again, electric currents may be of various types, such as continuous, single-phase alternating, polyphase alter- nating, unidirectional but pulsating, &c. Accordingly, transformers may be distinguished in another*~~

~~*way, in accordance with the type of transformation they effect. (1) An alternating current transformer is an appli- ance for creating an alternating current of any required magnitude and electromotive force from another of different value and electromotive force, but of the same frequency. An alternating current transformer may be constructed to transform either single-phase or polyphase currents. (2) A continuous current transformer is an appliance which effects a similar transformation for continuous currents, with the difference that some part of the machine must revolve, whereas in the alternating current transformer all parts of the machine are station- ary ; hence the former is generally called a rotatory transformer, and the latter a static transformer. (3) A rotatory or rotary transformer may consist of one machine, or of two separate machines, adapted for converting a single-phase alternating current into a polyphase current, or a polyphase current into a continuous current, or a continuous current into an alternating .current. If the portions receiving and putting out power are separate machines, the combination is called a motor-generator. (4) A transformer adapted for converting a single-phase alternating current into a unidirectional but pulsatory current is called a rectifier, and is much used in con- nexion with arc lighting in alternating current supply stations. (5) A phase transformer is an arrangement of static transformers for producing a polyphase alternating current from a single-phase alternating current. Alter- nating current transformers may be furthermore divided into (a) single-phase, (6) polyphase. Transformers of the first class change an alternating current of single- phase to one of single-phase identical frequency, but different power; and transformers of the second class operate in a similar manner on polyphase currents. (6) The ordinary induction or spark coil may be called an intermittent current transformer, since it transforms an intermittent low-tension primary current into an inter- mittent or alternating high-tension current.*~~

~~*Alternating Current Transformer. — The typical alter- nating current transformer consists essentially of two insulated electric circuits wound on an iron core constituting the magnetic circuit. They may be divided into (1) open magnetic circuit static transfor- mers, and (2) closed magnetic circuit static transformers, according as the iron core takes the form of a termi- nated bar or a closed ring. A closed circuit alternating*~~

~~current transformer consists of an iron core built up of thin sheets of iron or steel, insulated from one another, and wound over with two insulated conducting circuits, called the primary and secondary circuits. The core must be laminated or built up of thin sheets of iron to prevent local electric currents, called eddy currents, from being established in it, which would waste energy. In~~

~~practical construction, the core is either a simple ring, round or rectangular, or a double rectangular ring, that is, a core whose section is like the figure 8. To prepare the core, thin sheets of iron or very mild steel, not thicker than -014 of an inch, are stamped out of special iron (see Electromagnet) and carefully annealed.~~

~~Examples of the shapes in which these stampings are supplied are shown in Fig. 1. The plates when annealed are varnished or covered with thin paper on one side, and then piled up so as to make an iron core, being kept together by bolts and nuts or by~~

~~Fig. 2. — Closed Circuit Transformer.~~

~~Fig. 1. — Transformer Stampings and Core.~~

~~pressure plates. The designer of a transformer core has in view, first, economy in metal, so that there may be no waste fragments, and second, a mode of construction that facilitates the winding of the wire circuits. These consist of coils of cotton-covered copper wire which are wound on formers and baked after being well saturated with shellac varnish. The primary and secondary cir- cuits are sometimes formed of separate bobbins which are sand- wiched in between each other; in other cases they are wound one over the other (Fig. 2). In any case the primary and secondary coils must be sym- metrically distributed. If they were placed on opposite sides of the iron circuit, the result would be considerable mag- netic leakage. Sometimes a metal shield is placed between the primary and secondary coils ; in other cases safety sheets of mica or ebonite are used. The transformer is then well baked and placed in a~~

~~cast-iron case sometimes filled in with heavy insulating oil, the ends of the primary and secondary circuits being brought out through water-tight~~

glands. The most ordinary type of alternat- ing current transformer is one intended to transform a small electric current produced by a large electromotive force (2000 to 10,000 volts) into a larger current of low electromotive force (100 to 200 volts). Such a transformer is called a step-down transformer, but it may be obviously employed in the reverse direction for raising pressure and reducing current, in which case it is called a step-up transformer. A transformer when manu- factured has to be carefully tested to ascertain, first, its power of resisting breakdown, and, second, its energy-dissipating qualities. With the first object, the transformer is subjected to a series of pressure tests. If it is intended that the primary shall carry a current having an electromotive force of 2000 volts, an insula- tion test must be applied with double this voltage between the primary and the secondary, the primary and the case, and the pri- mary and the core, to ascertain whether the insulation is sufficient. To prevent electric discharges from breaking down the machine in ordinary work, this extra pressure ought to be applied for at least a quarter of an hour. In some cases three or four times the working pressure is applied for one minute between the primary and secondary circuits. When such an alternating current trans- former has an alternating current passed through its primary

circuit, an alternating magnetization is produced in the core, and this again induces an alternating secondary current. The second- ary current has a greater or less electromotive force than the primary current according as the number of windings or turns on the secondary circuit is greater or less than those on the primary. Of the power thus imparted to the primary circuit one portion is dissipated by the heat generated in the primary and secondary circuits by the currents, and^nother portion by the iron core losses due to the energy wasted in the cyclical magnetization of the core ; the latter are partly eddy current losses and partly hysteresis losses.

~~*In open magnetic circuit transformers the core takes the form of a laminated iron bar or a bundle of iron wire. An ordinary induc- tion coil is an instrument of this description. It has been shown, however, by careful experiments, that for alternating current trans- formation there are very few cases in which the closed magnetic circuit transformer has not an advantage. An immense number of designs of closed circuit transformer have been elaborated since*~~

~~*Fig. 3. — Diagrams of (A) Mordey (in section), (B) Kapp, and*~~

~~*(C) Ganz Transformers.*~~

~~*1, 1, primary circuit ; 2, 2, secondary circuit.*~~

~~*the year 1885. It suffices simply to mention the names of the principal modern types, such as those of Ferranti, Kapp, Mordey, Westinghouse, Berry, and Ganz. Diagrammatic representations of the arrangements of the core and circuits in some of these trans- formers are given in Fig. 3.*~~

~~*Alternating current transformers are classified into (i.) Core and (ii.) Shell transformers, depending upon the arrangements of the iron and copper circuits. If the copper circuits are wound on the outside of what is virtually an iron ring, the transformer is a core trans- former; if the iron encloses the copper circuits, it is a shell transformer. Shell transformers hare the dis- advantage generally of poor ventilation for the copper circuits. Berry, however, has overcome this difficulty by making the iron circuit in the form of a number of bunches of rectangular frames which are set in radial fashion and the adjacent legs all embraced by the two copper circuits in the form of a pair of concentric cylinders. In this manner he secures good ventilation and a minimum expenditure in copper and iron, as well as the possibility of insulating the two copper circuits well from each other and from the core.*~~

~~*The ratio between the power given out by a transformer and the power taken up by it is called its efficiency, and is best represented by a curve, of which the Efficiency. or(^nate js ftie efficiency expressed as a per- centage, and the corresponding abscissae represent the fractions of the full load as decimal fractions. The out- put of the transformer is generally*~~

~~reckoned in kilowatts, and the load is conveniently expressed in decimal fractions of the full load taken as unity. The efficiency on one- tenth of full load is generally a fairly good criterion of the economy of the transformer as a transforming agency. In large transformers the one-tenth load efficiency will reach 90 per cent, or more, and in small transformers 75 to 80 per cent. The general form of the efficiency curve for a closed circuit transformer is shown in Fig. 4. The horizontal distances represent fractions of full secondary load (represented by unity), and the vertical distances efficiency in percentages. The efficiency curve has a maximum value corresponding to that degree of~~

~~load at which the copper losses in the transformer are equal to the iron losses.~~

~~In the case of modern closed magnetic circuit transformers the copper losses are proportional to the square of the secondary current (I2) or to gl22, where q stands for the function (R!a2+R2) ; R], being the resistance of the primary and R2 that of the secondary circuit, while a is the ratio of the number of secondary and primary windings of the transformer. Let C stand for the core loss, and V2 for the secondary terminal potential difference (R.M.S. value). We can then write as an expression for the efficiency (?j) of the transformer,~~

~~I2V2 v C + 2I22+I2V2'~~

~~It is easy to show that if Ci, V2, and q are constants, but I2 is variable, the above expression for 17 has a maximum value when~~

~~C-gI22=0,~~

~~that is, when the iron core loss C=the total copper losses gl22.~~

~~The iron core energy waste, due to the hysteresis and eddy currents, may be stated in watts, or expressed as a fraction of the full load secondary output. In small transformers of 1 to 3 kilowatts output lron aad it may amount to 2 or 3 per cent., and in large ^ses. transformers of 10 to 50 kilowatts and upwards it should be 1 or less than 1 per cent. Thus the core loss of a 30-kilowatt transformer (one having a secondary output of~~

~~30,000 watts) should not exceed 300 watts. It has been shown that for the constant potential transformer the iron core loss is constant at all loads, but diminishes slightly as the core temperature rises. On the other hand, the copper losses due to the resistance of the copper circuits increase about 0.4 per cent, per degree Centigrade with rise of temperature. The side of the~~

~~IUU~~

~~so~~

~~80~~

~~TO~~

~~60 50 40 30~~

~~SO~~

~~10 0~~

~~,s~~

~~r-”~~

~~j~~

~~f~~

~~/~~

~~,~~

~~-J~~

~~•1 2 i * -5 -8 -7 -8 9 10~~

~~Fig. 4. — Efficiency Curve of Closed Circuit Transformer.~~

~~current taken in at the primary transformer, when the secondary circuit is unclosed, is called the magnetizing current, and the power then absorbed by the transformer is called the open circuit loss or magnetizing watts. The ratio of the terminal potential difference at the primary and secondary terminals is called the transformation ratio of the trans- former. Every transformer is designed to give a certain transformation ratio, corresponding to some particular pri- mary voltage. In some cases transformers are designed to transform, not potential difference, but current in a con- stant ratio. The product of the root-mean-square (R.M.S.), effective or virtual, values of the primary current, and the primary terminal potential difference, is called the ap- parent power or apparent watts given to the transformer. The true electrical power may be numerically equal to this product, but it is never greater, and is sometimes less. The ratio of the true power to the apparent power is called the power factor of the transformer. The power factor approaches unity in the case of a closed circuit transformer, which is loaded non-inductively on the secondary circuit to any considerable fraction of its full load, but in the case of an open -circuit transformer the power factor is always much less than unity at all loads. Power factor curves show the variation of power factor with load. A low power factor always implies a magnetic circuit of large reluctance.~~

~~The operation of the alternating current is then as follows : The periodic magnetizing force of the primary circuit creates a periodic magnetic flux in the core, and this being linked with the primary circuit creates by its variation what is called the back electromotive force in the primary circuit. The variation of the particular portion of this periodic flux, linked with the secondary circuit, originates in this last a periodic electromotive force. The whole of the flux linked with the primary circuit is not interlinked with the secondary circuit. The difference is called the magnetic leakage of the transformer. This leakage is increased with the secondary output of the transformer and with any disposition of the primary and secondary coils which tends to separate them. The leakage~~

~~exhibits itself by increasing the secondary drop. If a transformer is worked at a constant primary poten- tial difference, the secondary terminal potential difference at no load or on open secondary circuit is greater than it is when the secondary is closed and the trans- former giving its full output. The difference between these last two differences of potential is called the secondary drop. This secondary drop should not exceed 2 per cent, of the open secondary circuit potential difference.~~

~~The facts required to be known about an alternating current transformer to appraise its value are (1) its~~

~~full load secondary output or the numerical 1nen*'Se~· va^ue °f tne power ' it is designed to transform,~~

~~on the assumption that it will not rise in temperature more than about 60° C. above the atmos- phere when in normal use ; (2) the primary and second- ary terminal voltages and currents, accompanied by a statement whether the transformer is intended for producing a constant secondary voltage or a constant secondary current ; (3) the efficiency at various fractions on secondary load from one-tenth to full load taken at a stated frequency ; (4) the power factor at one-tenth of full load and at full load ; (5) the secondary drop between full load and no load ; (6) the iron core loss, also the magnetizing current, at the normal frequency ; (7) the total copper losses at full load and at one-tenth of full load ; (&) the final temperature of the trans- former after being left on open secondary circuit but normal primary potential for twenty-four hours, and at full load for three hours. The matters of most practical importance in connexion with an alternating current transformer are (1) the iron core loss, which affects the efficiency chiefly, and must be considered (a) as to its initial value, and (6) as affected by " ageing " or use ; (2) the secondary drop or difference of secondary voltage between full and no load, primary voltage being constant, since this affects the service and power of the trans- former to work in parallel with others ; and (3) the temperature rise when in normal use, which affects the insulation and life of the transformer. The shellacked cotton, oil, and other materials with which the trans- former circuits are insulated suffer a deterioration in insulating power if continuously maintained at any temperature much~~

~~above 80° C. to 100° C. In taking the tests for core loss and drop, the temperature of the transformer should therefore be stated. The iron losses are reduced in value as temperature rises and the copper losses are increased. The former may be 10 to 15 per cent, less, and the latter 20 per cent, greater than when the transformer is cold. For the purpose of calculations we require to know the number of turns on the primary and secondary circuits, represented by Nj and N2 ; the resistances of the primary and secondary circuits, re- presented by Rj and E2 ; the volume (V) and weight (M) of the iron core ; and the mean length (L) and section (S) of the magnetic section. The hysteresis~~

~~Fig. 5. — Arrangement for Testing Transformers.~~

~~loss of the iron reckoned in watts per pound per 100 cycles of magnetization per second and at a maxi- mum flux density of 2500 C.G.S. units should also be determined.~~

~~The experimental examination of a transformerinvolves the measurement of the efficiency, the iron core loss, and the secondary drop ; also certain tests as to insu- lation and heating, and finally an examination TesUn*- of the relative phase position and graphic form of the various periodic quantities, currents, and electromotive forces taking place in the transformer. The efficiency is best determine^ by the employment of a properly constructed wattmeter (see Measuring Instruments, Electric). The transformer T (Fig. 5) should be so arranged that, if a constant potential transformer, it is supplied with its normal working pressure at the primary side and with a load which can be varied, and which is ob- tained either by in- candescent lamps, L, or resistances in the secondary cir- cuit. A wattmeter, W, should be placed with its series coil, Se, in the primary circuit of the trans- former, and its~~

~~shunt coil, Sh, either across the primary mains in series, with a suitable non-inductive resistance, or con- nected to the secondary circuit of another transformer, T1, called an auxiliary transformer, having its primary terminals connected to those of the transformer under test. In the latter case one or more incandescent lamps, L, may be connected in series with the shunt coil of the wattmeter so as to regulate the current passing through it. The current through the series coil of the wattmeter is then the~~

~~*same as the current through the primary circuit of the transformer under test, and the current through the shunt coil of the wattmeter is in step with, and proportional to, the primary voltage of the transformer. Hence the watt- meter reading is proportional to the mean power given up to the transformer. The wattmeter can be standard- ized and its scale reading interpreted by replacing the transformer under test by a non-inductive resistance or series of lamps, the power absorption of which is meas- ured by the product of the amperes and volts supplied to it. In the secondary circuit of the transformer is placed another wattmeter of a similar kind, or, if the load on the secondary circuit is non-inductive, the secondary voltage and the secondary current can be measured with a proper alternating current ammeter, A2, and voltmeter, V2, and the product of these read- ings taken as a measure of the power given out by the transformer. The ratio of the powers, namely, that given out in the external secondary circuit and 'that taken in by the primary circuit, is the efficiency of the transformer.*~~

~~*In testing large transformers, when it is inconvenient to load up the secondary circuit to the full load, a close approximation to the power taken up at any assumed secondary load can be obtained by adding to the value of this secondary load, measured in watts, the iron core loss of the transformer, measured at no load, and the copper losses calculated from the measured copper resistances when the transformer is hot. Thus, if C is the iron core loss in watts, measured on open secondary circuit, that is to say, is the power given to the transformer at normal frequency and primary voltage, and if Rj and E2 are the primary and secondary circuit resistances when the transformer has the temperature it would have after running at full load for two or three hours, then the efficiency can be calculated as follows : Let O be the nominal value of the full*~~

~~*secondary output of the transformer in watts, Vi and V2 the terminal voltages on the primary and secondary side, Wi and N2 the number of turns, and Ai and A2 the currents for the two circuits ; then 0/V-. is the full load secondary current measured in amperes, and N2/Ni multiplied*~~

~~by 0/V2 is to a sufficient approxima- tion the value of the corresponding primary current. Hence CRa/Va* is the watts lost in the secondary circuit due to copper resistance, and 02RiN22/V22N"i2 is the corresponding loss in the primary circuit. Hence the total power loss in the transformer (= L) is such that~~

~~O2 /N2VO2~~

~~L = C-~~

~~V2~~

~~1R2+~~

~~:Ml~~

~~Ageing.~~

~~= C + (E2 + Eia2)02/V22.~~

~~Therefore the power given up to the trantfoimer 0 + L and the efficiency is the fraction 0/ (0 + L) expressed as a percentage. In this manner the efficiency can be determined with a considerable degree of accuracy in the case of large transformers without actually loading up the secondary circuit. The secondary drop, however, can only be measured by loading the transformer up to full load, and, while the primary voltage is kept constant, measuring the potential difference of the secondary terminals, and comparing it with the same difference when the transformer is not loaded.~~

~~No test of a transformer is complete which does not comprise some investigation of the "ageing" of the core. The slow changes which take place in the hysteretic quality of iron (see Electromagnet) when heated give rise to a time-increase in iron core loss. Hence a transformer which has a core loss, say, of 300 watts when new, may, unless the iron is well chosen, have its core loss increased from 50 to 300 per cent, by a few months' use. In some cases specifications for transformers include fines and deductions from price for any such increase ; but there has in this~~

~~respect been great im- provement in the manufacture of iron for magnetic purposes, and makers are now able to obtain supplies of good magnetic iron or steel with non-ageing qualities. It is always desirable, however, that in the case of large sub-station transformers tests should be made at intervals to discover whether the core loss has increased by ageing. If so, it may mean a very considerable increase in the cost of magnetizing power. Consider the case of a 30- kilowatt transformer connected to the mains all the year round ; the normal core loss of such a transformer should be about 300 watts, and therefore, since there are 8760 hours in the year, the total annual energy dissipated in the core should be 2628 kilowatt hours. Eeckoning the value of this electric energy at only one penny per unit, the core loss costs £10 19s. Od. per annum. If the core loss becomes doubled, it means an additional annual expenditure of nearly £11. Since the cost of such a transformer would not exceed £100, it follows that it would be economical to replace it by a new one rather than continue to work it at its enhanced core loss.~~

~~Iron sheet for transformer cores is always furnished to specifica- tions which state the maximum hysteresis loss to be allowed in it in watts per pound (avoirdupois) at a frequency of 100, and at a maximum flux-density during the cycle of 2500 C.G.S. units. When plates having a thickness t are made up into a transformer core, the total energy loss in the core due to hysteresis and eddy current loss when worked at a frequency n and a maximum flux- density during the cycle B is given by the empirical formulae~~

~~T= ■0032ri.B1-EB10-'+ (~·V or~~

~~T1 = 0-88mB,i-6S10-9 + ~(hnB^,~~

~~where T stands for the loss per cubic centimetre, and Ti for the same in watts per pound of iron core, B for the maximum flux- density in lines per square centimetre, and Bi for the same in lines per square inch, t for the thickness of the plates in thousandths of an inch (mils), and ti for the same in inches. The hysteresis loss varies as some power near to 1 "6 of the maximum flux-density during the cycle as shown by Steinmetz (see Electromagnet). Good sheet-iron for transformer cores should not have a~~

~~hysteresis loss of more than 0‘25 watt per pound per 100 cycles per 2500~~
~~B~~

~~max.; it can be produced as low as 0-I5 watt per pound, but with irons of very low hysteretic value there is always more risk of ” ageing ” than with the slightly higher values. The flux-density or induction in the core should never rise beyond a maximum value of 4000 to 5000, and it is preferably kept even lower. Since the hysteresis loss varies as the l‘6th power of the maximum flux- density during the cycle (B max.), the advantages of a low flux- density are evident. An excessively low flux-density increases, however, the cost of the core and the copper by increasing the size of the transformer. If the form factor (J) of the primary voltage curve is known, then the maximum value of the flux-density in the core can always be calculated from the formula~~

~~B~~

~~_ Ei~~

~~4/raSNi~~

~~Curve tracing.~~

~~where Ei is the R.M.S. value of the primary voltage, Ni the primary turns, S the section of the core, and n the frequency.~~

~~The study of the processes taking place in the core and cir- cuits of a transformer have been greatly facilitated in recent years by the improvements made in methods of observing and recording the variation of periodic currents and electromotive forces. The original method, due to Joubert, was greatly improved and em- ployed by Ryan, Bell, Duncan and Hutchinson, F'leming, Hopkinson, and Rosa and Callendar ; but the most important improvement was the introduction and inven- tion of the oscillograph by Blonde], subsequently improved by Duddell (see description in Measuring Instruments, Electric). This instrument enables us, as it were, to look inside a transformer, for which it, in fact, performs the same function that a steam engine indicator does for the steam cylinder.1 Delineating in this way the curves of primary and secondary~~

~~current and primary and secon- dary electromotive forces, we get the following result : — Whatever may be the form of the curve of primary ter- minal potential difference, or primary voltage, that of the secondary voltage or terminal potential difference is an almost exact copy, but displaced 180° in phase. Hence the alternating current transformer reproduces on its secondary terminals all the variations of potential on the primary, but changed in scale. The curve of primary current when the transformer is on open secondary circuit is different in form and phase, lagging behind the primary voltage curve (Fig. 6) ; but if the transformer is loaded up on its secondary side, then the primary current curve comes more into step with the primary voltage curve. The secon- dary current curve, if the secondary load is non-induc- tive, is in step with the secondary voltage curve (Fig. 7). These transformer dia- grams yield much informa- tion as to the nature of the operations proceeding in the transformer. Fig. 6.~~

~~The form of the curve of primary current at no secondary load is a consequence of the hys- teresis of the iron, combined with the fact that the form of the core flux-density curves of the trans- former is always not far removed from a simple sine curve. If e-i is at any moment the electromotive force, i⊥ the current on the primary circuit, and 61 is the flux-density in tho core, then we have the fundamental relation e\ = Riii + SNidbJdt, where Ba is the resistance of the crimary, and Ni the number of turns, and S is the cross-section of the core. In all modern closed circuit trans- formers the quantity Rj^ is very small compared with the quantity S~Ndb/dt except at one instant during the phase, and in taking the integral of the above equation, viz., in finding the value of feidt, the integral of the first term on the right-hand side may be~~

~~1 For a useful list of references to published papers on alternating current curve tracing see a paper by W. D. B. Duddell, read before the British Association, Toronto, 1897 ; also Electrician (1897), vol. xxxix. p. 636 ; also Handbook for the Electrical Laboratory and Testing Room (J. A. Fleming), vol. i. p. 407.~~

~~at no load. , primary voltage curve ; i „ primary current curve ; ea, secondary voltage curve.~~

~~neglected in comparison with the second. Hence we have ap- proximately 61 = ——fadt. In other words,, the value of the flux-~~

~~SNi density in the core is obtained by integrating the area of the primary voltage curve. In so doing the integration must be started from the time point through which passes the ordinate bi- secting the area of the primary voltage curve. When any curve is formed such that its ordinate y is the integral of the area of another curve, viz., y=fyidx, the first curve is always smoother and more regular in form than the second. Hence the process above described~~

~~Fig. 7. — Transformer Curves at full load.~~

~~ex, primary voltage curve ; i,, primary current curve ; ez, secondary voltage curve ; »2) secondary current curve.~~

~~when applied to a complex periodic curve, which can by Fourier's theorem be resolved into a series of simple periodic curves, results in a relative reduction of the magnitude of the higher harmonics compared with the fundamental term, and hence a wiping out of the minor irregularities of the curve. In actual practice the curve of electromotive force of alternators can be quite sufficiently re- produced by employing three terms of the expansion, namely, the first three odd harmonics, and the resulting flux-density curve i3 always very nearly a simple sine curve.~~

~~We have then the following rules for predetermining the form of the current curve of the transformer at no load, assuming that the hysteresis curve (see Electromagnet) of the iron is given, set out in terms of flux-density and ampere-turns per centimetre, and also the form of the curve of primary electromotive force. Let the time base line be divided up into equal small elements. Through any selected point draw a line~~

~~*perpendicular to the base line. Bisect the area enclosed by the curve representing the half wave of primary electromotive force and the base line by another perpen- dicular. Integrate the area enclosed between the electromotive force curve and these two perpendicular lines and the base. Lastly, set up a length on the last perpendicular equal to the value of this area divided by the product of the cross-section of the core and the number of primary turns. The resulting value will be the core flux-density b at the phase instant corresponding. Look out on the hysteresis loop the same flux-density value, and corresponding to it will be found two values of the magnetizing force in ampere-turns per centimetre, one the value for increasing flux -density and one for decreasing. An inspection of the position of the point of time selected on the time line will at once show whioh of these to select. Divide that value of the ampere-turns per centimetre by the product of the values of the primary turns and the mean length of the magnetic circuit of the core of the transformer, and the result gives the value of the primary current of the transformer. This can be set up to scale on the perpen- dicular through the time instant selected. Hence, given the form of the primary electromotive force curve and that of the hysteresis loop of the iron, we can draw the curves representing the changes of flux-density in the core and that of the corresponding primary current, and thus predict the root-mean-square value of the mag- netizing current of the transformer. It is therefore possible, when given the primary electromotive force curve and the hysteresis curve of the iron, to predetermine the curves depicting all the other variables of the transformer, provided that the magnetic leakage is negligible.*~~

~~*The elementary theory of the closed iron circuit transformer may be stated as follows : — Let Hi H2 be the turns on the primary and secondary circuits, Ri and R2 the resistances, S the ^,e' section of the core, and 61 and 62 the co-instantaneous*~~

~~*meaiary vaiue3 0f tne flux-density just inside the primary and theory. secondary windings. Then, if ii and i? and ei and e2 are the primary and secondary currents and potential differences at the same instant, these quantities are connected by the two equations*~~

~~*ea=SN2^-R2i2. dt*~~

~~*Hence, if &i=&2, and if Rii'i is negligible in comparison with*~~

~~*SNidb/dt, and iv=o, that is, if the secondary circuit is open, then e1/e2=II1/II2, or the transformation ratio is simply the ratio of the windings., This, however, is not the case if ia and i2 have not the same value ; in other words, if there is magnetic leakage. If the magnetic leakage can be neglected, then the resultant magnetizing force, and therefore the iron core loss, is constant at all loads. Accordingly, the relation between the primary current (%), the secondary current (£2), and the magnetizing current (£), or primary current at no load, is given by the equation N1i1-N2i8=N1£. Then, writing b for the instantaneous value of the flux-density in the core, everywhere supposed to be the same, we arrive easily at the identity*~~

~~*e&=esi, + (Ritf + Bai8) + St^WA — II2i2).*~~

~~*This equation merely expresses the fact that the power put into the transformer at any instant is equal to the power given out on the secondary side together with the power dissipated by the copper losses and the constant iron core loss.*~~

~~*The efficiency o'f a transformer at any load is the ratio of the mean value, during the period, of the product efa to that of the product e&i. The efficiency of an alternating current transformer is a function of the form of the primary electromotive force curve. Experiment has shown 1 that if a transformer is tested for efficiency on various alternators having electromotive force curves of different forms, the efficiency values found at the same secondary load are not identical, those being highest which belong to the alternator with the most peaked curve of electromotive force, that is, the curve having the largest form, factor. This is a consequence of the fact that the hysteresis loss in the iron depends upon the manner in which the magnetization (or what here comes to the same thing, the flux-density in the core) is allowed to change. If the primary electromotive force curve has the form of a high peak, or runs up suddenly to a large maximum value, the flux-density curve will be more square-shouldered than when the voltage curve has a lower form factor. The hysteresis loss in the iron is less when the magnetization changes its sign somewhat suddenly than when it does so more gradually. In other*~~

~~words, a diminution in the form factor of the core flux-density curve implies a diminished hysteresis loss. The variation in core loss in transformers when tested on various forms of commercial alternator may amount to as much as 10 per cent. Hence, in recording the results of efficiency tests of alternating current transformers, it is always necessary to specify the form of the curve of primary electromotive force. The power factor of the transformer, or ratio of the true power absorption at no load, to the product of the R. M. S. values of the primary current and voltage, and also the secondary drop of the transformer, vary with the form factor of the primary voltage curve, being also both increased by increasing the form factor. Hence there is a slight advantage in working alternating current transformers off an alternator giving a rather peaked or high maximum value electro- motive force curve. This, however, is disadvantageous in other ways, as it puts a greater strain upon the insulation of the trans- former and cables. At one time a controversy arose as to the relative merits of closed and open magnetic circuit transformers. It was, however, shown by tests made by Fleming and by Ayrton on Swinburne's "Hedgehog" transformers, having a straight core of iron wires bristling out at each end, that for equal secondary outputs, as regards efficiency, open as compared with closed mag- netic circuit transformers had no advantage, whilst, owing to the smaller power factor and consequent large R.M.S. value of the magnetizing current, the former type had many disadvantages (see Fleming, "Experimental Researches on Alternate Current Trans- formers," Proc. Inst. Elec. Eng., 1892).~~

~~The discnssion of the theory of the transformer is not quite so simple when magnetic leakage is taken into account. In all cases a certain proportion of the magnetic flux linked with the primary circuit is not linked with the secondary . *£f™ " circuit, and the difference is called the magnetic leakage. * '~~

~~This magnetic leakage constitutes a wasted flux which is non- effective in producing secondary electromotive force. It increases with the secondary current, and can be delineated by a curve on the transformer diagram in the following manner. The curves of primary and secondary electromotive force, or terminal potential difference and current, are determined experimentally, and then two curves are plotted on the same diagram~~

which represent the variation of (ei — Rri^/Ni and (e2 + Rsia)/^ ; these will represent the time differentials of the total magnetic fluxes S&i and S62 linked respectively with the primary and secondary circuits. The above curves are then progressively integrated, starting from the time point through which passes the ordinate bisecting the area of each half wave, and the resulting curves plotted to express by their ordinates S&i and S62. A curve is then plotted whose ordinates

1 See Dr G. Roessler, Electrician, vol. xxxvi. p. 150 (1895) ; Beeton, Taylor, and Barr, Journal Inst. Elec. Eng., vol. xxv. p. 474 ; also J. A Fleming, Electrician, vol. xxxiii. p. 580 (1894).

are the differences S&i — S62, and this is the curve of magnetic leakage.

*The existence of magnetic leakage can be proved experimentally by *>■ method due to Mordey, by placing a pair of thermometers, one of mercury and the other of alcohol, in the centre of the core aperture. If there is magnetic leakage, the mercury bulb is heated not only by radiant heat, but by eddy currents set up in the mercury, and its rise is therefore greater than that of the alcohol thermometer. The leakage is also determined by observing the secondary voltage drop between full load and no load, and de- ducting from it the part due to copper resistance ; the remainder is the drop due to leakage. Thus if V2 is the secondary voltage on open circuit, and "VY that when a current A2 is/ taken out of the transformer, the leakage drop v is given by the equation*

«=(V2-V2,)-{E2A!! + Ei

*(?>**

former design.

The term in 'the large bracket expresses the drop in secondary voltage due to the copper resistance of the primary and secondary circuits.

~~*In drawing up a specification for an alternating current trans- former, it is necessary to specify that the maximum secondary drop between full and no load to be allowed shall not exceed a certain value, say 2 per cent, of the no-load secondary voltage ; also that the iron core loss as a percentage of the full secondary output shall not exceed a value, say, of 1 per cent, after six months' normal work.*~~

~~*Jn the design of large transformers, one of the chief points for attention is the arrangement for dissipating the heat generated in their mass by the copper and Trans- jr0I1 losses. For every watt expended in the core and circuit, a surface of 3 to 4 square inches must be allowed, so that the heat may be dissipated. In large transformers it is usual to employ some means of producing a current of air through the core to ventilate it. In these, called air-blast transformers, apertures are left in the core by means of which the cooling air can reach the interior portions. This air is driven through the core by a fan actuated by an alternating current motor, which does not, however, take up power to a greater ex- tent than about one-quarter or one-tenth per cent, of the full output of the transformer, and well repays the outlay. In some cases transformers are oil-insulated, that is to say, included in a cast-iron box which is filled in with a heavy insulating oil. For this purpose an oil must be selected free from mineral acids and water : it should be heated to a high temperature before use, and tested for dielectric strength by observing the voltage required to create a spark between metal balls immersed in it at a distance of 1 millimetre apart. Oils, however, are in- ferior in dielectric strength or spark-resisting power to solid dielectrics, such as micanite, ebonite, &c, as shown by the following table of dielectric strengths (see T. Gray, Phys. Rev., 1898, p. 199).*~~

~~*Material.*~~

~~*Dielectric strength in kilowatts per centimetre.*~~

~~*Material.*~~

~~*Dielectric*~~

~~*strength in*~~

~~kilowatts per~~

~~centimetre.~~

~~Glass . Ebonite Indiarubber Mica . Micanite . American linen paper paraffined~~

~~285~~

~~538~~

~~492~~

~~2000~~

~~4000~~

~~540~~

~~Lubricating oil Linseed oil Cotton-seed oil Air film ‘02 cm~~

~~thick Air film 1‘6 cm~~

~~thick~~

~~83 67 57~~

~~27~~

~~48~~

~~Polyphase transformers are appliances of similar con- struction to the single — phase transformers already described, but modified so as to enable them to trans- form two or more phase-related primary alternating currents into similar secondary currents. Thus, a three- phase transformer may be constructed with a core, as shown in Fig. 8. Each core leg is surrounded with a primary coil, and these are joined up either in star or delta fashion, and connected to the three or four line wires. The secondary circuits are then connected in a~~

~~similar fashion to three or four secondary lines. In the case of two-phase transmission with two separate pairs of leads, single-phase transformers may be employed in each branch, but with two-phase three-wire supply, two-phase transformers must be supplied.~~

~~Phase transformers are arrangements of static or rotatory transformers intended to transform single-phase~~

~~I~~

~~Fig. 8. — Three-phase Transformer. 1, 1, 1, primary circuits ; 2, 2, 2, secondary circuits.~~

~~alternating currents into polyphase currents. An im- portant system of phase transformation has been described by Mr C. F. Scott.1 It is well known that if two alter- nating electromotive forces differing in phase are connected in series, the resulting electromotive force will in general differ in phase and value from either of the components.~~

~~Fig. 9. — Scott's arrangement for transformation of two- phase to three-phase currents.~~

~~Thus, if two alternating electromotive forces differing 90" in phase, and having magnitudes in the ratio of 1 : J 3, are connected in series, the resulting electromotive force will have a magnitude represented by 2, and the three can be~~

~~1 Proceedings of the National Electric Light Association, "Washington, U.S.A., 1894 ; also Electrician, vol. xxxii. p. 64fy~~

~~represented by the sides of a triangle which is half an equilateral triangle. If then a two-phase alternator, D, (Fig. 9) provides two-phase currents, and if the two circuits are connected, as shown, to a pair of single-phase~~

~~transformers, Tx and T2, we can obtain three-phase alternating currents from the arrangement. The primaries of both transformers are the same. The secondary circuit of one transformer, T2, has, say, 100 turns, and a con- nexion is made to its middle point O, and this is con- nected to the secondary of the other transformer which has 87 (= 50 J 3) turns. From the points A, B, C we can then tap off three-phase alternating currents. The advantages of the Scott system are that we can trans- form two-phase alternating currents into three-phase for transmission, and then by a similar arrangement retrans- form back again into two-phase for use. In this manner an economy of 25 per cent, in copper is effected, for instead of four transmission lines we only have three. The system adapts itself for the transmission of currents both for power in driving three-phase motors and for working incandescent lamps. A somewhat similar system — has been designed by Mr C. P. Steinmetz for producing three-phase currents from single-phase (see Electriciom, vol. xliii. p. 236.) When a number of alternating electro- motive forces are maintained in a closed circuit, the sum of all must be zero, and may be represented by the sides of a closed polygon. The fundamental principle of Mr Steinmetz's invention consists in so choosing the number of these electromotive forces that the polygon must remain stable. Thus, if three single-phase alternators are driven independently at constant speed and excitation, and if they are joined in series, then three wires led away from the junction points will provide three-phase currents to a system from which lamps and motors may be worked. Reference must be made in the next place to the con- tinuous current transformer. The conversion of a con- _ tinuous current supplied, say, at 100 volts, into**

tinuous one having an electromotive force of 10 volts, current can of course be achieved by coupling together trans- on the sarfle bedplate a suitable electric motor ormers. an(j a dynamo, ip^e combination is called a motor — dynamo set, and each machine preserves its own identity and peculiarity. The same result may, however, be accomplished by winding two separate armature circuits on one iron core, and furnishing each with its own commutator. The two circuits are inter- laced or wound on together. An arrangement of this kind constitutes a rotatory transformer, or continuous current transformer. It has the advantage of greater cheapness and efficiency, because one field magnet serves for both

~~*armature windings, and. there is only one arma- ture core and one pair of bearings ; moreover, no shift or lead of the brushes is required at various loads. The armature reactions of the two circuits annul each other. Machines of this description are self -starting, and can be constructed to take in primary current at high pressures, say 1000 to 2000 volts, and yield another larger current of much lower voltage, say 100 or 150 volts, for use with electric lamps. They are used in connexion with public electric supply by continuous current in many places.*~~

~~*Another important class of rotatory transformer is that also called a rotatory converter, by means of which con- tinuous current is translated into alternating current of one-, two-, or three-phase, or vice versd. The action of such an appliance may best be understood by considering the simple case of a Gramme ring armature (see Dynamo) having, in addition to its commutator, a pair of insulated rings on its shaft connected with opposite ends of the armature winding (Fig. 10). If such a ring is placed in a bipole field magnet, and if a pair of brushes make*~~

~~*contact with the commutator C and another pair with the two rings called slip rings, Sx S2, and if continuous current at a constant voltage is supplied to the commutator side, then the armature will begin to revolve in the field, and from the brushes in contact with the slip rings we can draw off an alternating current. This reaches its maximum value when the points of contact of the rings with the armature circuit pass the axis of commutation, or line at right angles to the direction of the magnetic field, for it has at this moment a value which is double the steady value of the continuous current being poured into the armature. The maximum value of the electromotive force creating this alternating current is nearly equal to the electromotive force on the con- tinuous current side. Hence if A is the maximum value of the continuous cur- rent put into the armature and V is the value of the continuous current*~~

~~*Fig. 10.—Converter, continuous two-phase.*~~

~~*brush potential difference on the side, then 2A is the maximum value of the outcoming alternating current and V is the maximum value of its voltage. Hence 2AV/2 = AV is the maximum value of the outcoming alternating current power, and if we neglect the loss in the armature for*~~

~~the moment, the power given out is equal to the power put in. Hence, assuming a simple har- monic law of variation, the effective value of the alternating current voltage is V/ J2, and that of the alternating current is 2A ^2. This conclusion follows at once from the fact that the mean value of the square of a sine function is half its maximum value, and hence the R.M.S. value is 1/^2 times the maximum value. The outcoming alternating current has its zero value at the instant when the ends of the diameter of the axis to which the rings are connected are in the direction of the magnetic field of the transformer. Hence the power output on the alternating current side varies from a maximum value AV to zero. The rotatory transformer thus absorbs continuous current power and emits it in a periodic form ; accordingly, there is a continual storage and emission of energy by the armature, and therefore its kinetic energy is periodically varying during the phase. The armature is also creating a back-electromotive force which acts at some instants against the voltage driving the current into the armature and at others is creating an electromotive force that assists the external impressed voltage in driving a current through the alternating current side. If we put on another pair of insulated rings and connect them to points of the insulated diameter at right angles to the points of connexion of the first pair of rings, we can draw off another alternating current, the phase of which differs 90 degrees from that of the first. Similarly, if we provide three rings connected to points removed 1 20 degrees apart on the armature circuit, we can tap off a three-phase alternating current.~~

~~Returning to the case of the single-phase rotatory transformer, we may notice that at the instant when the outcoming alternating current is zero the armature is wholly engaged in absorbing power and is acting entirely as a motor. When the alternating current is a maximum, the armature on the other hand is acting as a generator and adds current to the current put into it. The ratio~~

~~between the potential difference of the brushes on the continuous current side and the root-mean-square or effective value of the voltage between~~

~~*any pair of rings on the alternating current side is called the transformation ratio of the converter.*~~

~~*The following table, taken from a paper upon rotatory converters by Professor S. P. Thompson (Proc. Inst. Elec. Eng., November 1898), gives the voltage ratio or conver- sion ratio in the case of various forms of rotatory transformer : —*~~

~~*Number of slip rings.*~~

~~*Angle*~~

~~*between*~~

~~*points of*~~

~~*connexions*~~

~~*to armatures.*~~

~~*Type of current generated.*~~

~~*Voltage ratio.*~~

~~*Effective voltage on alternating current side as percentage of voltage on continuous current side.*~~

~~*2 3 4 4 6 6*~~

~~*180 deg.*~~

~~*120 „ 90 „ 90 „ 60 „ 60 „*~~

~~*Single-phase*~~

~~*Three-phase*~~

~~*Two-phase*~~

~~*Four-phase*~~

~~*Three-phase*~~

~~*Six-phase*~~

~~*^2:1 2»/2: a/3*~~

~~*v/2:l*~~

~~*2 : 1*~~

~~*3^/3: »/3 2^/2: 1*~~

~~*70-71*~~

~~*61-23*~~

~~*70-71*~~

~~*50*~~

~~*61-23*~~

~~*35-35*~~

~~*Neglecting the energy losses in the armature, and assuming that the continuous current side of the trans- former is supplied with 100 amperes, the following table, also taken from a paper by Professor S. P. Thompson, shows the effective value of the current on the alternating side put out into each line : —*~~

~~*Number of slip rings.*~~

~~*Angle*~~

~~*between*~~

~~*points of*~~

~~*connexion*~~

~~*to armature.*~~

~~*Type of current generated.*~~

~~*Effective cur- rent put out on each line in amperes.*~~

~~*2 3 4 6*~~

~~*180 deg.*~~

~~*120 „ 90 „ 60 „*~~

~~*Single-phase Three-phase Two-phase Six-phase*~~

~~*141·4 94·3 70·7 47·2*~~

~~*It is obvious that the same results of conversion can be obtained by coupling together two separate machines on the same shaft; thus we might obtain a single-phase alternating current from a continuous current by coupling together mechanically a continuous current motor and a single-phase alternator. Such a combination is generally called a motor-dynamo. In this case there are two field magnets and two separate armatures, and the hysteresis eddy current and copper losses are all in duplicate. If, however, the same armature winding is made to serve both purposes, the resulting machine is called a rotatory or rotary converter. In the former combination the brushes of the continuous current part require to be set with the usual lead or lag according as that part is generator or motor, but in the latter the armature reactions nearly annul each other, and lead or lag is no longer necessary. The fact was pointed out by S. P. Thompson, in connexion with continuous current trans- formers (Phil. Mag., August 1888). One objection to the rotatory converter arrangement, as above described, is the rather awkward fractional values of the conversion ratio. An ingenious modification of the single armature winding for obviating this difficulty has been described by Heldt (Electrical World, vol. xxviii., 1896).~~

~~*Finally, a brief allusion must be made to rectifiers, ■which are devices for transforming an alternating (gene- rally single-phase) current into a continuous but ere. pUisatory current. They may shortly be de- scribed as appliances for separating out each alternate current flux in an alternating current. An immense number of more or less imperfect methods of doing this have been proposed, but we have merely space for allusion*~~

~~*to two which may be called respectively the mechanical and the electrolytic methods. Of the first class a good example is the Ferranti rectifier (Fig. 11). This consists of a synchronous alternating current motor which is started up and driven in step with the alternator supply- ing the current. The motor drives a commutator of in- sulated segments, each alternate segment being connected to two insulated rings, against which press a pair of brushes. Another pair of brushes, so adjusted as to be in contact simultaneously with a pair of adjacent com- mutator segments, are in connexion with the alternator supplying the current to be commutated. The insulated rings are in connexion with the external circuit. It will easily be seen that when the commutator revolves at proper speed the currents delivered from the insulated*~~

~~*Fig. 11.— Ferranti Rectifier.*~~

~~*rings are unidirectional. The Ferranti rectifier is much employed .for rectifying alternating current for arc light- ing purposes. With this object it is associated with a constant current transformer which converts alternating current supplied at constant potential to one supplied at constant current. This is achieved by taking advantage of the repulsive force existing between the primary and secondary circuits of a transformer. These are wound separately, and so balanced that any increase in the cur- rent presses them away from each other and so reduces the secondary current to normal value. An appliance of the above description is useful for rectifying currents up to 10 or 15 amperes, but with larger currents it becomes trouble- some, owing to the excessive sparking at the contacts.*~~

~~*The electrochemical rectifier is based upon a pheno- menon originally discovered by Buff in 1857 (Lieb. Ann., lii. p. 296, 1857), and*~~

~~rediscovered by Ducretet in 1874 (Comptes Bendus, lxxx. p. 280, 1874). If plates of alumin- ium and carbon are placed in an electrolyte, say a solution of alum or dilute acids which yield oxygen on electrolysis,~~

~~it is found that a current can be sent through the liquid from the carbon to the aluminium, but that great counter- electromotive force is created to a current in the opposite direction. Gratz and Pollak (Elektrotechnische Zeit- schrift, 25, p. 359, 1897), taking advantage of this fact, have constructed a rectifying arrangement by arranging two series of carbon – aluminium (CA1) cells with alum or hydro-potassic phosphate solution as electrolyte. In one set the order of the plates is (CA1), (CA1),~~

~~The theory of the electrolytic rectifier has engaged the attention of a great many investigators, and although some progress has~~

~~been made towards the elucidation of its action and in~~

~~. e?'Ttr0m its application in eleetrotechnics, as illustrated by the~~

~~/ tic recti- numerou9 patents issued during the last few years, there~~

~~Y. are many points in its operation which have as yet been~~

~~imperfectly explained. The action of the aluminium electrolytic rectifier, consisting as it does of an aluminium plate and a lead or carbon plate placed in an aqueous electrolyte, is to oppose a great obstruction to a current passing out of the aluminium plate, hut little or no obstruction to the current passing into the aluminium plate, especially if the aluminium has been subjected to a previous treatment called formation. This unilateral conduc- tivity is dependent on a certain voltage or potential difference between the plates not being exceeded, but within these limits a plate of carbon and aluminium placed in a solution, say of hydro- sodic phosphate, acts as an electrical valve, allowing current to pass in one direction but not in another. An examination of the alu- minium plate~~

~~*after it has been so used shows that its appearance has changed and that its surface is covered by a thin film, the thickness of which varies with the electrolyte and the time of formation. After a certain period of use this film is seen as a grey, dull coating traversed by dark lines. It is impossible that the unilateral conductivity can be due to a true electrolytic polarization, because we know of no polarization of this latter kind which exceeds three volts, and the film can be made to resist the flow of a current under an electromotive force of 140 to 200 volts. The resistance of this film has been measured and found to be very high, so high as to be practically an insulation. Light was thrown upon the subject by F. Kohlrausch's discovery of the polarization capacity of metallic electrodes, and this discovery was applied to develop the theory of the aluminium cell by Streintz (1888), Scott (1899), and others.*~~

~~*This theory was expounded by Dr K. Nbrden in an article on the electrolytic rectifier (see the Electrician, vol. xlviii. p. 107). According to this view, the deposit covering the aluminium elec- trode forms the dielectric of a condenser. One plate of the con- denser is formed by the aluminium plate and the other by an opposite layer of electrically-charged ions in the electrolyte. The dielectric film on the aluminium having been formed, the electro- motive force of the circuit then charges the resulting condenser to the value of its own voltage, but immediately the impressed electro- motive force is removed this condenser discharges itself. This condenser theory receives support from the behaviour of the aluminium cell when placed in the circuit of an alternating current dynamo, for it is found that in these circumstances the current through the cell is in advance in phase of the difference of potential. The question then arises, What is the nature of this insulating film? The first discoverer of the phenomenon (Buff) considered it to consist of silicon. Later Professor Beetz disproved this by experiment, and, with many others, assumed that a sub-oxide of aluminium was formed ; but this has never been demonstrated in a satisfactory manner. By forming a sufficient quantrty of the film Dr K. Norden was able to obtain sufficient of the material to make a chemical analysis, and this revealed the fact that it consists of normal aluminium hydroxide, Al2(OH)6.*~~

~~According to the facts above stated, one wave of the alternating current produces the insulating film by converting the surface of~~

~~the aluminium into hydroxide, practically, therefore, blocking its own path very quickly by the creation of this film. If, then, the electromotive force reverses its direction, the current immediately flows. According to Dr Norden, the rapid removal of the insulat- ing film is due to the action of the electrolyte corroding or dis- solving the weak points in the coating and thus breaking down its insulating power. The insulating film is therefore a conductor in one direction, but when the current is reversed and flows out of the aluminium plate, the insulating film is renewed and is con- tinually being repaired and kept in order. Thus different electro- lytes yield aluminium valves having very different efficiencies.~~

~~Eectifying cells have been made by Pollak which will bear a voltage of over 140 volts, and which are said to have an efficiency of 75 per cent. The plates, however, must be removed when not in use, otherwise the film of hydroxide is destroyed by the electro- lyte. One great practical difficulty in connexion with the alu- minium rectifier is the tendency to heat in working, and as the temperature cannot be allowed to exceed 104° F. without producing ill effects, it is necessary to employ a cell many times larger than the plate it contains in order that there may be a sufficient amount of liquid to keep down the temperature. In any event, after 500 to 800 hours' working the aluminium plate becomes furrowed and in the end falls to pieces. These difficulties have not so far been overcome as to make the aluminium valve of any great practical utility. At its first introduction it was hailed as a practical means of obtaining direct currents from alternating currents for the purpose of charging accumulators and doing other chemical work, But although it has been employed in this manner to a limited extent, considerable improvements must be made before it can realize all the expectations which were once formed concerning it.~~

~~The historical development of the discovery of this unilateral conductivity of an electrolytic cell with an aluminium electrode is as follows. The effect was first noticed by Buff in 1857, but was not applied technically until 1874, when Ducretet employed it in telegraphy. Beret in 1877 and~~

~~*Streintz in 1887 discussed the theory of the cell and sought for an explanation. In 1891 Hutin and Leblanc, in their study of alternating currents, showed its uses in rectifying an alternating current. Pollak and Gratz laboured to give it a practically useful form. Pollak took 'out patents in 1895, and made a communication to the Academy of Sciences in Paris in June 1897 ; and Gratz presented a memoir at a meeting of the German Association of Electrochemists in Munich in 1897. M. Blondin has summarized all the work so far done on the aluminium rectifier in two articles in L' Eclairage Mlectrique, vol. xiv. (1898) p. 293, and vol. xxviii. (1901) p. 117. The choice of an electrolyte is of great importance. Buff, Ducretet, and Gratz employed dilute sulphuric acid, and the greatest difference of potential which could then be applied to the cell without breaking down its insulation in one direction was 20 volts. Pollak in 1896 found that when aqueous solutions of alkaline salts were used, and when the aluminium plate was subjected to a preliminary forma- tion, the back electromotive force or what is equivalent to it could be raised to 140 or 200 volts. Pollak found that the best results were given by the use of phosphate of potassium or sodium. It appears, therefore, that the ions of K or Na effect the breaking down of the film of aluminium hydroxide more quickly than the ion of hydrogen. The practical form of aluminium rectifier, according to Pollak, consists of plates of thick aluminium and lead placed in a large deep glass vessel filled with a solution of hydro-potassic phosphate.*~~

~~*The ordinary induction or spark coil may be said to perform the operation of converting an intermittent low-tension con- tinuous current into an intermittent high-tension one. An impetus has been given of late to the manu- facture of large spark coils by the demand for them in Rontgen ray and wireless telegraph work. A modern induction coil for the production of long sparks is constructed as follows : — ■ The primary coil consists of two or more layers of insulated wire wound on an iron core formed of a bundle of well annealed iron wire. This coil and core are entirely enclosed in a thick ebonite tube, leaving openings only for the entrance and exit of the primary coil and for a soft iron cylinder which is in magnetic connexion with the iron core. Over this tube is slipped a series of flat coils generally made of shellacked paper, the wire winding being in two vertical layers separated by an insulating disc. In this way the two ends of the coil*~~

~~are brought to the outside. These flat coils are electrically joined up so as to make one con- tinuous bobbin of wire in which the insulated wire is so disposed that parts of the wire near to each other are not very different in potential. This secondary winding is likewise enclosed in an ebonite tube. The coil is completed by a contact breaker and condenser. The former is an automatic vibrator on the principle of the vibrating hammer of an electric bell, which is actuated by the magnetism of the core and interrupts the circuit of the primary coil. The condenser consists of interleaved sheets of tin-foil and paraffined paper, the alternate sheets of foil being connected together. This condenser is connected across the break to the two~~

~~platinum points between which the rapid interruption of the pri- mary circuit takes place. The function of the condenser is to assist in rapidly demagnetizing the core, and in destroying the electric spark between these points as they separate. When the contact points are together the condenser is discharged but the core is mag- netized. "When the contact points separate the condenser is charged through the primary coil, and the charge takes place by a series of electrical oscillations which rapidly remove the remanent magnetism of the core. As the electromotive force in the secondary circuit depends on the rate at which the flux of magnetic induction is re- moved from the core, the condenser has a remarkable effect in increasing the secondary electromotive force at the break of the primary current. Accordingly the electromotive forces set up in the secondary circuit at break and at make of the primary circuit are very different in value, the former being enormously greater than the latter. Hence, when the secondary circuit is interrupted by a spark gap and the primary current is intermitted, the secondary discharges are also~~

~~*intermittent and unidirectional, being those which correspond with the break of the primary current. Lord Rayleigh has, however, shown that if the primary circuit is inter- rupted with great rapidity, as by severing it with a bullet, the secondary spark of the coil may be even longer without the con- denser across the break gap. The E.M.F. of the secondary is then greatly increased (see Phil. Mag., December 1901, p. 581).*~~

~~*The manufacture of very large induction coils is a matter requir- ing great care and experience. The reader may be referred for details to a book by Mr A. T. Hare on The Construction of Large Induction Coils (London, 1900). Also for details of many large historical induction coils see The Alternate Current Transformer (Fleming, vol. ii.). If the induction coil has a condenser, such as a Leyden jar, connected across its secondary terminals, the sparks produced become much shorter and brighter, but more intermittent and noisier. The current flowing from the secondary circuit charges the condenser, and hence at each discharge a much larger quantity of electricity passes than when the condenser is not used. The reason the spark lengths are so much reduced is as follows : — To charge a condenser of capacity C to a voltage V through a resist- ance R, the electromotive force must be applied steadily for a period at least equal to ten times the value of the product C R, where R is measured in megohms and C in microfarads. If the condenser is a Leyden jar having, say, 1 square foot of contact surface, the glass being about 1/10 of an inch thick, then the capacity will be ap- proximately 1/400 of a microfarad. The resistance of the second- ary circuit of a 6-inch spark coil is usually about 10,000 ohms, or 1/100 of a megohm. Hence, the product C R, or the time con- stant of the jar circuit, is 1/4000 of a second. Now the vibrating break of the induction coil may make from 20 to 50 oscillations per second, and the time during which the secondary electromotive force in the coil has approximately its maximum value, or value corresponding to the ordinary spark length, is probably less than 1/100 of the time period of the break. Accordingly, the electro- motive force of the coil is applied to the jar for a time too short to charge it up to the potential which corresponds to the full ordinary spark length (6 inches) of the coil.*~~

~~*The oscillatory discharges produced by discharging a large con- denser through a low resistance can be transformed in potential, and we can*~~

~~*construct an oscillation transformer. This is usually called a Tesla coil, but Mr Tesla was not by any means the first person to transform by induction the oscillatory discharges of a Leyden jar. A. length of copper wire is coiled on an insulating cylinder in one layer, the turns being preferably separated by a silk cord. Over this is placed another cylinder of glass or ebonite, and on this second cylinder another coil of fine wire is wound in one layer. If the primary coil of the above arrangement is connected in series with a Leyden jar or battery of jars, and the two together connected across the secondary terminals of an ordinary induction coil, the spark balls of which are separated by a few millimetres, then loud rattling discharges of the jar take place when the induction coil is worked. These discharges are oscillatory, and consist of groups of rapidly alternating currents flowing through the primary circuit of the oscillation transformer ; these oscillations are transformed up in potential by the secondary circuit, and from these latter terminals we can draw off a secondary discharge of higher potential and much higher frequency than the ordinary secondary spark of the induction coil (see Telegraphy : Wireless). These high potential, high frequency discharges pro- duce many interesting effects, and can be passed through the human body without producing painful shock. The secondary terminals of the oscillation transformer produce powerful brush discharges in air when separated beyond their sparking distance, and also very brilliant discharges through highly exhausted vacuum tubes.*~~

~~*The reader desirous of additional information is referred to the following works and original papers : — J. A. Fleming. The Alternate Current Transformer, 3rd edition. London, 1901 ; "Experimental Researches on Alternate Current Transformers," Proc. Inst. Elec. Eng., 1893 ; "Alternate Current Transformers," Cantor Lectures, Society of Arts, 1896 ; " Electric Oscillations and Electric Waves," Cantor Lectures, Society of Arts, 1900-1901 ; Handbook for the Electrical Laboratory and Testing Room. Lon- don, 1901. — S. P. Thompson. Dynamo Electric Machinery. Lon- don, 1896 ; Polyphase Electric Currents and Alternate Current Motors, 2nd edition. London, 1900; "Rotatory Converters," Proc. Inst. Elec. Eng., 1898. — G. Kapp. The Electric Transmis- sion of Energy and its Transformation. London, 1895 ; Alternat- ing Currents of Electricity. London, 1896 ; Transformers for Single and Multiphase Currents.*~~

~~London, 1896. — C. C. Hawkins and F. Wallis. The Dynamo, 2nd edition. London, 1896. — W. E. Golds- boroogh. "Transformer Tests," Proc. Nat. Electric Light Association, U.S.A., 1899. — C. P. Steinmetz. The Theory and Calculation of Alternating Current Phenomena, 2nd edition. New York, 1899. — A. Still. Alternating Currents of Electricity and the Theory of Transformers. — D. C. Jackson. Text-Book on Electromagnetism, vol. ii. London, 1896. — Loppe. Alternate Currents in Practice. — Martin. Inventions, Researches, and Writings of Nikola Tesla, New York, 1894. (j. a. f.)~~

~~Transkei. See Kaffrakia.~~

~~TRANSVAAL COLONY.~~

~~I. Geography and Statistics.~~

~~TRANSVAAL Colony, formerly the South African Republic, Africa, lies between 22° and 28° S. and 25° and 32° E. The boundaries laid down by the Con- vention of 27th February 1884 were modified by the Conventions of 1894 and 1897 relating to the district of Vryheid and the territory of Swazieland, and in 1902 as the result of the extension of Natal (q.v.). As thus de- limited the Transvaal presents the outlines of an irregular oblong disposed in the direction from south-west to north- east, and truncated in the north by the east to west direc- tion of the Limpopo, which forms the frontier river towards Bechuanaland and southern Rhodesia as far as the Lim- vubu confluence. The southern boundary coincides with the Vaal and its Klip headstream as far as Natal, where it follows the Drakensberg range to the head-waters of the Pongola river, which it follows to the border of the Utrecht district, while the Lobombo range forms the dividing line towards Zululand and Portuguese territory northwards to the Limvubu confluence. Prom this point to the lower Vaal at Platberg there was, before the altera-~~

~~tion of the boundary, an extreme length of about 500 miles, and a breadth of nearly 400 miles from the west- ern border near Mafeking to Komati Poort, where the Delagoa Bay railway enters the Transvaal from Portuguese territory. Within these limits there is a total area of about 126,000 square miles, and a population approximately estimated in 1898 at 1,094,000, of whom about 245,000 were whites, mostly Boers and British, and 748,000 natives of Bantu (Zulu and Bechuana) stock and speech. Some 8000 whites and 50,000 natives were added by the 1902 rectification of the frontier.~~

~~Mineral Wealth. — The Transvaal is one of the most highly mineralized regions in the world. The gold- bearing reefs are widely distributed over the whole land, ranging from Lydenburg, De Kaap, Komati, Barberton, and Swazieland in the extreme east to the Marico district in the extreme west, and from the Zoutpansberg and Murchison Hills in the north to Rustenburg,Krugersdorp, Schoonspruit, Rooderand, and especially the Witwaters- rand (" The Rand," with chief centre Johannesburg) in the south. Although many of the reefs in these districts have scarcely yet been tapped, the annual output rose~~

~~statistics]~~

~~from £2,924,000 in 1891, from which year date the first official returns, to £8,570,000 in 1895 and no less than £16,044,000 in 1898, the year before the outbreak of hostilities. The total yield from 1884 to 1900 probably exceeded £80,000,000, while with the institution of or- derly government it is expected that at least 20,000,000 tons of quartz will be annually dealt with on the Rand alone. But the mineral resources of the Transvaal are by no means confined to gold. Diamonds are found in the Pretoria district and other places, and in 1898 the product exceeded 22,000 carats, valued at nearly £44,000. Extensive deposits of good coal, including some very thick seams of steam coal, occur near the Rand and other goldfields, and although mining opera- tions are yet in their infancy, the output rose~~

~~*from 1,437,000 tons in 1896 to 1,600,000 in 1897 and 1,907,000 in 1898. It appears that the rich Carboniferous beds of the Newcastle district in northern Natal extend with little interruption northwards far into the Vaal basin, and are already used by Boer farmers for domestic purposes. , Like that of Newcastle, the Transvaal coal burns with a clear flame and leaves little or no ash. Amongst other mineral treasures are lead, sulphur, cobalt, saltpetre, iron, and copper. The last two are widely distributed, and the Yzerberg, "Iron Mountain," near Marabastad, which is now reached by rail from Pretoria, consists of a huge mass of exceedingly rich iron ore, which has been smelted and wrought into divers implements by the natives from the remotest times.*~~

~~*Agricultural Resources. — The agricultural prospects of the country, including both tillage and stock-breeding, are also much brighter than is commonly supposed. Husbandry, however, is still in a very backward state, and in 1898 not more than 50,000 acres altogether had been brought under cultivation. There are no doubt over 12,000 farms, averaging about 6000 acres each, but the Boers are essentially stock-breeders, and cultivate very little land, not enough even for the local demand, so that cereals and other produce have to be imported in considerable quantities — corn, vegetables, preserves, &c, to the value of £1,200,000 in 1898. All this and much more might be grown several times over in the country itself, where the Potchefstroom and Pretoria districts are specially suited for cereals, fruits, tobacco, the vine, and vegetables; Bustenburg, with its sub-tropical climate, for cereals, ground-nuts, tobacco, coffee, cane-sugar, bananas, and oranges ; Lydenburg, for cereals, tobacco, sugar, and coffee ; and all or most of these crops might also be easily raised in the Marico, Middelburg, Water- berg, and several other districts. The great drawbacks are the tsetse-fly, which, however, is mainly confined to the swampy tracts in the middle and lower Limpopo valley ; horse-sickness, which is being dealt with appar- ently with some success ; the locust plague, which might be abated by such measures as those adopted in Cyprus and Algeria; lastly, the deficient rainfall, which it is proposed to neutralize to some extent by regulating the discharge of the Vaal and Limpopo affluents, and hus- banding the flood-waters which now run waste. By these and other irrigation works it is calculated that, as*~~

~~*in Cape Colony, many hundred thousand acres of land now arid might be brought under cultivation.*~~

~~*Trade, &c. — No accurate returns are available for the exports, which consist chiefly of gold, wool, cattle, hides, grain, ostrich feathers, ivory, and minerals. The total exports rose from 8500 tons in 1895 to 51,400 tons in 1898, and of this quantity (value not stated) 47,645 tons represented such local produce as coal (38,800 tons), wool (2540), hides and skins (2100), ores (1920). The imports advanced from £6,440,000 in 1894 and £9,816,000 in 1895, to £14,088,000 in 1896 ; but owing to the political*~~

~~*unrest fell to £13,564,000 in 1897 and £10,633,000 in 1898, and in 1901 to £3,670,000, but this was exclusive of Government and military supplies. They consist chiefly of machinery, cottons, clothing, chemicals, cutlery, provisions, haberdashery, and furniture. In 1898, of the total imports £6,332,000 came from Europe, £1,159,000 from Cape Colony, £1,203,000 from Natal, £537,000 from the Orange Eree State, £537,000 from Lourenqo Marquez, and £481,500 from America and other countries. The revenue rose from £1,703,000 in 1893 to £4,807,000 in 1896, and then fell to £4,480,000 in 1897 and £3,984,000 in 1898, the expenditure being for the corresponding years £1,302,000, £4,671,000, £4,394,000, and £3,971,000. The communications are still in a backward state, the roads especially being generally very rough. But railway enterprise has made some progress since the development of the gold-mining industry. In 1898 there was a total length of 774 miles open, connecting Pretoria with the Cape through Bloemfontein, with Durban through Standerton, New-castle, and Ladysmith, with Delagoa Bay through Middelburg and Komati Poort, with Johannesburg, Pietersburg, and other places by branch lines ramifying from the capital. In the same year 270 miles were in progress and 250 projected.*~~

~~*II. Histobt.*~~

~~*From the time of the Great Trek out of Cape Colony to lands north of the Vaal river in 1833-37, down to the Sand Biver Convention in 1852, the history of the Trans- vaal Boers was one of continued strife with the natives. The Apprentice Law of 1856 practically legalized slavery, and the*~~

~~opposition which this measure e”xcited in the minds of many Englishmen was one of the most fertile causes of irritation between the Boers and the British authorities. Apart from the Trek Boers’ attitude towards the natives, their history in the Transvaal until 1877 shows that they carried with them to their ^a”er new home a spirit hostile not merely, as has been represented by many writers, to British rule, but to civilized rule in any shape or form. They and their fathers had, while still resident in the frontier districts of the colony, rebelled first of all against the government of the Dutch East India Company, and at a later date against the British Government, because they resented in both cases any interference with their relations either to the natives or to one another. Govern- ments within the Transvaal appointed by themselves, as a review of their history will show, fared no better, but even worse than those from the rule of which the Boers had withdrawn.~~

~~In 1856 a series of public meetings among the Boers, summoned by Commandant-General M. W. Pretorius was held at different districts in the Transvaal for the purpose of discussing and deciding whether the time had not arrived for abolishing the system of petty district govern- ments which had hitherto existed. The result was that a representative assembly of delegates was elected, p^j^ empowered to draft a constitution. In Decern- siroom ber this assembly met at Potchefstroom, and for assembly, three weeks was engaged in modelling the con- ,8S6' stitution of the country. The new constitution made provision for a Volksraad to which members were to be elected by the people for a period of two years, and in which the legislative function was vested. The adminis- trative authority was to be vested in a President, aided by an executive council. It was stipulated that members both of assembly and council should be members of the Dutch Reformed Church. In reviewing an incident so im- portant in the history of the Transvaal as the appointment~~

~~[histobt~~

~~*of the Potchefstroom assembly, it is of interest to note the gist of the complaint among the Boers which led to this revolution in the government of the country as it had. previously existed. In his History of South Africa, Theal says, " The community of Lydenburg" (the oldest district government) " was accused of attempting to dom- ineer over the whole country, without any other right to pre-eminence than that of being composed of the earliest inhabitants, a right which it had forfeited by its opposi- tion to the general weal." In later years this complaint ' was precisely that of the Uitlanders at Johannesburg. In order to endeavour to conciliate one of these district governments at Zoutpansberg, the new-born assembly at Potchefstroom appointed Mr Schoeman, a commandant of the Zoutpansberg district, commandant-general. This offer was, however, declined by Schoeman, and both Zoutpansberg and Lydenburg indignantly repudiated the new assembly and its constitution. The executive coun- cil, which had been appointed by the Potchefstroom assembly with Pretorius as President, now took up a bolder attitude : they deposed Schoeman from all author- ity, declared Zoutpansberg in a state of blockade, and denounced Boers of the two northern districts as rebels.*~~

~~*In order further to strengthen their position, Pretorius and his party also endeavoured to bring about a union with the Free State. With this intention they sent emissaries to the Free State Government to make over- tures on the subject. These overtures were rejected. Nothing daunted, Pretorius determined to win by force what he had failed to obtain by persuasion. There was*~~

~~*a certain number of Free State Boers prepared Presidency ^0 aecede to the proposals of Pretorius, and Pretorius. relying on their aid, Pretorius entered into an*~~

~~*intrigue to overthrow the President of the Free State, Boshof, and his Government. Pretorius placed himself at the head of a commando and crossed the Vaal, being joined by a certain number of Free State burghers. On learning of the invasion, President Boshof immediately took energetic measures to defend his country. He proclaimed martial law, called out his burghers, and marched towards Kroonstad to meet the invaders.. At the same time Boshof received an offer from the outraged*~~

~~*and deposed General Schoeman of Zoutpansberg to gather a force and come to his assist- ance. The forces of Pretorius and Boshof at length faced each other on opposite banks of the Rhenoster river. Threatened from the north as well as the south, Pretorius now recognized that he was engaged in a dan- gerous enterprise. He had as his lieutenant on this occasion no less a personage than Mr Stephanus Johan- nes Paulus Kruger, and to Mr Kruger was entrusted the task of bearing a flag of truce to the Free Staters, with an expression of hope that a peaceful settlement might be arrived at. A treaty, containing an apology from Pretorius, was agreed upon, and the invading force with- drew. By the year 1860, the foregoing events notwith- standing, Zoutpansberg and Lydenburg had become incorporated with the republic. Schoeman had accepted the post of commandant-general, and Pretoria was made the seat of Government and capital of the country. The state was now apparently united, and the Government founded on the will of the people. The Separatist Church of Holland in the year 1858 sent out a young expositor of its doctrines named Postma. This minister settled at Rustenburg and founded the first branch of the the Dopper sect, a sect which has since become famous in the Transvaal, as well as in the Free State and even Cape Colony. The tenets of the Separatist Reformed (or Dopper) Church do not call for close analysis here. It will be sufficient to say that they approached somewhat those held by the Scottish Covenanters. They raised*~~

~~*strong objection to the singing of hymns, other than paraphrases of Scripture, as part of the church service. Of this sect Paul Kruger, who resided near Rustenburg, became an adherent.*~~

~~*In 1860 a curious sequel to the invasion of the Free State by Pretorius occurred. Pretorius, while still Presi- ident of the Transvaal, was elected President of the Free State. He thereupon obtained six months' leave of absence and repaired to Bloemfontein, in the hope of peacefully bringing about a union between the two republics. He had no sooner left the Transvaal than the old. Lydenburg party, headed by Potgieter, landdrost of Lydenburg, protested that the union would be much more beneficial to the Free State than to internal the people of Lydenburg, and followed this up s/ons_ with the contention that it was illegal for any one to be*~~

~~President of the South African Republic and the Free State at the same time. Pretorius, apparently in disgust at the whole situation, resigned. Mr J. H. Grobelaar, who had been appointed President during the temporary absence of Pretorius, was requested to remain in office. The immediate followers of Pretorius now became extremely incensed at the action of the Lydenburg party, and a mass meeting was held at Potchefstroom, where it was resolved that: (a) the Volksraad ' no longer enjoyed its confidence ; (6) that Pretorius should remain President of the South African Republic, and have a year's leave of absence to bring about union with the Free State ; (c) that Schoeman should act as President during the absence of Pretorius ; (d) that before the return of Pretorius to resume his duties a new Volksraad should be elected.~~

~~In view of later events, the anarchy which has existed among the Trek Boers, north of the Vaal, from the earliest times demands the closest study, in order that the true character and aspirations of the Boers may be understood. • The action of the Volksraad, incited by the jealousies of the old district governments and their fol- lowers in Lydenburg and Zoutpansberg, was antagonistic to anything in the shape of a patriotic and truly repub- lican government. If at this stage of their existence the real ambition of the Transvaal Boers was to found a strong and compact republican state, their conduct in opposing a scheme of union with the Free State was foolish to a degree. The events of the year 1860, as well as of all they years that followed down to British annexation in 1877, show that licence rather than liberty, a narrow spirit of faction rather than patriotism, were the dominant instincts of the Boer. HIad the fusion of the two little republics which Pretorius sought to bring about, and from which apparently the Free State was not averse, actually been accomplished in 1860, it is more than probable that a republican state on liberal lines, with some prospect of permanence and stability, might have been formed. But a narrow, distrustful, grasping policy on the part of whatever faction might be dominant at the time invariably prevented the state from acquiring stability and security at any stage of its history. On no less than three occasions, unique opportunities were afforded for consolidating and estab- lishing this republic. The first of these occasions we have dealt with. The second occurred in 1887, and the third in 1895. Of these opportunities no advantage was taken.~~

~~The complications that ensued on the action of the Pretorius party subsequent to his resignation were interminable and complicated. Some of the new party were arraigned for treason and fined ; and for several months there were once more two acting Presidents and two rival governments within the Transvaal. At length Commandant Paul Kruger called out the burghers of~~

~~history]~~

~~his district and entered into the strife. Having driven Schoeman and his followers from Pretoria, Kruger in- vaded Potchefstroom, which, after a skirmish in which three men were killed and seven wounded, fell into his hands. He then pursued Schoeman, who doubled on his opponent and entered Potchefstroom. At this stage Pretorius intervened. A temporary peace was no sooner secured than Commandant Jan Viljoen rose in revolt and engaged Kruger's forces. At length in 1864, after a series of intestine quarrels, a conference was held lasting six days, followed by a new election for President, and once more Pretorius was called upon to fill that office. Kruger was appointed commandant-general.~~

~~Civil strife for a time was now at an end, but the injuries inflicted on the state were deep and lasting. The public funds were exhausted; taxes, always an abomination to the Transvaal Boer, were not only in arrear, but impossible to collect ; and the natives on the borders of the country and in the mountains of the north, taking advantage of the anarchy that prevailed, had thrown off all allegiance to the state. The prestige of the country was practically gone, not only with the world outside, but, what was of still more moment, with her neighbour the Eree State, which felt that a federation' with the Transvaal, which the Pree State once had sought but which it now definitely foreswore, was an evil avoided and not an advantage lost. A charge frequently laid at the door of the Boers, at that time and since, was that of enslaving the black races. It is true that laws pro- hibiting slavery were in existence, but the Boer who periodically took up arms against his own appointed Government was not likely to be,~~

~~*nor was he, restrained by laws. Natives were openly transferred from one Boer to another, and the fact that they were described as apprentices by the farmers did not in the least alter the status of the native, who to all intents and purposes became the property of his master. Missionaries were not at this time allowed to reside wherever they chose in the country, the Boers dreading an inculcation of doctrines among the natives likely to be subversive of their rule. Education, as need hardly be said, was in the 'sixties at a very low ebb. Even institutions for children were few in number, and nothing approaching the standard of a high school existed. The private tutor was a good deal in demand, but his qualifications were of the slightest. An unsuccessful European carpenter or other mechanic or even labourer not infre- quently occupied this position. At the various churches such elementary schools as existed were to be found, but they did not profess to teach more than a smattering of the three "B's" and the principles of Christianity.*~~

~~*In 1865 an empty exchequer called for drastic measures, and the Volksraad determined to endeavour to meet their liabilities and provide for further con- tingencies by the issue of notes. Paper money was thus introduced, and in a very short time fell to a con- siderable discount. In this same year the farmers of the Zoutpansberg district were driven into laagers by a native rising which for some considerable time they were unable to suppress. Schoemansdal, a village at*~~

~~*t _ the foot of the Zoutpansberg, was the most betg"native important settlement of the district, and the rising, most advanced outpost in European occupation ,865- at that time in South Africa. It was just one*~~

~~*degree north of the tropic, and was situated in a well- watered and beautiful country. It was used as a base by hunters and traders with the interior, and in its vicinity there gathered a number of settlers of European origin, many of them outcasts from Europe or Cape Colony. They earned the reputation of being the most lawless white inhabitants in the whole of South Africa, and*~~

~~*to-day a considerable number of these men or their descendants are still to be found in the northern Trans- vaal. When called upon to go to the aid of this settle- ment, which in 1865-66 was sore pressed by one of the*~~

~~*mountain Bantu tribes known as the Baramapulana, the burghers of the southern Transvaal objected that the white inhabitants of that region were too lawless and reckless a body to merit their assistance. Attempts on the part of the Government to raise a relief force met with very partial success. At length a small relief party proceeded to the district, but they had no sooner arrived than dissension arose between them and some of the more turbulent spirits of the Zoutpansberg. Ulti- mately Schoemansdal and a considerable portion of the district were abandoned, and Schoemansdal finally was burnt to ashes by a party of natives. For some time after the destruction of Schoemansdal a settlement con- tinued to exist in the district known as Potgieter's Rust. Por ten years it had been occupied by Europeans without ill effects, but in 1870 the inhabitants were attacked with fever, from which nearly the whole com- munity perished. The only village which remained under European occupation after this in the Zoutpansberg was Marabastad, at which the Boer landdrost continued to reside. Meanwhile the public credit and finances of the Transvaal went from bad to worse. The paper notes already issued had been constituted by the law legal tender for all debts, but in 1868 their power of actual purchase was only 30 per cent, compared with that of gold, and by 1870 it had fallen as low as 25 per cent. Civil servants, who were paid in this depreciated scrip, naturally suffered considerable distress. The revenue for 1869 was stated as £31,511 ; the expenditure at £30,836. The discovery of gold at Tati led President Pretorius in 1868 to issue a proclamation extending his territories on the west and north so as to embrace the goldfield, and on the east so as to advance considerably over the Portuguese boundary. This proclamation was followed by protests on the part of Her Majesty's High Commissioner, Sir Philip Wodehouse, as well as on the part of the consul-general for Portugal in South Africa. The boundary on the east was settled by a treaty with Portugal in 1870; that on the west was dealt with in 1871.*~~

~~*The Sand Eiver Convention of 1852 had not clearly defined the western border of the state, and the dis- covery of gold at Tati to the north-west, together with the discovery of diamonds on the Vaal in 1867, doubtless offered Pretorius every inducement to extend his boundary. Although to- day the great diamond mines are south of the Vaal river, it so hap- pened that the early discoveries of diamonds were made chiefly on the northern*~~

~~bank of the Vaal, near the site of the town now known as Barkly West. This territory was claimed by the South African Eepublic, by some of the Batlapin tribe, and aw^d also by Mr David Arnot, on behalf of Nicholas Waterboer, the chief of the Griquas, a race of bastards sprung from the illicit intercourse between Boers and native women, who had been settled north of the Orange since 1834. In order to settle the boundary question, an arbitration court was appointed, consisting of a Transvaal landdrost," Mr O'Reilly, on behalf of the South African Republic, and Mr John Campbell on behalf of the other claimants, with Lieu- tenant-Governor Keate of Natal as final referee. The two judges disagreed, and the final decision, afterwards known as the Keate award, was given by the referee. The decision was in favour of Waterboer, and conceded to him the boundary line to the north and north-east which his agent Arnot had claimed for him. Following~~

~~on this decision, Waterboer offered his territory to Queen Victoria. The offer was accepted, and the terri- tory became British under the title of Griqualand West. The Keate award practically brought Bechuana- land into existence as a separate state, and thus kept the great trade route to the north open to British enterprise.~~

~~The award caused a strong feeling of resentment among the Boers, and led to the resignation of President Pre- terms and his executive. The Boers now cast about to find a man who should have the necessary ability, as they said, to negotiate on equal terms with the British authorities should any future question of dispute arise. With this view they approached Brand, President of the Free State, and asked him to allow them to nominate him for the Presidency of the South African Bepublic. To this Brand would not consent. He recog- becomes nized that, even at this early stage of their President, history, in addition to having neither credit, ,872- nor resources, nor power of organization, the~~

~~Transvaal Boers were filled with the wildest ideas as to what steps they would take in the future to counter- act the influence of Great Britain. A number of them openly advocated a repudiation of such conventions as then existed, the extension of a road to Delagoa Bay so as- to exclude British trade, and the establishment of a gunpowder factory. Brand did not, in declining the Transvaal invitation, merely content himself with an official communication. He intimated clearly to many of the leading Transvaal Boers that in his opinion they were embarking on a rash and mistaken policy. He urged that their true interests lay in friendship with, not in hostility to, Great Britain and the British. Having failed with Brand, the Boers now invited the Bev. Thomas Francois Burgers, a member of a well- known Cape Colony family and a minister of the Dutch Reformed Church, to allow himself to be nominated. Burgers accepted the offer, and in 1872 was duly elected President. In 1871 gold reefs were discovered in . the Zoutpansberg district near Marabastad, and already a few gold-seekers from Europe and Cape Colony began to prospect the northern portions of the Trans- vaal. The miners and prospectors did not, however, exceed a few hundred in number for several years, and it was not until 1882 that they began to make themselves felt as a political and an important com- mercial factor in the development and future of the country.~~

~~The appointment of Burgers to the Presidency in 1872 was a new departure. Hitherto the Boers had always chosen one of their own number as President, but in Burgers they had selected a man from outside for the express purpose of securing an educated and capable leader. In a measure Burgers may be said to have fulfilled their choice. He was able, active, and enlight- ened, but he was unfortunately a visionary rather than a man of affairs or sound judgment. Instead of re- ducing chaos to order and concentrating his attention, as Brand had done so wisely in the Free State, on establishing security and promoting industry in the country, he took up with all its entanglements, the old misguided policy of intrigues with native chiefs beyond the border and the dream of indefinite expansion. Thus he had no sooner taken office than he endeavoured to support the claims of Moshette against Montsioa as paramount chief of Bechuanaland, and having failed in bringing about this change, he made overtures to Montsioa in the following year to induce him to alter the~~

~~Barolong boundary as settled by the Keate award. In this endeavour he was equally unsuccessful, and Montsioa, fearing further aggression, made a formal~~

~~request to be taken under British protection (see Bechuanalastd). In 1875 Burgers proceeded to Europe with the project of raising a loan for the construction of a railway to Delagoa Bay. He was empowered by the Volksraad to raise £300,000, but with great difficulty he ' obtained in Holland the sum of £90,000 only, and that at a high rate of interest. With this inadequate sum some railway plant was obtained, and subsequently lay for ten years at Delagoa Bay, the scheme having to be abandoned for want of funds. On his return to the Transvaal in 1876 Burgers found that the condition of affairs in the state was worse than ever. The acting President had in his absence been granted leave by the Volksraad to carry out various measures opposed to the public welfare; native lands had been indiscrim- inately allotted to adventurers, and a war with Secocoeni, a native chief on the eastern borders of the country, was imminent. A commando was called out, which the President himself led. The expedition was an igno- minious failure, and many burghers did not hesitate to assign their non-success to the fact that Burgers' views on religious questions were not sound. Burgers then proceeded to levy taxes, which were never paid; to enroll troops, which never marched ; and to continue the head of a Government which had neither resources, credit, nor power of administration. In 1877 the Trans- vaal one-pound notes were valued at one shilling cash. Add to this condition of things the fact that the Zulus were threatening the Transvaal on its western border, and the picture of utter collapse which existed in the state is complete. In 1877 the condition of the Trans- vaal appeared so menacing to the peace of South Africa that Sir Theophilus Shepstone was despatched to the country by the High Commissioner, Sir Henry Barkly, to confer with President Burgers as to its future govern- ment. By this time Burgers had had his eyes opened to the true state of things. He was no longer blinded by the foolish optimism of a visionary who had woven fine-spun theories of what an ideal republic might be. He had lived among the Boers and attempted to lead their Government. He had found their idea of liberty to be anarchy, their native policy to be slavery, and their republic to be a sham. His was a bitter awakening, and the bitterness of it found~~

~~*expression in some remarkable words addressed to the Volksraad : " I would rather," said Burgers in March 1877, " be a policeman under a strong Government than the Presi- dent of such a state. It is you — you members of the Baad and the Boers — who have lost the country, who have sold your independence for a drink. You have ill-treated the natives, you have shot them down, you have sold them into slavery, and now you have to pay the penalty. . . . We should delude ourselves by entertaining the hope that matters would mend by- and-by. . . . Do you know what recently happened in Turkey ? Because no civilized government was carried on there, the Great Powers interfered and said, 'Thus far and no farther.' And if this is done to an empire, will a little republic be excused when it misbehaves ? ... If we want justice, we must be in a position to ask it with unsullied hands. . . . To-day a bill for £1000 was laid before me for signature, but I would sooner have cut off my right hand than sign that paper, for I have not the slightest ground to expect that when that bill becomes due there will be a penny to pay it with."*~~

~~*After spending some months at Pretoria, Shepstone satisfied himself that annexation was the only possible salvation for the Transvaal. The treasury was empty, the Boers refused to pay their taxes, and there was no power to enforce them. A public debt of £215,000 existed, and*~~

~~*history]*~~

~~*Government contractors were left unpaid. Out of a male population of less than 9000, 3000 had already signed a petition for annexation. Sir Theophilus Shepstone there- fore, in April 1877, issued a proclamation annexing the country. The proclamation stated : " It is the wish of Her Most Gracious Majesty that it [the state] shall enjoy the fullest legislative privileges compatible with the circumstances of the country and the intelligence British °^ *ts People." The wisdom of the step taken anaexa- by Shepstone has been called in question. tioo. Unfortunately, foi- many years subsequently*~~

~~the matter was so surrounded with the sophis- try of English party politics that it was difficult for Englishmen to form any impartial opinion. The history of the Transvaal is more complete and better under- stood to-day than it was in 1877, and no one who ac- quaints himself with the simple facts of the position will deny that Shepstone's task was an extremely diffi- cult one, and that he acted with care and moderation. The best evidence in favour of the step is to be found in the publicly expressed views of the state's own President, Burgers, already quoted. Moreover, the men- ace of attack on the Zulu side was a pressing and serious one. Even before annexation had occurred, Shep- stone felt the danger so acutely that he sent a message to Cetewayo, the Zulu chief, warning him that British annexation was about to be proclaimed and that invasion of the Transvaal would not be tolerated. To this warn- ing Cetewayo, who, encouraged by the defeat of the Boers at Secocoeni's hands, had already gathered his warriors together, replied : " I thank my father Somtseu [Shepstone] for his message. I am glad that he has sent it, because the Dutch have tired me out, and I intended to fight with' them . . . and to drive them over the Vaal." A still further reason for Shepstone's annexation, given by Sir Bartle Frere, was that Burgers had already sought alliance with Continental Powers, and Shepstone had no reason to doubt that if Great Britain refused to interfere, Germany would intervene. The only military force at Shepstone's command at the time of annexation was twenty-five policemen, and it is quite certain that, apart from the attitude of President Burgers, which cannot be said to have been one of active opposition, a large number, probably a majority of the Boers, accepted the annexation with complacency. Burgers himself left the Transvaal a disappointed, heart-broken man, and a deathbed statement published some time after his decease throws a lurid light on the intrigues which arose both before and after annexation. He shows how, for purely personal ends, Mr Kruger allied himself with the British faction who were agitating for annexation, and in order to undermine him and endeavour to gain the Presidency, actually urged the Boers to pay no taxes. However this may be, Burgers was crushed, but as a con- sequence the British Government and not Mr Paul Kruger was, for a time at least, master of the Transvaal. In view of his attitude before annexation, it was not surprising that Mr Kruger should be one of the first men to agitate against it afterwards. The work of destruction had gone too far. The plot~~

~~had miscarried. And so Kruger and Jorissen, by whom he was accompanied, were the first to approach Lord Carnarvon with an appeal for revocation of the proclama- tion. To this request Lord Carnarvon's reply was that the act of annexation was an irrevocable one. Unfortu- nately, the train of events in England favoured the intrigues of the party who were bent on getting the annexation cancelled. In 1878 Lord Carnarvon resigned, and there were other evidences of dissension in the British cabinet.~~

~~Mr Kruger, who siDce the annexation had held a salaried appointment under the British Government,~~

~~again became one of a deputation to England. On this occasion Sir T. Shepstone not unnaturally determined to dispense with his further services as a Government servant, and terminated the engagement. In the be- ginning of 1879 Shepstone was recalled and Colonel Owen Lanyon, an entire stranger to the Boers and their language, was appointed his successor as admin- istrator in the Transvaal. In the meantime, the Zulu forces which threatened the Transvaal had been turned against the British, and the disaster of Isandhlwana occurred. Rumours of British defeat soon reached the Transvaal, and encouraged the disaffected party to become still bolder in their agitation f'Jfjff"1 against British rule. Thus Sir Bartle Frere~~

~~It ' will be seen from this review of the events follow- ing annexation that the first work accomplished, over and above establishing a solvent and responsible Govern- ment in the country, was the demolition by the British of the two native foes who for so long had harassed the Boers. In speaking, after the conclusion of the native wars, on the question of the revocation of the Act of annexation, Sir Garnet Wolseley assured the Boers at a public gathering that so long as the sun shone the British flag would fly at Pretoria. In May 1880 he returned to England. Meanwhile events in Great Britainhad once more taken a turn which gave encouragement to the disaffected Boers. Already in November 1879 Gladstone had con- ducted his Midlothian campaign. In his speeches he denounced in the strongest terms the annexation which had been carried out by the Beaconsfield Government. Referring to Cyprus and the~~

~~Transvaal, he went so far as to say, " If those acquisitions were as valuable as they are valueless, I would repudiate them, because they were obtained by means dishonourable to Effect of Mr the character of our country." Expressions ™Dafecn0™',* such as these were translated into Dutch and England. distributed among the Boers by some of their leaders, and it is impossible not to admit that they exer- cised a good deal of influence in fanning the agitation for retrocession already going on in the Transvaal. So keenly were the Midlothian speeches appreciated by the Boers that the Boer committee wrote a letter of thanks to Mr Gladstone, and expressed the hope that, should a ohange~~

~~in the Government of Great Britain occur, "the injustice done to the Transvaal might find redress." In April 1880 this change in the British Government did occur. Glad- stone became Prime Minister, and shortly afterwards Erere was recalled. Could events be more auspicious for the party seeking retrocession? If words in the mouth of an ex-minister at election-time meant any- thing, retrocession could only be a matter of time. The loyalists, not only in the Transvaal, but through- out South Africa, were disheartened and disgusted. The retrocession party in the Transvaal redoubled their efforts and their appeals. They were not destined to meet with such immediate success as the British premier's speeches, delivered during the heat of an election, very naturally led them to anticipate. On being directly appealed to by Kruger and Joubert, Mr Gladstone replied that the liberty which they sought might be " most easily and promptly conceded to the Transvaal as a member of a South African Confederation." This was not at all what was wanted, and the agitation continued. Meanwhile in the Transvaal itself, concurrently with the change of Prime Minister and HIgh Commissioner, the Adminis- trator, Colonel Lanyon, began vigorously to enforce taxation among the Boers. Men who would not pay taxes to their own appointed governments, and who were daily expecting to be allowed to return to that condi- tion of anarchy which they had come to regard as the normal order of things,~~

~~were not likely to respond willingly to the tax-gatherer's demands. That many of them refused payment in the circumstances which existed was natural.~~

~~In November matters were brought to a head by Bezuidenhout's waggons being seized in respect of the non-payment of taxes, and promptly retaken from the sheriff by a party of Boers. Lanyon began to recognize that the position was becoming grave, and wired to~~

~~Sir George Colley, the HIgh Commissioner of Outbreak South-East Africa, for military aid. This, how- ?«~~

~~Boers in public meeting at Paardekraal resolved once more to proclaim the South African Republic, and in the meantime to appoint a triumvirate, con- sisting of Kruger, Pretorius, and Joubert, who were to act as a provisional government. Within three days of the Paardekraal meeting a letter was sent to the Administrator demanding the keys of the Government offices within forty-eight hours. HIostilities forthwith began, and then followed a series of the most dis- astrous skirmishes, the most contradictory and most vacillating changes of policy, which have ever embar- rassed a military force or discredited a Government. No outbreak or rebellion ever occurred under more an- omalous conditions. While the administrator and HIgh Commissioner were endeavouring to carry out with very inadequate resources the declared policy of the British Government and their own instructions, contin- ual pressure was being put on the British Prime Min- ister, not only from the insurgent Boers, but from his own followers, to carry out the policy he had avowed while out of office, and to grant the retrocession of the country. But it was not until Great Britain was suffering from the humiliation of defeat that the Premier was convinced that the time for granting that retrocession had arrived. The first shots fired were outside Potchefstroom, which was then occupied by a small British garrison, who, aided by the loyal inhabitants of the town, successfully sustained a siege of the place until after the close of the war. On 29th December a small body of some 240 men, chiefly be- longing to the 94th Regiment, while marching from Lydenburg to Pretoria, were surprised and cut up by~~

~~*the Boer forces. Half the men were killed and wounded, the other half, including some officers, were taken prisoners. Of the prisoners, Captains Elliott and Lambert were subsequently treacherously shot by the Boers while crossing a stream, after they had been released on parole. In the meantime Pretoria, Bustenburg, Lyden- burg, and other smaller towns had been placed in a position of defence under the directions of Colonel Bellairs, who remained in command at Pretoria, the garrison con- sisting of a small number of troops and the loyal in- habitants. Sir George Colley, with about 1400 men, marched towards the Transvaal frontier, but before reach- ing it he found, on 24th January 1881, that the Boers had already invaded Natal and occupied Lang's Nek. He pitched his camp at Ingogo. Having been defeated at Lang's Nek, and suffered considerable loss in an engagement near Ingogo, Colley took a hw, mi. force to the top of Majuba, a mountain over- looking the Boer camp and the Nek. He went up dur- ing the night, and in the morning was attacked and over- whelmed by the Boers (February 27). Of the 554 men who constituted the British force on Majuba, 92 were killed and 134 wounded, Sir George Colley himself being amongst the slain.*~~

~~*Ten days previous to the disaster at Majuba, Sir Evelyn Wood had arrived at Newcastle with reinforcements. On Colley's death he assumed command, and on 6th March concluded an armistice with Joubert at Lang's Nek. Lord Kimberley then telegraphed offering an amnesty to the Boers. Gladstone announced in Parliament that an opportunity for a settlement of affairs in the Transvaal had arisen. On 6th March the terms of peace were arranged between the Boers and Sir Evelyn Wood. The most important of these terms were, that the Transvaal should have complete self-government under British suzerainty, and that a British Resident should be stationed at Pretoria. The treaty of peace practically conceded all that the Boers demanded, and was never regarded as anything else than surrender either by the Boers or the loyalists in South Africa. It had hardly been con- cluded when Sir Frederick Roberts arrived at the Cape with 10,000 troops, and after spending forty-eight hours there returned to England.*~~

~~*In the meantime, while the English general was making a treaty under the instructions of British ministers on the frontier, the beleaguered*~~

~~*garrisons of Pretoria, Potchef- stroom, and other smaller towns were stoutly and gal- lantly holding their own. The news of the surrender reached Pretoria through Boer sources, and when first received there was laughed at by the garrison and inhabi- tants as a Boer j oke. When the bitter truth was at length realized, the British flag was dragged through the dust of Pretoria streets by outraged Englishmen. At Potchef- stroom the garrison under Colonel Winsloe were hard pressed. Duringthe siegeathirdof theirnumberhadbeen killed and wounded. The Boer commander, Cronje, was duly informed of the armistice by his leaders, but in spite of this knowledge continued the siege for ten days after- wards, until Winsloe and his little band were compelled to surrender. In May the terms of settlement already agreed upon were drawn up at Pretoria Pretoria in the form of a convention and signed. The ttoZ”"' preamble to the Pretoria Convention of 1881 contained in brief but explicit terms the grant of self- government to the Boers, subject to British suzerainty. In later years, when the Boers desired to regard the whole of this convention (and not merely the articles) as cancelled by the London Convention of 1884, and with it the suzerainty which was only mentioned in the preamble, Mr Chamberlain pointed out that if the preamble to this instrument were considered cancelled,*~~

~~*history]*~~

~~*TRANSVAAL*~~

~~*433*~~

~~*The new*~~

~~*regime.*~~

~~*so also would the grant of self-government be cancelled. The Pretoria Convention contained thirty-three articles. The most important of these reserved to Her Majesty ” the control of the external relations of the said State, including the conclusion of treaties and the conduct of diplomatic intercourse with foreign Powers,” and the right to march troops through the Transvaal. The boundaries of the state were denned, and to them the Transvaal was strictly to adhere.*~~

~~*The retrocession of the Transvaal was a terrible blow to the loyalists. The Boers, on the other hand, found themselves in better plight than they had ever been before. Their native foes Cetewayo and Secocoeni had been crushed by British forces ; their liabilities were consolidated into a debt to Great Britain, to be repaid at convenience and leisure — as a matter of fact, not even interest was paid for some time. If ever a small state was well treated by a large one, the Trans- vaal was so in the retrocession of 1881. Unfortunately, this magnanimity was forthcoming after defeat. It appeared as though a virtue had been made of a ne- cessity, and the Boers never could regard it in any other light.*~~

~~*The new Volksraad had scarcely been returned, and Mr Kruger elected President, before a system of Govern- ment concessions to private individuals was started. These concessions, in so far as they prejudiced the commerce and general interests of the inhabitants, consisted chiefly in the granting of monopolies. Among the first monopolies which were granted in 1882 was one for the manufacture of spirituous liquor. The system continued steadily down to 1899, by which time railways, dynamite, spirits, iron, sugar, wool, bricks, jam, paper, and a number of other things, were all of them articles of monopoly. In 1882 also began that alteration of the franchise law which subsequently developed into positive exclusion of all but the original Boer burghers of the country from the fran- chise. In 1881, on the retrocession, full franchise rights could be obtained after two years' residence ; in 1882 the period of residence was increased to five years. Meanwhile the land-hunger of the Boers became stimulated rather than checked by the regaining of the independence of their country. On the western border intrigues were already going on with petty tribal chiefs, and the Boers drove out a portion of the Barolongs from their lands, setting up the so-called republics of Stellaland and Goshen (see Bechuanaland). This act called forth aprotest from Lord Derby, the minister chiefly responsible for the Pretoria Convention, stating that he could not recognize the right of Boer freebooters to set up governments of their own on the Transvaal borders. This protest, however, had no effect upon the freebooters, who issued one proclamation after another until in November 1883 they united the two new republics under the title of the " United States of Stellaland." Simultaneously with this "irresponsible" movement for expansion,*~~

President Kruger, having found the policy of putting pressure upon Great Britain so suc- cessful, proceeded to London to interview Lord Derby and endeavour to induce him to dispense with the suzerainty, and to withdraw other clauses in the Pretoria Convention on foreign relations and natives, which were objectionable from the Boer point of view. More- over, Kruger significantly requested that the term " South African Republic " should be substituted for Transvaal State.

The result was the London Convention of 1884. In this document a fresh set of articles was substituted for those of the Pretoria Convention of 1881. In the articles of the new convention the boundaries were once more defined, and to them the Transvaal was bound

" strictly to adhere." In what followed it must always be remembered that Lord Derby began by emphatically rejecting the first Boer draft of a treaty on the ground that no treaty was possible except be- London tween equal sovereign states. Moreover, it is tf°"™£^ undeniable that Lord Derby acted as though he was anxious to appear to be giving the Boers what they wanted. He would not formally abolish the suzerainty, but he was willing not to mention it; and though, as before stated, in substituting new articles for those of the Pretoria Convention he left the preamble untouched, he avoided anything which could commit the Boer delegates to a formal recognition of that fact. On the other hand, he was most indignant when in the House of Lords he was accused by Lord Cairns of impairing British interests and relinquishing the Queen's suzerainty. He declared that he had preserved the thing in its substance, if he had not actually used the word ; and this view of the matter was always officially maintained in the Colonial Office (which, significantly enough, dealt with Transvaal affairs) what- ever the political party in power. Unfortunately, the timid way in which it was done made as ineffaceable an impression on Mr Kruger even as the surrender after Majuba. Article 4 stated: "The South African Republic will conclude no treaty or engagement with any state or nation other than the Orange Pree State, nor with any native tribe to the eastward or west- ward of the Bepublic, until the same has been ap- proved by Her Majesty the Queen." The other article to which the greatest interest was subsequently at- tached was Article 14: — "All persons, other than natives, conforming themselves to the laws of the South African

~~Bepublic (a) will have full liberty, with their families, to enter, travel, or reside in any part of the South African Bepublic ; (6) they will be entitled to hire or possess houses, manufactories, warehouses, shops, and premises ; (c) they may carry on their commerce either in person or by any agents whom they may think fit to employ ; (<£) they will not be subject, in respect of their persons or property, or in respect of their commerce or industry, to any taxes, whether general or local, other than those which are or may be imposed upon citizens of the said Bepublic."~~

~~As the freebooters continued their operations in Bechuanaland, Sir Hercules Bobinson despatched the Bev. J. Mackenzie to adjust matters and if necessary "to order the ejectment of the persons now trespassing at Booi Grond " (see Bechuanaland). Mr Mackenzie met with but partial success, and Mr Rhodes was sent to succeed him, but the latter equally failed to bring about a settlement. Meanwhile President Kruger " provisionally " proclaimed and ordained, " in the interests of humanity," that the territory in dispute should be under the protection of the South African Republic. f^ZpT- Public protests were made in Cape Town and ditioa. throughout the Colony against this last act of aggression, and in October 1884 Sir Charles Warren was despatched by the British Government to "paci- ficate" and "hold the country" pending further in- structions. Thereupon President Kruger withdrew his proclamation, and on Sir Charles Warren's arrival met him and endeavoured to persuade him from pro- ceeding. Sir Charles Warren subsequently broke up the freebooters' two states, and occupied the country without a shot being fired. The expedition cost Great Britain a million and a half, but the attempt at farther extension westwards was foiled. At the eastern border a similar policy was followed by the Boers, and in this instance with more success. Following up the downfall of the Zulu power after the British conquest in 1879, several parties of Boers began intriguing with the petty~~

~~*Gold la*~~

~~*dustry.*~~

~~*chiefs, and in January 1883, in the presence of 10,000 Zulus, they proclaimed Dinizulu, the son of Cetewayo, to be king of Zululand (see Zululand). As a " reward " for their services to the Zulus, the Boers then took over from them a tract of country in which they established a "New Republic." Encouraged by success, the Boer claims were extended until at the end of 1885 they claimed about three-fourths of the whole Zulu territory. In 1886 the " New Republic," with limits considerably narrowed, was recognized by Great Britain, and the territory became incorporated with the Transvaal in 1888. Their eastern boundary, in the teeth of the spirit of the conventions, and with but scant observance of the latter, was by this means eventually considerably extended. A similar policy eventually brought Swazieland almost entirely under their dominion (see Swazieland).*~~

~~*Meanwhile, events occurring within the state augured ill for the future of the country. In 1884 a concession to a number of Hollander and German capitalists of all rights to make railways in the state led to the formation E a mic °^ *^e Netherlands Railway Company. This develop- company, which was not actually floated till meats : 1887, was destined to exercise a disastrous*~~

~~*influence upon the fortunes of the state. Gold*~~

~~*digging, which had commenced with the dis- covery in 1869 of the Zoutpansberg and Lydenburg gold- fields, had hitherto enjoyed in the Transvaal but a precarious existence. In 1883 the discovery of Moodie's Reef near the Kaap Valley led to a considerable influx of diggers and prospectors from the colonies and Europe, and by 1884 the Sheba Mine had been opened up and Barberton, with a population of 5000 inhabitants, sprung into existence. In 1886 the Rand gold-fields, which had just been discovered, were proclaimed and Johannes- burg was founded. From that time the gold industry made steady progress until the Rand gold mines proved the richest and most productive gold-field in the world. As the industry prospered, so did the European population*~~

~~increase. The revenue of the state went up by leaps and bounds. In 1882 it was £177,407; in 1889, £1,577,445; in 1896, £3,912,095. At the end of 1886 Johannesburg consisted of a few stores and some few thousand inhabitants. In October 1896 the Sanitary Board census estimated the popula- tion as 107,078, of whom 50,907 were Europeans. The wealth which was pouring into the Boer state coffers exceeded the wildest dreams of President Kruger and his followers. Land went up in value, and farms, many of them at comparatively remote distances from the actual gold-fields, were sold at enormously enhanced prices. In fact, so attractive did this sale of land become to the Boers that they eventually parted with a third of the whole land area of the country to Uitlander purchasers. Yet in spite of the wealth which the industry of the Uit- landers was bringing both to the state and to individuals, a policy of rigid political exclusion and restriction was adopted towards them.~~

~~An attempt was made in 1888, after the conference held between Cape Colony, the Orange Free State, and Natal, to induce the Transvaal to enter the Customs Union. Kruger would have none of it. HIs design at this time was ultimately to bring the whole of the external trade of the state, which was growing yearly as the gold industry developed, through Delagoa Bay and over the Netherlands railway (see Orange River Colony and Cape Colony).~~

~~HIs hostility towards Great Britain and even ritAuie' ^aPe Colony led him to adopt a commercial rest of policy both narrow and prejudicial to the in- south terests of the gold industry. In 1888 Sir~~

~~John Brand, President of the Free State, who had always been an enlightened advocate of civilization~~

~~and friendly relations with Great Britain, died. HIe was succeeded in 1889 by Mr Reitz. In the appointment of Mr Reitz, President Kruger recognized a new opportunity of endeavouring to cajole the Free State. While Brand was alive he had arranged, in the teeth of the strongest protests from Mr Kruger, that the Cape railway should extend to Bloemfontein and subsequently to the Vaal river. President Kruger now endeavoured to bind the future railway policy of the Free State, and induced the Free State to agree to a treaty whereby each state bound itself to help the other~~

~~*whenever the independence of either should be threatened or assailed, unless the cause of quarrel was, in the eyes of the state called in to assist, an unjust one. This was the thin end of the wedge, which in Brand's time President Kruger had never been able to insert into the affairs of the Free State.*~~

~~*President Kruger now turned his attention to finding a seaport, and was only prevented from doing so by the British annexation of Tongaland, which barred 0// his progress in that direction. In 1890 a feel- cticai ing of considerable irritation had grown up restric- among the Uitlanders at the various mono- tons' polies, but particularly at the dynamite monopoly, which pressed solely and with peculiar severity upon gold-miners. Requests for some consideration in the matter of the franchise, and also for a more liberal com- mercial policy in the matter of railways, dynamite and customs dues, began to be made. In response Kruger resorted to the most sweeping alteration in the franchise law. HIe enacted that the period of qualification for the full franchise should now be raised to ten years instead of five. HIe at the same time instituted what was called a second chamber, the franchise qualifications for which were certainly less, but which was not endowed with any real power. During this year Kruger visited Johannes- burg, and what was known as "the flag incident" occurred. HIe had by this time rendered himself somewhat un- popular, and in the evening the Transvaal flag, which flew over the landdrost's house, was pulled down. This in- censed Kruger so much that for many years he continued to quote it as a reason why no consideration could be granted to the Uitlanders.*~~

~~*In 1891 the Transvaal attempted its last border raid before the war of 1899. The Banjailand trek was or- ganized. The trekkers intended forcibly to annex a portion of the British South Africa Company's terri- tory. The HIgh Commissioner protested, and the Presi- dent prohibited the trek, but the trekkers were not finally turned back until they were opposed by the British South Africa forces under Dr Jameson and Colonel Goold-Adams.*~~

~~*In 1892 the Uitlanders began to feel that if they were to obtain any redress for their grievances some combined constitutional action was*~~

called for, and the first reform movement began. The Transvaal t/,!f*^ers National Union was formed. This consisted at the outset chiefly of mercantile and professional men and artisans. The mining men, especially the heads of the larger houses, did not care at this juncture to run the risk of political agitation. The Hon. J. Tudhope, an ex-minister in the Cape Government, was elected chairman of the Union. The objects of this body were avowed from the outset. They desired equal rights for all citizens in the state, the abolition of monoplies and abuses, together with the maintenance of the state's independence. In the furthering of this policy the Uitlander leader, Mr Tudhope, was supported by Mr Charles Leonard and his brother Mr James Leonard, who at one time had dis-tinguished himself as attorney-general of Cape Colony.

history]

Both the Leonards, as well as many of their followers, were South Africans by birth. They, in common with the great bulk of the Uitlanders, recognized that the state had acquired its independence, and had every right to have that independence respected. They neither sought nor desired to see it abolished. But they asserted that a narrow and retrogressive policy, such as Kruger was fol- lowing, was the very thing to endanger that independence. The soundness of these views and the legitimacy of Uit- lander aspirations were recognized by a few of the most enlightenedmenamongthe Boer officials at Pretoria. Some prominent burghers even spoke at Uitlander meetings in favour of the Uitlander requests. At a later date, Chief Justice Kotze when on circuit warned the Boers, that in its retrogressive action the Boer Government was undermining the grondwet or constitution of the state. It soon became evident that one course, and one only, lay open to President Kruger if he desired to avert acatastrophe. It was to meet in a friendly spirit those men who had by their industry converted a poor pastoral country into a richindustrialone, who represented more than half the inhabitants, who paid more than three-fourths of the revenue, and who were anxious to join him as citizens, with the rights of citizen- ship. He chose a course

~~diametrically opposite. In an interview accorded to seven delegates from the National Union, who visited him in 1892, with regard to reforms, he told Mr Charles Leonard to " go back and tell your people that I shall never give them anything. I shall never change my policy. And now let the storm burst." In 1894 there occurred an incident which not only in-censed the Uitlanders to fury, but called for Comwan- British, intervention. A number of British incident, subjects resident in the Transvaal, in spite of their having no political status, were com-mandeered for compulsory service to suppress a native rising. This led to a protest, and eventually a visit to Pretoria, from Sir Henry Loch. In the negotia- tions between Sir Henry Loch and President Kruger which followed, President Kruger at length agreed to extend "most favoured nation" privileges to British subjects in reference to compulsory military service, and five British subjects who had been sent as prisoners to the front were released. This result was not, however, achieved before President Kruger had done his utmost to induce Sir Henry Loch to promise some revision in favour of the Transvaal of the London Convention. Following this incident came a further alteration in the franchise law, making the franchise practically impossible to obtain. At a banquet given in honour of the German Emperor's birthday in Pretoria in January 1895, Kruger referred in glowing terms to the friendship of Germany for the Transvaal, which in the future was to be more firmly established than ever. This speech was public evidence of what was known to be going on behind the scenes. The German consul at Pretoria at this juncture was a volatile, sanguine man, with visionary ideas of the important part Germany was to play in the future as the patron and ally of the South African Eepublic, and of the extent to which the Bismarckian policy might go in abetting an anti-British campaign. Whether he deceived himself or not, he led President Kruger and the Boers to believe that the Kaiser was prepared to go to almost any length in support of the Transvaal if an opportunity occurred. His influence was an undoubted factor in the Kruger policy of that time.~~

~~A minor incident early in 1895 served to mark the truculent attitude which the Boer Government had come to adopt towards the Uitlander population at Johan- nesburg. The Netherlands railway had at length, very late in the day, completed their line from the Delagoa~~

~~*German flirtation.*~~

~~*Portuguese frontier to Pretoria. To the official banquet in honour of the event invitations were issued to the HIgh Commissioner and a host of minor Government officials in Pretoria. To the large commercial and mining houses in Johannesburg, to the men who had built up that very commerce which the new railway was built to carry, no invitations were sent. The Uitlanders were ignored. The Delagoa Bay railway now being completed, Kruger de- termined to take steps to bring the Band traffic over it. The Netherlands railway began by putting a prohibitive tariff on goods from the Vaal river ^J^nt (see Cape Colony). Not to be coerced in this manner, the Rand merchants proceeded to bring their goods on from the .Vaal by waggon. Kruger then closed the drifts (or fords) on the river by which the waggons crossed. HEonly reopened them after the receipt of what was tantamount to an ultimatum on the subject from Great Britain.*~~

~~*At this time the Uitlanders formed a majority of the population, owned half the land and nine-tenths of the property, and they were at least entitled to a hearing. When in August they forwarded one of their many petitions praying for redress of their grievances and an extension of the franchise, their petition with over thirty-five thousand signatures was Wander rejected with jeers and insult. One member movement. of the Baad, during a debate in the Chamber, called upon the Uitlanders to "come on and fight" for their rights if they wanted them. The words, it is true, were but the utterance of an individual Raad member, but they were only a shade less offensive than those used by President Kruger in 1892, and they too accurately described the attitude of the Boer execu- tive. In September a combined meeting of the Cham- bers of Mines and Commerce was held at Johannes- burg, and a letter on various matters of the greatest importance to the mining industry and community at Johannesburg was addressed to the Boer executive. It was never vouchsafed an answer. Men of any spirit among the Uitlanders were exasperated beyond measure. Their position was not merely unjust; it was humili- ating. What the next step should be was freely dis- cussed. It was easy to propound the question, impossible to answer it. Some urged an appeal to the Imperial Government; but others, especially men of colonial birth and experience, objected that they would be leaning on a broken*~~

reed. That men who had still the memory of Majuba in their hearts should have felt misgiving is not to be wondered at. At this juncture came over- tures to the leading Uitlanders from Mr Rhodes and Dr Jameson, leading to the Jameson Raid. To one or two men this scheme, subsequently known as ™J the Jameson Plan, had been revealed earlier in pian." the year, but to the majority even of the small group of leaders it was not known till October or Novem- ber 1895. The proposition came in a tempting hour. Mr Rhodes and Dr Jameson, after considerable deliberation, came to the conclusion that they might advantageously intervene between Mr Kruger and the Uitlanders. They induced Mr Alfred Beit, who was an old personal friend of Mr Rhodes, and also largely interested in the Rand gold mines, to adopt this view and to lend his co-operation. They then submitted their scheme to some of the Uitlander leaders. Between them it was arranged that Dr Jameson should gather a force of eight hundred men on the Trans- vaal border ; that the Uitlanders should continue their agitation; and that, should no satisfactory concession be obtained from President Kruger, a combined movement of armed forces should be made against the Government. The arsenal at Pretoria was to be seized ; the Uitlanders in Johannesburg were to rise and hold the town. Jameson

was to make a rapid march to Johannesburg. The various movements were to be started simultaneously. Meanwhile, in order to give Mr Kruger a final chance of making concessions with a good grace, and for the pur- pose of stating the Uitlander case to the world, Mr Leonard, as chairman of the National Union, issued a historic manifesto, which concluded as follows : —

We have now only two questions to consider : (a) What do we want ? (6) How shall we get it ? I have stated plainly what our grievances are, and I shall answer with equal directness the ques- tion, What do we want ? We want : (1) the establishment of this Kepublic as a true Republic ; (2) a

~~grondwet or constitution which shall be framed by competent persons selected by representa- tives of the whole people and framed on lines laid down by them — a constitution which shall be safeguarded against hasty alteration ; (3) an equitable franchise law, and fair representation ; (4) equality of the Dutch and English languages ; (5) responsibility to the heads of the great departments of the Legislature ; (6) removal of reli- gious disabilities ; (7) independence of the courts of justice, with adequate and secured remuneration of the judges ; (8) liberal and comprehensive education ; (9) efficient Civil Service, with adequate provision for pay and pension ; (10) free trade in South African products. That is what we want. There now remains the question which is to be put before you at the meeting of the 6th January, viz., How shall we get it ? To this question I shall expect from you an answer in plain terms according to your de- liberate judgment.~~

~~The Jameson conspiracy fared no worse and no better than the great majority of conspiracies in history. It failed in its immediate object. Dr Jameson did not obtain more than five hundred men. Johannesburg had the greatest difficulty in smuggling in and distributing the rifles with which the insurgents were to be armed. The scheme to seize the Pretoria fort had to be abandoned, as at the time fixed Pretoria was thronged with Boers. Finally, to make confusion worse con- founded, Dr Jameson, becoming impatient of delay, in spite of receiving direct messages from the leaders at Johannesburg telling him on no account to move, marched into the Transvaal on the day which had been provision- ally decided on.~~

~~The policy of delay in the execution of the plot which the Uitlander leaders found themselves compelled to adopt was determined by a variety of causes. Apart from the difficulty of obtaining arms, a serious question arose at the eleventh hour which filled some of the Uitlanders with mistrust. The reform leaders in the Transvaal, down to and including the Johannesburg rising, had always recog- nized as a cardinal principle the due observance and main- tenance of the independence of the state. Prom Cape Town it was now hinted that the movement in which Dr Jameson was to co-operate should, in Mr Rhodes's view, be carried out under the British flag. A meeting of Uitlander leaders was hastily summoned on 25th Decem- ber. Two messengers were that night despatched to t~~

~~*interview Mr Rhodes, who then gave the assurance that he approved of the republican flag. Meanwhile, on 29th December, Dr Jameson had started, and the news of his having done so reached Johannesburg from outside sources. A number of leading citizens were at once formed into a reform committee. In the absence of Mi**~~

~~*Charles Leonard, who had been sent as one of*~~

~~*been for three years in succession chairman of the Chamber of Mines, and he had persistently for several years endeavoured to induce President Kruger to take a reasonable view of the requirements of the industry. IIe was a man of marked ability and energy, and enjoyed the confidence of the great majority of the Uitlanders. Under the supervision of the reform com- mittee, such arms as had been smuggled in were now*~~

~~*v*~~

~~*distributed, and Colonel Frank Ehodes was given charge of the armed men. The canteens were closed in the towns and along the mines. A large body of police was enrolled, and order was maintained throughout the town. On 2nd January 1896 Dr Jameson, who found himself at Doorn-kop in a position surrounded by Boers, surrendered. Dr Jameson and his men were conveyed to Pretoria as prisoners, and subsequently handed over to the IIigh Commissioner. The whole of the reform committee (with the exception of a few who fled the country) were arrested on a charge of high treason and imprisoned in Pretoria ; they were then brought up for preliminary examination in the Raadzaal, and committed for trial. In April, at the trial, the four leaders — Mr Lionel Phillips, Colonel Frank Rhodes, Mr J. II. IIammond, and Mr George Farrar, who in conjunction with Mr Charles Leonard had made the arrangements with Dr Jameson — were sentenced to death, the sentence being after some months' imprisonment commuted to a fine of £25,000 each. The rest of the committee were each sentenced to two years' imprisonment, £2000 fine or another year's im- prisonment, and three years' banishment. This sentence, after a month's incarceration, was also commuted. The fine was exacted, and the prisoners, with the exception of Woolls Sampson and Karri Davis, were liberated on undertaking to abstain from politics for three years in lieu of banishment. Messrs Sampson and Davis, refusing to*~~

~~*appeal to the executive for a reconsideration of their sentence, were retained for over a year. At a later date both of them, as well as several of their reform colleagues, served gallantly in the Imperial Light Horse during thewar.*~~

~~*Sir Hercules Robinson was unfortunately in feeble health at the time, and having reached Pretoria on the 4th of January, he had to conduct negotiations under great physical disadvantage. He had no sooner learnt of the Raid in Cape Town than he issued a proclamation through Sir Jacobus de Wet, the British Resident at Pretoria, warning all British subjects in Johannesburg or elsewhere from aiding and abetting Jameson. This was freely dis- tributed among the public of Johannesburg. While in Pretoria the High Commissioner in the first instance ad- dressed himself to inducing Johannesburg to lay down its arms. He telegraphed to the reform committee that President Kruger had insisted " that Johannesburg must lay down arms unconditionally as a precedent to any dis- cussions and consideration of grievances." On the follow- ing day, 7th January, Sir Hercules telegraphed again through the British Agent, who was then at Johannes- burg, saying: "That if the Uitlanders do not comply with my request they will forfeit all claims to sympathy from Her Majesty's Government and from British subjects throughout the world, as the lives of Jameson and the prisoners are now practically in their hands." The two thousand odd rifles which had been distributed among the Uitlanders were then given up. With regard to the in- ducements to this step urged upon the reform committee by the High Commissioner, it is only necessary to say with reference to the first that the grievances never were considered, and with reference to the second it subsequently appeared that one of the conditions of the surrender of Dr Jameson's force at Doornkop was that the lives of the men should be spared. It was after the Johannesburg disarmament that President Kruger had sixty-four mem- bers of the reform committee arrested, announcing at the same time that his motto would be " Forget and for- give." Sir Hercules Robinson, in response to a message from the British Government urging him to use firm language in reference to reasonable concessions, replied that he considered the moment inopportune, and on 15th January he left for Cape Town.*~~

~~*In th e three years which intervened between the Jameson*~~

~~*history]*~~

~~*TRANSVAAL*~~

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~~*Raid and the outbreak of the war in 1899 Kruger's ad- ministration continued to be what it had been before the war; that is to say, it was not merely bad, but After the ft got progressively worse. His conduct imme- diately after Johannesburg had given up its arms, and while the reform committee were in prison, was distinctly disingenuous. Instead of discussing grievances, as before the Johannesburg disarmament he had led the High Commissioner to believe was his inten- tion, he proceeded to request the withdrawal of the London Convention, because, among other things, " it is injurious to dignity of independent Republic." When President Kruger found that no concession was to be wrung from the British Government, he proceeded, in- stead of considering grievances, to add considerably to their number. The Aliens' Expulsion and Aliens' Immi- gration Laws, as well as the new Press Law, were passed in the latter part of 1896.*~~

~~*In 1897 a decision of Chief Justice Kotze was over- ruled by an Act of the Volksraad. This led to a strong protest from the judges of the High Court, and eventually led to the dismissal of the Chief Justice, who had held that office for over twenty years, and during the whole of that time had been a loyal and patriotic friend to his country. While in office Mr Kotze had protested that no honourable man could continue to sit as judge under such conditions. After dismissal he spoke out still more plainly at a public dinner in Johannesburg, and openly charged President Kruger with the tyranny of a despot. An Industrial Commission appointed during this year by President Kruger fared no better than the High. Court had done. The commission was deputed to inquire into and report on certain of the grievances adversely affecting the gold industry. Its constitution for this purpose was anomalous, as it consisted almost entirely of Transvaal officials whose knowledge of the requirements of the in- dustry was scanty. In spite of this fact, however, the commission reported in favour of*~~

~~reform in various direc- tions. They urged, among other things, due enforcement of the liquor law, more police protection, the abolition of the dynamite concession, and that foodstuffs should be duty free. These recommendations made by President Kruger's own nominees were practically ignored. In January 1899 the British Colonial Secretary, Mr Cham- berlain, pointed out in a despatch to President Kruger that the dynamite monopoly constituted a breach of the London Convention. In order to help the Transvaal Government out of its difficulty, and to make one more effort towards conciliation, the financial houses of Johan- nesburg offered to lend the Transvaal Government £600,000 wherewith to buy out the dynamite company, and so terminate the scandal and bring some relief to the industry. The offer was not accepted. In May the Uitlanders, hopeless of ever obtaining redress from Pres- ident Kruger, weary of sending petitions to the Raad only to be jeered at, determined to invoke intervention if nothing else could avail, and forwarded a peti- Petitioa tion to Queen Victoria. This petition, the out- come of the second Uitlander movement for reform, was signed by 21,000 British subjects, and stated the Uitlander position at considerable length. The following extract conveys its general tenor : —~~

~~" The condition of your Majesty's subjects in this State has become well- nigh intolerable. The acknowledged and admitted grievances, of which your Majesty's subjects complained prior to 1895, not only are not redressed, but exist to-day in an aggravated form. They are still deprived of all political rights, they are denied any voice in the government of the country, they are taxed far above the requirements of the country, the revenue of which is misapplied and devoted to objects which keep alive a continuous and well-founded feeling of irritation, without in any way ad- vancing the general interest of the State. Maladministration and~~

~~peculation of public moneys go hand in hand, without any vigor- ous measures being adopted to put a stop to the scandal. The education of Uitlander children is made subject to impossible con- ditions. The police afford no adequate protection to the lives and property of the inhabitants~~

~~*of Johannesburg ; they are rather a source of danger to the peace and safety of the Uitlander popula- tion."*~~

~~*In response to this appeal, which the Imperial Govern- ment felt themselves bound to deal with, Mr Chamberlain proposed a conference ; and this was arranged between President Kruger and Sir Alfred Mil- Bioem- ner, who met at Bloemfontein on 31st May 'Terence. 1899. It no sooner opened than it was evident that Kruger had come to obtain, not to grant, conces- sions. He offered, it is true, a seven years' franchise law in place of the five years' franchise which Sir Alfred Milner asked for. But apart from the relief suggested being entirely inadequate, it was only to be given on certain con- ditions, one of which was that all future disputes which might arise between the Transvaal and the Imperial Gov- ernment should be referred to a court of arbitration, of which the president should be a foreigner. No arrange- ment was possible on such terms. Meanwhile feeling was running high at Johannesburg and throughout South Africa. Meetings were held in all the large towns, at which resolutions were passed declaring that no solution of the Transvaal question would be acceptable which did not provide for equal political rights for all white men. Sir Alfred Milner (who in a published despatch com- pared the position of the Uitlanders to that of " helots ") urged the Home Government strongly to insist upon a minimum of reform, and primarily the five years' fran- chise ; and Mr Chamberlain, backed by the Cabinet, adopted the policy of the High Commissioner.*~~

~~*(a. p. h.)*~~

~~*The Crisis of 1899.*~~

~~*A state of extreme diplomatic tension lasted all the summer. The British public, in whom there had always been the latent desire to wipe out the memory of Majuba, were at last awakened by the Ministerialist press to the necessity of vindicating British influence in South Africa, and the Government soon found that, in spite of a highly articulate Radical minority, the feeling of the country was overwhelmingly behind them. It was not then realized either by the public or the Government how seriously, and with what considerable justification, the Boers be- lieved in their ability, if necessary, to sweep the English "into the sea." President*~~

~~Kruger had every expectation of large reinforcements from the Dutch in the two Brit- ish colonies ; he believed that, whatever happened, Europe would not allow Boer independence to be destroyed ; and he had assured himself of the adhesion of the Orange Free State, though it was not till the very last moment that President Steyn formally notified Sir Alfred Milner of this fact. The Boers profoundly despised the military power of Great Britain, and there was no reason why they, any more than Germany or Prance, should con- template the possibility of the Empire standing together as a whole in such a cause. In England, on the other hand, it was thought by most people that if a firm enough attitude were adopted Mr Kruger would " climb down," and the effect of this error was shown partly in the whole course of the negotiations, partly in the tone personally adopted by Mr Chamberlain. It was only later that it was seen that if Great Britain intended effectually to champion the Uitlander cause, the moment for a test of strength had inevitably ar- rived. Negotiations could only bring the conflict a little nearer, delay it a little longer, or supply an opportunity to either side to justify its action in the~~

~~eyes of the world. The conditions of the problem were such that unless Great Britain were to accept a humi- liating rebuff, any correspondence, however skilfully con- ducted, was bound to bring into greater prominence the standing causes of offence between the two sides. The exchange of despatches soon led to a complete impasse. The persistent attempt of the South African Eepublic to assert its full independence, culminating in a formal denial of British suzerainty, made it additionally in- cumbent on Great Britain to carry its point as to the Uitlander grievances, while, from Mr Kruger's point of view, the admission of the Uitlanders to real political rights meant the doom of his oligarchical regime, and appeared in the light, of a direct menace to Boer supre- macy. The franchise, again, was an internal affair, in which the Convention gave Great Britain no right to interfere, while if Great Britain relied on certain definite breaches of the Convention, satisfaction for which was~~

~~*sought in the first place in such a guarantee of amend- ment as the Uitlander franchise would involve, the Boer answer was an offer of arbitration, a course which Great Britain could not accept without admitting the South African Eepublic to the position of an equal. Here was material enough for an explosion, even if personal mis-understandings and aggravations, adding fuel to the fire, had not naturally occurred (or even been deliberately plotted) during the negotiations. But the truth was that the Boers thought they stood to gain by fighting, while the British, though not expecting war, and acting up till the last month or so on the assumption that serious military preparations were either unnecessary or suffi- ciently unlikely to be necessary to make them politically inexpedient, had with no less confidence committed them-selves to a policy which was impracticable on peaceful terms.*~~

~~*After July the tactics of the Boer executive were simply directed towards putting off a crisis till the be- ginning of October, when the grass would be growing on the veldt, and meanwhile towards doing all they could in their despatches to put the blame on Great Britain. At last they drafted on 27th September an ultimatum to the British Government. But, although ready drafted, many circumstances conspired to delay its presentation. Meanwhile, the British War Office began to wake up. Certain departmental details were despatched to South Africa to form a working nucleus for military bases, and early in September the Cabinet sanctioned the despatch to Natal from India of a mixed force, 5600 strong, while two battalions were ordered to South Africa from the Mediterranean. Sir George White was nominated to the chief command of the forces in Natal, and sailed on 16th September, while active preparations were set on foot in England to prepare against the necessity of despatching an army corps to Cape Town, in which case the chief command was to be vested in Sir Redvers Buller. Fortunately, although the draft of the ultimatum was lying in the State Secretary's office in Pretoria, the Boers, unprepared in departmental ar- rangements which are necessary in large military operations, were unable to take the field with the prompti- tude that the situation demanded. They consequently forfeited many of the advantages of the initiative. Thus it happened that, while the ultimatum remained un-delivered in Pretoria, the British Government were able, if not to render their line of resistance secure, at least to prop it with sufficient*~~

~~reinforcements to enable it to defeat the crowning object of the Boer in-vasion of Natal — the capture of Pietermaritzburg and Durban.~~

~~The military strength of the two republics was practi- cally an unknown quantity. It was certain that, since~~

~~the troublous times of 1896, the Transvaal had greatly increased its armaments ; but at their best, except by a very few, the Boers were looked upon by English military experts as a disorganized rabble, which, while contain- ing many individual first-class marksmen, would be incapable of maintaining a prolonged resistance against a disciplined army. As was to be subsequently shown, the hostilities were not confined to opposition from the fighting strength of the two little republics alone ; the British had to face Dutch opposition in their own colonies, and it was only the apathy and caution of the South African Dutch, taken as a whole, which saved the Empire from disaster. The total fighting strength of the Boer republics was probably never more than 60,000 men, and of these it is doubtful if at any period of the war there were more than 36,000 in the field at the same time. But the fact that it was to a large extent a struggle with a nation in arms doubled the numbers of the force that the Transvaal executive was able to draw upon, while to this may be added the not insignificant total of 10,000 Uitlanders and foreigners, and 15,000 Kaffirs, employed in menial duties attendant upon military operations. Of this force only a micro- scopic proportion was permanent and disciplined. At the outbreak of war the disciplined forces in the Transvaal were the South African Eepublic Police, about 1400 strong, with 20 officers; the Swazieland Police, 400 strong ; and the Staats Artillerie, which, when the reserv- ists were called up in mobilization for war, numbered about 800 men. The permanent forces of the Orange Eree State simply consisted of an artillery corps, at the most 400 strong. Eor the rest, the bulk of the Dutch levies were organized on the burgher system — that is, each district was furnished with a commandant, who had under him field-cornets and assistant field-cornets, who administered the fighting capacity of the district. Each field-cornet, who, with the commandant, was a paid official of the state, was responsible for the arms, equip- ment, and attendance of his commando— the commando being the tactical as well as the administrative unit ; any number of commandoes might be grouped under~~

~~*one commandant. Vecht, or fighting generals, again, exercised an authority above the commandants, while the supreme military control was vested in the Commandant- General.*~~

~~*The plan of campaign which found favour with the Boers, when they determined to put their differences with Great Britain to the test by the ordeal of the sword, was to attack all the principal British towns adjacent to their own borders ; at the same time to despatch a field army of the necessary dimensions to invade and reduce Natal, where the largest British garrison existed. It is not too much to suppose that the executive in Pretoria had cal- culated that the occupation of Durban would inspire the entire Dutch nation with a spirit of unanimity which would eventually wrest South Africa from the British. On paper the scheme had everything to recommend it, as the expedient most likely to bring about the desired end. But the departmental executive could not push off the Natal invading force as early as had been anticipated, and it was not until 9th October that the ultimatum was presented to Mr Cunyngham Green, the British agent at Pretoria. This ultimatum proved to be an arrogant document, in which the situation was reviewed in a manner which showed clearly that the Boer Govern- ment had determined long before to put their differences to the final test of arms, and that the later negotia- tions had but served to cover the warlike preparations which were in hand. The scheduled demands were as follows : —*~~

~~*" (o) That all points of mutual difference shall be*~~

~~*war]*~~

~~*regulated by the friendly course of arbitration, or by whatever amicable way may be agreed upon by the Government with Her Majesty's Government.*~~

~~*"(b) That the troops on the borders of this ultimatum. Republic shall be instantly withdrawn.*~~

~~"(c) That all reinforcements of troops which have arrived in South Africa since the 1st of June 1899 shall be removed from South Africa within a reasonable time, to be agreed upon with this Government, and with a mutual assurance and guarantee on the part of this Government that no attack upon or hostilities against any portion of the possessions of the British Government shall be made by the Republic during further negotiations within a period of time to be subsequently agreed upon between the Governments, and this Government will, on compliance therewith, be prepared to withdraw the armed burghers of this Republic from the borders.~~

~~"(d) That Her Majesty's troops now on the high seas shall not be landed in any part of South Africa."~~

~~To these demands the Transvaal Government required an answer within 48 hours.~~

~~There could be only one reply, and on Wednesday, 11th October 1899, at five o'clock p.m., a state of war existed between the British Government and the two Boer republics. On the following day the Boer attack on an armoured train at Kraaipan, on the western frontier of the Transvaal, witnessed the first hostile shot of a bloody war, destined to plunge South Africa into strife for two years and a half.~~

~~The Wak of 1899-1902.~~

~~For the purposes of history the South African cam- paign may be conveniently divided into five distinct periods. The first of these would be the successful Boer invasion of British territory, terminating with the relief of Ladysmith on 28th February ; the second, the period of Boer organized resistance, which may be said to have finished with Lord Roberts's formal annexation of the Transvaal on 25th October 1900, and the flight of ex-President Kruger to Holland. The next therrrar ' Peri°~~

~~The first of these periods saw the severest fighting of the campaign. It opened with the investment of Mafe- king by a Transvaal force under A. P. Cronje, the envelop- ment of Kimberley by Free State commandoes under General Wessels, and on 1st November the complete isolation of~~

~~*the bulk of the Natal Field Force in Lady- smith by the main Federal army under Commandant- General Piet Joubert. The Natal Field Force, however, did not submit to investment without a struggle ; and*~~

~~*before the enemy finally cut the communication with the south, portions of Sir George White's force had fought four considerable actions with the invading _. _ army. The first two of these were of the white"**" nature of British successes. On 20th October operations the detached brigade at Talana drove back the '" NataL Boer left under Lucas Meyer. But this superiority was bought at a price which nullified many of the results of victory. General Sir W. Penn Symons, the British officer in command, was mortally wounded, and after losing half its mounted men as prisoners and 226 officers and men killed and wounded, the brigade only escaped being enveloped by beating a masterly retreat upon Lady- smith, where it arrived in a very exhausted state on 26th October. In the meantime Sir George White had taken the aggressive, and hearing on 20th October that an advance guard under General Kock had occupied Elandslaagte, and placed itself athwart the direct com- munications of General Symons's force, he detached a force of all arms under Major-General French, and de- feated Kock after a sanguinary engagement on 21st October (British losses, 258 all ranks killed and wounded). Three days later Sir George White fought a second engagement against the enemy advancing from the north at Tintwa Inyoni, in order to cover the retirement of the Dundee force. It was an inconsequent action, which cost the Natal Field Force 118 casualties, the majority of which occurred in the Gloucestershire Regiment. By 29th October Joubert's army had practically _.. , . _ enveloped Ladysmith, and Sir George White smith 3 determined to strike a blow in force which " eotaogle- should be decisive in effect. The result of weat" this decision was the battle of Lombard's Kop, outside Ladysmith, in which the whole of Sir George White's available garrison was engaged. The engagement was disastrous to the British, who had undertaken far too comprehensive an attack, and the Natal Field Force was obliged to fall back upon Ladysmith, with the loss of 1500 men in casualties, including the headquarters of the Gloucestershire and Royal Irish Fusiliers, which surrendered to the Free Staters and Johannesburg zarps at Nicholson's Nek. From that day the role of the Natal Field Force was changed from that of a hostile field army into the defence of a*~~

~~*standard on a hill, and two days later it was completely isolated, but not before General French had succeeded in escaping south by train, and the naval authorities had been induced by Sir George White's urgent appeals to send into the town a Naval Brigade with a few guns of sufficient range and calibre to cope with the heavy position artil- lery which Joubert was now able to bring into action against the town.*~~

~~*General Sir Redvers Buller, who had been given the supreme command in South Africa as soon as it was perceived that war was the only solution to the South African trouble — his force being an army Butler's corps in three divisions, the divisional generals arrival. being Lord Methuen, Sir W. Gatacre, and Sir W. Clery — arrived in Cape Town, ahead of his troops, on the day following the final bid of Sir George White's army. The situation which presented itself was delicate in the extreme. In Natal practically the whole of the available defence force was swallowed up by the steady success of the invasion ; on the western frontier two import- ant British towns were isolated and besieged ; and Federal commandoes were on the point of invading Cape Colony, which, as far as its Dutch population was concerned, seemed in peril of rebellion. The army corps, which had been mobilized for war, was about to arrive in South Africa ; but it was evident that the exigencies of the situation, and the widely divided areas of invasion, would for the*~~

~~*time being place in abeyance the original plan which had been formulated for an invasion of the Orange Free State from Cape Colony on three parallel lines. The first duty was to effect the relief of the 'British forces which had been rendered immobile, and to do this Sir Eedvers Buller had no choice but to disintegrate the army corps. Hildyard's and Barton's brigades were sent to Natal ; Sir William Gatacre, with a brigade instead of a division, was despatched to Queenstown, Cape Colony ; while Lord Methuen, with a division, was sent off at breathless pace to relieve Kimberley. As November wore on, the situa- tion did not improve. Cape*~~

~~Colony was invaded in earnest ; while in Natal a flying column of Boers, pushing down from the Tugela, not only captured an armoured train, but for a short time isolated Hildyard's forces concentrating at Estcourt. The situation in Natal seemed so serious that on 22nd November Sir Eedvers Buller suddenly disappeared from Cape Town, to arrive in Natal three days later. In the meantime Lord Methuen, with characteristic energy, had commenced his march to the relief of Kimberley. He encountered resistance at Belmont on 23rd. This he brushed aside by direct tactics, and two days later won another step on the stair to Kimberley at Enslin. Still persevering, he moved on to the Modder, where he was seriously opposed by De la Bey and P. A. Cronje, the latter having posted down from Mafeking with 2000 men and arrived on the previous night. The Boers, who held a river line, kept the British attack at bay all night, but eventually fell back, relinquishing the position after dark, as their right had been turned by General Pole-Carew's brigade.~~

~~It was a long and sanguinary fight, in which of""ora tne British lost 485 killed and wounded,, and Methuen what was more serious, Lord Methuen (himself aadQen. WOunded) found that his force had exhausted~~

~~its forward momentum, and that other than heroic tactics would have to be employed to raise the siege of Kimberley. The extent of the operations and the gravity of the situation now began to be felt in England, every available man was called up from the reserves, and the War Office made what at the time appeared to be adequate provision for the waste which it was seen would occur in a war under modern conditions. On 30th November the mobilization of a sixth division was ordered, offers of Colonial aid were accepted, and every facility provided for local recruiting in the South African ports. All through the early weeks of December confidence was considerably restored. Buller was ar- ranging for the relief of Ladysmith, which had already shown its spirit by two successful sorties to the besieg- ers' batteries. In every theatre the British strength was consolidating. But the full significance of British incapacity to cope with the situation presented by these two small nations in arms had not yet been appreciated. The confidence restored by the lull during the early part of December was destined to be roughly shattered. On 10th December Gatacre essayed a night march and attack upon the rebel~~

~~*position at Stormberg, and was himself surprised and beaten (719 killed, wounded, and missing). On the following day Lord Methuen delivered an attack upon the Spytfontein kopjes (Magersfontein), and failed hopelessly, losing General A. Wauchope and over 950 officers and men. But even this could be suffered with equanimity, since Buller was about to bring his own force into play, and Buller, it was confidently supposed, would not fail. He had collected at Chievely in Natal a brigade of mounted men, four brigades of infantry (Generals Lyttelton, Hart, Barton, and Hild-yard), and two brigade divisions of artillery, and he carried with him the trust alike of the army and the nation.*~~

~~*On 16th December the whole Empire was prostrated with the news that Buller had made his effort and failed ; that he had essayed an assault upon the positions fortified north of the Tugela by the Boers, under their newly found general Louis Botha, Bailer's and that he had been repulsed with the loss of Lord" 1100 men and 10 guns. The full nature of the Roberts failure was not realized by the British public, appointed nor the spirit in which the general had received Command. the finding of fortune. How he had lost heart, and actually suggested the surrender of Ladysmith, was only known to them later, but the Cabinet knew, and in the face of the serious situation thus created the Cabinet took strong action. They appointed Field-Marshal Lord Roberts, V.C., to the supreme command in South Africa, with Lord Kitchener as his Chief of the Staff. A wave of military enthusiasm shook the Empire, and as the final requisition for mobilizing a seventh division prac- tically drained the mother-country of trained men, a scheme for the employment of amateur soldiers was for- mulated, resulting in the Imperial Yeomanry and Volun-teer movement, which proved one of the most striking features of the South African campaign. Pending the arrival of Lord Eoberts and reinforcements, the situation in South Africa remained at a deadlock : the three be- sieged towns — Mafeking, Kimberley, Ladysmith — still held their own, but no headway was made by the relief columns ; all they could do was to stand on the defensive. The only bright spot, as far as the British were concerned, was to be found in northern Cape Colony, where General French, with two cavalry brigades and a scratch force, was able, by a magnificent display of strategy, to keep at arm's length a superi6r force of the enemy, over a front of thirty miles in the vicinity of Colesberg.*~~

~~*General French's achievement during this phase of the war was the more noteworthy since he had pitted against him the military skill of both De la Eey and De Wet, two of the three men of military genius produced by the war on the Boer side. On 6th January the Boers in Natal made a desperate attempt to reduce Ladysmith by storm. The garrison, already weakened by privation and sickness, made a stubborn resistance, and after one of the most sanguinary engagements of the war, at Caesar's Camp and Wagon Hill, the garrison repulsed the attack with severe loss to the enemy, itself having 500 casualties, including Lord Ava, the eldest son of the Marquis of Dufferin.*~~

~~*When Lord Eoberts arrived in Cape Town on 10th January 1900, three garrison towns were still invested, and the relieving forces were still maintaining their r61e of passive resistance. The Comman- p on op' der-in-Chief's first duty was to create out of the tangle of units in Cape Colony a field army capable of advancing into the enemy's country vid the Orange Free State. In the meantime Sir Eedvers Buller, who had been reinforced by Sir Charles Warren and a division, essayed a second attempt to cross the Tugela, by turning the Boer left. But the movement, sound in its conception, was indiffer- ently carried out, with the result that the disastrous action at Spion Kop (24th January) was fought, and the British were obliged to retire again across the Tugela. (British losses, 1700.) By 1st February Lord Eoberts had begun to feel his way, and on 3rd February he ordered a demon- stration against the right of the Boer position at Spyt- fontein to Koodoosberg to cover the withdrawal of General French and the cavalry from before Colesberg, and the concentration of his army at Modder Eiver. In spite of another set-back in Natal to Sir Eedvers Buller, who has essayed a third attempt to relieve Ladysmith on 5th February, and failed to make good the pur- ^^.s chase which he secured across the Tugela, Lord Eoberts matured his plans, and, arriving at Modder Eiver*~~

~~*war]*~~

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Paarde- berg.

on 9th February, he set his operations in motion two days later by detaching French to the relief of Kimber- ley. On the 15th February, French at the head of his cavalry galloped into Kimberley, spreading dismay through the ranks of the burghers under Cronje, who vacated the Spytfontein positions on the night of the 15th, and re- treated along the line of the Modder, crossing the front of the infantry division which was pushing up into the gap made by the cavalry advance. Lord Kitchener, who was with the infantry, at once sent the mounted infantry in pursuit and changed the direction of the infantry, sending word to French to bring his cavalry across to Koodoosrand Drift. French, with that unfailing energy which is the true attribute of a cavalry leader, con- formed to Kitchener's urgent appeal, and on the 17th seized the hills above Paardeberg just in front of Cronje's advance-guard. Thus checked, the pursuing infantry crashed into him on the 18th. Kitchener, who as chief of the staff issued orders, at- tempted to reduce Cronje, now in the river bed, by a coup de main, which, though costing over 1000 casualties, compressed Cronje into the confined area from which he was only to leave as a prisoner of war with 4000 of his men on 27th February, the anniversary of Majuba. Lord Eoberts's bold plunge into the Free State had automati- cally relieved the pressure in front of Buller, Ladysmitb. w° a^ter desperate fighting was able to turn the left flank of Botha's position at Colenso, and after ten days' fighting to relieve Ladysmith on the 28th February. Ladysmith had fared worst of all the be- leaguered garrisons, and its 22,000 inhabitants were al- most at their last gasp when relief came. The casualties from shell fire had only been 66, but those from sickness were many times as heavy as those by the chances of war. The relief had not been without a strain : Buller's operations had cost at Colenso 1200 men, at Spion Kop 1700 men, at Vaalkranz 400, and now in the last long- drawn effort 1600 more — over 5000 in all. But the tide of war had changed. The Natal invaders fell back to the mountains which enclose the north of the colony ; Olivier and Schoeman retired from Cape Colony before Gatacre and Clements ; and the Presidents of the Republics, real- izing that the British Empire was capable of more resist- ance than they had calculated upon, put forward feelers aiming at the restoration of the status quo before the war. These proposals were rejected

~~*by Lord Salisbury : there could be no end now but a complete destruction of the Boer power.*~~

~~*The surrender of Cronje and the relief of Ladysmith for the time being paralysed the Boer resistance. Two half-hearted attempts were made on 7th and 10th May, at Poplar Grove and Driefontein, to stem Lord Roberts's advance upon Bloemfontein, President Kruger himself arriving on the scene to give confidence to his burghers ; but the demoralization was so great that neither Capture of the military genius of the few nor the personal fonteto. influence of the President could bolster up an adequate resistance, and on 13th March 1900 Lord Eoberts's army marched into the Free State capital. This great move of the Field-Marshal's, accomplished in spite of the loss of a convoy which cut down his reserve supplies by two-thirds, and only possible by reducing the ration of the fighting man to a minimum and by under- taking the almost unprecedented risks of changing the line of communication three times, was followed by a period of reaction. It was not until 29th March that the new railway communication recommenced to feed the army. In the meantime rebellion had broken out in the Prieska district of Cape Colony, which was promptly quelled by Lord Kitchener. The halt at Bloemfontein was marked by the publication of proclamations, offering*~~

~~*protection to the burghers, which, however, the invaders had not yet the power to fulfil. The enforced halt was unfortunate ; it not only resulted in a bad outbreak of enteric, but it gave the Boers time to recuperate, and by the beginning of April they again took the initiative. The death of their commandant-general, Piet Joubert, on 28th March, seemed to mark a change in the fortunes of the Republican army. Commandant De Wet, who had first come into prominence as the capturer of Lord Roberts's convoy at Waterval, now added to his laurels by ambushing Broadwood's mounted brigade at Sannah's Post, just outside Bloemfontein, on 31st March, while four days later he reduced a detachment of Irish Rifles at Reddersburg, and then went south and invested Colonel Dalgety and a mixed force at Wepener, which was re- lieved after ten days by General Hunter's division, brought round to Aliwal North from Natal.*~~

~~These successes were not able to retard Lord Roberts's progress. It took the Field-Marshal six weeks to recon- struct his plan of operations, and on 1st May the grand army moved northwards upon the Transvaal capital. The main advance was taken with one cavalry and three infantry divisions (the cavalry commanded by French, and the infantry divisions by Generals Tucker, Pole- Carew, and Ian Hamilton). Rundle's division took the right of the advance ; Methuen and Hunter, moving from Kimberley, formed the left. Kelly Kenny, Colvile, and Chermside held the communications based on Bloemfontein. A flying column detached ffj£uj from Hunter, under Mahon, in conjunction with Plumer from the north, relieved Mafeking (where Baden- Powell aroused world-wide enthusiasm by his resistance) on 17th May, the same day that the Natal field force under Buller moved up into the Biggarsberg and occu- pied Dundee. On 10th May Lord Roberts had crossed the Zand River; on 12th May he entered Kroonstad. After a halt of eight days at Kroonstad, the grand army again moved forward and marched triumphantly, meeting but small resistance, without a halt into Johannesburg, which was occupied on 31st May, the Orange Free State having been formally annexed by proclamation three days earlier. On 30th May President Kruger fled his capital with the State archives, taking up his residence at Waterval Boven on the Komati Poort line. But while the gold mines were now in the possession of the British, attacks Cp^^ao1 were made on their line of communications by De Wet, who from this period organized a guerilla resistance which he maintained until the end of the war. On 5th June Lord Roberts's army occupied the capital of the Transvaal practically without resistance, setting free about 3000 British prisoners of war de- tained there.~~

~~It had been anticipated that the occupation of both the capitals would have brought the hostilities to a close, but this was not the case, and though after 5th June regular resistance was at an end, the occupation was met with two years of almost unparalleled and unprecedented partisan warfare. On 8th June Sir Redvers Buller forced his way over Alleman's Nek, and on the following day occupied Lang's Nek, while the Field-Marshal fought a more or less decisive action against Botha, De la Rey, and Kemp at Diamond Hill, 20 miles east of Pretoria. The pressure on the main communications was now so serious that a force was thrown~~

~~*back into the Orange River Colony under Hunter, which in co-operation with Rundle's division ac- complished the surrender of Prinsloo with 3000 Free Staters in the Brandwater basin (29th f^^r! July). A week before this satisfactory result the Field-Marshal had initiated a movement from Pretoria to sweep down to Komati Poort on the Portuguese frontier,*~~

~~*in which Buller, advancing from the south, was to co- operate. On August 26-27 the combined forces engaged and defeated Botha at Dalmaimtha and Bergendal, with the result that the enemy dispersed into the bush-veld north of the Middelburg railway. On 30th August the remainder of the British prisoners were released at Nooitgedacht. On 6th September Buller occupied Lyden- burg in the bush-veld, and five days later the aged President of the Republic, fleeing his country, took refuge in Lorenzo Marques. On 13th September Barberton was occupied, and on the 25th the Guards Brigade occupied Komati Poort. In October the military operations were confined to attempts to reduce guerilla commandoes*~~

~~*which had taken the field. Mr Kruger, desert- Mr Kruger. inS his countrymen, left for Europe in a Dutch*~~

~~*man-of-war, and General Buller sailed for Europe. On the 25th of this month Lord Roberts formally annexed the Transvaal as an integral portion of the British Empire.*~~

~~*In November there seemed to be evidences that the back of the trouble was broken, and the Field-Marshal, who had been appointed Commander-in-Chief at home, left South Africa, handing over the command of the army Lord °^ occupation to Lord Kitchener. Then followed*~~

~~Kitchener a long period of groping for a means to cope takes with the development of guerilla tactics, which~~

~~command. £or ^e nex|. sjx months were at their zenith. The railway communications were constantly damaged, isolated posts and convoys captured, and the armed guerilla bands always seemed able to avoid contact with the regular columns sent in pursuit. Before the close of 1900 they scored several signal successes. De Wet captured Dewetsdorp, Kemp defeated Clements in the Hekpoort Valley, and disaffection broke out in Cape Colony to an alarming degree, while, as forerunners of the promised invasion, scattered bodies of Free Staters crossed south of the Orange river to swell the rebellion. Against this the British scored one success, namely, the severe handling of De Wet's commando at Bothaville, when the gallant Le Gallais lost his life. The year closed badly, as the commandoes, under the direct influence of Louis Botha, attacked the whole of the railway posts on the Middelburg railway and captured Helvetia, with its 4-7 gun, though two attempts at invasion of Cape Colony in force had been frustrated by the watchfulness of Charles Knox's columns. Lord Kitchener called for more men, and on 22nd December the War Office announced that 30,000 more mounted men would be despatched to the seat of war.~~

~~With the opening of 1901 Lord Kitchener tried new schemes. He withdrew all his detached garrisons except in the most important centres, and set himself to make his railway communications perfectly secure. He determined to make the area of operations a waste, and instituted the concentration camps, into which he intended to bring the whole of the non-combatant inhabitants of the two re- publics. He despatched French with a large force to clear the south-eastern districts of the Transvaal ; and for the rest maintained a force to watch De Wet, and organized~~

~~a defence force in Cape Colony, while using the UonpoUcy. residue of his mounted men to sweep the country~~

~~of stock, forage, and inhabitants. Although there were no great disasters, the new policy was not pro- lific in success. The enemy invariably dispersed before superior forces; and theremoval of the women and children from the farms did not have the effect of disheartening the~~

~~*burghers as had been anticipated — it rather mended their vitality by relieving them of responsibility for their families' welfare. On 10th February De Wet, with five guns and 3000 men, carried out his promised in- vasion of Cape Colony. This invasion was a fiasco ; by*~~

~~*j udicious use of the railway Kitchener concentrated suf- ficient troops in the Colony to cope with the attempt, and, after being hunted from pillar to post for eighteen days, De Wet escaped back into the Orange River Colony with the loss of all his guns, munitions of war, and half his force. On 3rd March De la Rey, the lion of the western Transvaal, essayed an attack upon Lichtenburg,inwhichhe was heavily repulsed. Signs of weakness were now ap- parent, and as a result Louis Botha, acting with the authority of Schalk Burger, the representative of Presi- dent Kruger, opened negotiations with Kitchener. A meeting took place at Middelburg, Transvaal, on 28th February. These negotiations, however, broke down, mainly over the treatment to be awarded to Cape rebels.*~~

~~*The hostilities now entered upon a new phase. The establishment of a line of defensive posts between Bloem- fontein and Ladybrand had given Kitchener an idea, and he resolved upon the scheme of partition of the theatre of war by chains of blockhouses. In the mean- time, while these posts were under construction, po/;™f<",SB the harrying of the guerillas by mobile columns was continued. In March Babington captured three guns and six maxims from De la Rey near Ventersdorp. In April Plumer occupied Pietersburg, the last remaining seat of government open to the enemy. Rawlinson cap- tured a laager and guns at Klerksdorp. In May matters had so far improved that municipal government was given to Johannesburg, and a certain number of mines were al- lowed to recommence operations. De la Rey was defeated by Dixon at Vlakfontein, after a desperate encounter. June brought little of moment, though the Boers scored two minor successes, Kritzinger capturing the village of Jamestown in Cape Colony, and Hindon reducing the camp of the Victorian M.I. at Wilmansrust. In July there were further evidences of weakness on the part of the Boers, and Botha applied for permission to communicate with ex-President Kruger. This was allowed, but, as Mr Kruger advised a continuance of the struggle, the slow course of the war continued. In the meantime, the concentration camps were becoming*~~

~~*filled to overflowing, and a steady stream of captures and surrenders were reducing the hostile power of the republics. On 13th July President Steyn only escaped capture by Broadwood at Reitz by a few minutes ; and on 20th July the aged wife of the ex-President died in Pretoria. August was an im- portant month, as in it Kitchener promulgated a procla- mation, formally threatening the Boer leaders who should not surrender with permanent banishment from South Africa : this proclamation, though supported by the home Govern ment, unfortunately had very little effect. Kitchener also received letters from the Boer leaders, showing that they were still determined to keep the field. September showed some slight improvement in the situation in Cape Colony, when General (now Sir John) French was in supreme command. On the 5th, Scobell captured Lotter, who was subsequently executed for murder ; though this was rather balanced a few days later by Smut's attack on the 17th Lancers. Botha made a desperate effort to reinvade Natal, but his plans were rendered abortive by his failure to reduce the posts of Mount Prospect and Fort Itala, which he attacked on 26th Sep- tember. De la Rey was also defeated in the west, in an attack upon Colonel Kekewich's camp at Moedville. Desultory fighting continued till the close of the year, the balance of success being with the British, though on 30th October Colonel Benson's column had been defeated by Botha, at Brakenlaagte, in the south-eastern Transvaal. Affairs again took an unsatisfactory turn in Cape Colony, and on 8th October the whole colony was placed under martial law. But in December matters improved, and*~~

~~*General Bruce Hamilton's column, by a series of night marches, practically blotted out the resistance in the eastern Transvaal. The corps of National Scouts (burghers who had come over) was inaugurated, and matters so far mended in Johannesburg that the Stock Exchange reopened. By the end of the year the block- house system was complete, but this phase of the war was destined to close badly, as De Wet on*~~

~~*Christmas Eve captured the whole of Colonel Firman's Yeomanry camp at Tweefontein, Orange Biver Colony.*~~

~~*With 1902 the last phase of this protracted struggle commenced. The blockhouse system was practically finished, and Kitchener determined upon a new means of harassing the enemy, who still had a total of ^drives." about 25>000 men in the field. But the block- houses had already begun to serve the purpose for which they were designed. In the past the mobile columns, of which there were over sixty in the field, had always been bound to the railway for supply ; now con- voys could be pushed out to them along whatever block- house line they touched. In January Bruce Hamilton continued his successful night marches, and late in the month General Ben Viljoen was captured in the Ly den- burg district. The only set-back was the descent which Beyers made upon Pietersburg, breaking into the con- centration camp and carrying off a number of able-bodied refugees. Early in February Lord Kitchener commenced his first drive at Wolvehoek, and it was so successful that it was evident that the key to the situation had been found. As a mark of its success it drove the enemy still in the field to desperation, and for the rest of the winter were chronicled alternate successes and disasters. A British convoy was captured in the Colony ; the 28th Mounted Infantry were overwhelmed at Klip Drift ; the Scots Greys were roughly handled; De la Bey cap- tured von Donop's convoy. But against this could be set off the capture of a whole commando by Colonel Park, A.D.C., the capture of Hans Grobler's commando by Colonel Colin Mackenzie, and a successful drive in the north-east of the Orange Biver Colony which resulted in 600 prisoners. March was perhaps the most im- portant month in the last stage of the war. It opened with another success to De la Bey, who captured Paris's column and Lord Methuen; but for the rest, the great drive in the western Transvaal proved to the Boers the futility of any attempt to prolong the struggle. On 23rd March the representatives of the Boer Gov- ernment came into Pretoria, six weeks were spent in negotiation, and then a monster meeting of delegates, under the presidency of General Kemp, was held at Vereeniging.*~~

~~*As a result of this conference a peace was ratified at Pretoria on 31st May, and the South African war was a history of the past. The terms of*~~

~~*peace may be condensed into the following points: (1) Surrender of all burghers in the field, with all arms and muni- tions of war; (2) all burghers duly declaring them- selves subjects of King Edward VII. to be repatriated ; (3) no burghers who should surrender to be deprived of either their liberty or property; (4) no proceedings to be taken against burghers for any legitimate acts of war during the period of hostilities; (5) the Dutch language to be taught in public schools on the request of parents, and to be allowed in courts of law ; (6) sport- ing rifles to be allowed upon the taking out of licences ; (7) the military administration to be superseded by civil administration as soon as possible, the civil administration to lead up to self-government ; (8) the question of the native franchise not to be considered until after the intro- duction of self-government; (9) landed property not to be subjected to any special tax to defray the cost of the*~~

~~*war; (10) a commission to be formed to facilitate the repatriation of the burghers. A grant of £3,000,000 to be given as compensation for the destruction of farms. These terms were signed on behalf of the British Govern- ment by Lord Milner and Lord Kitchener ; on behalf of the Orange Free State by Messrs J. Brebner, C. E. de Wet, C. Olivier, and Judge J. B. M. Hertzog; on behalf of the Transvaal Government by Messrs S. W. Burger, F. W. Beitz, Louis Botha, J. H. De la Bey, Lucas Meyer, and Krogh.*~~

~~*In the whole war the British lost 5774 killed and 22,829 wounded, while the Boers lost about 4000 killed. The number of Boer prisoners in the hands of the British at the end of the war was about 40,000.*~~

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~~Trapani, a seaport town and episcopal see of Sicily Italy, on the west coast, 47 miles west by south of Palermo (121 miles by rail). It is a place of some trade, exporting salt, wine, fish, &c, to the annual value of about £100,000 (£116,500 in 1899), and importing wheat, timber, and coals to the value of £350,000 (£359,300 in 1899) annually. The port is the safest and largest on the west coast of Sicily, and gives a depth of 24 feet alongside the quays. It was in 1899 entered by 115 vessels of 84,640 tons. The people engage in tunny and sponge fishing, in the preparation of salt (the salt-pans, 45 in number, stretch from Tripani to Marsala, and produce about 200,000 tons every year), in the manufacture of ice and olive oil, and in alabaster work. The port is constantly dredged, and a second breakwater was built in 1899-1900. There are statues to Garibaldi (1890) and Victor Emmanuel (1882). Popu- lation (1881), 33,514 ; (1901), 60,257.~~

~~Trasimeno, or Lake of Peeugia, a lake of central Italy, 12 miles W. from Perugia. Area of lake, 59 square miles. Having no natural outlet, it was sub- ject to sudden and serious rises of the surface, which occasioned inundations, and these in turn malaria. Through the exertions of Cav. G. Pompili an artificial outlet, consisting of alternate canals and tunnels, has been made from the S.E. corner of the lake to the Caina, a small tributary of the Tiber. The work, which is about 4 miles long, cost only about £26,000, and was completed in 1898. It is estimated to leave about 2500 acres of land dry, and to convert another 2800 acres of marshy soil into cultivable land.~~

~~*Tras-os-Montes, a former province of Portugal, situated in the extreme N.E. of the country, and washed on the S. by the river Douro. It corresponds to the districts of Braganqa and Villa Beal. In addition to port wine, it produces olive-oil, corn, and vegetables. Cattle and sheep breeding are considerable industries. Area, 4291 square miles. Population (1900), 429,170.*~~

~~*Trail (Serbo-Croatian, Trogir; Latin, Tragurium), a coast town of the Austrian crownland of Dalmatia, a few- miles west of Spalato. It is situated on a small island in the Canale di Trail, and is connected with the mainland and the adjoining island of Bua by two bridges. It has a number of interesting architectural and historical remains, including the ruins of a Venetian fortification and a loggia, said to be " a perfect example of a public court of justice of the Venetian period," together with a beautiful 13th-century basilica, &c. The town is a steamship station (indifferent harbour), and has some trade in wine, figs, olives, and other fruit, the port being entered and cleared by 400,000 to 500,000 tons annually. In 1890 the population of the town was 3392, and of the commune 15,809 (1900, 17,064), chiefly Croatians.*~~

~~*Trail nstein, a town and summer resort of Bavaria, Germany, district of Upper Bavaria, 73 miles by rail east- south-east of Munich. It is one of the Bavarian towns which distil salt from the brine of Biechenhall, whence (22 miles distant) it is brought in pipes. It has a histori- cal museum, a couple of fine fountains (1526 and 1894), and monuments of the war of 1870-71 and to King Maximilian II. There are saline baths, whey cure, and breweries. In the vicinity are Empfing, with baths of all kinds, and Pastor Kneipp's cold-water cure establishment. Popula- tion (1885), 4909 ; (1900), 7516.*~~

~~*Trautenau (Czech, Trutnov), the chief town of a government district in Bohemia, situated on the Aupa, a tributary of the Elbe, at the foot of the Riesengebirge, in the frontier district adjoining Prussian Silesia. It is the centre of the Bohemian linen industry, and has a yarn exchange. In*~~

~~addition to its spinning and weaving estab- lishments, it has factories for the manufacture of paper and for the utilization of the waste products of the other mills. Trautenau was founded by German colonists invited to settle there by King Otto II. of Bohemia, and received a charter as a town in 1340. It was the scene of two battles between the Prussians and Austrians on 27th and 28th June 1866, which are now commemorated by public monuments. Population (1890), 13,290 ; (1900),~~

~~14,777.~~

~~Travancore, a state of southern India, in connexion with Madras. Area, 6370 square miles ; population (1881), 2,401,158 ; (1891), 2,557,736, showing an increase of 7 per cent., which has been continuous since 1875 ; average den- sity, 380 persons per square mile. In 1901 the population was 2,951,038, showing a further increase of 15 per cent.~~

~~The gross revenue is Rs. 88,55,000 ; tribute, Rs.8,10,652 ; military force, 1360 infantry, 61 cavalry, and 30 artillery with 6 guns ; number of police, 1632, under a European officer ; number of schools (1897-98), 3274, with 160,368 pupils, of whom 36,562 were girls ; proportion of pupils to population of school-going age, 40 per cent, (being 64 per cent, for boys and 19 percent, for girls), compared with 15-5 per cent, for the Madras Presidency ; regis- tered death-rate (1897), 15 per 1000. The Maharaja of Tra- vancore claims descent from Cheraman Perumal, the last Hindu monarch of united Malabar in the 14th century. Though he is a Kshatriya, the succession follows the local custom of inheritance through females ; consequently his sanad of adoption authorizes him to adopt sisters' sons. For two or three generations the rulers have been men of education and character, and the state is con- spicuous for good administration and prosperity. The two domi- nant sections of the population are the Namburi Brahmans and the Nairs or military caste. Native Christians, chiefly of the Syrian rite, form just one-fifth of the whole, being more numerous than in any Madras district. In 1897-98 the chief items of gross revenue were: land, Rs.22,71,000; salt, Rs.19,00,000; tobacco, Rs.10,49,000 ; customs, Rs.6,42,000 ; excise, Rs.6,35,000 ; forests, Rs.4,37,000 ; and stamps, Rs.3,56,000. The expenditure included Rs.22,95,000 on public works and Rs.3,17,000 on education. The value of~~

~~the sea-borne trade in that year, mainly of a coasting character, was Rs.2, 47, 98,100, of which Rs.1,46,93,752 represented exports, chiefly cocoanut products, timber, pepper, cardamoms, coffee, and tea. The principal ports are Alleppi, Quilon, and Paravur ; but there is no real harbour. Proposals have been con-~~

~~sidered for constructing a railway over the hills into British territory (including a line from Quilon to Tinnevelly). The Periyar project conducts water across the range in a tunnel to irrigate Tinnevelly district, for which compensation of Rs.40,000 is annually paid to Travancore. The capital is Trivandrum.~~

~~Traverse City, a city and lake port of Michigan, U.S.A., capital of Grand Traverse county, at the head of the west arm of Grand Traverse Bay, on the north-western coast of the Lower Peninsula, at an altitude of 605 feet. The harbour is good, and there is regular steamer com- munication during the open season with Chicago and other lake ports. The surrounding region is forested with pine, and the industries are chiefly connected with lumber, there being saw, planing, and shingle mills. Population (1880), 1897 ; (1890), 4833 ; (1900), 9407, of whom 2068 were foreign-born.~~

~~Treaties. — Since the publication of the article on Treaties in vol. xxiii. of this Encyclopaedia, treaty- making has entered more largely than ever into the life of nations. In the earlier article the different kinds of treaties were classified as (1) political ; (2) commercial ; (3) relating to social intercourse ; (4) to extradition ; (5) to copyright, trade-marks, &c. ; (6) to the conduct of war. To these we may now add a seventh class, relating to international arbitration.~~

~~1. Among the treaties belonging to the first class, concluded since 1888, two recent ones stand out as of first importance. The Hay-Pauncefote Treaty, signed at Washington 18th November 1901, and ratified by the American Senate 16th December 1901, to facilitate the construction of a ship canal through the Central American isthmus, and to remove any objection arising from the Convention of 19th April 1850, known as the Clayton-Bulwer Treaty, adopted as the basis for its neutralization the form of the International Convention of 29th October 1888 for the free~~

navigation of the Suez Canal. On 30th January of 1902 an Anglo-Japanese Treaty was signed in London, having for its object the maintenance of the " status quo and general peace in the extreme- East," and more especially "the independence and territorial integrity of the empire of China and the empire of Corea," and to secure " equal opportunities in those countries for the commerce and industry of all nations." It provides that, if either Great Britain or Japan should become involved in war with another Power through the defence of its interests in the countries concerned, the other will maintain a strict neutrality, and, if any further Power or Powers should join in the hostilities against either ally, the other contracting party will come to its assistance. A great number of conventions and arrangements of less importance dealing with the delimitation of frontiers and spheres of influence in Africa and elsewhere have also been concluded between Great Britain and different European Governments (see Hertslet's Treaties, vols. xviii., xix., xx., and xxi., and the " Treaty Series " published by the British Government), as well as with many native states in Africa, on the Persian Gulf, and in the Malay Peninsula. By a declaration signed at London 5th August 1890, France recognized the British protectorate over Zanzibar and Pemba, and Great Britain recognized the French protectorate over Mada- gascar; the appointment of a commission to settle the details of their respective spheres of influence in Africa set out in the declaration was also agreed to. By the declaration signed at London 15th January 1896, Great Britain and France settled their respective territorial policies on the Petcha Bouri, Meiklong, Menam, and Bang Pa Kong rivers. By this declaration also the two Govern- ments agreed that all advantages in the Chinese provinces of Yunnan and Szechuen obtained by either Government

should be enjoyed by both in common; the appointment of a commission to delimit the French and British posses- sions to the west of the Lower Niger was agreed upon ; and arrangements were made for the conclusion of a convention with regard to commercial matters in Tunis (see infra). By an agreement dated 1st July 1890 Great Britain ceded to Germany the

~~*island of Heligoland. By this same agreement spheres of influence of the two coun- tries in Africa were fixed (details to be ascertained by a mixed commission, whose proposals were embodied in an Anglo-German agreement signed at Berlin 23rd February 1901), and Germany recognized a British protectorate over Zanzibar and Pemba. The Samoan Islands were divided up under a " convention and declaration between Great Britain and Germany" signed at London 14th November 1899, which was completed by a tripartite con- vention between Great Britain, Germany, and the United States, signed at Washington 2nd December 1899.*~~

~~*2. British commercial treaties since 1888, in chronologi- cal order, include a general treaty of commerce and navi- gation with Mexico (27th November 1888) ; with Egypt (29th October 1889) ; with Greece (28th March 1890) ; with Muskat (19th March 1891) ; with Portugal, spheres of influence in Africa, transit dues, &c. (11th June 1891) ; with Servia (10th July 1893) ; with Japan (16th July 1894) ; with France, Commercial relations between France and Canada (4th October 1895) ; with Abyssinia (14th May 1897); with Bulgaria {24th July 1897); with France in connexion with Tunis (18th September 1897) ; with Belgium — a provisional modus vivendi, with subsequent extensions to British Colonies (27th July 1898); with Uruguay (15th July 1899); and others of less importance. By an exchange of Notes on 28th April 1899 Russia and England determined the territorial limits of their respective railway interests in China ; and by an agreement and exchange of Notes on 16th October 1900 Great Britain and Germany declared their intention to observe an open-door commercial policy in China, while respecting its territorial integrity. A new commercial treaty with China was signed 5th September 1902. For the Sugar Convention, see Sugar.*~~

~~*3. There have been a great number of minor accessions to existing postal and telegraphic conventions.*~~

~~*4. Extradition treaties are dealt with under Extra- dition.*~~

~~*5. The international protection of copyright and indus- trial property (patents, trade marks, &c.) has undergone considerable extension (see infra).*~~

~~6. To treaties relating to the conduct of warfare a great addition has been made by the two international conventions adopted at The Hague on 29th July 1899. By the first the principles of the Geneva Convention of 22nd August 1864 were adapted to maritime warfare. By the other the laws and customs of war by land in a great many cases were formulated, and it was provided that "until a more complete code of the laws of war"^ was issued "populations and belligerents" should remain " under the protection and empire of International Law " (see War).~~

~~7. There have been several important treaties relating to arbitration (see Arbitration, International), the most recent being the references of the Wauna and " Sergent Malamine " incidents by Great Britain and France to the decision of Baron Lambermont (3rd April 1901), and that of the difficulties arising out of the determination of the boundary between Brazil and British Guiana to the king of Italy (6th November 1901). A new departure in treaty-making in this connexion is that of treaties specifi- cally and exclusively devoted to providing for arbitration generally as between the contracting states. The first of these treaties was the Italo-Argentine Convention~~

~~(23rd July 1898). The Anglo-American Convention for the same purpose was signed (12th January 1897), but was not ratified by the American Senate.1 For The Hague Convention, creating a special court, see Arbitration, International. A Chile-Argentine Convention, provid- ing like the Italo-Argentine Convention for compulsory arbitration, was signed on the 12th August 1902.~~

~~Among new and interesting developments which have arisen, we may also place the international unions, or open international arrangements, which all states can join on subscribing to certain conditions. These international unions date from the formation of the Union Postale Universelle in 1874.2 It has been followed by others relating to industrial property (patents, trade marks, &c), copyright, railway traffic, the protection of submarine cables, suppression of African slavery, and Suez Canal quarantine (19th March 1897). The union relating to the protection of industrial property, to which the Govern- ments of Belgium, Brazil, Spain, France, Guatemala, Holland, Portugal, Salvador, Servia,~~

~~*and Switzerland subscribed, was concluded at Paris on 20th March 1893, and since that date Great Britain (with New Zealand and Queensland), Sweden, Denmark, Norway, Italy, Japan, the United States, and Tunis have acceded to its terms and joined the union. Turkey and Salvador have since withdrawn from it.8 The subjects or citizens of each of the contracting states enjoy, in all other states of the union, as regards patents, designs, models, trade marks, and trade names, all the advantages their respective laws grant to their own subjects or citizens, and consequently have the same protection as the latter and the same legal remedy against any infringement of their rights, provided they observe the formalities and conditions imposed on subjects or citizens by the internal legislation of each state. They have also a right of priority in respect of registration in the respective states. The International Copyright Union was created by the Berne Convention of 9th September 1886. Both unions maintain official bureaus at Berne, and issue periodical publications. The Railway Traffic Union applies to European continental goods traffic only (14th October 1890). Under a con- vention, signed 5th July 1890, thirty states, including Great Britain and most British colonies, are associated for the prompt publication at an office, established at Brussels, and at their joint expense, of the customs tariffs of the world and all modifications thereof. The General Act for dealing with the suppression of African slavery (signed at Brussels on 2nd July 1890) maintains offices at Brussels and Zanzibar for the centralization of all information and measures connected with the matters dealt with in the General Act.*~~

~~*Further subjects which have been suggested for universal inter- national regulation are anarchist conspiracies, the control of floating pauper populations, the white slave traffic, &c. One of the most remarkable instances of the tendency which states have at the present day to assimilate their intercourse to that between in- dividuals is the conclusion of arrangements for the granting to each other of leases. As between European states and Oriental states some such arrangements were made in the form of concessions granted to European settlements ; but as between European peoples*~~

~~*i The majority of forty-two to twenty-six in its favour did not amount to the two-thirds required by the United States Constitution in such cases.*~~

~~*2 Before this a Double Standard Monetary Union (23rd December 1865) had been created as between France, Italy, Belgium, and Switzerland (Greece only joined the Union in 1868), and a Single Standard Union (1873) between Sweden, Norway, and Denmark. These earlier unions were limited in their area.*~~

~~*8 Similar arrangements for the mutual protection of inventions, designs, and trade marks have been made between Great Britain on the one side and each of the following states and colonies on the other : Ecuador (designs and trade marks only) ; Greece (designs and trade marks only) ; Honduras ; Mexico ; Paraguay ; Rumania (de- signs and trade marks only) ; Tasmania ; Uruguay ; Western Australia.*~~

~~*such a case as that of the grant by Great Britain of leases to France of stations on the Niger (14th June 1898) is novel. Great Britain has taken similar leases of Wei-hai-Wei (1st July 1898) and of territory described as "Hong-Kong extension" (9th June 1898).*~~

~~*(t. ba.)*~~

~~*Trebizond. — (1) A vilayet of Asiatic Turkey, situated on the south coast of the Black Sea, between 36° .and 41° E. It has an area of 12,387 square miles, and is divided into four sanjaks — Janik (Samsiin), Trebi-zond, Lazistan, and Gunmsh-khaneh. The vilayet consists of a long irregular strip of coast country, the eastern half of which is deeply indented and mountainous. The mineral wealth is great and the soil extremely fertile. There are extensive forests of pine, fir, oak, elm, and chestnut. Large quantities of walnuts are grown. In 1900 the exports amounted to £1,302,640 and the imports to £1,795,760. The population consists of 932,800 Moslems and 231,200 Christians, of whom 181,100 are Greeks. The people are Laz, Georgian, Greek, and Armenian, with a*~~

~~few Kurds, Tatars, Persians, and Europeans. (2) The chief town of the vilayet (the Greek Trapezus), and a military station, situated on the south coast of the Black Sea, and connected with Constantinople and Batum by sea and with Erzerum by a chaussie which forms part of the caravan route to Persia. The only harbour is the bay on the east, which is exposed to north and north-east winds, and is unsafe during their prevalence. In winter there are heavy gales from the north-east with sleet and snow, but the snow rarely lies. In 1900, including the Persian transit trade (£629,800), which is decreasing annually, the exports — cattle, hazel-nuts, tobacco, carpets, tumbeki, &c. — were valued at £760,670 (as compared with £565,200 in 1876), and the imports — cotton and woollen goods, petroleum, &c— at £1,323,850 (£1,329,400 in 1876). Trebizond is the seat of British and other consuls. The population comprises 22,000 Moslems and 18,000 Christians. In October 1895 there was a massacre of Armenians, in which the police and soldiers took part.~~

~~Tredegar, an urban district (1894) and railway station in the Western parliamentary division of Mon- mouthshire, England, 7 miles east-north-east of Merthyr Tydfil by rail, on the river Sirhowy. The church of St James was erected in 1890, and the town hall in 1893. There is a large export trade in coal. Population (1891),~~

~~17,341; (1901), 18,574.~~

~~Treitschke, Heinrich von (1834-1896), Ger- man historian and political writer, was born at Dres- den on the 15th of September 1834. He was the son of an officer in the Saxon army who afterwards rose to be governor of Konigstein and military governor of Dresden. Young Treitschke was prevented by deaf- ness from entering the public service. After studying at Leipzig and Bonn, where he was a pupil of Dahl- mann, he established himself as a privat-docent at Leipzig, lecturing on history and politics. He at once became very popular with the students, who were attracted by his great oratorical power ; but his political opinions, which he brought even into the lecture-room, made it impossible for the Saxon Government to appoint him to a professorship. He was at that time a strong Liberal; he hoped to see Germany united into a single state with a parliamentary government, and that all the smaller states would be swept away. In 1863~~

~~*he was appointed professor at Freiburg ; in 1866, at the outbreak of war, his sympathies with Prussia were so strong that he went to Berlin, became a Prussian subject, was appointed editor of the Preussische Jahrbucher, and from that time was one of the ablest advocates of Prussia on the German*~~

~~*press. A violent article, in which he demanded the annexation of Hanover and Saxony, and attacked with great bitterness the Saxon royal house, led to an estrangement from his father, who enjoyed the warm friendship of the king. It was only equalled in its ill- humour by his attacks on Bavaria in 1870 ; his admiration for Prussia made it impossible for him to be just to those Germans who had not, like himself, voluntarily become Prussians. After holding appointments at Kiel and Heidelberg, he was in 1874 made professor at Berlin ; he had already in 1871 become a member of the Reichstag, and from that time till his death in 1896 he was one of the most prominent figures in the city. On Sybel's death he succeeded him as editor of the Historische Zeitschrift. Among the students he enjoyed great popularity. His ardent patriotism communicated itself to his hearers. He had outgrown his early Liberalism, and become the chief panegyrist of the house of Hohenzollern. He did more than any one to mould the minds of the rising generation, and he carried them with him even in his violent attacks on all opinions and all parties which appeared in any way to be injurious to the rising power of Germany. He supported the Government in its attempts to subdue by legislation the Socialists, Poles, and Catholics ; and he was one of the few men of eminence who gave the sanction of his name to the attacks on the Jews which began in 1878. As a strong advocate of colonial expansion he was also a bitter enemy of Great Britain, and he was to a large extent responsible for the anti-British feeling into which so much of German Chauvinism was directed during the last years of the 19th century. In the Reichstag he had originally been a member of the National Liberal party, but in 1879 he was the first to accept the new commercial policy of Bismarck, and in his later years he joined the Moderate Conservatives, but his deafness prevented him from taking a prominent part in debate. He died at Berlin on the 28th of April 1896.*~~

~~*As a historian Treitschke holds a very high place. HIs work, indeed, lies entirely in the history of the last two cen- turies. HIe approached historyas a politician ; he had none of the passion for research for its own sake, and confined himself to those periods and characters in which great political problems were being worked out : above all, he was a patriotic historian, and he never wandered far from Prussia. HIs great achievement was the HIstory of Germany in the Nineteenth Century. The first volume was published in 1879, and during the next sixteen years four more volumes appeared, but at his death he had only advanced to the year 1847. It will remain a fragment, and it is much to be regretted that he did not live to complete the account of the Revolution, in which he would have had a subject worthy of his peculiar powers. The work shows extreme diligence, scrupulous care in the use of authorities, and in the years he covered he has left little for future historians to discover. It is too discursive and is badly arranged, but it is marked by a power of style, a vigour of narrative, and a skill in delineation of character which give life to the most unattractive period of German history ; notwithstanding the extreme spirit of partisanship and some faults of taste, it will remain a remarkable monument of literary ability. Besides this he wrote a number of biographical and historical essays, as well as numerous articles and papers on questions arising out of contemporary politics, of which some are valuable contributions to political thought, while others are political controversy not always of the best kind.*~~

~~*The most important of the essays have been collected under the title Historische und politische Aufsatze, in four volumes, Leipzig, 1896 ; a selection from his more con- troversial writings was made under the title Zehn Jahre deutscher KCvmpfe; in 1896 a new volume appeared,*~~

~~*called Deutsche Kampfe, JSfeue Folge. After his death his lectures on political subjects were published under the title Politilc. HIe brought out also in 1856 a short volume of poems called Vaterlandische Gedichte, and another volume in the following year. The only works translated into English are two pamphlets on the war of 1870, What we demand from*~~

~~France (London, 1870), and The Fire-test of the North German Confederation (1870).~~

~~See Sciiiemann. Heinrich v. Treitschke's Lehr- und Wander- jahre, 1836-66. Munich, 1896. Gustav Freitag und Heinrich v. Treitschke im Brief wecJisel. Leipzig, 1900. Deutsche Rundschau, October 1896 ; and article by J. W. Headlam, Historical Review, December 1897. (j, w. HE \~~

~~Trencsen, a corporate town of Hungary, capital of the county of the same name, beautifully situated on the V&g, 70 miles north-east of Pressburg. Near it are the romantic ruins of the fort of Trencsen, which once played an important part in Hungarian history. Trencsen is one of the most considerable towns of upper Hungary, having a gymnasium with interesting collections, a State high school for girls, a public hospital, large barracks, a beautiful park, and several manufactories. The inhabit-ants of the town and of its vicinity are Slovaks, partly peddlers, who stroll through all parts of Europe with their merchandise. Not far from this town are the hot baths of Trencsen-Teplicz. Population (1891), 6075; (1901), 7011.~~

~~Trengganu. See Malay Peninsula.~~

~~Trent, the chief town of that portion of Tirol, Austria, inhabited by the Italian element, on the left bank of the Adige, 44 miles north by east of Verona. The extensive fortifications are intended for the defence of the-Adige valley and the one railway line leading directly from Italy into Tirol. Some of them occupy the isolated rocky height of Doss Trento, which rises about 230 feet above the town. Other outlying forts and batteries command separate ravines, valleys, and positions in the vicinity giving access to Trent from the west (Sarco Thai) and from the east (Val Sugana). Trent has now, in addition to the archiepiscopal seminary with complete theological faculty, an Italian upper gymnasium, an episcopal private gymnasium, a training college for female teachers, a school of commerce, &e. The manufactures comprise, in addition to the silk aud textile industry, the preparation of salami, a strongly-spiced Italian sausage, sweetmeats and pre- serves, spirits, playing-cards, earthenware and furniture. Viticulture and the quarrying of marble and gypsum are also important resources of the inhabitants. A large monument to Dante,~~

~~*designed by Zocchi, was erected in 1896. Population (1890), 21,486; (1900), 24,908, including garrison of 2231 men.*~~

~~*Trente et Quarante, like roulette, is a purely gambling game, for no ingenuity or calculation on the part of the player can enable him to win. No game could possibly be more one of chance. The diagram illustrates one half of the table, the other half precisely corresponding to it. Two croupiers sit on each side of the table, one of them being the dealer ; behind the two on the side opposite to the dealer a supervisor of the game has his seat. Six packs of fifty-two cards each are used ; these are well shuffled, and the croupier asks any of the players to cut, handing him a blank card with which to divide the mixed packs. There are only four chances at trente et quarante : rouge or noir, known as the grand tableau, couleur or inverse, known as thepetit tableau. The stakes are placed on the divisions indicated on the table, the maximum being 12,000 francs and the minimum 20 francs. The dealer, who has placed all the cards before him, separates a few with the blank card, takes them in his left hand and invites the players to stake with the formula, " Messieurs,*~~

~~faites votre jeu ! " After a pause he exclaims " Le jeu est fait, rien ne va plus ! " after which no stake can be made. He then deals the cards in a row until the aggregate number is something more than thirty, upon which he deals a second row, and that which comes nearest to thirty wins, the top row being always distinguished as noir, and the lower as rouge. In announcing the result the word trente is always omitted, the dealer merely announcing un, trois, quatre, as the case may be, though~~

~~r r p»~~

~~e~~

~~30~~

~~OR et ARGENT~~

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~~O K~~

~~o~~

~~Diagram of Half of Trente et Quarante Table.~~

~~N, noir; R, rouge ; G, grand tableau ; J, inverse.~~

~~when forty is turned up it is described as quarante. The words noir and inverse are also never used, the announce- ment being rouge gagne or rouge perd, couleur gagne or couleur perd. Gain or loss over couleur and inverse depends upon the colour of the first card dealt. If this should be also the colour of the winning row, the player wins. Assuming, for example, that the first card dealt is red, and that the lower row of the cards dealt is nearest to thirty-one, the dealer will announce "Rouge gagne et le couleur." If the first card dealt is red, but the black or top row of cards is nearest to thirty-one, the dealer announces "Rouge perd et le couleur." It fre- quently happens that both rows of cards when added~~

together give the same number. Should they both, for instance, add up to thirty-three, the dealer will announce "Trois apres," and the deal goes for nothing except in the event of their adding up to thirty-one. Un apres is known as a refait; the stakes are put in prison to be left for the decision of the next deal, or if the player prefers it he can withdraw half his stake, leaving the other half for the bank. Assurance against a refait can be made by paying one per cent, on the value of the stake with a minimum of five francs. When thus insured against a refait the player is at liberty to withdraw his whole stake. It has been calculated that on an average a refait occurs once in thirty-eight coups. After each deal the cards are pushed into a metal bowl let into the table in front of the

dealer. When he has not enough left to complete the two rows, he remarks "Les cartes passent"; they are taken from the bowl, re-shuffled, and another deal begins.

(a. e. t. w.)

Trenton, a city of Missouri, U.S.A., capital of Grundy county, on the Grand river, and the Chicago, Rock Island and Pacific, and the Omaha, Kansas City, and Eastern railways, in the northern part of the state, at an altitude of 812 feet. It is in a farming region, for which it serves as a trading centre. It was founded in 1841, incorporated as a town in 1857, and received a city charter in 1893. Population (1890), 5039; (1900), 5396, 192 being foreign-born and 200 negroes

Trenton, a city of New Jersey, U.S.A., capital of Mercer county and of the state, on the Delaware river, at the falls and head of navigation, on the west boundary of the state. The plan of the city is irregular; it is divided into fourteen wards, has good water-supply and sewerage systems, and is well paved, mainly with brick and asphalt Among the finer buildings are the state capitol, the public library, the court-house, and the United States building. Trenton is on the main line of the Pennsylvania railroad from New York to Philadelphia, and on a branch of the Philadelphia and

~~*Reading. It is a manufacturing city of great importance. In 1900 there were 570 establishments, with a total capital of $26,174,895. They employed 14,457 hands, and the pro- duct had a value of $31,645,695. The chief industries comprised iron and steel, $13,260,787; clay and pot- tery products, $4,785,142; rubber and elastic goods, $1,689,893; and foundry and machine-shop products, $894,239. For its pottery Trenton has long been famous, and also for the great wire works of the Roeblings. The assessed valuation of real and personal property was in 1900 $33,959,823, the net debt of the city was $2,613,990, and the rate of taxation was $21.50 per $1000. The total receipts, exclusive of loans, were $1,112,963, and the expenditure for maintenance and operation $698,450. At Trenton occurred one of the most celebrated military operations of the American Eevolution. On Christmas night, 1776, Washington crossed the Delaware river into New Jersey, and the following day surprised and captured a British force of Hessian mercenaries. Population (1890), 57,458, a great increase since 1880, due in part to the extension of the charter limits; (1900), 73,307, of whom 16,793 were foreign-born and 2096 negroes.*~~

~~*Treport, Le, a maritime town in the arrondissement of Dieppe, department of Seine-Inferieure, Prance, 45 miles in direct line N.N.E. of Rouen, on the railway from Beauvais, and at the mouth of the Bresle in the English Channel. It is a sea-bathing station, and a favourite resort of the Parisians. The principal buildings are the hotel de ville, a tower and the church of St Jacques, both of the 16th century, the latter with fine modern glass, and an ancient timbered house. A casino, sur- rounded by gardens, was erected at the east end of the beach in 1896-97. The fisheries and oyster parks with their dependent industries and shipbuilding furnish the chief occupations of the inhabitants. The plateau of Mont Huon, rising above the town and reached by an ascent of 380 steps, affords a good view. Three miles east of Treport is the little bathing town of Mere. Once a mere village, it now provides accommodation for the increasing number of visitors to Treport. The port com- prises a tidal harbour of 14 acres, with 1300 feet of quayage, depth alongside, high spring tide, 20 feet, and a new dock between the tidal harbour and the canal of 7 acres with 900 feet of quayage, depth alongside, 24*~~

~~feet. The canal from Treport to Eu has a length of 3 miles, and is navigable by vessels drawing 16 feet. The number of vessels entered in 1900 was 313 of 91,161 tons (from England 306 of 89,006 tons) ; cleared 354 of 97,471 tons (to England 347 of 96,379 tons). The total port traffic, including coasting trade, amounted to 193,331 tons. Large quantities of sugar, both raw and re- fined, are exported, chiefly to England, amounting in 1900 to 51,722 tons. Population (1891), 4297 ; (1901),~~

~~Trevelyan, Sir George Otto, Bart. (1838- -), British author and statesman, only son of Sir~~

~~Charles Trevelyan, was born on 20th July 1838 at Rothley Temple, Leicestershire. His mother was Lord Macaulay's sister. He was educated at Harrow and at Trinity Col- lege, Cambridge, where he was second in the classical tripos. In 1861 he wrote his Horace at the University of Athens. The following year he went out as a civil ser- vant to India, where he spent several years. During his stay he contributed Letters of a Competition Wallah to Macmillan's Magazine (republished 1864). Cawnpore, an account of that terrible tragedy, was published in 1865. During the same year he was elected to Parliament for Tynemouth in the Liberal interest. At the general elec- tion of 1868 he was returned for the Hawick Burghs, which he continued to represent until 1886. When the first Gladstone Ministry was formed, in December 1868, Mr Trevelyan was appointed Civil Lord of the Admiralty, but resigned in July 1870 on a point of conscience con- nected with the Government Education Bill. He advo- cated a sweeping reform of the army, including the abolition of the purchase of commissions, and both in and out of Parliament he was the foremost supporter for many years of the extension of the county franchise. In 1869 he wrote Tfie Ladies in Parliament, a humorous political brochure in verse. In the session of 1874 Mr Trevelyan brought forward his Household Franchise (Counties) Bill, which was lost on the second reading ; it was not till ten years later that the agricultural labourer was enfranchised. Among other causes which he warmly supported were women's suffrage, a thorough reform of metropolitan local government, and the drastic reform or abolition of the House of~~

Lords. He was also in favour of the direct veto and other temperance legisla- tion. In 1876 he published Tlie Life and Letters of Lord Macaulay, one of the most admirable and most delightful of modern biographies ; and in 1880 he published 27ie Early History of Charles James Fox. In the latter year he was appointed Parliamentary Secretary to the Admiralty. This office he held until May 1882, when, after the assassination of Lord Frederick Cavendish, he became for two years Chief Secretary for Ireland. From November 1884 to June 1885 he was Chancellor of the Duchy of Lancaster. In February 1886 he became Secretary for Scotland, but resigned on 26th March on account of his disagreement with some of Mr Gladstone's Irish Home Rule proposals. The same year he succeeded his father in the baronetcy. At the general election of 1886 Sir George Trevelyan lost his seat for Hawick. As a representative of the Unionist party he took part in the Round Table Conference, and being satisfied with the modifications made by Mr Gladstone in his Home Rule scheme, he formally rejoined the Liberal party. In August 1887 he re-entered the House of Commons as member for the Bridgeton division of Glasgow; and from 1892 to 1895 he was Secretary for Scotland. Early in 1897 he resigned his seat in Parlia- ment and retired into private life. In 1899 he published the first volume of a History of the American Revolution, coming down to 1776.

Treves (German, Trier), a town and episcopal see of Prussia, in the Khine province, on the right bank of the Moselle, 69 miles by rail south-west of Coblenz. The most noteworthy of the modern public buildings is the provincial museum, built of red sandstone in 1885-89, and containing antiquities (many of them Koman), pictures, and objects of industrial art. There are also a bronze monument of the Emperor William I. (1893) and a fountain (1897) in commemoration of Archbishop Baldwin. Population (1885), 33,019 ; (1900), 43,324.

Treviglio, a town of the province of Bergamo, Lom- bardy, Italy, 15 miles by rail south by west of Bergamo. It has a fine church, an old castle, a technical school, important silk manufactures, wool-spinning, and manu-

~~*facture of artificial manure, sulphuric acid, and glue. Population (1881), 9854; (1900), 10,000.*~~

~~*Treviso, a town, episcopal see, and capital of the province of Treviso, Venetia, Italy, on the plain between the Gulf of Venice and the Alps, 18 miles by rail north of Venice. In 1890 a monument to Dante (having regard to Paradiso, ix. 49) was erected on the bridge at the confluence of the Sile with the Botteniga. Treviso is the seat of various industries — ironworks, majolica and pottery, macaroni, cotton-spinning and rice-husking, paper, printing, brushes, brick-yards, flour-mills — and has a school of the industrial arts and sciences. Population*~~

~~*(1900), 34,004.*~~

~~*Triberg, a town and health resort of Germany, grand-duchy of Baden, on the Black Forest railway, 35 miles south-east of Offenburg, a centre of the Black Porest clock trade. Straw-plaiting, saw-milling, and the manufacture of wooden wares are also carried on. It has a fine waterfall (500 feet), an industrial hall, a nerve- cure establishment, and a couple of technical schools. Altitude, 2251 feet. Triberg is what in Germany is called a " Luft-kurort," to which convalescents resort after a course of baths elsewhere. Population (1900), 3368.*~~

~~*Trichinopoly, a city and district of British India, in the Madras Presidency. The city is on the right bank of the river Cauvery, which here forms an island at the head of its delta, about 56 miles from the sea. It is an important junction on the South Indian railway, 219 miles south-west of Madras. Population (1891), 90,669 ; (1901), 104,690, being the largest town in the province after Madras ; municipal income (1897-98), Ks.1,58,070. There is still a military cantonment. It has a large Soman Catholic population and several Protestant mis- sions. The well-known Trichinopoly cigars are largely made from tobacco grown outside the district at Dindigul : there are fifteen cigar factories. It has, besides, special- ities of goldsmith's work and of modelling in pith. The two colleges (Catholic and S.P.G.) had 335 students in 1896-97 ; the three high schools, 2604 pupils. There are seven printing-presses, one of which issues a Catholic periodical in Tamil, a reading-room and library. Bishop Heber died here in 1826.*~~

~~*The district of Trichinopoly has an area of 3631 square miles. Population (1881), 1,215,033; (1891), 1,372,717, showing an in- crease of 13 per cent, after the famine of 1876-78 ; average density, 378 persons per square mile. Native Christians, mostly Catholics, numbered 69,410, or 5 per cent. In 1901 the population was 1,445,118, showing. a further increase of 5 per cent. The land revenue and rates in 1897-98 were Rs.24,06,479, the incidence of assessment being R.l.13.4 per acre ; cultivated area, 934,833 acres, of which 206,947 were irrigated, including 104,657 from Govern- ment canals ; number of police, 729 ; boys at school (1896-97), 29,022, being 29-2 per cent, of the male population of school-going age; registered death-rate (1897), 21 per 1000. The principal crops are millet, rice, other food grains, and oil-seeds, with a little cotton, sugar-cane, indigo, and tobacco. The South Indian railway traverses the district for 93 miles.*~~

~~*Tricoupi, Charilaos (1832-1896), Greek states- man, was born at Nauplia in 1832. After studying law and literature in Athens and in Paris, he was sent to London in 1852 as an attache of the Greek Legation. By 1863 he had risen to be charge" d'affaires, but he aimed rather at a political than a diplomatic career. In 1865, therefore, after he had concluded the negotiations for the cession by Great Britain to Greece of the Ionian Islands, he entered the Greek Chamber of Deputies, and in the following year was made Foreign Minister, at the early age of thirty-four. In 1875 he became Prime Minister for a few months, but had no opportunity even to begin carrying out the policy which he had in mind. This policy was to develop the resources of his country so as to create an army and a fleet, and thus to give Greece the power to acquire a leading place among the nations of south-eastern Europe. It was not until 1882 that he was able to take measures to this end. In that year he became Prime Minister for the third time (his second *period of office, two years earlier, had lasted only for a few months), and at once set about the task of putting Greek finance upon a firmer basis, and of increas- ing the prosperity of the country by making roads, railways, and harbours. HIe was defeated at the general election in 1885, but in the following year he resumed office, and again took up the labour of economic and financial reform. HIis difficulties were now increased by the large expenditure which had been incurred for mili- tary preparations while he had been out of office, as the result of the*~~

~~union effected between Bulgaria and eastern Bumelia. The Greeks had demanded from Turkey com- pensation for this shifting of the balance of power, and had prepared to enforce their demand by an appeal to arms. The Great Powers, however, had interfered, and by blockading the Piraeus had compelled Greece to remain quiet. Tricoupi, nevertheless, believed that he could in a few years raise the value of Greek paper currency to par, and upon that assumption all his calculations were based. Unfortunately for himself and for his country, he was not able to make his belief good. HIs dexterity in finance called forth general admiration, and his schemes for the construction of roads and railways met with a certain amount of success. But at last he was obliged to recognize that the warnings offered to him had been sound. Greece could not meet her obligations. Tricoupi tried to make terms with the creditors of his nation, but he failed in this also. The first taxation which he proposed aroused great hostility, and in Janu- ary 1895 he resigned. At the general election, four months later, he and his party were defeated. HIe at once retired from public life, and soon afterwards the disease declared itself which eventually proved fatal HIe died at Cannes on 11th April 1896. The faults of excessive ambition and of a far too sanguine optimism, which marked Tricoupi's character, could not prevent him from being regarded, even during his lifetime, as the fore- most Greek statesman of his time. HIe was not a favourite with the populace, nor was he beloved so muchs as re- spected by his followers. By nature he was reserved — his nickname was " the Englishman " — and he had no sympathy with the arts of the demagogue. But, both in the ranks of his own party and by the nation at large, his abilities and his force of character were unquestioned. It was his misfortune that the circumstances of the time did not allow his wide schemes for the benefit of his country to be carried into effect. (h. h. f.)~~

~~Trieste (German, Triest; Slovene, Trst), the principal seaport of the Austro-HIungarian monarchy, at the north- east extremity of the Adriatic Sea, constituting, with its adjoining territory, a separate Austrian crownland, and~~

~~forming the seat of the administration for the Kilstenland or littoral ; total area, 36 square miles.~~

~~The population of the town and district, including 22 suburbs and villages and garrison of 1995 men, was in 1890, 157,466, or 437 per square mile (the population of town and suburbs was 146,556). Of this total 81,973 were female and 75,493 male (a reversal of the relations in the Kiistenland as a whole, where the proportion of females to males is 976 to 1000) ; 77 per cent. Italian, 18 per cent. Slovene, and 5 per cent. German ; 95 per cent. Roman Catholic, 3 per cent. Jews, and the Greek Orthodox and Protestant religions, 1 per cent. each. The population, which increases more slowly than the average of Austrian cities, was in 1900, including garrison, 178,672. In 1896 the marriage-rate was 8-15, the birth- rate, 30-92, or excluding still births, 30-16, and the death-rate, 27-73 per 1000. Of the births, 17-83 percent, were illegitimate. The marriage-, birth-, and death-rates are declining.~~

~~Trieste sends 5 members to the Reichsrath, all Italian. The provincial diet, which at the same time performs the functions of municipal council, is composed of 48 Italians and 6 Slovenes. (For education, communications, &c, see Kustenland.)~~

~~In 1888 a monument was erected in commemoration of the 500th anniversary of the connexion of the town with Austria. Trieste, which had been a free port since 1719, and owed its previous prosperity to the release thus granted from hampering legislation, was deprived of that privilege in July 1891. It lost this advantage at a moment when it had to contend with various and in- creasing difficulties arising from a diversion of traffic towards the Italian and German coasts, the loss of part of the Levant trade through the development of the Orient railway system, and the growing rivalry of the neighbouring HIungarian port of Fiume, whose interests were vigorously. promoted by the Transleithan Govern- ment. In 1901, however, the efforts to secure a second line of railway connecting Trieste with the interior were at length crowned with success through the~~

~~adoption by the Reichsrath of the railway programme of the Korber Ministry. This had been recognized by. successive Governments as of vital importance for the future of the Austrian export trade, and an important factor in the commercial rivalry between Austria and Germany, the Adriatic and the North Sea. The Government scheme provided for the realization of the two principal competing projects. The first was a line across the Karawanken range (Trieste-Klagenfurt, with a branch to Villach, to be opened in 1905), forming a direct connexion with Bohemia and the northern industrial districts of Austria, calculated to counteract the gravitation of traffic towards the German ports. The second was the Tauern scheme (from Mbllbriicken in Carinthia to Schwarzach in Salzburg, through the Gastein valley, to be completed in 1908), the shortest and cheapest route to the Austrian interior, as well as to south Germany, which was ex- pected to raise Trieste to the rank of a first-class harbour. An objection to this line was formerly raised by a section of the Italian element in the town. It would, they con- tended, bring the Germans to Trieste, and experience had shown that where they once set foot commercially they finished by establishing their political predominance. Another suggestion for reinvigorating Trieste is the con- struction of a canal connecting it with the Danube.~~

~~The total net tonnage of vessels entering and departing in 1871 was 1,900,000. In 1896 it amounted to 3,500,000 tons, the lowest increase of any large European port. In 1890, while still a free port, the total value of the exports and imports was £58,333,000. There was a reduction of £6,416,600 in the following year, but in 1892 trade had begun to recover, the total being £54,583,300, to fall again in 1895 to £52,390,000. Of the entire trade of Trieste, 55 per cent, is with the Levant and the Far East. In 1892 its mercantile fleet consisted of 1267 ships of an aggregate burden of 105,504 tons. These included 110 steamers, of which three-fourths belonged to the Austrian Lloyd, which receives subventions from the state. Fifty-one vessels (5 of them steamers) with a total ton- nage of 1660 were built in tbe docks of the Austrian Lloyd and the Stabilimento Tecnico Triestino, which employ over 3000 hands. Other important industries include the construction of marine~~

~~steam engines, brewing, tanning, the manufacture of anchors, cables, silk and cotton stuffs, soap, wax, wine, liqueurs, furniture and clothing. The most important natural products are fruit, corn, and oil.~~

~~Authokities. — Neumann-Spall a kt. Oesterreichs maritime Entwickelung und die Hebung von Trieste (Stuttgart, 1882). — Soossa. Storia cronografica di Trieste (Trieste, 1885-86). — Ireno della Ckoce. Storia di Trieste (Trieste, 1879).~~

~~(JE. o'n.)~~

~~Trifail (Slovene, Trbovlje), a commune in the government district of Cilli, in Styria, Austria, near the left bank of the Save and 28 miles east by north of Laibach. It is the centre of an extensive lignite deposit, which yields about 300,000 tons annually. There are also large cement works, and manufactures of chemicals and glass. Population (1890), 8464;' (1900), 10,851.~~

~~Trikkala (the ancient Trika), a town of Greece, capital of the province of Trikkala, 38 miles west of Larissa, and after that town the largest in Thessaly. It has the appearance of a Mussulman town, on account of its mosques (only one of which, however, is in actual use), and it is a centre of trade in wheat, maize, and tobacco. Population (1889), 14,820 ; (1896), 21,149.~~

~~Trincomali, a town and naval station on the north- east coast of Ceylon, 100 miles north-east by north of Kandy. It is no longer the principal capital, having been superseded by Batticaloa, but with its magnificent harbour — one of the five or six greatest natural harbours in the world — it continues to be the headquarters of the admiral commanding on the East Indian station, and there is a garrison of infantry and British artillery. A steamer from Colombo calls weekly with and for pas- sengers and cargo. Average annual rainfall, 62| inches ; average temperature, 81-2°. Some tobacco, rice, and palms are grown in the district. Population (1900), about 13,000 ; of district, 28,500.~~

~~Tring, a market town and urban district (1894), Hertfordshire, England, in the Watford parliamentary division of the county, 7 miles south-east of~~

~~Aylesbury. The Rothschild Museum, erected in 1889, contains a very extensive natural history collection, and in a paddock and cages a short distance from the building live animals are kept. Population (1891), 4525 ; (1901), 4368.~~

~~Trinidad, the most southerly, and with the ex- ception of Jamaica the largest, of the British West Indian Islands. Area, 1754 square miles, or nearly 1,123,000 acres. In 1889 Tobago was annexed to Trinidad to form one colony, and since 1899 that island has been incorporated as a ward of the united colony of Trinidad and Tobago. The soil of Trinidad is varied and extremely fertile. Population (1891), 200,028; (1901), 253,250. Of the population a third are East Indians. Of the other two-thirds, the upper classes are mainly of pure or mixed British, French, Corsican, or Spanish blood, while the lower clas'ses are of pure or mixed negro origin. Immigration from India is conducted under Government control, £48,809 being expended for this purpose during 1898. The immigrants numbered 1940 in 1893, 3087 in 1896, and 1292 in 1898. Port-of-Spain, the capital, has a fine harbour, with 7 miles of tramway and 500 miles of telephones ; its population in 1900 was 55,000. A system of underground drainage has been constructed. Two other boroughs of importance are San Fernando (7641) and Arima (3653).~~

~~The climate is both hot and damp: annual death-rate about 26 per 1000 ; average rainfall annually about 62 inches at the Botanic Garden. The wet season begins in June and lasts till December, with a short cessation in September. The mean annual temperature is about 80°. In Port-of-Spain, in May, June, Sep- tember, and October, the shade temperature often reaches 90° ; in December and March it often falls below 70° at night.~~

~~The principal industries are the cultivation of cacao, sugar- cane-growing, and the manufacture of sugar, rum, and bitters ; the growing of coffee, tobacco, cocoanuts, oranges, bananas, and timber (such as mahogany and cedar), dye-woods (logwood and fustic), and balata, rubber-trees ; stock-farming, &c. The area under cacao cultivation is~~

~~*nearly twice that of sugar. Cane- farms, as opposed to sugar estates, are on the increase. Large quantities of asphalt are annually exported from the Pitch Lake in La Brea, 90 acres in extent, by a British company which has the exclusive right of digging from the lake, in return for an annual sum (£10,000) and a royalty to the Government, which together in 1898 produced £34,056. The value of the imports in 1900 was £2,500,258; exports, £2,593,475. The trade is principally with the United Kingdom, the United States, France, and Venezuela. The transport trade (almost entirely with Vene- zuela) represents a quarter of the commerce of the colony. The values of the principal native products and manufactures ex- ported in 1900 were : sugar, with molasses and rum, £552,158 ; cacao, £978,632 ; asphalt, £177,460. Large quantities of Tonga beans, the produce of the mainland, are cured in Port-of-Spain, in bond ; and as much as £30,000 worth has been shipped in a single year. Out of a total area of 1,123,000 acres, 450,926 acres are unalienated Crown lands. About 205,000 acres are under cultiva- tion.*~~

~~*The revenue in 1900 was £698,939 ; expenditure,' £659,079 ; public debt, £918,472. About thirty-four steamers call at Trini- dad per month. Port-of-Spain is in direct communication with Southampton. The shipping entered and cleared in 1900 had a total tonnage of 1,178,494, of which 591,102 was British. The island is not well furnished with roads, the total mileage being 193. There are 90 miles of railway, besides several miles of steam, elec- tric, and mule tramways ; and 166 miles of internal telegraphs.*~~

~~*Places of worship are owned as follows : — Roman Catholic, 60 ; Anglican, 51 ; Baptist, 16 ; Wesleyan, 13 ; Presbyterian, 8 (and 59 chapels). The bishopric of Trinidad forms part of the West Indian Province of the Church of England. The 239 elementary schools are of two kinds : (1) 56 Government schools, which are secular; (2) 183 denominational schools, aided by grants. In 1898 there were 9810 children on the rolls of the former and 18,056 on those of the latter. Fees are paid. More than a quarter of the assisted schools are managed by a Canadian mission. Agri- culture is a compulsory subject. For higher education there are the Queen's Royal College (secular), and its affiliated institutions, St Mary's College (Roman Catholic), and a school managed*~~

~~by the Canadian mission. Attached to these are four exhibi- tions of the value of £150 a year, tenable for three years at an English university, granted annually. There are also many private schools. English is generally spoken in the towns, and in some of the districts. In the country parts of the north, and generally in the cacao-growing districts, the common language is a French patois. Over some small areas Spanish is still spoken. There are good i hospitals at Port-of-Spain (320 beds) and San Fernando (120 beds), 8 district hospitals, a segregation hospital, and a lunatic asylum. There is no poor law. There is no regular military force in the colony. There are three volunteer corps — light horse, garrison artillery, and light infantry — making a total force of 697 men. The police force numbers 655 officers and men. There is a Legislative Council consisting of the governor with 9 official and 11 unofficial members all appointed by the Crown.~~

~~(f. cu.)~~

~~Trinidad, an uninhabited island in the South Atlantic, 680 miles east of the coast of Espirito Santo, Brazil, in 20° 30′ S. and 29° 30′ W., 4 miles long by 2 broad. It is of volcanic formation, and has fertile springs of fresh water. As a possible coaling 'and tele- graph station in mid-ocean, it has formed a subject of contention between Brazil and Great Britain. The dis- pute was settled in favour of Brazil, which claimed on the ground of its discovery by Tristan da Cunha early in the 16th century, while Great Britain relied on its occupation by the astronomer Halley in the name of England in the year 1700. About 30 miles farther east are the three islets of Martin Vaz, so named from the Portuguese mariner who discovered them about 1510.~~

~~Trinidad, a city of Colorado, U.S.A., capital of Las Animas county, on the Purgatory river, at the foot of the Eaton Mesa, in the southern part of the state. It has a hilly site, on which it is regularly laid out, and has a good water-supply. It is on three railways — the Denver and Eio Grande, the Colorado and Southern, and~~

~~the Atchison, Topeka, and Santa Fe\ It is in a stock- raising region, and near the rich coal-fields of southern Colorado. It has railway works and~~

~~coking ovens, and handles large quantities of coal. Population (1895), 5982 ; (1900), 5345, of whom 659 were foreign-born and 125 negroes.~~

~~Trinidad, a town near the southern coast of Cuba, about 35 miles south-east of Cienfuegos, and 3 miles from its seaport, Casilda, which lies due south. It is one of the original seven cities of Cuba founded by Lieutenant- Governor Diego Velasquez in 1513. Sugar and honey are exported. The town, which is surrounded by high mountains, is mediaeval in aspect, but contains some fine buildings. The scenery, which is unexcelled, and the climate, which is considered to be the healthiest in Cuba, make the place a favourite resort for natives and foreigners. Population (1899), 11,120.~~

~~Tripoli, a Turkish vilayet (regency) of North Africa, extending from the Mediterranean to the Sahara Desert in 23£° N. Much fresh light has been thrown on its physical, ethnical, and economic relations by Haimann, Fournel, Cowper, Borsari, and other observers. Tripoli does not form a geographical unit, but comprises at least five distinct regions — Tripoli proper, the Barca plateau (Oyrenaicd), the Aujila oases, Fezzan, and the oases of Ghadames and Ghat — which with the intervening sandy and stony wastes occupy the whole space between Tunisia and Egypt, extend from the Mediterranean south- wards to the Tropic of Cancer, and have a collective area of about 400,000 square miles, with a population variously estimated at from 1,200,000 to 1,600,000. The regency has remained almost untouched by the political changes by which the map of Africa has been so pro- foundly modified since the early 'eighties. Towards the south and east the frontiers still remain undefined. But on the west side, where the country is contermi- nous with Tunisia, the conventional line laid down by agreement with Prance in 1886 was more accurately determined in 1892, when the terminal point on the Mediterranean was shifted from Borj-el-Biban to the Ras Ajir headland, 18 miles to the south-east, in 33° 12' N. and 12° E. Prom this point the line runs southwards along the Wed Magla and across the El Erg dunes in such a way as to leave Ghadames to Turkey. Beyond that oasis the line has not been traced, because the southern region as far as Ghat, which is recognized as belonging to the vilayet, is held by the still independent Azjar (Tuareg) nomads.~~

~~*For some distance east of Tunis the seaboard is low and sandy, and is often regarded as a part of the Sahara, which, however, begins only some 80 miles farther south, beyond the Jebels ISTefusi, Yefren, ™ta'S! and Ghurian (Gharian). The " Jebel," as this system is locally called, terminates eastwards in the Tarhona heights of the Homs (Khoms) coast district, has a mean altitude of about 2000 feet, and culminates in the Takut volcano (2800 feet), nearly due south of the capital. It is not, however, a true mountain range, but rather the steep scarp of the Saharan plateau, which encloses south- wards the Jefara coast plains, and probably represents the original coast-line. The Ghurian section is scored in places by the beds of intermittent coast streams, and on its lower slopes is clothed with a rich sub-tropical vegeta- tion. South of these escarpments, which Cowper calls the "Tripoli chain," the vast Hammada el-Homra, the "Red Hammada," an interminable stony tableland covering some 40,000 square miles, occupies the whole space between Tripoli proper and the Fezzan depression. The now uninhabited and waterless Hammada formerly drained through several large rivers, such as the Wadys*~~

~~*Targelat (Uani, Kseia), Terrgurt, Sofejin, Zemzem, and Bel, north-eastwards to the Gulf of Sidra (Syrtis major). Southwards the tableland is skirted by the Jebel Welad Hassan, the Jebel es-Suda, the Jebel Morai-Yeh, and other detached ranges, which hare a normal west to east trend in the direction of the Aujila oases, rising little above the level of the plateau, but falling precipitously towards Fezzan. The Jebel es-Suda (" Black Mountains "), most conspicuous of these ranges, with a mean altitude of 2800 feet, takes its name from the blackened aspect of its limestone and sandstone rocks, which have been subjected to volcanic action, giving them the appearance of basalt. Eastwards this range ramifies into the two crescent- shaped chains of the Hariij el-Aswad and Hariij el-Abiad ("Black " and "White " Hariij), which rise some 700 feet above the Ked Hammada, and enclose an extensive Creta- ceous plateau, which has iffiver been visited since it was crossed by Hornemann in 1798. Beyond*~~

~~*the barren Ghadama district in the extreme north, the dreary aspect of the wilderness is broken by several productive tracts under grass, corn, and date-palms, and even containing some permanent reservoirs in the beds of the Wadys Sofejin and Zemzem, where the plateau falls from a mean height of 2000 feet to 1000 and 530 feet respectively. But it again rises rapidly southwards to a somewhat uniform level of 1600 or 1700 feet, and here the main caravan route from Tripoli to Murzuk and Lake Chad traverses for a dis- tance of fully 130 miles a monotonous region of sandstone, underlying clays, marls, gypsum, and f ossiliferous silicious deposits. In its northern section this part of the Hammada, as it is locally called in a pre-eminent sense, is relieved here and there by a few patches of herbage, scrub, and brushwood, with even a little water left in the rocky cavities by the heavy showers which occasionally occur in this almost rainless desert.*~~

~~*North-eastwards the Neddik pass over the Jebel Morai-Yeh leads down to the remarkable chain of low-lying oases, which, „ from the chief member of the group, is commonly depression oal'ed the Aujila depression. Collectively the oases present the aspect of a long winding valley, which is enclosed on the north side by the southern escarpments of the Barca plateau, expands at intervals into patches of perennial verdure and shallow saline basins, and extends from the Wady el-Fareg, near the Gulf of Sidra, through the Bir Rassaro, Aujila, Jalo, Faredgha, and Siwah oases, to the Natron lakes and the now dried-up branch of the Nile delta known as the Bahr bila-Ma ("waterless river"). The whole region presents the aspect of a silted-up marine inlet, which perhaps in Pliocene times pene- trated some 300 miles south-eastwards in the direction of the Nile. Nearly all the fossil shells found in its sands belong to the fauna now living in the Mediterranean, and Siwah is still actually 98 feet below sea-level. This is true also of its eastern extensions, Sittra (80) and the Birket el-Kerun in the Fayum (141). But Aujila and Jalo stand, on the contrary, 130 and 296 feet re- spectively above sea-level, so that the idea at one time entertained by Rohlfs of transforming the chain of oases into a marine gulf, and thus converting the Barca plateau into an island or penin- sula in the midst of the Mediterranean waters, and in fact flooding the Libyan desert, must share the fate of Rudaire's equally vision- ary scheme in respect of the Algerian Sahara.*~~

~~*The Barca plateau, which falls in terraces down to the Aujila depression, and presents an unbroken rampart of steep cliffs towards the Mediterranean, is by far the most favoured The Barca region 0f the vilayet. Its many natural advantages p a eau. Qj cjjmatej so;^ an(j vegetation had already in remote times attracted numerous Egyptian settlers to Barke (later Ptolemais) and other points. But these were afterwards replaced by Greek colonies, the oldest and most famous of which was the Dorian settlement of Oyrene, dating from about 630 n.c. From this place the whole region took the name of Cyrenaica, and was also known as Pcntapolis, from its "five cities" of Cyrene, Apollonia, Arsinoe, Berenice, and Barke. The elevated plateau of Cyrenaica, which encloses the Gulf of Sidra on the west, is separated southwards by the Aujila depression from the Libyan desert, and projects northwards far into the Mediterranean, might seem, like the Atlas region in the extreme west, to belong geologically rather to the European than to the African main- land. It has a mean altitude of considerably over 2000 feet, and*~~

~~*in the Jebel Akhdar ("Green Mountains") attains a height of nearly 3500 feet. Eastwards the Barca uplands merge gradually in the less elevated Marmarica plateau, which nowhere rises more than 1800 feet above sea-level, and disappears altogether in the direction of the Nile delta.*~~

~~*South of the Aujila depression the land rises steadily to a height of nearly 1200 feet in the Kufra oases, which lie to the north of the Tropic of Cancer and due east of Fezzan, of which they may be regarded as a geographical Kufra*~~

~~*dependency. The group consists of five distinct oases oases- in the heart of the, Libyan desert — Taizerbo, Zighen, Bu-Zeima, Erbena, and Kebabo — which extend for a distance of 200 miles north-west and south-east, and have a collective area of 7000 square miles and a present population of 6000 or 7000 Arabo- Berber nomads. Good water is obtained in abundance from the underground reservoirs, which lie everywhere within a few feet of the surface, and suffice to support over a million date-palms. Kufra, that is, " Infidels " (in reference to the now extinct pagan Tibu aborigines), is a great stronghold of the Semisiya brotherhood, whose zawya (convent) at Jof, in Kebabo, ranks next in*~~

~~*importance to that of Jarabub, their chief station in the Sahara. . This circumstance, together with the great fertility of the group and its position midway on the caravan route between Cyrenaica and Wadai, imparts exceptional political and com- mercial importance to these oases.*~~

~~*Fezzan, the ancient Phazania, appears to have been the chief centre of the Garamantes, whose empire was overthrown by the Romans in the reign of Augustus. A stone monu- ment near their capital Gamma (now Jerma) marks Fezzan. the southernmost limit of the Roman dominion in the interior of the continent. The Romans were succeeded in the 7th century by the Arabs, who maintained their independence till the 16th century, when Fezzan was attached to the Turkish vilayet of Tripoli. The Hofra (" ditch "), as it is called, does not form a continuous fertile tract, as might be supposed from the large space on most maps coloured green and labelled "Fezzan," but rather consists of a monotonous sandy expanse somewhat more thickly studded with verdaut isles than the surrounding wastes. The oases are numerous, especially in the district of the capital, Murzuk, and farther north, in the Wady Lajal, a long narrow valley which trends north-east in the direction of the White Haruj, and the western section of which — the Wady Gharbi — is the most fertile tract in the whole of Fezzan. Here are several perennial springs, and even lacustrine basins with corn- fields and date-groves, enlivened by flocks of doves and hoopoes. One of these basins, the saline Bahr el-Dud ("Sea of Worms"), has an extent of no less than 600 square miles, with a depth, according to "Vogel, of at least 26 feet. Here stood Old Jerma (Garama), capital of the Garamantes and of the Roman province, later replaced by New Jerma, a little farther north. Murzuk, the present capital, dating from about the 12th century, is less favour- ably situated, lying farther east near the Wady Sherkiya wells, where the Hofra falls to its lowest level, about 600 feet above the sea. It has a mixed population of about 7000 Arabs, Tuaregs, and Negroes, who are almost entirely dependent on the caravan trade between Sudan and Tripoli.*~~

~~*From Murzuk a, beaten track leads across a stony waste, west by south, to the oasis of Ghat ; and it was at the Sharaba wells, on this route, that Miss Tinne' was murdered by the Tuaregs in 1869. East of Murzuk follow the oases of Traghen, Zuila, and Temissa, and far to the south-east Wau*~~

el-Kebir, discovered by Beurmann in 1862. Southwards the Hofra again rises to a height of 2000 feet, and in this direction lies the oasis of Gatron, followed by Tejerri ou the verge of the desert, which marks the southern limit of the date and the northern of the dum palm. Beyond Tejerri the. Saharan plateau rises continuously to the Tibesti high- lands, from which it seems evident that Fezzan is a true depression, like Lake Chad an old lacustrine basin without seaward outflow, and flooded at a time when the Sahara enjoyed a moister climate than at present.

Ghat stands 2400 feet above the sea, on the Wady Aghelad in the Igharghar basin, and consequently belongs, not to the Fezzan depression, but to the Saharan plateau. The Aghelad, _..

or " Passage," trends north to the Iasawan valley along the east foot of the Tasili plateau, that is, the divide between the waters which formerly flowed north to the Mediterranean, west to the Atlantic, and south to the Niger and Chad basins. Ghat, which is skirted eastwards by the Akakus range, forms a sandy plain dotted over with clumps or groves of date-palms. In the centre is an open space where is held a great annual fair, and to this, combined with its position on one of the caravan routes across the desert, the oasis owes all its importance. There is a collective population of perhaps 10,000, nearly all Ihajenen Tuaregs, about half of whom are concentrated in the town of Ghat, which appears to be a relatively modern place, successor to Mapsa, a great com- mercial centre and military station under the Roman empire.

Ghadames, on the contrary, is a very old place, being the Cyda- mus of the Garainantes, the capture of which by Cornelius Balbus Ghadames. ^ to ibe overthrow of their empire. The oasis, which

stands on the Cretaceous Tinghert plateau, 300 miles south-west of Tripoli, and 1200 feet above the sea, is enclosed by a circular rampart over three miles in circumference. The town, which occupies the south-west corner of the enclosure, has a popu- lation of about 7000, forming

~~*distinct ethnical and even hostile groups of Arabs, Berbers, and Negro freedmen, all following their own customs and speaking their own language, but using Berber as the medium of general intercourse. Owing to some perennial springs and artesian wells, the oasis is very productive, yieldiug an abundance of dates, figs, apricots, and vegetables, besides some wheat, barley, and millet. It occupies a highly advantageous position at the converging-point of several caravan routes, and has extensive trading relations with the markets of Tripoli, Tunis, and Sudan. The Turkish authority is little more than nominal, and the French masters of Tunis are looking forward to the peaceful occupation of Ghadames in the near future.*~~

~~*The explorations of Duveyrier, Largeau, Von Bary, and Cowper have shown that Tripoli was not only inhabited by primitive man,*~~

~~*but was the seat of a flourishing Neolithic culture, inhabitants comparable to and in many respects resembling that oVesent? of Iberia> Brittany, and the British Isles. As in other*~~

~~*parts of Mauritania, many now arid and uninhabitable wastes are strewn with monolithic and other remains, which occur in great variety of form and in vast numbers, as many as 10,000, chiefly of the menhir type, having been enumerated in the Mejana steppe alone. All kinds of megalithic structures are found — dolmens and circles like Stonehenge, cairns, underground cells excavated in the live rock, barrows topped with huge slabs, cup stones, mounds in the form of step pyramids, and sacrificial altars. Most remarkable are the "Senams," or trilithons of the Jebel Msid and other districts, some still standing, some in ruins, the purpose of which has not been determined. They occur either singly or in rows, and consist of two square uprights 10 feet high standing on a common pedestal and supporting a huge transverse beam. In the Terrgurt valley " there had been originally no less than eighteen or twenty megalithic trilithons in a line, each with its massive altar placed before it" (Cowper). There is reason to believe that the builders of these prehistoric monuments are represented by the Hamitic Berber people who still form the sub- stratum, and in some places the bulk, of the inhabitants of Tripoli proper. But even here the Berbers have for the most part been*~~

~~*driven to the Ghurian and Tarhona uplands by the Arab nomads, who now occupy the Jefara flats about the capital, and are in almost exclusive possession of Cyrenaica, Marmarica, and the Aujila oases. In Fezzan the Saharan Berbers (Tinylkum Tuaregs) are still dominant, but are here largely intermingled with Negro or Negroid intruders from Sudan. But even in the uplands many of the Berbers have been Arabized, and Cowper describes those of the Tarhona heights as even " pure-bred Arabs." Other early intruders are the Jews, some of whom arrived from Egypt in the time of the Ptolemies, and are still found leading the life of troglodytes in the limestone caves of the Ghurian escarpments. They are also numerous in the large towns, where the population is further diversified by the presence of Turkish officials and garrison troops, of Maltese, Italian, and other South European traders and artizans.*~~

~~*On the other hand, no trace can now be detected either of the Greeks who colonized Cyrenaica in the 7th century B.C., or of*~~

~~*the Phoenicians who at a still earlier date founded the*~~

~~*of 51,000 tons, were British. In Barca the only important centre of population is Benghazi, the ancient Berenice, at the southern extremity of a headland which formerly enclosed a spacious natural haven on the north-east side of the Gulf of Sidra. But the harbour has been partly rilled up by the ruins of a large fortress, and is now inaccessible to vessels drawing over 6 or 7 feet. Benghazi has a mixed population of about 15,000 Arabs, Berbers, Jews, and Negroes. East of Benghazi is the exposed roadstead of Dema, which was occupied by the Americans in 1815. Nothing has been done to complete the harbour works begun by them; but it is now proposed to restore the port of Marsa-Susa, the ancient Apollonia, which lies under the Bas Sem headland, and was formerly much frequented as the emporium of the neighbouring city of Cyrene (Grenna). The Government has displayed much activity in this fertile and healthy district, to which have been removed many of the Turkish inhabitants of Crete dissatisfied with the present relations in that island. Nearly the whole of the foreign exchanges pass through the ports of Tripoli and Benghazi, where the total imports were valued in 1900 at £499,500, and the exports at £418,500. Of the imports, chiefly cottons,*~~

~~silks, sugar, and flour, £123,000 were British ; while the exports to Great Britain, chiefly alfa-grass, sponges, ostrich feathers, wool, skins, and ivory, were valued at £158,000. The caravan trade across the Sahara with Sudan has suffered a severe blow by the opening of new routes to the Atlantic through British and French territories (Niger, Benue, and Senegal routes). Never- theless the total exchanges rose from £143,000 in 1897 to nearly £200,000 in 1898. The convoys bound for the interior of the con- tinent are laden chiefly with English cottons, Venetian beads, Bohemian glass, silks, paper, tea, and sugar, and return with ostrich feathers, dressed goat-skins, and ivory. Some of these wares reach the capital from Wadai by the Benghazi route. (For climate, natural history, administration, and other details, see Tripoli in the ninth edition of this work.)~~

~~Authorities. — L. Playfair. Bibliography of the Barbary States, Part I., "Tripoli and the Cyrenaica." London, 1892. — M. Bisson. La Tripolitaine et la Tunisie. Paris, 1881. — H. Haimann. Da Bengazi a Dema. Milan, 1881 ; and Cirenaica. Milan, 1886. — M. Fournel. La Tripolitaine, &c. Paris, 1887. — F. Borsari. Gfeographia, &c., della Tripolitania, Sc. Naples, 1888.— H. S. Cowpek. The Hill of the Graces. London, 1897 ; "Notes on a Journey in Tripoli," Geographical Journal, February 1896; and " Further Notes on the Tripoli Hill Range," Geograph- ical Journal, June 1897. (a. h. k.)~~

~~Tripoli, now Tardbulus, the chief town of a sanjak of the same name in the Beirut vilayet in Syria, situated about 2 miles inland from its port, el-Mina. The popu- lation, including el-Mina, amounts to 30,000 (Moslems 24,000, Christians 6000). In 1900 the exports were valued at £607,700 and the imports at £311,800, the principal exports being silk thread, cereals, lemons and oranges, wool, sponges, and soap.~~

~~Tristan da Cunha, a group of three islands belonging to Great Britain, situated in the South Atlantic, 1500 miles south-west of St Helena. Annexed in 1816, the garrison was removed in the next year. Three men, of whom one was married and had ten children, remained behind, and from these, together with settlers from whaling ships, the present population is derived. It consisted in 1897 of 64 persons, against 109 in~~

~~1880. In spite of healthy surroundings and of naturally fine physique, the race appears to be deteriorating from ■> , ant of infusion of fresh blood. What government there is is carried on under a patriarchal system. The question of education presents great difficulties. It has been pro- posed that the children should be sent to Cape Colony to receive their education. The climate, though very windy and rainy, is healthy, averaging from 68° in summer to 55° in winter. Tristan da Cunha is visited once a year by a British war-vessel.~~

~~Trivandrum, or Trevandrum, a town of southern India, capital of the state of Travancore, situated about 2 miles from the sea-coast. Population (1891), 27,887. The best houses and chief public build- ings stand on hilly terraces above. There is a canton- ment for the Nair brigade. The town contains the~~

~~Maharaja's college, a Sanskrit college, a high school, a school for girls, and an industrial school of arts, a hos- pital and medical school, an observatory and museum. There is little trade, but it makes a speciality of wood- carving.~~

~~Trochu, Louis Jules (1815-1896), French general, was .born at Palais, near Belleisle, Morbihan, on 12th March 1815. Educated at St Cyr, and at the Staff Corps Practical School, he received a commission in the army in 1837, was promoted lieutenant in 1840, and captain in 1843. He served as a captain in Algeria under Marshal Bugeaud, who, in recognition of his gallantry in the battles of Sidi Yussuf and Isly, made him his adjutant and entrusted him with important com- missions. He was promoted major in 1845, and lieutenant- colonel in 1853. He served with distinction throughout the Crimean campaign, first as colonel and aide-de-camp to Marshal St Arnaud, and then as general of brigade (Commander, Legion of Honour, and general of division). He again distinguished himself in command of a division in the Lombardy campaign of 1859 (Grand Cross, Legion of Honour). In 1866 he was employed at the Ministry of War in the preparation of army reorganization schemes, and he published~~

~~anonymously in the following year L'Arme'e Frangaise en 1867, a work inspired with Orleanist sentiment, which ran through ten editions in a few months and reached a twentieth in 1870. This brochure brought him into bad odour at Court, and he left the War Office on half-pay, but was afterwards selected to command the Toulouse division. After the disasters in the war with Germany in 1870, he was ap- pointed (17th August) governor of Paris and commander- in-chief of all the forces destined for the defence of the capital, including some 120,000 regular troops, 80,000 mobiles, and 330,000 National Guards. He worked energetically to put Paris in a state of defence. At the revolution of the 4th September, he became president of the Government of National Defence in addition to his other offices. His " plan " for defending the city raised expectations doomed to disappointment ; the successive sorties made on the besieging Germans were unsuccess- ful, and having declared in one of his proclamations that the governor of Paris would never capitulate, when capitulation became inevitable he resigned the governor- ship of Paris on 22nd January 1871 to General Vinoy, retaining the presidency of the Government until after the armistice in February. He was elected to the National Assembly by eight departments, and sat for Morbihan. In October he was elected president of the Council General for Morbihan. In July 1872 he retired from political life, and in 1873 from the army. He published, in 1873, Pour la Vdritd et pour la Justice, in justification of the Government of National Defence, and in 1879 L'Arme'e Francaise en 1879, par un officier en ; ".traite. He died at Tours on 7th October 189b. (b. h. v.)~~

~~Troitskosavsk, a district town of Russia, in the province of Transbaikalia, 2\ miles from Kyakhta arid i\ miles from the Chinese frontier. When the main trade was transferred to Kyakhta, the town fell into decay for a period, but it has already begun to revive, and was made the chief town of a district in 1901. Popu- lation (1897), 9213.~~

~~Trom betas. See Amazon.~~

~~Tromso, a seaport town of Norway, capital of the county of Tromso, in 69° 38' N. It has a trade, valued at £130,000 to £170,000 per annum, in the~~

~~*export of whale and seal oil (£34,500), and fish (£37,000) ; and in the import of coal (£25,250), textiles, salt, grain, and flour.*~~

~~*Mean temperature of year 36·4° Fahr. ; February, 25° ; July, 51·8°. Population (1875), 5409 ; (1900), 6955.*~~

~~*Trondhjem, a seaport town and bishop's see of Norway, on the west coast, and south side of Trondjhem Fjord, 349 miles by rail north of Christiania, and 531 by rail north-west of Stockholm via Ostersund. The resto- ration of the choir of the cathedral was finished in 1890 ; that of the north and south transepts in 1900. The bishop's palace has been converted into barracks and arsenal, and there are a new fisheries museum and indus- trial art museum. The city's commerce has grown with the prosperity of the Roros and Sulitelma mines, and with the opening of the railway from Ostersund, in- creasing from £747,000 in 1882 to £1,226,500 in 1892 and £1,903,000 in 1899. Of this about three-fifths is for imports — coal, grain and flour, groceries, salt, and machinery ; the remainder being for exports — timber, wood-pulp, fish, butter, copper, iron, and pyrites. The bulk of the imports comes from Great Britain, and a large portion of the exports passes overland by rail into Sweden. In 1900 the port was entered by 484 vessels of 277,743 tons, as compared with 230 vessels of 111,100 tons in 1886. The industries embrace saw-mills, wood- pulp factories, fish curing factories, machine shops, and a shipbuilding yard. Population (1891), 29,162; (1900),*~~

~~*38,156.*~~

~~*Troon, a police burgh (1896), seaport, railway station, and watering-place of Ayrshire, Scotland, 6 miles north by west of Ayr. It has the best natural harbour in the county, with over a mile of quayage, a breakwater 3000 feet long, and two graving* docks. In 1888, 2500 vessels of 251,514 tons entered ; in 1898, 1573 of 252,150 tons. The principal article of import is iron ore, and coal and pig-iron are the chief exports, 449,767 tons of the former having been shipped in 1898. Shipbuilding is the principal industry. The municipality is very pro- gressive, and controls waterworks (1895) and gasworks, both of which are being largely extended. Two golf- courses attract many visitors. Population (1891), 3315 ;*~~

~~(1901), 4696.~~

~~Troppau (Polish, Oppava; Czech, Opava), the capital of Austrian Silesia, situated on the Oppa river, close to the Prussian frontier, 37 miles north-east of Olmutz. The industries comprise the manufacture of hats and fezzes, jute fabrics, tiles, &c, beer, spirits, and liqueurs. Population (1890), 22,867 ; (1900), 26,725, in- cluding a garrison of 2154 men.~~

~~Trossachs, The, a characteristic Highland dis- trict in the south-west of Perthshire, Scotland. Strictly speaking, it is a narrow, beautiful-wooded glen or defile in the upper valley of the Teith, extending from Loch Katrine on the west to Lock Achray on the east, a distance of only about a mile. On the south-west the pass is shut in by the steep green slopes of Ben Venue (2393 feet), and on the north-east by the bolder and more precipitous Ben A'an (1750 feet), backed by two hills of much greater altitude — Ben Vorlich (3224 feet) and Ben Ledi (2875 feet). The region, which is one of great natural charm, owing to its blending of wood, water, rock, and hill, was made famous by Scott's poem Tlie Lady of the Lake (1810). From the lovely Ellen's Isle, near the east end of Loch Katrine, all the way to Callander, every mile recalls associations of the stirring poem — Brig of Turk, Glen Finglas, Lanrick Mead, Coilantogle Ford, Bochastle, Pass of Leny, Strathyre, St Bride's. And the publication, seven years later, of Rob Roy awakened equally romantic, though less poetic, associations of~~

~~another kind — namely, those which cluster about the "broken" clan of the MacGregors, as the Braes of Bal- quhidder, Rob Koy's cave, Portnellan, Glengyle, Glen- falloch, Aberfoyle, Killearn, Glen Fruin, Inversnaid, and so forth. In the wider usage of the term, the Trossachs embraces about a dozen lakes altogether, each as a rule lying amid grassy heath-clad hills 1000 to 3000 feet and more in altitude. The names of these lakes and other particulars regarding them are contained in the annexed table : —~~

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~~*Except for the lower (eastern) extremity of Loch Ven- nachar, all these lakes lie just within the Highland line, that is, immediately west of the great geological fault which stretches in a north-east to south-west direction right across Scotland, from the coast of Kincardineshire to the Firth of Clyde, and in a region which is seamed with secondary faults that branch off from the main fault at various angles. The district as a whole is built up of the crystalline schists which characterize the Highlands, the rock formations being mostly hard conglomerates and pebbly grits. Indeed, it was the hard coarse grits of Ben Ledi which originally dammed up the east end of Loch Katrine, and made the lovely pass of the Trossachs which links that lake with Loch Achray. As the table above clearly indicates, every one of these lakes is long and narrow, and relatively of no great depth, though the two largest do indeed go down below sea-level, namely, Loch Lomond to the extent of over 600 feet, and Loch Katrine 500 feet. From these circumstances, coupled with the general in- dications of their physical surroundings, it is pretty certain that they owe their origin, or at any rate their present shape and extent, to glacial action. In most cases each loch consists of but a single basin, which is scooped out to its ' greatest depth in a narrow trough along the middle ; but in Lochs Vennachar and Katrine the maximum depth is found in each case towards the east, and in Loch Voil, quite exceptionally, at the western end. The lake last named and its neighbour, Loch Doine, were at no very distant period connected, and obviously formed one sheet of water. Two of the lakes, however, namely, Loch Lubnaig and Loch Drunkie, have each two distinct basins, all more than 50 feet in depth throughout. Loch Lomond, which is not only the largest of the Trossachs lakes — in fact, it is the largest lake in Scotland — but is also esteemed the most beautiful, is divided into three distinct basins, separated by two sublacustrine barriers — one, at Bowardennan, coming to within 6 feet of the surface, and the other, at the island of Eilean Vow, not far from the head of the loch, only 48 feet below the surface. The greatest depth occurs in the middle basin between Tarbet and Inversnaid, namely, 630 feet. The lake is, however, widest at its southern*~~

~~*end, where its charm is greatly enhanced by about thirty green islets, the whole framed in a setting of soft green hills, which, in Smollett's words (Humphrey Clinker), " display a sweet variety of woodland, cornfield, and*~~

~~pasture . . . while the prospect terminates in huge mountains covered with heath." At its northern end the lake narrows to a mile and even less in width, and the enclosing hills not only wear a barer aspect, but draw together closer about the loch. About midway up, the chain of hills which fence in the lake on the east reach their culminating point in Ben Lomond (3192 feet). This, together with its sister hills on the north and south, forms the watershed of the middle belt of Scotland; on the east the Forth and its affluent, the- Teith (which flows out of Loch Katrine and through Lochs Achray and Vennachar), convey the drainage to the North Sea, and on the west the Leven carries the surplus water of Loch Lomond into the Clyde, and so into the Atlantic. Nearly opposite Ben Lomond, on the west side of the lake, a low narrow neck of land between Arrochar and Tarbet is all that separates Loch Lomond from the sea-fjord of Loch Long, and a subsidence of less than 40 feet would convert the former into what it no doubt was in pre- historic times, namely, an actual arm of the sea. Loch Lomond is well stocked with fish — sea-trout, lake-trout, pike, perch, and occasionally salmon, and formerly it also yielded flounders, eels, and the fresh-water herring (powan). There are also numbers of trout in Lochs Katrine, Vennachar, Lubnaig, and most of the smaller lakes, besides salmon, char, perch, and pike. The annual rainfall throughout the Trossachs region ranges from 53-7 inches on the west face (1800 feet) of Ben Ledi to 115-1 inches at Ardlui (50 feet) at the head of Loch Lomond. This matter has acquired special importance since 1855, and in an even much greater measure since 1884, owing to the city of Glasgow's schemes for drawing its water-supply from Loch Katrine. In consequence of the execution of these schemes the level of Loch Katrine has been raised 4 feet above its normal summer level, and may be raised yet another 5 feet; while the level of Loch Vennachar may be raised 5| feet and Loch Drunkie as much as 25 feet. Further authorization has been obtained to tap Loch Arklet, and convert it into a larger gathering basin by raising its level 25 feet ; and in case still greater sup- plies shall be necessary, it would probably be found feasible to draw upon Lochs Voil and Doine, which lie 50 feet above Loch Katrine, and upon Loch Lubnaig, which lies 41 feet above the latter, the water being in both cases conducted by means of aqueducts bored through the intervening hills. (See further under Glas- gow.)~~

~~The Trossachs are approached by coach from Callan- der station on the Stirling-Oban branch of the Cale- donian railway, and by coach from Aberfoyle station on the North British railway, by steamer up Loch Lomond, and since 1894 by the West Highland rail- way, which runs along the west side of Loch Lomond from Tarbet. In summer steamers ply on Loch Ka- trine, communicating with the rail at Balloch (southern end) and with rail or coach at Ardlui (northern end), and calling at Luss, Balmaha, Bowardennan, Tarbet, and Inversnaid.~~

~~Authorities. — Sir John Murray and F. P. Pullar. "A Bathymetrical Survey of the Fresh-water Lakes of Scotland, " in Scot. Geog. Mag., 1900, pp. 193, &c. — Dorothy "Wordsworth. Tour in Scotland. Ed. Principal Shairp. Edinburgh, 1874. — Sir G. B. Airy. Topography of " The Lady of the Lake. " London, 1873. — Scott. Introduction to Bob Boy. — Alexander Smith. A Summer in Skye. Edinburgh, 1865. Nathaniel Hawthorne. Passages from the English Note-Books. — Mackay. Historical Memoirs of Bob Boy. 1881. — A. H. Millar. History of Bob Boy. 1883. (j. t. be.)~~

~~Trouville-sur-Mer, a town, arrondissement of Pont l'35v§que, department of Calvados, France, 24 miles in direct line north-east of Caen, with terminal station (Trouville-Deauville) on railways from Caen and Pont l'JSvSque. Besides trawl-fishing and the provisioning of ships, in which Deauville is also engaged, Trouville has boat-building, rope, and briquette worts. The port, shared with Deauville, comprises in addition to the com- mercial harbour and the fishing quay (2132 feet long) a half-tide dock 230 feet long with 750 feet of quayage, connected with the railway. A reservoir, excavated in the bed of the river above the floating basin, is connected with the latter by siphons. The London and South- western Railway Company have a daily steamboat service to Trouville in connexion with their Southampton and Havre boats. Passengers arriving from Havre by steamer in 1900 numbered 110,850, and the departures 110,977. The number of vessels entered, 1900, was 143 of 48,718 tons (from England, 129 of 42,717 tons), cleared, 139 of 49,947 tons (to~~

~~England, 134 of 46,480 tons). Including coasting, the total port traffic amounted to 133,228 tons. The fisheries employed in the same year 100 ships with 385 men. Population (1891), 5627 ; (1901), 6137. Deau- ville (1901), 2857.~~

~~Trowbridge, a market town in the Westbury par- liamentary division of Wiltshire, England, 8 miles south- east of Bath, on the Great Western railway. Modern erections include a town hall and a high school. Popu- lation (1891), 11,901 ; (1901), 11,526.~~

~~Troy, represented now by important ruins on and about the mound of Hissarlik, situated in the north-west angle of Asia Minor, about 3J miles both from the Dardanelles and from Yeni Koi, which lies on the Mgean coast north of Besika Bay. The famous academic dispute concerning the precise site, which began about A.D. 160 with Demetrius of Skepsis, and was still being main- tained in the ninth edition of this Encyclopaedia (s.v. Teoad), may now be regarded as settled. After the full demonstration, made in 1893, that remains of a fortress, contemporary with the great period of Mycenae, and larger than the earlier acropolis town, first identified by Schliemann with Ilios, exist on the mound of Hissarlik, no reasonable person has continued to doubt that this last site is the local habitation of the Homeric story. The rival ruins on the Bali Dagh have been shown to be those of a small hill fort which, with another on an opposite crag, commanded the tipper Mendere gorge. It is inconceivable that this fort should have been chosen by poets, generally familiar with the locality, as the scene of the great siege, while in the plain between it and the sea there had lain from time immemorial, and lay still in the Myceneean age, a much more important settlement with massive fortified citadel.~~

~~No site in the Troad can be brought into complete accordance with all the topographical data to be in- geniously derived from the text of Homer. Indeed, it would be little short of miraculous if consistent accuracy in every small detail of the locality were pre- served in poems composed and combined as were the cantos of the Iliad. The hot and cold springs that lay just without the gate of " Troy " (H. xxii. 147) are no more to be identified with Buiiarbashi, which wells out more than a mile from the~~

~~*Bali Dagh ruins, than with the choked conduits, opened by Schliemann in 1882, to the south of Hissarlik. But the broader facts of geog- raphy ought to be, nay are, recognizable in the modern plain of the Mendere. The old bed of that river is the Scamander, and its little tributary, the Dumbrek Su, is the Simois. In their fork lies Hissarlik or Troy. In sight of it are, on the one side, the peak of Samothrace*~~

~~*(xiii. 11-14) ; on the other, the mass of the Kaz Dagh Ida (viii. 52). Hissarlik lies in the plain (xx. 216) less than 4 miles both from the Hellespontine and the ^gean coasts, easily reached day by day by foes from the shore, and possible to be left and regained in a single night by a Trojan visiting the camp of the Greeks (vii, 381—421). It is far less reasonable to demand a closer correspondence between the poem and geographical facts than to be astonished that the actual correspondence is so close.*~~

~~*In summarizing what has been found to exist on the mound of Hissarlik, in the excavations undertaken there since 1870, it is not advisable to observe the order of the finding, since Schliemann's want of experience and method caused much confusion and error in the earlier revelations. No certainty as to the distinction of strata or their relative ages was possible till "Wilhelm Dorpfeld obtained entire control in 1891, after the original explorer's death. There are in all nine strata of ancient settlement.*~~

~~*(1) On the virgin soil of the hillock, forming the core of the mound, scanty remains appear of a small village of the late -Xgean Neolithic, period^ at the dawn of the Bronze Age. This includes what were originally supposed by Schliemann to be two successive primitive settlements. Thin walls of rough stones, bonded with mud, are preserved mainly in the west centre of the mound. No ground plan of a house is recoverable, and there is no sign of an outer fortress wall. In this stratum were found implements in obsidian and other stones, clay whorls, a little worked ivory, and much dark monochrome pottery, either of a rough grey surface or (in the finer examples) treated with resin, highly hand-polished, and showing simple geometric decoration, which was incised and often filled in with a white substance.*~~

~~*(2) Superposed on these remains, where they still exist, but comprehending a much larger area, lies a better-con6tructed and better-preserved settlement. This has been twice rebuilt, and it was enclosed by a massive fortress wall of rudely squared Cyclopean character, showing different restorations, and now destroyed except on the south side of the mound. Double gates at the south-east and south-west are well preserved. The most complete and most important structures within the citadel lie towards the north. These are two rectangular blocks lying north-west to south-east, side by side, of which the southern and larger shows a megaron and vesti- bule of the type familiar in ‘ ‘ Mycenaean ‘ ‘ palaces, while the smaller seems a pendant to the larger, like the “women’s quarters” at Tiryns and Phylakopi (see Mycenjean Civilization). Other blocks, whose plans are difficult to bring into inter-relation in their present state of ruin, are scattered over the area, but mainly in the south-west. This is the fortress proclaimed by Schliemann in 1873 to be the Pergamos of Troy. But we now know that, while his identifications of Homeric topographical details in these ruins were fanciful, a much larger fortress succeeded to this long before the period treated of in the Iliad. The settlement in the second stratum belongs in fact to a primitive stage of that iEgean civiliza- tion which preceded the Mycenaean ; and it is this latter that is recalled by the Homeric poems. The pottery of the second stratum at Hissarlik shows the first introduction of paint, and of the “slip” and some what fantastic forms parallel to those of the pre-Mycenaan style in the Cy clades. The beaked vases, known as schnabelkannen, are characteristic, and rude reproductions of human features are common in this ware, which seems all to be of native fabrication. Bronze had come into nse for implements, weapons, and utensils ; and gold and silver make up a hoarded treasure found in the calcined ruins of the fortification wall near one of the gates. But the forms are primitive and singular, and the workmanship is very rude, the pendants of the great diadems being cut out of very thin plate gold. Discs, bracelets, and pendants, showing advanced spiraliform ornament, found mainly in 1878, and then ascribed to this same stratum, belong undoubtedly to a higher one, the sixth or “Mycenaean.” Rough fiddle-6haped idofs, whorls, a little worked ivory, and some lead make up a find of whose early period comparison of objects found elsewhere leaves no*~~

~~sort of doubt. This treasure is now deposited in Berlin and in Constantinople, but the larger part in the former city.~~

~~(8, 4, 5) This primitive "Troy" suffered cataclysmal ruin (traces of conflagration are everywhere present), and Hissarlik ceased for a time to have any considerable population. Three small village settlements, not much more than farms, were successively erected on the site, and have left their traces superposed one on another, but they yielded no finds of importance.~~

~~(6) The mound, however, stood in too important a relation to the plain and the sea to remain desolate, and in due time it was covered again by a great fortress, while a city spread out below. The latter has never yet been explored, but is a principal object of Dr W. Dbrpfeld's future plans. The remains of this stratum on the acropolis, however, have now been examined. A portion of~~

~~them was first distinguished clearly by Dbrpfeld in 1882, but owing to the confusion caused by Schliemann's drastic methods of trench- ing, the pottery and metal objects, really belonging to this stratum, had come to be confused with those of lower strata ; and some grey monochrome ware, obviously of Anatolian make, was alone referred to the higher stratum. To this ware Schliemann gave the name "Lydian,". and the stratum was spoken of in his Troja (1884) as the "Lydian city."~~

~~In 1893, however, excavations were carried out on the south of the mound in the hitherto undisturbed ground outside the limits of the earlier fortress ; and here appeared a second curtain wall of massive ashlar masonry showing architectural features which characterize the "Mycenaean " fortification walls of Mycenae itself, and at Phylakopi in Melos. With this wall was associated not only the grey ware, but a mass of painted potsherds of unmistak- ably " Mycenaean " character ; and further search in the same stra- tum to west and east showed that such sherds always lay on its floor level. The inevitable inference is that here we have~~

~~*a city, con- temporary with the mass of the remains of Mycenae, which im- ported "Mycenaean" ware to supplement its own ruder products. The area of its citadel is larger than the citadel of the second stra- tum ; its buildings, of which a large megaron on the south-west and several houses on the east remain, are of much finer construction than those which lie lower. This was the most important city yet built on the mound of Hissarlik. It belonged to the " Mycenaean " Age, which precedes the composition of the Homeric poems, and is reflected by them. Therefore this is Homer's Troy.*~~

~~*Its remains, however, having been obliterated on the crown of Hissarlik, almost escaped recognition. When some centuries later a third important city, the Hellenistic Ilios, was built, all the ac- cumulation on the top of the mound was cut away and a terrace made. In this process the then uppermost strata of ruins wholly vanished, their stones being taken to build the new city. The My- cenaean town, however, which had been piled stage upon stage to the summit, descended on the south side a little down the face of the mound ; and the remains of its fortifications and houses at that point, lying below the level cut down to by the Hellenistic terrace-makers, were covered by the depositing of rubbish from the crown and again built over. Thus we find them now on the southern slope of the mound only, but have no difficulty in estimating their original extent. Many tombs and a large lower city of this era will doubtless be explored ere long.*~~

~~*(7) To " Mycenaean " Troy succeeded a small unfortified settle- ment, which maintained itself all through the Hellenic age till the Homeric enthusiasm of Alexander the Great called a city again into being on Hissarlik.*~~

~~*(8) The Hellenistic Hios, however, has left comparatively little trace, having been almost completely destroyed in 85 n.c. by Fim- bria. Portions of fortifications erected by Lysimachus are visible both on the acropolis (west face chiefly) and round the lower city in the plain. A small Doric temple belongs to the foundation of this city, and a larger one, probably dedicated to Athena, seems to be of the Pergamene Age. Of its metopes, representing Helios and a gigantomachia, important fragments have been*~~

~~*recovered. Coins of this city are not rare, showing Athena on both faces, and some inscriptions have been recovered proving that Hellenistic Ilios was an important municipality.*~~

~~*(9) Lastly, about the Christian era, arose a Graeco-Eoman city, to which belong the theatre on the south-east slope of the hill and the ornate gateway in the same quarter, as well as a large building on the south-west and extensive remains to north-east.*~~

~~*(p. g. h.)*~~

~~*Troy, a city of New York, U.S.A., capital of Rensse- laer county. It is on the Hudson river at the mouth of the Mohawk, and near Albany, in the eastern part of the state. It is regularly laid out, has a water-supply by the Holly system, is sewered, and is well paved with granite blocks, bricks, and asphalt. It has three railways — the Delaware and Hudson, the New York Central and Hudson River, and the Eitchburg (Boston and Maine), which, with the Erie canal and boats on the Hudson, give it a large traffic. In 1900 there were 662 manufacturing establishments, with a total capital of $23,531,622. They employed 21,564 hands, and their total output was valued at $28,209,259. The most important products were furnishing-goods, with a value of $8,685,676; foundry and machine-shop products, $1,777,543; malt liquors, $1,438,869; and shirts, $4,774,520. Troy is the largest shirt-manufacturing place in the United States. Rensselaer Polytechnic Institute, situated here, in 1898 had 15 professors, and*~~

~~*was attended by 138 students. In 1900 the assessed valuation of real and personal property was $49,147,550, the net debt was $1,506,056, and the rate of taxation was $19.71 per $1000. Population (1890), 60,956 ; (1900), 60,651, of whom 14,384 were foreign-born and 400 negroes. Of 17,038 males 21 years of age and over, 895 were illiterate (unable to write).*~~

~~*Troy, a city of Ohio, U.S.A., capital of Miami county, on the Miami river, the Miami and Erie canal, and at the intersection of the Cleveland, Cincinnati, Chicago, and St Louis, and the Cincinnati, Hamilton, and Dayton railways, in the western part of the state. Population (1890), 4494; (1900), 5881, of whom 234 were foreign- born and 391 negroes.*~~

~~*Troyes, chief town of the department of Aube, Erance, 104 miles east-south-east of Paris, on the railway from Paris to Mulhouse. Many of the old timbered houses have been destroyed, and of modern structures the principal is the Monument des Enfants d'Aube, erected in 1890 in commemoration of the war of 1870-71. The library, now containing 110,000 volumes, has been installed in a new building, and a school of hosiery has been added to the educational establishments of the town (1888). Popula- tion (1891), 47,551 ; (1901), 51,195.*~~

~~*Troyon, Constant (1810-1865), Erench painter, was born on the 28th of August 1810 at Sevres, near Paris, where his father was connected with the famous manufactory of china. Troyon was an animal painter of the first rank, and was closely associated with the artists who painted around Barbizon. The technical qualities of his methods of painting are most masterly ; his drawing is excellent, and his composition always interesting. It was only comparatively late in life that Troyon found his mdtier, but when he realized his power of painting animals he produced a fairly large number of good pictures in a few years. Troyon entered the ateliers very young as a decorator, and until he was twenty he laboured assiduously at the minute details of porcelain ornamenta- tion ; and this kind of work he mastered so thoroughly that it was many years before he overcame its limita- tions. By the time he reached twenty one he was travel ling the country as an artist, and painting landscapes so long as his finances lasted. Then when pressed for money he made friends with the first china manufacturer he met, and worked steadily at his old business of deco- rator until he had accumulated enough funds to permit him to start again on his wanderings.*~~

~~*Troyon was a favourite with Roqueplan, an artist of distinction eight years his senior, and he became one of his pupils after having received certain tuition from a painter, now quite unknown, named Riocreux. Roqueplan introduced Troyon to Rousseau, (Jules Dupre, and the other Barbizon painters, and in his pictures between 1840 and 1847 he seemed to endeavour to follow in their footsteps. But as a landscapist Troyon would never have been recognized as a thorough master, although his work of the period i3 marked with much sincerity and met with a certain success. It may be pointed out, however, that in one or two pure landscapes of the end of his life he achieved qualities of the highest artistic kind ; but this was after lengthy experience as a cattle painter, by which his talents had -become thoroughly developed.*~~

~~*In 1846 Troyon went to the Netherlands, and at The Hague saw Paul Potter's famous " Young Bull." From the studies he made of this picture, of Cuyp's sunny landscapes, and Rembrandt's noble masterpieces he soon evolved a new method of painting, and it is only in works produced after*~~

~~this time that Troyon's true individuality is revealed. When he became conscious of his power as an animal painter he developed with rapidity and success, until his works became recognized as masterpieces in Great Britain and America, as well as in all countries of the Continent. Success, however, came too late, for Troyon never quite believed in it himself, and even when he could command the market of several countries he still grumbled loudly at the way the world treated him. Yet he was decorated with the Legion of Honour, and five times received medals at the Paris Salon, while Napoleon III. was one of his patrons ; and it is certain he was at least as financially successful as his Barbizon colleagues.~~

~~Troyon died, unmarried, at Paris on 21st February 1865, after a term of clouded intellect. All his famous pictures are of date between 1850 and 1864, his earlier work being of comparatively little value. His mother, who survived him, instituted the Troyon Prize for animal pictures at the iScole des Beaux Arts. Troyon's work is fairly well known to the public through a number of large engravings from his pictures.~~

~~In the Wallace Gallery in London are "Watering Cattle " and " Cattle in Stormy Weather " ; in the Glas- gow Corporation Gallery is a " Landscape with Cattle " ; the Louvre contains his famous "Oxen at Work" and " Eeturning to the Parm " (see Plate), while the Metro- politan Art Museum and other galleries in America con- tain fine examples of his pictures. His " Vallee de la Toucque, Normandy," is one of his greatest pictures ; and at Christie's sale-room in 1902 the single figure of a cow in a landscape of but moderate quality fetched £7350. Emile van Marcke (1827-1891) was his best- known pupil.~~

~~Authorities. — H. Dumesnil. Constant Troyon : Souvenirs Intimes. Paris, 1888. — A. Hustin. "Troyon," VArt. Paris, 1889, pp. 77 and 85. — Albert Wolfe. " Constant Troyon," La Capitate de VArt. Paris, 1886. — D.~~

~~*Croal Thomson. Tlie Barbizon School of Painters. London, 1890; " Constant Troyon, " The Art Journal. 1893, p. 22. (D. c. T.)*~~

~~*Trubau.*~~

~~*See Bohmisch-Tkubatj.*~~

~~*Trujillo, a town of Spain, province of Caceres, on a hill to the east of Caceres. The country around is rugged, but produces wheat, wine, oils, and fruit, besides live-stock of all sorts. Much phosphorite is found in the district, and the extraction of it has been resumed. Valuable forests are close to the town. In the oldest part of Trujillo are the remains of a Roman castle and the Julia tower, also Roman, like much of the fortifications. The streets are broad, and there are some fine squares. The principal parish church, Santa Maria, is a fine Gothic structure of the 15th century. Besides its Roman records, Trujillo was a town of importance in the Middle Ages. Pizarro, the conqueror of Peru, was born here. Population (1887),*~~

~~*10,773 ; (1897), 12,254.*~~

~~*Truro, episcopal city, municipal borough, and market town, in the Truro parliamentary division of Cornwall, England, at the confluence of the Allen and the Kenwyn, 11 miles north of Falmouth by rail on the Great Western railway. Truro cathedral (begun 1880, and designed by Mr Pearson) was opened in 1887. That part of it con- sisting of the old south aisle of the former parish church forms a small parochial church of itself, and by Act of Parliament of 1887 has all the legal rights of a parish church. A free library has been opened. There are tin- smelting works, several potteries, a boot factory, a biscuit factory, and works for jam-making and for the manufac- ture of shirts and clothing. Area, 1127 acres. Population*~~

~~*(1891), 11,131; (1901), 11,562.*~~

~~*Truro, the chief town of Colchester county, Nova Scotia, on the Salmon river, near the head of Cobequid Bay and 61 miles from Halifax by rail. It contains 10 churches, county and' school buildings, provincial normal*~~

~~*school, a factory for condensing milk, besides other fac- tories and mills. Victoria Park is noted -for its natural beauty. Population (1891), 5102 ; (1901), 5993.*~~

~~*Trust Companies. — Trust companies, as defined in this article, are confined almost exclusively to the United States, and are the growth of the last half of the 19th century. They mainly differ from banks of deposit and discount in the following particulars : — they are incorporated only under state laws; usually they must invest their capital in first-class securities, and also deposit large amounts in United States 'or city bonds with the respective state superintendents of banks ; they do not issue circulating notes ; they do not, as a rule, discount commercial paper, although they frequently buy such paper, often when representing large amounts due from corporations which have other business re- lations with them ; they pay interest on the deposits of customers, rarely more than 2 per cent., or perhaps a little more on moneys deposited for a stated period ; they make loans on real estate, usually for large amounts, although on a conservative basis such as 50 per cent, of the appraised value ; they act in fiduciary capacities, such as executors, trustees, receivers, committees, agents for corporations, fiscal agents for states, cities, or other municipalities, registrars or transfer agents for shares of capital stock, agents for the payment of coupons on the bonds issued by corporations, agents for the underwriting of new securities, depositaries of securities called for under plans of reorganization or held in escrow pending the transfer of ownership. Because of the more permanent character of their deposits, they are able to use such deposits for the general purposes enumerated above, many of which are foreign to the business of national and state banks. By reason of their special powers, the stable nature of their business, and their continued existence, trust companies have steadily grown in favour as executors or trustees of large estates. In Philadelphia, New York, and Boston this department had by 1900 assumed large proportions. In some parts of the United States, notably the Central West, the businesses of the trust company and the savings bank are combined by special charter, but as a rule, and especially in New York City, where the largest trust companies are situated, the trust company does not act as a savings bank. Some of the trust companies do not encourage the deposit of moneys subject to with-*~~

drawal on demand, preferring to restrict their deposit account to moneys held on an arrangement partaking of the nature of a trust, the latter sums being usually larger in amount, and not so liable to withdrawal as individual deposits. Because of the nature of the general business performed by trust companies, no portion of their deposits is required by law to be held as a cash reserve ; as a result the deposit accounts of the trust companies with the national and state banks are among the largest which those banks carry, it being customary for the latter to pay interest upon such balances. As a rule, trust companies exist only in the larger cities, and the profits accumulated by some of the companies, particu-larly those concerned with syndicate operations, are often very large. In recent years it has become customary to organize trust companies with a large paid-up surplus. This is often made equal to the total of the capital stock issued, the subscription price of the stock then being made twice the amount of its par value. On 2nd January 1900 the combined capital and surplus of the forty-two trust

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TRUSTEES

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*flsi^ft n^f i d°lng business in the city of New York was t IK i ' while their deposits on that date amounted to *485 711,429. Of the 614 loan and trust companies intne United States which gave more or less complete intonnation to the public authorities at the close of the £neri ■ i ' sported a paid-up capital of $203,587,935 ; 506 had surplus and undivided profits of $176,925,270 ;*

~~tot. ™ iLCash and due from banks the amount of ^1,774,508. The deposits of 504 of such loan and trust companies amounted to $1,156,784,312, while the loans, discounts, and securities on hand reported by 497 of such companies amounted to $1,145,353,387.~~

~~(t. r,. g.)~~

~~Trustees.— The chief modifications since 1887 of the English law of trust have been made by the Trustee Act, 1888, the Trustee Act, 1893, and the Judicial Trustee Act, 1896, and relate mainly to the position of trustees. It may be stated generally that the previous statute law concerning trustees was consolidated by the • Trustee Act, 1893. In the article in the ninth edition of the Encyclopedia Britannica it was stated in regard to investments that legislation had conferred on trustees a right to invest in certain securities. The Trustee Act, 1893, has consolidated the law on this point, and now provides, as it were, a code or charter of investment authorizing trustees, unless expressly forbidden by the (ir instrument (if any) creating the trust, to invest trust funds in various modes, of which the more important are as follows : — In any of the parliamentary stocks or public funds or Government securities of the United Kingdom ; on real or heritable securities in Great Britain or Ireland; in stock of the Bank of England or the Bank of Ireland ; in India 3£ per cent, stock and India 3 per cent, stock; in any securities, the interest of which is for the time being guaranteed by Parliament ; in consolidated stock created by the London County Council ; in the debenture or rent charge or guaranteed or preference stock of any railway company in Great Britain or Ireland incorporated by special Act of Parliament, and having during each of the ten years last past before the date of investment paid a dividend at the rate of not less than 3 per cent, on its ordinary stock ; in the debenture stock of any railway company in India, the interest on which is paid or guaranteed by the secretary of state in council of India ; in the " B " annuities of the Eastern Bengal, the East Indian, and the Sind, Punjab, and Delhi railways ; and also in deferred annuities — com- prised in the register of holders of annuity Class D, and annuities comprised in the register of annuitants Class C of the East Indian Railway Company ; in the stock of any railway company in India upon which a fixed or minimum dividend in sterling is paid or guaranteed by the secretary of state in council of~~

~~India, or upon the capital of which the interest is so guaranteed ; in the debenture or guaranteed or preference stock of any company in Great Britain or Ireland established for the supply of water for profit, and incorporated by special Act of Parliament or by royal charter, and having during each of the ten years last past before the date of investment paid a dividend of not less than £5 per cent, per annum on its ordinary stock ; in nominal or inscribed stock issued, or to be issued, by the corporation of any municipal borough having, accord- ing to the returns of the last census prior to the date of investment, a population exceeding 50,000, or by any county council under the authority of any Act of Parliament or Provisional Order; in any of the stocks, funds, or securities for the time being authorized for the investment of cash under the control or subject to the order of the High Court. Trustees may from time to time vary any such investments for others of an authorized nature. The I~~

~~statutory power to invest on real securities does not, of course, authorize the purchase of realty ; but by § 5 of the Trustee Act, 1893, a power to invest in real securities (in the absence of express provision to the contrary) authorizes investment on mortgage of leasehold property held for an unexpired term of not less than 200 years and not subject to a greater rent than one shilling a year, •or to any right of redemption or condition of re-entry except for non-payment of rent.~~

~~The Judicial Trustees Act, 1896, inaugurated a semi- official system of trusteeship which was new in England, but had been known in Scotland for upwards of 150 years. The general scope of the Act is indicated by § 1 (1), which runs as follows: — "Where application is made to the court by or on behalf of the person creating or intending to create a trust, or by or on behalf of a trustee or beneficiary, the court may, in its discretion, appoint a person (in this Act called a judicial trustee) to be a trustee of that trust, either jointly with any other person or as sole trustee, and if sufficient cause is shown, in place of all or any existing trustees." The Act and the rules made under it (the Judicial Trustees Rules, 1897) provide that judicial trustees shall be under the control and supervision of the court as officers thereof, and may be paid for their services out of the trust property. The trust accounts are to be audited annually, and a report thereon made to the court, which has power to order inquiries into~~

~~*transactions con- nected with the administration of the trust. A judicial trustee may be required to give security, and in any case has to keep the trust account with a bank approved by the court, and deposit title-deeds and other documents of title in such custody as the court directs. Communications between judicial trustees and the court with reference to their duties are permitted to be made with little or no formality, and strict proof of facts may be waived in proper cases. The Act may, in short, be described as an attempt to provide for an official check upon the administration of trusts, while avoiding the formality and expense incident to the procedure in an administration action.*~~

~~*The position of trustees in respect of what was fre- quently an undue personal responsibility for the adminis- tration of their trust has been much improved by § 8 of the Trustee Act, 1888 (not repealed by the Trustee Act, 1893), and § 3 of the Judicial Trustees Act, 1896. Sub-section (1) of the former enactment (with some omissions) runs as follows : — " In any action or other proceeding against a trustee or any person claiming through him, ex- cept where the claim is founded upon any fraud or fraudu- lent breach of trust to which the trustee was party or privy, or is to recover trust property, or the proceeds thereof still retained by the trustee, or previously received by the trustee and converted to his use, the following provisions shall apply — (a) All rights and privileges conferred by any statute of ' limitations shall be enjoyed in the like manner and to the like extent as if the trustee or person claiming through him had not been a trustee or person claiming through him. (b) If the action or other proceeding is brought to recover money or other property, and is one to which no existing statute of limitations applies, the trustee or person claiming through him shall be entitled to the benefit of, and be at liberty to plead the lapse of time as a bar to such action or other proceeding in the like manner and to the like extent as if the claim had been against him in an action of debt for money had and received." The statutory period of limitation which trustees are thus permitted to plead is the six years fixed as the period of limitation for actions of debt by the Limitation Act, 1623. It has been decided on the above section that in the case of a breach of trust consisting of an improper in- vestment of the trust funds, time begins to run in favour*~~

~~of the trustee from the date of the investment. Subsec- tion (3) of the Judicial Trustees Act, 1896, provides that " If it appears to the court that a trustee, whether ap- pointed under that Act or not, is or may be personally liable for any breach of trust, whether the transaction alleged to be a breach of trust occurred before or after the passing of that Act, but has acted honestly and reason- ably, and ought fairly to be excused for the breach of trust and for omitting to obtain the directions of the court in the matter in which he committed such breach, then the court may relieve the trustee either wholly or partly from personal liability for the same." Owing to the generally reduced rate of interest obtainable for money invested on trust securities, the court has in several in- stances, and even as against defaulting trustees, charged them with interest at 3 per cent, per annum (instead of 4 per cent., which was formerly the recognized rate) upon sums found due from them to the trust estate.~~

~~Under the old law trustees could not safely advance on mortgage more than two-thirds of the actual value of agricultural land or one-half of the value of houses. This " two-thirds rule " is now made statutory by § 8 of the Trustee Act, 1893, which enacts that " A trustee lending money on the security of any property on which he can lawfully lend shall not be chargeable with breach of trust by reason only of the proportion borne by the amount of the loan to the value of the property at the time when the loan was made, provided that it appears to the court that in making the loan the trustee was act- ing upon a report as to the value of the property made by a person whom he reasonably believed to be an able practical surveyor or valuer instructed and employed in- dependently of any owner of the property, whether such surveyor or valuer carried on business in the locality where the property is situate or elsewhere, and that the amount of the loan does not exceed two equal third parts of the value of the property as stated in the report, and that the loan was made under the advice of the surveyor or valuer expressed in the report." The same section protects trustees for not investigating the lessor's title when lending on the leasehold security, and for taking a shorter title than they~~

~~*might be otherwise entitled to on the purchase or mortgage of any property, if they act with prudence and caution. By § 9 (replacing § 5 of the Trustee Act, 1888), trustees who commit a breach of trust by lending more than the proper amount on any property are excused from making good any more than the excess of the actual loan over the sum which they might have properly lent in the first instance.*~~

~~*An inconvenience which formerly attached to dealings with trustees and trust property, in consequence partly of the rule " delegatus non potest delegare," and partly of the liability of persons dealing with trustees to see that money paid to them is properly applied, has been largely obviated by § 17 of the Trustee Act, 1893 (replacing § 2 of the Trustee Act, 1888), which in effect provides that a trustee may appoint a solicitor to be his agent to receive and give a discharge for any money or valuable consideration or property receivable by the trustee under the trust, by permitting the solicitor to have the custody of and to produce a deed having in the body thereof or endorsed thereon a receipt for the consideration money or other consideration, the deed being executed or the endorsed receipt being signed by the trustee ; and a trustee is not chargeable with breach of trust by reason only of his having made or concurred in making any such appointment ; and the pro- ducing of any such deed by the solicitor is a sufficient authority to the person liable to pay for his paying to the solicitor without the solicitor producing any separate or other direction or authority in that behalf from the trustee. The rule of equity by which a beneficiary who consented*~~

~~*to a breach of trust was liable to indemnify the trustees to the extent of his interest has now taken definite statutory shape in § 45 of the Trustee Act, 1893 (replacing § 6 of the Trustee Act, 1888), which enacts that when a trustee commits a breach of trust at the instigation or request, or with the consent in writing of a beneficiary, the High Court may, if it thinks fit, and notwithstanding that the beneficiary is a married woman entitled for her separate use and restrained from anticipation, make such order as to the court seems just for impounding all or any part of the interest of the beneficiary in the trust estate by way of indemnity to the trustee.*~~

~~*The Intestates' Estates Act, 1884, has altered the pre- vious law as to escheat, by which a trustee became entitled for his own benefit to real estate held upon trust for a cestui que trust who died intestate and without heirs, so that now equitable estates escheat in the same manner as legal estates. (e. m. bs.)*~~

~~*United States.*~~

~~*A trustee under American law is generally entitled to compen- sation for his services. Charitable trusts are becoming more frequent as the wealth of the United States increases, and aTe regarded with more favour by the courts. The cy pres doctrine has been either expressly or virtually applied to upboH them iD several of the states, and in some there has been legislation m the same direction. Spendthrift trusts, i.e., those under which the enjoyment of income bequeathed by will in such a way as to prevent creditors of the beneficiary from reaching it before it gets into his hands, are generally supported (Nichols v. Eaton, 91 United States Reports, 713).*~~

~~*A "voting trust" is a concerted transfer of their shares in a cor- poration by a majority of the shareholders to trustees to hold and vote on them for a specified period for the purpose of securing the adoption or continuance of a certain line of corporate action. Any shareholder may recede from such an arrangement and reclaim his stock. (s. E. B.)*~~

~~*Trusts. — The word "trusts," as used in this article, includes all those aggregations of capital engaged in productive industry that, by virtue of their industrial strength, have or are supposed to have some monopolistic power. Legal monopolies, as such, and natural monopolies are excluded, although it is frequently true that the trusts are aided by and sometimes control natural monopolies. Trusts are here considered to be identical with the so- called " capitalistic monopolies."*~~

~~*While it is probably true that trusts are a product of evolution, it is desirable to analyse and explain that conception in some detail if we are to understand their industrial significance. Competition, especially among industries managed on a great scale, often makes modern business unprofitable. Commercial men have been thus compelled in some way to*~~

modify former methods of doing business. So long as most industries were run on a small scale, the differences in the ability and the facilities of the various competitors were so great that only those at the lower end of the scale of excellence were forced out of the business — this to the general advantage of industrial society. The great mass of producers re- mained vigorously competing with one another, some making larger, others smaller profits, but all except a few at the lower margin making at least a living. Under modern business conditions competitors are often, re- latively speaking, few in number, of substantially equal ability, and controlling substantially equal facilities for managing the business economically. Consequently, in such circumstances, modern competition differs greatly from that form which was familiar to the earlier econo- mists. Among competitors of such great resources, the struggle may last long after the business has become unprofitable to all before any will fail. Among com- petitors so nearly equal in strength, the entire industry

may be very seriously injured by competition before enough are forced out to affect materially the severity of the competition.

The dictum of Stephenson, that " where combination is possible, competition is impossible," has a much wider application now than in the early days of railways. The modern facilities for the transportation of goods, for the rapid transmission of intelligence by fast mail, and espe- cially for the instantaneous exchange of information by the telegraph and telephone, have made it possible to manage easily a large business, however widely separated its dif- ferent plants or establishments may be. Half a century ago or thereabouts, on account of the lack of these facili- ties, management of such institutions would often have been impossible. Many of the advantages of combina- tions are entirely dependent upon these modern facilities, and on that account these facilities may be said to be an occasion, if not a eause, of the trusts.

If the product of an industry is of such a nature that its quality is substantially uniform and can be readily tested by purchasers, especially

*if the goods o7tr^iS are su°k *kat *hey are ordinarily sold in large industries, quantities, the competition between rival es- tablishments must almost of necessity be a competition in price. Sugar refining, oil refining, the dis- tilling of spirits, the manufacture of salt, are such indus- tries. The standard quality is readily tested, and the manufacturer who can offer the standard product at the lowest price effects a sale. Industries manufacturing comparatively inexpensive articles for the retail trade, put them up in packages which become well known to customers ; and those industries whose goods are sold under brands or trade-marks, or in some other form so that they are familiar to buyers, afford an example of competition of an entirely different kind. When the reputation of a certain brand of goods of this nature becomes established, consumers make no further efforts to test its quality, and the Tetail price often becomes a customary price. If a manufacturer of such goods finds his trade injured by a rival, his most effective means of competition will often be, not a lowering of the price, but an increase of the outlay on advertising. Soap, baking- powder, photographic cameras for general use, and of late years certain brands of coffee, patent medicines, and other goods of similar nature, are examples of this class. Those industries in which the competition becomes a matter of cutting of prices can by combination remove rivals from the field, and then put prices up to a re- munerative rate. Competitors in industries of the second class by combination can save many of the costs of selling, and thus without any increase in the price of the product may save enough of the cost to make the busi- ness profitable.*

Some of the advantages of combination over competi- tion which have led to the organization of trusts may be enumerated : —

(1) The cost of selling may be greatly lessened. As has been intimated, competition in the case of industries of the second class named above leads to very Savings expensive advertising in order to effect sales. An examination of the pages of any of the American magazines, with a thought as to the amount charged for the use of these advertising pages (from one hundred to as high as even four hundred dol- lars, or from £20 to £80, per page for a single insertion in some of the magazines with the largest circula- tion) will convince one of the cost of such competitive

~~*advertising. The expense involved in making attractive show windows in stores or shops, and in calling the attention of the public to popular wares by posters scattered about the country and by legends painted on*~~

~~*from com blnatlon.*~~

~~*rocks, on buildings along the lines of railways, &c, are other common examples.*~~

~~*(2) The salaries of commercial travellers, together with their hotel and travelling expenses, are of a similar nature. This competitive advertising in many cases does not increase to any noteworthy extent the consumption of the products in question, but merely attracts cus- tomers from one manufacturer to another. Combina- tion among establishments that do this costly advertis- ing saves a large part of the expense without lessening materially the quantity of goods sold.*~~

~~*(3) If different manufacturing establishments, scat- tered throughout the country, are brought under one management, it will be possible for orders for goods to be received at one central office, and then to be distributed to the federated establishments, so that goods can be despatched to customers in each case from the nearest establishment. In this way freight expenses may be very greatly lessened, cross freights over the same terri- tory being substantially eliminated. A single estab- lishment supplying all of its customers would often be compelled to deliver much longer distances at greatly increased expense.*~~

~~*(4) The entire profit of an establishment frequently depends upon the skill of the manager. When many different establishments are organized into one, it is possible to select the most skilful manager of all and to put him in charge of the combination, thus securing in many cases, if the trust includes practically all of the establishments in the entire industry, the ablest manager in the country for them all. It is of course true that as an establishment increases in size, or as a combination increases the number of its branches, especially if they are widely scattered, it becomes impossible for the manager to give his per- sonal supervision to the details of management of each institution. An executive officer of the highest skill, however, will so select his subordinates, so direct their work, and so*~~

~~*infuse into them his own spirit, that, under careful inspection, comparatively little will be lost from his inability to be present personally in each separate establishment. In the larger combinations frequent re- ports, often daily, are made from each concern, giving in detail the quantity of the output, the quality of the goods, the exact cost of the different processes of manu- facture ; so that it is possible to compare continually each of them with all of the others ; to detect the special weak- ness of each, and in this way to remedy any slight defects in any one establishment, and to bring all nearly up to the highest level of productive capacity.*~~

~~*(5) Each business manager is likely to have some special excellence in his methods of management. One will be particularly skilful in the technique of manufacturing ; another in the organization of the business ; a third in selling goods, and so on. By combining many establish- ments into one, it is possible so to distribute this mana- gerial skill that each superintendent will be given the department for which he is peculiarly fitted, and the whole establishment will thus get the benefit, not merely of the best executive ability at the head, but also of the best managing skill at the head of each separate depart- ment. In many cases it is probable that as much is saved in this way as is in any other.*~~

~~*(6) Besides this distribution of skill of the managers, it is sometimes equally beneficial to distribute the various products of the combination among the different plants. For example, in the manufacture of hoop and bar iron the products are turned out in great varieties of size, pro- bably from seventy -five to a hundred. Wholesale dealers in sending their orders to the mills are likely to call for from ten to fifty different kinds. If these orders go to an establishment which has but one large mill, it may*~~

~~*be necessary, in order to execute the order, to change the rolls in the mill several times, causing thus a waste of power, of time, and of energy. If several establishments are combined, each can be equipped for certain sizes. When, in these circumstances, a large order is received, to each*~~

~~*establishment will be sent that part of the order which it is especially equipped to fulfil, and thus, without any changes of rolls or stoppage of machinery, the separate sizes can be made. The same principle holds of course in nearly all lines of work, in some to a greater degree than in others ; but in the manufacture of hoop and bar iron a saving from this source amounting to from a dollar to a dollar and a half, or from 4s. to 6s., per ton is sometimes made.*~~

~~*(7) The advantage of unifying in one establishment the manufacture of products somewhat allied in nature appears also in selling goods. If customers can buy all of the various kinds of related goods in one establishment, much of their time and energy will be saved. Some of the larger combinations, therefore, in order to make this saving for their customers and thus to be sure of re- taining their orders, add to their plant facilities for making products which a smaller establishment could hardly manufacture. For example, the Distilling Com- pany of America, which controls probably 90 per cent, of the entire product of corn spirits, found it to its advantage to add to its plant several rye distilleries, and to purchase a number of the leading brands of whiskies for consumption as beverages, in order that they might supply the needs along different lines of prac- tically all dealers in spirits and whiskies, in this way saving for themselves many customers who otherwise might have been lost.*~~

~~*(8) The mere size of an establishment and its ability to supply at any time on short notice any order, however large, gives it also an advantage in retaining custom. A concern that controls only from 5 to 10 per cent, of the entire output of the country in any special line of goods might at times find it impossible to supply goods promptly. Large customers who might thus be embar- rassed are more ready to deal regularlyi with an estab- lishment controlling 75 to 90 per cent, of the output, if they can in this way be sure of having their orders attended to promptly. It is stated that the American Sugar Refining Company on this account is able to secure, with considerable regularity, one-sixteenth of a cent a pound more on its refined sugars than the inde- pendent refiners, the latter being frequently compelled to cut their prices to that extent in order to make sales.*~~

~~*(9) Owing to the fact that the introduction of goods into new markets, especially into foreign markets, is a matter of time, expenditure of energy, and of money, the large establishment with great capital has in this particular also a decided advantage. The Standard Oil Company, and American Tobacco Company, and other similar estab- lishments, have thus been able to open up new markets in Europe, in Japan, China, and other portions of the Far East more readily by far than individual producers along those lines could have done. This stimulus to the foreign trade acts also beneficially to the domestic trade, inasmuch as the exportation of part of the product tends to keep prices somewhat higher at home, and as the added demand for the raw material influences its price, thus creates a demand for labour along many lines.*~~

~~*(10) The combination also frequently saves for its stockholders considerable sums from its wiser dealing with credits, and this in a way also that is beneficial to the entire business community. When competition is very severe among different establishments, the managers, in order to increase their sales, will not infrequently grant credit somewhat unwisely. The combination controlling*~~

~~*a large part of the market is not so tempted, and more- over has the power to bring needed pressure to bear upon delinquent debtors more readily, so that losses from bad debts are much less frequent.*~~ •

~~*Besides the special savings which have been mentioned above that serve as reasons for the formation of combina- tions, certain special favours at times lead to their formation. favours to*~~

~~*(1) The protective tariff is most frequently combina- cited as such a favour. By the protection tlons' which a protective duty gives against foreign competi- tion, it doubtless often furnishes the occasion "for the formation of trusts. If a large amount of capital is tempted into the industry through the profits promised by the tariff, and therefore competition among the various establishments becomes fierce, it is much easier for them to form a combination with the certainty of good profits, provided the domestic competition can be overcome, if they are certain that foreign competition also is to be excluded. On the other hand, it would hardly be right to speak of the tariff as in this case the direct cause.*~~

~~*In other industries not protected by the tariff the same fierce competition leads to the formation of combina- tions. The tariff is simply an encouraging condition. The removal of the tariff would not destroy the combination unless it destroyed the industry at the same time ; but, on the other hand, the removal of a protective tariff might very easily prevent the abuses of exorbitant prices which might be exacted by a combination protected by the tariff.*~~

~~*(2) It is doubtless true that combinations have a good many times been encouraged by special discriminating rates of freight granted by the railways or other trans- portation agencies. There is, of course, a certain economic advantage to the railways in having goods despatched in large quantities by consigners who are able to supply their own cars, loading and unloading facilities, &c. Railways on that account often prefer to deal with large firms, and, other things being equal, are willing to give them some special rates. These concerns also are likely to have rather better credit than the smaller ones, so that dealing with them ensures prompt pay and cheaper collection of accounts. The competition among the different railways also for the freights which an important customer can furnish leads to cutting of the rates in their favour. These special rates, however, whether justified from the business point of view or not, are beyond any question from the social point of view often a very grave injury. A manufacturer who receives these special favours can build up a business substantially monopolistic in its ex- tent, whereas his rival of equal or even of greater ability, and equally skilful as a manufacturer, would be ruined if he did not receive like rates. The injustice of such discriminations and their evil effects on the community have been recognized by legislatures and courts in America, and they are practically universally forbidden. It nevertheless remains beyond question true that they are very frequently granted even at the present time.*~~

~~*In recent years in the United States there can be little question that the formation of the great combinations has been much encouraged by the opportunities, „ .,*~~

~~*, . , ill • r n i • ‘ Promotion.*~~

which promoters were able to seize, of making for themselves large profits. The movement towards com- bination was so fully recognized and the advantages in many cases so palpable, that a well-informed and skilful promoter was often able to persuade a large proportion of the manufacturers in some special industry to combine. In preparing the plan for such combination, the promoter has in many cases seen to it that he himself first bought the properties which he could very shortly turn over to the combination at high rates of profit ; or else he has

been able to persuade the new corporation to issue large amounts of stock, of which considerable proportions were given to him in return for his services. It has been true in many cases that these securities have been specula- tive in nature, but nevertheless the promoter has often reaped in this way large rewards. The possibility of this profit has doubtless stimulated his activity in urging the combinations.

Associated with the promoter in the organization of these combinations have usually been bankers or other financiers who stood ready, for an amount of ™/fe““der” stock or other promised profit sufficiently large to compensate them for their risk, to furnish to the combinations cash sufficient to start the business and to provide other needed capital. Usually the form of underwriting employed has been this : A promoter en- gaged in the formation of a combination and needing a certain fixed sum in cash, would make an arrange- ment with a bank to sell to it at a price agreed upon such portions of a named amount of stock as were not disposed of to other customers before a certain fixed date. Tor example, the bank might agree to furnish one million dollars in cash (£200,000) in return for say four millions of stock (£800,000), or to purchase itself at a fixed price all there mainder of the $4,000,000 stock unsold at the date agreed upon, the bank itself to become the sales agent. In those circumstances the bank would naturally use its best endeavours to sell the four millions of stock to other customers at the price agreed upon, say twenty-five dollars, or £5, per share. So far as it failed of disposing of the entire amount, it would take the remainder itself. For taking these risks,

~~*naturally the bank has almost invariably asked a very high commission, and not infrequently it has been asserted that the managers of the banks have been given a special bonus for themselves privately, in addition to the rates of profits granted the bank.*~~

~~*These large amounts of stock that are paid to the promoter and the financier for the purpose of bringing about the organization of a large trust, lead, of The basis course, to what is called over-capitalization. Ization. " What the proper basis of capitalization for a manufacturing industry should be, is a matter that cannot perhaps easily be determined by a definite principle which shall be applicable in every case. The laws that have been most strict on the subject attempt to limit the capitalization to the " actual cash value " of the business, by that being understood at times simply the cost of the plant itself with the running cash capital needed. On the other hand, most business men think that it is a wiser plan, and on the whole equally just, to capitalize a business on the basis of its earning capacity, regardless of what the plant may have cost. When, as has been frequently the case of late years, in addition to this cash value of the plant and the cash itself which may have been paid in, large sums of stock are issued also for properties which may be in themselves highly over- valued, and for the services of the promoter, the finan- cier, and others, we can see that the capitalization must be far above what may ordinarily be considered a paying basis. On the other hand, if the element of monopoly enters into the business to any noteworthy extent, the prices of the product may be kept so high that fair divi- dends may be paid even on this high capitalization. That the tendency towards increasing the capital has been very strong there can be no question. It is probable that in the near future the penalty that must be paid for this somewhat reckless financiering will have to be endured. As .soon as a slight depression in business comes, so that it is perfectly evident not merely that dividends cannot be paid on the common stock, but*~~

~~*that in all probability both the deferred stock and the? bonds, if any have been issued, will also have to go without interest, it will be necessary to reorganize many of these combinations and to start them anew on a much lower capitalization. According to a report of the United States Census Office, the actual value of the manufacturing capital employed by*~~

~~combinations which it investigated, June 1900, including2147 works, was $1 ,458,- 522,573. This huge sum equalled only 47-3 per cent, of the securities issued, though it exceeded the amount of bonds and preferred stock. The sum does not include the value of certain forest and mining lands held by some companies. When the person organizing the combination is himself an active business man, and has the intention of himself directing the affairs of the combination, another element besides that of personal profit very fre- The quently enters into the problem. Most strong maalgJr.' men like to take responsibility and to be domi- nant in affairs. When, owing to the advantages of com- bination that have been enumerated above, the prospect of a virtual monopoly seems certain, provided due skill in management is exercised, it is natural that the man- ager should wish to bring about the combination in order that he may himself have the satisfaction of being in substantially absolute control of the entire industry in a country, or possibly even in the world. The ambition thus to dominate in a great industry is akin to that of a statesman, and there can be little question that this pride of power and the desire to control the destinies of others has been a more or less conscious element in the forma- tion of many of the most successful and most skilfully managed combinations.~~

~~(1) The form of combination which has ordinarily been first adopted has been some kind of agreement with re- ference, to maintaining prices, or to paying wages,~~

~~or to dividing the territory for the distribution The forms of the product, or similar questions. Experi- „a~~

~~(2) In order to make the combination more permanent in its nature, the form of the trust, technically so called, was adopted. Under this form of combination, the stockholders of the various constituent companies of the trust place their stock in the hands of a small board of trustees, giving to these trustees an irrevocable power of attorney to vote the stock as they see fit, or in accordance with specific instructions given at the beginning. The title to the stock itself remains in the original holder, with the right to sell or pledge or dispose of it as he sees fit, but without the power of recalling his .right to vote. In return for this stock thus deposited with the~~

~~*trustees, the trustees have ordinarily issued trust certificates, which are in themselves negotiable, and take the place of the stock. Inasmuch as the holding of the voting power of the majority of the stock of each of the different constituent companies gave to the trustees absolute power of election of directors, and consequently the power of guiding harmoniously the affairs of all of the plant entering into the combination regardless of the will of the stockholders, the United States courts held that the corporations entering into such an agree- ment had gone beyond their powers, and that such a trust was illegal. Owing chiefly to these hostile decisions of the courts, this form of trust was aban- doned, and new forms, which still, however, leave the power of unified direction in the hands of a few men, were adopted.*~~

~~*(3) After the trusts were declared illegal, it was usual, when a combination was formed, to organize a new corporation which bought all of the properties of the*~~

~~*constituent members of the trust. These constituent companies then dissolved, and the one great corporation owning all of the properties remained.*~~

~~*(4) The form that of late seems to be much in favour approaches in its general nature more closely to that of the original trust. Under this form, a corporation is organized for the special purpose of buying and owning all, or a controlling share, of the stocks of each one of the constituent companies. The separate companies are then managed technically independently, the dividends of the separate corporations are all paid to the parent corpora- tion as the stockholder owning all of the stocks, and these dividends are the source of profits of the new corporation. The officers in this parent corporation, of course, vote the stocks of the separate companies, and thus absolutely control.*~~

~~*From the savings which it is possible for the combina- tions to make, it would seem possible for them to pay higher rates of wages to those*~~

~~*remaining in their T?5^L employment than it was possible for the con-*~~

~~*and wages. r J r . .*~~

~~*stituent companies to do. In certain instances, especially when the combination has first been made, wages have been increased. On the whole, however, it is probable that as yet the wage-earners have succeeded in getting an increase of wages in circumstances substan- tially similar to those under which their wages would be increased by single corporations. An increase of wages comes only through pressure on their part. Under a prosperous condition of industry it is possible, without materially lowering profits, to increase the wages.*~~

~~*Certain classes of employes, especially superintendents and commercial travellers, are less needed by the com- binations, and consequently the total sum of wages paid to these classes by the combination is less than that formerly paid by the constituent companies. On the other hand, the number of employes of these classes being less than before, the average wage has, in certain cases at least, been increased. Owing to the fact that competitive selling is in certain cases largely done away with, it has in some, perhaps in many, cases been possible for fewer travelling salesmen, of less skill and with lower wages, to do the work than before the combination, so that not merely has the total expense been lessened, but also the average salary paid to those retained in the business.*~~

~~*In case of disputes arising between the combination and the operatives, the position of the combination is stronger than that of an individual corporation. It is possible to close one or two works where troubles have arisen, and to transfer orders to the other works without any material injury to the business, provided the closing of the one or two establishments is not for too long a period. Such instances have occurred. On the other hand, labour organi- zations are also rapidly increasing in strength, and their leaders are of the opinion that within a comparatively short time they will be so thoroughly organized in all of the chief industries that a strike can be instituted and supported not merely in one or two establishments, but throughout the entire industry. Whenever this condition of affairs shall have been reached, the employe's will be substantially on an equality with their employers in such cases of conflict,*~~

~~*so that the advantage now resting with the combination will be largely removed. In certain industries this condition seems already to have been reached.*~~

~~*Prom the sources of savings that were enumerated*~~

~~*before, it is evident that it would be possible for a com-*~~

~~*bination either to increase the prices paid for*~~

~~*raw materials, or to lower the prices of its*~~

~~*finished products. Experience, however, seems to show*~~

~~*beyond question that whenever the combinations are*~~

~~*powerful enough to secure a monopolistic control, it has usually been the policy to increase the prices above those which obtained during the period of competition preceding the formation of the combination. Inasmuch, however, as an attempt to increase prices to any great extent, so as to secure very high profits, would certainly result in tempting new capital into the field, it has been the general experience that prices have either been increased only comparatively little after the combination was formed, or else that competition entering the field has comparatively soon forced a lowering of prices to substantially the former competitive rates. It should be noted, however, that in- asmuch as combinations have very frequently been formed only after a period of competition so fierce that practically all the competitors were running at a loss, it is hardly just to speak of a combination placing its prices above " competitive rates " unless one defines what is meant exactly by that expression. Whenever they have put their prices above the competitive rates existing just before the combination, it may mean that they have put their prices back to rates that will allow medium profits instead of losses, and not above rates that would be normal in the case of small competitors.*~~

~~*It will have been noted from what has been said that the excellences of the combination consist largely in the savings that have already been enumerated. The evils are: (1) The losses to investors %%£%£' through*~~

~~*the acts of the promoters and financiers at the time of the organization of the combinations, and through the speculation in the stocks which is at times carried on by the directors of the combinations themselves. (2) The losses to the wage-earners from the power that sometimes exists of forcing wages rather lower than it would be possible for a single corporation or manufacturer to do, and also from the discharge of certain classes of employes whose services are no longer needed, such as commercial travellers. It should be remarked of the latter case, however, that the injury is a personal one to those men that are discharged, but that it results in a saving to the community, and therefore presumably to the wage- earning class as a whole in the long run. (3) A further in- jury at times to the consumer arises, as has been suggested, from the increase in price. Other evils come through the power that is sometimes exercised by combinations in the corruption of legislatures ; in the control over industries of such a nature that it tends to destroy the spirit of individual activity and independence on the part of many persons who would otherwise enter business indepen- dently; and evils, also come through the increased force of any improper or dishonourable business practices, since this added force for evil is given to any combination by virtue of its greater influence in the community. It is not intended to convey the impression that managers of combinations are less moral than other business men, but merely that whenever they are dis- honourable in their practices the influence reaches more widely.*~~

~~*The chief remedies for these evils enumerated would seem to be more rigid laws with reference to the methods of incorporation and to the responsibility of directors to stockholders and to the public. This can perhaps best be brought about through greater publicity in both of these directions, probably under the inspection of Government officials. The other line of remedies would seem to be the removal of special favours granted to these combinations either by the Government or by railways or other bodies so situated that they can distribute favours to the larger combinations.*~~

~~*The movement towards consolidation of industries in the United States began to be noticeable soon after the Civil War (1861-65), but it had not reached noteworthy*~~

~~*coasolt datloa.*~~

~~*proportions, excepting in connexion with the railways, until within the last twenty years of the 19th century.*~~

~~*During the later years many consolidations Movement were made> the largest number during the years towards 1898-1900. From what has been said earlier,*~~

~~*it is evident that certain classes of industries,*~~

~~*especially those that require the investment of fixed capital to large amounts, are especially adapted for combination. Very little tendency towards consolida- tion is found in the farming industry, and, relatively speaking, little in industries that require the investment of but small capital. It is perhaps, however, not too much to say that in nearly all lines of industry which from their nature are adapted for consolidation combina- tions more or less firm have been made during the last few years. It is probable that as time passes we shall have many of these combinations reorganized, and that in many lines of industry there will be further consoli- dation of present combinations.*~~

~~*Experience has shown that when combinations are made in industries that from their nature do not seem well suited for consolidation, failure follows. In many individual instances corporation lawyers, who have had much practice in forming combinations, advise their clients in lines of business especially fitted for competition not to enter a combination, but to remain independent, assuring them that an individual is able to compete in such lines of industry with any combination, however large. Such advice of course would not be given were the industry one which was well adapted for consolidation. According to the United States census report of 1900, it seems a fair inference that not over one quarter of the value of the manufactured products of the United States is as yet produced by the combinations, powerful as they are in many lines.*~~

~~*Great Britain. — The tendency toward consolidation has been for several years very noticeable in Great Britain,*~~

~~*although until within the last few years the European form has been rather that of a pool or ring than*~~

~~*that of a trust or of a single large corporation.*~~

~~*In the coal and milling industries there have been agreements ; and, particularly in London and other distributing centres, these selling combinations have been able at times to control the market. This has also been true with reference to certain kinds of provisions, such as the bacon imported from Denmark.*~~

~~*Of late years there has been a marked tendency towards the formation of large corporations that buy up a very large proportion of competing manufacturing plant, and in this way secure at least a temporary mo-nopoly of the market. The Salt Union was formed along these lines, but this has not proved successful, owing probably to the fact that new sources of supply were discovered. The dyeing industries in Bradford and in Yorkshire have been consolidated, so that in certain respects they have an absolute monopoly of the business, and in most directions of over 90 per cent, of it. The calico printers, the fine cotton spinners, the thread manu- facturers, the bleachers, and others connected with the cotton manufacturing industries in Great Britain, have nearly all been brought together into large corporations which control from 90 per cent, upwards of the entire business. Similar combinations in cement, wall-paper, soap, and other trades have been formed. Most of these large corporations have been in existence for such a short time that one cannot yet judge accurately regarding their permanent success. Many of them seem to have been over-capitalized, and their dividends have not always met shareholders' anticipations. There has been no active popular movement against consolidation in England, and the Government has passed no laws*~~

~~*expert' ence.*~~

~~*opposed to it. Parliament, however, has passed strin- gent amendments to the Companies Acts, changes en- forcing publicity regarding the organization of all limited liability companies and their methods of management. The amended law is expected to prevent most of the abuses of the combinations.*~~

~~*Germany. — Germany seems to be peculiarly the home of combinations so far as Europe is concerned. In 1897 Liefmann, writing regarding combinations in Germany, was able to mention combinations which were inter- national in their scope in forty-one different branches of industry. Of combinations that were confined to Ger- many alone he mentioned 345, although many of them were in the same line of industry: for example, he found 80 combinations in different branches of the iron industry, 82 in the chemical industries, 38 in the textiles, and so on. Of that number he thought that definite information could be secured, but he was of the opinion that very many more of less importance existed, and had excluded from his reckoning all of those that were purely local, as for example those among the breweries in the different cities, as well as those among firms en- gaged merely in trade. The form of combination in Germany is ordinarily that merely of contracts among independent establishments regulating the amount of output for each, and in certain cases also the prices. As in Austria and in France, a central selling bureau for all the members of the combination is frequently found. The most successful combinations have been those among the coal-miners in western Germany, and the four or five in the leading branches of iron manufacture, also in western Germany. Lately two others of somewhat similar rank have been organized, one in the sugar in- dustry, which includes both refiners and producers, and one among the manufacturers of spirits. The former, following that among the Austrian sugar manufacturers, is somewhat peculiar in that the refiners guarantee to the producers of raw sugar a fixed price for their output so far as the sugar is intended for the home market, the' re- finers expecting to recoup themselves from the consumers through the monopolistic power which they possess. The law does not seem to be hostile to these combina- tions. Contracts that are immoral in their nature are, of course, non-enforceable. But the courts have, on the whole, not taken an attitude inimical to the larger com- binations, and the Government seems at times*~~

~~*to have been inclined to favour them. In one or two cases where the Government is itself a producer, as of soda, it is a member of a combination. Comparatively lately, one of the Prussian ministers in a speech in the Landtag ex- pressed himself favourably regarding the coal and iron combinations. The facts seem to show that the coal combination, at any rate, has used its power of fixing prices in a conservative way, and that during 1901 it has apparently held prices somewhat lower than they pro- bably would have been had free competition existed in that industry. So long as the combinations are managed thus conservatively, and so long as the Government is able to secure a careful supervision over them, it is not to be expected that there will be much hostility in Ger- many on the part of the Government.*~~

~~*France. — The number of combinations in France is probably much less than in Great Britain or Germany. In the Penal Code there has been a provision for many years against monopoly brought about by unfair means, and in one or two rather prominent instances there seem to have been convictions under this article. Conse- quently, the agreements that have been made, so far as they are intended to control prices, are usually kept secret. There have been, however, notably in the case of the iron industries, agreements made among the leading*~~

~~*manufacturers, under which the proportion of output assigned to each was fixed. A single selling bureau has also in such cases been established, which receives all orders, and fixes the prices for all of the different esta- blishments concerned. So far this form of organization, although in certain localities it seems to have secured monopolistic power, has not "been successfully attacked in the courts. For several years it has been supposed that a similar agreement existed among the sugar refiners. They themselves, however, acknowledge only an agreement regarding the amount of the output which shall be assigned to each, and deny any agreement as to prices. _ Of course an agreement regarding output would*~~

~~be likely to have a material effect upon prices. Somewhat similar combinations exist among the petroleum refiners, the porcelain makers, and some few others. The Government has taken no active steps in the matter, but popular opinion seems to be awakening somewhat.~~

~~Austria. — In Austria the development of combina- tions has been very marked. The most successful com- bination, on the whole, as well as one of the earliest, has been that of the iron industry. The sugar industry, how- ever, including both refiners and producers of the raw sugar, and the petroleum industry, are also combinations of great power. The form of these combinations is ordinarily that of an agreement regarding both output and prices. In some instances a central selling bureau fixes the prices, in others the market is divided, while in others still other forms of agreements of many kinds which serve to secure a monopoly are found. The move- ment has spread very rapidly indeed, until, in the opinion of many writers in Austria, practically all branches of industry, in which agreements for the lessening of com- petition will prove advantageous, are now largely con- trolled by combinations. The courts of Austria have, on the whole, within the last few years shown themselves hostile to the movement. Contracts for the division of the market, for the assignment of fixed proportions of the entire output to different establishments, the fixing of prices, &c, are declared void, and will not be enforced by the courts. This adverse action, however, does not seem to have affected very materially the tendency tow- ards combination, although it has perhaps tended some- what to encourage the formation of large corporations which should purchase all of the separate plant in any one industry. This tendency, again, is checked by the fact that the corporation law requires publicity in business, and that the taxes are heavier on corporations than on private firms, both as regards the legal rate and the certainty of collection. A Government commission has recommended recognition of the combinations by law and their careful supervision and regulation by govern- mental authority. (j. w. j.)~~

~~Tryon, Sir George (1832-1893), British ad- miral, a younger son of Thomas Tryon, of Bulwiok Park, Northamptonshire, was born on 4th January 1832. HIe entered the navy in 1848, on board Lord Dundonald's flagship on the North American station ; was afterwards in the Vengeance~~

~~with Lord Edward Russell in the Black Sea ; was landed for service with the naval brigade ; and was made a lieutenant in November, but dated back to 21st October 1854. From 1855 to 1858 he was in the Royal Albert, flagship of Sir Edmund Lyons ; and from 1858 to 1860 in the royal yacht, which gave him his pro- motion to commander on 25th October 1860. From 1861 to 1864 he was commander of the Warrior, the first British sea-going ironclad; from 1864 to 1866 he commanded the Surprise gun-vessel in the Mediterranean; and was promoted to be captain on 11th April 1866. In 1867 he was sent out as director of transports and store ships for~~

~~the Abyssinian expedition, a post which involved a great deal of hard work in a sweltering and unhealthy climate. He discharged his duties exceedingly well, but his health broke down, and he returned to England a helpless in- valid. From 1871 to 1873 he was private secretary to Mr Goschen, then First Lord of the Admiralty ; and from 1874 to 1877 commanded the Raleigh in India with the Prince of Wales, and afterwards in the Mediterranean. In the years 1878-81 he had command of the Monarch, one of the Mediterranean fleet under Sir Geoffrey Hornby and Sir Beauchamp Seymour, afterwards Lord Alcester. He was afterwards for two years secretary of the Ad- miralty; and for three years more, on his promotion in April 1884 to the rank of rear-admiral, commander-in- chief on the Australian station. On his return, in June 1887, he was made K.C.B. ; afterwards he was for three years superintendent of reserves, in which capacity it fell to him to command one of the opposing fleets during the summer manoeuvres, when he showed marked ability and originality of ideas. In 1889 he was promoted to be vice- admiral ; and in August 1891 was appointed to command the Mediterranean fleet, which under him — following the example of his old chief, Sir Geoffrey Hornby — became very distinctly an evolutionary and, in that sense, experi- mental squadron. Some of his methods were afterwards said to be dangerous ; but those which were most severely criticized do not appear to have had anything to do with the lamentable accident which ended Tryon's career. On the 22nd June 1893, the fleet being then off Tripoli on the coast of Syria, in two columns, Tryon made the signal to invert the course, the ships turning inwards in succes- sion. By a fatal error, the psychological cause of which has never been~~

~~*explained, he ignored the patent fact that the two columns were so near each other that the manoeuvre, as ordered, must entail the most serious risk, if not certainty, of collision. And in fact the two leading ships did come into collision, with the result that the Victoria, Tryon's flagship, was cut open and sank in a few minutes. Tryon and a lamentably large proportion of the men were drowned. A full Life of Tryon, by Bear-Admiral C. C. Penrose FitzGerald, has been published. He had married in 1869, and left issue. (j. k. l.)*~~

~~*Tsaidam. See Tibet.*~~

~~*Tsanpo. See Brahmaputra.*~~

~~*Tschaikovsky, Peter Iliitsch (1840-1893), Russian composer, born at Votkinsk, in the province of Vyatka, on the 7th May 1840, was the son of a mining engineer, who shortly after the boy's birth re- moved to St Petersburg to assume the duties of director of the Technological Institute there. While studying in the School of Jurisprudence, and later, while holding office in the Ministry of Justice, Tschaikovsky picked up a smattering of musical knowledge sufficient to qualify him as an adept amateur performer. Thus he became in demand in society. But the seriousness of his musical aspirations led him to join the classes held in connexion with the famous Musical Society, after which he entered the Conservatorium under Zaremba, and was induced by Anton Rubinstein, its principal, to take up music as a profession. He therefore resigned his post in the Ministry of Justice. On quitting the Conservatorium he was awarded a silver medal for his thesis, a cantata on Schiller's "Ode to Joy." In 1866 Tschaikovsky became practically the first chief of the recently founded Moscow Conservatorium, since Seroff, whom he succeeded, never took up his appointment. Although in Moscow Tschai-kovsky missed the life and bustle of St Petersburg, he met many artistic people whose services were useful. Thus Ostroffsky wrote for him his first opera libretto,*~~

~~*The Vojevoda. After the Russian Musical Society had rejected a concert overture written at Eubinstein's sug- gestion, Tscha'ikovsky in 1866 was much occupied on his Winter Day Dreams, a symphonic poem, which proved a failure in St Petersburg but a success at Moscow. In 1867 he made an unsuccessful debut as conductor. Failure still dogged his steps, for in January 1869 his Vojevoda disappeared off the boards after ten performances, and subsequently Tscha'ikovsky destroyed the score. The Romeo and Juliet overture has been much altered since its production by the Russian Musical Society in 1870, in which year the composer once more attempted un- successfully an operatic production, St Petersburg reject- ing his Undine. In 1871 Tscha'ikovsky was busy on his cantata for the opening of the Exhibition in celebra- tion of the bicentenary of Peter the Great, his opera The Oprischnik, and a text-book of harmony, which latter was adopted by the Moscow Conser- vatorium authorities. At Moscow in 1873 his in- cidental music to the Snow Queen failed, but some success came next year with the beautiful quartet in F. During these years Tschaikovsky was musical critic for two journals. On the death of Seroff he competed for the) best setting of Polousky's Wakula the Smith, and won the first two prizes. Yet on its production at St Petersburg in No- vember 1876 this work gained only a succes d'es- time. Since then it has been much revised, and is now known as Tlie Little Shoes. Meanwhile the Second Symphony and the Tempest fantasia had been heard, and the pianoforte concerto in B fiat minor completed. This was first*~~

~~*played by von Billow in Boston, U.S.A., some time later, and was entirely revised and republished in 1889. At last something like success came to Tschaikovsky with the production of The Oprischnik, in which he had incor- porated much of the best of Tlie Vojevoda. The Third — or Polish — Symphony, four sets of songs, the E flat quartet (dedicated to the memory of Lamb), the ballet The Swan Lake, and the Francesca da Rimini fantasia all belong to the period of the late 'seventies — the last being a rechauffe" of operatic remains. Opera still possessed Tscha'ikovsky, who in 1877 first conceived the germs of Eugen Onegin. With the production of this opera at the Moscow Con- servatorium in March 1879 real success first came to him. The story, by Pushkin, was a familiar one, and the music not so extravagant in its demands as in the earlier operas. Over part of this period of Tscha'ikovsky's life a mystery*~~

~~still hangs. M. Kashkin, his best friend, believes that even in 1877 the composer was engaged to be married. But no word on the subject ever passed between them, and the first intimation Kashkin received was his meeting with Tschaikovsky and his wife in the autumn of that year. Prom this time Tschaikovsky was~~

~~Peter Iliitscu Tschaikovsky. {From a photograph oy Jt&utlinger, Paris.)~~

~~a changed man. He became taciturn to moroseness, and finally he quitted Moscow and his friends for St Peters- burg. There he fell ill, and an attempt to commit suicide by standing chin-high in the river in a frost (whereby he hoped to catch his death from exposure) was only frus- trated by his brother's tender care. With his brother Tschaikovsky went to Clarens to recuperate. In 1878 he accepted (but later resigned) the post of director of the Russian musical department at the Paris Exhibi- tion, completed his Fourth Symphony and the Italian Capriccio, and worked hard at his " 1812 " overture, more songs, the second pianoforte concerto, and his interesting "Liturgy of St Chrysostom." This latter nearly came to an untimely end through the officialdom~~

~~which necessitated the im- primatur on all Greek Church music of the Court Chapel-Master, Bortnian- sky, who had been in his grave nearly half a cen- tury ! The year of rest following Tscha'ikovsky's domestic dibdcle gave him a taste for freedom. Con- sequently he returned only for a short time to Moscow. Thence he went to Paris. In 1879 he wrote his Maid of Orleans (produced in 1880) and his first suite for orches- tra. In 1881 Nicholas Rubinstein died — to whose memory Tschaikovsky dedicated one of his most beautiful and character- istic works, the trio in A minor. The following five years saw him fully occupied with travels, and working at Manfred and Hamlet, the operas Maz- eppa and Charodaika, the Mozartian suite, and the fine Fifth Symphony. Dur- ing a great part of the time he lived in retirement at Klin, where his gener- osity to the poor made him beloved. His operas The Queen of Spades and the one-act lolanthe were feeble by comparison with his earlier works, but the Sleeping Beauty and Casse-Noisette ballets are quite charming. In 1893 Tschaikovsky sketched his Sixth Symphony, now known as the Pathetic, a work that has done more for his fame in foreign lands than all~~

~~*the rest of his works. This symphony was at first thought to have aroused undue sympathy from an entirely fictitious autobiographical interest, and from its having been first conducted by the composer within ten days of his sudden death. Tschaikovsky died from cholera at St Petersburg, 6th November 1893, barely six months after Cambridge University had conferred on him in person the honorary degree of Doctor in Music.*~~

~~*Tschaikovsky's work is so unequal that it would be possible, by carefully chosen examples of his music, to prove him at once one of the immortals of music and a merely mediocre composer. In dramatic affairs he lacked point precisely as Anton Rubinstein lacked point. But in the matter of invention of broad, sweeping melody Tschaikovsky was far ahead of his compatriot, and as a composer of music saturated with what are popularly*~~

~~*understood to be national Russian characteristics was on a plane far above the other. Among his songs and smaller pianoforte works, as in his symphonies and quartets, are passages of exquisite beauty ; while, on the other hand, bizarrerie, and even downright uncouthness, are not always to seek. But the best of Tschaikovsky's work commands whole-hearted admiration. It is more dis- tinctly Russian and more beautiful than that of most of his compatriots ; it is not disguised German music, as is so much by Rubinstein and Glazounow, and it is not incoherently ferocious, like so much by Balakireff. Prob- ably time will place Tschaikovsky somewhere after Glinka and before his own contemporaries. (e. h. l.)*~~

~~*Tschudi. — The historical reputation of Giles Tschudi (1505-1572) has suffered very much owing to recent researches. HIs inventions as to the early history of the Swiss Confederation have been described under Tell. His statements and documents relating to Roman times and the early history of Glarus and his own family had long roused suspicion. Detailed examination of late years has proved beyond the shadow of a doubt that he not merely claimed to have copied Roman inscriptions that never existed, and amended others in a most arbitrary fashion, but that he deliberately forged a num- ber of documents with a view to pushing back*~~

~~*the origin of his family to the 10th century, thus also entirely misrepresenting the early history of Glarus, which is that of a democratic community, and not (as he pretended) that of a preserve of several aristocratic families. Tschudi's historical credit is thus hopelessly ruined, and no document printed or historical statement made by him can henceforward be accepted without careful verification and examination. These discoveries have a painful interest and importance, since down to the 19th century all Swiss historical writers had largely based their works on his investigations and manuscripts.*~~

~~*For a summary of these discoveries see Professor G. v. Wtss in the Jahrbuch of the Historical Society of Glarus, vol. xxx. (1895), in No. 1 , J.894, of the Anze iger f. Schweizerische Geschichte, and in his Geschichte d. Historiographie in d. Schweiz (1895), pp. 201-2. The original articles by Vogelin (Roman inscriptions) appeared in vols, xi., xiv., and xv. (1886-1890) of the Jahrbuch f. Schweizer Geschichte, and that by Schulte (Glarus) in vol. xviii. (1893) of the same periodical, Por a defence see a feeble pamphlet, Schulte u. Tschudi (Coire, 1898), by P. C. v. Planta. (y. a. B. c.)*~~

~~*Tseng Kuo-fan (1811-1872), Chinese statesman and general, was born in 1811 in the province of Hunan, where he took in succession the three degrees of Chinese scholarship. In 1843 he was appointed chief literary examiner in the province of Szechuen, and six years later was made junior vice-president of the Board of Rites. When holding the office of military examiner (1851) he was compelled by the death of his mother to retire to his native district for the regulation mourning. At this time the Taiping rebels were overrunning Hunan in their conquering career, and had possessed themselves of the cities and strongholds on both shores of the Yangtse- kiang. By a special decree Ts§ng was ordered to assist the governor of the province in raising a volunteer force, and on his own initiative he built a fleet of war junks, with which he attacked the rebels. In his first engagement he was defeated, but, happily for him, his lieutenants were more successful. They recovered the capital, Chang-sha, and destroyed the rebel fleet. Following up these victories of his subordinates, TsSng recaptured Wuchang and Hanyang, near Hankow, and was rewarded for his success by being appointed vice-president of the*~~

~~*Board of War. In 1853 other triumphs led to his being made a Baturu (a Manchu order for rewarding military prowess), and to his being decorated with a yellow riding-jacket. Meanwhile, in his*~~

~~*absence, the rebels retook Wuchang and burnt the protect- ing fleet. The tide quickly turned, however, and Te§ng succeeded in clearing the country round the Poyang lake, and subsequently in ridding the province of Kiangsu of the enemy. HIs father died in 1857, and after a brief mourning he was ordered to take supreme command in Chekiang, and to co-operate with the governor of Euh- kien in the defence of that province. Subsequently the rebels were driven westwards, and Tsgng would have started in pursuit had he not been called on to clear the province of Anhwe of rebel bands. In 1860 he was appointed viceroy of the two Kiang provinces and imperial war commissioner. At this time, and for some time previously, he had been fortunate in having the active support of Tso Tsung-t'ang, who at a later period recovered Kashgar for the emperor, and of Li HIung-Chang. Like all true leaders of men, he knew how to reward good service, and when occasion offered he appointed the former to the governorship of Chekiang and the latter to that of Kiangsu. In 1862 he was appointed assistant grand secretary of state. At this time the imperial forces, assisted by the " Ever-victorious Army," had checked the progress of the rebellion, and Tseng was able to carry out a scheme which he had long formulated of besieging Nanking, the rebel headquarters. While Gordon, with the help of Li HIung-Chang, was clearing the cities on the lower waters of Yangtse-kiang, Tseng drew closer his besieging lines around the doomed city. In July 1864 the city fell into his hands, and he was rewarded with the rank and title of marquis and the right to wear the double-eyed peacock's feather. After the suppression of the Taipings a rebellion, closely related to the former movement, broke out in Shantung, and Tsgng was sent to quell it. Success did not, how- ever, always attend him on this campaign, and by imperial order he was relieved of his command by Li HIung-Chang, who in the same way succeeded him in the viceroyalty of Chihli, where, after the massacre of Tient- sin (1870), Ts8ng failed to carry out the wishes of his imperial master. After this rebuff he retired to his viceroyalty at Nanking, where he died in 1872. Tseng was a voluminous writer. HIs papers addressed to the throne and his literary disquisitions are held in high esteem by the scholars in China,*~~

who treasure as a memorial of a great and uncorrupt statesman the edition of his collected works in 156 books, which was edited by Li Hung-Chang in 1876. (e. k. d.)

Tsetse Fly. — The tsetse fly (Glossina morsitans, Westwood) belongs to the dipterous family Muscidae. It is sometimes locally called " Tsaltsaya," although it is generally known to the natives as the tsetse or tzetze fly. This pest is met with throughout Central, South, and East Africa, on the Congo, and up the Niger on the west coast. It is the active agent in spreading one of the most virulent equine diseases of South Africa, the so-called tsetse disease or nagana. This disease, which is caused by minute protozoa of the genus Trypanosoma in the blood, affects the horse chiefly, but is also found in the ox, ass, goat, dog, and such wild animals as the koodoo deer. The germs of this disease are spread by the tsetse fly, which is a blood-sucker. On obtaining the blood of a horse or other animal suffering from this complaint the fly also obtains some of these protozoal parasites, which. even after two or three days' severance from their host retain their vitality. The germs which the tsetse fly has obtained are ejected into the next horse or ass which the insect attacks. At present it is not known if the fly acts in any way as an intermediate host, but it is generally assumed that it acts merely as a carrier of the haematozoa from beast to beast. In size the tsetse fly is about half

an inch long, that is, considerably larger than the com- mon house fly (Musca domestical. Its thorax is deep chestnut-brown, with four dark longitudinal lines, and with small bristles, which when denuded show small black specks ; the abdomen is bristly and dull yellowish- brown in colour, with black patches on the visible segments which are interrupted in the middle; the wings are of a smoky hue. The legs are buff-coloured with some yellowish markings. The proboscis is long, about twice the length of the head, and is in the form of a sharp piercing organ. When gorged with blood the female's abdomen swells to a great size and becomes reddish-brown beneath. Its favourite habitat seems to be the borders of marshes, river sides, places where ani- mals go to water, and in

~~*and around beds of reeds. It is very local, sometimes being confined to one side of a river in thousands, whilst on the opposite bank not one can be found. The so-called " fly-zones " make transport by horse almost impossible where the tsetse disease occurs. When on the wing Glossina morsitans makes a loud buzzing noise. When at rest the wings fold over one another. The female has been shown by Bruce to produce her young viviparously. The larva is yellow and nearly as large as the abdomen of the parent ; it is furnished with a black hood at one end and two hooks at the other, and consists of ten segments. After living a short free existence, it crawls into some hole or crevice, and in a few hours it has turned into a jet black puparium. The pupal stage lasts six weeks. The parent requires an enormous amount of blood for the nourishment of the young, hence she is always sucking blood from the various warm-blooded animals and man. The fly is found in districts in which tsetse disease does not occur, and when this is the case the bite alone, though annoy- ing, prodxices no further results than irritation; when piercing the skin the proboscis causes a sharp prick. According to Bruce, the reason why Glossina morsitans only carries the virus is that, being viviparous, the mother has to take constant nourishment for her develop- ing larvse. The bite has no effect upon man even when the fly has just left a diseased animal, except by causing irritation. When attacking a horse the fly usually settles on the legs, but also sticks on to the belly, inside the thighs, and under the tail. Their favourite feeding-time is sunset, but they also bite by moonlight. (f. v. t.)*~~

~~*Tsu-shima, signifying " the island of the port," an island belonging to Japan, situated about midway be- tween Korea and the island of Iki, so that the two islands were used as places of call in former times by vessels plying between Japan and Korea. It lies a little to the east of 129° E. and a little to the north of 34° K. It has a circumference of 454 miles, an area of 262 miles, and a population of 38,636. It is almost completely divided at the waist by a deep sound (Asaji-ura), and the southern section has two mountains, Yatachi-yama and Shira-dake, 2130 feet and 1680 feet high respectively, while the northern section has Ibeshi-yama and Mi-take, whose heights are 1128 feet and 1598 feet. The chief town is Izu-ga-hara. The Mongol armada visited the island in the 13th century and committed great depreda- tions. From Tsu-shima to Fusan, the principal Japan- ese*~~

~~*settlement in Korea, the distance is 65 miles, but the nearest point of the Korean coast is only 48 miles distant.*~~

~~*Tuam, an episcopal city in the county of Gal way, Ireland, on the Waterford, Limerick, and Western rail- way, 129 miles west of Dublin. A place of great antiq- uity, it has always had intimate ecclesiastical connexions. The Protestant archbishopric of Tuam was lowered to a bishopric in 1834, and the see joined to that of Killaloe.*~~

~~*It is, however, a Roman Catholic archbishopric. The Protestant cathedral is also the parish church, and was to a great extent rebuilt in the third quarter of the 19th century from plans by Sir Thomas Deane, at a cost of £16,000. Only the chancel of the old church remains, but its red sandstone arch is architecturally famous as a remarkably fine example of Norman work; it dates from the middle of the 12th century. The modern Eoman Catholic cathedral is perpendicular in style and cruciform in plan. The interior is elaborately decorated. The Cross of Tuam, re-erected in modem times, bears inscriptions in memory of Turlogh O'Conor, king of Ireland, and O'Hoisin, successively (1128) abbot of St Jarlath's Abbey, founded in the 6th century, and arch- bishop (1152) of Tuam. St Jarlath's College is a seminary for the education of priests. Population (1891), 3012 ;*~~

~~*(1901), 2890.*~~

~~*Tuamotu, an archipelago of coral formation in the South Pacific, between 14° and 24° S. and 135° and 150° W., officially part of the French dependency of Tahiti. The largest islands are Fakarava and Bavida ; the former is the administrative headquarters of the French resident. With three or four exceptions they are flat, and the vegetation which grows upon the arid lime- stone is scanty. The group is, however, planted with cocoa-nut, breadfruit, bananas, water-melons, yams, &c, which form the chief subsistence of the natives. The fine fisheries in the rocky and surf waters are a .source of revenue, the pearls being sold in Tahiti The best har- bour of the group is that of Fakarava, which, together with Mengarewa, is open to trade. The islands were first discovered by the Spaniard Pedro Fernandez Quiros in 1606. The area of tho entire group is about 330 square miles, and the population is about 7000, all of whom*~~

~~are natives, with the exception of a few French officials and other Europeans. The group passed under the protection of France in 1844, and was absorbed into the Bepublic in 1881.~~

~~Tuat, a Berber word signifying "oasis," sometimes applied generally to all the oases of the Algerian Sahara between 0° and 2\° E., 26° and 29° N., sometimes re stricted to z, particular group which borders the east side of the Wad Mzaud between 261° and 21\a N. According to the first-mentioned usage, it includes the oases of G-urara and Tidikelt with the important centre of Insalah. The district is comparatively fertile, being formed of recent alluvium extending along the base of the Tademait plateau (Cretaceous), and produces dates and some cereals and vegetables. It is peopled with a diversity of races, Arab, Berber, and negro being all represented, but the population is much less dense than formerly. The sepa- rate " ksur " or hamlets, of which the district is said to contain over 300, are in Tuat proper placed very closely together. The district is of importance as commanding the routes southwards to Timbuktu from both Morocco and Algeria, and it is thus a great centre of trade. Al- though formerly claimed by Morocco, the sovereignty of that kingdom has long been merely nominal, and the district was early in 1900 occupied by French troops as a step towards consolidating French influence over the routes to the south. Schemes have been set on foot for the extension of the Algerian railways to Tuat, the route most favoured being that vid Figig and Igli (occupied later in 1900), following the course of the Wad Susfana and Wad Saura. A step in this direction has already been taken by the continuation of the Western Algerian railway beyond Ain Sefra to Jenien-bu-Rezg (opened early in 1900). It has since been carried still farther.**

~~See works by Deportee, Algiers, 1890-91. — Flamakd, in La Geographie, May 1900 ; Annates de Gfeographie, 1900, pp. 233-242.~~

~~TUBERCULOSIS~~

~~Tuberculosis. — The word "tuberculosis," as now used, signifies invasion of the body by the tubercle bacillus, and is applied generally to all morbid~~

~~conditions set up by the presence of the active parasite. The name is derived from the " tubercles " or " little lumps " which are formed in tissues invaded by the bacillus ; these were observed and described long before their real nature or causation was known. (For an account of the organism, which was discovered by Koch in 1882, see Pathology : Parasitic Diseases). The bacillus attacks every organ and tissue of the body, but some much more frequently than others. The commonest seats of tubercular disease are the lungs, lymphatic glands, bones, serous membranes, mucous membranes, intestines, and liver. Before the discovery of the bacillus its effects in different parts of the body received separate names and were classified as distinct diseases. For instance, tuberculosis of the lung was called " consumption " or " phthisis," of the bones and lymphatic glands " struma " or " scrofula," of the skin " lupus," of the intestine " tabes mesenterica." Some of these names are still retained for convenience, but the diseases indicated by them are known to be really forms of tuberculosis. On the other hand, there are " tubercles " which are not caused by the tubercle bacillus, but by some other source of irritation, including various parasitic organisms, some of which closely resemble the tubercle bacillus. To these forms of disease, which are not as yet well understood, the term pseudo-tuberculosis has been given. Lastly, the word " tubercular " is still sometimes applied to mere lumpy eruptions of the skin, which have no connexion with tuberculosis or pseudo- tuberculosis.~~

~~Pathology. — The effects of tuberculosis on the struc- tures attacked vary greatly, but the characteristic feature of the disease is a breaking-down and destruction of tissue. Hence the word "phthisis," which means "wast- ing away" or "decay," and was used by Hippocrates, accurately describes the morbid process in tuberculosis generally, as well as the constitutional effect on the patient in consumption. According to the most recent views, the presence and multiplication of the bacilli excite by irritation the growth of epithelioid cells fr(om the normal fixed cells of the tissue affected, and so form the tubercle, which at first consists of a collection of these morbidly-grown cells. In a typical tubercle there is usually a very large or " giant " cell in the centre, surrounded by smaller epithelioid cells, and outside these again a zone of leucocytes. The bacilli are scattered among the cells. In the earliest stages the tubercle is~~

~~*microscopic, but as several of them are formed close together they become visible to the naked eye and con- stitute the condition known as miliary tubercle, from their supposed resemblance to millet seeds. In the next stage the cells forming the tubercle undergo the degenerative change known as " caseation," which merely means that they assume in the mass an appearance some- thing like cheese. In point of fact, they die. This degeneration is believed to be directly caused by a toxin produced by the bacilli. The further progress of the disease varies greatly, probably in accordance with the resisting power of the individual. In proportion as resistance is small and progress rapid the cheesy tubercles tend to soften and break down, forming abscesses that burst when superficial and leave ulcers, which in turn coalesce, causing extensive destruction of tissue. In proportion as progress is slow the breaking down and destructive process is replaced by one in which the formation of fibrous tissue is the chief feature. It may be regarded as Nature's method of defence and repair. In tuberculosis of the lungs, for instance, we have at one*~~

~~*end of the scale acute phthisis or "galloping consump- tion," in which a large part or even the whole of a lung is a mass of caseous tubercle, or is honeycombed with large ragged cavities formed by the rapid destruction of lung tissue. At the other end we have patches or knots of fibrous tissue wholly replacing the original tubercles or enclosing what remains of them. Such old encapsuled tubercles may undergo calcareous degeneration. Between these extremes come conditions which partake of the nature of both in all degrees, and exhibit a mixture of the de structive and the healing processes in the shape of cavities surrounded by fibrous tissue. Such intermediate conditions are far more common than either extreme ; they occur in ordinary chronic phthisis. The term "fibroid phthisis" is applied to cases in which the process is very chronic but extensive, so that considerable cavities are formed with much fibrous tissue, the contraction of which draws in and flattens the chest-wall. Tuberculosis commonly attacks one" organ or part more than another, but it may take the form of an acute general fever, resembling typhoid in its clinical features. " Acute miliary tuber- culosis " is a term generally used to indicate disseminated infection of some particular organ— usually the lungs or one of the serous membranes — in which the disease is so severe and rapid that the tubercles have not time to get beyond the*~~

~~*miliary stage before death occurs. Tuber- culosis is exceedingly apt to spread from its original seat and to invade other organs. The confusing multiplicity of terms used in connexion with this disease is due to its innumerable variations, and to attempts to classify diseases according to their symptoms or anatomical appearances. Now that the cause is known, and it has become clear that different forms of disease are caused by variations in extent, acuteness, and seat of attack, the whole subject has become greatly simplified, and many old terms might be dropped with advantage.*~~

~~*Tuberculosis in the Lower Animals. — Most creatures, including worms and fishes, are experimentally susceptible to tuberculosis, and some contract it spontaneously. It may be called a disease of civilization. Domesticated animals are more susceptible than wild ones, and the latter are more liable in captivity than in the natural state. Captive monkeys, for instance, commonly die^of it, and of birds the most susceptible are farmyard fowls. Of the domesticated animals, horses and sheep are least, and cattle most, affected ; pigs, dogs, and cats occupy an intermediate position. The percentage of tuberculous animals recorded at the slaughter-houses of Berlin in 1892-93 was as follows: Cows and oxen, 15-1 ; swine, l-55; calves, Oil ; sheep, 0*004. Similar records at Copenhagen in 1890-93 give the following result : Cows and oxen, 17-7; swine, 153 ; calves, 0-2 ; sheep, 0-0003. The order of the animals is the same, and it is confirmed by other slaughter-house statistics ; but the discrepancies between the figures indicate considerable variation in frequency, and only allow general conclusions to be drawn. A striking fact is the comparatively small amount of tubercle in calves. It shows, as Nocard has pointed out, that heredity cannot play an important part in the transmission of bovine tuberculosis. The in- frequency of the disease in sheep is attributed to the open-air life they lead, and no doubt that is an important factor. The more animals and persons are herded to- gether and breathe the same air in a confined and covered space, the more prevalent is tuberculosis among them. But there are evidently degrees of natural resistance also. Horses are more confined than cattleintheUnited Kingdom, yet they are far less affected ; and on the other hand, cattle running free in the purest air may take the infection from others. Professor McEachran of Montreal states that he has*~~

~~*seen tuberculosis prevalent in ranche cattle, few of which were ever under a roof, ranging on the foothills of the Rocky Mountains in Montana. In cows and monkeys the lungs are chiefly affected ; in horses and pigs the in- testine and abdominal organs. The relation between human and animal tuberculosis has not yet been determined. The bacillus in man very closely resembles that found in other mammalia, and they were considered identical or inter- changeable until Koch threw doubt upon this view at the British Congress on Tuberculosis in 1901. The bacillus in birds shows cultural differences, and is regarded as a distinct variety. Further reference will be made to this question, which has an important bearing on the spread and prevention of the disease.*~~

~~*Distribution and Mortality. — The distribution of tuber- culosis is world-wide, and seems to be unaffected by geographical situation. The experiments of Mr Swithin- bank, who exposed the bacilli to the temperature of liquid air (about 186° C. below zero) for forty two days, prove that their vitality is not destroyed by the most intense cold. It is not surprising, therefore, to find that the disease prevails in Greenland and Siberia. Bright sunlight, on the contrary, is said to render the bacilli inert in a few hours (Koch, Ransome). Nevertheless tubercu losis flourishes in the tropics, India, and Australia. The natural conditions which are least favourable to it are those which combine sunshine, abundant air-currents, dry soil, and a certain altitude. In the midlands and high- lands of Natal, for instance, Europeans and natives and cattle all enjoy nearly complete immunity (Allen). But in such localities, sparsely inhabited as a rule, both men and animals generally live an open-air life. Wherever they are aggregated together in dwellings tuberculosis is found among them. This appears to be a more important condition than climate, soil, or geographical situation. The comparative immunity of uncivilized races is ex- plained by their open-air life ; when brought to live under civilized conditions and in contact with white people they succumb far more readily than the latter. The coloured population of the United States, the Maoris, and South Sea Islanders illustrate this fact. Tuberculosis is most*~~

~~*rife in large centres of population in which the people live under the worst air conditions. In addition to its universal distribution, it is constantly active, unlike the more acute parasitic diseases, and has no periods of remission or quiescence ; consequently it is more destructive to life and health than any of them, more even than all of them put together. The annual mortality of the human race from this single cause is estimated at 5,000,000, or one-seventh of the whole (Hir'sch). In some countries (Russia) it is believed to be nearly one-fourth of the whole. The annual death-roll of tuberculosis is about 170,000 in Germany, 150,000 in France, 150,000 in the United States, and 60,000 in England, where it has been steadily diminishing since 1838. The exact figures for England and Wales during the ten years 1881-90 are 589,390 deaths out of 5,244,771, that is, one-ninth of the total number. Consumption accounts for more than four-fifths of this mortality, namely, 473,968, the remaining fifth — 115,422 deaths — being ascribed to other forms of tuberculosis. It is probable that in countries where less progress has been made in combating consumption, its preponderance over other tubercular diseases is still greater ; but full data are lacking. Attention has naturally been centred on consumption, on account of its excessive destructiveness, and a good deal of information has been collected with regard to its mortality in different countries and cities. The follow- ing table gives approximately the annual rates among European nations : —*~~

~~*Rates of Mortality from Consumption per 100,000 Living.*~~

~~*Russia (principal towns, 1890-92) . . . 399*~~

~~*Austria (1895-96) 362*~~

~~*Hungary (1893-95) 318*~~

~~*France (principal towns, 1894-97) . . . 302*~~

~~*Sweden (principal towns, 1894-97) . . . 231*~~

~~*Germany (1894-97) 224*~~

~~*Switzerland (1894-97) 203*~~

~~*Ireland (1894-97) 203*~~

~~*Denmark (principal towns, 1894-97) . . 191*~~

~~*Holland (1892-95) .... 188*~~

~~*Italy (1895-97) 187*~~

~~*Belgium (1890) 177*~~

~~*Norway (1891-95) 173*~~

~~*Scotland (1893-96) 173*~~

~~*England and Wales (1894-97) . . . .135*~~

~~*The excessive prevalence in Russia is explained by (1) low standard of living ; (2) overcrowding in unventilated and overheated rooms in winter ; (3) the use of furs, which harbour germs and are handed down from father to son. The two last factors operate also in other countries in central and northern Europe, but in a less degree.*~~

~~*Turning to the great cities, we find much higher rates prevailing. The following are towns of half a million inhabitants and upwards : —*~~

~~*Moscow (1889-92) . St Petersburg (1889-92) . Vienna (1894-97) . Budapest (1894-97) Paris (1894-97) Eio de Janeiro (1894-97) New York (1894-97) "Warsaw (1894-97) .*~~

~~*The favourable position occupied by Naples is ascribed to the fact that for a century the Italians, forestalling science, have regarded consumption as infectious, and have practised the isolation of patients suffering from advanced phthisis.*~~

~~*The following table of mortality rates from consumption in American cities in 1895-99 is taken from statistics prepared by the Prudential Insurance Company of America : —*~~

~~*Denver . San Francisco Albany, N.Y. Newark . New York Jersey City . Sacramento . Boston . Providence Cincinnati Philadelphia . Syracuse Camden . Indianapolis . St Louis .*~~

~~*These figures compare favourably with those for pro- vincial towns in Germany and France, as may be seen from the following rates for the year 1894 (Müinchener Medizinische Wochenschrift) : —*~~

~~*457*~~

~~*Berlin (1894-97) .*~~

~~*237*~~

~~*441*~~

~~*Glasgow (1894)*~~

~~*226*~~

~~*427*~~

~~*Hamburg (1894-97)*~~

~~*211*~~

~~*414*~~

~~*Manchester (1894) .*~~

~~*196*~~

~~*387*~~

~~*Amsterdam (1894-97) .*~~

~~*187*~~

~~*380*~~

~~*London (1894-97) .*~~

~~*177*~~

~~*252*~~

~~*Naples (1894-97) .*~~

~~*176*~~

~~*245*~~

~~*Buenos Aires (1894-97)*~~

~~*165*~~

~~*357*~~

~~*Dayton .*~~

~~*186*~~

~~*288*~~

~~*Hartford*~~

~~*176*~~

~~*266*~~

~~*Atlanta .*~~

~~*163*~~

~~*259*~~

~~*Fall River*~~

~~*161*~~

~~*246*~~

~~*Chicago .*~~

~~*154*~~

~~*241*~~

~~*Lynn, Mass. .*~~

~~*141*~~

~~*240*~~

~~*Buffalo .*~~

~~*129*~~

~~*237*~~

~~*Milwaukee*~~

~~*129*~~

~~*213*~~

~~*Spokane .*~~

~~*126*~~

~~*211*~~

~~*Reading, Pa. .*~~

~~*124*~~

~~*210*~~

~~*Minneapolis .*~~

~~*123*~~

~~*199*~~

~~*Pittsburg*~~

~~*116*~~

~~*193*~~

~~*Nashville*~~

~~*102*~~

~~*193*~~

~~*Salt Lake City*~~

~~*64*~~

~~*187*~~

~~*“Wiirzburg Havre . Rouen .*~~

~~*. 524 . 500 . 450*~~

~~*Lyons . Augsburg Rheims .*~~

~~*. 336 . 335 . 326*~~

~~*Nuremberg Breslau .*~~

~~*. 393 . 349*~~

~~*Munich . Nantes .*~~

~~*308 . 301*~~

~~*Nancy .*~~

~~. 337~~

~~Roubaix .~~

~~. 297~~

~~According to the registered mortality, tuberculosis has been decreasing in some countries for a number of years. This is the case with regard both to consumption and tuberculosis generally.~~

~~Death-rates from Tubercular Diseases per 100,000.~~

~~Year.~~

~~New York.~~

~~London.~~

~~Paris.~~

~~Berlin.~~

~~Vienna.~~

~~1884 1894~~

~~445 316~~

~~312 243~~

~~519 510~~

~~362 251~~

~~720 506~~

~~472~~

~~TUBERCULOSIS~~

~~*The records for England and Wales, which go back farther than any others, show a progressive diminution since 1838 ; but for strict comparison they are too imperfect in the early years of registration. Beginning with 1851-60, we find the death-rate from all tubercular diseases, which was 348 in that decade, had fallen gradually to 212 in 1891-95. Further details are given below. From the United States we have the following statistics (Hoffmann) : —*~~

~~*Death-rates from Consumption in Five Eastern States and Ten other Cities, with a Total Population of 14,301, 595 in- 1899.*~~

~~*1871*~~

~~*333*~~

~~*1886*~~

~~*:*~~

~~*281*~~

~~*1885*~~

~~*289*~~

~~*1900*~~

~~*212*~~

~~*Mean 307*~~

~~+~~

~~*Mean 232*~~

~~*In six large cities during the same period the death- rate among the white population fell gradually from 418 to 227, while among the coloured it fluctuated irregularly, but was always far higher, ranging from a maximum of 648 in 1885 to a minimum of 474 in 1899. In Saxony the*~~

~~*death-rate from tubercular diseases is said to have fallen since 1892 from 250 to 210, and in Baden from 300 to 260.*~~

~~*Age and Sex.— The most complete information under this heading is derived from the English records. " In both sexes," says Dr Tatham, " the real liability to phthisis begins somewhere between the fifteenth and the twentieth year. Among males it attains its maximum at age 45-55, when it reaches 3173 per million living. Among females it attains its maximum (2096) at age 35-45. In both sexes the rate rapidly declines after the attainment of its maximum. Practically the incidence of phthisis is upon the ages from 15 to 75 years, very old people and young children being comparatively exempt. According to recent experience, females seem to be rather less liable than males to death by phthisis at ages under 5 years, more liable at the age of 5-20, and again less liable at subsequent ages." These observations, it must be noted, refer only to consumption. The comparative immunity of the very young does not extend to all forms of tubercular disease. On the contrary, tuberculosis of the bowels, or tabes mesenterica, and tubercular meningitis are pre-eminently diseases of childhood. The following tables show in detail the relative incidence of consumption at different ages, and the steady diminution of the disease in England and "Wales since 1850 : —*~~

~~*England and Wales.*~~

~~*Tubercular Phthisis. — Mortality in several Periods, 1851-99. Annual Rate per Million Living.*~~

~~*Commenting on these tables, Dr Tatham remarks that, "with a few trifling exceptions, every age group in both sexes has experienced a decrease in the mortality ascribed to phthisis. In every case the mortality in 1895-99 was lower than it had been in 1851-60; but the rate of decrease has varied widely, and has been much greater among females than among males. The reduction indicated by the table may not be wholly real, and may be due in part to the vaguer statement of causes of death in the earlier period ; as, for instance, by the habitual use of the terms ' consumption ' and ' decline ' to describe any lingering disease of the lungs attended by ' wasting.' The figures must therefore be taken for what they are worth." The same qualification applies to all death-rates when an early period is*~~

~~*compared with a later one, and it should be always borne in mind ; but it is less likely to vitiate statistics which show an apparent decrease than those which show an apparent increase, as in the case of alco- holism or cancer, because in the earlier periods a large number of deaths were not classified at all. The greater diminution of consumption among females noted above is in agreement with experience in America. The figures given for a number of towns by Mr Hoffmann of the Prudential Insurance Company show that between 1871 and 1900 the death-rate fell from 361 to 274 among males, and from 369 to 183 among females.*~~

~~*Occupation has a marked influence on the prevalence of tuberculosis. The comparative mortality figures for various occupations compiled at the Registrar-General's Office (Supplement to 55th Annual Report) show very great differences. The following are the highest and the lowest among adult males in England and Wales : —*~~

~~*Adult Males in England and Wales.*~~

~~*Highest.*~~

~~*Lowest.*~~

~~*Tin miners*~~

~~*. 508*~~

~~*Coal miners (Derby, Notts)*~~

~~*69*~~

~~*Inn and hotel servants*~~

~~*. 476*~~

~~*Farmers .*~~

~~*79*~~

~~*Unoccupied males .*~~

~~. 448~~

~~Brick and tile makers~~

~~84~~

~~Costermongers .~~

~~. 443~~

~~Ironstone miners~~

~~90~~

~~File makers~~

~~. 402~~

~~Corn-millers~~

~~143~~

~~Cutlers .~~

~~. 382~~

~~Engravers . . . .~~

~~146~~

~~Lead miners~~

~~. 380~~

~~Lead “workers~~

~~148~~

~~Potters .~~

~~. 333~~

~~Blacksmiths~~

~~159~~

~~Copper miners .~~

~~. 331~~

~~Carpenters and shopkeepers~~

~~172~~

~~Printers .~~

~~. 326~~

~~Bakers . . . .~~

~~185~~

~~Bookbinders~~

~~. 325~~

~~Butchers . . . .~~

~~195~~

~~Period.~~

~~Ages.~~

~~All Ages.~~

~~Under~~

~~5~~

~~*Years.*~~

~~*5—*~~

~~*10—*~~

~~*16—*~~

~~*20—*~~

~~*25—*~~

~~*35—*~~

~~*45—*~~

~~*55—*~~

~~*65—*~~

~~*75-*~~

~~*1851-60*~~

~~*2579*~~

~~*1329*~~

~~*525*~~

~~*763*~~

~~*2399*~~

~~*4052*~~

~~*4031*~~

~~*4004*~~

~~3830~~

~~3331~~

~~2389~~

~~92S~~

~~1861–70~~

~~2467~~

~~990~~

~~4S1~~

~~605~~

~~2190~~

~~3833~~

~~4094~~

~~4166~~

~~3861~~

~~3297~~

~~2024~~

~~659~~

~~1871–80~~

~~2209~~

~~783~~

~~340~~

~~481~~

~~1675~~

~~3092~~

~~3699~~

~~4120~~

~~3860 ! 3195~~

~~1924~~

~~603~~

~~1881–85~~

~~1927~~

~~584~~

~~274~~

~~372~~

~~1381~~

~~2467~~

~~3246~~

~~3726~~

~~3567 2937~~

~~1800~~

~~645~~

~~1886–90~~

~~1781~~

~~621~~

~~234~~

~~318~~

~~1212~~

~~2222–2842~~

~~8436~~

~~3446~~

~~2904~~

~~1845~~

~~733~~

~~1891–95~~

~~1634~~

~~467~~

~~197~~

~~260~~

~~1075~~

~~2026–1–2548~~

~~*3268*~~

~~*3205*~~

~~*2686*~~

~~*1572*~~

~~*663*~~

~~*1896-99*~~

~~*1521*~~

~~*403*~~

~~*140*~~

~~*195*~~

~~*908*~~

~~*1841-2341*~~

~~*3110*~~

~~*3173*~~

~~*2627*~~

~~*1530*~~

~~*549*~~

~~*Period.*~~

~~*Ages.*~~

~~*All*~~

~~***Ages.***~~

~~***Under***~~

5

~~***Years.***~~

~~***5—***~~

~~***10—***~~

~~***15—***~~

~~20—~~

~~25—~~

~~35—~~

~~45—~~

~~55—~~

~~65—~~

~~75–716~~

~~1851–00~~

~~2774~~

~~1281~~

~~620~~

~~1293~~

~~8516~~

~~4288~~

~~4575~~

~~4178~~

~~3121~~

~~2383~~

~~1635~~

~~1861–70~~

~~2483~~

~~947~~

~~477~~

~~1045~~

~~3112~~

~~3967~~

~~4378~~

~~3900~~

~~2850~~

~~2066 l 1239~~

~~447~~

~~1871–80~~

~~2028~~

~~750~~

~~375~~

~~846~~

~~2397~~

~~3140~~

~~3543~~

~~3401~~

~~*2464*~~

~~*1777*~~

~~*1093*~~

~~*407*~~

~~*1881-85*~~

~~*1738*~~

~~*553*~~

~~*350*~~

~~*749*~~

~~*2006*~~

~~*2596*~~

~~*3070*~~

~~*2927*~~

~~*2197*~~

~~*1541*~~

~~*995*~~

~~*372*~~

~~*1886-90*~~

~~*1497*~~

~~*483*~~

~~*307*~~

~~*658*~~

~~*1626*~~

~~*2075*~~

~~*2552*~~

~~*2563*~~

~~*1936*~~

~~*1490*~~

~~*966*~~

~~*423*~~

~~*1891-95*~~

~~*1303*~~

~~*421*~~

~~*260*~~

~~*561*~~

~~*1428*~~

~~*1740*~~

~~*2155*~~

~~*2306*~~

~~*1742*~~

~~1294~~

~~800~~

~~350~~

~~1896-99~~

~~1141~~

~~334~~

~~201~~

~~410~~

~~1165~~

~~1547~~

~~1862~~

~~2096~~

~~1597~~

~~1242~~

~~787~~

~~366~~

~~The high incidence in the first group appears to be due to three causes : (1) Dust (file-makers, cutlers, potters, &c.) ; (2) exposure (costermongers and (?) miners) ; (3) alcoholism (inn-servants and unoccupied males). The two last classes have a high death-rate from alcoholism, as hatve coster- mongers ; but a general comparison of the occupa- tional mortality from consumption and alcoholism does not bear out the opinion expressed by Dr Brouardel at the London Congress in 1901 that there is a~~

~~*close connexion between them. This theory is contradicted by some of the conclusions to be drawn from the figures. Many industries show a low death-rate from alcoholism and a high one from consumption. Printers and cutlers, for instance, have a comparatively low alcoholic death-rate, butchers a very high one. The favourable position occupied by coal miners and ironstone miners is remarkable, and all the more so when contrasted with the ex- cessive mortality among miners of tin, lead, and copper. The English experience is broadly corro- borated by similar but much less complete statistics from the United States (Hoffmann), where miners (presumably coal miners) also enjoy the greatest immunity. These figures for the United States are shown in the following table : —*~~

~~*TUBERCULOSIS*~~

~~*473*~~

~~*United States.*~~

~~*Highest,*~~

~~*Lowest.*~~

~~*Stone workers*~~

~~*. 431*~~

~~*Miners*~~

~~*. 64*~~

~~*Printers .*~~

~~*394*~~

~~*Brakesmen*~~

~~*. 124*~~

~~*Glass workers*~~

~~380~~

~~Sailors~~

~~. 145~~

~~Brass workers~~

~~376~~

~~Merchants~~

~~. 172~~

~~Book-keepers~~

~~358~~

~~Blacksmiths~~

~~. 186~~

~~Plumbers.~~

~~353~~

~~Tailors~~

~~. 187~~

~~Salesmen .~~

~~346~~

~~Carpenter's~~

~~. 188~~

~~Hatters .~~

~~345~~

~~Butchers .~~

~~. 193~~

~~Silk workers~~

~~339~~

~~Masons .~~

~~. 198~~

~~Cigar makers~~

~~330~~

~~Iron and steel workers . 210~~

~~Potters .~~

~~287~~

~~Weavers .~~

~~. 214~~

~~The influence of dust is obvious in the first column. Dr Von Kbrosy has tabulated the result of seventeen years' observation in Budapest, which is an excessively tuberculous town. HIs figures include both males and females above fifteen years of age, and extend to 106,944 deaths. The field of observation is evidently very dif- ferent from those which furnished the statistics already given. HIs results are : (1) Males — printers 606, butlers 520, shoemakers 494, dyers 493, millers 492, joiners 485, tinkers and locksmiths 484, masons 467, labourers 433, tailors 418, bakers 398, drivers 370, servants 360, car- penters 339, officials 336, butchers 333, merchants 253, innkeepers 272, lawyers 205, physicians 118, capitalists 106 ; (2) Females — servants 353, day labourers (? char-~~

~~*women) 333, washerwomen 314, gardeners 269, capitalists 42. The inmates of lunatic asylums, who are classed among the " unoccupied," suffer excessively from tubercle. According to Dr Mott, pathologist to the London County Council, tubercular lesions are found in more than one-third of the bodies examined post mortem. The majority contract the disease in the asylums.*~~

~~*Heredity. — Medical opinion has undergone a great change with regard to the influence of heredity. The frequent occurrence of consumption among members of the same family used to be explained by assuming the existence of a tubercular " diathesis " or inherent liability to consumption which "ran in families " and was handed down from one generation to another. As the real nature of the disease was not understood, the inherited diathesis was regarded as a sort of latent or potential consumption which might develop at any time and could hardly be avoided. The children of consumptive parents had the "seeds" of the disease in them, and were thought to be doomed with more or less certainty. Great importance was therefore attached to heredity as a factor in the in- cidence of tuberculosis. The discovery that it is caused by a specific parasitic infection placed the ques- tion in a different light, and led to a more careful examination of the facts, which has re- sulted in a general and increasing tendency to minimize or deny the influence of heredity. At the Berlin Congress on Tuberculosis in 1899 Professor Virchow pronounced his disbelief in the theory on pathological grounds. "I dispute this heredity absolutely," he said. "For a course of years I have been pointing out that if we ex- amine the bodies of infants newly born, who have had no life apart from the mother, we find no tuberculosis in them. I am convinced that what looked like tuberculosis in the newly born was none of it tuber- culosis. In my opinion there is no authenticated case of tubercle having been found in a dissected newly born infant." Observations on animals similarly tend to dis prove the existence of congenital tuberculosis (Nocard). The theory that the germs may remain latent in the off- spring of tuberculous parents (Baumgarten) is unsupported by evidence. The occurrence of disease in such offspring is ascribed to infection by the parents, and this view is*~~

~~*confirmed by the fact that the incidence in consumptive families is greater on female children, who are more con- stantly exposed to home infection, than on the male (Squire). The statistical evidence, so far as it goes, points in the same direction. It is even denied that the children of consumptives are specially predisposed. An examina- tion of the family history of 1000 cases by Dr Squire showed that the incidence was only about 9 per cent, higher on the children of consumptive than on those of non-consumptive parents. In view of the chances of in- fection at home run by the former, this small difference does not support the theory that they are particularly susceptible. Dr Maxon King of New York goes farther, and believes that a family history of tuberculosis, instead of predisposing to the disease, tends rather to confer some degree of resistance. Out of 103 fatal cases, 76 were of non-tubercular, and only 27 of tubercular parentage ; and the average duration of the disease among the latter was 4‘01 yeafs, against 293 years among the former. The facts are interesting, but the numbers are not sufficient to warrant a decided conclusion. In the most recently published work on the subject {Diseases of the Organs of Respiration, by Samuel West, M.D., 1902), Dr West accepts "family predisposition" as an "essential factor in phthisis," but thinks that its influence is less im- portant than was formerly believed, and that only an "increased vulnerability of tissues" is transmitted. The whole question is still in a fluid state, and needs further elucidation. Perhaps the tendency to emphasize infection to the exclusion of other factors has been a little over- done, just as too much stress was formerly laid on the family inheritance of disease and death.*~~

~~*Density of Population and Overcrowding. — Recognition of the communicability of tuberculosis has directed atten- tion to the influence of conditions in which people live massed together in close proximity. The prevalence of the disease in large centres of population has already been noted, and the influence of aggregation is no doubt con- siderable; but it does not always hold good. The dis- tribution in England and Wales does not correspond with density of population, and some purely rural districts have a very high mortality. Broadly, however, the rural counties have a low mortality, and those containing large urban populations a high one. The following are the sevon highest and lowest counties ; London heads the list. The density of population is expressed by figures in six grades —*~~

~~*1 to 6 — according to the number of persons per square mile ; 6 represents the greatest density.*~~

~~*Death-rates from Consumption in English Counties, 1895-99.*~~

~~*Highest.*~~

~~*Lowest.*~~

~~*Counties.*~~

~~*Death- rate.*~~

~~*Density of Popula- tion.*~~

~~*Counties.*~~

~~*Death- rate.*~~

~~*Density of Popula- tion.*~~

~~*London .*~~

~~*Northumberland . North Wales Lancashire . Hampshire . South Wales Durham*~~

~~*176 166 156 151 145 143 136*~~

~~*6 2 1 6 3 2 5*~~

~~*Rutland*~~

~~*Westmorland*~~

~~*Monmouth .*~~

~~*Buckinghamshire*~~

~~*Worcestershire .*~~

Hereford

Wiltshire

74 85

• 94

96 98 98 99

1 1 3 2 4 1 1

Among those with the highest death-rates is one large and purely rural area — North Wales. The others all con- tain large towns. Among the lowest, Worcestershire, though a populous county, contains no large towns. The density of population, as measured by the number of persons to the square mile, is misleading, as a large area might consist of one or two large towns and the rest bare country, which is somewhat the case with Northumber- land. On the whole the distribution in England shows that the greatest incidence is on towns, but is not . at all

confined to them. When the " crude " death-rates are corrected by reference to the age distribution, it is found that the rural population has a higher rate during youth, a lower one in later life ; and that up to middle life con- sumption is not commoner in towns than in the country (Beevor).

A somewhat different conclusion is suggested by the following statistics of French towns prepared by Dr Lagneau. They go to show that the average incidence of tuberculosis is directly proportionate to the size of the communities.

Paris . .

~~*Eleven towns having over 100,000 inhabitants Forty -six towns having 30, 000 to 100,000 inhabitants Fifty towns having 20,000 to 30,000 inhabitants . One hundred and twenty — seven towns having*~~

~~*10,000 to 20,000 inhabitants .... Three hundred and thirty-two towns having 5000*~~

~~*to 10,000 inhabitants*~~

~~*Ninety-five towns having under 5000 inhabitants .*~~

~~*A more detailed investigation in London by the medical officer to the London County Council gave the following results : —*~~

~~*Phthisis, 1894-98.*~~

~~*Death-rate from*~~

~~*Tuberculosis.*~~

~~*490*~~

~~*363*~~

~~*305*~~

~~*288*~~

~~*271*~~

~~*216 181*~~

~~*Proportion of total population living more than two in a room (in tene-*~~

~~*Death-rates per 1000 living.*~~

~~*ments of less than Ave rooms).*~~

~~*1894.*~~

~~*1895.*~~

~~*1896.*~~

~~*1897.*~~

~~*1898.*~~

~~*Districts with under 10 per cent.*~~

~~*1-07*~~

~~*1-18*~~

~~*1-07*~~

~~*1-14*~~

~~*1-10*~~

~~*„ „ 10 to 15 „*~~

~~*1-38*~~

~~*1-49*~~

~~*1-46*~~

~~*1-42*~~

~~*1-43*~~

~~*„ „ 15 to 20 „*~~

~~*1-57*~~

~~*1-64*~~

~~*1-61*~~

~~*1-63*~~

~~*1-61*~~

~~*„ 20 to 25*~~

~~*1-81*~~

~~*1-83*~~

~~*1-67*~~

~~*1-75*~~

~~*1-80*~~

~~*„ „ 25 to 30 „*~~

~~*2-11*~~

~~*2-09*~~

~~*2-06*~~

~~*2-10*~~

~~*2-07*~~

~~*„ 30 to 35 „*~~

~~*2-26*~~

~~*2-42*~~

~~*2-13*~~

~~*2-32*~~

~~*2-42*~~

„ „ over 35 „

2-46

2-66

2-55

2-64

2-63

"There is therefore obviously relation between the amount of overcrowding and the phthisis death-rate. The figures do not, however, suffice to show whether the overcrowding caused phthisis ; or whether the disease by adding to family expenditure or by diminishing the wage-earning power left less money available for rent, and thus brought about the overcrowding ; or whether, again, overcrowding is associated with some other condition or conditions which are favourable to disease. In all probability all these circumstances have tended to pro- duce the results shown in the table" (Shirley Murphy). Comparing phthisis with other diseases in relation to overcrowding, the same authority found that " while associated with overcrowding is a tendency of the popu- lation to die from disease generally, this tendency is especially manifested in the case of phthisis, and is not manifested in the case of every disease."

Other Conditions. — Poverty, insufficient food, and in- sanitary dwellings are always more or less associated with overcrowding, and it is difficult to distinguish the relative influence of these factors. An analysis of 553 deaths in Edinburgh' according to rentals in 1899 gave these results: under £10, 230; from £10 to £20, 190; above £20, 106 (Littlejohn) ; but the corresponding popu- lation is not stated. An investigation of selected houses in Manchester gave some interesting results (Coates). The houses were divided into three classes : (1) infected and dirty ; (2) infected but clean ; (3) dirty but not in- fected ; infected meaning occupied by a tuberculous person. Dust was taken from all parts of the rooms and submitted to bacteriological tests. The conclusions may be summarized thus : The effects of overcrowding were not apparent ; a large cubic space

~~*was found to be of little avail if the ventilation was bad ; the beneficial effects of light and fresh air were markedly shown even*~~

~~*in the dirtiest houses ; ordinary cleanliness was found not sufficient to prevent accumulation of infectious material in rooms occupied by a consumptive ; no tuberculous dust was found in dirty houses in which there was no con- sumption. The upshot is to emphasize the importance of light and air, and to minimize that of mere dirt. This is quite in keeping with earlier investigations, and particularly those of Dr Tatham on back-to-back houses. Darkness and stuffiness are the friends of the tubercle bacillus. Another condition believed to be important is damp. A good deal of evidence has been collected on the sub- ject in Great Britain. Sir George Buchanan, formerly medical officer to the Local Government Board, ex- pressed the opinion that " wetness of soil is a cause of phthisis to the population living upon it. He based this conclusion on the comparative immunity enjoyed by persons living in pervious, high-lying, and sloping soils — that is, dry soils — contrasted with the opposite conditions, and on the fact that phthisis had been greatly reduced in towns where the water of the soil had been re- moved by drainage, and had not been reduced in towns where the soil had not been so dried. The English experience has been confirmed by observers in other countries, including Massachusetts (Bowditch), though some authorities in the United States deny that the connexion between a wet soil and consumption holds good in that country as a whole. It is not known in what manner wetness acts, whether by harbouring the bacillus or increasing susceptibility. An investigation into the relative prevalence of phthisis in Devonshire parishes, by Dr W. Gordon, showed a much greater incidence in jjiaces exposed to west and south-west winds {i.e., wet winds) than in sheltered ones.*~~

~~*The influence of tuberculosis on animals is at present the subject of controversy and investigation. Until recently the result of research in various countries had led' to a general consensus of opinion that tuberculous meat presents little danger, but that milk from tuber- culous cows may convey the disease, and is particularly dangerous to children. Administrative measures of great importance to agricultural and other commercial interests had been based on that opinion, which is still*~~

~~generally held. But at the British Congress in 1901 it was strongly attacked by Professor Koch, who in effect denied the connexion between human and animal tuberculosis. The weight attached to the utterances of this eminent authority has led to a revision of the question, which is now being made the subject of special experiments in Germany, Great Britain, the United States, and else- where. In the unsettled state of the scientific evidence, to discuss the arguments would be out of place here ; but it may be pointed out that primary tuberculosis of the intestinal tract, which at least throws suspicion on food, is by no means rare in Great Britain, and that no amount of negative evidence can dispose of recorded cases of accidental inoculation in human beings from bovine tuberculosis.~~

~~Prevention. — Measures for the prevention of tuber- culosis may be divided into two classes : (1) general ; (2) special. Great attention has been paid to the latter since the infectious nature of the disease was established. The former include all means by which the conditions of life are improved among the mass of the people. The most important of these are probably housing and food supply. The reduction of the disease recorded in England is attributed to the great changes which have gradually taken place in such conditions since, say, 1850. Wages have been raised, food cheapened, housing improved, pro- tection afforded in dangerous trades, air spaces provided, locomotion increased, the ground and the atmosphere~~

~~have been cleaned and dried by sanitary means. In addition to these general measures, foreign admirers have pointed to a special one, in which also England has taken the lead, namely, the provision of consumption hospitals, which act by segregating a certain amount of disease. Yet all these things, beneficial as they may be, do not wholly account for the reduction, for if the records can be trusted, it was in progress before they had made any way or had even been begun. This observation, coupled with the apparently general tendency to diminution among civilized races, suggests the operation of some larger agency. The theory of acquired resistance, which has been already mentioned, would~~

~~*explain the diminution ; and it is also in keeping with other facts, such as the great susceptibility of savage races, which have not been long exposed to tuberculosis, and the results of laboratory experiments in artificial immunity. The point is of great importance, and deserves careful attention ; for if the theory be correct, the special measures for preventing tuberculosis, which are occupying so much attention, may eventually have unexpected, results. Their general aim is the avoidance of infection, and they include (1) the pro- vision of special institutions — hospitals, sanatoria, and dispensaries ; (2) the prevention of spitting ; (3) the noti- fication of consumption ; (4) the administrative control of tuberculosis in animals ; (5) the dissemination of popular knowledge concerning the nature of the disease. (1) The sanatoria and other institutions are preventive measures, in that they involve the segregation of infected persons, but they may more properly be discussed under the head of treatment. (2) The greatest stress is laid upon the prevention of spitting, because the germs are contained in the sputum of consumptive persons, and are scattered broadcast by expectoration. The sputum quickly dries, and the bacilli are blown about with the dust. There is no question that infection is so conveyed. The Manchester scientific experiments, mentioned above, are only one series out of many which prove the infectivity of dust in the proximity of consumptive persons, and they are confirmed by actual experience. Several cases are recorded of healthy persons having contracted the disease after occupying rooms in which consumptive persons had previously lived. Inhalation is clearly the mode by which the poison most frequently gains entrance ; hence the overwhelming incidence upon the lungs. It is doubtful if the bacilli are carried directly into the lungs ; probably the actual seat of infection is more often the tissues of the throat at the junction of the air and food passages ; but they enter with the breath. Once in the mouth they may, in susceptible persons, attack the throat and the lungs, or, being swallowed, the intestinal organs. These considerations explain the importance attached to control of the sputum. It is a .legitimate inference that spitting in public is an important means of disseminating, tuberculosis, though it may be noticed that international prevalence by no means corre- sponds with this disgusting practice which is a perfect curse in Great Britain, and far more common both there and in the United States than on the continent of Europe. Prohibition of spitting under a statutory penalty is*~~

~~attended with certain difficulties, as it is obviously impos- sible to make any distinction between tuberculous and other persons ; but it has been applied in New York and elsewhere in America, and some local authorities in Great Britain have adopted bye-laws to check the practice. Another means of controlling dangerous sputa is more practicable, and probably more effective, namely, the use of pocket spittoons by consumptive persons. Convenient patterns are available, and their use should always be insisted on, both in public and in private. The most effective way of destroying the sputa is by burning. For this purpose spittoons of papier-mache and of turf have been successfully used in the Vienna hospitals (Schrotter). When glass spittoons are used the contents can be sterilized by disinfectants and passed down the drain. (3) Notification is of great service as an aid to practical measures of prevention. It has been applied to that purpose with good results in several cities and states in America, and in some towns in Great Britain. New York has made the most systematic use of it. Voluntary notification was adopted there in 1894, and in 1897 it was made compulsory. The measures linked with it are the sanitary supervision of infected houses, the education of the people, and the provision of hospitals. In England, Manchester has led the way. Voluntary notification was adopted there in 1899 : it was at first limited to public institutions, but in 1900 private practi- tioners were invited to notify their cases, and they heartily responded. The objects aimed at are to visit homes and instruct the household, to arrange and provide disinfec- tion, to obtain information bearing on the modes of infection, to secure bacteriological examination of sputum, and to collect information to serve as a basis of hospital provision. Disinfection is carried out by stripping off paper, previously soaked with a solution of chlorinated lime (l\ oz. to the gallon), and washing the bare walls, ceiling, floor, and everything washable, with the same solution. This is found effective even in very dirty houses. In clean ones, where the patients have not been in the habit of spitting about the rooms, it is sufficient to rub the walls with bread-crumb and wash the rest with soap and water. Clothing, bedding, &c, are dis- infected by steam. The advantages of these sanitary measures are obvious. Notification is no less important as a step towards the most advantageous use of hospitals and sanatoria by enabling a proper selection of patients to be made. It is~~

~~compulsory throughout Norway, and is .being adopted elsewhere, chiefly in 'the voluntary form. (4) As already explained, the question of animal tuber- culosis is still sub judice. Its importance from the point of view of prevention lies in the probability that abdominal tuberculosis, which is a very fatal form of the disease in young children, and has not diminished in prevalence like other forms, is caused by the ingestion of tuberculous milk. Whether it be so or not, it is obviously desirable that both meat and milk should not be tuberculous, if it can be prevented without undue interference with commercial interests. Preventive measures may be divided into two classes. They may deal merely with the sale of meat and milk, or they may aim at the suppression of bovine tuber- culosis altogether. The former is a comparatively easy matter, and may be summed up in the words "efficient inspection." The latter is probably impracticable. If practicable, it would be excessively costly, for in many herds one half the animals or even more are believed to be tuberculous, though not necessarily the sources of tuberculous food. Unless the danger is proved to be very much greater than there is any reason to suppose, " stamp- ing out " may be put aside. Efficient inspection involves the administrative control of slaughter-houses, cowsheds, and dairies. The powers and regulations under this head vary much in different countries ; but it would be useless to discuss them at length until the scientific question is settled, for if the reality of the danger remains doubtful, oppressive restrictions, such as the compulsory slaughter of tuberculous cows, will not have the support of public opinion. Whatever measures may be taken for the public protection, individuals can readily protect themselves from the most serious danger by boiling milk ; and unless the source is beyond suspicion, parents are recommended, in~~

~~the present state of knowledge, so to treat the milk given to young children. (5) A great deal has been done in most countries for the dissemination of popu- lar knowledge by forming societies, holding conferences and meetings, issuing cheap literature, and so forth. It is an important item in the general campaign against tuberculosis, because~~

~~*popular intelligence and support are the most powerful levers for setting all other forces in motion.*~~

~~*Treatment. — To discuss at all fully the treatment of the various forms of tuberculosis or even of consumption alone would be quite beyond the scope of this article. It must suffice to mention the more recent points. The open-air treatment of consumption has naturally attracted much attention. Neither the curability of this disease nor the advantages of fresh air are new things. Nature's method of spontaneous healing, explained above, has long been recognized and understood. There are, indeed, few diseases involving definite lesions which exhibit a more marked tendency to spontaneous arrest. Every case, except the most acute, bears signs of Nature's effort in this direction; and complete success is not at all un- common, even under the ordinary conditions of life. Perhaps it was not always so : the ominous character popularly attributed to consumption may once have been justified, and the power of resistance, as we see it now, may be the result of acquired immunity or of the gradual elimination of the susceptible. However this may be, the natural tendency to cure is undoubtedly much assisted by the modern system of treatment, which makes pure air its first consideration. The principle was known to Sydenham, who observed the benefit derived by con- sumptives from horse exercise in the open air ; and about 1830 George Boddington proposed the regular treatment of patients on the lines now generally recognized. The method has been most systematically developed in Ger- many by the provision of special sanatoria, where patients can virtually live in the open air. The example has been followed in other countries to a certain extent, and a good many of these establishments have been provided in Great Britain and elsewhere ; but they are, for the most part, of a private character for the reception of paying patients. Germany has extended these advantages to the working classes on a large scale. This has been accom- plished by the united efforts of friendly and philanthropic societies, local authorities, and the state ; but the most striking feature is the part played by the State insurance institutes, which are the outcome of the Acts of 1889 and 1899, providing for the compulsory insurance of workpeople against sickness and old age. The sanatoria have been erected as a matter of business, in order to keep insured members off the pension list, and they are supported*~~

~~*by the sick clubs affiliated to the institutes. They number forty five, and can give three months' treat ment to 20,000 patients in the year. The clinical and economic results are said to be very encouraging. In about 70 per cent, of the cases the disease has been so far arrested as to enable the patients to return to work.*~~

~~*The important features of the sanatorium treatment are life in the open air, independently of weather, in a healthy situation, rest, and abundance of food. The last has been carried to rather extravagant lengths in some in- stitutions, where the patients are stuffed with food whether they want it or not. The sanatorium movement on the German model is rapidly extending in all countries. It should, however, be remembered that the benefits of fresh air are not confined to sanatoria. If the super- stitious dread of the outer air, particularly at night, could be abolished in ordinary life, more would be done for public health than by the most costly devices for eluding microbes. Not only cousumption, but the other*~~

~~*respiratory diseases, which are equally destructive, are chiefly fomented by the universal practice of breathing vitiated air in stuffy and overheated rooms. The eases most suitable for the treatment are those in an early stage. Other special institutions for dealing with consumption are hospitals, in which England is far in advance of other countries, and dispensaries ; the latter find much favour in France and Belgium. Both have their uses. Hospitals are particularly valuable for the reception of advanced cases, unsuitable for sanatoria. Of specific remedies it must suffice to say that a great many substances have been tried, chiefly by injection and inhalation, and good results have been claimed for some of them, but none has met with general acceptance. The most not- able of them is Koch's tuberculin, a toxin prepared from tubercle bacilli. Three varieties have been tried. The first, announced in 1890, proved unsuccessful. The more recent preparations, known as T.O. and T.R., are said to have produced better results in consumption and lupus, but their efficacy has not been established. On the other hand, the value of tuberculin for diagnosing disease in cattle is generally recognized. Some serum preparations have also been tried, but without success. The only other specific methods of treatment that need mention are the application of light and of the Rontgen rays to lupus. Both have met with decided*~~

~~*success. The light treatment is the invention of Professor Einsen of Denmark, who employs 'the concentrated actinic rays from the sun, or a special electric lamp. The latter is very elaborate and expensive, but may be replaced by more simple forms of apparatus recently devised.*~~

~~*Authorities. — Transactions and Papers of the. Congress on Tuberculosis. Berlin, 1899 ; London, 1901. — Hillier. Tuber- culosis : its Nature, Prevention, and Treatment. — Hokton-Smith. "Tuberculosis," in Quain's Dictionary of Medicine (3rd edition). Report on the Prevention of Consumption. Public Health Com- mittee of Edinburgh. — Ransome. Milroy Lectures on Tuber- culosis. — Squire. Essays on Consumption. — Thorke-Thorne. The Administrative Control of Tuberculosis. — West. Diseases of the Organs of Respiration. London, 1902. (a. gL,)*~~

~~*Tubingen, a town of Wilrtemberg, Germany, on the Neckar, 45 miles by rail south by west of Stuttgart. It is the seat of the national university, which in 1900 was attended by 1544 students and had 104 professors, and the new buildings of which include the anatomical, surgical, physiological, and other medical institutes. There are also Protestant and Roman Catholic theological seminaries, chemical laboratories, a botanical garden, na- tural science collections, a numismatic collection, and a meteorological station. A monument to the poet Holderlin was erected in 1881. Population (1895), 13,976 ; (1900),*~~

~~*15,323.*~~

~~*T u b u a i . See Tahiti.*~~

~~*Tucson, a city of Arizona, U.S.A., capital of Pima county, on the Santa Cruz river, and on the southern overland line of the Southern Pacific railroad, in the southern part of the territory. It is regularly laid out on a level site, and has a good water-supply. It contains smelters for gold, silver, and copper ores. It is the seat of the University of Arizona, a non-sectarian institution, opened in 1891. In 1899 this had a faculty of 16 and was attended by 133 students, 60 of whom were women. Population (1890), 5150; (1900), 7531, of whom 2352 were foreign-born and 474 coloured, including 86 negroes.*~~

~~*Tucuman, a province in the west of the Argentine Republic, bounded on the N. by the province of Salta, on the W. and S. by that of Catamarca, on the E. by that of Santiago, 7S0 miles from Buenos Aires by rail, on the Rio Sail. It has a national college, normal school, public library, hospital, theatre, &c. Official area*~~

~~*at the census of 1895, 8926 square miles. Population (1869), 108,953 ; (1895), 215,742. It is divided into twenty-one departments. In 1895 there were 9973 farms and 80,172 acres planted in cereals.*~~

~~*Tucuman, a city of the Argentine Republic, and capital of the province of the same name, 780 miles from Buenos Aires by rail, on the right bank of the Eio Sail. It was founded in 1565 by Diego Villarroel. It has a national college, normal school, public library, hospital, theatres, &c, and is also the head of a provincial railway running to Medina. Population (1895), 34,305.*~~

~~*Tudela, a town of Spain, in the province of Navarre, on the Ebro, on the Saragossa-Alsasua railway, and terminus of the Tudela to Tarazona line. The industries include distilleries, saw-mills, fruit preserves, linen. Some of the public buildings, hospitals, schools, bull- ring, and town hall are modern. Population (1887),*~~

~~*9213 ; (1897), 8748.*~~

~~*Tuguegarao, capital of the province of Cagayan, in Northern Luzon, Philippine Islands. It is situated on the Cagayan river, about sixty miles from the mouth, and can be reached by large steam-launches or by stern-wheel steamers of light draught. Its climate is extremely good. The rich valley of the Cagayan river is the great tobacco- producing region of the Philippines, and Tuguegarao is important for its shipments of this article. Population,*~~

~~*16,000.*~~

~~Tula, a government of Central Eussia, lying to the south of Moscow. It has an area of 11,954 square miles, and its population in 1897 was 1,432,743 (domiciled only), of whom 754,820 were women, and 166,350 lived in towns. The great proportion of women to men, 111 to 100, merely shows that as the census was taken in the winter a considerable part of the male population had left the province in search of work, chiefly as carpenters in the Black Sea provinces. The government is divided into twelve districts, the chief towns of which are Tula, Bogoroditsk (11,210), Alexin (2268), Byeleff (9567), EpifafL (4176), Efremoff (9044), Kashira (4046), Krapivna (6797), Novosil (2919), Odoyeff (4443), Tchera (3612), and Venev (5219). Only 2‘6 per cent, of the aggregate area is considered as unavailable for culture, the remainder being distributed as follows : — peasants, 3,655,000 acres as allotments and 72,000 acres bought; nobility, 2,489,400 acres ; other private landowners, 842,000 acres ; Crown, towns, 161,300 acres. The forest covers about 675,000 acres. Agriculture is the chief occupation. There were in 1900 1,951,900 acres under crops, and the average yield in 1895-99 was: rye, 8;714,000 cwt. ; wheat, 145,000 cwt. ; oats, 6,163,000 cwt. ; and barley, 42,000 cwt.— all cereals, 15,720,000 cwt. Grain is ex- ported, but the crops are sometimes insufficient for the population, and years of famine have been experienced by parts of the province. The area under beetroot is increasing, but tobacco-culture is on the decline. The yield of potatoes in 1900 was 12,152,000 cwt. (chiefly for distilleries). Cattle-breeding is subsidiary only to agri- culture, there being in 1900 356,260 horses, 320,460 horned cattle, 966,500 sheep, and 142,650 pigs in the province. Small trades and domestic industries, which have always been flourishing, have not suffered from the development of manufacturing industries as carried on in factories, though this has been great ; on the contrary, several new domestic industries have been introduced. The aggregate annual return of the factories, which em- ploy 20,600 persons, now amounts to 24,500,000 roubles ; the principal establishments are machinery works, hard- ware factories, flour-mills, sugar works, and distilleries. Coal is extracted in seven mines (127,000 tons in 1899),~~

~~*as also pyrites and iron ore. Metallurgy is a growing industry. Education is on a better footing than in many other provinces of Central Eussia, there being in the villages one school for each 884 inhabitants ; the aggre- gate number of schools in 1899 was 1692, with 54,965 boys and 22,100 girls.*~~

~~*Tula, capital of the above province, on both banks of the Upa river, 120 miles by rail south of Moscow. It has become an industrial town of considerable importance, and its population has almost doubled since 1882, being 111,048 in 1897. It has a large imperial gun factory, a large sugar refinery, and a number of small factories and workshops for the manufacture of small-arms, bicycles, tea-urns, harmoniums, and all sorts of iron- mongery ; for these works more than 10,000 tons of iron, steel, and brass are imported every year. The factories employed in 1899 13,025 persons, and showed a yearly return of 10,295,000 roubles. The city is well provided, with schools, and carries on a considerable trade. A number of factories have been built around it, and a variety of domestic industries are carried on in the neighbouring villages.*~~

~~*Tulcea, chief town of the district of the same name, Eumania, picturesquely situated on the right bank of the Danube, 42 miles from its mouth, at Sulina, on the Black Sea. It is the seat of a court of first instance. The principal commerce is in fish and grain. The population, which is extremely mixed, is composed of Eumanians, Eussians, Turks, Greeks, and Jews, and ‘ numbered 18,800 in 1900. Wool is exported to France and Austria, and skins to Turkey.*~~

~~*Tulchin, a town of Eussia, government of Podolia, district of Bratslav, 8 miles from the Zhuravlevka station of the South-western railway. It must have been founded by the IIungarians, as is shown by the name of its suburb, Nesterwar, and suffered a great deal in the 16th and 17th centuries during the wars of the Cossacks with Poland. It was annexed to Eussia in 1793. It is a depot for grain and flour, and has several flour-mills, distilleries, tanneries, and military depots. Population (1897), 19,202.*~~

~~*Tulle, chief town of the department of Correze, Prance, and a bishop’s see, 60 miles east of Perigueux by the railway to Clermont-Perrand. In*~~

~~addition to the national small-arms factory, it has manufactories of per-fumery, leather, and breweries. Population (1901),~~

~~17,400.~~

~~Tunbridge, a town in the Tunbridge parliamentary division of Kent, England, 41 miles by rail south-east of London, with a station on the South-Eastern and Chatham railway. Since 1894 it has been controlled by an urban district council. On the banks of the Medway, upon which the town stands, there are gunpowder mills. Wool- stapling is a considerable trade. Population (1891),~~

~~10,117; (1901), 12,736.~~

~~Tunbridge Wells, a municipal borough (since 1889), fashionable watering place, and market-town of Kent, England, in the Tunbridge parliamentary division, on the South-Eastern and Chatham, and London, Brighton, and South Coast railways. The water of the celebrated chalybeate spring is of great purity. The chief in- dustry consists in the manufacture of the noted Tun- bridge ware — wood inlaid in mosaic — which is applied to numerous purposes. Amongst modern buildings are a new church (St Barnabas), erected 1890, the post office, 1897, and a drinking fountain and tower, in memory of Canon Hoare (died 1894), in 1897. Population (1881), 24,119; (1891, extended area), 29,254; (1901), 33,388.~~

~~Tungu, or Toungoo, a district in the Tenasserim division of Lower Burma; area, 6172 square miles. Population (1891), 211,784; (1901), 280,254. There were 1129 Tillages in the district in 1898-99, paying Es.4,69,142 revenue. The population was in 1891 made up of Buddhists and Jains, 164,694 ; aborigines, chiefly Karens, 14,681; Hindus, 3488; Mahommedans, 3081; Parsis, 11 ; and Christians, 25,829, the great majority of whom are Karens. The total acreage of the district is 3,950,080. Of this 195,749 acres were cultivated in 1898-99, and the remainder consisted of forests, 906,405 acres ; uncultivable land,~~

~~1,784,707 acres ; cultivable land, 1,062,882 acres; and current fallow, 337 acres. The rainfall in 1898-99 was 74-85 inches. There are eleven railway stations in the district. Rice is the chief cultiva- tion, but coffee cultivation has prospered sufficiently to supply the whole province with the berry. Tungu, the headquarters of the district, had a population of 19,232 in 1891. The detachment of British infantry stationed there before the annexation of Burma has been withdrawn, and its place is taken by a military police battalion.~~

~~Tunicata. — The article Tunicata in vol. xxiii. of this work was published in 1888, aud although far more investigations have been carried out and pub- lished on this group of animals since that time than in any previous similar period, still no epoch-making dis- coveries and no fundamental changes in our conclusions and ideas have been made. The statements in the former article still hold good, except in some quite minor details. It is not so much alterations and corrections as additions to our knowledge that we have now to record.~~

~~New Forms.— It is to the great national exploring expeditions that we owe the chief additions to our knowledge of new forms of Tunicata, and of the geographical distribution of the group ; but private collectors have also been active in many remote parts of~~

~~Fig. 1. — Octacnemua. A, Solitary form {after ITerdman) ; B, aggregated form (after Metcalf). a, anus ; At, atrial aperture ; br.s., branchial sao ; ff.8., gill silt ; m, mouth ; ce, oesophagus ; p.br., peribranchial cavity ; 8t, stolon,~~

~~the world. The third and last report upon the Tunicata of the Challenger expedition (1888) contained the description of a new Pyrosoma (P. spino'sum) of enormous size, over 4 feet in length ; of several new species of Doliolum and Salpa, and of the remark- able new family Octacnemidse (Fig. 1). Metcalf has since discov- ered a new species belonging to the genus Oetacnemus (O. patagoniensis), in which there is an aggregated or " chain " form, consisting of a small number of individuals (Fig. 1, B) united by a slender cord composed of test and body-wall. Oetacnemus has always been obtained from great depths (1050 to 2160 fathoms), and was described as an abyssal representative of the pelagic Salpidae, probably~~

fixed at the bottom. Metcalf, however, considers that the aggregated form described by him is more nearly allied to the Clavelinidse, and that therefore Oetacnemus does not belong to the Thaliacea. The reports on the German Plankton expedition have added considerably to our knowledge of the details of distribution, both horizontally and vertically, of the pelagic Tunicates and espe- cially of the Salpidse and Appendicularidss. Several new species of Salpa were described by Borgert, and of Appendicularia by Lohmann. Chun (1888) also made known some remarkable deep-sea Appendi-

cularidse of large size from the Mediterranean. One of these species, Megalocercus abyssorum (30 mm. long), is the largest known Appendicularian. Seeliger and Herdman have both published new figures of transverse sections of a typical Appendicularian (Oiko-

%-n. ch

Fig. 2. — Transverse section of Oikopleura ; anterior part of body and tail. At, atrial passage ; b.s., blood sinus ; br.s., branchial sac (pharynx) ; ecT ectoderm ; en, endoderm ; n, nerve ; n.ch., notochord ; B, rectum ; agr stigma ; t} test.

pleura). We give one of those here (Fig. 2) as illustrating, along with the longitudinal section (Fig. 12) in the former article (vol. xxiii.), the structure of these forms. It now seems clear that the supposed segmentation or vertebration of the tail in Appendicularia is an artifact and not an indication of true metameric segmentation. Bitter has described some new Ascidians from the far north, about Bering Sea ; Sluiter has been indefatigable in bringing to our knowledge new species — twenty from the Antilles, thirty from South Africa, and others from Australia and elsewhere ; Gottschald thas made known twenty-two new species from Ternate, and Michaelsen about fifteen from the Southern Ocean. Herdman has found and described some new forms from Puget Sound in the Pacific, and has drawn up a Descriptive Catalogue of Australian Tunicata (1899), which contains 183 species, of which 63 are described and figured for the first time. These are only a few of the considerable number of systematic papers recently published, and the number of new species which are found by such investigations shows that

we must still be very far from having anything like a complete knowledge of the Tunicata of our globe. Many of the new species have revealed anatomical features of considerable interest, some- of which are noted below. >

As to changes in classification since the previous article, Herdman issued in 1891 a Bevised Classification, with definitions- of all groups down to species, in which the classification of the Challenger reports was adhered to with little change ; and this, has also been in the main adopted by Seeliger in his great work on the Tunicata, in Bronn's Thier-Beich. Sluiter has proposed as a change in classification that the families of Compound Ascidians with short individual bodies, viz., the Botryllidse and Polystyelidae, should be united with Simple Ascidians under the term " Holosomata, " while the remaining families of Compound Ascidians along with the Pyrosomatidse form the " Merosomata." Herdman has suggested that these terms should be adopted in a somewhat restricted sense as indicating merely the two groups of Compound Ascidians — the Simple Ascidians being kept distinct from the Holosomata.

Anatomy and Histology. — One of the most important new facts that has been ascertained in regard to the minute structure of Tunicata is that the cells in the test or outer gelatinous tunic are derived from the mesoderm, and not, as was formerly supposed, from the ectoderm. In 1892 Kowalevsky made the remarkable discovery that cells belonging to the mesenchyme of the larva make their way through the ectoderm to the exterior during the metamorphosis, and become the first

cells of the young test. The thin structureless test of the free- swimming tailed larva previous to this has no cells. This discovery has since been corroborated and established by several investigators for other sections of the Tunicata, as, for example, by Salensky in the case of Pyrosoma ; and it accords well with the observations made by several investigators, that in Compound Ascidians the cells of the test act as phagocytes. Later

~~research has shown, however, that some at least of the cells in the adult test may be of ectodermal origin.~~

~~It has been shown that some of the cells in the lateral walls of the endostyle (Fig. 3) are sensory bipolar cells. Nerve-endings~~

~~have also been found ..End-... m tlie peripharyn- geal bands and other parts of the wall of the pharynx. The sensory nature of the oral tentacles has been demonstrated, and that of the dorsal tubercle, long suspected, has been confirmed. Atrial tentacles have now been found in a, number of the Cyn- thiidae and Poly- stylelidae, mainly in — Transverse section of the endostyle of an species which live ‘ ” e-“d’ “t‘8. of e,,d°- aggregated together~~

~~O30E3C*,~~

~~vv.~~

~~Fig.~~

~~Ascidian. br, branchial sac~~

~~style; (/I, glandular tracts; m.b., muscle bands; ^68 p.br., peribronchial cavity; sg, stigma; v.v,, m masses. Ihe SO- ventral vessel, called “otocysts”~~

~~of Salpa have been shown by Metcalf to be glandular organs very possibly related to the neural gland of Ascidians. The function of the neural gland must still be regarded as doubtful. The secretion is formed by the degeneration and disintegration of cells proliferated from the walls of the duct or its branches, and no concretions are found. The ciliated funnel of the dorsal tubercle is a sense organ, inner- vated by a large nerve from the ganglion.~~

~~Physiology. — It is well known that in the family Botryllidae, amongst Compound Ascidians, the ectodermal vessels containing blood which ramify through the common test and serve to connect the vascular systems of the various members of the colony have numerous large ovate dilatations, the ampullae, upon~~

~~*Fig. 4.— Young colony of Botryllus, showing buds and ampullae (after Picon). a, ampulla? ; 62, 63, &4, successive generations of buds ; e, stomach, i, intestine ; vp, vessels of the test.*~~

~~*their terminal twigs (Fig. 4). Various functions have been as- signed to these ampullae in the past, and Bancroft has shown that in addition to acting as storage reservoirs for blood, organs for the secretion of test matrix, and accessory organs of respiration, they are also organs for blood propulsion. The ampulla? execute co-ordinated pulsations, the co-ordination being due to varia- tions in the blood-pressure. It was actually found that the ampullae could keep up the circulation for some time in a por- tion of a colony independently of the hearts of the ascidiozooids. All the hearts in a colony of Botryllus contract simultaneously*~~

~~*and in the same direction. The reversal of the circulation may be regarded as due to the engorgement of the ampullae in the super- ficial parts of the colony. These when distended overcome the resistance of the heart's action, anil cause it to stop and then reverse. Fig. 4 shows the ampullae, and their relation to the rest of the colony ; and Fig. 5 gives a better representation of the scheme of circulation in an Ascidian than that shown in Fig. 0 of the article in the ninth edition of this work.*~~

~~*It will be remembered that Appendicularians have a remarkable temporary cuticular formation, probably representing the test of other Tunicata, and known commonly as the "HIouse." This*~~

~~*Dorsal*~~

~~*Ant.*~~

~~*Ventral*~~

~~*Fig. 5.— Diagram of the blood circulation in an Ascidian. The test is solid black, at, atrial aperture; br. branchial aperture; bv, branchio-visceral vessel; G.V., cardio-viscoral system; da, dorsal aorta; lit, heart; v. v., ventral vessel.*~~

~~may be formed with great rapidity, attain a great size, be rapidly cast off, and again reformed. Lohmann has made a careful study of the mode of formation of this "House" from certain large ectoderm cells the " oikoplasts," and he considers that it probably fulfils the following functions : — Its complicated apparatus of pas- sages with partial septa form a finely perforated network, through which a relatively large volume of water is strained so as to entrap microscopic food particles ; it helps in locomotion by its hydro- static effect, and it is also a protection to the animal, which may escape from enemies by throwing off the house, which is many times its own size.~~

~~Embryology and Life-History. — We owe to Castle (1896) the most complete account which has yet been given of the early stages of development in an Ascidian. His careful study of the cell lineage in C'iona has made it clear that some of the con- flicting statements of his predecessors arose from incorrect orientation of the embryos. One of the most important of his conclusions is that the mesoderm of Ascidians, and probably that of the archaic Vertebrates, is derived from both primary layers, ectoderm and endoderm. Further, he finds that Ciona produces both ova and spermatozoa at the same time, but self-fertilization very rarely occurs. The eggs are laid just before dawn, and the larva is hatched during the following night. The test cells adhering to the young homogeneous test have, it is now well known, no connexion with the cells found later in the adult test. The larvaa are free-swimming for from one to several days. They avoid the light. The spermatozoon enters at the ventral hemisphere, and that point determines the median plane and the posterior end of the embryo. The ventral is the animal pole. The cleavage is from the beginning bilateral. The first cleavage plane is vertical, and separates the right and left halves of the embryo. The four smaller dorsal cells with yolk give rise to the endodermal hemi- sphere ; the four larger, more protoplasmic cells form the ventral ectodermal hemisphere. The cells of the latter hemisphere divide more rapidly, and form the future aboral surface. When the dorsal hemisphere has twenty-two cells the ventral has fifty-four. The gastrulation is a combination of epiboly and invagination. The ventral ectoderm grows over, so as to envelop the dorsal hemisphere, while the latter sinks down and becomes saucer- shaped. In the centre of the dorsal surface ten cells form the future endoderm.~~

~~*Round these comes a ring of cells, the chorda- mesenchyme ring, from which the notochord and mesenchyme arise. Outside this ring is a row of cells, the neuro-muscular ring. The more anterior of these cells form the medullary plate, the more posterior the longitudinal musculature of the larva. The remainder of the cells (in the 112-cell stage) form ectoderm. By growth at the anterior end the blastopore gets pushed posteriorly, and the anterior chorda cells are covered up, and come to lie in the dorsal wall of the archenteron, sixteen cells in two rows, one over the other. The blastopore closes in the posterior part of the dorsal surface. In front of it is the me- dullary plate, with a continuation backwards at the sides of the blastopore. This region forms the trunk of the larva, the part posterior to it being drawn out to form the tail. The chorda cells pass back into the tail, while the mesenchyme cells shift forwards into the trunk. The muscle cells, derived from the neuro-muscular ring, lie behind the blastopore,*~~

~~*and form the muscles of the tail. The closure of the medullary canal takes place from the blastopore forwards, and then the nerve cord is grown over by ectoderm. After closure of the blastopore the mesenchyme cells lie as lateral masses in the trunk ; later they become the blood corpuscles and the mantle cells, &c.*~~

~~*Castle also discusses some important theoretical questions. He points out that, in Ciona at least, the chorda-mesenchyme ring takes part along with endoderm in the primary invagination, and so belongs to the primary endoderm ; while the rest of the mesoderm, the muscle cells of the neuro-muscular ring, are carried in by a secondary invagination, and belong to the outer layer of the young gastrula, or primary ectoderm. He considers that the chorda must be regarded as a mesodermal organ. He agrees with former observers in seeing no trace of enteroccele formation, and he doubts whether any Chordata are Enterocoela. He does not believe in distinguishing those Metazoa with a mesoderm from those with a "mesenchyme." He considers that embryology gives no support to the Annelid hypothesis as to the origin of Chordates.*~~

~~*Fig. 6.— Sketches of Ascidian larva?. A, Aseidia; S, Styela ; M, A%ur&lla ; C, Compound Ascidian.*~~

~~*Fig. 6 shows a few characteristic forms of Ascidian " tadpoles," or free-swimming larva;. A and S are typical simple Aseidians ; M is the aberrant tailless form found in some Molgulicke ; and C is the larva of a typical Compound Ascidian.*~~

~~*A long-continued discussion as to the origin, nature, and fate of certain cells, the " testa-zellen," which make their appearance between the young embryo and its follicle (Fig. 7), has ended*~~

~~*Fig 7. — Portion of mature ovum of Ascidian, showing F, follicle, and /, r, "test-cells." (After Pimm.)*~~

~~*in practical agreement that these small cells are derived from the follicle-cells, and have nothing to do with the test. In Salpa, however, certain follicle-cells enter the embryo, and perforin im- portant functions in guiding the development for a time.*~~

~~*Gemmation and Growth of Colonies. — A number of new obser- vations have been made, in recent years upon the budding of Compound Aseidians, some of which are very puzzling and con- tradictory in their results. Metschnikoff, Kowalevsky, Giard, Hjort, Pizon, Seeliger, Ritter, van Beneden, and Julin have all in turn added to our knowledge of the details of development and life-history, of the various processes of gemmation and of the formation of colonies. It is impossible as yet to reconcile all the conflicting accounts, but the following points at least seem pretty clear : —*~~

~~*Gemmation may be very different in its details in closely related Compound Aseidians. There are, however, two main types of budding, to one or other of which most of the described methods may be referred. There is first the "stolonial" or " epicardiac " type, seen in the Merosomata, typically in Distomidse and Polyelinidte, and comparable with the gemmation in Clavelinidte, Pyrosomida:, and Thaliaeea outside this group. Secondly, there, is the "parietal" or " peribronchial " type, seen in the Holosomata, typically in the Botryllidte. The re-*~~

~~*markable process of gemmation seen in the families Didemnids and Diplosomida? may probably be regarded as a modification of the stolonial type. The double embryo in the DiplosomidEe is probably to be interpreted as precocious budding (rather than as embryonic fission), due to acceleration in development (tachygenesis). The type of budding, and even details such as the length of the stolon, have much to do with differences in the nature and appearance of the colonies produced. The stolon, which has a wall continuous with the body-wall of the parent, contains an endodermal element in the form of the so-called*~~

~~*Fig. 8. — Young buds of JSotryllus sectioned to show the separation of the branchial (lib) from the peribranchial (cp) cavities, ov, dorsal tube ; 7ft, mesoderm cells ; gk, germ cells ; ect, ectoderm. (After Pizon.)*~~

~~*" epicardium," and also a prolongation of the ovary, or at least a string of migrating germ-cells, so that the reproductive elements are also handed on. Still, it is clear from recent researches that the development of the bud (blastozooid) and that of the embryo (oozooid) do not proceed along parallel lines. It is impossible to harmonize the facts of gemmation with the germ-layer theory, and attempts to explain budding in Aseidians as a process of regeneration, by which the organs of the parent or their germ-layers give rise to the corresponding organs in the bud, have signally failed.*~~

~~*Figs. 4 and 8 show the buds in the Botryllidre, after Pizon, who has followed day by day the changes of growth in young colonies of Botryllidse, tracing the rise of successive generations of buds and the degeneration of their parents. The buds are parietal, arising from the walls of the peribranchial cavities (Fig. 4), and at an early period they acquire the structure shown in Fig. 8, where there are two vesicles undergoing further subdivision and differentiation, but investigators still differ as to whether the inner, which gives rise to the branchial sac and alimentary canal, is not produced along with the outer from the ectoderm of the parent.*~~

~~*A remarkable case of polymorphism has been found by Caullery in the buds of the Compound Ascidian Oolella. Some of the buds have an abundant store of reserve materials in their outer layer of cells, while*~~

~~*others are without this supply. The former are placed deeply in the stalk, develop slowly, and probably serve to regenerate the colony when the head portion has been removed or has died down. In these cases where the ectoderm has taken on the function of storing the reserve, material, it is found that all the organs of the bud are formed from the cells of the endodermic vesicle.*~~

~~*Figs. 9 and 10 illustrate some details of structure of branchial sac and of stomach in various Aseidians which are made use of iu classification, and in definitions of genera and larger groups.*~~

~~*Geographical Distribution. — The new forms described from 1'uget Sound and Alaska have, drawn renewed attention to the similarity of the fauna in that region of the North Pacific and the fauna of north-west Europe. There is probably a common circumpolar Tunicate fauna which sends extensions downwards in both Atlantic and Pacific. As the result of the careful quantitative work of the German Plankton expedition, Borgert thinks that the temperature of the water has more to do with both the horizontal and the vertical distribution of pelagic Tunicata in the sea than any other factor. It is probable that the occasional phenomenal swarms of Doliolum which have been met with in summer in the North Atlantic are a result of the curious life-history which in favourable circumstances allows*~~

~~*a small number of budding forma to produce from the numerous minute buds an enormous number of the next generation. The great increase in the number of species known from nearly all seas during the last twelve or fifteen years of the 19th century*~~

~~*I ..*~~

~~*-ni.*~~

~~*iv ..*~~

~~*Fig. 9.— Diagrams showing transverse sections of typical branchial sacs. A, Unfolded type ; 8, Styela, with four folds on each side ; C, Cynthia, with eight folds on one side and seven on the other ; D. L, dorsal lamina ; End, endostyle ; I. II. &c, folds.*~~

~~*Fig. 10.— Types of stomach amongst Compound Ascidians. P, plain ; F, folded ; A, areola ted ; i, intestine ; <%, cesophagus ; at, stomach.*~~

~~*enables us now to form a truer estimate of the geographical distri- bution of the group than was possible when the Challenger collec- tions were described, and shows that the Tunicata at least give no support to the " bi-polar theory " of the distribution of animals.*~~

~~*Finally, it may be useful to add that the volume on Tunicata, in the new edition of Bronn's Thier-Be.ich, by Prof. O. Seeliger, is now in course of publication, and if this fine work is completed in the same exhaustive and judicious manner which characterizes the first thirty parts, there can be no doubt that it will be a most authoritative work of reference on the group for years to come.*~~

~~*(w. A. He.)*~~

~~*Tunisia (Regency op Tunis). — Geographical Boun- daries and Area. — Tunisia reaches the farthest point north of any part of Africa, Cape Blanc1 (Ras-al-Abiadh) being in 37° 20' N. On the south the boundary of the Tunisian Sahara is as yet undetermined, but it may be roughly placed at 32° N. This would give, therefore, a greatest length of something like 380 miles. The country lies between 11° 40' E. and 7° 35' E. The average length is about 300 miles, and the average breadth 150 miles ; con- sequently the area may be estimated at 45,000 miles.2 Geographically speaking, Tunisia is merely the eastern prolongation of the Mauritanian projection of northern Africa, of that strip of mountainous, fertile, and fairly well-watered country north of the Sahara desert, which in its flora and its fauna, and to some extent in its human race, belongs rather to Europe than to Africa. Tunisia is divided into four fairly distinct regions : — 1. On the north and north-west the Aures Mountains of Algeria are prolonged into Tunis, and constitute the mountainous region of the north,*~~

~~which lies between the Majerda river and the sea, and also includes the vicinity of the town of Tunis and the peninsula of the Dakhelat el~~

~~1 It is possible that Ras-ben-Sekka, a little to the west of Cape Blanc, may be actually the most northerly point.~~

~~2 Or 51,000 miles, if certain Sahara districts are allotted to Tunis instead of to Algeria.~~

~~Mawin, which terminates in Eas Addar (Cape Bon). This first division is called by the French " the Majerda Mountains." It includes within its limits the once famous district of the " Kroumirs," 3 a tribe whose occa- sional thefts of cattle across the frontier gave the French an excuse to invade Tunis in 1881. The highest point which the mountains attain in this first and northern division of Tunis is about 4125 feet, near Ain Draham in Kroumiria. The country, however, all round about Bizerta is very mountainous, though the summits do not attain a greater altitude than about 3000 feet. The dis- trict between Bizerta and the Gulf of Tunis is a most attractive country, resembling greatly the mountainous regions of South Wales. All this country is well watered by streams more or less perennial. Its vegetation is abundant, and recalls that of the more fertile districts of southern Spain and of Italy. On the higher mountains the flora has a very English character, though the actual species of plants may not be the same. 2. The central plateau region, stretching between the Majerda valley and the mountains of Gafsa. The average elevation of this country is about 2000 feet. The climate, therefore, in parts is exceedingly cold and bleak in winter, and as it is very wind-swept and parched in summer by the ter- rible south wind (qibli or " seirocco "), it is much less attractive in appearance than the favoured region on the northern littoral. Although it is almost always covered with some kind of vegetation, trees are relatively rare. A few of the higher mountains have the Aleppo pine and the juniper ; elsewhere only a rare wild terebinth is to be seen. In these two regions the date palm is never met with growing naturally wild. Its presence is always due to its having been planted by man at some time or another, and therefore it is never seen far from human habitations. These central uplands of Tunis in an un- cultivated state are covered with alfa or esparto grass ; but they also grow~~

~~*considerable amounts of cereals — wheat in the north, barley in the south. The range of the Saharan Atlas of Algeria divides (roughly speaking) into two at the Tunisian frontier. One branch ex- tends northwards up this frontier, and north-eastwards across the central Tunisian tableland, and the other con- tinues south-eastwards between Gafsa and the salt lakes of the Jerid. The greatest altitudes of the whole of Tunis are attained on this central tableland, where Mount Sidi Ali bu Musin ascends to about 5700 feet. About 30 miles to the south of the town of Tunis is the picturesque mountain of Zaghwan, which is approximately 4000 feet in altitude, and from whose perennial springs comes the water-supply of Tunis to-day as it did in the time of the Carthaginians and Romans. North-east of Zaghwan, and nearer Tunis, is the Jebel Resas, or Mountain of Lead, the height of which is just under 4000 feet. 3. The Sahel. This well-known Arab term for coast-belt (which in the plural form reappears as the familiar Swahili of Zanzibar) is applied to a third division of Tunis, which is the littoral region stretching from the Gulf of Ham- mamet to the south of Sfax. It is a region varying from 30 to 60 miles in breadth, fairly well watered and fertile. In a less marked way this fertile coast region is continued southwards in an ever-narrowing belt to the Tripolitan frontier. This region is rela- tively flat, in some districts slightly marshy, but the*~~

~~*8 The French seem systematically unable to master certain sounds foreign to their own language, or sounds which they suppose to be foreign. Thus the " w," though constantly represented in French by " ou," is continually changed by them into " v," when they transcribe foreign languages, just as the Greek x and the German and Scottish " ch " is almost invariably rendered by the French in Algeria and Tunis as "kr." Add to this the insertion of vowel sounds where they are lacking in the Arabic, and you derive from the real word Khmir the modern French term of Kroumir. In like manner sebkha, a salt lake, is constantly written by the French as sebkra.*~~

■*water oozing from the soil is often brackish, and in places large, shallow salt lakes are formed. Quite close to the sea, all along the coast from Hammamet to Sfax, there are great fertility and much cultivation ; but a little dis- tance inland the country has a rather wild and desolate aspect, though it is nowhere a desert until the latitude of Sfax has been passed. 4. The Tunisian Sahara. This occupies the whole of the southern division of Tunis, but although desert predominates, it is by no means all desert. At the south-eastern extremity of Tunisia there is a clump of mountainous country, the wind-and-water-worn frag- ments of an ancient plateau, which for convenience may be styled the Matmata tableland. Here altitudes of over 3000 feet are reached in places, and in all the upper parts of this tableland there is fairly abundant vegetation, grass and herbage with low junipers, but with no pine-trees. Fairly high mountains (in places verging on 4000 feet) are found beyond Gafsa and the salt lakes of the Jerid.*

These salt lakes are a very curious feature. They stretch with only two short breaks in a line from the Mediterranean at the Gulf of Gabes to the Algerian frontier, which they penetrate for a con- siderable distance. They are called by the French (with their usual inaccuracy of pronunciation and spelling) "chotts"; the word should really be the Arabic shat, the common Arab term for an inland sea, estuary, or lake. These shats, however, are, strictly speaking, not lakes at all at the present day. They are smooth, depressed areas (in the case of the largest, the Shat el Jerid, lying a few feet below the level of the Mediterranean), which for more than half the year are expanses of dried mud covered with a thick incrustation of white or grey salt. This salt covering gives them at a distance the appearance of big sheets of water. During the winter, however, when the effect of the rare winter rains is felt, there may actually be 3 or 4 feet of water in these shats, which by liquefying the mud makes them perfectly impassable. Otherwise, for about seven months of the year they can be crossed on foot or on horse- back. It would seem probable that at one time these shats (at any rate the Shat el Jerid) were an inlet of the Mediterranean, which by the elevation of a narrow strip of land on the Gulf of Gabes has been cut off from them. It is, however, a region of past volcanic activity, and these salt depressions may be due to that cause. Man is pro- bably the principal agent at the present day in

~~*causing these shats to be without water. All round these salt lakes there are numerous springs gushing from the sandy hillocks. Almost all these springs are at a very hot temperature, often at boiling-point. Some of them are charged with salt, others are perfectly fresh and sweet though boiling hot. So abundant is their volume that in several places they form actual ever-flowing rivers. But for the interven- tion of man these rivers would at all times find their way into the adjoining depressions, which they would maintain as lakes of water. But for a long period past the fresh-water streams (which predomi- nate) have been used for irrigation to such a degree that very little of the precious water is allowed to run to waste into the lake basins ; so that these latter receive only a few salt streams, which deposit on their surface the salt they contain and then evaporate. This abundant supply of fresh warm water maintains oases of extraor- dinary luxuriance in a country where rain falls very rarely. Peren- nial streams of the description referred to are found between the Algerian frontier and Gabes on the coast. The town of Gabes itself is on the fringe of a splendid oasis, which is maintained by the water of an ever-running stream emptying itself into the sea at Gabes after a course of not more than 20 miles. All this region round the shats has been called the " Jerid " from the time of the Arab occupation. "Jerid " means in Arabic " a palm frond," and inferentially "a palm grove." The fame of this Belad-el-Jerid, or " Country of the Date Palms," was so exaggerated during the 17th and 18th centuries that the European geographers extended the designation from this small area in the south of Tunis to cover much of inner Africa. With this country of Jerid may be included the island of Jerba, which lies close to the coast of Tunis in the Gulf of Gabes. The present writer believes that the date palm was really indigenous to this district of the Jerid, as it is to countries of similar description in southern Morocco, southern Algeria, parts of the Tripolitaine, Egypt, Mesopotamia, southern Persia, and north-western India ; but that north of the latitude of the Jerid the date did not grow naturally in Mauritania, just as it was foreign to all parts of Europe, in which, as in true north Africa, its presence is due to the hand of man. To some extent it may be said that true north Africa lies to the north of this Jerid country, which, be- sides its Saharan, Arabian, and Persian affinities, has a touch about it of real Africa, some such touch as may be observed in the valley of the Jordan. In the oases of the Jerid are found*~~

~~*several species of tropical African mammals and two or three of Senegalese birds,*~~

~~*and the vegetation seems to have greater affinities with tropical Africa than with Europe. In fact, the country between the Matmata highlands and the strait separating Jerba from the mainland is singularly African in the character and aspect of its flora. To the south of the Jerid the country is mainly desert — vast unexplored tracts of shifting sand with rare oases. Nevertheless, all this southern district of Tunis bears evidence of once having been subject to a heavy rainfall, which scooped out deep valleys in the original tableland, and has justified the present existence of immense water-courses — water-courses which are still, near their origin, favoured with a little water.*~~

~~*Rainfall. — There is no important running river in Tunis but the Majerda and its affluents. The rainfall in the first geographical division is pretty constant, and may reach a yearly average of about 22 inches. Over the second and third divisions the rainfall is less constant, and its yearly average may not exceed 17 inches. In the fourth division rain is most uncertain. Occasionally two or three years may pass without any rainfall ; then may come floods after a heavy downfall of a few weeks. Perhaps if an average could be struck it would amount to 9 or 10 inches per annum.*~~

~~*Geology. — The region of the Sahel and all the other great plains of Tunis are of relatively recent Quaternary formation ; the Kroumir country and much of the extreme north-west of Tunisia is of marine formation, and is of the Miocene and Pliocene divisions of the Tertiary epoch. Much of the interior tableland and of the ranges of hills round the shats is Cretaceous 1 ; the hilly country about the central Majerda, on the central plateau (Maktar), El Kef, and far- ther south, and in the northern part of the Jerid, belongs to the Upper and Lower Eocene. There are a few patches of the Lower Cretaceous all over the country.*~~

~~*Minerals. — Tunisia is better endowed with mineral wealth than was formerly believed. Coal has been discovered in the Kroumir country, but the principal mines at present worked in Tunis are those of lead and zinc. Zinc is chiefly found in the form of calamine. Valuable deposits of phosphates are present, chiefly in the south-west of Tunisia, round about*~~

~~the district of Gafsa. Marble is found in the valley of the Majerda (at Shemtu), at Jebel Ust (about 35 miles to the south of Tunis), and at Jebel Dissa, near Gabes. The marbles of Shemtu are the finest pink Numidian marbles, which were much esteemed by the Carthaginians and Romans. It has been sought to work again the ancient quarries of Shemtu, but it was found that the marble had been spoilt by ferru- ginous and calcareous veins. Hot and mineral springs may be almost said to constitute one of the specialities of Tunisia. They offered a singular attraction to the Romans, and their presence in remote parts of the country no doubt was often the principal cause of Roman settlement. Even at the present day their value is much appreciated by the natives, who continue to bathe in the ruined Roman baths. The principal mineral springs of medicinal value are those of Korbus and Hamman Lif (of remarkable efficacy in rheuma- tic and syphilitic affections and certain skin diseases) , of the Jehrid and Gafsa, of El Hamma, near Gabes, and of various sites in the Kroumir country.~~

~~Flora. — The flora of Tunis is very nearly identical with that of Algeria, though it offers a few species either peculiar to itself or not found in the last-named country. On the whole its character is less Saharan than that of parts of Algeria, for the influences of the desert do not penetrate so far north in Tunis as they do in Algeria. There are very few patches of real forest outside the Kroumir country, though it is probable that in the time of the Romans the land was a good deal more covered with trees than at the present day. Some authorities, however, dispute this, in a measure, by say- ing that it was not naturally forested, and that the trees growing represented orchards of olives or other fruit trees planted by the Romans or Romanized Berbers. But in the Majerda Mountains there are dense primeval forests lingering to the present day, and consisting chiefly of the cork oak (Quermts ruber), and two other species of oak, Quercus mirbeckii and Q. kermes, the pistachio or terebinth tree, the sumach (Rhus pentaphila), and other species of Rhus which are widely spread. In the mountains of Kroumiria and the central plateau there are also the alder, the poplar, the Aleppo pine, the caroub, the tamarisk, the maple, the nettle-tree, several willows and junipers. The jujube-tree (Zizyphus) is found at various places along the eastern littoral. The retama shrub is met with in sandy districts, especially in the Sahara, but also right up to the~~

~~north of Tunis. The wild olive, the wild cherry, two species of wild plums, the myrtle, the ivy, arbutus, and two species of holly are found in the mountains of Kroumiria, at various sites at high elevation near Tunis and Bizerta, and along the mountainous belt of the south-west which forms the frontier region between Tunis and Algeria. The present writer, riding up to these frontier mountains from the thoroughly Saharan country round Gafsa, found himself surrounded by a flora very reminiscent of Switzerland or~~

~~of~~

~~1 A patch ot Pliocene fori Tunis, to the west of Kair~~

~~mation also reappears in the very centre wan.~~

~~England. On the other hand, the flora of the shat region, of the south-eastern littoral, and of the Kerkena islands opposite Sfax, is thoroughly Saharan, with a dash, as it were, in places of an African element. The date palm grows wild, as has been already related, in Jerba. The only other species of palm found wild in Tunisia is the Chamoerops humilis, or dwarf palm, which is found on the mountains of the north at no very great altitude. The wild flowers of the north of Tunis are so extremely beautiful during the months of February, March, and April as to constitute a distinct attraction in themselves.1~~

~~Fauna. — The fauna of Tunis at the present day is much im- poverished/ as regards mammals, birds, and reptiles. In 1880 the present writer actually saw lions killed in the north-west of Tunis, but now the lion is said to be practically extinct in the regency, though occasional rumours of his appearance come from the Kroumir Mountains and near Feriana. Leopards of large size are still found in the north-west of central Tunisia. The cheetah lingers in the extreme south of the Jerld ; so also does the caracal lynx. The pardine lynx is found fairly abundantly in the west of Tunisia in the mountains and forest. The striped hysena is scattered over~~

~~the country sparsely. The genet and the common jackal are fairly abundant. The common ichneumon is rare. The zorilla, another purely African species, is found in the south of Tunis. The Barbary otter is present in the Majerda and in some of the salt lakes. The Tunisian hedgehog is peculiar to that country and to Algeria. There is a second species {Erinaceus deserti) which is common to all North Africa. In the south of Tunis, especially about the shats,the elephant-shrew (Macroscelides) is found, an animal of purely African affinities. Tunisia does not appear to possess the Barbary ape, which is found in Algeria and Morocco. Natives of Morocco and of the Sahara oases occasionally bring with them young baboons which they assert are obtained in various Sahara countries to the south and south-west of Tunis. These baboons appear to belong to the Nubian species, but they can- not be considered indigenous to any part of Tunis. The porcupine, and a large rodent called Ctenodactylus, the jerboa (two species), the hare, and various other rodents are met with in Tunisia. The wild boar inhabits the country, in spite of much persecution at the hands of " chasseurs." The forested regions shelter the hand- some Barbary stag, which is peculiar to this region and the ad- joining districts of Algeria. In the extreme south, in the Sahara desert, the addax antelope is still found. The hartebeest appears now to be quite extinct ; so also is the leucoryx, though formerly these two antelopes were found right up to the centre of Tunis, as was also the ostrich, now entirely absent from the country. In the marshy lake near Mater (north Tunisia), round the mountain island of Jebel Ashkel, is a herd of over 50 buffaloes ; these are said to resemble the domestic (Indian) buffalo of the Levant and Italy, and to have their origin in a gift of domestic buffaloes from a former King of Naples to a bey or dey of Tunis. Others again assert the buffaloes to have been there from time immemorial ; in which case it is very desirable that a specimen should be submitted for examination. They are the private property of the bey, who very properly preserves them. Far down in the Sahara, to the south of Tunis, the Arabs report the existence of a wild ass, apparently identical with that of Nubia. Roman mosaics show representations not only of this ass, but of the oryx, hartebeest, and perhaps of the addax. The dorcas gazelle is still common in the south of Tunis ; but perhaps the most interesting ruminant is the mag-~~

~~*1 List of Plants commonly met with in northern Tunisia.*~~

~~*Adonis microcarpa, DC. Nigella damascena, L. Fumaria spicata, L. Cistus halimifolius, L. Silene rubella, L. Oxalis cernua, Thunb. Geranium tuberosum, L. Malva sylvestris, L. Tetragonolobus purpureus,*~~

~~*Moench. Betama retam, Webb. Fedia cornucopise, Gaertn. Helichrysum Stvechas, DC. Centaurea (Seridia) , sp. Urospermum Dalechampi, Desf. Scorzonera alexandrina, Boiss. Stachys hirta, L. Stachys, sp. not identified. Anagallis collina, Schousb. Convolvulus tricolor, L. Solenanthus lanatus, DC. Echium sericeum, Vahl. Echium maritimum, Willd.*~~

~~*Anchusa italica, Retz.*~~

~~*Lycium europseum, L.*~~

~~*Solanum sodomseum, L.*~~

~~*Celsia cretica, L.*~~

~~*Linaria, sp. allied to L. reflexa,*~~

~~*Desf. Linaria triphylla, L. var. Orobanche, sp. Trixago apula, Stev. Cynomorium coccineum. Plantago albicans, L. Euphorbia serrata, L. Ophrysfusca, Link. Orchis papilionacea, L. Bomulea bulbocodiuni, Sebast. and*~~

~~*Mauri. Gladiolus byzantinus, Mill. Ornithogalum umbellatum, L. Allium roseum, L. Asphodelus fistulosus, L. Muscari comosum, Mill. Arum italicum, Mill. Lagurus ovatus, L.*~~

~~*To this list should also be added the common wild tulip, the Italian cyclamen, the common scarlet poppy, the fennel, wild carrot, and many varieties of thistle, some of gorgeous colouring.*~~

~~*niflcent udad or Barbary sheep, which is found in the sterile mountainous regions of south Tunisia. The birds have been ably illustrated by Mr Whitaker in the Ibis magazine of the British Ornithological Union. They*~~

~~are, as a rule, common to the south Mediterranean region. A beautiful little bird, almost peculiar to the south of Tunis and the adjoining regions of Algeria, is a species of bunting (Fringilla), called by the Arabs bu-habibi.* This little bird, which is about the size of the linnet, has the head and back silvery blue, and the rest of the plumage chocolate red- brown. It is of the most engaging tameness, being fortunately protected by popular sentiment from injury. It inhabits the Jerld, and extends thence across the Algerian frontier. Among reptiles the Egyptian cobra seems to be indigenous in the south, where also is found the dreaded horned viper. Some nine or ten other species of snakes are present, together with an abundance of lizards, including the Varanus, and most species of Mediterranean tortoises are represented. The coasts are very rich in fish, and the tunny fisheries of the north are one of the principal sources from which the world's supply of tunny is derived.~~

~~Population. — As regards the natives of Tunis at the present day, they belong mainly to two stocks, which we may roughly classify as the Berber and the Arab, about two-thirds being of Berber and the remaining third of Arab descent. But the Berbers of to-day are little more than an incomplete fusion of some four earlier and once independent stocks. These four divisions taken in the order of their assumed priority of invasion or habitation are : (1) the " Neanderthal " type, which is found in the districts of the shats and the adjoining Matmata tableland in the south, and in the Kroumir country of the north- west;3 (2) ordinary Berbers, dolichocephalous, and of brown complexion, found over the greater part of Tunisia, especially in the east and south centre ; (3) the short- headed Berbers, found in part of the Matmata country, part of the Sahara, the Island of Jerba, the Cape Bon Peninsula, and the vicinity of Susa, Kairwan, and Sfax ; (4) Berbers of a blond type, that is to say, with a tendency to brown or yellow moustaches, brown beard and head hair, and grey eyes. These are met with in the west and north-west of Tunisia, and in one patch on the coast of the Cape Bon Peninsula, near Nabeul. The Arabs of more or less unmixed descent are purely nomads. They are met with in a long strip of country south of Majerda, between the Algerian frontier and the sea-coast north of Susa, also inland, to the south-west of Susa, and near Kef; also in another long strip between the vicinity of Sfax on the north and the Jerld on the south. The extreme south of Tunis is~~

*ranged over by Berber Tawareq * or Tamasheq. Berber dialects are still spoken in Tunisia in the island of Jerba, in the Matmata country, and in the Tunisian Sahara. Elsewhere to a remarkable degree the Arabic language has extinguished the Berber tongue, though no doubt in vulgar Tunisian a good many Berber words remain. A short vocabulary of the Berber spoken in the Tunisian Sahara has been published by the present writer in the Proceedings of the Eoyal Geographical Society. On the north-eastern littoral of Tunis the population is of course very mixed. The inhabitants of the Cape Bon Peninsula show evident signs of Greek blood arising from Greek invasions, which began in prehistoric times and finished with the downfall of the Byzantine empire in North Africa. The presence of the Romans, and the constant introduction of the Italians, first as slaves, and quite recently as colonists, has also added an Italian element to the north Tunisian population. But from the fact that the bulk of the Tunisian population belongs to the*

2 " Father of my friend."

8 In this Matmata country are the celebrated Troglodytes, people living in caves and underground dwellings now, much as they did in the days when the early Greek geographers alluded to them. See " A Journey in the Tunisian Sahara," by the present writer, in the Geo- graphical Magazine, June 1898.

4 Tawareq (Tuareg) seems to be the Arab corruption of their tribal name.

Iberian section of the Berbers, and to this being no doubt the fundamental stock of most Italian peoples, the inter- mixture of the Italianized Berber with his African brother has not much affected the physique of the people, though it may have slightly tinged their mental characteristics. The Phoenicians have left no marked trace of their presence ; but inasmuch as they were probably of nearly the same race as the Arabs, it would not be easy to dis- tinguish the two types. Of course Arab and Berber have mingled to some extent, though no considerable

~~fusion of the two elements has taken place. In fact, it is thought by some French students of the country that the Arab element will probably be eliminated from Tunis, as it is the most un settled. It is considered that these nomads will be gently pushed back towards the Sahara, leaving cultivable Tunis to the settled Berber stock, a stock fundamentally one with the peoples of Mediterranean Europe. The present population of Tunis numbers approximately 1,925,000, and consists of : —~~

~~Berbers, more or less of pure race, say~~

~~Arabs, „ „ „ . .~~

~~Mixed Arab and Berber peoples, say~~

~~" Moors " (chiefly the population of the principal~~

~~cities, of mixed Roman, Berber, Spanish,~~

~~Moor, and Christian races, say Sudanese negroes and natives of Morocco,~~

~~Tripoli, and Turkey, say .... Jews (mostly natives of Tunis, indeed, some~~

~~descended from families settled at Carthage~~

~~before the destruction of Jerusalem)~~

~~600,000 500,000 500,000~~

~~100,000 40,000~~

~~60,000~~

~~Europeans (Christians)1 125,000~~

~~Towns. — Besides the capital, Tunis (population about 150,000), which has been sufficiently described in vol. xxiii. of this Encyclopaedia, the next most important town of Tunisia is probably Sfax, with a present population of nearly 50,000. Sfax, Susa, Kairwan, and most of the principal towns have not changed much. Bizerta (properly pronounced~~

~~*Ben Zert, the Roman and Greek- Carthaginian Hippo Diarrhytus) is situated on the banks of a narrow canal, more or less artificial, which connects the Mediterranean with a very large and deep salt lake, the Lake of Bizerta. Beyond this large salt lake (with an area of about 45 square miles) is a smaller fresh- water lake, connected with the salt lake by a narrow and impassable outlet. The French have determined to make Bizerta their second most important naval port in the Mediterranean. A new canal has been cut from the Mediterranean into the lake ; but this not being wide and deep enough, it is proposed to double the width and increase the depth. A great arsenal is being established on the shores of this lake, out of the reach of any marine artillery which could be directed on it from the sea. But the canal transit of 'some two miles from the open sea to the inner lake will always remain such a source of risk and danger to fleets passing in and out in a hurry, that it is question- able whether Bizerta can ever attain a high position as a great naval port.*~~

~~*Kairwan (see also Ency. Brit. vol. xiii.) is a most inter- esting city, which still displays the Moorish colour and picturesqueness prevalent before the Europeanization of the country. Gafsa, in the south of Tunis, is well worth a visit ; it is a most interesting old Roman town, with hot springs. Almost all the existing towns of Tunis were originally Roman or Romanized Berber settlements ; con- sequently the remains of Roman buildings form a large part of the material of which their existing structures are composed.*~~

~~*Objects of Interest. — In the first rank of these will prob- ably come the Phoenician and Roman antiquities. An*~~

~~*1 Of recent introduction for the most part, consisting (1901) of about 72,000 Italians, 37,500 French colonists and soldiers, 12,000 Maltese, 1000 Greeks, and the remainder British, German, Austrian, &c.*~~

~~*excellent museum has been founded at Carthage by the White Fathers of Cardinal Lavigerie's mission. Here may be seen many objects illustrating Phoenician art and culture, and still more the Roman and Byzantine civiliza- tion which followed. These objects have been obtained from the site of Carthage and its vicinity. Near this museum also may be seen vast cemeteries — Byzantine, Roman, and Carthaginian (Phoenician), the*~~

~~order usually being in layers, with the Phoenician at the bottom. The site of Carthage itself has been hideously vulgarized. On the monticule, where formerly stood the citadel and the magnificent palace of the Roman pro-consul, have been erected (1) a cathedral in the architectural style of a Moorish music-hall ; 2 (2) a hotel of the most ugly description, built by a former Belgian consul as a speculation; and (3) a "bicoque," or preposterous chalet, built by General Boulanger's son-in-law in theatrical imitation of a French " donjon." The site of the citadel of Carthage, which is seen from far and wide, and overlooks such a splendid panorama of gulf, moun- tain, lake, plain, and orchards, has been ruined for a time until some wise iconoclast will remove by an act of force the singularly ugly and tasteless erections which disfigure it. At the Bardo Museum, near Tunis, M. Paul Gauckler, the director of the Department of Art and Antiquities in the Tunisian Government, has assembled a magnificent collection of Carthaginian and above all Roman antiquities, especially Roman mosaics, and has also striven to illustrate the Saracenic art of Tunisia. The principal Roman ruins are the following: — the Roman aqueducts in the vicinity of Tunis ; the Temple of the Waters on Zaghwan Mountain ; the great reservoir near Carthage; the magnificent amphitheatre of El Djem (between Susa and Kairwan), the second or third largest in the world ; the ruins of Dougga, near Tebour- souk (the amphitheatre of Dougga, the ancient TJiugga, is a magnificent spectacle) ; the temples, bridge, and other ruins of Sbeitla (the ancient Suffetula) ; the baths and temples of Feriana (the ancient Thelepte) — the whole route between Feriana in Tunisia and Tebessa in Algeria is simply strewn on both sides with Roman ruins ; the old houses3 and other ruins at and near Thala; the baths and other ruins of Gaf sa ; the old Roman baths at Tuzer, El Hamma, and Gabes. There is also an interesting Phoenician burial-ground near Mehdia. There are other Roman ruins, but scarcely known, in the vicinity of Beja and the country of the Mogods. In short, Tunisia is as much strewn with Roman remains as is Italy itself.~~

~~Saracenic art has perhaps not attained here the high degree it reached in western Algeria, Spain, and Egypt ; still it presents much that is beautiful to see and worthy to be studied. One of the most ancient, as it is one of the loveliest fragments, strange to say, is found at Tuzer, in the Jerid, the mahrab of a ruined mosque.4 There are some very beautiful doorways to~~

~~mosques and other specimens of Moorish art at Gabes. In some respects perhaps Kairwan contains what is best worth seeing in this way, but unhappily its Saracenic art treasures have suffered cruelly, firstly, in the vulgarization which followed the Turkish occupation, and, secondly, in the well-meant but blundering attempts of the Franco- Tunisian authorities to restore buildings that were falling into ruin. Tunis itself and the Bardo palace near Tunis offer some fine specimens of carved and painted ceilings, of~~

~~2 The idea of Cardinal Lavigerie was that if he built his cathedral as much as possible like a showy mosque, he might induce Arabs to worship there.~~

~~8 Some of these old Roman dwellings are said still to retain their roofs.~~

~~4 Of which a reproduction was sent to the Paris Exhibition of 1900.~~

~~tiles, and of that beautiful naksha hadida, or carved stucco work, which is brought to such perfection in the Alhambra. But the visible remains of Saracenic art in Tunis and its vicinity are of relatively recent date, the few mosques which might offer earlier examples not being open to inspection by Christians. It may be noted, however, as a general condition that the native towns and villages of Tunisia, where they have not been spoiled by the shocking tastelessness of Mediterranean Europe, are exceedingly picturesque, and offer exceptional attractions to the painter.~~

~~Commerce. — The commerce of Tunisia is thriving under the Trench protectorate, having risen from an annual total of about £1,700,000 in 1881 to £3,915,119 in 1898 and £4,163,000 in 1900. During this period the value of British trade with Tunis has also risen, though undergoing vacillations at times. It stood at considerably over £600,000 in annual value during the year 1897, and again in 1898. The principal exports are olive oil, wheat, esparto grass, barley, sponges, dates, and fish. The imports consist mainly of European manufactured goods (especially~~

~~British cotton) , machinery, flour, alcohol, and petroleum. The town of Tunis now being connected with the sea by a navigable canal, the port of Goletta has lost all its former importance. Excellent ports have also been made by the French at Bizerta, Susa, and Sfax.~~

~~Industries. — The principal industries are agriculture (cultivation of cereals, olives, dates, almonds, vines, figs, oranges, roses and jasmines for perfume); stock-rearing (camels, horses, cattle, sheep, goats — horses and cattle are exported to Malta in large numbers); working of minerals and phosphates ; fisheries, sponge-fishing ; pottery-making, leather work, silk-weaving, wool manufacture, carpet-weaving, dyeing, and perfume-making.~~

~~Railways. — The " Bone-Guelma et Prolongements " Company has constructed and works nearly all the railways of eastern Algeria and Tunisia. It has bought the little railway (Tunis- Goletta-Marsa) originally constructed by a British company in the early 'seventies and then sold to an Italian company. The Tunisian railway system consists of (1) a line from the Algerian frontier to Tunis and Bizerta, (2) a line from Tunis to Goletta and Marsa, (3) a line from Tunis to Zaghwan, (4) a line from Tunis to Hammam Lif, Nabeul, Hammamet, Susa, and Kairwan ; and (5) a line from Sfax to Gafsa. All but the last-named are worked by the B6ne-Guelma Company, and are well managed.~~

~~Posts and Telegraphs. — The whole of Tunisia is covered with a network of telegraph lines, and there are telephones working in most of the large towns. The telegraph system penetrates to the farthest French post in the Sahara, is connected with the Turkish system on the Tripolitan frontier and with Algeria, and by cable with Sicily, Malta, Sardinia, and Marseilles. There are about 69 telegraph stations, 11 telephone stations, and 246 post offices.~~

~~Finance. — The principal bank is the Banque de Tunisie. The coinage formerly was the caroub and piastre (the latter worth about 6d.), but in 1891 the French reformed the coinage, sub- stituting the franc as a unit, and having the money minted at Paris. The values of the coinage are pieces of 5 and 10 centimes in bronze, of 50 centimes, 1 franc and 2 francs in silver, of 10 francs and 20 francs in gold. The inscriptions are in~~

~~*French and Arabic. The public debt was consolidated in 1884 into a total of £5,702,000. Since 1888 it has been converted into a loan paying 3£ per cent, interest. It is guaranteed by France. The weights and measures are those of France. The revenue for the year 1900 was £1,456,640, and the expenditure was £1,452,597. The princi- pal sources of revenue are direct taxation, stamp and death duties, customs, port and lighthouse dues, octroi and tithes, tobacco, salt, and gunpowder monopolies, postal and telegraph receipts, and revenue from the state domains (lands, fisheries, forests, mines). The civil list paid to the bey of Tunis amounts to £36,000 per annum, and the endowment of the princes and princesses of the beylical family to £31,200 a year more.*~~

~~*Administration. — From a native's point of view Tunisia still appears to be governed by the bey of Tunis, his Arab ministers, and his Arab officials, the French only exercising an indirect — though a very real — control over the indigenous population (Mahomme- dans and Jews). But all Christians and foreigners are directly governed by the French ; and the native administration is super- vised by a large staff of French " contrdleurs " and their sub- ordinates. All the departments of state have Frenchmen at their head, and the larger proportion of the bey's ministers are likewise French. France is directly represented in Tunisia by a minister Resident-General, and by an assistant Resident. The French Resident-General is the virtual viceroy of Tunisia.*~~

~~*History. — The following facts about the French occupa- tion may be noted. The French having, on more or less*~~

~~*fictitious pretexts, invaded the country in 1881 (the real cause of their invasion being an assurance given by Great Britain at the Conference of Berlin in 1878 that French predominance in Tunis would not be unfavourably re- garded by Great Britain), they contented themselves at first with the occupation of various points of the so-called regency of Tunis (for Tunis, before the French occupa- tion, was practically a fief of the Turkish empire). But in 1883 it was decided to undertake a thorough reform of the government and administration of the country, and from 1884 onwards Tunisia has been practically governed by the French minister Besident-General. Nevertheless, the Bey (Prince Sidi*~~

~~*Muhammad, who succeeded his brother in 1882) continues to reign in a measure over his native subjects, and is the ostensible head of the Govern- ment in their eyes. On the whole French control over the country has been indirectly and wisely exercised, so that the benefits of French rule have hitherto been much more apparent than the exercise of the firm hand that has put an end to Oriental corruption. In the last two or three years of the 19th century, however, an agitation sprang up among the French " colonists " for a government which should be less that of the benevolent despotism carried on by the present triumvirate of the French minister of foreign affairs, the French minister Resident, and the Bey of Tunis, than a kind of constitutional or parlia- mentary control, by which the small body of French colonists are to direct and control the administration. In short, some 10,000 French settlers would like to turn what is practically analogous to an English Crown colony into one with representative institutions. Such a policy might have much to recommend it in a country like West Australia, where the native population is very sparse, but in a country like Tunis, where there are 1,800,000 Mahommedan Berbers and Arabs as compared with 125,000 Christians, such a proposition is altogether another matter, and would lead to very serious troubles, as has been the case in Algeria. Sooner or later the position of the puppet prince must become a superfluity, but Tunisia must continue to be governed despotically, wisely, and well by a single French viceroy or pro-consul, until perhaps some distant epoch when the Arabs and Ma- hommedanism have jointly disappeared, and the great mass of the Berber population of Boman Africa has abandoned its fatal connexion with the East, and returned to that community of European nations to which by blood and affinities it belongs.*~~

~~*Besides the list of works given at the conclusion of the article on Tdnis in vol. xxiii. , may be added the two important articles on Tunisia in Nos. 22 and 23 of the Revue Generate des Sciences (30th November and 15th December 1896), Paris; and the still more important La Tunisie Franqaise, in two volumes, a Government publication (Berger, Levrault et Cie., Paris, 1896). An article on the "Tunisian Sahara, the Tunisian Cave-Dwellers, and Berber Languages," &c, by the writer of the present article, was published in the Geographical Journal for June 1898. Other articles by the same author appeared in the Graphic during the years*~~

1899, 1900, and 1902. An interesting dissertation on the question of the Berber race appears in Professor A. H. Keane's Man, Past and Present. Numerous other works in English and French have been published on Tunis from the tourist's point of view, but they are for the most part lacking in accuracy or novelty of observation. L'Afrique Romaine, by Gaston Boissieh, is a picturesque but somewhat superficial apercu of the principal Eoman ruins. Salammbo, by Flaubekt, ought always to be read by those who visit Carthage and Tunis. It was mainly written at La Marsa, near Carthage. (h. h. J.)

Tunnelling. — Progress has been made in the methods of cooling and ventilating tunnels, in the details of drilling machines, and notably in the use of shields for sub-aqueous and soft-ground tunnels.

The Simplon railway tunnel in the Alps, near the Simplon Pass, begun in August 1898, will have a length

of about 12^ miles, or one-third greater than the St Gothard tunnel. A novel method is introduced

*tanneis *n e use ° tw0 Para^e^ bores (56 feet apart,*

connected at intervals of 660 feet by oblique

galleries), which will greatly facilitate ventilation, and tend

to increased economy and rapidity of construction. One bore in the first instance, and as soon as required by the traffic the other also, will be made large enough for a single-track railway. It was expected that the first would be completed in 1904. The aggregate contract cost of

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Phases

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Fig. 1. — Boston Subway, first and second phases.

the two (not including track) is about £2,750,000. The rock consists of margarite, chalk, gneiss, mica, and gyp- sum. The rock in the middle of the tunnel will probably

have a maximum natural temperature of 120° E., which during construction will be lowered to a maximum of 80° E. by very ample ventilation and cold water sprays.

Fro. 2. — Boston Subway, third phase.

Electric propulsion of trains is proposed, to prevent vitia- tion of the air and to lessen the corrosion of metal, which has been so great in other tunnels. Alfred Brandt, the directing engineer on the north end, a man of great ability, whose drills have been used with much success, died in November 1899, and his place was taken by Colonel Edward Locher. The directing engineer on the south end is Carl Brandau.

Among other recent rock tunnels may be mentioned the Tequixquiac, for draining the valley of Mexico,

6 miles long, about 14 feet diameter, through sand- stone and other rocks, costing about $6,760,000 ; the Albula, through a granite ridge of the Rhaetian Alps, for a single-track narrow-gauge railroad, 3-6 miles long;

~~*tunnels on the Dore and Chinley railway, near Totley in Derbyshire, over 3-5 miles long, largely in shale ; Cow- burn, over 2 miles long, shale and harder rock, each 27 feet wide and 20-5 feet high inside ; the Cascade on the Great Northern railway, state of Washington, 2-5 miles long, 24 feet high by 20 wide, through shattered granite,*~~

~~*/Lonj^ert.Jecfio'nrtroiy/idfiie/d. . ".*~~

~~*Fig. 3.— Boston Subway, longitudinal vertical section through shield.*~~

~~*costing about $3,000,000; the Suram, on the Trans-*~~

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~~*through soft rock; the tail-race tunnel for the Niagara Falls Water Power Company, 1-3 mile long, 19 feet wide and 21 feet high, through argil-laceous shale and limestone, costing about $1,250,000 ; the narrow-gauge single-track electric railway tunnel from the Eiger Glacier to near the summit of the Jungfrau, about 6 miles long, 3-6 metres wide and 3-8 metres high ; portions of the Rapid Transit railroad in Park Avenue and Upper Broad- way, New York, aggregating about 3-5 miles in length, 25 feet wide by 18 feet high, mostly through gneiss.*~~

~~*The use of compressed air in the Hudson River tunnel by D. C. Haskin (in 1880 and succeeding years), and the use of annular shields and cast-iron lined tunnel in constructing the City and South London railway by Greathead (1886 to 1890) became widely known, and greatly influenced sub- aqueous and soft-ground tunnelling there- after. The pair of tunnels for the City and South London railway, from near the*~~

~~*Fie. 4.-Paris Metropolitan Tunnel, longitudinal horizontal section.*~~
~~*Monument to Stockwell, a distance of about*~~

~~Caucasus railway, for double track, 2-47 miles long, | 3£ miles, from 10 feet 2 inches to 10 feet 6 inches~~

~~Soft ground tunnels with iron wails.~~

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~~Fig. 5.— Paris Metropolitan Tunnel, longitudinal vertical section.~~

~~interior diameter, were constructed mostly in clay and without the use of compressed air, except for a com- paratively short distance through water-bearing gravel. In this gravel a timber heading was made, through which the shield was pushed. The reported total cost was £840,000. Among the tunnels constructed after the City and South London work was well advanced, lined with cast-iron segments, and constructed by means of annular shields and the use of compressed air, were a further extension of the Hudson River tunnel, through silt, 2000 feet, between 1888 and 1891, when work again stopped for lack of funds ; the St Clair, from Sarnia to Port Huron, 1889-90, through clay, and for a short distance through water-bearing gravel, 6000 feet, 18 feet internal diameter ; and the notable Blackwall tunnel under the Thames, through clay and several hundred feet of water- saturated gravel, 1892-97, about 3116 feet long, 24. feet 3 inches in internal diameter ; the shield, 19 feet 6 inches long, contained a bulkhead with movable shutters and other important features foreshadowed in Baker’s proposed shield (see Ency. Brit. vol. xxiii. p. 625). Numerous tunnels of small dia- meter have been similarly constructed in London and Glasgow for electric and cable ways, &c, one under the Mersey above Liver- pool for water-pipes, one under the East River in New York for gas-pipes, several for sewers in Melbourne, and two under the Seine at Paris for sewer siphons. Shields about 23 feet diameter were used in constructing stations on the Central London railway, and one 32 feet 4 inches in diameter and only 9 feet 3 inches long on the Clapham extension of the City and South London railway.~~

~~subway on Tremont Street. Each hydraulic press of the shield reacted against a small continuous cast-iron rod imbedded in the brick arch. Among the important masonry tunnels built in Paris by the aid of roof-shields are : the Collecteur de Clichy (extra-mural), 1896-97, about 1-1 mile long, 6 metres wide, 5 metres high ; the prolongation of the Orleans railway under the~~

~~6. — Paris Metropolitan Tunnel, section through centres.~~

~~Fig. 7. — Paris Metropolitan Tunnel, section through shield.~~

~~The Baltimore (U.S.A.) Belt railroad tunnel under Howard Street, about 1-4 mile in length, for a double- track railway, through sand and clay, was built mostly by the crown-bar method of timbering, in 1890-93; it is notable on account of an attempt to tunnel by means of a roof-shield on side-walls previously made. In 1896 this method with a roof-shield (exterior diameter 29 feet 4 inches) was successfully used on a portion of the Boston~~

~~Soft ground masonry tunnels.~~

~~running~~

~~quays south of the Seine, between the Austerlitz station and the Quai d'Orsay, in 1898-99, interior width 8 to 9 metres, with a height of about 5 metres above the rail ; and a portion of the Metropolitan! railway system from the Porte de Vincennes to the Porte Maillot, with branches, 1898-1900, 7-1 metres wide, 5-2 metres high inside. In the Orleans tunnel the shields moved on side-walls previously con- structed, as in Boston. In' the other two they moved on timber platforms with steel rails, the under portions of the tunnels being made by underpinning. In all the shields were pushed from the strongly-braced ribs of the masonry centres. The Thirty-ninth Street sewerage tunnel in Chicago, through clay and quicksand, about 2 miles long, has an internal diameter of 20 feet. The shields are pushed from a wall 8 inches thick of oak plank surrounding the brick walls (18 inches thick) of the sewer. The East Boston tunnel, the~~

first example of a shield-built monolithic concrete arch, from the Boston subway under the harbour to East Boston, is 14 mile long, of which 1 mile is to be ex- cavated (begun October 1900) by tunnelling with roof-shields about 29 feet wide and 12 feet 6 inches long through clay containing some pockets of sand and gravel. Some 23 miles of water-works brick-lined tunnels have been built since 1864 in clay under the Great Lakes, without the use of shields, but the more recent ones with the use of compressed air. The latest Cleveland tunnel, 9 feet interior diameter, was built at the rate of 17 feet per day, and cost about $18 per foot.

See latest editions of Simm's and of Drinker's Tunnelling; Paris editions of Legouez and of Philippe on Le Bouclier; 4th and 7th Annual Reports Boston Transit Commission.

(n. a. c.)

Tunstall, a market town and railway station, in the North-Western parliamentary division of Staffordshire, England, 4 miles north-west of Stoke. The Victoria Institute was erected at a cost of £15,000, and in 1891 a public free library was accommodated in the institute buildings. Public baths were opened in 1890, and a drill hall was built in 1895. There are many collieries, iron- works, and potteries in the immediate neighbourhood. Population (1891), 17,112 ; (1901), 19,492.

Tupper, Sir Charles, Bart. (1821), Brit- ish colonial statesman, son of the Rev. Charles Tup- per, D.D., was born at Amherst, Nova Scotia, on 2nd July 1821, and was educated at Horton Academy. He afterwards studied for the medical profession at Edin- burgh University, where he received the diplomas of M.D. and L.R.C.S. In 1855 he was returned to the Nova Scotia Assembly for Cumberland county. In 1862 he was appointed, by Act of Parliament, governor of Dalhousie College, Halifax ; and from 1867 till 1870 he was president of the Canadian Medical Association. Mr Tupper was a member of the Executive Council and provincial secretary

~~*of Nova Scotia from 1857 to 1860, and from 1863 to 1867. He became prime minister of Nova Scotia in 1864, and held that office until the Union Act came into force on 1st July 1867, when his Govern- ment retired. He was a delegate to Great Britain on public business from the Nova Scotia Government in 1858 and 1865, and from the Dominion. Government in March 1868. Mr Tupper was leader of the delegation from Nova Scotia to the Union Conference at Charlotte- town in 1864, and to that of Quebec during the same year ; and to the final Colonial Conference in London, which assembled to complete the terms of union, in 1866-67. On that occasion he received a patent of rank and precedence from Queen Victoria as an executive councillor of Nova Scotia. He was sworn a member of the Privy Council of Canada, June 1870, and was presi- dent of that body from that date until 1st July 1872, when he was appointed Minister of Inland Revenue. This office he held until February 1873, when he became Minister of Customs. His colleague, Sir John A. Mac- donald, the first premier of the Dominion House of Commons, resigned at the close of 1873, and Mr Tupper retired with him ; but on Sir John's return to power in 1878, Mr Tupper became Minister of Public Works, and in the following year Minister of Railways and Canals. At this time he was made K.C.M.G. Mr Tupper was the author of the Public Schools Act of Nova Scotia, and had been largely instrumental in moulding the Dominion Con- federation Bill and other important measures. Sir Charles represented the county of Cumberland, Nova Scotia, for thirty-two years in succession — first in the Nova Scotia Assembly, and subsequently in the Dominion Parliament until 1884, when he resigned his seat on being appointed High Commissioner for Canada in Lon- don. He was appointed by the Dominion Government Executive Commissioner for Canada to the Antwerp Exhibition of 1885 and the Colonial and Indian Exhibi- tion of 1886, of which also he was appointed Royal Commissioner by Queen Victoria. Shortly before the Canadian Federal elections of February 1887, Sir Charles re-entered the Conservative cabinet as Finance Minister. By his efforts the Canadian Pacific railway was enabled to float a loan of $30,000,000, on the strength of which the line was finished several years before the expiration of the contract time. He resigned the office of Finance Minister in May 1888, when he was reappointed High Commissioner for the Dominion of Canada in London. Sir Charles was designated one of the*~~

~~*plenipotentiaries of her Majesty Queen Victoria to the Fisheries Convention*~~

~~*at Washington in 1887, the result of which conference was the signing of a treaty in February 1888 — subject to ratification — for the settlement of the isatters in dispute between Canada and the United States in connexionwith the Atlantic fisheries. He was created a baronet in September 1888. When the Dominion cabinet, under Sir Mackenzie Bowell, was reconstituted in January 1896 Sir Charles Tupper accepted office, and in the following April he succeeded Bowell in the premiership. On both patriotic and commercial grounds he urged the adoption of a preferential tariff with Great Britain and the sister colonies. At the general election in the ensuing June the Conservatives were severely defeated, chiefly on the question of the Manitoba Roman Catholic schools, and Sir Charles Tupper and his colleagues resigned, Sir Wilfrid Laurier becoming premier. The Conser- vative party now gradually became more and more dis- organized, and at the next general election, in November 1900, they were again defeated. Sir Charles Tupper, who had long been the Conservative leader, sustained in his own constituency of Cape Breton his first defeat in forty years.*~~

~~*Tupper, Martin Farquhar (1810-1889), Eng- lish writer, the author of Proverbial Philosophy, was born in London, 17th July 1810, being the son of Mar- tin Tupper, a distinguished medical practitioner, who came of an old Huguenot family, another branch of which settled in the United States. He was educated at Charterhouse and Christ Church, Oxford, where he gained a prize for a theological essay, Gladstone being second to him. He was called to the bar at Lincoln's Inn, but never practised. He began a long career of authorship in 1832 with Sacra Poesis, and in 1838 he published Geraldine, and other Poems, and for fifty years was fertile in producing both verse and prose ; but his name is in- dissolubly connected with his long series of didactic moralizings in blank verse, the Proverbial Philosophy (1838-67), which for about twenty-five years enjoyed an extraordinary popularity that has ever since been the cause of persistent satire on the part of literary critics. The first part was, however, a comparative failure, and N. P. Willis, the American author, took it to be a for- gotten work of the 17th century. The uninspired character of*~~

~~*Tupper's poetry is indubitable, and the critics who have made his name a butt were so far justi- fied ; but the Proverbial Philosophy, though now unread, was full of a perfectly genuine moral and religious feel- ing and frequently of apt and striking expressions, together with an easy flow of language, which accounted quite naturally for its success among readers to whom the subtleties of a higher order of poetry would never appeal. A genial, warm-hearted man, Tupper's humane instincts were generally in the right direction, and he espoused many reforming movements which deserved and obtained success. He was a patriotic Briton, an early supporter of the Volunteer movement, and did much to promote good relations with America. He was also a mechanical inventor in a small way. In 1886 he pub- lished My Life as an Author; and on 29th November 1889 he died at Albury, Surrey.*~~

~~*Turbines, Steam. See Engines: Steam.*~~

~~*Turgai, a province of Russian Central Asia, formerly part of the Kirghiz Steppes, now one of the four provinces of the general-governorship of the Steppes, bounded by Uralsk and Orenburg on the W. and N., Akmolinsk on the E., and Syr-darinsk and the Sea of Aral on the S. It has an area of 176,219 square miles, and its population, which was estimated at 323,110 in 1882, was 453,123 (domiciled only) in 1897, of whom 215,511 were women, and only 19,527 lived in towns. The*~~

~~*population is still mainly composed of Kirghiz, but Russians have immigrated in large numbers, and they were estimated at 21,600 in 1890 and about 30,000 in 1897. The province is divided into four districts, the chief towns of which are Turgai (1180), which is also the capital of the province, and stands off the caravan road from Tashkend to Orsk, Ak- tube (2840), a fort, in the district of Iletsk, Irghiz (1536), and Kustanai (14,065), in the Nikolaievsk district, a prairie town which has grown with great rapidity. Agriculture is mainly car- ried on by the Russian settlers in*~~

~~*the Mkolaievsk dis- trict, where the crops (chiefly wheat and oats) do not suffer so much from droughts as they do elsewhere. But the Kirghiz are also beginning to cultivate the soil, and in 1900 there were in all 612,200 acres under cereals. The average yield in 1895-99 was : rye, 19,800 cwt. ; wheat, 933,000 cwt. ; oats, 226,000 cwt. ; barley, 22,000 cwt. ; all cereals, 1,115,000 cwt. ; also 22,000 cwt. of potatoes. Cattle-breeding is the leading occupation of the Kirghiz, and in 1896 there were in the province 682,000 horses, 332,000 horned cattle, 1,605,000 sheep, about 128,000 goats, and 149,000 camels, these last being kept by the nomads both for their own personal use in moving about from place to place and for the transport of goods between Bokhara, Khiva, and Rus- sian Turkestan. Cattle-breeding, however, suffers greatly from the snow-storms, which destroyed in 1879-80, 42 per cent, of all the herds, and in 1890-91, 48 per cent, of the horses, one-third of the horned cattle, sheep, and goats, and 22 per cent, of the camels. Considerable quantities of cattle and various animal products are exported to Orenburg, Orsk, and Troitsk, and to Ust-Ui and Zverinogolovsk, where large fairs are held. Hunting continues to keep its importance- There are a few. oil-works, tanneries, and flour-mills, and among the Kirghiz the making of carpets and felt goods is widely spread. Education is a little more advanced than in the other Steppe provinces ; the system of "migratory schools" has been introduced for the Kirghiz.*~~

~~*See Ya. Talferoff, The Turgai Province, 1896 ; Dobrosmye- loff, Cattle-breeding in Turgai, 1895 (both Russian).*~~

~~*(p. A. K.)*~~

~~*Turin, a city of northern Italy, formerly capital of Piedmont and the Sardinian states, and of Italy until the removal of the seat of government to Florence in 1865. It is now capital of the province of the same name, and headquarters for the first Italian army corps. Its geographical position is excellent : built upon alluvial soil at a short distance from the Alps, it stands upon two rivers, the Dora to the north, running from west to east, and the Po to the west, running from south to north. The area of the city is 4155 acres, and its octroi circle measures nearly 9 miles. The streets and avenues, almost all of which are straight, cut each other at*~~

~~*right angles, forming blocks of houses called "islands." In 1899 the population numbered 366,055, including the garrison 8500 strong. The marriage returns show that only 3 per cent, of the population are unable to read or write. The birth-rate is 21-7 and the death-rate 17-57 per thousand. The average length of life is 45 years.*~~

~~*For administrative purposes the city is divided into two municipal police sections and into seven govern- ment districts or mandamenti. The military organ- ization is proportionate in importance to the strategical position of Turin near the French frontier. There is a military arsenal with laboratories, a military academy for artillery and engineer officers, a war school, and a military hospital. Important new churches built since 1870 are : Santa Maria Ansiliatrice*~~

~~*and San Giovanni Evangelista, both the work of the Salesian Order, founded by Dom Bosco ; San Gioacchino ; the Sacro Cuor di Maria, in which is preserved one of the chefs-d'oeuvre of modern Italian sculpture, " Christ on the Cross," by Pietro Canonica ; Nostro Signore della Salute, still unfinished. The finest theatres are the Reggio and the Carignano, but several minor ones exist. Four public arcades have been built, namely, the Galleria Geisser, the Galleria Subalpina, the Galleria Nazionale, and the Galleria Umberto I. ; the three former in the centre of the city, and the latter in the working-class quarter of Porta Palazzo. The Po is spanned by four bridges, and the Dora by six. The principal public monu- ments are those to Cavour (by Dupre), to Carlo Alberto and Emanuele Filiberto (by Marochetti), to the Duke of Genoa (by Balzico), to Garibaldi (by Tabacchi), to Lamarmora (by Grimaldi), to Manin (by Vela), to Victor Emmanuel II. (by Pietro Costa). An equestrian monu- ment to Prince Amadeus of Savoy (by Calandra) was inaugurated in May 1902. It is one of the most suc- cessful pieces of modern Italian statuary. Other im- portant monuments are those commemorative of the Mont Cenis tunnel, and the magnificent " Standard- bearer " (by Vela) in honour of the Sardinian army. The Mole Antonelliana, built by Alessandro Antonelli, is the most important example of modern architecture in Turin. It belongs to the municipality, and is used for the Risorgimento Museum. It is the highest brick edifice in Europe, its summit being 510 feet above ground. In addition to the Royal Albertine Academy, the Turin museums and*~~

galleries include the Royal Pinacoteca, containing important works of the Pied- montese schools and Vandyck's famous picture, "The Sons of Charles I."; the Museum of Antiquities, notable for its collection of Egyptian antiquities; the Civic Museum, divided into two sections of fine arts and art applied to industry; the royal armoury, one of the most complete in Europe ; the museums of zoology, geology, and mineralogy ; and the museum of artillery. There are several libraries, including the national, the civic, and the royal, the latter containing a collection of 40,000 medals and coins. The Turin Obser- vatory is situated in the Palazzo Madama, formerly the seat of the Italian Senate. In regard to education Turin holds one of the first places in Italy. Its uni- versity, attended by 2700 students, comprises all the faculties. New and splendid buildings, erected in the Valentino Gardens, include the university buildings proper, physical, chemical, anatomical, and patholog- ical laboratories. Turin possesses, besides a school of practical engineering, an industrial museum, a school of veterinary medicine, a free school of agri- culture, a botanical garden, numerous hospitals, a psy- chiatrical institute, an obstetrical institute, a laboratory of political economy, three lyceums, six gymnasiums, a technical institute, and six technical schools, one of which is for women. The municipal elementary schools count 701 classes with 30,000 pupils. There are 40 in- fant asylums. Four daily political newspapers are pub- lished in Turin, besides 130 periodicals of various kinds. Musical education is cared for by the Liceo Musicale, while fine arts and annual art exhibitions are pro- moted by a special society and by the Artists' Club. Sport and athletics are furthered by several cycling clubs with two velodromes, an automobile club, a zootech- nical society, and a racing society ; a ground for the game of pallone ; a skating rink, two lawn-tennis clubs, a large rifle range, several athletic clubs, including an Alpine Club which, founded in Turin, has spread throughout Italy; a rowing club and several canoe clubs, which organize frequent regattas on the Po. There are more

~~*than twenty lines of electric trams worked by two com- panies. The total length of tramway lines is about 53 miles. Nine lines of steam tramway start from the city, their length within the octroi circle being 11 miles.*~~

~~*The industries comprise metallurgy, machine-making, chemicals, silk and cotton weaving, tanning, and leather-working. The appli- cation of electricity is widely developed on account of the proximity of Alpine valleys rich in torrents. The number of persons em- ployed in industries is 26,171, of whom 23,147 are adults (17,132 men and 6015 women), and 3024 minors (2487 males and 537*~~

~~*Among the hospitals is that called by the name of its founder, Co.ttolengo, a vast institution providing for more than 5000 per- sons ; there are also the Ospedale Maggiore dl San Giovanni, the Ospedale Mauriziano, and many other hospitals for special dis- eases, as well as asylums and charitable institutions of all kinds. Few Italian cities are so well provided as Turin with institutions for the needy and afflicted. In regard to sanitation, Turin has reconstructed the old quarters in order to admit light and air to the most densely-populated parts, and is completing its sewers on the most modern systems. An artificial ice company has pro- vided the city with meat storage rooms, a necessity of warm cli- mates ; the supply of drinking water, furnished by two aqueducts, is being increased by the addition of a third. The municipal budget for the year 1900 balanced with the revenue and expenditure of 14,164,803 lire. The principal sources of revenue are direct taxes and the octroi, which together produce more than 10,000,000 lire. Revenues derived from municipal properties and from municipal services yield 1,500,000 lire. Expenditure comprises 2,469,680 lire of general outlay, 2,354,000 lire for police and sanitation, 3,157,944 lire for public works, 1,786,940 lire of interest on the municipal debt, 854,710 lire of sinking fund, 2,643,895 lire for education, and 425,712 lire for worship and charity. Municipal properties are valued at 34,482,098 lire as against a debt of 33,150,771 lire, including 24,000,000 lire consolidated debt.*~~

~~*Though the opening of the St Gothard tunnel exercised a pre- judicial influence upon the traffic of the network of railways of which Turin is the centre, by diminishing trade with France, the new agreement with the St*~~

~~Gothard railway and the opening of the Simplon tunnel will compensate these disadvantages. Trade has been facilitated by the opening of telephonic communication with Novara, Milan', Como, and Pinerolo. Similar communica- tion has lately been opened with Rome, Modane, Lyons, Paris, and with the chief Swiss towns. 'Within the last twenty-five years of the 19th century, the activity of the Turinese succeeded in neutralizing the effect of the transfer of the capital to Florence and Rome. Since 1864 its population has nearly doubled, and the city, in virtue of its transformation into an active centre of trade and industry, has become eminently modern and progressive.~~

~~Among the surroundings of Turin the Hill of Superga (2300 feet above the sea) merits special mention. Victor Amadeus II. erected there a votive basilica in memory of the liberation of Turin from the French in 1706. King Charles Albert and other kings and princes of the Savoy dynasty are buried in the crypt. Not far from Turin are also the castles of Moncalieri, Stupinigi, Rivoli, Racconigi, Agle, Venaria, and the ancient monastery of the Sagra di San Michele (753 metres above sea- level). The last named is interesting archseologically, and famous for its view of the Alps as far as the beginning of the Lombard plain. (a. fe.)~~

~~Turkestan, a geographical term for a vast region in Central Asia, which, after excluding from it the Chinese province of Kulja and the Turkestan khanates of Af- ghanistan, may conveniently be divided into (I.) Western Turkestan, and (II.) Eastern or Chinese Turkestan.~~

~~I. Western Turkestan.~~

~~This country as a whole was fully described in the corresponding section of the article on Turkestan in the ninth edition of this work, and all that is now required is an account of the economic conditions of the various political divisions. These are : — (1) the vassal states of Bokhara and Khiva ; the Eussian provinces of (2) Turgai, Akmolinsk, and Semipalatinsk, forming part of the general-governorship of the Steppes ; (3) Semiryechensk, Syr-dariinsk, Samarkand, and Fergana, composing the general-governorship of Turkestan ; and (4) the Trans- caspian region. These are all treated under their re- spective headings, and those provinces which are included~~

~~*in the general-governorship of the Steppes are dealt with collectively under that head. Consequently it is only necessary here to deal collectively with the provinces com- prised in the general-governorship of Turkestan. The following table shows the area and population of these at the census of 1897. It should be noted that Syr-dariinsk includes the Amu-daria district, which was formerly a separate province.*~~

~~*Province.*~~

~~*Area, Square Miles.*~~

~~*Domiciled Population,*~~

~~*1897.*~~

~~*Density per square Mile.*~~

~~*Samarkand Fergana . Semiryechensk . Syr-dariinsk*~~

~~*Total*~~

~~*26,627*~~

~~*35,654*~~

~~*152,280*~~

~~*194,853*~~

~~*857,817 1,560,411*~~

~~*990,107 1,479,848*~~

~~*32 43*~~

~~*7 7*~~

~~*409,414*~~

~~*4,888,183*~~

~~*Notwithstanding immigration, the Russians still con- stitute a very small proportion of the population, except in the province of Semiryechensk, where the Cossacks, the peasants, and the artisans in towns number 130,000, and, with 10,911 Russian troops, constitute 14 per cent, of the aggregate population. The only other province containing any considerable number of Russians at all is Syr-dariinsk, where there are about 10,000 Russian settlers (less than 1 per cent, of the population). About 12,000 Russians are settled in Bokhara and about 4000 in Khiva.*~~

~~*There are several populous cities in Russian Turkestan. Its capital, Tashkend, in the Syr-daria province, had 156,414 inhabitants in 1897, and other cities of import- ance are Samarkand (54,900) in Zerafshan, Marghilan (36,592 in Old Marghilan, and 8977 in New Marghilan) in Fergana, Khojent (30,076) in Syr-daria, Kokand (82,054), Namangan (61,906), and Andijan (46,680) in Fergana.*~~

~~*Education. — In the way of education nearly everything has still to be done. In 1899, of middle schools, there were only four gymnasia and pro-gymnasia for boys and six for girls (346 pupils), one real school (50 pupils), two girls' schools of the Institution of the Empress Marie (207 pupils), one corps of cadets, and one teachers' semin- arium (148 pupils). Of primary schools there were 105, with 4305 pupils in the Russian schools, and about 95,000 pupils in 6400 Mussulman schools. A technical school and an experimental agricultural station with a school have been opened at Tashkend.*~~

~~*Pursuits. — Agriculture and horticulture are the main pursuits of the settled population, while the nomad Kirghiz are chiefly engaged in cattle-breeding. Both agriculture and horticulture are conducted in an excel- lent manner and with good results.*~~

~~*The only statistics available showing the area cultivated and the yield per annum are those for Semiryechensk. However, approximate estimates for the crops of 1888-89 in the four Turkestan provinces are : — rye, 136,000*~~

~~cwt. ; winter wheat, 6,714,000 cwt. ; spring wheat, 7,534,000 cwt. ; oats, 1,138,000 cwt. ; millet, 2,570,000 cwt. ; rice, 4,124,000 cwt. About 2,500,000 cwt. of "jugara" and some Indian corn must be added. Grain is consequently exported to Bokhara and Khiva, while the Transcaspian region has to import it. Considerable quantities of melons and all sorts of vegetables, as also various sorts of haricots and oleaginous seeds, are grown by the na- tives ; also the sunflower and the poppy (for oil) by the Russians. Garden culture stands at a high level. Since the Russian occupation progress has been made in certain branches of agriculture, notably in cotton-growing ; but though efforts are being put forth to extend the area irrigated, and though ambitious schemes have been drawn up for the irrigation of the Famine Steppe, some Russian authorities consider that the native system of irrigation, taking in an area of some 3,982,000 acres, is not so well maintained now as before the advent of the Russians. The improved results obtained in cotton-growing have~~

~~been chiefly brought about by the introduction of the American cotton-tree. At the same time a much larger area has been planted : whereas in 1883 only some 1300 acres were under cotton, in 1901 the trees covered nearly 719,500 acres. In 1900 the crop yielded 1,083,000 cwt. in Fergana alone, and over 1,590,000 cwt. in the four provinces, besides2,882,000 cwt. in Khiva and 1,451,000 cwt. in Bokhara ; over 800,000 cwt. of dressed cotton was obtained in 1899, of which from 500,000 cwt. to 700,000 cwt. was exported. Twenty- four steam cotton-dressing works are now in operation, and ninety in which water is the motive power. Wheat and rice of better quality are now grown. Perhaps the most characteristic feature of Turkestan agriculture is the variety of crops grown other than cereals and fodder plants. Kunjut (for oil), lucerne, madder, to- bacco, rice, melons, water-melons, cucumbers, onions, and fruit- trees— chiefly the apricot, plum, pistachio, mulberry, nut, and pomegranate — are all widely cultivated, and fruit and vegetables eaten with bread form a substantial part of the food of the popula- tion. Successful attempts have~~

~~also been made to introduce beet- root for the making of sugar. Sericulture was formerly a very im- portant industry, but about 1885 the silk-worms were attacked by disease, and the production of silk almost ceased. The industry is beginning to revive, and it is estimated that some 30,000 cwt. of raw cocoons are obtained annually. The vine, which was formerly grown only for its fruit (130,000 cwt. of currants, 600,000 roubles' worth, are exported annually), is being culti- vated for wine also, of which about 270,000 gallons are obtained annually. Cattle-breeding is extensively carried on, and the esti- mates for 1898-99 give 548,000 camels, 1,581,000 horses, 78,000 donkeys, 1,571,000 horned cattle, and over 11,500,000 sheep and goats, to which 1,000,000 horses, 300,000 camels, 700,000 cattle, and 7,000,000 sheep in Bokhara must be added. Nothing has been done to develop the not inconsiderable mineral resources of Turkes- tan. In 1899 some naphtha and about 30,000 cwt. of asphalt were obtained in Fergana, besides some 6000 tons of coal, chiefly in Samarkand, and small quantities of gold, copper ores, and sul- phur. About 600,000 cwt. of salt were raised in Turkestan and Transcaspian in 1899.~~

~~Railways. — The Transcaspian railway now connects Turkestan with Krasnovodsk on,the Caspian Sea. Its length via Merv, Charjui on the Amu, and Bokhara to Samarkand, is 938 miles. This line has been continued to Kokan, New Marghilan, and Andijan, 328 miles, with a branch from Chermyaevo station to Tashkend, 94 miles. A line from Tashkend to Orenburg, via Perovsk, Kazalinsk, and Irghiz, is now under construction. The Transcaspian railway is of great importance to Turkestan, being the main artery for the export of raw cotton and animal products and the import of man- ufactured goods.~~

~~II. Eastern Turkestan.~~

~~Several explorations were made in this territory during the years 1886-92, by the Russian expeditions of Pyevt- soff, Roborovski, and Kosloff (the travelling compan- ions of Prjevalsky, who continued his epoch-making work), the brothers Grum-Grzimailo, and the geologists Bogdanovitch and Obrucheff; Captain Younghusband, Carey, M. S. Bell, and M. A. Stein ; the Swedish explorer Sven Hedin; Dutreuil de Rhyns, Bonvalot,~~

~~Futterer, and several others. Owing to its position on the way to the yet unexplored plateaus of Tibet and the upper courses of the Yellow and the Blue rivers, East Turke- stan has been crossed over and over again by numerous expeditions. We have accurate maps of all the inhabited parts of this territory, which was a terra incognita when Prjevalsky ,began his memorable journeys ; l and rich collections of both the flora and the fauna of East Turke- stan are now found in all the chief museums of Europe. These explorations do not alter the conceptions concerning the orography and the leading topographical features of the country. Only partial additions are consequently needed to the description given in the earlier volumes of this Encyclopaedia.~~

~~Administration. — East Turkestan is now part of the Chinese province of Hsin-kiang, which comprises also the eastern Tian-shan and a portion of Dzungaria, the Bei-~~

~~i The best small-scale map (1 : 7,500,000) is that issued in 1902 in Stieler's Hand Atlas, 62, by B. Domaun, the orography being admira- bly represented.~~

~~shan and a portion of the Nan-shan highlands, and also a strip of land on the Tibet plateau along its northern border range, including the Ayak-kum and Atjiklanes. According to G. Gruin-Grzimailo, East Turkestan com- prises three different dao-tais — the" dao-tai of Kashgar (districts : Kashgar, Yarkand, and Khotan) ; of Aksu (districts, Aksu, Kucha, and Kurla-Karashar) ; and of Urumehi (districts : Turfan and Hami). The residence of the governor-general of the whole province is at Urumehi, and its chief towns are Kashgar (from 60,000 to 70,000 inhabitants), Yarkand (60,000), Khotan, Niya, Sa-chou; Aksu, Urumehi, Khotan, Uch-Turfan, Kunya Turfan (about 15,000 to 20,000 in the two towns, Chinese and Turkish, of this name), Kucha, Karashar, Hami, and Barkul.~~

~~Physical Features. — Both the natural and the adminis- trative limits of East Turkestan are pretty well denned by the mountains which surround it — namely, by the western and the eastern Tian-shan in the north, the eastern border-ranges of the Pamir on the west, and the succession of border ranges of the Tibet plateau which are comprised under the rather misleading name of Kuen-lun. On the east, East Turkestan is separated~~

~~*from the Gobi by the Bei-shan or Pe-shan — a slightly higher terrace of the plateau which joins the Hami extremity of eastern Tian-shan to the eastern extremity of the Altyn-tagh, and the Nan-shan. This terrace has an average altitude of about 4500 feet, and is intersected by a series of par- allel ranges which run east-north-east, have their base on the plateau, and reach a height of from 5500 to 7400 feet. Broad longitudinal valleys, covered with gravel and partly with the red " Gobi deposits," run between these low chains of ragged mountains, which consist of granites and crystalline rocks belonging to the Palaeozoic period. Two routes leading from Hami to the Chinese town Sa-chou cross the Bei-shan, and as they are better provided with water than the more western routes, they are taken in preference to the latter.*~~

~~*Hashun Gobi. — The eastern portion of East Turkestan, between the Bei-shan and the Tarim river, is occupied by the Hashun (or Gashun) Gobi, or Ilkhuma — a desert which has all the characteristics of the Gobi (see Mon- golia). It has been crossed by several expeditions, arid consists apparently of two distinct parts — a dry and stony rolling desert, about 4000 feet high, intersected by parallel ranges of hills in the north ; and a slightly lower portion in the south, separated from the former by the Kuruk-tagh escarpment. This latter portion comprises the Lob-nor and the Kum-tagh deserts, 2500 to 3500 feet high, and is covered with sand, especially in the neigh- bourhood of the Chinese town Sa-chou (on the Tan-ho or Dan-ho river). We have here evidently a strip of land running from the Lob-nor eastwards, between the northern foot of the Altyn-tagh escarpment and the low escarpment of Kuruk-tagh. The lowest por- tion of his land-strip is in the Khalachi, or Kara-nor, marshes, north of Sa-chou, and represents the remains of what formerly was a large lake, where now the Tan- ho (or Dan-ho) and the Su-li-ho (or Bulundsir) rivers are lost.*~~

~~*East Turkestan Proper. — As to East Turkestan proper — i.e., the trapezoidal plateau, 3000 to 4000 feet high, which stretches from the Tian-shan to the Altyn-tagh, and from the Pamir to the Hashun Gobi, and which is watered by the Yarkand-daria (or Tarim) and its tributaries — recent exploration has only con- firmed the conception of it which was established by its first explorers, namely, that of a dreadful desert, the*~~

~~*Takhla-makan, surrounded by a girdle of loosely-connected oases, which are disposed at the foot of the surrounding mountains. The num- erous expeditions which have travelled along "the southern route" — that is, from Kashgar via Yarkand, the Khotan (Ilchi), Keriya, Niya, and Cherchen oases, and Lob-nor to Sa-chou — have fully disclosed the border-ridge character of*~~

~~*the mountains which fringe the Tibet plateau from the north (see Kuen-lun). At their western extremity these mountains Join the system of parallel mountain ranges which are described under various names (Chung-kyr, Kilian, Kaskem, Sarikol ranges), and run in a south-east to north-west or "Himalayan" direction, fringing the Pamirs, and containing the Mustaghata peak (25,800 feet) so as to join farther on the Ulug-art range of the Tian-shan. It may be that — as the uplifting of the Himalaya took place at a relatively recent geological period — traces of a gulf of a Secondary period sea, obliterated by sub- sequent upheavals, will be found penetrating from the south into East Turkestan, and reaching perhaps by its head the corner formed by the Pamir and the Tibet border ranges about Yarkand. However, no traces of such an invasion of the sea during the Secondary age have been found as yet. It is now fully proved by the Russian explorers that the fossils which were found by Stoliczka in the Turag-art pass near Kashgar, and which he had described on the spot as Triassic, belonged in reality to the Devonian formation. Some doubt prevails, consequently, as regards the " chalk gryphaea " mentioned as having been found near Yanghi-hissar. On the contrary, distinct Carboniferous deposits have been found by Bogdanovitch in the south-western corner of Kashgaria, as well as in the Tibet border ranges west of Khotan. As to the supposed " Mesozoic and Tertiary transgressions " of which so much was written since Richt- hofen's journey — the sea being supposed to have invaded Bast Turkestan and the Gobi during the Secondary and the Tertiary periods — no traces whatever of these theoretical transgressions have been found in East Turkestan any more than they have been found in the Gobi (see Mongolia). The red marls,*~~

~~sand- stones, and often unstratified or loosely stratified conglomerates, or gravels, which are found in the deserts of East Turkestan as well as of the Gobi, must have, in all probability, a continental origin, and they were deposited either during the Glacial period or in Post-Tertiary lakes.~~

~~The "northern route" — which leads through the succession of oases situated at the southern foot of the western Tian-shan (Kashgar, Uch-Turfan, Aksu, Bai, and Kucha), and the eastern Tian-shan (Korla, Karashar, with Lake Bagrach-kul, . Kunya, Turfan, Lukchun, Pichan, and Hami) — has been equally well explored, as well as the mountains to the north of it. It is now known that in western Tian-shan the Kokshal-tau range (Tian- shan range on some Russian maps), which on the south-east borders the Tian-shan plateaus, or syrts, and faces the plains of East Turkestan, runs due south-west, from the snow-clad Khan Tengri (24,000 feet) to the passes Bedel and Terek-davan. This mighty range gives origin to large glaciers on both its north- western and south-western slopes (SemenofF s Mushketofi' s, the group Inylchek on the former, and Savabtsi and Djaparlyk on the latter) ; and it has the parallel ranges 'of Boz-tagh on the south-east and Kirghiznyn-Alatau on the north-west.1~~

~~Eastern Tian-shan. — As to the eastern Tian-shan, its compli- cated structure is not yet quite clear. It seems that in its western portion, from Peak Khan Tengri to the meridian of Urumchi, it is a mere continuation of the western Tian-shan ranges and syrts (high plateaus). The Terskei and the Narat mountains have, in- deed, a north-easterly direction. However, about Urumchi they meet with the Boro-khoro (or Iren-kabirga) mountains which come from the west-north-west, running from Kopal to Lake Bagratch-kul (with the small parallel range Kok-tekke farther south). These mountains evidently belong to a different, perhaps more recent, system of upheavals. The Barkul mountains, at the eastern extremity of the eastern Tian-shan, have the same direction — they run west-north-west to east-south-east, and are continued farther east by a range of low hills which join the extremity of the Chinese Altai. As to the intermediate space, from Urumchi to Barkul, it is occupied by the Bogdo-ola mountains, which represent a massive upheaval composed in all probability of several chains of mountains. Granites, various crystalline slates, and fossil-bearing deposits of the Palaeozoic age enter into the~~

~~com- position of the eastern Tian-shan. Its peaks are snow-clad, and on the Bogdo-ola group, in the north of Lukchun, the snow-line lies at a height of 12,800 feet, while the passes are from 11,500 feet (Davanchin Pass near Urumchi) to 9000 feet (opposite Hami). On both its slopes the eastern Tian-shan falls as a very stately escarpment to the plateau above which it rises. On its northern slope, in Dzungaria, the altitudes of the plains are 2400 feet at Gu-chen, 3100 feet at Urumchi, and 5000 feet at Barkul ; and at the southern base we find altitudes of from 2500 to 2800 feet.~~

~~Depressions. — A very interesting depression, from 50 to 100 miles wide, covered with loess, gravel, salted clays, and occasion- ally marshes, runs along the southern foot of the eastern Tian- shan. Its level — 3000 feet in the west and 2700 in the east — is~~

~~i See A. Bolsheff 's map of the Khan Tengri expedition of 1886, in the Russian Izvestia.~~

~~slightly below the general level of both the Takhla-makan desert and the Hashun Gobi, whose average altitudes are from 3300 to 4000 feet. It is watered in its western portion by the' Yarkand-daria, while its eastern portion was formerly drained by a river that has since dried up ; and it appears altogether very probable that this depression was occupied in Post-Pliocene times by an immense lake.~~

~~Lukchun. — Another still deeper depression is found in the very heart, so to say, of the eastern Tian-shan, between these moun- tains and the escarpment which is known as the Chol-tagh. "We see here that the 2000 feet level line, very closely followed by the 3000 feet horizontal, encircles a narrow elongated space from 10 to 40 miles wide and 340 miles long, from 88° 30' E. to 95° E. The Kurukgol river waters it. About Hami, round Shona-nor, the bottom of this depression is only 120 feet above the sea in its lowest part, while at its western extremity, about Lukchun, its bottom sinks to the sea-level, or even below it. The Lukchun depression was discovered in 1889 by the brothers Grum- Grzimailo, and a few months later by the Pyevtsoff expedition. An accurate map of it, with levellings, has been made since by Roborovski, while a meteorological station was established near Lukchun town in 1893, and observations~~

~~were made there during twenty-four consecutive months.2 It appears from this map that a lake, Bojante-kul, surrounded by marshes which cover an elliptical space about 45 miles long and 15 miles wide, lies to the west-south-west of Lukchun, and that the surface of this space is either at or below the sea-level, the lowest spot being 370 feet below the level of the observatory. The exact level of this last cannot, of course, be determined, so long as no geometrical levelling has been made ; but from a comparison of the twenty- four months' observations of the barometer at Lukchun, it can be inferred that the station was 56 feet below the sea-level, with a possible error of about ± 40 feet. The most striking point is the small size of the depression. Some 30 miles east and west of Lukchun town the altitudes already are from 2500 to 3000 feet ; s while the mountains a few miles north of Turfan rise to 5720 and 11,500 feet, and the Chol-tagh, a dozen miles south of Lake Bojante, reaches 3500 feet. Obrucheff has shown that a local subsidence of the rocks took place at Lukchun, along a narrow strip parallel to the main direction of the mountains,4 but the extent of that subsidence not being known, we have no idea as to whether it was not purely local, and whether it would be adequate to explain the formation of the whole of the Lukchun depression, as well as the other much larger depression at the foot of the Tian-shan, whose extent has been already mentioned. Erosion must have been at work, and it is more than probable that not only an immense elongated lake formerly spread at the foot of the eastern Tian-shan, but that other lakes must have existed in its valleys. Ice must have been a powerful excavating agency in these mountains, since during the Glacial age, when the Arctic Sea covered the lowlands of western Siberia, the western Tian-shan mountains were buried under a thick layer of snow. Eastern Tian-shan can hardly have escaped glaciation, and we have, in fact, direct observation to that effect. G. Grum- Grzimailo describes immense boulders of a fine-grained grey granite, 14 to 17 feet high and up to 100 feet in circumference, which he found lying at an altitude of 3200 feet about the mouth of the Gaib gorge which descends from the Karlyk-tagh moun- tains (12,000 feet) of eastern Tian-shan, in the north-east of Hami. The rocks of this gorge consisted, both at this spot and higher up, of quite a different sort of granite and crystalline slates, and a succession of side moraines was seen along the walls of the gorge.~~

~~*As to the present climate of the Lukchun depression, which happens to be situated in the very centre of Asia (the meteoro- logical station was in 42° 41' 57" ,N. and 89° 42' 28" E.), it is typical for Central Asia : the average temperatures were for the year 56° Eahr. ; for January, 17° ; for July, 88°. The lowest temperature observed was as low as 4-5° Eahr., and the highest as high as 109-5° (147° in the sun). The summer is thus as hot as in the Sahara, and January as cold as at St Petersburg. The dryness of the air is extreme, and in 1894 and 1895 there were only 22 and 17 rainy days respectively, while during the year the sky was quite cloudless on 147 days.*~~

~~*Antiquities. — The Lukchun depression, which belongs to the Turfan oasis, and lies at the junction of the roads from China and Lob-nor to Dzungaria, is very fertile even now, owing to excellent irrigation. It was inhabited even in the remotest times, and ruins of ancient cities and monasteries abound in it. The explora- tion by D. Klements of the ruins of some of these monasteries, now buried in sand, has led to the discovery of extremely*~~

~~*2 Memoirs of the expedition to Central Asia of Roborovski in 1893- 96, part iii. 1899 (Russian).*~~

~~*8 At Chektym, 57 miles from Lukchun, 1100 feet; 1770 feet at Lemchjim ; and 2810 feet at Hami.*~~

~~*4 Reproduced in Suess's Antlitz der Erde, iii.*~~

~~*interesting manuscripts, some of which are written in the Uigur language, and represent partly Buddhist religious texts, or Sanskrit texts in an Uigur transcription, and partly business documents,1 while others are written in alphabets quite unknown to linguists. Many more important discoveries may be ex- pected when the numerous ruins, dating from the first centuries of our era down to the 13th and even 16th centuries, are ex- plored. The same is true concerning the oases along the Tibet border,*~~

~~*where most remarkable discoveries have been made by M. A. Stein.2 At Dandan-uilig, situated in the Takhla-makan desert, on Hedin's route from the Khotan-daria to the Keriya- daria, fourteen detached temples and dwelling — houses were excavated ; and statues, votive offerings, and remarkable al-fresco paintings, as well as most interesting MSS., partly Sanskrit, were discovered. Most important MSS., written in Kharoshthi characters on wooden tablets and on leather, were unearthed, moreover, in the remains of some dwelling-houses on the Niya river.*~~

~~*Lob-nor. — In addition to what has been said in the ninth edition about the Tarim river, with its tributaries, and Lake Lob-nor (or Lop-nor), it must be noted that the discovery by Sven Hedin of lakes along that part of the Yarkand-daria where it flows south-east and south suggested to him the idea that the real Lob-nor of the Chinese was situated to the north of the great lake (Kara-koshun-kul) which was described as Lob-nor by Prjevalsky.8 However, this view was not accepted by most geographers, and there is little doubt that the elongated lake and marshy region which spreads in the direction in which the Cherchen-daria flows — that is, towards east-north-east from the settlement of Lob (39° 28′ N. and 88° 16′ E.), and along whose eastern coast Kosloff travelled in 1898 for 190 miles — are really what now remains of the great Chinese lake.4 In reality, it is possible that the whole of the triangular space between the Kuruk-tagh escarpment and the route of Kosloff in 1898 was once occupied by a large lake, traces of which Hedin found in 1900 along the southern foot of the Kuruk-tagh in the shape of extensive salt deposits and horizontal beds of clay, "with vast numbers of snail-shells, Zimncea, &c."6 This lake is marked as an ancient bed of the Konche-daria on the map of East Turkestan in Stieler's Atlas by B. Domann. During this same journey Sven Hedin descended the extremely sinuous bed of the Yarkand-daria in a boat as far as Yanghi-kul, and he explored, during a subsequent visit to Lob-nor, most interesting ruins, where important manuscripts were unearthed.6*~~

~~*Takhla-makan Desert. — As to the Takhla-makan desert, it is known that it consists of an undulating region covered mostly with gravel and partly with sand, slowly uprising from 3400 feet on the Tarim, at Shah-yar, to 4000 feet in its middle parts, and to 4680 feet at Keriya. Prjevalsky and*~~

~~*Carey, who crossed it, as also Hedin, who was nearly lost in its western part, found the journey extremely difficult on account of a want of water and fuel.*~~

~~*Communications. — The communications of East Turkestan with China proper are by means of three roads, one of which is known as the military road, and another is only available for carts ; all three start from Hami, cross the Bei-shan, and reach the Chinese towns of An-hsi-chou and Sa-chou. A fourth road, which, however, is seldom resorted to, connects Lob-nor with Turfan. The passages across the eastern Tian-shan are numerous, but all of them reach great heights, only one lying at an altitude of 5560 feet, while the others lie at altitudes of from 7000 to 10,384 feet. Only three passes, all very difficult, lead across the western Tian-shan mountains to Russian Turkestan, the chief of them being Muz-art; the others are the Bedel (13,700 feet) and Terek-davan (12,700 feet) passes. And finally, several very diflicult passes lead to the Pamir, the chief of them being Chichiklik (14,430 feet). The communications with India are still more difficult, the chief ones being the renowned pass of Kara-korum (18,500 feet), and another leading through the Raskem.*~~

~~*Industries. — Being composed of several oases, situated wide apart, East Turkestan offers a great variety as regards its agri- culture and industries. Every oasis has its own peculiar features.*~~

~~*1 Nachrichten tiber die von der K. Akad. d. Wissenschaften zu St Petersburg vm Jahre 1898 ausgerusteten Expedition, by D. A. Klements and W. Radloff. St Petersburg, 1899.*~~

~~*a Preliminary Report on a Journey of Archaeological and Topographical Exploration in Chinese Turkestan, by M. A. Stein. London 1901. Also Nature, 1902, vol. lxvi. 285.*~~

~~*3 Sven Hedin, Through Asia, London, 1898. Kosloff, the travelling companion of Prjevalsky, answered Sven Hedin's remarks in an elaborate paper in the Geographical Journal.*~~

~~*4 See a map of the region by P. Kosloff in the Geographical Journal, June 1898, vol. vi. p. 653. "The Lob-nor Controversy."*~~

~~8 Geogr. Journal, February 1901, p. 182. 6 Ibid. September 1901, p. 288.~~

~~Thus, the Khotan oasis is renowned for its silks, carpets, and felt goods. In Hami and Turfan the culture of the silk- worm and the fabrication of carpets are quite unknown, the distinctive feature of the latter oasis being its cotton goods. Kashgar is renowned for the dyeing of cottons, while Kucha is famed for its leather, Ak — su for its felts, metal goods, and leather, and Karashar is known for its saddlery. The East Turkestan goods are, however, considered inferior to those of Bokhara and Fergana. The system of irrigation has attained its highest perfection in the district of Turfan, where the irrigation canals are better than anywhere in Central Asia. The best gardens are found in Khotan, while the best melons come from Turfan and Hami ; the former is also renowned for its raisins, rice, sorghum, kunjut (Sesamum indicum), and hemp. Cotton and tobacco are grown everywhere. Madder is also culti- vated to some extent. East Turkestan is rich in all sorts of minerals, but their extraction continues to be very limited. Sulphur, saltpetre, and alum are obtained near Uch-Turfan and Yarkand. Jade and gold are found in the Kuen-lun mountains, lead in the west of Kashgar, where some naphtha, coal, and copper ores are also found. Some coppei is extracted on the southern slopes of the Bogdo-ola mountains. Coal is found in many places at Kurla, in the Karashar, in the Turfan oasis, and to the west of Hami. Rock-salt is obtained in the east of Ak-su and in northern Turfan. But all this mineral wealth still remains untouched, and metals, as also metal goods, are imported from Russia. Cotton, leather goods, sugar, matches, and so on, as also silk stuffs, are also imported from Russia, as well as silk goods fabricated in Russian Turkestan. Tea, silver, china, opium, and various small Chinese goods are imported from China. As to the trade with India, it has nearly disappeared — only some gold brocades, colours, tea, and drugs being imported. The chief exports from East Turkestan are silver, some cottons, raw silks, felts, and carpets to Russia ; dried fruit and various small goods to Dzungaria ; raisins and some raw cotton to China. However, the whole country has fallen into great poverty, and both the internal and external trade are passing through a crisis. Owing to a want of meadows, cattle-breeding has never been very much developed in East Turkestan, and horses are im- ported from the Kirghiz and Kalmyks. Lucerne is sown, but its crops are hardly sufficient for maintaining the~~

~~small number of cows. Goods are transported principally on horseback or on donkeys, camels being used only for long-distance caravans.~~

~~Authorities. — In addition to the works mentioned in the ninth edition, the following must be named : — Prjevalsky's Fourth Journey, 1886. — Carey and Dalgleish, in Proceedings R. Geog. Soc. 1887, xii. , and Suppl. Papers, iii. — W. T. Blanford. Scientific Results of the Second Yarkand Mission, based upon the Collections of the late If. Stoliczka. Calcutta, 1879. — S. D. Morgan, in Proceed. Geog. Soc. 1889, 375. — M.S. Bell, in Proceedings, 1890, 71. — Dutreuil de Rhins. L'Asie Gentrale, 1887-89 ; and his journeys, edited after his death; Memoirs {Trudy) of the Tibet Exped. of Pyevtsoff, 1891-93. — Bogdanovitch, in same publica- tion, vol. ii. 1892. — Roborovski. Expedition to Central Asia in 1893-95, 3 vols. 1897-99. — G. E. Grum-Grzimailo. Description of a Journey (Opisanie Puteshestviya) to Western China, 2 vols. 1897-99. — Potanin. Journey of, 1884-85, 2 vols. — Scientific Results of Prjevalsky' s Journeys. — Obrucheff. Central Asia, JsTorth China, and Nan-shan, 2 vols. 1899 and 1901 (the last seven works in Russian, with maps and numerous photographs, published by Russian Geographical Society). — P. K. Kosloff. "The Russian Tibet Expedition, 1899-1901," in the Geog. Journal, xix., May 1902. — F. E. Younghusband. The Heart of a Con- tinent, 1896. — Futterer. Durch Asien, vol. i. Berlin, 1901. — Sven Hedin. Scientific Results of my Journeys in Central Asia in 1894-97, in German. Gotha, 1900 ; and Through Asia, 2 vols. London, 1898 ; also in above-mentioned Proceedings. — Wegener. Versuch einer Orographic des Kwen-luns, 1891, con- taining a map upon which all itineraries to that date are given. — Woeikoff. Klimuate der Erde, 2 vols. 1887. — Richthofbn. "Morphology of East Asia," in Sitzungsberichte of the Prussian Acad, of Sc. 1900, ii. — Suess. Antlitz der Erde, especially vol. iii. 1901. (P> A- K \~~

~~Turkestan, or Hazret, a town of Kussia, in the Turkestan province of Syr-daria, on the highway from Orenburg to Tashkend, from which it is 180 miles distant. It lies on the right bank of the Syr river, 20 miles from it, at an altitude of 833 feet. It has a very old mosque of the saint Hazret-Yassavi, which attracts many pilgrims. It is now an important depot for~~

~~hides, wool, and other produce of cattle-breeding, the returns of its fairs reach- ing about 2,500,000 roubles a year. Population (1897),~~

~~11,592.~~

~~T U E K E Y.~~

~~I. Geography and Statistics.~~

~~THE Turkish or Ottoman empire comprises Turkey in Europe, Turkey in Asia, and the vilayets of Tripoli and Barca, or Bengazi, in North Africa ; and in addition to those provinces under immediate Turkish rule, it em- braces also certain tributary states, and certain others under foreign administration. Turkey in Europe, occupying the central portion of the Balkan Peninsula, lies between 38° 46' and 42° 50' N. and 19° 20' and 29° 10' E. It is bounded on the N.W. by Montenegro and Bosnia, on the N. by Servia and Bulgaria, on the E. by the Black Sea and the Bosphorus, on the S. by the Sea of Marmora, the Dardanelles, the Aegean Sea, and Greece, and on the W. by the Ionian and Adriatic Seas. Turkey in Asia, fronting Turkey in Europe to the south-east, and lying between 28° and 41° N. and 25° and 48° E., is bounded on the N. by the Black Sea, on the N.W. by the Bosphorus, the Sea of Marmora, and the Dardanelles, on the W. by the Aegean Sea, on the E. by Persia and Transcaucasia, and on the S. by Arabia and the Mediterranean. By the treaty of peace with Greece, 4th December 1897, about 1*80 square miles of Greek territory were ceded to Turkey — about 19 square miles being added to the vilayet of Janina, and the remainder to the independent district of Selfidje.~~

~~Population. — The following table is based, as regards European Turkey, on Petermann's Die Bevolkerung der Erde, Gotha, 1899, and as regards Turkey in Asia on Petermann's Mitteilungen (1896).~~

~~Vilayets, Districts, and Countries.~~

~~Area in sq. Miles.~~

~~*Population.*~~

~~*Per sq. Mile.*~~

~~*Turkey in Europe —*~~

~~*Constantinople (European*~~

~~*portion)*~~

~~*1,160*~~

~~*895,500*~~

~~*772*~~

~~*Adrianople ....*~~

~~*Thrace ....*~~

~~*Salonica ....*~~

~~*15,000*~~

~~*1,006,500*~~

~~*66*~~

~~*16,160*~~

~~*1,902,000*~~

~~*117*~~

~~*13,600*~~

~~*1,165,400*~~

~~*85*~~

~~*Selfidje (independent dis-*~~

~~*trict) ....*~~

~~*3,050*~~

~~*131,600*~~

~~*44*~~

~~*Monastir ....*~~

~~*7,650*~~

~~*715,800*~~

~~*94*~~

~~*Kossovo .... Macedonia and Bizas*~~

~~*12,100*~~

~~*961,000*~~

~~*80*~~

~~*(ancient Servia) . Scutari ....*~~

~~*36,400*~~

~~*2,973,800*~~

~~*80*~~

~~*4,570*~~

~~*322,000*~~

~~*71*~~

~~*Janina .... Albania .... Total Immediate Provinces*~~

~~*7,040*~~

~~*648,000*~~

~~*92*~~

~~*11,610*~~

~~*970,000*~~

~~*83*~~

~~*in Europe Turkey in Asia —*~~

~~*64,170*~~

~~*5,845,800*~~

~~*91*~~

~~*Constantinople (Asiatic por-*~~

~~*tion) ....*~~

~~*1,590*~~

~~*240,400*~~

~~*151*~~

~~*Archipelago*~~

~~*3,190*~~

~~*325,900*~~

~~*102*~~

~~*Ismidt (Mutessarifut x)*~~

~~*4,650*~~

~~*222,800*~~

~~*48*~~

~~*Biglia (Mutessarifut1)*~~

~~*2,890*~~

~~*129,400*~~

~~*45*~~

~~*Brusa*~~

~~*26,390*~~

~~*1,626,900*~~

~~*61*~~

~~*Smyrna*~~

~~.-•.~~

~~*20,450*~~

~~*1,396,500*~~

~~*68*~~

~~*Konia .*~~

~~.■~~

~~*35,340*~~

~~*1,088,000*~~

~~*31*~~

~~*Adana*~~

~~.~~

~~*15,390*~~

~~*403,400*~~

~~*26*~~

~~*Angora*~~

~~.~~

~~*32,020*~~

~~*892,900*~~

~~*28*~~

~~*Kastamuni*~~

~~*23,110*~~

~~*1,018,900*~~

~~*44*~~

~~*Sivas .*~~

~~,,~~

~~*32,290*~~

~~*1,086,500*~~

~~*33*~~

~~*Trebizond*~~

~~*:*~~

~~*12,070*~~

~~*1,047,700*~~

~~*87*~~

~~*Asia Mino*~~

~~*r . . .*~~

~~*209,380*~~

~~*9,479,300*~~

~~*47*~~

~~*1 Governed chiefly from Constantinople.*~~

~~*Vilayets, Districts, and Countries.*~~

~~*Area in sq. Miles.*~~

~~*Population.*~~

~~*Per sq. Mile.*~~

~~*Erzerum .... Mamuret-ul-Aziz*~~

~~*Bitlis*~~

~~*Diarbekir .... Van*~~

~~*Armenia ....*~~

~~*Aleppo .... Beirut .... Lebanon (Mutessarifut 2) Jerusalem (Mutessarifut2)*~~
:

~~*Syria*~~

~~*Zor (Mutessarifut1) Baghdad ....*~~

~~*Mosul*~~

~~*Bussorah (Basra)*~~

~~*Syria and Mesopotamia .*~~

~~*Eedjaz .... Yemen ....*~~

~~*Arabia ....*~~

~~*Total Turkey in Asia (Immediate Provinces) .*~~

~~*African Turkey —*~~

~~*Tripoli and Barca*~~

~~*Total Turkey in Asia and Africa ....*~~

~~*Grand total Immediate Provinces of Ottoman Empire*~~

~~*Under Turkish suzerainty, but not under its immediate government —*~~

~~*Eastern Rumelia .*~~

~~*Crete*~~

~~*Autonomous States .*~~

~~*Bosnia, Herzegovina (Aus- tria-Hungary) . Thasos ....*~~

~~*Under foreign adminis- tration ....*~~

~~*Bulgaria (Vassal State)*~~

~~*Total in Europe under Turkish suzerainty*~~

~~*Egypt*~~

~~*Cyprus .... Samos*~~

~~*Total in Africa underTurk- ish suzerainty*~~

~~*Grand total under Turkish suzerainty .*~~

~~*Grand total Turkish Empire*~~

~~*29,590 14,550 11,520 18,060 18,400*~~

~~*597,000 575,300 398,600 471,500 430,000*~~

~~*20 39 35 26 23*~~

~~*92,120*~~

~~*2,472,400*~~

~~*27*~~

~~*30,000 11,770 2,510 8,220 23,800 32,820 54,480 29,200 16,470*~~

~~*995,800 533,600 399,500 333,000 955,700 100,000 850.000 300,300 200,000*~~

~~*33 45 158 40 40 3 15 10 12*~~

~~*209,270*~~

~~*4,667,900*~~

~~*22*~~

~~*96,530 77,170*~~

~~300,000 750,000~~

~~3~~

~~10~~

~~173,700~~

~~1,050,000~~

~~6~~

~~684,470~~

~~17,669,600~~

~~26~~

~~397,110~~

~~-,000,000~~

~~3~~

~~1,081,580~~

~~18,669,600~~

~~18~~

~~1,145,750.~~

~~24,515,400~~

~~21~~

~~12,880 3,330~~

~~998,431 299,192~~

~~78 88~~

~~16,210~~

~~1,297,623~~

~~19,720 150~~

~~1,591,036 12,140~~

~~81 80~~

~~19,870~~

~~1,603,176~~

~~24,380~~

~~2,312,282~~

~~93~~

~~60,460~~

~~5,213,081~~

~~86~~

~~364,310~~

~~3,700~~

~~180~~

~~9,811,544~~

~~221,843~~

~~52,820~~

~~27~~

~~60~~

~~293~~

~~368,190~~

~~10,086,207~~

~~28~~

~~428,650~~

~~15,299,288~~

~~37~~

~~1,574,400~~

~~39,814,688~~

~~25~~

~~The following towns have over 50,000 inhabitants each : — Constantinople, 1,250,000; Smyrna, 200,000; Baghdad, 145,000; Damascus, 140,000; Aleppo, 122,000; Beirut, 118,000; Adrianople, 81,000; Brusa, 76,000; Kais- arieh, 72,000 ; Kerbela, 65,000 ; Mosul, 61,000 ; Mecca,~~

~~2 Governed directly from Constantinople.~~

~~[statistics~~

~~60,000; HIorns, 60,000; Sanaa, 58,000; Urfa, 55,000; and Marash, 52,000.~~

~~*Race and Religion. — Exact statistics are not available as regards either race or religion. The Osmanlis or Turks are supposed to number some 10 millions, of whom \ million belong to Turkey in Europe. Of the Semitic races the Arabs — over whom, however, the Turkish rule is little more than nominal — number some 7 millions, and in addition to about 300,000 Jews there is a large number of Syrians. Of the Aryan races the Slavs — Serbs, Bul- garians, Pomacks, and Cossacks — predominate, the other representatives being chiefly Greeks, Albanians, and Kurds. Mahommedans number more than half the population of the whole Ottoman empire. In the European provinces about two-thirds of the population are Christian and one-third Mahommedan. Full and fairly accurate statistics are available for a considerable portion of Asiatic Turkey. Out of a population of 13,241,000 (1896) in Armenia, Kurdistan, and Asia Minor, 10,030,000 were returned as Mahommedans, 1,144,000 as Armenians, 1,818,000 as other Christians, and 249,000 as Jews. There are also about 300,000 Druses and about 200,000 Gypsies. The non-Mussulman population is divided into millets, or religious communities, which are allowed the free exercise of their religion and the control of their own monasteries, schools, and hospitals. The communities now recognized are the Latin (or Catholic), Greek (or Orthodox), Armenian, Syrian, and United Chaldee, Maronite, Protestant, and Jewish.*~~

~~*Education. — The schools are of two classes : (1) public, under the immediate direction of the State ; and (2) private, conducted either by individuals or by the religious communities with the permission of the Government, the religious tenets of the non-Mussulman population being thus fully respected. State education is of three degrees : primary, secondary,- and superior. Primary education is Jratuitous and obligatory, and superior education is gratui- tous or supported by bursaries. For primary education there are three grades of schools : —*~~

~~*(1) Infant schools, of which there is one in every village.*~~

~~*(2) Primary schools in the larger villages.*~~

~~*(3) Superior primary schools, of which there are 100 altogether.*~~

~~*Secondary education is supplied by the grammar school, of which there is one in the capital of every vilayet. For superior education there is (1) the University of Constan- tinople, with its four faculties of letters, science, law, and medicine; and (2) special schools, including (a) the normal school for training teachers, (5) the civil imperial school, and (c) the school of the fine arts. In 1896 there were in European Turkey 821 Bulgarian schools, with 29,846 scholars; 1286 Greek, with 850,155 scholars; 80 Eumanian, with 3678 scholars ; and 162 Servian, with 7511 scholars.*~~

~~*Finance. — See separate article below.*~~

~~*Army and Navy. — In virtue of the enactments of May 1880, of November 1886, and February 1888, military service is obligatory on all Mussulmans, Christians being exempted on payment of a small military tax. It is this religious division which mainly cramps the military strength and efficiency of the Ottoman empire. The duration of service is twenty years : four with colours and two in reserves in the active service (nizam), eight in the reserve {rddif), and six in the territorial (mustahfiz). There is also the irregular cavalry (hamidieh), raised from the Kurds and the mountain tribes of Syria, and supposed to number 200,000 horsemen, but their effective value in war must be regarded as problematical. The army consists of seven corps d'armSe, each under a field-marshal.*~~

~~*The headquarters of the seven army districts are Constan- tinople, Adrianople, Monastir, Erzinjan, Damascus, Bagh- dad, and Sanaa (the Yemen). (For details see Armies : Turkey, vol. xxv. p. 665.)*~~

~~*For the navy the term of service is twelve years, of which five are in active service, three in the reserve, and four in the territorial. Much information as to the fleet is unattainable. The few ironclads are hopelessly out of date. There are several second-class cruisers, a consider- able number of gunboats, 2 torpedo-boat destroyers, about 40 torpedo-boats, and 2 Nordenfelt submarine boats. The navy is manned by about 2500 officers and 15,000 men.*~~

~~*Communications. — A considerable hindrance to the development of the empire's resources has been the lack of an adequate system of*~~

~~*communications ; but although it is still deficient in good roads, much has been done of late years to develop railways, extend canals, and improve river communications. From 1250 in 1885, of which 903 were in Europe and 347 in Asia, the mileage of railways had increased to some 3000 in 1900, of which 1240 are in Europe, 1500 in Asia Minor, and 260 in Syria. While in 1885 there were 14,600 miles of telegraph, with 26,000 miles of wire, there were in 1900 about 22,000 miles of telegraph, with 35,000 miles of wire.*~~

~~*Productions and Industries. — The Ottoman empire is renowned for its productiveness, but enterprise and skill in utilizing its capabilities are still greatly lacking, the most primitive methods being those in most common use. For the introduction of improvements something, however, has been done by the creation in 1892 of a special ministry of agriculture, to which is attached the depart- ment of mines and forests, formerly under the minister of finance. Since the year named an agricultural bank has been established, which advances money on loan to the peasants on easy terms. Schools of agriculture have been opened in the chief towns of the vilayets, and in connexion with those schools, and elsewhere throughout the empire, model farms have been instituted, where in- struction in the veterinary art can also be obtained.*~~

~~*To prevent the gradual destruction of the forests by un- skilful management and depredations, new regulations for their preservation have been passed. Schools of forestry have also been founded, and means have been taken for regulating the cutting of wood, and for replanting districts that have been partially denuded. About 21 millions of acres are under wood, of which over 3 millions are in European Turkey. In Europe the forest trees include the oak, the beech, the pine, the linden, the elm, the hazel, the olive, the walnut, and the mulberry ; in Asia the principal trees, in addition to most of those above named, are the juniper, the dogberry-tree, the pistachio, the plane, the cedar, the maple, the chestnut, and the ebony.*~~

~~*Wheat, maize, oats, barley, and rye are the chief agricultural products. The culture of cotton is making rapid progress, immigrants who receive a grant of land being obliged to devote one-fourth of it to cotton culture.*~~

Tobacco is grown all over the empire, the most important market for it being Smyrna. The tobacco leaf exported in 1896-97 amounted to 14,555 tons, of which 9921 tons were exported to foreign countries, and 4634 tons to other parts of the empire. Opium is mainly grown in Anatolia. All the more common fruit-trees nourish in most districts. In Palestine and elsewhere there is a large orange trade, and Bussorah, in Turkish Arabia, has the largest export of dates in the world. The vine is largely cultivated both in Europe and Asia, and muoh Turkish wine is exported to France and Italy for mixing purposes. From 127,785 in 1897-98 the number of vine-growers had decreased in 1898-99 to 95,488, but in 1899-1900 they had increased to 105,849. Owing to ravages of disease in the vineyards the export of wine sank from 11,984,550 kilos in 1897-98 to only 7,397,360 kilos in 1898-99 ; but in 1899-1900 it rose to 12,761,130 kilos, of which 4,509,662 were sent to France,

history]

3,499,035 to Italy, and only 106,133 to England. The chief centres of export are Adrianople (more than half), Constantinople, and Smyrna, the others being Brusa, Beirut, Ismidt, Mytilene, and Salonica. Under the auspices of the Administration of Public Debt silk culture is also carried on with much success, especially in the vilayets of Brusa and Ismidt. In 1888 a school of sericulture was founded for the rearing of silkworms according to the Pasteur method. During the first decade of administration the silk revenue averaged annually £28,594. During the seven years 1892-93 to 1898-99 the average was £50,918, and in 1899-1900 the amount was £81,669. The production of salt is also under the direction of the Council of Administration, and during the seven years 1892-93 to 1898-99 the annual average produced was 217,330 tons, and in 1899-1900 the amount was 227,540 tons. About a fourth of the salt produced is exported to foreign countries, and of this about three-fourths goes to British India. Since 1885 great attention has been paid to the sponge fisheries of Tripoli, the annual value of which is about £30,000. With its extensive sea-coast, and its numerous bays and inlets, Turkey has many

~~*excellent fishing-grounds, and the industry, the value of which is estimated at over £200,000 a year, could be greatly developed. Its general progress may be seen in the increase of the fishery revenue — derived from duties, permits, &c. — of the Administration of Public Debt. During the seven years 1892-93 to 1898-99 it was £40,738, and in 1899- 1900 the amount was £42,789. Among other important pro-*~~

~~*ductions of the Ottoman empire not already mentioned are sesame, coleseed, castor oil, flax, hemp, aniseed, mohair, saffron, olive oil, gums, scammony, and liquorice. Attar of roses is produced in large quantities both in European and Asiatic Turkey, and to aid in furthering the industry numerous rose plants are_ distributed gratuitously. The empire is rich in minerals, including silver, lead, copper, iron, coal, mercury, borax, emery, zinc ; and only capital is needed for successful exploitation. The silver, lead, and copper mines are mainly wrought by British capital. The more special industries of Turkey are tanning, and the manufacture of muslin, velvet, silk, carpets, and ornamental weapons.*~~

~~*Shipping and Commerce. — In 1890-91 the number of steamers that entered and cleared Turkish ports was 38,601, and of sail- ing vessels 140,726, the total tonnage of both classes of vessels being 30,509,861. In 1897-98 the number of steamers was 39,680 of 32,446,320 tons, the number of sailing vessels being 134,059 of 2,207,137 tons, thus giving a total tonnage of 34,653,457. About a third of the tonnage belongs to British vessels. The number of steamships belonging to Turkey in 1899-1900 was 177 of 55,938 tons, as compared with 87 of 46,498 tons in 1897-98, the number of sailing vessels in the same years being respectively 2205 of 141,055 tons and 1349 of 252,947 tons. The following tables give the total value of the exports and imports of the empire, arranged according to countries of destination, for 1890-91, 1895-96, and 1897-98 :*~~

—

~~*Exports 1890-91.*~~

~~*Exports 1895-96.*~~

~~*' Exports 1897-98.*~~

~~*Imports 1890-91.*~~

~~*Imports 1896-86.*~~

~~*Imports 1897-98.*~~

~~*Great Britain*~~

~~*£4,331,715*~~

~~*£5,755,602*~~

~~*£5,336,167*~~

~~*£8,930,502*~~

~~*£6,674,043*~~

~~*£8,885,731*~~

~~*Austria-Hungary*~~

~~*935,504*~~

~~*1,718,135*~~

~~*1,232,295*~~

~~*4,146,025*~~

~~*3,933,878*~~

~~*4,143,266*~~

~~*France .*~~

~~*3,358,880*~~

~~*3,561,365*~~

~~*3,897,354*~~

~~*2,550,244*~~

~~*2,135,388*~~

~~*2,181,762*~~

~~*Russia .*~~

~~*263,955*~~

~~*339,960*~~

~~*387,398*~~

~~*1,532,735*~~

~~*1,442,151*~~

~~*1,501,761*~~

~~*Italy .*~~

~~*498,787*~~

~~*502,322*~~

~~*437,275*~~

~~*449,802*~~

~~*604,073*~~

~~*891,600*~~

~~*Rumania*~~

~~*213,489*~~

~~*180,157*~~

~~*232,826*~~

~~*419,968*~~

~~*551,297*~~

~~*351,910*~~

~~*Bulgaria*~~

~~*366,952*~~

~~*312,389*~~

~~*338,281*~~

~~*859,939*~~

~~*789,554*~~

~~*3,011*~~

~~*Egypt .*~~

~~*617,099*~~

~~*17,303*~~

~~*56,495*~~

~~*478,997*~~

~~*130,477*~~

~~*Persia .*~~

~~*14,959*~~

~~*13,372*~~

~~*163,895*~~

~~*526,505*~~

~~*502,535*~~

~~*526,437*~~

~~*Belgium*~~

~~*11,237*~~

~~*86,780*~~

~~*163,545*~~

~~*450,965*~~

~~*535,164*~~

~~*518,025*~~

~~*Greece .*~~

~~*460,852*~~

~~*255,717*~~

~~*400,618*~~

~~*320,866*~~

~~*354,717*~~

~~*240,673*~~

~~*Germany*~~

~~*104,941*~~

~~*374,376*~~

~~*275,267*~~

~~*56,930*~~

~~*211,445*~~

~~*297,213*~~

~~*Holland*~~

~~*150,661*~~

~~*465,780*~~

~~*295,032*~~

~~*98,577*~~

~~*145,945*~~

~~*238,548*~~

~~*United States*~~

~~*164,363*~~

~~*319,763*~~

~~*40,310*~~

~~*67,222*~~

~~*30,334*~~

~~*46,497*~~

~~*Tunis .*~~

~~*721*~~

~~*115*~~

~~*126*~~

~~*35,800*~~

~~*23,985*~~

~~*12,861*~~

~~*Samos .*~~

~~*8,328*~~

~~*515*~~

~~*170*~~

~~*487*~~

~~*Other countries*~~

~~*50,386*~~

~~96,210~~

~~82,545~~

~~119,820~~

~~104,514~~

~~111,381~~

~~Total .~~

~~■~~

~~£11,552,829~~

~~£13,982,043~~

~~£13,384,776~~

~~£20,622,910~~

~~£18,518,190~~

~~£20,081,640~~

~~The total value of the exports in 1898-99 was £12,375,000, and of the imports £21, 663, 000. For 1896-97 the chief exports were— grapes (£1,742,620), silk (£1,313,890), wheat (£778,224), opium (£706,541), barley (£673,960), cocoons (£635,348), wool (£522,117), mohair (£408,524), ores (£437,845), figs (£414,656), cotton (£389,148), and sheep and goat skins (£371,760). The imports in the same year included quilting (£1, 485, 401), sugar (£1, 445,330), cotton yarn (£810,246), coffee (£783,531), rice (£660,990), and woollen stuffs (£506, 830). The exports from the Turkish empire to the United States for the twelve months ended 30th June 1901 amounted to $7,468,380, the amount beings almost equally distri- buted between Turkey in Europe and Turkey in Asia. The imports from the United States for the same year amounted to only~~

~~*$588,590. * The following table gives for 1899 the value of exports and imports, and the number and tonnage of shipping of the principal ports for which statistics are available : —*~~

~~*Exports.*~~

~~*Imports.*~~

~~*Ships entered.*~~

~~*Tonnage of Ships.*~~

~~*Constantinople .*~~

~~*15,924*~~

~~*11,548,056*~~

~~*Salonica*~~

~~*£1,651,021*~~

~~*£2,568,970*~~

~~*3,240*~~

~~*741,477*~~

~~*Smyrna*~~

~~*3,782,781*~~

~~*2,562,885*~~

~~*5,756*~~

~~*2,137,488*~~

~~*Beirut*~~

~~*1,051,950*~~

~~*1,580,165*~~

~~*3,370*~~

~~*849,008*~~

~~*Bussorah .*~~

~~*1,135,583*~~

~~*1,190,168*~~

~~*650*~~

~~*165,574*~~

~~*Eavala*~~

~~*1,200,200*~~

~~*262,200*~~

~~*2,191*~~

~~*246,525*~~

~~*Alexandretta*~~

~~*931,002*~~

~~*2,163,743*~~

~~*589*~~

~~*397,138*~~

~~*Trebizond .*~~

~~*569,400*~~

~~*1,324,730*~~

~~*8,470*~~

~~*694,462*~~

~~*Samsun*~~

~~*541,970*~~

~~*471,910*~~

~~*2,655*~~

~~*823,049*~~

~~*Tripoli (Africa) .*~~

~~*410,500*~~

~~*384,900*~~

~~*874*~~

~~*245,036*~~

~~*Tripoli (Asia) .*~~

~~*488,300*~~

~~*3,240*~~

~~*741,477*~~

~~*Jaffa .*~~

~~*316,158*~~

~~390,260~~

~~107~~

~~429,444~~

~~Scio .~~

~~247,400~~

~~265,900~~

~~4,179~~

~~733,666~~

~~Aivali~~

~~286,425~~

~~944,743~~

~~1,546~~

~~276,740~~

~~Monthly Summary of Commerce of the U.S. (Washington, 1901).~~

~~Authorities. — xLaveleye. La Pininsule des Balkans. Brussels, 1886. — Botje. Die Europaische Tilrkei, 2 vols. "Vienna, 1889. — Cr/INET. La Turquie d'Asie, 5 vols. Paris, 1891-94 ; Syrie, Liban et Palestine. Paris, 1896-98. — A. H. Die Tii/rkische Wehrmacht. Vienna, 1892. — Lamottch. L'Organisa- tion militaire de Vempire Ottoman. Paris, 1895. — Lebkt/n- ' Renat/d. La Turquie : Puissance Militaire. Paris, 1895. — Spry. Life on the Bosphorus. London, 1895. — Baudin. Progres de la Turquie. Paris, 1895 ; Turquie et les Ottomans. Paris, 1896. — Ramsay. Impressions of Turkey. London, 1897. — Hepworth. Through Armenia on Horseback. London, 1897. — Salmone. Fall and Resurrection of Turkey. London, 1898. — Kendall. — Turkish Bonds. London, 1898. — Bernard. Turquie~~

~~*a" Europe et Turquie d'Asie. Paris, 1899. — Oppenheim. Vom, Mittelmeer zwm, Persischen Golfe,*~~

~~*II. History since 1876.*~~

~~*The union of Eastern Rumelia with Bulgaria, which was accomplished in September 1885, closed the series of territorial questions arising out of the war of 1877-78 (see vol. xxiii. p. 652). At that time Abdul Hamid had reigned nine years, in the course of which important changes had been wrought in the internal condition of the empire. They were the direct outcome of the tempera- ment, character, and tendencies of the Sultan, and they were in the main prepared and brought about by himself. In order to trace these changes and to realize their signifi- cance, it is necessary to bear in mind that from the earliest days of Turkish rule in Constantinople to the date of the*~~

~~*[histoet*~~

~~*issue of the Hatt-i-Sherif of Gulhane by Sultan Abdul Medjid in 1839, the one ever constant feature in Turkish political life was the contest between the Palace and the Porte — the imperial court and the official hierarchy — for ascendancy in the direction of public affairs. The people, with whom were the Ulema, sided sometimes with the one, sometimes with the other, while the rivalry between the Sultan and the Sublime Porte was maintained in per- petuity. The Hatt of Gulhane limited the power of the Palace, and contemporaneously with its promulgation appeared a remarkable group of men — Reshid, Fuad, and A'ali — whose rare political aptitudes enabled them to follow out and render effective the purpose of the Hatt. While these men headed successive ministries, the govern- ment of the empire was conducted on the principle of ministerial responsibility ; but after 1871, when A'ali Pasha, the last of the trio, died, a period of confusion followed. On the recall of Mahmud Nedim Pasha to*~~

~~the grand vizierate in August 1875, the Palace again became paramount, and so continued until the softa riots of the following May brought about a change of ministry, Mehemed Eushdi becoming Grand Vizier, and Midhat, Minister of Justice. Then ensued the series of events which culminated, on 4th June, in the death of Sultan Abdul Aziz, followed by the enthronement of Murad, the assassination of two cabinet ministers by Hassan the Circassian, and the war with Servia and Montenegro. In August it was discovered that Murad's mental condition unfitted him for the sovereignty, and he was deposed, leaving the empire in a state of complete disorganization which seemed to threaten dissolution.~~

~~Such was the situation when Abdul Hamid came to the throne. He accepted everything that was proposed to Accession him, promised everything that was asked of of Abdul him, acted patiently the part of a champion of Hamid ii. Liberal ideas, and adopted the programme of the advanced party as set forth in Midhat Pasha's constitution, with a parliamentary system and every sort of individual liberty, including that of the press. The official aristocracy, who had been instrumental in bringing this about, believed that in so doing it had won the lasting gratitude and permanent support of the people, and that, this being the case, the domination of the Court was permanently superseded. But at the very first meeting of the Chamber of Deputies this illusion was dispelled. The official and popular elements in the assembly were brought into collision, and at each successive meeting the attacks of the latter on the former increased in violence ; independent members ap- parently rejoicing in the opportunities which Parliament afforded for vituperative criticism of ministerial action. The new tyranny drove ministers to despair, and they sought deliverance from it by praying the Sultan to prorogue Parliament and suspend the Constitution, of which the working proved so different from what they had fondly anticipated when they urged the Sultan to adopt and proclaim the parliamentary system as the law of the Ottoman empire. Abdul Hamid, notwithstanding his rooted dislike to every sort of political liberty, made a show of objecting to any interference with the Constitution, and was with difficulty, as it seemed, induced to consent to the convocation of an Extraordinary Council which was held at the palace. After much discussion, the Council decided to dissolve Parliament, to suspend the Constitu- tion, and to proclaim~~

~~*martial law In thus undoing the liberties of the people, the Porte practically surrendered its own traditional privileges, and allowed everything to come under the direct control of Sultan Abdul Hamid II., who in the space of a few months was transformed from a constitutional sovereign into a despotic autocrat of the most extreme type. Midhat Pasha, the author of the*~~

~~*Constitution, had been dismissed from office and sent into banishment six weeks after his proclamation and seven weeks before the meeting of Parliament.*~~

~~*In compassing the overthrow of Liberalism and the complete reinstatement of Palace domination, which was his purpose from the outset, Abdul Hamid was ably seconded by his secretary, Said Pasha, who was sub- sequently several times Grand Vizier. Without erudi- tion or general knowledge, Said was shrewd and adroit, with a remarkable aptitude for finding means to his ends ; while his mental constitution well fitted him to be the instrument of an autocratic master. He lent himself heart and soul to the achievement of his sovereign's scheme for extinguishing the influence of the Sublime Porte and reducing ministers to the position of puppets. Before his time, ministers' reports went up to the palace, and the sovereign decree followed the ministerial recommendation as a matter of course. But Said introduced the practice of modifying minis- terial decisions, and this system expanded so easily under the rule of Abdul Hamid that the respective parts of Porte and Palace were soon reversed ; all essentials came into the hands of the Palace, and formalities only were left to the Porte. Later, when Said Pasha became Grand Vizier, he awoke to a painful perception of the evils of the system which he had himself introduced ; but it was then too late to undo the mischief. The Sultan at this moment stood in an exceptionally strong position. He held the capital under martial law and the army under his own absolute control. Where terrorism failed, or proved imperfectly efficacious, it was supplemented by corruption in all its varied Oriental forms. Thus it was easy for Abdul Hamid to extinguish opposition. A few penal sentences sufficed to relegate to oblivion the parliamentary system and all that attached to it, and its disappearance attracted little notice, for the attention of the country was absorbed by" the events of the war with*~~

~~*Russia. Now it was that Abdul Hamid began to show how largely his mind was occupied by care for his personal safety, and how the fear of assassination was ever present with him. Feeling that for effectual self-preservation he required the fullest information about the life and conduct of every officer of state, and of every unofficial person of influence, he surrounded himself with an army of spies comprising men of every social position. There was little attempt at organization of this service ; its chief was the Sultan him- self, and he was always accessible to every member of it who had a denunciation to make. Year by year this system of espionage developed and expanded, until it overspread nearly the whole of the official body. Denun- ciators were always so liberally rewarded that even ministers found it worth their while to watch each other, and report to the Sultan anything that seemed likely to interest him. At the same time means were taken to prevent friendly intimacy between the members of the imperial household or public officials, and jealousies and rivalries among them were promoted, in order to prevent the possibility of dangerous combinations. In the early 'eighties, during which with two very brief interruptions Said Pasha was Grand Vizier, Abdul Hamid entertained three schemes on the furtherance of which he bestowed much endeavour. The most ambitious of these projects was the realization of the Pan-Islamic idea, i.e., the union of all Mahommedan peoples under the spiritual headship of the Khalif-Sultan. The other two schemes were the aboli- tion of the capitulations and the revocation of all privileges which in previous reigns had been granted by firman or other official act to the non-Mussulman communities of the empire. Said encouraged the Sultan in the pursuit of both these objects, and fostered his belief in the possibility of attaining them. But his influence was temporarily*~~

~~*histoey]*~~

~~*destroyed by the revolution of Philippopolis (September 1885), which proclaimed the union of Eastern Rumelia with the principality of Bulgaria.*~~

~~*Councils were held daily at the palace to determine what course the Government should adopt. In these councils, of which the leading men were Said Pasha and the Minister of War, the majority were in favour of military action; but an examination of the military resources revealed the fact that Turkey was wholly unprepared for war. Then the Sultan came to perceive that Said, with all his aptitude for dealing with internal affairs, was remarkably inefficient in the wider fields of policy. He had not kept in touch with the Courts' of Europe, where his agents might have learnt what was preparin g at Sofia. Moreover, he had failed to perceive the necessity of military reorganization which the events of 1877-78 had rendered indispensable. So, on the 24th September 1885, the Sultan dismissed Said, after six years and five months of office, and appointed Kiamil Pasha Grand Vizier in his stead.*~~

~~*Kiamil differed greatly from his predecessor, being free from fanaticism and narrow prejudices. In wily arts he was inferior to Said, but he had the advantage of him in general knowledge and in political judgment. Though broadly Liberal in his views, he was not dis- posed to force a Liberal system on the country for which he believed it to be unprepared. He was prudent, moderate, and practical, and his practice was based upon principle. Abdul Hamid took advantage of the Eume- lian incident to narrow still further the Porte's spheres of action and influence. He assumed the superior direc- tion of military affairs, and he instituted a secret intel- ligence service abroad, which had no connexion with the ministry for foreign affairs, and which communicated with the Palace direct. This latter undertaking was developed with great activity, so that in a very short time Turkish spies were in every European capital, and relations were established with the secret police of at least two European capitals. For the purposes of military reorganization and control, his majesty con- stituted a special staff under his own immediate orders, and also a permanent military commission which sat under his presidency at the palace of Yildiz. These innovations were costly, and the treasury was often embarrassed to find the money which the Palace required for the main- tenance of its elaborate system.*~~

~~*Owing to Said Pasha's dislike of foreigners, which he did not seek to disguise, the relations of Turkey with the governments of Europe during*~~

~~his tenure of vizirial office waxed colder and colder, till they had lost all cordiality ; but Kiamil Pasha, whose sympathies were large and un-trammelled by the fetters of a narrow fanaticism, adopted a different attitude, so that the intercourse of Turkey with the European Courts was restored to a normal geniality. HIs ministry (1885-93) was relatively a period of calm in foreign politics. In the earlier years of it, shortly after the accession of the German Emperor William II., at the time of his first visit to Constantinople, the question was mooted of Turkey joining the Triple Alliance. The idea necessarily fell through, as the position of the Ottoman empire requires liberty of action incompatible with such a bond. While Kiamil was in power, the Armenian revolutionary committees were formed in London, Paris, and Geneva, and the association called Young Turkey was reconstituted in Geneva. The first Armenian manifesta- tion took place at Kum-Kapu in the month of August 1890, painfully impressing the Sultan and quickening his dislike and distrust of the race. Out of these feelings certain confidants, such as Nazim Bey, minister of police, contrived to weave combinations which were highly profitable, and the way was prepared for that traffic in the~~

~~Sultan's likes and dislikes, fears and fancies, which took wholesale proportions in the time of Kiamil's successors. The manifestation, which was peaceful in its character, was made a pretext for employing coercive measures towards the Armenians, and for abrogating privileges enjoyed ab antiquo by the community. Kiamil's fall was the consequence of Abdul Hamid's insuperable objection to anything like ministerial self-assertion. A note was sent up from the council of ministers to the imperial chancellery remarking that the decisions of the Cabinet Council were so frequently annulled by the Sultan as sometimes to disturb that consistent sequence in Gov- ernmental action which it was desirable to maintain. The Sultan had long fretted under the sense of Kiamil Pasha's moral stability and lack of obsequiousness. So the memorandum, inasmuch as it suggested that the ministry had an individuality which it was inexpedient wholly to ignore, was answered in terms which left Kiamil Pasha no alternative but to resign. HIe did so, and was succeeded by Djevad Pasha, who at the time of his appointment was governor-general of Crete, where he was replaced by Mahmoud Djelal-ed-Din Pasha. Djevad Pasha possessed neither the moral nor intellectual worth of Kiamil ; but he was~~

~~docile ; and his sister was mistress of ceremonies in the imperial harem. On becoming Grand Vizier, Djevad Pasha surrendered the Porte wholly to the Sultan, who took into his own hands the direction of foreign affairs, which up to that time had been entirely managed by the Porte, and the conduct of which was generally considered to be the speciality in which the Porte excelled. But the Sultan practically took away the management of foreign affairs from the " Hardjie," which from that time has been nothing more than a sort of dragomanate and record office, interpreting to the embassies the Sultan's own views, and placing on record those expressed by the heads of the foreign mis- sions. Thus it came to pass that, under Djevad, the relations with Great Britain, which Kiamil had carefully fostered into kindliness, once more relapsed into the sourness of Said's days, and every opportunity of opposing or thwarting Great Britain was seized with avidity. On the other hand, the relations with Germany, which in Kiamil's time had been wrought into friendliness through the influence of the late Eeshid Bey, a private secretary of the Sultan, became more and more intimate, and German influence gained ascendancy at the Palace, ena- bling a German syndicate to obtain the concession of the Anatolian railway over the heads of British capital- ists who not only offered better terms, but under a pre- vious concession had built and opened a railway between Constantinople and Ismidt. This line — the first section of the Anatolian railway — they were compelled, in virtue of its right of purchase stipulated in the concession, to sell to the Porte, who forthwith resold it to the German syndi- cate to whom it conceded the line from Ismidt to Angora, extending the concession subsequently to Eski- shehr and Konieh, and in November 1899 to Baghdad and Basra. There can be no doubt that when the German Emperor and Empress, before their tour in Palestine in 1898, came to Constantinople, the concession of the extension to the Persian Gulf was promised to the German syndicate ; but there was some hesitation about granting it, because Russian, French, and British applicants for it came for- ward offering terms less onerous than thofce demanded by the Germans. At length, on the 24th November 1899, the German ambassador had audience of the Sultan, and on the morning of the 26th an irade was sent to the German embassy granting the concession to the German syndicate, and leaving the conditions for future adjust- ment.~~

~~*years (1893-95), brought the internal affairs of the em- pire into a deplorable condition. Time and effort were spent upon unattainable objects which, even had they been realizable, would have been profitless. The futile project, which Said so keenly pursued and Kiamil dropped, of obtaining the abrogation of the capitulations, was revived with new ardour. But Djevad was not likely to succeed where Said had failed ; the Porte could make no headway with the scheme, and met with rebuff on all sides. During Djevad's ministry the Sultan began to lay a heavy hand on the Christian communities, an- nulling or retrenching the privileges and immunities granted to them by his predecessors. Greeks and Arme- nians were laid under new restrictions and obligations which were enforced in the most vexatious manner. It is worthy of note that Mahmud Djelal-ed-Din, at that time Vali of Crete, strictly followed in that island, and with disastrous effect, the example given him by his sovereign in Constantinople. Abdul Hamid, in the ardour of his desire to concentrate all power in his own hands, did not foresee that powerful communities, with right on their side and many resources at their command, would not easily submit to his arbitrary de- crees. The patriarchates resolved on resistance, and in the winter of 1893-94 a serious crisis seemed imminent. As a protest against Abdul Hamid's ordinances, the (Ecu- menical Patriarch, just before Christmas, closed all the Greek churches of the capital, and was only persuaded to reopen them by the Russian ambassador, whose interven- tion the Palace solicited. At the same time the Arme- nians, inspired by the committees of London and Paris, prepared in many provincial districts demonstrations which mostly ended in bloodshed, and the Cretans began to shape the plan of their last revolt. By depriving the Christian communities of their privileges, Abdul Hamid had hoped to recover the sympathies and win the respect and admiration of his Mahommedan subjects ; but the Moslems perceived their sovereign's purpose, and de- spised it. In the midst of all this ferment*~~

~~came the earthquake of 10th July 1894, which turned the thoughts both of the Palace and of the public into another channel. (See Constantinople.)~~

~~Meanwhile the Sultan had found means to realize his long-cherished scheme of making soldiers of the Kurds. The idea originated with Shakir Pasha, who, when ambas- sador at St Petersburg, thought that the Kurds might be utilized by Turkey in the same manner as Russia utilized the Circassians, and that they might be turned to protective use on the frontier, where in their lawless state they were a constant source of trouble and danger. The idea pleased Abdul Hamid, who feared the Kurds just as he did the Albanians, and was longing to establish~~

~~a link between himself and them which would Armenian enable him to awaken them to the advantages troubles, derivable from loyal devotion to their imperial~~

~~master. So the "Hamidieh " light cavalry was formed out of Kurdish nomads, and divided into fifty- four squadrons. The force has not, however, proved of any value for the maintenance of order. It has always shown antagonism to the Turkish civil authorities, habitually joins in the predatory operations and frontier raids of the clansmen, and in Sasun, at Diarbekir, and other scenes of massacre, its services surpassed those which won such odious distinction for the Circassian cavalry in Bulgaria. It should be noticed that in order to form the " Hamidieh " cavalry it had been necessary to heal the deadly feuds between the Kurdish clans, to give them a sense of unity, and at the same time to win them from their relations with the Armenians, who re- garded them as landlords, and paid tithe to them on the increase of their flocks and herds and on the produce of~~

~~their industry. The means employed by the Sultan to this end were to send sheikhs and other holy men into Kurdistan to preach Pan-Islamic doctrine, union of all true believers, and fanatical hatred of all those outside the fold of Islam. These missions were successful be- yond expectation. In official circles it was felt that the ever-increasing demands of the Palace for money made it necessary to bring the Armenians of Kurdistan under taxation, which they had previously escaped on the plea~~

~~*that they were already taxed to excess by the Kurds, over whom the Ottoman authorities dared not attempt to exercise any restraint. This was the official interpretation of the Sultan's policy in Kurdistan, which was obviously not founded upon economic considerations. Indeed, it may safely be asserted that the main — if not the sole — purpose of Abdul Hamid in forming the "Hamidieh" cavalry, and in making it the object of his own special patronage, was to bring the Kurds under his own immediate command.*~~

~~*Sasun, a district lying to the west of Lake Van be- tween the plains of Mush and Diarbekir, consists of a block of mountain, deeply seamed in every direction by torrents, making a network of ravines, in the depths of which are the villages and the cultivated land. The slopes furnish food for flocks and herds when snow covers the rich pasturage of the mountain-top. Prior to the massacre, Kurds inhabited the eastern and Arme- nians the western half of the district. These latter, recognizing the Kurds as lords of the domain, paid the tribute regularly levied upon their pastoral and agricul- tural produce, on the dowries given to their brides, and other taxable matters. In exchange for this tribute the Kurdish aghas protected the Armenians from the depre- dations of the semi-nomad Kurds. Neither Kurds nor Armenians paid taxes to the Imperial Government. Such up to 1892 was the mode of life in Sasun. It satisfied the two parties concerned, and the Turkish authorities did not interfere with it. But in 1892 the Mutessarif of Mush received orders from Constanti- nople to collect taxes from the Armenians of Sasun. He tried to do so, but was told that it was impossible for them to pay imperial taxes so long as they had to pay tribute to the Kurdish aghas. The matter was allowed to drop for the time, but was brought up again in the fol- lowing year. Meanwhile, inasmuch, as the understanding and relations between the Kurdish aghas and the Arme- nians were regarded unfavourably by the Sultan, his maj esty sent out sheikhs into Kurdistan to heal tribal feuds and unite all Kurds in a bond of fanaticism against the Armenians. Thus it came to pass that in 1893, when the Mutessarif of Mush, to punish the Armenians for again pleading inability to pay the taxes he demanded, sent two tribes of nomads to feed their flocks on their mountains, no protection was afforded them by the Kurdish aghas, and a feeling of enmity was thus established between the two races. The Armenians suffered heavily from the nomads,*~~

~~and resolved to protect themselves in the following year, foreseeing a repetition of the measure. It was repeated ; but under the guidance of one Hamparsun Boyadjian the Armenians drove back the nomads, and were thereupon re- ported to the Sultan as being in rebellion. Abdul Hamid promptly ordered regular troops, with a large contingent of " Hamidieh " cavalry, to reduce the Armenians to sub- mission. The armed bands of the Kurdish aghas joined the troops. The Armenian district was surrounded ; flocks and herds were seized ; most of the villages were pillaged and burned ; and those who were unable to escape from them by flight were massacred — men, women, and children. In the village of Guelierguzan it was reported that trenches were dug, to the edge of which the victims were driven, and there they were bayoneted and their corpses cast into the~~

~~ditch. These events happened in July and August (1894), and the news of them reached Europe in October, pro- ducing a most painful impression on public opinion. • The massacre necessarily called forth the intervention of the three Powers — Great Britain, Prance, and Eussia — most interested in Turkey, and, after strenuous and prolonged opposition, their ambassadors were able to obtain the constitution of an international commission of inquiry. It began its work in January 1895, of which a full record is contained in Blue Book, Turkey, No. 1, of that year.~~

~~While these events were passing in Kurdistan, Lord Kosebery, in July 1894, brought forward a scheme of~~

~~reforms for Turkey, applicable more especially schemes. to *^e provinces inhabited by Armenians,~~

~~which he laid before the French and Bussian Governments. Count- Lobanoff, Russian Minister for Foreign Affairs, declared it to be impracticable, be- cause " the Turks never change." Lord Salisbury, who succeeded Lord Bosebery at the Foreign Office, followed up the idea ; but~~

~~he considerably modified the scheme, cutting it down to more attainable proportions, in the hope of inducing Eussia and France to join Great Britain in urging the Turks to adopt it. Meanwhile Sir Philip Currie was appointed ambassador in Constantinople, and shortly afterwards Matheos Izmirlian was elected Patriarch of the Gregorian Armenians. The negotiations opened by Great Britain with Eussia in reference to reforms in Turkey, and the horror created by the reports from Sasun, Diarbekir, and other places, brought about the European Concert, in virtue of which the ambassadors in Constantinople of the six Great Powers were instructed to draw up a project of reform for the six provinces inhabited by Armenians. That project, which was based upon the organic statutes of the Lebanon and of Samos, was completed by the ambassadors in April 1895, and was submitted by them to their respective Governments. Approved in all the chancelleries, it was presented to the Porte, accompanied by a Note Identique, in May. The Porte refused the reforms, and the Sultan sought to clear the situation by a change of ministry. HIe accordingly dismissed Djevad Pasha from the office of Grand Vizier, and conferred it once more upon Said Pasha. At this moment the situation in the provinces was full of menace, and at the same time the "Young Turkey " com- mittees of London and Paris were actively publishing periodicals, full of inflammatory matter, vast quantities of which were smuggled into the country and widely circu- lated. Their tone was bitterly, violently hostile to the Hamidian regime, and to the system upon which it was based, and the Sultan was kept in constant alarm by threatening letters and seditious placards, which were usually posted on the palace walls. Household influences, especially the Albanian element, strongly favoured Said ; and as he was the acknowledged representative of " Old Turkey" views as opposed to those which the "Young Turkey " party were now so actively propagating, the choice seemed expedient. The menchour conferring the appointment gave Said full liberty of action, but, in order to gratify the Albanians, imposed upon him Turkhan Pasha as Minister for Foreign Affairs. On taking office Said Pasha endeavoured to grapple with the most pressing evils, but was disconcerted at the eagerness shown by the ambassadors about their reform scheme. Very adroitly, however, pleading the urgent and complex nature of the questions with which he was called upon to deal, he in- duced the ambassadors to agree to allow the reform scheme to stand over until he had had time thoroughly to~~

~~*examine it. Undoubtedly the position of affairs was one of serious embarrassment. The system of centralization, which in earlier years Said himself had done so much to*~~

~~*develop, had absorbed everything, so that on returning to office he found the Porte impotent and the whole ad- ministration disorganized. He tried reaction, and vainly endeavoured to dislocate the direct relations which he found had been established between the Palace and the ministry of police. But all that Said gained by his endeavours to break them off was that he drew upon himself the suspicion of his sovereign. In July the ambassadors received instructions from their Governments to renew their demand for the adoption of the scheme of reforms presented two months previously and refused in the last days of Djevad's ministry. Then followed weeks of futile discussion and wrangling between the ambas- sadors and Turkhan Pasha, who, duly prompted from Yildiz, led the ambassadors through a long course of fruit- less negotiations. Great Britain proposed coercion, but the Tsar's ambassador in Constantinople was instructed to declare that Eussia would not participate in any measure which might be detrimental to the prestige of the Sultan. The doom of the reform scheme was thus sealed. Shortly afterwards a telegram went the round of Europe stating that a great Armenian rising was in preparation, and that it would lead to much bloodshed. At about the same time, in the hope of influencing the Powers to take a firmer attitude about the reform scheme, and the Porte to give ear to their representations, the " Huntchak " revolu- tionary committees of London and Marseilles passed the word to make an Armenian demonstration in Constanti- nople. Accordingly, on the 30th September 1895, it was proposed to present a memorial to the Grand Vizier Said Pasha. A large number of Armenians assembled at Kum- Kapu and marched towards the Porte. Their progress was intercepted by police and troops, who ordered them to turn back. The processionists refused to obey, and a con- flict began which overspread all the quarters of the city inhabited by Armenians. Early in the day the sofias (theological students) rushed forth and slew all the Armenians they could find. They ceased their butchery as suddenly as they began it. The carnage of the later afternoon and evening was wrought by the police in their endeavours to arrest persons on the " suspected " list of the department. The exact — even the approximate —*~~

~~number of Armenians put to death on this occasion has never been established, but it is estimated at about 500 more or less. There was a rush to the churches for asylum, but had it not been for the intercession of the embassies the refugees would have been dragged out to death. In the following week several hundred Armenians were massacred at Trebizond. The events of 30th Sep- tember afforded the Sultan a reason for removing the Grand Vizier. So Said was dismissed, and Kiamil was once more called to office. The panic caused by the massacre continued for several days. All shops kept by Armenians were closed, and the windows and doors of all Armenian dwellings were shuttered and barred. The refugees in the churches could not be induced to return to their homes, and it was not till Sunday, 13th October, that, with the help of the embassy drago- mans, the churches were emptied. As soon as he came into office, Kiamil Pasha took in hand the scheme of reforms for the provinces inhabited by Armenians, and induced the ambassadors to consent to expunge from it a clause which gave the European Concert a a right of supervision over the execution of the reforms through the instrumentality of a commissioner ad hoc, a foreign subject, whom they were to appoint. Kiamil having obtained this alteration of the reform convention, the Sultan accepted it, issued an irade" to that effect, and the decree was published in all the native papers. Mean- while the slaughter of about 700 Armenians was brought about at Bitlis.~~

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~~From the time of the issue of the reform decree to that of his fall, Kiamil Pasha was in difficulties about the composition of the commission of control for the new re- forms. Kiamil desired to form it of men of established character and capacity, and sent up to the Sultan a list of seven names which the ambassadors highly approved. But Abdul Hamid objected to them, and while this differ- ence of view was daily increasing the strain between the Sultan and his Grand Vizier, tidings were received in Constantinople of sanguinary events of which Marash, Baiburt, Urfa, Erzinjan, and Erzerum were severally the scenes, and which added~~

~~*heavily to the Armenian death- roll. In the same interval a letter addressed to the Sultan threatening his life was found on the table of Ghazi Osman Pasha, and greatly disturbed his majesty's mind. The result of the inquiry concerning this letter was that fourteen members of the imperial household were removed. Kiamil more than once intimated his de- sire to quit office, but his overtures were rejected. On 6th November, however, an irade dismissed Kiamil from the cabinet, appointed him Vali of Aleppo, and put Khalil Rifaat Pasha in his place as Grand Vizier. Palling ill at the very moment of his nomination to Aleppo, Kiamil refused that post, and was transferred to Smyrna. Khalil Rifaat Pasha, who was Minister of the Interior in the previous cabinet, owed his appointment as Grand Vizier mainly to the pressing recommendations of Sheikh Ebul Huda and Lutfi Agha, the Sultan's companion. It displeased the Albanians of the imperial household, who wanted Said in the Grand Vizierate, and clamoured for his recall. Said, however, firmly refused ; and, fearing that the Sultan would resent his refusal, sought refuge in the British embassy, where, notwithstanding the mes- sages of command, threat, entreaty, or promise which streamed from the Palace, he remained the guest of Sir Philip Currie until, on the fourth day, he obtained from the Sultan a written assurance, which was formally com- municated to the ambassadors, that his life and liberty should be respected. About the same period a palace chamberlain named Izzet Bey, by his denunciation of certain persons in whom the Sultan previously had con- fidence, established a powerful influence over his majesty's mind.*~~

~~*Just a fortnight after the new ministry entered upon office, five of the ambassadors demanded firmans for the inward passage of a second despatch-vessel to be attached to each embassy. Ordinary and special cabinet councils reported in favour of acceding to the ambassadors' de- mand, but the Sultan viewed it unfavourably, and — advised by Nazim Pasha, minister of police, that the admission of the vessels in question would dangerously excite Mahommedan feeling — placed the matter in the hands of Izzet Bey, and subsequently sent Kutchuk Said Pasha on a special mission to each ambassador praying him to relinquish the idea. They all, however, stood firm; but through Izzet Bey's proficiency in the art of procrastination ' three weeks elapsed before the firmans were delivered to the embassies. The disturbances in the Asiatic provinces*~~

~~which began while Kiamil Pasha was in office continued under the new ministry. The tragedies already mentioned were followed by similar scenes of bloodshed at Amasia, Marsovan, and Aintab, and by the drama of Zeitun — a town of about 10,000 in- habitants high up among the peaks of the Anti-Taurus. The Zeitunli had resisted taxation up to 1878, when a Turkish block-house was built near the town and garri- soned for the purpose of enforcing fiscal obligations. Alarmed at the events of the summer of 1895, the Zeitunli attacked the block-house, expelled the garrison, and closed all the approaches to the town. The Turks sent troops several times to open the place, but they were~~

~~always driven back, and in December a regular campaign was opened with the object of subduing the Zeitunli. They repelled the first attack, after which all non-com- batants left the place; but its defenders were soon forced to evacuate the block-house, and thereupon the ambassa- dors offered the mediation of the consuls to arrange a capitulation, the terms of which were concluded on 2nd March 1896. The Turks, however, were very tardy in fulfilling their engagements, and, notwithstanding the strenuous remonstrances of the combined embassies, three months passed before the capitulation was carried into effect. About this time affairs in the Hauran be- came critical. For many months the Sultan had fostered the intention of bringing the Druses of the Hauran and the Arab tribes of the Yemen into complete subjection. The first steps towards the attainment of this purpose were taken in December 1895, when the Martini rifles with which the Yemen troops were armed were replaced by Mausers, and the Sultan ordered that the Druses of the Hauran, who wore arms and refused to pay taxes, should surrender their weapons and submit to taxation. In pursuance of this latter command, the Vali, under promise of good usage, induced several Druse chiefs to go to Damascus to discuss differences ; but, notwithstanding the promise, the chiefs were imprisoned and maltreated. This act of bad faith caused in the Hauran great exas- peration, which was brought to a climax through the abduction in May by a Turkish officer of the daughter of a Druse chief. A few weeks later, about 17th June, the Druses rose against the troops and massacred four com- panies of infantry. The Porte thereupon sent reinforce- ments into the Hauran; the revolt was quelled; and the Druses paid their taxes.~~

~~*Meanwhile Cretan troubles were daily growing more acute. Karatheodory Pasha, who succeeded Mahmud Djelal-ed-Din Pasha as governor-general, and who in point both of character and ability stood in the forefront of Turkish public men, left early in 1896, and was replaced in March by Turkhan Pasha. By the middle of May the Christian population was in full insur- rection ; heavy reinforcements were sent to the island, and Marshal Abdullah Pasha was appointed to command them. On 6th June Abdullah Pasha asked for reinforcements, at the same time announcing the restoration of order and tranquillity. A week later the larger of two French despatch-vessels stationed at Constantinople was ordered to Canea. The European Concert had now taken the affairs of Crete in hand, and the ambassadors sought to convince the Sultan of the expediency of pacifying the island as promptly as possible. After much pressing, an imperial proclamation was sent to Abdullah Pasha inform- ing the insurgents that if they would lay down their arms the Porte would be ready to redress well-founded grievances and to satisfy reasonable demands. At the same time the Porte asked for the assistance of the consuls in negotiating with the insurgents. But the ambiguous language of the proclamation, which had from the outset raised misgivings in the minds of the ambassadors — and especially the condition that the laying down of arms was to precede the statement of grievances, — kindled such suspicions in the minds of the Cretans that they could not be induced to negotiate upon that basis. The ambassadors therefore in a collective note urged that the Sultan should modify his proclamation, appoint a Christian governor, authorize the convocation of the assembly, and offer to renew the pact of Halepa. Following up this note by individual pressure, the ambassadors at length (27th June) obtained the Sultan's acquiescence. Georgi Pasha Berovitch, prince of Samos, was appointed Vali of Crete, and a few days later the Sultan ordered the cessation of hostilities, the proclamation of a general amnesty, and an unconditional offer to renew*~~

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~~*the Halepa pact. But meanwhile the Cretan pretensions had expanded, and it was only after two months' endeavour that the consuls succeeded in bringing the insurgents to accept the proper terms. The Sultan did nothing to redeem his promises, and on 10th October the ambassadors expostulated with the Porte concerning their non-fulfil- ment. But the efforts of diplomacy were fruitless, and the year closed without any approach to pacification.*~~

~~*After the Zeitun settlement Armenian affairs dropped for a while into the background ; but the resignation of the second Patriarch, whose steadiness of purpose and Constant!- strength of will were displeasing to the Sultan, aopie was brought about early in August. Mgr*~~

~~*massacre. izmirlian was succeeded by Mgr Bartholomeos as locum tenens, and his council was replaced by Palace nominees. Izmirlian was ordered to make a " pilgrimage to Jerusalem." About the middle of August a member of the council who had been mainly instru- mental in procuring the resignation of Izmirlian informed the ambassadors that the Sultan would shortly proclaim an amnesty for all Armenians not suspected of revolu- tionary designs. A week later the Patriarch addressed a petition to the Sultan praying for this amnesty, and two days afterwards the second Constantinople massacre took place. The Patriarch Izmirlian had exercised over the revolutionists a restraining influence, which was nullified by his retirement. Just three weeks after that event the Patriotic Society put into execution the plan by which they hoped to enforce compliance with their demands. It was to place dynamite in the vaults of the Imperial Otto- man Bank, and to threaten to blow up that establishment unless the promised reforms were guaranteed. This was done in the forenoon of 26th August, when some thirty members of the society, armed with revolvers and bombs, concealed themselves in various parts of the bank ; bombs were thrown into the great vestibule ; a shell was exploded in the cash department ; and the whole staff of the bank, panic-stricken, fled to the roof, whence some few escaped into adjacent premises, while the majority remained as hostages in the hands of the " patriots," who closed and barred the outer doors. While this was going on in the bank, bombs were thrown and revolvers fired in several parts of Galata and Pera. Troops quickly occupied the main thoroughfares, and,*~~

~~*no less promptly, a mob of Lazes, Kurds, and Persians — the rabble of the Ma- hommedan populace — armed with iron-shod clubs and yataghans, poured into all the quarters north of the Golden Horn, and slaughtered every Armenian they could find, just as the softas had done in 1895, but on a scale proportioned to their vastly greater numbers. Neither troops nor police attempted to stay the carnage, which continued throughout the night, but ceased as if by word of command just before daybreak on the following morning. The hostages in the bank were released about midnight, in virtue of an arrangement concluded at Yildiz by the director-general of the bank, assisted by the first dragoman of the Russian embassy, by which the troops surrounding the bank were to be withdrawn, and the "patriots" were to be taken on board Sir Edgar Vincent's yacht at Kadikeui, thence to be transhipped by first steamer to England. The general conviction with regard to this frightful tragedy was that the Palace, by whose efforts the resignation of the Patriarch Izmirlian had been obtained, knew full well that some rash act on the part of the revo- lutionaries would follow that event, and had prepared and armed the mob of gourdineurs in order to take advantage of the expected opportunity. Sharing this conviction, the heads of the diplomatic missions ab- stained from illuminating their residences, as it is their custom to do, on the anniversary (31st August) of the*~~

~~*Sultan's accession. The number of victims in this affair exceeded 3000, besides 1000 missing, whose fate was never ascertained. The city was plunged into conster- nation, prolonged by the sequel of wholesale arrests and expulsions which, notwithstanding diplomatic re- monstrance, were continued up to nearly the end of September. In the course of that month upwards of 20,000 Armenians were shipped away to Black Sea or African ports, where they were landed and left in destitu- tion. On the morrow of the massacre the six embassies presented to the Porte a collective protest against the proceedings of the previous day ; but no notice was taken of it, and a second note was addressed, two days later, directly to the Sultan, declaring the state of anarchy in his capital to be intolerable, and setting forth the dangers to which it exposed his empire. The result was an irade, issued 10th September, ordaining the constitution of a special commission, comprising delegates from the embassies, to regulate arrests, expulsions, and other matters arising out of the events of 26th August.*~~

~~*Three days later the commission met, but achieved nothing, because the in- structions given to the Turkish members were such that the questions for consideration could not be treated on a basis corresponding with the intentions of the embassies, to whose delegates, moreover, the Turkish members allowed only a consultative voice in the proceedings. However, towards the middle of the month (September) an alarm was raisedabout the "Young Turkey" party, suggest- ing the expediency of reconciliation with the Armenians. The Council of Ministers determined, therefore, to adopt conciliatory measures, and the French Ambassador in an audience was able to impress the Sultan's mind with the imperative necessity of restoring a legal order of things in the capital, and of placing the provincial administration on a stable footing. This latter recommendation his majesty followed by extending to the whole empire the inoperative charter of reforms granted in October 1895 for the six provinces inhabited by Armenians. Nevertheless arrests, condemnations, and expulsions continued throughout October ; but early in November the Sultan authorized the convocation of the Armenian National Assembly in order to elect, in conform- ity with the prescription of the organic statute, a new Mixed Council, and to proceed to the election of a patriarch. This was carried out in the course of the month ; a respectable council was constituted, and Mgr Ormanian, a prelate of high character and attainments, moderate views, and rare discretion, was elected Patriarch. In December the Sultan issued a decree of amnesty, and a month later it was officially announced that " all amnestied Armenians," including four under sentence of death, had been released. At the time of granting the amnesty the Sultan accepted a plan of reconciliation proposed by Artin Pasha, but in the irade" ordaining its adoption it was so mutilated as wholly to destroy. its significance and value. This engendered much bitter feeling, and early in February wholesale arrests began again. Up to the middle of March the Patriarch was unable to obtain any concession, but the massacres of Everek and Tokat which occurred in that month called forth such severe reproba- tion from the ambassadors that in order to appease them an irade was issued granting, with some slight modifica- tions, the concessions comprised in Artin Pasha's plan. No action, however, was taken under this irade, and the Armenians could obtain no redress of their grievances. In August some street disorders occurred; some bombs were discovered in Armenian houses ; one was exploded at*~~

the Porte, and one was found in the possession of an Armenian, who proved to have just arrived from Russia, ascending the staircase of the bank. Denunciations, arrests, and expulsions began over again; and the patriarchate pro-

tested against the indiscriminate severities practised by the Turkish authorities, but the protest was unheeded. Towards the end of December the Mixed Council of Kum-Kapu presented to the Sultan a memorial embody- ing the twelve points of Artin Pasha's plan, together with four others relating to new grievances, and praying that his majesty would mercifully concede them. This petition elicited some vague promises which remain un- fulfilled, while, on the other hand, further restrictions on Armenian liberties were imposed during 1899. Wearied of his failures, Patriarch Ormanian in the month of September presented his resignation to the Sultan, who returned it, and ordained a constitution of a commission to inquire into Armenian grievances, but this ordinance has not yet borne fruit. During the years 1895-97 Armenians from the provinces swarmed across the Russian frontier and took refuge in the Caucasus to the number of between forty and fifty thousand. In June 1898 the Russian ambassador requested the Porte to facilitate the return of these fugitives to their former homes. The Porte replied evasively, and the ambassador several times ineffectually reiterated his demand. At length on 24th May 1899 the Sultan personally requested M. Zinoview to defer the question, and the ambassador accordingly abstained from urging it until the middle of February 1900, when he renewed the demand, but, finding the Sultan still strongly opposed to the return of the fugitives, did not press it. On the 10th July his excellency presented a note to the Porte asking permission for the return of about 3000 of the ex- patriated Armenians, but no reply was given. The massacre of Tokat (March 1897) was the last incident of historical importance in connexion with this episode in Armenian affairs. It need only be added that in August 1899 an irade was issued authorizing the con- vocation of the

~~*diocesans of the catholicosate of Sis to elect in the traditional manner a new catholicos, the office having been vacant for nearly two years in conse- quence of the Sultan's wish so to alter the mode of election as to give his majesty control over it.*~~

~~*During the late months of 1896 and the early months of 1897 the affairs of Crete became worse, mainly owing to the obstructive and evasive treatment they received at the hands of the Porte. After two months' discussion the mixed commission for organizing the gendarmerie was despatched from Constantinople on 3rd December, and a few weeks afterwards the Porte, in a circular to the Powers, protested against the attitude of Greece. Early in February Greece sent troops to Crete, whereupon the Vali, Georgi Pasha Berovitch, threw up his appointment and left the island. Towards the end of the same month the Porte sent another circular to the Powers about Greek inter- ference in Crete, and began to mobilize, moving troops from Asia into Europe, and despatching war material and stores by sea and land to depots in more or less proximity to the Greek frontier. Edhem Pasha was called up from Syria to take command of the forces in Macedonia. On the 2nd March the six ambassadors presented a col- lective note to the Porte, announcing the intention of the Powers to make Crete autonomous, and declaring that*~~

~~*there was no idea of handing over the island to Greece'*" Greece, which would be required to withdraw*~~

~~*her troops and warships. Three days later the ambassadors sent in another collective note in which they stated their views about the " progressive reduction " of the Turkish forces in Crete. The Porte raised no objection to the scheme of autonomy, but replied evasively concerning the withdrawal of the imperial troops. At this period the dominant, though undeclared, idea in the mind of the Sultan's most intimate advisers was to punish Greece for meddling in Cretan affairs. In pursuance of this purpose,*~~

~~*towards the end of March a naval squadron, composed of four ironclads, two cruisers, one gunboat, two torpedo- boats, and two torpedo-catchers, was despatched to Gallipoli, and the 2nd and 3rd army corps — of which the headquarters were Adrianople and Monastir — were reinforced.*~~

~~*Greece replied by increasing her forces on the frontier, and the Powers, through their representa- tives, warned (6th April) both states that in the event of war the aggressor would be held responsible, and if victorious would obtain no advantage. The Porte issued a series of circulars to its representatives abroad, all complaining of the situation, the last (10th April) pro- testing against a violation by Greek troops of the frontier near Metzovo. Meanwhile Edhem Pasha pressed for orders to advance into Thessaly. An irade issued 17th April instructed him to do so, and ordered the recall of the Ottoman minister from Athens and the delivery of passports to the Greek minister in Constantinople. Greece and Turkey were now at war. A few days revealed the fact that Greece was overmatched, and on 12th May the six ambassadors opened mediatory negotiations by presenting a collective note demanding an armistice. Shortly afterwards the mediating' Powers began treating for a basis of peace, but the Turkish demand, inter alia, for the cession of Thessaly, and for an indemnity of ten millions sterling, rendered the nego- tiations laborious. They extended over four months, the Sultan's acceptance of the preliminaries being com- municated to the ambassadors on 27th September. Dur- ing the first week in October the plenipotentiaries for the settlement of the peace treaty were appointed : for Turkey, Tewfik Pasha, foreign minister, with Assim Bey, Ottoman minister in Athens, as coadjutor; for Greece, Prince Mavrogordato, Greek minister in Constantinople. The negotiations lasted nearly seven weeks ; the treaty was signed on 4th December, and a fortnight later ratifica- tions were exchanged.*~~

~~*During the first weeks of the peace negotiations diplo- matic attention was withdrawn from Cretan affairs, but was attracted to them in July, when the Porte talked of sending reinforcements, and again later when Djevad Pasha, who had taken up his appointment as Vali, brought about a state of friction with the admirals which they reported to be intolerable. In the early days of October the Porte sent a circular to its representatives abroad bidding them urge the Powers to settle the Cretan ques- tion, and proposing to that end (1) the disarmament of the whole population ; (2) the appointment of a Christian Vali ; (3) that of a Christian or European officer in the Turkish service to the command of the troops stationed in the island. This measure was barren of result. The ambassadors had*~~

~~frequent meetings, in the course of which they drafted a scheme of organization for the government of the island, and at their last gathering in that year (2nd December) they refused to entertain the Porte's proposal to send fresh troops to replace about 4500 time-expired men. At the same meeting the Russian ambassador put forward the candidature of Prince George of Greece for the governorship. The Sultan manifested great repugnance to this proposal, and in a series of communications to the Powers maintained that this office could not be fitly or fairly bestowed upon any but an Ottoman subject. In March, however, Russia, seconded by Great Britain, brought the Porte to understand that the objections of Europe to that arrangement were insuperable. In June the question of a temporary regime, preparatory to the autonomy already decided upon, came under discussion. About the same time the Austrian and German ambassadors withdrew from the diplomatic conferences, and the solution of the Cretan problem was left to the representatives of France, Great Britain, Italy, and Russia, the performance of whose task~~

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~~the Porte did its utmost to obstruct. In official circles hopes were entertained that the German Emperor, expected in Constantinople in October, would give the Sultan effectual support in Cretan matters, and accord- ingly Djevad Pasha, ex-Vali of the island, was ordered to Beirut to meet the Emperor and accompany him to Palestine. About this time the four Powers gave notice to the Porte to evacuate Crete, and after some profitless endeavours to obtain a mitigation of this condition, and finding that there was nothing to expect from the Emperor William, the Porte ordered the troops to leave the island, and by the middle of November the evacuation was com- plete. The four embassies then notified the appointment of Prince George as High Commissioner, the Porte acknowledged the communication with many expressions of regret, and Cretan affairs passed out of the hands of the four ambassadors.~~

~~*It has already been mentioned that Sultan Abdul Hamid had in view the complete subjection of the Yemen, and to that end had, in 1895, furnished the 7th army corps with Mauser rifles. But with the exception of general instructions and occasional reinforcements sent to Ahmed Eeizi Pasha, civil and military governor, who by unremitting severity had succeeded in establishing a certain measure of order in the province, no action was taken until the spring of 1898, when, in consequence of the then prevalent scarcity, a revolt broke out. The Sultan appointed Hassan Hilmi Effendi to be Vali, leaving the military command in the hands of Eeizi Pasha. Hassan Hilmi's endeavours were pacificatory, but they were defeated by the intrigues of Ahmed Eeizi, whom the Sultan recalled early in June, appointing Abdullah Pasha, commander of the 5th army corps, in his place. Abdullah prayed to be relieved of this duty. At that time the Vali was blockaded in Sanaa by the insurgents. Their movements were ordered by the Imam Zeid, calling himself the " True Khalif," whose headquarters were at Sadeh, and whose pretensions were said to be countenanced by the Sherif of Mecca. The Sultan became seriously alarmed, ordered the despatch of reinforcements to the number of 16,000 men, and insisted that Abdullah Pasha should take command of them. In June it was officially announced that all the tribes had submitted, and that imperial authority had been established throughout the country. But it was learnt privately soon afterwards that Abdullah had been repulsed in an expedition against the Kublet-el-Azin tribes ; that the tax-gatherers had been driven from Libit, a district near Hodeida ; and that in the whole region north of the Hodeida-SanaS, line the only recognized ruler was the Imam Zeid. Tidings of similar purport were received in Constantinople early in October. A few days later the Sultan issued an irade ordaining the division of the Yemen into four vilayets, each with a governor-general and full provincial administration. That ordinance has not yet been carried into effect.*~~

~~*' Among the many troubles of 1898 was the evil fruit of the indulgence bestowed upon the Mahommedan Albanian s. This turbulent race, always prone to insubordination, defied all authority and committed every sort of Mace- outrage on the Servian, Bulgarian, and Monte- question. negrin residents in their country, violating on several occasions the Servian and Montenegrin frontiers. The governments of these states, and of Bulgaria,*~~

~~*formally protested, and the embassies of the Powers in Constantinople expostulated, but all that they obtained was the despatch of commissions of inquiry to Albania, and the reinforcement of the Turkish garrisons in that region. The Albanian excesses, however, went on as before, and complete anarchy overspread all the country between the river Vardar and the Adriatic. In*~~

~~*November 1901 Kiazim Pasha, Vali and military com- mander of Scutari in Albania, who for four years had bravely and ably contended with this situation, resigned his post, finding it useless to persevere without support from Constantinople. Out of all these circumstances grew what has become known as the " Macedonian Ques- tion," i.e., the project of transforming the Turkish provinces west of the Vardar into an autonomous state.*~~

~~*In the autumn of 1898 (28th October) the German Emperor and Empress, on their way to Jerusalem, paid a visit to the Sultan, and were his guests for four days in the Merassim Kiosk (specially built in Yildiz Park to receive them on their first coming in 1889), to which a new wing was added for this occasion. The outcome of the Emperor's visit was a concession (19th March 1899) to the Anatolian Railway Company, a German aerman undertaking, for a port and bonded warehouses com- at Haidar Pasha, where the line has its terminus menial in proximity to the British (Crimean) cemetery, p™/"**- from which the magnificent view which it formerly com- manded is now shut out by the new buildings. The Emperor also obtained a promise from the Sultan of the extension of this line from Koniehto Baghdad and Basra, and a firman to that effect was delivered to the company on the 27th November 1899. In compensation for this act of favour to Germany, Russia demanded and obtained a prior right, on equal terms, over all applicants for rail- way concessions in Asia Minor north of the German line. Up to the end of November 1901 the convention for the Konieh-Basra line was not concluded, as the syndicate, besides adding several branches to their original scheme, demanded many supplementary privileges and a Govern- ment guarantee of net traffic receipts to the amount of 13,000 francs per kilometre. The demand for branches and incidental privileges called forth no serious objection, but the Sultan was strongly opposed to the kilometric guarantee.*~~

~~*In April 1900 the Sultan announced his intention of constructing a railway from Damascus to the Hedjaz. In Palace circles it was said at the time that the idea originated in the Sultan's anxiety to exer- Tark,sb cise a stricter control over the caravans of .pilgrims, amongst whom seditious literature was said to be largely distributed by revolutionary agents. But it is certain that the Sultan was also actuated by other motives, the most direct of which was the desire to acquire a firmer hold of his Arabian provinces — Hedjaz and Yemen — where in recent years the weakness of his authority had been made conspicuous by many untoward incidents. Moreover, he felt that the railway would show forth its founder as a benefactor of Islam, and promote Pan-Islamic views. The Sultan at once set on foot a subscription towards the cost of the railway, and appealed for contributions to Mussulmans in all parts of the world. He headed the list with a subscription of £50,000 (Turkish), and the works were begun on 31st August, the twenty-fifth anniversary of his accession to the throne. In the latter part of 1901 the Sultan's activity was also shown in various intrigues against British influence on the Persian Gulf, notably at Koweit.*~~

~~*The "Young Turkey" Association, resuscitated at Geneva in 1891 after an entombment of twenty -two years, lacking as it does pecuniary resources, cohesion, definite purpose, and capable leaders, has not shown itself a formidable organization. Nevertheless alarms concerning its sinister intentions have been several times j^L raised in Constantinople, and on each occasion the Sultan has taken steps to win back to their homes and to their allegiance some of those Turks who had gone abroad to make open profession of "Young Turkey" doctrine ; and inasmuch as a large proportion of them had*~~

~~*The foreign post offices.*~~

~~*gone into exile with the express object of being persuaded to return, many were brought back by that means. Thus there remained in Western Europe (1) those who had no faith in promises ; (2) those whom the Sultan did not care to reclaim ; (3) a very few who, sincerely Liberal in their views, hold the existing system in abhorrence. These are the elements of which the " Young Turkey " Asso- ciation consists. In recent years the Sultan has been in- creasingly anxious about it, having become aware that aversion from his rule has inspired the great majority of educated Turks, including a large proportion of the Ulema, with Liberal ideas. At the end of 1900 the Sultan's anxieties about " Young Turkey " became more and more acute, and prompted him to measures of counteraction which the circumstances did not war- rant, and which, by the undeserved suffering they occasioned, greatly increased the disaffection of his Mahommedan subjects and largely swelled the ranks of the malcontents.*~~

~~*One of these measures brought him into serious diplo- matic difficulties. In April 1901 he was warned by his ambassador in Paris that the " Young Turkey " com- mittees were preparing a demonstration which was planned to come off in Constantinople early in June, or sooner if possible. The ambassador urged the Sultan to take all possible precautions, and especially to intercept the correspondence passing between the committees and the members of the association residing in Constantinople. The only way of accomplish- ing this was to break open the mail bags addressed to the foreign post-offices, which on arrival pass, sealed, through the Turkish post office, and, being inviolable according to international compact, are so delivered to the several foreign postmasters. Notwithstanding this well-established rule, the Turkish postal authorities on the 6th May opened the foreign mail bags, confiscated the letters which appeared to them suspicious, and distributed the remainder. The four embassies concerned — Austrian, British, Trench, and German — immediately presented to the Porte an identic note protesting against the violation of the mail bags as a breach pf international law, and telegraphed to their Governments for instructions. On the following day they sent dragomans, accompanied by marines and sailors from the*~~

~~*despatch-boats, to meet the mail train and take possession of the letter-bags addressed to their respective post offices. This was done, the Turkish postal authorities offering no resistance, but merely declaring that the Turkish post would no longer take charge of the outward bags. These the ambassadors therefore despatched by a special messenger. The Porte replied to the ambassadors' protest, justifying its action in opening the mail bags ; but the ambassadors refused the Porte's note, and returned it. A second note of similar purport was returned in like manner; a third, somewhat apologetic in tone, was ac- cepted. This change of tone was due to the fact that the Sultan had become aware that the embassies were dis-cussing, and indeed preparing, a naval demonstration which they had recommended to the sanction of their Governments. A week later the Sultan, overpowered by his dread of a naval demonstration, sent his Minister for Foreign Affairs to the four ambassadors to inform them that his majesty retracted all that had been ordered regarding the foreign mails, and that the foreign post offices were free to work as they had previously done, and to use the Turkish post for the transmission of their bags. The Austrian, British, and French ambassadors refused to take official cognizance of this declaration, as they were awaiting instructions from their Governments ; but the German ambassador immediately accepted it as a satis- factory solution of the difficulty. Three days later the Minister for Foreign Affairs again went to the three*~~

~~*embassies, and renewed the Sultan's declarations and assurances, adding to them a humble apology and the Sultan's formal pledge that the Government would never again interfere with the foreign post offices. These over- tures the ambassadors then acknowledged in a collective note, and having referred to their Governments, accepted them on the 14th May, and on the 16th May the status quo ante of the foreign post offices was re- established.*~~

~~*Another diplomatic difficulty arose in 1901. Early in the year the Quay Company, a French undertaking, brought complaints against the Turkish authorities for obstructing its works and for infringing its rights and privileges. The French embassy urged these complaints for several months at the Porte and at the Palace without obtaining any redress. The embassy had also in hand a claim in respect of the expropriation of a*~~

~~*French subject who had bought and drained the marshes of Ada Bazar. In May the embassy put forward the long-standing pecuniary claims of two Levantine bankers, French " protected " sub- jects, which the Porte showed so much disinclination to admit that its relations with the French embassy became discordant, and the ambassador, M. Constans, repeatedly threatened to leave Constantinople. Convinced at length that M. Constans was in earnest, the Porte early in August adjusted the Quay question and settled the Ada Bazar claim, but still shirked those of the two p^s wlth bankers. M. Constans therefore broke off relations with the Porte, and left Constantinople on the 26th August. Two months passed without arriving at a settlement, and at the end of October France despatched a naval squadron, under Admiral Caillard, to Turkish waters, and presented to the Porte four new demands, compliance with which the French Government declared to be a con dition sine qud non of the renewal of diplomatic relations. The new demands were (1) the legal recognition of all French educational institutions, whether national or pro- tected ; (2) the legal recognition of all French religious and elementary institutions, whether national or protected ; (3) firmans authorizing the restoration of all buildings, belonging to such institutions, which were damaged in the disturbances of 1894 and 1896 ; (4) the recognition of the Chaldean Patriarch. These demands were presented to the Porte on the 2nd November. The French squadron arrived at Mytilene on the 5th November, and on the following day the bankers' claims were arranged, an irade recognized the Chaldean Patriarch, and satisfactory assur- ances were given regarding the other demands. These assurances were supplemented two days later by a formal acceptance ; and by the evening of the 10th November all points were finally settled, the French squadron quitted Mytilene, and on the following day diplomatic relations were resumed. On the 9th November Khalil Eifaat Pasha died, having held office for six years, the record of which was one of steadily progressive deterioration in all departments of the public service, with a corresponding diminution of commercial and industrial prosperity alike in the capital and in the provinces. The Sultan hesitated for some days over his choice of a new Grand Vizier, but on the 16th November he recalled to that office Said Pasha, whom he had dismissed therefrom on the 2nd October 1895, and who had since been living in retirement.*~~

~~*The opening of the year 1902 found Turkey in friendly relations with all the European Powers, but involved in serious internal difficulties. These were financial embar- rassments ; stagnation and unprosperity throughout the whole domain of commerce and industry; anarchy in the eastern provinces of Asia Minor and in the western pro- vinces of the Balkan Peninsula ; disorganization in all departments of the central administration, rendering*~~

~~*finance]*~~

~~*utterly impotent those of the provinces. It was in view of these difficulties, and of " Kutchuk " Said Pasha's well- known aptitude for dealing with them, that the Sultan was induced to call once more to office the long- discarded favourite of the earlier years of his reign.*~~

~~*Authorities. — 1892 : Georgiades, T). La Turquie actuelle. Paris. — Leclerc. Voyage au Mont Ararat. Paris. 1893 : Berard, Victor. La Turquie et VIHellenisme contemporain. Paris, Calmann Levy. — Harris, W. A Journey through the Yemen. London, Blackwood and Sons. 1895 : Grosvenor, Prof. E. A. Constantinople, 2 vols, illus. London, Sampson Low. 1896 : Hogarth, D. S. A Wandering Student in the Levant. London, John Murray. — M'Coll, Canon. The Sultan and the Powers. London. 1897 : Berard, Victor. La politique du Sultan. Paris, Calmann Levy; La Macidoine. Paris, Cal- mann Levy. — Bigham, Clive. A Bide through Western Asia. London, Macmillan and Co. With Turkish Arms in Thessaly. London, Macmillan and Co. — Chaudordy, Comte de. La France et la question d' Orient. Paris. — Harris, J. Rendell. Letters from Armenia. London. — Vandal. Les massacres armeniens et la reforme en Turquie. Paris. — Walker, Mart A. Old Tracks and New Landmarks. London, Richard Bentley. 1898 : Beaman, H. Twenty Years in the Near East. London, Methuen and Co. — Driault. La question d' Orient. Paris. — Hepworth, Rev. G. H. Through Armenia on Horseback. London, Isbister and Co. — Miller, W. Travels and Politics in the Near East.*~~

~~London, Fisher Unwin. — Warkworth, Lord. Notes from a Diary in Asiatic Turkey. London, E. Arnold. (e. w*.)~~

~~III. Finance. Preliminary Sketch. — From the outset of their history the Osmanli Turks adapted to their own particular needs most of the political, economical, and administrative institutions which existed before them. Primarily their system was based on the great principles enunciated by the immediate successors of the Prophet, especially by Omar, involving the absolute distinction between, and impartiality of treatment of, the Mussulman conquerors and the races which they conquered ; and from this point of view a careful study of the financial history of Turkey will afford most valuable insight into the little understood causes of what has been known for generations as the Eastern Question.~~

~~In reward for the brilliant services 'rendered him by Ertoghral (the father of Osman) and by Osman himself, Ala-ed-din, the last of the Seljuk sultans, conferred certain provinces in fief upon these two great warriors. They in their turn distributed the lands so acquired among their sons and principal emirs on strictly feudal principles, the feudatory lands being styled ziamet and timar, a system long continued by their successors in regard to the territories which they conquered. The conquered peoples fell into an inferior caste, made to work for, and to pay for the subsistence of, their conquerors, as under the Arab domination ; the principal taxes exacted from them were the kharadj (a kind of poll-tax paid for the privilege of gaining means of existence in a Mussulman country), and the djiziye, a compulsory payment in lieu of military service. The conquerors were feudatories of the reigning prince or sultan, and their payments consisted principally in providing fighting forces to make up the armies of the prince. The kharadj, the djiziye, and the whole feudal system disappeared in theory, although its spirit, and indeed in some respects its practice, still exists in fact, during the reform- ing period initiated by Sultan Selim III., culminating in the Tanzimat-i-Khairiye (1839) of Abdul Medjid, and the Hatt-i- Humayoun issued by the same Sultan (1856). The adminis- tration of the state revenues was managed by a Government de- partment known as the Beit-ul-Mal or MaliyS, terms generally employed throughout Mamie countries since the commencement of Islam. But the entire financial authority resided in the Sultan as keeper, by right, of the~~

~~*fortune of his subjects. The public revenues were passed under three principal denomina- tions — (1) the public treasury ; (2) the reserve, into which was paid any surplus of revenues over expenses from the treasury ; (3) the private fortune (civil list) of the prince. Expenditure, as under the Seljuk sultans, was defrayed partly in cash, partly in "assignations" (havale). a system which will be referred to later.*~~

~~*The Osmanli sultans, as also the Mamelukes and the Seljuks, were accustomed to give largesse to their military forces on their accession to the throne, or on special occasions of rejoicing, a cus- tom which still is practised in form, as for instance on the first day*~~

~~*of the year, or the birthday of the Prophet (mevlftd). Largesse was especially given on the field of victory, and was, moreover, liberally distributed to stifle sedition and mutiny among the troops, the numerical strength of whom was continually increased as the empire enlarged its borders. This vicious system, grafted as it was upon an inefficient administration, and added to the weight of a continually depreciated currency, debased both by ill-advised fiscal measures and by public cupidity, formed one of the principal causes of the financial embarrassments which assailed the treasury with ever-increasing force in the latter part of the 16th and during the 17th and 18th centuries. The Turkish historian, Kutchi Bey, attributes the origin of the decline of the empire to the reign of Suleiman the Magnificent (1520-1566), when the conversion of many emiriye lands into vakoufs (see infra) was effected, and the system of farming out revenues first introduced. Impoverished by these different causes, as well as by prodigal extravagance in in- terior expenditure, by shameless venality among the ruling classes, and by continual wars, of which the cost, whether they were suc- cessful or not, was enormous, the public treasury was frequently empty. So long as the reserve was available, it was drawn upon to supply the void; but when that also was exhausted recourse was had to expedients, such as the borrowing, or rather seizure, of the Vakouf revenues (1622) and the sale of crown properties ; then ensued a period of barefaced confiscation, until, to restore public confidence in some measure, state budgets were published at intervals, viz., the partial budget of Ainy-Ali (in 1018 or a.d. 1609), the budget of Ali Aga (in 1064, or 1653), and that of Eyoubi*~~

~~Effendi (in 1071, or 1660). At this time (1657-1681) the brilliant administration of the two Keuprulus restored temporary order to Ottoman finance. The budget of Eyoubi Effendi is particu- larly interesting as giving the statement of revenue and expendi- ture for an average year, whereas the budget of Ainy-Ali was a budget of expenditure only, and even in this respect the budget of Eyoubi Effendi is far more detailed and complete. The receipts amounted in round figures to a sum of 2,400,000,000 aqtche, equivalent to 60,000 purses, or 30,000,000 crowns, or about 6,000,000 modern Turkish pounds (£Tl=about 18s. 2d. in ster- ling), and a deficit is shown of about 308 purses (or 12,330,000 aqtche= 154,000 crowns). The budget of Ali Aga is almost identical with that of Eyoubi Effendi, and is worthy of special note for the conclusions which accompanied it, and which, although drawn up 250 years ago, described with striking accuracy some of the very ills from which Turkish finance is still suffering. "This budget," said the director of the MaliyS, " shows a deficit of 2000 purses " (about 1,000,000 crowns) ' ' caused by the system of anticipation adopted by the previous grand vizier and defterdar : the receipts of 1064 have been totally absorbed, as also more than half those of 1065 ; con- sequently the revenues of those years will be almost nil, and there will be a large deficit. I must add that, for the most part, the salaries inscribed in the budget have not been paid to those entitled to receive theni ; there still remains to be paid a balance of 2000 purses, the amount of the deficit above shown."~~

~~Apart from unimportant modifications, the form of the budget must have remained unchanged until the organic reforms of Selim III., while its complete transformation into European shape dates only from the year 1278 (1862), when Euad Pasha attached a regular budget to his report on the financial situation of the empire. Since that time there has been no further change worth noting ; although the publication of the budget has only taken place at very irregular intervals, it must also be observed that the published budgets are by no means accurate. From the time of Eyoubi Effendi until the end of the grand vizierate of Ibrahim Pasha (1730), the empire experienced periodical relief from excessive financial distress under the series of remarkable grand viziers who directed the affairs of state during that time, but the recovery was not permanent. Ottoman arms met with almost systematic reverses ; both the ordinary and the reserve~~

~~*treasuries were depleted ; a proposal to contract a foreign loan (1783) came to nothing, and the public debt (d&y&n-i-umumiye) was created by the capitalization of certain revenues in the form of interest-bearing bonds (sehims) issued to Ottoman subjects against money lent by them to the state (1785). Then came forced loans and debased currency (1788), producing still more acute distress until, in 1791, at the close of a two years' war with Russia, in which the disaster which attended Ottoman arms may be largely ascribed to the penury of the Ottoman treasury, Selim III., the first of the "reforming sultans," attempted, with but little practical success, to introduce radical reforms into the administrative organization of his empire. These endeavours were continued with scarcely better result by each of the succeed- ing sultans up to the time of the Crimean war, and during the whole of that period the financial embarrassment of the empire was extreme. Partial relief was sought in the continual issue of debased currency (beshlik, altilik, and their subdivisions), of*~~

~~*which the excess of nominal value over intrinsic value ranged between 33 and 97 per cent., and finally paper money (kaimi) which was first issued in 1839, bearing an interest of 8 per cent., reduced in 1842 to 6 per cent., such interest being paid on notes of 500 piastres, but not on notes of 20 or 10 piastres which were issued simultaneously. Finally, usage of paper money was restricted to the capital only, and in 1842 this partial reform of the paper currency was followed by a reform of the metallic currency, in the shape of an issue of gold, silver, and copper currency of good value. The copper coinage has since dis- appeared, but the gold and silver currencies of Turkey are now practically the same as they were ordered then. The gold coins issued were 500, 250, 100, 50, and 25 piastres in value, the weight of the 100-piastre piece (Turkish pound), 7'216 grammes, "916§ fine. The silver coins were of 20, 10, 5, 2, 1, and J piastre in value, the 20-piastre piece weighing 24-055 grammes, '830 fine. The copper money was in pieces of a nominal value of 40, 20, 10, 5, and 1*~~

~~paras, 40 paras being equal to 1 piastre. In 1851 further attempts were made to withdraw the paper money from circula- tion, but these were interrupted by the Crimean war, and the Government was, on the contrary, obliged to issue notes of 20 and 10 piastres. Finally, at the outbreak of the Crimean war Turkey was assisted by her allies to raise a loan of £3,000,000 in London, guaranteed by Great Britain and France ; in 1855 an organic law was issued regulating the budget, and in the same year a second guaranteed loan of £5,000,000 was contracted in Great Britain. In 1857 an interior loan of 150,000 purses in bonds (esham-i-mumtaze"), repayable in three years and bearing 8 per cent, interest, was raised ; the term of repayment was, however, prolonged in- definitely. In the same year another series of bonds {hazine tahvili), bearing 6 per cent, interest, and repayable in 1861, was issued ; in 1861 the term of reimbursement was prolonged until 1875. In 1858 a third loan was contracted in Great Britain for £5,000,000, and thereafter foreign loans followed fast on one another, in 1860, 1862, 1863, 1864, 1865, 1869, 1872, 1873, and 1875, not to mention the two Egyptian tribute loans raised on Egyptian credit in 1871 and 1877. (For further information regarding the Ottoman public debt and suspension of payments in 1876, &c, see p. 510.) In 1859 the settlement of palace debts gave rise to the issue of 1,000,000 purses of new interior bonds (esham-i-djedide') spread over a period of three years, repayable in twenty-four years, and bearing interest at 6 per cent. Further 6 per cent, bonds, repayable in ten years, and styled serguis, were issued in the same year. Seeing the rapid increase of the financial burdens of the state, a commission of experts, British, French, and Austrian, was charged (1860) with setting the affairs in order, and with their assistance Fuad Pasha drew up the budget accompanying his celebrated report to the Sultan in 1862. Meanwhile kaimi was being issued in great quantities (about 60,000 purses a month) and fell to a discount (December 1861) of 250 per cent. In 1862 further sehims were issued, and these and the loan of 1862 (£8,000,000) were devoted to the withdrawal of the kaimi. Later, however, the kaimi was again issued in very large amounts, and the years succeeding 1872 up to the Russian war. presented a scarcely interrupted course of extravagance and financial disorder, the result of which is described below.~~

~~*The Budget is supposed to be drawn up according to an excellent set of regulations sanctioned by imperial decree, dated 6th July 1290 (1875), of which the first article absolutely pro- hibits the increase, by the smallest sum, of any of the expenses, or the abandonment of the least iota of the revenues, fixed by the budget. The revenues are divided into two categories, viz., the direct and the indirect. The first category includes the " imposts " properly so called, the fixed contributions (redevances fixes) to be paid by the "privileged provinces," and the military exoneration tax. In the second are comprised tithes, mine- royalties, forests and domains, customs, sheep-tax, tobacco, salt, spirits, stamps, and "various." The expenses are also divided into two categories — (1) "Periodic and fixed " expenditure, which admits of neither reduction nor delay ; and (2) the credits allowed to the various departments of state, which may be increased or diminished according to circumstances. The expenditure of the first category is made up of the service of foreign loans, of the general debt, of the dotations replacing ziamet and timarai (military fief3), and of fixed contributions such as vakoufs. In the second category are included the imperial civil list, the departments of the Sheikhu-'l-Islamat and of religious establishments, the ministries of the interior, war, finance, public instruction, foreign affairs, marine, commerce (including mines and forests), and public works, and, finally, of the Grand Master of Ordnance. For every province (vilayet) a complete budget of receipts and expenditure is drawn up by its defterdar (keeper of accounts) under the supervision of the vali (governor) ; this budget is forwarded to the minister of finance, while each ministry and department of state receives communica- tion of the items appertaining to it. Each ministry and depart- ment then sends in a detailed budget to the Sublime Porte before*~~

~~*the end of December of each year. (The Turkish financial year is from 1st March to 28th February o.s.) The Sublime Porte forwards these budgets, with its own added thereto, to the minister of finance, who thereupon draws up a general budget of receipts and expenses and addresses it to the Sublime Porte before 15th December. This is summarily considered by the council of ministers, and then referred to the budget commission, which is to be composed not only of State functionaries, but of private persons " worthy of confidence, and well versed in financial matters," and which is invested with the fullest powers of investigation and inquiry. The report*~~

~~drawn up by the com- mission on the results of its labours is submitted to the Council of Ministers, which then finally draws up a general summary of the definitive budget and submits it by mazbata (memorandum) for the imperial sanction. When this sanction has been accorded the budget is to be published. The remaining regulations set forth the manner in which extra-budgetary and extraordinary expenses are to be dealt with, and with the manner in which the rectified budget, showing the actual revenues and expenditure as proved at the close of the year, is to be drawn up with the assistance of the state accounts department (div&n-i-mouhassebdt). This rectified budget, accompanied by an explanatory memorandum, is examined by the budget commission and the Council of Ministers, and submitted for the imperial sanction, after receiving which it is ordered that both be published. Special instructions and regula- tions determine the latitude left to each department in the distribution of the credits accorded to it among its various heads of expenditure, the degree of responsibility of the functioaaries within each department, and the relations regarding finance and accounts between each department and its dependencies. These regulations provide carefully and well for all contingencies, but unfortunately they are only very partially carried out. It may indeed be said that it is only the previsionary budget (Anglici, "the estimates") that receives any approximately proper care on the lines laid down, while the rule that both the estimates and the definitive budget (at the close of each year) should be published is almost wholly honoured in the breach ; the budget has only twice been published, in 1880 and 1897, since the regulations were put into force. It must also be observed that not only are the budgets not published, but the utmost vigilance is exercised that no figures whatever should transpire in regard to the true position of the Turkish treasury, — which lays the accuracy of even the limited number of budgets published open to suspicion. It is therefore impossible to arrive at any trustworthy figures from published information, but the figures given below have been extracted or calculated from unpublished reports of budget commissions which did their work well and had the courage to record their opinions, and from carefully rectified budgets. ^ If anything, rather favourable figures are given, both as regards revenue and expenditure.~~

~~Revenue, — For the sake of simplicity the revenues will be here massed into groups, certain main items being separated out : — Direct Taxes. — " Verghi," direct tax on realty, £T12,100,000 ; "Temettii," proportional tax on business profits, £T443,000 ; "Military exoneration tax," which submits non – Mussulman male Ottoman subjects between 15 and 75 years old (except priests and religious orders) to a tax of £T50 for 135 persons : £T665,000. Tributes and contributions from " privileged provinces " it is not proposed to deal with here. All of them, save the Egyptian tribute (£T750,000), which is entirely pledged for the service of loans, have been handed over to the inter- national administration of the Ottoman public debt, whose revenues being hypothecated to the bondholders, do not, and probably will not for very many years, affect the general financial situation of the empire. A special section below gives a summary account of this administration. Indirect Taxes. — "Tithes," originally one-tenth of the agricultural produce of the country, but raised gradually under various pretences, styled "Public instruction," to 12 per cent., £T4,000,000 ; "Tax on sheep, camels, buffaloes, and hogs," a variation of the tithe, £T100,000 ; "Customs," 8 per cent, ad valorem duty on all articles imported pending the conclusion of new commercial treaties, £T2,000,000. The new treaties will establish specific duties. It is credibly estimated that under them, the imports remaining the same, the customs revenue will be increased by £T560,000, of which £T260,000 would be apportioned to the revenues assigned to the bond- holders, and £T300,000 would fall to the share of the imperial Government. It is uncertain when the treaties, for which the negotiations have already been protracted through many years, will come into force. "Posts and telegraphs," £T320,000 ; " Mines and forests," 15 per cent, on the value of ores extracted and wood cut, £T273,000 ; "Ministry of justice," stamps and fees (tribunals), £T210,000 ; "Municipal taxes," various dues collected on permits granted for construction, repairs, &c, £T91,000 ; " Registration and transfer fees " (tapou), registration and transfer of real property — for special reasons this revenue was considerably less in 1897, but sinoe these special reasons have to~~

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~~some extent ceased, it is considered better to take the averagef'of several preceding years— £T218, 000 ; "Sundries," these in- clude receipts from the "Mahsousse steamships," a commercial line of steamers worked directly by the Admiralty, £T202,000 ; "Various railway receipts," £T86,500 ; " Heraclea coal mines," £T42,000; "Interest on securities deposited with Imperial Ottoman Bank," £T38,700 ; "Rent of Tumbeki monopoly," £T40,000. Other revenues arising from various sources not included under the above headings are difficult to follow in detail, as the receipts of which they are composed are not always placed under the same heads, and the totals under various heads appear, therefore, to fluctuate without any assignable reason : £T1,992,000.~~

~~Expenditure. — (1) Civil list, £T1, 000,000. This is the amount estimated to be drawn by the Sultan on the Treasury. It does not include the very considerable revenues obtained from the Crown lands and properties which are the Sultan's private property and are administered by a special department, the hazinS-i-hassa (private treasury), under the authority of the "minister of the civil list," who works under the direct super- vision of the Sultan himself, to whom alone he is personally responsible. The Crown lands and properties being exempt from every kind of tax, many abuses have crept in through this channel to the great detriment of the state. One of the leading instances of this is the fact that at the time of the collection of the sheep- tax private individuals drive their flocks and herds, with the connivance of the civil list (which receives a consideration for its good services), on to the Crown lands, where they can without fear claim exemption from the tax. The civil list has also an insatiable appetite for land, which it acquires often far below market price, and sometimes for nothing at all, as is easily con- ceivable in a land ruled by an absolute despot. It is estimated that more than one-third of the empire, and generally the richest lands, have now passed into the hands of the sovereign. Abuses of the kind described above therefore tend to increase, while more and more property is becoming legally non-taxable. The contributions of the state revenues to the civil list are secured on the customs, the defter-khane, and tithes of the richest provinces. (2) Military. — This includes the three departments of war, £T5,200,000 ; ordnance,~~

~~*£T886,000; and gendarmerie, £T1, 014,000. It is curious to observe that the budget decree of 1880 stringently limited the peace strength of the Ottoman military forces to 100,000 men, "including officers and generals," in order to put a stop to the rapidly increasing military expenditure ; in spite of this decree, however, which has never been formally repealed, the peace strength has gradually increased until it now stands at over 180,000 men. Nevertheless, the expenditure which stood at £T9,500,000 for the three departments mentioned has been apparently reduced to £T7,100,000. This is accounted for partially by the facts that rearmament was proceeding in 1880, and that the expenditure on gendarmerie and ordnance is now comparatively small; and for the rest by the separation of certain payments into " extraordinary expenditure" which is not shown in the budget. (3) Marine. — The expenditure on the marine, as shown in the budget, was cut down in 1897 from £T640,000 to £T546,000; but this was a budgetary device. The Greek war (1897) showed the Sultan the decrepit state into which his navy had fallen, and the importance of strengthening it to the point of being able to hold his own at sea, at least against the Greeks. Considerable "extraordinary" expenditure was incurred in 1902 to put the most modern Turkish men-of-war into a serviceable condition, and the ordinary expenses of the marine have remained at the previous level. (4) Civil Departments. — (a) Ministry of interior, £T784,000 ; (6) posts and telegraphs, £T350,000 ; (c) customs service, £T279,000 ; (d) mines and forests, £T83,000 ; other civil administrations and sundries, £T2,658,000. Total civil department, £T4,154,000. (5) Religious Establishments and Sundries. — These include educational expenditure, pensions, contributions to vakoufs, and expenses of the sacred caravan, and amount to £T750,000. (6) Public Debt.— Although the revenues ceded to the bondholders and the tributes were expressly left out of the revenue account, certain payments must be entered on the expenditure side. These are —*~~

~~*To public debt administration in lieu of*~~

~~*ceded revenues ...._. £T152,600*~~

~~*„ Service of loans (secured on tithes,*~~

~~*railways, Tumbeki, &c.) . . . 1,137,000*~~

„ Railway guarantees ‘ 750,000

„ Russian war indemnity . . . 450,000

„ Commission to Ottoman Bank for

treasury services and new agencies . 80,000

Moating Debt. — It is impossible to fix accurately any annual outgoings under this head ; financially speaking, the Turkish Government lives in such a “hand-to-mouth” manner that it is more than probable that it does not itself know what is the real amount of the floating debt. An ingenious calculation in the Fortnightly Review of March 1897 places it at £T55,702,000. This includes average yearly deficits of £T3, 000,000 on the general budget of the empire for a period of fifteen years ; as these are largely composed of salaries in arrear, and other items of a similar kind, which it is probable that the Government will never in any circumstances make good, it would be safe, as the writer in the Fortnightly points out, to reduce the figure considerably, but even so, it could scarcely be compressed to less than £T25,000,000. Seeing, however, the impossibility of arriving at any positive conclusions, it will be better to adopt the official figure allowed in the last published budget, viz., £T523,400, as that annually required to meet the most pressing needs of the floating debt.

Normal Budget of the Ottoman Empire exclusive of Service of Consolidated Debt and Tribute Loans.

Revenue.

Verghi Temettu . Military exemption tax Tithes ... Sheep tax ... Customs ... Posts and telegraphs Mines and forests Ministry of justice . Municipal taxes Tapou ... Other taxes and sundries

Total .

Deficit.

~~*£T*~~

~~*2,100,000*~~

~~*443,000*~~

~~*665,000*~~

~~*4 000,000*~~

~~*1,700,000*~~

~~*2,000,000*~~

~~*320,000*~~

~~*273,000*~~

~~*210,000*~~

~~*91,000*~~

~~*218,000*~~

~~*1,992,000*~~

~~*14,012,000 2,725,000*~~

~~*16,737,000*~~

~~*Expenditure.*~~

~~*£T*~~

~~*Ministry of war .*~~

~~*5,200,000*~~

~~*Ordnance ....*~~

~~886,000~~

~~Gendarmerie~~

~~1,014,000~~

~~Marine ....~~

~~640,000~~

~~Ministry of interior .~~

~~784,000~~

~~Ministry of posts and tele-~~

~~graphs ....~~

~~350,000~~

~~Ministry of mines and~~

~~forests ....~~

~~83,000~~

~~Customs ....~~

~~279,000~~

~~Other civil administrations~~

~~and sundries .~~

~~2,658,000~~

~~Religious establishments~~

~~and sundries .~~

~~750,000~~

~~Public debt~~

~~2,569,600~~

~~Floating debt .~~

~~523,400~~

~~Total ....~~

~~16,737,000~~

~~Total~~

~~£T2,569,600~~

~~1 These naturally vary from year to year according to the receipts encashed by the various railways. The annual average is estimated at £T750,000.~~

~~This budget represents the normal situation of Ottoman finance ; it does not tally with the budget published in 1897, which was prepared with a special object in view, and was obviously full of inaccuracies, nor indeed does it agree with figures which could be officially obtained from the Porte. It is, however, compiled from the best sources of information, and it exaggerates nothing. The formidable deficit is met principally in three ways. (1) By leaving the salaries of state officials and the army unpaid. In many parts of the empire the soldiers rarely receive more than eight months' pay in the year, although in Constantinople the arrears are not so large. The reverse is the case with the civil officials, whose salaries in the provinces are paid more regularly than in Con- stantinople, owing to their being charged on the provincial budgets : the average arrears are from two to three months in Constantinople, and from one to three in the provinces. The arrears in civil and military salaries average annually about £T1, 750,000. (2) By means of loans, both public and from individuals. By financial expedients of this kind payments were effected~~

~~by the Treasury in fifteen years (1881 to 1896) amounting to £T11, 666,000, or at the rate of nearly £T800, 000 per annum. (3) By anticipating the revenues of future years. This is the method so frankly condemned by Ali Aga, as was seen above, in 1653. Delegations (havaU) are granted on the provincial treasuries for one or two years in advance, some- times for a series of years, in order to pay pressing debts too heavy to be met in a single payment. No better description of the financial distress and disorder of the empire can be given than that set forth in the official report of the budget commission of 1888. "It has hitherto been considered necessary, owing to financial embarrassment, to commence financial years with un- balanced budgets. Later, without taking into consideration the effective amounts in cash at the disposal of the vilayets, con- siderable sums were drawn upon them, by means of havaUs, out of proportion to their capacity. For these reasons, during the last two or three months of the financial year, the vilayets have not a para to remit to the central administration, and it has been considered imperatively necessary to draw on the revenues of the following year. Thus, especially during the last two years, urgent extraordinary expenses having been perforce partially covered by the proceeds of the ordinary revenues, the revenues of 1303 (1887) were already considerably anticipated in the course of 1302 (1886). The former year naturally felt the effect of this, and the tithes which should have been encashed in the last months of the year were discounted and spent several months in advance. Moreover, in order to meet to some extent the deficit arising as well from the accumulation of arrears of state departments since 1300 (1884) as, to a large degree, from gross deficiencies due to the neglect of the civil officials of the Government to encash the revenues — to meet, further, the needs of the central administration, and above all, the urgent military expenses of the empire, and to provide a~~

~~guarantee for bankers and merchants in business relations with the Government and the treasury, part of the revenues of 1304 were perforce~~

~~spent in 1303." This commission proved the deficit of the year to be £T4,370,000. It set out also at length the very defective and disorderly condition of the state accounts. During the finance ministry of Agop Pasha (1889 to 1894) a good deal was done to set matters in order, but most of the ground then gained has since been lost.~~

~~Method of Collection of Taxes. — The Ottoman empire possesses a very complete system of local self-government within certain limits. Every village or town district has a kind of mayor (moukhtar) appointed by election and approved by the official provincial authorities, and a "council of ancients" whose members are elected directly. The taxes are collected by means of the moukhtars, termed for this purpose kabz-i-mal (receiver of treasure), and under the supervision of gendarmes specially named, termed tahsildar (collectors). The official authorities provide lists of all the taxes to be collected to the tahsildars, who hand them, against formal receipt, to the kabz-i-mals. The latter are bound to pay in to the local authorities all sums collected in five days in town districts, and in fifteen days in villages, if under 1500 piastres ; sums of 1500 piastres and over are paid in at once. The tahsildars check the accounts of the kabz-i-mals, and, if they discover peculation, send them at once to be dealt with by the chief official authorities of the cam (department) ; all the electors of a mowkhtar are, ipso facto, joint sureties for him. If the tax- . payer declines to pay his due, he is brought before the proper authorities by the tahsildar ; if he persists in his refusal, all his goods, except those indispensable for his dwelling and the pursuit of his trade, are sold by auction, without recourse to a judgment by tribunal. If he has no goods which may be seized, he may be summarily imprisoned for a term not exceeding 91 days : two imprisonments for the same debt are not permitted. The military exemption tax is not collected as above, but by the spiritual chiefs of the various non-Mussulman communities. None of the above regulations apply to Constantinople, where no military exemp- tion tax is imposed, and where separate official regulations for the collection of taxes are in force. The system of farming out the revenues is admitted, and is almost invariably followed in the case of the tithes. When this is done, the revenues to be farmed are put up to public auction and sold to the highest bidder, pro- vided he can prove himself amply solvent and produce sufficient sureties. Elaborate regulations are in force for this~~

~~*method of collection to secure the state receiving its full due from the farmers, who, on the other hand, are entitled to full official assistance to enforce their rights.*~~

~~*Assessment of Taxes.—For the purposes of assessment the taxes may be divided roughly into two classes : (1) Variable taxes ; (2) non-variable taxes. Under the first head would be included proportional taxes dependent upon the value of the property taxed ; under the second, taxes whose amount does not depend upon that value. The first class contains such revenues as tjie emlalc verghi-si (duty on realty), a'shdr (tithes), temettii (patents tax), &c. ' In all such cases the taxable values are fixed by a commission of experts, sometimes chosen by the tax-payers themselves, sometimes by the official authorities ; in all cases both tax-payers and authorities are represented on the commis- sions, whose decisions may be appealed against, in last resort, to the Council of State at Constantinople, whose decision is final. Instances of revenues composing the second 'class are the tapou (registration tax), the ahali-i-gairi musliminin bedelat-i-askeriyisi (military exemption tax), which do not vary, unless by special decree, and of which the assessment is automatic.*~~

~~*The systems, both of assessment and collection, are equitable and far from oppressive in theory. In practice they leave almost everything to be desired. The officials, already too numerous and underpaid, frequently, as has been stated above, find such pay as they have far in arrear. They are therofore naturally open to bribery and corruption, with the result that, while the rich often get off almost scot free, the poor are unduly taxed, and often cruelly oppressed by the tax collectors and farmers of revenue. In all departments there ensues, thus, an alarming leakage of revenue, amounting, it is credibly estimated, to quite 40 per cent.*~~

~~*International Administration of the Ottoman Debt.—In conse- quence of the piling up of the exterior public debt as described in the preliminary sketch, it amounted after the issue of "general debt" in 1875 to £T190,750,000, and swallowed up annually upwards of £T10,000,000, or nearly half the revenue of the empire as it was then constituted. The revolt of various disaffected provinces brought matters to a climax ; in September 1875 one-half of the service of the interest was suspended,*~~

~~paper certificates known as " Ramazans " (since they were issued in the Arabic month of that name) being issued for that half in lieu of cash, and in the following March it was suspended altogether. After the war with Russia, in order to obtain credit from the Imperial Ottoman Bank and local financiers, who refused any~~

~~fui&her accommodation unless their previous and further advances were amply secured, revenues known as the "six indirect con- tributions " were handed over to a committee of local bankers (by decree of 22nd November 1879), to be administered and collected directly by them. These " six7 indirect contributions" were the revenues from tobacco, salt, wines and spirits, stamps (commercial), certain specified fisheries, and the silk tithe. Two years later, partly in view of the recommendations of the Congress of Berlin, partly to overcome insuperable difficulties in obtaining any kind of credit, the Sultan authorized the Sublime Porte to issue an invitation to the various bondholders' committees in Europe to send delegates to Constantinople for the purpose of negotiating a resumption of payments. These "committees" were the " Council of Foreign Bondholders " for Great Britain, the Imperial Ottoman Bank and its ' ' group " for France, Herr S. Bleichroder for Berlin, the Credit-Anstalt and its "group" for Austria-Hungary, and the Chamber of Commerce and of Arts of Rome for Italy. The Dutch bondholders placed their interests in the hands of the British council. Russia declined to countenance the negotiations in any way. Delegates from the various com- mittees assembled in Constantinople in the early summer of 1881. The commission formed by them in conjunction with the delegates of the Sublime Porte is more generally known as the " Valfrey- Bourke commission," from the leading parts played by the Right Hon. R. Bourke (Lord Connemara), the British delegate, and Monsieur Valfrey, the French delegate. The outcome of the negotiations was the- issue of an imperial decree, known as the " Decree of Mouharrem," owing to its bearing the date (Turkish style) of the 28th of Mouharrem (20th December) 1881. By this decree the outstanding capital of the exterior debt, to which were added the Ramazan certificates above mentioned, and all interest fallen due, making a grand total of £252,800,000, was scaled down to £106,437,234 (£T 117,080,958). On this reduced capital a minimum interest of 1 per cent, was to be paid, the rate of interest to be increased by quarters per cent, as the revenues set aside~~

~~*for the service of the reduced debt permitted. For purposes of sinking fund the old loans were combined into four groups : 1 Group i. containing the 1858 and 1862 loans, with a reduced nominal capital of £T7,902,259 ; group ii. the 1860, 1863, 1864, and 1872 loans, with a reduced nominal capital of £T11,265,153 ; group iii. the 1865, 1869, and 1873 loans, with a reduced nominal capital of £T33,915,762 ; and group iv. the "general debt," of which the last issue was in 1875, with a reduced nominal capital of £T48,365,236, and the " lottery bonds " 1 (railway loan), with a reduced nominal capital of £T15,632,548, the total of group iv. being thus £T63, 997,784. As security for the service of the new reduced debt it was provided that an international council should be formed, composed of one delegate each from the bondholders of the United Kingdom, France, Germany, Austria-Hungary, Italy, and Turkey, and one represent- ing the " priority bondholders," a term which will be explained later. On this council the Turkish Government has the right of naming an imperial commissioner with ' ' consultative voice," i.e., no voting power, but the right to express his opinion on the proceedings of the council, who would make all reports he considered necessary to his Government. The Government was empowered also to name controllers to whom all the accounts of the administration should be open for inspection on demand. In all other respects the council, provided that it kept within the limits of the laws the administration of which was entrusted to it, was to be entirely independent of the Ottoman Government, free to appoint and dismiss its own officials from highest to lowest, and to carry on its administration on such lines as it thought best. Proposals made by the council for the modification and improve- ment of the existing laws and regulations which concerned it were to receive an answer from the Government within six months ; this provision has remained a dead letter. Any differ- ence between the Government and the council, if not possible of adjustment, was to be sattled by arbitration. To this council, with these extended powers, was handed over the absolute administration, collection, and control of the "six indirect contributions " above enumerated, for the benefit of the bond- holders, and in addition, it was to encash for the same purpose bills on the customs, to be drawn half-yearly in its favour by the minister of finance, amounting annually to £T180,000, represent- ing the tax on TumbeTri (£T50,000) and the surplus revenue of Cyprus (£T130,000) ; the Eastern Rumelian annuity,*~~

originally fixed at £T245,000, but gradually reduced by force of circumstances, until after frequent suspensions of payment it reached in 1897 the level of £T114,000, and has since been again suspended ; the

1 For simplicity's sake, the lottery bonds having a special treat- ment different from that of the rest of the loans, these groups, when the new bonds of the reduced debt were exchanged against the old bonds of the original loans, became " series " thus : Series A, group i. ; series B, group ii. ; series C, group iii. ; series D, group iv.; and lottery bonds.

finance]

tribute of Bulgaria, the amount of which has never even been fixed, but as compensation for which the tobacco tithe up to a yearly amount of £T100,000 was ceded to the council on the same conditions as the " six indirect contributions " ; the proportional parts (generally known as the " contributive parts") of the Ottoman public debt to be borne by Bulgaria, Servia, Greece, and Montenegro, which according to the Treaty of Berlin were to be

adjudged by the representatives of the Great Powers at Constanti- nople, one of whom (the Russian) has never succeeded in obtaining his instructions, and which therefore have never been fixed ; and, finally, the excess of revenue resulting from a revision of the commercial treaties. These revenues, exclusive of the " con- tributive parts " and the excess from commercial treaties, were estimated by Mr Bourke, in his report to the bondholders on the

Table showing

Revenues at Various Periods to 1900-1901.

Average for

~~*Average for*~~

~~*Average for*~~

~~*First*~~

~~*Second*~~

~~*Third*~~

~~*Last Year of*~~

~~*Five Years of*~~

~~*Five Years of*~~

~~*Five Years of*~~

~~*Heads of Revenue.*~~

~~*Galata Bankers,*~~

~~*Council of*~~

~~*Council of*~~

~~*Council of*~~

~~*1900-1901.*~~

~~*Observations.*~~

~~*1881-82.*~~

~~*Public Debt, 1882-8S,*~~

~~*1886-87.*~~

~~*Public Debt,*~~

~~*1887-88, 1891-92.*~~

~~*Public Debt,*~~

~~*1892-93, 1896-97.*~~

~~*£T*~~

~~*£T*~~

~~*£T*~~

~~*£T*~~

~~*£T*~~

~~*+3*~~

~~*‘Tobacco (including arrears)*~~

~~*881,563*~~

~~*822,63s1*~~

~~*755, 4892*~~

~~*788, 3842*~~

~~*720, 7282*~~

~~*1 Two years gross, 3 net from*~~

~~*s =<.*~~

~~*Salt .*~~

~~*634,936*~~

~~*651,057*~~

~~*702,150*~~

~~*755,978*~~

~~*949,170*~~

~~*regie.*~~

~~*indi ntril ions*~~

~~*Stamps ....*~~

~~*129 833*~~

~~*146,822*~~

~~*185,930*~~

~~*212,815*~~

~~*225,926*~~

~~*2 All net.*~~

~~*Spirits ....*~~

~~*177,163*~~

~~*198,356*~~

~~*229,059*~~

~~*258,848*~~

~~*277,121*~~

~~*8 Only £T9843 collected in*~~

~~*M O*~~

~~*Fisheries ....*~~

~~*26,064*~~

~~*34,356*~~

~~*44,307*~~

~~*44,337*~~

~~*50,504*~~

~~*1882-83 owing to tardy deliv-*~~

~~*ISilk ....*~~

~~*17,118*~~

~~*24,145*~~

~~*39,398*~~

~~*56,393*~~

~~*69,847*~~

~~*ery of revenues by Govern- ment. 4 Payment suspended in 1886-87.*~~

~~*Tobacco tithe ....*~~

~~*Not collected*~~

~~*72,340»*~~

~~*81,866*~~

~~*104,688*~~

~~*114,073*~~

~~*Eastern Rumelian annuity .*~~

~~*150,040**~~

~~*126,688*~~

~~*129,222*~~

~~...~~

~~*6 First two years' tobacco ex-*~~

~~*Excess of Cyprus revenues .*~~

~~*130,000*~~

~~*113,557*~~

~~*102,596*~~

~~*penses running ; next two*~~

~~*Tax on Tumbeki ....*~~

~~*>» ti*~~

~~*50,000*~~

~~*50,000*~~

~~*50,000*~~

~~*50,000*~~

~~*tobacco revenues (regie) paid net ; last year advance of £T100,000 to regie.*~~

~~*Total of six indirect contributions*~~

~~*1,866,677*~~

~~*1,877,369*~~

~~*1,956,333*~~

~~*2,116,755*~~

~~*2,292,960*~~

~~*Expenses*~~

~~*378,789*~~

~~*388,000"*~~

~~*392, 4036*~~

~~*346,143”*~~

~~*473, 6957*~~

~~*e £T148,233 advance to regie during first two years, and £T150,000 paid to it during*~~

~~*Net revenues from six indirect*~~

~~*contributions ....*~~

~~*1,487,888*~~

~~*1,489,369*~~

~~*1,563,930*~~

~~*1,770,612*~~

~~*1,819,265*~~

~~*the last three, making £T59,640 per annum. 7 £T50,000 per annum paid to regie.*~~

~~*decree of Mouharrem, at £812,562 (£T993,818). A substantial reduction, however, had to be made in favour of the 5 per cent, "priority bonds," which were bonds issued to the local banks before mentioned in satisfaction of their claims, and which formed an annual first charge of £T590,000 on the whole of the revenues*~~

~~*ceded to the bondholders ; the capital amount of the "priority bonds " was £T8,169,986, which was to be extinguished by 1906. Four-fifths of the net product of the revenues, after deduction of the first charge of £T590,000, was to be applied to the service of the interest on the new reduced debt, and provided that the four-*~~

~~*Table shounng*~~

~~*the Capital of the Ottoman Debt outstanding on 13th March 1902.*~~

~~*Loans*~~

~~*Date of Issue.*~~

~~*Original Nominal Capital.*~~

~~*Rate of Interest and Amortization.*~~

~~*Annuity*~~

~~*required for*~~

~~*Service of*~~

~~*Loan.*~~

~~*Capital amortized up to 13th Sep- tember 1898.*~~

~~*Cost of Amortization*~~

~~*13th Sep- tember 1898.*~~

~~*Capital out- standing on 12th September*~~

~~*1898.*~~

~~*15 fSeries A .*~~

~~*asJ » b .*~~

~~*o l „ D .*~~

~~*Lottery Bonds .*~~

~~*4 per cent. Priority*~~

~~*Bonds . Deutsche Bank*~~

~~*Loan Osmanieh 4 per*~~

~~*cent. Customs Loan . Tumbeki Priority*~~

~~*Bonds Ottoman Railway*~~

~~*Loan*~~

~~*5 per cent. Otto- man, 1896*~~

~~*5 per cent. Otto- man, 19014 .*~~

~~*8-20th Dec. 1881 . >> >>*~~

~~*II II*~~

~~*11 11*~~

~~*11 II*~~

~~*18-30th April 1890 .*~~

~~*27-29th October 1888*~~

~~*18-30th April 1890 . 14th May 1886*~~

~~*8-20th May 1893 .*~~

~~*10-22nd May 1894 .*~~

~~*29-12th March 1896*~~

~~*21st Nov.-4th Dec.*~~

~~*1901*~~

~~*£T*~~

~~*7,902,2591*~~

~~*11,265,153 1*~~

~~*33,915,762 |*~~

~~*48, 365, 236 J*~~

~~*1 per cent, and redemption*~~

~~*Drawings and redemption*~~

~~*4 per cent, and 1 per cent.*~~

~~*5 per cent, and 2 per cent.*~~

~~*4 per cent, and 1 per cent.*~~

~~*5 per cent, and 1 per cent.*~~

~~*4 per cent, and 1 per cent.*~~

~~*4 p. cent, and 0-35 p. cent.*~~

~~*5 per cent, and J per cent. 5 per cent, and 1 per cent.*~~

~~*£T*~~

~~79.0231 112, 6511~~

~~339,15s1~~

~~483, 6521~~

~~£T~~

~~7,831,868 5,919,632 4,642,056 3,115,206~~

~~£T~~

~~3,572,129~~

~~2,461,863~~

~~1,158,132~~

~~688,476~~

~~£T~~

~~70,3912 5,345,521 29,273,706 45,250,030~~

~~101,448,410 15,632,548~~

~~8,609,964~~

~~1,650,000~~

~~4,999,500 6,499,988~~

~~1,000,000~~

~~*1,760,000*~~

~~*3,272,720*~~

~~*1,254,000*~~

~~*1.014.4841 156, 3251*~~

~~*430,500*~~

~~*115,500*~~

~~*249,975 390,000*~~

~~*50,000*~~

~~*76,560*~~

~~*180,000*~~

~~*75,240*~~

~~*21,508,762 1,930,360*~~

~~*1,240,800*~~

~~*594,176*~~

~~*760,100 1,365,122*~~

~~*106,700*~~

~~*57,398*~~

~~*90,200*~~

~~*7,880,600 3,439,982*~~

~~*1,240,800*~~

~~594,176~~

~~760,100 1,233,244~~

~~106,700~~

~~57,398~~

~~90,200~~

~~79,939,648s~~

~~13,702,188~~

~~7,369,164~~

~~1,055,824~~

~~4,239,400 5,133,766~~

~~893,310~~

~~1,702,602~~

~~3,182,520~~

~~146,127,130~~

~~2,738,584~~

~~27,653,618~~

~~15,403,200~~

~~117,218,422~~

~~1 Exclusive of amortization. 2 Prescribed. 3 Of this amount £T945,900 is prescribed. * Not yet (1902) issued to the public.~~

~~fifths were sufficient to allow the distribution of 1 per cent, interest, one-fifth was to , be devoted to sinking fund ; but this latter fifth was to be reduced, if necessary, by an amount sufficient to maintain the rate of interest at 1 per cent. The interest on bonds amortized was to be added to the funds available for sinking fund. The sinking fund was to work as follows : — First J per cent, on the whole reduced capital was to be applied~~

~~to group i. ; if there were any surplus this was to be applied to group ii., until that also received the same full £ per cent., and so on for group iii. and group iv., until the whole sinking fund amounted to 1 per cent, on the reduced capital. It was to be applied by redemption at the best price possible on the market, until that price stood at £T66.66, when, if the rate of interest served were 1 per. cent., it was to proceed by drawings; if the~~

~~interest were anything more than 1 per cent. , and less than 3 per cent., the limit of price for redemption was to be raised to £T75 ; if the interest were between 3 per cent, and 4 per cent, inclusive, the limit was to be raised to par. Any surplus of revenue beyond that necessary to provide 4 per cent, interest and 1 per cent, sinking fund was to be handed over to the Government. The lottery bonds receive a special treatment both in regard to interest and sinking fund, but as this class of security does not concern English readers, and as a considerable amount of space would be required to give a comprehensive description of the intricate arrangements made for these bonds, it is not proposed to deal with them here ; full information will.be found in the decree of Mouharrem and the published reports of the council of administra- tion of the Ottoman public debt. In 1890 the sinking fund was increased by the conversion of the "priority loan" into a 4 per cent, loan and the extension of the term of its redemption for 15 years. In this manner an annuity of £T159,500 was set free, of which £T11,000 per annum was allotted as "extraordinary sinking fund " to series A and £T49,500 per annum each to series B, C, and D ;~~

~~*the lottery bonds were originally excluded from this arrangement, and special compensation was granted to these later. Each series receives the benefit of the interest on bonds belonging to it amortized by this special annuity. Thus, in the financial year 1900-01 the total amount of the fund had risen from £T159,500 to £T231,500.*~~

~~*The arrangement set forth in and sanctioned by the decree of Mouharrem has on the whole worked admirably well ; while the revenues not under the control of the council have largely diminished (Eastern Rumelian annuity and excess of Cyprus revenues), those administered directly by it have greatly in- creased. The first table on the previous page gives the product of the revenues in 1881-82, the last year of the administration of the " Galata bankers," the average during the first three quinquennial periods of that of the public debt council, and the product in the year 1900-OL It must be observed that the tobacco monopoly has been handed over to a company to be administered as a "regie."*~~

~~*The total external indebtedness of the Ottoman empire (exclusive of tribute loans) is given in the second table on the previous page.*~~

~~*Tobacco Rigie. — From the commencement of the year 1881 the tobacco revenue has been worked as a monopoly by a company formed under Ottoman law, styled ' ' La regie imperiale cointe- ' ress6e des tabacs Ottomans." This company has the absolute monopoly of the manufacture and of the purchase and sale of tobacco throughout the Ottoman empire, with the exception of the Lebanon and Crete, but exportation remains free. It is bound to purchase all tobacco not exported at prices to be agreed between itself and the cultivators ; if no agreement can be arrived at, the price is fixed by experts. It is obliged also to form entrep6ts for the storage of the crops at reasonable distances from each other, and, on certain conditions, to grant advances to cultivators to aid them in raising the leaf. The cultivators, on the other hand, may not plant tobacco without permits from the regie, although the power of a refusal of a permit, except to known smugglers or persons of notoriously bad conduct, seems to be doubtful ; nor may they sell to any purchaser, unless for export, except to the regie, while they are bound to deposit the whole of the tobacco crops which they raise in any one year in the entrep8ts of the*~~

~~rdgie before the month of August of the year following, and may not move any tobacco from the place where they cultivate it without the regie's express authority. In order to facilitate supervision, a minimum area of one-half of a deunum (a deunum = about one-fourth of an acre) is fixed for ground upon which tobacco may be cultivated ; in the suburban districts of Constantinople and some other towns, and in enclosures surrounded by walls and attached to dwelling-houses, it is altogether prohibited. For its privileges the regie has to pay a rent of £T750,000 per annum to the Government (assigned to bond- holders), "even if it has no revenues at all," and after the payment of a dividend of 8 per cent, to its shareholders, and certain other deductions, it has to share profits with the Government and the bondholders according to a sliding scale agreed upon between the three parties. The r<5gie did badly during the first four years of its existence, owing principally to two causes : (1) Its ineffectual power to deal with contraband, to which the system described above leaves the door wide open ; (2) the admission of other than Turkish tobaccos into Egypt, which deprived it at once of about £T100,000 per annum. So great were its losses that in the year 1887-88 it was obliged to write them off by reducing its capital from £2,000,000 to £1,600,000. At the same time it was granted an extension of penal powers, and the losses on reftieh (duty on tobacco exported to Egypt) were to be partially borne by the Public Debt Administration. Things went better with it from that time until 1894-95, when, owing to internal troubles in the empire, and the consequent fear of creating worse disorders by the strict enforcement of the mono- poly, the Government withdrew most of its support, and contra- band enormously increased. The following table shows the**

movement of the revenue of the regie from the year 1887-88 inclusive : —

Tear.

Gross Receipts from all Sources.

Total Expenses.1

Net Profits.

£T~~

~~£T~~

~~£T~~

~~1887-88~~

~~1,776,378~~

~~1,671,013~~

~~105,365~~

~~1888-89~~

~~1,865,044~~

~~1,683,924~~

~~181,120~~

~~1889-90~~

~~1,846,720~~

~~1,709,723~~

~~136,997~~

~~1890-91~~

~~1,981,849~~

~~1,761,685~~

~~220,164~~

~~1891-92~~

~~2,151,328~~

~~*1,853,136*~~

~~*298,192*~~

~~*1892-93*~~

~~*2,314,468*~~

~~*1,982,626*~~

~~*331,842*~~

~~*1893-94*~~

~~*2,435,716*~~

~~*2,084,017*~~

~~*351,699*~~

~~*1894-95*~~

~~*2,451,285*~~

~~*2,099,278*~~

~~*352,007*~~

~~*1895-96*~~

~~*2,383,209*~~

~~*2,095,010*~~

~~*288,199*~~

~~*1896-97*~~

~~*2,069,254*~~

~~*1,925,021*~~

~~*144,233*~~

~~*1897-98*~~

~~*1,878,694*~~

~~*1,814,719*~~

~~*63,975*~~

~~*1898-99*~~

~~*1,972,378*~~

~~*1,882,079*~~

~~*90,299*~~

~~*1899-1900*~~

~~*2,188,338*~~

~~*1,922,398*~~

~~*265,940*~~

~~*1900-1901*~~

~~*2,209,418*~~

~~*1,929,471*~~

~~*279,947*~~

~~*1 Including fixed charges.*~~

~~*Railway Guarantees. — Up to the year 1888 the only railways existing in the Turkish empire (exclusive of Egypt) were, in Europe, the*~~

~~*Constantinople-Adrianople-Philippopolis line and the Salonica-Mitrovitza line (finished in 1872) ; and in Asia Minor, the Smyrna-Aidin (completed in 1866), the Smyrna- Kassaba (completed in 1866), the Constantinople-Ismidt (com- pleted in 1872), the Mersina-Adana (completed in 1886). The want of railways in Asia Minor was urgently felt, but no capitalists were willing to risk their money in Turkish rail-ways without a substantial guarantee, and a guarantee of the Turkish Government alone was not considered substantial enough. In 1888 it was proposed by the Public Debt Adminis- tration to undertake the collection of specified revenues to be set aside for the provision of railway guarantees, the principle to be followed being, generally, that such revenues should consist of the tithes of the districts through which the railways would pass, and that the Public Debt should hand over to guaranteed railway companies the amounts of their guarantees before transmitting to the Imperial Government any of the pro- ceeds of the revenue so collected. The Government adopted this proposal, and laid down as a, principle that it would guarantee the gross receipts per kilometre of guaranteed railways, such*~~

~~*gross receipts to be settled for each railway on its own merits, onsiderable competition ensued for the railway concessions under this system. The first granted was for the extension of the Con- stantinople-Ismidt railway to Angora to a group of German and English capitalists in 1888. The Germans having bought out the English rights, this concession became a purely German affair, although a certain proportion of the capital was found in London. Since that time various other concessions have been granted to French and German financial groups, principally the Imperial Ottoman Bank group of Paris and the Deutsche Bank group of Berlin. The following table gives the list of railway concessions, with or without guarantees, granted since and including the year 1888 :—*~~

~~*Railways for which*~~

~~*Approximate*~~

~~*Number of Miles com- pleted.*~~

~~*Amount of*~~

~~*Concessions have been*~~

~~*Date of*~~

~~*Length of*~~

~~*Kilometric*~~

~~*granted from 1888 to*~~

~~*Firman*~~

~~*Railway in*~~

~~*Guarantee,*~~

~~*1899 inclusive.*~~

~~*Miles.*~~

~~*£T.*~~

~~*Ismidt- Angora (Ana-*~~

~~*tolian Railway) .*~~

~~*Oct. 6, 1888*~~

~~*312*~~

~~*312*~~

~~*600*~~

~~*Jaffa-Jerusalem*~~

~~*» 6. »*~~

~~*eo*~~

~~50~~

~~Salon ica-M on astir .~~

~~„ 27, 1890~~

~~186~~

~~136~~

~~572~~

~~Mudania-Brusa~~

~~Feb. 22, 1891~~

~~26~~

~~26~~

~~Pander ma-Konia'~~

~~(with branches) .~~

~~a 23, „~~

~~50O~~

~~θ~~

~~Beirut — Damascus —~~

~~Hauran .~~

~~June 13, „~~

~~182~~

~~182~~

~~*Samsun — Sivas-Diar-*~~

~~*bekir*~~

~~*July 2, „*~~

~~*750*~~

~~*θ*~~

~~*St Jean d' Acre —*~~

~~*Damascus*~~

~~*Oct. 8, „*~~

~~*219*~~

~~*θ*~~

~~*Salonica — Oonstanti —*~~

~~*nople Junction*~~

~~*(with branches) .*~~

~~*Bski — shehr — Konia*~~

~~*May SO, 1892*~~

~~*316*~~

~~*816*~~

~~*620*~~

~~*(branch of Ana-*~~

~~*tolian Railway)*~~

~~Feb. 18, 1893~~

~~276~~

~~276~~

~~554~~

~~Angora-Cse.sarea pro-~~

~~longation of Ana-~~

~~tolian Railway~~

~~» 13, „~~

~~256~~

~~>.~~

~~700-5~~

~~Alashehr-Karahissar~~

~~(Smyrna — Kassaba~~

~~extension) .~~

~~») ^i ii~~

~~157~~

~~157~~

~~754-6~~

~~The total sum paid for guarantees in the year 1900 was £T735,000. It is estimated that for some years the average yearly amount will be about £T750,000.~~

~~The total mileage of the railways in the Ottoman empire is as follows : —~~

~~Number of Name of Railway. Miles worked~~

~~in 1900.~~

~~Constanti»ople-Adrianople-Mustafa-Pasha f Th 1~~

~~Salonica-Uskub-Mitrowitza I ~ . , , I -oc~~

~~Dedeagatch-Adrianople 1 0”ental t 785 Uskub-Zibevche [Railways]~~

~~Smyrna-Diner and branches (Smyrna-Aidin Railway) . 324~~

~~■Smyrna- Alashehr and branches (Smyma-Kassaba Railway) 320~~

~~Mudania-Brusa 26~~

~~Mersina-Adana 40~~

~~Jaffa-Jerusalem 54~~

~~Salonica-Monastir 136~~

~~Haidar-Pasha-Angora (Anatolian Railway) . . . 360~~

~~Eski-shehr-Konia „ , 276~~

~~Beirut-Damascus-Hauran (Syrian Railway) . . . 155~~

~~Salonica-Constantinople Junction, and branches . . 316~~

~~Total~~

~~Of the Hedjaz Railway, from Damascus to Mecca, about 180 miles were completed in the beginning of 1902. In February 1902 the Sultan approved of the construction, by German enter- prise, of a railway to connect Konia, the terminus of the Anatolian Railway, through the Taurus range and by way of the Euphrates, Nisibin, Mosul, the Tigris, Baghdad, Kerbela, and Nejef, with Basra, thus establishing railway communication between the Bosphorus and the Persian Gulf The total length, including branches to Adana, Aleppo, the ancient Edessa, and other places, will exceed 1550 miles or 2500 kilometres. In this case the Government guarantee is 12, 000 francs (£480) of net receipts per kilometre per annum, plus 4500 francs (£180) per kilometre for working expenses.~~

~~The systems of guarantee above described are clearly faulty, since theoretically the railway company which ran no trains at all would, up to the limit of the guarantees, make the highest profits. The concessionaire companies have, however, wisely taken the view that it is better to depend upon their own re- venues than upon any Government guarantee, and have done their best to develop the working value of the lines in their charge. The economic effect of the railways upon the districts through which they run is well shown by taking the comparative values of the tithes in the regions traversed by the Anatolian Railway in 1889 and 1898, in which years it so happened that prices averaged almost exactly the same. These values were as follows : —~~

~~District.~~

~~In 1889.~~

~~In 1898.~~

~~Increase.~~

~~Proportion per cent.~~

~~Ismidt Ertoghrul Angora . Kutahia .~~

~~Total .~~

~~£T~~

~~28,450 27,902 31,240 57,786~~

~~£T~~

~~35,606 44,385 49,867 85,612~~

~~£T~~

~~7,156 16,483 18,627 27,826~~

~~25-15 59-07 59-62 48-15~~

~~145,378~~

~~215,470~~

~~70,092~~

~~48-21~~

~~Imperial Ottoman Bank. — At the close of the Crimean war an English bank was opened in 1856 at Constantinople under the name of the Ottoman Bank, with a capital of £500,000 fully paid up. In 1863 this was merged in an Anglo-French bank, under a concession from the Turkish Government, as a state bank under the name of the Imperial Ottoman Bank, with a capital ■of £2,700,000, increased in 1865 to £4,050,000 and in 1875 to .£10,000,000, one-half of which is paid up. The original con- cession to the year 1893 was in 1875 extended to the year 1913, and in 1895 to the year 1925. The bank acts as banker to the ■Government, for which it has a fixed annual commission, and it is obliged to make a permanent statutory advance to the Govern- ment of £T1, 000,000, against the deposit by the Government of marketable securities bearing interest at a rate agreed upon. The bank has the exclusive privilege of issuing bank notes pay- able in gold. Its central office is in~~

~~Constantinople, and it is managed by a director-general and advisory committee appointed by committees in London and Paris.~~

~~Monetary System. — The monetary system presents » spectacle of perplexing confusion, which is a remnant of the complete chaos •which prevailed before the reforms initiated in 1844 by Sultan Ahdul-Medjid, and which are still far from completion. The basis of the system adopted was the double standard with a fixed relation of 1 to 15 '09, and free coinage. The unit was the piastre (= 2Jd.), nominally subdivided into 40 paras. The gold pound (18s. 2d.) was equivalent to 100 piastres ; the gold pieces struck -were £T5, £T1, £T4 and £TJ ; the standard is 0'916§ "fine, and "the weight 7 '216 grammes. The silver coinage consisted •of the medjidie (weight 24-055 grammes, 0'830 fine), equivalent to~~

~~20 piastres, and its subdivisions 10, 5, 2, 1, and \ piastre pieces. The altilik, beshlik, and metallik currencies struck, the first and last in the reign of Mahmoud II. and Abdul-Medjid, and the second in the reign of Mahmoud only, were not included in the reform ; these were debased currencies bearing a nominal value, the altilik of 6, 3, and \ piastres, the beshlik of 5 and 2J piastres, the metallik of 1, J, and \ piastres ; they represented the last degree of an age-long monetary depreciation, the original piastre having had a value of about 5s. 7d., which had fallen to 2Jd. The heavy depreciation in silver causing large losses to the Government, free coinage was suspended in 1880, and the nominal value of the medjidie was reduced by decree to 19 piastres (105-26 piastres thus =£T1), while in the same year the debased currencies were redueed, altilik, the 6-piastre piece, to 5 piastres, the 3-piastre piece to 2J piastres, the lj-piastre piece to 1£ piastre ; beshlik, the 5-piastre piece, to 1\ piastres, the 2^-piastre piece to 1J piastre ; metallik, the 1-piastre piece to J piastre, the J-piastre piece to J piastre, the J-piastre piece to J piastre — these values representing approximately the intrinsic value of the silver, at medjidie standard, contained in the debased coins. The eopper coinage (113,000,000 piastres) and the paper currency (kaime) (1,600,000,000 piastres) referred to in the pre- liminary sketch were withdrawn in 1880 by repudiation. The 20-piastre medjidie currency, in spite of the further enormous depreciation of silver since 1880, has scarcely varied in the Constantinople market, but has always remained at a discount of about 3~~

~~*per cent, (between 108 and 109 piastres to the pound) under Government rate ; this is doubtless due to the fact that the demand and supply of the coins are very evenly balanced. The fractional medjidie coins (5, 2, and 1 piastres) are quoted at a separate rate in the market, usually at a premium over the 20- piastre piece. Within the last twelve years of the 19th century the altilik currency was almost entirely withdrawn, and replaced by fractional medjidie ; a large proportion of the beshlik has also been withdrawn, but the metallik has not been touched. These debased currencies are usually at a premium over gold owing to the extreme scarcity of fractional coinage. The standard of the altilik is about 0”440 fine, that of the beshlik is 0-185 to 0-225 fine, that of the metallik is 0-170 fine. Foreign gold coins, especially the pound sterling (par value 110 piastres) and the French 20-franc piece (par value 8,74 piastres) have free currency. Throughout Arabia and in Tripoli (Africa) the principal money used is the silver Maria Theresa dollar tariffed by the Ottoman Government at 12 piastres. The Indian rupee and the Persian kran are widely circulated through Mesopotamia ; in Bussorah transactions are counted in krans, taking as a fixed exchanges £T1 = 34 ‘15 krans. The general monetary confusion is greatly intensified by the fact that the piastre unit varies for almost every province ; thus, while the pound at Constantinople is counted at 108 piastres silver, it is at about 127 piastres for one kind of transaction and 180 for another in Smyrna, 135 piastres at Adrianople, 140 at Jerusalem, and so forth, accounts being kept in “abusive piastres,” which exist no longer. ‘In some towns, e.g., Adrianople, small change is often supplemented by cardboard tickets, metal discs, &c. , put into circulation by private establishments or individuals of good credit. The amounts of Turkish gold, silver, and debased coin- age in circulation are approximately £T16, 500,000 in gold, £T,8,700,000 (940,000,000 piastres at 108) in silver medjidies and fractions, and 200,000,000 piastres in beshlik and metallik.*~~

~~*Tenure of Property. — Real property is held in one of four various ways : either mmlk, emiriyi, vakouf, or khaliyi. 1. Mulk is the absolute property of its owner, and can be disposed of by him as he wills without restrictions, save those enumerated lower down (general dispositions) as general for all the four classes. Mulk property is governed chiefly by the Sheri (sacTed law). A duty of 10 per mille on its estimated value has to be*~~

paid on transfer by sale, donation, or testament ; 5 per mille on transfer by in- heritance ; and a registration duty on expenses of transfer. 2. Emiriyi is practically "public domains." The State may grant land of this category to private persons on payment by the latter of the value of the proprietary right — the tithes, ground -rent (should there be private buildings upon it), and the land-tax. It is administered by imperial functionaries called arazi- mimourou ; it is with the consent of the latter only that the proprietary rights can be sold. These rights are of simple posses- sion, but they are transmissible in certain degrees to the heirs of the possessor. Emiriyi cannot be mortgaged, but can be given as security for debt on condition that it be restored when the debt has been repaid. The creditor may demand the arazi-mimourou to proceed to a forced sale, but the arazi-me'mourou is not obliged to comply with that demand ; no forced sale may take place after the decease of the debtor. Emiriyi is not transmissible by will, but may be transferred by donation, which returns to the donor should he outlive the beneficiary. Should a proprietor of emiriyi plant trees or vines, or erect buildings upon it, with the consent of the State, they are considered as mulk; an annual tax representing the value of the tithes on the portions of emiriyi

thus utilized is levied. The emiriye then becomes mulk, with certain restrictions as to transfer dues. A transfer duty of 6 per cent, on the estimated value of emiriyk is paid on transmission by sale, inheritance, or donation, of 2J per cent, on the amount of the debt in case of mortgage or release from mortgage, and of 10 per cent, on expenses of registration. A different scale is established for emiriye with moukataa (rent paid for emiriye with mulk property established upon it). 3. Vakouf is "all property dedi- cated to God, of which the revenue is consecrated to His poor " ; or " property of which the usufruct, such as tithe, taxes, and rents, is attributed to a work of charity and of public interest." When once a property has been registered as vakouf it can never be with- drawn. There are two classes of vakouf: — (a) Land so declared either directly by the

~~sovereign or in virtue of imperial authority ; (6) lands transformed by their proprietors from mulk into vakouf. The laws and regulations concerning vakouf are too intricate to be described ; generally it may be said that they form a great obstruc- tion to dealing with a large proportion of the most valuable pro- perty in Turkey, and therefore to the prosperity of the country. The vak'oufs are administered by a special ministerial department (evkaf nazareti), whose property, on behalf of the State, they theoretically are. The effect of the original system was that a vakouf property became the inalienable property of the State, and the original proprietor a mere tenant. All fundamental repairs thus fell to the charge of the State, which could not afford to effect them, and the vakouf revenues decreased so rapidly that already in the reign of Selim I. (a.d. 1511-1520) a serious effort was made to deal with the difficulty. But this resulted in so heavy a burden upon the public that the law had again to be altered to extend hereditary rights, and to admit a system of mortgage which was assimilated to that for emiriye; but the evils were little more than palliated. The curious guilds called guedik must here be men- tioned. They were established at a time when industry was not free, and the Government fixed the number of artisans of every kind of trade in each town, no one having the right to increase that number. The guedik, then, was the right to erect buildings on vakouf property and supply it with the tools, &c. , necessary to exercise a trade. The ancient guediks have not been abolished, the Government not daring to deprive them of their privileges ; but since the Tanzimat no new ones have been created, industry being declared free. The various special dues payable on vakouf form too long a list to be inserted ; the highest is 30 per inille. 4. Khaliye. This property is also styled mevad. It consists of uncultivated or rough lands, such as mountains, stony ground, &c, which are useless without clearance, to which no possession is claimed,' and which are at such a distance from the nearest dwelling that the human voice cannot be made to reach them from that dwelling. Any one can obtain a gratuitous permit to clear and cultivate such lands ; the laws governing ordinary agricultural lands then apply to them. The permit is withdrawn if the clearance is not effected within three years. If the clearance is effected without the necessary permit, the land is nevertheless granted on applica- tion, and on the payment of the tapou or sum paid by the proprietor to the State for the value of the land.~~

~~*General Dispositions. — By the "protocol of the 7th Sefer 1284 a.h." foreigners may enjoy the rights of proprietorship on the same conditions as Ottoman subjects throughout the empire, save in the Hedjaz . The transmission of property from a foreigner to his heirs is therefore governed by the Ottoman laws, and not those of the country to which he belongs. The real property of a Mussulman does not pass by inheritance to non-Mussulman heirs, but may pass to his Mussulman heirs of a foreign nationality, and vice versa. Property of an individual who has abandoned Ottoman nationality without legal authority so to do does not pass, to heirs, whether Ottoman or foreign, but devolves to the State ; if legal authority has been granted the Government under which the foreign heirs live must have accepted the protocol above cited. An heir who has voluntarily caused the death of the person from whom he should inherit loses all rights of succession. It is not proposed to trace the formalities of transfer and transmission of real property here ; they will be found in vol. iii. of the Destour (Ottoman Code).*~~

~~*General Dispositions as to Mines and Treasure-trove. — On emiriyk, property mines become the sole property of the State, as also in land of which the tithe or other taxes are vakouf; the original proprietor must, however, be repaid the surface value of such lands. In lands assigned to public use (roads, pasturage, &c.) one-fifth of the produce of the mines goes to the State, four- fifths to the discoverer of the mine ; in property entirely vakouf the mine becomes the sole property of the vakoufs. Mines found on mulk property belong to the proprietor of the soil. Deposits of fuel or "fusible matters" on arazi-i-eushriye (lands distri- buted at the conquest to the conquerors) or on arazi-i-haradjiye (lands left in the hands of native non-Mussulmans at the conquest) belong to the State for one-fifth, to the proprietor of the soil for four-fifths ; if they be not "fusible" they belong entirely to the proprietor of the soil. As to ancient coins, and all kinds of treasure*~~

~~*of which the proprietor is unknown, reference must be made to the Destour, No. 4, p. 89. The latest law on mines is that of the 26th . November 1306 a.h.*~~

~~*Conclusion. — It is beyond the scope of this article to discuss the problem of Turkish financial reorganization. The latent resources of the empire are enormous : in the greater part of Asia Minor the soil is fertile, water abundant, the climate admirable, while minerals of all kinds exist in plenty, and there are large stretches of forest land. All this natural wealth is only waiting to be turned to proper account. But the disease is too deep-seated to be cured by measures of a financial order only.*~~

~~*Authorities. — Von Hammer. Histoire de VEmpire Ottoman. Paris, 1835.' — Zinkeisen. Geschichte des Osmanischen Meichs in Europa. Gotha, 1853. — Belin. Essais zur V Histoire economique de la Turquie. Paris, 1865. — Aristarchi Bey. Legislation Ottomane. Constantinople, 1873. — Creasy. History of the Otto- man Turks. London, 1878. — Engelhardt. La Turquie et le Tanzimat. Paris, 1882. — Bourke. Seport to the British and Dutch Bondholders. London, 1882. — Mdller. Der Islam. Berlin, 1885. — Haupt. L' Histoire Monetaire de notre Temps. Paris, 1886. — Ongby-Miller. Ottoman Land Code. London, 1892. — Medjelle (Ottoman Civil Code') . Nicosia, 1895. — Caillard ; Babington-Smith. Beports on the Ottoman Public Debt. London, 1884-98, 1899-1902. — Morawitz. Les Finances de la Turquie. Paris, 1902. — Pech. Manuel des Societes Anonymes fonctionnant en Turquie. Paris, 1902. (y. h. P. C.)*~~

~~*Turks Islands. See Jamaica.*~~

~~*Turnau, the chief town of a government district in North Bohemia, Austria, on the Iser river, 14 miles south by east of Reichenberg. It has considerable glass-cutting industry, and manufactures of imitation jewellery and articles in gold and silver, cutting and polishing of precious stones, together with important trade in corn, fruit, and the local staples. Population (1890), 5963; (1900), 6278 (including garrison of 554 men), chiefly Czechs.*~~

~~*Turnhout, a town of Belgium, in the province and 26 miles north-east of the city of Antwerp by rail. Its industries include lace-making, the manufacture of playing- cards, and tanning. Population (1880), 16,670; (1890),*~~

~~*18,747 ; (1900), 20,887.*~~

~~*Turnu Magurele, chief town of the district of Teleorman, Rumania, situated about 2 miles from the left bank of the river Olt, near its junction with the Danube, almost opposite Nicopoli, in Bulgaria. A large quantity of grain is shipped in lighters to ports lower down the Danube. There is a court of first instance. Much damage was done to the town in 1853 during the war between the Russians and Turks. Population (1900),*~~

~~*8668.*~~

~~*Turnu Severin, chief town of the district of Mehedinti, Rumania, situated on the left bank of the river Danube, below the well-known Iron Gate cataracts. It is a modern commercial town, having a court of first instance, a school of arts and crafts, and several churches. There are also large Government yards for the building of river steamers, lighters, and tug-boats. Near Turnu Severin are the remains of the celebrated Trajan's bridge, built in a.d. 103 by the architect Apollodorus of Damas- cus. The river is about 4000 feet broad at this spot. The bridge was composed of twenty arches supported by stone pillars, several of which are still visible at low water. When the quays were constructed many inter- esting sarcophagi were found. There is a large trade in cattle and pigs. The town derives its name from an ancient tower of Severus, which stood on a small hill surrounded by a deep fosse. Population (1895) 17,000 ;*~~

~~*(1900), 18,626.*~~

~~*Tuscaloosa, a city of Alabama, U.S.A., capital of Tuscaloosa county, on the Black Warrior river, and the Mobile and Ohio and the Queen and Crescent rail- ways, in the western part of the state. It was at one*~~

~~*time the state capital, and is now the seat of the State University, Central Female College, Tuscaloosa Female College, and the Institute for Training Coloured Ministers. It also contains the Alabama insane asylum. Population (1890), 4215 ; (1900), 5094, of whom 76 were foreign- born and 2508 negroes.*~~

~~*Tuscany, a territorial division of Italy, occupying the west part of the middle of the peninsula, and includ- ing the provinces of Arezzo, Florence, Grosseto, Leghorn, Lucca, Massa and Carrara, Pisa, and Siena, with an area of 9304 square miles, and a population (1881) of 2,208,869 and (1901) 2,548,154. The surface is for the greater part mountainous, though there are plains near Florence and Arezzo, and along the coast. This last is the malaria- haunted district of the Maremma, embracing an area of about 850 square miles. In the first half of the 19th century Grand Duke Leopold II. of Tuscany began an elaborate and extensive system of drainage, which was afterwards extended until it comprised nearly the whole of the district. The greater part of it is pasture-land ; and on the drier parts corn is grown, the people coming down from the hills to sow and to reap. Wheat, maize, wine, olive oil, tobacco, chestnuts, and flowers are the chief products of Tuscany. But its real wealth lies in its mines and industries. Mules, sheep, and cattle are fed on the pastures. Iron (Elba), mercury (Monte Amiata), boracic acid, copper, salt, lignite, statuary marble (Carrara, Massa, &c), alabaster, and Sienese earths constitute the mineral resources. Mineral and hot springs abound, and some are well known (Montecatini, Bagni di Lucca) Beeswax is extensively made. The industries are exceedingly varied and carried on with great activity. The most important towns are Florence, Leghorn, Lucca, Pisa, Siena, Pistoja, Prato, Arezzo, and Massa ; Leghorn being the chief port. There are univer- sities at Pisa and Siena. Leghorn and Viareggio are much frequented for summer sea-bathing.*~~

~~*Tuskegee, a town of Alabama, U.S.A., capital of Macon county, in the eastern part of the state, in a cotton region. It is noted chiefly for its educational institu- tions — the Tuskegee Normal and Industrial Institute, Alabama Conference Female College, and Alabama Military Institute. The first of these was founded in 1881 by Mr Booker T. Washington for the purpose of giving an industrial education to the coloured race. It possesses a property of 2300 acres, 800 of which are under cultivation ; it has forty-five buildings, many of brick, all designed and constructed, even to the making of the bricks, by the teachers and students. No fewer than twenty-six trades are taught. In 1900 it had 88 in- structors, and was attended by 1000 students. Popula- tion (1890), 1803 ; (1900), 2170.*~~

~~*Tuticorin,a seaport town of British India, in the Tinnevelly district of Madras, 149 miles by sea from Colombo, in Ceylon ; terminus of the South Indian railway, 443 miles south-west from Madras. Population (1881), 16,281 ; (1891), 25,107. Municipal income (1897- 98), Rs.38,850. It is an old town, long in possession of the Dutch, and has a large Boman Catholic population. Though only an open roadstead where vessels have to anchor 2\ miles from the shore, it has become, since the opening of the railway in 1875, the second port in Madras and the sixth in all India. In 1897-98 the number of vessels that entered and cleared for foreign trade was 1046, with an aggregate of 279,422 tons, having increased in fifteen years from 882 vessels of 97,505 tons. The total sea-borne trade in the district of Tinnevelly was valued in 1897-98 at Es.3,08,03,307, being 10 per cent, of the entire trade of the province. The" exports are chiefly rice and live stock to Ceylon, cotton, sugar, coffee, and*~~

~~*spices. There are 7 factories for ginning and pressing cotton, and a cotton mill with 24,332 spindles, employing 1000 hands. The fishery of conch shells is important, but the pearl fishery has decayed. Caldwell College was closed in 1893. There are two high schools (Caldwell's and St Xavier's).*~~

~~*Tuttlingen, a town of Wilrtemberg, Germany, on the left bank of the Danube, 37 miles by rail north by east of Schaffhausen. The town is overlooked by the ruins of the castle of Honberg, and has a monument to Schneckenburger, the author of Die Waclit am Rhein. It is the seat of textile, shoe, cutlery, iron, and other industries, and of a trade in fruit. The site was inhabited in Roman times. Population (1885), 8659 ; (1895),*~~

~~*11,672; (1900), 13,465.*~~

~~*Tuxedo, a town of Orange county, New York, U.S.A., in a hilly country in the south-eastern part of the state, on the Erie railroad. Within the town is Tuxedo Lake, on whose shores and on the surrounding hills are beautiful villas erected as summer homes by business men of New York. The town was organized in 1889. Population (1890), 1678 ; (1900), 2277.*~~

~~*Tuy, capital of the district of Tuy, province of Ponte- vedra, Spain, on the right bank of the river Mino, oppo- site Valenca de Mino, which stands on*~~

~~*the left bank in Portuguese territory. It has a station on the Orense- Vigo line. The town is near Monte San Cristobal, whose far-spreading spurs constitute the fertile and pic- turesque Vega del Oro. Hard by is the river Louro, abounding in salmon, trout, lamprey, eel, and other fishes. Not far off are the springs of San Martin de Caldelas. The industries include soap factories, tanneries, and dis- tilleries, and there is a brisk trade in agricultural products. The town is clean, with well-built houses, regular streets, and many gardens. The cathedral is of a massive and fortresslike architecture, with a noble eastern facade of the 14th century. It has four naves, nine chapels, and a well-preserved cloister. There are several large convents and a few ancient parish churches, an old episcopal palace, hospitals, good schools, a theatre, and a very handsome international bridge over the Mino. Alphonso el Catolico drove the Moors from Tuy, and Portugal and Spain fought frequently for its possession. Population (1887), 11,284; (1897),*~~

~~*10,983.*~~

~~*Tver, a government of Central Eussia, on the upper Volga, to the north of Moscow. It has an area of 25,225 square miles ; its population, which was 1,567,300 in 1872, numbered 1,812,825 (domiciled only) in 1897, 986,570 of whom were women, and 149,762 lived in towns. The high proportion of women (119 to 100) is explained by the fact that a large number of the men leave their villages in the winter (the season when the census was taken) to work in the factories at St Peters- burg and Moscow. No less than 384,500 persons, of whom 77,000 were women and 26,000 children, left the pro- vince for this purpose in 1899. The population is almost entirely Great Russian, but includes about 115,000 Kar- elians. The government is divided into twelve districts, the chief towns of which are Tver, Byezhetsk (9000 inhabitants), Kalyazin (5497), Kashin (7468), Kortcheva (2379), Ostashkoff (10,457), Rzheff (21,397), Staritsa (5395), Torzhok (12,743), Vesiegonsk (3469), Vyshniy Volotchok (16,722), arid Zubtsoff (2984). The distribu- tion of landed property in 1896- was as follows : — The peasants owned 69 per cent, of the land, having since their liberation bought 2,660,300 acres from the land- owners, in addition to their allotments, which made 50*~~

per cent, of the land ; the nobility owned 13 per cent. ; other landowners, 6 per cent. ; the Crown, 7 per cent. ; and the Imperial family, 4 per cent. Only one-tenth of the land is considered as unavailable for culture. No fewer than 42,540 peasant families hold no land, while in addition to the land which they own the peasants rent 1,498,000 acres. Notwithstanding the very moderate fertility of the soil, which requires heavy manuring, and the great development of industries in the villages, the peasants hold under culture 80 per cent, of the total cultivable area of the province. Far from destroying agriculture, the village industries favour it by providing occupation and earnings in the winter. The crops are quite insufficient for the population, and grain has to be imported in large quantities, though 1,951,000 acres were under cereal crops in 1900. The average yield in 1895-99 was : rye, 4,543,000 cwt. ; wheat, 19,000 cwt. ; oats, 4,473,000 cwt.; and barley, 718,000 cwt.; also potatoes, 6,083,000 cwt. The sowing of grass is spread- ing, owing to the efforts of the zemstvos, and improved machinery is being introduced. Live-stock breeding is next in importance to the cultivation of the soil, there being in the province in 1899, 351,000 horses, 579,000 horned cattle, 476,000 sheep, and 60,000 pigs. Dairy- farming has developed, and dairy produce is exported. Manufactures have grown rapidly, the aggregate annual returns of all factories amounting to over 40,000,000 roubles, so that Tver occupies the seventh place among the governments of European Russia for manufactures. They employ over 25,000 persons (8400 women, 3430 children). Cotton-mills, flour-mills, tanneries, and dis- tilleries are the chief industrial establishments. The government of Tver is also a great emporium for village industries, of which a remarkable variety is carried on, nearly every district and even every village having its own speciality. The principal of these domestic industries are weaving, lace-making, boat-building, and the making of boots, sacks, nets, all sorts of wooden goods, nails, locks, and other hardware and agricultural implements, and felt goods. Trade is very active, and its returns were estimated in 1899 at 76,500,000 roubles, which is much below the real figure. The river ports on the systems of the Volga, the western Diina, and the Msta represented

~~an aggregate of 3680 vessels and 81,710 rafts cleared, and about as many entered, an aggregate of over 2,000,000 towns ; while the railway stations repre- sented a movement of 903,000 tons entered and 725,500 tons sent out. Owing to the efforts of the local county and district councils, and notwithstanding the opposition of the Government, education, as well as the organization of medical relief, mutual insurance against fire, co-opera- tive dairying, and agricultural instruction are in a better position than in most provinces of Russia. There were in 1899, 2 gymnasia and progymnasia for boys and 8 for girls, 1 real school, 2 teachers' seminaries and 1 theological seminary, 4 agricultural and 3 lower technical schools, and 1557 primary schools — 55 town schools (6517 pupils), 16 ministerial (2349 pupils), 704 of the zemstvos (52,381 pupils), 20 private (1534 pupils), and 762 schools of in- ferior grade of the synod (27,122 pupils). Consequently 76 per cent, of the young men taken for the army could read and write in 1899, as against 37 per cent, in 1875. There are 75 school libraries, in addition to 22 public libraries. Mutual insurance by the zemstvos is very successful in the village, representing an aggregate capital of 111,000,000 roubles. (p. a. k.)~~

~~Tver, the capital of the above government, 102 miles by rail north-west of Moscow, on the right bank of the Volga, opposite its junction with the Tvertsa river, which enters into the Vyshnevolotsk chain of canals, connecting~~

~~the Volga with St Petersburg. This system having become less used than the Mariinsk route, Tver has lost its im- portance as a centre for trade in corn, its place in this respect having been taken by Rybinsk. But this loss is compensated for by the great development in its manu- facturing industries, which now employ more than 10,000 workmen and show an aggregate annual return of more than 20,000,000 roubles. The chief works are cotton mills (16,500,000 roubles a year in one large factory employing 8200 persons) and flour mills, but there are also a number of machinery works, glass works, saw- mills, and tanneries ; large railway carriage works and a steamer-building wharf have also been opened. The town is a considerable centre for the distribution of goods in a wide industrial region. It has an important river port, which was visited in 1899 by 1670 vessels and 47,700 rafts entered (420,000 tons), while the imports~~

~~*by rail reached 150,000 tons. The general aspect of Tver has much improved, and its population has nearly doubled since 1861, being 53,477 in 1897. Tver is well provided with schools, both for primary and secondary education, has a good museum, seven libraries, and free hospitals, and is in telephonic communication with Moscow and St Petersburg.*~~

~~*Twain, Mark. See Clemens, S. L.*~~

~~*Twenty-four Parganas, The, a district of British India, in the Presidency division of Bengal. It occupies part of the G-angetic delta, east of the Hooghly, surrounding (but not including) the city of Calcutta. It also excludes the unsurveyed and almost uninhabited Sundarbans. The administrative headquarters are at Alipur, a southern suburb of Calcutta.*~~

~~*Area, 2108 square miles; population (1881), 1,618,420; (1891), 1,892,033, showing an increase of 17 per cent. ; average density, 898 persons per square mile. Classified according to religion, Hindus in 1891 numbered 1,187,667 ; Mahommedans, 690,816 ; Christians, 12,982, of whom 2010 were Europeans; "others," 569. In 1901 the population was 2,078,340, showing a further increase of 10 per cent. The land revenue and rates in 1897-98 were Rs. 17, 59, 130 ; number of police, 1332 ; hoys at school (1897-98), 67,679, being 45-6 per cent, of the male population of school-going age ; registered death-rate (1897), 24-4 per thousand. The TwentyT four Parganas form the tract of which the zamindari or landlord rights were granted to the East India Company after the battle of Plassey, while the revenue arising therefrom was conferred upon Clive, upon whose death it reverted to the Company. The district is traversed hy three railways, two of which terminate at the ports of Diamond Harbour and Matla, but numerous river channels are still the chief means of communication. Apart from the suburbs of Calcutta, there is hardly a single real town. The two principal industries are the pressing of jute and the weaving of gunny bags.*~~

~~*Twerton, a parish in the Frome parliamentary division of Somersetshire, England, l1- mile west of Bath, with a station on the Great Western railway. There are lias quarries in the parish, and bricks and woollen cloth are manufactured. Population (1891), 7685; (1901),*~~

~~11,098.~~

~~Twickenham, a parish and urban district in the Brentford parliamentary division of Middlesex, England, on the north bank of the Thames. The interior of the church of St Mary was decorated and its tower restored in 1897. Population (1891), 16,027 ; (1901), 20,991.~~

~~Twiss, Sir Travers (1809-1897), English jurist and civilian, son of the Rev. Robert Twiss, was born in London in 1809. At University College, Oxford, he obtained a first-class in mathematics and a second in classics in 1830, and was elected a fellow of his college, of which he was afterwards successively bursar, dean, and tutor. During his connexion with Oxford he~~

~~was, inter alia, a public examiner in classics and mathe- matics, Drummond professor of political economy (1842), and regius professor of civil law (1855). After he had forfeited his fellowship by marriage, he was elected to an honorary fellowship of University College. He pub- lished while at Oxford an epitome of Niebuhr's History of Rome, an annotated edition of Livy, and other works, but his studies mainly lay in the direction of political economy, law, chiefly international law, and international politics. In 1840 he was called to the bar at Lincoln's Inn, and became an advocate at Doctors' Commons. In the ecclesiastical courts he enjoyed a large practice, and filled many of the appointments incidental thereto, such as Commissary-General of the City and Diocese of Canter- bury (1849), Vicar-General to the Archbishop (1852), and Chancellor of the Diocese of London (1858). He was professor of international law at King's College, London (1852-55). In 1858, when the Probate and Divorce Acts of 1857 came into force, and the ecclesi- astical jurisdiction of Doctors' Commons had passed away, Twiss, like many other leading advocates of Doc- tors' Commons, became a Q.C., and in the same year he was also elected a bencher of his Inn. His successful career continued in the civil courts, and in addition to his large practice he was appointed in 1862 Advocate- General to the Admiralty, and in~~

~~1867 Queen's Advocate- General, an office since obsolete, the occupant of which took precedence of the Attorney-General. In 1867 he was also knighted. He served during his legal career upon a great number of royal commissions, such as the Maynooth commission in 1854, and others dealing with marriage law, neutrality, naturalization, and allegiance. He was also one of the commissioners who sat to deter- mine the boundaries of Canada and New Brunswick, while his reputation abroad led to his being invited by the King of the Belgians to draw up the constitution of the Congo Free State. In 1871 Twiss became in- volved in an unpleasant scandal, occasioned by allega- tions against the ante-nuptial conduct of his wife, whom he had married in 1862 ; and he threw up all his appointments and lived in retirement in London until his death in 1897, devoting himself to the study of international law and kindred topics. Among his more notable publications of this period were The Law of Nations in Peace and The Law of Nations in War, two works by which his reputation as a jurist will chiefly endure. (e. a. ak.)~~

~~Tyler, a city of Texas, U.S.A., capital of Smith county, in the north-eastern part of the state, at the intersection of lines of the International and Great Northern and the St Louis South-Western railways, at an altitude of 531 feet. It is in a cotton region, and contains cotton-gins and compresses, and has a large business handling that staple. It contains also repair works of the St Louis South-Western railway, and rolling-mills. Population (1880), 2423; (1890), 6908; (1900), 8069, of whom 286 were foreign-born and 2693 negroes.~~

~~-), English~~

~~Tylor, Edward Burnett (1832- — anthropologist, born at Caniberwell on 2nd October 1832, was the son of Joseph Tylor, a brassfounder. Alfred Tylor the geologist was an elder brother. His parents were members of the Society of Friends, at one of whose schools at Grove House, Tottenham, he was educated. In 1848 he entered his father's manufactory in London, but at about the age of twenty he » was threatened with consumption and forced to abandon business. During 1855-56 he travelled in the United States of America to recruit his health. Proceeding in 1856 to Cuba, he met Henry Christy the ethnologist, with whom he visited~~

~~*Mexico. Professor Tylor's association with Christy greatly stimulated his awakening interest in anthropology, and his visit to Mexico, with its rich prehistoric remains, led him to make a systematic study of the science. While on a visit to Cannes he wrote a record of his obser- vations, entitled Anahuac; or, Mexico and the Mexicans, Ancient and Modern, which was published in 1861. In 1865 appeared Researches into the Early History of Mankind, which made Tylor's reputation. It showed great research, original insight, and much constructive power in the formation of systematic views. The chap- ters on early myths and their geographical distribution are especially valuable. The work reached a third edition in 1878. This book was followed in 1871 by the more elaborate Primitive Culture : Researches into the Develop- ment of Mythology, Philosophy, Religion, Language, Art, and Custom (3rd edit., 1891), which is still the standard general treatise on anthropology. Tylor's treatment of animism (ch. xi.xvii.) is particularly elaborate, and he first determined the limits of that province of anthro pology, intending it to include "the general doctrine of souls and other spiritual beings." In 1881 Tylor published a smaller and more popular handbook on Anthropology. His work had already met with recogni- tion. In 1871 he was elected F.R.S., and in 1875 received the honorary degree of D.C.L. from the University of Oxford. He was appointed keeper of the University Museum at Oxford in 1883, and reader in anthropology in 1884. In 1888 he was appointed first Gifford lecturer at Aberdeen University, and delivered a two years' course on "Natural Religion." In 1896 he became first pro- fessor of anthropology at Oxford.*~~

~~*Tyndall, John (1820-1893), British natural philo- osopher, was born in county Carlow, Ireland, on 2nd August 1820, his father being the son of a small land- owner and, though in poor circumstances, a man of more than ordinary ability. Tyndall himself for many years represented to ordinary Englishmen the typical or ideal professor of physics. To correct the exaggerated estimate common in the active part of his lifetime a certain amount of detraction naturally followed, and his memory came to be unduly depreciated. So far from being typical, he was in many respects unique, and he was chiefly remark- able for strong character, abundant energy, and scientific enthusiasm.*~~

~~His knowledge of physics was picturesque and vivid rather than thorough and exact, and never did it make any pretence at being encyclopaedic. In amount it did not much exceed what any highly educated General man of genuine all-round culture should aim at, Eristics. though it was far in excess of what in England is commonly thought possible ; but its vividness and colour and garnish of enthusiasm were his own. HIs strong, picturesque mode of seizing and expressing things gave him an immense living influence both in speech and writ- ing, and disseminated a popular knowledge of elementary physics such as had not previously existed. Hence he has been styled a popularizer, and it has been thought that his function was to take some recondite matter in hand and expound it to the unlearned and the ignorant. But this idea of his function does him both more and less than justice. It is true that owing to prevalent scientific ignorance he, like many another man, found it neces- sary to expound elementary facts and fundamental doctrines in extremely simple language; it is true also that in this power of exposition to the unlearned he far excelled all his contemporaries, nor has there been another like him with his peculiar power of catching the popular imagination and riveting its attention. But one reason of his suceess was that he never attempted to~~

~~expound anything specially recondite — he never hesi- tated to elaborate the simple and illustrate the easy — so that persons unaccustomed to scientific conceptions of any kind were able by his aid to experience the novel sensation of really comprehending something in a region perfectly new — a fact which fully 'accounts for the great popularity of his lectures and books. What these lec- tures attempted they achieved with the utmost success ; they were works of art, and by them he was able to com- municate something of his enthusiasm for science to others. HIs continued success sometimes led him to employ a popular style in regions where it was unsuit- able — in scientific controversy, for instance, or at the Royal Society — and hence he attracted to himself a certain amount of criticism. For errors which were venial in popular exposition became~~

~~deadly in discussion with equals or scientific superiors : there they be- came painfully obtrusive, and afforded opportunity for surprising rebuffs. Of these lapses the public al- ways, and his youthful dis- ciples at first, knew nothing, and his lectures had a mar- vellously stimulating effect. There are some who hold that perfect lectures should awaken in a beginner a sense of the infinitude of knowledge and of his own hopeless ignorance. If so, M~~

~~Tyndall's lectures were not jBi in this sense perfect ; they "Mk encouraged rather than dis- '|~~

~~couraged; they gave one the satisfying feeling of com- plete comprehension, so that after an intelligent youth had attended and thoroughly absorbed six or ten lectures, on heat, for instance, he could for some years live under the impression that he knew the subject. So he did, up to a point — knew it far better than those he was likely to come across in ordinary life ; and the feeling of thorough comprehension of one department encouraged him to enter upon a study of others with hope of similar satisfaction, though without Tyndall's guiding hand it was in many cases a comparatively slow and difficult process. Whatever may be the merits and demerits of this mode of beginning the study of physics, it is by no means (dear that the orthodox modern portal of the quantitative physical laboratory constitutes anything like the. same effective initial entrance, although if the first difficulties are overcome, a far more extensive in- terior is thus opened up. If the object of training be to enable a student to measure physical quantities and devote himself to the science as to a profession, there can lie no question which is the best method ; but if the object be to imbue the beginner with ideas, and assist him to a general grasp of the. elementary princi- ples and qualitative foundations of the science, then the method of Tyndall is the right one. In any case, at the beginning it is a right method ; but the mistake should not, be made of supposing that the knowledge so im- parted is all, or even much. It is a sketch of the edifice, but the building, the foundations, and even the prelimi- nary work of collecting the materials must come later.~~

~~Professor Tyndall. {From a p7totograj>h hy Elliott unci Fry, London.)~~

~~*Had the faculty of exposition been all, there had been less to say. Tyndall was a true educator, but he was more than that : he was at heart a Naturalist, i.e., an explorer of Nature, a physicist of the field. He had the instincts which usually accompany a proclivity for biology or geology or some other exploring science; he was one of the finest field physicists of his century. The aspects of Nature appealed to him strongly and emotionally, and it was in the domain of observation that his best and most characteristic work lay.*~~

~~*His scientific life may be divided very roughly into periods, or at any rate into groups : — (1) The youth- ' ful period, dominated by study in Germany and by work in magnetism ; (2) the slaty cleavage and Swiss glacier period; (3) the Royal Institution and radiant*~~

~~*heat period ; (4) the final period, including his work in connexion with light- houses, dust and disease, and amateur theology.*~~

~~*Tyndall was to a large extent a self-made man; he had no early advantages, but with indomitable earnestness devoted him- self to study, to which he was stimulated by the writings of Carlyle. He passed from a National school in count}' Carlow to a minor post (1839) in the Irish Ordnance Survey, thence (1842) to the Eng- lish Survey, attending Mechanics' Institute lectures at Preston in Lancashire. He then became for a time (1844) a railway engi- neer and (1847) a teacher at Queenwood College, Hants. Thence with much spirit, and in face of many difficulties, he betook him- self, with his colleague Edward Frankland, to the University of Marburg (1848-51), where, by intense application, he obtained his doctorate in two years. At this period he cer- tainly learnt some mathematics, and his inaugural dissertation was an essay on screw-surfaces ; but he had not the genuine mathematical instinct, and never looked at things from the point of view of a mathematician. Some curious instances of this will occur as we proceed.*~~

~~*His early magnetic investigations, for instance (1850- 1855), sadly lack the detiniteness which was possible at their date, but they are characterized by r tj the same free intrepidity and lack of deference tions la to authority which distinguish nearly all his mag- work. He endeavours to measure the law of Det,sm- decrease of force with distance by pulling a*~~

~~sphere of iron off a large magnetized pole-piece from which it was separated by various thicknesses of paper, and expends much experimental care upon the operation, not at all realizing that it must necessarily lead to nothing. He makes many experiments on diamagnetic polarity, of which one series, on a plan suggested by Weber, is recognized as satisfactory, giving a definite result; but ho does not express it as a mathematician would. He does not connect polarity with the discontinuity to be expected when lines of force traverse the boundary of two~~

~~media of different permeability. The result of his crucial experiment is most naturally and simply stated by assert- ing that the permeability of bismuth is less than that of air ; and, regarded in this way, it is difficult to see how the fact of the so-called diamagnetic polarity could be doubted. His chief magnetic work was devoted to the qualitative examination of the magnetic deportment of crystalline bodies ; and he constructed artificial sub- stances which behaved similarly by subjecting bread and other soft substances to pressure so as to produce a lami- nated structure.~~

~~Shortly before the Ipswich meeting of the British Association in 1851 Tyndall made acquaintance and began a lasting friendship with Huxley. The two young men stood for chairs of physics and natural history respectively, first at Toronto, next at Sydney, but they were in each case unsuccessful. In February 1853, how- ever, Tyndall gave a famous Friday evening lecture (on " The Influence of Material Aggregation upon the Mani- festations of Force") at the Royal Institution, and was in the following May chosen its professor of natural philo- sophy, a post which exactly suited his striking gifts, and made him a colleague of Faraday, whom in 1866 he succeeded as scientific adviser to the Trinity House and Board of Trade, and in 1867 as superintendent of the Royal Institution. His reverent attachment to Faraday is beautifully manifested in his memorial volume called Faraday as a Discoverer (1868).~~

~~In 1854, after the British Association in Liverpool, a memorable visit occurred to the Penrhyn slate quarries, where the question of slaty~~

cleavage arose in Alpine his mind, and ultimately led him, with Hux-uoal. g*·· ley» to Switzerland to study the phenomena of glaciers. Here the mountains seized him, and he became one of the most intrepid and most resolute of explorers ; he was the first to ascend the Weisshorn (1861), among other feats of climbing. The strong, vigorous healthfulness and enjoyment which permeate the record of his Alpine work are magnificent, and traces of his influence remain in Switzerland to this day. In some respects the Swiss period gives the dominant note of his life, and it represents him fairly both in his strength and weakness : strength in observation and description, and pertinacious — often dangerous — measurements, skill in recording his adven- tures also, and in collecting information on the subject ; weakness in not clearly understanding the true physics of a process even when it had been discovered and laid bare by others. The problem of the flow of glaciers occupied his attention for years, — throughout the rest of his life, one may say, — and it excited a singular amount of controversy, some of it of a personal kind. Tyndall was a most fair-minded controversialist, but he revelled in guerilla warfare, and seldom or never realized the weight of armament which disciplined troops could bring to bear against him. Consequently his controversies were often personal, always buoyant and hopeful, and seldom ended in any misgivings. For though he sometimes expresses himself as unable to understand the argument of his antagonist, he clearly does not mean this to be understood as due to a defect on his own part. His. side of the controversy is always simple, and beautifully stated up to the lights of the average listener ; and any lights beyond that he strongly inclines to mistrust. This boyish or free-lance attitude sometimes irritated the masters of the heavy artillery of science, who were astonished at an attack with bows and arrows, slings and stones, and other well-aimed and curiously effective weapons. For there was a vein of wholesome Tightness about Tyndall, as well as a notable lack of the theoretical instinct : he

was in close touch with Nature, and often realized her processes in his own way. He speaks of the pleasure derived from actual observation even of a well-known fact, and likens his feelings to those of Antaeus on' touching his mother earth. But his was not the in- spired Tightness of Faraday ; doubtless it aimed at that, but his genius fell short of his

~~*master's in this respect, and whereas Faraday was more often right than the mathematicians, Tyndall was very liable to be in some vital points wrong ; and the fact that he stated his case clearly sufficed to exhibit his wrongness all the more plainly to the few who possessed the necessary knowledge. Many explorers must find their theories looked down upon by the learned men at home on their return, and wise are they who realize where their strength lies, and do not seek to argue on first principles as if on equal terms.*~~

~~*It would be tedious to rake among the ashes of the dead controversy about glacier motion, in which the names of Agassiz, J. D. Forbes, Rendu, and Tyndall were intermingled, but it contains n* conifth0' some permanent lessons which are better not Forbes and overlooked. Every one knew that glaciers others about moved, but the questions were how they j^*^. moved, for what reason, and by what mechanism. Some thought they slid like solids ; others that they flowed like liquids ; others that they crawled by alternate expansion and contraction, or by alternate freez- ing and melting ; others, again, that they broke and mended. Thus there arose a chaos of controversy, illu- minated by definite measurements and observations. The following summary of this part of the matter by Tyndall is as fair as possible : —*~~

~~*The idea of semi-fluid motion belongs entirely to Rendu ; the proof of the quicker central flow belongs in part to Rendu, but almost wholly to Agassiz and Forbes ; the proof of the retardation of the bed belongs to Forbes alone ; while the discovery of the locus of the point of maximum motion belongs, I suppose, to me.*~~

~~*But the chief bite of the controversy lay between Forbes and Tyndall. Forbes asserted that ice was viscous ; Tyndall denied it. All agreed that ice flowed as if it were a viscous fluid : in every detail this came out from the measurements ; as a description of the motion this statement is perfect, and gradually from the conflict this fact clearly emerged. But how came it so to flow ? That was what none of the combatants could explain. Tyndall thought it was by regelation, but he did not understand regelation. Nor did Faraday. The text- books of that period (e.g., Balfour Stewart's) enter into an elaborate fiction about the coldness of the interior*~~

~~of ice. It seems to have been spoken of as a property " inherent to ice " to have a cold inside. " Never can a calorific ray pass the first surface of ice to raise the temperature of the interior."~~

~~Tyndall speaks of " liquid liberty " on the surface of ice, and says that when two moist surfaces are brought into contact the liquid liberty is destroyed and the sur- faces freeze together. Forbes, on the other hand, said simply that ice possessed viscosity. Tyndall does not seem very clear wha.t viscosity is, and in a characteristic passage says, "What then is the meaning of viscosity or V|iscidity ? I have heard it defined by men of high culture as ' gluey tenacity.' . . . Viscosity then consists in the power of being drawn out when subjected to a force of tension, the substance, after stretching, being in a state of molecular equilibrium, or, in other words, devoid of that elasticity which would restore it to its original form." Forbes, however, must have known precisely what viscosity was, and in so far as he only asserted that ice behaved as if it had viscosity he was right ; and where a glacier consists of a heterogeneous assemblage of crystals and fragments it may be really viscous like a crystalline~~

~~metal; but if he meant, as undoubtedly be did mean, that a mass of homogeneous blue ice began to soften be- . fore it melted, and was really a viscous fluid (as glass is) a little below its melting-point, he was wrong ; and Tyn- dall felt and said that he was wrong.~~

~~A sufficient reason for the curious behaviour of ice was discovered, quite independently of the contro- versy, by a classical thermodynamical investi- James gation of Professor James Thomson (elder loiMo£S brother of Lord Kelvin), a man of the higher order of specific intellect, who developed by pure theory a result which explains this and vastly more, and opens a new chapter in physics — the application of the second law of thermodynamics to physical and chemical problems. The simple fact is that ice under sufficient pressure melts, without the supply of any heat, and the water instantly freezes again on escap- ing from the pressure. For this reason ice behaves as if it were viscous. It yields where~~

~~the pressure is greatest, and migrates to where the pressure is least; but it does not flow as ice, for ice is not viscous but a rigid solid ; it flows as water, but exactly simulates vis- cosity by reason of its potentiality for change of state. The only controversy which could remain is a logomachy as to how nearly any of the statements which had pre- viously been made corresponded to reality — a worthless subject for discussion.~~

~~On one point Tyndall holds Forbes very neatly. If ice were really viscous it would not crevasse when under tension, at least not to the extent it does ; criticisms an(^ Tyndall clearly notes and explains the of Forbes fact that the direction of the latteral crevasses, a"j* at 45° and slanting upstream from the retain-~~

~~ing walls, is just the direction required by the actual shear, being due to the extension-component of the distortion caused by the more rapid flow in the middle and the retardation of the edges, though it is at right angles to the direction which a casual observer would expect from the direction of the flow. But James Thom- son's theory of the apparent viscosity of ice he cannot grasp. When he tries to explain it in popular language he comes to grief. The fact itself he accepts, viz., that pressure lowers the melting-point of ice, as it raises the boiling-point of water, but in trying to state it he pro- ceeds thus : —~~

~~"When a liquid is heated the attraction of the molecules operates against the action of the heat, which tends to tear them asunder. At a, certain point the force of heat triumphs, the cohesion is overcome, and the liquid boils. But supposing we assist the attraction of the molecules by applying an external pressure, the difficulty of tearing them asunder will be increased ; more heat will be required for this purpose ; and hence we say that the boiling-point of the liquid has been elevated by the press- ure.~~

~~Here the sentence " more heat will be required for this purpose " is careless. The fact is that less heat is neces- sary to evaporate water under high pressure with the boiling-point raised ; but this does not sound right to the average man, while Tyndall 's statement does. So again when he comes to ice or bismuth he repeats the same kind of error in other terms — four times on two pages. (Glaciers of the Alps [1860], 1896 edition, pp. 408, 409.) It is curious to read Tyndall's attempts to understand James~~

~~Thomson's theory. HIs mode of approaching the matter is always fair and characteristic, and singularly unsuitable for the purpose in view : it was written after a second communication from James Thomson, in which that philosopher endeavoured to emphasize the needless- ness for any further talk about glacier motion or for spurious explanations of regelation : —~~

~~I confess that even now I do not understand the essential point of Mr Thomson's theory — that is to say, its application to~~

~~the phenomena of glacier motion. Indeed, it was the obscurity in my mind in connexion with this point, and the hope that time might enable me to seize more clearly upon his meaning, which prevented me from giving that prominence to the theory of Mr Thomson which, for aught I know, it may well deserve. I will here briefly state one or two of my difficulties, and shall feel very grateful to have them removed.~~

~~An admirable attitude ; but after another paragraph the ad captandum style of argument is resumed, showing no sense of proportion, not at all realizing the extraor- dinary and crushing magnitude of "the Messrs Thom- son," considered as theoretical physicists : —~~

~~I would invite Mr Thomson to imagine himself and me to- gether upon the ice, desirous of examining this question in a philosophic spirit ; and that we have taken our places beside a stake driven into the ice, and descending with the glacier. "We watch the ice surrounding the stake, and find that every speck of dirt upon it retains its position ; there is no liquefaction of the ice that bears the dirt, and consequently it rests on the glacier undis- turbed. After twelve hours we find the stake 15 inches distant from its first position . I would ask Mr Thomson how did it get there ?~~

~~Whereas, then, on the scientific side Tyndall had his weakness, on the human side he was superlatively strong. Scrupulous fairness up to his lights was his con- stant attitude, and he took pleasure in urging attitude S the claims of an unknown man or of a foreigner, towards So he acted for J. R. Mayer, physician of s^fnc Heilbronn, and so also for Rendu, bishop of Anneqy. Mr Ruskin permitted himself in Fors Clwuigem to join~~

~~*in the ice controversy, and to accuse Tyndall of showing a carping and detracting spirit in his effort to link the name of Rendu with that of Forbes ; but this was allowing his judgment to be biassed by friendship and respect for the memory of Forbes, also by a too ready acquiescence in a descriptive or superficial statement of the glacier problem as if it were the complete solution. But he made amends, for this misguided criticism of a man as fair as himself, by a note specially written for a translation of Rendu's Glaciers of the Savoy; this, being accessible only with difficulty, may be in great part here reproduced, as a statement for all time of the worthy attitude of scientific men in such matters ; and we can well imagine Tyndall acclaiming with a vigorous hand- shake his agreement with the substantial sentiment of this fine passage1: —■*~~

~~*It seems to me that all these questions as to priority of ideas or observations are beneath debate among noble persons. What a man like Forbes first noticed, or demonstrated, is of no real moment to his memory. What he was, and how he taught, is of con- summate moment. The actuality of his personal power, the sincerity and wisdom of his constant teaching, need no applause from the love they justly gained, and can sustain no diminution from hostility; for their proper honour is in their usefulness. To a man of no essential power, the accident of a discovery is apotheosis ; to him, the former knowledge of all the sages of earth is as though it were not : he calls the ants of his own generation round him, to observe how he flourishes in his tiny forceps the grain of sand he has imposed upon Pelion. But from all such vindication of the claims of Forbes to mere discovery, I, his friend, would, for my own part, proudly abstain. I do not in the slightest*~~

~~*1 To a book called Glaciers of Savoy, being a translation of Mon- sieur Rendu's book on the same subject, made by George Forbes in memory of his father, in which there are quoted several extracts from Fors Clavigera of October 1873 (Letter 34), Mr Ruskin adds a special supplementary note on 'the proper attitude of men of science to ques- tions of priority. Considered critically, it is not a complete statement, for it is not human to attempt to eradicate the last traces of individ- uality ; and the greatest men of science, to whom all other rewards were as nothing, have always felt a human interest in the personal side of all good work, and have been*~~

careful to attribute credit justly when they could. For as an artist signs a picture and resents a forgery, so may a man of science justly demand reasonable historical accuracy in the labelling of discoveries. But inasmuch as the labelling is often complicated, and misunderstandings must occur, especially in the care- less estimation of the public, the extract quoted iu the text is a true representation of the only attitude worthy of the dignity of science.

degree care whether he was the first to see this, or the first to say- that, or how many common persons had seen or said as much before. What I rejoice in knowing of him is that he had clear eyes and open heart for all things and deeds appertaining to his life ; that whatever he discerned, was discerned impartially ; what- ever he said, was said securely; and that in all functions of thought, experiment, or communication, he was sure to he eventually right and serviceable to mankind, whether out of the treasury of eternal knowledge he brought forth things new or old.

This is the essential difference between the work of men of true genius and the agitation of temporary and popular power. The first root of their usefulness is in subjection of their vanity to their purpose. It is not in calibre or range of intellect that men vitally differ ; every phase of mental character has honourable office ; hut the vital difference between the strong and weak — or let me say rather, between the availing and the valueless intelligence — is in the relation of the love of self to the love of the subject or occupa- tion. ... It may be felt in any single page of Porbes's writing, or De Saussure's [or Tyndall's either] that they love crag and glacier for their own sake's sake ; that they question their secrets in reverent and solemn thirst : not at all that they may commu- nicate them at breakfast to the readers of the Daily News — and that, although there were no news, no institutions, no leading article*, no medals, no money, and no mob in the world, these men would still labour, and be glad, though all their knowledgevwas to rest with them at last in the silence of the snows, or onfp to be taught to peasant children sitting in the shade of the pines.

~~*The remaining epochs of Tyndall's life need but short notice. He investigated the transparency and opacity of gases and vapours for radiant heat during many Principal years (1859-71/), and this is frequently con- dor*. " sidered his chief work. He definitely estab- lished the absorptive power of clear aqueous vapour — a point of great meteorological significance. He made brilliant experiments elucidating the blue of the sky, and discovered the precipitation of organic vapours by means of light. He called attention to curious phenomena occurring in the track of a luminous beam. He examined the opacity of the air for sound in connexion with lighthouse and siren work. And he finally clinched the proof of what had been already substantially demonstrated by several others, viz., that germ-free air did not initiate putrefaction, and that accordingly "spontaneous generation" as ordinarily understood was a chimera (1875, 1876). One practical outcome of these researches is the method now always adopted of sterilizing by a succession of gentle warm- ings, sufficient to kill the developed micro-organisms, instead of by one fierce heating attempting to attack the more refractory undeveloped germs of the same. This method of intermittent sterilization originated with Tyndall, and it was an important contribution to bio- logical science and industrial practice.*~~

~~*For the substantial publication of these researches reference must be made to the Transactions of the Royal Society ; but a popular account of many of them was incorporated in his best-known books, namely, Heat as a Mode of Motion (1863, and later editions to 1880); Tlie Forms of Water, &c. (1872); Lectures on Light (1873) ; Floating Matter in the Air (1881); On Sound (1867; revised 1875, 1883, 1893). The original memoirs themselves on radiant heat and on magnetism were collected and issued as two large volumes under the following titles : — Diamag- netism and Magne-crystattic action (1870) ; Contribu- tions to Molecular Physics in the Domain of Radiant Heat (1872).*~~

~~*His scientific achievements were none of them of the very first magnitude: it is not so much what he did as what he was that is of permanent interest ; and in the pursuit of pure science for its own sake, undisturbed by sordid considerations, he shone as a beacon light to many a struggling youth — an exemplar of simple tastes, robust nature, and*~~

~~*lofty aspirations. His elevation above the common run of men was conspicuous in his treatment*~~

~~*of the money which came to him in connexion with bis successful lecturing tour in America (1872, 1873). It amounted to several thousands of pounds, but he would touch none of it : he placed it in the hands of trustees for the benefit of American science — an act of lavishness which bespeaks a noble nature. That Mr Euskin should have allowed himself to belittle such a man is a painful instance of the mistakes which can be made through half- knowledge. There was in truth much kinship between them, and had they known each other better they would have been friends. They differed much in culture, no doubt, and in amount of achievement as well as in ana- lytic power. No comparison is intended, but they had fea- tures in common. Both of them rushed into subjects for which they had had no adequate training, and both, by their innate ability, critical faculty, and clear common- sense, exercised some revolutionary and wholesomely clarif jdng influence on any subject they touched.*~~

~~*Tyndall's incursions into theology were marked by the same crude fearlessness as we have noticed in the higher parts of physics or amid the forces of nature ; and he laid down the law, on prayer, for in- Theological stance, and on miracles, with easy assurance. ™"rsy.~ These writings — Fragments of Science, as he calls them, " for unscientific people " — are wholesome and interesting, though naturally they do not add to our knowledge appreciably; nor did the more ambitious Belfast Address (1874), delivered as President of the British Association, make any serious contribution to philosophy, though it stated a form of the materialistic position with his usual trenchant vigour, and made a great stir among those who were then busy with the supposed conflict between science and religion. At bottom Tyn- dall frequently displayed a reverent and religious spirit, but he was led away by his conception of physics into an endeavour to simplify the universe to an extrava- gant extent ; and his light-hearted exhilaration in this enterprise shocked many good people, who feared that he might succeed in- uprooting their treasured convictions.*~~

~~Tyndall was a vehement politician, with a characteris- tically Irish readiness and violence of expression ; though a thorough Liberal, he split from Mr Gladstone on Irish Home Rule, and exhibited activity in opposing it. In 1876 he married Louisa, daughter of Lord Claud Hamil- ton. He built in 1877 a cottage on Bel Alp above the B.h6ne valley, and in 1885 a house on Hindhead, near Haslemere. At the latter place he spent most of his later years ; his health was, however, no longer as vigorous as his brain, and he suffered frequently from sleeplessness. On 4th December 1893, having been accidentally given an overdose of chloral, he died at Hindhead. (o. «r. l.)~~

~~Tyne, The, a great river of England, flowing past Newcastle and emptying itself into the North Sea at Tynemouth. Perhaps the great feature of the Tyne, com- mercially speaking, has been the amalgamation of the great shipbuilding and engineering companies, enabling single firms to build and engine ships of the largest size, viz., Arm- strong, Whitworth and Company, Palmer's, and Swan and Hunter. Two yards in 1898 built vessels whose total tonnage exceeded 50,000, and two engineering firms made engines the total horse-power of which was more than 50,000. To enable this to be done the Tyne Commissioners have changed the river from a shallow stream into a river deep enough to allow a 5000-ton ship to proceed 14 miles up the river. In this work 100,000,000 tons of material have been dredged from the river, making the depth of water at Shields harbour 40 feet, and at Newcastle 31 feet at high-water spring tides. The amount spent on these works of improvement, and on the Tyne piers, is~~

~~nearly £6,000,000. Of this sum more than £1,000,000 has been spent on the two piers at the mouth of the river. The length of the north pier, which in 1898 was partly destroyed by a great storm, is 3059 yards, and that of the south is 5317 yards. The dangerous rocks known as the Black Middens are all but removed, and the Tyne now is a very safe harbour of refuge. The Tyne, Northumber- land, and Albert Edward docks, the Tyne~~

~~*Commissioners' and Dunston staiths, are the great depots from which coal is exported. In 1894 more coal was exported from Tyne dock than from any other dock in the world. At North Shields are two pontoon docks capable of docking the largest steamers in half an hour. There are two also at Wallsend, as well as one of the largest dry docks in the United Kingdom.*~~

~~*The following table gives some figures as to the progress of the Tyiie:—*~~

~~*1880.*~~

~~*1890.*~~

~~*1899.*~~

~~*Amount of coal exported, in tons ....*~~

~~*Average size of vessels using the port, in tons*~~

~~*8,131,419*~~

~~*359J*~~

~~*10,729,199*~~

~~*470f*~~

~~*13,979,097*~~

~~*553f*~~

~~*Tynemouth, a municipal and parliamentary borough (including the townships of the well-known watering-place Tynemouth, North Shields, Chirton, Pres- ton, and Cullercoats), at the mouth of the Tyne, north bank, 8 miles east of Newcastle by rail. The borough (area 4300 acres) was divided in 1889 into six wards, and the town council acts as the urban sanitary authority. The old priory and castle now serve at the headquarters of the Tyne Submarine Engineers. The lighthouse on the cliff, to the north-east of the castle, is no longer used, but a new one has*~~

~~been built on St Mary's Island, 2 miles north. A fine parade (1893), on which are the aquarium and winter gardens (£120,000), and a small park stretch along the seashore. A free library and school of art, and a new infirmary, have been opened at North Shields, which is the largest part of the borough and .is a port of great importance. The corporation have erected a covered market for general trade, and at the fish quay, which cost £81,000, 14,000 tons of fish are landed annually. The exports are coal and coke, of the value of £1,259,692 in 1899, and imports are corn, timber, and esparto grass, of the value of £486,700. In the same year 1091 British ships of 956,022 tons, and 1021 foreign ships of 539,260 tons cleared the port ; 276 ships of 96,167 tons are registered at the port. Tyne-mouth returns one member to Parliament. Population~~

~~(1891), 46,588; (1901), 51,514.~~

~~Type-setting and Type-casting Machines. — It has long been an object of inventors in connection with printing to perfect a mechanical system by which hand-work may be done away with both in setting type and in distributing it after use. The first step in this direction was the construction of composing machines in which the compositor put together types in the required order, not by lifting them one after another from his " boxes " and placing them by hand in his " stick," but by operating a key-board which liberated them from magazines and assembled them in the order in which the keys had been struck. Such machines were followed as a natural correlative by distributing machines which performed the converse operation. Then the idea occurred of avoiding distribution altogether, by returning the printing surface to the melting-pot and using the metal over again to produce an entirely new printing surface as required, instead of sorting the types into their various kinds to be set up again either by hand or by machine. The forms of apparatus by which it was first~~

~~sought to attain this end are in effect combinations of type-settingandtype-castingmachines,and maybe divided into two broad classes : (a) those in which, by the opera- tion of a key-board, letters are translated into metal types which appear as a product for use in the printing-press, not singly, but cast into complete bars or lines of type ; and~~

~~(&) those in which the final product is separate types, delivered made up into lines of the required length. The former class is exemplified by the Linotype, the Typo- graph, and the Monoline machines, the latter by the Lanston Monotype, the Tachytype, and the Goodson. Machines of the Linotype class all necessarily suffer from one important defect— the impossibility of making altera- tions in the bar of type after it has been east. The smallest change, such as the addition of a comma, involves the resetting and recasting of a whole line, while, if two or three words have to be added or removed, the compositor may have to recast a considerable number of lines, per- haps a whole paragraph. Moreover, in regard to the quality of the letterpress obtained, the uneven contraction on cooling of the bar of metal is apt to produce ir- regularities in the "height to paper" of the surface, the result being an uneven impression. Again, should the matrices become worn or slightly bent in the course of working, or should particles of dirt get in between them, they no longer lie flush with each other when set up for casting, interstices are formed, and the metal flowing into these casts little projecting tags which rise to the level of the paper and print the thin black lines that may sometimes be noticed between the letters in newspapers set up on the Linotype. The Monotype and similar machines permit of corrections being made just as with hand-set type, but they too have disadvantages of their own when looked at as devices to save time and money. Each of them is in effect two machines, one of which punches holes, representing the letter it is desired to cast, in a long slip of paper, while the other takes this slip and, guided by the holes, performs the operation of casting the letters. Hence either two operators are required, or one operator must work the two portions alternately. A machine invented by Mr H. Gilbert- Stringer is designed to avoid the disadvantages mentioned as appertaining to both the Linotype and Monotype machines by casting at a single operation separate types properly arranged in lines and uniformly spaced. Up to the point where the matrices are ranged in a line ready for the bar of type to be cast, the mechanism may be identical with that of the Linotype ; from that point each matrix is separately pushed into a mould which automatically varies in size to suit the size of the partic- ular letter it is casting, and also casts the spaces between the words (determined by the use of a modified Schuckers wedge-space), so that when all the individual types and spaces in the line are assembled after casting they exactly fill the line. The~~

~~machine requires only one attendant, and while one line is being cast the matrices which have formed the preceding one are being distributed to the magazine, as in the Linotype, and the following one is being set up. The matrices differ from those of the Linotype in that the face is impressed on their broad flat surface, not on the thin edge.~~

~~Composing Machines, — A very large number of machines for setting up ordinary foundry type have been invented since the early efforts of Church about 1820. In the machine of Young and Delcambre, which was used in London for composing the Family Herald in 1842, and was the forerunner of the Kastenbein machine employed in the Times office since 1809, the types are arranged in tubes placed either vertically or horizontally, and the lowest or endmost letter is, when wanted, ejected from the tube by a pusher actuated by a finger-key. It then passes down the channels of a guide-plate to a common point, whence it is pushed forward by a reciprocating motion to the line of previously composed matter and~~

~~flhVKT7 mto lines of tne re1uired length. To the same group belong the iraser machine (described and illustrated in Mncy. Brit. vol. ?;XI": P-'01) i the Hattersley, which has found a place in several English provincial printing offices, and the Empire, also known in America as the Burr. Another group of machines has been de- veloped from the rotary composer, invented by Alexander Mackie ot Warrington in 1871, and used in the office of the Warrington iruaraian. In this theHypes were arranged in vertical tubes round a rotating disc, and the letters were automatically selected by a strip of paper previously punched with holes through which feelers passed and caused the desired type to be ejected upon a travelling band. This device of using a paper strip perforated in different positions to correspond to different letters was patented by Felt in 1860 (U.S. Patent Spec. No. 28,463), and he also utilized it for effect- ing distribution, the "dead" orusedtypebeingdealt with by another machine through which the paper strip was run in the reverse direc- tion. This quality, however, was not so valuable as it might appear at first sight,~~

~~since any correction, however simple, of necessity made the perforated paper ineffectual as a guide in distribution. The Thorne machine, exhibited in the Paris Exhibition of 1878, was a development of the principle of a rotating disc, but the types, which were contained in a vertical cylinder, were selected by touching keys in the ordinary manner. When liberated they fell upon a rotating .table, whence they were deflected by a finger upon a travelling band and delivered into the composing race. The Simplex machine (see Plate), now being made in America, resembles the Thorne very closely. The Wicks composing machine (see Plate), again, adopts a different principle from both the above groups. The types are ejected upon a straight race set at an angle of 45°. Thus each has to travel a different distance from the other — a result which the in- ventors of the Delcambre group of machines were at pains to avoid ; and when several keys are struck together so as to give a combina- tion like " and, " the several types delivered to the race follow each other in proper succession to the point of assembly, the letter whose , key is nearest to the left side of the keyboard preceding those whose keys are more to the right.~~

~~The Paige composing, justifying, and distributing machine — an American invention — is one of the most remarkable pieces of mechanism ever put together. It contains 18,000 parts, and the patent specifications form an imposing volume. It is operated by keys in the ordinary way, but automatic mechanism advances the ejected letters in words, spaces them, and inserts the lines in the galley with leads if desired ; at the same time other mechanism automatically distributes dead matter and refills the tubes which contain the supplies of types. Two machines were made, and are said to have done good work, but the cost of construction and the complicated nature of the mechanism made the apparatus im- practicable commercially, and the two that were made are now on view as mechanical curiosities, the one in the Columbia Institute and the other in Cornell University. The Paige machine dispensed with the guide-plate of the Delcambre group, the letters being ejected on a plane along which a driver passed at intervals and swept the type into a receiving race on the left of the machine. The Dow composing and justifying machine (see Plate), a recent American invention, adopts this characteristic of the Paige, but has two drivers meeting at the centre of~~

~~*the plane which receives the letters. The types having been swept to the centre by these, a vertical driver forces them downwards into a vertical receiver. When a line has been set a justifying key is touched, the vertical line passes to a horizontal position, and is driven forwards to a point where apparatus measures it, and having removed temporary brass spaces, replaces them with others selected from a series of ten different thicknesses. The Empire machine (see Plate) has also been provided with an automatic justifier working on a plan similar in general conception to that adopted by Legerman in 1888 in a separate machine, which dealt with unjustified lines as an independent operation. The Paige, the Empire, and the Dow machines, each in its way, connect the apparatus with the composing machine and give it automatic operation. Another mode of automatic justification is presented by the Stringer and Wicks apparatus, the method of which is to insert two or more thin spaces between the words ; the line is then composed in excess of the required length, but is reduced by automatic mechanism, which rejects as many spaces as are necessary, without the need for others to be selected and inserted. In another Stringer ap- paratus the words as they are composed are divided by an em quad, and the line having been automatically measured, the spaces are reduced as requited by being passed in front of a cutter automa- tically adjusted for the purpose.*~~

~~*Distributing Machines. — There are two main classes of dis- tributing machines. One, which is exemplified by the Delcambre or the Eraser (illustrated in Ency. Brit. vol. xxiii. p. 702), is operated by a keyboard ; the compositor strikes the keys corre- sponding to the letters of the printed matter he wishes to distribute, and thus opens gates through which the types pass and find their way down a guide-plate to their proper tubes. The other comprises*~~

~~*a number of machines which agree in requiring the type to be specially nicked for their use. Each type has its own particular combination of nicks, and the receptacles in which the type is collated are provided at their entrances with wards corresponding to these nicks, so that each type can only enter the one receptacle for which its nicks are arranged (Fig. 1). In some cases, as in the*~~

~~*Fig. 1.— Nick System of Distribution (Simplex Machine).*~~

~~*Empire and the Dow, the distributor is a separate machine ; in others, as the Thorne and the Simplex, it is combined with the composing machine in such a way that the two work simultaneously.*~~

~~*Linotype. — An enormous amount of ingenuity has been expended on the Linotype, which was developed into a practical machine by Ottmar Mergenthaler, of Baltimore, though two of its elements — the solid bar of type and the wedge space — were invented by others, the former by T. W. Smith, of the Caslon Foundry, and the latter by Jacob W. Schuckers, of Washington. The following will give a general idea of its working : — In the magazine A (Fig. 2) are a series of matrices, formed with the characters in intaglio on one edge, which are discharged by gates, operated from the key- board D into the chutes E, and thence upon the travelling belt F ; this delivers them upon a revolving pusher wheel by which they are set up in proper order in the assembler block G. Above the assembler block is a space magazine, and from this the space key J releases a space bar, when desired, which drops into place in the line. As the matrices are forced into the assembler block they move to the left against the resistance of a' sliding abutment, thus being held compactly in place in the line. As soon as a complete line is set up, the compositor operates a hand lever by which the assembler block and matrices are raised to the level of a horizontal slide, where the line is grasped between two jaws and carried to the left, and lowered into position opposite the mouth of the mould wheel K. Here the justification of the line is effected by means of an upwardly moving plunger which drives the wedge-shaped spaces, seen in Fig. 3, into the line, and thus expands it -to the exact length required. 'The matrices are then locked firmly in a vice with the characters opposite the mouth of the mould. At this time the pump plunger in the melting pot M (Fig. 2) is forced downwards by mechanism actuated by suitable cams on the driving shaft, and a jet of molten type metal is ejected into the mould and against the characters on the matrices, thus casting the bar or "slug." The cast bar is next forced, by a revolution of the wheel K, between a pair of knives, by which it is trimmed, and into a galley, where it is pushed along by a packer arm and placed beside its fellows in a column ready for use.*~~

~~*It is next necessary to distribute the matrices to the magazines, in order that the operation of the machine may be carried on continuously. The matrices and spaces are raised from the vice and brought opposite a bar R, which carries on its under side a series of undercut ribs corresponding to the teeth which are shown at the edges of the V-shaped notch in the top of the matrices (Fig. 3), and the matrices are pushed on to this bar*~~

~~*so as to be suspended by the ribs. They are next pushed still farther towards the right of the machine into a box having ribs engaging the notches in the side of the matrices, but with down- wardly-inclined grooves crossing these ribs, by which the shoulders at the" upper end of the space bars are allowed to descend, and the*~~

~~*Fig. 2. — Diagram of Linotype Ma*~~

~~*spaces are thus dropped out of line and fall through a chute into the space-box from which they originally came. The matrices are pushed still farther to the right, where their teeth slide along the distributor bar T. being carried by two screws which engage opposite sides of the matrices and keep them separated so that they hang loosely from the distributor bar. The ribs of the distributor bar are so arranged as to support each matrix by one or*~~

~~*more pairs of teeth until it arrives oppo- site the mouth of its own magazine chan- nel, where they are interrupted in such a manner that the ma- trix is unsupported and drops into the magazine for further use. It will thus be apparent that there is a constant circulation of the matrices through the machine, and the composing of one line, the casting of another, and the distribution of a third are all carried on at the same time, which adds greatly to the speedoftheoperation. type machine have been ers, No. 437,13!) (23rd*~~

~~*Fig. 3. — Line (if Matrices with Spaces.*~~

~~*Several ingenious variations of the Lin invented. In the United States patent to R< September 1890), the matrices consist of hooked bars which slide' upon wires strung on a harp-shaped frame, with their outer ends spread out like a fan and their inner ends converging and brought into a vertical line at the composing point. The matrices are normally held at the outer ends of the wires by stops, and are released by the operation of keys, sliding down the wires and arranging themselves in line at the composing point. After the line is cast, the inner end of the frame is raised anil the matrices all slide back by gravity, and are again retained by their stops. In the Mergenthaler patent (U.S.A.), No. 614,229 (15th November 1898), the matrices slide on wires as in the Rogers machine, but two magazine frames are carried on an inclined rotating shaft, which allows one frame to be brought into connexion with the keyboard*~~

~~*while the matrices of the other are being returned to position by the inclination of the frame in its revolution with the inclined shaft. Another variation is found in the patent to Rogers, No. 534,917, in which the hooked-bar matrices are of various lengths and are supported, when in the reserve position, on a bar over which the hooks extend. As the keys are operated,- they are pushed off one by one upon a travelling cord belt on which the hook catches, and are carried by it down to the composing position, where they are run off upon another guide rod and stopped. When the line is cast, they are all pushed off the rod upon their belts, and are returned by them to their original position.*~~

~~*Lanston Monotype. — In the Lanston apparatus there are two distinct machines, a ribbon-punching machine and a type-casting and composing machine. The first of these (illustrated on the Plate) is a small device resembling a typewriter, having a number of keys, 225 in all, corresponding to all the characters used in a font of type, with a few additions to represent certain movements to be performed by the composing machine. Each key, as it is operated, works two punches, which make two perforations in a strip of paper fed step by step through the machine. These perforations stand in a transverse line across the strip, as shown in Fig. 4, and their relative position in the line varies with the particular key oper- ated. At the end of each word a spacing key is struck and suitable perforations are made in the strip, and as the end of a*~~

~~line is neared, a bell rings to warn the operator, who, by look- ing at a line scale fac- ing him on the machine, is enabled to see how many units of space remain to be filled, and can then determine whether another word or syllable can be set up. If not, it then be- comes necessary to pro- vide proper space-type to justify or fill out the line, which is done by increasing the width of the normal space-types already provided for in the proportion which the number of units of space still vacant in the line bears to the number of space-types~~

~~which the line contains. Tor example, if there are ten space-types and ^th of an inch of space remains to be filled, each space-type must be increased in thickness just -J-jjth of an inch completely to fill the line. It is not necessary, however, for the operator to make this calculation, for lie has only to consult the scales provided for this purpose, and is referred at once to the proper keys to punch the justifying perforations in the strip. The segmental scale on the front of the machine is divided by its radial lines to indicate the number of units of space in the line, and the pointer is moved by the action of each key over a space proportioned to the number of units of width of the type set. This scale is also divided by circular lines intersecting its radial lines and corresponding in number to the space-types which may occur in aline, and in the squares formed by these lines are placed numbers indicating the justifying keys which must be struck to effect the justification accurately. The pointer is graduated according to the possible number of space-types in a line, and on reading the number of space-types from the space counter and then noting the figures in the square on the justifying scale which lies opposite the proper space division on the pointer, the operator reads at once the num- ber of (lie proper justifying key or keys. Having justified the line, the operator works a lever at the left side of the machine ; this sets back all the counters to the zero mark, winds the springs which feed the paper, and punches the galley perforations which control the feed of the galley in the composing machine. These operations are. then repeated for the next and all succeeding lines.~~

~~The ribbon thus prepared in the punching machine is used^ to control all the movements of the casting or composing machine (see Plate). The matrices for forming the type faces are formed in a plate about 3 incites~~

~~*square, and any character is brought opposite the casting point by the movement of the matrix-carrier in twit directions," or rather by the resultant of two such in- dependent movements. As the perforations for controlling the galley movements and those for justifying the line are necessarily*~~

~~*Fig. i. — Perforated Strip.*~~

~~*made after the others in the perforating machine, and these opera- tions must be provided for in the composing machine before the line is set up, the latter machine is so organized that the ribbon is passed through and the types are set in the reverse order to that in which the strip was punched. The perforated ribbon is wound from one reel off to another, passing over the edge of a tracker board in which there are a number of holes corresponding to those which may occur in the ribbon, and each of these holes communi- cates by a tube with a small piston which controls some device for performing one of the various operations of the machine. As the ribbon passes over the tracker board, a jet of compressed air passes to the appropriate operating device whenever a ribbon perforation or any combination of them coincides with the proper holes. The two perforations on each transverse line control two stop pins which limit the movements of the matrix-carrier to bringing the proper matrix to the casting-point, while the justifying perforations set in motion devices which open the space mould to cast space type of the exact size to effect the proper justification of the line, and the galley perforation starts the feeding device which moves the galley for the next line of type. The matrix-carrier may be readily removed and another carrying a different style or size of type substituted therefor. Type-casting. — While the Linotype and other matrix-composing machines have come into extensive use for the production of news- papers in various parts of the world, the great mass of printing is still done by the aid of movable types, which alone yield work of the highest finish and excellence. Hence these still form one of the most important parts of a printer's outfit and one of the*~~

heaviest items in his capital account. Their costliness is largely due to the compara-

Fis. 5.— "Wicks Rotary Type-casting Machine.

tive slowness with which, until a recent date, they could be turned out by the founders, and this again was a consequence of the fact that automatic machinery had not been applied in type-casting to anything like the extent that had been found advantageous in many industries, so that the cost of skilled and highly specialized labour remained a dominating factor. This was the case even in America, the home of automatic machinery and a country where type-found- ing has been made a special study. In his book on The Practice of Typography (New York, 1900), De Vinne says that the machine invented in 1838 by David Bruce, Junr, of New York (a Scots-man who migrated to America), or some modification of it, fur- nished nearly all the type made for more than forty years after its invention, and that though real improvements were intro- duced from time to time, the changes did not increase the produc-

tiveness of the apparatus, the great defect of which was that it did not make the type perfect, i.e., various finishing operations had to be performed by hand. He goes on to say that though many machines had been designed to produce perfect type, none had been found entirely satisfactory by the type-founders of the United States, the nearest approach to success being that patented in 1888 by Henry Barth, of Cincinnati. The Barth machine casts the type, breaks off the jet, finishes the groove between the feet, rubs down the feather edge at the angles of the sides, and delivers the types in lines two feet long. It is claimed for it that not only is it more accurate, but that its output is one-half greater than the older machines : one of the latest forms is reported to be capable of yielding 70 ft) of brevier-body type in one working day, or say 35,000 types. A notable advance in the adoption of automatic machinery was, however, made in England just at the end of the 19th century, when the Wicks rotary type-casting machine was developed into a practical apparatus. This machine is able to produce finished types, which can be despatched to the printer without any inspection or treatment beyond pack- ing, at a continuous rate of 60,000 an hour. Essentially simple in

~~design, it yet requires to be made with an accuracy which is far beyond that attained in ordinary mechanical fitting, and is to be measured in ten-thousandths of an inch. It consists of a horizontal mould wheel, 20 inches in diameter, contained in the casing D (Fig. 5), in which are cut 100 radial slots, each hav- ing a matrix at its inner end. These slots thus form moulds, and are of varying size according to the dimensions of the let- ter each has to cast, the width for a letter, like m being much greater than for one like i. Each wheel can only pro- duce type of the particular body for which it has been cut, but by changing the matrices the moulds can be made to cast any description of face capable of being received upon the body. The wheel is rotated once in every six seconds, so that the slots are successively presented to a jet of molten type- metal, which is pumped from the metal reservoir A by a pump B of special construction, and forced out at high pressure through a nozzle under the shield C. As soon as any particular slot has passed the jet and been filled with metal, a cam-action comes into play and gradually pushes out the formed type. This opera- tion is completed in half a revolution, the ejected type being taken up by carriers mounted on a continuous chain E, which is moved along exactly in step with the wheel. The carriers, which are of different sizes ac- cording to the particular letters they have to hold, are raised by a cam-action as they come opposite the slots to receive the types, but fall again at the point F, depositing the letters at the end of the race G. Each successive type thus dropped pushes its predecessors farther along the race until when the row contains 200 types — the product of two revolutions of the wheel — an attendant lifts the whole series off and places them on the plate H, one row below the other. Since the sequence of the letters is of course the same in each revolution, the result is that each vertical line on the plate consists of the same character, and each sort can be easily removed and packed in any required form for despatch to the printer. As soon as each slot has been emptied of its type, another cam begins to draw in the matrix towards the centre of the wheel, so that it is in as far as it can go by the time the slot is again opposite the jet. To prevent a type from being drawn .back with the matrix, the bead- cam K engages with the nicks which have already been formed on the front of the type-bodies by the operation of \he machine. To ensure trueness and accuracy in the product, the conditions under which casting is conducted are maintained as uniform as possible. The composition of the type- metal alloy is kept~~

~~constant ; the temperature of the molten metal is carefully regulated by the aid of a pyrometer to about 800° F., so as not to volatilize the antimony it contains ; the pumps work up to a pressure of 900 lb to the square inch, and by the interposition of a reducing valve deliver the metal at the nozzle at a constant pressure of 200 ft) ; and the moulding slots are maintained at an equably cool temperature by an elaborate system of water circulation. The last particular represents a fundamental de-parture from established practice, in which it is regarded as possible to cast only from a mould heated to 200° E., and is held to be largely responsible for the accuracy and durability of the machines, one of which, attended only by one man and a boy, has during a continuous run of 20 months produced 207 million types (over 2 millions a week) without the product show- ing signs of depreciation through the wearing of the machine.~~

~~Such rapidity (and consequent cheapness) of production renders it not only economically possible, but profitable, for the type to he used for printing only once, and then returned straight to the melting-pot instead of being distributed. This practice was in fact adopted in 1900, as regards the greater part of its matter, by The Times, which, being thus printed from new type every day, secures the advantage of fresh unworn letters for each issue. The company owning the Wicks machine supply the printing-office (if The Times with some 5 millions of types weekly, and these, after being set up by composing machines and used to make the stereotype plates required for the daily issues of that journal, are returned to the foundry to be melted and recast.~~

~~(f. c. S. ; II. M. It.)~~

~~Typewriters. — Some historical details of the in- vention of typewriters will be found in the article on Writing Machines (Ency. Brit., vol. xxiv. p. 098). The earliest successful typewriting machines were placed upon the market in the United States about the year 1873. A British patent, No. .395 of 1714, was granted to Henry Mill for " An Artificial Machine or~~

~~*Method for the Impressing or Transcribing Letters, Singly or Progressively one after another as in Writing, whereby all Writing whatever may be Engrossed in Paper or Parch- ment so Neat and Exact as not to be distinguished from Print," but except by this title the patent gives no indication of the nature or construction of the machine. Other early patents on this subject are the U.S. patent to W. A. 'Part, 23rd July 1829; the French patent to Progrin, No. 3718, 6th September 1833; and the U.S. patent to Thurber, No. 3228, 26th August 1843. A num- ber of others were taken out later, but it was not until the issue to Sholes, Glidden and Soule of U.S. patent No. 79,205, 23rd .rune 1808, supplemented by others to Sholes in 1808 and 1871, that the foundation was laid of a commercially successful machine. A few of these machines were sold in 1873 and the next two or three years, but in 1878 their manufacture was placed in the hands of E. Kemington and Sons of Ilion, New York, and they became known as the Remington Typewriters. The great majority of modern machines are worked from a keyboard; the few which are not will be disregarded here, for although they are much less expensive in first cost than the others, they scarcely come into competition as practical instruments, on account of their slowness. Keyboard machines fall into two classes, according as the types which make the impressions are («) carried at the end of levers or type-bars which strike the paper when the keys are depressed, or (b) are arranged round the circumference of a wheel, or segment, which is rotated by the action of the keys until the corresponding type is brought opposite the printing-point. The former of these arrangements is the more common ; it may be seen in the Remington (Fig. 3), Densmore (Fig. 4), Fay-Sho (Fig. 5), New Century Caligraph (Fig. 6), liar-Lock (Fig. 7), Williams (Fig. 8), Oliver (Fig. 9), Smith Premier (Fig. 10), Empire (Fig. 11), while the type-wheel is used in the Hammond (Fig. 12) and the Plickensderfer (Fig. 13). Another point of difference is in the inking device; in some cases, as in the Yost (Fig. 14), the Williams, and the Blickensderfer, the type is inked by means of an ink-pad before being brought down on the paper to make the impression, but more frequently an inked ribbon is drawn along by the action of the machine between the type-face and the paper. A third basis of classification may lie found in the arrangement of the keyboard. In some machines there is one key fur each character, in others each key does duty fin two or more characters. For example, in the former class there is*~~

~~*one key for the capital A and another for the small a, the keys being arranged in two hanks corresponding to the upper and lower eases of a printer's type-ease; in the latter, one key is capable of striking both the small and the*~~

~~*capital letter, and it does one or other according as a subsidiary key is or is not brought into simultaneous use with it. In type-bar machines designed on this plan, each bar carries two or more letters (cf. Fig. 1), and the effect of the subsidiary key is to move the paper in such a way as to present it to the required letter.. This form of keyboard is also applied to type- wheel machines.*~~

~~*Though there are numberless differences in detail, all typewriters bear a general resemblance to each other in their mechanical arrange- ments. The really essential operations may be reduced to two; the machine must print a letter when a key is struck, and it must have a device by which the paper may be moved a short distance to the left with each stroke in order that the letters may be printed separately, not one on top of the other. Of the many subsidiary appliances that are fitted — a bell to warn the operator that he is approaching the end of a line, a lock to prevent the machine from working after the end of the line has been passed, attachments for facilitating insertion of fresh paper, corrections, and tabu- lation, &c. — some are cer- tainly of advantage, but others are more useful to the manufacturer in drawing up his advertisements than to the expert operator, whose first care often is to discon- nect them from his machine. Similarly with the " visible writing," which is sometimes put forward as a recom- mendation of extraordinary importance ; doubtless the*~~

~~*novice who is learning the keyboard finds a natural satisfaction in being able to see at a glance that he has struck the key he was aiming at, but to the prac- tised operator it is not a matter of great moment whether the writing is al- ways in view or whether it is only to be seen by moving the carriage, for he should as little need to test the accuracy of his performance by constant inspection as the piano- player needs to look at the notes to discover whether he has struck the right ones. The one important desideratum, without which no typewriter can produce work of*~~

~~*satisfactory ap- pearance, is accuracy of alignment, For the attain- ment of this the use of type-bars has given wide scope to the ingenuity of inventors, who have been confronted with the problem of making a system of levers at once strong, rigid, and*~~

~~*Fig. 1. — Type-bar of Oliver machine.*~~

~~*i. — Type-bars of Bar- Lock machine.*~~

~~*Fig. 3. — Remington.*~~

~~*Fig. 7. — Bar-Lock.*~~

~~*Fig. 11. — Empire.*~~

~~*Fig. 4. — Densmore.*~~

~~*Fig. 8. — Williams.*~~

~~*Fig. 12. — Hammond.*~~

~~*Fig. 5. — Fay-Sho.*~~

~~*Fig. 9. — Oliver.*~~

~~*Fig. 13. — Blickensderfer.*~~

~~*$la. 6. — New Century Caligraph.*~~

~~*Fig. 10. — Smith Premier.*~~

~~*Fig. 14. — Yost.*~~

~~*light, and of supporting them on bearings which are steady and adjustable for wear in conditions where space is much restricted. In the Oliver machine the type-bar is of the form shown in Fig. 1, to secure stiffness and a double bearing. In the Bar-Lock, the type-bars are arranged three in one hanger, so that each has a bearing three times as wide as would be possible in the same space if each had a hanger to itself (Fig. 2) ; in addition the wear of the pivots can be taken up by the screws seen on the right of the bearings, and as a further precaution each type-bar is locked at the printing point by falling between a pair of conical pins, which centre it exactly in the required place. In the Yost and the Empire, the type-bars pass through guides. The centre guide of the former is shown at G in Fig. 15, the type being just about to strike the paper. Pressure on one of the keys works the lever and pushes up the connecting rod C, when the type leaves the ink-pad P and passes through the guide, which is slightly bevelled so as to guide it exactly to the printing point. In the Smith Premier the shafts upon which the type-bars swing are mounted tangentially on the ring (Fig. 16), so that long supporting bearings are obtained, while the shortness of*~~

~~*Fig. 15.— Central guide and type-bar of Yost machine.*~~

~~*Fig. 16. — Type-bar bearings, Smith Premier.*~~

~~*the type-bars themselves renders it possible to make them very stiff. The rocking-shaft mechanism (Fig. 17), by which the power is transmitted from the keys to the type- bars, admits of each key having the same leverage and tends to uniformity of touch. This last quality is also aimed at by interposing an intermediate parallel bar be- tween the key levers and the type-bar, as in the New Century Caligraph. In the Densmore, the friction of the movements is minimized by the employment of ball bearings for the type-bar pivots. Electrical typewriters, in which the depression of a key does not work a type-bar directly, but merely closes a circuit that energizes an electro-magnet, have been suggested as a means of ob- taining uniformity of touch combined with ease and rapidity, but have not as yet displaced the ordinary machines to any extent.*~~

~~*One special form of typewriter, the Elliott and Hatch (Fig. 18), is designed to write in a book such as a ledger. One leaf is clamped between the platen and an open*~~

~~*Fig. 17.—Rocking-shaft mechanism of Smith Premier.*~~

~~*1, Key with stem ; 2, rocking shaft ; 8, connecting rod ; 4, type-bar ; A and B, conical bearings, 1§ inch apart.*~~

~~*frame which holds the paper smoothly. The operative parts slide on this frame, and move up and down the page so as to space the lines properly, the key-board, with the type-bars, ribbon, &c, travelling step by step across the page.*~~

~~*The United States, the country which first produced a practical typewriter, manufactures about 100,000 of*~~

~~*Fig. 18.—Elliott and Hatch Book Typewriter.*~~

~~*such machines annually, and many are also made in Great Britain and Germany. The purchaser in Great Britain will not be able to buy a machine from most of the best-known makers for less than £20 ; this high price is partly justified by the care and accuracy required in manufacture, but probably the reason for its maintenance is rather to be sought in the existence of a typewriter trust.*~~

~~*Typhoid Fever.—No disease has been more thoroughly studied in recent years than typhoid fever.1*~~

~~*1 The word "enteric" has been substituted for "typhoid" by the Royal College of Physicians in the nomenclature of diseases authorized by them, and the change was officially adopted by all departments of the British Government. Its advantages are doubtful, and it has been generally ignored by the English-speaking medical profession and by those foreign countries which used the word " typhoid." "Enteric" is preferable in that it cannot be confounded with "typhus "and bears some relation to the nature of the affection, the characteristic feature of which is a specific inflammation of the small intestine ; but it is open to the serious objection*~~

~~*of not being sufficiently distinctive. There are, in truth, several enteric fevers, and the particular appropriation of a term having a general meaning to one of them is awkward and cannot be sustained. Thus it is found*~~

~~*TYPHOID*~~

~~*529*~~

~~*The chief points requiring notice are (1) causation and spread, (2) prevalence, (3) treatment, (4) prevention.*~~

~~*Causation. — The cause is the bacillus typhosus, dis- covered by Eberth in 1880 (see Pathology, Parasitic Diseases). This organism multiplies in the body of a person suffering from the disease, and is thrown off in the discharges. It enters by being swallowed, and is con- veyed into the intestine, where it sets up the character- istic inflammation. It is found in the spleen, the mesenteric glands, the bile, and the liver, not infrequently also in the bone marrow, and sometimes in the heart, lungs, and kidneys, as well as in the faeces and the urine. It has also, though more rarely, been found in the blood. The illness is therefore regarded as a general toxtemia with special local lesions. The relation of the bacillus to the other numerous bacteria infesting the intestinal canal, some of which are undoubtedly capable of assuming a pathogenic character, has not been determined; but its natural history, outside the body, has been investigated with more positive results than that of any other micro-organism, though much still remains obscure. Certain conclusions may be stated on good evidence, but it is to be understood that they are all more or less tentative. (1) In crude sewage the bacillus does not multiply, but dies out in a few days. (2) In partly sterilized sewage (i.e., heated to 65° C.) it does not multiply, but dies out with a rapidity which varies directly with the number of other organ- isms present — the more organisms the quicker it dies. (3) It is not found in sewer air. (4) In ordinary water containing other organisms it dies in about a fort- night. (5) In sterilized water it lives for about a month. (6) In ordinary soil moistened by rain it has lived for 67 days, in sewage-polluted soil for at least 53 days, in soil completely dried to dust for 25 days, and in sterilized soil for upwards of 400 days. (7) Exposed to direct sunlight it dies in from four to eight hours. (8) It is*~~

~~*killed by a temperature of 58° C, but not by freezing or drying. (9) It multiplies at any temperature between 10° C. and 46° C, but most rapidly between 35° C. and 42° C. These conclusions, which are derived from experiment, are to a considerable extent in agreement with certain observations on the behaviour of the disease on a large scale.*~~

~~*The susceptibility of individuals to the typhoid bacillus varies greatly. Some persons appear to be quite immune. The most susceptible age is adolescence and early adult life ; the greatest incidence, both among males and females, is between the ages of 15 and 35. The aged rarely contract it. Men suffer considerably more than women, and they carry the period of marked susceptibility to a later age. Predisposing causes are believed to be debility, depression, the inhalation of sewer air by those unaccustomed to it, and anything tending to " lower the vitality," what-ever that convenient phrase may mean. According to the latest theories, it probably means in this con- nexion a chemical change in the blood which diminishes its bactericidal power. Typhoid is a common sequela of influenza. The lower animals appear to be free from it in nature ; but it has been imparted to rabbits and other laboratory animals. The disease is conveyed by various*~~

~~*necessary to revert to the discarded "typhoid," which has no real meaning in itself but is convenient as a distinctive label, when speak- ing of the cause of the disease or some of its symptoms. We have the "typhoid bacillus," "typhoid stools," "typhoid spots," "typhoid ulcers," &c. The word "enteric" cannot well be applied to these things, because of its general meaning. Consequently both words have to be used, which is awkward and confusing. It has therefore been thought better to adhere to the older word, a course followed by recent medical publications of high standing, such as Quain's Dic- tionary of Medicine (third edition).*~~

~~*channels. There is no evidence that it is infectious in the sense in which small-pox and scarlet fever are infectious ; and even persons in attendance on the sick do not often contract it when sufficient care is taken. The recognition of these facts has led to a general tendency to underrate contagion, direct and indirect, from the sick to the healthy as a factor in the dis- semination of typhoid fever, and to look too exclusively*~~

~~*to other modes of conveyance; but it must be remem- bered that the sick, from whose persons the germs of the disease are discharged, are always an immediate source of danger to those about them. In some cir- cumstances such personal infection may become a very important means of dissemination. There is evidence that this is the case with armies in the field ; e.g., the conclusions of the Commission appointed to inquire into the origin and spread of enteric fever in the military encampments of the United States in the Cuban campaign of 1898. Out of 1608 cases most thoroughly investigated, more than half were found to be due to direct and indirect infection in and from the tents (Childs : Sanitary Congress, Man- chester 1902). A similar but perhaps less direct mode of infection was shown to account for a large number of cases under more ordinary conditions of life in the remarkable outbreak at Maidstone in 1897, which was also subjected to very thorough investigation. It was undoubtedly caused in the first instance by contaminated water, but 280 cases occurred after this cause had ceased to operate, and these were attributed to secondary infection, either direct or indirect, from the sick. A good deal of evidence to the same effect by medical officers of health in England has been col- lected by Dr Goodall, who has also pointed out that the attendants on typhoid patients in hospital are much more frequently attacked than is commonly supposed (Trans. Epidem. Soc, vol. xix.). The re- ports of the medical officer to the Local Government Board contain several other instances of epidemic outbreaks in which personal contagion has played a part.*~~

~~*The other means of dissemination are polluted soil, food and drink, particularly milk and water. The precise mode in which polluted soil acts is not under- stood. The result of experiments mentioned above shows that the bacillus lives and multiplies in such soil, and epidemiological investigation has repeatedly proved that typhoid persists in localities where the ground is polluted by the leakage of sewage or by the failure to get rid of excrementitious matter. In some instances, no doubt, drinking water thus becomes con- taminated and conveys the germs, but there appears to be some other factor at work, for the disease occurs under the conditions mentioned where the drink- ing water is free from suspicion. Exhalation is not regarded as a channel of communication. The recent researches of Majors Firth and Horrocks prove that dust, flies, and*~~

~~clothing may convey the germs. Another way in which food becomes the medium of convey- ance is by the contamination of oysters and other shell-fish with sewage containing typhoid bacilli. This has been abundantly proved by investigations in Great Britain, America, and Prance. Uncooked vegetables, such as lettuces and celery, may convey the disease in a similar way. The most familiar and important medium, however, is water. It may operate directly as drinking water or indirectly by contaminating vessels used for holding other liquids, such as milk cans. Typhoid caused by milk or cream has generally been traced to the use of polluted water for washing out the cans, or possibly adulterating their contents. There is obviously no reason~~

~~why this chain of causation should not hold good of other articles of food and drink. Outbreaks have been traced to ginger beer and ice-creams. Water sources become contaminated directly by the inflow of drains or the de- posit of excretal matter; indirectly, and more frequently, by the leakage of sewage into wells or by heavy rains which, wash sewage matter and night soil from ditches and the surface of the land into springs and water-courses. Water may further be contaminated in the mains by leakage, in domestic cisterns, and in supply pipes by suction. There is some reason to believe that the bacilli may nraltiply rapidly in water containing suitable nourish- ment in the absence of large numbers of their natural foes. Prevalence. — Typhoid fever is more or less endemic and liable to epidemic outbreaks all over the world. It is more prevalent in temperate than in tropical climates. The following comparative death-rates show its relative prevalence in certain countries in 1890 :— Italy, 658 ; Austria, 470; U.S.A., 462; Prussia, 204; England, 179. It has undergone marked and progressive diminution of late years in many countries coincidently with improved sanitation, particularly in regard to drainage and water- supply. Table I. gives the annual death-rates in England and Wales since 1869, when typhoid was registered separately from typhus and "simple" fever.~~

~~*Table I. — Annual Mortality per Million Persons living from*~~

~~*Enter*~~

~~*ic Fever — England and Wales.*~~

~~*Tear.*~~

~~*Mortality.*~~

~~*Tear.*~~

~~*Mortality.*~~

~~*1869 . . .*~~

~~*390*~~

~~*1885 .*~~

~~*175*~~

~~*1870 .*~~

~~*388*~~

~~*1886 .*~~

~~*184*~~

~~*1871 .*~~

~~*371*~~

~~*1887 .*~~

~~*185*~~

~~*1872 .*~~

~~*1888 .*~~

~~*172*~~

~~*1873 .*~~

~~*376*~~

~~*1889 .*~~

~~*176*~~

~~*1874 .*~~

~~*374*~~

~~*1890 .*~~

~~*179*~~

~~*1875 .*~~

~~*371*~~

~~*1891 .*~~

~~*168*~~

~~*1876 .*~~

~~*309*~~

~~*1892 .*~~

~~*137*~~

~~*1877 .*~~

~~*279*~~

~~*1893 .*~~

~~*229*~~

~~*1878 .*~~

~~*306*~~

~~*1894 .*~~

~~*159*~~

~~*1879 .*~~

~~*231*~~

~~*1895 .*~~

~~*175*~~

~~*1880 .*~~

~~*261*~~

~~*1896 .*~~

~~*166*~~

~~*1881 .*~~

~~*212*~~

~~*1897 .*~~

~~*156*~~

~~*1882 .*~~

~~*229*~~

~~*1898 .*~~

~~*182*~~

~~*1883 .*~~

~~*228*~~

~~*1899 .*~~

~~*199*~~

~~*1884 .*~~

~~*236*~~

~~*1900 .*~~

~~*160*~~

~~*The diminution is more clearly shown if quinquennial periods are taken, as in Table II.*~~

~~*Table II. — Average Annual Mortality per Million in and Wales, and in London.*~~

~~*England*~~

~~*1871-75.*~~

~~*1870-80.*~~

~~*1881-85.*~~

~~*1886-90.*~~

~~*1891-95.*~~

~~*1896-1900.*~~

~~*England and*~~

~~*Wales London*~~

~~*354*~~

~~*256*~~

~~*278 234*~~

~~*218 226*~~

~~*180 150*~~

~~*176*~~

~~*136*~~

~~*176 148*~~

~~*London shows less improvement than the country as a whole, but it started with superior sanitary conditions, and though the reduction has not been maintained in the last recorded quinquennium, the mortality is still much below the mean. The disease is more prevalent in Paris, but the diminution effected has been far greater in the time, the average annual mortality per million having fallen from 1430 in 1882 and 581 in 1883-88 to 293 in 1889-94 and 172 in 1895-1900. Other recorded instances of diminution are Berlin, Hamburg, Munich, Copenhagen, the Netherlands, Buenos Aires (from 1060 per million in 1890 to 140 in 1899). In all these and other cases the improvement is attributed either to drainage or water-supply, or both. The case of Munich is so instructive that it deserves special mention. For many years typhoid was excessively prevalent in that city. The prevalence was continuous, but aggravated by large epidemic waves,*~~

~~*extending over several years. These gradually decreased in magnitude, and ceased towards the end of 1880. Since then the prevalence has still further diminished, the average annual mortality per million having fallen from 2024 in 1851-60, 1478 in 1861-70, and 1167 in 1871-1880, to*~~

~~160 in 1881-90, and 52 in 1891-1900. It has been forcibly argued by Dr Childs (Trans. Epidem. Soc, vol. xvii.) that drinking water had little, if any- thing, to do with the prevalence of the disease, and that its gradual reduction was due to purification of the soil by improved drainage systems and the abolition of slaughter-houses. The epidemic waves were found by von Pettenkofer to be associated with the rise and fall of the subsoil water ; when the water fell the fever rose, and vice versd. He did not, however, consider that the subsoil water exercised any influence itself; he merely regarded it as an index to certain conditions of moisture which exercised a favourable or unfavourable influence on the development of the disease. His theory, which has been much misunderstood, is to "some extent cor- roborated by some facts observed in Great Britain. One is the seasonal prevalence of typhoid, which in England- is an autumnal disease. The minimum occurs in May or June ; in August a marked rise begins, which continues throughout the autumn and reaches a maximum in No- vember, after which an abrupt fall sets in. These facts are in keeping with Pettenkofer's theory, for the sub- soil water reaches its maximum height at the end of spring and falls throughout the summer and a great part of the autumn. The coincidence is further em- phasized by the fact that in dry years, when the sub- soil water sinks lower than usual, typhoid is more preva- lent, and in wet years the contrary. A glance at the mortality table for England given above will show that the progressive improvement recorded down to 1892 was suddenly interrupted in 1893, when the rate rose abruptly from 137 to 229. That was an extraordinarily dry and hot year, and it was followed by a succession of dry and hot years, culminating in 1899, with two exceptions — 1894 and 1897. In both the typhoid rate fell again, but in all the others it rose. One explanation has been sug- gested by Mr Matthew Adams of Maidstone. He points out that organic matter deposited on or in the ground passes in normal years gradually through several layers of soil, and undergoes a process of destruction or purifi- cation before reaching the underground water; but in hot summers the ground becomes baked and cracked, and there is no such percolation; when rain comes every- thing is swept suddenly away without any purification, and finds its way into the sources of drinking water. Whether this be so or not, there is no doubt that danger- ous material does collect during the summer and is swept into water-courses by the autumnal rains. Perhaps this is sufficient to account~~

~~for the seasonal prevalence and the annual variations noted. On the other hand, there is a great deal of typhoid which has no connexion with water-supply at all. Numerous cases of persistent preva- lence have been investigated by the medical officers of the Local Government Board, in which drinking water has been exonerated and the mischief attributed to stand- ing pollution of the soil — for instance, Mold, Middles- brough, Southend, Swinton, and Pendlebury, &c. In such places the chronic prevalence is apt to swell at times to more epidemic proportions, as at Munich ; and possibly the condition of the ground may be the cause. An examination of the relative incidence of typhoid on the counties of England and Wales (Bulstrode) goes to show that its prevalence, broadly regarded, is not capricious. The areas of maximum and minimum incidence remained practically the same throughout the twenty years 1871-90, though there was everywhere a large diminution. This~~

~~fact suggests the reflection that standing conditions are more important factors than those accidental occurrences which attract public attention by causing sudden and explosive outbreaks. When these are on a small scale they may be due to milk ; on a large scale they are always water-borne and caused by sudden contamination of a public supply. The classical example is Maidstone. That outbreak began towards the end of August 1897, and within six weeks some 1500 persons were attacked. The total number of cases was 1847, with 132 deaths, in a population of about 34,000. With the exception of 280 cases of secondary infection, which lingered on till the following January, they all occurred before October 18, and the whole thing subsided almost as rapidly as it arose. A mass of evidence of different kinds left no possibility of doubt that accidental contamination of a water-supply was the cause. Perhaps the most striking point was that Maidstone is supplied with water from three different sources, known as Cossington, Boarley, and Farleigh, and out of 1681 cases the respective inci- dence in these areas was — Cossington 29, Boarley 69, Farleigh 1583. Another great example of water-borne typhoid is furnished by Philadelphia, where 14,082 cases occurred in 1898-99.~~

~~*Treatment. — Improved knowledge of the nature and causation of typhoid fever has not led to the successful introduction of a specific treatment ; nor have means been found to cut short the illness, though its fatality has been reduced. It still goes through the classical stages, which broadly coincide with first, second, and third weeks. Attempts have been made to deal directly with the toxins produced by the bacilli, on the hypothesis that they are formed in the intestinal canal, by the use of internal dis- infectants, such as mercury, iodine, carbolic acid, salol, &c, and these agents are sometimes beneficial ; but the treatment remains essentially symptomatic, and follows the principles that were recognized before the discovery of the bacillus typhosus. The most important improve- ment is the regular use of sponging or bathing for the reduction of temperature. It has even been developed into a continuous bath, in which the patient is kept in water throughout the illness. The fatality of typhoid fever varies greatly. The mean of 28 years in the London fever hospitals is 17-79 per cent., the minimum for a single year being 13-20 and the maximum 24-68. At Maidstone it was only 7-14 per cent., and in the hospitals there 5-5 per cent. Age exercises a marked influence, the fatality rising steadily after the period 5 to 10 years. The importance of careful and intelligent nursing is undoubtedly great in this illness, but there is a tendency, encouraged by some nurses, on the part of the public to over-estimate that factor and to think that*~~

~~*nothing more is needed. This is a grave mistake. No disease requires more vigilant attention or greater medical experience.*~~

~~*Prevention. — Broadly speaking, the problem of pre- venting typhoid fever is well understood. The difficulty lies less in want of knowledge than in the details of putting knowledge into practice. If house drainage were always perfectly carried out, sewage satisfactorily disposed of, water-supply efficiently protected or treated, patients segregated, and the typhoid material excreted by them effectually annihilated — if, in short, scientific cleanli- ness were completely attained, the disease would disappear, or be at least excessively rare. In some communities much has been done in the directions indicated, with the good results already noted ; but in many others the lessons of experience are quite ignored, and even in the best practice lags behind theory. This is mainly due to apathy and reluctance*~~

~~*to spend money, but there are certain real difficulties which stand in the way. To discuss them fully would involve a lengthy consideration of drainage, water-supply, and other matters, which are really separate subjects, and would be out of place here ; but some points must be noted. The most important is undoubtedly water-supply. The substitution of public water-supplies for shallow wells and small streams liable to pollution is one of the greatest factors in the diminu- tion of typhoid and other water-borne diseases ; but it may give rise to danger on a far larger scale, for a whole community may be poisoned at one blow when such a supply becomes contaminated. Unfortunately, it is ex- tremely difficult to prevent contamination with certainty in a populous country. Theoretically, water may be pure at its source, and may be distributed in that condition. Such is water derived from deep wells and springs, or gathered from uncultivated and uninhabited uplands. In the one case it has undergone natural filtration in the ground; in the other, it escapes all risk of pollution. These waters are generally pure, but the condition cannot be relied on. A tramp or a shepherd may pollute the most remote gathering-ground unless it be fenced in; deep wells may be similarly fouled by workmen, and sewage may find its way into them from the surface or through fissures. In an outbreak of enteritis and typhoid fever at Leavesden Asylum, investigated by the writer in 1899, the source of mischief was traced to contamination of the well, which was 250 feet deep in the chalk. The contamination did not take place from the surface, but from some underground source, and there were grounds — corroborated by subsequent observation — for believing that it occurred at irregular intervals, and was probably connected with the level of the deep under- ground water. At the same time the similar well of a*~~

~~*Table III. — Occurrences of Typhoid according to Sources of Water-Supply.*~~

~~*Source of Water.*~~

~~*Town.*~~

~~*Annual Typhoid Case-Bate per 100,000.*~~

~~*1892.*~~

~~*1893.*~~

~~*1894.*~~

~~*1895.*~~

~~*1896.*~~

~~*1897.*~~

~~*1898.*~~

~~*1S99.*~~

~~*1900.*~~

~~*Deep wells in Red Sandstone . Deep wells in Chalk*~~

~~*Upland surface water .*~~

~~*Rivers (filtered) ....*~~

~~*/ Wolverhampton . \ Birkenhead*~~

~~*Southampton*~~

~~*r Liverpool -J Manchester . (Plymouth*~~

~~*(Londou \ Reading (Worcester*~~

~~*109*~~

~~*157*~~

~~*145*~~

~~*152 120 126*~~

~~*65 30*~~

~~155~~

~~184 207~~

~~159~~

~~275~~

~~120~~

~~63~~

~~84~~

~~35~~

~~145~~

~~109 185~~

~~109~~

~~267 90~~

~~47~~

~~77~~

~~28~~

~~110~~

~~146~~

~~165~~

~~83~~

~~190 96 32~~

~~81 53 36~~

~~159 138~~

~~78~~

~~168 92 31~~

~~71 30 43~~

~~117 126~~

~~64~~

~~160 90 49~~

~~70 67 45~~

~~124 211~~

~~153~~

~~129~~

~~118~~

~~41~~

~~66 32 31~~

~~224 230~~

~~171~~

~~149 78 49~~

~~98 48 50~~

~~237 145~~

~~109~~

~~115~~

~~78~~

~~120~~

~~95~~

~~41 26~~

~~Average of 219 towns~~

~~88~~

~~142~~

~~103~~

~~115~~

~~102~~

~~100~~

~~115~~

~~127~~

~~116~~

~~532~~

~~TYPHOID~~

~~Table IV.-~~

~~—Statistics of Anti-Typhoid~~

~~*Inoculation.*~~

~~*No.*~~

~~*Group which was under Observation.*~~

~~*Number of In- oculated and Uninoculated in the Group.*~~

~~*Number of*~~

~~*Cases of*~~

~~*Typhoid*~~

~~*Fever.*~~

~~*Percentage*~~

~~*Incidence*~~

~~*of the*~~

~~*Disease.*~~

~~*Number of*~~

~~*Deaths from*~~

~~*Typhoid*~~

~~*Fever.*~~

~~*Percentage*~~

~~*Death-rate*~~

~~*for Typhoid*~~

~~*Fever.*~~

~~*Case Mortality— i.e.t Proportion of Deaths to Cases.*~~

~~*13*~~

~~*i*~~

~~*u*~~

~~*o*~~

~~*p*~~

~~*M*~~

~~*3*~~

~~*n*~~

~~*‘5,3*~~

~~*k*~~

~~*eg i i a*~~

~~*a”*~~

~~*3*~~

~~*o*~~

~~*g d*~~

~~*:*~~

~~*PS*~~

~~*a*~~

~~*3*~~

w «

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S

c

r-l

3

g-d

1-1

3

o

g-d

a

M

3

g-d

t-cg

3

o

g-d

~~=1~~

~~S>.3~~

~~a~~

~~M~~

~~a~~

~~0-3~~

~~a”~~

~~3~~

~~a~~

~~I’d~~

~~3-S~~

~~P.3~~

~~e~~

~~M~~

~~1~~

~~Nurses and Attendants, Banning Asylum.~~

~~84~~

~~116~~

~~0~~

~~4~~

0

1-34

2

Inoculated Regiments and other Units of the British Army in India.

4,502

25,851

44

657

0-98

2-54

9

146

0-2

0‘56

1 in 4-9

1 in 4-5

8

15th Hussars, Wives of same, and Officers.

360

179

~~2~~

~~11~~

~~0‘55~~

~~6-14~~

~~1~~

~~6~~

~~0-27~~

~~3-35~~

~~lin2~~

~~1 in 2-2~~

~~4~~

~~Garrison of Ladysmith.~~

~~1,705~~

~~10,529~~

~~35~~

~~1,489~~

~~2-05~~

~~14-14~~

~~8~~

~~329~~

~~0-47~~

~~3-12~~

~~1 in 4-7~~

~~1 in 4-5~~

~~5~~

~~British Garrison of Egypt and Cyprus.~~

~~720~~

~~2,669~~

~~1~~

~~68~~

~~0-14~~

~~2-55~~

~~1~~

~~10~~

~~0-14~~

~~0-37~~

~~linl~~

~~1 in 6-8~~

~~6~~

~~British Garrison in India.~~

5,999

54,554

52

731

0-87

1-69

8

224

0-13

0.58

1 in 6-5

1 in 3-3

7

Patients in Tintown Hos- pital, Ladysmith.

30.

265

2

5

linl5

lin53

~~8~~

~~Patients in Stationary Hos- pital, Harrismith.~~

~~263~~

~~947~~

~~”.~~

~~18~~

~~135~~

~~1 in 14·6~~

~~lin7~~

~~9~~

~~Patients in Portland Hos- pital.~~

~~54~~

~~178~~

~~4~~

~~25~~

~~1 in 13·5~~

~~lin7~~

~~10~~

~~Patients in the Irish Hos- pital.~~

~~80~~

592

5

74

linl6

lin8

11

Patients in Scottish National Bed Cross Hospital.

15

70

1

10

linl5

lin7

12

Patients in Imperial Yeo- manry Hospitals.

47

301

4

26

1 in 11-9

1 in 11-8

13

Patients in a Variety of Military Hospitals.

764

3,374

63

510

1 in 12

1 in 6-6

14

Staff of the Portland Hos- pital.

28

13 .

7

3

25

23

0

1

0

~~7~~

~~0in7~~

~~lin3~~

~~15~~

~~Staff of Imperial Yeomanry Hospital, Deelfontein.~~

~~59~~

~~25~~

~~4~~

~~4~~

~~6-8~~

~~16~~

~~0~~

~~0~~

~~0in4~~

~~Oin 4~~

~~16~~

~~Staff of Imperial Yeomanry Hospital, Pretoria.~~

~~32~~

~~72~~

~~3~~

7

9-3

9-7

θ

θ

θin3

θ in 7

17

Hj ‘ „ 1 General Hospitals

m. 10 J (Staffs of)-

87 Ud8

1101

47 J-276 119 J

iSIM

44”| 13 V93 36 J

J-14-8

j-33-5

51'

2 1-16

6j

~~J 0-9~~

~~U-8~~

~~|-1 in 16~~

~~tlin5-8~~

~~18~~

~~Staff of Second Section, Scottish Red Cross Hos- pital.~~

~~70~~

~~12~~

~~2~~

~~4~~

~~2-8~~

~~33-3~~

~~1~~

~~1~~

~~1-4~~

~~8-3~~

~~lin2~~

~~lin4~~

~~19~~

~~Fifth Battalion, Manches- ter Regiment.~~

~~200~~

~~547~~

~~3~~

~~23~~

~~1-5~~

~~4-2~~

~~0~~

~~7~~

~~0~~

~~1-3~~

~~0in 3~~

~~1 in 3-3~~

~~20~~

~~City Imperial Volunteers.~~

~~700~~

~~494~~

~~60~~

~~39~~

~~8-5~~

~~7‘9~~

~~9~~

~~11~~

~~1-8~~

~~2-2~~

~~1 in 6-7~~

~~1 in 3-5~~

~~21~~

~~Patients in Richmond Asy- lum, Dublin.~~

~~339~~

~~298~~

~~6~~

~~30~~

~~1-8~~

~~10-0~~

~~1~~

~~4~~

~~0-3~~

~~1-3~~

~~lin6~~

~~1 in 7-5~~

~~22~~

~~Officers Invalided from South Africa (first series).~~

~~112~~

~~109~~

~~32~~

~~24~~

~~28·5~~

~~22·0~~

~~...~~

~~23~~

~~Officers Invalided from South Africa (second series).~~

~~102~~

~~85~~

~~34~~

~~28~~

~~33·3~~

~~32·9~~

~~...~~

~~—~~

~~24~~

7th Hussars, South Africa.

307

244

9

20

2‘9

8-2

0

3

0

1-2

Oin 9

1 in 6-7

TYPHOID

533

neighbouring poor-law school was found to be dangerously- polluted, and it was ascertained that two others in the same locality had been condemned and closed in the past. The deep chalk in that neighbourhood was clearly unsafe, and this was thought to be due to the practice of digging holes called “dumb wells,” but in reality cess-pits, as much as 40 feet deep, in the chalk for the reception of sewage. The same practice is common in all inhabited localities on a chalk formation, as it is an extremely convenient way of disposing of sewage, which percolates away and renders it unnecessary to empty the cess-pit. Several similar cases of

deep well pollution have been recorded, notably those of Houghton-le-Spring in 1889 and Worthing in 1893. In order to secure purity, therefore, and prevent liability to outbreaks of typhoid and other intestinal disease, all gathering grounds should be fenced in, and water, even from deep wells, should be regularly examined, both chemically and bacterioscopically, in order that any change in composition may be detected. In the water-supplies of great populations such examina- tion should be made daily. Further, all supplies which are not above suspicion should be filtered through sand or sterilized by boiling. The latter can be carried out by simple means in the case of individual domestic water, and attempts are being made to apply it by means of mechanical apparatus to supplies on a larger scale. It is not, however, applicable to the water-supply of large towns because of the liability of such apparatus to break down or get out of order. Sand filtration is at present the best mode of dealing with these supplies (see Water Supply). There is no purer water than that which has been properly treated by subsidence and sand filtration, even when it is taken from an impure source. So far as the prevention of typhoid and other water-borne disease is concerned, it is certainly safer than the un- filtered water which is taken from so-called pure sources. It cannot be a mere coincidence that London, Hamburg, Berlin, and other towns using well-filtered but originally impure river water should be generally freer from water- borne disease than many large towns drawing their supply from purer sources but neglecting to filter it, such as Manchester, Glasgow, and the American cities. Table III., prepared by Mr Caink, engineer to the city of Worcester, illustrates this fact, which has also been noted by Professor Saltet of Amsterdam as holding good of the Netherlands.

Of course, the amount of typhoid is dependent on other factors besides the water-supply, but the close connexion between the two and the influence of filtration are well attested by the experience of Worcester, where the great reduction recorded since 1894 coincided with new and improved filtration. The weak point about sand filtration is that it is apt to be imperfectly performed when the filters are frozen or newly cleaned, or when the process is too rapid. Filtration through porcelain is an efficient purifier, but it is not applicable to sup- plies on a large scale, and is liable to break down through clogging of the filters. Other portable filters are

regarded as useless or worse. The best emergency treatment for suspected drinking water is boiling. Contamination of water in the mains is due to bad laying, and ought never to occur ; that of supply pipes can be prevented by a constant ser- vice, and of domestic filters by providing them with covers.

Next to water-supply, and hardly less important, is drainage. The drying and cleansing of the soil by good household drainage and sewerage is essential to the pre- vention of typhoid. Cess-pits, leaking drains and privies, especially when there is only one to several houses, as in many industrial towns, are powerful allies of this disease. The drainage of all old houses is defective and dangerous.

The ground about them is commonly honeycombed with cess-pits and saturated with sewage. The only way to discover and remedy such defects is to lay them bare with the pick-axe and shovel. Soil-pipes should always be trapped and ventilated. In short, no disease requires for its prevention more careful attention to house sanitation. The paving of yards and other spaces is also desirable in towns, on account of the liability of the unprotected soil to harbour moisture and filth. The other modes by which the disease is spread — such as shell-fish, milk, and un- cooked vegetables — suggest their own remedy. The dissemination by dust and flies is less easily prevented. All that can be done is to segregate the sick and promptly destroy all dangerous matters proceeding from them. It should be remembered that the urine may be an even greater source of danger than the fasces. The same observation applies to the prevention of infection from person to person. There is no doubt that sufficient care is often wanting, even in hospitals, in handling patients, soiled linen and clothes, and in dealing promptly and effectually with their excreta. For the effectual segregation and treatment of persons suffering from typhoid prompt recognition is necessary ; and this, unfortunately, is a matter of much difficulty on account of variation in the type and severity of the illness. Bacteriological science has here come to the assistance of the clinical physician with what "is called the Widal or serum reaction, which has a great diagnostic value when carefully performed. (See Bacteriology : Agglutinations.) But obviously it can only be applied to persons in the position of patients ; it is of no use in the case of those who do not

proclaim them- selves ill, but go about their business when suffering from the disease. Such " ambulatory " cases have long been recognized as an important factor in spread- ing the disease. Many of the most memorable epi- demics have probably been caused by them, and it is difficult to see how they can be guarded against. Kecent science, indeed, goes farther, and announces that the bacilli may live for years in persons who have had an attack, and may presumably be scattered far and wide by them. We need not, perhaps, be disturbed by this discovery. There are some grounds for supposing that the germs, or potential germs, of many parasitic fevers are virtually ubiquitous, but that they are not necessarily harmful.

The prevention of typhoid among armies in the field is a problem of the gravest practical importance, but of special difficulty, not in principle but because of the conditions. The water is generally polluted, and soldiers are too thirsty to wait while it is boiled or filtered, even if the means are at hand. The sanitary arrange- ments are such as to ensure the saturation of the ground with excreta ; flies and dust abound ; personal cleanli- ness is impossible, and men feed and sleep together in the closest proximity. No doubt a great deal might be done by efficient sanitary organization, which has hitherto been lacking, and by educating the men. Dr Leigh Carney in 1901 suggested a scheme for dealing systematically with the water-supply of an army.

One other point requires mention in connexion with prevention, namely, protective inoculation. This is per- formed with an anti-toxic substance prepared from dead cultures of bacilli, and has been tried on a fairly large scale, particularly on the British army in India and South Africa. It is notoriously difficult to prove the success of any protective treatment, and the reader will find some curious discrepancies in the foregoing statistical summary (Table IV.) published by Professor A. E. Wright of Netley (Lancet, 6th September 1902). Some of the results appear to be very satisfactory. (a. sl.)

~~*Tyres. — The tyre of a wheel is the outer circum ferential portion that rolls on the ground or the track prepared for it. When the track is smooth and level, as in a railway, the principal functions of the tyre are to give a hard, durable surface to the wheel, and to reduce to a minimum the resistance to rolling. Railway vehicle wheels are usually provided with hard steel tyres, this combination with the hard steel rail giving the maximum endurance and the minimum rolling resistance. For road vehicles also, in which durability is the prime considera- tion, the tyres are usually rings of iron or steel shrunk on the wooden wheels.*~~

~~*In bicycles, motor-cars, and other road vehicles in which freedom from vibration and shock from uneven road surface is desired, rubber or pneumatic tyres are employed. These elastic tyres are capable of absorbing small irregularities in the road surface without transmit- ting much vibration to the frame of the vehicle. Their range of yield is, however, too limited to absorb the larger irregularities met with on rough roads, so that their use does not obviate the necessity of spring support of the carriage body on the wheel axles. The pneumatic tyre has a very much smaller rolling resistance than a solid rubber tyre. Where the driving power is limited, as in bicycles, this consideration is by far the most important. A pneumatic-tyred bicycle requires less power to drive it at a given speed than does one with solid rubber tyres — in popular language, it is much faster ; hence pneumatic tyres are now almost universally used on bicycles.*~~

~~*Rolling Resistance. — Professor Osborne Reynolds, in his investi- gations on the nature of rolling resistance, found that it is due to actual sliding of the surfaces in contact. Fig. 1 shows an iron roller resting on a flat, thick sheet of indiarubber. A series of*~~

~~*Fig. I.*~~

~~*equidistant parallel lines drawn on the indiarubber are distorted by the pressure, as shown in the figure. The distance between the marks on the periphery of the roller corresponds to that between the lines on the undistorted sheet of rubber. The motion of the roller bging from left to right, actual contact takes place between C and D. The surface of the rubber is depressed at P, is bulged up in front at D, and behind at 0. The*~~

vertical compression of the rubber at P causes it to bulge laterally, this causing a lateral contraction at D, which in turn causes a vertical extension at D. There is thus created a tendency to relative creeping motion between the roller and rubber. Between /and e there is no relative sliding, but over the portions eD and Of there is slipping, with a consequent expenditure of energy. The action causes the actual distance traversed by the roller to he different from the geometric distance calculated from the diameter and number of revolutions of the roller. A certain amount of energy is expended in distorting the rubber between P and D ; part of this energy is restored as the rear portion of the roller passes over this and the rubber gets back to its original unstrained state.

With an elastic tyre rolling on a hard, smooth surface the action is similar. Fig. 2 shows a portion of the tyre flattened out : pi and P2 are the intensities of the pressures at points «i and a? at equal distances in front of and behind a, the geometrical point of contact : p\ opposes, ju2 assists the rolling of the wheel. At usual speeds the opposing force, Pi, will be greater than the force of restitution, p%, the difference being a measure of the elastic ^'S- 2.

hysteresis of the material, H, at

that speed. If the vertical compression cd of the tyre be denoted by y, the energy lost may be said to be proportional to Hy.

Comparing three tyres of steel, solid rubber, and air respectively rolling on a smooth, hard surface, H is probably smallest for steel and largest for rubber, y is least for steel, greater for a pneumatic tyre pumped hard, greater still for solid rubber and for a pneu- matic tyre insufficiently inflated. The rolling resistance of the

f f^T Miff p^^^pav

Fig. 3.

steel tyre will therefore be least ; next in order come the pneumatic tyre inflated hard, and the pneumatic tyre inflated soft, while the solid rubber tyre has the greatest resistance.

Pneumatic Tyres — Weight Supported. — Let a pneumatic tyre in- flated to p lb per square inch support a load W tb. The portion

Fig. 4.

near the ground is flattened (Fig. 3). If the tyre fabric is assumed to be perfectly flexible, then, since the part in contact with the ground is quite flat, the pressures p and q on the opposite sides must be equal ; that is, the tyre presses on the ground with an intensity p lb per square inch. The area of the flattened portion is therefore Wjp. Fig. 4 shows the shapes of the areas of contact of a bicycle tyre 28 inches by 1^ inch, for various amounts of vertical flattening, the figures annexed to the curves in plan and to the corresponding lines in elevation indicat- ing the amount of vertical flattening in sixteenth parts of an inch. Let y be the vertical flattening, x the semi-major axis, and h the semi- minor axis of the curve of contact. For small values of y, corresponding to a tyre pumped hard, the curves of contact

may be considered plane sections of a circular ring. The area of the curve may be taken equal to that of an ellipse having the same axes, i.e., ir.rz. But

% in.

FLATTENING

Fis

x= JR*-(R-yf= N/A'//-2/2= */yj2£-y,

z= Jr2-(r-i

VW2-S-2

R and r being the principal radii of section of the tyre longitudi- nally and transversely. Therefore, approximately,

A = tt.vz = Try J2R — y J2r — y.

For small values of y, y may be neglected in comparison with 2fl and 2r respectively, and the above equation becomes

and therefore

A = 27ryJRr, W=2irypjRr.

For larger values of y, A is smaller than that given by the above formula, as shown in Fig. 5, which gives the areas of contact

TYRES

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plotted with respect to the vertical flattenings for a tyre 28 inches by 1£ inch. The same curve may serve to show values of W, thus corresponding to the load-deflection curve of a spring. The curve clearly shows the small value of the pneumatic tyre as a spring device. Thus, when pumped hard, so that the normal load is carried with J inch vertical flattening, when the bicycle is travelling quickly a lump on the road equivalent to \ inch further flattening nearly doubles the upward reaction on the wheel. With the normal load carried with § inch vertical flattening the same lump on the road increases the upward reaction bv only 23 per cent., the area of contact of the tyre being increased from 6 '5 to 8 square inches. The above brief investigation, involving a few approxima- tions, is yet sufficiently accurate to afford a clear idea of the usual Conditions of a tyre.

Outer Cove?\ — The outer cover has to be strong enough to with- stand the air-pressure inside the tyre and to transmit the driving or the braking effort from the wheel to the road surface. For the latter purpose, the threads

d,

of the fabric are best dis posed spirally, as shown in Fig. 6. While driving in the direction of the arrow the tension on the fibres cc will be slightly

increased, that on the fibres dd decreased. The distortion of the fabric due to driving is thus re- duced to a minimum. A woven fabric is sometimes

Fig. 6.

Fig. 7.

used, but one made up of two or more layers of parallel threads embedded in rubber is better. This construction makes the outer cover more flexible, and consequently less energy is wasted in distorting the fabric as the tyre rolls on and off the ground, while greater durability is also secured. Fig. 7 shows a plain woven fabric, from which it is seen that each thread takes the form of a

sinuous line. As the air-pressure inside the tyre is increased the threads tend to become straighter, thus pressing together with a cut- ting action. The total thickness is greater than that of two layers of parallel threads, while on the latter the threads can be placed closer together. The woven fabric is therefore stiffer, weaker, and less durable than that built up of parallel layers. The tensile stress per inch width, t^, on the longi- tudinal section of the cover is given by the formula pd = 2

Single-tube, Double-tube, and Wireless Tyres.— A tyre, besides being strong enough to resist the stresses to which it is subjected, must he air-tight. In most tyres for cycles and motor — cars, an inner tube of india-rubber is made separate from the outer cover. In these double — tube tyres the outer cover is more or less easily de- tachable from the rim. The air under ' pres- sure is pumped inside the inner tube, which is supported by the outer cover. In case of puncture, the inner

tube is repaired by cementing a patch of rubber on the out- side of the inner tube, a solution of indiarubber in naphtha being the cementing agent employed. In a single-tube tyre, as its name indicates, the outer cover and the air-tight tube are vulcanized together to form a single hollow ring. To repair a simple puncture of a single-tube tyre it is not necessary to detach it from the rim ; but as the air-tight tube is inaccessible, a different procedure is used. Instructions for repair, which

need not be entered into here, are usually issued by the makers. A tube-less tyre, of which type the "Fleuss" (Fig. 8) is the best known,

Fig. 8.

F.I.

consists of the outer cover, as used in a double-tube tyre, to the inner surface of which an air-tight layer of sheet-rubber has been cemented. A continuous flap projects from one edge of the tyre, and when in position on the rim this flap is pressed against the other edge, forming an air-tight seal. A slight moistening of the flap with soft soap tends to remove any imperfection in the tightness of the air seal. The repair of a puncture of a tube- less tyre can be very quickly done. Since the inner surface of the air-tight layer is accessible, after placing the patch in position the tyre can be inflated and the bicycle ridden at once ; whereas in the double-tube tyre, sufficient time must elapse between the patching and the inflation to allow the rubber solution to set.

Methods of Attachment of Tyres to liims. — A single-tube tyre can be cemented directly to the rim. For detachable double-tube tyres on bicycles, two methods, the Dunlop- Welch endless wire (Fig. 9) and the "Clincher "(Fig. 11), account for by far the greater proportion. The Fleuss tubeless tyre is attached like the Clincher. In the Dunlop — Welch tyre the endless wires are embedded in the two edges of the outer cover re-spectively, the trans- verse tension of the fabric being trans- mitted to them. Each endless wire is formed of three coils, so as to give flexibility to the edge of the cover. The ring formed by each endless wire is smaller in diameter than the edge of the rim. The middle portion of the rim is deepened, its diameter being less than that of the ring of endless wire. To detach the tyre, after deflation, one part of the edge of the outer cover is depressed into the bottom of the rim, the opposite part then projects slightly beyond the edge of the rim and is pulled outside ; one portion being got outside, the rest easily follows. Fig. 10 shows the nature of the mutual action between outer cover C, rim R, and endless wire Wm& Dunlop- Welch tyre. The transverse tension T on the outer cover is transmitted to the endless wire IV, which is also subjected to the reaction N of the rim. The resultant Q must lie in the plane of the endless wire W,

~~and constitutes a radially outward force acting at all points, which in turn causes a longitudinal pull, P, on the wire. Let d be the diameter of the inner air-tube, JD the diameter of the ring formed by the endless wire W, p the air pressure, and 0 the angle between T and Q. Then for each inch length of wire T=pd/2, Q = T/ cos 0 ; while P= QD/2. Combining these results, we get P=pdD/i cos 0. If 9 = 30°, P=-29pdD, from which the section of wire for a tyre of any size can be calcu- lated. In the " Clincher " fastening thickened edges on the outer cover take into corresponding edges formed on the rim, and are securely held therein when the tyre is inflated.~~

~~Prevention of Punctures. — The outside of the tyre is covered with a thick layer of rubber, which protects the fabric from injury by contact with the rough road surfaces. In full roadster tyres this outer layer of rubber is thinner at the sides than at the tread (the part which actually rolls on the ground), but still completely covers 'the fabric. In light roadster and racing tyres the sides are not covered, and an appreciable gain in speed or ease of driving is due to the greater flexibility of the cover thus obtained.^ Numerous puncture-proof bands and other devices have been tried with the object of absolutely preventing punctures, or making the tyre self-sealing after puncture ; but since they increase the rolling resistance, and therefore the effort necessary to drive the bicycle at a given speed, it is questionable if they are at all necessary.^ The writer is of opinion that for the usual conditions of riding in England the chance of puncture of any first-class tyre inflated~~

~~Fig. 10.~~

~~Fig. 11.~~

~~sufficiently hard is so small as to render undesirable any addition that makes the tyre slower in the running.~~

~~*Valve for Pneumatic Tyre. — A non-return valve is permanently attached to the inner tube of the tyre, which allows the air forced from the infiater to pass inside the inner tube. The most com- monly used, the Dunlop-Woods valve, consists of a short piece of*~~

~~*Fig. 12.*~~

~~*rubber tubing mounted on a brass stem, which has a small hole communicating from its outer end to the inner surface of the rubber tube. Normally, the tubing closes the mouth of this hole, preventing the air from escaping from the tyre, but lifts freely when air is being forced from the infiater. The arrangement of the parts for deflating and for getting access to the rubber tubing is very simple and effective. The cyclist should be careful that the small piece of valve tubing, and the two fibre washers at the ends of the flexible connecter which serve to make air-tight the two joints between the latter and the pump and valve stem respec- tively, are always in good condition ; if faulty, they should be at once renewed. If either of these seemingly small details is out of order, it may be impossible to pump the tyres hard enough ; the bicycle being ridden, the tyres may be nipped in many places between the rim and sharp edges on the road surface, and prac- tically ruined.*~~

~~*Tyres for Motor Cars. — Although the pneumatic tyre for bicycles is efficient, durable, and trustworthy, the tyre problem for motor*~~

~~*Fig. 13.*~~

~~*cars ia still unsolved. For a slow-speed vehicle an ordinary steel tyre is cheap, durable, and to be depended on, but the vibration communicated to the body renders it undesirable for private cars. At slow speeds the solid rubber tyre, being not liable to puncture*~~

~~*Fig. 14.*~~

~~*like the pneumatic, is trustworthy if made of sufficient sectional area, but it is somewhat expensive, and lacks the comfort and easy running of the pneumatic. The thickness of the fabric of a pneu- matic tyre is much greater, even in proportion to the diameter of its transverse section, than*~~

that of a cycle tyre. The stiffness increases very quickly as the thickness increases ; consequently, even at the same speed of revolution as a cycle tyre the energy lost in bending and unbending is enormously greater. This energy appears as heat ; the temperature of the cover rises until the heat carried away by the air is equal to that generated. At high speeds the rise of temperature is still greater, and the injurious action on the rubber and fabric shortens the life of the tyre. Unfortunately at high speeds the solid rubber tyre is still worse off in this respect, its elastic hysteresis, and therefore the heating effect, being greater than that of a pnuematio tyre. Fig. 12 shows a section of Challiner's cup tyre and rim for motor cars, the tyre being of solid rubber.

The methods of fastening motor car tyres to the rim are more elaborate than those of cycle tyres, mechanical fastening, such as screws, being laTgely used. Fig. 13 shows the Clipper Con- tinental motor car tyre, the " Clincher " type of fastening being supplemented by the inner plates of trough section which, by means of thumbscrews, positively fasten down the beaded edges of the outer cover. Fig. 14 shows the Goodyear, detachable double- tube tyre. Expanding wires are embedded in the base of the outer cover, which comes off sideways after removing the flanges when it is desired to repair a puncture. The same firm also make a single-tube tyre for motor cars. The Martin pneumatic tyre is of the tubeless variety, and is fastened to the rim by side flanges.

(A. Sr.)

Tyrol. See Tieol.

Tyronei a borough of Blair county, Pennsylvania, U.S.A., on the Little Juniata river, and lines of the Penn- sylvania Railroad, in the central part of the state, at an altitude of 907 feet. It has manufactures, especially of iron and steel, flour, paper, and lumber. Population (1880), 2678 ; (1890), 4705 ; (1900), 5847, of whom 209 were foreign-born and 115 negroes.

Tyrone, an inland county of Ireland, province of Ulster, bounded on the N. by Londonderry, on the E. by Lough Neagh and Armagh, on the W. by Fermanagh and Donegal, and on the S. by Fermanagh and Monaghan.

Population. — The area of the administrative county in 1900 was 778,943 acres, of which 235,479 were tillage, 332,667 pasture, 463 fallow, 9658 plantation, 47,598 turf bog, 6843 marsh, 109,997 barren mountain, and 36,238 water, roads, fences, &c. The new adminis- trative county under the Local Government (Ireland) Act, 1S98, is identical with the old judicial county. The population in 1881 was 197,719 ; in 1891, 171,401 ; andin 1901, 150.468, of whom 74,233 were males and 76,235 females, divided as follows among the dif- ferent religions: — Roman Catholics, 82,425; Protestant Episco- palians, 33,740; Presbyterians, 29,722; Methodists, 3176; and other denominations, 1405. The decrease of population between 1881 and 1891 was 13‘31 per cent., and between 1891 and 1901, 12‘2 per cent. The average number of persons to an acre in 1891 was ‘22, and of the total population 154,696 persons inhabited the rural districts, being an average of 173 to each square mile under crops and pasture.

The following table shows the degree of education in 1891 : —

Percentage.

to

to

Males.

Females.

Total.

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Head and write.

63,168

60,858

104,026

6S-0

71-4

82-5

86-8

Read only .

10,605

14,396

24,901

18·6

15·1

10·5

8·8

Illiterate .

13,122

14,044

27,166

23·4

13·5

7·0

4·4

UBED A— U DINE

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The percentage of illiterates among Roman Catholics in 1881 was 30‘2. In 1891 there were 16 superior schools with 405 pupils (Roman Catholics 89, and Protestants 316), and 387 primary schools with 20,385 pupils (Roman Catholics 9752, and Protes- tants 10,633). The number of pupils on the rolls of the National schools on 31st December 1900 was 23,618, of whom 12,092 were Roman Catholics and 11,526 Protestants.

The following table gives the number of births, deaths, and marriages in the years specified : —

Year.

~~Wheat.~~

~~Oats.~~

~~Barley,~~

~~Bye,~~

~~Beans, &c.~~

~~Potatoes.~~

~~Turnips.~~

~~Other Green Crops.~~

~~Flax.~~

~~Meadow~~

~~and Clover.~~

~~Total.~~

~~1881 1891 1895~~

~~•1900~~

~~2088 1363 855 1545~~

~~108,005 95,455 94,526 91,323~~

~~377 905 408 307~~

~~43,248 42,458 41,091 38,067~~

~~14,815 16,017 16,614 16,633~~

~~3360 4418 3095 3658~~

23,508

12,636

17,241

7816

56,592 75,268 76,616 76,130

251,993 248,510 250,446 235,479

Year.

Births.

Deaths.

Marriages.

1881 1891 1900

4298 3415 3004

3482 3006 3133

713 713 685

In 1900 the birth-rate per 1000 was 20·0, and the death-rate 20‘8 ; the rate of illegitimacy was 4‘1 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 134,446, of whom 71,487 were males and 62, 959 were females. The chief towns in the county, with their populations, are Strabane, about 5000 ; Omagh, 4500 ; Dungannon and Cookstown, between 3000 and 4000.

Administration. — The county is divided into four parliamentary divisions — North, South, East, and Mid ; the number of registered electors in 1901 being respectively 6992, 6975, 7534, and 8661. The

~~rateable value in 1900 was £458,797. By the Local Govern- ment (Ireland) Act, 1898, the fiscal and administrative duties of the frand jury were transferred to a county council, urban arid rural istrict councils were established, and under that Act the county now comprises three urban and seven rural sanitary districts.~~

~~Agriculture. — The following tables show the acreage under crops, including meadow and clover, and the amount of live-stock in 1881, 1891, 1895, and 1900.~~

~~In 1900 the total value of the cereal and other crops was estimated at £1,540,522. The number of acres under pasture in 1881 was 314,102 ; in 1891, 327,494 ; and in 1900, 332,667.~~

~~Year.~~

~~Horses~~

~~and Mules.~~

~~Asses.~~

~~Cattle.~~

~~Sheep.~~

~~Pigs.~~

~~Goats.~~

~~Poultry.~~

~~1881 1891 1895 1900~~

~~23,823 25,929 26,694 23,508~~

~~1073 1532 1321 1496~~

~~166,116 177,505 176,181 179,019~~

45,933 88,991 68,733 77,680

28,417 48,001 46,961 41,193

8995 11,021

9507 10,721

716,315

850,589

925,737

1,077,876

The number of milch cows in 1891 was 72,475 ; in 1900, 69,440. It is estimated that the total value of cattle, sheep, and pigs in 1900 was £2,404,543. In 1900 the number of holdings not exceed- ing 1 acre was 2262 ; between 1 and 5, 2400 ; between 5 and 15, 7850 ; between 15 and 30, 7727 ; between 30 and 50, 4039 ; be- tween 50 and 100, 2461 ; between 100 and 200, 588 ; between 200 and 500, 158 ; and above 500, 40 — total, 27,525. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896 up to 31st March 1901 was 3272, amounting to £825,442. The number of loans for agricultural improvements sanctioned under section 31 of the Land Act, 1881, between 1882 and 1901 was 274, and the amount issued £17,212. The total amount issued on loan for all classes of works under the Land Improvement Acts from the com- mencement of operations in 1847 to 31st March 1901 was £150,776.

UbedcL, a town of Spain, province of Jaen, on the Guadalquivir. The surrounding country is very beautiful, full of vineyards and olive plantations, producing much wheat, pod and other fruit. There are fine pastures for the rearing of live-stock, especially horses. The streets are clean and well-paved, with some good public build- ings, theatre, bull-ring, schools, town hall and hospital. An important fair is held from 29th September to 5th October every year. The chief industries are concerned

with oil, soap, esparto grass, and linen. There are some remains of the old walls of the Saracenic and Christian epochs. The church of San Salvador is a noble pile of the 16th century, Sau Paul and San Nicolas are Gothic churches. Population (1887), 18,713 ; (1897), 20,026.

Uca.ya.9i. See Amazon.

Udaipur, or Oodeypoke, or Mewae (Meywar), a native state of India, in the Eajputana agency. Area, 12,861 square miles. Population (1881), 1,443,144; (1891), 1,862,478, including 134,429 Bhils. ; (1901), 1,021,664, showing a decrease of 45 per cent., compared with an increase of 29 per cent, in the preceding decade.

The estimated gross revenue is Rs. 37, 50, 000, of which Rs. 4, 16, 730 was expended on public works in 1897-98 ; tribute, Rs.2,50,000; number of children at school (1897-98), 3040. The chief, whose title is maharana, is the head of the Sesodia clan of rajputs, and claims to be the direct representative of Rama, the mythical king of Ajodhya. He is universally recognized as the highest in rank of all rajput princes. The dynasty offered a heroic resistance to the Mahommedans, and boast that they never gave a daughter to a Moghal Emperor. They are said to have come from Guzarat and settled at Chitor in the 8th century. After the capture of Chitor by the Emperor Akbar in 1568, the capital was removed to Udaipur by Maharana Udai Singh. During the 18th century the state suffered greatly from internal dissension and from the inroads of the Marathas. It came under British protection in 1817. The present maharana, Fateh Singh, G.C.S.I., was born in 1848, and succeeded by adoption in 1884. He is a rajput of the old school, devoted to field sports, and retains in his own hands all the powers

of administration. A portion of the state is traversed by the Malwa line of the Rajputana Railway. A branch from Chitor towards Udaipur (60 miles) was taken over by the state in 1898, and is now being extended nearer to the capital (6 miles) at an estimated cost of Rs.2,54,000. Like the rest of Rajputana, the state suffered severely from famine in 1900. The ancient coinage is of great historical interest as being of the Sassanian or Persian type, copper issues of this type being still in circulation. Modern coins

bear on the reverse the words ‘ ‘ Friend of London. ” In 1 897- 1898, the value of the silver coined at the miHlfcvas Rs. 83,422.

The city of Udaipur is 2469 feet above the sea. Population (1881), 38,214 ; (1891), 46,693 ; (1901), 45,595 ; death-rate (1897), 29-55 per 1000. Situated in a valley, amid wooded hills, on the bank of a large lake, with palaces built of granite and marble, it is perhaps the most picturesque place in India. In one of the palaces in the lake the European residents were sheltered during the Mutiny. In the neighbourhood is a collection of sculptured cenotaphs of former chiefs ; and farther off, beside another lake, stands the tutelary temple of Siva. The city has two hospitals, one of which is for women, under an English lady, and a high school.

UddevaHa, a seaport town of Sweden, county of Goteborg and Bonus, 45 miles north of Gothenburg (107 by rail), at the head of a fjord which penetrates to within 13 miles of Lake Wener. It has butter and porcelain factories, joinery works, sugar refineries, and wood-pulp mills, and in the vicinity granite and felspar quarries. In 1894-95 the harbour was both deepened and widened ; it is entered and cleared by shipping of about 100,000 tons annually. Population (1880), 7037 ; (1900), 9442.

Udding’Ston, a residential town, Lanarkshire, Scotland, on the Clyde, 7£ miles E.S.E. of Glasgow by rail. It has large preserve works and collieries. There is a public hall, a reading-room, and a grammar school. Population (1881), 3542; (1901), 7810.

Udine, a town, archiepiscopal see, and capital of the province of Udine, Venetia, Italy, situated between the Gulf of Venice and the Alps, 84 miles by rail north-east of Venice. The old castle is now converted into barracks.

One of the chief ornaments of the town is the bronze equestrian statue of Victor Emmanuel (1883), designed by Barzaghi, and there is also a

monument (1887) of Garibaldi by Michieli. There are a technical institute and a school of the industrial arts (1880). Silks, velvets, and cottons are the staple industries. Population (1881),

27,090; (1901), 37,933.

Uelzen, a town of Prussia, province of Hanover, on the Ilmenau, to the east side of the famous Liineburger Heide, at the junction of the Prussian state railways connecting Hamburg, Hanover, Bremen, and Stendal, and 52 miles south-east of Hamburg. The town is fairly well built, and in its vicinity are some interesting bar- rows and a whilom Benedictine monastery. Founded in the 10th century as Lowenwold,it became in the Middle Ages an active member of the Hanseatic League. Its principal buildings are the parish church and three chapels ; one of the latter, dedicated to the Holy Ghost, , has a valuable altar-piece dating from the 14th century. It has also a district court, a chamber of commerce, and a public school. The principal objects of its trade and industry are flax, tobacco, iron-works, gardening, and cattle. Population (1895), 8196 ; (1900), 8621.

Ufa, a government of south-east Russia, on the west- ern slope of the Urals. It has an area of 47,112 square miles, and its population, which was 1,793,260 in 1882, in 1897 numbered 2,220,497 (domiciled only), of whom 1,108,317 were women, and 105,667 lived in towns. This considerable increase in the population is chiefly due to Russian immigration. In 1900 the population had grown to 2,420,652, of whom 116,708 lived in towns. The gov- ernment is divided into six districts, the chief towns of which are Ufa, Belebei (5878), Birsk (8603), Menze- linsk (7542), Steiiitamak (15,538), and Zlatoust (20,973). Considerable towns have sprung up around the iron-works at Satkinsk, Yurezan, and Katav-Ivanovsk. The Russian element in the population is rapidly increasing, and in 1899 represented 45 per cent, of the whole, as against 36 per cent., in 1865, the ethnographical composition being : Russians, 1,070,872; Bashkirs, Tatars, and Mescher- yaks, 1,200,194; Tchuvash, Tehereniss, Votyaks, and Mordovians, 108,934 ; various, 3140. There were in the same year 1,070,555 Greek Orthodox, 23?761 Noncon- formists (under-estimated), 1631 Catholics, 1038 Luther- ans, 1,212,542 Mussulmans,

110,314 Buddhists, and 811 Jews. In 1899 nearly two-thirds of the land (i.e., 20,123,000 acres) were owned by the peasants, 18,494,000 acres as their allotments, and 1,629,000 acres bought — chiefly by village communities and co-operative societies ; 4,711,000 acres belonged to the nobility, and 1,151,700 acres to other private owners ; 2,684,000 to the Crown, 456,000 to the Imperial family, and 208,000 to the towns, &c. Out of a total of 29,254,000 acres, 1,460,000 acres only were considered unfit for agriculture. Since the wholesale plundering of the Bashkir lands which took place under Alexander II. (see RemezofPs Sketches from Wild Bashkiria, 2nd edition, 1889), the land is now sold by the nobles, and bought chiefly by the merchant class. Large estates are common, one man owning 691,000 acres, 13 owning from 27,000 to 540,000 acres, and 326 from 2700 to 27,000 acres, although it is the peasants and the peasants' co-operative societies that cultivate 85 per cent, of all the area under crops. Agriculture has greatly developed, owing partly to the Russian immigra- tion, and partly to the educational efforts of the local province and district councils ; and in 1900 there were no less than 4,860,000 acres under crops and 9,780,000 acres under cultivation. The average yield in 1895-99 was 9,450,000 cwt. of rye, 1,567,000 cwt. of wheat,

4,836,000 cwt. of oats, 104,000 cwt. of barley — the total cereal crop, 19,240,000 cwt. ; also potatoes, 1,885,000 cwt. The use of improved ploughs and machinery is becoming general, even among the Bashkirs, and grass sowing is practised. Peppermint and other aromatic herbs are cultivated. Cattle-breeding is extensively carried on, and there are excellent breeds of horses. There were in 1900 749,240 horses, 781,820 horned cattle, 1,751,000 sheep, and 138,800 pigs. Apiculture is also a valuable industry. The mining industry is very flourishing, the great iron works at Zlatoust belonging to the province. In 1897, 6360 cwt. of copper, 1,491,700 cwt. of pig iron, 355,300 cwt. of iron, 674,700 cwt. of steel, and 24,500 cwt. of iron chromates were obtained, and all industrial establishments showed an aggregate return of 14,000,000 roubles. Small trades in the villages are growing (weav- ing, wooden goods, hardware, agricultural machinery). There is a considerable export of grain, linseed, cattle, animal products, timber, metals and hardware. Owing chiefly to the efforts of the zemstvos, there are in the province 802 schools (35,050 boys and 12,370 girls) and about 1500 medresses. Medical assistance is also

well organized. Owing to the excellent dry climate of the steppes, a considerable number of consumptive patients come to the Bashkir settlements to take there koumiss (mare's milk fermented) ; one large sanatorium was built for that purpose, and several small ones have been estab- lished. The government is rich in antiquities belonging to three different periods — the Finnish or Chud period, the period of the Bulgarian empire, and the period of Nogai domination. The burial mounds of the Chud con- tain brass implements and decorations, and in one of them near Ufa a coffin covered with sheets of silver was found. Remains from the Bulgarian empire are found at Menzelinsk. But it is the ruins of the Mongolian period which are of greatest value, the remains of a large town, with a mausoleum and a palace, which have been found near Ufa, covering several miles along the Byelaya river. (p. a. k.)

Ufa, the capital of the above government, situated at the confluence of the Ufa with the Byelaya, on the trans- Siberian railway, 326 miles by rail E.N.E. of Samara. It has several iron and copper works, two machinery works, and several saw-mills. A museum and a public library have been opened. It is an important river port and a rapidly-growing city, carrying on a considerable trade with the surrounding agricultural region. Population

(1884), 25,660 ; (1897), 49,961.

Ufalei, Upper and Lower, two iron-works of Russia, in the government of Perm, in the district and 65 miles south of Ekaterinburg, near the Ufalei railway station. Nearly 10,000 tons of pig iron are obtained at the Upper works, and all sorts of iron goods are fabri- cated at the Lower works. The population is over 6000 at the former and over 5000 at the latter.

Uganda, a British protectorate in East Central Africa, in the Equatorial regions. The boundaries of this protectorate in 1901 were as follows : — On the N., the 5th degree of N. latitude (conterminous with the southern frontier of the Egyptian Sudan) ; on the E., the river Omo, the thalweg of Lake Rudolf, and a line drawn from the south-east corner of that lake southwards along the edge of the Laikipia and Kikuyu escarpments to the fron- tier of the German possessions ; on the S., the Anglo- German frontier in East Africa (for some distance coinci- dent with the 1st

degreeof S. latitude) ; and on theW., the frontier of the Congo Free State (a line which crosses Albert

trative divisions

Edward Lake, follows the Semliki river for part of its course, and terminates near the north end of Albert Nyanza), leaving the main stream of the Nile as the present north-western limits of the Uganda Protectorate, though the actual limit of the British sphere north of Lake Albert is the line of the Nile-Congo water-parting. The territory comprised within the above limits amounts to an approximate area of 150,000 square miles, but this area has since been re- duced by the transfer of Uganda's eastern province to the administration of the adjoining East Africa Pro- tectorate. This step will considerably modify the eastern boundaries 'of the Uganda Protectorate and diminish the extent of its territories by about one- sixth ; but as the full extent and limits of the area thus withdrawn from Uganda administration have not yet been fully determined by the Eoreign Office, it will be better for the purposes of this article to describe the Uganda Protectorate as it lay under the definition of boundaries recognized in 1901, the more so as there is a chance of these boundaries coming once more into force.

In 1900 the Uganda Protectorate was divided into six provinces — Eastern, Rudolf, Central, kingdom of Uganda, Western, and Nile — and these again into a Adminis- number of administrative districts. The king- dom of Uganda, which alone has a thoroughly efficient and recognized native government, was divided into no less than nineteen " counties " or districts, but the other provinces have as a rule only three or four subdivisions.

This extensive protectorate grew by degrees from out of the native kingdom of Uganda, a powerful and once populous state on the northern and western trau'on*' snores °f Victoria Nyanza. Uganda proper and still continues to be the kernel, the head-

govern- quarters of British dominion over the Nile sources. Whether it will remain so depends on the line followed by the British Government in its organi- zation and government of the East African territories. It has been proposed to place all these territories — Zanzi- bar, East Africa, Uganda, Somaliland — under one general control, which should have its headquarters in the healthy Eastern province of the Uganda Protectorate.

At the present time the Uganda territories are governed by a commissioner and consul-general (under the Eoreign Office) residing at Entebbe, on the north-western coast of Victoria Nyanza. He is assisted by a staff of officials differing little if at all from the functionaries of a Crown colony, and he himself is the equivalent of the governor of a Crown colony, though for some mysterious reason the British Eoreign Office prefers to regard him as a member of the consular service. The natives are ordinarily under the direct rule of their own' recognized chiefs, but in all the organized districts the commissioner alone has the power of life or death, of levying taxes, of carrying on war, of controlling waste lands and forests, and of administering justice to non-natives. In the case of Uganda proper special terms were accorded to the native king and people in the settlement dated 10th March 1900. The king was secured a minimum civil list of £1500 a year out of the native revenues ; pensions were accorded to other members of the Uganda royal family ; the salaries of ministers and governing chiefs were guaranteed ; compensation in money was paid for Temoving the king's' control over waste lands ; defi- nite estates were allotted to the king, royal family, nobility, and native landowners ; the native parlia- ment or , " Lukiko " was reorganized and its powers ■were defined; and many other points in dispute were settled. The king was accorded the title of "His

Popu- lation.

Highness the Kabaka of Uganda," and his special salute was fixed at eleven guns. By this agreement the king and his people pledged themselves to pay hut and gun taxes to the administration of the protectorate. Somewhat similar arrangements on a lesser scale were made with the king of Ankole, the kings of Toro and Unyoro, and with the much less important chieftains or tribes of other districts. The expenditure for

1902-03 was fixed at about £210,000, of Bxpendi- which about £170,000 is furnished by an S£™/ Imperial grant-in-aid and the balance from local revenue.

Trade is mainly conducted by native (i.e., Arab, Somali, and Negro) traders, by British Indians, and by Germans. The value of the trade during 1901-02 was approximately £500,000 in imports (two-thirds Trade. from Great Britain, India, or British colonies) and £50,000 in exports. The articles exported were ivory, indiarubber, skins and hides, and live stock (for con- sumption in East Africa).

The protectorate is inhabited at the present time by about 3,900,000 negroes and negroids (natives), 700 British Indians (including 400 Indian sol- diers), 100 Arabs, the same number of Somalis, and 300 Europeans (British, French, Germans, Italians, and Maltese).

The Uganda Protectorate, lying in Eastern Equatorial Africa, with a singularly diversified surface of lofty plateaux, snow-capped mountains, vast swamps, dense forests, and regions of desolate aridity Physical (valley of Lake Rudolf), offers a remarkable f/toate! V variety of climates — samples, as it were, of all the climates in the habitable world. Eastern pro- vince (Naivasha, Mau, Nandi, Baringo, and Suk) has, except on the extreme north and south, a mainly tem- perate climate, singularly agreeable and healthy, with a rainfall of from 20 to 60 inches per annum. Eastern province is hot and arid only in the country north of Lake Baringo and south of Lake Naivasha. Rudolf pro- vince lies low — an average altitude of not more than 2000 feet — is extremely hot, and has a very poor rainfall. In some of its districts no rain may fall for two years at a time, elsewhere scarcely as much as 10 inches per annum. Central province is abundantly well watered near Victoria Nyanza and around Mount Elgon and the Suk Hills (about 20 to 100 inches annually) ; elsewhere the rainfall lessens to about 20 inches. Busoga and the western part of the Elgon districts in this province have a regular West African climate — hot, moist, and not over- healthy. These are the conditions of Uganda proper, a country with an annual rainfall of from 40 to 60 inches, a regular West African climate, and severe and frequent thunderstorms. Much the same may be said about Western province, except for the

delicious cooling influence of the Ruwenzori snow range, which pleasantly affects Toro and northern Ankole. The rainfall on Ruwenzori and the central Semliki valley is quite 100 inches per annum. Along the Ruwenzori range are glaciers and snowfields nearly 30 miles in continuous length rand some 5 miles in breadth. Nile province is perhaps the hottest part of Uganda. Like the districts round Rudolf, the average altitude (near the Nile) is not more than 2000 feet, but the rainfall is far more abun- dant than in the terrible Rudolf region, being an average of 30 inches per annum.

The surface of the protectorate is very diversified. There is the celebrated Rift valley running nearly north and south through Eastern province. This is a broad (per- haps 30 miles in width) trough lying between mighty cliffs, the tilted edges of elevated plateaux. There is a great deal of volcanic activity about the Rift valley —

an active volcano near the Sugota swamps, cracks in many places through which steam pours, innumerable extinct craters and beds of lava. In the Rift ktteTJrt YalleJ> between Rudolf and the German frontier, rivers. ‘ are the fresh and salt lakes of Sugota, Baringo, Hannington, Nakuro, Naivasha, and smaller lakelets tedious to enumerate. West of the Rift valley lies that magnificent Nandi-Mau plateau, which stretches from the German frontier in the south to Mount Elgon and the Suk hills on the north. Here there are altitudes between 6000 and 10,000 feet, the general height above sea-level being 8000 feet. West of the Mau and Nandi heights the land slopes gently (with here and there an isolated mountain) to the general level of the shores of Victoria Nyanza and the Uganda Protectorate — 4000 feet. Mount Elgon, in Central province, is one of the leading physical features of the Uganda Protectorate. It consists of the vast crater — some 10 miles in diameter — of an extinct volcano, the rim of which rises in several places to over 14,000 feet. Terraces and buttresses extend and ramify in all directions from the central crater, so that the giant volcano and its surrounding heights form a mountain country (notable for its in- numerable cascades and dense forests) the size

of Montenegro. The mass of Elgon can be seen from the north-east coast of Victoria Nyanza, from near the main Nile stream, from the heights overlooking Lake Rudolf and from the Kikuyu escarpment. The remainder of Central province consists of well-forested, undulating land (Busoga) on the coast of the lake, a vast extent of marsh round the lake, like back- waters of the Victoria Nile (Lakes Kioga, Kwania, &c), and a more stony, open, grain-growing country (Bukedi, Lobor, Karamojo). The Turkana country west of Lake Rudolf has been of late years terribly arid. A little vegetation is met with in the stream valleys, but most of the rivers marked on the map have ceased to show running water in their lower courses. A good deal of high land — rising in some peaks to near 10,000 feet — is found in the eastern part of Nile province, and these heights attract moisture and nourish permanent streams flowing Nilewards. But much of the lower ground is stony and poor in vegetation, while the lowland near the main Nile is exceedingly marshy. The ultimate source of the Nile is usually held to be the springs of the river Kagera (rising near the north end of Lake Tanganyika, in German territory). The Kagera is the most important stream flowing into Victoria Nyanza (midway down its western coast). Something like a distinct current (checked sometimes by northerly winds) sets across the lake from the mouth of the Kagera to Ripon falls. Ripon falls, in the centre of the northern coast, at the head of the exquisitely beautiful Napoleon Gulf, mark the exit of the fully-born Nile from Victoria Nyanza. The Victoria Nile tumbles over 50 miles of cascades and rapids (descending some 700 feet in that distance) between Ripon falls and Kakoge. Here it broadens into Lake Kioga (in reality a vast backwater of the Nile), and continues navigable (save for sudd obstacles at times) right through Lake Kioga and thence northwards for 100 miles to Foweira and Karuma falls. Between Karuma and Murchison falls the Victoria Nile is un- navigable. At Fajao the navigation can be resumed into Lake Albert.

The Albertine Nile is a very important contribution to the main stream. It may be said to rise far to the south in the Ruchuru river (near Lake Kivu) and flows northwards through Lake Albert Edward and the Semliki into Albert Nyanza, joining the Victoria Nile at the north end of that lake. The main Nile stream

The Nile sources.

when it quits Lake Albert continues navigable as far north as Nimule (3° 40′ N.). Between Nimule and Port Berkeley the river flows through a deep gorge and falls nearly 1000 feet. Navigability really only begins again at Gondokoro on the Sudan frontier, from which point steamers now ply to Khartum. North of Gondo- koro the formidable obstacle of the sudd — a dense growth of papyrus and other water vegetation — com- pletely blocked Nile navigation as far north as Pashoda for many years together, from the time of the ancient Egyptians to our own, occasionally disappearing under the stress of exceptional floods. The sudd was cut through successfully by Anglo-Egyptian expeditions under the leadership of Major Malcolm Peake and others in

1900-01.

The geography of Western province includes many interesting features, the in many ways peculiar Albert Nyanza, the great snowy range of Ruwenzori, the dense Semliki, Budonga, Mpanga, and Bunyaraguru forests, the salt lakes and salt springs of Unyoro and western Toro, the innumerable and singularly beautiful crater lakes of Toro and Ankole, the vol- canic region of Mfumbiro (where active and extinct volcanoes rise in great cones to altitudes of 13,000 and 10,000 feet), and the healthy plateaux of Ankole, which are in a lesser degree analogous in climate and position, and the Nandi plateau on the east of Victoria Nyanza. Ruwenzori is a snowy range, and not a single mountain. Its greatest altitude — Stanley's " Saddle " mountain — is possibly above 20,000 feet, and therefore the highest point on the African continent. Uganda Protectorate is a land of great lakes, and includes, or partially includes, the water areas of Victoria Nyanza (about 27,000 square miles), Lake Rudolf (about 3500 square miles), Lake Kioga- Kwania (800 square miles), Albert Nyanza (2700 square miles), and Lakes Albert Edward and Dweru (1500 square miles), besides the smaller lakes of the Rift valley, Lake Ndo in the Elgeyo valley, Lakes Salisbury and Kirkpatrick in Central province, Waniala in Uganda, and Kachera in Ankole. The water of Lake Victoria is perfectly fresh. This is the case with all the other lakes

except Rudolf, Sugota, Baringo, Nakuro, Albert Nyanza, and Albert Edward, in which the water ranges from salt to slightly brackish.

The rocks in Eastern province are mainly volcanic (basalt, tuff, lava, kenyte). West of the volcanic region, nearer to Lake Victoria and Central pro- vince, ironstone, granite, gneiss, and schistose Pedology formations predominate, with phonolite in mineraiogy. places, and a small but valuable deposite of limestone in the Nyando valley. Opals have been found near Lake Nakuro, and there are indications of precious stones in the Kamasia hills. Iron ore (haematite) is abundant. In Central province the rocks are mainly quartz, gneiss, and granite, with sandstone in Busoga, basalt round Mount Elgon, slate (Busoga) and ironstone (Busoga and Bukedi). In Rudolf province there are the basalt, lava, tuff, and kenyte of the volcanic Rift valley, overlying a formation of granite, gneiss, and quartz. Gold — in some cases alluvial — is found in the mountainous country to the north-west of Lake Rudolf. Gneiss, granite, and quartz — the decomposed granite giving the red " African " clay — are the leading features in the formations of Nile province, of Uganda proper, and of Western province, with some sandstone in the littoral districts of Uganda and in Ankole, and eruptive rocks and lava in south-western Ankole and on the eastern flanks of Ruwenzori. There are indications of copper in Busoga, of gold in Unyoro. Iron is found nearly

everywhere. Graphite is present in Uganda and Unyoro.

The vegetation of this protectorate is luxuriant except in the Rudolf region, which has the sparse flora of Flora Somaliland. In Western province, Busoga, and

the Elgon district the flora is very West African in character. The swampy regions of the Nile and of Central province are characterized by an extravagant growth of papyrus and other rushes, of reeds and coarse grass. There are luxuriant tropical forests in the coast region of Uganda, in Busoga, West Elgon, West Nandi, western Unyoro, eastern Toro, the

central Semliki valley, and north-west Ankole. The Nandi plateau, the upper regions of Mount Elgon, Mount Debasien, and Mount Agoro are clothed with forests of conifers — jumper and yew — and witch-hazels (TricJio- clctdus). There are also giant yew-trees on the flanks of Ruwenzori and the Mfumbiro volcanoes between 7000 and 9000 feet, but no junipers. The alpine vegetation on all these lofty mountains is of a mixed Cape and Abyssinian character — witch-hazels, senecios, lobelias, kniphofias, everlasting flowers, tree heaths, and hyperi- cums. The really tropical vegetation of Uganda is nearly identical with that of West Africa, but there is no oil-palm.

The fauna also has many West African affinities in the hot, forested regions. In Eastern province, even, there is one West African mammal, the broad-horned tragelaph. As a rule, however, the fauna of the Upper Semliki valley, of parts of Ankole, Uganda and Unyoro, of Nile, Rudolf, and Eastern provinces, is of that " East African " " Ethiopic " character, which is specially the feature of South and East Africa and of the Sudan right across from Abyssinia to the river Senegal. Among notable mammals the chimpanzee is found in Unyoro, Toro, and n orth-west Ankole, and has only recently become extinct in Uganda; the newly-discovered okapi inhabits the Semliki forests on the Congo frontier ; the giraffe (the male developing five horn cores) is common in Nile, Central, Rudolf, and Eastern provinces ; there are three types of buffalo — the Cape, the Congo, and the Abyssinian ; two species of zebra (one of them Grevy's), the African wild ass, the square-lipped (" white ") and pointed-lipped (" black ") rhinoceroses, the elephant, hip- popotamus, the water tragelaph (" Speke's antelope "), the Cape ant-bear, the aard-wolf (Proteles), hunting-dog, and nearly every genus and most of the species of African antelopes. The birds are more West African than the mammals, and include the grey parrot, all the genera of the splendidly-coloured touracoes, the unique "whale-headed" stork, and the ostrich.

The human races indigenous to the protectorate are

mainly of the Negro species (with slight Caucasian inter-

mixture), and may be divided into the following

no ogy. ca^eg0rjes . —

I. Pigmy-prognatlious (so called "Congo" pigmies of Semliki forest, of Kiagwe in Uganda, and of the western flanks of Mount Elgon).

II. Pigmy, of the Hottentot-Bushman type (lingering in a much modified form in the Suk and Turkana countries and among the nomad Andorobo of Eastern province).

III. Bantu negroes (Banyoro, Baitu, Basese, Basoga, Bakonjo, Baganda, Kavirondo, and Karamojo).

IV. Nile negroes (Aluru, Bari, Madi, Acholi, Lango, Kedi, and South Kavirondo).

V. Masai (Masai, Gwas Ngishu, Burkeneji, Nandi, Suk, Turkana, Elgumi, &c).

VI. Harnitic (some tribes on islands and the north coast of Lake Rudolf ; and the remarkable " Hima " or " Hurna" aristocracy in Unyoro, Uganda, Toro, and Ankole).

The pigmies of the first class are generally known as Bambute or Batwa in the Semliki forests. They are both reddish-yellow and brownish-black (according to individual variation) in skin colour, with head hair often tending to russet, and body hair of two kinds — black and bristly on the upper lip, chin, chest, axillae and pubes ; and yellowish and fleecy on the cheeks, back, and limbs. Their faces are remarkable for the long upper lip and the depressed broad nose with enormous alee. Associated with these pigmies is an apish type (Lendu, Lega, Baamba, Banande) of normal human stature, but short- legged, and unusually prognathous. The Andorobo and some of the people in the Suk mountains are of very mixed type, but tend towards dwarfishness of stature, and occasionally produce individuals strongly resembling the South African Bushmen.

The Bantu negroes probably represent the future ruling race of the protectorate, and include the remarkable Baganda people. These last, prior to the arrival of Arabs and Europeans, displayed a nearer approach

~~to civilization than has as yet been attained by an unaided Negro people. Their dynasty of monarch s can be traced back with tolerable certainty to a period coincident with the reign of Henry IV. of England. The first Uganda king was probably a Hamite of the Hima stock (from Unyoro). Until recent years the Baganda and most of the other Bantu peoples of the protectorate wor- shipped ancestral and nature spirits who had become elevated to the rank of gods and goddesses. The Baganda are now mainly Christian. There is also a "totem" system still in vogue. All the Baganda be- long to one or other of twenty-nine clans or " Bik^," which are named after and have as totem familiar beasts, birds, fish, or vegetables. The Baganda are not a very moral people, but they have an extreme regard for decency, and are always scrupulously clothed (formerly in bark-cloth, now in calico). As a general rule, it may be said that all the Bantu tribes in the western half of the protectorate, including the Basoga, are careful to consider decency in their clothing, while the Kavirondo and Ksframojo are often completely nude in both sexes.~~

~~More or less, absolute nudity is characteristic of the Nile negroes, of the Masai and Andorobo, and even of the Bahima (Hamites). Such clothing as there may be is either worn by married women or (for warmth) by elderly men.~~

~~The Nile negroes, Masai, and Hamites are tall people. The Nile negroes are seldom handsome, owing to their flat faces and projecting cheek-bones. 'The Masai are nearly always comely, but the Bahima are often markedly handsome even to European eyes. In the Bahima the proportion of Caucasian blood is about \ ; in the Masai \ to ^ ; and in the Nile negroes and Bantu from ^ to none at all. The aboriginal stock of the Uganda Protec torate is undoubtedly the pigmy-prognathous, which has gradually been absorbed, overlaid, or exterminated by better developed specimens of the Negro species, or by Negro-Caucasian hybrids from the north and north-east.~~

~~The languages spoken in the Uganda Protectorate belong to the following stocks : — I. Harnitic (Murle and Rendile of Lake Rudolf) ; II. Masai (Bari, Masai, Elgumi, Turkana, Silk, &c.) ; Ha. Nandi; III. Nilotic . (Acholi, Aluru, Jaluo, &c.) ; IV. Madi (spoken on the Nile between Aluru~~

~~and Bari, really of West African affinities) ; V. Bantu (Lu-Ganda, Runyoro, Lu-Konjo, languages of West Elgon and Kavirondo, &c.) ; and lastly, the unclassified Lendu and Mbuba spoken by the pigmy-prognathous peoples.~~

~~History. — The countries grouped under this protectorate were invaded at some relatively remote period — say, four~~

~~or five thousand years ago — by Hamitic races from the north-east (akin to the ancestors of the ancient Egyptians, Gallas, Somalis), who mingled extensively with the Nile negroes first, and then the aboriginal inhabitants of Uganda, Unyoro, and Nandi. These Hamites brought with them a considerable measure of Egyptian civiliza- tion. There was probably no direct intercourse with Egypt by way of the Nile, but an overland trade with Somaliland (the Land of Punt) vid Mount Elgon and the Rudolf regions. In course of time even this intercourse with the non-Negro world died away, and powerful king- doms with an aristocracy of Galla descent grew up in Uganda, Unyoro, and Ankole. The kingdom of Uganda especially dominated the lands of Victoria Nyanza'in the 19th century.~~

~~In the 'forties and 'fifties of that century Egyptian officials, Austrian missionaries, and British, Dutch, Italian, and German explorers had carried our knowledge of the Nile beyond Khartum as far south as Gondokoro. In the same period of time the Zanzibar Arab traders were advancing on the Bahima kingdom of the western Victoria Nyanza and on Uganda from the south. King Suna of Uganda (great-grandfather of the present king) first heard of the outer world of white men in 1850 from a runaway Baluch soldier of Zanzibar. Captains Burton and Speke, on their Tanganyika expedition, heard of Uganda from the Arab traders in 1857. Captain Speke in 1862 reached Uganda, first of all Europeans to enter that country. In the late 'sixties Sir Samuel Baker (who had discovered Albert Nyanza) extended the rule of the Egyptian Sudan (of which he was governor-general) as far south as the Victoria Nile. General Gordon, who succeeded Baker, and who had Dr Emin Bey (afterwards Emin Pasha) as~~

~~lieutenant, attempted not only to annex Unyoro but also Uganda to the Egyptian dominions, and thoroughly established Egyptian control on Albert Nyanza. But owing to the indirect influence of the British Government, exercised through Sir John Kirk of Zanzibar, the Egyptian garrison south of the Victoria Nile were withdrawn.~~

~~Suna, the powerful king or emperor of Uganda, who was the first to hear of a world beyond Negroland, had been succeeded in 1857 by his still more celebrated son, Mutesa (Mutesa means "the measurer"). Mutesa had received Speke and Grant in a most friendly manner. Subsequent to their departure he had opened up rela- tions with the British agent at Zanzibar. In 1875 he received an epoch-making visit from the greatest of African explorers — Sir H. M. Stanley. Stanley, in response to Mutesa's questions about religion, obtained from that king an invitation to Anglican missionaries, which he transmitted to London through the Daily Tele- graph. Having made the first survey of Victoria Nyanza and confirmed Speke's guesses as to its shape and area, Stanley passed on (half discovering Euwenzori on the way) to the Congo.~~

~~Meanwhile the Zanzibar Arabs had reached Uganda in ever-increasing numbers as traders ; but many of them were earnest propagandists of Islam, and strove hard (with some success) to convert to that religion the king and chiefs of Uganda and adjoining countries.~~

~~In 1877 the Rev. C. T. Wilson, one of a party of missionaries sent in answer to Stanley's appeal, though not on the lines suggested~~

~~by him, arrived in Uganda, and towai-ds the end of Christian lg78 wag joined by Maokay. In 1879 another party TsT7-°879. arrived by the Nile route ; and "Wilson, after thirteen~~

~~months' actual residence, left for England with Felkin, who had arrived only three months before, taking with him envoys from Mutesa. In the same year the French Roman Catholic mission of the White Fathers of Algeria was inaugurated, and thus from~~

~~1879 dates the triangular rivalry of the creeds of Protestantism, Roman Catholicism, and Islam.~~

~~*In 1882 Islam gained an ascendancy, and the French withdrew for a time. In the autumn of 1884 Mutesa died. A great change had been wrought in Uganda during the latter years of his reign. Linen, firearms, and jewelled swords had*~~

~~*Mutesa succeeded*~~

~~*replaced the primitive bark-cloth and spear, while b under the teaching of the engineer Mackay the native Mwanga artisans had learnt to repair arms and use European 1884. tools. Mutesa was a clever man of restless energy, but regardless of human life and suffering, and consumed by vanity. He was succeeded by Mwanga, a cruel, vain, and weak youth. Encouraged by the intrigues of the Arabs, his suspicions and fears of the missionaries, and their influence over the growing numbers of their adherents, led him to attempt to stamp out the new creed.*~~

~~*In the early 'eighties the thoughts and aspirations of several European Powers turned towards Eastern Africa as a field for com- mercial and colonial expansion. The restless Arabs of Zanzibar had since 1857 steadily advanced Zanzibar influence to Tangan- yika, Nyasa, and even through the Masai countries to the north- east coast of Victoria Nyanza and the " back door " of Uganda. In 1882 the Royal Geographical Society despatched the great ex- plorer Joseph Thomson to discover through Masailand the direct route to Victoria Nyanza. Thomson succeeded (he also discovered Lake Baringo and Mount Elgon) , but turned back from the frontier of Busoga in order not to provoke the suspicious Mutesa to hos- tilities. Mr H. H. Johnston was despatched on a scientific mission to Kilimanjaro, and concluded treaties on which the British East Africa Company was subsequently based. The vague stir of these movements had perturbed Mutesa, and they were regarded with deep suspicion by his successor, Mwanga.*~~

~~*The annexations of Emin on Albert Nyanza, the visit of Thomson to the closed door of Busoga, the opposition of the Europeans to the slave trade, and, lastly, the identification of the missionaries with political embassies and their letters of Introduction from secular authorities, added to Mwanga's fears, and early in 1885, simul- taneously with the return of the French Fathers, the long smoulder- ing hostility broke out, and the*~~

Christian converts were seized and burnt at the stake. Bishop Hannington, who at- .

tempted to enter Uganda by the forbidden route from sfsbm ° the east, was murdered, and Ashe and Mackay only Hanninst- redeemed their lives by presents. The Waganda ton§ l8gS- Christians showed great heroism, and in spite of tor- tures and death the religion spread rapidly. Mwanga now deter- mined to rid himself of Christians and Mahommedans alike by inducing them to proceed to an island in the lake, where he meant to leave them to starve. The plot was discovered, and Mwanga fled to the south of the lake, and Kiwewa, his brother, was made king. The chiefs of the rival creeds — English, French, and Ba-Islamu, as they were called — divided the chiefships. The Mahommedans now formed a plot to oust the Christians, and treacherously massacred a number of their chiefs, and then defeated their unprepared adherents. Kiwewa, £3°"* refusing to submit to circumcision, was (after reigning three or four months) defeated, and expelled by the Ba-Islamu, who placed another brother, Kalema, on the throne, and began a fanatical propaganda, forcing the peasantry to submit to the hated circumcision. The British and French factions, who had taken refuge in Ankole, could not agree even in their common exile, and nearly came to blows, but on the spur of threatened famine they agreed to combine and to take back Mwanga as their king and strike a blow for supremacy in Uganda. Mackay opposed the return of Mwanga, but the priests supported it. In May 1889 Mwanga, aided by the trader Stokes, approached Uganda by water, and after several bloody battles captured the capital, but shortly after- wards was again defeated, and Kalema and the Ba-Islamu reoccupied Mengo. Appeals for help were sent to Mr Jackson, who had arrived on the east of the lake with a caravan of some 500 rifles, sent by the newly-formed East African Chartered Company. He replied saying he would come if all expenses were guaranteed and the British flag accepted. PereLourdel, who was Mwanga's chief adviser at this time, counseled acceptance of these terms, but Jackson only sent a flag and marched northwards. Returning three months later, he found that Dr Peters, a German in command of a filibustering expedition, had passed through his camp, read his letters, and, acting on the informa- tion thus obtained, had marched to Uganda, arriving in February 1890, where with the aid of Lourdel he concluded a treaty which was kept secret from the British party, French who repudiated it. The Baganda Christians before the jL"/.* arrival of Peters had again engaged the Mahomme- tactions. dans and driven them to the frontiers of Unyoro, where Kabarega gave them an asylum and aid. The posts of hon- our had been divided between the rival factions. Peters' Treaty had given

fresh offence and added to the disputes arising in the division of the offices of state, and the factions were on the point of fighting. Jackson arrived in April with 180 guns (the remainder

of his undisciplined rabble having mutinied), and presented a new treaty, which was refused by the French. Feeling Tan high, and Jackson withdrew his treaty, and, taking a couple of envoys w'ho should bring back word whether Uganda was to be French or British, he left the country, Mr Gedge remaining with a score or so of mutinous porters.

While these events were happening in Uganda, the Anglo- German treaty of July 1890 had assigned Uganda to Great Britain, L card's antl in Ootober 1890 Captain Lugard, then at Kikuyu, arrival half-way between the coast and the lake, received in-

1890. ' structions to go to Uganda. He had with him Messrs De Winton and Grant, some 60 Sudanese soldiers, and about 250 porters, armed for self-defence with cheap Snider carbines. Marching with hitherto unprecedented rapidity, he entered Mengo on 18th December. Lugard, by introducing the names "Protestant" and "Catholic" — till then unknown — and by insisting that all religion was free, endeavoured to dissociate it from politics, and urged that as Uganda was now under Great Britain, there could be no hostile ' ' French ' ' faction. This attitude was welcome to neither. The French party were unwilling to acknowledge British suzerainty, even though religion were quite free, for the divergence between the factions was more political than religious, while the British faction were disappointed that Lugard would not help them to crush their rivals. For some days the position of the new arrivals on the little knoll of Kampala was very precarious, and an attack in force was nightly ex- pected. Lugard's first object was to obtain a treaty which would give him a right to intervene in the internal affairs of the country. The hostile French faction was much the stronger, since at this time the king (whom the whole of the pagan party followed) was of that faction ; but after some critical episodes the treaty was signed on 26th December. Lugard then

endeavoured to settle some of the burning disputes between the two factions relative to the division of lands and chief ships, &c, and to gain the confidence of both parties. In this he was to some ex- tent successful, and his position was greatly strengthened by the arrival in January 1891 of Captain Williams, R.A., with a small force of Sudanese and a Maxim. The position, however, remained extremely critical, and the difficulties were increased by the atti- tude of the missionaries of both factions. In April Lugard, hoping to achieve better results away from the capital, led the combined factions against the Mahommedans, then raiding the frontier, whom he defeated. Seeing that the situation in Uganda was im- possible unless they had a strong central force, which the Company could not provide, Lugard and Williams had formed the idea of en- listing the Sudanese who had been abandoned by Emin and Stan- ley at the south of the Albert Lake. Taking with him Kasagama, the rightful king of Toro, he traversed the north of Ankole, with which country he made a treaty, and passing thence through southern Unyoro, along the northern slopes of Ruwenzori, reached Kavalli at the south end of Lake Albert, defeating the armies of Unyoro who opposed his progress. He brought away with him 8000 Sudanese men, women, children, and slaves. Some of these he left at the posts he established along southern Unyoro. After an absence of six months from Uganda Lugard reached the capital at the end of the year (1891) with 200 or 300 Sudanese soldiers and two or three times that number of followers. Meanwhile Williams, amid end- less difficulties, with a mere handful of men had managed to keep the two factions from civil war, though fighting had actually occurred in Buddu and in the islands, which Ashe asserts to have been in pursuance of a plan to bring on war before the return of Lugard and the simultaneous arrival of a large caravan from the coast. This plan miscarried, owing to the bravery of the Protestants and the indefatigable efforts of Williams.

After Lugard's return a lull occurred till the coast caravan left, when lawlessness again broke out and several murders were com- mitted. On 22nd January the killing of a Protestant Civil war, at tne capital (Mengo) produced a crisis. Lugard ,891' appealed to the king to do justice, but he himself was

~~*treated with scant courtesy, and his envoy was told that the French party would sack Kampala if Lugard interfered on behalf of the murdered man. Both sides rushed to arms, and in spite of strenuous efforts on the part of the British administrator to avert war (which at one time appeared to have succeeded), the French party, confident of victory, determined to fight, and committed fresh outrages, and finally attacked the British who had assembled round Kampala. Williams led a charge and had a narrow escape, but the king and French party were defeated and fled to the islands. The king and chiefs (except two ringleaders) were offered rein-statement, and they appeared anxious to accept these terms, but the French bishop joined them in the islands, and from that day all hopes of peace vanished. Fighting was recommenced by a "French" attack on " English " canoes, and Williams thereupon attacked the island and routed the hostile faction. After this the " French " slowly concentrated in Buddu in the south, the Pro- testants migrating thence. In this exodus the Buddu missionaries*~~

~~*and a Sudanese garrison, as well as Mr Bagge, who had gone south by water, had narrow escapes, but fortunately all arrived safely. Williams then led a successful expedition against the Sese islanders, and went on to the south of the lake to obtain one of the young princes— heirs to the throne— who were at the French mission there. But the Fathers were hostile, and though Mwanga was eager to accept Lugard's offers of reinstatement, he was a prisoner in the hands of his party. He succeeded eventually in escaping, and arrived in Mengo 30th March (1892). Anew treaty was made, and the British flag flew over the capital, while the French party were given a proportion of chiefships and assigned the province of Buddu. These conditions they themselves said were liberal, nor could they have dared to assume their old positions throughout Uganda.*~~

~~*The Mahommedans had all this time refrained from attacking the capital as had been expected. They now clamoured for recognition, and Lugard went to meet them, and after a somewhat precarious and very difficult interview, he succeeded in bringing back their king Mbogo to Kampala, and in assigning them three minor provinces in Uganda. >*~~

Lugard on his return to Uganda at the end of 1891 had received orders to evacuate with his whole force, as the Company could no longer maintain their position in the country. A re- prieve till the end of 1892 followed, funds having been Tne raised by the Church Missionary Society and friends, luestlon ot The lives of many Europeans were at stake, for anarchy ^^"/*o? must follow the withdrawal, and it seemed, impossible ' to repudiate the pledges to Toro, or to abandon the Baganda who had fought for the British. In June 1892, therefore, Lugard deter- mined to leave for England to explain the position of affairs and appeal against the decision for abandonment. Williams remained in Uganda, where the outlook was now fairly promising, and every effort was made to reduce expenses. On arrival in England Lugard found that the British Government had decided not to come to the help of the Company, and Uganda was to be left to its fate. A strong movement was set on foot for the "retention of Uganda," and on 10th December Lord Rosebery despatched Sir G. Portal to report on the best means of dealing with the mission country, and a subsidy was given to the Company to enable them to retain their troops there till 31st March 1893. Cap- tain Macdonald, who had been in charge of a railway survey to Uganda, was directed to inquire into the claims put forward by France for compensation for the priests. His report was set aside by the Government, who, however, in order to close the controversy with France, agreed to pay a sum to the French priests without admitting liability, and the Foreign Office published a categorical reply by Lugard to the accusations made. Portal and his staff reached Uganda in March, and Williams left soon afterwards with the original troops of the Company, leaving Selim's Sudanese ai.d Portal's large escort in Uganda. By his tact, fearless bearing, and freedom from bias he had, as before, during Lugard's absence prevented any fresh disturbances, though the Protestants had quarrelled among themselves. The country on Portal's arrival bore every mark of prosperity and revival. By increasing the territory of the Roman Catholics, and giving them estates on the road from Buddu to the capital, Portal gave effect to projects which the Protestants had violently opposed. He added also to their chiefships, and on 1st April hoisted the British flag, made- a new treaty with Mwanga, and sent Major Owen to enlist 400 Sudanese from the Toro colonies. He recommended to Govern- ment the retention of Uganda, the abandonment of Unyoro and Toro, and the

construction of a railway half-way only to the lake. He departed after two and a half months' residence, leaving Macdonald in charge.

Under Macdonald's regime the Sudanese under Selim Bey began to conspire against the British control. Selim Bey was deported to the coast.

In November 1893 Colonel Colvile arrived to take charge, and at once led the whole of the Baganda army against Kabarega of Unyoro. Captain " Roddy " Owen defeated the hostile army, first in the south and later in the north, and the Uganda

Colvlle's occupation

chiefs scattered the main body, while Colvile occupied 0fUnyoro the capital and built a line of forts from Uganda to Lake Albert, of which he left Major Thruston in command. This officer fought a number of brilliant actions, and aided by Cunningham, Vandeleur, Grant, and others, he overran Unyoro and broke down all resistance. In August 1894 Uganda was declared a protectorate, and at the end of the year Colvile was invalided. Mr Jackson now took temporary charge, pending the arrival in June 1895 of Mr Berkeley, the first Administrator.

At this time also it was decided to construct a railway to Uganda, but work was not actually begun till December 1896. Peace seemed assured in Uganda : territorial limits to religious teaching were abolished, English Catholic priests were added to the French Fathers, and the material progress of the country

1 Since reduced to one.

Rebellion of 1897.

Sudanese mutiny.

was very marked. European traders settled in the country, good permanent houses were built, roads were made and kept in repair, and many new industries introduced, chief among which were the expression of oil from various oil-seeds and the cultivation of coffee. Trees were imported and land set aside for planting forests. The success of these efforts at progress was largely due to Mr G. Wilson, C.B. The grant to the protectorate stood at £49,000, and the staff, both civil and military, had been largely increased.

In the middle of 1897, however, this era of peace was rudely in- terrupted. Colonel Ternan was acting commissioner, and Macdonald had returned to East Africa in command of an explor- ing expedition, for which Ternan had been ordered to supply 300 Sudanese. In June Wilson discovered a plot to revolt, and in July Mwanga fled to the south of Buddu and raised the standard of rebellion. The rebels were defeated by Ternan, and finally dispersed by Grant, while Mwanga was made a prisoner by the Germans. Ternan, apparently ignorant of the disaffection of his men, now sent three companies to Macdonald, selecting those who had been continuously fighting in TJnyoro, Nandi, and Buddu. This caused great discontent, which was in- creased by the fact that their pay was six months in arrears and their clothing long overdue. The men too resented the fact that their pay was but a fifth of that given to Zanzibari coolies and to those of their own body enlisted in the adjoining protectorate. They were sore at again being sent on service without their wives, and complained of harsh treatment from their officers. Necessaries had been delayed in the foolish attempt to import steamers from the coast before the railway was made. At this moment Ternan left for England, and the civil charge devolved upon Wilson, while Thruston became commandant of the troops ; but it was already too late to save the situation. The three companies had joined Macdonald and at once put forward their grievances, which they stated were unheeded ; and it is probable that the steps taken to effect a solution were purposely misrepresented to the men by their native officers. Thereupon they left in- a body to state their case to the acting commissioner at the "Ravine Station." Here they were fired upon by order of Captain Kirkpatrick, one of Macdonald's officers, who had ridden after them, and from that moment the insubordination became mutiny. Disregarding Jackson's efforts to bring them to reason, they

marched towards Uganda, looting as they went. Macdonald and Jackson followed with a force of Zanzibaris. Meanwhile Thruston — a man justly loved by his soldiers, in whom he had complete confidence — hurried to the garrison at Luba's on the Nile, relying on his personal influence to control the men, and risking his life in the heroic attempt. He and two other Europeans were seized and made prisoners. On 19th October a battle was fought between the mutineers and Macdonald's force, in which the former were defeated, while Fielding was killed and two officers wounded. The same night the Sudanese leaders, fearful lest their men might submit, murdered their prisoners, and sent letters to Uganda to incite their comrades to mutiny. Wilson, however, had already disarmed the troops in Kampala, who remained loyal, as also did Mbogo, the ex-king of the Baganda Mahommedans. A large Pro- testant army now went to the assistance of Macdonald, and from 19th October to 9th January the siege of Luba's continued, with con- stant skirmishes, in which the Rev. G. Pilkington and Macdonald, junior, and many Baganda lost their lives. Early in January Mwanga escaped from the Germans, and declaring himself a Mahommedan reached Buddu with a large force, which Macdonald defeated with the aid of the Baganda army. He then disarmed the Sudanese garrisons in Buddu. The garrisons in Unyoro (about 500) and in Toro remained loyal. Meanwhile the Sudanese at Luba's (numbering 600, with 200 Mahommedan Baganda) escaped in a Government dhow which they had seized, the containing force under Woodward being powerless to stop them since Macdonald had taken the steamer to Buddu. The mutineers proceeded up the east bank of the Nile and crossed the river, making their way to Muruli. It appeared probable that if they reached that point the Sudanese garrisons in Unyoro would revolt as well as the Ba- ganda Mahommedans, and the last hope of the Europeans would be lost. Leaving a small column to deal with Mwanga's force in the south, and another with Kabarega, Macdonald joined Wood- ward's force, now reinforced by 100 rifles under Harrison and by 150 Indian troops, as well as by Captain Austin's contingent. Lieutenant Scott was sent ahead to disarm the Unyoro garrisons, which he successfully did. Macdonald came up with the enemy in the swamps of Lake Kioga, and after a couple of successful skirmishes returned to Kampala, leaving Harrison in command. That officer, crossing a swamp supposed to be impassable, attacked the rebel stockade at Kabagambi, and carried it with

great gal- lantry. The brave Maloney was killed and Lieutenant Osborne wounded, but the crisis was past. A large number of Indian troops arrived early in 1899, and in May Colonel Martyr inflicted another heavy defeat on the mutineers at Muruli, while Eowler, Price, and Sitwell broke up the Mahommedans in the south. Mwanga, however, managed to get through and join Kabarega and

the rebels in the north. These were dealt with in a series of victories, but it was not until June 1899 that Colonel Evatt, I.S.C., had the good fortune to capture Mwanga and Kabarega, wno were deported to the coast. Martyr at the close of the year under- took an expedition up the Nile, and extended the limits of the protectorate in that direction. The year had been' a costly one, £329,000 being voted in aid. In the autumn of 1899 Sir Harry Johnston was sent out as Special Commissioner to Uganda, being also given the rank of commander-in-chief. By extensive re-organizations, and in spite of having to cope with a rising in Nandi, his commission resulted in reduction of expenditure and increase of local revenue. He gave the kingdom of Uganda a definite constitution, settled the land question throughout the protectorate, and also the question of native taxation. By agree- ments entered into with the Special Commissioner the natives of all the administered districts now pay hut and gun taxes as their contribution towards the upkeep of the protectorate. The armed forces and police of the protectorate were reorganized by Sir Harry Johnston, Colonel (afterwards General) Evatt, and Colonel A. H. Coles. The marine department (Government steamers on lakes and rivers) was placed under Mr C. W. Fowler, R.N. Mr J. F. Cunning- ham, who was secretary to the Special Commission, was appointed secretary to the Uganda Protectorate. Sir Harry Johnston's special commission terminated in the autumn of 1901, and he was succeeded as commissioner by Colonel Sadler.

In 1902 the Uganda railway, commenced in 1896, was finished. Its terminus is on Kavirondo Bay, Victoria Nyanza. It is some 580 miles long, ascends in places to altitudes of 7000 and 8000 feet (highest point 8300 feet), but has only one tunnel. Its cost was about £5,000,000.

Authorities. — Speke. Discovery of the Sources of the Nile. — Stanley. Through the Dark Continent, and In Darkest Africa. — Wilson and Felkin. Uganda and the Egyptian Sudan. — Ashe. Tvio Kings of Uganda. — Colvile. The Land of the Nile Springs. — Kollmann. The Victorian Nyanza. — Lugard. Our East African Empire. — Scott-Elliott. A Naturalist in Mid Africa. — Thom- son. Through Masailand. — Keltie. Partition of Africa. — Dr Ansorge. Under the African Sun. — Sir Richard Burton. Lake Begions of Central Africa. — Sir Samuel Baker. Albert Nyanza. — Emin Pasha. Journals (1886 edition : Sampson Low). — Count Teleki and Lieut. Hohnel. Lakes Rudolf and Stephanie. — Sir Harry Johnston. The Uganda Protectorate. — Government Blue- books (Africa) between 1885 and 1901. (h. h. J. ; F. D. L.)

Uglich, a district town of Russia, in the govern- ment of Yaroslavl, on the right bank of the Volga, 45 miles south-west of Rybinsk railway station. It was here that Prince Demetrius, son of John the Terrible, was killed in 1591 by order of the Regent Boris Godunoff. The palace of Demetrius, two very old monasteries, and a cathedral dating from the 13th century, are still in existence. It has several steam flour-mills and paper mills, and manufactures of corn sacks and tea urns are common domestic industries. Sausages and hams are exported in large quantities, and there is otherwise an active trade. Population (1897), 12,000.

Uist, North and South, are two islands of the Outer Hebrides, Scotland, lying between Harris and Barra, in the county of Inverness. North Uist is 75,431 acres in extent, and South Uist 70,400 acres. Both are crofting islands, and contain a considerable proportion of good soil. North Uist contains the village of Lochmaddy, which is the centre of a large trade, having a fine natural harbour, and is the seat of a sheriff court-house and of the Long Island combination poorhouse. The parishes of North and South Uist embrace a number of other inhabited and uninhabited islands, of which the princi- pal is Benbecula (in South Uist parish), lying directly between them. Population (1891), 10,008 ; (1901), 9377.

Uitenhage, a town of Cape Colony, 20 miles north- west of Port Elizabeth, with which it is connected by rail. This place, which was originally settled by the Dutch farmers spreading eastwards from Swellendam, has now

become completely English, and is a thriving centre of agricultural industry, with a population which increased from 3500 in 1887 to 5330 in 1891. A large number of the natives find employment in the mills scattered over the district, where vast quantities of wool from

the sheep farms of the eastern provinces are cleansed by machinery and forwarded for shipment at Port Elizabeth. The neighbourhood, which is pleasantly laid out With running waters and shady avenues, attracts many summer visitors and wealthy permanent residents.

Ujain, a city of India, in the native state of Gwalior, on the left bank of the river Sipra and a branch of the Bajputana railway from Batlam, which has been extended to Bhopal (114 miles west) at the coast of Sindhia. It was the capital of Malwa in Hindu and Mahommedan times, being traditionally famous as the residence of Vikramadi- tiya. It is now a centre of the opium trade. In 1897-98 the exports of opium amounted to 3712 chests, paying a duty of Bs.20,58,800. Besides the Madhava College, there is a high school and a dispensary. Population

(1881), 32,932 ; (1891), 34,691.

Ujvidek (German, Neusatz), a municipal town of Hungary, in the county of Baes-Bodrog, on the left bank of the Danube, opposite Petervarad. Among its educational establishments the most important are two upper gymnasia, a commercial academy, an upper girls' school, and the Servian educational society, " Matica Srbska." Its inhabitants carry on a brisk trade in fruit, vegetables, wine, and corn. There is a silk spinning-mill, which employs 500 hands. There are twenty-four credit institutes. Population (1891), 25,180 ;

(1901), 29,296.

Uleaborg (Finnish, Oulu), a government in the grand duchy of Finland, including a wide territory to the north of Kuopio and nearly reaching

~~Varangerfjord, taking in the high dreary plateau of Laponia (16,000 square miles) and the fertile plains of Osterbotten. It has a total area of 63,970 square miles, and its population, chiefly agricultural in Osterbotten and nomadic in Laponia, was, in 1899, 273,290 of whom 136,462 were women, and 22,126 lived in towns. The bulk of the inhabitants (99 per cent.) are Finnish. Immense spaces are covered with forests, and only 0‘4 per cent, of the area is under culture. The capital of the government is Uleabobg, a seaport on the Gulf of Bothnia, now connected by railway with Helsingfors (498 miles). Its population in 1898 was 15,042, and it had a few tanneries, as well as some export trade in pitch, timber, butter (200 tons), leather, and hides. The other towns of the govern- ment are quite insignificant.~~

~~U I m , a fortified town and bishop’s see of Wtirtemberg, Germany, on the Danube, 58 miles by rail south-east of Stuttgart. The tower of the west facade of the cathedral was completed in 1877-90 by Professor August Beyer, according to the original plans of Boblinger, and is with its 528 feet one of the loftiest towers in the world. There are new law courts, a hydropathic, a library, and an agricultural school. Being a river port, at the head of effective navigation on the Danube, Ulm has a brisk trade. Population (1895), 39,304 ; (1900), 42,860.~~

~~Ulverston, a parish and market town of the North Lonsdale parliamentary division of Lancashire, England, on the Furness railway, 22 miles N.W. of Lancaster. It has, through its connexion with Morecambe Bay by a ship canal of 1 mile in length, a’thriving shipping trade in iron and slates. It has manufactures of hardware, boots, and paper. Population (1891), 10,015; (1901),~~

~~10,064.~~

~~Ulwar. See Alwak.~~

~~Umballa, or Ambala, a city and district of British India, in the Delhi division of the Punjab. The city is 3 miles east of the river Ghaggar, 902 feet above the sea. It has a station on the North- Western railway (1077 miles~~

north-west of Calcutta), with a branch line to Kalka at the foot of the hills (39 miles), which is now being con- tinued up to Simla. Population (1881), 67,463 ; (1891), 79,294 ; municipal income (1897-98), Es.49,929 ; death- rate (1897), 28 per 1000. Umballa owes its importance to a large military cantonment for all three arms, which was first established in 1843. The cantonment, which lies 4 miles south-east of the native town, is well laid out, with broad roads shaded by trees. It contains a church, a club-house, several hotels, and English shops ; two high schools ; four printing-presses ; Hindu, Sikh, and Mahommedan literary institutions. A municipal water-supply has been constructed by means of a loan.

The district of Umballa has an area of 2754 square miles. Population (1881), 1,032,744 ; (1891), 1,033,427 ; average density, 375 persons per square mile. In 1901 the population was 816,110, showing a decrease of 21 per cent. The land revenue and rates in 1897-98 were Bs.9,83,402, the incidence of assessment being 14 annas per acre ; cultivated area, 716,060 acres, of which only 83,149 were irrigated, including 2759 from Government canals ; number of police, 867 ; number of schools (1896-1897), 246, attended by 9628 boys, being 10-2 per cent, of the boys of school-going age ; death-rate (1897), 30-3 per 1000. The principal crops are wheat, maize, pulse, millet, rice, cotton, and some sugar-cane. It has one factory for ginning and pressing cotton. Two opposite corners of the district are watered by the Sirhind and the Eastern Jumna canals. A portion is crossed by the main line of the North-Western railway and by the Delhi-Umballa-Kalka railway, which have their junction at Umballa city. The district suffered from drought in 1896-97, the maximum number of persons in receipt of relief being 5279 in March 1897.

Umbria, a territorial division of Italy, situated in the middle of the peninsula, between Tuscany and the Marches on the north and Borne and the Abruzzi on the south, and comprising the one province of Perugia, with an area of 3748 square miles, and population (1881) of 572,060, and (1901), 644,367. The surface is mountainous, but affords good pasture, and there are numerous fertile valleys, yielding wheat, maize, leguminous plants, vines, olives, and fruits. Lignite, colouring earths, pottery clay, and marble are the more important minerals. The industries embrace the manu- facture of silk, jute, and paper, iron-works

~~and engineer- ing shops, the preparation of olive oil, sugar-refining, the breeding of silkworms, and the manufacture of majolica, woollens, and glass. Modern Umbria formed down to 1860 a part of the States of the Church, and since that date has belonged to the kingdom of Italy. The most important towns are Perugia, Foligno, Terni, Spoleto, Orvieto, Bieti, Gubbio, Narni, and Assisi. Perugia is the seat of a free university.~~

~~Umea, a town of Sweden, capital of the county of Vesterbotten, 8 miles from the mouth of the Ume river, and 231 miles north by east of Stockholm by rail, being connected with the trupk line to the north by a branch railway (19 miles) to Vannas. The town has been almost entirely rebuilt since a fire in 1888, its chief buildings being the residence of the provincial governor (1894), a fine church (1894), a handsome town hall (1892), a museum of antiquities, higher' slojd school, seminary for female teachers, seamen's house, and saw-mills. The port — vessels unload and load at Sandvik, near the river mouth — is entered and cleared by . some 200,000 tons annually. Population (1880), 2818 ; (1900), 3883.~~

~~Umrawattee. See Amraoti.~~

~~Umritsar. See Amritsar.~~

~~Una.ia.ska., more correctly Unalashka, the largest of the Fox Islands, of the Aleutian chain, Alaska, U.S.A., and also, colloquially, the name of the principal settle- ment on the island, on the shores of Captain's Bay, in the north-east portion. The name is derived from two Aleut words meaning " next to the continent," referring to the position of the island. There was originally a large population of Aleuts, and numerous village sites can be recognized which have been depopulated for more than a century. The situation of the settlements was deter- mined by the necessity for protection for shipping, as Captain's Bay contains several good harbours.~~

The most accessible is Dutch Harbour, with its village of Udakhta on Amaknak Island. The oldest, settled in 1760-75, is Iliuliuk, which has a custom-house, Greek church, Methodist mission, and orphanage ; it is situated in 53° 53' N. and 166° 32' W. The mean temperature is 38‘3° F., and the annual rainfall about 38 inches. The island is mountainous and treeless, but with luxuriant growth of herbage. The active volcano of Makushin (5691 feet) is visible from Iliuliuk, and the volcanic islets Bogosloff and Grewingk, which rose from the sea in 1796 and 1883 respectively, lie about 30 miles west of the bay. The latter is still active. Unalaska is the principal port of Bering Sea, and enjoys a brisk trade, which has greatly increased since the gold discoveries. Many light-draught steamers have been built here for the Yukon, and it is the port of call for all the northern commerce of these waters. The population of Unalaska is small, comprising about 575 civilized Aleuts and 66 whites. In 1890 the population of the village of Unalaska was 317; in 1900 it was 428.

Unao, a town and district of British India, in the Lucknow division of Oudh. The town is 9 miles north- east of Cawnpore, and has a railway station. Popula- tion (1881), 9509; (1891), 12,931; municipal income (1897-1898), Bs.6928; no octroi is levied; incidence of

taxation, B.O :5 : 7 per head; death-rate (1897), 66‘5 per

thousand.

The district of Unao, north of the Ganges, between Cawnpore and Lucknow, has an area of 1778 square miles. Population (1881), 899,069 ; (1891), 953,636 ; (1901), 975,855. The land revenue and rates are Rs. 13, 93,531, the incidence of assessment per acre being R.l : 6 : 8 on the temporarily settled and R.O : 14 : 5 on the per- manently settled estates ; cultivated area (1896-97), 517,351 acres, of which 202, 074 were irrigated from wells, &c. ; number of police, 993 ; vernacular schools, 109, with 4440 pupils ; registered death- rate (1897), 42‘7 per thousand. The principal crops are barley, pulse, rice, wheat, millet, cotton, sugar-cane, and opium. The district is crossed by the main line of the Oudh and Bohilkhand Eailway. It has no Government canals.

Underground Railways. See Railways.

Ungava. See Labrador and North -West Territories.

Union, a town of Hudson county, New Jersey, U.S.A., just north of West Hoboken, a short distance from the west bank of the Hudson river, in the north- eastern part of the state. It partakes of the character- istics of Hoboken in its large foreign element, which consists chiefly of Germans. Population (1880), 5849 ; (1890), 10,643; (1900), 15,187, of whom 5179 were foreign-born.

Union, a town of South Carolina, U.S.A., capital of Union county, on the line of the Southern Railway, in the northern part of the state. Population (1890), 1609 ; (1900), 5400, of whom 15 were foreign-born and 1701 negroes.

Union Islands. See Polynesia.

Uniotltown, a borough of Pennsylvania, U.S.A., capital of Fayette county, in the south-eastern part of the state, on the Pennsylvania and the Baltimore and Ohio railways, at an altitude of 990 feet. It is in the coking coal and natural gas region, and has glass-works and iron and steel manufactures. Population (1880), 3265 ; (1890), 6359 ; (1900), 7344, of whom 449 were foreign- born and 803 negroes.

UNITED KINGDOM.1

THE United Kingdom of Great Britain and Ireland has an area of 120,677 square miles, and at the date of the census of 1891 had a population of 37,957,133, and in 1901 of 41,454,621. If the islands in Extent and British seas are included, the area is increased ad mims- £Q 120,979 square miles, and the population ‘ to 41,605,220. England and Wales, Scotland, and Ireland are politically united under a Parliament consisting of the King, the House of Lords, and the House of Commons, the preroga- tives of the Crown being exercised through responsible ministers. The House of Lords in January 1902 con- sisted of 590 members, viz., 4 members of the Royal family, 2 archbishops, 22 dukes, 22 marquises, 144 earls, 36 viscounts, 24 bishops, and 336 barons. The

number comprised 16 Scottish peers (9 earls, 1 viscount, Houses of ancj g |3arorla)j representing the Scots peerage ment. " during the continuance of the Parliament, and 28 Irish peers (10 earls, 5 viscounts, and 13 barons), representing the Irish peerage for life. The number of old peerages is steadily decreasing, but the

1 This article includes only what is common to the three Kingdoms. For information as to Justice, Pauperism, Religion, Education, Agri- culture, Railways, &c, see the articles on England and Wales, Scotland, and Ireland ; and for matter relating to the Empire, see British Empire, and the special articles on the Colonies and Protectorates.

House is maintained and increased by the creation of new peerages, while the holders of existing ones are frequently promoted to titles of higher rank. Of the peerages existing in 1902, 2 dukedoms, 3 marquisates, 15 earldoms, 6 viscounties, and 110 baronies had been created since 1877. Among the barons are in- cluded 5 life peers who either were or had been Lords of Appeal in Ordinary. The number of seats; appropriated to the lords spiritual has not been increased with the growth in the number of bishops in England and Wales. Of the 26 seats possessed by these dignitaries,. 2 are always held by the archbishops, and 3 by the bishops; of London, Durham, and Winchester ; the remaining 21 are divided among 29 bishops in order of consecration as vacancies occur. The bishop of Sodor and Man has a seat but no vote. The privilege of voting by proxy, formerly allowed in the House of Lords, was abolished by standing- order of the House in 1868.

The constitution of the House of Commons was modified by the Representation of the People Act, 1884, which conferred a " service " franchise on persons occupy- ing, in virtue of their employment, dwellings not occupied by their employers ; extended to householders and lodgers in counties the suffrages conferred in 1867 on house- holders and lodgers in boroughs ; and also placed the three divisions of the United Kingdom on a footing of equality as regards electoral qualification. Further changes

UNITED KINGDOM

were introduced by the Distribution of Seats Act, 1885, which divided the country anew into county and borough constituencies, and increased the total number of members to 670.

The number of members of the House of Commons representing county, boroiigh, and university constituencies respectively, and the number of registered electors in each class of constituency, according to a Return dated 20th February 1902, were as follows : —

Members. Electors.

England (465) and "Walks (30) — Counties 253

Boroughs Universities

Total .

495

5,464,231

Scotland —

Counties .

39

389,404

Boroughs

31

295,772

Universities

2

20,027

Total .

72

705,203

Ireland —

Counties .

85

597,676

Boroughs

16

119,491

Universities

Total .

2 103

4,492

721,659

Grand total

237 5

3,097,516 2,348,840 17,875

~~670~~

~~6,891,093~~

~~The dates of first meeting and of dissolution, and the duration of recent Parliaments, have been as follows : —~~

~~When met.~~

~~Victffria.~~

~~5th March 1874~~

~~29th April 1880~~

~~12th January 1886~~

~~5th August 1886~~

~~4th August 1892~~

~~12th August 1895~~

~~When dissolved.~~

~~23rd March 1880 18th November 1885 26th June 1886 28th June 1892 8th July 1895 25th September 1900~~

~~Duration.~~

~~Tears. Months. Days.~~

~~6 0 19~~

~~20~~

~~15~~

~~24~~

5

14

5 10 11

1

3rd December 1900 Edward VII. 14th February 1901

The Speaker of the House of Commons is appointed by vote of the House ; he holds office for the duration of the Parliament, but in a new Parliament the Speaker of the former is usually re-elected.

The Executive Government is carried on under the

supervision of ministers of state, the heads of departments,

and other dignitaries, the more important of

men*™" whom are united in tlle Cabinet. This body is unknown to the law, and neither the number of its members nor their offices are definitely fixed. In recent years their number has varied from sixteen to twenty, holders of various offices having been included or excluded at the discretion of the head of the Administration. The first minister of the Crown, or Prime Minister, whose position as such has no official recognition, is appointed by the King, usually on the advice of the retiring Prime Minister, to some dignified office, and he, having made choice of his colleagues, recommends them for appointment. The offices which, either singly or in various combinations, have been held by prime ministers in recent years are those of First Lord of the Treasury, Lord Privy Seal, Lord President of the Council, the Chancellor of the Exchequer, and the Secretary of State for Foreign Affairs.

The First Lord of the Treasury is nominally at the head of the Treasury Board, but takes no part in its work. Under him is the Chancellor of the Exchequer, who is in fact Minister of Finance, representing his department in the House of Commons and providing for the adjustment

~~*of revenue and expenditure. Other Treasury officials with political duties are the Financial Secretary, the Patronage Secretary, called the senior " whip," and three Junior Lords of the Treasury, called assistant " whips." The office of Lord President of the Council is mainly an office of dignity. The Privy Council, of which he is titular president, is a body usually containing about 230 members. They are appointed for life, or for the life of the sovereign, so that at*~~

~~*the accession of a new sovereign the Council must be re- constituted. The duty of the Council is to advise the King on affairs of State, the Lord President being required "to manage the debates in Council, to propose matters from the sovereign at the Council Table, and to report to the sovereign the resolution of the Council thereon." There are, in fact, no debates in Council, but the King by Orders in Council expresses his pleasure with respect to various administrative matters, such as government of colonies, grants of charters, the bringing of treaties into effect, and the regulating of departmental business. The Council has, besides, duties of a judicial or jwasi-judicial nature which it performs by committee or commission. For Ireland there is a separate Privy Council. Within the Cabinet also is the Lord Chancellor, who has both political and judicial duties, is Speaker of the House of Lords by prescription, and Keeper of the Great Seal. The holder of this office must belong to the Church of England and abjure the doctrine of Tran- substantiation. For Ireland there is a different Lord Chancellor, ' who also has a seat in the Cabinet. Other Cabinet ministers are the five Secretaries of State. Foremost among these is the Home Secretary, whose duties have a wide scope. He attends to the administration of criminal justice, police, and prisons, and through him the King exercises his prerogative of mercy. "Within his department is the supervision of lunatic asylums, reformatories, and industrial schools, and it is his duty to see to the health of the community, especially of the classes employed in dangerous occupations. The Secretary for Foreign Affairs is concerned chiefly with the policy of the country with respect to foreign countries. He conducts negotiations with other states, his inter- course being carried on either through the representatives of foreign states in Great Britain, or through representatives of Great i Britain abroad. The Secretary of State for War is responsible for the efficiency of the army. The heads of departments in*~~

the War Office advise him, and require his approval for every change. In Parliament he has to ask annually for the continuance of the standing army and for the money necessary for its maintenance. The Secretary for the Colonies, besides being the official medium of communication with colonial governments, has administrative duties respecting Crown colonies, and on his advice the Crown may veto an act of a colonial legislature. The Secretary of State fbridndia appoints the members of the Council of India, which under his direction conducts the business of the Indian Govern- ment transacted in the United Kingdom, and, sitting in Council, controls the expenditure of the Indian Government. In questions of policy towards foreign Powers or native states, and in matters requiring secrecy, he may proceed on his own authority and is re- sponsible to Parliament alone for his action. [For the functions of all officers of state not described herein, vide art. State, Great Officers of, vol. xxii. p. 458 of 9th edition.]

Within the Cabinet is the First Lord of the Admiralty, who has the general direction and supervision of all naval business. He is advised by four naval lords and a civil lord, each of whom, as the head of a separate department of naval administration, is responsible to him. The presidents of three boards which never meet have also seats in the Cabinet. The Board of Trade is technically a committee of the Privy Council, consisting of certain high dignitaries, but the president, who is assisted by a parlia- mentary secretary, is practically Minister of Commerce. The Board has a wide range of duties relating to trade, labour, shipping, harbours, railways, canals, fisheries, bankruptcy, and the preparation of statistics. The Local Government Board con- sists of the Lord President of the Council, the Secretaries of State, the Lord Privy Seal, the Chancellor of the Exchequer, and a presi- dent, who, as the Board never meets, is in fact the head of his department. The duties of the Board relate to the administration of the poor law, sanitary works, vaccination, adulteration of food, pollution of rivers. It has control over the finance of the various local authorities, and it audits their accounts. For Scotland there is a separate Local Government Board, of which the Secre- tary for Scotland is president, and another for Ireland, under the presidency of the chief secretary to the Lord-Lieutenant. The Board of Agriculture, formed in 1889, consists of the Lord President of the Council, the principal

Secretaries of State, the First Lord of the Treasury, the Chancellor of the Exchequer, the Chancellor of the Duchy of Lancaster, the Secretary for Scotland, and any others whom His Majesty may appoint. The Act which created the Board transferred to it certain powers and duties from the Privy Council and from the Land Commissioners for England. The Board exercises powers under Acts relating to tithe-rent charges, copyhold, enclosure of commons, allotments, and drainage and improvement of land. It is concerned also with diseases of animals, destructive insects, and the muzzling of dogs. It pro- motes agricultural study, and collects and publishes agricultural statistics and information. The Board of Works and Public Buildings consists of a First Commissioner, the Secretaries of State, and the President of the Board of Trade, but it never meets. The First Commissioner is sometimes included in the

Cabinet. The duties of the Board are to see to the palaces and parks and such public buildings as are not assigned to the care of other departments. The Postmaster-General is responsible for the working of the postal and telegraph systems, and for the various financial systems managed by his department. The Lord- Lieutenant of Ireland represents the King and maintains the formalities of government in that island, the business of govern- in e t being entrusted to the department of his Chief Secretary, who represents the Irish Government, in the House of Commons, and may have a seat in the Cabinet. In theory, Ireland is governed through the Home Office, but in fact the details of Irish administration do not pass through that office. The Chief Secretary occupies an important position, and in every Cabinet either the Lord-Lieutenant or he has a seat. The first Secretary for Scotland was appointed in 1885, when the Scottish Office was created. To this department were transferred duties formerly discharged by the English Home Secretary and by the Scottish Lord Advocate. The Secretary for Scotland is not a secretary of State, but has a seat in the Cabinet. With the office of Chancellor of the Duchy of Lancaster there are nominally associated certain judicial and administrative duties, but this office is

~~really a digni- fied sinecure, reserved for statesmen whose presence may be desir- able at the deliberations of the Cabinet. The Education Board, formed in 1900, has supervision of educational matters in England and Wales only. (See England and Walks.)~~

~~The Imperial revenue, which for the financial year 1880-81 amounted to £81,872,354, reached for the year 1898-99 the sum of £108,336,193, showing an increase of about 32 per cent. This increase did not take place with perfect regularity, but the fluctua- tions were within comparatively narrow limits. In 1886- 1887 the revenue amounted to £90,772,758, a sum which was not again reached till 1891-92, when the Exchequer receipts amounted to £90,994,786. The following year there was a fall of about £600,000, but since then the increase has been continuous.~~

~~The following table shows the Imperial revenue and expendi- ture (Exchequer receipts and issues), with the amount of revenue per head of population of the United Kingdom, for various years : —~~

~~Finance.~~

~~Tear~~

~~Revenue per~~

~~ending~~

~~Revenue.~~

~~Expenditure.~~

~~Head of~~

~~31st March.~~

~~Population.~~

~~1881~~

~~£81,872,354~~

~~£80,938,990~~

~~£2 7 1~~

~~1886~~

~~89,581,301~~

~~92,223,844~~

~~2 9 9~~

~~1891~~

~~89,489,112~~

~~87,732,855~~

~~2 6 2~~

~~1896~~

~~101,973,829~~

~~97,764,357~~

~~2 12 2~~

~~1899~~

108,336,193

108,150,236

2 13 11

1900

119,839,905

133,722,407

2 18 7

1901

130,384,684

183,592,264

3 2 10

1902

142,997,999

195,522,213

During the thirteen years 1887-99 there was, as a rule, a large annual surplus, amounting in the aggregate to £21,150,441. The largest surplus was that of 1895-96, amounting to £4,209,472, anT the only year in which there was a deficit was 1893-94, when the revenue receipts of the Exchequer were less than the issues for expenditure by £169,436. In each of the years 1899-1900 to 1901-02, however, owing to military operations in South Africa, there was a deficit.

The following statement shows the net receipts and the Exchequer receipts from the principal sources of revenue during the financial year ending 31st March 1902 : —

~~Sources of Revenue.~~

~~Net Receipts.~~

~~Exchequer Receipts.~~

~~Customs .....~~

~~£31,046,869~~

~~£30,993,000~~

~~Excise ....~~

~~31,597,961~~

~~31,600,000~~

~~Estate duties, &c. . . . .~~

~~14,250,827~~

~~14,200,000~~

~~Stamps (not fee stamps) .~~

~~7,772,423~~

~~7,800,000~~

~~Land tax .~~

~~775,219~~

~~725,000~~

~~House duty . . . . .~~

~~1,726,676~~

~~1,775,000~~

~~Income and property tax~~

~~35,378,700~~

~~34,800,000~~

~~Total tax revenue~~

~~£122,548,675~~

~~£121,893,000~~

~~Post Office~~

~~£14,228,906~~

~~£14,300,000~~

~~Telegraph service .~~

~~3,490,598~~

~~3,490,000~~

~~Crown lands ....~~

~~439,379~~

~~455,000~~

~~Interest on Suez Canal shares, &c.~~

~~869,634~~

~~869,634~~

~~Miscellaneous (fee stamps, Mint, &c.~~

~~2,004,350~~

~~1,990,365~~

~~Total non-tax revenue .~~

~~£21,032,867~~

~~£21,104,999~~

~~Total revenue~~

~~£143,581,542~~

~~£142,997,999~~

~~In the same year the Exchequer issues for expenditure charge- able against revenue to meet all requirements of the various services were as follows : —~~

~~Branches of Expenditure. National Debt services — Interest of funded debt Terminable annuities Interest of unfunded debt . Management of debt . Interest on war debt .~~

~~Total Debt services~~

~~Other Consolidated Fun 1 serv Civil list .~~

~~Annuities and pensions Salaries, &c. Courts of justice Miscellaneous .~~

~~Total Consolidated Fund services~~

~~Payments to local taxation accounts .~~

~~Supply services —~~

~~Army ....~~

~~Navy ....~~

~~*Civil services .*~~

~~*Customs and Inland Revenue*~~

~~*Post Office*~~

~~*Telegraph service*~~

~~*Packet service .*~~

~~*Expenditure Issues.*~~

~~*£15,076,023*~~

~~*2,754,424*~~

~~*314,751*~~

~~*173,617*~~

~~*3,366,716*~~

~~*£21,685,531*~~

~~*£487,746*~~

~~*258,708*~~

~~*78,916*~~

~~*515,428*~~

~~*302,992*~~

~~*£23,329,321*~~

~~*£1,153,892*~~

~~*£92,542,000*~~

~~31,030,000~~

~~30,500,000~~

~~2,955,000~~

~~9,240,000~~

~~4,010,000~~

~~762,000~~

~~£171,039,000~~

~~£195,522,213~~

~~The gradual increase in the amount of revenue (Exchequer receipts) derived from customs, excise, estate, &c., duties (mainly "death duties"), and stamps, is shown in the subjoined table. The death duties (probate, legacy, succession, &c, duties), for- merly included under the head of stamps, became an important source of revenue in 1894-95, when a new estate duty, payable on the property of personsldying after 1st August 1894, was imposed. The revenue from estate, &c, duties given below is exclusive of the large share paid annually to local taxation accounts : —~~

~~Total Supply services Total expenditure~~

~~Tear ending 31st March.~~

~~Customs.~~

~~Excise.~~

~~Estate, &c, Duties.~~

~~Stamps.~~

~~1881~~

~~£~~

~~19,184,000~~

~~£~~

~~25,300,000~~

~~£11,078,481~~

~~1886~~

~~19,827,000~~

~~25,460,000~~

~~11,590,000~~

~~1891~~

~~19,480,000~~

~~24,788,000~~

~~13,460,000~~

~~1896~~

~~20,756,000~~

~~26,800,000~~

~~£11,600,000~~

~~£7,350,000~~

~~1898~~

~~21,798,000~~

~~28,300,000~~

~~11,100,000~~

~~7,650,000~~

~~1899~~

~~20,850,000~~

~~29,200,000~~

~~11,400,000~~

~~7,630,000~~

~~1900~~

~~23,800,000~~

~~32,100,000~~

~~14,020,000~~

~~8,500,000~~

~~1901~~

~~26,262,000~~

~~33,100,000~~

~~12,980,000~~

~~7,825,000~~

~~1902~~

~~30,993.000~~

31,600,000

14,200,000

7,800,000

Customs duties are levied on tobacco, tea, colonial and foreign spirits, wine, currants and dried fruits, coffee, cocoa, chicory, and, since 1901, on sugar. In 1902 a duty was put on imported corn, meal, &c, estimated to yield £2,650,000 annually. The diminution of customs receipts in 1899 was mainly caused by a reduction in the tobacco duties in 1898. These duties in 1881 yielded £8,658,947, and in 1887, £9,367,186. In the latter year, however, the duty was reduced, and the receipts therefrom fell next year to £8,714,000, but then gradually rose till in 1898 they reached the sum of £11,433,909. The reduction of duty made in that year brought down the proceeds in 1899 to £10,994,000. In 1900 the duty was increased, and the proceeds in 1900-01 rose to £12,838,578, but in the following year fell to £10,567,706.

The customs duty (countervailing the excise duty) on spirits yielded £4,581,520 (besides £208,987 due to local taxation accounts) in 1901-02. The revenue from the duty on tea amounted in 1900 to £4,628,946 ; in the following year the duty was increased, and the revenue therefrom rose .to £6,264,515 in 1901, falling again, to £5,792,966, in 1902. The customs duties on sugar, molasses, &c, in 1901-02 yielded £6,399,224. The only export duty levied in the United Kingdom is that on coal, which, from 19th April 1901 to 31st March 1902, yielded the net amount of £1,311, 706.

In recent years important changes have been made in the taxes which fall under the head of excise. In 1880-81 the duties on malt and on sugar used in brewing were abolished, but at tho same time an equivalent beer duty was imposed. In 1890, under the Customs and Inland Revenue Act, additional duties of 3d. per barrel on beer and 6d. per gallon on

Excise.

UNITED KINGDOM

spirits were imposed, the proceeds of these taxes being assigned to local authorities. This step was in accordance with the system begun under the Local Government Act, 1888, by which English licences were transferred to county councils in England, a system which was extended to Scotland in the following year. (See Local Finance below.) In 1894 the duties on beer and spirits were increased ; in 1896 the duty on spirits was reduced. In 1900 both beer and spirit duties were increased. The revenue from the excise duty on spirits in 1881 amounted to £14,393,572 ; for some years it declined, but in 1891 it reached £14,770,730 ; in 1901, £19,206,690 ; and in 1902, £17,647,421. The beer excise duty in 1882 yielded £8,530,819 ; in 1891, £9,390,141 ; in 1901, £13,490,620 ; and in 1902, £13,276,073. The local taxation revenue from excise duty on spirits in 1902 amounted to £843,358, and on beer to £442,364. In 1901MJ2 the customs and excise receipts for Imperial and local revenue from spirits, beer, and wine amounted to the net sum of £38,475,160.

After various changes had been made in the "death duties," these taxes were in 1894 rearranged, and a new estate duty was imposed in substitution of probate and account duty and of the estate duty formerly levied. The new duty is levied on the principal value of all settled property passing on death, at rates which vary from 1 per cent, on property from £100 to £500 in value, to 8 per cent, on estates valued at over £1,000,000. Including the share due to local taxation accounts, the net produce of this tax in 1901-02 amounted to £13,908,490. The legacy duty yielded £3,133,588, and other duties, less productive (including the succession duty amounting to £1,308,136), brought up the total proceeds of the death duties to £18,513,714.

The incidence and rate of the property and income tax have been changed several times in recent years. TJp to 1894 the tax . was chargeable on incomes of and over £150, with

tax"16 abatement of £120 on incomes under £400. From 1895 it was chargeable only on incomes above £160, while abatements were allowed

of £160 on incomes not exceeding £400, of £150 on incomes above £400 but not above £500, of £120 on incomes above £500 and not over £600, and of £70 on incomes above £600 and not exceeding £700. The rate of the tax (which was 3d. per pound in 1878) and the amount of revenue which it has yielded in recent years are given as follows : —

Year ending 31st March. Bate per £1. Amount.

1881 6d. £10,650,000

1886 6d. 15,160,000

1891 6d. 13,250,000

1896 8d. 16,100,000

1899 8d. 18,000,000

1900 8d. 18,750,000

1901 12d. 26,920,000

1902 14d. 34,800,000

Intra' national

The revenue from taxation in 1901-02, as adjusted ortlon ^° saow> n0 ^ne amount collected in, but that con- of taxation tribited by the three divisions of the United yield. Kingdom, was as follows : —*

Revenue from

England.

Scotland.

Ireland.

Total.

~~Customs :~~

~~Coal exported .~~

~~£1,312,0001~~

~~Spirits~~

~~£3,834,000~~

~~£414,000~~

~~£334,000~~

~~4,582,000~~

~~Sugar ....~~

~~5,021,000~~

~~690,000~~

~~688,000~~

~~6,399,000~~

~~Tea ....~~

~~4,408,000~~

~~574,000~~

~~811,000~~

~~5,793,000~~

~~Tobacco~~

~~8,355,000~~

~~1,115,000~~

~~1,098,000~~

~~10,568,000~~

~~Wine ....~~

~~1,238,000~~

~~95,000~~

~~116,000~~

~~1,449,000~~

~~Various~~

~~Total~~

~~761,000~~

~~93,000~~

~~90,000~~

~~944,000~~

~~£23,617,000~~

~~£2,981,000~~

~~£3,137,000~~

~~£31,047,000~~

~~Excise :~~

~~Spirits~~

~~11,935,000~~

~~8,720,000~~

~~1,993,000~~

~~17,648,000~~

~~Beer ....~~

~~11,733,000~~

~~563,000~~

~~975,000~~

~~13,276,000~~

~~Various3 . Total~~

~~423,000~~

~~38,000~~

~~213,000~~

~~674,000~~

~~£24,091,000~~

~~£4,326,000~~

~~£3,181,000~~

~~£31,598,000 i~~

~~Estate, &c, Duties~~

~~12,033,000~~

1,411,000

641,000

14,251,0003

Land Tax and House

Duty3 .

2,354,000

148,000

2,502,000

Income Tax .

30,063,000

3,645,000

1,176,000

35,379,00O>

Stamps .... Grand total

6,818,000

604,000

316,000

7,772,000«

£98,976,000

£13,115,000

£8,451,000

£122,549, 000

These taxation revenues do not include the sums collected by Imperial officers for local authorities, amounting in 1901-02 to

1 Of this amount £1,085,000 was collected in England and £227,000 in Scotland. 2 As collected.

3 Including £166,000 from other sources.

4 Including £495, 000 from other sources. 6 Including £34,000 from other sources.

£8,314,000 for England, £1,082,000 for Scotland, and £261,000 for Ireland; total (including £73,000 contributed from other sources), £9,730,000.

The national expenditure is incurred mainly on account of the national debt, the army and navy, and the civil „ services. The expenditure for these purposes in every ^xPend,m fifth year from 1881 and in 1899-1902 was as follows : ”’

Tear ending March 81st.

National Debt Services.

Army and Navy.

Civil Service (excl. of Post-Offlce and Collect, of Rev.).

1881

£29,575,264

£25,784,600

£17,356,499

1886

23,449,678

39,538,593

19,214,151

1891

25,207,000

33,488,952

17,732,664

1896

25,000,000

38,344,000

21,211,357

1899

25,000,000

44,283,000

23,401,853

1900

23,000,000

69,815,000

23,899,810

1901

19,835,489

121,445,000

24,854,407

1902

21,685,532

123,787,000

31,928,790

The expenditure on the debt services in 1886 was abnormally low, and on the other services abnormally high. For that year the extinction of debt by means of terminable annuities (to the capital amount of £4,672,978) was suspended, and in the military ex- penditure there was included the sum of £9,451,000 on account of operations in Egypt. In 1900 and 1901 the sinking fund was suspended and the army expenditure was increased owing to the war in South Africa.

After 1880 the capital of the national debt rapidly dimin- ished up to the time of the war in South Africa. The total reductionfrom 1881 to 1899 amounted to £138,681,876. N . . This great reduction was brought about by the cancel- T^h?"a lation of £26,558,959 stock under the National Debt and Local Loans Act of 1887, and by redemption and other means. From 1888 to 1899 the net decrease amounted to £78,012,488, the annual average of decrease having been over £7,000,000. The capital of the funded and of the unfunded debt, and the total, including the capital value of terminable annuities, is shown below : —

Year (1st April).

Funded Debt.

Unfunded Debt.

~~Total (including ter- minable annuities).~~

~~1881 1886 1891 1896 1899 1900 1901 1902~~

~~£709,078,526~~

~~638,849,694 579,472,082 589,146,878 583,186,305 552,606,898 551,182,153 . 609,587,248~~

~~£22,077,500~~

~~17,602,800 36,140,079 9,975,800 8,133,000 16,133,000 78,132,000 75,133,000~~

~~£766,144,461~~

~~742,282,411 684,070,959 648,474,143 627,562,585 628,978,783 690,992,622 747,876,000~~

~~The increase of the funded debt and decrease of the unfunded debt shown for 1896 was due to the cancellation of £13,000,000 of unfunded and a corresponding addition to the funded debt in 1893. In 1901-02 the funded debt was increased by £60,000,000, and between 1899 and 1902 the unfunded debt was increased by £67,000,000, owing to the war in South Africa. By the operations under the National Debt Conversion Act, 1888, the interest on the funded debt was up to 1903 at 2| per cent., except £31,394,670, which was at 1\ per cent. Details of the capital of the debt oh 1st April 1902 (see also under National Debt) are given in the subjoined statement : —~~

~~Liabilities —~~

~~Funded debt~~

~~Terminable annuities .... Unfunded debt~~

~~Russian-Dutch Loan Act, 1891 Barracks Act, 1890 Telegraph Acts, 1892 to 1899 Naval "Works Acts, 1895 to 1901 . Uganda Railway Acts, 1896 to 1900 Public Offices Acts, 1895 and 1897 Royal Niger Company Act, 1899~~

~~. Military Works Acts, 1897 to 1901 Land Registry Act, 1900 Pacific Cable Act, 1901 .~~

~~Total liabilities .~~

~~Estimated Assets —~~

~~Suez Canal shares . . . .~~

~~Other assets~~

~~Exchequer balances at banks~~

~~£609,587,248~~

~~63,190,859 75,133,000~~

~~£747,911,107~~

~~203,838~~

~~2,425,349~~

~~2,386,202~~

~~5,456,450~~

~~4,703,592~~

~~949,927~~

~~828,190~~

~~2,626,835~~

~~158,452~~

~~793,444~~

~~£768,443,386~~

£27,935,000

726,855

8,566,948

550

UNITED KINGDOM

The revenues annually provided for expenditure by local

authorities for local purposes within the United King-

Loca dom. nave papi^jy increased in recent years. In the

finance. yearg 1880-81j 1890-91, and 1898-99 the receipts from

all sources, including loans, were as follows ■:■ —

1880-81.

1890-91.

1898-99.

England and Wales Scotland Ireland .

United Kingdom .

£53,867,043

6,058,600 3,872,249

£58,543,947

8,097,456 4,499,500

£91,492,0^7

~~13,804,788~~

~~5,242,042~~

~~£63,797,892~~

~~£71,140,903~~

~~£110,538,857~~

~~For England and Wales in 1898-99 the local government re- ceipts and expenditure were as follows : —~~

~~Receipts from~~

~~Rates~~

~~Water and lighting Repayments . Tolls, licences, &c. Rents and sales Government con- tributions . Loans . Miscellaneous~~

~~Total .~~

~~38,602,534 9,487,255 1,366,830 5,799,823 3,541,733~~

~~11,836,682~~

~~18,220,039~~

~~2,637,131~~

~~91,492,027~~

~~Expenditure.~~

~~Poor relief . School Boards Town police,' &c. . County police, &c. Harbours, &c. Highways, &c.~~

~~Various~~

~~Total~~

~~11,286,973~~

~~10,506,110~~

~~51,883,586~~

~~6,256,232~~

~~5,206,830~~

~~1,859,635~~

~~5,602,455~~

~~92,601,821~~

~~Contributions from Imperial funds towards local purposes are made in various forms, but since the passing of the Local Govern- ment Act, 1888, the most important grants are the proceeds of duties collected by Imperial officers and handed over to local authorities. In 1888 one-third of the probate duty was assigned to local authorities ; in 1889 the share was increased to one-half, and in 1894 this was exchanged for an equivalent share in the estate duty then imposed. The transference of the English and Scottish licence duties to local authorities took place under the Acts of 1888 and 1889, and the additional beer and spirit duties were assigned in 1890. The Agricultural Rates Act, 1896, for England, and Acts of similar purpose for Scotland and Ireland, provided relief for agricultural ratepayers by means of payments from local taxation accounts, but the enactment as regards Ire- land was repealed by the Local Government (Ireland) Act, 1898, which supplied other means of relief. For the year 1901-02 the payments to local authorities from the assigned duties were as shown below : —~~

~~Duties.~~

~~England and Wales.~~

~~Scotland.~~

~~Ireland.~~

~~United Kingdom.~~

~~Additional beer and~~

~~spirit duties Licences Probate and estate~~

~~duties~~

~~Total .~~

~~£~~

~~1,184,856 3,555,736~~

~~3,556,156~~

~~£~~

~~156,505 373,533~~

~~497,816~~

~~£~~

~~133,958~~

~~255,529~~

~~£~~

~~1,475,319 3,929,269~~

~~4,309,501~~

~~8,296,748~~

1,027,854

389,487

9,714,089

The system of making advances from state funds for local pur- poses which had grown up under various Acts of Parliament was set on a new basis by the National Debt and Local Loans Act, 1887. In the early part of the 19th century loans had been made for local purjioses out of Exchequer balances, and of these the out- standing amount on 31st March 1887 was about £13,000,000. To meet the increasing demand for advances, recourse was had in 1876 to the creation of unfunded debt, and of the amount so created there remained in 1887, £14,150,000. An Act of 1879 made the savings banks deposits available for such advances, and of these moneys the amount outstanding in 1887 was £9,468,713. The outstanding advances at that date thus amounted to £36,618,713. Of this amount, £36,526,057 was regarded as recoverable ; and under the Act of that year stock to an equivalent amount was created for the purpose of local loans. The advances from 1792 to 1901 for public works amounted to £153,929,114, of which in 1900 there remained outstanding £54,361,299.

The total debt of the local authorities in England and Wales in 1897-98 amounted to £276,229,048. This debt had been in- curred for the purpose of carrying out permanent improvements, the most important having been waterworks, the outstanding amount for which was £49,795,662 ; harbours, piers, docks, &c, £35,171,963; highways and streets, £34,445,784; schools^ £29,064,152; sewerage, £28,546,920; gasworks, £19,247,026. The local debt of Scotland at the end of the same year amounted

to £44,355,588, and the debts of certain classes of local authorities in Ireland, in respect of loans, amounted to £11,122,824.

In the Post Office Savings Bank the number of de- positors' accounts and the amount deposited have increased threefold, and within the same period there savings has been a substantial addition to the amount and of

~~the deposits in the trustee savings banks, wealth. though in the number of their depositors there has not been a corresponding increase.~~

~~The following statement shows the number of deposit accounts open at the end of 1881, 1891, and 1900 in the Post Office Savings Bank and in the trustee savings banks in the whole of the United Kingdom, and in England and Wales : —~~

~~Tear.~~

~~Post Office Bank. Trustee Banks.~~

~~United Kingdom.~~

~~England and ; United Wales. Kingdom.~~

~~England and Wales.~~

~~1881 1891 1900~~

~~2,607,612 5,118,395 8,439,983~~

~~2,410,946 4,723,929 7,685,317~~

~~1,532,486 1,510,282 1,625,023~~

~~1,184,627 1,079,066 1,078,705~~

~~The total amount received from and paid to depositors in the Post Office Savings Bank in each of those years, and the amount due to depositors at the end of each year (exclusive of Govern- ment stock held for depositors), were : —~~

~~United~~

~~I England and~~

~~Kingdom.~~

~~Wales.~~

~~(“Received .~~

~~£12,694,146~~

~~£11,685,367~~

~~1881~~

~~\ Paid.~~

~~10,244,287~~

~~9,482,725~~

~~(.Due .~~

~~36,194,496~~

~~33,771,412~~

~~1 Received~~

~~22,993,050~~

~~21,170,281~~

~~1891~~

~~i Paid.~~

~~19,019,855~~

~~17,574,047~~

~~[Due .~~

~~71,608,002~~

66,018,228

f Received

43,662,412

39,596,852

1900

\ Paid.

38,231,372

34,851,383

[Due .

135,549,645

122,365,193

In the trustee savings banks the amounts similarly received, paid, and due were as follows : —

United

England and

Kingdom.

Wales.

("Received .

£9,227,816

£6,611,249

1881

~~J Paid.~~

~~10,210,640~~

~~7,636,178~~

~~(Due .~~

~~44,140,116~~

~~35,204,605~~

~~(Received~~

~~9,253,470~~

~~6,039,149~~

~~1891~~

~~^Paid.~~

~~11,089,693~~

~~7,839,277~~

~~(Due .~~

~~42,875,565 •~~

~~31,066,149~~

~~|" Received~~

~~12,247,672~~

~~7,177,591~~

~~1900~~

~~^Paid.~~

~~13,448,957~~

~~7,988,990~~

~~{Due .~~

~~51,455,917~~

~~32,680,718~~

~~In 1880 began the system of purchasing Government stock to a limited amount for depositors in savings banks. The amount of stock so purchased and standing to the credit of depositors at the end of 1881, 1891, and 1900 was as follows :—~~

~~Tear.~~

~~Post Office Bank.~~

~~Trustee Banks.~~

~~United Kingdom.~~

~~United Kingdom.~~

~~England and Wales.~~

~~1881 1891 1900~~

~~£738,967~~

~~5,087,765~~

~~10,468,290~~

~~£124,668~~

1,282,238 1,365,517

£109,291

1,126,916 1,203,553

The total savings (deposits, interest, and stock) held by the savings banks of the United Kingdom at the end of 1900 thus amounted to £198,839,369, exclusive of a considerable sum repre- sented by contracts for immediate or deferred annuities.

The annual return relating to trustee savings banks for the year ending 20th November 1900 shows that there were in England on that day 146 such banks, with altogether 1,033,702 accounts open, and in Wales 11 with 18,558 accounts. Their number is decreasing, and every year a large amount of cash is transferred from them to the Post Office Bank. Seven English and four Welsh counties have now no trustee banks, and eight English and six Welsh counties have only one each. The counties where they are most favoured are Lancashire, where, in November 1900, 332,613 depositors had £11,304,985 standing to their credit; Middlesex, 141,490 depositors, with £3,031,459 to their credit;

the West Hiding of Yorkshire, 93,019 depositors, with £2,970,265 to their credit ; the East Riding, 72,892 depositors, with £1,816,419 ; Devonshire, 64,080 depositors, with £1,886,316 ; Northumberland, 38,959 depositors, with £1,545,874; Cheshire, 23,773 depositors, with £1,027,647.

While the amount of the savings of the working classes gives a fair idea of the general prosperity of the country, the revenue derived from income tax, and the annual value of property and profits as assessed for the purpose of that tax, afford a surer indication as to the condition of the national wealth. The rate of the tax has varied considerably, and changes have been made in its incidence for the purpose of affording relief, but the net produce for each penny of the tax, though fluctuating, has on the

~~*whole largely increased. The net produce per penny of tax in the United Kingdom for the years specified was as follows : —*~~

~~*Income tax.*~~

~~*Year.*~~

~~*For each Penny.*~~

~~*Tear.*~~

~~*For each Penny*~~

~~*1881 .*~~

~~*. £1,866,636*~~

~~*1896 .*~~

~~*. £2,033,162*~~

~~*1886 .*~~

~~*1,980,395*~~

~~*1899 .*~~

~~*2,284,000*~~

~~*1891 .*~~

~~*2,215,856*~~

~~*1900 .*~~

~~*2,364,000*~~

~~*A comparison of the assessed values given for various years is complicated by the numerous assessment changes which have been made,*~~

~~*notably by the substitution of one-third of the annual value in respect of the occupation of lands and tenements for the full value. In consequence of this reduction, the assessed value under Schedule B, which for the United Kingdom in 1895-96 stood at £55,471,734, fell in 1896-97 to £18,496,701, the fall with respect to England and Wales having been from £39,428,803 to £13,160,528. The total annual value of property and profits assessed in various years was as follows : —*~~

~~*Year.*~~

~~*1881 .*~~

~~*United Kingdom. . £585,223,890*~~

~~*England and Wale £493,583,819*~~

~~*1886 .*~~

~~*629,855,622*~~

~~*533,038,774*~~

~~*1891 .*~~

~~*. 698,407,549*~~

~~*597,265,843*~~

~~*1896 .*~~

~~*. 709,651,556*~~

~~*605,849,574*~~

~~*1899 .*~~

~~*. 758,571,709*~~

~~*653,686,806*~~

~~1900 .~~

~~. 788,023,603~~

~~678,742,789~~

~~The annual values of lands, tenements, Ac, assessed under Schedule A were for the United Kingdom, in 1881, £187,598,346 ; in 1891, £199,299,608 ; in 1900, £228,383,906. For England and Wales the corresponding values were in 1881, £154,711,410 ; in 1891, £165,956,061 ; in 1900, £191,112,811. The property under this schedule consists almost entirely of land and houses, and the increase in its assessed value is the more remarkable when the large decrease in the value of agricultural land is considered. The annual assessed values of lands and of houses respectively in 1881, 1891, and 1900 were for the United Kingdom and for England and Wales as follows : —~~

~~Year.~~

~~United Kingdom.~~

~~England and Wales.~~

~~Lands.~~

~~Houses.~~

~~Lands.~~

~~Houses.~~

~~1881 1891 1900~~

~~£~~

~~69,291,973 57,694,820 52,814,291~~

~~£~~

117,465,877 140,584,063 174,430,501

£

51,599,428 41,378,589 37,110,545

£

102,417,104 123,721,189 153,193,414

The fall in the annual value of land as assessed under Schedule A was for the period 1881-1900 equivalent to 23 per cent., while the rise in that of house property was at the rate of 48 per cent. Even more important are the indications of prosperity supplied by the assessments under Schedule D, which comprises professional earnings and gains from trade and from the working of railways, mines, &c. The assessed values of such profits in the United Kingdom and in England and Wales for various years were as follows : —

Years.

1881 1886 1891 1896 1899 1900

United Kingdom. £255,355,909

289,423,738 351,590,691 351,672,687 412,410,291 432,541,278

England and Wales. £219,996,536

249,457,490 306,854,829 306,199,331 357,834,541 374,947,879

The increase during the period 1881-99 thus exceeded 69 per cent, of the value in 1881.

In a paper published in 1878 Sir Robert Giffen discussed the growth of capital in the United Kingdom down to 1875, and, following the same method in a paper published in 1889, he estimated the capital value of the property and profits assessed to income tax, and of those not assessed to

~~*income tax, in 1885 at £10,037,036,000. The manner in which this result was ob- tained is shown in the subjoined table : —*~~

~~*Income.*~~

~~*Years'*~~

~~*purchase.*~~

~~*Capital.*~~

~~*£1000*~~

~~*£1000*~~

~~*Assessed to income tax :*~~

~~*Under Schedule A —*~~

~~*Lands ....*~~

~~*65,039*~~

~~*26*~~

~~*1,691,313*~~

~~*Houses ....*~~

~~*128,459*~~

~~*15*~~

~~*1,926,885*~~

~~*Other profits :*~~

~~*877*~~

~~*30*~~

~~26,310~~

~~Under Schedule B~~

~~65,223~~

~~8~~

~~521,864~~

~~Under Schedule C —~~

~~Public funds (less home~~

~~funds)~~

~~21,096~~

~~25~~

~~527,400~~

~~Under Schedule D —~~

~~Mines, quarries, iron-~~

~~works~~

~~10,801~~

~~4~~

~~43,204~~

~~Gasworks~~

~~5,026~~

~~25~~

~~125,650~~

~~Waterworks .~~

~~3,260~~

~~20~~

~~65,200~~

~~Canals, &c.~~

~~3,546~~

~~20~~

~~70,920~~

~~Fishings, markets .~~

~~1,208~~

~~20~~

~~24,160~~

~~Other public companies .~~

~~34,789~~

~~20~~

~~695,780~~

~~Foreign and colonial~~

~~securities . .~~

~~9,859~~

~~20~~

~~197,180~~

~~Railways in U. K. .~~

~~33,270~~

~~28~~

~~931,560~~

~~,, out of U.K.~~

~~3,808~~

~~20~~

~~76,160~~

~~Interest paid out of rates~~

~~5,041~~

~~25~~

~~126,025~~

~~Other profits .~~

~~1,435~~

~~20~~

~~28,700~~

~~Trades and professions . Total~~

~~36,096~~

15

541,440

428,833

7,619,751

Not assessed to income tax :

Trades and professions

omitted ....

8,179 x

15

108,285

Income of non-income tax

payers derived from

capital ....

67,000

5

335,000

Foreign investments not

in Schedules C and D

50,000

10

500,000

Movable property not yield-

ing income (furniture,

&c.)

960,000

Government and local

property

Grand total .

500,000

554,012

10,023,036

Since 1880 the normal effective strength of the army has been largely increased. The following figures show the average strength of the regular army at home and abroad in the years named : —

Army.

Year.

Strength.

Year.

Strength.

1881 .

188,798

1897 .

. 219,283

1886 .

203,805

1898 .

. 225,027

1891 .

209,699

1899 .

. 238,739

1896 .

220,742

1900 .

. 383,037

Recruits are enlisted (with few exceptions) for short service, usually seven years with the colours and five in the reserve, but the periods differ for different branches of service.

The recruits approved for the regular army in the last four years were enlisted as follows : —

In

1898.

1899.

1900.

1901.

England .... Wales .... Scotland .... Ireland ....

Total .

28,584 1,207 3,921 4,094

30,149

985

4,387

3,987

36,553 1,063 5,323 4,040

33,906 1,251 5,164 3,778

37,806

39,508

46,979

44,099

i

The numbers in the different arms of the militia and volunteers, 1902-03, were stated as follows : —

Artillery . Engineers . Infantry . CJxannel Isles, &c. Medical .

Militia.

~~Volunteers~~

~~19,054~~

~~52,918~~

~~2,352~~

~~19,587~~

~~109,412~~

~~270,786~~

~~6,002~~

~~919~~

~~3,478~~

~~Total~~

~~137,739~~

~~346,769~~

~~The enrolled yeomanry in 1902 numbered 17,407.~~

~~1 Comprising £960,000 not included in the capitalization.~~

~~The increase in the cost of the army is shown by the following~~

~~figures : — Year.~~

~~1881 1886 1891 1896~~

~~Expenditure. £14,680,762~~

~~17,027,084 17,550,023 18,459,800~~

~~Year.~~

~~1899 1900 1901 1902~~

~~Expenditure. £19,999,700~~

~~43,552,900 91,505,900 92,262,000~~

~~For 1902-03 the estimated expenditure amounted to the net sum of £69,310,000. The expenditure on staff, regimental, andreserve pay was put at £18,940,400; on militia pay at £1,381,000 ; on yeomanry and volunteer pay at £1,872,000 ; on transport and remounts at£ll, 242, 000; on provisions and forage at £16,066,000; on clothing at £3,970,000 ; on warlike stores at £8,332,000 ; on works, buildings, &c, at £2,190,000. On the non-effective services the expenditure (half pay, pensions, &c.) was put at £3,728,000. The vast increase in the army estimates was caused by the military operations in South Africa. (See Armies).~~

~~The actual fighting strength of the navy and the number of vessels completing and building on 1st January 1901 was as follows : —~~

~~Complete for Sea.~~

~~Launched~~

~~and completing.~~

~~Building or projected.~~

~~Battleships, 1st class . ,, 2nd class ,, 3rd class~~

~~Armoured cruisers~~

~~Protected cruisers~~

~~Torpedo gunboats, &c. ,, destroyers ,, boats, 1st class ,, ,, 2nd class ,, ships~~

~~14 12 11~~

~~6 125 33 96 11 71~~

~~2~~

~~7 8~~

~~i~~

~~8~~

~~6 2~~

~~12 4~~

~~Besides the completed vessels named above, there were 23 obsolete or coast defence battleships, 95 third class torpedo-boats, and many miscellaneous vessels of little account for fighting purposes.~~

~~The number of officers, seamen, and marines provided for in the~~

~~estimates for 1902-03 was : —~~

~~Sea service —~~

~~Officers and men for the fleet . . . 88,691~~

~~Coast guard 4,200~~

~~Marines 19,589~~

~~Other services (training, &c.) —~~

~~Officers and men 1,730~~

~~Pensioners 1,288~~

~~Boys 6,786~~

~~Marines 216~~

~~Total~~

~~122,500~~

~~In February 1902 the ships in commission were distributed : follows : —~~

~~Mediterranean and Red Sea . Channel squadron . North America and West Indies South-east coast of America .~~

~~Pacific~~

~~Cape Colony and West Coast of Afr:~~

~~East Indies~~

~~China~~

~~Australasia~~

~~Reservo squadron~~

~~Cruiser squadron~~

~~Surveying~~

~~Total~~

~~54 13 14 3 8 17 10 41 12 49~~

~~234~~

~~In consideration of subsidies amounting annuallyto £63,200, the Admiralty had up to 1902 a right to the services of 18 vessels, called "reserve merchant cruisers," belonging to the Cunard Company, the Peninsular and Oriental Company, the White Star Line, the Orient~~

Company, the Royal Mail Steam Packet Company, tlio Pacific Company, and the Canadian Pacific Railway Company ; and these companies held 31 other vessels at the disposal Of the Admiralty without further subsidy. In October 1902, owing to the formation of the Atlantic Shipping Trust, new arrangements were made, involving a special subsidy to the Cunard Line, for which see under Steam-ship Lines.

The Royal Naval Reserve consists of officers and men (fisher- men and others) to the number of 27,780, who when qualified

receive annual retainers and are drilled periodically in 9 drill ships, stationed at as many ports on the coasts of England and Scotland. There are two gunboats also provided for the training of reserve officers. The following statement illustrates the increase in the cost of this service : —

Year ending 81st March.

1881

1886

1891

1896

1897

Expenditure.

£10,511,840

12,660,509 14,125,358 19,724,000 22,170,000

Year ending Slst March.

1899 .

1900 .

~~1901 .~~

~~1902 .~~

~~Expenditure.~~

~~£24,068,000~~

~~26,000,000 29,520,000 31,030,000~~

~~(See also Navies and Admiralty Administration.)~~

~~The mineral production of the United Kingdom in 1900 reached a total value of £135,957,676, of which £121,652,596, or over 89 per cent., represented ^era/s the value of the coal output, and about 3 per mining. cent, that of the output of iron ore. The weight of the more important minerals produced in 1900 and 1901 was as follows : —~~

~~Description of Minerals.~~

~~1900.~~

~~Tons.~~

~~1901.~~

~~Tons.~~

~~Coal~~

~~225,181,300~~

~~219,046,945~~

~~Iron ore .~~

~~14,025,208~~

~~12,275,198~~

~~***Slate***~~

~~***585,859***~~

~~***488,772***~~

~~***Sandstone***~~

~~***5,019,874***~~

~~***5,115,675***~~

~~***Clays***~~

~~***14,049,694***~~

~~***14,161,877***~~

~~***Chalk***~~

~~***4,373,331***~~

~~***4,328,344***~~

~~***Other limestones***~~

~~***11,905,477***~~

~~***11,180,579***~~

~~***Salt.***~~

~~***1,861,347***~~

~~***1,783,056***~~

~~***Igneous rocks .***~~

~~***4,634,301***~~

~~5,049,312~~

~~Oil shale~~

~~2,282,221~~

~~2,354,356~~

~~Tin ore (dressed)~~

~~6,800~~

~~7,288~~

~~Lead ore .~~

~~32,010~~

~~27,976~~

~~Gravel and sand~~

~~1,837,202~~

~~1,958,929~~

~~Zinc ore .~~

~~24,675~~

~~23,752~~

~~Gypsum .~~

~~208,038~~

~~200,766~~

~~Arsenic~~

4,081

3,361

Copper ore and precipitate 9,488

6,792

Barytes .

29,456

27,613

Wolfram .

9

21

Strontium sulphate .

9,121

16,651

Gold ore, manganese ore, and uranium ore are produced in small quantities, and the list of minerals worked in the United Kingdom includes alum, clay and shale, phosphate of lime, chert, and flint.

From the ores comprised in the table given above metals were obtained in 1900 in quantity and value as follows : —

Description of Metal.

*<**

uantity.

Value at Average Market Price.

Iron

tons

4,666,942

£19,596,910

Tin .

4,268

587,869

Lead .

,,

24,364

418,960

Zinc

9,066

188,573

Aluminium

560

72,800

Copper

;

~~*7j*~~

~~*765*~~

~~*59,995*~~

~~*Silver .*~~

~~*oz.*~~

~~*190,850*~~

~~*22,465*~~

~~*Sodium*~~

~~*;*~~

~~*tons*~~

~~*250*~~

~~*31,000*~~

~~*Gold . '*~~

~~*Total*~~

~~*oz.*~~

~~*14,004*~~

~~*52,147*~~

~~*£21,030,719*~~

~~*The inspection of mines is provided for under the Coal Mines Regulation Acts, 1887-96, the Metalliferous Mines Regulation Act, 1872, and the Quarries Act, 1894. The United Kingdom is divided into 13 districts, two*~~

of which are in Scotland, while Ireland is united with one of the English districts. For the purposes of the Coal Mines Acts, and of those of the Metalliferous Mines and Quarries Acts, the districts are in general the same, but in some cases the areas differ, and one district is constituted only for the purposes of tho last-named Acts. Under the Coal Mines Acts are not only coal mines, but mines of stratified ironstone, shale, and fireclay. All mines not under these Acts are under the Metal- liferous MindS Act. A quarry, as defined by the Act of 1894, is a place (not a mine) in which persons work in getting mineral, and of which any part is more than 20 feet deep.

The total number of persons employed in and about all the mines of the United Kingdom in 1901 was 839,178, of whom 806,735 worked at 3397 mines under the Coal Mines Act, and 32,443 at 731 mines under the Metalliferous Mines Act. Of the 806,735 persons working at the mines under the Coal Mines Act, 647,822, or about 80 per cent., were employed below ground. Of the 158,193 surface workers, 5195 or 3‘2 per cent., were

females. At the mines under the Metalliferous Mines Act, 18,804 persons, or nearly 58 per cent., worked below ground, and of the 13,639 surface workers, 393, or nearly 2‘9 per cent., were females. At the quarries under the Quarries Act there were 94,188 persons employed, of whom 59,968 worked inside the actual pits or excavations, and 34,220 outside.

The number of mines under the Coal Mines Act in the United Kingdom, the number of persons employed under ground and above ground, and the number of deaths from accidents in every fifth year from 1881 were as follows : —

Year.

Mines.

Persons employed.

~~Deaths~~

~~from~~

~~Accident.~~

~~Under ground.~~

~~Above ground.~~

~~Total.~~

~~1881 1886 1891 1896 1901~~

~~3847 3391 3439 3385 3397~~

~~399,387 423,862 536.091 557,026 647,822~~

~~96,090~~

~~96,108~~

~~131,892~~

~~135,658~~

~~158,913~~

~~495,477 519,970 667,983 692,684 806,735~~

~~954~~

~~953~~

~~1005~~

~~1025~~

~~1101~~

~~*In 1901 at the coal and other mines there were 21 explosions of fire-damp or coal dust, causing 125 deaths ; 460 falls of ground, causing 482 deaths ; 65 accidents in shafts, causing 75 deaths ; the underground accidents from explosives, haulage, machinery, &c, numbered 255 and caused the death of 272 persons, while on the surface 151 persons were killed in 150 accidents.*~~

~~*Coal. — The production of coal in Great Britain, though marked by fluctuation, has on the whole largely increased since 1881, and in 1901 the output was 42 per cent, greater than that of 1881. The quantity extracted in every fifth year from 1881, with the value, was as follows : —*~~

~~*Year.*~~

~~*Quantity. Tons.*~~

~~*Value.*~~

~~*1881*~~

~~*. 154,184,300*~~

~~*£65,528,327*~~

~~*1886*~~

~~*. 157,518,482*~~

~~*38,145,930*~~

~~*1891*~~

~~*. 185,479,126*~~

~~*74,099,816*~~

~~*1896*~~

~~*. 195,361,260*~~

57,190,147

1901

. 219,046,945

Of the coal output of the United Kingdom in 1900, 159,325,402 tons, valued at £83,884,4li, were raised in England, and 32,618,935 tons, valued at £19,649,968, were raised in Wales, so that the coal production of England and Wales together constituted, in quantity and value, 85 per cent, of the whole.

In the various coal-producing counties of England and Wales the quantity raised in 1900 and its value at the pit's mouth were

as follows : —

Quantity. v ,

Tons. vame-

699,411 £367,212

2,022,327 932,377

15,243,031 8,002,591

34,800,719 17,939,771

1,578,386 1,025,951

24,842,208 13,367,925

2,106,343 1,140,936

9,818,829 5,891,297

11,514,521 5,928,539

8,626,177 4,708,455

780,420 409,720

1,046,792 693,500

14,222,743 7,179,573

2,957,490 1,577,328

940 564

806,739 369,755

28,247,249 14,345,730

Chester Cumberland . Derby Durham Gloucester . Lancashire . Leicester Monmouth . Northumberland Nottingham . Shropshire . Somerset Stafford Warwick Westmoreland Worcester York .

Total England Brecon Carmarthen . Denbigh Flint . Glamorgan . Pembroke .

Total Wales

Total England and Wales . . 191,933,360 £103,531,182

Thus it appears that of the coal raised in England in 1900 the county of Durham contributed 22 per cent., Yorkshire 17 per cent., Lancashire 16 per cent., Stafford and Derbyshire each about 9 per cent., and Northumberland 7 per cent., while of the coal raised in Wales 85 per cent, was contributed by the county of Glamorgan.

While the annual output of coal has largely .increased, the quantity annually exported has more than doubled since 1875. Including coke and patent fuel expressed in the equivalents in

159,314,365

~~440,682~~

~~1,333,880~~

~~2,447,092~~

~~662,523~~

~~27,686,758~~

~~48,140~~

~~£83,881,224~~

~~237,586~~

~~709,317~~

~~1,407,078~~

~~380,951~~

~~16,886,152~~

~~28,884~~

~~32,618,995 £19,649,968~~

~~coal, and also the coal supply shipped by steamers engaged in the foreign trade, the quantity exported was for various years as follows : —~~

~~Year.~~

~~Tons.~~

~~Year.~~

~~Tons.~~

~~1876 .~~

. 20,053,209

1896 .

. 44,586,811

1881 .

. 25,049,928

1898 .

. 48,266,699

1886 .

. 30,362,575

1899 .

. 55,810,024

1891 .

. 40,120,861

1900 .

. 58,405,087

Value.

Of the exports in 1900, 8,635,030 tons went to France, 5,985,161 to Germany, 5,336,157 to Italy, 4,485,416 to Sweden and Norway, 3,229,294 to Russia, 2,125,493 to Denmark, and 1,971,121 to Egypt.

Iron. — The annual output of iron ore in the United Kingdom has decreased both in quantity and value since 1881. The figures are as follows : —

~~Yea, Quantity.~~

~~1881 . . 17,446,065~~

~~1886 . . 14,110,013~~

~~1891 . . 12,777,689~~

~~1896 . . 13,700,764~~

~~1897 . . 13,787,878~~

~~1898 . . 14,176,938~~

~~1899 . . 14,461,330~~

~~1900 . . 14,028,208~~

~~The iron ore raised in the various shown in the subjoined table : —~~

~~Cumberland .~~

~~Derby .~~

~~Devon .~~

~~Durham .~~

~~Gloucester~~

~~Lancashire~~

~~Leicester .~~

~~Lincoln .~~

~~Monmouth~~

~~Northampton~~

~~Nottingham .~~

~~Oxford and Rutland~~

~~Shropshire~~

~~Somerset~~

~~Stafford .~~

~~Warwick~~

~~Wiltshire~~

~~Worcestershire~~

~~Yorkshire~~

~~Total England Carnarvon and Denbigh . Flint . Glamorgan~~

~~Total Wales Scotland . Ireland .~~

~~Total United Kingdom~~

~~The number of furnaces in blast, and the quantities of pig-iron obtained, ore smelted (including imported ore), and coal used were for various years as follows : —~~

~~£6,201,068~~

~~3,513,515~~

~~3,355,860~~

~~3,150,424~~

~~3,217,795~~

~~3,406,628~~

~~3,895,485~~

~~4,224,400~~

~~ounties in 1900 was~~

~~Tons.~~

~~Value.~~

~~1,103,430~~

~~6962,274~~

~~2,835~~

~~992~~

~~354~~

~~1,859~~

~~19,124~~

~~7,157~~

~~9,885~~

~~4,113~~

~~630,361~~

~~446,077~~

~~750,708~~

~~80,242~~

~~1,924,898~~

229,456

13,335

4,000

1,622,539

171,570

23

6

237,340

23,719

26,133

19,600

6,139

1,459

1,084,797

414,589

25,911

2,037

56,821

36,933

6,808

~~2,244~~

~~5,550,677 1,385,998~~

~~13,072,118 £3,794,325~~

~~489~~

~~334~~

~~677~~

~~232~~

~~6,252~~

~~3,126~~

~~7,418 £3,692~~

~~849,031 408,713~~

~~99,641 17,670~~

~~14,028,208 £4,224,400~~

~~Year.~~

~~Furnaces in blast.~~

~~Pig-iron obtained.~~

~~Ore smelted.~~

~~Coal used.~~

~~Tons.~~

~~Tons.~~

~~Tons.~~

~~1881~~

~~565~~

~~8,144,449~~

~~20,249,263~~

~~17,484,990~~

~~1886~~

~~399~~

~~7,009,754~~

~~17,297,483~~

~~14,249,715~~

~~1891~~

~~376~~

~~7,406,064~~

~~18,518,192~~

~~15,373,711~~

~~1896~~

~~373~~

~~8,659,681~~

~~21,204,284~~

17,114,374

1897

380

8,796,465

21,372,013

17,552,430

1898

378

8,609,719

20,958,167

17,196,436

1899

411

9,421,435

22,820,302

19,061,318

1900

403

8,959,691

22,100,774

~~18,742,022~~

~~The iron- works in operation, the furnaces in blast, and the pig-iron made in the various counties of England and Wales in 1900 are shown in the first table over leaf (fractions showing the proportion of the year furnaces were in blast). The total number of existing furnaces in 1900 was : in England 456, in Wales 42, in Scotland 106 ; total, 604 ; so that 33 per cent, of the number stood unused.~~

~~In 1888 the imports of iron ore amounted to 3,562,071 tons, in 1898 to 5,468,396 tons, in 1899 to 7,054,578 tons, in 1900 to 6,297,953 tons, in 1901 to 5,548,888 tons. In 1901, 4,749,933tons were imported from Spain.~~

~~UNITED KINGDOM~~

~~Works in~~

~~Furnaces in~~

~~Pig-iron~~

~~operation.~~

~~blast.~~

~~made.~~

~~Tons.~~

~~Cumberland~~

~~12~~

~~25A~~

~~856,851~~

~~Derby and Notts~~

~~13~~

~~43A~~

~~561.626~~

~~Durham ....~~

~~8~~

~~30~~

~~973,010~~

~~Lancashire~~

~~7~~

~~24A~~

~~729,074~~

~~Leicester and Lincoln~~

~~6~~

~~19~~

~~388,745~~

~~Monmouth~~

~~7~~

~~13A~~

~~324,261~~

~~Northampton .~~

~~7~~

~~ISA~~

~~247,908~~

~~Shropshire~~

~~3~~

~~4~~

~~39,177~~

~~Stafford .~~

~~24~~

~~38A~~

~~596,807~~

~~Wilts and Worcester~~

~~4~~

~~4~~

~~74,309~~

~~Yorkshire~~

~~Total England .~~

~~27~~

83^

2,427,185

118

298TV

7,218,953

Wales

12

19-A

583,853

Scotland .... Total United Kingdom .

19

85A

1,156,885

149

403T\

8,959,691

Lead.. — The quantity of lead ore produced within the United Kingdom is now less than one-half of the output of 1877, and the total value only one-fourth of what it then was. In 1877 the out- put amounted to 80, 850 tons, valued at £1, 123, 952. The quantity and value of the output for various years was as follows : —

Value.

~~£656,725~~

~~471,295 356,783 303,398 349,094~~

~~The most productive counties are Flint, Durham, Derby, and Denbigh ; the ore obtained in the Isle of Man is increased in value by the quantity of silver it contains. The output of ore, the quantity of lead and of silver obtainable from it, and the value of the ore in 1900 were as follows : —~~

~~Tear.~~

~~Quantity Tons.~~

~~1881 .~~

~~. 64,702~~

~~1886 .~~

~~. 53,420~~

~~1891 .~~

~~. 43,859~~

~~1896~~

~~. 41,069~~

~~1900 .~~

~~. 32,010~~

~~Lead Ore.~~

~~Lead ob- tainable.~~

~~Silver obtainable.~~

~~*Value of Ore.*~~

~~*England . Wales Scotland . Ireland . Isle of Man*~~

~~*Total .*~~

~~*Tons.*~~

~~*13,817 12,503*~~

~~*1,839 8*~~

~~*3,843*~~

~~*Tons.*~~

~~*10,306 9,800 1,432 6 2,820*~~

~~*Ounces.*~~

~~*43,788 67,948 10,003 36 66,077*~~

~~*£130,532*~~

~~*147,981*~~

~~*24,067*~~

~~*76*~~

~~*46,438*~~

~~*32,010*~~

~~*24,364*~~

~~*187,852*~~

~~*£349,09**~~

~~*Tin. — The annual output of tin ore, which in 1878 amounted to 15,045 tons, valued at £530,737, fell to 12,898 tons in 1881, though the value in that year rose to £697,144. During the years 1882-92 the average output was over 14,000 tons and its average value about £770,000, but in 1893 a decline began, as shown by the following figures : —*~~

~~*Year.*~~

~~*Tin Ore. Tons.*~~

~~*Value.*~~

~~*1893 .*~~

~~*. 13,689*~~

~~*£637,053*~~

~~*1895 .*~~

~~*. 10,612*~~

~~*370,530*~~

~~*1896 .*~~

~~*. 7,663*~~

~~*259,928*~~

~~*1897 .*~~

~~*. 7,120*~~

~~*254,218*~~

~~*1898 .*~~

~~*. 7,380*~~

288,325

1899 .

6,392

440,509

1900 .

6,800

523,604

Tin ore is obtained from thirty five mines and six quarries in Corn wall, and from refuse sand and mud on the shores and streams. The two mines which are worked in Devonshire are unimportant.

Copper. — Like others of the less important mining industries, copper mining in the United Kingdom has declined. In 1881 the output amounted to 52,556 tons, in 1891 to 9158 tons, in 1893 to 5576 tons. During the last few years (owing to a rise in the price of the metal) the output has slightly increased. The ore is obtained mostly from six mines in Cornwall and Devon- shire. Copper precipitate is taken from water pumped up from old copper mine's on Parys Mountain, in Anglesey.

Zinc. — Zinc ore is obtained chiefly from mines in Cumberland, Wales, and the Isle of Man. In 1881 the output reached 35,527 tons, valued at £110,043 ; in 1891 the output was only 22,216 tons, but its value was £113,445. In 1897 the quantity was 19,278 tons, and the value £69,134, but in 1898 the price had risen so that the output of 23,552 tons was worth £117,784. In 1900 the output of 24,675 tons was worth £97,606.

Gold. — Gold mines have been worked continuously in Merioneth- shire since 1888. In that year the output of auriferous quartz amounted to 3844 tons, valued at £27,300, and yielding 8745

ounces of gold worth £29, 982. The annual output and value of ore and gold have been as follows : —

~~Year.~~

~~Ore.~~

~~Value.~~

~~Gold.~~

~~Value.~~

~~Tons.~~

~~Ounces.~~

~~1895~~

~~13,266~~

~~£16,584~~

~~6,600~~

~~£18,520~~

~~1897~~

~~4,517~~

~~6,282~~

~~2,032~~

~~7,185~~

~~1898~~

~~703~~

~~1,158~~

395

1,299

1899

3,047

10,170

3,327

12,086

1900

20,802

42,925

14,004

52,147

In 1900 there were five productive mines belonging to as many companies. It should be noted also that from imported cupreous iron pyrites, copper, gold, and silver are extracted at thirteen metal extraction works in Great Britain. From 386,858 tons of burnt ore in 1900 there were obtained 13,925 tons of copper, 1777 ounces ofgold, and 309,486 ounces of silver.

Various Minerals. — The production of phosphate of lime (copro- lites) in the counties of Bedford and Cambridge amounted in 1884 to 51,866 tons, valued at £103,976, but had fallen in 1900 to 620 tons, valued at £1085. Sodium is produced at Runcorn, Cheshire. Alumina, produced from clay in Antrim, is despatched to Foyers, near Inverness, where aluminium is extracted by means of electricity generated by water-power.

The most important of the textile industries of Great Britain is cotton manufacture. The quantities of raw cotton imported, exported, and retained for consumption for various years since 1880 were , *? JL as follows : —

Tear.

Imported.

exported.

Retained.

1881 1886 1891 1896 1899 1901

lb

1,679,068,384 1,715,044,800 1,994,885,312 1,754,890,256 1,626,246,944 1,829,710,064

lb

207,710,608 197,858,080 182,008,064 183,823,808 283,932,768 204,465,856

lb

1,471,357,776 1,517,186,720 1,812,877,248 1,571,066,448 1,342,314,176 1,625,244,208

In 1890 there were in the United Kingdom 2538 cotton factories, of which 935 were for spinning only, 990 for weaving only, 438 for both spinning and weaving, and 175 for other operations. The number of spindles was : for spinning, 40,511,934, and for doubling, 3,992,885. The power-looms numbered 615,714. In 1890 there were 528,795 persons employed in cotton factories, 208,187 male and 320,608 female. In 1899 the total number employed was 526,107, of whom 328,406 were females. Of the 197,701 males employed, 51,059 were under eighteen years of age. Of the total number of workpeople, 496,296 were employed in England and

~~Wales, 29,002 in Scotland, and 809 in Ireland. In the cotton manufacturing districts in England the numbers were : Lancashire, 408,090 ; Cheshire, 34,289 ; West Riding of Yorkshire, 35,209.~~

~~The extent of the woollen and worsted manufactures of the United Kingdom is indicated by the following table showing the imports and exports of wool and the quantity retained for use in various years : —~~

~~Year.~~

~~Imports.~~

~~Exports of imported Wool.~~

~~Retained.~~

~~1881 1886 1891 1896 1899 1901~~

~~lb~~

~~450,141,735 596,470,995 720,014,070 718,537,253 668,817,315 692,374,231~~

~~lb~~

~~265,583,927 312,000,380 384,224,656 334,691,803 292,937,192 294,213,768~~

~~lb~~

~~184,557,808~~

~~2S4,464,615 335,7S9,414~~

~~383,845,450 375,880,123 398,160,463~~

~~The number of factories, spindles, and looms employed in the woollen, worsted, and shoddy industries in 1890 was as follows : —~~

~~Factories.~~

~~Spindles.~~

~~Power-looms.~~

~~61.831~~

~~67,391~~

~~2,284~~

~~Spinning.~~

~~Doubling.~~

~~Woollen-Worsted Shoddy~~

~~1793 753 125~~

~~3,107,209~~

~~2,402,922~~

~~94,404~~

~~299,793~~

~~669,32S~~

~~691~~

~~In these industries ,301,556 workpeople were employed in 1890 ; the number in 1899 was 256,425, of wliofn 106,207 were males and 150,218 females. Of the males, 24.217 were under 18 years of age ; of the females, 39,268. Of the total number, 224,879 were employed in England and Wales, 28,223 in Scotland, and~~

~~UNITED KINGDOM~~

3323 in Ireland. The district where woollen manufactures are principally carried on is the West Riding of Yorkshire, where the workpeople in 1899 numbered 187,079. In Lancashire their number was 10,746.

The number of flax, hemp, and jute factories, and the number of their spindles and power-looms in 1890, are given as follows : —

Factories.

Spindles.

Power-looms.

Spinning.

Doubling.

Flax . Hemp . Jute

357 105 116

1,134,813

41,724

268,165

61,521 11,949 11,874

48,714

516

14,107

In these industries there were employed in 1890, 162,965 work- people ; in 1899, 156,705. Of the latter number, 49,063 were males and 107,642 females. Of the males, 15,369 were under eighteen years of age ; of the females, 24,533. Of the total number, 15,907 were employed in England and Wales, 72,841 in Scotland, and 67,957 in Ireland. Of those in Scotland, 48,662 were in Forfarshire and 13,369 in Fife. Of those in Ireland, 38,331 worked in the county of Antrim, and 12,654 in Down.

In 1890 there were in the United Kingdom 628 silk factories, with 846,575 spinning and 182,778 doubling spindles, and 11,464 power-looms. The number of workers in the silk factories in that year was 41,277 ; the number in 1899 was 35,461, of whom 10,324 were males and 25,137 females. Of the males, 2255 were under eighteen years of age. Of the whole number, 33,196 were employed in England and Wales, 2194 in Scotland, and 71 in Ireland. Of the English workers, 9882 were in the West Riding of Yorkshire, 7114 in Cheshire, and 2991 in Lancashire.

In the manufacture of hosiery in 1890 there were 257 factories, employing 24,838 workpeople. In 1899 the number of workers in this industry was 35,464, of whom 18,677 were in Leicestershire. In 1890 there were 403 lace factories, employing 16,930 workers. In 1899 there were 17,005 lace workers, of whom 8133 were in Nottinghamshire and 4724 in Derbyshire. Other textile industries are the plaiting or weaving of horse-hair, elastic, and cocoanut fibre, employing in all 9403 workers in 1899. Elastic is woven chiefly in Leicestershire, and cocoanut fibre in Suffolk.

Factory Acts. — The Factory and Workshop Acts passed in the years 1878-97 have extended the inspection of factories and work- shops, and have made the regulations for their management more stringent. Provision has been made against insanitary condi- tions, overcrowding, danger from machinery, from tire, and from unhealthy conditions in processes of manufacture. The number of hours a day during which women or young people may be employed has been prescribed, and the registration of accidents is required. Regulations are laid down for the notification of acci- dents to the Government inspectors and, in the case of the more serious accidents, to the certifying surgeons as well. In 1896

~~the number of factories of all descriptions under the Acts was 160,948 ; in 1897, 178,756. In 1896 the persons employed numbered 4,483,800; in 1897, 4,398,983. The following figures show the number of accidents notified to certifying surgeons and the number (including these) notified to inspectors : —~~

~~Notified.~~

~~1891).~~

~~1S97.~~

~~1898.~~

~~To surgeons To inspectors~~

~~14,433 33,557~~

~~15,987 40,474~~

~~19,227 57,562~~

~~The increase in the number of notifications seems due, not to increase in the number of accidents, but to the extension of factory inspection.~~
~~Fisheries. — See article Fisheries.~~

~~The following table shows the value of the total im- ports, the exports of British produce and manufactures, a and the total imports and exports (including exports of foreign and colonial produce) for recent years : —~~

~~Tear.~~

~~Imports.~~

~~Exports of British Produce, &c.~~

~~Total Imports and Exports.~~

~~1881~~

~~£397,022,489~~

~~£234,022,678~~

~~£694,105,264~~

~~1886~~

~~349,863,472~~

~~212,725,200~~

~~618,822,935~~

~~1891~~

~~435,441,264~~

~~247,235,150~~

~~744,554,982~~

~~1896~~

~~441,808,904~~

~~240,145,551~~

~~738,188,118~~

~~1899~~

~~485,035,583~~

~~264,492,211~~

~~814,570,241~~

~~1900~~

~~523,075,163~~

~~291,191,996~~

~~877,448,917~~

~~1901~~

~~521,990,198~~

~~280,022,376~~

~~869,854,466~~

~~The proportion of imports and exports per head of population of the United Kingdom was : —~~

~~Tear.~~

~~Imports.~~

~~Exports of British~~

~~Total Imports~~

~~Produce.~~

~~and Exports.~~

~~1881~~

~~£11 7 4~~

~~£6 14 0~~

~~£19 17 5~~

~~1886~~

~~9 12 8~~

~~5 17 2~~

~~17 0 10~~

~~1891~~

~~11 10 5~~

~~6 10 10~~

~~19 4 0~~

~~1896~~

~~11 3 11~~

~~6 1 8~~

~~18 14 1~~

~~1898~~

~~11 14 1~~

~~5 16 2~~

~~19 0 6~~

~~1899~~

~~11 19 2~~

~~6 10 5~~

~~20 1 8~~

~~1900~~

~~12 15 9~~

~~7 2 4~~

~~21 9 0~~

~~The merchandise most largely imported consisted of food- stuffs (corn, flour, bacon, hams, butter, sugar, tea), raw materials for manufactures (chiefly cotton and wool), wood and timber, and manufactured silk ; while the chief exports are cotton, woollen, and linen manufactures, iron and steel manufactures and machinery, and coal.~~

~~In the calendar years 1899 imports were : —~~

~~Imports. Corn and flour Bacon and hams Butter . Sugar . Tea . Raw cotton Wool (with yarn) Wood and timber Silk manufactures~~

~~and 1900 the values of the chief~~

~~1899.~~

~~£58,087,692~~

~~14,494,102 17,213,516 19,163,502 10,620,007 27,672,399 26,957,616 25,676,988 16,108,596~~

~~1900.~~

~~£58,942,390~~

~~15,995,778 17,450,435 20,350,147 10,686,910 40,982,594 25,015,160 29,071,227 14,281,250~~

~~The chief exports of the produce and manufactures of the United Kingdom were : — Exports. Cotton manufactures — Piece goods, unbleached . ,, ,, bleached ,, ,, dyed or printed Other cotton goods . Cotton yarn~~

~~Total .~~

~~Woollen manufactures — Woollen tissues Worsted tissues Tapestry, blankets, carpets, &c Woollen yarn .~~

~~Total .~~

~~Linen manufactures — Piece goods Other linen goods Linen yarn~~

~~Total .~~

~~Iron and steel — Pig and puddled Bar, bolt, &c. . Railway . Wire (not telegraph) Tin plates~~

~~Hoops, sheets, plates Cast and wrought Old iron . Steel and manufactures~~

~~Total iron and steel~~

~~Machinery .... Coal, cinders, and fuel~~

~~1899.~~

~~£16,327,646~~

~~12,502,838~~

~~22,028,581~~

~~8,629,977~~

~~8,058,866~~

~~£67,547,908~~

~~£16,188,594~~

~~13,232,873~~

~~22,961,179~~

~~9,626,504~~

~~7,741,129 ■~~

~~£69,750,279~~

~~£5,275,691~~

~~6,250,541 3,262,938 6,721,792~~

~~£5,806,279~~

~~6,467,750 3,308,125 6,123,349~~

~~£21,510,962 £21,805,503~~

~~£3,795,056~~

~~1,277,736~~

~~909,066~~

~~£3,851,615~~

~~1,372,979~~

~~934,201~~

~~£5,981,858 £6,158,795~~

~~£5,994,306~~

~~1,543,143 3,192,067~~

~~904,142 3,976,796 4,978,351 6,328,154~~

~~369,322 4,706,394~~

~~£28,101,049 £31,992,675~~

~~£4,785,244~~

1,229,088 3,127,474 886,347 3,168,614 4,355,709 5,779,381 388,322 4,380,860

£18,372,184 £23,093,250

£18,167,784 £38,619,856

The annual value of the imports into the United Kingdom has largely increased, but there has been no corresponding increase in that of the exports of British produce and manufactures. Many industries which formerly were mainly in British hands have been developed on the continent of Europe, in America, and in the East, and the resulting commercial competition will doubtless become keener. The value of the manufactured cotton goods (exclusive of yarn) exported from the United Kingdom in 1881 amounted to £65,924,478, an amount which has not again been reached. The corresponding value in 1S97 was only £54,043,633, but rose in 1900 to £62,009,150. The value of the woollen and worsted manufactures exported in 1881 amounted to £18,128,756, in 1889 to £21,324,892, but in 1900 to only £15,682,154. In 1881 iron and steel goods were exported amounting to £27,590,908, in 1890 to £31,565,337, in 1894 to £18,688,763, and in 1900 to £31,992,675. The exportation of coal has steadily increased. In

1881 the value of the shipments to foreign countries amounted to £8,785,950, in 1891 to £18,895,078, and in 1900 to £38,619,856.

The following tables show the value of the imports from the principal British possessions and foreign countries into the United Kingdom, and of the exports of the produce and manufactures of the United Kingdom to the principal British possessions and foreign countries in 1901 : —

Imports. £27,391,734

34,852,936

~~British possessions — India~~

~~Australasia~~

~~British North America West Indies and Guiana Cape Colony and Natal Ceylon~~

~~Straits Settlements . Hong Kong Other possessions~~

~~Total . Foreign countries — United States . France Germany . Netherlands Belgium . Russia~~

~~Sweden and Norway Spain Denmark . Argentine Republic . Egypt . Turkey . Chile Italy~~

~~Portugal . Brazil~~

~~China (excluding Hong] Rumania . Greece Austria . Japan Peru~~

~~Philippine Islands . Java Cuba Uruguay . Other countries~~

~~Total .~~

~~Grand total~~

~~20,387,330 2,280,530~~

~~10,093,250~~

~~4,476,552~~

~~6,112,304~~

~~602,841~~

~~4,253,171~~

~~Exports. £34,978,126~~

27,013,778 8,143,695 2,471,529 17,154,380 1,534,914 3,203,511 2,612,725 7,675,743

£110,450,748! £104,788,401

Kong)

£141,015,465

51,213,424

32,207,214

32,871,843

24,666,081

21,903,574

15,352,063

14,040,184

14,234,102

12,414,863

11,905,646

5,838,556

4,313,095

3,383,858

3,305,150

4,957,794

2,116,119

~~3,993,970~~

~~1,465,985~~

~~1,191,294~~

~~1,830,290~~

~~1,813,505~~

~~2,701,810~~

~~212,222~~

~~38,070~~

~~474,501~~

~~6,325,814~~

~~£416,416,492~~

~~£18,393,883~~

~~16,472,068 23,573,785 9,089,149 8,156,203 8,673,334 7,699,985 4,827,110 3,615,223 6,751,632 6,314,867 6,881,976 3,230,837 7,612,562 1,710,829 4,152,091 6,773,599 1,023,103 1,679,138 2,141,185 8,132,223 991,350 862,711 2,028,473 1,217,945 1,322,968 11,905,746~~

~~£175,233,975~~

~~£526,867,240 1 £280,022,376~~

~~The customs revenue collected in the three divisions of the United Kingdom in 1900 and 1901 was as follows : —~~

~~1900. 1901.~~

~~England and Wales . £20,752,353 £26,228,335~~

~~Scotland . . . 2,305,259 2,990,814~~

~~Ireland .... 2,249,113 2,342,038~~

~~United Kingdom . £25,306,725 £31,561,187~~

~~Of the customs revenue in 1901, about 42 per cent, was collected at the port of London, 58 per cent, at London and Liverpool, and 73 per cent, at rive ports. As customs duties are levied on few articles, the amount received at different ports is not proportional to the volume of their trade. The following list comprises the names of all the ports or places in the United Kingdom where the customs receipts amounted to £150,000 in 1900 or 1901 : —~~

~~Port.~~

~~1900.~~

~~1901.~~

~~London~~

~~. £11,388,560~~

~~£13,249,155~~

~~Liverpool~~

~~4,174,793~~

~~5,011,837~~

~~Bristol .~~

~~1(886,808~~

~~2,321,596~~

~~Glasgow~~

~~1,408,760~~

~~1,435,087~~

~~Belfast .~~

~~1,264,828~~

~~1,158,358~~

~~Leith .~~

~~474,714~~

~~715,223~~

~~Dublin .~~

~~633,042~~

~~707,295~~

~~Newcastle and~~

~~Tyne ports 380,460~~

~~695,878~~

~~Cardiff~~.

~~36,999~~

~~490,097~~

~~Hull .~~

~~135,901~~

~~380,435~~

Nottingham .

385,794

378,538

Manchester ,

188,455

291,790

Newhaven .

222,713

260,218

Dundee

147,003

189,593

Harwich

139,122

171,268

Greenock

35,909

169,467

Sunderland .

101,996

162,336

1 This total includes the value of the diamonds exported from Cape Colony to Great Britain.

During recent years there has been a great development of the shipping movement of the United Kingdom. Since 1881 the tonnage entered and cleared at British ports from and to foreign countries and British possessions has increased by about 68 per cent. The tonnage of British vessels employed in the carrying trade between the United Kingdom and foreign countries has increased by about 51 per cent., and that of foreign vessels by about 110 per cent., but the absolute increase in the British tonnage so employed exceeds that of the foreign. The British and foreign vessels (both sailing and steam) that entered and cleared from and to foreign ports and British possessions in 1881 and in every subsequent fifth year were in aggregate tonnage as follows : —

Tear.

Entered.

British.

Foreign.

Total.

Tons.

Tons.

Tons.

1881 1886 1891 1896 1901

20,437,035 22,741,061 26,637,187 30,881,919 31,336,644

8,081,980

8,294,557

10,221,828

11,595,540

17,264,372

Cleared.

28,519,015 31,035,618 36,859,015 42,477,459 48,601,016

1881 1886 1891 1896 1901

21,106,224 23,337,238 27,320,248 31,182,416 31,453,197

8,324,306

8,468,221

10,633,357

11,802,547

17,296,800

29,430,530 31,805,459 37,953,605 42,984,963 48,749,997

In 1881 steam vessels engaged in the foreign and colonial trade entered British ports to an aggregate tonnage of 19,268,327, of which a tonnage of 16,038,726 consisted of British steamers ; in 1901 the steam vessels that entered had a total tonnage of 44,936,305, of which 30,272,229 tons represented British steamers.

In the coasting trade in 1901 the total tonnage that entered at ports of the United Kingdom amounted to 55,809,105, of which 50,176,941 tons represented steam vessels; the total cleared, 54,454,183 tons, of which 48,926,672 tons belonged to steamers.

~~*The tonnage of the vessels engaged in the foreign and colonial and coasting trade that entered and cleared at the principal ports of the United Kingdom in 1901 was as follows : —*~~

~~*Port.*~~

~~*Entered.*~~

~~*Cleared.*~~

~~*Total.*~~

~~*Tons.*~~

~~*Tons.*~~

~~*Tons.*~~

~~*London*~~

~~*15,952,453*~~

~~*15,204,882*~~

~~*31,157,335*~~

~~*Liverpool*~~

~~*9,704,160*~~

~~*9,671,604*~~

~~*19,375,764*~~

~~*Cardiff .*~~

~~*9,290,785*~~

~~*9,498,557*~~

~~18,789,342~~

~~Tyne ports .~~

~~8,491,535~~

~~8,299,793~~

~~16,791,328~~

~~Glasgow~~

~~3,757,271~~

~~4,022,149~~

~~7,779,420~~

~~Hull .~~

~~3,102,869~~

~~2,935,975~~

~~6,038,844~~

~~Southampton~~

~~2,892,346~~

~~2,793,171~~

~~5,685,517~~

~~Sunderland .~~

~~2,468,933~~

~~2,583,929~~

~~5,052,862~~

~~Dublin .~~

~~2,422,125~~

~~2,419,171~~

~~4,841,296~~

~~Cowes .~~

~~2,104,396~~

~~2,104,150~~

~~4,208,546~~

~~Newport~~

~~2,102,028~~

~~2,097,878~~

~~4,199,906~~

~~Greenock~~

~~1,963,030~~

~~2,121,478~~

~~4,084,508~~

~~The number and gross tonnage of the registered sailing and steam vessels belonging to the United Kingdom were as follows at the end of each of the years named : —~~

~~Year.~~

~~Sailing Vessels.~~

~~Steam Vessels.~~

~~Number.~~

~~Gross Tonnage.~~

~~Number.~~

~~Gross Tonnage.~~

~~1886 1891 1896 1901~~

~~16,179 13,823 12,274 10,572~~

~~3,512,783 3,108,379 2,909,296 2,135,265~~

~~6653 7720 8522 9484~~

~~6,321,504~~

~~8,545,252 10,237,703 12,472,584~~

~~These figures show, not only that steamers have been rapidly taking the place of sailing vessels, but also that large steamers are preferred to small, their average tonnage having increased from 950 tons in 1886 to 1315 in 1901.~~

~~Shipbuilding is carried on principally on the Tyne, at Sunder- land and Hartlepool, on the Clyde, and at Belfast. In the year 1901 there were finished (exclusive of vessels for the navy and vessels for'foreigners) 567 sailing vessels of an aggregate tonnage of 54,967, and 637 steamers of, in all, 720,714 tons net, the total net tonnage of the new vessels being thus 775,681, the largest turn-out of any former year having Been that of 1883, when the corresponding amount was returned as 768,576 tons. Of the steamers finished in 1901, 81, of 73,277 tons net, were built at~~

~~UNITED PROVINCES— UNITED STATES~~

East and West Hartlepool ; 58, of in all 132,284 tons net, at Sunderland ; 99, with an aggregate net tonnage of 141,982, at the Tyne ports (Newcastle and North and South Shields) ; 151, of altogether 217,008 tons net, on the Clyde, and 9, of 38,568 tons, at Belfast. For foreigners there were built 10 steamers, of, altogether, 11,000 tons net, for war purposes, and 71 sailing vessels, of 6696 tons, and 113 steamers, of 189,756 tons net, for mercantile purposes. The total net tonnage (exclusive of vessels for the British navy) completed during the year thus amounted to 983,133 tons. In the Board of Trade returns the value of the vessels built for foreigners in 1901 is put at £9,149,444.

Post Office. — See Post Office.

The telephone came into use in 1879, and soon after- wards two companies were formed to establish telephone

exchanges or offices whence lines should extend phones. *° *^e omces 0I subscribers. The proceedings of

these companies were declared to be an infringe- ment of the Post Office monopoly in the transmission of telegrams, but an arrangement was made whereby licences were granted to the companies to carry on the work of telephone exchanges in London and in various provincial towns, while the Post Office established exchanges in other places. This arrangement proved unsatisfactory, and in 1892 an Act was passed providing for the purchase by the Post Office of the trunk lines belonging to the companies, and for the restriction of the companies' operations to local areas. After about four years' negotiation the agreement for the transfer was signed 25th March 1896, and on 6th February 1897 the transfer was completed. The price paid to the National Telephone Company was £459,114. The length of trunk line transferred was 2651 miles, and the length of wire was 29,000 miles. The Post Office had erected 19,620 miles of trunk wire, and had in course of construction 4180 miles of trunk wire, so that in 1897 it had in all 52,800 miles of trunk telephone wire, and for trunk telephone business 243 post offices were open. On 31st March 1902 the number of post office trunk wire centres was 328 ; the trunk circuits in

use numbered 1165, and contained 98,000 miles of wire, the total amount of capital expenditure on the purchase and development of the system having been £1,896,650. During the year 1901-02 the number of trunk wire con- versations was 10,080,716, involving at least 20,161,432 spoken messages, and the revenue therefrom amounted to £238,720. At the end of March 1902 the number of contracts in existence for Post Office telephone exchange wires and for private telegraph wires was 6151 ; the mileage of such wires was 41,207 ; the instruments num- bered 15,432, and the rentals for the year amounted to £182,143. Under the Telegraph Act, 1899, works neces- sary for the establishment of a Post Office exchange system in the London area were undertaken, and on 24th February 1902 the central exchange was opened. The capital outlay up to 31st March 1902 was £795,846. The licence held by the National Telephone Company (granted for 31 years) will expire in 1911. The company pays to the Post Office department a royalty of 10 per

cent, of its gross receipts, the amount of the royalty in 1901-02 having been £149,910. At the end of the year 1901 the company in its various local areas had 219,849 telephone stations (or instruments), which worked through 1019 exchanges, the number of public call offices open being 2610. Of the exchanges, 762 were working as metallic circuit exchanges, and the rest were in process of conversion. During the year 1901 the number of messages was 723,000,000, or an average of about 2,410,000 for each working day. In the London metro- politan area the company had 46,364 telephone stations (or instruments), 51 exchanges, and 909 public call offices. The number of messages in London in 1901 was 125,000,000. In November 1901 a fresh agreement was made between the Post Office and the National Telephone Company providing for intercommunication between sub- scribers to the systems of the company and the Post Office in the London area.

(For Banking, Savings Banks, &c, see separate articles.)

Authorities. — The following publications relating to the United Kingdom are issued annually in London : — Finance Accounts; Financial Estimates; Return showing Revenue and Expenditure (England, Scotland, and Ireland) ; National Debt during 60 Years; Local Taxation

~~Returns; Army Estimates; Army Returns ; Army List (quarterly) ; Navy Estimates ; Navy List (quarterly) ; Mineral Statistics ; Reports of Inspectors of Mines; Reports on Factories and Workshops; Reports of Inspectors of Fisheries; Return of Fish conveyed inland by rail; Statement of the Trade of the United Kingdom; Statement of the Shipping and Navigation of the United Kingdom; Report of the Postmaster — General ; Statistical Abstract for the United Kingdom. Among books may be mentioned the following : — Anson. The Law and Custom of the Constitution. 2 vols., 2nd ed. Oxford, 1892-96. — Boutmy. Le Developpement de la Con- stitution et de la Sociiti politique en Angleterre. 2nd ed. Paris, 1897. [Of this there is an English translation (from 1st ed.) by I. M. Eaden. London, 1891.] Etudes de Droit Constitutionel, France, Angleterre, Etats-Unis. Paris, 1885. [English transla- tion by E. M. Dicey. London, 1891.] — Brassey. The Naval Annual. Portsmouth, 1886 onwards. — Clowes and other writers. History of the Royal Navy. London, 1896-1901. — Dicey. Introduction to the Study of the Law of the Constitu- tion. 5th ed. London, 1897. — Eardley-Wilmot. Our Fleet To-day and its Development during the Last Half Century. London, 1900.' — Fortescue. History of the British Army. London, 1899. — Gastuell. Our Trade in the World in relation to Foreign Competition, 1885-1895. London, 1897. — Giffen. Essays in Finance. London, 1880 and 1886. — Gneist. Das Englische Parlament in tausendjahrigen Wandelungen. Berlin, 1885. [Translated into English by A. H. Keane. History of the English Parliament. London, 1889.] Englische Verfassungs- geschichte.* Berlin, 1882. [Translated into English by P. A. Ashworth. London, 1891.] — Hull. Our Coal Resources at the Close of the Nineteenth Century. London, 1897. — Rogers. Industrial and Commercial History of England. London, 1892. — Seeley. The Growth of British Policy. 2 vols. London, 1895. — Taylor. The Origin and Growth of Hie English Con- stitution. 2 vols. London, 1889-99. — Todd. Parliamentary Government in England. New edition revised by S. "Walpole. 2 vols. London, 1892. (i. p. a. E.)~~

~~United Provinces.~~

~~Provinces and Oudh.~~

See Noeth — Westeen

UNITED STATES.

I. Physical Features.

THE natural resources and climate of the United States are treated at length in Ency. Brit. vol. xxiii. (ninth edition) (see also America, vol. xxv.). We have here to deal chiefly with the physical features in the light of recent physiographic researches.

An outlying upland of the Laurentian highlands of Canada projects into the United States west and south of Lake Superior. Although composed of greatly deformed

rocks, chiefly of crystalline texture, the upland as a whole is gently rolling, and the inter-stream surfaces are some- times plateau-like in their evenness, with alti- tudes of from 1400 to 1600 feet in the higher J"erior portions. The uplands are occasionally sur- oidiand. mounted by low hills of particularly resistant rocks. Here, therefore, we find one of those ancient mountain regions reduced by long-continued erosion to a surface of moderate relief. The erosion of the region must have been well advanced in very ancient times, for*

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[physical

the denuded surface is bordered by the overlapping marine fossiliferous strata of early geological date (Cambrian), which imply a depression of the region beneath an ancient sea subsequent to a long existence as dry land. After renewed elevation of moderate measures, erosion in later periods gently bevelled the ancient land in producing the even skyline of to-day. The valleys by which the uplands are here and there trenched indicate another uplift of still more modern date. Glaciation has strongly scoured away the deeply-weathered soils that presumably existed in pre -

Glacial time, revealing firm and rugged ledges in the higher parts and spreading an irregular drift cover over the lower parts, whereby the drainage is much disordered, here being detained in lakes and swamps (muskegs), there rushing down rocky rapids. The region is therefore uninviting to the farmer, but it is attractive to the lumberman and to the miner. Native copper is found on Keweenaw Point, on the southern side of Lake Superior ; and abundant iron ores, exploited in recent years, have greatly affected the iron industry of the United States. The Adirondack mountains of northern New York are of similar history, but they do not seem ever to have been so well worn down as the ancient mountains of the Superior region, and to-day they pre- sent rather strong relief, although without sharp peaks (Mount Marcy, 5344 feet). Their rugged rocky surface, heavy forests, and abundant lakes make them natural preserves of wild game and a noted summer resort. Much timber has been cut from them, but systematic effort is now directed towards the better conservation of the forested areas.

The Palaeozoic strata which lap upon the southern slope of the Superior oldland are but part of a great area of

similar strata, hundreds of feet in thickness, thSa"at whi°h decline very gently southwards from their Lakes. overlap upon the Laurentian oldland of Canada.

They represent the deposits of an ancient sea whose floor was provided by the submergence of a still more ancient land. Since the elevation of the region, and the addition of the sea-bottom sediments to the continental area, they have been much eroded, and hence do not now retain their original extent. As is always the case in the broad denudation of gently-inclined stratified structures, the weaker layers are worn down in subparallel belts of lower land between the more resistant strata which rise in uplands. The firm Niagara limestone makes one of these uplands ; it may be traced on a curving course from western New York, where it separates the lowlands that contain the basins of Lakes Ontario and Erie, through the province of Ontario to the belt of islands that separ- ates Georgian Bay from Lake Huron, thence westwards and southwards to along the narrow strip of upland that divides Green Bay from Lake

Michigan in eastern Wisconsin, and finally across southern Wisconsin and into north-eastern Iowa. The arrangement of the Great Lakes is thus seen to be closely sympathetic with two belts of weaker strata : Ontario, Georgian Bay, and Green Bay occupying depres- sions in the lowland, on the oldland side of Niagara up- land ; Erie, Huron, and Michigan lying in depressions in the lowland on the other side of the same upland. Lake Superior is an exception to this statement ; it lies in the oldland, as if occupying a basin of local deformation. This is a most fortunate though unsystematic extension of the Great Lakes, for thereby the wheat of the north- western prairies, the lumber from the forests, and the copper and iron ores of the Superior oldlands are given cheap transportation to the more eastern states ; the freight that passes through the Sault Ste Marie ship canal be- tween Lakes Superior and Michigan exceeds in tonnage, if not in value, that which goes through the Suez Canal.

The middle Appalachians, in Pennsylvania, Maryland, and northern Virginia, may be divided into two belts ; one chiefly of crystalline rocks on the south east, the other of heavy Palaeozoic strata on Middle the north-west. Both belts have been greatly]aPJ/,%ns- deformed, and both were doubtless strongly mountainous for a long period after the time of de-formation ; but that was so long ago that they have been reduced to a peneplain or lowland of mild relief by subsequent (Mesozoic) erosion. A general elevation oc- curred in Tertiary time, of greater measure to the north- west (inland) than to the south-east (near the coast), in consequence of which the weaker strata have been etched out of the uplifted lowland to form lower lands of a second order, while the resistant rocks still exhibit up- lands and long even-crested ridges, 1000 to 2500 feet in height, whose altitude indicates more or less closely the uplift given to the peneplain of the previous cycle of denudation. The belt of stratified rocks exhibits a peculiar large-scale zig-zag pattern in its ridges and valleys, somewhat similar to the lines seen on a weather- beaten board of irregular grain. This is the present geo- graphical consequence of the huge wave-like folds into which the strata were long ago crushed. The ridges are cloaked with coarse stony waste and are given over to tree growth ; the lowlands between them are generally occupied by farms whose soil is especially fertile when the underlying rocks are limestones. Some of the valleys between the ridges contain the important deposits of

anthracite coal for which Pennsylvania is famous. The chief streams and rivers of the region have eroded deep notches or "gaps" through hard strata of the ridges, during the etching of lowlands on the adjoining weaker strata ; hence the drainage lines have a rectangular pattern, changing from longitudinal paths in the valleys to transverse paths through the ridges.

The dissected uplands of the crystalline belt are of moderate height, because the uplift of this belt since its peneplanation has been of moderate measure. Along its north-west side the hills are high enough to make occupa- tion difficult ; the stony slopes are left forested, while the more even uplands are cultivated in isolated farms. On the south-eastern side of the crystalline belt, where its uplift was small, the rolling hills are usually cleared and occupied by farms and villages. Near the line of the Delaware river between Trenton, N.J., and Philadelphia, Pa., the uplands decrease in height till they dip underground, and thenceforward to the south-east they are covered by the later strata of the coastal plain.

The belt of stratified rocks in the Appalachians becomes less mountainous north-east of Pennsylvania and south- west of Virginia, because its resistant members there weaken or thin out more or less com- iHChians pletely. It is therefore generally worn down of the to a lowland, known as the Champlain-St north-east Lawrence valley, inland from New England ; sott^.weSf and as the valley of east Tennessee, inland from North Carolina. These two lowlands are indeed connected by some of the etched lowlands between the ridges of the middle Appalachian section described above ; and the continuous depression stretching from Lake Champlain to Alabama is commonly called the Great Appalachian valley. Conversely, the belt of crystalline rocks broadens from its middle to the north-east and south-west ; and in New England and North Carolina it forms extensive uplands — parts of the uplifted peneplain of the previous cycle of erosion — which gradually ascend inland from their lower border near the sea. The up- lands are much dissected by valleys, in which many of the villages and towns are situated. Over the uplands in the

features]

interior rise the White Mountains of Ne.w England and the Black Mountains of North Carolina, unconsumed remnants of a once much loftier and more extensive mountain system. They include many dome-like summits between 5000 and 7000 feet in height (Mount Washing- ton^ N.H., 6293 feet; Mount Mitchell, N.C., 6711 feet). Their slopes are seldom precipitous, and are usually covered by dense forests ; but the White Mountains rise somewhat above the tree line. In New England, where the sloping uplands descend gradually to the sea, the coast is of irregular outline, on account of a slight sub- mergence after the erosion of the upland valleys ; many low rocky headlands and islands are separated by inreach- ing arms of the sea. On the other hand, the eastward slope of the broad crystalline uplands that are piedmont to the mountains of southern Virginia and North Carolina leads forward to the coastal plain of the southern Atlantic states. The loss of breadth in the crystalline belt about Philadelphia — that is, midway between the broader and mountainous crystalline areas of New England and North Carolina — is probably only apparent. It is due to a greater depression in the middle than to the north-east or south-west after the region had been worn down to a peneplain, as above described. By reason of this depression, the sea overlapped the former land area more here than elsewhere ; and when elevation afterwards revealed the deposits of the overlapping sea in the coastal plain from New York southwards, the crystalline belt re- mained very narrow about Philadelphia. It is a highly significant fact that the important Atlantic cities — New York, Philadelphia, and Baltimore — all lie on the border of the narrowest part of the crystalline belt, where its reduced width and height offer the least obstruction to traffic between the coast and the interior ; while the mountains of the crystalline belt in the north-east and south-west are effective barriers to movement ; it is in spite of the hilly uplands, and largely on account of early settlement and shorter distance to European ports, that Boston has maintained its high position among the Atlantic cities.

After the general wearing down of the ancient Appa- lachian mountains, a portion of the lowland thus produced was depressed beneath the sea on the south- east, and there received as marine sediments the waste from the neighbouring mainland. North- east of New York City, a later movement of depression has allowed still further encroachment of the sea on the land, producing the New England harbours ; but south- west of the same point the later movements were up- lifts, and the sediments of the sea floor have been revealed in a broadening coastal plain that gives character to the border of the southern Atlantic and Gulf states. By these uplifts the mountains of North Carolina have gained an additional measure of height, while the northern depression has correspondingly lowered the mountains- of New England. If this balancing move- ment had been reversed, it might have added a thousand feet to the height of the White Mountains, which would then bear small glaciers, while now they are completely bare of snow in summer, except for a few lingering drifts in certain high ravines. The different parts of the southern coastal plain exhibit a good variety of the features that usually characterize such structures. In South Carolina, for example, where the plain is about 100 miles wide, the extension of the rivers from the crystalline oldland across the plain in the general direction of its slope, and the growth of numerous river branches on the plain itself, have produced many valleys whereby the plain has been more or less completely converted into a hilly region, especially along its inner half; only the coastal

The coastal plain.

border, where the uplift is more recent and of lesser height, still retaining a smooth surface. The plain is thus irregularly divided into many transverse hilly strips or " interfluves," that extend with decreasing height from the oldland towards the shore. A similar arrangement is found in the much wider Texan portion of the coastal plain. In Alabama, where the plain is over 150 miles wide, another style of dissection has resulted from the occurrence of a series of particularly weak calcareous strata at the base of the coastal plain series, followed by more resistant sandy strata in the middle. The former are eroded to a lowland of fertile soils along the inner side of the plain, while the latter retain in the " Chunnenugga ridge " much more of their original height of uplift, falling off to the inner low-

land by a relatively strong infacing slope, and descending very slowly to the coastal lowland. The inner lowland is the cotton belt of the state. Here the long rivers from the oldland on the north and the short streams from the infacing slope of the " ridge " unite to discharge their waters by a river that traverses the upland belt on its way to Mobile Bay. The narrowing plain in New Jersey exhibits a similar arrangement of relief, but of less strength ; the inner lowland is underlaid by plastic clays, supporting many potteries : it has long been a line of travel between New York and Philadelphia. The enclosing upland consists of sandy layers with some marl beds which are used as fertilizers all along 'the upland. The outer slope descends slowly to the sea, and is largely occupied by " pine barrens " on an infertile sandy soil ; here, as in other borders of the coastal plain, artesian wells afford excellent water. This longitudinal arrange- ment of relief is like that by which the Niagara upland and the lowlands of the Great Lakes are determined, as above described ; it is well known in many parts of the world, as in central England and north-eastern Prance, yet it has received no general name by which its features may be easily brought to mind, unless it may be called a belted coastal plain, or a coastal plain of longitudinal relief. Florida is an extension of the coastal j>lain — low and level, or gently undulating. Its calcareous strata contain many shallow lakes without outlet. Calcareous phosphates, promising to be of increasing value as the soils of northern prairies require fertilizers, occur abundantly here and in other low borders of the coastal plain. In its southern extremity Florida has been lengthened by the addition of fringing coral reefs and mangrove swamps. The mild climate of the peninsula induces the cultivation of semi-tropical fruits, but this is occasionally interfered with disastrously by the arrival of a " cold wave " in winter, with temperature just below freezing-point.

Certain parts of the coastal plain have been slightly depressed since their dissection, thus decreasing their breadth, drowning the lower valleys into bays of irregular outline, much valued as fishing grounds and oyster beds, and greatly shortening the rivers, while the dissected interfluves form peninsulas fringed with low headlands. Delaware and Chesapeake Bays, the lower part of what is called " Potomac river," with several other estuaries in "tide-water Virginia," and the large sounds, Albemarle and Pamlico, in North Carolina, are thus explained. Elsewhere the plain is

usually bordered by off-shore sand reefs, enclosing shallow salt-water lagoons or tidal marshes. Where the tides are weak, as in the Gulf of Mexico, the sand reefs extend without interruption for scores of miles, as along the Texas coast. Where the tides have a medium value, the reefs are broken, at distances of 10 or 20 miles, by inlets, kept open by flood or ebb currents, as along the New Jersey coast. Where the tides are some- what strengthened in a re-entrant of the coast, the inlets are numerous, becoming so close together that the reefs

are inconspicuous, as on the coast of South Carolina; here the transverse action of tidal currents seems almost to gain the ascendancy over the long-shore movements by which the smooth outline of the reefs is elsewhere con- trolled. All the tidal inlets are shallow and their channels are embarrassed by shifting bars ; hence they do not afford convenient entrance to harbours. A few exceptional forms' of shore line are found in the cusp-like capes of the North Carolina, coast, where the concave sand reefs of the inter- vening bights unite in sharp points projecting into the sea. The cusps are evidently formed and continuously maintained by the action of sea waves and currents, for otherwise their weak sandy points would soon be worn back by the attack of the sea. The controlling cause of their form is believed to be a series of slowly eddying currents between the Gulf Stream and the mainland, the prevalent 'long-shore movement being to the south-west in each bight, and the cusps occupying what would otherwise be dead-water triangles between adjacent eddies. Cape Canaveral, on the eastern coast of Florida, seems to be of similar origin.

The same series of Palaeozoic rocks that is folded in the Appalachians remains almost horizontal north-west of the mountains, sharing, however, the uplifts of Ter- ^*e tiary time. Originally a broadly continuous

plateau plateau gradually decreasing in height west- wards, the surface is now elaborately dissected by the valleys of irregularly-branching streams,

leaving a multitude of hills, with altitudes of from 2000 to 4000 feet near the Appalachians, and loca'l relief of quarter or half that height, but declining in strength westwards. This rugged country is known as the Catskill Mountains in New York, the Alleghany plateau in Pennsylvania and West Virginia, and the Cumberland plateau in Kentucky, Tennessee, and northern Alabama ; the second name is here used for the whole area. The valleys branch intri- cately between the hills and spurs, giving the impres- sion of an orderless maze. Here, if anywhere, one may be convinced of the origin of valleys by the erosive action of their streams ; for, as John Playfair wrote a hundred years ago, every stream runs in a valley propor- tionate to its size, and all the streams unite to form a system of valleys communicating with one another and having so nice an adjustment of their declivities that no branch joins a main valley at either too high or too low a level — " a circumstance which would be infinitely improb- able, if each of these valleys were not the work of the stream that flows in it." The general absence of either broad uplands or open lowlands and the prevalence of steep-sloping hill-sides has made the occupation of the dissected plateau difficult. There are few stretches of level ground adapted to agriculture ; every detached farm on an upland requires its own road from the valley, difficult to construct and expensive to maintain; the valley floors are narrow and exposed to floods that rise rapidly, so that bridges are o'ften swept away, the building of stronger ones being beyond the means of the scattered population. The higher parts of the dissected plateau re- main relatively a wilderness between the greater population of the coastal lands and the interior prairies, and the people are generally poor and slow of progress ; in the more remote districts, as yet not invaded by transverse railways, the people have been well called " our contemporary ancestors," so largely do they retain old-fashioned habits of action and speech. They call themselves " moun- taineers," in distinction from the dwellers in the open lower country. The great area of forest brings lumber- men to the hills and saw-mills to the valleys ; in western Pennsylvania the coking coals are of immense value in iron- works ; rock oil and natural gas have been actively

exploited ; and here a large industrial population has gathered, Pittsburg being a city of altogether exceptional size in the plateau country. In West Virginia, Kentucky, and Tennessee, the abundant coal beds are only

~~beginning to be worked extensively, and the fuller development of that part of the plateau country is left to the future.~~

~~Although the Glacial period is usually supposed to con- cern the geologist, still the effects of glacial action are manifest in many geographical features over the Tbe country north of the Ohio and east of the northern Missouri rivers. The dissected uplands around glaciated Lake Superior and in New England have been area' made more rugged, as we have seen, by the scouring off of the soil with which they were probably covered in pre- Glacial times, and the drainage has been much obstructed by the irregular distribution of Glacial drift ; hence the streams are held back in numerous lakes or turned into new courses, where they rush or fall over rocky ledges. Lower lands have on the other hand been made less rugged, partly by wearing away their more salient pre-Glacial forms, partly by blanketing them with drift of sub-Glacial origin (till), as in the district bordering the Great Lakes (except Superior) on the south; here the drift surface is continuous and nearly level for many miles together, while the under- ground rock floor has low hills and shallow valleys, as has been proved by numerous borings for gas and oil. In some districts the sub-Glacial drift or till was accumulated in arched hills of lenticular form one or two hundred feet high, known as " drumlins," giving the landscape a well- specialized appearance, as in parts of south-east Wisconsin, western New York, and southern New England. Boston harbour is characterized by drumlin islands, cliffed by the waves. A complexity in the Glacial period is proved by the greater or smaller erosion suffered by the till sheets of different districts ; thus in the prairies of northern Missouri and southern Iowa what was once a plain of till is now well dissected, even by small streams and rivulets ; this till is referred to an early Glacial invasion ; elsewhere the till retains its initial surface little changed, except where trenched by the narrow valleys of the larger streams, as in the prairies of northern Illinois and Iowa, and over much of Minnesota ; this till sheet is taken to be the deposit of the latest Glacial epoch. The inter-Glacial epoch, between the two invasions represented by these till sheets, was much longer than the current post-Glacial epoch.~~

~~The front of the latest ice sheet (best known because its records are least changed) was lobate, in consequence of the faster advance of the ice along the lowlands that led from its Canadian source, and of its retarded movement over the intervening higher lands. The occurrence of large lakes in close relation to the several ice lobes of the Glacial front has given ground for ascribing the lake basins in greater or lesser degree to Glacial erosion. Successive terminal moraines were formed around and under the lobate margin of the ice at its farthest advance and during halts in its final retreat. The moraines are belts of low hills enclosing undrained hollows ; they are often several miles in breadth, and sometimes over a hundred, feet in local relief, with increasing strength on the inter- lobate cusps ; they are frequently the only interruptions of the monotonous expanse of the prairies. Small lakes are numerous in the moraines of northern Indiana and throughout Minnesota. During the presence of the ice sheet the streams that ran away from the ice margin were charged with gravel and sand, with which they filled or aggraded their valley floors; after the ice retreat the streams trenched the valley gravels, producing terraces, such as are common from Ohio eastwards to New England. On the other hand, the rivers that flowed towards the ice sheet from the unglaciated country on the south were~~

~~features]~~

~~more or less disordered. It frequently happened that such rivers were constrained to flow along the ice margin ; temporary marginal lakes were thus formed in the obstructed -valleys, and new channels were cut by the deflected rivers through the hills of the pre-Glacial inter- fluves, ultimately draining the marginal lakes. It is believed that the present courses of the middle Ohio and of the lower Missouri rivers were thus in great part determined. Many of the ice margin lakes were small and short-lived ; their silty deposits are unimportant ; but in the later stages of retreat, when the ice sheets had evacuated the Great Lakes lowlands, but still obstructed their north-eastern discharge, vast bodies of standing water gathered in front of the ice margin, overflowing by the lowest~~

~~passes through the uplands on the south, and carving large channels on their way to the Mississippi. Many short channels of this kind are known among the hills of the Alleghany plateau in western Pennsylvania; an important channel of the same class is now followed by the Chicago drainage canal and Illinois river, and one of the longest and largest channels is that adopted by the existing Minnesota river. The silt deposited in the vast ice marginal lakes forms rich and smooth prairies to-day, as in the great plain of the Eed River of the North, stretching from Minnesota and North Dakota into Manitoba, and again around the southern borders of Lakes Erie and Michigan. It was only as a farther retreat of the ice front opened an eastward discharge of the marginal lakes that Niagara river came into existence ; hence the length of the gorge that it has cut from the north-facing bluff of the Niagara upland back (southwards) to the present cataract has been taken as measuring post-Glacial time (see Niagara Falls.). In these, and in very many other ways, the Glacial period was directly or indirectly responsible for numerous existing geographical features.~~

~~A slight warping of the continental mass, by which an axial trough was established between the broad slopes from the higher lands on the east and west, resulted in the formation of a vast river system of which the Mississippi is the trunk, with the Ohio and Tennessee as chief branches on the east, and the Missouri, Arkansas, and Eed on the west. The area of the basin is 1,240,000 square miles, and the actual river length from mouth to farthest head (in Montana, at the source of the Missouri) is over 4000 miles. The medial portion of this vast basin is often spoken of, rather vaguely, as the "Mississippi valley." On the east it begins with the glaciated uplands of Wisconsin; then follow the prairies of Illinois in the glaciated area ; the hilly uplands of western Kentucky and Tennessee, gradually descending from the Alleghany plateau; and the greater embayment of the southern coastal plain in westernmost Tennessee, Mississippi, and Louisiana. On the west the "valley" begins with the oldlands of Minnesota (Lake Itasca, a small lake among morainic hills, here gains a fictitious importance because the name "Mississippi" is carried all the way up to it, while many other head-waters of equal intrinsic importance and at greater distance from the Mississippi mouth are left unmentioned) ; the prairies on the smooth and rolling younger~~

~~and older drift sheets of Minnesota, Iowa, and Missouri; the Ozark plateau in southern Missouri and northern Arkansas, very similar in history and form to the less rugged parts of the Alleghany plateau ; the Ouachita (Washita) Mountains of central Arkansas and Indian Territory repeating many features in the history and topography of the stratified belt of the Appalachians ; and, finally, the southern coastal plain.~~

~~*In the earlier accounts of the United States much emphasis was given to the economic value of the navigable*~~

~~*The*~~

~~*Mississippi*~~

~~*valley.*~~

~~*members of the Mississippi system, on account of their great length and their penetration to great distances inland ; but with the enormous development of railways, especially on the prairies and plains of the interior, river transportation has taken a subordinate place. It is still of importance along the trunk river from St Louis to New Orleans, and of service for local traffic on the branch rivers; but the Mississippi and its larger tributaries are to-day rather hindrances than aids in commercial move- ment, on account of the great expense involved in bridg- ing their broad waters. The upper Mississippi and its branches follow valleys from one to five mile's wide that have been eroded in drift and the underlying rocks; they are therefore of modern date, and many of them gained their present form while the local river volume was increased during the ice retreat by the overflow of the great ice margin lakes, as already described. Throughout the northern part of' the system the flood plains are relatively narrow; but the lower Missis- sippi, below Cairo, III., traversing the great re-entrant of the southern coastal plain, has eroded a broad valley in the weak strata that it there encounters, forming a flood-plain that is from 20 to 60 miles in width; the plain being enclosed by the uplands of the coastal plain, on which cities are built wherever the great river swings against the marginal cliffs — Memphis, Vicksburg, Natchez, and Baton Rouge thus standing on the cliffs of the eastern uplands, and Helena on the western. The mighty river meanders freely on the flood plain, con stantly wearing away its outer bank, shifting its course laterally, and thus frequently cutting through the narrow- ing neck of land that separates two bends. A well- defined channel, often over 80 feet deep, is maintained near the outer side of the curves, but the stretches or tangents between the curves are obstructed with shifting shoals, making navigation difficult. As in all flat-floored valleys, the deposit of silt at time*~~

of flood, chiefly in the neighbourhood of the main channel, causes the flood- plain to slope gently away from the main river at a rate of 5 or 10 feet to the mile. Hence the flood -plain settlements are close along the river front ; but New Orleans is the only large city thus situated. The sides of the plain are frequently swampy, and not yet brought into cultivation, nor can they safely be utilized until a greater mastery of the river is accomplished by the completion of the system of levees (dykes) near its banks. Much of the plain is forested ; the soil is very fine and rich, and where the surface is high enough, or well enough protected by levees, it is cultivated and yields abundant crops of cotton and sugar-cane. Occasional high floods are still extremely destructive; that of 1897 covered 13,000 square miles of the plain, destroying property worth at least $15,000,000. The flood waters spread over and flow down the back swamps, returning to the main channel perhaps hundreds of miles below the points of chief overflow.

The delta of the Mississippi is strongly digitate in out- line and determined by the outflow of several distribu- taries or outgoing branches, whose mouths or " passes " lead to the gulf. One of the passes has been extended by the construction of artificial jetties, thus strengthen- ing the current and increasing the depth of the water to serve the needs of navigation. The volume of river dis- charge is 75,000 cubic yards a second ; it annually bears to the gulf 406,250,000 tons of suspended sediment, and 112,832,000 tons of materials (chiefly limestone and salt) in solution.

The Great Plains, standing at altitudes of from 3000 to 6000 feet at the base of the Rocky Mountains, slope very gradually eastwards for two-thirds of the distance to the

[physical

Mississippi river, where they merge into the several dis- tricts already described as composing the western side of the " Mississippi valley." The plains extend far northwards into Canada, but narrow rapidly southwards in Mexico. This belt of the con- tinent remained beneath sea-level until a late geological period, maintaining marine connexion between the Gulf of Mexico and the Arctic Ocean. The sediments there gathered were received largely from the waste of the mountains on the west, for the strata become thicker and coarser in that direction. The broad uplift of these marine strata produced the plains, with alternating con- ditions of erosion and deposition : the rivers from the mountains sometimes acted as destructive agents, denud- ing the uplifted surface ; sometimes as constructive agents, spreading the mountain waste far and wide in fluviatile deposits ; broad and shallow lakes are thought to have been formed in areas of slight depression, and here fine sedi- ment was gathered, of special interest from the numerous vertebrate fossils which it has preserved. The surface features of the Great Plains include a large variety of forms, although on the whole presenting the broad vistas to which their name is due. In North and South Dakota they are diversified by stony moraines of the Laurentian glacier. In Montana the neighbourhood of the Eocky Mountains is varied by forms of volcanic origin, includ- ing dissected volcanoes (Bearpaw Mountains), networks of dykes upholding horizontal strata elsewhere worn away (Crazy and Highwood Mountains), or isolated dykes and lava-capped mesas. Lava mesas and dyke ridges occur also in New Mexico and Colorado. There are a few local dome-like uplifts, more or less deeply eroded, of which the Black Hills of South Dakota are the largest ; here the deep underlying crystalline rocks have been revealed, and a centre of mining and lumbering has been deter- mined in the midst of the semi-nomadic life of the plains. The Little Kocky Mountains of northern Montana are of similar origin, but of much smaller area. Here and there in the eroded districts the more resistant strata rise in low uplands, and their outcropping edges stand forth in ragged escarpments. The western extension of the Ouachita Mountains narrows the plains in Oklahoma, but they broaden again in the Llano estacado of northern Texas, where an extensive upland descends eastwards in a strong escarpment of erosion. Most of the rivers occupy

~~valleys incised a few hundred feet beneath the general level, the valley sides being sharply dissected by wet- weather streams ; but so far is the volume of the rivers reduced by the small rainfall of the region, and so great is the load of waste borne by the rivers from the weak strata of the plains themselves, as well as from the mountains on the west, that they are unable to cut down their valleys to a very gentle grade ; hence the local relief of the region is less than might be expected from its considerable altitude. Indeed, Arkansas river in western Kansas flows for many miles at the level of the bordering plains, which appear to have been formed by river-borne waste ; the muddy stream here maintains a channel, but is unable to erode a valley.~~

~~Deficient rainfall is the leading climatic feature of the plains; the annual precipitation is generally under 18 inches, and in the south-west it is still less. Indeed, the gradual change to more populous districts on the east is due solely to the gradual increase of rainfall towards the Mississippi valley ; hence the vagueness of the boundary between these two physiographic areas. The surface is treeless, except for cottonwoods near the streams and scattered pines on some of the higher escarpments. In certain parts of the sub-arid plains, where the strata are of fine texture and vegetation is almost wanting, the~~

~~little rain that falls produces eroding rills even up to the finest head-water branches of a drainage system, thus carving the surface into innumerable little valleys separated by ridges and spurs of minute and intricate pattern. The early explorers or "voyageurs" called these districts " mauvaises terres pour traverser," because of their minute ruggedness; and this name is now rendered into "bad lands." The elaborate dissection and barrenness of the "bad lands" in Nebraska and Wyoming have laid bare great numbers of remarkable fossils, of much interest from the light they throw on the theory of evolution ; the many -toed ancestors of the modern horse being among the most important. Elsewhere, the sandy strata of the plains are heaped into innumerable dunes by the winds, giving the surface an undulating form beyond the limits of vision ; these are known as " sand-hill " districts, and are common in Nebraska and Kansas. Scanty pasture is found in the hollows among the dunes, as well as in the valleys of the bad lands. Here as well as elsewhere over the plains herds~~

of bison (" buffaloes ") used to wander ; they' have now been exterminated, except for a few that remain in protected parks, and are replaced by cattle, which range freely over great areas, reaching water once or twice a day, and there turned back by the " cow-boy " or by the fences of barbed wire that have now been stretched for thousands of miles over the once open plains. The passing traveller, accustomed to the grassy fields of moister lands, may wonder where the cattle find subsistence, and he may marvel how they survive the cold winds of winter. Truly, there is a struggle for existence ; yet the cattle are shipped by rail in large numbers from the plains to eastern markets, sometimes stopping on the prairies to improve their condition. Cul- tivation of the ground is not possible over the more arid plains, but wheat is grown in increasing quantities along their eastern border, towards the true prairies, and irriga- tion is practised in many valleys and on certain uplands along the base of the western mountains.

The eastern members of the Western highlands (or Cor- dilleras) of North America are known under the general name of the Rocky Mountains. This system of elevations, comprising many separate ranges, Tbe *oci3' is usually sharply separated from the plains on tajns ' the east ; on the north-west it extends far into Canada ; on the south it appears to be terminated in 36° N., where the region of the Basin Ranges reaches eastwards to the Great Plains in New Mexico ; on the west it is bounded by the lava plateaux of the Columbia and Snake rivers and by the plateaux of Utah and Arizona. The breadth of the system is usually from 150 to 300 miles. Altitudes of 10,000 to 14,000 feet frequently occur, but no summits reach 14,500 feet. There are many serrate ranges with well-defined peaks and passes, but they seldom have the sharp form that characterizes the European Alps or the boldest ranges of Canada. In the south the climate is so dry that even the highest summits (Blanca Peak, Colorado, 14,390 feet ; Mount Harvard, Colorado, 14,375 feet) retain only small snow patches in summer ; but in northern Montano snow-fields and glaciers of moderate size are found. Traces of ancient glaciers occur in all the higher ranges, and nearly all the few lakes that occur appear to be in association with past glacial action. The structure of different ranges varies greatly ; two examples only can be here described. South of the Missouri, the ranges fronting on the plains are of

~~comparatively simple anticlinal structure, exhibiting a broad granitic core, flanked with upturned Palaeozoic and Mesozoic strata ; but north of the Missouri a synclinal structure prevails, in which the youngest strata occupy the axial summits and the oldest strata are turned up in~~

~~features]~~

~~the flanks, the separation between mountains and plains probably being here determined by a great overthrust, as is known to be the case farther north in Canada. Dis- sected mountains of volcanic origin are occasionally found. The Spanish peaks, on the borders of the front range in southern Colorado, are of this kind. Land-slides of great dimensions are found in some of the narrower valleys of the San Juan range of south-western Colorado.~~

~~The continental divide between drainage discharging to the Atlantic and the Pacific is very irregularly set upon the various ranges of the Eocky Mountains. The branches of the Missouri system and of the Rio Grande source rise within the mountain belt ; one of the branches of the Columbia rises in northern Montana on the eastern flanks of the front range, traversing all the other ranges on its way to the Pacific. One of the best-marked character- istics of the region is the inclusion of numerous basins among the ranges, chiefly the result of warping or deformation of recent geological date, after much denuda- tion had already been accomplished. All the basins are heavily floored with waste brought by the streams from the surrounding mountains, and each basin is drained through a canon or gorge cut by the trunk river in the enclosing range. In many cases the canon Outlet is so narrow and steep-walled as to be impassable, unless by expensive railway construction ; hence ordinary roads run from one basin to another by climbing over passes in the ranges. According to the depth to which outflowing rivers have cut down their canons, the floors of the basins are more or less dissected, their altitudes commonly varying from 4000 to 7000 feet. Thus San Luis " valley," between the San Juan and Sangre de Cristo ranges of southern~~

Colorado and northern New Mexico, is a plain about 140 miles long and 50 wide, from which the Eio Grande escapes southwards through a deep canon ; but the canon is not yet cut deep enough for the river to trench the plain, except near the outlet. The upper Arkansas gathers its waters in a smaller basin behind the front range in Colorado, through which the river has cut the Eoyal Gorge, a deep and narrow cleft in granitic rocks, and the basin floor for some distance up-stream from the gorge is slightly trenched. Big Horn river (a branch of the Missouri system) rises in a large basin and cuts its way through an enclosing range of the same name ; the floor of the basin is well dissected, the valleys being several hundred feet below the uplands. Green river (a large head branch of the Colorado of the west) drains a large arid basin of the same name in Wyoming through a deep canon in the Uinta range on the south ; and the basin is deeply dissected, presenting "bad lands" of strong relief. All these basins seem at first sight to have con- tained lakes, but it is highly probable that, as a rule, the basin floors were aggraded, and the outlet canons were degraded about as' fast as the warping of the region pro- gressed, and that if lakes occurred at all they were shallow and short-lived ; continuous drainage by rivers probably prevailed during the time of deformation as well as since. This explanation applies to the examples above named and to many others, such as those of the upper Missouri and its branches among the ranges of Montana, the trunk river finally passing through the " Gate of the Mountains," as the gorge in the front range was named by the early explorers, Lewis and Clark. The higher basins in Colorado are known as "parks," from the scattered growth of their trees among grassy glades. The Yellow- stone Park is exceptional among the intermontane basins, in having its floor built up by heavy lava flows, above which rise the ruins of some once lofty volcanoes, while on the east the mountains are deeply-dissected masses of volcanic materials. The Park is remarkable for its geysers and hot

springs, on account of which it has been made a public reservation. The canon by which the Yellowstone river is discharged to the northward is a new course, deep cut in decomposed and many- coloured lavas, of the outlet of Yellowstone Lake, which formerly drained westwards vid Snake and Columbia rivers to the Pacific.

The basins among the Rocky Mountains are all of drier climate than those of the ranges, but their generally open surface promotes their use for grazing lands and for agri- cultural settlements, while the mountains are the seat of mining towns and lumber camps. Modern methods of mining usually exhaust rich mineral deposits in ten or twenty years, and the earlier mining camps in the Rockies are now abandoned and nearly forgotten. Even Lead- ville, growing rapidly between 1870 and 1880, under the feverish excitement of working rich silver mines, was on the decline for some years thereafter. Cripple Creek, Colorado, a more recent gold-mining district, is still largely productive. Butte, Montana, has an unusually long-last- ing productiveness of silver and copper ores ; mining and smelting works of great magnitude have been established there. The timber industry has been much injured, especially in the north-west, by forest fires, commonly the result of carelessness and indifference on the part of hunters and settlers ; but the enormous destruction of past years is now checked. The settlements in the basins are of a more permanent nature than those about the mines, and nearly all show signs of steady growth. Irrigation is practised as far as streams are available, but the amount of ground thus brought under cultivation is at the best only a small fraction of the region. None of these settle- ments has yet reached as great a population as Denver, the chief city of the plains, or as Salt Lake City, the chief one of the interior basin on the west.

The plateaux of Utah and Arizona embrace a lofty region of too arid a climate for settlement except upon small irrigated areas, but of marvellous geological Tbe history and extraordinary geographical form, piateauxot Here, as well as in the Eocky Mountains, there Utah ami was continuous deposition of stratified rocks from Arlzona- Palaeozoic and Mesozoic times, uninterrupted by the break at the close of the Carboniferous formation that was formerly thought to be universal. Here are broad up- heavals with hardly perceptible tilting over scores of miles, and great fractures or faults by which adjacent plateau blocks are separated. Here, as hardly anywhere else in the world, one finds manifest evidence of enormous erosion in the production of receding cliffs that form steps by which the altitude of successive plateaux rises from 6000 feet in the south to 10,000 or 11,000 feet in the north, and in the origin of deep- canons by which the platforms between the cliffs are trenched. The

cliffs of the plateau region may be divided into two classes, according to their origin and arrangement. Those of the first class have been formed by the normal processes of erosion, allowing the edges of the resistant strata to gain strong relief, " while the weaker strata are stripped off above and under- mined below ; cliffs of this nature have a relatively constant height, depending chiefly on the thickness of the resistant strata, but a very irregular front, receding where attacked by streams and advancing in inter-stream promontories. Most of the cliffs of the region belong to this class. They may be named by the formation that determines them, as Permian, Triassic, and Jurassic cliffs ; or according to their colour, clearly seen on their barren faces, as the brown, red, and white cliffs ; or by various local names. Cliffs of the second class are associated with the displacements or faults by which the region is divided into huge blocks, a hundred or more miles in length, north and south, but much less in breadth, with differential

upheavals of hundreds or even of thousands of feet. The cliffs follow the margins of the blocks, but the displacements are too ancient for the cliffs to show the actual faces of fractures ; erosion has already caused a greater or lesser amount of recession and dissection from the original fracture lines — great where the strata are weak, small where they are resistant ; it is the fault-cliffs that are still maintained by the resistant strata that are here considered. Cliffs of this nature are characterized by a relatively straight course for scores of miles, for the fractures have few sinuosities ; but the cliffs have signi- ficant variations of height, depending on the changing measure of displacement. The Grand Wash Cliffs, limiting the plateau region on the south-west, and the Hurricane ledge, a little farther east, are among the best-defined examples of this class. Associated with the dissected fault-cliffs are the slopes of the monoclinal displacements by which some of the plateau blocks are separated. These were due initially to an unequal uplift of the adjacent blocks, the two being separated not by a fracture but by a flexure of the

layers, so that the corresponding horizontal formations in adjacent plateaux differed in altitude by a thousand feet or more. The monocline, by which the Kaibab plateau descends to the platform of the Marble canon on the east, is an excellent example of its kind, the slope not now exhibiting its initial surface, but the surface of a resistant formation from which the weaker overlying strata have been worn away.

The deep and widespread erosion by which the overlying strata have been removed and the cliffs formed has been greatest where the uplift was greatest, mainly in the south-west. There a great expanse of strong Carboniferous strata (here of marine origin, and non-coal-bearing, as is always the case in the western United States) now forms a plateau at an altitude of 5000 or 6000 feet. Erosion has been much less to the north where uplift was less, and there are found the plateaux capped with youngest strata and of the greatest altitude, up to 9000 or 11,000 feet; they have a moister climate than the lower plateaux, and are well forested. The canons by which the plateaux are deeply dissected are the work of the rivers, aided by the weathering and washing of the walls. They are for the most part independent of the fracture lines, although between the higher plateaux on the north many valleys have been eroded along the fractures. The chief canons seem to have been eroded in consequence of a broad elevation of the region that took place, for the most part, after the widespread erosion above mentioned. The most remarkable canon is that of the Colorado, which traverses the entire plateau region from north-east to south-west. In the Kaibab plateau the canon is 5000 to 6000 feet deep and 12 or more miles wide; its sides are elaborately dissected by gigantic ravines. A branch railway nearly reaches the southern rim of the canon at one of the finest points of view. The few ' tributaries received by the Colorado enter it by side canons. Although the erosion required for the produc- tion of these canons is stupendous, it is very much smaller than that by which the general surface of the plateaux was stripped in the production of the cliffs.

Volcanic phenomena are exhibited on the plateaux in good variety. Some of the higher plateaux in the north are capped with heavy lava sheets, which must have been poured out in early Tertiary time before the great erosion of the region farther south. Dissected volcanic cones, several

~~thousand feet high, with forested slopes, are found on the broad Carboniferous platform south of the Colorado canon ; these must have been built after the great erosion, yet long enough ago to be deeply ravined. Ash cones and fresh black lava flows of recent date are found at various~~

~~points ; some of the flows poured into the Colorado canon in great volume, but have since been mostly worn away. In the north-east part of the region the Henry Mountains are laccoliths, or masses of intruded lava, blister-like, between the stratified formations which they domed up ; the covering strata have now been greatly denuded and the intrusive igneous rocks revealed. The settlements in the plateau region are few and small. Streams are so few and generally so inaccessible at the bottom of canons that irrigation is rarely possible. Springs are rare and of great value, and the rough roads or trails by which the plateaux are traversed are traced so as to pass by them. The higher plateaux have abundant timber and summer pasture, but their winter climate is severe and they do not attract permanent settlement. The population of the region must remain very small. Although the plateaux are traversed already by two railways, their surface is too rough and too inhospitable to detain the pleasure-seeker on a transcontinental journey ; but the region must become a place of pilgrimage for lovers of the grand and marvellous in desert nature.~~

~~An area of over 200,000 square miles between the Eocky Mountains and the Pacific ranges, chiefly in Idaho, Washington; and Oregon, is occupied with vast / sheets of lava, which have converted a broad plateaux intermontane basin into a plateau, whose present of the elevation, due to filling, uplift, and warping, Columbia varies from 600 to 3000 or more feet. The sources of these great outpourings is not certainly known, but they are believed to have been erupted from fissures ; their date is Tertiary. The margin of the lava sheet is unusually well defined against the surrounding mountains ; here entering and filling a valley as if to form a bay, there retreating around an advancing ridge as if rounding a promontory. Isolated mountain tops sometimes rise like islands above the plain, as in Steptoe Butte, a noted point of view, rising 1000 feet over the lavas. Local disturbances have here and there uplifted and tilted blocks of~~

the plateau in its western part, so as to form long ridges with a steep face of fracture on one side and a long descending slope on the other ; huge land-slides have sometimes fallen in disorder from the fractured face. The younger lava sheets still have a fresh and barren surface unworn by streams ; the older ones are well dissected by numerous valleys, between which the lavas of the uplands are deeply weathered into fine and fertile soil. In western Washington the lavas are often covered with the finely stratified sediment of a Tertiary lake.

The Commbia river has eroded an important valley near the northern and western margin of the lavas, exposing their successive sheets. In southern Idaho Snake river has worn a fine canon in which its famous cataract occurs ; farther north-west this river traverses the Blue Mountains of Washington, a broad arch of the plateau reaching a height of 5000 feet ; here occurs a cafion 4000 feet deep, rivalling that of the Colorado in strength and variety of form, but more sombre in colour. Uncounted lava flows are shown in the canon walls, with interstratified ash-beds containing petrified trees. At one point a mountain that was once completely buried by the lavas is now transected: its summit is 1500 feet below the plateau and 2500 feet above the river. No less remarkable is a canon once eroded by the Columbia river on the path that it temporarily followed while its main valley was invaded by the ice streams that descended from the mountains on the north and west during the Glacial period : the canon is now nearly or quite dry ; high walls enclose the greater part of its course, and near a small settlement known as Coulee City its floor is broken by the cliffs of what was once a great cataract, a feature

features]

that ranks high among the marvels of. the Western country.

The climate of the lava plateau is dry. It is treeless, except for scattered pines near its margin and on its higher uplifts. The more elevated parts

have an abund- ant pasturage, but the lower surface is covered with sage brush, an apparent waste, yet containing enough pasture to support numerous cattle, whose dusty trails leading to water are among the characteristic features of the lava plains. Irrigation is seldom practicable, owing to the depth at which the streams have eroded their valleys. But the deeper weathered soils, whose surface is some times rolling as if wind-blown, retain enough moisture to produce in eastern Washington excellent crops of wheat, of which there has been a large yield since the recent settlement of the region.

We come now to the extensive area, limited on the north by the Columbia lava plateaux (near the Nevada boundary), The region an<^ bounded there on the east and west by otthe the Wahsatch and Sierra Nevada Mountains,

basin narrowing in the- middle between the Arizona

ranges. plateaux and the southern Sierra, but widening farther south so as to reach the Pacific coast on the west in southern California, and to pass around the boundary of the Arizona plateaux and the Eocky Mountains, and meet the Great Plains on the east in New Mexico. The region continues into Mexico. It is traversed by numerous mountain ranges running roughly north and south, com- monly measuring from 30 to 100 miles in length and from 5 to 10 in width; rising to an altitude of from 6000 to 11,000 feet, or to a local relief of from 2000 to 6000 feet. The open space between the ranges is occupied by sloping piedmont plains, which unite to form broad flat- floored intermontane troughs; these are floored for the most part by the waste that has been washed from the valleys in the ranges. In the north-west, where this region enters southern Oregon, and north-eastern California, the ranges seem to be of relatively recent origin, for here they still retain the form of upheaved and tilted blocks, little sculp- tured ; while in the south-west the ranges are of much older date, for here they are but remnants of their former dimensions, much of their area being now reduced to gently — sloping floors of rock, grading into the medial plains of waste. But in general the mountains are of strong form and well carved ; sometimes rugged and sharply serrate, but more commonly exhibiting smoothed slopes and rounded summits.

The higher ranges enjoy a climate moist enough to permit the growth of trees, chiefly pines; running streams issue from the larger valleys, but the mountain flanks are dry and barren. The rocks of the ranges are of great variety, both igneous and sedimentary ; they sometimes contain valuable ore deposits, as at Vir- ginia City and Eureka, Nevada (gold and silver), and in the Phoenix district of Arizona (copper). Mining towns rise, flourish, and dwindle away in the neighbourhood of these deposits, as the mineral product grows and fails with the modern methods of rapid exploitation.

The sloping piedmont plains are arid, clothed with abundant sage-brush and other desert plants, but possess- ing very little pasture. Cattle nevertheless range over the less arid districts near the settlements. The smaller streams from the mountains soon wither away, yet even from dry valleys a heavy rain such as occasionally falls on the mountains produces rushing torrents that carry forward abundant coarse and fine detritus, spreading it in the stony alluvial fans of long radius and gentle declivity which give character to the region. Some of the fans in south-eastern California are of large size — 500 to 600 feet higher at the apex than at the margin, with a radius of 10 or more miles; ground water is here

stored in considerable quantities, and tunnels are driven in from near the base to convey water for irrigation on the lower slopes. The perennial mountain streams may flow far enough forward to unite in a trunk stream in the flat intermontane trough between the sloping plains ; and the trunk stream in turn withers away on a desert plain, or (especially in the north-west, where the streams are fed by the more abundant rains of the Sierra Nevada) forms a lake in a shallow basin, or (especially in the south- east) escapes to the sea by joining one or the other of the two outflowing rivers, the Colorado or the Rio Grande. Some of the rivers have the curious habit of traversing a mountain range in a deep-cut canon, instead of running around the end of the range not far distant, thus suggesting that the stream was antecedent to the moun- tains. The permanent streams are now used for irrigation on the piedmont slopes, thus supporting many settlements that would be called " oaSes " in Africa. Their popula- tion is largely Mormon in Utah, but less so elsewhere. The irrigated fields produce excellent crops, but their total

~~area is a very small fraction of the entire region ; thus a low limit is set upon the number of locally- supported inhabitants.~~

~~Most of the lakes in the intermontane basins are strongly saline ; others are brackish or alkaline. The most famous of the former is Great Salt Lake (salinity, 24 per cent.). The smaller lakes are as evanescent as the wet-weather streams ; mere films of water fed by occasional rains, turbid with fine silt that is raised from the bottom by the waves. When the waters dry away, a very smooth surface of mud is left absolutely barren; impassable when wet, hard baked when dry. Such mud plains are known by the Spanish name of playas. All the lakes were larger in a recent geological period of moister climate, presumably coincident with the Glacial period elsewhere, as proved by the extensive series of shore lines on the enclosing moun tains. The two largest of these extinct lakes, named Bonneville and La Hontan after early explorers of the region, have been elaborately described by Gilbert and Russell in Monographs I. and XL U.S. Geological Survey.~~

~~The Sierra Nevada of California and the Cascade range of Oregon and Washington, with the subordinate moun- tains nearer the coast, may be grouped under the general title, Pacific ranges. They are, as a ranges rule, clearly separated from the regions of the Columbia lava and of the basin ranges on the east by a strong ascent, that which leads from the interior basins to the southern Sierra being especially steep and high. The Sierra Nevada does not appear to be in its first cycle of erosion. It was deeply denuded after its original eleva- tion, and then uplifted en bloc; its eastern slope is the dis- sected face of a great fracture, while the slanting uplands of the western slope are now deeply canoned by many rivers. Lake Tahoe, a clear body of water of great beauty near the crest of the range, occupies a basin formed by a subordinate fracture. In the southern part of the range, chiefly of granitic rocks, erosion before uplift does not seem to have progressed so far as farther north ; here the mountain scenery is bold, including the highest summit in the United States (Mount Whitney, 14,898 feet), yet so dry in summer that the snow-fields are small and the glaciers are rare and minute. The Yosemite Valley, enclosed by precipitous granite walls, is a famous resort, now a public reservation. In the middle of the range the uplands are frequently covered by extensive~~

lava flows, of origin anterior to the erosion of the existing canons. Gold is found in the quartz veins of this district and in the river gravels that were formerly deposited at the western base of the range, now more or less uplifted and dissected, as

well as in the gravels here and there preserved under the lava flows. Farther north, volcanoes and lava sheets become increasingly important. Mount Shasta is the finest cone (14,380 feet), now extinct and well ravined by radial streams. Meadows about the base of this and other cones represent aggraded lakes, once formed by lava barriers in ancient valleys, now excellent agricultural land.

The deep transverse valleys of Pitt and Klamath rivers, by which a small part of the basin on the east gains dis- charge through the mountains, one north, the other south of Mount Shasta, to the Pacific, divide the Sierra Nevada from the Cascade range. The latter is, like the Sierra, an uplifted block in a second cycle of erosion. The mountain block as a whole appears to have been bent or faulted up from the lava-floored basin on the east. The highest summits are volcanic cones, most of which are deeply dis- sected. They bear snow-fields' and glaciers, of which the finest now known are on Mount Rainier (14,526 feet). Lake Chelan occupies a deep, fiord-like, ice-scoured valley on the eastern slopes. Crater Lake in southern Oregon occupies a deep circular basin or caldera, five miles in diameter, enclosed by strong cliffs that form the rim of a half-de- stroyed volcanic cone. The lake is marvellously beautiful, similar to the circular lakes of central Italy, but of grander proportions. Before the destruction of the lost summit of the cone, probably by under-melting and engulfment, radial ravines had been worn down its slopes ; the trun- cated ravines now notch the rim of the caldera. Glacial moraines lie in some of the ravines, as if deposited by glaciers that once descended from the summit of the cone ; hence the engulfment is probably of post^Glacial date. Columbia river traverses the Cascade range at its middle ; and like

the transverse rivers farther south, appears to be of origin antecedent to the uplift of the range. The lacustrine strata that lie on the north-west part of the lavas in the inner Columbia basin (see above) are probably to be correlated with the transverse valley of the river in the mountains, the lake standing behind the rising range, while the river was cutting down its canon. The forests on the western slopes of the range are noted for their density and for the great size of many of the trees ; they are now extensively cut for lumber.

The Coast ranges bordering the Pacific are, as a rule, of subdued form ; they have been repeatedly uplifted and deformed, and long eroded. The Santa Barbara Islands, off the coast of southern California, are to be associated with the Coast ranges as isolated mountain blocks. The sea-border of the mountains has few indentations, and some of the ranges — the Santa Lucia Mountains, for example — descend precipitously to an almost inaccessible shore. Transverse valleys are rare ; the most remarkable are slightly submerged in the Bay of San Francisco and in the estuary of Columbia river, the former determining the site of the chief city of the Pacific coast.

A more or less continuous depression lies between the inner and outer members of the Pacific ranges. The southern part of the depression is the " valley " of Cali- fornia, a great waste-floored basin formed by the flat, laterally confluent, alluvial fans of the rivers from the east and west ; along its axis, a level, unbroken plain. Tulare Lake lies on the southern part of the plain, a shallow and variable water-sheet, held back by the faster growth of some fans next on the north. This great plain has dry summers, especially in the south ; the winters are rainy, especially in the north ; irrigation is practised extensively, the form of the surface being excellently adapted to it. The extensive cattle ranges of the Mexican occupants before 1850 have been replaced by wheat farms, and these by the irrigated fruit orchards of the present.

Another basin of smaller size and more uneven surface opens between the inner and outer ranges north and south of Columbia river. The summer dryness is less marked here than farther south, and agriculture flourishes without irrigation. Farther north the many branches gf Puget Sound

~~indent the intermontane trough, providing many excellent harbours, two of which have become of import- ance as the termini of transcontinental railways. Here the forest growth is so heavy that the cost of clearing the land for farming is forbidding ; even if the trees are sawn for timber, the removal of the huge stumps is heavy work ; but when the land is once ready for cultivation, it returns rich harvests of grain and fruit. (w. M. D.)~~

~~II. Statistics.~~

~~Population. — The population of the United States, including that of Alaska, Indian territory, and Indian reservations, in 1890 was 62,979,766; in 1900 it was 76,149,386, to which must be added the population of Hawaii, giving a total of 76,303,387. The official census of Porto Rico, taken 10th November 1899, gave to it a population of 953,243. No official enumerations of the populations of the other new possessions of the United States have been made, but the latest estimates, accepted in the census bulletins, are as follows : Philippines, 6,961,339; Guam, 9000; and American Samoa, 6100. The grand total for the United States and its possessions thus stood at 84,233,069 in 1900. Taking only the populations of the states and territories, the increase in 1890 over 1880 was 24·9 per cent., and in 1900 over 1890, 20‘7 per cent., being a smaller percentage than was shown by any previous census. The population by geographical divisions in the census returns of 1890 and 1900 was as follows : —~~

~~States and Territories.~~

~~1890.~~

~~1900.1~~

~~Increase per cent.~~

~~North Atlantic South Atlantic North Central South Central Western Alaska Hawaii~~

~~17,406,969~~

~~8,857,922~~

22,410,417

11,170,137

3,102,269

32,052

89,990

21,046,695

10,443,480

26,333,004

14,080,047

4,091,349

63,592

154,001

20-9

17-9 17-5 26-1 31-9 98-4 71-1

The unusual rate for Alaska is explained by the influx of population due to the discoveries of gold deposits, and that of Hawaii by the rapid development of sugar planta- tions and the foreign labour introduced for the cultivation. Particular states showed remarkable differences in growth. Nebraska gave the smallest percentage of increase, 0‘3, and the territory of Oklahoma, thrown open to settlement in May 1890, gave the largest, 407 ‘6. While the relative importance of the great geographical divisions (census) remained unchanged since 1890, certain states altered their position or rank in the scale of importance. The states and territories showing an increased importance were New Jersey, Oregon, and Oklahoma ; those of diminished rank were Delaware, District of

~~Columbia, New Hampshire, Vermont, Nevada, Utah, and Wyoming. Nevada was the only state that showed an actual decrease in population since 1890.~~

~~The growth of the central and western divisions of. the country was due to the large immigration of foreigners, as well as to a steady movement of native population from' the eastern states. The force of this latter agency is measured by the returns of the native-born and the states of their origin. In the north central division, of a~~

~~1 The figures in this column do not include 91,219 persons in Hie military and naval service of the United States stationed abroad, not credited to any state or territory.~~

~~statistics]~~

~~total of native-born of about 22,000,000 persons, nearly 1,700,000 were born in the Atlantic states ; in the south central, of 13,700,000, nearly 730,000 were natives of the Atlantic states. These returns do not give the full movement, however, as a part of the migrants passed on to the western division, where 1,370,000 out of a total of 3,250,000 native-born came from states in the Union wholly beyond the limits of that division. The immigration movement of foreigners during the period 1887-1901 was as follows : —~~

~~Year.~~

~~Number of Immigrants.~~

~~Year.~~

~~Number of Immigrants.~~

~~Year.~~

~~Number of Immi grants.~~

~~1887 1888 1889 1890 1891~~

~~490,109 546,889 444,427 455,302 560,319~~

~~1892 1893 1894 1895 1896~~

~~623,084 502,917 314,467 279,948 343,267~~

~~1897 1898 1899 1900 1901~~

~~230,832 229,299 311,715 448,572 487,918~~

~~There has been a marked change in the origin and character of this movement. In earlier years western Europe furnished the larger part, and the United King- dom, Germany, and the Scandinavian countries were the principal factors. In 1888 all Europe sent 538,131 emigrants to the United States, and 373,846 of these came from the countries named. In 1901 the total movement from Europe was 469,237, but only 106,431 came from the same countries. Italy, Austria-Hungary, and Russia were the leading contributors, these three' nations giving 334,643 in that year. This change ill the nature of the immigration has occurred in the face of more rigid inspection of immigrants under laws intended to exclude the chronic pauper as well as the criminal and incompetent. While the lands of the west and south still attract permanent settlers, the mines and factories and such undertakings as railway construction and city im- provement give an opportunity for the temporary residence which is the characteristic of the Italian immigration. Although the laws excluding the Chinese are enforced as far as possible, more than two thousand Chinamen enter each year, and the immigration of Japanese has much increased and shows every evidence of becoming an im- portant factor.~~

~~The relation of foreign- to native-born population has not varied greatly since 1860. The census of 1900 gave~~

~~65,843,302 native-born, or 86'3 per cent, of the borag"' total P°Pulation> and 10,460,085 foreign-born,~~

or 13 7 per cent. Nearly one-half of this •foreign-born population (49-5 per cent.) was found in cities having upwards of 25,000 inhabitants ; and tbe proportion of foreign -born in the principal cities was nearly three times that of the country outside of these cities. The distribution of the foreign-born population has great significance, and in 1890 and 1900 was :—

Geographical Division.

1890.

1900.

Increase per cent.

North Atlantic . South Atlantic . North Central South Central Western

3,888,177 208,525

4,060,114 321,834 770,910

4,762,796 216,030

4,158,474 357,635 846,321

22-5 3-6 2-4

11-1 9-8

The increase in the foreign-born has been concentrated in a few states, and was not so large as that shown by the returns of 1890 and 1880. This is to be explained both by a decreased movement of immigration in the two periods and by the increase in a temporary migra- tion, a characteristic of the people of southern Europe. Nor Las the rate of growth of the foreign-born in the ten years ending 1900 equalled that of the native-born, being only 12 '4 per cent., compared with 22 -5 per cent.

in the previous decade. Natives of Germany constitute the largest element of the foreign-born (25-8 per cent.), and those of Ireland are second in

importance (15‘6 per cent.). The number of those who were born in south- eastern Europe more than doubled in the ten years 1890-1900, while that of the foreigners born in northern Europe, though absolutely greater, remained almost un- changed.

The number of persons born of foreign parentage (one or both parents being of foreign birth) was 26,198,939 in 1900, or 34 ‘3 per cent, of the total population. The corresponding figures for 1890 were 20,676,046, and 33 per cent. The manufacturing states of the east and of the north-central division contain the largest proportion of those of foreign parentage. Jlore than one-half (51-1 per cent.) of the total population of the North Atlantic division comes under this description, the highest percentages being those of Rhode Island (64 ‘2 per cent.), Massachusetts (62-3 per cent.), and New York (59‘4). Even these relations are ex- ceeded in some of the more western states, as in North Dakota, with 77 “5 per cent, of its total population of foreign parentage, Minnesota, with 74‘9 per cent., and Wisconsin, with 71 ‘2 per cent. In the states of the south the number of those ‘born of foreign parentage is so small as to be an inappreciable element in the total population, as North Carolina (0‘7 per cent.), South Carolina (1‘3 per cent.), Mississippi (1-8 percent.), and Georgia (1‘7 percent.). But in Louisiana tbe proportion is larger, 11 “8 per cent., as well as in Texas, 15‘5 per cent., exceptions explained by economic causes. Of the total native white population of the United States in 1900 (56,740,739), more than one-fourth (27 ‘6 per cent.) was of foreign parentage.

In the states and territories the persons of negro descent in- creased from 7,488,788 in 1890 to 8,840,789 in 1900, or 18‘1 per cent., the rate being somewhat less than that of the white population (21-4 per cent.). The census report “e^roes- says: “If an examination is made of the relative increases of these two elements in the south Atlantic and south — central divisions, in which nearly nine-tenths of all the persons of negro descent are found, the same conditions are apparent. In the south Atlantic division there has been an increase in the white population since 1890 of 19-9 per cent, as compared with an increase in the negro population of 14 ‘3 per cent., while in the south-central division the whites have increased during the same period 29 ‘1 per cent, and the negro element 19 ‘9 per

cent. If the comparison in these two divisions is extended to the several elements of the white population, it is seen that among the foreign white there has not been so rapid an increase as among persons of negro descent, but that among the native whites, both of native and foreign parentage, the relative increase during the decade lias been much greater." In two states South Carolina and Mississippi the negroes outnumber the whites, and in Louisiana they have been in the minority only since 1890. Such a situation has led to constitutional provisions for restricting the use of the franchise by the negro. On the whole, the relative numbers of negroes to whites for the entire country are steadily decreasing. The migratory movement of the negro population towards the far south has steadily progressed since 1850. (See Negro.)

The interior movement of the population from state to state is indicated by the returns of the state or territory of birth. Ex- eluding certain elements which were not covered by . the enumeration, the native-born living in the state /J,to™f or territory of birth constituted 79 per cent, of the miSrat'on- total native-born, or 51,!'79,651 in a total of 65,767,451. Since 1860 this proportion has slowly risen from 75'1 per cent, to its present figure. The two great divisions of the north and south Atlantic, though showing the largest percentage of native-born living in the state of birth, give a slight decrease compared with the returns of 1890, and only a single member in these divisions — West Virginia — offers an increased percentage. In the other geographical divisions the proportion of resident native-born is less, and the movement differs. The comparison by divisions is: —

Geographical Division.

North Atlantic .

South Atlantic .

North Central .

South Central . Western

The number of native-born persons living in states other than those of birth (13,787,800) is greater than the foreign-born (10,444,717). The native immigrants thus form a more im- portant element in the settlement of the states than the foreign

Percentage of Native-born residing in State or Territory of Birth.

1890.

1900.

87 '5 per cent.

86 '3 per cent

90-1

89-1 „

69-9

73-6 „

79

78-5 „

46

50-4

568

UNITED STATES

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immigrants. The constitution of the population of each state must be studied by itself, and it is not possible to generalize.

The extraordinary growth of cities has been continuous. Taking

the incorporated places — and these will include nearly all cities,

. towns, and villages of any size — there were 7578

1 tl suoh Plaoes in 189° and 10>602 in 1900. In the popa a on. former year 41 .4 per oent 0f tne tataj p0pUiation

was to be found in the incorporated places, and in 1900, 47 '1 per cent. Tire increase has been almost wholly in places of 25,000 inhabitants and over. It is the larger cities that have gained the most. The relative position of places having populations of less than 25,000 hardly changed within the decade ending 1900. In New York, New Jersey, Massachusetts, Illinois, Rhode Island, Pennsylvania, Colorado, and Connecticut more than three-fifths of the total population live in incorporated places. In the southern states, and in certain of the more recently constituted divisions of the west, like Oklahoma, less than one-fifth of the population is found in such places. The nineteen cities of the first class, which include those having a population in 1900 of 200,000 and over, increased in population by 40 '7 per cent, between 1880 and 1890, and by 32 6 per cent, between 1890 and 1900. Only New York, Boston, New Orleans, and Newark gave a greater rate of increase in the second period. So far as com parison may be made, the population of incorporated places in 1890 was 26,079,828, and 35,849,516 in 1900.

In determining the question of urban and rural population, other figures must be used, the reason being the practice of New England localities to include within town limits a, population that elsewhere ia treated as rural. The census gives the urban

population, on a basis of places of 4000 inhabitants or more, at 20,768,881 in 1890, or 32-9 per cent, of the total population ; and 28,411,698 in 1900, or 37 '3 per cent, of the total. The great increase has occurred in New York, New Jersey, Pennsylvania, and the states of the north-central division. In every division the urban population has increased since 1890 more rapidly than the total population, and the

difference is so large as to mark the intensity of the movement from the farm into the town or city : —

Geographical Division.

Increase in Total Population.

Increase in Urban Population.

Number.

Per cent.

Number.

Per cent.

North Atlantic South Atlantic North Central South Central Western

3,639,726 1,585,558 3,922,587 2,909,910 989,080

20-9 17-9 17”5 26-1 31-9

3,541,779 495,330

2,598,277 557,423 433,609

35-2 31-9 38-5 41-6 41-9

Yet in but few states outside of the north Atlantic division has there been an actual loss in the rural population, and both in the south and west many states show a substantia] gain. While in the north-eastern states the gain in population has almost wholly been in the urban, in the new states of the west and in some of those of the south the gain has been in the rural population. The movement of population is thus a fair indication of economic status or development.

Statistics of National Elections.

~~The general political complexion of each state is best shown by the division of its electoral vote in the~~

~~Presidential elections.~~

~~State .~~

~~1884.~~

~~1888.~~

- ***~~1892.~~***

~~1896.~~

~~1900.~~

~~Cleveland.~~

~~Blaine.~~

~~Cleveland. Harrison.~~

~~Cleveland.~~

~~Harrison.~~

~~Weaver.~~

~~Bryan.~~

~~McKinley.~~

~~Bryan. McKinley.~~

~~Dem.~~

~~Bep.~~

~~Dem.~~

~~Rep.~~

~~Dem.~~

~~Rep.~~

~~Pop.~~

~~Dem.~~

~~Rep.~~

~~Dem.~~

~~■~~

~~Rep.~~

~~Alabama~~

~~10~~

~~10~~

~~11~~

~~11~~

~~11~~

~~Arkansas~~

~~7~~

~~7~~

~~8~~

~~8~~

~~8~~

~~California~~

~~8~~

~~8~~

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~~Colorado~~

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~~Connecticut .~~

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~~Delaware~~

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~~Florida~~

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~~‘ 4~~

~~Georgia~~

~~12~~

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~~13~~

~~***Idaho .***~~

~~***3***~~

~~***3***~~

~~***3***~~

~~***Illinois***~~

~~***22***~~

~~***22***~~

~~***24***~~

~~***...***~~

~~***24***~~

~~***24***~~

~~***Indiana***~~

~~***15***~~

~~***15***~~

~~***15***~~

~~***15***~~

~~***15***~~

~~***Iowa***~~

~~***13***~~

~~***13***~~

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~~13~~

~~Kansas~~

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~~Kentucky~~

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~~13~~

~~Louisiana~~

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~~8~~

~~Maine .~~

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~~6~~

~~Maryland~~

~~8~~

~~8~~

~~8~~

~~8~~

~~8~~

~~Massachusetts~~

~~14~~

~~14~~

~~15~~

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~~15~~

Michigan

13

13

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14

14

Minnesota .

7

7

9

9

9

Mississippi .

“9

“9

“9

“9

9

Missouri

16

16

17

17

17

Montana

3

3

3

Nebraska

“5

“5

8

8

8

Nevada

3

3

3

~~3~~

~~3~~

~~New Hampshire .~~

~~4~~

~~4~~

~~4~~

~~4~~

~~4~~

~~New Jersey .~~

~~“9~~

~~9~~

~~i‘6~~

~~10~~

~~10~~

~~New York .~~

~~36~~

~~36~~

~~36~~

~~36~~

~~36~~

~~North Carolina~~

~~11~~

~~11~~

~~11~~

~~ii~~

~~ii~~

~~North Dakota~~

~~1~~

~~1~~

~~“1~~

~~3~~

~~3~~

~~Ohio .~~

~~23~~

~~23~~

~~1~~

~~22~~

~~23~~

~~23~~

~~Oregon~~

3

3

3

“;

4

4

Pennsylvania

30

>••

30

32

32

32

Rhode Island

4

4

4

4

4

South Carolina

~~“9~~

~~9~~

~~“9~~

~~9~~

~~9~~

~~South Dakota~~

~~4~~

~~4~~

~~4~~

~~Tennessee~~

~~12~~

~~12~~

~~12~~

~~12~~

~~12~~

~~Texas .~~

~~13~~

~~13~~

~~15~~

~~15~~

~~15~~

~~Utah .~~

~~3~~

~~3~~

~~Vermont~~

~~4~~

~~4~~

~~“i .~~

~~4~~

~~4~~

~~Virginia~~

~~12~~

~~...~~

~~12~~

~~12~~

~~12~~

~~12~~

~~Washington~~

~~,,,~~

~~4~~

~~4~~

~~4~~

~~West Virginia~~

~~6~~

~~8~~

~~6~~

~~“e~~

~~6~~

~~Wisconsin~~

~~11~~

~~11~~

~~12~~

~~12~~

~~12~~

~~Wyoming Total .~~

~~8~~

~~3~~

~~3~~

~~219~~

~~182~~

~~168~~

~~233~~

~~277~~

~~145~~

~~22~~

~~176~~

~~271~~

~~155~~

~~292~~

~~statistics]~~

~~UNITED STATES~~

~~569~~

~~The number of potential voters, that is, the number of males Voting twenty one years of age and over, in the United States population (ex°luding in 1900 the 226,837 of special enumera tion) was : —~~

~~Increase.~~

~~Total~~

~~1890.~~

~~1900.~~

~~Population~~

~~Number.~~

~~*Per cent.*~~

~~*Per cent.*~~

~~*Native-born .*~~

~~*12,591,852*~~

~~*16,082,261*~~

~~*3,490,409*~~

~~*27-7*~~

~~*22-4*~~

~~*Foreign-born*~~

~~*4,848,459*~~

~~*6,020,721*~~

~~*672,262*~~

~~*15‘5*~~

~~*11-9*~~

~~*Also divided into*~~

~~*16,940,811*~~

~~*21,102,982*~~

~~*4,162,671*~~

~~*24-6*~~

~~*20-7*~~

Native white —

Native parents .

8,807,223

10,535,748

1,728,525

19·6

18·5

Foreign parents

2,150,278

8,458,556

1,308,283

60·8

36·1

Foreign white

4,242,360

4,914,173

671,813

15·8

12·1

Coloured

~~*1,740,455*~~

~~*2,194,505*~~

~~*454,050*~~

~~*26·1*~~

~~*18·8*~~

~~*Persons of negro*~~

~~*descent .*~~

~~*(not given)*~~

~~*2,056,552*~~

~~*In every case the increase in the number of possible voters was greater than the increase in the same description of the general population. The geographical distribution of those of voting age in 1890 and 1900, by percentages, will indicate the changes that have occurred in the ten years.*~~

~~*Geographical Division.*~~

~~*Native White.*~~

~~*Foreign White.*~~

~~*Coloured.*~~

~~*Native Parents.*~~

~~*Foreign Parents.*~~

~~*North Atlantic 1890*~~

~~*Per cent.*~~

~~48·9~~

~~Per cent.~~

~~16·3~~

~~Per cent.~~

~~33·0~~

~~Per cent.~~

~~1·8~~

~~„„ 1900 South Atlantic 1890~~

~~44·0 57·7~~

~~20·1 3·8~~

~~33·7 4·9~~

~~2·2 33·6~~

~~1900~~

~~North Central 1890~~

~~58·8 51·1~~

~~4·2 16·0~~

~~4·1 30·9~~

~~32”9 20~~

~~1900~~

~~South Central 1890~~

~~48-5 59-9~~

~~21-7 ‘ 4-2~~

~~27-5 6-5~~

~~2-3 29-4~~

~~„ ,, 1900 Western 1890~~

~~60-9 43-5~~

~~5-2 13-1~~

~~5-3 34-0~~

~~28-6 9-4~~

~~1900~~

~~43-6~~

~~18-2~~

~~30-3~~

~~7-9~~

~~United States 1890~~

~~52-0~~

~~12-7~~

~~25-0~~

~~10-3~~

~~1900~~

~~49-9~~

~~16-2~~

~~23-1~~

~~10-8~~

~~For the United States there are 3 '6 persons to each potential voter. The results of the two enumerations of population on the number of representatives in the House of Representatives were~~

~~to increase the apportionment in 1890 to 356, and in 1900 to 386 members.~~

~~the returns of manufacturing in 1890 and 1900 are corn- comprises the more important~~

~~Manufactures. — So far as and mechanical industries parable, the following table items : —~~

~~1890. 1900.~~

~~Number of establishments . 355,415 512 726~~

~~Capital .... $6,525,156,486 $9,874,664|o87~~

~~Wage-earners, average number 4,251,613 5,321,087~~

~~Men, 16 years and over . 3,327,042 4,120,716~~

~~Women „ . 803,686 1,031,747~~

~~Children under 16 years 120,885 168,624~~

~~Total wages . . . $1,891,228,321 $2,330,273,021~~

~~Cost of material . . . $5,162,044,076 $7,360,954,597~~

Value of products . . . $9,372,437,283 $13,040,013,638

The figures for 1900 are preliminary, subject to some correction ; and the manner of preparing the returns differed in some particulars in the two censuses. The five leading states in manufactures, in the order of im- portance, were New York, Pennsylvania, Illinois, Massa- chusetts, and Ohio. The tendency to form combina- tions of a number of establishments, working under one financial management, also received attention in the census returns; but only such combinations were included as consisted of a number of formerly independent mills brought together into one company under a charter ob- tained for that purpose. A mere limited union of interests, or corporations organized with the object of holding the stock of other corporations, but not directly owning the plant or carrying on the business of manufacturing, were not considered. While these returns include the larger number of what are popularly known as "trusts," yet every large aggregation of capital or control of a number of plants should not be so regarded. The detailed list, issued by the Census Office, covers 2029 active plants, operated by 183 corporations.

The division into groups was as follows : —

Industry.

No. of Com- binations.

No. of Plants.

Capital.

Wages paid. Value of Products.

Iron and steel ..... Food and allied products . Chemicals ..... Metals, other than iron and steel Liquors and beverages Vehicles for land transportation Tobacco .....

Textiles

Leather . ...

~~Paper and printing ....~~

~~Clay, glass, and stone products~~

~~Lumber~~

~~Miscellaneous~~

~~Total ....~~

~~40~~

~~21~~

~~14~~

~~11~~

~~28~~

~~6~~

~~4~~

~~8~~

~~5~~

~~7~~

~~15~~

~~8~~

~~16~~

~~447~~

~~273~~

~~248~~

~~89~~

~~219~~

~~65~~

~~41~~

~~72~~

~~100~~

~~116~~

~~180~~

~~61~~

~~118~~

~~$341,779,954~~

~~246.623,633~~

~~175,002,887~~

~~118,519,401~~

~~118,489,158~~

~~85,965,683~~

~~16,191,818~~

~~92,468,606~~

~~62,734,011~~

~~59,271,491~~

~~46,878,928~~

~~24,470,281~~

~~45,408,869~~

~~$81,098,583 12,326,601 12,746,006 12,356,772~~

~~4,869,457 17,571,613~~

~~5,278,151 13,297,357~~

~~4,070,641~~

~~7,478,962 10,994,488~~

~~4,389,944 (8,056,140~~

~~$508,626,482~~

~~282,408,081~~

~~182,391,744~~

~~180,154,703~~

~~93,432,274~~

~~85,985,533~~

~~74,063,029~~

~~71,888,202~~

~~45,684,829~~

~~44,418,417~~

~~23,258,182~~

~~20,378,815~~

~~48,605,073~~

~~183~~

~~2029~~

~~$1,433,804,720~~

~~$194,534,715~~

~~$1,661,295,364~~

~~The total value of the products reported by these industrial combinations is estimated to be one-fifth (20-4 per cent.) of the total gross products of the manufacturing industries of the country as they existed in 1900. Of the 183 corporations, 63 were formed prior to the year 1897, 7 in 1898, 20 in 1899, and 13 prior to June 1900. Thus of the total number, one-half (92) were chartered from 1st January 1899 to 30th June 1900, or on the eve of taking the census. After the census was taken, the largest combination of all, the United States Steel Corporation, was formed, with an authorized capital of~~

~~$1,404,000,000.~~

~~Mineral Production. — The total value of the mineral products of the United States in 1890 was $619,512,173 ; in 1900, $1,092,224,380. The leading articles and their value in 1900 were reported by the U.S. Geological Survey as follows : —~~

~~Metallic products — Pig iron, long tons . Silver (coining value), troy oz. . Gold~~

~~Copper (value at New York), lb . Lead , , short tons~~

~~>t Zinc~~

~~Non-metallic products —~~

~~Bituminous coal, short tons~~

~~Anthracite coal, long tons~~

~~Natural gas~~

~~Petroleum, barrels~~

~~Brick clay .~~

~~Cement, barrels~~

~~Stone~~

~~Phosphate rock, long tons~~

~~Salt, barrels~~

~~Zinc, white, short tons~~

~~The coining value of silver was taken at $l-2929 per troy ounce : that of gold at $20-6718 per troy ounce. The~~

~~S. IX. — 72~~

~~Quantity.~~

~~Value.~~

~~15,878,354~~

~~$242,174,000~~

~~59,653,788~~

~~77,126,382~~

~~3,880,578~~

~~80,218,800~~

~~597,443,212~~

~~86,629,266~~

~~270,700~~

~~23,280,200~~

~~140,822~~

~~11,265,760~~

~~225,607,649~~

~~236,201,899~~

~~60,242,560~~

~~112,504,020~~

~~27,067,500~~

~~69,389,194~~

~~66,417,335~~

~~13,800,000~~

~~20,068,737~~

~~15,786,789~~

~~55,615,926~~

~~1,483,723~~

~~5,316,403~~

20,566,661

6,617,449

38,889

3,111,120

570

UNITED STATES

[statistics

quantity of iron ore mined in 1901 was 28,887,479 long tons, with a value at the mines of $49,256,245.

Railways. — Tlje number of miles of railway in the United States, exclusive of Alaska, Porto Eico, Hawaii, and the Philippine Islands, was 163,597 in 1890, and 193,346 in 1900. Since 1880 two years have been marked by large additions to the number of miles in operation : 1882, when the mileage increased by 11,569, and 1887, when 12,876 miles were added. Since 1890 the annual increase has been much less, never exceeding 4500 miles in any one year, and falling as low as 1650 miles in 1895. The number of miles per 100 square miles of territory was 5‘51 in 1890 and 6-51’in 1900 ; but measured by popula- tion it was 25-99 miles per 10,000 inhabitants in 1890, and 25‘44 in. 1900. The tendency of the railways towards consolidation, the shorter lines being absorbed by the longer, is shown by the fact that in 1890 lines of more than 1000 miles constituted 77,873 miles, or 47-5 per cent, of the total railway mileage of the United States, and in 1900, 117,880 miles, or 61 per cent, of the total. The economy in management since 1894, due to the increase in the size and power of locomotives and in size and capacity of cars, both freight and passenger, is also notable : — ■

Equipment — Number.

Locomotives — Passenger Freight . Others .

~~Cars —~~

~~Total~~

~~1894.~~

~~9,893~~

~~20,000~~

~~5,599~~

~~1900.~~

~~9,863~~

~~21,596~~

~~6,204~~

~~35,492~~

~~33,018 . 1,205,169 39,891~~

~~37,663~~

~~34,713~~

~~365,531~~

~~50,594~~

~~. 1,278,078~~

~~1,450,838~~

~~Freight . Others .~~

~~Total~~

~~A comparison of passenger and freight service in the two years 1890 and 1900 will demonstrate the work performed by the roads : —~~

~~Service —~~

~~Passengers, number carried . „ carried 1 mile .~~

~~Tons of freight carried~~

~~„ carried 1 mile .~~

~~1890. , 492,430,865~~

~~11,847,785,617 636,541,617~~

~~76,207,047,298~~

~~1900.~~

~~576,865,230~~

~~16,039,007,217~~

~~1,101,680,238~~

~~141,599,157,270~~

~~The amount of securities representing railway property in the two years was as follows : —~~

~~Stock- Common Preferred~~

~~1890. $3,803,284,943 606,373,542~~

~~14,409,658,485~~

~~Total . Funded debt- Bonds . . $4,123,921,557 Other obligations 450„654,574~~

~~Total . Total capital .~~

~~4,574,576,131~~

~~1900.~~

~~14,522,291,838~~

~~1,323,287,755~~

~~$5,845,579,593~~

~~$4,900,626,823 744,828,544~~

~~$5,645,455,367~~

~~8,984,234,616 $11,491,034,960~~

~~The income account was~~

~~Gross earnings from operation Operating expenses .~~

~~Income from operation Income from other sources~~

~~Total income Total deductions from income~~

~~Net income Total dividends~~

~~1890.~~

~~1,051,877,632 692,093,971~~

~~$359,783,661 126,767,064~~

~~r,0,725~~

~~384,792,138~~

~~$101,758,587 89,688,204~~

~~*1900. 51,487,044,814 961,428,511*~~

~~*$525,616,303 162,885,071*~~

~~*$688,501,374 461,240,927*~~

~~*$227,260,447 139,602,514*~~

~~*As statistics of the internal commerce of the United States are not prepared in any form, the nearest approach to such figures is afforded by the freight traffic movement on the railways. The total tonnage carried in 1900 was 957,863,605 tons, of which*~~

~~*516,432,217 tons originated on the reporting road. The principal descriptions of freight were : —*~~

~~*Tonnage originating on Line.*~~

~~*from Connecti Lines, &c.*~~

~~*Products of agriculture-*~~

~~*Grain*~~

~~*28,804,245*~~

~~*36,194,645*~~

~~*Flour*~~

~~*6,088,070*~~

~~*9,217,623*~~

~~*Hay. . . .*~~

~~*4,112,092*~~

~~*3,721,714*~~

~~*Cotton*~~

~~*2,482,930*~~

~~*3,497,417*~~

~~*Fruit and vegetables*~~

~~*5,213,210*~~

~~*7,892,816*~~

~~*Products of animals —*~~

~~*Live stock*~~

~~*8,491,998*~~

~~*7,130,059*~~

~~*Dressed meats .*~~

~~*1,589,703*~~

~~*3,122,722*~~

~~*Other packing-house*~~

~~*2,038,215*~~

~~*3,695,677*~~

~~*Hides and leather .*~~

~~*737,150*~~

~~*1,163,595*~~

~~*Products of mines —*~~

~~Anthracite coal~~

~~53,245,195~~

~~43,692,936~~

~~Bituminous coal~~

~~130,443,500~~

~~83,638,690~~

~~Coke~~

~~18,917,811~~

~~24,188,490~~

~~Ores~~

~~37,005,530~~

~~38,048,994~~

~~Stone, sand, and the~~

~~like~~

~~28,445,488~~

~~14,343,029~~

~~Products of forests —~~

~~Lumber .~~

~~40,977,098~~

~~35,107,899~~

Manufactures —

Petroleum

3,819,670

4,537,211

Sugar

2,050,558

2,216,190

Iron, pig and bloom .

12,281,361

13,028,848

Iron and steel rails .

3,565,501

3,219,360

Other castings and

machinery

7,186,880

7,831,321

Bar and sheet metal .

8,144,271

9,247,417

~~Cement, brick, and~~

~~lime~~

~~13,429,478~~

~~8,333,907~~

~~Merchandise~~

~~21,974,201~~

~~20,546,892~~

~~Foreign Commerce. — The salient features of the foreign commerce of the United States may be gathered from the following tables.~~

~~Domestic Exports (Value in Millions of Dollars).~~

~~Description.~~

~~1890.~~

~~1895.~~

~~1901.~~

~~Products of agriculture . ,, mining ,, forests . ,, fisheries~~

~~Manufactures~~

~~Miscellaneous~~

~~Total .~~

~~$629-8~~

~~22-3~~

~~29-5~~

~~7·5~~

~~151·1~~

~~5·1~~

~~$553·2~~

~~18·5~~

~~28·6~~

~~53~~

~~183·6~~

~~4·2~~

~~$943·8~~

~~38·0~~

~~54·3~~

~~77~~

~~412·2~~

~~4·5~~

~~$845·3~~

~~$793·4~~

~~$1460·5~~

~~The important growth has been in the exports of manu- factures. In 1890 they contributed 17 “9 per cent, of the total exports, and in 1901, 28·2 per cent.~~

~~*The value of imports for consumption (net imports), by classes, was : —*~~

~~*Description.*~~

~~*1890.*~~

~~*1S95.*~~

~~*1901.*~~

~~*Articles of food and animals*~~

~~*$248·6*~~

~~*$226·4*~~

~~*$213·7*~~

~~*))*~~

~~*in crude condition manufactured, for use*~~

~~*178·4*~~

~~*187·5*~~

~~*271·0*~~

~~*as materials*~~

~~*847*~~

~~*83·8*~~

~~*74·9*~~

~~*a*~~

~~*manufactured, ready*~~

~~*for consumption*~~

~~*154-5*~~

~~*140-8*~~

~~*135-8*~~

~~*H*~~

~~*volu ntary use, luxuries,*~~

&c

Total

107-5

92-7

112-5

$773-7

$731-2

SS07-8

Of the imports of 1901 the merchandise subject to duty was $468,670,045, or 48 per cent, of the total imports ; the amount of duty collected was $233,556,110, being 50 per cent, on the value of these imports.

The total movement of imports and exports of mer- chandise and silver between 1890 and 1901 was as shown in the following table : —

statistics]

UNITED STATES

571

1

Excess of

Excess of

| Exports.

Imports.

~~Exports over~~

~~Imports over~~

~~Imports.~~

~~Exports.~~

~~1890~~

~~$892,702,613~~

~~$818,091,965~~

~~$74,610,648~~

~~1891~~

~~907,071,798~~

~~871,896,684~~

~~35,175,114~~

~~1892~~

~~1,063,088,707~~

~~857,014,309~~

~~206,074,398~~

~~1893~~

~~888,402,518~~

~~889,594,174~~

~~$1,191,656~~

~~1894~~

~~942,591,837~~

~~668,281,174~~

~~274,310,663~~

~~1895~~

~~854,833,451~~

~~752,181,144~~

~~102,652,307~~

~~1896~~

~~943,148,608~~

~~808,501,860~~

~~134,646,748~~

~~1897~~

~~1,112,940,194~~

~~795,263,639~~

~~317,676,555~~

~~1898~~

~~1,286,587,569~~

~~646,977,435~~

~~639,610,134~~

1899

1,283,342,357

727,823,545

555,518,812

1900

1,451,195,357

885,197,486

565,997,871

1901

1,552,050,171

859,558,686

692,491,485

The increased export of the products of agriculture, beginning in 1897 and continuing through 1901, pre- sented an interesting feature in the commercial experience of the United States. The relative importance of exports, of agricultural produce in the total export trade was not materially changed, but the values represented gave rise to a large balance due to the United States amount- ing to more than $2,600,000,000 in the five years on merchandise account alone. This balance has proved to be largely fictitious, although it undoubtedly played an important part in supporting the feeling of prosperity that characterized that period. Erroneous methods of reporting official values of exports are in part responsible for this result.

Against this apparent excess of exports over imports the movement of gold coin and bullion was : —

~~***Excess of***~~

~~***Excess of***~~

~~***Exports.***~~

~~***Imports.***~~

~~***Exports over Imports.***~~

~~***Imports over ‘ Exports.***~~

~~***1890***~~

~~***$17,274,491***~~

~~***$12,943,342***~~

~~***$4,331,149***~~

~~***1891***~~

~~***86,362,654***~~

~~***18,232,567***~~

~~***68,130,087***~~

~~***1892***~~

~~***50,195,327***~~

~~***49,699,454***~~

~~***495,873***~~

~~***1893***~~

~~***108,680,844***~~

21,174,381

87,506,463

1894

76,978,061

72,449,119

4,528,942

1895

66,468,481

36,384,760

30,083,721

1896

112,409,947

33,525,065

78,884,882

1897

40,361,580

85,014,780

$44,653,200

1898

15,406,391

~~120,391,674~~

~~104,985,283~~

~~1899~~

~~37,522,086~~

~~88,954,603~~

~~51,432,517~~

~~1900~~

~~48,266,750~~

~~44,573,184~~

~~3,693,566~~

~~1901~~

~~53,185,177~~

~~66,051,187~~

~~12,866,010~~

~~Merchandise Exports and Imports, 1901.~~

~~Per cent.~~

~~Imports~~

~~of Total~~

~~of Total~~

~~from each~~

~~Exports.~~

~~Imports.~~

~~Country.~~

~~$631,177,157~~

~~42-42~~

~~United Kingdom~~

~~17-42~~

~~$143,388,501~~

~~191,780,427~~

~~12-89~~

~~Germany~~

~~12-21~~

~~100,445,902~~

~~78,714,927~~

~~5-29~~

~~France~~

~~9-17~~

~~75,458,739~~

~~84,356,318~~

~~5-67~~

~~Netherlands~~

~~2-50~~

~~20,598,799~~

~~49,389,259~~

~~3-82~~

~~Belgium~~

~~1-77~~

~~14,601,711~~

~~34,473,189~~

~~2-32~~

~~Italy~~

~~2-99~~

~~24,618,384~~

~~15,480,288~~

~~1-04~~

~~Spain~~

~~•66~~

~~5,409,301~~

~~105,789,214~~

~~7-11~~

~~Dominion of Canada~~

~~5-16~~

~~42,482,163~~

~~25,964,801~~

~~1-74~~

~~Cuba~~

~~5-28~~

~~43,423,088~~

~~8,876,052~~

~~•60~~

~~British West Indies~~

~~1-56~~

~~12,851,325~~

~~36,475,350~~

~~2-45~~

~~Mexico~~

~~3-50~~

~~28,851,635~~

~~6,707,465~~

~~•45~~

~~Central America~~

~~1-32~~

~~10,838,663~~

~~11,663,574~~

~~•78~~

~~Brazil~~

~~S-59~~

~~70,643,347~~

~~11,537,668~~

~~•77~~

~~Argentina~~

~~■98~~

~~8,065,318~~

~~5,294,726~~

~~•85~~

~~Chile~~

~~1-05~~

~~8,683,279~~

~~6,251,804~~

~~•42~~

British East Indies

5-33

43,882,493

19,000,640

1-28

Japan

3-55

29,229,543

10,405,834

■70

Chinese Empire

2-23

1S,303,706

8,009,848

•54

Hong Kong

•17

1,416,412

30,726,687

2-06

~~***British Australasia***~~

~~***■5S***~~

~~***4,7fi7,6fil***~~

~~***21,654,458***~~

~~***1-45***~~

~~***British Africa***~~

~~***■10***~~

~~***813,440***~~

~~***$1,136,504,605***~~

~~***76-39***~~

~~***Europe***~~

~~***52-19***~~

~~***$429,620,452***~~

~~***196,534,460***~~

~~***13-21***~~

~~***North America***~~

~~***17-63***~~

~~***145,158,104***~~

~~***44,400,195***~~

~~***2-98***~~

~~*South America*~~

~~*13-41*~~

~~*110,367,342*~~

~~*49,390,712*~~

~~*3-34*~~

~~*Asia*~~

~~*14-30*~~

~~*117,677,611*~~

~~*35,392,401*~~

~~*2-36*~~

~~*Oceania*~~

~~*1-3S*~~

~~*11,395,195*~~

~~*25,542,618*~~

~~*1-72*~~

~~*Africa*~~

~~*1-09*~~

~~*8,953,461*~~

~~*$1,487,764,991*~~

~~*$823,172,165*~~

The tariff law of 1890 provided for reciprocity agree- ments with other countries, with the object of reducing

somewhat the customs duties upon a small number of imported products, while extending the exportation of American commodities. With the single exception of Brazil, the results were not important, and in 1894 a return was made to general tariff provisions, in place of special reductions in duties in favour of a few countries. The removal of all duties upon sugar in 1890, and upon raw wool in 1894, did much more to extend commercial con- nexions than all the reciprocity agreements of 1900. Free wool, especially, opened an important trade with South American states — one of the avowed objects of the reciprocity policy. The Tariff Act of 1897, the highest protective measure ever passed in the United States, not only re-imposed the duties on wool, but raised almost the entire range of protective duties. Hides, exempt from duty since 1872, were made dutiable, and thus a double injury was inflicted upon South American export interests. A provision for framing reciprocity agreements was intended to relieve certain articles from excessive charges or to grant to certain countries advantages in the domestic markets. As the agreements formed under this provision were subject to the approval of both Houses of Congress, such an unusual condition has proved sufficient to prevent any action towards modifying duties through reciprocal arrangements with foreign countries.

Shipping. — The tonnage of the merchant marine of the United States in 1890 was — sailing vessels (including canal boats), 2,565,409 tons; in 1900, 2,507,042 tons: steam vessels (1890), 1,859,088 tons; (1900), 2,657,797 tons. The employment of this tonnage showed that the increase was almost entirely in shipping in the coasting trade. The steam tonnage engaged in foreign trade was 192,705 tons in 1890 and 337,356 tons in 1900. Since 1899 the number of steam

built in the United States has increased, but the total construction of vessels of all descriptions has not attained 500,000 tons in any one year. Foreign shipping . engaged in American trade may be controlled by American capital, but the vessels are not registered as American. The returns of the value of merchandise, imported and exported, carried in

American and in foreign vessels, are not entirely correct. These returns show that in 1890, of a total merchandise movement of $1,573,567,830, American vessels carried only 12‘9 per cent., or $202,451,086; in 1900 they took only 1195,084,192, which was 9-3 per cent, of the total of $2,089,528,616. The total tonnage of American and foreign vessels, sailing and steam, entered into the seaports of the United States in 1890 was 15,365,604 tons, of which 3,404,584 tons were American ; in 1900 the total was 23,533,597 tons, of which 3,974,239 tons were American.

Finances. — The total interest- bearing public debt of the United States in 1890 was $725,313,110, and in 1901, $957,141,000. The- annual interest charge was almost the same in the two years, being $29,417,603 in 1890 and $29,789,153 in 1901. In the latter year $445,940,750 of the principal carried 2 per cent, interest ; $99,621,420, 3 per cent.; $419,724,770, 4 per cent.; and $21,854,100, 5 per cent. The ordinary revenue of the Government in 1901 was : from customs, $238,585,456 ; in- ternal revenue, $307,180, 664; postal service,$lll, 631, 193 ; and miscellaneous, $41,919,217; total, $699,316,530. The more important objects of expenditure were : legislative, $11,211,515; treasury, $100,216,686; war, $147,493,921; navy, $60,985,304; interior, $168,959,479; post office, $118,180,981; total (including all other), $621,598,546. The expenditure for the interior covers that for pensions, which amounted to $138,531,484 in 1901. The number of pensioners carried on the lists was 997,735, of whom 748,649 were invalids.

UNITED STATES

(For details as to army, navy, education, religion, charities, crime, justice, industry and agriculture, banking, post office, telegraphs, communications, &c, see the articles on these subjects or the articles on the separate states or territories.) (w. c. f.)

III. Constitution and Government. i. Introductory.

§ 1. Whoever undertakes to describe the constitution and government of any country will naturally begin with an account of the various organs

and authorities which exist in it and of the rules and doctrines which determine their action, and will then proceed to show what is the actual working of these organs, and in what manner they discharge those administrative functions for which every civilized community must provide. In unified or centra- lized countries, where there is one supreme government, whence all minor authorities derive their powers, this is a comparatively simple matter. But in federal countries, where there are two distinct sets of governmental organs — those of the general or federal government, and those of the component communities or States, mem- bers of the federation — the task is more complicated, because it becomes necessary to describe two distinct governments, together with the relations of these two to one another. Accordingly, a description of the Government of the United States falls naturally into three parts : —

First, an account of the States and their govern- ments.

Second, an account of the Federal system, including the relation of the States as communities to the Federa- tion as representing the whole nation.

Third, an account of the structure and organization of the Federal Government considered as the general Government of the nation.

It is possible to begin either with the Federation or with the States. But as the States are older than the Federal Government, and as the latter was, indeed, in many respects modelled upon the scheme of govern- ment which already existed in the thirteen original States, it may be convenient to begin with the States and then to proceed to the National Government, whose structure is more intricate and will require a fuller ex- planation.

Before entering, however, on a description of the State Governments, one feature must be noticed which is common both to the States and to the Federation, and which gives to the governmental system of both a peculiar character, different from that of the Government of Great Britain. This feature is the existence of a supreme instrument of government, a document which has been enacted by the people, which controls, and which cannot be altered by, any or all of the ordinary organs of government. In Great Britain, Parliament is the supreme power,

~~*and can change any of the laws of the country at any moment. In the American Union, and in each and every State of the Union, there exists a documentary or rigid Constitution, creating and defining the powers of every authority in the Government. It is the expression of the ultimate sovereignty of the people, and its existenco gives to the working both of the Federal Government and of the several State Governments a certain fixity and uniformity which the European, and especially the British, reader must constantly bear in mind, because under such a Constitution a legislature enjoys far scantier powers than in the United Kingdom or, indeed, in most European countries.*~~

~~*ii. The State Governments.*~~

~~*§ 2. The State is the oldest political institution in America, and is still the basis and the indestructible unit of the American system. It is the out-0ti„ln growth from, or rather the continuation of the 0t the colony, as the latter existed before the Declara- American tion of Independence in 1776. In everyone of state- the North American Colonies there was in operation at that date a system of self-government under a charter granted by the British Crown. In each there was a governor, with minor executive officers, a legislature, and a judiciary; and although the Crown retained the power of altering the charter, and the British Parliament could legislate over the head of the colonial legislature so as to abrogate statutes passed by the latter, still in practice each colony was allowed to manage its own affairs and to enact the laws it desired. Thus the people were well accustomed to work their institutions, and when they gained their independence continued to maintain those institutions with comparatively little change. In two colonies, Ehode Island and Connecticut, the colonial charter was substantially maintained, as the constitution of the State, for many years, in the former case till 1842, in the latter till 1818.*~~

~~*§3. Each State was under the Confederation of 1781 sovereign (except as regarded foreign relations), and practically independent. In adopting the Federal Constitution of 1787-89, each parted RMtsand with some of the attributes of sovereignty, Estate." while retaining others. Those which were retained have been to some extent diminished by the 14th and 15th amendments to the Constitution, and if the right to secede from the Union*~~

~~ever existed (a point much controverted), it was finally negatived by the Civil War of 1861-65. Otherwise, however, these attributes survive. The powers of a State ' are inherent, not delegated, and each retains all such rights and functions of an indepen- dent government as it has not, by entering the Union, affirmatively divested itself of in favour of the Federal Government. Each has its own documentary constitu- tion ; its legislature of two elective houses ; its executive, consisting of a governor and other officials ; its judiciary, whose decisions are final, except in cases involving Federal law ; its system of local government and local taxation ; its. revenue, system of taxation, and debts ; its body of private, civil, and criminal law and procedure ; its rules of citizenship, which may admit persons to be citizens of the State and. of the Union, under conditions differing from those prevailing in other States.~~

~~The rights and functions of a State practically cover the field in which lie most of the relations of private citizens to one another and to the authorities with which they come into contact in daily life. An American may through a long life never be reminded of the Federal Government, except when he votes at Federal elections (once In every two years), lodges a complaint against the Post Office, or is required to pay duties of customs or excise. HIs direct taxes are paid to officials acting under State laws. The State (or a local authority created by the State) registers his birth, appoints his guardian, provides schools for him and pays for them, allots him a share in the property of a parent dying intestate, licences him when he enters a trade (if the trade needs a licence), marries him, divorces him, entertains civil actions against him, hangs him for murder. The police that guard his house, the local boards which care for the poor, control highways, provide water, all derive their powers from the State. Nevertheless, despite this wide range of powers, the State is (as will be explained later) a declining factor iu the public life of the nation,~~

~~because public interest tends more and more to centre in the Federal or National Government.~~

§ 4. The constitution of each State is framed and enacted by the State itself, without any Federal interference, save that in the case of new States (i.e., those which constita- ^ not already exist when the Federal Union tions. was formed, but were subsequently admitted to it) the Federal Legislature has the right of making the adoption, or omission, of any particular pro- vision in a State constitution a condition of the admission of that particular State. Even in these cases, however, the constitution derives its. force not from Congress, but from the people of the State. The invariable method of forming a constitution is for the citizens to elect by popular vote a body called a convention to draft the document, which, when drafted and circulated, is usually, though not quite invariably, submitted to popular vote. This is done either when a State is to be formed out of a Territory (as to which see post, § 10), or when an existing State desires to give itself a new constitution.1

A State constitution usually consists of the following parts : — –

A description of the boundaries of the State ;

A Bill of Eights, defining the so-called "primordial rights" of the citizens to security of life, liberty, and property ;

A declaration and enactment of the frame of State government, i.e., the names, functions, and powers of the houses of the legislature, the chief executive officials, and the courts of justice, with provisions regulating the electoral franchise ;

Provisions creating a system of local government for cities and rural areas ;

Miscellaneous provisions relating to law and adminis- tration, including the militia, revenue and taxation, State prisons and hospitals, agriculture, banking and other corporations, railways, labour questions ;

Provisions for the amendment of the constitution ;

A schedule prescribing the method of submitting the draft constitution to the vote of the people, with temporary provisions regulating the mode of

transition from the old constitutional arrangements to the new ones.

The method of amending the constitution varies in detail from State to State, but that most usual is for the legislature to propose amendments, often by a prescribed majority, and for these amendments to be voted on by the people. Such amendments have latterly come to constitute a species of direct legislation by the people similar in prin- ciple to what is called in Switzerland the Referendum.

Two remarkable changes have passed over the State constitutions. In the earlier days of the Republic they were comparatively short and simple instruments, confined to the definition of civic rights and the establishment of a frame of government. They have now become very long and elaborate documents, seven, eight, or ten times as long as the Federal Constitution, and containing a vast number of provisions on all sorts of subjects, many of them partaking of the nature of ordinary statutes passed by a legislature rather than safeguards suitable to a funda- mental instrument. And secondly, whereas in earlier days the constitutions were seldom changed, they are now frequently recast or amended. No State, except a few of the newest, now lives under its original constitution. Some have recast their constitutions six or seven times. Notwithstanding the facility and frequency of amendments, the variations between one constitution and another are

1 Details as to State constitutions will be found in the writer's American Commonwealth, chaps, xxxvii.-xxxix., which is referred to here and subsequently as containing a fuller treatment of all the topics dealt with in this article.

less conspicuous than might have been expected. There is, however, a distinction of type and character between those of the Western and those of the Eastern States, the former being generally more prolix, more prone to go into details, more apt to contain new experiments in legislation.

Comparing the old constitutions with the new ones, it may be said that 'the note of those enacted in the first thirty or forty years of the Republic was their jealousy of executive power and their careful safeguarding of the rights of the citizen ; that of the second period, from 1820 to the Civil

~~War (1861-65), the democratization of the suffrage and of institutions generally ; that of the third period (since the War to the present day) a disposition to limit the powers and check the action of the legislature.~~

~~§ 5. In every State the legislature consists of two houses. This remarkable feature, originally due to the practice that had prevailed in some colonies, and to the example of Great Britain, soon became state universal, and the belief in its necessity has inures. passed into a fundamental dogma, the idea being that a single chamber would be either hasty, or tyrannical, or unscrupulous — perhaps all three — so that there must always be a second chamber to keep the first in order. The smaller house is called the senate, the larger one is (usually) called the house of representatives, sometimes, however, the assembly. Both are chosen by popular vote, almost universally by the same voters, and usually in single-membered districts, and at the same time. The senatorial districts are, of course, larger than the house districts. A senator is usually chosen for a longer term (often four years) than a representative, and, in most cases, whereas the house is elected all at once, the senate is renewed only partially at each election. In some States by law, and in all by custom also, a member must reside in the district which he represents.~~

~~Universal manhood suffrage, subject to certain dis- qualifications (such as crime and the receipt of poor relief) is the rule in the great majority of States. Certain terms of residence within the United States, in the State, and in the voting district are generally prescribed, the periods varying from State to State. Four States — Wyoming, Colorado, Utah, and Idaho — give the electoral suffrage for all State elections to women.2 Women can vote at school elections in eleven States — viz., Kansas, Massachusetts, Michigan, Montana, New Hampshire, North Dakota, Ohio, Oregon, South Dakota, Washington, and Wisconsin, and in the Territory of Oklahoma. Two — Massachusetts and Connecticut — have excluded illiterates, while of later years a few Southern States, beginning with Mississippi (constitution of 1890) have been seeking to exclude from voting the negroes, or the great bulk of them, by means of educational tests, property qualifications, a combination of both, or by other means. The suffrage for legislature elections generally determines that for all other elections within the State. And by the Federal Constitution it is also~~

~~*the suffrage for Federal elections, viz., elections of members of Congress and of Presidential electors. (See post, § 20.)*~~

~~*The number of members of the legislative chambers varies from State to State. Delaware, with 9 senators and 21 representatives, has the smallest ; Minnesota, with 63 senators, has the largest senate ; and New Hampshire (a small State) has, with its 397 representatives, the largest house. The New York houses number 50 and 150 respectively; those of Pennsylvania, 50 and 244; of Illinois, 51 and 153; of Ohio, 36 and 109; of Massachusetts, 40 and 240. In all States members of the legislature*~~

~~*2 Woman suffrage amendments to State constitutions have been recently rejected by the people in eleven States and in two Territories. State organizations of women to oppose the extension of the suffrage to women exist in Illinois, Massachusetts, New York, and Oregon.*~~

~~*receive a salary, which is trie same for both, houses, some States fixing an annual sum, but most preferring a per diem rate, while the maximum is generally determined by a limitation on the length of the session.*~~

~~*It has become the wish of the people in most places to have sessions both short and few. Whereas formerly legis- latures met annually, regular sessions are now biennial except in New York, New Jersey, Massachusetts, Rhode Island, Georgia, and South Carolina — all original States.*~~

~~*The senates act as courts for the trial of State officers impeached by the house (in imitation of the British House of Lords and the Federal Senate), and Powers have in many States the function of confirming functions or refusing appointments made by the governor. of the Otherwise the powers and procedure of the two State houses are everywhere substantially identical,*~~

~~*latures. though it is worth noting that whereas every house chooses its own Speaker, the president of the senate is, in most States, the lieutenant-governor, whom the people have directly elected. Bills may originate in either house, save that in twenty-one States money Bills must originate in the house of representatives, a survival of British custom which has here, where both houses equally represent the people, no functional value. Both houses do most of their work by committees, much after the fashion (to be presently 'described) of the Federal Congress, and it is in these committees that the form of Bills is usually settled and their fate decided. Sometimes, when a committee is taking evidence on an important question, reporters are present, and the pro- ceedings receive comment in the newspapers ; but in general the proceedings of committees and even debates in the houses are imperfectly reported and excite no great public interest. In all the States except four, viz., Rhode Island, Delaware, North Carolina (all original States), and Ohio, Bills passed by the two houses must be submitted to the State governor for his approval. Should he return it to the legislature disapproved, it is lost unless repassed " over his veto " by a majority, usually of two-thirds, in each house. A good governor is apt to use his veto freely — indeed, a frequent exercise of the power is deemed in many States to be a sort of test of the governor's character.*~~

~~*Subjects of State legislation may be classified under three heads : —*~~

~~*1. Ordinary private law, including property, contracts, torts, family relations, offences, civil and criminal procedure.*~~

~~*2. Administrative law, including the regulation of urban and rural local government, State and local taxation and finance, education, public works, the liquor traffic, vaccination, adulteration, charities, asylums, prisons, the inspection of mines and factories, general laws relating to corporations, railways, labour questions.*~~

~~*3. Matters of a local or special nature, such as Bills for chartering and incorporating gas, water, canal, tramway or railway companies, or for conferring franchises in the nature of monopolies or special privileges upon such companies, or for altering their constitutions, as also for incorporating cities or minor communities and regulating their affairs.*~~

~~Although there usually exist general laws under which corporations or companies (including railway and tram- way companies) can be formed, laws which in some States and for some purposes confer a greater freedom of in- corporation than the general law allows in the United Kingdom, there is nevertheless a noticeable tendency to come to the legislature for special purposes of this kind.~~

~~As respects class 1, there is not much change in the law from year to year. The legal profession does not like to see the ordinaryand established rules disturl >od. Sometimes the laws belonging to this class are codified, or rather consoli-~~

~~dated, and then usually by a special committee of competent lawyers whose work is passed en bloc by the legislature.~~

~~As respects class 2, a good many measures are passed, particularly in matters affecting labour, and for the pro- tection of any sections of the population which may be deemed to need protection.~~

~~It is, however, in class 3 that the legislatures shew most activity, much of it pernicious, because prompted by persons seeking to serve private interests which are often opposed to the interests of the whole community. A peculiarly notable form of this special or private Bill legislation is that of dealing by special statutes with the governmental forms and details of management of muni- cipalities; and the control exercised by the State legisla- tures over city governments is not only a most important branch of legislative business, but at the same time a means of power to scheming politicians and of enrichment to greedy ones. Speaking generally, it is chiefly in the sphere of special or private legislation that State legisla- tures have shown their weak side, and incurred, in many States, the distrust of the people.~~

~~The members of these bodies belong for the most part, though by no means entirely, and least so in the agricul- tural States, to the class of professional politicians. They are seldom persons of eminent ability or high social standing. Except as a stepping-stone to a seat in Con- gress or a high executive post, the place is not one which excites the ambition of~~

aspiring men. The least respected legislatures are those of the richest and most populous States, such as New Yor^k and Pennsylvania.

The general decline in the quality of these bodies, and especially their proneness to pass ill-considered or perni- cious Bills at the instance of private promoters, has led to the restriction in recent years of their powers by the insertion in the State constitutions of many provisions forbidding the enactment of certain classes of measures, and regulating the procedure to be adopted in the passing, either of statutes generally or of particular kinds of statutes. Even these provisions, however, are frequently evaded.

§ 6. At the head of every State government stands an official called the governor, who is the descendant and representative of the governor of colonial times. Under the earlier constitutions of most of the f.te

original thirteen States, he was chosen by the legislature, but he is now everywhere directly elected by the people, and by the same suffrage as the legislature. His term of office is four years in twenty States (including Pennsylvania and Illinois), three years in one (New Jersey), two years in twenty-two (including New York and Ohio), and one year in two (Massachusetts and Rhode Island). There are no prohibitions on re-election.

It is the duty of the governor to see that the laws of the State are faithfully administered by all officials, and the judgments of the courts carried out. He has, in most States, the right of reprieving or pardoning offenders, but some recent constitutions place restrictions on this power. He is also commander of the militia or other armed forces of the State, which he can direct to repel invasion or suppress insurrection or riot. He appoints some of the State officials, his nominations usually re- quiring the concurrence of the State senate ; but his patronage is not in any State very large — in many it is indeed insignificant — because the offices of greatest im- portance are filled by direct popular election. He has also the almost mechanical function of representing the State for various formal purposes, such as demanding from other States the extradition of offenders, the issuing of writs for- the election of members of the

legislature and of members of the Federal House of Representatives, and the receiving of reports from various State officials or boards.

Not less important than his directly executive work is the influence which a governor exerts upon State legisla- tion through his possession (in all but four States) of a veto power. His right of recommending measures to the legislature (which does not include that of framing and presenting Bills) is of no great practical value, since that body need not regard his counsels, though when a com- mercial crisis occurs much may depend on his initiative. But his veto is a thing to be reckoned with. It is seldom overridden by a two-thirds majority, especially if the Bill against which it is directed be one of a jobbing nature. And as the people look to him to kill bad measures, he is frequently able, if he be a man both strong and upright, to convey intimations to the legislature, or to those who are influential in it, that he will not approve of certain pending measures, or will approve of them only if passed in a form satisfactory to him. The use of this potential authority which the possession of the veto power gives has now become one of a governor's most important duties.

In New England, and in the greater States generally, the governorship is still a post of dignity, and affords an opportunity for a display of character and talents. During the War of Secession, when each governor was responsible for organizing troops from his State, much turned upon his energy, popularity, and loyalty. And in recent years the danger of riots during strikes has in some States made it important to have a man of decision and fearlessness in the office which issues orders to the State militia.

In thirty States there is a lieutenant-governor, elected by popular vote. He is usually president of the State senate, is sometimes a member of some administrative boards, and steps into the governor's place should it become vacant.

Executive councils advising the governor, but not chosen by him, existed under the first constitutions of all but one (Georgia) of the original thirteen States. They have now disappeared except in Massachusetts, Maine, and North Carolina.

§ 7. The names and duties of the other officers vary from State to State. In every State there is a secretary ,. ,.. of state, who is custodian of the documents tratlve and archives, and a treasurer. Nearly every- offices la where there is also a comptroller or auditor, a State. w^0 ljeepS fljg accounts and is the principal financial officer, an attorney-general or legal adviser, an adjutant-general, who has immediate charge of the militia, and a superintendent of public instruction, with some little authority ovei the public schools. Most of the States have also a board of charities, a board of health, a board of railway commissioners, and either boards or single commissioners for banking, insurance, agriculture, public lands, and prisons. Other administrative depart- ments found in different States are those having control of public works — principally canals — insane hospitals, fac- tory inspection, labpur statistics, and immigration. New York State, with nearly fifty different administrative bureaus, has a larger number than any other State. In many States the most important of these officials are elected by the people at a general election, but some officials are either chosen by the legislature or appointed by the governor, the latter method applying mainly to offices of recent creation. The terms of office vary for the different offices, very few exceeding four years. The State officials, being thus largely independent of the governor, and responsible only to the people, are in no sense a cabinet or ministry. Each has his own department to administer, subject to the detailed regulation imposed by statutes, and as these statutes determine such matters as might come into controversy, a general agreement in policy among the administrative officials is not essential.

In many States officials may be removed, sometimes by

vote of the legislature, sometimes by the governor on the address of both houses, or by the governor either alone or with the concurrence of the senate ; but such removals must be made for specific misconduct.

The extent of direct State administration of public institutions and works is very limited, and most of the State bureaus have only a supervision over private enter- prises, or over local administrative officers. On this account the subordinate civil service of the State is not large compared with that of either the Federal Government or of the large municipalities, and only in a few States does it possess any importance. However, these bureaus are seldom well manned, because salaries and tenure of office are seldom such as to induce able men to offer themselves, while the places are often given as rewards for political service. New York, Massachusetts, and a few other States have systems of civil service examina- tions, similar to those in the Federal administration, which serve to keep certain branches out of politics.

§ 8. The judiciary is in every State an independent department of the Government, directly created by the State constitution, and not controlled in the exercise of its functions either by the legis- Tbf.s.tate lature or by the executive. In every State it includes three sets of courts : a Supreme Court or Court of Appeal ; superior Courts of Becord ; and local courts, but the particular names and relations of these several tribunals vary greatly from State to State.- Most of the original thirteen colonies once possessed also separate courts of chancery ; and these were maintained for many years after the separation from Great Britain, and were imitated in several of the earlier among the new States ; but special chancery courts now exist only in a few of the States, chiefly in the East and South. In other States the common law judges have also equity jurisdiction ; and in four States — New York, North Carolina, California, and Idaho — there has been a complete fusion of law and equity.

In colonial days the superior judges were appointed by the governors, except in Rhode Island and Connecticut, where the legislatures elected them. These precedents were followed in all the revolutionary constitutions, except in Georgia, where erection by the people was established. During the democratizing period from 1812 to 1860 the system of popular election was extended, especially in the new States, and at present this system prevails in thirty- two States, including practically all of 'the new States and four of the original States — New York, Pennsylvania, Maryland, and North Carolina. Five of the original thir-

teen have their judges elected by the legislatures, and in five others, together with Maine, Mississippi, and Louisiana among the newer States, they are appointed by the governor, subject to the approval of the executive council or the senate. Local judges are generally chosen by the voters of the- district in which they hold court.

Originally the superior judges were in most States ap- pointed for life and held office during good behaviour, but only four States now retain this system. Eight to ten years is the average term ; in New York it is fourteen years, and in Pennsylvania twenty-one years, while a judge is always re-eligible. Salaries, too, are small in most States, often not more than one-tenth of what a prominent lawyer can make by private practice.

These three factors — popular election, limited terms, and small salaries — have all tended to lower the character of the judiciary ; and in not a few States the State judges are men of moderate abilities and limited learning, in- ferior (and sometimes conspicuously inferior) to the best of the men who practise before them. Nevertheless, in nearly all States the bench is respectable in point of char- acter, while in some it is occasionally adorned by men

of the highest eminence. The changes introduced since 1870 have been on the whole towards improvement. Corruption seems to be very rare. Things would doubtless have become worse but for the watchfulness which the bar generally shows in endeavouring to secure the selection of honest and fairly competent men.

It must be remembered that the courts of each State form a judicial system, complete in itself, and independent of the Federal courts, and of course of other States. There is no appeal from the highest State court, except in those cases where a question of Federal law is involved, for then such cases may be removed, in manner to be explained here- after, to the Federal courts. And, subject only to this limitation, the jurisdiction of the State courts covers the entire field of civil and criminal law. The existing

legal systems of all the States, except Louisiana, whose law is based on the Koman, have been built upon the foundation of the principles contained in the common and statute law of England as that law stood in 1776, when the thirteen colonies declared their independence. In the development of the law since that time the courts of one State are not bound either by law or by usage to follow the decisions either of the Federal courts or of the courts of any other State, any more than they would follow English courts, although such decisions are used and discussed as evidence of the common law, and great deference is always shown to the opinions expressed by the Federal courts. In many States the legislatures have taken action in the development of law by adopting statu- tory codes of procedure, and in some instances have even enacted codes embodying the substance of the common law fused with the statutes. These latter codes have not, how- ever, received the general approval of the legal profession. It is of course to the State courts that the duty be- longs of construing the constitution as well as the statutes of the State, and if they find any State law to be inconsistent with the State constitution, it is their duty to declare it invalid. It is also the duty of the State court to declare any State law invalid if it is con- trary to the Federal Constitution or to a Federal statute or treaty. As in the case of the similar power of the Federal judges, this is founded on no special commission, but arises out of the ordinary judicial function of expound- ing the law and discriminating between the fundamental law and laws of inferior authority. Some observations on this point will be found in the account of the Federal courts to be given hereafter. (See post, § 25.)

§ 9. Wide as is the range of the rights and powers of a State, and elaborate as is the structure of its govern- ment, the State holds a practically less import- fh?ijse ant position in the American system than it political once did, and has not so strong a hold as it had import in the first quarter of the 19th century upon the loyalty and affection of its citizens. The political interest and the patriotism of the people generally are now given rather to the nation as a whole than to a State, whereas in the two generations following the Kevolutionary War the opposite would have been the case. This notable difference is due not to any con- stitutional changes, for there have been none except those contained in the 13th,

~~14th and 15th Amendments to the Constitution, but to the three following causes : —~~

~~The first is the growth of the party system with its complicated machinery, which has linked the citizens of different States more closely together, and has led to the eclipsing of political issues confined to a State by issues which are matters of controversy throughout the nation.~~

~~The second cause is the Civil War of 1861-65, which practically negatived the far-reaching claims of State sovereignty and the right of secession made by statesmen~~

~~ancv of the State.~~

~~of the type of Calhoun, and showed that the nation was really much stronger than any group of States.~~

~~The third is the enormous development of swift and cheap communications by land and water, which has brought every part of the country into much closer rela- tions with every other part, and has increased the sense of economic solidarity.~~

~~Thus the State, important as it is in the constitutional scheme, is both economically and sentimentally a declin- ing factor in the public life of the nation.~~

~~§ 10. During the entire history of the United States there has been a considerable area within the jurisdiction of the Federal Government not included in that of any one or more of the States ; and the systems ™^rri" of government for the various parts of this area, collectively called the Territories, require some description. The Territories now existing present many variations, and it will be necessary to consider separately : 1. The District of Columbia ; 2. the three organized Territories of the older type — Arizona, New Mexico, and Oklahoma ; 3. Alaska ; 4. the Indian Territory ; 5. the HIawaiian Islands ; 6. Porto Kico ; 7. the Philippine Islands ; and 8. the temporary military rule in Cuba.~~

The District of Columbia is a piece (>f land of seventy square miles, set apart to contain the c'.ty of Washington, which is the seat of the Federal Government. It has no local legislature nor locally-elected ofdcers of any kind. Congress itself is the legislative authoiity, while the local and municipal administration is in Ihe hands of three commissioners appointed by the President, and the judi- cial system consists of special courts, the judges for which are also appointed by the President.

Arizona, New Mexico, and Oklahonia. — These are the last remaining examples of the type ol districts enjoying almost complete autonomy, a type which began with the ordinance of 1787 providing for the government of the " territory of the United States north-west of the river Ohio." The government of these three Territories is estab- lished by Act of Congress, and there is nothing correspond- ing to a State constitution. The scheme of government, however, resembles in many respects that already de- scribed as existing in the States. There is a legislature of two houses — a council of twelve or thirteen, and a house of representatives of twenty-four or twenty-six — each elected by the voters of the Territory for two years. The sphere of legislation allowed to these bodies is almost as wide as that enjoyed by the legislature of a State, but Congress always retains the power to annul any act of a Territorial legislature and to legislate directly itself. There is a governor and other executive officers, chosen, however, not by the people, but by the President of the United States with the consent of the Senate. The judges are also appointed by the President, but the Territorial legis- lature is allowed to regulate the practice and procedure of the courts in which they sit. The Territories elect neither senators nor representatives to Congress, nor do they take any part in Presidential elections. Each, however, sends a delegate to the House of Eepresentatives, who is per- mitted to sit and speak, but not to vote. The Territories organized on this system may be called inchoate or rudi- mentary States, looking forward to becoming complete States. Nearly all of the States added to the Union since 1791 have passed through a similar stage of organization before their admission as States. When the population of such a Territory becomes equal to that of the average con- gressional district, its claim to be admitted as a State is strong. When a Territory is to be formed into a State, Con- gress either passes an Act accepting and ratifying a constitu- tion already adopted by

~~the people, or, more commonly, passes an Enabling Act, under which the inhabitants~~

~~elect a constitutional convention, which prepares and submits a constitution to the voters of the Territory ; ■ and when this constitution has been accepted by the voters the Act of Congress admitting the State takes effect.~~

~~Alaska has executive and judicial organs similar ‘ to those of the Territories above described, but has no local legislature, since the white population is extremely small and scattered over a vast area. The governor and judges are appointed by the President with the consent of the Senate, and owing to the size of the area there are three separate courts established, each having jurisdiction over part of the Territory.~~

~~The Indian Territory and the various Keservations occupied by Indian tribes have no single government. Each Indian tribe has its own internal organization, while the external relations of the tribes to the Federal Govern- ment are regulated by treaties. The interpretation of these, and the administration of justice between Indians and non-Indians, are performed by the Federal courts.~~

~~The Hawaiian Islands are governed very much like Terri- tories of the older type, with a governor, secretary, and Supreme Court judges appointed by the President of the United States with the consent of the Seriate, and an elected legislature of two houses ; but whereas in the older Territories the Territorial legislature’ has power over the electoral franchise, a Congressional statute regulates this matter for Hawaii, and requires an educational test of ability to read and write the English or Hawaiian language. The population of the islands is very mixed, including a large number of Portuguese, Japanese, and Chinese, as well as native Hawaiians and persons of American and British stock. The heads of the adminis- trative departments are appointed by the governor, a plan which departs from the method used in the States, and which~~

~~might seem to open the way for a governor's cabinet resembling that of the Federal President.~~

~~Porto Rico has received from Congress (Act of 12th April 1900) a government more limited as respects auto- nomy than that of Hawaii. Not only is the governor appointed by the President of the United States with the consent of the Senate, but also the six; principal adminis- trative officials ; and these, with five other persons ap- pointed in the same way, form the executive council, which is one chamber of the legislature, and has, more- over, important independent authority in the granting of franchises and concessions. Five members of this council must, however, be native inhabitants of Porto Eico. There is also an assembly elected by the voters of Porto Rico, which, with the executive council, forms the legisla- ture. As in other Territories, the judges and court officers are appointed by the President of the United States with the consent of the Senate.~~

~~The Philippine Islands were for a time under military rule, and thus governed entirely under the authority of the President of the United States. A commission of five persons, appointed by him, exercised legislative as well as executive functions, and through its action courts and municipal government were established in some districts, others still in rebellion remaining under the control of the military authorities. Under the Law signed by the Presi- dent, 1st July 1902, and executive proclamation of 4th July, the military government was abolished and civil government substituted. A legislative assembly is to be established consisting of two houses — -an upper house of eight members, five Americans and three Filipinos, and a lower house with elected members.~~

~~Cuba had for a time a military government, but this was avowedly a temporary system for the maintenance of order until a stable and independent government created by the Cubans themselves could be established. This~~

~~took place in 1902. A constitution was then adopted, and a president and legislature elected ; but the Cuban government is subject to certain conditions which the Federal Congress has imposed.~~

~~iii. Local Government.~~

~~§ 11. Every State in the Union has its own system of local administrative areas and local authorities, working under its own laws, these systems agreeing in „ many points with one another, and differing in iocai many others. Three main types of rural local govern- government may be distinguished, prevailing in men*- different regions. The first is characterized by its unit, the town or township, and exists in the six New England States. The second is characterized by a much larger unit, the county, and prevails in the Southern States. The third may be called the mixed system, combining some features of the first with some of the second, and is found under a considerable variety of forms in the Middle and North-western States. The different types spring from the original differences in the character of the colonists who settled on the Atlantic coast, and in the conditions under which the various colonial communities developed. (See American Commonwealth, chaps, xlviii. and xlix.)~~

~~The town, or township, of New England is generally a rural community occupying a comparatively small area, and with a population averaging about 3000, but ranging from 200 in newly-settled districts or thinly-peopled hilly districts to 15,000 in the vicinity of large cities and in manufacturing neighbourhoods. Each town is governed by the town meeting, an assembly of all the qualified voters within the limits, which meets at least once a year in the spring, and also at other times when specially summoned. This assembly elects the town officials at the annual meetings, but it is much more than an electoral body. It is also a deliberative assembly and the legislative authority for local matters. It enacts bye-laws and ordin- ances, receives the reports of the local officials, passes their accounts, manages the town property, votes appropriations for each item of expenditure, and authorizes the necessary taxation. Every resident has the right to bring forward and to speak in favour of any proposal. The meeting is presided over by a chairman called the moderator. In rural communities the attendance is usually good, the debates are sensible and practical, and a satisfactory ad- ministration is generally secured. But when the town meeting has grown to exceed seven or eight hundred persons, and especially when the farming class of native~~

American stock has been replaced by factory operatives of other nationalities, the institution works less perfectly.

The town officials consist of the " selectmen " (usually three, five, or seven, sometimes nine), the town clerk, treasurer, assessors, tax collector, school committeemen, and the holders of divers minor offices according to local needs. These are elected annually, except that in some cases the " selectmen " and school committee have a term of several years, one member of each board being elected annually. The " selectmen," who receive no regular salary, but may charge for expenses actually incurred, form a sort of directory or executive committee, which manages the ordinary administrative and financial business under such instructions as may have been given by the town meeting.

In the Middle and Western States the township is a more artificial organism than the rural town of New England. In one group of States — Pennsylvania, New Jersey, New York, Ohio, Indiana, Iowa — while the town- ship has more or less power, and there are town officials, there is no town meeting. In another group — Michigan, Ulinqis, Wisconsin, Minnesota, the two Dakotas — the town meeting reappears, though in a less primitive and less

perfect form. In the States west of the Alleghanies each township covers an artificial area 6 miles square, and a separate quasi-municipal organization is usually provided for the villages which have grown up in many townships. The county is to be found in every State of the Union, but its importance varies inversely with the position held in the system of local government by that smaller and older organism, the town. In New England the county was originally an aggregation' of towns for judicial pur- poses, and in that part of the Union it is still in the main a judicial district. There is no general representative council or board, but judicial officers, a sheriff and a clerk, are elected in each county, and also a

county treasurer and county commissioners. The latter have the management of county buildings, such as court-houses and prisons, have power to lay out new main highways, to grant licences, and to apportion among the towns and cities the taxation necessary to meet county expenses. Besides these officials there are generally to be found in New England a county school superintendent and an overseer of roads. In the Southern States the county is the local administrative unit, and in addition to its original judicial and financial functions, it has now also control over public schools, the care of the poor, and the construction and management of roads. County govern- ment is vested in a board of county commissioners, elected (in almost every State) by the people, and in various officials also directly elected. In some Southern States some counties have been subdivided into school districts, each of which elects a school committee, and from this nucleus there may possibly develop something resembling the New England town. In those Middle and Western States where the town meeting is not found, the functions and officials of the county tend to resemble those existing in the Southern States, while even in those parts of the West where the town meeting is found the county remains more important than in New England. Thus in many of these States poor relief is a county and not a town charge. In most States county administration belongs to a small board of three commissioners elected for the county at large, but in New York, Michigan, Illinois, and Wisconsin there is a larger board of supervisors elected by townships and cities within each county. Although local affairs do not now enlist, even in New England, so large a measure of interest and public spirit as the town system used to evoke in Massachusetts, Rhode Island, and Connecticut in the 'thirties, still, broadly speaking, the rural local government of America may be deemed satisfactory. The administration is fairly efficient, most so, on the whole, in the Northern and Western States, while jobbery and corruption are un- common—indeed, in the agricultural and poorer States seldom met with. The value of local self-government as a training for the duties of citizenship has been very great, and in many parts of the country, especially where the funds dealt with are small, elections are not fought and offices not distributed upon party lines.

~~§ 1 2. The tendency, now so marked in nearly all civilized countries, to the development of urban communities has been nowhere more marked than in the United Clty States. In 1790 there was only one city (Phila-~~

~~delphia) with more than 40,000 inhabitants, and but six with more than 8000. The aggregate population of these six was only 131,472, or 3-35 per cent, of the total population. In 1900 there were 346 cities exceeding 8000 in population, and 38 exceeding 100,000 ; and the aggregate urban population in cities and towns of over 8000 was 25,031,505, or 32'9 per cent, of the entire population of the country.~~

~~The increase in the range and importance of municipal~~

~~govern- ment.~~

~~functions has been not less striking than the growth of urban population. This can best be illustrated by the figures of municipal expenditure. In 1810 the annual budget of New York City — with a population of 100,000 — was* $100,000 ; to-day an average city of 100,000 population has an annual expenditure of from $1,000,000 to $2,000,000, and the total expenditure of the city of New York is nearly $100,000,000 a year. Municipal government is therefore a matter of high concern to America, and plays a large part in any study of American political institutions. But the diversities of system due to the variations in the laws of different States are so numerous that nothing more than an outline can be presented here.~~

~~The historical origin of American municipal govern- ment is to be found in certain boroughs which had been chartered in the colonial period, after the fashion of English boroughs. These American corporations had the usual English system of borough government, con- sisting of a mayor, aldermen, and councilmen, who carried out the simple administrative and judicial functions needed for the then small communities. The basis for the government of each American city is still a charter, but since the Revolution these charters have been granted by the State legislatures, and are subject to constant change by statute. The charters of cities have shown the same process of increasing length and detailed regu- lation as~~

the State constitutions ; and in details there are many differences between different cities. (See American Commonwealth, chaps, l.-lii.)

As a rule, one finds (1) a mayor, elected directly by the voters within the city, who is the head of the administra- tion ; (2) administrative officers or boards, some directly elected by the city voters, others nominated by the mayor or chosen by the council ; (3) a council or assembly, con- sisting sometimes of two, but more frequently of one chamber, elected directly by the city voters ; and (4) judges, usually elected by the city voters, but sometimes appointed by the State.

The mayor is by far the most important official in the city government. He is elected usually for two years, but sometimes for one, three, or four (in New York his term is now two years). He has almost everywhere a veto on all ordinances passed by the council, modelled on the veto of the Federal President and of a State governor. In many cities he appoints some or all of the heads of the administrative departments, usually with the approval of the council, but in some important cities (including. New York, Cleveland, Buffalo, Syracuse, and Rochester) the mayor has an absolute power of appointment. As the chief executive officer, he preserves the public peace. In practice he sometimes exerts a certain discretion as to the enforcement of the laws, especially those providing for Sunday closing. He usually receives a considerable salary, varying with the size of the city.

The practical work of municipal administration is carried on by a number of departments, some under single heads, and some under boards or commissions. The number and classification of these departments vary widely in the different cities. The board of education, which controls the public schools, is usually largely inde- pendent of the council, and in some important cities has an independent power of taxation. In Boston, St Louis, Baltimore, and some few other cities, the police board is appointed by the governor of the State.

The city councils pass local ordinances, vote appropria- tions, levy taxes, and generally exert some control over appointments to administrative positions. The recent tendency has been, however, to decrease the powers of the council and to increase those of the mayor. In some cities

the mayor has the absolute power of appointment ; the departments, especially the boards of health, have large ordinance-making powers ; statutes passed by the State legislature determine the principal lines of municipal policy, and the real control over appropriations and taxes is occasionally found vested in a board of estimate, con- sisting of the mayor, comptroller (the chief financial officer), and a few other administrative officials. In New York City, where the council had lost public confidence, and in some other places, the only important power still pos- sessed by the council is that of granting franchises to street railways, gas companies, and the like. In the smaller cities, however, the councils have retained a wider measure of authority.

The functions of city government may be distributed into three groups : — (a) Those which are delegated by the State out of its general coercive and administrative powers, including the police power and the granting of licences ; (b) those which, though done under general laws, are properly matters of local charge and subject to local regulation, such as education and the relief of the poor ; and (c) those which involve no questions of policy, but are of a purely business nature, such as the paving and cleansing of streets, the construction and maintenance of drains, the provision of water, &c. None of these, not even the last, is, as «, rule, satisfactorily discharged in the larger cities, because municipal government has un- fortunately been drawn into the vortex of party politics, and offices have fallen into the hands of unscrupulous professional politicians seeking their own gain. The Tammany King in New York City has been onjy the most conspicuous example of this degradation. In Philadelphia, Chicago, Cincinnati, San Francisco, and some others of the largest cities, municipal government has for many years past been, as a rule, more or less corrupt, while usually inefficient, and always costly ; and few of the persons who conduct it have belonged to the solid business part of the community. Happily, there has been of late years a more active spirit of reform at work, and the prospects of improvement have distinctly brightened.

~~iv. The Federal System.~~

~~§ 13. The component elements of the American Union, the stones out of which the fabric of the National Govern- Orixin ment has been raised, are the States, the consti- otthe tutions, general character, and powers of which Federal have been already described. It must now be Union. shown on what principles and by what devices the originally semi-independent communities have been bound together in a Federation.~~

~~When, in 1776, the thirteen colonies threw off their allegiance to the British Crown and took the title of States, they proceeded to unite themselves in a league by the Articles of Confederation of 1781 (see Ency. Brit., vol. xxiii. p. 746). This scheme of union proved de- fective, for its central authority, an assembly called Con- gress, was hopelessly weak. It had neither an executive nor a judiciary, nor had it proper means of coercing a recalcitrant State. Its weakness became so apparent, especially after the pressure of the war with Great Britain had been removed, that the opinion of the wisest men called for a closer and more effective union. Thus the present Constitution was drafted by a Convention in 1787, was ratified by nine States (the prescribed number) in 1788, and was set to work under George Washington as first President in 1789 (see Ency. Brit., vol. xxiii. pp. 749-752).~~

~~§ 14. The Constitution is a document of the first im- portance in the history of the world, because it has not only determined the course of events in the American Republic, but has also influenced, or become a model for,~~

~~other constitutions, such as those of Switzerland (1848 and 1874), Canada (1867), Australia (1900), besides Mexico and the numerous republics of South Tbe and Central America. It was in substance a Federal compromise effected between those who wished Constitu- tor a centralized government and those who de- t,on' sired to leave very wide powers to the component States ; and many subsequent difficulties arose from the omission to settle certain points, and from the somewhat vague lan- guage in which other points were referred to. Of these omissions and points left vague, some were inevitable, because an agreement could not have been reached, some were due to the impossibility of foreseeing what~~

difficulties the future would bring with it. But they were, considering the conditions under which the instrument was framed, comparatively few, and the Constitution, when one regards it as a piece of drafting, deserves the admiration which it has received from nearly all American and most foreign critics. It is, on the whole, admirably clear, definite, and concise, probably superior in point of technique to all the documents since framed on its model.

As respects substance, the Constitution, being enacted by and expressing the will of the people, who are the ultimate source of political power, is the supreme law of the land over the whole Union, entitled to prevail over all laws passed by Congress, the legislature which it creates, as well as over all State constitutions and all State laws. It can be altered only by the people, in manner to be hereafter mentioned. It is a comparatively short document, and consists of seven articles, subdivided into sections. Art. I. deals with the Federal Legislature, its structure and powers, and imposes certain restrictions upon the States. Art. II. provides for the election of an executive head, the President, and assigns certain powers and duties to him. Art. III. treats of the judicial power, defining its range and the mode of its exercise. Arts. IV., V., and VI. contain certain miscellaneous provisions, including those which regulate the mode of amendment. Two alternative methods of proposing amendments and four of passing them are recognized. They may be proposed either by a two-thirds vote in each House of Congress, or by a Convention called by Congress on the application of the legislatures of two-thirds of the States. They may be passed either by the legislatures of three- fourths of the States, or by conventions in three-fourths of the States. Congress has in every instance preferred the method of itself proposing amendments, and the method of submitting them to the State legislatures for ratifica- tion. (For the amendments adopted, see post, § 28.)

The provisions of the Constitution, which, be it re- membered, is later in date than the creation of the original States, and presupposes the existence and activity of those communities, include two sets of matters, which must be considered separately — (a) the Federal system, i.e., the relations of the National Government to the States ; and (b) the structure of the National Government itself.

~~§ 15. In the determination and allotment of the rights and powers of the National Government on one side and of the States, on the other, a determination which is the foundation of every Federal system, the 0's'r'*"- American Constitution proceeds upon the prin- powers ciples following : — between~~

~~1. No powers are expressly allotted to the tbe nation States, because the States are contemplated as Siate continuing to enjoy those pre-existing powers~~

~~which they have by their own right, and not as devolved upon them by the nation.~~

~~2. The powers allotted to the National Government are those, and those only, which are required for the purposes of the collective life of the nation, i.e., (a) powers which relate~~

~~to its action in the international sphere ; and (b) powers which can be exercised within the Union more efficiently and more to the benefit of the people by one Central Government than by a number of separate governments.~~

~~3. All powers which are not expressly allotted to the National Government are left to the States, unless speci- ally forbidden to be exercised by the latter, i.e., powers not specifically referred to remain with the States, and if the National Government wishes to claim any particular power, it must show affirmatively that that power has been granted to it by the Constitution. [This principle has been followed in the Constitution of Australia, but not in that of Canada.]~~

~~The powers given to the National Government may be described as those which subserve purposes of common national utility.1 They are the following (see Const., Art. I., § 8) : — ,~~

~~*To impose and collect taxes, which must be uniform throughout the United States ;*~~

~~*To borrow money on the credit of the United States ;*~~

~~*To regulate foreign and inter-State commerce ;*~~

~~*To establish a uniform rule of naturalization and a uniform bankruptcy law ;*~~

~~*To coin money and fix the standard of weights and measures ;*~~

~~*To establish post-offices and post-roads ;*~~

~~*To secure exclusive rights for limited time by granting patents and copyrights ;*~~

~~*To constitute tribunals inferior to the Supreme Court ;*~~

~~*To declare war, and regulate captures on land and water ;*~~

~~*To raise and maintain an army and a navy ;*~~

~~*To provide for calling out the militia, for organizing and arming them, and for governing such part of them as may be in the actual service of the United States ;*~~

~~*To exercise exclusive jurisdiction in the area selected for the seat of the National Government ;*~~

~~*To make all laws necessary for carrying out the above powers (including laws punishing such offences as fall within Federal jurisdiction as being transgressions of Federal law) ;*~~

~~*To pass laws protecting citizens of the United States against unjust or discriminating legislation by any State. (Amendments XIII. and XIV.)*~~

~~*§ 16. The National Government is, however, interdicted from using these powers in certain directions by the fol- lowing positive prohibitions (Art.*~~

~~I., § 9, and withheld ^rs* *en amendments) : — from the ‘ It may not~~

~~National Suspend the writ of Habeas corpus or pass a bill of attainder or an ex post facto law; give any State a commercial preference over another ; grant any title of nobility ; establish or pro- hibit any religion, or impose any religious test as a condition of holding office ; abridge the freedom of speak- ing or writing, or of public meeting, or of bearing arms ; try any person for certain offences except on the present- ment of a grand jury, or otherwise than by a jury of his State and district ; decide any common law action where the value in dispute exceeds $20 except by a jury. Al- though prima facie all powers not given to the National Government remain with the States, the latter are ex- pressly debarred from some powers, viz., the following : —~~

~~No State may (Art. I., § 10, and Amendments XIII., XIV., and XV.)~~

~~Make any treaty or alliance ; coin money or make anything, save gold and silver, a legal tender ; pass any bill of attainder or ex post facto law, or law~~

~~1 As to the scheme and working of the Federal Government in its relation to the States, see American Commonwealth, chaps, xxvii.-xxx.~~

~~Govern went.~~

~~impairing the obligation of contracts ; have any but a republican form of government; grant any title of nobility ; maintain slavery ; abridge the privileges of any citizen of the United States, or deny to him the right of voting in respect of race, colour, or previous condition of servitude ; deprive any person of life, liberty, or property without due process of law ; deny to any person the equal protection of the laws.~~

~~There are also certain powers which, though not abso- lutely withdrawn from the States, can be exercised only with the consent of the National Legislature, viz., those of laying duties on exports or imports, keeping troops or warships in time of peace, entering into agreements with another State or a foreign Power, engaging in war unless invaded. And it may be added that there are certain powers which, since they do not lie~~

within the province of the National Government and have been refused to the States, are said to be " reserved to the people." This expression means that it is only the people who can confer them and direct them to be exercised. Should the people wish to confer them, they would have to do so by way of amending the Constitution ; and herein lies a remarkable difference between the American system on the one hand and those of some European countries on the other, which, although they have created rigid constitutions, do not expressly debar the legislature from using any and every power of government.

*§ 17. The aim of those who framed the Constitution was to avoid friction between the State Governments and the Federal Government by rendering their re- spective spheres of action as separate and dis- Of*beons tinct as possible. They saw that the less National contact the less danger of collision. Their Oovern- wish was to keep the two mechanisms as iDde- %*nl£t pendent of each other as was compatible with the still higher need of subordinating, for national pur- poses, the State to the Central Government.*

Nevertheless there are, as was unavoidable, certain points of contact between the two, the chief of which are the following : —

The Constitution requires each State Government to direct the choice of, and accredit to the seat of the National Government, two Senators and so many repre- sentatives as the State is (in respect of its population) entitled to send ; to provide for the election, meeting, and voting of Presidential electors in each State, and to transmit their votes to the national capital; to organize and arm the militia forces of the State, which, when duly summoned for active service, are placed under the command of the President.

Besides these direct services imposed upon the States, each State is of course practically limited in its legislative and executive action by the power of the Federal judiciary (in the exercise of its function of interpreting the Consti- tution) to declare invalid laws passed or acts done incon- sistent with the Federal Constitution, or with statutes passed by the Federal legislature within the scope of the authority which the Constitution gives it.

So, too, when a subject, such as bankruptcy, is one on which a State may legislate in the absence of legislation by Congress, the State law is valid so long as Congress does not legislate, but if and when Congress does legislate, the State law falls to the ground.

Finally, another point of contact exists in the right of a State to call upon the National Government to protect it against invasion or domestic violence. This right has been several times exerted. (See American Commonwealth, chap, xxviii.)

§ 18. It is a fundamental principle of the American system that the National Government possesses a direct

*and immediate authority over all its citizens, quite irre- spective of their allegiance and duty to their own State. Direct ^^S autnority corresponds to and is co-extensive authority witn the sphere of the Federal Government. of the So far as the functions of that Government National extend, it acts upon the citizens not through meat over *he States, but as of its own right and by its the own officers. Beyond that sphere its authority*

citizens o/ stops, and State authority, unless inhibited by the states. the pederal Constitution, begins. But Federal authority is always entitled to prevail, as against a State legislature or officer, in all matters specifically allotted to it ; and in these its power of direct action has two great advantages. It makes the citizen recognize his allegiance to the power which represents the unity of the nation ; and it avoids the necessity of calling upon the State to enforce obedience to Federal authority, for a State might possibly be weak or dilatory, or even itself in- clined to disobedience. Thus the indirect taxes of customs and excise which the Federal Government imposes are levied by Federal custom-house collectors and excisemen, and the judgments of Federal courts are carried out by United States marshals distributed over the country. Nothing has done more to give cohesion and vigour to the American Federal system

~~*than the direct action of the Federal executive and Federal judiciary everywhere.*~~

~~*v. The Federal Government. >*~~

~~*§ 19. The Federal or National Government was created de novo by the Constitution of 1787-89. It was really a new creation rather than a continuation of the feeble organization of the pre-existing Confederation. But the principles on which it was constructed were old principles, and most of its features were drawn from the State Govern- ments as they then existed. These States themselves had been developed out of the previous colonial governments, and both they and the National Government have owed something to the example of the British Constitution, which had suggested the division of the legislature into two branches and the independent position of the judiciary. It was, however, mainly from the State constitutions, and not from the arrangements prevailing in Great Britain or in any other country, that the men of the Convention of 1787 drew their ideas and precedents.*~~

~~*Following what was then deemed a fundamental maxim of political science, they divided the government into three departments, the Legislative, the Executive, and the Judicial, and sought to keep each of these as far as possible detached from and independent of the other two.*~~

~~*In 1787 all the States but three had bicaiheral legisla- tures ; it was therefore natural that the new National The Government should follow this example, not to*~~

~~*Federal add that the division into two branches seems Legls- calculated to reduce the chances of reckless lature. haste, and to increase the chances of finding wisdom in a multitude of counsellors. There was, how- ever, another reason. Much controversy had raged over the conflicting principles of the equal representation of States and of representation on the basis of numbers, the larger States advocating the latter, the smaller States the former principle ; and those who made themselves champions of the rights of the States professed to dread the tyrannical power which an assembly representing population might exert. The adoption of a bicameral system made it possible to give due recognition to both*~~

principles. One House, the Senate, contains the repre- sentatives of the States, every State sending two; the other, the House of Eepresentatives, contains members elected on a basis of population. The two taken together

are called Congress, and form the National Legislature of the United States.

§ 20. The House of Eepresentatives is composed of members elected by popular vote in each of the various States, the representation of each State being in proportion to its population. Each State is House at liberty under the Constitution to adopt either °s\ntaPtlves. the "general ticket" system, i.e., the plan of electing all its members by one vote over the whole State, or to elect them in one-membered districts (the "district system"). The system of single-member districts now prevails almost everywhere. (Pennsylvania, however, has two representatives elected at large from the entire State, and there have been other similar instances.) The number of members in the House was originally 65, but it has steadily increased until, in October 1902, there were 357. (In and after 1903 the number was for ten years to be 386.) Besides the full members, each of the Territories is allowed to send a delegate, who has, however, no vote. The electoral franchise on which the House is elected is for each State the same as that by which, under the provisions of the State constitution, the members of the more numerous branch of the State legislature are chosen. Originally franchises varied much in different States, but for many years prior to 1890 what was practically man- hood suffrage prevailed in nearly all of the States. In that year some of the Southern States began to introduce restrictions which tend to exclude the bulk of the coloured population (see ante, § 5). It has already been observed that paupers and persons convicted of crime are excluded in many States, illiterates in some States. Every member must reside in the State which sends him, and custom, rarely broken, requires that he should reside even in the district which he represents. As a rule, members do not hold their seats for more than two or three Congresses.

The House of Representatives is chosen for two years, the terms of all the members expiring together. The election of a new House takes place in

November of the even years (i.e., 1904, 1906, &c). Members enter on their term of service in the March following, but the first regular session does not begin until the following December, or more than a year after the election. In fact, the old House holds its second regular session of three months after the new House has been elected. The rules are very complicated, and considerably limit the power of debate. A remedy against obstruction has been found in a system of closure called the "previous question." Speeches are limited to one hour, and may be confined in Committee of the whole House to five minutes. There is comparatively little good debating in the European sense of the term, and this is due partly to the great size of the hall, partly to the system of legislation by committees.

The organization of the House is entirely different from that of the British House of Commons or of most assem- blies on the European continent. The Ministers of the President do not sit, and since there are The ""'' thus no officials to undertake the leadership of syst^m- the majority and conduct business, legislative work is shaped and directed by a number of committees in each House. Every Bill when introduced is referred to some committee, and each Bill comes up for consideration by the whole House on the report of the committee which has dealt with it. There are now about 60 regular or standing committees in the House of Representatives, each consisting of from 3 to 16 members. The most im- portant committees are the following : Ways and Means, Rules, Elections, Appropriations (with several commit- tees for different branches of expenditure), Rivers and Harbours, Banking and Currency, and Foreign Affairs. Each committee has complete control of all Bills referred

to it, and nineteen-twentieths of the Bills introduced meet their death by the failure of the committee to take action on them. The Bills taken up for action are debated and freely amended by the committees, and sometimes public hearings are held. The committees on the expenditure of the various Government departments conduct minute investigations into the administration of each.

~~A Bill, as finally agreed on by a committee, is reported to the House, and when taken up for action the fate of most Bills is decided by an hour's discussion, opened by the member of the committee making the report. The more important measures, including taxation and appro- priation Bills, receive genuine discussion by the House at large, through special orders submitted by the Committee on Bules. Of the enormous number of Bills brought in very few pass.~~

~~The unifying force in this complicated system of com- mittee legislation is the Speaker of the House of Repre- sentatives. Like the Speaker of the British Soe k House of Commons, he is primarily the pre- siding official, but the character of his office has become different from that of the impartial moderator of the British House. The American Speaker, who of course has a vote like other members, always belongs to the party which commands a majority, and is indeed virtually the leader of the majority party in the House of Repre- sentatives. He resembles in some respects a European Prime Minister, and is second only to the President in political importance. His power is derived from three main sources. He appoints the members of all the com- mittees, he chooses the chairman of each, and he directs the reference of Bills to the various committees. He is himself chairman of the Committee on Rules (a small com- mittee of only five members), which practically determines the order in which important measures come before the House, and can keep back an objectionable Bill even when it has a favourable committee report. As presid- ing officer the Speaker exercises a right of discrimination between members rising to speak in debate. He is elected by the House of Representatives at its first session for the whole Congress, and his election is regularly carried by a strict party vote.~~

~~§ 21. The Senate at present(1902) consists of 90 members, two persons deputed from each State, be it great or small (New York with 7, 200,000population and Nevada with 42,000 having the same representation), who must be inhabitants of that State and at least thirty years of age. They are elected by the legisla- ture of their State for six years, and are re-eligible. It used to be supposed by many Europeans, following Tocque- ville, that this method of election was the cause of the (former) superiority of the Senators to members of the House. This was~~

~~an error, the true reason being that able men preferred a seat in the Senate owing to its larger powers and longer term. One-third retire every two years, so that the old members are always twice as numerous as the new members, and the body has been continuous ever since its first creation.~~

~~The Vice-President of the United States is ex officio presiding officer of the Senate, and this is his only active function in the Government. He has, however, no vote in the Senate, except a casting vote when the numbers are equally divided, and his authority on question's of order is very limited.~~

~~The methods of procedure in the Senate are somewhat different from those in the House of Representatives. There is a similar committee system, but the Senate com- mittees and their chairmen are chosen, not by the pre- siding officer, but by the Senate itself voting by ballot. Practically they are selected by caucuses of the majority~~

~~The Senate.~~

~~and minority parties. The Senate rules have no provision for the closure of debate, nor any limitation on the length either of a debate or of a speech. For the consideration of some classes of business the Senate goes into executive or secret session, although what is done at this session usually leaks out, and finds its way to the public through the press.~~

~~The functions of the Senate fall into three classes — legislative, executive, and judicial. In legislative matters its powers are identical with those of the House of Repre- sentatives, with the single restriction that Bills for raising revenue must originate in the popular assembly. In practice, too, the Senate is at least as influential in legis- lation as the House. Disagreements, which are frequent, are usually settled by compromise, and in these the Senate is apt to get the better of its antagonist. Serious dead- locks are of comparatively rare occurrence.~~

~~The executive functions of the Senate are : — (1) To approve or disapprove the President's nominations of federal officers, including judges, ministers of state, and ambassadors ; (2) to approve, by a majority~~

~~*of two-thirds of those present, of treaties submitted by the President. Through the latter power the Senate secures a general control over foreign policy. Its approval is necessary to any important action, and in general the President finds it advisable to keep the leaders of the Senatorial majority, and in particular the Senate' Committee on Foreign Relations, informed of pending negotiations. Through the power of confirming or rejecting the President's nominations to office, the senators of the President's party are able to influence a large amount of patronage. This sort of " dual control " works with less friction and delay than might have been expected, but better appointments would doubtless be secured if responsibility were more fully and more clearly fixed on the President alone.*~~

~~*The judicial function of the Senate is to sit as a high court for the trial of persons impeached by the House of Representatives, a vote of two-thirds of those present being needed for conviction. There have been seven cases of im- peachment. The most important was that of President Johnson, whose conviction failed by one vote — 35 to 19. Four of the other six cases also ended in acquittal, one for want of jurisdiction,1 and one by the resignation of the official before the impeachment was preferred in the Senate. Two Federal judges were many years ago thus deprived of office, impeachment being the only process by which a Federal judge can be removed.*~~

~~*§ 22. The procedure of each House in framing and passing Bills has already been noted. When a Bill has passed one Chamber it is sent to the other, and there referred to the appropriate committee. gresslonal In course of time this committee may report the legislation Bill as received from the other House, but fre- and quently an amended or an entirely new measure is presented, which is discussed and enacted on by the second House. When Bills passed by the two Chambers are not identical, and each persists in its own view, the regular procedure is to appoint a committee of conference, consisting of three members from the Senate and three from the House. These six meet in secret, and generally agree upon a compromise measure; which is forthwith adopted by both chambers. If no compromise can be arranged, the conflict continues until one side yields, or until it ends by the adjournment of Congress. After*~~

passing both Houses, the Bill goes to the President, and if approved by him becomes law : if vetoed, it returns to

1 This case was that of the impeachment of a senator, and the failure to convict arose from the fact that some of the senators at the time held the now generally accepted opinion that a member of Con- gress is not subject to impeachment.

the House in which it originated ; and if re-passed by a two-thirds vote, is sent to the other House ; and if again passed there by a two-thirds vote, it becomes law without the President's consent.

The scope of Congressional legislation has been indi- cated in the list given of the powers of the National Government (see ante, § 15). The most important measures are those dealing with the revenues and appropriations ; and the procedure on these matters is slightly different from that on other Bills. The Secretary of the Treasury sends annually to Congress a report containing a statement of the national income and expenditure and of the condition of the public debt, together with remarks on the system of taxation and suggestions for its improvement. He also sends what is called his annual letter, enclosing the estimates, framed by the various departments, of the sums needed for the public service of the United States during the coming year. With this the action of the Executive ceases, and the matter passes into the hands of Congress.

Revenue Bills for imposing or continuing the various customs duties and internal taxes are prepared by the House Committee on Ways and Means, whose chairman is always a leading man in the majority party. The report presented by the Secretary of the Treasury has been referred to this committee, but the latter does not necessarily in 'any way regard that report. Neither does it proceed on estimates of the sums needed to maintain the public service, for, in the first place, it does not know what appropriations will be proposed by the spending committees ; and in the second place, a primary object of the customs duties has been for many years past, not the raising of revenue, but the pro- tection of American industries by subjecting foreign imports to a very high tariff. Regular appropriation Bills down to 1883 were all passed by the House Committee on Appropriations, but in that year a new committee — on Rivers and Harbours — received a large field of expendi- ture ; and in 1886 certain other supply Bills were referred to sundry standing committees. These various appropria- tion committees start from, but are not restricted by

~~*and do not in fact adopt, the estimates of the Secretary of the Treasury. Large changes are made both by way of increasing and reducing his estimates.*~~

~~*The financial Bills are discussed, as fully as the pressure of work permits, in committee of the whole House. Fresh items of appropriations are often added, and changes are made in revenue Bills in the interest of particular purposes or localities. If the Senate is con- trolled by the same party as the House, it is likely to secure the acceptance of many of its amendments. The majorities in the two Houses then labour together to satisfy what they believe to be the wishes of their party. Im- portant legislation is almost impossible when the Houses are controlled by opposite parties.*~~

~~*When finally adopted by the House, the Bills go to the Senate, and are forthwith referred to the Committee on Finance or to that on Appropriations. The Senate com- mittees amend freely both classes of Bills, and further changes may be made by the Senate itself. When the Bills go back to the House, that body usually rejects the amendments : the Senate declines to recede, and a con- ference committee is appointed by which a compromise is' arranged, usually hastily and in secret, often including entirely new items, and this compromise is accepted with little or no discussion, generally in the last days of the session.*~~

~~*Thus it comes that comparatively slight use is made of the experience of the permanent financial officials in the framing of revenue-raising and appropriation Bills. There*~~

~~*is little relation between the amounts proposed to be spent in any one year and the amounts proposed to be raised, and there is a strong tendency to deplete the public treasury through special grants secured by indi- vidual members. These defects have long been felt, but Congress is not disposed either to admit officials to attend its sittings or to modify the methods to which it has grown accustomed.*~~

~~*§ 23. The executive power of the nation is vested in a President of the United States of America, who holds office during the term of four years. He, to- gether with the Vice-President, is nominally p*e chosen by a system of double election through an electoral college, but in practice this*~~

system operates as a roundabout way of getting the judgment of the people, voting by States.

The Constitution directs each State to choose a number of " Presidential electors equal to the number of its repre- sentatives in Congress " (both Senators and mem- bers of the House of Representatives). Members Tbe of Congress and holders of Federal offices are '„e/ye™f ineligible as electors. These electors (in 1902, 447, a number which in 1904 will have increased to 476) meet in each State on a day in November fixed by law, and give their votes in writing for the President and Vice-President. The votes are transmitted to Wash- ington, and there opened by the President of the Senate, in the presence of both Houses of Congress, and counted. A majority of the whole number of electors is necessary to elect. If no person have such majority, the President is chosen by the House of Representatives voting by States, and the Vice-President is chosen by the Senate. This plan of creating an electoral college to select the President was expected to secure the choice by the best citizens of each State, in a tranquil and deliberate way, of the man whom they in their unfettered discretion should deem fittest to be the chief magistrate of the Union. In fact, however, the electors exercise no discretion, and are chosen under a pledge to vote for a particular candidate. Each party during the summer preceding a Presidential election holds a huge party meeting, called a National Convention, which nominates candidates for President and Vice-President. (See post, § 33.) Candidates for the office of electpr are also nominated by party conventions, and the persons who are in each State chosen to be electors — they are chosen by a strict party vote — are expected to vote, and do in point of fact vote, for the presidential candidates named by their respective parties at the National Conventions. The Constitution leaves the method of choosing electors to each State, but by uni- versal custom they are now everywhere elected by popular vote, and all the electors for each State are voted for on a " general ticket." In the early days the electors were chosen in many States by the legislatures, but by 1832 South Carolina was the only State retaining this method, and in 1868 she also dropped it. Some States also, for a time, chose electors by districts, but by 1832 all had adopted the "general ticket" system. Michigan, how- ever, in the election of 1892 reverted to the "district" system, thereby dividing its electoral vote. Thus the election is virtually an

election by States, and the struggle concentrates itself in the large States, where the great parties are often nearly equally divided, e.g., the party which carries New York by even a small majority gains all the 39 electoral votes of that State. The polling for electors takes place early in November on "the same day over the whole Union, and when the result is known the contest is over, because the subsequent meeting and voting of the electors is a mere matter of form. Nevertheless, the system here described, being an election by States, is not the same

thing as a general popular vote over the Union, for it sometimes happens that a person is chosen President who has received a minority of the popular vote cast.

The Constitution requires the President to be a native- born citizen of the United States, not under thirty-five years of age, and for fourteen years resident in the United States. There is no legal limitation to his re-eligibility any number of times • but tradition, dating from the refusal of George Washington to be nominated for a third term, has established the rule that no person shall be President for more than two four-year terms. If the President dies, the Vice-President steps into his place ; and if the latter also dies in office, the succession passes to the Secretary of State. The President receives a salary of $50,000 a year, and has an official residence called the Executive Mansion, or more familiarly the White House.

Functions of the President. — These may be grouped into three classes : (1) those which relate to foreign affairs ; (2) those which concern legislation ; (3) those which relate to domestic administration.

The President appoints ambassadors and ministers to foreign countries, and receives those sent by foreign countries to the United States. He has, through his Secretary of State, immediate direction of all negotiations with such countries, and an unfettered initiative in all foreign affairs. He does not, however, enjoy a free hand in finally determining the foreign

~~policy of the Govern- ment. Treaties require the approval of two-thirds of the Senate, and the Foreign Affairs Committee of that body is usually kept informed of the negotiations which are being conducted by the Executive. The power to declare war formally belongs to Congress ; but the Executive may, without an act of Congress, virtually engage in hostilities and thus bring about a state of war (as happened in 1845-46, when war broke out with Mexico; and again, in 1861, at the opening of the War of Secession).~~

~~As respects legislation, the position of the President is in marked contrast to that of the British Crown. While nearly all important measures are brought into Parliament by the ministers of the Sovereign, and nominally under his instructions, the American President cannot introduce Bills either directly or through his ministers. All that the Constitution permits him to do in this direction is to inform Congress of the state of the nation and to recom- mend the measures which he deems to be necessary. This latter function is discharged by written messages addressed by the President to Congress, the message sent at the beginning of each session being usually the most impor- tant ; but the suggestions made in these messages do not necessarily or directly induce legislation.~~

~~Far more effective is the President's part in the last stage of legislation. His so-called "veto power" permits him to return to Congress, within ten days after its passage, any Bill of which he may disapprove, and, unless this Bill re-passes both Houses by a two-thirds vote, it does not become law. Most Presidents have made use of the veto power sparingly. Jackson, however, as well as Tyler, Johnson, and especially Cleveland, em- ployed it pretty boldly. Johnson's vetoes were promptly over-ruled by the large majority opposed to him in both Houses, but the vetoes of all the other Presidents have generally prevented the enactment of the Bills of which they disapproved.~~

~~The domestic executive authority of the President in time of peace is small, because by far the larger part of law and administration belongs to the State and local governments, while the Federal administration is regulated by statutes which leave little discretion to the Execu- tive. The~~

power of making appointments to the admini- strative service would invest him with a vast influence

but for the constitutional requirement of securing the con- sent of the Senate to the more important appointments made. The President is given a free hand in choosing his cabinet ministers ; but for most other appointments, whether or not they are by law in his sole gift, the senators belonging to the President's party have practically con- trolled the selections for offices lying within their re- spective States, and a nomination made by the President against the will of the senator concerned will gener- ally be disapproved by the Senate. The members of the President's party in the House also demand a share in the bestowal of offices as a price for their co-operation in those matters wherein the Executive may find it neces- sary to have legislative aid. Nevertheless, the distribution of offices under the so-called " spoils system " remains the most important ordinary function of the President, and the influence he exerts over Congress and legislation is due mainly to his patronage.

In time of war or of public disturbance, however, the domestic authority of the President expands rapidly. This was markedly the case during the Civil War. As commander-in-chief of the army and navy, and as "charged with the faithful execution of all laws," he is likely to assume, and would indeed be expected to assume, all the powers which the emergency requires. In ordinary times the President may be almost com- pared to the managing clerk in a large business establish- ment, whose chief function is to select his subordinates, the policy of the concern being in the hands of the board of directors. But when foreign affairs reach a critical stage, or when disorders within the Union require Federal intervention, immense responsibility is then thrown on one who is both commander-in-chief of the army and the head of the civil executive. In no European country is there any personage to whom the President can be said to correspond. He may have to exert more authority, even if he enjoys less dignity, than a European king. He has powers which are in ordinary times narrower than those of a European prime minister ; but these powers are more secure, for instead of depending on the pleasure of a parliamentary majority, they run on to the end of his term. Although he is always elected as a party candidate, he generally receives, if he shows tact

and dignity, abundant respect and deference from all citizens, and is able to exert influence beyond the strict limits of his legal power.

§ 24. There is in the Government of the United States no such thing as a Cabinet, in the British or French or Italian sense of the word. But the term is used to describe a council of the President, Caj/Be< composed of the heads of the chief adminis- andudmi- trative departments — the Secretary of Sta,te, the "istrative Secretary of the Treasury, Secretary of War, ° c as' Secretary of the Navy, Postmaster-General, Secretary of the Interior, Secretary of Agriculture, and Attorney- General. Like the British Cabinet, this council is not formally recognized by the law, but it is nevertheless accepted as a permanent feature in the Government. It is really a group of persons, each individually dependent on, and answerable to, the President, but with no joint policy, no collective responsibility. The final decision on all questions rests with the President, who is solely and personally responsible. Moreover, the members of the Cabinet are excluded from Congress, and are entirely independent of that body, so that an American Cabinet has no parliamentary tactics to contrive, no Bills to prepare, and few problems of foreign policy to discuss. It is not a Government, as Europeans understand the term, but a group of heads of departments, whom their chief, though he usually consults them separately, often finds it

useful to bring together in one room for a talk about politics, or in order to settle some administrative question which lies on the borderland between the provinces of two ministers.

The principal administrative departments are those already named, whose heads form the President's Cabinet. Adminis- ^e most important are the State and Treasury trative Departments. The former has the conduct of depart- foreign affairs and interests, and directs the meats. diplomatic service, but is obliged to keep in touch with the Senate, because treaties require the consent of the latter. It also has charge of the Great Seal of

~~the United States, keeps the archives, publishes the statutes of Congress, and controls the consular service.~~

~~The two main functions of the Treasury Department are the administration of the Government revenues and expenditures, and of the banking and currency laws. The Secretary has, however, a much smaller range of action than a finance minister in European countries, for, as he is excluded from Congress, he has nothing directly to do with the imposition of taxes, and very little with the appropriations for Government expenditure. In addition to its fiscal and currency functions, the Treasury Depart- ment has charge of several other bureaus, dealing with the mercantile marine, the lighthouse and life-saving service, commercial statistics, immigration, and the coast and geodetic survey. It is, however, proposed to transfer these to a newly created Department of Commerce.~~

~~The Department of the Interior is less important than in Prance or Italy, since the principal functions which there belong to it He, in the United States, within the field of State powers. In the United States the principal matters in this department are the management of the public lands, the conduct of Indian affairs, the issue of patents, the administration of pension laws, of the national census, and of the geological survey, together with the collection of educational information.~~

~~The Department of War controls the formerly very small, but now largely increased, army of the United States ; and its corps of engineers execute the river and harbour improvements ordered by Congress. The Navy Department has charge of the dockyards and vessels of war ; and the Post Office Department directs the postal system, including the railway mail service. The Depart- ment of Agriculture includes the Meteorological Bureau, the Bureau of Inspection of Animals, and other bureaus which conduct investigations and experiments. The Attorney-General is the legal adviser of the President, public prosecutor, and standing counsel for the United States, and also has general oversight of the Federal judicial administration, especially of the prosecuting officers called district attorneys and of the executive court officers called marshals.~~

Two commissions not connected with any of the above departments deserve some notice. The Inter-State Com- merce Commission, established by statute in 1887, is a semi-judicial, semi-administrative board of five members, with limited powers of control over inter-state railway transportation. The chief duty is to prevent discrimina- tions in freight rates and secret rebates from the published list of charges. The Civil Service Commission, established in 1883, conducts competitive examinations for appoint- ments to subordinate positions under all of the administra- tive departments. Some 90,000 posts are now filled from the candidates who pass these examinations.

§ 25. The Federal judicial system is made

The by the Constitution independent both of the

ludictaty. Legislature and of the Executive. It consists

of the Supreme Court, the circuit courts, and

the district courts.

The Supreme Court is created by the Constitution, and consisted in 1902 of nine judges, who are nominated by the President and confirmed by the Senate. They hold office during good behaviour, i.e., are removable only by impeachment, thus having a tenure even more secure than that of English judges. The court sits at Washington from October to July in every year. The sessions of the court are held in the Capitol. A rule requiring the presence of six judges to pronounce a decision prevents the division of the court into two or more benches; and while this secures a thorough consideration of every case, it also retards the despatch of .business. Every case is discussed twice by the whole body, once to ascertain the view of the majority, which is then directed to be set forth in a written opinion ; then again, when the written opinion, prepared by one of the judges, is submitted for criticism and adoption by the court as its judgment.

The other Federal courts have been created by Con- gress under a power in the Constitution to establish " in- ferior courts." The circuit courts

~~consist of twenty-five circuit judges, acting in nine judicial circuits, while to each circuit there is also allotted one of the justices of the Supreme Court. The judges of each circuit, acting with the justice of the Supreme Court for the circuit, consti- tute a Circuit Court of Appeals, established to relieve the Supreme Court. Some cases may, however, be appealed to the Supreme Court from the Circuit Court of Appeals, and others directly from the lower courts. The district courts are now seventy in number, each having a single justice. There is also a special tribunal called the Court of Claims, which deals with the claims of private persons against the Federal Government. It is not strictly a part of the general judicial system, but is a creation of Con- gress designed to relieve that body of a part of its own labours.~~

~~The jurisdiction of the Federal courts extends only. to those cases in which the Constitution makes Federal law applicable. All other cases are left to" the State courts, from which there is no appeal to the Federal courts, unless where some specific point arises which is affected by the Federal Constitution or a Federal law. The classes of cases dealt with by the Federal courts are as follows : —~~

~~1. Cases in law and equity arising under the Constitu- tion, the laws of the United States, and treaties made under their authority ;~~

~~2. Cases affecting ambassadors, other public ministers and consuls ;~~

~~3. Cases of Admiralty and maritime jurisdiction ;~~

~~4. Controversies to which the United States shall be a party;~~

~~5. Controversies between two or more States, between a State and citizens of another State, between citizens of different States, between citizens of the same State claim- ing lands under grants of different States, and between a State or the citizens thereof and foreign states, citizens, or subjects (Const., Art. III., § 2). Part of this jurisdic- tion has, however, been withdrawn by the eleventh Amendment to the Constitution, which declares that "the judicial power of the United States shall not be construed to extend to any suit commenced or prosecuted against one of~~

~~the United States by citizens of another State, or by citizens or subjects of any foreign State."~~

~~The jurisdiction of the Supreme Court is original in cases affecting ambassadors, and wherever a State is a party ; in other cases it is appellate. In some matters the jurisdiction of the Federal courts is exclusive ; in others it is concurrent with that of the State courts.~~

~~As it frequently happens that cases come before State courts in which questions of Federal law arise, a~~

~~provision has been made whereby due respect for the latter is secured by giving the party to a suit who relies upon Federal law, and whose contention is overruled by a State court, the right of having the suit removed to a Federal court. The Judiciary Act of 1789 (as amended by subsequent legislation) provides for the removal to the Supreme Court of the United States of " a final judgment or decree in any suit rendered in the highest Court of a State in which a decision could be had where is drawn in question the validity of a treaty or statute for an authority exercised under the United States, and the decision is against their validity ; or where is drawn in question the validity of a statute of, or an authority exercised under, any State, on the ground of their being repugnant to the Constitution, treaties, or laws of the United States, and the decision is in favour of their validity ; or where any title, right, privilege, or immunity is claimed under the Constitution, or any treaty or statute of a commission held, or authority exercised under the United States, and the decision is against the title, right, privilege, or im- munity specially set up or claimed by either party under such Constitution, treaty, statute, commission, or author- ity." If the decision of the State court is in favour of the right claimed under Federal law or against the validity or applicability of the State law set up, there is no ground for removal, because the applicability or authority of Federal law in the particular case~~

could receive no further protection from a Federal court than has in fact been given by the State court.

The power exercised by the Supreme Court in declaring statutes of Congress or of State legislatures (or acts of the Executive) to be invalid because inconsistent with the Federal Constitution, has been deemed by many Europeans a peculiar and. striking feature of the American system. There is, however, nothing novel or mysterious about it. As the Federal Constitution, which emanates directly from the people, is the supreme law of the land every- where, any statute passed by any lower authority (whether the Federal Congress or a State Legislature), which contravenes the Constitution, must necessarily be invalid in point of law, just as in the United Kingdom a railway bye-law which contravened an Act of Parliament would be invalid. Now, the functions of judicial tribunals — of all courts alike, whether Federal or State, whether superior or inferior — is to ^interpret the law, and if any tribunal finds a. Congressional statute or State statute inconsistent with the Constitution, the tribunal is obliged to hold such statute invalid. A tribunal does this not because it has any right or power of its own 'in the matter, but because the people have, in enacting the Constitution as a supreme law, declared that all other laws inconsistent with it are ipso jure void. When a tribunal has ascertained that an inferior law is thus inconsistent, that inferior law is there- with, so far as inconsistent, to be deemed void. The tribunal does not enter any conflict with the Legislature or Executive. All it does is to declare that a conflict exists between two laws of different degrees of authority, whence it necessarily follows that the weaker law is ex- tinct. This duty of interpretation belongs to all tribunals, but as constitutional cases are, if originating in a lower court, usually carried by appeal to the Supreme Court, men have grown accustomed to talk of the Supreme Court as in a special sense the guardian of the Constitution.

The Federal courts never deliver an opinion on any constitutional question unless or until that question is brought before them in the form of a lawsuit. A judg- ment of the Supreme Court is only a judgment on the particular case before it, and does not prevent a similar question being raised again in an another lawsuit, though of course this seldom happens, because it may be assumed

that the Court will adhere to its former opinion. There have, however, been instances in which the Court has virtually changed its view, on a constitutional question, and it is understood to be entitled so to do.

§ 26. As the Federal Constitution is a short document, which deals very concisely with most of the subjects it touches, a vast number of questions have arisen upon its interpretation in the course of the 113 constitu- years which have elapsed since its enactment, tionai The decisions of the Supreme Court upon these >"terpre- questions form a large body of law, a know- tat "" ledge of which is now indispensable to a mastery of the Constitution itself. By them the Constitution has been so expanded in the points which it expressly treats of, and so filled up in the matters which it covers only by way of implication, that it is now a much more complete instrument than it was when it came from the hands of its framers. Thus the courts have held, that while the National Government can exercise only such powers as have been affirmatively granted, it is not restricted in its choice of the methods for exercising such powers as have been granted. From this doctrine there has been derived a conspicuous activity of the National Government in such fields as taxation, borrowing of money, regulating com- merce, and carrying on war. Executive and legislative acts not authorized by the letter of the Constitution have also been allowed to remain unchallenged, and thus precedents have been in fact established, with the tacit recognition of the courts and the people, through which the sphere of the National Government has been enlarged. The purchase of Louisiana from France by President Jefferson is an instance. It may indeed be said that the Constitution as it now stands is the result of a long process of development ; and that process is still going on. So recently as 1901, the Supreme Court delivered several judgments in cases arising out of the annexation of Porto Rico, which handled, though they did not fully settle, divers points of novelty and of importance.

§ '27. It is not, however, only by way of interpretation that the Constitution has been developed. A great many matters which it passed over have become the subject of legislation by Congress ; and there has also sprung up a large mass of usages regulating matters not touched either by the Constitution or by any express enactment. These usages

have in many cases lasted so long and become so gene- rally accepted, that they may be regarded as parts of the actual or (so to speak) " working " Constitu- tion, although of course they could be at any moment changed. Among the matters that are now thus settled by usage the following may be mentioned : —

The President is limited to two terms of office. The Presidential electors are expected to vote for the candi- date of the party which has chosen them, exercising no free will of their own. The Senate always confirms the nominations to a Cabinet office made by the President. Both the Senate and the House conduct their business by means of standing committees. The appointment of committees of the House is left to the Speaker.

It may be added that in respect of one matter assigned by the Constitution to the States a momentous change has taken place since the enactment of the Constitution. This matter is the electoral franchise in Federal elections. In 1789 property qualifications were general, but now in all the Northern and Western States these have been long since abolished, and the electoral suffrage is practically manhood suffrage. In Wyoming, Colorado, Utah, and Idaho universal adult suffrage prevails. Down till 1890 manhood suffrage had prevailed in all the Southern

States also (as to some Southern States now, see ante, § 5). As the electoral suffrage for State legislature elections is also that for Federal elections (including the election of Presidential electors), the working of the Federal Consti- tution has thus been materially affected without any change in the Federal Constitution itself.

§ 28. Besides these changes which have been brought about by judicial interpretation and by usage, the Consti- Amend- tution has also been altered in the regular and meats to formal way which its own provisions permit (see the Coasti- ante, § 14). This has happened four times. tution. rpen amendment were enacted immediately after the adoption of the Constitution itself, in order to meet certain objections which had been taken to it. These may be described as a sort of Bill of Rights. Another, the eleventh, was enacted in 1794-98 to negative a con- struction which the Supreme Court had put upon its own powers. Another, the twelfth (1803-4), corrected a fault in the method of choosing the President ; and the last three (1865-70) confirmed and secured some of the results of the War of Secession (1861-65) (see Ency. Brit., vol. xxiii. p. 781). Many other amendments have been from time to time suggested, but very few have passed even the first stage of a formal proposal. This is due not merely to the respect of the Americans for their fundamental law, but also to the difficulties which surround the process of change. It is hard to secure the requisite majorities in Congress, and still harder a majority in three-fourths of the States. The obstacles placed in the way of amendment, which are greater than in the case of almost any other Constitution, may be reckoned among the causes which led to the War of Secession.

§ 29. As compared with the Cabinet system of Great Britain, of the British self-governing colonies, and of such General European countries as France, Italy, Holland, character and Belgium, the characteristic features of the

ot the scheme of the American National Government

frame ot ,, » ,,

National are the following :—

Govern- ■ (a) The Legislature and the Executive are

meat. independent and disjoined. The Executive does

not depend upon the Legislature; but holds its powers by

~~a direct commission from the people. No member of the~~

~~Executive sits in the Legislature, nor can the Legislature~~

~~eject any one from office save by impeachment.~~

~~(b) Both the Legislature and the Executive sit for fixed terms. As some one has said, the American system is an astronomical one — i.e., the action of the people in creating those who are to exercise parts of its sovereign powers takes place at intervals fixed by the calendar.~~

~~(c) No method is provided for getting rid of dead- locks, either between the Legislature and the Executive or between the two branches of the Legislature. Should action be needed which cannot be legally taken without the concurrence of these different authorities, and should they be unable to concur, the legal situation must remain in statu quo until by a new election the people have changed one or more of the conflicting authorities, and so brought them into harmony.~~

~~(rf) The judiciary holds a place of high importance, because it is the proper interpreter of the will of the people expressed in the supreme law, the Federal Con- stitution, which the people have enacted.~~

~~The defects which have been remarked in this system are, broadly speaking, the following : —~~

~~There is a danger that prompt action, needed in the interests of the nation, may fail to be taken owing to a deadlock between Legislature and Executive, or between the two branches of the Legislature.~~

~~There may be a difficulty in fixing responsibility upon any person, or small group of persons, because cases may~~

~~arise in which the Executive, being unable to act without the concurrence of the Legislature, can hardly be blamed for failing to act, while yet it is unable to relieve itself by resigning; while on the other hand the Legislature — which consists of two bodies, each of them numerous, and~~

~~in neither of which are there recognized leaders — contains no person on whom responsibility can be fixed.~~

~~On the other hand, the characteristic merits of the system may be summed up as consisting in the safeguards it provides against the undue predominance of any one power or person in the Government, and therewith against any risk there may be that the President should become a despot, and in the full opportunities it secures for the due consideration of all important measures. It is a system amply provided with checks and balances ; it recognizes and enforces the principle of popular sovereignty, and it is well calculated to maintain unchanged the relation of its component parts each to the other. There has been, in point of fact, no permanent shifting of weight or strength from any one organ of Government to any other. At some particular epoch the President has seemed to be gaining upon Congress, at other epochs Congress has seemed to be gaining upon the President. Now and then the Senate has been more influential than the House, now and then it has fallen back. The part played by the judiciary has at some moments been of special import- ance, while at others it has been little noticed. But, taking the history of the Republic as a whole, that equilibrium between the several organs of the Govern- ment which the Constitution was intended to secure has been substantially maintained.~~

~~vi. The Party System.~~

~~§ 30. The actual working of the Government of the Union and of the governments of the several States cannot be properly understood without some knowledge of the party system as it exists in the United States. That system is, as has been well observed by a recent writer,1 a sort of link between the executive and the legis- lative departments of government, and thus the policy and action of the party for the time being in power forms a sort of second and unofficial government of the country, directing the legal government created by the Constitution. In no country have political parties been so carefully and thoroughly organized. In no country does the spirit of party so completely pervade every department of political~~

~~life ; not that party spirit is any more bitter ,~~ „

than it is m Lurope, tor in some respects it is 0fthe

usually less bitter than in France, the United party Kingdom, or Austria, but that it penetrates systel" farther into the body of the people, and exerts mrking a more constant influence upon their minds, otthe Party organizations have in the United States Oovem- a wide range of action, for they exist to accom- """" ' plish five purposes. Three of these are pursued in other countries also. These three are — first, to influence govern- mental policy ; secondly, to form opinion ; and thirdly, to win elections. But the two others are almost (if now not quite) peculiar to the United States, viz., to select candi- dates for office and to procure places of emolument for party workers. The selecting by a party of its candidates, instead of allowing candidates to start on their own account, is a universal practice in the United States, and rests upon the notion that the supreme authority and constant activity of the people must extend not onjy to the choice of officials by vote, but even to the selection of those for whom votes shall be cast. So the practice of securing places for persons

1 Mr Henry Jones Ford, in his Rise and Growth of American Politics.

who have served the party, in however humble a capacity, has sprung from the maxim that in the strife of politics "the spoils belong to the victors," and has furnished a motive of incomparable and ever-present activity ever since the 'thirties. It is chiefly through these two practices that the party organizations have grown so powerful, and have been developed into an extremely complicated system of machinery, firm yet flexible, delicate yet quickly set up, and capable of working efficiently in the newest and roughest communities.

§ 31. The contests over the adoption of the Federal Constitution by the several States in 1787-91 brought to Orizin and *ne suria°e two opposite

~~tendencies, which may history be called the centrifugal and centripetal forces, ot the a tendency to maintain both the freedom of the~~

~~parties. individual and the independence, in legislation, in administration, and in jurisdiction, of the several States, and an opposite tendency to subordinate the States to the nation, and to vest large powers in the central Federal authority. These tendencies soon arranged themselves in concrete bodies, and thus two great parties were formed. One, which took the name of Republican, became the champion of States' rights, and claimed to be also the champion of freedom. It was led by Thomas Jefferson. The other, led by Alexander Hamilton, became known as the Federalist party, and stood for an energetic exercise, or even a practical extension — of course within the limits of the Con- stitution — of the powers of the Central Government. One of these two parties has continued ever since to subsist, and the other has, with two apparent breaches of continuity, been in reality nearly as permanent. The Jeffersonian party has had an unbroken continuity of life, though it has been known since about 1830 as the Democratic party. The Federalist party slowly decayed, and ultimately vanished between 1820 and 1830, but out of its ruins a new party arose, practically its heir, which continued powerful, under the name of Whigs, till 1854, when it broke up over ques- tions connected with slavery. Very soon thereafter a party, nominally new, but largely formed out of the Whigs, and maintaining many of its traditions, sprang up, and took the name of Republicans. Since 1856 these two great parties, Democrats and Republicans, have confronted one another, including between them the vast majority of the people, though several smaller parties, such as Green- backers, Laborists, Populists, and Prohibitionists, have from time to time been formed, and brought some com- plication into political struggles. It is not easy to describe the distinctive tenets of Democrats and Republicans at this moment, because the old principles which each party would respectively claim as its own have to a large extent disappeared through changes in recent and current political conditions, and each party is apt to be guided in its attitude on an actual issue by what it deems its immediate interest. In general, however, the Republican party has, since the War of Secession, advocated a protective tariff, and since 1898 it has defended the policy of acquiring trans-oceanic possessions ; while the Democrats have leant more towards~~

Free Trade, and have, quite recently, censured the annexation of the Philippine Island. (For a full ac- count of the history of the parties and their attitude to various great questions, see Unci/. Brit., vol. xxiii. p. 75-1, sqq., and the section following on American History.)

The Democratic party began to form for itself a regular organization about the time of President Andrew Jackson (1829-37), and the process seems to have been first seriously undertaken in 'New York State. The Whigs did the same ; and when the Republicans organized them- selves, shortly after the fall of the Whigs, they created a party machinery on lines resembling those which their predecessors had struck out. The establishment of the

system in its general form may be dated from before the Civil War, but it has since been perfected in its details.

§ 32. The machinery of an American party consists of two distinct but intimately connected sets of bodies, the one permanent, the other temporary, or rather intermittent. The function of the former is to tBe system manage the general business of the party from of party month to month and year to year. That of the organiza- latter is to nominate candidates for the next ensuing elections, and to make declarations of party opinion intended to indicate the broad lines of party policy.

The permanent organization consists of a system of

committees, one for each of the more important election

areas. There is a committee for every city, every

county, and every congressional district, and in Party

'„' , t j. v j commit-

some States even for every township and every

State legislature district. There is, of course, a committee for every State, and at the head of the whole stands a National Committee for the whole

Union, whose special function it is to make arrangements for the conduct of party work at a Presidential election. Thus the country from ocean to ocean is covered by a network of committees, each having a sphere of action correspond- ing to some election area, whether a Federal area or a State area. Each committee is independent and respon- sible so far as regards the local work to be done in con- nexion with the election in its own area, but is subordinate to the party committees above it as respects work to be done in its own locality for the general purposes of the party. The ordinary duties of these committees are to raise and spend money for electioneering and otherwise in the interests of the party, to organize meetings, to " look after the press," to attend to the admission of immigrants or new-comers as voters, and generally to attract and enrol recruits in the party forces. At election times they also direct and superintend the work of bringing up voters to the polls and of watching the taking and count- ing of the votes ; but in this work they are often aided or superseded by specially appointed temporary bodies called " campaign committees." These party committees are permanent, and though the membership is renewed every year, the same men usually continue to serve. The chair- man in particular is generally reappointed, and is often, in a populous area, a person of great and perhaps autocratic power, who has large funds at his disposal, and a regular army of " workers " under his orders.

The other and parallel branch of the party organization consists of the bodies whose function it is to nominate party candidates for elective posts, whether Party legislative or executive. (It must be remem- Nominat- bered that many executive State, county, and logCon- city officers are chosen by direct popular vote.) ven'/ons- These bodies are meetings of the members of the party resident in each election area. In the smallest areas, such as the township or city ward, the meeting is com- posed of all the recognized members of the party who are entitled to vote, and it is then called a Primary. In the larger election areas, such as a county or city, the num- ber of voters who would be entitled to be present renders it impossible to admit all, so the nominating meetings in these areas are composed of delegates elected in the various Primaries included in the area, and the meeting is called a Nominating Convention. This is the rule, but in some parts of the South and West nominations for mem- bers of the State

legislature and county officials, and even for members of Congress, are made by Primary assemblies meeting over the entire area, which all the party voters are entitled to attend. Where candidates are to be nominated for a State election, the number of delegates from Primaries would be too large, so the State

Nominating Convention is composed of delegates chosen at representative conventions held in smaller areas.

Every registered voter belonging to the party in the local election area for which party candidates are to be nominated is presumably entitled to vote in the Primary. In rural districts little difficulty arises, be- cause it is known what citizens belong to each party ; but in cities, and especially in large cities, where men do not know their neighbours by sight, it becomes neces- sary to have regular lists of the party voters entitled to attend a Primary ; and these lists are either prepared and kept by the local party committee, or are settled by the votes of the persons previously on the party rolls. The composition of these lists is of course a serious matter, because the Primary is the foundation of the whole party edifice. Accordingly, those who control the local organizations usually take pains to keep on the lists all the voters whom they can trust, and are apt to keep off those whom they think likely to show a dangerous independence. By their constant activity in this direction, and by their influence over the pliable members of the party, they are generally able to have a Primary sub- servient to their will, which is ready to nominate those whom they may suggest as suitable candidates, and to choose as delegates to the conventions persons on whom they can rely. In this way a few leaders may sometimes be able to obtain control of the nominating machinery of a city, or even of a State, for the local committees usually obey instructions received from the committees above them. (See as to the details of party machinery, American Commonwealth, chaps, lix.-lxiv.,

and the recently published book of M. Ostrogorski on Democracy in England and America.)

The great importance of these nominating bodies lies in the fact that in the United States a candidate has scarcely any chance of being elected unless he is regularly nomi- nated by his party, that is to say, by the recognized Primary or Convention. To control the Primary'or the Convention (as the case may be) of the party which is strongest in any given area is therefore, in ninety-nine cases out of a hundred, to control the election itself. As the desire to dominate Primaries was found to lead to many abuses, both in the way of manipulating the lists of party voters and in the unfair management of the Primary meetings themselves, reformers have made many proposals for controlling by law the procedure of these meetings, although they are theoretically mere private party meetings, which form no part of the legal machinery of government. And in several States, as notably in Massachusetts and New York, statutes have been enacted regulating the Primaries, so' as to permit all the voters of a party to be enrolled, and subjecting the conduct of the voting and counting of votes to safeguards similar to those provided for the regular public elections. The Primaries have in some cases indeed ceased to be meetings in the physical sense, and have become preliminary elections.

§33. One nominating body is of such conspicuous magnitude as to need special notice. For the selection of party candidates for the offices of President and Vice- President of the United States there is held once every four years, in the summer preceding the elec- Vationai tion (m November) of the President, a huge Nominat- party assembly of delegates from conventions lag Con- held in the several States, each State having rention. ^fa as many delegates as it has electoral votes to cast (i.e., twice as many as its Federal Senators and Federal Representatives). Two delegates are chosen for each congressional district by a District Convention, and four delegates for the State at large by a State Convention. Each State delegation usually keeps

together during the National Convention, and holds private meetings from time to time to decide on the course which it should as a whole

~~adopt.~~

~~When the National Convention has been duly organ- ized by the appointment of committees and of a chair- man, its first business is to discuss and adopt a series of resolutions (prepared by the Committee on Resolu- tions, but subject to amendment by the Convention as a whole), which, taken together, embody the views, programme, and policy of the party, and constitute what is called its " platform " for the ensuing election. It then proceeds to receive the nomination of various aspirants to the position of party candidate for the Presidency. The roll of States is called alphabetically, and each State, as reached in the roll, is entitled to present a candidate. Thereafter a vote is taken between the several aspirants. The roll of States is again called, and the chairman of each State delegation announces the vote of the State. In Democratic Conventions a State, delegation, when instructed by the State Convention to cast its whole vote solid for the particular aspirant favoured by the majority of the delegation, must do so (this is called the unit rule) : in the Conventions of the other parties in- dividual delegates may vote as they please. If one aspirant has obtained on the first roll-call an absolute majority of the whole number of delegates voting — or, in Democratic Conventions, a majority of two-thirds of those voting — he is held to have been duly chosen, and the choice is then made unanimous. If, however, no one obtains the requisite majority, the roll is again called until some one competitor secures the requisite number of votes. Some- times one or two votings are sufficient, but sometimes the process has to be repeated many times — it may even continue for several days — before a result is reached. Where this happens, there is much room for the display of tactical skill by the party managers in persuading delegates who favour one of the less prominent aspirants to transfer their votes to the person who seems most likely to unite the party. Scenes of great excitement sometimes occur.~~

~~When one aspirant has been duly selected as the party candidate for the Presidency, the Convention proceeds to choose in the same way a person to be candidate for the Vice-Presidency. This is a much simpler matter, because the post is much less sought after, and it is usually de- spatched with ease and promptitude. The two nominees are then deemed to be the~~

candidates of the whole party, entitled to the support, at the ensuing election, of the party organizations and of all sound party men throughout the Union, and the Convention thereupon dissolves.

§ 34. It is hardly too much to say that in the United States the parties work the Government, and that the party organizations are to the legal organs of infiuences Government what the motor nerves are to the which muscles, sinews, and bones of the human body, guide the The question follows, Who work the parties 1 parties.

The action of the parties depends upon and is the resultant of three factors, which are indeed more or less present in all constitutional representative governments. These are (a) individual leaders, who are powerful either by their talents or by the influence they enjoy over the citizens ; (b) rich men, who can supply the party with the very large sums of money needed for maintaining the party machinery in efficiency and for fighting the elec- tions ; and (c) the opinion of the mass of the citizens, who, though generally disposed to adhere to the traditions and follow the leaders of the party to which they belong, do, especially in the more educated classes and in the most advanced sections of the country, exert a certain measure of independence, and may refuse to vote for the party can- didates if they either distrust those candidates personally

or disapprove of the policy which, the party seems to be following. It need hardly be said that the relative im- portance of these three factors varies from time to time.

§ 35. The national parties have been so pervasive in their influence, and the working of their machinery has formed so important a part of the political history of results of ^e United States, that it is necessary here to the power call attention to the high significance of this of the element in the system of the Kepublic, although party limits of space make it impossible to describe

svstetn. ■■*

the way in which the party system has coloured the actual working of the Government as well as the politics of the country. Among its chief results the following may be noted : —

It has made nearly all elections, including those for State offices and city offices, the functions of which have, as a rule, nothing whatever to do with national party issues, matters of party strife fought upon party lines. It has disposed voters in State and city elections to support party candidates whom they might otherwise have disap- proved of, for the sake of maintaining in full strength for national purposes the local party organization, and it has thereby become a fruitful source of municipal misgovern- ment. It has thrown great power into the hands of party managers, because where the strife between the two great parties is keen and the result of a contest doubtful, discipline and obedience are deemed needful for success. It has tended to efface State lines, and to diminish the interest in State issues, and has thus helped to make the nation overshadow the States.

Strong as is the sentiment of party loyalty in the United States, the spirit of faction is not at present violent. Many persons regret the enormous power which party exerts, and would like to reduce the part it plays in the system of government. But no one has yet discovered any method by which the associative force of party as a motive power in government can be dispensed with.

(j. BR.)

IV. History since 1885.

The historical article on the United States in the ninth edition of the Encyclopaedia Britannica brought its account down to the period of President Cleveland's first acces- sion to office, and it will therefore be the object of the following sketch to indicate the important movements of events since 1885.

The Eepublican party, increased by loyal accessions, and doubly triumphant under President Lincoln in pre- serving the American Union while destroying Political slavery, did not, after the tragic death of that 1865?85'. great political chieftain, pursue his proposed policy of forbearance towards those impove- rished fellow-citizens who had laid down their arms in honourable submission. Besides a prolonged military occupation new guarantees, new pledges, were made the price of State admission ; and while the Southern people and their late leaders were treated with distrust, the dominant party faction, whose brain was in Congress, sought to build up influence by means of an alliance between new settlers from the north and the negro freed- men, upon whom the right to vote had been promiscuously bestowed. Such inversion of State autonomy could not last long. The white majority of the South, under leaders no longer for disunion, regained local control, while negro suffrage was largely suppressed. In the North the Democrats had meanwhile reorganized on national lines, and northern Democratic candidates for the Presidency received the solid vote of the South. National elections soon went by narrow margins, the "Empire State" of New York deciding the majority.

Again and again Democratic opposition carried the lower house of Congress ; and had all the Southern States re- gained by 1876 their normal condition in the Union, the opposition candidate for the Presidency, Mr Tilden, would have been declared elected. Later, in 1884, Mr Cleveland, the Democratic nominee, won by the electoral vote of New York, which was cast in his favour ; and the Eepublican party, despite all historical claims to public gratitude, had henceforth to contend for the favour of the people as one of two great national parties rather than as sole survivor and regenerator.

Mr Grover Cleveland had only come into prominence after the Civil War. A lawyer by profession, he had risen in the State of New York by successive

steps, as county sheriff, mayor of Buffalo, and President r ' l j.j j Cleveland,

governor, and gained wide renown as an ad- isss-89.

ministrator ; he was in favour of economies, honestly devoted to the public welfare, courageous, industrious, and discreet. These qualities he carried (March 1885) to the Presidency. The reactionary change predicted of an administration which was brought into favour so largely by Southern votes was not realized. President Cleveland surrounded himself with counsellors of his Democratic creed in whom the whole country might confide. He respected the principle of civil service stability, though yielding in some cases to local party pressure for removals, so that for the first time in more than half a century a radical change of national parties in the United States was followed by no general sweep of the offices. At the same time he firmly held, as Washington had done, to the constitu- tional authority of a chief executive over both appoint- ments and removals ; and when Senate opponents sought to elicit reasons from him as to certain changes he had seen fit to make, he positively refused to give them. His exercise, moreover, of the veto power was prompt and fearless, and the more so, since the Senate remained against him. No Bill for a private pension or bounty was too petty in amount to elude scrutiny as to the justice involved, while vast appropriation Bills which tended to paternalism or pauperism by the Government he promptly returned to Congress with his negative.

Inspired by such an example, though Cleveland's party strength lay only in the House, the forty-ninth Congress made a sound and sensible record. To adjust better the relations of executive and legislature, the Tenure Fortym of Office Act, passed in 1867 to restrain an ninth obnoxious President, was finally repealed; Congress, the order of Presidential succession in case of l88S'87- death or inability in the two highest offices was so changed as to devolve authority strictly in the executive line ; and definite provision was made for counting the electoral votes should Senate and House disagree. Other wise measures were the Inter-State Commerce Act, which placed common carriers under national supervision for foreign and inter-State traffic ; the grant of lands in severalty to Indians, in pursuance of a just civilizing experi- ment ; and an appropriation for the noble and commodious building of the Congressional Library, since erected.

The happy spectacle was now presented of national prosperity, peace, and harmony. The Southern States were once more contented within the Union, . Dros. and capital poured in to exploit their mineral perous resources and develop new industries. The admlnls- public revenues far exceeded all reasonable trat,on- demands for the efficient support of Government, and a surplus was piled up in the Treasury beyond immediate wants. So far as possible, outstanding issues of the public debt were called in for redemption ; and while Union pensions of the Civil War required a large and

increasing outlay beyond the normal expenses of the nation, yet the surplus grew, and constituted a tempta- tion to extravagance, which the administration, however, sought to avoid. The postal service, well managed, be- came nearly self-supporting. The naval establishment was modernized and its efficiency increased. The finances of the Union were prudently cared for, gold payments were maintained, the circulation of the national banks was gradu- ally contracted ; and while the authorized purchase of silver was somewhat of a menace to stability, Congress refused to sanction an unlimited coinage. The wheels of routine went smoothly, and in September 1887 Philadelphia cele- brated the first centenary of the Constitution in a three- days' public festival, at which the President bore official part. The autumn elections, of 1886 had gone favourably to the administration, and the new HIouse of Representatives, like its predecessor, was controlled by the Demo- Fiftieth crats. All things betokened Cleveland's nomi- meef"SS nation for a new term and his re-election. The Senate opposition,) though strong enough to defeat important treaties, for which a two-thirds vote was essential, showed an increasing respect. But Cleve- land jeopardized all chances of re-election by attempting to lead his party to the higher plane of aggressive principle. Recognizing an intelligent demand to reduce the increas- ing Treasury surplus, not by wasteful expenditure but through a reform in the tariff, he threw down the gauntlet, when the fiftieth Congress first met (December

~~1887), and discarding precedent devoted his whole annual message to that subject, instead of reviewing the general current of the year.~~

~~By this time the idle surplus revenue amounted to upwards of $55,000,000, and would by the end of the summer increase probably threefold ; all the land's outstanding public debt, moreover, which ad- tarift mitted of immediate retirement had been paid off. Hence the message proposed radical relief from the hardships and inequalities of existing tariff laws — the legacy of Civil War, the worst defects of which remained after twenty years of peace. "It is a condition which confronts us, not a theory," observed the President, deprecating all theorizing upon opposing ideas of protection and free trade, and proposing simply to reduce taxation to the essential wants of an economical public establishment. The House majority set to work to carry out the policy thus outlined ; and a Bill known as the " Mills Tariff," from its author and champion, the chairman of the Ways and Means Committee, passed that body in July after an exhaustive debate, and then was suspended in the Senate.~~

~~Upon this issue of tariff reform, so suddenly projected into the canvass, was fought the Presidential campaign of 1 888. At the National Democratic Conven- Defeat tion held at St Louis in June, Cleveland was unanimously renamed for President. The Re- publican Convention at Chicago, during the same month, made. Mr Benjamin Harrison its nominee after prolonged balloting, and pronounced for protection as the true doctrine for American industries. There had now passed from the scene that generation which, under President Polk in 1846, tried a low- tariff policy and sus- tained it with satisfaction, regardless of party or of former predilections, until Civil War with its ravenous necessities forced up once more the scale of duties, thereby reviving those older Whig tenets of Clay and Webster which came by inheritance to the new Republican party. Northern manufacturers had now come to demand of Congress more than ever a sedulous monopoly of the home market. The campaign was vigorously fought, but while Cleveland's own supporters were doubtful and~~

~~reform issue.~~

tor re- election.

divided over the new platform he had forced upon them — since recent party contests had been fought upon sentimental issues — the Republicans rallied the vested interests on their side, while capitalists contributed largely from their means to keep trade and their own special interests undisturbed. Cleveland was hindered, moreover, partly by the prejudice still strong in Northern States against the party of the once disloyal South, and partly by his own honest bluntness and want of tact, which had made secret enemies among the party managers. The efforts of both parties were directed mainly to the four doubtful Northern States which held the balance of power — all the once slave-holding States being still clearly Democratic. Two of those doubtful States, New Jersey and Connecticut, voted in November for Cleveland ; but Harrison won his own State of Indiana, and carried New York by some 15,000 votes, notwithstanding that a Democratic State governor was chosen. The result was that Cleveland was defeated by a narrow electoral margin, though the vote through the entire country showed a popular majority in his favour.

The final session of the fiftieth Congress that winter completed the first century of national existence under the Constitution of the United States. Four new States now found admission — North close of Dakota and South Dakota (two States from Coagress - a single Territory), Montana, and Washington. President Cleveland retired in March 1889 with the respect and confidence of a re-united people, to whom he had demonstrated that national patriotism and capacity were not monopolized by one great party or another, and that the Union had regained at length a salutary condi- tion of political equilibrium.

Benjamin Harrison was of an illustrious ancestry, which dated back in England to the Regicides. He was the grandson of a former President of the Preslde"t United States, and the great-grandson of a ig89-93 ' Virginian who had signed the Declaration of Independence. His strength lay rather in his steadfast loyalty to his political associates than in any individual traits of character ; he was a sure exponent of the Republi- can principles now prevalent, and one unlikely to perplex his party by a headstrong independence. He was small of stature, a lawyer of repute, a*

ready speaker, and in- fluential in the close State of Indiana, with which he had been identified from childhood. During the Civil War he had led a volunteer regiment to the front, and from 1880 to 1886 he had served a term in the United States Senate ; and though not very conspicuous! in either career, his record had been an honourable one.

In March 1889 he organized a creditable administra- tion, and followed the good example set by his prede- cessor in awarding the civil patronage ; and when the fifty-first Congress met in December, ^."^JjL with a working Republican majority in both branches, he recommended a new protective tariff law. Mr McKinley (afterwards President) reported accordingly from the Ways and Means Committee a Bill, soon styled by his own name, which, though nominally for equalizing duties and reducing the revenue, fixed high rates and promised bounties. At the later instance of the State department, the measure, as finally passed, provided for reciprocity through special treaty with other countries.

This Congress in its two sessions was wasteful of the Treasury surplus, reversing the economies of the preceding administration, and was unchecked by executive veto. A general Pension Bill, lavish in its Fifty-first allowances, passed without hindrance, and j ggg^s^' private pension Bills by the score. Under a gradual pressure, moreover, from silver-mining States,

using their equal suffrage in the Senate, the purchase of silver bullion was now increased to $4,500,000 a month, thus loading up the Treasury vaults, and, through depre- ciation of the white metal, threatening a ruinous ex- change in the common standard of value from gold to silver. Idaho and Wyoming, formerly Territories, were brought into the Union as States. Postal subsidies were carried, also a refund to loyal States of the direct tax levied in 1861. After much discussion a "force Bill" for controlling Federal elections at the South failed, as also a measure for the free coinage of silver, for which was sub- stituted the bullion purchase just mentioned. To the credit of this Congress were enactments for

relieving the Supreme Court by constituting lower tribunals of appeal, for international copyright, and for restraining the growing monopoly of trusts and combinations in trade. The surplus was spent, and so largely did appropriations exceed all former precedent in times of peace, that this was stigmatized as " the billion dollar Congress."

Among the treaties of Harrison's term was a tripartite arrangement concerning the Samoan Islands with Ger- many and Great Britain, which gave omen of a Foreign coming departure from the traditional policy of continental confinement, so as to extend American influence, conjointly with that of European Powers, far across the Pacific. Negotiations were also begun with Russia and Great Britain as to Alaska and Bering Sea.

The census of 1890 brought some interesting facts to light concerning the population of the United States. From 50,155,783 in 1880 the total had now fsgo^0' reacned 62,622,250; but the rate of increase was less than that of the previous decade, less than that normal advance which had doubled the aggregate numbers of the American people about once in thirty years. Males had increased in number more rapidly than females during the past ten years, owing probably to an excessive influx of adult manual labourers from abroad. The proportion of inhabitants of foreign parentage of both sexes was approximately cme-third of the whole population. Notwithstanding the enormous territorial expansion of the Union in the course of a hundred years, the density of its population was now more than four times that of 1790, when the national experiment fairly began.

The autumn elections of 1890 throughout the country showed great discontent with this administration and Congress. It showed, too, an irresistible Political p0pUiar drift towards ex-President Cleveland, regardless of election precedents or the schemes of party managers for shelving him permanently. When the fifty-first Congress came together in December 1891 after the usual long interval, the Democrats had a majority in the House and the Republicans only in the Senate. In such a condition legislation was at a deadlock, and discussions took the place of business. Labour disturb- ances had begun in various parts of the country ; a riot broke out at the Carnegie steel-works in Pennsylvania, which

private detectives were hired to resist. Free coinage was once more pressed in Congress by the silver advocates, and test votes showed that the Democrats themselves were greatly divided upon that issue. By an Act of 1892 the immigration of Chinese labourers was forbidden.

A new Presidential campaign was opened ; the Repub- licans (June 1892) in Minneapolis renominated Harrison, Cleveland wnile affirming protection linked with recipro- eiected city as the true tariff creed. At the Demo- over cratic Convention, held in Chicago the same Harrison. montj2; underhand political efforts had been made to suppress Cleveland's candidacy, but such was

the popular pressure that his renomination was carried on the first ballot by more than the needful two-thirds vote. While party Democrats made issue against the McKinley tariff and wasteful expenditure, they showed that, like the Republicans to a certain extent, they were susceptible to a new wave of Socialistic sentiment which was now sweeping over the West. A " Farmers' Alliance," formed in 1891, had merged into a " People's Party," which called for free silver coinage, Government railways and banking, a graduated income tax, and public lands for settlers only. With these " Populists," as they were called in the West, the Democrats inclined to fuse. Cleve- land swept the country with an unexpectedly large elec- toral and popular vote, and was in fact chosen President without needing New York, which nevertheless went for him. For the first time since 1861 the Republicans lost control of the executive and both branches of Congress.

On 4th March 1893, for the first time in history, a President returned to the White House which he had once vacated, to resume official authority and succeed his own successor. Cleveland's new inaugural Cleveland's address was in a serious strain, as though fore- second boding the business distress of the country now term,

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near at hand, and his own doubts about uniting

upon a judicious line of policy the new and incongruous

elements that had borne him back to power.

President Cleveland now recalled from the Senate, con- vened in extra session, a treaty for annexing the Hawaiian Islands, which his predecessor had recently submitted. Americans at Honolulu, long ambitious of annexing those islands to the United States, had (January 1893) pre- cipitated a revolution against the Hawaiian race and monarchy, probably aided actively by an American naval force under the advice of the United States consul. With Queen Liliuokalani summarily deposed, a provisional republic was set up, and a gift of the islands tendered by the white oligarchy to the United States. Meanwhile the stars and stripes had been hoisted at Honolulu as symbol of an American protectorate. But the President now despatched a special commissioner, who, after a full investigation, hauled down the flag as an act of repara- tion, ordered the garrison of American marines back to their ship, and brought the protectorate and annexation to a summary end. Mediation for restoring the deposed queen proved impracticable, however, and the new republic of Hawaii was left to itself during Cleveland's administra- tion, Congress taking no action on the subject.

Chicago opened in May its " World's Columbian Ex- position," an enterprise commemorative of the discovery of America, to which Congress had generously Tne contributed. The President took part in the World's opening ceremonies, and a marvellous white city Fair at of delicate creation and with fine landscape Cbicas°- effects drew for six months increasing crowds from the continent and abroad, making a signal success.

But dark clouds were already closing upon the financial horizon. Already the political canvass of 1892 had dis- closed dulness, distress, wage reductions, and riotous strikes in various quarters ; houses and J,nfac farms in the West and centre of the Union were heavily burdened with mortgage debts. Investment companies had placed loans recklessly ; railway building had been pushed too far into the wilderness. Trade had overleaped its limits, and now receded. Waste and cor- ruption had grown with enterprise. The old cycle of boastful prosperity rounding to an end, contraction and pinching want were inevitably to follow. In the painful

reorganization of industries which presently set in with bankruptcy and liquidation, Western cities of late promise were sharply arrested in development, the Western farmer

•was heavily indebted to the Eastern investor, and the •whole broad region beyond .the Mississippi, with its rich resources, seemed almost literally mortgaged through corporations to the old Northern States of the Atlantic coast. All had to suffer loss ; but the great debtor class grew hostile to their less impoverished creditors, and turned to desperate expedients for bettering their own condition.

To deal with so perilous a situation, President Cleveland convened the fifty-third Congress for a special session ; and Fifty- third when that body met early in August he sent Congress; a message which charged the new financial silver crisis largely to the forced purchase of silver repeal. bullion by Government under the compromise legislation of 1890. He urged the immediate repeal of that measure, and he now appealed, as to men above the plane of party politics, that experiments opposed to a sound and stable currency should be abandoned. Though Cleveland's views were entertained by financiers, and were strongly prevalent Eastwards, it was hard to bring his party supporters into line, so largely was the Demo- cratic majority in sympathy with debtor constituencies or with such as favoured free silver. Even in the House only a minority of the President's own party sustained him, and repeal was only carried by the aid of the " sound money " Eepublicans ; while in the Senate the disposition was to dally and postpone, until by dint of earnest executive pressure Cleveland at length carried his point, aided by Eepublican opponents and deserted by many of his professed partisans. The new Bill was signed, silver purchases ceased, and this extra session closed on the 3rd of November.

At the second or long session, which followed a month

later, with both branches organized by a Democratic

majority, the President found himself again at

*e/°™ issue with a large part of his nominal followers.

"After a hard struggle," observed the opening message, " tariff reform is directly before us"; and Cleve- land made heroic efforts to fulfil his party pledges. The Wilson Tariff Bill (named from the committee chairman who championed the Bill in the HOuse) finally became law, with an income-tax amendment. It relieved in large measure raw materials from taxation. The measure in its final shape was a great disappointment to tariff re-formers, though something in the new direction had been gained. The President himself concluded neither to veto nor approve, but allowed it to become a law without his signature.

In other respects this heterogeneous Congress showed incapacity for enacting good measures, though it repealed

some that were bad — the remnant of federal Fifty- third election laws, for instance, which was a legacy

of reconstruction. In the second session a

partial free silver Bill passed both branches of the Legislature by large majorities under the specious design of "coining the seigniorage," but the President's veto killed it. Utah was in 1894 admitted as a State. Currency and finance engaged the third and final session of this Congress, but the controlling influence of both HOuses had set at length so strongly against the adminis- tration policy of a gold standard, and in favour of at least some form of bimetallism, that no acceptable measure could be passed. To add to Democratic discomfiture, the Supreme Court now pronounced the income-tax illegal, unless apportioned as the Constitution prescribed for "direct taxes." Times continued hard, trade was de- pressed, current revenues under the new tariff failed to meet current expenses. HEavy drafts, too, were made upon the gold reserve of the Government. The President asked Congress to permit an issue of bonds payable

Congress Incapable.

expressly in gold,, and he made evident the economy of making such assurance to the lender ; but permission was not given, and under an earlier and defective law the administration borrowed in order to uphold the gold standard.

In the autumn elections of 1894 business distress and dissensions, which showed that the Democratic Congress and Democratic administration had drifted far pm apart, caused a heavy defeat at the polls ; and the fourth fifty-fourth Congress accordingly met (December Congress, 1895) with a large Eepublican majority in the 189Sm97- HOuse and an almost even division of parties in the Senate. No legislation of consequence could be carried for the rest of Cleveland's term. A restless war spirit had been engendered, while Cuba, near at hand, was seen in violent revolt against Spain. For a brief space the Presi- dent turned this disposition against Great Britain, when a boundary dispute sprang up between the British Govern- ment and Venezuela ; but arbitration soon followed, and the excitement ceased. When, in the course of a great railway riot in Illinois, danger arose of an organized assault upon vested property, and the governor was nerve- less, Cleveland despatched Federal troops to the scene and courageously restored order.

*The Presidential canvass of 1896 showed Socialistic effort against not plutocracy alone, but the plain business interests of the people. So greatly had the Democracy now yielded to new influences, that Democratic its party Convention at Chicago, refusing by a £ e*g96 large majority to praise the retiring leader for his course as President, demanded silver coinage at a ratio of 16 to 1 for gold, and made close fusion with Populists of various shades of opinion. Mr William J. Bryan, of Nebraska, became the candidate of three party Conventions, whose common purpose was the free coinage of silver at the ratio of 16 to 1. The Eepublicans at St Louis nominated Mr William McKinley, framing a platform looking to gold and sound currency, while re- newing their adhesion to a tariff of protection with reciprocity ; and the " gold Democrats," the last of Presi- dent Cleveland's unflinching friends, named independent candidates. Such was the menacing industrial danger in Bryan's candidature that the conservative vote of the Union drifted to the Eepublican side, and by a decisive electoral and popular majority*

McKinley was chosen in November, carrying all the Northern states east of the Eocky Mountains, hitherto doubtful, together with those usually classed as Eepublican. Cleveland retired in the following March, with general respect for the courage and honesty he had so signally displayed, as some solace for the political submersion of his most cherished plans.

Mr William McKinley, whose term of Presidential office now began (4th March 1897), had honourably served in the Civil War, in the House of Eepresentatives, and later as governor of Ohio. A Eepublican McKiniey's of good standing, and author of the tariff Bill first term ; passed under President Harrison, he was quite protective unlike his predecessor in temperament. He taritt- watched carefully the current of public sentiment, rarely expressed positive opinions, and showed considerable tact and political suavity in his public conduct. Senators were now deferred to, and Congress was kept in easy touch so that legislation might move harmoniously. In finance McKinley showed at the outset a disposition to conciliate the silver advocates by pressing bimetallism upon the notice of European Powers, and sending delegates to an international conference on that subject; all this in the end, however, proved barren of results. Congress met in extra session, March 1897, under his proclamation, with a House overwhelmingly Eepublican, to legislate for the

emergency created by Government receipts falling far short of expenditure. The Dingley Tariff Bill (once more named after the House chairman of the Ways and Means Committee) was reported in the House, embodying anew the Republican doctrine of high protection and reciprocity, and after passing the usual ordeal of Senate amendments which were adjusted in conference, it be- came law in the summer. Appropriation Bills, too, which had failed towards the close of Cleveland's term, were promptly renewed and passed.

The second and long session of this fifty-fifth Congress, which began in December, proved an important one by Fifty-fifth launching the United States into a war with Congress; Spain over Cuba, and providing strenuously for war with the emergency. Sympathizers with the Cuban Spain. revolution combined with those who were still eager for national exploit and aggrandizement and weary of prosaic peace. Congress showed a peremptory dis- position to intervene in Cuba, and just at the time when the negotiations with Spain tended towards a hostile issue, the U.S. battleship Maine was blown up in Havana harbour, probably by some submarine mine, on the night of 15th February 1898, and 260 American seamen lost their lives. This vessel's visit had been ostensibly received by the island authorities of Spain in a friendly manner, and they denied all complicity in the outrage ; but Americans disbelieved this, and such was the popular outburst of indignation that intervention in Cuba followed almost of necessity. President McKinley sent his ultimatum to Spain, despite that Government's disclaimer and its earnest efforts to meet all objections recited against its insular policy short of relinquishing sovereignty. McKinley's war message, 11th April, pro- posed intervention in the name of humanity in order to secure to the Cubans a stable government of their own. But that message did not recognize the revolutionary government on the island as a rightful republic or as a belligerent. With a like reservation Congress in both branches strongly sustained the President, and on the 25th a joint resolution declared war as already existing by Spain's rupture of official relations. As early as March large appropriations had been made for national defence, and now an ample war revenue Bill, which imposed stamp, licence, and succession duties, with increased taxation on liquor, beer, and tobacco, and in various other directions, passed both Houses by immense majorities, and became law with executive approval To unite the military capacity of all sections, the last of the disabilities placed upon the South after the Civil War were now removed, Confederate heroes still alive receiving national com- missions ; and while both volunteers and regulars were enrolled for a hostile army force, the navy was increased in efficiency at corresponding outlay.

The war with Spain began and ended at distant Manila, the capital of the Philippines. Commodore Dewey, of the U.S. Asiatic squadron, sailed

under the President's order from Hong Kong to strike a blow at the Spanish fbewfr 0t Possessi°ns in tne Pacific islands. At early dawn of 1st May, Dewey's squadron entered Manila harbour, sighted the Spanish fleet at the other end of the bay, and after a brisk encounter of several hours succeeded in destroying all the enemy's vessels and disabling the shore battery at Cavito, without the loss of a ship or a seaman. It was a remarkable victory, due largely to superior gunnery on the American side. In other respects this war with Spain was largely a naval one, signal superiority being shown by the United States. Cervera, the Spanish admiral, having sailed in April from Cadiz for the Cuban waters with a considerable fleet, brought his vessels into the narrow harbour of Santiago

de Cuba, where they were bottled up, unable to elude the vigilance of acting-Admiral Sampson, who blockaded the coast with an American fleet. An American military force under General Shafter landed in Cuba and threat- ened Santiago, so that Cervera made a desperate effort (3rd July) to dash out of the harbour and escape, but in so doing he lost all his vessels by capture or destruction, and Santiago soon after surrendered. General Miles, the American general commanding, made dispositions in July for the capture of the island of Porto Rico, but the in- habitants yielded themselves joyfully to American control. Finally, in the Philippines, where Dewey remained with his fleet, land reinforcements arrived under General Merritt from the Californian coast ; Manila capitulated in August just as the peace protocol was signed at Washing- ton. A Spanish relieving fleet seeking to approach the Philippines by way of the Suez Canal had already been forced to return home.

Peace negotiations were opened in the latter part of July through the French ambassador at Washington, acting on behalf of Spain. In accordance with a protocol agreed upon, commissioners from the two peace belligerents met by-and-by in Paris to arrange arranged a treaty. The American administration had by with this time become fully possessed with the idea sPaln- of commercial expansion towards China and colonial ac- quisition. During the summer of 1897 the President had submitted^ a treaty with the republic of Hawaii for incor- porating those islands as an integral part of the United States, but public sentiment

appeared reluctant, and Con- gress only yielded consent when in the midst of this war the President urged annexation as essential to naval operations. And now the administration demanded from Spain as the price of peace the cession of the Philippines as well as Porto Rico and the relinquishment of all sovereignty in Cuba. Spain argued in vain against the requirement of the Philippines, but was appeased by the present of $20,000,000 from the United States, while all other claims of war indemnity were forborne on either side. The treaty was signed by the commissioners in Paris, 10th December 1898, and ratified by their Govern- ments early in the following year. In the entire four months' campaign which brought this war to a practical end, the United States lost in fight not a flag or a vessel, and, except for the one daring instance of a naval exploit by Lieutenant Hobson at Santiago, not one of its soldiers or sailors was taken prisoner.

When Congress met in final session (December 1898), the Philippine acquisition provoked great controversy ; and though the needful votes were gained in the Senate for confirming the treaty as submitted, p0rto a war now followed with the native races of the Rico, Philippines. McKinley's administration treated and toe them as virtually bought from Spain with the j p' soil, and a struggle for racial independence broke out. The struggle continued, though President McKinley sent a commission to deal with the insur- gents, whose constituted government had placed Aguin- aldo at the head of affairs. Congress took no definite action, but virtually left the whole matter in the hands of the President. Towards Cuba the pledge of autonomy was renewed, and a constitutional convention was called ; but the United States remained in military control as protector until 1902, when the American military governor-general and the American troops were recalled, and the government was turned over to the new Cuban Republic. Porto Rico became by cession a terri- torial domain of the United States.

' The fifty-sixth Congress was convened in December 1899, with a working Republican majority in both

branches, and an unusual spirit of harmony with the Executive. With a new commercial expansion, improv- Fttty-sixth *n^ business conditions among the people, and a Congress; large surplus accumulating through war taxa- curreacy tion in the Treasury, the opportunity now came and for legislation favourable to a permanent gold

^nance, standard and currency reform. A Bill with this object passed Congress and was approved by the President (March 1900); it also refunded a consider- able part of the public debt at the rate of 2 per cent., and promoted the absorption by banks of the new loan. Dissension, however, arose over the unequal tariff Bill for Porto Eico, but the Act, as finally passed, levied light duties for a short time upon imports into the United States from Porto Eico, but made a gift to that island of the customs already collected there. Hawaii, on the other hand, received from Congress equal trading rights.

Appropriation Bills having been passed, this session closed in June, a date unusually early, so as to prepare Presi- ^or a new Presidential campaign, in which denti.il McKinley and Bryan were to be the chief op- campaign posing candidates, as in 1896. The former was of 1900. nominated in June for a second term by the Eepublican Convention at Philadelphia, the latter at Kansas City in July by the Democrats, with such Popu- listic and " free silver " alliance as still remained to unite in his personal support. To this was added a small anti- imperialist element which strongly protested against the new policy of acquisitions of distant territory. An anti- foreign uprising in China led, during this summer, to a joint military relief movement towards Peking, in which the United States took part with the chief European Powers. The aim of American diplomacy has been to bring about the " open door " policy in Chinese commerce, without disturbing Chinese autonomy.

Trusts had been a recent outgrowth in the industrial world against which both parties were nominally arrayed, amalgamation into colossal corporations being the latest phase of such combinations. How to check and control fundamentally such combinations was left unsettled by this Presidential campaign, but the Democrats made chief use of the issue in their canvass.

~~Mr Bryan, a remarkable orator, made an unprecedented stumping tour on behalf of his own candidature, while TheodoPe Eoosevelt, the Eepublican nominee for President Vice-President, canvassed quite as strenuously re'eJected. for tne administration ticket. But the young leader of the Democrats still repelled the In- dependents and most of those of his party who had supported Cleveland; the more so since he had insisted upon a positive declaration for " free silver " in the party platform of 1900, as in that of 1896. The fact that trade had reacted from its long depression was against his candidature once more, and prosperity rallied voters to the Eepublicans. The November ballots showed McKinley victorious for re-election to a second term, with a larger electoral vote and with a larger following in Congress than before. The majority of McKinley over Bryan in the electoral college was 137, the former receiving 292 votes and the latter 155. The total popular vote cast was 13,970,300, of which McKinley received 7,206,677 votes and Bryan 6,374,397 votes.~~

~~In the course of the short final session of Congress the Hay-Pauncefote treaty, negotiated with Great Britain, and dealing with' the construction of an inter- Hay oceanic canal near the Isthmus of Panama, was~~

~~treaty* "*" discussed by the Senate in executive session, and in December was amended by eliminating the neutrality clause and declaring the old Clayton-Bulwer convention superseded. This amendment Great Britain~~

~~declined to accept; but a new treaty was negotiated between the United States and Great Britain, and ratified 16th December 1901 by the Senate. Army reorganiza- tion, an apportionment of representatives under the new census, and a reduction of the war taxation which had created a large surplus in the treasury were leading results of legislation at this final session. Both Houses (January 1901) adopted resolutions of sympathy with the British people on the death of Queen Victoria. By an amend- ment to the army appropriation Bill (known from its mover in the Senate as the "Piatt Amendment"), the potential control of the United States in Cuban affairs was asserted more strongly than before. To this amend- ment the constitutional Convention of Cuba acceded after some reluctance (see Cuba).~~

~~At the second inauguration of President McKinley (4th March 1901), there was a great military and civic pageant at the Capitol, beyond former example. President No breach was made in the former group of McKiniey's Cabinet advisers, all of whom were confirmed second by the Senate, except for a change occasioned term- somewhat later for private reasons in the office of Attorney- General. During a brief executive session of the Senate, the new Vice-President, Theodore Eoosevelt, occupied the chair for the first and only time. The United States Supreme Court, shortly before adjourning in May, an- nounced its position on the question whether the Consti- tution of the United States extended ex proprio vigore to the new insular dependencies. In the case of De Lima et al. v. Bidwell action was brought to recover rebate of customs duties collected on goods imported into the United States from Porto Eico after the cession of the island by the treaty of Paris in 1899, and before Congress passed the Foraker Act imposing a new schedule of duties on such imports. The Court decided that the collection- of duties in the given instance was uncon- stitutional. In the case of Downes v. Bidwell, suit was brought to recover similar duties collected after the passage of the Foraker Act. In this case the duties were declared constitutional, the Court holding that although after the treaty of Paris Porto Eico was a territory appurtenant and belonging to the United States, still it was not a part of the United States within the revenue clauses of the Constitution, which provide that duties shall be uniform throughout the United States. In each of these cases the decision was by a bare majority of the Court, four of the nine judges dissenting. The decisions in these test cases, and in others brought in this Court with reference to the new revenue establishments in Porto Eico, Hawaii, and the Philippines, together with further decisions under the new doctrine, which were rendered in the succeeding term, have apparently deter- mined that Congress has the power to discriminate among constitutional rights in Territories belonging to the United States, so as to withhold the equal conditions hitherto enjoyed in such annexations, until the Territory has been admitted into full Statehood. In other words, the Constitu- tion in its entirety does not necessarily apply to Territories of the United States, but they are rather under the control of Congress; yet "where the Constitution has been once formally extended by Congress to Territories, neither Congress nor the Territorial legislature can enact laws inconsistent therewith."~~

With military aid a civil Territorial government was started by President McKinley, 4th July, in the Philippine Islands, Aguinaldo, the chief of the natives fighting for independence, having been captured by stratagem during March, and placed in confinement. On the anniversary of the American occupation of Porto Eico, 25th July, President McKinley proclaimed free trade between that

island and the United States, and the organization of a local Territorial establishment followed, with a governor appointed at Washington.

In September 1901 the President visited the Pan-Ameri- can Exposition in Buffalo, and on the 6th, while holding Assassina- a Public reception in one of its buildings, he Hon of was shot twice with a revolver by one Leon President Czolgosz, a native of the United States, but of McKiniey. Eur0pearL parentage. One bullet glanced from his right breast, but the other, after passing through the stomach, lodged in the muscles of the back, and could not be extracted. He died from the effects of this wound in Buffalo, on the 14th of September. Impressive funeral services were held at the Capitol in Washington on the 17th, where the body lay in state in the rotunda ; and afterwards the remains were borne by train to Canton, Ohio, the President's home, where the last services were held and the final interment took place. The popular grief and sorrow were universal, and expressions of profound sympathy came from foreign countries. The assassin, a professed anarchist, was indicted in Buffalo for murder of the President, and, being found guilty after a short trial, was executed in Auburn prison, N.Y., on the 29th of October.

Vice-President Theodore Koosevelt had meanwhile succeeded to the Presidency upon McKinley's death, taking unostentatiously, on the 14th of September, the President^ q^Jj 0f omce prescribed in. the Constitution. accession. At his request, all the members of his pre- decessor's Cabinet retained their portfolios, but in January changes were made for personal reasons. The fifty-seventh Congress assembled 2nd December. The message of the new President was well received, and the long session

opened with the Executive and the two branches of Congress firmly controlled by the Republican party. The result of the November elections was, on the whole, highly favourable to the administration in most of the important States, excepting the Southern section, which continued Democratic. Efforts to reunite the national Democracy met with little apparent success north of Maryland and Kentucky. In Pennsylvania, inclusive of Philadelphia, a fusion of the local voting elements for putting down Bepublican corruption failed ; while in New York City a corresponding fusion of the voters against the local Tammany (or Democratic) misrule carried Seth Low, a Republican in national and an independent in local politics, triumphantly into the mayor's chair, and secured the election of his associates on the Independent Reform ticket.

Various important matters of legislation occupied the attention of Congress during its long session. By • one of the earliest measures which passed both

Fifty- Houses and became law, a tariff was imposed Congress. uPon imports to the Philippines, superseding the military regulations in that respect, which the Supreme Court of the United States (2nd De- cember 1901) had pronounced invalid on the ground that, until Congress asserts its own will towards new Territorial possessions, no tariff barrier is presumed to exist. The question of an Isthmian canal provoked much discussion. The commission of 1899, after prolonged investigation, reported, shortly before Congress met, in favour of the Nicaragua route as on the whole the most feasible and practicable for construction and ownership by the United States. This report was transmitted to Con- gress when that body met in December. Later, however, the French Panama Company, whose previous demands for their unfinished works and goodwill had been deemed inadmissible, made a definite offer to sell out to the United States for $40,000,000, conveying a good title;

whereupon the Canal Commission made a supplementary report on 18th January 1902 declaring their preference for this rival route under terms so favourable. This report was referred at once by the President, and Con- gress at the end of June passed an Act which empowered the President, in case the French company could and would pass a good title to all their

property and work at Panama for not more than $40,000,000, and in case the Colombian Government would make a satisfactory grant of authority to the United States over the territory through which the canal would run, to have work begun at once on a canal at Panama. In case of failure of the French company to pass a good title, or of the Colombian Government to make the necessary concession, the President was to open negotiations for a canal at Nicaragua, and begin construction. It is hoped that under this Act active work on the canal will soon be begun.

Another topic of immediate interest was that of reci- procity with the Republic of Cuba in matters of tariff revenue. President Roosevelt, like his predecessor in office, espoused earnestly such a policy on the ground of plighted faith by the Government and the liberal dealing to which the Cuban people were justly entitled from the nation by whose arms and intervention their independ- ence had been won. But as reciprocity called for the immediate reduction by Congress of the high duties imposed upon sugar and tobacco imported into the United States, strong pressure adverse to such reduc- tion was brought to bear upon the two HIouses by American protected interests, and notably by those engaged in the new native industry of beet-sugar ; hence the sentiment of the Republican majority in Con- gress was greatly divided, and no Bill was passed. At the first Cuban election, 31st December 1901, the Liberal candidate, Mr Tomas Estrada Palma, was chosen Presi- dent of the new and independent republic, and the experiment of self-government in that island under the friendly auspices of the United States was begun.

Another important Bill passed by the Congress was that for the civil government of the Philippines. This provided for a census, and two years later, in case peace prevailed, for an Assembly or Congress in the Philippines composed of two houses ; an upper house of eight mem- bers, five Americans and three Filipinos all appointed by the President, and a lower house of representatives chose!; by property-owners and those who could speak Spanish or English. The rebellion in the Philippines had been so far crushed that on the 1st July 1902 the President abolished the office of military governor-general, recalled a considerable part of the troops, and placed those left under the control of the civil authorities. At the same time he issued a general pardon to all rebels and political*

prisoners who would take the oath of allegiance to the United States. (j. sch)

V. LITEEATUEE.

The literature of the United States in the last quarter of the 19th century was distinguished by no name equal in eminence to those of the authors who established their fame in the preceding period, and by no work which made the impression of a classic either at home or abroad. Lowell's "Commemoration Ode," which is not more defective than many another great ceremonial poem, and which, as the loftiest and most interesting literary memorial of a momentous crisis, must retain historical prominence, was the last American work in verse that can lay claim to that distinction ; and, in serious prose, Parkman's his- tories, already begun by 1864, have a similar commanding

position. Parkman and Lowell belong, together with Whittier and Holmes, who lived into the later time, to the elder group of which Emerson, Hawthorne, and Long- fellow were, in belles lettres, the memorable names. The generation that came to the front in succession to these, and for the most part still survives, has not struck so deeply into the minds or the affections of their country- men. Especially is this true of the fine art of literature, the imaginative and critical work, whether novel, essay, or poem. In the large departments of science, theology, and learning there has been a steady gain in systematic knowledge and scholarship and the results of research, and the putting forth of these in books has enhanced the national reputation in these fields of intellectual labour ; but literature, in the narrower and polite sense, has had a less favourable fortune.

The broad social conditions which have influenced literary production are perhaps too general in scope and too subtle in operation to be recognized clearly or stated briefly. There may have been some exhaustion in moral motives after the Civil War, and there appears to be a

change in culture among the educated classes, which for the purposes of literature amounts to a decline, and it may seem to some observers that the objects that receive attention are inferior in worth. The literature actually produced, however, possesses definite marks which indicate traits of its environment. Its miscellaneous nature, the blended pursuit of prose and poetry and of higher and inferior kinds by the same authors, the brevity and temporary effectiveness of much of their work, are obvious characteristics ; and there may be reasonably associated with these the great expansion of journalism, the power of the magazines in dictating limits of taste and of treatment as well as objects of attention, and — what is another phase of both these agencies — the democratization of the reading public. Journals and magazines have been the chief promoters of literature in the sphere of the essay, novel, and poem, nor has the pursuit of history been unindebted to them. Their position has been a cardinal one ; they make, so to speak, the literary climate. They have affected the productions of authors, as a class, more than the colleges have formed their minds. Few, indeed, are the imaginative and critical writers who have not habitu- ally been in touch with the public most directly through periodicals and papers. Condensed views and rapid writ- ing have been stimulated. The short story, the cameo forms of verse, reminiscences, nature-studies, scenes from abroad — all that can be packed into little room — have thriven ; and if longer works have been sought, they are such as could partake of the same brief and concentrated literary form by virtue of effective arrangement as serials. Authors have turned from one to another of these with versatility ; but a general sense of something small in the results is unavoidable. The magazine and journal cannot supplant the book as a governing mould of artistic thought; and the extent to which they have displaced it is one measure of general inferiority. It may reasonably be suggested that some connexion exists between an environ- ment which encourages clever versatility by material gains and ready notoriety, and the remarkable absence of that singleness of aim which belonged to Emerson, Haw- thorne, and Longfellow. It may be observed also that neither race-heredity nor the tradition of academic culture, so controlling in these three, is noticeable in the men of the later period. The prevalent insistence in the novel on accuracy of observation and truth to actual fact, as if these by themselves were sufficient for literature, and the interest in provincial life which produced the most

characteristic genre of the period in the dialect novel, are also to be reckoned limiting influences, though they were

favourable to the multiplication of books. An immense popular demand for the novel, and also for anything touching the national history, has had great determining power on the attention of authors to theme and treat- ment ; and the increased employment of women as writers is a factor of consequence. For the most part, authors have written out of and for the present hour, in the most temporary sense. Fecundity, versatility, and miscellaneous- ness characterize the general product ; historians, essayists, novelists, and poets have afforded an interesting and voluminous mass of writing ; but an average of excellence which, regarded as an average, is high, has been found consistent with a lower degree of individual eminence.

In the historical field the increase of value in the sub- stance is quite as notable as the decline in the power of style ; and here, if anywhere, an exception should be made to the general characterization of the literature of the period as an inferior kind. V?e The later writers have fallen heir to a deeper national self-consciousness, and respond to an overwhelm- ing popular demand for knowledge of American beginnings, of the spread through the wilderness, of the lives of the founders, and of military and civil heroes. The history of the Civil War makes up a special literature in which the period has been rich, largely the work — like the Memoirs of General Grant (1822-1885) — of those who participated in it. The most important work in the general field is the History of the United States, 1801- 1817, by Henry Adams (born 1838) ; in it the research of many years is stored by a mind distinguished by political acumen, incisive power, and firm judgment, experienced in state affairs ; here is shown on the broad scale what the author's lives of Gallatin and Randolph evinced by way of monograph in capacity of detail, as well as that under- standing of American statesmanship in which Mr Adams is unrivalled. The popular side of the nation's history was strikingly set forth in the History of the People of the United States by John Bach Ma'cMaster (born 1852), on the lines of Green's History of the English People ; but popular favour has been more variously cultivated by John Fiske (1842-1901), who united to the breadth of view and social interest developed in his

~~*philosophical studies a vivid and familiar style well fitted for narration, as in The Critical Period of American History, The Beginnings of New England, The American Revolution, The Discovery of America, &c. A sounder historian, in the sense of embodying the more learned results of research, was Justin Winsor (1831-1897), as is exempli- fied in his Geographical Discovery in the Interior of North America, Cartier to Frontenac, Christopher Columbus, and The Mississippi Basin. James Ford Rhodes (born 1848), in his History of the United States from the Compromise of 1850, able, discriminating, and disinterested, gathers the fruit of toilsome investigation. John Codman Ropes (1836-1899), especially distinguished as a military critic, and Henry Cabot Lodge (born 1850) and John Torrey Morse, Jr. (born 1840), have worked suc- cessfully in the American field ; and other younger men, especially connected with the universities, contribute to the continuation of a subject which must increase and multiply indefinitely. In the foreign field, James Breck Perkins (born 1847), for his volumes on the history of France, and William Milligan Sloane (born 1850), for his Life of Napoleon, are noteworthy. The various works on the Influence of Sea Power, by Captain Alfred Thayer Mahan (born 1840), have received wide recognition as original presentations of fact and theory. The History of Life in the United States, by Edward Eggleston (1837- 1902), though incomplete, deserves to be included, from the fact of its being confined to the social phase, and*~~

~~*The essayists,*~~

~~*from the novelty of its research. The national develop- ment of historical interest in the United States has thus been many-sided ; it has been broadly felt among the people, and served by painstaking students rather than great historians.*~~

~~*Of the older writers in the department of the essay, Dr Edward Everett Hale (born 1822), at the close of a long and hard-working literary career still in- terests his audience, and his later writings have the currency and*~~

also the contemporary prepos- session of literature for the time. Even more distinctly the books of Thomas Wentworth Higginson (born 1823), which he has put forth in the later days of his long career as reformer, soldier, orator, and poet, have the stamp of the daily or monthly press which has normally been his means of public communication by the pen. His close associa- tion with leaders of thought and action, his participation in many causes of reform, and especially his eye for human nature and his resources of livery narrative, together with the mixture of geniality and irony in his style, make his autobiographical works attractive and valuable, such as Cheerful Yesterdays, Contemporaries, and Life in a Black Regiment. Several of the portraits of men of the past age, contained in these volumes, are the best that have yet been given in compact, virile, and lifelike power. He is the last of the group of Cambridge authors to write much and variously, and with Charles Eliot Norton (born 1827), best known as the translator of Dante and editor of the papers of Lowell, Carlyle, and Emerson, brings to a conclusion the activity of that brilliant and noble com- pany which conferred literary distinction and pre-eminence on Massachusetts in the 19th century.

With Edmund Clarence Stedman (born 1833) a new period of literary activity on the part of a younger gene- ration, more broadly national in representation, began. Mr Stedman first became known by several volumes of verse, but the work of his later years has been diverted into critical prose, which, however, grew out of his love of poetry and was its natural fruition. Sympathy with ex- cellence in many kinds, sense of style, and wide informa- tion underlaid his critical energies, and gradually widened their scope and increased their productiveness. He first attempted a judgment of the modern poetry nearest to him, in Victorian Poets, being a pioneer in the subject by virtue of his scope and method. He continued his labour in the more delicate task of estimating the work of his fellow-countrymen in Poets of America. A third volume, The Nature and Elements of Poetry, set forth the general principles of the art, and concluded his direct critical writing on the broad scale. Two collections of verse, A Victorian Anthology and An American Anthology, were a fitting supplement to these volumes, and disclose the broad foundation of knowledge on which his criticism rested ; and, together with A Library of American Litera- ture, these important and laborious

compilations are of historical value as memorials of the general literary activity which they represent with fulness and justice. Mr Stedman is also distinguished by a formal quality in his thought, a conception of the subject on large lines, and an adherence to the logic of the development of his theme, which har- monize with a certain carefulness of composition. His vocabulary implies classical tradition. He is one of the few writers of current English whose style is still dis- tinctly literary and student-liko, with the reminiscence of old books and the aroma of the library, and yet has suppled itself to modernity of expression and the will of the spoken word. His later essay on the difficult subject of Poe exhibits his qualities at their highest efficiency. There is no finality in any criticism, and Mr Stedman's view of the English and American poetry

contemporary one ; but in comprehensiveness, appreciative power, and grace of presentation it holds the first place ; and, in connexion with the more theoretic third volume of the series, it forms the most elaborate and important work of pure criticism produced in America in its time.

Charles Dudley Warner (1829-1900), though he has written novels, biography, and books of travel, is charac- teristically an essayist. His writing is touched by tem- perament, and derives its charm from personality playing in a genial and frequently humorous way about the men. books, and things in the vicinity. Humour is the distinc- tive part in his literary fame. This gave flavour to his earliest essays, and made popular My Summer in a Garden and Backlog Studies. It is a refined humour, quiet, evasive, communicative, with a feeling for the oddity of human nature and its affairs, and given to novel and interesting remarks ; it has a touch of confidential con- versation, and a slightly-felt background of sentiment, and it is used as a delicate instrument of truth, and not merely to raise a laugh ; it is of the New England character and soil, and is perhaps a third shoot from the same native stem that produced Donald Grant Mitchell (" Ik Marvel ") and Oliver Wendell Holmes.

John Burroughs (born 1837) continues the type of which Thoreau is the eminent example in the older gene- ration ; but he is less characteristic of the type. His volumes are as naturally annual as seed-time and harvest. They are sympathetic and accurate studies of external nature, and take

minute observations of the animate and inanimate, sky, weather, and field ; and they find the other half of life, as Thoreau did, in an abstract and Emersonian thought which gives cadence to their prose. Mr Burroughs is also a critic of literature, but the natu- ralist in him, rather than the critic, is the salt of his work and gives its savour. Of the score or more of contempo- rary writers of nature-studies, he has most literary grace, and has correspondingly won most on popular favour. Wake Robin, Locusts and Wild Honey, and Indoor Studies represent his work.

William Dean Howells (born 1837) stands highest among the novelists ; and he is besides, by virtue of the copiousness and variety of his work, and his power to arrest public attention in many ways, ..

the most conspicuous literary figure of his generation. He has been, by example and precept, an apostle of realism in fiction, and of a democratic gospel of Socialistic sentiment hard to define ; but in these two aspects he is placed most vividly in the public mind as the adverse critic of Scott and Thackeray, and as the eulogist of Tolstoy. His art came to mark a complete break with the American tradition that had reached its culmination in Hawthorne. Mr Howells occupied a position with respect to Continental fiction not unlike that of Longfellow in the field of poetry. He was familiar with fiction as it was written by his contemporaries, not only in France, but in every foreign country from Madrid to St Petersburg, and from Naples to Stockholm ; and he was, in general, more appreciative of Continental than of English literature. He was eventually subdued to these foreign examples, and felt himself in the world-current by his participation in their ways. He endeavoured to make these foreign authors known to his countrymen, and made them the subject of a literary crusade in which he dis- played a lack of historical perspective that seriously im- paired his critical influence. This diminution of his reputation as a critic was unfortunate and, to some extent, undeserved ; for, on the positive side as an interpreter of the present, as a writer who popularized the great reputa- tions of his contemporaries abroad, Mr Howells did dis- tinguished and useful service by virtue of his thorough

understanding of the aims and methods of these authors, his acute sympathy with them in broad humanitarian and definitely artistic ways, and his generous and enlightened appreciation of their greatness. Led thus into the Con- tinental schools of art, what he found in their transcript of life naturally bred in his sensitive and democratic feelings that pessimism of outlook, that sentimentality in political and social thought, and that preoccupation with the barrenness and tedium and the narrowing limitations of life, which weigh upon his imaginative and reflective prose alike. Such views seem rather the outcome of Continental than American conditions ; the theories, both social and artistic, that foster them, are large and im- portant, and in certain environments are natural and fruitful of great work, as foreign literatures amply show ; but it is doubtful if an American novelist can at present find sufficient native material to illustrate them in a com- manding way. For this reason, possibly, in the numerous novels that Mr Howells has written, especially since The Lady of the Aroostook, the difference between the material and the art expended upon it is acutely felt. There is no great difference in their quality; The Rise of Silas Lapham is regarded as typical of his work, and together with A Modem Instance and A Hazard of New Fortvmes, illustrates his methods and aims. His attractiveness in other fields of composition, travel, criticism, and remini- scence has continued undiminished, while his fiction has shown less vitality.

Henry James (born 1843) is commonly named with Mr Howells as the second leading novelist of American birth. In his activity as a critic, principally of French subjects, he has shown skill in the modern, refined, some- what super-subtle, modes of praising a favourite author, and he has kept within lines of academic suavity and correctness of judgment. His ways are, in fact, Gallic, and his essays seem like translations from the French. In his novels, similarly, he shows the direct results of Parisian models in treatment. He has carried to the extreme the analysis of character and motive, and almost resolved both into meaninglessness, ending in a complexity of results, in inexplicability, rather than in any moral syn- thesis of character or of action. Of his later and maturer work, The Portrait of a Lady and The Princess Casamas- sima are important examples ; in both there is an effect of great elaborateness, of much forethought in the making, and especially of a long-winded pursuit of the

small game of conversation and incident which no pains taken with the stage setting can successfully counteract. The whole of his work in fiction is of an intellectual kind pre dominantly, and in that sphere is essentially analytic and logical, minutely subtle in movement and often evasive in meaning, as rich in variety as in inconclusiveness. The style sympathizes with the matter, and shows that high development of the mastery of words which makes saying nothing seem as clever as saying something. His contribution to our knowledge of some phases of human nature is interesting to a few of the specially placed men and women of the world, and the intellectual force mani- fest in his more important novels is impressive ; but he has cultivated evasiveness to the point of such success as to discourage his readers in their attempt to accompany him, and as he has gone on he has departed farther from what is welcome to American taste.

Francis Marion Crawford (born 1854), as an author seems neither American nor British, but writes for the English-speaking world. His first volumes were indebted to romantic elements of marvel, distance, and Costume for the quick popularity they won ; and, though he is char- acteristically a story-teller, in his later work there has been a greater attention to character. His residence in

Italy has helped him to his best subjects, and it is gene- rally agreed that the Koman series, of which Saracinesca was the first published, exceeds in interest, scope, and power his other novels, and stands apart from them on a superior plane. He is excellent in his handling of plot, and in giving intense interest to his main char- acters, and his scenes are well ordered and lively; he is, too, a good narrator. He has given forth, year after year, a series of attractive and wholesome tales of great variety in atmosphere and in the kind of human appeal they make, and has held successfully a place originally won by more popular and less artistic work. He undoubtedly represented a reaction from the realistic taste among readers, and was the forerunner of the later school of pseudo-adventure ; but his better novels exceed any of these in romantic breadth and historic vitality.

Another author who illustrates the popular revival of romance in closer connexion with history, and whose work is laboriously executed and conceived with nobility of aim, is Lew Wallace (born 1827), whose three stories, The Fair God, Ben^Hwr, and The Prince of India, were remarkable achievements of a native genius for romance, though im- perfectly developed by literary cultivation, and successful largely through spectacular elements.

Besides the novelists who dealt with modern society in various forms, and carried on the art of fiction as it developed in the last years of the 19th century in city life, there has flourished a more numerous school of the provincial tale in one or another form. It has achieved historical importance as well as popular success, because of the record that has been made of manners and cus- toms, and also character, in nearly all parts of the coun- try. The exploitation of locality and adherence to the rude or picturesque phases of American life was not alto- gether a new thing, but the general devotion of writers to the aspects of special phases of life in different parts of the country resulted in a great volume and variety of such writing, till the dialect novel seemed almost to absorb all new literary energy. Edward Eggleston (1837- 1902), already mentioned as a historian, led the way with The Hoosier Schoolmaster, a study of life in Indiana in the second generation of the settlement of that state ; and his portrayal revealed to others that there existed a wealth of material in the human nature and environ- ment of the newer portions of the country, similar to that which had so long and so successfully been used in the New England field. He continued in the vein he had opened, and wrote several other novels describing the earlier life of the Ohio river people and their neighbours, The End of the World, The Circuit Rider, and Roxy being the best of these.

Equal in fidelity to the past of a local community, and touched with a more poetic charm, were the novels of George Washington Cable (born 1844), who found in the Creole nature and traditions of Louisiana a mine of literature ; and aided by an uncommonly graceful gift of speech, and a nature-background that was itself a marvel of fascination, he rapidly produced a group of novels and tales which in certain subtle and rare quali- ties of appreciation and presentation, and in the touching power of

their characters, are scarcely equalled in the fiction of his generation ; they are a treasure of the past of old Southern days, with a climate, a race, a distillation all their own. Old Creole Days, The Grandissimes, Madame Delphine, Dr Sevier, and Bonaventure compose this group, which easily wins precedence in literary quality over all others of the provincial novels. The life of the mountaineers on the borders of Tennessee and North Carolina was depicted in its turn by Mary Noailles Murfree (born 1850), whose books appeared under the

pen name of "Charles Egbert Craddock." In the Ten- nessee Mountains and Where the Battle was Fought are good examples of her work. Mary Hallock Foote (born 1847) has used the local material of the Rocky Moun- tains; Thomas Nelson Page (born 1853) has performed a similar service for Virginia ; and James Lane Allen (born 1849) for Kentucky. The vogue of this species of novel has, in general, fallen off, and in its place a new movement in the direction of the half-military, half- historical romance of costume and adventure has begun in Hugh Wynne, by S. Weir Mitchell (born 1829), the ablest of his varied works of fiction.

Somewhat apart from the pure novelists stand Francis Eichard Stockton (1834-1902), who invented an idiosyn- cratic novel of his own, full of entertainment, surprising and widely popular, which is in essence extravaganza; and also three notable authors of fiction in different veins — Bret Harte (1839-1902), Thomas Bailey Aldrich (born 1836), and Samuel Langhorne Clemens, "Mark Twain" (born 1835). Bret Harte, whose early reputa- tion was won by tales of California, which introduced a new genre into fiction, continued to write most success- fully in the manner which he first made popular, but with less effect in America, possibly because of his pro- longed residence abroad. As is the case with several American authors, his reputation is greater in England than at home. Mr Aldrich, better known as a poet, has won highest regard in prose as a writer of short stories, in which department he stands at the head of his contemporaries, both in art and wit, and especially in the deftness of constructive power, in speed of narra- tion, and in capacity to

~~conceal the conclusion. As a humorist Mark Twain has sustained the fame won by The Innocents Abroad and Life on the Mississippi with- out developing any new traits, although as a lecturer and public character he has carried his reputation far and wide, and is the most popularly known man of the writers contemporary with him. His work in all its forms partakes of that huge caricature of America of which Walt Whitman was in the last generation the great example. It is perhaps more esteemed abroad than at home, where his earlier books retain a considera- tion, especially in relation to Western life, that has not been won by his more recent writings ; but the influence of his personality still renders any judgment on his works doubtful.~~

~~Among the few poets of this literary generation none has been so exclusively devoted to the art as the men of the former time, and with hardly an exception their prose seems equally as important to the public. All have been miscellaneous writers or concerned in practical affairs, and they have not obtained a national vogue comparable with that of their predecessors. Mr Stedman is pre-eminently a critic, for the reading world of his countrymen, and his verse is subordinated in their thoughts to his essays on the poets. He has written much verse, but in his later years has been less a producer of poetry than an admirer and collector of it ; yet in the ballad, in some of the stately forms of the art, and in poems of character, he obtained early recognition. He has published sparingly, but with great variety of subject and style, with masterly technique and with power of phrase, in language eloquent rather than impassioned, and preferring the ballad to the lyric. Thomas Bailey Aldrich, already referred to as a novelist and writer of short stories, holds in popular estimation the most con- spicuous position among the literary poets of the period. He is most widely recognized as skilful in the short lyric, the sonnet, and epigram and quatrain, forms of verse especially favourable to sentiment, wit, grace, and the~~

~~refinements of technique. In lyrical purity and melodi- ousness he reaches true distinction, and in spontaneity within the limits of artistic restraint he reveals the poetic impulse of a cultivated mind open to the world of nature and the heart ; while, on the worldly side of interest in human affairs, in history and travel, and the thoughts of men, he finds an~~

~~opening into reflective, narrative, and dramatic composition. From very early in his career he betrayed a love for the Orient, its colour and dreaminess, and he often sought in the East effects of reverie and atmosphere, and even a setting for wit. Spain and England have left their mark in Mercedes, a play written to be acted rather than read, and Wyndham Towers. Friar Jerome's Beautiful Booh is the most popular example of his use of mediaeval legend. His verse was essentially urban, and most at home among the tastes of a refined society. It is, in a literary sense, aristocratic verse, unemphatic, self-possessed, artistically content with the perfection of its class, and has habitually more the classic stamp than any of American poetry except Long- fellow's.~~

~~The only companion of Mr Aldrich in the public mind, as a frequent producer of literary verse, is Eichard Watson Gilder (born 1844), whose Five Books of Song contain his collected poems. He, too, prefers the short flights of poesy. His work is usually so brief as to give the impression of fragmentariness, and of slightness in the mass. In his earlier volumes, The New Day and The Celestial Passion, the tone was that of Eossetti and Italian mysticism and sentiment, and in his manage- ment of the love theme and the sonnet form his art was plainly of that school, a predilection for which was also indicated by his interest in pictorial symbolism and arrangement. Music as well as painting has been a source of poetic impulse ; and, in general, his muse has often been the handmaid of the other arts. His temperament exhibits that sensitive impressibility under colour, tone, and shadow which is associated with the artistic nature. In his later work he freed himself from the traditions which he had at first felt so domi- nating, and gained in reality, in breadth of treatment, and in contact with modern life. The Great Remem- brance, a memorial poem of the Civil War, not only in scale and style but also in its humanity, its rendering of the national passion, and its high-thoughted appeal, illustrates the later manner ; but in many of the memorial tributes, and frequently in sonnet and lyric, there was a deeper chord struck, though it might be only for a single note. The humanitarianism of much of this later verse, its spirit of democratic philosophy, is marked ; the presence of New York as a world-city, its characteristic features, interests, and intellectual and moral appeals, and its general life-movement, are elements in the verse, and, in fact, the civic feeling is~~

almost as strong in the poet as the patriotic ardour. This has given substance and sig- nificance to Mr Gilder's verse as a whole ; but it still remains in general brief poetry of personal expression, the product of a poetic sensitiveness rather than of conscious and masterful art.

Of others who have attracted special attention, with- out being popularly accepted as poets of distinction, Dr S. Weir Mitchell, eminent as a physician and dis- tinguished as a novelist, has found in verse the most subtle and most condensed expression of his literary faculty : his dramatic sketches, slight as they are, stand wholly apart from the poetic work of his contemporaries. Two poefs, Sidney Lanier (1842-1881) and Edward Eowland Sill (1841-1887), have obtained and still hold a certain intellectual vogue.

(g. b. w.)

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UNIVERSITIES.

DURING the years which have intervened since the publication of the ninth edition of the Encyclo- paedia Britannica there has been a good deal of research on all that concerns the history of the mediaeval universities, and much new material is now available in a printed form.

The first point on which it seems desirable to supple- ment the earlier article is as to the exact meaning of the terms universitas and stvdium generate. In the Mtea,n,?.g — north of Europe teaching had become in the Dark generate. Ages the monopoly of the Church ; in the south of Europe there was more liberty in educational matters. In the north licences to teach were granted by the Chancellor Scholasticus, or other officer of some cathedral church ; in the south it is probable that the gilds of masters (when these came to be formed) were at first free to grant their own licences, without any ecclesi- astical or other supervision. But in all cases such per- missions were of a purely local character. Gradually, however, towards the end of the 12th century, a few great schools obtained a certain oecumenical prestige. Practi- cally a doctor of Paris or Bologna would be allowed to teach anywhere. These great schools were

styled studia generalia, i.e., places resorted to by scholars from all parts. Eventually the term came to have a more definite and technical signification. The Emperor Frederick II. set the example of attempting to confer by an authoritative bull upon his new school at Naples the prestige which the earlier studia had acquired by reputation and general consent. In 1229 Gregory IX. did the same for Toulouse, and in 1233 added to its original privileges a bull by which any one who had been admitted to the doctorate or mastership in that university should have the right to teach anywhere without further examination. Other studia generalia were subsequently founded by papal or imperial bulls; and in 1292 even the oldest universities, Paris and Bologna, found it desirable to obtain similar bulls from Nicolas IV. From this time the notion began to prevail among the jurists that the essence of the studium generate was the privilege of conferring the jus ubicunque docendi, and that no new studium could acquire that position without a papal or imperial bull. By this time, however, there were a few studia generalia {e.g., Oxford) whose position was too well established to be seriously questioned, although they had never obtained such a bull ; these were held to be studia generalia ex consuetudine. A few Spanish universities founded by royal charter were held to be studia generalia respectu regni. The word universitas was originally applied only to the scholastic gild(or gilds) within the studium, and was at first not used absolutely; the phrase was always universitas magistrorum, or scholarium or magistrorum et scholarium. By the close of the mediaeval period, how- ever, the distinction between the terms studium generate and imiversitas was more or less lost sight of, and the term universitas was sometimes used alone.*

The researches of de Renzi and others have made it clear that the origin of the medical school at Salerno had nothing to do with the Saracens. Its Salerno. me(jicai 8yStem was originally an outcome of the Graeco-Roman tradition of the old Roman world, and the Arabic medicine was not introduced till the highest fame of the Ci vitas Hippocratica was passing away. It may have been influenced by the late survival of the Greek language in southern Italy, though this cannot be proved. It is an interesting fact that some of the earliest medical doctors at Salerno were women.

Further research has tended to throw back to a some- what earlier date the origin of the great law revival which ultimately centred in Bologna. This revival began at Pavia, where there was a famous school ° og"a' of Lombard law, and at Ravenna, which was the most important school of Roman law before the rise of Bologna. Bologna began to be famous as a school of the liberal arts about the year a.d. 1000 ; even the Digest was known considerably before the time of Irnerius (1100-30), and the name of one of his predecessors, a certain Pepo (fl. circa 1076), has come down to us. The tradi- tional story about the " discovery " of the Pandects at Amalfi in 1135 was disproved even before the time of Savigny. Schulte has shown that the publication of the Decretum of Gratian must be placed earlier than the traditional date, i.e., not later than 1142. In the case both of the Civil and the Canon Law, the gradual and evolutionary character of the legal renaissance has been strongly emphasized by recent investigation. The Roman law had never been entirely forgotten even in the Dark Ages, and it was not by any catastrophic " discovery " or invention that the Middle Ages emerged out of the darkness.

It should be made plain that the two imiversitates of ultramontani and citramontani (9th ed., vol. xxiii. p. 833) were composed exclusively of students in law. Tbe . Besides these closely allied gilds there was a versifies rector and university of medicine and arts, *< originally subordinate to the Jurist rectors, B»iogna. but completely independent from the year 1306. The universitates of students must be distinguished from the Collegia of Doctors — the College of Doctors of Civil Law, the College of Doctors of Canon Law, the College of Doctors in Medicine and Arts, and (from 1352) the College of Doctors in Theology. Though the professors were largely dependent upon the students, they had separate organizations of their own ; the college alone was concerned in the conferment of degrees. Each faculty was therefore at Bologna entirely independent of every other (except for the union of medicine and arts) : the only connecting link between them was the necessity of obtaining their degrees (after 1219) from the same chancellor, the Archdeacon of Bologna. The decline in the reputation of the studium from about 1250 was largely due to the successful efforts of the doctors to exclude all but Bolognese citizens from membership of the doctoral colleges (which alone possessed the valuable "right of promotion "), and from the more

valuable salaried chairs. They even attempted and partially succeeded in restrict- ing these privileges to members of their own families. The democratic character of the universities and the power of the rectors gradually diminished after the mediaeval period. From 1742 the rectorship was held by the Cardinal-legate, but the student universities main- tained a somewhat shadowy existence down to the time of the French Revolution.

It seems well to give a somewhat more detailed account of the organization of the university, the gradual growth of which is sufficiently described in the ninth edition. The completed mediaeval univer- sity was a federation of four distinct bodies, one of which was also itself a federation. There were the three " superior " faculties of theology, canon law, and medicine, and the " inferior " faculty of arts, which was divided into the four nations — France, England (later, Germany), Picardy, and Normandy. Each superior faculty was

presided over by its dean, each nation by its proctor. The whole faculty of arts was presided over by the rector, who by the middle of the 14th century had become the acknowledged head of the entire university. In congrega- tions of the university matters were decided by a majority of faculties ; the vote of the faculty of arts was determined by a majority of nations. The chancellor of Notre Dame, whose functions were now limited to the conferment of the licence, stood as such outside the university or gild altogether, though as a doctor of theology he was always a member of that faculty. In the course of the 16th and' 17th centuries this democratic constitution of the Middle Ages was largely superseded by the growth of a small oligarchy of officials. The tribunal of the university — the rector, deans, and proctors — came to occupy a somewhat similar position to the old " Hebdomadal Board " of heads of colleges at Oxford. Moreover, the teaching functions of the university, or rather of the faculty of arts, owing chiefly to the absence of any endowment for the regents or teaching

~~graduates, practically passed to the colleges. Almost as much as the English universities, Paris came to be virtually reduced to a federation of colleges, though the colleges were at Paris less independent of university authority, while the smaller colleges sent their members to receive instruction in the larger ones {colleges de plein exercise), which received large numbers of non-foundation members. This state of things lasted till the French Revolution swept away the whole university system of the Middle Ages. It may be remarked that the famous Sorbonne was really the most celebrated college of Paris — founded by Eobert de Sorbonne circa 1257 — but as this college and the college of Navarre were the only college foundations which provided for students in theology, the close connexion of the former with the faculty and the use of its hall for the disputations of that body led to the word Sorbonne becoming a popular term for the theological faculty of Paris.~~

~~The present writer believes that he has made it seem pro- bable (Universities of Europe in the Middle Ages, ii. p. 328~~

~~seq.) that the sudden growth of the school of Ox- Baglish for(j jn(;0 a stuoliiim generate was connected with sities. ' a migration or secession of English students from~~

~~Paris, which may be inferred to have taken place about the year 1167 or 1168. In the first-mentioned year we are told by John of Salisbury that " France, the mildest and most civil of nations," has "expelled her foreign scholars " (Materials for the History of Thomas Becket, ed. Robertson, vi. pp. 235-36). At about the same time we hear of an edict of Henry II., during the quarrel with Becket, recalling all clerks holding benefices in England (as they loved their benefices), and forbidding all clerks in England to cross the Channel (ibid., i. pp. 53-54). The archbishop himself remarks that " The king wills that all scholars shall be compelled to return to their country or be deprived of their benefices (ibid., vii. p. 146). Paris was at this time the great place of higher education for English students. No English school was a recognized studium generate. There are only three earlier allusions to Oxford, .and each of them only reveals the existence of one famous master teaching at the same time. The first allusion to the schools of Oxford is contained in the state- ment that~~

Theobaldus Stampensis (formerly a doctor of Caen) taught here about 1110 (Rashdall, Universities of Europe, ii. p. 333) ; Pullen is mentioned in 1133 ; Vacarius may have taught about 1149 (but was possibly later). Immediately after 1168 allusions to Oxford as a studium and a studium generate begin to multiply. The natural inference is that the breaking off of relations between England and Paris in 1167 or 1168 led to the growth of a studium generate in Oxford, formed no doubt in the first

instance of seceders from Paris. The first allusion to Cam- bridge is the secession of a body of Oxford students to that place in 1209, and there is no reason to believe in any earlier origin of the university. The traditional constitution of the English universities was in its origin an imitation of the Parisian chancellor, modified by the absence of the cathedral chancellor. As Oxford was not in the 12th century a bishop's see, the bishop (in 1214, if not earlier) appointed a chancellor for the express purpose of granting degrees and governing the studium. But he was from the first elected by the masters, and early obtained recognition as the head of the university as well as the representative of the bishop. The procuratores (originally alsa rectores) remained representatives of the faculty of arts and (there being at Oxford no deans) of the whole university. The Cambridge constitution was in the main the same as that of Oxford. The higher faculties in England never developed the same distinct organization as at Paris, and, though the two proctors were originally the representatives of the north countrymen and south countrymen respectively, the nations had hardly any separate existence. There are traces of an original "voting by faculties," but it passed away before the close of the mediseval period. By the statutes drawn up under the chancellorship of Archbishop Laud in 1631, the Hebdomadal Board obtained the sole right of initiative in university matters, and this state of things continued till the middle of the 19 th century. At Cambridge there was a somewhat similar but smaller oligarchy, called the Caput Senatus.

Recent research tends to show that at Oxford and Cambridge, as in other mediseval universities, the halls or hostels in which the bulk of mediseval students once resided were democratic institutions elect-4 r~ 0xto"1 ing their own principals. Before the close of the mediseval period the whole government of the hall had practically passed to the .principal. The few*

halls at Oxford which survived into modern times (at Cambridge they disappeared earlier) were doomed to destruction by the legislation of 1877, and have now ceased to exist, with the exception of St Edmund Hall, which, on a vacancy occurring in the principalship, will be closely connected with Queen's College.

Immensely exaggerated statements were made by mediseval writers as to the number of students attending the universities, not generally in their own ffumi,ers time, but at some period in the past. Thus tnmediee- Richard of Armagh declares that the numbers v«/ univer- at Oxford had fallen from 30,000 to 6000, s",es- while Wycliffe almost at the same time asserts that they had fallen from 60,000 to 3000 (Rashdall, Universities in the Middle Ages, ii. p. 581). It is probable that there could not at any time have been more than 3000 students at Oxford. It is possible that at Bologna in the height of its fame there may have been some 6000, and conceivably a somewhat larger number at Paris. The numbers at the great studia must have fallen off in the later mediseval period through the multiplication of universities. In some of the later and less famous universities we have complete matriculation books, and some of them show a member- ship of 1000 or 2000. This by itself tends to prove that the numbers at Paris and Bologna must once have been much larger.

In France the most remarkable change in the university system since 1888 has been the restoration of the provin- cial schools, which have, since the Napoleonic reorganization of education, formed merely R*-cent " academies " within the University of France as p^ce. compared with their ancient position as indepen- dent universities. This was done by a decree of 10th July 1896. There are now, therefore, the following universities

Great Britain.

in France : Paris, Aix, Marseilles, Besangon, Bordeaux, Caen, Clermont, Dijons, Grenoble, Lille, Lyons, Montpel- lier, Nancy, Poitiers, Rennes,

and Toulouse. This formal change was accompanied and preceded by several measures tending to give more real existence and power to the whole university, as distinct from either (a) the once independent " faculties " in each place, and (6) the Minister of Public Instruction. By these measures a real step has been taken towards a restoration of the ancient university autonomy, though the universities of France still remain under the direct supervision and con- trol of the State.

One of the most remarkable educational movements on the Continent has been the growth of institutes for higher commercial education. The Institut Supeneur commer. de Commerce at Antwerp was founded in 1852 ; ciai and at Paris the Ecole des Hautes Etudes Commer- techaicai ciales was established in 1881. There is also e uca on. an jnstitu.t Commercial at Paris, and Ecoles Superieures de Commerce at Paris, Bordeaux, Havre, Lille, Lyons, Marseilles, Dijon, Montpellier, Nantes, Nancy, and Rouen. In Germany Handelhochschulen have been established at Leipzig, Kbln, Aachen, Hanover, and Frankfurt-am-Main. None of the French or Belgian schools have been admitted to university privileges, but the German Handelshochschulen have been granted the privilege of conferring the" doctoral degree.

In Great Britain the period which has elapsed since 1888 has been marked by the gradual carrying into effect of the reforms enacted in 1877, by consider- nt""?esln a^e ref°rms m tne Scottish universities, by the incorporation of the three Welsh colleges into a new University of Wales in 1893; by the establishment of a new university at Birmingham (1900), and by the issue of an entirely new charter, by which the University of London has become a teaching university instead of a mere examining body.

The general effect of the changes introduced by the legislation of 1877 was sufficiently indicated in the ninth edition. They have been gradually carried out Oxford as tne occurrence of vacancies in the colleges bridge. ' ^as ma(ie possible the appropriation of portions of their revenue for the foundation of professor- ships and other university purposes, though in some cases the intentions of the commissioners have been frustrated by the effects of agricultural depression upon college revenues. The general

effect of the revolution has been a marked diminution in the clerical character of the college teaching bodies, the conversion of the college teaching staff from a temporary employment for bachelors awaiting livings or other preferment into a permanent profession, and the growth of a resident and working university pro- fessoriate. At the same time a change of almost equal significance has taken place in the teaching system of the university through the gradual growth of "inter-collegiate lectures." At Oxford nearly all honour lectures given by college tutors and lecturers have been thrown open to all members of the university : the college tutor is now recognized by the university as a teacher in the faculty to which he belongs, and the institution of boards of faculties has done something to bring the organization of the University into harmony with that of universities outside the British Isles. At Cambridge the system of inter-collegiate lectures has also developed itself, but to a considerably smaller extent. At both the old English universities the great widening of the courses of study open to senior students (honour men), which began about the middle of the 19th century, has been continued, while there has been some widening and modernizing of the studies by which a pass or " poll " degree can be obtained.

At Oxford there are now the following "Final Honour Schools " : Litteraj Humaniores (Classics, Ancient History, and Philosophy), Mathematics, Natural Science, Juris- prudence, Modern History, Theology, Oriental Languages, English Literature; and at Cambridge there are the following " Triposes " : Mathematics, Classics, Moral Sciences, Natural Sciences, Theology, Law, History, Oriental Languages, Medieval and Modern Languages, Mechanical Sciences (Engineering). Degrees in letters and science have also been instituted at both Oxford and Cambridge. The doctorate is given for original work. At Oxford the B.Litt. and B.Sc. can be taken by disserta- tion or original research, without passing the examination for B.A. At Cambridge the B.A. can be obtained in a similar manner by advanced students.

By the will of the South African statesman, Mr Cecil Rhodes, who died in 1902, a large portion of his great fortune has been devoted to the provision of scholarships to be held in Oxford by colonial Tne Anodes and foreign students. A large number of g£/?sar~ these scholarships are

~~to be held by students from the various colonies of the British Empire, while others are assigned to students from Germany (selected by the German Emperor) and from the United States. The founder has expressed a desire that the selection of the students shall be governed by moral and athletic considerations as well as intellectual, but the trustees appointed by the will have not yet drawn up a detailed scheme for their administration. The object of the bequest was to promote the unity of the British Empire and friend- ship with certain other countries. A considerable endow- ment was also left to Oriel College.~~

~~For about thirty years after the Act of 1858, the constitution of the Scottish universities remained practi- cally undisturbed. In 1889 a new Commission Tbe was appointed, which sat for nearly ten years, Scottish and completely transformed the organization unlver- and the curriculum alike. The government of s,tles- the universities was transferred from the Senatus to the Courts, which were enlarged so as to include represen- tatives from the Senatus, the General Councils of Gradu- ates, and the municipality within which the university is situated. In addition to these representatives, the principal, the Lord Rector, his assessor, the Chancellor's assessor, and the lord provosts of the cities of Aberdeen, Edinburgh, and Glasgow, and the provost of St Andrews have seats in the Courts of their respective universities. The provost of Dundee occupies a seat in the University Court of St Andrews in virtue of the incorporation of University College, Dundee, with the University of St Andrews by an ordinance of the Commission. The Lord Rector is the President of the Court. To the Court is entrusted the management of the property and finances of a Scottish university, and, in most cases, such patronage as does not belong to the Crown ; but in the case of Edinburgh, the patronage of some of the older chairs is in the hands of a body of curators. Disciplinary powers are retained by the Senatus, and the General Council remains, as under the Act of 1858, a purely advisory body. Another advisory body — the Students' Representative Council — was added by the Commission. The curriculum of all the faculties (except Divinity) was reorganized : the most important alterations consisted in the abolition of the once sacred six as compulsory subjects in Arts (Latin, Greek, Mathe- matics, Natural Philosophy, Logic, and Moral Philoso- phy). The curriculum was greatly widened, an elaborate scheme of "~~

options " introduced, and a new system of honours degrees was established. The length of residence required was reduced from four years to three, and the Courts were empowered to institute summer sessions,

and to admit women to lectures and degrees in all faculties.

A large number of new chairs and lectureships have been created in all the universities in accordance with these ordinances, and a considerable amount of building operations has also been necessitated. At Aberdeen, Marischal College has been more than trebled in size to accommodate new lecture-rooms and laboratories. The finances of the universities, which suffered greatly from the pressure of these new requirements, have been re- lieved by the gift of Mr Andrew Carnegie, who in 1901 handed over to a body of trustees securities amounting to two millions sterling, the interest of which is partially devoted to the equipment of the universities and partially to the payment of the fees of such students as may desire such assistance. The trustees in July 1902 prepared a preliminary scheme of allotment which should remain in force for five years.

There has been since the Act of 1858 a great develop- ment of student life, illustrated by the institution of students' unions in all four universities, by the publica- tion of undergraduate magazines, and by the growth, in Edinburgh, of combined residences and settlements.

By a royal charter, granted in 1893, the three uni- versity colleges at Aberystwyth, Cardiff, and Bangor were incorporated into a University of Wales. The University Tjjriversity Court was constituted of the Chan- cellor, persons nominated by the Lord President of the Council, and representatives of the county council and county boroughs of Wales, of the Central Inter- mediate Education Board, the Courts, Councils, and Senates of Constituent Councils, the teachers of Welsh schools, and the Guild of Graduates. The govern- ment of the University is mainly in the hands fii the Court, but the Senate, consisting of professors and lecturers,

may make recommendations to the Court. There are faculties of arts, letters, science, music, law, and theology.

The University of Birmingham was established by Act of Parliament and royal charter in the year 1900, the previously existing Mason College being dis- Birming- sojve(j an(j merged in the new institution. The . university is governed by a Chancellor (the first Chancellor being the Bight Hon. Joseph Chamberlain), Principal, a Court of Governors (consisting of a large number of persons, mostly ex officio, appointed by various public bodies), and a Council (consisting of the Principal, Vice-Principal, deans of faculties, and professors). There are faculties of science, arts, medicine, and commerce. It is a special aim of the university to bring the higher academic studies into closer relation with industry and commerce. Departments of brewing and engineering have been organized, and a department of commerce has just been formed. Degrees in science are given for engineering, and a diploma is granted for brewing. For the degree of Bachelor of Commerce the course includes (1) languages and history; (2) accounting; (3) applied science and business technique ; (4) commerce. The faculty of commerce began its work on 1st October

1902.

By the University of London Act, 1898, and the statutes of the commissioners named therein (issued in 1900), the University of London has been re- Vf[*ertlty constituted. The senate is to be composed of the chancellor and fifty-four members, of whom four are appointed by the King in council, sixteen by the convocation (i.e., doctors and proctors) of the university, sixteen by the various faculties, and the remainder by various public bodies or institutions. The senate is the supreme governing body, and has three standing com-

mittees, of which one is the academic council for "internal students," another the council for "external students," and the third a board to promote the extension of univer- sity teaching. Provision is made for the appointment of professors and other teachers by the university itself, and also for the recognition as teachers of professors and others teaching in such institutions in or near London as may be recognized as schools of

the university. The following bodies are constituted schools of the university : Univer- sity College and King's College, London ; the Royal Holloway College, Egham, and Bedford College, London (both colleges for women) ; the Royal College of Sciences ; the medical schools of the principal London hospitals ; the London School of Economics and Political Science ; the South-Eastern Agricultural College, Wye; the Central Technical College of the City and Guilds of London Institute; and several theological colleges. The "ap- pointed" and "recognized" teachers in each group of subjects form the various faculties of the university. Of these there are eight — theology, arts, law, music, medicine, science, engineering, economics and political science (in- cluding commerce and industry). Each faculty elects its dean. Courses of study are to be provided by the univer- sity for its "internal" students, i.e., those who pursue their studies in one of the schools of the university. Its degrees remain open to " external " students as heretofore, but separate examinations are in future to be held for " internal " and for " external " students respectively, and the senate is to " provide that the degrees conferred upon both classes of students shall represent, as far as possible, the same standard of knowledge and attainments." The whole scheme may be described as a compromise between the views of various schools of reformers — as an attempt to create a teaching university without destroying the existing purely examining university or erecting two distinct universities of London, and at the same time, without any immediate endowments, to create a university which might hereafter expand by utilizing existing institutions. One of the most important of these, King's College, it may be observed, has, without losing its con- nexion with the Church of England, abandoned its theological test for members of its teaching body. The Inns of Court have, so far, refused the invitation of the commissioners to co-operate with the university in the creation of an academic school of law.

The history of university education for women begins with the foundation of Girton College at Hitchin in 1869, or its removal to Cambridge in 1873. The college was originally in no official con- education nexion with the university, but its erection for women made it possible for women to receive a univer- In Oreat sity education, lectures being given at the college, partly by their own lady lecturers, and partly by university

professors or tutors of the colleges. Other colleges have since been opened at Cambridge and at Oxford. The actual degrees and formal membership of those universities have not been opened to women, but they are practically permitted to attend most of the university and college lectures, and to enjoy most other advantages of the university, while nearly all university examinations have been thrown open to them. Separate honour lists are issued of women who have entered for the same examinations and been examined by the same examiners as men. These lists have appeared in the calendar at Cambridge since 1882, at Oxford since 1893. In 1878 the University of London obtained a new charter to enable it to confer degrees upon women, and a similar step was taken by Durham in 1895. In all the new British universities women are admissible to all the same privileges (with the exception, in some cases of

medical lectures) as men. Within the last ten years of the 19 th century the degrees in arts, science, and medicine were opened to women in all the Scottish universities. At Dublin a limited number of lectures have been opened to women, and in 1895 it was resolved to admit women to some of the honours examinations as an experiment.

To enable women to avail themselves of these advan- tages, halls of residence have been opened for women in

the university towns, and other colleges have Women's been opened elsewhere, the students of which aa/haUs. en^er f°r the examinations at London or other

universities. The following is a list of the more important of these colleges. At Oxford : Somer- ville College (1879); Lady Margaret Hall (1879); St Hugh's Hall (1886); St Hilda's Hall (1893). At Cambridge : Girton College (1873) and Newnham Col- lege (1880). In London are Queen's (1848), Bedford (1849), and Westfield (1882) CoUeges. At Glasgow Queen Margaret College for women was incorporated with the University in 1893, and there are now colleges or halls for women in all

~~the Scottish universities and at Durham. A college for women on a magnificent scale, known as Holloway College, was established in 1886 at Egham, Surrey, under the will of Mr Holloway.~~

~~In the universities of France, Belgium (except in the Catholic university of Louvain), Holland, Denmark,~~

~~Norway, Sweden, Switzerland, Italy (by law of women in 1890), Greece, Bumania, Canada, Australasia, and foreign in most of those in the United States, students univer- are admitted to all or most of the advantages sities. enjoyed by men. In Germany an increasing number of universities allow women to attend some of the lectures by special permission. At Gottingen and Heidelberg they are admissible to degrees. In Austria and Bussia (with the exception of Finland) the univer- sities offer fewer facilities to women. In Spain the universities were opened to women in 1868, but the privilege is rarely claimed.~~

~~The following is a list of universities not mentioned in the ninth edition, or founded since that date : —~~

~~Adelaide (1872).~~

~~Aix-en-Provence (1409).~~

~~Allahabad (1887).~~

~~Amsterdam (free university, 1880).~~

~~Barcelona (1450).~~

~~Besancon (transferred from Dole in 1422).~~

~~Buenos Aires.~~

~~Bucharest (1864).~~

~~Cadiz (Medical Faculty of Seville, 1748).~~

~~Cagliari (1596 ; re-founded 1720 and 1764).~~

~~*Camerino (1727 ; since 1860 a "free university").*~~

~~*Caracas.*~~

~~*Catania (1444).*~~

~~*Cdrdoba (Argentina).*~~

~~*Dijon (1722).*~~

~~*Freiburg (Switzerland, 1889).*~~

~~*Gothenburg (a " HSgskola " founded in 1841, which now grants degrees in the philosophical faculty).*~~

~~*Granada (1531).*~~

~~*Havana (1721).*~~

~~*Kingston, Queen's University (1840).*~~

~~*Kyot3 (Japan, 1897).*~~

~~*Lahore, Punjab University (1882).*~~

~~*Lausanne (founded as academy, 1537 ; university, 1890).*~~

~~*Lima (1551 ; reorganized 1561).*~~

~~*Macerata (1540).*~~

~~*Manila, University of St Thomas (1605).*~~

~~*Messina (1838).*~~

~~*Modena (1683).*~~

~~*Montevideo (1876).*~~

~~Miinster (Papal bull in 1629; erected in 1771-73. Since 1818 it has been a " Konigliche Akademie," conferring degrees in theology and philosophy).~~

~~New Zealand (1877 ; colleges at Auckland, Canterbury, Dun- edin, and Wellington).~~

~~Oviedo (1574). Palermo (1779).~~

~~Parma (1422 ; reorganized 1855). Pisa (1343).~~

~~Pressburg (1465, but soon extinguished ; since 1875 a Faculty of Law only). Quebec (Universite Laval, 1852). Reykjavik (in course of foundation). Santiago (Spain ; 1504).~~

~~Santiago (S. America ; Universidad de Chile, 1743). Saragossa (1474). Sassari (1556). Seville (1502).~~

~~T&kyo (Imperial University of Japan, 1868). Tomsk (1888). Turin (1412).~~

~~Urbino (1671 ; now a free university). Valencia (1501).~~

~~"Warsaw (1816 ; suspended 1832 ; re-founded 1869). Wiirzburg (1402 ; revived in 1582).~~

~~This list is not to be regarded as complete as regards schools which have once been granted but have now lost university rank or ceased to exist altogether. In par- ticular large numbers of Jesuit colleges in Spain and elsewhere obtained recognition as universities in the 16th or 17th century, but lost it in the course of the 18th or 19th. It may be observed that in Spain the degree of B.A. is now given at the institutes (secondary schools), the M.A. at all universities, while the degree of Doctor can only be conferred by the Universidad Central at Madrid.~~

~~Additional Authorities. — The following are a few of the more important works which have appeared since the publication of the ninth edition, or were not noticed in it : — Rashdall, The Universities of Europe in the Middle Ages, 2 vols., Oxford, 1895, deals with the whole subject down to 1500. To this work the reader may be referred for a fuller bibliography.~~

~~Denifle and Chatelain have carried their splendid Chartularium Universi-tatis Parisiensis in successive volumes down to 1452. The later history of Paris is dealt with by Jourdain, Hist, de I' Univ. de Paris aux XVII: and XVIII". Siecles, Paris, 1862, and by Greard, Nosadieux a la vieille Sorbonne, Paris, 1893. The origines of Bologna are dealt with by Chiapelli, Lo Studio Bolognese, Pistoia, 1888 ; Fitting, Die Anfange der Mechtsschule zu Bologna, Bologna and Leipzig, 1888 ; Ricci, i" primordi d. Studio di Bologna, 2nd ed., Bologna, 1888. All the extant statutes are published by Malagola, Statuti d. univ. e dei eollegi d. studio bolognese, Bologna, 1888 ; and a new edition has ap- peared of the learned Sarti's De claris Archigymnasii Bono- niensis Professoribus, Bologna, 1888, &c. The statutes of all the French universities have been edited by Fournier, Statutes et Privileges des Univ. francaises, Paris, 1890. Kaufmann is publishing a very thorough Geschichte d. deutschen Universi- tdten, &c, 1888, &c. There is a history of the Spanish univer- sities, De la Fuente, Hist, des las Universidades, collegios y demos Establimentos de Ensenanza en Espana, Madrid, 1855. At Oxford most important work has appeared in the successive publications of the Oxford Historical Society, and a generally excellent series of Oxford and Cambridge College Histories is now nearly complete.~~

~~For information as to the recent universities the reader may be referred to the successive annual editions of a general Directory of Universities known as Minerva, published at Strasburg, some of which contain valuable historical notes. See also Mr Sadler's Special Reports (to the Education Office) on The Admission of Women to Universities and on Higher Commercial Education.~~

~~(h. Bl.)~~

~~Universities in the United States.~~

~~In the United States the word " university " has been applied to institutions of the most diverse character, and it is only since 1880 or thereabouts that an effort has been seriously made to distinguish between col- legiate and university instruction ; nor has that effort yet completely succeeded. Harvard, William and Mary, and Yale, the three pioneers of Colonial times, were or- ganized in the days of Colonial poverty, on the~~

plans of the English colleges which constitute the universities of Oxford and Cambridge. Graduates of Harvard and Yale carried these British traditions to other places, and similar

colleges grew up in New York, New Jersey, Pennsylvania, New Hampshire, and Khode Island, and later in many . other states. The underlying principle in these

institutions was discipline — mental, moral, and religious. Dormitories and commons were provided, and attendance upon religious worship in the chapel was enforced. Harvard and Yale were the children of the Congregational churches, Columbia was fostered by the Episcopalians, Princeton by the Presbyterians, Kutgers by the Dutch Reformed, and Brown by the Baptists. Around or near these nuclei, during the course of the 19th cen- tury, one or more professional schools were frequently attached, and so the word " university " was naturally applied to a group of schools associated more or less closely with a central school or " college." Harvard, for example, most comprehensive of all, has seventeen distinct departments, and Yale has almost as many. Columbia and Pennsylvania have a similar scope. In the latter part of the 19th century Yale, Columbia, Princeton, and Brown, in recognition of their enlargement, formally changed their titles from colleges to universities. The ecclesias- tical, or religious, note was a strong characteristic of these foundations. Protestant evangelical doctrines were taught with authority, especially among the undergraduates, who were spoken of as constituting " the college proper." In the oldest and largest colleges this denominational influence has ceased to have the importance it once possessed. Note- worthy innovations came when Thomas Jefferson, the philo- sophical statesman, returned to the United States from France, emancipated from some of the narrow views by which his countrymen were bound. He led the Virginians to establish, on a new plan, the university of Virginia as a child of the state ; and the freshness <5f his advice, the importation of distinguished foreign teachers, and the freedom of the student from an enforced curriculum awakened admiration and

emulation on the one hand, and animadversion on the other. But this university un- questionably led to broad conceptions of academic work, which appeared foreign and even questionable, if not irreligious, to the colonial universities already mentioned, although many of the features which were then regarded as doubtful peculiarities ape now familiar everywhere. Following Virginia's example, many of the new States in the West established State universities, most of which included a central college of the colonial type and after- wards one or more professional schools. Freedom from ecclesiastical control is found in all the foundations that make up this second group — the State universities. Michigan, Wisconsin, Minnesota, and California present distinguished examples of such organizations. In earlier days, Maryland, North and South Carolina, Georgia, and other States of the South had anticipated in a limited way the State support of higher education which was made so conspicuous in Virginia. In their plans of education, intellectual and moral, they adhered closely to the college methods which the Northern institutions had introduced from English antecedents. Since 1870 another class of universities has arisen, quite distinct from the colonial establishments and from the wards of the State. These are independent foundations due to individual generosity. The gifts of Cornell, Johns Hopkins, Rockefeller, Tulane, De Pauw, Clark, and Stan- ford have brought into being universities which for want of a better name may be called private foundations. They have no dependence upon State control, and when a de- nominational character is assured (as it is in at least one instance), this fact is not made prominent.

Thus, looking at their origin, we see three impulses given to American high schools, from Churches, States, and individuals. It is true that all receive from the State

some degree of authority as incorporations, but this authority is so easily obtained that in a single city there may be, and in some places there are, several incorpora- tions authorized to bestow degrees and to bear the name of universities. A foreigner cannot understand nor can an American justify this anomaly. The most that can be said for it is that there is complete freedom of organization, and that the best, and only the best, are likely to survive. Another influence, proceeding from the

~~national govern- ment, must also be borne in mind. During the Civil War, Congress, led by Senator Morrill of Vermont, be- stowed upon every State a certain portion of the public domain in the Far West — " land-scrip," as it was called — the proceeds of its sale to be devoted to the establishment and maintenance of one or more colleges in each State, where instruction should be given in agriculture and the mechanic arts, not excluding liberal studies, and including military tactics. In some States this bounty was directed to existing universities. New departments were organized in old institutions. Elsewhere new 'institutions were created. While all these schools were regarded as prac- tical and technical at the first, most of them as they developed became liberal and scientific ; and when Con- gress made later large appropriations for "experiment stations " in the sciences relating to agriculture, an im- pulse of the most valuable character was given to many departments of scientific research.~~

~~This sketch would not be complete without the mention of two foundations, each unique. The Catholic University in Washington has been created by the Pope, and in its government the hierarchy of the Roman Catholic Church is made dominant. Already the Roman Catholics had established, especially under the charge of the Jesuit fathers and of the Sulpicians, excellent colleges for liberal education, as well as schools of theology ; but the newer metropolitan university was distinctly organized on a broader plan, in closer accordance with the universities of continental Europe, and with a pronounced recognition of the importance of science.~~

~~The University of the State of New York is a super- visory body exercising a general control over all the schools of higher instruction in the State, and especially guarding the conditions upon which their degrees are conferred. 'It does not give instruction directly.~~

~~The interior organization of these institutions may now be considered. Some of them have but one depart- ment, the philosophical, which includes the liberal arts and sciences ; others have two, three, or many corre- lated departments. Clark University, for example, has but one faculty, the philosophical ; Harvard, as already stated, has many departments, including philosophy, law, medicine, and theology. So has~~

Yale. Princeton has but one. Johns Hopkins has two, the philosophical and the medical. In most American universities a sharp dis- tinction is made between undergraduates and graduates, between those who are candidates ®?8an za' for the baccalaureate degree (A.B., S.B., and Ph.B.) and those who are engaged in higher professional study, like law, medicine, and theology, or in the manifold branches of modern science, like philology, historical and political science (including economics), philosophy (includ- ing logic, ethics, and psychology), mathematics, physics, chemistry, biology, geology, &c. In certain places, as at Johns Hopkins, since 1876, emphasis is given to the idea that college instruction is disciplinary, requiring definite, but not uniform methods, and a certain deference to the authority of a master ; while university instruction is much freer, and the scholar is encouraged to inquire rather than to accept ; to test and observe rather than to hear and recite ; to walk with a friendly guide rather than

to obey a commander. This distinction is not universally recognized. Indeed, it has been made but recently in American institutions, so that older men are often heard asking, " What is the difference between a college and a university 1 " But generally it is admitted that college training is one thing, and work in a university is another ; that thorough instruction in language, history, mathe- matics, natural and physical sciences, and in morals, should precede the discipline of professional schools and the pursuit of the higher and more advanced studies in letters and science. In a complete university provision should be made, according to ancient and widespread usages, for the study of law, medicine, and theology ; but unfortunately the development of such schools in the United States has been fettered by narrow condi- tions. The schools of theology, with rare exceptions, are under denominational control ; and so established is this usage, that in the State universities, and in most of the private foundations (Chicago being an exception), theological departments are not encouraged, because of the dread of religious rivalries and dogmatism. Until

~~recently there have been no endowments for Profes- medical schools to any adequate extent, and schools, consequently the fees paid by students have been~~

~~distributed among the teachers, who have usually been the real managers of the institution, although acting under the name of some university. It is nearly the same in law. There are many indications that changes are at hand in these particulars. Theological schools make their denominational characteristics less pronounced, and the old colleges no longer speak of the schools of law and medicine as " outside " departments. The rapid growth of the physical and natural sciences during the 19 th century, and the extension of scientific methods of inquiry and verification to subjects which were formerly taught by the traditional methods of authority, have led to the development of laboratories and libraries. Everywhere special buildings, well equipped with the latest and best apparatus, are springing up, where the students of chemis- try, physics, biology (in its numerous sub-departments — bacteriology among them), and electricity have every facility for study and research. The introduction of laboratories for psychology is specially noteworthy. Pathological laboratories have become essential in schools of medicine.~~

~~Libraries are — as they always have been and always will be — storehouses where the books and manuscripts of the past are preserved ; but in American universities they have taken on another characteristic. Subdivided into special departments, or supplemented by fresh additions, they are the working-rooms of "seminaries," where capable teachers, surrounded by scholars properly qualified, are engaged in teaching, studying, and writing. Seminaries and laboratories distinguish the modern philosophical departments from those of old, where the lecture-room was the seat of instruction. Numerous memoirs and monographs proceed from this active life. Books, periodicals, and dissertations are contributions to the advancement of knowledge. Two agencies have effected these changes, most of which are the product of the last quarter of the 19th century. In the first place, gifts for higher education have been munificent, sometimes, especially in the East, from private citizens — often, especially in the West, from the treasuries of separate States. Quite as important has been the growth of liberal ideas. Very many of the~~

foremost professors in American universities are the scholars of European teachers, especially Germans. Candidates for professorships are resuming the usages which prevailed early in the 19th century, of studying in France and Great

Britain. On their return it is essential that they should keep themselves familiar with the latest literature in their departments, whatsoever may be the language in which it appears. Hence the American universities are no longer provincial. They must be judged, for better or for worse, by the standard of universities established in Europe. The bestowal of academic degrees ought to be strictly governed by some recognized authority, and according to ancient usages it is one of the highest functions of a university. In the United States there is but little restraint proceeding from law, tradition, or public opinion. Every "oollege" is at liberty to exercise this privilege. Hence the variety of academic titles that have been introduced ; hence, also, occasional and scandalous frauds in the issue of diplomas. The best institutions exercise due diligence ; the public may be protected by requiring that every one who claims the privileges of his degree, or who appends to his name the usual abbreviations in- dicative of professional or academic authority, should make it clear where, when, and how he received his title.

The institutions in the United States which claim to be univer- sities, in the world-wide use of that designation, recognize these principles and, so far as their means allow, > adhere to these methods: 1. There is a disciplinary stage in education which is the requisite introduction to the higher and freer work of the university. This is the sphere of the colleges. 2. The success of the higher work depends upon the intellectual and moral qualities of the professors. No amount of material prosperity is of value unless the dominant authorities are able to discover, secure, and retain as teachers men of rare gifts, resolute will, superior training, and an indomitable love of learning. 3. The professors in a university should be free from all pecuniary anxiety, so that their lives may be consecrated to their several callings. Pensions should be given them in cases of disability, and, in case of premature death, to their families. In methods of instruction they should have as large an amount of freedom as may be con- sistent with due regard for the co-operation of their colleagues and

the plans of the foundation. 4. The steady improvement of the libraries and laboratories is essential if the institution is to keep in the front line. The newest books and the best apparatus are indispensable, for instruments and books quickly deteriorate and must be superseded. 5. For all these outlays large endowments are required. To a considerable extent reliance must be placed on wealthy and public-spirited citizens. In order to enlist such sup- port, and also for higher consideration of the public welfare, the members of a faculty should manifest their interest in public affairs, and by books, lectures, and addresses should inform the public and interest them in the progress of knowledge. 6. Publi- (cation is one of the duties of a professor. He owes it not only to his reputation but also to his science, to his colleagues, to the public, to put together and set forth, for the information and criticism of the world, the results of his inquiries, discoveries, reflections, and investigations. Qualified students should also be encouraged, under his guidance, to print and publish their disserta- tions. 7. As a general rule, those who are most alert in their own intellectual life, those who know how to suggest difficult and fundamental inquiries, and who know how and where to seek for their solution, those who relish the high delights of investigation and production, will be found to be the most helpful and most inspiring teachers of youth. Research and instruction are so closely affiliated that the best teachers are always adding to their knowledge, while the best investigators and thinkers afford examples and inspiration to the youth around them. 8. There is at present great danger that the number of specialists will become too large for the United States to support — that is to say, too many young men are now aiming at professorships. Such persons are usually dependent upon salaries. But salaries, in good environment, cannot be com- manded at will. The development, within the last quarter of the 19th century, of several new and strong foundations and the enlarge-, ment of older universities, has opened many doors to the more recently promoted doctors of philosophy, but it is a serious question whether the supply of candidates will not soon surpass the demand. This, however, is certain. In so vast a country there are innumer- able positions, in addition to professorial chairs, which should be given to those who have had university residences long enough to become familiar with the principles and methods, the books and in- struments, by which modern civilization is promoted. The superin- tendents of public schools, the heads of

academies and high schools, the editors of newspapers, the leaders in philanthropic work, and the aspirants for consular and diplomatic service should all be men of liberal education.

Closely associated with the development of the univer- sity idea since 1875 is the improvement of the American college. Complaints are often made that the College number of colleges is too large, and it is menu' undoubtedly true that some institutions, in- ferior to city high schc)ls, have usurped the names, the forms, and some of thj functions that should be restricted to establishments with larger endowments and better facilities for the promotion of scholarship ; but while this is admitted, the great benefits which have resulted from the recognition, far and wide over the vast domain of the United States, of the value of higher education, must not be forgotten. The support of churches of every name,, and the gifts of States, cities, and .private citizens, have been everywhere enlisted in behalf of learning. In every college worthy of the name mathematics, ancient and modern languages, and the elements at least of modern science, are taught. More or less choice is permitted in the courses requisite to a bachelor's degree. Moral and religious influences are brought to bear on the formation of character. All this is favourable to the enlightenment of the people, and excuses, if it does not justify, the multiplication which is so often deprecated. The establishment of colleges for women, fully equal to the colleges for men, and in many places the admission of women to colleges and universities not originally intended for women, is one of the most noteworthy of the advances in higher educa- tion. Opinions are still divided in respect of the wisdom of co-education, especially in the undergraduate period, but there is no longer any question as to the wisdom of giving to women the very best opportunities for in- tellectual culture ; while the success that women have shown in the pursuit of many branches of science has led in many universities to their admission to the estab- lished laboratories and lecture-rooms. Separate colleges for women are now maintained in close connexion with Harvard, Columbia, Cornell, Tulane, and other institu-*

~~tions, and this mode of procedure seems likely to be introduced elsewhere. At the same time, independent foundations like Vassar, Smith, Wellesley, Bryn Mawr, and Baltimore are supported with so much vigour, and with such able faculties, that it is not easy to say which \ organization is the best, and indeed there is no occasion to raise the question. In the Western universities gene- rally, as in Michigan, Wisconsin, California, Chicago,~~

~~For the statistics of attendance, endowments, &c, of the univer- sities and colleges of the United States, reference should be made to the accurate and comprehensive reports of the United States Commissioner of Education and to the articles under the various headings in these volumes. The difficulty in using these tables is that of nomenclature. Universities of the highest character are described in the same schedule with those which, to say the least, are quite inferior. The World Almanac also publishes an excellent and trustworthy compendium of facts. (p, c. G.)~~

~~Unna, a town of Prussia, province of Westphalia, 15 miles by rail east of Dortmund. It is the seat of iron foundries, salt works, and coal mines, and has also machine-shops, a chemical factory, brickmaking, and brewing. Population (1885), 8904; (1900), 14,918.~~

~~Ursterwalden, one of the Swiss cantons sub- divided into Obwalden and Nidwalden. The total area of Obwalden is 183-2 square miles, and of Nidwalden 112-1 square miles. The population of the canton is as follows :— Obwalden (1888), 15,043; (1900), 15,270. Nidwalden (1888), 12,538; (1900), 13,017. In 1900 there were in Obwalden 83 inhabitants, and in Nid- walden 116 inhabitants to the square mile. Most of the inhabitants are Koman Catholic and German-speaking.~~

~~The capitals are Sarnen (population 3974), Obwalden, and Stans 2762. In 1900 Kerns, in Obwalden, had 2362, and Beckenried, in Nidwalden, 1659 inhabitants. Obwalden contains 7 and Nidwalden 11 " political com- munes," which are also administrative districts. In 1897 the cantonal finances were as follows : —~~

~~Revenue.~~

~~*Expenditure.*~~

~~*Public Debt.*~~

~~*Obwalden < Nidwalden <*~~

~~*238, 969 francs (a rise of 75$ per oent. since*~~

~~*1885).*~~

~~*199,676 francs (a rise of 45£ per cent, since*~~

~~*1885).*~~

~~*237,724 francs (a rise of 90 per cent, since*~~

~~*1885).*~~

~~*189,444 francs (a rise of 56 per cent, since*~~

~~*1885).*~~

~~*15,000 francs. 48,199 francs.*~~

~~*In 1898 Obwalden had a deficit of 11,738 francs, but Nidwalden a surplus of 9760 francs. The existing can- tonal constitutions date from 1867 for Obwalden, and from 1877 for Nidwalden. Besides the railway from Alpnachstad over the Briinig Pass to Meiringen, and that from Stansstad up to Engelberg, there are also mountain railways from Alpnachstad up Pilatus, and from Stans up the Stanserhorn. In 1896 the mountain pastures in Nidwalden "numbered 166, supporting 5207 cows.*~~

~~*See Beitrdge z. Geschichte Nidwaldens. Stans. Annually since 1884. — Blumbe. Stoats- u. Rechtsgeschichte d. Schweiz. Demo- kratien, 3 vols. St Gall, 1850-59. — Lutolf. Sagen, Brauche, Legenden, aus den Fiinf Orten. Lucerne, 1862. — Obwaldner Geschichtsbldtter. Zurich. From 1901. — Sowerby. The Forest Cantons of Switzerland. London, 1892. (w. A. B. C.)*~~

~~*Unyoro. -See Uganda.*~~

Upper Sind Frontier, the name of a dis- trict of British India, in the Sind province of Bombay, with administrative headquarters at Jacobabad. Area, 2549 square miles. Population (1881), 145,810 ; (1891), 174,584, showing an increase of 20 per cent., which has been continuous since 1872 ; average density, 68 persons per square mile. In 1901 the population was 232,462, showing a further increase of 33 per cent. The land revenue is Rs.10,16,681, the incidence of assessment being Rs.2.4.4 per acre. The cultivated area in 1897-98 was 416,487 acres, of which 372,508 were irrigated from Government canals ; number of police, 279 ; children at school (1897-98), 2343, being 1-7 per cent, of the total population; registered death-rate (1897), 22 per 1000. The principal crops are millet, oil-seeds, pulse, wheat, and rice. The district is crossed for about 30 miles by the Quetta branch of the North- Western Railway. The wild Baluchi inhabitants were pacified by General John Jacob between 1847 and his death in 1858.

UpsaJa, a town of Sweden, on the navigable river Fyris, 41 miles north of Stockholm by rail. The re- storation of the venerable cathedral, which was begun in 1885, was finished in 1893. In 1897 the Museum of Northern (Scandinavian) Antiquities was housed in Linnseus's garden. There is a new Victoria museum for Egyptian antiquities. In 1898 a part of the ruined castle was equipped for the custody of the provincial archives. In 1901 the number of students attending the university was 1384, the number of professors and lectors over 130; whilst the library contained 300,000 volumes and 12,000 MSS. There is a university astronomical observatory (59° 51' 31" N., 17° 37' 30" E.), founded in 1730, though there was a professorial chair in the preceding century. Some 10 miles south of the city is the fine chateau of Skokloster, built by Marshal Wrangel, and stored with the booty he brought home from Germany in the Thirty Years' War, including a valuable library, a

unique armoury, and a great accumulation of curios. Im- mediately south of the city stands the important Ultuna agricultural institute. Population (1890), 21,511 ; (1900),

~~22,855.~~

~~Ural Mountains, a complex mountain system in the Eussian Empire, extending from the Arctic Ocean nearly to the Caspian Sea, and generally considered as the geographical boundary between Europe and Asia. The full physical description in the ninth edition of this work leaves only their present economic value to be discussed here. It need only be added that during the years 1880-90 nearly the whole of the middle Ural mining region was mapped by the Geological Committee, and a number of still more detailed geological maps were made by private owners of their mines ; while in the northern Urals, the territory from 60° 40' to 64° 50' N. was well explored by the expedition of Fedoroff, who has published a geological map of the region. He distinguishes three zones in that part of the Urals : (i.) the eastern hill region, where one finds Mesozoic rocks (Chalk, Jurassic) in the north, and Devonian limestones, porphyrites, and quartz porphyries farther south ; in this zone most gold placers are found; (ii.) the central mountain zone consists of various amphibolitic metamorphic slates, and also of syenite and gabbro; granites, gneisses, and occasionally serpentines and porphyrites are found only subordinated to the former ; and (iii.) the western hilly zone consists chiefly of Carboniferous and Permo -Carboniferous deposits ; Middle and Upper Devonian limestones and, occasionally, crystalline slates are only found in a few meridional ridges.~~

~~Not only are the Urals very rich in minerals, but the vast areas covered with forests afford an almost inexhaus- tible supply of cheap fuel for smelting purposes.~~

~~a "g. ipjjus for a long time the Urals were the chief mining region in Eussia. But when coal began to be used for smelting purposes, South Eussia generally, and Ekaterinoslav in particular, became the chief iron-produc- ing region, and the Urals lost their primary importance. Attention has, however, again been directed to the great mineral wealth latent in the mountain region, and the last two years of the 19th century witnessed a "boom" in the purchase of iron and gold mines by foreign companies. The Urals possess, indeed, very rich mines of magnetic ore in Mount Blagodat, where the stock is estimated at 12,000,000 tons; in Mount~~

~~Vysokaya, in the central Urals ; and in Mount Magnitnaya, in the southern Urals ; of limonite ores in the Zlatoust district, which is capable of yielding several million tons ; and of haematite, which has been discovered in the basin of the Vishera river in the Cherdyn district. In 1898 only 1,417,000 tons of iron ore, chiefly limonite, was extracted in the Urals, while the production of pig-iron in 1898 was 714,000 tons, as against 394,000 tons in 1888, out of a total of 2,229,000 tons obtained in all Eussia, and it is considered that this might easily be doubled without resorting to the use of coal. The Urals are especially renowned for sheet-iron, and the production of iron goods in 1898 was 248,000 tons, and of steel goods 170,000 tons. The chief pig-iron and iron-works are at Nizhne-Taghilsk, and the principal steel-works at Bogos- lovsk. It is interesting to note that several large iron- works have been built in the basin of the Volga with the object of testing the value of naphtha for smelting purposes in the production of pig-iron. The manu- facture of agricultural machinery has increased in the southern Urals, especially at Krasnoufimsk, and the manu- facture of tea-urns has grown in importance at Perm. But the iron and machinery works are nearly all of the old~~

~~type — small and for the most part provided only with water motors ; and the lack of technical schools is a great obstacle in the way of the development of the iron industry. HIowever, four parallel railways, which Pro- fessor Mendeleeff advocated, are to be built across the mountains, and these should develop the industry con- siderably.~~

~~Gold is met with in the Urals both in veins and in placers, and 10,179 kilogrammes (25 per cent, of all the gold obtained in Eussia) were extracted in 1897. The Urals have also rich placers of platinum, often mixed with gold, iridium, osmium, and other rare metals, and now supply 6020 kilogrammes, i.e., 90 per cent, of all the platinum obtained in the world. Silver, mercury, nickel, zinc, and cobalt ores are also found. Kich mines of copper are found at Turinsk, Gumishev, and other places, yielding as much as 5 per cent, of pure copper ; nickel is obtained at Eevdinsk, and the extraction of iron chromates has also developed. Coal is found in many places on the western slope of the Urals, mainly on the Yaiva river, in the basin of the Kama, and the Usva (basin of the~~

Chusovaya), but less than 350,000 tons are raised annually. Several layers of coal have also been found on the eastern slope, and though a definite opinion cannot yet be passed as to their value, it is known that excellent anthracite is found at Irbit and good coal at Kamyshloff ; only 5000 tons were extracted in 1900. Sapphires, emeralds, beryls, chrysoberyls, tour- malines, aquamarines, topaz, amethysts, rock-crystal, garnets, and many kinds of jade, malachite, and marble are found and cut and polished at several stone-cutting works, especially at Ekaterinburg ; and diamond mining may prove successful. Good asbestos is found and ex- tracted, and pyrites is worked for the manufacture of sulphuric acid (16,000 tons). Many varieties of mineral waters are found in the Urals, the best being those at Serghinsk, Kluchevsk, and Elovsk.

The production of the principal minerals in the Urals (governments of Perm, Orenburg, Vyatka, and Ufa) in 1898 was as follows : — Gold, 11,137 kilogrammes (2562 kilo- grammes from veins and 8575 from placers) ; platinum, 6020 kilogrammes; copper, 3813 tons; pig-iron, 714,000 tons; iron, 248,245 tons; steel, 170,840, tons ; man- ganese ore, 3240 tons ; amiant, 1006 tons ; iron chro- mates, 13,220 tons ; sulphates, 15,660 tons ; coal, 350,650 tons in Perm only; and salt, 170,840 tons (also 8065 tons obtained in Uralsk).

The provinces of the Urals are being rapidly colo- nized by immigrants from the rest of Eussia, and the production of grain rose till in 1895-99 it averaged 5,220,000 tons per annum. Cattle- f*£caI' breeding also yields rich results. The chief towns of the Urals are Ekaterinburg and Perm. There are several iron- works, round which towns of over 10,000 inhabitants have grown ; such are Nizhne – Taghilsk (30,000), Neviansk (12,355), Kyshtym (10,000), and Berezovsky (10,190). Numerous villages have over 3000 inhabitants.

Authorities. — Feuoroff. Geological Researches in Northern Urals, 1884-96 ; and Bogoslovsk District, 1901 ; as also all publi- cations of the Eussian Geological Committee, the Mineralogical Society, and the Geographical Society. — Chupin. Geogr. and Stat. Diet, of the Government of Perm; Permskiy Sbornifc, published by the Perm Zemstvo ; Statistical Documents about Mining in Russia, pub- lished for the Nijni-

Novgorod Exhibition in 1896. — Mendeleeff. The Ural Iron Industry, 1900. (p. a. K.)

Uralsk, a province of Asiatic Eussia, belonging to the general-governorship of the Steppes, lying to the S.E. of the Ural river, which separates it from European Russia, and bordering on both the Caspian Sea and the

Sea of Aral. It has an area of 141,174 square miles, and its population, which was 525,330 in 1882, numbered 644,001 (domiciled only) in 1897, of whom 309,642 were women, and 53,714 lived in towns. Four years later (1901) it was 691,687 (327,933 women). Of these the nomads numbered 452,974, and the non- Cossack Eussian settlers 5930. The province is divided into four districts, the chief towns of which are Uralsk, Gurieff (9316), Kalmykoff (2847), and Temirsk, a small port on the Caspian. About 10,000 tons of salt are extracted annually from the lakes. Agricul- ture begins to develop among the Kirghiz, and besides the 569,900 acres which were under culture in 1900 among the Ural Cossacks, the Kirghiz had 203,000 acres under crops. Eye, wheat, oats, barley, millet, flax, and potatoes are the principal crops. The growth of agriculture is best seen from the increasing de- mand for improved agricultural machinery. Cattle- breeding is, however, the chief industry, and in 1900 there were about 680,000 horses, 844,800 horned cattle, 2,364,200 sheep, 144,600 goats, and 198,400 camels. The export of cattle is considerable, the figures for 1900 being 16,470 horses, 117,500 horned cattle, 416,500 sheep and goats, and 27,100 camels. Fishing is carried on by the Ural Cossacks, who treat their fisheries — the richest in the world — as the common property of the whole Cossack community, and allot them among the different villages under a rational system of administration. In 1901 the export of fish attained 710,000 cwt., and was valued at 3,000,000 roubles, but the Caspian Sea fisheries along the Kirghiz Steppe coasts(about 100,000,000 fishes a year) are not included in

~~the above. Gardening has increased greatly, as also the field culture of melons, sunflowers,~~

~~See Theletnoff. The Uralians, 1887 '. — Danilevsky. "TJra- lian Fishing, " in vols. iii. and v. of Russian Fisheries, ed. by Min. State's Domains. — N". Borodin, in Buss. Encycl. Diet., vol. lxviii., where a full bibliography is given. (p. a. K.)~~

~~Uralsk, the capital of the above province, on Ural river, 210 miles W.S.W. of Orenburg. It is now con- nected by a railway with Saratoff (273 miles), and is rapidly developing owing to its trade with the nomad Kirghiz in cattle, sheep, and animal products, all of which are exported to Eussia ; it is also a great centre for trade in grain. It has a real-sch.oo\, a gymnasium for girls, a school farm, a people's palace, two free libraries, a good theatre, and branches of the Geo- graphical and the Fisheries Society. Population (1897),~~

~~36,597; (1901), 38,919.~~

~~Ura-tyube, or Ora-tepe, formerly the chief town of an independent bekdom, now a town of Eussian Turkestan, in the province of Samarkand, lying 55 miles S.W. of Khojent, on the road from Fergana to Jizak across the Zerafshan range ; altitude 3000 feet. It is surrounded by a wall, and has a Eussian citadel, round which grows a small Eussian town. Its inhabitants carry on trade in horses and camel-wool cloth. Ura-tyube is supposed to have been founded by Cyrus under the name of Cyropol, and was taken in 329 b.c. by Alexander of Macedon. Later it was the capital of a kingdom, and received its present name from the Uzbek in the 15th century. The Eussians took it in 1866. Population (1897), 20,837, chiefly Uzbek.~~

~~Urban SI, a city of Illinois, U.S.A., capital of Champaign county, on the Embarras river, opposite Champaign, and on the Cleveland, Cincinnati, Chicago and St Louis, and the Wabash railways, in the eastern part of the state, at an altitude of 725 feet. It is~~

~~the headquarters of the Illinois State University, a non- sectarian, co-educational institution, opened in 1868. In 1898 its faculty numbered 183,~~

and it was attended by 1582 students, including 245 women. Of the total number of students, 199 were in the preparatory depart- ment, 696 in the collegiate department, 78 were pursuing graduate courses, and 587 were in the professional de- partments. The property of the university was valued at $1,544,000, and its income was $355,000. Popula- tion (1890), 3511; (1900), 5728, of whom 300 were foreign-born.

Urbana, a city of Ohio, U.S. A., capital of Cham- paign county, west of the centre of the state, on the Cleveland, Cincinnati, Chicago and St Louis, the Erie, and the Pittsburg, Cincinnati, Chicago, and St Louis railways, at an altitude of 1031 feet. It is the seat of Urbana University, a New Church institution opened in 1850. It has machine-shops, agricultural implement works, carriage and waggon factories, and other manufac- turing establishments. Population (1890), 6510 ; (1900), 6808, of whom 405 were foreign-born and 796 negroes.

Urbino, a town and archiepiscopal see in the pro- vince of Pesaro and Urbino, The Marches, Italy, standing amongst the eastern spurs of the Apennines, 23 miles south of Eimini. The ducal palace contains the picture gallery (including a " Eesurrection " by Titian), a collection of ancient inscriptions, and a gallery of sculpture. In the principal square was erected in 1897 a handsome monument to Eaphael by Belli ; it consists of a bronze statue (12 £ feet high) of the painter, mounted on a base of Carrara marble, with two reliefs and allegorical figures, the whole being 36 feet high. The free university (1564) has two faculties, and in 1900-01 had 148 students and 14 teachers. There is a technical school, and the town has manufactures . of silk, majolica, and bricks. Popu- lation (1900), 5000.

U rfah I", a town in the government district of Linz, Lower Austria, on the left bank of the Danube opposite Linz, with which it is connected by an iron bridge. It has considerable manufactures and trade in corn and agricultural produce. Population (1890), 8289 ; (1900),

12,827.

Uri, one of the Swiss cantons. Its total area is 415'3 square miles. The population in 1880 was 23,744, and in 1888 17,249, while in 1900 it was

19,732. In 1900 there were 48 inhabitants per square mile, the lowest rate of density in Switzerland save the Grisons (38). The inhabitants are nearly all Eoman Catholic and German-speaking. The capital is Altdorf. In 1900 Silenen (1885 inhabitants) was the third most populous village, and Erstfeld the second (2404) ; Wassen had but 991 and Goeschenen 792 inhabitants, all these variations being due to the fact that on the completion of the St Gothard railway the floating labour population disappeared. In 1898 Uri had 102 mountain pastures, supporting 10,354 cows. There are 20 "political com- munes " in Uri, which are also administrative districts. In 1897 the cantonal revenue was 360,626 francs (78,000 francs less than in 1885), and the expenditure 350,538 francs (71,000 francs less than in 1885), while in 1898 there was a surplus of 4122 francs. In 1897 the public debt was 709,000 francs.

See Historisches Neujahrsblatt (published by the Cant. Hist. Soc). Altdorf. From 1895. — Lusser. Der Kant. Uri. St Gall, 1834.— Casimir Nager. Die Jlpwirthschaft im Kant. Uri. Soleure, 1898. — Oeohsli. Die Anfange d. Schweiz. Mdgenossensehaft. Zurich, 1891. — Scitmid. Allgein. Geschichte d. Freystaates Uri, 2 vols. Zug, 1788-90. — Wanner. Geschichte d. Bams d. Got- hardbahn. Lucerne, 1885. (■%-. A. B. C.)

URUGUAY

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Uruguay, a country of South America, extending from 30° to 35° S., and from 53° to 58° 30' W. It lies on the north bank of the Rio de la Plata, its inland boundary on the east and north being the Brazilian frontier, and on the west the river Uruguay, which separates it from Argen- tine territory. The republic enjoys the reputation of possessing one of the most healthy climates in the world. The geographical position ensures uniformity of tem- perature throughout the year, the summer heat being tempered by the Atlantic breezes, and severe cold in the winter season being unknown. The southern half of the country is for the most part undulating grass land, well watered by streams and springs. The northern section is more broken and rugged ; barren ridges and low, rocky mountain ranges, interspersed with fertile valleys, being its characteristic

~~features. There is no forest, timber of any size being found only in the valleys near running water.~~

~~The area comprised within the limits of the republic is estimated at 72,151 square miles, and has a population of about 930,600. The country is divided into 19 depart- ures and men^S) ^he area and the population of which, accord- popuiation. ing to offioial estimates for 31st December 1900, are given in the subjoined table.~~

~~Departments.~~

~~Area. Sq. Miles.~~

~~Population~~

~~1900.~~

~~Pop. per Sq. Mile.~~

~~Artigas ....~~

~~4,390~~

~~26,004~~

~~5-9~~

~~Cauelones~~

~~1,835~~

~~84,749~~

~~46-1~~

~~Cerro Largo .~~

~~5,765~~

~~36,396~~

~~6-3~~

~~Durazno~~

~~5,525~~

~~37,141~~

~~67~~

~~Flores .~~

~~1,745~~

~~15,874~~

~~9-1~~

~~Florida~~

~~4,675~~

~~44,054~~

~~9-4~~

~~La Colonia .~~

~~2,195~~

~~50,275~~

~~22-4~~

~~Maldonado .~~

~~1,590~~

~~26,439~~

~~16-6~~

~~Minas .~~

~~4,795~~

~~36,085~~

~~7-5~~

~~Montevideo .~~

~~256~~

~~268,334~~

~~1048-1~~

~~***Paysandu***~~

~~***5,115***~~

~~***43,121***~~

~~***8-4***~~

~~***Rio Negro .***~~

~~***3,270***~~

~~***21,202***~~

~~***6-4***~~

~~***Rivera .***~~

~~***3,795***~~

~~***24,792***~~

~~***6-5***~~

~~***Rocha .***~~

~~***4,280***~~

~~***29,550***~~

~~***6-9***~~

~~***Salto .***~~

~~***4,865***~~

~~***44,675***~~

~~***9-2***~~

~~San Jose~~

~~2,690~~

~~41,055~~

~~15-2~~

~~Soriano~~

~~3,565~~

~~38,047~~

~~10-6~~

~~Tacuarembo .~~

~~8,115~~

~~37,851~~

~~4-6~~

~~Treinta y Tres~~

~~3,685~~

~~25,036~~

~~6”8~~

~~Total .~~

~~72,151~~

~~930,680~~

~~12-9~~

~~Of 597,289 persons whose nationality was ascertained, 509,165 were Uruguayan; 23,352, Spanish; 24,349, Italian; 24,720, Brazilian ; 9140, Argentine ; 4186, French ; 675, English ; 708, German ; 994, Swiss. ,~~

~~The natives of Uruguay, though living in conditions similar to those of the Argentine population, are in general more reserved, showing more of the Indian type and less of the Spaniard. In the north there is a strong Brazilian element, and the people are in- tensely conservative, their mode of life having undergone little change during the last 50 years.~~

~~The marriages, births, and deaths registered in four years~~

~~Tear.~~

~~Marriages.~~

~~Births.~~

~~Deaths.~~

~~Natural Increase.~~

~~1897 1898 1899 1900~~

~~2746 4318 4463 4549~~

~~27,763 29,870 31,613 31,593~~

~~13,013 13,255 12,343 13,882~~

~~14,750 16,615 19,270 17,711~~

~~The numbers of births and deaths include still-births, of which there were in 1899, 894, and in 1900, 1004, the proportion to total births being 3-2 per cent. The illegitimate births in 1899 numbered 7857, and in 1900, 8021, their proportion to the total births being 25 -4 per cent.~~

~~The number of immigrants into the republic in the years 1891- 1897 was 74,008 ; in 1898, 9467 ; in 1899, 9006 ; in 1900, 8892.~~

The emigrants in 1891-97 numbered 60,075 ; in 1898, 6411 ; in 1899, 5830 ; in 1900, 6705. The immigrants in 1900 comprised 3211 Italians, 2815 Spaniards, 685 Brazilians, 451 French, 252 Germans, and 290 English. The principal towns, with their population, are Montevideo, 268,000; Salto, 10,000; Paysandu, 7000 ; San Jose, 7000.

There has been no recent change in the political constitution of the republic. The senators number 19, and the deputies 69. Each department or province of the republic has a governor appointed by the executive, and an ad- A,""""Sm minstrative council, whose members are chosen by [t? n a" popular vote. The judicial power is vested in a ce'*

high court and many subordinate courts. There are three civil courts for ordinary and two for commercial cases ; one for cases affecting the Treasury ; two criminal courts, besides police and local courts. The administration of justice, however, is in a lamentable condition. Crime is practically unchecked, and murder and violence are common. The civil courts are little better than the criminal, and corruption exists in every branch.

Education is much neglected, and the public school system is inefficient. The attendance of children at the schools is small, and the instruction they receive is a smattering of „. .. superficial knowledge, of little use to them in after- life, and worthless in the formation of character. In 1900 the number of public schools was 571, with 52,474 pupils. Of private schools there were 344, with an attendance of 22,267. Thus the attendance at public and private schools combined is only equal to 8 per cent, of the total population, as compared with 21 per cent, in the United Kingdom, and 23 per cent, in the United States. The number of teachers employed in the public schools was 242 male and 889 female. The cost per pupil was $14'51, or about £3 sterling. There is a school of arts, with, in 1900, 157 students. At the University of Montevideo in 1900, 233 students were matriculated.

Of the national revenue nearly' two-thirds is derived from customs duties, taxes being levied also on real estate; licences, tobacco, stamped paper, and in other ways. More pinance than half the expenditure goes to meet debt charges, while government, internal development, and defence

absorb most of the remainder. The receipts for the years specified were as follows, Uruguayan dollars being converted into sterling at the par value, 4”7=£1 : —

Years.

Bevenue.

Tears. i Revenue.

1894-1895 1895-1896 1896-1897

£3,403,324

3,606,273 3,319,748

1897-1898 1898-1899 1899-1900

£3,213,180

3,351,000 3,236,300

Of expenditure for these years there is no authoritative statement. The estimated revenue and expenditure for the year 1901-02 balanced at $16,160,000, or £3,439,500. In 1891, when the debt of the republic amounted to 187,789,973, or about £18,678,710, the Government suspended payment of interest, and an arrangement was made with the bondholders. A new con- solidated debt of £20,500,000 was issued at 3J per cent, interest, and, as security for payment of interest, 45 per cent, of the customs receipts at Montevideo was assigned. At the same time the interest guaranteed to the railway companies was reduced from 7 to 3J per cent. In 1896 a 5 per cent, loan of £1,667,000 was issued, and in other ways the debt has increased, sq that on 31st December 1901 it stood as follows : —

External debt . Internal debt . International debt

$99,195,380

22,193,282

3,414,625

1124,803,287

= £26,554,000

In 1901-02 the annual debt charge amounted to $9,036,420, or about £1,923,000.

In recent years the, progress of agriculture has been fairly satisfactory. In 1885 Uruguay imported most of her breadstuff's ; now, not only are wheat and maize grown in sufficient quantities to meet the local demand, but a surplus is annually available for export. Land for farming purposes is expensive, and wages are high, leaving small profit, unless it happens that a man, with his family to assist him, works his own land. The farmers are chiefly Italians, Canary Islanders, and Frenchmen. The export of grain and flour during the six years 1896 to 1900 was :—

Agri- culture.

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URUGUAY

Year.

Wheat.

Flour.

Maize.

Tons.

Tons.

Tons.

1896

6,390

17,714

89,895

1897

12,548

11,454

1,377

1898

77,231

11,296

12,575

1899

62,673

20,726

10,926

1900

39,871

18,128

485

Since 1890 the cultivation of the grape and the manufacture of wine have considerably extended, especially in the neigh- bourhood of Salto. The number of vineyards in 1898 was 824 ; the produce disposed of was returned as 4,498,900 lb of grapes sold as fresh fruit, and 11,786,000 lb made into wine. The quantity of wine manufactured was 710,100 gallons of red and 27,200 gallons of white. Grape alcohol to the amount of 5320 gallons, and 2050 gallons of wine alcohol, were also produced. The olive-planting industry is becoming important ; the trees thrive well, and the area devoted to their cultivation is annually increasing.

Cattle-breeding and sheep-farming, however, are the principal industries in Uruguay. In 1899 the number of cattle in the republic was 5,218,948, as shown by returns in the annual statistical report. The lands are admirably adapted for cattle- breeding purposes, although not capable of fattening animals. The cattle are destined chiefly for the salade.ro establishments for the preparation of tasajo, or jerked beef, for the Brazilian and Cuban markets, and for the Liebig factory, where very large quantities of extract of meat are prepared for the European trade. The total number of animals slaughtered in these establishments in the season 1900 was 698,900. In the southern districts, where the farmers are Europeans, the breed of cattle is being steadily improved by the introduction of Durham and Hereford bulls. Dairy-farming is making some progress, especially in the Swiss colony near San Jose.

In 1899 Uruguay contained 15,111,739 sheep, and the industry of sheep-farming was in a very flourishing condition. Uruguayan wool is favourably regarded in foreign markets, on account of the clean state in which it is shipped, this being largely due to the natural conditions of the land and climate. In 1900 the quantity of wool exported was 26,755 tons. The business of shipping live sheep and frozen mutton has not yet been attempted on a large scale, owing principally to the lack of facilities for loading at the port of Montevideo or elsewhere.

Minerals are known to exist in the northern section of the republic, and gold-mining is carried on to a small extent. At Cunapiru some foreign capital has been invested in mining undertakings, but not with very satisfactory results up to the present time. Expert opinions have, however,

been advanced stating that the gold-mining industry in Uruguay can be made to yield dividends when the work is conducted under competent direction. In 1895 the output of gold was 1965 ounces ; in 1898, 2402 ounces ; in 1900, 2290 ounces. The other minerals found are silver, copper, magnesium, and lignite coal.

The economic development of Uruguay has been retarded by the corruption of successive governments, by revolutionary out- breaks, by the seizure of farm stock, without adequate commerce. compengation, for the support of military forces, by the consequences of reckless borrowing and over-trading in 1889 and 1890, and also by .the transference of commercial under- takings from Montevideo to Buenos Aires between 1890 and 1897, on the opening of the harbour and docks at that port. The annual value of the imports and exports in 1889 and in later years (4‘7 dollars taken at £1) was as follows : —

Year.

Imports.

Exports.

1889

. £7,834,860

£5,522,150

1891

. 4,037,110

5,744,310

1899

5,458,000

7f781,750

1900

. 5,101,740

6,257,600

1901

. 5,040,800

5,900,240

The principal imports consist of machinery, textiles, and clothing, food substances and beverages, and live-stock. The chief exports are animal products, £5,660,900, and agricultural products, £355,200 in 1900. Of the imports, 27 per cent, in value are from Great Britain, 14 per cent, from Germany, and smaller proportions from France, Argentina, Italy, Spain, the United States, and Belgium. Of the exports, Brazil takes 26 per cent., Belgium 17 per cent., and France 16 per cent. Trade is controlled by foreigners, the British being prominent in banking, finance, railway work, and the higher branches of commerce ; Spaniards, Italians, and French in the wholesale and retail trade. Uruguayans find an insignificant place in commerce. The foreign trade passes mainly through Montevideo, where the port is being imnroved. Maldonado is the only deep-water port.

and com- munica- tions.

At Montevideo in 1900 there entered from abroad 1206 vessels of 2,318,954 aggregate tonnage, and cleared 1033 of 2,052,723 tons. In the coasting trade 2020 vessels of 507,110 „.. , tons entered and 2063 of 508,986 tons cleared at f^ the port. The mercantile shipping of the republic in the same year consisted of 23 steamers aggregating 7036 tons net, and 58 sailing vessels of 15,848 tons. The rivers and streams belonging to or bordering on the re- public supply easy means of communication. There are about 2240 miles of national road, besides departmental roads. The railways have a length of 1080 miles open for traffic, and 155 miles were under construction in 1899. At the end of 1898

the capital outlay on the railways amounted to £11,150,857, of which £5,750,000, representing 882 miles, had a Government guarantee of 3£ per cent. There are 100 miles of tramway in operation. In 1900 there were 692 post offices, through which altogether 11,124,500 letters and postcards passed during the year. The telegraph lines had a length of 4598 miles (including 1058 miles of railway telegraph) ; they were served by 101 offices, through which passed 397,493 messages. In the same year there were two telephone companies, with altogether 9824 miles of wire and 3968 subscribers.

The Bank of the Republic was established in 1896 with a nominal capital of $12,000,000, and in 1899 it received the right to issue further shares amounting to $5,000,000. Its note issue, $5,034,426 in 1900, may not exceed fc«<»«- the value of half the subscribed capital. There are 3 other banks of issue with an aggregate capital of $8,070,000, and there are 4 foreign banks.

There is no Uruguayan gold coin in circulation, but the theoretical monetary unit is the gold peso nacional, weighing V697 grammes, "917 fine. The silver peso weighs 25 grammes, •900 fine. The silver in circulation is estimated at 2,000,000 pesos.

The metric system of weights and measures has been officially adopted, but the old Spanish system is still in general use.

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Uruguay. Bureau of the American Republics, Washington, 1892. — United States Consular Reports. Washington. — British Foreign Office Diplomatic and Consular Reports. London. — The Uruguay Republic : Territory and Con- ditions. Reprinted by authority of the Consul -General of Uruguay. London, 1888.

Recent History. — Tile history of Uruguay between 1875 and 1900 was the history of revolutions and con- spiracies, of bloodshed and anarchy, the struggle of one side to obtain possession of the administration and of the other to defend themselves against these aggressive movements. The two great political factors for genera- tions past have been the Colorados and the Blancos. So far as political principles are concerned, there is small difference between them. Men are Colorados or Blancos because their fathers and grandfathers were so before them, and not from any political convictions. The Colorados have held possession of the Government for many years, and it has been on account of the attempts of the Blancos to oust them from office that the country has been plunged into a series of revolutions. It should be stated, however, that the military element has been at the bottom of many of the conspiracies to compel this or that President to resign in order that his place might be filled by somebody more amenable to the demands of the army for additional preferment and a larger share in the official plunder pertaining to the administration.

In 1875 General Latorre headed a conspiracy against

President Ellauri, overthrew the administration, and obtained the resignation of the President. General Latorre then placed Dr Varela in power as dictator, but afterwards became dissatisfied with this arrangement. On 8th March 1876 he deposed Varela and proclaimed him- self dictator. In the following year Latorre caused himself to be elected President, but political unrest in all sections of the republic made his position untenable, and he resigned office in March 1880. The president of the senate, Dr Vidal, nominally administered the Government for two

years, when General Santos, who practically had held the real power, became President. His administration was so vicious and tyrannical that the Opposition organized a revolutionary movement through- out the country. Their forces, however, were surprised by the Government troops at Quebracho, on the Eio Negro, and totally defeated. Ultimately the Colorados them- selves determined that Santos should be deprived of his power, and a decree exiled him from the country. During his administration the national revenues were plundered to supply him with the means of extravagant living, and there was no attempt at government according to the constitution of the republic. The Colorados now placed General Tajes in power as President, the practical direction of the administration being in the hands of Dr Julio Herrera y Obes. In March 1890 General Tajes handed over the Presidency to Dr Herrera y Obes, a clever but unscrupulous man, who filled every official post with his own friends without any regard for their capacity to discharge the duties allotted to them. He also took care that none but supporters of himself should be returned to the Chamber of Eepresentatives, thus stifling all opposition to the official corruption which prevailed. Meanwhile the Blancos were re- organizing in order to be in a position to strike when the opportunity offered. In 1891, in consequence of the corrupt administration, President Herrera y Obes was obliged to suspend the service of the public debt and make arrangements by which the bondholders accepted a very much reduced rate of interest. The country was at this period, to all intents and purposes, con- ducted as if it were the private estate of the President. No accounts of revenue or expenditure were vouchsafed to the public, and Congress authorized any measures Herrera y Obes thought fit to propose. In 1894 the Colorados nominated Senor Idiarte Borda for the Presidency.

Senor Borda at first gave the impression of being inclined to make a determined attempt to respect civil rights and honestly discharge the duties of his office. Before long, however, it was clear that the evil influences surrounding him had caused a change in his attitude. Corruption was as marked as under the preced- ing regime. The Blancos, using the fraudulent elections in 1896 as a pretext, now broke out in armed revolt under the leadership of Aparicio Saraiva. The President made no attempt to conciliate them, and in March 1897 a body of

Government troops suffered a reverse. All this added greatly to the prestige of the revolt, and discontent began to spread rapidly through the country. On 25th August 1897 President Borda attended a Te Deum at the cathedral in Montevideo. As he was walking through the crowded square in which the cathedral stands a man named Arredondo fired at and killed him. Arre- dondo was tried at the end of July 1899 and sentenced to two years' imprisonment. The defence was that the murder was a political offence, and therefore not punish- able as an ordinary case of assassination for purposes of revenge or other personal motives.

The president of the senate, Senor Juan Cuestas, in

accordance with the terms of the constitution, assumed the duties of President of the Republic after the death of Idiarte Borda. No sooner was the new chief magistrate installed in office than he set about making some agree- ment with the insurgents in order to restore peace. Ultimately it was arranged that hostilities should cease on the conditions that representation of the Blancos was allowed in Congress from certain specified districts where they were known to predominate as regards eligible voters ; that a certain number of the jefes politicos should be nominated from the Blancos ; that free pardon be extended to all who had taken part in the revolt ; that a sufficient sum in money be advanced to allow the settle- ment of the expenses contracted by the insurgents ; and that the electoral law be reformed on a basis allowing the people to take part freely in the elections for the Chamber of Representatives. These terms were accepted by Congress, and the insurrection thus came to an end. It must be noted, however, that the Blancos openly stated that they intended to continue organizing in order to accomplish their object of turning the Colorados out of office by force of arms.

The task now before President Cuestas was a difficult one. It was necessary to reduce the chaotic condition of the administration to something approaching order. The military element began to find themselves shorn of many of the privileges they had formerly enjoyed, and civil officials were no longer allowed the freedom in their departments that in former days had permitted corrupt practices with impunity. In February 1898 President Cuestas, finding that the attitude of

Congress tended to provoke another revolutionary outbreak on the part of the Blancos, determined upon strong measures to maintain peace. On the 10th of February he assumed dictawjrial powers, dissolved the Chambers, and suspended all con- stitutional guarantees. In normal circumstances the Presidential election should have been held on 1st March 1898, but it was impossible in consequence of the action taken by Senor Cuestas. In the following year Congress was convoked in February, President Cuestas then resign- ing his office, and being re-elected to the Presidency on 1st March 1899. (w. w. r.; i. p. a. r.; c. e. a.)

Uruguay River. See Plate River.

Uryupina., a Cossack village of Russia, chief town of a district in the province of the Don Cossacks, on the left bank of the river Khoper, 234 miles by rail from Tsaritsyn. It has a great fair for cattle, hides, and sheepskins, which are exported, and all sorts of manu- factured goods, which are imported ; it is estimated that the turnover at this fair is not less than from £600,000 to £1,000,000. A considerable trade is also carried on in grain and animal products. Population (1897),

9612.

Ushak, a town of Asia Minor, altitude 3160 feet, in the Kutaya sanjak of the Brusa vilayet, situated in a fertile district, on a tributary of the Mendere, and con- nected with Smyrna and Konia by rail. It is noted for its heavy pile carpets, hhali, known as " Turkey carpets." The Oriental character of the carpets has been almost destroyed by the adoption of aniline dyes and the intro- duction of Western patterns. The town has a trade in valonea, cereals, and opium. The population consists of 9000 Moslems and 2000 Christians.

Usk, Thomas (died 1388), is a name which was first added to the history of English literature in 1897 by Mr Henry Bradley's discovery that The Testament of Love, an important prose work hitherto attributed to Chaucer, bore in the initial letters of its chapters a

~~statement of authorship — " Margaret of virtue, have mercy on thine Usk." By the light of this perception, various autobiographical statements became luminous, and there remained no possible doubt that the author was Thomas Usk, who was clerk of the closet to John of Northampton when he was mayor of London from 1381 to 1383. In July 1384 Usk was seized and put in prison, but was released on promise of bringing charges against the mayor. Usk had no wish to be what he called " a stinking martyr," and he freely produced evidence which sent John of Northampton to gaol. For this he was not forgiven by the Duke of Gloucester's party, although he continued to hold confidential posts in London until the close of 1386, when he was appointed sub-sheriff of Middlesex. But he fell with the king, in the triumph of the Duke of Gloucester, and on the 3rd of February 1388, Usk, among others, was tried for treason and condemned. He was sentenced " to be drawn, hung, and beheaded, and that his head should be set up over Newgate." Higden gives a horrid description of his execution, which occurred on the 4th of March 1388, in circum- stances of rude barbarity ; it took thirty blows of a sword to sever Usk's head from his shoulders. Professor Skeat has shown that the date of his book must be about 1387, for in it he reviews the incidents of his career, including the odd facts that, after his first imprisonment in 1384, he challenged any one who " contraried " his " saws " — that is to say, denied his allegations, to fight, but that no one took up his wager of battle. From 1381 to 1383, while Chaucer was comptroller of customs, Usk was collector, and they were doubtless acquainted. In The Testament of Love, the god is made to praise " mine own true servant, the noble philosophical poet in English," who* had composed " a treatise of my servant Troilus." Usk had at one time been a Lollard, but in prison he submitted to the Church and thought he was forgiven. His solitary work is remarkable, and the most elaborate production in original English prose which the end of the 14th century has bequeathed to us. It is, however, excessively tedious, and of its obscurity and dulness a very amusing proof is given by the fact that succes- sive editors — and even Mr Bradley and Professor Skeat — did not discover till too late that the leaves of the original MS. had been shuffled and the body of the treatise misarranged. No MS. of The~~

~~Testament of Love has been preserved ; it was first printed by Thynne in 1532. In 1897 Professor Skeat, with cancelled sheets to cover the unlucky mistake above referred to, issued a revised and annotated text in his Chaucerian and other Pieces. (e. g.)~~

~~Uskub, chief town and seat of government of the province (vilayet) of Kossovo, Turkey, comprising all North Albania. It has a population of 40,000, of whom about two-thirds are Albanian Mahommedans. The population has doubled since 1875, owing to the stimulus which trade has derived from the two railways, by one of which Uskub is connected with Mitrovitza, and by the other with Servia on the one hand and Salonica on the other. The imports (valued at £386,200 in 1900) consist principally of metals, woollen and cotton piece-goods, soap, leather, &c. The district produces and exports opium, cereals, fruits, tobacco, skins, and silk. Sericulture, under the encouragement extended to it by the Administration of the Public Debt, is increasing year by year, as it also is in the adjacent vilayets of Monastir and Salonica. Uskub also exports horned cattle and sheep. The butchers of Constantinople take annually over 200,000 head of these sheep. The total export trade was valued at £529,100 in 1900. The vilayet of Kossovo~~

~~has considerable mineral resources, but the Government does nothing to promote their development. Its pastoral industry is still very far from having attained full growth. It is capable of much further expansion owing to the wide extent of pasture-land in the province, and to a fluvial system which makes water everywhere abundant. '~~

~~Ust-ByelOkalitvenskaya, a Cossack village of Kussia, in the province of the Don Cossacks, at the junction of the northern Donets with the Kalitva. Quarries of good sandstone (Chalk), largely used for buildings, are close by, and there is a lively trade in grain and cattle. Population (1897), 18,039.~~

~~Ust-Kamenogorsk, a district town of Eussian Central Asia, in the province and 135 miles south-east of the town of Semipalatinsk, on the right bank of the Irtysh, at its junction with the Ulba, and on the highway to Bukhtarma. It is a prairie town that has grown rapidly, on account of~~

the development of trade in cattle and various raw products. Population (1897), 8958.

Ust-Khoperskaya, a Cossack village of Eussia, in the province of the Don Cossacks, at the junction of the Khoper with the Don. It is an agricultural town, and carries on an active trade in grain and cattle. Popu- lation (1897), 12,324.

Ust-Medvyeditsa, a Cossack village of Eussia, in the province of the Don Cossacks, of one of the districts of which it is the chief town, on the right bank of the Don, near its confluence with the Medvyeditsa, 63 miles from the Tsaritsyn railway station, Sebryakovo. Its trade in grain, formerly very active, has decreased, but its fairs have still importance for trade in horses and cattle. There is a military technical school. Population

(1897), 15,999.

Ustyugf Velikiy, a district town of Eussia, in the government of Vologda, 303 miles from the capital of the province, on the navigable Sukhora river, near its junction with the Yug. It carries on an active trade in corn, hemp, flax, bristles, and butter, which it exports. Its two yearly fairs are very animated, and the movement of the port is represented by some 350 vessels (about 20,000 tons) and over 200 rafts (3500 tons) entering, and as many vessels leaving. It has a gymnasium for girls, and two middle schools, and is well provided with primary schools. Its artisans are famous for their jewellery, for engraving upon silver, and the fabrica- tion of boxes with secret locks. Population (1897),

11,309.

Utah, a western state of the American Union. The progress of the state during the closing decade of the 1 9th century was both rapid and substantial. In 1880 the population was 143,963 ; in 1890 it was 207,905, of whom probably four-fifths were Mormons and nearly one-third of foreign birth. The population in 1900 was 276,749, of whom about two-thirds were Mormon. Of the total population 141,687 (51-2 per cent.) were males and 135,062 (48-8 per cent.) females ; 222,972 were native-born and 53,777 (19‘4 per cent.) foreign-born; 272,465 were white and

4284 (1‘5 per cent.) coloured, of whom 672 were negroes, 572 Chinese, 417 Japanese, and 2623 Indians. The gain in population for the decade 1890- 1900 was 33‘1 per cent., as compared with 44”4 per cent, for the ten years preceding.

The total land surface yf Utah is approximately 82,190 square miles, so that the density of population was, in 1890, 2‘5, and in 1900, 3‘4 persons to each square mile. There were, in 1900, 66 incorporated cities and towns, of which 18 had more than 2000 inhabitants, 4 had more

than 5000, namely, Salt Lake City with 53,531, Ogden with 16,313, Provo City with 6185, and Logan with 5451 inhabitants.

Political History: the Mormon, Question. — From the settlement of the Territory to 1890, the People’s party, composed of members of the Mormon Church, had entire political control. During this period the Liberal party, composed of Gentiles and apostate Mormons, had been constantly gaming in strength, and in 1889 and 1890 they elected the mayors of Ogden and Salt Lake, and also secured control of the public schools in these cities. On 24th September 1890 President “Woodruff of the Mormon Church issued the celebrated Anti-Polygamy Manifesto, in which he said : ” We are not teaching polygamy or plural marriage, nor permitting any person to enter into its practice. . . . And I now nublicly declare that my advice to the Latter Day Saints is to refrain from contracting any marriage forbidden by the law of the land.” This was read to the Mormon Conference, 6th October 1890, and by it unanimously sustained, on the motion of Lorenzo Snow (at that time president of the quorum, and on the death of President Woodruff, 2nd September 1898, elected President of the Mormon Church), in these words : “I move that, recognizing Wilford Woodruff as the president of the Church of Jesus Christ of Latter Day Saints, and the only man on the earth at the present time who holds the keys of the sealing ordinances, we consider him fully authorized by virtue of his position to issue the manifesto which has been read in our hearing, and which is dated

September twenty- fourth, 1890, and that as a church in general conference assembled, we accept his declaration concerning plural marriage as authori- tative and binding." This was accepted by the Gentile element as having been made in good faith, and as being the beginning of the end of the strife which had existed for years. Accordingly, the Liberal and People's parties were disbanded in 1893, and the two great national political parties organized in place thereof. Following these events, a petition was presented to the President of the United States by the authorities of the Mormon Church, asking amnesty and a removal of the political disabilities which had been put by Congress upon the Mormon people. This petition was endorsed by the Governor of the Territory and by the Chief Justice of the United States Court. On 4th January 1893 Presi- dent Harrison issued his proclamation granting ' ' full pardon to all persons liable to the penalties of the Tucker-Edmunds Act, who, since 1st November 1890, have abstained from unlawful cohabita- tion, but upon the express condition that they shall in the future faithfully obey the laws of the United States hereinbefore named, and not otherwise." During the years 1885-95 much personal and real property belonging to the Mormon Church had been escheated to the United States. This action was not instigated by the Gentiles — in fact, it was editorially opposed by the leading Gentile newspaper. It was the result of an Act of Congress designed to check the growing practice of unlawful cohabita- tion. After the manifesto was issued, this escheated property was returned to the Mormon Church with the hearty approval of the Gentiles.

Admission to Statehood: Recent Events. — Two propositions looking to the future good of the Territory were advocated. Home Rule was suggested by the Democrat and Statehood by the Republican party. In 1895 Congress passed an enabling Act, under which the constitution was prepared and adopted by the people. This con- stitution, in its third article, provides that polygamy shall be for ever prohibited, and, in addition, that this particular article shall never be repealed, ' ' except by the consent of the United States and the people of the state." It also gives the right of suffrage to women. In the autumn of 1895 the entire Republican state ticket was elected. By proclamation of the President, Utah was ad- mitted to the Union as the forty-fifth state on 4th January 1896. One of the first

~~acts of the Legislature was to declare legitimate all children born of polygamous marriages prior to 4th January 1896, thus enabling them to inherit from their fathers under the law.~~

~~About this time it was alleged, as had been frequently the case, that the Mormon Church was dictating to its members in political matters. The ground for the charge was a regulation of the Mor- mon Church that members holding offices of responsibility in the Church who desired political offices should take counsel of the Church authorities and receive permission before becoming candidates. For failing to do this an apostle, who was a Demo- cratic candidate for the United States Senate in 1897, was deprived of his apostleship and all offices in the Church. This charge of dictation was promptly denied by the first Presidency (consisting of the President and his two counsellors) in a manifesto presented at the Conference in April 1896, which was confirmed by a vote of the Conference, thus committing the Church. With this declaration all public strife between Gentiles and Mormons ceased, mutual good-feeling prevailed, and the state continued to grow and prosper. In 1897 the Jubilee Festival, commemorat- ing the coming of the Pioneers, was observed with the greatest~~

~~Educa- tion.~~

~~enthusiasm. Gentiles and Mormons vied with each other in making it a success. This harmony continued until 1898, when, a Mormon, B. H. Roberts, who had been elected to the National House of Representatives by the Democrats, was publicly charged with living in unlawful cohabitation with three wives, one of whom had been taken since the promulgation of the manifesto. Certain officials of the Mormon Church were also charged with the same offence and were arrested. Some pleaded guilty, and were fined ; others pleaded not guilty, and were tried and convicted. The charge against the member of Congress aroused the opposition of the entire country. By an overwhelming majority he was refused a seat in Congress. The vacancy was filled by the election of another Mormon, and the agitations relative to Mormonism ceased. On the return of the excluded member he was indicted for unlawful cohabitation, and on an agreed statement of the facts the case was~~

~~*submitted to the jury. A verdict of guilty was returned and a fine was imposed. On a technicality the case was appealed to the Supreme Court and afterwards dismissed because of a decision in a similar case, which would have meant a reversal of the decision of the lower court in this case.*~~

~~*In the Presidential election of 1896 Mr McKinley (Republican) received 13,484 votes, and Mr Bryan (Democrat) 64,517 votes. In the Presidential election of 1900 the same candidates received respectively 47,139 and 45,006 votes.*~~

~~*From 1867 onwards parochial schools had been established in a number of towns by the Episcopal Church and by several other Christian denominations. They trained a number of young people in habits of independent thinking, as is evidenced at each election by the Independent vote, and thus prepared the way for the adoption of a more advanced system of public instruction. In 1890 they were superseded by a public school system. The newly elected public school boards entered upon a vigorous policy of administration, excluding all sectarian instruction, and securing the best teachers to be found. New, large, and convenient school buildings were erected throughout the Territory, and the people took a keen interest in public school education. In 1900 there were 659 schools with 1395 teachers, and more than 70,000 children were in attendance. In 1900 the number of persons of school age (five to twenty years inclusive) was 106,513 ; and out of 67,172 adult males 2470 (3‘7 percent.) were illiterate (unable to write).*~~

~~*The State University, agricultural college, normal school, and school of mines, supported by taxation, and aided by generous legislative grants, have a teaching staff of 60, and an attendance of upwards of 1000 students. The state reform school is situated at Ogden, and the asylum for the care of the insane at Provo City.*~~

~~*The year 1890, which brought the anti-polygamy manifesto and the public school system, brought also a very decided industrial revival. Real estate advanced in price, and in the larger ... towns numerous public and private improvements were ““‘us”y• made. The chief business of the state, apart from agriculture, is mining. In 1899 the export value of the precious*~~

metals was $12,000,000, that of gold being $3,500,000. Coal mining has grown to be a very important industry. The output of 860,000 tons in 1899 was an increase of nearly 50 per cent, over that of 1898. The mining of lead has also increased to such an extent that in 1899 the output was 13 per cent, of the total output of the United States. In 1894 official statistics showed that there were 3^ million acres of irrigable land in the state, and that there were some 500, 000 acres under cultivation. These lands are divided into small farms owned largely by contented and prosperous Mormon farmers. Only 11 per cent, of these farms were at that time subject to mortgage indebtedness. There has also been a steady and decided increase in the value of cattle, sheep, and hogs. The chief agricultural products are alfalfa, wheat, oats, and barley. The sugar-beet industry has greatly developed. Two large sugar fac- tories have been erected at Lehi and at Ogden. Canneries for fruits and vegetables (numbering eight in 1 900), as well as many small factories of different kinds, have been built. The manu- factures of the state are largely an outgrowth of its agricultural development. Under the head of "flouring and grist mill pro- ducts " 80 establishments were reported in 1900, with a capital of $1,101,885 and products valued at $1,829,840 ; under "beet sugar and molasses," 3 establishments, with a capital of $1,789,370 and products of $1,037,355 ; under "cheese, butter, and condensed milk (factory product)," 57 establishments, with a capital of $269,247 and products of $713,889.

Finances,

were $120,790,250. The increase in the sale of real estate in Salt Lake City in the same year was 1J million dollars. In 1890 1090 miles and in 1900 1600 miles of railway were in operation.

(A. Le.)

Uta.ka.ma.nd, or Ootacamtjnd, a town of British India, administrative headquarters of the Nilgiris district in Madras, 32 miles by road from the

Mettapolliem station on the Madras Railway. Population (1881), 12,335; (1891), 13,991; municipal income (1897-98), Rs. 2,40,050. It is the principal sanitarium of southern India, and summer headquarters of the Madras Government, and is placed on a plateau about 7230 feet above the sea, with a fine artificial lake, and mountains rising to above 8000 feet. The mean annual temperature is 58°, with a minimum of 38° in January and a maximum of 76° in May ; average annual rainfall, 45 inches. The houses are scattered on the hillsides amid luxuriant gardens, and there are extensive carriage drives. In the neighbourhood are plantations of coffee, tea, and cinchona. It is pro- posed to extend the rack railway on the metre gauge from Coonoor. There is a brewery, with an output of 200,000 gallons a year, and two dairy farms. The Lawrence asylum for the children of European soldiers, founded in 1858, had 307 boys and 65 girls in 1896-97; the Breeks memorial and Basel mission high schools had 151 pupils in the same year. There are two printing-presses, one of which issues an English newspaper. The library and reading-room has some 300 members and an annual income of Rs.7660.

Utica, a city of New York, U.S.A., capital of Oneida county, on the south bank of the Mohawk river, in the central part of the state, at an altitude of 410 feet. It is divided into fifteen wards, is excellently paved, mainly with asphalt, has a fine water-supply, and is thoroughly sewered. Utica is well provided with transportation facili- ties ; it is on the Erie canal, and has four railways — the Delaware, Lackawanna, and Western ; the New York Central and Hudson Biver ; the New York, Ontario and Western ; and the West Shore, with lines in all directions. In 1900 there were 733 manufacturing establishments, with a total capital of $19,289,502. They employed 10,759 hands, and the product was valued at $19,550,850. The principal articles of manufacture, with their values, were clothing, $2,585,927 ; steam fittings, $1,204,693 ; foundry and machine-shop products, $1,101,826 ; hosiery and knitted . goods and boots and shoes, $2,514,073. The assessed valuation of real and personal property in 1900 was $41,108,660; the net debt was $672,911, and the rate of taxation $24.32 per $1000. The total income, exclusive of loans, was $897,641, and the expenditure for maintenance and operation $690,192. Population (1890), 44,007; (1900), 56,383, of whom 13,470 were foreign- born and 244 negroes.

~~*Utiel, a town of Spain, province of Valencia, to the north-west of Bequefia, and to the south of the Sierra of Aledua, near the Bio Magro, with a station on the railway from Valencia to Cuenca. The local brandies have some fame, and the surrounding country chiefly produces good wines, cereals, esparto grass, and sapan. There is a large parish church, and there are good' primary nchools, a theatre, and bull-ring. Population (1897), 11,465.*~~

~~*Utrecht, a Dutch province between Gelderland on the E., and North and South Holland on the W., the smallest of the eleven provinces in size, but the second in respect of fertility of soil and density of population. The sandy and hilly land in the east of the province is (6 per cent.) uncultivated, yet the edge of this tract near the clay*~~

~~*is sprinkled with thriving villages busied with agriculture and the rearing of stock — such as Amerongen, Leersum, Doom, Driebergen, and Zeist. The flatter and more fertile region west of the Kromme Bijn and Vecht, north of the Oude Bijn, and east of the Vecht in the north-east of the province, supports a population of 100 to 200 per square kilometre, against 50 to 100 in the east sandy district. This population is grouped in villages along the Vecht (Maarssen, Breukelen, Loenen, Vreeland), and small old towns on the Bhine and Hollandsche Yssel (Wyk-by- Duurstede, Ysselstein, Montfoort). The development of these towns is, however, rigorously limited by the rise of the capital, Utrecht, and the decay as waterways of the Bhine, Yssel, and Vecht. Population (1886), 212,454;*~~

~~*(1901), 254,867.*~~

~~*Utrecht, the capital of the above province, and the fourth town of Holland. It is an important rail- way junction, with two railway stations, 22 miles by rail south-south-east of Amsterdam. The town is not, how- ever, a commercial centre, as the Oude and Kromme Bijn, on which it is situated, are, though canalized, available only for small craft. The new waterway, moreover, from Amsterdam to the Lek (the Merwede canal) avoids Utrecht, although by means of the Keulsche Vaart the town has a connexion with the Merwede. Its university (over 50 professors, 824 students, and a library of over 200,000 volumes) was in 1894 enlarged by a building in the Early Benaissance style. Its veteri- nary school is the*~~

only one in the kingdom. A meteoro- logical observatory has been set up near Utrecht in the village of De Bildt. Population (1887), 79,166; (1901),

114,194.

Uttarpara, a town of British India, in the Hocghly district of Bengal, situated on the river Hooghly. Popu- lation (1881), 5307 ; (1891), 6489. It is famous for the public library founded and endowed by Jai Krishna Muk- harji, which is specially rich in books on local topography. There is an aided college, and a girls' school supported by a native association.

Uttoxeter, a market town and parish, in the Burton parliamentary division of Staffordshire, England, 15 miles north-east by east of Stafford by rail. Large works for the manufacture of agricultural implemeiits employ over 400 men. It was in the market-place here that Dr Johnson stood hatless in the rain doing voluntary penance for disobedience to his father. A bas-relief commemorates the incident. Population

(1901), 5133.

Uxbridge, an ancient borough and market town, in the Uxbridge parliamentary division of Middlesex, England, with a station on a branch of the Great Western Bailway. Since 1804 it has been governed by an urban district council. Area, 862 acres. Population (1901),

8585.

Uzes (Lat. Ucetia), a town of France in the depart- ment of Gard, and capital of an arrondissement of the same name. It is beautifully situated on an eminence above the Alzon, on the Paris, Lyons, and Mediterranean Bailway, 12 miles north-east of Nimes. It was an Episco- pal see from the 10th to the 17th century, when (in 1611) its cathedral, remains of which are still to be seen, was destroyed. Uzi'-s has some fine mediaeval buildings, notably the palace (L^ Duehe), and a clock-tower (Fdne-strelle) ; also a statue of Admiral Brueys, who fell at the battle of the Nile. There are extensive manufactures of silk, and a lively trade in wine and olive-oil. Population

~~(1901), 4060.~~

~~VAALPENS- VACCINATION~~

~~Vaalpens. See Bushmen.~~

~~Vacci nation is the term originally devised for a method of protective inoculation against small -pox, Hist rv consisting in the intentional transference to the human being of a disease of cattle called cow pox. The discovery of vaccination is due to Dr Edward Jenner, at the time a country medical practitioner of Berkeley, in the vale of Gloucester, whose investigations were first published in 1798 in the form of a pamphlet entitled An Inquiry into the Causes and Effects of the Variolas Vaccinae, &c. Many years previously, while he was an apprentice to a medical man at Sodbury, near Bristol, his attention was directed to a belief, widely prevalent in Gloucestershire during the latter half of the 18th century, that those persons who in the course of their employment on dairy farms happened to contract cow-pox were thereby protected from a subsequent attack of small-pox. In particular, his interest was aroused by a casual remark made by a young countrywoman who happened to come to the surgery one day for advice, and who, on hearing mention made of small-pox, immediately volunteered the statement that she could not take the disease, as she had had cow-pox. On coming up to London in 1770, to finish his medical education, Jenner became a pupil of John Hunter, with whom he frequently discussed the question of the possibility of obtaining protection against small-pox. On his return to his native village of Berkeley in 1773, to practise as a medical man, he took every opportunity of talking over and investigating the matter, but it was not until May 1796 that he actually began to make experiments. His first case of vaccination was that of a boy eight years of age, whom he inoculated in the arm with cow-pox matter taken from a sore on the hand of a dairymaid, who had become infected with the disease by milking cows suffering from cow-pox. It was apparently not until 1798 that he made his first attempt to carry on a strain of lymph from arm to arm. In the spring of that year he inoculated a child with matter taken directly from the nipple of a cow, and from the resulting vesicle on the arm of the child first operated upon, he~~

~~inoculated, or, as it may now be more correctly termed, "vaccinated," another. From this child several others were vaccinated. From one of these a fourth remove was successfully carried out, and finally a fifth. Four of these children were subsequently inoculated with small-pox — the "variolous test" — without result. The success of many such experiments, in his own hands and in those of his contemporaries, led Jenner to express his belief — a mistaken one, as events have proved — that the protective influence of vaccination would be found to last throughout the lifetime of the person operated on. Obviously he did not realize the fact that the data at his disposal were insufficient for the formation of an accurate judgment on this point, since time alone could prove the exact duration of the protection originally obtained. Subsequent experience has demonstrated that, as has been well said by a writer in the Edinburgh Review, "even after efficient vaccination a slow progress away from safety and towards danger is inevitable, and re-vaccination at least once after childhood is necessary if protection is to be maintained."~~

~~In applying to cow-pox the term "variolse vaccinas," Jenner gave expression to his belief that this disease was in reality nothing more nor less than small-pox shit'of"' °^ *he cow. But soon it was discovered that if varMa there were such a malady as " small-pox of the and cow," there was also, as Dr Loy first satisfactorily~~

~~vaccinia.~~

~~time as a source of vaccine lymph. Jenner had, indeed, put forward the suggestion that " grease " was a necessary antecedent to cow-pox ; but even taking this term to have been used by him in the sense of horse-pox, he was, in all probability, mistaken in his assumption. At the same time, however, there can be little doubt that these two diseases are very closely allied, if indeed they be not identical. As evidence of a definite relationship between human small-pox and cow-pox, it may be mentioned that whereas, prior to the introduction of vaccination, epidemics of these disorders frequently arose concurrently, the so- called " natural " cow-pox has now in great measure disappeared. There is, moreover, no appreciable difference in the minute anatomical appearances characteristic of the eruption following on inoculation of one or other of~~

these two affections in the human subject. But of far greater importance in this connexion are the results obtained by numerous observers who, in various parts of the world, and almost from the time of Jenner onwards, have set themselves the task of attempting, by experimental methods, to solve the problem of the true relationship of variola to vaccinia. As the outcome of this work it may now be definitely stated that small-pox lymph, more especially, as the writer has shown, if obtained from the primary vesicle of a case of the inoculated form of the disease, by passage through the system of the calf can be so altered in character as to become deprived of its power of causing a generalized eruption, while inducing at the site of inoculation a vesicle indistinguishable from a typical vaccine vesicle ; and, more important still, that when transferred again to man, it has by such treatment completely lost its former infectious character. Such being the case, it may fairly be asserted that cow-pox, or rather that artificially-inoculated form of the disease which we term vaccinia, is nothing more nor less than variola modified by transmission through the bovine animal. An outbreak of small-pox, indeed, may be turned to account for raising, by appropriate experimental methods, a fresh stock of vaccine lymph.

There is much evidence to prove that the results follow- ing on vaccination are due to a specific contagium, and, moreover, that the particular micro-organism concerned is capable of existing, during one B*cte”m period of its life-cycle, in a resting or spore form, in which condition it is more resistant to the germi- cidal effects of glycerine than is the case with non-sporing microbes. Advantage is taken of this fact, in the method devised by the writer, and now employed officially in England, as also on the Continent and in America, for ensuring the bacteriological purity of vaccine lymph. Up to the present, unfortunately, no satisfactory method has been discovered by which the micro-organism of vaccinia can be unfailingly cultivated on artificial media while still retaining its specific properties.

The publication in 1896 of the final report of the Royal Com- mission on Vaccination, in which the various phases of the vaccina- tion question are discussed on the basis of evidence (

obtained from witnesses of all shades of opinion during j.aCC’J?a”

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a period extending over no less than six years, con- mjssjon

siderably simplifies the task of dealing with this subject. IS89-96. The Royal Commission, originally numbering fifteen members,1 with the late Lord Herschell as president, was ap- pointed in May 1889, the terms of reference being as follows : "To inquire and report as to — (1) The effect of vaccination in

1 The original Commissioners were — Lord Herschell, C. Bradlaugh, Dr Bristowe, Dr Collins, Sir C. Dalrymple, J. S. Dugdale, Q.C., Prof. M. Poster, Sir E. H. Galsworthy, Sir Guyer Hunter, J. Hutchinson, Sir James Paget, J. A. Picton, Sir "William Savory, S. Whitbread, F. Meadows White, Q.C. Mr Bradlaugh, Dr Bristowe, and Sir William Savory died during the progress of the inquiry. Only one of the vacancies thus caused was filled up, Mr J. A. Bright having been appointed on the death of Mr Bradlaugh.

reducing the prevalence of, and mortality from, small-pox. (2) What means, other than vaccination, can be used for dimin- ishing the prevalence of small-pox ; and how far such means could be relied on in place of vaccination. (3) The objections made to vaccination on the ground of injurious effects alleged to result therefrom ; and the nature and extent of any injurious effeots which do, in fact, so result. (4) Whether any, and, if so, what means should be adopted for preventing or lessening the ill effects, if any, resulting from vaccination ; and whether, and, if so, by what means, vaccination with animal vaccine should be further facilitated as a part of public vaccination. (5) Whether any altera- tions should be made in the arrangements and proceedings for securing the performance of vaccination, and, in particular, in the provisions of

~~the Vaccination Acts with respect to prosecutions for non-compliance with the law."~~

~~The evidence given before the Royal Commission was published at intervals in a series of Blue-books, but, as stated, it was not until August 1896 that the final report made its appearance. As regards the effect of vaccination in reducing the prevalence of, and mortality from, small-pox, the following conclusions were arrived at, Dr Collins and Mr Picton alone dissenting: "(1) That it diminishes the liability to be attacked by the disease. (2) That it modifies the character of the disease and renders it (a) less fatal, and (b) of a milder or less severe type. (3) That the protection it affords against attacks of the disease is greatest during the years immediately succeeding the operation of vaccination. It is impos- sible to fix with precision the length of this period of highest pro- tection. Though not in all cases the same, if a period is to be fixed, it might, we think, fairly be said to cover in general a period of nine or ten years. (4) That after the lapse of the period of highest protective potency, the efficacy of vaccination to protect against attack rapidly diminishes, but that it is still considerable in the next quinquennium, and possibly never altogether ceases. (5) That its power to modify the character of the disease is also greatest in the period in which its power to protect from attack is greatest, but that its power thus to modify the disease does not diminish as rapidly as its protective influence against attacks, and its efficacy, during the later periods of life, to modify the disease is still very considerable. (6) That re-vaccination restores the pro- tection which lapse of time has diminished, but the evidence shows that this protection again diminishes, and that, to ensure the highest degree of protection which vaccination can give, the opera- tion should be at intervals repeated. (7) That the beneficial effects of vaccination are most experienced by those in whose case it has been most thorough. We think it may fairly be concluded that where the vaccine matter is inserted in three or four places, it is more effectual than when introduced into one or two places only, and that if the vaccination marks are of an area of half a square inch, they indicate a better state of protection than if their area be at all considerably below this. "~~

~~Limitations of space render it impossible here to repro- duce the evidence, statistical or otherwise, on which these conclusions are based. For such~~

further information the Reports of the Eoyal Commission should be consulted. But reference may here be made to two facts of which proof is overwhelming. (1) Small-pox, in pre- vaccination days a disease of infancy and childhood — like measles at the present day — has in the United Kingdom become a disease mainly of adults. The shifting of age-incidence can only be accounted for by the custom of vaccination in infancy. To this day, when small-pox attacks young unvaccinated children, it is found to be as virulent as, or even more virulent than, small-pox in the unvaccinated at higher ages. On the other hand, small-pox is practically un- known among well-vaccinated children. When, quite exceptionally, such children have been attacked, the disease has been so trivial in character as to be liable to escape recognition altogether. (2) Medical men, nurses, and other persons exposed to the disease habitually protect themselves by efficient re-vaccination, and when this pre- caution has been taken, never contract small-pox.

The clinical activity and bacteriological purity of the

lymph employed for vaccination ; the skilful performance

of the operation itself ; the making an adequate

Efficient number of insertions of lymph over a sufficient

vficci ft *i ~

Hon. area > *ne observance of precautions needful for

ensuring strict asepsis, both at the time of

vaccination and subsequently until the vaccination wounds

are soundly healed — all these are matters to be regarded

as essential to " efficient vaccination." Certain principles in respect of them are generally recognized, and in the case of public vaccinators, whose work comes under Government inspection, a series of instructions on these several points are prescribed by the Local Government Board.

First in regard to lymph. That which is now almost universally employed in Great Britain is glyceri- nated calf lymph, the use of which has entirely super- seded, in public vaccinations, the arm-to-arm method which for many years previously had been employed as the best means then attainable of ensuring the activity and comparative purity of the lymph. Glycerinated lymph, under proper conditions, usually retains its potency for many weeks or months ; but nevertheless, in certain circumstances at present imperfectly understood, is liable to become gradually weakened, and even eventually to become altogether inert. Possibly the condition of the calves from which the lymph is obtained, especially as regards their general health and the suppleness or the reverse of their skins, or exposure of the lymph to the action of light or to a high temperature, are of special importance. Consequently, in order to ensure the best results from its use, it is not only necessary that great care should be exercised in its manufacture, but it is also advisable^ that the lymph should be employed for vaccina- tion as soon as possible after bacteriological examination has demonstrated its freedom from suppurative and other extraneous micro-organisms. As regards the carrying out of the operation itself, it is somewhat unfortunate that there exists no official definition of what constitutes a " successful vaccination," and in consequence it is open to any practitioner to give a certificate of successful vaccina- tion in cases where but one minute vesicle may have been produced. It is to be feared that such certificates are too frequently given, and it cannot be too strongly urged that vaccination of this sort involves incomplete protection. The standard laid down by the Local Government Board ■— the production, namely, of a total area of vesiculation of not less than half a square inch, divided among four separate vesicles or groups of vesicles, not less than half an inch from one another — has for the most part proved easily attainable in practice, and it is much to be desired that in private as in public work the attainment of this standard should be aimed at in every instance.

The protection afforded by a primary vaccination tends gradually to diminish, and eventually to disappear more or less completely, with the lapse of time. In consequence, it is desirable that the operation should be repeated at the age of from seven to ten years, and thereafter, if it be possible, at intervals during later life. The final report of the Royal

Commission thus summarizes the evidence as to the value of such additional procedure : —

"Where re- vaccinated persons were attacked by, or died from, small-pox, the re-vaccination had for the most part been performed a considerable number of years before the attack. There were very few cases where a short period only had elapsed between the re- vaccination and the attack of small-pox. This seems to show that it is of importance, in the case of any persons specially exposed to the risk of contagion, that they should be re- vaccinated, and that in the case even of those who have been twice re-vaccinated with success, if a long interval since the last operation has elapsed, the operation should be repeated for a third, and even a fourth time."

It not unfrequently happens that in the case of a re- vaccination the process runs a somewhat different course from that witnessed in a typical primary vaccination. In a successful re-vaccination, the site of operation may be distinctly reddened and somewhat irritable by the second day, while papules will probably make their appearance about the third to the fifth day. The papules may or may not develop further into vesicles and pustules. Occasionally a re-vaccination appears to fail altogether ;

but, as pointed out by the Royal Commission, it is advis- able, as in the case of a primary vaccination, to make further attempts with lymph of known potency before concluding that, the individual is really insusceptible.

In a certain small proportion of cases the operation of vaccination has been followed, after a longer or shorter

interval, by various complications, of which by Alleged far ^e most imp0rtant are those of an inflam- effects. matory nature, such as erysipelas, which are not

~~peculiar to vaccination, but which constitute the danger of any local lesion of the skin, however caused. During the many decades in which vaccination from arm to arm was practised, in many millions of children, a few authenticated cases were recorded in which there was reason to believe that syphilis could have been invacci- nated. Such an occurrence could at no time have happened if proper care had been taken by the vaccinator ; and now that the use of calf lymph has become practically universal, the possibility of such occurrence in the future may be disregarded, since the calf is not capable of con- tracting this disease. Tubercle in its various forms and leprosy have also been included in the list of possible complications of vaccination, though without any sufficient proof. The employment of calf lymph, treated with glycerine after the manner first advocated by the present writer, will obviate any such danger, for even if tubercle bacilli or the streptococcus of erysipelas were by chance present in the lymph material when collected, it has been found experimentally that they are quite unable to survive prolonged exposure to the action of a 50 per cent, solu- tion of glycerine in water. Leprosy is not communicable to the calf. In view of the frequency of various skin eruptions in infancy, it is to be expected that in a pro- portion of cases they will appear during the weeks follow- ing vaccination. Eczema and impetigo in particular have, post hoc, been attributed to vaccination, but no direct con- nexion has been proved to exist between the operation and the occurrence of these disorders. In section 434 of the final report of the Royal Commission on Vaccination the extent to which other inoculable diseases are liable to complicate vaccination is thus summed up : —~~

~~"A careful examination of the facts which have been brought under our notice has enabled us to arrive at the conclusion that although some of the dangers said to attend vaccination are un- doubtedly real, and not inconsiderable in gross amount, yet when considered in relation to the extent of vaccination work done, they are insignificant. There is reason, further, to believe that they are diminishing under the better precautions of the present day, and with the additions of the future precautions which experience suggests, will do so still more in the future."~~

Under the provisions of the Vaccination Act, 1898, which came into force in January 1899 for a period of five years, and of the Vaccination Order (1898) Recent 0f {jjg Local Government Board, numerous lation changes in connexion with vaccination adminis- tration and with the performance of the operation were introduced, in addition to the supersession of arm-to-arm vaccination by the use of glycerinated calf lymph. Thus, whereas by the Vaccination Acts of 1867 and 1871 the parent or person having the custody of any child was required to procure its vaccination within three months of birth, this period by the Act of 1898 has been ex- tended to six months. Again, no parent is now liable to a penalty under the compulsory clauses of the Vaccination Acts who affords proof that he has, within four months of the birth of a child, satisfied a stipendiary magistrate, or two justices in petty sessions, that he conscientiously believes that vaccination would be prejudicial to the health of the child. Moreover, in no case can proceedings now be taken more than twice against a defaulting parent, namely, once under section 29 of the Act of 1867,

and once under section 31 of the same Act, provided that the child has reached the age of four years. Finally, the public vaccinator is now required to visit the homes of children for the purpose of offering vaccination with glycerinated calf lymph, " or such other lymph as may be issued by the Local Government Board." The operative procedure in public vaccinations was formerly based on the necessity of carrying on a weekly series of trans- ferences of vaccine lymph from arm to arm ; and for the purposes of such arm-to-arm vaccination the provision of stations, to which children were brought first for the performance of the operation, and again, after a week's interval, for inspection of the results, was an essential. The occasional hardships to the mothers, and a somewhat remote possibility of danger to the children, involved in being taken long journeys to a vaccination station in bad weather, or arising from the collecting together in one room of a number of children and adults, one or more of whom might happen to be suffering at the time from some infectious disorder, are a few of the reasons which appeared to render a change in this regulation desirable ; as a matter of fact, it would appear that nothing but good has arisen from the substitution of domiciliary for stational vaccination. The working of the so-called " conscience clause " also has by no means justified the somewhat gloomy forebodings

~~expressed, both in Parlia- ment and elsewhere, at the time of its incorporation in the Act of 1898. On the contrary, its operation has un- doubtedly tended to the more harmonious working of the Vaccination Acts, by affording a legal method of relief to such parents and guardians as are prepared to affirm their conscientious belief that the performance of the operation might, in any particular instance, be prejudicial to the health of the child. The period of five years during which the Act of 1898 was to remain operative would expire on 31st December 1903. Consequently, at some period antecedent to that date the whole ques- tion of vaccination, and presumably of re-vaccination also, must again occupy the attention of the British Legislature.~~

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~~Vacherot, Etienne (1809-1897), French philo- sophical writer, was born of peasant parentage at Torcenay, near Langres, 29th July 1809. He was educated at the Ecole Normale, and returned thither as director of studies in 1838, after some years spent in provincial schoolmaster- ships. His Histoire critique de I’Mcole d’Alexandrie (3 vols., 1846-51), his first and best-known work, drew on him attacks from the Clerical party which led to his sus- pension from office in 1851. Shortly afterwards he refused to swear allegiance to the new imperial Government, and was dismissed the service. His work Democratic (1859) led to a political prosecution and imprisonment. In 1868 he was elected to the French Academy. On the fall of the Empire he took an active part in politics, was maire of a district of Paris during the siege, and in 1871 was in the National Assembly, voting as a Moderate Liberal. In 1873 he drew nearer the Conservatives, and,~~

~~though never again successful as a parliamentary candidate, main- tained his principles vigorously in the p»ess. His other works are entitled La Mitaphy&ique et la Science (1858),~~

~~Essais de philosophie critique (1864), La Religion (1869), La Science et la Conscience (1870), Le nouveau spiritual- isme (1884), La Democratie liberate (1892). He died 28th July 1897. Vacherot was a man of high character and strict adherence to his principles, which were gene- rally opposed to those of the party in power. His chief philosophical importance consists in the fact that he was a leader in the attempt to revivify French philosophy by the new thought of Germany, to which he had been in- troduced by Cousin, but of which he never had more than a second-hand knowledge. Metaphysics he held to be based on psychology. He maintains the unity and free- dom of the soul, and the absolute obligation of the moral law. In religion, which was his main interest, he was much influenced by Hegel, and appears somewhat in the ambiguous position of a sceptic anxious to believe. He sees insoluble contradictions in every mode of conceiving God as real, yet he advocates religious belief, though the object of that belief have but an abstract or imaginary existence. (h. St.)~~

~~Va.ia.is, one of the Swiss cantons. Its total area is 2025-3 square miles. The population was 100,190 in 1880, and in 1900, 114,158. In 1900 there were 56 inhabitants to each square mile, the lowest rate of density in Switzerland save in the Grisons and Uri. Two-thirds of the people are French-speaking, and one- third German-speaking, and the canton is almost wholly Roman Catholic. As the highest summit of Monte Rosa rises on a promontory, it (and not the Dom as often stated) is the loftiest peak situated entirely within Swit- zerland. There is a funicular railway from Visp up to Zermatt, and thence an electric line up to the Gornergrat. The political capital is Sion. In 1890 the state revenue was 1,425,833 francs, a rise of 18f per cent, since 1885 (estimate for 1900, 1,518,229 francs), and the state ex- penditure 1,387,477 francs, a rise of 21 J per cent, since 1885 (estimate for 1900, 1,714,515 francs), while in 1898 there~~

was a surplus of 44,626 francs. In 1897 the public debt was 6,913,460 francs. The cantonal constitution of 1875 is still in force, but the legislative assembly now numbers 104 members, owing to the increase of population. The boring of the Simplon tunnel was commenced in 1899, and has brought about a great increase in population at Naters, close to Brieg, the labourers being all Italians.

See Blatter aus d. Wallisergeschichte (published by the Cant. Hist. Soc.). Sion. From 1889. — Gat. Hist, du Vallais, 2 vols. Geneva, 1888. — Gremaud. Documents relatifs a Vhist. du V., 8 vols, (to 1457). Lausanne, 1875-1898. — Heuslee.. Die Rechtsquellen d. Cant. Wallis. Basel, 1890. — Hoppelep… Beitrage z. Geschichte d. Wallis im Mittelalter. Zurich, 1897. Rameau. Le Vallais Historique. Sion, 1886. (w. a. B. c.)

Valdivia, a city of Chile, capital of a province and department of the same name. It is one of the most prosperous towns of southern Chile. One of the principal industries is beer brewing, one brewery producing over eight million litres a year. Tanning is also an important industry. In 1900, 439 ships of 450,912 tons entered the port (Corral, 12 miles distant), about the same number clearing. In the same year the imports were valued at 2,497,083, and the exports at 2,200,620 pesos. The coast- wise trade was represented in the same year by 598 steamers and 30 sailing vessels, which carried goods valued at 8,367,983 pesos. A railway runs from Val- divia to Osorno, and another connecting it with the north is being constructed. Population (1895), 8062; (1900),

9819.

Valdosta, a city of Georgia, U.S.A., capital of Lowndes county, at the intersection of four railways,

in the southern part of the state, near the Florida boun- dary. Population (1890), 2854; (1900), 5613, of whom 50 were foreign-born and 2958 negroes.

Valence, chief town of the department of Dr6me, France, 384 miles south-south-east of Paris, an important junction on the railway from Lyons to Marseilles. A fine bronze monument to Emile Augier (1820-1889), the

drama- tist, has been added to the public statues. Metal founding has declined, but the making of hosiery and the printing of linen and cotton handkerchiefs are amongst the leading industries. The annual value of the industrial products is about £800,000, of which more than one-third is supplied by flour and tinned foods. The surrounding vineyards, at one time nearly destroyed by the phylloxera, have been replanted and extended. Population (1891), 19,970;

(1901), 24,199.

Valencia, a Mediterranean province of Spain, with an area of 4352 miles. Population (1887), 733,978 ; (1897), 775,995. The birth-rate is 3-80 per cent., the death-rate 3 per cent. It is divided into nineteen dis- tricts and 265 parishes. There are 335 miles of railways. The industries are still important, although the silk manu- factures have declined after three decades of prosperity (from 1850 to 1880). Silk rose in importance when local causes brought about the decay of that industry in France. The manufactures of carpets and tapestry, woollen goods, hemp and linen stuffs, are considerable.

Rice grown in the lowlands provides splendid crops that give work to 140 mills. Both figs and oranges constitute important products and the staple articles of the export trade. The orange exports ranged from £42,000 to £100,000 between 1877 and 1895, and the average crop of figs has been 1,360,0001b a year. This province also produces sugar-cane, and has thriving sugar factories. About 120,000 acres are well irrigated, and over 1,500,000 culti- vated. HIalf a million acres are still covered with woods and commons. In 1897 wheat was grown on 94,784 acres, other cereals on 150,680 acres, pod fruit on 25,000 acres, vines on 275,582, olives on 73,120. The live stock in the same year included 28,733 horses, 30,765 mules, 30,112 asses, 6246 cattle, 178,658 sheep, 66,961 goats, and 66,989 pigs.

Valencia, capital of the above province, 3 miles from the Mediterranean, on the Guadalaviar. It is an archbishopric, the seat of an army corps and captain- general, and of a court of appeal. The city is connected with its port, El Grao, by two railways and two tram- ways. The older part still preserves its quaint and original character, but in the new town there are

broader streets and avenues, with many industries, splendid pro- vincial and municipal buildings, and good drainage. Valencia is a populous, thriving, progressive town, divided into ten districts and sixty-four quarters, with a population which rose from 170,763 in 1887 to 204,768 in 1897. There is a rich provincial museum, with paintings by Velazquez, Ribera, Diirer, Joannes, Bosco, Goya, and many modern artists. The industries include silks, cloths, linen, leather, ceramics, fans, and esparto grass rugs. Agricultural produce, especially oranges, rice, maize, and fruit of all sorts, is exported. El Grao is one of the largest, safest, and most important ports in Spain. The harbour works, begun in 1792 at local expense, have been improved down to 1897, and now provide many facilities for trade on the moles and wharves. In 1898, 877 foreign vessels of 624,481 tons entered the port and 362 foreign vessels of 621,688 tons cleared. The total value of exports in 1898 was £354,000, and of imports £124,100. The coasting trade is also important, and 260 vessels were engaged in it in 1898. The fishing fleet of El Grao comprises about 600 boats with 2800 hands.

Valencia de Alcantara, a town of Spain on

the Portuguese frontier, in the province of Caceres, on the left bank of the river Avid, with a station on the

railway from Madrid to Lisbon. It is the most important custom-house for direct traffic between the Peninsular kingdoms, and has a garrison, old-fashioned loopholed walls, and a dismantled castle on a hill. The town is clean, with regular streets, and some houses that still reveal Moorish traits in the interior yards and architec- ture. The town hall is of the 16th century, as are also the churches of Encarnacion and Roqueamador, and a fine convent. In ■ the neighbourhood there are Eoman ruins and an aqueduct that still brings water to the Alameda of Alcantara. The surrounding country yields agricultural produce of every kind, and also contains mines of phos- phorite and antimony. Alcantara was taken twice

~~by the Portuguese in the wars of 1664 and 1698 with Spain. Population (1887), 8230; (1897), 9276.~~

~~Valenciennes, chief town of arrondissement, department of Nord, France, 32 miles south-east of Lille, on the railway from Paris to Mons. The fortifications, dismantled in 1892, have been replaced by boulevards. Metallurgical industries are very active, employing more than 2000 persons. Among secondary industrial features large glass-works and factories for the manufacture of starch, chemicals, and soap have become noteworthy. Imports in 1899 were valued at £1,168,000, exports at £1,184,000. The port traffic in the same year amounted to 150,442 tons. Population (1891), 21,698; (1901),~~

~~28,786.~~

~~Valera y A leal a Galiano, Juan (1824-~~

~~-), Spanish novelist, son of a retired commodore,~~

~~Jose Valera, who married Dona Dolores Alcala Galiano, Marquesa de la Paniega, widow of a Swiss general named Freuller, was born on 18th October 1824 at Cabra, in the province of Cordoba. Valera was educated at Malaga and at the University of Granada, where he took a degree in law. Entering diplomacy in 1847, he was named unpaid attache to the Spanish embassy at Naples under the famous Duke de Eivas, the leader of the romantic movement in Spain. Valera witnessed the events of the revolution, was promoted second secretary to the embassy at Lisbon in 1850, and in 1851 was transferred as first secretary to Eio de Janeiro, where he remained for two years. After a short period passed at Dresden, he was appointed to the permanent staff of the Foreign Office at Madrid, and in 1857 was attached to the special embassy to St Petersburg under the Duke de Osuna. In 1858 he re- signed his post, was elected deputy for Archidona, in the province of Malaga, took his seat with the advanced Liberal Opposition, and joined with Albareda and Fabi^ in found- ing El Contemporaneo, a very influential journal. An expert in the art of covering an opponent with polite ridicule, he at once caught the ear of the Cortes, and his writings in the press attracted general attention. He was elected a member of the Spanish Academy in 1861, and remained in~~

Opposition till 1865, when O'Donnell appointed him minister to Frankfort : on the flight of Isabella II. in 1868 he returned to Spain, was elected deputy for Mon- tilla in the province of Cordoba, became under-secretary of state for foreign affairs, and was one of the deputation who offered the crown to Amadeus of Savoy in the Pitti Palace at Florence. Valera has always called him- self a Moderate Liberal, but he has invariably voted for what are considered Radical measures in Spain, and a speech delivered by him in February 1863 against the temporal power of the Pope created a profound sensation. However, though a member of the revolutionary party, he has steadily opposed organic constitutional changes, and therefore he retired from public life during the period of re-publican government. Since the Bourbon restoration he has acted as ambassador at Lisbon (1881-83), at Washington

(1885), at Brussels (1886), and at Vienna (1893-95). He is a life senator, and has ceased to take an active part in politics. Valera's first publication, Canciones, Romances y Poemas, was published in 1856 (2nd edition 1885). His verses are melodious, finished, and various in subject; but they are rather the imitative exercises . of a scholarly man of the world than the inspirations of an original poet. That they failed to attract notice is not altogether to be regretted, for, as Valera himself confesses, in his half-ironical, half-ingenuous preface, " In spite of my idleness, I should have shown a most deplorable fecundity had I been received with favour and applause." As it is, though he has published little more in the shape of verse, he has written incessantly in prose. More than two-thirds of his work he has left uncollected, buried in reviews and newspapers ; but we may safely take it that in the eighteen volumes which bear his name he has rescued all that he thought most valuable. His criticism may be read in the Fstudios criticos sobre literatura (1864), in the Diserta- ciones y juicios literarios (1878), and in the Nuevos estudios criticos (1888); yet, with all his penetration and taste, Valera labours under one disadvantage not frequent in critics. He suffers from an excessive amiability. He will say a hundred incisive, wise, witty, subtle, and sugges- tive things concerning the mysticism of St Theresa, the art of novel-writing, Faust, the Inquisition, Don Quixote, Shakespeare, the psychology of love in literature ; but, if he is to do himself justice, it is an almost indispensable condition that he should deal with the past. In the pre- sence of a living

author Valera is disarmed. Unless the writer be an incurable pessimist, Valera will find some- thing in his work to praise, exhausting the vocabulary of compliment and graceful tribute ; but, except in the Cartas americanas (1889), where the laudation is manifestly so exaggerated that no harm can come of it, this trick of eulogy is both perplexing and misleading. Valera, in effect, refuses to. criticize contemporary literature ; as a rival author, it seems to him an indelicacy to censure others, and he is either laudatory or silent. It is regrettable, for criticism is greatly needed in Spain. Valera, then, excels neither as a poet nor as an impartial critic; he has the vocation of the novelist, though he was slow in discovering it, since he was in his fiftieth year before he published the ^ novel which was to make him famous. Pepita Jimenez (1874) is a recital of the fall of Luis de Vargas, a semin- arist who conceived himself to be a mystic and a potential saint, and whose aspirations dissolve at the first contact with reality. It is easy to point out blemishes : as a piece of mechanics, the story is not well constructed, and it has pauses during which the writer's fantasy plays at pleasure over a hundred subjects not very germane to the matter ; but its characters are as real as any in fiction, the love story is told with the most refined subtlety and malicious truth, while page upon page is written in such Spanish as would not misbecome the best writers of the 16th and 17th centuries. Unquestionably Pepita Jimenez is a very remarkable achievement — so remarkable, that readers are reluctant to admit the superiority of its suc- cessors. It is certain that Valera's second novel, Las ilusiones del Doctor Faustino (1875), was received with marked disfavour, and that it has thef faults of over-refine- ment and of cruelty ; yet in keen analysis and in humour it surpasses Pepita Jimenez. The Comendador Mendoza (1877) is surely more pathetic and of a profounder signifi- cance ; and if Dona Luz (1879) repeats the situation and the general idea already used in Pepita Jimenez, it strikes a deeper and more tragic note, which came as a surprise to those most familiar with the lighter side of Valera's genius. Besides these elaborate psychological studies, Valera has published a volume of Cuentos (1887), some of these short

tales and dialogues being marvels of art and of insight. Thenceforward he was silent for eight years, but since his retirement from politics he has given us several good books — El hechicero (1895), Juanita la larga (1896), Genio y flgura (1897), De varios colores (1898), and Morsarnor (1899). These are not all of equal excel- lence, but they are characteristic of their author, and abound in understanding, humorous comment, and sym- pathetic creation. Valera is certainly the most eminent man of letters in Spain. He has not Pereda's force, nor his energetic realism; he has not the copious invention nor the reforming purpose of PeYez Gald6s ; yet he is as real as the former and as innovating as the latter. And, for all his cosmopolitan spirit, he has fortunately remained intensely and incorrigibly Spanish. His aristocratic scep- ticism, his strange elusiveness, his incomparable charm are his own : his humour, his flashing irony, his urbanity are eminently the gifts of his land and people. He is by no means an impersonal artist ; in almost every story there is at least oue character who talks and thinks, and sub- tilizes and refines as Valera himself does in his most brilliant essays. This may be a^fault in art ; but, if so, it is a fault which most great artists have committed, from Cervantes to Thackeray. It is dangerous to attempt a forecast of Valera's place in literary history, yet it seems safe to say that Pepita JitnAnez and Dona Luz will survive all changes of fashion and of taste, and that their author's name wjll be inseparably connected with the renascence of the mo/lern Spanish novel.

Va.lla.dol id, a province of Spain, almost in the centre of the Peninsula. Area, 3043 square miles. Popula- tion (1887), 267,148; (1897), 276,366. The birth-rate is 4-31 per cent., the death-rate 3-85 per cent., and the proportion of illegitimate births 5 '07 per cent, of the total births. The province is divided into 11 districts and 237 parishes. It has about 200 miles of railway. The industries are unimportant, excepting those connected with agriculture, flour and saw mills. There are some iron foundries, and linen and woollen factories. The principal exports are flour, cereals, wool, wine, and live stock.

The soil is excellent for all sort of cereals and fruit and vegetables, whilst the vineyards yield good red and white wines. Forests and brushwood occur only in the south-east, covering barely 250,000 acres. Much land is

devoted to pasture, and over 1,800,000 acres are well cultivated, of which 374,400 acres were in 1897 covered with wheat crops, 188,565 with other cereals, 85,940 with pod fruit, 197,125 with vines. The live stock in the same year included 3401 horses, 21,633 mules, 14,118 asses, 7585 cattle, 285,746 sheep, 3181 goats, and 5346 pigs.

Valladolid, capital of the above province, on the Pisuerga, a station on the railway from Madrid to the French frontier. Population (1887), 62,012; (1897), 68,746. It is the seat of an army corps, a court of appeal, and an archbishopric. The surrounding country is fertile and yields much wine, cereals, fruit, and vegetables ; the industries include flour, beer, paper, soap, leather, choco- late, woollen and linen stuffs, iron, porcelain, and pottery. The university has been well attended since the decline of Salamanca. There are an institute, normal and primary school, the royal academy for cavalry cadets, an artillery park, a provincial lunatic asylum, several hospitals, a seminary (raised in 1897 by Pope Leo XIII. to the rank of a pontifical university), an archaeological museum, a picture gallery, and a public library with 36,000 volumes. The greater part of the city has a modern aspect, with broad, regular streets, squares, and good houses several storeys high. The Pisuerga is spanned by an old bridge and more modern ones connecting the city with the suburbs.

Vallecas, a town of Spain, province of Madrid, to

the south-east of Madrid, with which it is connected by the Madrid-Saragossa railway and by a steam tramway. Its population was 5611 in 1887, and 9027 in 1897. It is situated in a flat, fertile country, through which flows the Manzanares, which produces much wine, pod fruit, vegetables, and cereals of every kind. It is mostly frequented by the lower and middle classes of Madrid on Sundays and fete days, owing to its very popular bull-ring. The parish church of San Pedro ad Vincula has two good paintings by Jordaens, and about 3 miles off, on the Argande road, there is a hermitage of Our Lady of the Towers with six fine plateresque altars. Vallecas was founded by the Christians after the expulsion of the Moors, and took its name from an Arab chief Kas — the vale of Kas.

VallejO, a city of Solano county, California, U.S.A., on San Pablo Bay and a branch of the Southern Pacific Eailroad. It has a good harbour,

and ships large quantities of wheat. It is the outlet of the beautiful Napa Valley, one of the finest fruit-growing regions of the State. Population (1890), 6343; (1900), 7965, of whom 2033 were foreign-born and 223 coloured, including 39 negroes.

Valletta. See Malta.

Valleyfield, or Salaherry de Valleyfield, town and port of entry, Beauharnois county, Quebec, 30 miles south-west of Montreal, at the foot of Lake St Francis — an expansion of the river St Lawrence — and at the head of the Beauharnois canal. It is a station on the Canada Atlantic and New York Central railways, and a port of call of all steamers plying between Montreal and Lake Ontario ports. It is the see of a Roman Catholic bishop, and con- tains a college and convent. It has extensive cotton and paper mills. Population (1891), 5515; (1901), 11,055.

Valparaiso, city and port of Chile, capital of a province and department of the same name. Population (1895), 122,447; (1900), 135,674. The bay and city are defended by twelve forts armed with modern guns of heavy calibre. In 1896, 1214 ships of 1,416,031 tons entered and 1224 ships of 1,427,413 tons cleared; in 1898, 1054 ships of 1,337,018 tons visited the port; and in 1900, 1027 ships of 1,386,884 tons entered and 1024 of 1,394,119 tons cleared. The value of the trade in 1900 was, in pesos (paper), imports, 79,109,629 ; exports, 12,792,527. In 1898 Valparaiso had 63-41 per cent, of the total import trade of the republic, and 16 '19 per cent, of the export trade. The customs receipts in 1900 were 19,598,112 pesos (paper). There were at the end of 1898 tramways of a total length of nearly 8 miles. Among the monuments are statues of Wheelwright, the builder of the first South American railway, Columbus, and Thomas Cochrane (tenth Earl of Dundonald), the organizer of the Chilian navy. The finest monument in Chile is probably that inaugurated in Valparaiso in 18^86 and dedi- cated to the national navy, on the summit of which is the statue of Admiral Prat.

Valparaiso, a borough of Indiana, U.S.A., capital of Porter county, in the north-western part of the state, at the intersection of the Grand Trunk, the New York, Chicago and St Louis, and the Pennsylvania railways, at an altitude of 736 feet. It contains foundries, machine-shops, and clock

factories.. Population (1880), 4461; (1890), 5090; (1900), 6280, of whom 660 were foreign-born.

Valtel I ina (German, Veltlin), , properly the name of the upper valley of the Adda, in North Italy. His- torically and officially, it also comprises the Liro valley,

which extends from the Spliigen Pass past Chiavenna to the Lake of Como, the Liro entering this lake slightly to the north of the Adda. These two valleys (but not Colico, which is in the province of Como) form together the province of Sondrio. Population (1881), 120,534;

(1901), 126,425.

Vambery, Arm in (1832), Hungarian

Orientalist and traveller, was born of humble parentage at Duna-Szerdahely, a village on the island of Shutt, in the Danube, on the 19th of March 1832. He was educated at the village school until the age of twelve, and owing to congenital lameness had to walk with crutches. At an early age he showed remarkable aptitude for acquiring languages, but straitened circumstances compelled him to earn his own living. After being for a short time apprentice to a ladies' tailor, he became tutor to an innkeeper's son. He next entered the untergymnasium of St Georgen, and proceeded thence to Pressburg. Meanwhile he supported himself by teaching on a very small scale, but his progress was such, that at sixteen he had a good knowledge of Hungarian, Latin, French, and German, and was rapidly acquiring English and the Scandinavian languages, and also Russian, Servian, and other Slavonic tongues. At the age of twenty he had obtained sufficient knowledge of Turkish to lead him to go to Constantinople, where he set up as teacher of European languages, and shortly afterwards became a tutor in the house of Pasha Hussein Daim. Under the influence of his friend and instructor, the Mollah Ahmed Effendi, he became, nominally at least, a full Osmanli, and entering the

Turkish service, was afterwards secretary to Fuad Pasha. After spending six years in Con- stantinople, where he published a Turkish-German Dictionary and various linguistic works, and where he acquired some twenty Oriental languages and dialects, he visited Tehran ; and then, disguised as a dervish, joined a band of pilgrims from Mecca, and spent several months with them in rough and squalid travel through the deserts of Asia. He succeeded in maintaining his disguise, and on arriving at Khiva went safely through two audiences of the khan. Passing Bokhara, they reached Samarkand, where the emir, whose suspicions were aroused, kept him in audience for a full half-hour ; but he stood the test so well that the emir was not only pleased with " Eesid Effendi " (Vambe>y's assumed name), but gave him handsome presents. He then reluctantly turned back by way of Herat, where he took leave of the dervishes, and returned with a caravan to Tehran, and subsequently, in March 1864, through Trebizond and Erzerum to Constantinople. By the advice of Prokesch- Osten and Eotvos, he paid a visit in the following June to London; there his daring adventures and linguistic triumphs made him the lion of the day. In the same year he published his Travels in Central Asia. In con- nexion with this work it must be remembered that Vambery could write down but a few furtive notes while with the dervishes, and dared not take a single sketch ; but the weird scenes, with their misery and suffering, were so strongly impressed on his memory, that his book is convincing by its simplicity, directness, and evidence of heroic endurance. Vambery also called the attention of politicians to the movements of Russia in central Asia, and aroused much general interest in that question. From London he went to Paris, and he notes in his autobiography that the Parisians were much more in- terested in his strange manner of travelling than in the travels themselves. He had an interview with Napoleon III., who failed to impress him " as the great man which the world in general considers him." Returning to

Hungary, he was appointed professor of Oriental languages in the University of Budapest : there he settled down, contributing largely to periodicals, and publishing a number of books, chiefly in German and Hungarian. His travels have been translated into many languages, and his Autobiography was written in English. Amongst the best known of his works, besides those alluded to, are Wanderings and Adventures in Persia

(1867); Sketches of Central Asia (1868); History of Bokhara (1873) ; Manners in Oriental Countries (1876) ; Primitive Civilization of the Turko-Tatar People (1879) ; Origin of the Magyars (1882) ; and The Turkish People

(1885).

Van. — (1) A vilayet of Asiatic Turkey, situated on the Persian frontier, between the vilayets of Erzerum and Mosul. It is divided into two sanjaks, Van and Hakkiari, has an area of about 18,000 square miles, and a popula- tion, according to Cuinet, of 430,000 (Moslems, chiefly Kurds, 241,000; Christians, 178,000, including 92,000 Nestorians ; J&w^ 5000 ; Yezidis, &c, 6000). The moun- tains have been disforested, and in summer are covered with pasture. The winter is long and severe. The mineral wealth of the vilayet has never been fully ex- plored, but is believed to be great. There are petroleum springs at Kordzot, a coal-field at Sivan, and hot sulphur springs at Zilan Deresi and Julamerk. The exporte — sheep, wool, mohair, hides, and furs — amounted in 1898 to £52,000, and the imports to £160,000.

(2) The chief town of the vilayet and of the Van sanjak, and a military station, altitude 5200 feet, situated about I J mile from the east shore of Lake Van, on the south side of an isolated ridge of rock which runs nearly east and west and rises to a height of 300 feet above the sur- rounding plain. The ridge is about 1400 yards long, and on its precipitous southern face is the trilingual inscrip- tion of Xerxes. On its north side and in other places are Vannic inscriptions, and on its summit is the old citadel. The town has flat-roofed mud houses and narrow, winding streets. On gently sloping ground towards the east are gardens covering an area of about 15 square miles, in which the European consuls, the missionaries, and wealthy inhabitants live. They are irrigated by the Shemiram Riid, an artificial canal 19 miles long, of very ancient date. The climate is very cold in winter, hot in summer, and unhealthy in autumn. Earthquakes are frequent; the last severe one was in 1891. There are a flourishing American mission and a Dominican mission. The population of 30,000 consists of 16,000 Moslems and 14,000 Christians, chiefly Armenians. Van occupies the site of Dhuspas, the capital of a kingdom of which the

native name was Biainas (Assyrian, Urardhu ; see Ararat), the Byana of Ptolemy and Ivan of Cedrenus, whence the modern Van. Dhuspas, the Thospia of Ptolemy, gave its name to the district Thospitis, the present Tosp. The Biainian dynasty, of which Sarduris I. circ. 833 B.C., was the first king, died out with Sarduris II., who in 645 B.C. entered into an alliance with Assur-bani-pal. Inscriptions of nearly all the kings exist, and excavations near Van have brought to light the foundations of a temple and various works of art, statuettes, vases, &c, which show an advanced state of civilization and great technical skill (see illustrations in Maspero's Hist. Ancienne, vol. iii. Les Em- pires). In the 6th century B.C. Van passed into the hands of the Persians, and, shortly before it fell to Alexander it was, according to Armenian historians, rebuilt by a native prince called Van. In 149 B.C. Valarsaces, or Vagharshag, rebuilt the town, and a colony of Jews was settled in it by Tigranes (94-56 B.C.). In the middle of the 4th century of our era it was taken by Sapor II. and became the capita]

of an autonomous province of the Sassanian empire until it fell into the hands of the Arabs, circ. 640, under whom it retained its autonomy. About 908 the governor of Van, or Vaspuragan, was crowned king by the Khalif Muk- tadir, and in 1021 his descendant Senekherim was persuaded by Basil II. to exchange his kingdom for the viceroyalty of the Sebasteian Theme. After having formed part of the possessions of Seljiiks, Mongols, Tatars, and Persians, Van passed to the Osmanlis in 1514 after the de- feat of Shah Ismail by Selim I. In 1845 the town was held for a time by the Kurd chief Khan Mahmud, who eventu- ally surrendered and was exiled. In November 1895 and June 1896 massacres of Armenians occurred in the town. Lake Van. — The water is too salt to drink, and a deposit of alkaline salts, consisting chiefly of carbonate of soda and chloride of sodium, is obtained by evapora- tion and used in washing. There is, however, good water along the coast from springs and streams. There are eighty-four native sailing boats, carrying about twenty tons.

~~Severe storms make navigation dangerous in winter, and no voyages are made between December and March.~~

~~See Sayce, ‘ ‘ Cuneiform Inscriptions of Lake Van, ” in Journal of Royal Asiatic Society, vols, xiv., xx., and xxvi. — Lynch, Ar- menia, vol. ii., 1901. — Belck and Lehmann, papers in Verhand. d. Berliner Ges. fur Anthropologic, 1892-99 ; Zeit. fur Ethnologie, 1892, 1899 ; Mitt. d. Geog. Ges. (Hamburg), 1898, 1899. — Consular Reports. — Murray’s Handbook to Asia Minor. (c. W. w.)~~

~~Van Beers, Jan (1821-1888), Belgian poet, usually called the elder to distinguish him from his son, the well-known painter, was born at Antwerp, 22nd February 1821. He was essentially a Netherlander, though politically a Belgian, expressing his thoughts in the same language as any North Netherland writer. In fact, the poems of Jan Van Beers are perhaps more popular in Holland than in Belgium, and of many of them there exist more editions printed in ‘ Holland than in his political fatherland. Van Beers started life as a teacher of Dutch language and literature, first at Malines, then at Lierre, and’ in 1860 was appointed a professor of both at the Athenaeum (high school) in Antwerp, where he had also been a sub-librarian in the communal library. Van Beers as a teacher was early in the field, with Hendrik Conscience, Willems, and others, when the Flemish movement began. He composed a Dutch grammar (1852), which, in enlarged editions, still holds the field, and a volume of selections from Dutch authors, both books being- so much appreciated that the Belgian Government made them text-books in the public schools. Van Beers’s historical poems, the prin- cipal of which is, perhaps, Jakob Van Maerlant (Am- sterdam, 1860), helped the Flemish revival in Belgium as powerfully as his school-books. He is best known, however, as the writer of ballads and songs. Jonge- lingsdroonun (“A Young Man’s Dreams”) first appeared at Antwerp and Amsterdam in 1853. These poems were followed by Levensbeelden (” Life Figures or Pictures,” Amsterdam, 1858), and by Gevoel en Leven (“Feeling- Living,” Amsterdam, 1861). His Rijzende Bladen (“Ris- ing Leaves “) first made its appearance at Ghent and Rotterdam in 1883. In the following year an edition de luxe of his poetry was published, adorned with pen- and-ink sketches by Jan Van Beers the younger, and a popular edition of his collected poems was~~

published at Ghent and Rotterdam in 1873 and 1884. Among the best known are De Blinde (" Blind "), De Ziel-e Jongeling (" Young and Doomed "), Bij 't Kerkportaal ("At the Church Porch"). Van Beers's poetry, full of glow and pathos, simple yet forcible, is somewhat akin to that of Longfellow. Van Beers died at Antwerp on the 14th of November 1888. (h. ti.)

Vancouver, a city of Washington, U.S.A., capital of Clarke county, on the north bank of the Columbia river, six miles north of Portland, in the southern ^part of the state. Its interests are connected with lumbering, and it is the terminus of a lumber rail- way running north-east into the heavy forests of the eastern part of the county. Large quantities of lumber are sawn and shipped here. Fort Vancouver, a United States military post, is situated here, also St James College, a Roman Catholic institution opened in 1856. Vancouver was a trading post of the Hudson Bay Com- pany, built as such in 1828, and is therefore one of the oldest settlements in the north-west. Population (1880), 1722; (1890), 3545; (1900), 4006, of whom 47 were foreign-born.

Vancouver, a town and port in the province of British Columbia, Canada, on the southern side of Burrard Inlet, the western terminus of the Canadian Pacific Railway. It is the chief Canadian shipping port for Japan, China, Australia, and the islands at which the C.P.R. mail steamers call. There are regular lines of steamers between Vancouver, calling at Victoria on Vancouver Island, and Alaska and the points of con- nexion with the Yukon Territory ; and lines also to Puget Sound and San Francisco in the United States. In 1886, soon after its establishment, fire swept the whole town out of existence, but the inferior wooden buildings at first erected have been largely replaced by stone and brick structures, giving a handsome appearance to the principal streets. Vancouver is well supplied with water, lighting, electric cars, a fine park, sea-bathing, and all improvements of modern cities. Though there is little agricultural land in the immediate neighbourhood, a large wholesale trade is carried on with the many scattered settlements of the province. It is, besides, the centre of the important timber industry of British Columbia. Population estimated at about 25,000.

Vancouver Island. See British Columbia.

Vanderbilt, Cornelius (1794-1877), Ameri- can capitalist and railway organizer, was born on Staten Island, New York, 27th May 1794. He was of Dutch ancestry, and received but little schooling. At the age of sixteen he worked a vessel regularly between Staten and Manhattan islands ; later he engaged in the coasting trade, and after 1817 was manager of steamboat lines from New York to New Brunswick and Elizabethport, N.J. After 1830 he built and worked on his own account steamboats on the Hudson river, Long Island Sound, and the Delaware river. In 1851 he established a steam- ship line from New York to California by the Nicaragua route, and from 1855 to 1861 conducted a transatlantic line. From his extensive relations with navigation, Vanderbilt became popularly known as the "Commodore." As early as 1845 he had become financially interested in railways, and in 1864, abandoning water transportation, he secured control of the New York and Harlem Railroad. He next reorganized the Hudson River Railroad, which in 1869 he consolidated with the New York Central Railroad, forming a through trunk line from New York to Buffalo. On this route was begun the movement of grain and other bulk freights to the seaboard. After 1873 the Lake Shore and Michigan Southern Railway was worked in conjunction with the New York Central and Hudson River as a continuous line from New York to Chicago, controlled by Vanderbilt, who was undoubtedly the fore- most railway manager of his time. Mr Vanderbilt's wealth at the time of his death, which took place in New York City on the 4th of January 1877, was variously estimated at from $60,000,000 to $100,000,000. He

had in 1873 founded Vanderbilt University at Nashville, Tennessee, and made other notable gifts for philanthropic purposes.

Vannes, chief town of the department of Morbihan, France, and a bishop's see, 3 miles north of the Bay of Quiberon, 84 miles north-west of Nantes by the rail- way to Brest. The present hotel de ville was built in 1884, and the Jules Simon College rebuilt in 1886. A monument was

~~erected to Lesage, author of Gil Bias, in 1892. There are various industries, amongst them ship- building, iron- works, tanneries, breweries, linen and cotton mills. Port du Conteau serves as the port of Vannes. Population (1886), 20,036; (1901), 23,375.~~

~~Van 't Hoff, Jacobus Hendricus (1852-~~

~~), Dutch chemist, was born in Kotterdam on 30th~~

~~August 1852. He studied from 1869 to 1871 at the polytechnic at Delft, in 1871 at the University of Leyden, in 1872 with Kekule at Bonn, in 1873 with Wurtz at Paris, and in 1874, when he took his doctor's degree, with Mulder at Utrecht. In 1876 he became lecturer of physics at the veterinary school at Utrecht. Two years later he was chosen professor of chemistry, mineralogy, and geology in Amsterdam University. In 1896 he was appointed ordinary honorary professor of chemistry in Berlin University. Van 't Hoff's name is especially associated with two important developments of chemical theory. In the first place, he may be regarded as the founder of the doctrine of stereo-isomerism, for he was the first, in 1874, to introduce a definite mechanical theory of valency, and to connect the optical activity exhibited by many carbon compounds with their chemical constitution. In respect of this doctrine of the "asymmetric carbon atom," van 't Hoff's name is generally linked with that of Le Bel (born on 21st January 1847, at Pechelbronn, Lower Alsace), who, only two months later, independently enunciated the theory of asymmetric combinations with carbon ; though it must be noted that J. Wislicenus, to whom van 't Hoff, in fact, acknowledges his indebtedness, had several years earlier definitely suggested that in order to explain the constitution of certain organic bodies, the tridimensional arrangement of atoms in space must be taken into account. For this work van 't Hoff and Le Bel received the Davy medal jointly from the Eoyal Society in 1893. Van 't Hoff is also identified with the development of the view that a close analogy must be recognized between the state of substances in solution and the same in the state of gas, and in a memoir on Les lois de Vdquilibre chimique (1886), he showed that for dilute solutions the osmotic pressure follows the same laws as for gases. Van 't Hoff is a prolific worker and writer in the domain of physical chemistry, and since~~

1885 has published the Zeitschrift fur physikalische Chemie, in collaboration with Professor Ostwald of Leipzig (born on 2nd September 1853 at Biga), another prominent investi- gator in the same field.

Van Wert, a city of Ohio, USA., capital of Van Wert county, in the north-western part of the state, at the crossing of the Pennsylvania and the Cincinnati Northern railways, at an altitude of 782 feet. It is in an agricultural region, for which it serves as a market and supply point. Population (1880), 4079; (1890), 5512; (1900), 6422, of whom 221 were foreign-born and 183 negroes.

Vaporization. — § 1. In common language, a vapour is a gaseous or elastic fluid, which emanates or evaporates from the surface of a solid or liquid at tempera- tures below its boiling-point. A volatile liquid or solid is one which evaporates rapidly at ordinary temperatures. It

is a matter of common experience that evaporation is accele- rated by currents of air, or by the use of an exhaust pump, or by any process which removes the vapour as rapidly as it is formed. On the other hand, it is retarded, and finally ceases, if the vapour is allowed to accumulate in a closed space. When this equilibrium state is reached, the space is said to be saturated with the vapour ; the density of the vapour is then the maximum which can exist in the presence of the liquid at the temperature of the experi- ment, and its pressure is called the saturation-pressure. The term vapour-pressure, when used without qualification, is also generally employed to denote the saturation or maximum pressure. Dalton showed that the saturation- pressure of a vapour depends only on the temperature, and is unaffected by the presence of any neutral gas or vapour. This relation has been more accurately verified by many subsequent observers, and the exceptions to it have been minutely studied and elucidated. The satura- tion-pressure invariably increases rapidly with rise of temperature, according to a . regular law which has been the subject of many elaborate investigations. When the vapour-pressure of a liquid becomes equal to the external pressure, bubbles of vapour are freely formed in the interior of the liquid by the familiar process of boiling or ebullition. The temperature at which this occurs under the normal atmospheric pressure of 760 mm. of mercury (reduced to 0° C.

~~*and sea-level in latitude 45°) is termed the boiling-point (B.P.) of the liquid, and is usually determined by taking the temperature of the saturated vapour under normal pressure, to avoid error from superheating or impurities in the liquid. If the external pressure remains constant, the temperature will also remain constant, provided that the liquid is pure and that its composition remains unaltered, until the whole is vaporized. If, on the other hand, the liquid is contained in a closed space, it may be made to boil at much lower temperatures by diminishing the pressure ; or the tempera- ture of the liquid may be raised considerably above the normal boiling-point, as in the boiler of a steam engine, if the pressure is raised by preventing the free escape of the vapour. In all cases, if the temperature is given, there is a corresponding equilibrium or saturation-pressure of the vapour, and vice versd, in accordance with Dalton's law. It was shown, however, by Cagniard de la Tour (Ann. Chim. Phys., 1822, 1823) that the temperature and pressure of the liquid could not be raised indefinitely in this manner. By heating liquids in strong glass bulbs with manometers attached, he found that at a certain temperature the meniscus or curved surface separating the liquid from the vapour disappeared, and the bulb became filled with an apparently uniform substance. The tem- perature at which this mixing of liquid and vapour occurs is definite for each liquid, and is called the critical tem- perature. La Tour found the critical temperature in the case of water to be 362° O, a result which has been remarkably confirmed by later researches (Cailletet, Ann. Chim. Phys., 25, p. 519, 1892). In many books of recent years, it has been the custom, following a suggestion of Andrews, to restrict the term "gas" to temperatures above the critical temperature, and the term " vapour " to temperatures below. But this is often inconvenient in practice, as there is no sudden change in the gaseous phase at ordinary pressures on passing the critical temperature. It is more convenient to employ the term "vapour" only when discussing the properties of the gaseous phase in relation to the liquid or solid, and to follow the common usage in describing substances like C02, or even S02 and NH3, as gases at ordinary tempera- tures and pressures.*~~

~~*§ 2. Continuity of State. — The form of the isothermal*~~

curve, representing the compression of a vapour at constant temperature, consists, as shown in Fig. 1a, of three discontinuous branches. The relation between pressure and volume for an unsaturated vapour is represented by the branch DE, which is similar to the isothermal of a gas obeying Boyle's law. When the saturation-pressure is reached at D the vapour begins to condense, and the volume diminishes without further increase of pressure, giving the isopiestic branch DCB. At B, when the vapour is completely liquefied, further compression produces a rapid rise of pressure, as shown by the branch BA, representing the behaviour of the

Axis of Volume o 1 2 3 * 5

Volume m c.c. per gm. A B

Kg. 1. A, James Thomson Isothermal ; B, Isothermals of CO, (Andrews).

liquid. It is possible, however, to trace the branch DN for the supersaturated vapour continuously beyond D without liquefaction in the absence of nuclei. It is similarly possible to trace the liquid branch ABM beyond B to lower pressures in the absence of dissolved gases. As the temperature is raised, the length of the branch BD, representing the increase of volume in passing from the liquid to the gas, diminishes, as shown in Tig. 1b, which represents the isothermals of COg,1 according to Andrews (Phil. Trans., 1869). Above the critical temperature, the discontinuities at B and D disappear from the isothermal curve, and it is impossible to obtain separa- tion of the two states, liquid and gas, however great the pressure applied. The critical pressure is the vapour-pressure of the liquid at the critical temperature. It is possible to obtain a perfectly continuous passage from the gaseous to the liquid state by keeping the vapour at a pressure greater than the critical pressure while it is cooled from a temperature above the critical point, at which it would expand indefinitely (if the pressure were reduced) without separation into two phases, to a temperature below the critical point, at which expansion

would produce separation into liquid and vapour as soon as the pressure was reduced to the saturation value. It was maintained by Andrews, on the basis of these and similar observations, that the gaseous and liquid states were merely widely separated forms of the same condition of matter, since one could be converted into the other without any breach of continuity or sudden

1 The slight increase of pressure observed during condensation was attributed by Andrews to the presence of a trace of air in the COo.

evolution of heat or change of volume ; just as an amorphous solid in the process of fusion becomes gradually more and more plastic as the temperature is raised, and passes into the state of a viscous liquid with continually diminishing viscosity. The same idea was further de- veloped by James Thomson (Proc. R.S., 1871), who suggested that the discontinuity of the isothermal at temperatures below the critical point was only apparent. He supposed that the extensions of the liquid and vapour curves BM, DN, in Fig. 1a, representing the states of superheated liquid and supersaturated vapour, might theoretically be joined by a continuous curve MN, repre- senting a homogeneous transforma- tion, which, however, could not be realized in practice, as the state of the substance corresponding to this part of the curve would be unstable. Maxwell (Nature, 1875) showed that the straight line BCD repre- senting the saturation-pressure must cut off loops BMC, CND, of equal area from this imaginary isothermal ; otherwise it would be theoretically possible to obtain a balance of work without any difference of temperature by taking the substance through the isothermal cycle BCDNCMB. The theoretical isothermal of James Thomson is qualitatively represented by an equation of the type devised by Van der Waals, in which the mutual attraction of the molecules of a gas is regarded as equivalent to an internal pressure of the form a/v2, which he supposes identical with the capillary pressure of the liquid. It has been found, however, that this simple expression is not sufficiently exact. It is probable that it is not merely a question of varying attraction between similar molecules. A vapour should rather be regarded as containing a certain proportion of compound or co-aggregated mole- cules, which partially dissociate when the pressure is diminished or the temperature raised. A liquid similarly contains dissolved molecules of

vapour, and the state of equilibrium is more nearly analogous to that between conjugate saturated solutions (e.g., water and phenol).

§ 3. Effect of Capillary Pressure. — It was observed by Sir William Thomson (Lord Kelvin) (Phil. Mag., iv. 42, p. 448, 1871) that if a capillary tube is partially immersed in a liquid which rises in the tube to a height h. above the plane surface, and the whole apparatus is contained in an isothermal enclosure, the vapour must be in equilibrium with the liquid both at the plane surface and at the curved surface in the capillary tube. The equilibrium vapour-pressures of the liquid at the two surfaces must therefore differ by an amount equal to the pressure due to a column of vapour of height h. If r is the radius of curvature of the meniscus in the capillary tube (supposed circular in section) at the point where the tangent is horizontal at a height h, and if T is the surface tension, g the acceleration of gravity, t> the density of the liquid, and d that of the vapour, the difference of pressure P between the liquid and vapour due to curvature of the meniscus is given by Laplace's formula

-P=2Tjr=gl

(p-p,)IP=dl(D-d) . . . (2)

If we substitute for d its value mp„jR6, where m is the molecular weight of the vapour and JS=8"Slxl07 C.G.S., and if we put D=T.jlr, where ViB the volume of unit mass of the liquid, neglect- ing the ratio dfD in comparison with unity, we have approximately

(p-Po)/pa=mPV/R0 . . . (3)

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Instead of regarding the effect as being due to the curvature of the surface, we may regard it as being directly due to the change of stress P=ghD in the liquid, in which case d should be omitted in the denominator of (2), and relation (3) is accurate. In the case of water we may deduce from formula (3) that the relative increase of the vapour-

pressure per atmosphere (megadyne) of increase of pres- sure Pis 18/83 x 273 at 0° C, or only 8 parts in 10,000 ; and that it varies inversely as 0, if we neglect the expansion of V. The corre- sponding compression of the liquid is about 1 in 20,000, which is a quantity of a similar order of magnitude, if we remember that the molecules of the liquid are already nearly in contact.

Although we cannot suppose the formula of Laplace to hold accurately for drops of molecular dimensions, this increase of vapour-pressure with curvature in the case of small drops affords a natural explanation of the phenomenon of supersaturated vapour already alluded to. A minute drop of liquid of radius r in a fog or cloud will evaporate unless the vapour-pressure in the sur- rounding gas exceeds the normal saturation-pressure by ITdjrD. Similarly, in order that a fog may form in a moist atmosphere containing dust or ionic nuclei, it is necessary that the temperature should be lowered until the vapour-pressure exceeds that corre- sponding to the temperature by 2Td/rD, where r is the equivalent radius of a nucleus. If there are no dust nuclei present, Wilson (Phil. Trans., 1898) has found that a, very fine fog of a distinct character is formed when the density of the vapour is about four times the saturation value. Assuming Laplace's formula, this would imply the normal presence of nuclei of a radius 4 x 10- 7 cms. This value of r approaches molecular dimensions, and the experiment may be regarded as a corroboration of the view that a vapour contains coaggregated or liquid molecules in solution.

The very considerable superheating of a liquid above its normal boiling-point, which occurs in the absence of dissolved gases, is readily explained as the direct effect of the capillary pressure. The pressure inside a small bubble of radius r must exceed that in the surrounding liquid by 2Tjr, which may be very large for bubbles of molecular dimensions. Moreover, the vapour-pressure inside such a bubble is less than the normal saturation-pressure by 1Td\rD. A liquid free from gas or other suitable nuclei can only evaporate at the surface, and may be considerably superheated, especially if its surface is covered with oil or some liquid of a higher boiling-point which does not mix with it.

~~We may suppose that a relation similar to (3) holds between the vapour-pressure of a solid and the pressure to which it is exposed, although in this case the theoretical or experimental proof would be more difficult, and possibly unsatisfactory. It is easy, however, to see that some such relation is required to correspond with the effect of pressure on the melting-point of a solid. (See Fusion.) The vapour-pressure of the solid at its melting-point, at which it is in equilibrium with the liquid, must be equal to that of the liquid ; otherwise the phase possessing the higher vapour-pressure would evaporate, and the vapour would condense on the phase possessing the lower vapour-pressure, until the whole were trans-formed. Above the melting-point the vapour-pressure of the liquid must be less than that of the solid, as the liquid is the stable phase ; below the melting-point the solid has the lower vapour- pressure. The curves of vapour-pressure of the solid and liquid phases intersect at an angle, and are not continuous as Regnault supposed. The difference of slope of the curves at the melting-point 0O was shown by Kirchhoff (see (24) below) to be L/v0o, where L is the latent heat of fusion and v the specific volume of the vapour. This may also be written Lmpo\R0'io, since pov=R0o/m. Hence if p', p" are the normal vapour-pressures of the solid and liquid respectively at a temperature 8 near the melting-point, the differ- ence (p'-p") due to change of temperature (6—0O) is given by the formula~~

~~(p'-p")IPo=Lm(e-d0)IR6\ . . (4)~~

~~Assuming formula (3) to apply to both liquid and solid, if V is the specific volume of the solid and V" that of the liquid, for the same increase of pressure P the vapour-pressure of the solid is increased by mPV'pJS0, and that of the liquid by mPVp^Se. The difference of vapour-pressure due to P is given by the formula~~

~~(p'-p")lpa = i.V'-V")mPjR0. . . (5)~~

~~If we suppose the pressure P applied by some neutral fluid such as air, the melting-point must change in such a manner that the vapour-pressure of the liquid may be the same as that of the solid at the new melting-point. The difference of vapour-pressures due to change of pressure P must be equal and opposite to that due to change of temperature. Equating the~~

values of (p' -p") in (4) and (5) with a change of sign, we obtain the well-known relation

(e-0o)/0o=(r"-v')PlL ■ ■ • (6)

Since this may be directly deduced from the second law of thermo-dynamics, we conclude that relation (3) correctly represents the change of vapour-pressure of a solid due to pressure P.

The same condition of equality of vapour — pressure evidently applies to other cases of "transition-points," or temperatures at

which two different phases or modifications of a substance are capable of coexisting in equilibrium with each other in presence of the vapour. For instance, the rhombic and monosymmetric forms of sulphur must have the same vapour-pressure at their transition point, 95 '6° C, the difference of slope of the vapour-pressure curves at this point being related to the latent heat of transition in the same manner as in the case of ice and water. Similarly at the transition point of two hydrates — e.g., the hydrates of zinc sulphate with 6 and 7 molecules of water respectively, which can exist in equilibrium with the same saturated solution at 39° C. (see Fusion) — the solubilities must be equal, and the pressure of aqueous vapour in equilibrium with each solid hydrate must be the same as the vapour-pressure of the saturated solution at the transition point.

§ 4. Mixtures and Solutions. — The vapour-pressure of a liquid is not appreciably affected by the presence of another gas or vapour (neglecting the small effect of pressure already discussed), except in so far as the latter is soluble in the liquid. If two liquids which are mutually insoluble evaporate into the same space, the vapour- pressure of each attains its normal saturation value independently of the presence of the other. If each is partially soluble in the other,, the mixture separates into two conjugate solutions, which must have the same vapour-pressure. The vapour-pressure of the mixture in this case is less than the sum of the separate vapour- pressures of the components. A solid dissolved in a liquid produces a similar lowering of vapour-pressure, which has been the subject of many important investigations.

~~The rise of boiling-point produced by substances in solution was demonstrated by Faraday in 1820. Babo, 1847, found that the "relative lowering" of the vapour-pressure of a solution (p-Po)/Pn where p is the vapour-pressure of the solution and p0 that of the pure solvent, at any temperature t, was independent of the temperature for the same solution. Wiillner (Pogg. Ann., 103, p. 529, 1858) found the lowering of vapour-pressure to be nearly proportional to the strength of solution for the same salt. Ostwald, employing Wiillner's results, found the lowering produced by different salts to be approximately the same for solutions of the same concentration C measured in gramme-molecules per c.c. A most important experimental contribution was that of Raoult (Comptes Rendus, 1886, 1887), who employed other solvents than water. He verified the laws of Babo, Wiillner, and Ostwald, except for strong solutions, and showed that the lowering in different solvents was the same for solutions of the same "molecular concentration," for which the ratio of the number of molecules of the dissolved substance or solute to the number of molecules of the solvent in a given volume of solution was the same. These experimental results have been theoretically explained in terms of the osmotic pressure of the solution by Arrhenius, van 't Hoff, and others. The relation of the lowering of vapour pressure to the osmotic pressure may be obtained by reasoning similar to that employed by Lord Kelvin for capillary pressure, and is identical in form with (2) if we regard the osmotic pressure as a diminution of the pressure of the mole- cules of the solvent, due to partial displacement by molecules of the solute. The osmotic pressure P may be measured by the height of a column of the solution maintained by osmosis when a vessel permeable to the solvent but not to the solute is filled with solution and immersed in the pure solvent. If we imagine the whole apparatus to be kept in an isothermal enclosure containing only the vapour of the solvent, the vapour must be in equilibrium with both solution and solvent at different levels, and the vapour- pressure of the solution p must be less -than that of the pure solvent p,,, by the pressure due to a column of vapour (density d), equal in height to the column of solution (density D) maintained by the osmotic pressure. This leads immediately to the relation~~

$$\cancel{(Po-p)IP=dl(D-d)}$$

(7)

which is identical with (2), except that the sign of P is changed, because the osmotic pressure P of the solute is equivalent to a diminution of the concentration pressure of the solvent. The relation in this form is generally true, and includes all cases of abnormal vapour-densities and abnormal osmotic pressures ; but for a considerable lowering of the vapour-pressure, it would be necessary to take account of the variation of density of the vapour, and to a less extent of that of the solution, in the height of the column corresponding to the osmotic pressure. The relation in this form is of little use, as the osmotic pressure cannot readily be measured. But in the case of dilute solutions we may make the usual assumption P=R0C. Since we have also p0=R8djm, the relation takes the simple form

(p«-P)IPo=‘mCjD

(8)

This corresponds approximately with Baoult’s experimental law for dilute solutions, since Djm is the number of gramme-molecules of the solvent per c.c. of the solution. It involves the assumption that the molecules of the solute and the vapour are both normal. The most important exceptions are : (1) electrolytes, the molecules of which in dilute solutions are more or less split up into separate

ions, which act as independent molecules as regards osmotic pressure ; and (2) substances, like acetic acid, with abnormal vapour-densities.

The rise of boiling-point produced by any substance in solution is readily calculated from the lowering of vapour-pressure by dividing it by the increase of pressure per degree of temperature (dp/dd) for the solvent at its boiling-point. As a simple example, if 342 grammes of sugar (one gramme-molecule) are dissolved in 18 litres (1000 gramme-molecules) of

water, the lowering of vapour- pressure at 100° C. is nearly one-thousandth part of the whole pressure, i.e., of 760 mm. The rate of increase of steam-pressure at 100° O. is 27 ‘2 mm. per 1° C. Hence the B.P. of the solution is raised by 760/27 “2 x 1000= -028° C.

§ 5. Total Heat and, Latent Heat. — To effect the conversion of a solid or liquid into a vapour without change of temperature, it is necessary to supply a certain quantity of heat. The quantity required per unit mass of the substance is termed the latent heat of vaporization. The total heat of the saturated vapour at any temperature is usually defined as the quantity of heat required to raise unit mass of the liquid from any convenient zero up to the temperature considered, and then to evaporate it at that temperature under the constant pressure of saturation. The total heat of steam, for instance, is generally reckoned from the state of water at the freezing-point, 0° C. If h denote the heat required to raise the temperature of the liquid from the selected zero to the temperature t° C, and if H denote the total heat and L the latent heat of the vapour, also at t° 0., we have evidently the simple relation

$$H=L+h \quad (9)$$

The pressure under which the liquid is heated makes very little difference to the quantity h, but, in order to make the statement definite, it is desirable to add that the liquid should be heated under a constant pressure equal to the final saturation-pressure of the vapour. The usual definition of total heat applies only to a saturated vapour. For greater simplicity and generality it is desirable to define the total heat of a substance as the function (E+pv), where E is the intrinsic energy and v the volume of unit mass. (See Thermodynamics.) This agrees with the usual definition in the special case of a saturated vapour, if the liquid is heated under the final pressure p, as is generally the case in heat engines and in experimental measurements of H.

The method commonly adopted in measuring the latent heat of a vapour is to condense the vapour at saturation- pressure in a calorimeter. The quantity of heat so measured is the total heat of the vapour reckoned from the final temperature of the calorimeter, and the heat of the liquid h must be subtracted from the total heat measured to find the latent heat of the

vapour at the given temperature. It is necessary to take special pre-cautions to ensure that the vapour is dry or free from drops of liquid. Another method, which is suitable for volatile liquids or low temperatures, is to allow the liquid to evaporate in a calorimeter, and to measure the quantity of heat required for the evaporation of the liquid at the temperature of the calorimeter and at saturation-pressure. The first method may be called the method of condensa- tion. It was applied in the most perfect manner by Kegnault to determine the latent heats of steam and several other vapours at high pressures. The second method may be called the method of evaporation. It is more difficult of application than the first, but has given some good results in the hands of Griffiths l and Dieterici, although the experiments of Eegnault by this method were not very successful.

It was believed for many years, in consequence of some

1 "Latent Heat of Steam," Phil. Trans., A. 1895 ; of "Benzene," Phil. May., 1896.

rough experiments made by Watt, that the total heat of steam was constant. This was known as Watt's law, and was sometimes extended to other vapours. An alternative supposition, due to Southern, was that the latent heat was constant. The very careful experiments of Eegnault, published in 1847, showed that the truth lay somewhere between the two. The formula which he gave for the total heat H of steam at any temperature t° C, which has since been universally accepted and has formed the basis of all tables of the properties of steam, was as follows :

=

S = 606-5 + 0-305< . . . . (10) He obtained similar formulae for other vapours, but the experiments were not so complete or satisfactory as in the case of steam, which may conveniently be taken as a typical vapour in comparing theory and experiment.

§ 6. Total Heat of Ideal Vapour. — It was proved theoretically by Eankine {Proc. B.S.E., vol. xx. p. 173, read February 1850, published 1853) that the increase of the total heat of a saturated vapour between any two temperatures should be equal to the specific heat S of the vapour at

~~constant pressure multiplied by the difference of temperature, provided that the saturated vapour behaved as an ideal gas, and that its specific heat was independent of the pressure and temperature. Ex- pressed in symbols, the relation may be written~~

~~H'-H"=S{6'-8") . . (11)~~

~~This relation gives a linear formula for the variation of the total heat, a result which agrees in form with that found by Kegnault for steam, and implies that the co- efficient of t in his formula should be equal to the specific heat S of steam. Rankine's equation follows directly from the first law of thermodynamics, and may be proved as follows : The heat absorbed in any transformation is the change of intrinsic energy plus the external work done. To find the total heat H of a vapour, we have H = E + p(v — b), where the intrinsic energy E is measured from the selected zero 60 of total heat. The external work done is p(y — b), where p is the constant pressure, v the volume of the vapour at 6, and b the volume of the liquid at 60. If the saturated vapour behaves as a perfect gas, the change of intrinsic energy E depends only on the temperature limits, and is equal to s{6 — 80), where s is the specific heat at constant volume. Taking the difference between the values of H for any two temperatures & and 6", we see that Rankine's result follows immediately, provided that p(v — b) is equal to (S-s)8 or Bd/m, which is approximately true for gases and vapours when v is very large compared with b. We may observe that the equation (11) is accurately true for an ideal vapour, for which pv = (S — s)8, provided that the total heat is defined as equal to the change of the function (E+pv) between the given limits. Adopting this defini- tion, without restriction to the case of an ideal vapour or to saturation-pressure, the rate of variation of the total heat with temperature (dH/d0) at constant pressure is equal to £ under all conditions, whether & is constant, or varies both with p and 6. (See Thermodynamics, § 7.)~~

~~§ 7. Specific Heat of Vapours.- — The question of the measurement of the specific heat of a vapour possesses special interest on account of this simple theoretical relation between the specific heat and the variation of the latent and total heats. The first accurate calculations of the specific heats of air and gases were made by Rankine in a continuation of the~~

paper already quoted. Employing Joule's value of the mechanical equivalent of heat, then recently published, in connexion with the value of the ratio of the specific heats of air S/s = 1-40 deduced from the velocity of sound, Rankine found for air S= -240, which was much smaller

than the best previous determinations (e.g., Delaroche and Berard, S= '267), but agreed very closely with the value £=•238, found by Regnault at a later date. Adopting for steam the same value of the ratio of the specific heats, namely, 1-40, Rankine found £='385, a value which he used, in default of a better, in calculating some of the properties of steam, although he observed that it was much larger than the coefficient 305 in Regnault's formula for the variation of the total heat. The specific heat of steam was determined shortly afterwards by Reg nault (Comptes Eendus, 36, p. 676) by condensing super- heated steam at two different temperatures (about 125° and 225° C.) successively in the same calorimeter at atmospheric pressure, and taking the difference of the total heats observed. The result found in this manner, namely, £=-475, greatly increased the apparent dis- crepancy between Regnault's and Rankine's formulae for the total heat. The discrepancy was also noticed by Kirchhoff, who rediscovered Rankine's formula (Pogg. Ann., 103, p. 185, 1858). He suggested that the high value for S found by Regnault might be due to the presence of damp in his superheated steam, or, on the other hand, that the assumption that steam at low temperatures followed the law pv = R6 might be erroneous. These suggestions have been frequently re- peated, but it is probable that neither is correct. Zeuner, at a later date (La Chaleur, p. 441), employ- ing the empirical formula pv = Bd + Cp'2S for satu- rated steam, found the value #="568, which further increased the discrepancy. Him and Cazin (Ann. Chim. Phys., iv. 10, p. 349, 1867) investigated the form of the adiabatic for steam passing through the state p = 760 mm., 0=373° Abs., by observing the pressure of super- heated steam at any temperature which just failed to produce a cloud on sudden expansion to atmospheric pressure. Assuming an equation of the form log (p/760)=a log (0/373), their results give a = S/B = 4-305, or $= 0-474,

~~which agrees very perfectly with Regnault's value. It must be observed, however, that the agreement is rather more perfect than the com- parative roughness of the method would appear to war- rant. More recently, Macfarlane Gray (Proc. Inst. Mech. Eng., 1889), who has devoted minute attention to the reduction of Regnault's observations, assuming S/s = 1 -400 as the theoretical ratio of specific heats of all vapours on his " ether-pressure theory," has calculated the properties of steam on the assumption S= 0*384. He endeavours to support this value by reference to sixteen of Regnault's observations on the total heat of steam at atmospheric pressure with only 19° to 28° of superheat. These observations give values for S ranging from 0'30 to 0-46, with a mean value 0-3778. But it must be remarked that the superheat of the steam in these ex- periments is only 1 or 2 per cent, of the total heat measured. A similar objection applies, though with less force, to Regnault's main experiments between 125° and 225° C, giving the value &= 0-475, in which the superheat (on which the value of S depends) is only one-sixteenth of the total heat measured. Gray explains the higher value found by Regnault over the higher range as due to the presence of particles of moisture in the steam, which he thinks " would not be evaporated up to 124° C, but would be more likely to be evaporated in the higher range of temperature." Perry (Steam Engine, p. 580), assuming a characteristic equation similar to Zeuner's (which makes v a linear function of the tempera- ture at constant pressure, and S independent of the pres- sure), calculates S as a function of the temperature to satisfy Regnault's formula (10) for the total heat. This method is logically consistent, and gives values ranging~~

~~from 0-305 at 0° to 0-341 at 100° C. and 0-464 at 210° C, but the difference from Regnault's £= 0'475 cannot easily be explained.~~

~~§ 8. Throttling Calorimeter Method.— The ideal method of determining by direct experiment the relation between the total heat and the specific heat of a vapour is that of Joule and Thomson, which is more commonly known in connexion with steam as the method of the throttling calorimeter. It was first employed in the case of steam by Peabody as a means of estimating the wetness of saturated steam, which is an important factor in testing the performance of an engine. If steam or~~

~~vapour is " wire-drawn " or expanded through a porous plug or thro]ttling aperture without external loss or gain of heat, the total heat (E+pv) remains constant (Thbemo- dynamics, § 11), provided that the experiment is arranged so that the kinetic energy of flow is the same on either side of the throttle. Thus, starting with saturated steam~~

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~~180~~

~~Fig. 2.— Throttling Calorimeter Method.~~

at a temperature & and pressure p, as represented by the point A on the pB diagram (Fig. 2), if the point B repre- sent the state p"6" after passing the throttle, the total heat at A is the same as that at B, and exceeds that at any other point D (at the same pressure p" as at B, but at a lower temperature ff) by the amount S(6" — ff), which would be required to raise the temperature from D to B at constant pressure. We have therefore the simple rela- tion between the total heats at A and D —

BA- HD = S{6" -B).

■ (12)

If the steam at A contains a fraction z of suspended mois- ture, the total heat HA is less than the value for dry saturated steam at A by the amount zL. If the steam at A were dry and saturated, we should have, assuming Regnault's formula (10), HA-HD = -2>0f> (ff-6), whence, if S = -475, we have zL = -305 (ff—6) — -475 (ff" — ff). It is evident that this is a very delicate method of determin- ing the wetness z, but, since with dry saturated steam at low pressures this formula always gives negative values of the wetness, it is clear that Regnault's numerical' co-efficients must be wrong.

From a different point of view, equation (12) may be applied to determine the specific heat of steam in terms of the rate of variation of the total heat. If we assume Regnault's formula (10) for the total heat, we have evidently the simple relation 5=0-305 (ff—ff)/(ff"—ff), supposing the initial steam to be dry, or at least of the same

quality as that employed by Regnault. This method was applied by Ewing \B.A. Rep., 1897) to steam near 100° C. He found the specific heat smaller than 0-475, but no numerical results were given. A very complete investiga- tion on the same lines was carried out by Grindley (Phil. Trans., 1900) at Owens College under the direc- tion of Osborne Eeynolds. Assuming dH/d$ = 0-305 for saturated steam, he found that £

was nearly independent of the pressure at constant temperature, but that it varied with the temperature from 0-387 at 100° C. to 0-665 at 160° C. Writing Q for the Joule-Thomson "cooling effect," d0/dp, or the slope BC/AC of the line of constant total heat, he found that Q was nearly independent of the pressure at constant temperature, a result which agrees with that of Joule and Thomson for air and C02 ; but that it varied with the temperature as (1/0)3-8 instead of (I/O)1. These results for the variation of Q are inde- pendent of any assumption with regard to the variation of H. Employing the values of S calculated from dHfdd = 0,305, he found that the product SQ was inde- pendent of both pressure and temperature for the range of his experiments. Assuming this result to hold generally, we should have S = 0'306 at 0° O, which agrees with Rankine's view ; but increasing very rapidly at higher temperatures to £= 1-043 at 200° O, and 1-315 at 220° C. The characteristic equation, if SQ = constant, would be of the form (y + SQ) = Rd/p, which does not agree with the well-known behaviour of other gases and vapours. Whatever may be the objections to Eegnault's method of measuring the specific heat of a vapour, it seems impossible to reconcile so wide a range of variation of S with his value 5=0-475 between 125° and 225° C. It is also extremely unlikely that a vapour which is so stable a chemical compound as steam should show so wide a range of variation of specific heat. The experimental results of Grindley with regard to the mode of variation of Q have been independently confirmed by Callendar (Proc. R.S., 1900), who quotes the results of similar experiments made at McGill College in 1897, but gives an entirely different interpretation, based on a direct measurement of the specific heat at 100° C. by an electrical method.

The method of deducing the specific heat from Reg- nault's formula for the variation of the total heat is evidently liable in a greater degree to the objections which have been urged against his method of determining the specific heat, since it makes the value of the specific ! heat depend on small differences of total heat observed under conditions of greater difficulty at various pressures. I The more logical method of procedure is to determine the specific heat independently of the total heat, and then to deduce the variations of total heat by equation (12). The simplest method of measuring the specific heat appears to be that of supplying heat electrically to a steady current of vapour in a vacuum-jacket calorimeter,

~~and observing the rise of temperature produced. Employing this method, Callendar finds 6' = 0-497 for steam at one atmosphere between 103° C. and 113° C. This is about 4 per cent, larger than Regnault's value, but is not really incon- sistent with it, if we suppose that the specific heat at any given pressure diminishes slightly with rise of tempera- ture, as indicated in formula (16) below.~~

~~§ 9. Corrected Equation of Total Heat. — Admitting the value »S=0-497 for the specific heat at 108* C, it is clear that the form of Eegnault's equation (10) must be wrong, although the numerical value of the coefficient 0-305 may approximately represent the average rate of variation over the range (100° to 190 0.) of the experiments on which it chiefly depends. Eegnault's experiments at lower temperatures were extremely discordant, and have been shown by the work of Griffiths (Proc. U.S., 1894) and Dieteriol (Wied. Ann., 37, p. 504, 1889) to give values of the total heat 10~~

~~to 6 calories too large between 0° and 40° 0. At low pressures and temperatures it is probable that saturated steam behaves very nearly as an ideal gas, and that the variation of the total heat is closely represented by Eankine's equation with the ideal value of S. In order to correct this equation for the deviations of the vapour from the ideal state at higher temperatures and pressures, the simplest method is to assume a modified equation of the Joule-Thomson type (Thermodynamics, equation (17)), which has been shown to represent satisfactorily the behaviour of other gases and vapours at moderate pressures. Employing this type of equation, all the thermodynamical properties of the substance may conveniently be expressed in terms of the diminution of volume c due to the formation of compound or coaggregated molecules~~

~~(v — b)=Reip-c0(8jey= v- c~~

~~(13)~~

~~The index n in the above formula, representing the rate of variation of c with temperature, is approximately the same as that express- ing the rate of variation of the cooling effect Q, which is nearly proportional to c, and is given by the formula~~

~~SQ=(n + l)c-b . . . (14)~~

~~The corresponding formula for the total heat is~~

~~H-H0=S0(8-80)-{n + \)(cp-c0p0) + b(p-p0) . (15)~~

~~and for the variation of the specific heat with pressure~~

~~S=SB + n[n + l)pclB . . . (16)~~

~~where S0 is the value of S when p=o, and is assumed to be inde- pendent of 6, as in the case of an ideal gas.~~

~~Callendar's experiments on the cooling effect for steam by the throttling calorimeter method gave m=3'33 and c = 26'3 c.c. at 100° C. Grindley's experiments gave nearly the same average value of Q over his experimental range, but a rather larger value for to, namely, 3-8. For purposes of calculation, Callendar (Proc. R.S. 1900) adopted the mean value to=3'5, and also assumed the specific heat at constant volume s = 3-5 R (which gives~~

~~Values calculated from these formulae are given in the table below. The values of H at 0° and 40° agree fairly with those found byDieterici (596 -7) and Griffiths (613-2) respectively, but differ considerably from Eegnault's values 606-5 and 618-7. The rate of increase of the total heat, instead of being constant for saturated steam as in Eegnault's formula, is given by the equation~~

~~dlHjdB = S{-QdpldB) .~~

~~(17)~~

~~and diminishes from 0'478 at 0° C. to about 0'40 at 100° and 0'20 at 200° C, decreasing more rapidly at higher temperatures. The mean value, 0'313 of dH/dB, between 100 and 200° agrees fairly well with Eegnault's coefficient 0-305, but it is clear that consider- able errors in calculating the wetness of steam or the amount of cylinder condensation would result from assuming this important coefficient to be constant. The rate of~~

change of the latent heat is easily deduced from that of the total heat by subtracting the specific heat of the liquid. Since the specific heat of the liquid increases rapidly at high temperatures, while dHfdd diminishes, it is clear that the latent heat must diminish more and more rapidly as the critical point is approached. Eegnault's formula for the total heat is here again seen to be inadmissible, as it would make the latent heat of steam vanish at about 870° C. instead of at 365° C. It should be observed, however, that the assumptions made in deducing the above formulae apply only for moderate pressures, and that the formulas cannot be employed up to the critical point owing to the uncertainty of the variation of the specific heats and the cooling effect Q at high pressures beyond the experimental range. Many attempts have been made to construct formulfe representing the deviations of vapours from the ideal state up to the critical point. One of the most complete is that proposed by Clausius, which may be written

RBjp — v = RB(v b){A BBn)/p(v + a)*8»

(18),

but such formulfe are much too complicated to be of any praotioal use, and are too empirical in their nature to permit of the direct physical interpretation of the constants they contain.

§ 10. Empirical Formulae for the Saturation-Pressure. — The values of the saturation-pressure have been very accurately determined for the majority of stable sub- stances, and a large number of empirical formulae have been proposed to represent the relation between pressure and temperature. These formulae are important on account of the labour and ingenuity expended in devising the most suitable types, and also as a convenient means of recording the experimental data. In the following list, which contains a few typical examples, the different for- mulae are arranged to give the logarithm of the saturation- pressure p in terms of the absolute temperature 6. As originally proposed, many of these

~~formulae were cast in exponential form, but the adoption of the logarithmic method of expression throughout the list serves to show more clearly the relationship between the various types.~~

~~log p =A+B0 . . . log p=G log (A + B0) . ‘ . log p=A0/(B + C0) \ogp=A+BW + CcO , log p= A +BI0 + C/0* . \ogp=A+BI0 + C\og6 log p=A+B/8<> . \ogp=A + B\og6 + C\og{8+c) log p= A + Bj{0 + C) .~~

~~(Dalton, 1800) . . (19)~~

~~(Young, 1820)~~

~~(Roche, 1830)~~

~~(Biot, 1844 ; Eegnault)~~

~~(Eankine, 1849)~~

~~(Kirchhoff, 1858 ; Eankine, 1866)~~

~~(Unwin, 1887)~~

~~(Bertrand, 1887)~~

~~(Antoine, 1888)~~

~~The formula of Dalton would make the pressure increase in geometrical progression for equal increments of tempera- ture. In other words, the increase of pressure per degree {dp/dff) divided by p should be constant and equal to B, but observation shows that this ratio decreases, e.g., from 0-0722 at 0° C. to 0-0357 at 100° C. in the case of steam. Observing that this rate of diminution is approximately as the square of the reciprocal of the absolute tempera- ture, we see that the almost equally simple formula log p = A+ B/d represents a much closer approximation to experiment. As a matter of fact, the two terms A + B/d are the most important in the theoretical ex- pression for the vapour-pressure given below. They are not sufficient alone, but give good results when modified, as in the simple and accurate formulae of Eankine, Kirchhoff, Antoine, and Unwin. If we assume formulae of the simple type A + B/6 for two different substances,~~

which have the same vapour-pressure p at the absolute temperatures ff and 6" respectively, we may write

logp=A' + E\0' = A" + B"/8"

(20)

from which we deduce that the ratio ff/6" of the tem- peratures, at which the vapour-pressures are the same, is a linear function of the temperature & of one of the sub- stances. This approximate relation has been employed by Eamsay and Young (Phil. Mag., 1887) to deduce the vapour-pressures of any substance from those of a standard substance, by means of two observations. More recently the same method has been applied by Findlay (Proc. U.S., 1902), under Ramsay's direction, for comparing solubilities which are in many respects analogous to vapour-pressures. The formulae of Young and Roche are purely empirical, but give very fair results over a wide range. That of Biot is far more complicated and troublesome, but admits greater accuracy of adaptation, as it contains five con- stants (or six, if 6 is measured from an arbitrary zero). It is important as having been adopted by Regnault (and also by many subsequent calculators) for the expression of his observations on the vapour-pressures of steam and various other substances. The formulae of Rankine and Unwin, though probably less accurate over the whole range, are much simpler and more convenient in practice than that of Biot, and give results which suffice in accuracy for the majority of purposes.

§ 11. Theoretical Equation for the Saturation-Pressure. — The empirical formulae above quoted must be compared and tested in the light of the theoretical relation between the latent heat and the rate of increase of the fapour- pressure (dp/dd), which is given by the second law oi thermodynamics, namely,

e(dp/d8)=LI(v-w),

(21)

in which v and w are the volumes of unit mass of the vapour and liquid respectively at the saturation-point (Thermodynamics, § 4). This relation

cannot be directly integrated, so as to obtain the equation for the saturation- pressure, unless L and v — w are known as functions of 6. Since it is much easier to measure p than either L or v, the relation has generally been employed for deducing either L or v from observations of p. For instance, it is usual to calculate the specific volumes of saturated steam by assuming Regnault's formulae for p and L. The values so found are necessarily erroneous if formula (10) for the total heat is wrong. The reason for adopt- ing this method is that the specific volume of a saturated vapour cannot be directly measured with sufficient accuracy on account of the readiness with which it condenses on the surface of the containing vessel. The specific volumes of superheated vapours may, however, be measured with a satisfactory degree of approximation. The deviations from the ideal volume may also be deduced by the method of Joule and Thomson. It is found by these methods that the behaviour of superheated vapours closely re- sembles that of non-condensible gases, and it is a fair inference that similar behaviour would be observed up to the saturation-point if surface condensation could be avoided. By assuming suitable forms of the char- acteristic equation to represent the variations of the specific volume within certain limits of pressure and temperature, we may therefore with propriety deduce equations to represent the saturation-pressure, which will certainly be thermodynamically consistent, and will probably give correct numerical results within the assigned limits.

The simplest assumptions to make are that the vapour behaves as a perfect gas (or that p(v — w) = R9), and that L is constant. This leads immediately to the simple formula,

log, (p/p0) = (l/<>0- 1/0) L/B, . . (22)

which is of the same type as log p = A + B/6, and shows that the coefficient B should be equal to L/R. A formula of this type has been widely employed by van 't Hoff and others to calculate heats of reaction and solution from observations of solubility and vice versa. It is obvious, however, that the assumption L = constant is not suf- ficiently accurate in many cases. The rate of variation of the latent heat at low pressures is equal to S — si, where si is the specific heat of the liquid. Under these

conditions both S and si may be regarded as approxi- mately constant, so that L is a linear function of the temperature. Substituting L = L0 + {S-si) {6 — 60), and integrating between limits, we obtain the result

where

logep=A +Ble+oioga e,

C=()Sr-s!)/i?15= -[L,, + (si-S)80yR,tma A = log. p. — Bj80 — O log, 0„.

(23)

A formula of this type was first obtained by Kirchhoff {Pogg. Ann., 103, p. 185, 1858) to represent the vapour- pressure of a solution, and was verified by Regnault's experiments on solutions of H2S04 in water, in which case a constant, the heat of dilution, is added to the latent heat. The formula evidently applies to the vapour-pressure

of the pure solvent as a special case, but Kirchhoff himself does not appear to have made this particular application of the formula. In the paper -which immediately follows, he gives the oft-quoted expression for the difference of slope (dp/dff)s — (dp/dff)i of the vapour-pressure curves of a solid and liquid at the triple point, which is imme- diately, deducible from (21), namely,

e{dp/de)s — 6{dp/de), = (L, — Z,)l(v -w) = Lf/(v — w) . (24),

in which Ls and Li are the latent heats of vaporization of the solid and liquid respectively, the difference of which is equal to the latent heat of fusion Lf. He proceeds to calculate from this expression the difference of vapour- pressures of ice and water in the immediate neighbour- hood of the melting-point, but does not observe that the vapour-pressures themselves may be more accurately cal- culated for a considerable interval of temperature by means of formula (23), by substituting the

appropriate values of the latent heats and specific heats. Taking for ice and water the following numerical data, Zrs=674‘7, Li= 595-2, i/=79-5, .# = 0-1103 cal/deg., #, = 4-61 mm., si — £=-519 cal/deg., and assuming the specific heat of ice to be equal to that of steam at constant pressure (which is sufficiently approximate since the term involv- ing the difference of the specific heats is very small), we obtain the following numerical formulae, by substitution in (23),

Ice. . . loglop=O,664O + 9-73«/0,

Water . log10^=0-6640 + 8-585 2/0-4-70 (log10 0/0„-Jft/0),

where «= 6 — 273, and M = -4343, the modulus of common logarithms. These formulae are practically accurate for a range of 20° or 30° C. on either side of the melting-point, as the pressure is so small that the vapour may be treated as an ideal gas. They give the following numerical values :

—

Temperature, C.

-20°

-10°

0°

+ 10°

+ 20°

V.P. of ice, mms.

0-79

1-97

4-61

10-20

~~21-27~~

~~V.P. of water, mms.~~

~~0-96~~

2-17

4-61

9-27

17-58

The error of the formula for water is less than 1 mm. (or a tenth of a degree C), at a temperature so high as 60° C.

Formula (23) for the vapour-pressure was subsequently deduced by Eankine (Phil. Mag., 1866), by combining his equation (11) for the total heat of gasefication with (21), and assuming an ideal vapour. A formula of the same type was given by Dupre1 (Thiorie de Chaleur, p. 96, Paris, 1869), on the assumption that the latent heat was a linear function of the temperature, taking the instance of Kegnault's formula (10) for steam. It is generally called Dupr^'s formula in Continental text-books, but he did not give the values of the coefficients in terms of the difference of specific heats of the liquid and vapour. It was employed as a purely empirical formula by Bertrand and Barus, who calculated the values of the coefficients for several substances, so as to obtain the best general agreement with the results of observation over a wide range, at high as well as low pressures. Applied in this manner, the formula is not appropriate or satisfactory. The values of the coefficients given by Bertrand, for instance, in the formula for steam, correspond to the values S='57Q and £ = 573 at 0° C, which are im possible, and the values of p given by his formula (e.g., 763 mm. at 100° C.) do not agree sufficiently with experiment to be of much practical value. The true application of the formula is to low pressures, at which it is very accurate. The close agreement found under these conditions is a very strong confirmation of the correctness of the assumption that a vapour at low

pressures does really behave as an ideal gas of constant specific beat. The formula was independently redis- covered by Hertz (Wied. Ann., 17, p. 177, 1882) in a slightly different form, and appropriately applied to the

calculation of the vapour-pressures of mercury at ordinary temperatures, where they are much too small to be accu- rately measured.

§ 12. Corrected Equation of Saturation-Pressure. — The approxi- mate equation of Eankine (23) begins to be 1 or 2 per cent, in error at the boiling-point under atmospheric pressure, owing to the coaggregation of the molecules of the vapour and the variation of the specific heat of the liquid. The errors from both causes increase more rapidly at higher temperatures. It is easy, however, to correct the formula for these deviations, and to make it thermodynamically consistent with the characteristic equation (13) by substituting the appropriate values of (v-w) and L = II-h from equations (13) and (15) in formula (21) before integrating. Omitting w and neglecting the small variation of the specific heat of the liquid, the result is simply the addition of the term (e — b)j V to formula (23)

logp = A +BJ9 + Clog e + (c-b)jV

(25)

The values of the coefficients B and C remain practically as before. The value of e is determined by the throttling experiments, so that all the coefficients in the formula with the exception of A are determined independently of any observations of the saturation- pressure itself. The value of A for steam is determined by the consideration that^)=760 mm. by definition at 100° C. or 373° Abs. The most uncertain data are the variation of the specific heat of the liquid and the value of the small quantity b in the formula (13). The term 6, however, is only 4 per cent, of s at 100° C, and the error involved in taking b equal to the volume of the liquid is probably small. The effect of variation of the specific heat is more important, but is nearly eliminated by the form of the equation. If we write h=s„t+dh, where s0 is a selected constant value of the specific heat of the liquid, and dh represents the difference of the actual value of h at t from the ideal value s„t, and if we similarly write for the entropy of the liquid at t, where d represents the corresponding difference in the entropy (which is easily calculated from a table of values of h), it is shown by Callendar {Proc. B. S. , 1900, loc. cit.) that the effect of the variation of the specific heat of the liquid is represented in the equation for the

vapour-pressure by adding to the right-hand side of (23) the term — (dtp — dhj6)/£. If we proceed instead by the method of integrating the equation H-h=8(v-w)dp/d8, we observe that the expression above given results from the integration of the terms — dh\Rffi + w(dpjde)jR$, which were omitted in (25). Adopting the formula of Regnault as corrected by Callendar (Phil. Trans. U.S., 1902) for the specific heat of water between 100° and 200° C, we find the values of the difference (dcj> — dhjS) to be less than one-tenth of d(j> at 200° C. The whole correction is therefore probably of the same order as the uncertainty of the variation of the specific heat itself at these temperatures. It may be observed that the correc- tion would vanish if we could write dh = wBdpld6=wLj(v-w). This assumption is made by Gray (Proc. Inst. C.E., 1902). It is equivalent, as Callendar (loc. cit.) points out, to supposing that the variation of the specific heat is due to the formation and solution of a mass wj(v-w) of vapour molecules per unit mass of the liquid. But this neglects the latent heat of solution, unless we may suppose it included by writing the internal latent heat Lt in place of L in Calendar's formula. In any case the correction may probably be neglected for practical purposes below 200° C.

It is interesting to remark that the simple result found in equa- tion (25) (according to which the effect of the deviation of the vapour from the ideal state is represented by the addition of the term (c — b)j V to the expression for log p) is independent of the assumption that c varies inversely as the n^- power of 6, and is true generally provided that c — b is a function of the temperature x only and is independent of the pressure. But in order to deduce the values of c by the Joule-Thomson method, it is necessary to assume an empirical formula, and the type c=c0(0„[8)n is chosen as being the simplest. The justification of this assumption lies in the fact that the values of c found in this manner, when substituted in equation (25) for the saturation-pressure, give correct results for p within the probable limits of error of Reg- nault's experiments.

§ 13. Numerical Application to Steam. — As an instance of the application of the method above described, the results in the table below are calculated for steam, starting from the following funda- mental data: — p = 760 mm. at t=!00° C. or 373-0° Abs. pVJ9 = 0-11030 calories per

degree for ideal steam. jS„=0-478 calories per degree at zero pressure, i = 540‘2 calories at 100° C. (Joly- Callendar), re=3-33, 0,00 = 26-30 c.c, & = 1 c.c, A=0-9970i+ wL/(v — w). 750 mm. Eg. = 1 megadyne per sq. cm.

V A R — V AHIATION

633

1

‘able of

Properties of Saturated Steam.

Temp.

Coaggrega-

Total

Latent

Specific

Saturation-

Cent.

tion, c

Heat, H

Heat, L

Heat, S

Pressure, p

cub. cms.

~~calories.~~

~~calories.~~

~~cals/deg.~~

~~mm. of Hg.~~

~~0°~~

~~74·43~~

~~595·2~~

~~595·2~~

~~·4786~~

~~4·6~~

~~20°~~

~~58·81~~

~~604·7~~

~~584·7~~

~~·4796~~

~~17·6~~

~~40°~~

~~47·19~~

~~614·0~~

~~574·0~~

■4818

55-4

60°

38-68

623-1

563-1

•4860

149-4

80"

31-60

631-9

551-9

•4926

355-0

100°

26-30

640-3

540-2

•5027

760-0

~~120°~~

~~21-93~~

~~648-1~~

~~527-8~~

~~•5163~~

~~1490-4~~

~~140°~~

~~18-73~~

~~655-1~~

~~514-5~~

~~•5347~~

~~2715-8~~

~~160°~~

~~16-00~~

~~661-4~~

~~500-3~~

~~•5571~~

~~4647~~

~~180°~~

~~13-76~~

666·9

485·3

·5834

7534

200°

11·92

671·6

469·3

·6134

11660

The values of the coaggregation volume c, which form the start ing-point of the calculation, are found by taking w=10/3 for con- venience of division in formula (13). The unit of heat assumed in the table is the calorie at 20° C., which is taken as equal to 4·180 joules, as explained in the article Calorimetry. The latent heat L (formula 9) is found by subtracting from H (equation 15) the values of the heat of the liquid h given in the same article. The values of the specific heat in the next column are calculated for a constant pressure equal to that of saturation by formula (16) to illustrate the increase of the specific heat with rise of pressure. The specific heat at any given pressure diminishes with rise of temperature. The values of the saturation-pressure given in the last column are calculated by formula (25), which agrees with Kegnault's observations better than his own empirical formulae. The agreement of the values of S with those of Griffiths and Dieterici at low temperatures, and of the values of p with those of Regnault over the whole range, are a confirmation of the accuracy of the foregoing theory, and show that the behaviour of a vapour like steam may be represented by a series of thermo- dynamically consistent formulae, on the assumption that the

limiting value of the specific heat is constant, and that the isothermals are generally similar in form to those of other gases and vapours at moderate pressures. Although it is not possible to represent the properties of steam in this manner up to the critical temperature, the above method appears more satisfactory than the adoption of the inconsistent and purely empirical formulae which form the basis of most tables at the present time.

A similar method of calculation might be applied to deduce the thermodynamical properties of other vapours, but the required experimental data are in most cases very imperfect or even entirely wanting. The calorimetrio data are generally the most deficient and difficult to secure. An immense mass of material has been collected on the subject of vapour-pressures and densities, the greater part of which will be found in Winkelmann's Handbook, vol. ii., and in similar compendiums. The results vary greatly in accuracy, and are frequently vitiated by errors of temperature measurement, by chemical impurities and surface condensation, or by peculiarities of the empirical formulae employed in smoothing the observations ; but it would not be within the scope of the present article to discuss these details. Even at the boiling-points the discrepancies between different observers are frequently considerable. The following table contains the most probable values for a few of these points which have been determined with the greatest care or frequency : —

Table of Boiling-Points at Atmospheric Pressure

on Centigrade Scale.

Hydrogen Oxygen . C02 . S02 . Aniline Naphthalene

-252° -6 -182°-8 -78°-3 -10°-0 + 184°'l + 218°-0

Benzophenone Mercury . Sulphur . Cadmium. Zinc .

+ 305°-8 + 356° -7 + 444°-5 + 756° + 916°

Alphabetical Index of Symbols.

~~A, B, C, Empirical constants in formulae ; section (10).~~

~~b, Minimum volume or co-volume of vapour,~~

~~tion (13).~~

~~C, Concentration of solution, gm. mols. per c.c.~~

~~c, Coaggregation-volume of vapour, equation (13). D, d, Density of liquid and vapour.~~

~~E, Intrinsic energy of vapour.~~

~~g, Acceleration of gravity.~~

~~H, Total heat of vapour.~~

~~h, Heat of the liquid ; height of capillary ascent~~

~~L, Latent heat of vaporization.~~

~~M, Modulus of logarithms.~~

~~m, Molecular weight.~~

~~equa-~~

~~P,~~

~~P,~~

~~Q, R, r, S,~~

~~T, t, V,~~

~~i>, w,~~

~~c, 4>,~~

~~Index of B in expression for c, equation (13).~~

~~*Osmotic or capillary pressure.*~~

~~*Pressure of vapour.*~~

~~*Cooling effect in adiathermal expansion.*~~

~~*Constant in gas equation, pv=RS.*~~

~~*Radius of curvature, formula (1).*~~

~~*Specific heat of vapour at constant pressure.*~~

~~*Specific heat of liquid, equation (23) ;*~~

~~*Specific heat of vapour at constant volume, § 8.*~~

~~*Surface tension of liquid.*~~

~~*Temperature Centigrade.*~~

~~*Ideal volume of vapour, equation (13).*~~

~~*Specific volume of solid or liquid, equation (5).*~~

~~*Specific volume of vapour or steam.*~~

~~*Specific volume of water or liquid.*~~

~~*Temperature on thermodynamic scale.*~~

~~*Entropy of vapour or liquid.*~~

~~*(h. L. C.)*~~

~~*Var, a department of the south-east of France, border- ing on the Mediterranean, and crossed by the offshoots of the Alps.*~~

~~*Area, 2334 square miles. Owing to Italian immigration, the population increased from 283,689 in 1886 to 325,490 in 1901. But the births in*~~

1899, numbering 6074, of which 435 were illegiti- mate, were fewer than the deaths, which amounted to 7044 ; marriages numbered 2252. The primary schools in 1896 numbered 474, with 34,000 pupils, 4 per cent, of the population being illiterate. There were 1,170,780 acres under cultivation in 1896, but only 350,740 acres were arable and 106,210 acres under vines, most of the remainder being covered with wood. In 1901 the vineyards yielded 29J million gallons of wine. The wheat grown in 1899 was valued at only £252,000 ; oats, £24,000 ; potatoes, £65,000 ; vines, £1,016,000; chestnuts, £24,200; plums, £2120; mulberry leaves, £14,500. Sericulture produced (1899) 8520 cwt. of cocoons. The live-stock numbered 10,100 horses, 8810 mules, 3450 asses, 2480 cattle, 193,400 sheep, 20,450 pigs, and 14,550 goats. There was mined in 1898, 3300 metric tons of lignite, 5865 tons of iron, which, with sea-salt and other substances, yielded a revenue of £63,000. There are, however, no important furnaces. The in- dustries of consequence are in paper, silk, and soap. Draguignan, the capital, had in 1901, 9671 inhabitants, and Toulon 101,172.

Varese, a town of the province of Como, Lombardy, Italy, 18 miles by rail west of Como and 37 north-west of Milan. It is a well-to-do place, planted in a beautiful situation near the Lake of Varese, and for this reason a favourite autumn resort of the Milanese, who have numerous country houses in the vicinity. The principal church is the basilica of St Victor (originally 7th century ; rebuilt 1580-1615 and 1795), to which is attached an ancient baptistery (9th and 13th centuries). There are other churches, an archaeological museum, a school of the industrial arts, and a theatre. Varese is the seat of active silk-spinning, tanning, paper-making, and the manufacture of organs and vehicles. Excellent wine is made. Large weekly markets are held. Population (1881), 8877; (1900), about 10,000.

Variation and Selection.—(l) The term

Variation, as used in biology, means the occurrence of individual animals or plants which differ from the "type" proper to their race or species. The diagnosis of a species given by most systematic zoo- logists is either an enumeration of characters which distinguish a certain individual called the "type" from members of other known species, or a statement, gained

from a study of numerous individuals, of the characters by which all these individuals differ from members of other species. In either case individuals which do not present exactly those characters described in the diagnosis of their species are said to vary. The conception of a specific or racial type, when it is not based upon a single specimen, is seldom clearly defined by zoologists ; several possible definitions will be discussed in the next paragraph.

For the purposes of comparative morphology, which endeavours to present the main facts of animal structure

in an intelligible form, it is necessary to consider species as if every individual were "typical," since the general facts can only be realized after some such process of simplification. For other purposes, such a treatment of species is altogether inadequate. The production of a regular series of variations, under given environmental conditions, is a property of species as constant as the production of typical individuals, and if we wish to study the relation between a race or species and its environment, or to test any theory of organic evolution, we must know the extent and frequency of such variations, as well as the frequency of the type.

(2) The characters of individual animals or plants depend upon so many complex conditions, mdst of which are generally unknown to us, that the statements we can make concerning them are of a peculiar kind. We cannot predict with any exactness the characters of a single unborn individual ; but if we consider a large number of unborn individuals, we can predict with con- siderable accuracy the percentage of individuals which will have the mean character proper to their generation, or will differ from that mean character within any assigned limits. So long as we confine our attention to one or two individuals, we fail to detect any order in the occurrence of variations ; but when we examine large numbers we find that it is possible to arrange them in an orderly series, which can be

~~easily and simply de- scribed. The series, into which we can arrange the results of observing phenomena of complex causation, whether exhibited by living organisms or not, have certain properties in common, which are dealt with by the theory of chance. Many of the properties of such series, and the methods of describing them, are dealt with in the article Error, Law op (vol. xxiii.) ; and the frequency with which the mean value or any deviation from the mean value of a character occurs in a race of animals or of plants may probably always be expressed in terms of one or other of the series there described. The theory of chance was applied to the study of human variation by Quetelet; but the most important applications of this theory to biological problems are due in the first instance to Mr Francis Galton, who first used the theory of correlation (cf. article Error, Law op, §§ 7, 8, and 18, 19) in describing the relation between the deviation of one character in an animal body from the mean proper to its race and that of a second character in the same body (correlation as com- monly understood), or between deviation of a parent from the mean of its generation and deviation of offspring from the mean of the following generation (inheritance). The conceptions indicated by Mr Galton have been extended and added to by Professor Karl Pearson, who has also developed the theory of chance so as to provide a means of describing many series of complex results in a simpler and more accurate way than was hitherto possible. The great majority of organic variations require for their description the formulae developed by him and described in the article Error, Law of, §§ 52-54.~~

~~(3) The conception of a race of animals or of plants as a group of individuals capable "of being arranged in an orderly series with respect to the condition of a particular character enables us to define the "type" of that character proper to the race. Table I. shows the number of female swine which had a given number of " Miiller's glands " on the right fore leg, in a sample of 2000 swine observed by Davenport in Chicago. If we take the whole number of glands in the series, and divide this by the whole number of swine, we obtain the mean number of glands per swine. For many purposes this is the most convenient " type " of the series.~~

~~Table I.~~

~~Number of~~

~~Number of~~

~~Number of~~

~~Glands.~~

~~Swine.~~

~~Glands.~~

~~Swine.~~

~~0~~

~~15~~

~~6~~

~~134~~

~~1~~

~~209~~

~~7~~

~~72~~

~~2~~

~~365~~

~~8~~

~~22~~

~~3~~

482

9

8

4

414

10

2

5

277

Two other ways of determining a “type” will be obvious by reference to the diagram, Fig. 1, in which the observed results are recorded by the thick continuous line, and the form of Pearson’s ” generalized probability curve ” best fitted to represent them by a dotted line. The ordinate

,‘j

1

♦ 00

S / 1 I

1

1

1

j

t

»/ it

t

J

t

■

t

t

n

i t

t

h

- ***h***

h

a

a

s

- ***Scale or Glands***

Fig. 1

of the dotted curve which contains its " centre of gravity " has, of course, for its abscissa the " mean " number of glands ; the maximum ordinate of the curve is, however, at 2 -98, or sensibly at 3 glands, showing what Pearson has called the " modal " number of glands, or the number occurring most frequently. The ordinate which divides the area of the dotted curve into two equal areas is the median of Galton : it lies in this case nearly at 3-38 glands. The best simple measure of the frequency of deviations from the mean character is the "standard^ deviation " or " error of mean square " of the system (see article Probability), in this case equal to 1 "68 glands.

In cases of nearly symmetrical distribution about the mean, the three "types," the mean, the median, and the mode, may sensibly coincide. For example, in Powis's table of the frequency of statures in male Australian criminals between 40 and 50 years of age (Biometrika, vol. i., part 1, p. 41), the mean stature is 66-91 inches, the modal 66'96 inches, the median lying between the two. In other cases the difference between the three may be considerable. As an example of extreme asymmetry we may take De Vries's record of the frequency with which given numbers of petals occur in a certain race of butter- cups. Pearson has shown {Phil. Trans., A., 1893) that this frequency may be closely represented by the curve whose equation is

2/ = 0-211225a: "°'332(7-3253-a;)s'U2.

The curve, and the observations it represents, are drawn in Fig. 2. The two are compared numerically in Table II. Here the mode is at 4-5 petals, the mean at 5"6 petals, the median lying of course between the two.

VARIATION and SELECTION

635

Table II.

Numbers of petals .

~~5~~

~~6~~

~~7~~

~~8~~

~~9~~

~~10~~

~~11~~

~~Frequency observed~~

~~133~~

~~55~~

~~23~~

~~7~~

~~2~~

~~2~~

~~0~~

~~Frequency given by~~

~~Pearson's curve .~~

~~136·9~~

~~48·5~~

~~22·6~~

~~9-6~~

~~3-4~~

~~0-8~~

~~0-2~~

~~The distributions represented in Figs. 1, 2, and 3 may be taken as examples of three common forms of series into which the individuals of a race may be arranged with respect to a single character ; a comparison of the three will show how little can be learnt from a mere statement of racial type, without some knowledge of the way in which deviations from the type are distributed.~~

~~(4) The variability of structures which are repeated in the body of the same individual (serial homologues) has been studied by Pearson and his pupils with important results. The simplest of such repeated elements are the cells of the tissues, more complex are cell-aggregates, from hairs, scales, teeth, and the like, up to limbs or meta- meres in animals, or the leaves and their homologues in plants. Serially homologous structures, borne on the same body, are commonly differen- tiated into sets, the mean character of a set produced in one part of the body, or during one period of life, differing from the mean character of a set produced in a different region or at a different time. Such differentiation may be measured by determining the correlation between the position or the time of production and the character of the organs pro- duced, the methods by which the correlation is measured being those described in the article Error, Law op. An excellent example of structures differentiated according to position is given by the appendages borne on the stem of an ordinary flowering plant — the one or two seed leaves ; the stem leaves, which may or may not be differentiated into secondary sets ; and the various floral organs borne at the apex of the stem or its lateral branches. The change which often occurs in the mean character and variability of the flowers produced at different periods of the flower- ing season by the same plant is an example of differentia- tion associated with time of production ; as this kind of differentiation is less familiar than differentiation according to the region of production, it may be well to give an example. In a group~~

~~*of plants of Aster pre- .nanthoides, examined by Shull (American Natwalist, xxxvi., 1902), the mean number of bracts, ray-florets, and disc-florets, and the standard deviation of each, was determined on four different days, with the following*~~

~~*result : —*~~

~~*Table III.*~~

~~*4-*~~

~~*1*~~

~~;~~

~~*V-*~~

~~*%*~~

~~*-*~~

~~*-*~~

~~*i*~~

~~*“*1*~~

~~*^*~~

~~*5CALC or PCTAL9*~~

~~*Fig. 2.*~~

~~*Sept. 27.*~~

~~*Sept. 30.*~~

~~*Oct. i.*~~

~~***Oct. 8.***~~

~~***Mean No. of bracts***~~

~~***47·41***~~

~~***44·34***~~

~~***43·83***~~

~~***41·92***~~

~~***Standard deviation***~~

~~***5·52***~~

~~***5·15***~~

~~***5·28***~~

~~***4·89***~~

~~***Mean No. of ray-florets .***~~

~~***30·77***~~

~~***28·71***~~

~~***28·25***~~

~~***26·34***~~

~~***Standard deviation***~~

~~***3·99***~~

~~***3·57***~~

~~***3·50***~~

~~3-01~~

~~Mean No. disc-florets~~

~~56-43~~

~~5171~~

~~49-16~~

~~45-78~~

~~Standard deviation~~

~~3-99~~

~~4-99~~

~~4-88~~

~~4-78~~

~~Notwithstanding this . differentiation, the mean character of a series of repeated organs is often constant through a considerable region of the body or a considerable period of time ; and the standard deviation of an " array " of repeated parts, chosen from such an area, or within such limits of time, may be taken as a measure of the indi- vidual variability of the organism which produces them. If such an array of repeated organs be chosen from the proper region of the body, within proper limits of time, in each of a large series of individuals belonging to a race, and if all the arrays so chosen be added together, a series will be formed from which the racial variability can be determined. Thus a series of arrays of beech leaves, gathered, subject to the precautions indicated, from each of 100 beech trees in Buckinghamshire by Professor Pearson, gave 16-1 as the mean number of veins per leaf, the standard deviation of the veins in the series being l-735. The number of leaves gathered from each tree was 26, and the frequency of leaves with any observed number of veins in the whole series of 2600 leaves was as follows : —~~

Table IV.

JSTo. of veins . No. ol leaves .

10 1

11

7

12 34

13 110

14 318

15 479

16 595

17 516

18 307

19 181

20 36

21 15

22 1

The whole series contains 2600 leaves. If a leaf from this series be chosen at random, it is clearly more likely to have sixteen veins than to have any other assigned number ; but if a first leaf chosen at random should prove to have some number of veins other than sixteen, a second leaf, chosen at random from the same series, is still more likely to have sixteen veins than to have any other assigned number. If, however, a series of leaves from the same tree be examined in pairs, the fact that one leaf from the

tree is known to possess an abnormal number of veins makes it probable that the next leaf chosen from the same tree will also be abnormal, or in other words, the fact that leaves are borne by the same tree establishes a correlation between them. Professor Pearson has measured this correlation. Taking each leaf of his series, with an assigned number of veins, he has determined the array of pairs of leaves which can be formed by pairing the chosen leaf with all others from its own tree in succession. The pairs so formed were collected in a table, from which the correlation between the first leaf and the second leaf of a pair, chosen from one tree, could be determined by the methods indicated in the article Error, Law of. The mean and standard deviation of all first leaves or of all second leaves will clearly be the same as those already determined for the series of leaves ; since every leaf in the series is used' once as a first member and once as a second member of a pair. The coefficient of correlation is 0-5699, which indicates that the standard deviation of an array is equal to that of the leaves in general multiplied by Jl .- (0-5699)2 ; and performing this multiplication, we find 1-426 as the standard deviation of an array. The variability of an array of such a table — that is, of any line or column of it — is the mean variability of pairs of leaves, each pair chosen from one tree, and having one leaf of a particular character ; it may therefore be taken as a fair measure of the variability of such a tree. We see therefore that while leaves, gathered in equal numbers from each of 100 trees, are distributed about their mean with a standard deviation of 1-735 veins, the leaves gathered from a single tree are distributed about their mean with a standard deviation of l-426 veins, the ratio between variability of the race and variability of the individual tree being

Jl -(0-5699)2 = 0-822.

The correlation between undifferentiated sets of serial homologues, produced by a single individual, is the measure of what Pearson has called homotyposis. In an elaborate memoir on the homotyposis in plants (Phil. Trans., vol. 197 A., 1901), from which the foregoing state- ments about beech leaves are taken, Pearson has given the correlation between

such sets of organs in a large number of plants : he and his pupils have subsequently deter- mined the correlation between structures repeated in the bodies of individual animals. The results obtained are sometimes puzzling, because it is sometimes difficult to choose the whole series of structures observed from a region of the body which is not affected by differentiation. In spite of this difficulty, however, the values of the correlation coefficients so far obtained cluster fairly well round the mean value of all of them, which is almost exactly . Prom this result it follows (see Error, Law of) that the standard deviation of the array, which we have taken as a measure of individual variability, is equal to the standard deviation of the race multiplied

*^'-G

2 or by J-

2"

These results cannot be

accepted as final, but they are based on so many investi- gations of animals and plants, of such widely different kinds, that they may confidently be expected to hold for large classes of organic characters. We may therefore conclude that for large classes of characters, both animal and vegetable, the variability of an individual, as measured by the standard deviation of its undifferentiated but repeated organs, is a constant fraction of the variability of its race, as measured by the standard deviation of the corresponding series of organs produced by all the indi- viduals of its race.

(5) Among the most important structures produced in repeated series are the reproductive cells ; and Pearson points out that if the variability of animals or of plants be supposed to depend upon that of the germ-cells from which they arise, then the correlation between brothers in the array produced by the same parents will give a measure of the correlation between the parental germ- cells, the determination requiring, of course, the same precautions to avoid the effects of differentiation as are necessary in the study of other repeated organs. After a large series of

measurements, involving the most varied characters of human brothers, Pearson has shown that the correlation has a value very nearly equal to J ; so that the variability of human children obeys the same law as that of other repeated structures, the standard deviation of an array, produced by the same parents, having an average value equal to the standard deviation of the whole filial generation

multiplied by . /l

or by ^f.

J 2

Such measure-

ments of fraternal correlation in the lower animal as Pearson and his pupils have at present made give values very close to J. The evidence that the correlation between sexually produced brethren is the same as that existing between the asexually repeated organs on an indi- vidual body renders it impossible to accept Weismann's view that one of the results produced by the differentiation of animals and plants into two sexes is an increase in the variability of their offspring. Warren has lately shown by direct observation that the correlation between brothers among the, broods produced parthenogenetically by one of the Aphides has a value not far from the J observed in sexually-produced brethren (Biometriha, vol. i. 1902) ; he has obtained a fairly concordant result for the broods of parthcnogenetic Daphnia (Proc. Roy. Soc, vol. lxv. 1899). Finally, Simpson has measured the correlation

between the pairs of young produced by the simple asexual division of Paramecium {Biometriha, vol. i. part 4, 1902), and after some necessary corrections the value he obtains is 0'56, a value which probably does not, if we remember the difficulties of the inquiry, differ very significantly from £. There is therefore in a large class of cases an indication that the variability of an array of brethren, produced either sexually or asexually, is a con- stant fraction of the variability of the race to which the brethren belong.

(6) The subject of inheritance is beyond the scope of the present article. It must, however, be pointed out that the constancy in the variability of arrays of brethren, indicated in the last paragraph, determines a limit below which the variability of a ijace cannot be reduced by any process of selecting parents. In the large number of cases investigated by Pearson and his pupils, in which the Qalton-Pearson law of inheritance holds, it is possible to produce a permanent change in the mean character of the race by selecting parents through only a very small number of generations ; but such a process of selection, indefinitely continued, will not reduce the variabihty of any generation below a fixed limit, given by the measure of fraternal variability. In many of the domestic races of plants and animals, produced by selection, the mean character of any large number of individuals is constant, but the characters of small numbers of individuals cannot be predicted with accuracy. These " unfixed varieties " are examples of races in which the fraternal variability is high. Among wild races of animals the existence of a high fraternal variability may lead to what Pearson has called "periodic selection." Thus in some races of the genus Clausilia the characters of the shell are subject to selection so stringent that only individuals with shells which closely approach the mean character of their race can become mature and breed. The mean character of the shell, in the young produced by these individuals, is identical with the mean character of the parental shells ; but the fraternal variability is so high that each successive generation contains a number of abnormal forms which are destroyed during growth by a selective process which reduces the variability of the race without changing its mean character (cf. Biometrika, No. i., 1901).

(7) Selection and its results can only be adequately studied in those cases which admit of statistical tabula- tion. In any race of animals, the number of young pro- duced in a season is almost always greater than the number which survives to attain maturity ; it is not certain that every one of those which become mature yrill breed, and not all of those which breed contribute an equal number of offspring to the next generation. At every stage some individuals are prevented from con- tributing to the next generation, and if the continual process of elimination affects individuals possessing any one character more strongly than it affects others, so that

a relation is established between individual character and the chance of producing a certain number of young, selection is said to occur.

We may distinguish broadly two ways by which such selective elimination of individuals from the number of those who contribute to the next generation may occur, namely, a differential destruction, which prevents certain classes of individuals from breeding by killing them, and a series of processes leading to differential fertility among the survivors, without necessarily involving any differential death-rate. A third form of selection, which may affect the composition of the next generation without of necessity involving a differential death-rate or a differential fertility, is assortative mating, or the tendency of those members of one sex which exhibit a particular character to mate only

with members of the other sex which exhibit the same or some other definite character.

Differential fertility may be induced in either of two ways. Individuals may not be able to pair, unless they pos- sess a character which is absent, or insufficiently developed, in some members of the race. The kind of selection in- volved may then be measured by comparing those animals which pair with the general body of adults. This is what Darwin especially intended to denote by the term "sexual selection." Or, again, individuals of certain character may be able to pair, but the fertility of their union may not be the same as that of unions between individuals with other characters. This kind of selection, called by Pearson " reproductive " or " genetic " selection, may be measured by finding the correlation between the characters of the individuals which pair and the number of young pro- duced. [For an attempt to treat the whole problem of differential fertility and assortative mating numerically see Pearson, The Grammar of Science, 2nd edition, London, 1900.]

Assortative mating exists when individuals which mate are not paired at random, but a definite correlation is established between the characters of

one mate and those of the other. This kind of selection is measured by the correlation between deviation of either mate from the type, and deviation of the other. Pearson has shown that Gabon's function has a value of 0‘28 for stature of middle-class Englishmen and their wives.

(8) The problems which arise when we attempt to discover whether any existing species is being maintained or modified by a process of natural selection can only be solved by methods, such as those indicated in the pre- ceding paragraphs, capable of giving numerical results. For this reason those cases in which the facts of variation, correlation, and inheritance can be numerically expressed have been treated at some length. It must not, however, be forgotten that many classes of variation exist which cannot at present be numerically described by any known formula. Among variations which have not yet been properly formulated are numerous cases of dimorphism, in which the variations in the same sex vary about two modes. Such cases are especially common in variations of secondary sexual characters. Many of these can probably be formu- lated as cases of " alternative " inheritance, and treated by the methods which express the facts of dimorphism in the colour of human eyes (cf. Galton, Natwral Inheritance, and Pearson, Proc. Roy. Soc, lxvi.).

Numerous cases of variation are on record, especially among domestic animals and plants, which are said to have appeared suddenly, and in such a way that they cannot be shown to form parts of orderly series, of the kind described in previous paragraphs. The origin of many domestic races is ascribed to such "sports." The evidence concerning these is seldom sufficient, in the judgment of the present writer, to make discussion of them profitable. They are, no doubt, sometimes the extreme terms of orderly series, in which the other terms have not attracted the attention of breeders ; their alleged frequency among animals and plants of mixed ancestry suggests that they are often due to " alternative " or to " particulate " inheritance; and a proper study of such cases involves a knowledge of the circumstances which determine whether inheritance is "particulate," or "alternative," or " blended." Many cases of bud variation in plants are doubtless cases of alternative inheritance. It would be impossible to describe these variations without discussing a great body of unsatisfactory evidence in each case separately. They are mentioned

here to show that the process of formulating variations, in such a way that our knowledge can be applied to the problem of organic

evolution, or to other problems of binomics, has not yet gone so far as to include, even approximately, all the phenomena observed.

(9) The theory of natural selection as the great factor in organic evolution, enunciated by Darwin, is essentially a statistical theory, resting upon three main conceptions : (1) the regular occurrence among all animals and plants .of an orderly series of variations, capable of being formu- lated in the manner already alluded to ; (2) the existence of a correlation between structure and fertility, or between structure and death-rate ; (3) the existence of a correlation between structure in parents and structure in their off- spring. These three factors — Variation, Selection, and Inheritance — must be studied statistically in a large num- ber of cases before the true value of Darwin's theory can be ascertained. A fertile source of misconception has hitherto been the habit of testing the theory of natural selection by our power of imagining an obvious use for the characters of animals which undoubtedly survive ; and the validity of the theory has been largely made a question of our power to recognize the " adaptive " or " useful " nature of specific characters. In our present condition of ignorance concerning the function of any organ in the great majority of animals, it is evident that our theories of their utility must often be erroneous or imperfect : the only really adequate test of such theories is the statistical test whether individuals which deviate from the type we consider useful or adaptive do in fact die more rapidly, or leave fewer descendants, than others which conform more nearly to our idea of what is useful ; but if we know that such a correlation between structure and death-rate, or between structure and fertility, actually exists, we know that a form of natural selection is at work ; and although the question of the physiological process by which this is brought about is one of the highest interest, it is of no importance as proof that the observed selection exists. A branch of biology is slowly but surely growing up which attempts to deal with Darwin's theory from a purely numerical standpoint. For the purposes of this new science, organisms may be considered simply as series of parts of variable magnitude, the functions of these parts, as ordinarily understood, being neglected. The variability of each organ, the

correlation between change in the mag- nitude of any one or more organs and change in the others, may be formulated by the methods indicated in the article Eeeoe, Law of, and the statements so made, for any species, embody that knowledge of variation which is the first necessity of the theory. Such knowledge being ob- tained, the next step is to formulate in the same way the correlation between change of structural character and change in death-rate or in fertility, thereby expressing the facts of selection. Finally, the numerical statement of correlation between organic structure in ancestors and, in offspring constitutes the necessary and sufficient statement of inheritance. All these statements are purely numerical, and involve no physiological or morphological theory what- ever. They are in themselves a sufficient statement of the facts of evolution ; but they are also, on the one hand, the only means by which any physiological theory of selec- tion or of inheritance can be judged, while, on the other, the knowledge that a particular character of unknown function is in fact associated with an increase or decrease in death-rate or fertility, affords a powerful stimulus to physiological inquiry. The hope of an ultimate answer to the questions which arise when we attempt to formulate a theory of organic evolution lies in the co-operation of workers pursuing two lines of inquiry, one purely statis- tical, one purely physiological, each in turn testing the hypotheses of the other, and suggesting new and wider fields of work. (w. f. e. w.)

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VARIATION OF AN INTEGRAL

Variation of an Integral. It was inevit- able that the ideas and methods of the Calculus of Variations should be subjected to the same kind of criti- cism as has been applied during the last half-century to other branches of mathematical analysis. In the founda- tions of analysis, and in many of its developments, the outcome of this critical process has been, on the one hand, a gain in logical precision, and, on the other hand, the achievement of new points of view and new results. A critical examination of the Calculus of Variations was made by P. du Bois Keymond, and the reformulation of the subject was undertaken by Weierstrass. The methods used by the latter and the results obtained by him were communicated to

students in his lectures ; from this source the new theory has spread over Europe and America, and its advance has been facilitated by the appearance of a small number of monographs dealing in accordance with Weierstrassian ideas with particular prob- lems of a general character. To this category belong the memoirs of Kobb and Zermelo. Other analysts — Mayer, Scheefer, Kneser — working on independent lines, have sought to make the methods of the calculus more rigorous. It is the purpose of this article to give some account of the methods and results of modern investigations in the simpler parts of the subject.

1. Nature of the Problems.- — All the problems of the Calculus of Variations are of geometrical or mechanical origin : thus we may inquire concerning the shortest line between two points in a plane pr on a given surface, the surface of maximum area with given volume, the course of a system for which the action is a minimum, and so on. In all cases the answer to the question will lie in the determination of one or more functions to satisfy certain conditions, of which one is that an integral involving these functions and one or more of their differential coefficients is to be a maximum or minimum. The nature of the problem itself imposes a restriction on the character of the function, if there is one, that can be the answer to the question ; for the question is one concerning a curve, or a course of motion, or some other geometrical or mechanical object, and the function that yields the answer to the question must accordingly be suitable for the representa- tion of objects of the kind sought. We have thus to find a function for the purpose of finding something that is not a function. It is, accordingly, necessary at the outset to recall, or, it may be, to reformulate, the analytical restrictions to be imposed on functions in order that they may be suitable for the purpose in hand. Another con- sideration of great importance is that there is a distinc- tion between a " greatest value," a " maximum," and a "superior limit," and between a "least value," a "mini- mum," and an "inferior limit"; and it is necessary to state with precision what is meant by a maximum or minimum of a quantity which is expressed as the integral of an unknown function through an imperfectly known domain.

2. Limitation of the Problems. The First Problem. — ■ We shall restrict ourselves for the present to questions relating to curves joining fixed

points ; and then, regarding x and y as the co-ordinates of a point of a curve, and writing y1 for dyjdx, we shall deal with questions in which the variable magnitude to be made a maximum or minimum is of the kind that can be represented by the line-integral

lY(x, y, y')dx ... (1)

/'■

taken along a curve joining the two fixed points. The function F must be such that this integral has a definite meaning. The only differential coefficient involved in F is of the first order. The form (1) is free from ambiguity

when the curve is such that y is a one-valued function of x ; but we can have no guarantee beforehand that this will be the case for the curve sought. To avoid this difficulty we define a curve, not by a functional relation between its co-ordinates, but by relations between the two co-ordinates and a variable parameter 6. We write

x = 4>{6),y = t{6),

and then the integral to be considered takes the form

jf(x, y, x, y)d6,

(2)

where * and y are the differential coefficients of x and y with respect to 0, and the function / is homogeneous of the first degree (but not necessarily rational) in * and y. The function / is assumed to be an analytic function of its four arguments.

The restrictions imposed on 0, <£(#), ^(0) are, then, as follows : —

(i.) Two fixed values, 00 and 6V of the parameter 6 are chosen to correspond to the two fixed points. The integral takes the form

/ («, y, *, y)dO,

h

and we shall suppose 0j > 60. The fixed point correspond- ing to 6a will be regarded as the " initial point " of the curve.

(ii.) The functions (&) and \p{6) take given values when 6 takes the values corresponding to the fixed points.

(iii.) The functions <£(0) and \|/{6) are one-valued and continuous throughout the interval between 60 and 6V

(iv.) The interval can be divided into a finite number of partial intervals within each of which the functions (6) and \j/(d) are monotonous (cf. Functions or Seal Variables, § 8).

(v.) The interval can be divided into a finite number of partial intervals within each of which the functions (6) and \j/{6) have finite and continuous differential coefficients of the first order with respect to 6, and at a junction of two such partial intervals these functions have finite pro- gressive and regressive differential coefficients.

The conditions (iii.), (iv.), and (v.) define analytically what is meant by a plane " curve," but an additional restriction is necessary if the curve is to be determined by differential equations, as in the methods that have been devised for the solution of questions of the kind proposed. The functions of a parameter, by means of which the co-ordinates of a point on a curve can be expressed, when the curve is determined by a differential equation, are analytic functions, or are such as can be expanded by Taylor's series in the neighbourhood of all but certain "singular" values of the parameter. We accordingly assume —

(vi.) The interval between the end- values of 6 can be divided into a finite number of partial intervals, within each of which the functions (9) and \j/(ff) are analytic and without singularities.

Corresponding to each such partial interval we have an arc of an "analytic curve," and the conditions (iii.), (iv.), (v.), and (vi.) may be expressed in the form that the curve sought is either an. analytic curve or

consists of a finite number of arcs of analytic curves. In what follows we shall restrict the sense of the word " curve " in this way. In accordance with (v.) such a curve may present points of discontinuity of direction.

We suppose that one curve has been drawn between the fixed points A and B, and consider any point P of this curve to be displaced to a new position P', in such a way that the locus of the point P' is a curve joining A and B. For this it is necessary that the co-ordinates of

P' should be. expressible in terms of the parameter 6 by- functions subject to the same restrictions as those which express the co-ordinates of P, or the locus of P' must be made up of a finite number of arcs of analytic curves. The locus of P' is described as a variation of the locus of P, or as a varied curve. We may form the integral such as (2) for the locus of P' instead of the locus of P, and then the excess of the value of the integral along the varied curve above its value along the original curve is a varia- tion of the integral. The displacement is said to be small if the distance between any point P and the corresponding point P' is everywhere less than some given small distance e. If the curve locus of P has been so chosen that it is possible to find a value of h, which has the property that the variation of the integral is positive (negative) for all values of e which are less than h, then the integral along the locus of P is a minimum (maximum). Thus a maxi- mum is a greatest value for all curves derived from the one in question by sufficiently small displacements. Simi- larly for a minimum. The point for point correspondence of the original curve and the varied curve is not essential. When the integral taken along the original curve is, as above, a maximum (minimum) then it is possible to mark off a simply connected region of the plane, containing this curve, and such that the integral is greater (less) for this curve than for any other curve joining the same two points and lying entirely within the region.

The variation of the integral is now formed as follows : — We replace x and y by x + £ and y + rj, where £ and rj are functions of the parameter 0,

which vanish at the end- values of 9, and obey the restrictions previously laid down ; then the variation is

rh rh

J /(* + £ V + v, * + i y+v)dd J f(x, y, x, y)dd,

and we seek to determine x and y as functions of 6, so that this expression may be one-signed for all functions £, tj, which obey the stated restrictions and are less than some fixed sufficiently small number.

3. In attempting the solution of the question thus pro- posed, which may be called the First Problem of the Cal- culus of Variations, there are two matters to which atten- tion must be directed. The first is that if any curve can be found which possesses the required property, then every part of the curve possesses the same property. Suppose that a particular curve has been found joining two points A and B, and having the property that a certain geometrical magnitude expressed by an integral of the form in question is a minimum for that curve, and let P and Q be any two points on the curve between A and B ; then the part of the curve between P and Q is a curve joining P and Q which has the property that the corre- sponding geometrical magnitude is a minimum for that curve.

The other preliminary remark to be made is that, if any (admissible) functions are chosen to represent the displacements £, r\ from the original curve to the varied curve, and a condition that the variation of the integral may be one-signed for that particular kind of displacement is deduced, this condition is a necessary condition which must be satisfied if the magnitude represented by the integral is a maximum or minimum. It may happen that a curve can be found for which the variation of the integral is one signed for some kinds of displacement, but not for others, however small they may be ; when this is the case the magnitude represented by the integral is a maxi mum or minimum for some displacements, but not for all admissible ones. The only restriction to which the func- tions that can represent admissible displacements are sub- ject are (a) those necessary to secure that the locus of the

~~displaced points is a curve, and (/?) that the integral has a meaning for the varied curve.~~

~~4. Stationary Curves. — We choose in the first place displacements £, tj, which can be expressed in the forms~~

~~£ = KU, -q = KV,~~

~~where k is a positive number which can be taken as small as may be wished, and u and v are independent of k, and, besides satisfying the conditions previously laid down, have their first differential coefficients continuous through- out the interval of integration. This additional restriction of the displacements may be stated in the form that no discontinuity of direction is introduced by the displace- ment ; when the original curve presents no such discon- tinuity the varied curve has the same property ; when the displacement is small the tangents to the original curve and the varied curve at corresponding points are nearly parallel.~~

~~"With these displacements the variation of the integral takes the form~~

~~'Pt(Mu+%v+E*+%*)de+<*~~

~~a)~~

~~where (k)i denotes an expression which has zero for its limit when k is indefinitely diminished. The term in k is called the first variation of the integral, and, in consequence of the conditions restricting u and v, it may be transformed by integration by parts into~~

~~It then appears that the variation of the integral cannot be one- signed unless x and y satisfy the differential equations~~

~~dB dx dx '~~

~~±¥J1=Q. dff dy dy~~

~~Further, these equations are not independent, but we have~~

(2)

Udd/ df\ ud dfjrs

‘ x\dBdy dy)

U±df df\ y\d8

where

Mi m+m9~m’

(3)

•‘1 y2 dx* a? dy1 xy i

all these relations arise from the fact that / (x, y, x, y) is homo- geneous of the first degree in x and y, and we have in particular another form of the differential equation, viz.,

m m+f^ m=0 ■ ■ (4)

The equations (2) and (4) are thus a single differential equation connecting x and y, and this is the same as the equation

A.

dx dy1 dy

that would be found by taking the integral in the form (1) of § 2 instead of the form (2) of the same §. It is thus the differential equation of a family of curves, and, being of the second order, a solution can in general be found which represents a curve passinc through two given points.

The curves which satisfy the differential equation are known as the stationary curves of the integral, and the differential equation is known as the principal equation. We have the result that the integral cannot be a maximum or minimum unless every analytic arc of the curve is an arc of a stationary curve.

~~5. Condition relative to Points of Discontinuity. — A stationary curve would be determined if one point on it and the tangent at that point were given, and thus, if the curve sought really consists of arcs of different stationary curves, the junction of two such arcs is a point of dis-continuity of direction. The possibility of such a solution of the maximum -minimum problem is restricted by a~~

~~condition which can be readily found by adopting a particu- lar type of displacement. If P is a point where two arcs of stationary curves meet, we may choose the functions u and v in such a way that they vanish everywhere except for a very short segment of the curve containing the point P, and then it appears that the variation of the integral can- not be one-signed unless the two arcs meeting at P are such that df/dx and df/dy are continuous at that point P, where x and y (or one of the two) are discontinuous. This condition precludes in most cases the possibility of such points of discontinuity.~~

~~As an example we will consider the problem : To find a curve joining two fixed points, which, by revolution about a straight line, in a plane containing the points, traces out a surface of minimum~~

~~area Taking the fixed line as axis of x, the integral to be~~

~~made a minimum is~~

~~and the principal equation is~~

~~d—yx .~~

~~dd V(*2+2>2) ‘~~

~~The stationary curves are the axis of x, straight lines parallel to~~

~~the axis of y, and catenaries of the family~~

~~. x-a y=c cosn ,~~

~~where a and c are arbitrary constants. The condition stated above~~

~~axis of x~~

~~Fig 1~~

~~shows that the broken line ACDB is the only "curve" with points of discontinuity of direction for which the first variation vanishes. For example, a broken line like AA'B'B is excluded.~~

~~6. Conjugate Points. — The conditions obtained from the consideration of the first variation are necessary to secure that the integral is a maximum or a minimum, but they are not sufficient. Until recently attempts to ascertain whether the integral along a stationary curve really possesses the maximum-minimum property were directed exclusively to the determination of the conditions under which the terms in k2 in the development of (1) § 4 are necessarily positive or necessarily negative. These terms are known as the second variation, and the problem of the transformation of the second variation to a shape in which its sign can be determined by inspection has attracted a great deal of attention. The investigation of this problem by Jacobi led to a very important discovery. Suppose that we consider all the stationary curves of the integral which start from the point A, and that one of them has been found which passes through B ; we take this as the original curve. Then, however small a distance € we choose, we can find an infinite number of stationary curves which run so near to the original curve between A and B that the segments they cut off on the normals to that curve are all less than c ; such curves may be called neighbouring stationary curves. In general, if B is not too distant from A, none of these curves cuts the original curve between A and B ; but if any one of them does so, then the point of intersection tends to a limiting position, A', when e is diminished indefinitely. The point A' is defined to be the point conjugate to A for the curve, and the relation between the points A and A' is a reciprocal one. The locus of the points such as A' on different stationary curves starting from A is part of the envelope of this family of curves,~~

~~*and thus A' is a point of contact of the original curve with the envelope of this family. For any integral of the form under consideration, there is a family of stationary curves, and those which start from a given point have an envelope (which may reduce to the point). When the envelope does not reduce to the initial point it touches any curve of the family in one or more points. If there is one such point distinct from the initial point, it is the point conjugate to the initial point for the curve ; if there are two or more of such points, any two of them, between which there is not another, are a pair of conjugate points. It is essential to observe that, if A and A' are a pair of conjugate points, and P is any point on the curve between them, the arc AA' does not contain the point conjugate to P ; in other words, as A moves along the curve in either sense A' moves along it in the same sense. We have the theorem : — The integral taken along the stationary curve between A and B is neither a maximum nor a minimum if A and B are conjugate points, or if there is a pair of conjugate points between A and B.*~~

~~*The most familiar examples are antipodal points on a sphere, which are conjugate for the geodesies on the sphere, and the conjugate foci of geometrical optics. In the application of the principle of least action in dynamics, situations of a system which correspond to conjugate points are known as "kinetic foci" (see Dynamics, Analytical, § 7). As another example let us consider the minimal surface formed by revolving a catenary about its directrix, referred to in § 5. Through any point A we can draw catenaries having the axis of x as directrix, and these are stationary curves for the problem ; the point conjugate to A for any catenary is the point of contact of the second tangent that can be drawn to that catenary from the point where the tangent at A meets the*~~

~~*Fig 2*~~

~~*directrix (Fig. 2). It can be shown that, if one catenary with a given directrix can be drawn to pass through two given points A, B, then another can generally be drawn, and the tangents to one of them at A and B meet on the nearer side of the directrix, and the tangents to the other on the remoter side ; thus there are two stationary curves of the catenary family joining the two points, but one of them does not trace out a*~~

surface of which the area is a true minimum. Further, it can be shown that, if the tangents at A and B to one catenary intersect on the directrix, there is not a second catenary. If no catenary with the given directrix can be drawn to pass through A and B, there cannot be a minimal surface of the kind sought unless the broken line ACDB of Fig. 1 § 5 can be regarded as the meridian curve of such a surface.

W. F. Osgood (Amer. Math. Soc. Trans, ii. p. 166, 1901) has called attention to an exceptional case, in which the integral taken along a stationary curve between two points A and B is a mini- mum, although A and B are conjugate points. An example is afforded by the equatorial geodesic curve of an oblate spheroid.

7. In the general problem, when there is a stationary curve joining the two fixed points A, B, and the point conjugate to the initial point A does not lie on the arc AB between the fixed points, it can be shown that the second variation of the integral is or is not one-signed, according as the function fY of § 4 is or is not one-signed along the curve ; if /j is positive (negative) at all points of the curve the second variation is positive (negative), and the integral is a minimum (maximum) for displacements of the type considered in § 4. When the integral is taken in the

form (F(a;, y, i/)dx, the corresponding condition is that

32F , WA

is positive (negative) for a minimum (maximum).

8. The Excess Function. — All the results which we have considered are obtained by subjecting the displacements of a point on the original curve to the condition stated in § 4. We proceed to explain a method of determining whether integrals which satisfy ajl the conditions so far obtained are maxima or minima for displacements of a more general

character. In this connexion we consider a particular type of displacement not subject to the condition so far assumed.

Let APB (Fig. 3) be a stationary curve joining the two fixed points A, B, and let PQ be a straight line meeting it at P. If there

is not a pair of con- jugate points on the arc AB, any other stationary curve starting from A in a direction suffi- ciently nearly coin- cident with that of the curve APB will meet PQ in a point Q which cannot coincide with P. The broken line made up of the stationary curve AQ, the straight line QP, and the stationary curve PB, may be treated as a varied curve, the original curve being the stationary curve APB ; and the variation of the integral is the value of

(integral along AQ) + (integral along QP) — (integral along AP) (1)

This is most simply expressed by taking the integral in the form

/2

| F(z, y, y')

then the integral along QP will have as an approximate expression

v cos ^{x, y, tan \j>),

where v is the length of QP, supposed very short, and

(integral along AQ) — (integral along AP)

consists of two terms : one arises from the variation of the end- value from the x of P to the x of Q, and this has the approximate expression

- v cos if>F(x, y, y') ;

the other arises from the term at the end-value corresponding to P in the first variation when expressed as

}Xo\dy dxdi/J' /Xo'dyJ

~~The integral here written vanishes, and t\ vanishes at Xo, but the value of r) at x is~~

~~- v cos ^(tan \j/ — y1),~~

~~(cf. Variations, Calculus of, vol. xxiv. p. 86). Thus we have for (1) an approximate expression, correct to the first order of v^ in the form~~

~~i \p | F(x, y, tan f) — F(a;, y, y') — (tan f —~~

~~y'\~~

~~dy'f~~

~~(2)~~

~~The corresponding expression when the integral is taken in the form~~

~~l>~~

~~'/&, y, x,~~

~~[\ ox dyJx=\, y=ix. \ ox dv/£=i, y=m J~~

~~(3)~~

~~where (a, p.) are the direction cosines of QP in the sense from Q to P, and (I, m) are the direction cosines of the tangent at P to the stationary curve APB in the sense from A to B.~~

~~The coefficient of v in the expression (2), or the equivalent expression (3), has been called Weierstrass's excess function. It depends upon the co-ordinates of the point P and the direction of the line Q P. We shall refer to QP as the straight segment. We have supposed the direction of this segment to be such that the integral can be formed along it, and thus it may happen that some~~

~~directions for this segment are inadmissible. We define as admis- sible directions those for which the integral is definite and real, and then the application of the above result yields a new condition which must be satisfied if the integral along the stationary curve APB is a maximum (minimum), viz., the excess function must be negative (positive) for all points P of the curve and all admissible directions of the straight segment.~~

~~In regard to the first form (2) it is to be observed that the expression has in general a finite limit, different from zero, when i/< = 0 and when i^=4ir, if these values are admissible ; also when f is very nearly equal to the angle 0, which the tangent to the original curve makes with the axis x, the expression approaches the value~~

~~32F cos 0^-^(tan \f/— tan f,~~

~~and thus the criterion for maxima and minima yielded by the sign of the excess function includes the special condition of § 7, viz. , that the function fx of § 4 must be one-signed.~~

~~As an example we will consider the problem : to find a curve joining two fixed points so that the integral~~

~~IfH'-~~

~~de,~~

~~taken along it shall be a maximum or a minimum. The principal equation is~~

~~de{ j«j °'~~

~~and the stationary curves include the axis of x, straight lines parallel to the axis of y, and the family of exponential curves y=aecx ; we select this family for further discussion. If the initial point is {x0, ya) the family of stationary curves starting from it is given by the equation~~

~~y=Voe >~~

~~these have no envelope, and thus there are no conjugate points. Also the function fx becomes Sx/y*, and thus the second variation is positive for curves going to the right from the initial point. The excess function is~~

~~2/2 cos V-(cot20 — 3 cotV+ 2 tan ■/- cot3~~

~~for any direction except \ji = 0, which is inadmissible ; on putting ^ = J7r we get 2j/2 cot3 cj>, and on putting ip = §tt we get — 2y2cot3 cj>. Thus the integral taken~~

~~AQ'PB can be made greater than that along APB, and the integral taken along AQPB can be made less than that along APB, by taking AQ and AQ' stationary curves suf- ficiently near to AP and drawing QPQ' parallel to the axis of y. It follows that the integral taken along the curve APB is neither a maxi-~~

~~Fig. 4.~~

~~mum nor a minimum.~~

~~It is worth while to observe that the excess function does not in all cases, as it does in this example, change sign when the sense of the straight segment is reversed, or when \p is replaced by it + \j/. For example, in the problem of the minimal surface discussed in §§ 5, 6, the excess function is 2y sin2 \(ip —).~~

~~*9. Arbitrary Displacements. — It can be proved that the condition found in the last section, with those found pre- viously, in general suffices to secure that the integral is a maximum or minimum for any type of displacements for which the locus of the displaced points consists of a finite number of arcs of analytic curves. Thus the necessary and sufficient conditions are in general :*~~

~~*(i.) The original curve is a stationary curve for the integral.*~~

~~*(ii.) The fixed end-points of the curve are not a pair of conjugate points, and there is not such a pair of points on the arc between them.*~~

~~*(iii.) The excess function is one-signed, and in general different from zero at all points of the curve, and for all admissible directions of the straight segment not coincid- ing with the tangent to the curve. The excess function may vanish at isolated points, or for particular directions of the straight segment, but it must not change sign.*~~

~~*This condition may be taken to include the special condition of § 7, that the function f1 of § 4 is one-signed.*~~

~~*Further, it can be proved that the only exception to this statement occurs if the excess function can vanish without changing sign at all points of the stationary curve, or of a finite arc of it, otherwise than by the straight seg- ment coinciding with the tangent to the curve. If this can occur, then the co-ordinates of a point on the stationary carve, or on a finite arc of it, must satisfy a certain differ- ential equation of the first order distinct from the principal equation. Such cases would be very exceptional.*~~

~~*In the analysis by which these conclusions are reached the function which plays the most important part is a generalized excess function. Instead of forming the excess function for the original curve, a point on*~~

~~it, and a straight segment ending at that point, the function is formed for a neighbouring stationary curve starting from the same initial point A and a straight segment ending at an arbitrary point of that curve. It appears that, in general, when the con- ditions for a minimum (maximum) are satisfied, it is possible to mark off a region between two stationary curves, both starting from A, and having the original stationary curve AB between them, within which the generalized excess function above described is everywhere positive (negative). Through any point of this region and the point A there passes one stationary curve of the integral, which lies entirely within the region, and these curves do not inter- sect themselves or each other within the region.~~

~~10. Isoperimetric Problems. — All the remaining problems of the Calculus of Variations may be regarded as extensions of the first problem. We will consider briefly problems of relative maxima and minima. Restricting ourselves to the simplest case, we seek to determine a curve joining fixed points which has the property that an integral of the~~

~~form / ¥(x, y, y')dx taken along the curve is a maximum or minimum, while another integral of the same form, say l&(x, y, y')dx taken along the same curve, has a given value. It is 'at once clear that no result can be obtained by introducing displacements of the type considered in § 4 ; for if the $ integral is unaltered by such displace- ments the curve is a stationary curve for that integral, and if the F integral is a maximum or a minimum for such displacements, the curve is a stationary curve for that integral also ; but the two integrals have not the same families of stationary curves. If, however, the displace- ments are of the type~~

~~£ = KjWj + k2u2, 7] = K^j + k2v2,~~

~~where kv k2 are constants which can be taken as small as may be wished, and uv u2 and vv v2 are functions of the kind considered in § 4, then it may be shown that these functions can be chosen in an infinite number of ways so that the 3> integral is unaltered and the first variation of the F integral vanishes. This method leads to the ordinary rule (Lagrange's) for determining the curve, if there is one, which yields the solution of the problem. The rule in question appears to have been at first accepted as axiomatic ; it was rigorously proved by P. du Bois Reymond.~~

~~11. Extension of the Theory. — All the theory here ex- plained can be extended to integrals involving a greater number of variables, and differential coefficients of higher orders, to multiple integrals, and to cases where the varia- tions are subject to restrictive conditions. The criteria for the existence of maxima and minima, and for distinguishing between them, are obtained by choosing particular types of functions to represent the alterations of the variables which correspond to displacements in the first problem. When these are subjected to restrictions of the same kind as the displacements in §§ 4 and 10 the same results are arrived~~

~~at as are commonly obtained by using the symbol S. These results are the differential equations of the problem cor- responding to the principal equation of § 4, and when they are satisfied the integral is said to be stationary ; thus, for example, the differential equations of theoretical dynamics are the conditions that the action may be stationary, the partial differential equation of minimal surfaces is the con- dition that the area may be stationary. In many mechanical and physical problems the condition that must be satisfied is really a stationary condition, not a maximum-minimum condition: in others, for example problems concerning stability, it is generally necessary to distinguish between maxima and minima. The use of the symbol 8 for finding the stationary condition for different forms of integrals under various restrictions has been explained in the article Varia- tions, Calculus of (Ency. Brit., 9th ed., vol. xxiv.).~~

~~In the solution of any problem in the Calculus of Varia- tions the first step is the formation of the principal equa- tions, of which the solutions render the integral under discussion stationary, and the second step is the solution of these equations. Among the integrals of the equations some will usually be adapted to satisfy also the imposed conditions corresponding to the fixing of the end-points in the first problem. The integrals of the equations may be regarded as determining loci in a homogeneous domain of two or more dimensions, and then the notion of a family of such loci, continuously filling up a domain within which they do not intersect, is generally valid if the integral can be a true maximum or minimum.~~

Some of the further conditions which are necessary in order that the stationary solutions may yield true maxima and minima have been sought by the process of transfor- mation of the second variation. After Jacobi's discovery, referred to in § 6, this process became the subject of numer- ous investigations, and Jacobi's results were extended to a great number of forms of integrals. Even when this process is carried out, and the necessary conditions are deduced, it may still happen that an integral satisfying all these conditions is nevertheless capable of being increased or diminished by some mode of variation less simple than that implied in the use of the symbol 8, and the question thus raised leads to the extension of Weierstrass's method of the excess function. This extension has been carried out in the case of simple integrals involving differential coefficients of any order, and in the case of double integrals involving differential coefficients of the first order. In both cases it has been shown that the conditions which can thus be obtained, together with those previously known, are suffi- cient to secure that the integral shall be a maximum or minimum.

12. The investigation of the criteria for distinguishing true maxima and minima from merely stationary solutions is usually complicated, even when the principal equations can be solved, and it has sometimes been sought to evade the process by other considerations. The 'most famous example of such evasion is the well-known attempt to obtain a proof of the theorem now called Birichlet's Principle, of which a particular case is the existence theorem in the theory of functions of a complex variable :

—

*Let I denote the integral *~·*

##{©■♦©■♦(sn~·*

taken through the volume wiihin a given closed surface S, and suppose that the integral is to be made a minimum subject to the condition that the value of V is given at all points of S. Employ- ing the method of the Calculus of Variations, we find the principal equation

32V

daP dy’

gay 3=V + 8za =

if we could solve this equation subject to the condition that V has

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a given value on S, we might then apply the methods of the oalculus to determine whether the solution obtained really makes the integral I a minimum. In general we cannot obtain this solution, and the question arises, Does such a solution exist ? If we could prove that among the functions which take the given value on S there is one that makes the integral a minimum, then we should know that a solution of the differential equation exists which takes the given value on S — we should have proved the existence-theorem. Now the argument runs : I must be positive, for the subject of integration is necessarily positive, and therefore there is a limit than which it cannot be smaller ; hence V can be chosen so as to make it a minimum.

This argument ignores the distinction between a minimum and an inferior limit. There is no evidence to show that the limit than which the value of the integral I cannot be smaller exceeds zero, or that such limit is a value “attained” by the integral for some form of V. If for instance L were the limit below which I could not fall, it might be impossible that any form of V should make I = L, although there were forms of V which would make I

Weierstrass illustrated this argument by the integral / x’y’IIx

taken along a curve joining the points (—1, a) and (1, 6). This integral also is always positive, and, according to the argument,

the principal equation ——(x^y’) = 0 should have a solution subject ax

~~to the conditions y=a when x= — 1 and y=b when x=l, and this solution would make the integral a minimum ; but on the one hand the solution is~~

~~y=~~

~~a + b a-b ~~2x~~~

~~y=-~~

~~which makes the integral divergent, and on the other hand curves can be found which shall make the value of the integral as small as we please ; . for example, we may take~~

~~— a + b a-b tan-1(a:/a) -2 2 tan_1(l/o)'~~

~~and then the integral can be made as small as we please by diminishing a.~~

~~In the case of the integral / / \ (5"") + (3^7) \d%dy, which~~

~~corresponds to I in two-dimensional problems relating to the theory of potential, a direct proof of the existence of a minimum has been sketched by D. Hilbert (Jahresber. d. deutsch. Math.- Vereinigung, 8, 1900). Very important results may be expected from, the development of the method which he employed.~~

~~Authorities. — Among the more important of the recent memoirs on the Calculus of Variations are the following : nu Bois Reymond, P. " Erlauterungen z. d. Anfangsgriinden d. Variationsrechnung," Math. Ann. 15, 1879. — Kneser. "Zur Variationsrechnung," Math. Ann. 50, 1898, and " Ableitung hinreichender Bedingungen . . . a. d. Theorie d. zweiten Varia- tion," Math. Ann. 51, 1899. — Kobb. "Sur les max. et les min. des integrales doubles," Acta Math. 16, 1892. — Mayer. " U. d. Kriterien d. Max. u. Min. d. einfachen Integrale," Crelle 69, 1868; and " Begriindung d. Lagrange'schen Multi- plicatorenmethode i. d. Variationsrechnung," Math. Ann. 26, 1886. — Sabinine. "Sur la methode de distinguer les max. et les min. des integrales d^finies multiples," Bull. acad. imp. sci. St. PStersbourg, 15, 1870 ; also two other memoirs on the same subject, Bull. sci. math. 1878, and Annali di mat. 1899. — Soheefer. "D. Max…u. Min.~~

d. einfachen Integrale," Math. Ann. 25, 1885 ; and "U. d. Bedeutung d. Begritfe Max. u. Min. i. d. Variationsrechnung," Math. Ann. 26, 1886. — Zermelo. Uhtersuchungen zur Variationsrechnung (Inaugural Dissertation). Berlin, 1894. A sketch of the theory from a historical point of view was given by Pascal in the third part of his Calcolo infinitesimale, Milan, 1897 ; and a German translation with the title Die Variationsrechnung was published at Leipzig in 1899. Still more recent is Kneser. Lehrbuch d. Variations- rechnung. Brunswick, 1900. — An introduction to modern work on the subject will be found in a memoir by Osgood, "Sufficient Conditions in the Calculus of Variations," Annals of Math. (ser. 2), 2, 1901. (a. E. H. L.)

Varna, a fortified town and the chief seaport of Bulgaria, on the south-west shore of the Black Sea, on a magnificent plain at the mouth of the Devna, on the north side of the Bay of Varna, at the terminus of a railway line from Bustchuk, and of another, opened in 1899, from Sofia, 48 miles east of Shumla, and 325 by rail

west-north-west of Sofia. Among modern buildings are the military barracks, the j.ost office, the National Bulgarian Bank, and higher-class college for girls. The extensive harbour works, in progress for some years, are already affording improved facilities for shipping; and the open- ing of the railway also tends greatly to the increase of trade. The principal exports are cattle and dairy produce, grain, lamb and goat skins, and coarse cloth; and the imports include fruit, vegetables, fuel, chemicals, oils, earthenware, metals, textiles, machines, ironmongery, &c. A British spinnery has been established which turns out large quantities of cotton yarn.

In 1895 the imports, amounting to 37,360 tons, were valued at £489,200, and the exports, of 97,500 tons, at £580,200. In 1900 the former were 29,400 tons, worth £435,300; and the latter, 52,500 tons, of the value of £349,800, the decline being due to bad harvests. In 1897 the number of vessels that entered the port was 767 of 458,172 tons, their cargoes amounting to 175,350 tons, and the cargoes of the vessels that cleared amounting to 245,292 tons ; in 1899 the number of vessels that entered was 546 of 424, 819 tons, .their cargoes amounting to only 35,274 tons,

~~while the cargoes of vessels that cleared amounted to only 52,294 tons. The popula- tion in 1892 was 28,174, and in 1900 it was 33,443. Less than one-fourth of the population are Turks, and Greeks and Bul- garians number each about one-third of the whole.~~

~~Vasa, or Nikolaistad, a town of Eussia, in the grand duchy of Finland, capital of the province of Vasa, on the east coast of the Gulf of Bothnia, 327 miles by rail north-west of Helsingfors. It has two classical lyceums for boys, a high school for girls, a reaZ-school, and various primary schools ; also a large cotton mill and a number of small factories showing an aggregate return of over 4,000,000 marks. Oats, butter, and cattle are ex- ported to Sweden. Vasa was founded on the coast of the Gulf of Bothnia in 1606, but after the great fire of 1852, as the sea had already receded for a considerable distance, the town was rebuilt nearer to the shore and received the official name of Nikolaistad. Population (1897), 13,493.~~

~~Vascular System. See Physiology.~~

~~Vasllli, a town in Bumania, chief town of the dis- trict bearing the same name, prettily situated on a hill at the junction of the rivers Vaslui and Berlad. The church of Biserica Domneasca (Our Lady) is fine. The annual fair is held on Ist-lOth September. There are ruins of a palace built by Stephen the Great in 1471. Population~~

~~(1895), 8500 ; (1900), 9024.~~

~~Vaticanism. — History since 1870. — The few months that elapsed between the 18th of July 1870 and the 18th of January 1871 witnessed four events that have been fraught with more consequence to the Papacy than anything else that has affected that insti- tution for the past three centuries. They were as follows : — (1) The proclamation of the Infallibility of the Pope on the 18th of July 1870; (2) the fall of the Napoleonic empire and the establishment of the third French republic on the 4th of September 1870 ; (3) the occupation of Borne by the Italian forces on the 20th of September 1870, resulting in the incorporation of the remaining States of the Church in the kingdom of Italy ; and (4) the foundation of the German empire by the proclamation, on the 18th of~~

January 1871, of the king of Prussia as hereditary German Emperor. These changes, which so greatly disturbed the current of all European relations, could not fail to react upon the Papal policy in various ways. They brought its existing tenden- cies into greater relief, set before it new aims and diverted it into new channels. Essential modifications could not, of course, be at once effected or even indicated in a Power whose life-blood is tradition, and whose main strength has always lain in calmly abiding the issue of events and in

temporizing. The eight years that Pius IX. was per- mitted to see after the loss of his temporalities entirely harmonize with this character. The veil that hides the negotiations which, during the closing months of the Franco-German war, were carried on between Bismarck and the Pope, through the agency of Cardinal Bonnhose, has not yet been lifted, and perhaps never will be. According to Prince Bismarck's own account of the matter, as given in his Gedanken und Erinnerungen, these negotiations were initiated by the Chancellor, who, between the 5th and 9th of November 1870, enter- tained pourparlers with Archbishop Ledochowski on the question of the territorial interests of the Pope. The Chancellor, acting, as he himself says, in the spirit of the adage, "one hand washes the other," proposed to that prelate that the Pope should give earnest of the relations subsisting between him and Ger- many by influencing the French clergy in the direction of the conclusion of peace. The cool reception his endeavours met with, both at the hands of the French ecclesiastics as well as in Eome, satisfied Bismarck " that the Papal hierarchy lacked either the power or the good- will to afford Germany assistance of sufficient value to make it worth while giving umbrage to both the German Protestants and the Italian national party, and risking a reaction of the latter upon the future relations between the two countries, which would be the inevitable result were Germany openly to espouse the Papal cause in Rome." These utterances are eminently characteristic. They show how far Bismarck was (even at the close of 1870) from comprehending the traditional policy of the Papacy towards Germany and

German interests, and how little he conceived it possible to employ the relations between the future empire and the Vatican as a point of departure for a successful and consistent ecclesiastical policy. Rome, in a certain sense, showed itself possessed of far greater foresight. Even to-day Papal diplomacy, like the French clergy, neither believes in the future of the German empire, nor admits that the overthrow of France has been final and complete. The German politicians and the Prussian diplomatists accredited to Rome had worked too openly at undermining the Papal hierarchy, and had veiled their sympathies for Piedmont far too lightly, to lead the Vatican to expect, after the 20th September 1870, a genuine and firm interven- tion on the part of Prussia on behalf of the temporal power of the Holy See. To satisfy the demands of Bismarck in November 1870 would have cost the Vatican more than it would ever have gained. It could neither afford to trifle with the sympathies of the French Catholics nor to interrupt the progress of those elements, which would naturally be a thorn in the side of the young German empire, thus undo Bismarck's work, and restore the Vatican policy to its pristine strength and vigour. It was soon to be perceived how carefully the Curia had made its calculations.

The address of the Catholic deputies to the Emperor William in Versailles on the 18th February 1871, plead- ing for the restoration of the States of the Church and the temporal sovereignty of the Pope, and for the reconstitu- tion of the Catholic Fraction formed in the Prussian Landtag in 1860 as the Centrum or Middle Party in the new Reichstag (April 1871), must not be regarded as the origin, but rather the immediate occasion, of the Kulturkampf. The congratulations which the Pope sent to the Emperor William on receiving the announcement of the establishment of the German empire (6th March 1871) were a last exchange of civilities, and the abolition of the Catholic department in the Prussian Kultus Ministry (8th July 1871) quickly followed, together with the appoint-

ment of Falk as Kultusminister (22nd January 1872), and the School Inspection Law of 9th February 1872.

On 30th January Bismarck took the opportunity of inveighing against the formation of the sectarian Centrum as being " one of the most monstrous

phenomena in the world of politics," and he left no room for doubt in the minds of his hearers that he regarded the leadership of Windthorst as constituting, in his eyes, a peril to the national unity. In his Memoirs (ii. 126) he declares that the Kulturkampf was mainly initiated by him as a Polish question. This declaration, in view of the development of affairs, must appear as strange as the Chancellor's con- fession {Memoirs, ii. 129 and fol.) that he endeavoured to persuade the emperor of the advantage of having a nuncio accredited to Berlin (in lieu of the Catholic depart- ment of public worship). The refusal of the Emperor William to entertain this project shows that in such matters his judgment was more correct than that of his counsellor, and the incident proves that the latter had anything but a clear insight into the historical position. He was drifting about with no higher aim than a " hand-to-mouth ". policy, whilst the Holy See could feel the superiority with which the consciousness of centuries of tradition had endowed it, and took full advantage of the mistakes of its opponent. The Chancellor never realized the gravity of the onslaught which, with his Kulturkampf, he was making upon the conscience and liberty of his Catholic fellow-citizens. He dealt with the great question at issue from the standpoint of the diplomatist, rather than from that of the statesman well versed in ecclesiastical history and possessing an insight into what it implies ; and by his violent, incon- siderate action he unwittingly drove into the ranks of Ultramontanism the moderate elements of the Catholic population. This conflict, moreover, brought Ultramon- tanism the enormous advantage that, even after the abolition of the May Laws, it had still left to it a well- disciplined press, an admirable organization, and a net- work of interests and interested parties ; and all these combined to make the Centrum the strongest and the most influential political party in Germany for the remainder of the 19th century. Owing to these circumstances, the rise and further development of the Kulturkampf were viewed in Jesuit and Vatican circles with feelings of the utmost complacency.

The purely ecclesiastical policy of Pius IX. was guided by the earnest desire to see the doctrine of Papal Infalli- bility brought to universal recognition. The definition of the Immaculate Conception (1854) and the proclamation of the Syllabus (1864) were finger-posts pointing the way to the Council of 1870. The Pope had been persuaded that the proclamation

of the new dogma would be effected without difficulty arid without discussion ; and when the pronouncement actually met with opposition, he was both surprised and embittered. For a moment the idea was entertained of giving way to the opposition and deferring a decision in the matter, or, in the manner of the Fathers in the Council of Trent, adjourning it to the Greek Kalends. But the party that needed for its purposes an infallible Pope readily persuaded Pius IX. that if the Council broke up without arriving at a decision favourable to the Papacy, this would be tantamount to a serious defeat of the Holy See and an open victory for the Gallican system. The consequence was the Bull Pastor ceternus, which Pius IX. issued on the 15th of July. This did not by any means represent all the demands of the Jesuits, and it was couched in terms which appeared not unacceptable to the majority of the Catholics. The fact that the bishops were prepared to forego their opposition was not unknown in Rome. It was anticipated by the authorities. But in Germany, as also in France, the waves of anti-Infallibility were rolling so

high, that the further development of events was viewed with no small concern. Under normal conditions, the situation could not fail to terminate favourably for the Vatican. That the Kvltwrkwmpf had followed so rapidly upon the war was the greatest piece of good fortune that could have befallen the Papal See. The war de- manded both in Germany and France the sacrifice of all available energy and public spirit ; while the Kultw- kampf, by bringing into relief the question of the external existence of the Church, thrust all internal dogmatic interests and problems completely into the background. The egregious blunder in the May Laws was the punitive clauses directed against the inferior clergy. Instead of enlisting them as friends, the Prussian Government con- trived by wild and wanton persecution to make them its enemies. The open protection it accorded to the Old Catholic movement contributed in no small measure to estrange those influential elements which, whilst favouring the suppression of Ultramontane tendencies, desired no schism in the Church, and viewed with horror the idea of a National Church in

Bismarck's sense. Thus we find that the bitter years of the Kultwrkwnvpf extricated the Vatican from one of the most difficult situations in which it had- ever been placed. Pius IX. could now fold his hands, so far as the future was concerned. It is well known that he fed on inspirations, and expected each day the advent of some supernatural occurrence which should bring about the triumph of the Church. In this frame of mind, on the 24th June 1872, he addressed the German Leseverein, and referred to the stone that would soon fall from on high and crush the feet of the Colossus. Yet the stone has not fallen from the summit of the holy hill, and the Colossus of the German empire has not crumbled into dust, which is more than can be said for the Pope's inspirations, which led him to expect the sudden with- drawal of the Italians from Eome, and a solution of the Eoman question in the sense inspired by his visionary policy. The Holy See directed all its energies towards the solution of the problem ; in the event of its proving to be insoluble, it would take care that it should remain a fester- ing sore in the body of the monarchy.

The documents of the Vatican Council which have been published since 1870 leave no room for doubt that the proclamation of Papal Infallibility was intended to be followed by a further declaration, to the effect that the doctrine of the temporal power of the Pope should be regarded as a revealed article of faith ; yet the advantage and necessity of the temporal power were not to be re- garded as a revealed dogma properly speaking, but as a truth guaranteed by the doctrinal body of the Holy Church. These articles, contained in the 5th Scheme, and zealously championed by the sectaries of the Jesuit order, reveal the immediate object for which the Council of 1869-70 was convened. The resolutions were devised to save the situation, in view of the impending loss of the temporalities. No one could expect that Pius IX. would recognize the annexation of Eome by Italy. Eome, even in the 19th century, had been a spectator of many changes in the political world. It had seen more than one kingdom rise and fall. No wonder, then, that the Vatican, confronted by a new Italy, observed a passive and expectant attitude, and sanctioned no jot or tittle that could infringe its rights or be interpreted as a re- nunciation of its temporal sovereignty. It was quite in keeping that Pius IX. availed himself to the full of the (for him) convenient clauses of the Italian "Guarantee Law" (13th May 1871), while refusing the civil list of three and a quarter

million francs provided for his use, and inhibiting Italian Catholics from participating in the elections to the House of Deputies (ne elettori ne eletti).

This step was regarded in Italy as a natural one. Although the Liberal record»of the Pope was a thing of the past, and his policy had, since Gaeta, become firmly identified with the reactionary policy of Antonelli, yet the early years of his pontificate were in such lively recollec- tion as to allow of Pius IX. 's appearing to some extent in the light of a national hero. And rightly ; for he had always had a warm heart for Italy ; and had it not been for the anti-ecclesiastical policy of the house of Piedmont, he would not, in the 'sixties, have been wholly averse from reconciliation. The hitherto unpublished correspondence of the Pope with Victor Emmanuel contains remarkable proofs in support of this contention, and a further cor- roboration can also be perceived in the conciliatory attitude of Pius IX. on the death of the king.

Pius died on the 7th of February 1878, only a few weeks later than his opponent. He had long passed the traditional years of Peter's Pontificate, had reigned longer than any previous wearer of the tiara, and had seen some brilliant days — days of illusory glory. On his death he left the Church shaken to its very foundations, and in feud with almost every Government. In Italy the Holy Chair was surrounded by a hostile force, whose " prisoner " the Lord of the Vatican declared himself to be. In Spain and Portugal, and also in Belgium, a Liberalism inimical to the Church was in power. Prussia, together with other German States, was in arms against Pope and episcopate. In France the Conservative mon- archical party had just shown its inability to preserve the Crown, whilst the Eepublic had anchored itself firmly by denouncing the Clergy as its enemy. There was hardly a sovereign or a government in Christendom against which Pius IX. had not either protested or against which he had not openly declared war. Such was the heritage that devolved upon Leo XIII. on his election on the 20th of February 1878.

Leo XIII. brought to his new dignity many qualities that caused his election to be sympathetically received. In contrast to his predecessor, he was a man of slow and calm deliberation, and it was natural to suppose

that he was little, if at all, accessible to impulses of the moment or to the persuasions of his entourage. He was endowed with a certain scholastic erudition, and enjoyed the repu- tation of being a good Latinist. As Nuncio in Brussels he had become acquainted with the trans-Alpine world, and had been initiated into the working of the machinery of modern politics and modern parliamentary government. The fact that he had for so long been absent from Eome afforded ground for the belief that he was not inclined to identify himself with any of the parties at the Vatican court. These were the considerations that had caused the Moderates in the Sacred College to fix their eyes upon him. The appointment of Franchi as secretary of state was a bid for peace that was viewed by the Irreconcilables with ill-disguised vexation. The following years of Leo XIII. 's pontificate only tended to increase their dissatisfaction. The first care of the new Pope was to pave the way for the restoration of peace with Prussia and the German empire. The correspondence which was interchanged during the regency of the Crown Prince in 1878 clearly manifests that both sides were eager to arrive at a recon- ciliation. But, as a matter of fact, there were great diffi- culties in the way ; for, on the one side, the Prussian Government and the Chancellor were not inclined defi- nitely to abolish the May Laws and to content themselves with the system of discretionary powers ; and on the other, the Pope had also to deal with elements that were nourished by the Kulturkampf, and owed their very existence to it. The great patience, persistence, and energy which Leo XIII. employed in overcoming these

difficulties, so that ultimately his labours for peace were crowned with victory, musi^be commended. The Holy Chair made on this occasion many concessions which appeared to the Zelanti to be excessive, and made even still greater ones to France and Eussia, to the great distress of the Poles. But at last Leo XIII. could boast not only of having re-established diplomatic relations with most of the Powers, but also of having entered into a convention with the Great Powers of the North, which accorded him, in conjunction with the three emperors, a leading

position as champion of the conservative interests of humanity. How proud Leo XIII. was of his import- ance in this position is shown by the beautiful Encyclical, De Civitatuni Constitutions Christiana (" Immortale Dei," of 1st November 1885), in which he adopted the strongest attitude against the principle of the sovereignty of the people (ex Us autem Pontificum prcescriptis Mud omnino intelligi necesse est, ortum publico? potestatis a Deo ipso, non a multitudine repeti posse), refuting the notion that the principle of public power emanates from the will of the people alone (principatum non esse nisi populi voluntatem), and absolutely rejecting the sover- eignty of the people as such. But this attitude was adopted by Leo XIII. not as an end but as a means. The real aims of his rule were disclosed in the second phase of his pontificate.

At its very commencement, the Pope in his first Encyclical (Easter 1878) proclaimed the necessity of a temporal hierarchy. This was at the time regarded merely as a formality imposed by circumstances, and one not to be seriously entertained ; but it became more and more evident that the recovery of the temporalities was the real mainspring of Leo's whole policy. In the negotiations with Germany, it was clearly seen that it was from that side that the Pope expected intervention in favour of restitution ; and, according to all appearances, Bismarck did for a while keep alive these representations, though with more tact than candour. After peace had been concluded, Leo, by the agency of Galimberti, reminded the Chancellor of the settlement of the Roman question. Bismarck replied that he was " unaware of the existence of any such question." The two visits paid by Emperor William II. to the Vatican could not fail to remove any doubts in the mind of the Pope as to the fact that Germany did not dream of giving him back Rome. The Austro-German-Italian triple alliance was a dire blow to his expectations, and Crispi's policy with its irritating and galling pin-pricks caused the cup to overflow.

Thus slowly, but yet deliberately, between 1887 and 1893, a transformation took place in Leo's spirit and policy, and with it was brought about one of the most momentous changes in the attitude of the Church towards the problems of the times and their impelling forces. A rapprochement with France inevitably entailed not only an alliance with modern democracy, but also a recognition of its principles and aims. In

~~Rome there was no room for both Pope and King. The note of the Pope to Rampolla of 8th October 1895, in consequence of the cele- brations on 20th September, declared, in terms more decided than any that had until then been uttered, that the Papacy required a territorial sovereignty in order to ensure its full independence, and that its interests were therefore incompatible with the existence of the kingdom of Italy as then constituted. The inevitable consequences ensued. Italy regarded the Pope more than ever as a foe within its walls ; and the policy of the Pope, as regards Italy, aimed at replacing the kingdom by one or more republics, in which the temporal power should, in some form or other, find a place. But the continuance of the Republic in Paris was a condition precedent to the~~

~~establishment of a republic in Rome, and the first had no chance of existence if the democracy in France did not remain in power. The result was the policy of the Ealliement. Instructions were given to the French Catholics to break with monarchical principles, and both externally and internally to cleave to the Republic as representing the best form of constitutional government. In carrying out the regime of Rampolla, which was, in every respect, a bad imitation of that of Antonelli, the Vatican left no stone unturned in its attempt to coerce the conscience of the French royalists ; it did not even stop at dishonour, as was evidenced by the case of the unhappy Mgr d'Hulst, who, in order to evade the censor- ship of his pamphlet on Old Testament criticism, had to abandon both his king and his principles, only to die in exile of a broken heart. The case was characteristic of the whole Catholic monarchical party, which, owing to the Pope's interference in French politics, became dis- integrated and dissolved, a fate that was all the more painful seeing that the Ralliement failed to influence the course of events. The " atheistic " Republic did not for one moment think of putting on sackcloth, or even of giving the Church a single proof of esteem and sympathy.~~

~~In one respect it was impossible for the Papacy to continue on the path it had taken. In his first Encyclical, Leo XIII. had sounded the clarion for battle against the Social Democracy; his Encyclical Novarum Rerum en- deavoured to show the means to be employed, mainly in view of the condition of things in Belgium, for solving the social question on~~

~~Christian lines. But the Christian Democracy, which, starting in Belgium and France, had now extended its activity to Italy, Austria, and Germany, and was striving to arrive at this solution, degenerated everywhere into a political party. The leaders of this party came into close contact with the Social Democrats, and their relations became so cordial that Social Democracy everywhere declared the " Democratic Chr^tienne " to be its forerunner and pioneer. The electioneering alliances, which were everywhere in vogue, but particularly in Germany, between the Catholics and popular party and the Social Democrats, throw a lurid light upon the character of a movement that certainly went far beyond the intentions of the Pope, but which it was now difficult to undo or to hold in check. For it is the essence of the matter that there were further considera- tions going far beyond the Roman question and forcing the Curia to adhere to the sovereignty of the people.~~

~~The external rehabilitation of the Church had become, in many points, a fait accompli, but, internally, events had not kept pace with it. Catholic romanticism had withered away in France, as it had in Germany. " Liberal Catholicism," which was its offspring, had died with Montalembert, after being placed under a ban by Rome. The national religious movement, associated in Italy with the great names of Rosmini and Gioberti, had similarly been disavowed and crushed. The development of the last decade of the 19th century had clearly shown that the educated bourgeoisie, the tiers e'tat, in whose hands the supreme power had since 1848 become vested through- out Europe, was either entirely lost to the Church or, at all events, indifferent to what were called Ultramontane tendencies. The educated bourgeoisie, which controls the fields of politics, science, finance, administration, art, and literature, does not trouble itself about that great spiritual universal monarchy which Rome, as heir of the Cissars, claimed for the Vatican, and to which the Curia of to-day still clings. This bourgeoisie and the modern state that it upholds stand and fall -with the notion of a constitutional state, whose Magna Charta is municipal and spiritual liberty, institutions with which the ideas of the Curia are~~

~~VATICANISM~~

in direct conflict. The more the hope of being able to regain these middle classes of society disappeared, the more decidedly did the Curia perceive that it must seek the support and the regeneration of its power in the steadily growing Democracy, and endeavour through the medium of universal suffrage to secure the influence which this new alliance was able to offer.

The pontificate of Leo XIII. in its first phase aimed at preserving a certain balance of power. Whilst not openly repelling the tendencies of the Jesuits, Leo yet showed himself well disposed towards, and even amenable to, views of a diametrically opposite kind ; and as soon as the Vatican threw itself into the arms of France, and bade farewell to the idea of a national Italy, the policy of equilibrium had to be abandoned. The second phase in Leo's policy could only be accomplished with the aid of the Jesuits, or rather, it required the submission of the ecclesiastical hierarchy to the mandates of the Society of Jesus. The further consequence was that all aspira- tions were subjected to the thraldom of the Church. The pontificate of Leo XIII. is distinguished by the great number of persecutions, prosecutions and injuries in- flicted upon Catholic savants, from the prosecution of Antonio Rosmini down to the proscription directed against the heads of the American Church. Episodes, such as the protection so long extended to the Leo Taxil affair, and to the revelations of Diana Vaughan (the object of which last was to bring Italian freemasonry and its ostensible work, the unity of Italy, into discredit), together with the attitude of the Ultramontane press in the Dreyfus affair, and later towards England, the in- vigoration of political agitation by the Lourdes celebra- tion and by anti-Semitism, were all manifestations that could not raise the " system " in the estimation of the cultured and civilized world. Perhaps even more dan- gerous was the employment of the whole ecclesiastical organization, and of Catholicism generally, for political purposes.

No one will be so foolish or so unjust as to hold Leo XIII. responsible for the excesses committed by the subordinate departments of his government, in disclosing, prosecuting, and sometimes even fraudulently

~~*misrepre- senting his aims and ends. But all these details, upon which it is not necessary to dwell, are overshadowed beyond all doubt by the one great fact that the ecclesias- tical regime of the present day not only takes under its wing the solution of social questions, but also claims that political action is within the proper scope of the Church, and, moreover, arrogates to itself the right of interfering by means of " Directives " with the political life of nations. This, as is well known, is nothing new, for as early as 1215 the English barons protested against it. But the weakening of the pontificate had allowed this claim to lapse for centuries. To have revived it, and to have carried it out as far as is possible, is the work of Leo XIII., and the very essence of the Vatican policy of modern times.*~~

~~*It would be both presumptuous and premature to pass a final verdict at present upon the value and success of a policy to which, whatever else be said, must be accorded a certain meed of praise for its daring. As long ago as 1892 Spiiller, in his Essay upon Lamennais, pointed out how the latest evolution of Catholicism was taking the course indicated by Lamennais in his Livre du Peuple (1837), and how the hermit of "La Chenaie," who de- parted this life in bitter strife with Rome, declared himself to be the actual precursor of modern Christian Socialism. He hinted that the work of Leo XIII. was, in his eyes, merely a new attempt to build up afresh the theocracy of the Middle Ages upon the ruins of the old*~~

~~*monarchies, utilizing to this end the inexperience of the young and easily- beguiled democracies of the dawning 20th century. To comprehend these views aright, we must first remember that what in the first half of the 19th century, and also in the days of Lamennais, was understood by Democracy was not coincident with the meaning of this expression as it is now used, and as the Christian Socialists understand it. Down to 1848, and even still later, " Democracy " was used to cover the whole mass of the People, pre-eminently represented by the broad strata of the bourgeoisie; in these days the Democratic party itself means by this term the rule of the labouring class organized as a nation, which, by its numerical superiority, thrusts aside all other classes, in- cluding the bourgeoisie, and excludes them from participa- tion in its rule. In like manner it would be erroneous to confuse the sense of the expression as it obtains on the Continent with what is understood under this term in*~~

England and America. In this* latter case the term " Democracy," as applied to the historical development of Great Britain and the United States, denotes a constitu- tional state in which every citizen has rights proportionate to his energy and intelligence. The Socialistic. idea, with which the " Democratic Chrdtienne " has identified itself both in France and Belgium, regards numbers as the centre of gravity of the whole State organism. As a matter of fact it recognizes as actual citizens only the labourer, or, in other words, the proletariat.

On surveying the situation, certain weak points in the policy of the Vatican become manifest. They may be summed up as follows : (1) An unmistakable decline of religious fervour in church life. (2) The intensifying and nurturing of all the passions and questionable practices which are so easily encouraged by practical politics, and are incompatible in almost all points with the priestly office. (3) An ever-increasing displacement of all the refined, educated, and nobler elements of society by such as are rude and uncultured, by what, in fact, may be styled the ecclesiastical " Trottori." (4) The naturally resulting paralysis of intelligence and scientific research, which the Church either proscribes or only sullenly tolerates. (5) The increasing decay and waxing corrup- tion of the Romance nations, and the fostering of that diseased state of things which of late has displayed itself in France in so many instances, such as the Dreyfus case, the anti-Semitic movement, and the campaign for and against the Assumptionists and their newspaper, the Croix. (6) The increasing estrangement of German and Anglo-Saxon feeling. As against these, there are also noteworthy reasons to be urged in favour of the new development. It is maintained that the faults just enume- rated are only cankers inseparable from every new and great movement, and that these excrescences will dis- appear in course of time, and the whole movement enter upon a more tranquil path. Moreover, it is pointed out that in the industrial districts of Germany, for example, the Christian industrial movement, supported by Protest- ants and Catholics alike, has achieved considerable results, and proved a serviceable means of combating the seduc- tions of Socialism. It is finally urged that we must not ignore the fact that in these days the Church has reminded the wealthy classes of their duties to the sick and toilers, and that by making

the social question its own it has gone a long way towards permeating all social and political conditions with the spirit of Christianity.

These are the arguments that can be urged against and for the policy of Leo XIII. We refrain from com- menting upon matters that are still in course of develop- ment, and leave it to the 20th century to make up the balance-sheet of this account. (f. x. k.)

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VAUCLUSE — VEGETARIANISM

Vaucluse, a department of the south-east of France, traversed by the Alps of Provence and watered by the Eh6ne.

Area, 1381 square miles. The population, 241,787 in 1886, numbered only 235,457 in 1901. The births in 1899 were 4517, of which 215 were illegitimate ; deaths, 5191 ; marriages, 1790. Four hundred and sixty -five schools in 1896 were attended by 29, 000 pupils, 5 per cent, of the population being illiterate. The land under cultivation in 1896 amounted to 679,250 acres; 405,080 acres arable, and 44,460 acres under vines. The wheat raised in 1899 was valued at £744,000 ; oats, £74,320 ; potatoes, £283,000; mangold-wurzel, £105,000; beetroot, £11,800. The vintage of

1899 was valued at £569,000. The sericultural production in 1898 amounted to 17,200 cwt. of cocoons. The live stock numbered (1899) 13,510 horses, 15,200 mules, 3560 cattle, 238,200 sheep, 42,100 pigs, and 14,380 goats. In 1898, 2774 metric tons of lignite and 8100 tons of sulphur were mined. The distilleries produced 74,000 gallons of alcohol in 1898. Other industries are in paper, linen stuffs, silk, and chemical products. Avignon, the capital, had in 1901, 46,209 inhabitants.

Valid, one of theJ3wiss cantons. Its total area is 1247-6 square miles. Of this no fewer than 1056-8 square miles are classed as "productive," forests covering 282 square miles, and vineyards 25^ square miles. Of the "unproductive" 190-8 square miles, 4-3 square miles are occupied by glaciers, while 123 \ square miles is the cantonal share of the Lake of

Geneva, 33 -1 square miles that of the Lake of Neuchatel, and 3-6 square miles that of the Lake of Morat. The population in 1888 was 247,655; in

1900 it was 284,673, or 226 inhabitants to each square mile. The great majority of the people are Protestant and French-speaking, the Eoman Catholics being about one-thirteenth of the whole and the German -speakers about one-eleventh. The capital is Lausanne. In 1897 the state revenue was 9,132,547 francs (a rise of 86f per cent, since 1885), and the state expenditure, 9,212,652 francs (a rise of 89f per cent, since 1885), while the public debt was 10,656,000 francs. The canton is divided into nineteen administrative districts. In 1888 Vevey had 7925 inhabitants, increased in 1899 to 10,482, so that it is the second town in the canton. " Montreux " is a general name for a number of villages scattered along the shore of the lake. From Glion, above Territet- Montreux, there is now a funicular railway up to the Eochers de Naye. Yverdon had 6275 inhabitants in 1888, and 7980 in 1900. The political cantonal con- stitution of 1885 is still in force.

See Dictionnaire gdographique et descriptif du Canton de V. Vevey, 1827. Documents relatifs a I'hist. du Pays de Vaud, 1293- 1750. Geneva, 1817. — P. Maillbfer. JSistoire du Canton de Vaud. Lausanne, 1902. — Mimoires and Documents (published by the Soc. de l'HIst. de la Suisse Romande). Lausanne. From 1838. — Meredith Read. HIstoric Studies in Vaud, Bern, -and Savoy, 2 vols. London, 1897. (w. A. B. C.)

Vegetarianism. — This comparatively modern word, which came into use about the year 1847, is ap- plied to the practice of living upon foods from which fish, flesh, and fowl are excluded. There have from time to time been various sects or schools of thought that have advocated narrower views. Some of these have excluded all animal products — -such as milk and eggs and cheese. Some have excluded all cooked foods, and have preached the virtues of fruits and nuts and grains in their natural ripe state. Some have abstained from all underground-grown roots and tubers, and have claimed special benefits from using only those fruits and vegetables that are grown in the sunlight. Some have given up all grain and pulse foods, and have declared that old age can be best resisted by living entirely upon fruits, salads, nuts, soft water, and milk products.

~~Some have added fish to their dietary ; but, speaking generally, all who are called vegetarians will be found to abstain from the use of flesh ;md fowl and almost invariably also from fish as food.~~

~~The fact, however, must not be overlooked that while vegetarian societies claim as " vegetarians " all who abstain from flesh foods, there is a large and growing number of people who repudiate the name of " vegetarian " because of its associations, but who none the less, for some of the reasons detailed below, abstain from eating anything that has been killed. The Order of the Golden Age, for example, of which the head- quarters are Barcombe Hall, Paignton, South Devon, has adopted the words " Fruitarian " and " Fruitarianism " to denote the dietary of its members. The rule laid down by the Order is abstinence so far as possible from all foods which are obtained by the cruel infliction of pain, and the minimum that is set is complete " absti- nence from flesh and fowl," while net-caught fish may be used by associate members.~~

~~The reasons that are advanced for the practice of fruitarianism or vegetarianism are very comprehensive, but the principal ones may be considered to be the following : —~~

~~1. Health. — (a) On the ground that animals are affected~~

~~by diseases which are communicable, and are actu- ally communicated, to man by the ingestion of their flesh, e.g., parasites, tuberculosis ; (/?) on the ground that the flesh of artificially-fed animals is full of excretory substances, and that, therefore, wider •modern conditions, flesh-eating is injurious, and may be a cause of excretory substance and uric acid deposits or rapid tissue-destroying diseases in man ; e.g., gout, cancer.~~

~~2. Economy. — On the ground that the assimilable~~

~~nutriment from a given weight of selected fruit and grain and nut and vegetable foods will cost less than the same nutriment obtained from flesh foods.~~

~~3. Social Economy. — On the ground that an acre of~~

cultivable land under fruit and vegetable cultiva- tion will produce from two to twenty times as much food as if the same land were utilized for feeding cattle.

4. Racial Improvement. — On the ground that the aim

of every prosperous community should be to have a large proportion of hardy country yeomen, and that horticulture and agriculture demand such a high ratio of labour, as compared with feeding and breeding cattle, that the country population would be greatly increased by the substitution of a fruit and vegetable for an animal dietary.

5. Character Improvement. — On the ground that after

the virtues of courage and valour and fearlessness have been taught in the lower stages of evolution, the virtue of gentle humaneness and extended sympathy for all that can suffer should be taught in the higher cycles of the evolutionary spiral. Flesh eating entailing necessarily an immense volume of pain upon the sentient animal creation should be abstained from by the " higher classes " in the evolutionary scale. Organizations have been established to advocate this method of living under the name of "Vegetarian Societies" in many countries — chiefly the United Kingdom, America, Germany, France, Austria, Holland, and Australia. Pro- pagandism is carried on by lectures, literature, cookery demonstrations, and restaurants. In England, the oldest and one of the most important societies is " The Vegetarian Society," of which the headquarters are at Oxford Street, Manchester. There are also several small London societies, and an active London Association. A few pro- vincial towns, too, have small societies. An attempt has been made to organize the various vegetarian societies of

the world under the title of "The Vegetarian Federal Union." The headquarters of the London societies and of the "Union" are at Memorial Hall, Farringdon Street, E.C.

There are nominally about 35 organized societies in existence, but the extent to which public opinion and practice in the matter of dietary has been affected during the last decade of the 19th century is not to be gauged by the membership of such organizations. There are in England some 60 vegetarian restaurants and boarding- houses, one hospital and one or two sanatoria. In Germany and America there are many institutions where flesh is only prescribed in special cases. Flesh food is not included in the dietary of the chief hospitals and orphanages of the Native States of India, excepting in the wards devoted to Europeans.

The athletic side has been represented in national and international races by vegetarians winning the Berlin and Dresden walking match (125 miles), the Carwardine Cup (100 miles) and Dibble Shield (6 hours) cycling races (1901 and 1902), the amateur championship of England in tennis (4 successive years up to 1902) and racquets (1902), the cycling championship of India (3 years), half- mile running championship of Scotland (1896), world's amateur cycle records for all times from 4 hours to 13 hours (1902), 100 miles championship Yorkshire Koad Club (1899, 1901), tennis gold medal (5 times).

In the religious world the Seventh Day Adventists (who are connected with many sanatoria and the manufacture of food specialities) and some Bible Christians, the worshippers of Vishnu and the Swami Narang and Vishnoi sects, amongst others preach abstinence from flesh food. The Salvation Army, the Tolstoyans, and the Doukhobors encourage it. A number of Orders in the Eoman Catholic Church (e.g., the Trappists) and in the Hindu faith (e.g., the Dadupanthi Sadus) are pledged abstainers.

Social movements are in certain directions tending also towards vegetarianism. Members of societies, like the various anti-vivisection societies and the animal pro- tection societies, are being met with the rejoinder to their propaganda, that if they want to convert other people to abstain from the infliction of pain upon animals they must themselves set the example by abstaining from foods which are obtained by the infliction of much pain.

The enormous importation of fruits, and the great development in the methods of preparing and preserving vegetable foods, are making it

increasingly easy for people to live as luxuriously as has been their wont without being obliged to use animal foods. The general con- clusion appears to be that while the middle and lower classes are now eating more meat than they used to do, there is growing up a wide conviction that people are eating " too much " meat, and the pendulum is swing- ing towards the teaching of the Fruitarian School.

The literature on the subject is considerable, but the two classics are perhaps The Ethics of Diet, by Howard "Williams, and The Perfect Way iit Diet, by Dr Anna Kingsford. In former years the "Vegetarian Society" was the most active in producing literature, but since about 1901 the Order of the Golden Age has come to the front with new and up-to-date books, booklets, and leaflets, and the Ideal Publishing Union has reprinted much of the earlier literature. The chief periodicals are the Vegetarian (weekly), the Herald of the Golden Age (monthly), the Vegetarian Messenger (monthly), the Vegetarian (American monthly), the Children's Garden (monthly). (j. o.)

Veitch, John (1829-1894), Scottish philosophical writer, was born at Peebles in 1829, and educated at Edin- burgh University. During the years 1855 and 1856 he acted as assistant lecturer to Sir William Hamilton and his successor Professor Campbell Fraser. In 1860 he was

appointed to the chair of logic, metaphysics, and rhetoric in St Andrews, removing four years later to the corre- sponding chair in Glasgow. He published a translation of Descartes' Discours de la methode in 1850, and of the Meditations, with selections from the Principes, in 1852. In conjunction with Dr Mansel he prepared Sir W. Hamilton's lectures for publication in 1859, and wrote a memoir of the latter. Among his other works are Insti- tutes of Logic, in which he adopts his master's innovation of the quantifying of the predicate, and Essays in Philo- sophy : Knowing and Being and Monism and Dualism. In these essays he exhibits the peculiarly critical and analytic cast of his mind. In philosophy he was an Intuitionist, dismissing the Idealist arguments with some abruptness. He was a great lover of poetry, and was an authority on Scottish Border ballads. He wrote also on The Theism of Wordsworth. He died 3rd September 1894.

~~Vejer de la Frontera, a town of Spain, in~~

~~the province of Cadiz, near the coast, on the right bank of the river Barbate, on a hill some five miles north of Cape Trafalgar. It has an old parish church, San Salvador, with several convents, and two other more modern churches, several hermitages, and a bridge of four arches on the Barbate. The surrounding country is very picturesque, hilly, with lovely vegetation, abounding in fruit and other agricultural produce, live stock, especially bulls bred for the ring, and famed for their agility and ferocity. The town was taken from the Moors in 1248 by San Fernando, and long remained a fief of the dukes of Medina-Sidonia. Population (1887), 7760; (1897), 10,861.~~

~~Vejle, a seaport town of Denmark, capital of the county of Vejle, at the head of a fjord on the eastern side of Jutland, 69 miles by rail north-west of Odense. The harbour is entered and cleared by about 140,000 tons annually. Population (1890), 9015; (1901), 14,592.~~

~~VelikO-MikhailOVka, a village of Russia, in the government of Kursk, 44 miles east-north-east of Byelgorod railway station. It carries on a considerable trade in grain and animal products. Population (1897),~~

~~20,700.~~

~~Velletri, a town and episcopal see of the province of Rome, Latium, Italy, at the south-east foot of the Alban mountains, 20 miles south-east of Rome. In 1883 a monolith was erected to commemorate Garibaldi's victory in 1849 over the Neapolitan troops. It is the see of the bishop of Ostia, and has a statue of Pope Clement VIII., and a technical school. Good wine is made. Population (1891), about 13,500; (1900), about 16,500.~~

~~Veil Ore, a town of British India, in the North Arcot district of Madras, on the river Palar, with a station on the South Indian Railway, 80 miles from Madras city. Population (1891), 44,925; (1901), 43,458; municipal income (1897-98), Rs.59,770. It is still a military can- tonment, and has a special manufacture of perfumery. An American mission manages a high~~

school (raised to the rank of a college in 1898). There are five printing-presses and three reading-rooms.

Vendee, a department of western France, bordering on the Atlantic Ocean and watered by the Sevre Niortaise and the Sevre Nantaise.

Area, 2692 square miles. The population, 434,808 in 1886, had increased to 439,637 in 1901. The births in 1899 were 10,246, of which 358 were illegitimate ; deaths, 8224 ; marriages, 3309. The 881 schools were attended in 1896 by 68,000 pupils, and 6 per cent, of the population was illiterate. The land under cultivation in 1896 amounted to 1,538,810 acres, of which 1,081,860 acres were arable and 41,, 990 acres under vines, a considerable area consisting of grass lands. The yield of wheat in 1899 was valued at £1,604,000; oats, £256,000; barley, £83,800, the other cereals

yielding but insignificant values. The potato crop was worth £248,300 ; mangold-wurzel, £272,900 ; the green crops (trefoil and lucerne), £201,200 ; natural pastures and grass lands, £495,300. The vintage of 1899 was valued at £638, 000. The horses numbered (1899) 26,500 ; cattle, 356,437 ; sheep, 166,800 ; pigs, 77,205 ; goats, 3403. The milk produced in 1899 was valued at £840,000. Mining in 1898 turned out 23,200 metric tons of fuel, and 48,318 tons of sea-salt were produced. Apart from starch-making and tanning, industry is in a backward state. La Roche-sur-Yon, the capital, had 12,710 inhabitants in 1901.

Venetia, a territorial division of North Italy, lying between the Alps and the Adriatic, and stretching from the frontier of Carinthia and Istria (Austria) in the north- east to the lower Po and Lombardy in the south-west. It comprises the provinces of Belluno, Padua, Eovigo, Treviso, Udine, Venice, Verona, and Vicenza, and has an area of 9476 square miles. Population (1881), 2,814,173; (1901), 3,130,429. The crops

principally grown are maize, wheat, rice, wine, mulberry, tobacco, chestnuts, potatoes, and hemp. Copper and lignite are mined, and turf is extracted. The chief industries are the manufac- ture of woollens, cottons, silks, glass, laces, tobacco, straw- plait, paper, sugar, and hemp, the breeding of silkworms, iron-works and foundries, saw-mills, and shipbuilding. Its history is that of its chief towns, especially Venice. The peasantry suffer much from the miserable disease of pellagra. The principal towns are Venice, Padua, Verona, Vicenza, Udine, Treviso,,Belluno, Eovigo, Chioggia, Vittorio, Legnago, and Este.

Venezuela, a country and republic of South America, lying on the Caribbean coast, and bounded inland by the frontiers of Colombia, Brazil, and British Guiana. It stretches from about 1° 40′ to 12° 26′ N. and about 59° 43′ to 73° 30′ W. The boundary towards Colombia was in the main determined by Spanish arbitra- tion, under the convention of 16th March 1891, that towards Brazil having been fixed under the convention of 1883. In the dispute with Great Britain as to the boundary on the eastern side, the Venezuelan Government sought the intervention of the United States, and, under a treaty ratified 14th June 1897, the question was referred to a court of arbitration, which sat at Paris and gave its decision on 3rd October 1899. According to this award the boundary starts from Point Playa on the Caribbean coast, and, crossing the river Barima, runs to the point where the rivers Haiowa and Amakuru unite. Thence it follows the line known as the Schomburgk Line as far as the point of confluence of the Cuyuni and Wenamu rivers, whence it ascends the Wenamu to its most westerly source, there rejoining the Schomburgk Line, which it follows for the rest of its course.

The area of Venezuela in 1891, inclusive of the regions awarded to Colombia and Great Britain since that year, was variously

estimated at from 396, 400 to 593, 940 square miles, and Area ana the population was put at 2,323,530. Though the terri- popu a- toria.1 claims of the Republic are now largely reduced,

the population within Venezuelan boundaries is only slightly altered, the greater part of the disputed regions being very sparsely inhabited. The population (1891) consisted of 1,137,140 males and 1,186,390 females.

Whites, mulattoes, and negroes numbered 1,997,530, and Indians 326,000, of whom 240,000 were domesticated, 20,000 were subjugated, and 66,000 were in- dependent. In 1894 the total population was put at 2,444,816. In the year 1897-98 the number of marriages within the Republic was returned at 3940 ; of births, 61,835 ; of deaths, 48,761 ; the registration results are, however, of little or no value. There is practically no immigration. Various schemes announced since 1896 for the introduction of Italian and other immigrants have come to nothing. The purely white element of the population gradually decreases, while the negro becomes stronger. The principal towns, with their populations, are Caracas, the capital (75,000), Valencia (38,000), Maracaibo (30,000), Barquisimeto (25,000), Victoria (15,000), Ciudad de Cura (12,,000), Ciudad Bolivar (11,000), Barcelona (12,000), Puerto Cabello (10,000), La Guayra (8000).

Govern- ment.

The constitution in force is that of 29th March 1901, which provides for the representation of the twenty states, for the reorganization of which, as they existed in 1864, an Act was passed in 1899. The Congress consists of the Senate and the Chamber of Deputies. Each state appoints (through its legislature) two senators for the term of six years. The Chamber of Deputies is composed of representa- tives of the states, elected by direct popular vote for six years, one deputy for every 40, 000 inhabitants, and another if there are over 20,000 inhabitants more. The President of the Republic is elected for six years, and is assisted by a cabinet of ministers. Each state has its own separate legislature. Federal territories are administered under the direction of the central Government.

The school system requires that primary instruction be free and compulsory. Certain revenues, including the proceeds of the sale of stamps, fines for the infraction of the law as to school attendance, duties on tobacco imports, and other taxes, E"ucatloa- amounting in 1898 to £105,000, have been assigned for educational purposes. The educational result, however, is unsatisfactory. There is nothing to show that the revenues nominally assigned to instruction are applied to that purpose, and it is clear that educa- tion is neglected, the great majority of the lower

classes being unable either to read or write. In the principal towns there are schools, and there the clergy render some assistance, but they make no .effort in the country districts where few schools exist, and the owners of coffee estates and other employers of labour are indifferent. For secondary instruction there are schools in various parts of the country ; at Caracas there is a university, and at Merida, Valencia, Maracaibo, Ciudad Bolivar, and Barquisimeto there are similar institutions. But the defects of these schools and colleges are such that the wealthier Venezuelans send their sons to the German school in Caracas, or to the British colony of Trinidad, or even to the United States or to Europe to be educated.

Justice is administered by the Federal High Court and the Supreme Court of Appeal, and by many local courts for civil and for criminal cases. In the civil courts, however, legal process is dilatory, and in the criminal it is seldom that offences us ce' are effectively dealt with. Away from the towns scarcely any attempt is made to protect life and property by an efficient system of police.

The army consists of about 3600 men, and there is a national militia in which all citizens may be required to serve. The Republic possesses three steamers and a sailing vessel.

The Federal revenue is derived chiefly from import duties and stamps ; the expenditure is devoted mainly to internal adminis- tration and debt charges. In 1898 the revenue was £1,337,200 and the expenditure £1,821,700, and in t">aaf- 1901-02 they were estimated to balance at £1,480,000 (25 boli- vares being taken as £1). Besides the national revenue, the Federal Government collects and accounts for the state revenues, which are derived entirely from an additional import tax (substituted for the former state tax on goods in transit), and from the proceeds of sales of salt and of mining and waste lands. The municipal revenues are obtained from taxes on house property and on certain industries. The external debt in the middle of the year 1901 amounted to £4,577,290, besides £593,858 arrears of interest, for the payment of which no arrangement had been concluded. At the end of 1898, according to Venezuelan accounts, the whole debt, internal and external, stood at

£7,803,400, or 195,084,071 bolivares. The principal obligations, besides the external loans of 1881 and 1896, were the consolidated internal debt of £2,494,400, or 62,358,643 bolivares, the Caracas waterworks loan, £422,600, and the diplo- matic debt (arising out of damage to property of foreigners), £267,600. The rates of interest range from 3 to 13 per cent, per annum. The total charge amounts to about £496,000. There is also a large floating debt.

The chief agricultural industries are the cultivation of coffee, cocoa, and the sugar-cane, but natural products such as vegetable ivory, mahogany and other woods are collected. The . . principal source of wealth is coffee, and its cultivation " „uL·· extends over all the northern districts. In 1896 the area under cultivation was estimated at 180,000 acres, yielding on the average 5 cwt. per acre. Owing to revolutionary disturbances and the low prices obtained for coffee, the plantations tend to diminish. In 1900 the exports of coffee from Venezuelan ports amounted to 43,217 tons (Maracaibo, 20,050 tons ; Puerto Cabello, 12,994; La Guayra, 10,160; Cindad Bolivar, 13). Cocoa is cultivated in the warm and moist lower lands. The shipments of raw cocoa in 1900 were: from La Guayra, 5650 tons; from Puerto Cabello, 455 tons ; from Maracaibo, 181 tons; from Ciudad Bolivar, 37 tons. A considerable quantity, in addition, is stated to leave the country in the form of manufactured chocolate. The sugar industry is only kept alive by the prohibition of the import of foreign sugar, neither the soil nor the climate being specially adapted for this culture. Minor agricultural pro- ducts are maize, beans, fruits, and vegetables cultivated for local consumption ; cocoa-nuts, grown partly for their oil, partly for export to the United States ; tobacco of inferior quality for local

consumption. Mahogany, lignum vitce, and other hard woods are worked in the Orinoco district, but the trees are widely scattered and the cost of transport is high. The number of cattle is esti- mated at between four and five millions, but the development of the cattle industry has been hindered by the chronic political troubles, all the parties to every quarrel making

free use of the herds grazing on the llanos. The animals are small-bodied and long-horned, the descendants of those introduced by the early Spanish colonists. They were formerly of value mainly for their hides, but large numbers of living animals have been shipped to Cuba. Other live stock consists of horses, mules, donkeys (indis- pensable for transport), sheep, goats, and swine, but of the numbers of these animals there is no really trustworthy estimate.

Gold mining, formerly prosperous, has fallen into disrepute.

The mines are to the south of the Orinoco, and in the Andine

district in the west. In 1890 gold was exported to the

mining. yalue of £349334 . in 1894 the Talue wa8 £180,000;

in 1898, £111,068; in 1899, £120,975 ; in 1900, £63,904 ; in 1901, £89,151. Copper mining has practically ceased. In 1890 the export of copper ores amounted to £97,990 ; since 1894 none has been exported. The iron ores found in the Imataca mountains, near the Orinoco, are being worked by a British syndicate, whose operations, however, are retarded by the difficulty of obtaining a clear title from the Government. Goal is worked near Guanta ; the salt mines continue to yield a large revenue.

The number of persons employed in the agricultural, pastoral, and mining industries is estimated at 60,500, of whom 41,000 work on coffee, cocoa, and sugar plantations ; 10,000 on agricul- tural farms ; 8000 on cattle ranches, and 1500 at the mines. Other industries, such as brewing, leather-work, candle-making, are of strictly local interest.

In recent years commerce has suffered from the reaction follow- ing a period of undue inflation. During the twelve years 1883- 1894 about £10,000,000 of European capital was intro- Commerce. uael for the construction of railways, port works, and other purposes, and when the inflow of money ceased, trade fell off. The commercial depression was subsequently deepened by the general decrease in the price of coffee, the

~~staple product. Trade statistics are largely estimates, but the following figures indicate the value of the imports and exports in various years : —~~

~~Year. Imports.~~

~~Exports.~~

~~1893 . 1895~~

~~1897 .~~

~~1898 .~~

~~£4,395,000~~

~~3,900,000 2,748,530 1,711,900~~

~~£3,456,800~~

~~4,458,200 3,729,800 2,979,902~~

~~Of the imports about 44 per cent, in value are supplied by the United States, chiefly in the form of flour, petroleum, rape, lard, &c. ; Germany sends hardware and beer ; Great Britain, cottons and other manufactured goods ; and France, wines and oils. The exports are mainly coffee, cocoa, hides and skins, and cattle, but rubber and gutta-percha, copra, fustic, divi-divi, fish sounds, feathers, quina bark, and copaiba are sent abroad in considerable quan- tities. Germany and the United States take most of the coffee ; France, most of the cocoa ; the United States, the hides and skins. The Venezuelan merchandise imported into Great Britain is mainly gutta-percha and ornamental feathers. There are few British or United States merchants within the Republic. Germans are numerous, Venezuelans coming next in importance, then French, Italians, and Spaniards.~~

~~The principal port is La Guayra, which has a breakwater about~~

~~2050 feet in length, within which there is accommodation for~~

vessels drawing 26 feet of water. In 1900 La Guayra

Shipping waa visited by 315 veasei3 . Maracaibo, by 403 ; Puerto

aa° , Cabello, by 267 ; Ciudad Bolivar, by 74. Five lines con\m"B " 0f steamers connect La Guayra with American and o s. Eur0pean ports. On the Orinoco, Apure, and other rivers steam and sailing vessels maintain communication between the coast and inland towns. Boads are in general mere mule tracks. There are 434 miles of railway, of which the Government owns 12 miles, the remainder being the property of nine com- panies. In the postal system there are 214 post-offices. The Government telegraph line extends 3880 miles, and is served (inefficiently) by 113 telegraph offices. A French cable connects Venezuela with the rest of the world. Two telephone companies are at work in Caracas and other towns.

The currency is on a gold basis, 12,000,000 bolivares in gold, and 8,000,000 in silver being in circulation. All foreign gold has fixed legal value, the bolivar for all purposes of calcula- Crea t. yon Dejng taken as a franc. In official statistics, sums of money are stated in bolivares, but in general commerce values are stated in pesos, or ' ' soft " dollars of four bolivares, as dis- tinguished from "hard" dollars of five bolivares. Gold coins of 20 and 25 bolivares are minted, and a few of 50 and 100 bolivares. The silver coins in circulation are the dollar (5 bolivares), 50 , 40 ,

20 , 10 , and 5-cent pieces. Nickel coins of 2 cents and 1 cent are used, and a few copper pieces of the same value. Bank-notes, issued by the banks of Venezuela and Caracas, are everywhere accepted at their face value. The Venezuelan Government has steadily refused the many offers made to establish a state bank to issue notes having the force of legal tender. This firm attitude has saved the country from a flood of inconvertible paper-money.

There are three banks, the Bank of Caracas, the Bank of Venezuela, and the Bolivar Bank, the first two being old-established institutions. The Bolivar Bank, established in 1897 with a capital of 20,000,000 bolivares, administers the salt deposits, receiving 10 per cent, of the net salt revenue.

~~The bank gives the Government a credit of 6,000,000 bolivares at 8 per cent, interest, and has also agreed to lend to farmers a sum of 10, 000, 000 bolivares.~~

~~The old Spanish weights and measures still linger, though the metric system is officially adopted.~~

~~Authorities. — William Barry. Venezuela. London, 1886. — H. W. Bates. Central and South America. London, 1882. — William Eleroy Curtis. Venezuela. New York, 1896. — R. H. Davis. Three Gringos in Venezuela and Central America. London, 1896. — G. Orsi de Mombello. Venezuela y sus Riquezas. Caracas, 1890. — F. Vizcarrondo Rojtas. ReseHa Geografica de Venezuela. Caracas, 1895. — Manuel Landaeta Rosales. Gran Recopilacion Geografica, Estadistica e Historica de Venezuela. Caracas, 1889. — United States Consular Reports. Washington. — Handbook of Venezuela. Bureau of the American Republics. Washington, 1899 (revised edition). — British Foreign Office Diplo- matic and Consular Reports. London. — Anuario Estadistico de los Estados Unidos de Venezuela. Caracas.~~

~~(w. w. E. ; I. P. A. E. ; C. E. A.)~~

~~Recent History. — For two decades after the close of the revolutionary troubles in 1870 the supreme power in Venezuela was, for all practical purposes, in the hands of Sefior Guzman Blanco. He evaded the clause in the Constitution prohibiting the election of a President for successive terms of office by invariably arranging for the nomination of some adherent of his own as chief of the executive, and then pulling the strings behind this figure- head. The tenure of the Presidential office was for two years, and at every alternate election Guzman Blanco was declared to be duly and legally chosen to fill the post of chief magistrate of the Republic. In 1889 there was an open revolt against the dictatorial system so long in vogue ; and President Rojas Paul, Blanco's locum tenens, was forced to flee the country and take refuge in the Dutch colony of Curacoa. A scene of riot and disorder was enacted in the Venezuelan capital. Statues of Blanco, which had been erected in various places in the city of Caracas, were broken by the mob, and wherever a portrait of the dictator was found it was torn to pieces. No follower of the Blanco regime was safe. An~~

election was held and General Palacios was nominated to the office of President. A movement was set on foot for the reform of the Constitution, the principal objects of this agitation being to prolong the Presidential term to four years, to give Congress the right to choose the President of the Republic, and to amend certain sections concerning the rights of persons taking part in armed insurrection arising out of political issues. All might have gone well for President Palacios had he not allowed ambitious ideas to lead him to suppose that this extension of the Presidential period might be made to apply to himself. His attempt to force this question produced violent opposition in 1891, and ended in a rising headed by General Joaquin Crespo. This revolt, which was accompanied by severe fighting, ended in 1892 in the triumph of the insurgents, Palacios and his followers being forced to leave the country to save their lives. General Crespo became all-powerful ; but he did not immediately accept the position of President. The reform of the Constitution was agreed to, and in 1894 General Crespo was duly declared elected to the Presidency by Congress for a period of four years. One of the clauses of the reformed Constitution accords belligerent rights to all persons taking up arms against the State authority, provided they can show that their action is the outcome

of political motives. Another clause protects the property of rebels against confiscation. Indeed, a premium on armed insurrection is virtually granted.

In April 1895 the long-standing dispute as to the boundary between British Guiana and Venezuela was brought to a crisis by the action of the Venezuelan authorities in arresting Inspectors Barnes and Baker, of the British Guiana police, with a few of their subordinates, on the Cuyuni river, the charge being that they were illegally exercising the functions of British officials in Venezuelan territory. Messrs Barnes and Baker were subsequently released, and in due course made their report on the occurrence. For the moment nothing more was heard of this boundary question by the public, but General Crespo instructed the Venezuelan

minister in Washington to ask for the assistance of the United States in the event of any demand being made by the British Government for an indemnity. Whilst this frontier difficulty was still simmering, an insurrection against General Crespo was fomented by Senor Bojas Paul, the representative of the Blanco regime, and came to a head in October 1895, risings occurring in the northern and southern sections of the Republic. Some desultory fighting tdok place for three or four months, but the revolt never was popular, and was completely suppressed early in 1896. The Guiana boundary question now began to assume an acute stage, the Venezuelan minister in Washington having persuaded President Cleveland to take up the cause of Venezuela in vindication of the principles of the Monroe Doctrine. On 18th December 1895 a message was sent to the United States Congress by President Cleveland practically stating that any attempt on the part of the British Government to enforce its claims upon Venezuela as regards the boundary between that country and Guiana without resort to arbitration would be con- sidered as a casus belli by his Government. The news of this message caused violent agitation in Caracas and other towns. A league was formed binding merchants not to deal in goods of British origin ; patriotic associations were established for the purpose of defending Venezuela against British aggression, and the militia were embodied. The question was subsequently arranged in 1899 by arbitration (see vol. xxv. p. 558), and by the payment of a moderate indemnity to the British officers and men who had been captured. Diplomatic relations between the two countries, which had been broken off in consequence of the dispute, were resumed in 1897.

In 1898 General Crespo was succeeded as President by Senor Andrade, who had represented Venezuela in Washington during the most acute stage of the frontier question. Towards the end of the year a revolutionary movement took place with the object of ousting Andrade from power. The insurrection was crushed, but in one of the final skirmishes a chance bullet struck General Crespo, who was in command of the Government troops, and he died from the effects of the wound. A subsequent revolt overthrew President Andrade in 1900. General Castro then became President. During 1901 and 1902 the internal condition of the country remained disturbed, and fighting went on continually between the Government troops and the revolutionists.

~~Nominally in Venezuela the inhabitants have a right to vote for the members of Congress, but in reality this privilege is not exercised by them. Official nominees are invariably returned without any opposition, the details of the voting having been previously arranged by the local authorities in conformity with instructions from head- quarters. In these circumstances the administration of public affairs fell into the hands of an oligarchy, who governed the country to suit their own convenience. It is~~

~~this system which is the constant cause of revolutionary outbreaks. Since Venezuela became independent there have been about fifty revolutions within her borders, and ten of these proved successful. (c. e. a.)~~

~~Venice, a maritime city in the north-east of Italy, at the head of the Adriatic. Since 1880 Dryden's "dream upon the sea," which for most foreigners is one vast but inert monument, has undergone considerable change and development. Its industries have become flourishing, its commerce has extended, its hygienic conditions have improved, and its population increased from 132,826 in 1881 to 167,184 in 1898, exclusive of the garrison, and to 169,749 in 1899, according to the municipal estimate. With the increase of population and commerce the wealth of the community has also grown, the city budget having shown a constant surplus since 1881. In 1899 the surplus was £5430 on a total income and expenditure of £407,560. The municipal debt, which at the end of 1895 amounted to £273,987, has been reduced by more than £20,000, and is expected to be almost entirely extinguished in 1920. The ancient glass - bead industry (conterie), which some years since suffered severely from over-production, has now regained its position through the union of the different factories, by which the output is controlled in such a way as to render trade profitable. Venetian beads are now sent in large quantities to the various colonies in Africa from Marseilles, Bordeaux, London, Liverpool, and Amsterdam, and are largely shipped to India, Sumatra, and Borneo direct from Venice by the Suez Canal. Similarly, the glass industry , has revived and is now as flourishing as in the most prosperous periods of the Republic of Saint Mark. Many new factories have been founded at Venice and Murano, new amalgams and methods of colouring have been dis- covered, and fresh forms have been diligently studied;~~

~~*Special progress has been made in the production of mirrors, electric lamps, candelabra, and mosaics. New industries, which have already acquired a firm footing, are those of tapestry, brocades, imitation of ancient stuffs, cloth of silver and gold, and Venetian laces. The secret of lace-making was believed to have been lost, but the late Signor Fambri discovered at Chioggia an old woman who knew it, and placed her at the head of a lace school. Fambri was ruined by his enterprise, but other manu- facturers, more expert than he, drew profit from his initiative and founded flourishing factories at Pellestrina and Burano. Other important industries are wood- carving (of an artistic excellence long unknown), artistic iron-working, jewelling, bronze-casting, the production of*~~

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steam engines, machinery, matches (largely exported to Turkey, Egypt, Russia, Austria-Hungary, and Greece),

VENICE

653

clock-making, ■wool-weaving, and the manufacture of chemical manures. In addition, an industrial and electrical company transmits to Venice electrical power generated by the torrent Cellina, which descends from Belluno and flows into the Meduna near Pordenone. The trade of the port consists chiefly of goods in transit. This transit trade necessitated the construction of a wharf, or mari- time station, with direct railway sidings, which was opened on 1st May 1880. It covers an area of 87 acres in the lagoon, and is traversed by the Buranei canal. It comprises a square landing stage extending as far as the Grand canal, across which a two-span iron bridge, 63 yards long, has been built to connect the wharf with the railway. A foot-bridge connects the wharf with the

Campo di Sant' Andrea. Upon the wharf stand the custom houses, railway offices, and warehouses, covering a total area of over 2 acres. A mole or jetty of an average width of 98 yards runs along the Scomenzara canal, opposite the Campo di Marte, and is used for unloading vessels of less than 13 feet draught. Between the jetty and the so-called Sacca Marginata is a basin for larger sea-going ships, 780 yards long and 211 yards broad, with a depth of 26 feet at high tide. This ac- commodation is now insufficient for the needs of the port, and considerable extensions are projected. The import- ance of Venice has developed so rapidly that while, in 1881, it held only the sixth place, it now holds the second place among Italian ports, coming next after Genoa.

VENICE

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Plan op Venice.

The table on the previous page gives the shipping (steam and sail) statistics for 1897 and 1899 (tonnage in thousands of tons).

The development of the port has stimulated enterprise. In 1898 the Societa Veneta di Navigazione placed the ancient flag of Saint Mark once more upon the high seas ; on 1st January 1901 inland navigation was reopened between Venice and Pa via along the Po and inland canals ; the building and fitting out of large iron steamers is being undertaken ; a new line of railway from Venice to Trieste, vid San Giorgio di Megaro, has reduced the journey to three and a half hours instead of the six required for the sea passage. Within the city and between the islands of the estuary and Chioggia and Fusina rapid and cheap communication is maintained by the steamers, large and small, of the Societa Veneta Lagunare, which constitute the tramways of Venice. During the bathing season these steamers run to the Lido, which has been revolu- tionized since 1880, a clean, populous, well-lighted seaside and bathing resort having replaced the former squalid village. The port of Lido, long rendered unserviceable

by sandbanks, has been reopened by the construction of two moles, one, 1\ miles long, running north-east and the other, If miles long, running south-west, at a cost of £240,882. These moles, which rise 6£ feet above high- water mark, have, by creating a channel 380 yards long, had the effect of greatly reducing the sandbanks, so that vessels of 23 feet draught can now enter the port. In order completely to remove the sandbanks it will be necessary to lengthen the moles. £3000 has also been spent in laying two gas buoys, in accordance with the requirements of the Washington Conference. The arsenal of Venice, which has kept pace with the developments of the port, has furnished thirteen war vessels and cruisers to the Italian navy since 1879. The arsenal has been enlarged by the addition of new docking basins and modern plant. It gives constant employment to 6000 workmen.

The public elementary schools impart instruction to some 9000 scholars of both sexes (5300 boys, 3700 girls), of which 7400 (4300 boys, 3100 girls) belong to the lower, and 1600 (980 boys, 620 girls) to the upper

standard. These figures do not include the four communal infant asylums, which maintain 295 male and 252 female children. As far as possible special school buildings have been constructed on hygienic principles, and efforts have been made to deal with the problem — especially difficult at Venice, where space is limited — of physical education. About 1880 a wealthy Venetian, Signor Combi, bequeathed a fund for clothing and feeding poor children during the winter, and an association entitled Pro Schola, with similar objects, has been formed with the help of the municipality. In addition, the commune subsidizes a superior girls' school and a girls' professional school, both for the poorer classes and both imparting technical in- struction. Private educational institutions are numerous. They include eighteen infant schools, twelve elementary boys', six elementary girls', and seven mixed schools. About half are lay and half religious ; but only four of the female and none of the male teachers belong to the clergy. All are required to possess Government diplomas. Some of the private educational institutes, like the Instituto Manin and the foundling hospitals, are really charitable institutions with resources of their own, which good administration and frequent legacies continually increase.

Since 1890 public charity has been regulated by a special law. Statistics for 1892-97 show the number of families relieved during that period to have been 16,709, exclusive of the Jews, whose poor are looked after by the Fraterna Generale Israelita, to which the Charity Commissioners assign a proportionate revenue. During the same period the number of Venetian charitable in- stitutions was 173, of which 28 were managed by the muni- cipality and 132 by the parochial clergy. A form of charity almost peculiar to Venice is the Caliatico, or subsidies to poor mothers with unweaned children under eight months. A special hospital for children exists at the Lido. For working girls, sewing institutes with sewing-machines have been opened. The unem- ployed are cared for by » provident society subsidized by the commune. The commune has also joined the savings bank in constructing workmen's dwellings in place of

the unhealthy houses demolished in accordance with the city reconstruction and improvement scheme. By means of an aqueduct Venice has been provided with excellent drinking water, and the ancient rainwater cisterns have been abolished. The question of the aqueduct was first raised in 1866, but financial and technical difficulties pre- vented the commencement of the work until 1881, when the Compagnie Generale des Eaux pour l'Etranger received a conces- sion for sixty years. A supply (capable of increase) of 183, 600 cubic feet of water per day is brought into the city from the Fontanelle di Sant' Ambrogio, near Castelfranco, the water of the Brenta, originally used, having proved impure. The aqueduct, which consists of a pitch-coated iron tube 2J feet in diameter and 7000 yards long, crosses the marshes and passes under the lagoon to a reservoir at Sant' Andrea. Careful bacteriological examinations of the water both at Sant' Ambrogio and Sant' Andrea are constantly made. It is proposed to lay a new tube, at a cost of £22, 000, in order to extend direct water-supply to Giudecca, San Giorgio, Santa Maria delle Grazie, San Servolo, and the Lido. An import- ant investigation undertaken by the Bacterioscopical Laboratory, with regarcf to the pollution of Venetian canals by the city sewage, led to the discovery that the water of the Venetian lagoons and canals possesses auto-purifying power, not only in the large canals but even in the smallest ramifications of the waterways. The investigation was carried out with scrupulous scientific rigour upon samples of water taken in every part of the city, at high tide and low tide, under various atmospheric conditions.

Closely connected with the question of hygiene is the so-called Piano di Eisanamento, or Reconstruction and Improvement Scheme, consisting of twenty-four projects, most of which were adopted in 1891, and of which eight have already been carried out. The scheme contemplates the demolition of unhealthy houses and the enlargement of streets — work especially arduous at Venice, whero the total street area is only 160 acres, and whero it is necessary quickly to rebuild accommodation for the tenants of the houses destroyed. The most important new streets are a Calle lanja, called after Giuseppe Mazzini, in place of the old Calle della Scimmia at San Salvatore ; the Calle largo, Giacinto Gallina, formed by widening the Calli della Panada, Del Fabbro, and Del Cavallo, at SS. Giovanni and Paolo ; and the enlargement of the Calle Trono della

~~Piavola at Saint Mark's. These changes have caused the destruction of several interesting relics, among others the house where Canova died. Less justifiable, because less neces-~~

~~sary, was the restoration in 1880 of the Fontego dei Turchi, a splendid palace of the 13th century in Byzantine style, and the installation there of the oifices of the municipality. This palace was originally the property of the Pesaro family, and afterwards of the duke of Este, and finally of the Republic, which used it as a dwelling-place for royal guests before letting it to Turkish merchants.~~

~~Unfortunately, in 1880 the mania for placing all ancient monu- ments in "perfect condition" was prevalent — a mania from the barbarous consequences of which even Saint Mark's suffered on two occasions, first during the restoration of the north facade in 1843, and again during that of the south facade, begun in 1865 and finished in 1878. The latter facade was completely reconstructed upon 2200 piles driven to great depths, with the result that the general harmony of the monument — the effect of time and of atmospheric conditions — was completely lost. A lively agitation all over Europe, and particularly in England (conducted by Ruskin and William Morris), led the Italian Government to discard the Austrian plan of restoration, at least as regards the interior of the Basilica, and to respect the ancient portions which had stood the test of time and had escaped "renewal" by man. In 1880 » Vigilance Committee was appointed to watch over the restoration of the interior. The committee secured much verde antico and porphyry for the restoration of the pavement, in place of the common marbles which it had been intended to use, and organized special workshops for the restoration and preservation of the ancient mosaics, which it had been intended to detach and replace. Pieces already detached were restored to their original positions, and those blackened by damp and dust were carefully cleaned. Breaks were filled up with cubes obtained from fragments of con- temporary mosaics previously demolished. In this way the mosaics of the two arches of the atrium and those of the Zeno chapel were cleaned and preserved. An annual report of the work done is published by the director-general of the Basilica restoration. On 14th July 1902 Venice suffered severe loss by the collapse of the Campanile of Saint Mark, which had formed the most prominent~~

architectural feature of the city for 1000 years. The exact cause of the misfortune is not yet precisely known, but it is considered to have been due to negligence on the part of the architects appointed to watch over and repair the monument, and especially to careless incisions in one of the walls near its base. The re- moval of the debris was at once undertaken under the super- intendence of Signor Giacomo Boni, and all other prominent Venetian monuments are being minutely examined. It is prob- able that Saint Mark's Tower will be reconstructed on the same spot and in the same form as before.

Contemporaneously with the restoration of the southern facade of Saint Mark's, the restoration of the colonnade of the Ducal Palace towards the Piazzetta and the Mole was undertaken at a cost of £23, 000. The chief work was executed at the south-west angle, where the columns of the arcade had become so broken and distorted as to menace the safety of the whole building. The corner towards the Ponte della Paglia was also restored, and the hideous device of walling up the five last arches, adopted in the 16th century by the architect Da Ponte, was removed without prejudice to the stability of the structure. This piece of restoration met with approval in Italy and abroad, although the architect was accused of having removed twelve of the thirty-six capitals of the columns of the arcade (magnificent work of the 14th and 15th centuries) without absolute necessity. Among these capitals that of the corner column was so badly reproduced as to be refused by the authorities, and the sculptor died heartbroken. Thcancient capitals now stand in an inaccessible room on the ground-floor of the Palace. In order to lighten the Palace the Venetian Institute of Science, Letters, and Arts removed its headquarters and its natural history collection to the Palazzo Pisani at Santo Stefano. For the ame reason the Biblioteca Marciana with its 350,000 volumes wi'.l .hcrtly be moved to the Old Mint, opposite the Ducal Palace. The spvie thus cleared has been used for the rearrangement of the Archaeological and Artistic Museum, a great part of which had not before been accessible to the public, or had "jeen piled up in the private apartments of the Doges. The Renaissance bronzes were placed in one of the new halls, and the collection of gems, with the famous cameo of Giove Egioco, arranged in the centre. The marbles of the archteological collection were arranged in the halls previously occupied by the institute, thus liberating the room of

the Scarlatti or Gritti Barbarigo. The collection of Greek reliefs lias remained untouched in the entrance gallery, on account of the danger of placing weighty statues in the Palace, but the entrance gallery itself has been transformed into an exit, and the other arm of the Golden Stair reopened to the public. Side by side with these changes lias proceeded the reorganization of the Royal Gallery of Ancient Art, which, created by Napoleon I. for the students of the adjoining Academy of Fine Arts, gradually acquired such importance that in 1882 the Government divided it from the Academy and rendered it autonomous. Although lack of space I precluded ideal arrangement of the pictures, the Gallery now

constitutes a unique collection of Venetian paintings from the most ancient artists down to Tiepolo, one hall only being reserved for other Italian schools and one for foreign schools. Altogether the Gallery contains twenty rooms, one being assigned to the complete cycle of the "History of Saint Ursula," by Carpaccio ; another to Giambellino and to the Gelliniani ; and a whole wall of a third being occupied by the famous Veronese, "H Gonvito in casa di Levi." Titian's " Presentazione al Tempio," painted for the Scuola della Carita, which is now the seat of the Gallery, has been placed in its original position. The hall of the Assumption has been left untouched. Nineteenth-century pictures have been eliminated as foreign to the character of the collection, and inferior works relegated to a side passage. The reorganization of the Archaeological and Artistic Museum and of the Royal Gallery of Ancient Art coincided with the inauguration in April 1895 of a series of biennial International Art Exhibitions, arranged in order to celebrate the silver wedding of the king and queen of Italy. A special brick structure was erected in the public gardens to receive the works of contemporary artists, both Italian and foreign. The selection of works was made by an international jury from which Venetian artists were excluded. The second exhibition, visited by 336,500 persons, was held in 1897, and a third in 1899. The success of this exhibition (visited by 407,930 persons) led to the organization of a fourth exhibition in 1901, largely devoted to the works

~~of Ruskin. The institution of these exhibitions has furnished Prince Giovanelli with an opportunity to found at Venice a Gallery of Modern Art with pictures bought by him at the three exhibitions. Other purchasers having followed his example, the Gallery has been provisionally installed in the Palazzo Foscari, pending its definitive establishment in the Palazzo Pesaro, bequeathed to the city by the late Princess Bevilacqua la Masa. (v. Ma.)~~

~~Venlo, a town in the Dutch province of Limburg, on the Maas, 43 miles below Maestricht, now the junction of the railway lines Maestricht-Nimeguen, Cologne-Flushing, and Paris-Hamburg. The town, narrow and irregularly built, is not of the ordinary Dutch type in the style of its buildings. There are a fine town hall and a college for the higher education of Eoman Catholic priests. Population~~

~~(1899), 14,399.~~

~~VenOSa, a town and bishop's see of the province of Potenza, Basilicata, Italy, on the eastern side of Mount Vulture, 22 miles north of Potenza and 52 by rail south- south-east of Foggia. It has a cathedral, a 15th-century castle, and an abbey (1058), in which lie the remains of Eobert Guiscard. It is the ancient Venusia, the birthplace of the Roman poet Horace (65 B.C.), and a Roman colony after 291 B.C. There are remains of an ancient amphi- theatre. Near by are Jewish catacombs, with inscriptions in Hebrew, Latin, and Greek, discovered in 1853. Bricks and pottery are made. Population (1881), 8014; (1899), about 8500.~~

~~Ventilation. — The air which we breathe consists chiefly of two gases, oxygen and nitrogen, with certain small proportions of other gases, such as carbonic acid, ozone, argon, &c. Oxygen, which is the active and important constituent, and on which life and combustion depend, provides about one-fifth of the whole, nitrogen, which is inert and acts as a diluent, forming nearly four- fifths. Of this mixture, according to a well-recognized authority, each adult person breathes some 2600 gallons or 425 cubic feet in twenty-four hours. In air that has passed through the lungs the oxygen is reduced and the carbonic acid increased ; this is because the air has come into contact with the blood, which it has re-oxygenated, in return becoming itself more or less carbonized. Anything~~

which has passed through the human body ought to be treated as excreta and rejected. Just as sewage is thrown away into the drains, so air that has passed through the human lungs should be got rid of at the earliest possible moment without allowing it.to go through the lungs of any one else.

In the ventilation of all large buildings three main

points have to be considered: — (1) The area of

Bandings. gQor to ^ pr0vided for each person, (2) the cubic

capacity of the room required for each occupant, and (3)

the number of cubic feet of air per minute which must be brought in, and then extracted, for each individual. Nos. 1 and 2 will depend upon the objects to which the room is devoted, whether a ward of a hospital, or a school, or a place of public assembly ; there are numerous text-books on hygiene which will afford sufficient guidance in such cases. As to No. 3 there is great diversity of opinion, but no great harm will occur to an audience occupying the room for a comparatively short time, if 30 cubic feet of air per minute is provided for each person. The United States Book on School Architecture gives a practical application to its remarks on this subject as follows : —

The amount of fresh air which is allowed to hospital patients is about 2500 cubic feet each per hour. Criminals in French prisons have to content themselves with 1500 cubic feet per hour. Assuming that we care two-thirds as much for the health of our children as we do for that of our thieves and murderers, we will make them an allowance of 1000 cubic feet each per hour, or about 16 cubic feet per minute. Forty-eight children will then need an hourly supply of 48,000 cubic feet. Definite provision must therefore be made for withdrawing this quantity of foul air. No matter how many inlets there may be, the fresh air will only enter as fast as the foul escapes, and this can only find an outlet through ducts intended for that purpose, porous walls and crevices serving in cool weather only for inward flow. What, then, must be the size of the shaft to exhaust 48,000 feet per hour ? In a shaft 20 feet high, vertical and

smooth inside, with a difference in temperature of 20°, the velocity will be about 1\ feet per second, or 9000 feet per hour ; that is, it will carry off 9000 cubic feet of air per hour for every square foot of its sectional area. To convey 48,000 cubic feet, it must have a sectional area of 5J square feet.

Such a supply of fresh air should not be regarded as satisfactory, but merely as an improvement upon the present state of things. The standard of purity suggested is low, and ought to be exceeded, but it might deter many from moving in the matter if a proper and higher standard were to be laid down at first. A volume of 30 to 40 cubic feet or more per minute ought to be obtained wherever possible. One of the most important points is the proper warming of the fresh air introduced into buildings, for unless that be done, when a cold day occurs all the ventilating arrangements will probably be closed. The fact should not be lost sight of that the air in a room may on the one hand be quite cold and yet very foul, and on the other, warm and yet perfectly fresh. To avoid draught the air should enter through a large number of small orifices, so that the currents may be thoroughly diffused. This is done by gratings. The friction of their bars, however, seriously diminishes their capacity for passing air, and careful experiments show conclusively that very ample grating area is required to deliver large volumes. The same remark applies to extracting — flues. Owing to the small size and the roughness of the surface the velocity of the upward current is small, and the quantity of air that passes out is often much less than is requisite.

No large building can be successfully ventilated without some mechanical force furnished by steam, electricity, falling water, or some such agency. Fans can then be worked with assured results, especially if both plenum and exhaust systems be combined ; whereas automatic extractors not infrequently become inlets, thus reversing the whole system, and pouring cold air on the heads of the audience. As regards the plenum system, whatever may be its merits and its success, open windows should also be provided to aerate, when required, the whole building in sections, and these should be so arranged that no corner can be left stagnant or unswept by the purifying current. The Victoria Hospital at Glasgow, and the Royal General Hospital at Birmingham, are, however, ventilated on

the plenum system, without the above-named method of open windows, so far, it is said, with satisfactory results. The

extraction of foul air should in most cases be effected at the top of a room or building, so as to utilize the natural tendency of warm air to rise ; but at Birmingham and else- where the outlets are near the floor, the fresh air being brought in half-way up the walls and directed towards the ceiling. The air-inlets should be Tobin tubes or similar devices, placed some 4 or 5 feet above the floor, and so arranged that the air should be passed through1 radiators or pipes to warm it before entering. In the case of a building for one of the American legislatures the warmed fresh air is allowed to enter on the level in front of the desk of each member, so that he secures a proper volume of fresh air for his own use before it is breathed by his neighbour. In the Houses of Parliament at West- minster, which were designed and built for the public business in 1836, considerable attention is devoted to the question of the purification of the air, but the arrange- ments are lamentably antiquated. The supply of fresh air, instead of being taken from a point as high up as possible, such as the top of the Victoria Tower or of the Clock Tower, is taken from the terrace at the river front. The result is that the miasmatic vapours of the river are drawn in ; the air-passages are exceedingly tortuous and restricted, and the bulk of the air, after passing through the various chambers and rooms, and finding its way to the top of the building, has to be dragged down against its specific gravity into the basement prior to its being v discharged into the ventilating furnace at the foot of the Victoria Tower.

The use of the anemometer or air-meter for testing the ventilation of buildings would soon reveal the objectionable state of affairs that frequently exists. Such instruments are in constant use in collieries and mines, but the great difficulty is to obtain an accurate measurement of the air actually passing through the ventilating -machine. No two anemometers are alike, the flow of air is constantly varying in -direction, and it is rarely, if ever, that two similar readings are obtainable. Yet,

~~notwithstanding these drawbacks, the use of the anemometer is of the greatest value.~~

~~The introduction of rapidly-revolving, but silent, fans, driven by electricity, is a great advance which places within the reach of the engineer or architect the means for solving the problem of ventilation of buildings. The fan and motor combined extend the advantages of positive mechanical ventilation to all who have access to electric current, with the further benefit that the extreme simplicity of the ■ electric driving of the fans greatly facilitates the control and distribution of ventilating effect. The moderate speed and power required by these fans for a given duty has contributed greatly to their extended use. The question of silence in running, in such places as houses of parliament, law courts, churches, and chapels, is of para- mount importance, and no fan should be accepted until it is proved by actual working to be noiseless.~~

~~The ventilation of mines was dealt with at considerable length in the ninth edition of the Ency. Brit. vol. vi. p. 70, and in vol. xvi. p. 460. The large volume of air required in coal-mines is rendered necessary not merely by the vitiation of the air in the mine by men and horses, and by the decay of timber, but also by the large " blowers " of inflammable gas which come from the beds of coal. Under the action of a falling barometer these " blowers " are sometimes of enormous volume, and therefore machinery of such design and power as to pro- vide a largely increased supply of fresh air should be furnished in case more fresh air be required. Explosions are prevented by deluging the mines with such large volumes of air as will dilute the fiery gases to below explosion point.~~

~~Some important and interesting facts are given by Dr Haldane, F.R.S., in his report to the Home Office on the subject of colliery explosions, and the deaths occurring in consequence (1896). He points out that while the presence of carbon dioxide is at once shown by the extinction of the lights, carbon monoxide is much more difficult of detection, and consequently is much more dangerous.. A man may go a long distance into a pit before he feels its effects, and when he does feel them he may be quite unable to escape. Dr Haldane, finding the influence of carbon monoxide to be far more rapid on small animals than on man, suggests~~

that a few white mice should be kept near at hand, and used by the men engaged in rescue work. Carried in a small cage, so soon as a dangerous percentage of the gas was present, they would begin to pant and show signs of weakness ; should they become un- conscious it would be an indication to the men that they must retire.

The Guibal ventilating fan (Fig. 1) has been described (Ency. Brit. vi. 70), and still maintains its name for efficiency and good work. It is now only desirable to call attention to electricity as a motive power for high-speed fans. By using electric motors the position of the boilers becomes a matter of indifference, and the constant

jjggjjlj

Fia. 1. — Guibal Ventilating Fan (from a diagram in the Proceedings of the Institution of Civil Engineers).

" torque " of the motor, in contrast with the reciprocating action of a steam engine, is in many cases a great advantage. Since 1888 large numbers of electric fans (Figs. 2, 3) have been fixed for ventilating mines in Great Britain, the United States, Germany, France, and elsewhere. They give in some cases as much as 265,000 cubic feet per minute, with the high water-gauge of 15 inches, and a useful effect claimed to be from 60 per cent, to 70 per cent. They seldom exceed 16 feet in diameter, and are run at high speed, sometimes by steam and sometimes by electricity.

The ideal engine is one which has only one rotating part, and in which the direction of movement is never reversed. Engineers have for many years been aware of

this fact, and much time and money have been expended in the endeavour to perfect the rotary engine. Since the introduction of such an engine in 1884, many improvements

have been effected, and at the present time the steam tur- bine is recognized to be an efficient and practical engine and is being applied to ventilating fans (Fig. 4).

The grave incon- veniences arising from smoke and bad air have neces- sitated the study of the question of ventilating tunnels, and great progress has been made since 1885. The Metropolitan Railway in London is a notorious instance of bad ventilation, for there the blow-holes set up no regular current, and the products of combustion increase the proportion of

Pig. 2.—Electric Ventilating Pan. (After Capell.)

Tunnels.

Fio. 3.—Electric Ventilating Fan. (After Capell.)

carbonic acid gas in the air to such high figures as 60, 69, 78, and even 89 parts in 10,000, when it ought not to exceed from 10 to 15 parts. In long tunnels on steep gradients, such as exist in Italy and elsewhere, artificial ventilation is

Fig. 4.—Ventilating Fan at a Colliery, driven by Parsons Steam Turbine (2000 revolutions per minute).

imperatively needed. In the cases of the Pracchia tunnel, 3000 yards in length on a gradient of 1 in 40 ; the Mont Cenis tunnel, with its peculiar longitudinal section and gradients of 1 in 40 at both ends ; the spiral tunnels, with

gradients of 1 in 40, on the St Gothard route ; and the long tunnel of Ponte Decimo near Genoa, serious incon- venience, and even worse, results. Asphyxiation is not unknown, and the loss of life attending the collision of the 11th August 1898, at the mouth of the last-named tunnel, in which twelve persons were killed and forty injured, was the direct result of bad air.

~~The Pracchia is one of fifty-two single line tunnels, with a gradient of 1 in 40, on the main line between k'lorence and Bologna, built by the late Mr Thomas Brassey. The traffic has greatly increased of late years, and has to be worked by heavy locomotives. Under any condition of wind the state of this tunnel, about 3000 yards in length, is bad ; but when the wind is blowing in at the lower end at the same time that a heavy goods or passenger train is ascending the gradient, the condition of affairs becomes almost insupportable. The engines, working with the regulators full open, often emit large quantities of both smoke and steam, which travel concurrently with the train. The goods trains have two engines, one in front and another at the rear of the train, and when, from the humidity in the tunnel, due to the steam, the wheels slip, and possibly the train stops, the state of the air is indescribable. A heavy train with two engines, conveying a royal party and their suite, arrived on one occasion at the upper exit of the tunnel with both enginenien and both firemen insensible ; and on another occasion, when a heavy passenger train came to a stop in the tunnel, all the occupants were seriously affected. Proper ventila tion would not only be of the greatest comfort to the men, hut would probably double the life of rails, the corrosion of which is at present very rapid.~~

~~Careful tests made in the Box and Severn tunnels of the Great Western Railway, to ascertain if possible the loss that takes place in the weight of rails owing to the presence of corrosive gases, gave the following results :~~

~~—~~

~~Box Tunnel (1 mile 66 chains in length).~~

~~Percentage of Wear per annum.~~

~~Per~~

~~Down line, gradient falling 1 in 100 — cent.~~

~~At east mouth ..... 0'439~~

~~28 chains from east mouth~~

~~1 mile 8 chains from east mouth At west mouth ....~~

~~Up line, gradient rising 1 in 100 — At east mouth .... 1 mile 8 chains from ea,st mouth 1 mile 28 chains from east mouth At west mouth ....~~

~~1-800 2-110 2-880 0-640~~

~~0-620 1-500 1-520 0-680~~

~~ft> per yard per aimum.~~

~~= 0-377 = 1-540 = 1-810 = 2-480 = 0-553~~

~~= 0-575~~

~~— 1-380~~

~~= 1-310~~

~~= 0-587~~

~~Severn Tunnel (4 miles 28J chains in length).~~

~~Percentage of Wear per annum. Per It, per yard~~

~~cent. per annum. Down line, outside and quite clear of tunnel,~~

~~Bristol end, gradient falling 1 in 100 . 0-280 = 0-240 Up line, outside and quite clear of tunnel,~~

~~Newport end, gradient falling 1 in 90 . 0‘440 = 0‘390~~

~~At Bristol mouth, gradient falling 1 in 100 1-200 = 1-020 33 chains from Bristol mouth, gradient~~

~~falling 1 in 100 2‘160 = 1-860~~

~~3 miles 75J chains from Bristol mouth,~~

gradient rising 1 in 90 .... 1-900 = 1-630

At Newport mouth 0-310 = 0-270

Down and up line under main-shaft level . 3‘200 = 2‘750

It will be seen that the maximum wear and corrosion together reached the extraordinary weight of 2J lb per yard per rail per annum — a very serious amount that involved great expenditure. The wear occurred over the whole of the rail, but the top, over which the engine and train passed, wore at a greater rate, presum- ably on account of the surface being kept bright and the gases being able to act on it. The Great Western Company tried the experiments in the Severn tunnel of boxing up the rails, so that the ballast approached their surface within 1 inch or II inches. It was found, however, that — in the case, at any rate, of the limestone ballast — the cure was almost worse than the disease, the result being a maximum wear of 2J lb and an average wear of just under 2 lb per yard per rail per year. The average on the open line would be about 0 -25 lb in the same time.

The first application of mechanical or fan ventilation to railway tunnels was made in the Lime Street tunnel of the London and North-Western Railway at Liverpool, which has since been replaced by an open cutting. At a later date fans were applied to the Severn and Mersey tunnels.

The principle hitherto acted upon, where mechanical

ventilation has been adopted, has been to exhaust the vitiated air at a point midway between the portals of a tunnel, by means of a shaft with which is connected a

ft,

.a

a

overhead, but a ventilating heading was driven from the middle of the river (at which point entry into the tunnel was effected) to each shore, where a fan 40 feet in diameter was placed. In this .way the vitiated air is drawn from the lowest point of the railway, while fresh air flows in at the stations on each side to replenish the partial vacuum, as indicated by arrows in the accompanying longitudinal section of the tunnel. The principle was, that fresh air should enter at each station and " split " each way into the tunnel, and that thus the atmosphere on the station platforms should be maintained in a condition of purity. The air has to travel towards a point midway between the stations, becoming more and more smoky as it goes, and is then extracted from the tunnel by the ventilation heading leading to the fans. In the Severn, owing to the middle of the tunnel being nearly at the Gloucestershire side of the river, a vertical shaft is sunk, and a fan, 40 feet in diameter, extracts the vitiated air at this point.

The fans in the Mersey tunnel are somewhat similar to the well- known Guibal fans, with the exception of an important alteration in the shutter. With the Guibal shutter, the top of the opening into the chimney from the fan has a line parallel to that of the fan-shaft and of the fan-blades, and, as a consequence, as each blade passes this shutter, the stoppage of the discharge of the air is instantaneous, and the sudden change of the pressure of the air on the face of the blade whilst discharging and the reversal of the pressure, due to the vacuum inside the fan-casing, cause the vibration hitherto inseparable from, this type of ventilator. As an illustration of the effect of the pulsatory action of the Guibal shutters the following figures may be given : a fan having ten arms and running, say, sixty revolutions per minute, and working twenty-four hours per day, gives (10 x 60 x 60 x 24=) 864,000 blows per day transmitted from the tip of the fan- vanes to the fan-shaft ; the shaft is thus in a constant state of tremor, and sooner or later reaches its elastic limit, and the consequent injury to the general structure of the fan is obvious. This difficulty is

avoided by cutting a A ” shaped opening in the shutter, thus gradually decreasing the aperture and allowing the air to pass into the chimney in a continuous stream instead of intermittently. The action of this regulating shutter increases the durability and effici- ency of the fans in an important degree. In towns like Liverpool and Birkenhead any pulsatory action would be readily felt by the inhabitants, but with the above arrangement it is difficult to detect any sound whatever, even when standing close to the buildings con- taining the fans. The admission of the air on both sides is found in practice to conduce to smooth running and to the reduction of the side thrust which occurs when the air is admitted on one side only. The fans (Fig. 5) are five in number ; two are 40 feet in diameter by 12 feet wide, and two 30 feet in diameter by 10 feet wide, one of each size being erected at Liverpool and at Birkenhead respect- ively. In addition, there is a high-speed fan 1 6 feet diameter in Liverpool which throws 300,000 cubic feet.

The following table gives the result of experiments made with the ventilating fans of the Mersey railway : —

ventilating fan of suitable power and dimensions. In the case of the tunnel under the river Mersey (Fig. 5), such a shaft could not be provided, owing to the river being

Fan at

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■§3 >

Hamilton Street,

Birkenhead .

30 x

10

47

113

1-30

1,895

214,135

Shore Road,

Birkenhead .

40 x

12

45

41

2-50

3.2881

134,685

James Street,

Liverpool

40 x

~~12~~

~~45~~

~~72~~

~~2-45~~

~~2,465~~

~~178,880~~

~~James Street,~~

~~Liverpool~~

~~30 x~~

~~10~~

~~60~~

~~60~~

~~2-30~~

~~2,062~~

~~123,720~~

~~Bold Street,~~

~~■ Liverpool~~

Total

300,000

951,120

The Severn tunnel (Fig. 6), which is 4 miles 624 yards in length, is ventilated by one fan placed on the Monmouthshire side of the Severn. This fan, which is 40 feet in diameter by 12 feet in width,

1 In the case of this circular drift-way (cut by the Beaumont boring machine) a velocity of 4000 feet per minute has since been attained.

2 Quick-running fan.

ejects from the tunnel 400,000 cubic feet per minute, and draws in an equivalent volume of fresh air from the two ends. Whether this quantity of air will prove sufficient for the increasing amount of traffic passing through the tunnel remains to be seen.

The consumption of coal by a, locomotive during the passage through a tunnel having been ascertained, and 29 cubic feet of poisonous gas being allowed for each pound of coal consumed, the volume of fresh air required to maintain the atmosphere of the tunnel at the necessary standard of purity of 20 parts of carbon dioxide in 10,000 parts of air is ascertained as follows: — The

CLOUC£STEIt3IIIIIE

- Total len§IIi oT Tunnel f Miles 62t Yards ->

Fro. 6. — Section of Severn Tunnel. (Fox.)

~~number of pounds of fuel consumed per mile, multiplied by 29, multiplied by 500, and divided by the interval in minutes between the trains, will give the volume of air in cubic feet which must be introduced into the tunnel per minute to maintain it in a sufficiently pure state to avoid inconvenience. As an illustration, assume that the tunnel is 1 mile in length, that the consumption of fuel is 32 lb per mile, and that one train passes through the tunnel every five minutes in each direction ; then the volume of air required per minute will be~~

~~32 lb x 29 cubic feet x 500 „„„„ ,. , .~~

~~— , —— -. -=185,600 cubic feet ;~~

~~2J minutes.~~

~~and the air will be maintained at a standard of purity in which the carbon dioxide does not exceed 20 parts in 10,000. It has been found by investigation and experiment that the air in a tunnel is satisfactory if this amount of carbonic acid is not exceeded.~~

~~The simplest method for ventilating a railway tunnel is to have numerous and wide openings to daylight at frequent intervals. If these are the full width of the tunnel, at least 20 feet in length, and not farther apart than 200 yards, it can be naturally ventilated and all expense of installing and maintaining machinery avoided.~~

~~About the year 1896 an excellent system was introduced by Signor Saccardo, the well-known Italian engineer, which to a great extent has minimized the difficulty of ventilating long tunnels under mountain-ranges where shafts are not available. This system, which is not applicable to tunnels~~

~~Pig. 7.— Diagram illustrating the Saccardo System for ventilating Tunnels (from the Proceedings of the Institution of Civil Engineers).~~

~~in which underground stations exist, is illustrated in the diagram (Fig. 7)v which represents its application to the single-line tunnel through the~~

Apennines at Pracchia. The tunnel was extended for about 15 or 20 feet by a

structure either of timber or brickwork, the inside line of which represented the line of maximum construction, and this was allowed to project for about 3 feet into the tunneL The space between this line and the exterior constituted the chamber into which air was blown by means of a fan. Considering the length of tunnel it might at first be thought there would be some tendency for the air to return through the open mouth, but nothing of the kind happened. The whole of the air blown by the fan, 164,000 cubic feet per minute, was aug- mented by the induced current yielding 46,000 cubic feet per minute, making a total of 210,000 cubic feet; and this volume was blown down the gradient against the ascending train, so as to free the driver and men in charge of the train from the products of combustion at the 7 miles earliest possible moment. Prior to the installation of this system the drivers and firemen had to be clothed in thick woollen garments, pulled on over their ordinary clothes, and wrapped round and round the neck and over the head, but in spite of all these precautions ' they some- times arrived at the upper end of the tunnel in a state of insensibility. The fan, however, immensely improved the condition of the air, which is now pure and fresh.

In the case of the St Gothard tunnel, which is 9J miles in length and 26 feet in width, the Saccardo system was installed in 1899, with most beneficial results. The Mont Cenis tunnel, 8^ miles in length and 26 feet in width, possesses no shaft. Owing to an alteration during construction, the Bardonnecchia entrance is at a considerably lower level than that originally intended, necessitating the introduction of an ascending gradient of 1 in 40 for a length of nearly 1000 yards from the portal. The tunnel is then level for nearly 3^ miles, when a descending gradient of about 1 in 40 occurs for nearly 4 miles towards the French entrance. This rise of level in the middle has compromised the ventilation, and sometimes great difficulty is experienced in carrying on the traffic. At the Bardonnecchia entrance there is a somewhat obsolete installation of seven overshot water-wheels, 5 metres in diameter, and 6 metres in length on the breast, over which in succession a mountain stream is conducted. These work air-compressors, the air being delivered under a pressure

between 4£ and 6 atmospheres, and discharged at points 1 kilometre apart throughout the tunnel. The quantity of air is so small, amounting only to 70 cubic metres per minute of air at 75 5> pressure per square inch, that for purposes of tunnel ventilation it has little effect, but it is of great advantage to the men em- ployed in the tunnel. At intervals of 1 kilometre there are refuges — supplied with fresh air, water, and a telephone — into which they can retire when the smoke is thick, and wait for an engine to take them out. The corrosion of rails is very rapid, and about 300 tons have to be relaid every year. With proper ventilation a saving of 150 tons would be effected annually, which would probably far more than pay for the necessary machinery. The Saccardo system is1 under consideration also for this tunnel.

The Hoosac tunnel in America, for a time, relied for its ventilation upon a central shaft which exists half-way, and which brought the cold air of the mountain above into the tunnel, driving the smoke out at the two ends. Now a fan has been installed 16 feet in diameter with a width of 8 feet. The two inlets, one on either side, are 9 feet in diameter, and the number of revolutions is 108 per minute, at which speed the volume of air thrown is 384,000 cubic feet per minute. If the fan run at 200 revolutions a minute, a yield of 700,000 cubic feet it is estimated will be obtained.

V E N T I M I G L I A — V E R A CRUZ

The introduction of electrical traction in the deep railway tunnels now being rapidly extended under London simplifies to a great extent the question of ventilation, since the absence of smoke and products of combustion of coal and coke renders necessary only such quantity of air as is required by the passengers and staff. This is but small, but arrangements are being made for changing the air of the tunnels twice every hour by means of electrically-driven fans.

The air supplied to divers and diving-bells has to be forced in by pumps, the pressure being that due to the hydrostatic "head." It is drawn from the ordinary atmosphere, and being pure and compressed the volume required for each diver is about 250 to 300 cubic feet, or in the case of

diving-bells 1300 cubic feet per Under hour. Where work is carried on under pressure,

compressed ^ ^ foun(jation caissons or in tunnels, an air- lock is provided which enables men to pass in and out of the chamber without allowing the pressure beyond the air-lock to be reduced. Fig. 8, which is from a model, shows the action of this apparatus.

The shaft marked A is under ordinary atmospheric pressure, say 15 lb to the square inch. The chamber at D is under the pressure

due to the depth below water, which we will assume to be 30 lb ad- ditional, or 45 lb in all. The portion marked B is reached by a door at top, A, and another at the bottom, C. By closing these doors the pressure inside B can te raised or lowered either to 15 lb or 45 lb by means of valves. When A and B are both at 15 lb the door at A can be opened, and men or material can pass into B. The door is then closed and the 45 lb pressure in D is allowed to enter B ; this effectually seals the door at A, but permits the door at C to be opened, and the men and material can enter the chamber at D, where excavation and work are going on.

The ventilation of chambers or tunnels under compressed air demands much attention, as upon it depends the health of the men engaged. Far greater necessity exists for purity in compressed air than in air under the ordi- nary pressure. Under pressure, in the case of a man entering the lock, the air is absorbed by the blood, carrying with it any gaseous impurities in its constitution; consequently, if it be at all high in carbonic acid gas the blood receives that impurity. In coming out of the compressed air, it is of great importance to be " locked out " slowly. It is well known that blood in the presence of air tends to coagulate, and investigations of cases which occurred in the deep sinking of cylinders at Newcastle and elsewhere showed that when the pressure was taken off, so that globules of air were released in the blood, there was the same tendency to coagulation. Where deaths have occurred, post-mortem examination has shown the veins and arteries to be filled with coagulated blood. If the pressure be

Fio. 8.— Type of Air Lock for Subaqeous Work. (Siebe, Gorman and Co.)

~~allowed to pass away slowly this risk is reduced. The danger lies in the possibility of the formation of a clot in the system.~~

~~Under ordinary atmospheric pressure the carbonic acid seems simply a measure of the impurities, and not in itself seriously detrimental, even in considerable quantities. But when compressed air is dealt with it is very different. If the working pressure is above 20 ft to the square inch, any percentage of carbonic acid gas which rises above 1 to 1 \ parts per 1000 is almost sure to makeitself felt on some men, and may have serious results. At the Blackwall tunnel and at the Hudson tunnel it was found necessary, in order to keep the air at the right degree of purity — that is, at about 1 to 1 \ parts per 1000 — to analyse it regularly. The provision of a constant volume per man, as gauged by the revolutions of the engine, was useless, for it was found on one occasion, when the Blackwall tunnel was passing under the old Isle of Dogs sewer, that the air was very impure, even when 6000 to 8000 cubic feet were being delivered. It is, therefore, absolutely necessary to give a varying supply, according to the analyses, in compressed-air works, and the limit should be about 1 to 1^ per 1000. An ample allowance in ordinary works is between 3000 and 4000 cubic feet per man per hour, and even less would do at pressures below 30 ft per square inch. In both the above tunnels men suffering from the pressure, or what is known as the "caisson disease," derived great benefit from a special chamber in which those who were overcome on coming out for the first time could be re-immersed in fresh air under similar pressure.~~

~~See Fox. "Ventilation of Tunnels and Buildings," Proc. Inst. O. E., vol. cxxxvi. part ii. — Haldane. Report to Secretary of State for Home Department on the Causes of Death in Colliery Explosions. (f. Fo.)~~

~~VentirnEglia, a frontier fortress, seaport town, and episcopal see of the province of Porto Maurizio, Liguria, Italy, 94 miles west by south of Genoa by rail, and 4 miles from the Franco-Italian frontier. The cathedral is built on the site of a temple to Juno, and the church of St Michael on the site of a temple to the Dioscuri. A collection of Roman antiquities is preserved in the town hall. Population (1881), 6567; (1899), about 7000.~~

~~Vontnor, a watering-place and railway station in the Isle of Wight parliamentary division of Hampshire, Eng- land, on the south coast of the island, 12 miles south by west of Ryde. St Catherine's, the parish church, has been enlarged, and St Catherine's Home for Consumptives rebuilt. Population (1891), 6566 ; (1901), 5866:~~

~~Vera CrilZ, a city and port of Mexico, in the state of Vera Cruz Llave, and situated on the Gulf of Mexico, with a population of 24,085. It is the most important commercial port of the republic. The development of domestic industries, owing to a high protective tariff coupled with the cheapness of labour and the depreciation of silver, has greatly reduced the list of imported articles, which can no longer compete in price with the native. The principal articles of import are machinery, hardware, vehicles, raw cotton, petroleum, textile fabrics. The ex- ports are ores and precious metals, coffee, tobacco, skins, vanilla, dyewoods, beans, &c.~~

~~The movement of shipping in the port is shown in the subjoined table : —~~

~~Year.~~

~~Entered.~~

~~Cleared.~~

~~Ships.~~

~~Tonnage.~~

~~Ships.~~

~~Tonnage.~~

~~1890 1895 1901~~

~~313 374 338~~

~~493,410 486,678 913,698~~

~~313 310 ' 321~~

494,203 463,860 916,336

The value of the trade of this port is shown in the following table. The figures expressing the values for 1901 represent Mexican currency, inasmuch as reducing them into any other currency would destroy their practical value as statistics on account of the great fluctuation of exchange during' that year : —

Year.

Imports.

Exports.

1890 1895 1901

£2,484,083 ■ £3,225,175

$22,349,788

£3,291,083 £2,737,763

$21,954,876

The climate is hot and unhealthy. The death-rate in 1895 was 48-62 per 1000 ; in 1896, 49-44 ; in 1897, 54-13. Harbour im- provements in the way of dredging, breakwaters, lighthouses, reclaiming the foreshore, customs pier, and necessary railway connexions are being steadily carried on. A practical system of drainage and the provision of an adequate water supply have been undertaken.

Vera Cruz Llave, a state of Mexico, bounded on the N. by Tamaulipas, on the W. by San Luis Potosi, Hidalgo, and Puebla, on the S. by Oaxaca, and on the E. by the Gulf of Mexico. Area, 29,210 square miles. Population (1879), 542,918; (1900), 960,570. It rises gradually from the coast line to

the crest of the Sierra Madre. In the south part is the snow-capped volcanic peak of Citlatepetl or Orizaba (5295 metres). Agriculture, stock-raising, and mining are the principal industries. There are, however, many manufacturing interests, cotton and woollen mills, saw-mills, paper-mills, foundries, and other minor ones. The railway system of the state is extensive, and its ports (Vera Cruz, Tuxpan, and Coatza- coalcos) are much frequented by shipping, both foreign and domestic. The state is divided into eighteen can- tons, subdivided into municipalities. The capital, Jalapa, has 18,168 inhabitants. Among the chief towns are Orizaba (31,512), Vera Cruz (24,085), San Andres Tuxtla (8855), Coatepec (8623), Cordoba (7974), Huatusco (6299), Santiago Tuxtla (5865), Tlacotalpan (5770), Tuxpan

(5697).

Vercelli, the chief town of an administrative dis- trict (mandamento), province of Novara, Italy, situated upon the right bank of the Sesia, half-way on the line of railway from Turin to Milan. It is the seat of an archbishopric, and an important railway centre. Its popu- lation numbers 31,150, not including a garrison of 1350 men. Since 1880 its inhabited area has greatly increased, especially upon the quadrilateral zone, 180,000 square metres in extent, formerly occupied by the western forti- fications of the city. Trade is considerable, on account of the exportation of cereals and especially of rice, for which Vercelli is one of the principal Italian centres. Corn and rice mills of large size are in a flourishing condition, while cotton and woollen mills and factories of artificial manure have attained importance. Electric power is derived from the Ivrea canal. Municipal finances are in equilibrium, the annual budget of income and expenditure amounting to nearly £40,000. Elementary and infant schools have been increased ; the technical institute, the technical schools, the lyceum-gymnasium, and the female normal school have been reorganized ; the library has been en- riched, since 1875, with 40,000 volumes. Three political journals are published. Numerous hospitals, asylums, and other charitable institutions have been opened. There are thirty mutual benefit societies ; the savings bank has a capital of nearly £100,000. Numbers of valuable pic- tures of the Vercelli school are preserved in the Basilica of Sant' Andrea, the Church of San Cristoforo,

and in the gallery of the Fine Arts Institute. Monuments have been erected to Victor Emmanuel II., Garibaldi, Cavour, and General Bava.

Verden, a town of Prussia, province of Hanover, near the right bank of the Weser, 22 miles south-east of Bremen by the railway to Hanover. The most noticeable edifices are the Gothic cathedral (1290) and a couple of other churches. It was the see of a bishopric founded in the first quarter of the 9th century, or earlier, and secularized in 1648. The duchy of Verden was ceded to Sweden, then in 1720 to Hanover, in 1810 to the kingdom of West- phalia, and in 1866 to Prussia. Population (1885), 8594;

(1900), 9842.

Verdi, Giuseppe Fortunino Fran- cesco (1813-1901), Italian composer, was born on 10th October 1813 at Le Roncole, a poor village near the city of Busseto. His parents kept a little inn, combined with a kind of village shop. Verdi received some instruc- tion from the village organist, but his musical education really began with his entrance into the house of business of Antonio Barezzi, a merchant of Busseto. Barezzi was a thorough musician, and under his auspices Verdi was speedily introduced to such musical society as Busseto could boast. He studied under Giovanni Provesi, who was maestro di cappella of the cathedral and conductor of the municipal orchestra, for which Verdi wrote many marches and other instrumental pieces. These composi- tions are now the principal treasures of the library of Busseto. Among them is Verdi's first symphony, which was written at the age of fifteen and performed in 1828. In 1832 Verdi went to Milan to complete his studies. He was rejected by the authorities of the Conservatorio, but remained in Milan as a pupil of Vincenzo Lavigna, with whom he worked until the death of Provesi in 1833 recalled him to Busseto. A clerical intrigue prevented him from succeeding his old master as cathedral organist, but he was appointed conductor of the municipal orchestra, and organist of the church of San Bartolomeo. After three years in Busseto, Verdi returned to Milan, where his first opera, Oberto Conte di San Bonifacio, was produced in 1839. His next work, a comic opera, known variously as TJn Giorno di Regno and H Finto Stanislao, was written in peculiarly distressing circumstances,

the com- poser having had the misfortune to lose his wife and two children in the course of two months. Un Giorno di Regno was a complete failure, and Verdi, stung by dis- appointment, made up his mind to write no more for the stage. He kept his word for a year, but was then per- suaded by Merelli, the impresario of La Scala, to look at a libretto by Solera. The poem took his fancy, in a s^hort time the music was written, and in 1842 the production of Nabucodonosor placed Verdi in the front rank of living Italian composers. The success of JVabucodonosor was sur- passed by that of its two successors, / Lombardi (1843) and Ernani (1844), the latter of which was the first of Verdi's operas to find its way to England. With Ernani Verdi became the most popular composer in Europe, and the incessant demands made upon him reacted upon his style.' For several years after the production of Ernani he wrote nothing which has survived to our time, nothing which deserved to survive. In Macbeth (1847) there are passages of some power, and passages too which indicate an approaching transition to a less conventional method ' of expression. In Luisa Miller (1849) also there is a noticeable increase of refinement in style, which contrasts favourably with the melodramatic vulgarity of his earlier manner.

It was unfortunate that / Masnadieri, which was written for the English stage and produced under Lumley's management at Her Majesty's Theatre in 1847, should have been one of the worst of the many bad works which Verdi composed at this period of his career. Not the

presence of the composer, who travelled to England to conduct the first performance, nor the genius of Jenny Lind, who sang the part of the heroine, could redeem it from failure. In 1851 Verdi won one of the greatest triumphs of his career with Rigoletto, a triumph which was fully sustained by the production two years later of H Trovatore and La Traviata. In these works Verdi reached the culminating point of what may be called his second manner. His development had been steady though gradual, and it is only necessary to compare the treat- ment of voice and orches- tra in Rigoletto with that in Frnani to realize how quickly his

~~*talent had de- veloped during these seven years. The popularity of Rigoletto, II Trovatore, and La Traviata was enormous, and consolidated Verdi's fame outside the frontiers of Italy. In 1855 he re- ceived a commission to write an opera for the Paris Opera, to be produced dur- ing the Universal Exhibi- tion. He wrote Les Vepres Siciliennes, a work which "A though temporarily success- 1 ful has , not retained its \ popularity. It contains S some fine music but suffers from the composer's per- haps unconscious attempt to adopt the grandiose manner of French opera. Of the works written dur- ing the next ten years only Un Ballo in Maschera (1859) has maintained a fitful hold upon public attention. La Forza del Destino (1862) and Don Carlos, the latter of which was written for the Paris Exhibition of 186V, have the faults incident to works written during a period of transition. At this point in his career Verdi was preparing to emancipate himself from the fetters of conventionality which had hitherto hindered his develop- ment. In these two works there are indications of an aspiration towards a freer method of expression, which harmonize ill with the more conventional style of the composer's earlier years. In Aida, an opera upon an Egyptian subject, written in response to an invitation from Ismail Pasha, and produced at Cairo in 1871, Verdi entered upon the third period of his career. In this work he broke definitely with the operatic tradition which he had inherited from Donizetti, in favour of a method of utterance, which, though perhaps affected in some degree by the influence of Wagner, still retains the main char- acteristics of Italian music. In Aida the treatment of the orchestra is throughout masterly, and shows a richness of resource which those who knew only Verdi's earlier works scarcely suspected him of possessing ; nevertheless, the human voice was still the centre of Verdi's system. Verdi kept thoroughly abreast of modern musical develop- ment, but his artistic sense prevented him from falling into the excesses of the German school. In the Requiem, which was written in 1874 to commemorate the death of Manzoni, Verdi applied his newly-found system to sacred music. His Requiem was bitterly assailed by pedants and purists, partly on the ground of its defiance of obsolete rules of musical grammar and partly because of*~~

~~*Giuseppe Veedi.*~~

its theatrical treatment of sacred subjects, but by saner and more sympathetic critics, of whom Brahms was not the least enthusiastic, it has been accepted as a work of genius. There are passages in it with which Protestant feeling can scarcely sympathize, but its passionate inten- sity and dramatic force, and the extraordinary musical beauty with which it abounds, amply atone for what to some may seem errors of taste. In 1881 a revised version of Simon Boccanegra, an earlier work which had not been successful, was produced at Milan. The libretto had

been in part rewritten by Arrigo Boito, and Verdi wrote a great deal of new music for the revival, which was eminently successful. After this it was generally supposed that Verdi, who had reached an advanced age, had finally relinquished composition, but after a lapse of some years it be- came known that he was at work upon a new opera, and in 1887 Otello was produced at Milan. The libretto, a masterly conden- • sation of Shakespeare's Othello, was the work of Boito. Otello recalls Aida in the general outlines of its structure, but voices and orchestra are treated with greater freedom than in the earlier work, and there is a conspicuous absence of set airs. In so far as regards the essential qualities of the music, Otello is an immense advance upon anything Verdi had previ- ously written. It has a dramatic force and a power of characterization for which it would be vain to look in his earlier work, and which are all the more remarkable as appearing for the first time in this high degree of development in a work written in extreme old age. All that has been said of Otello may be repeated of Fahtaff, which was produced in 1893, when the composer was in his eightieth year, with the addition that the later work contains, besides the dramatic power and musical skill of the earlier work, a fund of delicate and fanciful humour which recalls the gayest mood of Mozart. The libretto of Fahtaff, which is the work of Boito, is an adaptation of The Merry Wives of Windsor, with the addition of a few passages from Henry IV. After the production of Fahtaff, Verdi wrote nothing for the stage. In 1898 he produced four sacred pieces, settings of the Ave Maria, Laudi alia Virgine (words from Dante's Paradiso), the Stabat Mater, and the Te Deum, the first two for voices alone, the last two for voices and orchestra. In these pieces Verdi abandoned to a certain extent the theatrical manner of the Requiem for one more restrained and more in keeping with ecclesiastical traditions. In imaginative power and

musical beauty these pieces yield to none of Verdi's works. With the exception of these and the Requiem, Verdi has written little save for the stage. Among his minor works may be mentioned a string quartet, composed in 1873, a Hymn written for the opening of the International Exhibition of 1862, two sets of songs, a Paternoster for five part chorus, and an

Ave Maria for soprano solo, with string accompaniment. The venerable composer died at Milan on 27th January

1901.

The following is a complete list of Verdi's operas, with the dates and places of production : Oberto (Milan, 1839) ; Un Giorno di Regno (Milan, 1840) ; Nabucodonosor (Milan, 1842) ; / Lombardi (Milan, 1843) ; Ernani (Venice, 1844) ; / Due Foseari (Rome, 1844) ; Giovanna d'Arco (Milan, 1845) ; Alzira (Naples, 1845) ; Attila (Venice, 1846) ; Macbeth (Florence, 1847) ; I Masnadieri (London, 1847) ; II Gorsaro (Trieste, 1848) ; La Battaglia di Legnano (Rome, 1849) ; Luisa Miller (Naples, 1849) ; Stiffelio (Trieste, 1850) ; Mgoletto (Venice, 1851) ; Tl Trovatore (Rome, 1853) ; La Traviata (Venice, 1853) ; Les VSpres Siciliennes (Paris, 1855) ; Simon Bocca- negra (Venice, 1857 : revised version, Milan, 1881) ; Aroldo [a revised version of Stiffelio'] (Rimini, 1857) ; Un Ballo m Maschera (Rome, 1859) ; La Form del Destino (St Petersburg, 1862) ; Son Carlos (Paris, 1867) ; Aida (Cairo, 1871) ; Otello (Milan, 1887) ; Falstaff (Milan, 1893). (K. A. s.)

Verdun, a town and first-class fortress of France, in the department of the Meuse, and on the river of that name, which here divides into five arms, at the junction of the important railway lines Sedan-Toul and Rheims-Conflans (Metz). The military strength of Verdun consists in its strategical ring of detached modern forts which extend along a circle some 25 miles round. They are eleven in number, four lying on the left and seven on the right bank of the Meuse, the latter being connected by a chain of defence

~~works with the group of forts surrounding Toul. Since the Franco-German war and the loss of Metz, Verdun has been made the strongest defended town in eastern France. It has some manufactures of hard-ware, leather, liqueurs, and sweet-stuffs. Population~~

~~(1891), 18,195; (1901), 13,097.~~

~~Vergara, a town of Spain, in the Basque province of Guipuzcoa, on the right bank of the river Deva, with a station on the line from Bilbao-Durango to Zumarraga. The older streets full of massive Basque houses with iron-railed balconies, projecting carved roofs, doors em- bossed with heavy nails as knockers, much valued by antiquaries, stone coats of arms, are in marked contrast with the very modern mills of every kind with their tall chimneys and incessant activity. Paper, cloths, cotton and linen goods, and matches are manufactured in this old seat of theocracy and of Jesuits and despotism. Ver- gara has several convents and monasteries, good primary schools, a seminary founded in 1776, hospitals, some noble mansions, a parish church of San Pedro in the heart of the town with a square tower, another parish church of Santa Maria with three naves supported by heavy hand- some columns, and containing a few good paintings and tombs of local worthies. Vergara was prosperous in the 15th and 16th centuries owing chiefly to its arms factories, that afterwards decayed. It was long the headquarters of the Carlists in the first rising of 1834-40. The Liberal commander-in-chief, Espartero, captured it in August 1839, a few days before the celebrated Con- venio of 27th August of that year, by which the Carlist leader Maroto, with several others, and about five thousand men, betrayed the Pretender and secured the recognition of their rank and pensions from the Government of Isabella II. Population (1897), 6500.~~

~~Verkhne-Dnieprovsk, district town of Bussia,~~

~~in the government and 35 miles by rail north-west of the town of Ekaterinoslav, near the right bank of the Dneiper. It was founded in 1760, and has a steam flour-mill, candle works, a public library, and a hospital maintained by the zemstvo (provincial council). Four fairs are held annually in grain, cattle, and animal products. Population (1897),~~

11,607.

Verkhne-Udinsk, a district town of Asiatic Russia, East Siberia, province of Transbaikalia, on the right bank of the Uda, at its junction with the Selenga, 102 miles by rail (Trans-Siberian Railway) east of Lake Baikal, to which steamers also ply.

It was founded as a small fort in 1668, and is now a fairly well- built town, rapidly growing in importance as a centre for the over- land trade in tea with China, and as an emporium both for grain and animal products, which are exported, and for metals, machinery, and manufactured goods, which are imported. Its yearly fair is a centre for all the trade in Transbaikalia, and yields returns estimated at about 2,000,000 roubles. It has a progymnasium for girls, a number of primary schools, a public library, and a hospital. Population (1897), 8002.

Verkhne-Uralsk, a district town of Russia, in the government of Orenburg, on the left bank of the Upper Ural river, 205 miles east-south-east of Ufa. It was founded under the name of Verkho-Yaitsk in 1734, and has several tanneries and distilleries, and carries on an active- trade with the Kirghiz. Population (1897),

11,802.

Verlaine, Paul (1844-1896), the most personal and exquisite French lyric poet of his generation, was born at Metz, 30th March 1844. His first volume of poems, the Poemes Saturniens (1866), was written under Parnassian influences, from which the Fetes Galantes (1869), as of a Watteau of poetry, began a delicate escape. He married in 1870. In 1871 the strange young poet Rimbaud came somewhat troublingly into his life, into which drink had already brought a lasting disturbance. With Rimbaud he wandered over France, Belgium, England, until a pistol-shot, fortunately ill-aimed, against his companion brought upon him two years of imprisonment at Mons. Solitude, confinement, and thought converted a pagan into a Catholic, without, however, rooting out what was most human in the pagan ; and after many years' silence he published Sagesse (1881), a collection of religious poems, which, for humble and passionate conviction, as well as originality of poetic beauty,

must be ranked with the finest religious poems ever written. Romances sans Paroles, composed during the intervals of wandering, appeared in 1874, and shows us Verlaine at his most perfect moment of artistic self-possession, before he has quite found what is deepest in himself. During the rest of his life he lived in poverty, often in hospital, but always with the heedless and unconquerable cheerfulness of a child. After a long obscurity, famous only in the Latin Quarter, among the cafes where he spent so much of his days and nights, he enjoyed at last a European celebrity. In 1894 he paid a second visit to England, this time as a distinguished poet, and lectured at London and Oxford. He died in Paris on 8th January 1896. His eighteen volumes of verse (among which may be further mentioned Jadis et Naguere, 1884; Amour, 1888; Parallelement, 1889; Bonheur, 1891) vary greatly in quality as in substance ; they are all the sincere expression, almost the instantaneous notation, of himself, of his varying moods, sensual passion, the passion of the mystic, the delight of the sensitive artist in the fine shades of sensation. He brought into French verse a note of lyrical song, a delicacy in the evocation of sound and colour, which has seemed almost to create poetry over again, as it provides a language out of which rhetoric has been cleansed and a rhythm into which a new music has come with a new simplicity.

(a. by)

Vermont, one of the New England states of the American Union. Since 1870 the population has been nearly stationary. The census of 1890 gave a total of 332,422, a gain of but 136 over the previous enumeration. In 1900 the population was 343,641, an increase during

the preceding decade of 11,219, or 3·4 per cent. The density of the population per square mile in 1900 was 37·6. In 1890 the density per square mile was 36·4, giving nearly 19 acres to each inhabitant; males of militia age (18 to 44 years inclusive) numbered 67,203, and those of voting age (21 years or over), 101,697, of whom 82,011 were native-born.

In 1900 the males of militia age numbered 70,850, and those of voting age 108,356, of whom 87,465 were native-born and 20,891 were foreign-born. Of these native-born adult males in 1900, 3673 were illiterate (unable to write), and of the foreign-born 4871 were illiterate. There were only 826 negroes in the state. In 1900 there were 175,138 males and 168,503 females. In 1890 the urban population (persons in towns of over 4000 inhabitants) was 40,213, or 12"1 per cent, of the total population; in 1900 it had increased to 72,048, or 21 per cent. In the decade from 1890 to 1900, 171 towns out of 246, and 6 of the 14 counties, showed a decrease in population; the gains were chiefly in manufacturing and mining towns. In 1900 only 13 incorporated cities and villages had a popula- tion of more than 2000 each ; of these the largest were Burlington (18,640), Rutland (11,499), and Barre (8448). The number of families in 1890 was 75,869, or 4'38 to each family (ratio 5-36 in 1850) ; number of dwellings, 69,817, or 4-76 to a dwelling (5-57 in 1850) ; 46,584 families own their homes and farms. The whole number of marriages between 1890 and 1896 was 20,305 ; the number of divorces reported in the same seven years 1462, or one divorce to every 13-88 marriages.

State Institutions. — The state institutions are situated as follows : the State Prison at Windsor, the House of Correction at Rutland, the Soldiers' Home at Bennington, and the State Hospital for the insane at Waterbury. Previous to the opening of the last-named in 1891, the insane had been cared for chiefly at the Vermont Asylum or Retreat, opened at Brattleboro in 1836. This was aided by the state and is under its inspection. There are public hospitals at Burlington, St Albans, Montpelier, Rutland, and Colchester. At Burlington there are also five private hospitals (one for mental diseases), two homes for children, one for aged and one for friendless women, and one endowed foundation for the relief of the poor.

Education. — The public schools are supported by the income of the United States deposit fund of 1837, Vermont's share being 1669,086, by the income of the Huntington legacy, $211,130, by a state tax first voted in 1890, which chiefly benefits the smaller towns, and by local taxation. The total expenditure in 1900 was $1,074,222, or $16-28 per pupil. The number of children of school age (from 5 to 21) was 90,648, of whom 65,964 were in attendance. The teachers numbered 3742, of whom 3232

were females ; of the whole number 632 were graduates of Vermont normal schools and 201 of colleges. After twenty-two years' dis- cussion, the ojd district system was abolished in 1892, since which date there has been gratifying progress throughout the state. Licences to teach have been granted by county examiners since 1890. In 1890 there were enrolled in private schools 4553 pupils ; in denominational (including parochial) schools, 5671. In 1898 the state had 3 normal schools, 22 academies and 57 high schools. In 1901 the State University at Burlington had in the departments of arts and sciences 35 instructors and 295 students ; in its medical college, 32 instructors and 155 students. In the latter a four years' course has been adopted, to which admission is gained by examination, and the curriculum has been extended from 575 hours of teaching to nearly 2000 hours. The library contains 63,000 volumes. Middlebury College has a teaching staff of 10 and 113 students, with a library of 25,000 volumes. Norwich University at Northfield was mado tho state military school in 1898, and money appropriated for its uses. In 1899 the erection of Dewey Hall was begun. In 1901 it had 10 instructors and 73 students. Its library contains 6000 volumes. Thirty state scholarships were voted in 1888 to each of the three colleges, and these have since been continued. The state agricul- tural experiment station is connected with the university. In 1898 the state established a bacteriological laboratory at Burling- ton, and authorized the expenditure thereon of $8000 annually ;

in the following year the first systematic and gratuitous school for health officers in the United States was held in the same city.

Libraries. — In November 1900 151 towns had libraries, 117 of these being entirely free. Some of these are housed in handsome and substantial buildings ; twenty-one have over 4000 volumes each, eight above 10,000. This list omits the state library at Montpelier (38,200 volumes), the college libraries, and private collections. There are 94 newspapers, of which 8 are issued daily, 76 weekly, 1 twice a week, 1 twice a month, and 8 monthly.

Meligion. — The number of religious organizations of all denomi- nations in 1890 was 904 ; of edifices, 802 ; of sittings, 273,000. The total

~~valuation of church property was $4, 643, 80*0. The communicants numbered 106,315, or 31 "98 per cent, of the popu- lation. The leading denominations are Roman Catholics (42,810 communicants); Congregationalists (20,465); Methodists (17,268) ; Baptists (11,258).~~

~~Agriculture, &c. — A little more than 50 per cent, of the popula- tion is engaged in agriculture. There were, in 1900, 33,104 farms, averaging 142'7 acres ; of these 85'50 per cent, were cultivated by the owners. In 1880 there were 35,522 farms. The valuation of farms was, in 1900, $108,451,427 ; of farm products, $33,570,892. Between 1850 and 1900 the production of sheep decreased from 1,014,122 to 182,167, that of cheese from 8,720,834 lb to 406,659 ft, and of potatoes from 4,951,014 bushels to 3,547,829 bushels. In the same period the production of horses increased from 61,057 to 85,531 ; of milch cows from 146,128 to 270,194 ; of butter from 12,137,980 ft to 18,834,706 ft; of hay from 866,153 tons to 1,336,499 tons ; of barley from 42,150 bushels to 380,940 bushels ; and of Indian corn from 2,032,396 bushels to 2,322,450 bushels. Apples produced in 1889 1,176,822 bushels. The state continues its efforts to stock the streams and lakes with fish, and to protect game birds.~~

~~Manufactures. — Between 1890 and 1900 the number of manu- facturing establishments increased from 3031 to 4071 ; of em- ploye's from 22,119 to 29,455 ; of wages paid from $8,427,553 to $12, 237, 684 ; the value of products from $38, 340, 066 to $57, 646, 715 ; and of capital from $32,763,291 to $48,547,964. Among the most important products in 1900 were : lumber and timber products, valued at $6,131,808 ; cheese, butter, and condensed milk (factory proo.net), at $5,656,265; of monuments and tombstones, at $4,045,611 ; and of flour and grist mill products, at $3,222,347 ; of woollen manufactures, at $2, 822, 646 ; and of paper and wood pulp, at $3,384,773.~~

~~Minerals. — The total value of mineral products in 1889 was $5,674,022. Ofthisthirty-sixmarblequarriesproduced$2,169,560 ; the total of marble for all the rest of the United States being $1,318,560. Of the finer grades of marble Vermont produces seven times as much as any other state. Of granite in 1880 Vermont produced 187,140 cubic feet; in 1889, 1,073,586 cubic feet; in 1897 the output of eighty-seven companies was valued at~~

~~$1,512,543. In 1896 only Massachusetts and Maine produced more granite than Vermont. In 1898 Vermont produced more than Maine and within 6 per cent, of as much as Massachusetts. Of slate, in 1889, the product of sixty-one firms was valued at $842, 013, only Penn- sylvania producing more.~~

~~Finance. — There is virtually no state debt, what might figure as such being funds held in trust for colleges, schools, or towns. In the fiscal year ending 30th June 1901 the state treasurer paid auditor's orders to the amount of $690, 958, the whole sum passing through his hands being $1,283,970. The total combined debt of towns, &c, in 1890 was $3,785,373, being $11-39 per caput — less than in any other state of the North Atlantic group. The valuation of real and personal property in 1850 was $92,205,049, or $210 per caput ; and in 1890, $265,567,323, or $740 per caput.~~

~~On 30th September 1901 there were forty-seven national banks, with a total capital of $6,435,000, and a surplus of $1,449,163; loans and discounts amounted to $1 2, 81 8, 334 ; deposits, $1 1, 200, 202 ; the actual money reserve was $3,875,827. Deposits in forty-one savings banks, 30th June 1901, amounted to $40,209,059, being $326-50 to the credit of each of 123,151 depositors; gain in re- sources in 1900-01, $2,029,758. The business failures in 1898 were '83 per cent., against 1-10 per cent, for the United States and 1'64 per cent, for the whole of New England.~~

~~Commerce. — There are two United States collection districts, comprising in all sixteen customs offices. At Burlington, the port of entry for the district of Vermont, during the year ending 31st December 1901, the value of tho imports was $3,540,234, and of exports, $9,035,596. At Newport, the port of the district of Memphremagog, the imports for the same period amounted to $17,790,907 ; of exports, to $2,260,318.~~

~~Transportation. — In 1898 there were 992-06 miles of railway.' An additional line from Burlington to Montreal, 41 miles in length, through the islands of Lake Champlain, was completed in 1900. In 1890 there were but 13-33 miles of street railways ; in 1899 there were 66 miles of electric lines. The water power, in which the state abounds, is increasingly~~

utilized to work electric plant for the production of both light and power. A state road tax has been

levied annually since 1892, the proceeds of which are expended under state supervision. Upon Lake Champlain there were in 1889 22 steam vessels and 25 schooners ; total tonnage, 9061, of which 3837 tons were owned in Vermont ; freight carried, 1,760,549 tons ; passengers, 87,139. The number of craft owned in the Ver- mont district on 1st July 1901 was 26, with a tonnage of 4195.

Politics. — The political complexion of the state is strongly Re- publican in general elections. In the Presidential election of 1900 McKinley received 42,569 votes, and Bryan 12,849. In the election for governor in the same year the Republican candidate received 48,441 votes, and the Democrat, 17,129. Though the state sends but two representatives to Congress, ten members of that body are natives of Vermont, a larger ratio to the population than is shown by any other state.

Recent History. — The policy of prohibition has been steadily maintained since its adoption in 1852. In spite of considerable opposition from a few of the larger towns, nearly every assembly enacts still more stringent legislation. In 1888 the payment of a United States licence tax was made prima facie evidence that its holder was a common seller, and his place of business a nuisance. In 1898 anti-saloon leagues began to be organized throughout the state for the enforcement of the law, and in the next year druggists were vigorously prosecuted as holders of such licences, and not a few placed under injunction by the courts. A state Board of Trade was appointed in 1888. The incidence of taxation has been sensibly modified by a tax laid on corporations in 1883, from which $453,543 was realized in 1901. The Supreme Court ceased in 1892 to make the circuit of the several counties, and since that date holds three general terms at the capital in January, May, and October. Sen- tences to the state prison or house of correction for a maximum or minimum term were legalized in 1898, the prisoner to be paroled on probation at the expiration of the

shorter term, if the prison commissioners approve. At the outbreak of the Spanish- American war, the state promptly sent a full regiment of 1030 men, about twice the quota first called for, and voted in special session $7 a month additional pay to its volunteers, and to all residents of Vermont who should enlist in the navy or marine corps.

Authorities. — In addition to the books cited in vol. xxiv. p. 168 of the 9th edition of this Encyclopaedia, the following may be consulted with advantage : — Robinson. History of Vermont. 1892. — Williams. History of Vermont,, 2 vols. 1809. — B. H. Hall. History of Eastern Vermont. 1858. — R. C. Benton. Vermont Settlers and New York Speculators. 1894. — Hemenway. Vermont Historical Gazetteer, 6 vols. 1860-1902. — Palmer. History of Lake Champlain. 1852. — Gilman. Bibliography of Vermont. 1897. — Ira Allen's History of Vermont (London, 1798) is reprinted in vol. i. of the Collections of the Vermont Historical Society, and the Haldimand Papers in vol. ii. (j. e. G.)

Verne, Jules (1828-

-), French, author, was

born at Nantes on 8th February 1828. After completing his studies at the Nantes lycee, he went to Paris to study for the bar. About 1848, in conjunction with Michel Carre, he wrote librettos for two operettas, and in 1850 his verse comedy, Les Pailles Rompues, in which Alexandre Dumas fils had some share, was produced at the Gymnase. For some years his interests alternated between the theatre and the bourse, but some travellers' stories which he wrote for the Music des Families seem to have revealed to him the true direction of his talent — the delineation, namely, of delightfully extravagant voyages and adven- tures to which cleverly prepared scientific and geographical details lent an air of verisimilitude. Something of the kind had been done before, after kindred methods, by Cyrano de Bergerac, by Swift and Defoe, and more recently by Boistard and Mayne Beid. But in his own particular application of plausible scientific apparatus Verne undoubtedly struck out a department for himself in the wide literary genre of voyages imaginaires. His first success was obtained with Cinq Semaines en Ballon, which he wrote for Hetzel's Magazin d' Education in 1862, and thenceforward, for a quarter

~~of a century, scarcely a year passed in which Hetzel did not publish one or more of his fantastic stories, illustrated generally by pictures of the most lurid and sensational description by Kiou. The most successful of these romances include : Voyage au Centre de la Terre, 1864 ; De la Terre a la Lune, 1865 ; Vingt Mille Lieues sous les Mers, 1869 ; Les Anglais au P6le Nord, 1870, and Voyage autour du~~

~~Monde en quatre vingts Jours, which first appeared in Le Temps in 1872. The adaptation of this last (produced with immense success at the Porte St Martin Theatre, 8th November 1874) and of another excellent tale, Michael Strogoff (at the Chatelet, 1880), both dramas being written in conjunction with Adolphe d'Ennery, proved the most acceptable of Verne's theatrical pieces. The novels were translated into the various European lan- guages, and had an enormous success in England. But after 1877, when he published Hector Servadac, a romance of existence upon a comet, the writer's invention began to show signs of fatigue (his kingdom had been invaded in different directions and at different times by such writers as R. M. Ballantyne, Bider Haggard, and H. G. Wells), and he even committed himself, somewhat unguardedly, to very gloomy predictions as to the future of the novel. Jules Verne's own novels will certainly long continue to delight readers by reason of their sparkling style, their picturesque verve — apparently inherited directly from Dumas — their amusing and good-natured national carica- tures, and the ingenuity with which the love element is either subordinated or completely excluded. M. Verne, who was always extremely popular in society, divided his time for the most part between Paris, his home at Amiens, and his yacht. He was made a member of the Legion of Honour, and several of his romances were crowned by the French Academy. A brother, Paul Verne, has contributed to the Transactions of the French Alpine Club, and wrote an Ascenscion du Mont Blanc for his brother's collection of Voyages Extraordinaires in 1874.~~

~~Vernon, a town of Tolland county, Connecticut, U.S.A., with an area of 19 square miles of hill country, situated in the northern part of the state. It con- tains Bockville city, and the villages of Vernon, Vernon Centre, and Talcottville. Bockville is on a line of the New York, New Haven and Hartford Bailroad, and manufactures cotton, woollen, and silk goods.~~

Population of the town (1880), 6915 ; (1890), 8808 ; (1900), 8483 ; of the city of Bockville (1880), 5902; (1890), 7772; (1900), 7287, of whom 2548 were foreign-born.

Verona, a fortified city of Italy, in the division of Venetia, on the river Adige, 72 miles west of Venice by rail. In recent years it has seen important changes. In consequence of the disastrous flood of 1882, import- ant embankment works were executed along the Adige at a cost of £300,000. These works preclude all danger of future inundation. In addition to the Adige embank- ment, other hydraulic works have been either completed or undertaken. An irrigation canal, deriving water from the Sega, furnishes 11£ cubic metres per second to the fields of the upper Veronese district. The Camuzzoni industrial canal, which runs from the Chievo di S. Massimo to the suburb of Tombetta, furnishes 26 cubic metres of water per second, and generates 4000 horse-power. The cutting of this canal led to the construction of an aqueduct for drinking water, which, besides supplying the city, fur- nishes an ice factory with enough water to make 200 quintals of ice per day. The motive-power generated by the Camuzzoni canal is utilized by a large nail factory, flour mills, paper mills, cotton mills, and works for the distribution of electric energy.

The Adige embankment gave an impetus to building enterprise, the banks of the river being now flanked by villas and large dwelling-houses. The growth of industry and the development of the suburbs have led to the extension of the tramway system. Steam tramways run from Verona to Vicenza, and from Verona to Albaredo. The chief centres of the province are connected with the city by the Verona-Caprino Bailway.

Care for education has kept pace with the growth of the city. The number of schools has been increased from eighteen to twenty, and almost all are now communal property. The number of school children in 1901 was 4349.

Especial progress has been made in regard to charitable institu- tions since 1880. The hospital for the aged has been extended so as to accommodate a hundred more inmates. An asylum has been erected to provide shelter for beggars and unemployed paupers. It contains 700 places, but efforts are being made to obtain its en- largement. Public dormitories, with room for 150 persons, have been opened, and an institute capable of receiving a hundred waifs and strays has been founded. A private society cares for the children of poor parents, keeping them off the streets after school- hours, and providing them with food and recreation. The Alpine Colony Society sends 200 children per annum to recruit in the Alps, and the Asili Aportiani shelter and feed 800 children. In addition to these institutions there exist a female orphanage and a deaf and dumb institute, where those unable to speak and hear are taught, as far as possible, to articulate, sing, and under- stand spoken language.

Praiseworthy, if not always entirely satisfactory, efforts have been made to preserve and restore ancient monuments. In 1875, or thereabouts, the north-east corner of Santa Anastasia was isolated from the houses which surrounded it, and the four chapels which flank the high altar were restored to their original form. During the work some terra-cotta bas-reliefs of the 15th century (repre- senting the Passion) were discovered in the Cappella Pellegrini on the right of the high altar. The only defect of the work was the introduction of some stained glass scarcely in keeping with the style of the church. In 1900 measures were taken to save the celebrated fresco by Pisanello (San Giorgio) from nitrous in- filtrations.

The cathedral has been the object of care on the part of Cardinal Canossa. The pavement has been repaired with coloured marbles. Splendid frescoes have been discovered on . the walls, and the cloister has been restored. The steps before the facade have been renewed in their original proportions, and a wall removed so as to allow a full view of the side of the building. The belfry of the great Campanile has been strengthened.

Equal care has been taken of the churches Santissima Trinita, Santa Maria Antica, and San Pietro Martire. The ancient Eoman theatre was carefully preserved from harm during the construction of the Adige

~~embankment, and the arena partially restored and explored. Many Roman and mediaeval remains were brought to light during these operations, and during the excavation for the Adige embankment. They have been placed in the civic museum. Population (1881), 68,121 ; (1901), 73,917. (h. W. S.)~~

~~Versailles, chief town of the department of Seine- et-Oise, France, 12 miles west-south-west of Paris, with which it is connected by rail and tram. The library contains 75,000 volumes ; besides other institutions are a museum of the Eevolution and a municipal school of music. Distilleries, engineering workshops, and market gardening employ many of the people, but the town has scarcely any specially characteristic industry. Population~~

~~(1901), 54,081.~~

~~Verviers, a town of Belgium, on the Vesdre, an affluent of the Ourthe, and on the railway from Brussels to Cologne, capital of an administrative arrondissement of the province of Liege, almost entirely on the left bank of the Vesdre. It presents one part low, long, and narrow, stretching along the valley, and another high (770 feet above sea-level), forming a new quarter (dating from 1875) with boulevards, connected with the old town by the Escalier de la Paix, so called because it is crowned by a statue of Peace in bronze. The upper part of the town is industrial. The centre is commercial and has the appearance of a fine city. The educational institutions comprise a royal athenaeum, a school of manufactures, a school of music, a normal school, a middle-class boys' school and a middle-class girls' school. Besides a state hospital for old people of both sexes, there are orphanages for boys and girls, and a society for the building of working-men's houses. Verviers is an important centre of the cloth industry. The manufacture of cloths and woollen tissues (including the spinning of carded and combed wool, the washing of the wool, and the dressing~~

~~and dyeing of yarn and tissues) employs altogether 6000 workers. The wools are imported from the Argentine, the Cape, and Australia. The export in 1898 of woollen yarns, carded and dyed, amounted to over 17£ million B>, the greater part of which went to Great' Britain, the export of~~

woollen tissues to over 5 million lb. Mechanical tool- making employs 600 workers, exclusive of other acces- sories of the textile industry. Population (1876), 37,828 ;

(1900), 49,067.

Veshenskaya, a Cossack village of Kussia, in the province of the Don Cossacks, on the river Don, 133 miles from Sebryakovo railway station. Its in- habitants are chiefly engaged in gardening and cattle- breeding, and there is some trade in cattle. Population

(1897), 28,938.

Vianna do Caste Mo, a seaport town of

Portugal, capital of the district of Vianna, at the mouth .of the river Lima, 38 miles north of Oporto. It has manufactures of lace and milk foods. Fishing is followed, and both salmon and lampreys (fresh and pre- served) are exported. Population (1890), 9682; (1900), 9851. The district of Vianna do Castello has an area of 866 square miles, and population (1900), 214,599; density, 248 inhabitants to the square mile. Vegetation grows luxuriantly. The principal product is wine. There exist medicinal mineral waters at Moncao, near the river Minho. Cattle, sheep, and goats are kept in considerable quantities. Of the industries the first place is taken by butter-making. Lace is also made.

Viareggio, a maritime town and sea-bathing resort of the province of Lucca, Tuscany, Italy, on the Mediter- ranean, 13 miles north-west of Pisa by rail. Being sheltered by dense pine-woods on the north, and its malaria having been banished by drainage, it is frequented as a winter resort, and in summer by some thousands for its sea-bathing. It possesses a school of navigation and a technical school, and carries on some shipbuilding. Population (1881),

10,190; (1900), 16,000.

Viborgf, a market town of Denmark, capital of the county of Viborg, in the middle of Jutland, 54 miles by rail north-west of Aarhus. The most

notable building is the cathedral (1130-69, reconstructed 1864-76). Other build- ings are the Blackfriars' church (13th century), a museum, with specimens of the Stone, Bronze (collection of urns), and Iron Ages, also mediaeval antiquities, a town hall, and the Jutland archives (1890-91). The industries embrace distilleries, iron foundries, and manufactures of cloth. Population (1890), 8352; (1901), 8623.

Vicenza, a town, episcopal see, and capital of the province of Vicenza, Venetia, Italy, 42 miles west of Venice by rail. The modern buildings include a Renaissance theatre (1886) ; and there is a statue to Garibaldi (1887), and a monument (1880) and triumphal arch (1866) to Victor Emmanuel. There are an industrial institute and a technical school, and the Olympic Academy of Arts and Sciences (1555). The principal industries are silk-spinning, pottery and majolica, brick-works, iron-works and foundries, and the making of woollens and cottons, linen and hemp, furniture, watches, sugar, chemicals, and pianofortes. Population (1881), 39,431 ; (1901), 44,261.

Vichy-les-BainS, a town and railway station, arrondissement of Lapalisse, department of Allier, France, 33 miles, in direct line, south by east of Moulins. In the immediate vicinity are thirty springs, exclusive of those of the neighbouring cantons. The Lucas Spring, used chiefly for baths, and the Puits Carre yield, respectively, about 40,000 and 25,500 gallons in the twenty-four hours.

Queen Vhtotja. (From a Photograph by Chancellor and Snus, Dulilhi.)

The annual number of visitors is nearly 50,000, and 7,000,000 bottles of mineral water are exported. The so- called Vichy linen is manufactured at Roanne and Thizy. Population (1891), 10,425 ; (1901), 14,046.

Vicksburgf, the largest and most important city of Mississippi, U.S.A., capital of Warren county, on the cliffs above a "cut-off" lake of the Mississippi river, in the western part t>f the state, at an altitude of 192

feet. It has a beautiful situation, a regular street plan, an abundant water supply, and a good sewerage system. Two railways, the Queen and Crescent, and the Yazoo and Mississippi Valley, pass through it, and these, with boats on the river, afford outlets for its extensive commerce in cotton and lumber. The surrounding country is one of the finest cotton regions in the United States, while the uncultivated land is clothed with yellow pine timber. The city contains railway works, cotton and oil factories, and other manufactures. Population (1890), 13,373; (1900), 14,834, of whom 660'were foreign-born and 8147 negroes.

Victor Emmanuel III. (1869-

-), King op

Italy, son of King Humbert I. and Queen Margherita of Savoy, was born at Naples on 11th November 1869. Carefully educated by his mother and under the direction of Colonel Osio, he outgrew the weakness of his childhood and became expert in horsemanship and military exercises. Entering the army at an early age he passed through the various grades and, soon after attaining his majority, was appointed to the command of the Florence Army Corps. During — frequent journeys to Germany he enlarged his military experience, and upon his appointment to the command of the Naples Army Corps in 1896 displayed

sound military and administrative capacity. A keen huntsman, and passionately fond of the sea, he ex- tended his yachting and hunting excursions as far east as Syria and as far north as Spitsbergen. As repre- sentative of King Humbert he attended the coronation of Tsar Nicholas II. in 1896, the Victorian Jubilee celebrations of 1897, and the festivities connected with the coming of age of the German Crown Prince in 1900. The Prince's intellectual and artistic leanings were well known ; in particular, he was a collector of historic Italian coins, on which subject he became an authority. At the time of the assassination of his father, King Humbert (29th July 1900), he was returning from a yachting cruise in the eastern Mediterranean. Landing at Reggio di Calabria he hastened to Monza, where he conducted with firmness and tact the preparations for the burial of King Humbert and for his own formal accession, which took place on 9th August and 11th August 1900. The manly, earnest tone of his

first speech from the throne, delivered in the presence of both Houses of Parliament, created an exceedingly favourable impression. Upon the fall of the Saracco Cabinet in February 1901 King Victor Emmanuel evinced his Liberal tendencies by entrusting the premiership to Signor Zanardelli, leader of the Left, although it was evident that the latter could not govern without the support of the Socialist forces. He possesses the intrepidity and promptness in action characteristic of the House of Savoy, as was admirably proved on the occa- sion of a railway accident at Castel Giubileo, near Rome, in August 1900. On 24th October 1896 he married Princess Elena of Montenegro, who, on 1st June 1901, bore him a daughter named Yolanda Margherita.

VICTORIA, QUEEN.

VICTORIA (ALEXANDRINA VICTORIA), Queen of the United Kingdom of Great Britain and Ireland, Empress of India (1819-1901), only child of Edward, Duke of Kent, fourth son of King George III., was born in Kensington Palace, on 24th May 1819. Her parents had been living at Amorbach, in Franconia, owing to the Duke of Kent's straitened circumstances, but they returned to London on purpose that their child should be born in England ; and the Duke was so anxious for the safety of his wife that he himself drove the carriage over all the land part of the journey from Bavaria. The Duchess of Kent was the Princess Victoria Mary Louisa of Coburg, who had been married first to Prince Emich Karl of Leiningen, and

years. h? him had tw0 cnildren- The birth of the Duke of Kent's baby was not considered at the time an event of much importance, for several lives and many possibilities stood between the infant and her chance of succeeding to the throne. George III. was still alive — aged, blind, and insane — and two brothers of the Prince Regent older than the Duke of Kent were living also. The first of these, the Duke of York, was not likely to have children ; but the Duke of Clarence had been married on the same day as the Duke of Kent to the Princess Adelaide of Saxe-Meiningen, and he was to have two daughters, both of whom, however, died during infancy. The question as to what name the Duke of Kent's child should bear was not settled without bickerings. The Duke of Kent

wished her to be chris- tened Elizabeth, after England's greatest Queen, but the Tsar Alexander I. had promised to stand sponsor, and his Ambassador in London, Prince Lieven, made great efforts to get the child named Alexandrina. On the other hand, the Prince Regent desired that his niece should

be called Georgiana. In the end the Regent yielded to the Tsar, but said that as the name of George could stand second to none, that of Georgiana should not be conferred at all. The baptism was performed in a drawing-room of Kensington Palace on 24th June by Dr Manners Sutton, Archbishop of Canterbury, who used the gold font which figures among the Regalia in the Tower. The Prince Regent, who was present, named the child Alexandrina ; then, being respectfully requested by the Duke of Kent to give a second name, he said, rather abruptly, " Let her be called Victoria, after her mother, but this name must come after the other," upon which the Duke of York, as proxy for the emperor of Russia, made a low bow. Six weeks after her christening the Princess was vaccinated. This was the first occasion on which a member of the Royal Family underwent the operation, and it helped greatly to diminish the prejudice against Jenner's discovery among ignorant people. In January 1820 the Duke of Kent died, five days before his brother, the Prince Regent, succeeded to the throne as George IV. The widowed Duchess of Kent was no longer in her first youth. She was a woman of thirty- four, handsome, homely, a German at heart, and with little liking for English ways. But she was a woman of experience and shrewd ; and fortunately she had in her brother, Prince Leopold of Coburg, afterwards King of the Belgians, a safe and affectionate adviser. This Prince had been the husband of the Princess Charlotte of Wales, daughter of the Regent and direct heir to the British Crown, who died in 1817 with her new-born child, and this double bereavement had destroyed both his domestic happiness and his political expectations. In his sorrow he had never had the courage to look upon the face of his infant niece before her father's death, but

~~*from that day he took the child under his guardianship, lavishing as much devotion on her as if she had been his own daughter. The Prince lived at Claremont, and this became the Duchess of Kent's occasional home ; but she was much addicted to travelling, and spent several months every year in visits to watering-places. It was said at Court that she liked the demonstrative homage of crowds ; but she had good reason to fear lest her child should be taken away from her to be educated according to the views of George IV. Between the King and his sister- in-law there was little love. The spirited Duchess had never concealed her dislike for his Majesty's character, or her contempt for his associates of both sexes, and she had also managed to make an enemy of the ill-natured Duke of Cumberland, whom the King feared for his cutting tongue. The Duke sought to embitter his brother's mind against the Duchess of Kent, and when the death of the Duke of Clarence's two children, in 1820 and 1821, had made it pretty certain that Princess Victoria would become Queen, the Duchess felt that the King might possibly obtain the support of his Ministers if he insisted that the future Sovereign should be brought up under masters and mistresses designated by himself. The little Princess could not have received a better education than that which was given her under Prince Leopold's direction, and which tended to make her simply an accomplished lady. Her uncle considered that she ought to be kept as long as possible from, the knowledge of her position, which might raise a large growth of pride or vanity in her and make her unmanageable ; so Victoria was twelve years old before she knew that she was to wear a crown.*~~

~~*The Princess was zealously watched. Until she became Queen she never slept a night away from her mother's room, and she was not allowed to converse with any grown-up person, friend, tutor, or servant without the Duchess of Kent or the .Baroness Lehzen, her private governess, being present. Miss Lehzen, a native of Coburg, had come to England as governess to the Prin- cess Feodore of Leiningen, the Duchess of Kent's daughter by her first husband, and she became teacher to the Princess Victoria when the latter was five years old. George IV. afterwards made her a baroness of Hanover. The little Princess Drina, as she was called till her ninth year, at first took all her lessons in German, and she learnt to speak her native tongue with such a Teutonic accent that she made her*~~

uncles laugh by saying " Goot mornink." But this peculiarity wore off when in her tenth year she was placed under English masters. The Rev. George Davys, afterwards Bishop of Peterborough, taught her Latin ; Mr J. B. Sale, music ; Mr Westall, history ; and Mr Thomas Steward, the writing master of Westminster School, gave her instruction in penmanship, and often amused her by relating the pranks played by the King's scholars on Edward the Confessor's foundation. In all her studies the Princess was diligent, but she exhibited a special aptitude for modern languages, music, and drawing. She grew up to be a good linguist, she sketched cleverly, and she sang with a pretty voice and a correctness which in later years drew a surprised compliment from Mendelssohn.

George IV. complained that he did not see enough of his niece, and in 1829 he insisted that she should be present at a children's party which he gave in honour of Donna Maria da Gloria, the little Queen of Portugal, who was then aged ten, having been born in the same year as Victoria. Her small Majesty was a pretty child, but she got a fall in dancing, turned cross, and went away ; the English Princess, on the other hand, though observed to be "a short, plain child," won good opinions from everybody by her sweetness of temper.

In 1830 George IV. died, and William' IV. having ascended the throne, the Princess Victoria became his heir. A Begency Bill was introduced into Par- liament by Lord Lyndhurst, Chancellor in the Reigaot Duke of Wellington's Administration, and it was wniam judged that the Princess ought now to be told of her proper place in the order of succession. One day. the Baroness Lehzen put a genealogical table into her pupil's English history. What followed is mentioned in Sir Theodore Martin's Life of the Prince Consort :—

"The Princess opened the book, and perceiving the additional paper, said, ' I never saw that before. ' ' It was not thought necessary that you should, madam,' answered her governess. 'I see I am nearer the throne than I thought,' continued the Prin- cess, and after some moments resumed : ' Now, many a child would boast, but they don't know the difficulty. There is much splendour, bat there is more responsibility. ' The Princess, having lifted up the forefinger of her right hand while she spoke, gave the

~~Baroness her little hand, repeating, ‘ I will be good. I understand now why you urged me so much to read even Latin. My aunts, Mary and Augusta, never did ; but you told me Latin is the foundation of English grammar and of all elegant expressions, and I learned it as you wished it, but I understand all better now, ‘ and the Prin- cess gave her hand, repeating, ‘ I will be good. ‘ The governess then said, ‘ But your Aunt Adelaide is still young and may have children, and of course they would ascend the throne after their father, William IV. , and not you, Princess. ‘ The Princess answered, ‘ And if it were so I should not be disappointed, for I know by the love Aunt Adelaide bears me how fond she is of children.’”~~

~~Queen Adelaide was a very good woman. When the second of her children died she had written to the Duchess of Kent : ” My children are dead, but your child lives and she is mine too.” Kind old William IV. also cherished affectionate feelings towards his niece; unfortunately he took offence at the Duchess of Kent for declining to let her child come and live at his Court for several months in each year, and through the whole of his reign there was strife between the two ; and Prince Leopold who, after refusing the crown of Greece, had been induced to open a new career for himself as King of the Belgians, was no longer in England to act as peacemaker.~~

~~On 24th February 1831, the Princess Victoria for the first time attended a Drawing Room, and the King was angry because the Duchess of Kent behaved coldly to him, and, as he declared, “made little Victoria look at him stonily.” Soon afterwards there was trouble because the Duchess received royal salutes from the ships at Portsmouth when she went to the Isle of Wight. The King was much incensed at this, and negotiations were opened with the Duchess of Kent to make her forego these honours; but she stood on her rights, whereupon the King somewhat ungallantly ordered that no more gunpowder should be burned for her pleasure. Much time and temper was consumed over quarrels of this sort. Emissaries journeyed between Windsor and Ken- sington, long letters were written, the Duke of Wellington was referred to as arbiter, and as fast as the fire was ex- tinguished in one direction it broke out in another. The . Duchess had settled at Kensington Palace, and the King was~~

displeased at her appropriating a suite of seventeen rooms without his permission. In 1835, when the Princess Victoria was confirmed in the chapel of St James's Palace by the Archbishop of Canterbury, his Majesty felt hurt because the Duchess did not seize this opportunity of confessing her imputed wrongs and suing for a reconciliation. To make matters worse, the Duchess and her daughter spent a great part of 1834 and 1835 in rounds of visits to the country houses of the nobility, and certain mischievous busybodies persuaded the King that the object of these expeditions was to undermine his popularity. As a matter of fact, the Duchess of Kent had too much tact ever to speak of the King with disrespect, and her visits to Belvoir, Holkham,

Burghley, Chats-worth, Alton Towers, Walmer, and other places were undertaken because it seemed good that the Princess should become acquainted with the leading members of the aristocracy. It was equally desirable that the foremost among the King's subjects should see for themselves that their future Queen had been properly educated, that she was no German mis- pronouncing her native tongue, that she had no domi- neering spirit or unorthodox religious opinions, and, above all — a matter about which contemporary opinion was very sensitive — that she evinced no disposition to marry a Roman Catholic prince.

William IV. 's resentment against the Duchess of Kent only increased as the Princess grew older, and it found vent at last in a very violent and undignified attack on the Duchess at his own table. In 1836 the Princess Victoria had failed to attend two Drawing Rooms, and the Duchess had refused an invitation to spend a few days at Windsor on the occasion of Queen Adelaide's birthday. But she and her daughter were present at a banquet given on the 20th August ; and there the King, returning thanks for the drinking of his health, made a lachry- mose speech, in which he railed at his sister-in-law for being his enemy. " I hope," he continued with growing excitement, " that I may live at least nine months longer, until my dear niece is of age, so that there may be no Regency. A person

near me [the Duchess] is surrounded by evil counsellors, and is unfit to exercise the duties of her station."

In May 1837, the Duchess received an address from the City of London, congratulating her on the majority of her daughter, and in her reply she hinted that she had been friendless when she arrived in England, and had since that time met with kindness only from the nation, not from the Royal Family. Exasperated at this, the King vowed he would hold no more terms with the Duchess. The amount of the Princess's allowance was under discussion at the time, and the Duchess desired to be appointed trustee for her daughter ; but the King declared that the Princess should have £10,000 a year for her own sole use uncontrolled, and he wrote her a private letter to this effect in fatherly terms. The Marquis of Conyngham, Lord Chamberlain, bore the missive to Kensington, and the Duchess of Kent held out her hand to receive it. " The King's commands are that I should deliver the letter to the Princess Victoria," said Lord Conyngham as coldly as possible, and he did this. The Princess had never before had an unopened letter put into her hands. Before breaking the seal she turned with an affectionate gesture towards her mother, as if to beg her permission ; and eventually, by the Duchess's advice, a grateful answer was written, thanking the King for his intended kindness. But the allowance was never settled, since four weeks later William IV. died. The thoughts of his last hours dwelt often on his niece, and he re- peatedly said that he was sure she would be "a good woman and a good Queen. It will touch every sailor's heart to have a girl Queen to fight for. They'll be tattoo- ing her face on their arms, and I'll be bound they'll all think she was christened after Nelson's ship." He wanted much to see his niece at his bedside, and at twelve o'clock on Monday, the 19th, an express was sent to Kensington, commanding the Princess Victoria's im- mediate attendance. The Duchess of Kent chose to ignore this order, though she subsequently explained that the commands had not been brought to her in the King's name, and that she had not understood that his Majesty was at the point of death. It had been her intention to go to Windsor on the following day, but William IV. died in the night.

The King died at about 2 a.m., and half-an-hour after- wards Dr Howley, Archbishop of Canterbury, and the Marquis of Conyngham, started in a

landau with four horses for Kensington, which they reached Tbe at 5 o'clock. The sun broke from behind clouds accession. and shed a glory over the old red brick Palace as they drove up to it, and the Archbishop noted this as a good omen. Lord Conyngham observed that the proclamation would take place on the morrow, the first day of summer and the longest day of the year, which was of happy augury too. For a long time, however, the two dignitaries who came to hail the girl-Queen could not rouse the porter at the gate. Their servants rang, knocked, and thumped ; and when at last admittance was gained, the Primate and the Marquis were shown into a lower room and there left to wait. Presently a maid appeared and said that the Princess Victoria was "in a sweet sleep and could not be disturbed." Dr Howley, who was nothing if not pompous, and who, being attired in his rochet, was vexed that this garment had not obtained for him more respectful treatment, answered with some warmth that he had come on State business, to which everything, even sleep, must give place. The Princess was accordingly roused, and quickly came downstairs in a dressing-gown, her fair hair flowing loose over her shoulders. The Duchess of Kent accompanied her, like- wise en dishabille', and in a few minutes the ever- vigilant Baroness Lehzen entered upon the scene with a bottle of sal volatile and the words " Your Majesty " gushing from her lips. The young Queen shed tears on hearing the Archbishop's very solemn announcement, and for ' a few moments she stood weeping in silence, with her face resting on her mother's shoulder. "I felt no exultation, but something like fear," she wrote a few days later to her uncle Leopold. " I wished to ask the Archbishop to offer up a prayer. I had made up "my mind to do this when- ever the sad news should come, but I grew confused from hearing Mme von Lehzen address me by my new title and ask Lord Conyngham for details." The Queen's first care on regaining composure was to write a letter of con- dolence to Queen Adelaide, and she addressed this letter "To her Majesty the Queen." Somebody had the bad taste to suggest that the word "dowager" should be added. " I will not be the first to remind my aunt of the great loss she has sustained," answered the young Queen, thus evincing at the outset of her reign the kindly tact which ever distinguished her public and private conduct.

She was then in her nineteenth year, of pleasing coun- tenance without being pretty, and of dignified deportment without constraint in her movements. She had blue eyes and a rosy complexion ; she smiled readily, and had a gentle, wistful glance, which always seemed to solicit the approbation of those to whom she spoke, and turned quickly to astonishment or sadness if she met no genial response. Her dancing mistress, Mile Bourdin, had taught her to walk, bow, arid curtsey in the French fashion — that is, with gracious inclinations of the head and cheerful looks (which were contrary to the etiquette of German Courts, where everything used to be done with rigid gravity) — but the happy vivacity of the Princess's dis- position prevented any of her gestures from appearing artificial. She was always natural, and waived etiquette whenever it interfered with a free display of her impulses towards anybody whom she loved or honoured. Her demeanour throughout the trying day when she succeeded to the throne excited general admiration.

The Privy Council assembled at Kensington at 11 o'clock ; and the usual oaths were administered to the Queen by Lord Chancellor Cottenham, after which all present did homage. There was a touching incident when

the Queen's uncles, the Dukes- of Cumberland and Sussex, two old men, came forward to perform their obeisance. The Queen blushed to the brow, and descending from her throne, kissed them both, without allowing them to kneel. By the death of William IV., the Duke of Cumberland had become King of Hanover, and immediately after the ceremony he made haste to reach his kingdom. Within a fortnight of his arrival there he had revoked the Con- stitution of the country, and wrote to his friend the Duke of Buckingham boasting that he had "cut the wings of democracy." Had Queen Victoria died without issue, this Prince, who was arrogant, ill-tempered, and rash, would have become King of Great Britain ; and, as nothing but mischief could have resulted from this, the young Queen's life became very precious in the sight of her people. She, of course, retained the late King's Ministers in their offices, and it was under Lord Melbourne's direc- tion that the Privy Council drew up their declaration

~~to the kingdom. This document described the Queen as Alexandrina Victoria, and all the peers who subscribed the roll in the HOuse of Lords on 20th June swore allegiance to her under those names. It was not till the following day that the Sovereign's style was altered to Victoria simply, and this necessitated the issuing of a new declaration and a re-signing of the peers' roll.~~

~~The public proclamation of the Queen took place on the 21st at St James's Palace with great pomp, and it proved a severe ordeal for the nerves of a delicate girl still under her mother's care. Crowds lined the whole route from Kensington, which then stood quite in the suburbs ; and from Hyde Park Corner, where the masses became more dense, the young Queen, in her open carriage, was greeted with cheers so loud and hearty that by the time she reached St James's she was trembling with emotion. She appeared at a window in the court- yard of the Palace, dressed in deep mourning, with a white tippet, white cuffs, and a border of white lace under her small black bonnet ; and everybody noticed how pale she was. Sir Ralph Bigland, Garter King, made his proclamation, according to the quaint old forms, in pre- sence of the Lord Mayor of London and Sheriffs, the great officers of State, and a cohort of heralds ; and when his concluding words were followed by a blare of trumpets and the acclamations of a loyal crowd thronging all the approaches to the Palace, the Queen's fortitude for a moment forsook her. It was in allusion to this that Elizabeth Barrett Browning wrote her pretty lines about the child-Queen who " wept to wear a crown."~~

~~At the time of the Queen's accession, Lord Melbourne's Ministry had been in office two years. The Cabinet nominally commanded a good majority in the Lord Mel- HOuse of Commons, but it was not popular with tbeQueea. tne country, and at the general election which took place in July 1837 (in pursuance of the constitutional law which then required that the death of a Sovereign should be followed by a dissolution of Parliament), the ministerial majority was reduced to fourteen. The true cause for the weakness of the Whigs lay in the towering personal ascendancy of the two Tory leaders — the Duke of Wellington and Sir Robert Peel. All things considered, it was more surprising that the Whigs should have remained in office so long than that they should have been~~

feeble in their rule. So far as concerned Lord Melbourne personally, it was a positive disadvantage to him that from the first he ingratiated himself with the young Queen, and thereby exposed him- self to unreasoning party jealousies. Lord Melbourne was an amiable, warm-hearted man. There was a double danger that a man of his winning character might either yield too much to the Court, or by the charm of his

manner domineer over the Sovereign, and give her mind a bias towards his party. The Tories feared the latter con- tingency ; Lord Brougham, Mr Roebuck, and all ardent Liberals expressed their misgivings as to the former.

The Queen opened her first Parliament in person, and in a well-written speech, which she read with much feeling, adverted to her youth and to the necessity which existed for her being guided by enlightened advisers. When both Houses had voted loyal addresses, the question of the Civil List was considered, and a week or two later a message was brought to Parliament requesting an increase of the grant formerly made to the Duchess of Kent. Government recommended an addition of £30,000 a year, and this led to an angry scene in the Lords between Brougham and Melbourne. Brougham alluded to the " Queen Mother," upon which Melbourne inter- rupted, saying, " Mother of the Queen," which is very different. " I confess I am but rude of speech," answered Brougham. " My noble friend is much more of a courtier ; his tongue is better hung ; he is well acquainted with the motions of those who gloze and fawn and bend the knee in Courts." Stung to the quick, Melbourne retorted that he knew " of no man in the country who could more gloze and flatter and bend the knee " than Brougham. The proposed addition was voted, and before the close of the year a Civil List Bill was passed, settling £385,000 a year on her Majesty, Mr Hume's motion for reducing that grant by £50,000 mustering only nineteen votes. The remainder of the session was engrossed by the affairs of Canada, which gave the Queen her first insight into some of the curious tactics of party warfare.

It had long been arranged between the Duchess of Kent and her brothers, King Leopold and the Duke of Coburg, that the Queen should marry her cousin, Prince Albert of Saxe-Coburg, and the Prince himself had been

made acquainted with this plan from his earliest years. When he was three years old his nurse used to prattle to him about " the little May Flower," his destined bride in England. In 1836 Prince Albert, who was born in the same year as his future wife, had come on a visit to England with his father and with his brother, Prince Ernest, and his handsome face, gentle disposition, and playful humour had produced a favourable impression on the Princess, who, a few days after his departure, was frankly informed by King Leopold of the hopes which he cherished as to her marriage. The Princess's answer to her uncle (7th June 1836) left no doubt that her own heart was inclined to the scheme. " I have only now to beg you, my dearest uncle, to take care of the health of one now so dear to me, and to take him under your special protection. I hope and trust that all will go on prosperously as to this subject, which is now of such importance to me." The Duchess of Kent had communi- cated her projects to Lord Melbourne, and they were known to many other statesmen, and to persons in society ; but the gossip of drawing-rooms during the years 1837-38 continually represented that the young Queen had fallen in love with Prince This or Lord That, and the more imaginative babblers hinted at post-chaises waiting outside Kensington Gardens in the night, private marriages, and so forth.

The Coronation took place on 28th June 1838, and the event served to impress deeply on the minds of foreign princes — suitors or not — a notion of the British Sovereign's exalted and enviable position. na'/on°n>' No more touching ceremony of the kind had ever been performed in Westminster Abbey. Anne was a middle-aged, married woman at the time of her coronation ; she waddled and wheezed, and made no majestic appear- ance upon her throne. Mary was odious to her Protestant

subjects, Elizabeth, to those of the unreformed religion, and both these Queens succeeded to the crown in times of general sadness; but the youthful Queen Victoria had no enemies except a few Chartists, and the land was peaceful and prosperous when she began to reign over it. The

cost of George IV.'s coronation amounted to £240,000; that of William IV. had amounted to £50,000 only; and in asking £70,000 the Government had judged that things could be done with suitable luxury, but without waste. The traditional banquet in West- minster Hall, with the throwing down of the glove by the King's champion in armour, had been dispensed with at the coronation of William IV, and it was resolved not to revive it. On the other hand, it was arranged that the Sovereign's procession to the Abbey through the streets should be made a finer show than on previous occasions ; and it drew to London 400,000 country visitors. Old-fashioned ceremonial and acts of humble obeisance seemed peculiarly befitting in the case of a young Queen. Lord Melbourne was perfect as he redeemed the sword of State with a hundred shillings. The Earl of Albemarle, Trea- surer of the Household, knelt with a knightly grace to present the gold nugget of one-pound's weight, which the Queen was to put into the offertory plate ; and afterwards it was with a lordly air that he scattered among the crowds in the aisles handfuls of commemorative medals in gold and silver. This item in the proceedings caused much turbulent scrimmaging. Her Majesty's Judges, in their robes of scarlet and ermine, stretched forth their hands with decorous languor to try to seize some of the flying mementoes, but of course disdained to stoop and pick up anything from the floor ; the Aldermen of London, less proud, sprawled over the flags in their furred gowns, and grabbed one another by the sleeves in their rude scramble for the pieces. The culminating point of the ceremony occurred when, the Primate having placed the crown on the Queen's brow, the orb and sceptre in her two hands, all the peers and peeresses donned their coronets, and a deafening acclamation of "God save the Queen " arose, to be repeated again and again, while the organ pealed forth the National Anthem. When the tumult had subsided, trains of peers ascended the steps of the throne to do their homage — first touching the crown with the right hand, then bending the knee and kissing the Queen's hand. At former coronations the peers had kissed the Sovereign's cheek, but it had been thought right to spare a young lady such salutes from 500 gentlemen. Only one incident, for a moment, marred the ceremony. Lord Eolle, a large, infirm old man, was held up by two peers, and had nearly reached the royal footstool when he slipped through the hands of his sup- porters, and rolled over and over down the steps, lying at the bottom coiled up in his robes. His disaster sent a shock

through the assemblage. He was instantly lifted up, and he tried again and again to ascend the steps amid shouts of admiration at his valour. The Queen, having whispered to Lord Melbourne, rose, leaned forward and held out her hand to the old man, dispensing with his touching the crown. Three ambassadors for different reasons became objects of great interest at the coronation. Marshal Soult, Wellington's old foe, received a hearty popular welcome as a military hero ; Prince Esterhazy, who represented Austria, dazzled society by his Magyar uniform, which was encrusted all over, even to the boots, with pearls and diamonds ; while the Turkish ambassador, Sarim Effendi, caused much diversion by his bewilder- ment at the magnificence of the spectacle presented to his gaze. He was so wonder-struck that he could not walk to his place, but stood as if he had lost his senses, and kept muttering, " All this for a woman ! " The

glories of the Coronation were brought to an appropriate ending by all sorts of popular rejoicings, the most novel of which was a fair in Hyde Park, where the fun was kept up fast, furious, and noisy, during four days and nights.

Within a year of the Coronation the Court was brought into sudden disfavour with the country by two events of unequal importance, but both exciting. The Tbe first was the case of Lady Flora Hastings. In "Serf- February 1839 this young lady, a daughter of chamber the Marquis of Hastings, and a Maid of Honour plot-" to the Duchess of Kent, was accused by certain Ladies of the Bedchamler of immoral conduct. The charge having been laid before Lord Melbourne, he communicated it to Sir James Clark, the Queen's physician, and the result was that Lady Flora was subjected to the indignity of a medical examination, which, while it cleared her char- acter, seriously affected her health. In fact, she died in the following July, and it was then discovered that the physical appearances which first provoked suspicion against her had been due to enlargement of the liver. The Queen's conduct towards Lady Flora was kind and sisterly from the beginning to the end of this painful business ; but the scandal was made public through some indignant letters which the Marchioness of Hastings addressed to Lord Melbourne praying for the punishment of her daughter's traducers, and the general opinion was

~~• that Lady Flora had been grossly treated at the instiga- tion of some private Court enemies. While the agitation about the affair was yet unappeased, the political crisis known as the " Bedchamber Plot " occurred. The Whig Ministry had introduced a Bill suspending the Constitu- tion of Jamaica because the Assembly in that colony had refused to adopt the Prisons Act passed by the Im- perial Legislature. Sir Bobert Peel moved an amend- ment, which, on a division (6th May), was defeated by a majority of five only rn a House of 583, and Ministers thereupon resigned. The Duke of Wellington was first sent for, but he advised that the task of forming an Administration should be entrusted to Sir Bobert Peel. Sir Bobert was ready to form a Cabinet in which the Duke of Wellington, Lords Lyndhurst, Aberdeen, and Stanley, and Sir James Graham would have served ; but he stipulated that the Mistress of the Bobes and the Ladies of the Bedchamber appointed by the Whig ad- ministration should be removed, and to this the Queen would not consent. On 10th May she wrote curtly that the course proposed by Sir Bobert Peel was contrary to usage and repugnant to her feelings ; the Tory leader then had to inform the House of Commons that, having failed to obtain the proof which he desired of her Majesty's confidence, it was impossible for him to accept office. The Ladies of the Bedchamber were so unpopular in consequence of their behaviour to Lady Flora Hastings that the public took alarm at the notion that the Queen had fallen into the hands of an intriguing coterie ; and Lord Melbourne, who was accused of wishing to rule on the strength of Court favour, resumed office with diminished prestige.**

There can be no doubt that the Queen was badly advised in this emergency. Sir Bobert Peel could not be expected to govern while the Queen kept about her person ladies who were related to his political opponents. One of the Bedchamber ladies was wife of Lord Normanby, the Colonial Secretary, another was sister to Lord Mor- peth, the Chief Secretary for Ireland, and the warm friendship which the Queen proclaimed for these ladies was not a reassuring thing, constitutionally speaking. The Tories thus felt aggrieved ; and the Chartists also were so prompt to make political capital out of the affair that large numbers were added to their ranks. On~~

14th June Mr Attwood, M.P. for Birmingham, pre- sented to the House of Commons a Chartist petition alleged to have been signed by 1,280,000 people. It was a cylinder of parchment of about the diameter of a coach-wheel, and was literally rolled up the floor of the House. On the day after this curious document had furnished both amusement and uneasiness to the Com- mons, a woman, describing herself as Sophia Elizabeth Guelph Sims, made application at the Mansion House for advice and assistance to prove herself the lawful child of George IV. and Mrs Fitzherbert; and this incident, trumpery as it was, added fuel to the disloyal flame then raging.

The year 1839 was one of the most trying through which the Queen passed. Going in state to Ascot she was hissed by some ladies as her carriage drove on to the course, and two peeresses, one of them a Tory duchess, were openly accused of this unseemly act. Meanwhile some monster Chartist demonstrations were being organ- ized, and they commenced on 4th July with riots at Birmingham. It was an untoward coincidence that Lady Flora Hastings died on 5th July, for though she repeated on her deathbed, and wished it to be published, that the Queen had taken no part whatever in the proceed- ings which had shortened her life, it was remarked that the ladies who were believed to have persecuted her still retained the Sovereign's favour. The riots at Bir- mingham lasted ten days, and had to be put down by armed force. They were followed by others at Newcastle, Manchester, Bolton, Chester, and Macclesfield.

These troublous events had the effect of hastening the Queen's marriage. There prevailed a feeling that the Court was too much under the control of women, ™e f and Ministers were anxious to be relieved of marriage. *ne delicate responsibility of guiding the young Queen in domestic matters. Their position towards the Duchess of Kent was one of daily embarrass- ment. The Duchess had no officially recognized power, but so long as her daughter remained unmarried her will in the royal household was paramount, and there were occasions — ■ as in the Bedchamber affair — when domestic matters trenched to a dangerous extent on

politics. Lord Melbourne, who had publicly borne the odium of the " Bedchamber Plot," was in reality very loth to be^ rated as a Court favourite, and his paternal attach- ment to the Queen had made him view with concern the occurrences which had caused her name to be too freely bandied about. Accordingly, when he had ascer- tained that the Queen's dispositions towards her cousin, Prince Albert, were unchanged, he advised King Leopold, through M. Van der Weyer, the Belgian Minister, that the Prince should come to England and press his suit. The Prince arrived with his brother on a visit to Wind sor on 10th October 1839 ; but he had no idea that a speedy marriage was to result from this journey. A few weeks previously the Queen had written to her uncle, and said emphatically that she could entertain no project of matrimony for at least four years, and this having been reported to Prince Albert, he was under the impression that the Queen meant to break off their engagement, and that he had been summoned in order that a communication to this effect might be made to him in the most considerate manner possible. In the course of three days, however, he made such good use of his opportunities, that he carried his lady's heart by storm.

He had much improved since his last visit in 1836. He was no longer boyish, but tall and handsome, with a look of high intelligence in his clear, blue eyes and expansive forehead. On the evening of his arrival the

Queen wrote, with significant emotion, to King Leopold : " Albert's beauty is most striking, and he is most amiable and unaffected — in short, very fascinating." After this it is not surprising that on the 14th her Majesty should have informed Lord Melbourne that she had made up her mind. "I am very glad of it," answered the Premier with fatherly enthusiasm ; " the news will be very well received, for I hear that there is great anxiety now that his thing should be ; and you will be much more com- fortable, for a woman cannot stand alone, whatever her position may be." It was not till the following day that Prince Albert himself was apprised of the Queen's inten- tions. The proposal had to come from her, and maiden modesty being in conflict with royal etiquette, there was a natural timidity in her manner of approaching the moment which was to settle her life's course. The Prince had been hunting in the morning, and when he returned at noon he was summoned to the Queen's sitting-room,

where he found her alone. She began by talking on different subjects to gain time. M. Daguerre's invention for taking pictures by sunlight — not yet called "photography" — was then a new thing, and some daguerreotypes which had been exhibited to the Queen that morning lay on the table. Having shown these, she spoke of the great tournament which had lately been held at Eglinton Castle and of Lady Seymour, the " Queen of Beauty " ; then suddenly, after a pause, she said in German, with tears in her eyes, "Could you forsake your country for me ? " The Prince's answer was to take her in his arms, and all ended so happily, that, once more writing to her uncle an hour or two later, the Queen could say : " I love him more than I can tell, and I shall do everything in my power to render this sacrifice (for such in my opinion it is) as small as I can. I think ■ — and Albert approves — that we ought to be married very soon after Parliament meets, at the beginning of February."

The Prince, whose influence over the Queen was to be exercised in the most beneficial manner during a cloudless married life of twenty-two years, was a man whose worth was never fully known until after his death. He seemed to have been created on purpose for the position to which he was called ; he was certainly educated in view of it, and this with the most watchful care under the super- intendence of a German diplomatist who knew England well — Baron Friedrich von Stockmar. Lord Palmerston, who never much liked Stockmar, was obliged to confess of him : " He is the only absolutely disinterested man I have ever known." Stockmar was a native of Coburg, born in 1787, and had entered the service of Prince Leopold as private physician in 1816, when the Prince married the Princess Charlotte. The Princess died with her hand clasped in his, and it was owing to his skilful treatment that the Prince was enabled to bear the shock of a bereavement which seemed likely to crush him. Until the Prince became King of the Belgians Stockmar remained his private secretary, controller of his household, and his agent in all political negotiations. He was thus brought into contact with the leading statesmen of Europe, and their unanimous opinion of him was that he had no superior among diplomatists for penetration and tact. In 1831 he retired to his home at Coburg, being too shrewd to excite Belgian jealousies by residing at his master's court in the capacity of confidential

adviser ; but Leopold continued to ask his opinion by letter on all matters of importance, and he did so as regards Prince Albert's .training.

The bulletins which Stockmar drew up to describe the young Prince's character are examples of psychological diagnosis pushed almost to vivisection. Very few young

princes' characters could have borne such treatment. But Stockmar, knowing what were King Leopold's wishes, was anxious that Prince Albert should play the part which Leopold himself would have played had Princess Charlotte lived. Being aware, also, of how difficult the position of a Queen's Consort would be in England, no indication as to the Prince's habits seemed to his German mind too slight to be made a note of. Therefore he used to write that Prince Albert was sweet-tempered but list- less, chivalrous and clever but lazy in studying politics. He did not care for newspapers: "He says that the Augsburg Gazette is enough for any man's wants, but he does not read even that." Then the Prince was in- different to the society of ladies. "At parties he sits talking on art and war with old men, and takes no notice of the fair who are pining to dance with him." Extracts from these letters used to be shown to the Queen, and it is not certain that Prince Albert's callousness to the fascinations of German ladies constituted a blemish in her opinion. But she was sorry that he had no inclination towards politics ; and about a year before her betrothal she had hailed it as a piece of good news that the Prince had at last begun to read his Augsburg Gazette with proper assiduity.

Baron Stockmar was sent to England in January 1840, as representative of Prince Albert, to settle the treaty of marriage, and to make arrangements for the Prince's future household. But now the Court's quarrel with the Tories in 1839 brought disagreeable consequences. The Queen's announcement of her betrothal was read by her in the House of Lords on 16th January, and was, of course, enthusiastically received. Yet, when the Government proposed that Prince Albert should receive an annuity of £50,000, amendments were moved for reducing that sum, and

~~the Tories unexpectedly revealed themselves as rigid economists. The fault of this lay with Lord Melbourne. The proposals of his Government were in accordance with precedent, for in the cases of the last three Queens-Consort, and in that of Prince Leopold, the allowance had been £50,000, but the Opposition leaders should have been judiciously approached before the motion for the i grant was publicly made. Lord Melbourne had neglected to consult them, and he gave offence to the Tories by not describing Prince Albert as a Protestant Prince. The Duke of Wellington denounced this omission, reviving the old charge that the Ministry were bidding for the Irish Catholic vote ; and once more, the suspicion about Popery getting abroad, Lord Palmerston was obliged to ask Stockmar for assurance that 'Prince Albert did not belong to any sect of Protestants whose rules might prevent him from taking the Sacrament according to the ritual of the English Church. He got an answer couched in somewhat ironical terms to the effect that Protestantism owed its existence in a measure to the House of Saxony, from which the Prince descended, seeing that this House and that of the Landgrave of Hesse had stood quite alone against Europe in upholding Luther and his cause. Even this was not considered satisfactory, for certain High Churchmen held that a Lutheran was a " dissenter," and that the Prince should be asked to subscribe to the Thirty- Nine Articles. Other uneasy people doubted whether the Queen could constitutionally swear at the altar to " obey " & foreign prince, and wanted to have a special form of marriage service composed for her.~~

~~Much needless pain was given to the Queen by the angry temper shown in these discussions on the Prince's religion and his budget, and more especially on those concerning his future status as an Englishman It was out of the question that the Prince should receive the title of King Consort ; but the Queen naturally desired~~

~~that her husband should be placed by Act of Parliament in a position which would secure to him precedence, net only in England, but in foreign Courts. Lord Melbourne sought to effect this by a clause introduced in a Naturaliza- tion Bill; but, having mismanaged every detail of the business, he found himself obliged to drop the clause on the understanding that the Queen should confer what precedence she pleased~~

~~by letters patent. This was a lame way out of the difficulty, for the Queen could only confer precedence within her own realms, whereas an Act of Parliament bestowing the title of Prince Consort would have made the Prince's right to rank above all royal im- perial highnesses quite clear, and would have left no room f jr such disputes as afterwards occurred when foreign princes chose to treat Prince Albert as having mere courtesy rank in his wife's kingdom. On the Prince's Annuity Bill the Government sustained a severe defeat. An amendment moved by Mr Hume for reducing the allowauce to £21,000 was negatived ; but the amend- ment of Colonel Sibthorp — a politician of no great repute — for making the annuity £30,000, was carried against Ministers by 262 votes to 158, the Tories and Radicals going into the same lobby, and many Ministerialists taking no part in the division. All this mortified Prince Albert exceedingly, and gave him a poor idea of the welcome that awaited him in England. His misgivings increased and were mingled with irritation when he learned that he was not to be allowed to appoint his own secretary, but must accept the services of Mr Anson, who had formerly been Lord Melbourne's secretary. He was destined to get on very well with this gentleman, but at first he considered it an affront that a stranger should be forced upon him, and it required nothing less than the heartiness of the public greeting vouchsafed when he landed at Dover four days before the wedding to cheer him again about his prospects. Lord Melbourne assured him that what had happened was " only the result of high party feeling, and must not be taken as a mark of personal antipathy " ; and the Duke of Wellington strove to atone for Tory ungraciousness by agreeing, and, indeed, advis- ing that the Prince should be appointed a field-marshal : " He must wear a red coat at his wedding," said the Duke, " otherwise the people won't believe he's English."~~

~~The Queen's marriage was solemnized on 10th Feb- ruary 1840, in the Chapel Royal, St James's. The Queen was dressed entirely in articles of British manu- facture. Her dress was of Spitalfields silk ; her veil of Honiton lace ; her ribbons came from Coventry ; even her gloves had been made in London of English kid — a novel thing in days when the French had a monopoly in the finer kinds of gloves.~~

From the time of her marriage the Queen began to take a really active part in the affairs of State. Pre- viously, her Ministers had tried to spare her all disagreeable and fatiguing business. Death a"fai^ warrants were not submitted for her signature, and though she spent an hour or two every morning writing her name on public documents, these were seldom read to her, nor did she ask to be informed of their con- tents. Lord Melbourne saw her every day, whether she was in London or at Windsor, and he used to explain all current business in a benevolent, chatty manner, which offered a pleasant contrast to the style of his two princi- pal colleagues, Lord John Russell and Lord Palmerston. Lord John was never a lady's man. His natural kindli- ness was concealed under a somewhat sour air ; the tone of his voice was piping and dictatorial. He was always in earnest about trifles. Lord Palmerston was a persi- fleur. Handsome, affable, well dressed, and cool, there was a point of irony in his tone as if he felt he were

playing a comedy in talking to the Queen about serious things which a girl of her age could not be expected to understand, and in asking her for an approval which she could not refuse. Lord Melbourne always guarded him- self against the presumption of seeming to expect ap- proval as a matter of course. The words, "Your Majesty," sounded on his lips much like " My dear," but when the Queen had given assent to his proposals he showed the same kind of pleasure as a fond guardian who is glad to find his ward in harmony with him. Lord Melbourne failed as a party leader, but not as a Queen's Minister, and it may be questioned whether a statesman of firmer mould would have succeeded so well as he did in making rough places smooth for Prince Albert. Lord John Eussell and Lord Palmerston were jealous of the Prince's interference — and of King Leopold's and Baron Stockmar's exercised through him — in State affairs ; but Lord Melbourne took the common-sense view that a husband will control his wife whether people wish it or not. He did not object to the Prince being present when he opened his despatch-box before the Queen ;

~~and, knowing what soreness existed in her Majesty's mind against the Tories, he strove to mollify the Prince's feelings towards a party who might soon come to office. In this he behaved admirably, and he displayed wisdom, though the royal pair hardly appreciated it at the time, in desiring that the Queen should retain the Baroness Lehzen as her private secretary. The Duchess of Kent, after her daughter's marriage, retired to Ingestre House, Belgrave Square, and the Queen gave the Baroness some hints that she might retire too on a pension, resigning her secretaryship to Prince Albert. Lord Melbourne thought, however, that the office of private secretary held by a prince would seem to the public too much like a secretaryship of State, and would in any case bring the Queen's Consort into relations neither dignified nor agree- able with all sorts of people. A great part of a secretary's business consists in writing ^refusals to importunate re- quests. To confer on Prince Albert every honour that the Crown could bestow, and to let him make his way gradually into public favour by his own tact, was the advice which Lord Melbourne gave ; and the Prince acted upon it so well, avoiding every appearance of in- trusion, and treating men of all parties and degrees with urbanity, that within five months of his marriage he obtained a signal mark of the public confidence. In expectation of the Queen becoming a mother a Bill was passed through Parliament providing for the appointment of Prince Albert as sole Begent in case the Queen, after giving birth to a child, died before her son or daughter came of age.~~

~~The Begency Bill had been hurried on in consequence of the attempt of a crazy pot-boy, Edward Oxford, to Attempts ^ke the Queen's life. On 10th June 1840, on the the Queen and Prince Albert were driving up Queen's Constitution Hill in an open carriage, when n,e' Oxford fired two pistols, the bullets from which~~

~~flew, it is said, close by the Prince's head. He was arrested on the spot, and when his lodgings were searched a quantity of powder and shot was found, with the rules of a secret society, called " Young England," whose mem- bers were pledged to meet, " carrying swords and pistols and wearing crape masks." These discoveries raised the surmise that Oxford was the tool of a widespread Chartist conspiracy — or, as the Irish pretended, of a conspiracy of Orangemen to set the Duke of Cumberland~~

on the throne — and while these delusions were fresh, they threw well-disposed persons into a paroxysm of loyalty. Even the London street dogs, as Sydney Smith said, joined with O'Connell in barking " God save the

Queen." For several days, whenever the Queen and the Prince drove out, they were escorted by hundreds of ladies and gentlemen on horseback, who served as a bodyguard, while large and sympathizing crowds in the streets cheered uproariously. Oxford seems to have been craving for notoriety; but it may be doubted whether the jury who tried him did right to pronounce his acquittal on the ground of insanity. He feigned madness at his trial, but during the forty years of his subsequent confinement at Bedlam he talked and acted like a rational being, and when he was at length released and sent to Australia he earned his living there as a house painter, and used to declare that he had never been mad at all. His acquittal was to be deprecated as establishing a dangerous precedent in regard to outrages on the Sovereign. It was always Prince Albert's opinion that if Oxford had been flogged the attempt of Francis on the Queen in 1842, and of Bean in the same year, would never have been perpetrated. After the attempt of Bean — who was a hunchback, really insane — Parlia- ment passed a Bill empowering judges to order whipping as a punishment for those who molested the Queen ; but somehow this salutary Act was never enforced. In 1850 a half-pay officer, named Pate, assaulted the Queen by striking her with a stick, and crushing her bonnet; he was sentenced to seven years' transportation ; but the judge, Baron Alderson, excused him the flogging. In 1869 an Irish lad, O'Connor, was sentenced to eighteen months' imprisonment and a whipping for presenting a pistol at the Queen, with a petition, in St James's Park, but this time it was the Queen herself who privately remitted the corporal punishment, and she even pushed clemency to the length of sending her aggressor to Australia at her own expense. The series of attempts on the Queen was closed in 1882 by Maclean, who fired a pistol at her Majesty as she was leaving the Great Western Kailway Station at Windsor. He, like Bean, was a genuine madman, and was relegated to Broadmoor.

The birth of the Princess BoyaL on 21st November 1840, removing King Ernest of Hanover from the posi- tion of heir-presumptive to the British

Crown, was a subject of loud congratulations to the Blrtboft,le people ; and nothing happened after the con- p' ; s finement to give tjie nation a moment's uneasi- ness as to the mother's health or the baby's. A scare was occasioned at Buckingham Palace, however, when the little Princess was a fortnight old, owing to the intrusion of the celebrated " Boy Jones," who was found concealed under a bed in the royal nursery. This disagreeable lad, at first suspected of a design to kidnap the Queen's baby, was examined before the Privy Council, but as it appeared that he had no evil intent, he was handed over to a magistrate to be imprisoned for three months as a vagabond. Jones had a mania for palace — breaking. Three times he effected a clandestine entry into the Queen's residence, and twice he managed to spend several days there. By day he concealed himself in cupboards or under furniture, and by night he groped his way into the royal kitchen to eat whatever he could find. After his third capture, in March 1841, he coolly boasted that he had lain under a sofa, and listened to a private conversation between ,the Queen and Prince Albert. This third time he was not punished, but sent to sea, and turned out very well. Indirectly the Boy Jones was the means of doing some good, for he called public attention to the careless attendance, untidiness, and waste that prevailed in the royal household. This strength- ened Princte Albert's hands in trying to carry out sundry domestic reforms, which were being stoutly resisted by vested interests. The royal residences and grounds used

to be under the control of four different officials — the Lord Chamberlain, the Lord Steward, the Master of the Horse, and the Commissioners of Woods and Forests. Baron Stockmar, describing the confusion fostered by this state of things, said : —

" The Lord Steward finds the fuel and lays the fire ; the Lord Chamberlain lights it. The Lord Chamberlain provides the lamps ; the Lord Steward must clean, trim, and light them. The inside cleaning of windows belongs to the Lord Chamberlain's department, but the outer parts must be attended to by the Office of Woods and Forests, so that

~~*windows remain dirty unless the two departments can come to an understanding. ”*~~

~~*The Boy Jones had found his way into Buckingham Palace because there was no responsible authority to which all servants looked for orders ; and if he had been a little bolder he might have billeted himself upon some mess in the Palace without anybody being qualified to ask him what his business was. Ample as the Queen’s income looked in figures, it hardly sufficed to cover expenditure when no disbursements could be properly checked. Prince Albert, going over the Lord Steward’s accounts, once found an item of thirty-five shillings a week for ” Bed Boom wine.” After a patient investigation, sulkily hindered at every step, he ascertained that a certain chamber at Windsor had been temporarily used during George III.‘s reign as a guard-room, and five shillings a day had been allowed to provide wine for the officer on guard. The chamber had long ceased to be a guard-room, but the item for wine still figured in the cellarage accounts, and formed one of the perquisites of a half- pay officer, who enjoyed the sinecure of under-butler. This officer was much shocked when he was offered the alternative of renouncing his wine money or doing duty as butler ; and, of course, the sympathies of other sinecurists were all on his side. Even after Jones’s freak had set all the world laughing at the misrule of the Palace, it took Prince Albert four years of firmness and diplomacy to bring the Queen’s home under the efficient control of a Master of the Household. This was finally done according to a plan of Baron Stockmar’s in 1845, while Sir Bobert Peel was Premier; and the Queen’s Palaces were always from that time such models of good management that several foreign monarchs took pattern by them in reorganizing their own house- holds.*~~

~~*At the general election of 1841 the Whigs returned in a minority of seventy-six, and, being at once worsted in a*~~

~~*division on the Address, Lord Melbourne re- Sir Robert signed.. The Queen was affected to tears at Ministry. Partmg with him. She had experienced nothing*~~

~~*but kindness at his hands ; and she naturally felt some antipathy towards Sir Bobert Peel who suc- ceeded him. When the Queen got to understand*~~

Peel's mannerisms, and saw how excellent and genial a man he was in the main, she liked him much ; but to have him as an adviser after the courtly Melbourne was, at first, like exchanging an indulgent guardian for a prosy tutor. Peel, on his side, was far from comfortable about the reception he was likely to get from Prince Albert. He and his Tory friends had begun privately to repent of the support they had given to Colonel Sibthorp's motion for reducing the Prince's annuity, for it had placed them in a position repugnant to the traditions of their party. Coming to power in triumph they met with no Bed- chamber difficulties. The Whig ladies who had held high appointments at Court resigned, and their places were filled by others connected with Tory families ; but these others did not feel very proud of Colonel Sibthorp, all the less so as this gentleman had taken to singularizing himself by the most eccentric kinds of motions in Parlia-

ment. Prince Albert, perceiving there was embarrassment all round, set himself to allay it by exquisite good humour. He received Peel in a way that charmed the latter ; and his magnanimity met with instant reward, for one of the Tory Premier's first acts was to propose that a Boyal Commission should be appointed to consider the best means for promoting art and science in the kingdom, and he nominated Prince Albert as President. This graceful proceeding was fully appreciated, and it had its importance, as marking out for the Prince a set of non- political duties, which he ably discharged to the end of his life. He was a born artist, whose taste for painting and sculpture embraced everything that was well done, without predilection for any particular school ; he was an accomplished musician, too, and took an interest in all branches of science. The International Exhibition of 1851, the creation of the Museum and Science and Art Department at South Kensington, the founding of art schools and picture galleries all over the country, the spread of musical taste, and the fostering of technical education, may be attributed, more or less directly, to the Commission of distinguished men which began its labours under Prince Albert's auspices.

The Queen's second child, the Prince of Wales (see Edwaed VII.), was born on 9th November 1841. He was baptized in water brought from the Jordan. King Frederick William of Prussia came to Eng- B'Hp °f land to

~~*be his sponsor, and his birth " filled the of Wales- measure of the Queen's domestic happiness," as she said in her speech from the throne at the opening of the session of 1842.*~~

~~*It is unnecessary from this point onwards to go seriatim through the domestic history of the reign, which is given in the article English Histoey. At this time there was much political unrest at home, and serious difficulties abroad. As regards internal politics, it may be re- marked that the Queen and Prince Albert were much relieved when Peel adopted Free Trade and repealed the Corn Laws, for it closed a dangerous agitation which gave them much anxiety. When the country was in distress, when there were bread riots and bankruptcies, alarms among landholders and levelling menaces in every demagogue's mouth, the Queen felt a womanly repugnance for festivities ; and yet it was unde- rt,e Court sirable that the Court should incur the reproach country. of living meanly to save money. There was a conversation between the Queen and Sir Bobert Peel on this subject in the early days of the Tory Administration, and the Queen talked of reducing her establishment in order that she might give away larger sums in charities. " I am afraid the people would only say that' your Majesty was returning them change for their pounds in halfpence," answered Peel. " Your Majesty is not per- haps aware that the most unpopular person in the parish is the relieving officer, and if the Queen were to constitute herself a relieving officer for all the parishes in the king- dom, she would find her money go a very little way, and she would provoke more grumbling than thanks." Peel added that a Sovereign must do all things in order, not seeking praise for doing one particular thing well, but striving to be an example in all respects, even in dinner- giving. To a Queen of twenty-two, with a husband of the same age, both of whom read the newspapers, and wondered whether the vast changes which steam and electric wires were working in the world were not going to modify all ancient notions as to royal duties, such advice was not inopportune.*~~

~~*Meanwhile the year 1842 was ushered in by splendid fetes in honour of the King of Prussia, who held the Prince of Wales at the font. In the spring there was a*~~

fancy-dress ball at Buckingham Palace, which remained memorable owing to the offence which it gave in France. Prince Albert was costumed as Edward III., the Queen as Queen Philippa, and all the gentlemen of the Court as Knights of Poitiers. The French chose to view this as an unfriendly demonstration, and there was some talk of getting up a counter-ball in Paris, the Duke of Orleans to figure as William the Conqueror. In June the Queen took her first railway journey, travelling from Windsor to Paddington on the Great Western line. The Queen's Master of the Horse, whose business it was to first rail- provide for the Queen's ordinary journeys by w"y road, was much put out by this innovation.

loumey. jjg marcne(j £nto the station several hours before the start to inspect the engine, as he would have examined a steed ; but greater merriment was occasioned by the Queen's coachman, who insisted that, as a matter of form, he ought to make-believe to drive the engine. After some dispute, he was told that he might climb on to the pilot engine which was to precede the Koyal train, but his scarlet livery, white gloves, and wig suffered so much from soot and sparks that he made no more fuss about his rights in after trips. The run to Paddington was successfully accomplished, and the motion of the train was found to be so pleasant that the Queen readily trusted herself to the railway for a longer journey a few weeks later, when she paid her first visit to Scotland. There the noble scenery and warm-hearted people pleased the Queen so well that her resolution of buying an estate was formed before she returned to England, and Sir James Clark was instructed to make inquiries concerning the localities which were most healthy. HIs report led to the Queen's visiting Balmoral in 1848, and to the pur- chase of the Balmoral estate in 1852, and the Queen's diary of her journeys in Scotland shows what constant enjoyment she derived from her HIghland home. Seven years before this the estate of Osborne had been pur- chased in the Isle of Wight, in order that the Queen might have a home of her own. Windsor she con- sidered too stately, and the Pavilion at Brighton too uncomfortable. The first stone of Osborne HOuse was laid in 1845, and the Boyal Family entered into posses- sion in September 1846.

In August 1843 the Queen and Prince Albert paid a visit to King Louis Philippe at the Chateau d'Eu. They sailed from Southampton for Treport in a yacht, with ° and> as ^ happened to be raining hard when foreign they embarked, the loyal members of the South- ampton Corporation remembered Baleigh, and spread their robes on the ground for the Queen to walk over. In 1844 Louis Philippe returned the visit by coming to Windsor. It was the first visit ever paid by a King of France to a Sovereign of England, and Louis Philippe was much pleased at receiving the Order of the Garter. HIe said that he did not feel that he belonged to the " Club " of European Sovereigns until he received this decoration. The Tsar Nicholas also visited Windsor in 1844 (the year in which Prince Alfred, who was to marry the Tsar's granddaughter, was born). The Queen was

not much struck by the handsome Prussian autocrat. She wrote that she did not think him clever, as politics and military concerns were the only things in which he took an interest.

In 1846 the affair of the " Spanish Marriages " seriously troubled the relations between the United Kingdom and France. Louis Philippe and M. Guizot had planned the marriage of the Duke of Montpensier with the Infanta Louisa of Spain, younger sister of Queen Isabella, who, it was thought at the time, was not likely ever to have children. The intrigue was therefore one for placing a

sove- reigns.

son of the French King on the Spanish throne. Lord Normanby, British Ambassador in Paris, was instructed to deliver to M. Guizot a formal protest based on the Treaty of Utrecht and on formal assurances given by M. Guizot to Lord Aberdeen ; at the same time the Queen wrote privately to the Queen of the French, Marie Amelie, urging the many objections to the marriage. This letter caused Louis Philippe to write to his daughter Marie, Queen of the Belgians, as follows : —

" I am inclined to think that the good little Queen was as sorry to write the letter as I was to read it. But she now sees things only through the spectacles of Lord Palmerston, and these distort the truth too often. The difference between Palmerston and Aberdeen is that the latter wishes to be well with his friends, while the former seeks to quarrel with them. "

The marriage took place, but did not yield the political results contemplated, for Queen Isabella had children, and the Duke of Montpensier wholly failed to win popu- larity or influence in Spain. But as to Queen Victoria's intervention on this question and on others, these words, written by Gladstone in 1875, may be quoted : —•

"Although the admirable arrangements of the Constitution have now shielded the Sovereign from personal responsibility, they have left ample scope for the exercise of direct and personal in- fluence in the whole work of government. . . . The Sovereign as compared with her Ministers has, because she is the Sovereign, the advantage of long experience, wide

survey, elevated position, and entire disconnexion from the bias of party. Further, personal and domestic relations with the ruling families abroad give open- ings in delicate cases for saying more, and saying it at once more gently and more efficaciously than could be ventured in the formal correspondence and rude contacts of Government. We know with how much truth, fulness, and decision, and with how much tact and delicacy, the Queen, aided by Prince Albert, took a prin- cipal part on behalf of the nation in the painful question of the Spanish Marriages. "

The year 1848, which shook so many Continental thrones, left that of the United Kingdom unhurt. Revolu- tions broke out in Paris, Vienna, Berlin, Madrid, Rome, Naples, Venicea Munich, Dresden, and Budapest. The Queen and Prince Albert were affected in many private ways by the events abroad. Panic-stricken princes wrote to them for political assistance or pecuniary aid. Louis Philippe came to the shores of England almost destitute, and the Queen employed Sir Robert Peel as her inter- mediary for providing him with money to meet his im- mediate wants. Subsequently Claremont was assigned to the exiled Royal Family of France as a residence. During a few weeks of 1848 Prince William of Prussia (afterwards German Emperor) found an asylum in England.

In August 1849 the Queen and Prince Albert accom- panied by the little Princess Royal and the Prince of Wales paid a visit to Ireland, landing at the Cove of Cork, which from that day was renamed /gJp Queenstown. The reception was enthusiastic, and so was that at Dublin. " Such a day of jubilee," wrote The Times, " such a night of rejoicing, has never been beheld in the ancient capital of Ireland since first it arose on the banks of the Liffey." The Queen was greatly pleased and touched. She said in her diary : " It was a wonderful and striking scene, such masses of human beings, so enthusiastic, so excited, and yet such perfect order maintained — a never-to-be-forgotten scene when one reflected how lately the country had been in open revolt and under martial law." The project of establishing a royal residence in Ireland was often mooted at this time, but the Queen's advisers never urged it with sufficient warmth. There was no repugnance to the idea on the Queen's part, but Sir Robert Peel thought unfavourably of it as an " empirical " plan, and the question of

expense was always mooted as a serious consideration. Lastly, it had to be borne in mind that the Queen, becoming an

Irish landowner, would have to do as other landowners did — that is, exact fair rents — and submit to the conse- quent odium of ordering evictions when rents were, not paid. The scheme was never exactly rejected, but it was again and again shelved. There is no doubt that the absence of a royal residence in Ireland was felt as a slur upon the Irish people in certain circles.

During these years the Queen's family was rapidly becoming larger. Princess Alice (afterwards Grand Duchess of Hesse) was born on 25th April 1843; Prince Alfred (afterwards Duke of Edinburgh and Duke of Saxe- Coburg and Gotha) on 6th August 1844 ; Princess Helena (Princess Christian) on 25th May 1846; Princess Louise (Duchess of Argyll) on 18th March 1848 ; and Prince Arthur (Duke of Connaught) on 1st May 1850. It was in this same month, and while the Queen was still in delicate health, that — as we have mentioned — the lunatic Pate assaulted her Majesty. This event made the Queen ill, and was the indirect cause of Sir Robert Peel's death. Eeturning from Buckingham Palace, where he had called to inquire after the Queen's health, his horse stumbled on Constitution Hill, threw him heavily, and fell upon him (29th June). Peel died on 2nd July, and the Queen was for a time inconsolable. Baron Bunsen wrote : " The Queen's grief is excessive. She is in a constant flbod of tears, and with the greatest diffi- culty could be prevailed upon to hold the Levee, which, having been fixed for this day [3rd July], could not be put off."

The idea in which the Exhibition of 1851 originated was in keeping with the religious tolerance and with the

large-minded views of human progress which e^ft/Mw' Prmoe Albert always evinced. The idea was of 1851. his own, but he had to work for its realization

against an extraordinary outburst of angry ex- postulations. Every stage ini his project was combated. In the House of Peers, Lord Brougham denied the right of the Crown to hold the Exhibition in Hyde Park ; in the Commons, Colonel Sibthorp prophesied that England would be overrun with foreign rogues and revolutionists, who would subvert the morals of the people, filch their trade secrets from them, and destroy their faith and loyalty towards their religion and their Sovereign. Prince Albert was President of the Exhibition Commission, and every post brought him abusive letters, accusing him, as a foreigner, of being intent upon the corruption of England. He was not the man to be balked by talk of this kind, but quietly persevered, looking always to the probability that the manufacturing power of Great Britain would be quickened by bringing the best manu- factured products of foreign countries under the eyes of the mechanics and artisans. The artistic sense was at this time almost wholly wanting among the English people. One day the Prince had a conversation with a. great manufacturer of crockery, and sought to convert him to the idea of issuing something better than the eternal willow-pattern in white with gold, red, or blue, which formed the staple of middle and lower class domes- tic china. The manufacturer held out that new shapes and designs would not be saleable ; but he was induced to try, and he did so with such a rapid success that a revolution in the china cupboards of England was accom- plished from that time. A great difficulty in regard to the architecture and cost of the proposed Exhibition building was most happily overcome when Mr Joseph Paxton, head gardener on the Duke of Devonshire's estate at Chatsworth, suggested that the building should be made throughout of glass and iron on the model of a conservatory. The first column was set up on 26th September 1850, and the Exhibition was opened by

the Queen on 1st May 1851. The Exhibition proved in every way a colossal success. It remained open 138 days, and was visited by 6,007,944 persons, an average of 43,536 each day. The surplus, after all expenses had been paid, amounted to £150,000, and this sum was spent on establishing and endowing the Museum at South Kensington, and on the purchase of land in the neighbourhood.

~~In 1852 occurred the incident of Lord Palmerston's dis- missal from the office of Foreign Secretary. On 2nd December 1851, Prince Louis Napoleon struck j-he Queen his coup d'dtat which destroyed the French Re- and Lord public. Lord Palmerston expressed his approval Palmer- of the Prince's action, taking a very shrewd view sto°'' of the condition to which France had been reduced by the conflict of Pretenders and parties, and he was dis- missed from his post as Foreign Secretary in consequence. The circumstances, which have been told in detail in Sir Theodore Martin's Life of the Prince Consort, are of extreme interest for the light they throw on the Queen's very proper estimate of her constitutional position and authority. At this date, and earlier, Lord Palmerston was not persona grata at Court. His Anglo — Irish nature was not sympathetic with the somewhat formal character and German training of Prince Albert ; and his views of Ministerial independence were not at all in accord with those of the Queen and her husband. Al- ready in 1849, a propos of the Hungarian crisis, the Queen had to remind her Foreign Secretary that his despatches must pass through the hands of the Prime Minister, Lord John Russell, and Palmerston assented, and promptly and repeatedly disobeyed. A year later, on 12th August 1850, the Queen wrote to Lord John Russell the following important memorandum, which was communicated to the Foreign Secretary at the time, and, after his dismissal, was read by the Prime Minister in the House of Commons (3rd February 1852) : —~~

~~" Osborne, 12th August 1850.~~

~~"With reference to the conversation about Lord Palmerston which the Queen had with Lord John Russell the other day, and Lord Palmerston's disavowal that he ever intended any disrespect to her by the various neglects of which she has had so long and. so often to complain, she thinks it right, in order to avoid any mis- takes for the future, to explain what it is she expects from the Foreign Secretary.~~

~~" She requires —~~

~~"1. That he will distinctly state what he proposes in a given case, in order that the. Queen may know as distinctly to what she has given her royal sanction.~~

” 2. Having given her sanction to a measure, that it be not arbitrarily altered or modified by the Minister. Such an act she must regard as failing in sincerity to the Crown, and justly to be visited by the exercise of her constitutional right of dismissing that Minister. She expects to be kept informed of what passes between him and the Foreign Ministers, before important decisions are taken, based upon that intercourse ; to receive the foreign despatches in good time, and to have the drafts for her approval sent her in sufficient time to make herself acquainted with their contents before they must be sent off. The Queen thinks it best that Lord John Eussell should show this letter to Lord Palmerston.”

The offence of the Foreign Secretary at the time of the coup d’etat was that he had, of his own initiative, given assurances to Napoleon’s Ambassador, Count Walewski, which were not in accord with the views of the Cabinet and with the ” neutrality which had been enjoined ” by the Queen. The Prime Minister was justifiably annoyed, the Queen was rightly angry, and Lord Palmerston left the Foreign Office in disgrace — only, however, to come back as Prime Minister three years later.

The death of the Duke of Wellington in 1852 deeply affected the Queen. The Duke had acquired a position above parties, and was the trusted adviser of all statesmen

Prince

Albert’s

position,

and of the Court in emergencies. The Queen sadly needed such a counsellor, for Prince Albert’s position was one full of difficulty, and party malignity was continually putting wrong constructions upon the advice which he gave, and imputing to him advice which he did not give. fh^n’k During the Corn Law agitation offence was of Wei- taken at his*

having attended a debate in the lington: House of Commons, the Tories declaring that he had gone down to overawe the House in favour of Peel's measures. After Palmerston's enforced resignation, there was a new and more absurd hubbub. Napoleon's destruction of the Kepublic, and his proscription of all the leading statesmen, generals, and writers of France, seemed an odious act to the British people, and yet they were ready to clamour against Prince Albert for having recommended the punishment of the British Minister who had given his sanction to this act. Finally, when the difficulties with Bussia arose which led to the Crimean war, the Prince was accused by the peace party of wanting war, and (by the war party of plotting surrender ; and it came to be publicly rumoured that the Queen's husband had been found conspiring against the State, and had been committed to the Tower. Some said that the Queen had been arrested too, and the Prince wrote to Stockmar : " Thousands of people surrounded the Tower to see the Queen and me brought to it." This gave infinite pain to the Queen, and at length she wrote to Lord Aberdeen on the subject. Eventually, on 31st January 1854, Lord John Eussell took occasion to deny most emphatically that Prince Albert interfered unduly with foreign affairs, and in both Houses the statesmen of the two parties delivered feeling panegyrics of the Prince, asserting at the same time his entire con- stitutional right to give private advice to the Sovereign on matters of State. From this time it may be said that Prince Albert's position was established on a secure foot- ing. He had declined (1850) to accept the post of Commander-in-Chief at the Duke of Wellington's sugges- tion, and he always refused to let himself be placed in any situation which would have modified ever so slightly his proper relations with the Queen. The Queen was very anxious that he should receive the title of " King Consort," and that the crown should be jointly borne as it was by William III. and Mary ; but he himself never spoke a word for this arrangement. It was only to please the Queen that he consented (1859) to change his title to that of Prince Consort, and he only did this when it was manifest that statesmen of all parties approved the change.

For the Queen and Boyal Family the Crimean war time was a very busy and exciting one. Her Majesty personally superintended the committees of ladies The vtha organized relief for the wounded ; she

wan6”” helped Miss Florence Nightingale in raising bands of trained nurses ; she visited the crippled soldiers in the hospitals, and it was through her resolute complaints of the utter insufficiency of the hospital ac- commodation that Netley Hospital was built. The dis- tribution of medals to the soldiers and the institution of the Victoria Cross (February 1857) as a reward for in- dividual instances of merit and valour must also be noted among the incidents which occupied the Queen’s time and thoughts. In 1855 the Emperor and Empress of the French visited the Queen at Windsor Castle, and the same year her Majesty and the Prince Consort paid a visit to Paris. An International Exhibition had been opened in the French capital, although the times were not very propitious for such a thing. The Queen was splendidly received ; the fortifications of Paris on the- side where she entered were masked with flowers, and the

historical Chateau of Versailles was refurnished for her residence.

The Queen’s family life was a most happy one. Two more children had been born to the royal pair since Prince Arthur’s (the Duke of Connaught’s) birth in 1850, Prince Leopold (Duke of Albany) on The Queen 7th April 1853, and on 14th April 1857 their a^i” last child, the Princess Beatrice (Princess Henry of Battenberg), bringing the Boyal Family up to nine — four sons and five daughters. Less than a year after Princess Beatrice’s birth her Majesty’s eldest daughter, the Princess Boyal, was married to Prince Frederick William of Pi ussia, who was destined to reign too short a time over the German empire as Emperor Frederick. Of this marriage, as of the others in the Boyal Family, it may be said that the first consideration which the Queen always took into view was the domestic welfare of her children. Although the circle of choice was restricted to Protestant — or, at least, non-Catholic — houses there were princes and princesses enough in Europe whose alliance could have been recommended as offering solid political advantages ; but to the honour of the statesmen who advised the Crown, they did not attempt to thwart the Queen’s inclinations, or those of her children, by adducing reasons of State for or against such and such a marriage. As one royal betrothal after another came to be an- nounced in Parliament, it was always enough for the Minister of the day to say that the young people loved each other. The Queen’s children all had an excellent, if strict,

bringing-up. Their masters and governesses were chosen with care, and their father himself super- intended their education with an unceasing vigilance. At Balmoral and Windsor the Court lived in virtual privacy, and the Queen and the Prince Consort saw much of their children. Countless entries in the Queen's diaries testify to the anxious affection with which the progress of each little member of the house- hold was watched.

The next marriage after the Princess Boyal's was that of the Princess Alice to Prince Louis (afterwards Grand Duke) of Hesse-Darmstadt in 1862. In 1863 the Prince of Wales married the Princess ^°w\ Alexandra of Denmark. In 1866 the Prin- cess Helena became the wife of Prince Christian of Schleswig-Holstein ; and in 1871 the Princess Louise was wedded to the Marquis of Lome, eldest son of the Duke of Argyll. In 1874 Prince Alfred, Duke of Edinburgh, married Princess Marie Alexandrovna, only daughter of the Tsar Alexander II. The Duke of Con- naught married in 1879 the Princess Louise of Prussia, daughter of the soldier-prince Frederick Charles ; and in 1882 Prince Leopold, Duke of Albany, wedded the Princess Helen of Waldeck-Pyrmont. Finally came the marriage of Princess Beatrice in 1885 with Prince Henry of Battenberg.

On the occasion of the coming of age of the Queen's sons and the marriages of her daughters Parliament made provision. The Prince of Wales, in addition to the revenues of the Duchy of Cornwall, had £40,000 a year, the Princess £10,000, and an addition of £36,000 a year for their children was grapted by Parliament in 1889. The Princess Boyal received a dowry of £40,000 and £8000 a year for life, the younger daughters £30,000 and £6000 a year each. The Dukes of Edinburgh, Con- naught, and Albany were each voted an income of £15,000 and £10,000 on marrying. All these grants were voted under the conditions of the general financial settlement accepted by Parliament at the beginning of the Queen's reign, and according to which certain Crown lands were transferred to the nation. In providing for

~~the Queen's children Parliament simply fulfilled a contract.~~

~~The dispute with the United States concerning the Trent affair of 1861 will always be memorable for the part played in its settlement by the Queen and TJ"* the Prince Consort. In 1861 the accession of~~

~~cwn War. Abraham Lincoln to the Presidency of the United States of America caused the Southern States of the Union to revolt, and the sanguinary War of Secession began. The sympathies of the United Kingdom would have gone naturally with the Northern against the slave-holding States, but various reasons induced Great Britain to look coldly on the struggle. Among the upper classes indeed a very bitter feeling towards America had been engendered by the reckless praises which demagogues bestowed on republican institutions, and this feeling blazed out furiously when in November 1861 the British West India steamer Trent was boarded by a vessel of the Federal Navy, the San Jacinto, and Messrs Slidell and Mason, Commissioners for the Confederate States, who were on their way to England, were seized. The British Government were on the point of demanding reparation for this act in a peremptory manner which could hardly have meant anything but war, but the Queen and her husband insisted on drafting a despatch which gave the American Government an opportunity to concede the surrender of the prisoners without humiliation.~~

~~The year 1861 was the saddest in the Queen's life. On~~

~~16th March her mother, the Duchess of Kent, died,~~

~~and on 14th December, while the dispute~~

~~Death of wj^n America about the Trent affair was yet~~

~~the Prince~~

~~Consort, unsettled, the Prince Consort breathed his last at Windsor. Nobody could have suspected that he was so near his end. IIe was in the flower of man- hood, he seemed to be strong and full of animal spirits. But in the autumn his constitution suddenly gave way, and he caught a~~

cold which he could not shake off. One of his last journeys was to Cambridge to see the Prince of Wales, and his last actual appearance in public was when he reviewed the Eton College Rifle Corps in the Home Park at Windsor in the last week of November. On the Sunday before his death, while the Royal Family were at church, he lay at home on a sofa while the Princess Alice sang hymns to him. He closed his eyes with a serene expression, and after some minutes of silence said, " I am full of happy thoughts." In the course of the week symptoms of gastric fever declared themselves, and he died on 14th December.

His death left a void in the Queen's life which nothing could ever fill. She kept the memory of her wedded life and the lost Prince ever before her. She built at Frog- more a magnificent mausoleum where he and she might be buried. The anniversary of the Prince's death was regularly kept as a day of prayer. Statues and memorials sprang up on all sides. Of these the most conspicuous were the Albert Hall (1867) and the Albert. Memorial in Hyde Park (1876). The Albert Medal also (1866) was established as a decoration in reward for gallantry in saving life.

The new decorations instituted during the Queen's reign may here be noted : The Victoria Cross (1856), Order of the Star of India (1861), Royal Order of Victoria and Albert (1862), Imperial Order of Crown of India (1878), Order of the Indian Empire (1878), Royal Red Cross (1883), Distinguished Service Order (1886), and the Royal Victorian Order (1896).

A new epoch in the constitutional history of the United Kingdom was opened with the Prince Consort's death. When he died the controlling power of the Crown fell temporarily into comparative abeyance. The Queen in

her deep affliction retired for several years into almost complete privacy. Never again during her reign did the Queen live in London, and Buckingham Palace marriage was only used for occasional visits of a few of the days. For a time she was naturally diffident Prince of of exercising her full authority in State affairs, Wa,es- though as the years passed her personal influence became more felt, and for the last ten years of her reign she was recognized as the most experienced statesman in Europe.

~~So long as Lord Palmerston lived the inconveniences of the Queen's temporary withdrawal were not much felt, but Palmerston himself foresaw that mischief might some day arise if party conflicts should come to be fought out without the restraints which constitutional monarchy is intended to impose. At the time of the Prince's death the Prince of Wales was in his twenty-first year. He had spent several terms at each of the two Universities of Oxford and Cambridge, and he had already travelled much, having visited most of Europe, Egypt, and the United States. His marriage was solemnized at Windsor on 10th March 1863. The Queen witnessed the wedding from the private pew or box of St George's Chapel, Windsor, but she wore the deep mourning which she was never wholly to put off to the end of her life, and she took no part in the festivities of the wedding. In January 1864 a son was born to the Prince of Wales, and was christened Albert Victor after both his grand- parents.~~

~~In 1866 the Austro-Prussian war broke out, and many short-sighted people were tempted to side with France when, in 1867, Napoleon III. sought to obtain a " moral compensation " by laying a claim to Austro- the Duchy of Luxemburg. A conference met Wan in London, and the difficulty was settled by neutralizing the Duchy and ordering the evacuation of the Prussian troops who kept garrison there. But this solution, which averted an imminent war, was only arrived at through Queen Victoria's personal intercession. In the words of a French writer :~~

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~~"The Queen wrote both to the King of Prussia and to the Emperor Napoleon. Her letter to the emperor, pervaded with the religious and almost mystic sentiments which predominate in the Queen's mind, particularly since the death of Prince Albert, seems to have made a deep impression on the Sovereign who, amid the struggles of politics, had never completely repudiated the philanthropic theories of his youth, and who, on the battlefield of Solferino, covered with the dead and wounded, was seized with an unspeakable horror of war. "~~

~~During Disraeli's two Premierships (1868 ; 1874-80) it has been said with some justice that the parts of Sovereign and Minister became often inverted, that Disraeli reigned and the Queen governed. Di&raeii~~

Disraeli, at all events, rightly thought that the aiadstone. Queen ought to be a power in the State. His notion of duty — at once a loyal and chivalrous one — was that he was obliged to give the Queen the best of his advice, but that the final decision in any course lay with her, and that once she had decided he was bound, what- ever might be his own opinion, to stand up for her decision in public. The Queen, not unnaturally, came to trust Disraeli implicitly, and she frequently showed her friend- ship for him. At his death she paid an exceptional tribute to his " dear and honoured memory " from his "grateful and affectionate Sovereign and friend." To something like this position Lord Salisbury after 1886 succeeded. A somewhat different conception 6i the Sovereign's functions was that of Disraeli's great rival, Gladstone, who, though his respect for the person and office of the Sovereign was unbounded, not only expected all people, the Queen included, to agree with him when he changed his mind, but to become

suddenly enthusiastic about his new ideas. The Queen consequently never felt safe with him. Nor did she like his manner — he spoke to her (she is believed to have said) as if she was a public meeting. The Queeh was opposed to the Disestablishment of the Irish Church (1869; — the question which brought Gladstone to be Premier, and though she yielded with good grace, Gladstone was fretful and astonished because she would not pretend to give a hearty assent to the measure. It happens that this matter of Irish Disestablishment is one of the few political questions in the second half of the Queen's reign in regard to which we have a definite published record of her opinions and actions. The Life, of Archbishop Tait contains a deeply interesting correspondence between the Queesi and the Primate on the line to be taken with regard to the second reading, in the House of Lords, of the Government Bill ; a correspondence which it is im- possible to read without renewed admiration for the political wisdom, as well as the high religious character, of the Sovereign. The Bill had passed the House of Commons ; it seemed certain that the House of Lords would reject it, and the Queen, like the Archbishop, was deeply desirous

~~*that a conflict between the two Houses, resulting in a long and bitter agitation in the country, should not take place upon a religious question. Her Majesty commanded the Archbishop to confer with Glad- stone, with a view to coming to some agreement as to the limits of disendowment ; and then, after a meeting of peers had decided (Lord Salisbury dissenting) to oppose the second reading of the Bill, she endeavoured, through the Archbishop, to modify this decision, and to persuade the Lords to be content with improving the Bill in Com- mittee. Through her secretary, General Grey, the Queen pointed out that she had not concealed from Gladstone " how deeply she deplored " his having felt himself under the necessity of raising the question, and how apprehen- sive she was of the possible consequences of the measure ; but, when a general election had pronounced on the principle, when the Bill had been carried through the House of Commons by unvarying majorities, she did not see what good could be gained by rejecting it in the Lords. Later, when through the skilful diplomacy of the Primate the Lords had passed the second reading by a small but sufficient majority (179 to 146), and after various amendments had been adopted, the Queen herself wrote : —*~~

~~*' ' The Queen ... is very sensible of the prudence and, at the same time, the anxiety for the welfare of the Irish Establishment which the Archbishop has manifested during the course of the debates, and she will be very glad if the amendments which have been adopted at his suggestion lead to a settlement of the ques- tion ; but to effect this, concessions, the Queen believes, will have to be made on both sides. The Queen must say that she cannot view without alarm possible consequences of another year of agitation on the Irish Church, and she would ask the Archbishop seriously to consider, in case the concessions to which the Govern- ment may agree should not go so far as he may himself wish, whether the postponement of the settlement for another year may not be likely to result in worse rather than in better terms for the Church. The Queen trusts, therefore, that the Archbishop will himself consider, and, as far as he can, endeavour to induce the others to consider, any concessions that may be offered by the House of Commons in the most conciliatory spirit."*~~

~~The correspondence of which this letter forms a part is one of the few published witnesses to the Queen's careful and active interest in home politics during the latter half of her reign ; but it is enough to prove how wise, how moderate, and how steeped in the spirit of the Constitution she was ; how she disliked the premature raising of vital issues, and how at the same time she recognized the truth that, when the country had definitely declared its will at a general election, it would be the height of unwisdom not to give effect to that decision.~~

~~Another instance is that of the County Franchise and Bedistribution Bills of 1884-85. There, again, a conflict between the two HOuses was imminent, and the Queen's wish for a settlement had considerable weight in bringing about the curious but effective conference of the two parties, of which the first suggestion, it is believed, was due to Lord Bandolph Churchill.~~

~~Towards the end of 1871 the shadow of a great mis- fortune hung threateningly over the country and the Queen. In November the Prince of Wales was attacked with typhoid fever; on 8th December, Pr>"ceot after making good progress, he had a severe m^ess* relapse, and for many days his life was in immi- nent danger. The blackest moment was just before 14th December, the tenth anniversary of the Prince Consort's death ; but that day the improvement began, and his Boyal HIghness's recovery was assured. The intense excitement and sympathy of the whole people greatly touched the Queen, who gave full expression to her gratitude in a letter to her subjects, written on 26th December. "Their sympathy," she wrote, "has made a deep and lasting impression on her heart which can never be effaced. It is, indeed, nothing new to her, for the Queen had met with just the same sympathy when, just ten years ago,, a similar illness removed from her side the mainstay of her life, the best, wisest, and kindest of husbands." The sympathy thus nobly recognized found extraordinary expression two months later, on 27th February 1872, when the Queen and the Boyal Family went in state to St Paul's to return thanks for the Prince's recovery.~~

~~In 1876 a Bill was introduced into Parliament for con- ferring on the Queen the title of " Empress of India." It met with much opposition, and~~

Disraeli was accused of ministering simply to a whim of "P.m?™™ the Sovereign, whereas, in fact, the title was intended to impress the idea of British suzerainty forcibly upon the minds of the native Princes, and upon the population of Hindustan. The Prince of Wales's voyage to India in the winter of 1875-76 had brought the heir to the throne into personal relationship with the great Indian vassals of the British Crown, and it was felt that a further demonstration of the Queen's interest in her magnificent dependency would confirm their loyalty in face of the many insidious attempts made to subvert it.

The Queen's private life during the decade 1870-80 was one of quiet, broken only by one great sorrow when the Princess Alice died in 1878. In 1867 her Majesty had started in authorship by publishing Private The Early Days of the Prince Consort, com- piled by General Grey ; in 1869 she gave to the world her interesting and simply-written diary entitled Leaves from the Journal of our Life in the Highlands, and in 1874 appeared the first volume of The Life and Letters of the Prince Consort (2nd vol. in 1880) edited by Sir Theodore Martin. A second instalment of the Highland journal appeared in 1885. These literary occupations solaced the hours of a life which was mostly spent in privacy, although the Queen regularly transacted all the State business incumbent on her, and on occasions appeared in public ceremonies or inaugurated institutions of public usefulness. A few trips to the Continent, in which the Queen was always accompanied by her youngest daughter, the Princess Beatrice, brought a little variety into the home-life, and aided much in keeping up the good health which the Queen enjoyed almost uninter- ruptedly. So far as public ceremonies were concerned, the Prince and Princess of Wales were now coming for- ward more and more to represent the Royal Family. People noticed meanwhile that the Queen had taken a

great affection for her Scottish manservant, John Brown, who had been in her service since 1849; she made him her constant personal attendant,

and looked on him more as a friend than as servant. When he died in 1883 the Queen's grief was intense.

From 1880 onwards Ireland almost monopolized the field of domestic politics. The Queen felt great personal reluctance to sanction Gladstone's Home Kule policy ; but she observed in public a constitutional reticence on the subject. In the year, however, of the Crimes Act, 1887, an event took place which was of more intimate personal concern to the Queen, and of more attractive

import to the country and the Empire at large. Jubilee June 20th was the fiftieth anniversary of

her Majesty's accession to the throne, and on the following day, for the second time in English history, a great Jubilee celebration was held to commemorate so happy an event. Eelieved from the danger of a break- up of the United Kingdom, favoured by a summer of the most exceptional brilliancy and beauty, encouraged by the state of general peace which prevailed over the world, the country threw itself into the celebration with unchecked enthusiasm ; large sums of money were everywhere sub-scribed ; in every city, town, and village something was done both in the way of rejoicing and in the way of establishing some permanent memorial of the event. In London the day itself was kept by a solemn service in Westminster Abbey, to which the Queen went in state, surrounded by the most brilliant, royal, and princely escort that had ever accompanied a British Sovereign, and cheered on her way by the applauseof hundreds of thousands of her subjects. Around her carriage rode her sons and sons-in-law, and some of her grandsons, conspicuous among them being the noble figure of the ill-fated Crown Prince, afterwards the Emperor Frederick, with his son, after- wards the Emperor William II. Waiting to receive her Majesty in the Abbey were the ambassadors and ministers of all nations, the peers and the peeresses, the members of the House of Commons, the judges, the most dis- tinguished officers of both services, and a multitude of all that was eminent in every branch of the national life, while grouped together and gazed upon by every eye stood a representative body of the Indian princes. In one of those touching letters

~~to the nation which she wrote so naturally and so well the Queen three days afterwards addressed the Home Secretary : —~~

~~"WrrosoR Oastle, 2ith June.~~

~~" I am anxious to express to my people my -warm thanks for the kind, and more than kind, reception I met with on going to, and returning from, Westminster Abbey, with all my children and grandchildren. The enthusiastic reception I met with then, as well as on all these eventful days, in London as well as in Windsor, on the occasion of my Jubilee, has touched me most deeply. It has shown that the labour and anxiety of fifty long years, twenty-two of which I spent in unclouded happiness shared and cheered by my beloved husband, while an equal number were full of sorrows and trials, borne without his sheltering arm and wise help, have been appreciated by my . people. This feeling and the sense of duty towards my dear country and subjects, who are so insepar- ably bound up with my life, will encourage me in my task, often a very difficult and arduous one, during the remainder of my life. The wonderful order preserved on this occasion and the good behaviour of the enormous multitudes assembled merits my highest admiration. That God may protect and abundantly "bless my country is my fervent prayer. Victoria, K. and I."~~

~~The public ceremonials connected with the Jubilee were not, of course, confined to the Thanksgiving Service, nor did her Majesty limit her personal exertions to this one public appearance and to the entertainment of her Boyal guests at Buckingham Palace and Windsor. The Queen had already paid a memorable visit to the East End, when she opened the People's Palace on 14th May.~~

~~On 2nd July she reviewed at Buckingham Palace some 28,000 Volunteers of London and the home counties. On 4th July she laid the foundation stone of the Imperial Institute, the building at Kensington to which, at the instance of the Prince of Wales, it had been determined to devote the large sum of money collected as a Jubilee offering, and which was opened by the Queen in 1893. On 9th July her Majesty reviewed 60,000 men at Alder- shot ; and, last and chief of all, on 23rd July, one of the most brilliant days of a brilliant summer, she reviewed the Fleet at Spithead.~~

~~Altogether 135 vessels of wr.r were gathered together, including 26 armoured and 9 unarmoured ships, 38 first-class torpedo boats, the same number of gunboats, and 12 troopships, while outside the lines were moored innumerable merchant steamers, yachts, and other vessels of all sorts and sizes, thronged with proud and cheering spectators.~~

~~The year 1888 witnessed two events which greatly affected European history, and in a minor, though still marked, degree the life of the English Court. On 9th March the Emperor William I. died at The Queen Berlin. He was succeeded by his son, the sismarck. Emperor Frederick III., known to all the world as the Crown Prince Fritz, and regarded with special affection in England as the husband of the Princess Boyal. But at the time he was suffering from a malignant disease of the throat, and he died on 15th June, being succeeded by his eldest son, the Emperor William II., the grandson of the Queen. Meanwhile Queen Victoria spent some weeks at Florence at the Villa Palmieri, and returned home by Darmstadt and Berlin. In spite of the illness of the Emperor Frederick a certain numbef of Court festivities were held in her honour, and she had long con- versations with Prince Bismarck, who was deeply im- pressed by her Majesty's personality. Just before, the Prince, who was still Chancellor, had taken a very strong line with regard to a royal marriage in which the Queen was keenly interested — the proposal that Prince Alexander of Battenberg, lately ruler of Bulgaria, and brother of the Queen's son-in-law, Prince Henry, should marry Princess Victoria, the eldest daughter of the Emperor Frederick. Prince Bismarck, who had been anti-Battenberg from the beginning, vehemently opposed this marriage, on the ground that for reasons of State policy it would never do for a daughter of the German Emperor to marry a prince who was personally disliked by the Tsar. This affair caused no little agitation in royal circles, but in the end State reasons were allowed to prevail and the Chancellor had his way.~~

~~The Queen had borne so well the fatigue of the Jubilee that during the succeeding years she was encouraged to make somewhat more frequent appearances among her subjects. In May 1888 she at- tended a performance of Sir Arthur Sullivan's Golden Legend at the Albert Hall, and in August she visited Glasgow to open the magnificent new municipal~~

buildings, remaining for a couple of nights at Blythswood, the seat of Sir Archibald Campbell. Early in 1889 she received at Windsor a special embassy, which, though it attracted comparatively little attention at the time, was the begin- ning of a memorable chapter of English history ■ two Matabele chiefs were sent by King Lobengula to present his respects to the " great White Queen," as to whose very existence, it was said, he had up till that time been sceptical. Soon afterwards her Majesty went to Biarritz, and the occasion was made memorable by a visit which she paid to the Queen-Regent of Spain at San Sebastian, the only visit that an English reigning Sovereign has ever paid' to the Peninsula. On her return home the Queen paid a visit to Sandringham, where Henry Irving and the

Lyceum Company performed before her ; several Jubilee statues were unveiled during this summer by the Prince of Wales ; her Majesty, for the first time for very many years, went to see the procession of boats at Eton on the Fourth of June, and herself distributed the medals at the Koyal Agricultural Show which was held shortly after- wards in Windsor Park. In August she received the visit of her grandson, the new German Emperor, who came, accompanied by his fleet, to the Solent. It was on this occasion that her Majesty appointed William II. an Ad- miral of the Fleet, and in return was made by her grand- son Honorary Colonel of the 1st Dragoon Guards, which were thenceforward to be known as the "Queen of Eng- land's Own."

The relations between the Court and the country formed matter in 1889 for a somewhat sharp discussion in Parlia- ment and in the press. A Royal message was ^entVry brought by Mr W. H. Smith on 2nd July, ex- grant to pressing, on the one hand, the Queen's desire to the Prince provide for Prince Albert Victor of Wales, and, chtUr** S on ^e other, informing the House of the intended marriage of the Prince of Wales's daughter, the Princess Louise, to the Earl (afterwards Duke) of Fife. On

the proposal of Mr Smith, seconded by Gladstone, a Select Committee was appointed to consider these mes- sages and to report to the HOuse as to the existing prac- tice and as to the principles to be adopted for the future. The evidence laid before the Committee explained to the country for the first time the actual state of the royal income, and on the proposal of Gladstone, amending the proposal of the Government, it was proposed to grant a fixed addition of £36,000 per annum to the Prince of Wales, out of which he should be expected to provide for his children without further application to the country. The interesting point in this affair was the divergence of opinion manifested between Gladstone and some of his followers. The ex-Premier, with an experience of nearly sixty years of public life, came forward as a strong advo- cate for granting an ample, though not extravagant, allowance to the Royal Family, whereas not only Mr Bradlaugh and Mr Labouchere, but even Mr Morley, who moved an amendment to Mr Smith's resolution for pay- ment of the proposed sum, took a distinctly opposite view. The amendment was rejected by 355 to 134, and effect was given to it in a Bill called " The- Prince of Wales's Children's Bill," which was carried in spite of the per- sistent opposition of a small group of Radical members.

In the spring of 1890 the Queen visited Aix-les-Bains in the hope that the waters of that health resort might alleviate the rheumatism from which she was ' now frequently suffering. She returned as usual by way of Darmstadt, and shortly after her arrival at Windsor paid a visit to Baron E'erdinand Rothschild at Waddesdon Manor. The following year was one of great personal activity on the part of the Queen. In February she launched the battleship Royal Sovereign at Portsm outh ; a week later she visited the HOrse Show at Islington. HEr annual spring visit to the South was this year paid to the little town of Grasse, which lies a few miles inland, to the left of the railway between Toulon and Cannes. Returning much benefited, the Queen, for the first time since the death of the Prince Consort, commanded a dramatic performance at Windsor Castle, and The Gondo- liers was played in the Waterloo Gallery, the first of many similar performances at Windsor and Balmoral. A short time afterwards her Majesty paid a state visit to Derby, and opened a new hospital there.

At the beginning of 1892 a heavy blow fell upon the Queen, the Royal Family, and the country in the death of Prince Albert Victor, Duke of Clarence and Avondale.

The eldest son of the Prince and Princess of Wales

had never been of a robust constitution, and when he

was attacked by influenza, at that time so „ ,..

i -.. i . Death

prevalent, he made little resistance, pneumonia ofthe

supervened, and after a little more than a week's Duke of illness he died at Sandringham. The Queen c,arence- (whose motherly private letters to one sorrowing subject or another at various times endeared her more and more to all) addressed her people through the HIome Secretary in a touching letter, expressing the feelings of profound grief which the loss of the young and amiable Prince had caused to her. Only a short time before it had been an- nounced that the Prince was about to marry his seco.nd cousin, Princess May, daughter of the Duke and Duchess of Teck ; and the pathos of the Prince's loss was increased by the thought of the ruin of this new hope : —

"Osborne, 26th January 1892.

" I must once again give expression to my deep sense of the loyalty and affectionate sympathy evinced by my subjects in eveiy part of my Empire on an occasion more sad and tragical than any but one which has befallen me and mine as well as the nation. The over- whelming misfortune of my dearly-loved grandson having been thus suddenly cut off in the flower of his age, full of promise for the future, amiable and gentle, and endearing himself to all, ren- ders it hard for his sorely-stricken parents, his dear young bride, and his fend grandmother to bow in submission to the inscrutable decrees of Providence. The sympathy of millions, which has been so touchingly and visibly expressed, is deeply gratifying at such a time, and I wish, both in my own name and that of my

children, to express, from my heart, my warm gratitude to all. These testi-monies of sympathy with us, and appreciation of my dear grand- son, whom I loved as a son, and whose devotion to me was as great as that of - a son, will be a help and consolation to me and mine in our affliction. My bereavements during the last thirty years of my reign have indeed been heavy. Though the labours, anxieties, and responsibilities inseparable from my position have been great, yet it is my earnest prayer that God may continue to give me health and strength to work for the good and happiness of my dear country and Empire while life lasts. Victoria, R.I."

The death of the young Prince threw a gloom over the country, and caused the Royal Family to spend the year in such retirement as was possible. Her Majesty had already begun to pay annual visits to a warmer clime ; this year it was Costebelle, a suburb of Hyeres, in the south of France, that was her choice. In this sunny region she passed some quiet weeks and returned refreshed to take up her life of unobtrusive work.

In 1893 the country, on the expiration of the royal mourning, began to take a more than usual interest in the affairs of the Royal Family. On. 19th February the Queen left home for a first visit to Florence, and spent many delightful weeks in the Villa Palmieri. She was able to display remarkable energy in visiting the sights of this famous city, and even went as far afield as San Gimignano ; and her visit had a notable effect in strengthening the bonds of friendship between the United Kingdom and the Italian people. On 28th April her Majesty arrived home, and a few days later the Duke of York, who by his brother's death had been left in the direct line of succession to the throne, was betrothed to the Princess May, the marriage being celebrated on 6th July in the Chapel Royal of St James's Palace.

In 1894 the Queen stayed for some weeks at Florence, and on her return she stopped at Coburg to witness the marriage between two of her grandchildren, the Grand Duke of Hesse and the Princess Victoria Melita of Coburg. On the next day the Emperor William officially announced the betrothal of the Cesarevitch (after- wards the Tsar Nicolas II.) to the Grand Duchess Alix of Hesse, a granddaughter whom her Majesty had always regarded with special affection. After a few weeks in London her

~~Majesty went northwards and stopped at Manchester, where she opened the Ship Canal. Two days~~

~~1893.~~

~~1894.~~

~~VICTORIA, QUEEN~~

~~683~~

~~afterwards she celebrated her seventy-fifth birthday in quiet at Balmoral. A month later (June 23) took place the birth of a son to the Duke and Duchess of York, the child receiving the thoroughly English name of Edward.~~

~~In 1895 the Queen lost her faithful and most efficient private secretary, General Sir Henry Ponsonby, who for Death of many years had helped her in the management Prince of her most private affairs and had acted as an~~

~~Henry of intermediary between her and her Ministers Battenberg. w^ sjngUiar abiHty and success. His succes- sor was Sir Arthur Bigge. The following year, 1896, was marked by a loss which touched the Queen even more nearly and more personally. At his own urgent request Prince Henry of Battenberg, the Queen's son-in-law, who belonged to a fighting family, and who had a natural desire to see some form of life a little more adventurous than what can be afforded by the luxurious monotony of a Court, was permitted to join the Ashanti expedition, and early in January the Prince was struck down with fever. He was brought to the coast and put on board her Majesty's ship Blonde, where, on the 20th, he died. The news came as a terrible shock to the Queen and to the Princess Beatrice ; and, writing to the Home Secretary a few weeks later, her Majesty expressed her sense of loss in terms of touching sincerity. " This new sorrow," she wrote, "is overwhelming, and to me is a double one, for I lose a dearly-loved and helpful son, whose presence was like bright sunshine in my home, and my dear daughter loses a noble, devoted husband, to whom she was united by the closest affection."~~

~~In September 1896 the Queen's reign had reached a point at which it exceeded in length that of any other~~

~~English sovereign ; but by her special request Tbe all public celebrations of the fact were deferred~~

~~Jubilee until the following June, which marked the~~

~~completion of sixty years from her accession. As the time drew on it was obvious that the celebrations of this Diamond Jubilee, as it was popularly called, would exceed in magnificence those of the Jubilee of 1887. Mr Chamberlain, the Secretary for the Colonies, induced his colleagues to seize the opportunity of making the Jubilee a festival of the British empire. Accordingly, the Prime Ministers of all the self-governing colonies, with their families, were invited to come to London as the guests of the country to take part in the Jubilee pro- cession ; and drafts of the troops from every British colony and .dependency were brought home for the same purpose. The procession was, in the strictest sense of the term, unique. Here was a display, not only of Englishmen, Scotsmen, Irishmen, Welshmen, but of Mounted Bines from Victoria and New South Wales, from the Cape and from Natal, and from the Dominion of Canada. Here were Hausas from the Niger and the Gold Coast, coloured men from the West India regiments, zaptiehs from Cyprus, Chinamen from Hong Kong, and Dyaks — now civilized into military police — from British North Borneo. Here, most brilliant sight of all, were the Imperial Service troops, sent by the native Princes of India; while the detachments of Sikhs who marched earlier in the pro- cession received their full meed of admiration and applause. The route taken was from Buckingham Palace, along Constitution Hill, Piccadilly, St James's Street, Pall Mall, and the Strand to St Paul's Cathedral, where the procession halted while a short service was held on the steps, the Queen not leaving her carriage on account of her lameness. Thence her Majesty proceeded to the Mansion House, where she received an address, and then — the great novelty of the day — -crossed London Bridge, traversed South London amid crowds as great and~~

~~enthusiastic as those which thronged the West End, and returned home by way of Westminster Bridge and St James's Park. Altogether the Queen~~

was in her carriage for more than four hours, in itself an extraordinary physical feat for a woman of seventy-eight. Her own feelings were shown by the simple but significant message she sent to her people throughout the world : " From my heart I thank my beloved people. May God bless them." Some time later her Majesty gave a garden party at Buckingham Palace, and held numerous receptions at Windsor, including that of the Colonial troops and that of the members of the House of Commons and their wives. The illuminations in London and the great provincial towns were magnificent, and all the hills from Ben Nevis to the South Downs were crowned with bonfires. The Queen herself held a great review at Aldershot ; but a much more significant display was the review by the Prince of Wales of the Fleet at Spithead on Saturday, 26th June. No less than 165 vessels of all classes were drawn up in four lines, extending altogether to a length of 30 miles ; opposite were arrayed representative war- vessels from many foreign States, while a line of merchant steamers and scores of other steamers and yachts, crowded with guests, gave colour and at times movement to the scene. People learned, with something like amazement, that the vast fleet of modern vessels there assembled was drawn from home waters only ; and that with no difficulty it had been manned with 40,000 officers and men, only a very few of whom were drawn from the Naval Reserve.

The two years that followed the Diamond Jubilee were, as regards the Queen, comparatively uneventful. Her health remained good, and her visit to Cimiez in the spring of 1898 was as enjoyable and as beneficial as before. In May 1899, after another strengthening visit to the Riviera, her Majesty performed what proved to be her last ceremonial function in London ; she proceeded in " semi-state " to South Kensington, and laid the founda- tion stone of the new buildings completing the Museum — henceforth to be called the Victoria and Albert Museum — which had been planned more than forty years before by the Prince Consort.

Griefs and anxieties encompassed the Queen during the last year of her life. But if the South African war proved more serious than had been anticipated, it did more to weld the empire together than years rbe of peaceful progress might have accomplished. /ast y^ft The Queen's frequent messages of thanks and greeting to her colonies and to the

troops sent by them, and her reception of the latter at Windsor, gave evidence of the heartfelt joy with which she saw the sons of the empire giving their lives for the defence of its 'integrity ; and the satisfaction which she showed in the Federation of the Australian colonies was no less keen. The reverses of the first part of the Boer campaign, together with the loss of so many of her officers and soldiers, caused no small part of that " great strain " of which the Court Circular spoke in the ominous words which first told her Majesty's subjects that she was seriously ill. But the Queen faced the new situation with her usual courage, devotion, and strength of will. She reviewed the depart- ing regiments ; she entertained the wives and children of the Windsor soldiers who had gone to the war ; she showed by frequent messages her watchful interest in the course of the campaign and in the efforts which were being made throughout the whole empire ; and her Christmas gift of a box of chocolate to every soldier in South Africa was a touching proof of her sympathy and interest. She relinquished her annual holiday on the Riviera, feeling that at such a time she ought not to leave her country. Entirely on her own initiative, and

moved by admiration for the fine achievements of "her brave Irish " during the war, the Queen announced her intention of paying a long visit to Dublin ; and there, accordingly, she went for the month of April 1889, staying in the Viceregal Lodge, receiving many of the leaders of Irish society, inspecting some 50,000 school children from all parts of Ireland, and taking many a drive amid the charming scenery of the neighbourhood of Dublin. She went even further than this attempt to conciliate Irish feeling, and to show her recognition of the gallantry of the Irish soldiers she issued an order for them to wear the shamrock on St Patrick's Day, and for a new regiment of Irish Guards to be constituted.

In the previous November the Queen had had the pleasure of receiving, on a private visit, her grandson, the German Emperor, who came accompanied by the Empress and by two of their sons. HIs Foreign Minister, Count von Biilow, was with him ; there were long interviews

~~with Mr Balfour and Mr Chamberlain ; and there was a rapid visit to Sandringham, where Bishop Creighton preached a strong sermon on the need of a good understanding between the United Kingdom and Germany ; to which the Emperor replied, "You are preaching a doctrine which I am endeavouring with all my strength to impress upon my people." This visit of her grandson cheered the Queen, and the successes of the army which followed the arrival of Lord Roberts in Africa occasioned great joy to her, as she testified by many published messages. But in- dependently of the public anxieties of the war, and of those aroused by the violent and unexpected outbreak of fanaticism in China, the year brought deep private griefs to the Queen. In 1899 her grandson, the Hereditary Prince of Coburg, had succumbed to phthisis, and in 1900 his father, the Duke of Coburg, the Queen's second son, previously known as the Duke of Edinburgh, also died (July 30). Then Prince Christian Victor, the Queen's grandson, fell a victim to enteric fever at Pretoria ; and during the autumn it came to be known that the Empress Frederick, the Queen's eldest daughter, was very seriously ill. Moreover, just at the end of the year a loss which greatly shocked and grieved the Queen was experienced in the sudden death, at Windsor Castle, of the Dowager Lady Churchill, one of her Majesty's oldest and most intimate friends. These losses told upon the Queen at her advanced age. Throughout her life she had enjoyed excellent health, and even in the last few years the only marks of age were rheumatic stiffness of the joints, which prevented walking, and a diminished power of eyesight. In the autumn of 1900, however, her health began definitely to fail, and though arrangements were made for Death another holiday in the South, it was plain that Queen. ner strength was seriously affected. Still she continued the ordinary routine of her duties and occupations. Before Christmas she made her usual journey to Osborne, and there on 2nd January she received Lord Roberts on his return from South Africa and handed to him the insignia of the Garter. A fortnight later she commanded a second visit from the Field-Marshal ; she continued to transact business, and until a week before her death she still took her daily drive. -A sudden loss of power then supervened, and on Friday evening, 18th January, the Court Circular published an authoritative announcement of her illness. On Tuesday, 22nd January 1901, she died.'~~

Queen Victoria was a ruler of a new type. When she ascended the throne the popular faith in kings and queens was on the decline. She revived that faith ; she con- solidated her throne ; she not only captivated the affections of the multitude, but won the respect of thoughtful men ; and all this she achieved by methods which to her

predecessors would have seemed impracticable — methods which it required no less shrewdness to discover than force of character and honesty of heart to adopt stead- fastly. The Queen was no woman of placid temperament who could remain indifferent to public affairs so long as her domestic concerns were not interfered with. To imagine that she divested herself of all responsibilities and secured to herself a peaceful life by doing, without reflection, whatever her Ministers advised, would be absolutely to misunderstand her intelligent, sensitive nature, and to ascribe grand results to very petty causes. Whilst all who approached the Queen bore witness to her candour and reasonableness in relation to her Ministers, all likewise proclaimed how anxiously she considered advice that was submitted to her before letting herself be per- suaded that she must accept it for the good of her people. By thus acting she put statesmen on their mettle, raised the level of public morality, and laid down the lines of action for a modern constitutional ruler.

Though richly endowed with saving common-sense, the Queen was not specially remarkable for high development of any specialized intellectual force. Her whole life, public and private, was an abiding lesson in the para- mount importance of character. John Bright said of her that what specially struck him was her absolute truth- fulness. For nearly sixty-four years she watched, at first diffidently, later with ever-maturing experience, but always with insight, sympathy, and genuine patriotism, over the developments of national policy. The condition of Europe when she ascended the throne was one of extreme in- stability. A few years later it became one of turmoil and confusion, in which dynasties were overthrown and high potentates had to flee their countries for asylum elsewhere. That the British throne came through that troublous time unscathed, and even with added prestige, must be ascribed in no small measure to the character of its occupant. The extent of her family connexions, and the corre- spondence she maintained with foreign

sovereigns, together with the confidence inspired by her personal character, often enabled her to smooth the rugged places of international relations ; and she gradually became in later years the Mother of her people, and the link between all parts of a democratic empire, the citizens of which felt a passionate loyalty for their venerable Queen.

By her long reign and unblemished record her name had become associated inseparably with British institutions and British solidarity. Her own life was by choice, and as far as her position would admit, one of almost austere simplicity and homeliness ; and her subjects were proud of a Royalty which involved none of the mischiefs of caprice or ostentation, but set an example alike of motherly sympathy and of queenly dignity. She was mourned at her death not by her own country only, nor even by all English-speaking people, but by the whole world. The funeral in London on 1st and 2nd February, including first the passage of the coffin from the Isle of Wight to Gosport between lines of warships, and secondly a military procession from London to Windsor, was a memorable solemnity ; from beginning to end there was no false note, but a simple and serious realization that the greatest of English sovereigns, whose name would in history mark an age, had gone to her rest.

Tli ere is u, good bibliographical note at the end of Mr Sidney Loe's article in the National Dictionary of Biography. Sec also the full biography published by The Timzs, from which the above has been condensed, modified, and adapted.

Victoria, a state of the Commonwealth of Australia. The first discoverer of Victoria was Captain Cook, in command of H.M.S. Endeavour, who sighted Cape Everard, about half-way between Cape Howe and the

mouth of the Snowy river, on 19th April 1770, a few days prior to his arrival at Botany Bay. The first persons to land in Victoria were the supercargo and a portion of the crew of the merchant ship Sydney Cove which was wrecked at the Furneaux Islands in Bass Strait on 9th

February 1797. In the same year, Mr Bass, a surgeon in the navy, discovered the strait which bears his name and separates Victoria from Tasmania. Lieutenant Grant in the Lady Nelson surveyed the south coast in 1800, and in 1801 Port Phillip was for the first time entered by Lieutenant Murray. In 1802 that harbour was surveyed by Captain Flinders, and in the same year Mr Grimes, the surveyor-general of New South Wales, explored the country in the neighbourhood of the present site of Melbourne. In 1804 Lieutenant colonel Collins, who had been sent from England, formed a penal settlement on the shores of Port Phillip, but after remaining a little more than three months near Indented Head, he removed his party to Van Diemen Land. Victoria was visited in 1824 by two sheep farmers named Hume and Ho veil, who rode overland from Lake George, New South Wales, to the shores of Corio Bay. In 1826 a convict ory' establishment was attempted by the Government of New South Wales at Settlement Point, near French Island, Western Port Bay, but it was abandoned shortly afterwards. In 1834 Messrs Edward and Francis Henty, who had taken part in the original expedition to Swan Biver, West Australia, and afterwards migrated to Van Diemen Land, crossed Bass Strait, established a shore whaling station at Portland Bay, and formed sheep and cattle stations on the river Wannon and Wando rivulet, near the site of the present towns of Merino, Casterton, and Coleraine. In 1835 a number of flock owners in Van Diemen Land purchased through Batman from the aborigines, a tract of 700,000 acres on the shores of Port Phillip. The sale was repudiated by the British Government, which regarded all unoccupied land in any part of Australia as the property of the Crown, and did not recognize the title of the aborigines. Batman, however, remained at Port Phillip, and com menced farming within the boundaries of the present city of Melbourne. He was followed by John Pascoe Fawkner and other settlers from Van Diemen Land, who occupied the fertile plains of the new territory. In 1836 Captain Lonsdale was sent to Melbourne by the. Government of New South Wales to act as resident magistrate in Port Phillip. The first census taken in 1838 showed that the population was 3511, of whom 3080 were males and 431 females. In 1839 Mr Latrobe was appointed superintendent of Port Phillip, and a resident judge was nominated for Melbourne, with jurisdiction over the territory which now forms the state of Victoria. The years 1840 and 1841 were periods of depression owing to

the decline in the value of all descriptions of live stock, for which the first settlers had paid high prices, but there was a steady immigration from Great Britain of men with means, attracted by the profits of sheep-farming, and of labourers and artisans who obtained free passages under the pro- visions of the Wakefield system, under which half the proceeds from the sale and occupation of Crown lands were expended upon the introduction of workers. The whole district was occupied by sheep and cattle graziers, and in 1841 the population had increased to 11,738. Melbourne was incorporated as a town in 1842, and was raised to the dignity of a city in 1847. In that same year the first Anglican was ordained, and in 1848 the first Roman Catholic bishop. The third census (taken in 1846) showed a population of 32,870.

The elective element was introduced into the Legislative

Council of South Wales in 1842, in the proportion of twenty-four members to twelve nominated by the Crown, and the district of Port Phillip, including Melbourne, re- turned six members. But the colonists were not satisfied with government from and by Sydney; an agitation in favour of separation commenced, and in 1851 Victoria was formed . into a separate colony with an Executive Council appointed by the Crown, and a Legislative Council, partly elective and partly nominated, on the same lines as that of New South W^les. The population at that date was 77,435. Gold was discovered a few weeks after the colony had entered upon its separate existence, and a large number of persons were attracted to the mines, first from the neighbouring colonies — some of which, such as South Australia, Van Diemen Land, and West Australia, were almost denuded of able-bodied men and women — and subsequently from Europe and America. Notwithstanding the difficulties with which the local government had to contend, the task of main- taining law and order was fairly grappled with ; the foundations of a liberal system of primary, secondary, and university education were laid ; roads, bridges, and tele- graphs were constructed, and Melbourne was provided with an excellent supply of water.

Local self-government was introduced in 1853, and the Legislature found time to discuss a new Constitution, which not only eliminated the

nominee element from the Legislature, but made the executive Local sen-government responsible to the people. The jj^™" administration of the gold-fields was not popular, and the miners were dissatisfied at the amount charged for permission to mine for gold, and at there being no representation for the gold-fields in the local Legislature. The discontent culminated at Ballarat in December 1854, in riots in which there was a considerable loss of life both amongst the miners and the troops. Eventually, an export duty on gold was substituted for the licence fee, but every miner had to take out a right which enabled him to occupy a limited area of land for mining, and also for residence. The census taken in 1854 showed a population of 236,778. The new Constitution was pro- claimed in 1855, and the old Executive Council was gazetted as the first responsible ministry. It held office for about sixteen months, and was succeeded by an administration formed from the popular party. Several changes were made in the direction of democratizing the Government, and vote by ballot, manhood suffrage, and the abolition of the property qualification followed each other in rapid succession. To several of these changes there was strenuous opposition, not so much in the Assembly which represented the manhood, as in the Council in which the property of the colony was supreme. The Crown lands were occupied by graziers, termed locally " squatters," who held them under a licence renewable annually at a low rental. These licences were very valu- able, and the goodwill of a grazing farm or " run " com- manded a high price. Persons who desired to acquire freeholds for the purpose' of tillage could only do so by purchasing the land at auction, and the local squatters, unwilling to be deprived of any portion of a valuable property, were generally willing to pay a price per acre with which no person of small means desirous of em- barking upon agricultural pursuits could compete. The result was that although the population had increased in 1861 to 540,322, the area of land under crop had not grown proportionately, and Victoria was dependent upon the neighbouring colonies and even more distant countries for a considerable portion of its food. A series of Land Acts was passed, the first in I860, with the view of encouraging a class of small freeholders. The principle

underlying all these laws was that residence by land- owners on their farms, and their cultivation, were more important to the state than the sum realized by the sale of the land. The policy was only partially successful, and by a number of ingenious evasions, a large proportion of the best land in the colony passed into the possession of the original squatters. But a sufficient proportion was purchased by small farmers to convert Victoria into a great agricultural country, and to enable it to export large quantities of farm ajid dairy produce.

The greater portion of the revenue was raised by the taxation through the customs of a small number of pro- ducts, such as spirits, tobacco, wine, tea, coffee, &c. But an agitation arose in favour of such an adjustment of the : import duties as would protect the manufactures which at that time were being commenced. A determined opposi- tion to this policy was made by a large minority in the Assembly, and by a large majority in the Council, but by degrees the democratic party triumphed. The1victory was not gained without a number of political crises which shook the whole fabric of society to its foundations. The Assembly tacked the tariff to the Appropriation Bill, and the Council threw out both. The result was that there was no legal means of paying either the civil servants or the contractors, and the Government had recourse to an ingenious though questionable system by which advances were made by a bank which was recouped through the Crown "confessing" that it owed the money, whereupon the Governor issued his warrant for its payment with- out any recourse to Parliament. Similar opposition was made by the Council to payment of members, and to a grant made to Lady Darling, the wife of Governor Sir Charles Darling, who had been recalled by the Secretary of State on the charge of having shown partiality to the democratic party. Indeed on one occasion the dispute between the Government aud the Council was so violent,1 that the former dismissed all the police, magistrates, county court judges, and other high officials, on the ground that no provision had been made by the Council, which had thrown out the Appropriation Bill, for the payment of salaries.

Notwithstanding these political struggles the popula- tion of the colony steadily increased, and the Legislature found time to pass some measures which affected the social life and the commercial position of the dolonies. State aid to religion was abolished and divorce was made comparatively easy. A system of free, compulsory, and secular primary education was introduced. The import duties were increased and the transfer of land was simpli- fied. In 1880 a fortnightly mail service vid Suez between England and Melbourne was introduced, and in 1880 the first International Exhibition ever held in Victoria was opened. In the following year the census showed a population of 862,346, of whom 452,083 were males, and 410,263 females. During the same year the lengthy dispute between the two Houses of Parliament, which had caused so much inconvenience, so many heartburnings, and so many political crises, was brought to an end by the passage of an Act which reduced the qualifications for members and . the election of the Legislative Council, shortened the tenure of their seats, increased the number of provinces to fourteen, and the number of members to forty-two. In 1883 a coalition Government, in which the Liberal or protectionist, and the Conservative or free-trade party were represented, took office, and with some changes remained in power for seven years. During this political truce several important changes were made in the Con- stitution. An Act for giving greater facilities for divorce was passed, and with some difficulty obtained the royal assent. The Victorian railways were handed over to the

control of three commissioners, who to a considerable extent were made independent of the Government, and the civil service was placed under the supervision of an independent board. In 1887 the representatives of Victoria met those of the other British colonies and of the United Kingdom in London, under the presidency of Lord Knutsfordj in order to discuss the questions of de- fence, postal and telegraphic communication, and the con- tribution of Australia to the Imperial navy. In 1888 a weekly mail service was established vid Suez by the steamers of the P. & 0. and the Orient Company, and the second Victorian International Exhibition was opened. In 1890 all the Australian colonies, including New South Wales and New Zealand, sent representatives to a con- ference at Melbourne, at which resolutions were passed in favour of the establishment of a National Australian Convention empowered to

consider and report upon an adequate scheme for the Federal Constitution. This Convention met in Sydney in 1891 and took the first step towards federation (see Austealia).

In 1891 the coalition Government resigned and a Liberal administration was formed. An Act passed in that year placed the railways again under the control of the Government. Measures of a democratic and collectivist tendency have since obtained the assent of the Legislature. The franchise of property-holders not resident in an electorate was abolished and the principle of " one man one vote " was established. Acts have been passed sanctioning Old Age Pensions ; prohibiting shops, except those selling perishable goods, from keeping open more than eight hours ; compelling the proprietors to give their assistants one half-holiday every six days ; preventing persons from working more than forty-eight hours a week ; and appointing for each trade a tribunal composed of an equal number of employers and employed to fix a minimum wage.

Victoria enjoyed a large measure of prosperity during the later 'eighties and earlier 'nineties, and its financial prosperity enabled the Government to expend large sums in extending railway communication to almost every locality and to commence a system of irrigation. The soil of Victoria is on the whole more fertile than in any other colony on the mainland of Australia, and in no por- tion of the continent is there any locality equal in fertility to the western district and some parts of Gippsland. The rainfall is more equable than in any portion of Australia, but the northern and north-western districts, which are the most remote from the sea and the Dividing Range, are subject to droughts which, although not so severe or so frequent as in the interior of the continent, are sufficiently disastrous in their effects. The results of the expenditure upon irrigation have not been so successful as was hoped. Victoria has no mountains covered with snow, which in Italy and South America supply with water the rivers at the season of the year when the land needs irrigation, and it was necessary to construct large and expensive reservoirs. The cost of water is therefore greater than the ordinary agriculturist who grows grain or breeds and fattens stock can afford to pay, although the price may not be too high for orchardists and vine-growers. In 1892 the prosperity of the colony was checked by a great strike which for some months affected

production, but speculation in land continued for some time longer, especially in Melbourne, which at that fg/iS time contained nearly half the population, 500,000 out of a total of 1,140,105. There does not seem to have been any other reasons for this increase in land values for there was no immigration, and the value of every description of produce had fallen — except that the working-classes were prosperous and well paid, and

that the purchase of small allotments in the suburbs was a popular mode of investment. In 1893 there was a collapse. The value of land declined enormously, hun- dreds of persons believed to be wealthy were ruined, and there was a, financial panic which caused the suspension of all the banks, with the exception of the Australasia, the Union of Australia, and the New South Wales. Most of them resumed payment, but three went into liquidation. It was some years before the normal condition of prosperity was restored, but the great resources of the colony and the energy of its people discovered new markets, and new products for them, and enabled them materially to increase the export trade.

Government. — The Constitution of Victoria was estab- lished by an Act passed by the Legislature of the colony in 1854, in pursuance of the power granted by the original Act of the Imperial Parliament. The Legislative authority is vested in a Parliament of two Chambers — the Legis- lative Council, composed of 48 members, and the Legis- lative Assembly, composed of 95 members. According to an Act which came into force in 1881, members of Council must be in possession of an estate of the annual value of £100, and electors must be in possession or occupancy of property of the rateable value of £10 per annum, if derived from freehold, or of £25 if derived from leasehold, or the occupation of rented property. No electoral property qualification is required from graduates of British universities, matriculated students of the Melbourne University, ministers of religion of any denomination, certificated schoolmasters, lawyers, medical practitioners, and officers of the army and navy. One-third of the members of Council must retire every two years. The members of the Assembly are elected by universal suffrage, no

~~*persons being allowed to exercise more than one vote, for the term of three years, but can be dissolved at any time by the Governor in Council. Members of the Legislative Assembly are paid £300 a year. Clergymen of any religious denomination cannot hold seats in the Council or Assembly. (g. o. l.)*~~

~~*As regards population, Victoria maintained the leading position among the Australasian colonies until the end of the year 1891, when New South Wales overtook it. The population at the opening of 1902 was 1,208,700, the proportion of the sexes being nearly equal. In 1860 the population numbered 537,847; in 1870, 726,599; in 1880, 860,067; and in 1890, 1,133,266. The state has gained little, if anything, by immigration during these forty years, for the ejccess of immigration over emigration from 1861 to 1870, and from 1881 to 1890, was counterbalanced by the excess of departures during the period 1871 to 1880, and from 1891 to 1902. The births in 1901 numbered 31,008, and the deaths 15,904, representing respectively 25 '78, and 13 '22 per 1000 of the population. The birth-rate has fallen markedly since 1875, as the following statement of the averages arranged in quinquennial periods shows : —*~~

~~*Popula- tion.*~~

~~*Period.*~~

~~*Births per 1000 of Population.*~~

~~*Period.*~~

~~*Births per 1000 of Population.*~~

~~*1861-65 1866-70 1871-75 1876-80*~~

~~*43-30 39-27 35-69 31-43*~~

~~*1881-85*~~

~~*1886-90*~~

~~*1891-95*~~

1896-1901

30-76 32-72 31-08 26-20

The number of illegitimate births, calculated for a period of ten years, 1892-1901, represents 5 ‘53 of the total births, the number of illegitimate children born in 1901 being 1729, and the total births in that year 31,008. The death-rate has greatly improved, and now stands a little higher than 13 per 1000. Arranged in quin- .quennial periods the death-rates were :

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Period.

Deaths per 1000 of Population.

Period.

Deaths per 1000 of Population.

1861-65 1866-70 1871-75 1876-80

17-36 16-52 15-64 14-92

1881-85 1887-90 1891-95

1896-1901 „

14-65 16-07 14-10 13-67

Instruc- tion.

The marriages in 1901 numbered 8406, which represents a rate of 6-99 per 1000 persons, and 13-98 persons married. In the five years, 1871-75, the marriage-rate stood at 6‘38 per 1000 ; in 1876-80, 6-02 ; in 1881-85, 7”37 ; in 1886-90, 8-13. Since the period last named, the average has varied between 6 “3 and 6 ‘9 per

1000.

The aborigines number only 643, of whom a large proportion are half-castes and quadroons. Most of them reside in farms called Aboriginal Reserves, set apart in various localities. The chief cities and towns are Melbourne and suburbs, population, 459,500 (1901) ; Ballarat (43,823), Bendigo (30,774), Geelong (18,289), Warmambool (6404), Castlemaine (5703), Maryborough (5622), and Stawell (5318).

The Church of England had 421,723 adherents in 1901 ; the RomanCatholic Church, 261,187; Presbyterians, 175,373; Wesleyan and other Methodists, 155,954 ; Congregationalists, 23,220; Baptists, 29,291; Lutherans, 16,322; Jews, Re"«'on- 6786 ; and the Salvation Army is strongly represented in the state, its Australian headquarters being in Melbourne.

There are 1948 state schools, in which there are 243,667 children enrolled and 4562 teachers. There are also a large number of private schools (884 schools and 2652 teachers in 1901) and about 17 per cent, of the children are taught therein. The total children enrolled in the various schools is 291,817, and the daily attendance is 182,877. The majority of the private schools are connected with one or other of the principal religious denominations, the Roman Catholic Church alone supporting more than 190 schools, with an enrolment of 25, 000 children. The Melbourne University maintains its high position as a teaching body. In 1900 the number of matriculants was 108, of whom 21 were women ; and the graduates were 134, including 15 women. There are 407 public libraries, with about 1,150,000 books. The public library at Melbourne contains about 545,000 volumes. The proportion of men who sign the marriage register with a mark is now not more than 7 per 1000, while the proportion of women is even less. Crime is decreasing, and Victoria ranks with South Australia as having the smallest pro- portion of offenders. In 1900 there were 27,568 persons arrested, which represents about 23 arrests per 1000 inhabitants. The arrests firi drunkenness numbered 15,878. Serious offences have very greatly diminished, as the committals, for trials clearly show. In 1881 the number of arrests was 25,346, the summary convictions 16,448, and the committals for trial 591 ; in 1891 the arrests were 37,309, summary convictions 23,307, and committals 873 ; in 1900 tjie arrests were 27,568, summary convictions 18,384, and

~~committals 575. The population between 1881 and 1900 increased by over one-third, so that the latest figures show a large reduction in crime both trivial and serious.~~

~~Victoria has a complete system of local government, and the finances are not burthened with the cost of local works. The public revenue has not expanded of late years with the population, a circumstance due partly to the operation of high customs duties, and partly to the effect which the fall in prices has- had upon the value of imports ; the value of imports being greatly reduced, the ad valorem duties levied thereon showing a corresponding reduction. The public revenue in five-yearly periods since 1880 was: 1880, £4,621,282; 1885, £6,290,361; 1890, £8,519,159 ; 1895, £6,712,512 ; and 1901, £7,722,397. The sum last mentioned represents £6 10s. 3d. per inhabitant. The present sources of public revenue are : import and excise duties, £1,257,540 ; other taxes, £493,220 ; railway receipts, £3,302,200 ; posts and telegraphs, £625,761 ; public lands, £332,700 ; fees and fines £637,440; other revenue, £1,642,035. Included in this amount is a sum of £1,177,740 representing Commonwealth Balances returned by the Federal Treasurer. The main items of expenditure are working expenses: railways, £1,955,487; posts and telegraphs, £305,787 ; public instruction, £624,187 ; interest and charges on public debt, £1,955,173 ; and other services, £2,802,444. On 30th June 1901 the public debt stood at £55,406,118, equal to £46 5s. Id. per inhabitant. The great bulk of the proceeds of loans was applied to the construction of revenue-yielding works, only about three millions sterling being otherwise used. The state has alienated a little over 23,369,000 acres of the public domain, and has about 9 million acres under lease ; the area neither alienated nor leased amounts to 23, 500, 000 acres. The self-governing districts number 208, and control an area of 87; 322 square miles out of 87,884 square miles, the estimated area of the state. The capital value of properties as returned by the municipalities in 1900, was nearly £169,912,000, and the annual value £10,283,500. These figures are substantially less than in some preceding years. In 1884 the values were 104 millions and £8,099,000, andin 1891, 203 millions and £13,734,000; the year last mentioned marked the highest point of inflation in land values, and during the following years there was a vast re- duction, both in capital and in annual values^, the lowest point, touched being in 1895 ; since 1895 a gradual~~

~~*will continue. The revenues of municipalities are derived chiefly from rates, but the rates are largely supplemented by fees and licences, and contributions for services rendered. Excluding Government endowments and special grants, which at present amount to about £100,000, the revenues of the municipalities in the years named were: 1880, £616,132; 1885, £789,429; 1890, £1,273,855; 1895, £1,038,720; and 1900, £1,036,497. In addition to the municipalities there were other local bodies em- powered to levy rates ; these and their revenues were in 1900 : Melbourne Harbour Trust, £143,362 ; Melbourne and Metropolitan Board of Works, £269,213; and Fire Boards, £18,516. The Board of Works is the authority administering- the metropolitan water and sewerage works. Excluding revenue from services rendered, the amount of taxation levied in Victoria amounted in 1900 to £3,965,699, of which the Government levied £2,984,592, the municipalities £853,322, and the Melbourne Harbour Trust £127,785.*~~

~~*The defence force numbers about 7000 men, of whom 400 are paid and devote their whole time to the services of defence, 3500 partially paid, and 2900 unpaid volunteers. Besides ence. tnesej there are some 300 naval artillery, a force capable of being employed either as a light artillery land force or on board the local war vessels. For harbour defence there are the armoured turret ship, Cerberus, 3480 tons, two first-class, two second-class, and three wooden torpedo boats. Victoria contributes £33,000 towards the maintenance of an auxiliary fleet stationed by the Imperial Government in Australian waters. This fleet consists of five fast cruisers and two torpedo gunboats, and is attached to the command of the admiral of the Australian Naval Station. The total expenditure in 1900 for purposes of defence, was £201,611 from ordinary revenue, and £229 from*~~

loan votes, or in all £201,840, equal to about three shillings per inhabitant.

Minerals. — About 32,000 persons find employment in the gold- fields, and the quantity of gold won in 1900 was 807,407 oz.,

valued at £3,190.940, as against 854,500 oz., valued at Production £33530m in lg99 Thg y^ hag inorease(j con.

^"f siderably of late years, and the return for 1899 was

industry. on^ Qnce exoee(je(i during the preceding twenty-three years. Up to the close of 1900 the total value of gold won from the first discovery in 1851 was £256,984,830. No other . metallic minerals are systematically worked, although many valu- able deposits are known to exist. Brown coal, or lignite, occurs extensively, and attempts have frequently been made to use the mineral for ordinary fuel purposes, but without much success. Black coal is now being raised in increasingly large quantities, and is superseding the New South Wales coal to a certain extent, the exports of which to Victoria having fallen from 954,277 tons in 1894 to 866,895 tons in 1900. The principal collieries are the Outtrim Howitt, the Coal Creek Proprietary, the Jumbunna, and the Korumburra, all in the Gippsland district. The annual production of coal exceeds 260, 000 tons, nearly all of which is locally consumed.

Agriculture. — Judged by the area under tillage, Victoria ranks first among the states of the Australian group. The area under crop in 1901 was 3,810,413 acres, compared with 2,116,000 acres in 1891, and 1,435,000 acres in 1881. Wheat-growing claims the chief attention, 1,754,417 acres being under that cereal in 1901, the area of land devoted to other crops being as follows : maize, 10,020 acres; oats, 329,150 acres; other cereals, 41,548 acres; hay, 659,239 acres; potatoes, 40,058 acres; vines, 28,592 acres; orchards and gardens, 58,807 acres ; and other crops, 888,582 acres, of which 681,816 acres were in fallow when the returns were col- lected. The hay crops are chiefly wheat and oats. Victorian wheat is of exceptionally fine quality, and usually commands a high price in the London market. The average yield per acre is about 8J bushels. The yield of oats is about 20£ bushels per acre, and of barley

about 19 bushels, and of potatoes 3J tons. Great progress has been made in the cultivation of the grape vine, and Victoria now produces about one-third of the wine made in Australia.

Live Stock. — The number of sheep on the 31st March 1901 was 10,841,790. The quality of the sheep is steadily improving, and " Port Phillip " commands a higher price than any other Australian wool in the London market. Systematic attention to stock has brought about an improvement in the weight of the fleece, and careful observations show that between 1861 and 1871 the average weight of wool per sheep increased about one-third ; between 1871 and 1881 about one pound was added to the weight' per fleece, and there has been a further improvement since the year named. The following were the number of sheep depastured at the dates named: 1861,6,240,000; 1871, 10,002,000 ; 1881, 10,267,000; 1891, 12,928,000 ; and 1901, 10,841,790. The horses number 392,237, the swine 350,370, and the horned cattle 1,602,384 ; of these last 521,612 are dairy cows. Butter-making has greatly increased since 1890, and a fairly large export trade has arisen. In 1900 over 55J million lb of butter were made, 4,284,000 lb of cheese, and over 13 million lb of bacon and hams. Victorian dairy produce is of excellent quality.

Manufactures. — There has been a good deal of fluctuation in the amount of employment afforded by the factories, as the following figures show : hands employed, 1885, 49,297 ; 1890, 56.639 ; 1893, 39,473; 1895, 46,095; and 1900, 64,207. Of the hands last named, 45,794 were males, and 18,413 females. The total number of establishments was 3097, and the horse-power of machinery was 43,659, of which 33,410 horse-power was actually used. The value of machinery was returned at £4,711,000, and of land and buildings, £7,184,000. The majority of establishments are small, but there are, nevertheless, some of large size. There were in 1900 153 employing from 50 to 100 hands, and 107 over one hundred hands.

Excluding the coastal trade, the tonnage of vessels entering Victorian ports in 1900 was 2,929,389, or about 2\ tons per inhabi- tant. The imports in the same year were valued at . £18,301,811, and the exports at £17,442,552. These lraae- figures represent £15 6s. 8d. and £14 12s. per inhabitant respec- tively. According to the customs returns the

domestic produce exported was valued in 1900 at £13,918,556 ; in 1891 the value was £13,026,426, and in 1881 £12,480,567. The comparatively small increase over the period named is due mainly to the large fall in prices of the staple articles of local production. There has, however, been some loss of trade due to the action of the New South Wales Government in extending its railways into districts formerly supplied from Melbourne. The principal articles of local production exported during 1900, with their value, were as follows : butter, £1,489,548 ; gold (coined and bullion), £4,122,061 ; wheat, £700,814 ; frozen mutton, £107,747 ; frozen and preserved rabbits and hares, £183,929; sheepskins, £99,735; wool, £3,422,704; horses, £250,385 ; tallow, £172,397 ; oats, £257,899 ; flour, £196,899; hay and chaff, £316,352; leather, £311,239. As the total value of gold won during 1900 was only £3,190,940, part of the gold included in the amount stated in the foregoing list was not of local production, although classified as such. The customs returns show that the value of Victorian produce and manufacture exported in 1900 was £13,918,556, and the re-export trade £3,503,996. It is probable, however, the re-export trade was larger than the figures seem to indicate. The bulk of the trade passes through Melbourne, the imports in 1900 at that port being £15,351,819, and .the exports £16,188,595.

Railways. — The railways have a total length of 3238 miles, and the cost of their construction and equipment, up to 30th June 1901, was £40,145,404; this sum was obtained by raising loans, mostly in London, on the security of the °^man ‘ general revenues of the state. In 1901 the gross ca railway earnings were £3,337,797, and the working expenses £1,984,796, so that the net earnings amounted to £1,353,001, which sum represents a little over 3 per cent, on the capital cost. The gross earnings per train mile were 6s. and the working expenses 3s. 7d. The management of the railways is in the hands of a single commissioner, and, as in New South Wales, all proposals to construct new lines are submitted to a committee selected from both Houses of Parliament. This committee takes evidence as to the suitability of the route proposed for any new line, the probable cost of its construction, and its financial prospects, and according to the weight of the. evidence advises Parliament to adopt or reject the scheme proposed.

Posts and Telegraphs. — Victoria had a length of 6772 miles of telegraph line in operation in 1900 ; there were about 830 stations, and the business done was represented by 1,993,000 telegraphs. The post offices, properly so called, were over 1600 in number, and 66J million letters and postcards, 21 million newspapers, and 11 million packets passed through them. The postal service is carried on at a slight profit, as the revenue in 1900 was £625,761, and the expenditure £608,875. Telephones are widely used; in January 1901 the length of telephone wire in use was 16,750 miles, and the number of telephones 5136, bringing in a revenue of £53,300 per annum.

Melbourne is the headquarters of several of the principal banking companies operating in Australia, and was until recent years, if it be not so still, the financial centre of the colonies. At . .

the end of 1900 the banks of issue had liabilities to the extent of £31,895,571, and assets of £41,755,928. The capital employed by them in their business was, therefore, £9,860,357. The principal items amongst the liabilities were : notes in circula- tion, £963,447; deposits bearing interest, £18,373,300; and deposits not bearing interest, £12,264,985. The chief assets were : com, £7,352,135 ; bullion, £425,721 ; landed property, £2,800,419; notes and bills of other banks, £328,006 ; balances due from other banks, £237,114 ; and advances, discounts, and other debts due to the banks, £30,612,533. The money in deposit in the savings banks amounted to £9,110,793, to the credit of 375,070 depositors. The total sum on deposit in the state was, therefore, £39,749,078.

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VICTORIA— VICTORIA NYANZA

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(t. A. C.)

Victoria, the capital of the province of British Columbia, Canada, situated near the south-east corner of Vancouver Island. Its estimated population is 24,000, comprising a great variety of nationalities, including a large number of Chinese, and a small but increasing pro- portion of Japanese. With the exception of the handsome legislative buildings (opened 1899) and the post office, the city has few buildings of architectural pretensions. The city owns its waterworks and street-lighting plant. There are two hospitals, one managed by the nuns of the Eoman Catholic church, a city isolation hospital, and a marine hospital, supported by the Canadian Government. On otae of the islands of the Strait of Georgia is a leper hospital, the inmates of which are at present exclusively Chinese. There are churches of all denominations in the city, and a number of graded schools. The Japan and China steamers, and those of the Australian line, call at Victoria, and the headquarters of the British Pacific squadron is at Esquimalt, a fine harbour about 3 miles west of Victoria, and connected with it by an electric railway. This harbour, though spacious, is not much used by merchant vessels, being almost entirely a naval port. It is provided with a large dry dock, and is defended by fortifications of modern type. There is a naval hospital and barrack for the garrison. There are daily steamers carrying passengers, mails, &c, between Victoria and the city of Vancouver as well as a daily service to ports on Puget Sound, in the State of Washing son, and a fortnightly steamer to San Francisco. A large part of the goods destined for points in the Yukon Territory, the Atlin district of British Columbia, the northern fishing and mining districts, and the

sparsely settled islands in the Strait are shipped at Victoria. Until recently only ships drawing about 17 feet of water could call, but by the construction of a wharf at the entrance of the harbour, the port has been made available to the largest vessels. A large part of the wholesale business of the province is done in Victoria, and nearly all the principal banks of Canada have branches in the city.

Victoria. Land. See North- West Teeeitoeies.

Victoria Nyanza, the largest lake in Africa, lying between about 0° 25' N. to 3° S. and 31° 5' to 34° 52' E. It is the second in size of the fresh- water lakes of the world, and has probably an area of 25,000 to 26,000 square miles, but as the outline is still imperfectly mapped, no near estimate is yet possible. The most im- portant alteration of its contours is due to the discovery by Stanley in 1889 of a large gulf to the south-west, since named Emin Pasha Gulf, the existence of which had been before masked by the large islands which lie across its mouth. Beyond these it extends some 35 miles to the south. As now delineated the lake has roughly the form of a parallelogram, of which the length is about 200 miles and the average breadth 130 miles, the longer axis running from south-south-west to north-north-east. It is thus found to be somewhat longer and considerably

narrower than had been first supposed, the whole eastern coast having been shifted some 20 miles to the west as compared with Stanley's delineation in 1875. A modi- fication on a point of detail was introduced by the dis- covery in 1892 of an unsuspected bay on this coast in 2° N. It was made by Dr O. Baumann, whose name it has since borne. In the north-east a survey has more recently been carried out by Commander Whitehouse, which has for the first time revealed the true contours of the nearly land-locked Kavirondo Bay, formerly known as Ugowe Bay, the latter name being found to apply more correctly to a smaller bay to the north. The extreme west and east points are now placed in 31° 50' and 34° 52' E. respectively. According to the trigono- metrical survey of Captain G. E. Smith, B..E., the altitude of the lake is 3775 feet.

Victoria Nyanza fills a wide depression in the ex- tensive series of crystalline formations which occupy a large area between the central and

eastern rift valleys. The shores are still imperfectly known, oas s' especially on the east. The irregular northern coasts with the associated islands have been surveyed more or less accurately by officials of the Uganda protectorate, and those to the south (in part) and west (south of V S.) by various German officers and missionaries, especially Captain Herrmann. This officer well describes the general struc- ture of the country bordering the west coast, which is inti- mately connected with the form of the coast-line, here" running in an unusually straight line from north-north- east to south-south-west. The whole region is formed by a succession of elongated blocks (separated by depressions), composed of clay slates and quartzites elevated to a con- siderable height above the granite and gneiss found farther south. The actual coast-line may once have formed a chain of islands at a time when the depression to the west was occupied by the lake water ; while the present line of islands, running parallel to the coast, would eventually form the coast-line were the retreat of the water to be continued. A survey of the island of Ukerewe, which has somewhat modified its outline, has also been made by Captain Herrmann. The island is 25 miles long with a maximum breadth of about 12 miles, and its whole interior consists of a wooded, hilly country, quite uninhabited, rising to a height of 650 feet above the lake. The Sesse archipelago, at the opposite corner of the lake, was in part explored in 1893 by Father Brard, who found that the western half is formed of a single, narrow island of very irregular shape, almost cut in two near the middle at a spot where canoes can be dragged from one shore to the other. The island, like most of the group, has a number of villages, and has for some time been the site of a Catholic mission station, while a Government station (Fort Stanley) has been more recently established. Bukasa, the largest island in the east of the group, has a station of the Church Missionary Society.

The exact part played by Victoria Nyanza in the economy of the Nile is still a matter of discussion, some holding that the lake itself can alone be regarded as the source of the river, while others seek this in one or other of the df^e

head-streams of the Kagera, which enters from the V?.. e west, in 0° 58′ S. The Kagera is by far the largest ™"tem feeder of the lake, and the

mountainous region from which it comes has a ‘ much heavier rainfall than the rest of the catchment area, with the exception of a small district to the north- east, near Mount Elgon. The amount of precipitation over its basin is thus probably greater than that over the whole surface of the lake, which is, besides, counterbalanced by the evaporation from the same. The streams which enter on the south and south- east have been found to be quite insignificant except at the height of the rains, but those from the north-east are of more consequence, the principal being the Mori, which rises in the forests of the Mau plateau, and in its lower course is a copious stream 300 paces wide ; and the Nzoia, which derives its water-supply from the Guas

Fluctua tlons of level.

Political, &c.

Ngishu and Nandi plateaux and the southern slopes of Mount Elgon.

A considerable amount of information has been obtained of late years regarding the fluctuations of the lake level, which seem to be of three if not four distinct kinds. Any secular shrinking of the lake1 in common with the lakes of Central Africa generally must be so gradual as to have no practical importance, but a periodic variation with phases recurring at intervals of eighteen to twenty-five years has ibeen considered probable by some travellers, and would seem to be attributable to variations of rainfall. About 1878-81 the water seems to have been at its highest, but soon afterwards a fall set in which had, however, given place to a renewed rise in 1892. Since this date the movements have been irregular and of no great extent, a low level in 1900 having been followed by a comparatively high one in 1901. The extent of the fluctuation has been variously estimated at from 5 to 10 feet. Besides this, an annual and even a daily fluctuation has been noticed, and observations by which the former of

these may in time be elucidated were inaugurated in 1896 at stations on the north shore of the lake.2 They do not show an entire agreement with variations of rainfall in the districts bordering the lake, nor do the periods of highest and lowest level fall at the same portions of different years. The rain- fall at the sources of the tributary streams of course exercises an influence, as also does the regime of the winds which tend to pile up the water at different parts of the lake. The extreme yearly range observed down to the end of 1900, disregarding one in- fluenced by local causes, was 18 '5 inches, and the greatest difference between the highest and lowest months, 16'4 inches. But between November 1900 and June 1901 a difference of 42 inches was recorded. The winds may also be the cause of the daily variations of level, which on Speke Gulf have been found to reach 20 inches ; but this may also partake of the character of a " seiche. ' ' Currents setting towards the north or north-west have been ob- served in various parts of the lake.

By the Anglo-German agreement of 1890 the shores of the lake were divided between Great Britain and Germany, the boundary cutting the lake on both sides in 1° S. ; and stations have since been established at many points. A small steamer (the Ruwenzori) was launched on the lake by a Zanzibar firm in 1896, and has since done much service ; while in 1 900 a steamer (the William Mackinnon) built in Glasgow at the instance of Sir W. Mackinnon, and afterwards taken over by Government, made her first trip on the lake. There are also two small launches, one belonging to the German administration, the other to that of Uganda. The chief trade on the lake is, how- ever, still done by dhows, which bring goods from German territory to Uganda across the lake.

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*Vienna. (German, Wien), the capital of Austria, or (to use the correct official title) " the kingdoms and countries represented in the Reichsrath," and the largest city of Austria-Hungary. By the removal of the second or outer girdle of fortifications, which formed the boundary for the city imposts, and the incorporation in 1891, either wholly or in part, of about fifty suburban districts, the area of Vienna was more than trebled (from '21 *- to 69 English square miles) while over half a million was added to the population. The number of its wards was thus increased from ten to nineteen, which, in March 1900, was converted into twenty by the creation of a new district out of part of the old ward of Leopoldstadt. The new districts are : Simmering, Meidling, Hietzing, Rudolfsheim, Funfhaus, Ottakring, Hernals, Wahring,*

1 Supposed by some to be indicated by the presence of recent fresh-water shells at some distance from the present shores, especially towards the south, but this might be accounted for by an elevation of the land.

2 See British Association Reports on the Climatology of Africa,

1897-1901.

Dobling, and Brigittenau. In June 1902 preliminary arrangements were made for the further incorporation of the small manufacturing town of Floridsdorf (Vienna terminus of the projected Danube-Oder canal) and four adjoining communes on the left bank of the Danube. This new ward would increase the area of the city by about one-fifth and add nearly 50,000 to the population.

A distinguishing feature of the new city of Vienna is the unusually large proportion of woods, pastures, meadows, vineyards, and arable land within its bounds. These form 58^ per cent, of its total area, private gardens, parks, and open spaces occupying a further 1 3 per cent. It now ex- tends along the right bank of the Danube from the historic and legendary Kahlenberg to the point where the Danube canal rejoins the main stream, being rounded off liberally on the other side by a

~~considerable stretch of land which is rather rural than suburban in character. The object of these extensive annexations was to provide for the growth of the city in a symmetric and orderly fashion, by bringing the outlying districts within the scope of the regulations in force in the capital, both as regards the laying out of streets and the building of houses. While from the standpoint of. population it takes the fourth place among European capitals, Vienna covers nearly three times as much ground as Berlin, which occupies the third place. But the bulk of the inhabitants Iteing packed into a comparatively small portion of this area the working classes suffer greatly from overcrowding, and all sections of the community from high rents.~~

~~Population. — In 1800 the population of the old districts was 231,050 ; in 1840, 356,870 ; in 1857, 476,222 (or with suburbs, 587,235) ; in 1869, 607,514 (with suburbs, 842,951) ; in 1880, 704,756 (with suburbs, 1,090,119) ; in 1890, town and suburbs, 1,364,548 ; and in 1900, 1,662,269, including the garrison of 26,629 men. The marriage-rate (1898) was 10‘17 per 1000 ; in 1887, 8‘79 per 1000. The birth-rate, 34 -84 per 1000, of which 33‘05 per cent, were illegitimate (a diminishing ratio — in 1887, 42-7 per cent, of the births were illegitimate) ; and the death-rate was 20 ‘35 per 1000, likewise diminishing. Some 4000 children are annually legitimized by the subsequent marriage of their parents. Owing to a series of sanitary reforms, including an important extension of the drainage system, and presumably also to a larger influx of persons in the prime of life, the mortality has undergone a steady diminution. Between 1830 and 1898 it sank from 46‘6 to 20‘35, or (excluding the deaths of strangers) to 19 ‘63 per 1000. The decline in the death-rate from consumption, the most fatal disease of the Austrian capital, was equally satisfactory, falling from 63 76 per 10,000 of the population in 1878 to 37 ‘7 in 1893. The permanent population (some 45 “5 per cent, are born in the city) is recruited from all parts of Austria, and indeed of the entire monarchy. Previous to the loss of the Italian provinces, a considerable proportion came from Italy (30,000 in 1859), including artists, members of the learned profes sions, and artisans who left their mark on Viennese art and taste. The Italian colony now numbers about 2500 (chiefly navvies and masons), in addition to. some 1400 Austrian subjects of that nationality. At present the largest and most regular contributions to the~~

population of Vienna come from the Czech provinces of Bohemia and Moravia, next in importance being those from Lower Austria and Styria. This steady and increasing influx of Czechs is gradually infusing a large proportion of Slav blood in what Bismarck (in 1864) described as the German capital of a Slav empire. Formerly the Czech labourers, artisans, and domestic servants who came to Vienna were somewhat ashamed of their mother-tongue, and anxious to conceal that evidence of their origin as speedily as possible. The revival of the nationality agitation has produced a marked change in this respect. The Czech immi- grants, attracted to Vienna as to other German towns by the growth of industry, are now too numerous for easy absorption, which is further retarded by their national organization, and the provision of separate institutions, churches, schools (thus far private), and places of resort. The consequence is that they take a pride in accentuating their national characteristics, a circumstance which threatens to develop into a new source of discord. In 1900 the population included 1,386,115 persons of German nationality, 102,974 Czechs and Slovaks, 4346 Poles, 805 Ruthenians, 1329 Slovenes, 271 Serbo-Croatians, and 1368 Italians, all Austrian subjects. To these should be added 133,144 Hungarians, 21,733 natives of Germany (3782 less than in 1890), 2506 natives of Italy, 1703 Russians, 1176 French, 1643 Swiss, &c. Of this heterogeneous

population 1,461,891 were Roman Catholics, the Jews coming next in order with 146,926 (75,000 in 1880 and 118,495 in 1890). Protestants of the Augsburg and Helvetic Confessions numbered 54,364 (26,500 in 1880, 41,943 in 1890); members of the Church of England, 490 (531 in 1890) ; Old Catholics, 975 (1264 in 1890) ;

members of the Greek Orthodox Church, 3674 ; Greek Catholics, 2521 ; and Mahommedans, 889. Several other creeds are repre- sented by small numbers ranging from 5 to 100. Those returned as of no religion amounted to 2772, an increase of 638 in the decennial period.

Plan of Vienna.

Vienna enjoys autonomy for communal affairs, but is under the control of the Governor and the Diet of Lower Austria, while the election of the Chief Burgomaster

requires the sanction of the Sovereign, advised by the Prime Minister. The long struggle between the munici- pality and the Austrian Ministry arising out of the

refusal to sanction the election of Dr Lueger, the anti- Semitic leader and champion, recalls in some respects the Wilkes incident in London. In this instance the ulti- mate success of the Corporation greatly strengthened the Obscurantist and reactionary element throughout Austria. In comparatively few years the anti-Semites, with Clerical and reactionary support and by means of vigorous agitation and obstruction, had routed the Liberals and converted an insignificant minority into a two-thirds majority. Since their accession to power their share in great public works has been in the main confined to the execution of the schemes of their predecessors, to the erec- tion of new municipal gas works at an excessive cost, the introduction of electric traction on the tramway lines, and the building of a new theatre. The most important im- provement of the last decade of the 19th century was the realization of the metropolitan railway scheme, eagerly advocated as long ago as 1867. In this great work two reforms have been combined. It had long been recognized as of urgent necessity, on sanitary and other grounds, to regulate the river Wien, which, at ordinary times little mare than an ill-smelling brook at one side of an immense b3d, was occasionally converted into a formidable and destructive torrent. HIalf the bed of the river is now walled off for the new railway, while the other half for the reception of the stream has been deepened, and a portion of it within the town has been arched over. A be- ginning has thus been made for a new and magnificent avenue. This great work, begun in February 1893, involved the construction of huge reservoirs and the solution of some difficult engineering problems. By the latter half of 1899 it had proceeded so far that the new railway enclosed the more densely populated parts of the town and formed a connexion

between the various main lines. The completion in 1901 of the underground section along the Danube canal, which was carried out in conjunction with a further development of the main drainage system, closed the circle. Another public work of considerable immediate value and perhaps of still greater future possibilities is the conversion of the entire Danube canal into a harbour by the con- struction of a lock at its entrance. This gives the low-lying parts of the city (Leopoldstadt, Landstrasse, and Alsergrund) almost complete security from inun- dation, while the increased accommodation in the " winter harbour " at the other end of the canal would naturally promote trade in case the river navigation were to receive a much-needed impetus from the realization of the proposed Danube- March-Oder canal.

Belief of the congestion in the inner town has been obtained by the widening of the main arteries of traffic, a work which has also been vigorously pursued in the outer radial and cross streets.

There have been few additions to the number of important public buildings, excepting the completion (according to Fischer von Erlach's plans) of the fagade of the Hofburg, and of one wing of the adjoining palace facing the Ring, which was intended for the late Crown Prince Rudolph. There has, however, been great activity in the construction of new streets, with the palatial tenements and business houses characteristic of Vienna. In this work of extension and reconstruction, as well as in the stations of the metropolitan railway, the architects of the so-called " Secessionist " school, and their more orthodox rivals who cultivate the traditional Vienna baroque style, have indulged in ;i liberal display of open- air mural decoration in relief, colour, and even gilding. The result is usually novel, frequently attractive, and at the worst escapes the deadly monotony which is one of the pitfalls of wholesale reconstruction elsewhere. There

have also been erected several ecclesiastical structures, including a Russian church and a Hebrew temple, and mention should be made of a number of new bridges, theatres, baths, school-houses, parks, monuments, an ex- tension of the water-supply, &c. There are now eleven theatres in all.

The cost of the transformation of Vienna, which has been in progress since 1858, cannot be said to have fallen heavily on the population. Great part of the burden has been borne throughout by the " City Extension Fund," realized from the utilization of the ground formerly occupied by the fortifications and glacis. The subsequent regulation of the former suburbs has to a large extent covered its own expenses through the acquisition by the town of the improved area. It must not be regarded as having contributed to the growth of Socialism in the capital, which is rather a con- sequence of the increase of factories, foreign influence, and the political confusion of recent years.

Austrian Socialism is of German origin. As a political party of any moment the Socialists are of recent date. Previous to 1889 (the first Congress of the party at Hainfield) the hesitating attempts at the organization of the working classes were numeri- cally of little significance, and could scarcely be described as really Socialistic, such societies as existed being rather of the nature of mutual improvement associations and trade unions. A large number of these were subsequently converted to violent anarchism (1882-84) through the influence and teachings of the notorious Johann Most. The movement practically ceased for a few years in consequence of the severe repressive measures that followed a series of anarchist outrages in Vienna. On its revival the party adopted the tactics of German Socialism, and directed its energies mainly towards an extension of the suffrage. The only feature in the condition of Vienna specially calculated to promote Socialism is the high rents and the dearness of meat and certain other necessaries. This is attributed chjefly to inadequate communica- tions and markets, and to the heavy taxation of house rents, averaging about 45 per cent, of the receipts. The nationality and anti-Semitic agitation of recent years has afforded the Vienna Socialists a great opportunity. They have made many converts among the routed remnants of the old Liberal party and the badgered Jewish community. The growing strength of the Socialist party is manifest in the better organization of the working classes, and the increasing importance of strikes in Vienna and elsewhere.

The municipal finance has on the whole been sound, and not- withstanding the extra burdens assumed on the incorporation of the

suburbs, the equilibrium of the communal budget was main- tained up to the fall of the Liberal administration. In spite of short-sighted parsimony in the matter of schools, &c, and in- creased resources through the allocation to the municipality of a certain percentage of new state and provincial taxation, their anti- Semitic successors have been unable to avoid a deficit, and have been obliged to increase the rates. But the direct damage done in this and other ways would seem to be less than that produced by the mistrust they inspired for a time among the propertied classes, and the consequent paralysing of enterprise. Their violent anti-Magyar attitude has driven away a certain amount of Hungarian custom, and helped to increase the political difficulties of the cis-Leithan Government. From 1SS7 to 1S91, the last financial year prior to the incorporation of the suburbs, the total annual revenue, ordinary and extraordinary, varied from £1,748.118 to £1,800,968. There was a small surplus each year. In 1S92 the revenue rose to £2,562,615, and left a surplus of over £50,000. In 1894, the last year of the Liberal administration, the ordinary receipts amounted, in round numbers, to £2, 672, S00 and the extra- ordinary to £881,200 ; the1 ordinary expenditure being £2,691,940 and the extraordinary £708,180. In 1897, the first complete financial year of the anti-Semitic administration, the ordinary receipts were £2,976,350 and the extraordinary £1,146,800. The ordinary expenditure was £2,770,930 and the extraordinary £1,281,440. In 1900 the ordinary receipts were £4,060,840 and the extraordinary £510,800. The ordinary expenditure amounted to £3,905,780 and the extraordinary to" £828,420. This great increase within a few years is accounted for chiefly by a number of loans raised by the new administration (60,000,000 crowns in 1896, 30,000,000 in 1900, and 285,000,000 crowns in 1902, making a grand total of £15.625,000) for the erection of municipal gas works, the municipalization of the tramway system, and the intro- duction of electric traction, the establishment of electric works, an extension of the water-supply, and other purposes. The portion of these loans annually expended is included in the municipal balance sheet, which also comprise payments for older communal liabilities. It is too soon to form a final judgment on the sound- ness of these large investments and the general financial policy of the present municipal council.

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The foregoing facts and figures tend to show that Vienna has become a healthier, handsomer, and more commodious town. Concurrently with these improvements, however, it has lost a great deal of its secular repute for being the gayest capital in Europe. Moreover, although there may not be an absolute decline in its prosperity, it has unquestionably failed to keep pace with its neighbours and rivals, the capitals of the German empire and of Hungary. From this standpoint it may be described as a Switzer- land which has continued to develop all its domestic resources, material and moral, during a period marked by a steady diminu- tion in the number of its wealthiest visitors. While Berlin and Budapest have made the most rapid progress of all European cities, having multiplied their population by nine in the period 1800-90, Vienna — even including the extensive annexations of 1891 — has only increased its sevenfold. Many causes have conspired to this end, but most of them date from the years 1859, 1866, and 1867. The combined effect of these successive blows, aggravated by the long period of decentralizing policy from Taaffe to Badeni, is still felt in the Kaiserstadt. The gaiety of Vienna had for centuries depended on the brilliancy of its Court, recruited from all parts of Europe, including the nobility of the whole empire, and on its musical, light-hearted, and contented population. Even before it fell from its high estate as the social centre of the German-speaking world, it had suffered severely by the crushing defeats of 1859 and the consequent exodus of the Austrian nobles. These were held re- sponsible for the misfortunes of the army, and to escape the atmosphere of popular odium retired to their

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~~refusal to sanction the election of Dr Lueger, the anti- Semitic leader and champion, recalls in some respects the Wilkes incident in London. In this instance the ulti- mate success of the Corporation greatly strengthened the Obscurantist and reactionary element throughout Austria. In comparatively few years the anti-Semites, with Clerical and reactionary support and by means of vigorous agitation and obstruction, had routed the Liberals and converted an insignificant minority into a two-thirds majority. Since their accession to power their share in great public works has been in the main confined to the execution of the schemes of their predecessors, to the erec- tion of new municipal gas works at an excessive cost, the introduction of electric traction on the tramway lines, and the building of a new theatre. The most important im- provement of the last decade of the 19th century was the realization of the metropolitan railway scheme, eagerly advocated as long ago as 1867. In this great work two reforms have been combined. It had long been recognized as of urgent necessity, on sanitary and other grounds, to regulate the river Wien, which, at ordinary times little m are than an ill-smelling brook at one side of an immense bad, was occasionally converted into a formidable and destructive torrent. Half the bed of the river is now willed off for the new railway, while the other half for the reception of the stream has been deepened, and a portion of it within the town has been arched over. A be- ginning has thus been made for a new and magnificent avenue. This great work, begun in February 1893, involved the construction of huge reservoirs and the solution of some difficult engineering problems. By the latter half of 1899 it had proceeded so far that the new railway enclosed the more densely populated parts of the town and formed a connexion between the various main lines. The completion in 1901 of the underground section along the Danube canal, which was carried out in conjunction with a further development of the main drainage system, closed the circle. Another public work of considerable immediate value and perhaps of still greater future possibilities is the conversion of the entire Danube canal into a harbour by the con- struction of a lock at its entrance. This gives the low-lying parts of the city (Leopoldstadt, Landstrasse, and Alsergrund) almost complete security from inun- dation, while the increased accommodation in the "winter harbour" at the other~~

~~end of the canal would naturally promote trade in case the river navigation were to receive a much-needed impetus from the realization of the proposed Danube-March-Oder canal.~~

~~Belief of the congestion in the inner town has been obtained by the widening of the main arteries of traffic, a work which has also been vigorously pursued in the outer radial and cross streets.~~

~~There have been few additions to the number of important public buildings, excepting the completion (according to Fischer von Erlach's plans) of the facade of the Hofburg, and of one wing of the adjoining palace facing the Eing, which was intended for the late Crown Prince Rudolph. There has, however, been great activity in the construction of new streets, with the palatial tenements and business houses characteristic of Vienna. In this work of extension and reconstruction, as well as in the stations of the metropolitan railway, the architects of the so-called " Secessionist " school, and their more orthodox rivals who cultivate the traditional Vienna baroque style, have indulged in a liberal display of dpen- air mural decoration in relief, colour, and even gilding. The result is usually novel, frequently attractive, and at the worst escapes the deadly monotony which is one of the pitfalls of wholesale reconstruction elsewhere. There~~

~~have also been erected several ecclesiastical structures, including a Russian church and a Hebrew temple, and mention should be made of a number of new bridges, theatres, baths, school-houses, parks, monuments, an ex- tension of the water-supijly, &c. There are now eleven theatres in all.~~

~~The cost of the transformation of Vienna, which has been in progress since 1858, cannot be said to have fallen heavily on the population. Great part of the burden has been borne throughout try the "City Extension Fund," realized from the utilization of the ground formerly occupied by the fortifications and glacis. The subsequent regulation of the former suburbs lias to a large extent covered its own expenses through the acquisition by the town of the improved area. It must not be regarded as having contributed to the growth of Socialism in the capital, which is~~

rather a con- sequence of the increase of factories, foreign influence, and the political confusion of recent years.

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During the last quarter of the 19th century the number of textile establishments decreased from 120 to less than 30, but the production of fabrics doubled and the total value of the material, notwithstanding decline in price, rose from about £500,000 to over £750,000. The manu- facture of woollen caps and gloves is carried on in several establishments, and gives employment to about 1000 persons. Population (1891), 21,033; (1901), 22,768.

Vienne, Haute-, a department of western France, watered by the river from which it is named.

Area, 2120 square miles. The population increased from 363,182 in 1886 to 374,212 in 1901. The births in 1899 were 9170, of which 532 were illegitimate ; deaths, 7264 ; marriages, 3146. Though in 1896, 643 schools were attended by 58,000 pupils, more than 18 per cent, of the population was illiterate. The land under cultivation in 1896 amounted to 1,160,900 acres, of which only 701,480 acres were plough-land, the larger part of

~~the rest being laid out in grass. The wheat grown in 1899 was valued at £521,100 ; rye, £578,450 ; buckwheat, £143,220 ; oats, £141,500 ; potatoes, £448,300; mangold-wurzel, :£101,200 ; natural pastures and grass lands, nearly £903,000; hemp, £42,630; chestnuts, £47,760 ; apples, £28,000. The live-stock of 1899 included 8580 horses, 8652 asses, 241,200 cattle, 631,500 sheep — the second largest muster of sheep in France — 194,800 pigs, and 12,700 goats. The principal mineral produced is kaolin, which supplies an im- portant porcelain manufacture, having its seat at Limoges. There are also important paper-mills and nail factories. The population of Limoges, the capital, was (1901) 76,832.~~

~~Vierge, Daniel (1851-~~

~~-), Spanish painter and~~

~~draughtsman, was born in Madrid in 1851. He went to Paris in 1867 to seek his fortune, fired by the vivid energy of his national temperament. He became attached to the Monde Blustre' in 1870, just before the Franco-Prussian war broke out, and, like other artists in the paper, came under the powerful influence of Edmond Morin, the first newspaper draughtsman in France who sought to impart to drawings for journals the character of a work of art. Vierge's earlier drawings, therefore, partake greatly of Morin's style ; such are, " The Shooting in the Piue de la Paix," " The Place d'Armes at Versailles," "The Loan," "The Great School-fete of Lyons," "Anni- versary of the Fight of Aydes," and " Souvenir of Coul- miers." Vierge lost no time in proving the extraordinary vigour and picturesqueness of his art. Apart from the contribution of his own original work, he was required by his paper to re-draw upon the wood, for the engraver, the sketches sent in by artist – corre- spondents, such as Luc Ollivier Merson in Kome and Samuel Urrabieta (Vierge's brother) in Spain. From 1871 to 1878 his individuality became more and more pronounced, and he produced, among his best-known drawings, " Christmas in Spain," " The Eepublican Meet- ing in Trafalgar Square," " Attack on a Train in Andalusia," "Feast of St Kosalia in Palermo," "In the Jardin d'Acclimatation," " The Burning of the Library, of the Escurial, 1872," "Grasshoppers in Algiers," " Brigandage in Sicily," " Night Fete in Constantinople," "Episode of the~~

~~Civil War in Spain," "Marriage of the King of Spain," and " The Bull Fight." About this time he illustrated with remarkable dash and skill Victor Hugo's Annie Terrible (Michel Levy, 1874, and Hugues, 1879), "1813" (Hugues, 1877), and Les Mlscmhhx (1882). His masterpiece of illustration is Michelet's History of France (1876), consisting of 26 volumes containing 1000 drawings. In 1879 he was drawing for La Vie Moderne, and then proceeded to illus- trate Pablo de Segovia. While engaged upon this work he was attacked by paralysis in the right arm, but with characteristic energy and courage he set himself to acquire the necessary skill in drawing with the left, and calmly proceeded with the illustrations to the book. In 1891 he illustrated L' Espagnole, by Bergerat, and in 1895~~

~~Le Cabaret des Trois Vertus. In 1898 he held, at the Pelletan Gallery in Paris, an exhibition of his drawings for Chateaubriand's Le Dernier Abencerage (" The Last of the Abencerrages "), and in the following year a compre- hensive exhibition of his work (including the illustra- tions to Don Quixote) at the Art Nouveau Gallery, also in Paris. In 1898 Vierge contributed to L' Image, a magazine devoted to the encouragement of engraving upon wood ; and two years later, at the International Exhibition at Paris, he was awarded a Grand Prix. In 1902 he exhibited at the New Salon a scene from the Franco-Prussian war. The work of Vierge has also been seen in London, in an extensive exhibition held in the hall of Clifford's Inn.~~

~~See Roger Marx, L'linage (1898) ; Beraldi, La Gravure au 19' siecle.~~

~~Viersetl, a town of Prussia, Ehine province, 11 miles by rail south-west from Crefeld, the seat of velvet, silk, plush, damask, cotton, and linen industries, dye- works, machine factories, tanneries, brickworks, &c. It has a 15th-century Eoman Catholic parish church, and a new Evangelical church. Population (1885), 22,228 ;~~

~~(1900), 24,797.~~

~~Vieuxtemps, Henri (1820-1881), Belgian~~

violinist and composer, was born at Verviers, 20th Febru- ary 1820. Until his seventh year he was a pupil of Lecloux, but when De Beriot heard him he adopted him as his pupil, taking him to appear in Paris in 1828. From 1833 onwards he spent the greater part of his life in concert tours, visiting all parts of the world with uni- form success. He first appeared in London at a Phil- harmonic concert on 2nd June 1834, and in the following year studied composition with Pbeicha in Paris, and began the long series of works which are more highly appreciated by violinists than by any one else. From 1846 to 1852 he was solo violinist to the Tsar, and professor in the conservatorium in St Petersburg. From 1871 to 1873. he was teacher of the violin class in the Brussels Conserva- toire, but was disabled by an attack of paralysis in the latter year, and from that time could only superintend the studies of favourite pupils. He died in Algiers, 6th June 1881. He had a perfect command of technique, faultless intonation, and a marvellous command of the bow ; his staccato was famous all over the world, and his tone was exceptionally rich and full. In his playing and in his works there were occasional lapses from the ideal dignity of the highest art ; but in his compositions there are often good ideas, as well as themes pleasing to the ear and passages of formidable difficulty.

(j. A. P. M.)

Vigan, the capital of the province of South Ilocos, Luzon, Philippine Islands, slightly north of the centre of the province, and a mile inland from its coast. Its people are industrious, and in addition to agriculture, devote themselves to fishing, brick-making, cabinet-making, and also to shipbuilding upon a small scale. Vigan is the residence of the bishop of Nueva Segovia, and its public buildings are among the finest to be seen in the Philip- pines outside of Manila. The language is Ilocano. Population, 19,000.

Vigfusson, Gudbrandr (1828-1889), the foremost Scandinavian scholar of the 19th century, was born of a good and old Icelandic family in BreiCafjord in 1828. He was brought up, till he went to a tutor's, by his kinswoman Kristin Vigfussdottir, to whom, he records, he " owed not only that he became a man of letters, but almost everything." He was sent to the old and famous school at Bessastad and (when it removed

thither) at Keykjavik ; and in 1849, already a fair scholar, he came to Copenhagen University as a bursarius in the Regense College. He was, after his student course, appointed stipendiarius by the Arna-Magnaean, trustees, and worked for fourteen years in the Arna-MagnEean Library till, as he said, he knew every scrap of old vellum and of Icelandic written paper in that whole collection. During his Danish life he twice revisited Iceland (last in 1858), and made short tours in Norway and South Germany with friends. In 1866, after some months in London, he settled down in Oxford, which he made his home for the rest of his life, only quitting it for visits to the great Scandinavian libraries or to London (to work during two or three long vacations with his fellow- labourer, F. Y. Powell), or for short trips to places such as the Isle of Man, the Orkneys and Shetlands, the old mootstead of the West Saxons at Downton, the Roman station at Pevensey, the burial-place of Bishop Brynjulf s ill-fated son at Yarmouth, and the like. He held the office of Reader in Scandinavian at the University of Oxford (a post created for him) from 1884 till his death. He was a Jubilee Doctor of Upsala, 1877, and received the Danish Order of the Dannebrog in 1885. He had many friends who valued his character and learning — as Professors Unger and Mobius ; his distinguished fellow- countrymen Jon Sigurdson and Vilhelm Finnsen, and the Molierist H. Larpent, the friend of his youth ; and among Englishmen — Dean Liddell, "Bodley" Coxe, Dr Garth Wilkinson, Thomas and John Carlyle, Lord Sherbrooke, Lord Carnarvon, Sir Edmund Head, Sir G. W. Dasent, Arthur Lawrenson, James Sime, Bartholomew Price, the Dean of Durham, Mr G. Meredith, Dr Sweet, Mr James Bryce, Dr Rhys, Mr Gosse, Mr Moore, Professor Morfill, Dr Furnivall, Mr H. L. Ward, Professor Elton, Mr Sephton, and Mr H. M. Paget, who painted his portrait in 1888. VigMsson died of cancer on 31st January 1889, after a short and painless illness, the first in his life, and was buried in St Sepulchre's Cemetery, Oxford, 3rd February. He was a spare but strong man, with a handsome and notable face ; his hair was dark and curly, his eyes grey and full of light, his complexion healthy but almost colourless, his voice full. He was active of habit and enjoyed

exercise (in youth, though a light-weight, he had been a skilled wrestler), exceedingly temperate, both in eating and drinking, a most energetic and conscien- tious worker, and a man of real distinction and influence, easy of access, modest and unpretentious to a rare degree, living a simple, earnest, cheerful life. He was an excellent judge of literature, reading most European languages well and being acquainted with their classics. His memory was remarkable, and if the whole of the Eddie poems had been lost, he could have written them down from memory ; while to remember dates he had once read and references he had once made was no effort to him. He spoke English well and idiomatically, but with a strong Icelandic accent. He wrote a beautiful, distinctive, and clear hand, in spite of the thousands of lines of MS. copying he had done in his early life.

By his Tunatdl (written between October 1854 and April 1855) he laid the foundations for the chronology of Icelandic history, in a series of conclusions that have not been displaced (save by his own additions and correc- tions), and that justly earned the praise of Jacob Grimm. His editions of Icelandic classics, 1858-68, Biskopa Sogur, Bardar Saga, Forn Sogur (with Mobius), Eyrbyggia Saga, and Flateyar-bdk (with Unger) opened a new era of Ice- landic scholarship, and can only fitly be compared to the Rolls Series editions of chronicles by Dr Stubbs for the interest and value of their prefaces and texts. Seven years of constant and severe toil, 1866-73, were given to

the Oxford Icelandic-English Dictionary, incomparably the best guide to classic Icelandic, and a monumental example of single-handed work. His later series of editions, 1874-85, included Orkneyinga and Hdconar Saga, the great and complex mass of Icelandic historical sagas, known as Sturlunga, and the Corpus Poeticurn Boreale, in which he edited the whole body of classic Scandinavian poetry. As an introduction to the Stur- lunga, he wrote a complete though concise history of the classic Northern literature and its sources. In the introduction to the Corpus, he laid the foundations of a critical history of the Eddie poetry and Court poetry of the North in a series of brilliant, original, and well- supported theories that are gradually being accepted even by those who were at first inclined to reject them. His little Icelandic Prose Reader (with F. York Powell),

1879, furnishes the English student with a pleasant and trust- worthy path to a sound knowledge of Icelandic. The Grimm Centenary Papers (1886) give good examples of the range of his historic work, while his Appendix on Icelandic currency to Sir G. W. Dasent's Burnt Njal is a model of methodical investigation into an intricate and somewhat important subject. As a writer in his own tongue he at once gained a high position by his excellent and delightful Relations of Travel in Norway and South Germany. In English, as his " Visit to Grimm " and his powerful letters to The Times show, he had attained no mean skill. HIs life is mainly a record of well-directed and efficient labour in Denmark and Oxford.

(k y. p.)

VigO, seaport town of Spain, in the province of Pontevedra, connected by rail with Madrid, Portugal, and the north of Spain railway system. The most active industries are connected with the fisheries and the ship- ping interests, but there are also iron foundries, paper, flour, and saw mills, a petroleum refinery, distilleries, and some thirty sardine establishments. The town is acquiring a more modern aspect with large handsome streets, squares, fine buildings, schools, clubs or casinos, hotels, theatres, public gardens, quays, &c. In 1898, 1098 vessels of 104,940 tons entered, and 1593 vessels of 1,244,552 tons cleared. The exports in 1898 amounted to £128,658, the imports to £118,809. Population (1887), 15,044;

(1897), 17,222

Villach, the chief town of a government district in Carinthia, on the river Drave, 22 miles west of Klagenfurt, in a broad, fertile basin at the foot of the Dobratsch or Villach Alp. The parish church is an interesting Gothic edifice of the 15th century. The industry of Villach is to a great extent dependent on the vicinity of the lead mines of Bleiberg, and consists in various applications of that metal. Machinery, cement, coffee substitutes, leather, paper and pasteboard, and beer are also manufactured ; and marble is quarried in the neighbourhood. There is a considerable transit trade in and dep6ts for the sale of lead, iron, zinc, and steel, products of the mines and furnaces of the district. The warm sulphur springs of

Warmbad- Villach are about 2 miles from the town. Population (1890), »6765; (1900), 9690, including garrison of 829 men.

Villa. Concepcidn. See Concepcion.

Villa, del Pilar, an important city of Paraguay, about 104 miles from Asuncion. Including its suburbs, it has a population of 5742. The city has a municipal board, military commander, justice of the peace, custom-house, port captain, national college, many public and private schools, a branch of the Agricultural Bank, and telegraph and post offices. Orange trees grow throughout

the city, which is one of the largest orange-exporting towns in the republic, and has a fine harbour on the river Paraguay.

Viilafranea., a town of the province of Verona, Lombardy, Italy, 11 miles S.S.W. of Verona, on the railway to Mantua. It has considerable silk indus- tries. Here preliminaries of peace were signed between Napoleon III. and the Austrians in 1859 after the battle of Solferino. Population (1901), about 7500.

Viilafranea de Los Barros, a town of

Spain, province of Badajoz, on the railway from Merida to Seville. Population (1887), 9634 ; (1897), 9930. The surrounding country produces in abundance cereals of every kind, wine and oil, and is a noted district for the rearing of live stock. The town has modern houses and squares, a parish church of the 16th century, some old convents, a society, styled Tertulia Literaria, that has a remarkable archaeological museum, with fine ceramics and ancient sepulchral stones and coins, almost all collected from the neighbourhood.

Villajoyosa, a town of Spain, on the Mediter- ranean coast, in the province of Alicante, opposite the island of Benidorm. Its municipal

~~boundaries are exten- sive, and embrace much of the lovely and fertile huerta dotted with country houses and farms. The oldest part of the town, still showing some remains of the walls, is on the top of a hill, and is composed of narrow, crooked, steep streets, with a couple of parish churches. The more modern part, styled La Marina, or San Cristobal, is built at the foot of the hill, near the coast, and there is a suburb connected with it by a bridge across the little river Sella. The new town has broad, well-paved streets, a town hall, schools, asylum, and a fine chapel dedicated to Santa Marta, with a tower 29 metres high. The anchor- age is not very good for large ships, but much frequented by coasting vessels'. There is a lighthouse to the north- east of the town. The fisheries are important, and give employment to several hundred men with over a hundred boats. There is an active trade in agricultural products, and the industries include the making of rope, sails, nails, leather, shoes, hemp, esparto-grass rugs,' almond pastes, and chocolate. Near Villajoyosa is a lunatic asylum and sanatorium founded by Dr Izquierdo, founder of the lunatic asylum of Madrid. Population (1887), 8763;~~

~~(1897), 8981.~~

~~Villa Nova de Gaia, a town of Portugal, district of Oporto, a suburb of Oporto, on the left bank of the Douro, connected with Oporto by a couple of bridges. The manufactures include pottery, wine-casks, cottons, tobacco, glass, spirits, soap, corks, &c. Population (1890),~~

~~12,108; (1900), 14,754.~~

~~Villanueva de la Serena, a town of Spain,~~

~~province of Badajoz, to the south of the river Guadiana, on the railway from Cuidad R,eal to Badajoz. The flat country produces wheat, hemp, fruit, and wine. Much live stock is reared in the neighbourhood. Villanueva has regular, well-paved streets, and among its public buildings are the town hall, parish church, several con- vents and hermitages, and the schools. Population* (1887),~~

~~12,024; (1897), 11,731.~~

~~Villanueva y Geltru, a seaport town of~~

~~Spain, province of Barcelona, with a station on the line from Madrid to Barcelona. Agricultural interests are im- portant, and there are cotton, woollen, paper and linen manufactures, and iron foundries. The fisheries are active, giving employment to 900 men and boys with 310 boats. Most of the houses and public buildings are modern, well built, and the whole place has an air of ease~~

~~and growing prosperity. The harbour affords safe and deep anchorage, and is chiefly frequented by coasting and small craft. San Cristobal Cape is a lifeboat station. The museum and library was founded and endowed by the eminent poet and academician, Victor Balaguer. It contains 40,000 volumes, valuable MSS. and paintings, with prehistoric and other collections. The collection of ceramics includes 2000 specimens, that of engravings 3000, the numismatic 6000 ; the antiquities from the Far East especially are unrivalled. Population (1887),~~

~~13,811; (1897), 11,839.~~

~~Villa Real, a town of Portugal, capital of the district of Villa Real, situated 10 miles N. of the Douro, and 47 E.N.E. of Oporto. Population (1890), 5920; (1900), 6736. The district of Villa Real has an area of 1717 square miles, and population (1890), 237,302; (1900), 243,584, giving 142 inhabitants to the square mile. There are alkaline waters and baths at Vidago (near Chaves) and at Pedras Salgadas (near Villa Ponca dAguiar). The district adjacent to the Douro is known par excellence as the wine country; in 1892 the vine- yards covered 38,730 acres, and wine was produced to the extent of 8,827,170 gallons, and £448,670 in value. In 1898 the wine produced was 4,106,357 gallons. Cattle, sheep, and especially pig breeding are actively pursued, and hams are cured at Chaves and Murca.~~

~~Villa Rica, an important town of Paraguay, 90 miles east of Asuncidn, with about 25,000 inhabitants. It is situated in the interior of the country, in the midst of a rich agricultural region, with hills running east and west covered with fine timber. One of the national colleges is situated here, and~~

there are public schools. It has a church, many modern edifices, commercial houses, and a branch of the Agricultural Bank.

-), Italian

Villari, Pasquaie (1827-

historian, was born at Naples on 3rd October 1827. He studied under Basilio Puoti and Luigi La Vista, under whose auspices his first work, an attack upon the Bourbon regime in South Italy, appeared in 1847. Seeking refuge in Florence, Villari devoted himself to historical research in the archives of the Laurentian and Magliabecchi libraries, and produced in 1859 the first volume of his Storia di Girolamo Savonarola e de suoi tempi. A second volume followed in 1861, and the work, which was speedily recognized as an Italian classic, was translated into English, French, and German. It was followed in 1877 by a work of even greater critical value, Niccolo 3/achia- velli e i suoi tempi. In the meantime Villari had left his chair of history at Pisa to become professor of history at the Institute of Studi Superiori at Florence, and he was also appointed a member of the Council of Public Instruc- tion, to which body in 1862, having served as a juror at the international exhibition of that year, he contributed an important monograph upon education in England and Scotland. In 1869 he was general secretary of public instruction, in 1884 he was made senator, and in 1891 he was minister of public instruction in the Eudini cabinet. In 1893-94 he collected a number of historical studies from the X-uova Antologia, under the title of I primi due secoli dell a storia di Firenze ; and in 1901 he produced, in two volumes, Le Invaxioni barbariche in Italia, a popular account of the dissolution of the empire, based largely upon the researches of Gibbon, Bury, Hartmann, and Hodgkih. All these works have been translated into English by the historian's wife, Linda Villari (ne'e White), and all of them, especially the I/achiavelli, are of great value to the student of Italian history. Of Villari's literary and especially his Dante studies, the most im- portant are contained in Saggi Critici (1886). In Lettere

~~Meridionali he concerns himself mainly with social ques- tions. The most influential by far of his political writings was a pamphlet, Di chi e la colpa, reprinted from the Politecnico in 1866, for the disasters of which year it courageously sought to find an explanation in national, moral, and political foibles and shortcomings. As a his- torian "Villari is characterized by breadth of culture and sympathy rather than by profound insight. His sympathy with the aims of Savonarola led him to take what is probably a somewhat extravagant view of the moral and intellectual capacity of the reformer.~~

~~Villefra.nche, chief town of arrondissement, de- partment of Khone, France, 19 miles north by west of Lyons by rail. About twenty factories are engaged in the manufacture of cotton fabrics, of which the total value exceeds £1,000,000 a year. Establishments for dyeing and finishing goods give employment to about 1500 persons, and the manufacture of cotton thread and accessory branches of industry to 1000 or 1200 more. Population (1891), 11,581 ; (1901), 14,033.~~

~~Villiers de I'lsle-Adanrt, Auguste Philippe Mat hi as de (1838-1889), Count, French poet, was born at St Brieuc in Brittany, 28th November 1838. He may be said to have inaugurated the Symbolist movement, and Axel, the play on which he was engaged during so much of his life, though it was only published after his death, is the typical Symbolist drama. He began, at the age of twenty-one, with a volume of poems. This was followed by a wild romance of the supernatural, Isis, 1862, and by two plays, Elm, 1864, and Morgane, 1865. La Bevolte, a play in which Ibsen's Doll's House seems to be anticipated, appeared in 1870; Contes Gruels, his finest volume of short stories, in 1880 ; L'Eve Future, an amazing piece of buffoonery satirizing the pretensions of science, in 1886; Tribulat Bonhomet in 1887 ; Axel in 1890. He died at Paris, under the care of the Freres Saint- Jean-de-Dieu, 19th August 1889. Villiers has left behind him a legend, probably not more fantastic than the truth. Sharing many of the opinions of Don. Quixote, he shared also Don Quixote's life. He was the descendant of a Grand Master of the Knights of Malta, famous in history, and his pride as an aristocrat and as an idealist were equal. He hated mediocrity, science, progress, the present age, money, and " serious " people. In one division of his work he attacked all~~

the things which he hated with a savage irony ; in another division of his work he discovered at least some glimpses of the ideal world. He remains a remarkable poet and a remarkable satirist, imperfect as both. He improvised out of an abundant genius, but the greater part of his work was no more than improvisation. He was accustomed to talk his stories before he wrote them. Sometimes he talked them instead of writing them. But he has left, at all events, the Contes Gruels, in which may be found every classic quality of the French conte, together with many of the qualities of Poe and Hoffmann ; and the drama of Axel, in which the stage takes a new splendour and a new subtlety of meaning. Villiers's influence on the younger French writers was considerable. It was always an ex- altation. No one in his time followed a literary ideal more romantically. (a. St.)

Villingen, a town of Germany, grand-duchy of Baden, 52 miles by rail north of Schaffhausen. It is the chief seat of the watch-making industry of the Black Forest. It is in part still surrounded by walls, with ancient gate towers. It also produces musical -boxes, glass, and silk; and has a Gothic church of the 13th century and another of the 11th, a 15th-century town

hall, with a museum of antiquities, music, technical, and agricultural schools. Population (1885), 6140; (1900),

7819.

Vilna (properly Wilno), a Lithuanian government of West Bussia, bordering on Poland, with an area of 16,421 square miles. It is chiefly built up of Lower Tertiary deposits, but in the north Devonian sandstones appear on the surface. The Tertiary deposits consist of Eocene clay, slates, sandstones, limestones, and chalk, with gypsum, and are partly of marine and partly of land origin. The whole is covered with thick layers of Glacial boulder clay and post-Glacial deposits, containing remains of the mammoth and other extinct mammals. Interesting dis- coveries of Neolithic implements, especially of polished stone, and of implements belonging to the Bronze Age and the early years of the Christian epoch, have been made in the province.

~~The population, which was 1,223,260 in 1883, numbered in 1897 1,591,912 (domiciled only), of whom 797,676 were women, and 201,447 lived in towns ; nearly 400,000 of the inhabitants were Russians and 200,000 Jews, the remainder being Lithuanians and Poles. The province is divided into seven districts, the chief towns of which are Vilna, Vileika (3552 inhabitants), Disna (6739) Lida (8626), Oshmiany (6375), Sventsiany (6322), and Troki (3313). The standard of education is low ; in 1898 there were only 1053 primary schools, attended by 30,107 boys and 8450 girls. Lignite, iron ore, and peat are the only minerals found in the province. Of the total area of 10£ million acres, 2,796,900 acres were in 1898 covered with forests. The soil varies greatly, from fertile black earth in the west to clay and sandy soil elsewhere, and the standard of agriculture is generally low, both on the peasants' lands (3,644,000 acres) and on the small estates. The total area under cereal crops in 1900 was 2,445,600 acres, and the average yield in 1895-99 was : rye, 5,456,000 cwt. ; wheat, 253,000 cwt.; oats, 2,499,000 cwt.; barley, 1,032,000 cwt. ; also 10,393,000 cwt. of potatoes, which are largely grown for distilleries. Flax, hemp, and beetroot for sugar are widely cultivated, and some tobacco is raised. There are a number of school-gardens in connexion with the village schools, and one at the normal school for teachers. Cattle-breed- ing is second in importance only to agriculture, there being in the province in 1897 222,400 horses, 561,200 homed cattle, 488,000 sheep, and 340,400 pigs. Industries are undeveloped, and the annual returns of all factories (chiefly distilleries, breweries, tobacco works, tanneries, paper-mills, flour-mills, and a few wire and nail works) only amounted to 11,323,000 roubles in 1898.~~

~~Vilna] the capital of the above province, on the river Viliya, 436 miles by rail south-west of St Petersburg, near the junction of three important lines running from Libau to Odessa and to the Don, and from St Petersburg to Warsaw. It is the headquarters of the Governor- General of the Lithuanian provinces, and has grown very rapidly ; in 1897 its population was 159,568, as compared with 109,329 in 1889. It is an important centre for trade in timber and grain, which are exported both by rail and river. It has theological seminaries, both Orthodox and Catholic, a military school, a normal school for teachers, a number of lyceums, and a few pro- fessional schools. It is also the seat of many~~

scientific societies (geographical, medical, and archaBological), and has a good antiquarian museum and a public library.

Vilvorde, a town of Belgium, in the province of Brabant, 9 miles north of Brussels by rail, on the river Senne. It manufactures, among other commodities, chemical manure, oil, and alimentary pastes. There are also breweries. Population (1890), 11,138; (1900),

12,992.

VincenneS, a city of Indiana, U.S.A., capital of Knox county, on the east bank of the Wabash river, in the south-western part of the state, at an altitude of 420 feet. Its site is level, the street plan regular, and it has water-supply and sewerage systems. Four railways — the Baltimore and Ohio South- Western ; the Cleveland,

Cincinnati, Chicago and St Louis ; the Evansville and Terre Haute ; and the Pittsburg, Cincinnati, Chicago and St Louis — intersect here, making it a railway centre of importance. The city contains repair and car works, and manufactures in great variety. Population (1890), 8853 ; (1900), 10,249, of whom 736 were foreign-born and 432 negroes.

Vinita, a town of the Cherokee nation, Indian Terri- tory, U.S.A., in the northern part of the Territory, at the intersection of the St Louis and San Francisco, and the Missouri, Kansas and Texas railways, at an altitude of 700 feet. The lands of Indian Territory are, by United States law, the common property of the tribes, but in con- travention of the law, the nation has granted this town- site to individuals, and upon such deeds the titles in the town rest. It is in an agricultural and pastoral region, for which it is a collecting and distributing point. It is peopled almost entirely by whites, the Indians remaining aloof from railways. Population (1890), 1200 ; (1900),

Virchow, Rudolf (1821-1902), German patho- logist and politician, was born on 13th October at Schivelbein, in Pomerania, where his father was a small farmer and shop-keeper. As a boy he attended the volks- schule of his native village, and at the age of seventeen, having passed through the gymnasium of Kb'slin, went to Berlin to study medicine. He took his doctor's degree in 1843, and almost immediately received an appointment as assistant-surgeon at the Charite Hospital, becoming pro- rector three years later. In 1847 he began to act as privat-docent in the university, and founded with Bern- hardt the Archiv fur pathologische Anatomie und Physio- logie, which, after his collaborator's death in 1852, he carried on alone, and in 1848 he went as a member of a Government Commission to investigate an outbreak of typhus in Upper Silesia. About the same time, having shown too open sympathy with the revolutionary or re- forming tendencies of 1848, he was for political reasons obliged to leave Berlin and retire to the seclusion of Wiirz- burg, the medical school of which profited enormously by his labours as professor of pathological anatomy, and secured a wide extension of its reputation. In 1856 he was recalled to Berlin as ordinary professor of pathological anatomy in the university, and as director of the Patho- logical Institute, formed a centre for research whence has flowed a constant stream of original work on the nature and processes of disease. On 14th October 1901, his eightieth birthday was celebrated in Berlin amid a brilliant gathering of men of science, part of the core- monies taking place in the new Pathological Museum, near the Charite, which owes its existence mainly to his energy and powers of organization. On that occasion all Europe united to do him honour, many learned societies sent delegates to express their congratulations, the King of Italy gave him his own portrait on a gold medallion, and among the numerous addresses he received was one from Kaiser Wilhelm II., who took the opportunity of presenting him with the Grand Gold Medal for Science. In the early part of 1902 he slipped from a tramcar in Berlin and fractured his thigh ; from this injury he never really recovered, and his death occurred in Berlin on 5th September 1902.

Wide as were Virchow's studies, and successful as he was in all, yet the foremost place must be given to his achievements in pathological

investigation. He may, in fact, be called the father of modern pathology, for his view, that every animal is constituted by a sum of vital units, each of which manifests the characteristics of life, has

almost uniformly dominated the theory of disease since the middle of the 19th century, when it was enunciated. The beginnings of his doctrine of cellular pathology date from the earliest period in his career. When, towards the end of his student days in Berlin, he was acting as clinical assistant in the eye department of the Berlin Hospital, he noticed that in keratitis and corneal wounds healing took place without the appearance of plastic exudation. This observation led him to further work, and he succeeded in showing that in vascular organs the presence of cells in inflammatory exudates is not the result of exudation but

RUDOLF VIECHOW. (From a photograph by Elliott and Fry', London.)

of multiplication of pre-existing cells. Eventually he was able to prove that the biological doctrine of omnis cellula e cellula applies to pathological processes as well as to those of normal growth, and in his famous book on Cellular- pathologie, published at Berlin in 1858, he established what Lord Lister has described as the " true and fertile doctrine that every morbid structure consists of cells which have been derived from pre-existirg cells as a progeny." But in addition to bringing forward a fundamental and philosophical view of morbid processes, which has probably contributed more than any other single cause to vindicate for pathology the place which he claimed for it among the biological sciences, Virchow made many important contributions to histology and morbid anatomy and to the study of particular diseases. The classification into epi- thelial organs, connective tissues, and the more specialized muscle and nerve, was largely due to him ; and he proved the presence of neuroglia in the brain and spinal cord, discovered crystalline hfematoidine, and made out the structure of the umbilical cord. Medical science further owes to him the classification of new growths on a natural histological basis, the elucidation of leucaemia, glioma, and lardaceous tumours, and detailed investigations into many diseases — tuberculosis, pyaamia, diphtheria, leprosy,

V I R E — V IRGINIA

typhus, &c. Among the books he published on pathological and medical subjects may be mentioned Vorlesungen iiber Pathologie, the first volume of which was the Cellular- pathologie (1858), and the remaining three Die Krank- haften Geschwiilste (1863-67) ; Handbuch der speziellen Pathologie und Therapie (3 vols., 1854-62), in collabora- tion with other German surgeons ; Gesammelte Abhand- lungen zur wissenschaftlichen Medizin (1856) ; Tier Reden iiber Leben und Kranhsein (1862) ; Untersuchungen iiber die Entwicklung des Schadelgrundes (1857) ; Lehre von, den Trichinen (1865); Ueber den Hunger-typhus (1868); and Gesammelte Abhandlungen aus dem Gebiete der offent- lichen Medizin und der Seuchenlehre (1879). In England his pathological work won general recognition. The Koyal Society awarded him the Copley medal in 1892, and selected him as Croonian lecturer in the following year, his subject being the position of pathology among the biological sciences; and in 1898 he delivered the second Huxley memorial lecture at Charing Cross Hospital.

Another science which Virchow cultivated with con- spicuous success was anthropology, which he did much to put on a sound critical basis. At the meeting of the Naturforscherversammlung at Innsbruck in 1869, he was one of the founders of the German Anthropological Society, of which he became president in the following year ; and from 1869 onwards he presided over the Berlin Anthropological Society, also acting as editor of its pro- ceedings in the Zeitschrift fur Ethnologie. In ethnology he published a volume of essays on the physical anthro- pology of the Germans, with special reference to the Frisians ; and at his instance a census, which yielded re- markable results, was carried out among school children throughout Germany, to determine the relative distribu- tion of blondes and brunettes. His archaeological work included the investigation of lake dwellings and other prehistoric structures ; he went with Schliemann to Troy in 1879, fruits of the expedition being two books, Zur Landeskunde der Troas (1880) and Alt-trojanische Graber und Schddel (1882) ; in 1881 he visited the Caucasus, and on his return published Das Grdberfeld von Koban im Lande der Osseten; and in 1888 he accompanied Schliemann to Egypt, Nubia, and the Peloponnese.

~~As a politician Virchow had an active career. In 1862 he was elected a member of the Prussian Lower House. Professing advanced Liberal and democratic views, he was a founder and leader of the Fortschrittspartei, and the expression hdturkampf had, it is believed, its origin in one of his electoral manifestoes. For many years he was chairman of the finance committee, and in that capacity may be looked upon as a chief founder of the constitu- tional Prussian Budget system. In 1880 he entered the Reichstag as representative of a Berlin constituency, but was ousted in 1893 by a Social Democrat. In the Reichstag he became the leader of the Opposition, and a vigorous antagonist to Bismarck. In the local and muni- cipal politics of Berlin again he took a leading part, and as a member of the municipal council was largely respon- sible for the transformation which came over the city in the last thirty years of the 19th century. That it has become one of the healthiest cities in the world from being one of the unhealthiest, is attributable in great measure to his insistence on the necessity of sanitary reform, and it was his unceasing efforts that secured for its inhabitants the drainage system, the sewage farms, and the good water- supply, the benefits of which are reflected in the decreased death-rate they now enjoy. In respect of hospitals and the treatment of the sick his energy and knowledge were of enormous advantage to his country, both in times of peace and of war, and the unrivalled accommodation for medical treatment possessed by Berlin is a standing tribute to his~~

~~name, which will be perpetuated in one of the largest hospitals of the city. Of his writings on social and political questions may be mentioned Die Erziehung des Weibes (1865); Ueber die nationale Entwicklung und Bedeutung der Naturwissenschaften (1865) ; Die Aufgaben der Naturwissenschaften in dem neuen nationalen Leben Deutschlands (1871); Die Freiheit der Wissenschaft im modernen Stoat (1877), in which he opposed the idea of Haeckel — that the principles of evolution should be taught in elementary schools — on the ground that they were not as yet proved, and that it was mischievous to teach a hypothesis which still remained in the speculative stage.~~

~~Virej chief town of arrondissement, department of Calvados, France, 36 miles south-west of Caen, on the rail- way from Paris to Granville. A~~

library (30,000 volumes) and a small museum are installed in the Hotel de Ville (17th and 18th centuries). Ancient buildings are the Church of Notre Dame, of the 13th and later centuries, a fortified 13th-centmry gateway, the Tour d'Horloge, flanked by two crenelated towers, and a picturesque fragment of a 12th-century chateau, on a cliff over- looking the Vire, which is approached by a fine esplanade with triple rows of lime trees. A centenary monument of the Revolution stands in the Place Nationale; in the public garden is a statue of Marshal de Matigon (1525-1597) ; and the native poets Chenedolle' (1769-1833) and Castel (1758-1832) are represented, the former by a marble bust, the latter by a bronze statue. The Church of St Anne's is a handsome modern edifice with numerous statues. Cloth, hosiery, carding machines, and metallic boxes are manufactured, and fine granite, much of which is dressed in the town, is quarried in the vicinity. There is considerable trade in grain, dairy produce, and granite. Vire grew up around a castle built in the 12th century by Henry I. of England. South- west of the town is the gorge called Vaux-de-Vire, where the satiric songs, hence known as " Vaudevilles," had their origin. Population (1881), 6263; (1901), 6207.

Virginia.. — A state on the eastern coast of the United States. It was one of the thirteen commonwealths that established the American Union, and has played a leading part in every great crisis of that country's history. In the Civil War it was the chief battleground, and suffered more than any other state; but after years of courageous effort its material progress is now steadily upwards.

Population. — In 1880 the population was 1,512,565; in 1890, 1,655,980; and in 1900, 1,854,184, a gain for the latter decade of 12 per cent., as compared with 9 "5 per cent, for the preceding decade. Of the population in 1900, 925,897 were males and 928,287 females; 1,834,723 were native-born, and 19,461 (only 1 per cent.) foreign-born. The white population is increasing much more rapidly than the coloured. In 1880 there were 880,858 whites and 631,616 negroes; in 1890, 1,020,122 whites and 635,438 negroes; in 1900, 1,192,855 whites ana 660,722 negroes. Out of 301,379 adult white males, 36,493 (12-1 per cent.) were illiterate (unable to write); while out of 146,122 adult negro males, 76,764 (52-5 per cent.) were illiterate. In 1880 there were six cities — Richmond, Norfolk,

Petersburg, Lynchburg, Alexandria, and Portsmouth — with over 10,000 inhabitants each. In 1900 there were three others in addition, Roanoke, Newport News, and Danville. Richmond in 1900 had a population of 85,050; Norfolk (46,624), Petersburg (21,810), Roanoke (21,495), Newport News (19,635), Lynchburg (18,891), Portsmouth (17,427), Danville (16,520), Alexandria (14,528). The total land surface is 40,125 square miles, the average density of

population being 46-2 in 1900 per square mile, as com- pared with 41 -3 ten years earlier.

Education. — The following are the statistics of the school population — all between five and twenty-one years old : —

Year.

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1890 1899 1900 1901

376,657 425,658

275,388 265,662

220,210 241,696 250,697 258,222

122,059 117,129 119,898 123,339

5358 6492 6587 6637

2153 2314 2335 2311

5550 6671 6761 6809

1963 2165 2193 2199

The progress of the state university has been rapid, increasing from 306 students in 1886-87 to 670 on 19th January 1901, while the teaching staff

rose during the same period from 24 to 55. In the school for the deaf and the blind, who are taught various trades in addition to the common branches, there were 153 deaf and 57 blind pupils on 22nd December 1900.

Penal and Insane Institutions. — On 1st October 1899 the peni- tentiary contained 1263 convicts (224 white and 1039 coloured), and the state farm 253 (56 white, 197 coloured). Besides these, 28 coloured convicts were hired out, making a total of 1544 (280 white and 1236 coloured). The net gain to the state from the labour of the convicts for the year ending 30th September 1899

was $46,598. On 30th September 1900 the asylum for insane negroes at Petersburg (including insane epileptics in separate building) contained 868 patients. At the same date the three asylums (at Staunton, "Williamsburg, and Marion) for insane whites contained 1918.

Religion. — The religious statistics of the eight most numerous denominations were in 1890 as follows : —

Denominations.

Members.

Number of Churches.

Value of Church Property.

Baptists

303,134

1938

$3,152,582

Methodists .

154,693

~~1646~~

~~2,910,853~~

~~Presbyterians~~

~~27,746~~

~~369~~

~~1,234,501~~

~~Episcopalians~~

~~20,420~~

~~332~~

~~1,700,075~~

~~Campbellites~~

~~14,100~~

~~148~~

~~240,929~~

~~Roman Catholics.~~

~~12,356~~

~~44~~

~~458,800~~

~~Lutherans .~~

~~12,220~~

136

344,915

Dunkards .

7,244

93

78,473

Of the Baptists, 199,871 were negroes, owning 977 of the churches. Of the Methodists, 27,855 were negroes, owning 210 of the churches.

Industry. — The number of farms in the state in 1900 was 167,886, with an acreage of 19,907,883, of which 10,094,805 acres were im- proved, 9,813,078 unimproved. The value of farm property was $323,515,977, and of the products $86,548,545, as compared with $42,244,458 ten years earlier. The principal farm crops were Indian corn, , valued at $16,233,756; hay, $7,670,082; tobacco $7,210,195 ; wheat, $6,161,000 ; forest products, $3,797,116 ; and orchard fruits, $2,662,483. The following table shows the manu- facturing and mechanical industries as returned at the censuses of 1880, 1890, and 1900 with the percentage of increase : —

1880.

1890.

1900.

Percentage of Increase.

1880-1800.

1890-1900.

Number of establishments Capital .....

~~Wage earners ....~~

~~Value of product ....~~

~~5,710 $26,968,990~~

~~40,184 $51,780,992~~

~~5,915 $63,456,799~~

~~53,566 $88,363,824~~

~~8,248 $103,670,988~~

~~72,702 $132,937,910~~

~~3-6~~

~~135-3~~

~~33-3~~

~~70-6~~

~~39-4 63-4 357~~

~~50-4 ■~~

~~The leading industries, with the value of their products, are : tobacco, $21,278,266 ; flour and grist mills, $12,687,267 ; lumber and timber, $12,137,177; iron and steel, $8,341,888; foundries and machine shops, $4,833,137 ; and cars and shop construction by steam railway companies, $6,277,279. Virginia has become one of the greatest shipbuilding states in the Union, Newport News and Richmond being the chief centres.~~

~~Railways, Banks, &c. — In 1899 there were 3691 miles of railways and canals in Virginia, of which 985 belonged to the Norfolk and Western, 665 to the Southern, and 619 to the Chesapeake and Ohio. The value of all railway and canal property was $55, 460, 759, and the net income of~~

the same was $1,340,001. The value of all the property of the ten steam navigation companies (the two principal ones being the Old Dominion Steamship Company and the Virginia Navigation Company) was $825,752. The value of all property of express companies was $36,808, and that of all telegraph and telephone property was $653,320. In 1900 there were 128 banks, including 12 savings banks and 42 national banks. The total par value of shares was $10,595,661, and the market value was $11,652,452. In 1893-94 there were 83 building and loan associations.

Finances. — In 1899 the assessed value of real estate was $311,385,454, of which sum coloured persons owned $11,643,164. The assessed value of all personal property was $102,886,723, of which coloured persons owned $3,303,773. The total assessed value of all property was $414,272,177. The taxes on property and the income and capitation taxes amounted to $2,080,967, of which $183,932 was assessed on coloured persons. The receipts from liquor licences for the year ending 30th September 1899 wero $255,542, and from other licences, $382,168. The total receipts of the state from all sources were $3,475,404, and the total expendi- tures, $3,111,430. On 6th December 1900 the state debt amounted to $26,806,434.

History. — The most important episode in recent history is the controversy over the. state debt. This debt, amounting to nearly $39,000,000 when Virginia seceded from the Union, had been contracted chiefly for the purpose of buying stock in turnpike, canal, and railway companies. During the War of Secession additional debt was contracted, but as the payment of this was forbidden in the Fourteenth Amendment to the United States Constitution, we are concerned only with the ante helium debt. At the close of the war, the citizens of Virginia found themselves impoverished as few peoples have ever been. The Northern armies had seized cattle, horses, sheep, hogs, and crops, and had destroyed

many fences, stables, barns, and dwellings ; while a social and economic revolution, more sweeping than the French, had sud- denly given freedom to the slaves, upon whose value as property the state's ability to pay its debts had been largely based. Still both HHouses of her legislature passed a

~~*Bill pledging payment in full of her share of the debt — viz. , two-thirds of the sum due before the creation of the state of West Virginia took from Virginia one-third of her soil and population. In 1878 a new party sprung up led by General Mahone, and known as the "readjusters," openly advocating repudiation of a part of the debt. Mahone had been a candidate for nomination as governor by the Democrats, as the great majority of the white people called themselves, but failed to secure it. Too astute, however, to proclaim himself a Republican, he continued to label himself Democrat, and announced as his programme the "readjustment" of the debt. The negroes followed their new master. In the elections of 1879 and 1881 Mahone triumphed completely, and having both the legislature and Governor of Virginia under his control, proceeded to repudiate a considerable portion of the debt. Before his victory the Democrats had passed a Bill (March 1879) enabling the holders of state bonds to fund them in new bonds with tax-receivable coupons. Mahone's legislation, however, for- bade tax-collectors to receive coupons ; and the United States Supreme Court gave a decision which seemed to uphold the constitutionality of this device for evading the acceptance of coupons. The bondholders still maintained the fight ; but the confliet became one of legal technicalities, case after case being taken into the Federal courts to test the constitutionality of the various legislative Acts. In 1892 the battle ended by a compromise, under which the bondholders secure much more than at one time seemed possible ; while Virginia, though still heavily burdened with debt, is paying the interest, and steadily acquiring the financial strength to pay the principal also.*~~

~~*Recent Political History in Virginia. — Except during the period when a considerable minority -were led by the debt question into temporary alliance with the negroes, the vast majority of white Virginians have enrolled themselves, since the War of Secession, in the so-called Democratic party. For a time they styled themselves Conservatives ; and this name indicated more correctly their aim. In 1872 the state was carried by General Grant, the Republican candidate for the Presidency, but, the Democratic candidate, Horace Greele}', was a former abolitionist, and therefore obnoxious to the people of Virginia. The state has voted for every Democratic Presidential candidate since that time. No Republicans, and only*~~

one " Eeadjuster " — Cameron, in 1881 — has ever been elected Governor of Virginia. Mahone strained every nerve to be elected as a Republican in 1889, but was beaten by more than 42,000 majority ; and since then the Democratic party has been in com- plete control. In 1893 the Opposition called itself the " Populist " party, but was thoroughly beaten. In July 1900 a law went into effect requiring Virginian railways to provide separate, though equal, accommodation for negroes and whites. A constitutional con- vention was held in 1901 to frame a new Constitution. This was proclaimed, on 10th July 1902, as the organic law of the common- wealth. In many respects the new instrument is a great improve- ment upon the old, the executive, legislative, and judiciary departments being all conservatively remodelled with a view to increased efficiency and diminished expense, while the financial system is so modified as to promote the equalization of burdens, increase the revenue, and lower the rate of taxation. Important, too, is the "state corporation commission," consisting of three members to be appointed by the Governor, and clothed with power to issue all charters to domestic corporations and all licences to foreign corporations to do business in the state, as well as with the power and duty of supervising, regulating, and controlling transportation and transmission companies. But the most import- ant change relates to suffrage, the aim being to disfranchise as many negroes and as few whites as possible without violating the United States Constitution, which forbids disfranchisement on the ground of race, colour, or previous condition of servitude. To accomplish this aim the following provisions will be in force till 1st January 1904. Any male citizen twenty-one years of age who has resided two years in the state, one year in the city, county, or town, and thirty days in the voting precinct, may be registered as a voter for life, provided (1) that he has fought in the army or navy of the United States or the Confederate States or any single state ; or (2) that he is a son of such soldier or sailor ; or (3) that he has paid for the preceding year at least one dollar in taxes on property ; or (4) that he can read and explain any section of the Constitution, or, at any *- ate, understand and explain its meaning when read to him. Through one

or another of these four gates nearly every white man in the state can enter. Very few negroes, however, can enter through the first three, and it is confidently expected that not emly most of those unable to read, but many of those who can, will fail of entrance through the fourth gate. This is the "understanding clause," preferred by the Virginian Convention to the ' ' grandfather clause " adopted in some other states. After 1st January 1904 these four gates will be closed ; and thenceforth any new applicant must not only have paid his poll-taxes for the three preceding years, but must also apply for registration in his own handwriting, stating (without assistance of any sort) his name, age, date,, and place of birth, residence, and occupation at the time and for the two preceding years. He must also answer on oath any questions affecting his qualifications as an elector — the questions and answers being officially recorded. So much for the temporary and permanent conditions of registration. But no one, except those who fought on one or the other side in the "War of Secession, can actually vote who has not paid his poll- taxes for three years, and who cannot prepare and deposit his ballot without aid, unless he be one of those registered before 1st January 1904.

Authorities. — Virginia: A Hand-Book, giving its history, climate, and mineral wealth; its educational, agricultural, and industrial advantages. Published by direction of the State Board of Agriculture. By Thomas Whitehead. Richmond, 1893. — Virginia: A History of the People, by John Estex Cooke. Boston, 1883. — Economic History of Virginia in the 17th Century, by Philip A. Bruce. — History of the Virginia Debt Controversy, by William L. Royall. Richmond, 1897. (r. h. d.)

Virginia. City, a city of Nevada, U.S.A., capital of Storey county, on the eastern slope of Mount David- son, and on the Virginia and Truckee Eailroad, in the southern part of the state, at an altitude of 6339 feet. Following the fortunes of the Comstock lode, over which the city is built, it has declined in prosperity in recent years. The population, which in 1880 was 10,917, was in 1890 but 8511, and in 1900 had further dimi- nished to 2695, of whom 837 were foreign-born and 118 coloured.

Virgin Islands, a presidency of the Leeward Islands colony, West Indies. Population (1891), 4639 ; (1897), 4769. The inhabitants are peasant

~~proprietors, engaged in raising cattle and vegetables, and in burn- ing charcoal ; some are fishermen and boatmen. The climate is more healthy than that of the other West~~

~~India Islands, and the heat is not so great. The small trade that exists is chiefly with St Thomas. In 1898 the imports were valued at £3943, the exports at £3855. The revenue was £1715 and the expenditure £1783.~~

~~Vischer, Friedrich Theodor (1807-1887),~~

~~German writer on the philosophy of art, was born at Ludwigsburg, 30th June 1807, and was the son of a clergyman. He was educated at Tubingen, and began life in his father's profession. In 1835 he became privat- docent in aesthetics and German literature at his old university, was advanced in 1837 to extraordinary pro- fessor, and in 1844 to full professor. Immediately after- wards, as the 'result of a quarrel with the Clerical party, he was suspended for two years by the Wiirtemberg Government, and in his enforced leisure wrote the first two volumes of his Aesthetik, oder Wissenschaft des Schonen (1846), the fourth and last volume of which did not appear till 1857. Vischer threw himself heartily into the great German political movement of 1848-49, and shared the disappointment of patriotic democrats at its failure. In 1855 he became professor at Zurich. In 1866, his fame being now established, he was invited back to Germany with a professorship at Tubingen com- bined with a post at the Polytechnik of Stuttgart. He died at Gmunden, 14th September 1887. His writings include a great many literary essays collected under the titles Kritische Gauge and Altes und Neues, poems, an excellent critical study of Goethe's Faust (1875), and a successful novel, Auch Einer '(1878). Vischer was not an original thinker, and his monumental Aesthetik, in spite of industry and learning, has not the higher qualities of success. He attempts the hopeless task of explaining art by the Hegelian dialectic. Starting with the definition of beauty as " the idea in the form of limited appearance," he goes on to develop the various elements of art (the beautiful, sublime, and comic), and the various forms of art (plastic art, music, and poetry) by means of the Hegelian antitheses — form and content, objective and subjective, inner conflict and reconciliation. The shape of the work also is repellently~~

Hegelian, con- sisting of short highly technical paragraphs containing the main argument, followed by detailed explanations printed in different type. Still, Vischer had a thorough know- ledge of every branch of art except music, and much valuable material is buried in his volumes if one could detach it from the framework of antiquated theory. In later life Vischer moved considerably away from flegeli- anism, and adopted the conceptions of sensuous complete- ness and cosmic harmony as criteria of beauty ; but he never found time to rewrite his great book. HIs own work as a literary artist is of high quality; vigorous, imaginative, and thoughtful without academic techni- cality, (h. St.)

Visconti-Venosta, Emilio, Makquis(1829-

), Italian statesman, was born at Milan on 22nd

January 1829. A disciple of Mazzini, he took part in all the anti – Austrian conspiracies until the ineffectual rising at Milan on 6th February 1853, of which he had foretold the failure, induced him to renounce his Mazzinian allegiance. Continuing, nevertheless, his anti-Austrian propaganda he rendered good service to the national cause, but being molested by the Austrian police, was obliged in 1859 to escape to Turin, and was appointed by Cavour Eoyal Commissioner with the Garibaldian forces. Elected deputy in 1860, he accompanied Farini on diplomatic missions to Modena and Naples, and was subsequently despatched to London and Paris to acquaint the British and French Governments with the course of events in Italy. As a recompense for the tact displayed

on this occasion he was given by Cavour a permanent appointment in the Italian Foreign Office, and was sub- sequently appointed secretary-general by Count Pasolini. Upon the death of Pasolini he became foreign minister (24th March 1863) in the Minghetti Cabinet, in which capacity he negotiated the September Convention for the evacuation of Eome by the French troops. Kesigning office with Minghetti in the autumn of

1864, he was in March 1866 sent by La Marmora as minister to Constanti- nople, but was almost immediately recalled and reappointed foreign minister by Eicasoli. Assuming office on the morrow of the second battle of Custozza he succeeded in preventing Austria from burdening Italy with a proportion of the Austrian Imperial debt, in addition to the Venetian debt proper. The fall of Ricasoli in February 1867 deprived him for a time of his office, but in December 1869 he entered the Lanza-Sella Cabinet as foreign minister, and retained his portfolio in the succeeding Minghetti Cabinet until the fall of the Eight in 1876. During this long period he was called upon to conduct the delicate negotia- tions connected with the Franco-German war, the occupa- tion of Eome by the Italians and the consequent destruction of the temporal power of the Pope, the Law of Guarantees, and the visits of Victor Emmanuel II. to Vienna and Berlin. Upon the occasion of his marriage with the daughter of the Marquis Alfieri di Sostegno, grand-niece of Cavour, he was created marquis by Victor Emmanuel II. For a time he remained a member of the parliamentary Opposition, but in 1886 was appointed senator. In 1894, after eighteen years' absence from active political life, he was chosen to be Italian arbitrator in the Bering Sea question and in 1896 once more accepted the portfolio of foreign affairs in the Eudini Cabinet at a juncture when the disasters in Abyssinia and the indiscreet publication of an Abyssinian Green Book had rendered the international position of Italy exceedingly delicate. HIs first care was to improve Franco-Italian relations by negotiating with France a treaty with regard to Tunis. During the nego- tiations relating to the Cretan question and the Grseco- Turkish war, he secured for Italy a worthy part in the European Concert and joined Lord Salisbury in saving Greece from the loss of Thessaly. Eesigning office in May 1898 on a question of internal policy, he once more retired to private life, but in May 1899 again assumed the management of foreign affairs in the second Pelloux Cabinet, and continued to hold office in the succeeding Saracco Cabinet until its fall in February 1901. During this period his attention was devoted chiefly to the Chinese problem and to the maintenance of the equilibrium in the Mediterranean and the Adriatic. In regard to the Mediterranean he established an Italo-French agreement by which France tacitly undertook to leave Italy a free hand in Tripoli, and Italy not to interfere with French policy in the interior of Morocco ; and, in

regard to the Adriatic, he came to an understanding with Austria guaranteeing the status quo in Albania. Prudence and sagacity, coupled with unequalled experience of foreign policy, enabled him to assure to Italy her full portion of influence in international affairs and secured for himself the unanimous esteem of European Cabinets. Though credited with Francophil tendencies, his straightforward interpretation of the Triple Alliance quickly won for him the confidence of Germany and Austria, while the sincerity of his regard for Great Britain contributed to maintain the cordiality of Anglo – Italian relations. His policy was defined by himself in one of his last speeches to the Italian Chamber in the words : " Faithful to our alliances, but constant in our friendships ; . . . independent always, isolated never." In recognition of his remarkable services he was created Knight of the Annunziata by Victor

Emmanuel III. on the occasion of the birth of Princess Yolanda Margherita of Savoy (1st June 1901).

Vision. See Physiology : Special Senses.

Vistula., the chief river of eastern Prussia. In 1888 the Prussian parliament voted a credit of one million sterling, for the purpose of preventing or mini- mizing the inundations to which the lower (deltaic) portion of the Vistula was subjected. The money was spent in the construction (1895) of a straight cut, 4^- miles long, from the confluence of the Elbinger Vistula to the sea, the new waterway being made 1300 feet wide and 11 J feet deep. In 1898 the right-hand deltaic branches of the Vistula, known as the Kdnigsberger and the Elbinger Vistula, were both made' navigable by being dredged to a mean depth of 9 feet and widened to 100 feet. Moreover, from Eothebude on the Vistula an artificial channel (the Vistula-Haff canal) has been constructed to the Frisches Haff, a distance of 12^ miles, of which 8^ were actually dug out ; the surface width being 59 feet, the bottom width 37 feet, and the minimum depth 5^ feet.

Vatascope. See Cinematograph.

Vitebsk, a government of West Eussia, adjoining the Baltic Provinces, with an area of 17,440 square miles. It is mainly built up of Devonian red

sandstones and red clays, but the Carboniferous formation — both the Lower, characterized by layers of coal, and the Upper — appears in the east. The whole is covered with Glacial and post-Glacial formations, in which remains of extinct mammals and stone implements are found in large quantities. There are numerous burial-mounds containing bones and iron implements and decorations.

The population, which was 1,204,950 in 1884, numbered 1,502,916 (domiciled only) in 1897, of whom 753,898 were women, and 220,170 lived in towns ; 62 per cent, of the inhabitants are White Russians, 21 per cent. Letts, 10 per cent. Jews, 5 per cent. Great Russians, and 2 per cent. Poles. Nearly all the artisans are Jews. The government is divided into eleven districts, the chief towns of which are : Vitebsk, Drissa (4240), Dvinsk, formerly Diinaburg (72,231), Gorodok (5509), Lepel (6316), Lutsin (3929), Nevel (9988), Polotsk (20,751), Ryezhitsa (10,681), Sebezh (4344), and Velizh (12,201). The standard of education is low. In 1897 there were only 1022 primary schools attended by 30,800 boys and 8460 girls. Of the total area of 11,161,600 acres, forests covered 4,300,000 acres in 1855 ; large stretches have since been cut down, but woods still occupy 3,506,000 acres. About 30 per cent, of the total area is cultivated, and of this the peasants own 37 per cent., private persons 55 per cent, the Crown 6‘5 per cent., and various institutions 1‘5 per cent. Small landowners are especially numerous, the peasants eagerly buying land from their landlords. In 1900, 2,030,200 acres were under cereal crops, and the average yield in 1895-99 was : rye, 4,054,000 cwt. ; wheat, 125,000 cwt. ; oats, 2,422,000 cwt. ; barley, 1,412,000 cwt. ; also 7,547,000 cwt. of potatoes, largely cultivated for distilleries. Gardening is highly developed. Industries are in their infancy, and the annual returns of all factories (chiefly distilleries, match factories, chemical works, and plain woollen cloth mills) do not exceed 5,851,000 roubles.

Vitebsk, the capital of the above province, on both banks of the river Diina, 345 miles by rail west of Moscow. Being in railway communication with both capitals, as well as with Riga, Warsaw, and Prussia, and standing on a navigable river, it carries on an active trade, mainly in corn and animal products. Population (1897), •

66,143.

Viterbo, a city and episcopal see of the province of Rome, Latium, Italy, 54 miles by rail north-north-west of Eome. The church of Santa Maria della Verita, with 15th-century frescoes, is now used as a public hall. In the neighbourhood are the ancient Etruscan cemeteries Castel d' Asso, Norchia, &c. Viterbo is the centre of the territory of the "patrimony of Peter," which the Countess Matilda of Tuscany gave to the Papal see in the

12th century. The manufactures include soap, matches, and paper. In the vicinity are mines of alum and sul- phur. Population (1881), 16,563 ; (1900), about 16,000.

Vitoria., the capital of the Basque province of Alava, Spain, 31 miles south-south-east of Bilbao. It is the see of a bishop, and lies on the railway from Madrid to France. Electric light and other improvements have been introduced. Population (1887), 27,660; (1897),

30,514.

Vitry le Francois, chief town of arrondisse- ment, department of Marne, France, 20 miles south-east of Chalons, on the railway from Paris to Strasburg, at the junction of the Marne-Rhine and Haute-Marne canals. The church of Notre Dame is a 17th-century edifice, with fine 18th-century monuments. A convent of the Recollets is now occupied by the H6tel de Ville, the Palais de Justice, and a small museum ; other local institutions are a library with 17,000 volumes and over 70 MSS., com- munal colleges for boys and for girls, and a hospital. The Avenue Carnot, laid out since 1895 on the site of the former fortifications, connects a new square, containing a military monument, with the railway station, and a bronze statue and square preserve the memory of Roger Collard (1763-1845), a native of the district. There are im- portant cement works, and works for the manufacture of mosaics, bell-casting, and iron-founding ;

active com- merce is carried on in cereals, wood, malt, and wool. The port traffic on the Marne lateral canal amounted in 1900 to 34,330 tons, and on the Haute-Marne to 9868 tons. The present town was built in 1545 by Francis I. to replace the older one of Vitry-en-Perthois (population, 684 in 1901), 2£ miles to the north-east, burned in the previous year by Charles V. The new town was granted various commercial and administrative privileges, which drew to it many inhabitants from the surrounding district. Popu- lation (1896), 7709 ; (1901), 8075.

Vittorio, a town and episcopal see of the province of Treviso,' Venetia, Italy, 25 miles by rail north of Treviso. It is a summer resort, with sulphur and saline springs (51-8° to 59° Fahr.), and has been formed by the union of Ceneda and Serravalle. It possesses a cathedral with a fine altarpiece (1547) by Titian, another church with numerous paintings by Amalteo and others, and a statue to Victor Emmanuel (1882). It is a seat of the silkworm breeding and silk-throwing industries, and also carries on manufactures of woollens, paper, cement, and lime. Population (1900), about 11,000.

ViverO, a town of Spain, province of Lugo, in one of the deep fjords of Galicia. It is connected with the opposite bank of the estuary by a bridge of twelve arches and a causeway. It is an old-fashioned place, with a parish church, hermitages, an unpretentious town hall, and schools. Its fishing fleet, the coasting trade, and the agricultural products of the fertile country around are important. Population (1887), 11,926; (1897),

12,477.

Vivisection. — This word means literally the cut- ting of living animals (see Experiments on Animals), and might be applied to all surgical operations whether practised upon man or animals. As conventionally used, however, it has exclusive reference to operations upon the lower animals undertaken for experimental purposes. Such experiments have for their object the advancement of the sciences of physiology and pathology. From the earliest periods experimental vivisections have occasionally been practised, but it will be readily imagined that before the days of anaesthetics it was difficult to execute them, and not less difficult to draw conclusions. The invention

~~of anaesthetics has greatly extended the scope of the experimental method, because an animal can be kept unconscious and quiet without even a quiver of a muscle during prolonged operations and subsequent observation. Further, the introduction of the antiseptic method has made it possible to subject all tissues and regions of the body to surgical interference, and this has also had the effect of increasing the possibilities of experimental research.~~

~~In the year 1876 the practice of vivisection in the United Kingdom was made subject to law, and an Act was passed "To amend the Law relating to Cruelty to Animals." The chief provisions of this Act are as follows : — " A person shall not perform on a living animal any experiment calculated to give pain " except subject to the following restrictions, viz. : (a) The experimenter must be licenced by the Home Secretary, and the experiment must be carried on in a place duly registered by the Home Secretary. (6) The animal must be anaesthetized, and, if the pain be likely to continue, be killed before recover- ing from the anaesthetic, (c) The experiment must not be performed in illustration of a lecture unless an enabling certificate (in addition to the licence) be granted by two eminent men of science (Certificate C).~~

~~Certificates may also be granted by two eminent men of science for dispensing with the use of anaesthetics (Certificate A), and for allowing the animal to survive the initial operation (Certificate B). Some of the domestic animals are specially protected by the Act ; thus Clause 5 says, "An experiment shall not be per- formed without anaesthetics on a dog or cat " (Certificates E and EE), and " and shall not be performed on any horse, ass, or mule " (Certificate F) without enabling certificates granted by two eminent men of science. Clause 2 designates the eminent men of science (certain Presidents of Royal societies and colleges, and medical professors in chartered colleges), two of whom must sign every application for a licence and every certificate granted under the Act. The Home Secretary shall cause "all registered places to be visited from time to time by inspectors " (Clause 10). Clause 8 pro- vides that the Home Secretary may revoke a licence " on his being satisfied that such licence ought to be revoked," and further states that " there may be annexed to such licence any conditions which the Secretary of State may think~~

expedient for the purposes of better carrying into effect the objects of this Act, but not in- consistent with the provisions thereof."

Only the main provisions of the Act are given above but it is as well to state that the Act is rather complicated and not very clear, and that all intending licensees should obtain a copy and endeavour to master it. It is interest- ing to note that only one attempt (an unsuccessful one) to obtain a conviction under the Act has ever been made. In one sense this is to be regretted, because the Act stands in need of interpretation. The licensees have always obeyed the interpretation of the Home Office, and in fact Clause 8 gives the Home Secretary the power of interpreting the Act in any way he chooses. For example, the interpretation of Clause 5 has given rise to some discussion. This clause provides that " an operation shall not be performed without anaesthetics on a cat or dog " unless an enabling certificate be obtained (Certificate E). If anaesthetics be used, and if the animal be killed before recovery, it is clear that a cat or dog may be used without Certificate E. If anaesthetics be used for the initial operation, and the animal be allowed to recover (Certificate B), is it permissible to use a cat or dog without an enabling certificate, E? The Home Secre- tary has answered this question in the negative, because

so long as the animal lives it is in an experimental con- dition — a somewhat arbitrary decision. The custom is to issue two forms of certificates for the use of cats and dogs, one designated E to be coupled with Certificate A, and the other designated EE to be coupled with B.

The Act was framed for the control of "experiments calculated to give pain." All operations on the lower animals which are not of the nature of experiments, such as gelding and spaying, are still performed without let or hindrance by farriers, and the word " experiment " remains to be interpreted. A veterinary surgeon must sometimes be in grave doubt as to his relations to the Act. Again, the words "calculated to give pain" are left to be inter- preted by the licensee. The result is that the man who wishes to perform experiments on living animals of any kind usually protects

himself by applying to the Home Secretary for a licence and certificates, and the Home Secretary never takes upon himself the responsibility of saying that the experiments proposed are, from the point of view of pain, too trivial to come under the Act. Thus such experiments as feeding an animal on tubercu- lous meat, or rubbing the fungus of ringworm on the back of a mouse with a view to transplantation, have been performed under the Act. Such procedures are not in any sense "vivisections," but it is to be noted that the word vivisection is nowhere used in the Act, which is for the control of " experiments calculated to give pain."

Since the Act was framed the science of bacteriology has made great strides, and as a consequence the inoculation of animals (chiefly guinea-pigs and other small rodents) has become increasingly necessary, and the bacteriologist is accustomed to protect himself by becoming a licensee under the Act. Hence the belief is general that although one may vaccinate a baby, a risk of a £50 fine is incurred by vaccinating a guinea-pig. Whether a jury would take this view is doubtful. The writer has closely examined many thousands of inoculated guinea-pigs, and he has never seen one which he could say was in pain. It is quite clear to any one who reads the Act that the framers of it did not contemplate the trivial operation of inocula- tion. Out of 9151 experiments performed in 1898, no less than 7640 were needle pricks or proceedings equally trivial. (g. v. p.).

Vizagapatam, a town and district of British India, in the Madras Presidency. The town stretches for 3 miles along the coast on both sides of the mouth of a small river and has a station on a short branch of the East Coast Bailway, 494 miles north-east of Madras. Population (1881), 30,291; (1891), 34,487; municipal income (1897-98), Ks.44,000. The town owes much to the munificence of the neighbouring Raja of Viziana-gram. A water supply has been provided at a cost of Rs. 1,60, 000, and there is a system of sewage filtration. The European quarter is known as Waltair. There is a considerable Roman Catholic population and a London mission. The exports by sea include rice and sugar. Some weaving is carried on, and a speciality is made of ornamental boxes, &c, carved out of sandalwood, horn, ivory, porcupine quills, and silver. The aided college had 36 students in 1896-97, and "the three aided high

schools 950 pupils. There are eight printing-presses, issuing a district gazette, a7id two weekly newspapers in English; three reading-rooms and literary institutions. The hemp-mill producing bags and cloth has 2084 spindles and 98 looms, and employs 800 hands.

The district of Vizagapatam has an area of 17,242 square miles. Population (1881), 2,481,284; (1891), 2,802,992, showing an apparent increase of 13 per cent.; average density, 162 persons per square mile, ranging from 68 in the Agency tract to 421 in

the rest of the district. In 1901 thu population was 2,933,537, showing a further increase of 5 per cent. The land revenue and rates in 1897-98 were Rs.19,49,413, the incidence of assessment ranging from Rs.2.11.2 per acre in the rayatwari lands to R.0.1.7 in the zamindaris ; cultivated area (in the rayatwari lands alone), 235,431 acres, of which 95,298 were irrigated from tanks, &c, including 30,069 from Government canals ; number of police, 1727 ; boys at school (1896-97), 30,366, being 14‘5 per cent, of the male population of school-going age ; registered death- rate (1897), 31 “6 per 1000, the highest rate in the province. The principal crops are rice, millet, other food-grains, and oil-seeds. The district is traversed throughout by the East Coast Railway, opened from Madras to Calcutta in 1901 ; and it has been pro- posed to construct a line through the hills from Vizianagram to Raipur in the Central Provinces. The chief seaports are Bimli- patam and Vizagapatam. In 1897-98 the total sea-borne trade was valued at Rs.94,17,240, of which nearly half was with foreign countries.

Vizeu, a town and episcopal see of Portugal, capital of district Vizeu, 50 miles south-east of Oporto, and 4 ‘miles north-west of the Dao (an affluent of the Mondego). The cathedral, which was founded by Count Henrique, con- tains pictures by the native artist, Grao Vasco. The town stands near the ruins of the ancient Vacca, or Cava de Viriato, a Roman military colony founded by Decius Brutus, and captured by Viriathus the Lusitanian. Popu- lation (1890), 7996. The district of Vizeu, which corre- sponds to the ancient province of Beira Alta, has an area of 1920 square miles, and a population (1900) of 402,799.

~~Vizianagram, a town of British India, in the Vizagapatam district of Madras, 1 7 miles from the seaport of Bimlipatam ; station on the newly opened East Coast Railway (528 miles north-east of Madras), whence it is pro- posed to extend a branch north through the hills to Raipur. Population (1881), 22,577 ; (1891), 30,881 ; municipal income (1897-98), Rs.35,550. Until recently it was a military cantonment. It contains the residence of a zamin- dar of the same name, who ranks as the first Hindu nobleman of Madras. His estate covers an area of about 3000 square miles, with a population of 900,000. The estimated income is £180,000, paying a permanent land revenue of £50,000. The town possesses many fine buildings, entirely supported by the Maharaja. The college had 96 students in 1896-97; the two high schools 745 pupils. There are two printing-presses, one of which issues a newspaper in English, a library, and a young men's association.~~

~~Vladikavkaz, a town and fortress of Russia, northern Caucasia, the capital of the province of Terek, on a plateau, at an altitude of 2340 feet, on both banks of the Terek, where that river issues from the Darial gorge. It is 433 miles by rail from Rostov-on-the-Don, and has regular communication by coach with Tiflis (133^ miles). Moreover, a line of railway, running eastwards to the Caspian ports of Petrovsk and Baku, connects Vladikavkaz, or rather the station Beslan, 14 miles north of it, with the Transcaucasian Railway, that is, with Tiflis, Poti, and Batum. It occupies an important military position, defending the only good passage across the central portiou of the main Caucasus range, and is also advantageously situated for trade. Consequently its population has grown very rapidly from 2500 in 1859 to 10,000 in 1870, and 43,843 in 1897.~~

~~Russians, Armenians, and Jews constitute the bulk of the population, which also contains Ossets, Chechens, Ingushes, and others. The garrison numbers 12,000, besides Cossacks. There are soveral large distilleries and a number of smaller factories, showing an aggregate annual return of about £200,000. The town is well built, and has gymnasia for boys and girls, about twenty primary schools, a. handsome theatre, public gardens, and several monu- ments to Russian generals. The best quarter of the town is that on the right bank of the Terek ; an iron bridge connects it with tho commeroial quarter.~~

Vladimir, a government of Central Russia, lying between Moscow and Nijni-Novgorod, with an area of 18,864 square miles. The geology of the province, and especially of its western parts, has been investigated by Professor Nikitin, who has ascertained that under the Glacial and post-Glacial deposits — the lower layers of which contain remains of the mammoth and rhinoceros, and the upper widely-spread fossils of prehistoric forests — occur Lower Chalk deposits and deposits intermediate between the Chalk and the Jurassic ("Volga" deposits). Upper Jurassic (Kellaway and Oxford) and Upper Car- boniferous deposits are also found, and at Gorbatoff, Permian marls. Its population, which was 1,359,330 in 1883, numbered in 1897 1,570,733 (domiciled only), of whom 837,512 were women and 183,783 lived in towns.

It is divided into thirteen districts, the chief towns of which are: Vladimir, Alexandroff (6848), Gorokhovets (2783), Kovroff (14,570), Melenki (8904), Murom (12,589), Pereyaslavl Zalesskiy (8662), Pokroff (2925), Shuya (18,968), Sudogda (3406), Suzdal (8000), Vyazniki (7398), and Yurieff Polskiy (5637). Ivanovo- Voznesensk (53,949), Gusevsk, Kholui, and several others are important industrial towns. The zemstvos (provincial and dis- trict councils) make considerahle efforts to spread education and improve the sanitary arrangements, and there were in 1897 1313 primary schools attended by 51,077 boys and 18,021 girls. The peasants hold 5,591,000 acres in communal ownership, and of this 60 per cent, is arable land; 3,802,800 acres belong to private owners, 552,300 acres to the Crown, and 370,000 acres to the Imperial family. The soil is not very fertile and the standard of agriculture is low, the inhabitants being largely engaged in manufactures. Still there were in 1900 1,908,200 acres under cereals, and the average yield in 1895-99 was : rye, 5,588,000 cwt. ; wheat, 146,000 cwt. ; oats, 2,522,000 cwt. ; barley, 183,000 cwt. ; various cereals, 567,000 cwt. ; also 5,550,000 cwt. of potatoes. Cattle – breeding is only less important than agriculture, and in 1897 there were in the province 190,830 horses, 300,000 horned cattle, 271,000 sheep, and 17,000 p!gs. Gardening is very widely spread, and cherries and apples are

exported in considerable quantities. Of minerals the only important one is alabaster, of which some 8500 tons are obtained annually. Vladimir ranks third among the governments of European Russia for manufactures. It has some 500 large factories, which employ over 100,000 persons (one-third women), and the aggregate returns of which amounted in 1898 to no less than 206,557,000 roubles. The principal establishments are cotton, linen, and silk mills, dye-works, and rope, paper, cardboard, oil, chemical, machinery, glass, and iron works (producing annually 342,000 cwt. of pig iron and 136,000 cwt. of iron), tanneries and distilleries. "Wood, coal, naphtha, and peat are all used as fuel. There are, further, about 1000 small factories, employing about 5000 workers, and domestic industries are to be found in nearly every village ; the most important of these minor industries are cotton, linen, and silk weaving, and the making of hardware and glass goods. The movement of shipping on the Volga and its tributaries and sub-tributaries, the Oka, the Klyazma, and the Teza, is con- siderable. The principal ports are Murom on the Volga, and Kovroff, Vyazniki, and Oryekhoff on the Klyazma. Timber, wood for fuel, and manufactured goods are the chief exports. The province affords a very rich field for research to the archaeologist. Numbers of Palaeolithic stone implements, mixed with bones of the mammoth and the rhinoceros, and still greater numbers of Neolithic stone implements have been discovered. There are also a great number of burial-mounds belonging to the Bronze and Iron periods, and containing decorations in amber and gold ; nearly 2000 such burial-mounds are scattered round Lake Plescheyevo, some of them belonging to the pagan period and some to the early Christian. Coins from Arabia, Bokhara, Ger- many, and Anglo-Saxon lands are found in great quantities.

Vladimir, the capital of the above government, on the rivers Klyazma and Lybed, 114 miles by rail east of Moscow. It remains an old city, with very unsatisfactory sanitary arrangements, and its industries and trade are below those of several towns in the govern- ment. Besides the usual lyceums for boys and girls it has, however, a technical school with about 100 pupils, and its population is now increasing more rapidly, num- bering 28,065 in 1897.

~~Vladimir-Volhynsk, a district town of Russia, in the government of Volhynia, 17 miles N.N.E. of the~~

~~spot where the frontiers of Russia proper, Poland, and Galicia meet, and 34 miles S.W. of the South- Western Eailway at Kovel. It is an ancient town, not mentioned in the annals before 988, but probably in existence in the 9th century under the name of Ladomir. In the 10th century it was the capital of the principality of Volhynia, and in the Middle Ages covered a very large area, and was well fortified. The Tatars and the Lithuanians besieged it and destroyed it several times, but it always recovered, and only fell into decay in the 17th century. It was finally annexed to Russia after the first division of Poland. There are several very interesting ruins in and near the town, including remains of a church supposed to have been built by Vladimir, and of another built in 1160 by Mtsislav ; judging from parts of its floor which have been discovered, this latter was very well built, and its length exceeded that of the temple of St Sophie at Kieff. The town contains a good archaeological museum, and had in 1897 a population of 9695, three-fourths of whom were Jews.~~

~~Vladivostok, the chief Russian seaport and naval station in the Pacific Ocean, situated at the southern extremity of the Maritime Province, comparatively near the point where that government meets both Manchuria and Korea. It is now connected by rail with Khabarovsk (475 miles N.N.E.), the capital of the Amur region, and by means of the Trans-Manchurian Railway with Tchita in Transbaikalia (1280 miles), via Ninguta, Harbin, Tsitsikar, and Hailar. The town has greatly developed, and has several handsome buildings, a monument to Admiral Nevelskoy, gymnasia for boys and girls, several professional schools, a naval hospital, mechanical and naval works, four steam saw-mills, three steam flour-mills. In 1897 its population was 28,896. The port of Vladi- vostok grows every year in importance, chiefly for imports ; but the great bulk of the latter are for the Government, i.e., either for the Manchurian Railway or for the military. The great drawback of Vladivostok is that it has not, and cannot have, a well-developed hinterland. Efforts have been made by the Russian Government to supply the Usuri region (to the north of Vladivostok) with Russian settlers. However, the physical characters of the valley of the Usuri are such as to prevent a considerable agri- cultural~~

population from ever being settled there. In 1882, notwithstanding heavy expenditure, only 3000 Russian peasants had been settled in the South Usuri region, in fourteen villages, and only 1500 were added, during the next fifteen years, out of emigrants who had come overland. Besides 28,460 emigrants brought in in ships on 1st January 1899, the agricultural Russian popu- lation (in addition to the Cossacks) was 52,724, in 108 villages. Nearly all of these (103) were situated in the South Usuri district, near Lake Hanka, on the littoral near Vladivostok, and only five villages in the central part, i.e., in the valley of the Usuri. The Cossacks num- bered at the same' time only 11,293, in fifty villages. During the years 1899-1901, 28,256 persons more immi- grated (peasants), and a few thousand Cossacks were settled in the territory of the Usuri Cossacks, while on 1st January 1899 there were also 15,190 Koreans — all in the South Usuri district — and a still larger number of Chinese (estimated). Altogether, owing to the peculiarities of the wet climate, the Russian settlers do not prosper.

(p. A. K.)

Vogel, Sir Julius (1835-1899), British Colonial statesman, son of Albert Leopold Vogel, was born in London on 24th February 1835, was educated at Univer- sity College school, London, and emigrated to Victoria during the exciting years which followed the discovery of

gold-fields there. He became editor of a newspaper at Maryborough, stood for the Legislative Assembly and was defeated, and in 1861 left Victoria, carried in the mining rush to Otago, New Zealand, where much gold had just been found. Settling in Dunedin, he bought a half-share in the Otago Daily Times, and was soon its editor and a member of the Otago Provincial Council. He made his paper the most influential in the colony, and was returned to the House of Eepresentatives. In 1866 he was head of the Otago Provincial Executive; by 1869 he had made his mark in

~~the New Zealand Parliament, and was treasurer in the ministry of Sir William Fox. Without delay he brought forward his famous public works policy, a scheme for the construction of trunk railways and other public works, the purchase of land from the Maori tribes, and the introduction of immigrants, all to be done with money borrowed in London. At that time New Zealand hardly contained a quarter of a million of white settlers, was exhausted by the ten years' struggle with the Maori, not then ended, and was depressed by the low price of her staple product, wool, and the abatement of a gold-fever. Yet Vogel's sanguine, energetic appeals and remarkable gift of persuasion induced the House of Assembly to adopt a modified version of his scheme. For the next six years he was the most powerful man in the colony. Millions were borrowed, railways were pushed on, immi- grants — State and voluntary — streamed in. Lasting peace was made with the Maori, a telegraph line laid to Australia, a steam mail service secured across the Pacific to San Francisco ; a Government life insurance office, and a public trust office, were established, both of which proved useful and were well-managed. During a visit to London on the colony's financial business, Vogel suc- ceeded in arranging for the inscription of Colonial loans at the Bank of England, an arrangement afterwards confirmed by an Act of the Imperial Parliament. In**

~~1875 he was knighted. But in 1874 Vogel, until that time a supporter of the Provincial system, decided to abolish it. In this, with the aid of Sir E. W. Stafford and Sir H. A. Atkinson, he succeeded. In the struggle, however, he broke with many of his old allies, and in~~

~~1876 suddenly quitted New Zealand to take the post of Agent-General in London. This he held until 1880, and while holding it negotiated a loan for five millions. But having become connected with certain public companies, and the New Zealand Government objecting thereto, he had to resign his position. An attempt, too, which he made in 1880 to enter the House of Commons as Con- servative member for Penryn was unsuccessful. Still his influence was great in New Zealand, and when in 1884 he returned thither he was elected by acclamation to Parliament, and at once formed a coalition ministry with the Badical leader, Sir R. Stout. They held office for three years, but though Vogel showed some of his old financial skill, they were not years of prosperity for the colony, or~~

triumph for the Government. A deficit, a rejected scheme of taxation, and a crushing defeat at the polls, ended Vogel's career as a minister. After a few months of failure as leader of an outnumbered Opposition he gave up the contest, left New Zealand for the last time, and for the last eleven years of his life lived quietly near London. Throughout his life he had from time to time to struggle with deafness, lameness, and attacks of acute bodily pain, while an impulsive, speculative nature led him once and again into financial difficulties. The persistency with which he faced trouble and embarrass- ment, the hopefulness he showed under stress of ill-fortune, the sympathy and pleasantness of manner which won him friends at all times, were elements in his curious and interesting character no less remarkable than the fertility

and imaginative power of his busy brain. Vogel was among the pioneers of Imperial Federation; he would have extended Great Britain's influence in the Pacific Ocean had he been allowed. He was the first minister to secure the second reading of a Women's Franchise Bill in New Zealand. As long ago as 1874 he endeavoured to save the New Zealand forests from the reckless destruction by axe and fire which has ever since gone on. In 1889 a novel from his pen, Anno Domini 2000, was published, and reached a second edition. He died at East Molesey on 13th March 1899. His wife, who was the daughter of William Clayton, Government architect, New Zealand, two sons, and a daughter survived him. Another son had been killed in the Matabele war in South Africa. Vogel was a Jew of the Ashkenazi rite. (w. p. e.)

Voice. — The voice is produced by vibrations of the vocal cords, and developed in volume and quality by the resonance of the upper cavities. The general mechanism of the larynx has been described in the 9th edition of this work, vol. xxiv. p. 273 seq. And there are only a few points to be noticed that have received attention since the date of that article.

1. The Muscular Mechanisms. — The vocal cords are tightened by the action of the crico-thyroid, or, as it might be more appropriately termed, the thyro-cricoid muscle. It stretches the thyro-arytenoid ligaments, the free edges of which, covered by mucous membrane, form the vocal cords. The adductors of the cords are the lateral crico- arytenoids, while the

posterior crico-arytenoids are the abductors. The arytenoid muscle brings the cords to- gether. Many of the fibres of the thyro-arytenoid are inserted obliquely into the sides of the «ord, and in con- traction they tighten the cord by pulling on the edge and making it curved instead of straight. Some such action is indicated by the elliptical shape of the rima glottidis in passing from the chest register to the middle register. Other fibres, however, running parallel with the cord may tend to relax it in certain circumstances. All the muscles except the thyro-cricoid (which is innervated by the supe- rior laryngeal) receive nerve filaments from the inferior laryngeal branch of the vagus, the fibres being derived from the accessory roots. Both the abductor and adductor nerves come therefore from the inferior laryngeal. When deeply anaesthetized stimulation of the inferior laryngeal nerve causes abduction of the cord, but if the anaesthesia is slight, then we have adduction (Semon, Brit. Med. Jl., 1886, vol. ii. p. 405). The tonic contraction of the abduc- tors is stronger than that of the adductors, so in a state of rest the glottis is slightly open. The centre of inner- vation is in the medulla oblongata, and this is dominated by a centre in the Rolandic region of the cerebral cortex.

2. The Voice Registers. — The voice has been divided by writers into three registers, the lower or chest, the middle, and the small or head register. In singing, the voice changes in volume and in quality in passing from one register into another. There is remarkable diversity of opinion as to what happens in the larynx in passing through the various registers (see art. " Vocal Sounds," by author and Gray in Schafer's Text-Booh of Physiology, vol. ii. p. 1210, along with bibliography, p. 1214). There has also been much discussion as to the production of falsetto tones. Lehfeldt and Johannes Miiller held that a weak blast of air caused only a portion of the cords, as regards length, to vibrate ; Oertel noticed that when a falsetto tone is produced nodal lines are formed in the cords parallel to their edges, an observation supporting the first contention ; Garcia was of opinion that as the voice rose in pitch into falsetto only the ligamentous edges of the cords vibrated ; and Hodgkinson snowed by

dusting finely powdered indigo into the larynx and ob- serving the blue specks with the laryngoscope that "in the deeper note of the lower register the vibrating margin extended from the thyroid cartilage in front to a point behind the junction of the ligamentous and cartilaginous portions of the cord" (Hodgkinson, Brit. Med. JL, 1895, vol. ii. p. 482). In singing falsetto tones these additional parts are not thrown into action. Some remarkable and instructive photographs obtained by French show that in proceeding from the lowest to the highest notes of the lower register the cords became lengthened by one-eighth of an inch in a contralto singer's larynx ; the same singer, in passing into the middle register, showed a shortening oft the cords by one-sixteenth of an inch, and another increase in length when the upper part of the middle register was reached (Semon, Proc. Roy. Instit., London, 1891 ; French, Verhandl. d. internat. med. Kong., Berlin, 1890). 3. Vowel Tones. — During the last few years much attention has been directed to the musical quality of vowels. A vowel is a musical tone produced by the vibrations of the vocal cords. The tone produced by the vocal cords is a mixed one, composed of a fundamental and partials, and certain of the partials are strengthened . by the resonance of the air in the air-passages and in the pharyngeal and oral cavities. In this respect the quality of the human voice depends on the same laws as those determining the quality or timbre of the tones produced by any musical instrument. The pitch of the note of a musical instrument, however, depends on the pitch of the first or fundamental tone, while the partials are added with greater or less intensity so as to give a special char- acter to the sound ; and in the case of a vowel tone the pitch does not appear to depend on that of the funda- mental tone but on the pitch of the resonance cavity, as adjusted for the sounding of any particular vowel. When we wish to pronounce or sing a vowel the oral cavity must be adjusted to a certain form, and it is only when it has that form that the vowel can be sounded. Many attempts have been made to determine the pitch of the oral cavity, with the result that competent observers have given very different estimates, probably because the vowel tones of men of different nationalities are not alike (see art. " Voice," by author, in Schafer's Text-booh of Physiology, vol. ii. p. 1215 ; this also contains full bibliographical references). The nature of vowel tones has been investigated by means of the phonograph by Fleeming Jenkin and Ewing, Hermann, Pipping, Boeke, Lloyd, McKendrick, and others. These

observers may be ranged in two divisions — those who uphold the theory of relative as opposed to those who contend for the theory of fixed pitch. Assuming that a vowel is always a compound tone, composed of a fundamental and partials, those who uphold the relative pitch theory state that if the pitch of the fundamental is changed the pitch of the partials must undergo a relative change, while their opponents contend that whatever may be the pitch of the tone produced by the larynx, the pitch of the partials that gives quality or character to a vowel is always the same, or, in other words, yowel tones have a fixed pitch. The methods by which this problem can be investigated are mainly two. The pitch of the oral cavity for a given vowel may be experimentally deter- mined, or an analysis may be made of the curve-forms made on the wax cylinder of the phonograph when a vowel is sung into it. By such an analysis, according to Fourier's well-known theorem, the curve may be resolved into the partials that take part in its forma- tion, and the intensity of those partials may be thus determined. The observations of Donders, Helmholtz, Konig, and others as to the pitch of the resonating

cavities gave different results. Greater success has followed the attempts made by Hermann, Boeke, McKendrick, Lloyd, and Marichelle to analyse the curves imprinted on the phonograph. (Examples of such phono- grams are given by the author in the article on "Vocal Sounds" in Schafer's Physiology, vol. ii. p. 1228; see also Phonograph.)

The following is an instructive analysis by Boeke of the curves representing the tones of a cornet, and it illustrates the laws that govern the production of quality in such an instrument : —

Note ..12 3 4 5 6 7, 8 9 10 Partials.

/ =170 vibs. . 1 1'05 1-22 1-15 1-01 080 0'53 0*28 013 010 „

c' =256 „ . 1 092 0'81 053 0'39 0'20 0W 0'04 0-06 0'04 „

^=384 „ 1 0-76 0-46 0-14 0'09 0'06 0'07 0'02 0-01 0'01 „

c"=512 „ . 1 0-92 0-30 014 015 0'09 0'07 0'06 003 002 „

These figures represent the relative intensities of the partials entering into the formation of the note, and it will be observed that the intensity gradually diminishes. This analysis may be contrasted with that of the vowel da sung by Boeke (set. 50) on the notes / and c', and the same vowel sung on the notes (f and e" by his son (set. 12).

Man, set. 50, singing dd.

Pitch ..123456789 10 Partials. /= 170 -6 vibs. 1 0-86 0-46 1'74 T90 1'55 0-51 0-64 0-43 0'44 „ c'=256 „ 1 049 1'96 1-25 0'60 056 023 0'05 0'06 010 „.

Boy, set. 12, singing dd.

Pitch. . 12 3 4 5 6 Partials.

g =384 vibs. . 1 1-22 267 0-45 017 0-06 „ e' =640 „ . 1 8-09 1-45 053

It will be observed that in both these cases the intensity of the partials does not fade away gradually as we proceed from the lower to the higher partials, as with the cornet, but that certain partials are intensified more than others, namely, those printed in black. In other words, the form of the resonating cavity develops particular partials, and these modify the quality of the tone. If we multiply the vibrational number of the fundamental tone by the num- ber of the partial we obtain the pitch of the resonance cavity ; or if we take the mean of the partials reinforced, we obtain the pitch of the mean resonance. Lloyd applies this method to the above figures, as follows :— =-

Partials Reinforced.

Mean Partial.

Pitch in

Complete Vibration.

Man's dd. / =170-6 vibs. . . . c'=256 . . .

Boy's dd. / = 384 vibs. c"=640 „ ...

4-6 3-4

2-4 1-3

4-96 3-39

2'82 2-04

846 868

1084 1307

This analysis shows : (1) That the man's resonance rises slightly (half-semitone) in ascending seven semitones in the middle of his register ; (2) that the boy's resonance rises three semitones in ascending nine semitones in the upper half of his register ; and (3) in the mid-register the boy's resonance is to the man's as 5 : 4. Thus, as we sing a vowel in an ascending scale the pitch of the oral cavity slightly changes, or, in other words, the pitch of the resonating cavity for a given vowel may be slightly altered. Lloyd supports the view that vowels owe their quality not to the resonance of a partial or partials of a certain fixed pitch, but to the relative pitch of two or more partials. He describes a pharyngeal or a-resonance and an oral or ^-resonance, and the ratio of these resonances, or the radical ratio, as he calls it, determines the nature of the vowel. Thus, for a, as in "fat," the lower resonance has a pitch of 736, while the upper has 1121. The radical ratio is therefore

1121 736

= 1-47.

708

VOLCANOES — VOLHYNIA

It would appear that both theories are partially true ; they are not mutually exclusive. The view of Donders that each vowel has an oral

~~cavity of unchangeable and fixed pitch is too exclusive, and, on the other hand, it cannot be denied that each vowel has a predominant partial or predominant partials which give it a definite character, and which must be produced by the oral cavity as a whole, or by the double resonance of portions of the cavity, as suggested by Lloyd. As we sing a vowel in an ascending scale the form of the resonance cavity may slightly change, but not sufficiently to alter the quality of the vowel. Thus we still detect the vowel tone. A singer almost instinctively chooses such vowels as best suit the resonating arrangements of his or her voice, and avoids vowels or words containing vowels that would lead to the production of notes of inferior quality.~~

~~Authorities. — Helmholtz. Sensations of Tone, trans, by Ellis, 1875, p. 165. — Konig. Comptes Bendus, 1870, t. lxx. p. 931 ; also Qudques experiences d'acoustique, 1882, p. 47. — Donders. Be physiologie der spraakhlanken, 1870, s. 9; also "TJeber de Vokell, " Archiv f. d. Holland Beitr. 3. Nat. v. Heil., Utrecht, 1857, Bd. i. s. 354. — Donkin. Fourier's theorem, Acoustics, p. 65; Fleeminu Jenkin and Ewing, Trans. Roy. Soc. Ed., vol. xxviii. p. 750 ; Lloyd, Proc. Hoy. Soc. Ed., 1898 ; PJwnetische Stud. 1890-92 ; Jl. of Anat. and Phys., London, vol. xxxi. p. 233 ; ibid., vol. xxxi. p. 240. — Hermann. Phonophotographische Untersuch., Bd. i.-v. ; Archiv f. d. ges. Physiol., Bonn, Bd. xlv. s. 582 ; Bd. xlvii. s. 44 ; Bd. xlvii. s. 347 ; Bd. liii. ». 1 ; Bd. lviii. s. 255.— Pipping. Zeitschr. f. Biol., Munich, Bd. xxvii. s. 1 ; also Acta Societatis Scientiarum Fennicm, Bd. xx. part ii. — Boeke. " Mikroskopische Phonogram – studien, " Archiv f. d. ges. Physiol., Bonn, Bd. i. s. 297 ; also Proc. Roy. Soc. Ed., 1896. — McKendrick : Trans. Roy. Soc. Ed. , vol. xxxviii. part ii. ; Proc. Roy. Soc. Ed. , 1896-97 ; Sound and Speech Waves as revealed by the Phonograph, London, 1897 ; Schafer's Text-booh of Physi- ology, vol. ii. , Art. ' ' Vowel Sounds ; " and Nature, Dec. 26, 1901. (In the latter there is an account of the important researches of Dr Marage.) — Marichelle. La Parole d'apres la trace du Phonographe. Paris, 1897. — Marage. Theorie de la Formation des Voyelles. (j. g. M.)~~

~~Volcanoes. See Geology.~~

~~Volcano Islands, three small islands forming part of the Japanese empire, and known in Japan as Kwazan-retto (series of volcanic islands). They are situated between 24° and 26° N. and 141° and 142° E. Their names are Kita-iw6-jima, Iwo-jima, and Minami- iwo-jima. Kita-iw6-jima — which, as its name (kita) implies, is the most northerly of the three — rises to a height of 2520 feet above the water, and Minami-iwo-jima, the most southerly, to a height of 3021 feet.~~

~~Volchansk, a district town of Eussia, in the government and 53 miles N.E. of the town of Kharkoff, connected by a branch line (29 miles) with Byelgorod on the Kursk-Kharkoff Railway. Owing to the activity of the zemstvo (or district council) the primary schools in the town and the district are in an exceptionally good condition. In addition to a normal school for teachers the town contains several tanneries, while there are in the district several important distilleries and sugar works. The town was founded in 1674, and had in 1897 a population of 11,322.~~

~~Volga, the chief river of European Russia, and by far the largest river in Europe, rising on the Valdai plateau in the province of Tver, and after a sinuous course of 2325 miles entering the Caspian Sea at Astrakhan. It drains an area covering 563,300 square miles, or more than the aggregate areas of Germany, France, and the United Kingdom, with a population of over fifty millions. The total length of navigable rivers in its basin is 19,728 miles, that is, 38 per cent, of the length of all navigable rivers in European Russia. In 1898 the Volga and its tributaries were navigated by 1392 steamers of 86,775~~

~~horse-power, and 7600 other vessels of 5,505,000 tons. The Neva and the canals joining it to the Volga were further navigated by 362 steamers of 118,830 horse- power, and 7102 other vessels of 2,056,000 tops. Thus 55 per cent, of all the steamers plying in European Russia belong to the Volga basin.~~

~~The traffic on the Volga continues to he enormous, notwith- standing the competition of the railways. In 1897 14,515,000 tons of goods were transported in the basin of the Volga (includ- ing about 4,000,000 tons on rafts), of which 3,615,000 tons were timber, 1,540,000 tons wood for fuel, 2,291,000 tons cereals, 3,011,000 tons naphtha and various oils, 604,000~~

tons salt, and 3927 tons various goods. Further, no less than 125,000 tons were transported by way of canals from the Volga to the Neva, and 70,000 tons in the opposite direction, and 70,000 tons from the Volga to the Northern Dvina (Archangel), and 35,000 tons in the opposite direction. Considerable efforts have been made to keep the depth of the main channel always the same ; naturally, it varies to such an extent that in summer the river can only be navigated by vessels with one-half the draught and one-third the cargo of those it will receive in spring. A dozen dredging machines are kept continually at work, while some forty steamers are stationed near the main sandbanks to assist vessels running aground. The leakage from the boats which transport naphtha up stream from the Caspian Sea is so great that fears have been .excited that it may seriously affect the fishing industry. The following table shows the principal river ports, together with the movement of shipping in an average year : —

Chief River Ports on the Volga.

Vessels.

Tons.

Approxi- mate Value oi Trade.

Entered.

Cleared.

Imported.

Exported.

Total.

Astrakhan . Tsaritsyn Rybinsk

Nijni-Novgorod . Saratoff

2,724 6,412 3,760 12,960 1,639

~~3228 1482 6296 7685 1738~~

~~938,000 1,162,000~~

~~590,000 4,092,000~~

~~923,000~~

~~3,734,000~~

~~402,000~~

~~172,000~~

~~84,000~~

~~128,000~~

~~4,672,000 1,614,000 762,000 4,176,000 1,051,000~~

~~Roubles.~~

~~73,900,000 47,000,000 33,800,000 25,800,000 17,800,000~~

~~The chief ports for the export of cereals are Samara (278,600 tons), Balakovo (200,000 tons), Saratoff (100,000 tons), and Rovnoye (80,000 tons), all on the Volga, and Chistopol on the Kama (100,000) ; for salt, Vladimirovka on the Volga (200,000), and Novo Usolie and Dedyukhino on the Kama (100,000 and 50,000 tons respectively) ; for iron, Levchinsk on the Chusovaya (100,000 tons) ; for naphtha, Astrakhan. From the last-named over 2,870,000 tons of naphtha and naphtha refuse, and 500,000 tons of refined oil and other naphtha produce are shipped ; 660,000 tons are unloaded at Tsaritsyn to be shipped by rail into the interior of Eussia, 606,000 tons at Saratoff, over 700,000 tons at Nijni – Novgorod, and about 150,000 at Rybinsk. Wood is chiefly shipped from Vetluga and Makarieff on the Unzha. The export of eggs and poultry, both alive and dead, has assumed important dimensions ; the chief exporting governments (in the Volga basin) are Kazan, Samara, Saratoff, and Nijni-Novgorod. As a rule, the goods are shipped for long distances, varying,~~

ac- cording to the class of goods, from 200 miles to 1060 miles ; the average distance is 552 miles, so that the whole traffic is repre- sented by 15,390 ton-miles (23,085 .metric ton-kilometres) for all European Russia, as against 27,580 ton-kilometres for the traffic on all railways. Of the river traffic denoted by the above figure, about 55 per cent, falls within the basin of the Volga. As to cost it is estimated to be only one-third of that by rail. .

(p. A. K.)

Volhynia, a government of South-West Russia, on the Austrian frontier, with an area of 27,473 square miles. Its population, which was 2,096,500 in 1884, numbered 2,997,902 (domiciled only) in 1897, of whom 1,485,461 were women, and 231,083 lived in towns. It is divided into twelve districts, the chief towns of which are Zhi- tomir, which is also the capital of the province, Dubno (13,785), Kovel (17,304), Kremenets (17,618), Lutsk (18,525), Novgrnd Volhynskiy (16,873), Ostrog (14,530), Ovrutch (6057), Vladimir Volhynskiy (9695), Rovno (24,905), Staro – Konstantinoff (16,527), and Zaslavl (12,688). The standard of education is relatively high, and school gardens are extending in the villages.

The conditions of peasant ownership differ from those which prevail in other parts of Russia, and of the total area of 17,582,720 acres the peasants held in 1896 only 8,120,000 acres ; 42 per cent, of the total was in the hands of private owners a considerable

number of Germans having settled and bought land in the pro- vince. Forests occupied in 1897 5,632,000 acres, covering nearly 50 per cent, of the area in the north (that is, in the so-called Polyesie), and 15 per cent, elsewhere. Agriculture is well developed in the south, and in 1900 there were 4,222,400 acres under cereal crops alone. The average yield in 1895-99 was : rye, 8,817,000 cwt. ; wheat, 4,290,000 cwt. ; oats, 5,721,000 cwt. ; barley, 2,135,000 cwt. — all cereals, 5,801,000 cwt. ; also 14,290,000 cwt. of potatoes, which are largely grown for dis- tilleries. The beet crop of

1899 was estimated at 6,126,000 cwt., and that of tobacco (1500 acres) at 1000 tons. Gardening and apiculture (150,000 hives) are widely engaged in with excellent results, and large quantities of fruit are exported. The live- stock is increasing, especially horses in the southern districts ; in 1898 there were in the province 748,550 horses, 845,360 horned cattle, 916,000 sheep, and 613,000 pigs. Lignite and coal, some graphite and kaolin are mined, as also amber, which is often found in very big lumps. Manufacturing industries are not very highly developed. The factories are limited to a number of large sugar works and distilleries, some woollen cloth mills, and candle, tobacco, and agricultural machinery works, and their aggregate annual returns do not exceed 25,000,000 roubles. Domestic industry in the villages is chiefly limited to the making of all sorts of wooden goods, including parquetry. The exports of grain and timber, chiefly to Germany and Great Britain, and of wool and cattle, are considerable. The chief imports are agricultural machinery and manufactured goods.

Vo+kovysk (Wdtkowysk), district town of Russia, in the government of Grodno, 52 miles by rail east of Byelostok. It is an ancient town, the possession of which was long disputed by the princes of Volhynia and Lithuania, it being held first by one and then by the other. It was finally annexed to Russia after the first division of Poland. It has two flour-mills and several small factories, and had in 1897 a population of 10,584.

-), German

Vol I mar, Georg von (1850-

Socialist, was born at Munich in 1850. HIe was educated in a school attached to a Benedictine monastery at Augsburg, and in 1865 entered the Bavarian army as a lieutenant in a cavalry regiment. HIe served in the campaign of 1866, and then entered the Papal army as a volunteer. In 1869 he returned to Germany, and during the war with France served in the army railway depart- ment. HIe was severely wounded at Blois and pensioned. Permanently crippled by his wounds he devoted himself to political and social studies. In 1872 he was converted to the principles of Social Democracy, and as soon as his health was sufficiently restored threw himself with great energy into the political agitation. In 1877 he

became editor of the party organ at Dresden, and under the Socialist law was repeatedly condemned to various terms of imprisonment, and was also expelled from that city. From 1879 to 1882 he lived at Zurich, then the head- quarters of Social Democracy, when besides attending the university he took part in editing the Social-Demokrat. In 1881 he was elected member of the Reichstag, and from 1883 to 1889 was a member of the Saxon Diet. Since 1885 he has resided in Bavaria, and it is to him that is chiefly due the great success of the Socialists in the older Bavarian provinces ; he succeeded in completely defeating the Clerical party on their own ground, so that Munich was in 1902 represented in the Reichstag by four Socialists. His great popularity and influence in Bavaria have given him a peculiar position in the party and have enabled him to use his power to found a more moderate and opportunist section. He has decisively dissociated himself from the doctrine of a sudden and violent over- throw of society, and urged his associates to co-operate in bringing about a gradual development towards the Socialistic state. He has refused to identify Social Democracy with the extreme views as to religion and the family advocated by Bebel; he has expressed his approval of the military and foreign policy of the German Government, when, as in the Triple Alliance, it is necessary to preserve

the safety of Germany from foreign aggression, and has shown himself willing to co-operate with the Governments in practical measures for improving the condition of the working man. He successfully resisted attempts made in 1891 to expel him from the party in consequence of an important speech in which he explained his position, and in the Bavarian Diet, of which he has been a member since 1893, he has won for his party a better position than they have secured elsewhere. He has even succeeded in establishing occasional co-operation between Social Democrats and Liberals in opposition to measures of the Government which seemed dangerous to liberty.

VolO, a seaport town of Greece, on the east coast of Thessaly, in the province of Larissa, at the head of the Gulf of Volo. It is the chief seaport and second in- dustrial town of Thessaly, connected by rail with the town of Larissa. The anchorage is safe, vessels loading and discharging by

means of lighters. The port has a depth of 23 to 25 feet. Population (1889), 11,029;

(1896), 16,232.

Vologda, one of the largest governments of Euro- pean Russia, bordering on the Urals, and bounded on the N. by Archangel and Yaroslavl, on the E. by Tobolsk, on the S. by Perm, Vyatka, and Kostroma, and on the W. by Novgorod and Olonets. It has an area of 150,498 square miles, exceeding that of Great Britain, and its population, which was 1,172,250 in 1883, in 1897 numbered 1,365,587 (domiciled only), of whom 710,930 were women and only 57,407 lived in towns.

It is divided into ten districts, the chief towns of which are: Vologda, Gryazovets (3205), Kadnikoff (2356), Nikolsk (2550), Solvychegodsk (1710), Totma (4562), Ustyug Velikiy (11,307), Ust-Sysolsk (4463), Velsk (1796), and Yarensk (991). There were 1153 primary schools in 1898, attended by 40,090 boys and 9500 girls. Of the total area of 98,539,000 acres, 87,989,000 acres are covered with forests. Agriculture is the chief occupation of the people, but it thrives only in the three south- western districts, where dairy-farming and the making of butter and cheese are rapidly developing. In the remainder of the pro- vince only 4 per cent, of the area is under fields. Cattle-breeding occupies considerable numbers, and there were in the province in 1897 243,630 horses, 549,500 horned cattle, 419,820 sheep, and 51,000 pigs. A little salt is raised, and there are a few iron works, but manufacturing industries are in their infancy, the annual returns of all factories barely exceeding 4,300,000 roubles; the chief branch is the weaving of linen in the villages. Trade is limited to the export of linen, timber, a little iron, salt, hides, furs, fish, and game, and since Archangel lost so much of its foreign trade, the export of these has greatly fallen off.

Vologda, the capital of the above government, on the river Vologda above its junction with the navigable river Sukhona, connected by rail with the Volga, opposite Yaroslavl (128 miles), and with Arch- angel (395 miles). Its buildings are chiefly of wood. It has a few distilleries, tanneries, and oil, soap, tobacco, candle, and fur-dressing works, and carries on trade with St Petersburg, where it exports grain, hides, and eggs, and

Archangel, to and from which nearly 400 vessels pass by way of the river Sukhona every year. In 1897 it had a population of 27,822.

Volta, the largest river of the coast of Upper Guinea, from the Gambia to the Niger, with a length of about 900 miles. Although its lower course had been known since the early discoveries of the Portuguese, from whom it received its present name on account of the winding nature of its stream, it was only within the last fifteen years of the 19th century that the extent of its basin — extending as it does far north within the bend of the Niger — was first made known. There are two main upper branches, known respectively as the Black and White Volta, the Black Volta being probably the more important.

Their sources lie on the grassy plateaux to the north of the forest belt of the Guinea coast, the Black Volta rising (as the Baule) in about 111 N., 4° 50' W. Its course is -at first east and north-east to 12° 25' N., at which point, after receiving a tributary from nearly 14° N. — the most northerly point of the basin — it turns sharply south, maintaining that general direction till 8° 15' N. Here it is deflected east, and even north, by a mountain range composed of sandstone and granite, which it finally breaks through by a narrow pass, in which its width is only some 60 yards. Elsewhere it has a general width of 150 to 200 yards. In 0° 50' W. it receives the White Volta, which flows generally south from about 13° N. and likewise breaks through a narrow gap in the plateau escarpment. Both rivers are described as noble streams during four months in the year, but in the dry season they shrink greatly, reaching their lowest level at the end of January. Below the junction the Volta flows south-east and south, turning, however, east for 40 miles just north of 6°. In 7° 37' N. it receives on the left bank a large tributary, the Oti, coming from 12° N". In its lower course, through the forest belt, the river has often a width of over half a mile, with a depth 'in placds of 40 to 50 feet in the rains, but in 6° 18' N. it traverses a pass in which its width is narrowed to 30 yards. Its use as a waterway is limited by a number of rapids, the lowest of which occur in 6° 7' N., above the trading port of Akuse. Its mouth is also

obstructed during the greater part of the year by a bar. The lower Volta was explored by Bonnat in 1875, but the upper basin was first traversed by the German traveller Krause (1886-87) and the French Captain Binger .(1888). It has since been explored by a number of colonial officials — German, French, and British. Between 6° 41' and 8° 8' N. the Volta forms the boundary between the Gold Coast and German Togoland, while the upper course of the Black Volta separates the Gold Coast from the French Sudan and Ivory Coast.

See Binger, Du Niger au Golfe de Guinee (Paris, 1889) ; Northcote, Report on the Northern Territories of the Gold Coast (London, 1899) ; and various papers and maps in the Mitteilungen aus den Deutschen Schutzgebieten. (u. IIe.)

Volterra, a town and bishop's see of the province of Pisa, Tuscany, Italy, 51 miles south-east of Pisa by rail. The national museum (1731), with the Etruscan cinerary urns, is now in the Tagassi Palace, which also contains a library, mediaeval sculptures, and a collection of coins. There are an industrial institute, mineral spring (saline), iron-works, and the staple industries in alabaster, and salt-pans. Population (1881), 7349; (1900), about

7500.

Voltri, a lively industrial town of the province of Genoa, Liguria, Italy, on the coast, 9 miles north-west of Genoa by rail. Its principal industries are iron-works and shipbuilding yards, cotton, woollen, and jute mills, confetti and paper factories. It also possesses a pilgrimage church and a technical school. At Acquasanta, 3 miles to the north, are mineral baths (71"6° Fahr.). Population (1881), 7238; (1900), about 7500.

Vorarlberg', the most westerly province of the Austrian empire. It consists of three districts (Bregenz, Bludenz, and Feldkirch), which are under the adminis- trative authority of the " statthalter " (or "prefect") at Innsbruck, but possess a Governor and Diet of their own (twenty-one members), and send three members to the Imperial Parliament. Vorarlberg is composed of the hilly region of the Bregenzerwald, and (to its south) of the mountain valley of Montavon or of the upper III, through

which an easy pass leads to the Tirolese valley of Paznaun, and so to Landeck. Near Bludenz the Kloster glen parts from the 111 valley ; through the latter runs the Arlberg rail- way (1884) — beneath the pass of that name (5912 feet) — to Landeck and Innsbruck. The 111 valley is bounded on the south by the snowy chain of the Rhatikon (highest point, the Scesaplana, 9741 feet, a famous view-point), and the Silvretta (highest point, Gross Piz Buin, 10,880 feet), both dividing Vorarlberg from Switzerland ; slightly to the north-east of Piz Buin is the Dreilanderspitze (10,539 feet), where the Vorarlberg, Tirolese, and Swiss frontiers unite.

The total area of Vorarlberg ‘is 1004 ‘3 square miles. Of this 88 \ per cent. , or about 886 square miles, is reckoned ‘ ‘ productive, ” 30 per cent, of this limited area being occupied by forests, while 118 square miles rank as “unproductive.” According to the census of 31st December 1890, the population of the Vorarlberg amounted to 116,073 souls. All were Romanists save 1216, and all German-speaking save 3085 Italians. The largest town in the province is Dornbirn (which comprises several adjacent villages), of which the population was 10,678 in 1890. In 1890 Bregenz, the political capital of the Vorarlberg, had 5396 in- habitants (now about 7000) ; Feldkirch, 3811 (now about 4000) ; and Bludenz, 3265 (now 4504). Of all the Austrian Alpine lands Vorarlberg is the richest in milk products. In 1890 it possessed 58,231 horned cattle; and 12,424 goats ; the total amount of milk produced has been reckoned as high as 15 J million gallons per annum, of which nearly one-half is made into cheese. It is reckoned that in 1893 there were 265,000 spindles in the Vorarl- berg, employing about 7000 workmen, while embroidery at home supported from 13,000 to 14,000 persons.

Authorities. — J. R. von Bergmann. Landeskunde v. Vorarl- berg. Innsbruck, 1868. — Max Haushofer. Tirol and Vorarlberg. Bielefeld and Leipzig, 1899. — O. von Peister. Bos Montavon. Augsburg, 1884. — J. Staffler. Tirol und Vorarlberg, 5 vols. Innsbruck, 1839-46. — A. Waltenberger. Algau, Vorarlberg, und Westtirol, 8th edition. Innsbruck, 1896. See also the list of books at the end of Tirol, especially vol. xiii. (Tirol ‘u. Vorarl- berg), Vienna, 1893, of the great official work entitled Die oester- reichisch-ungarische Monarchie in Wort und Bild.

(w. A. B. C.)

Voronezh, a government of South Russia, with an area of 25,448 square miles. Owing to emigration from the province to Siberia its population only increased from 2,532,840 in 1883 to 2,546,255 (domiciled only) in 1897, of whom 1,279,196 were women and 173,907 lived in towns. The inhabitants are about equally divided into Great Russians in the north, and Little Russians in the south, but there are some 3000 Germans, 1500 Jews and Karaites, and 1200 Poles. The government is divided into twelve districts, the chief towns of which are : Voronezh, Biryuch (13,194), Bobroff (3891), Boguchary (6853), Korotoyak (9391), Nizhne – Dyevitsk (2426), Novokhopersk (6088), Ostrogozhsk (21,891), Pavlovsk (7221), Valuiki (7085), Zadonsk (8313), a great monas- tery, and Zemlyansk (6126). Several villages, such as Buturlinovka (21,694), Kalatch (12,928), and Vorontsovka (12,000), are more populous than some of the district towns, and carry on a considerable trade. The standard of education is higher than in many of the central governments, and there were in 1898 30 middle schools attended by about 6500 pupils, and 1545 primary schools attended by 73,000 boys and 17,440 girls. Owing to a very fertile soil agriculture is successfully prosecuted. The peasants own 67 per cent. (9,914,000 acres) of the land, the Crown and the Imperial domains 3 per cent., and private owners 30 per cent. Nearly seven-tenths of the total area is arable land, and in 1900 5,807,100 acres were under cereal crops. The average yield in 1895-99 was : rye, 11,614,000 cwt. ; wheat, 4,848,000 cwt. ; oats, 4,238,000 cwt. ; barley, 2,137,000 cwt. ; various cereals, 4,074,000 cwt. ; also potatoes, 8,216,000 cwt. Aniseed, sunflowers, tobacco, and beetroot are also widely culti- vated, and much attention is also paid to the growth

of the pineapple. There are large tracts of excellent pasture land, and cattle-breeding is carried on with much success ; good breeds of cart-horses and trotters are obtained. There were 181 breeding establishments in 1897, those at Hrenovoye and Chesmenka being the most important, and in 1897 the province contained 405,000 horses, 555,560 horned

cattle, 1,209,000 sheep, and 214,000 pigs. Forests cover nearly 8 per cent, of the area, and in many villages large numbers of the inhabitants are engaged in their homes in the making of wooden goods. Other domestic industries, such as the making of fire-bricks, pottery, carpets, hosiery, boots, peasants' gloves, and sheepskins, and the extraction of grindstone, are developing year by year. Factories (mostly flour-mills, distilleries, and oil, sugar, and tobacco works) show a yearly return of 18,800,000 roubles. Several cattle fairs are held along the banks of the Don, and assist in maintaining an active internal trade.

Voronezh], the capital of the above government, on the river of same name, 5 miles above its junction with the Don, and 331 miles by rail south-east of Moscow. It is one of the best-built and most picturesque provincial towns of Eussia. It is situated on the steep bank of the river, and is surrounded by three large suburbs — Troitskaya, Yamskaya, and Tchizhovka. It was here that Peter I. laid, in 1695, the beginnings of the Eussian fleet, and that, in 1772, the first shareholders' company for marine trade was formed in Eussia. The house of Peter I., which had been turned into a private wool-cleansing establishment, has now been restored, and a yacht club occupies the building of the Tsar's admiralty. There are monuments to Peter I. and to the two Voronezh poets, Koltsoff and Nikitin, a much venerated monastery, two museums,, and several public libraries. The theatre is renowned in the history of the drama in Eussia. Of schools there are two gymnasia for boys and three for girls, one real-school, a corps of cadets, a teachers' seminary, railway schools, and so on. Population (1897), 84,146.

VorontSOVka, a village of Eussia, in the govern- ment and 90 miles south-east of the town of Voronezh. It has several tanneries and holds important fairs, and its inhabitants have a reputation for the manufacture of cheap hunting rifles. Population (1897), 11,753.

V6r6svagas, a village of northern Hungary, in the county of Saros. In the Dubnik mines, belonging to this village, exists the only opal mine in Europe. The opal was mined there 800 years ago for its beautiful play of colours, and it was known in trade as a precious stone under different names, according to its tints. The largest piece hitherto found weighs 549

~~grammes (2940 carats), is 12 cm. long, 6 cm. broad, and 2-7 cm. thick, and is preserved in the museum of natural history of the Court in Vienna. It is estimated to have a value of four million crowns.~~

~~VosgfeS, a department on the eastern frontier of France, resting on the mountain chain of that name, bordering it on the east, and watered by the Meurthe and the Moselle.~~

~~Area, 2305 square mileB. The population (413,707 in 1886) had increased in 1901 to 419,784. The births in 1899 were 10,441, of whioh 931 were illegitimate ; deaths, 9069 ; marriages, 3163. The schools in 1896 numbered 949, with 50,000 pupils, only 1J per cent, of the population being illiterate. Of the entire surface 1,360,970 acres were in 1896 under cultivation, 538,460 acres being plough-land and 11,115 acres vineyards. The largest part of the rest is laid out in natural pastures and grass lands. The wheat reaped in 1899 was valued at £451,000 ; meslin, £81,150 ; rye, £131,200 ; oats, £381,000 ; potatoes, £696,000; natural pas- tures and grass lands, £731,000; vines, £182,000. The depart- ment in 1899 owned 31,230 horses, 145,570 cattle, 59,330 sheep, 77,110 pigs, and 15,470 goats. The production of milk (1899) was~~

~~valued at £791,000. In 1898 there were dug up 1683 metric tons of lignite and 1220 of peat. The industry in metals in 1898 pro- duced 145 metric tons of iron and 3818 tons of steel, valued at £33,000. The textile industry, however, takes precedence of all the others. The spinning and weaving of calico and other cottons employed, in 1898, 600,000 spindles and 23,000 looms at Spinal, St Die (19,226), and Kemiremont (8874). Wool-spinning is also a brisk industry ; cheese is made at Gerardmer (8075). Spinal, the capital, has (1901) 21,392 inhabitants.~~

~~Vosmaer, Carel (1826-1888), Dutch poet and art-critic, was born at The Hague on 20th March 1826. He was trained to the law, and was successful in that profession, holding various judiciary posts, until~~

~~1873, when he withdrew entirely from legal practice. In early life he cultivated literature but little, and only as an amateur. His first volume of poems, 1860, did not con- tain much that was remarkable. His temperament was starved in the very thin air of the intellectual Holland of~~

those days, and it was not until after the sensational appearance of Multatuli (Edward Douwes-Dekker) that Vosmaer, at the age of forty, woke up to a consciousness of his own talent. In 1869 he produced an exhaustive monograph on Eembrandt, which was issued in French. Vosmaer became a contributor to, and then the leading spirit and editor of, a journal which played an immense part in the awakening of Dutch literature ; this was the Nederlandsche Spectator, in which a great many of his own works, in prose and verse, originally appeared. The remarkable miscellanies of Vosmaer, called Birds of Diverse Plumage, appeared in three volumes, in 1872,

1874, and 1876. In 1879 he selected from these all the pieces in verse, and added other poems to them. In 1881 he published an archaeological novel called Amazone, the scene of which was laid in Naples and Eome, and which de- scribed the raptures of a Dutch antiquary in love. Vos- maer undertook the gigantic task of translating Homer into Dutch hexameters, and he .lived just long enough to see this completed and revised. In 1873 he came to London to visit his lifelong friend, Sir (then Mr) Lawrence Alma- Tadema, and on his return published Londinias, an ex- ceedingly brilliant mock-heroic poem in hexameters. His last poem was Nanno, an idyl on the Greek model. Vosmaer died, while travelling in Switzerland, on 12th June 1888. His literary activity was very great during the last fifteen years of his life, and he had become a powerful factor in the imaginative world of Holland. He was unique in his fine sense of plastic expression ; he was eminently tasteful, lettered, refined. Without being a genius, he possessed immense talent, just of the order to be useful in combating the worn-out rhetoric of Dutch poetry. His verse was modelled on Heine and still more on the Greeks ; it is sober, without colour, stately, and a little cold. He was a curious student in versification, and it is due to him that hexameters were introduced and the sonnet reintroduced into Holland. He was the first to repudiate the traditional, wooden alexandrine. In prose he was greatly influenced by Multatuli, in praise of whom he wrote an eloquent treatise, Een Zaaier (A Sower) ; it was interesting that the glow- ing, irregular spirit of Douwes-Dekker should have been that which peculiarly appealed to the refined and sculp- turesque Vosmaer. He was also somewhat under the influence of English prose models. His numerous con- tributions to art-criticism have not the durable value of

his imaginative writings. Vosmaer was an isolated and transitional figure in Dutch literature, and will hold a place in its history. (e. g.)

Voting Machines. — The election of public officers by ballot is so complicated a process, and so slow in giving returns, that various machines have been in- vented for registering and counting ballots mechanically.

In some, the voter unlocks the apparatus by the act of opening the door of the voting compartment, and on leaving locks it, so that it will not register until the door is opened by the next voter. One of the early machines — the Meyer American, legalized in one state as early as 1892 — was so arranged that a vote for one candidate, effected by pushing a knob, locked all other possible votes for the same candidate until the voter left the booth. The names of candidates were arranged in a vertical row on the face of the machine, the offices were arranged horizontally. By pushing the proper knob the vote for a given candidate for a specific office was recorded. Many machines use dial or counter mechanism, which can be instantly read, but give no record on paper. In the McTammany machine paper tally slips, one for each candidate, amendment or office to be voted for, are fed through the machine, and each voter punches a hole in the proper sheets to express his preferences. This machine presupposes that the voter knows how to read. In the Khines machine, a variation of the McTammany, all the marking devices are set at once, and a single additional movement registers them simultaneously. The Bardwell Votometer exposes a vertical face or board marked for each set of votes. As the voter enters a bar is lifted, which unlocks the machine, and it is lowered after him, closing the booth ; he records his vote by inserting a key in any desired aperture in the board, and if he makes an error he can reset the machine and correct it. If he wishes to vote in some way not arranged for on the face of the machine, a ballot-box is provided. On leaving the booth an exit bar locks the machine until the next voter enters. When a voter is qualified to vote on certain issues only the attendant at the back of the machine can lock any set for which the

particular voter has no franchise. The number of votes is recorded by the dial system, so that the results can be returned in a few minutes at the close of the election. The capacity of this machine is put at 600 voters per statutory election day by the New York State Commission on Voting Machines. In the Howe machine a printed record is obtained. The voter passes through a turnstile into a chamber where he is faced by a number of handles corresponding to the number of candidates. When he pulls one of these he changes a numerical printing apparatus in the machine ; the actual printing is done by the further motion of the turnstile as he leaves. There may be any number of handles, and by an inter- locking apparatus the number of candidates for whom any one voter can vote may be limited in any desired manner. The records belonging to each handle are printed vertically in separate columns on a long roll of paper ; hence the lowest figure in each column at once gives the number of votes which have been cast in favour of the candidate to whom that column is appropriated. In addition there is another column in which is recorded the total number of votes which have been cast ; the figure it gives must correspond with that shown by the numerical counter attached to the turnstile. In connexion with the machine a clerical check has been devised which, in the event of any particular voter's vote being challenged, enables his record in the machine to be traced without difficulty, so that it can be discovered for whom he voted, and consequently from which total his vote, if disallowed, is to be deducted. Voting machines are legalized and in use in various places in the United States, but not in the United Kingdom.

Voznesensk, a town of Kussia, in the govern- ment of Kherson, on the left bank of the river Bug, at the head of its navigable course, 61 miles from Nikolaieff

(railway station), to which steamers ply regularly. It is a river port of some importance, and holds four large fairs annually. The town is well built, and contains a cathedral, a large public garden, and several distilleries and breweries. Population (1897), 14,178.

Vranya, or Vkany;6, the most southerly town of the kingdom of Servia, 7£ miles from the Macedonian frontier, on a slope descending from Mount Placevitza to the plain of the Upper Morava, in a very picturesque and

fertile country. In the Russo- Turkish war of 1877 it was captured by the Servian, army from the Turks, and the Congress of Berlin sanctioned its remaining within the new boundary of Servia. It is the seat of the prefecture and a tribunal, and has a college for secondary education, and a modern hospital kept up by district rates. A regiment of the regular infantry is stationed there as garrison. Vranya is an important station on the railway line, Nish-Salonica, with a custom house, principally for merchandise imported into Servia vid Salonica. Its inhabitants are employed chiefly in the cultivation of flax and hemp, and in the making of ropes, which have an established reputation in the markets of the Balkan Peninsula. Four and a half miles to the east of Vranya there is a much frequented summer resort called Vranyska Banya, with baths of hot sulphurous mineral water. Population (1900), 11,921.

Vratza, chief town of a department, Bulgaria, and the seat of a bishopric, situated on the Vzatzanska, a tributary of the Botounia, 59 miles north-west of Sofia. It possesses tanneries and a considerable general trade. Both its wine and its jewellery have a high reputation. A school of sericulture has been established. During 1876 and 1877 many of the inhabitants of Vratza and neighbourhood suffered greatly from the atrocities of the Tcherkess, until the town was taken by the Russians after a short bombardment. Population, about 14,000.

Vries Island. See Izu-no-shichi-t6. Vryburg. See Bechuanaland. Vryheid. See Transvaal. Vurjeevandas Madhowdas (1817-1896),

a Hindoo merchant of Bombay, of the Kapole Banin caste, was born on 28th January 1817 at Gogla, in Kathiawar, whence his father came to Bombay with Sheth Manoredas for trading purposes. Vurjeevandas was educated in Bombay ; after learning Gujrathi he received a good English education at the Fort St George School and BoswelPs Academy. When his father died in 1840 he entered into partnership with Narotumdas, his eldest brother, who commenced business along with Sorabji Shapoorji Bengallee, CLE., as guarantee brokers to the well-known firm of W. and A. Graham. Some years later he started a new firm under the name of Vurjeevandas and Sons, and by shrewd and diligent management soon became one of the wealthiest merchants in Bombay. He married in 1833

~~and had six children. His private life was extremely simple. He was appointed a justice of the peace and a member of the Bombay Port Trust. He took a keen interest in the Royal Asiatic Society and the Bombay University, where a prize has been established to commemorate his name. His charitable disposition found vent in many forms. He constructed the Madhow Bang in memory of his father, and gave it to the use of poor Hindus, endowing it with nearly five lacs of rupees. He built a dkarmushala in Bombay, at the cost of Rs.57,000, in memory of his brother Mooljibhoy, and another one at Nassick at a cost of half that sum. The magnificent sanatorium which he~~

~~built in memory of his youngest son Bumhoredas at Sion Hill, at a cost of about Rs. 125,000, is a great boon to the poor people of his community. He also established a dispensary at Matoonga at a cost of Bs.40,000, and a sodavart for the relief of indigent Hindus, and for giving an annual feast to the poorer members of his caste at a cost of Ks.37,000. He died on 12th January~~

~~1896.~~

~~Vyatka, a Kussian government lying to the north- east of that of Nijni-Novgorod, with an area of 59,124 square miles. It consists of an undulating plateau reaching its highest level (1400 feet) in the north-east and gently sloping to the south-west, and according to Professor Krotoff's researches it is mainly built up of Permian deposits which crop out in the north, but are covered elsewhere by Jurassic sands and clays with layers of limestone and burning slates. Glacial boulder clay containing polished and scratched boulders covers wide areas, as do post-Glacial clays and iron-ore-bearing sands. These last reach in certain places a thickness of 70 feet, and were deposited in extensive lakes which covered the territory at a relatively recent period. In consequence of emigration to Siberia the population only increased from 2,859,000 in 1883 to 3,082,788 (domiciled only) in 1897, of whom 1,608,994 were women and 90,905 lived in towns. The bulk of the inhabitants (78 per cent.) are Bussians; Votyaks form 12~~

per cent., Cheremiss 5 per cent., and Tatars 4 per cent., the remainder being Bashkirs, Tepteres, &c. The government is divided into eleven districts, the chief towns of which are Vyatka, Elabuga (9776), Glazoff (3415), Kotelnitch (4236), Mal- myzh (3508), Nolinsk (4763), Orloff (3256), Sarapul (21,395), felobodskoi (10,052), Urzhum (4423), and Yaransk (4824). Izhevsk (21,500) and Votkinsk, or Kamsko-Votkinsk (21,000), have important iron-works. The zemstvos (or provincial and district councils) are among the most active in Kussia in their efforts to spread education, to develop domestic industries and agriculture, to organize the village posts, and to improve the sanitary arrangements. In 1899, 68 infirmaries with 116 doctbrs and 396 assistants and midwives were maintained by the zemstvos, and no less than 803,000 applications for medical aid were made in the' villages. The primary schools numbered 1581 in 1898, and were atfended by 84,000 pupils. Nearly half of the surface is covered with forests (17,084,000 acres), two-thirds of which belong to the Crown, and hunting (especially squirrel- hunting) still retains commercial importance, as does fishing. The peasants, who form 89 per cent, of the population, own 16,841,000 acres, the Crown 20,144,000 acres, the iron- works 1,148,000 acres, and private persons 826,000 acres. Vyatka is now one of the chief grain- producing governments of Eussia, the area under cereal crops (7,967,100 acres in 1900) being only exceeded in the government of Samara. The average yield in 1895-99 was: rye, 21,252,000 cwt. ; wheat, 432,000 cwt. ; oats, 14,933,000 cwt. ; and barley, 2,587,000 cwt. ; also potatoes, 4,406,000 cwt. Flax and hemp are exten- sively cultivated, and large numbers of cattle are kept, but they are mostly of poor breed. There were in the province in 1897, 663,000 horses — some of which be- longed to a race of good ponies that are widely exported — 1,068,900 horned cattle, 262,700 sheep, and 158,000 pigs. Domestic industries occupy large numbers of the inhabitants, who turn out in considerable quantities almost every variety of goods. Iron ores, alabaster, grindstones, limestone, peat, fireclay, and copper are all raised, and mining and smelting operations afford occupa- tion to 15,000 persons; in 1897, 6700 cwt. of copper,

23,900 tons of pig iron, 26,170 tons of iron, and 12,330 tons of steel were obtained. The chief iron-works are at Votkinsk, the annual returns of which amount to £190,000. Manufacturing industries are largely de-

veloped, and in 1898 there were 647 factories which showed an aggregate yearly return of 28,300,000 roubles. The principal establishments are tanneries, steam flour- mills, and hardware, machinery, paper, and fur-dressing works.

Vyatka, capital of the above government, on the left bank of the river Vyatka, at the head of the navigation on the Northern Dvina, connected by rail with Perm (458 miles) and Kotlas (353 miles). It is a rapidly-growing town, and has several distilleries, tanneries, and candle works. It carries on a considerable trade in grain, salt, metals, animal products, and various manufactured goods, which it exports to Moscow (mainly) and Archangel. It has gymnasia for boys and girls, a reo^-school, a theo-logical seminary, and a number of primary schools. Popu- lation (1897), 24,782.

Vyernyi (formerly Almaty), a town and fort of Asiatic Eussia and the capital of the province of Semiryechensk, situated at the northern foot of the Trans-Ili Alatau, at an altitude of 2430 feet. Water is obtained for irrigation from the river Almata, and its climate is warm and healthy. It is well built and pro- vided with boulevards and surrounded by rich gardens. It has the usual educational institutions, a school of gardening and sericulture, a public library, and a few distilleries, tanneries, and oil works. In 1897 its popula- tion was 22,982. It is notable as having been the centre of one of the most remarkable earthquakes of recent years. On 9th June 1887 shocks were experienced which lasted from 4 a.m. to 4.35, and transformed the whole town into a heap of ruins. The force of the earthquake was found to be 10, according to the scale of Forel, and the total number of shocks was about 600. More than 1000 houses were destroyed and 332 persons were killed or died from wounds. The earthquake spread over a very large area,' shocks being felt at Serghiopol in the north, Kashgar in the south, and Tashkent and TTrumchi in the east ; it seems, indeed, to have been experienced over an irregular ellipse of which the major axis ran south-west to north-east for nearly 1000 miles, and the minor axis had a length of 600 miles. The area of greatest destruc- tion, also elliptic in its form, had a length of 67 miles, and a width of about 35 miles. The cause of the earth- quake was found to have

been the giving way of deep- lying strata on the northern slope of the Trans-Hi Alatau, at a depth of about 7 miles below the surface.

See Professor Mtjshketoff, "The Earthquake at Vyernyi," in Memoirs of the Russian Geological Committee, vol. x., 1890 ; also Voznbsbnsky in the Meteorological Annual of the Russian Academy of Science, vol. xii., No. 4 (in German).

(P. A. K.)

Vyrnwy, Lake, an artificial reservoir in the north- west of Montgomeryshire, Wales, for the water supply of Liverpool (see Water Supply). It was formed by damming the river Vyrnwy, which flows through Mont- gomeryshire and joins the Severn above Shrewsbury. The lake has added largely to the beauties of the district.

Vyshnevolotskaya Sistema, one of a

series of Eussian waterways linking the Neva and the Volga. It has a length of nearly 540 miles, and has not only opened up the district which it traverses to the Baltic trade, but forms the most valuable medium of transit for Eastern products from the Caspian to St Petersburg.

Wabash, a city of Indiana, U.S.A., capital of Wabash county, on the river Wabash, and the Cleveland, Cincinnati, Chicago, and St Louis, and the Wabash rail- ways, in the northern part of the state, at an altitude of 710 feet. It has railway repair works, agricultural implement factories, and other manufactures. Population (1880), 38"0; (1890), 5105; (1900), 8618, of whom 498 were foreign-born and 134 negroes.

-), English theologian,

Wace, Henry (1836-

was born in London, 10th December 1836, and educated at Marlborough, Rugby, King's College, London, and Brasenose (Oxford). He was ordained in the Church of England in 1861, and held various curacies in London, being chaplain at Lincoln's Inn in 1872 and preacher in 1880. From 1875 to 1896 he was prominently connected with King's College, London, where he was professor of ecclesiastical history, and subsequently (1883) principal. Both as preacher and writer Dr Wace, who took his D.D. degree in 1883, became conspicuous in the theological world. He was Boyle lecturer 1874 and 1875, and Bampton lecturer 1879; and besides publishing several volumes of sermons, he was co-editor of the Dictionary of Christian Biography (1877-87), and editor of The Speaker's Commentary on the Apocrypha. He took a leading part as the champion of historic orthodoxy in the controversies with contemporary Rationalism in all its forms, and firmly upheld the importance of denomina- tional education and of the religious test at King's College ; and when the test was abolished in 1902 he resigned his seat on the council. In 1881 he was given a prebendal stall at St Paul's, and in 1889 was appointed a chaplain- in-ordinary to Queen Victoria. When he resigned the principalship of King's College in 1896 he was made rector of St Michael's, Cornhill.

Waco, a city of Texas, U.S.A., capital of McLennan county, on the river Brazos, at the mouth of the Bosque, towards the eastern part of the state, at an altitude of 400 feet. The site is level, the street plan regular, it has abundant water from artesian wells, and the streets are well paved. It is a railway centre of" much importance, since five lines intersect here — the Houston and Texas Central ; the Missouri, Kansas, and Texas ; the St Louis South- Western ; the San Antonio and Aransas Pass ; and the Texas Central. With these facilities Waco has become one of the leading shipping- points for the cotton crop. The city contains cotton com- presses, flour-mills, woollen and cotton mills. It contains several educational institutions, among which are Baylor University, Waco Female College, and Paul Quinn College (for coloured). Population (1890), 14,445; (1900), 20,686, of whom 1196 were foreign-born and 5826 negroes.

Wadai, a Mahommedan kingdom of the Central Sudan, occupying an area of some 100,000 square miles east of Lake Chad, much of the surface being arid and barren. By the Anglo-French agreement of 1898-99 the influence of France over the country was finally recognized, but no French traveller has yet entered the country, of which little definite information has been obtained since the journey of Matteucci and Massari (1880). The sultan, whose residence is at Abeshc or Abeshr, claims more or less influence over Kanem, north-east of Lake Chad, the borders of which were traversed in 1899—1900 by the French expeditions under Joalland and Foureau, and which has since been the scene of fighting between the French and the Tuaregs. In Wadai itself a revolution took place in 1901, owing to feuds among the ministers and great vassals of the crown. The Sultan Brahim was deposed, and Abugazali, son of a former

sultan, set up in his place. Another disturbing factor was the famous Sheikh el Senussi, who retired to Wadai from the Jarabub oasis in the northern Sahara, and took part in the opposition to the French in Kanem until nis death in 1902. In the south, the country of Dar Runga, once regarded as forming part of Wadai, seems to have become virtually independent under its Senussite sultan, whose capital, situated near the source of the Bangoran, a branch of the Shari, has been visited by French travellers from the south. According to M. Pries, Mahommedan influence was established in these parts about 1850, but the tenets of that religion are very loosely adhered to. With the closing of the route from Wadai to the Nile at the time of the Mahdist rebellion and the decline of the Kuka-Tripoli route owing to disturbances in Bornu, the road across the Sahara to Benghazi vid Kufra oases acquired some importance. The rulers in Wadai are the Mabas, a Negro race converted to Islam, but the sparse population of the country includes various other elements, including Arabs. The main occupation of the people is pastoral, and the chief exports to the north are ivory and ostrich feathers. The bulk of the natives of Dar Runga are of the Negro Banda stock.

See Nachtigal, Sahara und Sudan, vol. in., Leipzig, 1889; Massari, in Kosmos, 1882 ; Pbins, in La Geographic, March 1900.

Wadding-ton, William Henry (1826-

1894), French statesman and diplomatist, was born at St Remi-sur-1'Avre, in the department of Eure-et-Loir, on 11th December 1826. He was the son of a wealthy Englishman who had established a large spinning factory in France and had been naturalized as a French subject. After receiving his early education in Paris, he was sent to Rugby, and thence proceeded to Trinity College, Cam- bridge, where he was second classic and Chancellor's medallist, and rowed for the University in the winning boat against Oxford. Returning to France, he took up his French nationality, and for some years devoted himself to archaeological research, particularly numismatics and epigraphy. With this purpose he undertook travels in Asia Minor, Greece, and Syria, the fruits of which were published in two Memoires, crowned by the Institute, and in his Melanges de numismatique et de philologie (1861). Except his essay on The Protestant Church in France, published"vin 1856 in Cambridge Essays, his remaining works are likewise archaeological. They include the Fastes de V Empire romain, and editions of Diocletian's edict and of Lebas's Voyage arche'ologique. He was elected in 1 865 a member of the Academie des Inscriptions et Belles-Lettres. It was not till middle life that he entered on his political career. After standing unsuccessfully for the department of the Aisne in 1865 and 1869, he was returned by that constituency at the elections of 1871. His opinions remained always those of a Moderate Liberal, but he sympathized with Thiers when he was attacked by the Conservative party. He was minister of public instruction in the Dufaure cabinet from 19th May 1873 to the fall of Theirs on the 24th of the same month. In 1876, having been elected Senator for the Aisne, he was again entrusted by Dufaure with the ministry of public instruction, with which, as a Protestant, he was not permitted to combine the ministry of public worship, usually attached to it. His attitude aroused the violent hostility of the Clerical party, without satisfying the more advanced spirits on his own side. His most important project, a Bill transferring the conferment of degrees to the State, passed the Chamber, but was thrown out by the Senate. He continued to hold his office under Jules Simon, with whom he was overthrown on the famous seize Mai, 1877. The triumph of the Republicans at the

general election brought him back to power in the follow- ing December as minister of foreign affairs under Dufaure. He was the French plenipotentiary at the Berlin Congress, where he represented his country under exceptionally deli- cate and trying conditions with much dignity and tact, and made a strong impression upon Bismarck. He successfully upheld French claims to a protectorate over the Christians of the Levant, and it was on his motion that the Congress pronounced in favour of an extension of the Greek frontier. An ardent sympathy with Greece was indeed conspicuous throughout his connexion with European politics. The cession of Cyprus to Great Britain was at first denounced by the French newspapers as a great blow to his diplo- macy, but he obtained, in a conversation with Lord Salisbury, a promise that Great Britain in return would allow France a free hand in Tunis, and subsequent French influence in that country is the natural development of his policy. In December 1878 he delivered a speech that was received with much enthusiasm, declaring that he had maintained the interests of France while leaving her unfettered by conditions. Early in the following year Dufaure retired, and on 4th February Waddington suc- ceeded him as prime minister and minister of foreign affairs. Holding office by sufferance of Gambetta, he halted in an undetermined attitude between the Radicals and the reactionaries till the delay of urgent reforms lost him the support of all parties. He lacked, moreover, the coolness needed for facing the noisy interruptions of the Opposition. He succeeded on 2nd December in obtaining a vote of confidence from the Chamber, but found himself forced on 27th December to retire from office. He refused the offer of the London embassy, and in 1880 was reporter of the committee on the adoption of the scrutins. de liste at elections, on which he delivered an adverse judgment. In 1883, after representing France at the coronation of the Tsar Alexander III., he accepted the London embassy, which he continued to hold till 1893. His English descent and education stood him in good stead ; nevertheless, during the occasional difficulties that arose between Great Britain and France, notably on the Egyptian question, he showed an exceptional tenacity in defence of his country's

interests. Throughout his career as ambassador he had retained his seat in the Senate, and aspired to a resumption of his political career ; but at the commencement of 1894 he was rejected by his department, the Aisne. He did not long survive this defeat, and died on 13th January 1894. (h. st.)

Wade, Sir Thomas Francis (1818-1895),

British diplomatist, born in London on 25th August 1818, was the son of Major Wade of the Black Watch, by his wife Anne, daughter of William Smythe of Barba- villa, West Meath. His father was appointed in 1823 military secretary to Sir Lowine Cole in Mauritius. Here he received his grounding in knowledge, and was sub- sequently educated at Harrow and Trinity College, Cam- bridge (1837), where, however, he remained only one year, his father having purchased for him a commission in the 81st Begiment. From his corps he in the follow- ing year (1839) exchanged into his father's old regiment, the 42nd Highlanders, with which he served at Limerick, Templemore, Cork, and the Ionian Islands. While at Corfu he devoted his leisure to the congenial study of Italian and modern Greek. On receiving his commission as lieutenant in 1841 he exchanged into the 98th Regi- ment, then under orders for China, and landed in Hong Kong in June 1842. The scene of the war had at that time been transferred to the Yangtse-kiang, and thither Wade was ordered with his regiment. There he took part in the attack on Chinkiang-fu and in the advance on

Nanking. Already on his voyage out he had, with the great linguistic facility which he possessed, taken to the study of Chinese, and having improved his knowledge on the spot, he was on the return of the regiment (o Hong Kong appointed interpreter to the garrison. In 1845 he was appointed interpreter in Cantonese to the Supreme Court of Hong Kong, and in 1846 assistant Chinese secretary to the superintendent of trade, Sir John Davis. In 1852 he was appointed vice-consul at Shanghai. During his tenure of this office the progress of the Taip- ing rebellion had so disorganized the administration in the neighbourhood of Shanghai that it was considered advisable to put the collection of the foreign customs duties into commission, a- committee of three, of whom Wade was the

chief, being entrusted with the administra- tion of the customs. This formed the beginning of the Imperial Maritime Customs Service. In 1855 Wade was appointed Chinese secretary to Sir John Bowring, who had succeeded Sir J. Davis at Hong Kong, ar.d under- took a mission to Cochin-China on international concerns. On the declaration of the second Chinese war in 1857 he was attached to ' Lord Elgin's staff as Chinese secretary, and with the assistance of Mr H. N. Ley he conducted the negotiations which led up to the treaty of Tientsin (1858). In the following year he accompanied Sir Frederick Bruce in his attempt to exchange the rati- fication of the treaty, and was present at Taku when the force attending the mission was treacherously attacked and driven back from the Peiho. On Lord Elgin's return to China in 1860 he resumed his former post of Chinese secretary, and was mainly instrumental in arranging for the advance of the special envoys and the British and French forces to Tientsin, and subsequently towards Peking. For the purpose of arranging for a camping ground in the neigh- bourhood of Tungchow he accompanied Mr (afterwards Sir) Harry Parkes on his first visit to that city, where on the next day Parkes with Mr Loch and others was by an act of shameless treachery made prisoner. In the suc- ceeding negotiations Wade took a leading part, and on the establishment of the legation at Peking he took up the post of Chinese secretary of legation. In 1862 he was made a Companion of the Bath. On the return of Sir Frederick Bruce to England in 1864 he remained as charge d'affaires, and again from 1869 to 1871, when he was appointed minister, he filled the acting post. The Tientsin massacre in 1870 entailed long and difficult negotiations, which were admirably conducted by Wade. On the assumption of power by the Emperor T'ung-chih he, in common with his colleagues, requested an audience in accordance with the treaties, which was for the first time granted as a right. The murder of Mr Margary near Manwyne in Yunnan in 1875 threatened at one time to cause a rupture with the Chinese Govern- ment, and as a matter of fact Wade did leave Peking. But the Chinese finding that he was in earnest despatched Li Hung-Chang after him to Chefoo, where the two diplomatists arranged the penalties which were to be paid for the crime, and concluded a convention which, after a considerable interval, was ratified by the Governments. Wade was then made K.C.B., and in 1883 retired from the service. On his return to England the attractions of his

old university induced him to take up his residence at Cambridge, where he was appointed the first professor of Chinese. He died there on 31st July 1895. In 1889 he was made G.C.M.G. In 1868 he had married Amelia, daughter of Sir John Herschel. (e. k. d.)

Wad h wan, a town of India, in the Gujarat division of Bombay, the capital of a petty state of the same name, and the junction of the Kathiawar railway

system with the Bombay and Baroda line, 389 miles north of Bombay. Population (1881), 16,949; (1891), 24,604. It has considerable trade and manufactures. The school for girasias or feudatory nobles had 60 pupils in 1896-97, who were maintained at a total cost of Bs.10,452, and the high school had 254 pupils.

There are two printing-presses. The civil station is under British administration. The state of Wadhwan has an area of 237 square miles. Population (1891),

42,438.

Wady Haifa. See under Egypt and Sudan.

WAGES.

I. The United Kingdom.

nominal wages.

THE meaning of the term wage, the distinction between real and nominal wages, the various items properly included in the term, and the economic causes which deter- mine relative wages and wages in general, with historical illustrations, are sufficiently discussed in the Ency. Brit. vol. xxiv. p. 306 seq. In the present article it is proposed to discuss the statistical measurement of wages, and to tabulate some of the most

significant figures. The simplest method of procedure is to calculate first nominal wages, including in that term " all money wages, regular Real and or occasional, and perquisites and expectations, reckoned over a given period in the currency of a given time and place " (Palgrave's Diet, of Pol. Econ. iii. p. 639). For general statistical purposes of comparison it is usually impossible to allow for expecta- tions of pensions, for facilities for subsidiary earnings, for liability to want of work owing to commercial depression, for the shorter or longer part of 'a lifetime which can be spent at a particular occupation (see Walker, The Wages Question, p. 33 seq.), or for the relation of the value of services rendered by central or local governments to the amount paid in taxes or rates. Having determined nominal wages for labour at two or more districts or times, the second step is to estimate real wages, defined by Prof. Walker (ibid. p. 12) as " the remuneration of the hired labourer as reduced to the necessaries, comforts, or luxuries of life," by some mechanism for comparing the purchasing power of money at those districts or times. Nominal money wages are paid either for labour, without specific reference to its amount, performed in a given time (time-wage), or for labour of a given amount without specific reference to the time occupied (piece-wage). Mr D. P. Schloss (Methods of. Industrial Remuneration, p. 11 seq.) distinguishes also task-wages, where there is an agreement to perform a certain minimum of work in the given period, but the wage is otherwise a time-wage, and progressive wages, where a premium in addition to a time- or piece- wage is given for efficiency exceeding a specified minimum. Wages in hind, food, clothing* house-room, gratis or at a reduced price, are not uncommon, and these benefits can be valued in currency and added to nominal money wages. Lastly, remuneration for labour may take the form of an allotted share in the actual produce or in profits, under a co-operative copartnership or profit-sharing scheme : where the labourer has not a voice in the management, all such payments are properly included in nominal wages ; where he has, a difficult distinction should be drawn between profits and wages.

Kates of nominal wages can be stated : (i.) per unit of labour performed — this would be a good method if quantity of labour were measurable; (ii.) per piece — as with ordinary piece-wages; this is useful for comparison when the kind of work changes little, as with compositors, but

~~of limited use even in a single occupation, since methods of work vary so much, and of none for compari- son of occupations ; (iii.) per how — the hourly rate in the building trades is important, but the number of hours per week and the intensity of an hour's work vary greatly ;~~

~~(iv.) per day — the number of days' work in a normal week differs with occupation ; (v.) per week — this is the rate usually stated in wage records, and serves for comparisons by age, sex, class of work and district, and at various dates, in those cases where allowance is possible or not neces- sary for seasonal variations in employment or for seasonal payments ; (vi.) per year — this measurement should be generally attempted, since all seasonal fluctuations of work and annual payments are included, and a comparison of annual earnings in two trades shows all the essential con- ditions except any special liability to disease, the duration of working life, and the influence of commercial credit cycles ; (vii.) per working lifetime — this measurement would be very valuable, especially in comparing men's and women's wages, if trustworthy averages could be obtained.~~

~~Wages vary with age, sex, trade, specific occupation, and district. The following table gives a general view of the difference under the first three of these headings. Average Weekly Wages in October 1886 in the United Kingdom)~~

~~Girls~~

~~Lads~~

~~Women.~~

~~(under~~

~~18).~~

~~Men.~~

~~(under~~

~~18).~~

~~s. d.~~

~~General average ....~~

~~12 8~~

~~6 4~~

~~24 7~~

~~8 11~~

~~Number of trades included .~~

~~23~~

~~19~~

~~38~~

~~37~~

~~s. d.~~

~~s. d.~~

~~s. d.~~

~~s. d.~~

~~Cotton manufacture~~

~~15 3~~

~~6 10~~

~~25 3~~

~~9 4~~

~~Woollen „ ...~~

~~13 3~~

~~7 5~~

~~23 2~~

~~8 6~~

~~Worsted and stuff manufacture~~

~~11 11~~

~~6 2~~

~~23 4~~

~~6 6~~

~~Linen manufacture~~

~~8 11~~

~~4 11~~

~~19 9~~

~~6 3~~

~~Jute ,,~~

~~9 7~~

~~4 8~~

~~19 4~~

~~6 8~~

~~Silk~~

~~10 1~~

~~5 8~~

~~22 3~~

~~7 2~~

~~Hosiery ,,~~

~~11 6~~

~~8 3~~

~~24 5~~

~~9 6~~

~~Coal, iron ore, and ironstone mines~~

~~22 11~~

~~10 9~~

~~Metalliferous mines~~

~~16 6~~

~~7 0~~

~~General engineering, iron and brass~~

~~foundries, and machinery trades~~

...

25 9

9 1

Shipbuilding, iron and steel .

29 3

12 2

Pig-iron (blast furnaces)

24 6

10 8

Breweries .....

24 3

9 9

Police, 27s. 7d. ; printing and engraving (newspapers), men, 37s. Id.

Annual Earnings, 1886 ; valuing all payments in kind. — Mer- cantile seamen,1 £65; seamen and petty officers, R.N.,1 £65 ; army (N.C.O. and men),1 £48. Agricultural labourers2: England and Wales, £36 ; Scotland, £47 ; Ireland, £23. On railways1 : 1886, £59 ; 1891, £61, 10s.

Female domestic servants, average of annual money wage,3 1898, London, £18 ; rest of England and Wales, £16 ; Scotland, £16, 10s. (circa).

Average Weekly Wages in the Building Trades.1

January.

July.

1886.

1891.

18S6.

1891.

Masons

Bricklayers ..... Carpenters and joiners . Painters ..... Builders' labourers

s. d.

27 11 31 0 31 8 27 6 19 1

s. d.

30 10

32 3

33 9 29 2 19 9

5. d.

32 8 35 6 34 2 31 9 21 7

s. d.

34 6 36 11

35 3 33 7 22 9

1 General Report on the Wages of the Manual Labour Classes, 1893, pp. xiii. xviii. xxix. xxxiii. 25, 26, 27, 470 seq., O. 6889.

2 Journ. Stat. Soc, 1899, pp. 564, 567.

8 Report on the Money Wages of Indoor Domestic Servants, 1899, pp. 8, 10, C. 9346.

UNITED KINGDOM]

WAGES

717

In making use of this and other tables, it must be remembered that no wage statistics pretend to great accuracy ; those quoted in this a rticl e may be regarded as trustworthy estimates, whose accuracy and extent of application must be gathered from the original authorities. The figures given above show general averages for all workers in a trade ; the following table shows how great is the variation in different occupations in the same trade, even when , only the averages for those occupations are given.

Average Weekly Wages in Engineering and Machinery Works, October 1836.1

(Northumberland, Durham, and Cleveland District.)

Men.

Assistant j Boys.

No.

Time-

No.

Kece- ™

Time-

ployed.

~~Wages.~~

~~ployed.~~

~™^8- ployed.~~

~~Wages.~~

~~s. d.~~

~~s. d.~~ |

~~s. d.~~

~~Ironmoulders .~~

~~207~~

~~28 5~~

~~129~~

~~34 0 | 161~~

~~8 8~~

~~Core-makers .~~

~~31~~

~~27 8~~

~~17~~

~~85 1 1 16~~

~~8 9~~

~~Fettlers or dressers .~~

~~43~~

~~22 2~~

~~21~~

~~29 0 1 11~~

~~7 11~~

~~Planers .~~

~~31~~

~~24 3~~

~~12~~

~~30 9 1 6~~

~~7 0~~

~~Drillers and screwers~~

~~79~~

~~22 8~~

~~26~~

~~28 9 10~~

~~7 1~~

~~Riveters .~~

~~88~~

~~31 10~~

~~21~~

~~38 5~~

~~73~~

~~12 4~~

~~Smiths .~~

~~104~~

~~28 3~~

~~23~~

~~43 4~~

~~51~~

~~9 10~~

~~Smiths' strikers~~

~~82~~

~~19 10~~

~~27~~

~~28 11~~

~~Platers .~~

~~28~~

~~36 5~~

~~24~~

~~46 7~~

~~120~~

~~■7 0~~

~~14 42~~

~~Holders-up~~

~~29~~

~~24 2~~

~~7~~

~~29 5 ...~~

~~Bolt-makers~~

~~3~~

~~36 10, ...~~

~~Pattern-makers~~

~~95~~

~~29 11~~

~~... j 45~~

~~8 0~~

~~Brass-finishers .~~

~~16~~

~~28 5~~

... ! 15

8 2

Turners .

84

29 6

97

8 2

Fitters and erectors .

201

29 0

... ! 92

8 3

Unclassed — men

108

27 0

78

26 5 ! ...

Unclassed — boys

191

8 1

29

15 4

Rivet heaters — boys .

47

7 2

23

11 4

...

Weekly Time ■ Wages : Men.

No.

s. d.

No.

s. d.

Foremen

124

45 7

Labourers .

731

18 10

Stovemen .

~~8~~

~~17 8~~

~~Slotters and borers~~

~~17~~

~~25 10~~

~~Watchmen .~~

~~12~~

~~20 7~~

~~Millwrights . / .~~

~~13~~

~~30 9~~

~~Carters~~

~~11~~

~~21 5~~

~~Belt makers and~~

~~Painters~~

~~11~~

~~26 3~~

~~menders~~

~~5~~

~~22 0~~

~~Cupola men .~~

~~38~~

~~23 6~~

~~Stationary engine-~~

~~Coppersmiths~~

~~11~~

~~29 6~~

~~men .~~

~~41~~

~~21 7~~

~~Brass- founders~~

~~12~~

~~28 11~~

~~Storekeepers and~~

~~Crane-hands~~

~~30~~

~~20 11~~

~~timekeepers~~

~~20~~

23 3

Carpenters and

joiners

50

28 0

Before giving statistics of variation by district, it is necessary to develop a scheme of tabulation. Let a series of figures be arranged in ascending order ; the figure which lies half-way up the list, so that there are as many entries above as there are below it, is called the median (M in the sequel), those one-quarter and three-quarters up are the quartiles (Qx, Q3), those one-tenth and nine-tenths up are two of the deciles (L\, D9); A, Mm., and Max. represent the arithmetic average of the items included, and the minimum and maximum respectively. The following table shows the varia- tion of the wages and working hours for the same occupations, recognized in districts throughout the kingdom by certain trade unions.

1

2

3

4

5

6

7

8

9

~~10 | 11~~

~~s. d.~~

~~s. d.~~

~~s. d.~~

~~d.~~

~~hrs.~~

~~s.~~

~~s.~~

~~s. d.~~

~~d.~~

~~5. d. i s. d.~~

~~Min.~~

~~28 0~~

~~23 «i~~

~~23 6i~~

~~49~~

~~28~~

~~26~~

~~26 0~~

~~34~~

~~18 0 1 IS 0~~

~~Di~~

~~33 0~~

~~28 0~~

~~30 0~~

~~8*~~

~~50~~

~~30~~

~~28~~

~~30 0~~

~~5~~

~~28 0 i 30 0~~

~~Ol~~

~~35 4~~

~~30 7i~~

~~32 Hi~~

~~7~~

~~54~~

~~32~~

~~30~~

31 6

5+

29 6

31 6

M

37 4

33 9

35 3}

8

55*

34

32

34 0

6

31 6

34 0

Qs

39 7

36 0

37 8

~~8*~~

~~56+~~

~~36~~

~~34~~

~~36 0~~

~~34 0~~

~~35 0~~

~~D9~~

~~4010J~~

~~37 8~~

~~40 0}~~

~~9~~

~~56*~~

~~38~~

~~36~~

~~38 0~~

~~6}~~

~~35 0~~

~~38 0~~

~~Max.~~

41 3

42 4i

42 4J

9*

61*

38

38

38 0

«i

40 6

40 6

Columns 1, 2, 3, 4, 5. — Operative Bricklayers' Society3 : each dis- trict counted as one unit. 1, 2, 3, summer weekly wages ; 1,

1

1 General Report on the Wages of the Manual Labour Classes, 1893, pp. xiii. xxix. xxxiii. 25, 26, 27, 470 seq., C. 6889.

2 Piece.

3 Compiled from Standard Time Rates, pp. 2 seq. and 179 seq.

England north of Warwickshire ; 2, rest of England and Wales ; 3, United Kingdom ; 4, hourly rate (all) ; 5, summer weekly work- ing hours (all), 1893.

~~Columns 6, 7, 8. — Friendly Society of Ironfounders* : each district counted as one unit, weekly wages. 6, England, north of War- wickshire ; 7, rest of England and Wales ; 8, United Kingdom,~~

~~1893.~~

~~Column 9. — Typographical Association1 : piece-rate per 1000 ens brevier on newspapers other than daily ; each district counted as one unit ; United Kingdom, 1893.~~

~~Columns 10, 11. — Amalgamated Society of Engineers6 : weekly wages, United Kingdom. 10, Each district counted as one unit ; 11, each member counted as one unit, supposed earning standard rate of his district, 1891.~~

~~The rates dealt with in the preceding table are the standard minimum recognized by the trade unions ; in some cases they are higher than the wages actually paid, where the union is trying to raise wages, in others lower, where the more efficient workmen are paid above the minimum rate. In many cases rates are stated both by men's and masters' societies, and occasionally the masters' statement is higher than the men's, though the reverse is more frequent. Mr F. W. Lawrence (Local Variations in Wages, p. 31 seq.) finds that the recognized wages are, in the great majority of selected cases, those actually paid. The above table indicates that the level of wages in the north of England is considerably higher than thai; in the south, and this tendency would be more marked if London had been excluded. Mr Lawrence [loc. cit. p. 18) finds that wages bear a close relation to the population of the districts in which they are paid, " the larger the town the higher the wage," and that the excess above a certain minimum is roughly proportional to the square root of the number of inhabitants. The causes of this difference are not yet clearly known ; higher rents, greater efficiency of work, and better facilities for trade union action are some of the factors.~~

~~In discussing the progress of wages it has been usual to estimate the arithmetic average (the quotient of total wages paid divided by number earning), and it has been objected that the change in this quan- tity shows very little, since an increase may be due to the high wages of a small body of men, while the great mass may be actually losing ground. This~~

~~difficulty would be surmounted if we could estimate the median, quartiles, and deciles at various dates ; but since the material is not to hand for this, we may usefully notice that these quantities bear a fairly definite relation to the average ; in fact, that wages of a great miscellaneous body of workers are grouped about their average according to a fairly definite law (Bowley, Wages in the United Kingdom in the Nineteenth Century, sec. iii.). There are very few collections of statistics of wages paid to a sufficiently large number of workers ; the following table contains the analysis of four such groups : —~~

~~Grouping of Wages.~~

~~Use of average.~~

~~1~~

~~United Kingdom.~~

~~London.~~

~~United States.~~

~~1~~

~~2~~

~~3~~

~~4~~

~~5~~

~~6~~

~~7~~

~~8~~

~~9 1 10~~

~~s. d.~~

~~c.~~

~~s. d.~~

~~e.~~

~~s. d.~~

~~c.~~

~~$6~~

~~p.c.~~

~~$ 1 p. c.~~

~~JJ,~~

~~16 0~~

~~66~~

~~21 3~~

~~69~~

~~20 0~~

~~69~~

~~1 29~~

~~64~~

~~1 20 j 69~~

~~Q,~~

~~20 0~~

~~82~~

~~25 3~~

~~81~~

~~22 6~~

~~78~~

~~1-60~~

~~80~~

~~1-41 1 81~~

~~M~~

~~24 3~~

~~100~~

~~31 0~~

~~100~~

~~29 0~~

~~100~~

~~2-00~~

~~100~~

~~175 1100~~

~~A~~

~~24 7~~

~~101~~

~~2-17~~

~~108~~

~~2-00 1-114~~

~~Q,~~

~~28 9~~

~~119~~

~~37 6~~

~~121~~

~~35 0~~

~~121~~

~~2 ‘50~~

~~125~~

~~2-46 !l40~~

~~9~~

~~34 0~~

140

44 0

142

41 0

141

3 25

162

3-00 | 171 j

356,000men

75, 000 men

75,000men

5,000 men

6,500 men

These figures are only approximate. Column 1 is deduced from the Board of Trade report on wages (loc. cit.) and refers to the year 1886 ; column 3 from Mr Booth's Life and Labour of the People, ix. p. 371 ; and column 5 from the same source, corrected in accordance with suggestions there made. Columns 7 and 9 are compiled from the Senate Report on Wholesale Prices, Wages,

4 Standard Piece Rates, p. 172 seq., C. 7567, I., II., 1894. 3 Compiled from Fifth Report on Trade Unions, Board of Trade, 1893, p. 220 seq. , C. 6990, 1893. 6 This column is given in the inflated currency of 1875.

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and Transportation (Washington, 1893) for 1875 and 1891 respect- ively. The figures in each of these columns are expressed as percentages of the corresponding medians, and so given in the adjacent columns. The lowest line gives the number of workers included in the groups.

These examples are too few to establish a law, but they point to the following scheme : the median is a little below the average ; the quartiles are respectively | and f , and in the United Kingdom the deciles nearly f- and J of the median. A law of grouping will remain unchanged, if the proportionate demand for and supply of labour of various degrees of excess or defect from normal skill do not vary ; there is an impression among authorities that the tendency is to increase the demand for skilled labour, but this will only affect the law of grouping if this increase outpasses the increase of normal skill. At the least it may be granted that the change in grouping may be expected to be slow, and that this tentative law gives us some means of constructing the actual dis- tribution of wages when we only know the median or average. The less typical American figures for 1860, not here tabulated, however, show a different grouping.

Besides these numerical relations, we may generally notice that in a large group of wage figures there is a tendency to mass about two different sums. The following table is an excerpt from the Board of Trade General Report already cited, pp. 470-1 : —

Percentage

Number

of Men paid at Various Rate^

in October 1886.

Number concerned.

~~***Under***~~

~~***10/***~~

~~***Of 10/ and***~~

~~***under***~~

~~***15/***~~

~~***Of 15/ and***~~

~~***under***~~

~~***20/***~~

~~***Of 20/ and***~~

~~***under***~~

~~***25/***~~

~~***Of 25/ and***~~

~~***under***~~

~~***30/***~~

~~***Of 30/ and***~~

~~***under***~~

~~***35/***~~

~~***Of 35/***~~

~~***and under***~~

~~***40/***~~

~~Above~~

~~40/~~

~~Cotton~~

~~manu- facture . Silk~~

~~32,000~~

~~0~~

~~1-2~~

~~27 ‘3~~

~~27-4~~

~~14‘1~~

~~22-6~~

~~4‘9~~

~~2‘5~~

~~manu- facture . General~~

~~2,000~~

~~0~~

~~14-4~~

~~39-2~~

~~16-3~~

~~12-4~~

5-4

12-1

0-2

engineer- ing, &c. Coal

42,000

0

1-0

28-5

16-9

28-9

15-2

5-9

3-6

mines, &c.

All in returns 1

67,000 356,000

0

•1

•6

2-1

19·5 21·5

48·8 33·6

29·4 24·2

1·3 11·6

•2

4·2

•2

2·4

Here we see that there are groups in the cotton manufacture at about 20s. and 32s. 6d., and in the silk at about 17s. 6d. and 37s. 6d.; in general engineering there are less distinctly separated groups at about 17s. 6d. and 27s. 6d. ; in the case of coal mines, where the great mass of the work is done by one class of men, there is only one group. In the total there is an indication of an upper group, for if there was only one symmetrical group, the percentage between 30s. and 35s. would be smaller. The figures would result front the following groups : 2 —

10/

to 15/

15/

to 20/

20/

to 25/

25/

~~to 30/~~

~~30/~~

~~to 35/~~

~~35/~~

~~to 40/~~

~~Above~~

~~40/~~

~~1st group 2nd group~~

~~3~~

~~16 3~~

~~29 5~~

~~16 8~~

~~3~~

~~8~~

~~5~~

~~8~~

~~The numbers cannot be exactly analysed, since the limits of money used in the report are so wide ; but the figures are consistent with a large group round 22s. 6d. and a smaller one round 32s. 6d. This tendency to split into two groups is very marked in the American ficures used above, and can also be detected in Mr Booth's Life and Labour. It can be explained by regarding the working class as made up of two sections, — one, the majority, unskilled, and the other skilled ; the tendency would~~

~~probably be more marked in figures of 50 or 100 years ago, for in modern times skill has become more minutely graded, an intermediate class has grown up between the "tradesman " and the labourer, and a minute analysis applied to more complete figures might show four or five instead of two groups. Agricultural wages are not included in the above figures.~~

~~As a single measure, the median is at once easier to estimate and more useful to know than the average. The following table shows, probably with fair accuracy, the change of wages in two typical occupations, and contains a rough estimate of the change of the median wage throughout the 19th century. Material perhaps does not exist, and certainly has not yet been compiled, for~~

~~1 This line is calculated from the last line of p. 470 of the report.~~

~~2 The dissection into two groups has been performed by the method described by Prof. Karl Pearson, Phil. Trans. Royal Soc, 1894, A. pp. 71-110.~~

~~an accurate and detailed statement. The materials from which the first line is compiled are given by Mr Bowley (loc. cit. sec. xii.), the second line comes from the Journ. Stat. Soc., Sep- Trend of tember 1899, and the third is an estimate based on various material summarized by Mr Bowley (loc. cit.), and on Mr Wood's article in the Economic Journal, December 1899. It is very instructive to notice how the median wage has been moving away from the labourer's wage towards the artisan's since 1840. "~~

~~Table illustrating the Progress of Weekly Wages.~~

~~wages In the 19th i century.~~

~~Approximate Dates.~~

~~1790.~~

~~1810.~~

~~1820.~~

~~1840.~~

~~1860.~~

~~1890.~~

~~Building artisan, London (summer)~~

~~Agricultural lab- ourer,3 England .~~

~~Median, adult males, United Kingdom~~

~~18~~

~~8 10~~

~~«. d.~~

~~29 0~~

~~16 0~~

~~17 6~~

~~*. d.~~

~~29 0~~

~~14 0~~

~~15 6~~

~~s. d.~~

~~30 0 12 0 14 6~~

~~s d.~~

~~33 0 13 6 17 0~~

~~s d.~~

~~39 6 15 0 24 0~~

~~The material for dates since 1860 is more complete ; the follow- ing table gives estimates of the increase in average wages in many of the principal industries, based on Mr Bowley's tables published in the Journ. Stat. Soc, June 1895, September and December 1899, and March 1901, and in the Economic Journal, December 1898. More reliance can, in general, be placed on estimates of rates of change than on statical statements of wages ; actual wages at the various dates can, however, be estimated from this table in com- bination with the other statistics given in this article.~~

~~Course of Average Money Wages in Selected Industries in the United Kingdom. Wages in each Trade expressed as Percentages of their Value in 1860.~~

~~1860.~~

~~1866.~~

~~1870.~~

~~1874.~~

~~1877. 147~~

~~1880.~~

~~1883.~~

~~18S6.J 1891.~~

~~Agriculture~~

~~100~~

~~106~~

~~115 ! 144~~

~~133 129 ‘ 126 1 137~~

~~Building .~~

~~100~~

~~110~~

~~112~~

~~124~~

~~132~~

~~128 128 128 132~~

~~Cotton~~

~~100~~

~~115~~

~~115~~

~~141~~

~~141~~

~~133~~

~~141 , 146 156~~

~~Wool.~~

~~100~~

~~106~~

~~112~~

~~121~~

~~130~~

~~126~~

~~120~~

~~115 | 115~~

~~Jute .~~

~~100~~

~~133~~

~~140~~

~~127~~

~~120~~

~~142~~

~~120 140~~

~~Flax .~~

~~100~~

~~114~~

~~129~~

~~133~~

~~133 1 ...~~

~~*Iron 4*~~

~~*100*~~

~~*127*~~

~~*127*~~

~~*143*~~

~~*112*~~

~~*112*~~

~~*110 100 124*~~

~~*Engineering*~~

~~*100*~~

~~*108*~~

~~*110*~~

~~*124*~~

~~*123*~~

~~*120*~~

~~*127 i 126 126*~~

~~*Gasworks . .*~~

~~*100*~~

~~*115*~~

~~*120*~~

~~125~~

~~128~~

~~128~~

~~130 1 130 , 149~~

~~Seamen 6 .~~

~~100~~

~~113~~

~~103~~

~~129~~

~~123~~

~~102~~

~~118 : 110 143~~

~~Coal mining~~

~~100~~

~~109~~

~~106~~

~~147~~

~~110~~

~~103~~

~~110 ; 105 ‘ 147~~

~~Compositors Average 6 .~~

~~100~~

~~100~~

~~103~~

~~113~~

~~116~~

~~116.116 116 \ 121~~

~~100~~

~~112~~

~~115~~

~~140~~

~~135~~

~~129 1 134 132 145~~

~~In the above table it must be understood that each date refers to a short period, not to an individual year. If the figures for 1880-91 are compared with the statistics of occupation given in the Annual Labour Abstract, it will be found that in general, in those industries where wages have increased faster than the average, relative numbers employed have also increased, and vice versa (ikon. Journal, 1896, p. 469). There is, as Sir R. Giffen has pointed out (Essays hi Finance, 2nd series, p. 421 seq.), a continual transference from badly-paid to well-paid trades ; and to this we may add a further transference from trades where the rates increase slowly to those where the rates increase fast. Both tendencies are allowed due influence in the line of averages in the above table.~~

The change year by year is known for some occupations ; the figures in the following table are selected as being based on trustworthy evidence and illustrating a wide group of occupations. In this table we may notice the various effects of the cycle of commercial inflation and depression on the different industries, and also pick out the results of such single events as the failure of the City of Glasgow Bank in 1878. From the general view shown by the tables, it is at once clear that wages in some trades make regular slow progress, while in others the fluctuations are rapid and violent, and though there is a marked upward tend- ency, both since 1860 and since 1880, the highest point of the inflation of the early 'sevonties has not in some industries again been touched.

3 Valuing all special payments and perquisites.

4 Puddling and blast furnaces.

5 Merchant service : money wage only.

6 Allowing for relative numbers at each date, and for relative rates of wages, thus showing the estimated change in the average wage in these industries combined.

kingdom]

WAGES

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Agricultural

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s. d.

s. d.

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£

s. d.

8.

1860

33

22 0

25 0

~~35~~

~~36~~

~~3 6~~

~~6 3~~

~~1861~~

~~25 9~~

~~36~~

~~3 2~~

~~6~~

~~1862~~

~~3 1~~

~~1863~~

~~3 7~~

~~1864~~

~~21 3~~

~~4 0~~

~~1865~~

~~22 4~~

~~28 6~~

~~4 1~~

~~1866~~

~~36~~

~~25 6~~

~~27 7~~

~~4 6~~

~~1867~~

~~28 8~~

~~37~~

~~4 1~~

~~1868~~

~~37~~

~~38~~

~~3 7~~

~~7 3~~

~~1869~~

~~26 6~~

~~27 7~~

~~38~~

~~39~~

~~1870~~

~~39~~

~~41~~

~~3 9~~

~~1871~~

~~41~~

~~43~~

~~4 6~~

~~1872~~

~~27 8~~

~~29 9~~

~~44~~

~~46~~

~~7 0~~

~~1873~~

~~29 9~~

~~31 10~~

~~46~~

~~49~~

~~10 0~~

~~13 3~~

~~1874~~

~~31 10~~

~~34 0~~

~~47~~

~~51~~

~~7 2~~

~~11 6~~

~~1875~~

~~34 0~~

~~36 1~~

~~53~~

~~5 4~~

~~9 6~~

~~1876~~

~~36 0~~

~~40 4~~

~~46~~

~~54~~

~~4 8~~

~~9 3~~

~~1877~~

~~42 6~~

~~4 1~~

~~9 0~~

~~87~~

~~1878~~

~~31 10~~

~~27 7~~

~~45~~

~~53~~

~~3 2~~

~~7 8~~

~~1879~~

~~27 8~~

~~.25 6~~

~~43~~

~~50~~

~~4 7~~

~~7 1~~

~~0~~

~~1880~~

~~41~~

~~48~~

~~4 11~~

~~8 0~~

~~0~~

~~1881~~

~~27 7~~

~~40~~

~~46~~

~~4 7~~

~~7 7~~

~~2*~~

~~1882~~

~~29 9~~

~~39~~

~~8 4~~

~~6~~

~~1883~~

~~31 10~~

~~5 2~~

~~7 5~~

~~7*~~

~~1884~~

~~29 9~~

~~38~~

~~47~~

~~4 7~~

~~6 9~~

~~7~~

~~1885~~

~~37~~

~~4 1~~

~~6 5~~

~~6~~

~~1886~~

~~36~~

~~3 10~~

~~6 3~~

~~4~~

1887

29 9

37

48

4 2

4

1888

,,

38

6 4

4

1889

30 10

39

5 2

7 3

9

1890

38

31 10

~~31 10~~

~~49~~

~~6 2~~

~~8 3~~

~~30~~

~~1891~~

~~32 11~~

~~40~~

~~35~~

~~1892~~

~~32 11~~

~~35 1~~

~~7~~

~~5 6~~

~~30~~

~~1893~~

~~36 1~~

~~6 2~~

~~7 0~~

~~22~~

~~1894~~

~~34 0~~

~~37 2~~

~~5 3~~

~~6 11~~

~~25~~

~~1895~~

~~4 9~~

~~6 9~~

~~19~~

~~1896~~

~~36 1~~

~~38 37~~

~~39~~

~~4 4?~~

~~15~~

~~1897~~

~~38 3~~

:

~~4 6~~

7 0

16

1898

40 4

40 4

40

5 10

7 3

21

1899

>>

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9).

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6 7

8 0

28J

Annual earnings are affected greatly by the amount of lost time. The following table, from Mr Wood's "Statistics of Working Irreett- Class Progress since 1860" (Journ. Stat. Soc, 1899) larlty of anc^ fr°m *Qe monthly returns published in the Labour ^ Gazette, shows the average annual percentage number

~~*of unemployed members belonging to those trade unions whose returns are accessible.*~~

~~*Year.*~~

~~*p.c.*~~

~~*Tear.*~~

~~*p.c.*~~

~~*Tear.*~~

~~*p.c.*~~

~~*Year.*~~

~~*c.*~~

~~*Tear.*~~

~~*p.c.*~~

~~*1860*~~

~~*1-6*~~

~~*1868*~~

~~*8-5*~~

~~*1876*~~

~~*3-6*~~

~~*1884*~~

~~*7-4*~~

~~*1892*~~

~~6-2~~

~~1861~~

~~4-3~~

~~1869~~

~~7-4~~

~~1877~~

~~4-4~~

~~1885~~

~~9-0~~

~~1893~~

~~7-5~~

~~1862~~

~~7-8~~

~~1870~~

~~4-3~~

~~1878~~

~~6-3~~

~~1886~~

~~9-5~~

~~1894~~

~~6-9~~

~~1863~~

~~5-7~~

~~1871~~

~~1-8~~

~~1879~~

~~12-5~~

~~1887~~

~~7-8~~

~~1895~~

~~5-8~~

~~1864~~

~~2-6~~

~~1872~~

~~1-1~~

~~1880~~

~~5-9~~

~~1888~~

~~4-7~~

~~1896~~

~~3-4~~

~~1865~~

~~2-0~~

~~1873~~

~~1-3~~

~~1881~~

~~3-4~~

~~1889~~

~~2-1~~

~~1897~~

~~3-5~~

~~1866~~

~~3-1~~

~~1874~~

~~1-8~~

~~1882~~

~~1-9~~

~~1890~~

~~2-0~~

~~1898~~

~~3-0'~~

~~1867~~

~~7-3~~

~~1875~~

~~2-5~~

~~1883~~

~~2-2~~

~~1891 •~~

~~3-3~~

~~1899~~

~~2-4~~

~~These figures relate only to trades which are strongly " combined," and are not even strictly comparable with each other, since more and more unions are included as the series progresses. On the whole, there is no distinct evidence of improvement or the reverse. The following table, extracted from the Fifth Annual Abstract of Labour Statistics, pp. 72-73, shows the fluctuation month by month for certain groups of trades : —~~

~~1 Journ. Stat. Soc, Dec. 1899.~~

~~2 Wages in the United Kingdom, Bowley, pp. 89, 90, sec. xiii.~~

~~3 Journ. Stat. Soc, Sept. 1899.~~

~~4 Various authorities.~~

~~6 App. to Labour Commission, and the Labour Department's Changes in Rates of Wages.~~

6 Where blank spaces are left, figures cannot be accurately given.

7 Figures after these dates are from new estimates.

Mean for the 7

Percentage of Members Unemployed,

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years 1892-98.

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~~i~~

~~All trade unions~~

~~making re-~~

~~turns~~

~~6-1~~

~~5-8~~

~~6-2~~

~~4-8~~

~~4-7~~

~~4-5~~

~~4-R~~

~~s-n~~

~~f>-“>.~~

~~S-3~~

~~5-3~~

~~fl-n~~

~~5-2~~

~~Carpenters and plumbers~~

~~4-7~~

~~4-2~~

~~3-2~~

~~2-4~~

~~2-1~~

~~2-2~~

~~2-2~~

~~V9~~

~~2-0~~

~~2-2~~

~~2-4~~

~~3-7~~

~~2-8~~

~~Metal, engi-~~

~~neering and~~

~~shipbuilding trades .~~

~~8-1~~

~~7-6~~

~~7-0~~

~~6-8~~

~~6-5~~

~~fi-3~~

~~6-8~~

~~7:3~~

~~7-7~~

~~s-n~~

~~7-9~~

~~8-3~~

~~7-4~~

~~Printing and~~

~~bookbinding~~

~~trades~~

~~5-0~~

~~4-5~~

~~8-9~~

~~3-9~~

~~4-0~~

~~4-4~~

~~3-9~~

~~5-8~~

~~5-4~~

4-6

8-4

4-0

4-4

In the Wage Census (Board of Trade), 1886, the following partic.ulars were in all cases obtained : (i.) the number employed in that week of 1885 in which the greatest sum was paid in wages, which may perhaps be assumed to be the number dependent on the factories making returns, say n ; (ii.) the total amount paid in wages in 1885, say £a ; (iii.) the average wage paid in a particular week in October 1886, say £w. If the whole number of persons n had been employed throughout 1885, their earnings would have been approximately £nxwx 52 =£e, say ; then the ratio a : e is a rough measure of the ratio of the average number of weeks' wages obtained to those of a full year's constant work. Applying this method to the principal industries dealt with, we obtain the follow- ing figures : —

Rough Estimate of Number of Full Weeks' Wages obtained in the Year 1886.3

Industry.

No. of Weeks.

Industry.

No. of Weeks.

Industry.

No. of Weeks.

Cotton .

48

Silk .

44

Metal mines .

49

Wool .

45J

Carpet

44

Slate quarries

44

Worsted

46

Lace .

49

Granite „

43£

Linen .

49

Building .

44

~~Stone „~~

~~37~~

~~Jute~~

~~50~~

~~Railways .~~

~~44~~

~~Roads, &c. .~~

~~42i~~

~~Hemp .~~

~~42~~

~~Coal and "\~~

~~47~~

~~Gasworks~~

~~42~~

~~iron mines/~~

~~General average for above in~~

~~dustries, 46.~~

~~This estimate indicates that 12 per cent, on the average were out of work during 1885, a number greater than the 9 per cent, shown by the trade union returns, as might be expected.~~

A class, of great but unknown number, of manual workers is not taken into account in any of the above statistics relating to wages or employment. This class consists of all those who are per- manently out of work, through misfortune, incapacity, idleness, or other causes ; of those who occasionally get work, but are not attached to any regular trade ; and of large and, on the whole, badly-paid industries, domestic service, home tailoring, service iu shops, and others, with regard to which no systematic statistics on a large scale are forthcoming.

So far we have dealt with the statistics of nominal wages only ; imperfect as these statistics are, they are far more complete than those which relate to the purchasing power of money . and to real wages. We have, indeed, several estimates erof of the change in the value of money when measured „,a- es by other commodities, but these depend only on whole-sale prices. Among the best known are the index-numbers com- piled by Mr Sauerbeck (Journ. Stat. Soc, March, annually). From these we can deduce numbers representing the purchasing power of a sovereign in "general commodities." They are as follows : —

Purchasing Power of Gold in General (Wholesale) Commodities (Average of 1867-77 being 100).

Year.

Index No.

Year.

Index No.

Year.

Index No.

Year.

Index No.

1860

~~101~~

~~1870~~

~~104~~

~~1880~~

~~114~~

~~1890~~

~~139~~

~~1861~~

~~102~~

~~1871~~

~~100~~

~~1881~~

~~118~~

~~1891~~

~~139~~

~~1862~~

~~99~~

~~1872~~

~~92~~

~~1882~~

~~119~~

~~1892~~

~~147~~

~~1863~~

~~97~~

~~1S73~~

~~90~~

~~1883~~

~~122~~

~~1893~~

~~147~~

~~1864~~

~~95~~

~~1874~~

~~98~~

~~1884~~

~~131~~

~~1894~~

~~159~~

~~1865~~

~~99~~

~~1875~~

~~104~~

~~1885~~

~~139~~

~~1895~~

~~161~~

~~1866~~

~~98~~

~~1876~~

~~105~~

~~1886~~

~~145~~

~~1896~~

~~164~~

~~1867~~

~~100~~

~~1877~~

~~106~~

~~1887~~

~~147~~

~~1897~~

~~161~~

~~1868~~

~~101~~

~~1878~~

~~115~~

~~1888~~

~~143~~

~~1898~~

~~156~~

~~1869~~

~~102~~

~~1879~~

~~120~~

~~1889~~

~~139~~

~~1899~~

~~147~~

~~8 From Archiv filr soziale Gesetzgebung und Statistik, p. 314. Berlin, 1896.~~

[united kingdom

There is good reason for holding that numbers compiled on such principles represent with considerable accuracy the change in general wholesale prices (see Re-port of Brit. Assoc, for 1887, 1888, 1889, Committee on Variations of the Monetary Standard).' The fact that wholesale prices have fallen so rapidly makes it certain that there has been a corresponding fall in retail prices, but the extent of this fall as it affects incomes of different amounts is very imperfectly known. The necessary data for the solution of this question are the retail prices of the articles on which wages are spent and the fraction of the wage spent on each article at each date. Since prices of articles change at varying rates, it is clear that the change in purchasing power varies for different incomes, since the size of the income governs the object of the expenditure. At the lowest scale of expenditure in England, bread absorbs a large fraction of the wage, and the price of bread governs the purchasing power ; as means increase, meat, clothes, house-rent, luxuries, the cost of personal service, successively come into prominence, so that separate valuations are necessary for many classes. Again, the retail prices of articles vary not only with localities, but also with purchasers, who buy at various times and in various quantities, so that the difficulty of stating them is greatly increased. There are many compilations of budgets of expenditure of workmen in various ranks and countries and periods, but they do not lend themselves to the purpose in' hand. The following budgets are offered not as authentic, but as being sufficiently near the facts, shown in authentic collections, to illustrate the problem and its theoretic solution.

1860.

Bread, 8 quarterns Meat, 5 lb Bacon, 2 lb Potatoes, 20 lb Flour, 6 lb Rice and meal Vegetables Butter, 1 lb Milk, 8 pints Sugar, 3 lb Treacle, 2 lb Tea, 4 oz. Coffee, 8 oz. Soap

~~*Coal, \ cwt. Rent*~~

~~*Illustrative Artisan's Family Budget.*~~

~~*1900.*~~

~~*4 2 1 1*~~

~~*0 1 0*~~

~~*1 1 1*~~

~~*0*~~

~~*1*~~

~~*0 8*~~

~~*0 8*~~

~~*1 6 3 0*~~

~~*6*~~

~~*1*~~

~~*0*~~

~~*3*~~

~~*54*~~

~~*0*~~

~~*22 10*~~

~~*For clothes and sun- dries . . .52*~~

~~*"Weekly earnings . 28 0*~~

~~*Cost of this budget at prices of 1900, 25s. 5d. (about).*~~

~~*Hence increased purchasing power of money, 1900 over 1860, 10 per cent.*~~

~~*Bread, 6 quarterns Meat, 8 lb Bacon, 2J lb Potatoes, 10 lb Flour, Z\ lb Rice, oatmeal, &c.*~~

~~*Butter, 2 lb Milk, 8 pints Eggs, 6 . Sugar, 4 lb Jam*~~

~~*Tea, 12 oz. Cheese, 1 lb Soap, &c. Lights . Coal, 2 cwt. Rent*~~

~~*27 4*~~

~~*For clothes and sun- dries . . .88*~~

~~*Weekly earnings . 36 0*~~

~~*Cost of this budget at prices of 1860, 43s. (about).*~~

~~*Hence increased purchasing power of money, 1900 over 1860, 20 per cent.*~~

~~*Illustrative Agricultural Labourer's Family Budget.*~~

~~*1860.*~~

~~*Bread, 9 quarterns Bacon, 14 tb Butter, 1 lb Cheese, 1 lb Tea, 2 oz. . Sugar, 1 lb Treacle, 1 lb Potatoes . Soap, &c. . Light Rent*~~

~~*10 10*~~

~~*Clothes and sundries . 1 2*~~

~~*Weekly earnings .12 0*~~

~~*Cost of this budget at prices of 1900, 10s. (about).*~~

~~*Hence increased purchasing power of money, 1900 over 1860, 20 per cent.*~~

~~*1900.*~~

~~*Bread, 8 quarterns .*~~

~~*Bacon and meat, 4 lb .*~~

~~*Butter, 1 lb*~~

~~*Cheese, 2 lb .*~~

~~*Tea, 6 oz. .*~~

~~*Sugar, 3 lb .*~~

~~*Milk, skim, 2 quarts*~~

~~*Potatoes .*~~

~~*Soap, &c. .*~~

~~*Light*~~

~~*Fuel, 1 cwt.*~~

~~*Rent*~~

~~*2 1 1 0 0 0 0 0 0 1 1*~~

~~*13*~~

~~*Clothes and sundries . 1*~~

~~*Weekly earnings , IS 0*~~

~~*Cost of this budget at prices of 1900, 18s. 2d. (about).*~~

Hence increased purchasing power of money, 1900 over 1860, 21 per cent.

It is first to be noticed that these budgets are influenced greatly by the prices of bread and meat in 1860, which we do not know exactly. These are of more importance than the exact quantity of the various articles purchased. Hence the results obtained must be regarded for the present as merely tentative. As regards rent, it is probable that the increase is due partly to better value, especially when water and the benefits from the expenditure of •the rates included are considered, partly to increased pressure of population and ground rent ; in reckoning the comparative prices, half of the change is debited to each of these. Since the marg'n between the expenditure on food and the wage can be spent on any object, manufactured goods, clothes, travelling, and so on, it is reasonable to regard this margin as subject to the change in pur- chasing power of gold shown by wholesale index numbers ; this has been done in reckoning comparative prices. It is then seen that the benefit of reduced prices is chiefly in the share of income devoted to bread and in the margin ; the former is chiefly to the advantage of the agricultural labourer, the latter to that of the artisan ; both benefit in the cheapness of groceries. As a commodity becomes cheaper, more of it is purchased ; and as the wage increases, more is spent on dearer goods. This change in objects of expenditure is adequately allowed for, if we reckon the increased purchasing power as above, first on the basis of one, then on that of the other year's budget ; the quantity required must lie between the measurements so obtained ; in the case of the artisan the increase is therefore between 10 and 20 per cent., and while this nominal wage has increased 29 per cent., his real wage has risen about 48 per cent.

(129 115 \ — — x ———). The corresponding numbers for the agricultural

labourer are 25 per cent, and 50 per cent. If we had adopted Mr Sauerbeck's numbers without criticism, the real wages would have shown increments of 104 percent, and 100 per cent. It must be emphasized that this calculation is not intended actually to evaluate the increase in real wages, but to show the difficulties and dangers of the problem, and to suggest a method of solution when the requisite data have been obtained.

~~Yet we may deduce that real wages have probably risen faster than nominal wages, and that the divergence between them is not so great as that indicated by index-numbers of wholesale prices. There is not space to do more than enumerate the improvements in real wages which come from shortened hours of labour, better conditions of work enforced by legislation, the gift of free education to the labourer's children, and the public benefits open to him as a citizen.~~

~~Authorities. — The following are the chief books and papers containing wage statistics, &c, relating to the United Kingdom for years since 1860 :~~

~~—•~~

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and Piece Sates, 1894 and lSOO ; Reports on Profit-Sharing, 1894 ; Employment of Women and Girls, 1894 ; Gain-sharing, &c, 1895 ; Money Wages of Indoor Domestic Servants, 1899 ; Reports on Trade Unions (especially 4th, 5th, and 6th), annually since 1887 ; Reports on Strikes and Lock-outs, annually since 1888 ; Reports on Rates of Wages in many Trades and General Report ("The Wage Census "), 1889-93 (Papers by Command : C. 5807, 6161, 6455, 6715, 6889); Returns of Wages, 1830-86, 1887 (C. 5172). — 2. Miscellaneous : Factory Inspectors' Reports, half-yearly since 1835. Returns of Agricultural Wages, England, 1860, 1861, 1869, 1870, 1872 ; Scotland, 1860 ; Ireland, 1860, 1869. Agricultural Statistics of Ireland, annually since 1890. Merchant Seamen's Wages, 1867. Supply of Seamen, 1873. Merchant Shipping Returns, 1890. Report on Hours of Labour, 1890. Wages and Earnings of Agricultural Labourers (Cd. 346, 1900). — 3. Reports of Commissioners : On Children's Employment, 1863-67 ; Women and Children in Agriculture, 1867-69 ; Agricultural Interests, 1880-82 ; Depression of Trade, 1886 ; Agriculture, 1894 and 1896 ; Labour Commission, 1893-94 [especially C. 6894, xxiv. and xxv. (Agri- culture), and C. 7421, i. (appendix)] ; Financial Relations of Great Britain and Ireland, 1895-96.

~~See also the more complete biblio- graphy of wages, Economic Review, 1898, pp. 504-520 ; and the shorter bibliographies relating to prices, wages, and workmen's budgets in Palgrave's Dictionary of Pol. Econ. iii. pp. 195, 198, 641, 676. \A, L. bo.)~~

~~II. United States.~~

~~Nominal wages only are dealt with in this article. By " nominal wages " is meant rates of wages or earnings, without reference to the cost of living. Wage statistics as such were not known in the United States until perhaps 1875. The systematic collection and classification of wages constitute features in modern industrial statistics. For the period anterior to 1875 or thereabouts, therefore, reliance must be placed upon fugitive statements, rates drawn from accounts, and statements found in history. In the early colonial days attempts were made to fix rates of wages by law, but no such attempts have been made since the first half of the 17th century. In 1633 the Massachusetts Bay colony provided that carpenters, sawyers, masons, bricklayers, tilers, joiners, wheelwrights, mowers, and other master workmen should not receive more than two shillings per day. The statute provided that each workman should pay his own board, but if board was furnished they might receive fourteen-pence per day. The best skilled labourers might receive eighteen -pence per day, while the constable could fix the rates for poorer labourer* as well as for inferior workmen in the trades. Journeymen tailors were paid twelve-pence per day, but tailors of little skill could be paid only eight-pence, their living being added. Employers paying more than the rates allowed by law, or workmen receiving them, were to be punished. Such statutes did not work well, and were soon repealed, although others were enacted and also repealed. For a long time two shillings per day con- stituted a fair average wage for mechanical labour. This rate applied to mowers, wheelwrights, and that class of labour. Skilled workmen and labourers were annoyed by regulations fixing wages and imposing fines all through the 17th century, while there were laws in Massachusetts colony forbidding workmen to take wine in part pay- ment for services, and in 1672 labourers were forbidden to demand liquor as any part of their wages. In the same year two shillings per day constituted the pay of common labourers, and this had been the rate for forty years. Four pounds to five pounds per annum~~

was the compensation for women. Field hands (who were Indians to some extent) received eighteen-pence per day. At the close of the 1 7th century two shillings per day was the rate for common labourers in New England, while in New York they received two shillings and three-pence to three shillings. During the first few years of the 18th century four shillings per day was paid in some parts of the country. Ten pounds sterling per annum was the usual amount earned in Virginia colony. Wages remained

fairly steady throughout the 17th century, nor was there any particular change until far into the 18th century. The wages of mechanics were based upon those of farm labourers. At the close of the colonial period the latter were paid about 40 cents per day, the average from 1752 to 1760 being 31 cents. In 1780 butchers were paid 33^ and carpenters 52 cents per day. Boat-builders and ship carpenters at the close of the colonial period were able to earn 90 cents, shoemakers 73 cents, and black- smiths 70 cents per day.

The chief data from which quotations can be made for the period beginning at the close of the Revolutionary War relate very largely to the Eastern and Middle States, as very few can be obtained for other parts of the country. Not much change took place in the rates of wages paid in various trades until the period of 1790 to 1830, when the factory system had become known and its influences felt. During that period most labour was paid higher wages, on account of the greater demand. Carpenters, who were paid in 1790 60 cents a day, received 70 cents in 1800; in 1810, $1-09 ; in 1820, $1”13, and about the same in 1830, although in the northern parts of the country $1*40 was a fair average during the period from 1830 to 1840. There was not much change for carpenters until 1860. If the wages of labourers, as distinguished from skilled work- men, are taken as representative of general conditions, the records show that they were paid in 1790 about 43 cents a day on the average; in 1800, 62£ cents; from 1800 to 1810, 82 cents ; from 1810 to 1820, alittle over 90 cents ; while during the years from 1840 to 1860 they were paid from 87£ cents to $1 a day. When the 19th century opened, printers were paid about $1 a day, and this rate was increased to $1-75 by 1860. From 1790 to 1800 shoemakers received 73£ cents a day on the average, while from 1820 to 1830 it was $1*06, and by 1860 $1-70 per day. The wages of cotton-mill

operatives are not given anywhere for any period prior to 1820, but from then to 1830 they were paid, on the average, 44 cents a day, while during the next ten years they received 90 cents a day. There was little change till 1850, when during the next ten years their average pay was $1”03 per day. Woollen-mill operatives were paid somewhat better rates. During the years from 1820 to 1830 their wage was $1*12 a day, but they received little increase before 1880. After 1830 the records of mills and factories furnish a more complete statement of wages, while reports of agri- culture give information in that industry. In 1831 agri- cultural labourers ranged from 57£ cents to $1 per day. Blacksmiths were being paid $1 to $1*25; carpenters $1*07, but often as high as $1”50, while masons were paid $1*26 per day. After 1873 wages in the principal occupations doubled in most cases. Then came the minute division of labour and separation into classes, so that it is difficult to give an average wage, or at least an average wage gives but little idea of rates of wages for the different classes ; so one must look to a classification of wage rates in the last quarter of the 19th century, although we know that paper-mill operatives in 1831 received 66*6 cents, printers $1*25, shoemakers $1*06, cotton-mill operatives 88*6 cents, woollen-mill operatives 94*6 cents, glassmakers $1*13, and millwrights $1*21.

Two industrial depressions occurred between 1830 and 1860, one in 1837 and one in 1857. These, with other influences, helped to keep wages low ; nor did they fully recover from the depression of 1857 by 1860, but during the period ending that year there was a decided advance over the rates prevailing in 1830. A few quotations for that period must suffice. Agricultural labourers were paid $1*01 per day, blacksmiths $1*69, carpenters $2*03, masons $1*53, paper-mill operatives $1*17, printers Sl*75,

shoemakers $1”70, cotton-mill operatives $1‘03, woollen- mill operatives 87‘3 cents, glassmakers $2-96, and mill- wrights $1‘66. With the exception of woollen -mill operatives, these wages show some increase over 1830. The percentage of increase ranges from 16 ‘3 per cent, for cotton -mill operatives to 161 -9 for glassmakers. The examination of twenty different occupations shows that in but one was there an increase in average daily wages. The fluctuation in currency and the financial crisis of 1873 had some effect upon wages during the twenty years from 1860 to 1880, but, comparing the averages for these two years, it is found that agricultural labourers in 1880 received $1‘31 per day, blacksmiths $2-28, carpenters $2-42, masons $2‘79, paper-mill operatives $2-79, printers $2 18, shoemakers $1-76, cotton-mill operatives $1”40, woollen-mill operatives $1*24, and glassmakers $l-79.

These figures show positive increase in wages in all occupations during the fifty years from 1830 to 1880. Such general averages are somewhat unsatisfactory, but they must- be used in the absence of classified data. In some branches of industry, like cotton and woollen and others where there are numerous classes of employes, it is possible to make a gradation which is more satisfactory. Such grades indicate general rates of wages.’ In the carding department of a cotton factory in Massachusetts wages ranged from $2 for overseers, with thirteen hours of labour, in 1842, to $5 per day, with ten hours of labour, in 1891 ; while overseers in the weaving branch were increased from $1-75 in 1843 to $5 a day in 1891. Looking at the lower classes of labour in the same estab- lishment, it is found that the average daily wages of •pickers and section-hands increased from 71”5 and 69”5 cents respectively in 1842, to $1-03 and $1-64 in 1891, while the hours of work decreased from thirteen to ten. In an establishment in New York the pay of carpenters in 1843 was $1-50 per day, and in 1891 $3-50, while the hours were reduced from ten to eight. Bricklayers’ wages increased from $1‘75 in 1851 to $4 a day in 1891, while their helpers’ pay

rose from $1 to $2-50 in the same period, with ‘ a decrease of two hours in working time. The rates of pay of draughtsmen in New York increased from $1-75 in 1848 to $5”31 a day in 1891, and foremen blacksmiths from $2‘50 to $5‘83 in the same period. The pay of locomotive engineers rose from $2‘14 in 1840 to $3-77 a day in 1891, and of firemen from $1-06 to $l-96. During the same period the pay of passenger-car conductors increased from $2”11 to $3 -84 per day. From 1840 to 1891 the average daily rates of wages for all classes of mechanics and operatives in factories ranged between $1 and $2 per day.

Taking the earnings of common and agricultural labourers for the whole period from 1633 to the present time, it is found that the daily wages for the best labourers rose from 25 to 33 cents immediately preceding the Revolution to 42£ cents immediately after, while in 1891 their wages ranged from $2‘50 a day in Montana and $1 “25 in New York to 75 cents in the Carolinas. In the latter year farm labourers received from $30 to $40 per month, with board and lodging, in Montana and California, $9 and $10 in the Carolinas and Virginia, and $15 to $20 in New York. Masons (master workmen) received 33‘3 cents per day in 1633, and $1 in 1790, while during the busy season of 1891 their wages ranged from $4-50 to $5 per day in California and Colorado, $2‘50 in North Carolina, and $2-50 and $3‘36 in Pennsylvania and New York.

In 1893 an elaborate report was made by the Senate Committee on Finance, giving the range of wages from 1840 to 1891. This report took 100 as the basis in 1860. In twenty-one industries

and from almost 100 separate establishments, and by the use of a simple average, the committee found that wages stood at 87 “7 in 1840, at 100 (the basis) in 1860, at 152‘4 in 1866, and 160‘7 in 1891. So on this basis, which is a mathematical one, the increase was from 877 in 1840 to 1607 in 1891. This shows the mathematical range. On the basis of an elaborate report (sixteenth annual) of the Massachusetts Bureau of Statistics of Labour, making general comparisons for a long term of years, it was shown that the general average increase for the period ending with 1860, compared with that ending 1830, was 52-3 per cent.

~~*Wages in gold were higher in 1891 and 1892 than at any period in the history of the United States prior to 1900. The trend of wages since 1891 is shown by the following table, whi*~~

~~*Year.*~~

~~*Relative Wage.*~~

~~*Year.*~~

~~*1896*~~

~~*Relative Wage.*~~

~~*1891*~~

~~*100-00*~~

~~*97-93*~~

~~*1892*~~

~~*100-30*~~

~~*1897*~~

~~*98-96*~~

~~*1893*~~

~~*99-32*~~

~~*1898*~~

~~*9879*~~

~~*1894*~~

~~*98-06*~~

1899

101-54

1895

97-88

1900

103-43

In 1893 a severe industrial depression began, and wages were greatly reduced, the reduction ranging all the way from 10 to 40 per cent., and it was not until the latter part of 1898 and early in 1899 that a very general increase took place. The increase in the coal-mining industry during the year 1899 and the first half of 1900 has been all the way from 10 to 100 per cent. Miners in some districts who a few years ago received 45 cents per ton are now being paid 90 cents per ton. The wages in some industries have not increased much, but in those where an increase has not taken place there was not much reduction. In North Carolina blacksmiths now receive $1'67 as against $l-25 per day in 1890, while in Boston there has been little change, the rate now being |2-55, although some blackmiths are paid as high as $3 per day. There has not been much increase in railway labour wages.

Bricklayers in Augusta, Ga., are now paid |3 per day in place of $2 -25 in 1890, and in some other partsof the South they receive $3 per day. In San Francisco bricklayers receive $5 per day ; in Cleveland 45 cents per hour ; in Buffalo $3 -60 per day, although some receive less j in Boston $3-60, and in Chicago $4 per day. Carpenters receive $3"40 a day in Chicago, and as much in many other cities, while plumbers receive $4 per day, as also stone-cutters, gas- fitters, steam-fitters, plasterers, engineers, and tile-setters. It is impossible to give any rates of wages by occupations that can be considered typical of the whole country, for labour conditions vaiy in so large a country as the United States, and while a carpenter or other skilled workman may receive $4 per day in a large city, in a town near by he may receive but $2 50 a day. The general course of wages can be

~~determined only by a mathematical calcula- tion like that quoted from 1840 to 1891, and by the use of the average wage as distributed by manufacturing industries. Taking the total wages paid in 1850, 1860, 1870, 1880, and 1890, and dividing the total by the number representing the average number of persons (excluding officers and clerks) employed in the manufac- turing and mechanical pursuits in those years, an average is found which is fairly indicative of the general progress of wages, although such average is not mathematically correct, owing to the vary- ing divisor used ; yet, on the whole, it is fairly satisfactory. Such a calculation shows that the average annual earnings of each employ^ in such industries, including men, women, and children, were in 1850, $247 ; in 1860, $289 ; in 1870, $302 ; in 1880, $347 ; in 1890, $445. Wages in 1902 were higher than at any period in the history of the United States. The value of these figures is enhanced by the fact that they are corroborated by separate specific investigations independent of the census reports.~~

~~Authorities. — Wright. Industrial Evolution of the United States. MeadVille, Pa., 1897 ; and Historical Beview of Wages and Prices, 1752-188$. — Bulletins Nos. 29, 30, U.S. Department of Labor (16th Annual Report of Mass. Bureau of Statistics of Labor, 1885). — Weeks. Report on the Statistics of Wages, vol. xx., Tenth Census of the United States. Washington, 1880 ; U.S. Senate Committee on Finance, Report on Ivholesale Prices, Wages, and Transportation. Washington, March 1893 ; Reports of Bureaus of Statistics of Labour of various States. — Weeden. Economic and Social History of New England, 1620-1789. Boston, 1890. (c. D. W.)~~

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~~III. Continental Europe.~~

~~No attempt has ever been made by a statistical bureau to collect in a systematic way such wage data for the various countries of Europe as~~

would permit a fair com- parison of the wages paid in one country with those paid in another. The statistical or labour bureaus of a few of the Continental countries have in some instances made extensive inquiries regarding wages in certain occupations or industries, but the methods of inquiry and compilation adopted and the time periods selected were so diverse that an accurate comparison of the results of one investigation with those of another is practically impossible.

It may be said in a general way that wages are highest in those countries, or sections of a country, where the greatest progress has been made in industrial develop- ment, as in France, Germany, Belgium, and Switzerland, and lowest where the more primitive methods of pro- .. duction are employed, as in Spain, Russia, Austria, Italy, &c. This is perhaps mainly due to the fact that superior methods of production require a higher degree of skill and greater activity on the part of the workers, thus increasing the labour efficiency of the latter, and consequently their value as producers. This is illustrated by the fact that the difference in wages mentioned is usually greatest in the case of skilled labour and occupations involving the use of machinery, as in the textile industries, and least in the case of ordinary unskilled occupations, particularly agricultural labour.

In the larger countries of Europe where much progress has been made in industrial development in certain sec- tions, other sections of the same country often adhere to the older methods, resulting in a great diversity of wages for similar occupations. Thus in the mining districts of Westphalia wages are higher and people live better than in the mining districts of Silesia, Prussia. It is also observed that wages are higher in cities, where the cost of living is greater and the standard of life higher, than in village and rural districts, where workers obtain the necessaries of life for a smaller expenditure of money and where their wants are fewer. An illustration of this is found in an investigation made in 1891 l by the French Government, which showed that the average wages paid to all employes in 451 establishments, representing all the leading industries, were 5-28 francs per day in Paris, while in 2506 establishments engaged in similar industries in the rest of France the wages were but 3 52 francs per day, or about one-third lower.

Owing to this great variation in the wages paid in the same occupations in the same country, it is apparent that even though fairly accurate wage data were available, instead of the fragmentary material extant, it would still be impossible to establish any figure or set of figures which would represent the average wages of the workers of arjy country at a given time. In the absence of such average figures, a comparative statement of wages in the different European countries cannot be made. One can only judge in a general way by comparing the wages paid in similar occupations, or in industrial establishments operating under similar conditions, and by observing the general condition of the wage- workers in one country and in another. Such a comparison has led to the conclusions expressed in the beginning of this article.

Perhaps the only investigation ever made in which wage statistics were collected according to a uniform method in different countries was one undertaken by the United States Department of Labor from 1888 to 1891 2

1 Salaires et Durfe du Travail dans I'Industrie Fran^aise, 1897.

2 Sixth and Seventh Annual Reports of the United States Com- missioner of Labor, 1890, 1891.

on the cost or production of certain commodities. While this investigation covered a very limited field and was conducted in out a few countries, it affords, as far as it goes, a medium lor making some comparisons. Of three establishments considered in this investigation which were manufacturing cotton yarn, one in Germany, employing 332 persons, paid an average of W6 marks per day; one in Switzerland, employing 122 persons, paid 2-31 francs per day ; and one in Italy, employing 168 persons, paid 1 58 lire per day. Of three establishments manufacturing steel ingots, one in Belgium, employing 88 persons, paid an average of 3'99 francs per day ; one in France, em ploying 186 persons, paid 3'83 francs per day; aid one in Italy, employing 256 persons, paid an average of 3'47 lire per day. Of two establishments producing mixed iron and steel, one in Germany, employing 842 persons, paid an average of 2-37 marks per day ; and one in Belgium, employing 802 persons, paid an average of 2 "77 francs per nay. The rojjowmg tables show the wages paid

~~*in a few of the occupations in establishments con- sidered in the above-mentioned investigation : —*~~

~~*average Daily Wages, 1888-189L Cotton Textiles.*~~

~~*Occupations.*~~

~~*Card grinders . . Card strippers . Labourers Overseers, tarding Picking-room hands Piecers . Second hands . Spinners, mule*~~

~~*France. Germany.*~~

~~*Franca.*~~

~~*378 3-21 2-90 7-46 2-69 2-85 4-40 4-97*~~

~~*Marks.*~~

~~*2-14 1-81 2-23 4-12 1-76 1-26 3-40 2-14*~~

~~*Switzerland.*~~

~~*Italy.*~~

~~*Francs.*~~

~~*Lire.*~~

~~*2-59*~~

~~*2-38*~~

~~*2-28*~~

~~*1-81*~~

~~*2-49*~~

~~*1-71*~~

~~3-26~~

~~3-26~~

~~1-81~~

~~1-76~~

~~1-50~~

~~1-81~~

~~3 32~~

~~2-54~~

~~3-42~~

~~3-21~~

~~Steel Ingots.~~

~~)ccupations.~~

~~France.~~

~~Belgium.~~

~~Italy.~~

~~Francs.~~

~~Francs.~~

~~Lire.~~

~~Blacksmiths .~~

~~472~~

~~3-47~~

~~3-21~~

~~Blacksmiths' helpers~~

~~3-21~~

~~1-76~~

~~2-49~~

~~Blowers~~

~~6-27~~

~~4-20~~

~~3-26~~

~~Labourers~~

~~3-47~~

~~3-16~~

~~2-33~~

~~Ladlemen~~

~~4-45~~

~~4-09~~

~~1-71~~

~~Weighmen .~~

~~3-52~~

The above data seem to indicate that for similar occupa- tions in the countries mentioned, wages were highest in France and lowest in Italy. Germany, Belgium, and Switzerland probably ranked in the order named with regard to wages.

An examination of the fluctuation in wage rates from year to year also shows that the increase in wages in the different countries and industries has been fairly coincident with the development of industry, the increase being most marked and steadiest in those industries and countries where the greatest progress has been made in the improvement of the means of production. Thus during 26 years (from 1870 to 1896) the average wages paid in twenty-one identical occupations increased 25*5 per cent, in Paris, 22 per cent, in Lyons, and 11*3 per cent, in Liege. During this period the wages of agricultural labourers in France decreased, while in Belgium they remained stationary. In Italy, where comparatively little progress has been made, statistics of wages in leading industries from 1888 to ^897 show m some cases a decrease and in others but very jttxe change. In Germany, on the other hand, wherever wage statistics in leading industries are given for a series of years, they show a tendency to increase.

More attention has been given to the subject of wages statistics by the Government of France than by that of

any other country of continental Europe. The methods adopted in the various investigations have, however, been so diverse that a comparison of the wage data is somewhat hazardous. The most trustworthy official wages statistics compiled in France at different time periods J were those

~~*contained in the reports of the industrial inquiries of 1840 to 1845, 1860 to 1865, and*~~

~~*1891 to 1893; the annual inquiries made by local officials in 1853, 1857, and from 1871 to 1885 ; the statistics of the French mining service, and the reports of local officials in the various departments for 1853, 1874, and 1892. As these are by far the most important wages compilations made in France, a summary of their results is given in the following tables : —*~~

~~*Average Daily Wages of Working People in*~~

~~*he Department of the Seine by Sex and Industries, Inquiries of*~~

~~*1840-45, 1860-65, and 1891-93.*~~

~~*Industries.*~~

~~*Inquiry of 1840-46 (Suburbs of Paris).*~~

~~*Inquiry of 1860-65.*~~

~~*Inquiry of 1891-93*~~

~~*(Department of*~~

~~*the Seine).*~~

~~*Paris.*~~

~~*Suburbs of Paris.*~~

~~*Males.*~~

~~*Females.*~~

~~*Males.*~~

~~*Females.*~~

~~***Males.***~~

~~***Females.***~~

~~***Males.***~~

~~***Females.***~~

~~***Francs.***~~

~~***Francs.***~~

~~***Francs.***~~

~~***Francs.***~~

~~***Francs.***~~

~~***Francs.***~~

~~***Francs.***~~

~~***Francs.***~~

~~***Flour milling***~~

~~***3-00***~~

~~***3-00***~~

~~***5-85***~~

~~***Starch manufacturing***~~

~~***2-90***~~

~~***3-75***~~

~~***4-80***~~

Sugar refining ....

3-00

2-00

3-50

. 2-00

2-50

1-25

5-50

3-25

Brewing .....

3-00

4-00

415

5-25

Pastry and confectionery

3-50

1-25

4-00

1-50

4-90

~~270~~

~~Chemical products and fertilizers~~

~~3-00~~

~~3-00~~

~~3-50~~

~~4-70~~

~~Oil works~~

~~2-75~~

~~3-10~~

~~5-60~~

~~Glue~~

~~, 2-50~~

~~3-00~~

~~2-70~~

~~4-20~~

~~Stearine, soap, and perfumery .~~

~~3-00~~

~~1-45~~

~~3-10~~

~~2-00~~

~~***3-20***~~

~~***1-75***~~

~~***5-05***~~

~~***2-40***~~

~~***Matches***~~

~~***■ 2-25***~~

~~***1-30***~~

~~***4-00***~~

~~***2-00***~~

~~***2-50***~~

~~***1-25***~~

~~***5-25***~~

~~***3-50***~~

~~***Paper and pasteboard***~~

~~***3-30***~~

~~***1-25***~~

~~***4-00***~~

~~***2-00***~~

~~***3-40***~~

~~***1-25***~~

~~6-00~~

~~3-10~~

~~Printing~~

~~4-15~~

~~5-00~~

~~4-50~~

~~7-10~~

~~Tanning . . i .~~

~~4-50~~

~~2-00~~

~~4-40~~

~~4-00~~

~~1-50~~

~~5-45~~

~~3-15~~

~~Cotton thread ....~~

~~3-50~~

~~1-35~~

~~4-00~~

~~2-00~~

~~4-50~~

~~2-00~~

~~5-35~~

~~2-85~~

~~Saw-mills .....~~

~~4-00~~

~~4-00~~

~~6-00~~

~~Surgical instruments~~

~~3-00~~

~~5-00~~

~~:.~~

~~775~~

~~Music boxes and instruments .~~

~~3-50~~

~~5-00~~

~~..i.~~

~~5-80~~

~~Brick and tile works~~

~~4-00~~

~~1-25~~

~~5-00~~

~~1-75~~

~~3-50~~

~~1-35~~

~~5-15~~

~~2-25~~

~~China and pottery ....~~

~~3-50~~

~~070~~

~~3-00~~

~~5-50~~

~~3-55~~

~~Glass~~

~~All industries~~

~~3-50~~

~~1-25~~

~~5-00~~

~~2-50~~

~~3-90~~

~~*1·60*~~

~~*5·80*~~

~~*2·20*~~

~~*3·50*~~

~~*1·55*~~

~~*4·50*~~

~~*0·41*~~

~~*4·00*~~

~~*1·70*~~

~~*6·15*~~

~~*3·00*~~

~~*Average Daily Wages of Working People in the Departments of France other than the Seine, by Sex and Industries.*~~

~~*Inquiries of 1840-45, 1860-65, and 1891-93.*~~

~~*Average Daily Wages*~~

~~*Percentage of Women*~~

~~*and Children of Total Working People.*~~

~~*Industries.*~~

~~*Inquiry of 1840-45.*~~

~~*Inquiry of 1860-65.*~~

~~*Inquiry of 1891-93.*~~

~~*Males.*~~

~~*Females.*~~

~~*Males.*~~

~~*Females.*~~

~~*Males.*~~

~~*Females.*~~

~~*Inquiry of*~~

~~*1860-65.*~~

~~*Inquiry of*~~

~~*1891-93.*~~

~~*Francs.*~~

~~*Francs.*~~

~~*Francs.*~~

~~*Francs.*~~

~~*Francs.*~~

~~*Francs.*~~

~~*Mines and quarries*~~

~~*1-95*~~

~~*0-85*~~

~~*2-30*~~

1-10

4-10

1-60

10

14

Food products

1-90

1-05

2-10

0-95

3-65

2-00

18

22

Chemical products .

2-15

1-10

2-20

1-15

3-70

~~1-85~~

~~23~~

~~11~~

~~Printing and publishing~~

~~2-05~~

~~1-00~~

~~2-50~~

~~1-10~~

~~4-00~~

~~2-10~~

~~42~~

~~42~~

~~Hides and leathers~~

~~2-00~~

~~1-00~~

~~2-20~~

~~1-10~~

~~370~~

~~2-10~~

~~9~~

~~26~~

~~Textiles~~

~~1-90~~

~~1-00~~

~~2-05~~

~~0-95~~

~~3-45~~

~~2-10~~

~~55~~

~~56~~

~~Clothing~~

~~2-25~~

~~1-10~~

~~3-60~~

~~1-90~~

~~65~~

~~58~~

~~Wooden goods~~

~~1-85~~

~~0-80~~

~~2-40~~

~~1-15~~

~~3-75~~

~~1-90~~

~~12~~

~~10~~

~~Furniture .~~

~~2-50~~

~~1-20~~

~~3-65~~

~~1-55~~

~~38~~

~~36~~

~~Metal goods~~

~~2-40~~

~~1-00~~

~~2-75~~

~~1-20~~

~~4-20~~

~~1-75~~

~~10~~

~~12~~

~~Building (stonework) .~~

~~2-00~~

~~0-85~~

~~2-05~~

~~1-10~~

~~3-60~~

~~1-15~~

~~19~~

~~5~~

~~Glass, china, &c.~~

~~1-90~~

~~0-90~~

~~2-15~~

~~1-05~~

~~4-00~~

~~1-95~~

~~25~~

~~27~~

~~All industries~~

~~2-07~~

~~1-02~~

~~2-76~~

~~1-30~~

~~4-00~~

~~2-20~~

~~35~~

~~27~~

~~Average Daily Wages of Working People reported by Local Officials in the Departments of France other than the Seine, by Occupa- tions, 1853, 1874, and 1892.~~

~~Occupations.~~

~~1853.~~

~~1874.~~

~~1892.~~

~~Francs.~~

~~Francs.~~

~~Francs.~~

~~Saddlers and harness makers .~~

~~214~~

~~2-95~~

~~3-75~~

~~Shoemakers .~~

~~1-68~~

~~2‘60~~

~~3-31~~

~~Cartwrights .~~

~~2-06~~

~~3-08~~

~~3-76~~

~~Carpenters~~

~~2-20~~

~~3-45~~

~~4-32~~

~~Horseshoers .~~

~~T94~~

~~2-90~~

~~3-70~~

~~Plumbers and tinsmiths~~

~~2‘04~~

~~3-26~~

~~4-23~~

~~Excavators~~

~~1-57~~

~~2-55~~

~~3-17~~

~~Masons .~~

~~2-07~~

~~3-14~~

~~4-01~~

~~House painters~~

~~2-20~~

~~3-22~~

~~4-24 3-83~~

~~All occupations~~

~~1-99~~

~~3-02~~

~~1 See Salaires et Durie du Travail dans V Industrie Francaise, tome iv., 1897.~~

~~During the period of about fifty years covered by these investigations, wages just about doubled, those of females having increased a little more~~

than those of males. The proportionate increase was not the same, however, in all industries or occupations, nor in all parts, of France.

Other French sources from which comparative wage data may be obtained for a series of years are the statis- tical annuals of France.2 These annual publications show the following increases in the average daily wages in Paris fnun 1875 to 1887: — Bakers, 6-65 to 7‘00 francs; blacksmiths, 6 ‘50 to 7-00 francs ; cabinetmakers, 5 ‘00 to 7*75 francs ; carpenters, 5‘00 to 7 “50 francs; horseshoers, 5 -00 to 6 ‘00 francs ; house painters, 6 ‘00 to 7 “50 francs; masons, 5‘00 to 8-00 francs; quarrymen, -I’OO to 5-00

2 Anmiaire Statistique de la France, 1878 to 1SSS, and 1900, and Statistique Ginirale de la France, Statistique Ammelle, 1886 to 1887.

francs ; stonecutters, 6-00 to 8 ‘50 francs ; tinsmiths, 4*00 to 5 ‘00 francs. In the other principal cities of France the following increase in the average daily wages was shown during the same period: — Bakers, 3-35 to 3‘60 francs; blacksmiths, 3‘50 to 3-90 francs; cabinetmakers, 3‘32 to 3-65 francs; carpenters, 3-17 to 3-60 francs; horse- shoers, 2-98 to 3-35 francs; house painters, 3-36 to 3-85 francs ; masons, 3-27 to 3-65 francs ; quarrymen, 2-93 to 3-25 francs ; stonecutters, 3-70 to 4-05 francs ; tinsmiths,

3”11 to 3‘45 francs. The average wages per day of both males and females in from fifty-nine to sixty-one skilled trades increased from 3-96 francs in 1875 to 5-34 francs in 1885 in Paris. In the other leading French cities the average daily increase in sixty-two skilled1 trades was from 2-86 francs in 1875 to 3-18 francs in 1885.

The statistical annual of France for 1900 contains the following wage rates per hour, compiled from various sources : —

~~***Average Wages per Hour in Paris,***~~

~~***1806 to 1899.***~~

~~***Occupations.***~~

~~***Average Wages per Hour.***~~

~~***1806.***~~

~~***1842.***~~

~~***1852.***~~

~~***1856.***~~

~~***1862.***~~

~~***1873.***~~

~~***1880.***~~

~~***1899.***~~

~~***Francs.***~~

~~***Francs.***~~

~~***Francs.***~~

~~***Francs.***~~

~~***Francs.***~~

~~***Francs.***~~

~~***Francs.***~~

~~***Blacksmiths ,***~~

~~0-50~~

~~0-50~~

~~0-50~~

~~0-55~~

~~0-65~~

~~0-70~~

~~0-775~~

~~0-80~~

~~0-30~~

~~0-40~~

~~0-50~~

~~0-50~~

~~0-60~~

~~0-60~~

~~0-80~~

~~0-90~~

~~0-225~~

~~0-275~~

~~0-275~~

~~0-30~~

~~0·40~~

~~0·40~~

~~0·55~~

~~0·55~~

~~0·35~~

~~0·325~~

~~0·35~~

~~0·385~~

~~0·45~~

~~0·50~~

~~0·70~~

~~0·70~~

~~Labourers : building trades~~

~~0·225~~

~~0·225~~

~~0·30~~

~~0·35~~

~~0·40~~

~~0·50~~

~~0·525~~

~~0-325~~

~~0-415~~

~~0-425~~

~~0-525~~

~~0-525~~

~~0-55~~

~~0-75~~

~~0-75~~

~~0-17~~

~~0-245~~

~~0-26~~

~~0-275~~

~~0-335~~

~~0-35~~

~~0-50~~

~~0-50~~

~~0-55~~

~~0-55~~

~~0-675~~

~~0-70~~

~~070~~

~~0-75~~

~~0-85~~

~~0-80~~

~~0-30~~

~~0-40~~

~~0-45~~

~~0-40~~

~~0-45~~

~~0-50~~

~~0-55 ‘~~

~~0-55~~

~~0-325~~

~~0-42~~

~~0-425~~

~~0-55~~

~~0-55~~

~~0-55~~

~~0-75~~

~~0-75~~

~~*An original investigation made in 1896 by the United States Department of Labor 1 shows the increase in wages from 1870 to 1896 in Paris and Lyons in a number of well-defined occupations. The following statement was compiled from the published tables : —*~~

~~*Average Daily Wage.*~~

~~*in Gold*~~

~~*in Paris and Lyons,*~~

~~*1870 and 1896.*~~

~~*Daily Wages in*~~

~~*Daily Wages in*~~

~~*Occupations.*~~

~~*Paris.*~~

~~*Lyons.*~~

~~*1870.*~~

~~*1896.*~~

~~*1870.*~~

~~*1896.*~~

~~*Francs.*~~

~~*Francs.*~~

~~*Francs.*~~

~~*Francs.*~~

~~Blacksmiths~~

~~6-22~~

~~8-91~~

~~6-53~~

~~7-51~~

~~Blacksmiths' helpers~~

~~4-09~~

~~5-18~~

~~3-52~~

~~3-99~~

~~Boilermakers .~~

~~6-99~~

~~8-50~~

~~6-01~~

~~6-53~~

~~Boilermakers' helpers~~

~~3-99~~

~~4-97~~

~~Bricklayers~~

~~5-49~~

~~8-50~~

~~4-51~~

~~5-49~~

~~Cabinetmakers .~~

~~6-63~~

~~8-60~~

~~4-97~~

~~6-01~~

~~Carpenters~~

~~6-22~~

~~8-08~~

~~4-35~~

~~7-04~~

~~Compositors~~

~~6-01~~

~~6-53~~

~~4-97~~

~~6-01~~

~~Hod carriers~~

~~3-52~~

~~5-49~~

~~Ironmoulders .~~

~~6-37~~

~~7-20~~

~~Ironmoulders'. helpers~~

~~4-25~~

~~4-87~~

~~Joiners ....~~

~~5-49~~

~~6-99~~

~~4-97~~

~~6-01~~

~~Labourers~~

~~4-51~~

~~4-51~~

~~Labourers, street~~

~~3-26~~

~~3-73~~

~~Machinists~~

~~6-89~~

~~7-15~~

~~5-80~~

~~6-53~~

~~Machinists' helpers .~~

~~4-04~~

~~5-08~~

~~3-26~~

~~4-25~~

~~Masons, stone .~~

~~5-23~~

~~7-98~~

~~Painters, house~~

~~5-49~~

~~6-99~~

~~4-77~~

~~6-01~~

~~Patternmakers .~~

~~6-32~~

~~6-89~~

~~5-49~~

~~6-74~~

~~Plumbers ....~~

~~6-99~~

~~7-36~~

~~Stonecutters~~

~~4-56~~

~~7-77~~

~~4-97~~

~~6-99~~

~~Teamsters~~

~~Average daily wages .~~

~~6-11~~

~~6-58~~

~~4-35*~~

~~4-61+~~

~~5-49~~

~~6-89~~

~~4-77~~

~~5-80~~

- ~~In 1872.~~

~~t In addition to wages, teamsters receive from 0-29 to 0‘37 francs per day in gratuities.~~

~~The tables of wages during each year, as presented in the Bulletins of the United States Department of Labor, show that both in Paris and Lyons the increase in wages in the different occupations has been gradual and almost unbroken from year to year during the period from 1870 to 1896. As shown in the above statement, the average daily wages for all the occupations increased during the~~

~~1 Bulletin of the United States Department of Labor, Nos. 18 (1898) and 22 (1899).~~

~~period from 5-49 francs to 6-89 francs, or 25J per cent., in Paris, and from 4-78 francs to 5-83 francs, or 22 per cent., in Lyons.~~

~~With regard to agricultural labour in France, no such favourable result has been shown, as already mentioned. Statistics published by the French Ministry of Agriculture in 1897 2 show a decline in wages during the decade from~~

~~1882 to 1892. Thus the average daily wages of agricul- tural labourers in the summer season were 3‘05 francs in 1882 and 2-85 francs in 1892 for men, and 1-80 francs in 1882 and L70 francs in 1892 for women. Male market gardeners received 3-00 francs in 1882 and 2-85 francs in 1892, and female market gardeners received T75 francs per day in 1882 and 1”65 francs in 1892. No food or quarters were furnished with these wages.~~

~~While the available wage statistics of France are suffi- cient to give a fair idea of the earnings of working people in that country, this cannot be said of the statis- tics of wages in Germany or any other of the erma°y- continental countries of Europe, where they are at best incomplete and fragmentary and must be taken for what they are worth. No effort has ever been made to collect and publish wage statistics for the empire of Germany, the only official data available being those published by individual states or by city governments.~~

~~Whenever wages data have been collected for a series of years in Germany, the result has generally shown an increase from year to year. Thus in Berlin the returns published from year to year from 1882 to 1891 by the statistical bureau of that city 3 shows the following in- crease in weekly wage rates: — Blacksmiths from 20 marks in~~

~~1883 to 24‘53 marks in 1891 ; cabinetmakers, 16-50 marks in 1882 to 23-22 marks in 1891 ; carpenters, 18-00 marks in 1882 to 24-00 marks in 1891 ; house painters, 15-00 marks in 1882 to 24-00 marks in 1890; masons, 18-75 marks in 1882 to 27‘40 marks in 1888 ; stonecutters, 28-50 marks in 1882 to 32”22 marks in 1891 ; tinsmiths, 17-75 marks in 1882 to 22-09 marks in 1891 ; horse- shoers, 2000 marks in 1882 to 22-50 marks in 1891 ;~~

~~8 Statistique Agricole de la France : Resultat de VBnguSte Dlcen- nale de 1892.~~

~~3 Ermittelungen titer Lohnverhaltnisse in Berlin (1882 to 1889) and Stcutistisches Jahrbuch der Stadt Berlin (1889, 1891). Statis- tisches Ami der Stadt Berlin.~~

~~[continental~~

~~compositors, 25-00 marks in 1882 to 29‘80 marks in 1888 ; coopers, 18-00 marks in 1883 to 22-11 marks in 1891.~~

~~In the shipbuilding yards of Stettin,1 the follow- ing increase in the weekly wages of employes was reported from 1885 to 1899 : Carpenters, 17-50 marks to 21-00 marks; joiners, 15-45 marks to 20‘00 marks; machinists, 15”90 marks to 22-80 marks ; blacksmiths, 17-75 marks to 20-00 marks; labourers, 1D70 marks to 12-55 marks; painters, 12-40 marks to 18-10 marks; riveters, 14‘80 marks to 17-10 marks. The monthly wages of domestic servants in Stettin during the same period increased as follows : Housekeepers from 17-85 marks to 23-80 marks ; cooks from~~

~~14-30 marks to 23-80 marks; kitchenmaids from 7‘10 marks to 8‘40 marks; nursemaids from 5‘90 marks to 9”50 marks ; footmen, 28-70 marks to 38”10 marks; housemaids, 8‘80 marks to 11-40 marks.~~

~~The wages data published in the statistical year-book of Wiirtemberg show the following increase in the daily earn- ings of employes from 1885 to 1896: in the chemical industry from 2‘27 marks to 2-69 marks; the tobacco in- dustry from l-29 marks to D50 marks; sugar manufac-~~

~~turing, 2-10 marks to 2-85 marks. The yearly earnings of employes in the State railway service of Wiirtemberg in creased as follows from 1891 to 1899 : — Foremen, 1559-66 to 1828-33 marks; blacksmiths, 1235-70 to 1414-61 marks; carpenters, joiners, and wheelwrights, 1044-70 to 1240-73 marks; japanners and varnishers, 1028-68 to 1259‘52 marks; locksmiths and ironworkers, 1017-14 to 1206-35 marks; moulders, 1184-84 to 1290-02 marks; mounters and tool-makers, 1433-49 to 1571-64 marks; pattern-makers, 1285-17 to 1600 marks; saddlers, 1036-25 to 1317-75 marks; tuimers, 1183-98 to 1295-98 marks; unskilled labourers, 708-58 to 910-09 marks.~~

~~The wages per day of forestry workers in Wiirtemberg increased as follows: — Wood-cutters, 1895 to 1899, sum- mer work, 1‘97 marks to 2-08 marks; winter work, T76 marks to 1-84 marks; forestry culture workers, 1891 to 1899, males, 1‘89 marks to 2-04 marks; females, T12 to 1-20 marks.~~

~~The Prussian mine statistics likewise show a steady increase in the wages of employes. The following state- ment shows the increase in the yearly earnings of mine employes in certain districts from 1888 to 1900 :4 —~~

~~Groups of Occupations.~~

~~Yearly Earnings of Employes in Coal Mines of the Prussian Districts of~~

~~Yearly Earnings of~~

~~Employes in Metalliferous~~

~~*Mines of Oberharz*~~

~~*District, Prussia.*~~

~~*Upper Silesia.*~~

~~*Dortmund.*~~

~~*1888.*~~

~~*1900.*~~

~~*1888.*~~

~~*1900.*~~

~~*1888.*~~

~~*1900.*~~

~~*Miners and trammers ..... Other underground workmen ....*~~

~~*Superintendents, foremen, and other officers .*~~

~~*Marks.*~~

~~*565 558 498 516*~~

~~*1452*~~

~~*Marks.*~~

~~*983 918 771 877*~~

~~*2045*~~

~~*Marks.*~~

~~*936 763 797 863*~~

~~1393~~

~~Marks.~~

~~1592 1096 1125 1332 2020~~

~~Marks.~~

~~670 760 475 592~~

~~1028~~

~~Marks.~~

~~736 805 590 665~~

~~1902~~

~~Includes also earnings of women and children in Upper Silesia and of children in the other districts.~~

~~From 1897 to 1900 the average yearly earnings of all employes in the Prussian coal and lignite mines increased from 964 marks to 1138 marks, or 18 per cent., in three years.~~

~~The wages of forestry workers in Baden,2 published from year to year, increased as follows from 1891 to 1898 : — Male wood-cutters, 1‘94 marks to 2-24 marks per day ; forestry culture workers, males, from 1-80 marks to 2-04 marks; females, 1-25 marks to 1‘38 marks per day, without board or lodging.~~

~~In Belgium, as in France and Germany, a com- parison of wage rates at different periods shows a steady increase in the leading industrial occupations.~~

~~g ” ‘ Thus the wage statistics collected by the United States Department of Labor,3 for a number of well-defined occupations in Liege; from 1870 to 1896 show the following increase in the average daily wage rates during the twenty-six years : — Blacksmiths from 3-52 francs to 4‘61 francs ;~~

cabinetmakers, 3-52 francs to 3-68 francs; compositors, 3-32 francs to 4-15 francs; iron-moulders, 3-73 francs to 4-15 francs ; machinists, 3-42 francs to 3-52 francs; machinists' helpers, 2-49 francs to 2-69 francs; house painters, 2-85 francs to 3-32 francs; pattern-makers, 3-47 francs to 3-99 francs ; stone-cutters, 3-01 francs to 3-68 francs ; teamsters, 2-90 francs to 3-06 francs. During the same period the wages of such un-skilled occupations as blacksmiths' helpers and iron- moulders' helpers remained nearly stationary, while those of ordinary day labourers decreased from 2 "75 francs to 2-69 francs per day. Statistics of wages for shorter periods were given for other occupations, in all of which

1 United States Consular Report, No. 237, 1900.

2 Statistisches Jahrbuchfur das Grossherzogthum Baden.

3 Bulletin of the United States Department of Labor, No. 18, 1898.

an increase in wage rates is shown. The daily wages paid in these occupations in 1896 were : — Boilermakers, 3-89 francs; boilermakers' helpers, 3-32 francs; carpem ters and joiners, 4 -20 francs; hod-carriers, 2 -44 francs; stone-masons, 3 -68 francs; and plumbers, 3 -99 francs. The average daily wages for these occupations increased from 3-08 francs in 1870 to 3-43 in 1896, or 11J per cent.

Wages of coal-mine labourers in Belgium are published in the reports of the Belgian Ministry of Industry and Labour. According to these returns, the yearly earnings of Belgian coal – mine workers, male and female, were 878-00 francs in 1870, 1031-00 francs in 1876, 920-00 francs in 1880, 812-00 francs in 1885, 1117-00 francs in 1890, 948 francs in 1895, 694-00 francs in 1896, and 1006-00 francs in 1897.

A comparative study of the wages of coal-mine labourers in October 1896 and in May 1900, published by the Belgian labour bureau,5 shows the following interesting results : Taking the most numerous class of mine workers, the male adults engaged in underground work, it is found that while in 1896 over three-fourths earned form 3 francs to 5 francs, in 1900 less than one-half came within that class, the majority earning 5 francs per day and over. The wages under 2 francs per day have almost

disappeared, only 127 underground mine workers coming under that class in 1900, as compared with 1016 in 1896. On the other hand, in 1896 no underground mine worker earned as much as 9-50 francs, while in 1900, 631 earned 9-50 francs and over. It is estimated that male adults engaged in underground work had their daily wages increased

4 Zeitschrift filr das Berg-, Hiitten- und Salincn- Jl'esen im Prats-sischen Staate.

6 Statistique des Salaires dans les Mines de Souille (October 1896- May 1900).

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WAGES

"27

about 1-50 francs; male surface workers, about 1 franc; female adults working underground, about 1 "25 francs ; female adults doing surface work and boys working underground, about 0'50 franc. The wages of boys doing surface work, and of girls, showed no considerable change during the period from October 1896 to May 1900.

The reports of the Belgian census of agriculture contain statistics of wages of agricultural labourers at different time periods in each of the provinces of Belgium. A summary of these statistics shows that male agricultural labourers received 1'18 francs per day in 1846, 1-36 francs in 1856, 2-03 francs in 1874, 204 francs in 1880, 1-96 francs in 1890, and 1-98 francs per day in 1895. The daily wages of female agricultural labourers were 0-72 franc in 1846, 0-86 franc in 1856, T22 francs in 1874, 1-25 francs in 1880, 1-21 francs in 1890, and 1-22 francs in 1895. Board and lodgings were not furnished with these wages. The wages of agricultural labourers thus showed a tendency to increase from 1846 to 1874, and then apparently remained stationary for the rest of the period.

A fair idea of the range in the prevailing wage rates in different parts of Belgium may be obtained from an in- vestigation made by the communal

council of Brussels in May 1896 1 regarding the minimum wages per hour in the principal occupations in the building trades paid by the provinces and communes of Belgium for public works. Two provinces and sixteen communal governments re- ported minimum wage rates. The following statement, which was compiled from these returns, shows the mini- mum wage rates per hour paid in the locality where they were highest and in the locality where they were lowest in each occupation respectively : — Blacksmiths, 0‘25 franc to 0‘40 franc ; carpenters and joiners, 0-25 franc to 0-35 franc ; drivers, 0-28 franc to 0”30 franc ; excavators, 0-20 franc to 0‘35 franc; glaziers, 0”30 franc to 0‘40 franc; lead and zinc workers, 0-30 franc to 0-40 franc; lock- smiths, 0.-36 franc to 0-38 franc ; marble-workers, 0-30 franc to 0-36 franc ; masons, 0-25 franc to 0-40 franc ; painters, 0-25 franc to 0-38 franc ; paviours, 0-30 franc to 0”45 franc; plasterers, 0”30 franc to 0-36 franc; plumbers, 0-30 franc to 045 franc; roofers, 0”40 franc ; slaters, 0-30 franc to 0-32 franc ; slate roofers, 0-30 franc to 0-40 franc ; stonecutters, 0-30 franc to 0-40 franc ; whitewashers, 0-30 franc ; zinc workers, 0-30 franc to 0-35 franc.

The official wages statistics of other countries of con- tinental Europe are so meagre that they can be but briefly mentioned in this connexion.

In Austria the only statistics showing the course of wages from year to year are those published in the year- book of the Austrian Ministry of Agriculture. us r a. They gnow the average daily wages of mine workers for each year from 1892 to 1896. These returns show no perceptible change in the wages of coal and lignite mine workers and blast-furnace . men, and a slight increase in the wages of workers in other than coal- mines. According to these returns, the average daily wages of coal miners ranged from 2-10 crowns to 4-20 crowns in 1892, and from l-50 crowns to 4 ‘00 crowns in 1896; lignite miners received from 2 -60 crowns to 4 ‘50 crowns in 1892, and from 2-80 crowns to 4-40 crowns in 1896 ; ironstone miners received 2-35 crowns in 1892, and 2-70 crowns in 1896; other miners received from 1-50 crowns to 2-25 crowns in 1892, and from 2-15 crowns to 3-00 crowns in 1896; blast-furnace men received from 3-00 crowns to 5-60 crowns in 1892, and from 2-90 crowns to 5-20 crowns in 1896. [Austrian crown (100 hellers) = 10d.]

1 Minimum de Salaire: EnqvMe, Mai, 1896. Ville de Bruxelles, Travaux Pvhliis.

According to statistics published by the Austrian Minis- try of Finance,2 the following weekly wages were paid to employes in the Government tobacco factories in 1896 : — Cigar makers, 8-55 crowns ; cigarette makers, 9‘70 crowns; other tobacco workers, 8‘60 crowns; cardboard box makers, 11 ‘05 crowns; all employes, 8 “85 crowns.

The Hungarian Ministry of Agriculture published in 1900 the results of an investigation of the wages of agricultural labourers made in 1898. A summary of the returns published shows the following average daily wages, without board or lodging, paid at different seasons of the yeari — Men, spring, 108 hellers; summer, 178 hellers; autumn, 126 hellers; winter, 90 hellers; women, spring, 78 hellers; summer, 116 hellers; autumn, 88 hellers; winter, 66 hellers ; children, spring, 54 hellers ; summer, 76 hellers; autumn, 60 hellers; winter, 46 hellers. A comparison of these figures with those for the two previous years shows but very slight changes. [100 hellers = 10d.]

The United States consular report of September 1895 contains statistics of weekly wages in Austria and Bohemia, from which the following rates have been compiled: — Austria, 1894 — bricklayers, 17-40 crowns; masons, 18‘65 crowns ; plasterers, 20‘00 crowns ; plumbers, 20‘55 crowns; carpenters, 25-50 crowns; gas- fitters, 30‘00 crowns ; bakers, 23‘60 crowns ; blacksmiths, 15‘90 crowns; bookbinders, 15-50 crowns; brewers, 24-35 crowns; butchers, 18-00 crowns; brass-founders, 22-00 crowns ; cabinetmakers, 15-00 crowns ; confectioners, 15-20 crowns; coopers, 19-50 crowns; teamsters, 11 ‘00 crowns; horseshoers, 17-40 crowns; jewellers, 23-70 crowns; millwrights, 15-50 crowns; potters, 24-25 crowns; stonecutters, 20‘75 crowns; tailors, 20-15 crowns; tele- graphists, 33-65 crowns ; tinsmiths, 18-50 crowns. Bohemia, 1891 — masons, 13-15 crowns; carpenters, 14-25 crowns; blacksmiths, 12-85 crowns; brickmakers, 1120 crowns; brewers, 15-45 crowns; brass- founders, 16-55 crowns ; cabinetmakers, 14-25 crowns ; confectioners, 16-00 crowns; potters, 14-00 crowns. It is not likely that wages in Austria have changed very materially in recent years.

The most trustworthy wages statistics of Italy are those published in the Italian statistical year-books.3 These reports enable one to trace the course of wages in certain occupations from year to year since y'

1888, and show that, as a general rule, wages have either declined or remained stationary. In Turin carpenters received 3-50 lire per day in 1888 and 3-00 lire in 1897 ; blacksmiths, 3-50 lire in 1888 and 3-20 lire in 1897; and labourers in machine-shops, 2-20 lire during the entire period from 1888 to 1897. In Genoa machinists received 4-50 lire and blacksmiths 4-00 lire per day during the entire period from 1888 to 1898. In Leghorn machinists received 4-00 lire per day in 1888 and 4-25 lire in 1897 ; blacksmiths, 3-50 lire in 1888 and 4 -00 lire in 1897 ; labourers, 275 lire in 1888 and 3-00 lire in 1897. In the silk industry of Villanovetta female expert spinners received 1-20 lire per day, and female twisters received 1-30 lire per day during the period from 1888 to 1897. In Biella and Tollegno male wool carders received 2-40 lire in 1888 and 3-00 lire per day in 1898 ; male wool spinners, 4-00 lire per day in 1888 and in 1898 ; female wool twisters received 1-50 lire per day during the entire period from 1888 to 1898 ; female woollen weavers received 225 lire per day in 1888 and 2-50 lire in 1898. In Sehio expert male woollen weavers received 4-95 lire in 1888 and 4-25 lire in 1898 ; male wool combers, 2-86 lire in 1888 and 2-60 lire in 1898 ;

2 Mitleilwngen des k. k. F'inanz-ilinisteriums.

3 Annuario Statistico Italiano, 1900.

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male wool spinners, 5*50 lire in 1888 and 4-50 lire in 1898; male wool shearers, 2-86 lire in 1888 and 2-70 lire in 1898; male woollen dyers, 2-20 lire in 1888 and 2-10 lire in 1898; female woollen weavers received 1-76 lire in 1888 and l-50 lire in 1898; spoolers, 1-43 lire in 1888 and 1-30 lire in 1898; female wool twisters, 1-43 lire in 1888 and 1-30 lire in 1898. In

Caselecchio di Reno male hemp combers received 4-02 lire per day in 1888 and 3-25 lire in 1897 ; male hemp carders, 2-47 lire in 1888 and 2-55 lire in 1897 ; male hemp spinners, 2-11 lire in 1888 and 2-42 in 1897; female hemp spinners received 0-80 lira per day in 1888 and 0-76 lira in 1897 ; and female hemp twisters, 0-86 lira per day in 1888 and 0-77 lira in 1897. [Italian lira (100 centesimi) = 9Jd.]

The Italian statistical year-books also contain wage data for the Sardinian silver, lead, zinc, antimony, man- ganese, iron, and coal mines for each year from 1871 to 1897. The average wages of the better classi of miners increased from 3-50 lire per day in 1871 to 5-10 lire in 1876, when they reached their highest point. After this they fluctuated considerably from year to year, being 3-95 lire in 1898. Masons received 4-00 lire in 1871 and 2-92 lire in 1898, the highest average wage rate having been 5‘30 lire per day in 1880. Enginemen in mines received 3-50 lire in 1871 and 3-18 in 1898, the highest average rate during the period having been 5-00 lire per day in 1874. Wages in Switzerland vary greatly in the different cantons, being highest in the French and lowest in the Italian districts. According to the United States consular report for September 1895, the average wages paid in cotton-mills in 1895 varied be- tween 1-45 francs and 2-50 francs per day. In silk-mills 30 per cent, of the dyers and finishers received less than 1-50 francs, and about 15 per cent, received over 2‘00 francs; winders and twisters received 2-00 francs to 2-50 francs per day; spinners, l-65 francs to l-75 francs; warpers, 2-50 francs to 3‘00 francs ; weavers, 2-00 francs to 3 ‘00 francs per day. In foundries and machine-shops unskilled labourers received in 1895 an average of 3-00

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francs per day ; skilled workers, 2-50 francs to 5-00 francs per day.

In Holland, according to the United States consular reports, labourers employed on railways and at the dep6ts averaged, in 1892, from 0‘90 florin to l-75 florins per day, with gratuities amounting to from 3' 10 florins to 4 ‘00 florins per month. Drivers on tramway cars received from 10-10 florins to 14-20 florins, and con- ductors 13-10 florins per week. Blacksmiths and other workers employed in the carriage factories of the

~~tramway companies earned an average of 15-20 florins per week. Enginemen on steam tramways earned from 12-15 florins to 17-10 florins per week. In 1894 the weekly wages in shipyards were : — Pattern and boiler makers, 15-60 florins ; machinists, 16-80 florins; plumbers and pipe fitters, 13-20 florins; carpenters and painters, 12-00 florins; joiners, caulkers, furnacemen, and moulders, 15-00 florins; drillers, 12-20 florins; fitters-up and riveters, 17-50 florins; sheet- iron workers, 12-70 florins; coppersmiths, 14-10 florins; labourers, 10-50 florins. [Dutch florin = Is. 8d.]~~

~~Owing to the absence of trustworthy data, and the vast extent of the country, it is difficult to obtain a fair idea of wages in Russia. The following statistics of the wages per day of agricultural labourers in 1897 were obtained from the United^States consular report for November 1897 : — Nishni- Volga, men, 0-35 rouble to l'OO rouble ; women, 0-20 rouble to 0-40 rouble ; central Volga, men, 0-25 rouble to 0-65 rouble; women, 0'15 rouble to 040 rouble ; southern Steppe, men, 0-40 rouble to 060 rouble ; women, 0-25 rouble to 0-40 rouble ; central agri- cultural district, men, 0-20 rouble to 0-60 rouble ; women, 0-12 rouble to 0-40 rouble. These daily wages were received without board. The annual wages varied from 25 roubles to 100 roubles for a man, the average being perhaps 60 roubles. The annual wages for a woman were from 20 roubles to 60 roubles. [Rouble (100 kopecks) = 3s. 2d.]~~

~~The monthly bulletins 1 issued by the city of Moscow show the following average wages per day for the leading occupations each year from 1890 to 1901 : —~~

~~Average Daily Wages~~

~~in Moscou~~

1.

~~Black- smiths.~~

~~Car- penters.~~

~~***Kopecks.***~~

~~***Day Labourers.***~~

~~***Joiners.***~~

~~***Masons.***~~

~~***Painters (House).***~~

~~***Plasterers.***~~

~~***Roofers.***~~

~~***Stove Smiths.***~~

~~***Kopecks.***~~

~~***Kopecks.***~~

~~***Kopecks.***~~

~~***Kopecks.***~~

~~***Kopecks.***~~

~~***Kopecks.***~~

~~***Kopecks.***~~

~~***Kopecks.***~~

~~***1890 .***~~

~~***128***~~

~~***III***~~

~~***83***~~

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In Greece, according to the United States consular re- port of March 1896, the following average daily wages were paid in 1895: — Bricklayers from 1-65 drachmasto 2-75 drachmas ; butchers, 1-65 drachmas to 3-30 drachmas ; carpenters, 2-20 drachmas to 3-30 drachmas ; masons, 2-20 drachmas to 3-02 drachmas; painters, 1-65 drachmas to 2-75 drachmas; plasterers, 2-20 drachmas to 3-30 drachmas; shoemakers, T65 drachmas to 3-30 drachmas; shipwrights, 2-75 drachmas to 3-85 drachmas; farm labourers, 1-37 drachmas to 2-20 drachmas. Cooks received from 33-00 drachmas to 66-00 drachmas per month; chambermaids from 13-75 drachmas to 27-50 drachmas per month ; coachmen, 44-00 drachmas to 55-00 drachmas per month;' men-servants, 16-50 drachmas to 44-00 drachmas per month. [Drachma (100 lepta) = 9|d.]

In Malaga, Spain, according to the United States con- sular report of August 1895, the following average daily wages were paid in 1895 : — Blacksmiths and locksmiths, 3-00 pesetas to 3-50 pesetas ; brick- pB "'

makers, 4'00 pesetas to 5-00 pesetas ; bakers, 3-50 pesetas to 4-00 pesetas; butchers, 3-00 pesetas to 3-50 pesetas; coppersmiths, 2-00 pesetas to 3 -00 pesetas ; cabinetmakers, 4-20 pesetas to 4-50 pesetas; carpenters, 3-00 pesetas to 3-50 pesetas; caulkers, 4-00 pesetas to 5-00 pesetas; farriers, 2-00 pesetas to 3-00 pesetas; glaziers, 1-75 pesetas to 2 -00 pesetas ; harness and saddle makers, 3-00 to 3-50 pesetas; ironmoulders, 3-00 pesetas to 5-00 pesetas; laundresses, l-00 pesetas to 1-25 pesetas;

1 Bulletin Statistique Mensuel de la Ville de Moscou.

lithographers, 2-00 pesetas to 4 00 pesetas; masons, 2-00 pesetas to 3-25 pesetas; plumbers, 2-00 pesetas to 3-00 pesetas ; shipwrights, 4-00 pesetas to 5-00 pesetas ; stone- cutters, 2-00 pesetas to 4-00 pesetas; shoemakers, 2-50 pesetas to 3-00 pesetas ; tramway drivers and conductors, 2-50 pesetas ; watchmakers, 2*50 pesetas to 3-50 pesetas. [Peseta (100 centimos) = 9|d.]

In 1900 the Danish Government published a compre- hensive compilation of statistics of wages of skilled and „ unskilled workmen and apprentices in that

Denmark. , . rr . -, , . -, . ,

country,1 made in connexion with the industrial census of May 1897. The following figures, showing weekly wages of skilled workmen in certain leading occupations, are taken from that report: — Bakers, 18-67 crowns; blacksmiths, 14 '54 crowns; bookbinders, 17 -83 crowns; boot and shoe makers, 14-68 crowns; cabinet- makers, 18-68 crowns; carpenters, 21 -42 crowns; coopers, 19-16 crowns; coppersmiths, 22-92 crowns; glaziers, 18-77 crowns; joiners, 22-55 crowns; locksmiths, 2T66 crowns ; masons, 22-30 crowns ; painters (house and sign), 22-08 crowns; saddlers and upholsterers, 18-61 crowns; stonecutters, 18-63 crowns; tanners, 18-96 crowns; wheel- wrights and coachbuilders, 16 '16 crowns. These wages show an increase over those paid in previous years in Denmark. [Danish, Swedish, and Norwegian crown (100 ore) = Is. l^d.]

In Sweden, according to the annual report of the Royal Statistical Bureau for 1901,2 the average yearly wage in „ _ , 1899 of a male farm hand was 223 crowns, and

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of a woman servant 110 crowns, including food and lodging. The actual cost to the employer, counting food, lodging, and wages, was computed as 484 crowns for men and 267 crowns for women. The wages paid in the summer season to day farm labourers were 2-22 crowns for men and 1 -22 crowns for women, and in the winter season 1-55 crowns for men and

0-85 crowns for women. These wages have increased steadily since 1880. For Norway the most trustworthy wage statistics are those presented in the statistical year-book of that country for 1900. This publication gives the average wage rates paid in 1880 and 1895 in leading occupations. The rates given show a considerable increase during the fifteen-years period. Thus in the leading cities the wages of blacksmiths were 2-34 crowns in 1880 and 2-71 crowns in 1895; joiners, 2-17 crowns in 1880 and 2-53 crowns in 1895 ; carpenters, 2-22 crowns in 1880 and 2-86 crowns in 1895; coopers, 2-08 crown's in 1880 and 2-53 crowns in 1895 ; masons, 3-14 crowns in 1880 and 3-87 crowns in 1895; house painters, 2-34 crowns in 1880 and 2-93 crowns in 1895; bakers, 2-29 crowns in 1880 and 2-82 crowns in 1895; butchers, 2-19 crowns in 1880 and 2-54 crowns in 1895; tailors, 2-30 crowns in 1880 and 2-66 crowns in 1895; shoemakers, 2-00 crowns in 1880 and 2-30 crowns in 1895; cigar-makers, 2-73 crowns in 1880 and 3-44 crowns in 1895. The wages in rural districts for similar occupations were somewhat lower and show a smaller measure of increase. The yearly wages paid to domestic servants were as follows: cities — males, 203-00 crowns in 1880 and 265-00 crowns in 1895; females, 78-00 crowns in 1880 and 100 crowns in 1895; rural districts — males, 153-00 crowns in 1880 and 180-00 crowns in 1895 ; females, 60-00 crowns in 1880 and 85-00 in 1895.

In studying the preceding wage data, it must be borne in mind that the hours of daily labour varied greatly in the different industries, localities, and countries, and that

1 Arbejdsln samt Svende-og Lozrlingeforhold,

2 Statistik Tidskrift Utgifven afKwngl. Statistiska Centralbyran,

1901.

this variation has had some influence upon the daily, weekly, and monthly wage rates quoted. Furthermore, in the continental countries of Europe it is frequently the custom of employers to give gratuities, prizes, supplies,

Authorities. — France. Bureau du Travail : Salaires et Durie du Travail dans V Industrie Francaise, tome iv., 1897 ; U.S. De- partment of Labor,

~~Sixth and Seventh Annual Reports, 1890, 1891 ; Annuaire Statistique de la France, 1878 to 1888, and 1900 ; Statistique Cinirale de la France — Statistique Annuelle, 1886, 1887 ; U.S. Department of Labor, Bulletin No. 18, September 1898, and No. 22, May 1899 ; Statistique Agricole de la France : Besultat de VEnquite Decennale de 1892. Germany. Ermittelungen iiber Lohnverhaltnisse in Berlin, 1882 to 1889 ; Statistische Jahr- biicher der Stadt Berlin, 1889, 1891 ; U.S. Consular Report No. 237, June 1900 ; Wilrtembergische Jahrbiicher fur Statistik und Landeskunde; Zeitschrift fur das Berg-, Hutten- und Salinen- Wesen im Preussischen Staate ; Statistisches Jahrbuchfiir das Grossherzog-thum Baden, 1891-1899. Belgium. U.S. Department of Labor, No. 18, September 1898 ; Statistique des Salaires dans les Mines de Houille (October 1896-May 1900); Minimum de Salaire: EnquMe, Mai 1896 — Ville de Bruxelles. Austria. Statistische Jahrbiicher des k.k. Ackerbau-Ministeriums ; Mitteilungen des k.k. Finanz-Ministeriums ; U.S. Consular Report No. 180, September 1895. Italy. Annuario Statistico Italiano, 1900. Switzerland, Holland, Greece, Spain. U.S. Consular Reports. Denmark. Statistiske Meddelelser, Fjerde Raskke, Sjette Bind, Andet Hcefte. Russia. U.S. Consular Report No. 206, November 1897 ; Bulletin Statistique Mensuel de la Ville de Moscou. Sweden. Statistik Tidskrift Utgifven af Kungl. Statistiska Centralbyran. Norway. Statistick Aarbogfor Kongeriget Norge, Tyvende Aarbog, 190°- (e. E. L. G. ; G. A. w.)~~

~~Wagga Wagga, a town of New South Wales, Australia, in the county of Wynyard, on the left bank of the • Murrumbidgee, 309 miles south — west of Sydney. A steel viaduct has been constructed over the river, the approaches being formed by very heavy embankments. The waterworks reservoir has a capacity of one million gallons. There is a considerable amount of gold-mining in the district, which, however, is chiefly a pastoral one, though adapted for agriculture. Population (1881), 4096; (1891),~~

~~4596; (1901), 5114.~~

~~Wakefield, a city, parliamentary and municipal borough, and market town, Yorkshire, England, in the Normanton parliamentary division of~~

the West Riding (of which it is the shire town), on the Calder, 9 miles south of Leeds by rail. Waterworks, the property of the corpora- tion, were opened in 1888, having cost about £342,465. The bishopric was formed in 1888 almost entirely from that of Ripon. The twelve bells of the cathedral church (All Saints') were re-hung in 1892. The West Riding county offices, erected in 1896 at a cost of £90,000, adjoin the town hall. The county hall, a large and handsome edifice, with octagonal tower and dome sur- mounting the principal entrance, was opened in 1898. The acute hospital block in connexion with the lunatic asylum at Eastmore was completed at a cost of £100,000 in 1900, and in the same year the Stanley Hall for imbecile patients was rebuilt. A public park was opened in 1893. The municipal and parliamentary boroughs were conterminous until 1885, when the area of the latter was extended. Population (1881), 30,854; (1891, enlarged area), 38,832; (1901), 41,544.

Wakefield, a town of Middlesex county, Massa- chusetts, U.S.A., containing an area of 10 square miles diversified with small Glacial hills, situated in the north- eastern part of the state. The largest village, known also as Wakefield, is on a line of the Boston and Maine Railroad, at an altitude of 99 feet. Other villages in the town are Greenwood and Montrose. The town was incorporated in 1868. Population (1880), 5547; (1890), 6982 ; (1900), 9290, of whom 2347 were foreign-born.

WALDECK-P YRMONT- WALDENSES

Waldeck-Pyrmont, a principality of Germany, lying partly between Westphalia and Hesse-Nassau and partly between Lippe and Hanover. Area, 432 square miles; population (1885), 56,575; and (1900), 57,918, thus divided : — Waldeck, 407 square miles and population (1885) 48,598, (1900) 49,282; and Pyrmont, 25 square miles and population (1885) 7977, (1900) 8636. Density, 134 inhabitants to the square mile, giving 122 for Waldeck and 345 for Pyrmont. Of the total population in 1900, 27,935 were males and 29,983 females. Except for 1700 Koman Catholics and 696 Jews, the people are Evangelical Lutherans.

~~Agriculture supported 30,299 persons, or 52 ‘5 per cent, of the total population in 1895. In 1895 the principality included 10,067 farms, of which 8434, or 83 per cent., were each less than 25 acres. In 1900 the live-stock consisted of 38,956 sheep, 40,205 pigs, 30,954 cattle, and 6719 horses. The state revenue and expenditure were both estimated at £77,350 for 1901. In 1900 the public debt was £96,850, and the state contribu- tion to the imperial exchequer £29,090.~~

~~Waldeck — Rousseau, Pierre Marie~~

~~Ernest (1846-), French statesman, was born at~~

~~Nantes on 2nd December 1846. His father, Bene Waldeck-Rousseau, was a distinguished opponent of Louis Philippe and Napoleon III., and a prominent member of the Republican Assembly of 1848. Like his father, M. Waldeck-Rousseau adopted the profession of the law, but soon entered into politics, and in 1879 was elected deputy for Rennes. He came rapidly to the front, and in 1881 was entrusted with the ministry of the interior in Gambetta’s grand ministere. He had the same office in the Ferry cabinet of 1883-85, and proved himself the strongest and most resolute man in the ministry. At Angouleme he delivered a remarkable speech, in which he asked that political strife should be reconciled now that the country had given a decisive verdict for Republican institutions, and insisted that the duty of the Government was equally to grant liberty and to enforce order. In 1884 he was instrumental in securing the legal recognition of trade unions. In 1886 he was called to the Paris bar, and soon acquired a foremost place among French advo- cates. He continued to take part in the debates of the Chamber till 1889, and upheld the action taken by the Government against the Ligue des Patriotes and General Boulanger. A selection of his speeches appeared in 1889, under the title of Discours parlementaires. His growing practice now decided him to withdraw from politics. The most noteworthy of the many famous cases in which his cold and penetrating intellect and his power of clear exposition were retained was the defence of M. de Lesseps. In 1894 he returned to public life as senator for the department of the Loire, and in the following January st x>d against MM. Felix Faure and Brisson for the Presi- dency of the Republic, receiving the support of the Right, who were soon to become his~~

bitter antagonists. During the confusion into which parliamentary government fell in the next few years, owing to the Dreyfus case, he was recognized as a leader among the Moderate Republicans, who, while averse from violent changes, admitted the necessity of reform in the working of the political machine. The remedy advocated by M. Waldeck-Rousseau was a more frequent use by the ministryof the power of appealing to the constituencies. On the fall of the Dupuy cabinet in June 1899 he was one of the first statesmen summoned by President Loubet, but his efforts to form a Govern- ment were unsuccessful. When, however, all other combina- tions equally proved impracticable, and the very existence of the Republic seemed at stake, he formed, on the second attempt, a ministry of Republican defence in which were

united men of the widest divergence on every question except that of maintaining the Republic against Clerical reaction and Caesarism. The opposite poles were repre- sented by the Socialist leader, M. Millerand, who became minister of commerce, and by the minister of war, General de Galliffet, whose ruthless severity in suppress- ing the Commune of 1871 rendered him an object of special abhorrence to the Extreme Left. M. Waldeck- Rousseau himself took the ministry of the interior, to which fell the urgent task of suppressing the spirit of disorder with which the country was seething. In his declaration, read to the Chamber on 26th June, he announced his intention of enforcing respect for the law. The prestige that General de Galliffet enjoyed in the army enabled the Government to take the necessary military measures, and to leave the second court-martial of Dreyfus at Rennes an absolutely free hand ; and after the verdict a free pardon was granted to Captain Dreyfus without producing any evil consequences. M. Waldeck- Rousseau won a great personal success in October by his arbitration in the strikes at Le Creusot. The pro- longed Government prosecution of M. Deroulede and his confederates ended in January 1900 in their condemnation by the High Court. The Senate was staunch in support of M. Waldeck-Rousseau, and in the Chamber he displayed remarkable astuteness in winning support from various groups. The Amnesty Bill, passed on 19th December, chiefly through his unwearied advocacy, went far to smooth down the acerbity of the preceding years. With the object of aiding the industry of wine-producing, and of discouraging the consumption of spirits and other

deleterious liquors, the Government passed a Bill suppress- ing the octroi duties on the three " hygienic " drinks — wine, cider, and beer. The Act came into force at the beginning of 1901. But the most important measure of his later administration was the Associations Bill of 1901. Like many of his predecessors, he was convinced that the stability of the Republic demanded some restraint on the intrigues of the wealthy religious bodies. All previous attempts in this direction had failed. In his speech in the Chamber, M. Waldeck-Rousseau recalled the fact that he had endeavoured to pass an Associations Bill in 1882, and again in 1883. He declared that the religious associa- tions were now being subjected for the first time to the regulations common to all others, and that the object of the Bill was to ensure the supremacy of the civil power. The- royalist bias given to the pupils in the religious seminaries was undoubtedly a principal cause of the passing of this Bill ; and the Government further took strong measures to secure the presence of officers of un- doubted fidelity to the Republic in the higher positions on the staff. His speeches on the religious question were published in 1901, uuder the title of Associations et con- gregations, following a volume of speeches on Questions societies (1900). As the general election of 1902 ap- proached all sections of the Opposition united their efforts, and M. Waldeck-Rousseau's name served as a battle-cry for one side, and on the other as a target for the foulest abuse. The result was a decisive victory for Republican stability. With the defeat of the machinations against the Republic M. Waldeck-Rousseau considered his task ended, and on 3rd June 1902 he resigned office, having proved himself the strongest personality in French politics since the death of Gambetta.

Waldenses. — The Waldensian valleys lie to the south-west of Turin, in the direction of Monte Viso, but include no high or snowy mountains, while the glens them- selves are (with one or two exceptions) fertile and well wooded. The principal town near the valleys is Pinerolo.

Just to its south-west there opens the chief Waldensian valley, the Val Pellice, watered by the stream of that name, but sometimes called

~~*inaccurately the Luserna valley, Luserna being simply a village opposite the capital, Torre Pellice; near Torre Pellice the side glens of Angrogna and Rora join the Pellice valley. To the north-west of Pinerolo, up the Chisone valley, there opens at Perosa Argentina the valley of St Martin, another important Waldeusian valley, which is watered by the Germanasca torrent, and at Perrero splits into two branches, of which the Prali glen is far more fertile than that of Massello, the latter being the wildest and most savage of all the Waldensian valleys. The total Waldensian population (for they also contain Roman Catholics in no small number) amounts to about 20,000 all told : there are 16 parishes, with 18 pasteurs and 22 temples, and also 2 Sunday schools (3017 children) and 194 day schools (with 4218 children). In 1899 the full members (i.e., communicants) of the Waldensian faith amounted to 12,695. There were, besides, branches at Turin (1 temple, 2 pasteurs, and 750 members), in other parts of Italy, including Sicily (46 temples and as many pasteurs, while the number of members was 5613, of day scholars 2704, and of Sunday school scholars 3707). It is also reckoned that in Uruguay and the Argentine Republic there are about 6000 Waldensians; of these 1253 are full members, while the day scholars numbered 364 and the Sunday school children 670 The total contributions of these parishes (it is not clear whether South America is included) amounted in 1899 to 88,113 francs, to which must be added contributions from Great Britain of 189,802 francs.*~~

~~*Authorities. — Jules Chevalier. Memoires sur les Merisies en Dauphins' avant le 16eme siicle, accompagnis de documents inedits sur les sorciers et les Vaudois. Valence, 1890. — J. A. Chabrand. Vaudois et Protestants des Alpes : recherches his- toriques. Grenoble, 1886. — H. Haupt. Article in Von Sybel's Historiscke Zeitschrift, 1889, pp. 39-68. — W. A. B. Coolidge. Articles in the Guardian for 18th August 1886 and 4th December 1889. The writer is also indebted to Monsieur J. J. R. Tron, the " pasteur " of Massello, for information, chiefly statistical.*~~

~~*(W. A. B. C.)*~~

~~*Wales. See England and Wales.*~~

~~*Walker, Francis Amasa (1840-1897),*~~

American soldier and economist, was born in Boston, Massachusetts, 2nd July 1840, the son of Amasa Walker, who wrote a book on The Science of Wealth. He graduated at Amherst College in 1860, studied law, and fought in the Northern army during the whole of the Civil War of 1861-65, rising from the rank of sergeant-major to that of brevet brigadier-general of volunteers — awarded him at the request of General Winfield S. Hancock. As a soldier he excelled in analysis of the position and strength of the enemy. In 1864 he was captured and detained for a time in the famous Libby Prison, Richmond. After the war he became editorial writer on the Spring- field (Massachusetts) Republican, and later held public offices, as chief of the Government bureau of statistics, superintendent of the ninth and tenth censuses (those of 1870 and 1880), and commissioner of Indian affairs; but from 1873 to his death his work was educational, first as professor (1873-81) of political economy in the Sheffield Scientific School at Yale, and then as president of the Massachusetts Institute of Technology, Boston. While superintendent of the census he increased the scope and accuracy of the records ; and at the Institute of Techno- looy he enlarged the resources and numbers of the institution, which had 302 students when he assumed the presidency and 1198 at his death. In other fields he

promoted common-school education (especially in manual training), the Boston park system, and the work of the public library, and took an active part in the discussion of monetary, economic, statistical, and other public ques- tions, holding many offices of honour and responsibility. As an author he wrote on governmental treatment of the Indians, The Wages Question (1876), Money (1878), Land and its Rent (1883), and general political economy (1883 and 1884), besides producing monographs on the life of General Hancock (1884) and the history of his own Second Army Corps (1886). As an economist, from the time of the appearance of his book on the subject, he so effectively combated the old theory of the " wage-fund " as to lead to its abandonment or material modification by American students ; while in his writings on finance, from 1878 to the end of his life, he advocated international bimetallism, without, however, seeking to justify any one nation in the attempt to maintain parity between gold and silver. A collection of posthumously published Dis- cussions in Education (1899) was made up of essays and addresses prepared after his

taking the presidency of the Institute of Technology : their most noteworthy argument is that chemistry, physics, and the other sciences pro- mote a more exact and more serviceable mental training than metaphysics or rhetoric. Walker's general ten- dency was towards a rational conservatism." On the question of rent he called himself a "Ricardian of the Ricardians." To his Wages Question is due in great part the conception formed by English students of the place and functions of the employer in modern industrial economics. A remarkable feature of his writings is his treatment of economic tendencies not as mere abstractions, but as facts making for the happiness or misery of living men. General Walker died in Boston, 5th January 1897.

Wallace, Alfred Russel (1823-

-), British

naturalist, was born at Usk, in Monmouthshire, 8th Janu- ary 1823. After leaving school he assisted an elder brother in his work as a land surveyor and architect, visiting various parts of England and Wales. Living in South Wales, about 1840 he began to take an interest in botany, and commenced the formation of a herbarium. In 1847 he took his first journey out of England, spending a week in Paris with his brother and sister. In 1844-45, while an English master in the Collegiate School at Leicester, he made the acqaintance of H. W. Bates, through whose influence he became' a beetle collector, and with whom he started in 1848 on an expedition to the Amazon. In about a year the two naturalists separated, and each wrote an account of his travels and observations. Wallace's Travels on the Amazon and Rio Kegro was published in 1853, a year in which he went for a fortnight's walking tour in Switzerland with an old school-fellow. On his voyage home from South America the ship was burnt and all his collections lost, except those which he had despatched beforehand. After spending a year and a half in England, during which time, besides his book on the Amazon, he published a small volume on the Palm Trees of the Amazon, he started for the Malay Archipelago, exploring, observing, and collecting from 1854 to 1862. He visited Sumatra, Java, Borneo, Celebes, the Moluccas, Timor, New Guinea, and the Aiu and K& Islands. His deeply interesting narrative,

~~The Malay Archipelago, appeared in 1869, and he also published many important papers through the London scientific societies. The chief parts of his vast insect col- lections became the property of the late W. W. Saunders, but subsequently some of the most important groups passed into the Hope Collection of the University of Oxford and the British Museum. He discovered that~~

~~the Malay Archipelago was divided into a western group of islands, which in their zoological affinities are Oriental, and an eastern, which are Australian. The Oriental Borneo and Bali are respectively divided from Celebes and Lombok by a narrow'belt of sea known as "Wallace's Line," on the opposite sides of which the indigenous mammalia are as widely divergent as in any two parts of the world. Wallace became convinced of the truth of evolution, and origi- nated the theory of natural selection during these travels. In February 1855, staying at Sarawak, in Borneo, he wrote an essay " On the Law which has regulated the In- troduction of New Species " (Ann. and Mag. Nat. Hist., 1855, p. 184). He states the law as follows : " Every species has come into exist- ence coincident both in time and space with a pre-existing closely allied species." He justly claims that such a law connected and explained a vast number of indepen- dent facts. It was, in fact, a cautious statement of a belief in evolution, and for three years from the time that he wrote the essay he tells us that " the question of how changes of species could have been brought about was rarely out of my mind." Finally, in February 1858, when he was lying muffled in blankets in the cold fit of a severe attack of intermittent fever at Ter- nate, in the Moluccas, he began to think of Malthus's Essay on Population, and, to use his own words, " there suddenly flashed upon me the idea of the survival of the fittest." The theory was thought out (luring the rest of the ague~~

~~fit, drafted the same evening, written out in full in the two succeeding evenings, and sent to Darwin by the next post. Darwin in England at once recognized his own theory in the manuscript essay sent by the young and almost un- known naturalist in the tropics, then a stranger to him. "I~~

never saw a more striking coincidence," he wrote to Lyell on the very day, 18th June, when he received the paper : " if Wallace had my MS. sketch written out in 1842, he could not have made a better short abstract ! Even his terms now stand as heads of my chapters." Under the advice of Sir Charles Lyell and Sir Joseph Hooker, the essay was read, together with an abstract of Darwin's own views, as a joint paper at the Linnean Society on 1st July 1858. The title of Wallace's section was " On the Tendency of Varieties to depart indefinitely from the Original Type." The " struggle for existence," the rate of multiplication of animals, and the dependence of their average numbers upon food supply are very clearly demonstrated, and the following conclusion was reached: "Those that prolong their existence can only be the most perfect in health and vigour ; . . . the weakest and least perfectly organized must always succumb." The difference between Lamarck's theory and natural selection is very clearly pointed out.

• AlFRKD EUSSEL WAL1A0E.

(From a photograph by the London Stereoscopic Company.)

" The powerful retractile talons of the falcon and the cat tribes have not been produced or increased by the volition of those animals ; but among the different varieties which occurred in the earlier and less highly organized forms of these groups, those always survived longest which had the greatest facilities for seizing their prey. Neither did the giraffe acquire its long neck by desiring to reach the foliage of more lofty shrubs, and constantly stretching its neck for the purpose, but because any varieties which occurred among its antitypes with a longer neck than

usual at once secured a fresh range of pasture over the same ground as their shorter- necked companions, and on the first scarcity of food were thereby enabled to out- live them." With such clear statements as these in the paper of 1st July 1858, it is remarkable that even well-known naturalists should have failed to compre- hend the difference between Lamarck's and the Darwin- Wallace theory. Wallace also alluded to the resem- blance of animals, and more especially of insects, to their surroundings, and points out that " those races having colours best adapted to con- cealment from their enemies would inevitably survive the

longest." In 1871 Wallace's two essays, written at Sara- wak and Ternate, were pub- lished with others as a volume, Contributions to the Theory of Natural Selection. Probably, next to the Origin of Species, no single work has done so much to pro- mote clear understanding of natural selection and con- fidence in its truth ; for in addition to these two historic essays, there are others in which the new theory is applied to the interpretation of certain classes of facts. Thus one treats of "Mimicry" in animals, another on " Instinct," another on " Birds' Nests." Each of these served as an example of what might be achieved in the light of the new doctrine, which, taught in this way and in an admirably lucid style, was easily absorbed by many who found the more complete exposition in the Origin very hard to absorb. In this work, and in many of his subsequent publications, Wallace differs from Darwin on certain points. Thus the two concluding essays contend that man has not, like the other animals, been produced by the unaided operation of natural selection, but that other forces have also been in operation. We here see the influence of his convictions on the subject of " spiritual- ism." More recently he expressed his dissatisfaction with the hypothesis of " sexual selection " by which Darwin sought to explain the conspicuous characters which are displayed during the courtship of animals. The expres- sion of his opinion on both these points of divergence from Darwin will be found in Darwinism (1889), a most valuable and lucid exposition of natural selection, as suited to the later period at which it appeared as the Essays were to the earlier. Darwin died some years

before the controversy upon the possibility of the heredi- tary transmission of acquired characters arose over the writings of Weismann, but Wallace has freely accepted the general results of the German zoologist's teaching, and in Darwinism has presented a complete theory of the causes of evolution unmixed with any trace of Lamarck's use or disuse inheritance, or Buffon's hereditary effect of the direct influence of surroundings. Tropical Nature and other Essays appeared in 1878, since republished com- bined with the 1871 Essays, of which it formed the

natural continuation. One of the greatest of his publications was the Geographical Distribution of Animals (1876), a monu- mental work, which every student will maintain fully justifies its author's hope that it may bear " a similar re- lation to the eleventh and twelfth chapters of the Origin of Species as Mr Darwin's Animals and Plants under Domestication bears to the first." Island Life, which may be regarded as a valuable supplement to the last- named work, appeared in 1880.

Turning to his other writings, Wallace published Miracles and Modern Spiritualism in 1881. Here is given an account of the reasons which induced him to accept beliefs which are shared by so small a proportion of scientific men. These reasons are purely experimental, and in no way connected with Christianity, for he had long before given up all belief in revealed religion. In 1882 he published Land Nationalization, in which he argued the necessity of State ownership of land, a principle which he had originated long before the appearance of Henry George's work. In Forty-five Years of Registration Statistics (1885) he maintained that vaccination is useless and dangerous. Wallace has also published an account of what he holds to be the greatest discoveries as well as the failures of the 19th century, The Wonderful Century (1899). Possessed of a bold and intensely original mind, his activities have radiated in many directions, apparently rather attracted than repelled by the unpopularity of a subject. A non-theological Aiha- nasius contra mundurn, he has the truest missionary spirit, an intense faith which would seek to move the mountains of apathy and active opposition. Whatever may be the future history of his other views, he will always be remembered as an originator of a principle more illuminating than any which has appeared since the days of Newton, as one of its two discoverers whose scientific rivalry was only the beginning of a warm and unbroken friendship.

Wallace was married in 1866 to the eldest daughter of the botanist, Mr William Mitten, of Hurstpierpoint, Sussex. He has two surviving children, Violet, born 25th January 1869, and William Greenell, born 30th December le71. On his return from the East, Wallace lived with his sister in Westbourne Grove, and, after his marriage, in St Mark's Crescent, Regent's Park. In 1871 he built a house at Grays, Essex, in an old chalk-pit, and after living there four years, moved successively to Dorking (two

~~years) and Croydon (three years). In 1880 he built a cottage at Godalming near the Charterhouse School, and grew nearly 1000 species of plants in the garden which he made. In 1889 Re moved to Dorset- shire. Since his return to England in 1862, Wallace has visited the Continent, especially Switzerland, for rest and change (1866, 1896) and the study of botany and Glacial phenomena (August 1895). He also visited Spa, in Belgium, about 1870, and in October 1887 went for a lecturing tour in the United States. He delivered a course of six Lowell lectures in Boston, and visited New York, Newhaven, Baltimore, &c., spending the winter at Washington. The following March he went to Canada and Niagara, and then made his way westwards. He~~

~~saw the Yosemite Valley, the Big Trees, and botanized in the Sierra Nevada and at Gray's Peak. In July he returned to Liverpool by way of Chicago and the St Lawrence.~~

~~The first Darwin medal of the Royal Society was awarded to A. R. Wallace in 1890, and he had received the Royal medal in 1868. A pension was awarded him by Mr Gladstone at the beginning of 1881. Wallace received the degree of D.C.L. from Oxford in 1889, and of LL.D. from the University of Dublin in 1882. He was president of the Entomological Society of London in 1870-71.~~

~~A good deal of useful information is given in the biographical introduction to Wallace's Narrative of Travels on the Amazon and Rio Negro by the editor, Mr G. T. Bettany. For the purpose of this article, Dr A. R. Wallace has also kindly himself supplied details which could hardly have been recovered in any other way.~~

~~-), American soldier~~

~~Wallace, Lewis (1827-~~

~~and author, was born in Brookville, Indiana, 10th April 1827. He served in the Mexican war, and on returning to Indiana became a lawyer. He was senator in the state legislature for one year, and at the beginning of the war of 1861 was adjutant-general of the state, but soon entered active service as colonel, and then as brigadier- general of volunteers. He took~~

part in important move- ments in West Virginia and in the campaigns south of the Ohio river, especially at Fort Donelson and Shiloh. For his gallantry in the operations before Donelson, in which he commanded a division, he was made major- general. When in command of the 8th Army Corps, 9th July 1864, he was defeated by — Jubal A. Early at Monocacy Bridge, in Maryland. At the close of the war Wallace was a member of the court for the trial of the assassins of President Lincoln ; and was president of the court that tried Wirz, the keeper of Andersonville (Georgia) prison. He was governor of New Mexico, 1878-81, and minister to Turkey 1881-85. As an author, General Wallace made his first appearance in 187.3, when he published The Fair God; or, The Last of the 'Tzins, a tale of the conquest of Mexico. In 1880 his second historical romance, Ben-Hur : a Tale of the Christ, secured a widespread popularity. His later works comprise essays in dramatic composition, a Life of President Harrison, an illustrated monograph on The Boyhood of Christ, and The Prince of India (1893).

Wallace, Sir Richard, Baet. (1818-1890),

English art collector and philanthropist, was born in London, 26th July 1818. According to Sir Walter Arm- strong (see Diet, of National Biography, art. " Wallace "), he was a natural son of Maria, Marchioness of Hertford (wife of the third marquis), under whose auspices the boy was educated, mainly at Paris ; but it was generally sup- posed in his lifetime that he was a son of the fourth mar- quis (his elder by only eighteen years), and therefore her grandson. At Paris he was well known in society, and became an assiduous collector of all sorts of valuable objets d'art, but in 1857 these were sold and Wallace devoted himself to assisting the fourth marquis, who left London to reside entirely at Paris, to acquire a magnificent col- lection of the finest examples of painting, armour, furni- ture, and bric-a-brac. In 1870 the Marquis of Hertford died unmarried, bequeathing to Wallace an enormous pro- perty, including Hertford House and its contents, the house in Paris, and large Irish estates. Pending the re- opening of Hertford House, which had been shut up since the marquis had gone to live in Paris, Wallace sent some of the finest of his pictures and other treasures to the Bethnal Green Museum

for exhibition ; they were then transferred to Hertford House, which had been largely

transformed in order to receive them. In 1871 he was created a baronet for his services during the siege of Paris, when he equipped several ambulances, founded the Hert- ford British hospital, and spent money lavishly in relief. This munificence endeared Sir Eichard Wallace to the French people. From 1873 to 1885 he had a seat in Parlia- ment for Lisburn, but he lived mostly in Paris, where, in the Rue Laffitte and in his villa in the Bois de Boulogne, he dwelt among art treasures not inferior to those at Hertford House. In 1878 he was made one of the British Commissioners at the Paris Exhibition, and he was also a trustee of the National Gallery and a governor of the National Gallery of Ireland. He died in Paris, 20th July 1890. He had married in 1871 the daughter of a French officer, by whom he had a son, who, however, died in 1887 ; and Lady Wallace, who died in 1897, bequeathed his great art collection to the British nation. It is now housed in Hertford House, Manchester Square, which was acquired and adapted by the Government for the purpose.

Wallaroo, a seaport town of South Australia, in the county of Daly, 123 miles by rail north-west by north of Adelaide, on Wallaroo Bay, in Spencer Gulf. It is connected by rail with the celebrated Wallaroo copper mines (near Kadina, at a distance of 6 miles from the port). At Wallaroo Bay are the largest smelting works in the state, ranking with the largest in the world. Gold, silver, and concentrated ores are received from other parts of the continent and from Tasmania for smelting at these works, which have ample facilities for shipment. The Bectaloo reservoir for the supply of the district was constructed at a cost of £1,000,000, and has a storage capacity of eight hundred million gallons. Population (1891), 1685; (1901), about 3500.

Wallawalla, a city of Washington, U.S.A., capital of Wallawalla county. It is situated in 46° 04′ N. and 118° 21′ W., at the northern base of the Blue Mountains, on the Oregon Railroad and Navigation Com- pany and the

~~Washington and Columbia River railways, in the south-eastern part of the state, at an altitude of 923 feet. It is in the famous wheat region of eastern Washington, for which it serves as a shipping-point. It has excellent water-power, with foundries, machine-shops, and flour-mills. Population (1890), 4709 ; (1895), 7770 ; (1900), 10,049, of whom 1522 were foreign-born and 33 coloured, including 25 negroes.~~

~~Wallingrford, a municipal borough, railway station, and market town, Berkshire, England, in the Abingdon parliamentary division of the county, 16 miles north-east of Newbury, on the Thames, here crossed by a bridge of 14 arches. Until 1832 the borough returned two members to Parliament, but in 1885 its representation was merged in that of the county. The old church of St Mary is supposed to have existed shortly after the Conquest. The town hall, built in 1670, was restored and repaired in 1887. Wallingford Castle, of which only the moat remains, was a fortress of great strength, dating from the Roman occupation, destroyed by the Danes, and rebuilt between 1067 and 1071. Popula- tion (1891), 2989; (1901), 2808.~~

~~Wallingrford, a town of New Haven county, Connecticut, U.S.A., in the south-west of the centre of the state, including part of the valley of Quinnipiac river with the hills on either side. It contains the chartered borough of Wallingford and the villages of East Wallingford and Yalesvillo. The borough, situated in the level valley, is regularly laid out, and has manu- factures of -silver-plated, britannia, brass, and nickel ware.~~

~~Population of the town (1880), 4686; (1890), 6584; (1900), 9001 ; of the borough, (1880), 3017 ; (1890), 4230 ; (1900), 6737, of whom 1796 were foreign-born.~~

~~Wallis Archipelago. See New Caledonia.~~

~~-);~~

~~Wallon, Henri Alexandre (1812-~~

~~*French historian and statesman, was born at Valenciennes, 23rd December 1812. Devoting himself to a literary career, he became in 1840 professor at the Ecole Normale, under the patronage of Guizot. His works on slavery in the French colonies (1847) and on slavery in antiquity (1848) led to his being placed, after the Revolution of 1848, on a commission for the regulation of labour in the French colonial possessions, and in November 1849 he was elected to the Legislative Assembly by the depart- ment of the Nord. He resigned in 1850, disapproving of the measure for the restriction of the suffrage adopted by the majority. In the same year he was elected a member of the Academie des Inscriptions, of which he became per- petual secretary in 1873. Under the Empire he withdrew altogether from political life, and occupied himself entirely with his duties as a professor of history and with historical writings, the most important of which, his history of Joan of Arc, obtained the Gobert prize from the Academy in 1860. Although remaining a Republican, he exhibited decided Clerical leanings in his works, which included a reply to Renan's Vie de Jesus, published in 1864. Returning to politics after the Franco – German war, M. Wallon was re-elected by the department of the Nord in 1871, took an active part in the proceedings of the Assembly, and finally immortalized himself by carrying his proposition for the establishment of the Republic with a president elected for seven years, which, after violent debates, was adopted by the Assembly on 30th January 1875. "Ma proposition," he declared, "ne proclame pas la Republique, elle la fait." Upon the definitive establish- ment of the Republic M. Wallon became Minister of Public Instruction, and effected many useful reforms, but his views were too conservative for the majority of the Assembly, and he retired in May 1876. He had been chosen a life senator in December 1875. Returning to his historical studies, M. Wallon produced two works of great importance, though less from his part in them as author than from the documents which accompanied them : ffis- toire du tribunal revolutionnaire de Paris, 1880-82, and Les Repre'sentants du peuple en mission et la justice revolutionnaire dans les departements, 1888-90. M. Wallon has not achieved the highest distinction either as historian or politician, but he has manifested a happy instinct for doing the right thing at the right time. His history of Joan of Arc came at the moment when everything was ripe for an authoritative work, and ac- quired a reputation as the standard*~~

biography which it is not likely to forfeit. His works on the history of the French Revolution were no less seasonable ; and his parliamentary action at a critical moment terminated a period of suspense and uncertainty, and procured for a politician not otherwise conspicuous the distinction of founder of the Third French Republic.

Wall-papers. See Mural Decoration.

Walmer, a parish in the Eastern, or St Augustine's, parliamentary division of Kent, England, 2 miles south of Deal, with a station on the South-Eastern and Chatham Railway. It is a member of the Cinque Port of Sand- wich. Walmer Castle, which dates from the time of Henry VIII., is the official residence of the Lord Warden of the Cinque Ports. The Duke of Wellington, then Lord Warden, died at the castle in 1852. Since his death the post has been held by, amongst others, Lord

Sidney, Lord Granville, Mr W. H. Smith, Lord George Hamilton, and Lord Salisbury. The Royal Marine In- firmary has been enlarged. Lower Walmer is a bathing resort. Population (1891), 4565; (1901), 5248.

Walsall, a municipal, county (1888), and parlia- mentary borough and market town of Staffordshire, England, 123 miles by rail north-west of London, on a tributary stream of the Tame. In 1890 the borough was extended. The Science and Art Institute was erected in 1888. The free library was extended and a museum added in 1891. The Grand Theatre dates from 1890. A new cemetery, of 40 acres, was laid out in 1894. An arboretum was enlarged to 32 acres in 1891. As public recreation grounds there are Reed's Wood (46 acres) and Palfrey Park (8 acres). Walsall was the scene of the charitable activities of "Sister Dora" (the late Miss Pattison, for many years at the head of the nursing staff of the Cottage Hospital), to whom a marble statue by Mr F. J. Williamson has been erected in the principal square. According to the census of 1891, there were 5684 persons (1806 females) engaged in the making of harness, which, with other leather trades, forms the staple industry, 2403 in the

~~iron and steel manufacture, and 1447 in manufac- tures in mixed metals, and 1914 in coal-mining. The great majority of the horses' bits used in the United Kingdom, and a certain proportion of those used in the United States, are manufactured in Walsall and Bloxwich, one of its in- dustrial suburbs. Area of municipal and parliamentary borough, which are coextensive, 7480 acres. Population~~

~~(1891), 71,789; (1901), 86,440.~~

~~Walter. — The name of the Walter family is indis- solubly connected with the history of The Times. John Waltee (1), the founder of the paper, was born in 1738/9, probably in London, and from the death of his father, Richard Walter (about 1755/6), until 1781 was engaged in a prosperous business as a coal merchant. He played a leading part in establishing a Coal Exchange in London ; but shortly after 1781, when he began to occupy himself solely as an underwriter and became a member of Lloyd's, he over-speculated and failed. In 1782 he bought from one Henry Johnson a patent for a new method of printing from "logotypes" (i.e., founts of words instead of letters), and made some improvements in it. In 1784 he acquired an old printing office in Blackfriars, which formed the nucleus of the Printing-house Square of a later date, and established there his " Logographic Office." At first he only undertook the printing of books, but on 1st January 1785, he started a small newspaper called The Daily Universal Register, which on reaching its 940th number on 1st January 1788 was renamed The Times. The printing business developed and prospered, but the newspaper at first had a somewhat chequered career (see Ency. Brit., 9th ed., vol. xvii. p. 417). In 1789 Mr Walter was tried for a libel in it on the Duke of York, and was sentenced to a fine of £50, a year's imprisonment in Newgate, to stand in the pillory for an hour, and to give surety for good behaviour for seven years ; and for further libels the fine was increased by £100, and the imprisonment by a second year. On 9th March 1791, however, he was liberated and pardoned. In 1799 he was again convicted for a technical libel, this time on Lord Cowper. He had then given up the management of the business to his eldest son, William, and had (1795) retired to Teddington, where he died, 16th November 1812. In 1759 he had married Frances Landen (died 1798), by whom he had six children. William Walter very soon gave up the~~

duties he undertook in 1795, and in 1803 transferred the sole management of the business to his younger brother, John. — John Walter (2)

(1776-1847), who really established the great news- paper of which his father had sown the seed, was born 23rd February 1776, and was educated at Merchant Taylors' School and Trinity College, Oxford. About 1798 he was associated with his elder brother in the management of his father's business, and in 1803 became not only sole manager but also editor of The Times. He at once put new life into the paper, being careful to main- tain its independence of party ties, and carried it on with great energy and tact. His opposition to Pitt in 1803 resulted in the withdrawal by the Government of the appointment as Printer to the Customs which the elder Walter had enjoyed since 1787, but no such pressure had any effect upon the attitude adopted by The Times. It was not till about 1810 that John Walter the second handed over the editorial duties to Sir John Stoddart (succeeded in 1816 by Thomas Barnes, and in 1841 by Delane, q.v.), and in the meantime he had organized the paper on the main lines afterwards followed. He revolu- tionized its system of news transmission, obtained the best literary talent on the staff, and above all impressed upon the paper a character of strict anonymity combined with the highest standard of accuracy. In 1810 he de- feated an attempt on the part of his compositors to stop the publication of the paper by striking ; and in 1814 he introduced steam printing machinery (see Ency. Brit., 9th ed., vol. xxiii., art. Typography), an improvement on an invention of a German named Koenig. The prosperity of the paper rapidly increased as the result of the energy with which it was conducted. In 1832 Mr Walter, who had purchased an estate called Bear Wood, in Berkshire (where his son afterwards built the present house), was elected to Parliament for that county, and retained hia seat till 1837. In 1841 he was returned to Parliament for Nottingham, but was unseated next year on petition. He was twice married, and by his second wife, Mary Smythe, had a family. He died in London on 28th July 1847. — John Walter (3) (1818- 1894), his eldest son, was born at Printing-house Square in 1818, and was educated at Eton and Exeter College, Oxford, being called to the bar in 1847. On leaving Oxford he took part in the business management of The Times, and on his father's death • became sole manager, though he

devolved part of the work on Mr Mowbray Morris. He was a man of scholarly tastes and serious religious views, and his conscientious character had a marked influence on the tone of the paper. It was under him that the successive improvements in the printing machinery at last reached the stage of the " Walter Press "in 1869 (see Ency. Brit., vol. xxiii. p. 707), the pioneer of modern newspaper printing-presses. In 1847 he was elected to Parliament for Nottingham as a moderate Liberal, and was re-elected in 1852 and in 1857. In 1859 he was returned for Berkshire, and though defeated in 1865, was again elected in 1868, and held the seat till he retired in 1885. The history of The Times under his proprietorship is referred to else- where (see Newspapers). He was twice married, first in 1842 to Emily Frances Court (died 1858), and secondly in 1861 to Flora Macnabb. His eldest son by the first marriage, John, was accidentally drowned at Bear Wood in 1870; and on Mr Walter's own death on 3rd November 1894 he was succeeded as chief proprietor of The Times by Mr Arthur Fraser Walter (born 1846), his second son by the first marriage.

Waltham, a city of Middlesex county, Massa- chusetts, U.S.A., on the Charles river, and the Boston and Maine and the Fitchburg railways, in the eastern part of the state. The detached villages, among which

the population of the town was formerly distributed, have grown and extended until they have merged into an open-built city, irregular in plan and divided into seven wards. The chief industries are watch-making and textile manufacture. Population (1890), 18,707 ; (1900), 23,481, of whom 6695 were foreign-born.

Waltham Abbey, or Waltham Holy Cross, a parish, urban district, and ancient market town, in the Epping, or Western, parliamentary division of Essex, England, on the river Lea. The town lies 13 miles north of London by rail. New Government works were built in 1890 at Quinton Hill, half a mile west of the town, for the manufacture of cordite. Population of the

urban district (Waltham Holy Cross) and parish (Waltham Abbey) (1891), 6066; (1901), 6547.

Walton-on-Thames, a parish of Surrey, Eng- land, 5 miles south-west of Kingston, with a station on the London and South -Western Kailway. Since 1895 it has been governed by an urban district council. The village is a favourite resort of anglers and tourists. Population (1891), 7988 ;' (1901), 10,329.

Walton-On-the-Naze, a watering-place of Essex, England, 20 miles east of Colchester, with a station on the Great Eastern Kailway. Since 1894 it has been governed by an urban district council. The sea wall was repaired in 1892 at a cost of £14,000. Population of the urban district (Walton-on-the-Naze) and parish (Walton le Soken) (1891), 1586; (1901), 2014.

Wandsbek, a town of the province of Schleswig- Holstein, Prussia, practically forming a populous suburb of Hamburg, of which it lies 3 miles north-east. It is best known as the place of residence of Voss and . of Matthias Claudius, who here issued (1771-75) the memorable Wandsbecher Boten. There is a monument to Claudius outside the town. Its leading manufac- tures are spirits, tobacco, oleographs, and other wares. Population (1885), 17,760 ; (1900), 27,966.

Wappers, Egide . Charles Gu stave,

Baron (1803-1874), Belgian painter, was born at Antwerp, 23rd August 1803. After studying at the Antwerp Academy under the guidance of Herreyns and of Matthieu van Bree, he went to Paris in 1826. The Komantic movement was then astir in France, and in that vehement struggle towards a new ideal artists and political men were thrown together. Wappers was the first Belgian artist to take advantage of this state of affairs, and his first exhibited picture, " The Devotion of the Burgomaster of Leyden," appearing at the appro- priate moment, had a marvellous success in the Brussels Salon of 1830. The picture, although political, was in fact a remarkable work, which revolutionized the taste of Flemish painters. Wappers was invited to the Court of Brussels, and was favoured with commissions. In 1832 the city of Antwerp appointed him professor of painting, and his triumph was complete when he ex- hibited

at the Antwerp Salon of 1834 his masterpiece, " An Episode of the Belgian Kevolution of 1830 " (Brussels Gallery ; see Plate). He was subsequently appointed painter to the King of the Belgians, and at the death of Matthieu van Bree he was made director of the Antwerp Academy. Of his very numerous works we may name "Christ Entombed," ■" Charles I. taking leave of his Children," " Charles IX.," " Camoens," " Peter the Great at Saardam," and " Boccaccio at the Court of Joanna of Naples." Louis Philippe gave him a commission to paint a large picture for the gallery at Versailles, " The Defence of Rhodes by the Knights of St John of Jeru- salem," a work finished in 1844, when he received from the King of the Belgians the title of baron. After retiring from the post of director of the Antwerp Academy, he settled in 1853 in Paris, where he died on the 6th of December 1874.

See J. du Jaedin. L'Art Flamand. — Camille Lemonnier. Histoire des Beaux Arts en Belgique. — Ed. F£tis. "Notice aur Gustave "Wappers," Annuaire de VAcademie royale de Belgique,

1884.

WAR.

I. General Principles.

IT is not easy to determine whether industrial progress, improved organization, the spread of education, or mechanical inventions have wrought the greater change in the military art. War is first and foremost a

„ ^^«f . matter of movement ; and as such it has been conditions. } .

considerably affected by the multiplication of good roads, the introduction of steam transport, and by the ease with which draught animals can be collected. In the second place, war is a matter of supply ; and the large area of cultivation, the increase of live-stock, the vast trade in provisions, pouring the foodstuffs of one continent into another, have done much to lighten the inevitable difficulties of a campaign. In the third place, war is a matter of destruction ; and while the weapons of armies have become more perfect and more durable, the modern substitutes for gunpowder

have added largely to their destructive capacity. Fourthly, war is not merely a blind struggle between mobs of individuals, without guidance or coherence, but a conflict of well-organized masses, moving with a view to intelligent co-operation, acting under the impulse of a single will and directed against a definite objective. These masses, however, are seldom so closely concentrated that the impulse which sets them in motion

can be promptly and easily communicated to each, nor can the right objective be selected without some knowledge of the enemy's strength and dispositions. Means of intercom- munication, therefore, as well as methods of observation, are of great importance ; and with the telegraph, the tele-" phone, visual signalling, balloons, and improved field-glasses, the armies of to-day, so far as regards the maintenance of connexion between different bodies of troops, and the diffusion, if not the acquiring, of information, are at a great advantage compared with those of the middle of the 19th century.

War, then, in some respects has been made much simpler. Armies are easier to move, to feed, and to manoeuvre. But in other respects this very simplicity has made the conduct of a campaign more difficult. Not only is the weapon wielded by the general less clumsy and more deadly than heretofore, less fragile and better balanced, but it acts with greater rapidity and has a far wider scope. In a strong and skilful hand it may be irresistible ; in the grasp of a novice it is worse than useless. In former times, when war was a much slower process, and armies were less highly trained, mistakes at the outset were not necessarily fatal. Under modern conditions, the inexperienced commander will not be granted time in which to correct his deficiencies and give

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WAR

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himself and his troops the needful practice. The idea of forging generals and soldiers under the hammer of war disappeared with the advent of "the nation in arms." It is not too much to say that every state in Europe, except Great Britain, can employ the whole of its resources, physical, material, and intellectual, at the outset. Mili- tary organization has become a science, most carefully studied, both by statesmen and soldiers. Its principles, as a general rule, have been so thoroughly applied, that the moment war is declared the manhood of the country stands ready, armed, organized, and trained to defend the frontier. The lessons of history have not been neglected. Previous to 1870, in one kingdom only was it recognized that intellect and education play a more prominent part in war than stamina and courage. Taught by the dire disasters of 1806, Prussia set herself to dis- cover the surest means of escaping humiliation for the future. The shrewdest of her sons undertook the task. The nature of war was analysed until the secrets of success and failure were laid bare ; and on these in- vestigations a system of organization and of training was built up which, not only from a military, but from a political, and even an economical point of view, is the most striking product of the 19th century. The key- note of this system is that the best brains in the state shall be at the service of the war lord. None, therefore, but thoroughly competent soldiers are entrusted with the responsibility of command ; and the education of the officer is as thorough, as systematic, and as uniform as the education of the lawyer, the diplomatist, and the doctor. In all ages the power of intellect has asserted itself in war. It was not courage and experience only that made Hannibal, Alexander, and Csesar the greatest names of antiquity. Napoleon, Wellington, and the Archduke Charles were certainly the best educated soldiers of their time ; while Lee, Jackson, and Sherman probably knew more of war, before they made it, than any one else in the United States. But it was not until 1866 and 1870 that the preponderating influence of the trained mind was made manifest. Other wars had shown the value of an educated general ; these showed the value of an educated army. It is true that Moltke, in mental power and in knowledge, was in no wise inferior to the great captains who preceded him ; but the remarkable point of his campaigns is that so many capable generals had never before been gathered together under one flag. No campaigns have been sub- mitted to such searching criticism. Never have mistakes been more sedulously sought for or more frankly exposed. And

yet, compared with the mistakes of other campaigns, even with that of 1815, where hardly a superior officer on either side had not seen more battles than Moltke and his comrades had seen field-days, they were astonishingly few. It is not to be denied that the foes of Prussia were hardly worthy of her steel. Yet it may be doubted whether either Austria or France ever put two finer armies into the field than the army of Bohemia in 1866 and the army of the Bhine in 1870. Even their generals of divisions and brigades had more actual experience than those who led the German army corps. Compared with the German rank and file, a great part of their non- commissioned officers and men were veterans, and veterans who had seen much service. Their chief officers were practically familiar with the methods of moving, supply- ing, and manoeuvring large masses of troops ; their marshals were valiant and successful soldiers. And yet the history of modern warfare records no defeats so swift and so complete as those of Koniggratz and Sedan. The great host of Austria was shattered to fragments in seven weeks; the French Imperial army was destroyed in seven weeks and three days ; and to all intent and purpose the resist-

ance they had offered was not much more effective than that of a respectable militia. But both the Austrian and the French armies were organized and trained under the old system. Courage, experience, and professional pride they possessed in abundance. Man for man, in all virile qualities, neither officers nor men were inferior to their foes. But one thing their generals lacked, and that was education for war. Strategy was almost a sealed book to them ; organization a matter of secondary importance. It was no part of their duty, they declared, to train the judgment of their subordinates ; they were soldiers, and not pedagogues. Knowledge of foreign armies and their methods they considered useless ; ‘ and of war prepared and conducted on ” business principles ” they had never even dreamt.

The study of war had done far more for Prussia than educating its soldiers and producing a sound system of organization. It had led to the establishment of a sound system of command ; and this system Principles proved a marvellous instrument in the hands of maa^, a great leader. It was based on the recog- nition of three facts : first, that an army cannot

~~be effectively controlled by direct orders from one head- quarters ; second, that the man on the spot is the best judge of the situation ; and third, that intelligent co-operation is of infinitely more value than mechanical obedience. To explain more fully. In military operations space, time, and opportunity are dominant factors. For many reasons an army in the field can never be closely concentrated, and it is thus impossible for the commander to see everything for himself, to detect with his own eyes every blunder the enemy may commit, or to communicate his orders in such good time that openings shall not be lost. Nor can he forecast and provide for every contingency, for it is generally the unexpected that happens : the enemy's blunders cannot be foreseen ; and events move with such rapidity that an order an hour old is often quite inapplicable to the situation. Moreover, if those portions of the army unseen by the commander, and not in direct communication with him, were to await his orders before acting, not only would opportunities be allowed to pass, but other portions of the army, at critical moments, might be left without support. It was under- stood, therefore, in the Prussian armies of 1866 and 1870, that no order was to be blindly obeyed unless the superior who issued it was actually present, and therefore cognizant of the situation at the time it was received. If this was not the case, the recipient was to use his own judgment, and act as he believed his superior would have directed him to do had he been aware how matters stood. Again, officers not in direct communication with headquarters were expected not only to watch for and to utilize, on their own initiative, all opportunities of furthering the plan of campaign or battle, but, without waiting for instructions, to march to the thunder of the cannon, and render prompt assistance wherever it might be required. It was long before the system was cordially accepted, even in Germany itself; and it has been fiercely criticized. To soldiers whose one idea of command might be sum- marized in the sentence, " I order, you obey," and in whose eyes unqualified and unthinking obedience was the first of virtues, the new teaching appeared subversive of all discipline and authority. If, they said, subordinates are to judge for themselves whether an order is to be executed or not ; if they are to be encouraged to march, to attack, or to retreat, on their own volition ; if, in a word, each of them is to be considered an independent commander, the superior can never be certain,~~

at any given moment, where his troops are or what they are doing, and to manoeuvre them as a united whole will be

out of the question. Was it likely, they asked, that a junior officer left to himself would act as his superior would have directed him to act had he himself been present? Was it not probable that he would hinder rather than further the general plan ; and would not such untrammelled freedom lead to independent ventures, proline perhaps of personal glory, but absolutely de- structive of the harmony of action essential to success? These dangers, however, had been foreseen ; and while they were recognized as real, they were not considered so inevitable as to forbid the encouragement of an unfettered initiative, nor so formidable as to , be insurmountable. The first step was to make a clear distinction between " orders " and " instructions." An " order " was to be obeyed, instantly and to the letter. " Instructions " were an expression of the commander's wishes, not to be carried out unless they were manifestly practicable. But " orders," in the technical sense, were not to be issued except by an officer actually present with the body of troops concerned, and fully aware of the situation ; otherwise, " instructions " only would be sent. The second step was to train all officers to arrive at correct decisions, and so to make certain, so far as possible, that subordinates, when left to themselves, would act as their superiors would wish them to do. The third step was to discourage to the utmost the spirit of rash and selfish enterprise. In the German army of to-day the means employed to ensure, so far as possible, correct decisions are, first, a uniform training in handling troops. Every German officer, practically speaking, is educated in the same school and taught to adapt his action to the same principles. The school is that of the General Staff. The principles, few but comprehensive, are those laid down by the chief of staff; and they are disseminated through the army by his assistants, the officers of the General Staff, whom he himself has educated. Each army corps and each division has its own chief of the staff, all of them replicas of their teacher;

~~and no general, so far as possible, is appointed even to the command of a brigade unless he is thoroughly acquainted with the official principles. Instruction is not necessarily given at Berlin. Every commander has not passed through the Kriegsakademie, or served at headquarters. But at field exercises and manoeuvres, at war games and staff rides, the official principles, especially those concerned with " orders," are the ground-work of all criticism and the touchstone of every operation. The field exercises, too, are arranged so as to afford constant practice, under competent instructors, in solving the problems which present themselves in war. The second means is a systematic encouragement, from the first moment an officer joins his regiment, of the spirit of initiative, of independent judgment, and self- reliance. Each has his definitive responsibilities, and superiors are forbidden, in the most stringent terms, to infringe on the prerogatives of their subordinates. The third means is the enforcement of the strictest discipline, and the development of camaraderie in the highest sense. Despite the latitude that is accorded him, absolute and punctual obedience to the most trifling "order" is exacted from the German officer ; while devotion to duty and self-sacrifice, exalted to the same level as personal honour, and inculcated as the loftiest sentiment by which the soldier can be inspired, are trusted to counteract the tendencies of personal ambition. It may be remarked that Napoleon at St Helena, in his criticisms of his marshals, frequently made use of the significant expres- sion that so-and-so failed "because he did not under- stand my system." It is possible that Moltke, the real founder of the German system, took those words to heart. Be this as it may, he knew not only how to command an**

army, but how to teach an army; how to form skilled leaders, strategists and tacticians, men who could plan, execute, and instruct ; and in this respect he was far superior to Napoleon, or indeed to any general of modern times. In 1866 the system was not quite perfected; but in 1870 there were few German officers who were not thoroughly penetrated with the ideas of the chief of the staff; few who did not thoroughly understand how to interpret, and how to issue, " orders " and " instructions." The benefit to the state was enormous. It is true that the initiative of subordinates sometimes degenerated into reckless audacity, and critics have dilated on these rare instances with ludicrous persistence, forgetting~~

the hundreds of others where it was exercised to the best purpose, forgetting the spirit of mutual confidence that permeated the whole army, and forgetting, at the same time, the deplorable results of centralization in the armies they overthrew. It is inconceivable that any student of war, comparing the conduct of the German, the French, and the Austrian generals, should retain even the shadow of a prejudice in favour of blind obedience and limited responsibility.

" To what," asks the ablest commentator on the Franco- German war, " did the Germans owe their uninterrupted triumph 1 What was the cause of the constant disasters of the French ? What new system did ^fases ot the Germans put in practice, and what are the sacceSs. elements of success of which the French were bereft ? That system is, so to speak, official and authori- tative amongst the Germans. It is the initiative of the subordinate leaders. This quality, which multiplies the strength of an army, the Germans have succeeded in bringing to something near perfection. It is owing to this quality, that in the midst of varying events the supreme command pursued its uninterrupted career of victory, and succeeded in controlling, almost without a check, the (intricate mechanism of the most powerful army that the 19th century has produced. In executing the orders of the supreme command, the subordinate leaders not only did over and over again more than was demanded of them, but surpassed the highest expectations of their superiors, notably at Sedan. It often happened that the faults, more or less inevitable, of the higher authorities were repaired by their subordinates, who thus won for them victories which they had not always deserved. In a word, the Germans were indebted to the subordinate leaders that not a single favourable occasion throughout the whole campaign was allowed to escape unutilized. The French, on the other hand, never even suspected the existence of so powerful a factor ; and it is for this reason that they met with disasters, even when victory, so to speak, belonged to them by every rule of war. The faults and omissions of the French subordinate leaders are to be attributed to the false conception of the rights and functions of command, to the ingrained habit of blind and inert obedience, based on a principle which allowed no exception, and acting as a law, absolute and immutable, in all degrees of the military hierarchy. To the virile energy of the Germans they could oppose nothing but

impetuous courage. Compensation for the more powerful fire of the German artillery was found in the superior weapon of the French infantry. But to the intelligent, hardy, and even at times somewhat reckless initiative of the German subordinate leaders the French had nothing to oppose, in the grand as in the minor operations, but a deliberate inactivity, always awaiting an impulse from above. These were the real causes of the numerous reverses and the swift destruction of the valiant French army, and therein lies the true secret of German strength. Her foes of days to come will have to reckon seriously with this force, almost elementary in its

manipulation, and prepare themselves in time to meet it. No well-organized army can afford to dispense with the initiative of the subordinate leaders, for it is the determining factor in modern war, and up to the present it has been monopolized by Germany."

That the Prussian system should be imitated, and her army deprived of its monopoly of high efficiency, was naturally inevitable. Every European state has to-day its staff college, its intelligence department, its schools of instruction, and its courses of field manoeuvres and field firing. But that the full import of the German system has been thoroughly realized is very doubtful. So far as the history of warfare since the fall of Paris can be regarded as evidence, the contrary appears to be the case. In many of the campaigns since 1870, brains and system can hardly be said to have played the leading part. Individual generals have made great names as strategists, as organizers, as leaders of men ; but want of foresight, inadequate preparation, contempt of the enemy and ignorance of his strength, violation of great principles, and indifferent training, both of the staff and of the troops, have been too often apparent. It is possible that the same faults and deficiencies will be conspicuous, unless a knowledge of the real nature of' war is far more widely diffused than it is at present, in the 20th century. It is not quite true that some terrible catastrophe is required to bring home to a nation the vast importance of military efficiency, and to make all men realize in what that efficiency consists. If

~~Jena and Auerstadt made the Prussian army of 1870, and Sedan the French army of 1900, it is to the writings of Mahan that Great Britain owes in large measure the reform of her naval deficiencies. His brilliant analysis of the nature of naval warfare, and his masterly elucidation of the great principles of success and failure, have proved as effective a tonic as the occupation of Berlin or the fall of Paris.~~

~~But before a new conception of war, such as is involved in Moltke's system, can take hold of the instincts of a Difficulties Pe°ple there are many obstacles to be overcome. of the new Not the least is a very natural reluctance to conception admit that any foreign army is in any way of war. better than their own, just as the loyal citizen of London, Oliver Goldsmith, believed that " nature never exhibited a more magnificent prospect than that seen from the top of Hampstead Hill." But the chief are the traditional ideas that intellectual capacity is of far less value in the field than the military virtues, courage, endurance, and skill at arms, that the problems which confront the general are all to be solved by the exercise of ordinary common sense, and that war is a matter of such simplicity that it is hardly worth serious study. In a lawyer, a doctor, an engineer, in the mates of an Atlantic liner, or the officers of a battleship, the public expects to find a mastery of their profession, a proved capacity for conducting it, and a knowledge that is up to date. Nor does the ordinary layman venture to inter- fere with these acknowledged specialists. As regards the military art it is far otherwise. Soldiers are not acknowledged as specialists. Few Anglo-Saxons are not secretly convinced that with some knowledge of drill they would be most formidable rivals to the officers of the German General Staff, and many of the fiercest critics of the professional soldier are in exactly the same case as the Austrians of * 1866 and the French of 1870. They believe that they possess the mili- tary virtues, that they are fearless, cool, and resolute, and they flatter themselves that they are fitted with sufficient common sense to enable them to decide wisely and promptly in critical moments. Nor is it to be denied, especially in a nation of sportsmen, whose~~

~~familiarity with danger breeds energy and resolution, that so far they are perfectly right. They forget, however, that common sense, to be a really~~

useful guide to the judgment, must be trained common sense, fortified by knowledge and increased by practice, and they forget that encounters with the enemy are only incidents of a campaign. When they assume the form of pitched battles they are undoubtedly the most important incidents. But unless the strategy is sound, unless the preliminary opera- tions, such as the concentration on the frontier, the measures for protecting the communications, the arrange- ments for fortifying the bases, the marches, the reconnais- sances, have been devised and executed in such manner as to enable the troops to meet the enemy under the most favourable conditions ; and unless, when the victory has been won, the movements of the army are so directed as to reap the fruits thereof, battles, even if successful, are not likely to produce decisive results. But with strategy, that is, the operations which lead up to battle, and those which follow battle, the ordinary military virtues are not directly concerned, or rather, are much less concerned than intellectual capacity and a wide knowledge of war. For instance, in the war of 1870, the headquarters were so far to the rear that neither Moltke nor his assistants saw a shot fired before the day of Gravelotte, the sixth great battle. It would seem, therefore, to have been perfectly immaterial whether the officers of the headquarters staff possessed a superabundance of the military virtues, or whether they were absolutely without them. Yet the skill with which they planned the preliminaries was the foundation of the victories. Had not the general scheme of operations been thoroughly sound, the judgment and initiative of the subordinate leaders would assuredly have gone astray. But Moltke committed no mistake. Long before war had been declared every possible preparation had been made. And these included much more than arrangements for rapid mobilization, the assembly of superior numbers completely organized, and the establishment of magazines. The enemy's numbers, armaments, readiness, and efficiency had been submitted to a most searching examination. Every possible movement that might be made, however un- likely, had been foreseen, every possible danger that might arise, however remote, discussed and provided against. The concentration on the frontier was so devised that not only were the troops placed in the best position for either invasion or defence, but the chance of even a small reverse was hardly possible. Moreover, when the campaign opened, although half a million of men had to be supplied and manoeuvred in a hostile country,

and, as each victory brought about a fresh situation, fourteen army corps, every one of them as large as the army with which Wellington fought the battle of Quatre Bras, had to be given a fresh direction, transferred to other roads and assigned a new objective, the French were never offered a real opening from first to last. It is true that the Germans were superior in numbers ; but if it be borne in mind that exact information was but seldom forth- coming, that the movements of these huge masses de- pended on slight indications, and on inferences drawn from a knowledge of war, from a knowledge of the enemy's leaders, and of the influence on those leaders of French public opinion, it will be evident that the successful result was the fruit of a sustained intellectual effort of no ordinary kind.

The popular idea that war is a mere matter of brute force, redeemed only by valour and discipline, is responsible for a greater evil than the complacency of the amateur. It blinds both the people and its representatives to their bounden duties. War is something more than a mere outgrowth of politics. It is a political act, initiated

and controlled by the Government, and it is an act of which the issues are far more momentous than any other. And yet no branch of political science is less studied in the Anglo-Saxon communities. That obstacles to a mastery of the subject are very numerous it is idle to deny. A youthful Hohenzollern can be taught by a Moltke ; to train the sovereign people to a proper under- standing of things military is a different matter. For one thing, it is not easy to find instructors. There is no standard work on war in the English language, no volume of permanent value which deals with the organization, maintenance, and employment of armies from the point of view of the statesman and the citizen. History, as taught at the present day, includes an immense variety of subjects, but there is one subject which it has sedulously shunned, and that subject is the defence of empires. Hardly any well-known political writer, except Spenser Wilkinson, appears to have the least inkling that such knowledge should be part of the intellectual equipment of every educated man, and no great

teaching body has yet endeavoured to supply the deficiency. So, in both Great Britain and the United States, organization has been neglected, efficiency has been taken for granted, and the national resources have been either wasted or misused. Costly, ill-planned, and ill-conducted enterprises have been the inevitable result.

It is not pretended that if military history were

thoroughly studied all statesmen would become Moltkes,

or that every citizen would be competent to set

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practical art, and the application of theory to practice is not to be taught at a university or to be learned by those who have never rubbed shoulders with the men in the ranks. But if war were more generally and more thoroughly studied, the importance of organiza- tion, of training, of education, and of readiness would be more generally appreciated ; abuses would no longer be regarded with lazy tolerance ; efficiency would be some- thing more than a political catchword, and soldiers would be given ample opportunities of becoming masters of every detail of their profession. Nor is this all. A nation that understood something about war would hardly suffer the fantastic tricks which have been played so often by the best-meaning statesmen. And statesmen themselves would realize that when war is afoot their interference is worse than useless ; that preparation for defence, whether by the multiplication of roads, the construction of railways, of arsenals, dockyards, fortresses, is not the smallest of their duties ; and lastly, that so far as possible diplomacy and strategy should keep step. Each one of these is of far greater importance than in the past. In the wars of the 18th century, English cabinets and Dutch deputies could direct strategical operations without bringing ruin on their respective countries. The armies of Austria in 1792-95, controlled as they were by the Aulic Councils, were more formidable in the field than those of the French Republic. In the campaigns of 1854 and 1859 the plans of Newcastle and Napoleon III. worked out to a successful issue ; and if Lincoln and Stanton, his Secretary of War, imperilled the Union in 1862, they saw the downfall of the Southern Confederacy in 1865. But

in every case amateur was pitted against amateur. The Dutch deputies were hardly less incapable of planning or approving a sound plan of campaign than Louis XIV. The Aulic Council was not more of a marplot than the Committee of Public Safety. Newcastle was not a worse strategist than the Tsar Nicholas I. Napoleon III. and his advisers were quite a match for the courtier generals at Vienna ; while Lincoln and Stanton were not much more ignorant than Jefferson Davis. The amateur, however, can no longer expect the

good fortune to be pitted against foes of a capacity no higher than his own." The operations of Continental armies will be directed by soldiers of experience whose training for war has been incessant, and who will have at their command troops in the highest state of efficiency and preparation. It is not difficult to imagine, under such conditions, with what condign punishment mistakes will be visited. Napoleon III. in 1859 committed as many blunders as he did in 1870. But the Austrians had no Moltke to direct them ; their army corps were commanded by men who knew less of generalship than a Prussian major, and their armament was inferior. Had they been the Austrians of to-day, it is probable that the French and the allies would have been utterly defeated. And to come to more recent campaigns, while American officers have not hesitated to declare that if the Spaniards at Santiago had been Germans or French, the invasion would have ended in disastrous failure, it is impossible to doubt that had the Boers of 1899 possessed a staff of trained strategists, they would have shaken the British Empire to its foundations. The true test of direction of war is the number of mistakes. If they were numerous, although the enemy may not have been skilful enough to take advantage of them, the outlook for the future under the same direction, but against a more practised enemy, is anything but bright.

As regards preparation for defence, history supplies us with numerous illustrations. The most conspicuous, perhaps, is the elaborate series of fortifications which were constructed by Vauban for the rePf™' defence of France ; and there can be no ques- defence. tion that Louis XIV., in erecting this mighty barrier against invasion, gave proof of statesmanlike foresight of no mean order. An instance less familiar, perhaps, but even more creditable to the brain which conceived it, was Wellington's

preparation of Portugal in 1809-11. Not only did the impregnable stronghold of Torres Vedras, covering Lisbon, and securing for the sea-power an open door to the continent of Europe, rise as if by magic from the earth, but the whole theatre of war was so dealt with that the defending army could operate wherever opportunity might offer. No less than twenty supply depots were established on different lines of the advance. Fortifications protected the principal magazines. Bridges were restored and roads improved. Waterways were opened up, and flotillas organized ; and three auxiliary bases were formed on the shores of the Atlantic. Again, the famous "quadrilaterals" of Lombardy and Rumelia have more than fulfilled the purpose for which they were constructed ; and both Austria and Turkey owe much to the fortresses which so long protected their vulner- able points. Nor has the neglect of preparation failed to exert a powerful effect. Moltke has told us that the railway system of Germany before 1870 had been developed without regard to strategical considerations. Yet the fact remains that it was far better adapted both for offence and defence than those of Austria and France ; and, at the same time, it can hardly be denied that the unprovided state of the great French fortresses exercised an evil influence on French strategy. Both Metz and Strasburg were so far from forming strong pivots of manoeuvres, and thus aiding the operations of the field armies, that they required those armies for their protection ; and the retreat on Metz, which removed Bazaine's army from the direct road to Paris and placed it out of touch with its supports, was mainly due to the unfinished outworks and deficient armament of the virgin city. Since 1870 it has been recognized that, preparation of the theatre of war is one of the first duties of a Government. Every frontier of continental Europe is covered by a chain of entrenched camps. The great arsenals are amply fortified and strongly

garrisoned. Strategy has as much to say to new railways as trade; and the lines of communication, whether by water or by land, are adequately protected from all hostile enterprises. It is to be recognized that the

amount of preparation must vary with the extent of the frontier and with the character of the foe beyond. For example, to make the vast boundaries of the British Empire as secure as the eastern marches of France would be a financial impossibility and a military folly. Yet this does not imply that questions of defence may be postponed until war is imminent. Plevna has demonstrated, indeed, that hastily-constructed earthworks may be more useful than the most formidable citadel. But it was only the stupidity of the enemy that allowed Plevna to become impregnable. We now come to the third point, the importance of close concert between strategy and diplomacy. On the Concert continent of Europe they can easily keep pace, between for the theatre of war is always within easy diplomacy reach. But when the ocean intervenes between " two hostile states it is undoubtedly difficult to

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time an ultimatum so that a sufficient armed force shall be at hand to enforce it, and it has been said in high places that it is practically impossible. The expedi- tion to Copenhagen in 1807, when the British ultimatum was presented by an army of 27,000 men carried on 300 transports, would appear to traverse this statement. But at the beginning of the 20th century an army and a fleet of such magnitude could neither be assembled nor despatched without the whole world being cognizant. It is thus perfectly true that an appreciable period of time must elapse between the breaking off of negotiations and the appearance on the scene of an invading army. Events may march so fast that the statesman's hand may be forced before the army has embarked. But because a powerful blow cannot at once be struck, it by no means follows that the delivery or the receipt of an ultimatum should at once produce a dangerous situation. Dewey's brilliant victory at Manila lost the greater part of its effect because the United States Government was unable to follow up the blow by landing a sufficient force. Exactly the same thing occurred in Egypt in 1882. The only results of the bombardment of Alexandria were the destruction of the city, the massacre of the Christian inhabitants, the en- couragement of the rebels, who, when the ships drew off, came to the natural conclusion that Great Britain was powerless on land. Again, in 1899 the invading Boers found the frontiers unfortified and their march

opposed by an inadequate force. It is essential, then, that when hostilities across the sea are to be apprehended, the most careful precautions should be taken to ward off the chance of an initial disaster. And such precautions are always possible. It is hardly conceivable, for instance, that a great maritime power, with Cyprus as a place d'armes, could not have placed enough transports behind the fleet to hold a sufficient garrison for Alexandria, and thus have saved the city from destruction. Nor in the case of a distant province being threatened is there the smallest reason that the garrison of the province should be exposed to the risk of a reverse before it is reinforced. It may even be necessary to abandon territory. It will certainly be necessary to construct strong places, to secure the lines of communica- tion, to establish ample magazines, to organize local forces, to assemble a fleet of transports, and to keep a large body of troops ready to embark at a moment's notice. But there is no reason, except expense, that all this should not be done directly it becomes clear that war is probable, and that it should not be done without attracting public attention. In this way strategy may easily keep pace with diplomacy; and all that is wanted is the exercise of ordinary foresight, a careful study of the theatre of war, a knowledge of the

enemy's resources, and a resolute determination, despite some temporary inconvenience and the outcry of a thought- less public, to give the enemy no chance of claiming first blood. The Franco-German war supplies a striking example. Moltke's original intention was to assemble the German armies on the western frontier. The French, he thought, inferior in numbers and but half prepared, would probably assemble as far back as the Moselle. But, as so often happens in war, the enemy did what he was least expected to do. Hastily leaving their garrisons, the French regiments rushed forward to the Saar. The excitement in Germany was great; and even soldiers of repute, although the mobilization of the army was still unfinished, demanded that such troops as were available should be hurried forward to protect the rich provinces which lie between the Saar and Rhine. But the chief of the staff became as deaf as he was silent. Not a single company was de- spatched to reinforce the slender garrisons of the frontier towns ; and those garrisons were ordered to retire, de- stroying railways and removing rolling-stock, directly the enemy should cross the boundary. Moltke's foresight had embraced every possible

contingency. The action of the French, improbable as it was deemed, had still been pro- vided against ; and, in accordance with time-tables drawn up long beforehand, the German army was disentrained on the Rhine instead of on the Saar. Ninety miles of German territory were thus laid open to the enemy; but the temporary surrender of the border provinces, in the opinion of the great strategist, was a very minor evil compared with the disasters, military and political, that would have resulted from an attempt to hold them.

It is hardly necessary to observe that no civilian minister, however deeply he might have studied the art of war, could be expected to solve for himself the strategic problems which come before him. In default of Duties at practical knowledge, it would be as impossible for gunisUr him to decide where garrisons should be stationed, what fortifications were necessary, what roads should be constructed, or how the lines of communication should be protected, as to frame a plan of campaign for the invasion of a hostile state. His foresight, his prevision of the acci- dents inevitable in war, would necessarily be far inferior to those of men who had spent their lives in applying strategical principles to concrete cases ; and it is exceed- ingly unlikely that he would be as prolific of strategical expedients as those familiar with their employment. Nevertheless, although he would be more or less bound by expert advice, and although he might be aware that the attempt to control military operations, even so far as regards the preliminaries of a campaign, is a most dangerous proceeding, yet a knowledge of war could hardly fail to serve him in good stead. Arnold, in his Lectures on Modem History, puts the matter clearly : " There must be a point up to which an unprofessional judgment of a professional subject may not only be competent but of high authority, although beyond that point it cannot venture without presumption and folly. The distinction seems to lie originally in the difference between the power of doing a thing and that of perceiving whether it is well done or not. 'He who lives in the house,' says Aristotle, 'is a better judge of its being a good or bad one than the builder of it. He can tell not only whether the house is good or bad, but wherein its defects consist ; he can say to the builder, " This chimney smokes, or has a bad draught "; or " This arrangement of the rooms is inconvenient," and yet he may be quite unable to cure the chimney, or to

draw out a plan for his rooms which should suit him better. Nay, sometimes he can even see where the fault is which has caused the mischief, and yet he may not practically know how to remedy if

Following up this principle, it would appear that what we understand least in the profession of another is the detail of his practice. We may appreciate his object, we may see where he has missed it, or where he is pursuing it ill ; nay, may understand generally the method of setting about it, but we fail in the minute details. . . . But in proportion as we recede from those details to more general points, first, as to what is generally called strategy, that is to say, the directing the movements of an army with a view to the accomplishment of the object of the campaign, in that proportion general knowledge and power of mind come into play, and an unprofessional person may with- out blame speak or write on military subjects, and may judge of them sufficiently." Applying this wise rule to statecraft, the point where civilian control of mili- tary operations becomes presumptuous, as well as the extent of that control, may be easily defined. In the first place, to frame a sound strategical plan, whether for defence or invasion, requires not only an intimate acquaintance with innumerable details of which only a professional soldier can really judge, such as methods of supply and transport, the use of fortifications, the effects of climate, the maintenance of the lines of communication, the value of positions, the management of marches, the morale, armament, organization, tactics and resources of the opposing forces, but an intimate acquaint- ance with the principles and stratagems of war. It is here that the amateur strategist fails. HIe may have read enough to give him a good knowledge of principles, but he has no knowledge of the practical difficulties of war, and his criticism, as a general rule, is consequently of little value. All in war is simple, but the simple is most difficult ; and how difficult only those- who have made it, who have witnessed with their own eyes the turmoil, the confusion, the friction which even in the best armies attend the most ordinary operation, are in a position to understand. Even a theoretical acquaintance, derived from historical study, of the practical

difficulties is insufficient. Unless he who prepares a strategical plan has before his mind's eye a clear picture of all military operations, of marching, quartering, supply, entraining and disentraining, embarkation and disembarkation, and a personal know- ledge of the difficulties which attend on war, his work will be of little value. It is essential, too, that he should have a thorough knowledge of both officers and men, of the peculiar characteristics of the army, and of the system on which it works, of its strong points and its weak. A German, suddenly placed in command of British soldiers, would be much at sea, and vice versd. Every army has an indi- viduality of its own. ~ It is a living organism, of a very sensitive temper, and it can neither be properly controlled nor efficiently directed except by those who are in full sympathy with its every impulse.

It would appear, then, that while a statesman may be competent to appreciate the general principles of the pro- jects of operations laid before him, he should never attempt to frame a project for himself. Still less, when once he has approved of a plan of campaign, should he attempt to limit the number of troops to be employed, or to assign the position of the necessary detachments. Nevertheless, a knowledge of war may still be exceedingly useful to him. A Minister of War cannot divest himself of his responsibility for the conduct of military operations. In the first place, he is directly responsible that plans of campaign to meet every possible contingency are worked out in time of peace. In the second place, he is directly responsible that the advice on which he acts should be the best procurable. It is essential, therefore, that he should be capable of forming an independent opinion on the merits of the military projects which may be submitted to

him, and also on the merits of those who have to execute them. Pitt knew enough of war and men to select Wolfe for the command in Canada. Canning and Castlereagh, in spite of the opposition of the king, sent Wellington, one of the youngest of the lieutenant generals, to hold Portugal against the French. The French Directory had sufficient sense to accept Napoleon's project for the campaign of Italy in 1796. In the third place, strategy cannot move altogether untrammelled by politics and finance. But political and financial considerations may not present themselves in quite the same light to the soldier as to the statesman, and

the latter is bound to make certain that they have received due attention. If, however, modifica- tions are necessary, they should be made before the plan of campaign is finally approved ; and in any case the purely military considerations should be most carefully weighed. It should be remembered that an unfavourable political situation is best redeemed by a decisive victory, while a reverse will do more to shake confidence in the Government than even the temporary surrender of some portion of the national domains. "Be sure before striking" and Reculerpow mieux sauter are both admirable maxims; but their practical application requires a thorough apprecia- tion of the true principles of war, and a very large degree of moral courage, both in the soldier who suggests and in the statesman who approves. If, however, the soldier and the statesman are supported by an enlightened public, sufficiently acquainted with war to realize that patience is to be preferred to precipitation, that retreat, though inglorious,, is not necessarily humiliating, their task is very consider- ably lightened. Nothing is more significant than a com- parison between the Paris press in 1870 and the Confederate press in 1864. In the one case, even after the disastrous results of the first encounters had proved the superior strength and readiness of the enemy, the French people, with all the heat of presumptuous ignorance, cried out for more battles, for an immediate offensive, for a desperate defence of the frontier provinces. So fierce was their clamour that both the generals and the Government hesitated, until it was too late, to advise the retreat of Bazaine's army ; and when that army had been cut off at Metz, the pressure of public opinion was so great that the last reserve of France was despatched to Sedan on one of the maddest enterprises ever undertaken by a civilized state. In 1864, on the other hand, while Lee in Virginia and Johnston in the west were retreating from position to position, and the huge hosts of the Union were gradually converging on the very heart of the Confederacy, the Southern press, aware that every backward step made the Federal task more difficult, had nothing but praise for the caution which controlled the movements of their armies. But the Southern press, in three crowded years of conflict, had learned something of war. In 1866 and 1870 the German press was so carefully muzzled that even had there been occasion it could have done nothing to pre- judice public opinion. Thus both the sovereign and the generals were backed by the popular support that they so richly merited ; but it may be remarked

that the relations between the army and the Government were characterized by a harmony which has been seldom seen. The old king, in his dual capacity as head of the state and com- mander-in-chief, had the last word to say, not only in the selection of the superior officers, but in approving every important operation. With an adviser like Moltke at his elbow, it might appear that these were mere matters of form. Moltke, however, assures us that the king was by no means a figurehead. Although most careful not to assert his authority in a way that would embarrass his chief of staff, and always ready to yield his own judgment to sound reasons, he expressed, nevertheless, a perfectly

independent opinion on every proposal placed before him, and on very many occasions made most useful suggestions. And at the same time, while systematically refraining from all interference after military operations had once begun, he never permitted military considerations to override the demands of policy. In 1866, when it was manifestly of the first importance, from a military point of view, that the Prussian army should be concentrated in a position which would enable it to cross the border immediately war was declared, the political situation was so strained that it was even more important to prevent the enemy from setting foot at any single point on Prussian territory. The army, in consequence, was dispersed instead of being con- centrated, and the ultimate offensive became a difficult and hazardous operation. It is true that the king was an able and experienced soldier. Nevertheless, the wise restraint he displayed in the course of two great campaigns, as well as the skill with which he adjusted conflicting factors, are an admirable example of judicious statesmanship. And such statesmanship is not merely a valuable aid to the military chiefs, but it is imperatively demanded by the nature of great wars. Campaigns are not likely to be prolonged. Space has been annihilated by steam ; and it was space that was the real cause of such weary struggles as the war in the Peninsula or that of Secession in America. Troops are so easily transported and fed by means of railways and steamers, and organiza- tion is so perfect, that, as a general rule, far

larger numbers will be assembled for the initial encounters than heretofore. There will be more in, front and fewer in rear ; and the first battles, therefore, have assumed a new importance. In fact, unless one side has been completely surprised, and merely fights to gain time, they may be as decisive of the war as Jena, Eckmuhl, or Waterloo. It is therefore of the utmost importance that when once the plan of campaign has been approved, the military chiefs upon the spot should be given an absolutely free hand.

The duration of a campaign is largely affected by the deadly properties of modern firearms. It is true that the losses in battle are relatively less than Moral m the days of Brown Bess and the smooth- fire" ° k°re C3bTmol:l! an(i almost insignificant when com- pared with the fearful carnage wrought by sword and spear. The reason is simple. A battlefield in the old days, except at close quarters, was a compara- tively safe locality, and the greater part of the troops engaged were seldom exposed for a long time together to a hot and continuous fire. To-day death has a far wider range, and the strain on the nerves is consequently far more severe. Demoralization, therefore, sets in at an earlier period, and it is more complete. When troops once realize their inferiority, they can no longer be depended on. If attacking, they refuse to advance ; if defending, they abandon all hope of resistance. It is not the losses they have actually suffered, but those that they expect to suffer, that affect them. The ordeal of facing the hail of modern fire tells so heavily on ordinary flesh and blood that those who have been hotly engaged, if casualties have been very numerous, will seldom be brought to fight again, except on the defensive, the same day, or even the same month. There is no bringing up men again and again to the attack, as in the days of Napoleon ; and unless discipline and national spirit are of superior quality, unless even the private soldier is animated by something higher than the mere habit of mechanical obedience, panic, shirking, and wholesale surrender will be the ordinary features of a campaign. These phenomena made themselves apparent, though in a less degree, as long ago as the War of Secession, when the weapon of the infantry was the muzzle -loading rifle, firing at most

~~two rounds a minute, and when the projectiles of the artillery were hardly more destructive than the stone shot of Mons Meg. With the magazine rifle, machine guns, shrapnel, and high explosives, they have become more pro- nounced than even at Vionville or Plevna. " The retreat of the 38th (Prussian) Brigade," writes Captain Hoenig, an eye-witness of the former battle, " forms the most awful drama of the great war. It had lost 53 per cent, of its strength, and the proportion of killed to wounded was as 3 to 4. Strong men collapsed inanimate. ... I saw men cry like children, others fell prone without a sound ; in most the need of water thrust forth all other instincts; the body demanded its rights. ' Water, water,' was the only intel- ligible cry that broke from those moving phantoms. The enemy's lead poured like hail upon the wretched remnant of the brigade ; yet they moved only slowly to the rear, their heads bent in utter weariness; their features distorted under the thick dust that had gathered on faces dripping with sweat. The strain was beyond endurance. The soldier was no longer a receptive being ; he was oblivious of everything, great or small. His comrades or his superiors he no longer recognized ; and yet he was the same man who but a short time before had marched across the battlefield shouting his marching chorus. A few active squadrons, and not a man would have escaped ! Only he who has seen men in such circumstances, and observed their bearing, knows the dreadful imprint that their features leave upon the memory. Madness is there, the madness that arises from bodily exhaustion combined with the most abject terror. ... I do not shrink," he adds, " from confessing that the fire of Mars-la-Tour affected my nerves for months."~~

~~If such are the results of ill-success, a whole army might be reduced to the condition of the 38th Brigade in the first month of the campaign, and it is thus perfectly clear that some small mistake in conduct, some trifling deficiency in preparation, an ill-conceived order, or a few hours' delay in bringing up a reinforcement, may have the most terrible consequences. That mistakes can be wholly avoided is to expect too much. But the state has every right to demand that to make our preparations complete, to ensure skilful leading, close co-operation, and resolute action, neither by statesman nor soldier should thought, labour, or expense be spared.~~

The importance, nay the necessity, that the people, as a governing body, should keep as watchful an eye on its armed forces and the national defences as on diplomacy or legislation is fully realized, naturally enough, only by those nations whose instincts of self-preservation, by reason of the configuration of their frontiers or their political situation, are strongly developed. So remote is the prospect that either British or American NaZ?J at"1 soldiers may suddenly be called upon to confront force. the trained hosts of continental Europe, that the efficiency of the army has comparatively little interest for the nation at large. Yet even to these maritime empires an efficient army is of the first necessity. Their land frontiers are vulnerable. They may have to deal with rebellion, and a navy is not all-powerful, even for the defence of coasts and commerce. It can protect, but it can- not destroy. Without the help of an army, it can neither complete the ruin of the enemy's fleet nor prevent its resuscitation. It can ward off attack, but counter-attack is beyond its scope. Without the help of an army it can hardly force a hostile Power to ask for terms. Exhaustion is the object of its warfare ; but exhaustion, unless acceler- ated by crushing blows, is an exceedingly slow process. In the spring of 1861 the blockade was established along the coasts of the Southern Confederacy, and maintained with increasing stringency from month to month. Yet it was

not till the spring of 1865 that the colours of the Union floated from the capitol of Richmond, and it was the army ■which placed them there. A state, then, which should rely on naval strength alone, could look forward to no other than a protracted war, and a protracted war between two great Powers is antagonistic to the interests of the civilized world. With the nations armed to the teeth, and dominated to a greater or smaller extent by a militant spirit ; with commerce and finance dependent for health and security on universal peace, foreign intervention is a mere question of time. Nor would public opinion, either in Great Britain or America, be content with a purely defensive policy, even if such policy were practicable. Putting aside the tedium and the dangers of an interminable

~~campaign, the national pride would never be brought to confess that it was incapable of the same resolute effort as much smaller communities. " An army, and a strong army," would be the general cry. Nor would such an army be difficult to create. Enormous numbers would not be needed. An army supported by an invincible navy possesses a strength which is out of all proportion to its size. Even to those who rely on the big battalions and huge fortresses, the amphibious power of a great maritime, state, if intelligently directed, may be a most formidable menace ; while to the state itself it is an extraordinary security. The history of Great Britain is one long illustration. Captain Mahan points out that there are always dominant positions, outside the frontiers of a maritime state, which, in the interests of commerce, as well as of supremacy at sea, should never be allowed to pass into the possession of a powerful neighbour. Great Britain, always dependent for her prosperity on narrow seas, has long been familiar with the importance of the positions that command these waterways. In one respect at least her policy has been consistent. She has spared no effort to secure such positions for herself, or, if that has been impracticable, at least to draw their teeth. Gibraltar, Malta, St Lucia, Aden, Egypt, Cyprus are con- spicuous instances ; but above all stands Antwerp. In perhaps the most original passage of Alison's monumental work the constant influence of Antwerp on the destinies of the United Kingdom is vividly portrayed. " Nature has framed the Scheldt to be the rival of the Thames. Plowing through' a country excelling even the midland counties of England in wealth and resources, adjoining cities equal to any in Europe in arts and commerce ; the artery at once of Flanders and Holland, of Brabant and Luxembourg, it is fitted to be the great organ of communication between the fertile fields and rich manufacturing towns of the Low Countries and other maritime states of the world." Antwerp, moreover, the key of the great estuary, is eminently adapted for the establishment of a vast naval arsenal, such as it became under Philip II. of Spain and again under the First Napoleon. " It is' the point," continues the historian, "from which in every age the independence of these kingdoms has been seriously menaced. Sensible of her danger, it had been the fixed policy of Great Britain for centuries to prevent this formidable outwork from falling into the hands of her enemies, and the best days of her history are chiefly occupied with the struggle to ward off such a disaster." In ascribing, however, every great~~

~~war in which Great Britain has been engaged to this cause alone he has gone too far. The security of India has been a motive of equal strength. Nevertheless, it was to protect Antwerp from the French that Charles II. sided with the Dutch in 1670 ; that Anne declared war on Louis XIV. in 1704 ; that Chatham supported Prussia in 1742 ; that Pitt, fifty years later, took up arms against the Revolution.~~

~~The trophies of the British army in the great war with France were characteristic of the amphibious power. The~~

~~troops took more battleships than colours, and almost as many naval arsenals as land fortresses. Many were the blows they struck at the maritime strength of France and her allies; but had the expedition which landed on the Isle of Walcheren in 1809 been as vigorously conducted as it was wisely conceived, it would have hit Napoleon far harder than even . , the seizure of the Danish fleet at Copenhagen. actions of The great dockyard that the emperor had con- naval and structed on the Scheldt held the nucleus of a miutary powerful fleet. Eight line-of battle ships and ten opeta frigates lay in mid channel. Twenty vessels of different classes were on the slips, and in the magazines and store houses had been accumulated sufficient material to equip all these and twenty more. The destruction of Antwerp — and for a full week it was at Lord Chatham's mercy — would have freed scores of British frigates to protect British commerce ; Wellington, in his great campaign of 1813, could not have had to complain that, for the first time, the communication by sea of a British army was insecure ; the Americans, in the war which broke out in 1812, would have been more vigorously opposed; and Napoleon, who, while Antwerp was his, never altogether abandoned hope of overmastering Great Britain on her own element, might, on his own confession, have relinquished the useless struggle with the great sea Power. The ex- pedition failed, and failed disastrously. But for all that, fulfilling as it did the great maxim that the naval strength of the enemy should be the first objective of the forces of the maritime power, both by land and sea, it was a strategical stroke of the highest order.~~

~~The predominant part played by the army under Wellington in Spain and Belgium has tended to obscure the principle that governed its employment~~

in the war of 1793-1815. The army, in the opinion of the country, was first and foremost the auxiliary of the fleet ; and only when the naval strength of the enemy had been destroyed was it used in the ordinary manner, i.e., in the invasion of the hostile territory and in lending aid to the forces of confederate Powers. Events proved that these principles were absolutely sound. It was not in the narrow seas alone that the army rendered good service to the navy. Depriving France of her colonies, occupying her ports in foreign waters, ousting her from commanding posts along the trade routes, it contributed not only to her exhaustion, but to the protection of British commerce and to the permanent establishment of maritime supremacy. Few of these operations are of sufficient magnitude to attract much notice from the ordinary historian, yet it is impossible to overrate their effect. To the possession of the dominant positions that were captured by the army, Great Britain, in no small degree, is indebted for the present security of her vast dominions. The keynote of the fierce struggle with the French Empire was the possession of India. Before he became First Consul, Napoleon had realized that India was the throne of Asia ; that whoever should sit on that throne, master of the commerce of the East, of the richest and most natural market for the products of the West, and of the hardiest and most enlightened nations of the golden hemisphere, would be master of more than half the globe. But his prescience was not surer than the instinct of the British people. Vague and shadowy indeed were their dreams of empire, yet the presentiment of future greatness, based on the foothold they had already gained in Hindustan, seems always to have controlled the national policy. They knew as well as Napoleon that Malta and Egypt, to use his own phrase, were merely the outworks of their stronghold in the East ; and that if those outworks fell into the hands of France, a great army of warlike Mahommedans, led by French generals, stiffened by a French army corps, and gathering impetus

from the accession of every tribe it passed through, might march unopposed across the Indus. So, from first to last, the least threat against

Egypt and Malta sufficed to awaken their apprehensions ; and in their knowledge that India was the ultimate objective of all his schemes is to be found the explanation of the stubbornness with which they fought Napoleon. It is not to be denied that in thwart- ing the ambition of their mighty rival, or perhaps in furthering their own, the navy was the chief instrument ; but in thrusting the French from Egypt, in adding Ceylon, Mauritius, and Cape Colony to the outworks, the army, small as it was then, compared with the great hosts of the Continent, did much both for the making and the security of the British Empire.

But the scope of the military operations of a maritime state is by no means limited to the capture of colonies, naval arsenals, and coaling-stations. Timely diversions, by attracting a large portion of the enemy's fighting strength on the mainland, may give valuable aid to the armies of an ally. The Peninsular war is a conspicuous example. According to Napoleon, the necessity of main- taining Ms grip on Spain deprived him of 180,000 good soldiers during the disastrous campaign of 1813; and those soldiers, who would have made Dresden a decisive instead of a barren victory, were held fast by Wellington. Again, it was the news of Vittoria that made it useless for the emperor to propose terms of peace, and so escape from the coils that strangled him at Leipzig.

Nor is the reinforcement supplied by a small army based upon the sea to be despised. In 1793 a British contingent under the duke of York formed part of the allied forces which, had the British Government forborne to interfere, would in all probability have captured Paris. Twenty- two years later, under wiser auspices, another contingent, although numbering no more than 30,000 men, took a decisive part in the war of nations, and the blunders of the older generation were more than repaired at Waterloo. Nevertheless, the strength of the amphibious power has been more effectively displayed than in the campaign of 1815. Intervention at the most critical period of a war has produced greater results than the provision of a contingent at the outset. In 1782 the disembarkation of a French army on the Virginia Peninsula established the independence of the United States ; and in 1878, when the Russian invaders were already in sight of Constanti- nople, the arrival of the British fleet in the Dardanelles, following the mobilization of an expeditionary force, at once

arrested their further progress. Had the British Cabinet of 1807 realized the preponderating strength which even a small army, if rightly used, draws from the command of the sea, the campaign of Eylau would in all probability have been as disastrous to Napoleon as that of Leipzig. The presence of 20,000 men at the great battle would have surely turned the scale in favour of the allies. Yet, although the men were available, although a few months later 27,000 were assembled in the Baltic for the coercion of Denmark, his Majesty's ministers, forgetful of Marlborough's glories, were so imbued with the idea that the British army was too insignificant to take part in a Continental war, that the opportunity was let slip. It is a sufficiently remarkable fact that the successive Governments of that era, although they realized very clearly that the first duty of the army was to support the operations and complete the triumph of the navy, never seemed to have grasped the principles which should have controlled its use when the command of the sea had been attained. The march of the Allies on Paris, in 1793, was brought to a standstill because the British Cabinet considered that the contingent would be better employed in besieging Dunkirk. After the failure of the expedition under

Sir John Moore to achieve the impossible, and in con- junction with the Spaniards drive the French from the Peninsula, the ministry abandoned all idea of intervention on the main theatre, although, as we have seen, had such intervention been well-timed, it might easily have changed the current of events. It is true that when the main theatre is occupied by huge armies, as was the case during the whole of the Napoleonic conflict, the value of a com- paratively small force, however sudden its appearance, is by no means easily realized. For instance, it would seem at first sight that a British contingent of 100,000 men would be almost lost amid the millions that would take part in the decisive conflicts of a European war. It is remembered, however, that with enormous masses of men the difficulties of supply are very great. Steam has done much to lighten them, and the numbers at the point of collision will be far greater than it was possible to assemble in the days of Napoleon. Nevertheless, the lines of com- munication, especially railways, will require more men to guard them than heretofore, for they are far more vulner- able. The longer, therefore, the lines of communication, the smaller the numbers on the field of battle. Moreover, the great hosts of the Continent, not only for

convenience of supply, but for convenience of manoeuvre, will deploy several armies on a broad front. At some one point, then, a reinforcement of even one or two army corps might turn the scale.

The objections, however, to intervention of this character are numerous. Between allied armies, especially if one is far larger than the other, there is certain to be friction, as was the case in the Crimea ; and witness the question of supply is not easily settled. If, armies. however, the decisive point is near the coast, as in the campaign of Eylau, the army of the maritime power, possessing its own base, can render effective aid without embarrassment either to itself or its ally. But, under all other conditions, independent operations of a secondary nature are distinctly to be preferred. Such was clearly the opinion of the British ministries during the war with France. They recognized that by giving vitality and backbone to popular risings even a small army might create useful diversions. But their idea of a diversion was a series of isolated efforts, made at far distant points ; and even so late as 1813, they were oblivious of the self-evident facts that for a diversion to be really effective it must be made in such strength as to constitute a serious threat, and that it should be directed against some vital point. Fortunately for Europe, Wellington foresaw that the permanent occupation of Portugal, and the presence of a British army in close proximity to the southern frontier of France, would be a menace which it would be impossible for Napoleon to disregard. Yet with what difficulty he induced the Government to adopt his views, and how lukewarm was their support, is exposed in the many volumes of his despatches. In all history there are few more glaring instances of incompetent statesmanship than the proposal of the Cabinet of 1813, at the moment Wellington was contemplating the campaign that was to expel the French from Spain, and was asking for more men, more money, and more material, to detach a large force in the vague hope of exciting a revolution in southern Italy. Whether the improvement in communi-cations, as well as the increase in the size of armies, have not greatly weakened the value of diversions on the main- land, it is difficult to say. Railways may enable the defender to concentrate his forces so rapidly that even the landing may be opposed, and with the enormous numbers at his command he may well be able to spare a consider- able force from the

main theatre. It is possible to conceive that a small army, even if it completed its embarkation,

might find itself shut up in an entrenched position by a force little larger than itself. If, however, the diversion were made at a crisis of the campaign, the sudden appearance of a new army might be decisive of the war. Otherwise, the army would probably do more good if it refrained from landing and confined itself to threats. So long as it was hidden by the horizon, it would be invested with the terrors of the unknown. The enemy's knowledge that at any moment a well-equipped force, supported by a powerful fleet, might suddenly descend upon some prosperous port or important arsenal, would compel him to maintain large garrisons along the whole seaboard. The strength of these garrisons, in all probability, would be much larger in the aggregate than the force which menaced them, and the latter would thus exercise a far greater disintegrating effect on the enemy's armed strength than by adding a few thousand men to the hosts of its ally. On theatres of war which are only thinly populated or half civilized, a descent from the sea might easily produce a complete change in the situation. The 'occupation of Plevna, in close proximity to the Eussian line of communications and to the single bridge across the Danube, brought the Eussian advance through Bulgaria to a sudden stop, and relieved all pressure on Turkey proper. The deadlock which ensued is sugges- tive. Let us suppose that the invaders' line of communi- cations had been a railway, and Plevna situated near the coast. Supplied from the sea, with unlimited facilities for reinforcement, Osman's ring of earthworks would have been absolutely impregnable ; and had the ring been pushed so far inland as to secure scope for offensive action, the Eussians, in all human probability, would never have crossed the Balkans. It is perfectly possible, then, that if an army lands within reach of a precarious line of com- munications it may compel the enemy, although far superior in numbers, to renounce all enterprises against distant points.

~~Eailways in war are good servants, but bad masters. In some respects they are far superior to a network of high-~~

~~roads. Two trains will supply the daily needs~~

~~of 100,000 men several hundred miles distant from their base. But the road-bed is easily destroyed ; the convoy system is impracticable, and the regular course of traffic is susceptible to the slightest threat. So, when railways become the principal factors, as when an army finds itself dependent on a long and exposed line, a powerful aggressive combination becomes a matter of the utmost difficulty. The whole attention of the commander will be given to the security of his supplies, and even if he is not thrown on the defensive by the enemy's activity, his liberty of action will be exceedingly circumscribed. The relative values of the different kinds of communica- tions have a most important bearing on the art of war. A great waterway, such as the Nile, the Mississippi, the Danube, or the Ganges, is safer and surer than a railway. But railways are far more numerous than navigable rivers, and a series of parallel lines is thus a better means of~~

~~supplying a large army. But neither railways The sea as nor waterways as lines of supply or of operation operation. are to De compared with the sea. Before the~~

~~war of 1870, for instance, a study of the French railway system enabled Moltke to forecast, with absolute accuracy, the direction of Napoleon's advance, the distribu- tion of his forces, and the extent of front that they would occupy. In a war, therefore, between two Continental powers, the staff on either side would have no difficulty in determining the line of attack ; the locality for concentra- tion would be at once made clear ; and as the carrying capacity of all railways is well known, the numbers that would be encountered at any one point along the front might be easily calculated. But if the enemy's army,~~

~~supported by a powerful fleet, were to advance across blue water, the case would be very different. Its movements would be veiled in the most complete secrecy. It would be impossible to do more than guess at its objective. It might strike at any point along hundreds of miles of coast, or~~

it might shift from one point to another, perhaps far distant, in absolute security ; it could bewilder the enemy with feints, and cause him to disperse his forces over the whole sea-board. Surprise and freedom of movement are pre-eminently the weapons of the power that commands the sea. Witness the War of Secession. McClellan, in 1862, by the adroit transfer of 120,000 men down the reaches of Chesapeake to the Virginia Peninsula, had Eichmond at his mercy. Grant in 1864, by continually changing his line of communication from one river to another, made more progress in a month than his pre- decessors had done in two years. Sherman's great march across Georgia would have been impossible had not a Federal fleet been ready to receive him when he reached the Atlantic ; and, throughout, the war, the knowledge that at any moment a vast fleet of transports might appear off any one of the ports on their enormous sea-board pre- vented the Confederates, notwithstanding that the garrisons were reduced to a most dangerous extent, from massing their full strength for a decisive effort.

The power of striking like " a bolt from the blue " is of the very greatest value in war. Surprise was the founda- tion of almost all the grand strategical combinations of the past, as it will be of those to come. The first thought and the last of the great general is to outwit his adversary, and to strike where he is least expected. And the measures he adopts to accomplish his purpose are not easily divined. What soldier in Europe anticipated Marlborough's march to the Danube and Blenheim field? What other brain besides Napoleon's dreamt of the passage of the Alps before Marengo 1 Was there a single general of Prussia before Jena who foresaw that the French would march north from the Bavarian frontier, uncovering the roads to the Bhine, and risking utter destruction in case of defeat ? Who believed, in the early June of 1815, that an army 130,000 strong would dare to invade a country defended by two armies that mustered together over 200,000 un- beaten soldiers 1 To what Federal soldier did it occur, on the morning of Chancellorsville, that Lee, confronted by 90,000 Northerners, would detach the half of his own small force of 50,000 to attack his enemy in flank and rear ? The very course which appeared to ordinary minds so beset by difficulties and dangers as to be outside the pale of practical strategy has, over and over again, been that which led to decisive victory ■ and if Am' there is one lesson more

valuable than another as regards national defence, it is that preparation cannot be too careful or precautions overdone. Over- whelming numbers, adequately trained, commanded, and equipped, are the only means of ensuring absolute security. But a numerical preponderance, either by land or sea, over all possible hostile combinations, is unattainable, and in default the only sound policy is to take timely and ample precautions against all enterprises which are even remotely possible. There is nothing more to be dreaded in war than the combined labours of a thoroughly well trained general staff, except the intellect and audacity of a great strategist. The ordinary mind, even if it does not shrink from great danger, sees no way of ImPortm surmounting great difficulties ; and any opera- strategy. tion which involves both vast dangers and vast difficulties it scoffs at as chimerical. The heaven-born strategist, on the other hand, " takes no counsel of his fears." Knowing that success is seldom to be won without incurring risks, he is always greatly daring ; and by the

pbibious power.

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skill with which he overcomes all obstacles, and even uses them, as Hannibal and Napoleon did the Alps, and as some great captain of the future may use the sea, to further his purpose and surprise his adversary, he shows his superiority to the common herd. It is repeated ad nauseam that in consequence of the vastly improved means of transmitting information, surprise on a large scale is no longer to be feared. It is to be remembered, however, that the means of concentrating troops and ships are far speedier than of old ; that false information can be far more readily distributed; and also, that if there is one thing more certain than another, it is that the great strategist, surprise being still the most deadly of all weapons, will devote the whole force of his intellect to the problem of bringing it about.

Nor is it to be disguised that amphibious power is a far more terrible weapon than even in the days when it crushed Napoleon. Commerce has increased by leaps and bounds, and it is no longer confined within

territorial limits. The arteries vital to the existence of civilized communities stretch over every ocean. States which in 1800 rated their maritime traffic at a few hundred thousand pounds sterling, value it now at many millions. Others, whose flags, fifty years ago, were almost unknown on the high seas, possess to-day great fleets of merchant- men ; and those who fifty years ago were self-dependent, rely in great part, for the maintenance of their prosperity, on their intercourse with distant continents. There is no great Power, and few small ones, to whom the loss of its sea-borne trade would be other than a most deadly blow ; and there is no great Power that is not far more vulner- able than when Great Britain, single-handed, held her own against a European coalition. Colonies, commercial ports, dockyards, coaling-stations, are so many hostages to fortune. Year by year they become more numerous. Year by year, as commercial rivalry grows more acute, they become more intimately bound up with the prosperity and prestige of their mother-countries. And to what end ? To exist as pledges of peace, auspida melioris oevi, or to fall an easy prey to the Power that is supreme at sea and can strike hard on land ?

*Even the baldest and briefest discussion of the vast subject of war would be incomplete without some reference to the relative merits of professional and unprofessional soldiers. Voluntary service still holds its ground in the Anglo-Saxon states; and both the United Kingdom and America will have to a great extent to rely, in case of conflicts which tax all their resources, on troops who have neither the practice nor the discipline of their standing armies. What will be the value of these amateurs when pitted against regulars ? Putting the question of morale aside, as leading us too far afield, it is clear that the individual amateur must depend upon his training. If, like the majority of the Boers, he is a good shot, a good scout, a good skirmisher, and, if mounted, a good horseman and horsemaster, he is undeniably a most useful soldier. But whether amateurs en masse, that is, when organized Vai-e o/ *nto battalions and brigades, are thoroughly trust- unprofes- worthy, depends on the quality of their officers. atonal With good officers, and a certain amount of troops. previous training, there is no reason why bodies of infantry, artillery, or mounted infantry, composed en- tirely of unprofessional soldiers, should not do excellent service in the field.*

~~Where they are likely to fail is in discipline ; and it would appear that at the beginning of a campaign they are more liable to panic, less resolute in attack, less enduring under heavy losses and great hard- ships, and much slower in manoeuvre than the professionals. To a certain extent this is inevitable ; and it has a most important bearing on the value of the citizen soldier.~~

~~for, as we have already seen, the beginning of a campaign is a most critical phase. In short, troops who are only half-trained or have been hastily raised may be a positive danger to the army to which they belong ; and the shelter of stout earthworks is the only place for them. Yet the presence of a certain number of experienced fighting men in the ranks may make all the difference; and, in any case, it is probable that battalions composed of unpro- fessional soldiers, the free citizens of a free and prosperous state, are little if at all inferior, as fighting units, to battalions composed of conscripts. But it is to be under- stood that the men possess the qualifications referred to above, that the officers are accustomed to command and have a good practical knowledge of their duties in the field. A mob, however patriotic, carrying small-bore rifles is no more likely to hold its own to-day against well-led regulars than did the mob carrying pikes and flint-locks in the past. A small body of resolute civilians, well-armed and skilful marksmen, might easily on their own ground defeat the same number of trained soldiers, especially if the latter were badly led. But in a war of masses, the power of combination, of rapid and orderly movement, and of tactical manoeuvring is bound to tell. (g. f. e. h.)~~

~~II. Naval Strategy and Tactics.~~

~~Since the publication of the article on naval strategy in the ninth edition of this work, the subject has been treated by Captain Mahan of the United States navy in his three great works — The Influence of Sea Power upon History (1890), The Influence of Sea Power on the French Revolution and Empire (1892), and The Life of Nelson, the Embodiment of the Sea Power of Great Britain (1897) — in such a masterly and exhaustive manner that his books have been translated into the principal European languages, and are acknowledged to have thrown such a light on the~~

value of sea power as to cause the Great Powers of Europe to make efforts to obtain it, almost regardless of expense. Previously to the publication of Mahan's works there was a general idea that a strong navy was of considerable importance to a country with maritime interests, but until the appearance of his masterly analysis of the effects of " sea power " on the rise and fall of nations, it was not realized that the command of the sea had played such an all-powerful part in moulding the world's history. So far as Great Britain and the British Empire are concerned, there is now no shadow of doubt as to what their prosperity is founded on. It is her sea power, or command of the sea, or naval supremacy, or whatever term may be used to indicate that pre- ponderance in fighting power at sea which enables the country possessing it to keep the warships of her enemies blockaded in their ports, whilst her own warships sweep the seas, and ensure the safety of her merchant vessels, and if necessary of her troopships to transport armies in safety to any point upon the coast-line of any part of the globe. This freedom of action on the ocean is of vital importance to the very existence of the British Empire, and consequently it is British policy to spend the country's last shilling on the maintenance of a naval supremacy not only unrivalled in itself, but greater than that of any probable combination of Powers.

National policy and naval strategy have always been closely interwoven, and in the days before the invention of the electric telegraph centralized all infor- Coaaexion mation at the seat of government, and largely of policy deprived officers in command of fleets of their and powers of initiative, the issues of peace or stratezy- war not infrequently hung upon the decisions of an

admiral, who perhaps suddenly found himself in the position of being called upon to attack the forces of a nation with which his own country was not formally at war. Thus Eooke at Cadiz, Nelson at Copenhagen, and Codrington at Navarino, all had to initiate hostilities against Powers with which Great Britain was nominally at peace. In each of these cases the responsibility of taking action was fraught with momentous

consequences, and men with less force of character, less self-confidence, and weaker nerves, would probably have shrunk from it. Codrington, who had been ordered to resist certain move- ments of Ibrahim Pasha — " even if necessary by the use of cannon shot" — had the mortification of hearing his brilliant and successful action characterized in a speech from the Throne as an "untoward event." The responsibility for the attack on the Danish fleet and fortifications at Copenhagen was nominally Sir Hyde Parker's, but it was (as all the world knows) really Nelson's ; and notwithstanding that it was the most desperate battle that great admiral ever fought, attended as it was by risks and dangers (beyond the ordinary risks of battle) such as would have appalled a weaker man, Nelson too had to suffer the mortification of seeing this brilliant action treated with marked coolness and a complete lack of appreciation of its far-reaching con- sequences. Of Rooke at Cadiz (the third case mentioned above), it is needless to say more than that he was sent on the ambiguous — not to say illogical — mission of trying to coerce the sturdy Andalusians (with whom Great Britain was not at war) into espousing the cause of the Austrian nominee to the Spanish throne, instead of that of the Bourbon prince whom they had already accepted and declared for ; and that not even the bombard- ment of their fair city of Cadiz was successful in gaining their love for the former, notwithstanding that he was supported by all the moral and physical forces of the Grand Alliance.

The above cases — though many others might be men- tioned — are sufficient to show the close connexion between naval strategy and international politics ; and although it is unlikely that in the present days of rapid communication admirals will ever again be vested with such extensive opportunities of taking the initiative as occurred in the past, it is always possible that the break-down of a tele- graph cable, or the capture of a cruiser carrying

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in the despatches, may to some extent temporarily balance restore the old order. Though the China- Japanese and the Spanish American wars have not taught us any startling lessons in modern naval strategy, they are nevertheless likely to have momentous consequences on the balance of

~~naval power in the world, insomuch that they may be said to have given rise to two new navies. The United States ever since it became a nation has had a small navy, vary ing in strength according to circumstances, though never comparable to that of Great Britain or France ; but since the war with Spain it has launched forth on an ambitious programme of naval construction which bids fair to place it in a few years' time in the front rank of the naval Powers of the world. Its riches and resources are prac- tically unlimited, and with distant colonies to protect (the result of the afore-mentioned war) it is certain to maintain a most powerful navy. Young and vigorous Japan, too, having revolutionized everything in the country (including naval architecture) from the forms and methods of mediaeval times to those of the present day, with a marvellous rapidity, is completing a naval programme which includes battleships and armoured cruisers of the first rank, and in such numbers that there can be little doubt she will in a few years hold the balance of naval power in the Far East : in any quarrels about China,~~

~~of naval power.~~

~~Japan has to be reckoned with ; and she will never again allow herself to be robbed of the fruits of her victories through the want of a powerful navy. Thus future naval strategists will have to take account of the possibility of the United States or Japan becoming important factors in any naval war which may affect their honour or their interests.~~

~~One other Power demands special mention. Russia, by her gigantic efforts to increase her war navy, bids fair to rival her ally France, and to take second place amongst the navies of the world ; and as her present fleet of warships is already out of all proportion to her mercan- tile marine, and her coasts are practically inviolable from serious invasion, it seems obvious that this great war-fleet can only be intended for attack, and not for defence ; and it thus becomes something very like a menace to the interests of those nations which depend largely for their prosperity on sea-borne commerce. The seizure of Port Arthur, and the large increase in the Russian navy, are facts which must at any rate profoundly affect naval strategy in that region of the world which is known as the Far East.~~

~~*Some recent writers on naval strategy have laid down the axiom that " a fleet in being " (i.e., an undefeated though possibly inferior fleet of an enemy) is a sufficient menace to prevent territorial attack by a Power possessing a superior fleet. As a general principle, no doubt, naval history shows that the undefeated J ", ,, fleet of an enemy which is in a position to threaten the communications of the would-be invader has been considered a sufficiently serious threat to pro- hibit the embarkation of troops and the prosecution of military operations over sea. But the rule does not seem to be of universal application, as the threat of the British squadron (which very nearly caught him at sea) did not prevent Napoleon from invading Egypt; though the subsequent destruction of the ships that carried his army of invasion is held by some critics to show that the invasion of Egypt in the circumstances was an act of false strategy. Another instance where the threat of an undefeated fleet in being did not prevent the embarka tion of troops and the invasion of territory, was seen in the case of the British and French armies being trans- ported across the Black Sea and landed on the coast of the Crimea, while a powerful Russian fleet lay in Sebastopol harbour, and was certainly in a position to cause serious opposition — if not absolute disaster — to the troops of their enemies while in the act of disembarka- tion, had that fleet been handled with skill and bold- ness. It is also thought by some historians that if the Russian fleet had attacked the fleets of the Allies at sea, hampered as they were by transports, and the French warships so crowded with troops as to be scarcely capable of fighting their guns, terrible havoc would have been made amongst them, and in all probability the invasion prevented.*~~

~~*In criticizing naval strategy it is not uncommon to judge entirely by events, and to come to the conclusion that if- the general result of the combinations turns out to be successful, the strategy must necessarily have been sound, and vice versd. But when it is remembered how largely the element of chance enters into all operations at sea, mainly on account of the variability of the weather, it must be obvious that if we only judge by results we shall not infrequently be in error, as a fog or a gale of wind (impossible to foresee) may be the pivot upon which success or failure turns.*~~

themselves, there can be no doubt that the same causes have had a still wider effect on naval tactics. Strategy has been curtly described as the art of concen- trating an effective fighting force, complete in all details, at a given place at a given time ; and tactics as the art of using it to the best effect when there. A complete historical treatment of naval tactics is not necessary here. Suffice it to say that in the times called " ancient," and all through the period called the Middle Ages, when the Mediterranean Sea was the cockpit of the world, fighting ships were mainly dependent on oars for their mobility, but as the area of civilization (and consequently of naval warfare) came to be ex tended, and all the great oceans were traversed by the ships of various nations seeking new territories and wider commerce, oars were found to be inadequate to propel ships of ever-increasing dimensions on longer voyages, and they were gradually displaced by sails. During the 17th and 18th centuries, and half of the 19th century, sails may be said to have been the sole method of locomo- tion for fighting-vessels of considerable size and sea-going capabilities ; and all the great sea battles of modern times have been fought under sail or at anchor. The middle of the 19th century saw a great revolution in the art of naval warfare. This revolution still continues with unabated vigour, and he would be a bold prophet who would venture to predict what the state of affairs will be by the middle of the 20th century ; but, for the pre- sent, steam remains the sole motive power of fighting- ships. Electricity, or some other force, may possibly take its place ; but this is a mere speculative excursion into the unknown.

When the wind and sails constituted the motive power, the art of seamanship, in its generally accepted sense, was the main factor in naval warfare. The art of gunnery came next, and ere the close of the sail era it had assumed a most important position. In fact, its special votaries claimed for it first place. Now no one

(save perhaps an enthusiastic torpedoist) would Theim- deny to gunnery the leading place — though portaace ^^ Q£ tllese are ,iepen(Jent on and governed o gunnery. ^ ^ ^ ^ manoeuvring ships under steam. In brief, modern naval tactics consist in the art of so manoeuvring a ship or squadron as to bring the greatest amount of accurate gun and torpedo fire to bear upon an enemy. It is true that there still exists a small though diminishing school of naval officers who have faith in "ramming tactics"; and the terribly destructive effects of the ram in those cases where it has been accidentally brought into operation are quoted in support of the deliberate use of this weapon. Many practical seamen,

however, have come to the conclusion that, Ramming considerrng the speed of modern ships, the inaction. ram ^ not bg deliberately used in action, except perhaps to give the coup de grdce to a disabled enemy; but even this would appear to be the wanton destruction of a ship which might become a valuable prize, and a barbarous sacrifice of human life. Yet should a disabled enemy refuse to strike his colours, it might become necessary to put an end to him in this manner. It seems probable that when ramming does take place in action, it will more often be accidental than inten- tional. Two ships of from ten to fifteen thousand tons meeting end on at a speed of 28 knots (assuming the speed of each to be 14) would certainly produce mutual destruction, with loss of the lives of almost all on board ; so that it is difficult to believe that any two men who still retain their reason would deliberately adopt such a suicidal method of fighting, even if it be possible to steer two large ships at high speed with such accuracy

as to cause a direct end-on collision — a point which many practical seamen doubt. On the other hand, a ship strik- ing another on the broadside, or at any angle approaching a right angle, would probably cause the destruction of the latter, though with grave injury to herself ; but in order to place a ship in a position to strike such a blow (both ships being under way) she would herself have to assume a very critical situation ; that is to say, she would have to 'expose her broadside, or in other words, she would have to place herself almost as much across the assumed path of her adversary as the adversary is across hers ; in which position the miscalculation of a few seconds in time, a knot or two in

speed, or even a small touch of the helm of either ship at the last moment, would turn the would-be rammer into the victim. It seems probable, therefore, that if ramming takes place in action, it will be more frequently by accident than design. Much has been made by the advocates of "ramming tactics" of the incident at the battle of Lissa, where the Austrian wooden ship Ferdinand Max rammed and sank the Italian ironclad Be d Italia ; but it has been stated on the best authority that the gallant Tegethoff himself disclaimeTt"any design in the matter, further than that he suddenly saw through the smoke a grey object ahead of the Ferdinand Max, which he took to be an enemy's ship ; that he ordered the engines of the Ferdinand Max to go full speed ahead, and the ship to be steered for the grey object ; and that he then found he had rammed and sunk the Re d' Italia. Other cases of ramming, such as the Vanguard and Iron Duke, where the Vanguard was sunk ; Victoria and Camperdown, where the Victoria was sunk, have been pointed to as illustrating the deadly effects of the ram, even at low speeds ; but as a matter of fact nobody questions its deadly effect. What is doubted is the practical application of it without the extreme proba- bility of self-destruction, and this mainly for the reasons given.

It is so impossible to simulate active war tactics at peace manoeuvres with modern battleships, and the actual experiences of purely naval battles since the introduction of steam have been of such a very limited nature, with generally such one-sided results, that there may be said to be practically no established facts on which to Theories found theories of modern naval tactics. This, based on however, has not prevented the admirals of man- the various nations from founding theories fleovres- based on such knowledge of the manoeuvring powers of modern warships as it has been possible to gain at peace manoeuvres. During the period that fleets of war- ships were worked and fought under sail, all tactics were necessarily dependent on the wind. Ships could not move freely in all directions ; if they wanted to get to windward, they had to do so by making a series of tacks, or zigzags, a slow and laborious process. Thus all com- manders of squadrons on sighting an enemy manoeuvred so as to get the "weather gauge"; but winds being frequently variable and unsteady, it not uncommonly happened that skill was frustrated by chance, and a sudden shift of wind might at any moment alter the whole

aspect of a tactical problem, and give to the less skilful com- batant an advantage which his adversary had fairly earned and deserved. All this has been completely changed by the introduction of steam : ships and squadrons being now independent of the wind, a discussion of the tactics of sailing days can only be of historical interest ; though the guiding principle of seeking to concentrate an overwhelming force on a portion of the adversary's armaments, with the view of crushing that portion before succour can be afforded to it by its friends, remains the same with steam as it was with sails, and is common to both land and sea warfare.

It is generally assumed that in view of the large number of rapid-firing guns carried by modern warships, it will be almost — if not quite — impossible to make signals during an action ; and if this is the case it becomes obvious that when once a battle has commenced, the admiral in command will practically lose control over the movements of all the ships of his squadron save his own flagship. There is, however, one formation which will enable him at any rate to keep his ships together, and prevent them from becoming a danger to each other, and this is the formation known as " single line ahead " — a very simple formation, which amounts practically to "follow my leader"; and it maybe added that it is a formation in which a battle might be fought to the bitter end between two steam squadrons, if both sides accepted battle ; but for a general chase, or a general retreat, it would be inadmissible — as in one case the leading ships, and in the other case the rearmost ships would be sacrificed. It is generally admitted that the numerous complicated tactical manoeuvres which are practised in peace time by all the Powers possessing war navies are only intended- — i or exercise, and to teach officers, by practical experience, what can be done with their ships in relation to speed, time, distance, and turning power, but that such manoeuvres would never be attempted in battle. The Spanish American war was (by sea) a contest so unequal that it failed to solve any of the numerous prob lems of modern naval tactics ; and it seems scarcely possible that these can be solved until

~~a bond fide mari- time war shall have taken place between two first-class Powers.~~

~~It remains to mention one more weapon, an instrument of unknown power, viz., the locomotive torpedo, commonly known as the "Whitehead." What effect this weapon will have upon the naval tactics of the future it is im- possible to say. When first it was introduced as part of the equipment of warships, its special Tactical votaries claimed for it that it would cause torpedoes a cornplete revolution in naval tactics ; in .short, that it would supersede the gun as the principal weapon of all warships. Its destructive effects (when it hits and explodes) are so terrible that the claim of the torpedoist seemed at first sight to be plausible. The artillerist, however, never admitted the claim — in fact, treated it with ridicule, and pointed out that the torpedo, moving in a far denser medium, a weapon of less accuracy, much shorter range, more dangerous to handle, costing far more money for each shot, and the supply being necessarily much more limited, could never become a serious rival to modern artillery, the power of which had lately been so greatly improved in all the important points of accuracy, penetration, range, rapidity of loading, ease of training, and absence of smoke to obstruct the view; whereas with the recent addition of the gyroscope — which has undoubtedly improved its accuracy — the torpedo appears for the present to have reached the limits of improvement. In short, the tactical value of torpedoes is not so highly estimated now as it was a few years ago. Its legitimate place appears to be in small vessels especially built for the purpose. In the latest designs for battleships the British Admiralty have wisely discarded all fittings above water for dis- charging torpedoes, and confined the torpedo equipment to four submerged broadside tubes only — a position in which this delicate and somewhat erratic weapon may at any rate be manipulated with reasonable safety to those using it ; but it remains for future naval battles to prove whether a locomotive torpedo, when used from battleships or large cruisers, will produce a governing, or indeed any decided influence on naval tactics. There is another**

~~locomotive torpedo in use, known as the " Brennan " ; but as it is unsuitable for use in ships, and its proper place appears to be the~~

guarding of comparatively narrow channels, it does not claim notice under" the heading of naval tactics.

The French constructors, with their well-known in- genuity, perseverance, and special genius for mechanical invention, have for some years past been de- voting much attention to the perfecting of f "™ari'e submarine boats, and should their efforts be crowned with success, they hope thereby to adjust the balance of naval power as between France and Great Britain, which is now considerably in favour of the latter, and perhaps sweep her battleships from the sea, and thus pave the way for an invasion of England — a vision of conquest and glory which appears to possess a special and absorbing fascination for many French soldiers, sailors, and statesmen. The British Admiralty, after watching for some years the development of the submarines, built half a dozen in 1902, more for experimental purposes, it would appear, than from any firm belief in their utility as practical engines of warfare. Some were also built for the American navy. The fact is, that no maritime Power can afford to ignore any invention of the sort which offers even a remote prospect of success, lest her rivals steal a march upon her, as the Prussians did upon the Austrians with the needle-gun, and pick a quarrel with her before she is ready. Least of all can Great Britain afford to do so, as her very existence depends upon her maritime supremacy.

No seaman would venture to predict that submarine navigation would never become a practical factor in naval warfare, though it is certainly not the general opinion that it has become so at present. The French have been working most assiduously at the problem, and they claim (1902) to have achieved considerable success (in mimic warfare) by torpedoing some of their own battleships. The conditions, however, do not appear to have much relation to those which exist in actual warfare. The limitations of the submarine, both as to navigability and radius of action, are considerable. Some of them may, of course, be removed in process of time ; and with each improvement the submarine must become more formid- able. One of the greatest difficulties which stand in the way of the development of the submarine appears to be the lack of stability, and specially of longitudinal stability, to which all totally immersed bodies are necessarily subject.

Wireless telegraphy is one of the latest inventions of science which seems destined to have some effects on naval tactics, and possibly even on strategy. It fe not possible — with our present experience — to assign a limit to the effect which it may have, wireless but it opens up a vision of such a revolution in trapfty. the hitherto recognized methods of communica- tion at sea, promising as it does to put a power into the hands of an admiral to communicate with distant ships and squadrons which he did not previously possess, that it cannot fail to have far-reaching consequences, more especially as we may reasonably look for improvement in an art of such recent birth. (c. c. P. F.)

War, Laws Of. — The law of war does not apply to all armed conflicts, but only to such conflicts as, by the usage of states, constitute war. War exists when the organized armed forces of one state are opposed to the organized armed forces of another state. War also exists within the bounds of a single state when organized armed forces, of sufficient power to make the issue doubt- ful, place themselves in opposition to the armed forces of

the existing government. If the disaffected forces are in a state of flagrant inferiority in comparison with those of the existing government, there is not a state of war but Civil war °^ rebellion. The combatants in civil war are as ills- entitled to treatment in accordance with the law of tinguisbed war. Rebels, as outlaws, have no rights. In the 'nteiiioa. S.outh African campaign (1899-1902) the ques- tion arose whether the manifest inferiority of the Boer forces, the possession by the British forces of the seats of government, and their practical occupation of the whole country, did not put an end to the state of war and constitute the Boer fighting forces rebels against a new existing government which had proclaimed annexation of the conquered states and was obviously in a position to retain its conquest. The action of the British commanders is a precedent in favour of the view that the fighting forces of an invaded state are entitled to belligerent rights, though in a state of hopeless inferiority, so long as they remain in the field in organized bands. In this, as in many

cases which have formed international usage, the danger of reprisals more than the logic of principles has dictated a different line of conduct from that which the strict principles of law suggested. A somewhat similar, but more complicated situation, arose out of the cession by Spain to the United States of the Philippine Islands. The insurgents being in possession of them at the time, Spain ceded what she did not in fact possess. Thus it has been contended that the position of the insurgents became that of belligerents defending their country against conquest by invading forces.

Wars have been classed in different ways — wars of intervention, wars of conquest, wars of defence, wars of independence, just wars, unjust wars, and so on — but the law of war applies to them all without distinction. States do not sit as judges over each other, but treat war, subject to their own interest, as a fact. Interest, how- Neutrai everj ^jth the increasing development of inter- national relations is becoming a more important factor in the determination of the attitude of the neutral onlooker (see Neutrality).

In the Chino-Japanese war the Japanese had to decide whether the Chinese were entitled to treatment under the War with European law of war. Japan acceded to the barbarous Geneva Convention (see below) in 1886, and peoples, to the Declaration of Paris (see below) in 1887. China was a party to neither, and observed the provisions of neither. Japan, nevertheless, as related by her learned judicial advisers, Professors Ariga and Takahashi, ob- served towards the Chinese forces, combatant and non- combatant, all the rules of European International Law without resorting to the reprisals to which Chinese bar- barities provoked her.

The position of neutral governments towards insurgent forces is always a delicate one. If they are not recognized Neutral as belligerents by the state against which they position are arrayed, the state in question theoretically towards accepts responsibility for the consequences of insurgents, their acts in respect of neutral states. A neutral state may be satisfied with this responsibility, or it may recognize the belligerent character of the insurgents. If it does not, however, do so, the insurgent forces cannot exercise rights of war against neutral property without exposing

themselves to treatment as outlaws and pirates. A case of such treatment occurred in September 1902 in connexion with a pending revolution in Hayti, a Ger man cruiser, the Panther, having treated an insurgent gunboat, the Crete-a-Pierrot, as a pirate vessel,1 and sunk her for having stopped and confiscated arms and

1 Tlie Times, 9th September 1902.

ammunition among the cargo of the German steamer Markomannia on the ground of their being contra- band destined for the armed forces of the existing Haytian Government. The Crete-a-Pierrot had for some years formed part of the Haytian navy, and was com- manded by Admiral Killick, who had been an admiral of that navy. There had been no recognition of the belligerency of the insurgents. No state seems to have made any observations on the incident, which may be taken to be in accordance with current international usage.

A well-known instance of a neutral government re- cognizing insurgent forces as belligerents, in spite of the

denial of that character to them by the state „ ..,. .

. i i . . ., . . British re*

against which they are carrying on hostilities, cognition occurred in the North American civil war. of the Con- The right asserted by Great Britain to re- federates- cognize the belligerency of the Confederate forces was based on the contention that British commercial interests were very largely affected by the blockade of the Southern ports. It is agreed, however, among international jurists that, where the interests of neighbouring states are not affected, the recognition of an insurgent's belligerency is needless interference.2

The recognition of belligerency does not entail re- cognition of the belligerent as a sovereign state. The recognition of belligerency goes no farther Effect ot than its immediate purpose. The belligerent recognition armies are lawful combatants, not bandits ; sup- of belllger- plies taken from invaded territory are requisi- ency' tions, not robbery. The

belligerent ships of war are lawful cruisers, not pirates ; and their captures, made in accord- ance with maritime 'law, are good prize; and their blockades if effectual, must be respected by neutrals. But this does not suffice to invest the belligerent with the attributes of independent sovereignty for such objects as negotiation of treaties, and the accrediting of diplomatic and consular agents. This was the attitude of Great Britain and France towards the Confederates in the American civil war.

The position of a vassal state or a colony carrying on foreign war without the consent of the suzerain or parent state might involve still more complicated issues.3

2 It is also agreed that, as the existence of belligerency imposes burdens and liabilities upon neutral subjects, a state engaged in civil war has no right, in endeavouring to effect its warlike objects, to em- ploy measures against foreign vessels," which, though sanctioned in time of peace, are not recognized in time of war. In other words, it cannot enjoy at one and the same moment the rights of both peace and war. Thus, in 1861, when the Government of New Grenada, during a civil war, announced that certain ports would be closed, not by blockade, but by order, Lord John Russell said, "That it was perfectly competent to the government of a country in a state of tranquillity to say which ports should be open to trade, and which should be closed. But in the event of insurrection or civil war in that country, it was not competent for its government to close ports which were de facto in the hands of the insurgents, and that such a proceeding would be an invasion of international law relating to blockade." (Hansard, clxiii., 1846). Subsequently the Government of the United States proposed to adopt the same measure against the ports of the Southern States, upon which Lord John Eussell wrote to Lord Lyons that " Her Majesty's Government entirely concur with the French Government in the opinion that a decree closing the Southern ports would be entirely illegal, and would be an evasion of that recognized maxim of the law of nations that the ports of a belligerent can only be closed by an effective blockade." (State Papers, North America, No. 1, 1862.) In neither case was the order carried out. When in 1885 the President of Colombia, during the existence of civil war, declared several ports to be closed with- out instituting a blockade, Mr Bayard, Secretary of State of the United States, in a despatch of 24th April of that year, fully acknow- ledged the principle of this contention by refusing to acknowledge the closure.

3 In the Servo-Bulgarian war of 1885 the Sultan, though suzerain of Bulgaria, was unmoved by the invasion of his vassal's dominions.

WAR

Civilized warfare, the textbooks tell us, is confined, as far as possible, to disablement of the armed forces of the enemy ; otherwise war would continue till one of the parties was exterminated. " It is with good reason," observes Vattel, " that this practice has grown Regular jn^0 a cust0m with the nations of Europe, at civilians. ^east ^^ those that keep up regular standing armies or bodies of militia. The troops alone carry on war, while the rest of the nation remain in peace " (Law of Nations, iii. 226). Modern notions of patriotism do not, however, view this total and uncondi- tional abstention of the civilian population as any longer possible. They have found, to some extent, ex- pression in the following Articles of The Hague War- Regulations : 1 —

"Art. 1. The laws, rights, and duties of war apply not only to armies, but also to militia and volunteer corps fulfilling the follow- ing conditions : (a) To be commanded by a person responsible for his subordinates ; (6) to have a, fixed distinctive emblem recog- nizable at a distance ; (c) to carry arms openly ; and (d) to conduct their operations in accordance with the laws and customs of war. In countries where militia or volunteer corps constitute the army, or form part of it, they are included under the denomination ' army. '

"Art. 2. The population of a territory which has not been oc- cupied, who, on the enemy's approach, spontaneously take up arms to resist the invading troops without having time to organize them- selves in accordance with Article 1, shall be regarded as belligerent if they respect the laws and customs of war. " 2

By these provisions, irregular combatants whom both the Government of the United States in the American civil war, and the German Government in the Franco- German war refused to regard as legitimate belligerents, are now made legally so.3 It may be contended that the second Article covers the irregularities of the Boer Army.

Connected with the position of private persons in time of war is that of their property in invaded territory, a subject which has often been

~~misunderstood. Asser- tions as to its immunity from capture in warfare on land have been made which are historically inaccurate and are~~

~~1 To distinguish between the three Conventions adopted at the Peace Conference at The Hague, all of which bear the same date, we shall refer to the Convention described as " for the pacific settle- ment of international disputes " as " The Hague Arbitration Conven- tion," to that described as "with respect to the laws and customs of war by land" as "The Hague War Convention," the regulations provided for therein as "The Hague War-Regulations," and to that " for adapting to maritime warfare the principles of the Geneva Con- vention of 22nd August 1864" as "The Hague (Red Cross) Maritime Convention."~~

~~2 The preamble of the Convention refers specially to Articles 1 and 2 in the following terms : — " In the view of the High Contracting Parties, these provisions, the wording of which has been inspired by the desire to diminish the evils of war so far as military necessities permit, are destined to serve as general rules of conduct for bel- ligerents in their relations with each other and with populations ;~~

~~"It has not, however, been possible to agree forthwith on provi- sions embracing all the circumstances which occur in practice ;~~

~~" On the other hand, it could not be intended by the High Con- tracting Parties that the cases not provided for should, for want of a written provision, be left to the arbitrary judgment of the military commanders ;~~

~~" Until a more complete code of the laws of war is issued, the High Contracting Parties think it right to declare that in cases not included in the Regulations adopted by them, populations and belligerents remain under the protection and empire of the principles of inter- national law, as they result from the usages established between civilized nations, from the laws of humanity, and the requirements of the public conscience ;~~

~~" They declare that it is in this sense especially that Articles 1 and 2 of the regulations adopted must be understood."~~

3 The instructions for the government of armies of the United States in the field, issued in 1863, provided : — ■

"Men or squads of men who commit hostilities, whether by fighting or inroads for destruction or plunder, or by raids of any kind, without commission, without being part and portion of the organized hostile army, and without sharing continuously in the war, but who do so with intermitting returns to their

not borne out by contemporary usage. No doubt con- temporary usage is an improvement on older usage. An invading army, before the practice of war be- Baemy came more refined, lived by foraging and pillage property in the invaded country ; pillage, in fact, being on invaded ; one of the inducements held out to the adven- terrltory- turers who formed part of the fighting forces either as officers or as common soldiers, and this continued down to comparatively recent times. Attenuations followed from the rise of standing and regular armies, and the consequent more marked distinction between soldier and civilian. They have now taken the form of systematic requisitions and contributions, the confining of the right of levying these to generals and commanders-in-chief, the institution of quittances or bills drawn by the belligerent invader on the invaded power and handed in payment to the private persons whose movable belongings have been appropriated or used, and of war indemnities. These are methods of lessening' the hardships of war as regards the private property on land of the subjects of belligerent states. Their object and effect have by no means been to arrive at immunity, but to develop an organized system by which damage and losses to individuals, whom the fortune of war has brought into immediate contact with the enemy, are spread over the whole community. There is thus no immunity of private property in warfare on land, and The Hague War-Regulations, far from declaring the contrary, have ratified the right of appropriation of private property in the following Article : —

' ' Neither requisitions in kind nor services can be demanded from communes or inhabitants except for the necessities of the army of occupation. They must be in proportion to the resources of the country,

~~and of such a nature as not to involve the population in the obligation of taking part in military operations against their country.~~

~~‘ ‘ These requisitions and services shall only be demanded on the authority of the Commander in the locality occupied.~~

~~” The contributions in kind shall, as far as possible, be paid for in ready money ; if not, their receipt shall he acknowledged ” (Article 52).~~

~~homes and avocation, or with the occasional assumption of the semblance of peaceful pursuits, divesting themselves of the character or appearance of soldiers — such men or squads of men are not public enemies, and therefore, if captured, are not entitled to the privileges of prisoners of war, but shall be treated summarily as highway robbers or pirates.” Germany seven years later declined to recognize the irregular bands of Franc-tireurs unless each individual member of them had been personally called out by legal authority, and wore a uniform or badge, irremovable and sufficient to distinguish him at a distance. The older publicists were, on the whole, strongly opposed to the legaliza- tion of irregular troops. Halleck settles the question in a summary way by calling those who engage in partisan warfare, robbers and murderers ; and declaring that when captured they are to be treated as criminals (International Law, chap, xviii. s. 8). It is easy to understand the unfavourable opinion of partisan bands usually ex- pressed by the military authorities when the enormous power for damage of modern arms is considered. At the Brussels Conference of 1874 the representatives of the great military Powers of the Con- tinent naturally desired to keep spontaneous movements within the narrowest possible bounds, while the delegates from the secondary status, who have to rely for their defence chiefly upon the patriotism of their people, endeavoured to widen the right of resistance to an invader. Finally the Conference adopted the provisions which were later formally recognized at The Hague Conference (see British State Papers Miscellaneous, No. 1, 1875, pp. 252-257). It is noteworthy that both at the Brussels aud The Hague Conferences, the British delegate ranged himself on the sidd of the smaller states in favour of the recognition of guerilla bands. At The Hague Conference Sir John Ardagh gave notice of his intention to propose an additional Article, to**

the effect that nothing in the Regidations should " be considered as tending to diminish or suppress the right which belongs to the population of an invaded country patriotically to oppose the most energetio resistance by every legitimate means." The upshot of this notice was to cause the insertion of a proviso in the preamble of the Convention denying the right of military commanders to act accord- ing to their own arbitrary judgment (Parliamentary Papers, No. 1, 1899, u. 9534).

In another Article provision, moreover, is made for the utilization of property in kind belonging to private persons : —

"An army of occupation can only take possession of the cash, funds, and property liable to requisition belonging strictly to the state, depfits of arms, means of transport, stores and supplies, and, generally, all movable property of the state which may be D«ed for military operations.

"Railway plant, land telegraphs, telephones, steamers, and other ships, apart from cases governed by maritime law, as well as depSts of arms, and, generally, all kinds of war material, even though belonging to companies or to private persons, are likewise material which may serve for military operations, but they must be restored at the conclusion of peace, and indemnities paid for them " (Article 53).

And utilizable neutral rolling-stock is not excepted, Article 54 only providing that the

"plant of railways coming from neutral states, whether the pro- perty of those states, or of companies, or of private persons, shall be sent back to them as soon as possible. "

Enemy property at sea is subject to different rules from those which govern it on land. It is liable to capture and

~~confiscation wherever found on the high seas or Enemy ^ enemv waters. The United States has made aTsea. * strenuous efforts to get this rule of maritime~~

~~warfare altered, and immunity from capture accepted as the law of the sea. It has even made this a condition of its accession to the Declaration of Paris (see Neutrality). But thus far other Powers have shown no disposition to agree to any alteration. At The Hague Conference the United States raised the question again, but it was not taken into consideration, though somewhat vaguely reserved for a future conference. And, in fact, the considerations which have led mankind to systematize the practice of war in regard to private property on land do not arise in the same form in con- nexion with private property at sea. Here there is no question of seizing the live-stock, or the bedding, or the food, or the utensils of the private citizen. If ship and cargo are captured, it may be hard upon the merchant, but such captures do not directly deprive him of the neces- saries of life. Yet, as in the case of war on land, its hardships have been attenuated, and progress has been made by developing a more systematic procedure of capture of private property at sea. Thus exemption from capture is now allowed by belligerents to enemy merchant ships which, at the outbreak of war, are on the way to one of their ports, and they also allow enemy merchant- men in their ports at its outbreak a certain time to leave them. A somewhat similar practice exists as regards pursuit of merchant ships which happen to be in a neutral port at the same time with an enemy cruiser. Lastly, there has grown up, on grounds similar to those which have led to the indulgence shown to private property on land, a now generally recognized immunity from capture of small vessels engaged in the coast fisheries, provided they are in no wise made to serve the purposes of war. This has all been done with the object of making the operations of war systematic, and enabling the private citizen to estimate his risks and take the necessary precautions to avoid capture, and of restricting acts of war to the purpose of bringing it to a speedy conclusion.~~

~~We have seen that the only immunity of private pro- perty yet known to the laws of war is a limited one at sea. War, by its very nature, prevents the growth of any such immunity. The tendency in war on land has been~~

~~*to spread its effects over the whole community, to keep a faithful record on both sides of all confiscations, appropria- tions, and services enforced against private citizens ; be- yond this, protection has not yet been extended. There*~~

~~*is good reason for this. The object of each belligerent being to break the enemy's power and force him to sue for peace, it may not be enough to defeat him in the open field ; it may be necessary to prevent him from repairing his loss both in men and in the munitions of war. This may imply crippling his material resources, trade, and manufactures. It has been contended that " to capture at sea raw materials used in the manufactur- ing industry of a belligerent state, or products on the sale of which its prosperity, and therefore its taxable sources depend, is necessarily one of the objects, and one of the least cruel, which the belligerents pursue. To capture the merchant vessels which carry these goods, and even to keep the seamen navigating them prisoners, is to prevent the employment of the ships by the enemy as transports or cruisers, and the repairing from among the seamen of the mercantile marine of losses of men in the official navy." 1*~~

~~*The question of reform of the existing practice would naturally be viewed in different countries according to their respective interests. The United States has obviously an interest in the exemption of its merchant vessels and cargoes from capture, a small official navy being sufficient for the assertion of its ascendency on the American conti- nent. It may also be presumed to be in the interest of Italy, who, in a treaty with the United States in 1871, provided for mutual recognition of the exemption.*~~

~~*In the Austro-Prussian war of 1866 the principle of inviolability was adhered to by both parties. Germany proclaimed the same principle in 1878, but afterwards abandoned it.*~~

~~*Whether it is expedient for Great Britain at the present day to agree to the immunity of private property at sea from capture, must be dictated by the circumstances of the particular war in which she engages. It is quite con- ceivable that different considerations would weigh with her in a war with the United States from those which would arise in a war with France or Germany. In the case of the United States it might be in the interest of*~~

both parties to localize the operations of war, and to interfere as little as possible, perhaps for the joint exclusion of neutral vessels, with the traffic across the Atlantic. In the case of a war with France or Germany, Great Britain might con- sider that the closing of the high sea to all traffic by the merchantmen of the enemy would be very much in her own interest. i

The converse subject of the treatment of enemy subjects who remain in the country of the other belligerent also was not dealt with at The Hague. British practice in this matter has always been in- ^JJrftecto— dulgent, the protection to the persons and pro- their pro- perty of non-combatant enemies on British soil pertyon dating back to Magna Charta (s. 48), and this b°er^0 is still the law of England. The practice on the continent of Europe varies according to circumstances, to which no doubt, in the event of the invasion of Great Britain, British practice would also have to adapt itself.

The Hague War-Begulations deal fully with the treat- ment of prisoners, and though they add nothing to exist- ing practice, such treatment is no longer in the discretion of the signatory Powers, but is bind- p^soners ing on them. They provide as follows : —

Prisoners of war are in the power of the hostile government, but not in that of the individuals or corps who captured them. They must be humanely treated. All their personal belongings, except arms, horses, and military papers, remain their property (Article 4). Prisoners of war may be interned in a town, fortress, camp, or any other locality, and bound not to go beyond certain fixed limits ; but they can only be confined as an indispensable measure of safety (Article 5). The state may utilize the labour of

1 Barclay," Proposed Immunity of Private Property at Sea from Capture by Enemy," Law Quarterly Review, January 1900.

~~prisoners of war according to their rank and aptitude. Their tasks shall not be excessive, and shall have nothing to do with the military operations. Prisoners may be authorized to work for the public service, for private persons, or on their own account. Work done for the state shall be paid for according to the tariffs in force for soldiers of the national army employed on similar tasks. When the work is for other branches of the public service or for private persons, the conditions shall be settled in agreement with the military authorities. The wages of the prisoners shall go towards improving their position, and the balance shall be paid them at the time of their release, after deducting the cost of their maintenance (Article 6). The government into whose hands prisoners of war have fallen is bound to maintain them. Failing a special agreement between the belligerents, prisoners of war shall be treated, as regards food, quarters, and clothing, on the same footing as the troops of the government which has captured them (Article 7). Prisoners of war shall be subject to the laws, regula- tions, and. orders in force in the army of the state into whose hands they have fallen. Any act of insubordination warrants the adoption, as regards them, of such measures of severity as may be necessary. Escaped prisoners, recaptured before they have succeeded in rejoining their army, or before quitting the territory occupied by the army that captured them, are liable to disciplinary punishment. Prisoners who, after succeeding iu escaping, are again taken prisoners, are not liable to any punishment for the previous flight (Article 8). Every prisoner of war, if questioned, is bound to declare his true name and rank, and if he disregards this rule, he is liable to a curtailment of the advantages accorded to the prisoners of war of his class (Article 9). Prisoners of war may be set at liberty on parole if the laws of their country authorize it, and, in such a case, they are bound, on their personal honour, scrupulously to fulfil, both as regards their own government and the government by whom they were made prisoners, the engage- ments they have contracted. In such cases, their own government shall not require of nor accept from them any service incompatible with the parole given (Article 10). A prisoner of war cannot be forced to accept his liberty on parole ; similarly the hostile govern- ment is not obliged to assent to the prisoner's request to be set at liberty on parole (Article 11). Any prisoner of war who is liberated on parole and recaptured, bearing arms against the government to whom he had pledged his honour or~~

against the allies of that government, forfeits his right to be treated as a prisoner of war, and can be brought before the courts (Article 12).

An interesting addition assimilates individuals who follow an ■army without directly belonging to it, such as newspaper corre- spondents and reporters, sutlers, contractors, who fall into the enemy's hands, to prisoners of war, provided they can produce a certificate from the military authori- ties of the army they were accompanying.

A new departure is made by a provision in the Regulations pro- viding for the institution of a bureau for information relative to prisoners of war. This is to be created at the com- Informa- menocmeI1t 0f hostilities, in each of the belligerent

on-o-ce s£ate3 g^j,^ when necessary, in the neutral countries on

. whose territory belligerents have been received. It is

' intended to answer all inquiries about prisoners of war, and is to be furnished by the various services concerned with all the necessary information to enable it to keep an individual return for each prisoner of war. It is to be kept informed of internments and changes, as well as of admissions into hospital and deaths. It is also the duty of the information bureau to receive and collect all objects of personal use, valuables, letters, &c, found on the battlefields or left by prisoners who have died in hospital or ambulance, and to transmit them to those interested. It is, more- over, to have the privilege of free postage. Letters, money orders, and valuables, as well as postal parcels destined for the prisoners of war or despatched by them, are to be free of all postal duties, both in the countries of origin and destination, as well as in those they pass through. Gifts and relief in kind for prisoners of war are to be admitted free of all duties of entry and others, as well as of payments for carriage by the government railways.

Furthermore, relief societies for prisoners of war, regularly con- stituted with the object of charity, are to receive every facility, within the bounds of military requirements and ad- iti ministrative regulations, for the effective accompliah- soclet es. men^ 0f their task. Delegates of these societies are to be admitted to the places of internment for the distribution

of relief, as also to the halting-places of repatriated prisoners, "if furnished with a personal permit by the military authorities, and on giving an engagement in writing to comply with all their regulations for order and police."

The obligations of belligerents with regard to sick and wounded on land are governed by the Geneva Conven- tion of 1864. By this convention ambulances and mili- tary hospitals, their medical and administrative staff and

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chaplains are invested with a neutral character. Cer- tain immunities are granted to the tenants of any private houses in which wounded men are SlckaJ"i cared for, and a uniform flag and arm-badge bearing a red cross were provided as a distinguishing mark of their neutral character. A convention, accepted at the Peace Conference, has now adapted the principles of this convention to maritime warfare. The, new (Red Cross) Maritime Convention jwovides : —

That military hospital-ships, that is to say, ships constructed or assigned by states specially and solely for the purpose of assist- ing the wounded, sick, or shipwrecked, and the names of which have been communicated to the belligerent powers at the com- mencement or during the course of hostilities, and in any case before they are employed, are to be respected and cannot be captured while hostilities last.

As regards hospital-ships, equipped wholly or in part at the cost of private individuals or officially recognized relief societies, they likewise are to be respected and exempt from capture, pro- vided the belligerent or neutral power to which they belong shall have given them an official commission and notified their names to the hostile power at the commencement of or during hostilities, and in any case before they are employed.

The belligerents have the right to control and visit them ; they can refuse to 'help them, order them off, make them take a certain course, and put a commissioner on board ; they can even detain them, if important circumstances require it.

~~The religious, medical, or hospital staff of any captured ship is inviolable, and its members cannot be made prisoners of war.~~

~~Lastly, neutral merchantmen, yachts, or vessels, having, or taking on board, sick, wounded, or shipwrecked of the belligerents, cannot be captured for so doing.~~

~~Under the Declaration of St Petersburg (1868), to which most European states were parties, a minimum weight was fixed for projectiles. The Hague War-Regulations, which, by the way, do not refer to the St Petersburg Declaration, Arms f°" contain provisions forbidding the use of poisoned arms Prolec es> or the employment of arms, projectiles, or material of a nature to cause superfluous injury. The following agreements, to which Great Britain is not a party, were also adopted : —~~

~~"1. To prohibit the launching of projectiles and explosives from balloons or by other similar new methods.~~

~~" 2. To prohibit the use of projectiles, the only object of which is the diffusion of asphyxiating or deleterious gases.~~

~~"3. To prohibit the use of bullets which expand or flatten easily in the human body, such as bullets with a hard envelope, of which the envelope does not entirely cover the core, or is pierced with incisions. " l~~

~~The following prohibitions are also placed by The Hague Regula- tions on the means of injuring the enemy : —~~

~~To employ poison or poisoned arms.~~

~~To kill or wound treacherously individuals belonging Iniuring to the hostile nation or army. enemy.~~

~~To kill or wound an enemy who, having laid down f geJ*'j arms, or having no longer means of defence, has Dom·a surrendered at discretion. me~~

~~To declare that no quarter will be given.~~

To employ arms, projectiles, or material of a nature to cause superfluous injury.

To make improper use of a flag of truce, the national flag, or military ensigns and the enemy's uniform, as well as the distinctive badges of the Geneva Convention.

To destroy or seize the enemy's property, unless such destruction or seizure be imperatively demanded by the necessities of war ; to ^attack or bombard towns, villages, habitations, or buildings which are not defended.

To pillage a town or place, even when taken by assault.

Ruses of war and the employment of methods necessary to obtain information about the enemy and the country, on the contrary, are considered allowable.

In sieges and bombardments all necessary steps are to be taken to spare as far as possible buildings devoted to religion, art, science, and charity, hospitals, and places where the sick and wounded are collected, provided they are not used at the same time for military purposes ; but the besieged are to indicate these buildings or places by some particular and visible signs, and notify them to the assailants.

A spy is one who, acting clandestinely, or on false pretences, obtains, or seeks to obtain, information in the zone of operations of a belligerent, with the intention of communicating it to the hostile party (The Hague War Convention, Art. 29). Thus, soldiers

1 The texts of these Declarations will be found in Parliamentary Paper, "Miscellaneous, No. 1, 1899." C. 9534.

not in diaguise who have penetrated into the zone of operations of a hostile army to obtain information are not considered spies. Similarly, the following are not considered spies: p es' soldiers or civilians, carrying out their mission openly,

charged with the delivery of despatches destined either for their own army or for that of the enemy. To this class belong likewise individuals sent in balloons to deliver despatches, and generally to maintain communication between the various parts of an army or a territory (ib.) A spy taken in the act cannot be punished with- out previous trial, and a spy who, after rejoining the army to which he belongs, is subsequently captured by the enemy, is a prisoner of war, and not punishable for his previous acts of espionage.1

Territory is considered as occupied when it is actually under the authority of the hostile army. The authority having passed into the hands of the occupant, the latter takes all possible Occupation gt to re.eatablish public order and safety. Com- ° °"*«"e pulsion of the population of occupied territory to take territory. ^^ jn military operations against its own country, and pressure to take the oath to the hostile power are prohibited. Private property must be respected, save in case of urgent military necessity (Arts. 47 and 23). The property of the communes, that of religious, charitable, and educational institutions, and of art and science, even when state property, are assimilated to private

Sroperty, and all seizure of, and destruction, or intentional damage one to such institutions, to historical monuments, works of art or science, is prohibited.

As regards Continental criticism of the conduct of the Boer war

by the British commanders, who are alleged to have frequently

violated these provisions of The Hague War-Regula-

d'//Var tions, it would be carping to contend that, as the

J?" faf6 Boer Republics were not parties to the convention,

«on" " ^ey were n0 ent'tle

however, was irrelevant, The Hague War-Regulations

relating only to "occupation" by a hostile army and not to the

military establishment of a conquering state in possession of

annexed territory, to which international regulations can have no

application.

Declaration Contemporary practice as regards declara- of war. tions of war varies.

The Franco-Prussian war of 1870 was preceded by a deliberate declaration. In the war between Japan and China there was no declaration. (See Ariga, "mctice Lcb Guerre Sino-Japonaise, Paris, 1896). The delivery of an ultimatum specifying those terms, the compliance with which is demanded within, a specified time, is practically a conditional declaration of war which becomes absolute in case of non-compliance. Thus the note communicated by the United States to Spain on 20th April 1898 demanded the "immediate withdrawal of all the land and sea forces from Cuba," and gave Spain three days to accept these terms. On the evening of 22nd April the United States seized several Spanish vessels, and hostilities were thus opened. In the case of the Transvaal war, the declaration also took the form of an ultimatum. (See as to the formal notification of the existence of a state of war, Neutrality.)

Too much confidence must not be placed in regulations concerning the conduct of war. Military necessity, the heat of action, the violence of the feelings Future of w|1jcj1 COme into play will always at times defeat the most skilfully-combined rules dip- lomacy can devise. Still, such rules are a sign of condi- tions of public opinion which serve as a restraint upon the commission of barbarities among civilized peoples. The European operations in China consequent on the "Boxer" rising show how distance from European criti- cism tends to loosen that restraint. On the other hand, it was significant that both the United States and Spain, who were

not parties to the Declaration of Paris, found themselves, in a war confined to them, under the necessity of observing provisions which the majority of civilized states have agreed to respect. (T. ba.)

1 See as to Flags of Truce, Art. 32 of The Hague Regulations.

2 Art. 2. The provisions contained in the Regulations mentioned in Art. 1 are only binding on the contracting powers in case of war between two or more of them.

Warburton, Colonel Sir Robert (1842-

1899), Anglo-Indian soldier and administrator, was the son of an artillery officer who was taken prisoner at Kabul in 1842, and who escaped through the good offices of an Afghan princess. He married this lady, and she trans- mitted to their son that power of exercising influence over the tribes of the north-west frontier which stood him in good stead during his long service in India. Warburton entered the Eoyal Artillery in 1861, took part in the Abyssinian war of 1867-68, and then joined the Bengal Staff Corps. He served with distinction in the expedition against the Utman Khels in 1878 and in the Afghan war of 1878-80. Very soon after the British Government had made permanent arrangements for keep- ing open the Khaibar Pass, Warburton was appointed to take charge of it as political officer. This post he held, discharging its duties with conspicuous ability, between 1879 and 1882 with intervals of other duty, and con- tinuously from 1882 until 1890. He turned the rude levies which formed the Khaibar Rifles into a tine corps, ready to serve the Indian Government wherever they might be required. He made the road safe, kept the Khaibar Afridis friendly, and won the thanks of the Punjab Government, expressed in a special order upon his retirement, for his good work. When the Afridis began to cause anxiety in 1897, Colonel Warburton was asked by the Government of India if he would assist in quieting the excitement amongst them. He declared him- self ready to do so, but in the meantime the trouble had come to a head. Colonel Warburton took part in the campaign which followed ; at its close his active career ended. He occupied his leisure in retirement by writing his memoirs, which, under the title of Eighteen Years in the Khyber, were published by Murray in 1900. He died at Kensington on 22nd April 1899.

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~~Ward, Adolphus William (1837-~~

~~historian and man of letters, was born at Hampstead, 2nd December 1837, and was educated in Germany and at the University of Cambridge. In 1866 he was ap- pointed professor of history and English literature in Owens College, Manchester, and was principal from 1890 to 1897, when he retired. He took an active part in the foundation of Victoria University, of which he was vice-chancellor from 1886 to 1890 and from 1894 to 1896. In 1897 the freedom of the city of Manchester was conferred upon him, and in 1900 he was elected Master of Peterhouse. His most important work is his standard History of English Dramatic Literature to the Age of Queen Anne (1875), re-edited after a thorough revision in 1899. He has also written The Souse of Austria in the Thirty Years' War (1869), and the volumes on Chaucer and Dickens in the " English Men of Letters " series edited by Mr John Morley, and has translated Curtius's History of Greece, 1868-73. He has also been an extensive contributor to high-class periodical literature.~~

~~Ward, Elizabeth Stuart Phelps (1844-~~

~~), American authoress, was born in Boston, Massachu~~

~~setts, 13th August 1844. Her father was Austin Phelps, who became, soon after her birth, professor in Andover Theo- logical Seminary, and was the author of The Still Hour and other popular works on the spiritual life. Miss Phelps began her literary career by the production of juvenile tales of no special significance, but in 1868 appeared The Gates Ajar, a realistic study, in the form of fiction, of the possibilities of the life after death, which attained immediate popularity, and was followed by the similar Beyond the Gates (1883) and The Gates Between (1887). Her other numerous writings fall under the divisions of~~

~~novels, short stories, tales for children, personal reminis- cences, religious books, hints on dress reform, and verse ; the most significant being the novel, Doctor Zay (1882) ; such strong tales as The Tenth of January (a narrative of the falling and burning of a cotton-mill in Lawrence, Massachusetts, in 1860, which appeared in The Atlantic Monthly for March 1868); and the Gloucester tragedy entitled Jack the Fisherman (1887) ; the "Trotty " stories for children, one of the best features of Our Young Folks magazine between 1865 and 1873 ; and the readable Chapters from a Life, reprinted from a monthly periodical in 1896, and giving a characteristic record of certain passing phases of religio-social life in New England in the middle of the 19th century. In 1888 Miss Phelps married Herbert Dickinson Ward, a Congregational minister and writer, with whom she collaborated in some of her less important works of fiction.~~

~~Ward, John Quincy Adams (1830),~~

~~American sculptor, was born in Urbana, Ohio, 29th June 1830. His education was received in the village schools. In 1850 he entered the studio of Henry K. Browne, where he remained as student and assistant until 1857. Between that date and 1861, when he opened a studio in New York, he executed busts of Joshua B. Giddings, Alexander H. Stephens, and Hannibal Hamlin; prepared the first sketch for the "Indian Hunter," and made studies among the Indians themselves for the work. In 1863 he became a member of the National Academy of Design (New York), and was elected its president in 1872. Among his best- known statues are the " Indian Hunter," finished in 1864 (Central Park, New York) ; Washington, heroic size (on the steps of the U.S. Sub-Treasury, Wall Street, New York) ; Henry Ward Beecher (Brooklyn) ; an equestrian statue of General George H. Thomas (Washington); Israel Putnam (Hartford); and the seated statue of Horace Greeley, the founder of the New York Tribune, in front of the office of that newspaper. In 1896 he was elected president of the newly organized National Sculpture Society (New York). Unlike his fellow-country- man, W. W. Story, he acquired his training, his inspiration, and his themes from his own country.~~

Ward, William George (1812-1882), Eng- lish Boman Catholic theologian, was born 21st March 1812. His career is extremely interesting as illustrating the development of religious opinion at a remarkable crisis in the history of English religious thought. Ward is de- scribed by his son and biographer as somewhat unequally gifted by nature. For pure mathematics he had a special gift — almost a passion. For history, applied mathematics — for anything, in fact, outside the exact sciences — he felt something approaching to contempt. He was endowed with a strong sense of humour and a love of paradox carried to an extreme. He went up to Christ Church, Oxford, in 1830, but his father's subsequent pecuniary embarrass- ments compelled him in 1833 to try for a scholarship at Lincoln College, which he succeeded in obtaining. His ex- amination for mathematical honours exhibited some of the peculiarities of his character and mental powers. Four out of his five papers on applied mathematics were sent up absolutely blank. Honours, however, were not refused him, and in 1834 he obtained an open fellowship at Balliol. In the previous year the Tractarian movement had commenced, and Ward's relations with that movement were as original as the rest of his life. He was attracted to it by his hatred of moderation and what he called " respectability " in any shape — a characteristic of which some amusing instances have been handed down. He was repelled from it by the conception he had formed of the character of Newman, whom he regarded as a mere

antiquary. When, however, he was at length persuaded by a friend to go and hear Newman preach, he at once became a disciple. But he had, as Newman afterwards said of him, " struck into the movement at an angle." He had no taste for historical investigations. He treated the question at issue as one of pure logic, and disliking the Beformers, the right of private judgment which Protestants claimed, and the somewhat prosaic uniformity of the English Church, he flung himself into a general campaign against Protes- tantism in general and the Anglican form of it in particular. He nevertheless took deacon's orders in 1838 and priest's orders in 1840. In 1839 he became the editor of the British Critic, the organ of the Tractarian party, and he excited suspicion among the adherents of the Tractarian s themselves by his violent denunciations of the Church to which he still belonged. In 1841 he urged the publica- tion

of the celebrated "Tract XO," and wrote in defence of it. From that period Ward and his associates worked undisguisedly for union with the Church of Borne, and in 1844 he published his Ideal of a Christian Church, in. which he openly contended that the only hope for the Church of England lay in submission to the Church of Borne. This publication brought to a height the storm which had long been gathering. The University of Oxford was invited, on 13th February 1845, to condemn " Tract XO," to censure the Ideal, and to degrade Ward from his degrees. The two latter propositions were carried, and " Tract XO" only escaped censure by the 9i07i placet of the proctors Guillemard and Church. The condemnation precipitated an exodus to Borne. Ward left the Church of England in September 1845, and was followed by many others, including Newman himself. After his reception into the Church of Borne Ward gave himself up to ethics, metaphysics, and moral philosophy. He wrote articles on Free Will, the Philosophy of Theism, on Science, Prayer, and Miracles for the Dublin Review. He also dealt with the condemnation of Pope Honorius, carried on a controversial correspondence with John Stuart Mill, and took a leading part in the discus- sions of the Metaphysical Society founded by Mr James Knowles, of which Tennyson, Huxley, and Martineau were also prominent members. He was a vehement opponent of Liberal Catholicism. In 1851 he was made professor of moral philosophy at St Edmund's College, Ware, and was advanced to the chair of dogmatic theology in 1852. In 1868 he became editor of the Dublin Review. He gave a vigorous support to the promulgation of the dogma of Papal Infallibility in 1870. After his admission into the Roman Catholic Church he had, rather to the dismay of his friends, entered the married state, and for a time had to struggle with poverty. But his circumstances afterwards im- proved. He died 6th July 1882. (j. J. l.)*

Ward ha, a town and district of British India, in the Nagpur division of the Central Provinces, which take their name from the Wardha river. The town is situated 48 miles south-west of Nagpur by rail. It was laid out in 1866, shortly after the district was first constituted. Population (1881), 5816 ; (1891), 8322. There are two steam factories, pressing 153,000 maunds of raw cotton.

The district of Wardha has an area of 2428 square miles ; population (1881), 387,221 ; (1891), 400,854, showing an increase of 4 per cent. ; average density, 165 persons per square mile. In 1901 the population was 385,483, showing a decrease of 4 per cent. The land revenue and rates were, Rs. 7, 31, 292, the incidence of assessment Being R.0-7-5 per acre ; cultivated area (1897-98), 916,854 acres, of which 3149 were irrigated from wells ; number of police, 389 ; boys at school, 6115, being 20 per cent, of the male population of school-going age ; registered death-rate (1897), 58 ‘37 per 1000. The principal crops are cotton, millet, wheat, and oil-seeds. This region has given its name to the cotton known in the market as

Hinganghat. There are two cotton-mills at Hinganghat and Pulgaon, and eight steam cotton presses. The district is traversed by the Nagpur line of the Great Indian Peninsula Railway, with five stations. A branch runs from Wardha town past Hinganghat to the Warora coal-field in the district of Chanda.

Ware, a town of Hampshire county, Massachusetts, U.S.A. It comprises an area of 28 square miles of hill country, in the central part of the state, containing several villages, the largest of which bears the same name as the town, and is on the Ware river, and on the Boston and Albany and the Boston and Maine railways, at an altitude of 488 feet. It is irregularly laid out, and has an excellent water-supply. Its chief industry is the manufacture of cotton and woollen goods. Population of the town (1880), 4817; (1890), 7329; (1900), 8263, of whom 3263 were foreign-born.

Wareham, a municipal borough of Dorsetshire, England, 17 miles south-east of Dorchester, near Poole Harbour, with a station on the London and South-Western Railway. It formerly sent two members to Parliament, but in 1832 its representation was merged in that of the county. In the ancient church of St Mary is a chapel said to be the burial-place of the Anglo-Saxon kings. The town and neighbourhood have been long noted for their lime and cement, and large quantities of potters’, pipe, fire, and other

~~kinds of clay are sent to Staffordshire and to foreign countries. Population (1891),~~

~~2141 ; (1901), 2003.~~

~~Warminster, a market town and railway station in the Westbury parliamentary division of Wiltshire, England, 21 miles west-north-west of Salisbury. The restoration of the church of St Denys has been completed, and the missionary college provided with new buildings. There is a technical and industrial institute. Area of parish (an urban district), 6564 acres. Population (1891),~~

~~5563; (190!). 5547-~~

~~Warner, Charles Dudley (1829-1900),~~

~~American author, was born at Plainfield, Massachusetts, 12th September 1829. He graduated at Hamilton College, Clinton, New York, 1851 ; became a lawyer, and practised in Chicago 1856-60 ; but in 1861 removed to Hartford, Connecticut, as editor of the Press (merged in the Courant in 1867). There he continued to reside, engaged in editorial work upon that journal and Harper's Magazine, in lecturing, in such public services as prison reform, city park supervision, &c, and in literary work. Of his numerous volumes the first was The Book of Eloquence (1853), a collection of extracts for declama- tion ; but his place in American literature dates from the appearance of the humorous and reflective sketches entitled My Summer in a Garden, first published in his newspaper, and reissued in a small volume in 1870. Their literary style was midway between the formal sentiment of Irving and the brisk paradoxes of Mark Twain; and the pleasure they gave to the reader was due to their delicacy of touch, kindly suggestiveness, and humorous wholesomeness of tone. Their general method of entertaining comment on things and men was after- wards applied by the author to many successive collections of sketches of travel, life, &c, such as Saunterings (in western Europe, 1872), Baddeck and That Sort of Thing (Nova Scotia, &c, 1874), and Back-Log Studies (1872). A more descriptive and on the whole a less jocose style was adopted in Mummies and Moslems (1876), In the Levant (1877), On Horseback (in the Southern states, 1888), and~~

~~Our Italy (southern California, 1891). Warner also wrote a book of reminiscences of child- hood, and biographies of Captain John Smith and Washington Irving (the first semi-humorous and the~~

~~second wholly serious). He edited the "American Men of Letters" series, and a large "Library of the World's Best Literature " ; but his chief contributions to literature, apart from the books named and the graceful little collec- tion of Harper's Magazine essays under the titles of As We Were Saying (1891) and As We Go (1893), are his novels, The Gilded Age (in collaboration with Mark Twain, 1873), Their Pilgrimage (1886), A Little Journey in the World (1889), The Golden House (1894), and That Fortune (1899). The first of the novels is a broad satire on American "shiftiness"; the others, like Howells's Their Wedding Journey, combine topographical descrip- tion with quiet character-study — the author's expression of the society in which he has lived. The three last named form a trilogy on the general subject of money- making and money-losing. Warner died at Hartford, Connecticut, 20th October 1900.~~

~~Warnsdorf, a town in the government district of Rumburg, in Bohemia, near the Saxon frontier. The chief industries comprise cotton spinning, weaving, and calico printing, the manufacture of cloth, woollen and linen stuffs, satin «,nd velvet, machinery, cement, colours, &c. The ecclesiastical edifices include an old-Catholic church, and there is a monument to the imperial reformer, Joseph II. Population (1890), 18,268 ; (1900), 21,150.~~

~~Warora, a town of British India, in the Chanda district of the Central Provinces, with a railway station. Population (1881), 8022; (1891), 10,018. Warora gives its name to a coal-field. The colliery, which is worked by the Government, employs about 1500 persons. In 1897-98 the output was 115,652 tons, of which 56,070 tons were sold to the railway; total expenditure, Rs.3,97,594, being Rs.3.7.0 per ton ; total receipts, Bs.5,40,749, showing a profit of 7 "7 per cent, on the capital outlay. A fireclay industry under the same management raised 2065 tons of iron-clay in 1897, and sold bricks and tiles to the value of Rs.34,948. Warora is connected with Wardha on the Great Indian Peninsula Railway by a state line 45 miles in length.~~

~~Warren, a city of Ohio, U.S.A., capital of Trum- bull county, on the Mahoning river, and on the Penn- sylvania, the Erie, and the Pittsburg and Western railways, in the north-eastern part of the state, at an altitude of 872 feet. ' It is in a region of coal and iron mining, and has rolling-mills, machine-shops, and other manufactures. Population (1880), 4428; (1890), 5973 ; (1900), 8529, of whom 1161 were foreign-born and 137 negroes.~~

~~Warren, a borough of Pennsylvania, U.S.A., capital of Warren county, on the Allegheny river, and the Dun- kirk, Allegheny Valley and Pittsburg, the Pennsylvania, and the Western New York and Pennsylvania railways, in the north-western part of the state, at an altitude of 1189 feet. It is in the oil region, and most of its industries are directly connected with the production, refining, and distribution of oil. Population (1880), 2810 ; (1890), 4332 ; (1900), 8043, of whom 1529 were foreign-born.~~

~~Warrensburg', a city of Missouri, U.S.A., capital of Johnson county, on the Black river, and on the Missouri Pacific Railway, in the western part of the state, at an altitude of 831 feet. Its site is hilly, its street plan regular, it has a good water-supply, and is divided into four wards. It is surrounded by a rich farming region, for which it serves as a shipping and supply point. Population (1880), 4049; (1890), 4706; (1900), 4724, of whom 127 were foreign-born and 556 negroes.~~

~~Warrington, a municipal, county, and parlia- mentary borough and market town, in the Newton parlia- mentary division of Lancashire, England, 18 miles west- south-west of Manchester, on the river Mersey, with stations on several railways. Parr Hall, opened in 1895, was built at a cost of £10,000, and a county court-house was erected in 1897. Victoria Park and Queen's Gardens were opened in 1897. Population (1891), 52,288 ; (1901),~~

~~64,241.~~

WarrnambOOl, a seaport town, Victoria, Aus- tralia, in the county of Villiers, 166 miles south-west of Melbourne, and its nearest port on the western seaboard. A viaduct and breakwater pier, 2400 feet in length, have been constructed. Dairy produce is exported to the value of about £150,000 annually. Race meetings are held, the steeplechase course being said to be the best in the colony. Luxurious sea-baths have been fitted up by the corporation. The summer climate is the coolest in the Australian states. Population (1881), 4839; (1891),

6582; (1901), 6410.

Warsaw, a government of Russian Poland, occupy- ing a narrow strip of land on the left bank of the Vistula and the lower Bug down to the Prussian frontier. It has an area of 5623 square miles, and its population, which was 971,730 in 1885, in 1897 numbered 1,933,689 (domiciled only), of whom 949,794 were women, and 791,746 lived in towns, chiefly in the city of Warsaw. The inhabitants are mostly Poles, Jews (about 225,000), and Germans (about 90,000). The government is divided into thirteen districts, the chief towns of which are War- saw, Bronie (2981), Gostynin (6455), Grojec (5800), Kutno (11,213), Lowicz (12,434), Neszawa (2573), Novo- Minsk (7978), Ptonsk (7907), Eadzymin (3629), Skier- newice (9846), Sochaczew (5968), and Wtocfawek (23,065). In spite of an unfertile soil, agriculture is prosecuted with considerable success. The total area under cereal crops in 1900 was 1,605,800 acres. The average yield in 1895-99 was : wheat, 1,701,000 cwt. ; rye, 5,371,000 cwt. ; barley, 863,000 cwt. ; oats, 2,044,000 cwt.— all cereals, 10,559,000 cwt. ; also pota- toes, 15,430,000 cwt. Cattle-breeding is also widely en- gaged in, and there were in the province in 1898 119,970 horses, 339,800 horned cattle, 453,600 sheep, and 171,300 pigs. Manufacturing industries have greatly developed. In 1898 the aggregate returns of all factories amounted to 106,316,000 roubles, as compared with 54,700,000 roubles in 1885, thus making Warsaw the fifth industrial province in Russia in Europe. The princi- pal establishments are machinery and sugar works, flour- mills, and factories for plated silver, carriages, carpets, woollen cloth, boots and shoes, and ready-made clothing.

Warsaw (Polish, Warszawa), the chief town of the above government and the capital of Poland, on the left bank of the Vistula. It is an important railway junction, from which five railways radiate to Danzig in Prussia, St Petersburg (700 miles), Moscow (870 miles), vid Siedlce and Brest Litovsk, Kieff and south-west Russia, vid Lublin, Berlin (404 miles), and Vienna, vid Skier- newice. It has continued to develop, and had in 1897 a population of 638,208. About one third of these are Jews ; Germans form an important element, and the Russian garrison numbers some 31,000 ; the rest are Poles. The abolition of the central administra tion of the lieutenancy of Poland and of the adminis- trative autonomy of the Polish provinces has in no wise diminished the national importance of the city, nor has the fact that in all the educational institutions but two in- struction is given in Russian. On the contrary, it acquires every year more and more importance as an intellectual

centre — literary, dramatic, and musical — for all Polish- speaking peoples, and as an industrial centre both for Poland and the western portion of the Russian Empire. From a military point of view Warsaw remains the chief strong- hold for the military defence of Poland ; the Alexander Citadel has been much improved, and the bridge across the Vistula is defended by a strong fort, Sliwicki. Many large and handsome buildings have been erected, and several empty spaces have been converted into gardens and beautiful squares; improvements have been made in the Saxon Garden, and the " Uyazdovsk " boulevards have been planned in imitation, on a small scale, of the Champs Elysees of Paris. The iron and steel industry has greatly developed. The principal steel works now pro- duce annually no less than 100,000 tons of steel goods, half of which are rails, and some of the establishments rank among the largest of their kind, though out of 368 factories registered in 1895, 100 employed less than 16 workers each, 175 from 16 to 50, and only 34 more than 100. The machinery works have suffered to some extent from competition with those of southern Russia, and find the high price of land a great obstacle in the way of extension. But the manufactures of plated silver, carriages, boots and shoes (annual turnover 80,000,000 roubles), millinery, hosiery, gloves, and all sorts of small artistic house decorations retain their importance, chiefly owing to the skill of the workers. There are altogether more than 50,000 artisans in the city. Trade is principally

~~in the goods enumerated above, but the city is still a centre for trade in corn, leather, coal, and sugar, and its two fairs (wool and hops) have a great reputation throughout western Russia. (p. a. k.)~~

~~Warthe, or Wartha, a river of Poland and Prussia. It rises on the north slope of the mountains north of Cracow, flows north as far as Radomsk, then west, then north again past Sieradz, until it reaches Kolo, where it again turns west, crosses the frontier into the Prussian province of Posen, wheels north again to beyond the town of Posen, then once more bends west, and flowing past Schwerin and Landsberg, enters the Oder, from the right, at Kiistrin. Its total length is 440 miles, of which 210 are in Poland and 230 in Prussia ; it is navigable up to Konin in West Poland, a distance of 265 miles. Its banks are mostly low and flat, its lower course especially running through marshes (drained and cultivated). It is connected with the Vistula through the Netze (its own right-hand tributary) and the Bromberg canal. The area of its drainage basin is 17,240 square miles.~~

~~Warwick, a midland county of England, bounded on the W. by Worcester, on the N.W. by Stafford, on the N.E. and E. by Leicester and Northampton, and on the S. by Oxford and Gloucester.~~

~~Area and Population. — The area of the- ancient county is 577,462 acres, or 902 square miles, with a population in 1881 of 737,339 ; in 1891 of 805,072, of whom 388,261 were males and 416,811 females ; and in 1901 of 897,678, the number of persons per square mile being 995, and of acres to a person 0‘64. The area of the administrative county, as given in the census tables of 1891, was 562,797, with a population of 307,193, or, including the county boroughs of Birmingham and Coventry, 578,595 acres, with a population of 838,039. Since 1891, however, various changes have been made in the administrative area. In 1895 the part of the parish of Drayton Bassett in Warwick was transferred to Stafford, and the parish of Stoneton was transferred from North- ampton to Warwick ; and in 1896 the part of the parish of Batsford in Warwick was transferred to Gloucester, and the parish of Oldberrow from Worcester to Warwick. The area of the registration county is 621,833 acres, with a population in 1891 of 801,738 and in 1901 of 906,451, of whom 439,177 were males and~~

467,274 were females. Within the registration area the increase of population between 1881 and 1891 was 9 ‘75 per cent., and between 1891 and 1901, 13 per cent. The excess of births over

deaths between 1881 and 1891 was 106,685, and the actual increase of resident population was 71,223.

The following table gives the numbers of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 :—

Year.

Marriages.

Births.

Deaths.

Illegitimate Births.

Males.

Females.

1880 1890 1898

5174 6643 8064

25,975

24,567 28,123

14,481 15,971 16,199

481 476

592 475 422

In 1899 the number of marriages was 8009, of births 28,586, and pf deaths 16,843.

The following table gives the marriage-, birth-, and death-rates per thousand of the population, with the percentage of illegitimate births, for a series of years : —

1870-79.

18S0.

1880-89.

1890.

1888-97.

1898.

Marriage-rate

16-7

14-3

14-9

167

16-6

18-9

Birth-rate :

~~37·4~~

~~35·8~~

~~33·5~~

~~30·8~~

~~31·5~~

~~32·9~~

~~Death-rate .~~

~~22 2~~

~~20·0~~

~~190~~

~~20·1~~

~~19·2~~

~~19·0~~

~~Percentage of ille-~~

~~gitimacy .~~

~~4·2~~

~~4·2~~

~~4·1~~

~~3‘9~~

~~3·7~~

Both the birth-rate and the death-rate are high, but the per- centage of illegitimacy is much below the average. The number of Scots in the county in 1891 was 3453, of Irish 7084, and of foreigners 2591.

Constitution and Government. — The county contains six municipal boroughs: Birmingham (522,182), Coventry (69,377), Royal Leamington Spa (26,888), Stratford-on-Avon (8310), Sutton Coldfield (14,264), and Warwick (11,889). Birmingham and Coventry are county boroughs. The following are urban districts : Aston Manor (77,310), Bulkington (1548), Erdington (16,366), Kenilworth (4544), Nuneaton and Chilvers Coton (24,995), and Rugby (16,838). "Warwickshire is in the midland circuit, and assizes are held at Warwick. The boroughs of Birmingham, Coventry, Royal Leamington Spa, Stratford-upon-Avon, Sutton Coldfield, and Warwick have separate commissions of the peace, and the boroughs of Birmingham and Warwick have, in addition, separate courts of quarter sessions. The ancient county, which is mostly in the diocese of Worcester, contains 276 entire ecclesi- astical parishes or districts, with parts of 14 others.

Education. — Birmingham is the seat of a university and other important educational institutions, and Rugby of one of the most famous of English public schools. There is a day training college for schoolmasters and schoolmistresses in connexion with Mason University College, Birmingham. In Birmingham there are two board deaf schools, a general institution for the blind, and the royal institution for the deaf and dumb. At Aston there is a board deaf school. The total number of elementary schools on 31st August 1899 was 415, of which 120 were board and 295 voluntary schools, the latter including 243 National Church of England schools, 4 Wesleyan, 36 Roman Catholic, and 12 "British and other." The average attendance at board schools was 77,952, and at voluntary schools 58,332. The total school board receipts for the year ended 29th September 1898 were £356,656. The income under the Agricultural Rates Act was over £1878.

Agriculture. — About five-sixths of the total area is under cul- tivation, and of this about two-thirds is in permanent pasture. About 2500 acres

~~are under orchards and 21,000 under woods. The acreage under corn crops has greatly diminished, the decrease being chiefly in that under wheat, which amounts to about one- third of the wheat acreage. Wheat is, however, still grown on about two-fifths of the corn acreage, while barley occupies less than one-third and oats only about one-seventh. More than half the acreage under green crops is occupied by turnips, swedes, and mangold, much attention being paid to cattle-rearing and dairy-farming. The following table gives the acreages of the larger main divisions of the cultivated area at intervals from 1885 :—~~

~~Tear.~~

~~Total Area under Cul- tivation.~~

~~Corn Crops.~~

~~Green Crops.~~

~~Clover.~~

~~Permanent Pasture.~~

~~Fallow.~~

~~1885 1890 1895 1900~~

~~496,850 495,490 494,680 495,284~~

~~110,426 10,101 92,829 92,513~~

~~31,784 29,283 29,894 28,349~~

~~41,857 35,175 37,836 33,174~~

~~298,352 317,502 324,703 334,583~~

~~14,430~~

~~10,108~~

~~8,922~~

~~6,115~~

~~The following table gives particulars regarding the principal live-stock during the same years : —~~

~~Tear.~~

~~Total Horses.~~

~~Total Cattle.~~

~~Cows or Heifers~~

~~in Milk or in~~

~~Calf.~~

~~Sheep.~~

~~Pigs.~~

~~1885 1890 1895 1900~~

~~20,630 20,695 22,273 22,482~~

114,296

104,360

95,305

108,592

38,432 35,425 32,249 35,958

296,867 306,913 272,856 272,189

41,348 45,835 46,498 36,405

Industries and Trade. — According to the report for 1898 of the chief inspector Of factories (1900), the total number of persons employed in factories and workshops in 1897 was 192,444, as compared with 182,302 in 1896. Of these only 5110 were em- ployed in textile factories, woollen and worsted industries, &c, employing 1396, and silk (including ribbons at Coventry and Nuneaton) 2427. Non-textile factories employed 156,008, the percentage of increase between 1895 and 1896 being 17 '6, while between 1896 and 1897 it was 5'6. As many as 60,731 persons were employed in the manufacture of machines, appliances, con- veyances, and tools, 16,354 in the founding and conversion of metals, 14,718 in the manufacture of jewellery, plate, instruments, and fancy articles (Warwickshire ranking in this respect next to London), 12,140 in furniture-making, 7180 in the manufacture of paper, &c, 6618 in the galvanizing and finishing of metals, 3792 in clothing industries, 1739 in clay and stone industries, 1605 in the manufacture of glass, 1869 in indiarubber and gutta- percha manufactures, and 1051 in the manufacture of chemicals. Of the 31,326 persons employed in workshops, 6387 were engaged in clothing industries, 6236 in jewellery, &c, industries, 4270 in furniture-making, 3873 in the manufacture of machines, &c. , and 1179 in the manufacture of paper, &c. The total number of persons employed in connexion with mines and quarries in 1899 was 10,440. In the same year 651,433 tons of clay were raised, 227,959 tons of limestone, 116,440 tons of sandstone, 139,352 tons of

~~*igneous rocks, 41,405 tons of gravel and sand, and 5709 tons of iron pyrites ; 27,354 tons of fireclay, valued at £5471, were raised in 1899, as compared with 35,299 tons, valued at £7069, in 1890. Iron ore, of which 10, 981 tons, valued at £5490, were obtained in 1885, has been mined in increasing quantities, 30,497 tons, valued at £3176, having been obtained in 1899. The following table gives the output from coal-mines in 1890 and 1898 : —*~~

~~*Coal.*~~

~~*1890 1898*~~

~~*Tons.*~~

~~*1,744,174 2,873,098*~~

~~*Value.*~~

~~*£697,670*~~

~~*969,671*~~

~~*Authorities. — Burgess. Early Earthworks in Warwickshire. Birmingham, 1884. — Deacin. Sketches in Shakespeare Villages. Birmingham, 1885. — Timmins. History of Warwickshire (Popular County History series). London, 1889. — Burgess. Historic Warwickshire. Birmingham, 1892-93. — Hannet. The Forest of Arden. Birmingham, 1894. — Nuthall. Warwickshire Word Book. (English Dialect Society.) London, 1897.*~~

~~*(T. F. H.)*~~

~~*Warwick, a municipal and parliamentary borough and county town of Warwickshire, England, on the Avon, 98 miles north-west by west of London by rail. The King's School was founded during the reign of Edward the Confessor. Upon the same foundation are the high school for girls and the King's Middle School. There is a free library and a museum.*~~

~~There are iron-works and a gelatine factory. Area of muni- cipal borough, 5613 acres. Population (1891), 11,903;~~

~~(1901), 11,889.~~

~~Warwick, a town of Queensland, Australia, in the county of Merivale, 169 miles by rail north-west of Brisbane. The district is a wheat- and maize-growing one. Vine-culture has also been successfully tried, and is extending. The town has substantial public and private buildings, and two large parks besides smaller recreation grounds. The water — supply from the Condamine is excellent and unlimited. Coal is found in various parts of the district, as are also excellent building stone and brick-clay. Mean rainfall (12 years), 32”13 inches. Population (1891), 3402 ; (1901), 3836.~~

~~Warwick, a town of Kent county, Bhode Island, U.S.A., comprising an area of 44 square miles of level . country, fronting on Narragansett Bay, and traversed by a line of the New York, New Haven, and Hartford Eailroad. Its population is scattered among more than a score of small villages, whose chief industry is the manufacture of cotton goods. Warwick was settled in 1642, and in- corporated five years later. Population (1880), 12,164; (1890), 17,761; (1900), 21,316, of whom 7792 were foreign-born and 183 negroes.~~

~~Wasa. See Vasa.~~

~~Washburne, Elihu Benjamin (1816-~~

~~1887), American statesman, was born in Livermore, Me., on the 23rd of September 1816. He was one of seven brothers, of whom four sat in Congress from as many different states. After a common school education he was admitted to the bar ; in 1840 he removed to Galena, 111. He was elected to Congress in 1852, where, first as a Whig and afterwards as a Kepublican, he represented his district without intermission till 1869. ,He contributed much to aid General Grant early in the Civil War, and the~~

~~*latter on becoming President made Washburne Secretary of State. Prevented by ill- health from serving in this position, he was appointed minister to France, where during the Franco German war and the Commune he won much distinction as pro tector of German and other foreign citizens in Paris. In 1877 he retired from public life, and died in Chicago, 111., 22nd October 1887.*~~

~~*Washington, one of the states of the American Union, occupying the extreme north-western portion of the country. Wholly within it lies Puget Sound, on the shores of which cities have grown up within a few years that carry on a large share of American trade with the Orient. It was organized as a territory in 1853, and was admitted as a state in 1889.*~~

~~*Population. — The population has rapidly increased from 11,594 in 1860 to 349„390 in 1890 and 518,103 in 1900, an increase of 48”3 per cent, during the decade 1890-1900. The density per square mile had increased during the same period from 5-2 to 7‘7. In 1890 the three principal cities contained 28”27 per cent, of the population. Between 1890 and 1900 Seattle increased from 42,837 to 80,671, Tacoma from 36,006 to 37,714, and Spokane from 19,922 to 36,848. The three then con- tained about 30 per cent, of the population. There were in 1900 ninety incorporated places, of which only twenty had a population of more than 2000. The urban population (including under this head all persons in cities of more than 4000 inhabitants) increased from 33 ‘8 per cent, of the total population in 1890 to 36‘4 per cent, in 1900. In the latter year the population comprised 304,178 males (58-7 per cent.) and 213,925 females (41-3 per cent.) The foreign-born numbered 111,364 (21-5 per cent.) and the coloured 22,799 (4-2 per cent.). The coloured population included 2514 negroes, 3629 Chinese, 6617 Japanese, and 10,039 Indians.*~~

~~*Railways. — Until the advent of railways, settlement progressed slowly. Since the construction of the trans- continental lines, commercial development has been more marked than increase of population. Three trans-conti- nental systems cross or enter Washington. The Great Northern and Northern Pacific traverse its entire length from east to west, and the Canadian Pacific has access by traffic arrangements on lines*~~

passing from the international boundary to Seattle. There are railways from Seattle and Tacoma south to the Oregon line, from Walla Walla

in the south-eastern corner to Spokane, and from Spokane north to British Columbia. Numerous branches tap agri- cultural and mineral regions, and many extensions are under construction. In 1880, when the first railway was built, the mileage was 289. This increased to 2012 in 1890 and 2914 in 1900.

Commerce. — The official statement of the Puget Sound customs shows that the exports have grown from $3,184,908 in 1885 to $20,678,829 in 1901, and the imports from $238,036 in 1885 to $6,721,060 in 1901. The exports have been largely wheat, flour, and lumber ; the imports tea, silks, and other Oriental products. Large quantities of iron, cotton, and other merchandise from the middle west now take this route to China and Japan, while return traffic, heretofore carried by way of the Suez Canal, is being diverted to the eastward passage and the Pacific coast. So extra-ordinary has been the demand for ocean carriage that the Great Northern Railway is now (1902) finishing several steamers (of more than 20, 000 tons each) for the Pacific trade.

Lumber. — First in importance of the natural resources of Wash- ington at the present time are its forests. The department of geography and forestry of the United States Geological Survey estimates the timber standing in the state at 114,778,000,000 feet, of which 71 , 000, 000, 000 are fir, 18, 000, 000, 000 cedar, 1 7, 278, 000, 000 hemlock, and 8,500,000,000 spruce. Practically all of this is on the western side of the Cascade Mountains, the fir and cedar being in the north-western portion of the state, and the hemlock and spruce in the south-western part. It is estimated by the Govern- ment that, since lumbering began in the state, 40,000,000,000 feet have been destroyed by fire and 36,000,000,000 handled by the mills. The total standing timber in western Washington is estimated at 103,504,276,000 feet. There are 533 saw and shingle mills, and 344 logging camps. The grand total output for all the mills for 1901 was 1,450,000,000 feet. In 1901, 52,337 cars of lumber and shingles were shipped east, an increase of 9651 cars over the best previous record. The total lumber shipments (by cargo and rail) were 889,500,046 feet, and of

shingles 4,485,600,000 pieces. While the main timber supply is drawn from the forests between the summit of the Cascades and the Pacific, there is a considerable growth on the eastern slope of the range and north of the Columbia river. The timber in this region consists mostly of white and yellow pine, with some red fir. Washington lumber is shipped to California, Australia, South America, Hawaii, China, Alaska, South America, Mexico, and the Philippines, and to all principal European ports. A large demand for this lumber from the middle western states is growing with the decrease of the pine forests of Minnesota, Wisconsin, and Michigan. Large forest areas have been set aside in the state, by executive pro- clamation under Acts of Congress, as permanent forest reserves (see Forestry).

Fisheries. — The principal item in the fishing industry is the can- ning of salmon. In the Puget Sound district the official report for 1901 shows twenty-four canneries employing 8657 men, and putting upon the market 1,410,444 cases of salmon, valued at $5,641,776. With the addition of fresh, salt, and smoked fish of other varieties, and of shellfish, the total product of the district for the year aggregated $6,817,041. Large canneries are still being built. The total salmon packed for the state of Washington for 1901 was 1,584,650 cases, valued at over $6,335,000. This is over one-third of the total pack of the Pacific coast, which was 5,024,538 cases, valued at over $20,000,000. The largest cannery in the world is situated at Fairhaven. The salmon supply is re- inforced by the work of fish hatcheries supported and conducted by the state. Twenty-one of these in 1901 gave an output of 57,156,500 young salmon.

Minerals. — The coal-fields are of wide area, lying mostly on the western side of the Cascades in the north-western part of the state. The product is bituminous and lignite, no anthracite having been found thus far. There are twenty-one coal mines, whose total out- put for 1900 was 2,418,034 tons, having an average value at the mine of $1.83 per ton. Mines have been conducted principally in Kittitas, King, Pierce, Whatcom, and Snohomish counties. From the bituminous coals, the best quality of coke is produced, the fixed carbon ranging from 50 to 60 per cent. There has been little deco prospecting for coal, the measures that have been opened having been developed from the outcrop. The increasing de- mand for

Washington coal, both for the growing manufacturing industry of the state, and for the large fleets of steamers from Puget Sound, encourages prospecting, and new measures are being discovered. Coal is shipped in considerable quantities to San Francisco, and some to Honolulu. The value of the total output is over $4,000,000 a year, and some 4338 men find work in the mines. There are extensive deposits of iron ore in various parts of the state that have not been developed commercially owing to the absence of a market. Much of the ore is of good Bessemer quality. The Skagit valley has iron-fields covering an area of 5 to 6 miles

wide, by 15 to 18 miles long. The ore is found in veins varying from 6 to 60 feet in width, and assays 5 per cent, to 11 per cent, manganese, 38 per cent, to 50 per cent, of iron, 38 per cent, to 55 per cent, of silica, with small percentage of silver and phosphorus. Bed haanatite is found in the Lake Cushman district, running 40 per cent, to 50 per cent. iron. Hsematite iron, carrying $5 to $7 in gold and 50 per cent, iron, exists in the Clugston Creek district. Other deposits of iron are found on the Snohomish, Cedar, Chewelah, Icicle, Green, and Snoqualmie rivers, and in Mason and Thurston counties. Placer mining exists on the Columbia, Palouse, Skagit, and other rivers, although the deposits are not especially rich. The famous republic district in the northern part of the state which was opened in 1898, has become one of the notable gold-mining camps in the country. In the main range of the Kettle river, gold, silver, and copper are found, and along the Okanogan river there are deposits of free gold and gold-copper. Free gold and concentrating ores exist in the Slate Creek and Mount Baker districts. Dry silver is found in the Colville district. Index has gold and copper ; Monte Cristo, low grade galenas in large bodies ; Peshastin, free gold and concen- trating ores ; Cle-Elum, gold and copper. The total value of the gold and silver produced in 1900 was $1,008,463. The gold pro- duction for the year 1900 increased to 95,432 fine ounces, valued at $718,200 ; and the silver production to 148,300 fine ounces, with a coinage value of $290,263. In connexion with the mining of the precious metals, there was a yield in 1898 of 857,555

~~pounds of lead, valued at $32,416. At the Government Assay Offices established at Seattle there were received from the date of their establishment, 15th July '1898 to 31st December 1901, gold deposits amounting to $55,973,856.07; of which $508,600.63 was from the mines of Washington, $43,967,275.38 from Alaska, the Klondike, and adjacent districts, and $2,315,950.11 from British Columbia.~~

~~Agriculture. — Of the 44,796,160 acres included in the area of Washington, 11,756,785 acres are still unappropriated and un- reserved. While a considerable portion of these tracts is moun- tainous and unfit for cultivation, there is much good agricultural land, and a large area which needs only irrigation to make it ex- tremely productive. In eastern Washington there are millions of acres of good farm land, and in western Washington a large amount adapted to the raising of oats, barley, and vegetables, and to dairying. The tide .marsh lands when dyked produce 100 bushels of oats, 80 bushels of barley, 60 bushels of wheat, and 14 tons of hay per acre. In the western portion of the state the wooded slopes stretching down to meadows and river banks, the abund- ance of pure water, the mildness of the climate, and the ex- treme coolness of the nights during the entire year are favour- able to the making of high – grade dairy products. In 1900 there were 33,202 farms with an acreage of 8,499,297, of which 3,465,960 were improved. The total value of farm property was~~

~~$144,040,547.~~

~~Education, dec. — Ample provision is made for public education. In 1900 Washington had 2060 school districts, and of 139,097 census children, 122,104 were enrolled in the common schools. The teachers numbered 3784. The total expenditure for school purposes was $1,818,060.05, of which $977,632.25 was paid to teachers. Of the population over ten years of age in 1890, 4-3 per cent, were illiterates. Among 195,572 adult males in 1900, 6635 were illiterate (unable to write), of whom 3989 were foreign-born. The State University at Seattle has 600 students and 40 instructors. There are three state normal schools, with 675 pupils in all, and a flourishing agricultural college, with an attendance of 638. School revenues are derived from the sales and leases of school lands, and from~~

general and special taxes. When the state was admitted, 622,000 acres of public lands were granted for public buildings and state institutions. The school for defec- tive youth at Vancouver includes departments for the deaf, the blind, and the feeble-minded.

Marine, Interests. — Though the native woods are well adapted to shipbuilding, high wages have prevented the prosecution of the industry on an extensive scale. Most of the boats built are sailing craft. One yard at Port Blakely turned out 100 vessels in the decade 1890-1900, registering an average of more than 500 net tons. The Government despatch-boat Seward was built at Seattle, the torpedo-boat Rowan was launched there in 1899, and there is now (1902) under construction at that city the first- class battleship Nebraska. The largest dry dock is located at Port Orchard. A canal is under construction by the Federal Govern- ment from Puget Sound to Lakes Union and Washington. These will constitute a fresh -water harbour for the largest ocean-going vessels. Another fresh-water harbour is being constructed at the mouth of the Snohomish river at Everett.

Coast Defences. — -The entrance to Puget Sound is defended by heavy fortifications upon which over a million dollars have been expended. At three points — Point Wilson, Admiralty Head, and Marrowstone Point — these works have been constructed and provided with modern guns of the heaviest calibre. The forts are

arranged in a triangle so that their fire could be concentrated upon any point in the channel, and no fleet could pass the entrance. In addition to this, the cities of Seattle and Tacoma and the navy yard at Port Orchard are defended by strong fortifications in their immediate vicinities.

Fincmces. — On 30th September 1900 the outstanding warrants on the general fund of the state amounted to 1600.719.67, the military funds warrants to $2039.22, and the state bonds to $817,671.72 ; making a total state indebtedness of $1,418,391.39. The assessed valuation of real estate as equalized for the year 1901 was $188,816,920 ; of personal property, $54,890,300 ; and of railway trackage, $16,473,514 ; making a total valuation of $260,180,734. The state tax was $676,464, and the state school tax, $1,300,902. Since the close of the period of depression in

~~1893, the banking interest of the state has increased rapidly. The total deposits of the forty-two national and state banks in the autumn of 1901 amounted to $29,198,129, or more than $56 per caput. Of this sum $24,255,000 was in the national institutions, the capital stock of which was $3,155,000, and the loans and discounts, $15,078,000. The state banks had a total capital stock of $1,602,800, and the capital, surplus, and undivided profits and individual deposits, amounted to $5,945,210, and the total resources to $9,533,859. The deposits of the national banks increased from $7,009,614 in 1893. For the calendar year 1901 the bank clearings of the three principal cities were : Seattle, $144,634,367 ; Spokane, $58, 856, 221 ; Tacoma, $59,622,548. Savings banks are few, and no statistics with regard to them are available.~~

~~Politics: Woman's Suffrage. — The territorial legislature in 1883 passed an Act extending the suffrage to women, and it was declared valid by a decision of the Supreme Court in the following year. In 1886 it was amended, and under this law women voted at all general and municipal elections, and served on grand and petty juries. In 1887 the Supreme Court again reviewed the law, and declared it void on account of a technical defect in the title. The law was re-enacted in 1888 to cure the defect, and was this time overthrown by the Court on the ground that women were not ' ' citizens of the United States " within the meaning of the Organic Act. When the constitution prepared for the state of Washington was submitted to the voters, women's suffrage was embodied in a section which was voted upon separately and defeated. Continued efforts were made to secure another vote on the question, and it was brought before the people again in the election of 1898, when a suffrage amendment was voted upon and lost by some 9000 votes. Under the constitution of the state, the state legislature consists of a senate of 34 members and a house of representatives of 80 members. The governor holds office for four years. The total vote of the state for governor was 58, 543 in 1889, and 89,897 in 1892, in both of which years a Republican was elected ; in 1900 it was 103,907, when a Democrat was elected with a plurality of 2084 votes. In the presidential election of 1896 the Democratic candidate received a plurality of 12,493, and in 1900 the plurality of the Republican nominee was 12,623.~~

(J. G. P.)

Washington, a city and the capital of the United States of America. It is on the north bank of the Potomac river, at the head of tide and navigation. The statue on the Capitol dome is in 38° 53' 23-25" N. and 77° 00' 33-55" W. The city is commonly regarded as identical in area and population with the District of Columbia, since the entire District is under one govern ment, and no distinction, except in matters of taxation, is made between urban and rural portions. Owing to the rapid growth and extension of the city, the area of the District, 60 square miles of land surface, is already in great part covered by urban population. That part of its site lying below the cliffs has become entirely occupied, and urban settlement has extended upon the plateau above the cliffs to the boundaries of the District in several directions.

Washington is one of the best paved cities of the world. More than one-half of its street area is paved with sheet asphalt, while a smaller part, including those streets sub- jected to heavy traffic, is paved with granite blocks, and altogether about five-sixths of its street area is paved. Its street car service is equally satisfactory : after a long struggle the overhead electric trolley has been banished from the central portions of the district, and the under- ground trolley adopted on all the urban lines, comprising some 50 miles of double track. The suburban lines are

run by overhead trolley. Besides the numerous circles and . parks, large and small, which are scattered throughout the city, there are several large parks in its neighbourhood. Among them is the soldiers' home park, north of the centre of the city, comprising an area of 523 acres, in which are the buildings of the national home for soldiers of the regular army. The Zoological Park, on Kock Creek, north-west of the city, comprises an area of 167 acres. Its site is very picturesque, and the collection of animals makes it a popular resort. North of this, and extending to the

boundary of the district, and including both banks of Eock Creek, with its wild and picturesque beauty, is a tract of 1600 acres, known as Eock Creek Park, which has been purchased by the Government and as yet is largely unimproved. On the opposite side of the Potomac, in Virginia, is Fort Myer, a military post, with ample grounds, and adjoining it, Arlington, for- merly the estate of the Lee family and now a National Cemetery, in which lie buried 16,000 Union soldiers and many distinguished officers. Among the fine build- ings recently erected is the new city post office, which occupies an entire square on Pennsylvania Avenue. It is a steel and stone structure, nine storeys in height, with a tower. It houses not only the city post office, but the entire department of the General Post Office, which has been removed from the old post office building on 7th Street.

The libraries of the city are rich and numerous. First in order of mention is the library of Congress, now housed in its new building just east of the Capitol, probably the finest building of its kind in the world. Its dimensions are 470 by 340 feet, thus cover- ing nearly 4 acres. It is of granite, three storeys in height, surmounted by a dome. The interior decorations are exceedingly ornate, many American artists having furnished mural paintings. It was erected between 1888 and 1897 at a cost exceeding $6,000,000, and contains 800,000 books and 250,000 pamphlets. The free city library, housed in a new building on Mount Vernon Square, contains 20,000 volumes. Besides these, several of the Government departments and bureaus maintain libraries, some of which, being on technical subjects, are both valu- able and exhaustive. The fine arts are well represented. Many of the smaller parks and circles are embellished with statues of men prominent in American history ; the Capitol contains many others, besides noteworthy paintings. The Corcoran Gallery of Art, founded and largely maintained by private endowment, contains a most noteworthy collection of paintings and statuary. It occupies a beautiful new marble building near the state, war, and navy building. The city contains numerous clubs, the principal of which are the Cosmos (scientific and literary), the Metropolitan, the Army and Navy, and the Washington Club. The last is composed of ladies. The rapid growth of the scientific element among the people is illustrated by its scientific societies, ten in number, with a total membership of about

4000. There are in the city numerous hospitals and homes for the dependent. Among the former are Providence Hospital, Garfield Hospital, Columbia Hospital, National Hoinceo- pathic Hospital, Freedmans Hospital, and the Emergency Hospital. Among the latter are the Louise Home, in- dustrial home school, reform school, House of the Good Shepherd, home for the aged, children's hospital, and several orphan asylums.

The city contains many educational institutions, in- cluding an excellent public school system, private schools and seminaries, and six colleges besides the Carnegie Institution, which was founded by Mr Carnegie in 1902 to " encourage investigation, research, and discovery,"

and to which he gave $10,000,000. The colleges are as follows : — Columbian University, a Baptist institu- tion, opened in 1821, which in 1899 had a faculty of 173 professors and was attended by 1041 students, including 118 women; Georgetown College, a Jesuit institution, opened in 1891, which had in 1899 a faculty of 113 and was attended by 634 students; Gonzaga College, a Eoman Catholic institution, opened in 1821, which had in 1899 a faculty numbering 15 and was attended by 151 students. Gallaudet College, a Govern- ment institution for the education of deaf mutes, was opened in 1865 ; in 1899 its faculty numbered 18 and the attendance was 103, including 39 women ; the Catholic University of America, opened in 1889, and intended for graduate students only, had ten years later a faculty numbering 34 and an attendance of 168; the buildings of the American Methodist University are in course of erection.

Washington has in proportion to its population little manufactures or commerce, its industries being mostly such as are required to supply the needs of its in- habitants. The city exists almost wholly for the machinery of government, and contains few other interests. In 1900 it had 2754 manufacturing establish- ments, with a total capital of $41,981,245. They em- ployed 24,693 hands, and paid in wages $14,643,714. The raw materials used were valued at $19,369,571, and the product was $47,667,622.

The assessed valuation of assessable real and personal property of the District in 1900 was $189,761,256. The non-assessable property, most of

which was the property of the general Government, had a value of very nearly the same amount. The net debt of the District was $14,553,874. The rate of taxation for urban property was $15‘00 per $1000, for farm lands $10-00. The income of the District was $7,835,680, and the expenditure for maintenance and operation $5,018,211. Because of its large property holdings, the United States Government assumes one-half of the expense of carrying on the District government and one-half of the District debt. The death-rate of the total population of the city in 1890 was 23”7 ; in 1900 it was 22-8, that of the coloured element being 31 0, and that of the whites 19‘1. Population (1890), 230,392; (1900), 278,718, of whom 191,532 were white and 87,186 coloured, including 86,702 negroes. (h. g*.)

Washington, a city of Indiana, U.S.A., capital of Davies county, at the “intersection of the Baltimore and Ohio South-Western, the Evansville and Indiana- polis, and the Southern Indiana railways, in the south-western part of the state, at an altitude of 510 feet. It is in a coal-mining region, and has a large business in the shipment of coal. Population (1880), 4323; (1890), 6064 ; (1900), 8551, of whom 391 were foreign-born and 255 negroes.

Washington, a city of Fayette county, Ohio, U.S.A. It is at the intersection of the Baltimore and Ohio, the Cincinnati and Muskingum Valley, the Cin- cinnati, Hamilton, and Dayton, and the Ohio Southern railways, south-west of the centre of the state, at an altitude of 970 feet. It is a railway centre of importance, and is in a rich farming region, for which it serves as a shipping-point. Population (1880), 3798 ; (1890), 5742 ; (1900), 5751, of whom 135 were foreign-born and 708 negroes.

Washington, a borough of Pennsylvania, U.S.A., capital of Washington county, on the Baltimore and Ohio, the Pittsburg, Cincinnati, Chicago and St Louis,

~~and the Waynesville and Washington railways, in the south-western part of the state, at an altitude of 1049 feet. It is in a region of coal and natural gas, and has manufactures of iron, steel, brass, and glass. It is the seat of Washington and Jefferson College, a Presby- terian institution, opened in 1802. In 1899 it had a faculty numbering 16 and was attended by 345 students. Population (1880), 4292; (1890), 7063; (1900), 7670, of whom 465 were foreign-born and 984 negroes.~~

~~Wastries, a town of Belgium, in the province of Hainaut, 7 miles south-west of Mons by rail. It is one of a series of mining towns in the rich coal district known as Le Borinage. Population (1890), 13,105;~~

~~(1900), 14,538.~~

~~Watches. — The most important modern develop- ment in watch manufacture is the application of machinery. This was proposed in 1848 by Aaron L. Dennison of Boston, Mass., U.S.A., and two years later, in partnership with Howard and Curtis, a factory was opened at Roxbury, Mass., which was subsequently removed to Waltham, Mass. In 1900 the Waltham factory produced 2500 watches per day, and employed 1400 women and 800 men. The number of separate pieces in a Waltham watch is 160, and in their manufacture and assemblage 3750 different operations are involved. Blanks of sheet metal for wheels are punched out at the rate of 25,000 a day. Fifty or more are strung upon a mandrel, and the teeth are cut by a rotary cutter. For pinions three cutters operate in succession, giving a true epicycloidal shape to the teeth. The microscopic screws are cut and shaped by 41 machines, with a capacity of 175,000 screws per day. There is no attempt to evade necessary operations. Thus the hands require three separate punchings to give them shape, after which they are polished while resting on a rocking support to give the proper rounded contour.~~

~~The success of machine-made watches and the possi- bilities of the factory system led to the manufacture of cheap watches. By the suppression of the fusee and chain a very great reduction had already been brought about in the number of pieces, which was to be still further diminished. The Waterbury watch, the pioneer in the field, had originally fifty-four pieces, less than one- half the number usually found even in a~~

~~chainless watch. To secure even running the mainspring was made four times as long as usual, or fully nine feet, and the entire movement rotated in the case once every hour. The objectionable feature was the time required to wind the watch. About 1891-92 the "long- wind" construction was discarded. Previous to 1879 the cheapest "short- wind " watch was a Swiss one, costing £3. The modern short-wind watch is composed of forty-seven machine- made parts, and costs but a small fraction of this price. One of the leading manufactories of such watches employs from 500 to 800 operatives. To meet American competi- tion the Swiss have introduced the factory system, together with schools of watch-making, which are most exacting in their curriculum. In England the most expensive watches contain from one hundred and fifty to over one thousand pieces. Yet the factories of the United States produce watches of the finest as well as the cheapest qualities, and some remarkable results in the way of accuracy have been attained with American factory-made watches. But in spite of their success, watch factories in the United States have suffered great vicissitudes. Since 1860 twenty have gone out of existence. A new method for marking dials accurately has been introduced at the watch factory at Elgin, Illinois. A standard plate is engraved with the complete design of the dial. Black enamel powder is dusted over it and wiped off, leaving the material in the~~

~~lines of the engraving. Collodion solution is then poured over the plate, and, saturating the powder, forms a film, which is floated off in water, and as it floats is picked up upon the blank enamelled watch face. After drying, the face is fired in an enameller's furnace, the collodion burns away, and the enamel of the design fuses. A most accu- rate dial is the result. A recent innovation is a movement in which the hands rotate in the reverse direction. Such watches are made for sale in the East, and are designed to correspond with the right to left text prevalent in some Oriental countries. Phonographic watches naming the hour are another curiosity in watch-making.~~

~~The trials instituted at Kew Observatory in 1884 under the auspices of the Royal Society, and now carried out by the National Physical Laboratory, have had a decided effect in maintaining and improving the quality of English hand-made watches. Three classes of certificates are granted,~~

known respectively as A, B, and C. The A test is by far the most severe. It extends over 45 days, divided into 8 periods of 5 days each, with 4 intermediate and extra days, during which the watch is not rated. During the first three periods the watch is kept at a temperature of 60°-65° F. , in a vertical position, the pendant being up in the first period, to the right in the second, and to the left in the third. Then after a day of rest the watch is placed in a refrigerator at a temperature of about 40° F. with the dial up. Having remained there for 5 days, it is kept for a further 5 days with the dial in the same position at about 65° F., and then it is removed, still with the dial up, to an oven having a temperature of about 90° F. In the seventh period it remains for 5 days in a horizontal position, with dial downwards, in a temperature of about 65° F., and finally it spends its eighth period, as at the beginning, in a vertical position with the pendant up. The conditions it must fulfil during the test, in order to gain a certificate, are : (1) The average of the daily de- partures from the mean daily rate during the same stage of trial must not exceed 2 seconds in any one of the 8 stages; (2) the mean daily rate while in the pendant-up position must differ from the mean daily rate in the dial-up position by less than 5 seconds, and from that while in any other position by less than 10 seconds ; (3) the mean daily rate must be affected by change of temperature to an amount less" than J second per degree F. ; (4) the mean daily rate must not exceed 10 seconds while in any posi- tion. An absolutely perfect watch passing through these trials would receive a total of 100 marks, made up of 40 marks in respect' of absence of daily variation of rate, 40 marks' for absence of change of rate with change of position, and 20 marks for absence of change of rate with change of temperature. But no watch is absolutely perfect, and those that are sent in are deprived of marks in a regular proportion as they fall short of perfection — in temperature, for instance, for each -015 second by which the watch departs from zero, that is from no variation, it loses one mark. Watches that obtain 80 marks or more are classed as "especially good." In spite of the severity of the tests applied, the number which gains this distinction shows a distinct tendency to increase in comparison with the number which are awarded simply the class A certificate, and the percentage in 1901, viz., 36-5 per cent., was the highest on record, though the total sent in for trial was much smaller than in many preceding years. The highest number of marks, viz., 91'3, ever gained by a watch was also

reached in 1901. Even the most elaborate watches are now made to pass the class A tests with the highest distinction ; thus a London firm obtained 83-8 marks for a watch which is probably the most com- plicated ever produced, being a clock watch striking the hours with minute repeater, minute and seconds and split seconds chronograph, and perpetual calendar, showing day of the week and month and phases of the moon. Non-magnetizable watches, i. e., watches that can be exposed to a strong magnetic field, such as is produced by a dynamo, without injury to their time-keeping qualities, are also now constructed to pass class A tests. Watches which are candi- dates for B or C certificates have to pass much less severe tests than those which aspire to be ranked in class A, the trials for the former lasting for 31 days and for the latter only 16 days.

Waterbury, a town and city of New Haven county, Connecticut, U.S.A. The town contains an area of 29 square miles of hilly country, situated west of the centre of the state. The city, which includes most of the population of the town, is situated on the Naugatuck river. It is regularly laid out, its streets are poorly paved, and it derives an excellent water-supply from the sur- rounding hills. It is on a line of the New York, New Haven, and Hartford Bailroad, and is at an altitude of 260 feet. Waterbury is a prominent manufacturing centre.

In 1900 it contained 404 manufacturing establishments, ■with a total capital of $23,421,140. They employed 14,914 hands, and the products were valued at $33,778,905. These consisted in great part of brass goods, which were manufactured to the value of 113,239,031. Buttons, foundry and machine-shop products, and stamped ware were items of secondary importance. In 1900 the assessed valuation of real and personal property was $11,619,908, the net debt of the city was $1,386,302, and the rate of taxation per $1000 was $32”00. Population (1890) of the town, 33,202; of the city, 28,646; (1900) of the town, 51,139 ; of the city, 45,859, of whom 15,368 were foreign-born and 540 negroes.

Waterford, a maritime county of Ireland, pro- vince of Munster, bounded on the N. by counties Tipperary and Kilkenny, on the E. by county Wexford, on the W. by county Cork, and on the S. by the Atlantic. The area of the county in 1900 was 452,743 acres, of which 77,016 were tillage, 245,465 pasture, 19,455 plantation, 1347 turf bog, 15,410 marsh, 75,140 barren mountain, and 18,910 roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, comprises the old judicial county except one electoral division, now added to Kilkenny, and the portions of Clonmel and Carrick-on-Suir formerly situated in Waterford. The population in 1881 was 112,768; in 1891, 98,251; and in 1901, 87,030, of whom 42,905 were males and 44,125 females, divided as follows among the different religions : Roman Catholics, 82,494 ; Protestant Episcopalians, 3645 ; Presbyterians, 312 ; Methodists, 214 ; and other denominations, 365. The decrease of population between 1881 and 1891 was 12-87, and between 1891 and 1901 9"1 per cent. The average number of persons to an acre in 1891 was '21, and of the total population 72,136 persons inhabited the rural districts, being an average of 147 to each square mile under crops and pasture.

The following table gives the degree of education in 1891 (exclud- ing the city of Waterford) : —

Males.

Females.

Total.

Percentage.

d

DO

Read and write Read only . . Illiterate . .

22,053 3,154 9,363

22,149

3,300

10,396

44,202

6,454

19,759

61·5

9·4

21·9

92·9 3·2 3·9

92‘9 5·3 1·8

94·3 1·2 4·5

The percentage of illiterates among Roman Catholics in 1881 was 40·6. In 1891 there were 8 superior schools with 477 pupils (Roman Catholics, 442, and Protestants, 35), and 150 primary schools with 11,447 pupils (Roman Catholics, 11,046, and Protestants, 401). The number of pupils on the rolls of the National schools on 31st December 1900 was 12,921, of whom 12,467 were Roman Catholics and 454 Protestants. The following table gives the number of births, deaths, and marriages in various years :—

Year.

Births.

Deaths.

Marriages.

1881 1891 1900

3154 2207 1889

2771 1891 1809

494 441 407

In 1901 the birth-rate per 1000 was 217, the death-rate 20‘8, and the rate of illegitimacy 4 ‘5 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 100,147, of whom 53,983 were males and 46,164 females. The chief towns in the county are Waterford, Dungarvan, and Tramore.

Administration. — The county is divided into two parliamentary divisions, East and West, the number of registered electors in 1901 being respectively 4665 and 4724. The rateable value in 1900 was £314,339. By the Local Government (Ireland) Act,

1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises one urban and seven rural sanitary districts. The city of Water- ford constitutes a separate county.

Agriculture. — The following tables show the total extent of land under crops, including meadow and clover, and the amount of live stock, in 1881, 1891, 1895, and 1901. The figures for 1901 are for the new administrative county.

Year.

Wheat.

Oats.

Barley, Eye,

~~Pota- toes.~~

~~Tur- nips.~~

~~Other Green Crops.~~

~~Meadow~~

~~and Clover.~~

~~Total.~~

~~1881 1891 1895 1901~~

~~8553~~

~~1170~~

~~388~~

~~387~~

~~30,043 28,167 29,159 29,331~~

~~1383 1333 1762 1572~~

~~14,453 13,165 11,875 10,177~~

~~6933 6274 7058 6472~~

~~3852~~

~~4384~~

~~4432~~

~~. 5806~~

~~20,979 23,209 23,024 24,628~~

~~86,196 77,702 77,698 78,373~~

~~In 1900 the total value of the cereal and other crops was esti- mated at £525, 398, the smallest amount of any county in Munster. The number of acres under pasture in 1881 was 236,888, in 1891 239,670, and in 1900 245,465.~~

~~Year.~~

~~Horses~~

~~and Mules.~~

~~Asses.~~

~~Cattle.~~

~~Sheep.~~

~~Pigs.~~

~~Goats.~~

~~Poultry.~~

~~1881 1891 1895 1901~~

~~13,447 15,763 17,699 15,982~~

~~4220 5105 5524 5938~~

~~97,839 108,803 105,668 112,516~~

~~49,600 85,137 62,213 72,140~~

~~42,719 44,795 44,763 31,860~~

~~4892 6790 5734 7467~~

276,793 273,003 293,843 344,094

The number of milch cows in 1891 was 39,307, and in 1901 39,557. It is estimated that the total value of cattle, sheep, and pigs for 1901 was £1,621,965. In 1900 the number of agricultural holdings not exceeding 1 acre was 2956 ; between 1 and 5, 1216 ; between 5 and 15, 1427 ; between 15 and 30, 1387 ; between 30 and 50, 1284 ; between 50 and 100, 1660 ; between 100 and 200, 825 ; between 200 and 500, 221 ; and above 500, 26 ; total, 11,002. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901 was 1144, amounting to £949,210. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, between 1882 and 1901 was 170, and the amount issued, £12,288. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations in 1847 to 31st March in 1901 was £90,591.

Fisheries. — The number of vessels registered in the deep-sea and coast fishery district of Waterford in 1900 was 88, employing 279 hands. The number of persons employed in the salmon fishing districts of Waterford and Lismore in the same year was 2281, and the licence duty paid amounted to £1542. (w. H. Po.)

Waterford, a maritime city, county and parlia- mentary borough (returning one member), on the river Suir, 97 miles south-south-west of Dublin by rail. Water- ford is the second most important port on the south coast of Ireland, vessels of 4000 tons being able to discharge at the quays. In all 1827 vessels of 480,900 tons entered in 1900, and 1427 of 396,764 tons cleared. The value of the imports, which included 792,900 cwts. of maize, amounted to £364,851. In the same year the number of vessels registered in the port was 32 of 4927 tons. The salmon fishery district is extensive, and in 1900 1412 persons were employed. Eighty-eight vessels were registered in the same year in the deep-sea and coast fishery district, employing 279 hands. There is consider- able inland navigation, and the junction of the river Barrow with the Grand Canal allows barges to be worked through from Dublin to Waterford. The trade of the town is almost entirely agricultural. In 1898 Waterford was constituted one of the

six county boroughs which have separate county councils. The rateable value in 1901 was £48,300. Population (1891), 20,852; (1901), 27,947, the increase being largely due to the extension of the municipal area.

Waterford, a town of Saratoga county, New York, U.S.A. It is situated in 42° 48′ N. and 73° 41′ W., on the west bank of the Hudson, just above the mouth

of the Mohawk, and opposite Lansingburg, on the Dela- ware and Hudson Railroad, in the eastern part of the state. It has excellent water-power, and a variety of manufactures. Population (1880), 4328; (1890), 5286; (1900), 6157, of whom 474 were foreign-born.

Waterhouse, Alfred (1830), English

architect, was born at Liverpool on 19th July 1830, and passed his professional pupilage under Eichard Lane in Manchester. His earliest commissions were of a domestic nature, but his position as a designer of public buildings was assured as early as 1859 by suc- cess in the open competition for the Manchester assize courts. This work marked him not only as an adept in the planning of a complicated building on a large scale, but also as a champion of the Gothic cause. Nine years later, in 1868, another competition secured for Waterhouse the execution of the Manchester town hall, where he was able to show a firmer and perhaps more original handling of the Gothic manner. The same year brought him the rebuilding of part of Caius College, Cambridge, not his first university work, for Balliol, Oxford, had been put into his hands in 1867. At Caius, out of deference to the Renaissance treatment of the older parts of the college, the Gothic element was intentionally mingled with classic detail, while Balliol and Pembroke, Cambridge, which followed in 1871, may be looked upon as typical specimens of Hie style of his mid-career—Gothic tradition (European rather than British) tempered by individual taste and by adaptation to modern needs. Girton College, Cambridge, a building of simpler type, dates originally from the same period (1870), but

~~*has been periodically added to by further buildings. Two important domestic works were undertaken in 1870 and 1871 respectively — Eaton Hall for the Duke, then Marquis, of Westminster, and Heythrop Hall, Oxfordshire, the latter, a restoration, being of a fairly strict classic type. Iwerne Minster for Lord Wolverton was begun in 1877. In 1865 Waterhouse had removed his practice from Manchester to London, and he was one of the architects selected to compete for the Royal Courts of Justice. He received from the Government, without competition, the commission to build the Natural History Museum, South Kensington, a design which marks an epoch in the modern use of terra-cotta. The New University Club — a Gothic design — was undertaken in 1866, to be followed nearly twenty years later by the National Liberal Club, a study in Renaissance composition. Waterhouse's series of works for Victoria University, of which he was made LL.D. in 1895, date from 1870, when he was first engaged on Owens College, Manchester. Yorkshire College, Leeds, was begun in 1878 , and Liverpool University College in 1885. St Paul's School, Hammersmith, was begun in 1881, and in the same year the Central Technical College in Exhibition Road, London. Waterhouse's chief remaining works in London are the Prudential Assurance Company's offices in Hol- born (1876 to present time) ; University College Hospital, now in progress ; the National Provincial Bank, Piccadilly, 1892; the Surveyors' Institution, Great George Street, 1896; and the Jenner Institute of Preventive Medicine, Chelsea, 1895. For the Prudential Company he has designed many provincial branch offices, while for the National Provincial Bank he also designed premises at Manchester. The Liverpool infirmary is Waterhouse's largest hospital; and St Mary's Hospital, Manchester, the Alexandra Hospital, Rhyl, and extensive additions at the general hospital, Nottingham, have also engaged him. Among works not already mentioned are the Salford gaol ; St Margaret's School, Bushey ; the Metropole Hotel, Brighton; Hove town hall; Alloa town hall; St Elizabeth's*~~

~~*church, Reddish ; the Weigh House chapel, Mayfair ; and Hutton Hall, Yorks.*~~

~~*Waterhouse became a fellow of the Royal Institute of British Architects in 1861, and president from 1888 to 1891. He obtained a Grand Prix for*~~

architecture at the Paris Exposition of 1867, and a "Rappel" in 1878. In the same year he received the Royal Gold Medal of the Royal Institute of British Architects, and was made an associate of the Royal Academy, of which body he became a full member in 1885 and treasurer in 1898. He is =•■ member of the Academies of Vienna (1869), Brussels (1886), Antwerp (1887), Milan (1888), and Berlin (1889), and a corresponding member of the Institut de France (1893). Since 1886 he has been constantly called upon to act as assessor in architectural competitions, and was a member of the international jury appointed to adjudicate on the designs for the west front of Milan Cathedral in 1887. In 1890 he served as architectural member of the Royal Commission on the proposed enlargement of Westminster Abbey as a place of burial. From 1891 to 1902, when he retired, his work was con- ducted in partnership with his son, Paul Waterhouse.

Waterloo, a city of Iowa, U.S.A., capital of Black- hawk county, on the Cedar river, and the Burlington, Cedar Rapids, and Northern, the Chicago Great Western, and the Illinois Central railways, in the eastern part of the state, at an altitude of 841 feet. It is in a rich agricultural region, for which it serves as a shipping and supply point, and it has varied manufactures. Population (1895), 8490; (1900), 12,580, of whom 1334 were foreign-born.

Water Motors. — The most notable developments in the use of water power since the date of the article on Hydromechanics in vol. xii. of this Encyclopaedia have been in the supply of high-pressure water from central power stations in large cities like London, Manchester, Glasgow, Liverpool, Antwerp, Melbourne,

Hydraulic Lifts. — The direct-acting lift is perhaps the simplest of all machines using pressure-water, but as the height of the lift increases, certain problems in construction become exceedingly difficult to cope with, notably those due to the great increase in the weight and displacement of the ram. In fact, with a simple ram it is not possible to lift beyond a certain height with a given pressure and load. It becomes, therefore, necessary to balance in some way the varying displacement of the ram if economy is to be secured in the working : this is often done by

the use of counter- weights attached to chains travelling over head sheaves, but this largely destroys the simplicity and safety of the direct-acting lift, and hence some form of hydraulic balancing is more satisfactory and more certain. In one form, shown in Fig. 1, the lift cylinder is in hydraulic connexion with a pair of short cylinders placed one above the other, the pistons working in them being connected together by a common rod. Below the piston of the upper cylinder is an annular space E (surrounding the common piston rod) with a capacity equal to the maximum displacement of the lift ram, while the corre-sponding annular area C of the piston of the lower cylinder is just large enough when subjected to the work- ing water-pressure to enable the work of lifting the net load to be done and any friction to be overcome. The area B of the top side of the upper piston is proportioned in such a way that when under the full water pressure the dead weight of the ram and cage is just balanced when the former is at the bottom of its stroke. With this arrange- ment the lift ram and the two balance pistons are always

terf

in equilibrium, or, in other words, the ever-changing dis- placement of the lift-ram is automatically in balance. To work the lift, pressure-water is admitted to the annular space C above the lower of the two balance pistons (the space B above the upper one is always in communication with the pressure-water), and the combined pressure on the two pistons is sufficient to lift the cage, ram, and load. As the ram ascends it apparently increases in weight, but this is balanced by the greater pressure on the two balance pistons as they descend, owing to the increase of the head of water acting on them. To allow the lift-ram to de- scend, the pressure-water in C above tne lower balance cva,de

piston is discharged through the exhaust into the drain, while that above the upper piston is simply pushed rnmSa/piji back into the pressure main. As an illustration of the economy of this system, it may be men- tioned

that in one lift hav- ing a 6-inch ram with a lift of 90 feet, the working load being 1 ton and the maximum working speed 180 feet a minute, the quantity of pressure-water used per journey of 90 feet was reduced from 109 to 24£ gallons by the use of this method of balanc- ing.

In another system of hydraulic balance (Fig. 2) the ram A has an annular area so proportioned that

when it is connected with Fig. 1.—Hydraulic Balancing, the water in an elevated

tank (usually placed somewhere in the roof of the build- ing), the hydraulic pressure upon it just balances the weight of the ram and cage. Here again, since the intensity of the pressure on A becomes greater as it descends owing to the increased head, the apparent increase of weight of the lift-ram as it rises is automatically balanced ; water from the high-pressure system is admitted down the hollow ram B and does the work of lifting the live load.

Since the introduction of deep-level electric railways in London and elsewhere, hydraulic passenger lifts on a large scale have been brought into use for conveying passengers up and down from the street level to the underground stations.

Direct-acting Water Motors.—Owing to the difficulty of securing a durable motor with a simple and trust- worthy means of automatically regulating the quantity of water used to the power needed at various times from the motor, not much advance has been recently made in the use of water motors with reciprocating rams or pistons. Probably the most successful one has been a rotary

engine invented by Mr Arthur Bigg.1 In this engine the stroke, and therefore the amount of water used, can be varied either by hand or by a governor while it is running ; the speed can also be varied, very high rates, as much as 600 re- volutions a minute, being attainable without the question of shock or vibration becoming troublesome. The cylinders are cast in one piece with a circular valve, and rotate about a main stud S (Fig. 3), while their plungers are connected to a disc crank which rotates

above the point O, which is the centre of the main crank ; O S being the crank length or half stroke of the engine, any variation in its length will vary the power of the engine and at the same time the quantity of water used. The move- ment of S is obtained by means of a relay engine, in which there are two rams of different diameters ; a constant pressure is always acting on the smaller of these when the motor is at work, while the governor (or hand-power if desired) admits or exhausts pressure- water from the face of the other, and the movements to and fro thus gfven to the two rams alter the position of the stud S, and thus change the stroke of the plungers of the main engine. Fig. 4 gives an outside view of a 30 H.P. engine capable of using water at a pressure of 700 B> per square inch ; the governor is carried within the driving pulley shown at the right-hand end, while the working revolving cylinders are carried inside the boxed-in flywheel at the left-hand end, the relay cylinder and its attachments being fixed to the bed-plate in front of the flywheel. On a test one of these engines gave an efficiency or duty of 80 per cent.

Water Wheels. — The Pelton water wheel (Fig. 5) has proved a most successful motor when very high heads are available, heads of 2000 feet having been used occasionally. Such machines have been exten-

Fig. 2.— Hydraulic Balancing.

Kig. 3. — Section of Rigg's Water-Engine.

sively employed in America, and have also lately been used in Great Britain, worked by the high-pressure water

1 This engine was fully described in Engineering, vol. xlv. p. 61.

supplied in large towns. The wheel carries a series of cups placed at equal distances around the circumference. A jet or jets of water impinge on the cups, the interiors of which are shaped in such a way that the jet is discharged parallel to its original direction. If the linear velocity of the

cups in feet a second is V1, and the linear velocity of the jet is V2, then the velocity of the jet relative to

Fig. 4. — External View of Eigg's Water-Engine.1

the cup is V2 — Yx feet a second, and if the whole energy of the water is to be given up to the cups, the water must leave the cup with zero absolute velocity. But its velocity relative to the cup, as it passes backwards, is – (V2 — Vj), and since the forward velocity of the cup is Yv the absolute velocity of the water is — (V2 — Yx) + Y1 or 2Vj — V2. This will become zero if Yt is £V2, that is, if the linear velocity of the cup-centres is one-half that of the jet of water impinging upon them. The theoretical efficiency of the wheel would then be 100 per cent. The actual efficiency of these wheels when used with high falls is from 80 to 86 per cent. ; when used in connexion with high-pressure water in London an efficiency of 70 per cent, has been obtained, and when a dynamo is driven directly by them about 66 per cent. of the hydraulic energy has been converted into electric energy.

Pelton wheels are very sensitive to variation of load, and considerable trouble was experienced at first in securing adequate governing when they were used to gene- rate electric energy ; but this difficulty has been overcome, and they have been rendered most efficient machines for use with high falls, where ordinary tur- bines would be diffi- cult to manageowing to the excessive speed

at which they would run. In a small installation in the United States water is brought in a 36-inch pipe a distance of 1800 feet, and supplies six Pelton wheels each 28 inches in diameter, running at 135 revolutions a minute under

1 This and some of the other drawings have been taken from Blaine's Hydraulic Machinery.

Fig. 5.— Pelton Wheel.

a head of 130 feet. The total power developed is 600 H.P., and though the load factor varies very greatly in this case, the differential type of

~~governor used secures perfect control of the running of the wheels.~~

~~Turbines. — The turbine has now become one of the most efficient of the prime movers employed by man, and in the United States of America and on the Continent of Europe 2 its use has enormously increased of recent years. Though no radical changes have been made in the design of turbines for some years, an immense amount of skill and ingenuity has been shown in perfecting and improving details, and such machines of great size and power are now constantly* being made, and give every satisfaction when in use. In the "Hercules" turbine, shown in Fig. 6, the flow is what is called mixed, that is, it is partly a radial inward and partly an axial flow machine. On entering, the water flows at first in a radial direction, and then gradually, as it passes through the wheel, it receives a downward component which becomes more and more important. Professor Thurston has published the results of a test of one of these, which gave an efficiency of 87 per cent, at full load and 70 per cent, at about three-fifths full load.~~

~~Another turbine of the mixed flow type is the "Victor," which consists of three parts — the outer guide case, and, inside this, the and the wheel. The gate regulates the wheel by varying the quantity of- water ; when fully open it merely forms a continuation of the guide passages, and thus offers no obstruction to the flow of the water, but by giving it a movement through a part of a revolution the passages are partly blocked and the flow of water is checked. This form of regula- tion is fairly efficient down to three-quarter opening. Turbines of this type may also be used on horizontal shafts, and are very useful in the case of low falls where there is a large amount of water and the head is fairly constant. At Massena, in the United States, 75,000 H.P. is to be developed from fifteen sets of these tur- bines working under a head of 40 feet. Each generator can develop 5000 H.P. at a potential of 2200 volts, and is driven by three horizontal double turbines on the same shaft ; when working under a minimum head of 32 feet at 150 revolutions, each turbine will have a nominal horse-power of 1000.~~

~~Probably the most important application of turbines to the generation of power on a great scale is that at Niagara Falls. The water is tapped off~~

~~*from the river Niagara about a mile above the falls and brought by a canal to the power-house. The wheel-pit is 180 feet in depth, and is connected with the river below the falls by*~~

~~*2 The following statistics of turbine construction in Switzerland are taken from Schweizerische Bauzeitung, 1901, p. 128, which, in the same volume at p. 53, contains a valuable article on the most important improvements in turbines and their regulation shown in the Paris Exhibition of 1901 :*~~

~~=~~

~~*register gate, speed of the*~~

~~*Period.*~~

~~*Number*~~

~~*of Turbines.*~~

~~*Total H.P.*~~

~~*Average H.P.*~~

~~*1844-1869 . . 1869-1879 . . 1879-1889 . . 1889-1899 . .*~~

~~*767 1006 1840 2231*~~

~~*36,894*~~

~~*66,688*~~

~~*133,579*~~

~~*400,474*~~

~~*48*~~

~~*66J*~~

~~*72i*~~

1794

Totals

5844

637,635

768

WATER MOTORS

a tail-race, consisting of a tunnel 21 feet high and 18 feet 10 inches wide at its largest section. The original turbines were of the " Fourneyron " type, and a pair were mounted on each vertical shaft, the two being capable of giving out 5000 H.P. with a fall of 136 feet. Each pair of

Fig. 6 " Hercules " Turbine.

wheels is built in three storeys, and the outflow of the water is controlled by a cylindrical gate or sluice, which is moved up and down by the action of the governor. As the pair of wheels and the big vertical shaft (which is of

Fig. 7. — Jonval Turbine.

hollow steel 38 inches in diameter) with the revolving part of the dynamo mounted on the upper end of the shaft weigh about 152,000 ft, a special device, since adopted in other similar power plants, was designed to balance iD part this dead weight. The water passes from

the penstock through the guide blades of the upper wheel, and in doing so acts in an upward direction on a cover of the upper wheel, which thus becomes, as it were, a balance-piston. The total upward pressure on this piston is calculated to be equal to 150,000 ft; hence the shaft- bearings are practically relieved from pressure when the wheels are running. Another turbine which has come into extensive use is the "Francis," an exceedingly efficient turbine on a low fall with large quantities of water. At Schaffhausen two of them with a fall of 12| feet de- veloped 430 H.P.,

when the older turbines only gave 260 H.P., the efficiency of the Francis turbine being in this case 86 per cent, at full load and 77 per cent, at half load.

A recent form of the Jonval turbine is shown in Fig. 7. This turbine was designed to give 1250 H.P. with a fall of 25 feet and an efficiency of 77 per cent. It is fitted with a suction pipe and a circular balanced sluice for admitting and cutting off the water-supply. The wheel is 12 feet 3£ inches in diameter, and has a speed of fifty revolutions per minute, and the power generated is transmitted through bevel-gearing to a horizontal shaft from which the power is taken off for various purposes. When complete the turbine weighed about 140 tons. There is a regulating arrangement, by which one-half of the guide-passages can be shut off in pairs from the water, and at the same time air is freely admitted into these unused passages by pipes which pass through the hinges of the controlling shutter. Tests of a turbine of this slow-moving type showed an efficiency of 82 per cent, at full gate, and one of 75 per cent, when half of the passages in the guide-blades were closed by the shutters, as described above.

As an illustration of the use of water-power, even at a considerable distance from a town, the case of Lausanne may be described. The town has secured the right of using a waterfall of 113 to 118 feet high, by impound- ing the Eh6ne near Saint Maurice. In dry seasons this will supply 6000 H.P., and for quite ten months in an ordinary year 14,000 H.P. The plant in 1902 con- sisted of five turbines, having horizontal axles, and each developing 1000 H.P. when running at 300 re- volutions a minute. They drive electric generators, and the current so produced is taken at a pressure of 22,000 volts on overhead wires a distance of 35 miles to Lausanne, the loss being estimated not to exceed 10 per cent, in the long transmission. Near the town is a station for reducing the voltage, and current is distributed at 125 volts for lighting purposes and at 500 volts for use on the tramways and for other power purposes.

For further information concerning the construction and em- ployment of water motors, the reader is referred to the following papers and text-books: — Proc. Inst. Mech. Eng., 1882, p. 119; 1889, p. 350 ; 1895, p.

353. (These papers contain full accounts of recent forms of lifts.) — Engineering, vol. lxvii. pp. 91, 128, 160 ("Power Station at Niagara") ; vol. lxxii. pp. 391-767 ("Govern- ing of "Water Wheels"). — Proc. Inst. Civil Eng., vol. lxxxvi. p. 60 (" Mersey Railway Lifts ") ; vol. xciii. p. 596 ("Experiments on jonval and Girard Turbines at Alching"); vol. xcvi. p. 182 ("Hydraulic Canal Lifts"); vol. cii. p. 154 ("Keswick Water- Power Electric Station") ; vol. cxii. p. 410 ("Hydraulic "Works at Niagara ") ; vol. cxviii. p. 537 (" A 12-Mile Transmission of Power Generated by Pel ton Wheels") ; vol. cxxiii. p. 530 ("The Pelton "Water Wheel ") ; vol. cxxiv. p. 223 (' ' The Niagara Power Works ") ; vol. cxxvi. p. 494 ("The Rheiufelden Power Transmission Plant ") ; vol. cxli. p. 269 ("Electrio Transmission Plants in Transvaal"), p. 307 ("Turbines"); vol. cxlii. p. 451 ("Electrical Installations at Lausanne") ; vol. cxlv. p. 423 ("Water Power at Massena") ; vol. cxlvii, p. 467 (" Some Large Turbine Installations").' — Wood. Tlieory of Turbines. — Bovey. Hydraulics. — Bjorling. Hy- draulic Motors. — Blaine. Hydraulic Machinery. — Bodmek. Hydraulic Motors. — Unwin. "Water Motors." (Lectures on Hydro-Mechanics, Inst. Civil Eng., 1885.) (t. h. B.)

WATEE SUPPLY.

11 J ATER, parted by evaporation from its impurities, V V condensed into cloud or vapour, returned to the earth as rain, 'dew, snow, or hoar frost, and once more gathering impurities on its way to the sea, is artificially collected and sold in England to the value of more than seven millions sterling annually. Collected, purified, and de- livered at the home of the consumer, and forced to the top of his house, it : costs him commonly about 2d. per ton ; but the difficulty of obtaining it is increasing, and the cost is increasing also in a much higher ratio than the population. Nor can we at any future time hope for assistance from other countries in this particular necessary of life. The problem is everywhere of the first importance, and in the future of the British Isles it is a most serious, if not an alarming one.

Nomadic and scattered tribes seem to have set the example of preferring springs or wells to streams, and perennial springs have determined the

~~sites of many ancient cities ; but it is doubtful whether, except when navigable, the presence of a river has ever done so. Where towns or villages are situated even upon mountain rivers or streams the preference for natural springs or artificial wells is very marked. The brightness and freedom from colour of most underground waters has led to a general assumption, not always justified, of their comparative wholesomeness. In times of flood open water courses are discoloured with both organic and inorganic matter which may be perfectly harmless, while the brilliancy of a spring is no security whatever against the presence of pathogenic bacteria thriving more readily alone than among their harmless relatives in the river water. When chemistry was in its infancy and bacteriology unknown, it was never suspected that the waters of a turbid river were often perfectly wholesome, while the pellucid spring might con- tain the germs of disease.~~

~~Collecting Grounds.~~

~~Surface Waters. — The whole area from which water, flowing over the surface of the ground, will naturally pass a given point in any natural water-course is com- monly known in Europe as the " hydrographic basin" above that point. In English it has been called indiffer- ently the "catchment basin," the "gathering ground," the "drainage area," and the "watershed." The latter term, though originally equivalent to the German Was- serscheide — "water-parting" — is perhaps least open to- objection. The water-parting is the line bounding such an area and dividing it from other watersheds. The banks of a river op" sides of a valley are distinguished as the right or left bank respectively, the spectator being understood to have his back to the source of the stream.~~

~~When no reservoir exists, the volume of continuous supply from the surface of any water- shed area is evidently limited to the minimum flow of the stream draining that area. This cannot be determined from the rainfall; it entirely depends upon the power of the soil and rock to store water in the particular area under con- sideration. Mountain areas of 10,000 acres and upwards, partly covered with moorland, upon nearly impermeable rocks with few water-bearing fissures, yield in temperate~~

climates, towards the end of the driest seasons, from a fifth to a quarter of a cubic foot per second per 1000 acres ; in the case of the river Severn, the head-waters of which are chiefly supplied from such formations, this rate does not materially change even down to the city of Worcester, past which the discharge flows from 1,256,000 acres. But in smaller areas, which on the average are necessarily nearer to the water-parting, the. limits are much wider, and the rate of minimum discharge is generally smaller.

Thus, for example, on 1000 acres or less, it commonly falls to one-tenth of a cubic foot, and upon an upland Silurian area of 940 acres, giving no visible sign of any peculiarity, the discharge fell, on the 21st September 1893, to one-thirty-fifth of a cubic foot per second per 1000 acres. In this case, however, some of the water probably passed through the beds and joints of rocks to an adjoining vaJey lying at a lower level, and had both streams been gauged the average would probably have been considerably greater. The Thames at Teddington, fed largely from cretaceous areas, fell during ten days in September 1898 (the artificial abstractions for the supply of London being added) to abont one- sixth of a cubic foot per second per 1000 acres ; while since 1880 the discharge has occasionally fallen, in each of six other cases, to about one-fifth of a cubic foot per second per 1000 acres. Owing, however, to the very variable permeability of the strata, the tributaries of the Thames, when separately gauged, yield the most divergent results. It may be taken as an axiom that the deviation of minimum surface-discharges from their mean in- creases as the separate areas diminish. In the eastern and south- eastern counties of England even greater variety of dry weather flow prevails than in the west, and upon the chalk formations there are generally no surface streams, except such as burst out after wet weather and form the so-called "bournes."

When, however, a reservoir is employed to equalize the flow during and before the period of dry weather, the first essential in determining the yield is to „alafall ascertain the rainfall. For this purpose, if there are no rain gauges on the drainage area in question, we can only form an estimate from the records of numerous gauges throughout the country, most of which are pub- lished in British Rainfall by the successors of the

late Mr G. J. Symons, F.R.S. ; but even in the hands of those who have spent years in such investigations, this method may lead to most incorrect conclusions. If any observa- tions exist upon the drainage area itself they are com- monly only from a single gauge, and this gauge, unless the area is very level, may give results widely different from the mean fall on the whole area. Reliance upon single gauges in the past has been the cause of serious errors in the estimated relation between rainfall and flow off the ground.

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Fig. 1.

The uncertainties are illustrated by the following actual example. A battery of fourteen rain gauges, in the same vertical plane, on ground having the natural profile shown by the section (Fig. 1), gave during three consecutive years the respective falls shown by the depth of the dotted lines below the datum line. Thus on the average, gauge C recorded 20 per cent, more than gauge D, only 70

feet distant. The prevailing winds are along the section from left to right, between A and N ; their direction is therefore necessarily inclined upwards, and a large proportion of the drops are thus thrown clear of the gauge D to augment the fall in the gauges F to I. Then comes the curious depletion at gauge J, an effect of the wind eddy caused by the obstruction between C and D. At C in 1897 the rainfall was actually 30 per cent, greater than at J, only 187 yards distant. At the place where these observations were made the average rainfall is about 70 inches, and the

altitude exceeds 1400 feet above the sea. In less exposed positions such extreme variations would not occur, but it is nevertheless essential every-where to guard against the perturbations which apparently slight irregularities of the surface may cause. It has been commonly stiated that the rainfall increases with the altitude. This is broadly true. A rain-cloud raised vertically upwards expands, cools, and tends to precipitate ; but in the actual passage of rain- clouds over the surface of the earth other influences are at work. In Fig. 2 the thick line represents the profile of a vertical section

A B

■%■ 8-

F G H I J

9- ^

crossing two ranges of hills and one valley. The arrows indicate the directions of the prevailing winds. At the extreme left the rain-clouds are thrown up, and if this were all, they would precipi- tate a larger proportion of the moisture they contained as the altitude increased. But until the clouds rise above the hill there is an obvious countervailing tendency to compression, and in steep slopes this may reduce or entirely prevent precipitation until the summit is reached, when a sudden fall of pressure must occur. Very high mountain ranges usually consist of many ridges, among which rain-clouds are entangled in their ascent, and in such cases precipitation on the windward side of the main range, though on the leeward sides of the minor ridges of which it is formed, may occur to so large an extent that before the summit is reached the clouds are exhausted or nearly so, and in this case the total precipitation is less on the leeward than on the windward side of the main range ; but in the moderate heights of the United Kingdom it more commonly happens from the causes explained that precipitation is prevented or greatly retarded until the summit of the ridge is reached. The following cause also contributes to the latter effect. Imagine eleven raindrops A to K to fall simul- taneously and equi-distantly from the horizontal plane AM. A strong wind is urging the drops from left to right. The drops A and K may

be readily conceived to be equally diverted by the wind, and to fall near the tops of the two hills respectively. Not so drop C, for directly the summit is passed the wind neces- ‘ sarily widens out vertically and, having a greater space to fill, loses forward velocity. It may even eddy backwards, as indicated by the curved arrows, and it is no uncommon thing, in walking up a steep hill in the contrary direction to the flight of the clouds, to find that the rain is coming from behind. Much the same, tendency exists down to E, but at F the wind has begun to accom- modate itself to the new regime and to assume more regular forward motion, and as J is approached, where vertical contraction of the passage through which the wind must pass takes place, there is an increasing tendency to lift the raindrops beyond their proper limits. The general effect is that the rain falling from between G and .K is spread over a greater area of the earth G’ K’ than that falling from the equal space between B and F, which reaches the ground within the smaller area B F. From this cause also, therefore, the leeward side of the valley receives more rain than the windward side. In the United Kingdom the prevailing winds are from the south- west, and some misapprehension has been caused by the bare, but perfectly correct, statement that the western slope is wetter than the eastern. Over the whole width of the country from coast to coast, or of the Welsh mountain ranges only, this is so ; but it is nevertheless true that the leeward side of an individual valley generally receives more rain than the windward side, and also that the leeward side of an individual ridge receives more rain than the windward side. Successive abstraction of rain-drops as the rain- clouds pass over ridge after ridge causes a gradually diminishing precipitation, but this is generally insufficient to reverse the local conditions, which tend to the contrary effect in individual ranges. The neglect of these facts has led to many errors in estimating the mean rainfall on watershed areas from the fall observed at gauges in particular parts of those areas.

On large watersheds at least two rain gauges to eveiy thousand acres have been found necessary to determine the annual rainfall with sufficient accuracy, and on smaller areas the proportion necessary for equal accuracy must be greater. ‘ In the simplest case of a single valley we ought at least to know the rainfall at five points, three being in the axis of the valley, and one near the point of intersection of that axis with the

watershed. Then, in order to connect with these the effect of the right- and left-hand slopes, there should be at least one gauge on each side about the middle height, and approximately in a line perpendicular to the axis of the valley passing through the central gauge. The relative depths recorded in the several gauges depend mainly upon the direction of the valley and steepness of the bounding hills. The gauge in the bottom of the valley farthest from the source will generally record the least rainfall, and one of those on the south- west side the highest. Much will depend upon the judicious placing of the gauges. Each gauge should have for 10 or 15 yards around it an uninterrupted plane fairly representing the general level or inclination, as the case may be, of the ground for a much larger distance around it. The earliest records of such gauges should be carefully examined, and if any apparently anomalous result is obtained, the cause should be traced, and when not found in the gauge itself, or in its treatment, other gauges should be used to check it. The central gauge is useful for correcting and checking the others, vbut in such a perfectly simple case as the straight valley above assumed it may be omitted in calculating the results, and if the other four gauges are properly placed, the arithmetical mean of their results will probably not differ widely from the true mean for the valley. But such records carried on for a year or many years would afford no knowledge of the worst conditions that could arise in longer periods, were it not for the existence of much older gauges not far distant and subject to somewhat similar conditions. The nearer such long-period gauges are to the local gauges the more likely are their records to rise and fall in the same proportion. The work of Mr James Glaisher, F.B.S., of the late Mr G. J. Symons, F.R.S., of the Meteorological Office and of the Boyal Meteorological Society has resulted in the establishment of a vast number of rain gauges in different parts of the United Kingdom, and it is generally, though not always, found that the mean rainfall over a long period can be determined, for an area upon which the actual fall is known only for a short period, by assigning to the missing years of the short-period gauges rainfalls bearing the same proportion to those of corresponding years in the long-period gauges that the rainfalls of the known years in the short-period gauges bear to those of corresponding years in the long-period gauges. In making such comparisons, it is always desirable if possible to select as standards long-period gauges which are so situated that the short-period

~~district lies between them. "Where suitably placed long-period gauges exist, and whei e care has been exercised in ascertaining the authenticity of their records and in making the comparisons, nearly correct results may thus be obtained in carrying back the records of the local gauges.~~

~~Bainfall is proverbially uncertain ; but it would appear from the most trustworthy records that observations of a single gauge, ex- tending over 50 years, will probably not vary more than 1 or 2 per cent, from the true mean, while the records of any period of 25 years will generally be found to fall within 3J per cent, of the mean of 50 years. It is equally satisfactory to know that there is a nearly constant ratio, at any given place, between the true mean annual rainfall, the rainfall of the driest year, the two driest consecutive years, and any other groups of driest con- secutive years. Thus if from a period of 50 years the two or three driest are selected, their rainfalls will generally be found to differ but little, while the rainfall of the driest will be about 63 per cent, of the mean for the 50 years.~~

~~That of the two driest consecutive years will be about 72 per cent, of the mean for the 50 years.~~

~~That of the three driest consecutive years will be about 77 per cent, of the mean for the 50 years.~~

~~That of the four driest consecutive years will be about 80 per cent, of the mean for the 50 years.~~

~~That of the five driest consecutive years will be about 82 per cent, of the mean for tho 50 years.~~

~~That of the six driest consecutive years will be about 83f per cent, of the mean for the 50 years. As a single rain gauge only represents the actual rainfall upon an exceedingly small area of the earth's surface, its annual records are subject to greater perturbations than can occur when the mean of several gauges near together is used for the determination. Hence the fact that isolated gauges occasionally show somewhat greater deviations in particular years from the true mean does not vitiate the general trustworthiness of the results. But if, instead of regarding only tho mean rainfall over a series of years, we com- pare the relative falls in~~

short intervals of time among gauges yielding the same general averages, the discrepancies prove to be enormous, and it follows that the maximum possible intensity of discharge from different areas rapidly increases as the size of the

watershed decreases. Extreme cages of local discharge are due to the phenomena known in America as "cloud-bursts," which occa- sionally occur in Great Britain and result in discharges of far greater intensity than anything yet recorded by rain gauges. The periods of such discharges are so short, their positions so isolated, and the areas affected so small, that we have little or no exact knowledge concerning them, though their disastrous results are well known. They do not directly affect the question of supply, but may very seriously affect the works from which that supply is given.

Where in this article the term " evaporation " is used alone, it is to be understood to include absorption by „ vegetation. Of the total quantity of rainfall a

tion . mil very variable proportion is rapidly absorbed absorp- 0r re-evaporated. Thus in the western moun- tlon' tain districts of Great Britain, largely composed

of nearly impermeable rocks more or less covered with pasture and moorland, the water evaporated and absorbed by ^getation is from 13 to 15 inches out of a rainfall of 80 inches, or from 16 to 19 per cent., and is nearly con- stant down to about 60 inches, where the proportion of loss is therefore from 22 to 25 per cent. The Severn down to Worcester, draining 1,256,000 acres of generally flatter land largely of the same lithological character, gave in the dry season from the 1st July 1887 to 30th June 1888 a loss of 17'93 inches upon a rainfall of 27-34 inches, or about 66 per cent. ; while in the wet season, 1st July 1882 to 30th June 1883, the loss was 21-09 inches upon a rainfall of 43'26 inches, or only 49 per cent. Upon the Thames basin down to Teddington, having an area of 2,353,000

acres, the loss in the dry season from 1st July 1890 to 30th June 1891 was 17-22 inches out of a rain- fall of 21-62 inches, or 79 per cent.; while in the wet season, 1st July 1888 to 30th June 1889, it was 18-96 out of 29‘22 inches, or only 65 per cent. In the eastern counties the rainfall is lower and the evaporation ap- proximately the same as upon the Thames area, so that the percentage of loss is greater. But these are merely broad examples and averages of many still greater varia- tions over smaller areas. Again, with the same rainfall in two different seasons the evaporation may vary greatly. An inch falling in a single day on a saturated mountain area will nearly all reach the rivers, but if it falls during a drought seven-eighths may be lost so far as the period of the drought is concerned. In such a case most of the water is absorbed by the few upper inches of soil, only to be re-evaporated during the next few hours or days, and the small proportion which sinks into the ground probably issues in springs many months later. Thus the actual yield of rainfall to the streams depends largely upon the mode of its time-distribution. Without a knowledge of this it is impossible to anticipate the yield of a particular rain- fall, and in judging of the minimum annual flow of a stream we must not only assume the incidence of a minimum rainfall, but also that its distribution will be such that a maximum re-evaporation and absorption of that rainfall will occur. In estimating the evaporation to be deducted from the rainfall, for the purpose of deter- mining the, flow into a reservoir, it is important to bear in mind that the loss from a constant water surface is nearly twice as great as from the intermittently saturated land surface. A simple and safe rule is to add the mean water surface of the reservoir (between the limits of high and low water) to the total area, including the reservoir, over which the rainfall and evaporation are calculated.

Even neglecting the isolated and local discharges due to excessive and generally unrecorded rainfall, the variation in the discharge of all streams, and Variation especially of mountain streams, is very great. of dis- We j^ye seen that the average flow from moun- ” arg0' tain areas in Great Britain towards the end of a dry season does not exceed one-fifth of a cubic foot per

second per 1000 acres. Adopting this general minimum as the unit, we find that the flow from such areas up to about 5000 acres, whose mean annual rainfall exceeds 50 inches, may be expected occasionally to reach 1500 such units ; while from similar areas of 20,000 or 30,000 acres with the same mean rainfall the discharge sometimes reaches 1200 or 1300 such units. It is well to compare these results with those obtained from much larger areas but with lower mean rainfall. The Thames at Teddington has been continuously gauged by the Thames Conservators since 1883, and the Severn at Worcester by the writer, on behalf of the corporation of Liverpool, during the 10 years 1881 to 1890 inclusive. The highest flood, common to the two periods, was that which occurred in the middle of February 1883. On that occasion the Thames records gave a discharge of 7·6 cubic feet per second per 1000 acres, and the Severn records a discharge of 8·6 cubic feet per second per 1000 acres, or 38 and 43 respectively of our units ; while in February 1881, before the Thames gaugings were commenced, the Severn had risen to 47 of such units, and subsequently in May 1886 rose to 50 such units, though the Thames about the same time only rose to 13. But in November 1894 the Thames rose to about 80 such units, and old records on the Severn bridges show that that river must on many occasions have risen to considerably over 100 units. In both these cases the natural maximum discharge is somewhat diminished by the storage produced by artificial canalization of the rivers.

These illustrations of the enormous variability of dis- charge serve to explain what is popularly so little under- stood, namely, the advantage which riparian owners, or other persons interested in a given Compen- stream, may derive from works constructed water. primarily for the purpose of diverting the water of that stream — it may be to a totally different watershed — for the purposes of a town supply. Under modern legis- lation no such abstraction of water is usually allowed, even if limited to times of flood, except on condition of an augmentation of the natural dry-weather flow, and such a condition at once involves the construction of a reservoir. The water supplied to the stream from such a reservoir is known as " compensation water," and is generally a first charge upon the works. This water is usually given as a continuous and uniform flow, but in special cases, for the convenience of mill-owners, as

an intermittent one. In the manufacturing districts of Lancashire and York- shire it generally amounts to one-third of the whole so-called "available supply." In Wales it is usually about one-fourth, and elsewhere still less ; but in any case it amounts to many times our unit of one-fifth of a cubic foot per second per 1000 acres. Thus the benefit to the fisheries and to the riparian owners generally is beyond all question ; but the cost to the water authority of conferring that benefit is also very great — commonly (according to the proportion of the natural flow intended to be rendered uniform) 20 to 35 per cent, of the whole expenditure upon the reservoir works.

Down to the middle of the 19th century, the propor- tioning of the size of a reservoir to its work was a very rough operation. There were few rainfall YleId of statistics, little was known of the total loss by stream evaporation, and still less of its distribution ■with over the different periods of dry and wet reserrolr- weather. Certain general principles have since been laid down, and within the proper limits of their application have proved excellent guides. Generally it has been stated, with respect to any watershed area, that if from the average annual rainfall of the three driest consecutive

years we deduct the corresponding evaporation and absorption by vegetation, the result will be the available supply or flow from that area. But this is evidently only the case when the reservoir impounding the water from such an area is of just sufficient capacity to equalize that flow without possible exhaustion in any one of the three summers. If the reservoir were larger it might equalize the flow of the four or more driest consecutive years, which would be somewhat greater than that of the three ; if smaller, we might only be able to count upon the average of the flow of the two driest consecutive years, and there are many reservoirs which will not yield the average even of the single driest year. With further experience it has become obvious that very few reservoirs are capable of equalizing the full flow of the three consecutive driest years, and each engineer, in estimating the yield of such reservoirs, has

~~deducted from the quantity ascertained on the assumption that they do so a certain quantity repre- senting, according to his judgment, the overflow which in one or more of such years might occur. The actual size of the reservoir which would certainly yield the assumed supply throughout the driest periods has therefore been largely a matter of judgment. Empirical rules have grown up assigning to each district, according to its average rainfall, a particular number of days' supply, independently of any inflow, as the contents of the reservoir necessary to secure a given yield throughout the driest seasons. But any such generalizations are dangerous, and have frequently led to disappointment and sometimes to needless expenditure. The exercise of sound judgment in such matters will always be necessary, but it is nevertheless important to formulate so far as possible the conditions upon which that judgment should be based. It is necessary to know not only the mean flow of the stream, as represented by the rainfall less the evapora- tion, but also the distribution of that flow throughout the year.~~

~~The most trying distribution of which the author has had experience in the United Kingdom, or which he has been able to discover from a comparison of rainfalls upon nearly impermeable areas exceeding 1000 acres, is graphically represented in Fig. 3. In this the total depth of the diagram is marked 100 per cent., and represents the total flow of the year, while the months~~

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~~Fig. 3.~~

~~during which that flow occurs are measured horizontally. The thick irregular line shows the least favourable distribution, cumulatively recorded throughout the year, of the How off the ground, resulting from the fluctuations of rainfall during a single year, while the straight line a b represents uniformly distributed supply, also cumulatively recorded, of the same quantity of water over the same period. But, apart from the diurnal fluc- tuations which are equalized by local "service reservoirs," uniform distribution of supply throughout twelve months is rarely what we require ; and to represent the demand in most towns correctly, we should increase the angle of this line during the summer and diminish it during the winter months, as indicated by the dotted lines 6 b. The most noticeable features of this particular diagram are as follows : Up to the end of 59 days (to the 28th February) the rate of flow is, with rare exceptions, greater than the mean flow for the year, but during the 184 days between this and the end of the 243rd day (31st August) the rate of flow is~~

~~generally below the mean, while from that day to the end of the year it is again above the mean. Now in order that a reservoir may enable the varying flow, represented cumulatively by the irregular line, to be discharged in a continuous and uniform flow to satisfy a demand represented cumulatively by the straight line, its capacity must obviously be at least equal to the greatest deficiency c d of the cumulative flow below the cumulative demand, plus the greatest excess / e of the cumulative flow over the cumulative demand. The former is the later condition, and arises in this case on the 243rd day (31st August), when the total cumulative deficiency is graphically shown by the vertical distance d g to the line a' a' drawn parallel to a a, and touching the point e of maximum excess of cumulative flow. This height, shown by a~~

thickened line, is equal, on the vertical scale, to the difference between 48 per cent, and 78 per cent., or 30 per cent, of the stream flow during the year. A reservoir so proportioned to the demand, with a small addition to avoid drawing off the bottom water, would probably be safe in Great Britain in any year, or, if it failed, that failure would be of very short duration, and would probably only occur once in 50 years.

It may be at first sight objected that a case is assumed in^hich there is no overflow before the reservoir begins to fall, and There- fore no such loss as generally occurs from that cause. This is true, but it is only so because we have made our reservoir large enough to contain all the water that falls before the 28th February in this particular year, and if more water had fallen before that date the rainfall for the year would have been increased, and the year would not have been the driest. Ex- perience shows, in fact, that, for the assumed rainfall of the year, the distribution on the diagram is the least favourable likely to occur, and that if for the same average fall a different distribution occurs, that distribution will not try the reservoir more severely, unless the demand is differently distributed. The particular drought shown on the diagram is the result of an ex- ceptionally early deficiency of rainfall. The reservoir begins to fall at the end of February, and continues to do so with few and short exceptions until the end of August, and it so happens that about the end of August the curved dotted line representing actual cumulative demand crosses the line of uniform demand, so that the excess of demand, represented by the slope from June to Sep- tember, is balanced by the deficiency of demand, represented by the flatter slope in the first five months, except as regards the small quantity b f near the end of February, which, not having been drawn off during January and February, must overflow before the end of February. When, however, the drought ends later, at the end of October, for example, the excess of the dotted line at that time is to be added to its deficiency at the end of February, or whenever the fall in the line of flow begins, and the capacity of the reservoir must be increased to this extent. When the maxi- mum monthly demand does not exceed the average by more than 13 per cent., the excess from this cause at the end of the drought, added to the deficiency at the beginning of the drought, is about 3 per cent, of the flow during the year, and in the case of a one- year reservoir it therefore increases the

necessary capacity from 30 to 33 per cent, of the flow. But in assuming this condition of demand, and increasing our reservoir to meet it, we assume also that some additional supply to that reservoir can be obtained from the' previous year. The most trying assumption is that the rainfall of the previous year together with that of the driest year will be the rainfall of the two driest consecutive years. We have already seen that while the rainfall of the driest of 50 years is about 63 per cent, of the mean, that of the driest two consecutive years is about 72 per cent, of the mean. It follows, therefore, that the year immediately preceding the driest cannot have a rainfall less than about 81 per cent, of the mean. As the loss by evaporation is a deduction lyhrg between a constant figure and a direct pro- portional to the rainfall, we should err on the safe side in assuming the flow to be increased proportionately to the rainfall, or by the difference between 63 and 81, equal to 18 per cent, of the mean of 50 years. This 18 per cent., if spread over the two years, is evidently much more than sufficient to meet the summer excess over the average demand up to the 15th October of the driest year ; and an increase in the size of the reservoir sufficient to carry over, from the first to the second year, the small additional quan- tity of water represented by 3 per cent, of the yield of the driest year will therefore meet the irregular demand.

But in determining the capacity of reservoirs intended to yield a supply of water equal to the mean flow of two, three, or more years, the error, though on the safe side, caused by assuming the evaporation to be proportional to the rainfall, is too great to be neglected. The evaporation slightly increases as the rainfall increases, but at nothing like so high a rate. Having determined this evaporation for the second driest consecutive year and deducted it

from the rainfall — which, as above stated, cannot be less than 81 per cent, of the mean — we may extend our cumulative diagram of flow into the reservoir, and of demand, from one to two years. In the same way we may group in a single diagram any number of consecutive driest years, and either ascertain the reservoir capacity necessary for a given uniform

~~yield (represented cumu- latively by a straight line corresponding with a a, but drawn over all the years instead of one), or conversely, having set up a vertical at the most trying point (repre- senting, in percentage of the total annual now1 of the driest year, the capacity of reservoir which it may be convenient to provide), we may draw a straight line of uniform yield from the head of that vertical to the previous point of maximum excess of cumulative flow. That line, produced to the boundaries of the diagram, will give the total uniform supply which may be safely drawn from the reservoir within the given period, always provided that the higher end to the right does not rise above the thick irregular line of natural cumulative flow. It is to be observed that any irregularity in the rate of supply from the reservoir may occur between the critical periods of maximum excess of cumulative flow and maxi- mum deficiency of cumulative flow (e and g respectively, in the one year diagram), which does not increase the total supply between those points, or cause the line of cumulative supply from the reservoir to cut the line of cumulative flow into it; and the correction for excess of demand during dry weather in the single year reser- voir evidently requires no addition by reason of the increase in the number of years over which the reservoir equalizes the flow.~~

~~From a diagram, covering many years and constructed upon these principles, the general diagram (Fig. 4) has been produced. To illustrate its use, assume the case of a mean rainfall of 50 inches (figured in the right-hand column at the end of a curved line) and of 14 inches of evaporation and absorption by vegetation (marked upon that line). The ordinate, to any point upon this curved line, then represents the yield per day for each acre of drainage area, from a reservoir whose capacity is equal to the corresponding abscissa. Thus, if we require a yield of 1080 gallons per acre, we find the point on the curve, whose ordinate is 1080, on the scale to the left of the diagram; while on the scale at the foot we find that the corresponding abscissa is equal to 120,000 gallons. If, then, for example, the drainage area is 2000 acres, the required reservoir capacity will be 240,000,000 gallons (in addition to any allowance for bottom water, or excess of summer demand above the mean supply). The point which, in this case, we have selected on the curve, is intersected by the left-hand radial line, showing that the yield of the reservoir is exactly~~

equal to the natural flow during the driest year ; and therefore, as already stated, that the capacity of the reservoir is just 30 per cent, of that flow. Similarly, the yield from any given reservoir, or the capacity required for any yield, corresponding with any mean rainfall from 30 to 100 inches, and with the flow over any period, from the driest year to the six or more consecutive driest years, may be determined from the diagram.

It is instructive to note the ratio of increase of reservoir capacity and yield respectively for any given rainfall. Thus, assuming a mean rainfall of 60 inches during 50 years, subject to evaporation and absorption equal to 14 inches throughout the dry period under considera- tion, we find from the diagram the following quantities (in gallons per acre of drainage area) and corresponding ratios : — v

Number of driest conse- cutive years the flow of which is equalized.

Net Capacity of Reservoir.

Yield of Reservoir.

Gallons per acre of drainage area.

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~~In terms of yield of~~

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293·4

0

55·4 27·5 18·5 13·1 10·4

1475

1815 .

1987

2103

2187

2255

100

123·1

134·7

142·6

148·3

152·9

0 23·1 9·4 5·9 4·0 3·1

It is thus manifest that so great is the increase required in the size of a reservoir in relation to its increased yield, that only in the most favourable places for reservoir con- struction, or under the most pressing need, can it be worth while to go beyond the capacity necessary to render uniform the flow of the two or three driest consecutive years.

It must be clearly understood that the diagram Fig. 4 /does not relieve the reader from any exercise of judg- ment, except as regards the net capacity of reservoirs when the necessary data have been obtained. It is merely a geometrical determination of the conditions necessarily consequent upon a given mean rainfall over many years, upon evaporation and absorption in particular years (both of which he must determine for himself), and upon certain limiting variations of the rainfall, already stated to be the result of numerous records maintained in Great Britain for more than 50 years. It must also be remembered that the total capacity of a reservoir must be greater than its net available capacity, in order that in the driest seasons fish life may be maintained and no foul water drawn off.

Throughout Europe the annual variations of rainfall, in relation to the mean, follow nearly the same law as in Great Britain, but in some parts the distribution of rain- fall in a single year is often more trying. The droughts are longer, and the rain, when it falls, especially along the Mediterranean coast, is often concentrated into shorter periods. Moreover, it often falls upon sun-heated rocks, thus increasing the evaporation for the time ; but gaugings made in the northern Apennines indicate that this loss is more than compensated by the greater rapidity of the fall and of the, consequent flow. In such regions, there- fore, for reservoirs equalizing the flow of two or more years, the capacity necessary does not materially differ from that required in Great Britain. As the tropics are approached, even in mountain districts, the irregularities become greater, and occasionally the rainy season is entirely absent for a single year, though the mean rainfall is con- siderable.

Springs and Wells. — We have hitherto dealt only with the collection and storage of that portion of the rainfall which flows over the surface of nearly impermeable areas. Upon such areas the loss by percolation into the ground may be neglected, and the only loss to be considered is that of re-evaporation into the air and of absorption by vegetation. The crust of the earth varies from almost complete impermeability to almost complete permeability. Among the sedimentary rocks we have, for example, in the clay slates of the Silurian formations, and in parts of the Greensand and Chalk, the opposite extremes ; while the igneous rocks are for the most

part only permeable in virtue of the fissures they invariably contain. Wherever, below the surface, there are pores or fissures, water

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CAPACITY OF RESERVOIR IN QALLONS PER ACHE OF DRAINAGE AREA

Fig. 4.

derived from rainfall is (except in the rare cases of dis- placement by gas) found at heights determined by the

resistance to its passage underground towards springs. some neighbouring sea, lake, or water-course.

The positions of the springs at which such water reaches the surface are determined by the superimposition of permeable upon less permeable strata, sometimes com- bined with a fault or a synclinal fold of the strata, forming the more permeable portion into an underground basin lying within comparatively impermeable boundaries. At the lower lip or at the most permeable part of such a basin the water collected from rainfall issues as a spring.

Perennial springs of large volume rarely occur in Great Britain at a sufficient height to afford supplies by gravita- tion, the best known being those from the Chalk discharged either below or near the sea-level ; but from the Limestone of Italy and other parts of the world very considerable volumes issue far above the sea-level, and are thus avail- able, without pumping, for the supply of distant towns. On a small scale, however, springs are fairly distributed over the United Kingdom, for there are no

formations, except perhaps blown sand, which do not vary in their resistance to the percolation of water, and therefore tend to produce overflow above the valley levels. But even the rural populations have generally found springs not suffi- ciently constant for their use. The natural remedy has been to excavate to the underground basins, at levels below their natural outfalls, and thus to obtain access to stored water which after prolonged droughts might cease to overflow, or the overflow of which may be too distant. Hence throughout the world we find the shallow well still very common in villages and near isolated dwellings. The shallow well, however, rarely supplies enough water for more than a few houses, and the cost -of pumping and distribution by pipes being generally prohibitive, the water has to be carried by hand. It follows that such wells are almost invariably found in immediate proximity to human habitations, with the natural consequence that the water is, as a rule, seriously polluted. Deep wells owe their comparative immunity from pollution to the circumstances that the larger quantity of water yielded renders it worth while to pump that water and convey it over greater distances, and that any impurities must pass through a great depth of filtering material and take a long time to reach the well. The principal water-bearing formations, utilized in Great Britain by means of deep wells, are the Chalk and the New Red Sandstone. The Upper and Middle Chalk are permeable almost through their mass. They hold water like a sponge, but part with it under pressure to fissures by which it is intersected, and, in the case of the Upper Chalk, to beds of flints. A well sunk in these formations without striking any fissure or water-bearing flint bed would receive water only at a very slow rate ; but if, on the other hand, it struck one or more of the natural water-ways, the quantity of water capable of being drawn from it would be greatly increased. This increase is simply due to the much greater water- bearing area with which the well is thus put into com- munication. In practice it is usual to drive small tunnels, or " adits " as they are called, below the water-level, to intercept fissures and water-bearing beds, and thus still farther extend the collecting area.

It is a notable peculiarity of the Upper and Middle Chalk formations that below the present valleys the p underground water passes more freely than

bin ty of elsewhere. This is explained by the fact that different the Chalk fissures are almost invariably rounded strata. an(j eniarged by the erosion of carbonic acid carried by the water passing through them. These fis- sures take the place of the streams in an impermeable

area, and those beneath the valleys must obviously be called upon to discharge more water from the surface, and thus be brought in contact with more carbonic acid, than similar fissures elsewhere. Hence in the process of time they have become greatly enlarged, and the best position for a well in the Chalk is therefore generally that over which, if the strata were impermeable, the largest quan- tity of surface water would flow. The Lower Chalk for- mation is for the most part little permeable. tIt, however, contains many ruptures and dislocations, "smashes" as they are now commonly called, in the interstices of which large bodies of water, received from the Upper and Middle Chalk, may be naturally stored, or which may merely form large passages for the stores of water above them. A striking example is that known as Lydden Spout, under Abbot's Cliff, near Dover. The acid erosion of the chalk is shared by all the purer limestones, such as the Carboniferous or Mountain Limestone, but no similar benefit is felt. So greatly has this formation been distorted, that the valleys which traverse it are not the valleys which may be conceived to have originally supplied carbonic acid to its fissures, and all trace of the lines of underground erosion is generally lost.

Next in importance to the Chalk formations comes the Trias or New Bed Sandstone, consisting in Great Britain of two main divisions, the Keuper at the top and the Bunter below, of which the greater part, with the exception of the Bed Marls forming the upper part of the Keuper, is permeable. Some portions of the New Bed Sandstone contain, when saturated, even more water than Chalk ; but, as in the case of the Chalk, a well or borehole in the sandstone yields very little water unless it strikes a fis- sure ; hence it is a common thing to form underground chambers or adits in search of additional fissures, and sometimes to sink many vertical boreholes with the same object in view.

There are other water-bearing formations, such as the Greensands, the permeability of which varies very greatly in different districts. Where it is

considerable, the sand is generally in a loose condition, and the difficulty of sinking a deep well through it is thus greatly increased. Moreover, when such a well is successfully sunk, special precautions are required to prevent sand from being forced in as well as water. Perhaps the most important of these formations in Great Britain is that portion of the Lower Greensand, the outcrop of which, emerging along the south-eastern shore of the Wash, passes south-west- wards. This formation, probably more or less permeable throughout, attains a thickness to the east of Bedford considerably exceeding 250 feet, and is to be utilized for the supply of Bedford and other large areas in the county.

In formations like loose Greensand, the cost of driving horizontal adits, which must necessarily in such cases be lined with brickwork or other materials, would be prohibitive, and the yield to the well is Ylejf of therefore confined to the quantity of water which can reach it without the aid of artificial pas- sages, and which can be introduced into it free from sand. A well, surrounded by a porous mass of sand charged with -water, receives its supply by percolation across whatever opening into the well may have been prepared for its passage and closed by strainers against the sand which seeks to follow it. A few feet from any such opening the hemispherical area, traversed by the water from all directions, may be many times greater than the area of the opening into the well ; therefore it is only at, and close to, the opening that the frictional resistance of the sand to the flow of the water is at all important, and anything that reduces that resistance will proportionately

increase the total yield. This end may be accomplished by injecting air or water through the opening into the sand, and alternately reversing the flow to allow the finer disturbed particles to pass with the water into the well. If such work is properly conducted, the whole of the sand surrounding each opening may be so far freed from the finer particles which it contains that the yield will be immensely increased. Where, however, rock of any kind is encountered, the yield of a well (under a given head of water) can only be increased by enlargement of the main

well in depth or diameter, or by boreholes or adits. No rule as to the adoption of any one of these courses can be laid down, nor is it possible, without examination of each particular case, to decide whether it is better to attempt to increase the yield of the well or to construct an additional well some distance away. By lowering the head of water in a well the yield is always temporarily increased, but, unless the rate of flow towards the well is equal to the quantity drawn from it, the yield thus at first obtained cannot be permanent. Every well has its own particular level of water while steady pumping at a given rate is going on, and if that level is lowered by harder pumping, it may take months, or even years, for the water in the interstices of the rock to accommodate itself to the new conditions ; but the permanent yield after such lowering will always be much less than might be supposed from the quantity pumped shortly after the change. We have hitherto supposed the pumps for draw- ing the water to have been placed in the well so as to be accessible without being lifted out. Pumps, however, may be (and have been) placed deep down in boreholes, by which means the head of pressure in the boreholes tending to hold the water back in the rock has been greatly reduced, and the supply has consequently been increased ; but when the cost of maintenance is included, the increased supply from the adoption of this method rarely justifies expectations. When the water has been drawn down to the new level its passage through the Sandstone or Chalk in the neighbourhood of the borehole is further resisted, both by virtue of the smaller length of borehole below the water and of the greater quantity of water called upon to pass into that smaller length ; and there are many instances in which repeated lowering and increased pumping, both from wells and boreholes, have had the result of reducing the water available, after a few years, nearly to the original quantity ; in some cases it falls even lower than when pumped from a greater height. One other method — the use of the so-called " air-lift " — should be mentioned. This ingenious device, which has been employed for some years in America, has been adopted in a few places in Great Britain. The object attained by the air-lift is precisely the same as that attained by putting a pump some distance down a bore- hole ; but instead of the head being reduced by means of the pump, it is reduced by mixing the water with air. A pipe is passed down the borehole to the desired depth, and connected with air-compressors at the surface. The compressors being set to work, the air is

~~caused to issue from the lower end of the pipe and to mix in fine bubbles with the rising column of water, sometimes several hundred feet in height. The effect is that the weight of the column of water, or rather of water and air mixed, is reduced in proportion to the volume of air it contains. The method will therefore always increase the yield for the time, and it may do so permanently, though to a very much smaller extent than at first ; but its economy must always be less than that of direct pumping.~~

~~Sedimentary rocks, formed below the sea or salt lagoons, must originally have contained salt water in their inter- stices. On the upheaval of such rocks above the sea-level,~~

~~fresh water from rainfall Degan to flow over the surface, and, so far as the strata were permeable, to lie in their interstices upon the salt water. The weight of Presb the original . salt water above the sea-level, and water of the fresh water so superimposed upon it, below caused an outflow towards the sea. A hill, as sea-,er^1- it were, of fresh water rested in the interstices of the rock upon the salt water, and continuing to press downwards, forced out the salt water even below the level of the sea. There is, indeed, no physical reason why this process should not continue to any depth at which the rock is sufficiently porous to admit of the necessary percolation, and in such rocks fresh water has usually been found as far down as borings have yet penetrated. It would con- ceivably take but a small fraction of the period that has in most cases elapsed since such upheavals occurred for the whole of the salt water to be thus replaced by fresh water, and for the condition to be attained as regards saturation with fresh water, in which we now find the porous portions of the earth's crust wherever the rainfall exceeds the evaporation. There are cases, however, such as the valley of the Jordan, where the ground is actually below the sea-level, and where, as the total evaporation is equal to or exceeds the rainfall, the lakes also are below the sea-level. Thus, if there is any percolation between the Mediterranean and the Dead Sea, it must be towards the latter.~~

~~In considering the theory of well supplies it is important to bear these facts in mind. The crust of 'the earth, so far as it is permeable and above the sea-level, receives from rainfall its supply of fresh water. That supply,~~

so far as it is not evaporated or absorbed by vegetation, passes away by the streams or rivers or sinks into the ground. If the strata were uniformly porous the water would lie in the rock at different depths below the surface (but always above the sea-level), according to the time of year and distribution of the rainfall. It would slowly, bufc constantly, percolate downwards and towards the sea, and would issue at or below the sea-level, rarely reaching the earth's surface ear Her except in deep valleys. Precisely the same thing happens in the actual crust of the earth, except that, in the formations usually met with, the strata are so irregularly permeable that no such uniform per- colation occurs, and most of the water, instead of oozing out below the sea-level, meets with obstructions which cause it to issue, sometimes below the sea-level and sometimes above it, in the form of springs. After jtro- longed and heavy rainfall the upper boundary of the sub- soil water is in most strata practically coincident with the surface. After prolonged droughts it still retains more or less the same figure as the surface, but has sunk to lower depths.

Perhaps the only cases of nearly uniform percolation in nature are those which occur in some islands or peninsulas formed wholly of sea sand. Here water is held up in the sand above the sea-level by the more or less continuous supply from rainfall, and may be drawn off by wells or borings. But such formations are generally recent, and the rainfall has often not had time to displace the sea water much below the sea-level. On such an island, a mile and a quarter in diameter, in the centre of which a borehole had been put down, brackish water was reached at a depth of only 196 feet; this formed a saucer, as it were, floating upon the salt water, but ever descending towards a more cup-like form.

Although such uniformly permeable sand is rarely met with in great masses, it is useful to consider in greater detail so simple a case. Let Fig. 5 be the section of a circular island a mile and a quarter in diameter, of uniformly permeable sand. The surface of the ground is shown by a strong black line, the limit downwards of the permeable sand by the full line//, the mean sea-level a a by a

dotted line, and the natural mean level of saturation b b above the sea-level by a curved dot and dash line. The water, contained in the interstices of the sand above the mean sea-level, would (except in so far as a film, coating the sand particles, is held up by capillary attraction) gradually sink to the sea-level if there were no rainfall. The resistance to its passage through the sand is, however, sufficiently great to prevent this from occurring while

Vertical jaile 13 funes bmaiutrtimtj scale Diameter •aHsland It Miter

Surface of Ground.

Outer and ten -permeatfe strata,.

Fig. 5.

percolation from annual rainfall takes place. Hence, according to the age of the island or promontory, we have some such constantly deepening figure as oc, representing the bounding surface between fresh and salt water. A well is sunk in the middle of the island, and a certain quantity of water is drawn daily. For small supplies such a well may be perfectly successful ; but however small the quantity drawn, it obviously has the effect of diminishing the supply of fresh water, which contributes to the maintenance of the level of saturation above the sea-level ; and with further pumping the fresh water would be so far drawn upon that the mean level of saturation would sink, first to a figure such as that represented by the new level of saturation dd, and later to the figure represented by the lines e e, in which the level of saturation has everywhere been drawn below the mean sea-level. At this stage the converse process begins, and percolation inland from the sea occurs. The figure in this case of uniform percolation assumed by the water levels approaching a deep well is a surface of revolu- tion, and however irregular the percolation and the consequent shape of the figure, it is commonly, but somewhat incorrectly, called the "cone of depression." It cannot have straight, or approxi- mately straight, • sides in any vertical plane, but in nature is an exceedingly irregular figure drawn about curves — not unlike those in Fig. 5. In this case, as in that of a level plane of uniformly porous sand, the vertical section of the figure has

~~asymptotes to the vertical well and to the natural level of the subsoil water ; and in the case of the sand island, upon horizontal impermeable strata, the vertical sections of the water surface are logarithmic curves. The illustration has been drawn from calculations which, on the hypothesis of uniform permeability, show that when the water is pumped down to the lower curve e e the well yields four times as much water as it would from the upper curve d d, in both cases assuming steady pumping for an indefinite period.~~

~~The importance of this illustration is to be found elsewhere than in islands, or peninsulas, or in uniformly porous sand. Where the strata are not uniformly porous, they may resist the passage of water from the direction of the sea or they may assist it ; and round the whole coast of England, in the Magnesian limestone to the north-east, in the Chalk and Greensand to the east and south, and in the New Red Sandstone to the west, the number of wells which have been abandoned as potable supplies, owing to the. percolation of sea water, is very great. Perhaps the first important cases occurred in the earlier part of the 19th century on the Lancashire shore of the Mersey estuary, where, one after another, deep wells in the New Red Sandstone had to be abandoned for most purposes. On the opposite side, in the Cheshire peninsula, the total quantity of water drawn has been much less, but even here serious warnings have been received. In 1895 the single well then supplying Eastbourne was almost suddenly rendered unfit for use, and few years pass without some similar occurrence of. a more or less serious kind. The remarkable suddenness with which such changes are brought about is not to be wondered at when the true cause is considered. The action of sandstone in filtering salt waters was investigated in 1878 by Mr Isaac Roberts, F.R.S., who showed that when salt water was allowed to percolate blocks of sandstone, the effluent was at first nearly fresh, the salt being filtered out and crystallized for the most part near the surface of ingress to the sandstone. As the process continued the salt-saturated layer, incapable of further effective filtration, grew in thickness downwards, until in the pro- cess of time it filled the whole mass of sandstone. But before this~~

was accomplished the filtration of the effluent became defective and brackish water was received, which rapidly increased nearly to the saltness of the inflow. . Into such blocks, charged with salt crystals and thoroughly dried, fresh water was then passed, and precisely the converse process took place. A thickness of only 12 inches of Buuter sandstoue proved at first to be capable of removing more than 80 per cent, of the chlorides from sea water ; but, after the slow passage of only 0‘6 gallon through one cubic foot of stone, the proportion removed fell to 8 ‘51 per cent. The general lesson to be learned from these facts is, that if the purity of the water of wells not far removed from the sea is to be maintained, that water must not be pumped down much below the sea-level. In short, the quantity of water drawn must in no case be allowed to exceed the quantity capable of being supplied through permeable areas by rain falling upon the surface of the land. If it exceeds that quantity, the stock of water held in the interstices of the rock, and capable of flowing towards the well, must disappear ; and the deficit between the supply and demand can only be made up by water filtering from the sea and reaching the well at first quite free from salt, but sooner or later in a condition unfit for use.

H. Dams.

Any well-made earthen embankment of moderate height, and of such thickness and construction as to ensure freedom from excessive percolation at any point, will in the course of time become almost impermeable Bartheu to surface water standing against it ; and when permeable rocks are covered with many feet of soil, the leakage through such soil from standing water newly placed above it generally diminishes rapidly, and in process of time often ceases entirely. Even the beds of sluggish rivers carrying fine detritus over porous strata generally become so impermeable that excavations made in their neighbour- hood, though freely collecting the subsoil water, receive’ no river water whatever. Thus natural or artificial sur- faces which are completely permeable to rainfall may be- come almost impermeable when protected by surface water from drought and frost, and from earth-worms, vegeta- tation, and artificial disturbance. But in order that this may be so, the initial resistance to percolation of water at every part of the soil or embankment must be such that the motion of the water shall be insufficient to disturb the water-

borne mineral and organic particles lodged on the surface or in the interstices of the soil. If, therefore, a reservoir so formed survives the first few years without serious leakage, it is not likely, in the absence of artificial disturbance, to succumb owing to leakage at a later period. Hence, as the survival of the fittest, there are many artificial waters with low dams consisting exclusively of earth — and sometimes very sandy earth — satisfactorily performing their functions with no visible leakage. But if, as in the case of a reservoir for water supply, large portions of the bottom are liable to be uncovered and exposed to hot sunshine, it is never advisable to depend upon this action where the materials of the bottom are naturally permeable.

According to the commoner method of construction in Great Britain, wherever an area intended to be converted into a reservoin»is not everywhere bounded by sufficiently impermeable rising ground, a trench ^°"^truc' is cut along the portion not so beunded, and carried down to rock or such other formation as, in the engineer's opinion, forms a sufficiently impermeable sheet beneath the whole surface to be covered with water. Into this trench so-called " puddled clay," that is, clay rendered plastic by kneading with water, is filled and thoroughly worked with special tools, and trodden in layers. In this manner an underground compartment is formed, the bottom of which is natural, and the sides partly natural and partly artificial, both offering high resistance to the passage of water. Above ground the same puddle walls or cores are carried up to the required level, and are supported as they rise by embankments of earth on either side.

Fig. 6 is a typical section, of a low dam of this class, impound- ing water upon gravel oveiiying impermeable clay. In such a structure the whole attention as regards water-tightness should be concentrated upon the puddle wall or core. When, as may happen in dry seasons, the puddle wall remains long above the water level, it parts with moisture and contracts. It

is essential that this contraction shall not proceed to such an extent as may pos- sibly produce cracking. Drying is retarded, and the contraction due to a given degree of drying is greatly reduced by the presence of sand and small stones among the clay. Nearly all clays, notably those from the Glacial deposits^ naturally contain sand and stones, 40 to 50 per cent, by weight of which is not too much if uniformly distributed. But in the lower parts of the trench, where the clay can never become dry, plasticity and ductility are, for

Overflow Level

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Fig. 6. — Section of Typical Low Earth Embankment in Flat Plain.

reasons to be explained below, the first consideration, and there the proportion of grit should be lower. The embankments are merely to support the puddle and to keep it moist above the ground level when the reservoir is low. They may be quite permeable, but to prevent undue settlement and distortion they must, like the puddle, be well consolidated. In order to prevent a tendency to slip, due to sudden and partial changes of satu- ration, and still more to prevent the accumulation of pressure beneath the outer embankment from escapes of water through or below the puddle, that embankment should always be permeable, except near the puddle, and well drained at the base. The less permeable materials should be confined to the inner parts of the inner embankment, where, when the water level falls, they may remain moist without becoming liable to slip. The inner slope should be protected from the action of waves by so-called ' ' hand- pitching, " consisting of roughly-squared stonework, bedded upon a layer of broken stone to prevent local disturbance of the embankment by action of the water between the joints of the larger stones. The largest and deepest reservoirs formed by means of dams of this class are to be found in mountain valleys, where it often happens that only a single straight dam crossing the valley is required ; but an exception has

been made in connexion with the London water- supply. The Staines reservoirs, designed by Messrs Hunter and Middleton for the storage of Thames water — mainly to avoid depletion of the river by pumping for the supply of London in summer weather — are constructed upon a nearly level plane of gravel overlying the impermeable London Clay formation, and are therefore of the class shown in Fig. 6. The puddle trenches pass down to the clay, and, with the puddle walls and embankments, entirely surround each reservoir. This exception is a notable one, for although the depth of water is only 40 feet, the water area already authorized is nearly 400 acres, while the capacity of the reservoirs will exceed three thousand million gallons.

In mountain valleys, rock or shale, com- monly the most impermeable materials met with in such positions, are sometimes not reached till great depths are attained. There are several cases in Great Britain in which it has been necessary to go down about 200 feet below the water level of the intended reser- voir. The highest dams of this class impound water to a level of about 110 feet above the bottom of the valley. Such great works have generally been well constructed, and there are many which after fifty years of use are perfectly sound and water-tight, and afford no evidence of deterioration. On the other hand, the partial or total failure of smaller dams of this description to retain the reser- voir water has been much more common in the past than is generally supposed. Throughout Great Britain there are still many reservoirs, with earthen dams, which cannot safely be filled ; and others which, after remaining for years in this condition, have been repaired. From such cases and their successful repair valuable experience of the causes of failure may be derived.

*Most of these causes are perfectly well understood by experienced engineers, but instances of malconstruction of recent date are still met with. A few such cases will now be men- tioued. The base of a puddle trench is often found to * " on y have been placed upon rock, perfectly sound in itself, * '*

but having joints which are not impermeable. The loss of water by leakage through such joints or fissures below the puddle wall may or may not be a serious matter in itself ; but if at any point there is sufficient

movement of water across the base to produce the slightest erosion of the clay above it, that movement almost invariably increases. In this manner the finer particles of clay in a line crossing its base are washed away, while the sandy particles remain behind and form a constantly deepening porous bar of sand crossing the base of the puddle. Percolation through this sand is thus added to the original leakage. Some-

times, but not always, when the barrier of clay

— — — — is passed, the water rises to the surface of the

— ground, producing a visibly turbid spring.

Directly such a leakage begins to carry away particles of clay a space, formerly occupied by mixed clay and sand, ' becomes contracted to the volume of the sand alone. A3 erosion con- tinues, the contraction continues, chiefly by the falling in of the clay roof above the sand. Thus, the permeable bar grows vertically rather than horizontally, and ultimately assumes the form of a thin vertical sheet traversing the puddle wall, often diagonally in plan, and having a thickness which has varied in different cases from a few inches to a couple of feet or more, of almost clean sand rising to an observed height of 30 or 40 feet, and only arrested there by the necessary lowering of the reservoir to avoid serious danger. The settlement of the plastic clay above the eroded portion soon pro- duces a surface depression over or nearly over the leakage, and thus sometimes gives the first warning of impending danger. It is not always possible to prevent any leakage whatever through the strata below the bottom or beyond the ends of the trench, but it is always possible to render such leakage entirely harmless to the work above it, and to carry the water by relief-pipes to visible points at the lower toe of the dam. Wherever the base of a puddle wall cannot be worked into a continuous bed of clay or shale, or tied into a groove cut in sound rock free from water-bearing fissures, the safest course is to base it on an artificial material at once impermeable and incapable of erosion, interposed between the rock and the puddled clay. Water-tight concrete is a suitable material for the purpose ; it need not be made so thick as the puddle core, and is therefore sometimes used with consider- able advantage in lieu of the puddle for the whole depth below ground. In Fig. 7 a case is shown to

~~*be so treated. Obviously, the junction between the puddle and the concrete might have been made at any lower level.*~~

~~*However well the work may be done, the lower part of a mass of puddled clay invariably settles into a denser mass when weighted with the clay above. If, therefore, one part is held up,*~~

~~*Fig. 7. — Earth Embankment, with stone toe and concrete trench.*~~

~~*while an adjoining part has no support but the clay beneath it, a fracture — not unlike a geological fault — must result. Fig. 8 is a part longitudinal section through the puddle wall of .*~~

~~*an earthen embankment. The puddle wall is crossed fJUaent by a pedestal of concrete carrying the brick discharge se em culvert. The puddle at a was originally held up by the flat head of this pedestal ; not so the puddle at 6, which under the superincum- bent weight settled down and produced the fault be, accompanied with a shearing or tangential strain or, less probably, with actual fracture in the direction bd. Serious leakage at once began at 6, and washed out the clay particle by particle, but did not wash out the sand, which remained behind in the crevice. The clay roof constantly falling in caused the leakage to work up along the piano bd of tangential strain. The overflow level of the water,*~~

originally at ef, was lowered for safety to gli ; and for many years the reservoir was worked with its general level much below gh. The sand-lilled vein, several inches in width, was found, on taking out the puddle, to have terminated near the highest level to which the water was allowed to rise, but not to have worked downwards.

Fig. 8. — Lower Neuadd Culvert Leakage.

There can be little doubt that the puddle at the right-hand angle,/ was also strained, but not to rupture, as owing to the rise of the bottom- there was comparatively little room for settlement on that side. In repairing this work the perfectly safe form shown by the dotted lines ha, kj was substituted for the flat surface aj, and this alone would have prevented dangerous shearing strains. As an addi- tional precaution, however, deep tongues of concrete, like those in Fig. 7, were built in the rock throughout the length of the trench, and carried up the sides and over the top of the pedestal. The puddle was then replaced, and remains perfectly .water-tight. The les- son taught by Fig. 8 applies also to the end of puddle walls where they abut againBt steep faces of rock. Unless such faces are so far below the surface of the puddle, and so related to the lower parts of the trench that no tension, and consequent tendency to separation of the puddle from the rock, can possibly take place, leakage with disastrous results may occur.

In other cases leakage and failure have arisen from allowing a part of the rock bottom of a puddle trench to overhang, as in Fig. 9. Here the straining of the original horizontal puddle in settling down is indicated in a purposely exaggerated way by the curved lines. There is considerable distortion of the clay, result- ing from combined shearing and tensile stress, above each of the steps of rock, and reaching its maximum at and above the highest step ab, where it has proved sufficient to produce a dangerous line

Fig. 9.—Overhanging Rock Leakage.

of weakness ac, the tension at a either causing actual rupture, or such increased porosity as to permit of percolation capable of keep- ing open the wound. In such cases as are shown in Figs. 8 and 9 the growth of the sand vein is not vertical, but inclined towards the plane of greatest distortion. In Fig. 9 a further cause of occasional failure, referred to above as sometimes due to allowing the ends of puddle walls to abut against steep faces of rock, is shown at b, where the clay has actually drawn away from the rock. When it is considered that a parting, sufficient to allow the thinnest film of water to pass, may start the formation of a vein of porous sand in the manner above ex- plained, it will be readily seen how great must be the attention to details, in unpleasant places below ground, and below the water level of the surrounding area, if safety is to be secured. In cases like Fig. 9 the rock should always be cut away to a slope, such as that shown in Fig. 10. If no difference of water-pressure had been allowed between the two sides of the puddle trench in Figs. 8 or 9 until the clay had ceased to settle down, it is probable that the inter- stices, at first formed between the puddle and the concrete or rock, would have been sufficiently filled to prevent injurious percolation at any future time. Hence it is always a safe precaution to afford plenty of time for such settlement before a reservoir is charged with water. But to all such precautions should be added the use of concrete or brick- work tongues running longitudinally at the bottom of the trench, such as those shown at a higher level in Fig. 7.

In addition to defects arising out of the condition or figure of the rock or of artificial work, upon which the puddle clay rests, the puddle wall it- self is often defective. . ^ The original material may have been

'' perfectly satisfactory, but if, for ex-*

ample, in the progress of the work a stream of water is allowed to flow across it, fine clay is sometimes washed away, and gravel or sand left to a sufficient extent to permit of future percolation. Unless such places are carefully dug out or repuddled before the work of filling is resumed, the percola- tion may increase along the vertical plane where it is greatest, by the erosion and falling in of the clay roof, as in the other cases cited. Two

instances probably originating in some such cause are shown in Fig. 11 in the relative positions in which they were carefully measured when found, as the puddle was removed from a crippled re- servoir dam. They are vertical planes stretching entirely across the puddle trench, and reach- ing in one case, cm, nearly to the highest level at which the reservoir had been worked for seventeen years after the leak- age had been dis- covered. The larger and older of these veins was 44£ feet high, of which 14 feet was above the ground; and it is interesting to note that this portion, owing probably to the smaller resistance to leakage, was much wider than below. The little vein to the left marked bb, about 3J feet deep, is curious. It looks like the beginning of success of an effort made by a slight percolation during the whole life of the reservoir to increase itself materially by erosion. There is no reason to believe that the cause of such a leakage could be developed except during construction, and it is certain that once begun it would increase. Only a know- ledge of the great loss of capital that has resulted from abortive reservoir construction justifies this notice of defects which can always be avoided, and are too often the direct result, not of design, but

Defects in puddle wall.

Fig. 10. — Proper Figure for Rock Slope.

of parsimony in providing a sufficiency of intelligent, experienced, and conscientious supervision, especially below ground, in the execution of such works.

In some cases, as, for example, when a high earthen embank- ment crosses a gorge, and there is plenty of stone to be had, it is desirable to place the outer toe of the earthen bank upon a toe or platform of rubble stonework, as in Fig. 7, by which means the

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~~Fig. 11. — Vertical Veins Leakage.~~

~~height of the earthen portion may be reduced and complete drain- age secured. But here again great care must be exercised in the packing and consolidation of the stones, which will otherwise crack and settle.~~

~~As with many other engineering works, the tendency to slipping either of the sides of the valley or of the reservoir embank- ment itself has often given trouble, and has sometimes led to serious disaster. This, however, is a kind of failure not always attributable to want of proper inspection, but rather to improper choice of the site, or treatment of the case, by those primarily responsible.~~

~~In countries where good clay or retentive earth cannot be obtained, numerous alternative expedients have been Dams with adopted with more or less success. In the diaphragms mining districts of America, for example, where °stZ°0d' timber is cheap, rough stone embankments concrete, have been lined on the water face with &c. timber to form the water-tight septum. In~~

~~such a position, even if the timber can be made sufficiently water-tight to begin with, the alternate immersion and~~

~~exposure to air and sunshine promotes expansion and con- traction, and induces rapid disintegration, leakage, and decay. Such an expedient may be justified by the doubtful future of mining centres, but would be out of~~

the question for permanent /water-supply. Eiveted sheets of steel have been occasionally used, and, where bedded in a sufficient thickness of concrete, with success. At the East Canon Creek dam, Utah, the height of which is about 61 feet above the stream, the trench below ground was filled with concrete much in the usual way, while above ground the water-tight diaphragm consists of a riveted steel plate varying in thickness from T6^ inch to ^ inch. This steel septum was protected on either side by a thin wall of asphaltic concrete supported by rubble stone embank- ments, and owing to irregular settling of the embankments became greatly distorted, apparently, however, without causing leakage. Asphalt, whether a natural product or artificially obtained, as, for example, in some chemical manufactures, is a most useful material if properly used in connexion with reservoir dams. Under sudden impact it is brittle, and has a conchoidal fracture like glass ; but under continued pressure it has the properties of a viscous fluid. The rate of flow is largely dependent upon the proportion of bitumen it contains, and is of course re- tarded by mixing it with sand and stone to form what is commonly called asphalt concrete. But given time, all such compounds, if they contain enough bitumen to render them water-tight, appear to settle down even at ordinary temperatures as heavy viscous fluids, retaining their fluidity permanently if not exposed to the air. Thus they not only penetrate all cavities in an exceedingly intrusive manner, but exert pressures in all directions, these, owing to the density of the asphalt, being more than 50 per cent, greater than would be produced by a corre- sponding depth of water. From the neglect of these con- siderations numerous failures have occurred.

In one instance in the writer's experience the retaining wall of a service reservoir, abutting upon a street footway in the higher part of a great town, had been built of ashlar of exceptional thick- ness, divided longitudinally by a thin vertical diaphragm of bituminous composition. In the process of time this asphalt very slowly settled down, till, eighteen years after the reservoir was constructed, the diaphragm had considerably increased in thickness, and the outside batter of the wall had been correspond- ingly reduced. Slow and insidious though the action was, its effect in pressing the wall over was at last noticed from the thoroughfare, though there was no leakage, and by timely warning .a terrible disaster

was averted. This retaining wall, considered as a monolith, had abundant strength to resist any possible water- pressure from the reservoir ; but its half-thickness was quite incapable of withstanding the lateral pressure due to an apparent solid, but a virtual fluid, one-and-a-half times the density of water, acting under a head somewhat greater than the head of water in the reservoir.

Elsewhere, a simple concrete or masonry wall or core has been used above as well as below ground, being carried up between embankments either of earth or rubble stone. This construction has received its highest develop- ment in America. At the south end of the new masonry dam now being built across the Croton river for the supply of New York, the section of the main dam changes to a masonry core wall carried into the hill and supported above ground by earthen embankments. At its junction with the main dam this core wall when finished will be 175 feet high. Its base is there 18 feet thick, reduced 10 feet higher up to about 14 feet, and at the top to about 6 feet. The precaution is taken to slope the sides of the trench for a depth of about 20 feet, and then to carry it down vertically, about twice as wide as the average thickness of the wall, the space so left being refilled with earth. By this expedient the strains to which the wall would be subject if the lower part were fixed, and the upper part only sustained by artificial

embankments liable to irregular saturation and settle- ment, will be greatly reduced.1 On the Titicus, a tribu- tary of the Croton river, an earthen dam was completed in 1895, with a core wall 100 feet high — almost wholly above the original groun4 level — which is said to be impermeable ; but other dams of the same system, with core walls of less than 100 feet in height, are apparently in their present condition not impermeable. Reservoir No. 4 of the Boston waterworks, completed in 1885, has a concrete core wall of this description. The embankment is 1800 feet long and 60 feet high. The core wall is about 8 feet thick at the bottom and 4 feet thick at the top, and in the middle of the valley nearly 100 feet in height. At irregular intervals of 150 feet or more but- tresses 3

feet wide and 1 foot thick break the continuity on the water side. That this work has been regarded as successful is shown by the fact that Reservoir No. 6 of the same waterworks was subsequently constructed and completed in 1894 with a similar core wall. The embank- ments' supporting the last named appear to have been constructed with great care, and with walls of such pro- portions it is obvious that extreme care is necessary to avoid sufficient irregular settlement of the earthwork to produce undue strains in the diaphragm. There is no serious difficulty in so constructing walls of this kind as to be practically water-tight while they remain unbroken ; but they are undoubtedly subject to irregular stresses which cannot be calculated, and under which, speaking generally, plastic materials are much safer. In Great Britain masonry or concrete core walls have been generally confined to positions below ground, in which case it is better to construct them against the solid earth or rock. Thus placed, no serious strains are caused either by undue changes of temperature or by movements of the lateral supports, and with proper ingredients and care a very thin wall may be made perfectly water-tight, and in some English practice has proved satisfactory.

The next class of dam to be considered is that in which the structure as a whole is so bound together that, with

certain reservations, it may be considered as Masonry a m0nolit]i subject chiefly to the overturning

tendency of water — pressure resisted by the weight of the structure itself and the supporting pressure of the foundation. Masonry dams are merely retaining walls of exceptional size, in which the overturning pressure is water. If such a dam is sufficiently strong, and is built upon sound and moderately rough rock, it will always be incapable of sliding. Assuming also that it is incapable of crushing under its own weight and the pressure of the water, it must, in order to fail entirely, turn over on its outer toe, or upon the outer face at some higher level. It may do this in virtue of horizontal water- pressure alone, or of such pressure combined with upward pressure from intrusive water at its base or in any higher horizontal plane. Assume first, however, that there is no uplift from intrusive water. This case, neglecting as it does the limited resistance to

~~crushing, is entirely hypo- thetical, but is useful to fix the ideas. As the pressure of water is nil at the surface and increases in direct propor- tion to the depth, the overturning moment is as the cube of the depth ; and the only figure which has a moment of resistance due to gravity, varying also as the cube of its~~

~~1 It appears that this remarkable core wall, a great part of which has been constructed, is not destined to be completed. A com- mission appointed to consider the question having examined the condition, as regards saturation, of the outer earthen embankments of other dams with high core walls on the Oroton river or its tributaries, has submitted an adverse report, and it is understood that the masonry dam will be carried across the whole width of the valley.~~

~~depth, is a triangle. The form of stability having the least sectional area is therefore a triangle. It is obvious that the angles at the base of such a hypothetical dam must depend upon the relation between its density and that of the water. It can be shown, for example, that for masonry having a density of 3, water being 1, the figure of minimum section is a right-angled triangle, with the water against its vertical face; while for a greater density the water face must lean towards the water, and for a less density away from the water, so that the water may lie upon it. For the sections of masonry dams actually used in prac- tice, if designed on the condition that the centre of all vertical pressures shall be, ,as hereafter provided, at two- thirds the width of the base from the inner toe, the least sectional area for a density of 2 also has a vertical water face. As the density of the heaviest rocks is only 3, that of a masonry dam must be below 3, and in practice such works if well constructed vary from 2-2 to 2 '6. For these densities, the deviation of the water face from the vertical in the figure of least sectional area is, however, so trifling that, so far as this consideration is concerned, it may be neglected.~~

~~If the right-angled triangle dbc, Fig. 12, be a profile 1 foot thick of a monolithic dam, subject to the pressure of water against its vertical side to~~

~~the full depth db = d Vefer IgvgL a~~

~~in feet, the horizon- tal pressure of water against that section of the dam, increasing uniformly with the depth, is properly re- presented by the equilateral right- angled triangle abe, in which he is the maxi- mum water - pressure due to the full depth dr while the area abe= d?/2 is the total hori- Fig. 12.~~

~~zontal pressure against the dam, in cubic feet of water, acting at one-third its depth above the base. Then w=cP/2 is the resultant horizontal pressure with an overturning moment of~~

~~2 ” 3 6 [‘~~

~~If x be the width of the base, and p the density of the masonry, the weight of the masonry in terms of a cubic foot of water will~~

~~be p— , acting at its centre of gravity g, situated at — from the 2t o~~

~~outer toe, and the moment of resistance to overturning on the outer toe,~~

~~dx 2x „da? ,„.~~

~~PT-l=p-B (2)~~

~~Equating the moment of resistance (2) to the overturning moment (1), we have~~

~~da? d?~~

~~Diagram of Eight Angled Triangle Dam.~~

~~and~~

~~‘3-6~~

~~d x= —;=.~~

~~»/2p~~

That is to say, for such a monolith to be on the point of overturn- ing under l!he horizontal pressure due to the full depth of water, its base must be equal to that depth divided by the square root of twice the density of the monolith. For a density of 2 '5 the base would therefore be 447 per cent, of the height.

We have now to consider what are the necessary factors of safety, and the modes of their application. In the first place, it is out of the question to allow the water to rise to the vertex a of such a masonry triangle. A fT"0 minimum thickness must be adopted to give sub- sa y' stance to the upper part ; and where the dam is not used as a weir it must necessarily rise several feet above the water, and may in either event have to carry a roadway. Moreover, considerable mass is required to reduce the internal strains caused by changes of temperature. In the next place, it is necessary to confine the pressure, at every point of the masonry, to an intensity which will

give a sufficient factor of safety against crushing. The upper part of the dam having been designed in the light of these conditions, the whole process of completing the design is simple enough when certain hypotheses have been adopted, though somewhat laborious in its more obvious form. It is clear that the greatest crushing pressure must occur, either with the reservoir empty at the lower part of the water face ab, or with the reservoir full at the lower part of the outer face ac. If the dam is well built the intensity of

J&Z&T-18K&.

Centre of -Hj'&kr pressure — j.j£

*"*** 1-7'*

*Fig. 13. — Factor of Safety Diagram. *• (/*

vertical pressure will (neglecting local irregularities) vary nearly uniformly from face to face along any horizontal plane. Thus, to take the simplest case, if abce (Fig. 13) represents a rectangular mass already designed for the superstructure, and g its centre of gravity, the centre of pressure upon the base will be vertically under g, that is, at the centre of the base, and the load will be properly represented by the rectangle bfgc, of which the area is

Ovtrflmv LeveZ

mt

Fig. 14. — Diagram showing Lines of Pressure in Masonry Dam.

equal to the total load and the uniform depth to its uniform intensity. At this high part of the structure the intensity of pressure will of course be much less than- its permissible intensity. If now we assume the water to have a depth d above the base, the total water pressure represented by the triangle kbh will have its centre at dIZ from the base, and by the parallelogram of forces assuming the density of the masonry to be 2 '5, we find that the centre of pressure upon the base be is shifted from the centre of the base to a point i nearer to the outer toe c, and the rectangular diagram of pressures will thus be distorted from the figure bfgc to the equal figure bjlc, having its centre o/'vertically under the point

at which the resultant of all the forces cuts the base be. For any lower level the same treatment may, step by step, be adopted, until the maximum intensity of pressure el exceeds the assumed permissible maximum, or the centre of pressure approaches within an assigned distance from the outer toe c, when the base must be widened until the maximum intensity of pressure or the centre of pressure, as the case may be, is brought within the prescribed limit. The resultant profile is of the kind shown in Fig. 14.

Having thus determined the outer profile under the conditions hitherto assumed, it must be similarly ascertained that the water face is everywhere capable of resisting the vertical pressure, and the base of each compartment must be widened if necessary in that direction also. Hence in dams above 100 feet in height, further adjustment of the outer profile

may be required by reason of the deviation of the inner profile from the vertical. The effect of this process is to give a series of points in the horizontal planes at which the resultants of all forces above those planes respectively cut the planes. Curved lines, as dotted in Fig. 14, drawn through these points give the centre of pressure, for the reservoir full and empty respectively, at any other horizontal plane. For the sake' of simplicity only gravity and horizontal water pressure have hitherto been referred to ; but wind pressure should not be neglected, and where the water face is curved in vertical section the weight of the water lying vertically above such face is to be added to the vertical pressures. The effect of waves is only pertinent to the upper por- tion of the dam, but the pressure of ice may in some cases affect thedesign to a somewhat greater depth. These general principles had been recognized before 1870 by Messrs Graeff and Delocre of the Ponts et Chausse'es, and had been put into practice in the Furens dam near St Etienne. When the late Professor Eankine, F.E.S., whose remarkable perception of the practical fitness or unfitness of purely theoretical deductions gives his writings excep- tional value, received from Major Tulloch, B.E., on behalf of the municipality of Bombay, a request to consider the subject generally, and with special reference to very high dams, such as have since been constructed in India, Eankine pointed out that before the vertical pressure approached the maximum pressure permissible, the pressure tangential to the slope might reach it. Thus conditions of stress are conceivable in which the maximum would be tan- gential to the slope, and would therefore increase the vertical stress in proportion to .the cosecant of the slope. It is very doubt- ful whether this pressure is ever reached, but such a limit rather than that of the vertical stress must be considered when the height of a dam demands it. Next, Eankine pointed out that, in a structure exposed to the overturning action of forces which fluctuate in amount and direction, there should be no appreciable tension at any point of the masonry. But there is a still more important reason why this condition should be strictly adhered to as regards the inner face. We have hitherto considered only the horizontal overturning pressure of the water ; but if from originally defective construction, or from the absence of vertical pressure towards the water edge of any horizontal joint, as at ab in Fig. 14, water intrudes beneath that part of the masonry more readily than it can obtain egress along be, or in any other direction towards the outer

~~*face, we shall have the uplifting and overturning pressure due to the full depth of water in the reservoir over the width ab added to the horizontal pressure, in which case all our previous calculations would be futile. The condition, therefore, that there shall be no tension is important ; but when we come to construction, we must see also that no part of the wall shall be less permeable than the water face. In Fig. 13 we have seen that the varying depth of the area bjlc approximately represents the varying distribution of the vertical stress. If, therefore, the centre of the figure became so far removed to the right as to make j co- incident with b, the diagram of stresses would become the triangle b'el', and the vertical pressure . at the inner face would be nil. This will evidently happen when the centre of pressure is two- thirds from the inner toe and one- third from the outer toe ; and if we displace the centre of pressure still farther, the condition that the centre of figure of the diagram shall be vertically under that centre of pressure can only be fulfilled by allowing the line b'V to cross the base as at b"V, thus giving a negative pressure or tension at the inner toe. ' Hence it follows that the line of pressures, when the reservoir is full, should not at any horizontal plane fall outside the middle third of the width of that plane.*~~

~~*Eankine in his report adopted the prudent course of taking as the saf« limits certain pressures to which, at that time, such structures were known to be subject. Thus for the inner face he took, as the limiting vertical pressure, 320 feet of water, or nearly 9 tons per square foot, and for the outer face 250 feet of water, or about 7 tons per square foot. For simplicity of calculation Eankine chose logarithmic curves for both the inner and outer faces, and they fit very well with the. conditions. Since his time an immense amount of mathematical energy has been devoted to the problem, but nothing better has been evolved, and results have in some cases been brought out which physical considerations would have shown the authors to be quite inapplicable in practice.*~~

~~*WATER SUPPLY.— Plate I*~~

~~*The Vyknwy Valley, Montgomeryshire, June 1888.*~~

~~*Lake Vyrnwy, December 1889. (.From Photographs by J. Maclardy.)*~~

Bouzky Masonry Dam.

Masses of masonry from tlie ruptured clam, weighing about 1000 tons each, lying in the positions below the reservoir to which they had been carried by the flood consequent upon the failure of the dam in April 181)5.

So far we have only considered water-pressure against the re- servoir side of the dam ; but it sometimes happens that the water- pressure against the outer face is considerable enough to modify the lower part of the section. In dams of moderate height above ground and considerable depth below ground there is, moreover, no reason why advantage should not be taken of the earth resist- ance due either to the downstream face of the trench against which the foundations are built, or to the materials excavated and properly embanked against that face above the ground level, or to both. We do not always know the least resistance which it is safe to give to a retaining wall subject to the pressure of earth, or, conversely, the maximum resistance to side-thrust which natural or embanked earth will afford, because we wisely neglect the important but very variable element of adhesion between the particles. It is notorious among engineers that retaining walls designed in accordance with the well-known theory of conjugate pressures in earth are un- necessarily strong, and this arises mainly from the assumption that the earth is merely a loose granular mass without any such adhesion. As a result of this theory, in the case of a retaining wall supporting a vertical face of earth beneath an extended hori- zontal plane level with the top of the wall, we get

p wz? 1-sin 0 $_2$ ” 1 + sin ‘ where P is the horizontal pressure of the earth against the wall exerted at one-third its height, w the weight of unit volume of the material, x the height of the wall, and the angle of repose of the material. That the pressure so given exceeds the maximum possible pressure we do not doubt ; and, conversely, if we put

p, i«c2 1 + sin ~ ~2 ‘ 1 — sin 0'

we may have equal confidence that P will be less than the maxi- mum pressure which, if exerted by the wall against the earth, will be borne without disturbance. The theory of conjugate pressures in earth, applied with due consideration for the angle of repose and the variations introduced by earth embankments of limited width, is perfectly safe for use in determining the resistance of earth to the overturning of masonry dams. The greater portion of the length both of the Neuadd and the Fisher Tarn dams-was designed on these principles with much economy and with per- fectly satisfactory results.

In the construction of the Vyrnwy masonry dam Port- land cement, mortar, and concrete were used in the joints. Even when less than a year old, 9-inch cubes of this mate- rial never cracked under compression below 100 tons per square foot ; and the mean resistance to cracking of all the blocks tested between two and three years after moulding exceeded 215 tons per square foot, while blocks cut from the concrete of the dam gave from 184 to 329 tons per square foot. It has been shown that the best hydraulic lime, or volcanic puzzuolana and lime, if properly ground while slaking, and otherwise treated in the best-known manner, as well as some of the so-called natural (cal- careous) cements, will yield results certainly not inferior to those obtained from Portland cement. The only ob- jection that can in any case be urged against the natural products is that a longer time is required for induration ; but in the case of masonry dams sufficient time necessarily passes before any load, beyond that of the very gradually increasing masonry, is brought upon the structure. The result of using properly treated natural limes is not to be judged from the careless manner in which such limes have often been used in the past. Any stone of which it is desirable to build a masonry dam must possess an average strength at least as great as the above figures for concrete and mortar; the clay slate of the Lower Silurian formation, used in the case of the Vyrnwy dam, had an ultimate crush- ing strength of from 700 to 1000 tons per square foot. If, therefore, with such materials the work is well done, and is not subsequently liable to be wasted or disintegrated by expansion or contraction or other actions which in the process of time affect all exposed surfaces, it is clear that 15 to 20 tons per square foot

~~must be a perfectly safe load. There are many structures at present in existence bearing considerably greater loads than this, and the masonry of at least one, the Bear Valley dam in Cali- fornia, is subject to compressive stresses, reaching, when~~

~~the reservoir is full, at least 40 to 50 tons per square foot, while certain brickwork linings in mining shafts are sub- ject to very high circumferential stresses, due to known water-pressures. In one case which has been investigated this circumferential pressure exceeds 26 tons per square foot, and the brickwork, which is 18 inches thick and 20 feet internal diameter, is perfectly sound and water-tight. In portions of the structure liable to important changes of pressure from the rise and fall of the water and subject to the additional loads which expansion and contraction by changes of temperature induce, and in view of the great difficulty of securing that the average modulus of elasticity in all parts of the structure shall be approxi- mately the same, it. is probably desirable to limit the calculated load upon any external work, even of the best kind, to 15 tons per square foot. It is clear that the material upon which any high masonry dam is founded must have a large factor of safety against crushing under the greatest load that the dam can impose upon it, and this consideration unfits any site for the construction of a masonry dam where sound rock, or at least a material equal in strength to the strongest shale, cannot be had ; even in the case of such a material as shale the foundation must be well below the ground.~~

~~The actual construction of successful masonry dams has varied from the roughest rubble masonry to ashlar work. It is probable, however, that, all things con- sidered, random rubble in which the flattest a era s. side of each block of stone is dressed to a fairly uniform surface, so that it may be bedded as it were in a tray of mortar, secures the nearest approach to uniform elasticity. Such stones may be of any size (in the Vyrnwy dam they reached 8 or 10 tons each), and the spaces between them, where large enough, must be similarly built in with smaller, but always the largest possible, stones ; spaces too small for this treatment must be filled and rammed with concrete. All stones must be beaten down into their beds until the mortar squeezes up into the joints around them. The faces of the work may be of squared masonry, thoroughly tied into the hearting; but,~~

in view of the expansion and contraction mentioned below, it is better that the face masonry should not be coursed. Generally speaking, in the excavations for the foundations springs are met with ; these may be only sufficient to indicate a continuous dampness at certain beds or joints, but all such places should be connected by relief drains carried to visible points at the back of the dam. It should be impossible, in short, for any part of the rock beneath the dam to become charged with water under pressure, either directly from the water in the reservoir or from higher places in the mountain sides, as may conceivably happen when a large area of rock at the base of a dam is sealed down. For similar reasons care must be taken to ensure that the structure of the water face of the dam shall be the least permeable of any part. In the Vyrnwy, Neuadd, and Fisher Tarn dams this was secured by bedding the stones near to the water face in somewhat finer mortar than the rest, and in the first case by placing pads to fill the joints for several inches from the water face, so that the mortar was kept away from the face and was well held up to its work. On the removal of the pads, or the cutting out of the face of the mortar where pads were not used, the vacant joint was gradually filled with almost dry mortar, a hammer and caulking tool being used to consolidate it. By these means practical impermeability was obtained. If the pores of the water face are thus rendered extremely fine, the surface water, carrying more or less fine detritus and organic matter, will soon close them entirely and assist in making it the least permeable portion of the structure.

But no care in construction can prevent the com- pression of the mass as the superincumbent weight comes upon it, Any given yard of height measured during construction, or at any time after construction, will be less than a yard when additional weight has been placed upon it; hence the ends of such dams placed against rock surfaces must move with respect to those surfaces when the superincumbent load comes upon them. This action is obviously much reduced where the rock sides of the valley rise slowly ; but in cases where the rock is very steep, the safest

~~course is to face the facts, and not attempt to cement the masonry to the rock, but rather to provide a vertical key, or dowel joint, of some material like asphalt, which will always remain water- tight. Such a joint, moreover, will yield without damage to the stresses caused by expansion and contraction to which the dam must necessarily be subject. So far as the writer has been able to observe or ascertain, there are only two or three masonry dams in Europe or America which have not been cracked transversely in their higher parts. They generally leak a little near the junction with the rock, and at some other joints in intermediate positions. In the case of the Neuadd dam this difficulty was met by deliberately omitting the mortar in transverse joints at re- gular intervals near the top of the dam, except just at their faces, where it of course cracks harmlessly, and by filling the rest with asphalt. Serious movement from expansion and contraction does not usually extend to levels which are kept moderately damp, or to the greater mass of the dam, many feet below high- water level, and it is much more satisfactory to distribute the total movement over numer- ous transverse planes than to risk the travelling of cracks, due to more concentrated movement, from the vertical into more or less horizontal directions, and thus render the upward pressure of intrusive water possible.~~

~~The Furens dam, already referred to as the earliest type of a scientifically designed structure of the kind, is subject to a pressure of about 166 feet of water : the valley it crosses is only about 300 feet wide at the water level, and the dam is curved in plan to a radius of 828 feet. Much discussion has taken place as to the utility of such curvature. A simple calculation will show that, except in very narrow valleys with steep sides, a masonry dam, assumed to depend for its stability upon resistance tangential to the curvature, as in a horizontal arch, becomes of much larger sectional area than a corresponding gravity dam, and therefore that it is generally not worth while to attempt the reduction of those stresses which are produced purely by water-pressure against the masonry, by giving a curvature to the dam. This considera- tion becomes the more pertinent, by reason of the necessarily smaller resistance to compression in a horizontal than in a vertical direction. But in narrow rock gorges extremely interest- ing problems relating to the combined action of horizontal and vertical stresses arise, and in some such cases it is evident that much may be done~~

by means of horizontal curvature to reduce the quantity of masonry without reduction of strength. The Bear Valley dam, California, is the most daring example in existence of the employment of the arch principle. Its height from the rock bed is 64 feet, and it is subject during floods to a head of water not much less. The length of the chord of the arc across the valley is about 250 feet and the radius 335 feet. The dam was begun in 1883, with a base 20 feet thick, narrowing to 13 feet at a height of 16 feet. The cost of this thickness being regarded as too great, it was abruptly reduced to 8 feet 6 inches, and for the remaining 48 feet it was tapered up to a final width of about 3 feet. The masonry is described by Mr Schuyler as " a rough uncut granite ashlar, with a hearting of rough rabble all laid in cement mortar and gravel." This dam has been in satisfactory use since 1885, and the slight filtration through the masonry which occurred at first is said to have almost entirely ceased. It is not improbable that the immunity from cracks in this case is actually due to the thinness of the structure, and this leads to the consideration of the utility of the curved form in wider valleys merely for the purpose of diminishing the strains which arise from expansion and con- traction. In all dams, especially when the outer face is towards the sun, expansion of that face during the day and contraction during the night takes place in any free direction. If we curve the dam upstream the exposed face will be comparatively free to expand and contract horizontally ; while the water face, possibly

maintained at a nearly uniform temperature, can only do so by straining. Between summer and winter there is the same tendency to maintain the outer face in a variable condition of horizontal tension ; and clearly, the thicker the dam and the smaller the radius, the greater must be that tension. It appears, therefore, that the comparative freedom to expand and contract given to a long dam by curving it may permit of strains which are less manageable than those in a straight dam. In any event, precau- tions of the same kind to avoid harmful cracking are desirable.

The first masonry dam of importance constructed in Great Britain was that upon the river Vyrnwy, a tributary of the Severn, in connexion with the Liverpool water-supply (Plate I.). Its height, subject to water-pressure, is about 134 feet, and a carriage- way is carried on arches at an elevation of about 18 feet higher. As this dam is about 1180 feet in length from rock

to rock, it receives practically no support from the sides of the valley. Its construction drew much attention to the subject of masonry dams in England, where the earthwork dam, with a wall of puddled clay, had hitherto been almost universal, and after it five more masonry dams of smaller size were completed, while in connexion with the Elan and Claerwen works, in Mid-Wales, for the supply of Birmingham, six masonry dams were projected, some of which are nearing completion, including the Caban Goch dam, 590 feet long at the water level, and subject to a water-pressure of 152 feet above the rock foundations and of 122 feet above the river bed, and the Craig-yr-allt Goch dam, subject to a head of 133

lowest}j>art_o£_e foundation,. VsSy

Fio. 15. — Section of Croton Dam.

feet. The latter dam is curved in plan, the radius being 740 feet and the chord of the arc 515 feet. In the Derwent Valley scheme, in connexion with the water supplies of Derby, Leicester, Notting- ham, and Sheffield, six more are projected. Of these the highest is the Hagglee, on the Ashop, a tributary of the Derwent, which will impound water to about 136 feet above the river bed, the length from rock to rock being 980 feet. Two of these dams are now in course of construction, one of which, the Howden, will be 1080 feet in length and will impound water to a depth of 114 feet above the river bed. In 1892 the excavation was begun for the foundations of a masonry dam across the Croton river, in con- nexion with the supply of New York, which eclipses every other project of the kind. The length of the new Croton dam from rock to rock at the overflow level is about 1500 feet. The water face, over the maximum depth at which that face cuts the rock founda- tions, is subject to a water-pressure of about 260 feet, while the height of the dam above the river bed is 163 feet. The section shown in Fig. 15 has been well considered. The hearting is of nibble masomy, and the faces are coursed ashlar. So-called "natural cement " has been used, except during frosty weather, when Port- land cement was substituted on account of its more rapid setting. An important feature in connexion with this dam is the nature of the foundation upon which it stands. Part of the

~~rock is sohist, but the greater portion limestone, similar in physical qualities to~~

~~the Carboniferous limestone of Great Britain. The lowest part of this rock was reached after excavating through alluvial deposits to a depth of about 70 feet, but owing to its fissured and cavernous nature it became necessary to excavate to much greater depths, reaching in places more than 120 feet below the original bottom of the valley. Great pains appear to have been taken to ascertain that the cavernous portions of the rock had been cut out before the building was begun.~~

~~Something has been said of the failures of earthen dams. Many masonry dams have also failed, but, speaking generally, we know less of the causes which have led to such failures. The ufes' examination of one case, however, namely, the bursting in 1895 of the Bouzey dam, near Epinal, in France, by which many lives were lost, has brought out several points of great interest. It is probably the only instance in which a masonry dam has slipped upon its foundations, and also the only case in which a masonry dam has actually overturned, while curiously enough there is every probability that the two circumstances had no connexion with each other. The work was examined by~~

~~Fig. 16. — Section of Bouzey Dam.~~

~~Professor Unwin1 and the writer shortly after the catastrophe, and the condition in which the ruined portion was then seen is shown in Plate II. Some of the blocks of rubble masonry carried down the stream weighed several hundred tons. The original section of the dam is shown by the continuous thick line in Fig. 16, from which it appears that the work was subject to a pressure of only about 65 feet of water. In the year 1884 a length of 450 feet of the dam, out of a total length of 1706 feet, slipped upon its foundation of soft sandstone, and became slightly curved in plan as shown at a. b, Fig. 17, the maximum movement from the original straight line being about a foot. The accident was repaired by the con-~~

struction o% the cross-lined portions in the section (Fig. 16). These precautions were perfectly effective in securing the safety of the dam up to the height to which the counterfort was carried. As a consequence of this horizontal bending of the dam vertical cracks appeared and were repaired. Eleven years after this, and about fifteen years after the dam was first brought into use, it overturned on its outer edge, at about the level indicated by the dotted line just above the counterfort ; and there is no good reason to attribute to the movement of 1884 or, to the vertical cracks it caused, any influence in the overturning of 1895. Some of the worst cracks were, indeed, entirely beyond the portion over- turned, which consisted of the mass 570 feet long by 37 feet in depth, and weighing about 20,000 tons, shown in elevation in Fig. 17. The line of pressures as generally given for this dam with

1 See Proc. Inst. O. E., vol. cxxvi. pp. 91-95.

the reservoir full, on the hypothesis that the density of the masonry was a little over 2, is shown by long and short dots in Fig. 16. Materials actually collected from the dam indicate that the mean density did not exceed 1-85 when dry and 2 '07 when saturated, which would bring the line of pressures even closer to the outer face at the top of the counterfort. In any event it must have approached well within 3J feet of the outer face, and was more nearly five-sixths than two-thirds of the width of the dam distant from the water face ; there must, therefore, have been considerable vertical tension at the water face, variously computed according to the density as- sumed at from 1 J to If ton per square foot. This, if the dam had been thoroughly well constructed, either with hydraulic lime or Port- land cement mortar, would have been easily borne. The materials, however, were poor, and it is probable that rupture by tension in a roughly horizontal plane took place. Directly this occurred, the front part oi the wall was subject to an additional overturning pressure of about 35 feet of water acting upwards, equivalent to about a ton per square foot, which would certainly, if it occurred throughout any considerable length of the dam, have immediately overturned ' it. But, as a matter of fact, the dam actually stood for about fifteen years. Of this circum- stance there are two possible explanations. It is known that more or less leakage took place through the dam, and to

moderate this the water face was from time to time coated and repaired with cement. Any cracks were thus, no doubt, temporarily closed ; and as the structure of the rest of the dam was porous, no opportunity was given for the percolating water to accumulate in the horizontal fissures to anything like the head in the reservoir. But in reservoir work such coatings are not to be trusted, and a single hori- zontal crack might admit sufficient water to cause an uplift. Then, again, it must be remembered that although the full consequences of the facts described might arise in a section of the dam 1 foot thick (if that section were entirely isolated), they could not arise throughout the length unless the adjoining sections were subject to like con- ditions. Any horizontal fissure in a weak place would, in the nature of things, strike somewhere a stronger place, and the1 final failure would be deferred. Time would then become an element. By reason of the constantly changing tempera- tures and the frequent filling and emptying of the reservoir, expansion and contraction, which are always at work tending to produce relative movements wherever one portion of a structure is weaker than another, must have assisted the water-pressure in the extension of the horizon- tal cracks, which, growing slowly during the fifteen years, provided at last the area required to enable the intrusive water to overbalance the little remaining stability of the dam.

It is obvious that the water of a reservoir must never be allowed to rise above a certain prescribed height at which the works will be perfectly safe. In all reservoirs impounding the natural flow of a stream, this involves the use of an overflow. Where the dam is of masonry it may be used as a weir ; but where earthwork is employed, the overflow, commonly known in such a case as the "bye-wash," should be an entirely inde- 0vertloWm pendent work, consisting of a low weir of sufficient length to prevent an unsafe rise of the water level, and of a narrow channel capable of easily carrying away any water that passes over the weir. The absence of one or both of these conditions has led to the failure of many dams.

Reservoirs unsafe from this cause still exist in the United King- dom. Where the contributory drainage area exceeds 5000 acres, the discharge, even allowing for so-called "cloud-bursts," rarely or never exceeds the

rate of about 300 cubic feet per second per 1000 acres, or 1500 times the minimum dry weather flow, taken as one-fifth of a cubic foot ; and if we provide against such an occa- sional discharge, with a possible maximum of 400 cubic feet at much more distant intervals, a proper factor of safety will be allowed. But when a reservoir is placed upon a smaller area the conditions are materially changed. The rainfall which produces, as the average of all the tributaries in the larger area, 300 cubic feet per second per 1000 acres, is made up of groups of rainfall of very varying intensity, falling upon different portions of that area, so that upon any section of it the intensity of discharge may be much greater.

The height to which the water is permitted to rise above the sill of the overflow depends upon the height of the embankment above that level (in the United Kingdom commonly 6 or 7 feet), and this again should be governed by the height of possible waves. In open -places that height is seldom more than about one and a

half times the square root of the "fetch," or greatest distance in nautical miles from which the wave has travelled to the point in question ; but in narrow reaches or lakes it is relatively higher. In lengths not exceeding about 2 miles, twice this height may be reached, giving for a 2-mile "fetch " about 3J feet, or If foot above the mean level. Above this again, the height of the wave should be allowed for "wash," making the embankment in such a case not less than 5J feet above the highest water level. If, then, we determine that the depth of overflow shall not exceed 1J foot, we arrive at 6f feet as sufficient for the height of the embankment above the sill of the overflow. Obviously we may shorten the sill at the cost of extra height of embankment, but it is rarely wise to do so.

The overflow sill or weir should be a masonry structure of rounded vertical section raised a foot or more above the waste-water course,

~~ELEVATION~~

~~fc. 450-0-~~

~~PLAN~~

~~Flo. 17. — Elevation and Plan of Bouzey Dam.~~

~~in which case for a depth of 1J foot it will discharge, over every foot of length, about 6 cubic feet per second. Thus, if the drain- age area exceeds 5000 acres, and we provide for the passage of 300 cubic feet per second per 100D acres, such a weir will be 50 feet long for every 1000 acres. But, as smaller areas are approached, the excessive local rainfalls of short duration must be provided for, and beyond these there are extraordinarily heavy discharges gene- rally over and gone before any exact records can be made ; hence we know very little of them beyond the bare fact that from 1000 acres the discharge may rise to two or three times 300 cubic feet per second per 1000 acres. In the writer's experience at least one ease has occurred where, from a mountain area of 1300 acres, the rate per 1000 was for a short time certainly not less than 1000 cubic feet per second. Nothing but long observation and experi- ence can help the hydraulic engineer to judge of the configuration of the ground favourable to such phenomena. It is only necessary, however, to provide for these exceptional discharges during very short periods, so that the rise in the water level of the reservoir may be taken into consideration ; but subject to this, provision must be made at the bye-wash for preventing such a flood, how- ever rare, from filling the reservoir to a dangerous height.~~

~~From the overflow sill the bye-wash channel may be gradually narrowed as the crest of the embankment is passed, the water be- ing prevented from attaining undue velocity by steps of heavy masonry, or, where the gradient is not very steep, by irregularly set masonry.~~

~~Eeseevoirs.~~

~~From very ancient times in India, Ceylon, and else- where, reservoirs of great area, but generally of small depth, have been built and used for the purposes of irrigation ; and in modern times, especially in India and~~

America, comparatively shallow reservoirs have been con- structed of much greater area, and in some cases of greater capacity, than any in the United Kingdom. Yet the hilly parts of the last-named country are rich in magni- ficent sites at sufficient altitudes for the supply of any parts by gravitation, and capable, if properly laid out, of affording a volume of water, throughout the driest seasons, far in excess of the probable demand for a long future. Many of the great towns had already secured such sites within moderate distances, and had constructed reservoirs

of considerable size, when, in 1879 and 1880 respectively, Manchester and Liverpool obtained statutory powers to draw water from relatively great distances, viz., from Thirlmere in Cumberland, in the case of Manchester, and from the river Vyrnwy, in the case of Liverpool. The latter work, completed in 1892, includes a reservoir which is still by far the largest in Europe.

This reservoir is situated in a true Glacial lake-basin, and having therefore all the appearance of a natural lake, is commonly known as Lake Vyrnwy. It is 825 feet above the sea, has an area of 1121 acres, an available capacity exceeding 12,000 million gallons, and a length of nearly 5 miles. yrnwy. Its position in North "Wales is shown in black in Fig. 18, and the two views on Plate I. show respectively,, the portion of the valley visible from the dam before impounding began, and the same portion as a lake on the completion of the work. Before the valves in the dam were closed, the village of Llanwddyn, the parish church, and many farmsteads, were demolished. The church was rebuilt outside the watershed, and the remains from the old churchyard were removed to a new cemetery adjoining it. The fact that this valley is a post-Glacial lake-basin was attested by the borings and excavations made for the foundations of the dam. The trench in which the masonry was founded covered an area 120 feet wide at the bottom, and extending for 1172 feet across the valley. Its site had been determined by about 190 borings, probings, and shafts, which, following upon the indications afforded by the rocks above ground, proved that the rock bed crossing the valley was higher at this point than elsewhere. Here then, buried in alluvium at a depth of 50 to 60 feet from the surface, was found the rock bar of the post-Glacial lake ; at higher points in the valley, borings- nearly a

hundred feet deep had failed to reach the rock. The Glacial strife, and the dislocated rocks — moved a few inches or feet from their places, and others, at greater distances, turned over, and beginning to assume the sub-angular form of Glacial boulders — were found precisely as the glacier, receding from the bar, and giving place to the ancient lake, had left them, covered and preserved by sand and gravel washed from the terminal morain. Later came the alluvial silting-up. Slowly, but surely, the deltas of the tributary streams advanced into the lake, floods deposited their burdens of detritus in the deeper places, the lake shallowed and shrank and in its turn yielded to the winding river of an alluvial strath, covered with peat, reeds, and alders, and still liable to floods. It is interesting to record that during the construction of the works the implements of Neolithic man were found, near the margin of the modern lake, below the peat, and above the alluvial clay on which it rested. Most of the large reservoir sites in Wales, shown by shaded lines in Fig. 18, are in all probability similar post-Glacial lake-basins, and in the course of time may become the sites of still greater reservoirs. They are—provided with well-proportioned watersheds and rainfall, and being nearly all more than 500 feet above the sea, may be made available for the supply of pure water by gravitation to any part of England. In 1892 the Corporation of Birmingham obtained powers for the construction of six reservoirs on the rivers Elan and Claerwen, also shown in Fig. 18. The sites of these reservoirs are long narrow valleys, not lake basins, and their aggregate capacity will be about 18,000 million gallons.

Of natural lakes in Great Britain raised above their ordinary levels that the upper portions may be utilized as reservoirs, Loch' Katrine supplying Glasgow is well known. Whitehaven is similarly supplied from Ennerdale, and in the year 1894 Thirlmere in Cumberland was brought into use, as already mentioned, for the supply of Manchester. The corporation have statutory power to raise the lake 50 feet, at which level it will have an available capacity of about 8000 million gallons ; to secure this a masonry dam has been constructed, though the lake is at present worked at a» lower level.

Purification. t

When surface waters began to be used for potable pur- poses, some mode of arresting suspended matter, whether living or dead, became necessary. In many cases gauze strainers were at first employed, and, as an improvement upon or addition to these, the water was caused to pass through a bed of gravel or sand, which, like the gauze, was regarded merely as a strainer. As such strainers were further improved, by sorting the sand and gravel, and using the fine sand only at the surface, better clari- fication of the water was obtained ; but chemical analysis indicated, or was at the time thought to indicate, £hat that improvement was practically confined to clarification,

as the dissolved impurities in the water were certainly very little changed. Hence such filter beds, as they were • even then called, were regarded as a luxury tration ‘ ra^ner than as a necessity, and it was never suspected that, notwithstanding the absence of chemical improvement in the water, changes did take place of a most important kind. Following upon Dr Koch’s discovery of a method of isolating bacteria, and of making approximate determinations of their number in any volume of water, a most remarkable diminution in the number of microbes contained in sand-filtered water was observed ; and it is now well known that when a properly constructed sand-filter bed is in its best condition, and is worked in the best-known manner, nearly the whole of the microbes existing in the crude water will be arrested. The sand which is nominally the filter has interstices about thirty times as wide as the largest dimensions of the larger microbes ; and the reason why these, and, still more, why organisms which were individually invisible under any magnifying power, and could only be detected as colonies, were arrested, was not understood. In pro- cess of time it became clear, however, that the worse the condition of a filter bed, in the then general acceptation of the term, the better it was as a microbe filter ; that is to say, it was not until a fine film of mud and microbes had formed upon the surface of the sand that the best results were obtained.

Even yet medical science has not determined the effect upon the human system of water highly charged with bacteria which are not known to be individually patho- genic. In the case of the bacilli of typhoid and cholera, we know the direct effect ; but apart altogether from the

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WATER.

FINE SAND

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Fig. 19.—Section of Sand Filter Bed.

presence of such specific poisons, polluted water is un- doubtedly injurious. Where, therefore, there is animal pollution of any kind, more especially where there is human pollution, generally indicated by the presence of bacillus coli communis, purification is of supreme import- ance, and no process has yet been devised which, except at extravagant cost, supersedes for public supplies that of properly-conducted sand

filtration. Yet it cannot be too constantly urged that such filtration depends for its com- parative perfection upon the surface film, that this surface film is not present when the filter is new, or when its materials have been recently washed, that it may be, and very often is, punctured by the actual working of the filters, or for the purpose of increasing their discharge, and that at the best it must be regarded as an exceed- ingly thin line of defence, not to be depended upon as a

safeguard against highly polluted waters, if a purer source of supply can possibly be found. Such filters are not, and in the nature of things cannot be, worked with the precision and continuity of a laboratory experiment.

In Fig. 19 a section is shown of an efficient sand-filter bed. The thickness- of sand is 3 feet. In the older filters it we^s usual to sup- port this sand upon small gravel resting upon larger gravel, and so on until the material was sufficiently open to pass the water later- ally to under-drains. But a much shallower and certainly not less efficient filter can be constructed by making the under-drains cover the whole bottom. In Fig. 19 the sand rests on small gravel of such degree of coarseness that the whole of the grains would be re- tained on a sieve of |-inch mesh and rejected by a sieve of J-inch mesh in the clear, supported upon a 3-inch thickness of bricks laid close together, and constituting the roof of the under-drains, which are formed by other bricks laid on thin asphalt, upon a concrete floor. In this arrangement the whole of the materials may be readily removed for cleansing. In the best filters an automatic arrangement for the measurement of the supply to each separate filter, and for the regulation of the quantity within certain limits, is adopted, and the resistance at outflow is so arranged that not more than a certain head of pressure, about 2J feet, can under any circumstances come upon the surface film, while a depth of several feet of water is maintained over the sand. It is essential that during the working of the filter the water should be so supplied that it will not disturb the surface of the sand. When a filter has been emptied, and is being re-charged, the water should be intro- duced from a neighbouring filter, and should pass upwards in the filter to be charged, until the surface of the sand has been covered. The unfiltered water may then be allowed to flow quietly and to fill the space above the sand to a depth of 2 or 3 feet. It would appear to be impossible

with any water that requires filtration to secure that the first filtrate shall be satisfactory if filtration begins immediately after a filter is charged ; and if the highest results are to be obtained, either the unfiltered water must be permitted to pass extremely slowly over the surface of the sand without passing through it, or to stand upon the sand until the surface film has formed. With waters giving little or no sediment, which are often the most dangerous, some change, as by the first method, is neces- sary. It has been proposed, on the other hand, to allow the filter to act slowly until the surface film is formed, and to discard the first effluent. This course can scarcely fail to introduce into the sand many bacteria, which may be washed through when the full working of the filters is begun ; and it should not, therefore, be adopted when the source of the supply is known to be subject to human pollution. The time for the formation of an efficient sur- face varies, according to the quality of the raw water, from a few hours to a few days. Judging from the best observations that have been made on a large scale, the highest rate of efficient filtra- tion when the surface film is in good condition is about 4 inches downwards per hour of the water contained above the sand, equivalent to about 50 gallons per day from each square foot of sand. When the surface film has once been formed, and the filter has begun its work, it should continue without interruption until the resistance of that film becomes too great to permit of the neces- sary quantity of water being passed. That period will vary, accord- ing to the condition of the water, from eight or ten days to four weeks. The surface film, together with half an inch to an inch of sand, is then carefully scraped off and stored for subsequent wash- ing and use. This process may be repeated many times until the thickness of the fine sand is reduced to about 18 inches, when the filter bed should be restored to its full thickness.

A lately discovered effect of sand filtration is of great import- ance in connexion with the subject Aqueduct, treated in vol. xxv. A brown slimy sediment, having the appearance of coffee grounds when placed in clear water, has been long observed in pipes conveying surface waters from mountain moorlands. The deposit grows on the sides of the pipes and accumulates at the bottom, and causes most serious obstruction to the flow of water. The chemists and bacteriologists do not appear to have finally determined the true nature and origin of this growth, but it is

~~*found in the im- pounded waters, and passes into the pipes, where it rapidly increases. It is checked even by fine copper wire gauze strainers, and where the water passes through sand-filter beds in the course of an aque- duct, the growth, though very great between the reservoir and the filter beds, is almost absent between the filter beds and the town. Even the growth of the well-known nodular incrustations in iron pipes is much reduced by sand filtration. From these facts it is clear that, other things being the same, the best position for the strainers and filter beds is as close as possible to the reservoir.*~~

~~*Some surface waters dissolve lead when bright, but cease to do so when the lead becomes tarnished. More rarely the action is continuous, and the water after being passed through lead cisterns and pipes produces lead poisoning — so called "plumbism." The liability to this appears to he entirely removed by efficient sand filtration.*~~

~~*WATER SUPPLY*~~

~~*788*~~

~~*Sand filtration, even when working in the best possible manner, falls short of the perfection necessary to prevent the passage of bacteria which may multiply after the filter is passed. Small, however, as the micro-organisms are, they are larger than the capillary passages in some materials through which water under pressure may be caused to percolate. It is therefore natural that attempts should have been made to construct filters which, while permitting the slow percolation of water, should preclude the passage of bacteria or their spores. In the laboratory of Pasteur probably the first filter which successfully accomplished this object was produced. In this apparatus, known as the Pasteur-Chamber-*~~

land filter, the filtering medium is biscuit porcelain. It was followed by the Berkefield filter, constructed of baked infusorial earth. Both these filters arrest the organisms by purely mechanical action, and if the joints are water-tight and they receive proper attention and frequent sterilization, they both give satisfactory results on a small scale for domestic purposes. The cost, how- ever — to say nothing of the uncertainty — where large volumes of water are concerned, much exceeds the cost of obtaining initially safe water. Moreover, if a natural water is so liable to pathogenic pollution as to demand filtration of this kind, it ought' at once to te discarded for an initially pure supply ; not necessarily pure in an apparent or even in a chemical sense, for water may be visibly coloured, or may contain considerable proportions both of organic and inorganic impurity, and yet be tasteless and free from patho- genic pollution.

There are several materials now in use possessing remarkable power to decolourize, clarify, chemically purify, and oxidize water ; but they are too costly for use in connexion with public water supplies unless a rate of filtration is adopted quite inconsistent with the formation of a surface film capable of arresting micro- organisms. Thisfact does not render them less useful when applied to the arts in which they are successfully employed.

Attempts have been made, by adding certain coagulents to the water to be filtered, to increase the power of sand and other granu- lar materials to arrest bacteria when passing through them at much higher velocities than are possible for successful filtration by means of the surface film upon sand. The effect is to produce between the sand or other grains a glutinous substance which does the work performed by the mud and microbes upon the surface of the sand filter. Elsewhere centrifugal force, acting somewhat after its manner in the cream separator, has been called in aid.

The sedimentation tank forms a very important help to filtration. In the case of river waters liable to turbidity the water should always be passed through such Sedimea- tanks before being placed in the filters. They tank". form, moreover, additional safeguards against organic impurity. Sedimentation tanks on a sufficient scale may effect the purification of the water to almost any desired extent. This is shown to be the case by the

purity of some lake waters ; but the first cost of the works and the subsequent removal of the sediment are in some cases a serious matter, and any approach to the comparatively perfect action of lakes is out of the question. By the use of such tanks, however, when the con- dition of the water demands it, and by passing the effluent water through sand filters when in good condition, the number of microbes is found to be reduced by as much as 97 or even 99 per cent. This, when attained, is undoubtedly a most important reduction in the chance of pathogenic bacteria passing into the filtered water ; but much more must be done than has hitherto in most places been done to ensure the constancy of such a condition before it can be assumed to represent the degree of safety attained. No public supply should be open to any such doubt as ought to, or may, deter people from drinking the water without previous domestic filtration or boiling.

Distribution.

The earliest water supplies in Great Britain were generally distributed at low pressure by wooden pipes or stone or brick conduits. For special purposes inter- ^e Komans introduced cast-lead pipes, but they supply. were regarded as luxuries, not as necessaries, and gave way to cheaper conduits made, as pump barrels had long been made, by boring out tree trunks, which are occasionally dug up in a good state of

preservation. This use of tree-trunks as pipes is still common in the wooded mountain ' districts of Europe. Within the 19 th century, however, cast iron became general in the case of large towns; but following the precedent inseparable from the use of weaker conduits, the water was still delivered under very low pressure, rarely more than sufficient to supply taps or tanks near the level of the ground, and generally for only a short period out of each twenty-four hours. On the introduction of the Waterworks Clauses Act, 1847, an impetus was given to high-pressure supplies, and the same systems of distributing mains were frequently employed for the purpose ; but with few exceptions the water con- tinued to be supplied intermittently, and cisterns or tanks were necessary to store it for use during the periods of intermission. Thus it happened that pipes and joints intended for a low-pressure supply were subjected, not only to high pressure, but to the trying ordeal of sud- denly varying pressures. As

~~a rule such pipes were not renewed : the leakage was enormous, and the diffi- culty was met by the very inefficient method of re- ducing the period of supply still farther. But even in entirely new distributing systems the network is so extensive, and the number of joints so great, that the aggregate leakage is always considerable ; the greatest loss being at the so-called " ferrules " connecting the mains with the house " communication " or " service " pipes, in the lead pipes, and in the household fittings. But a far greater evil than mere loss of water and inconvenience soon proved to be inseparable from intermittent supply. Imagine a hilly town with a high-pressure water supply, the water issuing at numerous points, sometimes only in exceedingly small veins, from the pipes into the sub-soil. In the ordinary course of intermittent supply or for the purpose of repairs, the water is cut off at some point in the main above the leakages ; but this does not prevent the continuance of the discharge in the lower part of the town. In the upper part there is consequently a tendency to the formation of a vacuum, and some of the impure sub-soil water near the higher leakages is sucked into the mains, to be mixed with the supply when next turned on. We are indebted to the Local Government Board for having traced to such causes certain epidemics of typhoid, and there can be no manner of doubt that the evil has been very general. It is therefore of supreme importance that the pressure should be constantly maintained, and to that end, in the best-managed waterworks, the supply is not now cut off even for the purpose of connecting house- service pipes, an apparatus being employed by which this is done under pressure. Constant pressure "being granted, constant leakage is inevitable, and being constant it is not surprising that its total amount often exceeds the aggregate of the much greater, but shorter, draughts of water taken for various household purposes. There is therefore, even in the best cases, a wide field for the conservation and utilization of water hitherto entirely wasted.**

Following upon the passing of the Waterworks Clauses Act, 1847, a constant supply was attempted in many towns, with the result in some cases that, owing to the enormous loss arising from the prolonga- Consjant tion of the period of leakage from a fraction of an hour to twenty-four hours, it was impossible to main- tain the supply. Accordingly, in some places large sections of the mains and service pipes~~

were entirely renewed, and the water consumers were put to great expense in changing their fittings to new and no doubt better types, though the old fittings were only in a fraction of the cases actually causing leakage. But whether or not such stringent methods were adopted, it was fQund necessary

to organize a system of house — to — house visitation and constantly recurring inspection. In Manchester this was combined with a most careful examination, at a depot of the Corporation, of all fittings intended to be used. Searching tests were applied to these fittings, and only those which complied in every respect with the Dtte

Its action is based upon the following considerations : When water is passing through a main and supplying nothing but leakage the flow of that water is necessarily uniform, and any instrument which graphically represents that flow as a horizontal line conveys to the mind a full conception of the nature of the flow, and if by the position of that line between the bottom and the top of a diagram the quantity of water (in gallons per hour, for example) is recorded, we have a full statement, not only of the rate of flow, but of its nature. We know, in short, that the water is not being usefully employed. In the actual instrument, the paper diagram is mounted upon a drum caused by clockwork to revolve uniformly, and is ruled with vertical hour lines, and horizontal quantity lines representing gallons per hour. . Thus, while nothing but leakage occurs the uniform horizontal line is continued. If now a tap is opened in any house connected with the main, the change of flow in the main will be represented by a vertical change of position of the horizontal line, and when the tap is turned off the pencil will resume its original vertical position, but the paper will have moved like the hands of a clock over the interval during which the tap was left open. If, on the other hand, water is suddenly drawn off from a cistern supplied through a ball-cock, the flow through the ball-cock will be recorded, and will be represented by a sudden rise to a maximum, followed by a gradual decrease as the ball rises and the cistern fills ; the result being a curve having its asymptote in

the original horizontal line. Now, all the uses of water, of whatever kind they may he, produce some such irregular diagrams as these, which can never be confused with the uniform horizontal line of leakage, but are always superimposed upon it. It is this leakage line that the waterworks engineer uses to ascer- tain the truth as to the leakage and to assist him in its suppression. In well-equipped waterworks each house service pipe is controlled by a stop-cock accessible from the footpath to the officials of the water authority, and the process of waste detection by this method depends upon the manipulation of such stop-cocks in conjunction with the differentiating meter. As an example of one mode of applying the system, suppose that a night inspector begins work at 11.30 P.M. in a certain district of 2000 persons, the meter of which records at the time a uniform flow of 2000 gallons an hour, showing the not uncommon rate of leakage of 24 gallons per head per day. The inspector proceeds along the footpath from house to house, and outside each house he closes the stop-cock, recording opposite the number of each house the exact time of each such operation. Having arrived at the end of the district he retraces his steps, re-opens the whole of the stop-cocks, removes the meter diagram, takes it to the night complaint office, and enters in the "night inspection book " the records he has made. The next morning the diagram and the "night inspection hook " are in the hands of the day inspector, who compares them. He finds, for example, from the diagram that the initial leakage of 2000 gallons an hour has in the course of a 4£ hours' night inspection fallen to 400 gallons an hour, and that the 1600 gallons an hour is accounted for by fifteen distinct drops of different amounts and at different times. Each of these drops is located by the time and place records in the book and the time records on the diagram as belonging to a par- ticular service pipe ; so that out of possibly 300 premises the bulk

of the leakage has been localized in or just outside fifteen. To each of these premises he goes with the knowledge that a portion of the total leakage of 2000 gallons an hour is almost certainly there, and that it must be found, which is a very different thing from visiting three or four hundred houses, in not one of which he has any particular reason to expect to find leakage. Even when he enters a house with previous knowledge that there is leakage, its discovery may be difficult. It is often hidden, sometimes underground, and may only be brought to light by

~~excavation. In these cases, without some such system of localization, the leakage might go on for years or for ever. There are many and obvious variations of the system. That described requires a diagram revolving once in a few hours, otherwise the time scale will be too close ; but the ordinary diagram revolving once in 24 hours is often used quite effectively in night inspections by only closing those stop-cocks which are actually passing water. This method was also first introduced in Liverpool. The night inspector carries with him a stethoscope, often consisting merely of his steel turning-rod, with which he sounds the whole of the outside stop- cocks, but only closes those through which the sound of water is heard. An experienced man, or even a boy, if selected as possessing the necessary faculty (which is sometimes very strongly marked), can detect the smallest dribble when the stop-cock is so far closed as to restrict the orifice. Similar examinations by means of the stop-valves on the mains are also made, and it often happens that the residual leakage (400 gallons an hour in the last case) recorded on the diagram, but not shut off by the house stop-cocks, is mentioned by the inspector as an " outside waste, " and localized as having been heard at a stop-cock and traced by sounding the pavement to a particular position under a particular street. All leakages found on private property are duly notified to the water tenant in the usual way, and subsequent examinations are made to ascertain if such notices have been attended to. If this work is properly organized, nearly the whole of the leakage, so detected is suppressed within a month. A record of the constantly fluctuating so-called "night readings" in a large town is most interesting and instructive. If, for example, in the case of a hundred such districts we watch the result of leaving them alone, a gradual growth of leakage common to most of the districts, but not to all, is observed, while here and there a sudden increase occurs, often doubling or trebling the total supply to the district. Upon the original installation of the system in any town, the rate of leakage and consequent total supply to the different districts is found to vary greatly, and in some districts it is usually many times as great per head as in others. An obvious and fruitful extension of the method is to employ the inspectors only in those districts which, for the time being, promise the most useful results.~~

~~*In many European cities the supply of water, even for domestic purposes, is given through ordinary water meters, and paid for, according to the meter record, much in the same manner as a supply of gas or electricity. By the adoption of SuPP'y "y this method great reductions in the quantity of water '*~~

~~*used and wasted are in some cases effected, and the water tenant pays for the .leakage or waste he permits to take place, as well as for the water he uses. The system, however, does not assist in the detection of the leakage which inevitably occurs between the reservoir and the consumer's meter ; thus the whole of the mains, joints, and ferrules connecting the service pipes with the mains, and the greater parts of the service pipes, are still exposed to leakage, without any compensating return to the water authority. But the worst evil of the system, and one which must always prevent its introduction into the United Kingdom, is the circumstance that it treats water as an article of commerce, to be paid for according to the quantity taken. In the organization of the best municipal water undertakings in the United Kingdom the free use of water is encouraged, and it is only the leakage or occasional improper employment of the water that the water authority seeks, and that successfully, to suppress. The objection to the insanitary effect of the meter-payment system has, in some places, been sought to be removed by providing a fixed quantity of water, assumed to be sufficient, as the supply for a fixed minimum payment, and by using the meter records simply for the purpose of determining what additional payment, if any, becomes due from the water tenant. Clearly, if the excesses are frequent, the limit must be too low ; if infrequent, all the physical and administrative complication involved in the system is employed to very little purpose.*~~

~~*The question of the distribution of water, rightly con- sidered, resolves itself into a question of delivering water to the water tenant, without leakage on the way, and of securing that the fittings employed by the water tenant shall be such as to afford an ample and ready supply at all times of the day and night without leakage and without any unnecessary facilities for waste. If these conditions are complied with, it is probable that the total*~~

~~rate of supply will not exceed, even if it reaches, the rate necessary in any system, not being an oppressive and in- sanitary system, by which the water is paid for according to the quantity used. (g. f. d.)~~

~~Waters, Territorial.—" Territorial waters " are the belt of sea adjacent to their shores which states re- spect as being under their immediate territorial jurisdiction, subject only to a right of "inoffensive" passage through them by vessels of all nations. As to the breadth of the belt and the exact nature of this inoffensive right of passage, however, there is still much controversy. The 3 miles' limit recognized and practised by Great Britain, France, and the United States of America seems to have been derived from the cannon range of the period, when it was adopted as between Great Britain and the United States, i.e., towards the close of the 18th century. Bynkershoek, a famous Dutch jurist, whose authority at one time was as great in England as in his own country, in a disserta- tion on the Dominion of the Sea, (1702), had devised a plausible juridical theory to support a homogeneous jurisdiction over environing waters in the place of the quite arbitrary claims made at that time to any distance seawards from whole seas to range of vision. Starting from the fact that fortresses can give effective protec- tion within range of their cannon, and that in practice this effective protection was respected, he argued that the respect was not due to the reality of the presence of cannon, but to the fact that the state was in a position to enforce respect. This it could do from any point along its shore. Hence his well-known doctrine : terrae dominium finitur, ubi finitur armorum vis. The doctrine satisfied a requirement of the age and became a maxim of inter- national law throughout northern Europe, both for the protection of shore fisheries and for the assertion of the immunity of adjacent waters of neutral states from acts of war between belligerent states. Germany still holds in principle to this varying limit of cannon range. Norway has never agreed to the 3 mile, maintaining that the special configuration of her coast necessitates the exer- cise of jurisdiction over a belt of 4 miles. Spain lays claim to jurisdiction over 6 miles from her shores. The writers and~~

~~specialists on the subject are quite as much divided. A British Fishery Commission in 1893 reported that " the present territorial limit oft 3 miles is insufficient, and that, for fishery purposes alone, this limit should be extended, provided such extension can be effected upon an international basis and with due regard to the rights and interests of all nations." The committee recommended that " a proposition on these lines should be submitted to an international conference of the Powers who border on the North Sea." There is already an international convention, dated 6th May 1882, between Great Britain, France, Belgium, Holland, Germany, and Denmark, relating to the regulation of the fisheries in the North Sea, which has fixed the limit of territorial waters as between the contracting parties at 3 miles measured from low-water mark and from a straight line drawn from headland to headland at the point where they are 10 miles across. In the British Act of 29th June 1893, giving effect to a subsequent convention (16th November 1887) between the same parties for the regulation of the liquor traffic in the North Sea, " territorial waters " are declared to be as defined in the Territorial Waters Jurisdiction Act, 1878. In this Act the definition is as follows : —~~

~~The territorial waters of Her Majesty's dominions in reference to the sea means such part of the sea adjacent to the coast of the United Kingdom, or the coast of some other part of Her Majesty's dominions, as is deemed by international law to be within the territorial sovereignty of Her Majesty ; and for the purpose of any~~

~~offence declared by this Act to be within the jurisdiction of the admiral, any part of the open sea within one marine league of the coast measured from low-water mark shall be deemed to be open sea within the territorial waters of Her Majesty's dominions.~~

~~This definition only restricts the operation of the 3 miles limit to offences dealt with in the Act, and does not deal with bays. The Act of 1893 declares that the articles of the convention "shall be of the same force as if tbey were enacted in the body of the Act," but this convention gives no definition of territorial waters.~~

~~The jurisdiction exercised in British territorial waters under the Territorial Waters Jurisdiction Act of 1878 * is asserted without~~

~~distinction between them and inland waters. " All offences " committed by any person, whether a British subject or not, and whether or not committed " on board or by means of a foreign ship," "within the territorial waters of Her Majesty's dominions," are made punishable under it. No exception is made for offences committed on merely passing foreign vessels, except that there is this attenuation in their case, that no prosecution can take place without a special authorization given by certain high officers of state.2 It is doubtful whether any Continental state would recognize so complete a jurisdic- tion. The subject has been exhaustively dealt with by both the Institute of International Law and the Inter- national Law Association, the following considerations and rules being suggested : —~~

~~Whereas there is no reason to confound in a single zone the distance necessary for the exercise of sovereignty and protection of coast fisheries and the distance necessary to guarantee the neutrality of non-belligerents in time of war ; And whereas the distance most commonly adopted of 3 miles from low-water mark has been recognized as insufficient for the protection of coast fisheries ; And whereas, moreover, this distance does not corre- spond to the real range of cannon placed on the coast ; The follow- ing dispositions are adopted : —~~

~~Art. I. The state has the right of sovereignty over a belt of sea along its coast subject to the right of inoffensive passage reserved in article 5. This belt is called territorial waters (mer territoriale).~~

~~Art. II. Territorial waters extend for 6 sea miles (60 to 1 degree of latitude) from low-water mark along the whole extent of its coasts.~~

~~Art. III. For bays, territorial waters follow the trend of the coast except that it is measured from a straight line drawn across the bay from the two points nearest the sea where the opening of the bay is of 12 marine miles in width, unless a, greater width shall have become recognized by an immemorial usage.~~

~~Art. IV. In case of war the adjacent neutral state shall have the right to extend by its declaration of neutrality or by special notification its neutral zone from 6 miles to cannon range from the coast.~~

~~Art. V. All sliips, without distinction, have the right of inoffen- sive passage through territorial waters, subject to the belligerent right to regulate, and for purposes of defence to bar, .the passage through the said waters for every ship, and subject to the right of neutrals to regulate the passage through the said waters for ships of war of all nationalities.~~

~~Art. VI. Crimes and offences committed on board foreign ships passing through territorial waters by persons on board such ships, upon persons or things on board the same ships, are, as such, beyond the jurisdiction of the adjacent state, unless they involve a violation of the rights or interests of the adjacent state, or of its subjects or citizens not forming part of its crew or its passengers.~~

~~1 This Act was passed to meet what was thought to be a defect in British law, the decision in the well-known Franconia case having been that territorial waters were "out of the realm," and that criminal jurisdiction within them over a foreign ship could be exercised only in virtue of an Act of Parliament.~~

~~2 Proceedings, says sec. 3 of the Act, for the trial and punishment of a person who is not a British subject, and who is charged with any offence as is declared by this Act to be within the jurisdiction of the admiral, shall not be instituted in any Court of the United Kingdom, except with the consent of one of the principal Secretaries of State, and on his certificate that the institution of such proceedings is in his opinion expedient, and shall not be instituted in any British dominions outside of the United Kingdom except with the leave of the governor of the part of the dominions in which such proceedings are proposed to be instituted, and on his certificate that it is expedient that such proceedings should be instituted.~~

~~Art. VII. Ships passing through territorial waters must conform to the special rules laid down by the adjacent state, in the interest and for the security of navigation and for the police of the sea.~~

~~*Art. VIII. Ships of all nationalities, by the simple fact of being in territorial waters, unless merely passing through them, are sub- ject to the jurisdiction of the adjacent state.*~~

~~*The adjacent state has the right to continue upon the high seas the pursuit of a ship commenced within territorial waters, and to arrest and try it for an offence committed within the limits of its waters. In case of capture on the high seas the fact shall, how- ever, be notified without delay to the state to which the ship belongs. The pursuit is interrupted from the moment the ship enters the territorial waters of its own state or of a third Power. The right of pursuit ceases from the moment the ship enters a port either of its own country or of a third Power.*~~

~~*Art. IX. The special position of ships of war and of ships assimilated to them is reserved.*~~

~~*Art. X. The provisions of the preceding articles are applicable to straits not exceeding 12 miles in width, with the following modifications and exceptions : —*~~

~~*(1) Straits, the coast of which belong to different Powers, form part of the territorial waters of the adjacent states, their jurisdiction respectively extending to the middle line of the straits ;*~~

~~*(2) Straits whose coasts belong to the same state, and which are indispensable for maritime communication between two or more states other than the state in question, form part of the territorial waters of the said state whatever the proximity of the two coasts may be ;*~~

~~*(3) Straits serving as a, passage between one open sea and another can never be closed.*~~

~~*Art. XL The position of straits already regulated by conventions or special usage is reserved.*~~

~~*The Dutch Government in 1896 brought these rules to the notice of the leading European Governments, and suggested the desirability of concluding an international convention on the subject. The only*~~

Government which was unfavourable to the proposal was that of Great Britain.

Authorities. — CoulsCn and Forbes. Law of Waters. 2nded. 1902. — Thomas Barclay. Question de la Mer Territoriale. Pub- lished by the Association Internationale de la Marine. Paris, 1902. — Annuaires de I'lnstitut de Droit International for 1893 and 1894. — Special Report of the International Law Association (replies to Questionnaire), 1893 ; and Report and Discussion, 1895.

(T. Ba.)

WatertOWn, a town of Middlesex county, Massa- chusetts, U.S.A., on the north bank of the Charles river, adjoining Cambridge, and on the Fitchburg (Boston and Maine) Bailroad. It contains a United States arsenal, the beautiful Mount Auburn cemetery, and extensive and varied manufactures. It is one of the oldest towns of the state, having been incorporated in 1630. Popula- tion, (1890), 7073 ; (1900), 9706.

WatertOWn, a city of New York, U.S.A., capital of Jefferson county. It is situated in 43° 58' N. and 75° 54' W., on Black river, 7 miles from its mouth in Lake Ontario, and on a line of the New York Central and Hudson Biver Railroad, in the northern part of the state, at an altitude of 418 feet. Black river furnishes excellent water — power, which is extensively .used in manufactures, particularly in carriage and waggon works, paper, planing, and flour mills, foundries and machine- shops, and furniture factories. Population (1890), 14,725 ;

(1900), 21,696.

WatertOWn, a city of Dodge and Jefferson counties, Wisconsin, U.S.A., situated in 43" 12' N. and 88° 48' W., on the river Rock, and on lines of the Chicago and North-Western and the Chicago, Milwaukee, and St Paul railways, in the south-eastern part of the state, at an altitude of 824 feet. The river furnishes valuable water-power, which has been put to use in varied manufactures. Watertown contains North-western Univer- sity a Lutheran institution, opened in 1865. Population

~~(1890), 8755 ; (1900), 8437.~~

~~Waterville, a city of Kennebec county, Maine, U.S.A., on the river Kennebec, 18 miles above Augusta, and on a line of the Maine Central Railroad, in the southern part of the state, at an altitude of 112 feet. It has excellent water-power, and has cotton factories, foundries, railway repair work's, and other industries. It is the seat of Colby University, a Baptist institution, opened in 1818. Waterville was settled about 1650, was set off and incorporated as a town in 1802, and received a city charter in 1888. Population (1890), 7107; (1900),~~

~~9477.~~

~~Watervliet, a city of Albany county, New York, U.S.A., formerly the village of West Troy, in the low ground on the west bank- of the river Hudson, opposite Troy, in the eastern part of the state. The United States Government arsenal contains large works for the construc- tion of field, coast defence, and siege ordnance, and for the manufacture of shot and shell gun-carriages, &c. Population (1890), 12,967 ; (1900), 14,321.~~

~~Watford, an ancient market town and parish, in the Watford, or Western, parliamentary division of Hertford- shire, England, 8 miles south-west of St Albans by rail, on the river Colne. Bushey, on the opposite side of the Colne, is connected with the • town by a bridge of five arches. A chapel of ease, St John's, was built in 1893, and a Roman Catholic church in 1895. Population (1891),~~

~~17,063; (1901), 29,023.~~

~~Watkin, Sir Edward William, 1st Bart.~~

~~(1819-1901), English railway manager, was born in Man- chester on 26th September 1819. In 1845 he became secretary of the Trent Valley line, which was soon afterwards absorbed by the London and North-Western Company. He next joined the Manchester and Sheffield Company, of which he became general manager and then chairman, subsequently combining with the duties thus entailed the chairmanship of the South-Eastern (1867) and of the Metropolitan (1872). His connexion with these~~

three railways was maintained to within a short time of his death, and they formed the material of one of his most ambitious schemes — the establishment of a through route under one management from Dover to Manchester and the north. This was the end he had in view in his successful fight for the extension of the Manchester, Sheffield, and Lincolnshire Railway (now the Great Central) to London ; and his persistent advocacy of the Channel tunnel (q.v.) between Dover and Calais was really a further development of the same idea, for its construction would have enabled through trains to be run from Paris to Lancashire and Scotland, vid the East London (of which also he was for a time chairman) and the Metropolitan. The latter scheme, however, failed to obtain the necessary public and political support. Other projects had even less success. His plans for a tunnel between Scotland and Ireland under the North Channel, and for a ship canal across Ireland from Galway to Dublin, did not come to anything ; while the great tower at Wembley Park (near Harrow), intended to surpass the Eiffel Tower at Paris, stopped at an early stage. It was in the realms of railway politics that Watkin showed to best advantage; for the routine work of administration pure and simple he had no aptitude. He entered Parliament as a Liberal, and after representing Stockport from 1864 to 1868, sat as member for Hythe for twenty-one years from 1874, becoming a Liberal-Unionist at the time of the Home Rule split, and subsequently acting as a "free lance." In 1868 he received a knighthood, and in 1880 he was created a baronet. His death occurred at Northenden, Cheshire, on 13th April 1901. (h. m. e.)

WatSOn, Thomas (1557 (?) 1592), an English lyrical poet, whose "position as a pioneer of the Elizabethans has of late years been considerably emphasized, was born in London, probably in 1557. He proceeded to Oxford, and, while quite a young man, enjoyed a certain repu tation, even abroad, as a Latin poet. His £>e Remedio Amoris, which was perhaps his earliest important com- position, is lost, and so is his "piece of work written in the commendation of women-kind," which was

also in Latin verse. He came back to London and became a law-student. The earliest publication of Watson's, which has survived, is a Latin version of the Antigone of Sophocles, issued in 1581. It is dedicated to Philip Howard, Earl of Arundel, who was perhaps the patron of the poet, who seems to have spent some part of this year in Paris. Next year Watson appears for the first time as an English poet in some verses prefixed to Whetstone's Heptarneron, and also in a far more important guise, as the author of the 'EKaTOfj.Tra8la or Passionate Century of Love. This is a collection or cycle of 100 pieces, in the manner of Petrarch, celebrating the sufferings of a lover and his long farewell to love. The technical peculiarity of these interesting poems is that, although they appear and pro- fess to be sonnets, they are really written in triple sets of common six-line stanza, and therefore have eighteen lines each. It seems likely that Watson, who courted comparison with Petrarch, seriously desired to recommend this form to future sonneteers ; but in this he had no imitators. Among those who were at this time the friends of Watson we note Matthew Koyden and George Peele. In 1585 he published a Latin translation of Tasso's pastoral play of Aminta, and his version was afterwards translated into English by Abraham Fraunce (1587). Watson was now, as the testimony of Nash and others prove, regarded as the best Latin poet of England. In 1590 he pub- lished, in English and Latin verse, his Meliboeus, an elegy on the death of Sir Francis Walsingham, and a collection of Italian Madrigals, put into English by Watson and set to music by Byrd. Of the remainder of Watson's career nothing is known, save that on the 26th of September 1592 he was buried in the church of St Bartholomew the Less, and that in the following year his latest and best book, The Tears of Fancy, was posthumously published. This is a collection of sixty sonnets, regular in form, so far at least as to have fourteen lines each. Spenser is supposed to have alluded to the untimely death of Watson in Colin Clout's Come Home Again, when he says : —

' ' Amyntas quite is gone and lies full low, Having his Amaryllis left to moan,"

which perhaps points to Watson's having left a widow. It is certain that this poet enjoyed a great reputation in his lifetime, and that he was not without a direct influence upon the youth of Shakespeare. He was the

first, after the original experiment made by Wyat and Surrey, to introduce the pure imitation of Petrarch into English poetry. He was well read in Italian, French, and Greek literature. Watson died young, and he had not escaped from a certain languor and insipidity which prevent his graceful verses from producing their full effect. This demerit is less obvious in his later than in his earlier pieces, and with the development of the age, Watson, whose contemporaries regarded him as a poet of true excellence, would probably have gained power and music. As it is, he has the honour of being one of the direct forerunners of Shakespeare (in Venus and Adonis and in the Sonnets), and of being the leader in the long procession of Elizabethan sonnet-cycle writers. The English works of Watson were first collected by Professor Edward Arber.

(e. g.)

Watts, George Frederick (1817-

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English painter and sculptor, was born in London on 23rd February 1817. While hardly more thaii a boy he was permitted to enter the schools of the Eoyal Academy ; but his attendance was short-lived, and his further art-educa- tion was confined to personal experiment and endeavour, guided and corrected by a constant appeal to the standard of ancient Greek sculpture. There are portraits of him- self, painted in 1834; of Mr James Weale, about 1835; of his father, "Little Miss Hopkins," and Mr Richard Jarvis, painted in 1836; and in 1837 he was already far enough advanced to be an exhibitor at the Academy with a picture of " The Wounded Heron " and two por- traits. His first exhibited figure – subject, " Cavaliers," appeared on the Academy walls in 1839, and was fol- lowed in 1840 by " Isabella e Lorenzo," in 1841 by " How should I your true love know," and in 1842 by a scene from Cymbeline and a portrait of Mrs Ionides. The Royal Commission appointed for the decoration of the new Houses of Parliament, offered prizes in 1842 to those artists whose cartoons for frescoes should be adjudged best adapted to its object, and at the exhibition vin West- minster Hall next year Watts secured a prize of £300 for a design of " Caractacus led in triumph through the streets of Rome." This enabled him to visit Italy in 1844, and

he remained there during the greater portion of the three following years, for the most part in Florence, where he enjoyed the patronage and personal friendship of Lord Holland, the British ambassador. For him he painted a portrait of Lady Holland, exhibited in 1848, and in his Villa Careggi, near the city, a fresco, after making some experimental studies in that medium, fragments of which are now in the Victoria and Albert Museum. To Lord Holland's encouragement, also, it was chiefly due that in 1846 the artist took part in another competition, the third organized by the Royal Commissioners, who on this occasion announced a further list of prizes for works in oil. Watts sent in a cartoon depicting "Alfred inciting his subjects to prevent the landing of the Danes, or the first naval victory of the English," which after obtaining a first-class prize of £500 at the exhibition in Westminster Hall, was purchased by the Government, and hangs in one of the committee rooms of the House of Commons. It led, moreover, to a commission for the fresco of " St George overcomes the Dragon," which, begun in 1848 and finished in 1853, forms part of the decorations of the Hall of the Poets in the Houses of Parliament. He next proposed to adorn gratuitously the interior of the Great Hall of Euston railway station with a series of frescoes illustrating " The Progress of the Cosmos," but the offer was refused. A similar proposition made shortly afterwards to the Benchers of Lincoln's Inn was received in a less commercial spirit, and was followed by the execution of the fresco, " Justice : a Hemicycle of Lawgivers " on the north side of their Hall.

While this large undertaking was still in progress Mr Watts was working steadily at pictures and portraits. In 1849 the first two of the great allegorical compositions which form the most characteristic of the artist's produc- tions were exhibited — " Life's Illusions," an elaborate pre- sentment of the vanity of human desires, and " The people that sat in darkness," turning eagerly towards the grow- ing dawn. In 1850 he first gave public expression to his intense longing to improve the condition of humanity in the picture of " The Good Samaritan " bending over the wounded traveller ; this, as recorded in the catalogue of the Royal Academy, was " painted as an expression of the artist's admiration and respect for the noble philanthropy of Thomas Wright, of Manchester," and to that city he

presented the work. In 1856 Mr Watts paid a visit to Lord Holland at Paris, where lie was then ambassador, and through him made the acquaintance and painted the por- traits of Thiers, Prince Jerome Bonaparte, and other famous Frenchmen ; while other celebrities who sat to him during these years were Guizot (1848), Colonel Eawlinson, C.B., Sir Henry Taylor, and Thomas Wright (1851), Lord John Russell (1852), Tennyson (1856, and again in 1859), John Lothrop Motley the historian (1859), the Duke of Argyll (1860), Lord Lawrence and Lord Lyndhurst (1862), Lord Wensleydale (1864), Mr Gladstone (1858 and 1865), Sir William Bowman and Swinburne (1865), Panizzi (1866), and Dean Stanley and Dr Joachim in 1867. Notable pictures of the same period are "Sir Galahad" (1862), "Ariadne in Naxos" (1863), "Time and Oblivion" (1864), originally designed for sculpture to be carried out "in divers materials after the manner of Phei- dias," and "Thetis" (1866). In spite of these and many other evidences of his importance, it was not until 1867 that Mr Watts was elected an Associate of the Royal Academy, but the council then conferred ,i

upon him the rare distinc- :,':j| tion of promoting him, in I

the course of the same year, M

to full Academicianship. M Thenceforward he con- gfll tinued to exhibit each year, j with a few exceptions, at the Academy, even after 1 his retirement in 1896, and II he was also a frequent con- 11

tributor to the Grosvenor Gallery, and subsequently to the New Gallery, at 1 which last a special exhibi- tion of his works was held in the winter of 1896-97. Though he travelled abroad to some extent, going to

Asia Minor in 1857 with the expedition sent to in- vestigate the ruins of Halicarnassus, and visiting in later years Italy, Greece, and Egypt, the greater part of his life was passed in the laborious seclusion of his studio either at Little Holland House, Melbury Road, Kensington, where he

settled in 1859, or in the country at Limnerslease, Compton, Surrey, and was, apart from his art, happily uneventful, the sole facts necessary to record being his marriage in 1886 with Miss Mary Fraser-Tytler, an early union with Miss Ellen Terry having been dissolved many years before ; his twice receiving (1885 and 1894), but respectfully declining, the offer of a baronetcy, and his inclusion in June 1902 in the newly founded Order of Merit.

The world is exceptionally well provided with opportunities of judging of the qualities of Mr Watts's art, for with a noble gene- rosity he presented to his country a representative selection of the best work of his long life. A prominent element in it, and one which must prove of the greatest value to posterity, is the inestim- able series of portraits of his distinguished contemporaries, a series no less remarkable for its artistic thari for its historical interest. A glance through the list of his subjects shows the breadth of his sym- pathies and his superiority to creed or party. Among politicians are the Duke of Devonshire (1883), Lords Salisbury (1884), Sherbrooke (1882),Campbell(1882),Cowper(1877),Ripon(1896),Dufferin(1897),

George Frederick Watts, K.A. (From a photograph by Elliott and Fry, London.)

and Shaftesbury (1882), Mr Gerald Balfour (1899), and Mr John Burns (18.97) ; poets, Tennyson, Swinburne (1884), Browning (1875), Matthew Arnold (1881), Rossetti (1865, and subsequent replica), and William Morris (1870) ; artists, himself (1864, 1S80, and eleven others), Lord Leighton (1871 and 1881), Calderon (1872), Prinsep (1872), Burne-Jones (1870), Millais (1871), Walter Crane (1891), and Alfred Gilbert (1896) ; literature is represented by John Stuart Mill (exhibited 1874), Carlyle (1869), George Meredith (1893), Max Mtiller (1895), and Mr Lecky (1878) ; music, by Sir Charles Halle ; while among others who have won fame in diverse paths are Lords Napier (1886) and Roberts (1899), General Baden- Powell (1902), Garibaldi, Sir Richard Burton (1882), Cardinal Manning (1882), Dr Martineau (1874), Sir Andrew Clark (1894), George Pea- body, Mr Passmore Edwards, Claude Montefiori (1894). Even more significant from an artistic point of view is the great

collection of symbolical pictures in the Tate Gallery which forms the artist's message to mankind. Believing devoutly in the high mission of didactic art, he strove ever to carry out his part of it faithfully.

To quote his own words : " My intention has not been so much to paint pictures that charm the eye, as to suggest great thoughts that will appeal to the imagination and the heart, and kindle all that is best and noblest in humanity " ; and his tenet is that the main ob- ject of the painter should be " demanding noble aspirations, condemning in the most trench- ant manner prevalent vices, and warning in deep tones against lapses from morals and duties."

There are not wanting critics who radically dissent from this view of the proper functions of art. It must be admitted that there is force in their objection when the inner meaning of a picture is found to be exceed- ingly obscure, if not incompre- hensible, without a verbal ex- planation. In the female figure, forinstance,bendingblindfolded on the globe 'suspended in space and sounding the sole remain- ing string upon her lyre, while a single star shines in the blue heavens, it is not obvious to everyone that the idea of "Hope" (1885) is suggested. There can be few, neverthe- less, who will maintain that his aim is not a lofty one ; and the strongest evidence of the artist's greatness, to those who accept his doctrine, is the fact that lie has not only striven untiringly for his own ideals, but has very often gloriously attained them. Moreover, in so doing he has not failed on^ccasion to impart to his work much of that very charm which is to him a secondary consideration, or to exhibit an assured and accomplished mastery of the technical achievement which is to some the primary object and essential triumph of painting. It was, in short, the rare combination of supreme handicraft with a great imaginative intellect which secured to Mr Watts his undisputed place in the public estimation of his day. The grandeur and dignity of his style, the ease and purposefulness of his brushwork, the richness and harmoniousness of his colouring— qualities partly his own, partly derived from his study of Italian masters at an early and impressionable age- are acknowledged even by those to whom his elevated educational intentions are a matter of indifference, if not of absolute dis- approbation; while many, to whom his exceptional artistic attainment is a sealed book, have gathered courage or

consolation from the grave moral purpose and deep human sympathy of his teaching. He expresses his ideas for the most part in terms of beauty, an idealized, classical beauty of form, a glowing, Venetian beauty of colour, though his conviction of the deadly danger of heaped-up riches, which he vindicated in his life as well as in his work, has, in such cases as " The Minotaur " (exhibited in 1896), "Mammon" (1885), and "Jonah" (1895), where the unveiled vileness of Cruelty and Greed is fearlessly depicted, driven him to the presentment of sheer ugliness or brutality. Par oftener a vast, all-embracing tenderness inspires his work ; it is the sorrow, not the sin, that stirs him. When he would rebuke the thoughtless inhumanity which sacrifices its annual hecatombs of innocent

birds to fashionable vanity and grasping commerce, it is not upon the blood and cruelty that he dwells, but the pity of it that he typifies in "Dedication" or "The Shuddering Angel" (1892) weeping over the altar spread with Woman's spoils.

Yet it is as a teacher that the artist is seen at his highest : he would sooner point out the true way to those who seek it than admonish those who have wandered. He never wearies of em- phasizing the reality of the power of Love, the fallacy underlying the fear of Death. To the early masters Death was a bare and ghastly skeleton, above all things to be shunned ; to Watts it is a grand, impressive figure, awful indeed but not horrible, irre- sistible but not ruthless, a bringer of rest and peace, not to be rashly sought but to be welcomed when the inevitable hour shall strike. "Sic transit" (1892) conveys most completely, perhaps, Mr Watts's lesson on the theme of death. Stretched on a bier and reverently sheeted lies a corpse ; strewn neglected on the ground lie the ermine robe of worldly rank, the weapons of the warrior, the lute of the musician, the book of human learning, the palmer's robe of late repentance, and the roses of fleeting pleasures ; the laurel crown remains as the one thing worth the winning, and the inscription, "What I spent I had; what I saved I lost; what I gave I have," points the moral. Such is the significance of the still more masterly "Court of Death " (finally completed 1902 and now in the Tate Gallery).

To the same early masters Love was usually a. mere distributor of sensual pleasures, a tricksy spirit instinct with malice and bringing more harm than happiness to humanity, though neither was of much moment. Watts has not altogether ignored this view, and in "Mischief" (1878) has portrayed Man, love-led, entangled among the thorns of the world, but, in the main, Love to him is the chief guide and helper of mankind along the barren, rock-strewn path of life, through whom alone he can attain the higher levels, and who triumphs in the end over Death itself. To these views on the all-importance of love a trilogy of pictures in the Tate Gallery gives full expression. In the first, "Love and Life," exhibited in 1885 (see Plate), a replica of an earlier picture in the Metropolitan Museum, New York, and of another version presented by him to the Luxemburg, Paris, Love, a figure in the prime of manhood, leads and supports the slender, clinging girl who symbolizes Life up to the craggy mountain-top, while he partly shields her from the blast under a broad wing. Of this he himself said, " Probably ' Love and Life ' best portrays my message to the age. Life, represented by the female figure, never could have reached such heights unless protected and guided by Love," 1 and in the prefatory note to the exhibition of his works in 1896 he wrote, "The slight female figure is an emblem of the fragile quality in huma.nity, at once its weak- ness and its strength ; sensibility, aided by Love, sympathy, tender- ness, self-sacrifice, and all that the range of the term implies, humanity ascends the rugged path from brutality to spirituality." The limitations of earthly love are shown in the second "Love and Death," one version of which was exhibited in 1877 and others in 1896, &c. In this, Love, a beautiful boy, striving vainly to bar the door to the mighty figure of Death, is thrust back with crushed wings powerless to stay the advance ; but that the defeat is merely apparent and temporary is suggested rather than asserted by the third " Love Triumphant " (1898), where Time, with broken scythe, and Death lie prostrate, while the same youth, with widespread wings and face and arms upraised to heaven, stands between them on tiptoe as if preparing to soar aloft. Though the purely sym- bolical is the most distinctive side of Mr Watts's art, it is by no means the only one. He has drawn inspiration largely from both the Old and New Testaments, more rarely from the poets and classical myths ; still more rarely he has treated subjects of modern life, though even in these he has not abandoned his moral purpose, but has sought out such incidents,

whether fictitious or historical, a< will serve him in conveying some lesson or monition. The three pictures of the story of Eve in the Tate Gallery, "She shall be called woman" (1892), "Eve Tempted" and "Eve Repentant" (both exhibited in 1896), and "The Curse of Cain" (1872) in the Diploma Gallery, may be cited as examples of the first ; " For ho had great possessions" (1894) of the second; "Sir Galahad (1862), "Orpheus and Eurydice " (see Plate) and "Psyche" (1880), of the third; and "The Irish Famine" (about 1847), and "A patient life of unrewarded toil" (1890), of the last of these. Never has he treated religion from a sectarian point of view.

Mr Watts is before all things a painter with a grave and earnest purpose, painting because that form of expression was easier to him than writing, though he has published some few articles and pamphlets, Chiefly on art matters ; but he too has his lighter side, and has daintily treated the humorously fanciful in "Good luck to your fishing" (1889); "The habit does not make the monk" (1889), in which Cupid, half-hidden under the frock, taps maliciously at a closed door ; and " Trides light as air " (exhibited 1901), a swarm of little amorini drifting in the summer air like a cloud of gnats; while in "Experientiadocet B.C." (1890), a primeval

1 O. F. Watts, R.A., by Charles T. Bateman.

woman watching with admiration, not unmixed with anxiety, the man who has first swallowed an oyster, he condescends, not very successfully, to the frankly comic. These must be regarded, how- ever, as merely the relaxations of the serious mind that has left its impress even on the relatively few, but very admirable, landscapes he produced, in which, as for instance "The Carrara Mountains from Pisa " (1881), a sober dignity of treatment is conspicuous.

Watts's technique is as individual as his point of view. It is chiefly remarkable for its straightforwardness and simplicity, and its lack of any straining after purely technical effects. The idea to be expressed is of far higher importance to him than the manner of expressing it. The statement of it should be a matter of good, sound workmanship, not of artistic agility or manual dexterity. To say what he has to say as clearly and briefly as may be is his aim, and when he has achieved the effect he desires, the

method of his doing so is of no further moment. In the use of paint as paint, in the intrinsic beauties of surface and handling, he would seem in his later years to take no delight. Thus in parts of the picture the rough coarse canvas he prefers may be so thinly covered that every fibre of the material can be seen, while in others a richly modelled impasto loads the surface. He employs, as far as possible, pure colours laid on. in direct juxtaposition or broken into and across each other, not blended and commingled on the palette. He eschews all elaboration of detail and, except in portraiture, works rarely from the living model, neglecting minor delicacies of form or passages of local colour, conventionalizing to a standard of his own rather than idealizing — a process not always unproductive of faults of drawing and proportion, as in the figure of "Faith " (1896), or of singularities of tint, as in the curious leaden face and pris- matic background in "The dweller in the innermost" (1886). He avoids, as a rule, the use of definite outline, leaving the limits of his forms to melt ! imperceptibly into the background; nor does texture interest him greatly, and a, uniform fresco-like surface is apt to represent flesh and foliage, distance and foreground alike. He intends deliberately that the things he depicts, be they what they may, shall be symbols, useful for their meaning alone, and he makes no attempt at conferring on them an accurate actuality, which might distract the attention from the paramount idea. That this reticence is intentional may be learned from an examination of his earliest works, in which the accessories are rendered with a precise, if sometimes a diy, truthfulness of observation ; that it is not due to carelessness or indifference is shown by the inexhaustible patience with which each picture has been executed. His earlier pictures are unsurpassed in the art of England for fine technical qualities of colour and delicacy of handling. Though working unceasingly, Watts never hurried the completion of any canvas. Of two slightly differing versions of ' ' Fata Morgana, " both begun in 1847, the first was not finished before 1870, the second not until ten years later. Even after finishing a picture sufficiently for exhibition, he often subsequently worked further upon it. The portrait of Lord Leighton, exhibited in 1881, was repainted in 1888 ; the version of "Love and Death," exhibited in 1877, in 1883, and all the pictures presented to the Tate Gallery in 1897, were more or less retouched when hung there. Further- more, he painted more than one version of several of his favourite subjects, a circumstance

which, combined with the fact that he rarely added the year to his signature and kept no record of his annual production, makes the task of precisely dating his pictures for the most part impossible, while it renders any attempt to dispose his works in periods untrustworthy and artificial, since even the growth and inevitable decay of artistic power are to a considerable extent obscured.

Founded admittedly on the Grecian monuments, there is a sculpturesque rather than pictorial quality in most of his com- positions, a regulated disposition which, though imparting often a certain air of unreality and detachment, inspires them never- theless with that noble impressiveness which forms their most conspicuous characteristic. It is natural, therefore, that in sculp- ture itself he should also take a high place. A taste for this he acquired as a boy ; he was a constant visitor to the studio of Behnes, where he not infrequently made drawings from the casts, though he was never in any sense his pupil. Among his works in this branch of art are a bust of " Clytie " (1868), monuments to the Marquis of Lothian, Bishop Lonsdale, and Lord Tennyson, a large bronze equestrian statue of " Hugo Lupus" at Eaton Hall (1S84), and a colossal one of a man on horseback, emblematical of " Physical Energy," originally intended for a place on the Embankment, but now destined to stand among the Matoppo Hills as an enduring evidence of the artist's admiration for Cecil Rhodes. It was the practical idealism of Rhodes that appealed to him, and in this quality Watts himself was by no means lacking. Much of his time and attention were given to the promotion of the Home Arts and Industries Association ; he assisted Mrs Watts with both money and advice in the founding of an art pottery at Compton, and in the building at the same place of a highly decorated mortuary chapel, carried out almost entirely by local labour ; and it was entirely due to his initiative that the ereotion in Postmen's Park, Aldersgate Street,

London, of memorial tablets to the unsung heroes of everyday life was begun.

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Watts — Dunton, Walter Theodore

(1836), English man of letters, was born at St Ives,

Huntingdon, in 1836, his family surname being Watts, to which he added in 1896 his mother's name of Dunton. He was originally educated as a naturalist, and moved much among the East Anglian gypsies, of whose supersti- tions and folk-lore he made careful study. Abandoning natural history for the law, he qualified as a solicitor and practised for many years in St Ives, giving his spare time to his chosen pursuit of literature. In 1872 he came up to London and contributed regularly to the Examiner from 1874 and to the Athenceimi from 1875, being for more than twenty years the principal critic of poetry in the latter journal. Mr Watts-Dunton has been the friend of many of the leading men of letters of his time ; he enjoyed the confidence of Tennyson, was interested in the Pre-Raphaelite movement, and has for many years shared the same home with Mr Swinburne. The obituary notices and appreciations of the poets of the time, which he has contributed to the Athenaeum and other periodicals, have borne testimony to his sympathy, insight, and critical acumen. It was not, however, until he had passed his sixtieth year that he published any volume under his own name, his collection of poems called The Coming of Love, portions of which he had printed in newspapers from time to time, appearing as a complete book in 1897. In the following year his romance Aylwin attained immediate success, and ran through many editions in the course of a few months. Both The Coming of Love and

~~Aylwin set forth, the one in poetry, the other in prose, the romantic and passionate associations of Romany life, and maintain the traditions of Borrow under somewhat novel aspects. Imaginative glamour and mysticism are their prominent characteristics, and the novel in particular has had its share in restoring the charms of pure romance to the favour of the general public.~~

~~Wailkegan, a city of Illinois, U.S.A., capital of Lake county, on a cliff on the shore of Lake Michigan, 36 miles north of Chicago, and on the Chicago and North- Western and the Elgin, Joliet, and Eastern rail-ways. It has a regular plan, well paved streets, and a water-supply. It has a good harbour and much lake traffic. Population (1880), 4012; (1890), 4915; (1900), 9426, of whom 2506 were foreign-born.~~

~~Waukesha, a village of Wisconsin, U.S.A., capital of Waukesha county. It is situated in 43° 01' N. and 88° 12' W., on the river Fox and the Chicago and North- western, the Chicago, Milwaukee and St Paul, and the Wisconsin Central railways, in the south-eastern part of the state, at an altitude of 808 feet. It is irregularly laid out, and has water-works and a sewerage system. It is one of the leading health resorts of the state, containing magnesian springs, whose waters are re- puted to cure liver and kidney troubles. The waters are bottled and sold in vast quantities throughout the country, and enjoy a high reputation. Population (1880), 2969 ; (1890), 6321 ; (1900), 7419, of whom 1408 were foreign-born.~~

~~Wausau, a city of Wisconsin, U.S.A., capital of Marathon county. It is situated in 44° 57' N. and 89° 36' W., on both sides of the river Wisconsin, and on the Chicago and North- Western and the Chicago, Milwaukee and St Paul railways, in the central part of the state, at an altitude of 1219 feet. The city is regularly laid out on gentle slopes towards the river, the business streets are paved, and the city has an ample water-supply. It is in the region of white pine timber, and its industries are largely connected with wood-working. It has saw-mills, planing-mills, box and furniture factories, besides flour- mills, tanneries, &c. Population (1880), 4277; (1890), 9253 ; (1900), 12,354, of whom 3747 were foreign-born.~~

~~Waverly, a village of Tioga county, New York, U.S.A It is situated in 42° 00' N. and 76° 32' W., on the river Chemung, at the mouth of Cayuta~~

creek, and near the southern boundary of the state, at an altitude of 825 feet. It is on the Delaware, Lackawanna, and Western, the Erie, and the Lehigh Valley railways, and is the shipping-point for a large dairy-farming region. Population (1880), 2767; (189Q), 4123; (1900), 4465.

Wavre, a town of Belgium, in the province of Brabant, 16 miles south-east of Brussels, with a station on the line from Louvain to Nivelles. It has numerous manufactures, but is chiefly memorable as the scene of an engagement between the Prussians and a French corps on the day of the battle of Waterloo. Although Grouchy, the French commander, was victorious, he could not, on account of this engagement, reach the main army in time to be of service. He learnt here the news of Napoleon's defeat. Population (1890), 7575 ; (1899), 8200.

WaycrOSS, a town of Georgia, U.S.A., capital of Ware county, in the south-eastern part of the state. It is an important railway junction, three lines crossing at this place. Population (1890), 3364 ; (1900), 5919, of whom 46 were foreign-born and 2899 negroes.

. Waynesboro, a borough of Franklin county, Pennsylvania, U.S.A., on the Western Maryland and the Cumberland Valley railways, in the southern part of the state. Population (1890), 3811 ; (1900), 5396.

Wazirabad, a town of British India, in the Gujranwala district of the Punjab, near the left bank of the river Chenab, with a railway station, 62 miles north of Lahore. Population (1881), 16,462; (1891), 15,786; municipal income (1897-98), Rs.20,017. It is an im- portant railway junction. The main line of the North- Western Railway here crosses the Chenab by the Alexandra bridge, opened by the Prince of Wales in 1876. The branch to Sialkot has been extended to Jamu (51 miles) ; another branch follows the line of the Chenab canal towards Mooltan. There is extensive boat-building, as well as manufactures of steel and iron. There are three high schools — Scottish mission, Mahommedan, and Sikh.

Waziristan, a section of the mountain districts of the north-west frontier of India, lying between the Tochi (or Dawar) river on the north and the Gomul on the south. It is independent, geographically as well as politically, both of British India and of contiguous tribal states. The Tochi

valley is ethnically included in Waziristan, the Dawaris being related to Waziri clans ; but the Gomul now offers a trade route into Afghanistan, which is open to all tribes, the blackmailing of the Waziris having been suppressed since the British occupation of Wana, on its northern flank. The Tochi and the Gomul rivers enclose Waziristan, their affluents rising to the west of that country in the upland valleys of Shawal and Birmal, and flowing north and south to a junction

with the main streams. Between the two rivers stretches the central dominating range of Waziristan from north- east to south-west, geologically connected with the great limestone ranges of the Sulimani hills to the south, and dominated by the great peaks of Shuidar (Sheikh Haidar) and Pirghal, both of them between 11,000 and 12,000 feet above the sea, and hardly inferior to the Khaisargarh peak of the Takht-i-Suliman. From these peaks westwards a view is obtained across the grass slopes and cedar woods of Birmal and Shawal (lying thousands of feet below) to the long, serrated ridges of the central watershed which shuts off the plains of Ghazni from the hill states of the frontier. To the eastward several lines of drainage strike away for the Indus, breaking through parallel folds and flexures of the mountains, of which the conformation is here distinctly observable, although not so marked as it is south of the Gomul. These lines of drainage are, as usual, the main avenues of apj^roach to the interior of the country. They are the Khaisora and the Shakdu on the the north, which, uniting, join the Tochi south of Bannu, and the Tank Zam (which is also called Khaisor near its head) on the south. The two former lead from the fron- tier to Basmak and Makin, villages of some local import- ance, situated on the slopes of Shuidar ; and the latter leads to Kauigoram, the Waziri capital, and the centre of a considerable iron trade. Kanigoram lies at the foot of the Pirghal mountain.

Amongst the mountains of Waziristan there is much fine scenery and a delightful climate. Thick forests of ilex clothe many of the spurs, which reach down to the grassy deodar-covered uplands of Birmal on the west ;

and the spreading poplar attains magnificent dimensions amongst the flats and plateaus of the eastern slopes. The indigenous trade of the country is inconsiderable, although Waziri iron is much esteemed. The agricultural products are poor, and the general appearance of the priest-ridden people is significant of the endurance of many hardships, even of chronic starvation. The most notable product of the country is the Waziri breed of horses and donkeys. The latter especially deserve to rank as the best of their kind on the Indian frontier, if not in all India.

The geological formation of Waziristan is the same as that of the contiguous frontier. Recent subaqueous deposits have been

disturbed by a central upheaval of limestone ; the lower eo ogy. hills are soft in composition and easily weather-worn, the slopes are rounded, and large masses of detritus have collected in the nullah beds and raised their level. Through these deposits heavy rain-floods have forced their way with many bends and curves to the plains, enclosing within each curve a ‘ ‘ warn ” or “raghza,” which slopes gradually to the hills and affords the only available space for irrigation and agriculture. A ‘ ‘ warn ” is a gently sloping open space, generally raised but slightly above the river level. A ‘ ‘ raghza ” differs from a ‘ ‘ warn ” in being on a higher level and often beyond the reach of irrigation. Pasture is found abundantly in the hills, but cultivation only on the borders of the main streams. Passing up and down these main water- courses, there is an appearance of great fertility and wealth, which is entirely due to these thriving strips of verdure, their restricted and narrow limits being hardly visible from the river beds. From above, when viewed from the flanking ridges, the vast extent of hill country, neither high, nor imposing, nor difficult of access, but invariably stony and rough, compares strongly with the narrow bands of enclosed cultivation winding about like green ribbons, and marking the course of the main streams from the snow-covered peaks to the plains. The physiography of Waziristan is that of the Kuram to the north rather than that of the Sulimani hills to the south.

The Wazirs (or Waziris) are divided into two important clans,

each subdivided into many smaller sections or “kliel.” The

~~1 Mahsud Wazirs occupy all the central portions of the~~

~~Popu a- country . the Darwah Khel extend round its western~~

~~borders, holding the Gomul tributaries, the valleys of Shawal and Birmal, and spreading into the Tochi on the north. The occupation of the heights of the main range and of the upland valleys at its western foot is, however, dependent on the season and the pasturage ; the permanent settlements of the country,~~

~~belonging chiefly to the Mahsuds, are on the eastern slopes facing the Indus. Although not to be compared in physical development with the Ghilzai povindahs (the Suliman Khel, Nasir Khel, and others who migrate yearly between Afghanistan and India), the Waziris are nevertheless a hardy, independent race of mountaineers, fully capable of holding their own with the Afghans on their borders, and of giving the British much trouble.~~

~~Expeditions into Waziristan were undertaken in 1860 and 1881, the former under General Chamberlain, and the latter under Generals Kennedy and John Gordon. On the first occasion the resistance was stubborn and determined, and a fierce II's'ory. night attack was with difficulty repulsed. In 1881 no very great stand was made against the advancing troops, and guerilla tactics alone were adopted. The demarcation of a boundary between Waziristan and Afghanistan in 1895 and the occupation of Wana (an upland valley in the south-west of Waziristan) led to another outbreak, when a night attack was directed with great skill against the camp of the brigade supporting the demarcation parties, and with such determination that a partial success was achieved, and the Waziri actually reached the centre of the camp. This led to a punitive expedition directed against the Mahsuds in southern Waziristan and the permanent occupation of Wana. In June 1897, after the boundary demarcation was completed, another outbreak occurred in the Tochi, when the Mada Khel, a section of the Darwah Khel, treacherously attacked the escort of the political agent at Maizar and killed several of the military officers. This again led to a punitive expedition, in which no stand was made by the enemy, who dispersed amongst the upper valleys of the Shuidar range, or across the boundary~~

~~*into Afghanistan. Since then the Tochi valley has been occupied by British troops.*~~

~~*The Tochi is a wide, well cultivated, and open valley (except at its debouchment into the plains near Bannu), and it undoubtedly was once a much used highway between Ghazni and the Indian border. At present it is little utilized as Tochi.*~~

~~*a Jchapila route, excepting for purely local trade. It has a bad reputation for unhealthiness, and the inhabitants of the valley (known as Dawari and disowned by the Waziri) enjoy a reputa- tion for depravity which is unique even amongst border Pathan tribes.*~~

~~*Information about Waziristan is to be found only in the gazet- teers and survey reports of the Indian Government. Nothing like an exhaustive description of the country or of its people has yet been attempted. (t. h. H*.)*~~

~~*Wa.ZZ3.ri, a small picturesque hillside town, Morocco, 60 miles north-west by north of Fez. It has grown up about the tomb of a sainted Idrisi Sharif (17th century), and is famous as a religious centre, but is otherwise unimportant. It is the headquarters of its founder's descendants. There are no European residents. Popu- lation, 10,000.*~~

~~*Webb City, a city of Jaspar county, Missouri, U.S.A., on the St Louis and San Francisco, the Missouri Pacific, and the Kansas City, Fort Scott, and Memphis railways, in the south-western part of the state, at an altitude of 969 feet. It is in the rich lead and zinc region of south-western Missouri and south-eastern Kansas, and its industries are connected with mining and shipping these metals. Population (1880), 1588 ; (1890), 5043; (1900), 9201, of whom 248 were foreign-born.*~~

~~*Weber, Wilhelm Eduard (1804-1891),*~~

~~*German physicist, was born at Wittenberg on the 24th of October 1804, and was a younger brother of Ernst Heinrich Weber of Weber's Law. He studied at the University of Halle, where he took his doctor's degree in 1826 and became extraordinary professor of physics in 1828. Three years*~~

later he removed to Gottingen as professor of physics, and remained there till 1837, when lie was one of the seven professors who were expelled from their chairs for protesting against the action of the King of Hanover (Duke of Cumberland) in suspending the constitution. A period of retirement followed this episode, but in 1843 he accepted the chair of physics at Leipzig, and six years later returned to Gottingen, where he died on 23rd June 1891. Weber's name is especially known for his work on electrical measurement. Until his time there was no established system either of stating or measuring electrical quantities ; but he showed, as his

colleague Gauss did for magnetic quantities, that it is both theoretically and practically possible to define them, not by reference to other arbitrary quantities of the same kind, but absolutely in terms in which the units of length, time, and mass are alone involved. He also carried on extensive researches in the theory of magnetism ; and it is interesting that in connexion with his observa- tions in terrestrial magnetism he not only employed an early form of mirror galvanometer, but also, about 1833, devised a system of electromagnetic telegraphy, in which a distance of some 9000 feet was worked over. In con- junction with his elder brother he published in 1825 a well-known treatise on waves, Die Wellenlehre auf Experi- mente gegriindet ; and in 1833 he collaborated with his younger brother, the physiologist Eduard Friedrich (1806-1871), in an investigation into the mechanism of walking.

Webster, a town of Worcester county, Massa- chusetts, U.S.A., situated in the southern part of the state. It has an area of 16 square miles of hill and valley country, interspersed with ponds. It contains several villages, the largest of which bears the same name as the town, is situated on the French river, and on lines of the Boston and Albany, and the New York, New Haven, and Hartford railways. It is largely engaged in the manufacture of cotton and woollen goods and boots and shoes. The town was incorporated in 1832. Popula- tion (1880), 5696 ; (1890), 7031 ; (1900), 8804, of whom 3562 were foreign-born.

Wed nes bury, a municipal (since 1886) and par- liamentary borough and market town, in the Handsworth parliamentary division of Staffordshire, England, 8 miles north-west of Birmingham by rail. An overhead electric tramway connects the town with Walsall. The town hall was improved in 1891. Adjoining is an art gallery, erected in the same year. A drill hall was built in 1893, a new fire brigade station in 1899, and an isolation hospital in the same year. Stoneware potteries are now important ; the neighbourhood furnishes limestone and clay. Population (1891), 25,347; (1901), 26,544.

Weighing Machines. — The theory of weigh- ing machines is simple ; but a great amount of skill and ingenuity has been used in constructing them so as to combine convenience and cheapness with efficiency, and this has given rise to an immense variety of forms and to a number of practical problems which find no place in the general theory. With few exceptions, weighing machines belong to one or other of the following types : —

Equal-armed balances, which may be divided into

(1) Scale-beams or balances in which the scale-pans

are below the beam.

(2) Counter machines and balances on the same

principle, in which the scale-pans are above the beam. Unequal-armed balances, which may be divided into

(1) Balances consisting of a single steelyard.

(2) Balances formed by combinations of unequal-

armed levers and steelyards, such as platform machines, weighbridges,

Equal-armed Balances.

Scale-beams are the most accurate balances, and the most generally used. When constructed for purposes of extreme accuracy they will turn with the one-millionth part of the load weighed, though to ensure such a result

the knife-edges and their bearings must be extremely hard (either hardened steel or agate) and worked up with great

care. The beam must be provided with a small ball of metal which can be screwed up and down a stem on the top of the beam for the purpose of accurately adjusting the position of the centre of gravity, and there should be a small adjustable weight on a fine screw projecting horizontally from one end of the beam for the purpose of accurately balancing the arms.

The theory of the scale-beam is well stated by Weisbach in his Mechanics of Machinery and Engineering, as follows : — In Fig. 1 D is the fulcrum of the balance, S the centre of gravity of the beam alone without the scales, chains, or weights ; A and B the points of suspension of the chains. If the length of the arms AC = BC = Z, GD = a, SD=s, the angle of deviation of the bal- ance from the hori- zontal = , the weight

of the beam alone = G, the weight on one side=P, that on the other=P + Z, and lastly the weight of each scale with its appur- tenances = Q ; then

, , ZJ

tan0 {2(p + Q) + z}a + Gj .

From this it is inferred that the deviation, and therefore the sensitiveness, of the balance increases with the length of the beam, and decreases as the distances, a and s, increase ; also, that a heavy balance is, ceteris paribus, less sensitive than a light one, and that the sensitiveness decreases continually the greater the weight put upon the scales. In order to increase the sensitiveness of a balance, the line AB joining the points of suspension and the centre of gravity of the balance must be brought nearer to each other. Finally, if a is made extremely

Z I small, so that practically tan 0= j=|-^-' the sensitiveness is inde- pendent of the amount weighed by the balance. "Weisbach also shows that if Gj/2 is the moment of inertia of the beam, the time, t, of a vibration of the balance is

Fig. 1.

t=T/S/;

2(? + Q)(P + ai) + G.y2 ?{2(P + Q).a + Gs}

This shows that the time of a vibration increases as P, Q, and I increase, and as a and s diminish. Therefore with equal weights a balance vibrates more slowly the more sensitive it is, and therefore weighing by a sensitive balance is a slower process than with a less sensitive one.

The conditions which must be fulfilled by a scale-beam in proper adjustment are : — (1) The beam must take up a horizontal position when the weights in the two scale-pans are equal, from nothing to the full weighing capacity of the machine. (2) The beam must take up a definite position of equilibrium for a given small difference of weight in the scale-pans. The sensitiveness, i.e., the angle of deviation of the beam from the horizontal after it has come to rest, due to a given small difference of weight in the scale-pans, should be such as is suited to the purposes for which the balance is intended. Bearing in mind that with ordinary trade balances there is always a possibility of the scale- pans and chains getting interchanged, these conditions require : (a) That the beam without the scale-pans and chains must be equally balanced and horizontal ; (b) that the two scale — pans with their chains must be of equal weight ; (c) that the arms of the beam must be exactly equal in length ; i.e., the line joining the end knife-edges must be exactly bisected by a line drawn perpendicular to it from the fulcrum knife-edge. By testing the beam with the scale-pans attached and equal weights in the pans, and noting carefully the position which it takes up ; and then interchanging the scale-pans, &c, and again noting the position which the beam takes up, a correct inference can be drawn as to the causes of error ; and if after slightly altering or adjusting the knife-edges and scale-pans in the direction indicated by the experiment, the operation is repeated, any required degree of accuracy may be obtained by successive approximations. The chief reason for testing balances with weights in the scale-pans rather than with the scale-pans empty, is that the balance might be un- stable with the weights though stable without them. This is not an unfrequent occurrence, and arises from the tendency on the part of manufacturers to make balances so extremely sensitive that they are on

the verge of instability. In Fig. 2 let ABCD be the beam of a scale-beam, Z the fulcrum knife-edge, and X, Y the knife-edges on which the scales are hung. In order to ensure a high degree of sensitiveness, balances are sometimes

constructed so that Z is slightly below the line joining X and Y, and is only slightly above H, the centre of gravity of the beam with the scale-pans and chains attached. The addition of

weights in the scales will have the effect of raising the point H till it gets above Z, and the balance, becoming unstable, will turn till it is brought up by a stop of some kind.

For the weighing of very small quantities with balances of great delicacy, the following method is adopted : — If the balance be in perfect adjustment, and I be the length of each arm, and w a very minute difference of the weights in the two scale-pans, by which the beam is deflected from the horizontal by a very small angle , varies as w x I. Therefore the angle of deflection which would be produced

by a grain weight hung at the distance — (for example) from the

centre is the same as would be produced by fVth of a grain in the scale-pan at the distance I. Therefore by graduating the top of the beam and shifting a rider grain weight till the beam is horizontal, it is easy to ascertain the small difference of weight in the scale-pans which caused the deflection to the j-Juth or isVyth part of a grain without using a weight smaller than a grain.

With such delicate machines as scale-beams, the fitting of the knife-edges is of great importance. In ordinary trade balances a triangular piece of hard steel, with a finely-ground edge, is driven through a triangular hole in the beam and jammed tight. This forms the knife-edge, and the scale-pans are hung from the two projecting ends of the piece of steel. Similarly

the two projecting ends of the central piece of steel which forms the fulcrum take bearing on two cheeks of the stand, between which the beam sways. It is clear that errors Will arise if the pieces of steel are not truly perpendicular to the plane of the beam, and the adjust- ment for great accuracy would be very tedious. Therefore for balances of precision the end knife-edges are fixed on the top of the beam so as to present a continuous unbroken knife-edge, and the fulcrum knife-edge is also made continuous, the beam being cored out or cut away to admit of the introduction of the stand bearing. With this arrangement the knife-edges can be easily adjusted and examined, and the system is now rapidly extending to the better class of trade balances.

The knife-edges of weighing machines ar^ the parts that wear out soonest, but very little is known about them experi- mentally, and the knife-edges made by different makers vary extremely in their angles. Those made by some of the best makers for the most delicate machines are formed to an angle of about 80° between the sides, with the finished edge ground to an angle varying from 110° to 120°. The following may be taken as the maximum loads per inch of acting or efficient knife-edge allowed by the best makers : —

(1) For scale-beams of the highest accuracy — From J lb per inch

for a machine of i lb capacity, to 25 lb per inch for a machine of 80 lb capacity.

(2) For ordinary trade scale-beams, counter machines, and dead-

weight machines — From 20 lb per inch for a machine of 7 lb capacity, to 600 lb per inch for a machine of J ton capacity.

(3) For platform machines and weighbridges — From 120 lb per

inch for a machine of 4 cwt. capacity, to 1 ton per inch for a

machine of 25 tons capacity. The sensitiveness of scale-beams depends entirely upon the skill and care used in their construction. With balances of the highest precision it may be as high as TTfo&ooo °f the load

~~weighed, while with trade balances when new it would be about -in^-j- of the load.~~

~~In Emery's testing machine there are no knife-edges, but their function is performed by thin steel plates, which are forced under a very heavy pressure into slots formed in the parts that are to be connected, so that the parts are united by the plate. In this case there is no friction and no sensible wear, so that very great permanency of condition and constancy of action might be expected. But the resistance to bending of the steel plates would render this arrangement unsuitable for scale-beams, in which the movement is large. In some respects it would appear to be very suitable for weighbridges, in which the movement of the lever is very small, but for general convenience of adjustment the knife-edges appear preferable.~~

~~Counter machines have an advantage over scale- beams in not being encumbered with suspension chains~~

~~and the beam above. They are usually made with two beams, each with its three knife-edges, rigidly tied to- gether or cast in one piece and some distance apart, so that the scale-pans being carried on two knife-edges, each is prevented from tipping over sideways. To prevent them from tipping over in the direction of the beams a vertical leg is rigidly fastened to the under side of each pan, the lower end of which is loosely secured by a horizontal stay to a pin in the middle of the frame. In using these machines there is seldom any question of determining the weight to any great nicety, and rapid action is generally of high importance. Hence they are very commonly made unstable, or " accelerating," i.e., they are constructed with the fulcrum knife-edges lower than the. line joining the end knife-edges, and they are arranged so that the beam is horizontal when the stop of the weights-pan is hard down on its bearings. This arrangement is well adapted for weighing out parcels of goods of a definite weight, though not for ascertaining the correct weight of a given article. For the latter purpose machines are used of which the beams are made stable, or "vibrating," by constructing them with the fulcrum knife-edges above the line joining the end knife-edges.~~

“Accelerating” machines can be used to the advantage of the vendor in two ways. Firstly, in using them to determine the weight of a given article. For with unstable balances, although the smallest excess of weight in the goods-pan will cause it to descend till it is brought up by its stop, yet being in this position, a very much greater weight than the difference which brought it there will be required in the weights-pan to enable it to mount again. If W be the weight in each pan when the goods-pan commenced to sink, I the length of each arm, m the distance of the fulcrum below the line joining the end knife-edges, and /3 the angle at the fulcrum which defines the range of sway of the beam, it can easily be shown that w, the additional weight required in the weights-pan to enable the goods-pan to rise from

its stop, is given by the equation w = W j — ■£= . So that if,

for example, a fishmonger uses such a machine to ascertain the weight of a piece of fish which he places in the goods-pan, and thereby depresses it down upon its stop, and then places weights in the weights-pan till the goods-pan rises, the customer is charged for more than the real weight of the fish. Secondly, in using them out of level, with the goods end of the machine lower than the weights end. If S be the angle of tilt of the machine, and the other symbols be as before, it may be shown that the additional weight, w, which is needed in the weights -pan to enable the goods-pan to rise off its stop, is given by the equation

w=W-^ : — ^= — L . When $ is negative, as it is when the

•l-m tan (p — 8)

goods end of the machine is lower than the weights end, the

value of w may be very appreciable. With ” vibrating ” machines

the value of m is in general so extremely small that w is of no

practical importance in either of the above cases.

If a counter machine be made with a large flat goods-pan, as in

~~Fig. 3, an error may be caused by placing the goods eccentrically~~

~~Fig. 3.~~

~~on the pan, as at D or E. Using the symbols of the diagram, it can be shown that the effect of placing the weight W at E~~

~~instead of F is to cause the end of the beam to descend, as if under the action of an additional weight, w, at F such that~~

~~•=w.!(=+taB,).~~

~~The condition that must exist in order that the balance may weigh correctly for all positions of the weight W is w=o, or~~

~~tan0 = -y ; that is, the stay KG must be adjusted parallel to~~

~~the line joining the points A and C. From the equation for w, it is seen that the larger h is the smaller w will be. There- fore for the larger counter-machines, where it is not convenient to have the scale-pans raised high above the counter, and for " dead- weight " machines on the same principle, where it is not convenient to have the scale-pans raised high above the floor, there is~~

~~Fig. 4.~~

~~an advantage in adopting the ' ' inverted counter machine " arrange- ment (Fig. 4), because the vertical leg can be produced upwards as high as is required. This arrangement is very common. As will be readily understood from the construction of the machines, there is more friction in counter machines than in scale-beams. The "sensitiveness " error allowed by the Board of Trade for counter machines is five times as great as that allowed for scale-beams.~~

The torsion balance made by the United States Torsion Balance and Scale Company of New York is a counter machine made with- out knife-edges, and is very sensitive. It is constructed with two similar beams, one above the other, which are coupled together at the ends to form a parallel motion for carrying the pans up- right. The coupling is effected by firmly clamping the ends of

the beams upon the top and bottom respectively of a loop of watch-spring, which is tightly stretched round the casting carry- ing the pan, as is shown in the end view in Fig. 5. At their middles the beams are similarly clamped upon the top and bottom of a loop of watch-spring which is tightly stretched round a cast- ing which is bolted upon the bed- plate. When the case which holds the machine is adjusted horizontally by means of its foot- screws, and the weights in the pans are equal, the beams re- main perfectly horizontal ; but with the slightest difference of weight in the pans the beams are tilted, and the elastic resistance of the springs to torsion allows the beams to take up a definite position of equilibrium. The lower beam carries on a saddle a scale which is raised nearly to the top of the glass case in which the machine is enclosed, and as the beams sway this scale plays past a scratch on the glass, which is so placed that when the zero point on the scale coincides with the scratch the beams are horizontal. With proper care this machine should be very per- manent in its action.

Unequal-armed Balances.

Steelyards are simple, trustworthy, and durable, but unless special contrivances are introduced for ascertaining the position of the travelling poise with very great accuracy, there will be a little uncertainty as to the reading, and therefore steelyards are not in general so accurate as scale-beams. When carefully nicked they are well adapted for weighing out definite quantities of goods', such as 1 B>, 2 B>, &c, as in such cases there is no question of estima- tion. The ordinary way of using a steelyard is to bring it into a horizontal position by means of movable weights, and to infer the amount of the load from the positions of these. But it is sometimes convenient to use a fixed weight on the long arm, and to infer the amount of the load from the position of the steelyard. The rule for

graduation is very simple. The simplest form is that which has a single travelling poise. The more elaborate ones are made either with a heavy travelling poise to measure the bulk of the load with a light travelling poise for the remainder, or else with a knife-edge at the end of the steelyard, on which loose weights are hung to measure the bulk of the load, the remainder being measured with a light travelling poise. The advantage of the first arrangement is that the weights on the steelyard are always the same, and incon- sistencies of indication are avoided, while in the second arrangement the loose weights are lighter and handier, though they must be very accurate and consistent among themselves, or the error will be considerable, by reason of the great leverage they exert.

Steelyards, like other weighing machines, will be "accelerat- ing," or "vibrating" according to the arrangement of the knife- edges. In Fig. 6 let Z be the fulcrum knife-edge, X the knife- edge on which the load R is hung, and H the centre of gravity of the weights to the right of Z, viz., the weight, W, of the steelyard acting at its centre of gravity, G, the travelling poise, P, acting at M, and the weights, Q, hung on the knife-edge at Y. Then if Z be below the line joining X and H, the steelyard will be "accelerating" ; i.e., with the smallest excess of moment on the left-hand side of the fulcrum, the end C of the steelyard will rise with accelerating velocity till it is brought up by a stop

J. o— -v H

•

i

a

w

Fig. 6.

P

A

of some sort ; and with the smallest excess of moment on the right-hand side of the fulcrum, the end C of the steelyard will drop, and will descend with accelerating velocity till it is brought up by a similar stop. If Z be above the line XH, the steelyard is "vibrating" ; i.e., it will sway or vibrate up and down, ulti- mately coming to rest in its position of equilibrium. Steelyards, again, are frequently arranged as counter machines, having a scoop or pan resting on a pair of knife-edges at the short end, which is prevented from tipping over by a stay arrangement similar to that of other counter machines.

Steelyards are largely used in machines for the automatic weighing out of granular substances. The principle is as follows: — The weighing is effected by a steelyard with a sliding poise which is set to weigh a definite weight of the material, say 1 lb. A pan is carried on the knife-edges at the short end, and is kept from tipping over by stays. A packet is placed on the pan to receive the material from the shoot of a hopper. A rod, connected at its lower end with the steelyard, carries at its upper end a horizontal dividing knife, which cuts off the flow from the shoot when the steelyard kicks. When the filled packet is removed, the steelyard resumes its original posi- tion, and the filling goes on automatically.

The automatic personal weighing machine found at most railway stations operates by means of a steelyard carrying a fixed weight on its long arm, the load on the platform being inferred from the posi- tion of the steelyard. In Fig. 7 the weight on the platform is trans- ferred by levers to the vertical steel band, A, which is wrapped round an arbor on the axle of the disc-wheel, B, to which is rigidly attached the toothed segment, C. The weight, D, is rigidly

attached to the axle of the wheel, B, and the counterbalance, E, is hung from the wheel, B, by means of a cord wrapped round it. "When the pull of the band, A, comes upon the wheel, B, it revolves through a certain

angle in the direction of the arrow until the three forces, viz., the pull of A, the weight, D, and the counterbalance, E, are in equilibrium. The toothed segment, C, actuates the pinion, F, which carries the finger, G, and this finger remains fixed in position so long as the person is standing on the platform. If now a small weight, as a penny, be passed through the slot, H, it falls into the small box, I, and causes the

lever, J, to turn ; the lever, J, which turns in friction wheels at K, and is counter- balanced at 0, carries a toothed segment, L, which actuates a small pinion on the same axle as F, and is free to turn on that axle by a sleeve. This small pinion carries a finger, it, which is arranged to catch against the finger, G, when moved up to it. Con- sequently as the lever J, turns, the finger, M, revolves, and is stopped when it reaches G. The sleeve of the pinion which carries M also carries the dial finger, and if the dial is properly graduated its finger will indicate the weight. The box, I, has a hinged bottom with a projecting click finger which, as the box descends, plays idly over the staves of a ladder are. When the weight is removed from the platform, the counterbalance, E, causes the finger, G, to run back to its zero position, carrying with it the finger, M, and causing the click finger of the box, I, to trip open the bottom of the box and let the penny fall out. The lever, J, regains its zero posi- tion, and all is ready for another weighing. Since so small a weight as » penny has to move the lever, J, together with the dial finger, &c, it is evident that the workmanship must be good and the friction kept very low by means of friction wheels.

Some of the largest and most accurate steelyards are those made for testing machines for tearing and crushing samples of metals and other materials. They are sometimes made with a sliding poise weighing 1 ton, which has a run of 200 inches, and the steelyard can exert a pull of 100 tons.

Balances are frequently u^ed as counting machines, when the articles to be counted are all of the same weight or nearly so, and this method is both quick and accurate. They are also used as trade computing machines, as in the case of the machine made by the Computing Scale Company, Dayton, Ohio, U.S.A. In this machine the goods to be priced

are placed on the platform of a small platform machine whose steelyard is adjusted to balance exactly the weight of the platform, levers, and connexions. The rod which transmits the pull of the long body lever of the plat- form machine to the knife-edge at the end of the short arm of the steelyard is continued upwards, and by a simple mechanical arrangement transmits to an upper steelyard any additional pull of the long body lever due to the weight of goods placed on the platform. This upper steelyard is arranged as in Fig. 8, where A

C7

Fig. 8

is the point where the pull of the long body lever due to the weight of the goods on the platform comes upon the steelyard ; C is the fulcrum of the steelyard, which with the steelyard can be slid to and fro on the frame of the machine ; and Q is a poise

which can be slid 'along the upper bar of the steelyard. The steelyard is exactly in balance when there is no weight on the platform and Q is at the zero end of its run, at O. Suppose that

the weight of the goods on the platform is (p) lb, and that -th

n of this weight is transmitted by the long body lever to the point

P A, so that — lb is the pull at A. Let the lower bar of the steel- yard be graduated in equal divisions of length, d, each of which represents one penny, so that the distance GA=qxd represents q pence. Then the number p x q represents the total value of the goods on the platform. If Q lb be the weight of the poise Q, the position of Q when the steelyard is exactly in balance is

given by the equation xq. d=Q x OQ, or OQ=p xjx,. If

therefore the upper bar be graduated in divisions, each of which

is ——, the indication of the poise Q, viz., p x q graduations, gives

correctly the value of the goods. Thus to ascertain the value of goods on the platform of unknown weight at a given price per lb, it is only necessary to slide the steelyard till the weight acts at the division which represents the price per lb, and then to move the poise Q till the steelyard is in balance ; the number of the division which defines the position of the poise Q will indicate the sum to be paid for the goods. When the load on the platform is large, so that the value of the goods may be considerable, it is convenient to measure the larger part of the value by loose weights which, when hung at the end of the steelyard, represent each a certain money value, and the balance of the value is determined by the sliding poise Q.

In the machines commonly used to weigh loads exceed- ing 2 cwt. the power is applied at the end of the long arm of the steelyard and multiplied by levers from 100 to 500 times, so that the weights used are small and handy. The load is received upon four knife-edges, so that on the average each knife -edge receives only one -fourth of the load, and, as will be seen, it is immaterial whether the load is received equally by the four knife-edges or not, which is essential to the useful application of these machines.

In Fig. 9 AB is the steelyard. The platform and the load upon it are carried on four knife-edges, two of which, Xj and x%, are shown, and the load is transferred to the steelyard by the two

Fig. 9.

levers shown, the upper one CD being known as the " long body," and the lower one EF as the "short body." If zixl =z&>, and 2j« = s2j/2, then the leverage of any portion of the load applied at x2 will be the same as the leverage of any part of the load applied at x1 , and the pressure produced at y1 will be the same for equal portions of the load, whether they were originally applied at a^ or x. Platform machines, like steelyards, may be arranged either on the "accelerating " principle or on the " vibrating " principle. If in Fig. 9 gx be the centre of gravity of the long body CD, and /Sj be the centre of gravity of the three vertical forces acting down- wards at the points aS] , t , and g^ , considered as weights collected at those points ; then if Aj be above the line Sjj/j it can be shown that this

arrangement of the knife-edges of CD favours the "acceleration" principle, and is suited to act with and assist an "accelerating" steelyard, and similarly if the point A2 be above the line z^y^ in the case of the short body EF. If the knife-edges be placed so that hx and ft2 are below the lines x^y^ and x2y2

respectively, the arrangement will favour the "vibration" prin- ciple, and is suited to act with and assist a "vibrating" steelyard. It is very important that platform machines should be truly level. With accelerating machines a small amount of tilt in any

Elevation.

Plan with cover removed.

Section on AB.

Section on CD. Section on BP.

Fig. 10.

direction considerably affects the accuracy of the weighing, and when the amount of tilt is considerable the action may be changed, so that a machine which was intended to act as an accelerating machine acts like a vibrating one. Vibrating machines are only slightly affected by being out of level in comparison with accelerat- ing machines, and in this matter they have a distinct advantage. When a platform machine is in true adjustment, and the loose

weights which are intended to be hung at the end of the steel- yard are correct and consistent among themselves, » good and new machine, whose capacity is i cwt. , should not show a greater error than 4 oz. when fully loaded. Platform machines are slightly affected by changes of temperature. In some cases they are made "self-recording " by the

following arrangement : — The steelyard is provided with a large and a small travelling poise. Each of these poises carries a horizontal strip of metal, which is graduated and marked with raised figures corresponding to those on the steelyard itself. These strips pass under a strong punching lever arranged on the frame of the machine. A card prepared for the purpose is introduced through a slit in the frame between the punch and the strips. When the poises have been adjusted to weigh a load on the platform the punch is operated by a strong pull, and the im- pression of the raised figures is left on the card. Thus the weight is recorded without reading the positions of the poises. In another arrangement the self-recording parts are entirely enclosed in the travelling poise itself.

Fig. 10 shows the ordinary arrangement of the parts of a plat- form machine, but there are many types which differ greatly in detail though not in principle.

When the goods to be weighed are very heavy, portable weigh- bridges or platform machines are inapplicable and it is necessary to erect the weighbridge on a solid foundation. Some weigh- bridges are arranged in a manner similar to that of the platform machines already described, but having the long body lever turned askew, so that the end of it projects considerably beyond the side of the weighbridge casing, and the pillar and steelyard which receive its pull are clear of the waggon on the platform. In another arrangement two similar triangular levers take bearing on opposite sides of an intermediate lever which communicates their pressures to the steelyard ; this is a very sound and simple arrangement for ordinary long weighbridges. Lastly, when the weighbridge is very long — and they are sometimes made 40 feet long, and are arranged to weigh up to 100 tons or more — it is practically composed of two platform machines end to end, each having its four knife-edges to receive the load, and the two long bodies take bearing on the opposite sides of an intermediate

Fig. 11.

horizontal lever, the end of which is connected with the steel- yard. When skilfully made they are very accurate and durable.

A useful application of weighbridges is to ascertain the exact weights on the separate wheels of locomotive engines, so that they may be properly adjusted. For this purpose a number of separate weighbridges of simple construction are erected, one for each wheel of the engine, with their running surfaces in exactly the same horizontal plane. The engine is moved on to them, and the pressures of all the wheels are taken simultaneously, each by its own weighbridge.

There are many kinds of weighing machines depending for their action on combinations of levers, and arranged to meet special requirements. Such are coal platform machines for weigh- ing out coal in sacks, the levers of which are arranged as in the ordinary platform machines, but for the sake of compactness the steelyard is returned back over the long body, and when loaded with the proper weight indicates the correct weight of the coal in the sack by its end kicking up. Crane machines are used to weigh goods as they are hoisted by a crane ; the lever arrange- ment is shown in Fig. 11.

A crane machine of peculiar construction, well adapted for weighing heavy loads, and extremely simple and compact, which does not properly come under any of the heads under which the machines have been classified, is the hydrostatic weighing machine. This machine is constructed with an open top cylinder,

a stirrup strap being provided by which it may be suspended from a crane. The cylinder, which is filled with oil or other liquid, is fitted with a piston having a piston-rod passing downwards and terminating in an attachment for the goods to be weighed. As the goods are lifted by the crane the whole of their weight is taken by the liquid in the cylinder, and the pressure on the liquid, as indicated by a pressure gauge, gives the weight. The gauge has a plain dial, marked off to indications given by the application of standard tons and cwts. ; it could probably be read to about J per cent, of the load weighed.

Spring Balances.

For many purposes spring balances are the most con- venient of all weighing machines. They depend upon the extension of one or more spiral springs, and as this is proportional to the weight the graduation is very simple. The springs in general are accurate and uniform in their action, but as their range is necessarily

limited it is often convenient to indicate the extension (and consequently the load) by means of a small rack and pinion which give motion to an index on a dial plate. Thus the correctness of the indications depends upon the condition of the rackwork and upon the friction, which vary with the wear, and although the errors would not be large for the purposes for which such machines are gene- rally used, yet for satisfactory working they need to be tested with standard weights from time to time. The springs are also affected by temperature.

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(W. At.)

WEIGHTS AND MEASURES.

THIS subject may be most conveniently considered under three aspects — I. Scientific ; II. Historical ; and III. Commercial.

I. Scientific.

1. Units. — In the United Kingdom two systems of weights and measures are now recognized — the imperial and the metric. The fundamental units of these sys- tems are — of length, the yard and metre; and of mass, the pound and kilogram. The units of the imperial system have been referred to in an earlier volume of this work (Ency. Brit., vol. xxiv. pp.

~~478-79). Of the metric units international definitions have been stated as follows : —~~

~~(a) The unit of volume for determinations of a high degree of accuracy is the volume occupied by the mass of 1 kilogram of pure water at its maximum density and under the normal atmospheric pressure ; this volume is called litre.~~

~~(b) In determinations of volume which do not admit of a high degree of accuracy the cubic decimetre can be taken as equivalent to the litre ; and in these determinations expressions of volumes based on the cube of the unit of linear measure can be substituted for expressions based on the litre as defined above.~~

~~(c) The kilogram is the unit of mass ; it is equal to the mass of the international prototype of the kilogram.1~~

~~(d) The term " weight " denotes a magnitude of the same nature as a force ; the weight of a body is the pro- duct of the mass of the body by the acceleration of gravity ; in particular, the normal weight of a body is the product of the mass of the body by the normal acceleration of gravity. The number adopted for the value of the normal~~

~~cm~~

~~acceleration of gravity is 980-965 — r2-~~

~~2. Standards. — The metre (metre-a-traits) is represented by the distance marked by two fine lines on an iridio- platinum bar (t = 0° C.) deposited with the Standards Department. This metre (m.) is the only unit of metric extension by which all other metric measures of extension — whether linear, superficial, or solid — are ascertained.~~

~~The kilogram (kg.) is represented by an iridio-platinum standard weight, of cylindrical form, by which all other metric weights, and all measures having reference to metric weight, are ascertained in the United Kingdom.~~

~~1 Troisieme Conference Giniralc des Poids et Mesures. Paris, 1901. — Metric Units Com. Roy. Soc. 1898.~~

~~From the above four units are derived all other weights and measures (W. and M.) of the two systems.~~

~~The gallon is the standard measure of capacity in the imperial system as well for liquids as for dry goods.~~

~~In the United Kingdom the metric standard of capacity is the litre, represented (Order in Council, 19th May 1890) by the capacity of a hollow cylindrical brass measure whose internal diameter is equal to one-half its height, and which at 0° O, when filled to the brim, contains one kg. of distilled water of the temperature of 4° O, under an atmo- spheric pressure equal to 760 millimetres at 0° C. at sea level and latitude 45° ; the weighing being made in air, but reduced by calculation to a vacuum. In such defini- tion an attempt has been made to avoid former confusion of expression as to capacity, cubic measure, and volume ; the litre being recognized as a measure of capacity hold- ing a given weight of water.~~

~~For the equivalent of the litre in terms of the gallon, vide III. Commercial.~~

~~In the measurement of the cubic inch it has now been found that 2 the specific mass of the cubic inch of distilled water freed from air, and weighed in air against brass weights (A=8-13), at the temperature of 62° F., and under an atmospheric pressure equal to 30 inches (at 32° F.), is equal to 252-297 grains weight of water at its maximum density (4° O). Hence a cubic foot of water would weigh 62-281 lb avoir., and not 62-321 lb as at present legally taken.~~

~~For the specific mass of the cubic decimetre of water at 4° O, under an atmospheric pressure equal to 760 mm., Dr Guillaume and Dr Chappuis of the Comity Inter- national des Poids et Mesures at Paris (C.I.P.M.) have obtained 0‘9999707 kg.,8 which has been accepted by the committee.~~

~~The two standards, the cubic inch and the cubic deci- metre, may not be strictly comparable owing to a difference in the normal temperature~~

~~(Centigrade and Fahrenheit scales) of the two units of extension, the metre and the yard.~~

~~For the weight of the cubic decimetre of water, as deduced from the experiments made in London in 1896 as to the weight of the cubic inch of water, Professor D. Mendeleeff (Proc. Roy. Soc, 1895) has obtained the following results, which have been adopted in legislative enactments in the United Kingdom : —~~

~~2 Phil. Trans. Soy. Soc, 1892; and Proc. Roy. Soc., 1895. p. 143,~~

~~3 Proc. Vera. Com. Intern, des Poids et Mesures. 1900, p. 84. Congrcs International de Physique reuni a Paris en 1900.~~

~~WEIGHTS and MEASURES~~

~~805~~

~~Temperature on~~

~~the Hydrogen~~

~~Thermometer Scale.~~

~~Weight of Water in vacuo.~~

~~Of a Cubic~~

~~Decimetre in~~

~~Grammes.~~

~~Of a Cubic Inch in Grains.~~

~~Of a Cubic~~

~~Inch in~~

~~Russian DollB.~~

0.

F.

0°

4 15 161 20

32° -0

39-2 59-0 62-0 68-0

999-716 999-847 998-979 998-715 998-082

252-821 252-854 252-635 252-568 252-407

368-686 368-734 368-414 368-316 368-083

In this no account is taken of the compressibility of water — that is to say, it is supposed that the water is under a pressure of one atmosphere. The weight of a cubic decimetre of water reaches 1000 grammes under a pressure of four atmospheres ; but in vacuo, at all temperatures, the weight of water is less than a kilogram.

3. National Standards. — National standards of length are not legally now referred to natural standards or to physical constants,1 but it has been shown by Professor A. A. Michelson that a standard of length might be

Section of bar.

Section at a a'.

Fig 1. — Present Imperial Standard Yard, 1844. Total length of bronze bar, 38 inches ; distance as', 36 inches, or the imperial yard ; a a', wells sunk to the mid-depth of the bar at the bottom of each of which is inserted a gold stud, having the denning line of the yard engraved on it

restored, if necessary, by reference to the measurement of wave-lengths of light. Preliminary experiments have given results correct to ±0-5 micron, and it appears probable that by further experiments, results correct to ± 0"l/x may be obtained. That is to say, the metre might be re-determined or re- stored as to its length within one ten-millionth part, by reference to, e.g., 1553163-5 wave-lengths of the red ray of the spectrum of cadmium, in air at 15° C. and 760 mm.

In all countries the na- tional standards of weights and measures are in the cus- tody of the State, or of some authority administering the government of the country. The standards of the British Empire, so far as they relate to the imperial and metric systems, are in the custody of the Board of Trade. Scientific research is not, of course, bound by official standards.

For the care of these na- tional standards the Stan- dards Department was developed, under the direction of a Boyal Commission 2 (of which the late Mr H. W. Chisholm

1 Valeur du Metre, A. A. Michelson, Paris, 1894 ; Units, Everett, Illustrations of C.G.S. System ; Unites et Etalons, Guillaume, Paris, 1890 ; Lupton's Numerical Tables, 1892 ; Metric Equivalent Cards, 1901 ; Dictionary of Metric Measures, L. Clark, 1891 ; Glazebrook and Shaw's Physics, 1901.

a Report Standards Commission, 1870.

*■

J 1

>cu

Fig. 2. — Imperial Standard Pound, 1844.

Platinum pound avoirdupois, of cylindrical form, with groove at a for lifting the weight.

was a leading member), to conduct all comparisons and other operations with reference to weights and measures in aid of scientific research or otherwise, which it may be the duty of the State to undertake. Similar standardizing offices are established at Berlin, St Petersburg, Paris, Vienna, Borne, Madrid, Lisbon, Brussels, Bucharest, and Constantinople, as well as at Washington, Ottawa, Mel- bourne, and Sydney. In India the standards are kept at the branch mints of Calcutta and Bombay. Verified " Parliamentary Copies " of the imperial standard are placed at the Boyal Mint, with the Boyal Society, at the Boyal Observatory, and in the Westminster Palace.

The forms of the four primary standards representing the four units of extension and mass, already referred to (see Ency. Brit., vol. xxiv. p. 480), are shown in Figs. 1 to 4.

A secondary standard measure for dry goods is the bushel of 1824, con- taining 8 imperial gallons, represented by a hollow bronze cylinder having a plane base, its internal diameter being double its depth.

The imperial standard measure of capacity is a hollow cylinder (Fig. 5) made of brass, with a plane base, of equal height and diameter; which when filled to the brim, as de- termined by a plane glass disc, contains 10 lb weight of water at «=62° F.B. = 30 inches, weighed in air against brass weights.

4. Atmospheric Pressure, and Materials. — In the verification of a precise standard of length there may be taken into ac- count the influence of the variation of atmospheric pres- sure. Taking the range of the barometer in Great Britain from 28 to 31 inches, giving a difference of 3 inches (76

~~millimetres), which denotes a variation of 103 grammes per square centimetre in the pressure of the atmosphere, the change caused thereby in the length of a standard of linear measurement would appear to be as follows :—~~

~~For the yard measure of tlje form shown in Fig. 1 a difference of length equal to 0-000002 inch is caused by the variation of atmospheric pressure from 28 to 31 inches. For the metre of the form shown in Fig. 3 the difference in length for a varia- tion of 76 mm. in the barometer would be 0-000048 mm. on the metre.~~

~~With reference to the materials of which standards of length are made, it appears that the Matthey alloy iridio-platinum (90 per cent, platinum, 10 per cent, iridium) is probably of all substances the least affected by time or circumstance, and of this costly alloy, therefore, a new copy of the imperial yard has been made. There appears, however, to be some objection to the use of iridio- platinum for weights, as, owing to its great density (A=21‘57), the slightest abrasion will make an appreciable difference in a weight; sometimes, therefore, quartz or rock-crystal is used; but to this also there is some objection, as owing to its low density (A = 2-65) there is a large exposed surface of the mass. For small standard weights platinum (A=21”45) and aluminium (A = 2‘67) are used, and also an alloy of palladium (60 per cent.) and silver (40 per cent.) (A = 11 -00).~~

~~For ordinary standards of length Guillaume’s alloy [invar) of nickel (357 per cent.) and steel (64-3 per cent.) is used, as it is a metal that can be highly polished, and is capable of receiving~~

~~Fig.~~

~~3. — National Standard Metre, 1897.~~

~~Iridio-platinum .bar of Tresca section as Bhown at A. The two micro- scopic lines are engraved on the measuring axis of the bar at b, one near to each end of the bar. The standard metre (metre-a-traite) was supplemented by the delivery to Great Britain, in 1898, of an end standard metre (tnetre-a-bouts) also made of iridio-platinum, and also verified by~~

the C.I.P.M. A com- parison of the yard with the metre was made by the C.I.P.M. in 1896, and of the pound and kilogram in 1888-85 (see III. Commercial).

fine graduations. Its coefficient of linear expansion is only 0-0000008 for 1° O.1

5. Electrical Standards. — Authoritative standards and instruments for the measurement of electricity, based on the fundamental units of the metric system, have been placed in the Electrical Laboratory of the Board of Trade.2 These include

Current measuring /The standard ampere, and sub-standards

instruments. \ from 1 to 2500 amperes.

p , , . , ■ fThe standard volt, and sub-standards

• j. „ j. \ for the measurement of pressure from

instruments. | 25 to 3000 volts.

Resistance measuring fThe standard ohm. sub-standards up Resistance measuiingj 100,000 ohms, and below 1 ohm to

instruments. , ‘, ‘

I t*W ohm. %

6. Temperature. — In the measurement of temperature the Fahrenheit scale is still followed for imperial stan- dards, and the Centigrade scale for metric standards. At the time of the construction

of the imperial standards in 1844, Sheepshanks's Fahren- heit thermometers were used; but it is difficult to say now what the true

temperature then, of 62° F., may have been as compared with 62° F., or 16·667° C, of the present normal hydrogen scale. For metrological pur- poses the C.I. P.M. have adopted as a normal ther- mometry scale the Centri- grade scale of the hydrogen thermometer, having for fixed points the tempera- ture of pure melting ice (0°) and that of the vapour of boiling distilled water (100°), under a normal atmospheric pressure ; hydrogen being taken under an initial mano- metric pressure of lm', that is to say, at V°F presented by the weight of a column of mercury 760mm- in height; the specific mass of mercury being now taken as 13·5950, after Volkmann and Marek, and at the normal intensity followed under this pressure. The value of this

intensity is equal to that of the force of gravity at the Bureau Interna- tional, Paris (at the level of the Bureau), divided by 1·000332 ; a co- efficient which al- lows for theoretical reduction to the latitude 45° and to the level of the sea. The length of the metre is inde- pendent of the thermometer so far that it has its length at a definite physical point, the temperature of melting

Fig. 4. — National Standard Kilogram, 1897.

Fig. 5. — Present Imperial Standard Gallon, 1824.

1 Rapport da Yard, Dr Benoit, 1896.

2 Orders in Council, 1894.

ice (0° O), but there is the practical difficulty that for ordinary purposes measurements cannot be always carried 'out at 0° C.

The International Geodetic Committee have adopted the metre as their unit of measurement. In geodetic measure- ments the dimensions of the triangles vary with the tem- perature of the earth, but these variations in the same region of the earth are smaller than the variations of the temperature of the air, less than 10° C. Adopting as a coefficient of dilatation of the earth's crust 0·000002, the variations of the distances are smaller than the errors of measurement.

7. Standardizing Institutions. — Besides the State de- partments dealing with weights and measures, there are other standardizing institutions of recent date. In Ger- many, e.g., there is at Charlottenburg (Berlin) a technical institute (Physikalisch-technische-Reichsanstalt) established under Dr W. Forster in 1887, which undertakes researches with reference to physics and mechanics, particularly as applied to technical industries.3 In England a National Physical Laboratory (N.P.L.) has been established, based on the German institute, and has its principal laboratory af. Bushey House, near Hampton, Middlesex. Here is carried out the work of standardizing measuring instru- ments of various sorts in use by manufacturers, the deter- mination of physical constants, and the testing of materials. The work of the Kew Observatory, at the Old Deer Park, Eichmond, has also been placed under the direction of the N.P.L. (see in. Commercial).* The C.I.P.JI. at Paris, the first metrological institution, also undertakes verifica- tions for purely scientific purposes. A descriptive list of the verifying instruments of the Standards Department, London, has been published.5 In the measurement of woollen and other textile fabrics, as to quality, strength, number of threads, &c, there exists at Bradford a voluntary standardizing institution known as the Condi- tioning House (Bradford Corporation Act, 1887), the work of which has been extended to a chemical analysis of fabrics.

II. HlSTOBJCAL.

1. Standards of 1758-60.— A "troy pound" and a new standard yard, as well as secondary standards, were constructed by direction of Parliament in 1758-60, and were deposited with the Clerk of the House of Commons. When the Houses of Parliament were burned down in 1834, the pound was lost and the yard was injured. It may here be mentioned that the expression " imperial " first occurs in the Weights and Measures Act of 1824. The injured standard was then lost sight of, but it was in 1891 brought to light by the Clerk of the Journals, and has now been placed in the lobby of the residence of the Clerk of the House, together with a standard "stone" of 14 ft).6

2. Ancient Standards of England and Scotland. — In the measurement of liquids the old " wine gallon " (231 cubic inches) was in use in England

until 1824, when the present imperial gallon (Fig. 5) was legalized ; and the wine gallon of 1 707 is still referred to as a standard in the United States. Together with the more ancient standard of Henry VII. and of Queen Elizabeth, this standard is

3 Wissenschaftliche Abhcimllunrtcn drr fthysikalischen Keichsan- staltti Band ii., Berlin, 1900. ZknkscJirift betrcffend die Thatirjkeit di'.r K. Nor., Archangs Kommti., 1869-1900.

4 Treasury Committee on National Physical Laboratory, Parlia- mentary Paper, 1898.

5 Descriptive List of Standards and Instruments, Parliamentary Paper, 1892.

" Report on Standards deposited in House of Commons, 1st November 1891.

deposited in the Jewel Tower at Westminster. They are probably of the Norman period, and were kept in the Pyx Chapel at Westminster, now in the custody of the Commissioners of Works. A sketch of these measures is given in Fig. 6.1

Besides these ancient standards of England (1495, 1588, 1601) there are at the council chambers of Edinburgh and

Fig. 6.

A, Winchester Bushel of Henry "VII. ; B, Standard Hundredweight (112 ft) of Elizabeth ; C, Ale Gallon of Henry VII. ; D, the old Wine Gallon.

Linlithgow some of the interesting standards of Scotland, as the Stirling jug or Scots pint, 1618 ; the choppin or half-pint, 1555 (Fig. 7) ; the Lanark troy and tron weights of the same periods (Fig. 8).2

Fig. 7. — The Scots Choppin or Half-Pint, 1555.

Fig. 8. — Lanark Stone Troy Weight, 1618.

3. Standards of the East. — Arabic glass weights of ancient origin are preserved at the British Museum, and many of the coin cabinets of Europe contain a few glass discs closely resembling such Arabic coins in size, weight, and inscription. Of these a catalogue has been prepared by Mr Stanley Lane Poole.3 These ancient weights are in the form of small glass discs used by the Arabs (a.d. 717 to 1130) mainly in testing the accuracy of current coins, and have sometimes inscribed on them benedictory phrases, as well as the denominations of the coins whose weights they represent — as, ‘ ‘ God's measure ” (translated) ; ” God ordains honesty ” ; ” weight ofdeenar,” “weight of nine keerats,” ” kharroobeh, ” “dirhem,” “fels,” &c. Closely allied to glass weights are the curious glass stamps found on measures of capacity and wine vessels (a.d. 870- 932), known as bottle stamps, inscribed “kist,” &c.

In connexion with the most ancient use of gold, the cow or ox unit has been followed in measuring value in primitive times. Professor Ridgeway has set out in an interesting treatise the origin of metallic currency. He states the values of the primitive cow or ox unit, which formed the first gold unit, in the weight standards, to be as follows : 4 —

Ox unit-

-Homeric ; Roman = Sicilian Ancient “\ German /

= 1301t°135 Grains

- 35 \ of ” 135 gold.

120 ;

1 The Art Journal, August 1900, Mr S. Fisher.

2 Ancient Scotch Standards, Buchanan.

3 Catalogue of Arab Glass Weights, S. Lane Poole, 1891.

4 Origin of Metallic Currency, Prof. Ridgeway, Cambridge, 1892.

Relative to the uncertain connexion of length, capacity, and weight in the ancient metrological systems of the East, Sir Charles "Warren, R.E., F.R.S., has obtained by deductive analysis a new equivalent of the original cubit.6 He shows that the length of the cubit arose through the weights ; that is to say, the original cubit of Egypt was based on the cubic double — cubit of water — and from this the several nations branched off with their measures and weights. For the length of the building cubit Sir C. Warren has deduced a length equivalent to 20'6l6§ English inches, which compares with a mean Pyramid cubit of 20 '6015 inches as hitherto found. By taking all the ancient cubits, there appears to be a remarkable coincidence throughout with 20-6109 inches.

Sir C. Warren has derived a primitive unit from a proportion of the human body, by ascer- taining the probable mean height of the ancient people in Egypt, and so thereby has derived a standard from the stature of man. The human body has furnished the earliest measure for many races,6 as the foot, palm, hand, digit, nail, pace, ell (ulna), &c. It seems probable, therefore, that a royal cubit may have been derived from some kingly stature, and its length perpetuated in the ancient buildings of Egypt, as the Great Pyramid, &c.

So far this later research appears to confirm the opinion of Bockh that fundamental units of measure were at one time derived from weights and capacities. It is curious, however, to find that an ancient nation of the East, so wise in geometrical proportions, should have followed what by modem experience may be regarded as an inverse method, that of ob- taining a unit of length by deducing it through weights and cubic measure, rather than by deriving cubic measure through the unit of length.

A curious Babylonian weight has been added to the collec- tion of the British Museum, bearing an inscription in cuneiform : " One maneh standard weight, the property of Merodach-sarilami, a duplicate of the weight which Nebuchadnezzar, king of Babylon, the son of Nabopollassar, king of Babylon, made in exact accord- ance with the weight (prescribed) by the deified Dungi, a former king." (By Professor

Sayce, Academy, 19th December 1891.) Dungi lived about 3000 B.C. Professor W. M. Flinders Petrie has found this weight to be equal to 15,097 grains, and estimates that its original weight was 15,112 grains. It is a green stone weight of conical form, and was found in Egypt.

III. Commercial.

1. Denominations. — The denominations of trade weights and measures at present used in the United Kingdom are represented by "Board of Trade standards," by which are regulated the accuracy of the common weights and measures handled in shops, (fee. : 7 —

Imperial Measures of Length. — 100 feet, 66 feet or a chain of 100 links, rod, pole, or perch, measures from 10 feet to 1 foot ; 18 inches ; yard of 36 inches, \, J, J, rV yard, nail, inch, and duodecimal, decimal, and binary parts of the inch.

Imperial Measures of Capacity. — Liquid measures from 32 gallons to 1 gallon, quart, pint, \ pint, gill, \ gill, J gill. Dry measures of bushel, \ bushel, peck, gallon, quart, pint, \ pint.

Apothecaries' Measures. — 40 fluid ounces to \ fl. oz., 16 fluid drachms to \ fl. dr., 60 minims to 1 minim.

Avoirdupois Weights. — Cental (100 lb), 56 lb (\ cwt.), 28 lb, 14 lb (stone), 7, 4, 2, 1 ft ; 8, 4, 2, 1, i ounce (8 drams) ; 4, 2, 1, \ drams.

Troy Weights. — The ounce (480 gr.) and multiples and decimal parts of the ounce troy from 500 ounces to O'OOl oz.

Apothecaries' Weights. — -10 oz. to 1 oz. (480 gr.) ; 4 drachms to \ oz. ; 2, 1 drachms ; 2 scruples to \ scruple ; and 6 grains to f grain.

Pennyweights. — -20 dwt. (480 grains), 10, 5, 3, 2, 1 dwts.

Cmin Weights. — iOOO, 2000, 1000 gr. (making 7000 gr. or 1 ft), 500 to 0-01 gr.

~~2. The international trade metric weights and measures (1897) handled in shops, &c, of which there are also Board of Trade standards, are set out as follows, and illustrations of these are given in Fig. 9 : —~~

~~Quarterly, April, July, October,~~

~~6 Palestine Exploration Fund~~

~~1899~~

~~The Coming of the Kilogram, H. O. Arnold-Forster, 1898. 7 Board of Trade Model Regulations, 1892 ; Weights and Measures Acts, 1878, 1889, 1892, 1893.~~

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~~WEIGHTS and MEASURES~~

~~Length, — Decametre or 10 metres; double metre; metre or 1000 millimetres; decimetre or 0”1 metre; centimetre or 0 01 metre ; millimetre.~~

~~Capacity. — 20 litres ; 10 litres or decalitre ; 5, 2, 1, 0‘5, 0-2, 0-1 (decilitre) ; 0-05, 0‘02, 0‘01 (centilitre) ; 0-005, 0-002, 0-001 (millilitre) litres.~~

~~Cubic Measures. — W0Q (litre), 500, 200, 100, 50, 20, 10, 5, 2 cubic centimetres, 1 c.c. or 1000 cubic millimetres.~~

~~Weights. — 20, 10, 5, 2, 1 kilograms ; 500 to 1 gramme ; 5 to 1 decigram ; 5 to 1 centigram ; 5 to 1 milligram. (Series 5, 2, 21, 1, i.e., with a duplicate weight of ” 2.”)~~

~~3. Equivalents. — The metric equivalents of the units of the metric system in terms of the imperial system, as recalculated in 1897, are as follows : 2~~

~~=~~

~~METRE divided into Decimetres, Centimetres, and Millimetres.~~

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~~Fig. 9.— International Metric Trade Weights and Measures, 1897. A, Linear; B, Capacity; C and D, Weights.~~

~~Imperial to Metric.~~

~~1 yard =~~

~~1 square yard =~~

~~1 cubic inch =~~

~~1 gallon 1 =~~

~~1 pound (7000 grains) =~~

~~1 ounce troy (480 gr.) = 1 fluid drachm 1 fluid ounce~~

~~0 0~~

~~16 4 0~~

~~31~~

~~= 2~~

~~■914399 m. •836126 m2. •387 c.c. •5459631 1. •45359243 kg. ■1035 grammes. ■552 millilitres (ml.). •84123 centilitres (cl.).~~

~~1 The equivalent of the litre in gallons may also be derived as follows : — —~~

~~Let~~

~~HM1!)~~

~~where P is the weight of the water contained in the gallon when weighed in London—~~

~~g. London =g. Paris (45°) x 1-000577. The correction for temperature, 62° F., is — 0 '0906 in. ; hence 29'9094 inches. One inch = 25-4 mm.~~

~~29-9094 x 26-4 = 759-69876. 759-698761- x 1-000577 = 760-137 mm. P1 is the weight of the brass weights (10 Th) A = 8'143. p, the density (0-001218738) of dry air, containing 4 vols, of car- bonic acid in 10,000 vols.; £ = 16-667° C. ; B = 760-137 mm. of~~

~~1 metre (m.) at 0° C. 1 square metre (m2) 1 cubic; decimetre (c.d.)~~

~~or 1000 cubic centimetres (c 1 litre (1.) 1 kilogram (kg.)~~

~~1 gramme (g.)~~

~~Metric to Imperial.~~

~~39-370113 inches at 62° 10-7639 square feet.~~

~~F.~~

~~J-~~

~~61-024 cubic inches.~~

~~17598 pints. 2-2046223 lb avoir. 4323564 grains or 7716 scruple.~~

~~Z Z'~~

~~ris-~~

~~1 0-7~~

~~mercury at 0°, lat. 45° and at sea-level. Coefficient of expansion of air = 0-00367 ; A mercury at 0° C. = 13'595.~~

~~d is the density of water at 62° F. (16-667° C.) = 0-9988611. dl, the density of the brass as above.~~

~~10 lb = 4-5359243 kg. From the above it follows that~~

P = 4-5407857 kg.

Therefore — , p

1 gallon =

0-9988611

= 4-5459631 litres. 2 Metric Equivalents, King's Printers, 1898.

WEIGHTS and MEASURES

809

The equivalents of the Kussian weights and measures, in terms also of the imperial and metric weights and measures, were re-calculated in 1897.1 The following are the leading equivalents : —

C 0-025 pood. 1 Russian pound = J. 96 zolotniks.

(9216dolis. = 0-40951240 kg. = 0-90282018 lb avoir.

{0-00066 verst. °'SvaJctk, 280 liniias." = 0711200 metre. = 0-777778 yard.

] vedro = (10 sehtoffa

\ =100 tcharkas

= 12-299 litres

= 2-7056 gallons. 1 tohetverte = 8 tohetveriks

= 2-0991 hectolitres

= 5-7719 bushels.

4. Local Control. — The necessary local inspection and verification of weights and measures in use for trade (as distinct from the verbal and written use of weights and measures) is in the United Kingdom

undertaken by inspectors of weights and measures, who are appointed by the local authorities, as the county and borough councils. An inspector is required to hold a certificate of qualification, and for his guidance general regulations are made by his local authority as to modes of testing weights, measures, and weighing instruments.2 In Europe the local inspection is generally carried out through the State, and a uniform system of local verifi- cation is thereby maintained.

5. Errors. — In the verification of weights and measures a margin of error is permitted to manufacturers and scale-makers, as it is found to be impossible to make two weights, or two measures, so identical that between them some difference may not be found either by the balance or the microscope. For common Weights and measures this margin (tolerance, remedy, or allowance, as it is also called) has been set out by the Board of Trade for all the various kinds of weights and measures in use for commercial purposes in the United Kingdom, and similar margins of error are recognized in other countries. For instance, on 1 lb avoir, weight made of brass, 2 grains in excess are allowed ; on 1 oz. troy or apothecaries' weight, +0-2 grain is allowed ; on 1 pint pot, 4 fluid drachms is permitted ; on 1 brass yard, 0-05 inch in excess or 0'02 inch in deficiency in length is allowed for ordinary trade purposes.

6. Foreign Weights and Measures. — Throughout the British Empire the imperial system of weights and measures is legal.

In Eussia, as in the United Kingdom and the United States, the national weights and measures are followed (§ 3 above), although the use of metric weights and measures is permissive.

In India the native weights,

In standardizing a weight for use in India, correction has to be made for the weight of air displaced by the material standard, and for such purpose the normal temperature of 85°, atmospheric pressure

29-8 inches, latitude 22° 35' 6-5" (Calcutta), g= |4|'0-0-9982515 j

are taken. The "tola" (180 grains) is properly the Government unit of weight for currency ; and 80 tolas make the " Government

1 G.I.P.M. Proc&s-Verbaux, 1897, p. 155.

2 Regulations, Birmingham, Glasgow, London, Manchester, &c.

7. Customary Weights and Measures. — In some dis- tricts of the United Kingdom, as well as in provincial districts of other countries, old local and customary denominations of weights and measures are still found to be in use, although their use may have been prohibited by law. So powerful is custom with the people.3

8. Legislation. — In everyday transactions with refer- ence to weights and measures, the British legislature also exercises control in industrial pursuits. For instance, in weighing live cattle, owners of markets are now required to provide adequate accommodation.4 Useful statutes have also been passed to protect the working class, as in checking the weighing instruments used in mines in Great Britain, over which instruments wages are paid, and in the inspection of similar instruments used in factories and workshops. The Merchandise Marks Act, 1887, makes it an offence also to apply in trade a false description, as to the number, quantity measure, gauge, or weight of goods sold; and this Act appears to reach offences that the Weights and Measures Acts may perhaps not reach.

9. Pharmaceutical Weights and Measures. — By the Medical Act of 1858, and the Act of 1862, the General Council of Medical Education and Kegistration of the United Kingdom are authorized to issue a " Pharma- copoeia " with reference to the weights and measures used in the preparation and dispensing of drugs, &c. The British Pharmacopoeia issued by the Council in 1898 makes no alteration in the imperial weights and measures required to be used by the Pharmacopoeia of 1864. For all pharmaceutical purposes, however, the use of the metric system alone is employed in all paragraphs relating to analysis, whether gravimetric or volumetric. For measures of capacity the Pharmacopoeia continues to use imperial measuring vessels graduated at the legal temperature of 62° F. The official names of the metric capacity units are defined at 4° C, as

generally on the Continent. The new Pharmacopoeia also follows foreign practice, and employs metric measures of capacity and volumetric vessels gradu- ated at 15·5° C, or 60° F. Specific gravity bottles are also adjusted at 60° F., the figures indicating specific gravities being quotients obtained by dividing in each instance the weight of the solid or liquid by the weight of an equal bulk of water, both taken at 60° F.5

10. Gauges. — " Gauges, " as understood at one time, included only those used in the measurement of barrels, casks, &c, and hence the term ' ' gauger. " For engineering and manufacturing purposes the more important linear gauges are, however, now used, adjusted to some fundamental unit of measure as the inch ; although in certain trades, as for wires and flat metals, gauges continue to be used of arbitrary scales and of merely numerical sizes, having no reference to a legal unit of measure ; and such are rarely accurate. A standard gauge, however, exists (Order in Council, August 1883), based on the inch, but having numbered sizes from 7/0 (0'5 inch) to No. 50 (0·001 inch) to meet the convenience of certain trades.6

11. Screws. — The screw is an important productive measuring instrument, whether used as a micrometer-screw of less than an inch in length, or as a master-screw of 20 feet in length. The probable errors and eccentricities of small micrometer-screws have been carefully investigated to + 0 -00001 inch ; but the accuracy of leading screws used in workshops has not been sufficiently verified. For some engineering purposes it would appear to be desirable to produce master-screws to an accuracy of i0\6 of an inch to the foot of screw, so as to serve indirectly for the verification of ' ' guiding- screws " for general use in workshops.7 Attempts in this direction

3 Report Select Committee, 1892 ; Merchant's Handbook, W. A. Browne, 1892 ; Reports H.M. Representatives Abroad, Foreign Office,

1900-1901.

4 Markets and Fairs (Cattle) Acts, 1887, 1891 ; Coal Mines Regula- tion Act, 1887 ; Factory and "Workshop Act, 1878.

5 Pharmacopma, 1901 ; Calendar Pharmaceutical Society, 1902.

6 Order in Council, 26th August 1881.

7 SysUmatique des Vis horlogeres, Thury, Geneva, 1878. Bulletin Soc. d'Encouragement pour l'lndustrie Nationale, Paris, 1894. Report of British Association on Screw-threads, 1900.

were originally made by Whitworth, Clement, Donkin, Rogers, Bond, and others, but we still need a higher accuracy in screw-threads.

12. Educational. — Ordinary arithmetic books often contain refer- ences to local and customary weights and measures and to obsolete terms of no practical use to children. It appears to be desirable, as the Committee of Council on Education have done, to recognize only the legal systems of weights and measures — the imperial and metric. The Education Code of Regulations for 1900 prescribes that the tables of weights and measures to be learned include those only which are in ordinary use, viz., in all classes or forms above the third the tables of

(Weight — ton, cwt., stone, lb, oz., and dr.,

.j Length — mile, furlong, rod or pole, chain, yd., ft., and inch, [Capacity — quarter, bushel, pk., gall., qt., and pt.

In Code standards above the fifth, in addition to the foregoing, the tables of

/Area — sq. mile, acre, rood, pole, yd., ft., and inch, \ Volume — cubic yard, foot, and inch.

Instruction in the principles of the metric system, and in the advantages to be gained from uniformity in the method of forming multiples and sub-

~~multiples of the unit, are, under this Code, to be given to the scholars in Standards IV., V., VI., and VII. As a preparation for this it is stated in the Code that it will be useful to give in Standard III. (arithmetic) elementary lessons on the nota- tion of decimal fractions.~~

~~(h. J. o.)~~

~~Table of the Principal Foreign Weights and Measures now in use, and of their Equivalents in Imperial or in Metric Weights and Measures.~~

~~Almude . .~~

~~Portugal~~

~~16·8 litres.~~

~~Anoman . .~~

~~Ceylon . .~~

~~0 '699 quarter (dry measure).~~

~~Ara ....~~

~~Italy . . . Turkey . .~~

~~1 metric are.~~

~~Arehin, or Ar-~~

~~1 new arehin (Law 1881) =1 metre~~

~~shin~~

~~(39 '37 inches) = 10 parmaks (de- cimetres). 1 parmak = 10 khats (centimetres). 1 mill = 1000 ar- chins (kilometre). Pharoagh = 10 mills. Another pharoagh = 2 hours' journey.~~

~~Arehin . . .~~

~~*Bulgaria*~~

~~*0‘758 metre (masons). 0‘680 metre (tailors).*~~

~~*Archine, or Ar-*~~

~~*Russia . .*~~

~~*28 inches, or 07112 metre.*~~

~~*chinne*~~

~~*Ardeb . . .*~~

~~*Egypt . .*~~

~~*5 ‘447 bushels (Customs). 5 bushels (old measure).*~~

~~*Are ....*~~

~~*= 100 sq. metres = 119 ‘6 sq. yds.*~~

~~*Area . . .*~~

~~*Spain . .*~~

~~*1 metric are.*~~

~~*Arpent . . .*~~

~~*France . .*~~

~~*1 Legal arpent was equal to 100 sq.*~~

~~*Canada .*~~

~~*-! perches = 51 ‘07 metric ares. In (, Quebec = 180 French feet.*~~

~~*Arroba . .*~~

~~Portugal . .~~

~~14‘68 to 15 kilogrammes.~~

~~Spain . .~~

~~Mayor = 3 ‘55 gallons, or 1 cantara.~~

~~Artaba . . .~~

~~Persia . .~~

~~1-809 bushel. Menor = 2-76 gallons (liquids).~~

~~Aune . . .~~

~~Belgium . .~~

~~1 metre. Formerly 1 -312 yard.~~

~~France .~~

~~1-885 metre (1812).~~

~~Jersey . .~~

~~4 feet.~~

~~Barilo . . .~~

~~Rome~~

~~12-834 gallons.~~

~~Bat, or Tical .~~

~~Siam . . .~~

~~234 grains.~~

Batman . .

Persia

6J lb. av. ; varies locally.

Turkey .

= 10 ocks.

Behar . . .

Arabia .

439-45 lb. av., nearly.

Berri

Turkey . .

1 -084 mile (old measure).

Boisseau . .

Belgium .

15 litres.

Boutylka . .

Russia . .

1 -353 pint (wine bottle).

Braca .

Portugal

2 '22 metres.

Braccio . . .

Spain

0-670 metre (commercial).

Rome

Braccio-d' ara = 29 '528 inches.

Brasse . . .

France .

5-328 feet.

Braza .

Argentina .

5-682 feet.

Bu, or tsubo .

Japan . .

3'0306 square metres.

Bushel . .

U. States .

(" 2150-42 cubic inches, about 0-96944

Canada .

j imperial bushel. 1 bushel = 8 (, gallons = 32 quarts = 64 pints. 2 '471 acres (old hectare).

Bunder . . .

~~*Netherlands*~~

~~*Cabot . . .*~~

~~*Jersey .*~~

~~*10 pots, or 4 gallons, 1 quart 3 gills imperial measure.*~~

~~*Candy . . .*~~

~~*Bombay . .*~~

~~*560 lb. av.*~~

~~*Madras*~~

~~*493-7 lb. av.*~~

~~*Cantar . . .*~~

~~*Turkey .*~~

~~*124-7 lb. av. (old weight).*~~

~~*Cantara piccolo*~~

~~*Italy . . .*~~

~~*74-771 lb. av.*~~

~~*Capicha . .*~~

~~*Persia . ‘.*~~

~~*0-58 gallon.*~~

~~*Catty . . .*~~

~~*China*~~

\ lb. av. See Tad.

N. Borneo .

l\ lb. av.

Siam .

2-675 lb. av., or -jV hap.

Cawnie . . .

Madras .

1-322 acre.

Cental . . .

U. States . Canada .

j-100 lb. av. (As in Great Britain.)

Centigramme .

= t^ grm. = 0-154 grain. = rihr litre = 0-07 gill.

Centimetre

= 0-394 inch = T^ m.

Centimetre, cubic (c.c.) . .

= 0‘061 cubic inch, or 1 c.c.

= 0-155 square inch.

Centner . .

Austria .

~~110-231 lb. av.~~

~~Denmark .~~

~~50 kilogrammes.~~

~~Switzerland~~

~~60 kilogrammes.~~

~~Chain . . .~~

~~Canada~~

~~. 66 feet.~~

~~Cyprus~~

~~. 0-33 pic.~~

~~Chang . . .~~

~~China~~

~~. 10 ch'ih = 141-0 inches (Treaty).~~

~~Siam .~~

~~. 2-675 lb.~~

~~Chapah . . .~~

~~N. Borneo . If lb. av.~~

~~Chee. See Tahil.~~

~~Chek . . .~~

~~Hong Kong. 14g inches.~~

~~Chenica . .~~

~~Persia~~

~~. 0-289 gallon.~~

~~Ch'ien . . .~~

~~China~~

~~. 58J grains (silver weight).~~

~~. Varies throughout China from 11~~

~~Ch'ih . . .~~

~~China~~

~~to 15 '8 inches. For Custom*~~

~~purposes the Treaty ch'ih =14'1~~

~~inches, and 5 ch'ih = 1 pu.~~

~~Peking~~

~~— 12') fPu° works.~~

~~= 12-4 statistics.~~

~~= 12'6 architects.~~

~~= 12'7 common.~~

~~= 13'1 tribunal of mathematics.~~

~~Shanghai~~

~~. 13-2 Board of Revenue. 14'1 Customs.~~

~~Chilogramme .~~

~~Italy .~~

~~. 1 kilogramme.~~

~~Chin or Catty~~

~~China~~

~~. 1J lb. av. (Treaty).~~

~~Ching . .~~

~~China~~

~~. 121 sq. feet (Treaty).~~

~~Ch'ing . . .~~

~~China~~

~~. 72,600 sq. feet (Treaty).~~

~~Chittaek . .~~

~~Bengal~~

~~. 5 tolas, or 900 grains.~~

~~Ch'ok . . .~~

~~Corea~~

~~. 7| in. (linear); 12J in. (build-~~

~~Chuo . . .~~

~~China~~

ing)' . 1815 sq. feet (Treatv).

Chupah . .

Singapor

; . 1-66 lb. av. of water at 62° F., as a measure of capacity.

Malacca

144 oz. av. of water.

Chupak . .

Straits S(ments

ttle- 8 gills.

Collothun . .

Persia

. 1-809 gallons.

Coss ....

Bengal

. 1‘136 metre.

Covado . . .

Portugal

. 0-6(5 metre.

Covid, or Cubit

Madras

. 18 to 21 inches.

Bombay

. 18 inches.

Siam .

. 18 inches.

Covido . . .

Arabia

. 18 inches approximately.

Covido (Great)

27 inches.

Cuartillo . .

Spain

. 1-16 litre (dry) ; 0-504 litre (liquid^

Daktylon (Royal) Greece Daribah . . Egypt Decagramme ....

Decalitre

Decametre

Ddc'fatina . . Russia Decigramme ....

Decilitre

Decimetre

Decimetre, cubic . . . Decimetre, square Denaro . . . Rome Deunam . . Turkey Diraa, or Draa, "I t, or Pic 'JEsypt

Turkey

Dirhem .

Egypt

Djerib . . . Turkey .

Dol'ia, or Dola Russia .

Drachma . . Netherlands Turkey .

1 centimetre.

~~43-58 bushels (Customs).~~

~~10 grms. = 5 '64 drams av.~~

~~= 10 litres = 2'2 gallons.~~

~~= 10-936 yards.~~

~~= 2400 square sagenes.~~

~~=tV grm. = 1-54 grain.~~

~~=tV litre = 0-1 76 pint.~~

~~= 3-937 inches = 0-l metre.~~

~~= 1000 o.c. = 61-024 cub. in.~~

~~= 100 sq. centm. =15-5 sq. in.~~

~~18-17 grains (old weight).~~

~~1 metric are.~~

~~(27 inches usually. 21-3 inches Nile measure. 27 inches (old measure of~~

~~pike). 1'761 dram av. (Customs). 3-0884 grammes (Cairo). 1 hectare. 1 0-686 grain. (.96 doli=l zolotnick. 3-906 grammes. 154-324 grains.~~

~~WEIGHTS and MEASURES~~

~~Drachma (Royal) Greece . . 1 gramme (gold weight).~~

~~Constantinople = 57 871 grains. Bee Och, Dram. See Oke.~~

~~Ducat . . . Vienna . . 53-873 grains. Duim . . . Netherlands 1 centimetre.~~

~~Eimer . El . . , Ell . . , Ella . . Elle . . Endaseh, > Hindazl~~

~~*Faltche .*~~

~~*Pass . . Feddan .*~~

~~*Fen . . . Fjerdingkar Fod . . .*~~

~~*Foglietto . Foot . .*~~

~~*Fot*~~

~~*Austria . . Netherlands Jersey . . N. Borneo . Switzerland Egypt . .*~~

~~*Moldavia Argentina Portugal Spain ■ Peru . .*~~

~~*Germany Egypt .*~~

~~*China . . Denmark . Denmark . Norway . . Rome*~~

~~*TJ. States . Canada Amsterdam . \ South Africa/ Old Rhenish Sweden .*~~

~~*12-448 gallons.*~~

~~*1 metre. (Old ell=27‘08 inches.)*~~

~~*4 feet.*~~

~~*1 yard.*~~

~~*0-6561 yard.*~~

~~*Usually 25 inches.*~~

~~*Founte, orFunt, Russia*~~

~~*or Livre Foute, or Pied Frasco . . . Fuss ….*~~

~~*1 hectare, 43 ares, 22 centiares.*~~

~~*3-773 bushels.*~~

55-364 litres.

1-526 bushel.

1J bushel.

1-615 acre, but varies locally.

1 hectolitre.

1-038 acre (Masri). Also 1 -127 acre

locally. 1-266 acre (old). 5-83 grains (silver weight). 0-9564 bushel. 1-0297 foot. 0-3137 metre. 0-8 pint. 12 inches. French foot=12-8 inches.

n‘147in-lold measure.

12-356 in. J

11-689 in. 10 fot=l stong. 1 ref

= 10 stanger. 1 mil = 360 ref. 0-90282 lb. av.

Russia . . Argentina . Vienna . Switzerland

1 English foot. 2| litres.

12 zolls= 1-037 foot. 3 J fuss=l metre. See Stab.

Gallon . Gantang

Garnetz . . . Gin. See Kati. Gisla . . . Go ... . Grain . . . Gramme (gr.) .

U. States . (“231 cubic inches=8‘3389 lb. av. Canada . . \ of water at t. 39‘8° Fahr. At

62° Fahr. =0-8325 imp. gallon. Straits Settle- 32 gallons.

ments N. Borneo . 144 oz. av. weight of water as

~~measure of capacity. Russia . . 0-3607 peck.~~

~~Zanzibar Japan Russia .~~

~~Gramme' (Royal)~~

~~Gramo~~

~~Grano~~

~~Grao~~

~~Grein~~

~~Guz .~~

~~Greece . .~~

~~Spain~~

~~Rome~~

~~Portugal~~

~~Netherlands~~

~~India : Bengal , , Bombay „ Madras~~

~~Persia . .~~

~~Arabia . .~~

~~Measure of 360 lb. av. of rice.~~

~~180-39 cubic centimetres.~~

~~0-960 grain (apothecaries).~~

~~= 15-4323564 grains av. troy.~~

~~=0-2572 drachm, or 0-7716 scruple.~~

~~0-03215 oz. troy.~~

~~1 millimetre.~~

~~1 gramme.~~

~~0-757 grain.~~

~~0‘768 grain ; also measure 0‘18 in.~~

~~= 0‘065 gramme.~~

~~36 inches.~~

~~27 inches.~~

~~33 inches, Government Survey.~~

~~The guz, gueza, or zer varies from 24 to 44 inches. A guz of 40 ‘95 inches (Guz, Azerbaijan) is com- mon. Government standard guz=36| inches. There is a guz for retail trade of 25 inches.~~

~~25 inches to 37 inches (Bassorah).~~

~~Hat’h, or Moo-/Bengal . . 18 inches.~~

~~lum, or Cubit \ Bombay . . 18 inches, or cubit.~~

~~Hectare =100 ares, or 2-471 acres.~~

~~Hectogramme 100 grm. = 3-53 oz. av.~~

~~Hectolitre 100 litres = 2‘75 bushels.~~

~~Hectometre =109-36 yards.~~

~~Hiyaka-me . Japan . . 5797-198 grains.~~

Hiyak-kin . . Japan . . 132£ lb. av. Hoon. See To-

hil.

Hu .

Immi-Joch

Kaima Kan .

China . . 12-J gallons, nearly.

Switzerland 1 -5 litre.

Austria- Hun- 1 -422 acre, gary

Kanne or Kanna

Kantar, or Can- taro

Sweden . Netherlands Hong Kong Germany Sweden . . Egypt . .

***Karwar . . Kassabah . . Kati, Catty, or / Gin ***

Keila, or Pishi Ken . . . Kerat . . .

Kette, or Chain

Keu . . .

Khat (New) .

Kile . . .

Killow . . .

Kilogramme . Kilometre .

Kin . . . .

~~*Klafter . . .*~~

~~*Koddi . . . Koilon (Royal)*~~

~~*Koku . . . Kon. . . . Korn-tonde*~~

~~*Kom-top Maal Korrel . Kotyle (Royal) Kouza . . Koyan . . . Krina . . . Kung . . . Kup .... Kwan or Kuwan Kyat . . .*~~

~~*Lak't . . . Last .*~~

~~*Leang .*~~

~~*Lekha .*~~

~~*Li' . .*~~

~~*Persia . . Egypt . . China, Straits Settlements Zanzibar Japan Turkey . .*~~

~~*Germany*~~

~~*Siam . . .*~~

~~*Turkey . .*~~

~~*Cyprus . .*~~

~~*Turkey . .*~~

~~*Japan . . Austria . . Switzerland Arabia . . Greece . .*~~

~~*Japan*~~

~~*Corea . . Norway , . Sweden . Norway . . Netherlands Greece Cyprus . Straits Setts. Bulgaria . China Siam .*~~

~~*Burma . .*~~

~~*Bulgaria. Netherlands China Bulgaria . China . .*~~

~~Liang . . Libbra . . . Libra . . Libra (Castilian) Libra, or Ar-~~

~~ratel Line or Ligne . Liniia . . . Litra (Royal) . Litre . . . Litre (metric) . Litro . . .~~

~~China . . Italy . . Argentina . Spain . . Portugal~~

~~Paris . Russia Greece Cyprus~~

~~Livre (lb) . .~~

~~Livre-poids Lotli . .~~

~~Maass~~

~~Maatze Mace~~

~~Mahud~~

~~:]~~

~~Spain Italy Russia~~

~~Belgium~~

~~France~~

~~Germany~~

~~Switzerland Vienna . .~~

~~Austria . Switzerland Netherlands China N. Borneo Arabia . .~~

~~0-576 gallon.~~

~~1 litre.~~

~~1J lb. av.~~

~~1 litre, or formerly 1 “762 pint.~~

0-576 pint.

99-0492 lb. av. = 100 rotls (Cus- toms). 45 kilogrammes of cotton. 44 '5 kilogrammes other produce.

100 batman.

3-8824 yards (Customs).

[lj lb. av.

Measure of 6 lb. av. of rice.

l"Si metre.

1| inch measure (old).

3'09 grains weight (old).

14-994 ellen, or 10-936 yards.

40 inches.

1 centimetre.

8 gallons. 0-97 bushel.

1000 grin. = 2-2046223 lb. av.

= 0-6214 mile.

0-601 kilogramme.

= 2-0740 yards.

1-9685 yard.

1-67 gallon.

1 hectolitre. Old koilon=33-16

litra. = 10 to. 1J lb. av. 138-97 litres. 3-821 bushels. 160 litres. 1 decigramme. 1 decilitre.

9 quarts. 5333J lb. av. 12-8 litres.

78-96 inches (Treaty).

10 inches.

3-75652 kilogrammes. 100kyats=3-652 1b. av.

0-650 metre. 30 hectolitres. 583J grains (silver weight). 229-83 sq. metres, about J mile = 360 pu. Varies with length of ch'ih. . A small weight 0'583 grain. 16 liang = l chin=lj lb. av. 0-7477 lb. av. 1-0127 lb. av. 1-014 lb. 1-012 lb. av.

^ point, or 0-089 inch. 0-1 inch. 1 archine = 280 liniias. 1 litre = 100 mystra. 2* quarts. 1-7598 pint.

1 litre.

0-90282 lb. av. Apoth. livre =

11-5204 oz. troy. Kilogramme. 0'4895 kilogramme. New loth = l decagramme. Old

loth, nearly \ oz. av. 15'625 grammes. 270-1 grains. Postal loth, 257 -2

grains.

1-245 quart. 2-64 gallons. 1 decilitre. 58J grains. 93J lb. av. 204 lb. av.

812

WEIGHTS and MEASURES

Maik

Burmah . .

~~*Marc, or*~~

~~*Mark*~~

~~*France . Sweden . . Vienna . .*~~

~~*Marco Maund*~~

~~*Portugal Spain India . .*~~

~~*Megametre (as- tronomy) Metre (m.)*~~

~~*Metre, cubic . Metre, square .*~~

~~*U. States . Great Britain*~~

~~*Metro . .*~~

~~*Metz . . Micron (u.) . Miglio . . Mijle . . Mil, or Mill*~~

~~*Mile . . .*~~

~~*Mile (postal) Milha . . Mille . . Milligramme Millilitre . Millimetre . Miscal . . Mkono . . Mna . . . Momme Morgen . .*~~

~~*Spain Italy . Austria*~~

~~*Rome Netherlands Turkey . Denmark France . Germany Austria . Portugal France .*~~

~~*Mou .*~~

~~*Mud . . . Myriagramme*~~

~~*Persia . East Africa . Greece . Japan Denmark Norway . Prussia . . China . .*~~

~~*Netherlands*~~

~~3 maik = cubit = 19 J inches.~~

~~0‘2448 kilogramme (old weight).~~

~~0-4645 lb. av.~~

~~4331-37 grains = 24 karato.~~

~~= 8 oncas = 229‘5 grammes.~~

~~3550-54 grains.~~

~~82-286 lb. av., Government.~~

~~72J lb. (old bazaar).~~

~~74‘67 lb. av., factory.~~

~~28 lb. nearly, Bombay.~~

~~25 lb. nearly, Madras.~~

~~37 to 44 lb., Juggerat.~~

~~Local maunds vary on either side~~

~~of 80 lb. 1,000,000 metres.~~

~~39-37 inches. 39-370113 inches = 1 m. = 1000 c.d. = 35-315 cubic feet. = 100 square decimetres = 10-764 square feet.~~

~~j 1 metre.~~

~~1-691 bushel.~~

~~= nnnr millimetre.~~

~~0-925 mile.~~

~~1 kilometre.~~

~~1000 archins (new mil).~~

~~4-680 miles.~~

~~> Nautical mile = 1852 metres.~~

~~4-714 miles.~~

~~1-296 mile.~~

~~1-949 kilometre.~~

~~= rsVjf gramme = 0‘015 grain/~~

~~= nita litre-~~

~~= 0-03937 inch = t^ m.~~

~~71 grains.~~

~~45‘72 centimetres.~~

~~1J kilogramme = 1-172 oka.~~

~~tbSt kwan.~~

~~1 0-631 acre.~~

~~Commonly 806-65 sq. yds. Varies locally. Shanghai = 6600 sq. ft. (Municipal Council). By Cus- toms Treaty = 920 -417 sq. yds., based on ch’ih of 14 -1 inches.~~

~~1 hectolitre.~~

~~= 10 kilogrammes=22-046 lb. av.~~

~~Nin .~~

~~Obolos Ock .~~

~~*Octavillo Oitavo . Oke . .*~~

~~*Onca . . . Once Oncia .*~~

~~*Onze . . .*~~

~~*Ounce . . .*~~

~~*Panken . . Palame (Royal)*~~

~~*Palm . . . Palmo .*~~

~~*Para . Parah . Parasang. Parmak.*~~

~~*East Africa . Siam .*~~

~~*Greece . Turkey .*~~

~~*Spain*~~

~~*Portugal*~~

~~*Bulgaria*~~

~~*Cyprus Egypt*~~

~~*Greece*~~

~~*Turkey*~~

~~*Portugal France Rome*~~

~~*Netherlands U. States .*~~

~~*Russia .*~~

~~*Greece .*~~

~~*Holland .*~~

~~Portugal~~

~~Spain~~

~~N. Borneo . . Ceylon . See Persakh. See Archin. . . Bengal .~~

~~“i\ keilas. \% inch.~~

~~1 decigramme.~~

~~Legal ock (1881) = 100 drachmas.~~

~~New batman = 10 ocks, and~~

~~kantar =10 batmans ock =~~

~~1 kilogramme. 0-29 litre. 1-730 litre.~~

~~1-28 litre (for liquids). 1 -282 kilogramme (old). 24 lb. av.=400 drams (Cyprus). 2-751 lb. av. (Customs). 2-805~~

~~lb. (Alexandria). 1 ‘282 kilogramme. 1-33 litre. 1-1518 pint. 2-834 lb. av. (old~~

~~weight). 28‘688 grammes. 30‘59 grammes (old). 436-165 grains.~~

~~1 hectogramme. 10 onzen = pond. Av. ounce = 437 “5 grains.~~

~~1083-382 lb. av. 1 decimetre. 1 decimetre. 0-22 metre. 8-346 inches. 90 11). av. 5‘59 pints.~~

~~5 seers.~~

~~76 . . . .~~

~~Portugal~~

~~.\ metre (old).~~

Pecheus (Royal

Greece .

. 1 metre = 1 '543 old pecheuse.

Pecul . . .

China

. 183J lb. av.

Perche . . .

France .

. 22 square pieds de roi. In Quebec

Canada .

18 French feet.

Persakh,or Para

■ Persia

. Probably 3-88 miles = 6000 guz.

sang

Pfund . . .

Germany

. =16unzen = 321oth~\ -,, . ,. 1 -01 to 1-23 lb. av. j

Prussia .

. Old zoll. lb. = 1-1023 lb. av.

~~*Switzerland 500 grammes =16 unze.*~~

~~*Apoth. pf. = 375 grammes.*~~

~~*Vienna*~~

~~*Pfund = 560‘06 grammes.*~~

~~*Zoll. pfund (1871) = 500 grammes.*~~

~~*Pharoagh. See Archin.*~~

~~*Pic ... .*~~

~~*Cyprus .*~~

~~*. 2 feet.*~~

~~*Picul . . .*~~

~~*Japan*~~

~~*Straits Set- J-133J lb. av.*~~

~~*tlements J*~~

~~*Siam .*~~

~~*. 13-75 lb.*~~

~~*North Borneo A measure of 180 lb. weight of*~~

~~*water.*~~

~~*Picki . . .*~~

~~*Greece*~~

~~*. 0-648 metre.*~~

~~*China*~~

~~*. 25 gallons (dry measure).*~~

~~*Pie ... .*~~

~~*Rome*~~

~~*. 11-73 inches.*~~

~~*Pie de Burgos*~~

~~*Spain*~~

~~*. 11-13 inches.*~~

~~*Pied. . . .*~~

~~*Belgium*~~

~~*. 11-81 inches = 10 pouncces.*~~

~~*Canada*~~

~~*. 12-79 inches.*~~

~~*Pied de Roi .*~~

~~*Paris .*~~

~~*. 0-3248 metre.*~~

~~*Pike. . . .*~~

~~*Turkey*~~

~~*. See Dir'aa.*~~

~~*Pint. . . .*~~

~~*U. States*~~

~~*. 0·8325 imperial pint.*~~

~~*Pinte . . .*~~

~~*France*~~

~~*. 0·931 litre.*~~

~~*Pipa ….*~~

~~*Portugal*~~

~~*. 534 litres (Oporto). 420 litres (Lisbon). 500 litres (officially).*~~

~~*Pipe. . . .*~~

~~*Gibraltar*~~

~~*. 105 to 126 gallons.*~~

~~*Pishi. See Keila. Poide de Marc France . . Polegada . . Portugal Pond . . . Netherlands*~~

~~*Pot .*~~

~~*Pouce*~~

~~*Poud, or Pood Pound . . .*~~

~~*Pu . . Puddee .*~~

~~*Pulgada Pund .*~~

~~*Quart . Quarto .*~~

~~*Quintal .*~~

~~*Quintal (metric) Quintale . .*~~

~~Ratel . . . Rattel, or Bottle~~

~~Denmark . Switzerland Belgium . Norway . France . . Russia . Russia . . U. States .~~

~~Russia Jersey~~

~~China Madras~~

~~Spain Denmark Norway Sweden~~

~~U. States Rome Portugal Spain Portugal Argentina France . Italy . .~~

~~Persia . Arabia .~~

~~Ri . .~~

~~Rode . . . Roede . . . Rotl, or Rottolo~~

~~Rottol Rubbio ,~~

~~Japan . .~~

~~Denmark Netherlands Egypt . .~~

~~Cairo . . .~~

~~Alexandria .~~

~~Turkey . . Spain~~

~~0-2448 kilo = 8 onces.~~

~~27‘77 millimetres.~~

~~1 kilogramme. Apothecaries pond~~

~~= 375 grammes. 1”7 pint = 4 psegle. 2‘64 pints or 1-5 litre. 1£ litre (dry). 4 litre (liquid). 0-965 litre.~~

~~1”066 inch (old measure). 1 inch. 0-016122 ton. Standard troy lb. = 5760 grains.~~

~~Avoir, lb. = 7000 grains. 0-902821b. av. (0-4095kilogramme). 7561 grains = 16 oz. Jersey = 1~~

~~livre. 70‘5 inches =5 ch’ih. 2‘89 pints. 100 cubic inches=~~

~~Government puddee. 0-927 inch.~~

~~1-1023 lb. av., or 500 grammes. 0‘4981 kilogramme. 6560 grains. Varies locally. 5500-5 grains (apoth.).~~

~~See Bushel.~~

~~2-024 bushels.~~

~~3-46 litres.~~

~~100 libras (Castilian).~~

~~58-752 kilogrammes, or 129J lb. av.~~

~~100 libras, or 101-27 lb. av.~~

~~= 100 kilogrammes = 1‘968 cwt.~~

~~1 metric quintal.~~

~~1-014 lb. av.~~

~~1-02 lb. av. , nearly (dry measure).~~

~~17-219 lb. av. weight.~~

~~2-440 miles (itinerary). 2-118~~

~~miles (natural). 3‘762 metres. 1 dekametre. 0-9905 lb. av. (Customs). 0‘9805~~

~~lb. av. (Govt.). 2-206 lb. great rottolo. 0-715 lb. less rottolo. 2-124 lb. great rottolo. Eottolo~~

~~mina = f oka. 2‘513 pints (old measure). 1-012 quarter (dry measure’).~~

~~WEIHAIWEI~~

~~813~~

~~Sagene .~~

~~. Russia . .~~

~~7 feet.~~

~~Tcharka~~

~~. Russia .~~

~~0-866 gill.~~

~~5-772 bushels = 8 tchetveriks, or~~

~~Scheffel~~

~~. Germany~~

~~50 litres, formerly 14 -56 metzen~~

~~Tchetverte~~

~~. Russia . .~~

~~(Prussia).~~

~~2-099 hectolitres.~~

~~Sohepel .~~

~~. Netherlands~~

~~1 decalitre.~~

~~Teng .~~

~~. Burma . .~~

~~Burmese measures of capacity de-~~

~~Sohoppen~~

~~. Germany~~

~~4 litre, formerly O'll gallon.~~

~~pend on the teng or basket.~~

~~Switzerland~~

~~0-375 litre. •~~

~~Officially a basket is 2218-2~~

~~Se . .~~

~~. Japan . . . India . .~~

~~118-615 square yards ("9918 are).~~

~~cubic inches, but the teng varies~~

~~Seer . .~~

~~Government seer = 2^ lb. av.~~

~~locally : —~~

~~Bengal, 80 tolas weight of rice~~

~~Akyab = 23 lb. of rice.~~

~~(heaped measure), about 60 cubic~~

~~Bassein = 51 lb. of rice.~~

~~inches (struck measure).~~

~~Moulmein = 48 lb. of rice.~~

~~Southern India = weight of 24~~

~~Rangoon = 48 to 50 lb. of rice.~~

~~current rupees.~~

~~Thanan .~~

~~. Siam . . .~~

~~1*5 pint.~~

~~Madras, 25 lb. nearly.~~

~~Thangsat~~

~~. Siam . . .~~

~~4·688 gallons.~~

~~Juggerat, weight of 40 local rupees.~~

~~To . .~~

~~. Japan . .~~

~~18·0391 litres.~~

~~Bombay, old seer, about 28 lb.~~

~~Toise .~~

~~. France . .~~

~~2-1315 yards.~~

~~Ceylon . .~~

~~Measure ‘of 1-86 pint.~~

~~Tola .~~

~~. India~~

~~180 grains. Legal weight of~~

~~Persia . .~~

~~16 miscals, or 1136 grains weight~~

~~rupee.~~

~~(Sihr).~~

~~Tomand~~

~~. Arabia . .~~

~~187-17 lb. av. of rice.~~

~~Note. — In India the seer, like the maund, varies~~

~~Ton . .~~

~~2240 lb. av., also a net ton of~~

~~considerably ; usually 40 seers go to a maund.~~

~~2000 lb.~~

~~Seidel .~~

. Austria . .

0-6224 pint.

44-4 miles, nearly.

1 litre (Indian Law, 1871).

Tonde .

. Denmark .

131-392 litres (liquid measure).

Sen . .

. Siam . . .

139-121 litres (dry measure).

Ser . .

. India . .

Tonne, or Mil- France . .

[■1000 kilogrammes.

Shaku .

. Japan . .

0-36 metre, also 9‘18273 square decimetres ; also 18-039 cubic

lier

ueiinany

1000 kilogrammes = 0-9842 ton. 793”15 kilogrammes.

~~*centimetres.*~~

~~*Tonnelada*~~

~~*. Portugal*~~

~~*Sheng . Sh66 .*~~

~~*. China . . . . Japan . .*~~

~~*2 pints, nearly. 1-804 litre.*~~

~~*Tonos . Tou . .*~~

~~*. Greece . . . China . .*~~

~~*29-526 cwt.*~~

~~*2‘5 gallons approximately.*~~

~~*Skaal-pund*~~

~~*. Sweden . .*~~

~~*435-076 grammes, or 0-959 lb. av. 0-4981 kilogramme, or officially*~~

~~*\ kilogramme. 17-39 litres.*~~

~~*Tovar .*~~

~~*. Bulgaria. .*~~

~~*128-2 kilogrammes.*~~

~~*Norway .*~~

~~*T’sun . Tu . .*~~

~~*. China . . . China . .*~~

~~1 “41 inch (Treaty measure). 100-142 miles = 25 li, based on the~~

~~Skeppe .~~

~~. . Denmark~~

~~ch’ih of 14‘1 inches.~~

~~Skjeppe~~

~~. Norway .~~

~~17-37 litres.~~

~~Stab . .~~

~~. Germany~~

~~1 metre, or 3- J old fuss, but varied.~~

~~Vara~~

~~. Peru . . .~~

~~33 inches.~~

~~Stadron (Royal) Greece . .~~

~~1 kilometre.~~

~~Spain . .~~

~~2-782 feet.~~

~~Stere (metr~~

~~10)~~

~~1 cubic metre.~~

~~*Argentina .*~~

~~*2-841 feet.*~~

~~*Stero*~~

~~*. Italy . . . . Holland . .*~~

~~*1 metric stere.*~~

~~*Portugal*~~

~~*I'll metre.*~~

~~*Streepe .*~~

~~*1 millimetre.*~~

~~*Vat . .*~~

~~*. Holland . .*~~

~~*1 hectolitre.*~~

~~*Stremma*~~

~~*. Greece .*~~

~~*1 metric are. 238:1 square pecheus (Constantinople).*~~

~~*Vedro .*~~

~~*. Russia . .*~~

~~*2-7056 gallons=10 schtoffs, or 12-3 litres.*~~

~~*Strich .*~~

~~*. Germany*~~

1 millimetre.

Bulgaria.

12-8 litres.

Striche .

. Switzerland

3 J strich = 1 millimetre.

Verchok

. Russia .

1‘75 inch.

Stunde .

. Germany

Old itinerary measure, 2-3 to 3‘4

Versta, orVerst Russia .

0-66288 mile.

miles.

Vierkanteroede Holland . .

1 metric are.

Switzerland

4‘8 kilometres. Stunder=5 stun-

Viertel .

. Denmark

1”7 gallons.

den, or 24 kilometres.

Switzerland

15 litres.

Sultchek

. Turkey . .

Cubic measure (1881) whose sides equal a parmak (decimetre)

Viss . .

. Rangoon

3^ lb. av.

Sung .

. Corea . .

4 lb. av., nearly.

Wa . .

. Siam . . .

•80 inches.

“Wigtje .

. Netherlands

1 gramme.

~~*Tael . .*~~

~~*. Siam . . . Hong Kong*~~

~~*936J grains. 1J oz. av.*~~

~~*Wisse .*~~

~~*. Netherlands*~~

~~*1 metric stere.*~~

~~*China*~~

~~*Silver weight, 1J oz. av.*~~

~~*Yard .*~~

~~*. V. States*~~

~~*36 inches.*~~

~~*Japan*~~

~~*10 momme.*~~

~~*Mexico . .*~~

~~*838 centimetres.*~~

~~*(No currenl*~~

~~*coin of the tael.)*~~

~~*Tahil .*~~

~~*. Straits Settle-*~~

~~*1J oz. av. = 10 chee = 100 hoon.*~~

~~Zac . .~~

~~. Netherlands~~

~~1 hectolitre.~~

~~ments~~

~~Zer (Persia'~~

~~. See Guz.~~

~~Tarn .~~

~~. Hong Kong~~

~~133J lb. av.~~

~~Zoll . .~~

~~. Switzerland~~

~~3 J zoll = l decimetre. Old zoll~~

~~Tan . .~~

~~. China . .~~

~~= 25 gallons. Also 133 J lb. weight.~~

~~nearly one inch. (See also~~

~~Tang .~~

~~. Burma . .~~

~~2 miles, nearly.~~

~~Pfuncl.)~~

~~Tank .~~

~~. Bombay .~~

~~177*5- grains, or 72 tanks = 30 pice.~~

~~Zolotnik~~

~~. Russia .~~

~~65-8306 grains, or 96 doli.~~

~~Weihaiwei, a British, naval and coaling station, situated on the north-east coast of the Shantung peninsula, China, about 40 miles east of the treaty port of Chefoo. It was formerly a Chinese naval station strongly fortified, but was captured by the Japanese in February 1895, and occupied by their troops, pending the payment of the indemnity, up till May 1898. Port Arthur having in the spring of that year been acquired by the Eussian Government under a lease from China for twenty-five years, a similar lease was granted of Weihaiwei to the British Government, and on the withdrawal of the Japanese troops the British fleet took possession, the flag being hoisted on 24th May 1898. No period was fixed for the termination of the lease, but it was stipulated that it should continue so long as Bussia continued to hold Port Arthur. The harbour is formed by an island named Liukung-tao running east and west across the mouth of a small bay, leaving an entrance at each end. Towards the mainland the water shoals, and the best anchorage is under the lee of the island.~~

~~The cession comprises, besides the harbour and island, a belt of the mainland, 10 English miles wide, skirting the whole length of the bay. The coast line of the bay is some 10 miles, and the area thus leased extends to about 1 20 square miles, and contains a native population which may be estimated at 200,000. Within this area Great Britain has exclusive jurisdiction ; and she has, besides, the right to erect fortifications, station troops, and take any other measures necessary for defensive purposes at any points on or near the coast of all that part of the peninsula which lies east of 121° 40′ E. Chinese war- vessels are at liberty to use the anchorage, notwithstanding the lease ; and Chinese jurisdiction~~

may continue to be exercised within the walled city of Weihaiwei, so far as not inconsistent with military requirements. Weihaiwei was made the headquarters of a native Chinese regiment in the pay of Great Britain, and organized and led by British officers; but this regiment was disbanded in

1902.

Weimar, a town of Germany, capital of the grand- duchy of Saxe- Weimar, 14 miles east of Erfurt. In 1896 the Goethe-Schiller archives, containing MSS. by Goethe, Schiller, Herder, Wieland, lmmermann, Fritz Eeuter, Morike, Otto Ludwig, and others, were opened. Weimar possesses also natural science, archaeological, and ethno- graphical collections, the Liszt Museum, grand – ducal school of art, geographical institutes, a technical school, commercial school, music school, teachers' seminaries, and deaf and dumb and blind asylums. Population (1885),

21,565; (1900), 28,509.

Weinberg^, or more correctly Konigliche Wein- beegb (Czech, Vinohrady Krdlovski), the chief town of a government district in Bohemia, Austria, and a suburb of Prague, with which it is now practically merged. Popu- lation (1890), 34,531 ; (1900), 52,483. Of all Bohemian towns, this and the other three suburbs of Prague show the largest increase of population within the last half of the 19th century.

Weinheim, a town of Germany, grand-duchy of Baden, 11 miles north of Heidelberg, on the "Mountain Road " (Bergstrasse), at the foot of the Odenwald. The town hall, Berkheim and Windeck castles, the house of the Teutonic Knights, and the churches are the principal buildings. The town dates from the middle of the 8th century. It has various manufactures (leather, machinery, chemicals, &c), and cultivates fruit and wine. Popula- tion (1885), 7595; (1900), 11,168.

~~Wei pert, a town in the government district of Kaaden, north-west Bohemia, Austria, on the slope of the Erzgebirge, 20 miles north-north-east of Karlsbad. Silver and cobalt ores were formerly mined. The town is now the chief centre of the Austrian lace and fringe making industry, both by machine and hand, and has also manu- factures of small-arms, paper, &c. Population (1890),~~

~~8351 ; (1900), 10,037.~~

~~Weisanann, August (1834), German~~

~~biologist, was born at Frankfort-on-Main on the 17th of January 1834, and studied medicine in Gottingen. After spending three years in Rostock, he visited successively Vienna (1858), Italy (1859), and Paris (1860), and from 1861 to 1862 he acted as private physician to the Archduke Stephen of Austria at Schaumburg Palace. 'In 1863 he went to Giessen to devote himself to biological study under Leuckart, and in 1866 he was appointed extra- ordinary professor of zoology at Freiburg, becoming ordinary professor a few years later. HIs earlier work was largely concerned with purely zoological investigations, one of his earliest works dealing with the development of the Diptera. Microscopical work, however, became impossible to him owing to impaired eyesight, and he turned his attention to wider problems of biological in- quiry. Between 1868 and 1876 he published a series of papers in which he attacked the question of the variability of organisms ; these were published in an English trans- lation by Professor R. Meldola in 1882, under the title Studies in the Theories of Descent, Darwin himself contri- buting a preface in which the importance of the nature and cause of variability in individuals was emphasized. Weismann's name, however, is best known as the author of the germ-plasm theory of heredity, with its accompany- ing denial of the transmission of acquired characters — a theory which on its publication met with considerable opposition, especially in England, from orthodox Darwin- ism. A series of essays in which this theory is expressed was collected and published in an English translation (Essays upon Heredity and Kindred Biological Problems, vol. i. 1889, vol. ii. 1892). Weismann has published many~~

~~other works devoted to the exposition of his biological views, among them being Die Dauer des Lebens ; Verer- bung ; Ewigkeit des Lebens ; Die Kontinuitat des Keim- plasmas als Grundlage einer Theorie der Vererbung ; Das Keimplasma ; Die'Allmacht der Natwrzuchtung ; Aeussere Einfliisse als EntwicMungsreize ; Neue Gedanken zur Verer- bungsfrage, and Germinal-Selektion. For an account of the doctrines he advocates, the reader is referred to the articles on Heredity, Regeneration, and Reproduc- tion, in these new volumes.~~

~~WeiSSenburgf, a town of Germany, in Alsace- Lorraine, district of Lower Alsace, 42 miles by rail north- north-east of Strasburg. The church of St Peter and St Paul, Early Gothic (1294), contains old stained glass of the 13th-15th centuries, and also a museum of antiquities. Weissenburg grew around a Benedictine abbey of the 7th century, and became a free imperial city in 1305. The production of matches, paper,~~

~~WeiSSenburg-am-Sand, a town of Bavaria, Germany, district of Middle Franconia, 33 miles by rail south by west of Nuremberg. It is still surrounded by old walls and towers, and has a couple of Gothic churches and a Gothic town hall. A Roman castle has recently been discovered, and there is a collection of antiquities in the modern school. The old fortalice of Wulzburg (2060 feet) overlooks the town. Gold and silver fringe, cloth, &c, are manufactured. Weissenburg dates from the 8th century, and in the 14th was made a free imperial town. Population (1885), 6025; (1900), 6550.~~

~~WeiSSenfelS, an industrial town of Prussia, in the government of Merseburg on the Saale, at the junction of the Halle-Bebra-Frankfort-on-Main and Weis- senfels-Zeitz lines of the Prussian state railways, 20 miles south-west of Leipzig. It is at the centre of extensive fields of brown coal, and has a lively trade in various manufactured articles, notably electric plant, paper, and boots, the last-named employing nearly 3000 hands. Population (1885), 21,766; (1895), 25,681; (1900),~~

~~28,201.~~

~~Weisskirchen, or Mahrisch-Weisskirchen~~

(Czech, Hranice), the chief town of a government district in Moravia, on the Betschwa, a tributary of the March, 3 miles east of Olmiitz. The manufactures comprise cloth, flannel, liqueurs, chocolate, and preserves ; also dyeing, corn-milling, and the manufacture of hemp. Population (1890), 7795; (1900), 7821, mostly Czech.

Wekerle, Alexander (1848-

-), Hungarian

statesman, was born on the 14th of November 1844 at Mdor, in the comitat of Stuhlweissenburg. After studying law at the university of Budapest he graduated doctor juris. He then entered the Government service, and after a period of probation was appointed to a post in the

Arc welding.

ministry of finance. He still, however, continued an academic career by lecturing on political economy at the university. In 1886 Wekerle was elected to the House of Deputies, became in the same year financial secretary of state, and in 1889 succeeded Tisza as minister of finance. He immediately addressed himself to the task of improv- ing the financial position of the country, carried out the conversion of the State loans, and succeeded, for the first time in the history of the Hungarian budget, in avoiding a deficit. In November 1892 Wekerle succeeded Count Szapary as premier, though still retaining the portfolio of finance. At the head of a strong Govern- ment he was enabled, in spite of a powerful" opposi- tion of Catholics and Magnates, to carry in 1894 the Civil Marriage Bill (see Hungary). The continued opposition of the Clerical party, however, brought about his resignation in 1895, when he was succeeded by Banffy.

Welding, Electric. — In electric welding and metal working the heat may be communicated to the metal by an electric arc, or by means of the electric resistance of the metal, as in the Thomson process. Arc welding is

~~the older procedure, and it appears to have been first made use of by De Meritens in 1881 for uniting the parts of storage — battery plates. The work -piece was placed upon a support or table, and connected with the positive pole of a source of current capable of maintaining an electric arc. The other pole was a carbon rod directed by the hand of the operator so as first to make contact with the work-piece, and then to effect the proper separa- tion to maintain the arc. The heat of the arc was partly communicated to the work and partly dissipated in the hot gases escaping into the surrounding air. The result was a fusion of the metallic lead of the storage-battery plate, which united various parts of the plate. The process was somewhat similar to the operation of lead- burning by the hydrogen and air blowpipe, as used in the formation of joints in chemical tanks made of sheet- lead. The method of De Meritens has been modified by Bernardos and Olszewski, Slavienoff, Coffin, and others.~~

~~In the Bernardos and Olszewski process the work is made the negative pole of a direct current circuit, and an arc is drawn between this and a carbon rod, to which a handle is attached for manipulating. As this rod is the positive terminal, particles of carbon may be intro- duced as a constituent of the metal taking part in the operation, making it hard and brittle, and causing cracks in the joint or filling; the metal may, in fact, become very hard and unworkable. The Slavienoff modification of the arc - welding process consists in the employment of a metal electrode in place of the carbon rod. The metal electrode gradually melts, and furnishes fused drops of metal for the filling of vacant spaces in castings, or for forming a joint between two parts or pieces.~~

~~In arc welding, with a current source at practically constant potential, a choking resistance in series with the heating arc is needed to secure stability in the arc current, as in electric arc lighting from constant potential lines. Little effective work can be done by the Bernardos and Olszewski method with currents much below 150 amperes in the arc, and the value in some cases ranges above 500 amperes. The potential must be such that an arc of 2 to 3 inches in length is steadily maintained. This may demand a total of about 150 volts for the arc and the choking resistance together. In the Slavienoff arc the. potential required will be naturally somewhat lower than when a carbon electrode is used, and the~~

current strength will be, on the other hand, considerably greater, reaching,

it appears, in certain cases, more than 4000 amperes. In some recent applications of the arc process the polarity of the work-piece and the arc-controlling electrode has, it is understood, been reversed, the work being made the positive pole and the movable electrode the negative. More heat energy is thus delivered to the work for a given total of electric energy expended.

The arc method is essentially a fusing process, though with due care it is used for heating to plasticity the edges of iron sheets to be welded by pressure and hammering. It has been found applicable in ■special cases to the filling of defective spots in iron castings, by fusing into blow- holes or other spaces small masses of similar metal, added gradually, and melted into union with the body of the piece by the heat of the arc. Similarly, a more or less complete union between separate pieces of iron plate \ to £ inch in thickness has been effected by fusing addi- tional metal between them. The range of operations to which the arc process is-applicable is naturally somewhat limited, and depends to a large extent upon the skill acquired by the operator, who necessarily works with his eyes well screened from the glare of the large arc. Unless the space in which the work is carried on is large, the irritating vapours which rise from the arc stream add to the difficulty. Strong draughts of air which would disturb the arc must also be avoided. These factors, added to the relative slowness of the work and the uncertainty as to its result, have tended to restrict the application of arc welding in practice. Moreover, much heat energy is dissipated in the arc flame and passes into the air, while, owing to the time required for the work, the metal undergoing treatment loses much heat by radiation. Yet the method requires little special machinery. The current may be taken from existing electric lighting and power circuits of moderate potential without transformation, and may be utilized with simple appliances, consisting chiefly of heavy wire leads, a carbon or metal electrode with a suitable handle for its manipu lation, a choking or steadying resistance, and screen of dark glass for the operator's eyes.

~~In 1874 Werdermann proposed to use, as a sort of electric blow- pipe, the flame gases of an electric arc blown or deflected by an air jet or the like — a suggestion recently revived by Zerener for arc welding. The arc in this instance is deflected from the space between the usual carbon electrodes by a magnetic field. The metal to be heated takes no part in the conduction of current, the heat is communicated by the gases of the arc, and, to a small extent, by the radiation from the hot carbon electrodes between which the arc is formed. The process is scarcely to be called electric in any true sense. Another curious operation, resembling in some respects the arc methods, has been proposed for the heating of metal pieces before they are brought under the hammer for forging or welding. The end of a metal bar is plunged into an electrolytic bath while connected with the negative pole of a lighting or other electric circuit having a, potential of 100 to 150 volts. The positive pnle is connected with a metal plate as an anode immersed in the electrolyte, or forming the side of the containing vat or tank. A solution of sodium or potassium carbonate is a suitable electrolyte. That part of the bar which is immersed acts as a cathode of limited surface, and is at once seen to be surrounded by a luminous glow, with gas bubbles arising from it. The immersed .end of the bar rapidly heats, and may even melt under the liquid of the bath. It is probable that an arc forms between the surface of the metal and the adjacent liquid layer, the intense heat of which is in part communicated to the metal and in part lost in the solution, causing thereby a rapid heating of the bath. This singular action appears to have been first made known by Hoho and Lagrange. It is distinctly a form of electric heating, having no necessary relation to such subsequent operations as welding, and is, moreover, wasteful of energy, as the heat is largely earried off in the liquid bath.~~

~~The Thomson process, first brought to public notice in 1886, has since that time been applied commercially on a large scale to various metal-welding operations. The metal pieces to be united are held in massive clamps and~~

Thomson process.

pressed together in firm contact; and a current is made to traverse the proposed joint, bringing it to the welding temperature. The union is effected by forcing the pieces together mechanically. The charac- teristic feature of the process is the fact that the heat is given out in the body of the metal. The voltage does not usually exceed two or three, though it may reach four or five volts; but as the resistance of the metal pieces to be joined is low, the currents are of very large values, sometimes reaching between 50,000 and 100,000 amperes. Even for the joining of small wires the current is rarely less than 100 amperes. Such currents cannot, of course, be carried more than a few feet without excessive loss, unless the conductors are given

Fig. 1. — Thomson Welding Transformer.

very large section. With alternating currents, also, the effectiveness of the work speedily diminishes, on account of the inductive drop in the leads, if they are of any considerable length. The carrying of the welding currents over a distance of several feet may, in fact, lead to serious losses. These difficulties are overcome in the Thomson welding transformer, which resembles the step-down transformers used in electric lighting distribution by alternating currents, with the exception that the second- ary coil or conductor, which forms part of the welding circuit, usually consists of only one turn of great section, S S (Fig. 1). This is often made in the form of a copper casing, which surrounds or encloses the primary coil P P in whole or in part. The primary coil is of copper wire of many turns. The secondary casing, with the primary enclosed, is provided with the usual laminated iron-transformer core, I, constitut- ing a closed iron magnetic circuit threading both primary and secondary electric circuits. The terminals of the single-turn secondary serve as connexions and supports for the welding clamps C D, which hold the work. The clamps are variously modified to suit the size, shape, and character of the metal pieces, M N, to be welded, and the propor- tions of the transformer itself are made proper for the conditions existing in each case. The potential of the primary circuit may be selected at any convenient value, provided the

~~winding of the coil P P is adapted thereto, but usually 300 volts is employed, and the periodicity~~

~~is about 60 cycles. Inasmuch as only the proposed joint and a small amount of metal on each side of it are concerned in the operation, the delivery of energy is closely localized. The chief electrical resistance in the welding circuit is in the projections between the clamps, where the electric energy is delivered and appears as heat. A portion of the energy is, as usual, lost in the transformation and in the resistance of the circuits else- where, but, by proper proportioning, the loss may be kept down to a moderate percentage of the total, as in other electric work.~~

~~The pieces are set firmly in the welding clamps, with the ends to be joined in abutment and in electric contact. The projection of each piece from the clamp varies with the section of the pieces, their form and the nature of the metal, and the time in which a joint is to be made ; but it rarely exceeds the thickness or diameter of the pieces, except with metals of high heat conductivity such as copper. When the pieces are in place the current is turned into the primary coil of the transformer, sometimes sud- denly and in full force, but more often gradually. Switches and regulating devices in the primary circuit permit com- plete and delicate control. At least one of the clamps, D (Fig. 1), is movable through a limited range towards and from the other, and is thus the means of exerting pressure for forcing the softened metal into complete union. In large work the motion is given by a hydraulic cylinder and piston, under suitable control by valves. At about the time the current is cut off, it is usual to apply increased pressure. The softened metal is upset or pressed outwards at the joint and forms a characteristic burr, which may be removed by filing or grinding, or be hammered down while the metal is still hot. Sometimes the burr is not objectionable, and is allowed to remain. Lap welds may be made, but butt welds are found to be satisfactory for most purposes. The appearance of round bars in abutment before welding is shown in Fig. 2 at A ;~~

~~Fig. 2.~~

~~Fig. 3.—Automatic Welder.~~

~~and at B they are represented as having been joined by an electric butt weld, with the slight upset or burr at the~~

~~joint. Before the introduction of the Thomson process a few only of the metals, such as platinum, gold, and iron, were regarded as weldable; now nearly all metals and alloys may be readily joined. Such combinations as tin and lead, copper and brass, brass and iron, iron and nickel, brass and German silver, silver and copper, copper and platinum, iron and German silver, tin and zinc, zinc and cadmium, &c, are easily made ; even brittle crystalline metals like bismuth and antimony may be welded, as well as different metals and alloys whose fusing or softening temperatures do not differ too widely.~~

~~If the meeting ends conduct sufficiently to start the heating, it is not necessary that they should fit closely together, nor is it necessary that they should be quite clean, the effect of the incipient heating being to confer conductivity upon the scale and oxide at the joint. In some cases the application of a flux, such as borax, enables the welding to be accomplished at a lower tem- perature, thus avoiding risk of injury by excessive heating. While the pieces are heating, the increase of temperature may raise the specific resistance of the metal so that the current required will be lessened per unit of area, while on the other hand the growing perfection of contact during welding, by increasing the conducting area at the joint, compensates for this in that it tends to the increase of current.' With some alloys like brass and German silver, which have a low temperature coefficient, this compensating effect is nearly absent. The increase of specific resistance of the metals with increase of tem- perature has another valuable effect in properly distributing the heating over the whole section of the joint. Any portion which may be for the moment at a lower tempera- ture than other portions will necessarily have a lower relative resistance, and more current will be diverted to it. This action rapidly brings any cooler portion into equality of temperature with the rest. It also prevents the overheating of the interior portions which are not losing heat by radiation and~~

convection. The success of the electric process in welding metals which were not formerly regarded as weldable is probably due in a measure to this cause, and also to the ease of control of the opera- tion, for the operator may work within far narrower limits of plasticity and fusibility than with the forge fire or blowpipe. The mechanical pressure may be automatically applied and the current automatically cut off after the completion of the weld. In some mere recent types of welders the clamping and releasing of the pieces are also accomplished automatically, and nothing is left for the operator to do but to feed the pieces into the clamps. Repetition-work is thus rapidly and accurately done. The automatic welder represented in Fig. 3 has a capacity of nearly 1000 welds per day. The pressure required is subject to considerable variation : the more rigid the material at the welding temperature, the greater is the necessary pressure. With copper the force may be about 600 pounds per square inch of section ; with wrought iron, 1200 pounds ; and with steel, 1800 pounds. It is custom- ary to begin the operation with a much lighter pressure than that used when all parts of the pieces at the joint have come into contact. The pressure exerted in com- pleting the weld has the effect of extruding from the joint all dross and slag, together with most of the metal, which is rendered plastic by the heat. The strongest electric welds are those effected by this extrusion from the joint, in consequence of heavy pressure quickly applied at the time of completion of the weld. The unhammered weld, as ordinarily made by the electric process, has sub- stantially the same strength as the annealed metal of the bar, the break under tensile strain, when the burr at the weld is left on, usually occurring a little to one side of

the joint proper, where the metal has been annealed by heating. Hammering or forging the joint while the metal cools, in the case of malleable metals such as iron or copper, will usually greatly toughen the metal, and it should be resorted to where a maximum of strength is desired. The same object is partially effected by placing the weld, while still hot, between dies pressed forcibly together so as to give to the weld some desired form, as in drop-forging.

The amount of electric energy necessary for welding by the Thomson process varies with the different metals, their electric conductivity, their

~~heat conductivity, fusi- bility, the shape of the pieces, section at the joint, &c. In the following table are given some results obtained in the working of iron, brass, and copper : —~~

~~Energy used in Electric "Welding.~~

~~Iron and Steel.~~

~~Section, Sq. In.~~

~~Watts in Prim- ary of Welder.~~

~~Time in Sees.~~

~~Watt-seconds.~~

~~0-5 .~~

~~8,500~~

~~33~~

~~280,500~~

~~1-0 .~~

~~16,700~~

~~45~~

~~751,500~~

~~15 .~~

~~23,500~~

~~55~~

~~1,292,500~~

2-0 .

29,000

65

1,885,000

2-5 .

34,000

70

2,380,000

3-0 .

39,000

78

3,042,000

3-5 .

44,000

85

3,740,000

4-0 .

50,000

90

4,500,000

Brass.

■25 .

7,500

17

127,500

•5

13,500

22

297,000

•75

19,000

29

551,000

1-0

25,000

33

825,000

1-25

31,000

38

1,178,000

1-5

36,000

42

1,512,000

1-75

40,000

45

1,800,000

2- .

44,000

48

2,112,000

Copper.

•125

6,000

8

48,000

•25 .

14,000

11

154,000

•375

19,000

13

247,000

■5 .

25,000

16

400,000

■625

31,000

18

558,000

•75 .

36,500

21

766,500

•875

43,000

22

946,000

1-0 .

49,000

23

1,127,000

The figures are of course only approximate, and refer to one condition alone of time-consumption in the making of each weld. The more rapidly the work is done, the less, as a rule, is the total energy required ; but the rate of output of the plant must be increased with increase of speed, and this involves a larger plant, the consequent expense of which is often disadvantageous. If in the foregoing table the watts for a given section be multi- plied by the time, the relation between the total energy required for different sections of the same metal, or for the same section of the different metals, is obtained. These products are given under the head of watt-seconds. It will be seen that the energy increases more rapidly than the sections of the pieces — doubtless because the larger pieces take a longer time in welding, with the result of an increased loss by conduction of heat along the bars back from the joint. If the time of welding could be made the same for various sections, it is probable that the energy required would be more nearly in direct

proportion to the area of section for any given metal. This relation would, however, only hold approximately, as there is a greater relative loss of heat by radiation and convection into the air from the pieces of smaller section. The total energy in watt-seconds for any given section of copper will be found to be about half as much again as that for the same section

~~of iron, while the amounts of energy required for equal sections of brass and iron do not ' greatly differ.~~

~~In practice, joints in solid bars or in wires are the most common, but the process is applicable to pieces of quite varied form. Joints in iron, brass, or lead pipe are readily made; strips of sheet metal are joined, as in band saws ; bars or tubes are joined at various angles ; sheet metal is joined to bars, &c. One of the more interesting of the recent applications of electric welding is the longitudinal seaming of thin steel pipe. The metal or skelp is in long strips, bent to form a hollow cylinder or pipe, and the longitudinal seam moves through a special welder, which passes a current across it. The work is completed by drawing the pipe through dies. The welding of a ring formed by bending a short bar into a circle affords an excellent illustration of the character of the currents employed in the Thomson process. Not- withstanding the comparatively free path around the ring through the full section of the bent bar, the current heats the abutted ends to the welding temperature. In this way waggon and carriage wheel tyres, harness rings, pail and barrel hoops, and similar objects are extensively produced. The process is also largely applied to the welding of iron and copper wires used for electric lines and conductors, of steel axles, tyres and metal frames used in carriage work, and of such parts of bicycles as pedals, crank hangers, seat posts, forks, and steel tubing for the frames. The heat, whether it be utilized in welding or brazing, is so sharply localized that no damage is done to the finish of surfaces a short distance from the weld or joint. Parts can be accurately formed and finished before being joined, as in the welding of taper shanks to drills, the lengthening of drills, screw taps, or augers, and the like. Electric welding is applicable to forms of pieces or to conditions of work which would be impracticable with the ordinary forge fire or gas blowpipe. A char- acteristic instance is the wire bands which hold in place the solid rubber tyres of vehicles. The proximity of the rubber forbids the application of the heat of a fire or blowpipe, but by springing the rubber back from the proposed joint and seizing the ends of wire by the electric welding clamps, the union .is rapidly and easily made. When the rubber of the tyre is released, it covers the joint, regaining its complete form. Special manufactures have in some cases arisen based upon the use of electric welding. The welding clamps, and the mechanical devices con-~~

nected with them, vary widely in accordance with the work they have to do. A machine for forming metal wheels is so constructed that the hubs are made in two sections, which when brought together in the welder are caused to embrace the radiating iron or steel spokes of the wheel. The two sections are then welded, and hold the spokes in solid union with themselves. Another machine, designed for the manufacture of wire fences, makes several welds automatically and simultaneously. Galvanized iron wires are fed into the machine from reels in several parallel lines about a foot apart, and at intervals are crossed at right angles by wire sections cut automatically from another reel of wire. As the wire passes, electric welds are formed between the transverse and the parallel lines. The machine delivers a continuous web of wire fencing, which is wound upon a drum and removed from time to time in large rolls. In the United States, street railway

rails are welded into a continuous metal structure. A huge welding transformer is suspended upon a crane, which is borne upon a car arranged to run upon the track as it is laid. The joint between the ends of two contigu- ous rails is made by welding lateral strap pieces, covering the joint at each side and taking the place of the ordinary fish-plates and bolts. The exertion of a greatly increased pressure at the finish of the welding seems to be decidedly favourable to the permanence and strength of the joints. When properly made, the joint is strong enough to resist the strains of extension and compression during temperature changes. For electric railways the welded joint obviates all necessity for "bonding" the rails together with copper wires to convert them into continuous lines of return conductors for the railway current. In railway welding the source of energy is usually a current delivered from the trolley line itself to a rotary converter mounted on the welding car, whereby an alternating current is obtained for feeding the primary circuit of the welding transformer. Power from a distant station is thus made to produce the heat required for track welding, and at exactly the place where it is to be utilized. In this instance the work is stationary, while the welding apparatus is moved from one joint to the next. Welding transformers are sometimes used to heat metal for annealing, for forging, bending, or shaping, for tempering, or for hard soldering. Under special conditions they are well adapted to these purposes, on account of the perfect control

of the heating or energy delivery, and the rapidity and cleanliness of the operation. Divested of its welding clamps, -the welding transformer has found a unique application in the armour-annealing pro- cess of Lemp, by means of which spots or lines are locally annealed in hard-faced ship's armour, ™our" so that it can be drilled or cut as desired. Before annealing. the introduction of this process, it was practi- cally impossible to render any portion of the hardened face of such armour workable by cutting tools without detriment to the hardness of the rest. A very heavy electric current is passed through the spot or area which it is desired to soften, so that, notwithstanding the rapid conduction of heat into the body of the plate, the metal is brought to a low red heat. In order that the spot shall not reharden, it is requisite that the rate of cooling shall be slower than when the heating current is cut off suddenly ; the current therefore undergoes gradual diminu- tion, under control of the operator. The welding trans- former has for its secondary terminals simply two copper blocks fixed in position, and mounted at a distance of an inch or more apart. These are placed firmly against the face of the armour plate, with the spot to be annealed bridging the contacts, or situated between them. As in track welding, the transformer is made movable, so that it can be brought into any position desired. When the annealing is to be done along a line, the secondary ter- minals, with the transformer, are slowly and steadily slid over the face of the plate, new portions of the plate being thus continually brought between the terminals, while those which had reached the proper heat are slowly removed from the terminals and cool gradually, (e. t.)

We lies ley, a town of Norfolk county, Massachu- setts, U.S.A., on the Boston and Albany Railroad, in the eastern part of the state. It is chiefly known as the seat of Wellesley College, a non-sectarian college for women, opened in 1875. In 1900 it had 84 instructors and was attended by 716 students. In 1S99 its property was valued at $1,745,975, and its income from all sources was $226,448. Population (1890), 3600; (1900), 5072, of whom 1306 were foreign-born.

~~Wellhausen, Julius (1844-~~

~~-), Bible~~

~~scholar and Orientalist, was born at Hameln, West- phalia, on the 17th of May 1844. Having studied at the University of Gbttingen, he established himself there in 1870 as privatdocent for Old Testament history. In 1872 he was appointed to the chair of theology in Greifs- wald. Resigning in 1882 owing to conscientious scruples, he became in the same year professor extraordinary in the faculty of philology at Halle, was elected ordinary pro- fessor of Oriental languages at Marburg in 1885, and was transferred in a like capacity to Gbttingen in 1892. Wellhausen made his name famous by his critical in- vestigations into Bible history, and the uncompromising scientific attitude he adopted in testing its problems brought him into antagonism with the older school of Biblical interpreters. The best known of his works are De Gentibus et familiis Judaeis (Gottingen, 1870) ; Die Pharisder und Sadducaer (Greifswald, 1874); Prolegomena zur Geschichte Israels (Berlin, 1878 ; English translation, 1885) ; Muhammed in Medina (Berlin, 1882); Die Kom- position des Hexateuchs und die historischen Biicher des Alten Testaments.~~

~~Wellingborough, an urban district (1894) and market town in the Eastern parliamentary division of Northamptonshire, England, 10j miles easi>north-east of Northampton by rail, on the London and North-Western and Midland railways. The church of All Saints' was enlarged in 1890, and a chapel-of-ease (St Barnabas's) to the parish church was built in 1893. The town has grown rapidly, its staple industry, the leather trade, having increased enormously since the manufacture of shoe-uppers was introduced. The iron industry is also nourishing. Population (1881), 13,794; (1901),~~

~~18,412.~~

~~Wellington, a town of New South Wales, Australia, 248 miles north-west of Sydney, in the county of Wellington, on the left bank of the river Macquarie, which is here spanned by a fine bridge. Many new buildings have been erected, and there is an excellent water-supply. Stock-rearing~~

~~and agriculture are exten- sively carried on, and rich gold-bearing reefs are known to exist. From the celebrated caves in the neighbourhood great quantities of fossil bones were sent to England for examination by Professor Owen. Population (1901),~~

~~2988.~~

~~Wellington, the capital and most central seaport of New Zealand, Hutt county, North Island, 158 miles S. by E. of New Plymouth. Since 1885 it has made more progress than any other town in the colony. Its population rose from 27,833 in 1886 to 46,638 (or with suburbs 49,344) in 1901. The town is supplied with electric light, and has tramways. Much land has been reclaimed from the harbour, and on this and in the central streets many substantial brick buildings have been erected. The rambling, unhealthy, Parliamentary buildings have been rebuilt and a fitting library added. The Wellington school of art is perhaps the best in the colony. A good public library, a new public park formed and levelled on the crest of a hill overlooking the centre of the town, and an adequate system of drainage are other improvements. Wellington is in touch by rail- way with Napier and New Plymouth. By vote taken in 1901 the municipality decided thenceforth to levy urban rates on the unimproved value of land in the city. The tonnage of vessels entering in 1900 was 213,874 ; cleared, 277,503. The harbour board's receipts were £86,551, its expenditure £117,887. The total trade in 1893 was £2,815,758; in 1896, £3,079,112; in 1901, £4,990,670.~~

~~Wells, a cathedral city, municipal borough, and market town in the Wells parliamentary division of Somersetshire, England, 135 miles west of London by rail, at the foot of the Mendip Hills. The recreation grounds, six acres in area, near the bishop's palace, were laid out in 1888. Population (1891), 4822; (1901),~~

~~4849.~~

~~Wells, Charles Jeremiah (1798 (?)i 879),~~

~~English poet, was born in London, probably in the year 1798. He was educated at Cowden Clarke's school at Edmonton, with Tom Keats, the~~

~~*younger brother of the poet, and with E. H. Home. He became acquainted with John Keats, and was the friend "who sent me some roses," to whom Keats wrote a sonnet on the 29th of June 1816:—*~~

~~*When, 0 Wells ! thy roses came to me,*~~

~~*My sense with their deliciousness was spelled ;*~~

~~*Soft voices had they, that, with tender plea,*~~

~~*Whisper'd of peace and truth and friendliness unquelled."*~~

~~*Unfortunately, Wells soon afterwards played a cruel prac- tical joke on the dying Tom Keats, and reappears in the elder poet's correspondence as " that degraded Wells." Both with Keats and Eeynolds, Wells was in direct literary emulation, and his early writings were the result of this. In 1822 he published Stories after Natwe — or rather, in the manner of Boccaccio, tempered by that of Leigh Hunt — a curious little volume of brocaded prose. At the close of 1823, under the pseudonym of H. L. Howard, appeared the Biblical drama of Joseph and his Brethren (dated 1824). For the next three years Wells saw Hazlitt, as he said, "every night," but in 1827 the two men were estranged. When Hazlitt died, in September 1830, Wells took Home to see his dead friend, and afterwards raised a monument to the memory of Hazlitt in the church of St Ann's, Soho. His two books passed almost unnoticed, and although Hazlitt said that Joseph and his Brethren was " more than original, aboriginal, and a mere experi- ment in comparison with the vast things " Wells could do, he forebore to review it, and even dissuaded the young poet from writing any more. Wells was now practising as a solicitor in London, but he fancied that his health was failing, and proceeded to South Wales, where he occupied himself with shooting, fishing, and writing poetry until 1835,' when he removed to Broxbourne, in Hertfordshire. In 1840 he left England, never to set foot in it again. He settled at Quimper, in Brittany, where he lived for some years. A story called Claribel appeared in 1845, and one or two slight sketches later, but several important tragedies and a great deal of miscel- laneous verse belonging to these years are lost. Wells stated in a letter to Home (November 1877) that he had composed eight or ten volumes of poetry during his life, but that, having in vain attempted to*~~

find a pub- lisher for any of them, he burned the whole mass of MSS. at his wife's death. The only work he had re- tained was a revised form of Joseph and his Brethren, which was praised in 1838 by Wade, and again, with great warmth, by Home, in his New Spirit of the Age, in 1844. The drama was then once more forgotten, until in 1863 it was read and vehemently praised by D. G. Rossetti. The tide now turned at last ; Joseph and his Brethren became a kind of shibboleth — a rite of initia- tion into the true poetic culture — but still the world at large remained indifferent. Finally, however, Mr Swin- burne wrote an eloquent study of it in the Fortnightly Review in 1875, and the drama itself was reprinted in 1876. The old man found it impossible at first to take his revival seriously, but he woke up at length to take a great interest in the matter, and between 1876 and 1878

he added various scenes, which are in the possession of Mr Buxton Forman, who published one of them in 1895. After leaving Quimper, Wells went to reside at Marseilles, where he held a professorial chair. He died on the 17 th of February 1879.

From R. H. Home, the author of Orion, the present writer received the following account of the personal appearance of Wells in youth. He was short and sturdy, with dark red hair, a sanguine complexion, and bright blue eyes; he used to call himself "the cub," in reference to the habitual roughness of his manners, which he was able to resolve at will into the most taking sweetness and good-humour. Wells's wife, who had been a Miss Hill, died in 1874. Their son, after his father's death, achieved a notoriety which was unpoetical, although recorded in popular song, for he was the once-famous " man who broke the bank at Monte Carlo."

The famous Joseph and his Brethren, concerning which criticism has recovered its self-possession, is an overgrown specimen of the pseudo-Jacobean drama in verse which was popular in ultra-poetical circles between 1820 and 1830. Its merits are those of rich versification, a rather florid and voluble eloquence, and a subtle trick of reserve, akin to that

~~displayed by Webster and Cyril Tourneur in moments of impassioned dialogue. Mr Swinburne has said that there are lines in Wells "which might more naturally be mistaken, even by an expert, for the work of the young Shakespeare, than any to be gathered else- where in the fields of English poetry." This may be the case, but even the youngest Shakespeare would have avoided the dulness of subject-matter and the slowness of evolution which impede the reader's progress through this wholly undramatic play. Joseph and his Brethren, in fact, although it has been covered with eulogy by the most illustrious enthusiasts, is less a poem than an odd poetical curiosity. (e. g.)~~

~~Wells, Sir Thomas Spencer, 1st Bart.~~

~~(1818-1897), English surgeon, was born at St Albans, 3rd February 1818, and was given a medical education in Leeds, Dublin, and St Thomas's Hospital, London (M.R.C.S. 1841). From 1841 to 1848 he served as a surgeon in the navy, and in 1848 he went to Paris to study pathology. In 1853 he settled in London, and took up ophthalmic surgery, interrupting his work to go out to the East in the Crimean war. In 1854 he became surgeon to the Samaritan Free Hospital for Women and Children, London. His reputation in surgery had ob- tained for him in 1844 the fellowship of the Royal College of Surgeons, and he subsequently became a member of council, Hunterian professor of surgery and pathology (1878), President (1882), and Hunterian Orator (1883). In 1883 he was made a baronet. His name is best known in connexion with his successful revival of the operation of ovariotomy, which had fallen into dis repute owing to the excessive mortality attending it ; and in his skilful hands, assisted by modern surgical methods, the operation lost almost all its danger. His book on Diseases of the Ovaries was published in 1865. Sir Spencer Wells married in 1853 Miss Elizabeth Wright, and had a son and daughters. He died 31st January 1897. His estate at Golder's Hill, Hampstead, was sold after his death to the London County Council and con- verted into a public park.~~

~~Wellston, a city of Jackson county, Ohio, U.S.A. It is at the intersection of the Baltimore and Ohio South- western, the Cincinnati, Hamilton, and Dayton, the Hocking Valley, and the Ohio Southern railways, in the~~

southern part of the state. Population (1890), 4377 ; (1900), 8045, of whom 311 were foreign-born.

WellSVille, a city of Columbiana county, Ohio, U.S.A., on the Ohio river and the Pennsylvania Railroad, in the eastern part of the state, at an altitude of 687 feet. It is in a farming and coal-mining region, has rail-way works, rolling-mills, boiler works, and other manu- factures. Population (1880), 3377; (1890), 5247; (1900), 6146, of whom 475 were foreign-born and 113 negroes.

We Is, the chief town of a government district in Upper Austria, and formerly the capital of that arch- duchy, on the river Traun, about 17 miles by railway from Linz. The parish church is a restored Gothic structure, supposed to date from the 9th century. In 1519 the Emperor Maximilian died in the old castle, now private property. There is a Protestant church, erected by the Gustavus Adolphus Association in 1849- 1850, a theatre, a handsome town hall, and a fine park. The town draws a supply of natural gas, used for lighting, heat, and motive power, from deep artesian borings first made in 1891. It has an important trade in corn, timber, horned cattle, pigs, and horses, fowls, dairy produce, and lard; and considerable manufactures, including machinery, cast-iron, copper and brass goods, calico, gunpowder, oil, paper, articles in felt, flour, leather, and biscuits. Popula- tion (1890), 10,118; (1900), 12,187, including garrison of 1268 men.

Wener (Swedish, Vener or Vaner), the largest lake in Sweden and the third largest in Europe. It has an area of 2149 square miles; a maximum length of 112 miles ; a breadth of 56 miles ; a maximum depth of 295 feet; an altitude above sea-level of 144 feet, though the surface sometimes rises as much as 10 feet or more, for the lake is the recipient of the waters of numerous streams, the largest being the Klar, which drains the forests of Vermland and Kopparberg to the north. It is almost divided into two basins by two peninsulas and a group of islands, the western half being known as Lake Dalbo. The northern shores are high, rocky, and in part wooded, the southern open and low, though isolated hills occur, such as the far-famed Kinnekulle (774 feet above Lake Wener). Several islands break the surface, such as Leek, Kalland, and Thor. This lake and Lake

Wetter contain degenerate species of marine fauna, left after the retreat of the ice of the Glacial period. The principal outflow is the Gota, discharging into the Cattegat. By means of the Dalsland canal the lake, which is the scene of a busy traffic in timber, iron, and agricultural produce, has communication with Frederiks- hald in Norway ; by the Gota canal with the Cattegat, and also by the same canal with Lake Wetter, and so with the Baltic. On the shores of the lake stand the towns of Carlstad, Venersborg, Christinehanm, Mariestad, and Lidkoping.

Upon the relations of these lakes to the Baltic, see Professor Ckedner in Oeogr. Zeitschrift, 1895.

Wenersborg, or Venersborg, a lake port of Sweden, county Elfsborg, on a tongue of land between the Gota and the Vassbotten, the southernmost bay of Lake Wener, 54 miles by rail north-north-east of Gothen- burg. A canal 2^ miles long, with two sluices, made in 1604-11, cuts through the peninsula, thus avoiding the falls of Rannum in the river. The town is further connected with Frederikshald in Norway by the Dalsland canal (1863-68). It was founded in 1642, but has been repeatedly burnt down. It possesses a museum, a bridge (1642), a technical school, a deaf and dumb school, and iron foundries, tanneries, and match and paper factories. The port (on Lake Wener) is entered and cleared by an aggregate of over 320,000 tons annually. Population

(1880), 5482; (1900), 6395.

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~~WENLOC K— W ESER~~

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~~Wen lock, a municipal borough (including the market towns of Much Wenlock, Madeley, and Iron- bridge), Shropshire, England, in the Ludlow parliamentary- division, 12 miles south-east of Shrewsbury, with a station on the Great Western Railway. The district is not only important agriculturally, but includes coal-mines at Made- ley, limestone quarries, and iron-works at Madeley and Coalbrookdale. A drinking fountain was erected in 1897 as a memorial of the Diamond Jubilee of Queen Victoria. Population (1881), 17,557; (1901), 15,866.~~

~~Wennerberg, Gunnar (1817-1901), Swedish~~

~~poet, musician, and politician, was born at Lidkoping, of which place his father was parish priest, on the 2nd of October 1817. He passed through the public school of Skara, and in his twentieth year became a student at Upsala. He was remarkable from the first, hand- some in face and tall in figure, with a finely trained singing voice, and brilliant in wit and conversation. From the outset of his career he was accepted in the inner circle of men of light and leading for which the university was at that time famous. In 1843 he became a member of the musical club who called themselves " The Juvenals," and for their meetings were written the trios and duets, music and words, which Wennerberg began to publish in 1846. In the following year appeared the earliest numbers of Gluntame (or~~

~~"The Boys"), thirty duets for baritone and bass, which continued to be issued from 1847 to 1850. The success of these remarkable pro ductions, masterpieces in two arts, was overwhelming : they presented an epitome of all that was most unique and rjtost attractive in the curious university life of Sweden. In the second volume of his collected works Wennerberg gave, long afterwards, a very interesting account of the inception and history of these celebrated duets. HIs great personal popularity, as the representa- tive Swedish student, dip not prevent him, however, from pursuing his studies, and he became an authority on Spinoza ; in 1849 he was appointed lecturer in philosophy at Skara College. In 1850 he first travelled through Sweden, singing and reciting in public, and his tour was a long popular triumph. In 1860 he published his col- lected trios, as The Three. In 1865, at the particular wish of the king, Charles XV., Wennerberg entered public life as the official representative of elementary education. HE succeeded Fahlcrantz in 1866 as one of the Eighteen of the Swedish Academy, and in 1870 became Minister for Religion in the Adlerscreutz Government, upon the fall of which in 1875 he retired for a time into private life. HE was, however, made lord-lieutenant of the province of Kronoberg, and shortly afterwards was elected to represent it in the Landsthing. HIs active parliamentary life con- tinued until he' was nearly eighty years of age. In 1881 and 1885 he issued his collected works, mainly in verse. In 1893 he was raised to the Upper HOuse. HE pre- served his superb appearance in advanced old age, and he died, after a very short illness, on the 24th of August 1901, at the royal castle of Lecko, where he was visiting his brother-in-law, Count Axel Rudenschold. HIs wife, the Countess HEdvig Cronstedt, whom he married in 1852, died in 1900. Wennerberg was the most remark- able type which our age has seen of the lyrical, ardent Swedish aristocrat, full of the joy of life and the beauty of it. In the long roll of his eighty-four years there was scarcely a crumpled rose-leaf. HIs poems, to which their musical accompaniment is almost essential, have not ceased, in half a century, to be universally pleasing to Swedish ears ; outside Sweden it would be difficult to make their peculiarly local charm intelligible. (e. g.)~~

~~Wepener. See Oeakge River Colony.~~

~~Werda.ll, a town of Germany, on the Pleisse, 5 miles by rail west of the town and in the circle of Zwickau, kingdom of Saxony. The industries include wool-spinning, dyeworks, the building of carriages, chemical works, the making of spinning and electric lighting machinery. Population (1885), 14,638; (1900), 19,352.~~

~~Werden, a town of Prussia, in the Rhine province, on the river Ruhr, 6 miles by rail south of Essen. It has an interesting church (Roman Catholic), which belonged to the Benedictine abbey founded about 796 by St Ludger, whose stone coffin is preserved in the crypt. The abbey buildings are used as a prison. The manufacture of cloth, woollens, shoes, and paper, steam hammers, tanneries, dyeworks, distilleries, breweries, coal and iron mining, and stone quarrying are the principal industries. The Gothic Codex Argenteus of Ulphilas (now in Upsala University library) was discovered here in the 16th century. Population (1895), 9413; (1900), 10,701.~~

~~Werner, Anton Alexander von (1843-~~

~~-), German painter, was born at Frankfort-on-the-~~

~~Oder, 9th May 1843. He first studied painting at the Berlin Academy, pursued his studies at Carlsruhe, and, having won a travelling scholarship upon the exhibition of his early works, he visited Paris in 1867, and afterwards Italy, where he remained for some time. On his return he received several State commissions, and on the outbreak of the Franco-Prussian war in 1870 he was sent with the staff of the third corps d'armde, and stayed in France till the close of the campaign. In 1873 he was appointed professor at the Berlin Academy, of which he afterwards became director. Among his more important works must be named "The Capitulation of Sedan" (see Plate), " Proclamation of the German Empire at Versailles," "Moltke before Paris," "Moltke at Versailles," "The Meeting of Bismarck and Napoleon III.," " Christ and the Tribute Money," "William I. visiting the Tombs," " The Congress of Berlin," and some decorations exe- cuted in mosaic for the Triumphal Arch at Berlin. Von Werner's work is chiefly interesting for the historic value of his pictures of the events of the Franco-German war. He is, in fact, the State~~

~~*painter of Germany, and has had such influence over the art of his country as might be expected from his position.*~~

~~*See Kumst fur Alle, vol. i. — Knackfuss. KuTixtler-Monograph- ieen, No. 9.*~~

~~*Wervicq, a town of Belgium, in the province of West Flanders, 35 miles south-west of Bruges, on the left bank of the river Lys. It is on the French border, and opposite a French village of the same name. Its station is on the line from Courtrai to Ypres. The tobacco manufactured here is noted. Population (1890), 7484 ;*~~

~~*(1899), 8736.*~~

~~*Wesel, a fortified town of Prussia, in the Rhine province, at the confluence of the Lippe and the Rhine, 35 miles by rail north by west of Duisburg. The forti- fications are being demolished; those adjacent to the Berlin gate were taken down in 1892. The church of St Willibrord was restored in 1882-96. Amongst its insti- tutions are the Lower Rhenish Museum of Antiquities, &c, and a meteorological station. Population (1885),*~~

~~*20,677; (1900), 22,547.*~~

~~*Weser, one of the chief rivers of Germany, flowing for the most part through the Prussian province of Hanover. In the years 1890-95 the Fulda, one. of the head streams of the Weser, was canalized between Cassel and Fulda for a distance of 17^ miles, being at the same time widened to 263 feet and deepened to 5 feet. In that distance the river falls 58 feet (from 439 to 381 feet), and is provided*~~

~~*with seven sluices, each 199 feet long, 28 feet wide, and 5 feet deep on the sill. (For the deepening and other improvements which have been effected in the river between Bremen and the sea, see Bremen.) The total length is*~~

270 miles, or including also the Werra, its principal affluent, 440 miles ; area of its drainage basin, 18,530 square miles. Boats- of 350 tons can ascend generally as far as Miinden.

Wesley, Samuel Sebastian (1810-1876),

English composer and organist, natural son of Samuel Wesley, the eminent composer, was born in London on 14th August 1810. He was one of the Children of the Chapel Royal from 1819, held various unimportant posts as organist from the age of fifteen, and in 1832 was appointed to Hereford Cathedral. His career as a composer began with his splendid anthem, "The Wilderness," which was probably written for the opening of the Hereford organ in that year. In 1834 it fell to him to conduct the Festival of the Three Choirs, and in the following year he resigned Hereford for Exeter Cathedral ; and during the next six years his name became gradually more and more widely known. In 1842 Dr Hook, afterwards Dean of Chichester, offered him a large salary to become organist of Leeds parish church, and at Leeds much of his finest work as a composer was done. In 1849 he quitted this post for Winchester, in order to secure educational ad- vantages for his sons. He was at Winchester until 1865, when he offered himself as a candidate for' Gloucester Cathedral, the last of his many posts. He again con- ducted the Three Choirs Festivals of 1865, 1868, 1871, and 1874. A civil list pension of £100 a year was con- ferred on him in 1873 ; he died at Gloucester 19th April

1876, and was buried at Exeter. Like his father, some of whose peculiarities he may have inherited, he was a very eccentric man, but his compositions show powers that are found in very few Englishmen of his date. If the list of his compositions is smaller than that of his father's, it must be remembered that his anthems, in which is contained his best work, are far more important and more extensive than most compositions so called : in many of them the whole anthem is no longer sung, but even the selections from them make up anthems of ordinary length. They are masterly in design, fine in inspiration and ex- pression, and noble in character. His " Blessed be the God and Father," "The Wilderness," already mentioned, " Ascribe unto the Lord," " O Lord, Thou art my

God," and many others, are masterpieces in their way, and in all of these, as in the service in E, published with a rather trenchant preface in 1845, there is a happy combination of the modern resources of harmony with the dignified cathedral style, a combination which naturally alarmed the orthodox party of his time. (j. a. p. m.)

West Africa, French. — The name of French West Africa is semi-officially applied to a group of French colonies, constituted by decree of June 1895, reorganized by a decree of 17th October 1899, and now consisting of Senegal, three military territories, French Guinea, the Ivory Coast, and Dahomey. By the decree of 1899 the Middle Niger region, including the greater ■ part within the bend of the river, was placed under separate military administration, while the western portion of the old. Sudan province was united to Senegal under the adminis- tration of a civil governor. For the boundaries between French West Africa and the British sphere see Nigeria.

WEST AUSTRALIA.

I. Geography and Statistics.

THIS state occupies the whole of the continent of Australia to the westward of 129° E., and is thus bounded by the sea on the N., W., and S., and by South Australia and Northern Territory on the E. Very rapid developments have taken place during recent years, and a great amount of information in regard to the physical features of the country has been obtained, which has enabled many errors formerly current to be corrected, especially errors in regard to the characteristics of the country lying beyond the coastal fringe.

Archasan Rocks. — A vast area of West Australia is occupied by metamorphic, gneissic, granitoid, and schistose rocks, which form the basis on which the newer strata have been laid eo ogy. down, an(j which have been declared by observers to be of true Archaean age. The so-called Archsean rocks may be classified in six great divisions. The first or western belt extends from the river Murchison to the south coast. The rocks of this belt are for the most part comparatively soft, consisting of clay slates, quartzites, and schists, with dykes of diorite and granite and

veins of quartz containing lead, copper, zinc, iron pyrites, and ferruginous graphite. The second belt extends northwards from the south coast, forming the edge of the great plateau called the Darling Range, to the Murchison. The course of the river is followed for about 200 miles in a narrow belt, when it suddenly spreads out to the east and north-west from the Robinson Range to the Lyons Range, disappearing beneath the magnesian limestones to the northward. The rocks in this division are principally gneiss and schist, with dykes of diorite, granite, and felstone, and veins of quartz frequently auriferous. Tin is also found, the ore being derived from the disintegration of quartz-porphyry dykes, where it is associated with tourmaline and titanic iron. Large deposits of kaolin of good quality also occur, while near Bridgetown a bed of graphite 20 feet thick has been opened up. The third or granite belt is about 100 miles in width, and extends from the south coast to the river Murchison at a distance of 100 miles east from the west coast. It consists chiefly of gneiss or granite, the rocks in

many cases rising to a height of 100 feet. The belt is entirely destitute of mineral veins, and it is through the existence of this barrier that the rich gold-fields of the east remained so long unpro- speeted. The fourth or first auriferous belt lies to the eastward of the granite belt, and averages about 20 miles in width. Starting from the south coast at Phillips river, it extends northwards, by the Ravensthorpe Range, Parker's Range, Southern Cross, Golden Valley, Mount Magnet, Mount Kenneth, Austin's Lake, to Cue. Thence it bends to the north-east to Nannine and the Star of the East, where it strikes to the north and, skirting the heads of the Murchison and Gascoyne rivers, turns north-west and follows down the Ashburton valley to its junction with the Henry, finally disappearing beneath the Paleozoic formation. The rocks in this division consist chiefly of hornblende, mica, or talc schists, and are broken and faulted by granite and diorite dykes and quartz lodes containing gold, iron, and copper. There are also magnesia. lode masses rich with fine gold, while many of the lodes contain large quantities of chlorite. The fifth or second granite belt ex- tends from the south coast, following the line of the first auriferous belt to the north, where it dips under the Palaeozoic tableland of the Forteseue. The sixth or second auriferous belt lies next, and has proved extremely rich in gold. It extends north from the Dundas Hills

~~through Wagemulla, Coolgardie, Lady Carey, &c, and, following about the same line as the other belts, turns to the north-west by Nullagine, Marble Bar, Pilbarra, Egina, and Mallina on the north-west coast. The rocks in this division are generally similar to those in the first auriferous belt, but are much more faulted and disrupted ; the lodes, however, are the richest yet discovered.~~

~~Cambrian Rocks extend in a north-east and south-west direction from the Burt Range and for some distance to the southward of Mount Dockri'll. The Cambrian rocks of the Kimberley district are of considerable importance, as they form the matrices of the auriferous quartz reefs which have furnished rich yields of the precious metal.~~

It is claimed that the rocks of the Stirling Range, about 50 miles to the north of Albany, belong to the Silurian Group. The strata consists of quartzites, sandstones, and shales traversed by quartz veins, and show evidence in places of folding, contorting, and faulting.

The Devonian Socks in the Kimberley district consist mainly of

statistics]

WEST AUSTRALIA

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hard grits, indurated limestones, and shales and conglomerates. The strata rest unoonformably upon schists and slates which are believed to be of Lower Silurian age, and are covered by basaltic lavas in turn overlaid by Carboniferous rocks. It has been calcu- lated that the Devonian beds occupy an area of 2000 square miles, with a thickness of 10,000 feet. Besides Spirifera, Orthoceras, and Goniatites, the Kimberley beds contain such fossils as Actino- strom% clatkratum, Pacypora tumida, Oyathophyllum virgatum, Rkynchonella, cuboides, and various others. Associated with these sedimentary strata are contemporaneous basalts, dolerites, aname- sites, volcanic breccias, and ashes. The deposits of these eruptive rooks have been estimated to reach a depth of upwards of 1000 feet, and they extend over a considerable area of country.

The first mention of the occurrence of rocks of Carboniferous age in West Australia appears in the Journal of Expeditions, by Sir George Grey, published in 1841. In 1848 Dr F. von Sommer, the first Government geologist of the colony, traced the Carboniferous beds from the head of the Irwin river to the sources of the Moore for a distance of 160 miles. Fossiliferous strata of Carboniferous age have been proved in the colony in three distinct districts. In the Kimberley district the bed9 consist of widespread deposits of , sandstones, grits, and conglomerates containing bands and nodules of haematite as well as magnesian and other limestones. In the Gascoyne district the deposits consist of a series of crystalline limestones rich in corals, dipping at an angle of 10° to the

west- ward, while beneath them are beds of shale yielding Lower Car- boniferous fossils. In the Irwin river district the Carboniferous strata are supposed to stretch in an easterly direction from Minge- new, covering an area of about 20 square miles, the greatest length from north to south being about 30 miles/ and the width from east to west about 17 miles.

Mesozoic Rocks. — The character of the strata belonging to this period has been described as follows : — Beds of highly ferruginous claystone or shale, sandstones, grits, conglomerates, clays and limestone, placed in horizontal layers on the older rocks which originally they must have entirely covered, but through denuda- tion have since been worn down so as to leave in places tablelands and cliffs with steep escarpments and slopes. There are two prin- cipal areas occupied by this formation. The first, which varies in width from 10 to 30 miles, extends from the neighbourhood of Gingin and Yatheroo to the Murchison, and probably farther northwards in a line more or less parallel to the coast. Eastwards it thins out and only exists as outliers and cappings on the hills. The second principal area of this formation embraces the country extending from near Cape Riche to beyond Phillips river. Boring operations near Geraldton have proved the Mesozoic beds to be of a thickness of at least 1100 feet.

Cainozoic Bocks occupy an extensive area. In the Eocene group are included the coralline and chalky limestones with flints extend- ing along the whole length of the Australian Bight and for about 150 miles inland. To the Pliocene belong the ‘ ‘ Pindan, ” large sandy plains developed on each side of the river Fitzroy, and stretching away to the southward into Warburton’s Desert, and constituting also the great sandy plains of the interior which form one of the characteristic features of West Australia. The Pleistocene deposits include ancient river gravels and lake basins found in several places in the ranges, lower estuarine deposits found as far inland as Perth, and shelly limestones and sandstones containing fossils very similar to the living forms. The Recent deposits embrace the alluvium of the inland lake basins, which are in many instances covered with layers of salt and gypsum, the latter often occurring in the form of selenite crystals, river valley and estuarine deposits, coastal sand plains

~~and raised beaches, and various marls, gravels, and other surface deposits.~~

~~West Australia attained the position of an independent colony with responsible government on 21st October 1890, and the first representative Parliament was opened on 30th December of that year. Population made very slow increase under the old conditions of settlement, and even when gold was discovered in 1882 at Kimberley, and five years later at Yilgarn, no great impetus was given to the colony, and at the census of 1891 the population was still under 50,000. The sensational gold finds at Coolgardie in 1892, however, had a most important influence in drawing popu- lation, and in three and a half years the population was doubled : during a portion of this time the rush of miners to the gold-fields was so great as to be reminiscent of the experience of the eastern colonies during the 'fifties. The slowness of the early growth and the more rapid strides of later years will be gathered from the following figures : Population (1860), 15,227; (1870), 25,084; (1880),~~

~~Papula- tlott.~~

~~29,019; (1890), 46,290; (1895), 101,238; (1901),~~

~~194,889; the last total comprising 118,762 males and 76,127 females. West Australia has three towns whose populations exceed 5000 — viz., Perth, 36,274 ; Fremantle, 20,444 ; and Kalgoorlie, 6652. Some of the other towns have populations approaching 3000 ; Boulder has 4601 ; but the number of people on all gold-field towns fluctu- ates very greatly. Coolgardie, for example, was returned in July 1894 as having within its municipal boundaries 12,000 people, and in March 1901 only 4249.~~

~~The births during 1901 numbered 5718 and the deaths 2519, the rates per thousand of population being respectively 30-'32 and 13-36, showing a net increment of 16-96 per 1000. The birth-rates in five-yearly periods since 1861 were as follows : —~~

~~Birth-rate~~

~~Birth-rate~~

~~Years.~~

~~per 1000 of~~

~~Years.~~

~~per 1000 of~~

~~Population.~~

~~Population.~~

~~1861-65 .~~

~~39-07~~

~~1881-85 .~~

~~34-57~~

~~1866-70 .~~

~~33-86~~

~~1886-90 .~~

~~36-88~~

~~1871-75 .~~

~~31-30~~

~~1891-95 .~~

~~30-77~~

~~1876-80 .~~

~~32-97~~

~~1896-1901~~

~~28-65~~

~~The decline in the birth-rates has been a common experience of all the Australian states ; in West Australia it is due in a large degree to the decline in the proportion of females to males. In 1870 the females numbered 62 per cent, of the males, and in 1880 75 per cent., while in 1895 the proportion was only 45 per cent. The illegitimate births during the five years preceding 1901 were slightly in excess of 5 per cent, of the total births, and are increas- ing. The death-rate is higher than in the other states of Austra- lasia, but much below the European standard. Grouping the deaths in five-yearly periods, from 1861 onwards, the rates were as follows : —~~

~~Deaths~~

~~Deaths~~

~~Years.~~

~~per 1000 of~~

~~Years.~~

~~per 1000 of~~

~~1861-65 .~~

~~Population.~~

~~Population.'~~

~~16-31~~

~~1881-85 .~~

~~17-19~~

1866-70 .

15-55

1886-90 .

15-97

1871-75 .

16-03

1891-95 .

16-31

1876-80 .

14:32

1896-1901

14-73

The large influx of young unmarried men in the years 1894-98 was followed by the arrival of a large number of single women, and the marriage — rates increased from 7 per 1000 in the five years 1891-95 to 10-7 per 1000 in 1897 and 9-6 in 1901. The rates for these latter years must be looked on as abnormal, and the probabilities point to a return to a rate of 7 per 1000 inhabi- tants for marriages, or 14 per 1000 for persons married. Except for a slight influx of population in the three years 1885-87, due to the gold discoveries at Kimberley, there was very little immi- gration to West Australia prior to 1891 ; in that year, however, there was a considerable inpouring of population from the eastern colonies, notably from Victoria and South Australia, and in the seven years which closed with 1897 the population of the colony gained nearly 110,000 by immigration alone. In 1898 there was still a large inflow of population, but the outflow was also great, and in 1898 and the following year the two streams balanced one another ; but 1900 showed an excess

of 6000, and 1901 of nearly 12,000, gained by immigration. West Australia is the most sparsely populated of all the states ; only the coastal fringe and the gold-fields show any evidences of settlement, and if the area were divided amongst the population, there would be but ten persons to 52 square miles. In a country so sparsely settled municipal government has little scope for operation ; the total area controlled by muni- cipalities properly so-called is only 100 square miles. Besides the municipalities there are district roads boards, elected by the rate- payers of their respective districts to take charge of the formation, construction, and maintenance of the public roads throughout their districts. There were in 1900 eighty-eight such boards in existence, some of the districts being of enormous eize, Pilbarra, for example, being 14,356 square miles in area, and the Upper Gascoyne 136,000 square miles: over areas so vast little effective work can be accomplished, but where the districts are small the administration is much the same as in the municipalities. The receipts from rates of all local districts in 1900 was £82,300, and the grants by the Government £60,028, making a total of £142,328. The population is almost exclusively of British origin, and only differs from that of the other states in that there is a larger body of Australian-born, who are not natives of the colony itself. About 45 per cent, of the population are members of the Church of England,

and one -fourth belong to other Protestant denominations; the Roman Catholic Church also claims one-fourth.

Instruction. — Attendance at school is compulsory upon all chil- dren over six years and under fourteen years of age. Instruction is imparted only in secular subjects, but the law allows special religious teaching to be given during half an hour each day by clergymen to children of their own denomination. Children can claim free education on account of inability to pay fees, of living more than a mile from school, or of having attended school for more than 400 half-days during the preceding year. The state expended in 1900 £78,030 on public instruction, the great bulk of which was devoted to primary schools. The number of schools supported by the

state was 218, to which 513 teachers were at- tached, the net enrolment of scholars being 18,557 and the average attendance 14,663. There were in 1900 75 private schools, with 248 teachers and 5462 scholars, the average attendance being 4248. All schools therefore numbered 293, teachers 761, and scholars 24,019. Judged by the number of persons arrested, crime is more prevalent than in any other part of Australia. The gold- fields have attracted some of the best and most enterprising of the Australian population ; at the same time many undesirable persons flocked to the state expecting to reap a harvest in the movement and confusion of the gold diggings. These latter form a large part of the criminal population of the state. The arrests in 1900 numbered 13,880, of which 3644 were for serious offences, so that for every thousand of the population 59 were arrested for trivial and 19 for serious crimes.

Finance. — The discovery of gold and the settlement on the gold- fields of a large population, for the most part consumers of dutiable goods, has entirely revolutionized the public finances of the state. In 1891 the revenue was £497, 670, that is, £10 15s. per inhabitant ; in 1895 it rose to £1,125,941, or £12 10s. per inhabitant ; and in 1897 to £2,842,751, or £20 12s. 2d. per inhabitant. For 1901 the figures were £3,078,034, or £16 18s. 8d. per inhabitant. The chief sources ofrevenue in 1901 were: customs and excise, £992,216; other taxation, £144,103 ; railways, £1,347,089 ; posts and telegraphs, £210,126; public lands (including mining), £251,292; all other sources, £133,208 ; total, £3,078,034. The expenditure has risen with the revenue, but the treasurer has been able to keep within his income, and for the ten years ending with 1901 the total excess expenditure amounted to about £198,000. The chief items of expenditure in 1901 were : railway working expenses, £1,071,576 ; public works, £324,123 ; posts and telegraphs, £255,514 ; interest and charges upon debt, £486, 800 ; other services, £1, 027, 231. These figures give a total of £3,165,244. The chief feature in the expenditure is the great increase in the sum devoted to the con- struction of public works. In 1890 the sum expended on this service was about £30,000; in 1895 it rose to £145,000, in 1897 to £931,000. The public debt is of comparatively recent creation. In August 1872 an Act was passed authorizing the raising of certain sums for the construction of public works ; in 1881 the amount owing was not more than £511,000, and in 1891 only £1,613,000, or £30 5s. 8d. per

~~inhabitant; from the year last named the indebtedness has increased by leaps and bounds, and in 1901 had mounted up to £12,709,430, a sum equal to £67 14s. 6d. per inhabitant, involving an interest charge of £486,800, or £2 12s. per inhabitant. The proceeds of the loans were used largely for the purpose of railway extension, the expenditure on this service at the middle of 1901 was £6,968,965; on water supply and sewerage works, £1,597,375 ; on telegraphs and telephones, £269,308 ; and on other works not revenue-yielding, £3,050,484. The return from works constructed out of loan funds, in excess of the working expenses, amounted in 1901 to £246,300, compared with the interest charge of £486,800, which reduces the actual annual burthen of the debt to £240, 500.~~

~~Defence. — The actual strength of the defence forces is 2247 men, 54 paid and 2193 partially paid. Military works have been con- structed for the defence of King George Sound and Princess Royal Harbour, and works have been commenced for the protection of Fremantle. The garrison of the batteries, King George Sound, is provided by West Australia, and the state bore one-fourth of the cost of construction and equipment, the other states con- tributing the remainder on a population basis. West Australia contributes £5100 towards the upkeep of the Australian Auxiliary Squadron.~~

~~Minerals. — Gold-mining is the main industry, and finds employ- ment for 30,000 men in the actual work of mining, besides almost as large a number indirectly. Agriculture gives employment to about 12,000, and pastoral pursuits 2700, while about 1000 others are employed in forests and fisheries. West Australia makes an enumeration of its factories, but the number of hands employed therein can only be given for recent years. In 1885 there were 140 establishments, in 1890 175, and in 1900 632; the average number of hands employed in 1900 was 11,200. Gold, coal, tin, and copper are the chief minerals mined, the value of other minerals obtained was in 1900 less than £17,000. The production of gold in each year from 1888 onwards was : —~~

~~1888 .~~

~~1889 .~~

~~***1890 .***~~

~~***1891 .***~~

~~***1892 .***~~

~~***1893 .***~~

~~***1894 .***~~

~~***£13,273***~~

~~***1895***~~

~~***58,874***~~

~~***1896***~~

~~***86,663***~~

~~***1897***~~

~~***115,182***~~

~~***1898***~~

~~***226,282***~~

~~***1899***~~

~~***421,386***~~

~~***1900***~~

~~***787,098***~~

~~***1901***~~

~~***[statistics***~~

. £879,749

. 1,068,807

. 2,564,977

. 3,990,699

. 6,246,733

. 6,007,610

. 7,235,652

West Australia now ranks as the largest gold producer of the Australian group. Coal is worked at Collie, 25 miles east of Bunbury, and has been found in several other places. The future of the industry is uncertain, but it is probable the production of coal will be limited to the local demand. The export of copper in 1901 was valued at £110,769, and of tin £52,102.

Agriculture. — The agricultural resources are restricted, as the rainfall in the southern and temperate portion does not extend far from the coast, and the land where the fall is satisfactory is only good over small areas. The area cultivated in 1871 was 52,000 acres ; in 1881 it was 53,000 acres, in 1891 64,000 acres, and in 1901 201,000 acres. The principal crops grown in the year last named were : wheat 74,000 acres, and hay (wheaten and oaten) 104,000 acres. The wheat yield, calculated over a period of ten years, was eleven bushels per acre, and the hay crop not quite a ton per acre. In 1901 the number of sheep depastured was 2,434,000, the cattle 338,600, and the horses 68,000. These figures show an increase for all classes of stock. There are more than 3000 camels. The number of sheep has increased during the ten years 1891-1900, while the weight of wool exported was considerably more in 1900 than in 1891. In 1871 2,000,000 lb of wool were exported, in 1881 4,100,000, in 1891 8,800,000, and in 1900 9,514,000 ; in each case the equivalent weight of greasy wool has been taken where washed wool was exported. West Australia has very extensive forests of timber, and it has been estimated that the forest surfaces cover more than 20 million acres, of which 8 million

~~acres are jarrah ; 1,200,000 acres, karri; 200,000 acres, tuart ; 7 million acres, wandoo ; and 4 million acres, York gum, yate, sandalwood, and jam. The principal timber ex- ported is jarrah, karri, and sandalwood, and in 1900 the value of the export was: jarrah, £297,847 ; karri, £160,180 ; and sandal- wood, £39,038. There were in operation fifty-one saw-mills, em- ploying about 3400 hands.~~

~~Fisheries. — The pearl-shell fisheries in the north-west and in Shark Bay have been a considerable source of wealth, the ex- ports of pearls and pearl shell being valued at £110,667 in 1899, £106,607 in 1900, and £130,730 in 1901. In 1892 the export was valued at £119,519.~~

~~Commerce. — All the great lines of steamers trading between Australia and Europe make one of the ports a place of call both on the inward and outward voyage ; this makes the shipping tonnage very large compared with the population. In 1891 the tonnage entered and cleared equalled 21 tons per head, and in 1901 19 '8 tons : these amounts were altogether beyond the requirements of the trade of the colony in the year named, as the total weight of imports and exports in 1901 was only 750,000 tons, equal to 3'8 tons per inhabitant. The increase of tonnage is shown by the following figures : 1881, tonnage entered 145,048; 1891, 533,433; and 1901, 1,842,236. There are three important ports, viz., Fre- mantle, Albany on King George Sound, and Geraldton. In 1900 the tonnage entering Fremantle was 522,152, and the imports were valued at £5,489,493 and the exports at £5,146,603 ; these figures include the trade of Perth. The shipping entering Albany had a tonnage of 1,032,435, and the imports were valued at £184,819 and the exports at £2,190,234. The trade of Geraldton was: imports £143,109, and exports £94,542 ; at no other port did the trade in 1900 ljach the value of £230,000. The trade has in- creased very rapidly under the influence of the gold discoveries, as the following figures show : —~~

~~Year.~~

~~Imports.~~

~~Exports.~~

~~*Total.*~~

~~*Per Head.*~~

~~*Total.*~~

~~*Per Head.*~~

~~*1861 1871 1881 1891 1901*~~

~~*147,913*~~

~~*226,000*~~

~~*404,831*~~

~~*1,280,093*~~

~~*6,454,171*~~

~~*£ s. d.*~~

~~*9 9 8*~~

~~*9 0 10*~~

~~*13 14 3*~~

~~*25 2 5*~~

~~*34 4 5*~~

~~*« 95,789*~~

~~*209,196 502,770 799,466*~~

~~*8,515,623*~~

~~*£ s. d.*~~

6 2 10

8 6 11

17 0 8

15 13 9

45 3 0

About 54 per cent, of the trade is with Great Britain, and 21 per cent, with the other Commonwealth states. The principal articles of local production exported during 1901, with their values, were : gold, £6,749,638 ; pearls and pearl-shell, £130,730 ; sandalwood, £73,931 ; skins, £86,559 ; timber, £572,354 ; wool, £378,135 ; copper, £110,769 ; and tin, £52,102.

Communications. — West Australia is the only state of Aus- tralia in which there is any considerable length of railway lines not owned by the state. The total railway mileage is 1978, of

history]

WEST AUSTRALIA

825

which 623 miles are privately owned. The divergence of the policy of West Australia from that pursued by the other states was caused by the inability of the Government to construct lines at a time when the extension of the railway was most urgently required in the interests of settlement. Private enterprise was therefore encouraged by liberal grants of land to undertake the work of construction. Changed conditions have modified the state policy in respect of land grants, and in 1897 the Government acquired the Great Southern Railway, 243 miles in length, one of the two trunk lines in private hands. The cost of constructing and equip- ping the state lines open for traffic in 1901 was £7,098,240, and the earnings amounted to £1,353,704, which represents a return of 4‘4 per cent, upon the capital cost. The interest paid by the state on its loans is 3‘6 per cent.,

so that there was in 1901 a net profit of nearly 1 per cent, on the railways of the state, and this has in some years been greatly exceeded. The extension of railway facilities will be seen from the following figures : mileage open for traffic, 1876, 38 miles ; 1881, 92 miles ; 1891, 202 miles ; and 1901, 1978 miles. The postal business has grown enormously since the gold discoveries. In 1900 there were 178 post offices, compared with 86 in 1891. The postal business for the years specified is shown in the following table : —

Year.

Letters.

Newspapers.

No.

Per Head.

No. | Per Head.

1881 1891 1900

995,000

3,200,000

13,163,000

34 64

74

715,000 24 1,665,000 33 6,993,000 40

In addition to the letters and newspapers, there were 3,413,000 packets, 36,600 parcels, and 459,000 post-cards delivered or de- spatched by the post offices during 1900. There were in the same year 161 telegraph stations, 6052 miles of line, and 8872 miles of telegraph wire in use, while

the number of telegrams sent and received (counting each telegram once) was 1,167,197 ; this repre- sents the large average of seven telegrams per inhabitant.

Banking. — There are six banks of issue, with seventy-one branches in various parts of the country. The liabilities of these banks in 1901 averaged £4,929,042, and the assets, £5,944,769; the note circulation was £378,372; the deposits bearing interest, £1,456,373, and those not bearing interest, £2,980,390 ; making the total deposits £4,436,763. The gold and silver held by the banks, including bullion, was £2,378,055. The savings banks are directly controlled by the Government, and are attached to the post offices ; in 1901 there were 39,339 depositors in these banks, with £1,618,359 to their credit. In 1891 there were only 3564 depositors, and £46,181 at credit.

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(t. A. C.)

II. Recent History.

The progressive history of West Australia may be said to commence in 1870, when its energetic and capable governor, the late Sir Frederick Weld, began to inaugurate public works on a large scale. It was still the day of small things, for the colony, though of the enormous extent of a million square miles, was practically unknown, its resources were restricted, and its population scanty. However, a beginning was then made, and the first Loan Bill to raise money for pushing on telegraphs, for survey- ing lines of projected railways, and above all for starting exploring expeditions, passed the Legislative Council. The colony was fortunate in possessing two brothers of the best practical type of explorer,

~~John and Alexander Forrest. The object of their earliest expeditions was to find more land available for pastoral or agricultural settle- ment. Vast distances in various directions were covered, and severe hardships, chiefly from want of water, under- gone by these intrepid pioneers. Perhaps the most famous of these journeys was that accomplished by Mr (afterwards Sir) John Forrest between Eucla and Adelaide in 1870.~~

~~Other dauntless explorers — notably Mr Ernest Giles, the Gregorys, and Mr Austin — had also contributed to the growing knowledge of the resources of the vast territory, and the state owes and gratefully acknowledges its debt to these stalwart and splendid pioneers. Although, in consequence of the vast amount of gold which had been found in the eastern colonies, principally in Victoria, all these explorers had carefully examined any likely country for traces of gold, it was not until 1882 that the Govern- ment geologist reported indications of auriferous country in the Kimberley district, and the first payable gold-field was shortly afterwards " proclaimed " there. Exploring expeditions in every direction were then started both privately and publicly, and prosecuted with great vigour. Within five years gold-fields were proclaimed at Yilgarn, about 200 miles to the east of Perth, and the discovery of patches of rich alluvial gold in the Pilbarra district quickly followed, but the rush for the Coolgardie and Kalgoorlie gold-fields did not begin until 1893.~~

~~The year 1889 found the colony on the eve of re- sponsible government. Two years before, a practically unanimous vote of the Legislature had affirmed the principle of autonomy, and the general election in the following year showed still more plainly the desire of the people of West Australia for the self-government which had enabled the eastern colonies to control their own affairs successfully for thirty years. The new Legislative Council of 1889 therefore drafted a Constitution Bill, which after some discussion was forwarded to Lord Knutsford, the Secretary of State for the Colonies. This Bill was duly laid before the Imperial Parliament ; but the measure was then rejected by that assembly, chiefly owing to the misunderstanding of vital questions, such as the control of Crown lands, the scantiness of the scattered population, and other less important details. However, the governor of that day, the late Sir Frederick Napier Broome, K.C.M.G., having satisfied himself that the~~

con- stitutional change was necessary not only for the imme- diate needs of the rapidly growing colony, but in view of the larger question of Imperial Federation, supported the demands of the Legislature in every possible way. A clear and able statement of the colonists' case, which ap- peared above his signature in The Times in the summer of that year, helped to bring about a better understanding of the subject ; and a slightly modified Constitution Bill having been passed by the new Legislative Council, the governor and two members of the Legislature (Sir T. C. Campbell and Mr S. H. Parker, Q.C.) were selected to proceed to England as delegates to explain and urge the wishes of the colonists upon the Imperial Parliament. A select committee, with Baron de Worms as chairman, was appointed, and the matter was carefully considered ; with the satisfactory result that the Bill enabling the Queen to grant a constitution to West Australia passed its third reading in the House of Commons on 4th July, and re- ceived the royal assent on 15th August 1890. Since then the colony has made great progress. Sir John Forrest, who was for ten years its Premier, brought to his arduous task not only administrative ability of a very high order, but a thorough and intimate knowledge of the needs and resources of the vast colony over so much of which he had travelled. The scanty and scat- tered population of 45,000 persons to whom the Imperial Parliament hesitated in 1890 to confide the guidance of their own affairs increased to 200,000, and the average annual revenue (1880-90) is now exceeded by the Trea- surer's monthly returns. The geographical position of West Australia is much in its favour, offering, as it does in Fremantle, the first port of call for ocean steamers.

For a long time the advantages of Federation were not so apparent to the people of West Australia as to those of the eastern colonies, and although Sir John Forrest consistently and patiently laboured at every opportunity to explain the principles of the Bill framed by the Federal Convention which had held its sittings since 1886 in Adelaide, Sydney, and

Melbourne, the desire to federate was of slow growth. Among the objections was the feeling that so far as West Australia was concerned the step was premature, and that the colony had more to lose than gain by Federation. This applied chiefly to the questions of tariff and free trade, and to the loss of the individual control of such sources of revenue as customs, postal and telegraph services. On the subject of defence there could be but one opinion, in favour of Federation, but that was hardly enough to counterbalance the fears of the local producer, who had become accustomed to a pro- tective tariff. Then the gold-fields expressed a desire to be made into a separate colony, and although a numerously signed petition to that effect was forwarded to the Queen, it was regarded in the light of a party move, and did not prove successful. Still there was great hesitation on the part of many of the colonists of West Australia to join the Commonwealth without receiving a pledge for the retention of their own customs dues for five years, and early in 1900 Sir John Forrest made a personal attempt to obtain this concession from the sister Governments. He was, however, unsuc cessful, aa was Mr S. H. Parker, Q.C., who in the same year accompanied the delegates from the eastern colonies to London, and endeavoured to obtain the insertion in the Enabling Bill of certain recommendations of the select committee in Perth. Yet as a whole the people of West Australia were loyal to the Federal cause, and therefore it was considered best to submit the Bill to a referendum of the electors, when a majority of over 25,000 votes decided in favour of Federation, as the Constitution Act provided that this state should have the right to enact her own tariff as against the sister states for the desired five years, decreasing annually at the rate of one-fifth of the amount of the original duty until the whole disappeared. (m. A.- B.)

West Bay City, a city of Bay county, Michigan, U.S.A. It is on the river Saginaw, near its mouth and at the head of navigation, and on the Grand Trunk and Michigan Central railways, in the eastern part of the Lower Peninsula, at an altitude of 587 feet. Situated near the pineries of the Lower Peninsula, its industries are mainly connected with the manufacture and shipping of lumber. It has saw and planing mills, and other wood- working establishments. Population (1890), 12,981 ; (1900), 13,119, of whom 3754 were foreign-born.

Westboro, a town of Worcester county, Massa- chusetts, U.S.A., containing an area of 17" square miles of hilly country, situated in the central part of the state. The principal village bears the same name as the town, and has a level site, on which it is laid out irregularly. It is on the Boston and Albany Kailroad, and is at an alti- tude of 300 feet. It contains a state insane asylum, and has manufactures of boots and shoes, hats, bicycles, &c. Population (1890), 5195 ; (1900), 5400, of whom 1127 were foreign-born.

West Bromwich, a municipal, county (1888), and parliamentary borough and market town of Stafford- shire, England, on the Tame, 5 miles north-west of Birming- ham by rail, and in water-communication with all parts of England. The corporation has laid down electric lighting and power plant. The school board for the parish has spent about £47,000 on school buildings ; and, in addition to board, there are numerous other schools, one of which maintains pauper children and teaches spade husbandry, baking, engineering, &c. The Institute (1886), providing instruction in science and art, was taken over by the cor- poration in 1894 ; law courts were erected in 1891 ; Oak House was opened as a museum and art gallery in 1898. Places of public recreation include Dartmouth Park, 65i acres, Farley Park (1891), Kenrick Park (1895), and Hill Top Park (1897). Within the borough is Sandwell Park, lately the seat oj the Earls of Dartmouth. In 1891 there ware 6486 persons (males) engaged in the iron and steel manufacture, 726 in manufacture in mixed metals; 581

in the making of machines and tools ; and 1395 in coal-mining. A thirty-feet coal-field of about 2000 acres in area has been discovered. Area of municipal and county and parliamentary boroughs, which are coextensive 5860 acres. Population (1891), 59,538; (1901), 65,172!

Westbrook, a city of Cumberland county, Maine, U.S.A., on the river Presumpscot, and the Maine Central and the Portland and Rochester railways, in the south- western part of the state, adjoining Portland. The river furnishes water-power, which is utilized to a large extent in manufacture. There are factories for 'making paper, cotton and silk goods, and other articles. Population (1880), 3981 ; (1890),, 6632 ; (1900), 7283, of whom 1673 were foreign-born.

West bury, a parish and town in the Westbury or Western parliamentary division of Wiltshire, England, 26 miles north-west of Salisbury by rail. The town is of very ancient origin, and formerly sent two members to Parliament. Since 1885 its representation has been merged in that of the county. The church of All Saints' was restored in 1867 and the Laverton Institute opened in 1873. The chief trade is, in fancy woollen coatings and meltons, but there are also brick and tile works and two blast-furnaces, employing a large number of hands. Popu- lation (1891), 4439 ; (1901), 3300.

West Chester, a borough of Pennsylvania, U.S.A., capital of Chester county, on the Pennsylvania Railroad, in the south-eastern part of the state, at an altitude of 406 feet. It is surrounded by market gardens, dairy farms, &c, and to some extent is a residential suburb of Philadelphia. Population (1890), 8028; (1900), 9524, of whom 566 were foreign-born and 1777 negroes.

Westcott, Brooke FOSS (1825-1901), Eng- lish divine and Bishop of Durham, was born on the 12th of January 1825 in the neighbourhood of Birmingham. His father, Frederick Brooke Westcott, was a botanist of some distinction. Westcott was educated at King Edward VI. School at Birmingham. There he came under the influence of Dr Prince Lee, from whom he seems to have derived the ideal of exact scholarship and broad intel- lectual sympathy, of which he was himself the most conspicuous example among the many distinguished Eng- lish Churchmen of the 19th century. To King Edward's School he was also indebted for his friendship with Joseph Barber Lightfoot. In 1844 Westcott obtained a scholar- ship at Trinity College, Cambridge. At the University he had a brilliantly distinguished career. He obtained Sir William Browne's medal for a Greek ode in 1846 and 1847, the Members' Prize for a Latin essay in 1847 as an undergraduate and in 1849 as a bachelor. He took his degree in January 1848, obtaining double-first honours. In mathematics he was twenty-fourth wrangler, Todhunter being senior, Bishop Barry and Lord Alwyne Compton (Bishop of Ely) being in the same class. In classics he was senior, being bracketed with Scott, afterwards head- master of Westminster School. After obtaining his degree, Westcott remained for four years in residence at Trinity. In 1849 he obtained his fellowship; and

~~in the same year he was ordained deacon and priest by his old headmaster, Prince Lee, who had become Bishop of Manchester. The time spent at Cambridge was devoted to most strenuous study. He took pupils ; and among his pupils there were reading with him, almost at the same time, his school friend Lightfoot and two other men who became his attached and lifelong friends, Edward White Benson (afterwards Archbishop of Canterbury) and Fenton John Anthony Hort (afterwards Lady Margaret~~

~~professor of divinity at Cambridge). The inspiring in- fluence of Westcott's intense enthusiasm left its mark 'upon these three distinguished men. It is not too much to say that they regarded Westcott not only as their friend and counsellor, but as in an especial degree their teacher and oracle. The precocity of Westcott's attainments and learning was early recognized. But the publication of his Norrisian prize essay in 1851, with the title Elements of Gospel Harmony, first proclaimed to the reading world the promise of a great theologian. He de- voted much attention to philosophical, patristic, and his- torical studies, but it soon became evident that he would throw his strength into New Testament work.~~

~~In 1852 he became an assistant master at Harrow. Shortly afterwards he was married to Miss Whithard, daughter of Mr Thomas Middlemore Whithard of Kings- down, Bristol. He prosecuted his school work with char- acteristic vigour, and succeeded in combining with his school duties an enormous amount both of theological research and of literary activity. He worked at Harrow for nearly twenty years under Dr Vaughan and Dr Montagu Butler. He was felt in the school to be a unique person- ality, of whom the school was proud, but whom neither the boys, nor even the masters probably, pretended altogether to comprehend. Perhaps it is true that he never really understood the limitations of boy nature. At any rate,' while he was always conspicuously successful in inspiring a few senior boys with something of his own intellectual and moral enthusiasm, be was never in the same measure capable of maintaining discipline among large~~

~~numbers. The writings which he produced at this period created a new epoch in the history of modern English theological scholarship. In 1855 he published the first edition of his History of the New Testament Canon, which, frequently revised and expanded, became the standard English work upon the subject. In 1859 there appeared his Charac- teristics of the Gospel Miracles. In 1860 he expanded his Norrisian essay into an Introduction to the Study of the Gospels, a work remarkable for insight and minuteness of study, as well as for reverential treatment combined with considerable freedom from traditional lines. Westcott's work for Smith's Dictionary of the Bible, notably his articles on "Canon," "Maccabees," "Vulgate," entailed most careful and thorough preparation, and led to the composition of his subsequent valuable popular books, The Bible in the Church (1864) and a History of the English Bible (1869). To the same period belongs The Gospel of the Resurrection (1866). As a piece of con- secutive reasoning upon a fundamental Christian doctrine it deservedly attracted great attention. Its width of view and its recognition of the claims of historical science and pure reason were thoroughly characteristic of Westcott's mode of discussing a theological question. At the time when the book appeared his method of apologetic showed both courage and originality, but it must be owned that the excellence of the work is somewhat impaired by the diffi- culty of the style.~~

~~In 1865 he took his B.D., and in 1870 his D.D. He received in later years the honorary degrees of D.C.L. from Oxford (1881), and of D.D. from Edinburgh (1883). In 1868 Westcott was appointed examining chaplain by Bishop Magee (of Peterborough) ; and in the following year he accepted a canonry at Peterborough, which neces- sitated his leaving Harrow. For a time he contemplated with eagerness the idea of a renovated cathedral life, de- voted to the pursuit of learning and to the development of opportunities for the religious and intellectual benefit of the diocese. But the regius professorship of divinity at Cambridge fell vacant, and Lightfoot, who was then Hulsean professor, declining to become a candidate himself,~~

~~insisted upon Westcott's standing for the post. It was due to Lightfoot's support almost as much as to his own great merits that Westcott was~~

elected to the regius pro- fessorship on 1st November 1870. This was the turning- point of his life. He now occupied a great position for which he was supremely fitted, and at a juncture in the reform of university studies when a theologian of liberal views, but universally respected for his massive learning and his devout and single-minded character, would enjoy a unique opportunity for usefulness. Supported by his friends Lightfoot and Hort, he threw himself into the new work with extraordinary energy. His whole life was devoted to the promotion of the theological studies in which his own interests were absolutely centred. He deliberately sacrificed many of the social privileges of a university career in order that his studies might be more continuous and that he might see more of the younger men. His lectures were generally on Biblical subjects. His Commentaries on St John's Gospel (1881), on the Epistle to the Hebrews (1889), and the Epistles of St John (1883) resulted from his public lectures. One of his most valuable works, The Gospel of Life (1892), a study of Christian doctrine, incorporated the materials upon which he was engaged in a series of more private and esoteric lectures delivered on week-day evenings. The work of lecturing was an intense strain to him, but its influence was immense : to attend one of Westcott's lectures — even to watch him lecturing — was an experience which lifted and solemnized many a man to whom the references to Origen or Bupert of Deutz were almost ludicrously unintelligible. Between the years 1870 ard 1881 Westcott was also continually engaged in work for the revision of the New Testament, in which he took a conspicuous part, and, simultaneously, in the preparation of a new text in conjunction with Hort. The years in which Westcott, Lightfoot, and Hort could thus meet frequently and naturally for the discussion of the work in which they were all three so deeply engrossed formed a happy and privileged period in their lives. Westcott's residence at Cambridge during the tenure of his pre fessor- ship was 6 Scroope Terrace. In the year 1881 there appeared the famous Westcott and Hort text of the New Testament, upon which had been expended nearly thirty years of incessant labour. The reforms in the regulations for degrees in divinity, the formation and first revision of the new theological tripos, the inauguration of the Cambridge mission to Delhi, the institution of the Church Society (for the discussion of theological and ecclesiastical questions by the younger men), the meetings for the divi- nity faculty, the organization of the new Divinity

School and Library, and, later, the institution of the Cambridge Clergy Training School, " were all, in a very real degree, the result of Westcott's energy and influence as regius professor. To this list should also be added the Oxford and Cambridge preliminary examination for candidates for holy orders, with which he was from the first most closely identified. The success of this very useful scheme was due chiefly to his sedulous interest and help.

The departure of Lightfoot to the see of Durham in 1879 was a great blow to Westcott. Nevertheless it resulted in bringing him into still greater prominence. He was compelled to take the lead in matters where Lightfoot's more practical nature had previously been predominant. In 1883 Westcott was elected to a pro- fessorial fellowship at King's. Shortly afterwards, having previously resigned his canonry at Peterborough, he was appointed by the Crown to a canonry at West- minster, and accepted the position of examining chaplain to Archbishop Benson. His little edition of the Paragraph Psalter ' (1879), arranged for the use

of choirs, and his admirable lectures on the Apostles' Creed, entitled Historic Faith (1883), are reminiscences of his vacations spent at Peterborough. He held his canonry at Westminster in conjunction with the regius professorship. The strain of the join,t work was very heavy, and the constant attendance at meetings and committees both in Cambridge and in London told upon him severely. The intensity of the interest and study which he brought to bear upon his share in the labours of the Ecclesiastical Courts Commission, of which he had been appointed a member, added to his burden.

Preaching at the Abbey gave him an opportunity, which he valued immensely, of deal- ing with social questions. His sermons were generally por- tions of a series ; and to this period belong the volumes Ghristus Consummator (1886) and Social Aspects of Christianity (1887).

~~In March 1890 he was nominated to the see of Dur- ham, there to follow in the steps of his beloved friend Lightfoot, who had passed away in December 1889. He was consecrated on the 1st of May at Westminster Abbey by Archbishop Thomp- son (of York) : Hort was the preacher upon the occasion. Benson (Archbishop of Canterbury) also was present, but did not take part in the service, Durham being in the Northern Province. West- cott was enthroned at Dur- ham Cathedral on the 15th of May. The change of work and surroundings could hardly have been greater. But the sudden immersion in the practical administra- tion of a northern diocese gave him new strength. He surprised the world, which had supposed him to be a~~

~~recluse and a mystic, by the practical interest he took in the mining population of Durham and in the great shipping and artisan industries of Sunderland and Gateshead. Upon one famous occasion in 1892 he succeeded in bringing to a peaceful solution a long and bitter strike which had divided the masters and men in the Durham collieries ; and his success was due to the confidence which he in- spired by the extraordinary moral energy of his strangely " prophetic " personality, at once thoughtful, vehement, and affectionate. His constant endeavour to call the attention of the Church to the religious aspect of social questions was a special note in his public utterances. He was a staunch supporter of the co-operative movement. He was practically the founder of the Christian Social Union. He continually insisted upon the necessity of promoting the cause of foreign missions, and he gladly gave four of his sons for the work of the Church in India. His energy was remarkable to the very end. But during the last two or three years of his life he had become suddenly older : the deaths of Hort and Benson had left him with a sense of loneliness ; he was much troubled, too, with deafness, and complained of shortness of breath. In his visits to Cambridge in 1900 to lay the~~

~~Bishop Westcott.~~

~~(From a photograph by the London Stereoscopic and~~

~~Photographic Co., Ltd.)~~

foundation stone of the Clergy School (which will always be associated with his memory), and again in December to preach the Commemoration Sermon at Trinity College, he displayed all the old vigour ; but it was a farewell to his beloved university. His wife — who had been for some years an invalid — died rather suddenly on the 28th of May 1901. He placed a stone to her memory; the inscription on it was to wait until his own time came. It was not for long. He dedicated to her memory his last book, Lessons from Work (1901). He attended meetings in London in the early part of July. He preached a farewell sermon to the miners in Durham Cathedral at their an- nual festival, on the 20th of July. Then came a short, sudden illness, and he fell asleep on the 27th of July. He was buried in Auckland Castle chapel, in the same grave with his wife, and close to the grave of Bishop Lightfoot.

In appearance Westcott was short and spare ; his face was one of striking power and beauty. The in- tensity of his look has been well caught by Sir William Bichmond, whose picture of him hangs in the Fitzwilliam Museum at Cambridge. He was quick and active in move- ment ; was always a vigorous walker ; was wiry and tough in physique, and enjoyed good health. He was no narrow specialist. He had the keenest love of poetry, music, and art. He was him- self no mean draughtsman, and used often to say that if he had not taken orders he would have become an archi- tect. His literary sympathies were wide. He would never tire of praising Euripides, while few men had given such minute study to the writings of Robert Browning. He followed with delight the development of natural science studies at Cambridge. He spared no pains to be accurate, or to widen the basis of his thought. Thus he devoted one summer vacation to the careful analysis of Comte's Politique Positive. He studied assiduously The Sacred Boohs of the East, and earnestly contended that no systematic view of Christianity could afford to ignore the philosophy of other religions. The outside world was wont to regard him as a mystic ; and the mystical, or sacramental, view of life enters, it is true, very largely into his teaching. He had in this respect many points of simi- larity with the Cambridge Platonists of the 17th century, and with F. D. Maurice, for whom he had profound regard. But in other respects he was very practical ; and his strength of will, his learning, and his force of character made him really masterful in influence wherever the subject under discussion

was of serious moment. He was a strong supporter of Church reform, especially in the direction of obtaining larger powers for the laity. He was always an energetic advocate of international arbitration as the means of settling national disputes. But in the Boer war he was convinced of the righteousness of the British

contention. Preaching on 7th January 1900 he used these words, " It is not only our paramount authority in South Africa which is at stake, but, as involved in that, our dominion in India, and our fitness to inspire and guide the life of Great Britain."

He kept himself aloof from all party strife. He de- scribes himself when he says, " The student of Christian doctrine, because he strives after exactness of phrase, because he is conscious of the inadequacy of any one human formula to exhaust the truth, will be filled with sympathy for every genuine endeavour towards the em- bodiment of right opinion. Partial views attract and exist in virtue of the fragment of truth — be it great or small — which they include; and it is the work of the theologian to seize this no less than to detect the first spring of error. It is easier and, in one sense, it is more impressive to make a peremptory and exclusive statement, and to refuse to allow any place beside it to divergent expositions ; but this show of clearness and power is dearly purchased at the cost of the ennobling conviction that the whole truth is far greater than our individual minds. He who believes that every judgment on the highest matters different from his own is simply a heresy must have a mean idea of the faith ; and while the quali- fications, the reserve, the lingering sympathies of the real student make him in many cases a poor controversialist, it may be said that a mere controversialist cannot be a real theologian " (Lessons from Work, pp. 84-85). His theological work was always distinguished by the place which he assigned to Divine Revelation in Holy Scripture and in the teaching of history. His own studies have largely contributed in England to the better under- standing of the doctrines of the Resurrection and the Incarnation. His work in conjunction with Hort upon the Greek text of the New Testament will endure as one of the greatest achievements of English Biblical criticism.

The principles which are explained in Hort's introduc- tion to the text had been arrived at after years of elaborate investigation and continual correspondence and discus- sion between the two friends. The place which it almost at once took among scientific scholars in Great Britain and on the Continent was a recognition of the great advance which it represented in the use and classifica- tion of ancient authorities. As a commentator his anno- tations upon St John's Gospel and Epistles and upon the Epistle to the Hebrews rank with Lightfoot's commen- taries as the best type of Biblical exegesis produced by the English Church in the 19th century. As a preacher and speaker his reputation is due almost en- tirely to the last twenty years of his life. The late development of his power and effectiveness in this respect was very remarkable. He had a strong voice and a retentive memory ; he spoke with great energy and con- viction. At times, as, for instance, on the occasion of the famous demonstration in the Albert Hall, London, against the disestablishment of the Church in Wales, and, again, on the occasion of Mr Arthur Balfour's visit to Cambridge for the inauguration of Cambridge House in South London, a cherished hope of Westcott's, his speeches were pieces of oratory.

The following ia a bibliography of Westcott's more important writings, giving the date of the first editions : — Elements of the Gospel Harmony (1851) ; History of the Canon of First Four Centuries (1853) ; Characteristics of Gospel Miracles (1859) ; Introduction to the Study of the Gospels (1860) ; The Bible in the Church (1864) ; The Gospel of the Resurrection (1866) ; Christian Life Manifold and One (1869) ; Some Points in the Religious Life of the Uni- versities (1873) ; Paragraph Psalter for the Use of Choirs (1879) ; Commentary on the Gospel of St John (1881) ; Commentary on the Epistles of St John (1883) ; Revelation of the Risen Lord (1882) ; Revelation of the Father (1884) ; Some Thoughts from the Ordinal (1884) ; Christus Consummator (1886) ; Social Aspects of

Christianity (1887) ; The Victory of the Cross; Sermons in Holy Week (1888) ; Commentary on the Epistle to the Hebrews (1889) ; From

~~Strength to Strength (1890) ; Gospel of Life (1892) ; The Incarnation and Common Life (1893) ; Some Lessons of the Revised Version of the New Testament (1897) ; Christian Aspects of Life (1897); Lessons from Work (1901). (H. E. E.)~~

~~Westerns, or Vesteras, a town and bishop's see of Sweden, capital of the county of Vestmanland, on a northern bay of Lake Malar, 60 miles north-west by west of Stock- holm. Its Gothic cathedral, consecrated in 1271, was restored in 1850-60, and again in 1896-98. The episcopal library contains the valuable collection of books which Oxenstierna, the chancellor of Gustavus Adolphus, brought away from Mainz near the end of the Thirty Years' War. There is a 16th-century castle, built by Gustavus Vasa. Several national diets were1 held in this town, the most notable being those of 1527, when Gustavus Vasa formally introduced the Reformation into Sweden, and 1544, when he had the Swedish throne declared hereditary in his family. Population (1880), 6201 ; (1890), 8122 ; (1900),~~

~~Westerly, a town of Washington county, Rhode Island, U.S.A., containing an area of 31 square miles of undulating country with marshes and ponds, in the south- western corner of the state. The principal village, also known as Westerly, lies on Pawcatuck river, and on the New York, New Haven, and Hartford Railroad. It is irregular in plan, and its principal industry is the manu- facture of cotton and woollen goods, while granite is quarried in the town. Other villages are White Rock, Potter Hill, Avondale, Watch Hill, and Noyes Beach, the two last being seaside resorts. The town was incorporated in 1669. Population of the town (1880), 6104 ; (1890), 6813 ; (1900), 7541, of whom 1788 were foreign-born and 185 negroes.~~

~~West fie Id, a town of Hampden county, Massa- chusetts, U.S.A., containing an area of 41 square miles of fairly level surface, situated in the south-western part of the state. The principal village, also known as West- field, is beautifully situated in a valley, is irregularly laid out, but has broad streets, excellent water-supply and sewerage systems, and extensive manufactures of a great variety of articles. It is on the Boston and Albany and the New York, New Haven, and Hartford railways.~~

Population of the town (1880), 7587; (1890), 9805; (1900), 12,310, of whom 2441 were foreign-born and 81 negroes.

West Ham, a parliamentary and county borough and suburb of London, in the county of Essex, England. The parish stretches north and south from Wanstead and Leyton to the Thames, and east and west from East Ham to the river Lea. It is divided into four wards — Church Street, Stratford-Langthorne, Plaistow, and Upton. The manor of West Ham was settled upon Stratford-Lang- thorne Abbey, founded by William de Moritfichet in 1 1 35 for monks of the Cistercian order. The abbey stood in the marshes, on a branch of the Lea known as the Abbey Creek, about half-a-mile south of Stratford Broadway. West Ham Church, dedicated to All Saints, is a large building, which contains some interesting features and a good Perpendicular west tower. In the restoration of 1866 a Transition Norman clerestory was discovered. West Ham Park (80 acres) occupies the site of Ham House and park, for many years the residence of Samuel Gurney, the banker and philanthropist. The place was purchased for £25,000, and vested in the Corporation of London for the use of the public. Of this amount the Gurney family contributed £10,000 and the Corporation the same sum, the remaining £5000 being collected from the inhabitants

of West Ham. The house was taken down, and the park was formally opened for public use by the Lord Mayor on the 20th July 1874. Mrs Elizabeth Fry lived in a house in Upton Lane, on the confines of her brother's park. In 1762 the number of houses in West Ham parish was stated to be 700, of which " 455 are mansions and 245 cottages." Now few large houses remain, but the smaller houses have greatly increased. West Ham has become the home of chemical and other manufactures which have been driven away from London itself ; and its la,rge popula- tion, which has increased by leaps and bounds, can be also traced to the foundation of the Victoria and Albert docks at Plaistow. Population (1871), 99,142 ; (1881), 200,958 ;

~~(1891), 204,903; (1901), 267,308.~~

~~West Haven, a borough of New Haven county, Connecticut, U.S.A., on New Haven harbour, adjoining the city of New Haven, of which it is a suburb. Popula- tion (1900), 5247, of whom 893 were foreign-born.~~

~~West Ho bo ken, a town of Hudson county, New Jersey, U.S.A., on the Hudson river cliffs, north of Jersey city, and opposite New York. It is largely engaged in silk manufacture, for which there are several factories. Population (1880), 5441; (1890), 11,665; (1900), 23,094, of whom 9119 were foreign-born.~~

~~West Indies, The, sometimes called the Antilles (a name more properly applied to the West India Islands, excluding the Bahamas), an archipelago stretching in the shape of a rude arc or parabola from Florida and Yucatan in North America to Venezuela in South America, and enclosing the Caribbean Sea (615,000 square miles) and the Gulf of Mexico (750,000 square miles in area). The land area of all the islands is nearly 100,000 square miles, with an estimated population of about 6£ millions ; that of the British islands about 12,000 square miles. The islands differ widely one from another in area, popu- lation, geographical position, and physical characteristics. They are divided into the Bahamas, the Greater Antilles (Cuba, Jamaica, Hayti, and Porto Rico), and the Lesser Antilles (comprising the remainder). The Lesser Antilles are again divided into the Windward Islands and Leeward Islands. Geographically, the Leeward Islands are those to the north of St Lucia, and the Windward, St Lucia and those to the south of it ; but for administrative purposes the British islands in the Lesser Antilles are grouped as is shown in the table given later.~~

~~The population of the "West Indies represents many original stocks, the descendants of which have developed variations of habits and customs in their New World environment. They may be divided into six main classes: (1) Europeans — immigrants (English, French, Spanish, and in a lesser degree Dutch, Danish, and German) and West Indian born ; (2) African negroes — immi- grants (a fast vanishing quantity) and West Indian born ; (3) a mixture of Europeans and Africans ; (4) coolies from India — im- ported and West Indian born ; (5) Chinese ; (6) aboriginal Indians of~~

~~more or less pure descent. Of these, the people of pure African blood are in a large majority, the ‘ ‘ coloured ” race of mixed European and African blood being next in numerical importance. Under English influence the negroes of the West Indies have become English in thought and habit ; and it would seem that the stimu- lating influence of European direction and encouragement is abso- lutely necessary for the future development and progress of these islands. Owing to recent occupation by the United States, Cuba and Porto Rico are in a state of transition. In the republics of San Domingo and Hayti the negroes are left to drift along, while the French and Danish islands show no great sign of progress.~~

~~Area and Population. — The following list of the West India islands gives their area and population (in the case of British islands, that of 1881 compared with that of 1897), British Guiana and British Honduras — which for the purposes of colonial adminis- tration are classed with the West India islands — being omitted. Notwithstanding the operations of educational institutions and of large numbers of missionaries of various religious denominations, the percentage of illegitimate births amongst the population of the British West Indian islands still remains very high — in Barbados,~~

~~53”9 ; in Jamaica, 63-4 ; in Trinidad, 59‘2 per cent, of the general births ; and 79 ‘2 per cent, of the East Indian.~~

~~Nationality Name.~~

~~Area,~~

~~Population.~~

~~Square Miles.~~

~~1881 (Census).~~

~~1897 (estimated).~~

~~British Colonies —~~

~~Bahamas~~

~~4,466~~

~~43,521~~

~~52,000~~

~~Jamaica . Turks Island~~

~~IS} *.*»~~

~~{W}588,902~~

~~HS}«V«~~

~~Leeward Islands :~~

~~Virgin Islands .~~

~~m\~~

~~5,vzr\~~

~~St Kitts Nevis .~~

~~J mV 665~~

~~41,001~~

~~Antigua~~

~~34,964 Y1W-m~~

~~129,751~~

~~Montserrat.~~

~~32~~

~~10,083~~

~~Dominica .~~

~~29lJ~~

~~28,21lJ~~

~~Barbados~~

~~166~~

~~171,860~~

~~1^0,000~~

~~Windward Islands :~~

~~St Lucia~~

~~233”!~~

~~38,651)~~

~~f47,332”\~~

~~St Vincent .~~

~~132)■ 498~~

~~40,548)121,502~~

~~-^ 46,112 y 154,743~~

~~(Jrenada~~

~~133 J~~

~~42,403)~~

~~(.61.299J~~

~~Trinidad Tobaqo~~

~~) 1,868~~

~~171,179~~

~~275,363~~

~~French Colonies—~~

~~Guadeloupe and \ dependencies / Martinique .~~

~~722”)~~

~~400 \ !-“»~~

~~”,~~

~~(“170,0001~~

~~-[187,692 Y 360,692 I. 3,000 J~~

~~St Martin (part)~~

~~2IJ~~

~~Butch Colonies—~~

~~St Martin (part)~~

~~17-V~~

~~(4,023 \~~

~~Curacao~~

~~210~~

28,187 1

Buen Ayre . Aruba .

69 h «*

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St EustatiuB

8

1,613 I

Saba .

6)

1. 2,065 J

Danish Colonies—

St Thomas .

23\

(“32,7861

St John

21 V 118

:.

■I 960 V 52,166

St Croix

74J

U8.430J

United States Terri-

tory-

Porto K,ico .

3,550

806,708

Republics —

San Domingo Hayti .

2°;g|}29,830

i

500,000\, ,,.. „„, 1,244;650}1‘744‘660

Cuba . Grand total

45,000 92,077

1,631,687

1,216,510

6,157;684

The total value of the imports into the British West Indies in 1898 was £6,323,413, and exports £5,657,391, there being but little change for twenty years.

~~Government. — The British West India colonies are either Crown colonies — that is to say, their government is absolutely under the control of the British Colonial Office, the official members of their councils predominating, and the unofficial members being nomi- nated by the Crown, as in the Windward and Leeward Islands — or they have a measure of representative government, as in the Bahamas, Barbados, British Guiana, Trinidad, and Jamaica, in which all or part of the legislatures are elected and are more or less independent of Crown control. The laws of the various colonies are English, with local statutes to meet local needs. The governors and high officials are appointed by the Crown ; other officials are appointed by the governor. Each governor acts under the advice of a privy council.~~

~~Religion. — In all the British colonies there is full religious toleration. The Church of England Province of the West Indies is divided into the following bishoprics: — Jamaica, Nassau (i.e., Bahamas), Trinidad, (British) Honduras, Antigua (i.e., Leeward Islands), Barbados, Windward Islands, (British) Guiana. With the exception of Barbados and British Guiana, the Church of England is disestablished, disendowment taking place gradually, the churches thus becoming self-supporting. In Barbados the Church is both established and endowed. In the Bahamas and Jamaica disendowment is gradually taking place ; in Trinidad and British Guiana the Church of England receives endowment con- currently with other religious bodies. The Windward Islands, Lee- ward Islands, and British Honduras are totally disendowed. In all the islands, except Trinidad, St Lucia, Grenada, and Dominica, the Church of England, though in all cases in a minority when compared with the aggregate of other bodies, is the most numerous of any denomination. There are Roman Catholic bishops at Port-of-Spain (Trinidad), Roseau (Dominica — for the Leeward Islands), Jamaica, British Guiana and Barbados (resident at Georgetown), British Honduras, Guadeloupe, Martinique, Hayti (archbishop and four bishops), San Domingo (archbishop), Cuba (archbishop and bishop), Porto Rico, - and Curacao. Other reli- gious denominations working actively in the West Indies are the Baptists, Wesleyans, Presbyterians, Congregationalists, and Moravians.~~

~~Defence. — The only fortified places in the British West Indies are Jamaica, Barbados, and St Lucia — all of importance as coaling stations. In many of the islands there are local volunteer forces.~~

~~The police forces of the colonies are in the main modelled on the Irish constabulary, supplemented by rural constabulary. The force is usually officered by Europeans. The only naval dockyard is at Port Royal, Jamaica.~~

~~Production. — The great change of the last quarter of the 19th century has been the farther decline of sugar cultivation and the development of that of bananas and other fruits, and in Trinidad and Grenada, of cacao. Of the islands, Barbados, Antigua, St Kitts, and Nevis are extremely well fitted for the cultivation of sugar, and hardly for that of any other product valuable for exportation. In 1902 Martinique and St Vincent suffered severely from volcanic eruptions. With a view to the improvement of agriculture in Barbados and the Windward and Leeward Islands in particular — and throughout the British West Indies generally — a Commissioner of Agriculture for the West Indies has been appointed at the expense of the British Exchequer, having his headquarters at Barbados. The general movement of trade is towards the United States (where most of the British West Indies find the best markets for their produce) at the expense of Great Britain. In order to foster trade with the mother country, a direct line of subsidized steamers was started to Jamaica in 1901.~~

~~Authorities. — 0. P. Lucas. A Historical Geography of the British Colonies, vol. ii. Oxford, 1890. — C. Washington Eves, C.M.G. The West Indies, 4th edition. London, 1897. — A. Caldecott, B.D. The Church in the West Indies (Colonial Church Histories). London, 1898. — Robert T. Hill. Cuba and Porto Rico, with the other Islands of the West Indies. London, 1-898. — Amos Kidder Fiske. The West Indies. New York, 1899.~~

~~(f. Cu.)~~

Westmeath, an inland county of Ireland, province of Leinster, bounded on the N. by Longford and Meath, on the E. by Meath, on the W. by Roscommon, and on the S. by King's County.

Population. — The area of the administrative county in 1900 was 434,626 acres, of which 78,489 were tillage, 86,542 pasture, 194 fallow, 7915 plantation, 35,127 turf bog, 5219 marsh, 880 barren mountain, and 20,260 water, roads, fences, &c. The new adminis- trative county under the Local Government (Ireland) Act, 1898, includes the portion of the town of Athlone formerly situated in Roscommon. The population in 1881 was 71,798; in 1891, 65,109; and in 1901, 61,629, of whom 31,880 were males and 29,749 females, divided as follows among the different religions : Roman Catholics, 56,673 ; Protestant Episcopalians, 4271 ; Presbyterians, 319 ; Methodists, 251 ; and other denominations, 115. The decrease of population between 1881 and 1891 was 9-32 per cent., and between 1891 and 1901, 10-18 per cent. The average number of persons to an acre in 1891 was -16, and of the total population 56,546 persons inhabited the rural districts, being an average of 100 to each square mile under crops and pasture The following table gives the degree of education in 1891 : —

Kales.

Females.

Total.

Percentage

R. C. j £p°j 1 Pres. iMeth.

Read and write Read only Illiterate .

22,253 3,476 5,154

19,948 3,656 4,646

42,201 7,132 9,800

69-5 193-9 (90-6 193-0 12-81 3-2 1 6-51 2-7

17-71 2-9' 2-9 ‘ 4-3 |

The percentage of illiterates among Roman Catholics in 188. was 25-0. In 1891 there were 5 superior schools with 345 pupils (Roman Catholics, 186, and Protestants, 159), and 154 primary schools with 9200 pupils (Roman Catholics 8609, and Protestants 591). The number of pupils on the rolls of the National schools on 31st December 1900 was 10,419, of whom 9805 were Roman Catholics and 614 Protestants. The following table gives the number of births, deaths, and marriages in the years specified :—

Year.

Births.

Deaths.

Marriages.

1881 1891 1900

1018 1334 1140

812 | 139

1076 238 1197 219

In 1900 the birth-rate per 1000 was 8-0, and the death-rate 9;5 ; the rate of illegitimacy was T9 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 50,283, of whom 26,738 were males and 23,545 females. The chief towns m the county, with their populations in 1901, are: Athlone, 6617; Mullingar, 4500. Administration.— The county is divided into two parliamentary divisions, North and South, the number of registered electors in

1901 being respectively 6208 and 6570. The rateable value in 1900 was £323,523. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises one urban and six rural sanitary districts.

Agriculture. — The following tables show the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1901. The figures for 1901 are for the new administrative county.

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61

1881

147

~~22,837~~

~~494~~

~~11,771~~

~~5319~~

~~2717~~

~~54,560~~

~~97,845~~

~~1891~~

~~91~~

~~16,757 15,540~~

~~751~~

~~10,251~~

~~4692~~

~~2678~~

~~48,384~~

~~83,604~~

~~1895~~

~~45~~

~~463~~

~~9,096~~

~~4364~~

~~3013~~

~~49,345~~

~~81,866~~

~~1901~~

~~120~~

~~13,272~~

~~545~~

~~8,293~~

~~3798~~

~~3283~~

~~48,516~~

~~77,827~~

~~In 1900 it was estimated that the total value of the cereal and other crops was £492,185. The number of acres under pasture in 1881 was 269,379 ; in 1891, 278,438 ; and in 1900, 286,542.~~

~~Year.~~

~~Horses & Mules.~~

~~Asses.~~

~~Cattle.~~

~~Sheep.~~

~~*Pigs.*~~

~~*Goats.*~~

~~*Poultry.*~~

~~*1881 1891 1895 1901**~~

~~*12,268 13,870 14,529 12,104*~~

~~*4323 4740 4870 ‘5482*~~

~~*100,150 108,134 109,731 116,997*~~

~~*128,751 157,488 127,133 131,276*~~

~~*16,722 19,487 18,614 14,916*~~

~~*6108 7717 7125 6909*~~

~~*275,246 294,250 305,467 324,575*~~

- ~~*The figures for 1901 have not been revised.*~~

~~*The number of milch cows in 1891 was 14,794, and in 1901, 15,330. It is estimated that the total value of cattle, sheep, and pigs for 1901 was £1,761,938. In 1900 the number of holdings not exceeding 1 acre was 2217 ; between 1 and 5, 1728 ; between 5 and 15, 2367 ; between 15 and 30, 2134 ; between 30 and 50, 1372 ; between 50 and 100, 1058 ; between 100 and 200, 540 ; between 200 and 500, 289 ; and above 500, 47 ; total, 11,752. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901, was 726, amounting to £313,873. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, was 344, and the amount issued £30,276. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations in 1847 to 31st March 1901 was £106,465.~~*

Westminster, largely synonymous with what is known as the "West End" of London, was formed into a borough by the London Government Act of 1899, and created a city by royal charter of the 29th of October 1900. It is governed by a mayor, ten aldermen, sixty councillors, and has as a municipality superseded the ten previously existing vestries and the district board of works. It comprises the three parliamentary boroughs of the Strand, Westminster, and St George's Hanover Square — each returning one member to the House of Commons — and three poor-law unions, which have the same names as, but yet are not conterminous with, the parliamentary boroughs. ' Westminster is bounded on the E. by the City of London and Clerkenwell, on the N. by Oxford Street, on the W. by South Kensington and Chelsea, and on the S. by the Thames. Its rateable value in 1901 was roughly f>\ millions sterling, and the population 183,000. It has five public libraries, five public baths, and a cemetery at Hanwell.

In Westminster centres the official and to a great extent the social and fashionable life of the metropolis, and within the past few years public and private enter- prise have laboured together to embellish it in a manner befitting its dignity. A large number of imposing build- ings have been erected, new thoroughfares laid, and old thoroughfares widened.

Proceeding westwards from Temple Bar, the work of reconstruction is immediately visible ; the removal of Holywell Street has permitted at that point the widening of the Strand, which is to be continued throughout its

whole length, to Charing Cross. Opposite Somerset House a new street is planned to connect the Strand with Holborn. But it is in and around Charing Cross that the greatest changes have been effected. Old Northum- berland House has given way to an avenue flanked by huge hotels and clubs ; the National Gallery has received an addition in the New Portrait Gallery, in Italian palatial style, adjoining it on the north side. From this point the new Charing Cross Road, which has swept away many of the purlieus of Soho, proceeds to Tottenham Court Road, being

~~joined at Cambridge Circus by another new artery, Shaftesbury Avenue. In Whitehall, the Admiralty has been enlarged by a wing abutting on St James's Park ; a new War Office is in process of erection on a site between the Horse Guards Avenue and Whitehall Place ; the banqueting hall of the former Whitehall Palace has been converted into the United Service Institution ; and a magnificent pile of new Ministerial offices, to house the Local Government Board, Board of Education, and Board of Trade, is being built immediately south of the Home Office. The Victoria Embankment has been further embellished, and is now flanked by new municipal and other buildings, such as School Board Offices, Medical Examination Hall, some large hotels, Whitehall Court, the National Liberal Club, and New Scotland Yard, and may be described as one of the most magnificent thoroughfares in the world.~~

~~.Although the project of continuing the Embankment to Chelsea has not yet been realized, the way has been pre- pared by the rebuilding of Vauxhall Bridge and the erection, on the site of the Millbank Penitentiary, of the Tate Gallery of British Art, opened in 1897 and enlarged in 1899. The Victoria station of the London, Brighton, and South Coast Railway is being rebuilt, with a frontage to Buckingham Palace Road, at an estimated cost of two millions sterling. In and around the Green Park other great changes have been made — Constitution Hill has been thrown open to vehicular traffic, Piccadilly has been widened at Hyde Park Corner. To the north of this thoroughfare the district about Grosvenor Square has been rebuilt on an extensive scale, whilst on the extreme west the Imperial Institute, erected in 1887-93, is now the seat of London University.~~

~~In the Abbey itself, among the illustrious dead who have been laid there come the names of Darwin, Tenny- Bedesi- soni Browning, Gladstone. The Church House, astical adjoining Dean's Yard — a memorial of Queen buildings. Victoria's Jubilee, 1887 — consists at present of a spacious hall in brick and stone, with offices for many Church societies. The Roman Catholic Cathedral in Ashley Gardens is the most notable church built of recent years. The edifice is of brick and stone, in Early Byzantine style, and of grand proportions ; its length being 360 feet, breadth 156 feet, height to cupola of nave 117 feet, while its campanile~~

tower, since the destruction of that in Venice the highest in the world, soars to a height of 283 feet. The founda- tion stone was laid in 1896, and it was proposed to con- secrate and open the building for divine service in 1903.

Westmorland, a north-western county of Eng- land, bounded on the S. and S.W. by Lancashire, on the N.W. and N. by Cumberland, on the N.E. by Durham, and on the E. and S.E. by Yorkshire.

Area and Population. — The area of the ancient and administra- tive county, as given in the census returns, is 500,906 acres or 783 square miles, with a population in 1881 of 64.191 ; in 1891 of 66,098, of whom 32,326 were males and 33,772 females ; and in 1901 of 64,305, the number of persons per square mile being 82, and of acres to a person 7 '8. The area of the registration county is 503,073 acres, with a population in 1891 of 66,216, of

whom 24,949 were urban and 41,266 rural ; and in 1901 of 64,411, of whom 30,551 were males and 33,860 w^re females. Within this area there was between 1881 and 1891 an increase of 2-96 per cent, but between 1891 and 1901 a decrease of 27 per cent. The excess of births over deaths between 1881 and 1891 was 8553, and the actual increase of population was 1907. The following table gives the numbers of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 :

—

Year.

Marriages.

Births.

Deaths.

Illegitimate Births.

Males.

Females.

1880 1890 1898

412 423 423

1995 1711 1541

1177

1020

906

66 68

47

76 58 49

The number of marriages in 1899 was 460, of births 1534, and of de.ths 874. The following table gives the marriage-, birth-, and death-rates per thousand of the population, with the percentage of illegitimate births, for a series of years :—

1870-5-9.

1SS0.

1880-89.

1890.

1888-97.

1808.

Marriage-rate-.

~~14·4~~

~~12·8~~

~~12·7~~

~~12·8~~

~~12·8~~

~~12·6~~

~~Birth rate~~

~~31·0~~

~~30·9~~

~~29·1~~

~~26·0~~

~~257~~

~~22·9~~

~~Death rate~~

~~17·7~~

~~18·2~~

~~15·8~~

~~15·4~~

~~15·1~~

~~13·4~~

~~Percentage of ille-~~

~~gitimacy~~

~~7·7~~

~~7·1~~

~~7·0~~

~~7·3~~

~~6·4~~

~~6·2~~

~~The marriage-, birth-, and death-rates are below the average, but the percentage of illegitimacy is high. In 1891 there were in the county 1114 natives of Scotland, 625 natives of Ireland, and 84 foreigners.~~

~~Constitution and Government. — The county contains two municipal boroughs: Appleby (1764) and Kendal (14,183). The following are urban districts : Ambleside (2536), Bowness-on-Windermere (2682), Grasmere (781), Kirkby Lonsdale (1638), and Windermere (2379). The ancient county, which is entirely in the diocese of Carlisle, eojitains 81 entire ecclesiastical parishes or districts, and parts of 3 others.~~

~~Education. — The total number of elementary schools on 31st August 1899 was 116, of which 20 were board and 96 voluntary schools, the latter including 81 National Church of England schools, 1 Roman Catholic, and 14 "British and other." The average attendance at board schools was 1159, and at voluntary schools 8805. The total school board receipts for the year ended 29th September 1898 were over £5591. The income under the Agricultural Rates Act was over £459.~~

~~Agriculture. — Only about one-half of the total area of the county is under cultivation, and of this acreage about five-sixths is in permanent pasture, both cattle and sheep being largely kept There are also about 208,000 acres in hill pasture, and over 17,000 acres are under woods.~~

~~Orchards occupy over 400 acres, and small fruit on an average only about 100 acres. About sixteen-seven- teenths of the acreage under corn crops is occupied by oats, and of the remaining 1000 acres the larger half is occupied by barley, and usually only about 200 acres by wheat, both these latter acreages having greatly diminished. About three-fourths of the acreage under green crops is occupied by turnips, potatoes occupying usually less than one -seventh. The following table gives the acreages of the larger main divisions of the cultivated area at intervals from 1885 : —~~

~~Year.~~

~~Total Area under Cul- tivation.~~

~~Corn Crops.~~

~~Green Crops.~~

~~Clover.~~

~~Permanent Pasture.~~

~~Fallow.~~

~~1885 1890 1895 1900~~

~~250,465 251,575 250,972 248,279~~

~~18,947 19,010 17,910 16,064~~

~~9,848~~

~~10,047~~

~~9,958~~

~~8,828~~

~~15,798 16,049 16,909 16,899~~

~~205,608 206,175 205,942 206,360~~

~~263~~

~~255~~

~~120~~

~~62~~

~~The following table gives particulars regarding the principal live stock for the same years : —~~

~~Year.~~

~~Total Horses.~~

~~8620 8850 9614 8942~~

~~Total Cattle.~~

~~Cows or Heifers~~

~~in Milk or~~

~~in Calf.~~

~~Sheep.~~

~~Pigs.~~

~~1885 1890 1895 1900~~

~~65,586 65,194 64,107 67,608~~

~~24,434 25,136 23,644 24,096~~

~~332,923 359,787 359,978 374,453~~

~~4617 5979 4755 4274~~

Industries and Trade. — According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 4401, as com- pared with 4187 in 1896. In non-textile factories 3085 persons were employed. Explosives are manufactured. In 1899, 71,492 tons of limestone were raised, 66,000 tons of granite, 2953 tons of Blate, and 810 tons of coal. The production of lead was 1198 tons (below the average) valued at £11,976 ; of gypsum, 6009 tons valued at £1352, as compared with 2100 tons in 1890.

Authorities. — Sir D. Fleming. Description of Westmorland, 1671. London, 1882. — Braithwaite. The Salmonidas of West- morland. London, 1884. — Barrow. Mountain Ascents in West- morland. London, 1886. — GrBsoN. Legends and Notes on Places of North Westmorland. London, 1887. — Taylor. Manorial Sails of Westmorland. Kendal, 1892. — Jackson. Papers and Pedigrees relating to Cumberland and Westmorland (Cumberland Antiquarian Society's publications). 2 vols. London, 1892. — Ellwood. Landnama Book of Iceland as it illustrates the Dialect and Antiquities of Westmorland. Kendal, 1894. — Ferguson. History of Westmorland (Popular County Series). London, 1894.

WestOil-SUper-Mare, an urban district and watering-place, in the Wells parliamentary division of Somersetshire, England, 20 miles south-west of Bristol by rail; on a recess in the Bristol Channel. A north aisle was added to the parish church of St John the Baptist in 1891. A new wing was added to the town hall in 1897. In 1896 the urban district council purchased an extensive bathing establishment. Grove Park, once the manor house, is now the property of the council, and is used as a free library, its grounds being laid out as a public park. The free library and museum, on the Boulevard, erected to commemorate Queen Victoria's Diamond jubilee, was opened in 1900. Population (1891),

15,860; (1901), 19,047.

West Orange, a town of Essex county, New Jersey, U.S.A., in the north-eastern part of the state, on a branch of the Delaware, Lackawanna, and

Western Eailroad. Population (1890), 4358; (1900), 6889, of whom 1772 were foreign-born.

Westphalia, a western province of Prussia, with an area of 7803 square miles, and population (1895) of 2,701,420 ; (1900), 3,187,977. This province contains the principal coal fields of Germany, the chief centre being Dortmund and the vicinity. The output has increased very greatly since 1870, when 11,570,600 tons were produced; in 1880 the output was 22,495,200 tons; in 1890, 35,469,300 tons; and in 1900, 42,557,150 tons, valued at £17,958,000. In 1900 the number of workmen ■employed was 167,839. The other chief mining statistics for 1900 are as follows : — 1,215,000 tons of iron ore, valued at £639,550; 19,997 tons of zinc, valued at £78,800; 10,730 tons of lead, valued at £106,700; copper, 44,985 tons, valued at £18,400; and 145,130 tons of pyrites, valued at £49,100 : aggregate value of all minerals mined in the province in 1900, £18,850,000. Of Glauber salts, 4640 tons, valued at £6000, and 26,800 tons of common salt, valued at £37,150, were also pro- duced in the same year. The smelting furnaces produced 1,684,965 tons of iron, valued at £5,743,500; 14,920 tons of zinc, valued at £307,800 ; and 64,960 tons of sulphuric acid, valued at £74,950 : total value of metals, £6,126,250. The iron foundries, forges, &c, yielded 387,957 tons of ingots, bars, pig-iron, rails, &c, valued at £3,177,650. Of the area of this province 42-5 per cent. is arable and garden ground, 25 per cent, meadow and pasture, and 28 per cent, forest. Dairying and gardening are thriving industries. There are a dairy school (at Dortmund) and two agricultural colleges, a dozen agri- cultural schools, and an agricultural experimental station (at Minister); there is also a State stud (horses) at Warendorf. In 1900 the live stock embraced 883,476 pigs, 660,452 cattle, 223,609 sheep, and 155,427 horses.

In 1900 the sugar factories produced 17,620 tons of sugar; the breweries, 85,061,200 gallons of beer; and the distilleries, 2,873,000 gallons of pure alcohol.

West Pittston, a borough of Lackawanna county, Pennsylvania, U.S.A., in the valley of the North Branch of the Susquehanna river, in the

anthracite coal region, in the north-eastern part of the state. Population (1900), 5846, of whom 1192 were foreign-born.

West Point, a military post, and the seat of the United States Military Academy. It is on the west bank of the Hudson river in Orange county, New York, and on the West Shore Eailroad, in the south-eastern part of the state. The site of the academy is on high ground, 180 feet above the river. This academy is the training school for army officers. The students, known as cadets, commonly number about 300. Each Congressional district and each Territory is entitled to have one cadet in the Academy, who is appointed by the Secretary of War at the request of the representative or delegate in Congress from the district or Territory in which the person so appointed is a resident. The course of instruction is an arduous one, requiring four years of study and drill. The instructors are officers of the regular army.

West Springfield, a town of Hampden county, Massachusetts, U.S.A., containing 18 square miles of broken country, west of the Connecticut river, in the southern part of the state. It contains a few small villages, but most of the population is rural. Popula- tion (1880), 4149; (1890), 5077; (1900), 7105, of whom 1501 were foreign-born.

West Troy. See Wateevliet.

West Virginia, one of the eastern states of the American Union. The population of the state in 1900 was 958,800,. as compared with 762,794 in 1890 and 618,457 in 1880. The percentage of increase from 1890 to 1900 was 25-7, as against 23‘3 for the decade just preceding. Of the population in 1900, 499,242 were males and 459,558 were females; 936,349 were native- born, and only 22,451 (2-3 per cent.) were foreign-born. The negroes and persons of negro descent numbered 43,499, or about 4-5 per cent, of the total population. The white population born of native parents was 88 per cent, of the total, and of this white population probably 90 per cent, are descended from Kevolutionary stock. The urban population in 1900 (classing as such all persons in cities of more than 4000 inhabitants) was 11 “6 per cent, of the total, as compared with 8-8 per cent, in 1890. Out of 240,970 adult males in 1900, 32,066 were illiterate (unable to write), of whom 5584 were negroes and 2904 were foreign-born. The total

land surface of West Vir- ginia is approximately 24,645 square miles, the average number of persons to the square mile being 31 in 1890 and 38-9 in 1900. There were (1900) 140 incorporated cities, towns, and villages, of which twenty-two had a population of more than 2000 inhabitants ; of these, eight had more than 5000, namely, Wheeling with 38,878, Huntington with 11,923, Parkersburg with 11,703, Charleston with 11,099, Martinsburg with 7564, Fair- mont with 5655, Grafton with 5650, and Moundsville with 5362 inhabitants. Although destined to become one of the first coal-mining and oil-producing states of the Union, West Virginia is yet chiefly agricultural and grazing, and the population is composed chiefly of inde- pendent persons living upon their own land.

Education, Charity,

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amount of 11,669,201 and state funds to the amount of |349,964. There were six normal schools supported by legislative grants from the state treasury, with 48 teachers and an attendance of 1557 students. The state also possesses what is known as the state school fund, into which certain state revenues annually pass, and which, 1st July 1900, amounted to $1,040,968 ; the interest from the investment of this fund is a perpetual income for the support of the schools of the state, in supplement to the additional moneys raised by direct local taxation. The University of West Virginia, which is supported by state grants, is situated at Morgan- town, and had, in 1900, 65 instructors and 800 students. The state also supports the preparatory branch of the University at Montgomery, with 4 teachers and 64 students ; the West Virginia Coloured Institute, in Kanawha county, 11 teachers, 168 students; the Bluefield Coloured Institute at Bluefield, 5 teachers, 70 stu- dents ; two hospitals for the insane — one at Weston, the other at Spencer — with a total of 1629 inmates ; an asylum for the blind, at Eomney, with 19 instructors and 209 inmates ; a reform school for boys, at Pruntytown, with 288 inmates ; an industrial school for girls, at Salem, with 50 inmates. The penitentiary, at Mounds- ville

~~(508 inmates), is entirely supported by the profits derived from the labour of the convicts. There are miners' hospitals at Fairmont, McKendree, and Welch, and also an asylum for incur- ables at Huntington. The leading religious denominations in the order of their size (1900) are the Methodist, the Baptist, the Roman Catholic, the United Brethren, and the Presbyterian.~~

~~Banks. — There were in the state (30th June 1900) 34 national banks, with a paid-up capital of $3,551,000, surplus and undivided profits of $1,238,070, and deposits of $11,919,158 ; 89 state banks, with capital of $3,449,000 and deposits of $19,362,000 ; 6 savings banks or banks of deposit with savings departments, with $1,461, 000 savings deposits. The legal rate of interest is 6 per cent.~~

~~Coal and Coke. — In 1899 the coal-mines of West Virginia produced 18,201,189 long tons (2240 lb) of bituminous coal; 1,950,179 tons (of 2000 lb) of coke were manufactured ; 8591 coke ovens were in blast ; and 24, 726 men were employed at 3000 col- lieries, working an average of 240 days in the year. West Virginia is now the third state in the Union in the production of coal, and second in that of coke. Of the fifty-five counties, fifty are more or less underlain by coal. The state contains over 22,000 square miles of coal area, the most extensive in the United States. The building of the Chesapeake and Ohio Railway in 1872 from tidal water at Newport News, and its completion to Cincinnati, Ohio, in 1888, opened up the extensive deposits of bituminous coal in the counties of Raleigh, Fayette, and Kanawha, along the New and Great Kanawha rivers. In the New River coal- field the coals are known as the No. 12 (after Rogers) measures or conglomerate (or Pottsville Conglomerate of Pennsylvania geo- logy). In these measures some sixty mines and collieries ship coal east and west, and 3000 ovens are manufacturing coke. The fixed carbon in the coals averages as high as 70 to 72 per cent., and in the coke as high as 94 to 96 per cent. Along the Kanawha valley great development in the coal measures known as No. 13 (Rogers), or Freeport and Kittanning measures of the Pennsylvania geologists, have taken place. From the lower seams of the series (Kittanning seams) a superior coke is manufactured in Fayette county ; and from the upper seams (Freeport) great quantities of coal locally known as " hard splint~~

“or ” block ” coal, famous for its ability to stand transportation, is shipped east and west by rail, and west and south by water, on the Kanawha and Ohio rivers. The extensive system of locks and dams, completed by the United States Govern- ment in 1899, renders the shipment of coal from the mines by the Great Kanawha possible at all seasons of the year. The building of the Norfolk and Western Railway in 1884, from Norfolk, Vir- ginia, on Chesapeake Bay, westward to and along the southern border of the state, has developed the now celebrated “Poca- hontas” or “Flat Top” coal-field, where the No. 12 (Rogers) measures greatly thicken. These coals, like those of the New River and Kanawha basins, are worked by horizontal drifts, and have become renowned for their steam-producing qualities, being said to excel the famous Cardiff coals of Wales. Some fifty collieries are now shipping their coals eastwards to Norfolk and westwards to the Great Lakes and Chicago. The analyses of these coals are similar to the New River region, to which geologically they belong. In the northern district of the state extensive mines in the famous Pittsburg seam, along the upper waters of the Monongahela River, are shipping coal and coke by both Pennsylvania and Baltimore and Ohio railways’ connexions. In the north-eastern “pan-handle” of the state, along the West Virginia Central and Pittsburg Railway, extensive mines are now working in the No. 13 measures (Rogers). Coal and coke are hauled directly to Baltimore and Philadelphia, and are thence shipped by rail and water.

Oil and Gas. — West Virginia has become one of the leading oil-producing states in the Union. The petroleum, known as white sand paraffin oil, is of the highest quality, and similar to that of the Pennsylvania pools. In 1899 there were 2412 new wells

drilled, the total number of oil-producing wells was 10,200, and the total production was 13,910,620 barrels, with a value of $18,014,766. The oil is mainly pumped through pipe lines to Baltimore and Philadelphia, a distance of three or four hundred miles. The entire western district lies within probable oil-produc- ing limits, and every month an increasing number of producing wells are opened. With the production of oil natural gas of great power has been developed. Most of the cities of the northern and western districts are now heated and lighted by gas which is piped

~~directly from the wells, and the Pittsburg manufacturing region is also largely supplied. The production and transportation are regulated by stringent laws for the prevention of waste, and it is probable that West Virginia will be an unfailing source of natural gas supply for many years. In 1899 the number of new gas wells drilled was 78 ; the total number was 338, with a value for the gas produced of $3,036,623.~~

~~Manufactures. — The following table shows the condition of the manufacturing industries in 1890 and 1900 : —~~

~~1890.~~

~~1900.~~

~~Percent- age of Increase.~~

~~Number of establishments Capital .... Wage — earners, average~~

~~number Total wages Value of products .~~

~~2376 $28,118,030~~

~~19,340~~

~~$6,911,779~~

~~$38,702,125~~

~~4415 $55,719,938~~

~~33,085 $12,876,902 $74,177,681~~

~~85-8 98-2~~

~~71-1 86-3 91-7~~

~~The leading industries were iron and steel, lumber and timber products, flouring and grist mill products, coke, and leather.~~

Political History. — The original situation of the state capitol at Wheeling in the northern "pan-handle," at the extreme north- western border, was necessarily inconvenient to the people at large. So early was this recognized, that in the session of the legislature ef 1869 a resolution was passed to remove the capitol to a more central situation, and Charleston, in Kanawha county, was chosen. In May 1870 the archives of the state were moved to Charleston and lodged in a building erected for the purpose, presented by the citizens of the Great Kanawha valley. The accommodation for the state's needs was still too contracted how- ever, and on 20th September 1875 the capitol was transferred back to Wheeling, and there remained for a period of ten years. Mean- while the question of the permanent situation was submitted to a vote of the people in August 1877, and Charleston, receiving » majority of the votes, was selected as the seat of the state govern- ment. A new and commodious capitol building was then erected, and upon its completion in the spring of 1885, the archives were removed from Wheeling. In 1894 the Republican party carried the state for the first time since the Civil War, and in 1896 it elected a full state ticket and all four Congressmen ; West Virginia was thus the first Southern state to leave the Democrat ranks and become entirely Republican. In 1900 McKinley received a still larger majority over Bryan than in 1896. This great political change was due partly to extensive emigration from Ohio and Pennsylvania, and partly to general economic conditions and manufacturing interests. (w. S. E.)

Westward HO, a seaside resort of England, on the east side of Barnstaple Bay, Devonshire, and 2\ miles north-west of Bideford. It is of modern growth (since about 1867), and takes its name from Charles Kingsley's well-known novel. It is a favourite place of residence with Anglo-Indians and others, and has a college and first-rate golf links. It forms part of the parish of Northam, which had a population in 1901 of

5322.

Wetter (Swedish, Tetter or Vdtter), a lake of Sweden, 733 square miles in area, with a drainage basin of 2528 square miles ; length, 80 miles ; breadth, 18 miles ; maximum depth, 391 feet ; altitude above sea- level, 289 feet. Its shores are picturesque, on the east side steep, and its waters

of remarkable transparency and blueness. The lake is subject to sudden storms. Near the south end is the picturesque island of Vising (8 miles long by 2 broad), with a ruined palace of the Brahe family (1662). On the shores of the lake stand the towns of Jonkdping and Vadstena. By the western branch of the Gbta canal it has navigable communication

■with Lake Verier, and so with trie Cattegat, and by the eastern branch of the same canal with the Baltic. Its only outflow is by the Motala river, on the east side. The mean depth on the sill of the sluice (made 1810) of the Motala is 10 feet; volume of discharge, 1118 cubic feet per second.

Wetteren, a town of Belgium, in the province of East Flanders, 9 miles south-east of Ghent by rail, on the right bank of the Scheldt. Its numerous manu- factures include cotton and linen goods, lace and gun- powder. Population (1890), 11,923; (1900), 14,441.

Wetzlar, a town of Prussia, Rhine province, on the Lahn, 64 miles by rail east by north of Coblenz. It was formerly a free imperial town and the seat (1689-1806) of the Supreme Court of the empire, the archives of which are still preserved in the town. The most conspicuous build- ing is the cathedral, dating in part from the 11th, in part from the 14th 16th centuries. The town preserves associations of Goethe, who lived here as an official of the Supreme Court, and of Charlotte Buff (cf. Werthers Leiden: Lotte). Overlooking the town are the ruins of the mediaeval castle of Kalsmunt. There are iron mines, glove, optical instrument, and chemical factories. Popu lation (1885), 7844; (1900), 9043.

Wexford, a maritime county of Ireland, province of Leinster, bounded on the N. by Wicklow, on the E. by St George's Channel, on the W. by Waterford, Kilkenny, and Carlow, and on the S. by the Atlantic Ocean.

Population. — The area of the administrative county in 1900 was 578,718 acres, of which 193,160 were tillage, 321,393 pasture, 204 fallow, 10,206 plantation, 794 turf bog, 7694 marsh, 17,090 barren mountain, and

28,177 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, includes the portion of the town of New Ross, formerly situated in Kilkenny. The population in 1881 was 123,854 ; in 1891, 111,778; and in 1901, 103,860, of whom 51,614 were males and 52,246 females, divided as follows among the different religions : ,Roman Catholics, 95,284 ; Protestant Episcopalians, 7805 ; Presby- terians, 272 ; Methodists, 332 ; and other denominations, 167. The decrease of population between 1881 and 1891 was 975 per cent., and between 1891 and 1901, 7‘3 per cent. The average number of persons to an acre was ‘19, and of the total population, 86,810 persons inhabited the rural districts, being an average of 110 to each square mile under crops and pasture. The following table gives the degree of education in 1891 :

=

S

to

s

OS

o H

Percentage.

&

fl

CO

Pn

Read and write Read only Illiterate .

33,876

5,750

~~10,234~~

~~34,988 7,081 9,654~~

~~68,864 12,831 19,888~~

~~65·7 13·4 20·9~~

~~89·7 4·9 5‘4~~

~~95·8 1·4 28~~

~~94·4 1·8 3·8~~

~~The percentage of illiterates among Roman Catholics in 1881 was 27·4. In 1891 there were twelve superior schools with 589 pupils (Roman Catholics 537, and Protestants 52), and 200 primary schools with 15,070 pupils (Roman Catholics 13,894, and Protes- tants 1176). The number of pupils on the rolls of the National schools on 31st December 1900 was 14,312, of whom 13,177 were Roman Catholics, and 1135 Protestants. The following table gives the number of births, deaths, and marriages in the years specified : —~~

~~Year.~~

~~Births.~~

~~Deaths.~~

~~Marriages.~~

~~1881 1891 1900~~

~~3084 2314 2157~~

~~2551 2003 2050~~

~~554 445 479~~

~~1851 and 31st December 1900 was 72,109, of whom 37,953 were males and 34,156 females. The chief towns in the county are Wexford, New Ross, Enniscorthy, and Gorey.~~

~~Administration. — The county is divided into two parliamentary divisions, North and South, the number of registered electors in 1901 being respectively 9158 and 8800. The rateable value in 1900 was £384,456. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises three urban and four rural sanitary districts.~~

~~Agriculture. — The following tables show the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1901. The figures for 1901 are for the new adminis- trative county.~~

~~Year.~~

~~Wheat.~~

~~Oats.~~

~~Barley, Eye, &c.~~

~~Pota- toes.~~

~~Tur- nips.~~

~~Other Green Crops.~~

~~Meadow~~

~~and Clover.~~

~~Total.~~

~~1881 1891~~

~~18a5~~

~~1901~~

~~7933 6984 3388 4664~~

~~46,766 60,717 63,954 44,718~~

~~60.700 34,036 29,233 31,978~~

~~22,451 23,057 21,359 18,868~~

~~17,818 18,942 20,091 20,245~~

~~5623 6363 6327 8599~~

~~59,695 58,471 63 635 58,978~~

~~209,986 197,570 107,987 188,050~~

~~Wexford produces more barley than any other county in Ireland. In 1900 the total value of the cereal and other crops was estimated at £1,295,280, the largest amount of any county in Leinster. The number of acres under pasture in 1881 was 297,153, in 1891, 308,385, and in 1900, 321,393.~~

~~Year.~~

~~Horses~~

~~and Mules.~~

~~Asses.~~

~~Cattle.~~

~~Sheep.~~

~~Pigs.~~

~~Goats.~~

~~Poultry.~~

~~1881 1891 1895 1901*~~

~~28,300 32,047 35,055 31,048~~

~~8116 8341 8911 9154~~

~~118,483 126,011 124,208 134,936~~

~~114,516 203,250 175,273 213,706~~

~~61,215 80,459 76,064 66,153~~

~~6023 8324 8279 7384~~

~~557,517 599,958 671,780 735,039~~

~~In 1900 the birth-rate per 1000 was 20·8, and the death-rate 197 ; the rate of illegitimacy was 3·5 per cent, of the total births. The total number of emigrants who left the county between 1st May~~

- ~~The figures for 1901 have not been revised.~~

~~The number of milch cows in 1891 was 35,824, and in 1901, 36, 097. It is estimated that the total value of cattle, sheep, and pigs for 1901 was £2,254,200. In 1900 the number of holdings not exceeding 1 acre was 2578 ; between 1 and 5, 2165 ; between 5 and 15, 3070 ; between 15 and 30, 3031 ; between 30 and 50, 2625 ; between 50 and 100, 2447 ; between 100 and 200, 871 ; between 200 and 500, 189 ; and above 500, 18 ; total, 16,994. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896 up to 31st March 1901, was 1976, amounting to £993,925. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, between 1882 and 1901, was 224 ; and the amount issued, £17,608. The total amount issued on loan for all classes of works~~

under the Land Improvement Acts from the commencement of operations in 1847 to 31st March 1901 was £137,890.

Fisheries. — In 1900 the number of vessels registered in the deep- sea and coast fishing district of Wexford was 92, employing 326 hands. In the same year the number of persons employed in the salmon fishing district of Wexford was 517. (w. h. Po.)

Wexford, a maritime town, capital of the above county, inland, on the river Slaney, 82 miles south of Dublin by rail. Under the Local Government (Ireland) ■ Act, 1898, it retains its mayor and corporation, which, however, has now practically the status of an urban district council. In 1900, 567 vessels of 73,418 tons entered and 251 of 49,052 tons cleared. The number of vessels registered in the fishery district in 1900 was 92, employing 326 men and boys. Population (1891),

11,545; (1901), 11,154.

Wexid, or Vexio, a town and bishop's see of Sweden, county of Kronoberg, 124 miles north-east of Malnio by rail. It has been rebuilt since a fire in 1843. The cathedral dates from about 1300, but has been restored, the last time in 1898. The town has the Smaland Museum, with anti- quarian and numismatic collections, a library, and a bust of Linnaeus ; also a deaf and dumb school, an asylum for the insane, with iron foundries, a match factory,

royal palace of Kronoberg, and on an island in the lake the ruins of a former castle of the same name. Popu- lation (1890), 6606 ; (1900), 7365.

Weyler y Nicolau, Valeriano, Don

(1839), Spanish general, senator, and Marquis of

Tenerife, was born on 17th September 1839 at Palma de Majorca. His family were originally Prussians, and served in the Spanish army for several generations. He entered a,t sixteen the military college of infantry at Toledo, and, when he attained the rank of lieutenant, passed into the staff college, from which he came out number one in his class. Two years afterwards he became captain, and was sent to Cuba at his own request. He distinguished himself in the expedition to Santo Domingo in many fights, and especially in a daring reconnaissance with few men into the heart of the enemy's lines, for which he got the cross with laurels of San Fer- nando. From 1868 to 1872 he served also brilliantly against the Cuban rebels, and commanded a corps of volunteers specially raised for him in Havana. He returned to Spain in 1873 as brigadier-general, and took an active part against the Carlists in the eastern provinces of the Peninsula in 1875 and 1876, for which he was raised to the rank of general of division. Then he was elected senator and given the title of Marquis of Tenerife. He held the post of captain-general in the Canary Isles from 1878 to 1883, and in the Balearic Isles afterwards. In 1888 he was sent out as captain-general to the Philippines, where he dealt very sternly with the native rebels of the Carolines, of Mindanao, and other provinces. On his return to Spain in 1892 he was appointed to the command first of the 6th Army Corps in the Basque Provinces arid Navarre, where he soon quelled agitations, and then as captain- general at Barcelona, where he remained until January 1896. In Catalonia, with a state of siege, he made himself the terror of the Anarchists and Socialists. After Marshal Campos had failed to pacify Cuba, the Conservative Govern- ment of Canovas del Castillo sent out Weyler, and this selec- tion met the approval of most Spaniards, who thought him the proper man to crush the rebellion. Weyler attempted to do this by a policy of inexorable repression against the non-combatant population that sympathized with the insurgents, literally leaving them no alternative but that of joining the enemy in the forests and bush or sub- mitting to concentration within the Spanish lines, there to live on the barest means of existence doled out by the authorities. This stern policy, and vigorous mili- tary operations by which he drove the rebels out of four provinces to two in the eastern mountainous and forest-clad provinces, made Weyler famous, but pre- cipitated the intervention of American diplomacy in the person of General Woodford, who insisted upon his recall. This recall was

granted by the Liberal Government of Sagasta, but Weyler afterwards asserted that, had he been left alone, he would have stamped out the rebellion in six months. On his return to Spain he coquetted in succession with all the parties — Carlists, Bepublicans, Conservatives — and finally endeavoured to become the ally of the Liberals, with a view to getting some day into the War Office under Sagasta. He became in the meanwhile the most popular leader of the military mal- contents of all ranks from the old colonial armies, and was looked upon as the likely dictator of the future and the man who would revive the influences of militarism in Spain. He kept quiet until he saw one of the Cuban generals, Linares, the defender of Santiago against the Americans, become War Minister. His appointment as captain — general in Madrid by

Linares caused a ministerial crisis, involving the dis- missal of two Conservative ministers — Dato and Gasset — who would not assent to the idea of placing at the head of the garrison of the capital such an ambitious officer. Silvela resigned the post of premier on seeing the impression caused by the appointment of Weyler, but he advised the Queen to send for General Azcar- raga to form another Conservative administration that did not dare to dispense with the services of Linares as War Minister and of Weyler.

Weymouth and Melcombe Kegis, a municipal borough (extended 1895), seaport, and market town in the southern parliamentary division of Dorsetshire, England, at the mouth of the Wey, 142 miles south-west by west of London by rail. The Royal Eye Infirmary has been enlarged, and cottage homes have been erected. Wey- mouth is the Great Western Kailway packet station for the Channel Islands. In 1888 the registered shipping totalled 29 vessels of 2264 tons; in 1900, 22 vessels of 1241 tons. In 1888, 970 vessels of 108,778 tons entered, and 957 of 107,746 tons cleared ; in 1900, 1032 vessels of 198,792 tons entered, and 1032 vessels of 197,689 tons cleared ; these numbers include repeated voyages. The imports were in 1900 valued at £517,520 and the ex- ports at £328,335. Population (1891), 16,100 ; (1901),

19,831.

Weymouth, a town of Norfolk county, Massa- chusetts, U.S.A., containing an area of 18 square miles of undulating country, in the eastern part of the state. It contains several villages, among which are Weymouth, East Weymouth, South Weymouth, and Weymouth Land- ing, most of the population of the town being rural. In the villages the principal industry is the manufacture of boots and shoes. Population (1880), 10,570; (1890), 10,866; (1900), 11,324, of whom 1845 were foreign- born.

Wheat. See Agkiculttire.

Wheeler, William Almon (1819-1887),

Vice-President of the United States from 1877 to 1881, was born at Malone, New York, on the 30th of June 1819. After studying at the University of Vermont, he was admitted to the bar in 1845. As a Whig and then a Republican he played a substantial part in state politics, and repre- sented his district in Congress from 1869 to 1877. His most notable achievement during this time was the pacification of parties disputing for the government of Louisiana through the so-called "Wheeler compromise" of 1875. Nominated for Vice-President by the Republicans in 1876 to serve with President Hayes, he was installed in office through the decisions of the electoral commission, and at the end of his term he retired from public life. He died at Malone on the 4th of June 1887.

Wheeling', a city of West Virginia, U.S.A., capital of Ohio county, and the largest and most important city in the state. It is situated in 40° 05' N. and 80° 43' W., in the " pan-handle," on the east bank of the river Ohio, and on an island in the river, at an altitude of 645 feet. It is regularly laid out, mainly in the level bottom lands, the residential portion spreading up on the cliffs. It is divided into eight wards, has a good water- supply by pumping, is sewered and well paved. It is an important railway centre, since the lines of seven companies enter the city. These are the Baltimore and Ohio ; the Cleveland, Lorain, and Wheeling ; the Ohio River ; the Pittsburg, Cincinnati, Chicago, and St Louis ; the Wheeling and Elm Grove ; the Wheeling and Lake Erie, and the Wheeling Bridge and Terminal

railways. These, with the boats on the river, which is navigable at all times of the year, afford ample faci- lities for commerce. It is primarily, however, a manli- facturing city; in 1900 it contained 406 manufacturing establishments, with a total capital of $13,224,577. They employed 7219 hands, and the products had a value of $16,747,544. The item first in value was iron and steel, $5,833,950. In 1900 the assessed valuation of real and personal property was $23,683,532, the net debt of the city was $640,414, and the rate of taxation per $1000 was $18.90. Population (1890), 34,522 ; (1900), 38,878, of whom 54-61 were foreign-born and 1066 negroes.

Whidah. See Dahomey.

Whippingrham, a parish, Hampshire, England, in the Isle of Wight, 3£ miles north by east of Newport by rail, is beautifully situated above the estuary of the Medway. The chancel of the church of St Mildred was built at the sole cost of Queen Victoria. Osborne House, situated in this parish, was given to the British people in 1902 by King Edward VII. as a thank-offering for his coronation.

Whistler, James Abbott McNeill (1834-

-), American artist, was born, it is believed, in Lowell,

Mass., about 1834. His father was Major G. W. Whistler, and his mother one of the Baltimore family of Winans. He was first heard of in Europe in 1857, when he had already been an art student, in Paris, in the studio of Gleyre. His first etchings, those known as " The French Set," were the-

means of bringing him under the notice of certain people interested in art, but the circu- lation of these first, like that of his later etchings, has always, of necessity, been more limited than their fame. The impressions from each plate are generally few. It was still in etching that Whistler continued his labours, and, coming to London in 1859, it appears, he almost at once addressed himself to the chronicle of the quaint riverside buildings and lthe craft of the great stream — the Thames "below Bridge." The "French Set" had included De Hooch-like or Nicholas Maes-like genre pieces, such as "La Vieille aux Loques," the "Marchande de Moutarde," and " The Kitchen," this last incomparably improved and perfected by the retouching that was accomplished a quarter of a century after the first performance. The Thames series of sixteen etchings, wrought chiefly in 1859, disclosed a new vision of the river, in which there was expressed, with perfect draughts- manship, with a hitherto unparalleled command of viva- cious line, the form of barge and clipper, of warehouse, wharf, and waterside tavern. "The Pool," "Thames Police," and " Black Lion Wharf " are perhaps the finest of this series. Before it was begun, Whistler, ere he left Paris, had proceeded far with a plate, existing only in the state of trial proof, and, in that, of extreme rarity. — It is called "Paris, lie de la CiteV' and has distinct and curious manifestations of a style to be more generally adopted at a later period. For several years after the completion of the "Sixteen Etchings," Whistler etched comparatively little ; but about 1870 we find him entering what has been described as his "Leyland period," on account of his connexion with the wealthy shipowner and art patron, Mr Leyland, of Prince's Gate, whose house became famous for Whistler's. Peacock Eoom,1 painted in 1877. In that period he worked greatly in dry-point. The "Model Besting," one of the most graceful of his figure pieces, and "Fanny Leyland" — an exquisite instance of girl

1 Whistler quarrelled with Leyland, and eventually painted his life-size portrait as a devil with horns and hoofs.

portraiture — are notable performances of this time. To it also belong the largely conceived dry-points, so economical of means and endowed with so singular a unity of effect, the "London Bridge," and "Price's Candle-works." A little later came the splendid visions of the then dis- appearing

wooden bridges of Battersea and Putney, and the plate " The Adam and Eve," which records the river-front of old Chelsea. This, however, is only seen in perfection in the most rare proofs taken before the pub- lication by the firm of Hogarth. From these plates we pass almost imperceptibly to the period of the Venetian etchings, for in 1879, at the instance of the Fine Art Society, Whistler made a sojourn in Venice, and here he wrought, or to speak accurately, commenced, not only the set of prints known as the "Venice Set," but also the "Twenty six Etchings" — likewise chiefly, though not wholly, of Venice — issued later by the firm of Dowdes well. One or two of the minor English subjects of the "Twenty-six Etchings"- — those done after the artist's return from Venice — give indications of the phase reached more clearly in certain little prints executed a few years later, and, with perhaps one exception, never formally published. " Fruit Shop," " Old Clothes Shop," and " Fish Shop, busy Chelsea," belong to this time. Later, and bent upon doing justice to quite different themes, which demand different methods, the ever flexible artist again changes his way, and — not to speak of the dainty little records of the places about the Loire, which in method have affinity with the pieces last named — we have " Steps, Amsterdam," " Nocturne, Dance House," with its magical suggestion of movement and light, and the admirable landscape "Zaandam." With the mention of these things may fitly close a sketch of Whistler's periods in etching; but before proceeding to other branches of his work, the main characteristics of the whole series of etchings (of which, in Wedmore's Whistler's Etchmgs, nearly 300 examples are described) should be briefly indicated. These main characteristics are precision and vivacity ; freedom, flexibility, infinite technical resource, at the service always of the most alert and comprehensive observation; an eye that no picturesqueness of light and shade, no interesting grouping of line, can ever escape — an eye, that is, that is emancipated from conventionality, and sees these things therefore with equal willingness in a cathedral and a mass of scaffolding, in a Chelsea shop and in a suave nude figure, in the facade of a Flemish palace and in a " great wheel " at West Kensington. Mr Whistler's pictures have as a chief source of their attrac- tiveness those mental qualities of alertness and emancipa- tion. Charm of colour and of handling enhance the hold which they obtain upon such people of taste as may be ready to receive them. There are but very few of them, however, at

least very few oil pictures, when one considers the number of years since the artist began to labour ; and one notable fact must be at once understood — the admitted masterpieces in painting belong almost entirely to the earlier time. " Sarasate " is an exception, and " Lady Archibald Campbell," and in its smaller, but still charming, way " The Little Eose of Lyme Begis " ; but even these — save the "Little Rose" — are of 1885 or thereabouts. A few years earlier than they are the "Connie Gilchrist," the "Miss Alexander," and the "Rosa Corder," and the Thames " Nocturnes " ; but we go- farther back to reach the "Portrait of the PainteP s Mother," which is now in the Luxembourg (see Plate), the "Portrait of Carlyle," now at Glasgow, the "Cremorne Gardens," the "Nocturne, Valparaiso Har- bour," the " Music Room," with little Miss Annie Haden standing by the piano while her mother plays, and the "White Girl," or "Little White Girl," in which Whistler

shows the influence, but never the domination, of the Japanese. Of the slight but always exquisitely har- monious studies in water colour, undertaken by Whistler in his middle period, none calls for special notice. To the middle time, too, belong, not perhaps all of his slight but delicately modelled pastels of the figure, but at least his more universally accepted pastels of Venetian scenes, in which he caught the sleepy beauty of the Venetian byeway. In pastel, as in painting, in water colour and in etching, Whistler has never been unmindful of the particular qualities of the medium in which he has worked, nor of the applicability of a given medium to a given subject. The result, accordingly, is not now a victory and now a failure, now a "hit" and now a "miss," but rather a succession of triumphs great and small. One other medium taken up by Whistler must now be mentioned. His lithographs — his draw- ings on the stone in many instances, and in others his drawings on that "lithographic paper" which with some people is the easy substitute for the stone to- day — are perhaps half as numerous as his etchings. Mr T. K. Way has catalogued about a hundred. Some of the lithographs are of figures slightly draped ; two or three of the very finest are of Thames subjects — including a

“nocturne” at Limehouse, of unimaginable and poetic mystery ; others are bright and dainty indications of quaint prettiness in the old Faubourg St Germain, and of the sober lines of certain Georgian churches in Soho and Bloomsbury. An initiator, in his own generation, and ever tastefully experimental, Whistler no doubt has found enjoyment in the variety of the mediums he has worked in, and in the variety of subjects he has brilliantly tackled. The absence of concentration in the Whistlerian temperament, the lack of great continuity of effort, may probably prove a drawback to his taking exactly the place as a painter of oil pictures which, in other circum- stances, his genius and his taste would most certainly have secured for him. In the future Whistler must be accounted, in oil painting, a master exquisite but rare. But the number and the range of his etched subjects and the extraordinary variety of perception and of skill which he has brought to bear upon the execution of his nearly three hundred coppers, ensure, and have indeed already compassed, the acceptance of him as a master among masters in that art of etching. Eembrandt’s, Van Dyck’s, Me>yon’s, Claude’s, are, in fact, the only names which there is full warranty for pronouncing beside his own.

No account of Whistler’s career would be complete without a reference to his supremely controversial personality. In 1878 he brought a libel action against Ruskin for his criticisms in Fors Clavigera (1877). Ruskin had denounced one of his nocturnes at. the Grosvenor Gallery as “a pot of paint flung in the public face.” After a long trial, Whistler was awarded a farthing damages. HIs examination caused much interest, especially in artistic circles, on account of his attitude in vindication of the purely artistic side of art ; and it was in the course of it that he answered the question as to how long a certain ” impression ” had taken him to execute by saying, “All my life.” HIs eccentricity of pose and dress, combined with his artistic arrogance, sharp tongue, and bitter humour, made him one of the most talked-about men in London, and his mots were quoted everywhere. HIe followed up his quarrel with Ruskin by publishing a satirical pamphlet, Whistler v. Buskin: Art v. Art Critics. In 1885 he gave his Ten o’Cloch Lecture in London, afterwards embodied in The Gentle Art of Making Enemies (1890). The sub- stance of this flippantly-written and amusing outburst

was an insistence on the liberty of the artist to do what was right in his artistic eyes, and the inability of the public or the critics to have any ideas about art worth considering at all. In 1895 another quarrel, with Sir William Eden, whose wife's portrait Whistler had painted, but refused to hand over, came into the courts in Paris; and Whistler, though allowed to keep his picture, was condemned in damages.

Whitby, a watering-place, urban district (1894), and market town, Yorkshire, England, in the Whitby parlia- mentary division of the North Riding, 56 miles north-east of York by rail, on both banks of the Esk, where it enters the sea. Brunswick Wesleyan church was erected in 1891, and a new lifeboat station was opened in 1895. Iron ships are now built here. In 1901, 482 vessels of 79,699 tons entered, 475 vessels of 79,312 tons cleared. Population

(1891), 13,075; (1901), 11,748.

").

White, Andrew Dickson (1832-

American author and diplomatist, was born at Homer, New York, 7th November 1832. He graduated at Yale College in 1853, studied history in Paris and Berlin, was an attache' of the United States legation at St Petersburg, and became professor of history in the University of Michigan in 1857. Returning to his native state in 1864, he was elected to its senate, and was influential in shaping the legislation whereby Cornell University, at Ithaca, was opened on the basis of the governmental land grant for state agricultural colleges and of a large gift by Ezra Cornell. Dr White became its first president in 1867, and developed its educational and material resources as a scientific and literary institution primarily designed for students of slender financial means ; he also gave it his valuable historical library of 30,000 volumes and 10,000 manuscripts, and other considerable donations. Resigning the presidency in 1885, he devoted himself to literary and diplomatic pursuits. In 1871, while retain- ing his position at Cornell, he had been United States Commissioner to the republic of San Domingo, and from 1879 to 1881 minister to Germany, by appointment of President Hayes. Between 1892 and 1894 he

was minister to Russia under President Harrison ; was a member of the commission concerning the Venezuela boundary — in dis- cussion between Great Britain, Venezuela, and the United States — in 1896-97 ; and in 1897 was appointed ambas- sador to Germany by President McKinley (a post from which he retired in 1902), also serving as a member of the Peace Conference at The Hague in 1899, and being chair- man of the American delegation. As a diplomatist his long experience enabled him to combine graciousness with decision in an unusual degree. Of his published writings, which are not numerous, but cover various topics in history, finance, and governmental politics, the chief is* a history of The Warfare of Science with Theology (1st edition 1876, afterwards revised and enlarged), which was reissued in London with a preface by John Tyndall.

White, Maria. See Lowell, James Russell.

White, Richard Grant (1821-1885), Ameri- can author, was born in New York City, 22nd May 1821, graduated at the University of New York in 1839, and became a lawyer, but soon devoted the greater part of his time to the writing of dramatic, musical, and art criticisms for the daily press, also being editor-in-chief of the Cowrier and Enquirer, 1854-59. From 1853 until his death he was constantly engaged in the study of Shake- spearean and related textual and critical problems, and between 1857 and 1865 produced, in twelve volumes, the first thorough American edition of the poet, with useful collateral essays on his life and on the history of the

English drama. This edition was reissued in 1883, and in 1885 appeared a readable collection of Studies in Shakespeare, pleading for a rational treatment of the plays, without over-annotation, textual or aesthetic. He also wrote Words and tjieir Uses, Past and Present (1870), and Everyday English (1880), which, without linguistic thoroughness or scholarly value, stimulated interest in the general subject of good use in language. His other work included fiction and sketches of travel in England, but more important was the series of letters to the London Spectator during

the Civil War, which aided in developing English sympathy with the Union cause. From 1861 to 1878 he was employed in the United States Kevenue Marine Bureau in New York, where he died, 8th April 1885.

White, Sir William Arthur (1824-1891),

British diplomatist, was born at Pulawy, in Poland, on 13th February 1824. He was descended on his father's side from an Irish Roman Catholic family. His mother's family, though not of Polish extraction, owned consider- able estates in Poland, where White, though educated at King William's College, Isle of Man, and Trinity College, Cambridge, spent a great part of his early days, and thus gained an intimate knowledge of the Slavonic tongues. From 1843 to 1857 he lived in Poland as a country gentleman, but in the latter year he accepted a post in the British consulate at Warsaw, and had almost at once to perform the duties of acting consul-general. The in- surrection of 1863 gave him an opportunity of showing his immense knowledge of Eastern politics and his com- bination of diplomatic tact with resolute determination. He was promoted in 1864 to the post of consul at Danzig. The Eastern Question was, however, the great passion of his life, and in 1875 he succeeded in getting transferred to Belgrade as consul-general for Servia. In 1878 he was made British Agent at Bucharest. In 1-884 he was offered by Lord Granville the choice of the legation at Rio or Buenos Aires, and in 1885 Lord Salisbury, who was then at the Foreign Office, urged him to go to Peking, pointing out the increasing importance of that post. White's devoted friend, Sir Robert Morier, wrote in the same sense. But White, who was already acting as am- bassador ad interim at Constantinople, decided to wait ; and during this year he rendered one of his most con- spicuous services. It was largely owing to his efforts that the war between Servia and Bulgaria was prevented from spreading into a universal conflagration, and that the union of Bulgaria and eastern Rumelia was accepted by the Powers. In the following year he was rewarded with the embassy at Constantinople. He was the first Roman Catholic appointed to a British embassy since the Refor- mation. At Constantinople he was by general consent the most influential and most successful British repre- sentative since the days of Lord Stratford de Redcliffe. He pursued consistently the policy of counteracting Russian influence in the Balkans

~~by erecting a barrier of independent states animated with a healthy spirit of national life, and by supporting Austrian interests in the East. To the furtherance of this policy he brought an unrivalled knowledge of all the under-currents of Oriental intrigue, which his mastery of languages enabled him to derive not only from the newspapers, of which he was an assiduous reader, but from the obscurest sources. His bluff and straightforward manner, and the know- ledge that with him the deed was ready to follow the word, enabled him at once to inspire confidence and to overawe less masterful rivals. The official honours bestowed on him culminated in 1888 with the G.C.B. and a seat on the Privy Council. He was still ambassador at Constan-~~

~~tinople when he was attacked by influenza during a visit to Berlin, where he died on 28th December 1891.~~

~~(h. sy.) White, Sir William Henry (1845),~~

~~English naval architect, was born at Devonport on 2nd February 1845, and at the age of fourteen became an apprentice in the dockyard there. In 1864 he took the first place in the scholarship competition at the Royal School of Naval Architecture, which had then just been established by the Admiralty at South Kensington, and in 1867 he gained his diploma as fellow of the school with first-class honours. At once joining the constructive staff of the Admiralty, he acted as confidential assistant to the chief constructor, Sir Edward Beed, until the latter's retirement in 1870. The loss of the Captain in that year was followed by an inquiry into designs for ships of war, and in connexion with this White, together with his old fellow-student, William John, worked out a long series of calculations as to the stability and strength of vessels, the results of which were published in an important paper read in 1871 before the Institution of Naval Architects. In 1872 White was appointed secretary to the Council of Construction at the Admiralty, in 1875 assistant con- structor, and in 1881 chief constructor. In April 1883 he left the service of the Admiralty, at the invitation of Lord (then Sir W. G.) Armstrong, in order to undertake the difficult task of organizing a department for the con- struction of warships of the largest size at the Elswick works ; but he only remained there for two and a half years, for in October 1885 he returned~~

to the Admiralty in succession to Sir Nathaniel Barnaby as director of naval construction, retaining that post until the begin- ning of 1902, when ill-health obliged him to relinquish the arduous labours it entailed. During that period, which in Great Britain was one of unprecedented activity in naval shipbuilding as a result of the awakening of public opinion to the vital importance of sea power, more than 200 vessels of various types were added to the British navy, at a total cost of something like 100 millions sterling, and for the design of all of these, as well as for the work of their construction, Sir William White was ultimately responsible. In addition, he has done much to further the knowledge of scientific ship building. He was professor of naval architecture at the Royal School from 1870 to 1873, and when in the latter year it was moved to Greenwich to be merged in the Royal Naval College, he reorganized the course of instruction and acted as professor for eight years more. The lectures he gave in that capacity were the foundation of his Manual of Naval Architecture, which has been translated into several foreign languages and is recognized as a standard text-book all over the world. Sir William White, who was chosen a fellow of the Royal Society in 1888, is also the author of many professional papers read before various learned and engineering societies. He was created K.C.B. in 1895.

Whitehaven, municipal (since 1894) and parlia- mentary borough, railway station, seaport, and parish, in the Egremont or Western parliamentary division of Cumberland, England, 41 miles south of Carlisle. There is a tidal harbour and dock. In 1888, 2554 vessels of 299,091 tons entered and 2542 of 291,960 tons cleared; in 1901, 1186 vessels of 185,424 tons entered and 1187 of 186,146 tons cleared. Since 1892 the port has been subordinate to that of Maryport. Smelting and finished- iron works are increasing in number in the neighbourhood of the iron-ore mines. In 1893 the electric lighting of the town was inaugurated. Population (1891), 19,370; (1901),

19,325.

White Mountains, a name loosely applied to a portion of the Appalachian system in New Hampshire, U.S.A., but more properly perhaps to a group

~~comprising the highest of these mountains, among which is Mount Washington, situated in the northern part of the state. These mountains, like the Adirondacks of New York, are composed of somewhat homogeneous granite rocks, and represent the remnants of long-continued erosion of a region formerly greatly elevated. In this group rise the Androscoggin and Merrimac rivers and branches of the Connecticut. Among the summits are Mount Washington, 6293 feet ; Mount Adams, 5805 feet ; Mount Clay, 5540 feet ; Mount Jefferson, 5725' feet ; Mount Madison, 5380 feet ; and Mount Monroe, 5390 feet. The summit of Mount Washington, on which is an excellent hotel, is reached by a cog-wheel railway. This region has long been known as a popular summer resort, is traversed by railways, and contains numerous villages and fine hotels.~~

~~White Plains, a vil- lage of New York, U.S.A., capital of Westchester county, in the south-eastern part of the state, on the Harlem branch of , the New York Central and Hudson Eiver Eailroad, 22 miles north-east of New York, at an altitude of 201 feet. It is a residence suburb of New York, and is the seat of the Bloomingdale insane asylum. At this place, 28th October 1776, theAmeri- can army was defeated by the British forces under General Howe. Population (1880),~~

~~2381; (1890), 4042; (1900),~~

~~7899, of whom 1679 were foreign-born and 369 negroes.~~

~~Whitman, Walt~~

~~(1819-1892), American poet, was born at West Hills, on Long Island, New York, 31st~~

~~May 1819. His ancestry was mingled English and Holland Dutch, and had flourished upon Long Island more than 150 years — long enough to have taken deep root in the soil and to have developed, in its farmers and seafaring men, many strong family traits. His father, Walter Whitman, was a farmer and carpenter ; his mother, Louisa Van Veisor, was the granddaughter of a sea captain. There do not appear to be any men in his line of descent given to scholarly or intellectual pursuits till we get back to~~

the 17th century, when we come to Abijah Whitman, a clergyman, settled in Connecticut. Later this Abijah moved to Long Island, and from him all the Whitmans on the island descended. Walt was the second of a family of nine children. The parents early moved to Brooklyn, where Whitman spent his youth. His career was a chequered one, like that of so many other self-made American men. First he was an errand boy in a lawyer's office ; then he was employed in a printing office ; next he became a country school teacher ; then he edited the Long Islander at Huntington (1838), and later a daily paper in Brooklyn (the Eagle, 1846-47) ; then he was found in New Orleans, on the editorial staff of the Crescent (1848-49); afterwards he passed his time

Wait Whitman. (From a photograph by Bartlett F. Kenney, Boston.)

carpentering, building, and selling small houses in Brooklyn (1851-54), in the meanwhile writing for the magazines and reviews and turning out several novels, and finally revolving in his mind the scheme of his Leaves of Grass. This scheme was probably gestating in his mind during the years 1853, 1854, and 1855. He frequently stopped his carpentering to work at his poems. He left voluminous manuscript notes, showing the preparatory studies and reflections that preceded the Leaves ; many of them, under the title of Notes and Fragments, were privately printed by his literary executor, Dr Bichard Maurice Bucke, in 1899. Finally, in the summer of 1855 the first edition of Leaves of Grass appeared — a small quarto of ninety -four pages. The book did not

attract the attention of the critics and the reading public till a letter from Emerson to the poet, in which the volume was characterized as " the most extraordinary piece of wit and wisdom that America has yet contributed," was published in the New York Tribune. This created a demand for the book, and started it upon a career that has probably had more vicissitudes and called forth more adverse as well as more eulo- gistic criticism than any other contemporary literary work. In 1856 a second and much enlarged edition of Leaves of Grass appeared. In 1860 a third edition, with much new matter, was published in Boston. In 1862 Whitman wrent to Washington to look after his brother, Lieutenant- Colonel George W. Whitman, who was wounded at the battle of Fredericksburg. Henceforth,

~~for more than ten years he remained in and about Washington, acting as a volunteer nurse in the army hospitals as long as the war lasted, and longer, and then finding employment as a clerk in the Government departments, in the meantime adding to and revising his Leaves and publishing two or three editions of them, himself his own publisher and bookseller. Out of his war experiences came in 1866 his Drum Taps, subsequently incorporated into the main volume. Early in 1873 he suffered a paralytic stroke which partially disabled him. He then went to Camden, New Jersey, to live, and continued to reside in that city till his death on 27th March 1892. In 1871 appeared his prose volume called Democratic Vistas. In 1876 he published a thin volume, called Two Rivulets, made up of prose and verse. Specimen Days and Collect, also prose, appeared in 1882. New editions of his Leaves continued to appear at intervals as long as he lived. A final and complete edition of his works, including both prose and verse, was published in Philadelphia in 1889.~~

~~Whitman never married, never left America, never laid up, or aimed to lay up, riches : he gave his time and his substance freely to others, belonged to no club nor coterie, associated habitually with the common people — mechanics, coach-drivers, working men of all kinds — was always cheerful and optimistic. He was large and picturesque of figure,~~

~~slow of movement, tolerant, receptive, democratic, and full of charity and goodwill towards all. His life was a poet's life from first to last — free, unworldly, unhurried, uncon- ventional, unselfish, and was contentedly and joyously lived. He left many notes that throw light upon his aims and methods in composing Leaves of Grass. " Make no quota- tions," he charged himself, " and no reference to any other writers. Lumber the writing with nothing — let it go as lightly as the bird flies in the air or a fish swims in the sea. Avoid all poetical similes ; be faithful to the perfect likelihoods of nature — healthy, exact, simple, dis- daining ornaments. Do not go into criticisms or argu- ments at all ; make full-blooded, rich, flush, natural works. Insert natural things, indestructibles, idioms, character- istics, rivers, states, persons, &c. Be full of strong sensual~~

germs. . . . Poet ! beware lest your poems are made in the spirit that comes from the study of pictures of things — and not from the spirit that comes from the contact with real things themselves." The mother-idea of his poems, he says, is democracy, and democracy " carried far beyond politics into the region of taste, the standards of manners and beauty, and even into philosophy and theology." His Leaves certainly radiates democracy as no other modern literary work does, and brings the reader into intimate and enlarged relations with fundamental human qualities — with sex, manly love, charity, faith, self-esteem, candour, purity of body, sanity of mind. He was democratic because he was not in any way separated nor detached from the common people by his quality, his culture, or his aspirations. He was bone of their bone and flesh of their flesh. Tried by current standards his poems lack form and structure, but they undoubtedly have in full measure the qualities and merits that the poet sought to give them. (j. bu.)

Whitney, Josiah Dwight (1819-1896),

American geologist, was born at Northampton, Massa- chusetts, 23rd November 1819. He graduated at Yale in 1839, and after two years' work as assistant in the geological survey of New Hampshire, spent some time in Europe in the study of geology. Returning to the United States in 1847, he laboured successively in the copper and iron lands of the Lake Superior region, in Iowa, in the lead region of the upper Missouri river, in Wisconsin, and in Illinois, publishing many reports, singly or in collaboration with others. From 1860 to 1874 he was state geologist of California, and superintended a comprehensive and thorough series of reports on its topography, geology, and botany. In 1869, with William H. Brewer, he accurately determined the heights of the principal Rocky Mountain summits ; and in recognition of his labours Mount Whitney (14,900, in Inyo county, California, the highest peak in the United States) re- ceived its name from him. From 1865 until his death he was professor of geology and director of the school of mining * and practical geology at Harvard University, residing in Cambridge save when absent on expeditions of research. The records of his investigations are somewhat dispersed ; the most homogeneous of his writings are The Metallic Wealth of the United States, described and com- pared with that of other

~~Countries (1854), a work of importance at the time of its issue, and Contributions to American Geology (vol. i. only, 1880). He died at Lake Sunapee, New Hampshire, 18th August 1896.~~

~~Whitney, William Dwight (1827-1894),~~

~~American philologist, was born at Northampton, Mas- sachusetts, 9th February 1827. He was the fourth child and the second surviving son of Josiah Dwight Whitney, a banker, and Sarah Williston, daughter of the Rev. Payson Williston of Easthampton, Massachusetts.~~

~~Through both parents he was descended from New England stock remarkable alike for physical and mental vigour ; and he inherited all the social and intellectual advantages that were afforded by a community noted, in the history of New England, for the large number of distinguished men whom it has produced. At the age of fifteen (1842) he entered the sophomore class of Williams College (at Williamstown, Massachusetts), where he graduated three years later with the highest honours. His attention was at first directed to natural science, and his interest in it always remained keen, while his know- ledge of its principles and methods exerted a noticeable influence upon his philological work. In 1849 he had charge of the botany, the barometrical observations, and the accounts of the United States survey of the Lake Superior region conducted by his brother, Josiah D. Whitney, and in 1873 assisted in the geographical work of the Hayden expedition in Colorado. His interest in the study of Sanskrit was first awakened in 1848, and he at once devoted himself with enthusiasm to this at that time little explored field of philological labour. After a brief course at Yale with Professor Salisbury, then the only trained Orientalist in the United States, Whitney went to Germany (1850) and studied for three years at Berlin, under Weber, Bopp, and Lepsius, and at Tubingen (two summer semesters) under Roth, returning to the United States in 1853. In the following year he was appointed professor of Sanskrit in Yale, and in 1869, also of comparative philology. He also gave instruction in French and German in the college until 1867, and in the Sheffield Scientific School until 1886. An urgent call to a professorship at Harvard was declined in 1869. The importance of his contributions to science was early and widely recognized. He was~~

elected to membership of numerous learned societies in all parts of the world, and received many honorary degrees, the most notable testimonial to his fame being his election, 31st May 1881, as Foreign Knight of the Prussian order pour le mirite for science and 'arts to fill the vacancy caused by .the death of Carlyle. In 1870 he received from the Berlin Academy of Sciences the first Bopp prize, for the most important contribution to Sanskrit philology during the preceding three years — his edition of the Taittiriya- Prdtipdkhya (Journal of the American Oriental Society, vol. ix.). His death occurred at New Haven, Connecti- cut, 7th June 1894.

As a philologist Whitney is noted especially for his work in Sanskrit, which placed him among the first scholars of his time. He. edited (1855-56) with Professor Roth the Atharva-Veda-Sanhitd, published (1862) with a translation and notes; the Atharva-Veda -PratiQdkhya; made important contributions to the great Petersburg lexicon ; issued an index verborum to the published text of the Atharva-Veda (Journal of the American Oriental Society, 1881) ; projected a second volume of the Roth- Whitney edition of the Atharva-Veda, which he did not live to complete ; and published a large number of special articles upon various points of Sanskrit philology. His most notable achievement in this field, however, is his Sanskrit Grammar (1879), a work which, as Professor Delbriick has said, not only is "the best text-book of Sanskrit which we possess," but also places its author, as a scientific grammarian, on the same level with such writers as Madvig and Kriiger. To the general public Whitney is best known through his popular works on the science of language and his labours as a lexicographer. The former are perhaps the most widely read of all English books on the subject, and have merited their popularity through the soundness of the views which they present and the lucidity' of their style. His most important

~~service to lexicography was Ms guidance, as editor-in-chief, of the work on The Century Dictionary (1888-91). Apart from the permanent value of his contributions to philology, Whitney is notable for the great and stimulating influence which he exerted throughout his life upon the development of American scholarship. No man has done more, by precept and example, to establish it upon a solid and enduring foundation.~~

~~The chronological bibliography of Whitney's writings appended to the nineteenth volume (first half) of the Journal of the American Oriental Society, issued in May 1897, contains 360 numbers. Of these' the most important, in addition to those mentioned above, are : Translation of the Surya-Siddhanta, a Text-book of Hindu Astronomy, Jour. Am. Oriental Soc, vol. vi. (1860) ; Language and the Study of Language, 1867 ; A Compendious German Grammar, 1869 ; Oriental and Linguistic Studies, 1873, second series 1874 ; The Life and Growth of Language, 1875 ; Essentials of English Grammar, 1877 ; A Compendious German and English Dictionary, 1877 ; A Practical French Grammar, 1886 ; Max Mutter and the Science of Language, 1892. (b. E. S.)~~

~~Whitstable, urban district (1894), watering-place, and seaport, in the Eastern, or St Augustine's, parlia- mentary division of Kent, England, on the south side of the Thames estuary, 5£ miles north-north-west of Canter- bury. In 1896 a special Act of Parliament transferred the management of the celebrated oyster fishery from the Incorporated Company of Dredgers to the Whitstable Oyster Fishery Company. The harbour has berths along its quay to accommodate vessels of 350 to 400 tons. The urban district consists of parts of the old parishes of Whitstable and Seasalter. Population (1891), 5669;~~

~~(1901), 7086.~~

~~Whittier, John Greenleaf (1807-1892),~~

~~America's " Quaker poet " of freedom, faith, and the sentiment of the common people, was born in a Merrimack Valley farmhouse, Haverhill, Mass., 17th December 1807. The dwelling was built in the 17 th century by his ancestor, the sturdy immigrant, Thomas Whittier, notable through his efforts to secure toleration for the disciples of George Fox in New~~

England. Thomas's son Joseph joined the Society of Friends and bore his share of obloquy. Suc- cessive generations obeyed the monitions of the Inner Light. The poet was born in the faith, and adhered to its liberalized tenets, its garb and speech, throughout his lifetime. His father, John, was a farmer of limited means but independent spirit. His mother, Abigail Hussey, whom the poet strongly resembled, was of good stock. The Rev. Stephen Bachiler, an Oxford man and a Churchman, who became a Nonconformist and emigrated to Boston in 1632, was one of her forebears and also an ancestor of Daniel Webster. The poet and the statesman showed their kinship by the " dark, deep-set, and lustrous eyes" that impressed one who met either of these un- common men. The former's name of Greenleaf is thought to be derived from the French Feuillevert, and to be of Huguenot origin ; and there was Huguenot blood as well in Thomas Whittier, the settler. The poet thus fairly inherited his conscience, religious exaltation, and spirit of protest. All the Whittiers were men of stature and bodily strength, John Greenleaf being almost the first exception, a lad of delicate mould, scarcely adapted for the labour required of a Yankee farmer and his house- hold. He bore a fair proportion of it, but throughout his life was frequently brought to a halt by pain and physical debility. In youth he was described as "a handsome young man, tall, slight, and very erect, bashful but never awkward." His shyness was extreme, though covered by a grave and quiet exterior, which could not hide his love of fun and sense of the ludicrous. In age he retained most of these characteristics, refined by a serene expression of peace after contest. His eyes never lost their glow, and

were said by a woman to be those of one " who had kept innocency all his days."

Whittier's early education was restricted to what he could gain from the primitive "district school" of the neighbourhood. His call as a poet came when a teacher lent to him the poems of Burns. He was then about fifteen, and his taste for writing, bred thus far upon the quaint Journals of Friends, the Bible, and The Pilgrim's Pro- gress, was at once stimulated. There was little art or inspiration in his boyish verse, but in his nineteenth year an older sister thought a specimen of it good enough for submission to The Free Press, a weekly paper which William Lloyd

~~Garrison, the future emancipationist, had started in the town of Newburyport. This initiated Whittier's literary career. The poem was printed with a eulogy, and the editor sought out his young contributor : their alliance began, and continued until the triumph of the anti-slavery cause thirty-seven years later. Garrison overcame the elder Whittier's desire for the full services of his son, and gained permission for the latter to attend the Haverhill academy. To meet expenses the youth worked in various ways, even making slippers by hand in after-hours ; but when he came of age his text-book days were ended. Meanwhile he had written creditable student verse, and contributed both prose and rhyme to newspapers, thus gaining friends and obtaining a decided if provincial reputation. He soon essayed journalism, first spending a year and a half in the service of a publisher of two Boston newspapers, The Manufacturer, an organ of the Clay protectionists, and The Philanthropist, devoted to humane reform. Whittier edited the former, having a bent for politics, but wrote for the latter also. His father's last illness recalled him to the homestead, where both farm and family became his pious charge. Money had to be earned, and he now secured an editorial post at Hartford, Conn., which he sustained until forced by ill-health, early in his twenty-fifth year, to re-seek the Haverhill farm. There he remained from 1832 to 1836, when the property was sold, and the Whittiers removed to Amesbury in order to be near their meeting-house and to enable the poet to be in touch with affairs. The new home became, as it proved, that of his whole after – life ; a dwelling then bought and in time remodelled was the poet's residence for fifty-six years, and from it, after his death on 7th September 1892, his remains were borne to the Amesbury graveyard.~~

~~While in Hartford, Whittier issued in prose and verse his first book, Legends of New England (1831), and edited the writings of the poet Brainard. Thenceforward he was constantly printing verse, but of the hundred or more pieces composed before his settlement at Amesbury, less than fifty are retained in his final collection. Of these none has more significance than the poem to Garrison, which appeared in 1831, and was read (December 1833) at the Philadelphia Convention that formed the Anti-Slavery Society. To that convention, with one-third of its membership composed of Friends, Whittier was a delegate, and was appointed one of~~

the committee that drafted the famous Declaration of Senti- ments. Although a Quaker, he had a polemical spirit; men seeing Whittier only in his saintly age knew little of the fire wherewith, setting aside ambition and even love, he maintained his warfare against the "national crime," employing action, argument, and lyric scorn. A future was open for him among the Protectionists, who formed the Whig party, and doubtless soon would have carried him to the United States Congress. As it was, he got no farther than the legislature of his own state (1835-36), elected by his neighbours in an anti- slavery town. But if Garrison, Phillips, and Sumner

and Mrs Stowe were to be the rhapsodists of the long emancipation struggle, Whittier was its foreordained poet-seer. In 1833 he had issued at his own cost a pamphlet, Justice and Expediency, that provoked vehe- ment discussion North and South. Later, he shared with the agitators their experience of lawlessness, mob- violence, and political odium. His sister Elizabeth, who became his life companion, and whose verse is preserved with his own, was president of the Woman's Anti- Slavery Society in Amesbury. It is to be noted that the first collection of Whittier's lyrics was the Poems written during the Progress of the Abolition Question in the United States, issued by a friend in 1837. But Mogg Megone (1836) was his first book, a crude attempt to apply the manner of Scott's romantic cantos to a native theme. Among his other lyrical volumes, of dates earlier than the Civil War, were Lays of- my Home (1843), Voices of Freedom (1846), Songs of Labor (1850), The Chapel of the Hermits (1853), The Pano- rama (1856), Home Ballads (1860). The titles of In War Time (1863) and National Lyrics (1865) rightly designate the patri- otic rather than Tyrtsean contents of these books. The poet was closely affili- ated with the The Atlantic Monthly from the founda- tion of that classic magazine in 1857. His repute be- came national with the welcome awarded to Snow- Sound in 1866, and brought a corresponding material re- ward. Of his later books of verse may be mentioned The Tent on the Beach (1867), The Pennsylvania Pilgrim (1872), The Vision of

~~Echard (1878), The King's Missive (1881), At (1890). As early as 1849 his poems appeared, and his Poetical Works was issued in London in 1850. During the ensuing forty years no less than ten successive collections of his poems appeared. Meanwhile he did much editing and compiling, and produced, among other works in prose, The Stranger in Lowell (1845), Supernaturalism in New England (1847), Leaves from Margaret Smith's Journal (1849), a pleasing treatment in old-style English of an early Colonial theme. When he died, in 1892, in New Hamp- shire, among the hills he loved and sang so well, he had been an active writer for over sixty years, leaving more than that number of publications that bore his name as author or editor. His body was brought to Amesbury for interment ; the funeral services were held in the open air, and conducted after the simple rites of the Friends, in the presence of a large concourse, certain of whom " spake as they were moved " in tribute to the bard. The Amesbury house has been acquired by the "Whittier Home Association," so that the building and grounds are guarded as he left them, and form a shrine to which there is a constant pilgrimage. The Haverhill homestead, memorized in Snow-Bound, is also held by trustees "to~~

~~John Gkeenleaf Whittier. (From a photograph by Conly, Boston.)~~

~~Sundown, his last poems an illustrated collection of~~

~~preserve the natural features of the landscape," and to keep the buildings and furniture somewhat as they were in their minstrel's boyhood.~~

~~It would be unjust to consider Whittier's genius from an aca- demic point of view. British lovers of poetry— except John Bright and others of like faith or spirit^have been slow to comprehend his distinctive rank. As a poet he was essentially a balladist, with the faults of his qualities ; and his ballads, in their freedom, naivete", even in their undue length, are among the few modern examples of unsophisticated verse. He returned again and again to their production, seldom labouring on sonnets and lyrics of the Victorian mould. His ear for melody was inferior to his sense of time, but that his over-facility and structural defects were due less to lack of taste than to early habit, Georgian models, disassocia- tion from the schools, is indicated by his work as a writer of prose. In Margaret Smith's Journal an artistic, though suppositive,~~

~~Colonial style is well maintained. -„ Whittier became very sensible of~~

~~his shortcomings ; and when at leisure to devote himself to his art he greatly bettered it, giving much of his later verse all the polish that it required. In ex- tended composition, as when he followed Longfellow's Tales of a Wayside Inn with his own Tent on the Beach, he often failed to rival his graceful brother poet. In American balladry he was pre-eminent ; such pieces as "The Swan Song of Parson Avery," "Marguerite," " Bar-clay of Ury," " Skipper Ireson's Bide," "In the 'Old South,'" hold their place in literature. It is necessary above all to con- sider the relation of a people's years of growth and ferment to the song which represents them ; for in the strains of Whittier, more than in those of any other 19th-century lyrist, the saying of Fletcher of Saltoun as to the ballads and laws of a nation finds a historic illustration. He was the national bard of justice, humanity, and reform, whose voice went up as a trumpet until the victory was won. Its lapses resembled those of Mrs Brown- ing, who was of his own breed in her fervour and exaltation. To the last it was uncertain whether a poem by Whittier would "turn out a sang," or "perhaps turn out a sermon"; if the latter, it had deep sincerity and was as close to his soul as the other. He began as a liberator, but various causes employed his pen ; his heart was with the people, and he was understanded of them ; he loved a worker, and the Songs of Labor convey the zest of the artisan and pioneer. From 1832 to 1863 no occasion escaped him for inspiring the assailants of slavery, or chanting paeans of their martyrdom or triumph. No crusade ever had a truer laureate than the author of "The Virginia Slave Mother," "The Pastoral Letter" — one of his stinging ballads against a time-serving Church — "A Sabbath Scene," and "The Slaves of Martinique." "Randolph of Roanoke "is one of the most pathetic and most elevated of memorial tributes. " Ichabod " and " The Lost Occasion," both evoked by the attitude of Webster, are Roman in their condemnation and "wild with all regret."~~

~~The green rusticity of Whittier's farm and village life imparted a bucolic charm to such lyrics as "In School Days," "The Bare- foot Boy," "Telling the Bees," "Maud Muller," and "My Schoolmate. " His idyllic masterpiece is the sustained transcript of winter scenery and home-life, Snow-Bound, which has had no equal except Longfellow's "Evangeline "~~

~~in American favour, but, in fact, nothing of its class since "The Cottar's Saturday Night" can justly be compared with it. Along with the Quaker poet's homing sense and passion for liberty of body and soul, religion and patriotism are the dominant notes of his song. His conception of a citizen's prerogative and duty, as set forth in ' ' The Eve of Election," certainly is not that of one whose legend is "our country, right or wrong." Faith, hope, and boundless charity pervade the "Questions of Life," "Invocation," and "The Two Angels," and are exquisitely blended in " The Eternal Goodness," perhaps the most enduring of his lyrical poems. " We can do~~

~~without a Church," he wrote in a letter ; "we cannot do with- out God, and of Him we are sure." The inward voice was his inspiration, and of all American poets he was the one whose song was most like a prayer. A knightly celibate, his stainless life, his ardour, caused him to be termed a Yankee Galahad ; a pure and simple heart was laid bare to those who loved him in "My Psalm," "My Triumph," and "An Autograph." The spiritual habit abated no whit of his inborn sagacity, and it is said that in his later years political leaders found no shrewder sage with whom to take counsel. When the question of primacy among American poets was canvassed by a group of the public men of Lincoln's time, the vote was for Whittier ; he was at least one whom they understood, and who expressed their feeling and convictions. Parkman called him "the poet of New England," but as the North and West then were charged with the spirit of the New England states, the two verdicts were much the same. The fact remains that no other poet has sounded more native notes, or covered so much of the American legendary, and that Whittier's name, among the patriotic, clean and true, was one with which to conjure. He was revered by the people cleaving to their altars and their fires, and his birthdays were calendared as festivals, on which greetings were sent to him by young and old.~~

~~In his age the poet revised hia works, classifying them for a definitive edition, in seven volumes, published at Boston, 1888. Their metrical~~

portion, annotated by Horace E. Scudder, can be found in the one-volume "Cambridge Edition," Boston, 1894. Whittier's Life and Letters, prepared by his kinsman and literary executor, Samuel T. Pickard, also appeared in 1894.

(E. 0. S.)

Whitworth, Sir Joseph, Bart. (1803-1887),

English engineer, was born at Stockport, near Manchester, on the 21st of December 1803. On leaving school at the age of fourteen, he was placed with an uncle who was a cotton-spinner, with the view of becoming a partner in the business ; but his mechanical tastes were not satisfied with this occupation, and in about four years he gave it up. He then spent some time with various machine manufacturers in the neighbourhood of Manchester, and in 1825 moved to London, where he gained more experi-ence in machine shops, including those of Maudslay and Holtzapffel. In 1833 he returned to Manchester and started in business as a tool-maker. In 1840 he attended the meeting of the British Association at Glasgow, and read a paper on the preparation and value of true planes, describing the method which he had successfully used for making them when at Maudslay's, and which depended on the principle that if any two of three surfaces exactly fit each other, all three must be true planes. The accuracy of workmanship thus indicated was far ahead of what was contemplated at the time as possible in mechanical engi- neering, but Whitworth not only proved that it could be attained in practice, but also showed how it could be measured. He found that if two true planes were arranged parallel to each other, an exceedingly small motion towards or from each other was sufficient to determine whether an object placed between them was held firmly or allowed to drop, and by mounting one of the planes on a screwed shaft provided with a compara- tively large wheel bearing a scale on its periphery, he was able to obtain a very exact measurement of the amount, however minute, by which the distance be-tween the planes was altered, by observing through what angular distance the wheel had been turned. In 1841, in a paper read before the Institution of Civil Engineers, he urged the necessity for the adoption of a uniform system of screw threads in place of the various heterogeneous pitches

then employed, and he had the satisfaction of seeing the uniformity he desired become universal in less than twenty years. His system of standard gauges was also widely adopted. The prin- ciples of exact measurement and workmanship which he advocated were strictly observed in his own manufactory, with the result that in the Exhibition of 1851 he had a show of machine tools which were far ahead of those of any competitor. It was doubtless this superiority in

machine construction that caused the Government three years later to request him to design, and estimate for making, the machinery for producing rifled muskets at the new factory at Enfield. He did not see his way to agree to the proposition in this form, but it was ultimately settled that he should undertake the machinery for the barrels only. Finding that there was no established practice to guide him, he began a series of experiments to determine the best principles for the manufacture of rifle barrels and projectiles. He ultimately arrived at a weapon in which the necessary rotation of the projectile was obtained, not by means of grooving, but by making the barrel polygonal in form, with gently rounded angles, the bullets also being polygonal and thus travelling on broad bearing-surfaces along the rotating polygon. The projectile he favoured was 3 to 3J calibres in length, and the bore he fixed on was 0-45 inch, which was at first looked upon as too small. It is reported that at the trial in 1857 weapons made according to these principles ex- celled the Enfield weapons in accuracy of fire, penetration, and range to a degree " which hardly leaves room for com- parison." He also constructed heavy guns on the same lines ; these were tried in competition with Armstrong's ordnance in 1864 and 1865, and in their inventor's opinion gave the better results, but they were not adopted by the Government. In constructing them Whitworth experi- enced difficulty in getting large steel castings of suitable soundness and ductility, and thus was led to devise his compressed steel process, in which the metal is subjected to high pressure while still in the fluid state, and is after- wards forged in hydraulic presses, not by hammers. In 1868 he founded the Whitworth scholarships, setting aside an annual sum of £3000 to be given for " intelligence and proficiency in the theory and practice of mechanics and its cognate sciences," and in the following year he was created a baronet. He died at Monte Carlo, whither he had gone for the sake of his health, on the 22nd

of January 1887. In addition to handing over £100,000 to the Science and Art Department for the permanent endowment of the thirty Whitworth scholarships, his residuary legatees, in pursuance of what they knew to be his intentions, expended over half a million on charitable and educa- tional objects, mainly in Manchester and the neighbour- hood, (h. m. r.)

-), British

Whymper, Edward (1840-

artist, explorer, and mountaineer, was born in London on 27th April 1840. The son of an artist, he was himself at an early age trained to the profession of a wood-engraver. In 1860 he was commissioned to make a series of sketches of Alpine scenery, and undertook an extensive journey in the Central and Western Alps. Finding, on his first expeditions, that he possessed the steady head and sure foot of ^he mountaineer, he planned for the following year an ambitious programme. Among the objects of his tour in 1860 had been the illustration of an attempt, which proved unsuccessful, made by Professor Bonney's party, to ascend Mont Pelvoux, at that time believed to be the highest peak of the Dauphine Alps. IIe successfully accomplished the ascent in 1861 — the first of a series of expeditions that threw much light on the topography of a district at that time very imperfectly mapped. From the summit of Mont Pelvoux he made the important discovery that it was overtopped by a neighbouring peak, subsequently named the Pointe des Ecrins, which, before the annexation of Savoy added Mont Blanc to the possessions of France, was the highest point in the French Alps. Its ascent by Mr Whymper's party i,n 1864 was perhaps the most re- markable feat of mountaineering up to that date. The years 1861 to 1865 are filled with a number of new

expeditions in the Mont Blanc group and the Pennine Alps, among them the ascent of the Aiguille Verte and the crossing of the Morning Pass. But the peak which from the first exercised its fascination upon him, and with which his name remains inseparably associated, is the Matterhorn.

Professor Tyndall and Mr Whymper emu- lated each other in fruitless attempts to reach the summit by the south-western or Italian ridge. Mr Whymper, six times repulsed, determined to try the eastern face, convinced that its precipitous appearance when viewed from Zermatt was an optical illusion, and that the dip of the strata, which on the Italian side formed a continuous series of overhangs, should make the opposite side a natural staircase. No more brilliant example can be named of the application of scientific reasoning to the conquest of natural obstacles. His attempt by what is now the usual route was crowned with success (14th July 1865) ; but on the descent four of the party slipped and were killed, and only the breaking of the rope saved Mr Whymper and the two remaining guides from the same fate. The account of his attempts on the Matterhorn occupies the greater part of his Scrambles among the Alps (1871) — one of the classics of Alpine literature. In one respect it stands unique, the illustrations being engraved by the author himself. No engraving could surpass the reproduction of rock-texture in " Matterhorn from the Biffelberg," or of the characteristic appearance of freshly-fallen snow on a lofty peak in " Matterhorn from the summit of the Theodule Pass." His campaign of 1865 had been planned to exercise his judgment in the choice of routes as a preparation for an expedition to Greenland. Entirely an individual effort, save for small grants from the British Association and the Boyal Geographical Society, the expedition resulted in an important collection of fossil plants, which were described by Professor Heer and de- posited in the British Museum. Mr Whymper's report was published in the Report of the British Association for the year 1869. Though hampered by want of means and by the prevalence of an epidemic among the natives, he proved that the interior could be explored by the use of suitably-constructed sledges, and thus contributed an important advance to Arctic exploration. Another expedition followed in 1872, and was devoted to a survey of the coast-line. He next organized an expedition to Ecuador, designed primarily to collect data for the study of moun- tain-sickness and of the effect of diminished pressure on the human frame. He took as his chief guide Jean Antoine Carrel, whose subsequent death from exhaustion on the Matterhorn after bringing his employers into safety through a snow-storm forms one of the noblest pages in the history of mountaineering. During 1880 Mr Whymper on two separate occasions ascended Chimborazo, whose summit, 20,500 feet

above sea-level, had never before been reached ; spent a night on the summit of Cotopaxi, separated from its fires by so thin a crust that the temperature of the ground in his tent rose to 110°, and obtained a photograph of the crater ; and made first ascents of half-a-dozen other great peaks. In 1892 he published the results of his journey in a volume, entitled Travels amongst the Great Andes of the Equator. His observations on mountain sickness led him to conclude that it was caused by " diminution in atmospheric pressure, which operates in at least two ways — namely, (a) by lessening the value of the air that can be inspired in any given time, and (b) by causing the air or gas within the body to expand, and to press upon the internal organs"; and that " the effects produced by (b) may be temporary and pass away when equilibrium has been restored between the internal and external pressure." The publication of his work was recognized on the part of the Boyal Geo

graphical Society by the award of the Patron's medal. HIs experiences in South America having convinced him of certain serious errors in the readings of aneroid baro- meters at high altitudes, he published a work, entitled HOw to Use the Aneroid Barometer, and succeeded in introducing important improvements in their construction. IIe afterwards published two excellent guide-books to Zermatt and Chamonix. In 1901 he undertook an im- portant expedition in an unexplored region of the Canadian Jtockies.

Wichita., a city of Kansas, U.S.A., capital of Sedgwick county. It is situated in 37° 40' N. and 97° 20' W. in the broad bottom lands of the river Arkansas, in the southern part of the state, at an altitude of 1300 feet. The site of the city is level, its plan regular ; it is divided into six wards, and. it has water-supply and sewer systems. Four great railway systems enter the city — the Atchison, Topeka, and Santa Fe ; the Chicago, Bock Island, and Pacific ; the Missouri Pacific, and the St Louis and San Francisco — and make of it an important transportation centre for the rich agricultural region surrounding it. In 1900 the city contained 328 manu- facturing establishments, with a total capital of $2,108,524. They employed 1505 hands, and the product was valued at $4,724,068. The city contains also stock-yards and meat-packing establishments. Like other cities of central and western Kansas, Wichita suffered from the "

~~boom " which occurred between 1880 and 1890. In 1880 it had a population of but 4911 ; in 1890 the number had leaped to 23,853. This was followed by a great falling-off, and it is only in recent years that the city has recommenced to gain. In 1900 the population was 24,671, of whom 1447 were foreign- born and 1389 negroes.~~

~~Wick, a royal and parliamentary burgh (Wick group), seaport, and county town of Caithness, Scotland, on the German Ocean, 161 miles north-north-east of Inverness by rail. The town hall and county buildings have been en- larged ; there are two free libraries. A harbour extension, begun in 1884, cost £100,000, and a further extension is in progress. In 1888, 1169 vessels of 142,280 tons entered; in 1898, 1057 of 113,262 tons. Exports (mainly fish) were valued at £111,428 in 1888, and £108,282 in 1898. 152 boats employing 636 men belonged to Wick and Pulteneytown in 1899, and the value of the fish landed was £75,669. A new industry is the manufacture of fish guano and fish food products. Population (1891), 8464 ;~~

~~(1901), 7881.~~

~~Wick low, a maritime county of Ireland, province of Leinster, bounded on the N. by Dublin, on the E. by St George's Channel, on the W. by Carlow and Kildare, and on the S. by Wexford.~~

~~Population. — The area of the administrative county in 1900 was 499,957 acres, of which 89,582 were tillage, 238,481 pasture, 308 fallow, 17,957 plantation, 4446 turf bog, 11,937 marsh, 119,444 barren mountain, and 17,852 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, includes the portion of the township of Bray formerly situ- ated in Dublin. The population in 1881 was 70,386, in 1891, 62,136, and in 1901, 60, 679, of whom 30, 500 were males and 30, 179 females, divided as follows among the different religions : Koman Catholics, 48,001 ; Protestant Episcopalians, 11,323 ; Presbyterians, 495 ; Methodists, 606 ; and other denominations, 254. The decrease of population between 1881 and 1891 was 1172 per cent., and between 1891 and 1901 5 '9 per cent. The average number of persons to an acre in 1891 was '12, the smallest average of any county in Ireland, and of the total population 50,159 persons inhabited the rural districts,~~

being an average of 100 to each square mile under crops and pasture. The following table shows the degree of educa- tion in 1891 :—

3

a

*e3

o

Percentage.

69-6 107 19-7

A m

00

■3

Read and write Read only . . Illiterate . .

20,300 2,636 5,056

21,159 2,637 4,312

41,459 5,273 9,368

89-9 4-5 5-6

94-9 2-4 27

95-3 2-1 2-6

~~The percentage of illiterates among Roman Catholics in 1881 was 25‘2. In 1891 there were nine superior schools with 261 pupils (Roman Catholics, 142, and Protestants, 119), and 154 primary schools with 9094 pupils (Roman Catholics, 7245, and Protestants, 1849). The number of pupils on the rolls of the National schools on 31st December 1900 was 9636, of whom 7834 were Roman Catholics and 1802 Protestants. The following table gives the number of births, deaths, and marriages in the years specified : —~~

~~Year.~~

~~Births.~~

~~Deaths.~~

~~Marriages.~~

~~1881 1891 1900~~

~~1462 1249 1286~~

~~1188 1037 1199~~

~~281 297 287~~

~~In 1900 the birth-rate per 1000 was 21-2, and the death-rate 19 ‘8 ; the rate of illegitimacy was 2-6 per cent, of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 29,072, of whom 16,217 were males and 12,855 females. The chief towns in the county are Bray, Arklow, and Wicklow.~~

~~Administration. — The county is divided into two parlia- mentary divisions, East and West, the number of registered electors in 1901 being respectively 5069 and 4668. The rate- able value in 1900 was £285,501. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county comprises two urban and five rural sanitary districts.~~

~~*Agriculture. — The following tables show the acreage under crops, including meadow and clover, and the amount of live-stock in 1881, 1891, 1895, and 1901. The figures for 1901 are for the new administrative county.*~~

~~*Year.*~~

~~*Wheat.*~~

~~*Oats.*~~

~~*Barley, Rye, &c.*~~

~~*Pota- toes.*~~

~~*Tur- nips.*~~

~~*Other Green Crops.*~~

~~*Meadow*~~

~~*and Clover.*~~

~~*Total.*~~

~~*1881 1891 1895 1901*~~

~~*3397 954*~~

~~*295 267*~~

~~*25,209 23,480 23,847 21,568*~~

~~*1199*~~

~~*551 614 508*~~

~~*11,374*~~

~~10,264~~

~~9,067~~

~~7,719~~

~~5237 5414 6241 6691~~

~~1849 2469 2116 2583~~

~~59,168 55,106 57,807 61,872~~

~~107,433 98,238 99,987 90,208~~

~~In 1900 the total value of the cereal and other crops was estimated at £546,507. The number of acres under pasture in 1881 was 225,919, in 1891, 226,229, and in 1900, 238,481.~~

~~Year.~~

~~Horses~~

~~and Mules.~~

~~Asses.~~

~~Cattle.~~

~~Sheep.~~

~~Pigs.~~

~~Goats.~~

~~Poultry.~~

~~1881 1891 1895 1901*~~

~~12,309 12,366 13,194 12,224~~

3585 3607 3615 3611

76,654 81,809 74,847 78,770

183,222 215,321 202,686 219,391

19,204 23,465 22,542 19,020

7016 6769 5883 5384

214,509 226,873 229,767 247,446

- The figures for 1901 have not been revised.

The number of milch cows in 1891 was 24,032, and in 1901 21,845. It was estimated that the total value of cattle, sheep, and pigs in 1901 was £1,494,549. In 1900 the number of holdings not exceeding 1 acre was 1388 ; between 1 and 5, 834 ; between 5 and 15, 1301 ; between 15 and 30, 1260 ; between 30 and 50, 1175 ; between 50 and 100, 1348 ; between 100 and 200, 730 ; between 200 and 500, 282 ; and above 500, 65 ; total, 8383. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901, was 319, amounting to £289,538. The number of loans for agricultural improvements, sanctioned under sect. 31 of the Land Act, 1881, was 192, and the amount issued, £17,002. The total amount issued in loan for all classes of works under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1901, was £128,070.

Fisheries. — In 1900 160 vessels, employing 838 hands, were registered in the deep-sea and coast fishery district of "Wicklow.

(w. H. Po.)

Widdin, or Viddin, a fortified, town and seaport, and the capital of a department of the same name, in the principality of Bulgaria, situated on the right bank of the Danube, 151 miles north-north-west of Sofia. It consists of three divisions — the modern suburbs extending along the

~~banks of the Danube, the old town surrounded by walls, and the citadel. The old town contains the ruined mosque of Mustafa Pasha, the ruined palace of the pashas, and the clock tower. The chief trade is in cereals, dried fruit, and jewellery, and there is also a large dis- tillery. The exports in 1899 amounted to 33,914 tons, valued at £123,856, and the imports to 39,052 tons, valued at £70,824. Population, 14,772.~~

~~Widnes, a municipal borough (since 1892) and manufacturing town, in the Widnes parliamentary division of Lancashire, "England, on the river Mersey, 13 miles south-east of Liverpool by rail. A technical school and free library were opened in 1896. The fever hospital was enlarged in 1900, at a cost of £10,000, and in the same year the Victoria Park (34 acres) and the Victoria Promenade, bordering the river, were opened. A cemetery of 15 acres, with three mortuary chapels, was laid out in 1898. Population (1891), 30,011;~~

~~(1901), 28,580.~~

~~-), French~~

~~Widor, Charles Marie (1845-~~

~~composer and organist, was born at Lyons, 22nd February 1845. He studied first at Lyons, then at Brussels under Lemmens for the organ and Fetis for composition. In 1870 he became organist of the church of Saint Sulpice in Paris. He succeeded C^sar Franck as professor of the organ at the Paris Conservatoire, where he was also appointed professor of composition, counterpoint, and fugue in 1896. M. Widor is a very prolific composer, and has displayed his creative ability in a variety of different styles. His works include an opera, Maitre Ambros (Opera Comique, 1896), La Xorrigane (ballet, given at the Opera, 1880), incidental music to Conte d'Avril (1885), Les Jacobites (1885), and Jeanne cFArc (a pantomime play, 1890), two symphonies, The Walpurgis Night, and other works for orchestra, a quintet for strings and piano, trio for piano and strings, a mass, psalm, and other sacred compositions, symphonies for organ, a large number of piano pieces, and many songs.~~

~~Wiedemann, Gustav Heinrich (1826-~~

1899), German physicist, was born at Berlin on the 2nd of October 1826. After attending the Cologne gymnasium, he entered the University of Berlin in 1844, and took his doctor's degree there three years later. His thesis on that occasion was devoted to a question in organic chemistry, for he held the opinion that the study of chemistry is an indispensable preliminary to the pursuit of physics, which was his ultimate aim. In Berlin he made the acquaintance of Helmholtz at the house of Magnus, and was one of the founders of the Berlin Physical Society. In 1854 he left Berlin to become professor of physics in Basel University, removing nine years afterwards to Brunswick Polytechnic, and in 1866 to Carlsruhe Polytechnic. In 1871 he accepted the chair of physical chemistry at Leipzig. The attention he had paid to chemistry in the earlier part of his career enabled him to hold hte own in this position, but he found his work more congenial when in 1887 he was transferred to the professorship of physics. He died at Leipzig on the 24th of March 1899. His name is probably most widely known for his literary work. In 1877 he undertook the editorship of the Annalen der Physik und Chemie in succession to Poggendorff, thus starting the series of that scientific periodical which is familiarly cited as Wied. Ann.

Another monumental work for which he was responsible was Die Lehre von der Mektricitcit, or, as it was called in the first instance, Lehre von Galvanisrmus und Elektro- magnetismus, a book that is unsurpassed for accuracy and comprehensiveness. He produced the first edition in 1861, and a fourth, revised and enlarged, was only com- pleted a short time before his death. But his original work was also important. His data for the thermal con- ductivity of various metals were for long the most trust- worthy at the disposal of physicists, and his determination of the ohm in terms of the specific resistance of mercury showed remarkable skill in quantitative research. He carried out a number of magnetic investigations which resulted i,n the discovery of many interesting phenomena, some of which have been rediscovered by others ; they related among other things to the effect of mechanical strain on the magnetic properties of the

magnetic metals, to the relation between the chemical composition of com- pound bodies and their magnetic properties, and to a curious parallelism between the laws of torsion and of magnetism. He also investigated electrical endosmosis and the electrical resistance of electrolytes. His eldest son, Eilhaed, born at Berlin on the 1st of August 1852, became professor of physics at Erlangen in 1886, and his younger son, Alfred, born at Berlin on the 18th of July 1856, was appointed to the extraordinary professorship of Egyptology at Bonn in 1892.

Wieliczka, a mining town in Galicia, Austria, 9 miles from Cracow, built on the slopes of a hill which half encircles the place, and over the celebrated salt-mines of the same name. Two of the entrances to the mines are in the town. They suffered from inundations in 1868 and 1879, the former of which greatly damaged the sub- terranean chapels with their altars, statues, and ornaments in rock-salt. The worst effects of both inundations were averted, but the whole soil on which the town is built shows signs of subsidence. There are about 1000 hands employed in the mines, which in 1894 yielded 80,170 tons of salt, of a value of £291,600. Theyhave> been in the exclusive possession of the Austrian State since 1814. Population (1890), 6037; (1900), 6012.

Wiener-Neustadt, an important manufactur- ing town in Lower Austria, about 30 miles south of Vienna by rail. The town has a large ammunition factory in addition to its other industries, and an important pig fair. Population (1890), 25,040 ; (1900), 28,438, includ- ing a garrison of 1595 men.

Wieniawski, Henri (1835-1880), Polish

violinist and composer, was born at Lublin, in Poland, 10th July 1835. He was a pupil of the Paris Conservatoire from 1843 to 1846, and again in 1849-50. Meanwhile he had given concerts in his native country and in Russia, and in 1850 entered upon the career of a travelling virtuoso, together with his brother Joseph, a distinguished pianist. He was appointed solo violinist to the Tsar in 1860, and taught in the Conservatoire of St Petersburg from 1862 to 1867. He went on tour again in 1872 with Rubinstein in America, and on his return in 1874 was appointed to succeed Vieuxtemps as professor in the Brussels Con-

servatoire ; but like his predecessor, he was compelled through ill-health to give up the post after three years, returning to a public career in spite of his illness, until his death in Moscow, 31st March 1880. He was a wonderfully sympathetic player, who had conquered in early life all possible technical difficulties; he was a good if not a great quartet player, but his impulsive nature fitted him rather for the interpretation of works like his own, compositions which, with their strongly

marked individuality, make a direct appeal to the average hearer, are eminently grateful to the player, and by no means unpleasing to musicians. His Legende, the fantasias on Faust and on Russian airs, his two con- certos, and some other pieces, have retained their high place in the violin repertory.

Wiesbaden, a watering-place of Prussia, province of Hesse — Nassau, on the southern slope of the Taunus range, and 6 miles north of Mainz. The total number of persons who in the year visit its mineral baths and various health institutions is estimated at 120,000. A new drink- ing hall was built in 1888-90 to enclose the "Koch- brunnen." In 1884-87 a new town hall was constructed of sandstone in the German Renaissance style ; it affords shelter to the Fischbach textile museum. The Protestant Ring-Kirche, a Transitional building (1892-94), forms a conspicuous object on the west side of the town. The Augusta Victoria bath-house, a fine Renaissance edifice, opened in 1895, is equipped interiorly like the Friedrich bath-house in Baden. There is a new (1893-95) Roman Catholic church, Mariahilfkirche. In 1892-94 the royal theatre was provided with a new rear facade (1892-94). The town is adorned with bronze statues of the Emperor Frederick III. (1897) and Bismarck (1898), and a marble statue by Schilling of the Emperor William I. (1894). A chemical laboratory, agricultural institute and experimental station, technical school, architects' school, musical con- servatoriums, blind asylum, and several special medical institutions are the principal educational and health establishments. Population (1885), 55,454; (1895),

74,133; (1900), 86,086.

Wigan, a municipal, county (1888), and parlia- mentary borough And market town of Lancashire, Eng- land, 195 miles by rail north-west of

London. In 1890 it was divided into 10 wards under a mayor, recorder, 10 aldermen, and 30 councillors. The convent of Notre Dame (1854), with a college for pupil teachers and a high school for girls, was rebuilt in 1894. There are four Roman Catholic churches and five Roman Catholic schools. In 1891 there were 5086 persons (4103 females) employed in the manufacture of cotton goods, 5937 in coal-mining, and 1180 in the iron and steel manufacture. Area of municipal and parliamentary borough, which are coexten- sive, 2188 acres. Population (1891), 55,013; (1901),

60,770.

Wight, Isle Of, an island adjacent to the south coast of Hampshire, England, from which it is separated by the Solent and Spithead. It is much frequented by holiday visitors all the year round, and by invalids, especially those suffering from pulmonary complaints, in winter. Cowes (for yachting), Ryde, Shanklin, and Ventnor are the places chiefly visited ; the last named is also the principal winter resort. But in addition to these, there are several smaller places rising more or less rapidly into note, in part for sea-bathing, as Bembridge, Sea view, near Ryde, and Sandown, on the east coast; and Freshwater Gate and Totland Bay, at the western extremity of the island. The south and west coasts offer stretches of picturesque scenery, the most famous being the TJnder- cliff, Blackgang Chine, 400 feet in height, backed by St Catherine's Hill (830 feet), the highest point in the island. The stretch of cliff scenery between Fresh- water Bay and Alum Bay reaches 400 to 500 feet and overlooks the Needles, three chalk pinnacles which rise 100 feet above the sea, the outermost bearing a lighthouse. In the vicinity of Freshwater Gate is Farringford, for some time the residence of Lord Tenny- son, the poet, to whom a national monument, in the

shape of a beacon on Freshwater Down, was erected in 1897. One of the loveliest spots in the island is the village of Bonchurch, immediately east of Ventnor. Yar- mouth, near the west end of the island, has a good natural harbour, used by the steamboats which ply to Lymington, and is

the headquarters of the Solent Yacht Club. The associations which knit the British royal family with the Isle of Wight centre chiefly in Osborne House, a villa in the Italian style, close to East Cowes and overlooking the channel of Spithead, where Queen Victoria used to spend some months every year, and where she died. Osborne HOuse was presented to the nation in 1902 by King Edward VII. in commemoration of his coronation. Whippingham church, close by, was designed by the Prince Consort, and its font by Princess Christian and Princess Louise. It contains memorials of the Prince Consort and of Prince Henry of Battenberg. Princess Beatrice succeeded her husband as honorary governor of the Isle of Wight in 1896. Population

(1891), 78,672; (1901), 82,387.

Wig"tOWI1, a royal burgh and county town of Wigtownshire, Scotland, on Wigtown Bay, and the Wigtownshire Bail way, 129 miles south-south-west of Edinburgh by road. There are a town hall, two burgh crosses — the latter built to commemorate Waterloo — and a mechanics' institute. The harbour admits ships of 300 tons. At the end of 1898, 18 vessels of 709 tons were registered at the port ; in 1888, 434 vessels of 30,947 tons entered and 433 of 30,755 tons cleared; in 1898, 246 vessels of 14,551 tons entered and 257 of 15,034 tons cleared. Two public schools had an average attendance of 217 in 1898-99, and a Boman Catholic school 36. Valuation in 1889-90, £5401; 1899-1900, £7011. Population (1881), 1780; (1891), 1509; (1901), 1386.

Wigtownshire, a maritime county in the south- west corner of Scotland, bounded on the N. by the Irish Channel and Ayrshire, on the E. by Kirkcudbright and Wigtown Bay, on the S. by the Irish Sea, and on the W. by the Irish Channel.

Area and Population. — The area of the county (foreshore excluded) is 314,405 acres, or about 491 square miles. The population was, in 1881, 38,611 ; in 1891, 36,062 ; in 1901, 32,683, of whom 15,269 were males and 17,414 females. Taking the land area only (310,747 acres, or 485'5 square miles), the number of persons to the square mile in 1901 was 67, and the number of acres to the person 9 '6. In the registration county the popula- tion decreased between 1881 and 1891 by 6"7 per cent. Between

~~1881 and 1891 the excess of births over deaths was 4293, and the decrease of the resilient population 2568. The following table shows the births, deaths, and marriages, with the percentage of illegitimacy : —~~

~~Year.~~

~~Deaths.~~

~~Marriages.~~

~~Births.~~

~~Percentage of Illegitimates.~~

~~1880 1890 1899~~

~~699 667 600~~

~~185 169 174~~

~~1169 971~~

~~775~~

~~16·9~~

~~15·86~~

~~14·1~~

~~The following table gives the birth-rate, death-rate, and marriage- rate per thousand of the population for a series of years : —~~

~~1880.~~

~~1881-90.~~

~~1890.~~

1801-98.

1899.

Birth-rate . Death-rate . Marriage-rate

30-39

18-17

4-81

29-31

17-76 5-23

26-92

18-49

4-68

26-81

12-01

5-54

22-95

1776

5-15

In 1891 there were 68 Gaelic-speaking persons in the county and 14 foreigners. Valuation in 1889-90, £209,732; 1899-1900, £221,690.

Administration. — The county returns one member to Parliament. There are three royal burghs — Stranraer (6009), Whithorn (1186), and

~~Wigtown (1386), the county town. There are 17 civil parishes, forming with Ballantrae in Ayrshire, the Wigtownshire combination.~~

~~The number of paupers and dependents in September 1899 was 1116. Wigtownshire forms part of the sheriffdom of Dumfries and Galloway, and a sheriff-substitute sits at Wigtown and Stranraer.~~

~~Education. — Eighteen school boards manage 48 schools, which had an average attendance of 5088 in 1898-99, while 3 Roman Catholic schools had an average attendance of 133. There are 3 high schools, 1 in Stranraer and 2 in Newton-Stewart. Whithorn and Wigtown public schools have secondary departments, and 9 other public schools earned grants in 1898 for giving higher education. The county council expends the " residue " grant in providing bursaries for science pupils, and in subsidizing agricul- tural classes at Kilmarnock and Edinburgh University, cookery classes and the science departments of the high schools.~~

~~Agriculture. — The percentage of cultivated area was 48 "8 in 1898, the county ranking tenth in Scotland in this respect. Oats are the predominant crop. Wheat, which covered 7343 acres in 1855, covered only 560 in 1898, and barley continues to decline. The greatest development has taken place in dairying, which is now carried on in large combinations and on scientific principles. Creameries have been established all over the dairy country, and in 1900 there were 7 of them in operation. The following table gives the principal acreages in 1885 and various subse- quent years: —~~

~~Year.~~

~~Area under Crops.~~

~~Corn Crops.~~

~~Green Crops.~~

~~Clover.~~

~~*Permanent Pasture.*~~

~~*Fallow.*~~

~~*1885 1890 1895 1899*~~

~~*147,214 153,447 152,963 154,311*~~

~~*37,502 36,693 36,059 35,125*~~

~~*18,580 18,332 18,367 17,841*~~

~~*69,364 71,036 65,393 66,977*~~

~~*21,371 27,067 32,910 34,033*~~

~~*397 301 221 311*~~

~~*The following table gives particulars of the live-stock during the same years : —■*~~

~~*Year.*~~

~~*Total Horses.*~~

~~*Total Cattle.*~~

~~*Cows or*~~

~~*Heifers in*~~

~~*Milk or Calf.*~~

~~*Sheep.*~~

~~*Pigs.*~~

~~*1885 1890 1895 1899*~~

~~*5879 6029 6501 5966*~~

44,347 46,968 48,323 59,778

21,090 22,088 24,077 23,743

116,352 128,198 117,974 127,032

9,011 11,093 11,236 12,020

Of the 1325 holdings in 1898 the average size was 115 acres. The percentage under 5 acres was 13 "21 ; between 5 and 50 acres, 20-79, and over 50 acres, 66p00. Farms between 50 and 100 acres numbered 183, between 100 and 300, 442, between 300 and 500, 93, and over 500, 24, one being over 1000. In 1895, 7952 acres were under wood, 220 having been planted since 1S81. At the census of 1891, 4685 men and 899 women were returned as being engaged in agriculture.

Authorities. — Sir Herbert Maxwell. History of Dumfries and Galloway. Edinburgh, 1896. — .35neas B. Hutchison. Memorials of Dundrennan Abbey. Exeter, 1857. — Sir Andrew Agnew. The Agnews of Lochnaw. Edinburgh, 1893. — The Galloway Herd-Book. Dumfries, 1880.. — Thomas Maclelland. "The Agriculture of Wigtownshire" (Trans, of H. and A. Soc). 1875. — Proceedings of Soc. of Ant. of Scotland, passim. — Gordon Eraser. Wigtown and Whithorn. Wigtown, 1877. — J. M 'Andrew. List of Wigtownshire Plants. 1894. — Trans, of Dumfriesshire and Galloway Natural History Society. Dumfries, 1862.

Wilde, Oscar O'Flahertie Wills (1856-

1900), English author, son of Sir William Wilde, a famous Irish surgeon, was born in Dublin, 15th October 1856; his mother was well known in Dublin, as a graceful writer of verse and prose, who adopted the pen-name of "Speranza." Having distinguished himself in classics at Trinity College, Dublin, Oscar Wilde went to Mag- dalen College, Oxford, in 1874, and won the Newdi- gate prize in 1878 with his poem "Ravenna," besides taking first-classes in classical Moderations and Greats. But his career at Oxford, brilliant intellectually as he showed himself to be, was chiefly signalized by the part he played in what came to be known as the ^Esthetic Movement. He adopted what to undergraduates appeared the

effeminate pose of casting scorn on manly sports, wearing his hair long, decorating his rooms with pea- cocks' feathers, lilies, sunflowers, blue china, and other objets d'art, which he declared his desire to " live up to " affecting a lackadaisical manner, and professing intense

emotions on the subject of " art for art's sake " — then a new-fangled doctrine which Mr Whistler was bringing into prominence. Wilde made himself the apostle of this new cult, which — though at Oxford his behaviour pro- cured him a ducking in the Cherwell, and a wrecking of his rooms — spread among certain sections of society to such an extent that languishing attitudes, "too- too" costumes, and " sestheticism " generally became a recog- nized pose, and culminated in the production of Gilbert and Sullivan's travesty Patience (1881), which practically killed by ridicule the absurdities to which it had grown. At the same time it cannot be denied that the movement was one side of something better, which, as represented by the school of Morris and Rossetti, had a permanent influence on English decorative art. As the leading "aesthete," Oscar Wilde became one of the most pro- minent personalities of the day ; apart from the ridicule he encountered, his affected paradoxes and his witty sayings were quoted on all sides, and in 1882 he went on a lecturing tour in the United States. In 1884 he married Constance Lloyd. He had already published in 1881 a selection of his poems, which, however, only attracted admiration in a limited circle. In his writings there was to most people an undertone of rather nasty suggestion, and his novel Dorian Gray (1888), with all its sparkle and cleverness, impressed them more from this point of view than from its purely literary brilliance. Wilde contributed some characteristic articles to the reviews, all coloured by his peculiar attitude towards art and life, and in 1891 republished three of them as a book called Intentions. He also published some fairy tales ; but his first real success was as a dramatist with Lady Windermere's Fan at the St James's Theatre in 1892, followed by A Woman of No Importance (1893), The Ideal Husband (1895), and The Importance of Being Earnest (1895). The dramatic and literary ability shown in his plays, all of which were published later in book form, was as undoubted as their diction and ideas were characteristically paradoxical. In 1893 the licenser of plays refused a licence to Wilde's Salome", but it was produced in Paris. His success as a dramatist had by this time gone some way to disabuse hostile critics of the suspicions as regards his personal character which had been excited by the apparent looseness of morals which since his Oxford days it had always pleased him to affect ; but to the consternation of his friends, who had never credited the existence of any real moral obliquity, in 1895

~~*came fatal revelations as the result of his bringing a libel action against the Marquis of Queensberry ; and at the Old Bailey, in May, Wilde was sentenced to two years' imprisonment with hard labour for offences under the Criminal Law Amendment Act. It was a melancholy end to what might have been a singularly brilliant career. Even after leaving prison he was necessarily an outcast from decent circles, and he lived mainly on the Continent, where he died on 30th November 1900. In 1898 he published his powerful Ballad of Reading Gaol. His Collected Poems, containing, it must be admitted, some beautiful verse, had been issued in 1892. The Old Bailey revelations removed all doubt as to the essential unhealthiness of Oscar Wilde's influence ; but his literary gifts were none the less remarkable, and his plays were perhaps the most original contributions to English dramatic writing during the period.*~~

~~*Wilderness, a region in north-eastern Virginia, U.S.A., famous as the scene of some of the fiercest battles of the Civil War. In May 1864, General Grant began his determined movement upon Richmond, the Confederate capital. General Meade, who was in*~~

~~*command of the army of the Potomac, was encamped between the Rappahannock and the Rapidan. With Meade's forces, Grant advanced upon Lee, who was encamped upon the south bank of the Rapidan, about sixty miles north of Richmond. The opposing armies met in a wild, swampy region called " The Wilderness," and on 5th May the fighting began. It lasted two days, resulting in severe losses on both sides, but in no decisive victory for either. The Union loss is estimated at 15,000 in killed, wounded, and prisoners ; but the Confederates, who were familiar with the country, lost only about 10,000 in killed and wounded, and few prisoners. These battles were the beginning of the close of the war ; they were followed by the bloody contests at Spottsylvania, North Anna, and Cold Harbor. It is said that at least 100,000 men on both sides were lost in little over a month in killed, wounded, and missing.*~~

~~*Wilhelmina (Wilhelmina Helena Pauline*~~

~~*Makia, Queen of the Netherlands (1880),*~~

Princess of Orange-Nassau, was born at The Hague on the 31st of August 1880. Her father, William III. (Willem Paul Alexander Frederik Lodewijk), had by his

queen Wilhelmina. (From a photograph by Wegner and Mottu, Amsterdam.)

first wife, Sophia Frederika Mathilde of Wiirtemberg, three sons, all of whom predeceased him. Having been left a widower on 3rd June 1877, he married on the 7th of January 1879 Adelheid Emma Wilhelmina Theresia, second daughter of Prince George Victor of Waldeck-Pyrmont, born 2nd August 1858, and Wilhelmina was the only issue of that union. She succeeded to the throne on her father's death, which took place on the 23rd of November 1890, but until her eighteenth year, when she was "inaugurated" at Amsterdam on

the 6th of September 1898, the business of the State was carried on under the regency of the queen-mother, in accordance with a law made on the 2nd of August 1884. On the 7th of February 1901 Queen Wilhelmina married Henry Wladimir Albert Ernst, Duke of Mecklenburg- Schwerin (born on the 19th of April 1876), and the rejoicings on that occasion, though the celebration was somewhat damped by the death of Queen Victoria, were little less than those called forth by her formal installa-tion. (See also under Holland : History.)

Wilhelmshaven, the chief naval station and port of Prussia on the North Sea coast, on the western side of Jahde Bay, forming an exclave of the province of Hanover, in the heart of the duchy of Oldenburg, 60 miles by rail north-west of Bremen. The so-called new harbour (170 acres in area and 26^ feet deep) is connected by means of a sluice (571 feet long) with the new harbour entrance, which was completed in 1886. On the north it is connected with the "equipment dock" (3832 feet long, 446 feet wide),

~~which again is connected by a sluice (158 feet long) with the outer basin (617 feet long, 410 feet wide), and so with the old harbour entrance. On the west side of the " equip- ment dock" lies the shipbuilding basin (1237 feet long by 742 feet wide), with three dry docks (of which two are each 453 feet long, 85 feet wide, and more than 30 feet deep, whilst the third is 394 feet long), and also with two slips of the largest size. The special torpedo harbour is in the south- east of the new harbour. There are also an observatory (8° 8' 48" E. and 53° 31' 57" N.), a laboratory, infirmary, machine shops, steam hammers, iron foundries, boiler works, &c. The commercial harbour lies on the south side of the town; in 1899 it was cleared by 961 vessels of 55,186 tons engaged'- in foreign trade. Wilhelmshaven is visited for its sea-bathing. Population (1885), 13,972;~~

~~(1895), 19,422; (1900), 22,571.~~

~~Wilkesbarre, a city of Pennsylvania, U.S.A., capital of Luzerne county. It is situated in 41° 14' N. and 75° 56' W., on the north branch of the river Susque- hanna, in the north-eastern part of the state, at an altitude of 545 feet. The plan of the city is regular, it is divided into sixteen wards ; its water-supply, owned by private parties, is in part obtained by gravity and in part by pumping ; it is well sewered, and well paved in great part with asphalt. It is in the anthracite coal region, and its industries are in great part connected with mining and shipping coal. It has five railways — the Central of New Jersey ; the Delaware and Hudson ; the Lehigh Valley ; the New York, Susquehanna, and Western ; and the Pennsylvania, affording ample means of transporta- tion. The city is an important manufacturing place. In 1900 it contained 438 manufacturing establishments, with a total capital of $10,501,537. They employed 5977 hands, and the product was valued at $10,758,348. In 1900 the assessed valuation of real and personal property was $18,155,939, the net debt' of the city was $602,391, and the rate of taxation was $26-75 per $1000. Population (1890), 37,718 ; (1900), 51,721, of whom 12,188 were foreign-born and 680 negroes.~~

~~Wilkinsburg, a borough of Allegheny county, Pennsylvania, U.S.A., in the south-western part of the state, a few miles east of Pittsburg, of which it is~~

~~a suburb. Population (1890), 4662; (1900), 11,886, of whom 1336 were foreign-born and 275 negroes.~~

~~Wilkinson, James John Garth (1812-~~

~~1899), Swedenborgian writer, the son of James John Wilkinson (died 1845), a writer on mercantile law and judge of the County Palatine of Durham, was born in London on 3rd June 181.2. He studied medicine, and set~~

~~up as a homoeopathic doctor in Wimpole Street in 1834. He was early attracted by the works of William Blake, whose Songs of Experience he endeavoured to interpret, and of Swedenborg, to the elucidation of whose writings he devoted the best energies of his life. Between 1840 and 1850 he edited Swedenborg's treatises on The Doctrine of Charity, The Animal Kingdom, Outlines of a Philo- sophic Argument on the Infinite, and Hieroglyphic Key to Natural and Spiritual Mysteries. Wilkinson's preliminary discourses to these translations and his criticisms of Cole- ridge's comments upon Swedenborg displayed a striking aptitude not only for mystical research, but also for original philosophic debate. The vigour of his thought won ad- miration from Henry James (father of the novelist) and from Emerson, through whom he became known to Carlyle and Froude ; and his speculation further attracted Tenny- son, the Oliphants, and Edward Maitland. He wrote an able sketch of Swedenborg for the Penny Cyclopaedia, and a standard biography, Emanuel Swedenborg (published in 1849) ; but interest in this subject far from exhausted his intellectual energy, which was, indeed, multiform. He was a traveller, a linguist, well versed in Scandinavian literature and philology, the author of mystical poems entitled Improvisations from the Spirit (1857, 16mo), a social and medical reformer, and a convinced opponent of vivisection and also of vaccination. He died at Finchley Boad, South Hampstead, where he had resided for nearly fifty years, on 18th October 1899. He is com- memorated by a bust and portrait in the rooms of the Swedenborgian Society in Bloomsbury Street, London.~~

~~(t. Se.)~~

Wollesden, a suburb of London and important railway junction in the Harrow parliamentary division of Middlesex, about 4 miles north-west of Hyde Park Corner. An isolation hospital, completed in 1894, cost £20,000. In the same year a recreation ground of about 26 acres was laid out. Population (1881), 27,453; (1891), 61,265;

(1901), 114,815.

Wi I Nam II. (Feiedeich Wilhelm Victor Albert),

King op Prussia and German Empeeoe (1859),

was born 27th January 1859 at Berlin, being the eldest child of Prince Friedrich of Prussia, afterwards Crown Prince and second German Emperor. Like all princes of the House of Hohenzollern, he was on his tenth birthday introduced into the army, being appointed second lieu-tenant in the First Begiment of the Guards, but contrary to all precedent, at the special wish of his mother, he was with his younger brother Heinrich educated at a public school. From September 1874 to January 1877 he attended the lyceum at Cassel ; afterwards for two years he was a student at the University of Bonn, where his father also had studied. On the conclusion of his general education he was for some years chiefly occupied with military affairs, in which he displayed great interest and ability. In 1885 he became colonel of the Hussars of the Guards, a position in which he showed, as throughout his career, that he was not content with holding the honorary titles which came to him in virtue of his birth, but carried out the duties of his office with the strictness and dili- gence which would be demanded from every other officer. It was natural that he was at this time much influenced by the military associations in which most of his life was spent, and in his opinions on political affairs he was more in sympathy with the strongly monarchical feelings of the Emperor William and Bismarck than with the more liberal views of his own parents. Until the illness of his father in 1887 he took no part in political or public life, and proposals that during the absence of the Crown Prince from Berlin authority should be given to Prince

WILLIAM II.

~~William to sign State papers for his grandfather, whose health was failing, were not carried out owing to the fear that it would cause offence to the Crown Prince. The death of his grandfather was quickly followed by that of his father, and on 15th June he became ninth king of Prussia and third German Emperor. In accordance with Prussian tradition, there was no formal coronation. His accession was regarded with some apprehension, for it was feared that his mili- tary ardour might induce him to take Frederick the Great as his model, and that he might break the peace of Europe in order to win laurels for himself, while his strong monarchical feelings might lead him to unconstitutional acts. By attending a meeting at the house of Count Wal- dersee in aid of the Berlin City Mission he had also to some extent identified himself with the re- ligious endeavours of the Conservative and Christian Socia- list party. These fears were also in- creased by the determination with which he brought forward the military side of his position : his first act was an address to the army and navy, while that to his people fol- lowed after three days ; and through- out his reign he has repeatedly stated that the army was the true basis of his throne : " The soldier and the army, not parlia- mentary majori- ties, have welded together the Ger- man Empire. My confidence is placed on the army."~~

~~For a history of the political events of his reign the reader is referred to the article on Germany. It is sufficient here to say that from the first day of his accession the new Emperor took the reins of government into his own hand. Full of self-confidence, and believing in a special Providence watching over the fortunes of his country and his House, he was not satisfied any longer to leave the real management of things to Bismarck. From the first he showed his intention to be his own Chancellor, and it was this which brought about the quarrel with Bismarck, who could not endure to be less than all- powerful. The decision with which the great statesman was dismissed, and the determination with which the founder of the Empire was placed in disgrace, first~~

~~revealed the resolution of the new ruler ; for it is to his personal wishes that we must attribute the steps by which the disgrace of Bismarck was~~

officially proclaimed. Equally marked were the distinctions showered on him when the reconciliation took place — the almost royal hon- ours with which he was received at his last visit to Berlin ; the visit of the Emperor on the Prince's eightieth birthday ; the telegram in which the Emperor expressed the indigna- tion and disgust of the nation that a majority of the Reichstag refused on this occasion to vote an address of congratulation; and the offer on his death to give him a grave among the tombs of his own ancestors. In favour and disgrace alike we see the fixed will that the greatness of the statesman should appear to depend on, and be secondary to, that of the Hohenzollern. He even on one occasion, in words which referred to Bismarck, spoke of "the councillors who had the honour of carrying out the thoughts of the Em- peror William I." as "tools of his exalted will, filled with the spirit of the exalted Emperor " — words which in Germany called forth many indignant protests. As regards foreign affairs, the appre- hensions felt at his accession were not fulfilled. With all his enthusiasm for the army, he was as determined as every other respon- sible statesman to avoid the catas- trophe of a European war. While he maintained and confirmed the alliance with Austria and Italy, in obedience to the last injunctions of his grandfather, he repeatedly attempted to establish more cordial re- lations with "the Eastern neighbour," Eussia. By his frequent visits to the other courts of Europe he soon made himself the most conspicuous figure in Europe, and his individuality became one of the chief factors in the European system. Within little more than a month of his accession, attended by a powerful squadron of ships of war, he visited the three Baltic courts — St Petersburg, Stockholm, and Copenhagen— a strange and striking inauguration of his reign. His overtures to Russia were scarcely received with a cordiality equal to the empresse- rnent which he showed. The intimacy of Russia with

William II., German Emperor. (From a photograph by Reichard and Lindner, Berlin.)

France increased, and more than a year passed before the Tsar appeared on a short visit to Berlin. In 1890 the Emperor again went to Russia, and .the last meeting between him and Alexander III. took place at Kiel in the autumn of 1891, but it was marked by considerable coolness. By his visit to Copenhagen, as in his treat- ment of the Duke of Cumberland and in his frequent overtures to France, the Emperor William showed the strong desire, by the exercise of his own great personal charm and ability, to heal- the wounds left by the events of a generation before, but the visit was not repeated. In the autumn of 1888 he visited not only the courts of the Confederate Princes, but those of Austria and Italy. While at Rome he went to the Vatican and had a private conversation with the Pope, and this visit was repeated in 1895. In 1889. the marriage of his sister, the Princess Sophie, to the Duke of Sparta, took him to Athens ; and thence he sailed to Constantinople, where he was received by the Sultan with marked honour. It was the first time that one of the great rulers of Christendom had been the guest of the Padishah. A more active interest was now taken by Germany in the affairs of the Levant, and the Emperor showed that he would not be content to follow the secure and ascertained roads along which Bismarck had so long guided the country. It was not enough that Berlin had become the centre of the European system. The Emperor was the apostle of a new Germany, which claimed that her voice should be heard in all political affairs, in whatever quarter of the globe they might arise. Once again, in 1898, he went to Constantinople. It was the time when the memory of the Armenian massacres had made the name of Abdul Hamid notorious in Western Europe, and the very striking friendliness shown towards him scarcely seemed consistent with the frequent claims made by the Emperor to be the leader of Christendom ; but any scruples on this point were doubtless outweighed by the great impulse he was able to give to German trade and German influence in the East. From Constantinople he passed on to Palestine. He was present at the consecration of the German Protest- ant Church of the Redeemer. By the favour of the Sultan he was able to present to the German Catholics a plot of ground, the Dormition de la Sainte Vierge, very near to the Holy Places.

The Emperor's constant travels soon gained for him the nickname of "Der Reise- Kaiser," his grandfather's having been " Der greise Kaiser,"

~~*and his father's " Der weise Kaiser." It was unusual at the time of his accession for Germans to travel abroad as English people of the same class did, and his activity struck them as unnatural. As time went on, however, the Emperor's example began to be followed by his subjects, and at the end of the 19th century they were to be found as tourists in foreign countries to almost the same extent as Englishmen or Americans. With the exception of France and the Iberian Peninsula, there is not a country in Europe that he did not cepeatedly visit. Not politics alone guided his movements, but a keen interest in men and things, the desire to know and see. His love of the sea was shown in an annual voyage to Norway, and in the visits to the Cowes regatta which he made each year from 1889 to 1895. An ardent sportsman, he hunted the wild reindeer beyond the North Cape, and whale in the Arctic Ocean, bears in Russia and the Carpathians, red deer on the Scottish moors, and grouse, as the guest of Lord Lonsdale, on the famous Wemmersgill moors. On each of his journeys not only was he occupied in spreading the name of his country, but he was always active to observe the institutions of the countries he visited, and to bring back inventions and suggestions for the government of his own.*~~

~~*The Emperor's relations with Great Britain are of special interest, for in them we can see the constant struggle between a genuine affection and admiration for a country to which he was attached by many close ties and the exigencies of the political situation. At the time of his accession there was a strong manifestation of anti-British feeling in Berlin, and there seemed reason to suppose that the party from which it proceeded had the patronage of the Emperor. Any temporary misunderstanding was removed by his visit to England in 1 889. For the next six years he was every year the guest of Queen Victoria, and during the period that Caprivi held office the political relations between Germany and Great Britain were very close. While the Emperor's visits were largely prompted by personal desires and family ties, they were not without an important effect on the political situation ; and in 1890, when he was entertained at the Mansion House in London and visited Lord Salisbury at Hatfield, the basis for an entente cordiale was discussed. After 1895 the growth of the colonial spirit in Germany and the strong spirit of rivalry with Great Britain, which became each year more manifest, made the conduct of the*~~

Emperor more difficult. His own ambitions and his conviction as to the necessity for a vigorous naval policy made him the leader of those who were always ready to appeal to the spirit of emulation against Great Britain, which in many degenerated into deliberate and bitter hatred. On the occasion of the Jameson Raid he despatched to the President of the Transvaal a telegram, in which he congratulated him that " without appealing to the help of friendly Powers," he had succeeded in restoring peace and preserving ' the independence of his country. It is impossible to regard this merely as unconsidered and generous sympathy with a weak state unjustly attacked. It was warmly approved in Germany, but the political results were unsatisfactory, for it caused a long alienation from Great Britain, and helped to bring about that concentration of British energy which it was in the interests of the German colonial parties to prevent. Moreover, it at once became clear that on colonial questions any misunderstanding with Great Britain would leave Germany in a dangerous isolation. The Emperor did not again visit England till, at the beginning of 1901, he hurried away from the celebration of the two hundredth anniversary of the foundation of the kingdom of Prussia to attend the deathbed and funeral of Queen Victoria. On this occasion he placed himself in strong opposition to the feelings of the large majority of his countrymen by conferring on Lord Roberts the Order of the Black Eagle, the most highly prized of Prussian decorations. He had already refused to receive the ex-President of the Transvaal on his visit to Europe.

The most important work to which the Emperor turned his attention was the increase of the German naval forces, and he will always be remembered as the real founder of the German fleet. As a young man he had no connexion with the navy ; his occupation was in the army, while his brother Henry was attached to the fleet. From the moment of his accession he constantly showed the keenest interest in naval affairs, and set himself to create among the people an interest in the navy equal to that in the army. At his accession he made a proclamation to the navy as well as to the army, in which he expressed the " lively and warm interest which since his earliest years had united him to the navy." The numerous changes made in the organization during the next years were due to his personal initiative. It was from the beginning of 1895 that he publicly put himself at the head of the movement for making Germany a sea Power. In

this he was doubtless much influenced by his close acquaintance with Great Britain and the British fleet, and also by the

numerous works on naval policy which at that time ap- peared in England. In January 1895, at an evening recep- tion to members of the Reichstag, he gave a lecture of nearly two hours' length on the necessity for increasing the navy ; and some weeks later at the Berlin Military Academy lectured on the relations of the army and navy with special reference to the CHino-Japanese war. Next year, in the great speech at the anniversary of the foundation of the Empire, he declared that it was the duty to bind together the Germans beyond the seas, for the " German Empire has become a World Empire." In all the discussions on the naval Bills his influence was decisively used to overcome the resistance of the Reichstag. In an evening reception he overcame the reluctance of many of the Conservative and National Liberal members to the new naval policy ; he sent to the Reichstag tabular representations of the com- parative increase of the great fleets of the world during the last years, signed by himself. In speeches in all parts of the country he combated the indifference of the inland Germans to the sea, as when at Carlsruhe he declared that " the trident is now in our hands." " I will not rest," he telegraphed to his brother, " till I have brought my navy to the same height at which my army stands." " Vaterlandslose " he called those who had "succeeded in preventing the provision of the most necessary ships."

During his constant sea journeys he gained a really intimate acquaintance with the machinery of a modern warship, and he found time to occupy himself with sketches and designs of ships drawn by his own hand. As an amateur yachtsman he himself steered the Meteor when it won the Queen's Cup in the Cowes regatta in 1893. HE did much to introduce into Germany yacht- ing and other aquatic sports. HE founded numerous prizes at different regattas, and there may be mentioned especially that for an annual race from Dover to HEligo- land. Every year he sent a telegram to congratulate the winners of the Oxford and Cambridge boat-race. A pro- nounced lover of all open-air occupations,

~~he attempted to popularize boat-racing in Germany as a means towards combating the too exclusively sedentary life followed by the younger men and boys. His personal vigour was illustrated by the fact that though his left arm was crip- pled owing to an accident at birth, he made himself an excellent rider and a successful sportsman.~~

~~The Emperor's speeches revealed considerable rhetorical power. Clear, concise, positive, in many passages they show deep feeling and a powerful imagination, but they are touched sometimes with the theatrical. Thus, in a characteristic utterance when he despatched his brother, Prince Henry, in command of a German squadron to China, he proclaimed that " the power of the Empire implies power by sea," and instructed his brother, "if any one attempts to injure us in our good right, then strike him with mailed fist." He has always been imbued with a belief in the special Providence which watches over the fortunes of his country and family, and a deep convic- tion of the necessity for Christianity as the foundation of the state. Thus, at Brandenburg, he declared his " con- viction that our old ally of Rossbach and Dennewitz will not leave me in the lurch. He has given Himself such endless trouble with our old Mark and our House that we cannot assume that He has done this for nothing." He ever appealed to the traditions of his family as repre- sented especially by his grandfather, who at Konigsberg " had proclaimed the kingdom by the Grace of God," that the Hohenzollern " had received their kingdom from God alone." It was, indeed, with almost mystic reverence that he spoke of William I., for whom, with a curious mis- application of an epithet too often misused, he decreed the title of " The Great." " He came forth from Coblenz as~~

~~a chosen instrument of the Lord " ; " Providence chose him as a tool " ; " Had he lived in the Middle Ages he would have been beatified ; from every land would have come pilgrimages to offer their prayers at his relics. Thank God, now too that is so."~~

~~By temper and traditions an autocrat, and unchecked by any real organization of popular opinion in Germany, where, in the absence of a strong parliamentary system, the army is the dominating institution, the Emperor from time to time made his will felt in every department of social~~

life. A patron of the stage, he required that the dramatists should adopt his canons of taste : " The royal theatre should be an instrument of the monarch," he said in 1898 ; " the artists must aid the Emperor to serve the causes of idealism with firm confidence in God, and to fight against materialism and un-German ways to which German playhouses have unfortunately descended." In the technical questions of schools he had strong, clear, and well thought out plans of reform. The excessive study of Latin and the abnormally long hours of study common in German schools were censured by him, and his speech at the Educational Congress which he summoned at Berlin in 1890 deserves the careful study even of professional teachers. He decorated Berlin with many monuments of his ancestors ; and in the plastic arts he supported the older idealist school, and not the modern developments in which the younger artists were interested. At the beginning of his reign he took much interest in projects for social reform, and summoned to Berlin a general European Conference to discuss questions connected with the hours and conditions of labour. But soon he more than adopted Bismarck's policy of hostility to the Social Democrats. He publicly declared that every Social Democrat was an enemy to the Empire and his House. The Socialists are fond of referring with indignation to a speech which he is reported to have made to the recruits of the Guard, in which he said to them, " You have given yourselves to me body and soul. For you there is only one enemy, and that is my enemy. It may happen — I pray that God avert it — that I order you to shoot down your relations, your brothers, nay, your parents ; but then without a murmur you must obey my commands."

The Emperor married on the 27th of February 1881 Princess Auguste Victoria, daughter of Frederick, Duke of Schleswig-Holstein-Sonderburg-Augustenburg, who in 1 864 had come forward as claimant to the duchies of Schleswig- Holstein ; the marriage had, therefore, some political importance, for it sealed the reconciliation of one of the dynasties that had suffered by the rise of Prussia. The Empress took no part in political affairs. There are six sons and one daughter sprung from the marriage, viz., Wilhelm, born 6th May 1882, Crown Prince, whose com- ing of age was celebrated with much ceremony on his eighteenth birthday; Eitel Friedrich, born 7th July 1883 ; Adalbert, born 14th July 1884 ; August

Wilhelm, born 29th January 1887; Oskar, born 27th July 1888 ; Joachim, born 17th December 1890; and Victoria Louise, born 13th September 1892.

Williams, Sir William Fenwick, Baet.

(1800-1883), British general, colonel-commandant Royal Artillery, second son of Commissary-General Thomas Williams, barrack-master at Halifax, Nova Scotia, was born at Annapolis, Nova Scotia, on 4th December 1800. He entered the Royal Artillery as second lieutenant in 1825. His services were lent to Turkey in 1841, and he was em- ployed as a captain in the arsenal at Constantinople. He was British commissioner in the conferences preceding the treaty of Erzerum in 1847, and again in the settlement of the Turko-Persian boundary in 1848 (brevet majority and

lieutenant-colonelcy and C.B.). Promoted colonel, he was British commissioner with the Turkish army in Anatolia in the Bussian war of 1854-56, and, having been made &ferik (Turkish lieutenant-general) and a pasha, he practically commanded the Turks during the heroic defence of Kars, repulsing several Bussian attacks and severely defeat- ing the Bussian general Muravieff in the battle of Kars on 29th September 1855. Cold, cholera, famine, and hopelessness of succour from without, however, compelled Williams to make an honourable capitulation on 28th November following. A baronetcy with pension for life, K.C.B., the war medal with clasp, the grand cross of the Legion of Honour and of the Turkish Medjidie, the freedom of the City of London with a sword of honour, honorary degree of D.C.L. of Oxford University, were the distinctions conferred upon him for his valour. Promoted major-general in November 1855 on his return from captivity in Bussia, he held the Woolwich command, and represented the borough of Calne in Parliament from 1856 to 1859. He became lieutenant-general and colonel-commandant Boyal Artillery in 1864, general in 1868, commanded the forces in Canada from 1859 to 1865, held the governorship of Nova

Scotia until 1870, and the governorship of Gibraltar until 1876. He was made G.C.B. in 1871, and Constable of the Tower of London in 1881. He died in London on 26th July 1883.

(e. h. v.)

Williamsburg", a city of Virginia, U.S.A., capital of James City county, on the Chesapeake and Ohio Bail- way, about 50 miles south-east of Bichmond, between the James and York rivers. It is the oldest incorporated city in the state, and until 1779 was the state capital. On the 5th of May 1862 a battle was fought here be- tween the Union forces under General Sumner and the Confederates under General Longstreet. It was a part of McClellan's peninsula campaign, and resulted in the voluntary abandonment of the city by the Confederates, who withdrew towards Bichmond.. It is the seat of William and Mary College. Population (1880), 1480 ;

(1890), 1831 ; (1900), 2044.

Williamson, Alexander William (1824-

), English chemist, was born at Wandsworth,

London, on 1st May 1824. After working under Gmelin at Heidelberg, and Liebig at Giessen, he spent three years in Paris studying the higher mathematics under Comte. In 1849 he was appointed professor of practical chemistry at University College, London, and from 1855 until his retirement in 1887 he also held the professorship of chemistry. He had the credit of being the first to explain the process of etherification and to elucidate the formation of ether by the interaction of sulphuric acid and alcohol. Ether and alcohol he regarded as substances analogous to and built up on the same type as water, and he further introduced the water-type as a widely applicable basis for the classification of chemical compounds. The method of stating the rational constitution of bodies by comparison with water he believed capable of wide exten- sion, and that one type, he thought, would suffice for all inorganic compounds, as well as for the best-known organic ones, the formula of water being taken in certain cases as doubled or tripled. So far back as 1850 he also suggested

~~a view which, in a modified form, is of fundamental im- portance in the modern theory of ionic dissociation, for, in a paper on the theory of the formation of ether, he urged that in an aggregate of molecules of any compound there is an exchange constantly going on between the elements which are contained in it ; for instance, in hydrochloric acid each atom of hydrogen does not remain quietly in juxtaposition with the atom of chlorine with which it~~

~~first united, but changes places with other atoms of hydrogen. A somewhat similar hypothesis was put for- ward by Clausius about the same time. For his work on etherification Williamson in 1862 received a Boyal medal from the Boyal Society, of which he became a fellow in 1855, and which he served as foreign secretary from 1873 to 1889.~~

~~Williamson, William Crawford (1816-~~

~~1895), English naturalist, was born at Scarborough on 24th November 1816. HIs father, John Williamson, after beginning life as a gardener, became a well-known local naturalist, who, in conjunction with William Bean, first explored the rich fossiliferous beds of the Yorkshire coast. HIe was for many years curator of the Scarborough natural history museum, and the younger Williamson was thus from the first brought up among scientific surroundings and in association with scientific people. William Smith, the " father of English geology," lived for two years in the Williamsons' house. Young Williamson's maternal grandfather was a lapidary, and from him he learnt the art of cutting stones, an accomplishment which he found of great use in later years, when he undertook his work on the structure of fossil plants. Williamson very early made a beginning as an original contributor to science. When little more than sixteen, he published a paper on the rare birds of Yorkshire, and a little later (in 1834) presented to the Geological Society of London his first memoir on the Mesozoic fossils of his native district. In the meantime he had assisted Lindley and Hutton in the preparation of their well-known Fossil Flora of Great Britain. On entering the medical profession he still found time to carry on his scientific work during his student days, and for three years acted as curator of the Natural HIstory Society's museum at Manchester. After completing his medical studies at~~

University College, London, in 1841, he returned to Manchester to practise his profession, in which he met with much success. When Owens College at Manchester was founded in 1851 he became professor of natural history there, with the duty of teaching geology, zoology, and botany. A very necessary division of labour took place as additional professors were appointed, but he retained the chair of botany down to 1892. Shortly afterwards he removed to Clapham, where he died on 23rd June 1895. Williamson's teaching work was not confined to his university classes, for he was also a successful popular lecturer, especially for the Gilchrist Trustees. His scientific work, pursued with remarkable energy through- out life, in the midst of official and professional duties, had a wide scope. In geology, his early work on the zones of distribution of Mesozoic fossils (begun in 1834), and on the part played by microscopic organisms in the formation of marine deposits (1845), was of fundamental importance. In zoology, his investigations of the development of the teeth and bones of fishes (1842-51), and on recent Foraminifera, a group on which he wrote a monograph for the Bay Society in 1857, were no less valuable. In botany, in addition to a remarkable memoir on the minute structure of Yolvox (1852), his work on the structure of fossil plants established British palaeobotany on a scientific basis : on the ground of these researches Williamson may rank with Brongniart as one of the founders of this branch of science. His contributions to fossil botany began in the earliest days of his career, and he returned to the subject from time to time during the period of his geological and zoological activity. His in- vestigation of the Mesozoic cycadioid fossil Zamia (now Willmmsonia) gigas was the chief palfeobotanical work of this intermediate period. (See Paleobotany : Mesozoic.)

His long course of researches on the structure of Car- boniferous plants belongs mainly to the latter part of his life, and his results are chiefly, though not wholly, embodied in a series of nineteen memoirs, ranging in date from 1871 to 1893, in the Philosophical Transactions of the Royal Society. In this series, together with some works (notably the monograph

oxiStiffmariaficoides,FalmoTi- tographical Society, 1886), published elsewhere, William- son elucidated the structure of every group of Palaeozoic vascular plants. Among the chief results of his researches may be mentioned the discovery of plants intermediate between ferns and cycads, the description of the true structure of the fructification • in the extinct cryptogamic family Sphenophyllese, and the demonstration of the cryptogamic nature of the dominant Palaeozoic orders Calamariese, Lepidodendrese, and Sigillariese, plants which on account of the growth of their stems in thickness, after the manner of gymnospermous trees, were regarded as phanerogams by Brongniart and his followers. After a long controversy, the truth of Williamson's views has been fully established, and it is now known that the mode of growth, characteristic in present times, of dicotyledons and gymnosperms, prevailed in Palaeozoic ages in every family of vascular cryptogams. (See Paleobotany : Palaeozoic.) Thus, as Count Solms-Laubach has pointed out, palseobotany for the first time spoke the decisive word in an important question of general botany. William- son's work in fossil botany was scarcely appreciated at the time as it deserved, for its great merits were somewhat obscured by the author's want of familiarity with the modern technicalities of the science. Since, however, the subject has been seriously taken up by botanists of a newer school, the soundness of the foundation he laid has become fully recognized. It may be added that he was a skilled draughtsman, illustrating all his works by his own drawings, and practising water-colour painting as his favourits recreation.

A full account of Williamson's career will be found in his autobiography, entitled Reminiscences of a Yorkshire Naturalist, edited by his wife, London, 1896. Among obituary notices may be mentioned that by Count Solms-Laubach, Nature, 5th Septem- ber 1895, and one by the present writer in Proc. R. S.t vol. lx., 1897. (d. H. S.)

Williamsport, a city of Pennsylvania, U.S.A., capital of Lycoming county. It is situated in 41° 15′ N. and 77° 04′ W., on the west branch of the Susque- hanna river, north-east of the centre of the state, at an altitude of 524 feet. The city is somewhat irregu- larly laid out, is divided into thirteen wards, has an excellent water-supply from springs in the hills, and its business streets are paved with brick and asphalt. Four railways

enter the city — the New York Central and Hudson Kiver, the Northern Central, the Pennsylvania, and the Philadelphia and Beading — affording ample facilities for transportation. Williamsport has extensive manufactures. In 1900 there were 396 manufacturing establishments, with a total capital of $9,863,811. They employed 5595 hands, and their product was valued at $11,199,600. The chief item of production was lumber, valued at $1,429,028. In 1898 the assessed valuation of real and personal property was $9,169,659, the net debt of the city was $721,022, and the rate of taxation $26.30 per $1000. Population (1890), 27,132; (1900), 28,757, of whom "2228 were foreign-born and 1142 negroes.

WilliamstOWn, a town in Victoria, Australia, in the county of Bourke, 9 miles south-west of Melbourne, with which it is connected by rail. Shipping is the chief business of the place, there being commodious piers, breakwater, also provision "for the repair of vessels,

patent slips, and shipbuilding yards. Several quarries of superior' basalt are worked near the town, and brown coal of good quality has also been found. Population (1881),

9034; (1891), 15,960; (1901), 14,083.

Wiiltmantic, a city of Windham county, Con- necticut, U.S.A., on the river Willimantic, in the eastern part of the state, at an altitude of 228 feet. It has a fairly regular plan, a good water-supply, and is sewered. It is on the Central Vermont and the New York, New Haven, and Hartford railways. It has fine water-power in the river, and extensive manufactures, especially of textiles and paper. Population (1890), 8648; (1900), 8937, of whom 2491 were foreign-born.

Wilmington, the largest and most important city and seaport of Delaware, U.S.A., and capital of Newcastle county. It is situated in 39° 44' N. and 75° 33' W., on the Delaware river at the mouth of Brandywine creek, in the northern part of the state. The city has a low, level site and a regular street plan, divided into twelve wards. The water-supply is obtained from Brandy- wine creek by pumping; the city is well sewered, and the streets are well paved, mainly with bricks and granite blocks. There are steamboat lines running up the Delaware to Philadelphia, connecting

there with lines to Atlantic ports. Three railways enter the city — the Balti- more and Ohio ; the Philadelphia, Wilmington, and Balti- more ; and the Wilmington and Northern, the last two being parts of the Pennsylvania system. Wilmington is a manufacturing city of great importance, due in part to water power furnished by Brandywine creek. In 1900 it contained 759 manufacturing establishments, with a total capital of $28,372,043. They employed 16,054 hands, and the product had a value of $34,053,324. The most prominent products were leather, value $9,379,504 ; railway carriages, $3,274,922; foundry and machine- shop products, $3,299,509; shipbuilding, $2,945,267; and iron and steel goods, $2,934,993. In 1900 the assessed valuation of real property was $43,647,072, the net debt of the city was $2,163,537, and the rate of taxation was $20 per $1000. Personal property is not assessable. Population (1890), 61,431; (1900), 76,508, of whom 10,478 were foreign-born and 9736 negroes.

Wi I m i ng"ton, a city and seaport of North Carolina, U.S.A., capital of New Hanover county. It is situated in 34° 14' N. and 77° 56' W., on the east bank of the Cape Fear river at the head of its estuary, 30 miles from the sea. It is regularly laid out on a level site, divided into five wards, and has a good water-supply. It has three railways — the Atlantic Coast Line, the Sea- board Air Line, and the Wilmington Sea Coast — which bring cotton, lumber, and naval stores to the city for shipment. Its exports in 1898 had a value of $9,761,606 ; its imports were trifling. Being in the main a commercial city, its manufactures are not of great importance; in 1900 it had 124 manufacturing establishments, with a total capital of $1,819,333. They employed 1469 hands, and the product had a value of $2,246,237. Population (1890), 20,056; (1900), 20,976, of whom 467 were foreign-born and 10,407 negroes.

Wilson, Thomas (1525?1581), statesman and critic, was the son of Thomas Wilson of Strubby, in Lincolnshire. He was educated at Eton and King's College, Cambridge, where he joined the school of Hellen ists to which Cheke, Thomas Smith, Haddon, and others belonged. His earliest work of importance was The Ride of Reason, 1551, a treatise on logic, which has often been reprinted. The book on which Wilson's fame mainly

~~rests, The Art of Rhetorique, is said to have been printed about the same time, but the first edition extant is dated January 1553. It is the earliest systematic work of literary criticism existing in the English language. Wilson threw in his lot with the Dudley family, and when they , fell, he fled to the Continent. He was with Sir John Cheke in Padua in 1555-57, and afterwards at Eome, whither in 1558 Queen Mary wrote, ordering him to return to England to stand his trial as a heretic. He refused to come, but was arrested by the Eoman Inquisition and tortured. He escaped, and fled to Ferrara, but in 1560 he was once more in London. Wilson became Master of St Katherine's Hospital in the Tower, and entered Parliament in 1562. In 1570 he published a translation, the first attempted in English, of Demosthenes, on which he had been engaged since 1556. His Discourse upon Usury appeared in 1572. From 1574 to 1577, Wilson, who had now become a pro- minent person in the diplomatic world, was principally engaged on embassies to the Low Countries, and on his return to England he was made a Privy Councillor and sworn Secretary of State ; Walsingham was his colleague. In 1580, although he was not in holy orders, Queen Elizabeth made Wilson Dean of Durham. He died at his house in the Tower of London, on the 16th June 1581, and was buried next day, " without charge or pomp," at his express wish. The Art of Rhetorique gives Wilson a high place among the earliest artificers of English style ; and it is interesting to see that he was opposed to pedantry of phrase, and above all to a revival of uncouth mediaeval forms of speech, and encouraged a simpler manner of prose writing than was generally appreciated in the middle of the 16th century.~~

~~Wilson, Sir William James Erasmus,~~

~~generally known as Sir Erasmus Wilson (1809-1884), British surgeon and philanthropist, was born in London on 25th November 1809, studied at St Bartholomew's Hospital in London, and at Aberdeen, and early in life became known as a skilful operator and dissector. It was his sympathy with the poor of London and a sug- gestion from Mr Thomas Wakley of The Lancet, of which Wilson acted for a time as sub-editor, which first led~~

him to take up skin diseases as a special study. The horrible cases of scrofula, anasmia, and blood-poisoning which he saw made him set to work to alleviate the sufferings of persons so afflicted, and he quickly estab- lished a reputation for treating this class of patient. It was said that he cured the rich by ordering them to give up luxuries ; the poor, by prescribing for them proper nourishment, which was often provided out of his own pocket. In the opinion of one of his biographers, we owe to Wilson in great measure the habit of the daily bath, and he helped very much to bring the Turkish bath into use in Great Britain. He wrote much upon the diseases which specially occupied his attention, and his books, A Healthy Skin and Student's Book of Diseases of the Skin, though they were not received without criticism at the time of their appearance, long remained text-books of their subject. He visited the East in order to study leprosy, Switzerland that he might investigate the causes of goitre, and Italy with the purpose of adding to his knowledge of the skin diseases affecting an ill-nourished peasantry. He made a large fortune by his successful practice and by skilful investments, and, since he had no family, he devoted a great deal of his money to charitable and educational purposes. He founded in 1869 the chair and museum of dermatology in the Koyal College of Surgeons, of which he was chosen president in 1881, and which just before his death awarded him its honorary

gold medal, founded in 1800 and only six times previously awarded. He also founded a professorship of pathology at Aberdeen University. After the death of his wife the bulk of his property, some £200,000, went to the Royal College of Surgeons. In 1878 he earned the thanks of the nation, upon different grounds, by defraying the expense of bringing the Egyptian obelisk inaccurately called Cleo- patra's Needle from Alexandria to London, where it was erected on the Thames Embankment. The British Govern- ment had not thought it worth the expense of transporta- tion. He was knighted by Queen Victoria in 1881, and died at Westgate-on-Sea on 7th August 1884.

Wilton, municipal borough and parish, in the Wilton or southern parliamentary division of Wiltshire, England, 3 miles north-west of Salisbury by rail. The borough returned two members to Parliament from 1293 to 1832, when the number was reduced to one, and in 1885 its

representation was merged in that of the county. The parish church of SS. Mary and Nicholas was built in 1844 at a cost of £40,000 in Romanesque style. This town claims to have been the first in England to manufacture carpets. There is a large carpet factory, which produces Axminster as well as Wilton carpets. Population (1891),

2120; (1901), 2203.

Wilts, or Wiltshire, a south-western county of England, bounded on the W. by Somerset, on the N.W. and on the N. by Gloucester, on the E. by Berkshire and Hampshire, and on the S. by Hampshire and Dorset.

Population. — The area of the ancient and administrative county is 880,248 acres, or 1375 square miles, with a population in 1881 of 258,970, in 1891 of 264,997, of whom 130,662 were males and 134,335 females, and in 1901 of 273,845, the number of persons per square mile being 199, and of acres to a person 3·2. Since 1891 various changes have been made in the administrative area. In 1895 the part of the parish of Hungerford in Wilts was trans- ferred to Berks, part of the parish pf Shalbourn in Berks to Wilts, the parts of the parishes of Maiden Bradley with Yarnfield and Stourton with Gaspar in Somerset to Wilts, and the parishes of Bramshaw, Martin, Melchet Park, Plaitford, South Damerharo, Toyd Farm with Allenford, and part of the parish of Whichbury, from Wilts to Hampshire ; and in 1896 the parishes of Kemble, Poole Keynes, and Somerford Keynes in Wilts were transferred to Gloucester, and the parish of Kilmington, Somerset, was transferred to Wilts. The area of the registration county is 811,367 acres, with a population in 1891 of 255,119, of whom 95,304 were urban, 159,815 rural ; and in 1901 of 263,921, of whom 130,758 were males and 133,163 were females. Within this area the percentage of increase between 1881 and 1891 was 2‘68, and between 1891 and 1901, 3. The excess of births over deaths between 1881 and 1891 was 31,366, and the increase in population was 6653. The following table gives the numbers of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 :

=

Year.

~~*Marriages.*~~

~~*Births.*~~

~~*Deaths.*~~

~~*Illegitimate Births.*~~

~~*Males.*~~

~~*Females.*~~

~~*1880 1890 1898*~~

~~*1528 1662*~~

~~*1780*~~

~~*7598 6997 6770*~~

~~*4407*~~

~~*4114 3807*~~

~~*196 153 155*~~

~~*173 149 128*~~

~~*The number of marriages in 1899 was 1915, of births 6725, and of deaths 4267. The following table gives the marriage-, birth-, and death-rates per thousand of the population, with the percentage of illegitimate births, for a series of years : —*~~

~~*1S70-79.*~~

~~*1SS0.*~~

~~*I880-S9.*~~

~~1SP0.~~

~~18SS-97.~~

~~189S.~~

~~Marriage-rate~~

~~13-1~~

~~12-3~~

~~12-6~~

~~13-1~~

~~13-1~~

~~13-7~~

~~Birth-rate .~~

~~31-3~~

~~31-5~~

~~29-7~~

~~27-5~~

~~27-2~~

~~26-1~~

~~Death-rate .~~

~~18-9~~

~~177~~

17-1

16-2

16-0

14 7

Percentage of ille-

gitimacy .

5-1

4 ‘8

4-8

4-3

4-2

4-2

In 1891 there were in the county 660 natives of Scotland, 758 natives of Ireland, and 274 foreigners.

Constitution and Government. — The county contains seven munioipal boroughs : Calne (3?56), Chippenham (5074), Devizes

(6532), Malmesbury (2854), Marlborough (3046), Salisbury (17,117), and Wilton (2203). The following are urban districts : Bradford- on-Avon (4514), Melksham (2450), Old Swindon (44,996), Trow- bridge (11,526), Warminster (5547), and Westbury (3300). The ancient county, which is

chiefly in the diocese of Salisbury, contains 312 ecclesiastical districts or parishes, and parts of 11 others.

Education. — The total number of elementary schools in the county on 31st August 1899 was 359, of which 35 were board and 324 voluntary schools, the latter including 295 National Church of England schools, 5 Roman Catholic, and 24 "British and other." The average attendance at board schools was 10,775, and at volun- tary schools 31,473. The total school board receipts for the year ended 29th September 1899 were over £34,065. The income under the Technical Instruction Act was over £135, and that under the Agricultural Rates Act was over £947.

Agriculture. — There is a college for agriculture at Downham. About five-sixths of the total area of the county is under cultiva- tion, and of this nearly three-fifths is in permanent pasture. There are less than 15,000 acres in hill pasture, about 52,000 acres under woods, and over 3600 acres are under orchards. The acreage under corn crops has decreased nearly one- third, the decrease being chiefly in the acreages under wheat and oats, the acreage under barley showing comparatively little variation. Wheat still, however, occupies nearly two-fifths of the corn crop acreage, and oats more than two-sevenths. Turnips and swedes occupy more than half the acreage under green crops, and there are large acreages under mangold and under cabbage, &c. ; while tares and vetches occupy more than one-fifth of the acreage, and potatoes usually only a little more than one-thirteenth. The following table gives the acreages of the larger main divisions of the cultivated area at — in- tervals from 1885 : —

Year.

Total Area

under Cultivation.

Corn Crops.

Green Crops.

Clover.

~~Permanent Pasture.~~

~~Fallow.~~

~~1885 1890 1895 1900~~

~~757,196 758,564 759,472 733,409~~

~~184,906 171,731 153,033 146,706~~

~~99,879 92,839 87,771 80,201~~

~~80,020 80,142 81,205 74,213~~

~~380,042 402,764 424,369 423,884~~

~~12,349~~

~~10,968~~

~~12,760~~

~~8,238~~

~~The following table gives particulars regarding the principal live stock for the same years : —~~

~~Year.~~

~~Total Horses.~~

~~Total Cattle.~~

~~Cows or Heifers~~

~~in Milk or~~

~~in Calf.~~

~~Sheep.~~

~~*Pigs.*~~

~~*1885 1890 1895 1900*~~

~~*23,214 23,274 23,595 22,942*~~

~~*108,788 108,336 106,072 115,900*~~

~~*58,486 59,746 60,129 64,316*~~

~~*660,029 613,399 534,389 520,888*~~

~~*64,534 77,008 79,195 60,334*~~

~~*Win burg1. See Okange River Colony.*~~

~~*Industries and Trade. — According to the return for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 22,071, as com- pared with 21,291 in 1896. Of these 2423 were employed in textile factories, woollen industries employing 2117. Non-textile factories employed 16,837 persons, there being an increase between 1895 and 1896 of 13‘4 per cent., and between 1896 and 1897 of 5 ‘4 percent. About three-fourths (12,073) were employed in the manufacture of machines, appliances, conveyances, and tools, the majority in connexion with the locomotive works of the Great Western Railway at Swindon. There is now some manufacture of paper. Of the 2811 persons employed in workshops, 1114 were employed in clothing industries. The total number of persons employed in connexion with mines and quarries in 1898 was 1417. In the same year 196,795 tons of limestone were raised, and 29,735 tons of clay. The most valuable mineral is, however, iron ore, obtained from quarries over 20 feet deep, the total output in 1899 being 67,603 tons, valued at £43,942. The annual pig-iron pro- duction at Westbury is included in the return for Worcestershire.*~~

~~*Authorities. — Sir H. Saint-George. Visitation of Wiltshire. London, 1882. — Goldik. Saints of Wiltshire. London, 1885. — Nightingale. Church Plate in Wilts. Devizes, 1884 ; new ed. Salisbury, 1891. — Smith.*~~

~~Guide to the British and Roman An- tiquities of the Wiltshire Bourns. Devizes, 1885.— Dartnell and Goddakd. Glossary of Words in Wiltshire (English Dialect Society). London, 1893. — Dowding. Old Wiltshire Market Towns and Villages. London, 1896. — See also Wiltshire Notes and Queries, and the publications of the Wiltshire Archaeological Society. (t. F. H.)~~

~~Wimbledon, an urban district (1894) and suburb of London, in the county of Surrey, 7 \ miles south-west of London by rail. Population (1881), 15,950; (1901),~~

~~41,604.~~

~~Winchester, a city, municipal and parliamentary borough, and market town of Hampshire, England, on the Itchen, 66 miles south-west by west of London by rail. The cathedral has undergone extensive repairs. The barracks (which developed out of the unfinished palace of Charles TI.) were burned down in 1894, and new ones erected. The Royal Hants County Hospital has been extended, and a new building provided for. There is a Jubilee Victoria Hospital. Area of parlia- mentary borough, 1049 acres; population (1891), 19,073; (1901), 19,001. Area of municipal borough (extended in 1900), 1931 acres; population (1891), 20,563; (1901),~~

~~20,929.~~

~~Winchester, a town of Litchfield county, Con- necticut, U.S.A., with an area of 36 square miles of hill country, interspersed with lakes and ponds, in the north-western part of the state. It contains several villages, the most important of which is the borough of Winsted, situated on Still and Mad rivers at their junction, and at the intersection of the Central New England and the New York, New Haven, and Hartford railways. It derives a fine water-power from Mad river, and has extensive manufactures, largely of cutlery and other iron and steel goods. Population of the town (1880), 5142; (1890), 6183; (1900), 7763; of Winsted borough (1880), 4195; (1890), 4846; (1900), 6804, of whom 1213 were foreign-born.~~

Winchester, a town of Kentucky, U.S.A., capital of Clark county, on the Chesapeake and Ohio, the Lex- ington and Eastern, and the Louisville and Nashville rail- ways, not far from the centre of the state, at an altitude of 964 feet. It is in the Blue Grass region, devoted to agriculture and stock raising, for which it serves as a supply and distributing point. It contains several minor institutions of learning, among them the Kentucky Wes- leyan College, a Methodist Episcopal South institution. Population (1880), 2277; (1890), 4519; (1900), 5964, of whom 65 were foreign-born and 3128 negroes.

Winchester, a town of Middlesex county, Massachusetts, v U.S.A., 8 miles north-east of Boston, of which it is a suburb, on a line of the Boston and Maine Railroad, in the north-eastern part of the state. Its principal industries are the manufacture of leather and furniture. Population (1880), 3802 ; (1890), 4861 ; (1900), 7248, of whom 1968 were foreign-born and 140 negroes.

Winchester, a city of Virginia, U.S.A. It is situated in 39° 11' N. and 78° 10' W., in the fertile Shenandoah valley, at the intersection of a branch of the Baltimore and Ohio with the Cumberland Valley Railroad, in the northern part of the state, at an altitude of 717 feet. Though within the limits of Frederick county and containing the court-house, it is not subject to county-government. It is regularly laid out on an undu- lating site, and has a variety of small manufactures. Near here during the Civil War the Federals under Shields de- feated the Confederates under Jackson (23rd March 1862), and the Confederates under Early defeated the Federals under Crook (24th July 1864). More important, however, was the battle fought near here 19th September 1864, between the Federals under Sheridan and the Con- federates under Early, in which the former were victorious. Population (1890), 5196 ; (1900), 5161, of whom 62 were foreign-born and 1106 negroes.

~~Windsor, or New Windsor, a municipal and parlia- mentary borough, in the Eastern, or Wokingham, parlia- mentary division of Berkshire, England, on the right bank of the Thames, 21 miles west of London by rail. The Eoyal Albert Institute was opened in 1881, and a small hall was added in 1898. A Government school of art and technical classes are held here. The Jubilee statue of Queen Victoria was unveiled in 1887, and a bronze equestrian statue of Prince Albert in 1890. Old Windsor is a parish and village adjoining ; Cumberland Lodge and the greater portion of Windsor Park are in this parish. Population (1881), 12,273; (1891), 12,327; (1901),~~

~~13,958.~~

~~Windsor, a city and port of entry of Essex county, Ontario, Canada, on the left bank of the Detroit river, opposite Detroit city. It is the terminus of the Grand Trunk, Canadian Pacific, and Michigan Central railways, which connect at this point with the railways of the United States by means of large and powerful Car-ferries. There is electric railway communication. Salt works, flour-mills, typograph and bicycle works are the principal industries. Exports for the year 1900-01, $2,236,035, and imports, $2,283,062. Population~~

~~(1891), 10,322; (1901), 12,153.~~

~~Windthorst, Ludwig (1812-1891), German politician, was born on the 17th of January 1812 at Kaldenhof, a country house about 8 miles from the city of Osnabriick. IIe sprang from a Eoman Catholic family which for some generations had held important posts in the IIanoverian civil service. IIe was edu- cated at the Carolinum, an ancient endowed school at Osnabriick, and studied at the universities of Got- tingen and Heidelberg. In 1836 he settled down as an advocate in Osnabriick : his abilities soon procured him a considerable practice, and he was appointed presi- dent of the Catholic Consistorium. In 1848 he received an appointment at the supreme Court of Appeal for the kingdom of IIanover, which sat at Celle. In the next year the revolution opened for him, as for so many of his contemporaries, the way to public life, and he was elected as representative for his native district in the Second Chamber of the reformed IIanoverian Parliament. IIe belonged to what was called the~~

Great German party, and opposed the project of reconstituting Germany under the leadership of Prussia ; he defended the Government against the Liberal and Democratic opposition : at this time he began the struggle against the secularization of schools, which continued throughout his life. In 1851 he was elected president of the Chamber, and in the same year minister of justice, being the first Catholic who had held so high an office in Hanover. As minister he carried through an important judicial reform which had been prepared by his predecessor, but had to retire from office because he was opposed to the reactionary measures for restoring the influence and privileges of the nobility. Though he was always an enemy to Liberalism, his natural independence of character prevented him from acqui- escing in the reactionary measures of the king. In 1862 he again was appointed minister, but witli others of his colleagues resigned when the king refused his assent to a measure for extending the franchise. Windthorst took no part in the critical events of 1866 ; contrary to the opinion of many of his friends, after the annexation of Hanover by Prussia he accepted the fait accompli, took the oath of allegiance, and was elected a member both of the Prussian Parliament and of the North German Diet. At Berlin he found a wider field for his abilities, lie acted as representative of his exiled king in the negotiations with the Prussian Government concerning his private

property and opposed the sequestration, thus for the first time being placed in a position of hostility to Bismarck. He was recognized as the leader of the Hanoverians and of all those who opposed the " revolution from above." He took a leading part in the formation of the party of the Centre in 1870-71, but he did not become a member of it, fearing that his reputation as a follower of the king of Hanover would injure the party, until he was formally requested to join them by the leaders. After the death of Malincrodt in 1874 he became leader of the party, and maintained that position till his death. It was chiefly owing to his skill and courage as a parliamentary debater and his tact as a leader that the party held its ovi-n and constantly increased in numbers during the great struggle with the Prussian Government. He was especially ex- posed to the attacks of Bismarck, who attempted person- ally to discredit him and to separate him from the rest of the party. And he was far the ablest and most dangerous critic of Bismarck's policy. The change of policy in 1879

led to a great alteration in his position : he was recon- ciled to Bismarck, and even sometimes attended receptions at his house. Never, however, was his position so difficult as during the negotiations which led to a repeal of the May Laws. In 1887 Bismarck appealed to the Pope to use his authority to order the Centre to support the military proposals of the Government. Windthorst took the responsibility of keeping the Papal instructions secret from the rest of his party and disobeying them. In a great meeting at Cologne in March 1887 he defended and justified his action, and claimed for the Centre full independence of action in all purely political questions. In the social reform he supported Bismarck, and as the undisputed leader of the largest party in the Beich- stag he was able to exercise great influence over the action of the Government after Bismarck's retirement. His relations with the Emperor William II. became very cordial, and in 1891 he achieved a great parliamentary triumph by defeating the School Bill and compelling Gossler to resign. A few days afterwards he died, 14th March 1891, at Berlin. He was buried in the Marien- kirche in Hanover, which had been erected from the money subscribed as a testimonial to himself. His funeral was a most remarkable display of public esteem, in which nearly all the ruling princes of Germany joined, and was a striking sign of the position to which, after twenty years of incessant struggle, he had raised his party. Windthorst was undoubtedly one of the greatest of German parliamentary leaders : no one equalled him in his readiness as a debater ; his defective eyesight com- pelled him to depend entirely upon his memory. It was his misfortune that nearly all his life was spent in opposition, and he had no opportunity of showing his abilities as an administrator. He enjoyed unbounded popularity and confidence amorg the German Catholics, but he was in no way an ecclesiastic : he was at first opposed to the Vatican Decrees of 1870, but quickly accepted them after they had been proclaimed. He was a very agreeable companion and a thorough man of the world, singularly free from arrogance and pomposity; owing to his small stature, he was often known as " der kleine Excellenz." He married in 1839. Of his three children, two died before him ; his wife survived him only a few months.

See the biographies of Windthorst by Manzenbach, 1891-92, and Knopp, 1898. (j. w. He.)

~~Windward Islands, a group of British West Indian islands, comprising Grenada, St Vincent, the Grenadines (half under St Vincent, half under Grenada), and St Lucia. There is a governor and commander-in-~~

~~chief (resident at St George, Grenada). Each island has its own institutions : there is no common legislature, laws, revenue, or tariff; there is a common court of appeal, and the colonies unite for other common purposes. (See articles on the separate islands.)~~

~~Winfield, a city of Kansas, U.S.A., capital of Cowley county, on the river Walnut, and the Atchison, Topeka, and Santa Fe, the Missouri Pacific, and the St Louis and San Francisco railways, in the southern part of the state, at an altitude of 1121 feet. It is surrounded by a rich farming country, for which it serves as a supply and distributing point. It is the seat of St John's (Lutheran) and South-west Kansas (Methodist-Episcopal) Colleges. The former had in 1899 a faculty of 8 and an attendance of 84, the latter a faculty of 15 and an attendance of 322 students. Both are co- educational. Population (1880), 2844; (1890), 5184; (1900), 5554, of whom 203 were foreign-born and 282 negroes.~~

~~Winnipeg1, a lake and river, Canada. The lake is in Manitoba and Keewatin, and is situated between 50° 20' and 53° 50' N. and 96° 20' and 99° 15' W. It covers an area of 8555 square miles, is at an altitude of 710 feet above the sea, is 260 miles long, 25 to 60 miles wide, and contains several large islands, including Eeindeer, 70 square miles, and Big Island, 60 square miles. The principal affluent rivers are : Bed, from the south ; Winnipeg, Bloodvein, Berens, and Poplar from the east ; and the Dauphin and Saskatchewan from the west. It discharges its waters by the river Nelson into Hudson Bay. The river Winnipeg rises near Savanne station, in 48° 47' N. and 89° 57' W., and flows in a westerly direction under the names of Savanne, Seine, and Eainy rivers to the Lake of the Woods ; issuing thence as the Winnipeg, it flows north-westerly to the lake of the same name. It is navigable from the foot of the Lake of the Woods~~

~~to the head of Eainy Lake — with a short portage at Fort Frances falls — a dis- tance of 208 miles. Its principal tributary is English river.~~

~~Winnipeg1, the capital of Manitoba, Canada, situated at the confluence of Eed and Assiniboine rivers, midway between the Atlantic and Pacific, 1424 miles (by rail) west of Montreal, and 1472 miles east of Vancouver. It is an important station on the Canadian Pacific and Canadian Northern railways, and is the terminus of the Emerson, Pembina, South-western, Stone- wall, and West Selkirk branches of the former, and of the Portage la Prairie branch of the latter. The pro- posed lock at St Andrews rapids, a few miles below the city, will give steamboat communication with all parts of Lake Winnipeg. The wheat exports of the province in 1901 — including flour — all of which was grown in the territory tributary to the city, aggregated 55,000,000 bushels. The total assessment in 1881 was $9,196,435, and in 1901, $28,305,200; clearings at the clearing- house in 1896, $64,146,438, and in 1901, $134,199,483; exports in 1887, $816,260, and in 1901, $1,014,263; imports in 1887, $1,929,120, and in 1901, $5,125,262. Population (1891), 25,639; (1901), 42,340.~~

~~WinnipegfOSiS, a lake of Manitoba and Sas- katchewan, Canada, situated between 51° 34' and 53° 11' N. and 99° 37' and 101° 06' W. Its greatest length is 122 miles; greatest width 17 miles; shore- line 570 miles ; and area, exclusive of islands, 2000 square miles. Its greatest ascertained depth is 38 feet, and mean altitude 828 feet above the sea. Mossy,~~

~~Swan, and Red Deer rivers are the only considerable streams that fall into it. It was discovered by the Chevalier de la Verendrye in 1739.~~

~~Winona., a city of Minnesota, U.S.A., capital of Winona county. It is situated in 44° 04' N. and 91° 42' W., on the west bank of the Mississippi, in the south-eastern part of the state, at an altitude of 660 feet. It is on a level terrace in the bottom lands surrounded by high bluffs, is regularly laid out, is divided into four wards, has a good water-supply by the Holly system, and is well sewered. It is an important railway centre, being the meeting point of five lines — the Chicago, Burlington and Quincy ; the Chicago and North-Western ; the Chicago, Milwaukee and St Paul ; the Green Bay and Western ; and the Winona and Western — which give it a~~

large trade, mainly in wheat and other cereals. Besides a trade in lumber, there are manufactures of agricultural implements and waggons. Population (1890), 18,208; (1900), 19,714, of whom 5000 were foreign-born.

Winsfbrd, a town in the Northwich parliamentary division of Cheshire, England, on the Weaver, 6 miles south of Northwich by rail. Large salt-works employ about 2000 persons. The salt, obtained chiefly from brine, but also from rock-salt, is carried down the Weaver, here navigable for vessels of 300 tons, and exported from Liverpool to the extent of over 500,000 tons annually. Owing to the subsidence of the ground caused by the pumping of the brine, about 200 acres near the river have been submerged. An iron bridge, erected in 1856, was raised in 1871, in 1876, and in 1882 ; the town hall, built of wood and plaster in 1872, was raised 8 feet and the foundations relaid in 1879. There are public baths, recreation grounds, a public library, and a market hall. Area of urban district, 5780 acres. Population (1891),

10,440; (1901), 10,382.

WinSOr, Justin (1831-1897), an American writer and librarian, was born at Boston, Massachusetts, on 2nd January 1831. At the age of nineteen, while a freshman in Harvard College, he printed a History of Duxbwry, Massachusetts, the home of his ancestors. In the beginning of his senior year he left Cambridge, and sought greater freedom and enlarged opportunity of study in Germany. While still at Harvard he planned to write an extended memoir of Garrich and his Contemporaries, and to compile a critical edition of Shakespeare's works. For fourteen years he had the Garrich more or less on his mind, and in 1864 he completed the first draft of it. The manuscript, occupying ten folio volumes with a mass of notes, is accessible to students in the library of Harvard University. In 1866 Winsor was appointed a trustee of the Boston public library, one of the most important libraries in America. Becoming chairman of the examining com- mittee, he presented to the trustees in 1867 a masterly report on the condition of the library, which led to his appointment in 1868 as superintendent. In 1877 he became librarian of Harvard University, and retained the position until his death. He kept clearly in

mind what librarians had mainly ignored, namely, that books are collected to be used, and by their use to influence not only scholars but the mass of the people. He may almost be said to have founded the modern American library system. While at the Boston public library he edited a most useful catalogue of books in history, biography, and travel, and compiled the first of a series of separate lists of works of historical fiction. On his transfer to the Harvard library he forwarded every plan to make it the laboratory for those departments of learning

whose evidence consists mainly in printed books. In 1876 he began a series of monumental publications. The first of the series was a Bibliography of the Original Quartos and Folios of Shakespeare, with particular refer- ence to copies in America. It was illustrated with sixty-eight heliotype facsimiles of title-pages, &c. Unfortunately, all save about a hundred copies of this great work were burned. The preparation of the illustrations seems to have turned his attention to the possibility of reproducing by photography rare bits of original material. He planned The Facsimilist, a quarterly record of rarities in biblio- graphy, archaeology, palaeography, and cartography. The same fire that consumed the Shakespeares destroyed the sheets of the first number of The Facsimilist and the negatives of the illustrations of several other numbers. From this time he devoted himself to American history and cartography. A small volume entitled The Reader's Handbook of the American Revolution is still the model of a reasonable bibliography. In 1880 he began the editing of the Memorial History of Boston in four quarto volumes, with the co-operation of seventy writers. He so manipulated the contributions and supplemented them with notes as to give an air of unity to the whole work, and completed it in twenty-three months. He at once set to work on a still larger co-operative book, The Nar- rative and Critical History of America, which was com- pleted in eight royal octavo volumes. These great tasks had compelled Winsor to make a careful and systematic study of historical problems with the aid of contem- poraneous cartography. Among the early results of this study

were the Bibliography of Ptolemy's Geography and the Catalogue of the Kohl Collection of Maps relating to America, published in the Harvard Library Bulletins. His vast knowledge took the final form of four volumes in which history and cartography are so interwoven as to be almost undistinguishable. These volumes are entitled Christopher Columbus, Cartier to Frontenac, The Mis- sissippi Basin, and The Westward Movement. Besides great stores of information hitherto accessible only to the specialist, these contain many strong expressions of dis- sent from currently received views. Winsor served for many years on . the Massachusetts Archives Commission. His Report on the Maps of the Orinoco-Essequibo Region was prepared at the request of the Venezuela Boundary Commission, and is a most careful geographical statement. Winsor died on the 22nd of October 1897.

Many of the facta contained in this sketch are taken from Horace E. Soudder's ' ' Memoir of Justin Winsor " in the Pro- ceedings of the Massachusetts Historical Society, 2nd series, vol. xii. A hibliography of Mr Winsor's writings is in Harvard College library, Bibliographical Contributions, No. 54. (j;. Ch.)

Winsted, a borough of Connecticut, U.S.A., capital of Litchfield county, on the Mad river, and the New York, New Haven, and Hartford, and the Central New England railways, in the north-western part of the state. It obtains excellent water-power for manufacturing from Mad river. Population (1890), 4846; (1900), 6804, of whom 1213 were foreign-born.

Winston, a city of North Carolina, U.S.A., capital of Forsyth county, in the northern part of the state, at the intersection of lines of the Norfolk and Western and the Southern railways, at an altitude of 858 feet. The city is continuous with Salem, so that the two places are commonly coupled as Winston-Salem. Winston has had a rapid growth, due in a large measure to the tobacco trade and manufacture, for which it contains many large factories and warehouses. It has also cotton factories and various minor manufactures. Population of Winston (1880), 2854; (1890), 8018;. (1900), 10,008, of whom

610 were foreign-born and 5043 negroes ; of Salem (1880), 1340; (1890), 2711 ; (1900), 3642, of whom 18 were foreign-born and 488 negroes.

Winterthur, a town in the Swiss canton of Zurich, 16^ miles from Zurich by rail. Its population in 1880 was 13,502, and in 1888 (when it ranked as the tenth most populous town in Switzerland) 15,805, while in 1900 it was 22,320. It is practically wholly German- speaking, and nearly four-fifths of the inhabitants are Protestants, the remainder being Roman Catholic, with a sprinkling of Jews.

Winther, Christian (1796-1876), the Danish

lyrical poet, was born on the 29th of July 1796 at Fens- mark, in the province of Prassto, where his father was priest. He went to the University of Copenhagen in 1815, and studied theology, taking his degree in 1824. He began to publish verses in 1819, but no collected volume appeared until 1828. Meanwhile, from 1824 to 1830, Winther was supporting himself as a tutor, and with so much success that in the latter year he was able to go to Italy on his savings. In 1835 a second volume of lyrics appeared, and in 1838 a third. In 1841 King Christian VIII. appointed Winther to travel to Mecklen- burg to instruct the Princess Caroline, on the occasion of her betrothal to the Crown Prince of Denmark, in the Danish language. Further collections of lyrics appeared in 1 842, 1848, 1850, 1853, 1865, and 1872. When he was past his fiftieth year Winther married. In 1851 he received a pension from the State as a poet, and for the next quarter of a century he resided mainly in Paris. Besides the nine or ten volumes of lyrical verse mentioned above, Winther published The Stag's Flight, an epical romance in verse, 1855; In the Tear of Grace, a novel, 1874; and other works in prose. He died in Paris on the 30th of Decem- ber 1876, but the body was brought to Denmark, and was buried in the heart of the woods. In the verse of Christian Winther the scenery of Denmark, its beech- woods, lakes, and meadows, its violet-scented dingles, its hollows perfumed by wild strawberries, found such a loving and masterly painter as they are never likely to find again. He is the most spontaneous of lyrists; his little poems are steeped in the dew and light and odour of a cool, sunshiny morning in May. His melodies are art- less, but full of variety and delicate harmony. When he was forty-seven he fell in love, and at that mature age startled his admirers by publishing for the first time a cycle of love-songs. They were what were to be expected from a spirit so unfaded ; they still stand alone for tender homage and simple

~~sweetness of passion. The technical perfection of Winther's verse, in its extreme simplicity, makes him the first song-writer of Denmark. (e. g.)~~

~~Wisbech, a river port, municipal borough, and market town, Cambridgeshire, England, in the Wisbech parliamentary division of the county, in the Isle of Ely, 21 miles east-north-east of Peterborough by rail. The river Nene flows through the town, the greater part of which stands on its south side, where in 1891 piling to strengthen the bank was undertaken at a cost of £20,000. Vessels of 789 tons can enter the port. Coal is exported. Nearly all the foreign trade is with the northern ports of Russia. Population (1891), 9395; (1901), 9831. '~~

~~Wisby, a seaport, seaside resort, and bishop's see of Sweden, capital of the county and island of Gothland, on the west coast. It is thoroughly mediaeval in appearance, possessing several ancient houses (13th and 17th centuries) and nearly a dozen ruined churches, mostly built in the 13th century. The only ancient church now used is St Mary's, the cathedral (1190-1225), restored in the end of~~

~~the 19th century, and rich in memorials of the 17th century. The modern buildings include the Gothland museum of antiquities, the high school, with a museum and library, and a chemical station (1899). The harbouj, consisting of two basins, and lying south of the ancient Hanseatic harbour (now filled up), does not afford much protection, and the roads are even more exposed. Population (1880),~~

~~6922; (1900), 8376.~~

~~Wisby — a word derived from the old Norse ve (sanctuary) and by (town) — was no doubt a place of religious sacrifice in heathen times. At any rate, it was a notable trading-place and emporium as early as the Stone Age, and continued to enjoy its importance as such through the Bronze and Iron Ages, as is proved, inter alia, by the large number of Arabic, Anglo-Saxon,1 and other coins which have been found on the island.~~

Gothland was subject to Sweden in 890, and earlier ; and in 1030 was in all probability Christianized by St Olaf, king of Norway, when returning from his exile at Kieff. At that time it was one of the most important trading towns in the Baltic, and the chief dis- tributing centre of the Oriental commerce which came to Europe along the rivers of Russia. It became in the early years of the Hanseatic League, or about the middle of the 13th century, the chief depot for the produce of the eastern Baltic countries, includ- ing, in a commercial sense, its daughter colony (11th century or earlier) of Novgorod the Great. Although Wisby was an inde- pendent member of the Hanseatic League, the influence of Liibeck was paramount in the city, and half her governing body were men of German descent. Indeed, Bjorkander endeavours to prove that the city was a German (Hanseatic) foundation, dating principally from the middle of the 12th century, and that down to the year 1288 there were two town corporations, which became fused in the year just mentioned. However that may be, the importance of Wisby in the sea trade of the North is conclusively attested by the famous code of maritime law which bears its name. This Water- recht dat de Koopliide en de Schippers gemakt hebben to Visby (" sea- law which the merchants and seamen have made at Wisby ") was a compilation based upon the Liibeck code, the Oleron code, and the Amsterdam code, and was first printed in Low German in 1505, but in all probability had its origin about 1240, or not much later. By the middle of the 14th century the reputation of the wealth of the city was so great that, according to an old balladj ' ' the Gotlanders weighed out gold with stone weights and played with the choicest jewels. The swine ate out of silver troughs, and the women spun with distaffs of gold." This fabled wealth was too strong a temptation for the energetic Waldemar Atterdag of Denmark. In 1361 he invaded the island, routed the defenders of Wisby under the city walls (a monolithic cross marks the site), and plundered the city. From this blow it never recovered, its decay being, how- ever, materially helped by the fact that for the greater part of the next 150 years it was the stronghold of successive freebooters or sea-rovers — first, of the Hanseatic privateers called Vitalienbrbdre or Viktualienbriider, who made it their stronghold during the last eightyears of the 15th century ; then of the Teutonic Knights, whose Grand; Master drove out the "Victuals Brothers," and kept the island until it was redeemed by Queen Margaret, the " Semiramis of the North. " There too Erik XIII. (the

Pomeranian), after being driven out of Denmark by his own subjects, established himself in 1437, and for a dozen years waged piracy upon Danes and Swedes alike. After him came Olaf and Ivar Thott, two Danish lords, who down to the year 1487 terrorized the seas from their pirates' stronghold of Wisby. Lastly, the Danish admiral Soren Norrby, the last supporter of Christian I. of Denmark, when his master's cause was lost, waged a guerilla war upon the Danish merchant ships and others from the same convenient base. But this led to an expedition by the men of Liibeck, who partly destroyed the city in 1525. By the peace of Stettin (1570) Wisby was con- firmed to the Danish Crown, to which it had been given by Queen Margaret. But at the peace of Bromsebro in 1645 it was at length restored to Sweden. It was then, however, a mere wreck of its former self ; its commercial supremacy and its prosperity " had alike disappeared. Except for the three years 1676-79, when it was forcibly occupied by the Danes, and a few weeks in 1808, when the Russians landed a force, the island has remained subject to the Swedish Crown.

See Visby och dess MinnesmarJcen, by Hans Hildebrand (Stockholm, 1892 et seq.), and Till Wisby Stads JEldsta Historia,

1 The Stockholm Royal Numismatic Collection contains no less than 11,000 pieces of Anglo-Saxon coinage found in Gothland, some of date 901-924, but the bulk of a later date.

by A. Bjorkander (1898), where most of the literature dealing with the subject is mentioned ; but some of Bjbrkander's argu- ments require criticism. (j. t. Be.)

Wisconsin,' one of the north central states of the American Union. It had in 1890 a population of 1,686,880, with a density of 30'98 to the square mile, and in 1900 a population of 2,069,042, with a density of 38 to the square mile, the rate of increase during the decade being 22-2 per cent. In 1900, 1,067,562 were males and 1,001,480 were females; 1,553,071 were native-born and 515,971 (24-9 per cent.) were foreign- born; 2,057,911 were white and 11,131 were coloured (2542 negroes, 217 Chinese and Japanese, and 8372 Indians). Out of 570,715 adult males, 31,136 were illiterate (unable to write), of whom 23,956 were foreign- born and 1294 were Indians. In 1900 there were forty incorporated cities and villages

~~with a population of more than 2000 and less than 5000, fifteen of more than 5000 and less than 10,000, and eighteen with more than 10,000. The ten largest cities in 1900 were Mil- waukee, 285,315; La Crosse, 28,895; Oshkosh, 28,284; Superior, 31,091; Eacine, 29,102; Sheboygan, 22,962; Eau Claire, 17,517 ; Green Bay, 18,684 ; Madison, 19,164; Marinette, 16,195. During the financial de- pression of 1893-97 there was a marked movement from the cities to the cheap wild lands of northern Wisconsin, but since the latter year the cities, especially Milwaukee, have grown rapidly. In 1890 the urban population (classing as such all persons in places of more than 4000 inhabitants) comprised 30‘9 per cent, of the total popula- tion; in 1900 the percentage had risen to 34‘5.~~

~~Agriculture. — In 1900 there were 169,795 farms, of an average size of 117 acres. The total acreage of farms was 19,862,727, of which 8,615,755 acres were improved land. Of these farms 146,799 were cultivated by the owners, and 10,249 were occupied by cash tenants and 12,747 by share tenants. The total value of farm property was given as $811,712,319, and the value of the farm products for the preceding year was $157,445,713. The produce was estimated as follows : Wheat, 9,005,170 bushels; Indian corn, 53,309,810; oats, 84,040,800; barley, 18,699,690 ; rye, 5,142,606 ; potatoes, 24,641,498 ; hay, 3,667,212; sorghum, 160,414 gallons; tobacco, 45,500,480 ft. Of cheese, 1,635,618 ft were produced, and of butter, 44,739,147 ft. There were on farms 521,867 horses, 2,314,105 cattle, 1,675,453 sheep and lambs, and 2,014,631 swine. The dairy interest in the north as well as in the south has greatly developed, the northern counties from which the timber has been cut having been devoted to agriculture.~~

~~Manufactures, Railways, dec. — Large water-powers are found, chiefly on the Fox, Wisconsin, and Chippewa ‘ rivers. The following table shows the condition of the manufacturing industries in 1890 and 1900 : —~~

~~1890.~~

~~1900.~~

~~Per cent, of Increase.~~

~~Number of estab-~~

~~lishments .~~

~~10,417~~

~~16,187~~

~~55·4~~

~~Capital .~~

~~$246,515,404~~

~~$330,568,779~~

~~34·1~~

~~Wage-earners, aver-~~

~~age number~~

~~120,006~~

~~142,076~~

~~18·4~~

~~Wages .~~

~~$42,958,267~~

~~$58,407,597~~

~~36·0~~

~~Value of product .~~

~~$248,546,164~~

~~$360,818,942~~

The leading industries, with the values of their pro- ducts, are: lumber and timber,' $57,634,816; flouring and ' grist mills, $26,327,942 ; foundries and machine- shops, $22,252,730 ; butter, cheese, and condensed milk factory product, $20,120,147; leather, $20,074,373; malt liquors, $19,394,709 ; wholesale slaughtering and

meatpacking, $13,601,125 ; and wood pulp, $10,895,576. The mining industry is gradually increasing in import- ance. In 1899 there were 6592 miles of railway, valued

at $247,502,364.

Administration. — The state sends ten representatives to Con- gress. The Supreme Court is composed of a chief justice and four associate justices ; there are seventeen judicial circuits, each with a judge ; and besides these are county and municipal judges and justices of the peace. The state legislature meets biennially. The "Wisconsin National Guard numbered, in October 1900, three regiments and a battalion of infantry, a troop of cavalry, and a battery. This force aggregates 2899 enlisted men and 191 officers.

Finance. — The value of all taxable property for 1890, as de- ■ termined by the state board of assessment, was as follows : — Personal propertyf $122,041,032; real estate, $477,958,960; total assessed value of all property, $599,999,992. Taxes in 1896 were as follows: — Town, city, village, and county taxes, $15,018,687; roads, bridges, poll-tax, &c, $4,289,166. The total county, municipal, and school district indebtedness in 1890, less the sink- ing fund, was $8,145,189. The combined debt of the state, less the sinking fund, was $10,440,580. The bonded indebtedness of towns, cities, villages, and school districts on 31st December 1895 was $10,712,569. In July 1900 the several state banks had a combined capital

~~of $6,417,725 and deposits of $45,929,285. The private banks had resources aggregating $12,257,519.~~

~~Charities and Correction. — The state supports two hospitals for the insane ; in 1900 these contained 604 inmates, and there were 3397 insane in county asylums, gaols, and poorhouses. The school for the deaf has an average attendance of 175 ; school for blind, 111 ; industrial school for boys, 324. The number of prisoners in reformatories in 1900 was 945. The state board of control has charge of these institutions.~~

~~Education. — The number of persons of school age in 1899-1900 was 731,063. Of these 445,172 attended public schools, 4115 normal schools. In 1896 there were 27 colleges, academies, and seminaries, with a total of 3484 pupils. There were 394 private schools, with an attendance of 24,077. The number of free high schools was 197. The school fund in 1898 amounted to $792,502. The State University at Madison had in 1900 a total income of $426,663. In 1901-02 it had in all departments, including a summer session, an attendance of 2777. The number of teachers employed in common and high schools in 1900 was 13,063, and in private schools 1500.~~

~~Libraries. — The State Historical Society at Madison, the capital, has 230,000 titles. Its beautiful new fireproof building was com- pleted in October 1900. It is of Bedford (Indiana) limestone, and is the finest building owned by the state. The university library, housed in the State Historical Society's building, has 72,000 titles. The library of the Wisconsin Academy of Sciences, in the same building, has 12,000 titles. The state law library, in the state house, has 45,000 titles.~~

~~Politics. — With the economic change of the last fifteen years of the 19th century in Wisconsin has gone a decided political change. It is no longer an agricultural state, but a decided manufacturing and commercial state. In the Presidential election of 1896, the succeeding Congressional election of 1898, and the Presidential election of 1900, Wisconsin was firmly in favour of the money policy of the Republican party. The large German and Scandi- navian elements constitute important conservative factors in the state politics. (v. j. t.)~~

Wiseman, Nicholas Patrick Stephen

(1802-1865), English cardinal, was born at Seville 2nd August 1802, the child of Anglo-Irish parents recently settled in Spain for business purposes. On his father's death in 1805 he was brought to Waterford, and in 1810 he was sent to Ushaw College, near Durham, where he was educated until the age of sixteen, when he proceeded to the English College in Kome, re-opened in 1818 after having been closed by the Ee volution for twenty years. He graduated doctor of theology with distinction in 1825, and was ordained priest in the following year. He was appointed vice-rector of the English College in 1827, and rector in 1828, when not yet twenty-six years of age. This office he held until 1840. From the first a devoted student and antiquary, he devoted much time to the examination of Oriental MSS. in the Vatican library, and a first volume, entitled Horce Syriacce, published in 1827, gave promise of a great scholar. Leo XII. appointed him curator of the Arabic

MSS. in the Vatican, and professor of Oriental languages in the Koman University. At this date he had close relations, personal and by correspondence, with Mai, Bunsen, Burgess (bishop of Salisbury), Tholuck, and Kluge. His student life was, however, broken by the Pope's com- mand to preach to the English in Bome; and a course of his lectures On the Connexion between Science and Revealed Religion, though now necessarily out of date, deservedly attracted much attention, his general thesis being that whereas scientific teaching has repeatedly been thought to disprove Christian doctrine, further investigation has shown that a reconstruction is possible. He visited England in 1835-36, and delivered lectures on the principles and main doctrines of Boman Catholicism in the Sardinian Chapel, Lincoln's Inn Fields, and in the church at Moorfields, now pulled down. Their effect was considerable ; and at Pusey's request Newman reviewed them in the British Critic (December 1836), treating them for the most part with sympathy as a triumph over popular Protestantism. To another critic, who had taken occasion to point out the resemblance between Catholic and pagan ceremonies, Wiseman replied, boldly admitting the likeness, and maintaining that it could be shown equally well to 'exist between Christian and heathen doctrines. In 1836 he founded the Dublin Review, partly to infuse into the lethargic

English Catholics higher ideals of their own religion and some enthusiasm for the Papacy, and partly to enable him to deal with the progress of the Oxford Movement, in which he was keenly interested. At this date he was already distinguished as an accomplished scholar and critic, able to converse fluently in half-a-dozen languages, and well informed on most questions of scientific, artistic, or antiquarian interest. In the winter of 1838 he was visited in Bome by Macaulay, Manning, and Gladstone. An article by him on the Donatist schism appearing in the Dublin Review in July 1839 made a great impression in Oxford, Newman and others seeing the force of the analogy between Donatists and Anglicans. Some words he quoted from St Augustine influenced Newman pro- foundly : " Quapropter securus judicat orbis terrarum bonos non esse qui se dividunt ab orbe terrarum." And preaching at the opening of St Mary's church, Derby, in the same year, he anticipated Newman's argument on reli- gious development, published six years later. In 1840 he was consecrated bishop, and sent to England as coadjutor to Bishop Walsh, vicar-apostolic of the Central district, and was also appointed president of Oscott College near Birmingham. Although he had not the gifts requisite to make a successful college head, he was beloved by the students, and Oscott under his presidency became a centre for English Catholics, where he was also visited by many distinguished men, including foreigners and non- Catholics. The Oxford converts (1845 and later) added considerably to Wiseman's responsibilities, as many of them found themselves wholly without means, while the old Catholic body looked on the new-comers with distrust. It was by his advice that Newman and his companions spent some time in Bome before undertaking clerical work in England. Shortly after the accession of Pius IX. Wiseman was appointed temporarily vicar-apostolic of the London district, the appointment becoming per- manent in February 1849. On his arrival from Bome in 1847 he acted as informal diplomatic envoy from the Pope, to ascertain from the Government what support England was likely to give in carrying out the liberal policy with which Pius inaugurated his reign. In response Lord Minto was sent to Bome as "an authentic organ of the British Government," but the policy in question proved abortive. Besiding in London in Golden

WISEMAN

Square, Wiseman threw himself into his new duties with many-sided activity, working especially for the reclama- tion of Catholic criminals and for the restoration of the lapsed poor to the practice of their religion. He was zealous for the establishment of religious communities, both of men and women, and for the holding of retreats and missions. He preached (4th July 1848) at the opening of St George's, Southwark, an occasion unique in England since the Reformation, 14 bishops and 240 priests being present, and six religious orders of men being represented. The progress of Catholicism was undeniable, but yet Wiseman found himself steadily opposed by a minority among his own clergy, who dis- liked his Ultramontane ideas, his "Romanizing and in- novating zeal," especially in regard to the introduction of sacred images into the churches and the use of de- votions to the Blessed Virgin and the Blessed Sacrament, hitherto unknown among English Catholics. In July 1850 he heard of the Pope's intention to create him a cardinal, and he took this to mean that he was to be permanently recalled to Rome. But on his arrival there he ascertained that a part of the Pope's plan for restoring a diocesan hier- archy in England was that he himself should return to England as Cardinal and Archbishop of Westminster. The Papal brief establish- ing the hierarchy was dated 29th September 1850, and on 7th October Wiseman wrote a pastoral, dated " from out of the Maminian Gate " — a form diplomati- cally correct, but of bom- bastic tone for Protestant ears — in which he spoke enthusiastically, if also a little pompously, of the " re- storation of Catholic Eng- land to its orbit in the

ecclesiastical firmament." Wiseman travelled slowly to England, round by Vienna; and when he reached London (11th November) the whole country was ablaze with indignation at the "Papal aggression," which was misunderstood to imply a new and unjustifiable claim to territorial rule. Some indeed feared that his life was endangered by the violence of popular feeling. But Wiseman displayed calmness and courage, and immediately penned an admirable Appeal to the English People (a pamphlet of over 30 # pages), in which he explained the nature of the Pope's action, and argued that the admitted principle of toleration included leave to establish a diocesan hierarchy ; and in his con- cluding

~~*paragraphs he effectively contrasted that dominion over Westminster, which he was taunted with claiming, . with his duties towards the poor Catholics resident there, with which alone, he was really concerned. A course of lectures at St George's, Southwark, further moderated the storm. In July 1852 he presided at Oscott over the first Provincial Synod of Westminster, at which Newman preached his sermon on the "Second Spring"; and at this*~~

~~*CARDINAL WISEMAN. (From a photograph by Russell and Sons, London.)*~~

~~*date Wiseman's dream of the rapid conversion of England to the ancient faith seemed not incapable of realization. But many difficulties with his own people shortly beset his path, due largely to the suspicions aroused by his evident preference for the ardent Roman zeal of the converts, and especially of Manning, to the dull and cautious formalism of the old Catholics. The year 1854 was marked by his presence in Rome at the definition of the dogma of the immaculate conception of the Blessed Virgin (8th December), and by the publication of his historical romance, Fabiola, a tale of the Church of the Catacombs, which had a very wide circulation and was translated into ten languages. In 1855 Wiseman applied for a coadjutor, and George Errington, bishop of Plymouth,*~~

~~*his friend since boyhood, was appointed, with the title of Archbishop of Tre- bizond. Two years later Manning was appointed by the Pope Provost of West- minster, and he established in Bayswater his community of the "Oblates of St Charles"; and all Wise- man's later years were darkened by Errington's conscientious but implacable hostility to Manning, and to himself in so far as he was supposed to be acting under Manning's influence. The story of the estrange- ment, which was largely a matter of temperament, is fully told in Ward's bio- graphy. Ultimately, in July 1860, Errington was de- prived by the Pope of his coadjutorship with right of succession, and he retired to Prior Park, near Bath, where he died in 1886. In the summer of 1858 Wiseman paid a visit to Ireland, where, as a cardinal of Irish race, he was received with enthusiasm. His speeches, sermons, and lectures, delivered during his tour, were printed in a volume of 400 pages, and show an extraordinary power of rising to the occasion*~~

and of speaking with sympathy and tact. Wiseman was able to use considerable influence with English politicians, partly because in his day English Catholics were wavering in their historical allegiance to the Liberal party. As the director of votes thus doubt- ful, he was in a position to secure concessions that bettered the position of Catholics in regard to poor schools, reformatories and workhouses, and in the status of their army chaplains. In 1863, addressing the Catholic Congress at Malines, he stated that since 1830 the number of priests in England had increased from 434 to 1242, and of convents of women from 16 to 162, while there were 55 religious houses of men in 1863 and none in 1830. The last two years of his life were troubled by illness and by controversies in which he found himself, under Manning's influence, compelled to adopt a policy less liberal than that which had been his in earlier years. Thus he had to condemn the Association for the Pro- motion of the Unity of Christendom, with which he had

shown some sympathy in its inception in 1857 ; and to forbid Catholic parents to send their sons to Oxford or Cambridge, though at an earlier date he had hoped (with Newman) that at Oxford at least a college or hall might be assigned to them. But in other respects his last years were cheered by marks of general regard and admiration, in which non-Catholics joined; and after his death (16th February 1865) there was an extraordinary demonstration of popular respect as his body was taken from St Mary's, Moorfields, to the cemetery at Kensal Green, where it was intended that it should rest only until a more fitting place could be found in a Eoman Catholic cathedral church of Westminster.

Wiseman was undoubtedly an eminent Englishman, and one of the most learned men of his time. IIe was the friend and corre- spondent of many foreigners of distinction, among whom may be named DSllinger, Lamennais, Montalembert, and Napoleon III. As a writer he was apt to be turgid and prolix, and there was a some- what un-English element of ostentation in his manner. But his accomplishments and ability were such as would have secured for him influence and prominence in any age of

~~the Church ; and besides being highly gifted intellectually and morally, he was marked by those specially human qualities which command the interest of all students of life and character. He combined with the principles known as Ultramontane no little liberality of view in matters ecclesiastical. He insisted on a poetical interpretation of the Church's liturgy ; and while strenuously maintaining her Divine commission to teach faith and morals, he regarded the Church as in other respects a learner ; and he advocated a policy of conciliation with the world, and an alliance with the best tendencies of contemporary thought. It was, in his judgment, quite in accordance with the genius of the Catholic Church that she should continuously assimilate all that is worthy in the civilization around.~~

~~The authority for his life is the excellent biography by Wilfrid Ward, The Life and Times of Cardinal Wiseman, 2 vols., 1897 ; fifth and cheaper edition, 1900. (a. W. En.)~~

~~Wishaw, a mining town and police burgh of Lanark- shire, Scotland, 1 5 miles east-south-east of Glasgow by rail. It has important railway works, a sewing factory, and engineering works. A parish hall has been erected, and there are a town hall, a Victoria Hall, and a public park. Gravitation waterworks have been constructed, and a large public school with secondary department has been built, as well as an Episcopal church. Population (1891), 15,252;~~

~~(1901), 20,869.~~

~~Wislicenus, Johannes (1835-~~

~~-), German~~

~~chemist, was born on the 26th of June 1835 at Klein- Eichstedt, in Thuringia. In 1865 he became professor of chemistry at Zurich University, and in 1870 also at the polytechnic of that town; in 1872 he was appointed to the ordinary chair of chemistry at Wiirzburg, and in 1885 he took up the same post at Leipzig. As an original investigator he has devoted himself almost exclusively to organic chemistry, and especially to stereochemistry. His work on the lactic acids cleared up~~

many difficulties con- cerning the combination of acid and alcoholic properties in oxy-acids in general, and resulted in the discovery of two substances differing in physical properties though possessing a structure of proved chemical identity. To this phenomenon, then noticed for the first time, he gave the name of geometrical isomerism. So far back as 1869, before the publication of the doctrine of van 't Hoff and Le Bel, he expressed the opinion that the ordinary consti- tutional formuke did not afford an adequate explanation of certain carbon compounds, and suggested that account must be taken of the verschiedene Lagerimg ihrer Atome vm Raume. Later (see Die raumliche Anordnung der Atome in organischen Molekihlen, 1887) he extended the application of the van 't Hoff-Le Bel theory, believing that it, together with the supposition that there are " specially directed forces, the affinity-energies," which control the spatial relations of atoms towards each other,

afforded a method by which the spatial arrangement of atoms in particular cases may be ascertained by experi- ment. Wislicenus is also known for his work on aceto- acetic ether and its application as a synthetical agent. He was awarded the Davy medal by the Boyal Society in

1898.

WiSITiar, a town and seaport of Germany, grand- duchy of Mecklenburg-Schwerin, on a bay of the Baltic, 20 miles by rail north of Schwerin. The town hall (rebuilt in 1819) contains a collection (1898) of pictures. St George's church was restored in 1887-88. Wismar has an industrial school and a school of navigation. The port is accessible to vessels drawing 17 feet, and in 1899 was cleared by 875 vessels of 120,841 tons engaged in foreign trade. Population (1885), 15,797 ; (1900), 19,758.

WitkOWltZ (Czech, Vitkovic), a mining village in eastern Moravia, in the district of Mahrisch-Ostrau. Over 10,000 hands are employed in the coal-mines and iron- works. The bulk of the population (10,294 in 1890, 19,128 in 1900) is German, Witkowitz and its environs constituting a small German enclave.

Witney, market town and urban district, Oxford- shire, England, in the Woodstock parliamentary division of the county, 11 miles west by north of

Oxford by rail. The urban district was extended in 1898 to include portions of the scattered villages of Hailey and Curbridge. The blanket-making was in 1710 of such importance that the weavers of the town and neighbourhood were then incor- porated by royal charter. In 1899 the industry employed 250 looms and between 700 and 800 hands, and the production was larger than at any previous time. Gloves and other woollen goods are also made. Population

(1891), 3731 ; (1901), 3574.

Witte, Serge Julievitch (1849—), Bus

sian Minister of Finance, was born in 1849 at Tiflis, where his father (of German extraction) was a member of the Vice-regal Council of the Caucasus. His mother was a lady of the Fadeyef family, by whom he was brought up as a member of the Eastern Orthodox Church and thoroughly imbued with nationalist feeling in the Russian sense of the term. After completing his studies at Odessa University, in the faculty of mathematics and physical science, and devoting some time to journalism in close relations with the Slavophils and M. Katkoff, he entered in 1877 the service of the Odessa State Railway, and so distinguished himself in the transport operations necessi- tated by the Turkish campaign of 1877-78, that he was soon afterwards appointed general traffic manager of the South- western Railway of Russia and member of an Imperial commission which had to study the whole question of railway construction and management throughout the empire. His speciality was an intimate acquaintance with the problem of railway rates in connexion with the general economic development of the country, and in 1883 he published a work on the subject which attracted some attention in the official world. Among those who had discovered his exceptional ability in matters of that kind was M. Vishnegradski, Minister of Finance, who ap- pointed him head of the railway department in the finance ministry. In 1892 he was promoted to be Minister of Ways of Communication, and in the following year, on the retirement of M. Vishnegradski, he succeeded his patron as Minister of Finance. In this important post he dis- played extraordinary activity, and applied practically many of the principles of the German economist, Friedrich List, of whom he had long been an

ardent disciple. Following the teachings of his master, who had advocated, in opposition to the cosmopolitan principles of Adam

Smith, a genuinely national system of political economy, he sought to develop home industries by means of moderate protection and the introduction of foreign capital for industrial purposes. At the same time he succeeded by drastic measures in putting a stop to the great fluctuations in the value of the paper currency and in resuming specie payments. The rapid extension of the railway system was also largely due to his energy and financial ingenuity, and he embarked on a crusade against the evils of drunkenness by organizing a Govern- ment monopoly for the sale of alcohol. In the region of foreign policy he greatly contributed to the extension of Eussian influence in northern China and Persia. Natu- rally of a combative temperament, and endowed with a persevering tenacity rare among his countrymen, he struggled for what he considered the liberation of his country from the economic bondage of foreign nations. Germany was, in his opinion, the neighbour whose aggressive tendencies had to be specially resisted. He was therefore not at all persona grata in Berlin, but the German Imperial authorities learned by experience that he was an opponent to be respected, who understood thoroughly the interests of his country, who was ready to assume heavy responsibilities, who was not to be intimi- dated, and who was quite capable of adopting if necessary a vigorous policy of reprisals.

Wittenberg, a town of Prussia, province of Saxony, on the right bank of the Elbe, 59 miles by rail south-west of Berlin. The castle church was restored in 1885-92 ; in front of it stands a bronze statue of the Emperor Frederick III. (1894). The industries of the town include cloth and other textiles, flower-cultivation, brewing, and distilling. Population (1885), 13,865 ;

(1900), 18,333.

Wittenberge, a town of Prussia, on the Elbe, near the influx of the Stepenitz into that river, 54 miles north-north-west of Brandenburg by rail, in the circle of Westprignitz, government district of Potsdam. The bridge here spanning the Elbe, 5300 feet long, was built in 1851 at a cost of £237,500. There are wool, cloth, shoddy, and oil factories, brickyards, shipping, and transport trade. Population (1890), 12,587 ; (1900), 16,258.

Wittingau (Czech, TYebon), the chief town of a government district in southern Bohemia, Austria, 14 miles E. by N. of Budweis. It is situated on the Gold- Tjach, a small tributary of the Luschnitz, in a marshy ■district. The parish church is a Gothic edifice of the ^ 14th century, with fine cloisters; and the Schwarzen- berg chateau, dating from the 15th century, is reputed to contain the most extensive and valuable archives in Bohemia. The artificial cultivation of fish, now chiefly carp, in the numerous ponds that surround the town is the most interesting feature of its industry, and dates from the 14th century. Several of these have latterly been drained and converted into meadows, or utilized as arable land, while others are alternately used for both purposes. The industry further comprises the manufacture of beer, bricks and tiles, turpentine, and the products of the steam rolling-mills and saw-mills. Popu- lation (1890), 5421 ; (1900), 5467, mostly Czech.

Woburn, a city of Middlesex county, Massachu- setts, U.S.A., 10 miles north-west of Boston, in the north-eastern part of the state. It contains an area of 14 square miles, and is divided into seven wards. The closely-built urban part is irregularly laid out, and has an excellent water-supply from Horn Pond. It has a fine public library, containing over 40,000 volumes, besides artistic and antiquarian collections. The city is

traversed by the Boston and Maine Kailroad, and has extensive manufactures of leather and boots and shoes. It received a city charter in 1888. Population (1890), 13,499 ; (1900), 14,254, of whom 3840 were foreign-born and 261 negroes.

Woking1, a town in the Chertsey parliamentary division of Surrey, England, 24 miles south-west of London by rail. The river Wey and the Basingstoke canal pass through the parish. St Peter's church dates from the 1 3th century. Modern structures include a public hall, an Oriental

~~institute (in the building erected for the Royal Dramatic College, containing a museum of Eastern an- tiquities, a mosque, and residences for Orientals), Surrey county asylum, a female convict prison, barracks, St Peter's Memorial Home, and two cottage hospitals. At Woking is Brookwood cemetery, belonging to the London Necro- polis Company, with a crematorium containing a chapel. Area of civil parish (an urban district), 8889 acres. Popu- lation (1891), 9776 ; (1901), 16,222.~~

~~Wokingham, municipal borough (since 1885) and market town, Berkshire, England, in the Wokingham parliamentary division of the county, 14 miles south- west of Windsor, with a station on a branch of the South — Western Railway. Population (1891), 3254;~~

~~(1901), 3551.~~

~~Wolf, Joseph (1820-1899), Anglo German artist, the son of a German farmer, was born in 1820 at Miinstermaifeld, on the river Moselle, in the Rhine Province. In his boyhood he was an assiduous student of bird and animal life, and showed a remarkable capa city as a draughtsman of natural history subjects. His powers were first recognized by Professor Schlegel of the Leyden museum, who gave him employment as an illustrator. In 1848 he settled in London, where he remained till his death on 20th April 1899. He made many drawings for the Zoological Society, and a very large number of illustrations for books on natural history and on travel in various countries ; but he also won a considerable success as a painter.~~

~~See A. H. Palmer. The Life of Joseph Wolf. London, 1895.~~

~~Wolfenbiittel, a town of Germany, duchy of Brunswick, 7 miles by rail south of Brunswick. The Roman Catholic church of St Peter was built in 1889-91, and a synagogue in 1893. There are also ducal archives and a Bismarck monument. The chief industries include the making of machinery, iron-foundries, wood-turning, preserves factories, and gardening. Population (1885),~~

~~13,453; (1900), 17,873.~~

Wolgast, a seaport town of the province of Pome- rania, Prussia, on the river Peene, which separates it from the island of Usedom, 30 miles by rail east of Greifs- wald. It has a trade in timber, iron, granite (imports), and in wheat, cement, and chemicals (exports) ; manu- factures cement, chemicals, woollen and silk embroidery, steel goods and machinery ; and has iron — foundries, granite working and polishing, and amber working. It was formerly fortified, but endured great vicissitudes during the Thirty Years' War ; was captured by the Great Elector in 1675, by the Russians in 1713, and by the Swedes in 1715. Population (1890), 7880; (1900), 8251.

Wollaston Land. See Noeth-West Terei- toeies.

Wolseley, Garnet Joseph Wolseley,

Viscount (1833), British field-marshal, eldest son

of Major Garnet Joseph Wolseley of the King's Own Borderers (25th Foot), was born at Golden Bridge, County Dublin, on the 4th June 1833. Educated at Dublin, he

obtained a commission as ensign in the 12th Foot in March 1852, and was transferred to the 80th Foot, with which he served in the second Burmese war. He was severely wounded on the 19th March 1853 in the attack of Donabyu, was mentioned in despatches, and received the war medal. Promoted to be lieutenant and invalided home, he exchanged into the 90th Light Infantry, then in Dublin. He accompanied the regiment to the Crimea, and landed at Balaklava in December 1854. He was selected to be an assistant engineer, and did duty with the Royal Engineers in the trenches before Sebastopol. He was promoted to be captain in January 1855, after less than three years' service, and served throughout the siege, was wounded at the Quarries on the 7th June, and again in the trenches

on the 30th August. After the fall of Sebastopol Wolseley was employed on the quarter- master – general's staff, as- sisted in the embarkation of the troops and stores, and was one of the last to leave the Crimea in July 1856. For his services he was twice mentioned in de- spatches, was noted for a brevet majority, received the war medal with clasp, the 5th class of the French Legion of Honour, the 5th class of the Turkish Mejidie, and the Turkish medal. After six months' duty with the 90th Foot at Aldershot, he went with it again, in March 1857, to join the expedition to China under Major-General the Hon. T. Ashburnham. Wolseley em- barked in command of three companies in the transport Transit, which was wrecked in the Strait of Banka. The troops were all saved,, but with only their arms and a few rounds of ammu- nition, and were taken to Singapore, whence, on ac- count of the Indian Mutiny, they were despatched with

all haste to Calcutta. Wolseley distinguished himself at the relief of Lucknow under Sir Colin Campbell in November, and in the defence of the Alambagh position under Outram, taking part in the actions of the 22nd December 1857, the 12th and 16th January 1858, and the repulse of the grand attack of the 21st February. In March he served at the final siege and capture of Lucknow. He was then appointed deputy-assistant quarter- master-general on the staff of Sir Hope Grant's Oudh division, and was engaged in all the operations of the campaign, including the actions of Bari, Sarsi, Nawab- ganj, the capture of Faizabad, the passage of the Gumti, and the action of Sultanpur. In the autumn and winter of 1858 he took part in the Baiswara, trans-Gogra, and trans-Rapti campaigns, ending with the complete suppression of the rebellion. For his services he was frequently mentioned in despatches and, having received his Crimean majority in March 1858, was in April 1859 promoted to be lieutenant-colonel, and received the Mutiny medal and clasp. Wolseley continued to serve

on Sir Hope Grant's staff in Oudh, and when Grant was nominated to the command of the British troops in the Anglo-French expedition to China in 1860, accom- panied him as deputy-assistant quartermaster-general. He was present at the action at Sin-ho, the capture of Tang-ku, the storming of the Taku Forts, the occupation of Tientsin, the battle of Pa-le-

cheau, and the entry into Peking. He assisted in the re-embarkation of the troops before the winter set in. He was mentioned in de- spatches, and for his services received the medal and two clasps. On his return home he published the Narrative of the War with China in 1860.

In November 1861 Wolseley was one of the special service officers sent to Canada to make arrangements for

the reception of troops in case of war with the United States in connexion with the mail steamer Trent incident, and when the matter was amicably settled he remained on the headquarters staff in Canada as assistant quarter- master-general. In 1865 he became a brevet colonel, was actively employed the fol- lowing year in connexion with the Fenian raids from the United States, and in 1867 was appointed deputy quar- termaster-general in Canada. In 1869 his Soldiers' Pocket Book for Field Service was published, and has since run through many editions. In 1870 he successfully com- ■manded the Bed River ex- pedition to put down a rising under Louis Riel at Fort Garry, now the city of Winnipeg, the capital of Manitoba, then an outpost in the wilderness, which could only be reached through a network of rivers and lakes extending for 600' miles from Lake Superior, traversed only by Indians, and where no supplies were obtainable. The admirable arrangements made and the careful organization of the transport reflected great credit on the commander, who on his return home was made K.C.M.G. and C.B.

Appointed assistant adjutant-general at the War Office in 1871, he worked hard in furthering Mr Cardwell's schemes of army reform, was a member of the Localization Committee, and a keen advocate of short service, territorial regiments, and linked battalions. From this time till he became commander-in-chief Wolseley was the prime mover and the deciding influence in practically all the steps taken at the War Office for promoting the efficiency of the army under the altered conditions of the day. In 1873 he commanded the expedition to Ashanti, and, having made all his arrangements at the Gold Coast before the arrival of the white troops in January 1874, was able to com- plete the campaign in two months, and re-embark them for home before the unhealthy season began. This- was the campaign which made his name a household word

in England. He fought the battle of Amoa- ful on the 31st January, and, after five days' fighting,

Viscount Wolseley. (From a photograph by J^Lliott and Fry, London.)

ending -with the battle of Ordahsu, entered Kumasi, which he burned. He received the thanks of both Houses of Parliament and a grant of £25,000, was promoted to be major-general for distinguished service in the field, received the medal and clasp, and was made G.C.M.G. and K.C.B. The freedom of the City of London was conferred upon him with a sword of honour, and he was made honorary D.C.L. of Oxford and LL.D. of Cam- bridge Universities. On his return home he was appointed inspector-general of auxiliary forces, but had not held the post for a year when he was sent on a mission to Natal as administrator and general commanding. In November 1876 he accepted a seat on the Council of India, from which in 1878, having been promoted lieutenant-general, he went as High Commissioner to the newly-acquired possession of Cyprus, and in the following year to South Africa to supersede Lord Chelmsford in command of the forces in the Zulu war, and as Governor and High Commissioner of South-East Africa. But the Zulu war was practically over, and after effecting a settle- ment and seizing a Kaffir chief, Sekukuni, who had given trouble, he returned home in 1880 and was appointed quartermaster — general to the forces. For his services in South Africa he received the Zulu medal with clasp, and was made G.C.B.

In 1882 he was appointed adjutant-general to the forces, and in August of that year was given the com- mand of the British forces in Egypt to suppress the re- bellion of Arabi Pasha. Having seized the Suez Canal, he disembarked his troops at Ismailia, and after a very short and brilliant campaign completely defeated Arabi Pasha at Tel-el-Kebir, and suppressed the rebellion. For his services he received the thanks of Parliament, the medal with clasp, the bronze star, was promoted general for distinguished service in the field, raised to the peerage as Baron Wolseley of Cairo and Wolseley, and received from the Khedive the 1st

class of the order of the Osmanieh. In 1884 he was again called away from his duties as adjutant-general to command the Nile expedition for the relief of General Gordon and the besieged garrison of Khartum. The expedition arrived too late : Khar- tum had fallen, and Gordon was dead ; and in the spring of 1885 complications with Russia over the Penjdeh incident occurred, and the withdrawal of the expedition followed. For his services he received two clasps to his Egyptian medal, the thanks of Parliament, and was created a viscount and a Knight of St Patrick. He con- tinued at the War Office as adjutant-general to the forces until 1890, when he was given the command in Ireland. He was promoted to be field - marshal in 1894, and was nominated colonel of the Royal Horse Guards in 1895, in which year he was appointed by the Unionist Govern- ment to succeed the Duke of Cambridge as commander- in-chief of the forces. This was the position to which his great experience in the field and his previous signal success at the War Office itself had fully entitled him. His powers were, however, limited by a new Order in Council, and after holding the appointment for over five years, he handed over the command - in - chief to Earl Roberts at the commencement of 1901. The fact that the unexpectedly large force required for South Africa was mainly furnished by means of the system of reserves which Lord Wolseley had originated was in itself a high tribute to his foresight and sagacity; but the new con- ditions at the War Office had never been to his liking, and on being released from responsibility he brought the whole subject before the House of Lords in a speech which resulted in some remarkable disclosures. Lord Wolseley had been appointed colonel-in-chief of the Royal Irish Regiment in 1898, and in 1901 was made gold-stick

in waiting. He married in 1867 Louisa, daughter of Mr A. Erskine, his only child, Fiances, being heiress to the viscountcy under special remainder. A frequent contributor to periodicals, he has also published The Decline and Fall of Napoleon (1895) and The Life of John. Churchill, Duke of Marlborough, to the Accession of Queen Anne (1894).

Wolverhampton, a municipal, parliamentary, and, since 1888, county borough of Staffordshire, England, 125 miles north-west of London by rail. Modern institu- tions include a higher-grade, board and national schools, a nursing institution, a theatre, and west and east end (1895)

parks. In 1891, 1401 persons were engaged in the making of machines and tools; 4153 in iron and steel manufactures (turning out some 370,000 locks alone in a week); 1303 in tin and zinc manufactures; 643 in the making of bicycles and tricycles. There are 2 daily news- papers. An industrial and art exhibition was held in 1902. Area of municipal borough, 3525 acres. Popula- tion (1891), 82,662; (1901), 94,179.

Womb-Well, a township, urban district, and parish, in the Barnsley parliamentary division of the West Riding of Yorkshire, England, 4J miles south-east of Barnsley by rail. The ancient church of St Mary's has been replaced by a modern building erected in 1896. Population (1891),

10,942; (1901), 13,252.

Women. — Remarkable changes affected the lives and work of women in the second half of the 1 9th century. The industrial, religious, educational, and philanthropic work of women increased out of all proportion compared with what was done before that period, and it is desirable not only to know what has been accomplished, but to have also some knowledge of the agencies that have been instrumental in carrying it out. There is no complete history of the movement, though there is ample fragment- ary information on certain subjects. The larger objects of women's work have occupied the attention of the public, while many of the equally useful but smaller objects attained are unknown.

Before the accession of Queen Victoria there was no systematic education for English women, but as the first half of the 19th century drew to a close, broader views began to be held on the subject, while the humanitarian movement, as well as the rapidly- increasing number of women, helped to put their educa- tion on a sounder basis. It became more thorough ; its methods were better calculated to stimulate intellectual power ; and the conviction that it was neither good, nor politic, for women to remain intellectually in their former state of ignorance, was gradually accepted by every one. The movement owed much to Frederick Denison Maurice. He was its pioneer ; and Queen's College, which he founded, was the first to give a wider scope to the training of its scholars. Out of its teaching, and that of its professors (including Charles Kingsley), grew nearly all the educational advantages

which women enjoy to-day ; and to the women who were trained at Queen's College we owe some of the best teaching in England. Bedford College, Cheltenham College, the North London Collegiate School for Girls, the Girls' Public Day School Company's schools, are some of those which sprang into life in different parts of England, and were filled, as rapidly as they were opened, by the girls of the middle and professional classes. From their teaching came the final stage which gave women the same academic advantages as men. Somerville College and Lady Margaret Hall at Oxford, Girton and Newnham Colleges at Cambridge, Westfield College in London, St Hilda's College, St Hugh's Hall, Holloway College, Owens College, the Manchester and Birmingham

Public work.

and Victoria Universities, and other colleges for women in all parts of the United Kingdom, are some of the later but equally successful results of the movement. The necessity for testing the quality of the education of women, however, soon began to be felt. The University of Cambridge was the first to institute a special examination for women over eighteen, and its example was followed by Oxford ; but while London, Dublin, Victoria, Edinburgh, Glasgow, and St Andrews Universities now grant degrees, Oxford and Cambridge do not. Women, however, may point with justifiable pride to the fact that within a very few years of their admission to university examinations they pro- vided both a senior classic and a senior wrangler. The temperate, calm, earnest demeanour of women, both in the schools and in university life, has awakened admiration and respect from all ; while it is impossible to exaggerate the effect the women's educational movement has had on the community, for it has brought into existence a vast number of women as well educated as men. Anxious for employment, hard-working, persevering, and capable, they have invaded many professions, and hold their ground where a sound education is the foundation of success.

~~*The pioneers of female education spent their energies in developing their higher and more intellectual ideals, but*~~

~~*the later years opened up other positions which*~~

~~*their better education has enabled women to fill.*~~

~~*It is not possible for every woman to be a scholar, a professor, a doctor, a lawyer, or possibly to attain the highest positions in professions where competi- tion with men is keen, but the development of women's work has opened many other outlets for their energies. As members of school boards, factory inspectors, poor law guardians, sanitary inspectors, they have had ample scope for gratifying their ambition and energy. The work that has been done in factory inspection by Mrs Tennant and her successors, and was initiated by Mrs Senior in the metropolitan poor law schools, can scarcely be equalled for comprehensiveness and thoroughness, and their appoint- ments have been followed by others equally successful. The Board of Trade in 1893 appointed Miss Clara Collet as a labour correspondent of the Labour Department of the Board of Trade, especially to collect statistics and watch over the interests of the women workers. At the Home Office there are seven factory inspectors who are women. The Local Government Board has three board- ing-out inspectorships which are held by women. The Board of Education employs fifteen women among its various departments, and in the office at Whitehall sixteen girls act as clerks. Four women are employed in the General Post Office as lady superintendents. In England, Scotland, Wales, and Ireland women are serving in large numbers on urban, district, and parish councils, as well as on school boards and boards of guardians. The London County Council employs about 135 women, and town councils and county councils are yearly employing them in increasing numbers.*~~

~~*There are a few successful women architects now work- ing in England ; a large number of women travel for*~~

~~*business firms ; in decorative work, as silver- Techalcal srnitlis, dentists, law copyists, proof-readers, and*~~

~~in plan tracing, women have begun to work with success ; while wood-carving has become almost as recognized a career for them as that of typewriting and shorthand, in which an increasing number are finding employment. Agriculture and gardening have opened up a new field of work, and, with it, kindred occupations. A large number of women are employed to give instruc- tion in dairy work in the United Kingdom, as well as in Canada ; and the Horticultural College at Swanley in Kent is not only giving practical training in horticulture,~~

~~but is sending out a large number of women, who are proving excellent head gardeners on private properties,* good market gardeners, and lecturers on horticulture and botany. The Warwick Hostel at Beading exists for the practical and scientific teaching of women in the lighter branches of agriculture, such as dairy work and poultry keeping ; and a special department has been opened for colonial training. A large number of students have availed themselves of the opportunity for studyirg this branch of work, which is specially adapted for women.~~

~~There are many women also engaged in scientific work and research in the United Kingdom and the colonies. Astro- nomy, bacteriology, botany, chemistry, geology, geography, physics, physiology, mathematics, and Scle"titlc zoology are some of the subjects in which they are working successfully, and a scientific woman specialist holds an appointment under the Board of Agriculture in Ireland. There is an examiner in physics to the Univer- sity of Dublin who is a woman, as well as over fifty women lecturers in various colleges and medical schools throughout the kingdom. A few women have found employment as curators and librarians of museums, and the demand for women to fill such pests is ir creasing.~~

~~In literature women have more than held their own. It would be impossible to enumerate all, but there are some whose names are inseparably connected with social developments since 1850, such as Harriet Martineau, George Eliot, Elizabeth Barrett Brown- ing, Mrs Humphry Ward, and Mrs Jameson. Harriet Martineau typified, more completely than any other woman, the modern phase of literary activity, being a novel writer, essayist, historian, and journalist. She entered into~~

the routine everyday work of literature, and her writings perhaps represent, better than any others, the tone ar.d feeling which characterize the women's movement of to-day. The branch of literature in which women have been most prominent is that of fiction. The names of well-known women authors are but a small part of the large number who make a good income by their writings. There are degrees in this as in other work, and many authors, whose works, though they do not rise to the highest standard, are in good demand at the libraries, have a large circulation, and always command an apprecia- tive public. A large quantity of second-rate fiction is written by women who have the power of producing pleasant, brightly-written, and readable stories. Journal- ism is, for the moment, the most fashionable profession for the literary woman, for women generally have a light touch, and can throw off readable, if sometimes super- ficial, articles on any subject which is the interest of the hour. The large increase of papers for women is largely accounted for by the importance which is attached to fashion in dress and other matters on which women can write with special knowledge, and which now occupy so important a place in public interest that they cannot be dis- regarded. Nearly all the great daily journals in the United Kingdom and in the colonies have women on their staffs, whose work principally consists in chronicling information which will interest their women readers. This work is poor and unimportant enough from a literary standpoint, but it is of sufficient importance to enable many women to make a good living. In the colonies and America the work of women, both in fiction and in journalism, is increasing rapidly. In journalism they are pressing their male competitors very severely. Their command of lan- guage, vividness of expression and description, though r.ot denoting a high standard of education or taste, happens to suit the popular fashion better than a more temperate and less highly-coloured style. The large numbers of women who live by writing must further increase with

the demand for cheap literature. and the low rate at which ,they are paid for their work compared with men.

The industrial development has increased the number of trades in which women are employed outside their homes. industrial ^^e returns of people employed in factories work and showed a total in 1898-99 of 472,587 women combina- engaged in textile factories, as against 290,797

men, arid in cotton factories the figures showed a slight increase in women and a decrease in men. In non-t&tile factories 368,634 women were employed and 2,033,868 men, but the trades in which men are engaged include those of machinery, working in metals, and others in which women are unable to compete. The wages paid to women are much lower than those paid to men, partly because their labour is worth less ; it is also difficult to compare it, as in very few industries do they perform the same work. The absence of a uniform rate of payment to women for the work similar to that done by men is partly due to their want of organization, lack of combination, and the few opportunities that they have of discussing their industrial condition. The principal reason is, however, to be found in the fact that a man adopts a profession, and has to make his living and support a family on his earnings, while a woman is content to take unskilled work at lower wages, as the physical effort is less and she has more inde- pendence. The domestic servants of England represented in 1891, 1,748,954, the largest industry in, the kingdom ; but the numbers show a decrease owing to the growing spirit of independence among women of all classes, and the facilities for getting employment where there is less restraint. The difficulty of getting good general servants has become a very serious question in domestic life, espe- cially in the rural districts. In towns the effect is already seen in the large number of flats, which are increasing every year, where fewer servants are required. Laundry work employs many women, and the extension of the Factory Acts to this industry has improved the conditions under which they work. The HHome Office Eeport of 1897 gave a total of 5223 women working in mines. The Shop Assistants' Union gave 750,000 as the number of people employed in shops, of which 60 per cent, were women and young persons under eighteen years of age ; and a large number of women are employed as barmaids and waitresses, but there are no

statistics as to their numbers. The same reasons which cause the lower wages earned by women lead to their weakness in trade unions. The best organiza- tions are those where they work with men and belong to the same unions. There are no accurate statistics as to the number of women unionists, but one return gives it as 122,047, of whom 108,982 are in the textile trades, 4315 in the clothing trades, 1200 in metal trades and the various other trades which employ women.

The great Conservative political organization, the Prim- rose League, owes its success to women, who have adapted

it to the political exigencies of the period. The Politics. p0j;tjcai interests of women have made them platform speakers, not only in political contests, but on all subjects in which they are interested. Women speak well, have good voices and address, they are generally voluble, and when keenly interested are often eloquent, and many a cause has gained largely by its feminine advocates. They speak with an enthusiasm, straightfor- wardness, and conviction which touch their hearers. The temperance movement, and that for the protection of women and children, as well as most of the humani- tarian questions of to-day, have some of their ablest advo- cates in women. Probably no organization has in so short a time enrolled so large a number of members as the Primrose League, for they amounted in 1902 to 1,571,490, and were increasing yearly. The Women's

Liberal Federation, a comparatively youthful body, has a large and important council, 447 branches, and 55,000 members. There are also three or four other branches of the same organization, but there are no statistics forth- coming about them or their work. The Women's Liberal Unionist Association, also a large and powerful political crganization, came into existence at the period of the Home Eule agitation. The question of women's suffrage has not advanced in the United Kingdom. There is an active and enthusiastic minority of the female community which attaches great importance to the question ; but the great majority of women in England are either indifferent or opposed to any change in their political position. The question has not made any advance with either political party, the magnitude of such an addition to the elec- torate, and the uncertainty of the effect it would have, ■making both

parties unwilling to adopt it; and while women show so much indifference on the subject, there is no reason to suppose that they are in favour of having the suffrage extended to them. In New Zealand and in South and West Australia, on the other hand, the franchise has been granted to women ; in New South Wales the Government of 1902 brought in a Bill to enfranchise women, and -in Victoria a Bill passed the Assembly in 1896, 1898, 1899, and 1900, with an increased majority every year, but was rejected by the Legislative Council.

By the constitution of the Church of England laymen can take little part, officially, in its management, only one office — that of churchwarden — being open to them, though this is equally available to women. ^J'rf.l'"'s But in the great voluntary associations in con- nexion with Church work women have taken a recognized and undisputed place. Their assistance has become a necessity to the welfare of the Church, for in all the great branches of Church work and labour, both in Great Britain and in the colonies, they have shown a devotion and capacity without which the Church would be in a less powerful position than she now occupies. There are about twelve parishes in England where women act as church-wardens. The Evangelical, and later the High Church, movements opened up another vocation and a wider field of work for women at home, and provided, by means of religious communities, sisterhoods, and deaconesses, a career for those whose capacity for work, under proper control and supervision, was infinite. It would be difficult to over-estimate the work of Mrs Sellon, Mrs Monsell, the All Saints' Sisterhood, the Sisters of the Church, St Mary's, Wantage, St John the Baptist at Clewer, or the labours of Miss Neale in connexion with Mr Lowder's work at the London docks. The large centres of population bear testimony to the work done by the sisterhoods in England, and by the deaconesses, who represent another school of religious thought, without whose labour many of the civi- lizing and humanizing movements which have revolution- ized the social life of England would not have existed. The religious work of the great Dissenting bodies in Eng- land is as thorough and comprehensive as that of the Church, and in missionary enterprise they have done splen- did service, especially for the London Missionary Society, which now sends out seventy female workers all over the world. The Salvation Army is an organization which owes its success in a

remarkable measure to the ministry of its women, and to Mrs Bramwell Booth belongs the honour of having been the pioneer of one of the greatest opportunities women have had of exercising their influence in the cause of religion. Boman Catholic and Jewish women work as unceasingly for their faith ; and Roman Catholic communities and sisterhoods have increased, while many women of high rank and great wealth among them have given up their position and riches to work in hospitals

and prisons. Long before the religious vocation of womo.. had begun in England, they had thrown themselves witli great enthusiasm into missionary work. Some of the earliest and most devoted of English missionaries were women who, in Japan, China, India, and Africa, devoted their lives to attempting to improve and evangelize the inhabitants of the countries to which they were sent. The Zenana missions were started under their auspices, and many women have lost their lives in their endeavours to benefit others in distant parts of the world. The lives of these missionaries were isolated and solitary ; but the mystery and sorrow which shadowed the women of the East appealed strongly to them, and no soldier ever died a nobler death than some of these pioneers of Christianity. The work they began has grown and flourished, as the innumerable societies for missionary work testify. There is no lack of workers ; as fresh territories come under the influence of Western civilization, there are women ready to step out of the ranks of the great army of Church workers to carry the message of Christianity to their inhabitants.

It is impossible without statistics, of which there are none, to say how many women are engaged in missionary work, but the reports of the various societies, such as the London Missionary Society, the Zenana Medical Mission, the Presbyterian Missionary Society, the Moravian Mission, the Wesleyan Mission, show that there are hundreds belonging to each, as well as those belonging to smaller agencies, working in every continent. The religious organi- zation of Mildmay Park, the Church

guilds, the Anglican sisterhoods and deaconesses, as well as the largest re- ligious body of women devoted to religious and missionary work — the sisters of St Vincent de Paul, numbering 40,000, who work all over the globe — cannot be over- looked in any article treating of the religious work of women. The social purity question, which has become a distinct branch of religious work, was initiated and advocated almost wholly by women, notably Mrs Josephine Butler, and shows how strongly the religious feeling of the day has raised the standard of life and morality, and how earnestly women are striving to attain to their ideal.

The philanthropic work of women, as apart from that of religion, is so vast that anything like a detailed narra- tive is impossible, but it may be divided into a Phiiaa- few heads. The associations for progress and work. " social reform, such as the International Council of Women, " to promote unity, mutual under- standing, and trust between women workers of all nations," which has numerous councils affiliated to it in the United States, the colonies, Germany, France, and many other countries, as well as branches in every large town in England, and endless associations and societies which it is fostering and increasing, is one of the most important. The organizations which deal directly with the poorer classes in charitable and parish work (such as the Charity Organization Society), though not entirely woman's work, are largely carried on by them. The women's settlements also date from the year 1887, when the women's colleges started their university settlement in south-east London. These settlements are now scattered over various districts in London, and are taking root in the large provincial towns. The lines on which settlement work is carried on are social, educational, remedial, and religious to a certain extent, but not distinct enough to class them as religious organizations. The influence for good that well-educated, devoted women, living among the poor, exercise is incal- culable, and the work done by the various settlements is admirable. There are about twenty-eight settlements now existing in England, and one in India — the missionary

settlement for university women at Kamballa Hill, Bombay. Emigration work is largely in the hands of women in the United Kingdom and in the colonies, where various organi- zations exist for the purpose of assisting women and girls who are sent out to Australia, Africa, and Canada. A

certain number of homes for children and women, such as Dr Barnardo's Homes, and the Church of England Home for Waifs and Strays, and the Colonial Training Home for Ladies, and the Lady Warwick Hostel give a training to women and girls to fit them for colonial life. The preventive agencies for the protection of girls and young women, and the Ladies' Association for the care of Friendless Girls have branches all over the United Kingdom ; the Keformatory and Refuge Union, the certified Reformatory and Industrial School for women and girls, and the large number of homes and centres of rescue work, such as the Church Penitentiary Association, the London Diocesan Council for preventive, penitentiary, and rescue work, and the National Vigilance Association, besides hundreds of kindred homes and centres, are all under the supervision and control of women. The number of homes, convales- cent homes, hospitals, and societies worked by women for women are multiplying every year, and a superficial glance at any list of charitable institutions will bear testi- mony to the remarkable work that women are doing in helping others who have been unable to fight the battle of life. There, are three societies for the benefit of women too interesting and important to be overlooked — the Young Women's Christian Association, the Girls' Friendly Society, and the Metropolitan Association for Befriending Young Servants. They each owe their existence to the devoted work of three women — Lady Kinnaird, Mrs Nassau Senior, and Miss Townsend. The first was founded for the pur- pose of providing a home and suitable lodgings for young women who were engaged in business, who were left to spend their leisure alone, or in walking about the streets for want of somewhere else to go to ; out of the small homes then started there are now, in London alone, fifty institutes, homes, and restaurants for their use. Educa- tional classes, libraries, gymnasiums, social evenings, read- ing rooms, give scope for every taste, and no girl in London need be at a loss where to live and spend her leisure. The ramifications of the association are endless : in London there are thirty thousand members, besides numbers all over the kingdom, where the work is also carried on. The society has spread to America and Canada, and the International Committee of the United States and Canada has 355 associations and 26,000 members. In Germany, and every country in Europe but Russia, in South America, Africa, Australia, India, the West Indies, Japan, and China there are associations in co-operation with it,

and a large and successful one in Cape Town, besides others at Durban, Johannesburg, and in Basutoland. The Y.W.C.A., which has its headquarters in London at 17 Old Cavendish Street, now possesses a membership of five hundred thousand women, scattered all over the world. The Metropolitan Association for Befriending Young Servants, the work of Miss Frances Power Cobbe, Mrs Senior, and Miss Elliott, was founded for the purpose of looking after young girls placed in service from the parish or pauper schools. It now numbers 8000 members in London alone and 1000 lady visitors. The Girls' Friendly Society, which befriends only virtuous girls, is perhaps the largest society of its kind, as it shows a total in England and Wales of 150,000 members, 47,210 candi-dates, 16,750 associates, and 15,445 honorary associates, as well as 43,006 members and 9986 associates in America, India, Africa, and the colonies. There are many working girls' and women's clubs in London and the large towns of England, in which education and recreation are provided

for those who are employed during the day. District-visiting provides work for many women, but is badly paid in many cases, and it is not an occupation that is popular with the better class of women workers.

It would be impossible to enumerate all the organizations which exist for charitable and humanitarian work under the control or supervision of women — one branch alone, which embraces convalescent homes, being of great mag- nitude. Reformatory work, training homes for servants, and work among young children, which is so pronounced a feature of the day, are all carried out by women. The care of feeble-minded children, and the special schools, of which the London School Board have opened a large number in London, are some of the most interesting and most remarkable results of the work which women are doing. Any account of women's efforts for the good of the world must be imperfect which omitted to make re- ference to their labours in the cause of temperance. It has, of necessity, been largely directed to the social and personal aspect of the movement, though their associations have been most energetic in

furthering and promoting legislative reform. It was a woman who first started the Band of Hope, one of the largest of the temperance societies. In 1899 it numbered 8,430,117 boys and girls as members. The large and increasing amount of drunken- ness among women has aroused a special interest among temperance reformers, and women have been more anxious than any other class for the abolition of " grocers' licences." There are several important temperance organizations : the National British Woman's Temperance Association, of which Lady Henry Somerset is president, and the Women's Total Abstinence Union, are the best known ; they have kindred associations in Scotland and Ireland, while in Canada and the colonies temperance work is just as strenu- ously advocated as in Great Britain. There are several temperance societies for young people besides the Band of Hope, and many homes for the care and cure of inebriates. In all these institutions women work or are associated, for they have long learnt by experience that drunkenness lies at the root of nearly all the crime, vice, and suffering of the world.

The philanthropic work of women also laid the founda- tion of what has become one of the most popular, as well as the most useful, of their occupations, namely,

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nurses, there was little novelty in their adoption of nursing as a recognized calling ; but until the Crimean war there was no such organized system of nursing in England as existed in. Germany and Italy. The condition of the sick and wounded during the Crimean campaign was so terrible that Miss Nightingale, who was well known for her in- terest in all charitable works, and who had gone through a course of training at Kaiserswerth, then the only school of nursing of any importance, was requested by the Secre- tary for War to organize a nursing staff for the hospital at Scutari. Her achievements there gave her undying fame ; and she crowned her noble enterprise by giving the sum of £50,000, subscribed for her by the country, towards founding a training school for nurses, which had its beginning in the old buildings of St Thomas's Hospital in Southwark. That nursing school has been the alma mater of thousands of women who have made successful careers for themselves as

nurses, not only in England, but all over the world. The work Miss Night-ingale initiated has been developed and improved on, and the system of nursing in England is the best in the world. The class of women who enter the profession has improved, the training is longer and more complete, and the standard required so high, that only the most , capable women succeed. Nearly every important hospital has its own

nursing school, and the period of training is seldom less than three years. What' has been done in improving hospital nursing has also been carried out in workhouse infirmaries and in midwifery. Miss Nightingale said truly, " Hospitals are but an intermediate stage of civiliza- tion. The ultimate object is to nurse all sick at home," and her words are being realized, for nursing the sick poor at their own homes now gives occupation to thousands of nurses, who are trained not altogether on the same plan as those who are employed only in hospital work. No more necessary or useful work has ever been undertaken, and it has brought comfort, relief, and peace to millions of sick poor in England. The Metropolitan and National Training Association and the East London Nursing Society were the parent institutions out of which have grown many smaller associations all over the kingdom. The greatest development in district nursing was, however, brought about in 1899 by the establishment of Queen Victoria's Jubilee Institute for Nurses, founded by means of £70,000 presented to Queen Victoria on her Diamond Jubilee by the women of England. Nearly 20,000 women are employed as nurses in England, and the number in the colonies is proportionately large, so that the, Queen's Jubilee gift towards further developing the work was a fitting tribute to their devotion and excellence.

A natural consequence of the capacity shown by women in nursing was the inauguration of one of the most important changes affecting their future careers, namely, their admission to the medical profes- Medlcal sion. No practical progress was made until- 1858, when Miss Elizabeth Blackwell and Miss Garrett (Mrs Garrett Anderson) resolved to study medicine with a view to practising in England. The struggle was a long and bitter one, and nothing but the ability, courage, and tenacity of the women who fought it could have ensured success. After rebuffs, disappointments, and defeats, the Government passed a Bill conferring

the same rights on women as on men, and in 1876 the battle was won. The bitterest opponents of medical women cannot deny that they have justified the demands they made, for not only has experience shown that there was a wide field for women doctors, but by their wisdom, tact, and ability they have won the respect of the community, and are occupying positions of responsibility not only in the United Kingdom, but all over the world. The London Medical School for Women is sending out, daily, well-qualified practitioners ; and after years of the keenest opposition and the most minute scrutiny, there has been no case in which women have shown themselves either incompetent or unworthy of the position they occupy. Whatever difference of opinion may have existed as to the need for medical women in England, no one can deny the urgent necessity for the services of fully-qualified medical women in India, where religion and native custom make it impossible for women to be attended by a man. In 1872, Surgeon- General Balfour reported that out of the hundred million women in India, at least two-thirds were debarred by social custom from receiving the visits of a medical man, and that the suffering and disease in consequence were incalculable. No more useful or beneficent field of work was ever inaugurated than the labours of medical women in the East : the establishment of one hospital after another, the crowds waiting for admission, together with the number of native women who at once enrolled them- selves as students at the various medical schools in India, added to the initiative taken by native residents, as well as the large funds collected by them, was sufficient evi- dence of the necessity which existed for female doctors. The recognized position of medical women in India is one of the greatest victories won by them, and with their success

will be associated, in ever grateful remembrance, the name of Lady Dufferin, whose energy and kindness placed it on a safe financial footing. The number of medical women now practising in the United Kingdom, and all over the world, is very large, and the number of medical institu- tions in which women hold office is rapidly increasing. A few hospitals have admitted them on their boards of manage- ment. The London Eoyal

~~Free Hospital School of Medicine for Women, with Mrs Garrett Anderson as its dean, has a large number of students, and has trained and sent out most of the medical women who are practising, both in the United Kingdom and in the British colonies. There are several valuable scholarships attached to the Royal Free Hospital, the London School of Medicine for Women, which are offered to students who require assistance in the pursuit of their medical studies, as well as the Stuart Mill scholarship, given to women willing to practise in India.~~

~~Music, painting, and the stage offer still a great charm to women of the artistic temperament, and the schools Tbe of music, such as the Royal Academy of Music,~~

~~arts and the Royal College of Music, and the Guildhall various School of Music, provide an excellent musical professions, training at a moderate cost. Each school has scholarships which are of great assistance to girls who need some extra help to enable them to get through the long training which is necessary. The Royal Academy of Art schools at Burlington House admit women as well as men to their instruction, and the Royal College of Art at South Kensington has a large number of female students. The Central School of Arts and Crafts, established by the technical branch of the London County Council, provides instruction in all branches of design bearing on the various artistic trades ; and the Female Royal School of Art, in connexion with the Science and Art Department at South Kensington, teaches drawing, painting, modelling, as well as decorative 'design ; while the metropolitan art schools in connexion with the Board of Education have centres in all parts of London and evening classes for women. There are endless minor arts in which women are engaged, and at which they earn a fair salary, such as chromo-litho- graphy, lace designing, bookbinding, fashion-plate drawing, illustrating books and newspapers, designing Christmas cards, &c. The designing of wall-papers is largely carried out by women, who possess not only taste, but have generally gone through a long course of artistic training. The stage does, and always will, possess a fascination for women which no other profession can offer them, and many women go on the stage without much training. Even if they do not attain to a high position in their profession, they can earn a small salary, while to those~~

who study seriously there are high prizes and opportunities of public success ; but the life is a hard one, and full of temptation. Fortunately the standard of conduct has risen, and a woman can be on the stage and at the same time lead a virtuous life. Many women of good birth have become actresses, though only occupying unimportant positions.

In the great demand for work which exists among women, housewifery has come to the front, and to the schools of cookery, which have improved the gastronomy of the country, have been added other training schools for teaching housekeeping. The National Training School of Cookery still carries on its excellent work, and the classes are well attended. There are a few "lady cooks" in London who go out and cook dinners, and some ladies trained in the housekeeping schools do well. The various hygienic and sanitary associations which exist employ women as lecturers, and those who are capable find em- ployment easily. The National Health Society trains women to qualify as lecturers on the laws of health and

Clubs.

sanitary subjects under the County Council scheme of technical education, and also as factory inspectors, sanitary inspectors, and lecturers. The Manchester Ladies' Health Society employs twenty-three women as health visitors in Manchester and Salford.

In athletics women are now almost as much interested as men. Archery, which formerly was exclusively a woman's sport, is now seldom practised, and cycling, golf, tennis, rowing, swimming, and skating have taken its place. Fishing, hunting, and shoot- ing are the pastimes of the well-to-do, but there are many good fisherwomen as well as good shots, and there are some packs of harriers hunted by women. Some are yachtswomen, and sail their own boats ; and there are some good whips, as the competitions in team and tandem driving show.

As women of the working classes have their clubs, so, in the other classes, women have found them a great advantage. The majority are for women only, though there are a few for both sexes, but in nearly every club men are admitted as guests. In many of the clubs the subscription is large, but there are also humbler ones which supply a want much felt by women

engaged in daily work, such as clerks, jour- nalists, typists, actresses, and those occupied in social and charitable business. Reading, writing, and refresh- ment rooms are provided, and as many of the ordinary conveniences of a club as may be possible. The foundation of women's clubs was a great innovation, and they were viewed with much suspicion and distrust, but experience has justified their introduction, many of them having several hundred members. The clubs are non-residential, with one or two exceptions. There are a few flats in London for women only, which are let at reduced rents, and are intended for single women who earn their own livelihood, but more accommodation of a like nature is one of the most crying wants of to-day.

Modern legislation has also favoured the protection and liberation of women. The Married Women's Property Act dealt a severe blow at the power of men over women, and though it has been beneficial Lezal to thousands of working women, it has entirely ^swo^en- altered the position of the sexes with regard to each other. The Act affecting the custody and guardian- ship of children gave women a further independent posi- tion, which undoubtedly many hard cases justified. The position of a woman with regard to her children, where a father might be unworthy or bad, was, before the passing of these measures, both unjust and cruel as regarded her- self, and often most injurious for her offspring.

The foregoing facts demonstrate how varied and com- prehensive the work of women became during the last quarter of the 19th century, and how much it must certainly increase with their higher educa- ae?,erff

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tion and training. In addition to the confidence that experience of their capacity, their perseverance, and the quality of their work has given them, their honest conscientiousness produces results hardly, if at all, inferior. It is the earnest and serious spirit which animates the women who have embraced a professional or independent career, added to their high standard of work, which has laid the woman's movement on such deep foundations, and has justified the position now accorded to them on every side. A less ambitious, a less heartfelt effort would not have sufficed, and

the pioneers of the movement have long ago justified their contention that if women were to enter into competition on anything approaching an equality with men, they could only succeed by producing work and results so high as to silence criticism and prove their ability. That their adoption of such careers qud

•women would always be attacked, they fully realized, and also that their justification would lie in success ; but the great persistency with which they have laboured, and carried their position, does not admit of dispute as to their absolute victory over critics and opponents.

One of the most remarkable facts connected with the woman's movement lies in the rapidity of its growth — barely the work of fifty years. Their whole mode of life has^ been revolutionized in that time, and it is much to their credit that they have borne their new position with such dignity. The moment was opportune. The large mass of unemployed women were seeking not only an outlet for their energy, but a means of making a liveli- hood. Necessity made them take advantage of the new conditions of life, and they thankfully entered the open door which led to the future they had long hoped for. There is no more creditable page in the history of a great movement than the part played by women in the in- dustrial revolution of the 19th century. Two causes had undoubtedly contributed to bring it about ; one, the gradual disappearance of the domestic life which, before the invention of machinery, had made women the pro- ducers of all the necessaries of the house : the wife and daughters were the slaves of the household; not only were they the purveyors and makers of food, but they performed all the menial work, and in their spare time spun the wool, and wove and made up the mate- rial, which provided their mankind with clothes. The spinning — wheel and the spinning — jenny destroyed the distaff, and the factory took the place of the home worker, and though women still found employment, it was as an occupation, not as a household duty. With the sewing- machine and the cheapening of ready-made clothing, the principal occupation for the women of a household dis- appeared. The second cause was the demand for a higher

~~*standard of education, and the founding of innumerable high schools for girls, which destroyed the only occupa- tion then open to women, namely, that of teaching. The daily governess and the teacher of the small school, insufficiently educated, but knowing enough to impart the rudiments of knowledge, were swept away, and terribly sad are the stories of the suffering and want of the large and helpless class of inferior governesses and teachers.*~~

~~*What was to be the fate and future of women ? Their natural career, that of marriage, was impossible to many in a country where there were half a million more women than men, and the difficulties which beset them in their struggle for an outlet and a profession were gigantic. A few women saw the moment, the difficulty, and the way of salvation ; and Miss Martineau, Miss Cobbe, Mrs Garrett Anderson, Miss Buss, Miss Florence Nightingale, with others too numerous to mention, demonstrated what women could do, and by their example gave encourage- ment to others. The woman's movement in America found its echo in England, and the influence of American thought and life on the United Kingdom largely contri- buted to promote the higher education and the spirit of independence which have enabled women to attain their present position. The facilities of communication, the increasing power of the press, the cheapening of literature, could not fail to produce great changes, especially in a society where so preponderating an element existed of superfluous women. The narrow, dreary existence which custom had assigned to them was no longer possible, and the example of their sisters in America gave a precedent for their encouragement. The standard of work that women have set before them is a high one, and they have not been contented to attain less than their ideal, and it is that which has given the movement its reality and strength ; moreover, English women are physically a*~~

~~*strong class, and strenuous as has been the battle, they have had that great reserve to fall back upon. By their use of athletics and exercise they have preserved that standard of health without which no one can do really good work. It is too soon yet to judge what the effect of work and the expenditure of energy will be on the coming generation, or whether the mothers of the future will pro- duce the like healthy offspring of their*~~

progenitors. One effect is that women of the higher working classes marry less early, and have fewer children ; and another result of the emancipation they enjoy, coupled with the fact that they need not depend on marriage as their only career, is a disinclination among many to marry. Among working women the infant mortality is large, owing to the absence of the mothers at their work, and the consequent neglect of the children ; and the deterioration in the health of the survivors is undoubted, and cannot be otherwise where they are brought up on unhealthy food, without maternal care, breathing bad air, and living without light and sun- shine. Legislation has improved both the lives of the women and the conditions under which they work, with a corresponding improvement in the health of their offspring ; but with the higher standard of comfort, the increased expense of living, and the demand for cheaper labour which women's work supplies, it is not possible to prevent their augmenting the, family income by taking employ- ment, whether it be healthy or not.

Over the bright future of a gallant struggle and fair fulfilment there looms a cloud, " small as a man's hand," yet one that grows. The demand for women's work, con- sequent on their successful capture of the field of labour, has flooded Great Britain with educated women, and the supply has become greater than the demand. The preju- dice against domestic service also has created a class of half-educated women clerks, bookkeepers, &c, for whom there is little demand ; they are unfitted by training for other employment, and the market is full. The best educated women can always command employment, but the majority are not the best, and the warning note of the unemployed women has already been sounded. There is no room in the labour market in England for all the women who are willing and able to work, but there is an outlet and a place where they can do the same work that other women have done for England. In the British colonies women are wanted for all purposes, even the elementary occupation of wife and mother, and emigra- tion must be the solution of the difficulty that is looming over their future.

In reviewing the effects of the last half of the 19th century on the lives of women, it is impossible, in looking to the future, not to ponder on how much further the move- ment will increase, and what will be the ultimate

~~result. As far as the past is concerned, the effect on the char- acter of women has been beneficial. It has strengthened and elevated them, and in giving them a career has developed the best and highest part of their nature, while it has not unsexed or destroyed any of the qualities which give them their charm and power. The excrescences which inevit- ably appeared during so rapid and complete a transition have disappeared or become submerged in the wholesome ebb and flow of their life. The influence of religion has still maintained its hold, and the serious spirit in which women undertake their new mission is the outcome of the religious sentiment which pervades their life and which they pour into their work. The consciousness that in elevating themselves they are helping to make their life higher and more useful to others, was the faith mainly which helped them through the opposition, scorn, and hard struggles they underwent; and that religious sentiment still animates them and is in reality the spring from~~

~~■which their efforts flow. Eeligion is a necessity for women, and if their belief in the dogmatic truths of Christianity has waned, the spirit of humanitarianism, which is the foundation of its teaching, has survived. That feeling will retain its supremacy ; and if, in the first youth and exuberance of women's emancipation, they have shown the calm dignity which is the distinctive character- istic of their conduct, there need be no apprehension as to the future, under the softening and mellowing influence of time and custom. (m. J.)~~

~~Wood, Ellen [generally known as Mrs Henry Wood] (1814 — 1887), English novelist, was born at Worcester on 17th January 1814. Her maiden name was Price. In 1836 she was married to Henry Wood, and the next twenty years of her life were passed abroad. Though she had previously contributed short stories to Bentley's Miscellany and the New Monthly Magazine, her literary career may be said to have begun with her winning (in 1860) a £100 prize offered by the Scottish Temperance~~

~~*League, with a novel entitled Danesbury House. About a year afterwards East Lynne appeared, and achieved extraordinary popularity. It was widely translated, and a number of dramatic versions of it were made, and proved very much to the taste of unsophisti- cated lovers of melodrama. In 1865 Mrs Wood started the Argosy magazine, which she edited till her death, assisted in her later years by her son, C. W. Wood. In this she wrote anonymously a series of tales, which were afterwards republished under her name as Johnny Ludlow. These stories, which contain some of her best work, differ considerably from her longer novels, the majority of which are melodramatic in character. She published in all about thirty-five novels, some of the most popular (besides those mentioned above) being The Chan- nings (1862), The Shadow of Ashlydyat (1863), Roland Yorhe (1869), Within the Maze (1872), Edina (1876). She died in London on 10th February 1887. Her husband predeceased her in 1866.*~~

~~*Wood, John George (1827-1889), English writer and lecturer on natural history, was born in Lon- don on 21st July 1827. He was educated at Ashbourne grammar school and at Merton College, Oxford ; and after he had taken his degree in 1848 he worked for two years in the anatomical museum at Christ Church under Sir Henry Acland. In 1852 he was ordained a deacon of the Church of England, became curate of the parish of St Thomas the Martyr, Oxford, and also took up the post of chaplain to the Boatmen's Floating Chapel at Oxford. He was ordained priest in 1854, and in that year gave up his curacy to devote himself for a time to literary work. In 1858 he accepted a readership at Christ Church, Newgate Street, and he was assistant- chaplain to St Bartholomew's Hospital, London, from 1856 until 1862. Between 1868 afld 1876 he held the office of precentor to the Canterbury Diocesan Choral Union. After 1876 he devoted himself to the production of books and to delivering in all parts of the country lectures on zoology, which he illustrated by drawing on a black- board or on large sheets of white paper with coloured crayons. These " sketch lectures," as he called them, were very popular, and made his name widely known both in Great Britain and in the United States. In 1883-84 he delivered the Cornell lectures at Boston. Wood was for a time editor of the Boy's Own Magazine, to which he constantly contributed papers on natural history. His most important work was a Natural History in three volumes, but he was better known by the series of*~~

~~*books which began with Common Objects of the Sea-Shore, and which included popular monographs on shells, moths,*~~

~~*beetles, the microscope, and Common Objects of the Country. Our Garden Friends and Foes was another book which found hosts of appreciative readers. He wrote in a pleasant style, and as much as possible avoided technicalities ; and many who would never have taken up the study of animal life at the instance of more scientific writers, owed to Wood a lifelong interest in beasts and birds and insects. He compiled also a number of educa- tional works connected both with his special subjects and with Old Testament and New Testament history. ■ He died at Coventry on 3rd March 1889. (h. h. f.)*~~

~~*Wood Engraving'. See Engraving.*~~

~~*Woodstock, a municipal borough and market town in the Woodstock parliamentary division of Oxford- shire, England, 8 miles north-north-west of Oxford by rail. The town hall is now also used as a public library. The manufacture of gloves has somewhat decayed. As constituted since 1886, the borough includes the old borough with parts of two adjacent parishes. Area, 157 acres; population (1881), 1649; (1891), 1628. Half a mile distant is the parish of Blenheim Park, which takes its name from the seat of the duke of Marlborough.*~~

~~*Woodstock, a town and port of entry of Oxford county, Ontario, Canada, 30 miles east-north-east of London by rail, on the Thames river, and the Grand Trunk and Canadian Pacific railways. It is in one of the best agricultural sections of the province, and has a large export trade in cheese, butter, and farm produce. It contains a college, affiliated with McMaster University, Toronto, court-house, town hall, hospital, and reformatory, and manufactories of musical instruments, furniture, waggons, and stoves. Population (1891), 8612; (1901),*~~

~~*8833.*~~

~~*Woolner, Thomas (1825-1892), English*~~

sculptor and poet, was born at Hadleigh, Suffolk, 17th December 1825. He went to school at Ipswich, and later in London. When quite a boy he distinguished himself to such a degree by modelling in clay and carving marble, that when barely thirteen years old he was taken as an assistant, without a premium, into the studio of William Behnes, and trained with exceptional care by that accom- plished executant and stringent teacher during nearly six years, so that he became a master of the technique of his art. In December 1842 Woolner was admitted a student in the Eoyal Academy, and in 1843, amid the applause of his fellow artists, contributed to the Exhibition there "Eleanor sucking poison from the wound of Prince Edward," and again at the British Institution in the following year. Continuing his studies with unabated zeal, Woolner did not at first meet with the rewards his genius, industry, and extraordinary skill deserved. When English art was, in 1844, stirred to its depths by the competitions for decorating 'the Houses of Parliament, Woolner was represented by a life-size group of " The Death of Boadicea," which was so excellent that it did not suffer from the juxtaposition of Foley's beautiful " Youth at a Stream." Hard work and small gains did not discourage the artist. In 1846 he had at the Boyal Academy a graceful recumbent figure of Shelley's dreamy " Alastor." All this while he was working on and off for Behnes. Then came (1847) "Feeding the Hungry," a bas-relief, at the Academy ; and at the British Institution a brilliant and animated statuette of " Puck " perched upon a toadstool and with his toe rousing a frog which had couched beneath. " Eros and Euphrosyne " and an elegant figure of " The Rainbow " were seen at the Academy in 1848.

Woolner, who, like all the leading members of the

circle to which he belonged, had lofty ideas of the nature and functions of art, spiritual, inventive, and technical, became, in the autumn of 1848, one of the seven Pre- Raphaelite Brethren who formed themselves into a society in order to carry their views into effect by means of their works. These students, of whom the sculptor was the oldest, found what may be called their point of crystal- lization at a meeting of Rossetti, Holman

Hunt, and Millais in the studio of the last. Here was formulated the pregnant idea of a brotherhood to which Woolner and two other artists immediately acceded, with Mr W. M. Rossetti as a lay secretary. There was no propaganda nor any conversion whatever. Each man had his own views before the union, and maintained them thereafter. Without this it was impossible that Woolner or his com- panions could have been included ; nor had Pre-Raphael- itism any effect upon his art, which, unlike that of some of the Brethren, was already Pre-Raphaelite of the higher strain. In this capacity the sculptor took a leading part in The Germ, 1850, the opening poem in which, called "My Beautiful Lady," was by him. He had already modelled and exhibited portraits of Carlyle, Browning, and Tennyson. Unable to make his way in art as he wished, Woolner in 1852 tried his luck as a gold-digger in Australia, when the " gold fever " was at its height. Failing in this, he returned to England in 1857, where during ' his absence his reputation had been increased by means of a statue of " Love" as a damsel lost in a day- dream. Then came his second portraits of Carlyle, Tennyson, and Browning, a pulpit for Llandaff Cathedral, the memorial portrait of Wordsworth in Grasmere church, the likenesses of Sir Thomas Fairbairn, Rajah Brooke of Sarawak, Mrs Tennyson, Sir W. Hooker, and Sir F. •Palgrave. The fine statue of Bacon in the New Museum at Oxford was succeeded by very important public commis- sions, which proved how rapidly the sculptor's powers were vindicating themselves. The examples included full-size statues of Prince Albert for Oxford, Macaulay for Cambridge, William III. for the Houses of Parlia- ment, London, and Sir Bartle Frere for Bombay ; busts of Tennyson, for Trinity College, Cambridge, Dr Whewell, and Archdeacon Hare ; statues of Lord Lawrence for Calcutta, Queen Victoria for Birmingham, Field for the Law Courts, London, Palmerston for Palace Yard, the noble colossal standing figure of Captain Cook that over- looks the harbour of Sydney, New South Wales, which is Woolner's masterpiece in that class ; the recumbent effigy of Lord F. Cavendish (murdered in Dublin) in Cartmel church, the seated Lord Chief Justice Whiteside for the Four Courts, Dublin, and John Stuart Mill for the Thames Embankment, London ; Landseer, and Bishop Jackson for St Paul's, Bishop Fraser for Manchester, and Sir Stamford Raffles for Singapore. Among Woolner's busts are those of Newman, Darwin, Sedgwick, Huxley, Cobden, Pro- fessor Lushington, Dickens, Kingsley,

~~and Sir William Gull, besides the repetition, with variations, of Gladstone for the Bodleian, Oxford, and Mansion House, London, and Tennyson. The last has since been acquired for Adelaide, South Australia.~~

~~Woolner's poetic and imaginative sculptures include " Elaine with the Shield of Lancelot," three fine panels for the pedestal of the Gladstone bust at Cambridge, the noble and original " Moses " which is on the apex of the gable of the Manchester Assize Courts, and two other works in the same building; " Ophelia," a statue, 1869 ; " In Memoriam " ; " Virgilia sees in a vision Coriolanus routing the Volsces " ; " Guinevere " ; " Mercury teaching a shepherd to sing," for the Royal College of Music; "Ophelia," a bust, 1878; " Godiva," and "The Water Lily." In these, as in his portraits, it was Woolner's~~

~~ambition to embody something of Pheidian dignity, sim- plicity, and naturalness, with exhaustive representation of detail, sculpturesque repose, and exquisite rendering of flesh. He was elected an Associate of the Royal Academy in 1871, and a full member in 1875 in place of Foley, deceased. Apart from his art, Woolner wrote and pub- lished two amended versions of " My Beautiful Lady " from The Germ, as well as the poems " Silenus," "Tiresias," .and "Nelly Dale." Having been elected professor of sculpture in the Royal Academy, he began to prepare lectures in that capacity, but he did not deliver them; he resigned the office in 1879. Woolner died somewhat suddenly, 7th October 1892, and was buried at Hendon. (p. g. s.) .~~

~~Woolsey, Theodore Dwight (1801-1889),~~

~~American author, was born in New York, 31st October 1801. He graduated at Yale in 1820 ; studied in Europe for three years; was professor of Greek in Yale from 1831 to 1846 ; and was president of the college (also holding the Greek chair for a few years) from 1846 to his resigna- tion in 1871, after which date he continued for some time to act as a lecturer on international law. He edited for college use some of the works of Euripides, Sophocles, iEschylus, and Plato. In his later years he made a thorough study of international law, on which he pre- pared a treatise (1860) which was subsequently revised and enlarged in successive editions, and was widely used as a college text-book and diplomatic~~

~~authority ; and he published in 1877 Political Science ; or, The State Theoreti- cally and Practically Considered (2 vols.), and in 1880 a discussion of Communism and Socialism. He also contributed voluminously to the scholarly periodicals of his time, on philological, theological, sociological, and governmental subjects, and was chairman of the American company of revisers of the New Testament, 1871-81. The most noteworthy fact in his work at Yale was that, while his tastes and labours were largely those of a classi- cal scholar, his writings and influence strongly tended to give Yale the prominence in political and social science which it has since retained. He died in New Haven, 1st July 1889.~~

~~Woolwich, a metropolitan borough and garrison town, and the principal artillery arsenal of England, in the county of London, 10 miles from Charing Cross by rail and 12 by river ; a parish in the ancient county of Kent. The borough includes Eltham, Plumstead, and Woolwich, and occupies 13 square miles. In area it holds the second place among the metropolitan boroughs, and is more than twenty times as big as the smallest borough, which is Holborn. Woolwich Common is partly in the borough of Greenwich and partly in that of Woolwich. Population (1891), 98,994; (1901), 117,178. Noeth Woolwich was locally within the county of Essex before it was included in the county of London. The North Woolwich Gardens were formerly somewhat notorious, but are now under the control of the London County Council, and are open to the public under the name of the " Royal Victoria Gardens, North Woolwich " (10 acres).~~

~~WoonSOCket, a city of Providence county, Rhode Island, U.S.A., on the river Blackstone, and the New York^ New Haven, and Hartford and the New England railways, in the northern part of the state, at an altitude of 162 feet. It is irregularly laid out, being a consolidation of several villages, is divided into five wards, has an ample water-supply and good sewerage system. In 1900 it contained 242 manufacturing estab- lishments, with a total capital of $14,279,361. • They employed 8093 hands, and their product had a value of~~

$15,627,539. Of this $2,389,586 consisted of cotton goods, and $3,559,507 of woollen and worsted goods. Woonsocket received a city charter in 1888. Population (1890), 20,830; (1900), 28,204, of whom 12,518 were foreign-born.

Wooster, a city of Ohio, U.S.A., capital of Wayne county, north-east of the centre of the state, at the intersection of the Baltimore and Ohio and the Penn^ sylvania railways, at an altitude of 900 "feet. It is in a rich farming region, for which it serves as a market-place, and it has varied manufactures. It is the seat of Wooster University, a co-educational Presbyterian institution opened in 1870. In 1899 this had a faculty of 23 and was attended by 548 students, including 169 women. The city is one of the oldest in the state, having been founded in 1808. Population (1880), 5880; (1890), 5901 ; (1900), 6063, of whom 407 were foreign-born.

Worcester, a midland county of England, bounded on the N. by Stafford, on the E. by Warwick, on the S. by Gloucester, on the W. by Hereford, and on the N.W. by Shropshire ; but several parishes of the ancient county are detached from the main portion.

Area ami Population. — The area of the ancient county is 480,500 acres, or 751 square miles, with a population in 1881 of 380,283, in 1891 of 413,760, of whom 197,867 were males and 215,893 females ; and in 1901 of 488,401, the number of persons per square mile being 650, and of acres to a person 0'98. The area of the administrative county in 1891 was 473,542 acres, with a popula- tion of 296,661, or, including the county boroughs of Dudley and Worcester, 480,342 acres, with a population of 385,309. Since 1891 certain changes have, however, been made in the administrative area : in 1893 a small portion was transferred to Hereford ; in 1895 the parish of Dowles in Shropshire and the parish of Upper Arley in Stafford were transferred to Worcester ; in 1896 the parish of Oldberrow in Worcester was transferred to Warwick ; and in 1897 the parishes of Acton Beauchamp and Mathon Rural were transferred from Worcester to Hereford, and part of the parish of Cradley and the parish of Stoke Bliss from Hereford to Worcester. The area of the registration county in 1891 was 441,510 acres, with a population of 422,530, of whom

242,384 were urban and 180,146 rural ; and in 1901 of 500,792, of whom 237,229 were males and 263,563 were females. Within the registration area the percentage of increase between 1881 and 1891 was 10‘31 per cent., and between 1891 and 1901, 15‘6 per cent. The excess of births over deaths between 1881 and 1891 was 56,071, and the increase in the resident population was 39,497. The following table gives the numbers of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898 :—

Tear.

Marriages.

Births.

Deaths.

Illegitimate Births.

Males.

Females.

1880 1890 1898

2539 3067 3696

12,399 12,129

13,7u7

6494 7293 7539

317 269 270

319 265 260

The number of marriages in 1899 was 3860, of births 14,027, and of deaths 7674. The following table gives the marriage-, birth-, and death-

~~rates per thousand of the population, with the percentage of illegitimate births, for a series of years : —~~

~~1870-79.~~

~~1880.~~

~~1880-89.~~

~~1890.~~

~~1S88-97~~

~~189S.~~

~~Marriage-rate~~

~~151~~

~~13-3~~

~~13-8~~

~~14‘6~~

~~14-6~~

~~16-4~~

~~Birth-rate .~~

~~34-4~~

~~32-6~~

~~31-4~~

~~28-9~~

~~29-6~~

~~30-3~~

~~Death rate .~~

~~19-3~~

~~171~~

~~171~~

~~17-4~~

~~167~~

167

Percentage of ille-

gitimacy .

5-3

51

4-9

4 -i

4 ‘3

39

In 1891 there were in the county 1410 natives of Scotland, 1797 natives of Ireland, and 672 foreigners.

Constitution and Government. — There are six municipal boroughs : Bewdley (2866), Droitwich (4163), Dudley (48,809), Evesham (7101), Kidderminster (24,692), and Worcester (46,623). Dudley and Worcester are county boroughs. The urban districts are : Broms- grove (8416), King’s Norton and Northfield (57,120), Lye and Wollescote (10,972), Malvern (16,448), North Bromsgrove (5687), Oldbury (25,191), Redditch (13,493), Stourbridge (16,302), and Stourport (4529). The ancient county, which is mostly in the diocese of Worcester, with a few parishes in that of Hereford,

contains 217 entire ecclesiastical parishes or districts, with parts of 12 others.

Education. — At Dudley there is a board deaf school. The total number of elementary schools on 31st August 1898 was 313, of which 62 were board and 251 voluntary schools, the latter including 215 National Church of England schools, 4 Wesleyan, 14 Roman Catholic, and 18 ” British and

~~other." The average attendance at board schools was 18,601, and at voluntary schools 46,440. The total school board receipts for the year ended 29th September 1898 were over £90,121. The income under the Technical In- struction Act was £55, and that under the Agricultural Rates Act was £1818.~~

~~Agriculture. — About five-sixths of the total area of the county is under cultivation, and of this about five-eighths is in permanent pasture. There are also over 21,000 acres under orchards — the county ranking in this respect fifth among English counties — and over 19,000 under woods. Since 1880 the acreage under corn crops has diminished by about one-fifth, the main diminution being in the wheat acreage, which still, however, amounts to about two-fifths of the whole, oats coming next with about one-fifth, while there -are considerable acreages under barley, beans, and peas. Turnips are grown on only about one-third of the green crop acreage, and potatoes on about one-fourth. About 4000 acres are usually under hops, and over 3000 acres under small fruit. In the neighbourhood of Worcester there are large nurseries. The following table gives the larger main divisions of the cultivated area at intervals from 1885 :—~~

~~Year.~~

~~Total Area under Cultiva- tion.~~

~~Com Crops.~~

~~Green Crops.~~

~~Clover.~~

~~Permanent Pasture.~~

~~Fallow.~~

~~1885 1890 1895 1900~~

~~402,845 405,839 404,103 406,254~~

~~95,234 91,142 77,997 78,710~~

~~33,518 30,454 31,189 28,757~~

~~34,482 28,661 30,386 28,316~~

~~223,527 240,694 248,248 252,005~~

~~13,174~~

~~10,191~~

~~9,104~~

~~5,048~~

~~The following table gives particulars stock for the same years : —~~

~~regarding the principal live-~~

~~Tear.~~

~~Total Horses.~~

~~Total Cattle.~~

~~Cows or Heifers~~

~~in Milk or in~~

~~Calf.~~

~~Sheep.~~

~~Pigs.~~

~~1885 1890 1895 1900~~

~~19,871 19,925 21,486 21,008~~

72,461 64,956 60,319 69,057

29,067 26,206 24,613 26,458

183,442 179,794 164,909 170,617

41,402 44,785 51,007 39,794

Manufactures and Minerals. — According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 55,972, as com- pared with 54,457 in 1896. Of these 7070 were employed in textile factories, woollen industries employing 6744. Non-textile industries employed 40,551, there being an increase between 1895 and 1896 of 10 per cent., and between 1896 and 1897 of 2-2 per cent. As many as 15,014 were employed in the manufacture of machines, appliances, conveyances, and tools (including engines and iron bridges at Dudley; iron tanks, iron and chain cables, &c, at Netherton ; agricultural implements and other machines at Worcester ; and needles, fish-hooks, &c, at Redditch) ; 5692 in the founding and conversion, galvanizing, finishing, and extracting of metals ; 3849 in food industries ; 2589 in furniture- making ; 2636 in clothing industries ; 1840 in clay and stone industries (including china ware, &c.) ; 1468 in the manufacture of chemicals ; and 1015 in paper-making, &c. The total number employed in workshops was 8351, of whom 2727 were employed in clothing industries, 2677 in the manufacture of machines, &c. The total number of persons employed in counexion with mines and quarries in 1899 was 3182. In the same year 718,959 tons of clays were raised, 49,021 tons of limestone, 67,868 tons of sandstone, 20,351 tons of gravel and sand, and 16,045 tons of igneous rocks. Salt is produced wholly from brine. Pig iron to the amount of 67,639 tons was made in 1885, and of 37,343 tons in 1890. In later years the returns are bracketed with those of Wilts, the total pig iron of the combined counties amounting in 1899 to 76,547 tons, of which probably about five-sixths was made in Worcestershire. There are six blast-furnaces, all in the neighbourhood of Dudley. The following table gives the tonnage and value of the more valu- able minerals in 1890 and 1899 : —

Year.

~~Fire-olay.~~

~~Coal.~~

~~Iron Ore.~~

~~Salt.~~

~~Tons.~~

~~Value.~~

~~Tons.~~

~~Value.~~

~~Tons.~~

~~Value.~~

~~Tons.~~

~~Value.~~

~~1890 1899~~

~~97,540 113,019~~

~~£~~

~~26,011 31,075~~

~~928,581 842,951~~

~~£~~

~~296,800 263,422~~

~~12,22S~~

3,881

£

6114 1594

267,848 171,562

£

120,306

77,364

Authorities. — Visitation of the County of Worcester (Harleian Society's publicatious). London, 1880. — Chamberlain. Glossary of West Worcestershire Words (English Dialect Society). London, 1882.^ — Cukzon. Manufacturing Industries of Worcestershire. Birmingham, 1883. — Stanton. Rambles among Worcestershire Churches. London, 1884. — Cotton. Coins, Tokens, and Medals of Worcestershire. Bromsgrove, 1885. — Salisbury. Glossary of Words used in South-East Worcestershire (English Dialect Society). 1894. — Brassington. Historic Worcestershire. Birmingham, 1894-95. — See also various publications of the Worcester Historical Society. (T- P- H-)

Worcester, a municipal, parliamentary, and county (1888) borough, episcopal city, county in itself, and county town of Worcestershire, England, on the Severn — here crossed by a stone bridge of five arches and an iron railway bridge of two spans — 120 miles by rail west-north-west of London. In 1885 the municipal borough became coextensive with the parliamentary. A Victoria Institute, including a library, museum, and art gallery, has been erected, and there are a cathedral school, choir school, a free grammar school, municipal art, science, and technical schools, and a large recreation ground. The Koyal Porcelain Works cover

5 acres. Eailway signal works and iron foundries have "been added to the industries. Some pro- gress has been made in deepening the river, and further improvements are contemplated. There are two daily newspapers. At Worcester, alternately with Hereford and Gloucester, is held the festival of the "Three Choirs." Area, 3185 acres. Population (1891), 42,908; (1901),

46,623.

Worcester, a town of Cape Colony, near the sources of the river Breede, north by east of Cape Town, with which it is connected by rail. It stands 2000 feet above sea-level, in one of the most extensive wine-growing districts of the colony, and is a busy agricultural centre with a population which rose from 4000 in 1887 to 5400 in 1891. In the neighbourhood is a copious thermal spring credited with valuable medicinal properties.

Worcester, a city of Massachusetts, U.S.A., capital of Worcester county. It includes an area of 32 square miles of hill country, dotted with lakes and ponds, and is situated near the centre of the state. The urban, closely-built portion comprises but a small part of the area of the 'city. It is irregular in plan, is divided into eight wards, has excellent water-supply and sewerage systems, and its business streets are paved with granite blocks, the residence streets macadamized or gravelled. Its altitude is 475 feet at the Union central railway station. Worcester contains several institutions for advanced education, among them Clark University, a non-sectarian institution, opened in 1889 for graduate study, which in 1898 had a faculty of 1 1 and was attended by 44 students. There is also the College of the Holy Cross, a Eoman Catholic institution opened in 1843, which in 1898 had a faculty of 25 and an attendance of 341 students. The Wor- cester Polytechnic Institute, which was opened in 1868, had in 1898 a faculty numbering 30 and an attendance of 216. Worcester is a railway centre of much im- portance, four companies having lines which enter the Union station ; these are the Boston and Albany, the Boston and Maine, the Fitchburg (also of the Boston and Maine), and the 'New York, New Haven, and Hartford railways. It is, however, chiefly as a manufacturing city that Worcester is prominent. In 1900 it had 1071 manufacturing establishments, with a total capital of $42,966,743. They

employed 25,593 hands, and the products were valued at $53,348,783. These were in great variety, the principal being the following : foundry and machine-shop products, value $8,492,686 ; boots and shoes, $1,610,605; woollen goods, $1,531,047; wire-

work, $1,531,047. Envelopes, musical instruments, clothing, firearms, food preparations, marble and stone work, leather and cotton goods were also produced in large quantities. The assessed valuation of real and personal property in 1900 was $112,043,973, the net debt of the city was $5,676,237, and the rate of taxation was $16.40 per $1000. The total income, exclusive of loans, was $3,205,458, and the expenditure for maintenance and operation was $2,516,118. Population (1890), 84,655; (1900), 118,421, of whom 37,652 were foreign-born and 1215 coloured, including 1104 negroes.

Wordsworth, Dorothy (1771-1855), diarist,

was the third child and only daughter of John Words- worth of Cockermouth, and his wife, Anne Cookson- Crackenthorpe. The poet William Wordsworth was her brother and a year her senior. On the death of her father in 1783, Dorothy found a home at Penrith, in the house of her maternal grandfather, and afterwards for a time with a maiden lady at Halifax. In 1787, on the death of the elder William Cookson, she was adopted by her uncle, and lived in his Norfolk parish of Forncett. She and her brother William, who dedicated to his sister the Evening Walk of 1792, were early drawn to one another, and in 1794 they visited the Lakes together. They determined that it would be best to combine their small capitals, and that Dorothy should keep house for the poet. From this time forth her life ran on lines closely parallel to those of her great brother, whose companion she continued to be till his death. It is thought that they made the acquaintance of Coleridge in

1797.

From the autumn of 1795 to July 1797 William and Dorothy Wordsworth took up their abode at Bace- down, in Dorsetshire. At the latter date they moved to a large manor-house, Alfoxden, in the northern slope of the Quantock hills, in West Somerset, S. T. Coleridge about the same time

settling near by in the town of Nether Stowey. On the 20th of January 1798 Dorothy Wordsworth began her invaluable Journal, used by successive biographers of her brother, but first printed in its quasi-entirety by Professor W. Knight in 1897. The Wordsworths, Coleridge, and Chester left England for Germany on the 14th of September 1798; and of this journey also Dorothy Wordsworth preserved an account, portions of which were published in 1897. On the 14th of May 1800 she started another Journal at Grasmere, which she kept very fully until the 31st of December of the same year. She resumed it on the 1st of January 1802 for another twelve months, closing on the 11th of January 1803. These were printed first in 1889. She composed Recollections of a Tour made in Scotland, in 1803, with her brother and Coleridge ; this was first published in 1874. Her next contribution to the family his- tory was her Journal of a Mountain Ramble, in November 1805, an account of a walking tour in the Lake district with her brother. In July 1820 the Wordsworths made a tour on the continent of Europe, of which Dorothy preserved a very copious and careful record, portions of which were given to the world in 1884, the writer having refused to publish it in 1824 on the ground that her " object was not to make a book, but to leave to her niece a neatly-penned memorial of those few interesting months of our lives." Meanwhile, without her brother, but in the company of Joanna Hutchinson, Dorothy Wordsworth had travelled over Scotland in 1822, and had composed a Journal of that toiir. Other MSS. exist and have been examined carefully by the editors and biographers of the poets, but the records which we have mentioned and her letters form the principal literary

relics of Dorothy Wordsworth. In 1829 she was attacked by very serious illness, and was never again in good health. After 1836 she could not be considered to be in possession of her mental faculties, and became a pathetic member of the interesting household at Grasmere. She outlived the poet, however, by several years, dying at Grasmere on the 25th of January 1855. Her life, by Mr E. Lee, appeared in 1886.

~~*It would be difficult to exaggerate the importance of Dorothy Wordsworth's companionship to her illustrious brother. He has left numerous tributes to it, and to the sympathetic originality of her perceptions. " She," he said,*~~

~~*" gave me eyes, she gave me ears ;*~~

~~*And humble cares, and delicate fears ;*~~

~~*A heart the fountain of sweet tears ;*~~

~~*And love, and thought, and joy."*~~

~~*The value of the records preserved by Dorothy Words- worth, especially in earlier years, is hardly to be over- estimated by those who desire to form an exact impres- sion of the revival of English poetry. When Wordsworth and Coleridge refashioned imaginative literature 'at the close of the 18th century, they were daily and hourly accompanied by a feminine presence exquisitely attuned to sympathize with their efforts, and by an intelli- gence which was able and anxious to move in step with theirs. " S. T. C. and my beloved sister," William Wordsworth wrote in 1832, " are the two. beings to whom my intellect is most indebted." In her attitude to nature, in the quickness of her eye, in the alertness of her observation, in her ductility to new impressions, Dorothy Wordsworth is revealed in her marvellous Journals as keeping on a level with and even pushing sometimes ahead of the great authors of the Lyrical Ballads. In her pages we can put our finger on the very pulse of the machine ; we are present while the New Poetry is evolved, and the sensitive descriptions in her prose lack nothing but the accomplishment of verse. Moreover, it is certain that the sharpness and fineness of Dorothy's observation, "the shooting lights of her wild eyes," actually afforded material to the poets. Coleridge, for instance, when he wrote his famous lines about " The one red leaf, the last of its clan," used almost the very words in which, on the 7th of March 1798, Dorothy Wordsworth had recorded " One only leaf upon the top of a tree . . . danced round and round like a rag blown by the wind."*~~

~~It is not merely by the biographical value of her notes that Dorothy Wordsworth lives. She claims an inde- pendent place in the history of English prose as one of the very earliest writers who noted, in language dslicately chosen, and with no other object than to pre- serve their fugitive beauty, the little picturesque pheno- mena of homely country life. When we speak with very high praise of her art in this direction, it is only fair to add that it is called forth almost entirely by what she wrote between 1798 and 1803, for a decline similar to that which fell upon her brother's poetry early invaded her prose ; and her later journals, like her Letters, are less interesting because less inspired. It is only since 1897, when Professor Knight collected and edited her scattered MSS., that Dorothy Wordsworth has taken her inde- pendent place in literary history. (e. g.)~~

~~Workington, a municipal borough, market and seaport town, in the Cockermouth parliamentary division of Cumberland, England, 34 miles south-west of Carlisle by rail, at the mouth of the river Derwent. A cycle and motor-carriage factory has been introduced. In 1898, 129,584 tons of coal were shipped coastwise from this~~

~~port. Since 1892 it has been subordinate to the port of Maryport. The municipal borough incorporated in 1888 did not include the whole area of the previously-existing urban district. Population (1891), 23,836; (1901),~~

~~26,141.~~

~~Worksop, a market town, urban district, and parish, in the Bassetlaw parliamentary division of Nottingham- shire, England, 1 6 miles east-south-east of Sheffield by rail. The mechanics^ institute was converted in 1896 into a free public library. A new cemetery of 15 acres has been opened. There is a considerable trade in Windsor chairs and wood for packing-cases for Sheffield cutlery. Population (1891), 12,734; (1901),~~
~~16,112.~~

~~Worm. — This article deals with the true worms or Chaetopoda, and is divided into two sections, the first treating of the Oligochaeta, land and fresh-water forms, the second of the Polychaeta, marine forms. Some~~

~~other animals popularly known as worms are discussed under the articles Nematoda, Nemertini, Planarians.~~

~~I. Oligoceoeta.~~

~~In this section the principal advances in our knowledge of the Oligochseta since the publication of the article Worm in the ninth edition of this Encyclopaedia will be dealt with under the heads of structure, classification, and distribution.~~

~~Bespiratory Organs. — Cuvier's definition of the Oli- gochseta as " Annelides abranches setigeres " no longer holds good. The finger-like processes arranged round the anus of Dero have been long known, but the retractile gills upon the hinder end of the largely aquatic genus Alma (= Siphonogaster and Digiti- branchus), though correctly described by Levinsen, were generally regarded as pertaining to some Polycheet worm until the existence of these gills (though in one only of the three or four species of the genus) was proved by Michaelsen. Several aquatic Oligochseta belonging to Claparede's group Limicolae are also provided with gills. Bourne found in a Naid, Chaetobranchus, a series of paired and lateral processes of the body, containing an extension of the ccelom, and provided with capillary loops ; these are situated on the anterior part of the body, and many of the gills lodge also the long setae of the worm. Others are free from the setae. Branchiura is a genus of unknown habitat (found in the Victoria regia tank at the Botanical Society's gardens in London) which belongs to the family Tubificidae. This genus, discovered by Beddard, is pro- vided at the tail end of the body with dorsal and ventral simple gills, containing a prolongation of the coelom and supplied with blood-vessels. A somewhat similar form, Hesperodrilus branchiatus, was described by the same author from South America, but in it the quite similar gills are lateral in position. The last-mentioned instance recalls Alma, for only one out of the four species of the genus is gilled. Since the Tubificids breathe chiefly at the tail end of the body, which is thrust out of the mud in which they live, the differentiation of gills in this region is intelligible.~~

~~Ccelom. — In all Oligochaeta the ccekjm consists of a series of chambers divided from each other by transverse partitions, which correspond with~~

the external meta- merism. Only at the head end is this arrangement con-fused by the degeneration of the septa into more irregular masses of muscles. In certain earthworms the ccelom is further subdivided. In Deinodrilvs the dorsal vessels (there are two dorsal vessels in this genus, in Octocha'tus, and in some others, a state of affairs which is a retention of an embryonic condition) are entirely enclosed within a

sac ; this seems to be clearly a part of the ccelom, which is thus differentiated into a " pericardium." The same ccelomic sac envelops the dorsal vessel of Megascolides, and in other worms other vessels may be thus contained in separate ccelomic spaces. The gills of Branchiura are shut off from the general ccelom by septa (Fig. 1) ; and in the same worm and in Libyodrilus there are lateral cavities shut off from the rest of the ccelom which are comparable

FIG. 1.—Cross-section through Branchiwa.—Br d and Br v, dorsal and ventral branchire ; l7it, intestine; sp, septum dividing ccelom; DV, dorsal blood-vessel ; VV, ventral blood-vessel ; N, -nerve cord.

to similar spaces in the Capitellidse. Investigations into the structure of the ccelom will be further dealt with in the section devoted to the organs of reproduction.

Nephridia.—It has been known since the year 1885 that among the Megascolicidse the typical paired nephridia of the Oligochseta were often replaced by more numerous nephridia in a single segment. There are many details which require further investigation ; but it has been ascer-tained that in such genera as Pheretima (= Perichaeta), Octochcetus, Penhamia, &c, there are exceedingly numerous nephridiopores upon each segment to which correspond as many micronephridia, as they have been termed. These micronephridia may, or apparently may not, be provided with ccelomic funnels. It is disputed whether they are connected

with each other in the same segment or in consecutive segments, or whether each nephridium is entirely separate from its neighbours. In any case it has been shown (in Octochœtus, Pheretima, and Megascolides) that the " plectonephric " or " micronephric " condition is preceded by a pair of nephridia in each segment which ultimately break up into many ; since the many nephridia thus produced are in connexion for a time before they break loose, the persistence of the connexion in the adult

of Pheretima which has been asserted becomes of less im- portance. This discovery does away with the difficulty which was at one time felt — and embodied in a classifica- tion — which divorced such manifestly related forms as Perionyx and Megascolex, since the former had paired nephridia and the latter a complex of many micronephridia. These micronephridia may become connected with the gut at the posterior end as well as the anterior, where the existence of salivary glands which are undoubtedly nephridia has been long known. In Octochœtus not only is there a nephridium opening into the buccal cavity, but numerous tubes open into the intestine in the last few segments of the body, an arrangement which recalls the " respiratory trees " of certain Echiuroidea. A highly remarkable modification of the nephridial system is to be seen in certain Eudrilidse. It was first discovered by Beddard in Libyodrilus, but occurs in other genera of that family. The nephridia are paired structures, a pair to each segment, as usual, but the body-wall is pervaded by a system of branching and anastomosing tubes, which open on to the exterior by numerous pores, and are formed out of the terminal portion of the nephridium, not out of the excretory tubules themselves.

Alimentary Canal. — The principal fresh discoveries with Tegard to the gut of Oligochseta relate to the calciferous glands. These glands may be absent; if present, there are from one to six pairs appended to the oesophagus. They are not simple diverticula, but the interior is com- plicated by an abundant folding of the lining membrane. Among the lower aquatic families these glands are not present except in the Enchytrseidse, which are possibly to be looked upon as simplified members of the higher earth- worms. These glands are differentiated in some of the Eudrilidse into two series. In Polytoreutus, for example, and in other allied genera there are a pair of calciferous glands, usually in the

thirteenth segment, and in addition to these a single unpaired ventral gland of the same structure in each of segments ix, x, xi. The latter have been distinguished by Michaelsen under the name of " chylus-taschen," but their minute structure is so similar that it is hard to believe in a difference of function. Moreover, it has been shown that both kinds of glands secrete similar crystals. In any case, the calciferous glands do undergo a remarkable modification in some other genera of Eudrilidse. In Stuhlmannia, for example, there are six pairs of glands appended to the oesophagus which appear from their position and relations to be the equivalents of these glands. Their structure, however, is different. There is a short lumen opening into the oesophagus and lined with an unfolded layer of epithelium. This is surrounded by a mass of cells permeated every- where by blood-vessels, which pursue a devious course through the gland. Along the edges of the vessel the granular cells become arranged in a regular fashion sug- gestive of the cells lining the lumen of a gland ; but here the lumen is a blood-vessel. This mass of cells presents no resemblance to the cells lining the short lumen of the gland connected with the oesophagus, which latter is, moreover, less developed in some genera than in others. They are more like chloragogen cells. But in any case, i.e., whatever the origin of these glands, it seems clear that their function differs from that of the " normal " calciferous glands of Oligochseta, and the large blood- vessel with its coating of modified cells suggests that they have acquired some function connected with the blood. Their communication with the gut by a much shrunken epithelium-lined duct leads to the belief that they are in reality modified calciferous glands.

Reproductive Organs. — It has been shown that in all Eudrilidse which have been studied with sufficient minute-

ness, except Nemertodrilus, the ovaries are not freely dependent into the general body cavity as they are in all other Oligochaeta. They occupy the usual position, i.e., on the anterior wall of segment xiii, but are invested

by a sac which communicates with a system of large sacs which perform in most eases the office of spermathecae. There is thus brought about a direct communication between ovary and oviduct, a state of affairs comparable to that obtaining in the male organs of the bulk of earth-worms, where the testes are similarly enclosed in seminal sacs, into the interior of which open the sperm-duct funnels. In spite of the system of often very spacious sacs which communicate with the space surrounding the ovary, these worms also possess egg sacs (receptacula ovorum) of the ordinary terricolous pattern. Into these latter, moreover, open the oviducts, which are perfectly normal, and pre- sumably serve as the conduit for the eggs to the ex- terior, though the eggs might pass out through the large sacs already spoken of. The arrangement and degree of complication of these sacs vary considerably. This complex female apparatus is either single or double ; in the former case the orifices of the oviducts remain as the normal two, but the sacs into which the ovarian chamber open reach the exterior by a single pore. This aperture is placed in front of or behind that of the male' ducts. The sac which directly communicates with the exterior seems to perform the office of a spermatheca. In many genera of Eudrilidas, such as Polytoreutus, there is no other spermatheca. An interesting series of transitions exists between those ceslomic spermathecal sacs and sper- mathecae of the usual pattern. In Heliodrilus (Fig. 3) there is a long, single, and median spermatheca, which opens on to the exterior in the middle line of segment xi. At the opposite extremity it ends blindly, but the extremity dips into the system of ccelomic sacs connected with the ovarian chamber. In Hyperiodrilus (Fig. 2) there is also a single

FlO. 2.—Female reproductive system of Hyperiodrilus.—xiii, xiv, thirteenth and fourteenth segments ; sp, spermatheca ; sp', spermathecal sac involving the last ; ov, ovary ; r.o, egg sac ; od, oviduct.

median spermatheca, which is precisely of the same struc- ture as in Heliodrilus, but much smaller ; its distal blind extremity is also concealed within the interior of the ccelomic sac. In both these cases the ova can only leave the body through the oviducts. It is plain, too, that the sperm cannot reach the interior of the large sacs which involve the end of the spermatheca, unless indeed it enters by the oviducts. In other genera of

Eudrilidae blindly-ending spermathecae have entirely vanished, and the large median sac or sacs open directly on to the exterior by a pore or pores, which may be either near to the position of the ovaries or far away from them. The median sac, in the case of Libyodrilus, has been shown to

contain sperm. There is thus clearly a formation of a new kind of spermatheca, which first involves and then entirely replaces the type of spermatheca possessed by Heliodrilus, and which is like that of other earthworms in structure, and in position especially recalls the sperma-thecae of the Geoscolicidae. The large sacs have been

Fig. 3. — Female reproductive system of Heliodri- lus. — xi-xiv, eleventh to fourteenth segments; sperm, spermatheca ; sp. o, its external orifice ; sp. sac, spermathecal sac ; ov, sac containing ovary ; r.o, egg sac ; od, oviduct.

shown by Eosa and Beddard to be in reality sacs developed out of the septa and enclosing a space that is a part of the cœlom. Perhaps the actual orifice, or rather its walls, are in these forms the last vestiges of true spermathecag like those of other Oligochseta. The substitution of a spermatheca morphologically quite different for the existing Oligochaetous spermatheca is quite analogous to the sub- stitution of a backbone for the notochord in vertebrates. These structures naturally appear late, comparatively speaking, in development. In Libyodrilus it has been ascertained that the young worm has reproductive organs like those of typical earthworms, the ovaries being free.

Formerly the Oligochaeta were divided (Claparede) into two divisions, the Limicolae and the Terricolae, a grouping expressive of the different mode of life which was believed to go along with differences of c'«ss'"- an important kind in structure. The former group, which embraces the first seven families, agrees with the latter in the anterior position of the clitellum, in the large size of the large yolked ova, in the simple structure of the clitellum (one cell thick), and in the short- ness of the sperm ducts, which occupy but two segments. In the Terricolae the clitellum is farther back and is more complex in structure ; the ova are small, and with but little yolk ; and the sperm ducts occupy several, often many, segments. 2toniligaster and Alluroides prevent such a grouping. The former, though

an earthworm in many characters, has abundantly yolked though not very large ova, the clitellum is anterior in position, and the sperm ducts traverse only a single segment. In Alluroides the ova are large and abundantly yolked, the clitellum is one cell layered, the ovaries are in segment xiii (as in all Terricolae), and the sperm ducts traverse several segments. We shall therefore divide the Oligochaeta into the following twelve families, which embody the present state of our knowledge : —

polych^eta]

WORM

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1. ffiolosomatidae (by Sedgwick referred to the Arohiannelida). —Setae in four bundles. Brain continuous with epidermis. Testes (unpaired) in v ; ovary in vi. No sperm duets ; oviduct represented by a pore on vi. Spermathecae in three pairs in iti-v. Asexual reproduction also occurs. ^Eolosoma (perhaps also Gtenodrilus).

2. Naididse. —Setae varied in form, in four bundles ; dorsal bundles often deficient in anterior segments or (Chastogaster) throughout the body. Clitellum v-vii ; testes v ; ovaries vi ; spermathecae v ; male pores vi associated with genital setae. Oviducts a simple pore. Asexual reproduction also occurs. Nais, Dero, Ohcetobranchus, ha.

3. Tubificidse. —Setae varied in form, in four bundles. Clitellum usually xi, xii (sometimes x, xi, xii (xiii), or xii, xiii). Testes x or xi ; ovaries xi or xii ; spermiducal glands opening on xi or xii (orifice rarely single and median). Spermathecae in x, xii, or xiii (or absent — Bothrioneuron). ; Oviducts xii/xiii. Tubifex, Clitellio, Heterochceta, Limnodrilus, Hemitubifex, Branchiura, Ver- miculus, Embolocephalus, Phreodrilus, Hesperodrilus,1 &c.

4. Lumbriculidsa. — Setae always paired, never in bundles, some- times bifid at extremity, sigmoid. Clitellum variable, vii-xv, x-xii, &c. Testes one or two pairs in viii or (ix), x. Ovaries one or two pairs. Spermiducal glands -in viii or x (usually) or xiii, rarely single. One or usually two pairs

~~of sperm ducts opening into spermiducal gland. Spermathecae one to five pairs between viii-xv, rarely (Sutroa) single median and with diverticula. Dorsal vessel often with csecal contractile branches. Lumbriculus, Mhynchelmis, Sutroa, Stylodrilus, Phreatothrix, Thinodrilus, &c.~~

~~6. Phreoryetidse. — Setse in four couples or four single setae, simple, sigmoid. Clitelhim xi-xiv. Testes x, xi ; ovaries xii or xii, xiii. Sperm ducts without spermiducal glands opening in x, xi. Oviducts on following segments. Spermathecae vii, viii, ix, without diverticula, &c, viii. Phreoryctes, Pelodrilus.~~

~~6. Enchytraeidae. — Setae single, paired, or in groups ; short, simple, straight, or sigmoid, or absent (Anachceta). Calciferous glands sometimes present. Clitellum xii, xiii. Testes in . xi, male pores on xii. Spermiducal glands rudimentary, oviducts rudimentary. Spermathecae in v often with diverticula, rarely two pairs. Dorsal pores sometimes present. Enchytrceus, Paehy- drilus, Henlm, Marionina, Stercutus, Fridericia, &c.~~

~~7. Discodrilidae. — Parasitic forms with sucker at hind end. Pharynx with chitinous jaws. No setae. Spermathecae ix, opening by common orifices ; testes ix, x ; generally two pairs of vasa deferentia, with one median spermiducal gland in x. Oviducts pores only ; ovary xi. Bddlodrilus, &c.~~

~~8. Moniligastridae. — Large or small earthworms, with eight simple setae per segment. Clitellum x-xiii. Testes x ; , ovaries xi or xiii ; spermiducal glands (like those of Lumbriculidce in structure) opening x/xi or two pairs of glands. Spermathecae viii or ix, without diverticula. Many gizzards. Moniligaster, Desmogaster.~~

~~9. Megascolicidse. — Large or small worms, with simple setae, eight, twelve, or numerous in each segment. Clitellum usually xii or xiii or xiv to xvi-xxiii or so. Gizzard in middle of oesophagus. Nephridia diffused or paired. Testes x, xii, or xi. Spermiducal glands one or two pairs, opening with or independently of sperm ducts, generally in xvii, xviii, or xvii, xxix. Spermathecae one to six pairs, always with diverticula ; rarely many pairs in one segment. Pheretima, Megascolex, Acanihodrilus, Benhamia, Dicho- gaster, Gordiodrilus, &c.~~

~~10. Lumbricidae.2 — Size moderate. Setae eight per segment. Clitellum rather far back. Gizzard at end of oesophagus. Male pores on xv, rarely anterior. Testes x, xi. No spermiducal glands. Spermathecae one to eight pairs, very rarely numerous pairs in one segment. Lumbricus, Allolobophora, Allurus, &c.~~

~~11. Geoscolicidea. — Small or large worms. Setae eight per seg- ment, often larger and more ornamented upon clitellum. Gizzard in middle of oesophagus. Clitellum variable. Spermiducal glands generally absent. Spermathecae one to six pairs, without diverti- cula ; often many pairs in one segment. Microchceta, Pontpscolex, Kynotus, &c.~~

~~12. Eudrilidae. — Size moderate. Setae eight per segment. Ovaries enclosed in ccelomic sacs which communicate with a spermatheca also ccelomic. True spermathecae rarely present ; if so, without diverticula. Spermiducal glands always present, into which the vasa deferentia (one or two pairs) always open. Eadrilus, Polytoreutus, Alvania, Hyperiodrilus, Metadrilus, Eudriloides, &c.~~

~~There are now about 1000 species of Oligochseta known- before the year 1883 the -number was only about 150. No conclusions can be formulated at present~~

~~1 It has been suggested that these last two genera should be united to form a distinct family.~~

~~2 Perhaps the Luinbrioidae and Geoscolicidae form but one family.~~

~~concerning the distribution of the aquatic forms. The earthworms permit of some general statements. Eliminat- ing forms which can be shown on reasonable probability to have been introduced, the world can be mapped into regions in accordance with the ^^r”””” range of the families and genera. These are : (1) the Ethiopian, the most distinct of all, to which the Eudrilidae are limited as well as (probably) the genus Benhamia and a number of Geoscolicidae. (2) Antarctic, New Zealand to Patagonia, with intervening islands such as Kerguelen. It has no particular family, but contains the bulk of the species of Acanihodrilus and Microscolex, and the peculiar genera Deinodrilus, Plagiochceta. There are no~~

~~Geoscolicidae. (3) Infio-Australian, containing the vast preponderance of the Megascolicidse. It may be subdivided into Indian (including Burma), with most Moniligastridae, and genera Typhoeus, Hoplochaeta ; Malayan, the headquarters of Pheretima ; and Australian, with the majority of Megascolex, Digaster, and other Crypto- drilids. (4) Palsearctic (with uncertain limits, but certainly Europe and Asia, not Japan), to which Lumbricidae are nearly confined. (5) Neotropical. All South America except Patagonia, with Geoscolicidae, and genera Kerria, Ocnerodrilus. (6) Nearctic. The existence or non- existence of such a region is a matter for further inquiry. North America is mainly a mixture of South American forms with Palsearctic, as is the case with its mammals. We have of the former the genera Ocnerodrilus, Kerria, Microscolex, and among the latter species of Allolobophora, some of them distinct from European forms. There is also the distinctive genus Dichogaster, which is mainly confined to this region, and Sparganophilus, which is in the same position. The alternative arrangement would be the extension northwards of the Neotropical region and the placing of the more northerly parts of North America with the Palsearctic into a Holarctic region.~~

~~(p. E. B.)~~

~~II. POLYCHiETA.~~

~~A comprehensive account of the structure and habits of the Polychseta having been already given in Ency. Brit., vol. ii. pp. 65-68, it will only be necessary here to refer to some special advances in our knowledge of the group made in recent years, and some general conclusions reached as to its morphology and affinities.~~

~~The body of the various Polychsete worms, although~~

~~FIG. 4. — A, side view of the head region of Nereis cultrifera. B, dorsal view of the same. E, eye ; M, mouth ; d.c, dorsal cirrus ; per, peri-stomiura, probably equal to two segments ; per.c, peristomial cirri ; pi, prostomial palp; pp, parapodium ; pr, prostomium ; pr.t, prostomial tentacle ; t.s, trunk segment ; v.c, ventral cirrus.~~

differing greatly in outward shape, can be referred to a common plan of structure, common also in great part to the other members of the phylum Annelida, of which the Polycheeta form an order. There is an anterior region, the prostomium, projecting above

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the mouth, followed by a number of segments or meta- meres, generally provided with lateral appendages, the parapodia, and a terminal pygidium surrounding the anus. Neither the prostomium, which contains the brain, nor the pygidium is homologous with the segments lying between them. From the prostomium may spring various processes, primarily sensory in function. The more dorsal are tentacles, the ventral pair at the sides of the mouth are palps (Fig. 4). Often these processes may become converted into gills ; this is especially the case with those worms which live in tubes, as this mode of life leads to the extreme modification of the anterior region, which, as a rule, alone projects to the exterior. Special sense organs are also generally situated on the prostomium, such as eyes, and two lateral ciliated pits near its posterior border, the nuchal organs, comparable to the lateral pits of Nemertines. The first true segment is the peristomium, surrounding the mouth. Together with the prostomium it constitutes the " head " of the worm, and almost always differs considerably from the more posterior segments. The paired metameric parapodia are hollow processes of the body-wall, bearing the characteristic bristles, or seta?, and typically drawn out into two lobes, a dorsal noto- podium and a ventral neuropodium, each provided with a

FIQ. 6.— A, diagram of the nephridium of Nereis diversicolor. B, diagram of the nephridium of Alciope, into which opens the large genital funnel (coelomostrome). C, small portion of the nephridium of Glycera siphono- stoma, showing the canal cut through, and the adenocytes on the outer surface. D, optical section of a branch of the nephridium of

Nephthys scolopendroide8. c.8, cut surface ; est, ccBlomostome ; /, flagellum ; g[f, genital funnel ; n, neck of solenocyte ; n.c, nephridial canal ; n.p, nephri- diopore ; net, nephridiostome ; nu, nucleus of solenocyte ; s, BOleno- cytes ; t , tube {from Goodrich).

cirrus, a solid process with sensory epithelium. Such fully developed parapodia are only found among the active, freely moving, or swimming forms. In those worms which burrow in the sand, or live in tubes, the lobes and cirri often become much reduced, or disappear in certain regions altogether. The setaa also may become converted into short stout hooks, known as " crotchets," useful in moving up and down the tube or burrow. The seg- ments and parapodia in the neighbourhood of the head often become modified (cephalization). During growth new segments are always added from a special growing

zone immediately in front of the pygidium, and become differentiated from before backwards.

Internally there is a spacious body-cavity, the ccelom, filled with a corpusculated fluid, and distinct from the blood-vascular system. The nephridia of the Polychasta are not of uniform structure. Essentially paired segmental ciliated tubular excretory organs, as in other Annelids, they are of two main varieties, one without and the other with an opening into the ccelom.

The first kind of nephridium found in the Nephthyidae, Glyoeridse, and Phyllodocidse consists of a tubular duct opening to the exterior, and ending internally in a more or less toanched extremity. The blind branches are beset with peculiar cells, the solenocytes (Fig. 5), provided with a long narrow cuticular tube opening into the nephri- dial canal at one end, and fixed to the body of the cell containing the nucleus at the other ; here a long flagellum is attached, which works down inside the tube, projecting into the lumen of the nephridium. Such closed nephridia seem to be comparable to the branched excretory organs, ending in flame-cells, found in Platyhelminths, KTemertines, and Rotifers, and exactly resemble the excretory organs of Amphioxus (Goodrich). In the Capitellidse and Nereidse (Lycoridea), the nephridium is provided with a nephridiostome opening into the ccelom. In the majority of Polychsetes,

however, the excretory organs appear to be formed by the fusion of the nephridium with a funnel of coelomic origin (see below).

The reproductive cells are developed from the coelomic epithelium, ripen in the coelom, and are carried to the exterior at maturity by special genital ducts (ccelomostomes), probably developed from the ccelomic epithelium, as in other Annelids. In the Capitellidse the ccelomostomes are independent funnel-like structures opening to the exterior. In the Phyllodocidse and Glyceridse (Fig. 5) they become grafted on to the nephridial canal, and. thus open only indirectly. The Hesionidse have compound organs, serving both as excretory and as genital ducts, formed by the grafting of the ccelomostome on to the nephridiostome. Finally, in most other Polychasta the large open funnel of the adult nephridium would appear to be formed by the ccelomostome. These compound organs, called nephromixia, may fulfil one or both of their primitive functions ; generally a small number in front become specialized as renal organs, and the remainder as genital ducts — this is the case in the Terebellidse, Sabellidse, and their allies.

Of late years Kleinenberg, v. Drasche, Salensky, Meyer, and Hatschek have added much to our knowledge of the development of the Polychseta, while Wilson and others have worked out in detail the early cleavage of the fertilized ovum. In the majority of forms the egg, provided with a considerable amount of yolk, undergoes unequal division according to the spiral

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FIG. 6.— A, side view of the larva of Lopadorhynchus (from Kleiiwnberg), showing the developing trunk region. B, side view of the trochophore larva of Eupoinatus uncinatus (from Hatschek). A, anus ; E, eye ; M, mouth; ap, apical organ; ft, "head kidney"; i, intestine; me, meso- blaat; m#, larval muscle; o, otocyst; pp, parapodiumj pr, praoral ciliated ring, or protdtroch.

type of cleavage, giving rise to four large cells, the macromeres, from which are segmented off successive generations of small cells, the micromeres. The ectoderm

is derived from the latter, the endoderm from the former, while the mesoderm is chiefly or entirely derived from one of the fourth quartet of micromeres. This cell soon divides into two mesoblastic teloblasts, which become lodged between the two primary germ-layers. It has been found that not only is there a remarkable uniformity in the early cleavages of the most diverse forms of Polychastes, but also that these early stages bear a most striking resemblance to the corresponding stages of the development of other Annelida, and of the Mollusca. This similarity is maintained even in the later development of the Mollusca and Polychasta, for in both groups is found the very characteristic free-swimming larval form known as the trochosphere larva (or trochophora).

In a Serpulid Eupomatus, for instance, where there is little yolk in the egg, cleavage gives rise to a blastosphere, the lower half of which invaginates to form the gut, the blastopore remaining as the mouth, and the anus being formed later. The cells at the top of the upper half of the rounded larva develop cilia, and become differentiated into the apical plate or larval brain. An equatorial belt of cells develops into a prseoral ciliated ring, the prototroch, characteristic of the trochosphere. A smaller ring of cilia, the telotroch, subsequently becomes developed round the anus, and cilia also extend round the mouth and along the ventral line from mouth to anus. Meanwhile the mesoblastic teloblasts, situated one on either side of the alimentary canal, near the anus, give rise by their repeated division to the bands from which are developed the adult mesodermal tissues (muscles, connective tissue, &c). A pair of larval excretory organs (‘ ‘ head-kidneys “) without internal opening, the nephridia of the first segment, open laterally to the exterior (Fig. 6).

Such a larva develops into the adult worm by the elongation of the region between the prototroch and the telotroch. The growing mesoblastic bands become broken up into somites, which are hollowed out to form the

~~ccelom. The nephridia are developed from large cells situated near the epidermis. Whilst the region in~~

~~no 7.—A, Autolutm (after Menseh) with numerous buds. B, portion of a colony of Syttis ramosa (from M'Intosh). b.z, budding zone ; p, anterior region of the parent worm ; 1-5, buds.~~

~~front of the prototroch gives rise to the prostomium, the brain itself is formed in connexion with the apical plate, and the ventral nerve-cord from the ectoderm along the ventral region. The para- podia arise as outgrowths of the body-wall, and the setae as secre- tions of the epidermis. .~~

~~Concerning reproduction by budding and fission in the byllidse, many details have been worked out by Malaquin and others. Some genera {Odontosyllis, Exogene) assume a heterosyllid con- dition, similar to the Heteronereid form of Nereis, m which the anterior and posterior regions of the body exhibit different parapodia~~

~~and setae, and the posterior region only is sexually developed. In Syttis this posterior region may become separated, and may develop a head of its own after separation ; but in Autolytus the pos- terior sexual region develops a head before separation takes place. Again, in this genus and in Myrianida gemmation may occur, a succession of individuals being budded off from a special zone at the hinder end of the anterior non-sexual region (Fig. 7, A). The segments in each individual bud become differentiated from before backwards as usual ; but the oldest and most developed buds are, of course, towards the hinder end of the chain. These chains may be formed of male or of female buds, which become free as they ripen, and often differ considerably in structure according to their sex. In Syllis ramosa is presented an extraordinary case of lateral budding, leading to the formation of a branched worm, first described by M'Intosh from the Challenger's collection (Fig. 7, B).~~

~~The old classification of Polyclnetes into two groups, Errantia and Sedentaria, is now generally considered inadequate ; but although Hatschek and Benham have proposed new Mca-~~

systems, the affinities of the various families to one "" another remain in most cases too obscure to allow of a satisfactory classification being yet established. Adopting pro- visionally some of Benham's conclusions, we may group the chief families in suborders as follows : — Suborder 1 : Nereidiformia, containing the Phyllodoeidae, Nephthyidse, Glyceridae, Kereidse, Hesionidse, Syllidae, Aphroditidae, and Eunicidse. With the ex- ception of a few aberrant genera, all these families have the fol- lowing characters in common : the prostomium carries sensory tentacles ; the palps, when present, are simple ; the segments are fairly uniform ; the parapodia bear well-developed cirri, and anal cirri are present on the pygidium ; there are supporting acicula, and jointed setae ; the muscular pharynx is protrasible, and generally armed with chitinous teeth. The Amphinomidse are doubtless related to some of these families, and so also are perhaps the Ariciidae.

In the remaining families of the Polychaeta the prostomial pro- cesses are either highly modified (gills of the Serpulidae), or much reduced if not absent altogether. Similarly the parapodial cirri are rarely typically developed, and the anal cirri are absent. The setae are never compound, and there are no acicula, the para- podia being as a rule much modified. The body is divided into regions — thoracic and abdominal — differing in external form, and frequently also in internal structure. The muscular pharynx is little developed, and never armed. These families may be grouped in suborders, as follows : — Suborder 2, Spioniformia : including the Spionidae, Polydoridae, Chaetopteridae, Magelonidae, and perhaps the Ammocharidse. Suborder 3, Capitelliformia : Capitellidfe. Suborder 4, Scoleoiformia : Maldanidae, Arenicolidae, and per- haps the Scalibregmidaa and Opheliidae, Suborder 5, Terebelli- formia : Terebellidae, Ampharetidae, Amphictaenidse, to which the Cirratulidae may possibly be added. Suborder 6, Sabellifokmia : Sabellidas, Serpulidae, Hermellidae. The Chlorhsemidae may per- haps be related to the last suborder. Sternaspis, a very aberrant form which used to be associated with the Echiuroidea, is now definitely placed among the Polychaeta. In the disappearance of segmentation, the coiling of the gut, the reduction of the number of nephridia, and in many other respects, Sternaspis approaches the Chlorhaemidse.

~~From a general survey of the structure of the Polychteta, and a comparison of them with the other groups of the phylum Annelida, it must be concluded that they are the least specialized of its orders ; and further, that the Polychaeta must have been derived from a common ancestral form differing not so very widely from the more primitive living Nereidiformia.~~

~~Authorities. — Benham. ‘ ‘ Polychseta, ” in Cambridge Natural History. 1896. — Eisig. ” Die Capitelliden, ” Fauna u. Mora des Golfes von Neapel, Monograph xvi., 1887.— Goodrich. “The Nephridia of the Polychaeta, ” Quart. Jowrn.Mic. Sci., vols, xl.-xliii., 1897-1900 ; “The Anatomy of Sternaspis, ” ibid., vol. xl., 1897.— Hatschek. “Entwick. der Trochophora von Eupomatus,” Arb. Zool. Inst. Wien, vol. iv., 1881. — Kleinenbero. “Die Enste- hung des Annelids aus der Larve von Lopadorhynchus,” Zeit. f. < Wiss. Zool., vol. xliv., 1886. — Malaquin. Recherches sur les Syllidiens. Lille, 1893. — Meyer. " Studien iiber den Korperbau der Anneliden," Mitth. d. Zool. St Neapel, vols. vii. and viii., 1887-88. — M'Intosh. " On the Annelida Polychaeta," Challenger Report, xii., 1885 ; and Monograph of the British Annelides, part 2. Ray Society, 1900. — Perrier. Zoologie, fasc. 4. Paris, 1897. — Racovitza. " Le lobe cephalique, &c, des Annflides Polychetes," Arch. Zool. Exp., vol. iv., 1896.— Rietsch. "Sur le Sternaspis scutata," Ann. Sci. Nat. Zool, vol. xiii., 1882.— Vejdovskt. " Unters. iiber die Anatomie, &c, von Sternaspis," Denkschr. Wiener ATcad., vol. xliii., 1882.— Wilson. "The Cell-lineage of Nereis," Journ. Morph., vol. vi., 1892.~~

~~[haplodrili~~

~~III. Haplodrili.~~

~~In the group Haplodrili (Lankester), often called Archiannelida (Hatschek), may be provisionally included a number of interesting lowly-organized marine worms, whose affinities are very doubtful. Polygordius and Protodrilus live in sand, but while the former moves~~

Fig. 8. — A, Polygordius neapolitanus (from Fraipont). B, transverse section of Polygordius (from Fraipont). C, trochophore of Polygordius ; and D, later stage of the same, showing the development of the trunk (from Hatschek). E, dorsal view of DinophUus tceniatus. F, male apparatus of the same (from Harmer). a, anus ; ap, apical organ ; c, ccelom; a.o, ciliated pit; c.t, cuticle; d.v, dorsal vessel; e, eye; ep. epidermis; g.f, genital funnel; h, "head kidney," with second nephridium just below it ; i, intestine ; l.m, longitudinal muscles ; m, mouth ; m.o, muscular pharyngeal organ ; m.p, male pore ; n, nephridium ; o.m, oblique muscles; ov, ovary; p, penis; pr, prototroch ; pt, prostomial tentacle ; sp, sperm-sac ; spd, sperm-duct ; at, stomach ; t, testes ; tr, trunk segment ; it, telotroch ; v.n, ventral nerve cord ; v.v, ventral vessel.

by means of the contraction of its body-wall muscles, Protodrilus can progress by the action of the bands of cilia surrounding its segments, and of the longitudinal ciliated ventral groove (see article Worm, 9th edition). Saccocirrus, which also lives in sand, and more closely resembles the Polychseta, has throughout the greater length

of its body on each segment a pair of small uniramous parapodia bearing a bunch of simple setae. No other member of the group is known to have any trace of setae or parapodia at any stage of development.

These three genera have the following characters in common. The body is composed of a large number of segments ; the pro- stomium bears a pair of tentacles ; the nervous system consists of a brain and longitudinal ventral nerve cords closely connected with the epidermis (without distinct ganglia), widely separated in Saccocirrus, closely approximated in Protodrilus, fused together in Polygordius ; the ccelom is well developed, the septa are distinct, and the dorsal and ventral longitudinal mesenteries are complete ; the nephridia are simple, and open into the ccelom. Polygordius differs from Protodrilus and Saccocirrus in the absence of a distinct subcesophageal muscular pouch, and in the absence of a peculiar closed cavity in the head region, which is especially well developed in Saccocirrus, and probably represents the specialized ccelom of the first segment. Moreover, in Saccocirrus the genital organs, present in the majority of the trunk segments, have become much complicated (Fig. 9).

In the female there is in every fertile seg- ment a pair of spermathecse opening at the nephridiopores. In

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Fig. 9.— Diagram of a transverse section of Saccocirrus (from Goodrich), showing on the left side the organs in a genital segment of a male, and on the right side the organs in a genital segment of a female.

the male there are a right and a left protrusible penis in every genital segment, into which opens the nephridium and a sperm-sac. The wide funnels of the nephridia of this region are possibly of coelomic origin.

Dinophilus is a free-swimming form without tentacles, and with segmental bands of cilia(Fig. 8). The parasitic Histriodrilus (Histrio- bdella) feeds on the eggs of the lobster. It resembles Dinophilus in the possession of a ventral pharyngeal pouch (which bears teeth in Histriodrilus only), the small number of segments, and absence of distinct septa, the absence of a vascular system, the presence of distinct ganglia on the ventral nerve cords, and of small nephridia which do not appear to open internally. Histriodrilus resembles Saccocirrus in the possession of two posterior adhesive processes, and to some extent in the structure of the complex genital organs, which, however, are restricted to a single segment. In Dinophilus there is also only a single pair of genital ducts behind ; and in the male there are sperm-sacs and a median penis. In some species of Dinophilus there is pronounced sexual dimorphism (the male being small and without gut) as in the Eotifera. The resemblance of Dinophilus to the Rotifera is, however, quite superficial, and the general structure of this genus with distinct traces of segmenta- tion, especially in

the embryo, points to its close affinity, if not to Polygordius in particular, at all events to the Annelida.

That Polygordius, Protodrilus, and Saccocirrus are on the whole primitive forms, and related to each other, there can be little doubt, but their place amongst the Annelida is difficult to deter- mine. The development of Polygordius alone is well known, having been studied by Hatschek, Fraipont, and others. The larva (Fig. 8, C and D) is a typical but very specialized form of trocho- phore, provided with a branching nephridium bearing solenocytes. The trunk develops on the lower surface of the disc-like larva, which undergoes a more or loss sudden metamorphosis into the young worm (Fig. 8). There appears to be little either in the development or in the structure of the Haplodrili to warrant the view held by Hatschek and Fraipont that Polygordius and Protodrilus are exceedingly primitive forms, ancestral to the whole group of seta- bearing Annelids (Oligochseta, Polychocta, Hirudinea, and Echiu- roidea). Whatever may be the conclusion as to the position of Dinophilus and Histriodrilus, it seems only reasonable to suppose that Polygordius and Protodrilus, so far from representing a stage

in the phylogeny of the Annelida before setse were developed, have lost the setse, which are already in a reduced state in Saccocirrus.

Authorities. — H atschek. ‘ ‘ Studien z. Entw. der Anneliden, ” Arb. Zool. Inst. Wien, vol. i., 1878 ; ” Protodrilua, ” ibid., vol. iii., 1881.— Fraipont. ” Le Genre Polygordiua, ” Fauna and Flora d. Oolfes o. Neapel, xiv., 1887.— Weldon. “Dinophilus gigas,” Quart. Journ. Micr. Sci., vol. xxvii., 1886.— Harmer. “Dino- philus,” Journ. Mar. Biol., N.S. vol. i., 1889.— Sohimkewitsoh. “Entwickl. de Dinophilus,” Zeit. f. Wiss. Zool., vol. lix., 1895. — Korschelt. ” Ueber Bau u. Entw. des Dinophilus,” Zeit.f. Wiss. Zool., vol. xxxvii., 1882.— Fcbttinger. ” Histriobdella, ” Arch. Biol, vol. v., 1884.— Goodrich. ” On Saccocirrus,” Quart. Journ. Micr. Sci., vol. xliv., 1901.

IV. Myzostomida.

The Myzostomida are a remarkable group of small parasitic worms which live on Crinoid echinoderms. They were first discovered by Leuckart in 1827. Some species, such as Myzostoma cirriferwm, move about on the host ; others, such as M. c/labrvm, remain stationary with the pharynx inserted in the mouth of the Crinoid. M. defor- mator gives rise to a " gall " on the arm of the host, one

FIG. 10. — A, ventral view of Myzostoma. B, diagram of Myzostoma, showing the nervous and alimentary systems. C, diagram of Myzostoma, showing the genital organs (from v. Graff and Wheeler). D, larva of Myzostoma glabrum (after Beard). E, portion of the arm of Pentacrinus, showing a cyst containing Myzostoma. a, cloacal aperture ; or, arm ; c, cirrus ; el, "cloaca"; cce, coelom; ct, swollen pinnule forming a cyst; i, intestine and its caeca ; Is, larval setae ; m, mouth ; n, ciliated tube (nephridium ?) ; o, opening ; ov, ovary ; p, parapodium ; ph, pharynx ; s, sense organ ; sp, sperm-sac ; vn, ventral ganglionic mass ; & , male opening ; 9 , female opening.

joint of the pinnule growing round the worm so as to enclose it in a cyst (Fig. 10, E) ; whilst M. pulvinar lives actually in the alimentary canal of a species of Antedon.

A typical Myzostomid (Fig. 10, A, B, 0) is of a flattened rounded shape, with a thin edge drawn out into delicate radiating cirri. The skin is ciliated. The dorsal surface is smooth ; ventrally there are five pairs of parapodia, armed with supporting and hooked setae, by means of which the worm adheres to its host. Beyond the parapodia are four pairs of organs, often called suckers, but probably of sensory nature, and comparable to the lateral sense organs of Oapitellids (Wheeler). The mouth and cloacal aperture are generally at opposite ends of the ventral surface. The former leads to a protrnsible pharynx (Fig. 10, B), from which the oesophagus

opens into a wide intestinal chamber with branching lateral diver- ticula. There appears to be no vascular system. The nervous svstem consists of a circumcesophageal nerve, with scarcely differentiated brain, joining

below a large ganglionic mass no doubt representing many fused ganglia (Fig. 10, B). The dorso- ventral and the parapodial muscles are much developed, whilst the ccelom is reduced mostly to branched spaces in which the genital products ripen. Full-grown Myzostomids are hermaphrodite. The maleorgan (Fig. 10, C) consists of a branched sac opening to the exterior on each side. The paired ovaries discharge their pro- ducts into a median ccelomic chamber with lateral branches (Fig. 10, C), often called the uterus, from which the ripe ova are dis- charged by a median dorsal pore into the terminal region of the rectum (cloaca). Into this same cloacal chamber open ventrally a pair of ciliated tubes communicating by funnels with the ccelom (Nansen and Wheeler) ; these are possibly nephridia, and excretory in function.

The Myzostomida are protandric hermaphrodites, being functional males when small, hermaphrodite later, and finally functional females (Wheeler). Small "males" are in some species constantly associated with large her- maphrodites, but according to Beard there are in some cases true dwarf males, comparable to the complementary males described by Darwin in the Cirripedia. The embryology of Myzostoma has been studied by Metschnikoff and Beard. Cleavage leads to the formation of an epibolic gastrula and ciliated embryo which hatches as a free- swimming larva remarkably like that of a Polychaete worm (Fig. 10, D). The larva is provided with postoral and perianal ciliated bands, and on either side with a bunch of long provisional setae. The mesoderm becomes segmented, and the parapodia subsequently develop from before backwards; but almost all internal traces of segmentation are lost in the adult. The structure and development of the Myzostomida seem to show that they are nearly related to Polychaeta, though highly modified in relation to their parasitic mode of life.

Authorities. — L. v. Graff. Das Genus Myzostoma. Leipzig, 1877; and "The Myzostomida," Challenger Reports, vol. x.', 1884. — E. Metschnikoff. Zeit. Wiss. Zool., v. xvi., 1866. — J. Beard. Mitth. Z. St Neapel, vol. v., 1884. — W. M. Wheeler. Ibid., vol. xii., 1896. (E. s. g.)

Worms, a town of Germany, grand-duchy of Hesse- Darmstadt, on the left bank of the Rhine, and 9 miles by rail north by west of Mannheim. The

people's theatre and hall were built in 1889, and St Martin's church was restored in 1888. In 1895 an obelisk was erected to the memory of Grand-Duke Louis IV. The municipal library, technical school, academy for brewing, milling, and agri- culture, and a large hospital are the principal institutions. There is a good river harbour, entered and cleared by about 175,000 tons annually. Population (1885), 21,839;

(1895), 28,636; (1900), 40,714.

Worthing, a municipal borough (1890) and water- ing-place, in the Lewes parliamentary division of Sussex, England, 61 miles south by west of London by rail. A drainage scheme has been completed at a cost of about £50,000, and new waterworks provided at a cost of over £36,000. Modern erections are municipal buildings, a theatre, a public library, and two convalescent homes. The infirmary and dispensary have been enlarged. Fruit- growing is a thriving industry. Area, 1425 acres. Popu- lation (1891), 16,606 ; (1901), 20,006.

WrangeJ, Friedrich Heinrich Ernst,

Count von (1784-1877), Prussian field — marshal, was born at Stettin, Pomerania, on 13th April 1784. He entered a dragoon regiment in 1796, and fought in the greater part of the Prussian campaigns against Napoleon, especially distinguishing himself at Heils- berg in 1807, and receiving the Order of Merit. He was a captain in 1812, and won distinction and promotion to lieutenant-colonel in the campaign of deliverance

in 1813, and became colonel in 1815. He commanded a cavalry brigade in 1821, and two years later was promoted major-general. He commanded the 13th Divi- sion, with headquarters at Miinster, in Westphalia, in 1834, when riots occurred owing to differences between the Archbishop of Cologne and the Crown, and the determina- tion and resolution with which he treated the Clerical party prevented serious trouble. He was

~~promoted lieutenant- general, received many honours from the Court, enjoyed the confidence of the Junker party, and commanded at Kdnigsberg and Stettin successively. In 1848 he com- manded the Second Corps of the German Federal army in the Schleswig-Holstein campaign, and in the autumn was summoned to Berlin to suppress the riots there. As governor of Berlin and commander-in-chief of the Marches (appointments which he held till his death) he proclaimed a state of siege, and ejected the Liberal president and members of the Chamber. In 1856, having seen sixty years' service, he was made a field-marshal: At the age of eighty he commanded the Austro-Prussian army in the war with Denmark in 1864 with great ability but some barbarity. After the capture of Diippel he resigned the command, was created a count, and received other honours for his brilliant and rapid successes. In 1866 he assisted in the Bohemian campaign, but without a command on account of his great age. He took a keen interest in the war with France in 1870-71. He died at Berlin on 1st November 1877. (e. h. v.)~~

~~Wrang-ell, formerly Fort St Dionysius (1833), Fort Stickeen (1840), and Fort Wrangell (1867), a settlement at the north-west end of Wrangell Island, South-east Alaska, U.S.A., in 56° 28′ N. and 132° 23′ W., named after Baron Ferdinand von Wrangell, Russian governor and Polar explorer. The first settle- ment here was made by Zarembo in 1833, to repel antici- pated trespass by the Hudson Bay Company, but later the whole region was leased for trading purposes by the Russian-American Company to the Hudson Bay Company. The British traders were attacked by the Indians in April 1842, and saved by the opportune arrival of Sir George Simpson with two armed vessels. Wrangell is the port of transhipment of goods for the interior of British Columbia (Cassiar district) from sea-going vessels to river steamers navigating the Stikine river. As such it enjoyed great prosperity in 1874-77 during the Cassiar gold excite- ment, when it had a population of 4000, and again in 1896-97, during the efforts to reach the Klondike by the so-called Edmonton trail. The failure of this project left the settlement in a torpid state. The first Presbyterian mission station in Alaska was established here in 1877 by Mrs M'Farland and Dr Sheldon Jackson. At present there is a custom-house, a mission home for native chil- dren, a settlement of Stikine Indians, and a small body of white settlers. Population in 1890 was 71~~

whites and 228 natives, exclusive of the mining population, which varies with the season of the year. In 1900 the total population was 868.

Wreck. — The present law of wreck found within the territorial waters of the United Kingdom is contained in the Merchant Shipping Act, 1894. "Wreck" was at common law applied only to wrecked property cast by the sea upon the land, but in the Act the term includes jetsam, flotsam, lagan, and derelict, found in or on the shores of the sea or any tidal water. It does not include a barge adrift in the Thames, nor a drifting raft of timber with no one in charge. Wreck must consist of the hull, cargo, or appurtenances of a ship or vessel.

The provisions of the Act dealing with wreck (ninth part) may be summarized as follows : — The Board of Trade

(as the receiver-general of droits of Admiralty) has the general superintendence of wreck in the United Kingdom, and appoints receivers of wreck for the whole coast, who are paid by fees. Where a British or foreign vessel is wrecked, stranded, or in distress, at any place on or near the coasts or any tidal water within the limits of the kingdom, it is the duty of the receiver for the district to proceed there and give directions for preserving the ship, the lives on board her, and her cargo and apparel. He can require the assistance of any person, especially the master of any vessel, or the use of any waggons, carts, or horses, near at hand ; and for this purpose any person may, unless there is a public road equally convenient, pass and repass with or without horses or carriages over any adjoining lands without the owner's or occupier's consent, doing as little damage as possible, and may also deposit there any things recovered from the ship ; any damage so done is a charge on the ship, cargo, or articles, and is . recoverable like salvage (q.v.). Penalties are imposed on any owner or occupier hindering the operations. The receiver has power to suppress any plundering or disorder, or any hindering of the preservation of the ship, persons, cargo, or apparel. Where any vessel, wrecked or in distress as above, is plundered, damaged, or destroyed, by any riotous or tumultuous assembly ashore or afloat, compensation must be made to her owner in England and Scotland by the same authority which would be liable to pay compensa- tion in cases of riot (q.v.) and in Ireland in cases

of malicious injuries to property. In the absence of the receiver, his powers may be exercised by the following officers or persons in successive order, viz., a chief officer of customs, principal officer of coast-guard, inland revenue officer, sheriff, justice of the peace, and naval or military officer on full pay. These persons act as the receiver's agent and put the salvage in his custody, but they are not entitled to any fees nor are they deprived of any right to salvage by so doing. An examination is also directed to be held, in cases of ships in distress on the coasts of the kingdom, by a wreck receiver, wreck commissioner, or his deputy, at the request of the Board of Trade or a justice of the peace, by evidence on oath as to the name and description of ship, name of master, shipowner, and owner of cargo, ports to and from which the ship was bound, the occasion of the ship's distress, the services rendered, and the like. The Act provides as follows for dealing with wreck : — Any one finding wreck, if he is the owner of it, must give notice of his having done so to the receiver of the district, and if he is not the owner he must deliver it to that officer as soon as possible. No articles belonging to a wrecked ship found at the time of the casualty must be taken or kept by any person, whether their owner or not, but must be handed over to the receiver. The receiver taking possession of any wreck must give notice of it, with a description, at the nearest custom-house ; and if the wreck is in his opinion worth more than £20, also to Lloyds. The owner of any wreck in the hands of a receiver must establish his claim to it within a year, and on so doing, and paying all expenses, is entitled to have it restored to 'him. Where a foreign ship has been wrecked on or near the coast, and any articles forming part of her cargo are found on or near the coast, or are brought into any port, the consular officer of the foreign country to which the ship or cargo belongs is deemed to be the agent for the owner so far as the custody and disposal of the articles is concerned. The receiver may in certain cases, e.g., where the value is small, sell the wreck and hold the pro- ceeds till claimed. The right to unclaimed wreck belongs to the Crown, except in places where the Crown has granted that right to others. Persons so entitled, such as admirals, vice-admirals, lords of manors, and the like, are

~~entitled, after giving the receiver notice and particulars of their title, to receive notice from the receiver of any wreck there found. Where wreck is not claimed by an owner within a year after it was found, and has been in the hands of a receiver, it can be claimed by the person entitled to wreck in the place where it was found, and he is entitled to have it after paying expenses and salvage connected with it ; if no such person claims it, it is sold by the receiver, and the net proceeds are applied, for the benefit of the Crown, either for the duchy of Lancaster or the duchy of Cornwall; if these do not claim it, it goes to the Crown. Where the title to unclaimed wreck is disputed, the dispute may be settled summarily, as in cases of salvage; either party, if dis- satisfied, may within three months after a year since the wreck came into the hands of the receiver proceed in any competent court to establish his title. Delivery of un- claimed wreck by the receiver discharges him from liability, but does not prejudice the title thereto. The Board of Trade has power to purchase rights of wreck. No person exercising Admiralty jurisdiction as grantee of wreck may interfere with wreck otherwise than in accordance with the Act. Duties are payable on wrecked goods coming into the United Kingdom or Isle of Man as if they had been imported thither ; and goods wrecked on their homeward voyage may be forwarded to their original destination, or, if wrecked on their outward voyage, to their port of shipment, on due security being taken for the protection of the revenue. Wreck commissioners may be appointed by the Lord Chancellor to hold investigations into shipping casualties, to act as judges of courts of survey, and to take examinations in respect of ships in distress (see above).~~

~~The owner of a wrecked ship, sunk by his negligence in a navigable highway, so as to be an obstruction to navi- gation, if he retains the ownership of her, is liable in damages to the owner of any other ship which without negligence runs into her. If, however, the owner has taken steps to indicate her position, or the harbour authority at his request has undertaken to do so, no action lies against him for negligence either in rem or in personam. He may, however (whether the sinking was due to his negligence or not), abandon the ship, and can thus free himself from any further liability in respect of her. If he abandons her to any other person — e.g., an underwriter — who pays for her as for a total loss, that~~

~~person does not become liable for her unless he takes possession or control in any way. Harbour authorities generally have by local statute, as they have by the general Harbours, Docks, and Piers Clauses Act, 1847 (if incorporated in their own Act), the power of removing the wreck in such a case, and recouping themselves for their expenses from its pro- ceeds. The general Act also gives a personal right of action against the owner for any balance of expense over the value of the wreck ; but if the owner has abandoned it, and no one else has taken it, neither he nor any one else is liable. A particular or local Act (as e.g., one of the state of Victoria) may, however, fasten this liability on the person who is owner at the time when the ship is wrecked, and then he cannot free himself of it. A harbour authority is not obliged to remove a wreck because it has power to do so, unless it takes dues from vessels using the harbour where the wreck lies, or in some way warrants that the harbour is safe for navigation, in which case it is under an obligation to do so. Further statutory provision is now made in this respect by the Merchant Shipping Act, which empowers harbour authorities to raise, remove, or destroy (and meantime buoy or light), or to sell and reimburse themselves out of the proceeds of any vessel or part of a vessel, her tackle, cargo, equipment, and stores, sunk, stranded, or abandoned in any water under their~~

~~control, or any approach thereto, which is an obstruction or danger to navigation or lifeboat service. They must first give due notice of such intention, and offer the wreck to the owner. The Act gives similar powers to lighthouse authorities, with a provision that any dispute between a harbour and lighthouse authority in this respect is to be determined finally by the Board of Trade.~~

~~The method of dealing with wreck outside territorial waters (which does not come within the scope of the Act) is governed by the previous general law relating to droits of Admiralty (see below). The Board of Trade, as receiver- general, in its instructions to receivers, directs that wreck picked up at sea out of the limits of the United Kingdom, or brought to it by British ships, is to be taken possession of by the receiver and held by him on behalf of the owners, or, if the owners do not claim it, on behalf of the Crown. Derelict ships picked up at sea outside territorial limits and brought into British ports must be delivered to the receiver and kept by~~

him until the owner can be found (but not longer than a year and a day). Wreck picked up out of territorial limits by a foreign ship need not be interfered with by the receiver, unless upon application by a party interested. For the receiver's rights with respect to property in distress and its liability to salvage, see Salvage.

Legal provision for the protection of wreck is found in English law from very early times. At present, under the Merchant Shipping Act, it is a felony to take wreck in terri- torial limits to a foreign port, and it is punishable by fine to interfere with a wreck. The receiver has power, by means of a search warrant from a justice, to search for wreck which he has reason to believe is concealed. By the general criminal law in Scotland plundering wreck is punishable at common law ; and in England and Ireland it is a felony to plunder or steal any wreck or part thereof, to destroy any wreck or part thereof, to prevent or impede any person on board a wreck from saving himself, and to exhibit any false signal with the intent of endangering any ship, or to do anything tending to the immediate loss or destruction of a ship for which no other punishment is provided.

Of old it seems to have been the general rule in the civilized maritime countries of Europe that the right to wreck belonged to the sovereign, and formed part of the royal revenue. This was so under the Roman law and the feudal law ; and in England the common law set out in the statute Be prcerogatim regis (17 Edw. II., 1324), provided that the king has wreck of the sea, whales, and sturgeons taken in the sea and elsewhere within the kingdom, except in certain places privileged by the king. This right, which it is said had for its object the prevention of the practice of destroying the property of the shipwrecked, was, however, gradually relaxed ; and the owner of wreck was allowed to recover it if he made claim to it, and gave proof of his ownership within a certain time — fixed at a year or a year and a day alike by a decree of Antonine the Great, the feudal law, the general maritime law, the law of France, and English law. Richard I. released his prerogative right to wreck to the extent of allowing children, or if there were none, brothers and sisters of a perishing owner, to have his goods ; and Henry III., by a charter of 1236, allowed the owner of wrecked goods to have his property again if he claimed within three

months, provided that any man or beast escaped from the ship. The statute of Westminster the First (1276, 3 Edw. I.), provided that where a man, a dog, or a cat, escape alive out of the ship, such ship or barge or anything in it shall not be adjudged wreck, but the goods shall be saved and kept by view of the sheriff, coroner, or the king's bailiff, and delivered into the hands of such as are of the town where the goods were found, so that if any one sue for those goods and prove that they were his, or perished within his keeping, within a year and a day, they shall he restored to him without delay, and if not they shall remain to the king or to such others to whom the wreck belonged. In 1277 the statute Be officio coronatoris made provision for the safe custody of wreck ; and one of 1353 provided for the delivery to the merchants of goods coming to land which may not be said to be wreck, on payment of salvage. In Scotland, a statute of Alexander II., similar to that of West- minster, declared that where any creature escapes alive from a

wrecked vessel, the goods east away are not accounted wreck, but are to be preserved by the sheriff for those who within a year shall prove their property therein ; otherwise they shall escheat to the Crown. For a long time the view of English law was that the right to recover wrecked property depended on the fact of a live creature escaping, though in Hale's words, ' ' because it was lex odiosa to add affliction to the afflicted, it was bound up with as many limits and circumstances, and restricted to as narrow a compass as might be " ; and the Admiralty records illustrate the statement. Thus in 1382 the prior of Wymoudham claimed as wreck a ship which came ashore with no one on board, the men having left her for fear of their lives because of an enemy ship which was about to capture her ; but the King's Council, before whom it came, by certiorari from the admiral of the north, decided against the claim. In 1543, ships grounded on the Goodwins were held to be waif and wreck, although their crews to save their lives made their way to shore ; and in 1637 a ship in the Cinque Ports was proceeded against in Admiralty and condemned, ' ' no man or dog being on board, but only a dead man with his head shot off." Finally,

~~in 1771 Lord Mansfield and the King's Bench held definitely that the property in wrecked goods is not divested out of the owner by the fact that no living thing escaped from the wreck, but the owner may prove his ownership in any other way ; and the law in Scot- land by a decision in 1725 had already, it seems, allowed prior owners to reclaim wrecked goods on proving their title and paying salvage, though no creature escaped alive, and notwithstanding the year had elapsed. The sovereign might grant the right of wreck in a particular place to a subject, who would theu have the same rights in respect of it as the Crown. Hale says that ' ' though wreck of the sea doth de jure communi belong to the king, yet it may belong to a subject by charter or by prescription. . . . Sometime wreck hath belonged to an honour by prescription, as in the honour of Arundel, sometimes to the owner of a county. The lords of all counties palatine regularly had wreccum maris within their counties palatine as part of their jura regalia, but yet inferior lords might prescribe for wreck belonging to their several manors within a county palatine. The Earl of Cornwall had wreccum maris per Mum comitatum Oomubice ; for though Cornwall was not a county palatine, it had many royalties belonging to it, viz., as against the king, though particular lords might prescribe for wreck against the earl " {De Jure Maris, i. vii. ; Hargrave, 41). In the Isle of Man unreclaimed wreck, whether cast on shore or found in the sea, within thje headlands of Man, belongs to the lord, now the Crown by purchase from the duke of Athol ; in the Channel Islands all wreck cast on shore or within reach of a person standing on shore, except certain valuables which go to the Crown, belongs to the lord of the manor if not reclaimed within a year and a day ; while in Wales the old law made everything thrown on shore belong to the king, for "the sea is a packhorse of the king" (A. 67. v. Jones, 2 H. & C. 347). This royal franchise of wreck was probably granted out in nearly all manors in England by the end of the reign of Henry II. In Scotland the admiral is considered the king's donatory of wreck where no special right is shown in another ; and so in England the lord high admiral's patents, from the time of Henry VI. onwards till the Crown took the office of Admiralty into its own hands, contain express grants of wreck, which were asserted against lords of manors and others, including the warden of the Cinque Ports. The dispute between the lord high admiral and the lord warden was settled in 1624 by Buckingham agreeing to rent the right of the lord~~

~~warden to wreck and sea estrays within the Cinque Ports for a fixed sum of money.~~

~~From early times a distinction was made in English law between wreck cast ashore and floating wreck called droits of Admiralty (see Admiralty). Wreck proper, or common law wreck, ejectus navis, is what is cast by the sea upon the shore ; for " nothing shall be said to be wreccum maris but such goods as are cast or left upon the land" (Sir B. Constable's Case, 1599, 5 Rep. 106), and this belonged to the king jure coronce, and was dealt with by the common law. Floating wreck belonged to the Crown as inter regalia, but was granted to the lord admiral jure regis. Even when the office of lord high admiral is in abeyance, and the duties performed by commissioners, as now, these rights which then belong to the Crown are distinguished from the other royal revenues as belonging to the Crown in its office of Admiralty. The admiral, however, tried to usurp, and there are several instances of his aotually usurping jurisdiction over wreck proper ; and in the reign of Richard II. special statutes (which were only declaratory of the common law) were passed for the purpose of confining the jurisdiction of the admiral to its proper limits. One of these (15 Ric. II.) declared that "of all manner of contracts, pleas, and quereles, and all other things arising within the bodies of the counties as well by land as by water and also of wreck of the sea, the Admiral's Court shall have no manner of cognizance, power, nor jurisdiction, but all such manner of contracts, pleas, and quereles, and all other things rising within the^bodies of counties as well by land as by water as afore, and also wreck of the sea, shall be tried by the laws of the land and not before nor by the admiral nor his lieutenant in any~~

~~wise." In spite of this statute, instances still occurred of the Admiralty Court exercising this jurisdiction, until by frequent prohibition by the common law courts, especially in the 17th century, and by the admission of the Admiralty judges themselves, it was recognized as beyond the scope of their authority. These Admiralty droits are classified as flotsam, jetsam, lagan, and derelict. In Lord Coke's words, flotsam is "when a ship sinks or otherwise perishes, and the goods float on the sea"; jetsam is "when goods are cast out of a ship to lighten her when in danger of sinking, and afterwards the ship perishes " ; and ligan, or lagan, is ' ' when heavy~~

~~goods are, to lighten the ship, cast out and sunk in the sea tied to a buoy or cork, or something that will not sink, in order that they may be found again and recovered." Derelict is a ship or cargo, or part of it, abandoned by its master and crew sine spe recuperandi et sine animo revertendi. ' ' None of these goods," adds Coke, "which are so called, are called wreck so long as they remain in or upon the sea ; but if any of them by the sea be put upon the land then they shall be said to be wreck " [Sir R. Constable's Case, 1599, 5 Rep. 106 ; and 2 Inst. 167). Hale says "they are not wreck of the sea but of another nature, neither do they pass by wreccum maris as is recorded in Sir Henry Constable's case and the case of the 3 Edw. II., where they are styled adventarae maris. And as they are of another nature, so they are of another cognizance or jurisdiction, viz., the admiral jurisdiction. Flotsam, jetsam, and lagan, and other sea estrays, if they are taken up in the wide ocean, belong to the taker of them if the owner cannot be known. But if they be taken up within the narrow seas that do belong to the king, or in any haven, port, or creek or arm of the sea, they do primd facie and of common right belong to the king, in case where the ship perisheth or the owner cannot be known. . . . But if the owner can be known he ought to have his goods again, for the casting them overboard is not a loss of his property. Although the right of these adventures of the sea within the king's seas belongs to him where the owner cannot be known, yet the king hath little advantage of it, for by the custom of the English seas the one moiety of what is gained belongs to him that saves it [this is not the present rule]. ... A subject may be entitled to these as he may be entitled to wreck — (1) by charter; (2) by prescription" (De Jure Maris; Hargrave, 41, 42), The difference between these two kinds of wreck is clearly brought out in R. v. 49 Casks of Brandy (1836, 3 Hagg. Ad. 257 ; and B. v. 2 Casks of Tallow, ibid. 294) — a dispute between the Crown and a grantee of wreck, where it was decided that objects picked up below low water mark, and within three miles of it, as also objects afloat between high and low water marks, never having touched the ground, are droits of the Crown, whereas objects picked up aground between high and low water marks, or though aground, yet covered by the waves, are wreck.~~

~~The distinction that Hale draws in the above passage between sea waifs or estrays taken on the high seas, and those taken in the seas of the realm,~~

seems to be founded on the occupatio of the civil law ; but although favoured by the similar rule existing in the case of royal fish, it has not been recognized by the courts, which have always held that in both cases they are droits of the Crown in its office of Admiralty, and, subject to the right of the salvor to reward and the right of the owner to reclaim them in a year and a day, go to the royal revenue (Lord Stowell, The Aquila, 1798, 1 C. Rob. 37). Lord Stowell bases this prerogative right ‘ ‘ on the general rule of civilized countries that what is found derelict on the seas is acquired beneficially for the sovereign, if no owner shall appear. ” It seems that this was also Coke’s view (2 Inst. 168).

Authorities. — Hargrave. Tracts. London, 1787. — Palmer, Law of Wreck, Law Tracts. London, 1843. — Marsden, Select Pleas of Admiralty. Selden Society, London, 1892 and 1897. — Board of Trade, Instructions as to Wreck and Salvage. London.

(g. G. p\)

Wrexham, a municipal borough of North Wales, Denbighshire, 11 miles south-south-west of Chester, with a station on the Great Western Railway and another on the Great Central Railway. It is included in the Denbigh district of parliamentary boroughs. Population (1881),

10,978; (1901), 14,966.

Writing1. — Very early in the history of mankind three needs become pressing. These are (a) to recall at a particular time something that has to be done ; (6) to com- municate with some other person who is not present, nor for the moment easily accessible ; (c) to assert rights over tools, cattle, &c, by a distinctive mark, or by a similar mark to distinguish one’s own production (e.g., a special make of pottery) from that of others. The last-named use, out of which in time develops every kind of trade-mark, is itself

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~~a development of the earlier property mark. The right to property must be established before traffic, whether by way of barter or of sale, is possible.~~

~~Every one is familiar with devices to achieve the first of these aims ; one of the commonest is to tie a knot in a handkerchief. It is obvious that by multiplying the number of knots a number of points equal to the number of knots might in this way be referred to, though it is probable that the untrained memory would fail to recall the meaning attached to more than a very limited number of knots. The simplest application of these knots is in keeping a record of a number of days, as in the story~~

~~related by Herodotus (iv. 98), to the effect that si7as. Darius, ou crossing the Ister in his Scythian~~

~~expedition, left with the Greeks appointed to guard the bridge a thong with a number of knots equal to the number of days that their watch over the bridge was to be continued. One knot was to be undone each day, and if the king had not returned by the time that all the knots were undone, the Greeks were to break down the bridge and go away. A development of this is found in the Peruvian quipu, which consists of a number of thongs or cords hanging from a top-band or cross-bar. In its simplified form, knots are merely tied upon the indi- vidual cords. In its more elaborate forms, one of which is figured in colours in Berger's Histoire de l'£criture dans V Antiquity p. 6, the cords are of different colours, and are knotted together so as to form open loops of various shapes. In the Antiguedades Peruanas,1 we are told that the knots of the quipu in all probability indi- cated only numbers originally, but that as time went on the skill of the makers became so great that historical events, laws, and edicts could thus be communicated. In every place of any importance there was an official whose business it was to interpret quipus received from a dis- tance, and to make quipus himself. If, however, the quipu which was received came from a distant province, it was not intelligible without an oral explanatiqp. Un- fortunately, the art of interpretation of quipus is lost, so that it is impossible to ascertain how far the knots were merely a mnemonic for the messenger, and how far they were intelligible without explanation to a stranger. Similar mnemonics are said to have~~

been used in the remotest antiquity amongst the Chinese, the Tibetans, and other peoples of the Old World.2

Similar in character to the quipu is the message-stick, which is still in use amongst the natives of Australia. A

branch of a tree is taken and notches made upon /Message ^ These are now cut with a knife ; in earlier

times they were made with the edge of a mussel shell. The notches are made in the presence of the messenger, who receives his instructions while they are being made. The notches are thus merely aids to memory, and not self-explanatory, though if messages frequently passed between two persons, practice would in time help the person to whom the message was sent to guess at the meaning, even without a verbal explanation. The follow- ing was the method of the Wotjoballuk of the Wimmera river in Victoria.3 " The messenger carried the message- stick in a net bag, and on arriving at the camp to which he was sent, he handed it to the headman at some place apart from the others, saying to him, ' So-and-so sent you this,' and he then gives his message, referring as he does so to the notches on the message-stick ; and if his message requires it, also enumerates the days or stages, as the case

1 Quoted by Middendorf, Das Runa Simi oderdie Keshua Sprache (Leipzig, 1890), p. 8.

2 Cf. Andree, Ethnologische Parallelen und Vergleiche, i. p. 184 ff.

3 A. W. Howitt in Journal of the Anthropological Institute, xviii. (1889), p.'si8ff.

may be," by a method of counting on different parts of the body.

For the purposes of communication with absent per- sons, however, another method commended itself, which in time was adopted also for mnemonic purposes. This method was the beginning whence some forms at least of later writing have been derived. From the very earliest times to which the energy of man can be traced, date two kinds of writing : (a)

engraving of a visible object on some hard substance, such as the flat surface of a bone ; (b) drawing, painting, or engraving marks which could again be identified. Of the first kind are the engravings of reindeer, buffaloes, and other animals by the cave men of prehistoric times ; of the second are a large number of pebbles discovered by M. Ed. Piette at Mas d'Azil, on the left bank of the Arize, an account MYu,ed of which is published by the discoverer in L' Anthropologic, vol. vii. (1896), pp. 384 ff. This layer of coloured pebbles is intercalated between the last layer of the Eeindeer Age and the first of the Neolithic period. The layer is over 2 feet thick, of a reddish-black colour, and along with the pebbles are found cinders, peroxide of iron, teeth of deer perforated, probably in order to be strung like beads, harpoons of various kinds, and the bones of a large number of animals, some wheat, and, in the upper part of the layer, nuts, cherry-stones, and plums. The stones were coloured with peroxide of iron. The characters are of two kinds : (a) a series of strokes which possibly indicate numbers, (b) graphic symbols. The stones were scattered about without connexion or relation one with another. Whatever the meaning may be, it is clear that the markings are not accidental. It is notice- able, however, that none of them definitely represent any animal, though some of them bear a certain resemblance „ to caterpillars or serpents. Others look like rough attempts to represent trees and river plants. A great number closely resemble symbols of the alphabet, like E, I, T, O, A, Z, 0, n, \, X, L, or others of the same kind, as V, &c. It might be therefore a safer conclusion to suppose that if they passed beyond magic symbols, to be buried like the Australian churinga (some of which, e.g., No. 5 of Fig. 21 in Spencer and Gillen's Native Tribes of Central Australia are very similar, and deposits of which are kept in caves like the rock-shelter at Mas dAzil), they were conventional marks understood by the members of the clan or tribe which frequented the caves of Mas dAzil. Colonel Garrick Mallery, referring to an earlier discovery described by M. Cartailhac in L'Anthropologic, ii. p. 48, suggests that, like similar things among the American Indians, they were used in playing games or gambling.

A very large number of conventional marks, however, are demonstrably reductions from still older forms, con- ventional marks often developing out of pictographs. Picto- graphy has, in fact, left its traces in all parts of

the world. It has, however, been most widely developed in the New World as a system lasting down to modern times. The best and fullest account of the picture-writing of the American Indians has been given by Colonel Garrick

Mallery in the Tenth Annual Eeport of the Bureau of Ethnology to the Secretary of the Smithsonian Institution American (1893). Although there are other forms of picture- pictograph which are much older, it may be writing, well to take those of the New World first, as they, unlike those of Egypt and China, have never shown any tendency to develop beyond the genuine picture stage towards a syllabary or an alphabet. The American Indians, besides picture-writing, used also (1) the simple mnemonic of a notched stick to record various inci- dents, such as the number of days spent on an expedition, the number of enemies slain, and the like ; (2) wampum belts, consisting of strung beads, which could be utilized as a mnemonic, exactly like a rosary. Wampum belts, however, were employed in more intricate forms; white beads indicated peace, purple or violet meant war (Mallery, Report, p. 230). Sometimes a pattern was made in the belt with beads of a different colour, as in the belt presented to William Penn on the making of a treaty with the Leni-Lenape chiefs in 1682. Here, in the centre of the belt two figures, intended to represent Penn and an Indian, join hands, thus clearly indicating a treaty. Very simple pictures are drawn upon birch bark, indicat- ing by their order the subjects in a series of song chants with sufficient precision to enable the singer to recall the theme of each in his recitation. An account can be kept of sales or purchases by representing in perpendicular strokes the number of items, and adding at the end of each series a picture of the animal or object to which the particular series refers. Thus three strokes followed by the picture of a deer indicate that the hunter has brought three deer for sale. A conventional symbol (a circle with a line across it) is used to indicate a dollar, a cross repre- sents ten cents, and an upright stroke one cent, so that the price can be quite clearly set forth. This

practice is followed in many other parts of the world. In clay tablets ‘ discovered by Mr Arthur Evans during his exploration of the great palace at Knossos, in Crete, a somewhat similar method of enumeration is followed ; while at Athens con- ventional symbols were used to distinguish drachm* and obols upon the revenue records, of which considerable frag- ments are still preserved.

In comparatively recent times, according to Colonel Mallery, the Dakota Indians invented a chronological table, or winter count, wherein each year is recorded by a picture of some important event which befell during that year. In these pictures a considerable amount of symbol- ism was necessary. A black upright stroke indicates that a Dakota Indian was killed, a rough outline of the head and body spotted with blotches indicates that in the year thus indicated the tribe suffered from small-pox. Some- times, in referring to persons, the symbol is of the nature of a rebus. Thus, Ked Coat, an Indian chief, was killed in the winter of 1807-8 ; this fact is recorded by a picture of a red coat, with two arrows piercing it and blood dripping. There is, however, nothing of the nature of a play upon words intended, and even when General Many- adier is represented as a figure in European dress, with the heads of two deer behind his head and connected with his mouth, no rebus was intended (many a deer), but the Indians supposed that his name really meant this, like their own names Big Crow, Little Beaver, and so forth. Here the Mexicans proceeded a stage farther, as in the often quoted case of the name of Itz- coatl, literally knife-snake, which is ordinarily represented by a reptile (coatl) with a number of knives (itz) projecting from its back. It is, however, also found divided into three words,, itz-co-atl — knife-pot- water — and represented by a different picture accordingly. The Mexicans, moreover, to indicate that the picture was a proper name, drew the upper part of

the human figure below the symbol, and joined them by a line, a practice adopted also amongst their northern neigh- bours when, as in names like Little-King, the represen- tation would hardly be sufficiently definite. Simple abstract notions could also be expressed in this picture- writing. Starvation or famine was graphically represented by a human figure with the ribs showing prominently. A noose amongst the Mexicans was the

symbol for robbery, though more logically belonging to its punishment. In a Californian rock-painting reproduced by Mallery (p. 638), sorrow is represented by a figure from whose eyes drop tears. This could be abbreviated to an eye with tears falling from it, a form recorded by Schoolcraft as existing amongst the Ojibwa Indians. The symbol is so obvious that it is found with the same value among Egyptian hieroglyphics.

The civilization of the American Indians was nowhere very high, and for their simple needs this system, without further development, sufficed. It was different in the more elaborate civilizations which prevailed among the ancient peoples of the Old World, to whom with certainty the development of writing from pictography can be ascribed—the Assyrians, Egyptians, and Chinese. Here more complex notions had to be expressed. The develop- ment of the system can be traced through many centuries, and, as might be expected, this development shows a tendency to conventionalize the pictorial symbols em- ployed. Out of conventionalized forms develop (a) sylla- baries, (b) alphabets.

In Chinese the development of the script from picture writing is certain, though no actual Chinese picture-writ- ing exists as the earlier stage of the present script, which can be traced back to 1000 B.C. ^™se or 800 B.C. By that period the script was de- veloped in the form in which it still exists. From the forms existing in the oldest Chinese dictionary, how- ever, it is clear how it developed. For example, the symbol for brightness B$ goes back to two symbols, a circle for the sun, a crescent for the moon, which were so drawn as long as the writing was done on a hard sub- stance with a hard point. When paper, silk, and other soft materials came into use, and the writing was done not with a hard point but with a brush, the symbols gradually passed into their present shapes. As yet the antiquities of Chinese script have not been adequately studied, and forgeries and sham antiques have long been provided by the Chinese for the curious. By the historical period other concrete forms have been developed into abstractions. Thus the form ^, which is so often cited as being the primitive Chinese picture for a tree, is not known to exist in any genuine ancient Chinese writing. Thus 7}v is the historical form for a tree. Doubled it is a forest ; tripled ^ it indicates the abstraction ”

darkness." The oldest form for the hand is said to be i£ as repre- senting the five fingers. It is not so found, the historical form being J , but the symbol for friendship /5t g°es back to the very natural picture of two hands *%. The form for mountain in the historical script is [Jj, which goes back to an existing form j^ ; and this latter is obviously a picture, just as the symbol for mountain is in Egyptian also. The earliest recorded form for child is ^, which has now become ^p, an obvious develop- ment when the whole symbol is in practice made without lifting the brush more than once.

The language could have been represented only in the rudest way if the development of writing had stopped at this point. Concrete objects like house, child, horse, leg, eye, were easy enough to represent by a picture. Abstractions were much more difficult to express in such

a way as to be generally intelligible. Moreover, even if Chinese had arrived at alphabetic writing, its difficulties would have been by no means over. As the language is monosyllabic, it must of necessity have a very large number of its words with the same combination of sounds. In the spoken language the different modulations or tones increase very considerably the distinctions possible be- tween forms that would be spelt identically in an alphabet, and no doubt a method of indicating these tones could have been invented, as has been done in Greek and Vedic Sanskrit for the much less complicated systems of those languages, in distinguishing, as in Greek, acute, grave, and circumflex. Chinese, however, followed an entirely different path. The Peking dialect has only 420 vocables with differ- ing sounds, while the words of the ordinary vocabulary are at least ten times as many. Instead of any attempt towards alphabetical development the Chinese fell upon the in- genious method of taking the symbol for some simple con- crete idea and using it for other words which contained the same sounds, distinguishing which idea was intended by prefixing to the original symbol another which should be, as it were, a diacritical mark for the genus of the thing indicated. Thus the vocable ting has for one of its simplest meanings that of sting of a bee,

&c, the symbol for which is ~J", the crossbar probably representing the termination of the body, the rest the sting with a barb at the end. From the shape of the symbol and the signification, transition to the idea of nail was easy. But there were many other mean- ings to the vocable ting. Thus it meant an ingot of metal, a boil or blain, to give orders, to settle by deliberation. To express an ingot the symbol for metal was prefixed — metal- nail (this form itself is now used for nail) ; to express a boil the symbol for disease is prefixed, cp. French clou. Verbal ideas are more difficult ; order, however, is expressed by prefixing the symbol for mouth, settle by prefixing the symbol for words, which itself represents something like smoke proceeding from a mouth.1 The Chinese is the hardest of all scripts to master, but this ingenious device en- sures that once the simple forms have been learnt there shall be comparatively little ambiguity as to the meaning. Out of it the Japanese have developed a syllabary for the writing of their language, which is of an altogether different type, a proceeding which we shall see has parallels elsewhere.2

The Egyptian system of writing is perhaps the oldest

of known scripts and was carried on till the Ptolemaic

period, when the more convenient Greek alpha-

Bgyptiaa. bgt ^ tQ .^ gra(juai disuse. But, as in

Chinese, the fact that it has been so long in use has led to the conventionalizing of the pictures and in many cases to a complete divorcement between the symbol and the sound represented, the original word having often become obsolete. In this case it is no longer possible to trace it. Attempts have been made to connect the three great pictographic systems of the Old World, some authorities holding that the Chinese migrated eastwards from Babylonia, while others contend that the civiliza- tion of Egypt sprang originally from the valley of the Euphrates, and that the ancient Egyptians were of the same stock as the Somali and were overlaid and per- meated by a Semitic conquest and civilization. At many periods in their history Assyria and Egypt were in close political relations, but at present there is no clear evidence that the Egyptian system of writing was not a develop- ment in the Nile valley itself,3 or that

~~it was either the descendant or the parent of the pictographic system which~~

~~i For further details see H. A. Giles, China and the Chinese, Lec- ture I. (New York, 1902).~~

~~2 See Taylor, The Alphabet, i. p. 34 ff.~~

~~8 F. LI. Griffith in Journal of the Anthropological Institute, xxx. (1900), p. 158.~~

~~developed into the cuneiform of Assyria and neighbouring lands.~~

~~Egyptian started from the same point as every other pictographic system — the representation of the object or the concrete expression of the idea. But like the Chinese, it took the further step, short of which the American pictographs stopped ; it converted its pictures into a syllabary from which there was an imperfect de- velopment towards an alphabet. Egyptian, however, never became alphabetic in the sense in which the western languages of modern Europe are alphabetic. That this last step was never taken by Egyptian is attributed by Mr Griffith4 to the natural conservatism of the people and the influence of the artist scribes, "who fully ap- preciated the effect of decorative writing ; to have limited their choice of signs by alphabetic signs would have con- stituted a serious loss to that highly important body." The effect of this love for decorative effect, combined with a desire for precision, is shown by the repetition several times over in the symbols of the sounds contained in a word. The development of Egyptian was exactly parallel to Chinese. A combination of sounds, which was originally the name of an object, was represented by the picture of that object. This picture again, like Chinese and like the Indian name Little Bing, required at the end a determinative — a picture of the kind of object intended — in order to avoid ambiguity. As the alphabet repre- sented only consonants and semi-consonants, and the Egyptian roots consisted mostly of only three letters, the parallelism with Chinese is remarkably close. (For the further history of this system, with its hieratic and demotic forms, see the articles Egyptology and Hieroglyphics.)~~

~~The explanation of the cuneiform writing of Asia has been entirely the work of the 19th century. In the same year (1802) Akerblad, a Swede, began the decipherment of Egyptian, and Grotefend published his first attempt to elucidate the Persian cunei- form inscriptions. As Champollion and Thomas Young developed, with the aid of the Rosetta stone, the study of Egyptian, so Grotefend and Sir Henry Rawlinson laid the foundations of cuneiform scholarship by elucidating the inscriptions set up by Darius Hystaspes in 516 B.C. Here the existing remains of the Persian sacred books — the A vesta — which are written in a dialect closely akin, afforded great assistance ; and when once the Old Persian was deciphered, the interpretation of the parallel columns of Susan and Babylonian was only a question of time. Later discoveries of material in many parts of Asia Minor have vastly increased our knowledge of the cuneiform writing, and the history of the Euphrates valley has started into being from the clay tablets found on the sites of Nineveh and Babylon. The peculiar wedge shape of the cuneiform symbols arose from the use of clay as a writing material, for the papyrus plant, which furnished from its bark such an excellent substance for writing in Egypt, was not Utilized for this purpose in Mesopotamia in very early ages, and in Syria, according to Pliny (If. H., xiii. 73), was used only for ships' cordage in Antigonus's time.5 On the soft clay before it was baked the scribe wrote with a square-ended stylus, which, when held at an angle, natur- ally made a deeper impression with its lowest corner, thus producing a wedge-shaped mark. The result in process of time was that, unlike Egyptian, the pictograph in Assyrian ceased altogether to be recognizable as such. The oldest~~

~~i Op. cit., p. 154.~~

~~5 Papyrus now grows in the Anapns, near Syracuse, but not on the Egyptian Nile north of Fashoda, though it flourishes luxuriantly throughout tropical Africa, and is one of the chief components of the "sudd" which used to obstruct the navigation of the upper Nile.~~

symbols, however, are clear enough. The symbols for hand !|j and arm |^ are exactly like the crude attempts of children to represent the same objects. That the symbol ^ should mean heart, the symbol =£> ox seems natural enough ; both are obviously pictographs, the latter of the head of the animal only. A wavy line or set of wavy lines is an obvious pictograph for water ; it is so employed in Chinese, Egyptian, and Babylonian. The secondary notion of verbal action, whereby a leg |~^ indicates walk or stand, is easily attained. Here again Egyptian is parallel, two legs ^ turned towards the left indicating go, walk, stand, while one leg bent at the knee

*? means to run away, and two legs moving towards the right to retreat. More complicated operations are ex- pressed by combinations : eating and drinking are repre- sented by putting the symbol for food or water inside the symbol for mouth ; a tear is naturally represented by the combination of eye and water, just as it is in Egyptian, and as we have already seen sorrow was expressed by the American Indians. At least two hundred symbols, how- ever, have no obvious explanation of this kind, and the attempt of Delitzsch 1 to account for them has met with severe criticism from some of the other experts in the study. He seems, however, to have proved that, by the addition of four parallel strokes to a simple symbol, a strengthening or modification of its meaning was brought about, and that a considerable number of symbols hereto- fore regarded as units could be resolved into still simpler elements.

The difficulties of the interpretation of the cuneiform inscriptions are considerably increased (1) by the fact that the system was not the invention of the Semitic-speaking people who employed it in Babylonia, but was borrowed by them from the Sumerian pre-Semitic inhabitants; (2) by the use of symbols, not merely as ideograms, but also as syllables, whether as in Cyprian (see below), consisting of a consonant followed by a vowel, or of two consonants separated by a vowel. Here, as in the American Indian's reckoning, in Chinese and in Egyptian it was necessary to employ determinatives. These in most cases were prefixed to the symbol which was actually pronounced, in order to show its exact value in the particular place. Another method was to add the phonetic complement : in other words, to give the final syllable of the word for

which the symbol was intended. This method was particularly useful in the verb in order to indicate the proper tense forms.2

From Assyria and Babylonia this cuneiform writing spread to other lands and other peoples who spoke tongues that were in no way akin to those of either its e' inventors, the Sumerians, or their conquerors, the Semitic Babylonians. A widespread series of inscriptions, found in many parts of Asia and even in the islands of the Aegean, which are generally described as Hittite, are written in a script of pictographic origin, although prob- ably independent of Babylonian in its development. Of these the decipherment, in spite of many attempts, is but beginning, and it is not possible to discuss those attempts here.3 As we have already seen, it was from the Indo- European Old Persian that the decipherment of cuneiform first began.

1 Die Entstehung des ältesten Schriftsystems oder der Ursprung der Keilschriftzeichen (Leipzig, 1897). Delitzsch lias replied to his critics in a Nachwurt (Leipzig, 1898).

2 See further L. W. King in Encyclopaedia Biblica, i. p. 422 ff.

3 P. Jensen, in his Hittiter und Armenier (Strasburg, 1898), con- tends that these so-called Hittites were the prehistoric ancestors of the Armenians. Professor Sayce made an attempt at decipherment in a paper read before the Society for Biblical Archajology in June 1902 (reported in Athenceum of 21st June, p. 788).

At a very early period a colony of Greeks from the Peloponnese, speaking a dialect closely akin to the Ar- cadian dialect (which is known to us only from a much later period), had settled in the island of Cyprus. Alone among the Greeks this colony did not write in an alphabet, but under some Asiatic influence adopted a syllabary. Even when the island came .again closely in touch with their Greek kinsfolk, after the Persian wars, the Greek inhabitants continued to write in their sylla- bary. In the recent excavations made by the authorities of the British Museum an inscription ip of the 4th century B.C. was discovered, whereon a dedication to Demeter and Persephone was given first in Greek letters and repeated below in the syllabary, the Greek (as universally at so late a period)

reading from left to right, the syllabary from right to left. This syllabary has five vowel symbols, but it could not distinguish be- tween long and short vowels. In its consonant system it is unable to distinguish between breathed, voiced, and aspirated stops, thus having but one symbol to represent re, Se, and 6t. It is, of course, unable to represent a final consonant, but this is achieved by using the symbol for a syllable ending in e conventionally for the final consonant. Thus ka-se stands for /cas, the Cyprian equivalent of k

(1) that v preceding another consonant is omitted alto- gether, the vowel being probably nasalized as in French;

(2) that, as in the previous word, there is a sort of vowel euphony whereby the unnecessary vowel accompanying t takes the colour of the succeeding vowel. In other cases, however, it follows the preceding vowel, as in a-ri-si-to- pa-to-o-a-ri-si-ta-go-ra-u =' AptoTo<£avTo(s) 6 A-purrayopav.

The discussion of Cyprian brings us face to face with the question of the origin of the alphabet, which spread from Phoenicia and Greece first round the coasts of the Mediterranean, and gradu- °rig'B ally extended its sway till it conquered the alphabet. world. Until the last few years the view of Vicomte Emmanuel de B,oug£, first propounded to the Academie des Inscriptions in 1859, but unnoticed by the world at large till republished after de Eouge's death by his son in 1874, was generally accepted. According to this view, the alphabet was borrowed by the Phoenicians from the cursive form of Egyptian hieroglyphics. The resemblances in some cases are strik- ing ; in other cases the differences are equally remark- able. De Rouge's famous Memoire was published just as the era of excavation in the eastern Mediterranean commenced. The discoveries of symbols like alphabetic characters in all quarters of the Mediterranean, and dating back to very remote ages, began to give scholars pause, and finally in the volume published by the Egyptian Exploration Fund in 1900, which contained the results of Professor Flinders Petrie's excavations at the Egyptian royal tombs at Abydos, it became clear that a system of signs closely resembling the symbols of the alphabet, and coexisting with hieroglyphics, preceded even the first dynasty of Egyptian kings known to history.4 According to Professor

Flinders Petrie, " the usage of such forms in the same country from about 6000 B.C. to 1"200 b.c, or later, shows that we have to deal with a definite system. And it seems impossible to separate that in 1200 b.c. in

op

a, b, c, d.

i. cit., p. 31 ff., and vol. ii. (1901), p. 47, with plates lv.

WRITING.

V

Inscribed Pebbles from Mas d'Azil.

d

■^^tmimmnvAMM.

Gold Fibula from Praeneste, with Early Latin Inscription. Right to left.

Prehistoric Linear Script from Crete.

Vad.stena Pendant, with Runic Alphabet; about a.d. 600.

>A

J d^^f/J/-CKf|\0 £v 0<» s O ItflSToTT'S OK I of o\ £ 'I <*? tfK» s «,K'»/f T ^M

Cyprian Inscription (4th century b.c.) from Curium (British Museum Excavations, p. 64). Below are (1) the transliteration of the symbols, (2) the Greek words, both like the Cyprian reading from right to left.

Oldest Attic Inscription. From a Dipylon vase probably of Sth century b.c. Right to left.

V«*'

Inscription on Buddha Vase, perhaps 4th century B.C.

Egypt from the similar forms found in other lands con- nected with Egypt from 800 B.C. down to later times ; we may find many of these also in the Cretan inscriptions long before 800 b.c." i These dates put the old explana- tions of the alphabet as a development by the Phoenicians from the later Egyptian out of the question. But as yet it would be premature to form any further hypothesis. It is possible that the symbols were pictographic in origin. Unless there is extraordinary variety in representation they cannot be alphabetic, for their different forms can be counted by hundreds.

In Egypt and in Crete, where Mr Arthur Evans in his excavations at Knossos has discovered many hundreds of inscribed clay tablets, investigation into this problem is only beginning, and the next quarter of a century may see as surprising a development as has taken place in the period since 1875. The provisional accounts of the records found in Crete in the spring of 1900, which have been given by Mr Evans in the Annual of the British School at Athens and elsewhere,2 show that in Crete two if not three Cretan systems of writing prevailed. The first of these

is a pictographic script, the existence of which as a system was first proved to the world by the same discoverer in his articles in the Journal of Hellenic Studies* in 1894 and 1897. Before this time symbols had been observed in the engravings on Mycensean objects, but no attempt had been made to collect them or to regard them as other than ornamental devices to fill vacant spaces. In the first of these articles Mr Evans showed conclusively that, whatever their meaning, the individual symbols were part of a system, and were not merely decorative. They were in fact hieroglyphics, but in no way identical with Egyptian hieroglyphics,

~~though naturally the same themes, such as parts of the human body and figures of animals and birds, occur in this system as well as in Egyptian. Of eighty-two such pictographs six represent the human body and its parts, seventeen arms, implements, and instruments, eight parts of houses and household utensils, three marine subjects, seventeen animals and birds, eight vegetable forms, six heavenly bodies and derivatives, one a geographical or topographical sign, four geometrical figures, twelve uncertain symbols. Now that a large part of the ruins of the great palace at Knossos has been unearthed, it seems clear that this script be- longed especially to the " prae-Mycenaean " population of the island.4 We know from Homer (Odyssey, xix. 175 ff.), who belongs to a later epoch still than the Mycensean supremacy, that the population of Crete was extremely mixed, and the fact that this script probably belonged to the 'ErcoK/^Tes or True Cretans of Homer implies nothing whatever as to the comparative age of the pictographs and the linear writing. From the clay tablets containing accounts which Mr Evans has discovered, the conclusion seems probable that these earlier inhabitants were tribu- tary to the Mycenaean invader. But the invader's system of writing is not less antique because he is a newcomer in the island. On the contrary, as the excavations at Abydos have shown, the Mycenaean script, which in many of its forms corresponds to the Egyptian pottery marks antedating even the First Dynasty, is as old as the hiero- glyphic writing, if not older. Whether the forms of this~~

~~1 The Royal Tombs of the First Dynasty, vol. i. (1900), p. 31.~~

~~2 See Annual of British School at Athens, vi. (1899-1900), p. 55 ff., and for the later excavations, vii. (1900-1901), p. 10 and p. 100 ff. ; and Athenaeum, 5th July 1902, p. 36.~~

~~3 "Primitive Pictographs and a pras-Phojnician Script from Crete and the Peloponnese," vol. xiv. pp. 270-372; "Further Discoveries of Cretan and Aegean Script, with Libyan and Proto-Egyptian Com- parisons," vol. xvii. pp. 327-395. The two articles are also published together as a separate volume.~~

~~4 Cp. Journal of Hellenic Studies, xiv. p. 362.~~

script were syllabic or alphabetic, we do not yet know. The forms bear resemblances not only to the Egyptian pottery marks, but also to the forms of the Cyprian syllabary. Moreover, this script has many points of resemblance to that which is employed in Asia Minor for Carian and for Lycian, to that of the ancient Iberian inscriptions in Spain, and even to the modern Berber writing. Isolated resemblances are of course no proof of relationship. As has already been remarked, the pos- sible permutations and combinations of a few straight or crooked strokes are very limited, and therefore in widely separated areas similar forms may arise accident- ally. Here, however, the differences are too small, as compared with the resemblances, to admit of the possi- bility that the similarities are merely accidental. It is too early to dogmatize, but facts seem to favour Professor Flinders Petrie's view of the origin of the alphabet — that out of a large body of symbols in use from prehistoric times around the shores of the Mediterranean, the Phoeni- cians, to whom hitherto the development of the alphabet has been attributed, specialized as alphabetic signs those which they had utilized as numerals, and that this special- ization was the starting-point of the alphabet as we know it. The use as numerals " would soon render these signs as invariable in order as our own numbers, and force the use of them on all countries with which the Phoenicians traded. Hence, before long these signs drove out of use all others, except in the less changed civilization of Asia Minor and Spain. This exactly explains the phenomena of the early Greek alphabets • many in variety, and so diverse that each has to be learned separately, and yet entirely uniform in order. Each tribe had its own signs for certain sounds, varying a good deal ; yet all had to follow a fixed numerical system. Certainly all did not learn their forms from an independent Phoenician alphabet, unknown to them before it appeared as a whole. The history of the alphabet is as old as civilization." s

It is to be noticed, however, that even in ancient times there was a tradition that Crete acted as an intermediary for the spread of civilization in Caria and Lycia. Accord- ing to Herodotus (i. 171), the Carians came into Asia from the islands ; while the people of Caunus, whose language Herodotus regarded as very closely akin to the Carian, according to their own tradition (which he rejects) came from Crete (i. 172). He admits that the Lycians are of Cretan ancestry (i. 173); and, by his language regard-

ing them, he seems to identify them with the "EreoKp-qres. The excavations at Knossos, however, seem to indicate a close relationship between Caria and the "Mycensean" civilization there discovered. Carian and Lycian seem to be closely connected, but there is no satisfactory proof that the languages are of the Indo-European stock. On the other hand, the Phrygian inscriptions show a language which is certainly closely akin to Greek. In none of the three tongues do the inscriptions go back earlier than the 6th century B.C. Hence, although owing to the great difference in sounds between Greek and these languages of Asia Minor (especially Lycian), the alphabets show a considerable number of symbols different from any Greek alphabet, it has been customary to assume that their alphabets were derived from some Greek alphabet, the Dorian system of Bhodes being generally fixed upon as the ancestor. This view, however, is at once rendered doubtful by Mr Evans's discovery at Knossos of a third form far more closely resembling Greek writing than the linear script of the great mass of clay tablets dis- covered in 1900. "Out of twenty-one varieties ten are practically identical, both in shape and position, with

5 Mayal Tombs, i. p. 32.

later Greek alphabetic forms; while four more are the same, though in a different position. Thus we have — A, A, H, A/, I, n, £, Y, ↑, and a form approaching the digamma, as well as 3, H, — , ■ Yet the Mycenaean date of these bone pieces is as well ascertained as any thing found within the walls of the palace." *

At this point we seem to be driven to the conclusion that the symbols found upon Egyptian pottery, the varieties of which run into hundreds, may have arisen, not from pictographs, but from the third of the needs indicated at the beginning of this article. The sign scratched upon pottery indicates one of two things : (a) that it is the property of the man who made it, and that he wishes to be able to retain it by putting such a mark upon it ; (b) that his work is recognized mark"b'P ^ ms neighDours as of high quality. The mark, like its modern development, the trade mark, is at

once a certificate of value and an advertisement of the maker. Such indications have existed at all periods in the world's history. They imply knowledge neither of literature nor of ability to write in the ordinary sense of the word. They are still in use among the Samoyedes and other peoples of the northern parts of the Russian empire, who at no period of their history are known to have been able to write. In the United Kingdom they are used to mark cattle and other animals which are sent to a distant market, or are liable to be confused with the property of other owners. Among the Swedish Lapps these marks present a considerable likeness to the old Norse runes. Still more remarkable is the resemblance which the pro- perty marks of the Cheremissian and Chuwash tribes of Russia present to the symbols found in Egypt and Crete.2 Among them are the symbols H, X, hj Y>)£, ^. Among the Samoyede signs are) (., T, /V> X» M, ~Z-, "%. The tamga or brands used to mark their horses by the Circassians present other forms which resemble those of Egypt and Crete. Here, however, the forms are more complex. Writing, as generally understood, is altogether unknown among the Wotjaks, but each father of a family has his, own distinctive mark, which passes to his son at his death, or if there are several sons, is divided amongst them. How the division is carried out our authorities unfortunately do not inform us.

Of the same nature are the masons' marks, which are found wherever in the Old World great building operations have been undertaken. They have in regions very distant from one another so close a resemblance that Brugsch 8 con- tends that the stones in the quarries were marked accord- ing to a definite system, and that the ancient gilds of stonecutters possessed an alphabet, possibly of a cryptic nature, which survived down to the 17th century. Among the sixteen forms which Brugsch gives appear T, +, S, A, A, O, O, ?.

As the Greek-looking signs on the Mycenaean bone pieces which were found by Mr Evans at Knossos were

1 Evana, Annual of British School at Athens, vii. (1900-1901), p. 118. The bone pieces referred to were shaped like fishes. "On their under sides were engraved a series of signs accompanied by various scores in the

shape of perpendicular lines, like those which on the clay tablets with the linear script indicate units."

2 These Russian marks are most accessible in Andree's Ethno-graphische Parallelen und Vergleiche (Neue Folge, Leipzig, 1889). Schiefner called attention to the Samoyede marks in the Bulletin Historico-philologique de V Academic cle St Pe'tcrsbourg for 1855, 301 if. Homeyer's Die Haus- und Hofmarken, 1870 (reprinted with appen- dix, 1890), contains the fullest treatment of the subject.

3 Reise nach Persien, ii. p. 61. The marks from the Servian Wall at Rome are collected by Bruzza (Annali del Instituto di Corri- spondema Archcologica, xlviii. (1876), p. 72 ff.). To this collection some additions are made by Professor E. C. Clark in Proceedings of the Society of Antiquaries for 1901, p. 392 ff.

accompanied by upright strokes, which are obviously intended to indicate numbers, it seems safe to assume, provisionally at least, that the symbols were owners' marks. But any further research into this question is impossible until the signs and the various forms of script have been completely published. Table I. (p. 901) will illustrate the varieties of form of these symbols which have prevailed since the earliest times around the shores of the Mediterranean.4 From the table it is clear enough that the early Phoenician alphabet, from which the earliest Greek alphabets in historical times are derived, is not in- dependent of these symbols, however or wherever they may have originated.

The discovery of the famous Moabite stone in 1868 gave a new impulse to the study of the alphabet (see Table II., p. 902). It is to be remembered, however, that important as this monument is for the develop- Moabite ment of the alphabet, and because it can be dated with certainty as not much later than 895 B.C., the dialect and alphabet of Moab are not proof for the Phoenician forms which influenced the peoples of the Aegean and, through them, western Europe. The frag- ment of a bronze bowl discovered in Cyprus in 1876,5 which bears round its edge an inscription dedicating it to Baal-Lebanon as a gift from a servant of Hiram, king of the Sidonians, is probably the oldest Phoenician document which we possess. This bowl, though perhaps a little earlier than the Moabite stone,

in all probability is not more than a century older, while some think it is even later.

*We have already seen that the symbols of the alphabet were in existence thousands of years before the date of the Moabite stone and the bowl of Baal-Lebanon, and that de Rouge's theory of the development s£]*_°fn' of the Phoenician alphabet from Egyptian hieratic Pbwoician is destitute of foundation. . The rival theory pro- wltb pounded by Deecke in 1877-6 never met with As*yHan- much acceptance. Deecke contended that the early Semitic alphabet was derived from the late Assyrian cursive cuneiform. He unduly magnified, however, the undoubted resemblances of some of the forms by taking similar ones from different geographical areas and different epochs and classing them all together as if they formed a uniform series. As we are still only on the threshold of investigation into the early history of the alphabet, it is possible that further discoveries may show that the Phoenicians owed more to Assyrian culture than is at present proved. Meanwhile there is no evidence whatever that the Phoenician alphabet was of Assyrian origin,7 and such evidence, if discovered, must carry*

4 The forms in this table are drawn from Petrie, Royal Tombs, p. 31 ; Evans, Journ. Hell. Soc., xvii. p. 386 ; Sayce (for Carian), Transac- tions of tlie Society of Biblical Archaeology, ix. p. 138 ; Kretschmer, Einleitung in die Geschichte der griechischen Sprache, p. 367 ff. ; Kalinka (for Lycian), Tituli Asiae Minoris, vol. i. ; Hiibner (for Ancient Iberian), in Monumenta Linguae Ibericce ; Maciver and "Wilkin (for Libyan and Tifmagh), in Libyan Notes (1901).

6 This is figured in Berger's Histoire de VEcriturc, p. 123, and on a larger scale in plate iv. to vol. i. of the Corpus Jnscriptionum Semiti- carum.

0 Der Ursprung des alt-semitischen Alphabets aus der neuassy- rischen Keilschrift (Zeitschrift der deutschen morgenlandischen Gesell- schaft, xxxi. p. 102 ff.). A still more sweeping theory of the same nature is propounded by the Rev. C. J . Ball in the Proceedings of the Society of Biblical Archaeology, xv. (1893), p. 392 ff.

7 One point of connexion has, however, been established by Zinrmern {Zcitsch. deutsch. morg. Gesell., vol. 1. (1896), p. 668). Assyrian signs as well as Phoenician letters are used for numbers. The, numbers iudicated in the two eases are different, and Assyrian begins with m, not a. The symbols corresponding in name to the Phoenician Mem, Nun, 'Ajin, Pe, Resh, indicate numbers which, though not consecutive, increase from trst to last. The same is true of those corresponding to Aleph, Beth, Daleth (gamalla, which corresponds to Gimel, is a borrowed word in Assyrian).

back the Phoenician alphabet thousands of years earlier than any date which can at present be established for its existence. Though we know of the existence of the symbols from an early date, we have at present no certain evidence of what the values of the symbols at this date were. Wherever the symbols originated, it was to the Phoenicians that the Western world owed its alphabet, as is clear (1) from the forms of the letters themselves;

(2) from the names which the Greeks gave to them;

(3) from the Greek tradition of such origin.

The discovery of a large number of very archaic inscrip- tions in the island of Thera which was made by Freiherr Hiller von Gartringen in 1896, has shown that the earliest Greek alphabet was even more like the Phoenician than had been heretofore believed. The symbol for /3 in Thera (Q) is nearer than any previously known to the Semitic letter (^), though, as not infrequently happens Relation- *n *^e transference of a symbol from one people ship of to another, its position is inverted — a fate which Greek in this alphabet has befallen also A. (Semitic L, t°Pt"»- Thera «|), and possibly o- (Semitic \V, Thera M). The era of excavation initiated by Dr Schliemann on the grand scale has increased our know- ledge of Greek inscriptions beyond anything that was earlier dreamt of. Besides the excavation of Athens, Delos, Epi- daurus, and Delphi, the results of which are most important for the 5th century B.C. and later, the

exploration of the sites of Olympia, of the Heraeum near Argos, of Naucratis in Egypt, and of various Cretan towns (above all the ancient Gortyn), has revolutionized our knowledge of the archaic alphabets of Greece. We can now see how long and laborious was the process by which the Greeks attained to uniformity in writing and in numeration. In no field, perhaps, was the centrifugal tendency of the Greeks more persistent than in such matters. In numeration, indeed, uniformity was not attained till at least the 2nd century of the Christian era. The differentiation of the local alphabets is found from the very beginning of our records. Unfortunately, as yet no record is preserved which can with any probability be dated earlier than the 7th cen- tury B.C., and the Phoenician influence had by then nearly ceased. How long this influence lasted we cannot tell. If in Crete a system of writing of an entirely different nature had been developed seven or eight centuries before, there must have been some very important reason for the entire abandonment of the old method and the adoption of a new. In Crete, at least, the excavations show that the old civilization must have ended in a social and political cataclysm. The magnificent palace of Minos — there seems no reason to withhold from it the name of the great prince whom Thucydides recognized as the first to hold the empire of the sea — perished by the flames, and it evidently had been plundered beforehand of everything that a con- queror would regard as valuable. The only force in Greek history which we know that could have produced this change was that of the Dorian conquest. As every- where in the Peloponnese, except at Argos, there seems to have been a sudden break with the earlier civilization, which can have been occasioned only by the semi-barbarous Dorian tribes, so the same result seems to have followed from the same cause in Thera. The Dorians apparently were without an alphabet, and consequently when Phoeni- cian traders and pirates occupied the place left vacant by the downfall of Minos's empire, the people of the islands, and of the sea coasts generally, adopted from them the Phoenician alphabet. That the alphabet was borrowed and adapted independently by different places not widely separated, and that the earliest Greek alphabets did not spread from one or a few centres in Greek lands, seems clear (a) from the different Greek sounds for which the

Phoenician symbols were utilized ; (b) from the different symbols which were employed to represent sounds which the Phoenicians did not possess, and for which, therefore, they had no symbols. The Phoenician alphabet was an alphabet of consonants only, but all Greek alphabets as yet known agree in employing A, E, I, O, Y as vowels. On the other hand, a table of Greek alphabets x will show how widely different the symbols for the same sound were. Except for a single Attic inscription (see Plate), the alphabets of Thera and of Corinth are the oldest Greek alphabets which we possess. Yet at Corinth alongside^ ^, which is found for the so-called spurious diphthong u (i.e., the Attic ei, which does not represent an Indo-European u, but arises by contraction, as in 4>i\tire, or through the lengthening of the vowel sound as the result of the loss of a consonant, as in etp?j/ievos for FeFprjfiivos) the short e sound is represented by B ; ‘ is found at Corinth in its oldest form ^, and also as X, while in Thera it is £. In Thera the w sound of digamma (F) was entirely lost, and therefore is not represented. Both Thera and Corinth employ in the earliest inscriptions ^ for f, not £, though in both alphabets the ordinary use as £ is adopted, no doubt through the influence of trade with other states. On the other hand, at CleonaB, which is distant not more than 8 or 9 miles from Corinth, an ancient inscription written /Sovctt/ooc^Sov has recently been discovered, which shows that though Cleonse for B wrote rj”, like the Corinthian J1, and, as at Corinth, wrote £ for a vowel sound, the vowel thus represented was not short and long e (e and rf) as at Corinth, but r; only, as in XP(£A* Ai A*£ (xprjfia, fi-q). Here ^ represents e, and the spurious diphthong is represented by et, as in ^ ^ |V|_| ^ (e^v, Doric infinitive = etvtu), a form which shows that i has at Cleonse the more modern form I as distinguished from the Corinthian §.2

Eegarding three other questions controversy still rages. These are : (a) how Greek utilized the four sibilants (Shin, Samech, Zain, and Tsade) which it took over from the Phoenician ; (6) what was the history of development in the symbols for <£, x, ^ o> (the history of £ belongs to both heads) ; (c) the history of the symbol for the digamma F.

In the Phoenician alphabet Zain was the seventh letter, occupying the same position and having the same form approximately (I) as the early Greek Z, while 0reek in pronunciation it was a voiced s-sound ; Samech

use of (Jf.) followed the symbol for n and was the Phoenician ordinary s-sound, though, as we have seen, it is sU>llaats- in different Greek states at the earliest period f as well as £; after the symbol for p came Sade (|'v), which was a strong palatal s, though in name it corresponds to the Greek CvTa; while lastly Shin (W) follows the symbol for r, and was an sA-sound. The Greek name for the sibilant (o-iyfia) may simply mean the hissing letter and be a derivative from ; many authorities, however, hold that it is a corruption of the Phoenician Samech. Un- fortunately, it is not clear how many sibilants were dis- tinguished in Greek pronunciation, nor over what areas a particular pronunciation extended. There is, however, considerable evidence in support of the view that Greek cro- representing the sound arising from ay, xyf Ty, 9y, was pronounced as sh (s), while £ representing gy, dy was pronounced in some districts zh (z).3

1 See, for example, the tables at the end of Roberts's Introduction to Greek Epigraphy (1887) ; or Kirchhoff 's Studien zur Geschichte des griechischen Alphabets (ed. 4, 1887); or Larfeld's Griechische Epi- graphik in Iwan von Miiller's Handouch der klassischen Alterthums- loissenschaft, vol. i. (1892).

2 Cp. Frankel, Corpus Inscriptionum Graxarum Peloponnesi, i., No. 1607.

3 See Witton, in American Journal of Philology, xix. p. 420 ff., and Lagerkrantz, Zur griechischen Lautgischichte (Upsala, 1898).

On an inscription of Halicarnassus, a town which stood in ancient Carian territory, the sound of crcr in ' KXiKapvao-irkwv is represented by T, as it is also in the Carian name Panyassis (HavuaTios, genitive), though the ordinary SS is also found in the same inscription. The same variation occurs at the neighbouring Teos, while the coins of Mesembria in Thrace show regularly MET A and METAAABPIANUN, where T represents the sound which resulted from the fusion of 8y, and which appears in Homer as crcr in eo-cros, while in later Greek it becomes /mctos. This symbol T is in all probability the

early form of the letter which was known to the Greeks as San (crdv) and at a later time as Sampi, and which is utilized as the numeral for 900 in the shape ~fr. Accord- ing to Herodotus (i. 139), San was only the Dorian name for the letter which the Ionians called Sigma. This would bring it into connexion with the Phoenician W (Shin), which, turned through a right angle, is possibly the Greek Z, though some forms of Sade on old Hebrew coins and gems (g 2£.) equally resemble the Greek letter. From other forms of Sade, however, the other early form of cr, viz., A\, is probably derived. The confusion is thus ex- treme : the name Sade assimilated in Greek to the names fjro. and QfJTa. becomes Crjra, though the form is that of Zain ; the name of Samech is possibly the origin of Sigma, while the form of Samech is that of E which has not taken over a Phoenician name. It is probable that the form V is an abbreviation in writing from right to left of the earlier rA, and £ of the four stroke §. That the con- fusion of the sibilants was not confined to the Greeks only, but that pronunciation varied within a small area even among the Semitic stock, is shown by the difficulty which the Ephraimites found in pronouncing "shibboleth" (Judges, xii. 6).

For the history of the additional symbols which are not Phoenician we must begin with Y. There is no Greek alphabet in which the symbol is not repre- Uits^ry sented. But the Phoenician form correspond- digamma. ^nS to it is the consonant w, and occupies the position of the Greek digamma as sixth in the series. Whence did the Greeks obtain the digamma ? The point is not clear, but probably the. Greeks acted here as they did in the case of the vowel i and the consonant y, adopting the consonant symbol for the vowel sound. As, however, except in Cyprus, Pamphylia, and Argos, the only y sound which survived in Greek — the glide between i and another vowel as in Sua = diya — is never represented, there was no occasion to use the Phoenician Jod in a double function. With Vau it was different; the ■ii-sound existed in some form in all dialects, the w-sound survived in many far into historical times. The Phoenician symbol having been adopted for the vowel sound, whence came the new symbol p or E for the digamma ? Hitherto there have been two views. Most authorities have held that the new form was derived from E by dropping the lowermost crossbar ; some have held that it developed out of the old Vau, a view which is not impossible in itself and has the similar development in Aramaeic (Teina) in its favour. But as Mr Evans has found a form like the digamma among his most recent types of

symbols, and as we have no intermediate forms which will prove the development of p from y, though the form found at Oaxos in Crete, viz., jy, shows a form sufficiently unlike p, it is necessary to suspend judgment.

The Greek aspirates were not the sounds which we re- present by ph, th, ch (Scotch), but corresponded

aerates rat'ler to ^e sound of the final consonants in asp ra s, ^^ worcjs as ^-^-^^-^ fog^]! being

audible after the formation of the consonant. It is not clear that Greek took over 0 with this value,

for in one Theran inscription 0 H are found combined as equivalent to T — H, while the regular representation of and x is n £7 and K fi, or Cp (koppa) Q re- spectively. In the great Gortyn inscription from Crete and occasionally in Thera, n (in Crete in the form C) and K are used alone for c/> and x, jtifit as conversely even in the 5th century the name of Themistocles has been found upon an ostrakon. spelt Gc/xtcr^oKA^s. Such confusions show that even to Greek ears the distinction between the sounds was very small. To have recorded it in writing at all shows considerable progress in the observation of sounds. Such progress is more easily indicated by changes in the symbols among a people whose acquaintance with the art is not of long standing nor very familiar. English, though possessing sounds comparable to the Greek 8, , X, has never made any attempt to represent them in writing. On the other hand, no doubt Athens in 403 B.C. officially adopted the Ionic alphabet and gave up the old Attic alphabet. The political situation in Athens, how- ever, at this time was as exceptional as the French Eevolution, and offered an opportunity not likely to recur for the adoption of a system in widely extended use which private individuals had been employing for a long time.

•The history of the symbols and x is altogether un- known. The very numerous theories on the subject have generally been founded on a principle which itself is in need of proof, viz., that these symbols must have arisen by differentiation from others already existing in the

alphabet. The explanation is possible, but it is not easy to see why, for example^ the symbol 9 or

outside Aeolic (a dialect which is not here in question) are never confused. On the other hand, if we remember the large number of symbols belongicg to the prehistoric script, it will seem at least as easy to believe that the persons who, by adding new letters to the Phoenician alphabet, attempted to bring the symbols more into accordance with the sounds of the Greek language, may have borrowed from this older script. It is now generally admitted that the improvements of the alphabet wore made by traders in the interests of commerce, and that these improvements began from the great Greek emporia of Asia Minor, above all from Miletus. Symbols exactly like ci, x, and f (0, X, *P) are found in the Carian alphabet, and transliterated by Professor Sayce1 as v (and if), h, and kh respectively. If the Carian alphabet goes back to the prehistoric script, why should not Miletus have borrowed them from it 1 We have already seen that, in the earliest alphabets of Thera and Corinth, the ordinary symbol for £ in the Ionic alphabet was used for £ This usage brought in its train another — the use of V, not for \p as in Ionic, but for £ in the name AAEVA | CORA = 'A A.e£ayd/3a,and similarly in Melos, . PAY | IKVA | ECA\ = npa^3eos.2 This experi- ment, for it was no more, belongs apparently to the latter part of the 6th century, and was soon given up. As the Ionians kept the form if, which the people of Thera used for £, in the same position in their alphabet as Samech occupied in the Phoenician alphabet, there can be no doubt as to its origin. The symbol + which the Chalcidian Greeks used in the 6th century B.C. for £ may be derived, according to the most widely accepted theory, from a primi- tive form of Samech £B , which is recorded only in the aliecedaria of the Chalcidian colonies in Italy. In this

1 See especially Proceedings of the Society of Biblical Archaeology for 1895, p. 40 ; cf. also Kalinka, Xeue JaJirbiicher fur Philologie, iii. (1899), p. 683.

2 Inscriptiones Or. Insularum Maris Aegaei, Nos. 811, 1149.

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case the borrowing of the Greek alphabet must long precede any Phoenician record we possess. But it is not probable that the Ionic and Phoenician ^= developed independently from the closed form. Kretschmer, how- ever, in several publications x takes a different view. He thinks that the guttural element in £ was a spirant, and therefore different from x> which is an aspirate. He points out that in Naxos, in a 6th-century inscription,2 £ in Nation, c^o^os, and Qpdgov is represented by [|2, the first element in which he regards as a form of 0 = h. As x is found in the same inscription (in the form X), the guttural element must have been different, else £ would have been spelt XS. Attica and most of the Cyclades kept X for the guttural element in £ (written X£ or + £) and for x as well. On the west of the Aegean a new symbol Y was invented for the aspirate value, and this spread over the mainland and was carried by emigrants to Ehodes, Sicily, and Italy. The sign X was kept in the western group for the guttural spirant in £, which was written XS ; but, as this spirant occurred nowhere else, the combination was often abbreviated, and X was used for XS precisely as in the Italic alphabets we shall find that F =/ develops out of a combination FH.

The development of symbols for the long vowels rj and

The discoveries of the last quarter of the 19th

century carried back our knowledge of the Latin

alphabet by at least two centuries, although

Lf *'hh t ^e monuments 0I an earty a8e which have *p been discovered are only three, (a) In 1880

was discovered between the Quirinal and Viminal hills a little earthenware pot of a curious shape, being, as it were, three vessels radiating from a centre, each with a separate mouth at the top.3 Round the sides of the tri- angle formed by the three vessels and under the mouths runs an inscription of considerable length. The use for which the pot was intended and the purport of the in- scription have been much

~~disputed, there being at least as many interpretations as there are words in the inscription. The date is probably the early part of the 4th century B.c. Though found in Home, the vessel is small enough to be easily portable, and might therefore have been Tae brought from elsewhere in Italy. It is equally~~

~~Dveaos in- possible that the potter who inscribed the words scription. upon it was not a native of Rome. One or two points in the inscription make it doubtful whether the Latin upon it is really the Latin of Rome. .It is generally known as the Dvenos inscription, from the name of the maker who wrote on the vessel fr&m right to left the inscription, part of which is DVENOS MED FECED (= fecit), (b) The second of these early records is the inscription on a gold fibula found at Prseneste and published in 1887. The inscription runs from right to left and is in letters which show more clearly than~~

~~The~~

~~Prseneste~~

~~fibula.~~

~~1 See especially Athenische Mittheilungen, xxi. p. 426.~~

~~2 Figured in Roberts's Introduction to Greek Epigraphy, p. 65.~~

~~8 It is figured most accessibly in Egbert's Introduction to the Study of Latin Inscriptions, p. 16.~~

~~ever that the Roman alphabet is borrowed from the alphabets of the Chalcidian Greek colonies in Italy. Its date cannot be later than the 5th and is possibly as early as the 6th century B.C. The words are MANIOS MED FIIEFIIAKED NVMASIOI, "Manius made me for Numasius." The symbol for M has still five strokes, s has the angular form 5, £. The inscription is earlier than the Latin change of s between vowels into r, for Numasioi is the dative of the older form which corresponds to the later Numerius. The verb form is remarkable. In the Dvenos inscription the perfect of facio is feced; here it is a reduplicated form with the same~~

vowel as the present. The spelling also is interesting. The symbol K is still in ordinary use, and not merely used for abbreviations as in the classical age. But most remarkable is the representation of Latin F by F-H . The reason for this is clear. The value of F in the Greek alphabet is w and not / as in Latin. Greek had no sound corresponding to Latin F, consequently an attempt is made by combining F and H to indicate the difference of sound. Etruscan uses F-H in the same way. As Latin, however, made the symbol V indicate not only the vowel sound u, but also the consonant sound v (i.e., English w), the sign for the digamma F was left un-employed, and as F-H was a cumbrous method of repre- senting a sound which did not exist in Greek, the second element came to be left out in writing. Thus F came to be the representative of the unvoiced labiodental spirant instead of that for the bilabial voiced spirant. Whether the form fefahed was ever good Latin in Rome may be doubted, for the Romans, in spite of the few miles that separate Preeneste from Rome, were inclined to sneer at the pronunciation and idiom of the Prsenestines (c/. Plautus, Trin. 609, True. 691; Quintilian, i. 5, 56). (c) The last, and in some respects the most important of these records, was found in 1899 under an ancient pave- ment in the Comitium at the north-west corner of the Roman Forum. It is engraved upon the four sides and one bevelled edge of a pillar, the top of which has been broken off. As the writing is s°^lo”” f3ovo-TpoRECEI, which is probably the dative of rex. H has still the closed form 0, M has the five-stroke form, S is the three-stroke ^ , tending to become rounded. R appears in the Greek form without a tail, and V and Y are both found for the same sound. The manner of writing up and down instead of backwards and forwards across the stone is obviously appropriate to a surface which is of considerable length, but comparatively narrow, a connected sense being thus much easier to observe than in writing across a narrow surface where, as in the gravestones of Melos, three lines are required for a single word. The form of the monu- ment corresponds to that which we are told was given to the revolving wooden pillars on which the laws of Solon were painted. That the writing of Solon’s laws, which was Bova-Too

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by the phrase o Kwrwdev v6[lo$ in Demosthenes's speech Against Aristocrates, § 28, for which Harpocration is unable to supply a satisfactory explanation.

The differentiation of the Roman alphabet from the Greek is brought about (a) by utilizing the digamma for the unvoiced labiodental spirant F ; (b) by nation ot dropping out the aspirates 0, , x (V in the Roman Chalcidian alphabet, whence the Roman is de- trom Greek rived) from the alphabet proper and employing ap abe . ^em only as numerals, 6 (O) being gradually modified till it was identified with C as though the initial of centum, 100. Similarly ® became in time identified with M as though the initial of mille, 1000, and the side strokes of x in the above form were flattened out till it became [, and ultimately L, 50. (c) After 350 B.C., at latest, there was in Latin no sound corresponding to Z, which was therefore dropped. In the Chalcidian alphabet the symbol for x was placed after the symbols common to all Greek alphabets, a position which X retains in the Latin (and also in the Faliscan) alphabet. K in time passed out of use except as an abbreviation, its place being taken by C, which, as we have seen, is in the earliest inscription still g. Three points here require explanation : (1) Why K fell into disuse ; (2) why C took the place of K ; (3) why the new symbol G was put in the place of the lost Z. It is clear that C must have become an equivalent of K before the latter fell out of use. There is some evidence which seems to point to a pronunciation of the voiced mutes which, like the South German pronunciation of g, d, b, but slightly differentiated them from the unvoiced mutes, so that confusion might easily arise. The Etruscans, who were separated from the Romans only by the Tiber, had lost all the voiced mutes. But another cause was perhaps more potent. C and I C, as k was frequently written, would easily be confused in writing, and Professor Hempl [Transactions of the American Philological Association for 1899, p. 24 ff.) shows that the Chalcidian form of f — I developed into shapes which might have partaken of the confusion. Owing to this confusion, the new symbol G, differentiated from C, took the place of the useless I. In abbreviations, however, C remained as before in the value of G, as in the

names Gaius and Gnaeus. Y and Z were added in the last century of the republic for use in transliterating Greek words containing v and £

The dialect which was mo9t closely akin to Latin was Faliscan. The men of Falerii, however, regularly took the side of the Etrus- cans in wars with Rome, and it is clear that the civilization of the old Falerii, destroyed for its rebellion in 241 B.C., was Etruscan and not Roman in character. Peculiar to this alphabet is the form for t — /|V Much more important than the scanty remains of Faliscan is the Oscan alphabet. The history of this alphabet is different from that of Rome. It is certain from the symbols which they develop or drop that the people of Campania and Samnium borrowed their alphabet from the Etruscans, who held dominion in Campania from the 8th to the 5th century B.C. Previous to the Punic wars Campania had reached a higher stage of civilization than Rome. Unfortunately, the remains of that civilization are very scanty, and our knowledge of the official alphabet outside Capua, and at a later period Pompeii, is practically confined to two important inscriptions, the tabula Agnonensis, now in the British Museum, and the Cippus Abellanus, which is now kept in the Episcopal Seminary at Nola. Of Etruscan origin also is the Urn brian alphabet, represented first and foremost in the bronze tablets from Gubbio (the ancient Iguvium). The Etruscan alphabet, like the Latin, was of Chalcidian origin. That it was borrowed at an early date is shown by the fact that most of its numerous inscrip- tions run from right to left, though some are written f}owrpo

underwent very great phonetic changes at an early period, so that the voiced mutes B, D, G disappeared. Of the existence of the vowel O there is no evidence. If it ever existed in Etruscan, it had been lost before the Oscans and Umbrians borrowed their alphabets. On the other hand, both of their alphabets preserve B and Umbrian G in the form >. Etruscan also retained this symbol in the form), and utilized it exactly as Latin did to replace JJ. Oscan, in order to represent D, introduced later a form SJ, thus creating confusion between the symbols for d and for r. This form was adopted for d because Q had already been borrowed from Etruscan as the symbol for r, although q is also found on Etruscan inscriptions. For the Greek digamma Etruscan used both ^ and ^ , but the former only was borrowed by the other languages. Etruscan, like Latin, used □ "3

(from right to left) to represent the sound of Latin F, hut, unlike Latin, adopted □ not 3 as the single symbol. This form it then wrote as two lozenges ^ , whence developed a later sign, Q , which is used also in Umbrian and Oscan. As the old digamma was kept, this new sign was placed after those borrowed from the Chalcidian alphabet. Similarly it used dS and X for the Chalcidian f ; Umbrian bor rowed the first, Oscan the second form. The form for h was still closed 0, which Etruscan passed on to Oscan, while Umbrian modified it to g) . The form for m has five strokes ; from a later form LU the Oscan form was borrowed. Of the two sibilants, M and < or 2> Oscan adopted only , Umbrian both M and the rounded form 3. *? is found on Etruscan inscriptions, but not in the alphabet series preserved ; neither Umbrian nor Oscan has this form. T appears in Etruscan as y , 7 and X ; of these Umbrian borrows the first two, while Oscan has a form T like Latin. Etruscan took over the three Greek aspirates, 6,

Besides the Italic alphabets already mentioned, which are all derived from the alphabet of the Chalcidian Greek colonists in Italy, there were at least four other alphabets in use in different parts of Italy : (1) the Messapian of the south-east part of the penin- sula, in which the inscriptions of the Illyrian dialect in use there were written, an alphabet which, according to Pauli (Alt-italische Forschungen, iii. chap, ii.) was borrowed from the Locrian alpha- bet ; (2) the Sabellic alphabet, derived from that of Corinth and Corcyra, and found in a few inscriptions of eastern-central Italy ; (3) the alphabet of the Veneti of north-east Italy derived from the Elean ; (4) the alphabet of Sondrio (between Lakes Como and Garda), which Pauli, on the insufficient ground that it possesses no symbols corresponding to 0 and x> derives from a source at the same stage of development as the oldest alphabets of Thera, Melos, and Crete.

From the fact that upon the Galassi vase (unearthed at Cervetri, but probably a product of Caere), which is now in the Gregorian Museum of the Vatican, a syllabary is found along with one of the most archaic Greek alphabets, and that a similar combination was found upon the wall of a tomb at Colle, near Siena, it has been argued that syllabic preceded alphabetic writing in Italy. But a syllabary where each syllable is made by the combination of a sym- bol for a consonant with that for a vowel can furnish no proof of the existence of a syllabary in the strict sense, where

each symbol represents a syllable ; it is rather evidence against the existence of such writing. The syllabary upon the Galassi vase indicates in all probability that the vase, which resembles an ink-bottle, belonged to a child, for whose edification the syllables pa, pi, pc, pu, and the rest, were intended. The evidence adduced from the Latin grammarians, and from abbreviations on Latin inscriptions like lubs for lubens, is not sufficient to establish the theory.

1 For further details of these alphabets, see Conway, The Italic Dialects, ii. p. 458 ff.

It has been argued that the runes of the Teutonic

peoples have been derived from a form of the Etruscan

alphabet, inscriptions in which are spread over

Teutonic t t of nortnern ltaly but of which

runes. & * t t ^ ‘,

the most characteristic are found in the neigh- bourhood of Lugano, and in Tirol near Innsbruck, Botzen, and Trent. The Danish scholar L. P. A. Wimmer, in his great work Die Rimenschrift (Berlin, 1887), contends that the resemblance, though striking, is superficial. Wimmer’s own view is that the runes were developed from the Latin alphabet in use at the end of the 2nd century a.d. Wimmer supports his thesis with great learning and ingenuity, and when allowance is made for the fact that a script to be written upon wood, as the runes were, of necessity avoids horizontal lines which run along the fibres of the wood, and would therefore be indistinct, most of the runic signs thus receive a plausible explanation. The strongest argument for the derivation from the Latin alphabet is undoubtedly the value of / attaching to p ; for, as we have seen, the Greek value of this symbol is w, and its value as / arises only by abbreviation from FH. On

the other hand, several of Wimmer's equations are undoubtedly forced. Even if we grant that the Latin symbols were inverted or set at an angle (a proceeding which is paralleled by the treatment of the Phoenician signs in Greek hands), so that ft repre- sents Latin V, M Latin E, |^ Latin U, and ^. Latin D ; whilet hes ymbol for the voiced spirant S is ^ doubled, jXl, JX], it is difficult to believe that the symbol for the spirant g, viz., X, represents a Latin K (which was of rare occurrence), or again "-j^, J(" a Latin N, or that the symbol for ng, Q, represents <-c doubled. More- over, the date of the borrowing seems too late. The runes are found in all Teutonic countries, and the Bomans were in close contact with the Germans on the Rhine before the beginning of the Christian era. We hear of correspondence between the Bomans and German chieftains in the early days of the empire. It is strange, therefore, if the Roman alphabet, which formed the model for the runes, was that of two whole centuries later, and even then the formal alphabet of inscriptions. By that time the Teutons were likely to have more convenient materials than wood whereon to write, so that the adapta- tion of the forms would not have been necessary. That the Germans were familiar with some sort of marks on wood at a much earlier period is shown by Tacitus's Ger- mania, chap. x. There we are told that for purposes of divination certain signs were scratched on slips of wood from a fruit-bearing tree (including, no doubt, the beech ; cp. book, German buch and buchstabe, a letter of the alphabet); the slips were thrown down promiscuously on a white cloth, whence the expert picked them up at random and by them interpreted fate. In these slips we have the origin of the Norse kefli, the Scots kaivel, which were and are still used as lots. The fishermen of north- east Scotland, when they return after a successful haul, divide the spoil into as many shares as there are men in the boat, with one share more for the boat. Each man then procures a piece of wood or stone, on which he puts a private mark. These lots are put in a heap, and an outsider is called in who throws one lot or kaivel upon each heap of fish. Each fisherman then finds his kaivel, and the heap on which it lies is his. This system of "casting kaivels,"1 as it is called, is certainly of great antiquity. But its existence will not help to prove an early knowledge of reading or writing, for in order that everything may be fair, it is clear that the umpire should

1 This phrase, which is well known in north-east Scotland, seems to have escaped both the New English Dictionary and the Dialect Dictionary.

not be able to identify the lot as belonging to a particular individual. It has, however, been contended that a system of primitive runes existed whence some at least of the later runes were borrowed, and the ownership marks of the Lapps, who have no knowledge of reading and writing, have been regarded as borrowed from these early Teutonic runes.2 Be this as it may, the resemblances between the runic and the Mediterranean alphabets are too great to admit of denial that it is from a Greek alphabet, whether directly or indirectly, that the runes are derived. That Wimmer postdates the introduction of the runic alphabet seems clear from the archaic forms and method of writing. It is very unlikely that a people borrowing an alphabet which was uniformly written from left to right should have used it in order to write from right to left, or /3ovo-Tpo(fir)86v. Hence Hempl contends 8 that Wimmer's view must be discarded, and that the runes were derived about 600 B.C. from a western Greek alphabet which closely resembled the Formello alphabet (one of the ancient Chal- cidian abecedaria) and the Sabellic and North Etruscan alphabets. He thus fixes the date at the same period as Isaac Taylor had done in his Greeks and Goths and The Alphabet. Taylor, however, derived the runes from the alphabet of a Greek colony on the Black Sea. Hempl's initiative was followed by Professor Gundermann of Giessen, who announced in November 1897 4 that he had discovered the source of the runic alphabet, the introduction of which he declares preceded the first of the phonetic changes known as the "Teutonic sound-shifting," since <=g is used for k, X = x f°r ffi a Theta-like symbol for d, while zd is used for st. If this view (which is identical with Taylor's) be true, we have a parallel in the Armenian alphabet, which is similarly used for a new value of the sounds. Hempl, on the other hand, contends that the sound-shifting had already taken place, and, arguing that several of the symbols have changed places {e.g., |2 / and £• a, Q u and 9 b, because at this time b was a bilabial spirant and not a stop), ultimately obtains an order — a b d e f z kgw h i j ^- prstulmnSo. As neither Gundermann nor Hempl has published the full evidence for his view, no definite conclusion at the moment is possible. In one of the earliest runic records which we possess, the pendant found at Vadstena in Sweden in 1774, and dating from about

a.d. 600 (see Plate), the signs are divided up into three series of eight fJJL- (the twenty fourth, |><], being omitted for want of room). Upon the basis of this division a system of cryptography (in the sense that the symbols are unintel- ligible without knowledge of the runic alphabet) was developed, wherein the series, and the position within the series of the letter indicated, were each represented by straight strokes, the strokes for the series being shorter than those for the runes, or the series being represented by strokes to the left, the runes by strokes to the right, of a medial line.5 From this system probably developed the ogam writing employed among the Celtic peoples of Britain and Ireland. The ogam inscriptions in Wales are frequently accompanied by Latin legends, and they date probably as far back as the 5th and 6th centuries a.d. Hence the connexion between Celt and Teuton as regards writing must go back to a period preceding the Viking

2 E. M. Meyer, Paul Braune und Sievers' Beitrdge, xxi. (1896), p. 162 ff.

3 In a paper published in the volume of Philologische Studien, pre- sented as a " Festgabe " to Professor Sievers in 1896, and in a second paper in the Journal of Germanic Philology, ii. (1899), p. 370ff.

4 See Literaturolalt filr germanische und romanische Philologie for 1897, col. 429 f.

6 A species of cryptography exactly like this, based npon the "abjad" order of the Arabic letters, is still in use among the Eastern Persians (E. G. Browne, A Year Amongst the Persians, p. 391 f.).

inroads of the 8th century. Taylor, however, conjectures {The Alphabet, ii. p. 227) that the. ogams originated in Pembroke, " where there was a very ancient Teutonic settlement, possibly of Jutes, who, as is indicated by the evidence of runic inscriptions found in Kent, seem to

have been the only Teutonic people of southern Britain who were acquainted with the Gothic Futhorc." How- ever this may be, the ogam alphabet shows some know- ledge of phonetics and some attempt to classify the sounds accordingly. The symbols are as follows : 2 —

h d

I I 1

t

I I I

I I I I

I I I I

ng /(?z)

/ // /// ////

//// I II 111 I I 1 I

I I I

I I I I I

Ml |.|.|.| MM! / // /// /// //// I M I I I I I I I Mill

The form of the ogam alphabet made it easy to carve hastily ; hence in the old sagas, when a hero is killed we find the common formula, " His grave was dug and his stone was raised, and his name was written in ogam." According to Sophus Miiller (Nordische Altertumskunde, ii. p. 264), it was from Britain that the use of runes upon gravestones was derived, a use which, to judge from the number of bilingual inscriptions in Britain, the Celts derived from the Bomans.

"While the Carian and Lycian were, as we have seen, probably independent of the Greek in origin, so, too, at the opposite end of

. . the Mediterranean was the Iberian (see Table I.). On Phrygian, ^ other hand, the Phrygian was very closely akin to the Greek in alphabet as well as in linguistic character. The Greek alphabet, with which it was most closely connected, was the "Western, for the evidence is strongly in favour of the form "\ having the value of x, not ip, in Phrygian, as it certainly has in the Etruscan inscription found on Lenmos in 1886, which is in an alphabet practically identical.

To a much later era belongs the Armenian alphabet, which,

according to tradition, was revealed to Bishop Mesrob in a dream.

The land might have been Grecized had it not,

Armenian. about A ^ ggy^ be(Jn divided between Persia and

Byzantium, the greater part falling to the former, who discouraged Greek and favoured Syriac, which the Christian Armenians did not understand. As those within Persian territory were forbidden to learn Greek, an Armenian Christian literature became a necessity. Taylor contends that the alphabet is Iranian in origin, but the cir- cumstances justify Gardthausen and Hubschmaun in claiming it for Greek. That some symbols are like Persian only shows that Mesrob was not able to rid himself of the influences under which he lived.

Of the later development of Phoenician amongst Phoenician people little need be said here. It can be traced in the graffiti of the mercenaries of Psammetichus at Abu Simbel in Upper Egypt, where Greeks, Carians, and Phoenicians all cut their names upon the legs of the colossal statues. Still later it is found on the stele of Byblos, and on the sarcophagus of Eshmunazar (about 300 B.C.). The most numerous inscriptions come from the excavations in Carthage, the ancient colony of Sidon. One general feature characterizes them all, though they differ somewhat in detail. The symbols become longer and thinner ; in fact, cease to be the script of monuments and become the script of a busy trading people. While the Phoenician alphabet was thus fertile in de- veloping daughter alphabets in the "West, the progress of writing was no less great in the East, first among the Semitic peoples, and through them among other

peoples still more remote. The carrying of the alphabet to the Greeks by the Phoenicians at an early period affords no clue to the period when Semitic ingenuity constructed an alphabet out of a heterogeneous multitude of signs. If it be possible to assign to some of the monuments discovered in Arabia by Glaser a date not later than 1500 B.C., the origin of the alphabet and its dissemination are carried back to a much earlier period than had hitherto been supposed. Next in date amongst Semitic records of the Phoenician type to the bowl of Baal-Lebanon and the Moabite stone comes the Hebrew inscrip- tion found in the tunnel at the Pool of Siloam in 1881, which possibly dates back to the reign of Hezekiah (700 B.C.). The only other early records are seals with Hebrew inscriptions and potters' marks upon clay vessels found in Lachish and other towns.1 Like the Phoenician, these Hebrew signs are distinctly cursive in character, but, as the logend on the coins of the Maccabees shows, became stereotyped for monumental use, while the Jews after the exile gradually adopted the Aramaic writing, whence the square Hebrew script is descended. The Samaritans alone stuck fast to the old Hebrew as part of their contention that they, and not the Jews, were the true Hebrews.

The oldest records in Aramaic were found at Sindjirli, in the north of Syria, in 1890, and date to about 800 B.C. At this epoch the Aramaic alphabet, or at any rate the alphabet of these records, h but little different from that shown upon the Moabite stone.

1 These are figured most accessibly in Lidzbarski's article on the alphabet in the Jewish Encyclopedia, vol. i. (1901).

Either two sounds are confused under one symbol, or these records represent a dialect which, like Hebrew and Assyrian, shows sh, z, and c, where the ordinary Aramaic representation is .

t, d, and t, the Arabic th, dh, and th. The Aramaic rama °- became in time by far the most important of the northern Semitic alphabets. Even while long and important documents in Assyria were still written on clay tablets, in cuneiform, a docket or prdcis of the contents was made upon the side in Aramaic, which thus became the alphabet of cursive writing — a fact which explains its later development. Two changes, the inception of which

*is early, but the completion of which belongs to the Persian period, gave the impulse which Aramaic obeyed in all its later developments. These were (a) the opening of the heads of letters, so that beth), daleth, £\, and resh A become respectively J, H' and *-\, while O becomes first*

In the land of the Nabatseans, a people of Arabian origin, the Aramaic alphabet was employed in a form which ultimately de- veloped into the modern Arabic alphabet. Probably the . . . earliest example of the Aramaic script in Arabia is the stele of Tema, in north-western Arabia, whereon is commemorated the establishment of a worship of an Aramaic divinity. This monument, now in the Louvre, is not later than the 5th century B. c. In it the writing preserves its ancient form, the heads of the closed letters being only very slightly opened. The Nabatsean inscriptions belong to a different epoch and a different style. They were first discovered by Charles Doughty in 1876-77, who was followed between 1880 and 1884 by Hiiber and Euting, to whom a complete collection of these records is due. The records are fortunately dated, and belong to the period from 9 B.C. to a.d. 75. A further development can be traced in the graffiti with which pilgrims adorned the rocks of Mount Sinai down to the 2nd or 3rd century a.d. By the help of these inscriptions it is possible to trace the development of the modern Arabic where so many of the forms of the letters have become similar that diacritic points are essential to distinguish them, the original causes of confusion being the continuous development of cursive writing and the adoption of ligatures. Arabic writing, as known to us from documents of the early Mahommedan period, exhibits two principal types which are known respectively as the Cufic and the nashki. The former soon fell into disuse for ordinary purposes and was retained only for inscriptions, coins, &c. ; the latter, which is more cursive in character, is the parent of the Arabic writing of the present day. Another form of the Aramaic alphabet, namely, the so-called Estrangela writing which was in use amongst the Christians of northern Syria, was carried by Nestorian missionaries into Central Asia and became the ancestor of a multitude of alphabets spreading through the Turkomans as far east as Manchuria.

There still remains a branch of the Semitic languages which, except for one or two of the languages belonging to it, was practi- cally unknown till

recent years. This is the South Semitic. Till

- *Of. Rhys, Outlines of Manx Phonology, p. 73 (Publications of the Manx Society, vol. xxxiii.) ; Rh$s and Brynmor Jones, The Welsh People, pp. 3, 502. An interpretation of the oldest ogam inscrip- tions is given by Whitley Stokes in Bezzenberger's Beitrage, xi. (1886), p. 113 ff. Besides the collections of ogams by Brash (1S79) and Ferguson (1887), a new collection by Mr R. A. S. Macalister is in course of publication (Studies in Irish Epigraphy, 1897, 1902). Professor Rhys, who at one time considered runes and ogam to be connected, how thinks that ogam was the invention of a grammarian in South Wales who was familiar with Latin letters.*

3 See Berger's Histoire de I'Ecritwre dans V Antiquity p. 252 ff. ; Lidz- barski, Nnrdsemitische Epigraphik, p. 186 ff., from whom this summary is taken. Lidzbarski's second volume contains the most convenient collection of Northern Semitic inscriptions for the student's purposes.

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the 19th century the earliest form known of this alphabet was the Ethiopian or Geez, in which Christian documents have been pre- Soath served from the early centuries of our era, and which

Semitic. js 8'^ use<* ^ the Abyssinians for liturgical purposes. The travels of two English naval officers, Wellsted and Cruttenden, through Yemen in southern Arabia in 1835, first called attention to the earlier monuments of Arabia. Fulgence Fresnel first established the importance of the inscriptions dis- covered by these Englishmen, and in 1843, when French consul at Jeddah, obtained through a French traveller, Francois Arnaud, information about other monuments of the same kind. In 1869 Joseph Halevy brought back nearly seven hundred inscriptions from Yemen, and this number has been increased from oiher quarters by several thousands, through the energy of several adventurous scholars, but chiefly by Eduard Glaser's repeated journeys. The south Arabian inscriptions to which the terms Himyaritic and Sabsean are applied fall*

*into two groups, the Sabaean proper and the Minsean. These are distinguished by differences in grammar and phraseology rather than in alphabet. The relative age of the Minsean and Sabsean monuments is a matter of dispute amongst Semitic scholars. Inscriptions in a kindred dialect were brought from El-Ola, in the north of the Hedjaz, by Professor Euting. To these D. H. Miiller i gave the title of Lihyanite, from the name of the tribe (Libjan) to which they belong. Their date is supposed to be earlier than that of the Sabsean and Minsean. Minrean inscriptions were found at the same place, the Minseans having had a trading station there. In 1893 J. Theodore Bent copied carefully at Yeha in Abyssinia a few inscriptions, some of which had been already copied in 1814 by the English traveller Salt. These inscriptions are of the greatest importance, because they demonstrate, according to D. H. Muller,8 that the Sabieans had colonized Abyssinia as early as 1000 B.C. Other inscriptions copied by Bent at Aksum belong to the 4th century a.d. and later. Two of the earliest are written in Sabaean characters, but in the language which is known as Geez or Ethiopic. From about A.D. 500 Ethiopic was written in an alphabet which according to Miiller was no gradual growth but an ingenious device of a Greek scholar of this period at the court of Abyssinia. The Sabsean, like other Semitic, inscriptions are generally written from right to left, but a few are fiamTpt><$rtfibv ; the Ethiopic is written from left to right, and makes a marked advance upon the ordinary Semitic manner of writing by indi- cating the vowels. This is done by varying the form of the consonant according to the vowel which follows it. The Ethiopic system is thus rather a syllabary than an alphabet. It is noticeable that the changes thus established were made upon the basis of the old Sabsean script, which in its oldest form is evidently closely related to the old Phoenician, though it would be premature to say that the Sabsean alphabet is derived from the Phoenician. It is as likely, considering the date of both, that they are equally descendants from an older source. The characteristics of the Sabsean are great squareness and boldness in outline. It has twenty-nine symbols, whereby it is enabled to differentiate certain sounds which are not distinguished from one another in the writing of the Northern Semites. As we have seen, it is a tendency in Northern Semitic to open the heads of letters, and therefore it is possible that the Sabaean form for Jod V may be older than the Phoenician \i . Similarly if Pe means mouth, Hommel is right in contending that the Sabsean *

is more like the object than the Phoenician ^)t if we suppose the form, like ^ or the Phoenician \ J and ^ for the Phoenician ‘ / , turned through an angle of 90°. So also if Kaf corresponds to the Babylonian Kappu, “hollow-hand,” the Sabsean form p) which Hommel3 interprets as the outline of the hand with the fingers turned in and the thumb raised is a better pictograph than the various meaningless forms of Tc (^J, &c.).

The rock inscriptions in the wild district of Safah near Damascus which have been collected by Halevy are also written in an Arabic dialect, but, owing chiefly to their careless execution, they are to a large extent unintelligible. The character appears to be akin to the Sabsean. It has been suggested that they were the work of Arabs who had wandered thus far from the south.

There still remain for discussion the alphabets of the Indo- European peoples of Persia and India from which the other alpha- bets of the Farther East are descended. “We have already Persia. geen [na] wnen Darms in 5×6 Bi 0. caused the great Behis- tun inscription to be engraved, it was the cuneiform writing that was adopted for this purpose. We have also seen that at Babylon itself the Aramaic language and character were well known. It is probable therefore, & priori, that from the Aramaic alphabet the

1 Miiller, Epigraphische Denkmaler aus Arabien (Vienna, 1889).

2 Epigraphische Denkmaler aus Abessinien (Vienna, 1894).

3 Hommel, Sud-arabische Chrestomathie (Munich, 1893), p. 5.

later writing of Persia should be developed. The conclusion is confirmed by the coins, the only records with Iranian script which go back so far ; but the special form of Aramaic from which the Iranian alphabet is derived must at present be left undecided. The later developments of the Iranian alphabet are the Pahlavi and the Zend, in which the MSS. of the Avesta are written. Of these manuscripts none is older than the 13th century A.D. The Pahlavi is properly the alphabet of the Sassanid kings who ruled in Persia from a.d. 226 till the Arab conquest in the 7th century A.D. Under the Sassanids the old Persian worship, which

TABU I. EARLIEST MEOITE/tMf|lEAK SYMBOLS

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had fallen with the Achaamenid dynasty in Alexander's time, and had been neglected by the subsequent Arsacid line, was revived and the remains of its liturgical literature collected. The name is, however, also applied to the alphabet on the coins of the Parthian or Arsacid dynasty, which in its beginnings was clearly under Greek influence ; while later, when a knowledge of Greek had disappeared, the attempts to imitate the old legends are as grotesque as those in western Europe to copy the inscriptions on Roman coins. The relationship between the Pahlavi and the Aramaic is clearest in the records written in the "Chaldseo- Pahlavi " characters ; the most important of these documents is the liturgical inscription of Hadji-abad where the Arsacid and Sassanian alphabets are found side by side. Taylor (The Alphabet, ii. p. 248 f.) regards the former as probably derived from the "ancient alphabet of Eastern Iran, a sister alphabet of the Aramaean of the satrapies," while the Sassanian belongs to a later stage of Aramaic.

The alphabets of India all spring from two sources: (a) the Kharosthi, (J) the Brahmi alphabet. The history of the former is fairly dear. It was always a local alphabet, and never attained

the importance of its rival. According to Biihler,1 its range lay- between 69° and 73° 30' E. and 33° to 36° N., a con- a' elusion which is not invalidated by the fact that some

important modifications are found beyond this area, nor by Dr Stein's discovery of a great mass of documents in this alphabet at Khotan in Turkestan, for, according to tradition, the ancient in- habitants of Khotan were emigrants banished in the time of King Acoka from the area to which Biihler assigns this alphabet (see Stein's Preliminary Report, 1901, p. 51). Eapson2 has pointed

out that both Kharosthi and Brahmi letters are found upon Persian silver sigloi, which were coined in the Punjab and belong to the period of the Achsemenid kings of Persia. As Biihler shows in detail, the Kharosthi alphabet is derived from the alphabet of the Aramaic inscriptions which date from the earlier part of the Achsemenid period. The Aramaic alphabet passed into India with the staff of subordinate officials by whom Darius organized his conquests there. The people of India already possessed their Brahmi alphabet, but had this other alphabet forced upon them

Table II. — Development of the Semitic Alphabet.

OLDEST SAB/ZAN NASHKI TEMA SIND^IRU MOABITE PHOENICIAN f^cmP "^Forum'" BRAHMI KHAROSTHI ATHIOPIC (Himyarifta (ARABIC' 500 BC 800BC Stone (CYPRUS) ofMELOS Inscription

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~~in their dealings with their rulers. The Kharosthi is then the gradual development under local conditions of the Aramaic~~

~~1 Biihler, Indian Studies, iii. (2nd edition, 1898), p. 93. The account of these alphabets is drawn from this work and from the same author's Indische Palceographie in the Grundriss der indo-arischen Philologie, to~~

which is attached an atlas of plates (Strasburg, 1896), and in which a full bibliography is given.

2 For a coin and a gild token with inscriptions see Rapson's Indian Coins (in Grundriss d. ind-ar. Phil.), plate i.

alphabet of the Persian period. As Stein's explorations show, Doth alphabets may be found on opposite sides of the same piece of wood. The history of the Brahmi alphabet is more difficult. In its later forms it is so unlike other alphabets that many scholars have regarded it as an invention within India itself. The discovery of earlier inscriptions than were hitherto known has, however, caused this view to be discarded, and the problem is to decide from which form of the Semitic alphabet it is derived. Taylor (The Alphabet, ii. p. 314 ff.), following Weber, argues that it comes from the Sabseans who were carrying on trade with India as early as 1000 B.o. Even if the alphabet had not reached India till the 6th

century B.C., there would be time, he contends, for the peculiari- ties of the Indian form of it to develop before the period when records begin. The alphabet, according to Taylor, shows no resemblance to any Northern Semitic script, while its stiff, straight lines and its forms seem like the Sabaean. Buhler, on the other hand, shows from literary evidence that writing was in common use in India in the 5th, possibly in the 6th, century B.C. The oldest alphabet must have been the Brahml lipi, which is found all over India. But he rejects Taylor's derivation of this alphabet from the Sabaean script, and contends that it is borrowed from the North Semitic. To the pedantry of the Hindu he attributes its main characteristics, viz. : (a) letters made as upright as possible, and with few exceptions equal in height ; (b) the majority of the letters constructed of vertical lines, with append- ages attached mostly at the foot, occasionally at the foot and at the top, or (rarely) in the middle, but never at the top alone ; (c) at the tops of the characters the ends of vertical lines, less frequently straight horizontal lines, still more rarely curves or the points of angles opening downwards, and quite exceptionally, in the symbol ma,

~~two lines rising upwards. A remarkable feature of the alphabet is that the letters are hung from and do not stand upon a line, a characteristic which, as Buhler notes (Indian Studies, iii. p. 57 n.), belongs even to the most ancient MSB., and to the Acoka inscriptions of the 3rd century B.C. When these specially Indian features have been allowed for, Buhler contends that the symbols borrowed from the Semitic alphabet can be carried back to the forms of the Phoenician and Moabite alphabets. The proof deals with each symbol separately ; as might be expected of its author, it is both scholarly and ingenious, but, it must be admitted, not very convincing. Further evidence as to the early history of this alphabet must be discovered before we can definitely decide what its origin may be. That such evidence will be forthcoming there is little doubt. Even since Buhler wrote, the vase, the top of which is reproduced (see Plate), has been discovered on the borders of Nepal in a stupa where some of the relics of Buddha were kept.^ The inscription is of the same type as the Acoka inscriptions, but, in Buhler's opinion (Journal of the Royal Asiatic Society, xxx., 1898, p. 389), is older than Acoka's time. It reads as follows : iyam salilanidhane Budhasa bhagavate saMyanam sukitibhatinam sabhaginikanam saputadalanam. "This casket of relics of the blessed Buddha is the pious foundation (so Pischel, no doubt rightly, Zeitsch. deutsch. morg. Gesell., vol. lvi. p. 158) of the Cakyas, their brothers and their sisters, together with children and wives. "~~

~~How this alphabet was modified locally, and how it spread to other Eastern lands, must be sought in the specialist works to which reference has already been made.~~

~~Authorities. — Since the article on Alphabet in the ninth edition of this Encyclopaedia in 1875, the only general works that have been produced are The Alphabet (2 vols.), by Canon Isaac Taylor (1883), reprinted from the stereotyped plates with small necessary cor- rections (1899) ; and Histoirc de I'Ecriture dans V AntiquiU, par M. Philippe Berger (Paris 1891, 2nd edition 1892). The literature of separate departments has been indicated in the notes. The writer is indebted to Mr A. J. Evans for the photograph of a Cretan tablet and for information regarding the excavations in Crete, and to Professors H. A. Giles and Bevan of Cambridge and Mr F. "W. Thomas, sub-librarian of the India Office, for~~

~~help in their respec- tive departments of Chinese, Semitic, and Indian languages.~~

~~(p. Gl.)~~

~~Wuchang, the capital of the combined provinces of Hupeh and Hunan, China, situated on the right bank of the river Yangtse, almost directly opposite the foreign settlement of Hankow. It is the seat of the provincial government of the two Hu or Hukwang, as these provinces are collectively termed, at the head of which is a governor- general -or viceroy. Next to Nanking and Canton, it is one of the most important vice-royalties in the empire, disposing of large revenues, and employing a considerable military force, which is partially foreign drilled and armed. It possesses an arsenal, and a mint for the coinage of silver dollars and copper cash. The provincial government has also at great cost established iron-works for the manu- facture of rails and other railway material. As the works did not pay under official management, they have been transferred to the director-general of railways. Wuchang is not open to foreign trade and residence, but a consider- able number of missionaries, both Catholic and Protestant, live within the walls and carry on their work without molestation. The native population is estimated at 800,000, including cities on both banks.~~

~~Wuchow, a treaty port in the province of Kwangsi, China, situated on the left bank of the Si-kiang (West river), at its junction with the Fuho. It is 220 miles above Canton, with which it is in navigable connexion for vessels drawing up to eight feet of water. It is a large commercial centre for local distribution of goods. The country round about is rich and in a high state of culti- vation. In 1900 the value of the trade passing through the maritime customs amounted to H. taels 6,552,590 (£1,017,000), representing, however, only a portion of the trade. Of this total, two-thirds were for imports, consist- ing principally of cotton and cotton goods, kerosene oil, woollens, ha. Sugar, various oils, hides, and aniseed were the chief exports. The native population is estimated at about 50,000. The scenery on the Si-kiang, as Wuchow is approached, is very fine. At Shuihing the river cuts transversely a ridge of hills, and flows for five miles through a deep gorge bordered by limestone cliffs 2000 feet in~~

height. Farther up the river threads its way through a series of rocky defiles, forming at intervals what seems an inland lake with no apparent outlet. During summer floods the water thus pent up by the gorges rises at Wuchow 50 or 60 feet.

Wun, a town and district of India, in Berar or the Haidarabad' Assigned Districts. Population of the town (1881), 4207; (1891), 4856. There is no municipality. An important cattle fair is held annually. The district of Wun has an area of 3911 square miles; population (1881), 392,102 ; (1891), 471,613 ; (1901), 466,811. The land revenue and rates are Bs.6,63,458 ; cultivated area (1897-98), 1,178,219 acres; number of police, 440; boys at school (1896-97), 4775; death-rate (1897), 41-6 per 1000. The principal crops are millet, cotton, pulse, oil- seeds, and wheat. The chief centre of trade is Yeotmal (population, 6464), where cotton is ginned and pressed, and exported by road to the railway in the neighbouring district of Amraoti. Coal has been found, but is no longer worked ; and iron ore abounds.

Wundt, Wilhelm Max (1832-), German

physiologist and philosopher, was born 16th August 1832 at Neckarau, in Baden. He studied medicine at Tubingen, Heidelberg, and Berlin, and in 1857 began to lecture at Heidelberg on medical subjects. In 1864 he became assistant professor there, and in 1866 was chosen to represent Heidelberg in the Baden Chamber, but he soon resigned this office. In 1874 he was elected regular professor of philosophy at Zurich, and in the following year was called to the corresponding chair at Leipzig. The list of Professor Wundt's works is a long and compre- hensive one, for it includes physiology, psychology, logic, and ethics. His earlier works deal chiefly with physi- ology, though often in close connexion with psychology, as in the Vorlesungen iiber die Menschen- und Tier-seele (1863), Lehrbuch der Physiologie des Menschen (1865), and Grundzuge der physiologischen Psychologie (1874). He published an important work on Logik (1880-83), and this was followed in 1886 by his Ethik. According to Wundt, the straight road to ethics lies through ethnic psychology, whose especial business it is to consider the history of custom and of ethical ideas from the psycho- logical standpoint. We must look for

ethics to supply the corner-stone of metaphysics, and psychology is a necessary propaedeutic. The System der Philosophie (1899) contains the results of all Wundt's past work, both in the domain of science and in the more strictly philosophic field. The metaphysical or ontological part of psychology is in Wundt's view the actual part, and with this the science of nature as well as the science of mind are to be brought into relation, and thus constituted as far

as possible philosophical sciences. In 1892 Wundt pub- lished a volume on Hypnotismus und Suggestion. The Philosophische Studien, published at Leipzig, contains articles by Wundt and his pupils, dealing chiefly with experimental psychology. (See also Metaphysics.)

Wurnu. See Nigeria.

Wurtemberg, a kingdom of Germany, with an area of 7528 square miles, and population (1885), 1,995,185; (1895), 2,081,151; (1901), 2,169,434. The density is thus 288 inhabitants to the square mile. The population of the four circles into which the kingdom is divided is shown in the following table : —

Circle.

Area in sq. miles.

Population,

1895.

Population,

1900.

Density per

sq. mile,

1900.

Neckar . Black Forest . Jagst Danube .

1284 1842 1984 2418

697,373 488,431 398,887 496,460

745,675 509,258 400,005 514,496

581 276 201 213

Total

7528

2,081,151

2,169,434

- 288

Between 1885 and 1895 the population thus increased at the rate of 4‘3 per cent., and between 1895 and 1900 at the rate of 4 -2 per cent. In the last-mentioned year the urban population numbered 35 per cent, of the whole, and the rural population 65 per cent. There were 1,052,716 males and 1,116,718 females, or 1060 females for every 1000 males. Classified according to religion, 1,497,349, or “69 per cent., were Evangelical Protestants in 1900, and 649,876, or 30 per cent., Roman Catholics; Jews numbered 11,859; “others,” 10,350. The marriage-rate was 7 ‘8 per 1000 inhabitants, the birth-rate 35-4, the death-rate 22‘1. The illegitimate births were just under 10 per cent, of the total births. Wurtemberg takes the very highest rank in respect of educational efficiency, a result largely due to the energy and talent of the late Dr von Sarwey. There is not an individual in the kingdom, above ten years of age, who cannot both read and write. In 1900 there were 2340 elementary public schools, 174 modern and classical schools, and 6 lyceums. The higher branches of

learning are provided in the University of Tubingen , in the technical high school, with academic rank since 1900, of Stuttgart (627 students in 1900), and at various special schools, e.g., the royal building trades school (over 800 pupils), the veterinary high school at Stuttgart, the com mercial college at Stuttgart, and two commercial improve- ment schools, one at Stuttgart, the other at Heilbronn. There are, further, seven spinning, weaving, and knitting schools, and a mechanicians' technical school. Stuttgart is famous for its conservatory of music, and has a good school of art. In 1899 there were twelve girls' higher schools, the Olga Institute and the Catherine Institute (two colleges for girls), and the girls' gymnasium (founded in 1899). The agricultural college of Hohenheim (usually about 100 students) is one of the best equipped institutions of the kind in Europe. In addition there are three farming schools and nearly a dozen winter agricultural schools. There is a school of viticulture at Weinsberg. The emigra- tion steadily decreased from 6445 in 1888 to 1151 in 1898, but was 1250 in 1899 and 1160 in 1900.

—Agriculture. — Of the entire area, 64 per cent, is under cultiva- tion, mostly by peasant proprietors. In 1895 the total number of farms was 306,643, and of these 106,846, or 34'8 per cent., were each less than 2J acres ; 173,422, or 56'6 per cent., were each be- tween 2J and 25 acres ; 26,219 between 25 and 250 acre9 ; and 156 exceeded 250 acres. Some 1,080,000 persons, or half of the entire population, are supported by agriculture. In 1900 vineyards covered 41,740 acres, and yielded 9,637,000 gallons of wine, valued at close upon one million sterling; and 11,640 acres were planted with hops. The fruit crop, chiefly of cherries and apples (which are

made into cider), averagessome £400,000 annually. In 1900 the live stock comprised 1,017,683 cattle, 512,485 pigs, 315,965 sheep, and 112,129 horses. The kingdom has over 400 co-operative dairies.

Mining and Industry.- — Salt-works produced 280,870 tons of salt, valued at £103,900, in 1900. The produte of the iron foundries and furnaces amounted to 48,920 tons, and was valued at £565,400. The sugar factories turned out 14,410 tons of sugar ; the breweries, 85,286,300 gallons of beer ; and the distilleries, 862,970 gallons of pure alcohol. The

manufacturing industries developed at a rapid rate during the last years of the 19th century. For example, the number of workpeople employed in the fifteen leading industries increased nearly 50 per cent, in the years 1894-99. As in other parts of Germany, the chemical and electrical industries made remarkable progress. Amongst other interesting developments is the manufacture of liquid carbonic acid gas procured from natural gas springs beside the Eyach, a tributary of the Neckar.

Communications. — In 1900 the railways had a total length of 1193 miles, of which 1141 miles belonged to the state.

Finances. — The state revenue for 1902-03 was estimated at £4,557,415, and the public expenditure at £4,427,800. The revenue is principally derived from the railways and forests, and direct taxation. The public debt in 1902 amounted to £24,758,400, of which over 90 per cent, was incurred for railway construction. Nearly 16 per cent, of the total national annual expenditure is spent upon "worship and education," principally the latter, or say some £650,000 out of a total of 4J millions sterling. The quota which Wurtemberg contributed to the imperial treasury in 1901 amounted to £1,092,500.

Army. — The forces formingthe 13th corps of the imperial German army had on a peace footing 24,106 men in 1901.

Wiirzburg, a city and episcopal see of Bavaria, Germany, capital of the district of Lower Franconia, 63 miles north-west of Nuremberg by the railway to Frank- fort, and on the river Main. The exterior of the cathedral was restored in 1882-83. Amongst the most notable additions to the town buildings are the law courts (1892- 1895), two fountains — the Kilian (1895) and the Luitpold (1893), and two bridges across the Main — the Luitpold (1887) and the Ludwig (1894). In the castle are pre- served a picture gallery and the collections of the Historical Society. The university was attended by 1108 students in 1901, and had 91 professors. Its institutions embrace a library of over 250,000 volumes, and laboratories and collections in all departments, especially medical and physical. There are many other educational establish- ments; e.g., a botanical garden, art museum, picture and sculpture galleries, cabinet of coins, astronomical observa- tory, antiquarian museum, schools of

agriculture, viticul- ture, and horticulture, theological and pedagogic semi- naries, a music school, polytechnic schools, weaving school, deaf and dumb and blind asylums. It is a centre of the German wine trade. Population (1885), 55,010; (1895),

68,747 ; (1900), 75,497.

Wurzen, a town of Germany, on the Mulde, here crossed by two bridges, 15 J miles by rail east by north of the city and in the circle of Leipzig, kingdom of Saxony. It has an old cathedral, a castle, a higher-grade girls' school, and an agricultural school. The industries comprise iron-founding and the making of machinery^ There are also important mills, with a large biscuit factory. Popula- tion (1890), 14,635; (1900), 16,614.

Wyandotte, a city of Wayne county, Michigan, U.S.A., on the Detroit river, and the Michigan Central, the Detroit and Lima Northern, and the Lake Shore and Michigan Southern railways, in the south-east part of the lower peninsula. Population (1890), 3817; (1900), 5183, of whom 1267 were foreign-born.

Wyoming, a north-western state of the United States, admitted to the Union on 10th July 1890. The increase in population has been continuous though not rapid. The leading industries — stock-raising, coal-mining, and irrigated agriculture — are not calculated to secure a rapid growth. In 1880 the population was 20,789 ; in 1890, 60,705; and in 1900, 92,531. Cheyenne, the state

capital, is the largest city. Its population in 1890 was 1 1,760, and in 1900 it was 14,087. Of the total population in 1900, 58,184 were males and 34,347 were females; 75,116 were native-born and 17,415 (18-8 per cent.) foreign-born. There were 940 negroes, 461 Chinese, 393 Japanese, and 1686 Indians. Out of 37,898 adult males, 1636 were illiterate (unable to write), of whom 979 were foreign-born, 348 were Indians, and 102 were negroes. The lack of railway centres and of manufacturing districts has

~~thus far operated against the growth of towns. The principal increase in population since 1890 has been in the irrigated districts and mining camps, but there are indications that manufacturing will in the near future assume greater importance.~~

~~Agriculture and Stock- Raising. — The free pasturage afforded by the large areas of public land covered with scanty but nutritious grass has made the pioneer industry of stock-raising a lucrative, if somewhat hazardous, business. Formerly all kinds of stock were left on the open range all the year round, but winter feeding on the irrigated farms has greatly increased, to the advantage of both the farmer and the stock-raiser. The significant feature of the range stock business in recent years has been the decrease in cattle and the increase in sheep. Between 1889 and 1899 the number of cattle declined from 623,283 to 311,629, and their value from $7,014,661 to $5,412,792; while the number of sheep rose from 459,991 to 2,164,701 and their value from $794,557 to $4,380,681. In 1899 there were 82,446 horses valued at $1,336,490, and 3192 swine valued at $13,754. The total value of all live stock was $11,143,717.~~

~~Finances. — The total valuation of state property in 1889 was $31,431,495; in 1894 it had fallen to $29,198,041, and in 1899 it had risen again to $35,578,806. State taxes, excepting the support of state educational and charitable institutions and interest on the public debt, are limited to four mills on the dollar of assessed valuation, and county taxes to twelve mills on the dollar of assessed valuation. The state has no floating debt. Its total bonded debt is $320,000, incurred for building the capital, the university, the insane asylum, and other public buildings. The rate of interest on the debt is 6 per cent. In 1899 the state levied taxes for state, county, general schools, special schools, interest on bonds and other purposes, to the amount of $813,535, not including the school poll-tax. Of the 63 million acres of the state's . area, less than 10 per cent., or 6,192,233 acres, is taxed, the average assessed value being a little over $1 per acre. Three-fourths of this is, or was, a part of the Union Pacific land-grant. A surprisingly small percentage of the public lands has been disposed of under the public land laws. There are in all in the state thirteen national banks, nine state banks, and nine private banks, with a. capital in 1900 of $1,168,867 and deposits of $5,572,549.~~

~~*Irrigation. — About one million acres of land are irrigated, the water being diverted in between 6000 and 7000 ditches from over 600 natural streams. The following table summarizes the grants of titles to water for the land proved to be irrigated between the organization of the state in 1890 and the end of 1898 : —*~~

~~*Year.*~~

~~*Streams.*~~

~~*Certificates of Appropria- tion.*~~

~~*Volume cubic feet per second.*~~

~~*Acres Irrigated.*~~

~~*J891 . .*~~

~~*1893 . . 1895 . . 1897 . .*~~

~~*35*~~

~~*50*~~

~~*60*~~

~~*153*~~

~~*993*~~

~~*548*~~

~~*1010*~~

~~*947*~~

~~*3,074-05*~~

~~*902-48*~~

~~2,262-14~~

~~1,678-81~~

~~203,658 55,442-36 113,270-41 108,986-71~~

~~Total .~~

~~298~~

~~3498~~

~~7,917-48~~

~~481,357-48~~

~~To this are to be added decrees for water to irrigate 100,000 acres, issued between 1888 and the time of Wyoming's admission as a state, and for nearly half a million acres now being irrigated, for which proof has not as yet been submitted.~~

~~Mining and Manufacturing. — Although some of the richest mines of silver and gold in the country are within fifty miles of each of the four borders of the state, there is not a single paying silver mine within them, and the profitable gold-mines can be counted on the fingers of one hand. Coal is the chief mineral product It is found in every county in the state, and is mined~~

~~commercially in all but two. In 1890 the output was 1,870,366 tons, and by 1901 it had steadily risen to more than double this, or 4,392,497 tons, valued at $7,686,869, the estimated value at the mine being $1.75 per ton. Coal oil is produced, but the product is heavy, being better suited for lubricating than for illuminating. A small refinery at Casper produces machine oils, axle grease, and paraffin products. Copper has been discovered in paying quantities. There are two deposits of hsematite ore of known excellence. The deposit at Hartville, Laramie county, covers an area of several square miles and extends to an unknown depth. It assays over 60 per cent, iron, and is one of the greatest deposits of Bessemer ore~~

~~in the world. It can be mined and loaded wholly by machinery. Two railways have been built to this place. The other deposit at Seminoe, in Carbon county, is also a Bessemer ore of excellent quality. Its extent is as yet unknown. The opening up of the iron-mines and oil-fields promises the beginning of an era of manufacturing and a more diversified industrial life. Better transportation will make available soda, building stone, and a long list of minerals of less commercial importance. The manufacturing establishments, which are confined mostly to products for local consumption, numbered 196 in 1900 (excluding those classified as hand trades, and others with a product of less than $500). They had » total capital of $2,242,840, an average number of 1963 wage-earners, and products valued at $3,493,306.~~

~~Railways and Telegraphs. — In 1900 there were 1180 miles of railways, assessed at a value of $7,118,902, and 1017 miles of telegraph lines, assessed at $103,364. Almost half of this was constructed after 1890 ; and by the end of 1900 about 200 miles of railway was added. The leading lines are the Union Pacific with its tributaries (534 miles), Grand Island and North Wyoming (237 miles), Burlington and Missouri (about 200 miles), Cheyenne and Northern (154 miles), and Wyoming Central (130 miles).~~

~~Education. — For the school year closing in September 1901 there were enrolled 15,764 pupils, who were taught in 620 common schools by 563 teachers. School attendance is compulsory. Text-books are free, being furnished by the state. The i'unds for the support of both primary and higher education are derived in part (rom taxation and in part from the rentals of school lands, of which the state owns about 4,000,000 acres. As the lands may not be sold for less than $10 an acre, or more than ten times their market value, only a few hundred acres adjoining town sites have been sold. To support the schools $191,773 was collected by taxes, $25,607 was received from the common school land income fund, and $7575 received mainly from interest on the proceeds of land sales. The State University at Laramie is an institution for higher education, the state agricultural college being combined with it. The buildings completed, or now in proeess of com- pletion, represent a total expenditure of over $150,000. The attendance for 1899 was 142, 76 of~~

~~*whom were males and 66 females. The total number of instructors is 13, In addition to the funds provided by the state, the agricultural college and experiment station receives $40,000 a year from the National Government.*~~

~~*Religion and Charities. — Large sections of Wyoming are so sparsely and so recently settled that many districts are not able to, support church organizations ; and although their inhabitants may be church members, it is difficult to secure accurate statistics regarding them. The three largest denominations are the Roman Catholics, with about one-tenth of the population of the state, the Latter Day Saints or Mormons, whose membership is unknown, and the Methodists.*~~

~~*The state insane asylum at Evanston, the miners' hospital at Rock Springs, the two penitentiaries at Laramie and Rawlins, are . all commodious and well equipped. There is also a state soldiers' home at Cheyenne, . and a state poor farm at Lander.*~~

~~*Legislation and Politics. —The constitution and laws under which the state was admitted to the Union contain few special features. All state officers, except judges of the Supreme Court, are elected for a term of four years ; the latter for eight years. The sessions of the legislature are limited to forty days. Two features of the con- stitution were departures from existing instruments at the time of its adoption in 1890. The first was the giving of equal suffrage and equal political rights to both sexes. The second was the result of the realization of the fact that the social and industrial problems of arid lands are largely problems of water. The constitution makes the water of all natural streams, springs, lakes, and other collections of still water the property of the state, providing for its use under state control. Both innovations have justified the claims of their supporters. State control of streams has relieved the irrigators of Wyoming from the controversies over water rights which have proved so burdensome in some bther states.*~~

~~*Wyoming, unlike most or all of the surrounding states, voted for the maintenance of the gold standard at the Presidential elections of 1892 and 1896. The difference was probably due to the absence of silver-mines*~~

~~and to the general prosperity which prevailed. In the Presidential election of 1900, out of a total vote of 20,863, the Re-~~

~~(E. M*.)~~

~~publicans polled 10,072 and the Democrats 10,655.~~

~~S. IX.~~

~~Xanthi (or in Turkish, Eskidja), a town in the sanjak of Gumuldjina, vilayet of Adrianople, Turkey in Europe, situated at the foot of the slopes of Mount Rhodope, and on the Salonica-Dedeaghatch-Constanti- nople railway, 29 miles west of Gumuldjina. There are remains of the ancient stronghold of the Middle Ages, and on the plain the ruins of an ancient Greek town. The town, which is built in the form of an amphitheatre, possesses six mosques, five Orthodox churches, three monasteries, a theatre with public garden, and a municipal garden. Among other schools is a preparatory one for boys and girls founded and endowed by Mazzini. There is a considerable general trade, but the town is chiefly notable for the famous De Yemidje tobacco. The popula- tion is estimated at 14,000, of whom the bulk are Turks~~

~~and Greeks in about equal proportions, and the remaindec (about 4000) Armenians, Catholics, or Jews.~~

~~Xenia, a city of Ohio, U.S.A., capital of Greene county, in the Miami valley, on the Cincinnati, Hamilton, and Dayton, and the Pittsburg, Cincinnati, Chicago, and. St Louis railways, in the south-western part of the state, at an altitude of 910 feet. It is regularly laid out, with broad streets, and is divided into seven wards. It is surrounded by a rich farming region, for which it serves as a market-place. It has varied manufactures.~~

~~Popula- tion (1890), 7301 ; (1900), 8696, of whom 410 were foreign-born and 1988 negroes.~~

~~XingfU. See Amazon.~~

~~Yachting. — It is both natural and desirable that one of the leading pastimes of a maritime nation should be yachting, while, in addition to the health and pleasure to be derived from its pursuit, there are few other sports in which the individual interested can equally employ his intellectual powers. Almost every known mechanical principle, and some as yet not .fully understood, find a place in the designing of a modern racing yacht. For several centuries British sovereigns, as well as a few of their subjects, owned yachts, while in 1720 and 1775 respectively the Cork Water Club and the Cumberland Fleet, upon the Thames, were formed to encourage the sport. Still, it was not until the early part of the 19th century that yachting became even in a measure popular, while it may be said that the vessels built then were either examples of artisans' skill working on tradi- tional lines, or, and more rarely, the result of blind experi- ments. Now, however, the designer works with a knowledge of the principles involved, for the effect of every curve in the vessel is calculated before her keel is laid, and the desired result in a great measure arrived at. Still, it must be remembered that the axioms of one generation are frequently disproved by the next. Like any other sailing vessel, a yacht is essentially a compromise between many opposing forces, for the quality that renders her safe and stable may make her slow, that which tends to speed may reduce her internal accommodation, and the power of beating to windward unduly increase her draught. Thus few advantages are secured without sacrificing others. Pacing is the dominating influence in yachting, for even vessels built entirely for cruising generally follow the type of racing craft more or less. Therefore the history of yachting is bound up with that of yacht-racing and its measurement rules.~~

~~Racing yachts may be divided into three classes, mentioned inversely to their order of importance. (1) There is what may be called the free handicap class, i.e., vessels built for cruising or obsolete racers. These are generally handicapped on their supposed merits, instead of on a definite scale, and though this rarely affords universal satisfaction, such races are~~

~~fairly numerous. The system of starting a race and allowing for handicap may be briefly explained. Yachts are now almost invariably started level. An imaginary line is taken between two anchored vessels, a pier and a buoy, or other convenient marks, and the competing yachts get under way when it suits their owners. Fifteen minutes exactly before the starting-time a flag is hoisted denoting the race. Ten minutes later this flag comes down, a gun is fired and the blue peter hoisted, while the yachts manreuvre for the best position near the line. Then, at the exact moment,~~

~~a second gun is fired, the blue peter run down, and the helmsman endeavours to take his craft across the line almost simultaneously. Should any spar, however, cross it a moment too soon, the boat is recalled, and must keep clear of the others while regaining a position to start again. Then, as the yachts eventually pass the finishing marks, their times are carefully taken, and the number of minutes each has to allow deducted ; while it occasion- ally happens that the last boat wins because the leaders have not arrived sufficiently long before her. The fore- going also applies to vessels handicapped on the Yacht Racing Association scale of rating.~~

~~(2) Probably with a desire to prevent other competitors from being crushed out by owners of superior wealth (for, as will be shown, the production of the fastest boat is to a great extent a question of the heaviest investment), what are called one-design, or restricted, classes have latterly become popular, especially in case of the smaller craft Various yacht clubs adopt a definite model to which their racers must be built, sometimes also fixing the exact cost, or draw up a rigid specification allowing only small differ- ences in construction and rig. There is no time allowance in the case of such boats, and the first to pass the finishing mark is the winner. Thus excessive expenditure may be checked, and prize-winning becomes a question of superior seamanship ; but the system has disadvantages, because it curtails the scope of invention for the designer or owner.~~

~~(3) The third and principal class is that in which time is allowed in accordance with a standard scale (generally abbreviated to Y.R.A. rating), appointed since 1875 by the Yacht Racing Association, while the successive rules for its calculation have had a marked effect upon the~~

form of the racing yacht. Their aim has been to encourage a fast, safe, and seaworthy vessel, though they may have occasionally failed in this to some extent.

At the beginning of the 19th century yachts were built upon the lines of successful smugglers or revenue cutters, full in the bows and broad, generally three or four beams to length, with sharp under-water sterns, on the then generally accepted theory that to sail fast a vessel must have a cod's broad head and a mackerel's slender tail. In the case of some floating bodies the rule still holds good, for large pine logs are usually towed with the thicker end first. The yachts were held upright against the heeling effort of their canvas by an inside load of stones or ore, and as there was no time allowance, the largest boat generally won, so that size largely increased : the Alarm, 193 tons, and the Limisa, 180 tons, both rigged as cutters, were the racers of the 'fifties. This result naturally suggested the necessity for some handicapping

scale, and the first adopted was based on the 1794 merchant tonnage law, length of keel and breadth alone being effectively taxed for time allowance. This did not at first lead to a change in type, for designers worked chiefly by tradition then, but they eventually began to realize that as breadth increased the number of minutes each boat had to allow it might with advantage be reduced. Now, any sailing vessel is enabled to withstand the over- turning effort of the wind by two principal factors — the resistance of the water, which increases as her breadth, and the weight of cargo or ballast below her water-line. The latter must be lifted through an arc before she can be cap- sized, and it is evident that the lower this weight is placed and the heavier it is so the power of the righting lever is increased. Therefore, as breadth diminished, constructors sought for means to increase the righting lever or artificial stability, and naturally found it in lead. Nevertheless, mathematics counting little then against precedent, such an innovation was condemned, and it was only by degrees that a little lead inside gave place to the heaviest possible load placed as low as possible, i.e., on the vessel's keel, because each inch

~~gained below the water-line increased its effective power. Thus, slowly at first, more rapidly later, yacht-builders grasped the fact that, however narrow a vessel became, she would stand upright if sufficient lead were hung on her, while, depth not being taxed in the formula, the direct result was that between about 1875 and 1886 yachts grew narrower and narrower, until they had diminished from three to six beams to length. Minor rules were adopted earlier by the Royal London and New Thames Yacht Clubs, which, in order to invalidate various devices for evading the taxed length, decreed that the latter should be measured on deck ; and the so-called Thames measure- ment is still the yachting standard — except for racing.~~

~~The advent of the United States schooner America in 1851 (when she won the famous Cup in a race round the Isle of Wight) with a long hollow bow and flat-cut sails, exploded the British cod's-head theory, and led to most new vessels being built with lean hollow bows, and many older ones altered to that model. What Scott Russell's wave theory, propounded earlier, had failed to do, ocular demonstration accomplished. In 1875 the Yacht Racing Association was founded, and one of its first rules decreed that length should be measured on the load water-line (l.w.l.). Still, it was only slowly that designers discarded the old straight stem and adopted the overhanging bow, thus getting a longer boat than they were handicapped for. In 1881 a measurement formula was also introduced which appeared likely to encourage the building of broader vessels, but failed to do so, until in 1886 the racing yacht resembled a long-drawn-out wedge, and a change became imperative. Therefore a new Y.R.A. rule was passed, taking only length and sail area into account, thus leaving it open to increase the beam, and permitting the use of a centre-board. This was a simple formula : length (on the water-line) multiplied by sail area and divided by 6000 gave the Y.R.A. rating, for every foot of which so many seconds' time had to be allowed. Nevertheless, it was not till 1893 that large racing vessels exhibited much increase of beam, when Saianita, Britannia, Gallvma, Valkyrie, about four beams to length, were the leading yachts.~~

~~Approximately, the narrow and deep craft may be con- trasted with the broad and shallow one as follows : — The former, depending on her~~

~~weight of lead for stability, is more costly, but she will sail to windward, especially through broken water, faster than the other, for the long lean hull with the momentum of its heavy load shears more readily through the seas that meet it diagonally. Lacking this weight and displacement, and consequent "power," the shallower boat will not do so equally well ; but with a fair~~

~~wind may outsail the former, while as she depends partly on breadth for stability, she is, other things being equal, cheaper to construct.~~

~~In 1895 the Y.R.A. rule which taxes breadth and depth by making girth a factor was formulated. It has been shown how yachts diminished from three beams in length to six, and then broadened again to much the original beam ; but meanwhile, with the measuring of length on the water-line, another change began. The older vessels had straight keels, with stem and sternpost nearly vertical, which made them slow to answer the helm ; but it became apparent that by raking, or slanting, stem and sternpost a vessel could be built much longer on the deck than on the water-line, and yet not be handicapped accordingly. Thus the present overhangs were initiated. Their advantage is chiefly that when the vessel is heeled by the wind they become immersed, and consequently increase her water-line length. This, however, would not alone account for the modern racing yacht's profile, and it must be explained that, besides helping to keep the ballast low, a yacht's depth serves her by presenting a large area of immersed surface to the water, which prevents her from being pushed away sideways by the wind when sailing close-hauled, for which purpose the centre-board, or sliding keel, is used in shallow craft. There are also two factors which check a vessel's speed — wave-making, or the pushing aside and piling up of water, and, what is sometimes more important, skin-friction, i.e., the drag of water along her bottom. The importance of the latter was long under-rated, and builders believed that a large area of deadwood formed by an approximately right-angled junction of stem and keel was necessary for lateral resistance, or power of holding on to windward. The famous yawl Jullanar, 126 tons, with one or two other vessels built about 1875, with this area of forefoot completely cut away, thus saving a large amount of skin-friction, disproved the theory. Little by little the modern under-water profile was reached, which~~

roughly resembles an isosceles triangle, though two lines are more or less curved. The deck forms one side, the other long one is the sweep from head of stem along the keel to the apex at its junction with the sternpost, and the third, and shortest, side the line from the foot of the latter to the deck again. This reduces skin-friction and renders the craft quick upon her helm, although it is sometimes over-done and too little surface left for lateral resistance. In 1901 another new rating rule, which aims at encouraging a vessel of fuller body, came into force for seven years. It takes the difference between the actual midship section of the yacht and a line drawn straight from her keel to water-line into special account, and thus should prevent undue hollowness of section ; but it is premature to anticipate its exact effect.

The last great change has been in the direction of light- ness of construction, for whereas the earlier yachts were heavily built, the modern ones are the thinnest shell, though the Y.R.A. now propose to introduce a scantling rule. The reason is simply that all weight above the water-line tends to capsize a vessel, while that beneath it tends to hold her upright. Thus, as the hull will only float a certain weight, it is important to place as much as possible upon her keel. Therefore the weight of hull is pared down to the uttermost, and some small vessels have to be braced inside like a lattice-girder to preserve their shape, while in the case of the America Cup challenger of 1901, Shamrock, which had a draught of nearly 20 feet, the lead keel weighed approximately 90 tons. To save weight her submerged portion was plated with manganese bronze, which is half the weight of steel, while for that above water even this was not light enough, so an aluminium alloy one-third the weight of the other was used. The

cost of such construction, necessitating not only first-class material but the highest workman's skill, is enormous.

Thus the modern racer has been evolved. Her chief characteristics are — the lightest possible hull, the heaviest possible keel, long overhangs, a,

cut-away under-body suffi- cient for lateral resistance with minimum surface for skin- friction, a hollow steel mast, and sails of the lightest and closest material. She is also almost universally rigged as a cutter, for though schooners, ketches, and yawls can be handled more comfortably by a smaller crew, the cutter can readily beat them to windward, and this in spite of the fact that the Y.R.A. allow a reduction in the rating of the former craft. So each successive rule has had its influence, but whether the most satisfactory type has been produced is a question which has always been fiercely debated. At present the racing vessel of a given size increases in cost year by year, while there are not wanting those who predict that plating of aluminium and keels of platinum may eventually become a necessity unless some effort is made to check the excessive expenditure. (h. bs.)

YakOba. See Nigeria.

Yakub Khan (1849- ■

-), ex-Amir of Afghan-

istan, son of the Amir Sher Ali, was born in 1849. He showed great ability at an early age, and was made governor of Herat by his father, but broke into open rebellion against him in 1870, and was imprisoned in 1874 in Kabul. However, when Sher Ali in 1878 fled before the British, he handed over the government to Yakub, who, on his father's death in the following February, was proclaimed Amir, and signed a treaty of peace with the British at Gandamak. He agreed to receive a British Resident, and was in turn to receive a subsidy and support against foreign attack. But in September of the same year his revolted troops attacked the British Residency, and the Resident, Sir Louis Cavagnari, and his staff and suite were cut to pieces. This outrage was instantly avenged, for in October Earl (then Sir Frederick) Roberts with a large force defeated the Afghans on the 6th and took possession of Kabul on the 12th. Yakub Khan thereupon abdicated, and took refuge in the British camp, and was sent to India on the 13th of December, to remain in safe custody as a deposed sovereign.

Yaku-Shima, an island belonging to Japan, lying to the south of Kiushiu, in 30° 30′ N. and 130° 30′ E. It is shaped like an irregular pentagon, and measures 14 miles in width and the same in length. It is separated from Tanega-shima by the Yaku-kaiky6 (Vincennes Strait), 12 J miles wide, and its surface is broken by lofty moun- tains, of which Yaye-dake rises to a height of 6515 feet, and Eboshi-dake to a height of 4840 feet. It is covered with dense forest, in which are some of the finest crypto- meria in Japan, known as Yaku-sugi.

Yakutsk, an extensive province of Asiatic Russia, eastern Siberia, covering nearly one-fifth of the Russian Empire, bounded on the N. by the Arctic Ocean, on the W. by Yeniseisk, on the S. by Irkutsk, Transbaikalia, and Amur, and on the E. separated from the Pacific Ocean by a narrow strip only belonging to the Maritime Province (Primorskaya Oblast). The Yakutsk expedition has carried out much valuable exploring work, and made important researches into the ethnography and demo- graphy of the province. Only incomplete accounts of the expedition have yet appeared. The province has an area of 1,533,400 square miles, but its population in 1897 was only 261,731 (domiciled only), of whom 125,670 were women, and 9019 lived in towns. The bulk of the inhabitants (213,800) are Yakuts ; Russians number

18,360, of whom 6370 are exiles; Tungus, 10,050 ; Tatars, 1350; Lamuts, 2840 ; Chukchi, 1600. The province is divided into five districts, the chief towns of which are Yakutsk, Olekminsk (1178), Sredne – Kolymsk (538), Verkhoyansk (356), and Viluisk (609). The standard of education is low, and in 1898 there were only 75 primary schools attended by 1 100 boys and 225 girls. Though the production of gold dust from gold washings has been on the decrease, 9097 kilogrammes were still obtained in 1898, and over 15,000 workers are employed in the Olekma and Vitim system of gold-mines. Though it has been proved by the exiles that barley could be grown much more widely than it is at the present time, immense tracts are quite unsuitable for agriculture, and only 43,000 acres are under crops, chiefly barley. Most of the inhabit- ants are engaged in cattle-breeding, and it is estimated that there are in the province 117,000 horses, 213,000 horned cattle, about 20,000 reindeer, and 1700 sledge-dogs. Fish is an important article of food, especially in the Kolyma region, where the

supply for the year has to be obtained during the six or se'ven weeks that the rivers are free from ice. There is a great dearth of salt, and the fish have to be frozen as they are for future use. In the northern districts hunting remains important ; it was estimated in 1898 that it employed nearly 15,000 men, who obtained from 100,000 to 175,000 squirrels, about 11,000 ermines, 237,000 hares, from 3000 to 3700 foxes, from 3000 to 4000 Arctic foxes, but only from 100 to 150 sables, some 50 beavers, and about 150 bears. These estimates, how- ever, seem to be too small.

See "W. L. Sieroszewski. The Yakuts, vol. i. St Petersburg, 1896. — V. G. Bogoraz. Materials for the Study of the Chukehi Language and Folk-lore, vol. i. Published by the St Petersburg Academy of Sciences, 1900. — Bulletin of the East-Siberian Geo- graphical Society. (p. a. K.)

Yakutsk, capital of the above province, situated in 62° 2′ N. and 129° 44′ E., on a left-bank branch of the Lena, 1800 miles north-east of Irkutsk. It consists of a small number of wooden houses, most of which have their windows made of mica (this is replaced by ice in winter), and of many Yakut tents built amidst the houses. It has one reai-school, a theological seminary, a high school for girls, and three primary schools, and carries on an active trade with the rest of the province. Population

(1897), 6534.

Yale University. — Yale College, which received its charter in October 1701, and took its name in 1718 from its early benefactor, Governor Elihu Yale of England, became legally Yale University in 1887. At first instruc- tion was given in various towns in Connecticut, but in 1717 the commencement exercises were held at New Haven, Conn., where the institution has since remained. At the end of the administration of the first rector, Abraham Pierson, in 1707, there were 19 students and 2 members of the faculty. The record at the close of certain subsequent administrations was as follows : Thomas Clap, 1766- — 116 students, 5 members of faculty ; Timothy Dwight, 1817 — 325 students, 14 members of faculty; Theodore Dwight Woolsey, 1871—755 students, 65 mem- bers of faculty; Timothy Dwight, 1899 — 2511 students, 260 members of faculty. Arthur Twining Hadley was inaugurated President, 18th October 1899. The main groups of buildings occupy the larger part of four adjoin-

ing squares, extending over half a mile in length, in the centre of the city of New Haven. The oldest, South Middle, built in 1750, has been preserved. Eighteen buildings, or nearly half of the accommodation of the University in 1900, were erected during the administration of the second Timothy Dwight, between 1885 and 1899.

The different libraries of the University contain over 300,000 volumes. The value of the land and buildings is estimated at $7,000,000. In 1901 the permanent funds were $6,234,026. This included about $760,000 of bicen- tennial and other special building funds. By July 1902 about $2,000,000 had been given for buildings com- memorative of the bicentennial celebration, and for other purposes in connexion with that event. Nearly all the acquisitions of property and money since 1850 have been by private gifts.

The curriculum of the college proper, or academic department, is in the freshman year nearly all prescribed work. In the sophomore year the student may choose six out of twelve courses offered, but must indicate his general line for the rest of the course. The last two years are entirely elective, but subject to this general choice, and also to the requirements of consistency and symmetry. The first considerable introduction of the elective system in the college was made in 1885, when the last two years were made four-fifths elective, the first two re- maining nearly all prescribed work. The other changes were introduced in 1900 and 1901. The purpose of the latter changes was to allow the student to group his studies earlier in some general direction, while he is still required to take nearly the same amount of elementary study as a foundation. The academic department num- bered 1240 students in 1901. The other undergraduate department, the Sheffield Scientific School, has main- tained its system of group electives, which was fixed early in its history at a time when the modern system of electives was unknown. It allows the student to choose the goal of his studies, while the faculty fixes the means by which this may best be reached. In the freshman year there is the same work for all, with a general scientific basis of physics, chemistry, and

mathe- matics, accompanied by the study of English and modern languages. The system is one of general studies, scientific, literary, and linguistic, and the underlying principle is preparation rather than technical equipment. The course is three years, and the requirements for a baccalaureate degree have been much increased by raising the standard of admission. The school numbered 675 students in 1901.

The rapid development of the University life has been evidenced by the establishment of an excellent depart- ment of music in 1894, the first distinct school of music granting degrees in the United States ; by the foundation of a School of Forestry in 1900; by a very large increase in the amount of instruction in the Graduate School ; by the increased attention paid in new University courses and lectureships to the problems of democratic government and the duties of American citizenship, and by closer co- operation under the administration of President Hadley among all departments.

Among the professional schools, the most conspicuous events have been the increase of the Medical School course of study in 1895 from three to four years, and of the Law School course in 1897 from two years to three. Individual instruction has become the dis- tinguishing feature of the Medical School instruction. The school was founded in 1810, and in 1901 en- rolled 147 students. The Law School has developed a character as a school of direct instruction, and is drawing largely for its faculty on men on the bench or in active practice. The school was founded in 1843, and its students in 1901 numbered 249. The chair of divinity, first established in 1755, developed into a distinct theological class in 1822. The Yale Theological School in the last quarter of the 19th century kept itself well abreast of the most enlightened scholarship of

the new school of theology. It enrolled 100 students in the year 1901. The Yale School of Fine Arts was estab- lished in 1864, and enrolled 166 students in 1901, al- though its connexion with the University enables it to give instruction to nearly 300 students annually. The government of the University is vested first in the cor- poration, comprised of the president of the University, the governor and lieutenant-governor of Connecticut; ten Congregational ministers of Connecticut, who elect their own successors,

~~and six graduates of the University, chosen by vote of the graduates. The University council, composed of representatives of the several departments is advisory in character. The different faculties care for practically all matters of their respective departments.~~

~~From the first, Yale College, or the academic depart- ment, has required daily attendance on religious services, which were formerly conducted by the president, always a minister of the Gospel until President Hadley's election and, since his accession, by members of the faculty. The active religious life of the college is contained in the students' voluntary association known as the Yale Young Men's Christian Association. It enrolls more than half of the men of the University, making a larger number than any other similar organization in the world, and conducts a great variety of religious services and philanthropic and missionary enterprises. The attendance at Yale remains conspicuously national in its character. Nearly two- thirds of the students of the academic department reside in college dormitories in and about the old college square.~~

~~Among the graduates, of Yale, well known in recent times, may be named the late Theodore Dwight Woolsey, the scholar and educator ; the late James Dwight Dana, the geologist; the late Hubert A. Newton, the mathe- matician ; the late Elias Loomis, the mathematician ; the late Henry Barnard, the educator ; the late Horace Bushnell, the theologian ; President Daniel C. Gilman of Johns Hopkins University ; Justices George Shiras, David J. Brewer, and Henry B. Brown, of the United States Supreme Court; the Hon. Andrew D. White, the educator and diplomat ; the Hon. Simeon E. Baldwin, the jurist; Professor Josiah Willard Gibbs, the mathe- matician ; the late Professor Othniel Charles Marsh, the palaeontologist ; the late William D. Whitney ; the Hon. William H. Taft, governor-general of the Philippine Islands. (l. s. w.)~~

~~Yalta, a district town and seaport of Kussia, in the government of Taurida, on the south coast of Crimea, at the foot of the Yaila mountains, 57 miles south of Simpheropol. It is the Galita or Jalita of the Arab geographers. Its roadstead is open, but it enjoys a very temperate climate, and has some reputation as a winter resort. Population (1897), 13,269.~~

Yam bo I, or Yamboli, Jambol, or Iambol, a town in the Slivno department of eastern Kumelia, Bulgaria, on the Tunja, an affluent of the Maritza, 49 miles west of Burgas by rail. It has a large agricultural trade, being situated in the centre of one of the chief corn districts of eastern Bumelia. A large number of mul- berry trees have been planted on the banks of the Tunja. The river is crossed by two wooden bridges resting on stone pillars. There are the remains of the old fortifications, and the ruins of a fine old mosque. The bezetlan, or old market-house, is entire, but is now used as a military magazine. An ancient Macedonian town lay some 4 miles to the north, but Yambol is first mentioned in the 11th century, when it was known by the Byzantines as Dampolis or Hyampolis. During the wars between the Byzantines and Bulgarians it was an important frontier fortress. Under the Turks it was the

favourite residence of the Sultan Mahommed IV. Popu- lation (1893), 13,588, of whom about three-fourths are Bulgarians.

Yamethin, a district in the Meiktila division of Upper Burma, lying between the Shan States and the Meik- tila Magwe and Toungoo districts. Area, 4258 square miles. Population (1891), 206,557. There were 1098 villages in 1898-99, paying a revenue of Ks. 4,37,826. The popula- tion was made up in 1891 of 195,880 Buddhists and Jains, 2247 Hindus, 7119 Mahommedans, 679 Christians, 488 of whom were natives, mostly Karens, and 632 others, mostly Shans and Karens.

The northern part of the district is a plain, sloping up to the Shan hills on one side and to the Pegu Yomas on the other, and mostly under rice cultivation. The southern portion, the former district of Pyinmana, is covered with dense forests to the south, and produces some of the best teak in Burma. Of a total area of 2,724,965 acres, there were 180,350 cultivated in 1898-99 ; current fallow covered, 11,375 acres ; and the amount remaining available for cultivation was 566,840 acres; 629,120 acres were under forests, and the uncultivable area covered 1,337,280 acres. The total rainfall taken at Yamethin was 41 ‘14 inches, but in the

south of the district there was probably one-half more. The thermometer frequently rises over 100° F. in the hot weather, and the mean minimum reading in the cold weather is about 59°. The head- quarters of the district are at Yamethin, which had a population, according to the census of 1891, of 6584. There are large railway works on the Mandalay-Rangoon section. Pyinmana, the southern sub-divisional town, had in 1891 a population of 12,926. It is a considerable trading town, and is a station on the railway, as is also Pyaw-bwe, a thriving township to the north of Yamethin, which is visited by many caravans from the southern Shan States.

Yangftse-kiamg', the name by which the great river and commercial highway of China is known to the world. It takes its rise in the high table-lands of central Asia, as do all the great rivers of the eastern continent. It derives its origin from the junction of a series of small streams draining the eastern slopes of the Tibetan plateau, and for the first third of its course flows almost parallel with two other large rivers of eastern Asia, which have had a similar origin, viz., the Mekong and the Salween, each, however, separated from the other by intervening ridges of great height. The total length of the Yangtse has not been ascertained with precision, but is calculated to be not less than 3000 miles. Although the term Yangtse is applied by Europeans to the whole course of the river, in China itself the name is employed to indicate only the last three or four hundred miles, where it flows through a division of the empire which in ancient time was known as " Yang " — a name which also survives in the city of Yang Chow in the province of Kiangsu. The ordinary official name for the whole river is Ch'ang Kiang (pronounced in the north, Chiang) or Ta Chiang, meaning the "long river " or the "great river." Popularly in the upper reaches every short section has its own local name. As it emerges from Tibet into China it is known as the Kinsha Kiang or river of Golden Sand, and farther down as the Pai-shui Kiang. In Szechuen, after its junction with the large .tributary known as the Min, it is for some distance called the Min-kiang, the people being of opinion that the Min branch is in fact the main river. The fall in the upper reaches is very rapid. At the junction of the two main affluents in Upper Tibet, where the river is already a formidable torrent barely fordable at low water, the alti-tude is estimated at 13,000 feet. From Bathang (8540' feet) to Wa-Wu in

~~Szechuen (1900 feet) the fall is about eight feet per mile, thence to Huang-kuo-shu (1200 feet) about six feet per mile, and farther down to Pingshan (1039 feet) the fall is about three feet per mile. At Ping-shan, in the province of Szechuen, the river first becomes navigable, and the fall decreases to about six inches per mile down to Chungking (630 feet). From Chungking through the gorges to Ichang (130 feet), a distance of nearly 400 miles, the fall again increases to about fourteen inches per mile, but from Ichang down to the sea, a distance of 1000 miles, the fall is exceedingly small, being as far as Hankow at the rate of two and a half inches, and from Hankow to the mouth at the rate of little more than one inch per mile. The last 200 miles are in fact practically a dead level, for at low-water season there is a rise of tide enough to swing ships as far up as Wuhu, 200 miles from the mouth.~~

~~The principal tributaries, counting from the sea upwards, are (1) the outlet from Poyang Lake, draining the province of Kiangsi ; (2) the Han river, entering on the left bank at Hankow ; (3) the outlet from Tungting Lake on the right bank, draining the province of Hunan ; (4) the three great rivers of Szechuen, the Kialing, the To Kiang, and the Min, all entering on the left bank ; and (5) the Yalung, draining a vast area on the border-land between Szechuen and Tibet. The whole drainage area is about 650,000 square miles, of which more than four-fifths lie above Hankow. The period of low water is from December to March. The melting of the snows on the Tibetan highlands combined with the summer rainfall causes an annual rise in the river of from 70 to 90 feet at Chungking and from 40 to 50 at Han-kow and Kiukiang. The mean volume of water discharged into the sea is estimated at 770,000 cubic feet per second. The quantity of sediment carried in solution and deposited at the mouth is similarly estimated at 6428 million cubic feet per annum, representing a subaerial denudation of the whole drainage area at the rate of one foot in 3707 years. (See Journal of the China Branch of the Royal Asiatic Society, vol. xvi. , Dr. Guppy.)~~

~~Commercially speaking, the Yangtse-kiang forms a highway of first-class importance. As the rise in the, river is only about 130 feet for the first 1000 miles, it resembles a huge canal expressly formed for steam~~

navigation. Except at winter low water, steamers of five or six thousand tons can reach Hankow with ease. Between Hankow and Ichang, especially above the out- let from Tungting Lake, the volume of water diminishes very much, and as the channel is continually shifting with the shifting sand-banks, navigation is more difficult. Above Ichang, where the river flows between rocky gorges, and where a series of rapids are encountered, navigation is still more difficult, and the problem of how best to introduce steam towage is not yet solved. But taking the Yangtse as a whole, with its numerous subsidiary streams, canals, and lakes, it forms a highway of communication unrivalled in any other country in the world. About half the sea-borne commerce of all China is further distributed by means of the Yangtse and its connexions, not to mention the inter- change of native produce between province and province, which is carried by native sailing craft numbered by thousands.

The Yangtse valley as a political term indicates the sphere of influence or development which by international agreement has been assigned to Great Britain. This was first acquired in a some- what negative manner by the Chinese Government giving an undertaking, which they did in 1898, not to alienate any part of the Yangtse valley to any other Power. A more formal recogni- tion of the British claim was embodied in the agreement between the British and Russian Governments in 1899 for the delimitation of their respective railway interests in China, Russia agreeing not to interfere with British projects in the basin of the Yangtse, and Great Britain agreeing not to interfere with Russian projects north of the Great Wall (Manchuria). The basic or valley of the Yangtse was defined to comprise all the provinces bordering on the Yangtse river, together with the provinces of Honan and Chekiang. This agreement was communicated to the Chinese Government, and has been generally acknowledged. Germany has similarly claimed the province of Shantung as her special field of enterprise. The only object of these negotiations was to guard against conflict of railway interests ; in all other respects the policy known as that of the "open door" was advocated by Great Britain and the chief commercial states. This policy was more fully declared by mutual engagements entered into in 1900 by llio Great Powers on the initiative of the United States, whereby each undertook to guarantee

equality of treatment to the commerce of all nations within its own sphere. (a. t.)

Yanina. See Janina.

Yankton, a city of South Dakota, U.S.A., capital of Yankton county, on the northern bank of the Missouri river, at the mouth of the James, in the south-eastern part of the state, at an altitude of 1200 feet. It is entered by the Chicago and North-Western, the Chicago, Milwaukee, and St Paul, and the Great Northern railways, which, with boats on the river, give it a large trade, and

make it a market-place for a large area of the fertile -wheat-producing plains which surround it It is the seat of Yankton College, a Congregational institution opened ' in 1882. This had in 1899 a faculty of 14 and an ' attendance of 18-5 students, of whom 79 were women. ' Population (1890), 3670 ; (1900), 4125, of whom 850 were foreign-born.

Yap. See Miceonesia.

Yapura. See Amazon.

Yaritag'lia, a town in Venezuela, capital of Yari- tagua district. It is 18 miles from Barquisimeto, in a beautiful and extensive valley 1037 feet above the sea, with a* population of 12,000. It is an industrial and commercial centre. Coffee, sugar-cane, cacaq, and, above all, tobacco of an excellent quality are cultivated.

Yarmouth, a seaport town and port of entry, Yar- mouth county, Nova Scotia, on the Dominion and Atlantic Railway, 7 1 miles south of Digby. It contains many fine public buildings, good^chools, important manufactories, two banks and one bank agency, is lighted by electric light and gas, and has an electric street railway. Ship- building is important. In

1900 197 vessels, net tonnage 25,084, were registered in this port. In 1901 the exports were $1,309,462, and imports $590,968. Population

(1891), 6089; (1901), 6430

Yarmouth, Great, a municipal, county, and parliamentary borough of England, also an important watering-place and fishing station, and a seaport, mostly in Norfolk, though partly in Suffolk, 122 miles north-east of London by rail. In 1890 the area of the municipal horough was extended by the inclusion of Gorleston with Southtown, so that it is now coincident with the area of the parliamentary borough, namely, 3567 acres. But for ■ecclesiastical purposes Gorleston with Southtown is still regarded as belonging to Suffolk. The town has a sea frontage of about 1£ miles. The parish church of St Nicholas has been restored and enlarged since 1883, and also St John's and St George's chapel. The toll-house was adapted for the free library in 1885. The other new buildings and institutions include a museum, a theatre, the Boyal Aquarium Theatre, the Yarmouth hospital, the isolation hospital, the Gorleston cottage hospital, and the shipwrecked mariners' refuge at Gorleston (1892). 'There are two new lighthouses at the mouth of the Yare. In 1895 the North Sea Church Mission was established here. The recent educational institutions include the borough of Great Yarmouth technical school and the cor- poration technical schools. Public recreation grounds were laid out about 1890. Since 1896 the principal streets and the quays have been lighted by electricity. For certain purposes Yarmouth was in 1888 declared a county horough. It returns one member to the HOuse of Commons. The average annual value of the imports for the ten years ending 1895 was £204,900 ; of the exports, £16,830 ; the respective figures in 1900 were £350,532 and £210,043. In 1900 the port was entered by 317 vessels of 70,881 tons engaged in foreign trade, and by 1205 vessels of 148,940 tons engaged in the coasting trade. The registered fleet of the port amounted in 1900 to 314 vessels of 15,194 tons. There is a fishing fleet of nearly 500 vessels of some 20,000 tons, manned by about 3000 men and boys. Population (1891), 49,334 ; (1901), 51,250. Birth-rate, 27"6 ; death-rate, 21 -5. •

Yaroslavl, a government of Central Russia, on the upper Volga, with an area of 13,751 square miles. Its population, which is thoroughly Russian, decreased .'rom 1,118,130 in 1883, to 1,072,478 (domiciled only) in

1897, but, as large numbers of men leave their homes in winter (when the 1897 census was taken) to go and work in the capitals, the population is really more than this latter figure would indicate. In 1897 612,245 were women, and 142,441 lived in towns. It is divided into ten districts, the chief towns of which are Yaroslavl, Daniloff (4288), Lyubim (3002), Mologa (4206), Myshkin (2238), Poshekhoniye (4036), Romanoff-Borisoglyebsk (6518), Rostoff (13,016), Rybinsk (25,223), and Uglich (9698). Several industrial villages are more important than most of these towns. The standard of education is relatively high, and in 1897 there were 1033 primary schools attended by 36,750 boys and 11,420 girls. Yaroslavl belongs to the manufacturing region of Central Russia, but agriculture is still carried on every- where, even in the manufacturing villages, the domestic character of many industries permitting the inhabitants both to cultivate their fields and to work in small factories. The peasants and peasant communities hold 5,050,000 acres, or about 57 per cent, of the total area, of which they have acquired nearly 1,000,000 acres by purchase since their emancipation ; 30 per cent, is held by private persons, and 7 per cfent. by the Crown. The forests still cover 39 per cent, of the aggregate area, namely, 44,439,400 acres. There were in 1900 1,169,000 acres under cereal crops, and the average yield in 1895-99 was : rye, 4,531,000 cwt. ; wheat, 161,500 cwt. ; oats, 3,070,000 cwt. ; and barley, 244,000 cwt. ; also potatoes, 7,142,000 cwt. Flax is widely cultivated both for linseed (70,000 qrs.) and fibre (200,000 cwt.). Kitchen gardening is pur- sued on a.large scale, and both fresh and dried vegetables are widely exported ; Rostoff enjoys a great reputation as the centre of the trade. Cattle-breeding is of only less import- ance than agriculture, and the export of poultry is growing rapidly. Large numbers of the inhabitants find employ- ment in a great variety of domestic trades (the making of hardware, locks, felt boots, &c). The weaving of linen has declined as a domestic industry, and though nearly 6000 persons are still engaged in it, the yearly returns only amount to £11,000. Factories, however, have con- siderably developed, and their annual turnover is about 28,000,000 roubles. The principal establishments are cotton, flax,

~~and woollen mills, flour-mills, tobacco works, distilleries, breweries, chicory works, tanneries, candle works, naphtha refineries, chemical works and match works. The three great centres of trade are Yaroslavl, Rybinsk, and Rostoff, where fairs are held every year.~~

~~Yaroslavl, capital of the above government, situated on the upper Volga, 173 miles by rail north-east of Moscow, and connected also with Vologda and Archangel by a railway which has added considerably to its importance. Its educational institutions are above the average, and include a high school with a faculty of law. It has cotton-mills, flour-mills, tobacco factories, &c, with an annual turnover of nearly 15,000,000 roubles, and as the chief intermediary in the trade of Moscow with northern Russia, it is of very considerable commercial importance. Population (1897), 70,610.~~

~~Yasin. See Gilgit.~~

~~Yassy. See Jassy.~~

~~Yates, Edmund Hodgson (1831-1894),~~

~~English journalist and author, son of the actor Frederick Henry Yates (1797-1842), was born at Edinburgh, 3rd July 1831. He was educated at Highgate, and in 1847 was given a clerkship in the General Post Office, with which he continued to be connected up to 1872, becoming in 1862 head of the missing letter department. He married in 1853, and soon began to write for the press, his father's~~

~~friends being very useful in giving him a start in that direction. Charles Dickens helped him by making him dramatic critic to the Daily News and a contriFutor to Household Words ; and he wrote several farces which were acted between 1857 and 1860. In 1855 he had begun writing a column for the Illustrated Times (under Henry Vizetelly), headed "The Lounger at the Clubs": this was the first attempt at combining "smart"~~

~~*personal paragraphs with the better class of journalism ; and in 1858 Yates was made editor of a new paper called Town Talk, which carried the innovation a step forward. His first number contained a laudatory article on Dickens, and the second a disparaging one on Thackeray, containing various personal references to private matters. Thackeray, regarding this as a serious affront, brought the article before the committee of the Garrick Club, of which he contended that Yates had made improper use, and the result was that Yates was expelled. Besides editing Temple Bar and Tinsley's Magazine, Yates during the 'sixties took to lecturing on social topics, and published several books, including his best novel, Black Sheep (1867) ; and under the heading of "Le Flaneur" he continued in the Morning Star the sort of "personal column" which he had inaugurated in the Illustrated Times. On his retirement from the Post Office in 1872 he went to America on a lecturing tour, and afterwards, as a special correspon- dent for the New York Herald, travelled through Europe. But in 1874, with the help of E. C. Grenville Murray (1819-1881), who was living in Paris, he established a new London weekly, The World, " a journal for men and women," which he edited himself, and with which his memory is now chiefly connected. The paper at once became a success, and Yates bought out Grenville Murray and became sole proprietor. The World was the first of the new type of "Society papers," abounding in personal criticism and gossip : one of its features was the employ- ment of the first person singular in its columns, a device by which the personal element in this form of journalism was emphasized. After Truth was started in 1877 by Mr Henry Labouchere (who was one of Yates's earliest contributors), the rivalry between the two weeklies was amusingly pointed by references in The World to what " Henry " said, and in Truth to the mistakes made by " Edmund." In 1885 Yates, having been convicted of a libel in 1884 on Lord Lonsdale, had the unpleasant ex- perience of being sent to prison at Holloway for seven weeks. In the same year he published his Recollections and Experiences in two volumes. He continued to edit The World, but his health gradually gave way, and on 20th May 1894 he died. He had been the typical fldneur in the literary world of the period, an entertaining writer and talker, with a talent for publicity of the modern type — developed, no doubt, from his theatrical parentage — which, through his imitators, was destined to have con- siderable influence on journalism.*~~

~~Yatsauk, called by the Shans Lawksawk, a state in the central division of the southern Shan States of Burma. It is bounded on the north by the state of Thibaw, on the east by the states of Laihka, MOng Kiing, and Mong Nai ; on the south by the Yawnghwe and the Myelat states of Pangtara and Maw Son ; and on the west by the district of Kyaukse, by Yc-ngan and Maw states. Area, 2196 square miles, with 285 villages. As a whole it is mountainous, with ranges running north and south. The main range has a general height of 5000 feet, with peaks, such as Loi Sampa, rising to 7846 feet. The middle and southern portions, however, consist of open rolling country, with an average height of .'5500 feet. To the north the country falls away to the Nam Tu (Myitnge),~~

~~where there are fine teak forests as well as here and there along the Nam Lang and Nam Et, which with the Zawgyi form the chief rivers of the state. Most of them disappear underground at intervals, which makes the extraction of timber impossible except for local use.~~

~~The population is estimated at no more than 15,000. The tribute paid by the sawbwa in 1890 was Rs.12,000, which was only half the sum paid to the kings of Burma. The inhabitants of the state are Shans, Danus, Taungthus, Taungyos, and Palaungs. The Shans form one-half of the entire population, and the Danus three- quarters of the remainder. Cotton blankets of a particular pattern, pottery, coarse paper and lacquer ware, are the chief industries and exports. Lawksawk, the capital, in 21° 15' N. and 96" 55' E., stands in bare undulating country, on the north bank of the Zawgyi, on a small weedy lake. The old brick Avails and the moat are falling into decay. The position was formerly a very strong one. The chief at the time of the annexation had been at war with the Burmese, but refused to submit to the British, and fled to Keng Hung, where he died some years afterwards. The sawbwa chosen in 1887 belonged to another Shan ruling house. He died in 1900, and was succeeded by his son.~~

~~YailCO, a small city in the western part of the province of Ponce, Porto Eico. It is the centre of an extensive coffee-producing district, and is connected by rail with Ponce. Population (1899), 6108.~~

~~Yazd, or Yezd, a province of Persia, bounded on'the S. by Kerman, on the W. by Fars and Isfahan, and on the N. and E. by the central Persian~~

deserts. It contains an area of about 20,000 square miles, but its population barely exceeds 100,000, of whom about half inhabit the capital of the province. Its subdivisions are : (1) the city of Yazd and immediate environs ; (2) Ardakan ; (3) Baf k ; (4) Taft; (5) Kuhistan (Pish Kiih, Mian Kiih, Pusht Kiih, on the slopes and in the valleys of the Shir Kiih, a part of the great Central Range of Persia west of the city of Yazd, and rising to an elevation of 11,000 feet); and (6) Shahr i Babek. The last is situated far south near Kerman, and sometimes is regarded as part of that pro- vince. The revenues of Yazd, including customs (470,000 krans), amount to 2,850,000 krans, or £57,000 a year.

Yazd, or Yezd, a town in Persia, capital of the above province, at an elevation of 4370 feet. Its population is 45,000 to 50,000, including 1300 Zoroastrians and 2000 Jews. About 5000 Zoroastrians live in twenty-two villages a few miles to the west, and have a number of fire-temples. Four fire-temples are kept up in the city. In 1879 the Zoroastrian community of Yazd, city and villages, num- bered 6480 souls, but as many subsequently emigrated, it was computed in 1901 that the number in the district was about the same, or a little less. The grain produced in the district sufficing for only two or three months' consump- tion, supplies have to be obtained from elsewhere, mostly from Khorasan, and wheat and barley are in consequence generally dearer than at other places in Persia. About 1000 looms manufacture nearly 2,000,000 yards of silk stuffs yearly. Much silk was grown in the district, but 84,500 lb of raw silk were imported from Gi'lan. Great quantities of felts (nimads), yellow cotton stuffs (a kind of nankeen), are also manufactured, and much opium for home consumption and export is produced. The people of Yazd and surrounding districts are exempted from military service. A branch of the Imperial Bank of Persia was established there in 1891.

Yecla, a town of Spain, province of Murcia, on the railway to Villena. It is in a mountainous, well-watered district, which produces much wheat, wine, oil, esparto grass, and fruit. The parish church is a large structure of Corinthian style. The square where the town hall stands has arcades all round. The streets are clean and regular, though it is an old town with many ruins. Population (1887), 17,706; (1897), 17,085.

Yedo. See T6ky6.

—Yeisk, a district town of Russia, northern Caucasia, in Yeisk Bay, in the north-east of the Sea of Azov, province of K!uban, 140 miles north-west of Ekaterinodar. Owing to its situation in a fertile region, its exports of corn, wool, and linseed are of some importance. Population (1897),

YellOW Fever.—In the course of these volumes it has been shown that several of the most dreaded and destructive diseases have been elucidated and to a large extent brought under control by modern science. (See Cholera, Malaria, Plague, Tuberculosis, Typhoid Fever.) The latest to be added to the list is yellow fever. Recent evidence leaves no doubt that its efficient cause has been discovered, and that prevention is practic- able.

This disease is of strictly limited geographical distribu- tion, but of great importance within the area of incidence, and, consequently, to maritime Powers whose vessels frequent ports within that area. It is more or less endemic in the tropical and subtropical regions of Central and South America, in the West Indies, and in tropical West Africa. It is not endemic in the Southern states of North America ; but it appears there in epidemic form, and occasionally it has extended its range farther to the north and the south. Great Britain and the United States, therefore, are both concerned in its prevention. The first step towards this was taken in 1881, when Dr Charles Finlay, of Havana, propounded the theory that mosquitoes were the carriers of the infection ; but it was not until nearly twenty years later that the suggestion was followed up by systematic investigation and eventually established by the work of a commission appointed by the United States Army Department. Numerous theories had previously been brought forward, notably that of a bacillus, named the bacillus icteroides, and described by Sanarelli : it is now certain that this organism is not the cause of yellow fever. Other authorities held that the disease was spread by contagion, by miasmata, or some other of the vague agencies which have always been put forward in the absence of exact knowledge. Finlay's mosquito theory remained in abeyance until

attention was again drawn to it by the demonstration in recent years of the part played by these insects in the causation of other tropical diseases. Then it was taken up and worked out experimentally with brilliant results by Reed, Carroll, and others. The mosquito selected by Finlay was the Stegomyia fasciata, a black insect with silvery markings on the thorax, which is exceedingly common in the endemic area. It frequents towns, and breeds in any stagnant water about houses. Specimens were caught, fed upon yellow fever patients, kept for a fortnight, and then allowed to bite susceptible persons established in a special camp with other susceptible persons as a control. Those bitten developed the fever, the others did not. The experiments were made in 1900, and their publication was followed by a vigorous campaign against mosquitoes in Havana in the year 1901, based on the methods applied to the suppression of malaria, and carried out under the direction of Major W. C. Gorgas of the United States army, chief sanitary officer of Havana. The work was begun on 27th February 1901. An order was issued that all receptacles containing water were to be kept mosquito-proof ; sanitary inspectors were told off for each district to maintain a constant house-to-house inspection, and to treat all puddles, (fee, with oil ; receptacles found to contain larva were destroyed and their owners fined ; breeding-grounds near the town were treated by draining and oil; hospitals and houses containing yellow fever |

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~~patients were screened; infected and adjacent buildings were fumigated with pyrethrum powder. The results exceeded all expectation. There had been 24 cases with 7 deaths in January, and 8 cases with 6 deaths in February. The record of cases for the ensuing months up to February 190:! was — March, 2; April, 2; May, 4; June, 0 ; July, 4 ; August, 6 ; September, 1 ; October, 0 ; November, 0 ; December, 0 ; January, 0. The cases in July and August were traced to infection introduced from a suburb, which was afterwards placed under control, when the disease wholly ceased. An important point in the evidence is that the second half of the year is always the period of greatest prevalence in Havana.~~

~~Two criticisms may be made. One is that the dis- appearance of yellow fever may have been really due to the general sanitary measures carried out by the adminis- tration. On that head Major Gorgas's report (15th February 1902) states that in spite of the most energetic measures and a marked fall in the general death-rate, no impression was made on yellow fever ; on the contrary, it increased and became severely epidemic in 1900, with 1244 cases and 310 deaths. The second point is that the fever has similarly disappeared in other places with- out any mosquito campaign. The answer is that it dis- appears in parts where frost occurs in winter, and in comparatively small places where immunity is estab- lished among the residents and fresh blood is not im- ported ; but it has never before disappeared in Havana. The foregoing table of recorded deaths shows the remarkable change introduced in March 1901. It is a convincing proof of the correctness of the mosquito theory and of the efficacy of the preventive measures described. The experience encourages the hope that yellow fever may be effectually suppressed in the near future. It should be added that the precise nature of the poison conveyed by the mosquitoes remained to be ascertained. Some authorities believe it to be of a protozoal nature like the malarial parasite (see Malaria), but up to 1902 they had not demonstrated it. Dr Durham, who carried out a special investigation for the British School of Tropical Medicine, believes it to be bacterial. (a. sl.)~~

~~Yellow River. See Hwang Ho.~~

Yemen. See Arabia.

Yeniseisk, a province of Asiatic Russia, eastern Siberia, in the General-Governorship of Irkutsk, bounded on the N. by the Arctic Ocean, on the W. by Tomsk, on the E. and N.W. by Irkutsk and Yakutsk, and on the S. by Mongolia. It has an area of 987,189 square miles, and its population, which was 458,570 in 1890, in 1897 numbered 559,902 (domiciled only), of whom 268,347 were women, and 59,005 lived in towns. The population is almost entirely Russian, there being only some 11,000 Tatars, 2750 Tungus, and a few Germans and Jews. The province is divided into five districts, the chief towns of which are Krasnoyarsk (26,000), Achinsk (6714), Kansk (7504), Minusinsk (10,255), and Yeniseisk, and there is one division (otdyel) of Turukhansk and one new district, Usinsk, including the southern gold-mining region. The standard of education is low ; in 1898 there were only 237 primary schools, attended by 6570 boys and 3000 girls. Agriculture is the chief occupation of the Russians, and is especially flourishing in the southern part of the province, in the district of Minusinsk. No less than 1,117,000 acres are under crops, and the average yield in 1895-99 was: rye, 2,351,000 cwt. ; wheat, 1,541,000 cwt. ; oats, 1,528,000 cwt.; and barley, 207,000 cwt.; also potatoes, 866,000 cwt. Cattle-breeding is very extensively carried on, and there are in the province, though the estimates are much too small, 402,000 horses,

272,000 horned cattle, 638,500 sheep, about 70,000 reindeer, and 92,000 pigs. Fishing, especially on the lower Yenisei, is of great importance, yielding the inhabitants' their chief supply of food. In 1825 sables were killed to the amount of 3000 pieces a year, but there are now none to be found, and the hunters obtain chiefly squirrels, foxes, Arctic foxes, and bears. Min- ing has been on the decline for many years. In the 'fifties from 13,000 to 16,400 kilogrammes of gold were obtained annually in the districts of northern and southern Yeniseisk, but in 1897 only 3395 kilogrammes were extracted. The province is extremely rich in iron ores, but the iron industry is in its infancy, and only 44,000 cwt. of pig iron and 38,000 cwt. of iron were obtained in 1897. Salt is extracted to the amount of 43,000 cwt. a year, as well as some Epsom salts. Coal has been found on the lower Tunguska, near the mouth of the Yenisei, and in many places in the south of the province. Silver, copper, lead, brown coal, rock-

~~salt, graphite, and mica are all found in large quantities, but are not yet regularly mined. In 1898 factories employed only 2320 workers ; there are several distilleries, and iron- works have been established on the Abakan. The province is now crossed from west to east by the Siberian Rail- way, and considerable efforts have been made to establish regular steamer communication between the mouth of the Yenisei and western Europe. Hydro- graphical surveys have been carried out, and a well-protected bay has been discovered in the estuary of the Yenisei. Since 1890, indeed, with the exception of a single summer, European steamers have reached the mouth of the Yenisei, importing all sorts of provisions and machinery for the gold-mines. The Yenisei is navi- gated by ten steamers, and efforts have been made to clear the rapids of the Angara, so as to bring Lake Baikal into steamer communication with the Yenisei. Owing to the shallowness of the small tributaries of the Yenisei, the canal connecting the Yenisei with the Ob has not yet proved as serviceable as was expected. (p. a. k.)~~

~~Yeniseisk, a district town of the above province, on the right bank of the Yenisei, 200 miles north-north- west of Krasnoyarsk, with which it has regular com- munication by steamer. It is the centre of the north Yeniseisk gold-mining region, and has a public library, a good natural history and archaeological museum, and more than the usual number of schools. Population~~

~~(1897), 11,539.~~

~~Yeola, a town of British India, in the Nasik district of Bombay, on the chord line of the Great Indian Pen- insula Railway, 18 miles from Manmar junction. There are important manufactures of silk cloth and thread, and of gold and silver wire. Population (1881), 17,685;~~

~~(1891), 18,861.~~

~~Yeovil, a parish, municipal borough, and market town in the southern parliamentary division of Somerset- shire, England, on the Yeo, 22 miles south of Wells by rail. Modern erections are Established and Roman Catholic churches, and a Masonic hall. A foundry and motor-car and~~

~~bicycle works have been established. Area, 699 acres. Population (1881), 8479; (1891), 9648; (1901), 9838.~~

~~Yezd. See Yazd.~~

~~Yezo, or Ezo, the most northerly of the five principal islands forming the Japanese empire, the five being Yezo, Nippon, Shikoku, Kiushiu, and Formosa. It is situated between 45° 30′ to 41° 21′ N. and 146° T to 139° 11′ E. j its coast line measures 1423·32 miles, and it has an area of 30,148·41 square miles. On the north it is separated from Saghalien by Soya Strait (La Perouse), and on the~~

~~south from Nippon by Tsugaru Strait. Its northern shores are washed by the Sea of Okhotsk, its southern and eastern by the Pacific Ocean, and its western by the Sea of Japan.~~

~~Orography. — The highest mountain in the island is Ishikari-dake (6955 feet), and the next in importance is Tokachi-yama (6541 feet). Yubari-dake in Ishikari has a height of 6508 feet, and in the province of Kushiro are O-akan-dake (4470 feet) and Me-akan-dake (4500 feet). Dr Rein's investigations led him to state that Tokachi-dake forms a species of central elevation whence most of the principal rivers flow towards the sea, and that the mountain system is a continuation, on the western side, of the Saghalien range, and on the eastern of the Kuriles range ; the former consisting of granite and old schists, the latter chiefly of volcanic formations. Near Hakodate are two conspicuous volcanic peaks, Komaga-take (3860 feet) and Tokatsu-dake (3800 feet) ; and 24 miles from Kushiro (by rail) is a volcano called Atosa-nobori, or Iwo-zan (sulphur mountain), whence great quantities of first-rate sulphur are exported to the United States. Mention must also be made of Rishiri-jima, an islet on the extreme north-west of Yezo, which has a peak of the same name rising to a height of nearly 6000 feet.~~

Miners. — Yezo boasts the largest river in the Japanese empire, namely, the Ishikari-gawa, which has not been accurately sur- veyed, but is believed to measure over 400 miles. Its other large rivers are the Teshio-gawa (192 miles), the Tokachi-gawa (120 miles), the Shiribeshi-gawa (88 miles), the Kushiro-gawa (81 miles), the Toshibetsu-gawa (64 miles), and the Yubetsu-gawa (64 miles). The valley of the Ishikari is believed to be the most fertile part of the island ; the Tokachi is navigable to a point 56 miles from its mouth, but the Teshio has a bar which renders its approach extremely difficult. A peculiarity of several of the rivets is that, on approaching the sea-shore, they run parallel to it for some dis- tance before finding an exit. Those flowing to the south coast take, in this way, a westerly direction, those flowing to the east coast, a northerly direction. This phenomenon is attributed to the fact that the prevailing winds set up the sand so as to deflect the rivers from their straight course. Nearly all these rivers abound with salmon, the most remarkable in that respect — though a com- paratively small river — being the Nishibetsu-gawa, which yields an average of over two thousand tons of fish annually.

Lakes. — There are no large lakes, the most extensive — Toya, Shikotsu, and Kushiro — not having a circumference of more than 30 miles. Lagoons, however, are not uncommon. The largest of these — Saruma-ko in Kitami — is some 17 miles long by 7 wide. It abounds with oysters nearly as large as those for which the much smaller lagoon at Akkeshi is famous, the molluscs measuring about 18 inches in length.

Climate. — The climate differs markedly from that of the main island of Japan, resembling rather the climate of the British Isles, though the winter is longer and more severe, and the atmosphere in the warm season contains a greater quantity of moisture. During five months the country is under snow, its depth averaging about two feet in the regions along the southern coast, and more than six feet in the northern and western regions. An ice-drift, setting from the north and working southwards as far as the vicinity of Nemuro, effectually stops all sea-trade on the east coast during January, February, and March, though the west coast is protected by the warm current of the Kuro-shiwo against this inconvenience. Fogs prevail along the east coast during the summer months, and it is not uncommon to find a damp, chilly atmosphere near

the sea in July, whereas, a mile inland, the thermometer stands at 80° or 90 F. in the shade, and magnolia trees are in full blossom.

Zoology. — Tsugaru Strait has been shown by the late Captain Blakiston, R.A., to form a line of zoological division. Pheasants and monkeys are not found on the Yezo side of this line, though they abound on the island of Nippon, and, on the other hand, Yezo has grouse and solitary snipe which do not exist in Nippon. The Yezo bear,' too, is of a distinct species, and the island has an abundance of singing birds which are conspicuous by their absence southwards of the strait. There are also notable differences in the flora, the trees and flowers of Yezo resembling those of the British Isles rather than those of Japan.

Population. — The island seems to have been originally peopled by a semi-barbarous race of pit-dwellers, whose modern representa- tives are to be found in the Kurilsky or their neighbours of Kam- chatka and Saghalien. These autochthons were driven out by the Ainu and the latter, in their turn, succumbed to the Japanese. The population of Yezo is 605,742, of whom 17,573 are Ainu. There is a steadily growing but not large emigration from Japan proper to Yezo. The actual number of immigrants increased from 14 512 in 1890 to 52,248 in 1898. The population at present being only 20'1 per square mile, whereas even Tsushima and the Ogasa- wara islands have populations of 144'9 and 168-4 per square mile respectively, Yezo still offers large opportunities for immigration.

Divisions and Towns. — Yezo is divided into ten provinces, the names of which, commencing from the south, are Oshima, Shiri- beshi, Ishikari, Teshio, Kitami, Iburi, Hidaka, Tokachi, Kushiro, and Nemuro. Of these Oshima, Shiribeshi, and Shikari are by far the most important. There are only three towns having a popula- tion of over 20,000, namely, Hakodate (50,314), Sapporo (46,147), and Otaru (34,586). Other towns of importance are Fukuyama (formerly called Matsumaye), the seat of government in feudal days, Esashi, Mombetsu, Oiwake, Tomakomai, Piratori (the chief Ainu settlement), Muroran, Kushiro, Akkeshi, Nemuro, Horobetsu, Yunokawa, Abashiri, and Mashiki. Yunokawa, 4£ miles from Hakodate, is much frequented for the sake of its hot springs ; Oiwake is

~~the junction of the main line of railway with the branch to the Yubari collieries ; Kushiro is a special port of export for coal and sulphur ; Akkeshi is celebrated for its oysters, there being large reefs entirely composed of them.~~

~~Industries and Products. — Marine products constitute the prin- cipal wealth of Yezo. Great quantities of salmon, sardines, and cod-fish are taken. The salmon are salted for export to Nippon and other parts of Japan ; the sardines are shipped away to be used as an agricultural fertilizer, their value for that purpose varying from £2 to £5 per ton ; and the cod-fish serve for the manufacture of oil. An immense crop of edible sea-weed is also gathered and sent to Chinese markets as well as to Japanese. This Icombu, as it is called, sometimes reaches a length of 90 feet and a width of 6 inches. The herring fishery, too, is a source of wealth, and the canning of Akkeshi oysters as well as of salmon gives employment to many hands. Vast tracts are covered with a luxuriant growth of ash, oak, elm, birch, chestnut, and pine, but owing to difficulties of carriage this supply of timber has not yet been much utilized. One of the earliest acts of the Meiji Govern- ment was to organize a colonization department for the purpose of developing the resources of Yezo and encouraging Japanese to emigrate thither. Free grants of agricultural land were made, roads were constructed, model farms established, beet-sugar factories and saw-mills opened, horse-breeding undertaken, foreign fruit trees planted, and railways laid. The outlays incurred on these accounts did not immediately bear fruit, and are sometimes thoughtlessly described as wasted. But they accomplished their object, for they attracted large numbers of settlers. During recent years attention has been attracted to the mineral resources of Yezo. Coal of fair quality is abundant, and a railway has been built for its carriage ; an apparently inexhaustible supply of sulphur is obtained from a mountain near Kushiro Lake, whence it is carried to the sea coast by rail and river ; petroleum seems likely to pay exploiters, and in 1899 gold was discovered at Usotannai, Pankanai, and other places along the Poropetsu river, near Esashi in Kitami province.~~

~~Communications. — The roads are few and in bad order, but there is a railway which, setting out from Otaru, on the west coast, runs, vid~~

Sapporo and Iwamizawa, to Mororan on the south coast, a distance of 133J miles, with branches from Iwamizawa, eastwards to Horonai and Ikushumbetsu, and northwards to Shibetsu, and from Oiwake north-east to the Yubari coal-mines. In districts beyond the railway route, travelling is done on horseback, there being an abundant supply of ponies. There is good coastwise communication by steamer.

Defence. — Until recent years the defence of Yezo depended on a local militia called tonden-hei, but in the programme of arma- ments expansion drafted in 1896, after the war with China, Sapporo appeared as the headquarters of a new divison, the seventh, now fully organized.

History. — Yezo was not brought under Japan's effective control until mediaeval times. In 1604 the island was granted in fief to Matsumaye Yoshihiro, whose ancestor had overrun it, and from the close of the 18th century, the eastern part was governed by officials sent by the sh6gun in Edo, whose attention had been attracted thither by Russian trespassers. In 1871 the task of developing its resources and administering its affairs was entrusted to a special bureau, which employed American agriculturists to assist the work and American engineers to construct roads and railways ; but in 1881 this bureau was abolished, and the Govern- ment abandoned to private hands the various enterprises it had inaugurated. Yezo is not yet included in the general political system of the Japanese empire. It has no local assemblies, nor does it send representatives to the Diet, its affairs being adminis- tered wholly by officials sent from Tokyo.

YohchOW, or Yuchow, a city in the province of Hunan, China, situated at the outlet of Tungting Lake on the right bank of the Yangtse. It was declared open to foreign trade in 1899, in pursuance of a promise made to the British Government. The actual settlement, however, is not at Yohchow itself, but at a small village named Chinlingki, 5 J miles below Yohchow and half a mile from the Yangtse. The object of selecting this site was its proximity to the

great river, which it was supposed would induce the regular river steamers to make it a port of call. The importance of Yohchow is that it is .the only open port in the province of Hunan, a province which had been extremely hostile to the. advent of foreign trade, while at the same time its trading capabilities were known to be very considerable. From Yohchow the large cities of Changsha and Changteh are accessible for steam vessels drawing up to four or five feet of water by means of Tungting Lake and its affluents, the Siang and Yuen rivers. Changsha, the capital of the Hunan province, has a population of 300,000. Changteh, a short distance up the Yuen river, is a place of great trade, with an 'enormous junk traffic and a population estimated by Captain Barton at 500,000.

Yola. See Nigeria.

Yonge, Charlotte Mary (1823-1901), Eng- lish novelist and writer on religious and educational sub- jects, daughter of William Crawley Yonge, 52nd Kegiment, and Frances Mary Bargus, was born 11th August 1823 at Otterbourne, Hants. She was educated by her parents, and from them inherited much of the religious feeling and' High Church sympathy which coloured her work. She resided at Otterbourne all her life, and was one of the most prolific writers of the Victorian era. In 1841 she published no fewer than five works of fiction, including The Clever Woman of the Family, Dynevor Terrace, and The Trial ; and after that she was the author of about 120 volumes, including novels, tales, school manuals, and biographies. Her first conspicuous success was attained with The Heir of Radclyffe (1853), which enjoyed an enormous vogue. The Daisy Chain (1856) continued the success ; and among her other popular books may be mentioned Heartsease (1854), The Young Stepmother (1861), and The Dove in the Eagle's Nest (1866). In more serious fields of literature she published Land- marks of History (three series, 1852-57), History of Christian Names (1863), Cameos of English History (1868), Life of Bishop Patteson (1874), English Church History for Use in Schools (1883), and many others. She also edited various educational works, and was for more than thirty years editor of The Monthly Packet. She died at Otterbourne, on 24th March 1901. The fault of Miss Yonge's work lies on the other side of its dominant quality ; she was essentially earnest, and her earnestness led her at times into dull didacticism. Her books are

mainly suited to young girls, among whom they have exercised a wide and wholesome influence. The sincerity of her piety has been often proved in generous practice. It is said that the money realized by the early sales of The Daisy Chain was given to the building of a missionary college at Auckland, N.Z., while a large portion of the proceeds of The Heir of Radclyffe was devoted to the missionary schooner The Southern Cross. Few writers have done so much to mould the mind of the " English girl, divine, demure," and the standards of gentleness and grace which she maintained have been of abiding value to her generation. (a. Wa.)

Yonkers, a city of Westchester county, New York, U.S.A. It is situated in 40° 56' N. and 73° 54' W., on high ground on the east bank of the Hudson river, op- posite the Palisades, adjoining New York on the north. It is a residence suburb of New York, and is connected with it by the New York Central and Hudson Eiver, and the New York and Putnam railways. Its site is hilly, rising from the river in terraces, and its plan is irregular. It has a good water-supply and sewerage. It contains many beautiful and expensive residences built on the terraces, which afford fine views of the river and the Palisades. It has considerable importance as a manufacturing city. Iu

1900 it contained 387 manufacturing establishments, with a total capital of $13,097,205. They employed 8615 hands, and the product had a value of $19,580,324. The principal items were carpets, hats and caps, foundry and machine-shop products, and silk and silk goods. In 1900 the assessed valuation of real and personal property was $38,211,230, the net debt was $3,375,224, and the rate of taxation was $23.93 per $1000. Population (1890), 32,033; (1900), 47,931, of whom 14,634 were foreign- born and 1005 negroes.

Yonne, a department of central France, watered by the river naming it.

Area, 2894 square miles. From 355,364 inhabitants in 1886 the population in 1901 had declined to 316,047. The births in 1899 were 5125, of which 336 were illegitimate; deaths, 6957; marriages, 2124. The schools in 1896 numbered 949, with 50,000 pupils, less than 1J per cent, of the population being illiterate. Out of 1,729,000 acres of land under cultivation in 1896, 1,101,620 acres were arable and 83,980 acres were

~~under vines. Woods and forests covered a surface of more than 320, 000 acres. The wheat reaped in 1899 was valued at £1,485,000 ; rye, £88,000 ; barley, £106,000 ; oats, £620,000 ; potatoes, £201,000 ; mangold-wurzel, £272,000 ; green crop (trefoil, lucern, and sainfoin), £521,000; beetroot, £28,300 ; vines, £408,000 ; cider-apples, £67,100. The live-stock in 1899 comprised 47,070 horses, 5170 asses, 151,380 cattle, 298,850 sheep, 31,290 pigs, and 4890 goats. The production in milk (1899) was valued at £711, 000. In 1898, 73 metric tons of lignite were cut. A great deal of building stone was quarried. There Was a mediocre production of work in metals. In 1898 there were distilled 22,100 gallons of alcohol. There are thriving sugar refineries, glass- works, and saw yards. Auxerre, the capital, had (1901) 18,901 inhabitants.~~

~~York, a north-eastern county of England, by far the largest in extent, but second to Lancashire in population, bounded on the N. by Durham, on the E. by the North Sea, on the S. by Lincoln, Nottingham, and Derby, on the S.W. by Cheshire, and on the W. by Lancashire and Westmorland.~~

~~Area and Population. — The county is divided into East, North, and West Ridings (properly Thriding, from Icelandic thriding= a third part, the loss of the th being probably due to the wrong division of the compounds East-thriding, West-thriding). The total area of the ancient county is 3,882,848 acres, or 6067 square miles, of which 749,513 are in the East Riding, 1,361,465 in the North Riding, 1,768,279 in the West Riding, and 3591 in the city of York. The following table gives the population of the ancient county and its subdivisions in 1881, 1891, and 1901 : —~~

~~Year.~~

~~Bast Riding.~~

~~North Riding.~~

~~West Riding.~~

~~City of York.~~

~~Yorkshire.~~

1881 1891 1901

309,408 341,546 367,319

340,687 360,383 393,143

2,174,737 2,439,895 2,746,867

61,789 67,004 77,793

2,886,621 3,208,828 3,585,122

Males in 1891 numbered 1,568,843, and females 1,639,985. In 1901 the number of persons per square mile was 599, and of acres to a person 1*08, the proportions in the East Riding being 314 and 2-04, in the North Riding 185 and 3‘46, in the West Riding 994 and 0‘64, and in the city of York 14,144 and ‘04. The area of the administrative county of the East Riding (in- cluding the county borough of Kingston-upon-Hull) in 1891 was 750,053 acres, with a population of 341,560 ; of the North Riding (including the county borough of Middlesbrough), 1,360,925 acres, with a population of 360,369 ; of the West Riding (including the county boroughs of Bradford, Halifax, Huddersfield, Leeds, and Sheffield), 1,773,782 acres, with a population of 2,444,931 ; of the city of York, 3591 acres, with a population of 67,004, the total area of the administrative counties being 3,888,351 acres, with a population of 3,213,864. Since 1891, however, various changes have been made in the administrative areas : in 1893 part of the contributory place of Clifton in the North Riding was transferred to the city of York ; and in 1895 the part of the township of Linthorpe in the borough of Stockton was transferred from the North Riding to Durham, and the part of the parish of Walling- wells in the West Riding was transferred to Nottingham, while the part of the parish of Auckley in Nottingham was transferred to the West Riding, the parts of the parishes of Humberton and llilby in the West Riding, and four detached parts of the parish of Nunwick with Howgravo, from the West Riding to the North Riding, a detached part of the township of Enedlington from the

YORK

East Riding to the West Riding, and the parts of the parishes of Lower Dunsforth and Upper Dunsforth with Branton Green, from the North Riding to the West Riding. Excluding county boroughs, the populations of the new administrative divisions in 1901 were as follows :— East Riding, 145,194; North Riding, 285,671 ; and West Ridinsr, 1,460,861. The area of the registration county of the East Riding (including the city of York) is 692,995 acres, with a population in 1901 of 454,271 ; of the North Riding, 1,277,104 acres, with a population of 375,909 ; and of the West Riding, 1,750,992 acres, with a population of 2,766,215. In the

East Riding the percentage of increase between 1881 and 1891 was 10·41 ; in the North Riding, 5 ‘96 ; and in the West Riding, 12·12, the corresponding increases for the period between 1891 and 1901 being 8‘9, 9·9, and 12·6 per cent., and for the whole county 11 ‘7 per cent. The excess of births over deaths in the whole registration area of Yorkshire between 1881 and 1891 was 387,664, and the increase in resident population was 324,080. The following table gives the numbers of marriages, births, and deaths, with the number of illegitimate births, in Yorkshire and the several Ridings for 1880, 1890, and 1898 :—

Marriages.

Births.

Deaths.

Illegitimate Births.

1880. | 1890.

1898.

1880.

1890.

1898.

~~1880.~~

~~1890.~~

~~1898.~~

~~1880.~~

~~1890.~~

~~1898.~~

~~East RidiDg . North Riding West Riding.~~

~~Yorkshire~~

~~2,844~~

~~2,212~~

~~16,661~~

~~8,154~~

~~2,778~~

~~20,329~~

~~8,756~~

~~2,905~~

~~23,083~~

~~12,482 11,445 77,457~~

~~12,106 10,939 74,549~~

~~13,407 10,905 79,397~~

~~7,656~~

~~6,624~~

~~46,794~~

~~7,696~~

~~6,541~~

~~51,617~~

~~7,882~~

~~6,628~~

~~49,131~~

~~689-673-3886~~

~~650~~

~~645~~

~~3475~~

~~724~~

~~619~~

~~3554~~

~~21,717~~

~~26,261~~

~~29,744~~

~~101,344~~

~~97,594~~

~~103,709~~

~~61,074~~

~~65,854~~

~~63,641~~

~~5248~~

~~4770~~

~~4897~~

~~The number of marriages in the East Riding in 1899 was 3730, of births 13,670, and of deaths 7851 ; of marriages in the North Riding 3048, of births 11,021, and of deaths 6882 ; of marriages in the West Riding 23,572, of births 79,837, and of deaths 49,704.~~

~~The following table gives the marriage-, birth-, and death-rates per thousand of the population in the East, North, and West Ridings, with the percentage of illegitimate births, for a series of years : —~~

~~Bast Riding.~~

~~North Riding.~~

~~West Riding.~~

~~1870-79.~~

~~1880.~~

~~1880-89.~~

~~1890.~~

~~1888-97.~~

~~1898.~~

~~1870-79.~~

~~1880.~~

~~1880-89.~~

~~1890.~~

~~1888-97.~~

~~1898.~~

~~1870-79.~~

~~1880.~~

~~1880-S9.~~

~~1890.~~

~~1888-97.~~

~~1898.~~

~~Marriage-rate . Birth-rate Death-rate Percentage of illegitimacy .~~

~~18-3 35-5 21-5~~

~~6-2~~

~~15-8 36-6 21-3~~

~~5-6~~

~~15-8 33-2 19‘7~~

~~5-8~~

~~15-9 30-5 19-4~~

~~5-4~~

~~16-1 ‘31-3 18 ‘8~~

~~5-4~~

~~17-5~~

~~SI ‘3~~

~~18-4~~

~~5-4~~

~~15-3 36‘5 20-1~~

~~7-0~~

~~13-4 34-7 20-0~~

~~5-9~~

~~13-8 33‘7 18-3~~

~~6-0~~

~~157 31-0 18-5~~

~~5-9~~

~~14-1 301~~

~~17:7~~

~~5-9~~

15·8 29·6 18·0

5·7

17·7 88·7 23·8

5·2

15·3 35·6 21·5

5·0

15·4 32·9 20·1

5·1

16·6 30·5 21·1

4·7

16·1 30·7 19·3

4·6

17·3 29·8

18·4 «

4·5

A striking feature is the diminution in both the birth- and death- rates. In 1891 there were in the county 21,387 natives of Scotland, 43,098 natives of Ireland, and 15,755 foreigners.

Constitution and Government. — Each of the three Ridings is, for most purposes, a distinct county ; but there is one sheriff for the whole county. The municipal boroughs of Bradford, Halifax, Huddersfield, Kingston-upon-Hull, Leeds, Middles- brough, Sheffield, and the city of York, are county boroughs. The East Riding contains five municipal boroughs :

Beverley (13,185), Bridlington (12,473), Hedon (1010), Kingston-upon-Hull (240,618), and York (77,793). Its urban districts are Cottingham, (3752), Filey (3004), Great Driffield (5766), Hessle (3754), Hornsea (2381), Norton (3842), Pocklington (2463), and Withernsea (1439). The North Riding contains four municipal boroughs : Middlesbrough (91,317), Richmond (3836), Scarborough (38,160), and Thornaby- ■on-Tees (16,053). The following are urban districts : Eston (11, 182), Guisborough (5645), Hinderwell (1937), Kirklington-cum-TJpsland (255), Loftus (6508), Malton (4758), Northallerton (4009), Ormesbv (9477), Pickering (3491), Redcar (7965), Saltburn-by-the-Sea (2578), Skelton and Brotton (13,239), South Bank in Normanby (9645), and Whitby (11,748). The West Riding contains the following municipal boroughs : Barnsley (41,083), Batley (30,321), Bradford (279,809), Brighouse (21,735), Dewsbury (28,050), Doncaster (28,924), Halifax (104,933), Harrogate (28,414), Huddersfield (95,008), Keighley (41,565), Leeds (428,953), Morley (23,638), Osset (12,886), Pontefract (13,422), Pudsey (14,907), Ripon (8225), Rotherham (54,348), Sheffield (380,717), Todmorden (25,419), and Wakefield (41,544). The urban districts are too numerous for complete mention, but the following is a list of those with a population of over 10,000 : Bingley (18,448), Castleford (17,382), Cleckheaton (12,523), Elland (10,412), Eeatherstone (12,093), Goole (16,576), Handsworth (14,157), Hoyland, Nether (12,464), Liver- sedge (13,978), Mexborough (10,417), .Mirfield (11,346), Normanton (12,353), Rawmarsh (14,587), Rothwell (11,702), Saddleworth (12,319), Shipley (25,570), Skipton (11,986), Sowerby Bridge (11,477), Stanley (12,158), Swinton (12,217), Thornhill (10,290), Wombwell (13,252), and Worsborough (10,335). The ancient county of York contains 1135 ecclesiastical parishes and districts and parts of 13 others ; it is situated partly in the dioceses of Durham, Lincoln, Manchester, Ripon, Southwell, Wakefield, and York.

Education. — Leeds and Sheffield are the seats of university colleges. In connexion with both there are day training colleges for schoolmasters and schoolmistresses; at York there, is a residential training college (diocesan) for schoolmasters, and at Ripon a residential training college (diocesan) for school- mistresses. There are board deaf schools at Bradford, Kingston- upon-Hull, Leeds, Middlesbrough, and Sheffield ; at

~~*Bradford there is a blind school, at Leeds a board home and school for the blind, at Sheffield an institution for the blind, at York the York- shire school for the blind, at Boston Spa an institution for the deaf and dumb, and. at Doncaster the Yorkshire institution for the deaf. The total number of elementary schools in the county on*~~

~~*31st August 1899 was 2098, of which 692 were board and 1406 voluntary schools, the latter including 1112 National Church of England schools, 76 Wesleyan, 107 Roman Catholic, and 111 "British and other." The average attendance at board schools was 279,503, and at voluntary schools 238,458. The total school board receipts of the united county boroughs for the year ended 29th September 1899 were over £808,708. Their income under the Technical Instruction Act was £3080, and that under the Agri- cultural Rates Act over £1621. 'Excluding the county boroughs, the total school board receipts of the East Riding were over £14,373, of the North Riding £70,793, and of the West Riding over £460, 672. In the East Riding there was no income under the Technical In- struction Act, and that under the Agricultural Rates Act was over £1469; in the North Riding the two several incomes were over £214 and over £2126, and in the West Riding over £3844 and over £7293.*~~

~~*Agriculture. — Nearly seven-eighths of the total area of the East Riding is under cultivation, but of the North and West Ridings only about two-thirds. Wheat is largely grown in all the Ridings — in the East and West Ridings occupying about two-sevenths of the corn crop acreage, and in the North Riding about one-sixth. Oats are now the principal corn crop, barley holding an intermediate position. Of the green crop acreage, the bulk is devoted to turnips and swedes ; but in the West Riding about one-fourth is usually under potatoes, in the East Riding about one-ninth, and in the North Riding about one-seventh. In the flat East Riding only about 2000 acres are in hill pasture, but in the North Riding about 315,000, and in the West Riding about 216,000. Both the North and West Ridings are well wooded, but in the East Riding the acreage under woods is only about 17,000. The following table gives the acreages of the larger main divisions of the cultivated area in the several Ridings at intervals from 1885 : —*~~

~~1885.~~

~~East Riding North Riding West Riding~~

~~1890.~~

~~East Riding North Riding West Riding~~

~~1895.~~

~~East Riding North Riding West Riding~~

~~1900.~~

~~East Riding North Riding West Riding~~

~~Total Area under Cul- tivation.~~

~~662,506~~

~~854,605~~

~~1,211,928~~

~~863,756 1,216,528~~

~~669,993~~

~~864,297~~

~~1,201,897~~

~~672,354~~

~~865,729~~

~~1,197,768~~

~~Corn Crops.~~

262,134 206,270 220,971

253,067 193,052 206,286

245,765 183,298 192,497

247,500 183,627 192,246

Green Crops.

111,076 78,809 99,744

105,016 74,897 92,274

108,698 75,834 94,732

109,421 76,928 94,747

86,217 72,714 82,969

91,814 75,026 82,418

94,345 75,826 78,267

92,232

71,918 74,463

Perma- nent Pasture.

184,241 469,874 791,483

200,037 497,286 820,783

206,342 509,071 824,568

211,220 518,972 827,630

18,428 26,923 16,208

~~17,500 23,115 13,069~~

~~14,037~~

~~19,567~~

~~9,715~~

~~11,062~~

~~13,698~~

~~6,992~~

~~918~~

~~YORK—YORKTOWN~~

~~The following table gives particulars regarding the principal live-stock for the same years :—~~

~~Total Horses.~~

~~Total Cattle.~~

~~Cows or~~

~~Heifers in~~

~~Milk or in~~

~~Calf.~~

~~Sheep.~~

~~Pigs.~~

~~1885.~~

~~East Riding North Riding West Riding~~

1890.

East Riding North Riding West Riding

1895.

East Riding North Riding West Riding

1900.

East Riding North Riding West Riding k

37,625 39,704 51,327

88,189 171,473 274,506

27,070

55,566

123,894

424,724 636,221 630,054

46,472 50,864 74,007

40,068 42,074 54,494

83,989 168,402 263,399

26,326

54,756

126,052

483,338 710,643 685,167

61,400 64,042 91,028

46,033 45,493 61,413

83,136 164,254 260,296

24,936

51,867

122,504

436,237 676,762 672,856

63,080

58,667

103,351

43,743 44,177 59,993

88,860 174,744 271,922

26,342

53,712

127,321

429,856 733,757 676,485

56,074 47,673 89,001

Industries and Trade. — According to the report for 1898 of the chief inspector of factories (1900), the total number of persons in the East Riding employed in factories and workshops was 30,734, as compared with 28,353 in 1896 ; in the North Riding 39,750, as compared with 38,546 ; and in the West Riding 538,002, as com- pared with 535,764. In the West Riding textile factories employed 237,344 persons, there being an increase between 1895 and 1896 of 0‘7 per cent., but between 1896 and

1897 a decrease of 5‘7. In the woollen and worsted industries nearly fifteen times as many persons (191,622) were employed as in Lancashire, which comes next. Nearly all the important towns are engaged in this industry, several districts having their own special branches. The cotton industry in the West Riding employed 31,337 persons, chiefly in the neighbourhood of Halifax: silk 9998, and flax, hemp, &c, 3774. Non-textile industries employed in the East Riding 23,449 persons, in the North Riding 35,337, and in the West Riding 257,882, the increase in the East Riding between 1895 and 1896 being 5-2 per cent, and between 1896 and 1897, 7‘0 per cent. ; while in the North. Riding the percentages of increase were 17 ‘0 and 4 ‘3, and in the West Riding 5‘6 and 5‘0. In the manufacture of machines, conveyances, appliances, and tools, 9248 persons were employed in the East Riding, 11,514 in the North Riding, and 87,137 in the West Riding. Metal extracting, founding, and conversion employed in the North Riding 15,414, and in the West Riding 40,716. Leeds, Sheffield, and Middlesbrough are the chief seats of the metal industries. In the North Riding the manufacture of chemicals employed 4739, and in the West Riding 4901. Other important industries of the West Riding are clothing, employing 25,802 ; printing, bleaching, &c, 20,294 ; paper making, &c, 12,463; the making of jewellery, &c, 9895; glass making, 6398 ; food industries, 6060 ; drink industries, 5441 ; furniture making, 5699 ; and clay and stone industries, 5269. Workshops in the East Riding employed 7051, in the North Riding 4175, and in the West Riding 42,776. Of those in the West Riding 20,939 were employed in clothing industries, 6829 in the manufacture of machines, &c, 4070 in furniture making, 1847 in cotton and woollen industries, and 1571 in the manufacture of jewellery, &c. The total number of persons employed in con- nexion with mines and quarries in 1899 was 113,096. In the same year 1,352,995 tons of clay were raised, 997,915 tons of limestone, 940,951 tons of sandstone, 180,800 tons of igneous rocks other than granite, 50,249 tons of chalk, 15,820 tons of alum shale, 5656 tons of slate, and 2358 tons of barytes. Of salt 44,481 tons were obtained from brine. But the principal mineral productions are coal and iron. In 1885 the pig iron made in the North Riding (Cleveland) amounted to 1,747,598 tons, and in the West Riding it amounted to 165,857 tons ; in 1890 the amounts were 1,961,328 tons and 248,581 tons ; in 1895 they were 2,058,279 tons and 195,123 tons, and in 1899 they were 2,211,222 tons

~~and 305,583 tons. The following table gives the tonnage and value of the coal and iron ore production at intervals from 1885 : —~~

~~Coal.~~

~~Iron Ore.~~

~~North Riding.~~

~~West Riding.~~

~~North Riding.~~

~~East and West Ridings.~~

~~Tons.~~

~~Value.~~

~~Tons.~~

~~Value,~~

~~Tons.~~

~~Value.~~

~~Tons.~~

~~Value.~~

~~1885 1890 1895 1899~~

~~3906 3776 3531 2970~~

~~£1433~~

~~1463 1148 965~~

~~18,497,778 22,335,110 22,807,507 26,001,495~~

£4,624,444

9,771,610 7,317,408

10,312,240

5,932,244 5,617.573 5,285,617 5,612,743

£963,9S9

1,053,295

858,913

1,109,821

120,596 77,433 45,588 69,136

£63,298

47,750 29,030

32,525

The fisheries are of some importance, but not so much as the amount of fish landed at Hull would seem to indicate. The quantity landed there in 1899 was 1,249,123 cwt., valued at £941,712 ; at Scarborough it was 187,100 cwt., valued at £117,696 ; the total value of the port's fish, including shell-fish, being £119,601. The total quantity landed at all other fishing ports was 49,583 cwt., valued at £31,007 ; the total value, including shell-fish, being £40,256.

Authorities. — Frank. Ryedale and North Yorkshire Anti- quities. 1888. — Parkinson. Yorkshire Legends. London, 1888. — Boyle. Lost Towns of the Sumber. Hull, 1889. — Ross. Legendary Yorkshire. Hull, 1892. — Bloom. Heraldry in the Churches of the West Riding. Hainworth, 1892-95. — Wright. Grammar of the District of Windhill in the West Riding. London, 1892. — Holroyd. Collection of Yorkshire Ballads. London,

1892. — W. A. Character, Customs, and Folk-lore of the West Hiding. London, 1898. (t. F. H.)

York, a cathedral city, municipal, county (1888), and parliamentary borough, and the county town of Yorkshire, England, on the river Ouse, 188 miles north of London by rail. New municipal offices were erected in 1889-91, and new courts of justice (£25,000) in 1892. In 1891 the nave of the cathedral was restored, and in 1892 the corporation purchased the building of the York Institute of Science and Art for a free library. In 1893 the area of the city and county borough was extended by the transfer- ence to it of part of the contributory place of Clifton, an addition of 138 acres with a population of 995. Popula- tion (1891), 67,749; (1901), 77,793.

York, a city of Nebraska, U.S.A., capital of York county, at the intersection- of the Chicago, Burlington, and Quincy, the Fremont, Elkhorn, and Missouri Valley, and the St Joseph and Grand Island railways, in the south-eastern part of the state. Population (1890), 3405 ; (1900), 5132, of whom 477 were foreign-born

York, a borough of Pennsylvania, U.S.A., capital of York county. It is situated in 39° 58' N. and 76° 40' W., on Codorus creek, in the south-eastern part of the state, at an altitude of 381 feet. It has an undulating site, on which it is laid out with great regularity. It is divided into thirteen wards, has a good water-supply from springs by gravity, and good sewerage. It is sur- rounded by a rich farming country, made tributary to it by four railways — the Northern Central, the Pennsyl- vania, the Western Maryland, and the York Southern. In 1900 it contained 464 manufacturing establishments, with a total capital of $9,640,784. They employed 7785 hands, and the product was valued at $11,961,706. Among these products were foundry and machine-shop products, carriages and waggons, lumber, confectionery, iron and steel, tobacco and cigars, and agricultural imple- ments. Population (1890), 20,793; (1900), 33,708, of whom 1304 were foreign-born and 776 negroes.

York River, a tributary to Chesapeake Bay, U.S.A. Its sources, the Mattapony and Pamunkey rivers, rise in the " piedmont " region of Virginia, and, flowing south-east, join at "West Point to form York river,

which is through- out a tidal estuary. Situated upon it, a few miles above its mouth, is Yorktown, one of the oldest settlements of Virginia.

YorktOWn, capital of York county, Virginia, U.S.A., situated in the south-eastern part of the state, at the mouth of the York river. It is famous as the scene of the surrender of Lord Cormvallis, 19th October 1781, the closing event of the Eevolutionary War. Cornwallis, with a force of about 8000 men, had established himself at Yorktown, where he was besieged by the combined American and French forces, under Washington and Lafayette, numbering about

16,000. The arrival of British reinforcements was pre- vented by Count de Grasse, who had a large French fleet in the harbour. After several days of hard fighting and an ineffectual sortie, the British commander was obliged to surrender his whole force. In May 1862, during the Civil War, Yorktown was a second time be- sieged^ this time by General McClellan with a large body of Union troops. A great contest was anticipated, but after the elaborate preparations for the siege were com- pleted, it was discovered that the Confederates under General Johnston had secretly evacuated the place, taking with them everything of any value. Population (1890), 221; (1900), 151. V

Yoruba. See Nigeria.

Yosemite, a famous valley on the western slope of the Sierra Nevada of California, about 150 miles east of San Francisco and 4000 feet above the sea. It is 7 miles long, half a mile to a mile wide, and nearly a mile deep, eroded out of hard massive granite by glacial action. Its precipitous walls present a great variety of forms and sculpture, determined by the grain or cleavage of the rock — domes, gables, towers, battlements, and majestic mountain cliffs, partially separated and individualized by recesses and side canons. The bottom, a filled-up lake basin, is level and park-like, diversified with groves of oak and pine, clumps of flowering shrubs, and spacious ferny meadows and wild gardens through which the river

Merced meanders in tranquil beauty; while the whole valley resounds with the, booming of its unrivalled waterfalls. The most notable of the wall rocks are : EI Capitan, 3300 feet high, a sheer, plain mass of granite, the end of one of the most enduring of the mountain ridges, which stands forward beyond the general line of the north wall in imposing grandeur ; the Three Brothers, North Dome, Glacier Point, the Sentinel, Cathedral, Sentinel Dome and Cloud's Best, from 2800 to nearly 6000 feet high ; and Half Dome, the noblest of all, which rises at the head of the valley from a broad, richly sculptured base to the height of 4740 feet. These rocks are majestic glacial monuments, illustrating on a grand scale the action of ice in mountain sculpture. For here five large glaciers united to form the grand trunk glacier that eroded the valley and occupied it as its channel. Its moraines, though mostly obscured by vege- tation and weathering, may still be traced ; while on the snowy peaks at the headwaters of the Merced a consider- able number of small glaciers, once tributary to the main Yosemite glacier, still exist. The Bridal Veil Fall, 900 feet high, is one of the most interesting features of the lower end of the valley. Towards the upper end the great Yosemite Fall pours its white floods from a height of 2600 feet, bathing the mighty cliffs with clouds of spray and making them tremble with its thunder-tones. The valley divides at the head into three branches, the Tenaya, Merced, and South Fork canons. In the main (Merced) branch are the Vernal and Nevada Falls, 400 and 600 feet high, in the midst of most novel and sublime scenery. The Nevada is usually ranked next to the Yose- mite among the five main falls of the valley. Its waters are chafed and dashed to foam in a rough channel before they arrive at the head of the fall, and are beaten yet finer by impinging on a sloping portion of the cliff about half- way down, thus making it the whitest of all the falls. The Vernal, about half a mile below the Nevada, famous for its afternoon rainbows, is staid and orderly, with scarce a hint of the passionate enthusiasm of its neigh- bour. Nevertheless it is a favourite with visitors, because it is better seen than any other. One may safely saunter along the edge of the river above it,

and stand beside it at the top, as it calmly bends over the brow of the precipice. At flood time it is a nearly regular sheet about 80 feet wide, changing as it descends from green to purplish grey and white, and is dashed into clouds of irised foam on a rugged boulder talus that fills the

gorge below. In the south branch, a mile from the head of the main valley, is the Illilouette Fall, 600 feet high, one of the most beautiful of the Yosemite choir. It is not nearly as grand a fall as the Yosemite, as symmetrical as the Vernal, or as airily graceful as the Bridal Veil; nor does it ever display as tremendous an outgush of snowy magnificence as the Nevada ; but in fineness and beauty of colour and texture it surpasses them all.

Considering the great height of the snowy mountains about the valley, the climate of the Yosemite is remarkably mild. The vegetation is rich and luxuriant. The tallest pines are over 200 feet high ; the trunks of some of the oaks are from 6 to 8 feet in diameter ; violets, lilies, goldenrods, ceanothus, manzanita, wild rose, and azalea make broad beds and banks of bloom in the spring ; and on the warmest parts of the walls flowers are in blossom every month of the year.

The valley was discovered in 1851 by a military company in pur- suit of marauding Indians; regular tourist travel began in 1856. The first permanent settler in the valley was Mr J. C. Lamon, who built a cabin in the upper end of it in 1860 and planted gardens and orchards. In 1864 the valley was granted to the State of California by Act of Congress on condition that it should be held as a place of public use, resort, and recreation inalienable for all time. In the number and height of its vertical falls and in the massive grandeur of El Capitan and Half Dome rocks Yosemite is unrivalled. But there are many other valleys of the same kind. The most noted of those in the Sierra, visited every summer by tourists, hunters, and mountaineers, are the Hetch Hetchy Valley, a wonderful counterpart of Yosemite in the Tuolumne canon ; Tehipitee Valley, in the Middle Fork canon of King's river ; and the King's river Yosemite in the South Fork canon, the latter being larger and deeper than the Merced Yosemite. All are similar in their trends, forms, sculpture, and vegetation, and are plainly and harmoniously related to the ancient glaciers. The Komsdal and Naerodal of Norway and Lauterbrunnen of the Alps are well characterized glacial valleys of the Yosemite type, and in south- eastern Alaska many may be observed in process of formation.

(j. Mu.)*

Youghcll, a maritime town and urban sanitary district in the county* of Cork, Ireland, on the estuary of the Blackwater, 157 miles south-west of Dublin by rail. The number of vessels registered in the fishery dis- trict in 1900 was 84, and the number of men and boys employed 411. Population (1881), 5826; (1891), 4317. Extension of the town boundaries has since increased tie population to nearly 6000.

YoungStOWn, a city of Ohio, U.S.A., capital of Mahoning county. It is situated in 41° 07' N. and 80° 38' W., on the Mahoning river, in the Western Reserve, in the north-eastern part of the state, at an altitude of 837 feet. The business portion of the city lies in the bottom land, while the residences have spread up the bluffs on both sides of the valley. It is irregularly planned, and is divided into ten wards. It derives its water-supply from the river, and is well sewered. Its business streets are paved with brick and asphalt, and many of its residence streets are macadamized. Youngs- town has ample railway accommodation, since five rail- ways enter it. These are the Erie, the Lake Shore and Michigan Southern, the Pennsylvania, the Pittsburg and Lake Erie, and the Pittsburg and Western, and they give it a large transportation business. It is an important manufacturing centre, especially of iron and steel goods. It has blast furnaces, rolling and puddling mills, foundries, machine and boiler works, and bridge works. In 1900 there were 260 manufacturing establishments, with a

total capital of $22,360,097. They employed 9150 hands, and the product was valued at 134,801,101. Of this iron and steel goods composed over three-quarters, or $28,303,856. In 1900 the assessed valuation of real and personal property was $14,896,410, the net debt of the city was only $662,880, and the rate of taxation was $32.20 per $1000. Population (1890), 33,220; (1900), 44,885, of whom 12,207 were foreign-born and 915 negroes.

YpreS, a town of Belgium, in the province of West Flanders, 32 miles south-west of Bruges by rail. Linen and lace are its chief manufactures.

~~Population (1890),~~

~~16,505; (1899), 17,394.~~

~~Ypsilanti, a city of Washtenaw county, Michigan, U.S.A. It is on the Huron river and on the Lake Shore and Michigan Southern and the Michigan Central rail- ways, in the south-eastern part of the Lower Peninsula, at an altitude of 712 feet. It is regularly laid out on both sides of the river, is divided into five wards, and has an excellent water-supply. It is in a farming region for which it serves as a market place, and has also varied manufactures. It was settled in 1824, and chartered as a city in 1858. Population (1880), 4984; (1890), 6129; (1900), 7378, of whom 899 were foreign-born and 608 negroes.~~

~~Ystad, a seaport town of Sweden, county of Malmohus, on the south coast, 39 miles by rail east-south- east of Malmo. It is -an ancient place, two of its churches dating originally from the 13th century. Its harbour, which will admit vessels drawing 19 feet, is the freest from ice in winter of any Swedish Baltic port. Apart from a growing import trade in coal and machinery, its commerce is declining. The shipping clearing the port decreased from 776 vessels of 140,000 tons in 1888 to 247 of 55,850 tons in 1899. Population (1880), 7025; (1890), 8235;~~

~~(1900), 9862.~~

~~Ystrad-y-fodwg', an extensive coal-mining parish and town, Glamorganshire, South Wales (the parish form- ing the Bhondda division of the county), on the Bhondda, 20 miles north-west of Cardiff by rail. Since 1894 the district has been governed by an urban district council, and the name changed to Bhondda. Population (1891),~~

~~88,351; (1901), 113,735.~~

~~Yucatan, a state of Mexico, bounded on the N. by the Gulf of Mexico, on the E. by the Caribbean Sea, on the S. by British Honduras and Guatemala, and on the W. by the state of Campeachy. Area, 35,214 square miles. Population (1879), 302,315; (1895), 298,850. The climate is generally pleasant. The prin- cipal agricultural product is henequen, and~~

~~in the north- west some sugar-cane is raised. The state is divided into seventeen partidos. Capital, Merida, 36,935 inhabitants. The principal towns are Acanceh (22,916 inhabitants), Tekax (18,346), Motul (17,995), Temax (16,807), Espita (10,179), Maxcanu (9613), Hunucma (8920), Tixkokob (6934), Peto (6739), Progreso (5911).~~

~~Yuchow. See Yohchow.~~

~~Yukon River. See Alaska.~~

~~Yule, Sir Henry (1820-1889), British Orientalist and administrator, was the youngest son of Major William Yule of the Bengal army, and was born 1st May 1820 at Inveresk, near Edinburgh. He was educated in Scot- land, and, being destined for an Indian military career, entered Addiscombe College in February 1837. In the following year he was gazetted lieutenant in the Bengal~~

~~Engineers, and proceeded to India early in 1840. His first employment was in connexion with the canals in the North- Western Provinces, and his first experiences of real warfare were in the Sutlej and Punjab campaigns, 1848-49. On the outbreak of war with Burma he was. appointed to survey the Arakan frontier, and coming under the notice of Sir Arthur Phayre, accompanied that officer on his special mission to Ava in 1855 as private secretary, and afterwards Wrote an account of the embassy, enriched with archaeological, historical, and geographical details. In 1857 he was employed on defensive works in Allahabad, Benares, and Mirzapore, and was, attached to the railway department in the following year. From 1857 to 1862 he was secretary of the Public Works Department, but in the latter year, partly on account of ill-health, he retired from the service with the honorary rank of colonel and settled at Palermo. It was not until 1875 that he returned to official life, and then, having been appointed a life member of the India Council, he acted in that capacity as long as health would permit, a period of about six months. But it is by the work done during the long intervals of retirement that Sir Henry is most widely known and will be longest remem- bered. In 1866 he edited for the Hakluyt Society, under the title of Cathay and the Way Thither, a collection of mediaeval notices of the attempt to reach China overland, and showed himself to be a geographical expert of the~~

first rank. This he followed up five years later by a critical edition of The Booh of Ser Marco Polo. Then in conjunction with Mr Burnell he compiled the famous learned and humorous glossary of Anglo-Indian terms, Hobson-Jobson, published in 1886. For the Hakluyt Society, of which he was for some time president, he also edited the Mirabilia descripta of Jordanus (1863) and the Diary of William Hedges (1887), and he contri- buted to the transactions of many other learned societies and to the leading periodicals. Sir Henry was considered particularly happy in composing epitaphs, the best known being those on the well at Cawnpore and the statue of Outram at Calcutta. He was a model editor, a severe critic of himself and others, and a sure guide in the intricacies of Asiatic research. He studiously avoided politics, and all through the vexed Central Asian contro- versy he adopted a neutral attitude. To this fact probably he owes his great reputation as an accurate historian, for it is certain that the stores of information he accumulated were the result of an unbiassed and diligent inquiry into truth. The honour of K.C.S.I. was conferred upon him less than a year before his death, which took place in London on 30th December 1889.

Yuriev. — This is now the official name of the Bussian town formerly called Doepat, in the government of Livonia (q.v.). It is on the river Embach, and is pictur- esquely situated, with a station on the Biga and Beval railway. The ancient University is the principal centre of higher education in the province, and its activities are well maintained. Population (1891), 40,880; (1901),

42,421.

Yuzgat, the chief town of a sanjak of the same name in the Angora vilayet of Asia Minor, altitude 4380 feet, situated near the head of a narrow valley through which the Angora-Sivas road runs. The town was built, largely out of the ruins of Nefez Keui (Tavium), by Chapan Oghlu, the founder of a powerful Dere Bey family. There is a trade in yellow berries and mohair. The sanjak is very fertile, and contains good breeding grounds, upon which horses, camels, and cattle are reared. The population of 15,000 includes a large Armenian com- munity.

ZAANDAM- ZAMBEZI

Zaandam, a town in the province of North Hol- land, Netherlands, at the influx of the canalized Zaan into the Y. It is the junction of the line Amsterdam-Helder •with the line to Hoorn and Enkhuizen, with which places and Haarlem, the North Sea, and the Noord-Hollandsche canal it has also steamboat communication. On both banks of the Zaan is the " Zaanstreek," a series of in- dustrious villages, with 400 mills, now in large part steam mills. Population (1901), 21,597

ZcLbern (French, Saverne), a town of Germany, in Alsace-Lorraine, district of Lower Alsace, 27 miles north- west of Strasburg, on the Khine-Marne canal, and at the foot of a pass over the Vosges. Its principal building, the former episcopal residence, built by Cardinal de Kohan in 1779, is now used for military purposes. There are also a 15th-century church and an antiquarian museum. In the vicinity are the ruined castles of Hohbarr, Grossgeroldseck, Ochsenstein, Greifenstein, &c. It has stone quarries and factories for machinery. Population (1885), 6936 ; (1 900),

8499.

Zacatecas, a state of Mexico, bounded on the N. by Coahuila, on the E. by San Luis Potosi, on the S. by Aguascalientes, and on the W. by Durango. Area, 35,214 square miles. Population(1879),422,506; (1895), 452,578. Its mean altitude is 7000 feet above sea-level. Cereals, sugar-cane, and maguey are valuable products, and stock- raising is important. It is immensely rich in minerals, especially in silver ; gold, mercury, iron, copper, zinc, lead, coal, bismuth, and salt are also found. Commer- cially it is one of the great centres of the republic. Its exports are estimated at about $19,000,000 annually, its imports at 115,000,000, its local trade at $7,000,000. The principal manufacturing industries are the production of sugar, rum, and wine, reduction of ores, cotton and woollen mills, <&c. The capital, Zacatecas, on the Mexican Central Eailway, 442 miles from Mexico City, has a popula- tion of 39,212. Other principal towns are Sombrerete (10,082), Ciudad Garcia (9420), Guadalupe (8781), Pinos (8183), San Juan del Mezquital (7113), Fresnillo (6757), and Kio Grande (5008).

~~Zagrab. See Agram.~~

~~Zaisan, a district town of Eussian Central Asia, in the province of Semipalatinsk, near the Chinese frontier, at an altitude of 2200 feet, on the Jemen river, 29 miles south-east of where it flows into the south corner of Lake Zaisan. In 1897 it had a population of 4471. Lake Zaisan, situated in an open valley between the Alai range on the north-east and the Tarbagatai in the south, lies at an altitude of 1800 feet. It has a length of about' 87 miles, a width of from 10 to 20 miles, an area of 707 square miles, and a maximum depth of 50 feet. Its water is fresh, as it receives the Black Irtysh and the Kendyrlyk from the east and several small rivers from the west, all of which leave the lake at its north-west corner in the White Irtysh. The fisheries, which yield abundantly, are in the hands of the Siberian Cossacks.~~

~~Zambezi, the fourth in size of the rivers of Africa, and the largest of those flowing eastwards to the Indian Ocean. Its length is estimated at about 2000 miles, and the area of its basin is 513,500 square miles, according to Dr Bludau, or rather ' less than half that of the Nile. Additions to our knowledge of the Zambezi system have been mainly the work of Major Gibbons and his assistants, who during two expeditions, in 1895-96 and 1898-1900, ably continued the work of exploration begun by Dr Living-stone in the upper basin and central course of the river. The source of the Zambezi — the main channel of which is, according to Major Gibbons, clearly marked from beginning~~

~~to end, no tributary being at all comparable to it in size — is now placed in 11° 21' 3" S., 24° 22' E., or some 40 miles west of the position previously assigned to it. It lies in a depression of an undulating country 5000 feet above the sea, covered with bracken and open forest, the water, like that of all the rivers of the neighbourhood, issuing from a black marshy bog, and quickly collecting into a well-defined stream. In the first hundred miles of its course the river is known as the Yambeshe — in sound almost identical with its name on its lower course, though intervening sections are known as Liambeshe and Liambai. From the source eastwards the water-parting between the Congo and Zambezi basins is a well-marked belt of high ground, falling abruptly north and~~

south, and running nearly east and west between 11° and 12 S. West of the source also the parting of the waters is more com- plete than was once supposed, Lake Dilolo belonging to the Zambezi system only, and sending none of its water to the Kasai.

The course of the main stream will be spoken of below, in con- nexion with its use as a navigable channel, the new information respecting the tributaries being first summarized. The Kabompo, which flows in from the east in about 14° 8' Trlbw S., rises not far from 11° 34' S., 25° 17' E. In 13£ taries.

S. it receives on the right bank a tributary, the Lunga, said to be .more important than the upper Kabompo itself, and rising somewhat farther north. The Lungwebungu, which enters the Zambezi from the west in 14° 35' S., is a strong, deep stream 200 yards wide in its upper course, flowing in a valley bordered, like others of this part of the country, by undulations of white sand covered by thin forest, its floor forming at times an inundated plain 2 to 3 miles wide. The Kwando, formerly known as the Chobe, rises in about 12° 40' S., 18° 50' E., and flows in a generally straight course south-east to 17° 30' S., at which point it makes a sudden bend to the south before flowing east to the Zambezi. Apart from its head-streams, it receives most of its tributaries from the west, and at its most southern bend is joined by the Magwe'- kwana, which in time of flood receives some of the surplus water of the Okavango (see Ngami). In its lower course the Kwando presents the phenomenon of a double rise, one occurring at the height of the dry season, which has been attributed to the nature of the soil in its source region.

Of the streams which enter the upper Zambezi from the east, the largest, after the Kabompo, is the Luena, which rises in 10° S., 26° E. , and flows , first north-west, afterwards west-south-west, joining the main river a little north of 15° S. Others are the Njoko, joining in 17° 8' S., and the Machili, which enters in •about 25° E. The largest tributary of the middle Zambezi — the Kafukwe — has been found to rise in about 11° 40' S. The main head- stream, which flows first south-east, afterwards south-west, is joined in 14° 35' S. by the Lunga or Luanga, an important right-bank tributary, the united stream then flowing first south, afterwards due east.

The lower Kafukwe is a large navigable river until about 40 miles from its mouth, but it then descends from the plateau by a series of falls and cataracts, the drop being over 1000 feet in 15 miles, one very high fall occurring in a stupendous chasm. The next great tributary to the east — the Loangwa — has, with its branches, been explored since 1890 by many travellers, including officials of the British Central Africa Protectorate and South Africa Company. The main stream flows in a generally level valley, bounded by steep plateau escarpments, and is for the most part shallow and rapid, though fairly wide. In 14° 30' S. , how- ever, it passes through narrow gorges with a speed of 8 or 9 miles an hour. In 15° 5' S. it is joined by the Lunsefwa, which, with its tributary, the Lukosasi, drains a large extent of the western plateau, its basin being separated by the Mchinga mountains from that of the Loangwa.

The entrance of vessels from the sea to the Zambezi has been much facilitated since the discovery by Mr D. J. Rankin in 1889 of a practicable channel north of the main mouths of the river. It is known as the Chinde mouth, and, Naviga- though for the most part narrow and winding, has a “”’ minimum depth at low water of about 7 feet at the entrance and of 12 feet farther within. The channel is, however, subject to changes. From the sea to the Kebrabasa rapids, a distance of 400 miles, navigation is always possible for shallow-draught steamers, though difficult on account of sandbanks. The Kebrabasa rapids are in their present condition quite impassable (as was found by Livingstone in 1858) ; but Major Gibbons suggests that the difficulty may be removed, either by the cutting of a side channel or the building of a dam to convert the gorge into a lake,

to be connected with the river below by a lock and weir. The middle Zambezi, from Kebrabasa to a short distance below the Victoria Falls, has a length of about 800 miles, during which navigation, though quite practicable for nine months in the year, is much impeded at low water by the rocky nature of the gorges which occur on this section and the impetuosity of the current. One of the most difficult passages is that of a grand gorge a little above the mouth of the Loangwa, in about 30° E.,

~~named by Major Gibbons Livingstone's Kariba, in distinction from a second Kariba (= "gorge") a little beyond the Kafukwe confluence. Between the two gorges the river is generally unobstructed, but at the western end of the second Kariba navigation is dangerous at low water. At the Molele rapids, 140 miles below the Victoria Falls, a broken section begins, within which the fall is 800 feet, which makes the upper Zambezi practically a separate river. Of this the 100-miles section beginning just below the Kwando confluence and ending with the series of rapids including the Gonye falls is navigable, and above Gonye there is a clear stretch of 300 miles, terminated by the Sapuma cataract in 13° 7′ S. The Lungwebungu, which enters in this section, is likewise navigable for a long distance, thus supplying communication with the extreme north-west corner of the Zambezi basin. Beyond the Sapuma there is another 120-miles stretch of navigable water on the upper Zambezi, while parts at least of the Luena, Kafukwe, and Loangwa tributaries are also capable of being navigated. The possibility of connecting the Kwando with the navigable waters of the Okavango, at the point where the above-mentioned overflow takes place, has likewise been suggested. The Shire, which flows from Lake Nyasa, has for many years been navigated with the exception of a stretch of 80 miles between Katunga and Malope, which involves a troublesome portage. A scheme has, however, been set on foot for connecting these two points by a light railway. The sum of such navigable reaches within the Zambezi basin as exceed 100 miles is estimated at nearly 4000 miles.~~

~~See Bankin in Pros. R.O.S., March 1890. — Shakpb, ibid., December 1890. — Gibbons, Reid, and Bertrand in Geog. Jour- nal, February 1897. — Gibbons, ibid., February 1901; and Journ. R. Colonial Inst., February 1901. — Coillard, On the Threslwld of Central Africa. London, 1897. — Grey, in Geog. Journal, July 1901. (j;. he.)~~

~~Zam bOEnga, a town situated at the extreme point of the peninsula of Mindanao, Philippine Islands. It was formerly the capital of the district of Zamboanga, but in 1901 was made the capital of the department of Mindanao and Sulu. It has one of the most healthful sites in the islands, its climate being decidedly cooler than that of Manila. There is an abundant supply of water, which flows in canals down the principal street.~~

The town was set on fire by insurgents in 1899 and was badly injured, but was afterwards rapidly rebuilt. Zamboanga is a port of entry, and has good anchorage for large vessels close to the shore. In earlier days it was the base of Spanish operations against the Moro pirates of the southern Philippines. A large and strong stone fort, which was constructed at that time, is still well preserved. Many of the inhabitants are descendants of slaves who escaped from the Moros and sought Spanish protection. A Spanish patois, called " Zamboangueno," is spoken by most of the native in- habitants. A large Moro town, ruled over by Dato Mandij, has sprung up beside the settlement of Christian natives. Agriculture is less highly developed in the vicinity of Zamboanga than in many of the northern pro- vinces of the Philippines. Guttapercha, damar, and other valuable forest products from the neighbouring forests are exported in increasing quantity. Population, 18,000.

Z £L mora, a province of Spain, with an area of 4135 square miles. Population (1887), 270,072 ; (1897), 275,354. The birth-rate is 3-81 per cent., and the death- rate 3'23 per cent. The proportion of illegitimate births is 3'77 per cent. It is divided into 8 districts and 300 parishes, and has 25 miles of railway. Education is in a very backward condition. In 1897 there were 2,600,000 acres under culture, 324,105 producing wheat, 102,580 rye, barley, oats, maize, 29,502 pod fruit, 132,422 covered with vines, and 1200 with olives. The commons and forests cover about 300,000 acres. In the same year

there were 2324 horses, 5047 mules, 7442 asses, 23,770 cattle, 220,553 sheep, 34,799 goats, and 18,700 pigs. Much live-stock is exported to Portugal. Insufficiency of means of communication paralyses the mining interests.

Zamora, capital of the above province, on the Douro, 57 miles west by south of Valladolid. Agricultural products from the surrounding country are the staple trade. It is the seat of a bishopric. Population (1887),

.15,292; (1897), 16,453.

Zatno^d (Russian, Zamostie), a district town of Russian Poland, in the government and 50 miles east of the town of Lublin. It is an old town

founded by the Zamoiskis, and was annexed to Austria after the third partition of Poland in 1795, but afterwards came into the hands of Russia. At the beginning of the 19th century it was an important fortress, but none of the fortifications now remain. It has a bent-wood furniture factory, and two gymnasia for boys and girls. Population

(1897), 12,400.

Zanardelli, Giuseppe (1826-), Italian

jurisconsult and statesman, was born at Brescia on 29th October 1826. A combatant in the volunteer corps during the war of 1848, he returned to Brescia after the defeat of Novara, and for a time earned a livelihood by teaching law, but was molested by the Austrian police and forbidden to teach in consequence of his refusal to contribute pro-Austrian articles to the press. Elected deputy in 1859, he received various administrative ap-pointments, but only attained political office in 1876 when the Left, of which he had been a prominent and influential member, came into power. Minister of Public Works in the first Depretis cabinet of 1876, and Minister of the Interior in the Cairoli cabinet of 1878, he in the latter capacity drafted the franchise reform, but created dissatisfaction by the indecision of his administrative acts, particularly in regard to the Irredentist agitation. Over-thrown with Cairoli in December 1878, he returned to power as Minister of Justice in the Depretis cabinet of 1881, and succeeded in completing the Commercial Code. Abandoned by Depretis in 1883, he remained in opposi-tion until 1887, when he again joined Depretis as Minister of Justice, retaining his portfolio throughout the ensuing Crispi ministry until 31st January 1891. During this period he promulgated the Penal Code, and began the reform of the magistracy. After the fall of the Giolitti cabinet in 1893, Zanardelli made a strenuous but un-successful attempt to form an administration. Elected President of the Chamber in 1894 and 1896, he exercised that office with ability until, in December 1897, he accepted the portfolio of Justice in the Rudini ca'binet, only to resign in the following spring on account of dissensions with his colleague, Visconti-Venosta, over the measures necessary to prevent a recurrence of the tumults of May 1898. Returning to the presidency of the Chamber, he again abandoned his post in order to

associate himself with the obstructionist campaign against the Public Safety Bill (1899-1900), and was rewarded by being enabled to form an administration with the support of the Extreme Left upon the fall of the Saracco cabinet in February 1901. Consistently Liberal, though doctrinaire, in his political ideas, honest, and gifted with considerable oratorical powers, he has long been regarded as the leader of the constitutional Left, though the indecision of his temperament has hitherto prevented him from being classed among Italian statesmen of the first rank. As Premier at the moment of the birth of Princess Yolacda Margherita of Savoy (1st June 1901), he received the honour of Knighthood of the Supreme Order of the Annunziata.

Zanella, Giacomo (1820-1888), Italian poet, was born at Chiampo, near Vicenza, 9th September 1820, and was educated for the priesthood. After his ordination he became professor at the lyceum of his native place, but hia patriotic sympathies excited the jealousy of the Austrian authorities, and although protected by his diocesan, he was compelled to resign in 1853. After the liberation of Venetia, the Italian Government conferred upon him a professorship at Padua, and he achieved distinction as a poet on the publication of his first volume of poems in 1868. In 1872 grief for the death of his mother occasioned a mental malady, which led to the resignation of his professorship. After his complete and permanent recovery he built himself a villa on the bank of his native river, the Asti-chello, and lived there in tranquillity until his death on the 17th of May 1888. HIs last published volume contains a series of sonnets of singular beauty, addressed to the river, resembling Wordsworth's " Sonnets to the Duddon," but more perfect in form ; and a blank verse idyll, " H Pettirosso " (" The Redbreast "), bearing an equally strong, though equally accidental, resemblance to the similar compositions of Coleridge. His ode to Dante, and that on the opening of the Suez Canal, are distinguished by great dignity. Of his other compositions, the most in-dividual are those in which," deeply impressed by the problems of his day, he has sought to reconcile science and religion, especially the fine

~~dialogue between Milton and Galileo, where the former, impressed by Galileo's predictions of the intellectual consequences of scientific progress, resolves " to justify the ways of God to man." Zanella was that rare personage in modern Italy, a broad- minded and patriotic ecclesiastic, and his character is justly held in equal honour with his poetry, which, if hardly to be termed powerful, wears a stamp of peculiar elegance and finish, and asserts a place of its own in modern Italian literature. In character, talent, and fortune Zanella offers a strong resemblance to Cowper.~~

~~(r. g.)~~

~~Zanesville, a city of Ohio, U.S.A., capital of Muskingum county. It is situated in 39° 58′ N. and 81° 59′ W., on the river Muskingum, east of the centre of the state, at an altitude of 704 feet. The city has a level site on both banks of the river, is laid out regularly with broad streets, has an excellent water supply and good sewerage, and is divided into ten wards. It has ample railway accommodation in the seven railways which centre there. These are the Baltimore and Ohio; the Bellaire, Zanesville, and Cincinnati; the Cincinnati and Muskingum Valley; the Cleveland, Akron and Columbus; the Columbus, Sandusky, and Hocking ; the Wheeling and Lake Erie ; and the Ohio and Little Kanawha. Surrounded by a rich and productive farming region, these lines give the city a large trade. Zanesville is' a manufacturing city. In 1900 it had 293 manufacturing establishments, with a total capital of $5,162,067. They employed 4603 hands, and the product had a value of $7,468,839. The products were very varied, the principal ones being bricks, tiles, and pottery, flour, railway cars and repairs, foundry and machine-shop products, glass, soap, and candles. Popula- tion (1890), 21,009 ; (1900), 23,538, of whom 1435 were foreign-born and 1012 negroes.~~

~~Zanjan, or Zinjan, a town of Persia, capital of the Khamseh province, about 205 miles north-west of Tehran, on the high road thence to' Tabriz, at an elevation of 5180 feet. It has a population of about 25,000, post and telegraph offices, and was one of the original strongholds of the Babf sectarians, who held it against a large Persian force from May 1850 to the~~

~~end of the year, when most of them were massacred. It has extensive gardens, well~~

~~watered by the Zanjaneh, which flows south of it. The well-stocked bazaar supplies the neighbouring districts.~~

~~Zante. See Greece : Ionian Islands.~~

~~Zanzibar, a sultanate and British protectorate of East Africa. After many losses it still comprised in 1887 some strips of the mainland and several of the adjacent islands, with a total area of 7420 square miles and a population of 765,000. Subsequently the process of dismemberment was continued until 1890, when the sultan's dominions were reduced to the two islands of Zanzibar and Pemba. They have a collective area of 1020 square miles and a population (1902) of 200,000. On 12th June 1890 the sultanate was proclaimed a British protectorate in conformity with the Anglo-German and Anglo-French Conventions, by which Great Britain ceded Heligoland to Germany and renounced all claims to Madagascar in favour of France. Soon afterwards the Sultan Seyyid Ali, who had succeeded his brother, Seyyid Khalifah, in February 1890, took measures gradually to suppress the slave trade, and slavery itself was abolished with compensation on 6th April 1897. Seyyid Ali was succeeded in March 1893 by Hamed bin Thwain, on whose death in August 1896 his cousin, Seyyid Khalid, proclaimed himself sultan, but was dispossessed by the British authorities in favour of Hamud bin Mahommed, brother of Hamed bin Thwain (27th August 1896). The government was reconstituted under British auspices in October 1891, when Sir L. Mathews was appointed Prime Minister, and the sultan made virtually a Crown pensioner, with a civil list of 120,000 rupees. Other salutary reforms were followed by the proclamation of Zanzibab, the capital, as a free port on 1st February 1892, and since then the protectorate has made steady progress, the total imports advancing from £1,148,000 in 1893, and £1,400,000 in 1897, to £1,555,000 in 1898; and the exports from £1,002,000 and £1,190,000 to £1,498,000 in the same period. In 1900 the foreign imports and exports were £1,116,000 and £1,168,000 respectively. In 1900 the imports from Great Britain, British India, and British East Africa (chiefly piece-goods, rice, coal, and groceries) were valued at about £585,000, and the exports~~

~~*to these countries (cloves, ivory, copra, rubber) at £331,000. In the same year the capital (which had an estimated popula- tion in 1902 of 50,000 to 60,000) was visited by 200 vessels of 348,000 tons, including 68 British of 107,000 tons.*~~

~~*Mahommedanism is the dominant religion, but there are several Protestant and Roman Catholic missions with branches extending far into the mainland. The adminis- tration of justice has also shared in the general improve- ment, and in December 1892 the sultan delegated to the British agent and consul-general his right to try all cases in which a British subject is plaintiff or accuser, and the defendant or accused is a Zanzibar subject. There is a regular army of nearly 1000 men, including police, under a British officer.*~~

~~*Authorities. — "W. W. A. Fitzgerald. Travels in the Coastlands of British East Africa. London, 1898. — A. H. Keane. Africa, vol. ii. London, 1895. — J. S. Keltie. The Partition .of Africa, 2nd edition. London, 1895. — F. D. Lugard. The Rise if our East African Empire, 2 vols. London, 1892. — H. S. Newman. Banani, the Transition, from Slavery to Freedom in Zanzibar and Pemba. London, 1898. — E. Eeclus. Universal Geography, English edition, vol. xiii. (a. h. K.)*~~

~~Zara (Serbo-Croatian, Zadar), seaport town, capital of Dalmatia, and seat of the Diet, 73 miles north-west by west of Spalato, Austria. Population (1890) of town, 11,496; of commune, 28,230; (1900), 32,506, including garrison of 1339 men. The Italian element is chiefly concentrated in the town proper. The industry now~~

~~includes corn-milling and the preparation of wax and oil. The shipping shows a considerable increase — in 1895 over 2300 vessels entered and cleared, with a total tonnage of~~

~~499,300.~~

~~Zaraf, Bahr el. See Kile.~~

~~Zaragoza, or Saeagossa, a province of Spain. Area, 6607 square miles. Population (1887), 415,195 ; (1897), 413,480. The birth-rate is 3‘68 per cent., the death-rate 3‘35 per cent., and the proportion of illegiti- mate births 4-71 per cent. The province is divided into 13 districts and 306 parishes. There are 260 miles of railway. Education is well cared for both by the pro- vincial council and the parishes. The industries are less important than the, agricultural interests. Since 1885, however, the Aragonese have bestirred themselves, especially since the extremely protectionist policy of 1890, which gave great impetus to native industries all over Spain. The growing industries include paper, leather, soap, brandies, liqueurs, machinery, carriages of all sorts, railway material, pianos, beds, glass, bronze, chocolate, jams, woollen and linen goods, and foundries. Much timber is drawn from the forests of the northern part, and the chief exports are live stock, excellent wines, flour, oil, and fruit. In 1897 there were 1,400,000 acres under culture, of which nearly 200,000 were irrigated from wells, and 3,000,000 acres of commons and forests (public, communal, and private property included) ; 285,900 acres devoted to wheat crops, 285,900 to rye, barley, oats, maize, and other cereals, 8500 to pod fruit, 238,015 to vines, and 13,600 to olives. The live~~

stock in the same year included 4396 horses, 31,408 mules, 21,145 asses, 6458 cattle, 533,608 sheap, 57,319 goats, and 34,556 pigs. The province contains important mineral resources, the bulk of which, however, await development.

Zaragoza, capital of the above province, on the Ebro and the Huerva. There is now a splendid railway bridge. Several lines converge upon the town. It owes part of its development to' the fertile, well-watered dis- tricts in the Ebro valley that lie all around the city. The industries are increasing, and include machinery, iron foundries, tanneries, carriages, preserves, breweries, glass, candles, soap, liqueur, distilleries, and porcelain. Popula- tion (1887), 92,407; (1897), 98,188.

Zarhon, a hill in Morocco, 9| miles north of Mequinez. A city of refuge on the hill, forbidden to all but the Faithful, has grown around the tomb of Mulai Idrees I., founder of the Moorish empire (8th century). Close by are the ruins of the Roman capital, Volubilis.

Zaslav, or Zaslavl, a district town of Russia, in the government of Volhynia, on Goryn river, 155 miles south-west of Zhitomir. It is a very old town, supposed to have been founded in 987, and mentioned in the Russian annals in 1127. It afterwards became part of Lithuania, and was finally annexed to Russia in 1795. It is the centre of a flourishing district containing several large sugar works, distilleries, paper-mills, and tanneries. Population (1897), 12,688.

Zayendeh. See Isfahan.

Zeeland, a province in the south—west of the Netherlands, constituting part of the Rhine, Maas and Scheldt delta. It was gradually built up in a shallow bay, separated by dunes from the North Sea. The rivers named, depositing their silt in the bay, constructed a series of oblong islands, between which the rivers force their way in channels westwards to the sea, which in turn ascends them on the flood. The uncultivated land, mostly dunes on the western side of the islands, forms 1"5 per

cent, of the land of the province. The soil of these low- lying islands consists of fertile clay, well adapted for agriculture and stock raising. The

once flourishing com- mercial towns — Veere, Arnemuiden, Aardenburg, Sluis, &c. — have, owing to the silting up of their harbours and the opening of new highways of commerce, been reduced to provincial trading and fishing ports. Area, 690 square miles. Population (1900), 216,295.

Zeerust. See Teansvaal.

Zeilah. See Somaliland.

Zeitun, a town in the Aleppo vilayet of Asiatic Turkey, situated in the heart of Mount Taurus, about 20 miles north-north-west of Marash. The Armenians, about 10,000, are interesting from their character and historical position as a remnant of the kingdom of Lesser Armenia. The importance of Zeitun dates from the capture of Leo VI. by the Egyptians in 1375. The town long maintained practical independence, and it was only in 1878 that the Turks, after a long conflict, were enabled to station troops there. In 1890 there was a serious revolt, and in 1895, when the Armenian massacres commenced, the people again rose and, after holding out for more than three months against a large Turkish force, secured honourable terms of peace.

Zeitz, a town of Prussia, province of Saxony, on the Weisse (white) Elster, 28 miles by rail from Leipzig. In 1899 a statue of the Emperor William I. was unveiled. There are manufactures of cloth and other textiles, pianofortes, perambulators, and machinery ; dyeing and market-gardening are also carried on. Population (1885),

19,797 ; (1895), 24,834.

), German philo

Zeller, Eduard (1814-

sopher, was born at Kleinbottwar in Wiirtemberg on the 22nd of January 1814. In 1840 he was privat- docent of theology at Tubingen, in 1847 professor of theology at Bern, in 1849 professor of theology at Mar- burg, migrating soon afterwards to the faculty of philo- sophy as the result of

disputes with the Clerical party. He became professor of philosophy at Heidelberg in 1862, removed to Berlin in 1872, and retired in 1895. His great work is his Philosophie der Griechen (1844-52), most of which has been translated into English. He has also written on theology, and published three volumes of philosophical essays. Like most of his contemporaries, he began with Hegelianism, and then shook himself free of it to develop a soberer thought of his own. He saw the necessity of going back to Kant in the sense of de- manding a critical reconsideration of the epistemological problems which Kant had made but a partially successful attempt to solve. Zeller's not inconsiderable merits as an original thinker are far outshone by his splendid services to the history of philosophy. It is true that his view of Greek thought is somewhat warped by Hegelian formalism. He is not alive enough to the very intimate relation which thought holds to national life and to the idiosyncrasy of the thinker. He lays too much stress upon the '" concept," and explains too much by the Hegelian antithesis of subjective and objective. But, these allowances made, his history of Greek Philosophy, which went into several new editions, remains a noble monument of solid learning informed with natural sagacity, and will always be interesting and valuable.

Zerafshan, a province of Samarkand, Russian Turkestan. Prior to its incorporation it was itself a province of Russian Turkestan, being formed in 1868 out of the eastern portions of Bokhara annexed to Russia.

It was enlarged in 1871 by the addition of the then annexed semi-independent bekdoms of Upper Zerafshan and Farab (on the Kashka-daria), and was finally included in Samarkand under the name of Zerafshan district.

Zerbst, a town of Germany, duchy of Anhalt, 27 miles by rail south-east from Magdeburg. It is still sur- rounded with walls, towers, and moats. Famous for its vegetables, and for centuries for its bitter beer. There is an archaeological museum. Zerbst is the seat of very various industries

~~(machinery, gold and silver thread, starch, &c). Population (1885), 15,069; (1895), 16,983.~~

~~Zermatt, a mountain village at the head of the Visp valley and at the foot of the Matterhorn, in the canton of the Valais, Switzerland. It is 22J miles by rail from Visp in the Rh6ne valley, and there is also a railway from Zermatt past the Riffel inns to the very top of the Gornergrat (10,289 feet). The village is 5315 feet above the sea, and in 1900 had 752 permanent inhabitants (all Romanists, and almost all German-speaking), resident in 52 houses. Formerly Zermatt was called " Praborgne," and this name was mentioned in the Swiss census of 1888. Its originally Romance population seems to have been Teutonized in the course of the 15th century, the name " Matt " (now written " Zermatt," i.e., the village on the meadows) first occurring at the very end of that century. Zermatt was long known to botanists and geologists only, and has an interesting though very local history. De Saussure in 1789 was one of the first tourists to visit it. But it was not till the arrival of M. Alexandre Seiler in 1854 that its fame as one of the chief tourist resorts in the Alps was laid, for tourists abound only where there are good inns. When M. Seiler died in 1891 he was proprietor of most of the great hotels in and around Zermatt. The Matterhorn, which frowns over the village from which it takes its name, was not conquered till 1865, Mr Whymper and two guides then alone surviving the terrible accident in which their four comrades perished.~~

~~See Sir Martin Conway. Climbers' Guides to the Central and Eastern Pennine Alps, 2 vols. London, 1890-91. — W. A. B. Coolidge. How Zermatt became a Mountaineering Centre (in his "Swiss Travel and Swiss Guide-Books," p. 251-322). London, 1889. — Joseph Euden. — Familien-Statisti/c d. loblichen Pfarrei von Zermatt. Ingenbohl (Schwyz), 1870. (w. A. B. O.)~~

~~Zhukovski. See Alexander II.~~

~~Zila.ll, a corporate town of Hungary, capital of the county of Szilagy, 38 miles north-west of Kolozsvar. Among its public buildings, besides the administrative and other offices, are the gymnasium, the hospital, and an old mansion where Charles XII. of Sweden rested after the battle of~~

Bender. It has a county museum. There is a large trade in wine. Population (1891), 6595 ; (1901),

7639.

Zimbabwe. See South Africa, British.

Zinc. — The improvements made of late years in zinc metallurgy are only the natural developments of the process first employed. The metal is distilled from a mixture of ore and carbon in closed fire-clay vessels, and condensed in cooler vessels also of fire-clay just outside the furnace walls. These distilling vessels are called retorts if they are supported only at the ends, and the furnace using them is termed a Belgian furnace. If they are supported at intervals along a flat side, they are called muffles, and the furnace is known as a Silesian furnace. Various combinations and modifications of these two types of furnace have given rise to distinctive names, and as each system has its advantages and disadvantages, local conditions determine which is the better. In the following

paragraphs are enumerated improvements made of late years that may be applied to furnaces of either system.

Gas Firing. — Three modes of gas firing must be noticed, each of which is adapted to special local conditions, (a) The gas is made from the fuel in a detached fireplace and conducted hot into the combustion chamber of the fur- nace, and the air for complete combustion is heated by the products of combustion on their way to the chimney. (6) Both the producer gas and the air are heated before they enter the combustion chamber, as in the Siemens system of regenerative firing, (c) Natural gas is piped to the furnace, where it meets air heated by the chimney gases. The primary advantages of gas firing are that less fuel is required, that there is better control of the heat in the furnace, and that larger and more accessible furnaces can be built. In Silesia the introduction of gas firing has led to the use of furnaces containing eighty muffles. In the United States, Belgian furnaces of type (a) are built to contain 864 retorts ; of type (6), to contain 300 to 400 retorts ; and of type (c), preferably about 600 retorts. The use of gas-fired furnaces greatly simplifies manual labour. On a direct-fired furnace at least one man, the brigadier, must be

~~an expert in all the operations involved ; but with a gas furnace a division of labour is possible that makes it easier to get workmen and keep them content. One man who understands the use of gaseous fuel can regulate the heat of a thousand or more retorts. The men who charge and empty the retorts, those who draw and cast the metal, and those who keep the furnace in repair, need not know anything about the making or using of gas, and the men who make the gas need not know anything about a zinc furnace. Again, in direct-fired furnaces there are commonly seven or eight rows of retorts, one above another, so that to serve the upper rows the workman must stand upon a table, where he is exposed to the full heat of the furnace and requires a helper to wait upon him. With gas firing the retorts can be arranged in four horizontal rows, all within reach of a man on the furnace-room floor. Furthermore, with the large furnaces which gas firing makes possible mechanical appliances may be substituted for manual labour in many operations, such as removing and replacing broken retorts, mixing and conveying the charge, drawing and casting the metal, charging and emptying the retorts, and removing the residues and products.~~

~~Machine-made Retorts. — Even a machine of simple type, like the ordinary drain-pipe machine, in which the retorts are made by forcing the plastic clay mixture through a die, may result in greater economy and uniformity than is possible when retorts are made by hand. When hydraulic pressure to the amount of 2000 to 3000 lb per square inch is applied, the saving is unquestioned, since less time is required to dry the pressed retort, its life in the furnaces is longer, its. absorption of zinc is less, and the loss of zinc by passage through its walls in the form of vapour is reduced.~~

~~Mechanical Roasters. — For the desulphurization of zinc blende where it is not intended to collect and save the sulphur there are many mechanical kilns, generally classi- fied as straight-line, horse-shoe, turret, and shaft kilns; all of these may be made to do good work on moderately clean ores which do not melt at the temperature of desul- phurization. But the problem of saving the sulphur is yearly becoming more important. In roasting a ton of rich blende containing 60 per cent, of zinc enough sulphur is liberated to produce one ton of strong sulphuric acid, and~~

unless this is collected not only are poisonous gases discharged, but the waste is considerable. When sulphuric or sulphurous acid is to be collected, it is important to keep the fuel gas from admixture with the sulphur gases,

and kilns for this purpose require some modification. If hot air is introduced into the kiln, the additional heat developed by the oxidation of the zinc and the sulphur is sufficient to keep up a part of the reaction ; but for the complete expulsion of the sulphur an externally fired muffle through which the ore is passed is found to be essential.

Labour-saving Machinery. — Machinery has been sub- stituted for manual labour in handling the coal, ore, fire- clay, residues, and metal, from the raw material to the finished product. These improvements are applicable only in large works, and their full value is realized only where manual labour is expensive. Moreover, difficulties are met with in the permanent and economical construction of large furnaces, and it cannot be demonstrated that they effect a saving of metal as compared ■ with direct-fired furnaces properly proportioned to the work of three men — the brigadier, the long-shift man, and the short-shift man — particularly when each of these men is skilful and careful to save all of the zinciferous crusts and coatings which collect about the furnace. Neither do the improvements remedy any of the defects of the process to which the high loss of metal must be attributed, such as volatilization in the roasting kiln, absorption of zinc by the retort, or the passage of zinc vapour through the walls of the retort, the breaking of retorts, and the losses due to incomplete con- densation and to zinc remaining in the residue. These losses vary with the conditions from 10 to 35 per cent, of the metal in the ore.

As ores of zinc are usually shipped before smelting from widely separated places — Sweden, Spain, Algiers, Italy, Greece, Australia, and the Eocky Mountains region of North America — it is important that they be separated from their mixtures at the mines. The difficulty in separating

zinc blende from iron pyrites is well known, and probably the most elaborate ore-dressing works ever built have been designed with this end in view. The Wetherill system of magnetic concentration has been remarkably successful in separating the minerals contained in the well-known deposit in Sussex county, N.J. Here very clean non-magnetic concentrate of willemite, which is an anhydrous silicate of zinc and a very high-grade zinc ore, is separated from an intimate mixture of willem- ite, zincite, and franklinites, with calcite and some silicates of manganese. The magnetic concentrates contain enough zinc to be well adapted to the manufacture of zinc oxide. Magnetic concentration is also applied in the removal of an excess of iron from partially roasted blende. Neither mechanical nor magnetic concentration can effect much in the way of separation when, as in many complex ores, carbonates of iron, lime, and magnesia replace their isomorph zinc carbonate, when some iron sulphide contain- ing less sulphur than pyrites replaces zinc sulphide, and when gold and silver are contained in the zinc ore itself. Hence only in exceptional circumstances is it possible to utilize a large class of widely distributed ores, carrying from 10 to 35 per cent, of zinc, in which the zinc alone, estimated at four cents (2d.) a pound, is worth from $8 to $28 per ton of ore. The ores of the Joplin district, in the Ozark uplift in the Mississippi valley, are remark- able in that they are specially adapted to mechanical concentration. The material as mined will probably not average over 10 per cent, of zinc, but the dressed zinc ore as sold ranges from 45 to 62 per cent, of zinc. This region now furnishes the bulk of the ore required by the smelters of Illinois, Missouri, and Kansas.

The specific effects of different impurities on the physical properties of zinc have not been sufficiently studied. For- tunately, the small amounts of any of them that are likely to be found in commercial zinc are not for most

purposes very deleterious. It is generally recognized that the purest ores produce the purest metal. Grades of com- mercial zinc are usually based on selected ores, and brands when they mean anything usually mean that the metal is made from certain ores. Chemical control of the metal purchased is not nearly as common as it should be, and the refining of zinc is at best an imperfect operation. To obtain the metal chemically pure

~~a specially prepared chemically pure oxide or salt of zinc is distilled. A redistilled zinc, from an ordinarily pure commercial zinc, is often called chemically pure, but redistillation is seldom practised except for the recovery of zinc from galvanizer's dross and from the skimmings and bottoms of the melting furnaces of zinc rolling mills. The only other method of refining is by oxidizing and settling. A bath, even of very impure zinc, is allowed to stand at about the temperature of the melting-point of the metal for forty-eight or more hours, whereupon the more easily oxidizable impurities can be largely removed in the dross at the top, the heavier metals such as lead and iron settling towards the bottom. This method is rarely practised except by the rollers of zinc. A certain amount of refined zinc can be dipped from the furnace ; a further amount, nearly free from iron, can be liquated out of the ingots cast from the bottom of the bath in a subsequent slow remelting, and it is some- times possible to eliminate a zinciferous lead which collects in the sump of the furnace. Owing to the fact that at temperatures between its melting and boiling point zinc has a strong affinity for iron, it is often contaminated by the scraper while being drawn from the condenser, as is shown by the fact that the scraper wears away rapidly. As each retort in a furnace is in all essentials a separate crucible, and as the metal from only a few of them goes into a single ingot, there can be no uniformity either in the ingots made from the same furnace during a day's run or in those made from several furnaces treating the same ore. Some brassfounders break from a single ingot the quantity of zinc required to produce the amount of brass they wish to compound in one crucible, but when perfect uniformity is desired the importance of remelting the zinc on a large scale cannot be too strongly emphasized.**

~~Zinc oxide is manufactured for paint by two processes — directly from the ore mixed with coal by volatilization on a grate, as in the Wetherill oxide process, and by oxidizing the vapour given off by a boiling bath of zinc metal. The oxide made by the latter method has generally a better colour, a finer texture, and a greater covering power. It is also manufactured by the latter process from the metallic zinc liquated out of galvanizer's dross.~~

~~*The following table gives the world's production of zinc for the years 1888-99, the production of Holland being divided between Belgian and English companies. All weights are given in tons of 2000 lb avoirdupois.*~~

~~*is*~~

~~*'u tr.*~~

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~~Si~~

~~a~~

~~146,853~~

~~4265~~

~~Q~~

~~5640~~

~~PdQ~~

~~H~~

~~88,923~~

~~29,998~~

~~18,695~~

~~55,921~~

~~854,710~~

~~1889~~

~~5835~~

~~90,96S~~

~~84,504~~

~~19,822~~

~~149,884~~

~~40..S~~

~~6217~~

~~5S.S78 369,666~~

~~1890~~

~~6006~~

~~91,161~~

~~32,644~~

~~21,354~~

~~158,512~~

~~4154~~

~~6525~~

~~67,363~~

~~382,719~~

~~1891~~

~~5518~~

~~94,797~~

~~32,940~~

~~22,703~~

~~153,609~~

~~4051~~

~~6235~~

~~80.2S7~~

~~400,140~~

~~1892~~

~~5773~~

~~100,911~~

~~8:t,949~~

~~22,796~~

~~154,254~~

~~8968~~

~~6581~~

~~S4.0S2~~

~~412,264~~

~~1893~~

~~6471~~

~~105,452~~

~~81,778~~

~~24,712~~

~~157,580~~

~~4985~~

~~6340~~

~~76,234~~

~~413,552~~

~~1894~~

~~7507~~

~~106,968~~

~~85,911~~

~~25,780~~

~~15S,265~~

~~5527~~

~~5622~~

~~74,003~~

~~419,583~~

~~1895~~

~~Villi~~

~~118,678~~

~~83,033~~

~~26,676~~

~~165,660~~

~~5543~~

~~6443~~

~~81,840~~

~~444,989~~

~~1896~~

~~7598~~

~~124,958~~

~~27,864~~

~~50.24S~~

~~168,762~~

~~6897~~

~~6760~~

~~77,637~~

~~470,719~~

~~1897~~

~~6874~~

~~127,941~~

~~26,240~~

~~41,961~~

~~166,160~~

~~6466~~

~~6883~~

~~100.3S6~~

~~482,911~~

~~1898~~

~~8049~~

~~131,248~~

~~81,291~~

~~40,956~~

~~170,710~~

~~6243~~

~~6648~~

~~114,103~~

~~509,248~~

~~1899~~

~~8051!~~

~~154,829~~

~~86,518~~

~~29,742~~

~~168,823~~

~~6972~~

~~7165~~

129,679

540,280

This table is compiled from figures given in The Mineral Industry: its Statistics, Technology, and Trade, vols, i.-viii., edited by Dr R. P. Rothwell, New York, 1892-1900, to which reference should be made for the latest details of production and for full particulars of present practice in zinc metallurgy. The

comprehensive Handbook of Metallurgy, by Dr Carl Schnabel, in its translation by Henry Louis (Macmillan and Co., London and New York, 1898), affords for English readers a storehouse of valuable facts.

While the files of technical literature are filled with statements of actual operations in other branches of metallurgy, the literature of zinc is meagre and scattered. Instead of being an openly practised art, zinc metallurgy is like a gild mystery of the Middle Ages. Its well-known imperfections are partly the cause of this state of affairs and partly the consequence of it, and it cannot be doubted that greater liberality on the part of those in the business, and greater publicity, would be to the advantage of all concerned.

(f. L. c.)

Zindei", an important town on the northern margin of the central Sudan, a great emporium of the trade across the Sahara between the Hausa states of the south and the Tuareg countries and Tripoli in the north. Its ruler was formerly subordinate to Bornu, but with the decline of that kingdom shook off the yoke of the sultan, and on the conquest of that country by Eabah seems to have maintained his independence. By the Anglo-French agreement of 1898 the territory round Zinder was included in the French sphere, having already been the object of French political action. The explorer Cazemajou was assassinated there in 1897,

~~but the town was occupied in 1899, after a slight resistance on the part of its inhabitants, by Lieutenant Pallier of the reconstructed Voulet-Chanoine mission. A French post (named Fort Cazemajou) has been established just outside the town on a mound of huge granite blocks. Zinder was the first point in the Sudan reached by M. Foureau after his great journey across the Sahara through Air in 1899. It is described by him as a large and fine town surrounded with high earthen walls, very thick at the base and pierced with seven gates. It covers a large area, and its houses, in part built of clay, in part of straw, are interspersed with trees, which give the place a pleasing aspect. There is an important colony of Tuareg merchants, who occupy the suburb of Zengu, and who deal in a variety of wares, from cottons, silks, spices, ostrich feathers, &c, to French scent bottles. A busy market is held outside one of the gates.~~

~~See Cazemajou, in Bui. Com. de VAfrique Francaise, 1900. — Foukeau, in La Giographie, December 1900 ; D' Alger au Gongo par le Tchad, Paris, 1902. — Joalland, in La Giographie, vol. iii., 1901.~~

~~Zionism. — One of the most interesting results of the anti-Semitic agitation (see Anti-Semitism) has been a strong revival of the national spirit among the Jews in a political form. To this movement the name Zionism has been" given. In the same way that anti-Semitism differs from the Jew-hatred of the Early and Middle Ages, Zionism differs from previous manifestations of the Jewish national spirit. It was originally advocated as an expedient without Messianic impulses, and its methods and proposals have remained almost harshly modern. None the less it is the lineal heir of the attachment to Zion which led the Babylonian exiles under Zerubbabel to rebuild the Temple, and which flamed up in the heroic struggle of the Maccabees against Antiochus Epiphanes. Without this national spirit it could, indeed, never have assumed its present formidable proportions. The idea that it is a set-back of Jewish history, an unnatural galvanization of hopes long since abandoned for a spiritual and cosmopolitan conception of the mission of Israel, is a controversial fiction. The consciousness of a spiritual mission exists side by side with the national idea. The great bulk of the Jewish people have throughout their history remained faithful to the dream of a restoration of their national life in Judea. Its manifestations have suffered temporary~~

~~modifications under the influence of changing political conditions, and the intensity with which it has been~~

~~held by individual Jews has varied according to their social circumstances, but in the main the idea has been passionately clung to.~~

~~The contention of some modern rabbis that the national idea is Messianic, and hence that its realization should be left to the Divine initiative (e.g.,. Chief Eabbi Adler, Jewish Chronicle, 25th November 1898), is based on a false analogy between the politics of the Jews and those of other oppressed nationalities. As all Hebrew politics were theocratic, the national hope was necessarily Messi- anic. It was not on that account less practical or less disposed to express itself in an active political form. The Messianic dreams of the Prophets, which form the framework of the Jewish liturgy to this day, were essentially politico-national. They contemplated the re- demption of Israel, the gathering of the pbople in Pales- tine, the restoration of the Jewish state, the rebuilding of the Temple, and the re-establishment of the Davidic throne in Jerusalem with a prince of the House of David. How little the dispersed Jews regarded this essentially political programme as a mere religious ideal is shown by their attitude towards the pseudo- Messiahs who endeavoured to fulfil it. Bar Cochba (a.d. 117-138) lived at a period when a Jewish national uprising might well have been exclusively political, for the dissolu- tion of the kingdom was scarcely half a century old, and Palestine still had a large Jewish population. None the less Bar Cochba based his right to lead the Jewish revolt on Messianic claims, and throughout the Roman Empire the Jews responded with enthusiasm to his call. Three centuries later Moses of Crete attempted to repeat Bar Cochba's experiment, with the same results. In the 8th century, when the Jews of the West were sufficiently remote from the days of their political independence to have developed an exclusively spiritual conception of their national identity, the Messianic claims of a Syrian Jew named Serene shook the whole of Jewry, and even among the Jews of Spain there was no hesitation as to whether they had a right to force the hands of Providence. It was the same with another pseudo-Messiah named Abu-Isa Obadia, who unfurled the national banner in Persia some thirty years later.~~

During the Middle Ages, though the racial character of the Jews was being transformed by their Ghetto seclu- sion, the national yearning suffered no relaxation. If it expressed itself exclusively in literature, it was not on that account undergoing a process of idealization. (Cf. Abrahams's Jewish Life in the Middle Ages, pp. 24-25.) The truth is that it could not have expressed itself differently. There could have been no abandonment of national hopes in a practical sense, unless the prospect of entering the national life of the peoples among whom they dwelt had presented itself as an alternative. Of this there was not the remotest sign. The absence of militant Zionism during this period is to be ac- counted for partly by the want of conspicuous pseudo- Messiahs, and partly by the terror of persecution. Unlike the modern Greeks, the mediaeval Jews could expect no sympathy from their neighbours in an agitation for the recovery of their country. One may imagine what the Crusaders would have thought of an international Jewish conspiracy to recapture Jerusalem. In the 15th century the aversion from political action, even had it been possible, must have been strengthened by the fact that the Grand Signor was the only friend the Jews had in the world. The nationalist spirit of the mediaeval Jews is sufficiently reflected in their liturgy, and especially in the works of the poet, Jehuda Halevi. It is impossible to read his beautiful Zionide without feeling that had he lived another twenty years he would have gladly

played towards the pseudo-Messiah David Alroy (circa 1 1 60) the part that Akiba played towards Bar Cochba.

The strength of the nationalist feeling was practically tested in the 16th century when a Jewish impostor, David Keubeni (circa 1530), and his disciple, Solomon Molcho (1501-1532), came forward as would-be liberators of their people. Throughout Spain, Italy, and Turkey ' they were received with enthusiasm by the bulk of their brethren. In the following century the influence of the Christian Millenarians gave a fresh impulse to the national idea. Owing to the frenzy of persecution and the apoca- lyptic teachings of the Chiliasts, it now appeared in a more

mystical form, but a practical bias was not wanting. Menasseh ben Israel (1604-1657) co-operated with English Millenarians to procure the resettlement of the Jews in England as a preliminary to their national return to Palestine, and he regarded his marriage with a scion of the Davidic family of Abarbanel as justifying the hope that the new Messiah might be found among his offspring. The increasing dispersion of the Marranos or crypto-Jews of Spain and Portugal through the Inquisition, and the persecution of the Jews in Poland, deepened the Jewish sense of homelessness the while the Millenarians encour- aged their Zionist dreams. The Hebraic and Judeophil tendencies of the Puritan revolution in England still further stirred the prevailing unrest, and some Jewish rabbis are said to have visited England in order to ascertain by genealogical investigations whether a Davidic descent could be ascribed to Oliver Cromwell. It only wanted a leader to produce a national movement on a formidable scale. In 1666 this leader presented himself at Smyrna, in the person of a Jew named Sabbatai Zevi (1626-1676), who proclaimed himself the Messiah. The news spread like wildfire, and despite the opposi- tion of some of the leading rabbis, the Jews everywhere prepared for the journey to Palestine. Not alone was this the case with the poor Jews of Lithuania and Germany, but also with well-to-do communities like those of Venice, Leghorn, and Avignon, and with the great Jewish merchants and bankers of Hamburg, Amsterdam, and London. Throughout Europe the nationalist excitement was intense. Even the downfall and apostasy of Sabbatai were powerless to stop it. Among the wealthier Jews it partially subsided, but the great bulk of the people refused for a whole century to be dis- illusionized. A Messianic frenzy seized upon them. En- couraged on the one hand by Christian Millenarians like Pierre Jurien, Oliger Pauli, and Johannes Speeth, pan- dered to by Sabbataic impostors like Cardoso, Bonafoux, Mordecai of Eisenstadt, Jacob Querido, Judah Chassid, Nehemiah Chayon, and Jacob Franks, and maddened by fresh oppressions, they became fanaticized to the verge of demoralization.

The reaction arrived in 1778 in the shape of the Mendelssohnian movement (Ency. Brit., art. Jews). The growth of religious toleration, the attempted emancipation of the English Jews in 1753, and the sane Judeophilism of men like Lessing and Dohm, showed that at length the

dawn of the only possible alternative to nationalism was at hand. Moses Mendelssohn (1729-1786) sought to prepare his brethren for their new life as citizens of the lands in which they dwelt, by emphasizing the spiritual side of Judaism and the necessity of Occidental culture. His efforts were successful. The narrow nationalist spirit everywhere yielded before the hope or the progress of local political emancipation. In 1806 the Jewish San- hedrin convened by Napoleon virtually repudiated the nationalist tradition. The new Judaism, however, had not entirely destroyed it. It had only reconstructed it on a wider and more sober foundation. Mendelssohnian culture,

by promoting the study of Jewish history, gave a fresh impulse to the racial consciousness of the Jews. The older nationalism had been founded on traditions so remote as to be almost mythical ; the new race conscious- ness was fed by a glorious martyr history, which ran side by side with the histories of the newly adopted nationalities of the Jews, and was not unworthy of the companionship. From this race consciousness came a fresh interest in the Holy Land. It was an ideal rather than a politico-nationalist interest — a desire to preserve and cherish the great monument of the departed national glories. It took the practical form of projects for improv- ing the circumstances of the local Jews by means of schools, and for reviving something of the old social condition of Judea by the establishment of agricultural colonies. In this work Sir Moses Montefiore, the Eoth- schild family, and the Alliance Israelite Universelle were conspicuous. More or less passively, however, the older nationalism still lived on — especially in lands where Jews were persecuted — and it became strengthened by the re- vived race consciousness and the new interest in the Holy Land. Christian Millenarians also helped to keep it alive. Lord Ashley, afterwards Lord Shaftesbury, Colonel Gawler, Mr Walter Cresson, the United States consul at Jerusalem, Mr James Finn, the British consul, Mr Laurence Oliphant, and many others organized and supported schemes for the benefit of the Jews of the Holy Land on avowedly restora- tion grounds. Another vivifying element was the reopen- ing of the Eastern Question and the championship of oppressed nationalities in the East by the Western Powers. In England political writers were found to urge the re- establishment of a Jewish state under British protection as a means of assuring the overland route to India

(Hollingsworth, Jews in Palestine, 1852). Lord Palmerston was not unaffected by this idea (Finn, Stirring Times, vol. i. pp. 106-112), and both Lord Beaconsfield and Lord Salisbury supported Mr Laurence Oliphant in his negotiations with the Porte for a concession which was to pave the way to an autonomous Jewish state in the Holy Land. In 1854 a London Jew attempted to float a com- pany " for the purpose of enabling the descendants of Israel to obtain and cultivate the Land of Promise " (Hebrew Observer, 12th April). In 1876 the publication of George Eliot's Daniel Deronda gave to the Jewish nationalist spirit the strongest stimulus it had experienced since the appearance of Sabbatai Zevi.

It was not, however, until the spread of anti-Semitic doctrines through Europe made men doubt whether the Mendelssohnian denationalization of Judaism possessed the elements of permanency that the Jewish nationalist spirit reasserted itself in a practical form. As long as the anti-Semites were merely polemical, the nationalists were mute, but when in Kussia their agitation took the form of massacres and spoliation, followed by legislation of mediaeval harshness, the nationalist remedy offered itself. In 1882 several pamphlets were published by Jews in Russia, advocating the restoration of the Jewish state. They found a powerful echo in the United States, where a young Jewish poetess, Miss Emma Lazarus, passionately championed the Zionist cause in verse not unworthy of Jehuda Halevi. But the movement did not limit itself to literature. A society, " Chovevi Zion," was formed with the object of so extending and methodizing the establishment of agricultural colonies in Palestine as to make the eventual acquisition of the country by the Jews possible. From the beginning it was a great success, and branches, or " tents " as they were called, were established all over the world. At the same time two other great schemes for rescuing the Jewish people from oppression were brought before the public. Neither was Zionist, but both served

to encourage the Zionist cause. One was due to the initiative of Mr Cazalet, a financier who was interested in the Euphrates Valley Railway

~~project. With the assist- ance of Mr Laurence Oliphant he proposed that the con- cession from the Porte should include a band of territory 2 miles wide on each side of the railway, on which Jewish refugees from Russia should be settled. Unfortu- nately the scheme failed. The other was Baron de Hirsch's colossal colonization association (see Hirsch, Maurice de). This was neither political nor Zionist, but it was supported by a good many members of the " Chovevi Zion," among them Colonel Goldsmid, on the ground that it might result in the training of a large class of Jewish yeomen who would be invaluable in the ultimate settlement of Palestine. (Interview in Daily Graphic, 10th March 1892.)~~

~~None of these projects, however, proved sufficiently inspiring to attract the great mass of Jewish nationalists. The Chovevi Zion was too timid and prosaic ; the Hirsch scheme did not directly appeal to their strongest sympa- thies. In 1897 a striking change manifested itself. A new Zionist leader arose in the person of a Viennese jour- nalist and playwright, Dr Theodore Herzl (born 1860). The electoral successes of the anti-Semites in Vienna and Lower Austria in 1895 had impressed him with the belief that the Jews were unassimilable in Europe, and that the time was not far distant when they would be once more submitted to civil and political disabilities. The Hirsch scheme did not, in his view, provide a remedy, as it only transplanted the Jews from one uncongenial environment to another. He came to the conclusion that the only solution of the problem was the segregation of the Jews under autonomous political conditions. His first scheme was not essentially Zionist. He merely called for a new exodus, and was ready to accept any grant of land in any part of the world that would secure to the Jews some form of self-government. The idea was not new. In 1566 Don Joseph Nasi had proposed an autonomous settlement of Jews at Tiberias, and had obtained a grant of the city from the Sultan for the purpose. In 1652 the Dutch West India Company in Curacao, in 1654 Oliver Cromwell in Surinam, and in 1659 the French West India Company at Cayenne had attempted similar experiments. Marshal de Saxe in 1749 had projected the establishment of a Jewish kingdom in South America, of which he should be sovereign ; and in 1860 Judge Noah purchased Grand Island, on the river Niagara, with a view to founding upon it a Jewish state. All these projects were failures. Dr Herzl was not slow to perceive that with- out an impulse of real~~

~~enthusiasm his scheme would share the fate of these predecessors. He accordingly resolved to identify it with the nationalist idea. His plan was set forth in a pamphlet, entitled The Jewish State, which was published in German, French, and English in the spring of 1896. It explained in detail how the new exodus was to be organized and how the state was to be managed. It was to be a tribute-paying state under the suzerainty of the Sultan. It was to be settled by a chartered com- pany and governed by an aristocratic republic, tolerant of all religious differences. The Holy Places were to be exterritorialized. The pamphlet produced a profound sensation. Dr Herzl was joined by a number of distin- guished Jewish literary men, among whom were Dr Max Nordau and Mr Israel Zangwill, and promises of support and sympathy reached him from all parts of the world. The haute finance and the higher rabbinate, however, stood aloof.~~

~~The most encouraging feature in Dr Herzl's scheme was that the Sultan of Turkey appeared favourable to it. The motive of his sympathy has not hitherto been made known. The Armenian massacres had inflamed the whole~~

~~of Europe against him, and for a time the Ottoman Empire was in very serious peril. Dr Herzl's scheme provided him, as he imagined, with a means of securing powerful friends. Through a secret emissary, the Chevalier de Newlinsky, whom he sent to London in May 1896, he offered to present the Jews a charter in Palestine provided they used their influence in the press and otherwise to solve the Armenian question on lines which he laid down. The English Jews declined these proposals, and refused to treat in any way with the persecutor of the Armenians. When, in the following July, Dr Herzl himself came to London, the Maccabaean Society, though ignorant of the negotiations with the Sultan, declined to support the scheme. None the less, it secured a large amount of popular support throughout Europe, and to-day Dr Herzl has a following of over a quarter of a million Jews, 100,000 of whom are paying members of the Zionist organization, while the remainder are connected with affiliated societies. The Zionist organization has a thousand electoral districts throughout the world, with 950 societies in Russia alone. The English membership is about 7000.~~

~~Of practical work the Zionist organization has done little. It has held five congresses (four at Basel — in 1897, 1898, 1899, and 1901— and one in London in 1900), at which it has discussed the condition of the Jews all over the world, has drawn up a political programme and a colonization scheme, and has established a Colonial bank and a Jewish national fund. The political pro- gramme which was adopted at the first Basel congress runs as follows : —~~

~~"Zionism aims at establishing for the Jewish people a publicly and legally assured home in Palestine. For the attainment of this purpose the Congress considers the following means serviceable : (1) The promotion of the settlement of Jewish agriculturists, artisans, and tradesmen in Palestine. (2) The federation of all Jews into local or general groups, according to the laws of the various countries. (3) The strengthening of the Jewish feeling and consciousness. (4) Preparatory steps for the attainment of those governmental grants which are necessary to the achievement of the Zionist purpose."~~

~~As yet the " preparatory steps " have yielded no result. In May 1901 and August 1902 Dr Herzl had audiences of the Sultan, and was received with great distinction at Yildiz Kiosk. At the latter interview concessions were proposed by the Porte, but they were not considered ade- quate by the Zionists, and the negotiations consequently failed. The colonization scheme has made no progress, chiefly because the Turkish Government, fearful of a new nationality question in Palestine, has placed severe restrictions on Jewish immigration. The colonial bank, which was founded at the second congress, is the finan- cial instrument of political Zionism. Of its capital of £2,000,000 in £1 shares, £352,000 has been subscribed by 126,000 shareholders. Nothing, however, is known of the business it has transacted. The object of the national fund is to purchase land, but nothing will be done until £200,000 has been subscribed. Notwithstanding this barren record, the enthusiasm of Dr Herzl's adherents has not diminished, and the Zionist movement is to-day the greatest popular movement that Jewish history has ever known.~~

~~Despite the great ability of Dr Herzl and the number and faith of his supporters, it is doubtful whether the nationalist aspirations of the Jewish~~

~~*people can, humanly speaking, be fulfilled. No Turkish Sultan has ever will- ingly relaxed his hold on any portion of his dominions, and even if the present Sultan were disposed to come to terms with the Zionists, it is questionable whether Christendom — and especially the Roman and Greek Churches — would permit the Holy Land to pass to the*~~

~~*Jews, even though the Holy Places were exterritorialized. In the event of these obstacles being overcome, still more formidable difficulties would await the Jewish state. The chief of these is the religious question. The state would have to be orthodox or secular. If it were orthodox it would desire to revive the whole Levitical polity, and in these circumstances it would either pass away through internal chaos or would so offend the modern political spirit that it would be soon extinguished from outside. If it were secular it would not be a Jewish state. The great bulk of its present supporters would refuse to live in it, and it would ultimately be abandoned to an outlander population consisting of Hebrew Christians and Christian Millenarians.*~~

~~*Dr Herzl's scheme is vitiated by its erroneous premisses. It is based on the idea that anti-Semitism is unconquerable. Keasons have been adduced in the article on Anti-Semitism for believing that the whole movement is artificial and doomed to extinction. Under the influence of religious toleration and the naturalization laws, nationalities are daily losing more of their racial character. The coming nationality will be essentially a matter of education and economics, and this will not exclude the Jews as such. With the passing away of anti-Semitism, Jewish nationalism will disappear. If the Jewish people disappear with it, it will only be because either their religious mission in the world has been accomplished or that they have proved themselves unworthy of it.*~~

~~*Literature. — A Zionist bibliography has been published by the Federation of American Zionists. Besides the works already cited in the*~~

~~body of this article, see on the early nationalist move- ment Graetz, Geschichte der Juden, under the heads of the various pseudo-Messiahs and their adherents. Jewish agricultural colonies will be found discussed very fully in The Jewish Encyclopaedia, vol. i. pp. 240-262. For early Zionist projects see Publications of the American Jewish Historical Society, No. 8, pp. 75-118 ; Laur- ence Oliphant, Land of Gilead ; Mrs Oliphant, Life of Laurence Oliphant, pp. 168 et seq. The Zionist movement since 1895 is fully recorded in the Jewish Chronicle (London) and Die Welt (Vienna). For proceedings of the Congresses see the Official Protocols published for each year by the society ' ' Erez Israel " of Vienna ; also Herzl, Der Baseler Congress, Vienna, 1897. On the movement generally, see J. de Haas, Zionism, Jewish Needs and Jewish Ideals; also articles by Dr Herzl in Contemporary Review, October 1897 ; I. Zangwill in Cosmopolis, October 1897, and Contemporary Review, October 1899 ; Dr Gaster in Asiatic Quarterly Review, October 1897 ; H. Bentwitch in Nineteenth Century, October 1897, and Fortnightly Review, December 1898 ; Reich, Nineteenth Century, August 1897. (l. W.)~~

~~Zitta.ll, a town of Germany, on the Mandau, near its confluence with the Neisse, 25 miles by rail south-east of the town and in the circle of Bautzen, near the Bohemian and the Silesian frontier, kingdom of Saxony. In 1883-90 a Roman Catholic church was erected. The schools include a building, a mining, and a technical drawing school. The public library numbers over 40,000 volumes. The corporation owns estates yielding an annual income of about £15,000. Population (1885), 23,215;~~

~~(1895), 28,132; (1900), 30,921.~~

~~Zi£koV, chief town of a government district in Bohemia, Austria, and a suburb of Prague, with which it is now practically merged. Population (1890), 41,236 ; (1900), 60,089, mostly Czech.~~

~~Zfoczdw, the chief town of a government district in Galicia, Austria, on a tributary of the river Bug, e;ist of Lemberg. Linen weaving is the chief industry. Popu- lation (1890), 10,113; (1900), 12,209, including garrison of 1699 men, mostly Polish-speaking.~~

~~Znaim (Czech, Znojmo), a town in Moravia, Austria. Its industries include the manufacture of textiles, earthen- ware, vinegar, and tanning. There is a considerable trade~~

~~in corn, fruit, cucumbers, vegetables, mustard, and wine, together with important fairs and weekly markets. Popu- lation (1890), 14,156; (1900), 16,261.~~

~~Zoantharia. See Anthozoa.~~

~~-), Egyptian Pasha and~~

~~Zobeir Ahmet (1830-~~

~~Sudanese governor, known as the Black Pasha, is supposed to have been born about 1830, but his parentage and birth- place are unknown, and he first appears about 1870 as chief of the slave-dealers in equatorial Africa. He had gradually established an extended range of strongholds along the upper Nile, a flotilla and depots of military stores; and during a quarter of a century he flooded Egypt, Turkey, and Persia with slaves sold by his agents in the markets of Bahr-el-Ghazal. About 1860 he had attained so strong a position that he ventured to refuse payment of the tribute to the Khedive, his nominal sovereign, who conse- quently ceased to connive at the slave trade, and in 1869 sent an expedition against him. It was, however, utterly defeated and the commander was slain, and Zobeir estab- lished himself in a position of complete independence of the Khedive, who made feeble attempts at conciliation by making him first a bey and then a pasha. Finding that nothing short of the office of governor-general of the Sudan would satisfy his ambitious vassal, the Khedive sent first Sir Samuel Baker and then General Gordon into the Sudan to uphold his authority. In 1873, when Gordon was appointed governor of the Sudan, Zobeir, having been deprived of the governorship of Darfur, went to Cairo to plead his cause in person. There he was detained, but his son Suleiman rose against the new governor in obedience to orders from his father, and was not subdued until after twelve bloody battles. For this Zobeir was condemned to death, but the sentence was remitted, and he remained at Cairo. In 1884 General Gordon, who had been sent to Khartum to effect, if possible, the relief of the Egyptian garrison which was being besieged~~

by the Mahdi, astonished Europe by requesting that Zobeir, whose son he had overthrown and whose trade he had ruined, should be sent up to Khartum as his successor. But to reinstate the notorious slave-dealer was naturally regarded as far too perilous an expedient, e*en in the extreme circumstances then existing. In March 1885 Zobeir was arrested in Cairo by order of the British Government for treasonable corre- spondence with the Mahdi and other enemies, and was interned at Gibraltar.

Zola, Emile Edouard Charles An-

toine (1840-1902), French novelist, was born in Paris on the 2nd April 1840, of a French mother, his father being an engineer, part Italian and part Greek. The father seems to have been an energetic, visionary man, who, dying while his only son was yet but a little lad, left to his family no better provision than a law-suit against the municipality of the town of Aix. It was at Aix, which figures as Plassans in so many of his novels, that the boy received the first part of his education. Thence he proceeded, in 1858, to Paris, where, as later at Marseilles, he failed to obtain his bachelor's degree. Then came a few years of terrible poverty ; but at the beginning of 1862 he ob- tained a clerkship, at the modest salary of a pound a week, in the house of Hachette the publisher. Mean- while he was writing apace, but nothing of particular merit. His first book, Contes a Ninon, appeared on the 24th October 1864, and attracted some small amount of attention, and in January 1866 he determined to abandon clerking and take to literature. Vigorous and aggressive as a critic, his articles on literature and art in Villemessant's paper L'Evinement created a good

deal of interest. So did the gruesome but powerful novel, Therese Raquin, which came out in 1867. But meanwhile, with characteristic energy, Zola was projecting something larger and more important : the creation of a world of his own, like that of Balzac's Comidie Humame — the history of a family in its various ramifications during the Second Empire. The history of this family, the Rougon-Macquart, was to be told in a series of

~~novels containing a scientific study of heredity — science was always Zola's ignis fatuus — and a picture of French life and society. The first novel of the series, La Fortome des Rougon, appeared in book form at the end of 1871. It was followed by La Curie, Le Ventre de Paris, La Conquete de Plassans, La Faute de VAbbi Mouret, Son Excellence Eugene Rougon (1875) — all books unquestion- ably of immense ability, and in a measure successful, but not great popular successes. Then came L'Assommoir (1877), the epic of drink, and the author's fortune was made. Edition followed edition. He became the most discussed, the most read, the most bought novelist in France — the sale of VAssommoir being even exceeded by that of Nana (1880) and La Debacle (1892). From the Fortune des Rougon to the Docteur Pascal (1893) there are some twenty novels in the Rougon-Macquart series; Zola also wrote a series of three romances on cities, Lour des, Rome, Paris, novels on. the "gospels" of population (Fe'condite) and work (Travail), a volume of plays, several volumes of criticism, and other things besides. And these books are based on study and observation ; the novels are crowded with characters. It is a gigantic~~

~~Zola, was the apostle of the "realistic "or " naturalistic " school ; but, as has been often shown, he was in truth not a " naturalist " at all, in so far as " naturalism " is to be regarded as a record of fact. He was an idealist, but while other idealists idealize the nobler elements in human nature, so has he, for the most part — the later books, however, show improvement — idealized the elements that are bestial. He saw man's lust, greed, gluttony, as in a vision, magnified, overwhelming, portentous. And what he saw he presented with tremendous power. His style may lack the classic qualities of French prose — lightness, delicacy, sparkle ; it certainly has not Daudet's colour and felicity of touch. The first impression it produces may be one of heaviness, and the later " gospels " on population and work are distinctly ponderous. But for~~

~~rendering the gloomy horror of the subjects in which he most delights — detail on detail being accumulated till the result is overwhelming — Zola has no superior. There are some of his descriptions of crowds in movement that have never been surpassed.~~

~~Zola played a very important part in the Dreyfus affair, which convulsed French politics and social life at the end of the 19th century. At an early stage he came to the conclusion that Dreyfus was the innocent victim of a nefarious conspiracy, and on the 13th January 1898, with his usual intrepidity, he published in the Aurore newspaper, in the form of a letter beginning with the words J'accuse, a terrible denunciation of all those who had had a hand in hounding down that unfortunate officer. Zola's object was a prosecution for libel, and a judicial inquiry into the whole affaire, and at the trial, which took place in Paris in February, though the court used every effort to circumscribe the field of investigation, a, fierce flood of light was thrown on the case. The chiefs of the army put forth all their power, and Zola was con- demned. He appealed. On the 2nd April the Cour de Cassation quashed the proceedings. A second trial took place at Versailles, on the 18th July, and without waiting the result Zola, by the advice of his counsel and friends, and for reasons of legal strategy, abruptly left France and took refuge in England. Here he remained in hiding, writing Feconditi, till the 4th June 1899, when, im- mediately on hearing that there was to be a revision of the first Dreyfus trial, he returned to Paris. Whatever may be thought of the affaire itself, there can be no ques- tion of Zola's superb courage and disinterestedness.~~

~~On the morning of the 29th of September 1902 Zola was found dead in the bedroom of his Paris house, having been accidentally asphyxiated by the fumes from a defec- tive flue. This sudden and tragical death caused a great sensation. He received a public funeral, at which Captain Dreyfus was present, but no serious public disturbance occurred. M. Anatole France delivered an impassioned oration at the grave. At the time of his death Zola had just completed a novel, Verite, dealing with the incidents of the Dreyfus trial. A sequel, Justice, had been planned, but not executed. After a life of constant struggle and an obloquy which never relaxed, the sensational close of Zola's career was the signal for an extraordinary burst of eulogy. The verdict of posterity will probably be kinder than the first, and less unmeasured than the second. Zola's literary position would have more than qualified him for the French Academy. He was several times a candidate in vain. (f. t. m.)~~

~~ZOOLOGICAL DISTRIBUTION.~~

I. Makine.

AT the date of the publication of the first volume of r\ the ninth edition of the Encyclopaedia Britannica, the Challenger expedition had not returned to England. This, despite its many successors, still stands out as the most important of the oceanographic expeditions, alike by the work achieved, the distance traversed, the time occupied, and the money devoted to the publication of the results. Though it did not confirm the dramatic expectations of those who half hoped to find Jurassic monsters at great depths, yet, what was of far greater consequence, it laid the foundation of our knowledge of the physics and chemistry of ocean water, of oceanic and atmospheric currents, of the contour of the sea-bottom, and of the main features of distribution of deep-sea life.

Later work has confirmed and expanded, but not revoked, the conclusions thus attained. But, in spite of this and of several subsequent expeditions, it cannot be pretended that we are in a position to formulate general canons of marine distribution other than of the most tentative char- acter. A dredge or trawl cast here and there, almost at random, is ludicrously disproportionate to the immensity of the ocean, and years of systematic labour must pass before even such " laws " as are assigned to the distribu- tion of terrestrial organisms can be accepted in marine zoology. Two fallacies underlie many attempts to define distributional oceanic areas for special groups : the one, that such areas can be made to bear some relation to exist ing geographical or even national divisions; the other, that what is true for one group of the animal kingdom must hold good equally for another. It is necessary at the

outset to divest oneself of these errors ; oceanic conditions depend only very indirectly upon the distribution of the land, and strongly swimming or freely floating animals are not to be confined by the same factors as determine the distribution of sessile forms, whose range is governed by a variety of circumstances.

~~As Wyville Thomson pointed out long ago, there is but one ocean. This surrounds the southern half of the globe,~~

~~FIG. 1. — Diagram of the Atlantic Ocean, showing the main surface currents (some are seasonal only) : the corresponding Indian and Pacific currents are cited in parentheses ; they are rarely so strongly marked as in the Atlantic. 1. Counterequatorial (also 1' Pacific and Indian) ; 2. North Equatorial (also Pacific) ; -2'. The Equatorial (also 2" Pacific and Indian) ; 3. Gulf Stream proper (Japan Stream) ; 3'. Brazil Current (Australian Current) ; 3". Mozambique Current (recurved off Cape Agulhas) ; 4. Labrador Current (Kamchatka Current) ; 4'. Falkland Current ; 5. North Atlantic Drift, generally called Gulf Stream (North Pacific Drift); 5'. South Atlantic Drift, ill defined (South Pacific Drift) ; 6. North African Current (Mexico Current) ; 6'. Benguela Current ; 6". Peru Current ; 7. Antarctic Circumpolar Drift, and 7', its northerly branches on the west sides of Africa and South America.~~

~~and has two large gulfs, generally called the Atlantic and Pacific Oceans, which meet through narrow channels in the small Arctic Ocean, and a half gulf, the Indian Ocean. The Atlantic and Pacific exhibit a striking homology of atmospheric pressure and of prevalent wind and current ; the Indian, to a great extent, resembles the southern half of a larger one, but this resemblance is modified by the neighbourhood of vast land masses. The prevalent winds, dependent on the fairly constant distribution of atmospheric pressure over the great oceans, are the most important determinant of currents. As at most points in the ocean the temperature, salinity, and chemical com- position of the water are mainly determined by the cur- rents — that is, by the condition at the place whence the water came — it is obvious that a study of currents must precede any general view of the distribution of marine forms.~~

~~Eegard must be had not merely to the superficial cur- rents indicated in Pig. 1, but also to the movements of the deeper layer. Ice melting at the poles, together with polar precipitation of hail, snow, and rain, yields large quantities of water of low salinity and very low tempera- ture ; this water sinks under the warmer salter surface~~

water drifted from lower latitudes, and, creeping slowly north and south from the poles, covers the bottom of all the great open oceans at very uniformly low temperatures (in some cases as low as 30° F.). Between surface and bottom the temperature gradually decreases (except where affected by local circumstances), and in the middle layers the existence of slow currents is suspected. The cold bottom water wells up to the surface in certain areas, replacing the surface water drained away by currents, notably to the westward of the great land masses. Ocean water is remarkably uniform as regards its contained salts and gases, and it does not seem likely that we can look to these to explain the facts of distribution. In its tem- perature, on the contrary, there is enormous variation. While the bottom water of the ocean is very cold, and the mid-water of a more or less intermediate temperature, the surface water, according as it has drifted from the equator polewards or in the reverse direction, has a mean annual temperature somewhere between 84° and 30° F., losing

FIO. 2. — Mean Annual Surface Isotherms of the Atlantic. (After Buchan, " Challenger " Report on "Oceanic Circulation.") On the north-east and south-west sideB they are deflected polewards by the warm North Atlantic Drift and Brazil Current ; on the south-east and north-west sides equatorwards by the cold Labrador and Benguela Currents, Note the markedly different latitudes of the same isotherms east and west of South America and Africa ; also the effect of the Falkland Current against the Brazil Current

or gaining heat on its way. In the case of narrow or " closed " seas, and near land masses, sea water does not exhibit that uniformity of composition which characterizes the open ocean ; but even in such cases the temperature is largely influenced by adjacent currents, and, though less obviously than in the open ocean, seems to be a very important agent in distribution.

The fauna of the sea is divisible into the plankton, the swimming or drifting fauna which never rests on the bottom (generally taken now to include Hseckel's nekton,

ZOOLOGICAL DISTRIBUTION

the strong swimmers, such as fish and cephalopods), and the benthos, which is, fixed to or crawls upon the bottom. These groups require a further subdivision according to depth — the more necessarily since, to some zoologists, any water over 100 fathoms is " deep " or even " abyssal." It is simplest to begin with the benthos. From the shore sea-wards we may distinguish several zones. Even the tidal zone, between high and low water-mark, is subdivisible by its fauna and flora. There generally follows on this a very gentle slope to the depth of about 100 fathoms, locally subdivisible into many lesser zones. It. has been termed the continental shelf or littoral zone, not very appropriately, since it occurs round many oceanic islands, and even away from any land. In this zone, if near land, fall to the bottom the heavy materials produced by land waste and river drainage. The fauna of this zone, gene- rally very well characterized, may be distinguished as the epibenthos. As with the shallowest or tidal zone, its nature varies much more according* to latitude and the character of the coast than the deeper zones. Everywhere, however, the epibenthic fauna is exposed to certain definite en-vironmental conditions, as compared with a deeper fauna : namely, a high or fairly high temperature (except near the poles) ; a fairly good light, with its important conse- quence, a vegetable basis of food supply ; tide and current to distribute the larvae to a suitable habitat, which the varied nature of the bottom near land is likely to furnish. Passing farther seawards, we find a steeper slope to about the 500-fathom line, the so-called continental slope. In this zone the environment is absolutely different. The water, no longer subject to seasonal variations of tempera-ture, or to direct sunlight, is cold, and of a nearly uniform annual temperature (300 fathoms, ±44'7° F.). Light has disappeared from all but the shallower part, and with it plant life ; tide and current are no longer felt. To the latter fact is due, however, a great part of the food supply which maintains in this zone an abundant fauna : a great quantity of organic matter, brought down by river action, produced by disintegrated seaweed, and due to the death of surface organisms, together with the finer clayey mate- rials of land waste, settles to the bottom in quiet water, near the 100-fathom contour, thus making the mud-line the richest feeding-ground in the ocean (Murray). The mud-line is the real upper

limit of this zone : it typically begins at about 100 fathoms, but may begin at 5 to 20 fathoms in deep sheltered firths, or be pushed down to 300 fathoms where currents are strong. The fauna of this zone may be termed the mesobenthos; it is not so abundant, nor so sharply characterized, as the epibenthos, and yet is sufficiently distinct to deserve at any rate a provisional name. Another difference of condition between epibenthos and mesobenthos is the pressure of the water'; at a depth of 500 fathoms this is, roughly speaking, half a ton to the square inch. It is very doubtful whether this enormous pressure makes the slightest difference to marine invertebrates, the tissues of which are uniformly permeated by fluids, so that the pressure is uniform in every direction ; but animals with free gases naturally re- quire time to adjust the gas-pressure when altering their levels. As regards the penetration of light, assimilative rays useful to plant life probably do not reach beyond 150 fathoms. Photographic rays have been detected as low as 220 fathoms, and if any light penetrate beyond this depth, it will consist only of blue, violet, and ultra- violet rays : it has been suggested that the red colour prevalent in many deep-sea animals may be a screen from these hurtful rays. Below the 500-fathom line the ocean bottom exhibits almost uniform conditions everywhere, varied only by the character of the bottom deposit and the amount of food supply. In this zone, which extends

from about 500 fathoms to the greatest depths (which may in some cases exceed 5000 fathoms, or more than 5£ miles), the temperature at any given point is uniform throughout the year, and is always very low : the mean at 2200 fathoms is 35·2° F. ; at greater depths and in special circumstances less than 30° F. has been recorded. The darkness is probably absolute ; for food the animals are dependent upon each other and upon the incessant rain of dead plankton from higher levels ; the pressure may be anything between half a ton and five tons per square inch. To the fauna which lives in these remark- able circumstances the name hypobenthos may be applied. That each of the three benthic groups is well charac- terized by a special fauna is shown by the following table, out of the total numbers of species captured by the Challenger at seventy stations in these three zones : —

Species confined to this Zone.

Species occurring in other Zones.

Epibenthos Mesobenthoa . Hypobenthos .

91 per cent. 74 „ 61 „

8 per cent. 25 „ 38 „

Out of the 25 per cent, of its species which the meso- benthos shares with other zones, 59 per cent, occur also in the epibenthos, about 40 per cent, in the hypobenthos ; the mesobenthos therefore, on these figures, may be taken to consist of 74 per cent, of peculiar species, 15 per cent, shared with the epibenthos, 10 per cent, with the hypo- benthos. Speaking of the benthos as a whole, it may be said that the following statement holds good : — The number of individuals, the proportion of species to genera, and the number of individuals of a given species, all decrease with increasing .depth. Animal life also tends to diminish with increasing distance from land ; this may be partly due to the greater food supply near land, partly to the fact that population is obviously thinnest on the advancing fringe of a migration.

The plankton can be subdivided into at least two groups. The fauna to which light and warmth are more or less necessary, which feeds either upon plants or upon organisms nearly dependent upon plant life, may be termed the epiplankton. This fauna is capable of a good deal of vertical movement upwards and downwards, the causes of which are still obscure, but most of its members seem rarely to descend lower than about 100 fathoms. Below this depth the fauna may be called the mesoplanhton. In every area this appears to have its peculiar species, but the careful study by opening and closing tow-nets of the distribution of the mesoplankton is of so recent a growth, that no statistics, such as we have of the benthos, are available. It is now generally admitted that the mesoplankton extends to the lowest depths yet searched (2730 to 2402 fathoms, Valdivia) ; but the number of specimens decreases rapidly after 200 fathoms, and below 1000 fathoms very little is captured. The conditions of light, temperature, pressure, &c, are practically those of the corresponding depths of the benthos ; as regards the food, however, the mesoplankton can only depend on intercepting dead organisms which are falling from higher

horizons, or on capturing the scanty prey of its own zone. It is possible that the plankton immediately over the bottom may prove to be sufficiently distinct to be separately classed as hypo- plankton.

The main subdivisions of the marine fauna having thus been briefly sketched, it is advisable to consider them in somewhat more detail. The epibenthos is obviously that fauna to which, except in polar regions, light and warmth are necessary ; and the absence of these at greater depths

is probably the chief barrier to its vertical extension ; the food supply is sufficiently plentiful in, at any rate, the upper parts of the mesobenthic zone to present no obvious barrier. The chemical constitution of the water (except to animals in brackish water near river mouths) and the pressure appear to exert little or no influence ; and only those species which attach themselves to clean hard substances would be repelled by the mud-line. The chief barrier to a horizontal extension of the epibenthos is undoubtedly temperature. As an example of its dis- tribution may be taken the Gastropod and Lamellibranch Molluscs, as groups of which the distribution has been studied for many years by specialists. The shallow-water species fall into provinces (compare Cooke, Camb. Nat. Hist., vol. " Molluscs," ch. xii.), and a comparison of Figs. 1 and 3 shows at once the profound influence upon them of the great currents. Taking the Atlantic Ocean, we find the Arctic species, tempted southwards by the cold Labrador

Current, repelled northwards by the warm North Atlantic Drift. The Boreal or sub- Arctic species, many of which are identical on both sides of the ocean (2 and 2', Fig. 3), lie much farther southwards on the west than on the east side, from the same causes. The warm-water molluscs of West Africa (5) are cut off from those of the east side (7) by the cold water from the great easterly Antarctic Drift, which impinges on the Cape, giving it a special fauna (6). On the South American coasts the tropical and temperate fauna reach respectively to 28° S. and 45° S. on the east coast, owing to the warm Brazil Current ; but the corresponding groups

~~on the west coast only to 5° S. and 37° S., being kept back by cold upwelling and Hum- boldt's Current. This influence is visible in individual species as well as in the f acies of a fauna : Purpura lapillus, a temperate form, reaches on the east side of the Pacific to 24° N. and on the East Atlantic to 32° N. ; but on the West Pacific only to 41° N. and the West Atlantic to~~

~~Fig. 3. — Diagram showing the coastwise (not seaward) extension of the provinces of Epibenthic Gastropods and Lamellibranchs. Provinces : 1, Arctic ; 2, Boreal of East Atlantic ; 2', Boreal of West Atlantic ; 3, Celtic ; 4, Lusitanian ; 5, West African ; 6, South African ; 7, Indo- Paciflc ; 8, Japanese ; 9, Australian ; 10, New Zealand ; 11, Aleutian ; 12, Californian ; 13, Panama ; 14, Peruvian ; 16, generally termed Patagonian or Magellanic for purely epibenthic forms, but in many Orders part of the circumpolar Antarctic region ; 16, Argentinian ; 17, Caribbean ; 18, Transatlantic.~~

~~42° N, being repelled by the Japan Stream (and other warm currents of the south-west monsoon) and Gulf Stream respectively.~~

~~But while some species may be confined to a bay, others to a province, others to an ocean, there are cosmopolitan species which either vertical or horizontal barriers, or both, fail to restrain. In relation to temperature the wide-ranging species are termed euryihermal, the limited, stenothermal (Moebius) ; the terms are useful to record a fact, but are not explanatory. It seems to be the case that to every organism is assigned a minimum temperature below which it dies, a maximum temperature above which it dies, and an optimum temperature at which it thrives best ; but these have to be studied separately for every species. Similarly, in regard to depth, species have been classed as eurybathia and stenobathic, but, since increased depth practically means diminished temperature, these are probably merely expressions of the same fact in another form. That an Arctic shallow- water species should stretch to considerable depths is not surprising, but it is remark- able to find such forms as, for example, Venus mesodesma~~

~~on a New Zealand beach at 55° F. and in 1000 fathoms at 37° F. off Tristan d'Acunha. The provinces of zoological distribution, like the~~

~~geographical divisions of mankind, must be taken merely to indicate the facies of a well- characterized fauna, not to imply the restriction of all its habitants to that area.~~

~~In considering the effect of temperature (and this applies to plankton as well as to benthos down to 100 fathoms), attention must be directed not only to the question of general warmth or cold as expressed by the mean annual temperature, but also to the range between the annual extremes : these ranges of variation have been carefully mapped by Murray (Geoff. Journ., xii. 113 ; compare ibid., xiv. 34). Still more important to the death-rate than these is the suddenness with which such variations occur : many animals are known to endure great extremes of heat ai:d cold if exposed to them gradually, but to succumb to rapid alterations of temperature. Hence the frontier districts (Mischgebiete) between opposing currents are characterized by a heavy death-rate, and constitute marked barriers. A conspicuous instance of such a barrier in distribution~~

~~Number of Specimens.~~

~~Horizon.~~

~~8. T. X.~~

~~4248~~

~~0-100~~

~~0-6~~

~~1887~~

~~100-500~~

~~2~~

~~616~~

~~500-1000~~

4

493

1000-1500

7

394

1500-2000

7

247

2000-2500

9

153

over 2500

9

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is afforded at the Cape. The -warm Mozambique Current, with a south-westerly direction off Natal, meets a north- east branch of the cold Antarctic Drift, and is beaten back eastwards : a result of the constant warring of these hot and cold currents is a high range of sudden temperature variation. Hence the Cape fauna consists mainly of only such species from neighbouring provinces as can endure high sudden variations; and the district is practically impassable. For example, nineteen species of Echinoids are known from the Cape dis?rict. Of these twelve are peculiar to the Indo-Pacific province, which stretches from East Africa to the Sandwich Islands and from Japan to Australia ; two species are Southern Ocean forms, all but confined to south of 40" S. ;

four species are peculiar to the Atlantic Ocean : of these eighteen, not one gets past the Cape into the next province ; the nineteenth is practically a cosmopolitan (Agassiz, " Challenger " Reports : " Echino- idea " ; compare also Chun, Aus den Tiefen des Weltmeeres, pp. 157, 158).

Among the barriers to the horizontal extension of epi- benthos must be mentioned a wide deep ocean. The Indo-Pacific fauna ranges from East Africa to about 108° W., stepping from island to island over the Pacific ; but this continuity is then broken by 37 degrees of longitude and more than 2000 fathoms of water, and such sessile species as are most Mollusca (cf. Fig. 3) are unable to reach the American coast. This is presumably due to the fact that the planktonic larvae of epibenthic adults must settle on a suitable bottom within a certain period or die. In spite of the direct set of the currents from Florida to the British Isles, the epibenthos of the two is absolutely dis- similar ; the similarity of the two Boreal provinces (2 and 2', Fig. 3) is to be assigned to a former continuity by way of Greenland, Iceland, and Faroe ; a similar con- tinuity, still unbroken, is exhibited by the Aleutian province on both sides of the Pacific. Though larvae cannot cross wide oceans, adults may no doubt traverse great stretches occasionally on floating timber, &c.

This barrier by distance may be instanced in another way. In the Arctic regions land masses are continuous or contiguous, and there are many circumpolar species, as, for example, Rhynchonella psittacea : towards the South Pole the southern continent is almost ice-bound, and the available land consists only of the tips of the continents and of the few oceanic islands. Hence few if any littoral species are circumpolar. For ex- ample, not a single littoral Ophiurid surrounds the South Pole, but five or six species are circumpolar in the northern hemisphere.

Taking next the mesobenthos and hypobenthos, living at depths where temperature is constant and current practically negligible, there appears theoretically to be no reason why an organism which can thrive at 500 fathoms should not have a world-wide range over the bottom of all oceans. Yet this is not often, although occasionally, known to be the case ; and although perhaps, speaking generally, hypobenthic species have wider ranges than epibenthic, still they also seem to be limited. It must,

~~however, be remembered that the ocean is large, deep hauls of trawl or dredge few, and individuals at great depths scattered, so that too much stress must not be laid on this point. The Challenger results seem to allow of at least one generalization — the deeper the fauna, the wider its range. This is shown by the following table of the Challenger benthos : the first column gives the number of benthos species captured at depths in- dicated in fathoms by the second column ; the percentage of these species which is known to have been captured between the tropics, as well as south and north of the tropics, is shown in the third column : —~~

~~We can only guess at the causes of the apparently limited range of many deep-sea types, (a) One of these is probably the limited food supply : presumably, as with a land fauna, there are as many mouths in a given area as it will support, and an equilibrium of species is main- tained which will at least hinder the extension of any one. For food the bulk of the deep-water fauna is dependent upon the rain of dead organisms falling from higher levels ; these, slowly disintegrating (probably under chemical, not bacterial, action), seem to form with the bottom deposit a kind of nitrogenous ooze, through which many deep-sea organisms slowly swallow their way, as an earthworm goes through earth, extracting nutriment. (b) Another hindrance to the extension of many deep- sea species is that they are holobenthic, that is, do not pass through a free-swimming larval stage ; the means of dispersal is therefore regulated by the animal's own power of locomotion. Generally speaking, as might be expected, the freely-moving hypobenthos, fish and Crustacea, have the widest ranges, and even these are not helped by currents, as are epibenthic or planktonic forms. The larval history of deep-water forms is, however, unfor- tunately obscure, (c) Lastly, extension of area of a species being at best difficult in deep water for non-swimmers, the place and date of their first migration must be taken into account; forms which have comparatively recently adopted deep-water life cannot be expected to have spread far from their original centre. As regards this point, in the first place, it is with migration, not with local evolu- tion, that we have to deal : no classes and orders, only a few families and genera, rarely sub-orders, are peculiar to the hypobenthos ; the deep members of each group consist~~

for the most part of widely separated genera, the species do not grade into each other, as is so often the case in the epibenthos ; and evolution could hardly have produced these species and genera under the uni- formity of their present environment. This migration downwards from the mud-line has no doubt occurred all over the world, notably in the Southern Ocean, if we may judge by the richness of the deep-water fauna there to-day ; probably also largely in Arctic and sub-Arctic regions, less so in tropical and temperate zones. As to the date of migration, the following fact seems to show that it is of comparatively recent origin, and is indeed still in progress : taking the Challenger species from the epibenthos, from the mesobenthos, and then from zones of 500 fathoms down to 2500, each zone shares a larger percentage of species with the zone above it than with that below it (except in one case where they are nearly equal). But it is not to be supposed that all our pre- sent-day deep-water forms began their migration simul- taneously, and we can say with fair certainty that migration to deep water did not begin before the close of the Mesozoic epoch. Had it begun earlier, we should find typical Mesozoic and even older forms, or their con- geners, at great depths : so far is this from being the case, that the most venerable animals of to-day — Lingula, Amphioxus, Limulus, 75 per cent, of Crinoids, 90 per cent, of Brachiopoda, &c. ■ — are epibenthic or meso- benthic. On the other hand, it is extremely likely that the

Cretaceous epoch marked the commencement of migration. The hexactinellidan sponges are known to have lived in quite shallow water at the date of deposition of the Inferior Oolite ; to-day none occur at a less depth than 95 fathoms ; and as only two genera are known from the shallow Tertiary deposits, it would seem that the migration began about Cretaceous times ["Challenger" Reports : " Hexactinellida," Schulze). In 1881 (Agassiz, " Chal- lenger" Reports: " Ecliinoidea ") 105 living genera of Echinoidea were admitted ; of these 23 per cent, were known from Cretaceous but not from Tertiary deposits, 35 per cent, from Tertiary but not Cretaceous, and 40 per cent, as Kecent only. The species of

~~Cretaceous genera constituted only 29 per cent, of the epibenthic Echinoids, 44 per cent, of the mesobenthic, and no less than 55 per cent, of the hypobenthic. These species of Cretaceous genera were distributed fairly evenly over all three zones, but 72 per cent, of the species of Tertiary genera and 55 per cent, of the Recent forms were confined to the epibenthos. As out of the twenty-five living genera known from the Cretaceous only seven are known also from Jurassic deposits, it is obvious that the close relation- ship is between Cretaceous and hypobenthos, rather than between any other geological and bathymetric horizons. Other instances, such as that of the Eryonidae, seem to point to similar conclusions.~~

~~Excepting the essential air-breathers, practically every phylum and class and most orders are represented in the benthos. The epibenthos of warm seas appears to be especially wealthy in such forms as secrete heavy calcareous skeletons ; but in colder water, among the epibenthos of polar or subpolar regions, and the hypo- benthos everywhere in open oceans, the predominant forms are those which exhibit little or no calcareous secretion : even the apparent exceptions, Madreporaria and Echinoderma from great depths, tend to develop slighter skeletons than their warm-water congeners. The following table will serve to illustrate this pojnt, and to give an idea of the composition of the epibenthos of cold and warm seas and of the hypobenthos : the figures are the percentages of total species captured in each locality by H.M.S. Challenger, the balance being made up by few specimens in scattered groups : —~~

~~Kerguelen~~

~~Area — over~~

~~1260 fm.~~

~~Kerguelen~~

~~Area — 0 to~~

~~150 fm.~~

~~Cape York — 0 to 12 f m.~~

~~Madreporaria Alcyonaria Shelled Mollusca Decapoda . Echinodermata . Actiniaria . . j Hydrozoa . . (Annelida . Crustacea . . i exc. Decapoda. j Tunicata .~~

~~0-8 1-2 8-0 3-6 33-6~~

~~6-8~~

~~6-8~~

~~16-5~~

~~4.4~~

~~o-o~~

~~1-0~~

~~197~~

~~0-8~~

~~11-7~~

~~4-6~~

~~8-0~~

~~25-0~~

~~6-8~~

~~3‘3 \ 3 a -d~~

~~3-3 8-SaB.~~

~~57-3 VS^g.S~~

8-1 ||.S*P 7-9 J6™ ■%

1-7 \ m

g d ■£ 0-9 SjjsS

7‘6 \%&~z

81-7

77-6

91-2

While the Madreporaria represent only 3 ‘3 of the species at the tropical station, it must be remembered that they probably made up 80 per cent, or more of the weight.

The epiplanlcton is dependent either directly or proxi- mately upon light, warmth, and the presence of plant life. The wealth of minute organisms near the surface is in- coiiceivable to those who have not seen the working of a tow-net : it may be gauged by the fact that a single species is sometimes present in such quantities as to colour the sea over an appreciable area, and by the estimate that the skeletons of epiplankton from a .square mile of tropical ocean a hundred fathoms deep would yield 16 tons of

lime. In the tropics the wealth of species, and towards the poles the number of individuals of comparatively few species, are characteristic of these latitudes. In temperate and tropical regions there is a great difference between the epiplankton near land and that far out at sea : the former is termed neritic ; it extends, roughly speaking, at least as far out as the mud-line, and is characterized by the predominance of what may be termed hemibenthic forms, that is, benthic forms with a planktonic larval stage {Decapoda, Polychceta,

In the first hundred fathoms at sea the fall of tempera- ture is gradual and slight, and forms practically no hindrance to the dhirnal oscillation

of the oceanic epi- plankton — the alleged rise and fall of almost the entire fauna. Eoughly speaking, the greatest number of animals is nearest the surface at midnight ; but different species sink and rise at different times, and to or from different depths. Apart from this diurnal oscillation, unfavourable conditions at the surface send or keep the fauna down in

a remarkable way : for example, in the Bay of Biscay few organisms are to be found in the first fathom in bright sunlight, but on a still, hot day the next few fathoms teem with life; yet, after a few minutes' wind or rain, these upper layers will be found almost de- serted. This leads to the consideration of the hydro- statics of the plankton : apart from strong swimmers, the majority contests the tendency to sink either by some means of diminishing specific gravity (increasing floating power), or by increased frictional resistance. The former is generally attained (a) by increase of bulk through development of a fluid secretion of low specific gravity (vacuoles of Foraminifera, Radiolaria, &c.) ; (b) or of a gelatinous secretion of low specific gravity (Medusas, Chastopod and Echinoderm larvae, Chcetognatha, Thaliacea : the characteristic transparence of so many oceanic forms is probably attributable to this); (c) by secretion or retention of air or other gas (Physalia, Minyas, Evadne) ; (d) by development of oil globules (Copepoda, Cladocera, fish ova). Increased frictional resistance is obtained by flattening out of the body (Phyllosoma, Sapphirina), or by its expansion into lateral processes (Tomopteris, Glaums), or by the development of long delicate spines or hairs (pelagic Foraminifera, many Radiolaria, many Chsetopod and Decapod larvae). In many cases two or more of these are combined in the same organism. Notwithstanding the above adaptations, some of which are adjustable, it is difficult to understand the mechanics of the comparatively rapid oscillations of the epiplankton, of which both causes and methods are still obscure.

It will be seen from the distribution of the Thecoso- matous Pteropoda — a purely oceanic group — how difficult it will prove to draw distributional areas for classes of epiplankton. Pelseneer recognizes in all ten such pro-

vinces (" Challenger " Reports : " Zool.," xix., xxiii.) and 42 good species : of the latter 1 is confined to the Arctic, 4 to the Antarctic province, but of the remaining 37 species and eight provinces, 30 per cent, occur in all eight, 16 per cent, in seven, and only 35 per cent, have as yet been captured in a single province only.

The mesoplankton has only received (serious attention during the last few years. In the Challenger, open nets towed at various depths seemed to show the existence of a deep-water plankton, but this method gives no certain information as to the horizon of capture, the nets being open in their passage down and up. Chun constructed the first efficient net which could be opened and shut at known depths, using a propeller mechanism {Bibl. Zool., vol. i.) ; and he improved his original pattern for the National and Valdivia expeditions. The present writer has devised a net, of which the opening and closing are effected from the deck by heavy weights ; this has been used success- fully on the Siboga expedition and in cruises of the Research (Proc. Zool. Soc, 1898). Garstang has con- structed an ingenious net which is useful in comparatively shallow water, but is open to criticism as being- too light for depths beyond 100 fathoms; and several other types are in use. The existence of a mesoplankton, that is, of a plankton living between 100 fathoms from the surface and the bottom, has been generally considered as definitely proved by these nets. On the other hand, Agassiz, using the Tanner tow-nets, contends that while a mixture of surface and bottom species may occur in a closed sea near land, there is no intermediate fauna in the open ocean between about 200 fathoms from the surface and the bottom ; his conclusions, based on negative evidence, have not met with general acceptance. Animals captured below the first hundred fathoms in the open sea (the Mediter- ranean, for special physical reasons, is on a special footing) are divisible into at least three categories : (1) those which

are eury thermal and eurybathic, e.g., C alarms flnmarchi- cus; (2) those which, so far as we know, are purely meso- plankton ic and never come to the surface, for example, the Badiolarian family Tuscaroridce ; (3) those which, like some Schizopoda, spend a larval period in the epiplankton, and seek deeper water when adult, rising to the surface, if at all, only at night. But until the publication of the results of expeditions provided with

efficient mesoplank- ton nets, generalizations about this fauna had better be stated with all reserve. There is, however, a certain amount of evidence to show that the ■ mesoplankton includes different organisms in different latitudes ; that surface animals of the north and south, unable to spread into the warmer surface water of lower latitudes, there sink into the cooler waters of the mesoplankton ; the distributional area of such an organism will be in three dimensions bounded by isotherms (isobathytherms) and isothermobaths. As with the hypobenthos, there seems to be no theoretical reason against the universal distribu- tion of the mesoplankton.

When a more systematic investigation of the various horizons has been carried out, many of the present cases of supposed discontinuous distribution will doubtless disappear. There are, however, undoubted cases of discontinuity where physical barriers have cut across a distributional area, an example of which may be cited here. The Isthmus of Panama was apparently only upraised about Miocene time, having been previously an archipelago through which a great circumequatorial current could pass ; consequently the benthos of the Panama region shows marked alliance with the Caribbean, with which it was formerly continuous, but practically none with the Indo- Pacific. To the same cause is doubtless attri- butable the distribution of the five Decapoda which are characteristic of the Sargasso Sea, which are circum- equatorial oceanic types, only occasionally littoral : three of these are known only from the Atlantic, one occurs in the Atlantic and Pacific, one in the Atlantic, Pacific, and Indian Oceans. The damming of a great circumequa- torial current by the Isthmus of Panama is probably also responsible for that dislocation of currents which resulted in the present relations of the Gulf Stream and North Atlantic Drift to the Labrador Current, and cut the Atlantic Boreal fauna into two discontinuous districts (2 and 2', Fig. 3).

Under the head of discontinuous distribution, the alleged phenomenon known as bipolarity must be men- tioned. In summarizing the work of the Challenger, Sir John Murray maintained on the basis of the reports that numerous species occurred in both polar and sub- polar areas which were absent from the tropics. He regarded them as the hardy survivors of a universal fauna which had withstood that polar cooling which set in towards the close of the Mesozoic period (Murray, Trans. Roy. Soc. Edin.,

xxxviii., 1896 ; Pfeffer, Verh. deutsch. Zool. Gesell., ix., 1899). This view and the facts on which it was based have been acutely contested, and the ques- tion is still far from settlement (for lists of the literature see Ortmann, Am. Nat., xxxiii. 583 ; and Pratt, Mem. Manchester Soc, xlv., 1901). As regards the purely epi- benthic and sessile fauna, there are a few undoubted instances of actual specific identity : in some classes, how- ever, such as the Echinoderms, this does not appear to hold (Hamburger Magalhaensche Sammelreise; and Eomer and Schaudinn's Fauna Arctica) ; but even in these the general composition of the fauna and the presence of certain identical and peculiar genera seem to point to something more than a mere " convergence " due to similar environment. As regards the plankton of the two polar regions and such epibenthic forms as extend also

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into deep water, the suggestion has been made that the Arctic and Antarctic benthos and plankton are really con- tinuous by way of deep water in the main oceans, where the organisms can find a suitably low temperature. As an instance of this, Chun (Bezieh. zwischen dem arkt. und antarkt. Plankton, 1897) cites Krohnia hamata, a charac- teristic Arctic and sub- Arctic constituent of the epiplankton and mesoplankton, known only from the mesoplankton in the tropics, but rising to 38 fathoms at 40° S. 26° E. More exact information, such as may be expected from the various Antarctic expeditions, is required to settle this interesting question with its far-reaching corollaries ; and, like other matters of marine distribution, it can only be solved by a more systematic, more restricted, and more co-ordinated scheme of exploration than has characterized former expeditions. (g. h. Fo.)

H. Teeeesteial.

The discoveries and investigations which have taken place since 1887 render it advisable to make some emenda- tions in the scheme of

zoological regions into which the land surface of the globe was parcelled out in the ninth edition of this work (vol. vii. p. 269). Much of the evidence in favour of these new ideas has been drawn from the remarkable palaeontological discoveries which have taken place in Patagonia. The result of these has been to demonstrate that while in certain respects the fauna of South America is even more peculiar than had been supposed, yet at the same time it exhibits previously unsuspected relationships with that of Australia (as exemplified by the dis- covery of Australian types of extinct marsupials), while its connexions with that of Africa have likewise been intensified. Another result of such discoveries has been to engender a wide belief that the alternations of land and sea on different parts of the surface of the globe have been much greater than was formerly considered probable. Indeed, several lines of evidence indicate that during the Jurassic and Cretaceous epochs of the Mesozoic,or Secondary, period of the earth's history there was a continuous land- connexion between Africa (by way of Madagascar and the Seychelles) and India ; while at some time in the Mesozoic era South America was in communication with South Africa by way of what is now the South Atlantic.1 This latter connexion appears to have been a survival from an older Palaeozoic girdle of land, which, from the evidence of fossil floras, seems to have existed in low latitudes round nearly three-quarters of the circumference of the globe, and was cut off by sea from the land to the north. One of the problems still remaining for solution is whether a remnant of this old land-girdle served to connect the southern continents in Tertiary times, or whether these communica- tions were by means of an Antarctic continent. For it is now generally admitted that both Africa and South America have been connected to the southward with Australasia during the Tertiary epoch, although not necessarily (or indeed probably) at the same time or for any very long period. Dr H. 0. Forbes 2 was one of the first to urge that these connexions took place by way of the Antarctic continent ; and although this view has been controverted,3 it has been accepted by several American writers, among them Dr W. B. Scott. For the present the question may be left open, with the remark that there is no evidence to indicate that during the Tertiary period such an Antarctic continent was ever suited to the existence

1 See M. Neumayr, Erdgeschichte, vol. ii. p. 263 (1895).

s "The Chatham Islands; their Relation to a former Southern Continent," Supplemental Papers R. Geographical Society, 1893, pp. 607-637.

8 R. Lydekker, A Geographical History of Mammals, p. 134 (1896).

of temperate forms of animal life. Some may, however, contend that this remark is in favour of the Antarctic theory, seeing that the forms common to the three areas are but few, and that these few just managed to effect a crossing under unfavourable climatic conditions, while other types that made the attempt perished.

One of the defects in the scheme of zoological regions adopted in the article in the ninth edition was that it did not bring into sufficient prominence the essential and striking differences by which the mammalian (and to a great extent also the avian) faunas of Australasia and South America are respectively distinguished from that of the whole of the remaining land-surface of the globe. To remedy this defect Dr W. T. Blanford4 in 1890 proposed to make three primary zoological divisions of the land area of the earth, which he respectively called the Australian, the South American, and the Arctogsean regions. A weak point in this otherwise admirable scheme is that since the term " region " is likewise applied to the subdivisions of Arctogasa, there is considerable danger of confusion between the primary and secondary divisions. An amend- ment proposed anonymously6 in 1893 was to substitute the names Notogsea, Neogsea, and Arctogaea for the three primary divisions of Dr Blanford. Yet another emendation, suggested by the present writer,6 and sub- sequently adopted by Professor H. F. Osborn,7 was to designate these three primary divisions as "realms," and to reserve the name " region " for their subdivisions.

In addition to these all-important changes in the main scheme of zoological division of the globe, various modifi- cations of the limits of these regions, as defined in vol. vii. of this work (p. 269), have from time to time been suggested by different writers. One of the most important of these — the separation from the Ethiopian of a distinct Malagasy region — was urged by Dr Blanford in the address already cited. The same writer also advocated the union of the Patearctic and the northern part of the Nearctic region, under the name of Aquilonian, while he separated

~~the southern portion of the Nearctic as the Medio-Columbian region. For this latter region Dr C. H. Merriam8 adopted the less cumbrous title Sonoran. It may be added that if the Palaearctic and Nearctic regions (exclusive of their southern portions) are regarded as one, it seems preferable to employ the term Holarctic, which appears to have been proposed by Dr Heilprin in 1878. Yet another important innovation was made in 1896 by Mr W. L. Sclater,9 who proposed the transfer- ence of the island of Celebes from the Australian to the Oriental region, this view being subsequently sup- ported by Dr Max Weber.10 A further step in the same direction was made in 1898 (partly on information obtained from Dr Blanford) by the present writer,11 who suggested that a similar transference should be made in the case of Lombok, Flores, and Timor. The effect of this change was to do away with "Wallace's line" (the channel between Bali and Lombok), to which so much importance was attached in the ninth edition of this work, but it~~

- ~~Proc. Geol. Soc., 1890, p. 76. 6 Natural Science, vol. iii. p. 289.~~

~~6 Lydekker, op. cit, p. 27.~~

~~7 "Correlation between Tertiary Mammal Horizons of Europe and America," Annals New Fork Academy, vol. xiii. p. 48 (1900).~~

~~8 "The Geographical Distribution of Life in North America, with special reference to the Mammalia," Proc. Biol. Soc. Washington, vol. vii. pp. 1-64 (1892).~~

~~8 "The Geography of Mammals," part v., Geographical Journal,~~

~~1896.~~

~~10 " On the Origin of the Fauna of Celebes," Ann. Mag. Nat. Hist., ser. 7, vol. iii. pp. 121-136 (1899).~~

~~11 Lydekker, "Celebes; a Problem in Distribution," Knowledge, vol. xxi. pp. 175-177 (1898) ; see also " Deer of All Lands," p. 168~~

~~(1898).~~

appears that the deepest channel is really situated to the eastward of the island of Timor.

Still another modification of the older scheme already referred to has to be recorded. Several writers had suggested the advisability of regarding the southern por- tion of the Pahearctic as a distinct region, and in 1896 this idea was carried into execution by Dr P. Matschie,1 who denned a Mediterranean-Chinese region, which should include northern Africa, south and a part of central ■fcjurope, and that portion of Asia lying between the Himalaya and the Altai (inclusive) and its eastern exten- sion. To this region the name Mediterranean seems most suitable. It may be added that Dr Matschie, together with several American writers such as Dr Merriam and Professor Osborn, also advocate a Boreal, or Arctic region, to embrace the northern parts of both hemispheres, which extends farther south on the eastern coast of North

America than elsewhere. There are, however, many arguments against the claims of this tract to rank as a distinct zoological region of Arctogaea.

The zoological realms and regions of the land surface of the globe, as indicated by the distribution of mammals, may accordingly be tabulated as follows (Fig. 4) : — i. Notogjsa, containing the Australian region; ii. Neog^ea, with the Neotropical region ; and, iii., Aectog^a, including, 1, the Malagasy; 2, the Ethiopian; 3, the Oriental, or Indo- Malayan (which is taken to embrace Celebes, Flores, Timor, &c); 4, the Mediterranean; 5, the Holarctic (regarded by many authors as two, the Palsearctic and Nearctic), and 6, the Sonoran region. It may be added that the name Indo-Malayan is preferable to Oriental, on account of the latter term being employed by botanists to denote Asia Minor and the adjacent countries ; also that perhaps a Polynesian and a Hawaiian region may be

Fig. 4. — Map of the Would showing the Zoological Eealms and Regions of the Land Surface.

recognized in Notogaea, although from a mammalian stand- point these regions are of little or no importance, owing to the practical absence of mammals from the islands by which they are represented. One other point needs mention before this portion of the subject is dismissed. In the ninth edition' of this work the Ethiopian region was taken to include Arabia south of the tropic, but Mr E. I. Pocock 2 has pointed out that the distribution of scorpions does not support this division of Arabia, and he would refer the whole of it to the Holarctic or Mediterranean region. This contention is in some degree supported by the discovery of a species of thar (Hemitragus) in southern

1 " Geographische Fragen aus der Saugethierkunde," Verhandl. des. Erdhunde, Berlin, 1896, pp. 245-256.

2 "Scorpions and their Geographical Distribution," Natural Science, vol. iv. pp. 353-264 (1894).

Arabia, since this group of animals has no representative in Africa, but occurs elsewhere only in the Himalaya and the mountains of southern India. Other writers, however, have not accepted Mr Pocock's emendation; and the reference of the northern half of Arabia to the Medi- terranean and of the southern half to the Ethiopian region is usually followed.3 The area is admittedly a meeting-ground of at least two faunas, so that a difference of opinion in regard to its classification is only to be expected.

To a very large degree the distribution of birds accords

s In the map of the Ethiopian regiqn facing p. 132 in Messrs. Sclater's Geography of Mammals (1899), southern Arabia is re- ferred to the Ethiopian region, but in tjie map of the world forming pi. i. of the same work the whole of Arabia, together with the Sahara, is coloured as Ethiopian.

with the foregoing zoo-geographical regions, which are made on the evidence of mammals. This, however, is not so with regard to' reptiles, amphibians, and fishes ; and to a certain extent this discrepancy may be explained by the greater antiquity of these groups, which began their wanderings at an epoch when mammals occupied a very subordinate position among the world's inhabitants. But there is some difficulty in accepting this explanation as altogether sufficient, since it has been shown by Mr Pocock 1 that the distribution of scorpions (which form an extremely ancient group) and of certain other groups of Arachnida indicates zoological regions very curiously similar to those given above. In addition to the Holarctic (Palsearctic and Nearctie), Mr Pocock recognizes a Medi- terranean, Ethiopian, Oriental, Australasian (excluding Celebes and Timor), Sonoran, and Neotropical region, so that the sole difference between this and the mammalian scheme is the non-recognition of a distinct Malagasy region. Even here, however, the difference is more apparent than real, since it is stated that the scorpions of Madagascar entered that island at an earlier date than those now found on the mainland, which are strikingly different from the Malagasy forms ; a similar explanation is generally applied to the case of the Malagasy mammals. The geographical distribution of scorpions, however, does not support the division of the land surface of the world into three primary " realms."

As regards the distributional areas indicated by other vertebrates, those of the land tortoises, lizards, and snakes, which differ essentially from one another, will be found in the article (ninth edition) on Reptiles, by Dr A. Giinther, who gives the divisions indicated by fresh-water fishes in the article on Fishes. The distribution of amphibians has been studied by Mr G. A. Boulenger, who recognizes (1) a Northern Zone, in which the tailed forms (Caudata) are abundant and the limbless forms (Apoda) absent, and which is subdivided into a European-Asiatic and a North American region ; and (2) an Equatorial Southern Zone, divided into two sections, one of which comprises an Indian and an African region, and the other a tropical American and an African region. The regions are there- fore not very dissimilar to those given in the article in vol. vii. of this work. But Madagascar has strong claims to recognition as a distinct region. It may also be mentioned that, in the regions indicated by land and fresh-water

tortoises, tropical America and Madagascar are grouped together, owing to the occurrence in both areas of forms like Podocnemis. Since, however, that genus occurs fossil in the early Tertiary deposits of the northern hemisphere, its peculiar distribution may be accounted for without the necessity of invoking a direct land connexion between the two areas to which it is now restricted.

Reverting to the consideration of mammals, this point brings us face to face with two diametrically opposite views as to the mode in which a large number of forms have reached their present habitats in the southern hemisphere. According to what may be called the old-fashioned hypothesis, as advocated by Huxley and Wallace, at least a very large proportion of the animals now restricted to the southern continents originated in the northern hemisphere and made their way south by various land routes. This hypothesis receives support from the circumstance that a large number of such southern types are represented in the Tertiary deposits of the northern hemisphere, whereas they are quite unknown in those of the south. On the other

1 Op. cit, and "The Geographical Distribution of the Arachnida of the Orders Pedipalpi and Salifugse," Natural Science, vol. xiv. pp. 213-231 (1899).

hand, according to a more modern theory, all or most of such southern types, in spite of the above-mentioned fossil evidence, are regarded as having originated in the southern hemisphere. Not only is this considered to have been the case with modern forms now confined to the south, but it is inferred to have been so with Mesozoic types which are at present known only from the northern hemisphere. For instance, it has been suggested that the few Mesozoic mammals known from the European Jurassic were stragglers from a southern land where such forms were abundant.2 Apart from the boldness of a hypothesis which transfers the origin of creatures from localities where they certainly did exist to others where there is no evidence of their occurrence, it may be pointed out that the rarity of such remains in Europe is quite what might have been expected from the rarity of fresh-water deposits in the Jurassic series. Moreover, whenever such deposits do occur, there mammalian remains

are invariably met with. On the older hypothesis, a large amount of evolution in respect of the more modern types must have taken place in the southern hemisphere, and such evolution must in some cases have taken place while the three great southern continents were still connected with one another at certain periods.

Taking these three continents seriatim, it may be noticed that Dr Wallace adopted the view that Australia received its population of marsupials from Asia by way of the Austro-Malayan islands, as has certainly been the case with its limited and later rodent fauna. This view was supported and expanded by the present writer.8 One of the argu- ments employed is the occurrence of remains of opossums (Didelphys) in the lower Tertiaries of both Europe and North America, these animals being nearly allied to the Australian Dasyuridce. Professor B. Spencer,4 on the other hand, is of opinion that the Australian marsupials reached their present home from Antarctica by means of a land connexion subsequent to the insulation of New Zealand, and that consequently the group is of southern, instead of northern, origin. However this may be, the discovery in the Tertiary deposits of Patagonia (which are probably of Miocene age) of remains of extinct marsupials, such as Prothylacinus and Amphiproviverra, nearly related to the existing Thylacinus of Tasmania, seems to afford indisputable evidence of a land connexion between South America and Australia at a time when the marsupials of the latter area had already become differentiated into their present types. Probably the occurrence in South America of another family of marsupials — the Epanorthida — of which all the representatives save Canolestes are extinct, affords additional evidence in favour of the same land-con- nexion. Still more important is' the occurrence in both areas of large tortoises belonging to the extinct genus Miolania, which is quite unknown in the northern hemi- sphere. Moreover, seeing that in Australia the remains of this genus occur in strata, which are probably of Pleisto- cene age and are certainly not older than Pliocene, it would seem likely that the land-bridge occurred at a comparatively late epoch. The land connexion must, however, apparently have been either very imperfect or must have lasted for only a very limited period, as, had it been otherwise, the resemblances between the faunas of Notogsea and Neogsea would have been much more marked than is now the case. All who have written on this subject

are practically in accord as to the existence of this land-bridge ; the only dis- crepancies are as to how and when it occurred. According

2 Sec A. S. Woodward, Vertebrate Palaeontology, p. 417 (1898),

3 (Geographical History of Mammals, p. 127.

4 Report of the]/<•>■» Expedition to Central Australia, pp. 187 and

188 (1896).

to the views suggested by the present writer, it took place (possibly by way of Polynesia) subsequently to the peopling of Australia with its marsupials from Asia, whereas ac- cording to Professor Spencer it was the means of sup- plying Australia with its marsupials from the Antarctic continent.

Admitting, then, some form of land-bridge between Australia and South America by means of which the common types of marsupials passed from the one area to the other, the next point for consideration is the origin of the other members of the peculiarly isolated fauna of Ncogsea, this isolation being especially marked in middle Tertiary times. Now, there is a considerable amount of evidence to indicate the separation by sea of this area from North America during much of the Tertiary period, and if this be the case there would seem to be strong primd facie probability that the ancestors of the peculiar South American Ungulata, Edentata, Primates, and Kodentia effected an entrance into their present habitat by some route other than that afforded by the Isthmus of Darien. If the necessity for such an alternative route be admitted, Africa is the only country which will serve as the means of communication. This view has been advanced both by Professor W. B. Scott 1 and the present writer,2 the former remarking that the connexion " is much more likely to have been due to the junction of both continents with the Antarctic land mass than to a transatlantic bridge. Such a mode of connexion would explain the very

wide divergence in the character of the mammalian faunas which still exists between Africa and South America, for a circumpolar land would very likely oppose climatic barriers to migration and confine that migration to com- paratively few groups." Considerable difficulty, however, is now experienced in accepting this hypothesis, on account of the circumstance that the Eocene Ganodontia — the presumed ancestors of the Edentates — appear to have attained their chief development in North America. Professor Osborn 3 is inclined to regard the latter country as the feeder which supplied Neogsea with the most characteristic elements of its fauna. He is, however, compelled to admit that there has probably been also some land connexion between South America and Africa, which is presumed to have been by way of Antarctica. This connexion is considered to have led to the introduction of the Hyrax-like Ungulates met with in the Patagonian Tertiaries, and to have taken place at a later date than the presumed connexion with North v America. It is further urged that during the connexion with Africa the latter country received from South America the ancestors of its pangolins and aard-varks. From the evidence of the scorpions and their allies, Mr Pocock 4 likewise inclines to the opinion that Neogsea received the bulk of its fauna from North America, but that certain elements in it may be traced to a connexion with Africa. Possibly it may prove that this is the true explanation with regard to the mammals, and that while the ancestral Eden- tata, and probably some of the Ungulata, effected an entrance during a transient connexion with North America, the Hyrax-like Ungulata came in from Africa together with the Hystricomorphous Eodents and perhaps certain other types.

Amid this uncertainty it is satisfactory to be able to touch firm ground in one place. After a long period of more or less complete isolation from the north, it is certain that about the close of the Miocene epoch a land con- nexion was established between Neogasa and North America,

1 "Antarctic Paleontology," Science, ser. 2, vol. iii. pp. 308 and

309 (1896).

2 Geographical History of Mammals, p. 127.

3 Annals Neio York Acad., p. 54.

4 Natural Science, vol. xiv. p. 236.

and that by means of this bridge not only did a certain number of characteristic South American types effect an entrance into the latter area, but a host of northern forms, such as bears, sabre-toothed tigers, raccoons, deer, llamas, peccaries, tapirs, horses, mastodons, and squirrels made their first appearance in a land where glyptodons, ground-sloths, ant-eaters, armadilloes, sloths, and a host of peculiar ungulates had rjreviously been the dominant types.

Turning to the Ethiopian region, it is mentioned in the ninth edition (vol. xii. p. 275) that this area received its presejit fauna of large mammals from the north, and it is abundantly proved that a number of generic types now restricted to this region flourished during the Pliocene epoch in southern Europe and Asia. It has further been urged that this great immigration of modern types took place subsequently to the insulation of Madagascar, which had been populated by an earlier immigration of more lowly types. Professor Osborn,5 however, has propounded the theory that, instead of being of foreign origin, the present Ethiopian fauna is autochthonous, and that Africa has been at first a great centre of evolution and sub- sequently of dispersal, so that it has formed the feeder of southern Europe and Asia, instead of having drawn its fauna from these areas. Several migrations northwards from Africa are assumed to have occurred, the scale-tailed squirrels (Anomalwidae), with perhaps the aard-varks and pangolins, being some of the earlier emigrants. The mastodons and dinotheres, he says, started later, while a third emigration included antelopes, giraffes, hippopo- tamuses, horses, and rhinoceroses. It is urged that by this hypothesis alone can be explained the apparently sudden appearance of the Proboscidea in the European Miocene. But there is decisive evidence to show that the evolution of the elephants from the mastodons took place in south- eastern Asia during the Pliocene epoch, and this renders it highly probable that the African elephant is of Asiatic origin. This being so, and since nothing is known of the vertebrate palaeontology of that area below the Upper Miocene, it is a fair inference that the evolution of the Pro- boscideans themselves from other Ungulata

should have occurred there also. Again, in the face of evidence that modern types of African mammals flourished in Europe and Asia during the Pliocene, and in the absence of any evidence of their existence in Ethiopian Africa previous to the present epoch, it is a very bold statement to say that the latter area was their birthplace. Moreover, the fact that many of these Asiatic mammals, such as the hippopotamus, are more generalized than their modern representatives is against their African origin. There are also difficulties with regard to Madagascar. In the first place, on the assumption that Africa was the ancestral home of its present fauna of large mammals (which, on this hypothesis, must date from the Miocene), it is not easy to explain why this fauna failed to effect an entry into the adjacent island before its separation from the mainland. In the second place, it is still more difficult to account for the intimate relationship which has been demonstrated to exist between the extinct Adapis of the European Oligocene and the existing Malagasy lemurs — a relationship which it is per- fectly easy to understand on the old hypothesis that Mada- gascar received its fauna from Europe vid Africa before the immigration of the higher types into Ethiopia took place and at a period when it was still united with the mainland. (k. l*.)

5 Annals New York Acad., vol. xiii. p. 56, and "The Geographical and Faunal. Relations of Europe and America during the Tertiary Period, and the Theory of the Successive Invasions of an African Fauna," Science, ser. 2, vol. xi. pp. 561-574 (1900).

Zorilla, Manuel Ruiz, Don (1834-1895),

Spanish politician, was born at Burgo de Osma in 1834. He began bis education at Valladolid, and studied law afterwards at Madrid University, where be began to show a strong leaning towards Radicalism in politics. In 1856 he was elected deputy for the first time, and soon attracted notice among the most advanced Progressists and Demo- crats. He took part in the revolutionary propaganda that led to the military movement in Madrid 22nd June 1866. He had to take refuge in France for two years, like his

fellow-conspirators, and only returned to Spain when the revolution of 1868 took place. He was one of the members of the first cabinet after the revolution, and in 1869, under the regency of Marshal Serrano, he became minister of grace and justice. In 1870 he was elected president of the House of Deputies, and warmly seconded Prim in offer- ing the throne to Amadeus of Savoy. He went out to Italy as president of the commission which had received from the Cortes the mission of carrying to the prince at Florence the official news of his election. On the arrival of Amadeus in Spain, Kuiz Zorilla became minister of public works for a short time, and resigned by way of protesting against Serrano and Topete entering the councils of the new king. Six months later, in 1871, he was invited by Amadeus to form a cabinet, and he con- tinued to be the principal councillor of the king until February 1873, when the monarch abdicated in sheer disgust at the resistance he met with in the army, and at the lack of sincerity on the part of the very politicians and generals who had asked him to come over and ascend the throne. After the departure of Amadeus, Ruiz Zorilla resolutely advocated the establishment of a republic in Spain. Notwithstanding this, he was not called upon either by the Federal Republicans to help them during the year 1873, or by Marshal Serrano during 1874 to join Martos and Sagasta in his cabinet. Immediately after the restoration of Alphonso XII., early in 1875, Ruiz Zorilla went once more to France and became the most persevering adversary of the new state of things. He was for nearly eighteen years the soul of the repub- lican conspiracies, the prompter of the revolutionary propaganda, the chief inspirer of the persistent intrigues concerted by discontented military men of all ranks. He gave so much trouble to the Madrid Governments that they organized a special watch over his movements and doings, with the assistance of the French Government and police, especially when it was discovered that the two military movements of August 1883 and September 1886 had been prepared and assisted by the exile. During the last two years of his life Ruiz Zorilla took less active part in the propaganda of the Progressist Republicans, who still looked up to him as a leader. Failing health and the loss of his wife had decreased his energies, and at last the Madrid Government allowed him to return to his native land some months before he died at Burgos, 13th June 1895, of heart disease. (a. e. h.)

Zorrilla y Moral, Jose, Don (1817-1893),

Spanish poet and dramatist, son of a magistrate in whom Ferdinand VII. placed special confidence, was born at Valladolid on 21st February 1817. He was educated by the Jesuits at the Real Seminario de Nobles in Madrid, wrote verses when he was twelve, became an enthusiastic admirer of Scott and Chateaubriand, and developed his taste for the theatre by taking part in the school perform- ances of plays by Lope de Vega and Calderon. In 1833 he was sent to read law at the University of Toledo, but the study had no interest for him, and, after a year of elaborate idleness, he fled to Madrid, where he horrified the friends of his absolutist father by making violent

speeches and by founding a newspaper which was promptly suppressed by the Government. The young editor narrowly escaped transportation to the Philippine Islands, and passed the next few years in great poverty. The tragic death of the satirist Larra brought Zorrilla into notice. His elegiac poem, declaimed at Larra's funeral on 15th February 1837, was much admired, and served as an introduction to the leading men of letters. In 1837 he published a book of verses, mostly imitations of Lamartine and Hugo, which was so favourably received that he was encouraged to print six additional volumes of verse within three years. His subjects are treated with fluency and grace, but the carelessness which disfigures so much of his work is prominent in these juvenile poems. After collaborating with the popular playwright, Antonio Garcia Gutierrez, in a piece entitled Juan Ddndolo (1839), Zorrilla began his individual career as a dramatist with Cada cual con su razdn (1840), and during the following five years he wrote twenty-two plays, many of them extremely successful. His Cantos del trovador (1841), a collection of national legends versified with infinite spirit, showed a decided advance in technical skill, and secured for the author the place next to Espronceda in popular esteem. National legends also supply the themes of his dramas, though unfortunately in this department Zorrilla has somewhat compromised his fame by merely adapting older plays which had fallen out of fashion. For example, in El Zapatero y el Bey he recasts El montanes Juan Pascual by Juan de la Hoz y Mota ; in La mejor razdn la espada he borrows from Moreto's Travesuras del estudiante Pantoja ; in Don Juan Tenorio he adapts from

~~*Tirso de Molina's Burlador de Sevilla. But his clever rearrangements usually contain original elements of value, and in Sancho Garcia, El Rey loco, and El Alcalde Ronquillo he apparently owes little to any pre-decessor. The last and (as he himself believed) the best of his plays is Traidor, inconfeso y mdrtir (1845). Upon the death of his mother in 1847 Zorrilla left Spain, resided for a while at Bordeaux, and settled in Paris, where his incomplete Granada, a striking poem of gorgeous local colour, was published in 1852. In a fit of profound depression, the causes of which are not known, he emigrated to America three years later, hoping, as he says, that yellow fever or small-pox would carry him off. During eleven years spent in Mexico he produced little, and that little was of no merit. He returned in 1866, to find himself a half-forgotten classic in a Spain which had not seen him for nearly twenty years. His old fertility was gone, and new standards of taste were coming into fashion. A small post, obtained for him through the influence of Jovellar and Canovas del Castillo, was abolished by the republican minister. He was always poor, but for some twelve years after 1871 he was in the direst straits. The law of copyright was not retro- spective, and, though some of his plays made the fortunes of managers, they brought him nothing. In his untrust-worthy autobiography, Recuerdos del tiempo viejo (1880), he bitterly asked if it were just that an author who each year filled every theatre in Spain and Spanish-speaking America during the month of October should be driven to die in the hospital or in a madhouse. A small pension of 30,000 reales secured him from actual want in his old age, and the reaction in his favour became an apotheosis. In 1885 the Spanish Academy, which had elected him a member many years before, presented him with a gold medal of honour, and in 1889 he was publicly crowned at Granada as the national laureate. He died at Madrid on 23rd January 1893. Zorrilla is so intensely Spanish that it is difficult for foreign critics to do him justice. It is certain that the extraordinary rapidity of his methods*~~

has seriously injured his work. He declares that he wrote El Cdballo del Rey Don Sancho in three weeks, and that he put together El PuTwil del Godo (which owes much to Southey) in two days ; and, if these stories be true, his deficiencies need no other explanation. An improvisator with the characteristic faults of luxuriance and verbosity, he wrote far too much, and as in most of his numbers there are numerous technical flaws, the reading of his verse is seldom an unalloyed pleasure. Yet the richness of his imagery, the movement, fire, and variety of his versification, will preserve some few of his choicest songs in the anthologies. His appeal to patriotic pride, his accurate dramatic instinct, together with the fact that he invariably gives at least one of his characters a most effective acting part, have enabled him to hold the stage ; and, unless some very unforeseen change of taste should occur, it is not impossible that Don Juan Tenorio may still be played sixty years hence. In any case, it is by Don Juan Tenorio, the play of which he thought so meanly, that Zorrilla will be best remembered. (j. f. k.)

Zugf, the smallest of the Swiss cantons. Its total area is 92 square miles. Population (1888), 23,029 ; (1900), 23,276, or 253 per square mile, the canton in respect of density ranking eleventh in the Confederation. The population is mostly Catholic and German-speaking. The capital is Zug, with 6471 inhabitants ; Baar has 4481, and Cham 3019. A railway runs from Zug to Arth along the east shore of the Lake of Zug. There are eleven administrative districts in the canton.

A new cantonal constitution was adopted in 1894. The legisla- ture (one member to every 350, or fraction over 150, inhabitants) and the seven members of the executive are elected directly by popular vote, proportional representation obtaining in both cases if more than two members are to be elected to similar posts in the same electoral district. Besides the former "facultative Referen- dum" in certain cases, and the "Initiative" at the demand of 1000 citizens in case of amendments to the cantonal constitution, there is now also an ' ' Initiative " in case of Bills, to be exercised at the demand of 800 citizens. In 1897 the state revenue of Zug was 444,727 francs (a rise of 91 j per cent, since 1885), and the state expenditure 442,815 francs (a rise of 66| per cent, since 1885), but in 1898 there was a deficit of 2220 francs. In 1897 the public debt was

843,000 francs. Herr Karl Biirkli has shown that the battle of Morgarten in 1315 certainly took place on the eastern shore of the Lake of Aegeri, between Haselmatt and Buchwaldi, so that the battlefield is wholly in the canton of Zug, and not in that of Schwyz, as formerly imagined.

See Blumer. Stoats u. JKechtsgeschichte d. Schweiz. Demokratien, 3 vols. St Gall, 1850-59.— Buekli. EinDenkmal am Morgarten: woistseinPlatz? Zug, 1895.— Stadlin. Die Topograph™ d. Kant. Zug, 4 vols. Lucerne, 1819-24.— -Staub. Der Kant. Zug, 2nd edition. Zug, 1869. ' (w. A. B. C.)

Zllider Zee, an inland gulf or sea of the Nether- lands, bounded on the north by a chain of islands, namely, Texel, Vlieland, Terschelling, Ameland, and Schiermon- nikoog, and on the west, south, and east by the pro- vinces of North Holland, Utrecht, Gelderland, Overyssel, and Friesland. The Zuider {i.e., southern) Zee was once bounded on the north by a line of land stretching between Stavoren (Friesland) and Enkhuizen (North Holland). In the early centuries of our era the Zuider Zee was still a land-locked lake, Flevo, surrounded by fens and moors, into which the Vecht, Eem, and Yssel dis- charged their waters. Thence these waters issued as the Vliestroom, which, winding its way through the low clay and fens of North Holland and Friesland, reached the North Sea by the Vliegat, between Vlieland and Terschel- ling. High tides and north-west storms swept away the western banks of Vliestroom and Lake Flevo. In 1170 the land between Stavoren, Texel, and Medemblik was washed away. The open waterway between Stavoren and Enkhuizen, such as it now exists, dates from 1400. In

the south and east the work of destruction was arrested by the high sandy shores of Gooi, Veluwe, Voorst, and Gasterland.

This brief sketch of its history will suffice so far to account for the shallowness of the Zuider Zee, the condition of its shores, and the nature of its bottom. In its actual state it measures 85 miles from north to south, has a maximum breadth of 45 miles ; area, 2027 square miles. Its mean depth is 11 '48 feet; depth in the southern basin of the former lake, 19 feet ; at Val van Urk (deep water to the west of the island of Urk), 14J feet. If a line be drawn from the island of Urk to Marken, and thence westwards to Hoorn (Worth Holland) and north-north-east to Lemmer (Fries- land),

these lines will connect parts of the Zuider Zee having a uniform depth of 8 feet. The other parts on the coast are only 3 feet deep or less. This shallowness of its waters served to protect the Zuider Zee from piracy and the invasion of large ships of war. It also explains how in our times many commercial towns, only accessible at high-water to ships of 4 '8 to 8 feet draught, have declined to the rank of provincial trading and fishing ports. Eighty per oent. of the bottom consists of sea clay and the more recent silt of the Yssel ; 20 per cent, of sand, partly in the north about Urk and Enkhuizen, partly in the south along the high shores of Gooi, Veluwe, &c. The shallowness of the sea and the fertility in its bottom have for many years occasioned various projects of drainage, the more serious of which emanate from the Zuider Zee Vereeniging (1886), two of them forming the subject of a report in 1894 by a State Commission. The two pro- jects agree in building a dyke from the island of Wieringen to the coast of Friesland. The area to the south of this would be divided into four polders, with reservation, however, of a lake, Ysselmeer, covering the part where the sea was deep and the bottom less fertile, whence branches would run to Yssel and the Zwolsche Diep, to Amsterdam, and, by sluices near Wieringen, to the northern part of the sea. The four polders with their areas of fertile soil would be : —

(1) North-west polder, area 53,599 acres ; fertile soil, 46,189 acres.

(2) South-west „ „ 77,854 „ „ „ 68,715 „

(3) South-east „ „ 266,167 „ „ „ 222,275 „

(4) North-east „ „ 125,599 „ „ „ 120,783 „

The Lake Ysselmeer would cover 358,150 acres. The gain would be the addition to the kingdom of a new and fertile province of the area of North Brabant, a saving of expenses on dykes, diminution of inundations, improvement of communication between the south and the north of the kingdom, protection of isles of the sea, &c. The costs are calculated as follows : (1) enclosing dyke, sluices, and regulation of Zwolsche Diep, £1,760,000; (2) reclamation of four polders, £5,200,000 ; (3) defensive works, £400,000 ; (4) indem- nity to fishermen, £180,000 ; total, £7,540,000. (c. M. K.)

ZululcLnd, a British protectorate in south-east Africa, forming part of Natal, bounded on the N. by Portuguese possessions, on the S.E. by the Indian Ocean, on the S. and S.W. by the river Tugela, and on the W. by Transvaal and Swaziland. After the defeat of Cetewayo by the rival chief Zibebu (1883), and his death in 1884, his feeble successor, Dinizulu, held his ground for some time, and was even able by the aid of the Transvaal Boers to expel Zibebu. But the Zulu nation, exhausted by a long series of foreign wars and dynastic feuds, were no longer in a position to resist the steady advance of the Boers, who had already absorbed the Wakkerstroom and Utrecht districts, and set up the " New Bepublic " within the recognized frontier of Zululand proper (1880). The acquisition of this terri- tory was a direct infringement of the spirit if not of the actual letter of both the Pretoria and London Conventions. The Boers in 1885 were so encouraged with the success of the policy which had given them the " New Republic " that by the end of that year their claims extended to nearly three-quarters of Zululand. These claims were finally dealt with in 1886 by the British Government, who agreed to recognize the "New Republic," but with boundaries considerably less extended than the Boers desired. In May 1887 the British Government at length decided to annex what remained of Zululand, and accordingly proclaimed the country British territory, under the title British Zululand. The British flag had actually been hoisted at St Lucia Bay in 1886, when it

was evident that Germany had designs on this coast, but the annexation at that time on the part of the British was not formally extended to the " hinterland " (see South Afkica). In 1888 the "New Eepublic" was, with the consent of the British Government, incorporated with the South African Eepublic, and subsequently became known as the Vryheid district of that state.

From 1883 to May 1887 "the Zulu Native Beserve" was under the administration of a resident commissioner. The resident was under the control of the British special commissioner for Zulu affairs, and a mounted native police force was maintained to keep order. The same

~~organization was extended after annexation to the whole territory. The governor of Natal was created governor of Zululand, and had supervision of the administration of the country. The resident commissioner's headquarters were at Eshowe.~~

~~At the end of 1889 and beginning of 1890 some small tracts of territory lying between Zululand and Tongaland, under the rule of petty semi-independent chiefs, were added to British Zululand ; and in 1895 the territories of the chiefs Sambana and Umtegiza, 688 square miles in extent, lying between the Portuguese territories, Swazi- land, Zululand, and Tongaland, were also added. In the same year a British protectorate was declared by Sir Henry Loch, acting under instructions from Lord Bipon, over Tongaland. The coast-line was thus secured for Great Britain up to the boundary of the Portuguese territory at Delagoa Bay. The advisability of securing this coastline will be obvious when it is borne in mind that in the first instance Germany had endeavoured to obtain St Lucia Bay in 1884, and that the Boers were intriguing with native chiefs in order to obtain the terri- tories of Sambana and Umtegiza in 1895. In reference to the British annexation of the territories under these two chiefs, Mr Kruger telegraphed a protest, in which he said: "Taking into consideration previous negotiations, and the fact that the two territories are not of the least importance to her Majesty's Government, this annexation cannot be regarded by this Government otherwise than as directed against this Eepublic. They must therefore regard it as an unfriendly act, against which they hereby protest." This protest must be considered in connexion, not only with the natural desire of Great Britain to pre- vent another Power from establishing itself on the south- east African seaboard, but also with the fact that the Boers had been the first to reap the benefit of Great Britain's defeat of the Zulu power by acquiring the "New Eepublic," and further that a similar policy of more or less irresponsible annexation had enabled them to establish themselves in Swaziland. For a time Tonga land was administered by the governor of Zululand as special commissioner for Tongaland. On 27th December 1897 Tongaland was annexed to Zululand, and on 30th December of the same year the whole of Zululand became a portion of Natal, being represented by one member in the Legislative Assembly.~~

Zululand comprised a total area of 11,000 square miles, with a population approximately estimated (1900) at 185,000, thus distributed :—

Area in Square Miles.

Population.

Province of Zululand South (British) Tongaland .

9,000 2,000

143,000 42,000

Total .

11,000

185,000

When the country was incorporated with Natal, certain reservations were made with a view to safeguarding the

material and moral interests of the natives. None of the public lands can be sold to European settlers without the sanction of the Imperial Government, nor can any change be made in the tribal customs in respect of land tenure or other matters compatible with orderly government. Thus, while witchcraft and all sanguinary rites are abolished, the former regulations affecting the sale of arms and spirits are maintained in full vigour. Dinizulu, who had been exiled to St Helena after the revolt of 1888, was at the same time restored to his country.

Authorities.—Russell. The Story of Natal. Natal Statis- tical Year-Books.—Ingram. Natalia.—Pratt. Leading Points in South African History. (a. p. h.)

Zurich, one of the Swiss cantons, ranking officially as the first. Its total area is 665 square miles. Of this 620‘3 square miles are classed as "productive," forests covering 191-4 square miles and vineyards 19-3 square miles. The population was 316,074 in 1880, and 337,183 in 1888,

while in 1900 it was 430,336. In 1900 there were 648 inhabitants to each square mile. The Protestants were then estimated at 344,206, Eoman Catholics at 81,424, and there were 2987 Jews. Classified according to language, 414,105 spoke German, 4019 French, 11,081 Italian, and 614 Eomonsch. The state revenue of the canton in 1897 was 16,988,089 francs (a rise of 167^ per cent, since 1885), and the state expenditure 16,645,822 francs (a rise of 194| per cent, since 1885), while the surplus in 1898 was 912,193 francs. In 1897 the public debt was 28,678,876 francs. The budget for 1901 showed 19,889,426 francs expendi- ture as against 18,204,879 francs revenue, i.e., a deficit of 1,684,547 francs. The cantonal constitution of 1869 is still in force, but in 1898 it was decided by a popular vote that the legislature has power to fix the number of the members of the executive. Zurich and Winterthur are the two chief towns of the canton. There are many railways in the canton, as well as a partly electric and partly funicular line from Zurich up the Zurichberg, where is the Dolder Hotel.

Zurich, the capital of the Swiss canton of the same name, and the most populous and most important town in the Swiss Confederation. In 1893 the nine outlying communes or townships were incorporated with the town proper. Population (1888), 90,088; (1900), 150,703. The majority of the inhabitants, nearly four to one, are Protestants, and they are almost all German-speaking. In 1898-99 the University had 65 professors and an attendance of 403 matriculated students, besides 20 "hearers" (in the summer session of 1900, 1039 in all). In 1899-1900 the Federal Polytechnic School had 1007 full students and 449 "hearers." The town has grown very rapidly in size, wealth, and prosperity. Much land has been rescued from the lake, and is now covered with fine public buildings and splendid private villas. One of the most magnificent of the newer buildings is the Swiss National Museum, behind the railway station. This museum, which was opened in 1898, contains a wonderful collection of Swiss antiquities and art treasures of all kinds, some of which are placed in rooms of the actual date, removed from various ancient buildings. To the stranger this museum is now the chief object of interest in Zurich.

Authorities. — Burkt.i ■ Meyer. Oeschichic d. Zilrcher Sei- denindustrie. Zurich, 1884. — Eqli. Aetensammlung z. Gesch. d. Zilrcher Reformation,

1519-1.533. Zurich, 1879. — Meyer von Knonau. Der Kant. Zurich, 2 vols. St Gall and Bern, 1834 and 1846. Mittheil. d. antiq. Gesellschaft von Zurich. From 1841. — Stahelin. Huldreich Zwingli, 2 vols. Basel, 1895-97.

(W. A. B. C.)

Zutphen, a town in the province of Gelderland, Holland, at the influx of the Berkel into the Yssel, about 10 miles by rail south of Deventer, and 18 miles north- north-east of Arnhem. Its provincial trade has been improved by the railway connexion with Amsterdam, Arnhem, and Germany. Population (1900), 18,490.

ZvenigfOrodka, a district town of Russia, in the government of Kieff, 35 miles from Tsvyetkovo (a junction on the railway from Kieff to Nikolaieff). It has several flour-mills and distilleries, and carries on trade in grain and animal products. Population (1897), 16,972.

Zwickau, a town of Germany, capital of the circle of Zwickau, on the Zwickauer Mulde, 20 miles by rail west-south-west of Chemnitz, kingdom of Saxony. There is a gymnasium, with a public library of 20,000 volumes,

a real gymnasium, a higher-grade and six other burgher schools, a mining, a technical, two commercial, and several guild schools. The archives of the town hall include documents of the 13th century and MSS. of the works of Hans Sachs. The coal-fields in the precincts comprise 55 pits reaching to a depth of over 2000 feet, employing upwards of 11,000 persons and yielding over £1,000,000 annual value. Population (1880), 35,005; (1890), 44,198 ;

(1900), 55,825.

Zwolle, capital of the province of Overyssel, Hol- land, on the Zwarte Water, near the influx of the Vecht, 55 miles by rail north-east of Utrecht, connected by canals with the Yssel and the Zuider Zee. Its cattle-market is, next to that of Rotterdam, the most important in the kingdom. Population (1901), 30,848.